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**NOTE: For New Vehicle Preparation information, see the separate publication, 81-170-00003.**

**NOTE: Group names with the suffix "S" indicate groups pertaining to the the 2.4L Gas Supplement**

# INTRODUCTION

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## FASTENER IDENTIFICATION

### DESCRIPTION

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 10.9. 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 (Fig. 1) and (Fig. 2).

FASTENER IDENTIFICATION (Continued)

**Bolt Markings and Torque - Metric**

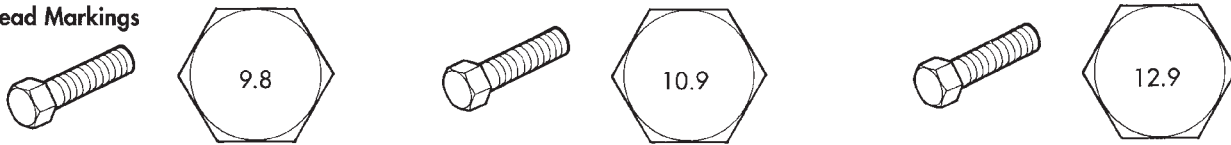
Commercial Steel Class

9.8

10.9

12.9

Bolt Head Markings



Body Size	Torque				Torque				Torque			
	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
	Diam. mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m
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



Bolt Torque - Grade 5 Bolt








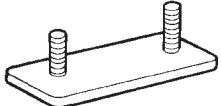

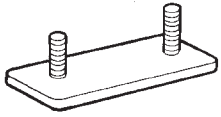
Bolt Torque - Grade 8 Bolt

Body Size	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

Fig. 1 FASTENER IDENTIFICATION

FASTENER IDENTIFICATION (Continued)

HOW TO DETERMINE BOLT STRENGTH

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

95IN-4

Fig. 2 FASTENER STRENGTH

## FASTENER USAGE

### DESCRIPTION

### DESCRIPTION

**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.

## DESCRIPTION

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

## THREADED HOLE REPAIR

























### DESCRIPTION

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

## INTERNATIONAL SYMBOLS

### DESCRIPTION

The graphic symbols illustrated in the following International Control and Display Symbols Chart (Fig. 3) are used to identify various instrument controls. The symbols correspond to the controls and displays that are located on the instrument panel.

 1	 2	 3	 4	 5	 6
 7	 8	 9	 10	 11	 12
 13	 14	 15	 16	 17	 18
 19	 20	 21	 22	 23	 24

**Fig. 3 INTERNATIONAL CONTROL AND DISPLAY SYMBOLS**

80be4788

- |    |                                      |    |                            |
|----|--------------------------------------|----|----------------------------|
| 1  | High Beam                            | 13 | Rear Window Washer         |
| 2  | Fog Lamps                            | 14 | Fuel                       |
| 3  | Headlamp, Parking Lamps, Panel Lamps | 15 | Engine Coolant Temperature |
| 4  | Turn Warning                         | 16 | Battery Charging Condition |
| 5  | Hazard Warning                       | 17 | Engine Oil                 |
| 6  | Windshield Washer                    | 18 | Seat Belt                  |
| 7  | Windshield Wiper                     | 19 | Brake Failure              |
| 8  | Windshield Wiper and Washer          | 20 | Parking Brake              |
| 9  | Windscreen Demisting and Defrosting  | 21 | Front Hood                 |
| 10 | Ventilating Fan                      | 22 | Rear hood (Decklid)        |
| 11 | Rear Window Defogger                 | 23 | Horn                       |
| 12 | Rear Window Wiper                    | 24 | Lighter                    |

# METRIC SYSTEM

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

## DESCRIPTION

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

### 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	x 1.0936	= Yards
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
mph	x 0.4470	= Meters/Sec (M/S)	M/S	x 2.237	= mph
Kilometers/Hr. (Km/h)	x 0.27778	= Meters/Sec (M/S)	M/S	x 3.600	Kilometers/Hr. (Km/h)

### 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	

Refer to the Metric 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.)

METRIC SYSTEM (Continued)

in-lbs to N•m

N•m to in-lbs

Table with 18 columns and 37 rows showing conversions between in-lb and N•m.

ft-lbs to N•m

N•m to ft-lbs

Table with 18 columns and 20 rows showing conversions between ft-lb and N•m.

in. to mm

mm to in.

Table with 16 columns and 20 rows showing conversions between inches and millimeters.

# TORQUE REFERENCES

tions Chart for torque references not listed in the individual torque charts.

## DESCRIPTION

Individual Torque Charts appear within many of the Groups. Refer to the Standard Torque Specifica-

### 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

### TORQUE SPECIFICATIONS



## VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

### DESCRIPTION

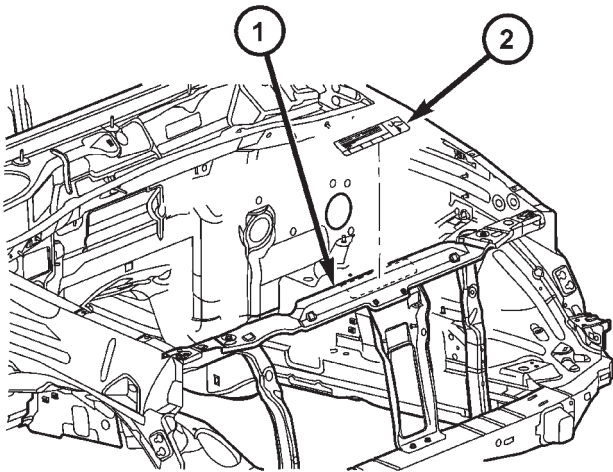
All models have a Vehicle Emission Control Information (VECI) Label. DaimlerChrysler permanently attaches the label in the engine compartment (Fig. 4). The label cannot be removed without defacing label information and destroying label.

The label contains the vehicle's emission specifications and vacuum hose routings. All hoses must be connected and routed according to the label.

The label also contains an engine vacuum schematic. There are unique labels for vehicles built for sale in the state of California and the country of Canada. Canadian labels are written in both the English and French languages.

The VECI label 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



80c97de8

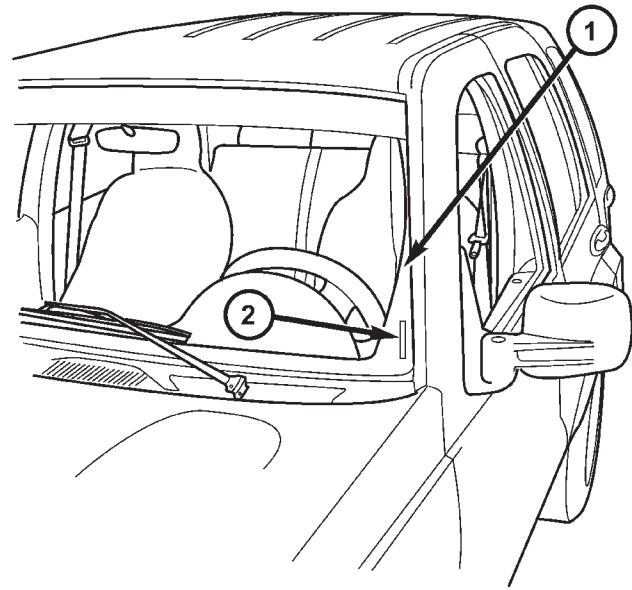
**Fig. 4 VECI LABEL LOCATION**

- 1 - RADIATOR SUPPORT  
2 - VECI LABEL

## VEHICLE IDENTIFICATION NUMBER

### DESCRIPTION

The Vehicle Identification Number (VIN) plate is located on the lower left A-pillar and is visible through the windshield (Fig. 5). The VIN contains 17 characters that provide data concerning the vehicle. Refer to the VIN decoding chart to determine the identification of a vehicle.



80c9011d

**Fig. 5 VIN NUMBER LOCATION**

- 1 - A-PILLAR  
2 - VIN CODE PLATE

The Vehicle Identification Number is also imprinted on the:

- Vehicle Safety Certification Label.
- Frame rail.

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 IDENTIFICATION NUMBER (Continued)

VEHICLE IDENTIFICATION NUMBER DECODING CHART

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = United States
2	Make	J = Jeep
3	Vehicle Type	4 = MPV W/O Side Airbags. 8 = MPV With Side Airbags.
4	Gross Vehicle Weight Rating	F = 4001 - 5000 lbs. G = 5001 - 6000 lbs.
5	Vehicle Line	K = Liberty 4X2 (LHD) L = Liberty 4X4 (LHD) M = Cherokee 4X4 (RHD)
6	Series	3 = Liberty Renegade 4 = Liberty Sport/Cherokee Sport 5 = Liberty Limited/Cherokee Limited
7	Body Style	8 = Sport Utility - 4 Door
8	Engine	K = 3.7L 6 cyl MPI Gasoline 1 = 2.4L 4 cyl MPI Gasoline 7 = 2.5L 4 cyl Diesel
9	Check Digit	0 through 9 or X
10	Model Year	2=2002
11	Assembly Plant	W = Toledo North Assembly Plant
12 thru 17	Vehicle Build Sequence	

VEHICLE SAFETY CERTIFICATION LABEL

DESCRIPTION

A vehicle safety certification label (Fig. 6) is attached to every DaimlerChrysler Corporation vehicle. The label certifies that the vehicle conforms to all applicable Federal Motor Vehicle Safety Standards. The label also lists:

- 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.
- Bar code.
- Month, Day and Hour (MDH) of final assembly.
- Paint and Trim codes.
- Country of origin.

The label is located above the door hinge on the driver-side A-pillar.

**MFD BY: CHRYSLER CORPORATION**

DATE OF MFR: 1-96	GAWR: 1978 KG 4380 LB
GAWR FRONT: 0998 KG 2200 LB	WITH P205/75R15 TIRES
	RIMS AT 244 KPA (33 PS1) COLD
GAWR REAR: 1180 KG 2600 LB	WITH P205/75R15 TIRES
	RIMS AT 244 KPA (33 PS1) COLD
	15 X 8.0
	15 X 8.0



THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN:XXXXXXXXXXXXXXXXXX	TYPE: MPV	MDH:013012 315
VEHICLE MADE IN U.S.A.	PAINT: PR4	TRIM: J6C3 4648508

Fig. 6 Vehicle Safety Certification Label—Typical



# LUBRICATION & MAINTENANCE








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## INTERNATIONAL SYMBOLS

### DESCRIPTION — INTERNATIONAL SYMBOLS

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

 <b>CHRYSLER CORPORATION</b>			
	ENGINE OIL		BRAKE FLUID
	AUTOMATIC TRANSMISSION FLUID		POWER STEERING FLUID
	ENGINE COOLANT		WINDSHIELD WASHER FLUID

9500-1

**Fig. 1 International Symbols**

## FLUID TYPES

### DESCRIPTION

#### DESCRIPTION - FLUID TYPES

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

Only lubricants bearing designations defined 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)

#### SAE VISCOSITY RATING

An SAE viscosity grade is used to specify the viscosity of engine oil. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Example SAE 5W-30 = multigrade engine oil.

DaimlerChrysler Corporation only recommends multigrade engine oils.

## FLUID TYPES (Continued)

## API QUALITY CLASSIFICATION

This symbol (Fig. 2) on the front of an oil container means that the oil has been certified by the American Petroleum Institute (API) to meet all the lubrication requirements specified by DaimlerChrysler Corporation.



9400-9

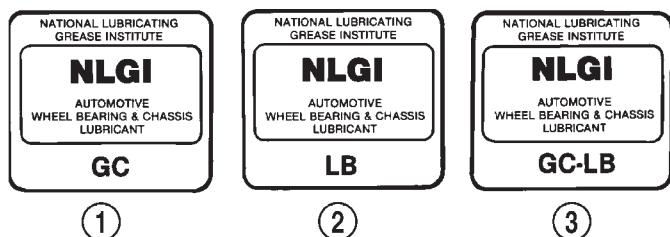
Fig. 2 API Symbol

## GEAR LUBRICANTS

SAE ratings also apply to multigrade gear lubricants. In addition, API classification defines the lubricants usage. Such as API GL-5 and SAE 75W-90.

## 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 letter "L". The letter following the usage letter indicates the quality of the lubricant. The following symbols indicate the highest quality.



9200-7

Fig. 3 NLGI Symbol

- 1 - WHEEL BEARINGS
- 2 - CHASSIS LUBRICATION
- 3 - CHASSIS AND WHEEL BEARINGS

## SPECIALIZED LUBRICANTS AND OILS

Some maintenance or repair procedures may require the use of specialized lubricants or oils. Consult the appropriate sections in this manual for the correct application of these lubricants.

## DESCRIPTION - AXLE

A multi-purpose, hypoid gear lubricant which conforms to MIL-L-2105C and API GL 5 quality specifications should be used. Mopar Hypoid Gear Lubricants conforms to these specifications.

## FRONT AXLE

- Lubricant for 186FIA (Model 30) axle is SAE 75W-140 SYNTHETIC.

## REAR AXLE

- Lubricant for 198RBI (Model 35) axle is SAE 75W-140 SYNTHETIC.
- Lubricant for 8 1/4 axle is a thermally stable SAE 75W-90. For trailer tow or heavy duty applications the lubricant should be replaced with SAE 75W-140 SYNTHETIC.

**NOTE:** Trac-lok® equipped axles require a friction modifier be added to the lubricant.

**CAUTION:** If axle is submerged in water, lubricant must be replaced immediately to avoid possible premature axle failure.

## DESCRIPTION - MANUAL TRANSMISSION

Mopar® manual transmission fluid is the lubricant recommended for the NV1500 and the NV3550 transmissions.

## DESCRIPTION - AUTOMATIC TRANSMISSION FLUID

**NOTE:** Refer to the maintenance schedules in this group for the recommended maintenance (fluid/filter change) intervals for this transmission.

**NOTE:** Refer to Service Procedures in this group for fluid level checking procedures.

Mopar® ATF +4, type 9602, Automatic Transmission Fluid is the recommended fluid for DaimlerChrysler automatic transmissions.

**Dexron II fluid IS NOT recommended. Clutch chatter can result from the use of improper fluid.**

Mopar® ATF +4, type 9602, Automatic Transmission Fluid when new is red in color. The ATF is dyed red so it can be identified from other fluids used in the vehicle such as engine oil or antifreeze. The red color is not permanent and is not an indicator of fluid condition. As the vehicle is driven, the ATF will begin to look darker in color and may eventually become brown. **This is normal.** ATF+4 also has a unique

## FLUID TYPES (Continued)

odor that may change with age. Consequently, odor and color cannot be used to indicate the fluid condition or the need for a fluid change.

## FLUID ADDITIVES

DaimlerChrysler strongly recommends against the addition of any fluids to the transmission, other than those automatic transmission fluids listed above. Exceptions to this policy are the use of special dyes to aid in detecting fluid leaks.

Various "special" additives and supplements exist that claim to improve shift feel and/or quality. These additives and others also claim to improve converter clutch operation and inhibit overheating, oxidation, varnish, and sludge. These claims have not been supported to the satisfaction of DaimlerChrysler and these additives **must not be used**. The use of transmission "sealers" should also be avoided, since they may adversely affect the integrity of transmission seals.

## DESCRIPTION - TRANSFER CASE - NV231

Recommended lubricant for the NV231 transfer case is Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

## DESCRIPTION - TRANSFER CASE - NV242

Recommended lubricant for the NV242 transfer case is Mopar® ATF+4, type 9602 Automatic Transmission Fluid.

## DESCRIPTION - ENGINE COOLANT

**WARNING: ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASE COOLANT PROPERLY, CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE, PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED, PERSONAL INJURY CAN RESULT.**

**CAUTION: Use of Propylene Glycol based coolants is not recommended, as they provide less freeze protection and less corrosion protection.**

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769), or the equivalent ethylene glycol base coolant with organic corrosion inhibitors (called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% Ethylene Glycol and 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

**CAUTION: Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769) may not be mixed with any other type of antifreeze. Mixing of coolants other than specified (non-HOAT or other HOAT), may result in engine damage that may not be covered under the new vehicle warranty, and decreased corrosion protection.**

## COOLANT PERFORMANCE

The required ethylene-glycol (antifreeze) and water mixture depends upon climate and vehicle operating conditions. The coolant performance of various mixtures follows:

**Pure Water**-Water can absorb more heat than a mixture of water and ethylene-glycol. This is for purpose of heat transfer only. Water also freezes at a higher temperature and allows corrosion.

**100 percent Ethylene-Glycol**-The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°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°C (-8°F).

**50/50 Ethylene-Glycol and Water**-Is the recommended mixture, it provides protection against freezing to -37°C (-34°F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. If percentage is lower, engine parts may be eroded by cavitation. Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7°C (-90°F). A higher percentage will freeze at a warmer temperature. Also, a higher per-

## FLUID TYPES (Continued)

centage of antifreeze can cause the engine to over-heat because specific heat of antifreeze is lower than that of water.

**CAUTION:** Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

**CAUTION:** Do not use coolant additives that are claimed to improve engine cooling.

### OPERATION - AUTOMATIC TRANSMISSION FLUID

The automatic transmission fluid is selected based upon several qualities. The fluid must provide a high level of protection for the internal components by providing a lubricating film between adjacent metal components. The fluid must also be thermally stable so that it can maintain a consistent viscosity through a large temperature range. If the viscosity stays constant through the temperature range of operation, transmission operation and shift feel will remain consistent. Transmission fluid must also be a good conductor of heat. The fluid must absorb heat from the internal transmission components and transfer that heat to the transmission case.

## FLUID CAPACITIES

### SPECIFICATIONS - FLUID CAPACITIES

DESCRIPTION	SPECIFICATION
FUEL TANK	18.5 U.S. Gallons (70 Liters)****
ENGINE OIL	
Engine Oil - with Filter - 2.4L	2.4L (5.0 qts.)
Engine Oil - with Filter - 3.7L	3.7L (5.0 qts.)
Engine Oil - With Filter - 2.5L Diesel	6.5L (6.9 qts.)
ENGINE COOLANT	
Cooling System - 2.4L	9.6L (10.1 qts.)
Cooling System - 3.7L	12.3L (13.0 qts.)
Cooling System - 2.5L Diesel	12.5L (13.2 qts.)
AUTOMATIC TRANSMISSION	
Service Fill - 45RFE	4.73L (10.0 pts)
O-haul Fill - 45RFE	13.33L (28.0 pts)
Dry fill capacity 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 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/FLUID - STANDARD PROCEDURE)	
TRANSFER CASE	
NV231	1.4L (2.95 pts.)
NV242	1.6L (3.4 pts.)
MANUAL TRANSMISSION	
NV1500 (Approximate dry fill or fill to bottom edge of the fill plug hole.)	2.28L (2.41 qts.)
NV3550 (Approximate dry fill or fill to bottom edge of fill plug hole.)	2.28L (2.41 qts.)
FRONT AXLE	
186 FIA (Model 30)	1.24L (41.9 fl. oz.)
REAR AXLE	
198 RBI (Model 35)	1.78L (60.2 fl. oz.)*
8 1/4	2.08L (4.4 pts.)*
* When equipped with Trac-lok, include 4.0 ounces of Friction Modifier.	
****Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.	

## FLUID FILL/CHECK LOCATIONS

### DESCRIPTION

The fluid check/fill point locations are located in each applicable service manual section.

## MAINTENANCE SCHEDULES

### DESCRIPTION

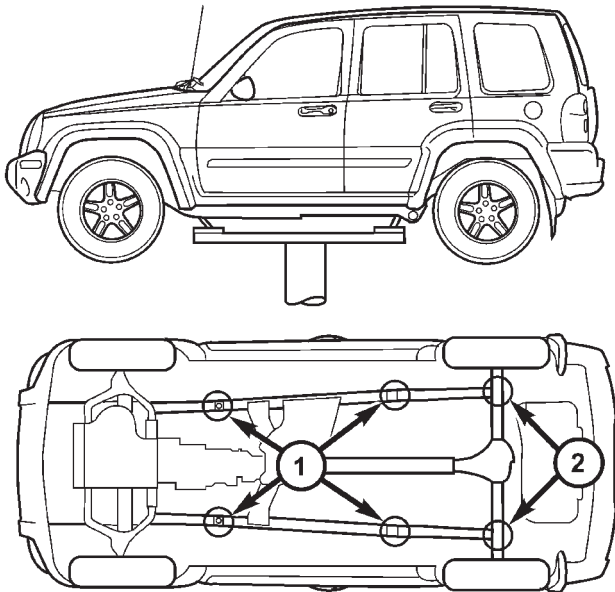
"Maintenance Schedule Information not included in this section, is located in the appropriate Owner's Manual."

## HOISTING

### STANDARD PROCEDURE - HOISTING RECOMMENDATIONS

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

When properly positioned, a floor jack can be used to lift a Jeep vehicle (Fig. 4). Support the vehicle in the raised position with jack stands at the front and rear ends of the frame rails.



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**Fig. 4 Correct Vehicle Lifting Locations**

- 1 - Frame Contact Lift (Single Post)  
Chassis Lift (Non-Axle Dual Post)  
Outboard Lift (Dual Post)  
Floor Jack

---

- 2 - Floor Jack

**CAUTION:** Do not attempt to lift a Jeep vehicle with a floor jack positioned under:

- A body side sill.
- A steering linkage component.
- A drive shaft.
- The engine or transmission oil pan.
- The fuel tank.
- A front suspension arm.
- Transfer case.

**NOTE:** Use the correct sub-frame rail or frame rail lifting locations only.

### HOIST

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

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.

**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 OR SECURE VEHICLE TO HOISTING DEVICE WHEN THESE CONDITIONS EXIST.



## JUMP STARTING

### STANDARD PROCEDURE - 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 BATTERY INDICATOR DOT IS YELLOW OR BRIGHT COLOR. BATTERY CAN EXPLODE.
- 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 ARCHING OF BATTERY CURRENT.
- WHEN USING A HIGH OUTPUT BOOSTING DEVICE, DO NOT ALLOW DISABLED VEHICLE'S BATTERY TO EXCEED 16 VOLTS. PERSONAL INJURY OR DAMAGE TO ELECTRICAL SYSTEM CAN RESULT.

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

**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, turn off all accessories, place gear selector in park or neutral, set park brake or equivalent and operate engine at 1200 rpm.

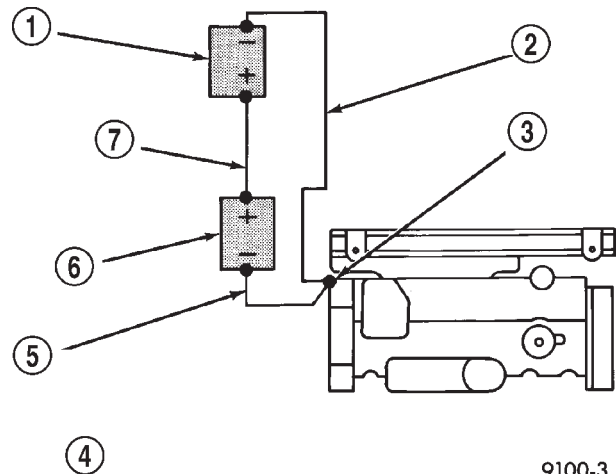
(3) On disabled vehicle, place gear selector in park or neutral and set park brake or equivalent. Turn OFF all accessories.

(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 (Fig. 5). Review all warnings in this procedure.

(5) On disabled vehicle, connect RED jumper cable clamp to battery positive (+) terminal. Connect BLACK jumper cable clamp to the engine as close to the ground cable connection as possible (Fig. 5).

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

(6) 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.



9100-3

**Fig. 5 Jumper Cable Clamp Connections**

- 1 - BOOSTER BATTERY
- 2 - NEGATIVE JUMPER CABLE
- 3 - ENGINE GROUND
- 4 - DO NOT ALLOW VEHICLES TO TOUCH
- 5 - BATTERY NEGATIVE CABLE
- 6 - DISCHARGED BATTERY
- 7 - POSITIVE JUMPER CABLE

#### 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.

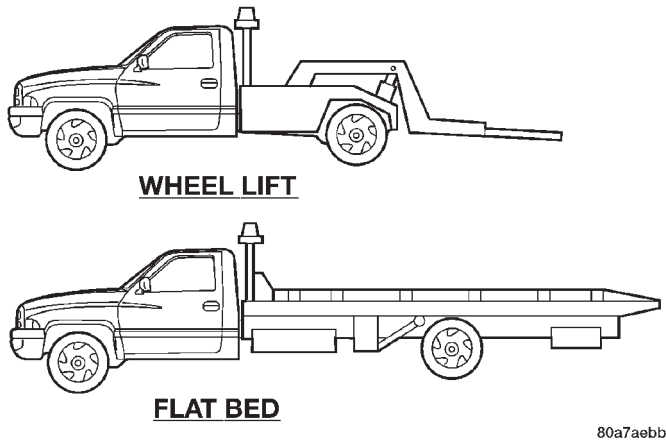
## TOWING

### STANDARD PROCEDURE - TOWING

A vehicle equipped with SAE approved wheel lift-type towing equipment can be used to tow Jeep vehicles. When towing a 4WD vehicle using a wheel-lift

## TOWING (Continued)

towing device, use tow dollies under the opposite end of the vehicle. A vehicle with flatbed device can also be used to transport a disabled vehicle (Fig. 6).



**Fig. 6 Tow Vehicles With Approved Equipment**

## 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.
- 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, or J-hooks to a bumper, steering linkage, drive shafts or a non-reinforced frame hole.
- Do not tow a heavily loaded vehicle. Use a flat-bed device to transport a loaded vehicle.

## TWO-WHEEL-DRIVE VEHICLE TOWING

DaimlerChrysler 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).

**WARNING:** ENSURE VEHICLE IS ON A LEVEL SURFACE OR THE WHEELS ARE BLOCKED TO PREVENT VEHICLE FROM ROLLING.

## TWO WHEEL DRIVE TOWING-REAR END LIFTED

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

2WD vehicles can be towed with the front wheels on the surface for extended distances at speeds not exceeding 48 km/h (30 mph).

- (1) Attach wheel lift device to rear wheels.
- (2) Place the transmission in neutral.
- (3) Raise vehicle to towing position.
- (4) Attach safety chains. Route chains so not to interfere with tail pipe when vehicle is lifted.
- (5) Turn the ignition switch to the OFF position to unlock the steering wheel.

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

- (6) Secure steering wheel in straight ahead position with a clamp device designed for towing.
- (7) Place transmission in park.

## TWO WHEEL DRIVE 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.

- (1) Attach wheel lift device to rear wheels.
- (2) Place the transmission in neutral.
- (3) Raise the rear of the vehicle off the ground and install tow dollies under rear wheels.
- (4) Attach wheel lift device to front wheels and raise vehicle to towing position.
- (5) Attach the safety chains.

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

- (6) Turn the ignition switch to the OFF position to unlock the steering wheel.
- (7) Secure steering wheel in straight ahead position with a clamp device designed for towing.
- (8) Place transmission in park.

## FOUR-WHEEL-DRIVE VEHICLE TOWING

DaimlerChrysler Corporation recommends that a 4WD vehicle be transported on a flat-bed device. A Wheel-lift device can be used provided **the trailing wheels are off the ground and positioned in tow dollies.**

## TOWING (Continued)

**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.**

**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.

**FOUR WHEEL DRIVE TOWING—REAR END LIFTED**

**WARNING: ENSURE VEHICLE IS ON A LEVEL SURFACE OR THE WHEELS ARE BLOCKED TO PREVENT VEHICLE FROM ROLLING.**

- (1) Attach wheel lift device to front wheels.
- (2) Place the transmission in neutral.
- (3) Raise the front of the vehicle off the ground and install tow dollies under front wheels.
- (4) Attach wheel lift device to rear wheels and raise vehicle to towing position.
- (5) Attach safety chains. Route chains so not to interfere with tail pipe when vehicle is lifted.
- (6) Turn the ignition switch to the OFF position to unlock the steering wheel.

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

- (7) Secure steering wheel in straight ahead position with a clamp device designed for towing.
- (8) Place transmission in park.

**FOUR WHEEL DRIVE TOWING—FRONT END LIFTED**

**WARNING: ENSURE VEHICLE IS ON A LEVEL SURFACE OR THE WHEELS ARE BLOCKED TO PREVENT VEHICLE FROM ROLLING.**

- (1) Attach wheel lift device to rear wheels.
- (2) Place the transmission in neutral.
- (3) Raise the rear of the vehicle off the ground and install tow dollies under rear wheels.
- (4) Attach wheel lift device to front wheels and raise vehicle to towing position.
- (5) Attach the safety chains.

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

- (6) Turn the ignition switch to the OFF position to unlock the steering wheel.
- (7) Secure steering wheel in straight ahead position with a clamp device designed for towing.
- (8) Place transmission in park.

# SUSPENSION

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## SUSPENSION

### DIAGNOSIS AND TESTING - SUSPENSION AND STEERING SYSTEM

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT END NOISE	1. Loose or worn wheel bearings. 2. Loose or worn steering or suspension components.	1. 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. 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. 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. 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. Power steering fluid low. 3. Column coupler binding. 4. Tire pressure. 5. Alignment.	1. Adjust or replace steering gear. 2. Add fluid and repair leak. 3. Replace coupler. 4. Adjust tire pressure. 5. Align vehicle to specifications.
VEHICLE PULLS TO ONE SIDE DURING BRAKING	1. Uneven tire pressure. 2. Worn brake components. 3. Air in brake line.	1. Adjust tire pressure. 2. Repair brakes as necessary. 3. Repair as necessary.

## SUSPENSION (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
VEHICLE LEADS OR DRIFTS FROM STRAIGHT AHEAD DIRECTION ON UNCROWNED ROAD	<ol style="list-style-type: none"> <li>1. Radial tire lead.</li> <li>2. Brakes dragging.</li> <li>3. Weak or broken spring.</li> <li>4. Uneven tire pressure.</li> <li>5. Wheel Alignment.</li> <li>6. Loose or worn steering or suspension components.</li> <li>7. Cross caster out of spec.</li> </ol>	<ol style="list-style-type: none"> <li>1. Cross front tires.</li> <li>2. Repair brake as necessary.</li> <li>3. Replace spring.</li> <li>4. Adjust tire pressure.</li> <li>5. Align vehicle.</li> <li>6. Repair as necessary.</li> <li>7. Align vehicle.</li> </ol>
KNOCKING, RATTLING OR SQUEAKING	<ol style="list-style-type: none"> <li>1. Worn shock bushings.</li> <li>2. Loose, worn or bent steering/suspension components.</li> <li>3. Shock valve.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace shock.</li> <li>2. Inspect, tighten or replace components as necessary.</li> <li>3. Replace shock.</li> </ol>
IMPROPER TRACKING	<ol style="list-style-type: none"> <li>1. Loose, worn or bent track bar.</li> <li>2. Loose, worn or bent steering/suspension components.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inspect, tighten or replace component as necessary.</li> <li>2. Inspect, tighten or replace components as necessary.</li> </ol>

# WHEEL ALIGNMENT

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## WHEEL ALIGNMENT

### DESCRIPTION

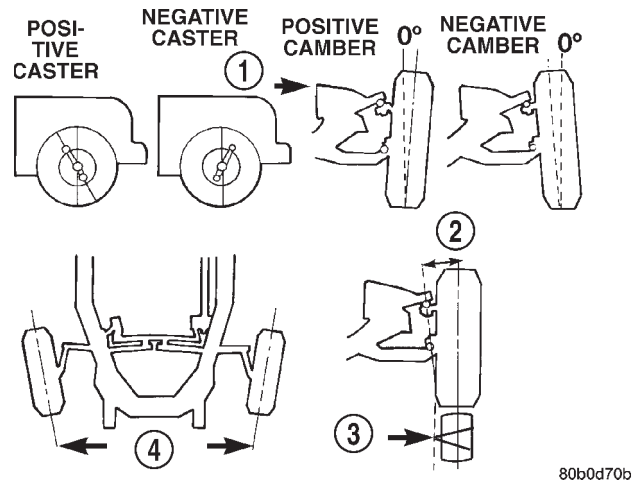
Wheel alignment involves the correct positioning of the wheels in relation to the vehicle. The positioning is accomplished through suspension and steering linkage adjustments. An alignment is considered essential for efficient steering, good directional stability and to minimize tire wear. The most important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

**CAUTION:** Never attempt to modify suspension or steering components by heating or bending.

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

### OPERATION

- **CASTER** is the forward or rearward tilt of the steering knuckle from vertical. Tilting the top of the knuckle forward provides negative caster. Tilting the top of the knuckle rearward provides positive caster. Positive caster promotes directional stability. This angle enables the front wheels to return to a straight ahead position after turns (Fig. 1)
- **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 (Fig. 1)



**Fig. 1 Wheel Alignment Measurements**

- 1 - FRONT OF VEHICLE
- 2 - STEERING AXIS INCLINATION
- 3 - PIVOT POINT
- 4 - TOE-IN

- **TOE** is the difference between the leading inside edges and trailing inside edges of the front tires. Wheel toe position out of specification cause's unstable steering, uneven tire wear and steering wheel off-center. The wheel toe position is the **final** front wheel alignment adjustment (Fig. 1)
- **THRUST ANGLE** is the angle of the rear axle relative to the centerline of the vehicle. Incorrect thrust angle can cause off-center steering and excessive tire wear. This angle is not adjustable, damaged component(s) must be replaced to correct the thrust angle (Fig. 1)

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WHEEL ALIGNMENT (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - HEIGHT MEASUREMENT

RIDE HEIGHT

**NOTE: The suspension is non-adjustable.**

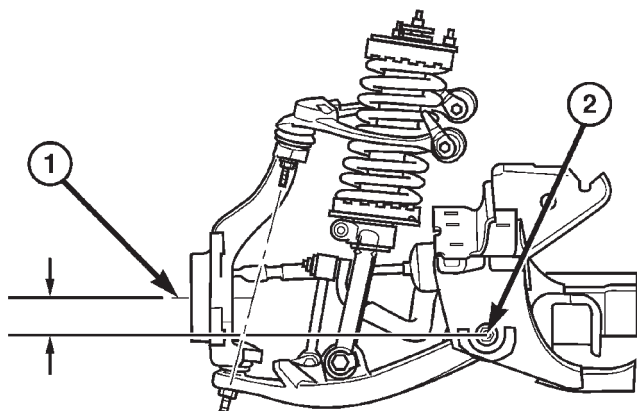
The vehicle suspension height should be measured before performing wheel alignment procedure. Also when front suspension components have been replaced. This measure must be performed with the vehicle supporting it's own weight and taken on both sides of the vehicle.

Front and rear ride heights are not adjustable. The spring selections at assembly determine ride height for acceptable appearance of the vehicle. Ride height dimensions assume full fluids (including fuel) and zero passengers. Refer to the table below for front ride height dimensions.

Vehicle ride height audits should be performed utilizing the following procedure:

- (1) Drive the vehicle straight and forward on a non-tacky surface for a minimum of 20 feet to neutralize track width.
- (2) Bounce the front of the vehicle five times.
- (3) Measure and record the dimensions

**FRONT RIDE HEIGHT** Front ride height is defined by the relative vertical distance between the spindle center line and the rear pivot point of the front lower control arm to cradle attachment. The spindle center line is to be measured at the outer wheel face (point A). The rear pivot point is to be measured at the center of the cam bolt (point B) at its rearward most end (nut end). (Fig. 2)

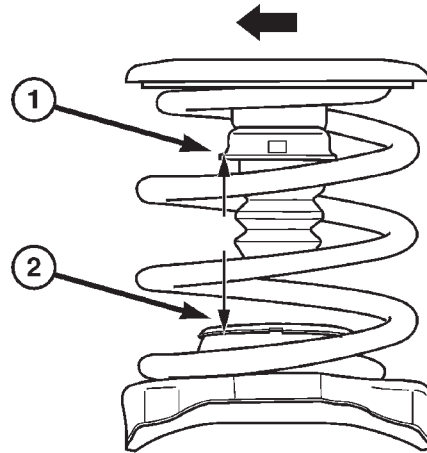


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**Fig. 2 FRONT RIDE HEIGHT MESUREMENT**

- 1 - POINT - A
- 2 - POINT - B

**REAR RIDE HEIGHT** Rear ride height is defined by the relative vertical distance between the top of the lower spring seat strike surface and the bottom of the jounce cup (true metal to metal jounce travel). This is to be measured vertically inside the coil from the point intersecting the inboard edge and the for/ aft center of the jounce cup (point C) down to the strike surface (point D). (Fig. 3)



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**Fig. 3 REAR RIDE HEIGHT MEASUREMENT**

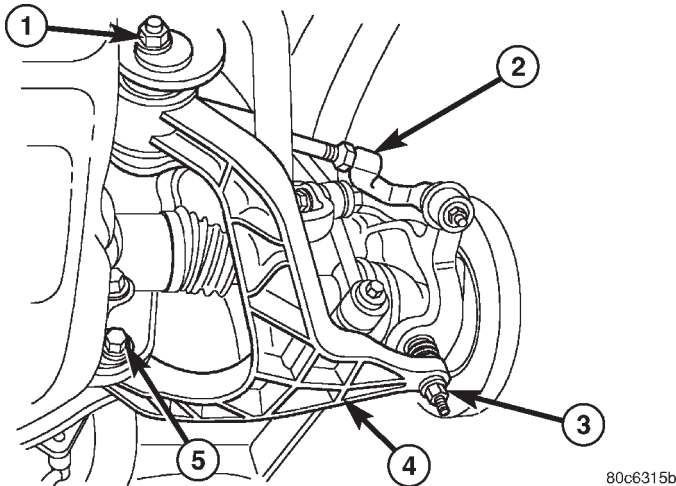
- 1 - POINT - C
- 2 - POINT - D

Measurement	Target	Minimum	Maximum
Front Ride Height Distance AB	48.8 mm Z=996.81 - 948.03	38.8mm	58.8mm
Front Cross Ride Height Left - Right	0.0 mm	-10.0 mm	10.0 mm
Rear Ride Height Distance CD	116.1 mm	106.1 mm	126.1 mm
Rear Cross Ride Height Left - Right	0.0 mm	-10.0 mm	10.0 mm

WHEEL ALIGNMENT (Continued)

**STANDARD PROCEDURE - CAMBER AND CASTER ADJUSTMENT**

Camber and caster angle adjustments involve changing the position of the lower suspension arm cam bolts. (Fig. 4)



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**Fig. 4 LOWER CONTROL ARM**

- 1 - FRONT CAM BOLT
- 2 - OUTER TIE ROD END
- 3 - LOWER BALL JOINT NUT
- 4 - LOWER CONTROL ARM
- 5 - REAR CAM BOLT

**STANDARD PROCEDURE - TOE ADJUSTMENT**

4X4 SUSPENSION HEIGHT MEASUREMENT MUST BE PERFORMED BEFORE AN ALIGNMENT.

The wheel toe position adjustment is the final adjustment.

(1) Start the engine and turn wheels both ways before straightening the wheels. Secure the steering wheel with the front wheels in the straight-ahead position.

(2) Loosen the tie rod jam 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 as necessary (Fig. 5).

(4) Tighten the tie rod jam nut to 75 N·m (55 ft. lbs.).

(5) Verify the specifications

(6) Turn off engine.

**STANDARD PROCEDURE - CAMBER, CASTER AND TOE ADJUSTMENT**

Camber and caster angle adjustments involve changing the position of the lower suspension arm cam bolts. (Fig. 4)

**CASTER**

Moving the rear position of the cam bolt in or out, will change the caster angle significantly and camber angle only slightly. To maintain the camber angle while adjusting caster, move the rear of the cam bolt in or out. Then move the front of the cam bolt slightly in the opposite direction. (Fig. 4)

To increase positive caster angle, move the rear position of the cam bolt outward (from the engine). Move the front of cam bolt inward (toward the engine) slightly until the original camber angle is obtained. (Fig. 4)

**CAMBER**

Move both of the cam bolts together in or out. This will change the camber angle significantly and caster angle slightly. (Fig. 4)

After adjustment is made tighten the cam bolt nuts to proper torque specification.

**TOE ADJUSTMENT**

The wheel toe position adjustment is the final adjustment.

(1) Start the engine and turn wheels both ways before straightening the wheels. Secure the steering wheel with the front wheels in the straight-ahead position.

(2) Loosen the tie rod jam nuts.

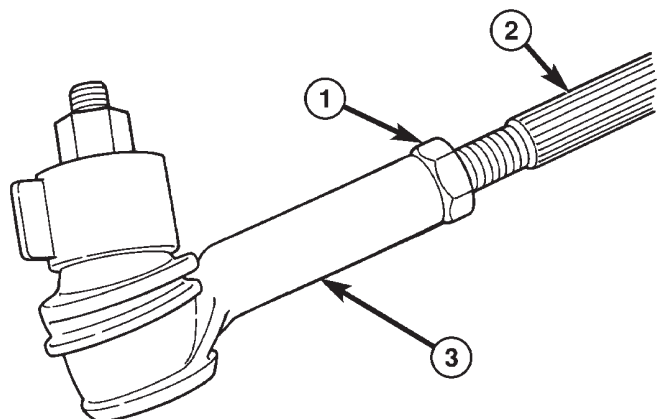
**NOTE:** Each front wheel should be adjusted for one-half of the total toe position specification. This will ensure the steering wheel will be centered when the wheels are positioned straight-ahead.

(3) Adjust the wheel toe position by turning the tie rod as necessary (Fig. 5).

(4) Tighten the tie rod jam nut to 75 N·m (55 ft. lbs.).

(5) Verify the specifications

(6) Turn off engine.



**Fig. 5 TIE ROD END**

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- 1 - JAM NUT
- 2 - TIE ROD - INNER
- 3 - TIE ROD END - OUTER



WHEEL ALIGNMENT (Continued)

SPECIFICATIONS

ALIGNMENT

NOTE: Specifications are in degrees.

FRONT

SPECIFICATIONS

DESCRIPTION	SPECIFICATION		
PREFERRED	CASTER 3.5° ± .6°	CAMBER 0° ± .375°	TOTAL TOE-IN .20° ± .125°
RANGE	2.9° to + 4.1°	-.375° to +.375°	.07° to + .33°
MAX RT/LT DIFFERENCE	0.5°	0.7°	.13°

REAR

SPECIFICATIONS

DESCRIPTION	SPECIFICATION		
PREFERRED	CAMBER -.25°± .375°	THRUST ANGLE 0° to ± 0.25°	TOTAL TOE-IN .25° to ± .41°
RANGE	-.625° to .125°	-.25° to +.25°	-.16° to .66°

# FRONT

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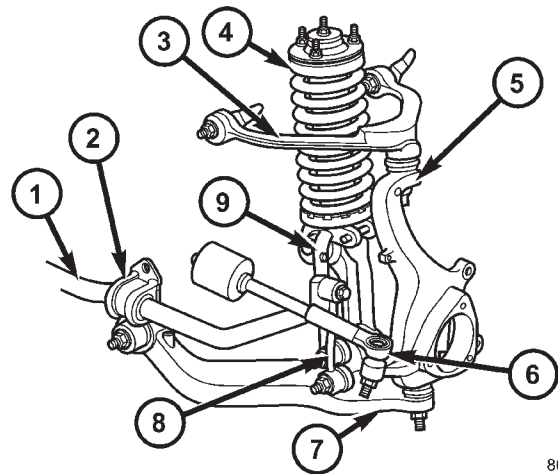
## FRONT

### DESCRIPTION

The front suspension is designed to allow each wheel to adapt to different road surfaces independently. The wheels are mounted to hub bearings on the steering knuckle spindles. The double-row hub bearings are sealed and lubricated for life. The steering knuckles turn (pivot) on ball joints riveted to the outboard portion of the control arms. The ball joints are lubricated for life. (Fig. 1)

### WARNING

**WARNING::** Suspension components with rubber bushings must 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 will be affected and cause premature bushing wear.



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**Fig. 1 FRONT SUSPENSION**

- 1 - SWAY BAR
- 2 - SWAY BAR BUSHING/BRACKET
- 3 - UPPER CONTROL ARM
- 4 - SPRING / SHOCK ASSEMBLY
- 5 - STEERING KNUCKLE
- 6 - OUTER TIE ROD END
- 7 - LOWER CONTROL ARM
- 8 - SWAY BAR LINK
- 9 - CLEVIS BRACKET

FRONT (Continued)

## SPECIFICATIONS

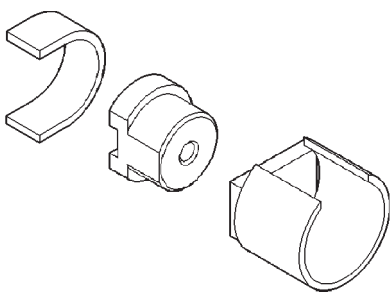
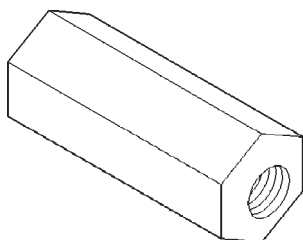
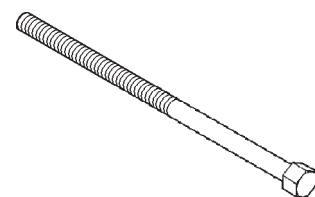
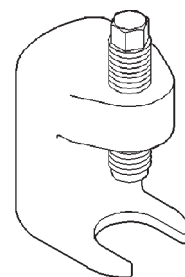
## TORQUE CHART

## TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Front Shock Absorber Clevis Bracket Upper Nut	136	100	—
Front Shock Absorber Clevis Bracket Lower Nut	150	110	—
Front Shock Absorber Top (4) Mounting Nuts	108	80	—
Front Shock to Spring and Insulator Nut	41	30	—
Upper Suspension Arm Front Nut	122	90	—
Upper Suspension Arm Rear Nut	122	90	—
Lower Suspension Arm Front Nut	170	125	—
Lower Suspension Arm Rear Nut	170	125	—
Stabilizer Bar Clamp Nut	149	110	—
Stabilizer Bar Link Upper Nut	136	100	—
Stabilizer Bar Link Lower Nut	115	85	—
Hub/Bearing Bolt	130	96	—
Hub/Bearing Halfshaft Nut	135	100	—
Upper Ball Joint Nut	81	60	—
Lower Ball Joint Nut	81	60	—
Wheel Speed Sensor	13.5	10	—

## SPECIAL TOOLS

## FRONT SUSPENSION

**Remover/Installer Suspension Bushing 7932****Nut, Long 7603****Bolt, Special 7604****Remover C-4150A**

## BUSHINGS

### REMOVAL - STABILIZER BAR BUSHINGS

- (1) Raise vehicle on hoist.
- (2) Remove the stabilizer bushing clamps.
- (3) Remove the stabilizer bushings from the stabilizer bar.

### INSTALLATION - STABILIZER BAR BUSHINGS

- (1) Install the stabilizer bushings to the stabilizer bar.
- (2) Install the stabilizer bushing clamps. Tighten the nuts to 149 N·m (110 ft.lbs.).
- (3) Lower the vehicle.

## HUB / BEARING

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

**CAUTION:** Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose will result. Provide a suitable support to hang the caliper securely.

- (4) Remove the disc brake rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
- (5) Remove the wheel speed sensor (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - REMOVAL).
- (6) Remove the bracket securing the wheel speed sensor wire.
- (7) Remove the axle shaft nut. (if equipped with four wheel drive)
- (8) Remove the three mounting bolts for the hub/bearing assembly.
- (9) Remove the hub/bearing.

### INSTALLATION

- (1) Install the hub/bearing assembly to the vehicle.
- (2) Install the three mounting bolts for the hub/bearing. Tighten the bolt to 130 N·m (96 ft.lbs.).
- (3) Install the axle shaft nut. Tighten the nut to 135 N·m (100 ft.lbs.). (if equipped with four wheel drive)
- (4) Install the bracket to the wheel speed sensor wire.
- (5) Install the wheel speed sensor to the hub. Tighten the bolt to 13.5 N·m (10 ft.lbs.) (Refer to 5 -

BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - INSTALLATION).

(6) Install the disc brake rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(7) Install the disc brake caliper adapter. Tighten the nut to 135 N·m (100 ft.lbs.) (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(8) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

## KNUCKLE

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the caliper adapter. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - REMOVAL).

**CAUTION:** Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose will result. Provide a suitable support to hang the caliper securely.

- (4) Remove the disc brake rotor. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
- (5) Remove the wheel speed sensor. (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - REMOVAL).
- (6) Remove the axle shaft nut. (if equipped with four wheel drive)
- (7) Remove the hub/bearing. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL).
- (8) Remove the outer tie rod end. (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).
- (9) Remove the lower ball joint nut.
- (10) Separate the lower ball joint from the suspension arm using tool C-4150A.
- (11) Remove the upper ball joint nut.
- (12) Separate the upper ball joint from the knuckle using tool C-4150A.
- (13) Remove the knuckle from the vehicle.

### INSTALLATION

- (1) Install the knuckle to the vehicle.
- (2) Install the upper ball joint nut. Tighten the nut to 81 N·m (60 ft.lbs.).
- (3) Install the lower ball joint nut. Tighten the nut to 81 N·m (60 ft.lbs.).
- (4) Install the outer tie rod end. (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).

## KNUCKLE (Continued)

(5) Install the hub/bearing. (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - INSTALLATION).

(6) Install the axle shaft nut. Tighten the nut to 135 N·m (96 ft.lbs.).(if equipped with four wheel drive).

(7) Install the wheel speed sensor. (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - INSTALLATION).

(8) Install the disc brake rotor. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(9) Install the caliper adapter. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - INSTALLATION).

(10) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(11) Perform the set toe procedure (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

## LOWER BALL JOINT

### DIAGNOSIS AND TESTING - LOWER BALL JOINT

(1) Raise the vehicle on a drive-on hoist.

**NOTE:** If a drive-on hoist is not available, use wooden blocks with jack stands to support the lower control arm in the ball joint area. Place the jack stands appropriately and lower the hoist placing weight on the lower control arm. The lower control arms should now be supporting the vehicle weight.

(2) With the use of jack stands, lift the front end off the hoist and position wooden blocks underneath both lower control arms supporting the vehicles weight.

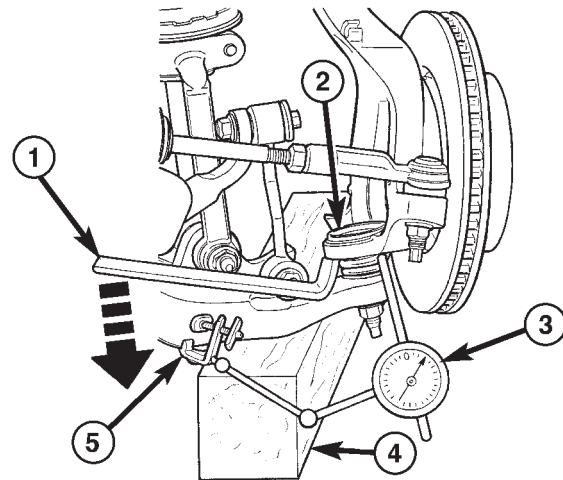
(3) Remove the tire and wheel assembly.

(4) Attach a dial indicator to the base of the lower control arm and align the dial indicator's contact point with the direction of the stud axis, touch the machined flat on the knuckle and zero the dial indicator. (Fig. 2)

**NOTE:** Use care when applying the load to the knuckle, so the parts are not damaged using care not to tear the boot.

(5) From the front of the vehicle, insert a pry bar to get it rested on the lower control arm and use lever principle to push the knuckle up until the arm of the dial indicator no longer moves.

(6) Record the ball joint movement on each side of the vehicle. The end play is acceptable with no more than 1.5mm of end play back to back.



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**Fig. 2 SUSPENSION IN THE CURB POSITION**

- 1 - PRY BAR
- 2 - BALL JOINT
- 3 - DIAL INDICATOR
- 4 - WOODEN BLOCK OR SUPPORT
- 5 - CLAMP

## LOWER CONTROL ARM

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the lower clevis bracket bolt at the lower control arm.
- (4) Remove the stabilizer link bolt at the lower control arm.
- (5) Remove the lower ball joint nut.
- (6) Separate the lower ball joint from the lower control arm using tool C-4150A.

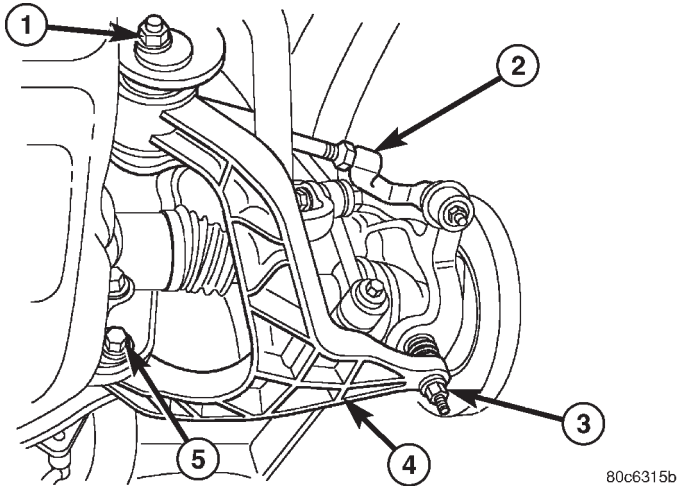
**NOTE:** Marking the lower control arm pivot bolts front and rear will aid in the assembly procedure.

- (7) Mark the lower control arm pivot bolts front and rear.
- (8) Remove the front cam/pivot bolt. (Fig. 3)
- (9) Remove the rear cam/pivot bolt. (Fig. 3)
- (10) Remove the lower control arm from the vehicle.

### INSTALLATION

- (1) Install the lower control arm to the vehicle.
- (2) Install the rear cam/pivot bolt.
- (3) Install the front cam/pivot bolt.
- (4) Install the lower ball joint nut. Tighten the nut to 81 N·m (60 ft.lbs.)

## LOWER CONTROL ARM (Continued)

**Fig. 3 LOWER CONTROL ARM**

- 1 - FRONT CAM BOLT
- 2 - OUTER TIE ROD END
- 3 - LOWER BALL JOINT NUT
- 4 - LOWER CONTROL ARM
- 5 - REAR CAM BOLT

(5) Align the marks front and rear at the cam/pivot bolts and tighten the bolts. Tighten the bolts to 170 N·m (125 ft.lbs.)

(6) Install the stabilizer link bolt at the lower control arm. Tighten the bolt to 136 N·m (100 ft.lbs.)

(7) Install the lower clevis bracket bolt at the lower control arm. Tighten the bolt to 150 N·m (110 ft.lbs.)

(8) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Perform a full wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

**SHOCK****REMOVAL****REMOVAL - LEFT SIDE**

- (1) Disconnect the battery.
- (2) Remove the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).
- (3) Unclip the power center and move it to the side out of the way.
- (4) Remove the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL).
- (5) Disconnect the battery temperature sensor from the battery tray.
- (6) Remove the four upper shock mounting nuts.
- (7) Raise and support the vehicle.

- (8) Remove the left tire and wheel assembly.
- (9) Remove the lower bolt at the lower control securing the clevis bracket.

(10) Remove the stabilizer link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - REMOVAL).

(11) Remove the lower ball joint nut.

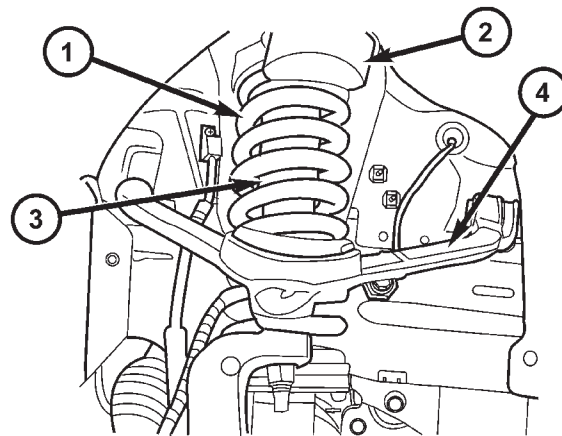
(12) Separate the lower ball joint from the lower control arm using tool C-4150A.

(13) Rotate the lower control arm downward to allow access.

(14) Remove the clevis bracket at the shock.

(15) Remove the shock assembly from the vehicle. (Fig. 4)

(16) Remove the spring from the shock (if needed).

**Fig. 4 SHOCK ASSEMBLY**

- 1 - SPRING
- 2 - JOUNCE BUMPER
- 3 - SHOCK
- 4 - UPPER CONTROL ARM

**REMOVAL - RIGHT SIDE**

(1) Remove the air box (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).

(2) Remove the two cruise control servo mounting nuts.

(3) Remove the upper shock mounting nuts.

(4) Raise and support the vehicle.

(5) Remove the right side tire assembly.

(6) Remove the lower bolt at the lower control securing the clevis bracket.

(7) Remove the stabilizer link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - REMOVAL).

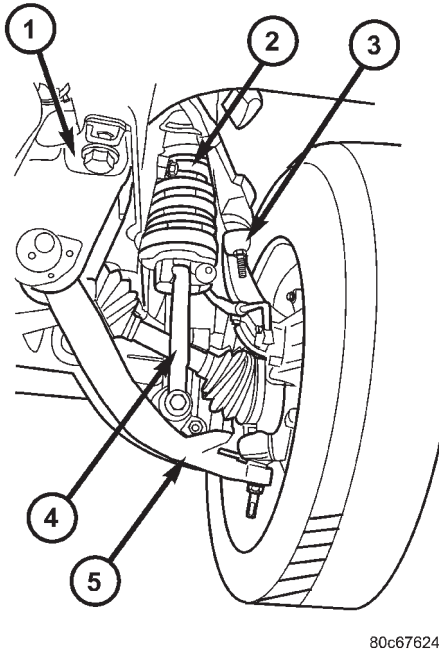
(8) Remove the lower ball joint nut.

(9) Separate the lower ball joint from the lower control arm using tool C-4150A.

(10) Rotate the lower control arm downward to allow access.

## SHOCK (Continued)

- (11) Remove the clevis bracket at the shock. (Fig. 5)
- (12) Remove the shock assembly from the vehicle. (Fig. 5)
- (13) Remove the spring from the shock (if needed). (Refer to 2 - SUSPENSION/FRONT/SPRING - REMOVAL).



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**Fig. 5 SHOCK & CLEVIS ASSEMBLY**

- 1 - FRONT CRADLE
- 2 - SPRING & SHOCK ASSEMBLY
- 3 - STEERING KNUCKLE
- 4 - CLEVIS BRACKET
- 5 - LOWER CONTROL ARM

## INSTALLATION

**INSTALLATION - LEFT SIDE**

- (1) Install the spring to the shock (if removed).
- (2) Install the shock assembly to the vehicle.
- (3) Install the four upper shock mounting nuts. Tighten the nuts to 108 N·m (80 ft.lbs.).
- (4) Install the clevis bracket at the shock. (Refer to 2 - SUSPENSION/FRONT/CLEVIS BRACKET - INSTALLATION). Tighten the bolt to 88 N·m (65 ft.lbs.).
- (5) Raise the lower control into place and reconnect the lower ball joint nut. Tighten the nut to 81 N·m (60 ft.lbs.).
- (6) Install the clevis bracket at the lower control arm. (Refer to 2 - SUSPENSION/FRONT/CLEVIS BRACKET - INSTALLATION). Tighten the bolt to 150 N·m (110 ft.lbs.).

(7) Install the lower stabilizer link at the lower control arm. Tighten the bolt to 136 N·m (100 ft.lbs.) (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - INSTALLATION).

(8) Install the left tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Lower the vehicle.

(10) Reconnect the battery temperature sensor.

(11) Install the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION).

(12) Install the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

(13) Reconnect the battery cables.

**INSTALLATION - RIGHT SIDE**

(1) Install the spring to the shock (if removed). (Refer to 2 - SUSPENSION/FRONT/SPRING - INSTALLATION).

(2) Install the shock assembly to the vehicle.

(3) Install the four upper shock mounting nuts. Tighten the nuts to 108 N·m (80 ft.lbs.).

(4) Install the clevis bracket at the shock. (Refer to 2 - SUSPENSION/FRONT/CLEVIS BRACKET - INSTALLATION). Tighten the bolt to 88 N·m (65 ft.lbs.).

(5) Raise the lower control into place and reconnect the lower ball joint nut. Tighten the nut to 81 N·m (60 ft.lbs.).

(6) Install the clevis bracket at the lower control arm. (Refer to 2 - SUSPENSION/FRONT/CLEVIS BRACKET - INSTALLATION). Tighten the bolt to 150 N·m (110 ft.lbs.).

(7) Install the lower stabilizer link at the lower control arm. Tighten the bolt to 136 N·m (100 ft.lbs.) (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - INSTALLATION).

(8) Install the right tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Lower the vehicle.

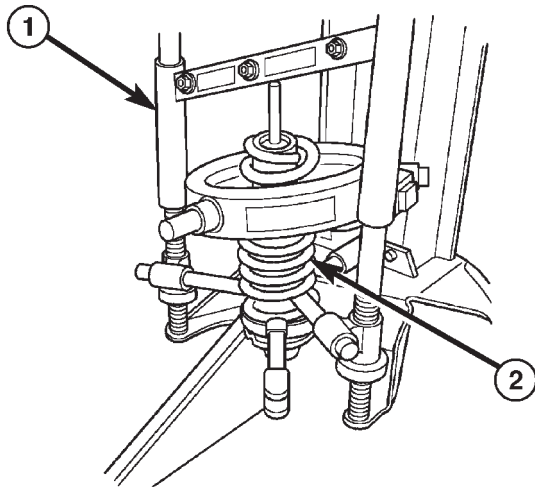
(10) Install the cruise control servo mounting nuts.

(11) Install the airbox (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - INSTALLATION).

## SPRING

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the shock. Refer to the proper side shock removal procedure being worked on. (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).
- (4) Secure the shock assembly into a Pentastar Service Equipment W-7200 Spring compressor. (Fig. 6)
- (5) Compress the spring.



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**Fig. 6 SPRING COMPRESSOR**

- 1 - SPRING COMPRESSOR
- 2 - SPRING

- (6) Remove the shock mount nut.
- (7) Remove the shock from the spring compressor.
- (8) Transfer the necessary parts to the type of repair being done (Insulator, Spring, shock and mount).

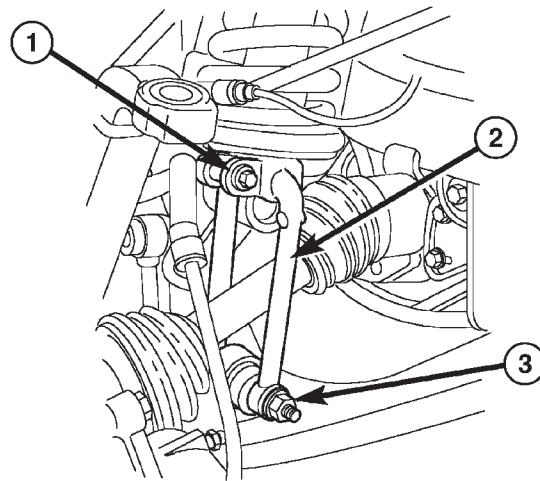
### INSTALLATION

- (1) Install the shock to the spring and spring compressor, After the transfer of the necessary parts to the type of repair being done (Insulator, Spring, shock and mount).
- (2) Install the shock mounting nut. Tighten the bolt to 41 N·m (30 ft.lbs.).
- (3) Loosen the compressed spring.
- (4) Remove the shock assembly from the spring compressor.
- (5) Install the shock to the vehicle. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).
- (6) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (7) Remove the support and lower the vehicle.

## CLEVIS BRACKET

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the lower clevis bolt at the lower control arm. (Fig. 7)
- (4) Remove the upper clevis bolt at the shock. (Fig. 7)



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**Fig. 7 CLEVIS BRACKET**

- 1 - UPPER BOLT
- 2 - CLEVIS BRACKET
- 3 - LOWER BOLT

- (5) Remove the lower stabilizer link bolt at the lower control arm.
- (6) Remove the lower ball joint nut.
- (7) Separate the lower ball joint from the lower control arm using tool C-4150A.
- (8) Swing the lower control arm downward to allow clearance to remove the clevis bracket.
- (9) Remove the clevis bracket from the vehicle.

### INSTALLATION

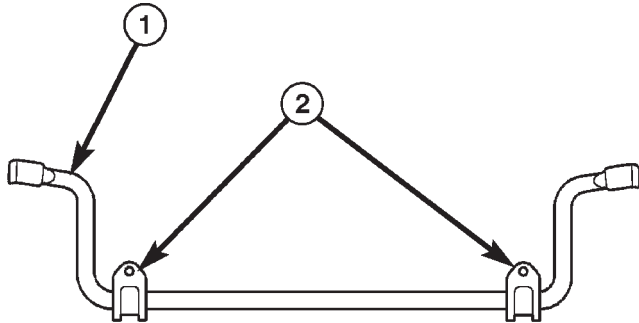
- (1) Install the clevis bracket to the shock. Tighten the bolt to 136 N·m (100 ft.lbs.) (Fig. 7).
- (2) Raise the lower control arm to the lower ball joint.
- (3) Install the nut to the lower ball joint. Tighten the nut to 81 N·m (60 ft.lbs.).
- (4) Install the clevis bracket to the lower control arm. Tighten the bolt to 150 N·m (110 ft.lbs.).
- (5) Install the lower stabilizer link bolt at the lower control arm. Tighten the bolt to 115 N·m (85 ft.lbs.).
- (6) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (7) Lower the vehicle.



## STABILIZER BAR

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the upper stabilizer link bolts at the stabilizer bar.
- (4) Remove the stabilizer bar bushing clamps from the frame (Fig. 8).
- (5) Remove the stabilizer bar from the vehicle.



**Fig. 8 SWAY BAR**

- 1 - SWAY BAR  
2 - SWAY BAR BUSHINGS

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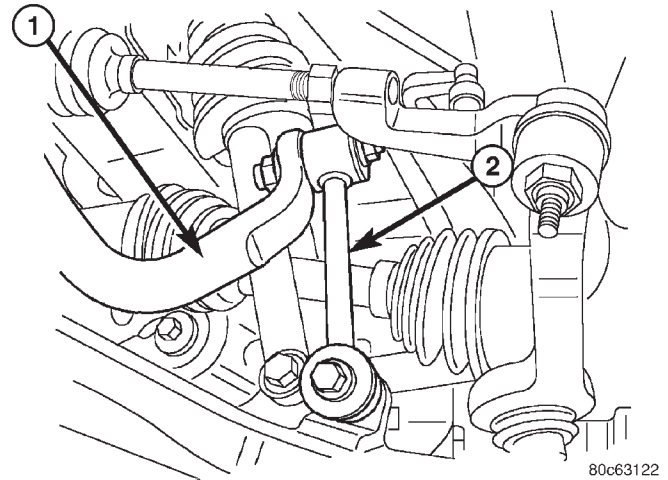
### INSTALLATION

- (1) Install the stabilizer bar to the vehicle.
- (2) Install the stabilizer bar bushing clamps (Fig. 8). Tighten the nuts to 149 N·m (110 ft.lbs.).
- (3) Install the upper stabilizer link bolts and washer at the stabilizer bar. Tighten the bolt to 136 N·m (100 ft.lbs.).
- (4) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (5) Lower the vehicle.

## STABILIZER LINK

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the lower stabilizer link bolt at the lower control arm.
- (4) Remove the upper stabilizer link bolt at the stabilizer bar.
- (5) Remove the stabilizer link. (Fig. 9)



**Fig. 9 STABILIZER BAR LINK**

- 1 - STABILIZER BAR  
2 - STABILIZER BAR LINK

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### INSTALLATION

- (1) Install the stabilizer link (Fig. 9).
- (2) Install the upper stabilizer link bolt and washer at the stabilizer bar. Tighten the bolt to 136 N·m (100 ft.lbs.).
- (3) Install the lower stabilizer link bolt and washer at the lower control arm. Tighten the nut to 115 N·m (85 ft.lbs.).
- (4) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

## UPPER CONTROL ARM

### REMOVAL

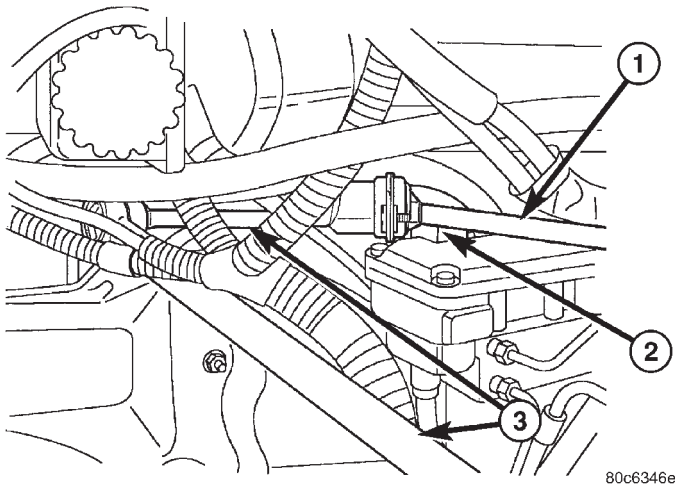
#### REMOVAL - RIGHT SIDE

- (1) Raise and support the vehicle.
- (2) Remove the right side tire and wheel assembly.
- (3) Remove the upper ball joint nut.
- (4) Separate the upper ball joint from the steering knuckle using tool C-4150A.
- (5) Lower the vehicle.
- (6) Remove the air box (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
- (7) Remove the cruise control servo mounting nuts.
- (8) Remove the upper control arm rear bolt.
- (9) Remove the upper control arm front bolt.
- (10) Remove the upper control arm from the vehicle.

UPPER CONTROL ARM (Continued)

**REMOVAL - LEFT SIDE**

- (1) Raise and support the vehicle.
- (2) Remove the left side tire and wheel assembly.
- (3) Remove the upper ball joint nut.
- (4) Separate the upper ball joint from the steering knuckle using tool C-4150A.
- (5) Lower the vehicle.
- (6) Remove the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).
- (7) Unclip the power center and move it to the side out of the way.
- (8) Remove the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL).
- (9) Disconnect the battery temperature sensor from the battery tray.
- (10) Remove the upper control arm rear bolt by using a ratchet and extension under the steering shaft and positioned by the power steering reservoir. (Fig. 10)



**Fig. 10 REAR BOLT**

- 1 - STEERING SHAFT
- 2 - REAR BOLT
- 3 - RATCHET WITH AN EXTENSION

- (11) Remove the upper control arm front bolt.
- (12) Remove the upper control arm from the vehicle.

**INSTALLATION**

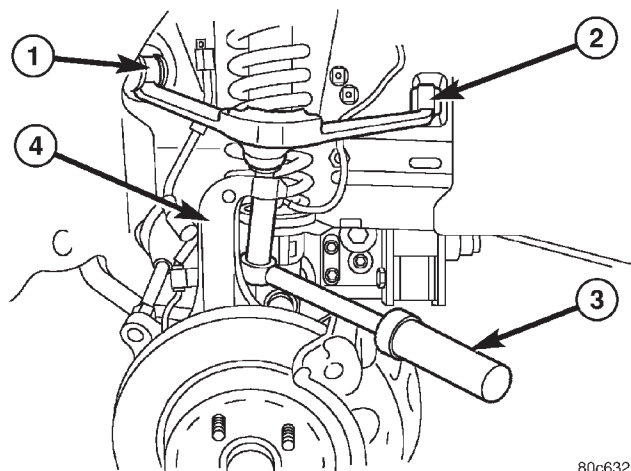
**INSTALLATION - RIGHT SIDE**

- (1) Install the upper control arm to the vehicle.
- (2) Install the upper control arm front bolt. Tighten the bolt to 122 N·m (90 ft.lbs.).
- (3) Install the upper control arm rear bolt. Tighten the bolt to 122 N·m (90 ft.lbs.).
- (4) Install the cruise control servo mounting nuts.

- (5) Install the air box (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - INSTALLATION).
- (6) Install the upper ball joint nut. Tighten the nut to 81 N·m (60 ft.lbs.).
- (7) Install the right side tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (8) Lower the vehicle.
- (9) Set the toe and center the steering wheel (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

**INSTALLATION - LEFT SIDE**

- (1) Install the upper control arm to the vehicle.
- (2) Install the upper control arm front bolt (Fig. 11). Tighten the bolt to 122 N·m (90 ft.lbs.).
- (3) Install the upper control arm rear bolt (Fig. 11). Tighten the bolt to 122 N·m (90 ft.lbs.).
- (4) Reconnect the battery temperature sensor to the battery tray.
- (5) Install the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION).
- (6) Install the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).
- (7) Reclip and mount the power center.
- (8) Install the upper ball joint nut (Fig. 11). Tighten the nut to 81 N·m (60 ft.lbs.).



**Fig. 11 UPPER CONTROL ARM**

- (9) Install the left side tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (10) Lower the vehicle.
- (11) Set the toe and center the steering wheel (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

# REAR

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## REAR

### DESCRIPTION

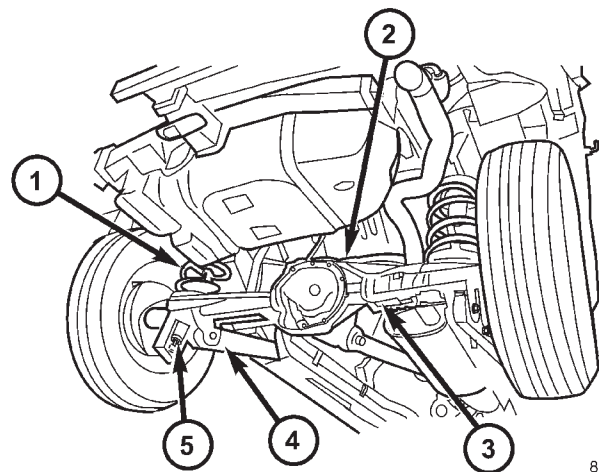
The rear suspension (Fig. 1) is comprised of :

- Drive axle
- Shock absorbers
- Coil springs
- Lower suspension arms
- Upper suspension arm
- Stabilizer bar

**CAUTION:** Suspension components with rubber/urethane bushings 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. This will maintain vehicle ride comfort and prevent premature bushing wear.

### WARNING

**WARNING::** Suspension components with rubber bushings must 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 will be affected and cause premature bushing wear.



80c86ea2

**Fig. 1 REAR SUSPENSION**

- 1 - COIL SPRING
- 2 - UPPER SUSPENSION ARM
- 3 - STABILIZER BAR
- 4 - LOWER SUSPENSION ARM
- 5 - SHOCK

REAR (Continued)

**DIAGNOSIS AND TESTING - REAR SUSPENSION**

<b>CONDITION</b>	<b>POSSIBLE CAUSES</b>	<b>CORRECTION</b>
VEHICLE INSTABILITY	1. Loose or worn wheel bearings. 2. Loose, worn or bent suspension components. 3. Tire pressure.	1. Replace wheel bearings. 2. Inspect, tighten or replace components as necessary. 3. Adjust tire pressure.
VEHICLE PULLS TO ONE SIDE	1. Weak or broken spring. 2. Alignment. 3. Tires. 4. Brakes.	1. Replace spring. 2. Align vehicle to specifications. 3. Replace tires. 4. Repair as necessary.
KNOCKING, RATTLING OR SQUEAKING	1. Worn shock bushings. 2. Loose shock mounting. 3. Shock valve. 4. Loose upper ball joint. 5. Loose, worn or bent suspension components.	1. Replace shock. 2. Tighten to specifications. 3. Replace shock. 4. Replace ball joint. 5. Inspect, tighten or replace components as necessary.
IMPROPER TRACKING	1. Loose, worn or bent suspension components. 2. Bent axle.	1. Inspect, tighten or replace components as necessary. 2. Replace axle.

**SPECIFICATIONS**

**TORQUE CHART**

*TORQUE SPECIFICATIONS*

<b>DESCRIPTION</b>	<b>N·m</b>	<b>Ft. Lbs.</b>	<b>In. Lbs.</b>
Shock Absorber Upper Nut	108	80	—
Shock Absorber Lower Nut	115	85	—
Suspension Arm Upper Ball Joint Nut	95	70	—
Suspension Arm Upper Frame Bolts	100	74	—
Rear Upper Ball Joint Bracket Bolts	136	100	—
Suspension Arms Lower Body/Axle Bracket Nut	163	120	—
Suspension Arms Lower Frame Bracket Nut	163	120	—
Stabilizer Bar Bolts	99	73	—

## SHOCK

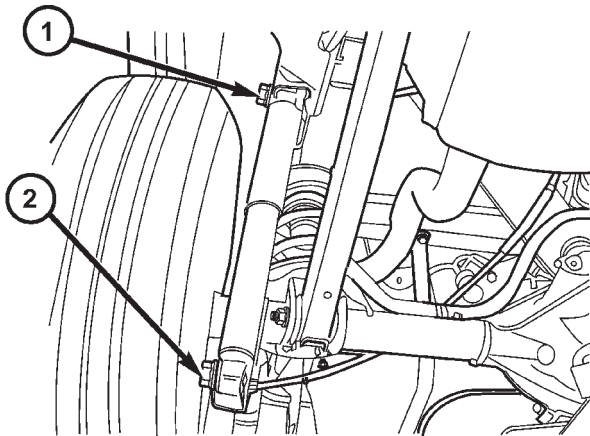
### REMOVAL

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

**CAUTION: Do not allow the axle to hang from the upper suspension arm ball joint.**

(2) Remove the upper nut and bolt from the frame bracket (Fig. 2).

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



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**Fig. 2 SHOCK ABSORBER**

- 1 - UPPER MOUNTING BOLT
- 2 - LOWER MOUNTING BOLT

### INSTALLATION

(1) Install the shock absorber in the frame bracket and install the bolt and nut (Fig. 2).

(2) Install the shock absorber in the axle bracket and install the bolt and nut (Fig. 2).

(3) Remove the supports and lower the vehicle.

(4) Tighten the upper mounting nuts to 108 N·m (80 ft. lbs.). Tighten the lower mounting nuts to 115 N·m (85 ft. lbs.).

## SPRING

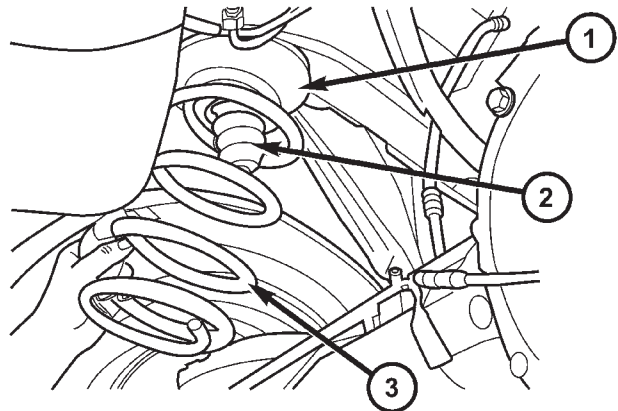
### REMOVAL

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

(2) Remove the shock absorber lower bolt from the axle bracket.

(3) Lower the hydraulic jack and tilt the axle and remove the coil spring (Fig. 3).

(4) Remove and inspect the upper and lower spring isolators (Fig. 3).



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**Fig. 3 COIL SPRING**

- 1 - UPPER INSULATOR
- 2 - JOUNCE BUMPER
- 3 - COIL SPRING

### INSTALLATION

(1) Install the upper isolator (Fig. 3).

(2) Install the lower isolator (Fig. 3).

(3) Pull down on the axle and position the coil spring in the lower isolator.

**CAUTION: Ensure the spring is positioned on the lower isolator.**

(4) Raise the axle with the hydraulic jack.

(5) Install the shock absorber to the axle bracket and tighten to 115 N·m (85 ft. lbs.).

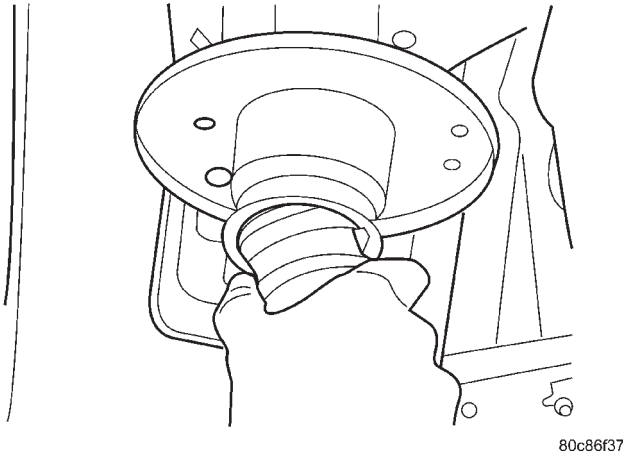
(6) Remove the supports and lower the vehicle.

(7) Tighten the stabilizer bar links to 99 N·m (73 ft. lbs.).

## JOUNCE BUMPER

### REMOVAL

- (1) Remove the shock (Refer to 2 - SUSPENSION/ REAR/SHOCK - REMOVAL).
- (2) Remove the coil spring (Refer to 2 - SUSPENSION/REAR/SPRING - REMOVAL).
- (3) Pull the jounce bumper downwards to remove. (Fig. 4)



**Fig. 4 JOUNCE BUMPER**

### INSTALLATION

- (1) Install the jounce bumper into the mount by twisting the bumper into place (Fig. 4).
- (2) Install the coil spring (Refer to 2 - SUSPENSION/REAR/SPRING - INSTALLATION).
- (3) Install the shock (Refer to 2 - SUSPENSION/ REAR/SHOCK - INSTALLATION).

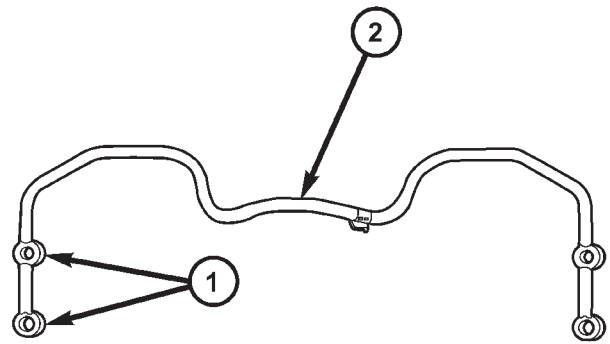
## STABILIZER BAR

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the stabilizer bar bolts from the lower suspension arm. (Fig. 5).
- (3) Remove the stabilizer bar.

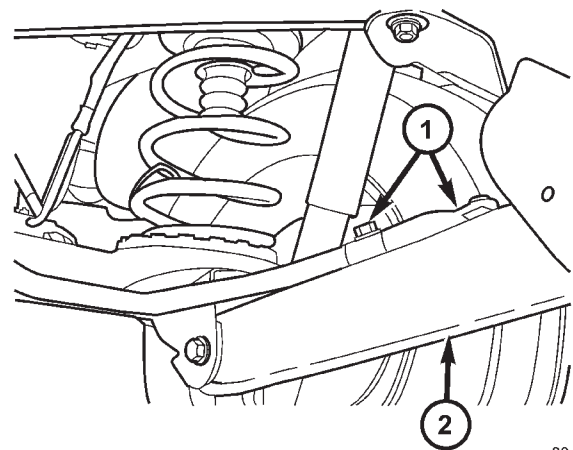
### INSTALLATION

- (1) Position the stabilizer bar over the axle and install the bolts to the lower suspension arm (Fig. 6). Ensure the bar is centered with equal spacing on both sides. Tighten the bolts to 99 N·m (73 ft. lbs.).
- (2) Remove support and lower the vehicle.



**Fig. 5 REAR STABILIZER BAR**

- 1 - MOUNTING HOLES
- 2 - STABILIZER BAR



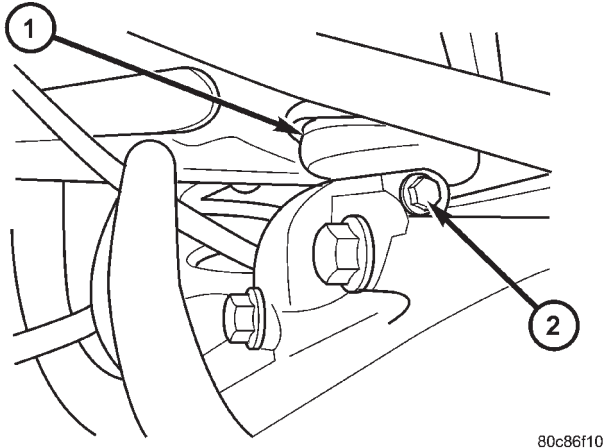
**Fig. 6 STABILIZER BAR MOUNTS**

- 1 - STABILIZER BAR MOUNTING BOLTS
- 2 - LOWER SUSPENSION ARM

## UPPER BALL JOINT

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Support the rear axle with a hydraulic jack.
- (3) Remove the ball joint pinch bolt from the top of the axle. (Fig. 7)
- (4) Separate the ball joint arm assembly from the differential housing by prying upwards.



**Fig. 7 BALL JOINT PINCH BOLT**

- 80c86f10
- 1 - UPPER BALL JOINT  
2 - PINCH BOLT

### INSTALLATION

- (1) Raise the rear axle with a hydraulic jack to align the ball joint with the differential housing bracket.
- (2) Insert the ball joint into the differential housing bracket.
- (3) Install the ball joint pinch bolt and tighten to 95 N·m (70 ft. lbs.). (Fig. 7).
- (4) Remove the supports and lower the vehicle.

## UPPER CONTROL ARM

### DESCRIPTION - UPPER SUSPENSION ARM, BUSHINGS, AND BALL JOINT

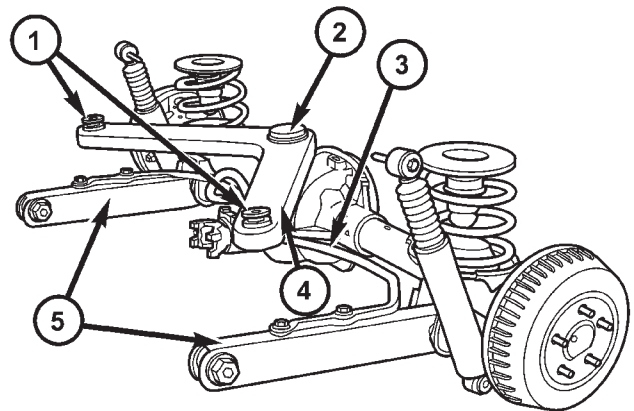
The suspension arm uses vertical spool bushings to isolate road noise. The suspension arm is bolted through bushings to cage nuts in the body and a ball joint to the top of the differential housing.

### OPERATION - UPPER SUSPENSION ARM, BUSHINGS, AND BALL JOINT

The upper suspension arm provides fore/aft and lateral location of the rear axle. The suspension arm travel is limited through the use of jounce bumpers in compression and shock absorbers in rebound.

### REMOVAL

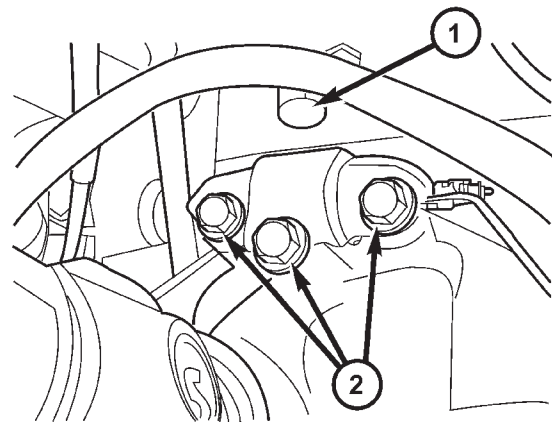
- (1) Raise and support the vehicle.
- (2) Support the rear axle with a hydraulic jack.
- (3) Remove the ball joint pinch bolt from the top of the differential housing bracket (Fig. 7).
- (4) Remove partial nuts from the heat shield in order to lower the shield down enough to get the proper clearance to remove the right side bolt from the body.
- (5) Remove the upper suspension arm mounting bolts from the body and remove the arm (Fig. 8).



**Fig. 8 UPPER CONTROL ARM**

- 80cb181c
- 1 - BODY MOUNTS  
2 - UPPER BALL JOINT  
3 - STABILIZER BAR  
4 - UPPER CONTROL ARM  
5 - LOWER CONTROL ARM

- (6) Remove the support bracket mounting bolts if needed. (Fig. 9)



**Fig. 9 BALL JOINT BRACKET**

- 80c86f8e
- 1 - UPPER BALL JOINT  
2 - SUPPORT BRACKET BOLTS

## UPPER CONTROL ARM (Continued)

## INSTALLATION

- (1) Position the upper suspension arm in the frame rail brackets (Fig. 8).
- (2) Install the mounting bolts and tighten to 100 N·m (74 ft. lbs.).
- (3) Retighten the heat shield back into place.
- (4) Pull the arm down on the differential housing bracket and install the pinch bolt and nut. Tighten the nut to 95 N·m (70 ft. lbs.) (Fig. 7).
- (5) Remove the supports and lower the vehicle.

## LOWER CONTROL ARM

## DESCRIPTION

The lower suspension arms are stamped steel and welded and use voided round bushings at the axle end and solid rubber at the body end of the arm.

## OPERATION

The bushings provide isolation from the axle. The arms mount to the unibody frame rail bracket and the axle brackets. The arm and bushings provide location and react to loads.

## REMOVAL

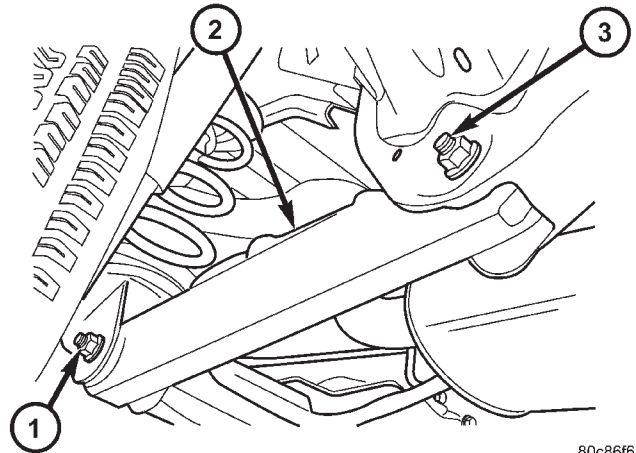
- (1) Raise the vehicle and support the rear axle.
- (2) Remove the stabilizer bar retaining bolts from the suspension arm.
- (3) Remove the lower suspension arm nut and bolt from the axle bracket (Fig. 10).

**NOTE:** When removing the right side suspension arm from the frame rail it will be necessary to pry the exhaust over slightly to allow enough clearance to remove the bolt.

- (4) Remove the nut and bolt (Fig. 10) from the frame rail and remove the lower suspension arm.

## INSTALLATION

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



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**Fig. 10 LOWER SUSPENSION ARM**

- 1 - AXLE BRACKET BOLT
- 2 - LOWER CONTROL ARM
- 3 - BODY BRACKET BOLT

**NOTE:** The end of the arm with the voided round bushing attaches to the axle bracket.

- (2) Install the axle bracket bolt and nut finger tight (Fig. 10).

**NOTE:** When installing the right side suspension arm to the frame rail it will be necessary to pry the exhaust over slightly to allow enough clearance to install the bolt.

- (3) Install the frame rail bracket bolt and nut finger tight.
- (4) Install the stabilizer bar retaining bolts to the suspension arm.
- (5) Remove the supports and lower the vehicle.
- (6) With the vehicle on the ground tighten the nut at the frame to 163 N·m (120 ft. lbs.). Tighten the nut at the axle bracket to 163 N·m (120 ft. lbs.).





# SUSPENSION

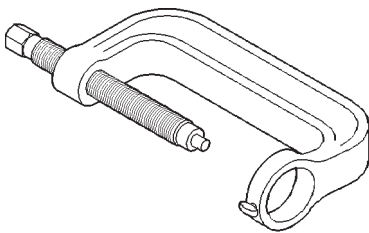
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## FRONT

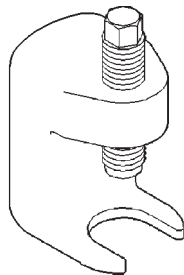
### SPECIAL TOOLS

#### FRONT SUSPENSION

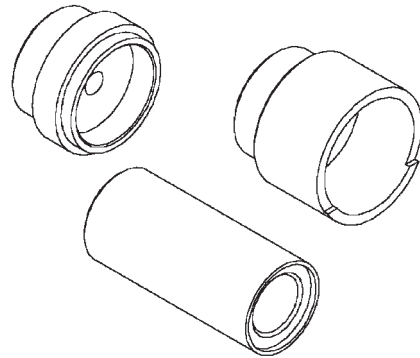


C-4212F-801144af

**BALL JOINT PRESS - C-4212F**

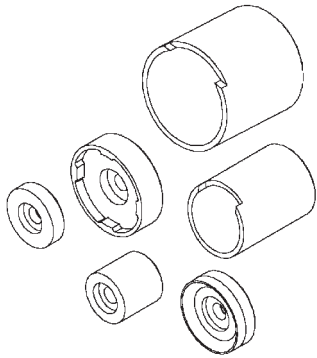


**Remover C-4150A**

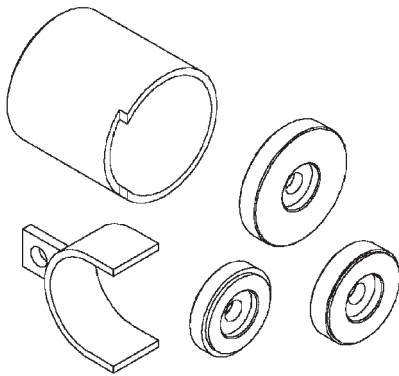


**REMOVER / INSTALLER FRONT LOWER BALL JOINT - 8859**

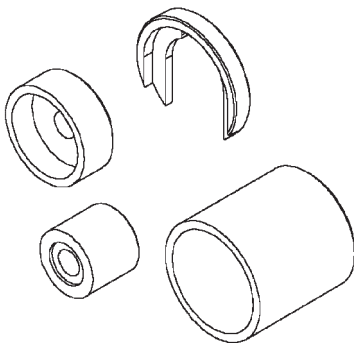
## FRONT (Continued)



**FRONT LOWER CONTROL ARM & CLEVIS  
BUSHING REMOVER/INSTALLER - 8858**



**REAR LOWER CONTROL ARM BUSHING  
REMOVER/INSTALLER - 8862**



**FRONT LOWER CONTROL BUSHING REMOVER/  
INSTALLER - 8830**

## BUSHINGS

## REMOVAL

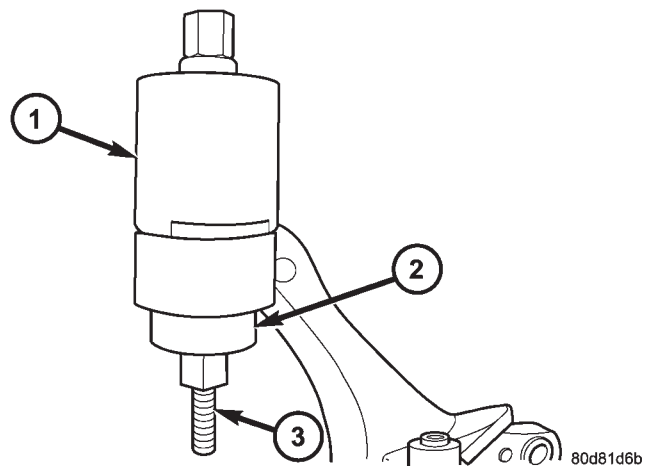
**REMOVAL - LOWER CONTROL ARM BUSHING**

(1) Remove the lower control arm (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL).

(2) Secure the control arm in a vise.

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(3) Press the bushing out using special tools 8858-5 (Receiver), 8858-6 (Driver) and 8839 with the threaded rod and the bearing as shown (Fig. 1)



**Fig. 1 LOWER CONTROL ARM BUSHING -  
REMOVAL**

- 1 - 8858-5 RECEIVER  
2 - 8858-6 DRIVER  
3 - 8839 THREADED ROD

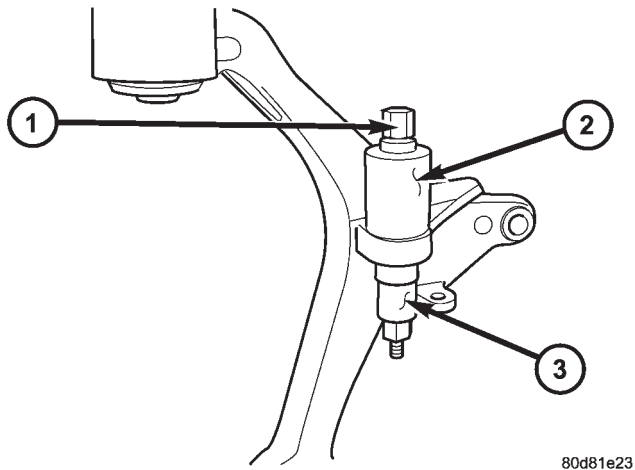
**REMOVAL - CLEVIS BRACKET BUSHING**

(1) Remove the clevis bracket from the shock (Refer to 2 - SUSPENSION/FRONT/CLEVIS BRACKET - REMOVAL).

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

BUSHINGS (Continued)

(2) Press the bushing out using special tools 8858-1 (receiver), 8858-3 (driver) and 8839 with the threaded rod 8839 and the bearing as shown (Fig. 2)



**Fig. 2 CLEVIS BRACKET BUSHING**

- 1 - 8839 THREADED ROD
- 2 - 8858-1 RECEIVER
- 3 - 8858-3 DRIVER

**REMOVAL - UPPER CONTROL ARM BUSHINGS**

(1) Remove the upper control arm (Refer to 2 - SUSPENSION/Front/UPPER CONTROL ARM - REMOVAL).

(2) Secure the control arm in a vise.

**NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.**

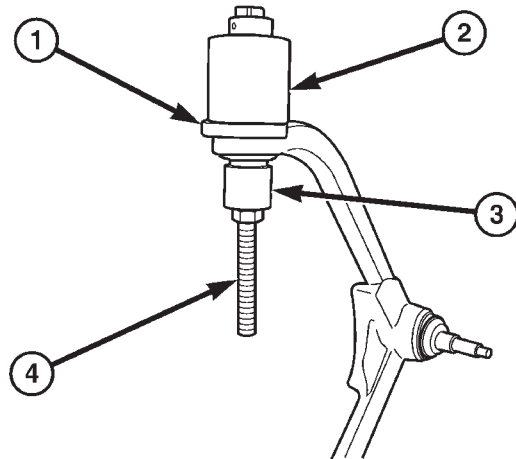
(3) Install bushing remover tools 8830-3, 8830-2 and 8830-4 with the threaded rod 8838 and the bearing as shown (Fig. 3)

(4) Press out the bushing.

**INSTALLATION**

**INSTALLATION - LOWER CONTROL ARM BUSHING**

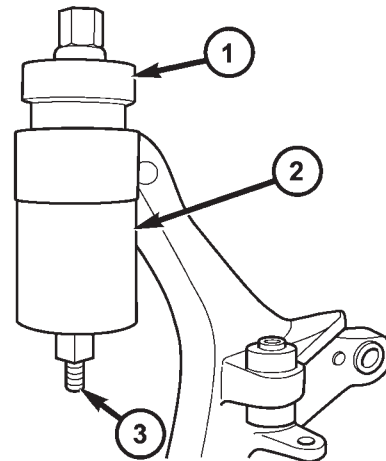
**NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.**



**Fig. 3 UPPER CONTROL ARM BUSHING REMOVAL**

- 1 - 8830-3
- 2 - 8830-2
- 3 - 8830-4
- 4 - 8838

(1) Install the new lower control arm bushings into the lower control arm using tools 8858-5 (driver), 8858-6 (receiver) and the bearing with the threaded rod 8839 (Fig. 4) making sure to properly orient the bushing in the control.



**Fig. 4 LOWER CONTROL ARM BUSHING - INSTALLATION**

- 1 - 8858-5 DRIVER
- 2 - 8858-6 RECEIVER
- 3 - 8839 THREADED ROD

## BUSHINGS (Continued)

(2) Remove the control arm from the vise.

(3) Install the lower control arm (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION).

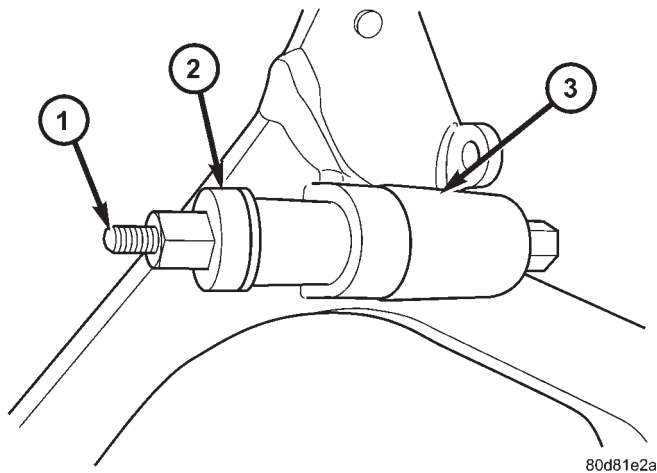
(4) Reset the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(5) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

## INSTALLATION - CLEVIS BRACKET BUSHING

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the new clevis bracket bushing into the lower control arm using tools 8858-2 (driver), 8858-1 (receiver) and the bearing with the threaded rod 8839 (Fig. 5) making sure to properly orient the bushing in the control.



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**Fig. 5 CLEVIS BRACKET BUSHING**

- 1 - 8858-2 DRIVER  
2 - 8858-1 RECEIVER  
3 - 8839 THREADED ROD

(2) Install the clevis bracket (Refer to 2 - SUSPENSION/FRONT/CLEVIS BRACKET - INSTALLATION).

## INSTALLATION - UPPER CONTROL ARM BUSHINGS

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

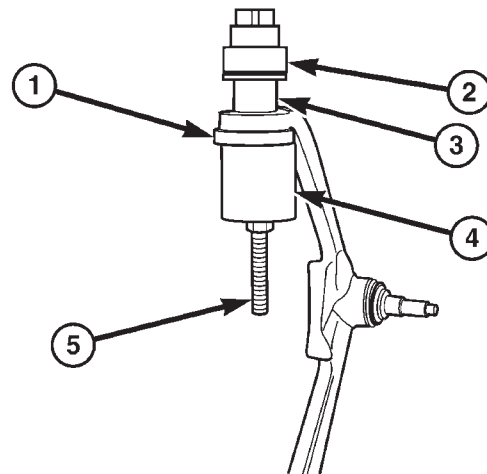
(1) Install the new upper control arm bushings into the upper control arm using tools 8830-3, 8830-1 and 8830-2 the bearing with the threaded rod 8838 (Fig. 6) making sure to properly orient the bushing in the control arm.

(2) Remove the control arm from the vise.

(3) Install the upper control arm (Refer to 2 - SUSPENSION/FRONT/UPPER CONTROL ARM - INSTALLATION).

(4) Reset the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(5) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).



80d71c51

**Fig. 6 UPPER CONTROL ARM BUSHING - INSTALLATION**

- 1 - 8830-3  
2 - 8830-1  
3 - BUSHING  
4 - 8830-2  
5 - 8838

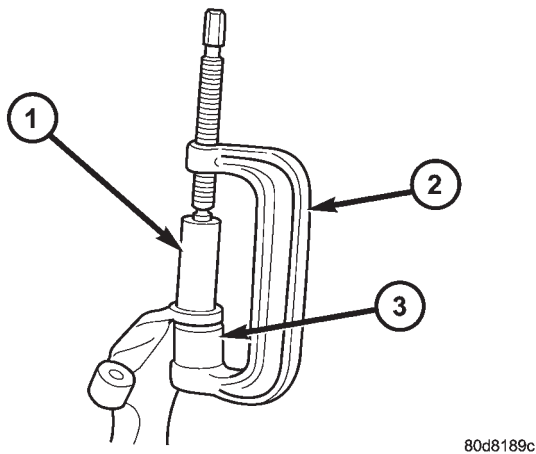
## LOWER BALL JOINT

### REMOVAL

- (1) Remove the tire and wheel assembly.
- (2) Remove the brake caliper and rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
- (3) Disconnect the tie rod from the steering knuckle (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).
- (4) Remove the steering knuckle (Refer to 2 - SUSPENSION/FRONT/KNUCKLE - REMOVAL).
- (5) Move the halfshaft to the side and support the halfshaft out of the way (If Equipped).

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

- (6) Secure the steering knuckle in a vise.
- (7) Press the ball joint from the steering knuckle using special tools C-4212-F (PRESS), 8859-2 (RECEIVER) and 8859-1 (DRIVER) (Fig. 7).



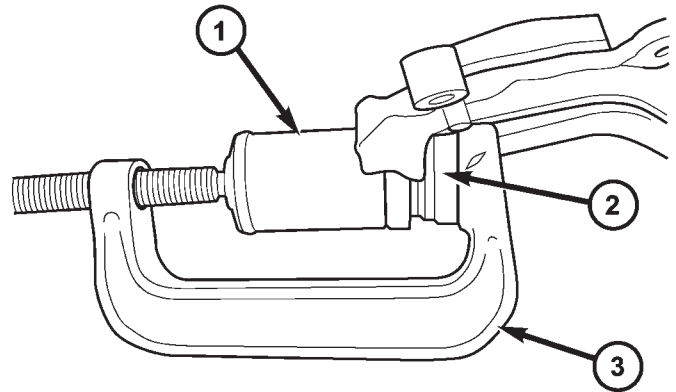
**Fig. 7 LOWER BALL JOINT**

- 1 - 8859-1 DRIVER
- 2 - C-4212F PRESS
- 3 - 8859-2 RECEIVER

### INSTALLATION

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

- (1) Install the ball joint into the steering knuckle and press in using special tools C-4212-F (press), 8859-3 (driver) and 6761 (receiver) (Fig. 8).



80d818a4

**Fig. 8 LOWER BALL JOINT**

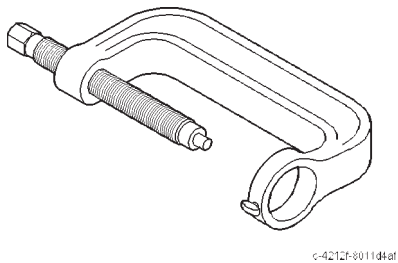
- 1 - 6761 RECEIVER
- 2 - 8859-3 DRIVER
- 3 - C-4212F PRESS

- (2) Install the ball joint boot.
- (3) Remove the support for the halfshaft and install into position (If Equipped).
- (4) Install the steering knuckle (Refer to 2 - SUSPENSION/FRONT/KNUCKLE - INSTALLATION).
- (5) Install the tie rod end into the steering knuckle (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).
- (6) Install and tighten the halfshaft nut to 136 N·m (100 ft. lbs.).
- (7) Install the brake caliper and rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).
- (8) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (9) Check the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).
- (10) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

REAR

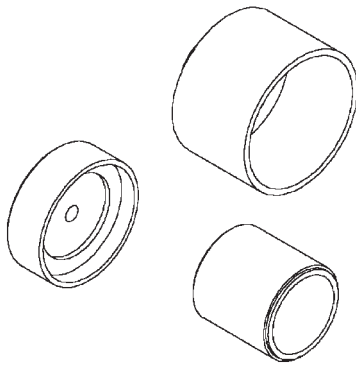
SPECIAL TOOLS

REAR SUSPENSION

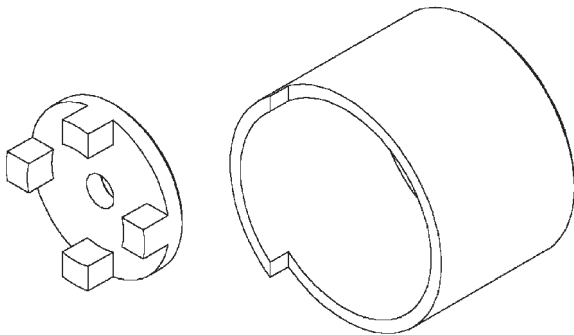


C-4212F-801144af

**BALL JOINT PRESS - C-4212F**



**REMOVER / INSTALLER REAR UPPER BALL JOINT - 8861**



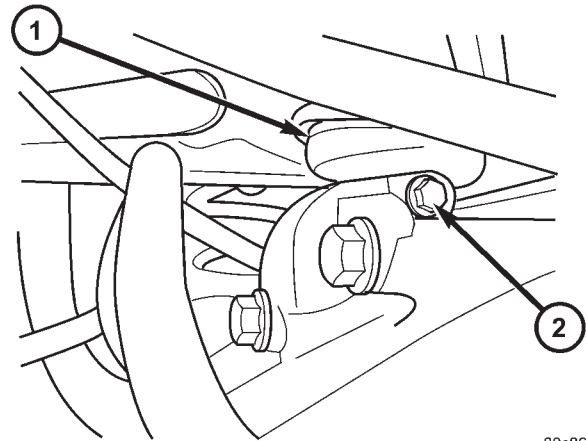
**REMOVAL / INSTALLATION REAR UPPER CONTROL ARM BUSHINGS - 8860**

UPPER BALL JOINT

REMOVAL

- (1) Raise and support the vehicle.
- (2) Support the rear axle with a hydraulic jack.
- (3) Remove the ball joint pinch bolt from the top of the axle. (Fig. 9)

- (4) Separate the ball joint arm assembly from the differential housing by prying upwards.



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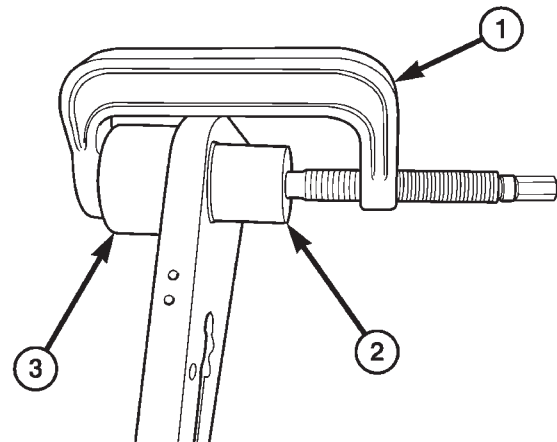
**Fig. 9 BALL JOINT PINCH BOLT**

- 1 - UPPER BALL JOINT
- 2 - PINCH BOLT

- (5) Remove the upper suspension arm from the vehicle (Refer to 2 - SUSPENSION/REAR/UPPER CONTROL ARM - REMOVAL).

- (6) Secure the suspension arm in a vise.

- (7) Install special tools C-4212F (press), 8861-3 (driver) and 8861-2 (receiver) (Fig. 10)



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**Fig. 10 UPPER BALL JOINT - REMOVAL**

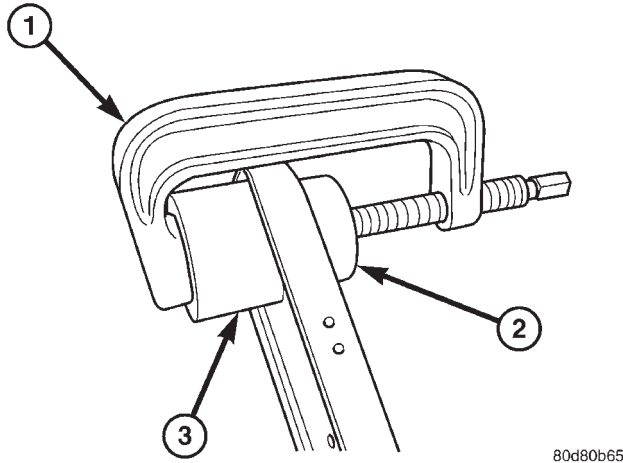
- 1 - C-4212F PRESS
- 2 - 8861-3 DRIVER
- 3 - 8861-2 RECEIVER

- (8) Press out the old ball joint.

INSTALLATION

- (1) Install special tools C-4212F (press), 8861-1 (receiver) and 8861-2 (driver) with the ball joint in place (Fig. 11).

UPPER BALL JOINT (Continued)



**Fig. 11 UPPER BALL JOINT - INSTALLATION**

- 1 - C-4212F PRESS
- 2 - 8861-1 RECEIVER
- 3 - 8861-2 DRIVER

(2) Press the ball joint in the upper suspension arm.

(3) Remove the upper suspension arm from the vise.

(4) Reinstall the upper suspension arm (Refer to 2 - SUSPENSION/REAR/UPPER CONTROL ARM - INSTALLATION).

(5) Raise the rear axle with a hydraulic jack to align the ball joint with the differential housing bracket.

(6) Insert the ball joint into the differential housing bracket.

(7) Install the ball joint pinch bolt and tighten to 95 N·m (70 ft. lbs.). (Fig. 9).

(8) Remove the supports and lower the vehicle.

**BUSHINGS**

**REMOVAL**

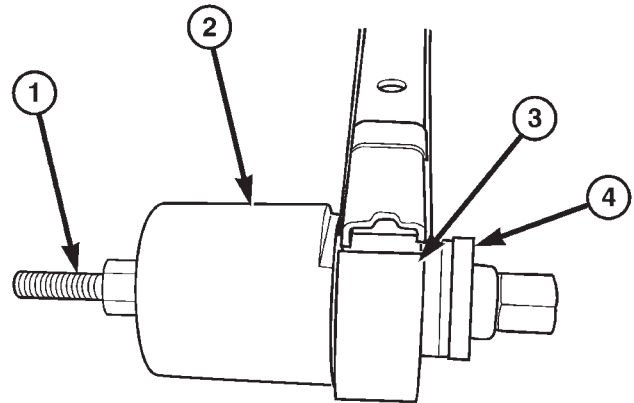
**REMOVAL - LOWER SUSPENSION ARM BUSHING**

(1) Remove the lower suspension arm (Refer to 2 - SUSPENSION/REAR/LOWER CONTROL ARM - REMOVAL).

(2) Secure the suspension arm in a vise.

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(3) Install special tools 8862-4 (receiver), 8862-5 (spacer) and 8862-1 or 8862-2 (driver) with the threaded rod 8839 and the bearing as shown (Fig. 12)



**Fig. 12 LOWER SUSPENSION ARM BUSHING REMOVAL**

- 1 - 8839 THREADED ROD
- 2 - 8862-4 RECEIVER
- 3 - 8862-5 SPACER
- 4 - 8862-1 OR 8862-2 DRIVERS

(4) Press out the bushing.

**REMOVAL - UPPER SUSPENSION ARM BUSHING**

(1) Remove the upper suspension arm (Refer to 2 - SUSPENSION/REAR/UPPER CONTROL ARM - REMOVAL).

(2) Secure the suspension arm in a vise.

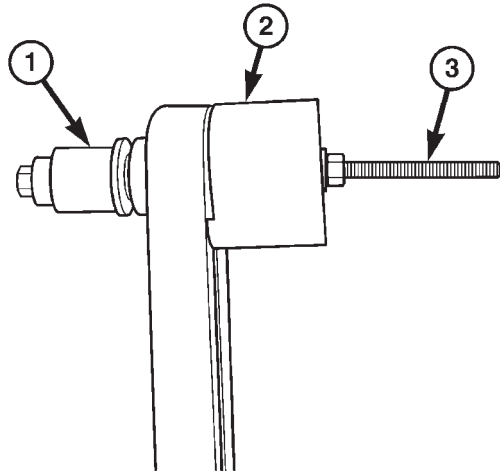
**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(3) Install special tools 8853-3 (driver), 8860-1 (receiver) and with the threaded rod 8838 and the bearing as shown (Fig. 13)

(4) Press out the bushing.



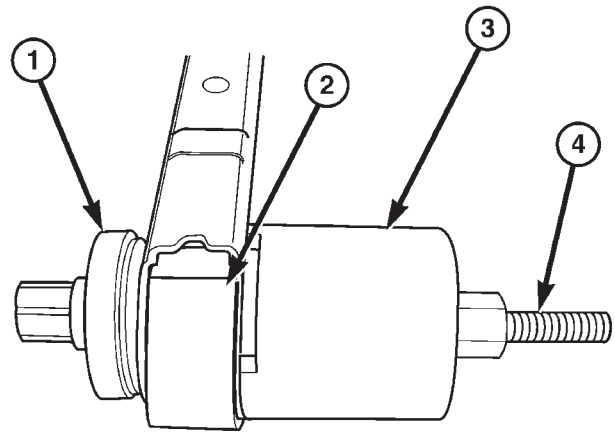
## BUSHINGS (Continued)



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**Fig. 13 UPPER SUSPENSION ARM BUSHING - REMOVAL**

- 1 - 8853-3 DRIVER
- 2 - 8860-1 RECEIVER
- 3 - 8838 THREADED ROD



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**Fig. 14 LOWER SUSPENSION ARM BUSHING INSTALLATION**

- 1 - 8862-3 DRIVER
- 2 - 8862-5 SPACER
- 3 - 8862-4 RECEIVER
- 4 - 8839 THREADED ROD

## INSTALLATION

## INSTALLATION - LOWER SUSPENSION ARM BUSHING

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the new lower suspension arm bushings into the lower suspension arm using tools 8862-3 (driver), 8862-4 (receiver), 8862-5 (spacer) and the bearing with the threaded rod 8839 (Fig. 14) making sure to properly orient the bushing in the suspension arm.

(2) Remove the suspension arm from the vise.

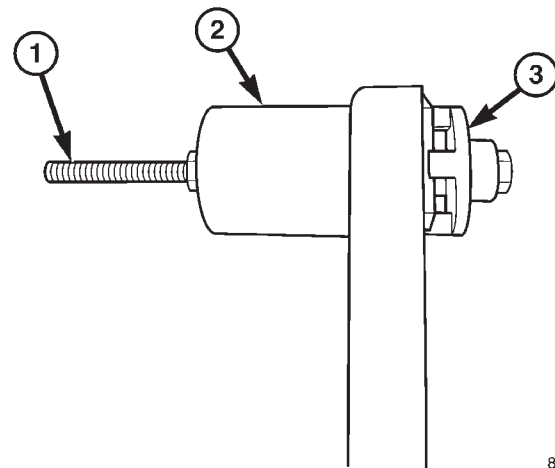
(3) Install the lower suspension arm (Refer to 2 - SUSPENSION/REAR/LOWER CONTROL ARM - INSTALLATION).

## INSTALLATION - UPPER SUSPENSION ARM BUSHING

**NOTE:** Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the new upper suspension arm bushings into the upper suspension arm using tools 8835-3

(receiver), 8860-2 (driver) and the bearing with the threaded rod 8838 (Fig. 15) making sure to properly orient the bushing in the suspension arm.



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**Fig. 15 UPPER SUSPENSION ARM BUSHING - INSTALLATION**

- 1 - 8838 THREADED ROD
- 2 - 8835-3 RECEIVER
- 3 - 8860-2 DRIVER

(2) Remove the suspension arm from the vise.

(3) Install the upper suspension arm (Refer to 2 - SUSPENSION/REAR/UPPER CONTROL ARM - INSTALLATION).

# DIFFERENTIAL & DRIVELINE

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## PROPELLER SHAFT

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## PROPELLER SHAFT

### DIAGNOSIS AND TESTING - PROPELLER SHAFT

#### VIBRATION

Tires that are out-of-round, or wheels that are unbalanced, will cause a low frequency vibration.

Brake rotors that are unbalanced will cause a harsh, low frequency vibration.

Driveline vibration can also result from loose or damaged engine mounts.

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 joints or an incorrect propeller shaft angle, are usually the cause of such a vibration.

PROPELLER SHAFT (Continued)

DRIVELINE VIBRATION

Drive Condition	Possible Cause	Correction
Propeller Shaft Noise	<ol style="list-style-type: none"> <li>1. Undercoating or other foreign material on shaft.</li> <li>2. Loose U-joint clamp screws.</li> <li>3. Loose or bent U-joint yoke or excessive runout.</li> <li>4. Incorrect driveline angularity.</li> <li>5. Worn joint.</li> <li>6. Propeller shaft damaged or out of balance.</li> <li>7. Broken rear spring.</li> <li>8. Excessive runout or unbalanced condition.</li> <li>9. Excessive drive pinion gear shaft runout.</li> <li>10. Excessive axle yoke deflection.</li> <li>11. Excessive transfer case runout.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean exterior of shaft and wash with solvent.</li> <li>2. Install new clamps and screws and tighten to proper torque.</li> <li>3. Install new yoke.</li> <li>4. Measure and correct driveline angles.</li> <li>5. Install new joint.</li> <li>6. Install new propeller shaft.</li> <li>7. Install new rear spring.</li> <li>8. Re-index propeller shaft, test, and evaluate.</li> <li>9. Re-index propeller shaft and evaluate.</li> <li>10. Inspect and replace yoke if necessary.</li> <li>11. Inspect and repair as necessary.</li> </ol>
Joint Noise	<ol style="list-style-type: none"> <li>1. Loose U-joint clamp screws.</li> <li>2. Lack of lubrication.</li> </ol>	<ol style="list-style-type: none"> <li>1. Install new clamps and screws and tighten to proper torque.</li> <li>2. Replace joints as necessary.</li> </ol>

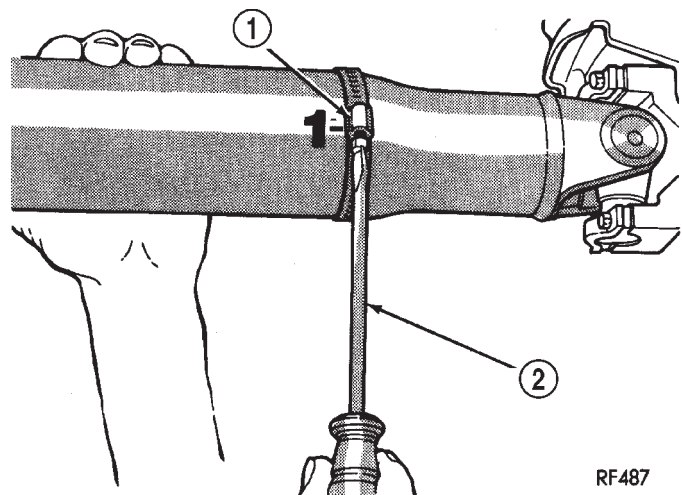
BALANCE

**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. 1).



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Fig. 1 CLAMP AT POSITION 1

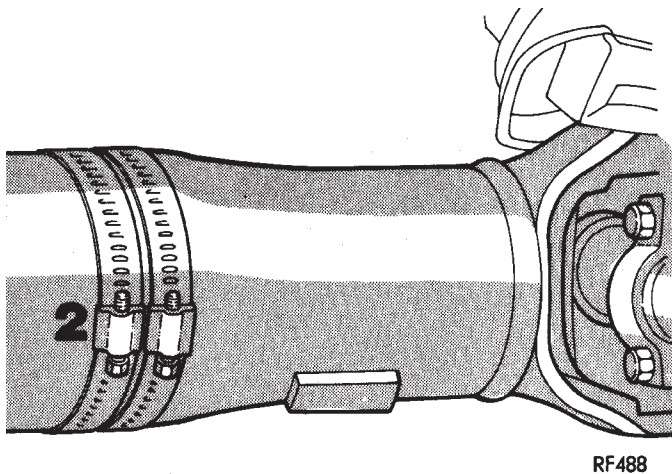
- 1 - CLAMP
- 2 - SCREWDRIVER

PROPELLER SHAFT (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.

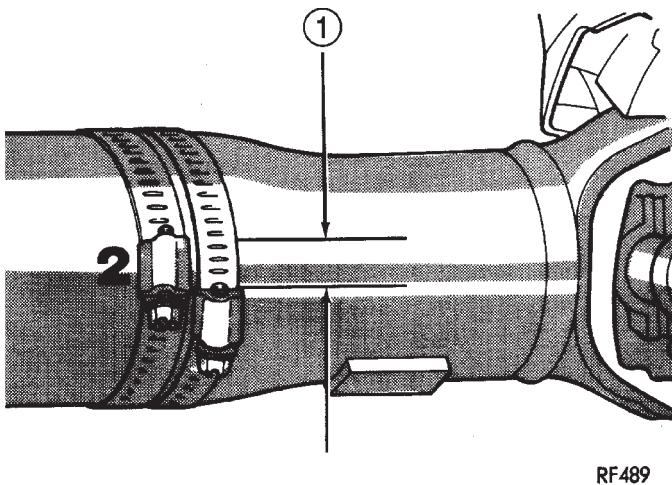
(11) If there is no difference in vibration at the other positions, the source of the vibration may not be propeller shaft.

(12) If the vibration decreased, install a second clamp (Fig. 2) and repeat the test.



**Fig. 2 TWO CLAMPS AT 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. 3).



**Fig. 3 CLAMPS SEPARATED**

1 - 1/2 INCH

(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.	

**STANDARD PROCEDURES - PROPELLER SHAFT ANGLE**

The procedure applies to both the front propeller shafts and the rear propeller shaft. To obtain the front (output) angle on the C/V front propeller shaft, the inclinometer is placed on the machined ring of the pinion flange. To obtain the propeller shaft angle measurement on the C/V front propeller shaft, the inclinometer is placed on the propeller shaft tube.

(1) Raise and support the vehicle at the axles as level as possible. Allow the wheels and propeller shaft to turn.

(2) Remove any external bearing snap rings from universal joint if equipped, so the inclinometer base will sit flat.

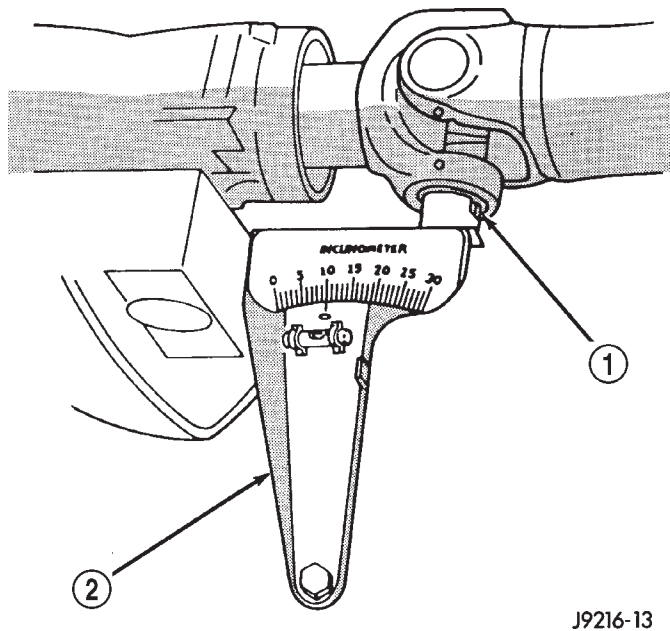
PROPELLER SHAFT (Continued)

(3) Rotate the shaft until transmission/transference case output yoke bearing cap is facing downward, if necessary.

**NOTE:** Always make measurements from front to rear.

(4) Place Inclinator on yoke bearing cap, or the pinion flange ring, (A) parallel to the shaft (Fig. 4). Center bubble in sight glass and record measurement.

**NOTE:** This measurement will give you the transmission or Output Yoke Angle (A).



J9216-13

**Fig. 4 OUTPUT YOKE ANGLE (A)**

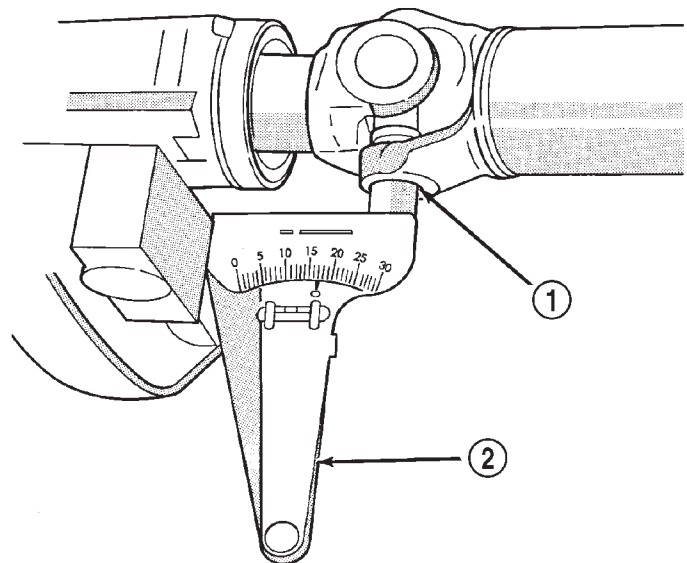
- 1 - SLIP YOKE BEARING CAP
- 2 - INCLINOMETER

(5) Rotate propeller shaft 90 degrees and place Inclinator on yoke bearing cap, or propeller shaft tube on C/V propeller shaft, parallel to the shaft (Fig. 5). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

**NOTE:** This measurement will give you the propeller shaft angle (C).

(6) Subtract smaller figure from larger (C minus A) to obtain transmission output operating angle.

(7) Rotate propeller shaft 90 degrees and place Inclinator on pinion yoke bearing cap parallel to the shaft (Fig. 6). Center bubble in sight glass and record measurement.

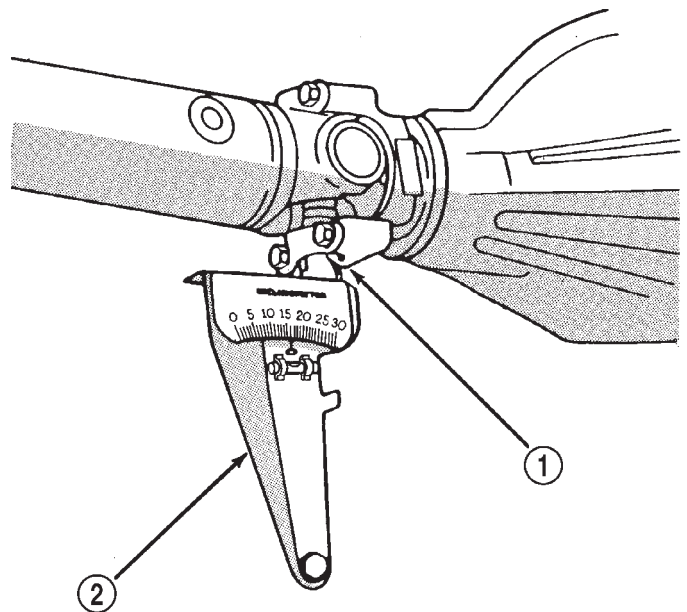


J9216-9

**Fig. 5 PROPELLER SHAFT ANGLE (C)**

- 1 - SHAFT YOKE BEARING CAP
- 2 - INCLINOMETER

**NOTE:** This measurement will give you the pinion shaft or input yoke angle (B).



J9216-12

**Fig. 6 INPUT YOKE ANGLE (B)**

- 1 - PINION YOKE BEARING CAP
- 2 - INCLINOMETER

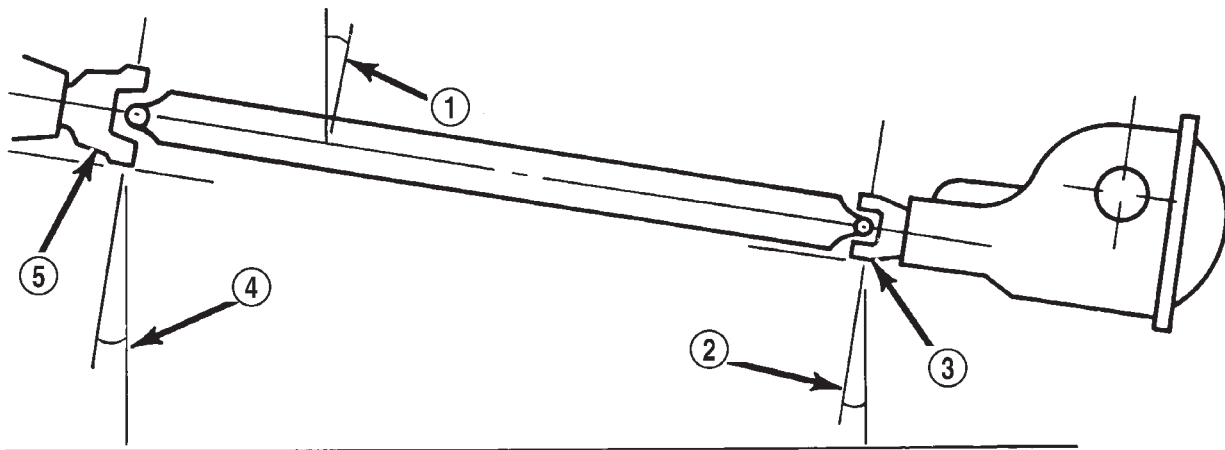
PROPELLER SHAFT (Continued)

(8) Subtract smaller figure from larger (C minus B) to obtain axle Input Operating Angle.

Refer to rules given below and the example in (Fig. 7) for additional information.

• Good cancellation of U-joint operating angles (within 1°).

- Operating angles less than 3°.
- Operating angles less than 10° for double cardan U-joint.
- At least 1/2 of one degree continuous operating (propeller shaft) angle.



Horizontal Level

(A) Output Yoke = 3.0° or 4.9°  
 (C) Prop. Shaft = 4.9° or -3.0°

Transmission Output Operating Angle 1.9°

(B) Axle Input Yoke = 3.2° or 4.9°  
 (C) Prop. Shaft = 4.9° or -3.2°

Axle Input Operating Angle 1.7°

Trans. Output Operating Angle 1.9°  
 Axle Input Operating Angle -1.7°

Amount of U-Joint Cancellation 0.2°

J9316-3

**Fig. 7 U-JOINT ANGLE EXAMPLE**

- 1 - 4.9° Angle (C)
- 2 - 3.2° Angle (B)
- 3 - Input Yoke

- 4 - 3.0° Angle (A)
- 5 - Output Yoke

## PROPELLER SHAFT (Continued)

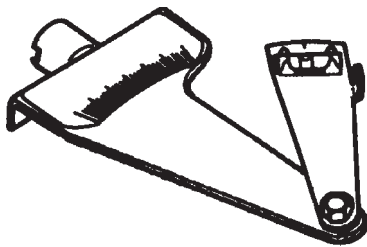
## SPECIFICATIONS

## PROPELLER SHAFT

## TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Front Shaft - Companion Flange Bolts	30	22	-
Rear Shaft - Yoke Nuts	18	13	-

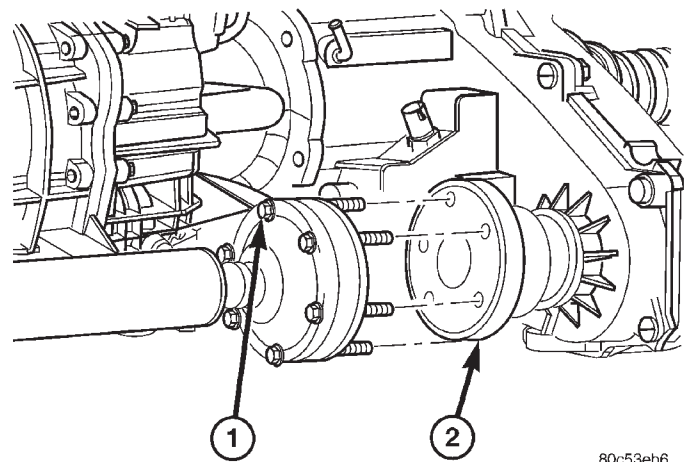
## SPECIAL TOOLS

*Inclinometer 7663*

## PROPELLER SHAFT - FRONT

## REMOVAL

- (1) Shift transmission and transfer case into Neutral.
- (2) Raise and support the vehicle.
- (3) Mark companion flanges and C/V joints at the front and rear of the propeller shaft for installation reference.
- (4) Remove bolts from the front and rear C/V joints.
- (5) Push propeller shaft forward to clear transfer case companion flange (Fig. 8).
- (6) Remove the shaft from the front axle companion flange.
- (7) Tilt the front of the shaft down and pull shaft forward and remove from the vehicle.



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**Fig. 8 TRANSFER CASE COMPANION FLANGE**

- 1 - FLANGE BOLT
- 2 - COMPANION FLANGE

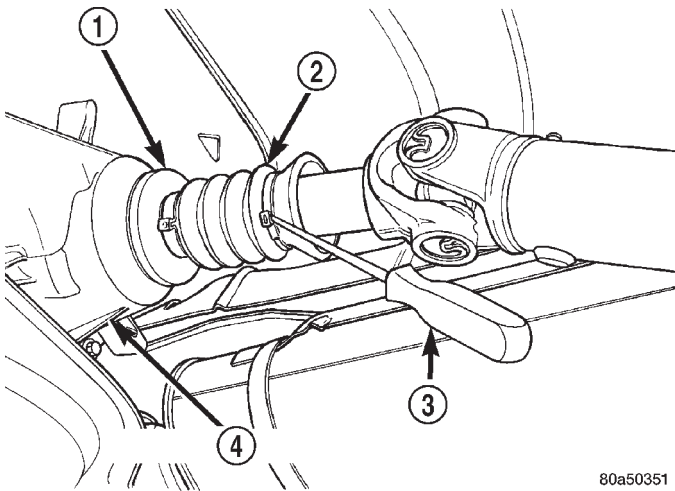
## INSTALLATION

- (1) Install propeller shaft between companion flanges.
- (2) Align marks on the companion flanges with the marks on the C/V joints.
- (3) Install front C/V joint bolts and tighten to 30 N-m (22 ft. lbs.).
- (4) Install rear C/V joint bolts and tighten to 30 N-m (22 ft. lbs.).
- (5) Lower vehicle.

## PROPELLER SHAFT - REAR

### REMOVAL

- (1) Shift the transmission/transfer case into Neutral.
- (2) Raise and support vehicle.
- (3) Mark a reference line across the pinion yoke and propeller shaft for installation.
- (4) Remove U-joint strap bolts at the pinion shaft yoke.
- (5) Pry open clamp holding the dust boot to propeller shaft yoke (Fig. 9), if equipped.



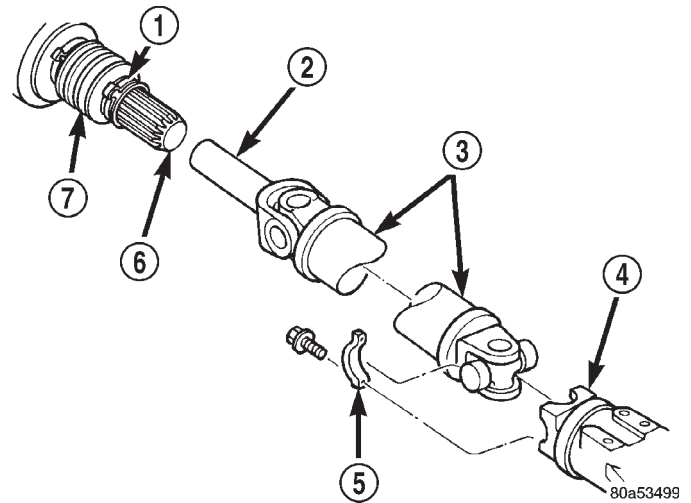
**Fig. 9 DUST BOOT CLAMP**

- 1 - SLINGER
- 2 - BOOT
- 3 - AWL
- 4 - TRANSFER CASE

- (6) Slide slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft (Fig. 10).

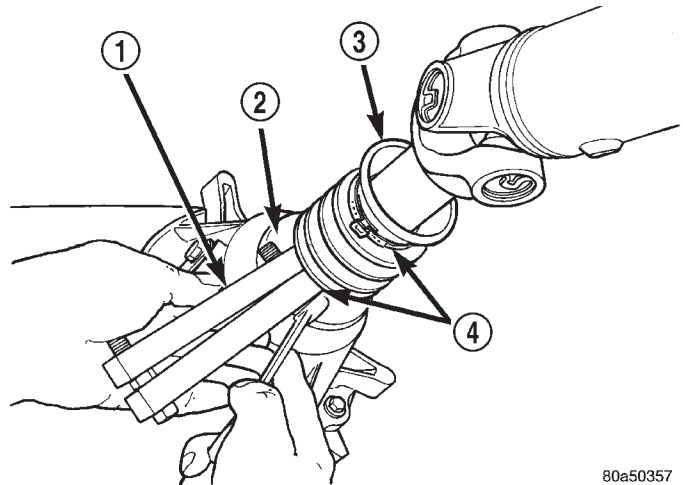
### INSTALLATION

- (1) Slide slip yoke on the transmission/transfer case output shaft.
- (2) Align reference marks on the pinion yoke and propeller shaft.
- (3) Install U-joint straps and tighten strap bolts to 18 N·m (13 ft. lbs.).
- (4) Tighten dust boot clamp if equipped with Clamp C-4975A (Fig. 11).
- (5) Remove support and lower the vehicle.



**Fig. 10 REAR PROPELLER SHAFT**

- 1 - CLAMP
- 2 - YOKE
- 3 - PROPELLER SHAFT
- 4 - AXLE YOKE
- 5 - CLAMP
- 6 - OUTPUT SHAFT
- 7 - BOOT



**Fig. 11 CRIMPING BOOT CLAMP**

- 1 - CLAMP TOOL
- 2 - SLINGER
- 3 - BOOT
- 4 - CLAMPS

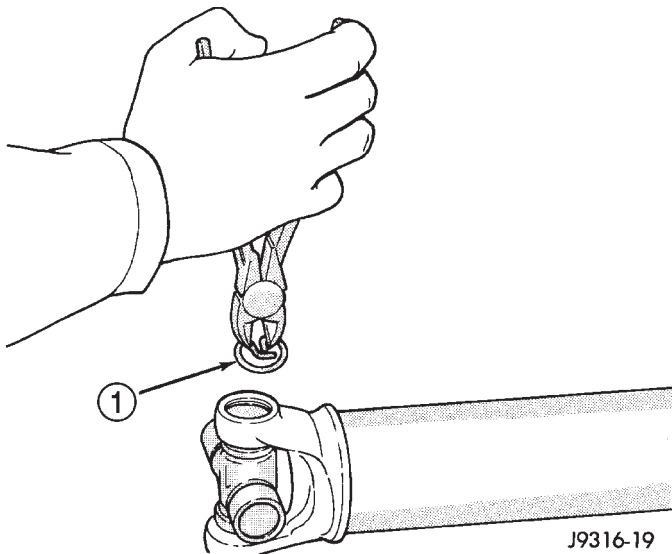


## SINGLE CARDAN UNIVERSAL JOINTS

### DISASSEMBLY

**NOTE:** 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) Tap the outside of the bearing cap assembly with a drift to loosen snap ring.
- (3) Remove snap rings from both sides of yoke (Fig. 12).



**Fig. 12 REMOVE SNAP RING**

1 - 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.

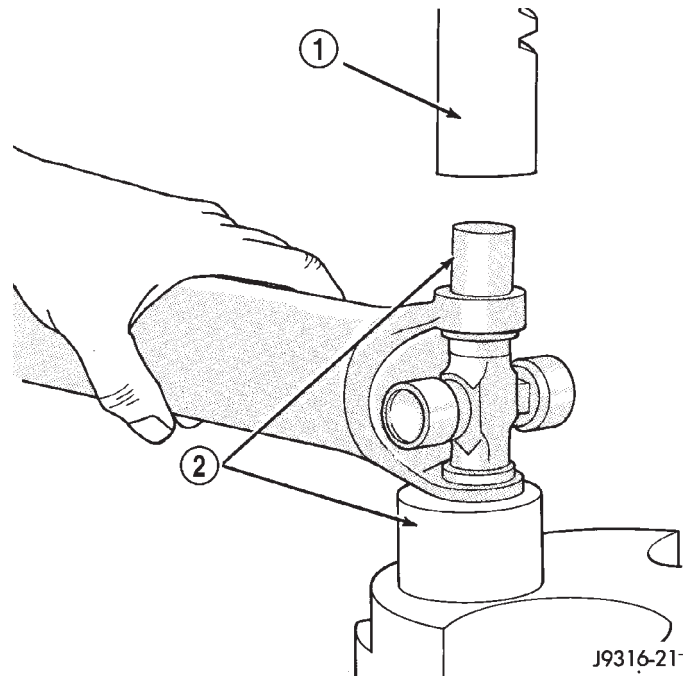
(5) Position the yoke with the grease fitting, if equipped, pointing up.

(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. 13).

(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.

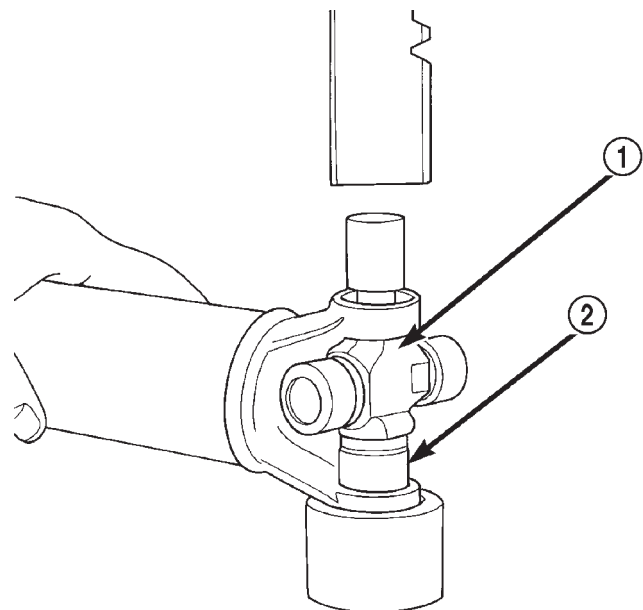
(8) To remove the opposite bearing cap, turn the yoke over and straighten the cross in the open hole. Then, carefully press the end of the cross until the remaining bearing cap can be removed (Fig. 14).

**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. 13 PRESS OUT BEARING**

1 - PRESS  
2 - SOCKET



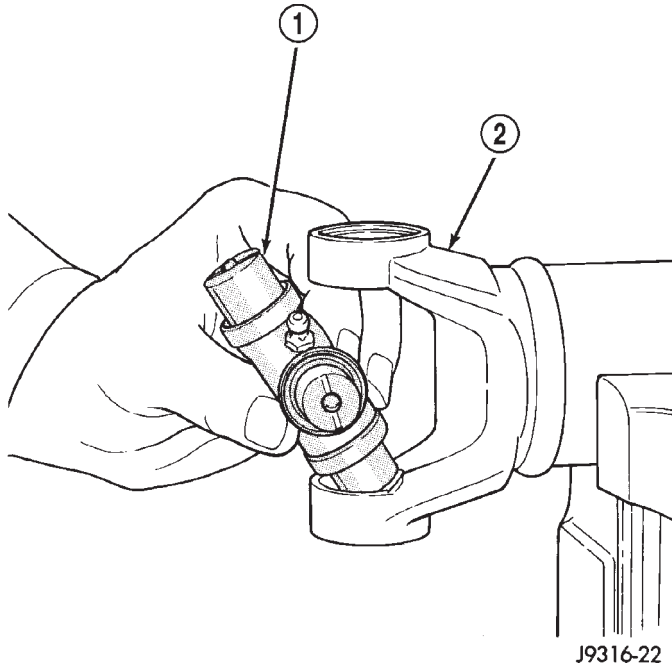
**Fig. 14 PRESS OUT REMAINING BEARING**

1 - CROSS  
2 - BEARING CAP

SINGLE CARDAN UNIVERSAL JOINTS (Continued)

**ASSEMBLY**

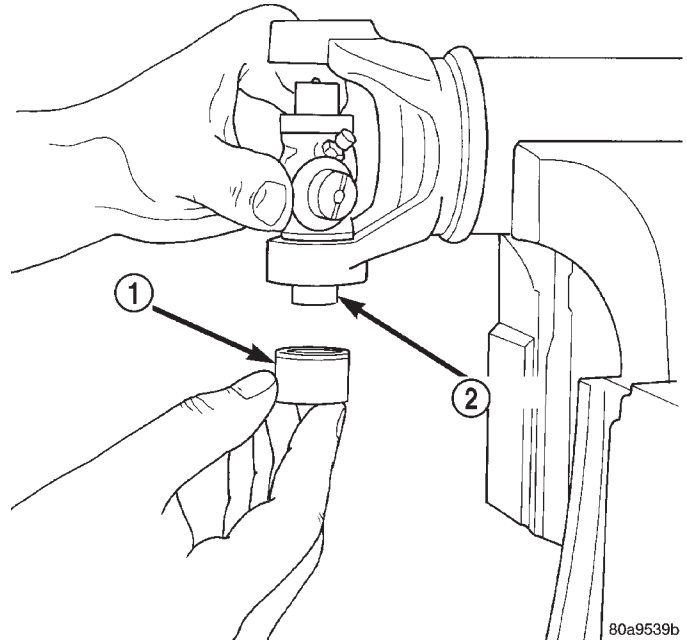
- (1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to inside of yoke bores.
- (2) Position the cross in the yoke with its lube fitting, if equipped, pointing up (Fig. 15).



**Fig. 15 CROSS IN YOKE**

- 1 - CROSS
- 2 - YOKE

- (3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 16). Keep the needle bearings upright in the bearing cap.



**Fig. 16 INSTALL BEARING ON TRUNNION**

- 1 - BEARING CAP
- 2 - TRUNNION

- (4) Press the bearing cap into the yoke bore enough to clear snap ring groove.
- (5) Install a snap ring.
- (6) Repeat Step 3 and Step 4 to install the opposite bearing cap.

**NOTE: 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.

# HALF SHAFT

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## HALF SHAFT

### CAUTION

**CAUTION::** Never grasp half shaft assembly by the boots. This may cause the boot to pucker or crease and reduce the service life of the boot.

Avoid over angulating or stroking the C/V joints when handling the half shaft.

Half shafts exposed to battery acid, transmission fluid, brake fluid, differential fluid or gasoline may cause the boots to deteriorate.

### DIAGNOSIS AND TESTING - HALF SHAFT

Check for grease at the inboard and outboard C/V joint. This is a sign of boot or boot clamp damage.

### NOISE AND/OR VIBRATION IN TURNS

A clicking noise or a vibration in turns could be caused by a damaged outer C/V or inner tripod joint seal boot or seal boot clamps. This will result in the loss/contamination of the joint grease, resulting in inadequate lubrication of the joint. Noise could also be caused by another component of the vehicle coming in contact with the half shafts.

### CLUNKING NOISE DURING ACCELERATION

This noise may be a result of a damaged or worn C/V joint. A torn boot or loose/missing clamp on the inner/outer joint which has allowed the grease to be lost will damage the C/V joint.

### SHUDDER OR VIBRATION DURING ACCELERATION

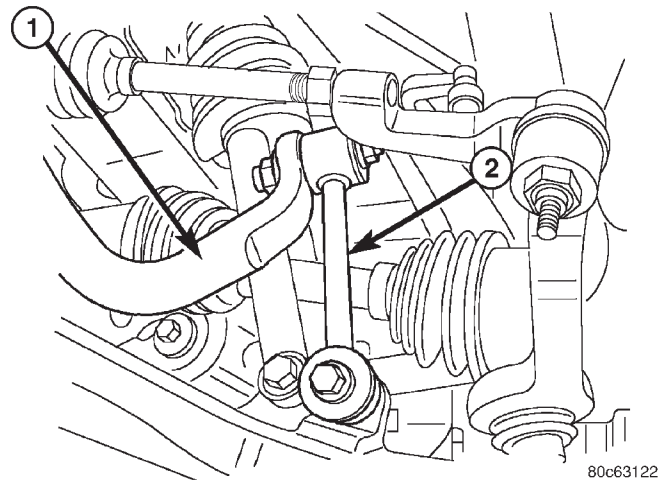
This problem could be a result of a worn/damaged inner tripod joint or a sticking tripod joint. Improper wheel alignment may also cause a shudder or vibration.

### VIBRATION AT HIGHWAY SPEEDS

This problem could be a result of out of balance front tires or tire/wheel runout. Foreign material (mud, etc.) packed on the backside of the wheel(s) will also cause a vibration.

### REMOVAL

- (1) Raise and support vehicle.
- (2) Remove wheel and tire assembly.
- (3) Remove half shaft hub nut.
- (4) Remove stabilizer link (Fig. 1).



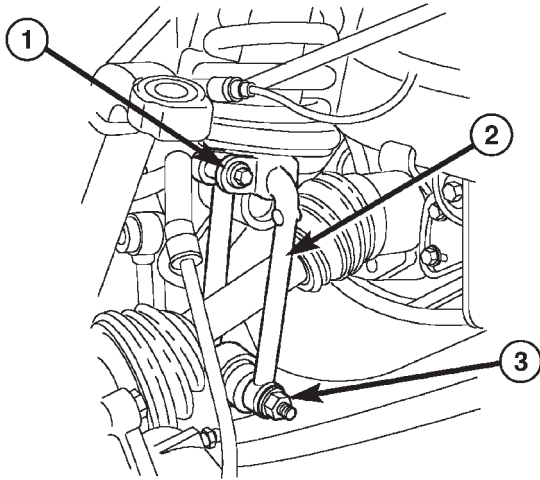
**Fig. 1 STABILIZER BAR LINK**

- 1 - STABILIZER BAR
- 2 - STABILIZER BAR LINK

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HALF SHAFT (Continued)

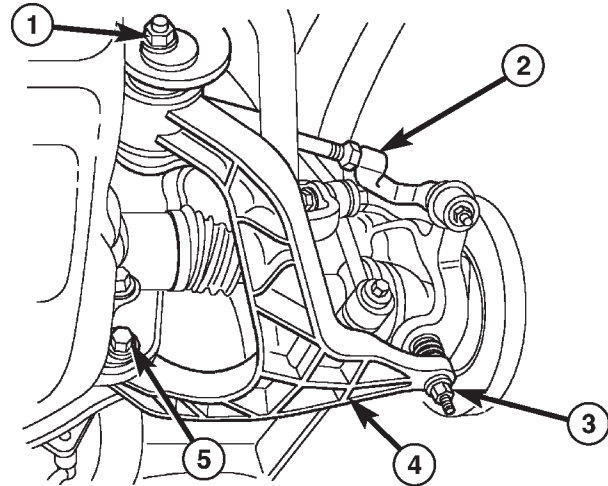
(5) Remove lower clevis bolt (Fig. 2).



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**Fig. 2 CLEVIS BRACKET**

- 1 - UPPER BOLT
- 2 - CLEVIS BRACKET
- 3 - LOWER BOLT



80c6315b

**Fig. 3 LOWER CONTROL ARM**

- 1 - FRONT CAM BOLT
- 2 - OUTER TIE ROD END
- 3 - LOWER BALL JOINT NUT
- 4 - LOWER CONTROL ARM
- 5 - REAR CAM BOLT

(6) Separate lower ball joint from the lower control arm (Fig. 3).

(7) Pull out on the steering knuckle and push the half shaft out of the knuckle.

(8) With a pry bar remove the half shaft from the axle.

**NOTE:** The right side has a splined axle shaft that will stay in the axle.

**INSTALLATION**

(1) Apply a light coat of wheel bearing grease on the female splines of the inner C/V joint.

(2) Install half shaft on the axle shaft spline and push firmly to engage the snap ring. Pull on the half shaft to verify snap has engaged.

(3) Clean hub bearing bore and apply a light coat of wheel bearing grease.

(4) Pull out on the steering knuckle and push the half shaft through the knuckle.

(5) Install lower ball joint into the lower control arm and tighten pinch bolt.

(6) Align clevis with knuckle. Install and tighten lower clevis bolt.

(7) Install stabilizer link.

(8) Install half shaft hub nut.

(9) Install wheel and tire assembly.

(10) Remove support and lower vehicle.

**SPECIFICATIONS**

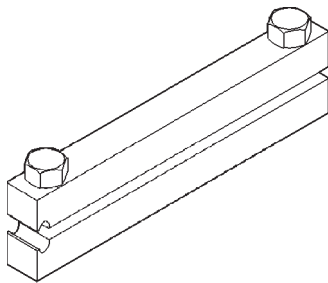
**HALF SHAFT**

*TORQUE SPECIFICATIONS*

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Half Shaft Nut	136	100	-

HALF SHAFT (Continued)

SPECIAL TOOLS



CLAMP INSTALLER C-4975A

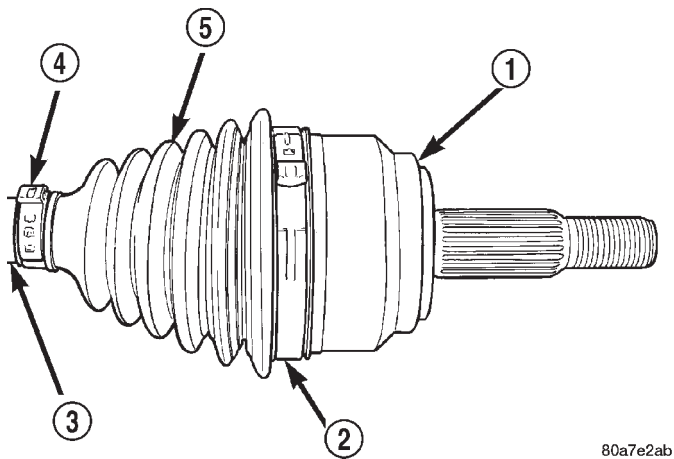
CV JOINT/BOOT-OUTER

REMOVAL

(1) Clamp shaft in a vise (with soft jaws) and support C/V joint.

(2) Remove clamps with a cut-off wheel or grinder (Fig. 4).

**CAUTION:** Do not damage C/V housing or half shaft.

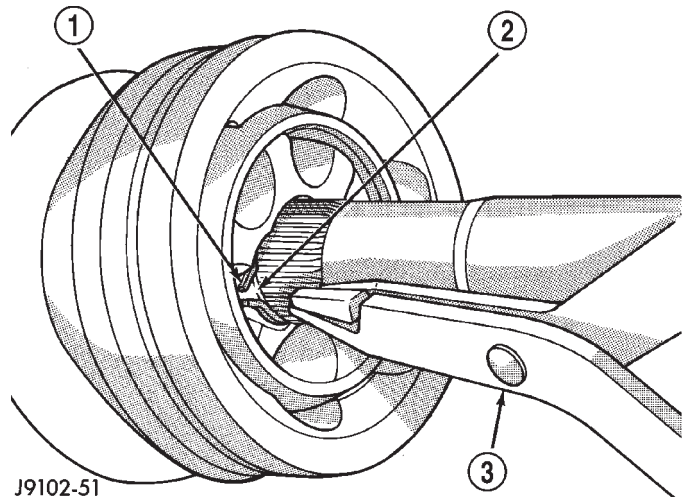


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Fig. 4 BOOT CLAMP LOCATIONS

- 1 - C/V HOUSING
- 2 - CLAMP
- 3 - HALF SHAFT
- 4 - CLAMP
- 5 - C/V BOOT

- (3) Slide the boot down the shaft.
- (4) Remove lubricant to expose the C/V joint snap ring.
- (5) Spread snap ring and slide the joint off the shaft (Fig. 5).
- (6) Slide boot off the shaft and discard old boot.

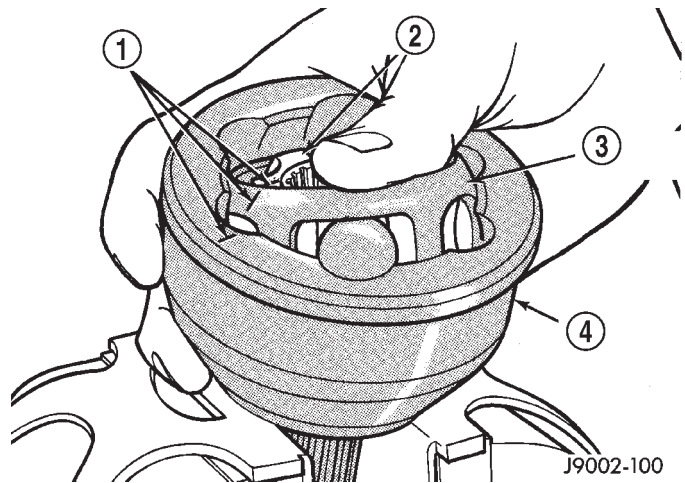


J9102-51

Fig. 5 OUTER C/V JOINT

- 1 - SNAP RING
- 2 - SNAP RING GROVE
- 3 - SNAP RING PLIERS

(7) Mark alignment marks on the inner race/hub, bearing cage and housing with dabs of paint (Fig. 6).



J9002-100

Fig. 6 BEARING ACCESS

- 1 - ALIGNMENT MARKS
- 2 - BEARING HUB
- 3 - BEARING CAGE
- 4 - HOUSING

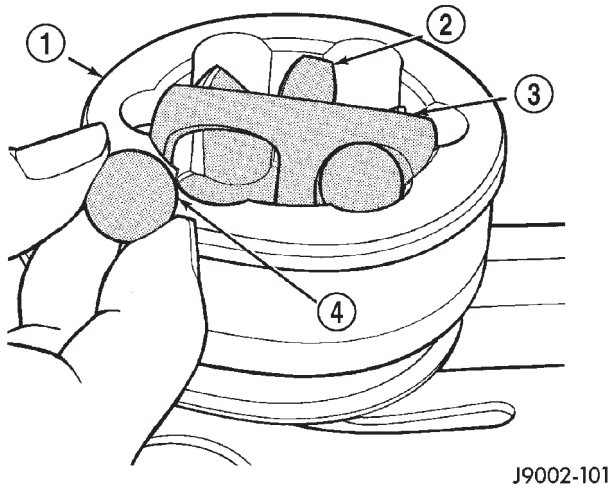
(8) Clamp C/V joint in a vertical position in a soft jawed vise.

(9) Press down one side of the bearing cage to gain access to the ball at the opposite.

**NOTE:** If joint is tight, use a hammer and brass drift to loosen the bearing hub. Do not contact the bearing cage with the drift.

CV JOINT/BOOT-OUTER (Continued)

(10) Remove ball from the bearing cage (Fig. 7).

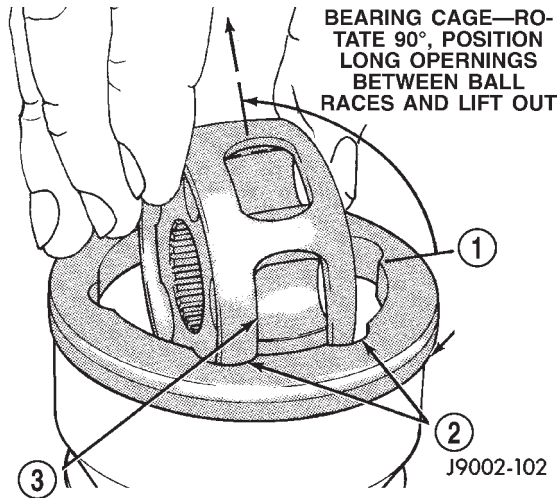


**Fig. 7 BEARING**

- 1 - HOUSING
- 2 - INNER RACE/HUB
- 3 - BEARING CAGE
- 4 - BALL

(11) Repeat step above until all six balls are removed from the bearing cage.

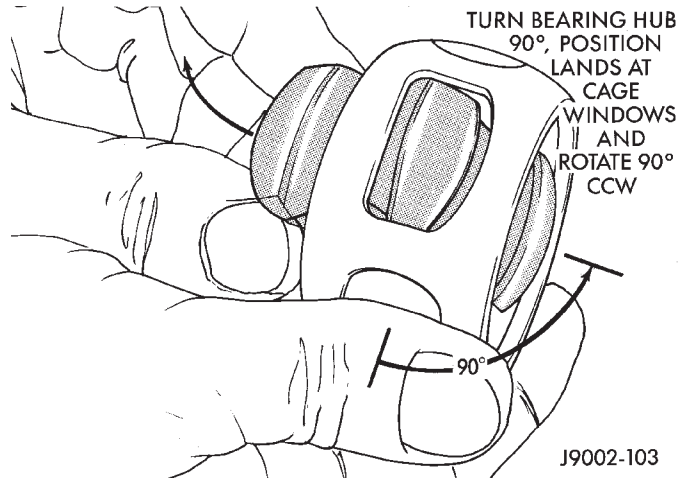
(12) Lift cage and inner race upward and out from the housing (Fig. 8).



**Fig. 8 CAGE AND INNER RACE/HUB**

- 1 - HOUSING
- 2 - INNER RACE
- 3 - CAGE WINDOW

(13) Turn inner race 90° in the cage and rotate the inner race/hub out of the cage (Fig. 9).



**Fig. 9 INNER RACE/HUB**

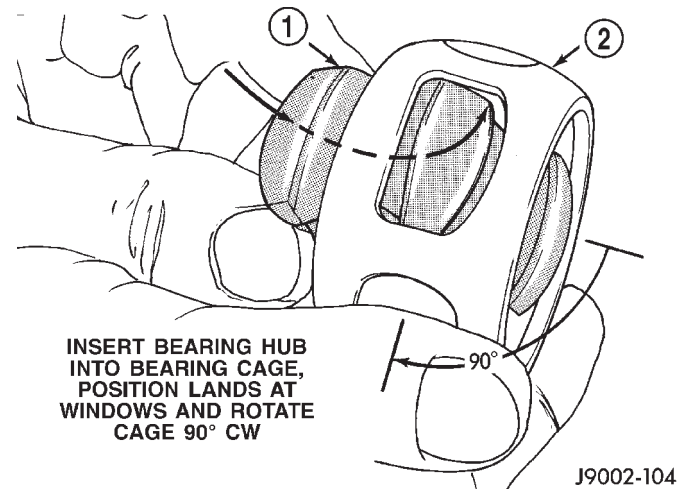
**INSTALLATION**

**NOTE:** If C/V joint is worn, replace entire C/V joint and boot.

(1) Apply a light coat of grease to the C/V joint components before assembling them.

(2) Align the inner race, cage and housing according to the alignment reference marks.

(3) Insert the inner race into the cage (Fig. 10) and rotate race into the cage.

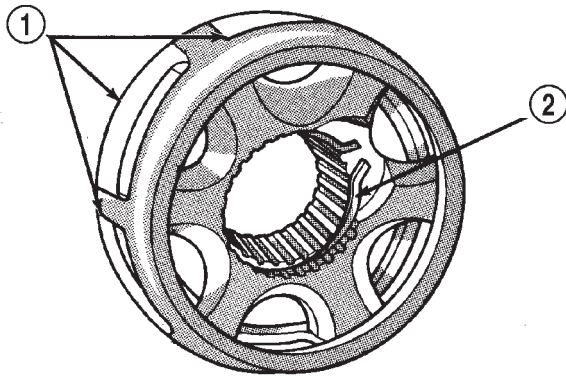


**Fig. 10 INNER RACE/HUB**

- 1 - INNER RACE/HUB
- 2 - BEARING CAGE

CV JOINT/BOOT-OUTER (Continued)

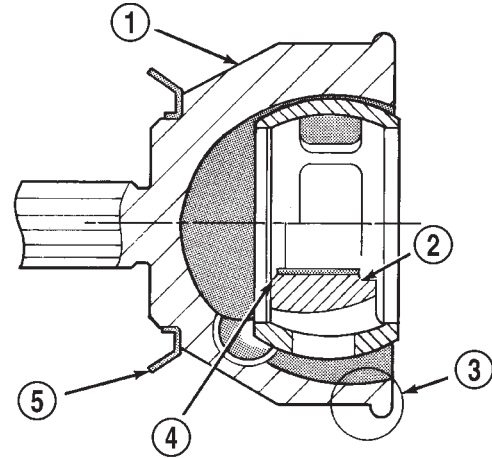
(4) Rotate the inner race/hub in the cage (Fig. 11).



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**Fig. 11 CAGE AND INNER RACE/HUB**

- 1 - CAGE WINDOWS
- 2 - SNAP RING

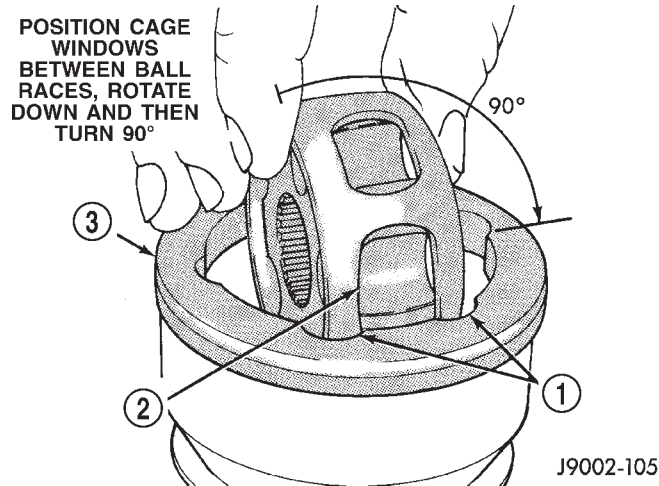


J9102-43

**Fig. 13 CAGE AND INNER RACE/HUB**

- 1 - C/V HOUSING
- 2 - BEARING HUB LARGE COUNTERBORE OUTWARD
- 3 - BOOT RETAINING SHOULDER
- 4 - BEARING HUB SMALL COUNTERBORE INWARD
- 5 - SLINGER

(5) Insert cage into the housing (Fig. 12). Rotate the cage 90° into the housing (Fig. 13).



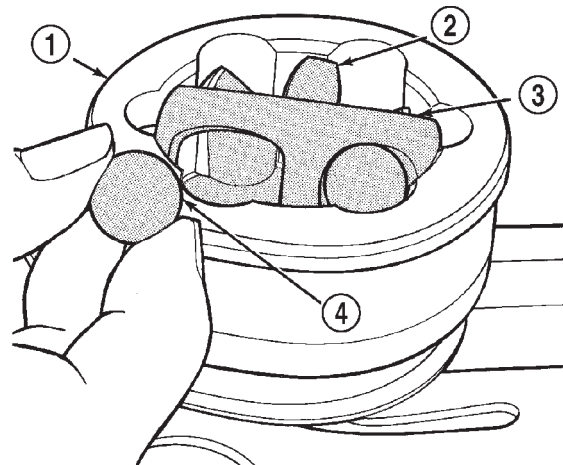
J9002-105

**Fig. 12 BEARING CAGE AND HOUSING**

- 1 - OUTER RACE
- 2 - BEARING CAGE WINDOW
- 3 - CV JOINT HOUSING

(6) Apply the lubricant included with the replacement boot to the ball races. Spread the lubricant equally between all the races.

(7) Tilt inner race/hub and cage and install the balls (Fig. 14).



J9002-101

**Fig. 14 BALL BEARING**

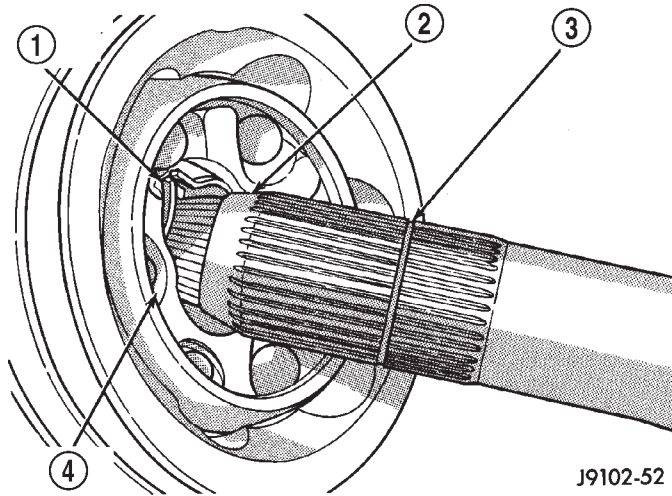
- 1 - C/V HOUSING
- 2 - INNER RACE/HUB
- 3 - BEARING CAGE
- 4 - BEARING

CV JOINT/BOOT-OUTER (Continued)

(8) Place new clamps onto new boot and slide boot onto the shaft to it's original position.

(9) Apply the rest of lubricant to the C/V joint and boot.

(10) Install the joint onto the shaft. Push the joint onto the shaft until the snap ring seats in the groove (Fig. 15). Pull on the joint to verify the span ring has engaged.



**Fig. 15 OUTER C/V JOINT**

- 1 - SNAP RING
- 2 - SHAFT TAPER
- 3 - SNAP RING GROVE
- 4 - BEARING HUB

(11) Position the boot on the joint in it's original position. Ensure that the boot is not twisted and remove any excess air.

(12) Secure both boot clamps (Fig. 16) with Clamp Installer C-4975A. Place tool on clamp bridge and tighten tool until the jaws of the toll are closed.

CV JOINT/BOOT-INNER

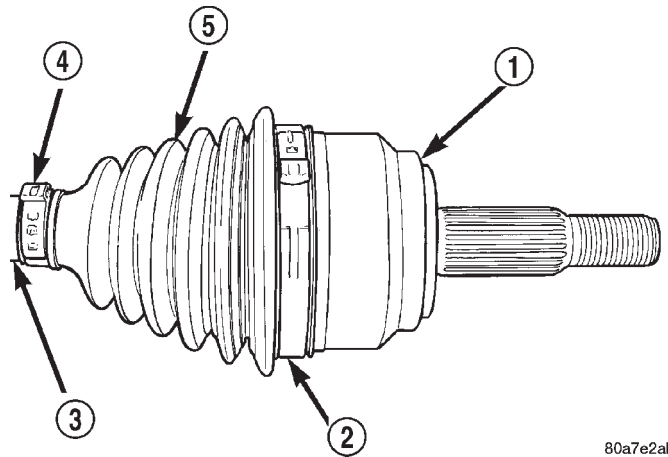
REMOVAL

(1) Clamp shaft in a vise (with soft jaws) and support C/V joint.

(2) Remove clamps with a cut-off wheel or grinder.

**CAUTION: Do not damage C/V housing or half shaft.**

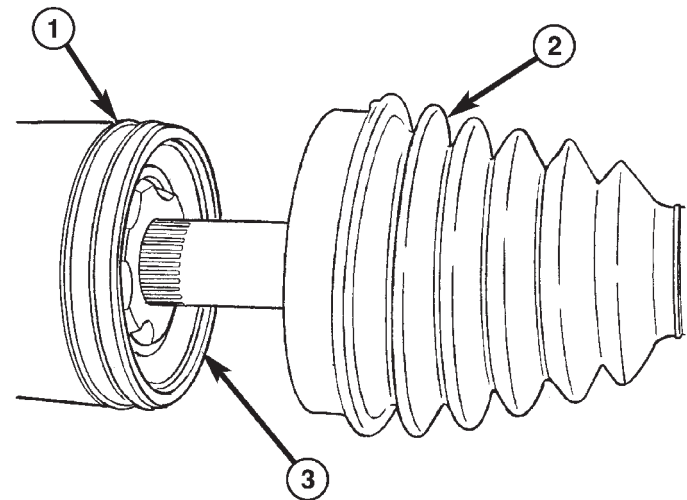
(3) Slide the boot down the shaft (Fig. 17).



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**Fig. 16 BOOT CLAMP LOCATIONS**

- 1 - C/V HOUSING
- 2 - CLAMP
- 3 - HALF SHAFT
- 4 - CLAMP
- 5 - C/V BOOT



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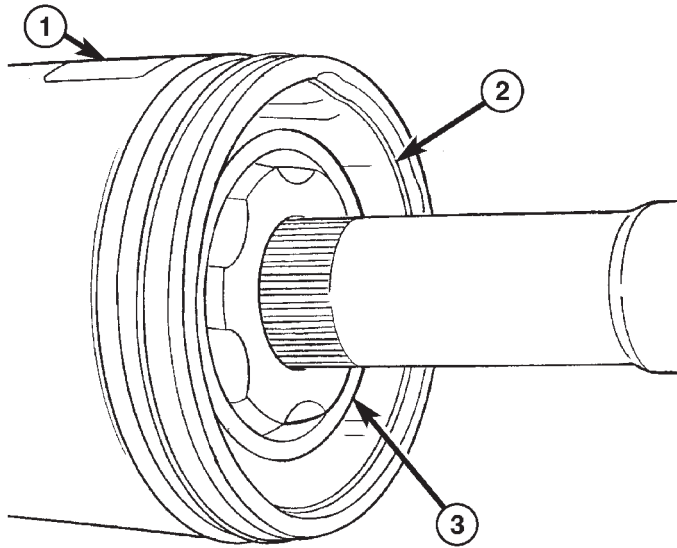
**Fig. 17 INNER C/V BOOT**

- 1 - HOUSING
- 2 - BOOT
- 3 - HOUSING SNAP RING



CV JOINT/BOOT-INNER (Continued)

(4) Remove lubricant to expose the C/V housing snap ring and remove snap ring (Fig. 18).

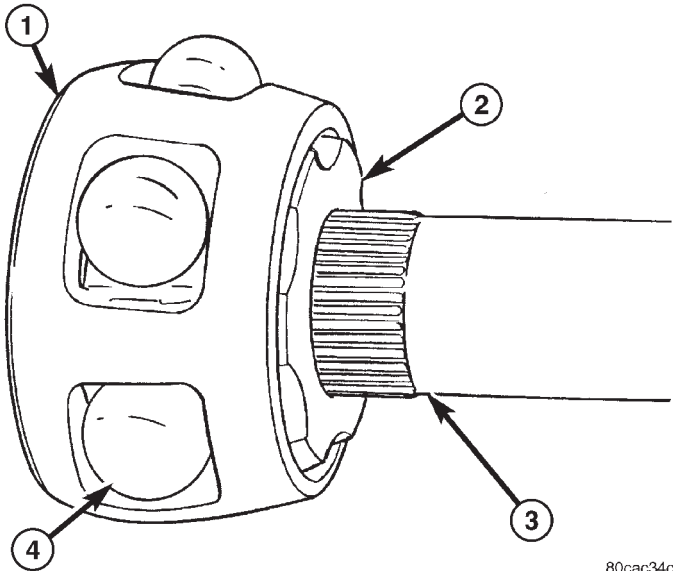


**Fig. 18 HOUSING SNAP RING**

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- 1 - HOUSING
- 2 - SNAP RING
- 3 - CAGE/INNER RACE

(5) Remove bearings from the cage (Fig. 19).



**Fig. 19 C/V BEARINGS**

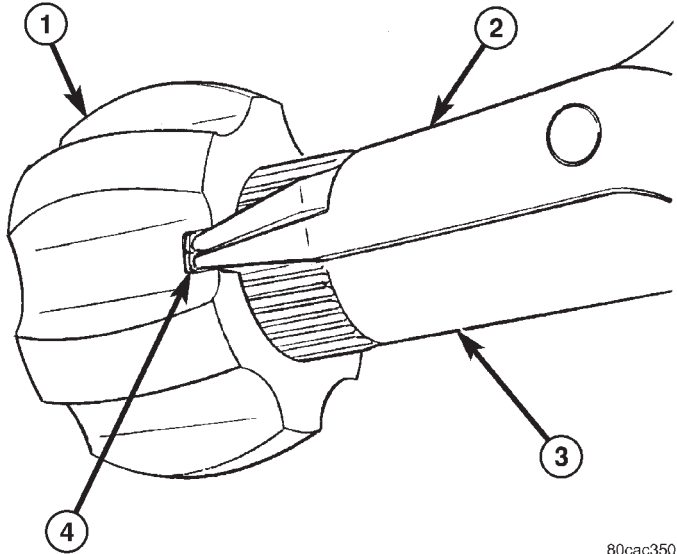
80cac34c

- 1 - CAGE
- 2 - INNER RACE
- 3 - SHAFT
- 4 - BEARING

(6) Rotate cage 30° and slide cage off the inner race and down the shaft.

(7) Remove spread inner race snap ring (Fig. 20) and remove race from the shaft.

(8) Remove boot from the shaft and discard.

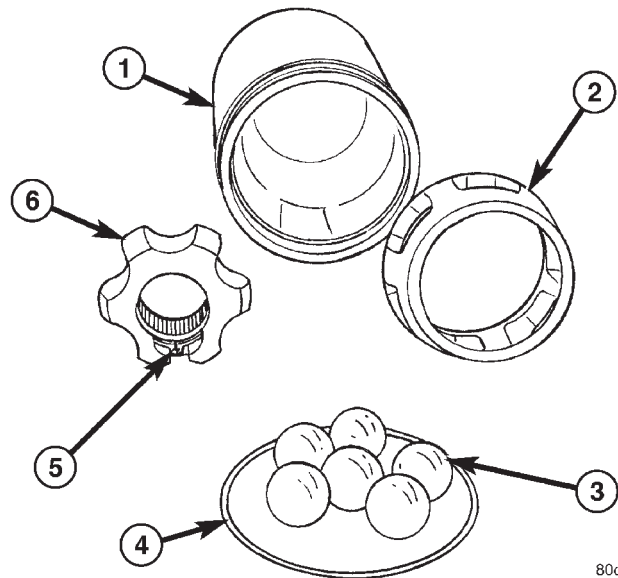


**Fig. 20 INNER RACE**

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- 1 - INNER RACE
- 2 - PLIERS
- 3 - SHAFT
- 4 - SNAP RING ACCESS

(9) Clean and inspect all components for wear or damage (Fig. 21).



**Fig. 21 INNER C/V JOINT**

80cac3a6

- 1 - HOUSING
- 2 - CAGE
- 3 - BEARINGS
- 4 - HOUSING SNAP RING
- 5 - INNER RACE SNAP RING
- 6 - INNER RACE

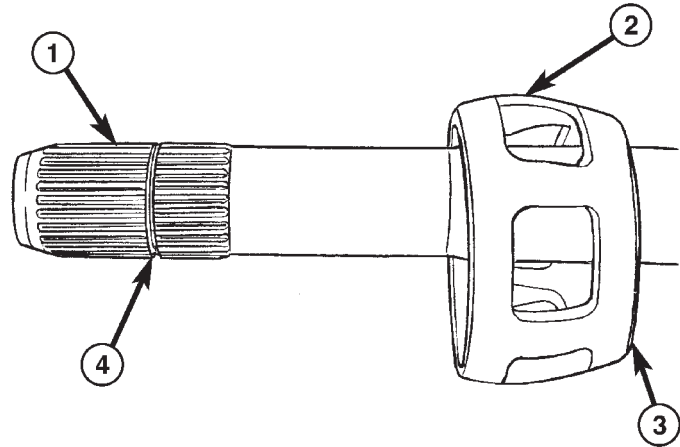
CV JOINT/BOOT-INNER (Continued)

**INSTALLATION**

(1) Apply a coat of grease supplied with the joint/ boot to the C/V joint components before assembling them.

(2) Place new clamps on the new boot and slide boot down the shaft.

(3) Slide cage onto the shaft (Fig. 22) with the small diameter end towards the boot.



**Fig. 22 BEARING CAGE**

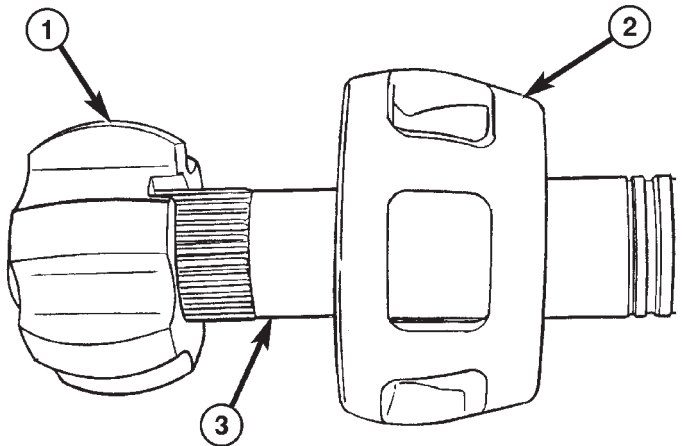
- 1 - SHAFT
- 2 - CAGE
- 3 - SMALL DIAMETER
- 4 - SNAP RING GROOVE

(4) Install the inner race onto the shaft (Fig. 23). Pull on the race to verify snap ring has engaged.

(5) Align cage with the inner race and slide over the race.

(6) Turn the cage 30° to align the cage windows with the race (Fig. 24).

(7) Apply grease to the inner race and bearings and install the bearings.

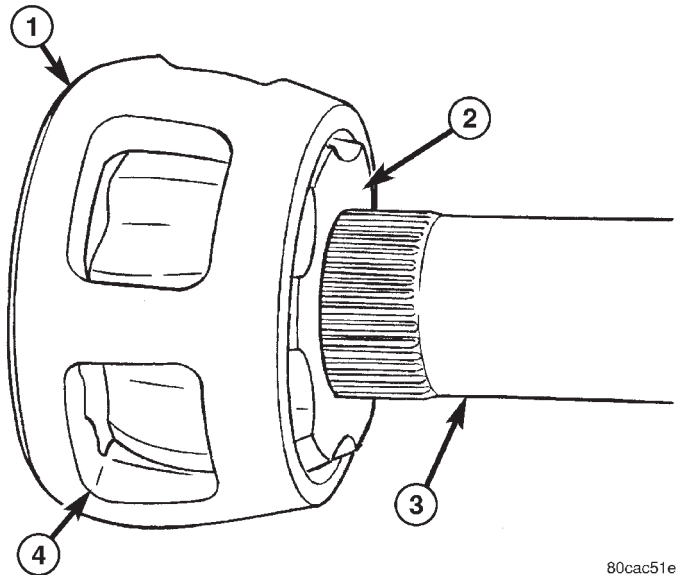


**Fig. 23 INNER RACE**

- 1 - INNER RACE
- 2 - CAGE
- 3 - SHAFT

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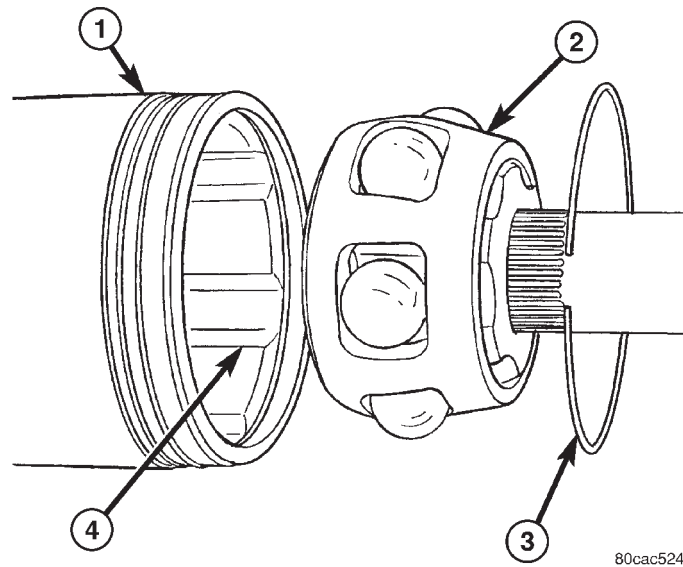
**Fig. 24 CAGE/INNER RACE**

- 1 - CAGE
- 2 - INNER RACE
- 3 - SHAFT
- 4 - CAGE WINDOW

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## CV JOINT/BOOT-INNER (Continued)

(8) Apply grease to the housing bore (Fig. 25) then install the bearing assembly into the housing.



**Fig. 25 C/V COMPONENTS**

- 1 - HOUSING
- 2 - BEARING ASSEMBLY
- 3 - HOUSING SNAP RING
- 4 - HOUSING BORE

(9) Install the housing snap ring and verify it is seated in the groove.

(10) Fill the housing and boot with the remaining grease.

(11) Slide the boot onto the C/V housing into its original position. Ensure boot is not twisted and remove any excess air.

(12) Secure both boot clamps with Clamp Installer C-4975A. Place tool on clamp bridge and tighten tool until the jaws of the tool are closed.

# FRONT AXLE - 186FIA

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## FRONT AXLE - 186FIA

### DESCRIPTION

The 186FIA (Model 30) axle consists of an aluminum center section with an axle tube extending from one side. The tube is pressed into 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 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 (select thickness). The shims are located between the differential bearing cups and the axle housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer.

The power is transferred from the axle through two constant velocity (C/V) drive shafts to the wheel hubs.

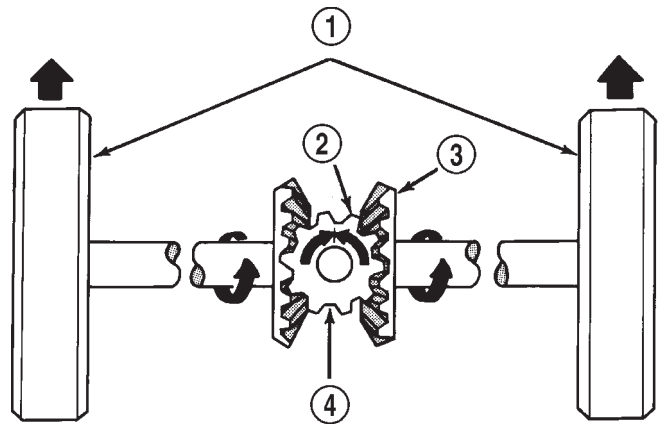
The differential cover provides a means for inspection and service without removing the axle from the vehicle. The cover has a vent tube used to relieve internal pressure caused by vaporization and internal expansion.

### OPERATION

The axle receives power from the transfer case through the front propeller shaft. The front propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the

differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle 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).



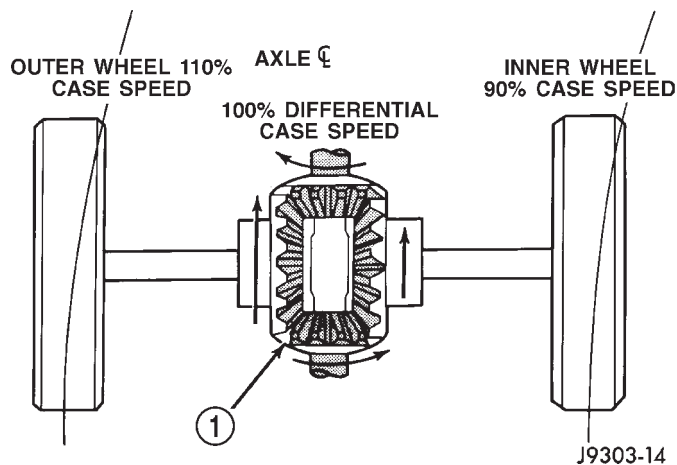
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**Fig. 1 DIFFERENTIAL-STRAIGHT AHEAD DRIVING**

- 1 - STRAIGHT AHEAD DRIVING
- 2 - PINION GEAR
- 3 - SIDE GEAR
- 4 - PINION GEARS ROTATE WITH CASE

## FRONT AXLE - 186FIA (Continued)

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-ON TURNS**

1 - PINION GEARS ROTATE ON PINION SHAFT

## DIAGNOSIS AND TESTING - AXLE

### GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, worn/damaged gears or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then 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 gears and pinions 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 vehi-

cle turns. A worn pinion mate shaft can also cause a snapping or a knocking noise.

### BEARING NOISE

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched 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 shaft bore will also cause low speed knock.

### VIBRATION

Vibration at the rear of the vehicle is usually caused by:

- 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.

FRONT AXLE - 186FIA (Continued)

**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.
- Transmission shift operation.
- 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 to 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.

*DIAGNOSTIC CHART*

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube. 2. Bent or sprung axle shaft. 3. End-play in pinion bearings. 4. Excessive gear backlash between the ring gear and pinion. 5. Improper adjustment of pinion gear bearings. 6. Loose pinion yoke nut. 7. Scuffed gear tooth contact surfaces.	1. Inspect axle tube alignment. Correct as necessary. 2. Inspect and correct as necessary. 3. Refer to pinion pre-load information and correct as necessary. 4. Check adjustment of the ring gear and pinion backlash. Correct as necessary. 5. Adjust the pinion bearings pre-load. 6. Tighten the pinion yoke nut. 7. Inspect and replace as necessary.
Axle Shaft Broke	1. Misaligned axle tube. 2. Vehicle overloaded. 3. Erratic clutch operation. 4. Grabbing clutch.	1. Replace the broken shaft after correcting tube mis-alignment. 2. Replace broken shaft and avoid excessive weight on vehicle. 3. Replace broken shaft and avoid or correct erratic clutch operation. 4. Replace broken shaft and inspect and repair clutch as necessary.

## FRONT AXLE - 186FIA (Continued)

Condition	Possible Causes	Correction
Differential Cracked	<ol style="list-style-type: none"> <li>1. Improper adjustment of the differential bearings.</li> <li>2. Excessive ring gear backlash.</li> <li>3. Vehicle overloaded.</li> <li>4. Erratic clutch operation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.</li> <li>2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.</li> <li>3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.</li> <li>4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.</li> </ol>
Differential Gears Scored	<ol style="list-style-type: none"> <li>1. Insufficient lubrication.</li> <li>2. Improper grade of lubricant.</li> <li>3. Excessive spinning of one wheel/tire.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace scored gears. Fill differential with the correct fluid type and quantity.</li> <li>2. Replace scored gears. Fill differential with the correct fluid type and quantity.</li> <li>3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.</li> </ol>
Loss Of Lubricant	<ol style="list-style-type: none"> <li>1. Lubricant level too high.</li> <li>2. Worn axle shaft seals.</li> <li>3. Cracked differential housing.</li> <li>4. Worn pinion seal.</li> <li>5. Worn/scored yoke.</li> <li>6. Axle cover not properly sealed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Drain lubricant to the correct level.</li> <li>2. Replace seals.</li> <li>3. Repair as necessary.</li> <li>4. Replace seal.</li> <li>5. Replace yoke and seal.</li> <li>6. Remove, clean, and re-seal cover.</li> </ol>
Axle Overheating	<ol style="list-style-type: none"> <li>1. Lubricant level low.</li> <li>2. Improper grade of lubricant.</li> <li>3. Bearing pre-loads too high.</li> <li>4. Insufficient ring gear backlash.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill differential to correct level.</li> <li>2. Fill differential with the correct fluid type and quantity.</li> <li>3. Re-adjust bearing pre-loads.</li> <li>4. Re-adjust ring gear backlash.</li> </ol>

FRONT AXLE - 186FIA (Continued)

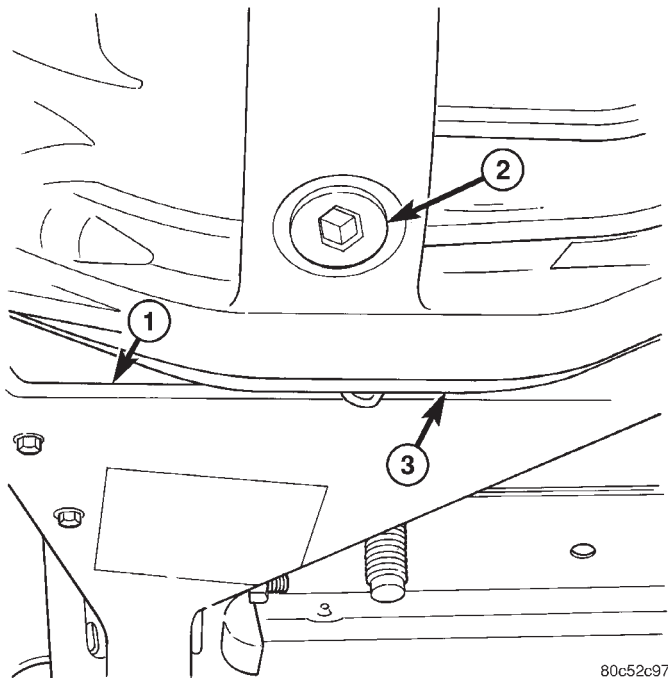
Condition	Possible Causes	Correction
Gear Teeth Broke	<ol style="list-style-type: none"> <li>1. Overloading.</li> <li>2. Erratic clutch operation.</li> <li>3. Ice-spotted pavement.</li> <li>4. Improper adjustments.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace gears. Examine other gears and bearings for possible damage.</li> <li>2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.</li> <li>3. Replace gears and examine remaining parts for damage.</li> <li>4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.</li> </ol>
Axle Noise	<ol style="list-style-type: none"> <li>1. Insufficient lubricant.</li> <li>2. Improper ring gear and pinion adjustment.</li> <li>3. Unmatched ring gear and pinion.</li> <li>4. Worn teeth on ring gear and/or pinion.</li> <li>5. Loose pinion bearings.</li> <li>6. Loose differential bearings.</li> <li>7. Mis-aligned or sprung ring gear.</li> <li>8. Loose differential bearing cap bolts.</li> <li>9. Housing not machined properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill differential with the correct fluid type and quantity.</li> <li>2. Check ring gear and pinion contact pattern.</li> <li>3. Replace gears with a matched ring gear and pinion.</li> <li>4. Replace ring gear and pinion.</li> <li>5. Adjust pinion bearing pre-load.</li> <li>6. Adjust differential bearing pre-load.</li> <li>7. Measure ring gear run-out. Replace components as necessary.</li> <li>8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued to the proper specification.</li> <li>9. Replace housing.</li> </ol>



## FRONT AXLE - 186FIA (Continued)

**REMOVAL**

- (1) Raise and support vehicle.
- (2) Remove wheel and tire assemblies.
- (3) Remove half shaft hub nuts.
- (4) Remove lower control arms. Refer to 2 suspension for procedure.
- (5) Remove half shafts.
- (6) Remove skid plate.
- (7) Remove differential drain plug (Fig. 3) and drain fluid.

**Fig. 3 DRAIN PLUG**

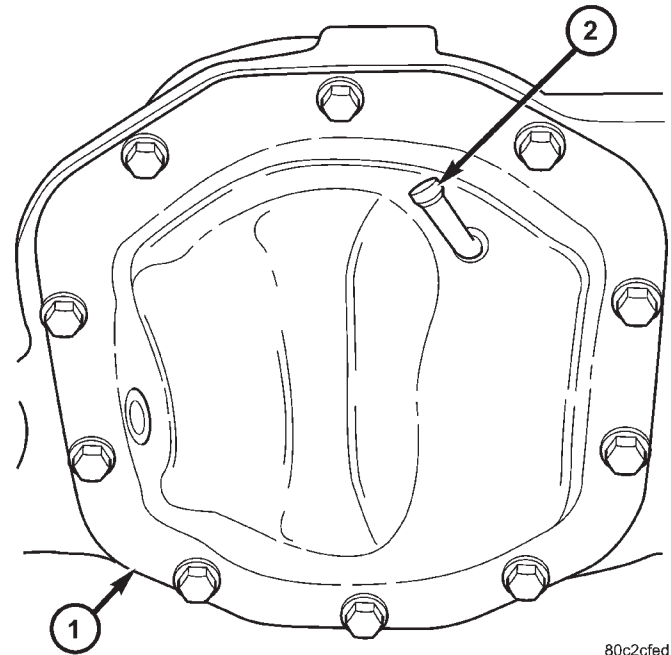
- 1 - LEFT FRONT AXLE BRACKET
- 2 - DRAIN PLUG
- 3 - DIFFERENTIAL HOUSING

(8) Remove differential vent hose (Fig. 4) from cover.

- (9) Remove propeller shaft from pinion flange.
- (10) Support axle with a lift/jack.
- (11) Remove bolt from left front axle bracket frame mount (Fig. 5).
- (12) Remove bolts from right axle bracket frame mounts (Fig. 6).
- (13) Remove bolt from left rear axle bracket frame mount (Fig. 7).
- (14) Lower axle from vehicle.
- (15) Remove brackets from axle if necessary.

**INSTALLATION**

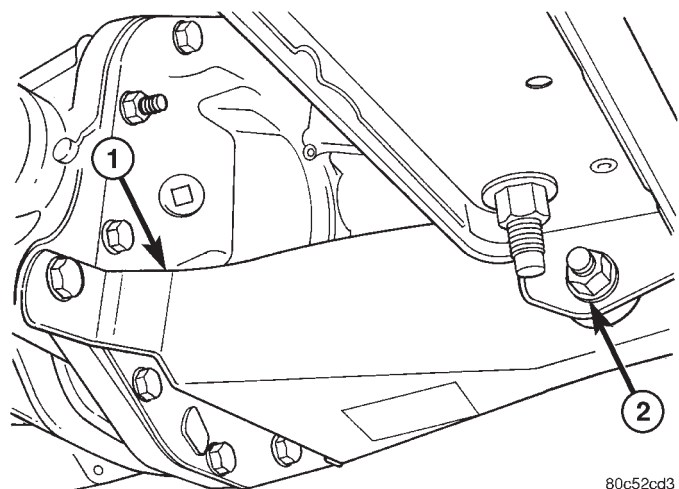
- (1) Install left rear bracket to axle and tighten to 61 N·m (45 ft. lbs.).
- (2) Install right bracket to axle and tighten to 88 N·m (65 ft. lbs.).



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**Fig. 4 DIFFERENTIAL COVER**

- 1 - COVER
- 2 - VENT TUBE



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**Fig. 5 LEFT FRONT AXLE BRACKET**

- 1 - LEFT FRONT AXLE BRACKET
- 2 - BRACKET BOLT

(3) Install left front bracket to axle and tighten to 61 N·m (45 ft. lbs.).

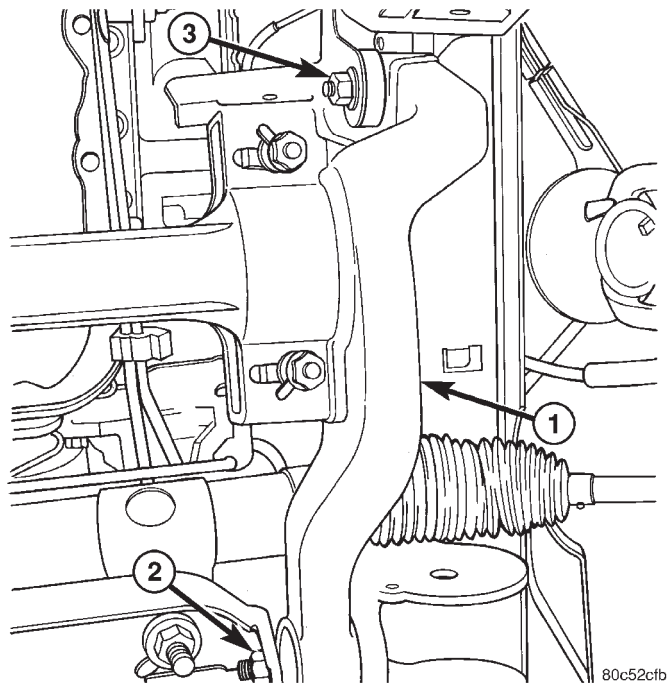
(4) Raise axle up and align brackets with frame mounts.

(5) Install frame mount bolts and tighten to 88 N·m (65 ft. lbs.).

(6) Install propeller shaft.

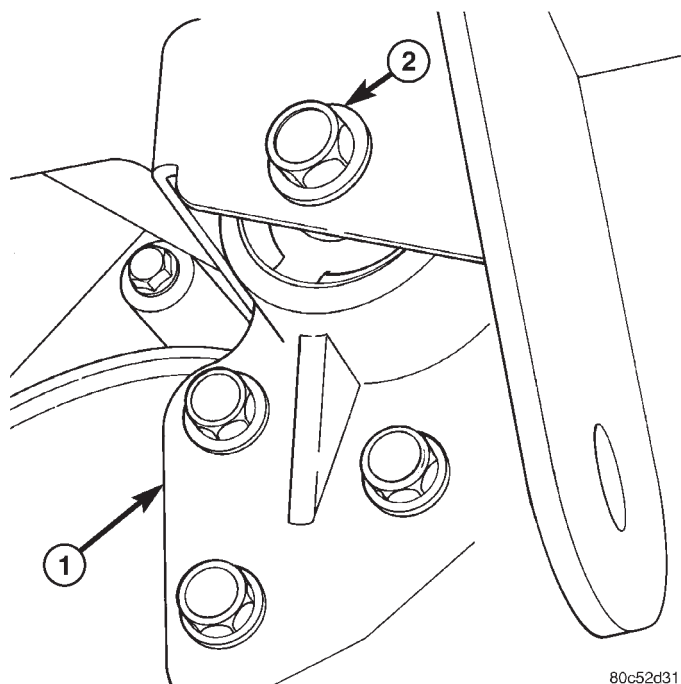
(7) Install half shafts.

FRONT AXLE - 186FIA (Continued)



**Fig. 6 RIGHT AXLE BRACKET**

- 1 - RIGHT AXLE BRACKET
- 2 - FRONT BRACKET BOLT
- 3 - REAR BRACKET BOLT



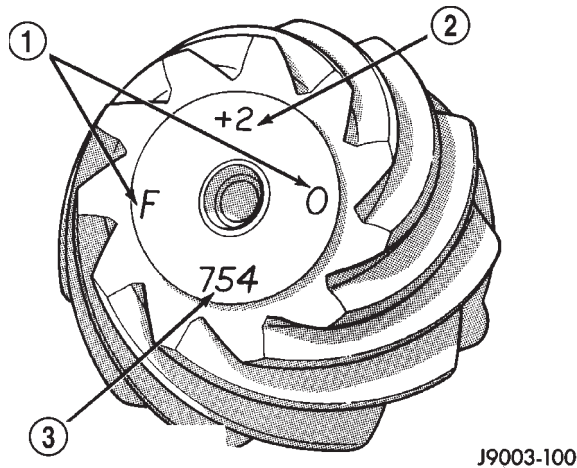
**Fig. 7 LEFT REAR AXLE BRACKET**

- 1 - LEFT REAR AXLE BRACKET
- 2 - BRACKET BOLT

- (8) Install lower control arms, refer to 2 Suspension for procedures.
- (9) Install new half shaft hub nuts and tighten to 136 N·m (100 ft. lbs.).
- (10) Install axle vent hose.
- (11) Fill differential with gear lubricant.
- (12) Install skid plate.
- (13) Install wheel and tire assemblies.
- (14) Remove support and lower vehicle.
- (15) Check vehicle alignment.

**ADJUSTMENTS**

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched onto each gear (Fig. 8). 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 92.1 mm (3.625 in.). The standard depth provides the best gear tooth contact pattern. Refer to Backlash and Contact Pattern Analysis paragraph in this section for additional information.



**Fig. 8 PINION GEAR ID NUMBERS**

- 1 - PRODUCTION NUMBERS
- 2 - DRIVE PINION GEAR DEPTH VARIANCE
- 3 - GEAR MATCHING NUMBER

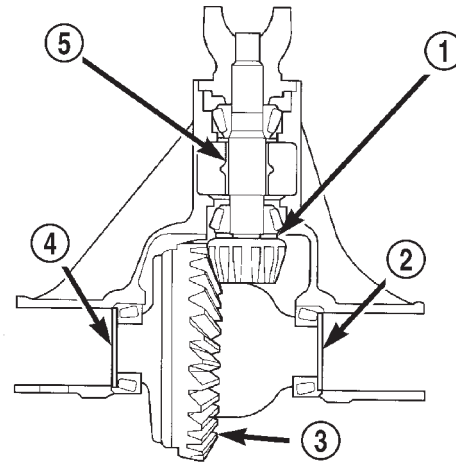
FRONT AXLE - 186FIA (Continued)

Compensation for pinion depth variance is achieved with a select shim/oil slinger. The shims are placed between the rear pinion bearing and the pinion gear head (Fig. 9).

If a new gear set is being installed, note the depth variance etched into both the original and replacement pinion. Add or subtract this number from the thickness of the original depth shim/oil slinger to compensate for the difference in the depth variances. Refer to the Pinion Gear Depth Variance chart.

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus the amount needed.

Note the etched number on the face of the pinion gear head (-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 shims. If the number is positive, subtract that value from the thickness of the depth shim. If the number is 0 no change is necessary.



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**Fig. 9 SHIM LOCATIONS**

- 1 - PINION GEAR DEPTH SHIM/OIL SLINGER
- 2 - DIFFERENTIAL BEARING SHIM
- 3 - RING GEAR
- 4 - DIFFERENTIAL BEARING SHIM
- 5 - COLLAPSIBLE SPACER

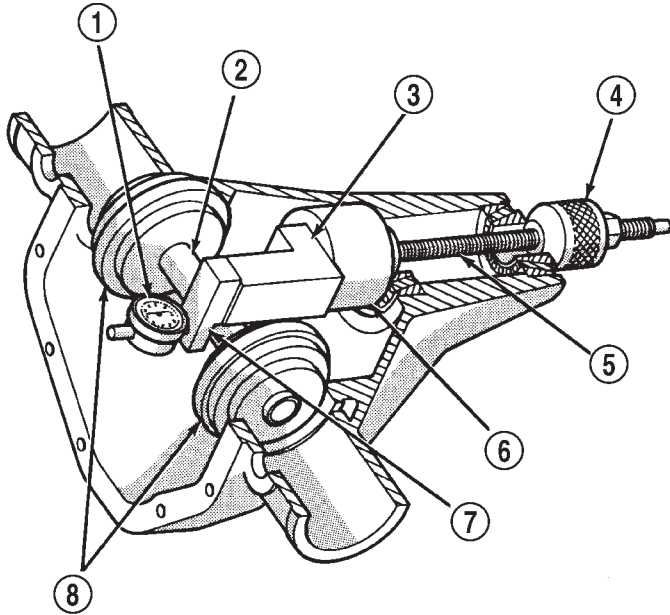
*PINION GEAR DEPTH VARIANCE*

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	-4	-3	-2	-1	0	+1	+2	+3	+4
<b>+4</b>	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
<b>+3</b>	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
<b>+2</b>	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
<b>+1</b>	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
<b>0</b>	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
<b>-1</b>	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
<b>-2</b>	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
<b>-3</b>	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
<b>-4</b>	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

## FRONT AXLE - 186FIA (Continued)

**PINION DEPTH MEASUREMENT**

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339 (Fig. 10).



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**Fig. 10 PINION GEAR DEPTH TOOLS**

- 1 - DIAL INDICATOR
- 2 - ARBOR
- 3 - PINION HEIGHT BLOCK
- 4 - CONE
- 5 - SCREW
- 6 - PINION BLOCK
- 7 - SCOOTER BLOCK
- 8 - ARBOR DISC

(1) Assemble Pinion Height Block 6739, Pinion Block 8804 and rear pinion bearing onto Screw 6741 (Fig. 10).

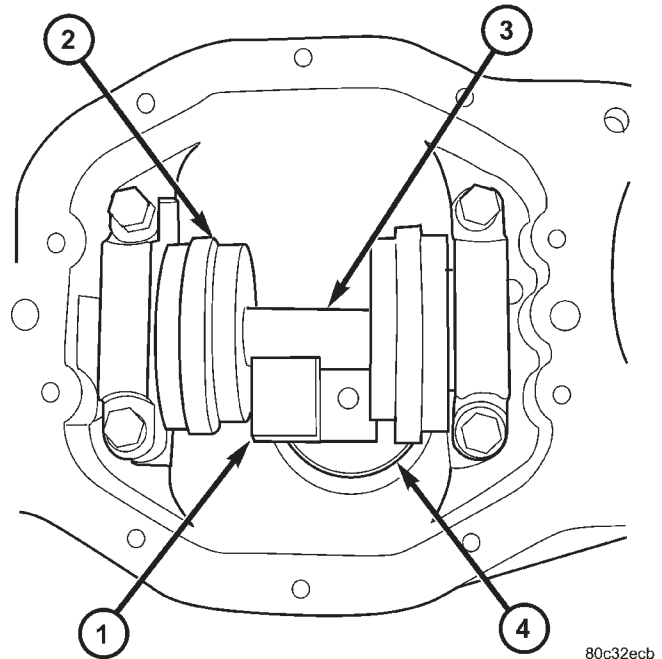
(2) Insert height gauge components into the housing through pinion bearing cups.

(3) Install front pinion bearing and hand tight Cone-nut 6740 onto the screw.

(4) Position Arbor Disc 6732 and Arbor D-115-3 into the housing bearing cradles. Install differential bearing caps on Arbor Discs and tighten bolts to 41 N·m (30 ft. lbs.) (Fig. 11).

**NOTE:** Arbor Discs 6732 has different step diameters to fit other axles. Choose proper step for axle being serviced.

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.



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**Fig. 11 DEPTH TOOLS IN HOUSING**

- 1 - PINION HEIGHT BLOCK
- 2 - ARBOR DISC
- 3 - ARBOR
- 4 - PINION BLOCK

(6) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold the scooter block and zero the dial indicator.

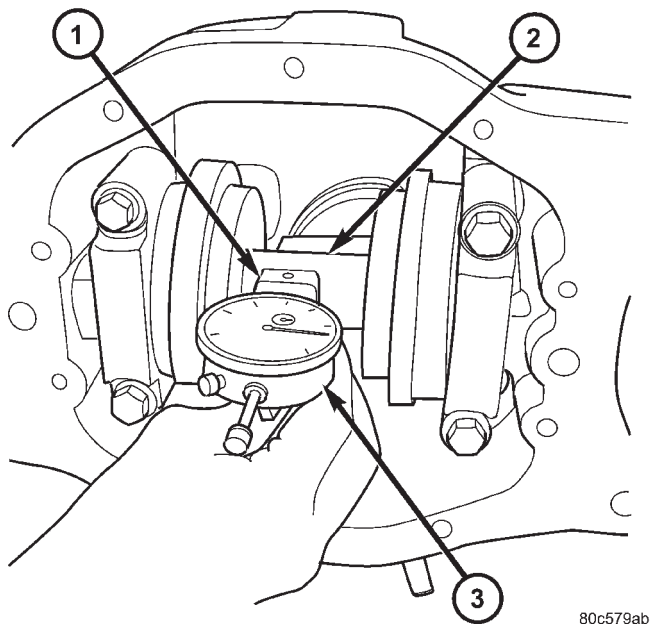
(7) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 12). Move the scooter block till the dial indicator probe crests the arbor and record the highest reading.

(8) Select a shim/oil slinger equal to the dial indicator reading plus the pinion depth variance number etched in the face of the pinion (Fig. 8). For example, if the depth variance is  $-2$ , add  $+0.002$  in. to the dial indicator reading.

**DIFFERENTIAL**

Differential bearing preload and gear backlash is adjusted by the use of selective shims. The shims are located between the differential bearing cups and the differential housing. The proper shim thickness can be determined using slip-fit Dummy Bearings D-348 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 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 is installed, and the gear backlash

## FRONT AXLE - 186FIA (Continued)

**Fig. 12 PINION DEPTH MEASUREMENT**

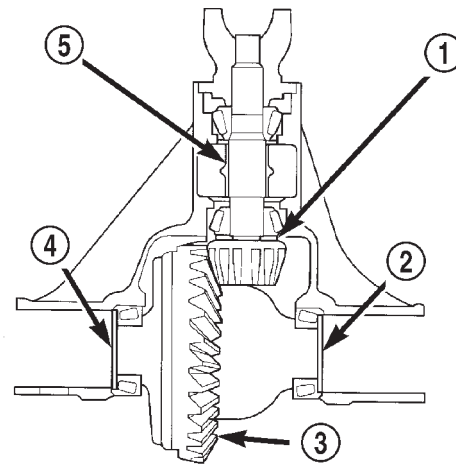
- 1 - SCOOTER BLOCK
- 2 - ARBOR
- 3 - DIAL INDICATOR

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. 13). Differential shim measurements are performed with 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.

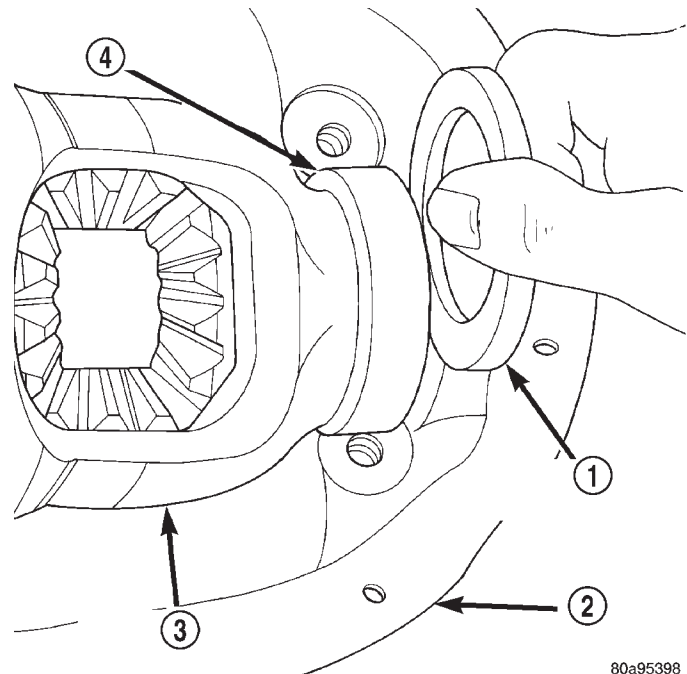
- (1) Remove differential side bearings from differential case.
- (2) Install ring gear on differential case and tighten bolts to specification.
- (3) Install Dummy Bearings D-348 on differential case.
- (4) Install differential case in the housing.
- (5) Record the thickness of Dummy Shims 8107. Insert the shims between the dummy bearings and the differential housing (Fig. 14).



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**Fig. 13 SHIM LOCATIONS**

- 1 - PINION GEAR DEPTH SHIM/OIL SLINGER
- 2 - DIFFERENTIAL BEARING SHIM
- 3 - RING GEAR
- 4 - DIFFERENTIAL BEARING SHIM
- 5 - COLLAPSIBLE SPACER



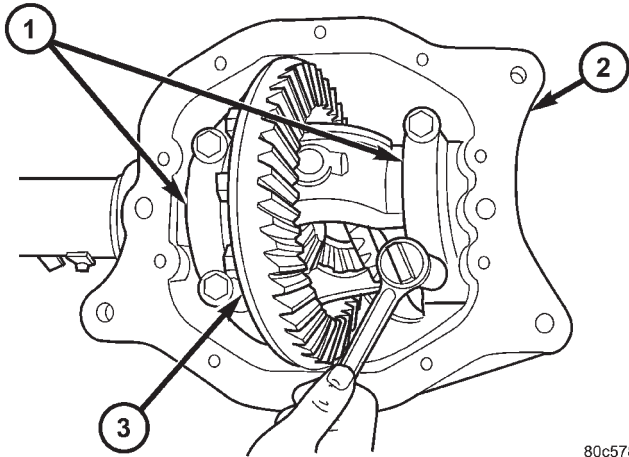
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**Fig. 14 DUMMY SHIMS**

- 1 - DUMMY SHIM
- 2 - DIFFERENTIAL HOUSING
- 3 - DIFFERENTIAL CASE
- 4 - DUMMY BEARINGS

FRONT AXLE - 186FIA (Continued)

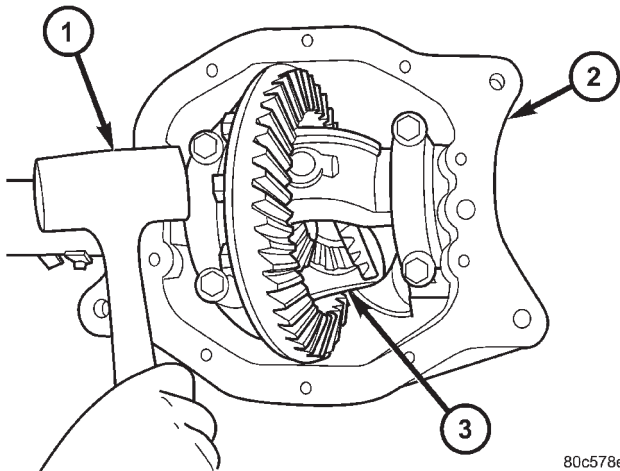
(6) Install the bearing caps in their correct positions and snug the bolts (Fig. 15).



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**Fig. 15 BEARING CAP BOLTS**

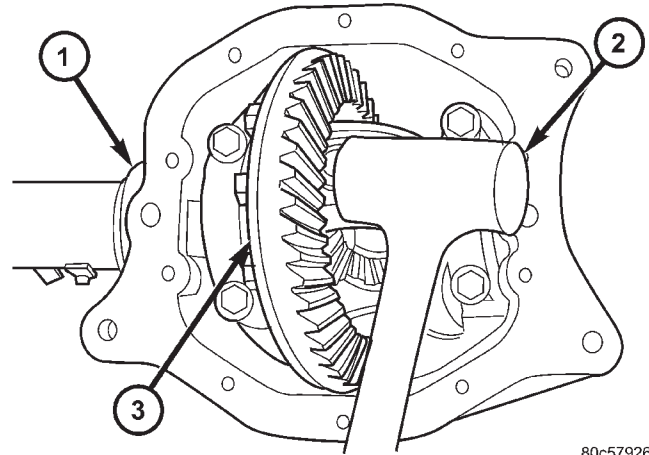
(7) With a dead-blow hammer, seat the differential dummy bearings to each side of the axle housing (Fig. 16) and (Fig. 17).



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**Fig. 16 SEAT DUMMY BEARINGS PINION SIDE**

- 1 - HAMMER
- 2 - DIFFERENTIAL HOUSING
- 3 - DIFFERENTIAL



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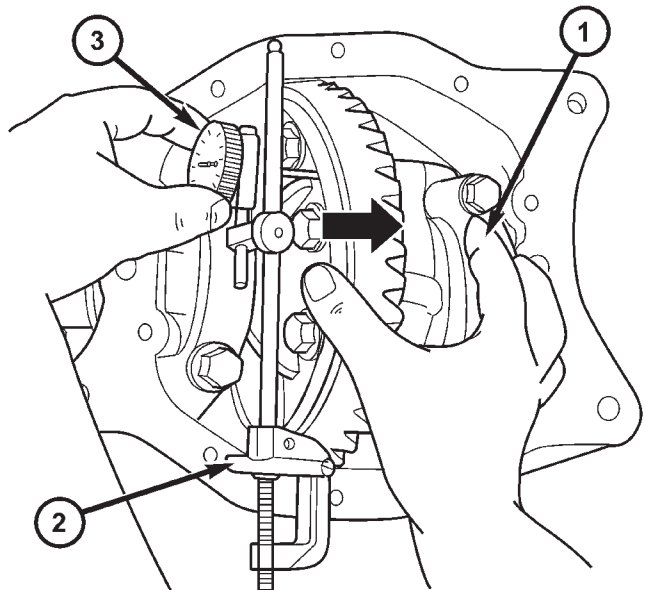
**Fig. 17 SEAT DUMMY BEARING RING GEAR SIDE**

- 1 - DIFFERENTIAL HOUSING
- 2 - HAMMER
- 3 - RING GEAR

(8) Thread Pilot Stud C-3288-B into rear cover bolt hole below ring gear.

(9) Attach a Dial Indicator C-3339 to the Pilot Stud. Position the dial indicator plunger on flat surface between the ring gear bolts.

(10) Push and hold differential case to pinion gear side of the housing and zero dial indicator (Fig. 18).



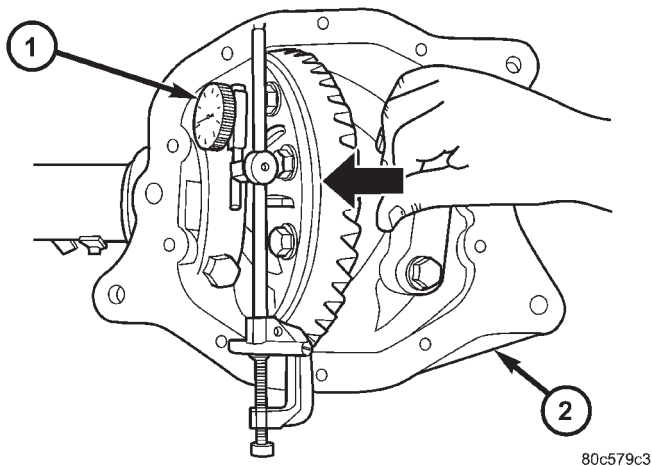
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**Fig. 18 DIFFERENTIAL PINION GEAR SIDE**

- 1 - PINION SIDE
- 2 - PILOT STUD
- 3 - DIAL INDICATOR

## FRONT AXLE - 186FIA (Continued)

(11) Push and hold differential case to ring gear side of the housing and record dial indicator reading (Fig. 19).



**Fig. 19 DIFFERENTIAL RING GEAR SIDE**

- 1 - DIAL INDICATOR  
2 - DIFFERENTIAL HOUSING

(12) Add 0.152 mm (0.006 in.) 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.

(13) Rotate dial indicator out of the way on the pilot stud.

(14) Remove differential case and dummy bearings from the housing.

(15) Install the pinion gear in the housing. Install the pinion yoke and establish the correct pinion rotating torque.

(16) Install differential case and Dummy Bearings D-348 in the housing.

(17) Install a single dummy shim in the ring gear side. Install bearing caps and tighten bolts snug.

(18) Seat ring gear side dummy bearing (Fig. 17).

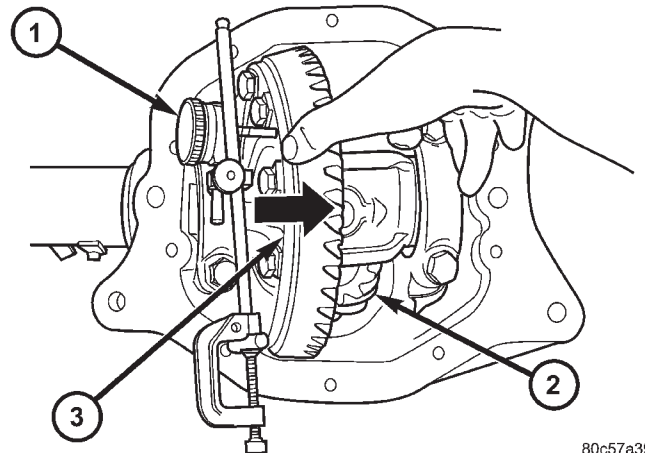
(19) Position the dial indicator plunger on a flat surface between the ring gear bolt heads.

(20) Push and hold differential case toward pinion gear and zero dial indicator (Fig. 20).

(21) Push and hold differential case to ring gear side of the housing and record dial indicator reading (Fig. 21). Add dummy shim thickness to this reading. This will be the total shim thickness to achieve zero backlash.

(22) Subtract 0.076 mm (0.003 in.) from the dial indicator reading to compensate for backlash between ring and pinion gears. This total is the thickness shim required to achieve proper backlash.

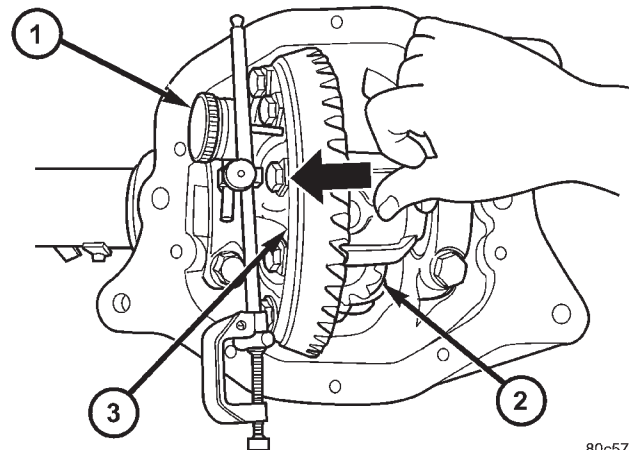
(23) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the axle housing.



**Fig. 20 DIFFERENTIAL PINION GEAR SIDE**

- 1 - DIAL INDICATOR  
2 - PINION GEAR  
3 - RING GEAR

80c57a39



**Fig. 21 DIFFERENTIAL RING GEAR SIDE**

- 1 - DIAL INDICATOR  
2 - PINION GEAR  
3 - RING GEAR

80c57a31

(24) Rotate dial indicator out of the way on pilot stud.

(25) Remove differential case and dummy bearings from the housing.

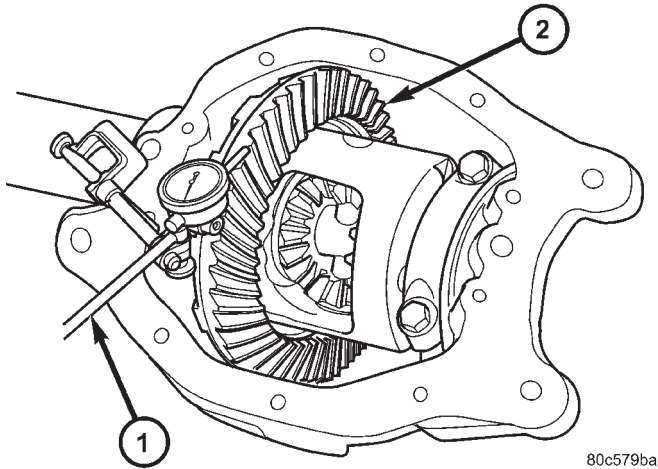
(26) Install side bearings and cups on differential case.

(27) Install spreader W-129-B with Adapter Set 6987 on the housing and spread axle opening enough to receive differential case.

**CAUTION:** Never spread the differential housing over 0.34 mm (0.013 in.). If the housing is over-spread, it could be distorted or damaged.

FRONT AXLE - 186FIA (Continued)

- (28) Place the bearing preload shims in the axle housing, against the axle tubes.
- (29) Install differential case into the housing.
- (30) Remove spreader from the housing.
- (31) Rotate the differential case several times to seat the side bearings.
- (32) Position the indicator plunger against a ring gear tooth (Fig. 22).

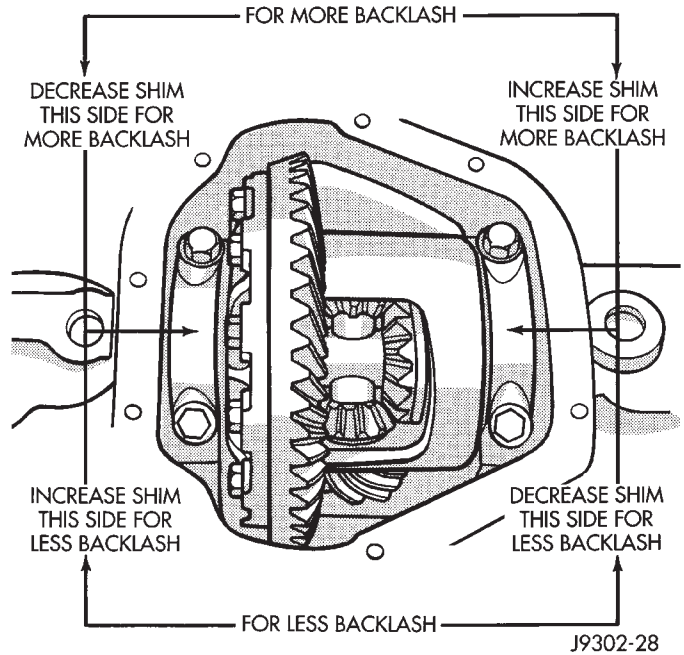


**Fig. 22 RING GEAR BACKLASH**

- 1 - DIAL INDICATOR
- 2 - RING GEAR

- (33) Push and hold ring gear upward while not allowing the pinion gear to rotate.
- (34) Zero dial indicator face to pointer.
- (35) 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 housing to the other (Fig. 23).
- (36) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at eight 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. 23 BACKLASH SHIMS**

**GEAR CONTACT PATTERN**

The ring gear and pinion teeth contact patterns will show if the pinion depth is correct in the 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. This will provide a more distinct contact pattern.
- (3) With 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 teeth will squeeze 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. 24) and adjust pinion depth and gear backlash as necessary.



FRONT AXLE - 186FIA (Continued)

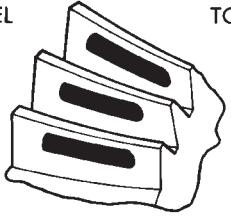
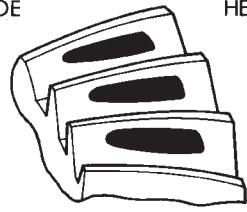
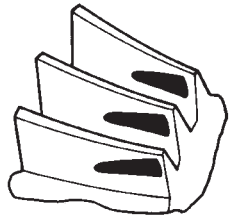
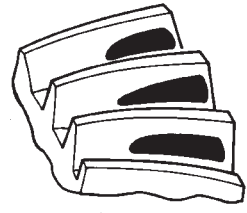
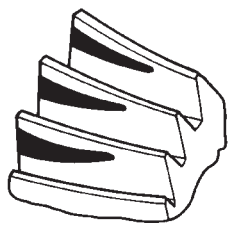
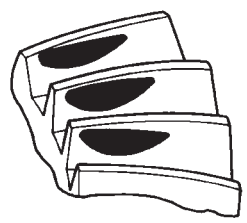
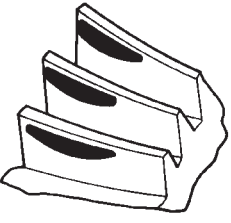
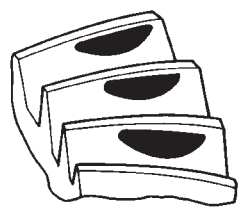
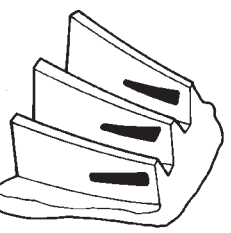
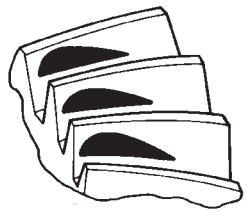
<p>DRIVE SIDE OF RING GEAR TEETH</p> <p>HEEL TOE</p> 	<p>COAST SIDE OF RING GEAR TEETH</p> <p>TOE HEEL</p> 	<p>DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.</p>
		<p>RING GEAR BACKLASH CORRECT. <b>THINNER</b> PINION GEAR DEPTH SHIM REQUIRED.</p>
		<p>RING GEAR BACKLASH CORRECT. <b>THICKER</b> PINION GEAR DEPTH SHIM REQUIRED.</p>
		<p>PINION GEAR DEPTH SHIM CORRECT. <b>DECREASE</b> RING GEAR BACKLASH.</p>
		<p>PINION GEAR DEPTH SHIM CORRECT. <b>INCREASE</b> RING GEAR BACKLASH.</p>

Fig. 24 GEAR TOOTH CONTACT PATTERNS

FRONT AXLE - 186FIA (Continued)

**DIFFERENTIAL BEARING PRELOAD CHECK**

The final check on the differential assembly before installing the axles, is torque to rotate pinion and differential combined. This will verify the correct differential bearing preload.

Torque to rotate the differential and pinion is the torque to rotate the pinion plus:

- Gear Ratio 3.73 . . . . 0.45-0.75 N·m (3.9-6.6 in. lbs.)
- Gear Ratio 3.91 . . . . 0.43-0.72 N·m (3.8-6.4 in. lbs.)
- Gear Ratio 4.10 . . . . 0.41-0.69 N·m (3.6-6.0 in. lbs.)

**SPECIFICATIONS - FRONT AXLE**

*SPECIFICATIONS*

DESCRIPTION	SPECIFICATION
Axle Ratio	3.73, 3.92, 4.10
Ring Gear Diameter	186 mm (7.33 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Pinion Gear Standard Depth	92.1 mm (3.625 in.)
Pinion Bearing Preload	1.69-2.82 N·m (15-25 in. lbs.)
Differential Bearing Preload Added To Pinion Torque To Rotate	
Gear Ratio 3.73	0.45-0.75 N·m (3.9-6.6 in. lbs.)
Gear Ratio 3.92	0.43-0.72 N·m (3.8-6.4 in. lbs.)
Gear Ratio 4.10	0.41-0.69 N·m (3.6-6.0 in. lbs.)

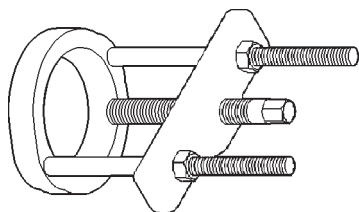
*TORQUE SPECIFICATIONS*

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Ring Gear Bolts	95-122	70-90	-
Differential Bearing Cap Bolts	54-67	39-50	-
Differential Cover Bolts	19-26	14-19	-
Pinion Nut	217-352	160-260	-
Left Axle Bracket Bolts	61	45	-
Front Axle Bracket Bolts	61	45	-
Right Axle Bracket Bolts	88	65	-
Axle Brackets To Frame Bolts	88	65	-

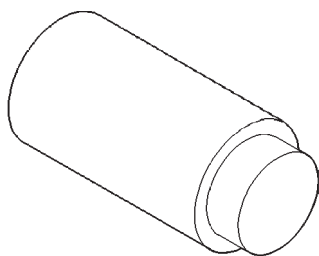
FRONT AXLE - 186FIA (Continued)

SPECIAL TOOLS

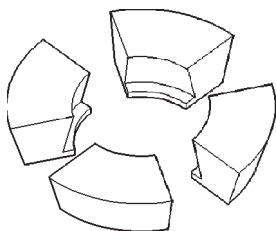
FRONT AXLE



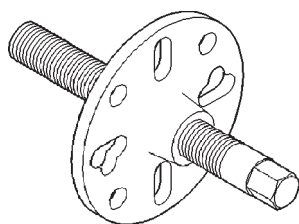
**PULLER C-293-PA**



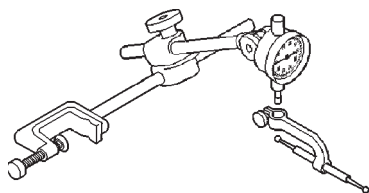
**PLUG SP-3289**



**ADAPTER C-293-39**

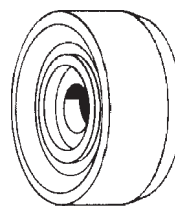


**PULLER C-452**

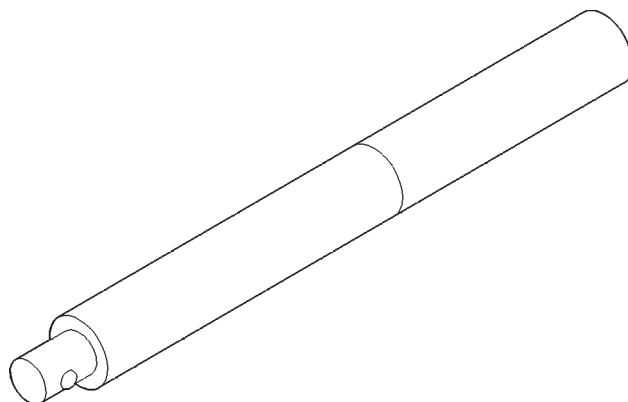


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**DIAL INDICATOR C-3339**



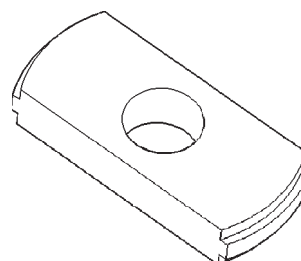
**INSTALLER C-3716-A**



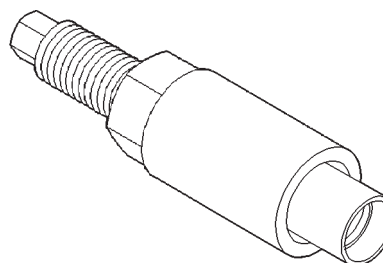
**HANDLE C-4171**



**INSTALLER D-146**

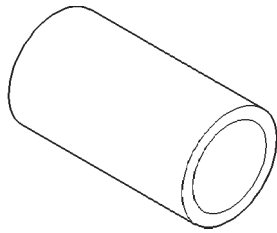


**REMOVER D-149**

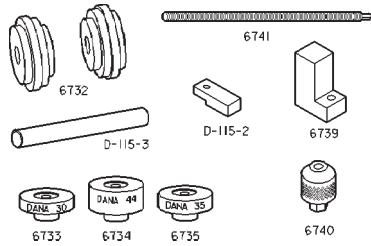


**INSTALLER W-162-D**

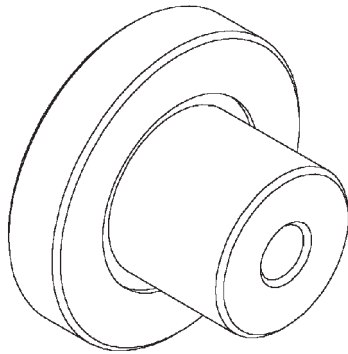
FRONT AXLE - 186FIA (Continued)



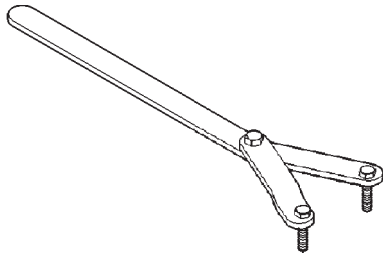
**CUP 8109**



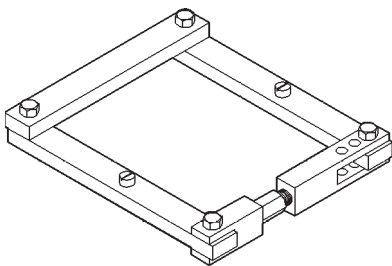
**PINION DEPTH SET 6774**



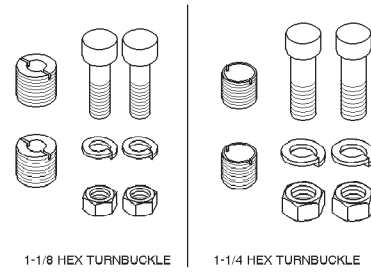
**PINION BLOCK 8804**



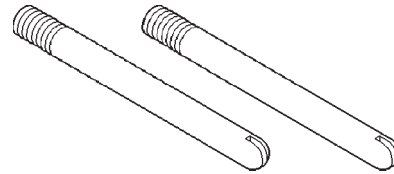
**SPANNER WRENCH 6958**



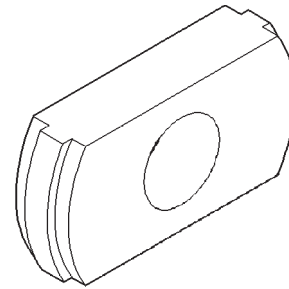
**SPREADER W-129-B**



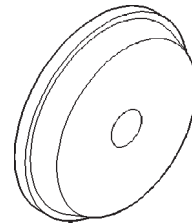
**ADAPTER KIT 6987B**



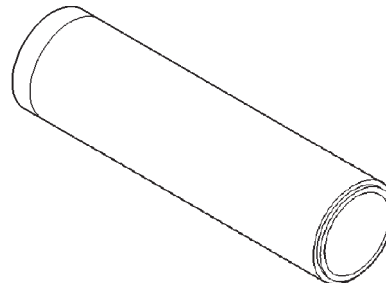
**PILOT STUD C-3288-B**



**REMOVER C-4307**

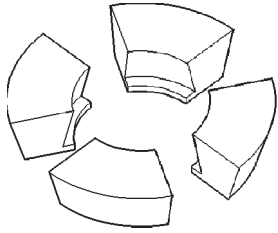


**INSTALLER C-4308**

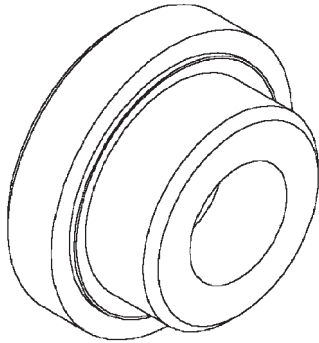


**INSTALLER 6448**

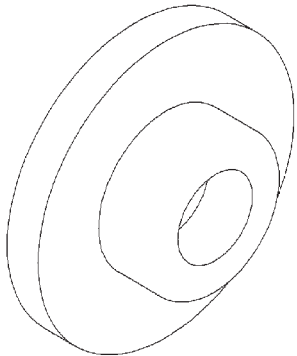
FRONT AXLE - 186FIA (Continued)



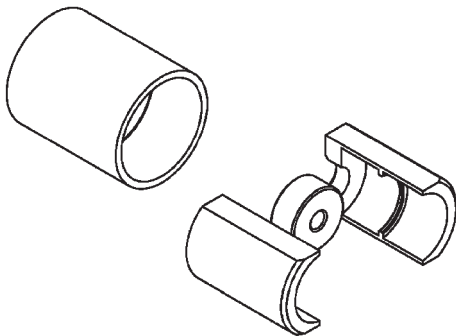
**ADAPTER C-293-42**



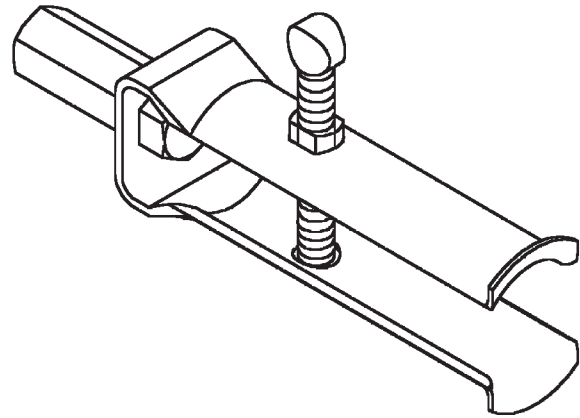
**INSTALLER 8805**



**INSTALLER 8806**



**REMOVER 8420A**

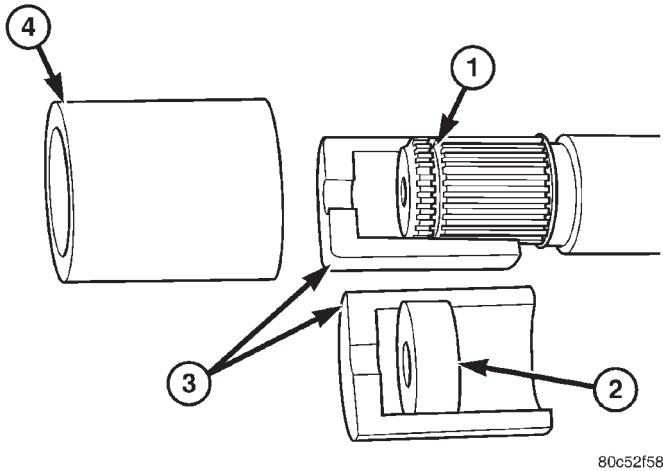


**REMOVER 7794-A**

## AXLE SHAFTS

### REMOVAL

- (1) Place the transmission in Neutral.
- (2) Raise and support vehicle.
- (3) Remove right wheel and tire and assembly.
- (4) Remove right half shaft from vehicle.
- (5) Remove snap ring from axle shaft.
- (6) Assemble Remover 8420A onto the shaft (Fig. 25). Thread slid hammer into remover and remove shaft.



**Fig. 25 AXLE SHAFT PULLER**

- 1 - SNAP RING GROVE
- 2 - SLID HAMMER THREADS
- 3 - REMOVER BLOCKS
- 4 - REMOVER COLLAR

- (7) Slide axle shaft out of the axle tube.

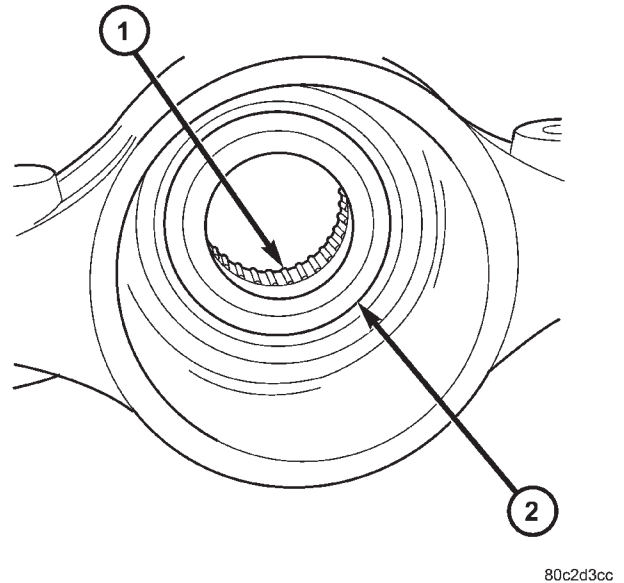
**NOTE:** Use care to prevent damage to axle shaft bearing and seal, which will remain in axle shaft tube.

### INSTALLATION

- (1) Lubricate bearing bore and seal lip with gear lubricant. Insert axle shaft through seal, bearing (Fig. 26) and engage it into side gear splines.

**NOTE:** Use care to prevent shaft splines from damaging axle shaft seal.

- (2) Push on the axle shaft until the axle shaft snap-ring passes through the side gear.
- (3) Install right half shaft.
- (4) Install right wheel and tire assembly.
- (5) Check differential fluid level.
- (6) Lower vehicle.



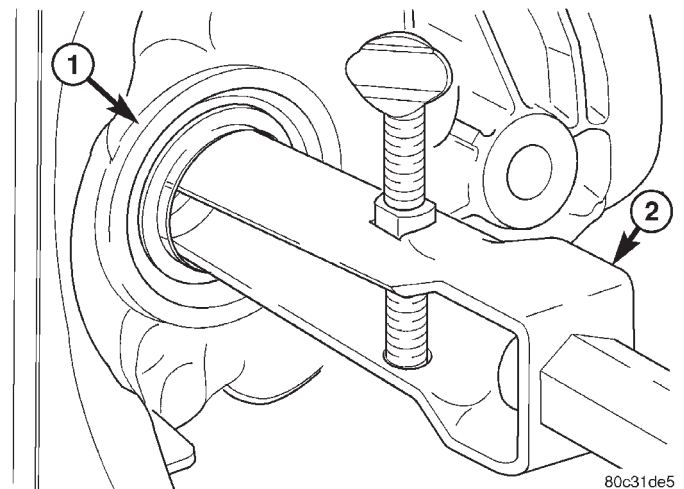
**Fig. 26 AXLE SHAFT SEAL**

- 1 - BEARING
- 2 - SEAL

## AXLE SHAFT SEALS

### REMOVAL

- (1) Remove half shaft.
- (2) Remove axle shaft for right side seal removal.
- (3) Remove shaft seal with Remover 7794-A and a slide hammer (Fig. 27).



**Fig. 27 SHAFT SEAL REMOVER**

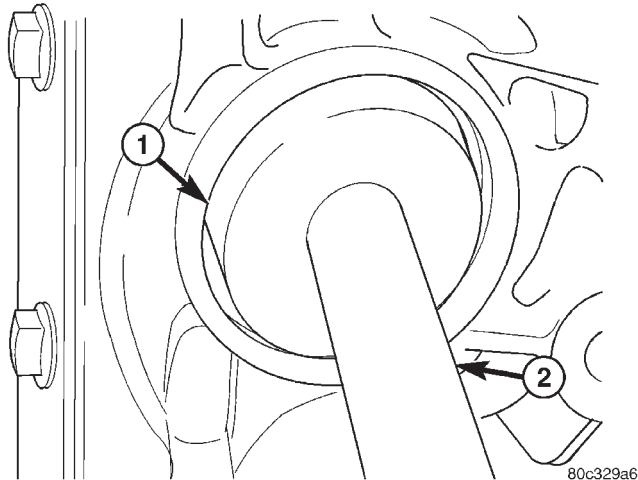
- 1 - SHAFT SEAL
- 2 - REMOVER

## AXLE SHAFT SEALS (Continued)

## INSTALLATION

(1) Apply a light coat of lubricant on the lip of the shaft seal.

(2) Install **new** shaft seal with Installer 8806 and Handle C-4171 (Fig. 28).



**Fig. 28 SEAL INSTALLER**

- 1 - SEAL BORE  
2 - INSTALLER

- (3) Install right axle shaft if removed.  
(4) Install half shaft.

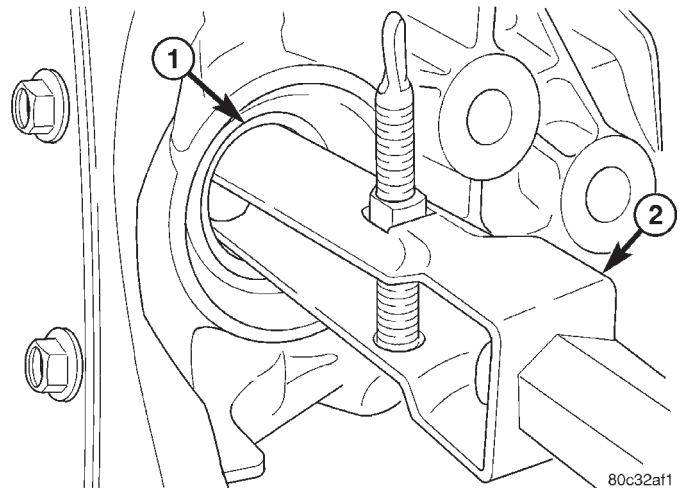
## AXLE BEARINGS

## REMOVAL

- (1) Remove half shaft.  
(2) Remove axle shaft for right side seal removal.  
(3) Remove shaft seal with Remover 7794-A and a slide hammer.  
(4) Remove shaft bearing with Remover 7794-A and a slide hammer (Fig. 29).

## INSTALLATION

- (1) Install **new** shaft bearing with Installer 8805 and Handle C-4171.  
(2) Apply a light coat of lubricant on the lip of the shaft seal.  
(3) Install **new** shaft seal with an appropriate installer.  
(4) Install right axle shaft if removed.  
(5) Install half shaft.



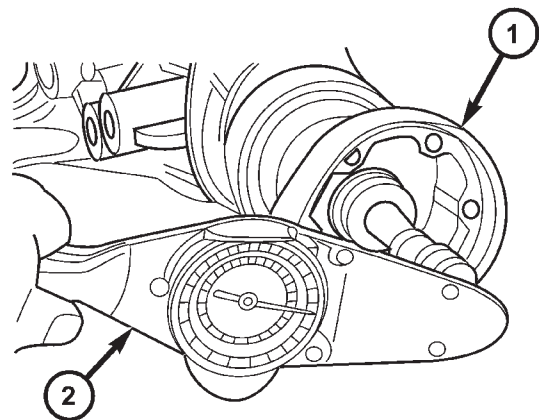
**Fig. 29 SHAFT BEARING REMOVER**

- 1 - SHAFT BEARING  
2 - REMOVER

## PINION SEAL

## REMOVAL

- (1) Raise and support the vehicle.  
(2) Remove wheel and tire assemblies.  
(3) Remove brake calipers and rotors, refer to 5 Brakes for procedures.  
(4) Mark propeller shaft and pinion companion flange for installation reference.  
(5) Remove propeller shaft from the pinion companion flange.  
(6) Rotate pinion gear a minimum of ten times and verify the pinion rotates smoothly.  
(7) Record the torque to rotate the pinion gear (Fig. 30) with a inch pound torque wrench.

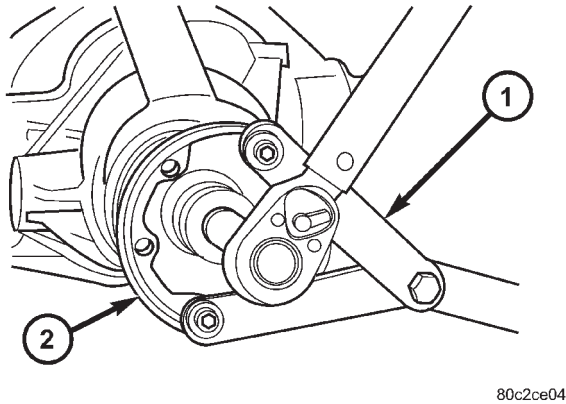


**Fig. 30 PINION ROTATING TORQUE**

- 1 - PINION COMPANION FLANGE  
2 - TORQUE WRENCH

PINION SEAL (Continued)

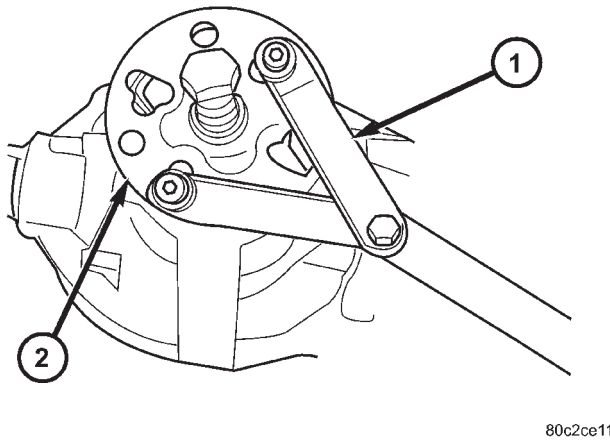
(8) Using a short piece of pipe and Spanner Wrench 6958 to hold the pinion companion flange (Fig. 31) and remove the pinion nut.



**Fig. 31 PINION FLANGE NUT**

- 1 - SPANNER WRENCH
- 2 - PINION COMPANION FLANGE

(9) Remove pinion companion flange (Fig. 32) with Remover C-452 and Spanner Wrench 6958.



**Fig. 32 PINION FLANGE REMOVER**

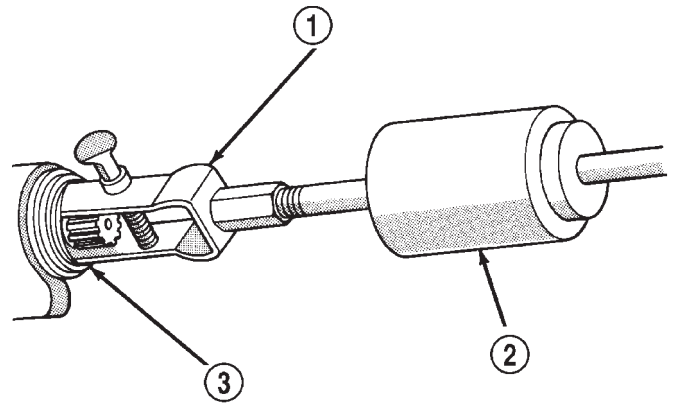
- 1 - SPANNER WRENCH
- 2 - REMOVER

(10) Remove pinion seal with Remover 7794-A and a slide hammer (Fig. 33).

**INSTALLATION**

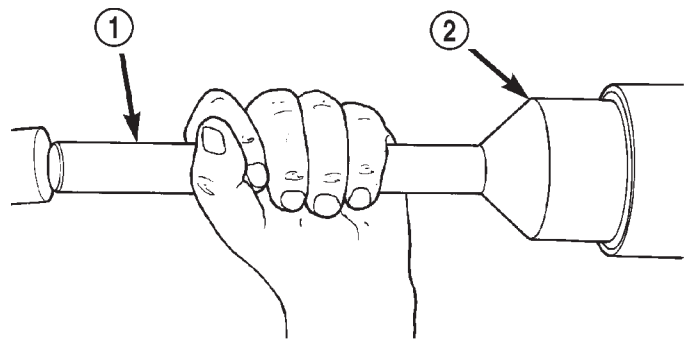
(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with an appropriate installer (Fig. 34).

(2) Install pinion companion flange on the pinion gear with Installer W-162-D, Cup 8109 and Wrench 6958.



**Fig. 33 PINION SEAL**

- 1 - REMOVER
- 2 - SLIDE HAMMER
- 3 - PINION SEAL



**Fig. 34 PINION SEAL INSTALLATION**

- 1 - HANDLE
- 2 - INSTALLER

**CAUTION:** Do not exceed the minimum tightening torque 216 N-m (160 ft. lbs.) while installing pinion nut at this point. Damage to collapsible spacer or bearings may result.

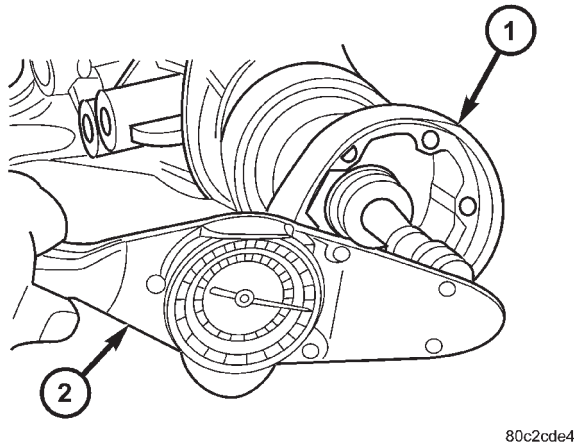
(3) Install a **new** nut on the pinion gear. **Tighten the nut only enough to remove the shaft end play.**

**CAUTION:** Never loosen pinion nut to decrease pinion rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed.



## PINION SEAL (Continued)

(4) Rotate pinion a minimum of ten times and verify pinion rotates smoothly. Rotate the pinion shaft with an inch pound torque wrench. Rotating torque should be equal to the reading recorded during removal plus 0.56 N·m (5 in. lbs.) (Fig. 35).



80c2cde4

**Fig. 35 PINION ROTATING TORQUE**

- 1 - PINION COMPANION FLANGE  
2 - TORQUE WRENCH

(5) If the rotating torque is low, use Spanner Wrench 6958 to hold the pinion companion flange and tighten the pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

**CAUTION:** If maximum tightening torque is reached prior to reaching the required rotating torque, the collapsible spacer may have been damaged. Replace the collapsible spacer.

(6) Install propeller shaft with installation reference marks aligned.

(7) Fill differential with gear lubricant.

(8) Install brake rotors and calipers.

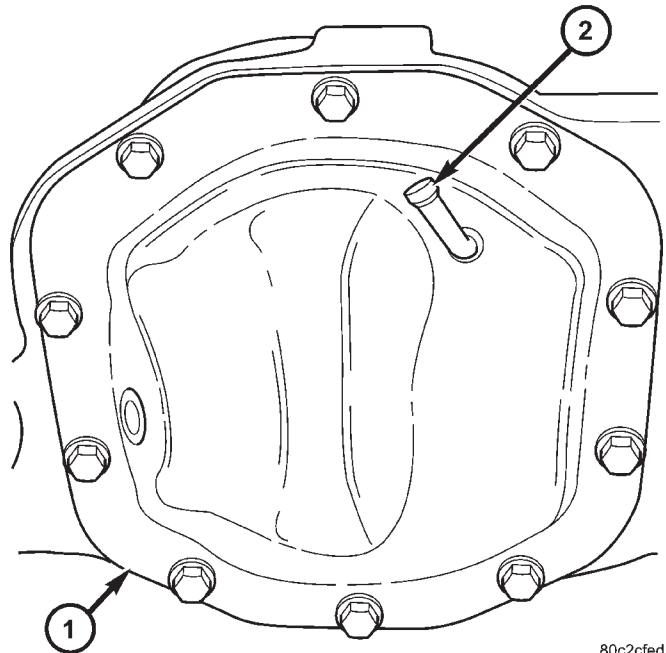
(9) Install wheel and tire assemblies.

(10) Lower the vehicle.

## DIFFERENTIAL

## REMOVAL

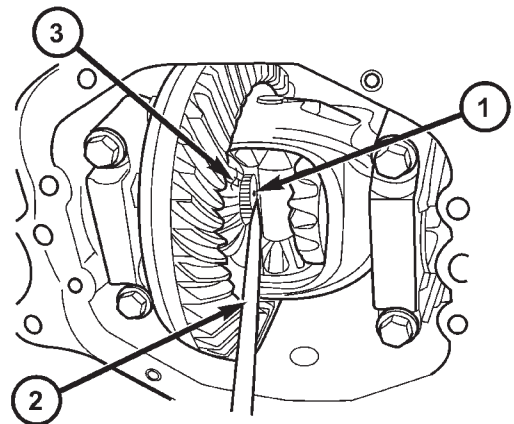
- (1) Remove axle from the vehicle.
- (2) Remove differential housing cover (Fig. 36).
- (3) Push right axle shaft out of side gear (Fig. 37) and remove the shaft.
- (4) Mark differential bearing caps for installation reference.
- (5) Loosen the bearing cap bolts.



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**Fig. 36 DIFFERENTIAL COVER**

- 1 - COVER  
2 - VENT TUBE



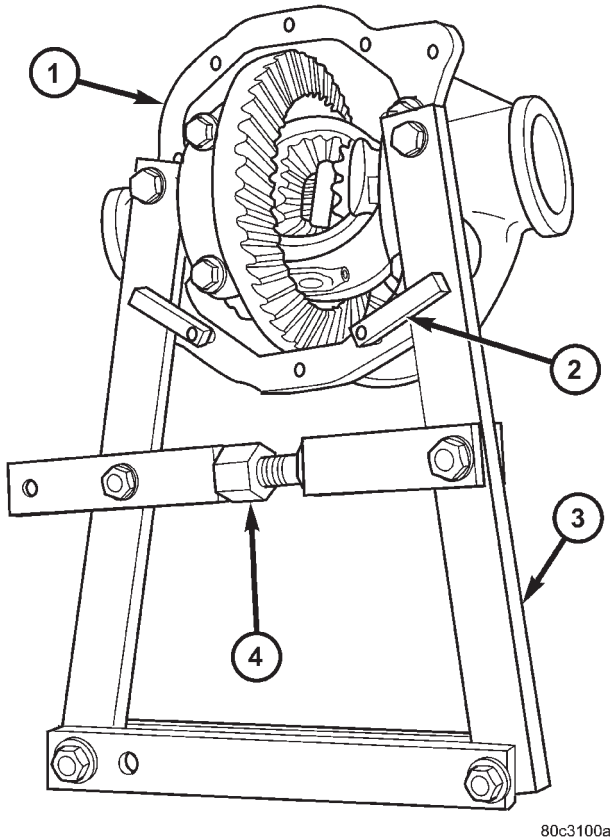
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**Fig. 37 RIGHT SHAFT IN SIDE GEAR**

- 1 - AXLE SHAFT  
2 - SCREWDRIVER  
3 - SIDE GEAR

DIFFERENTIAL (Continued)

(6) Position Spreader W-129-B onto the differential locating holes and install the safety holddown clamps (Fig. 38). Tighten the tool turnbuckle finger-tight.



**Fig. 38 DIFFERENTIAL SPREADER**

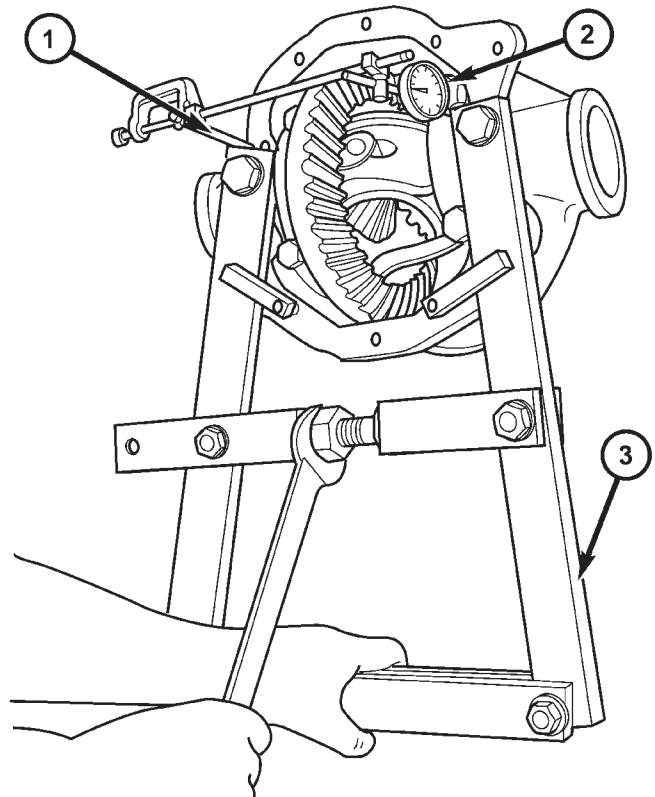
- 1 - DIFFERENTIAL HOUSING
- 2 - SAFETY CLAMPS
- 3 - SPREADER
- 4 - TURNBUCKLE

(7) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load indicator plunger against the opposite side of the housing and zero the indicator.

(8) Spread the housing to remove the differential case from the housing. Measure the distance with the dial indicator (Fig. 39).

**CAUTION:** Never spread the differential housing over 0.34 mm (0.013 in). If housing is over-spread, it could be distorted or damaged.

- (9) Remove the dial indicator.
- (10) Holding the differential case in position, and remove bearing cap bolts and caps.
- (11) Remove the differential from the housing (Fig. 40). Ensure differential bearing cups and shims remain in position on the differential bearings.



**Fig. 39 SPREAD DIFFERENTIAL CASE**

- 1 - PILOT STUD
- 2 - DIAL INDICATOR
- 3 - SPREADER

- (12) Tag differential bearing cups and shims to indicate their location.
- (13) Remove spreader from housing.

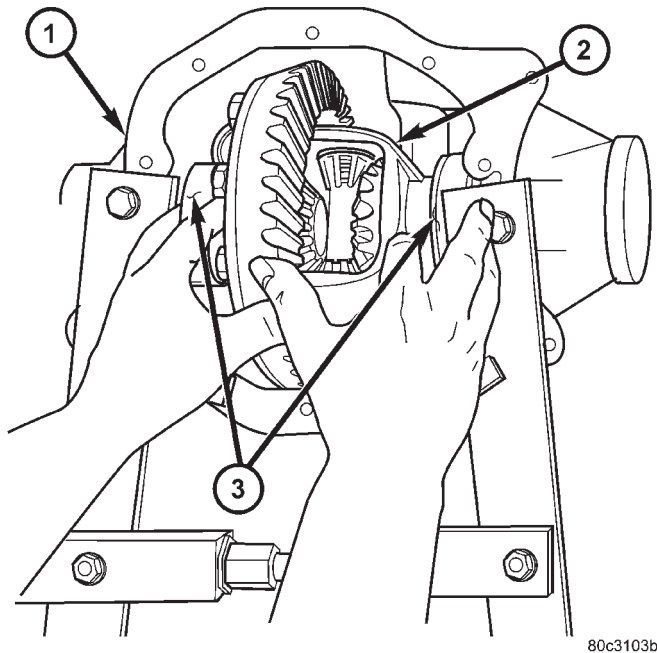
**DISASSEMBLY**

- (1) Remove ring gear.
- (2) Remove roll-pin holding mate shaft in housing.
- (3) Remove pinion gear mate shaft.
- (4) Rotate differential side gears and remove the pinion mate gears and thrust washers (Fig. 41).
- (5) Remove differential side gears and thrust washers.

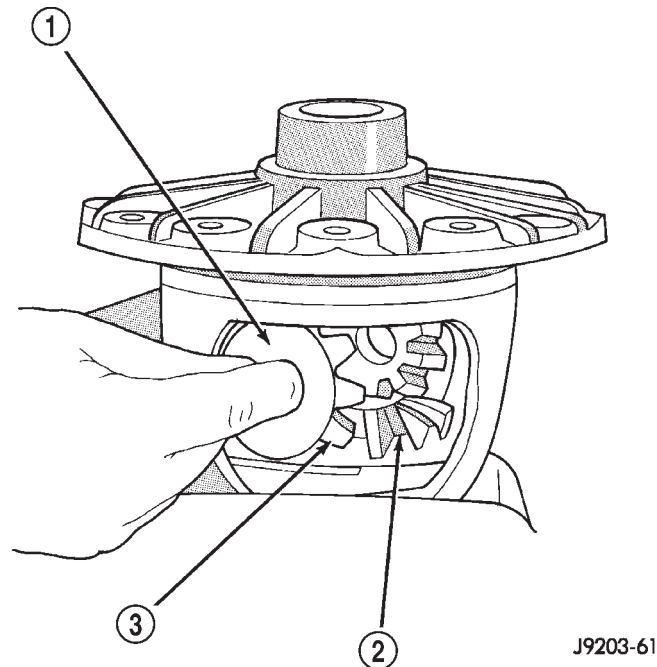
**ASSEMBLY**

- (1) Install differential side gears and thrust washers.
- (2) Install pinion mate gears and thrust washers.
- (3) Install pinion gear mate shaft.
- (4) Align hole in the pinion gear mate shaft with the hole in the differential case.

## DIFFERENTIAL (Continued)

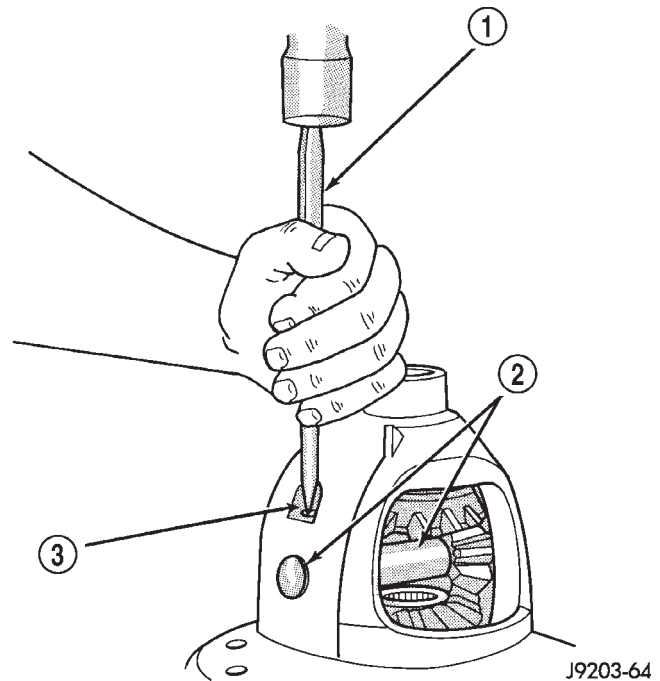
**Fig. 40 DIFFERENTIAL CASE**

- 1 - DIFFERENTIAL HOUSING
- 2 - DIFFERENTIAL CASE
- 3 - DIFFERENTIAL BEARINGS

**Fig. 41 PINION MATE GEAR**

- 1 - THRUST WASHER
- 2 - SIDE GEAR
- 3 - PINION MATE GEAR

(5) Install the roll-pin in the differential case with a hammer and punch (Fig. 42). Peen the edge of the roll-pin hole in the differential case in two places 180° apart.

**Fig. 42 PINION MATE SHAFT ROLL-PIN**

- 1 - PUNCH
- 2 - PINION MATE SHAFT
- 3 - MATE SHAFT LOCKPIN

(6) Lubricate all differential components with hypoid gear lubricant.

(7) Install ring gear.

**INSTALLATION**

**NOTE:** If differential bearings or differential case are replaced, Refer to adjustments fore Differential Bearing Preload and Gear Backlash procedures.

(1) Position Spreader W-129-B on differential location holes and install safety holddown clamps. Tighten the tool turnbuckle finger-tight.

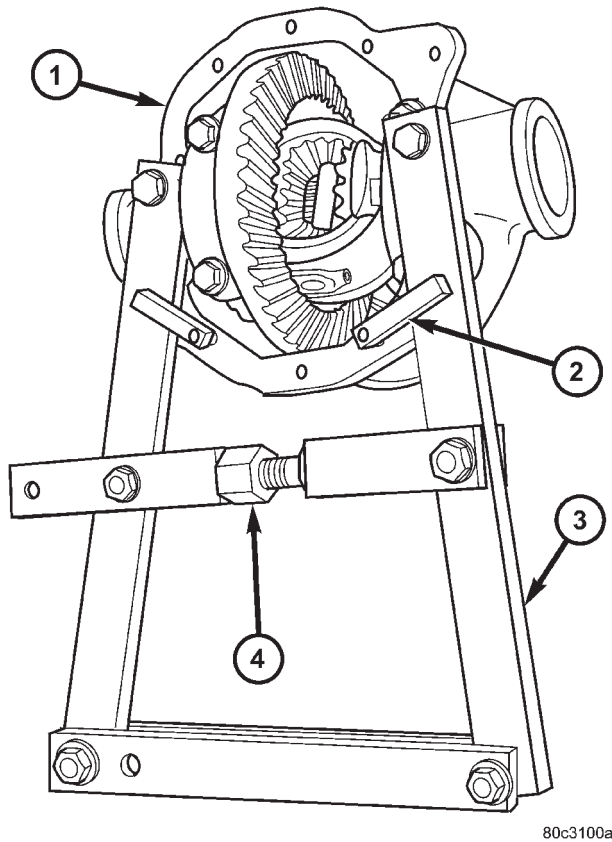
(2) Install Pilot Stud C-3288-B to the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load the indicator plunger against the opposite side of the housing and zero the indicator.

(3) Spread the housing to install the differential case and preload shims in the housing. Measure the distance with the dial indicator.

**CAUTION:** Never spread the differential housing over 0.34 mm (0.013 in). If housing is over-spread, it could be distorted or damaged.

DIFFERENTIAL (Continued)

- (4) Remove the dial indicator.
- (5) Install differential case in the housing. Ensure differential bearing cups remain on the bearings and preload shims are seated in the housing. Tap differential case to ensure bearings cups are seated in the housing.
- (6) Install bearing caps to their original locations and loosely install cap bolts.
- (7) Remove differential housing spreader (Fig. 43).



**Fig. 43 DIFFERENTIAL SPREADER**

- 1 - DIFFERENTIAL HOUSING
- 2 - SAFETY CLAMPS
- 3 - SPREADER
- 4 - TURNBUCKLE

- (8) Tighten the bearing cap bolts in a criss-cross pattern to 54-68 N·m (39-50 ft. lbs.).
- (9) Install the right axle shaft.
- (10) Apply a 6.38mm (1/4 in.) bead of red Mopar Silicone Sealer or equivalent to the housing cover.

**CAUTION:** If cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

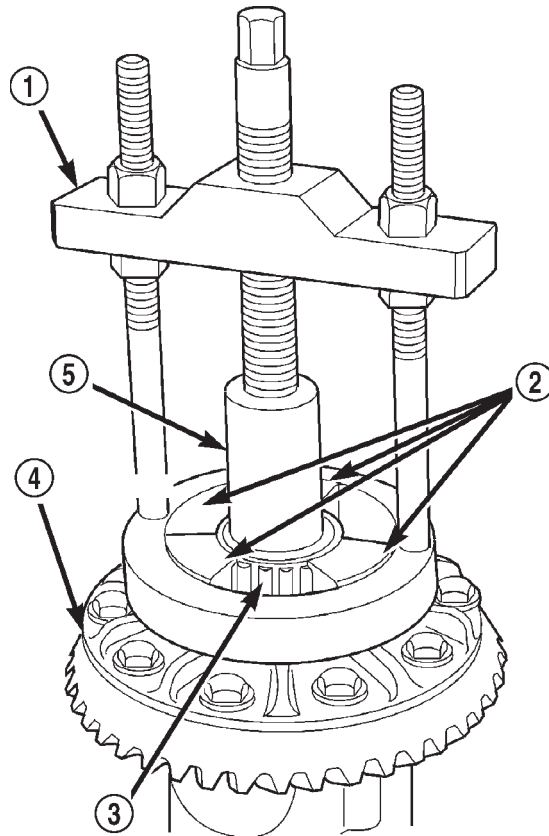
- (11) Install differential housing cover and tighten bolts in a criss-cross pattern to 19-26 N·m (14-19 ft. lbs.).

- (12) Install axle assembly in vehicle.
- (13) Fill differential with lubricant and install fill plug.

DIFFERENTIAL CASE BEARINGS

REMOVAL

- (1) Remove differential from the housing.
- (2) Remove bearings from the differential case with Puller/Press C-293-PA, Adapters C-293-39 and Plug SP-3289 (Fig. 44).



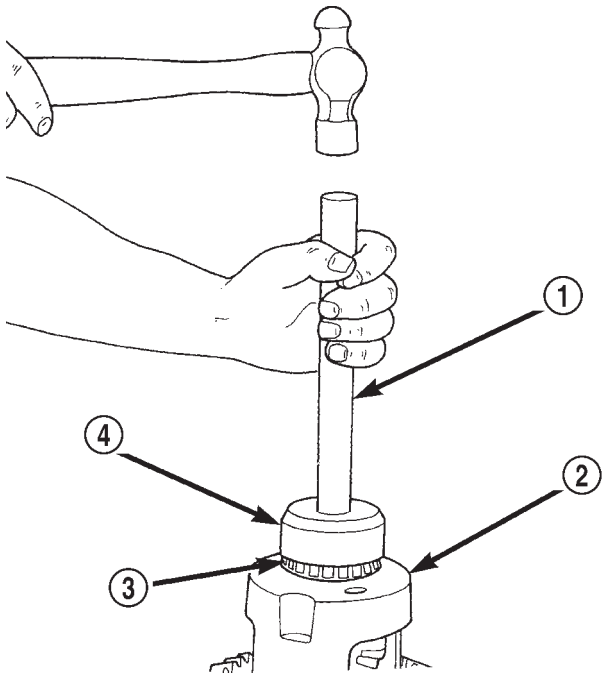
**Fig. 44 DIFFERENTIAL BEARING PULLER**

- 1 - PULLER
- 2 - ADAPTERS
- 3 - BEARING
- 4 - DIFFERENTIAL
- 5 - PLUG

## DIFFERENTIAL CASE BEARINGS (Continued)

## INSTALLATION

(1) Install differential case bearings with Installer C-3716-A and Handle C-4171 (Fig. 45).



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**Fig. 45 DIFFERENTIAL CASE BEARINGS**

- 1 - HANDLE
- 2 - DIFFERENTIAL
- 3 - BEARING
- 4 - INSTALLER

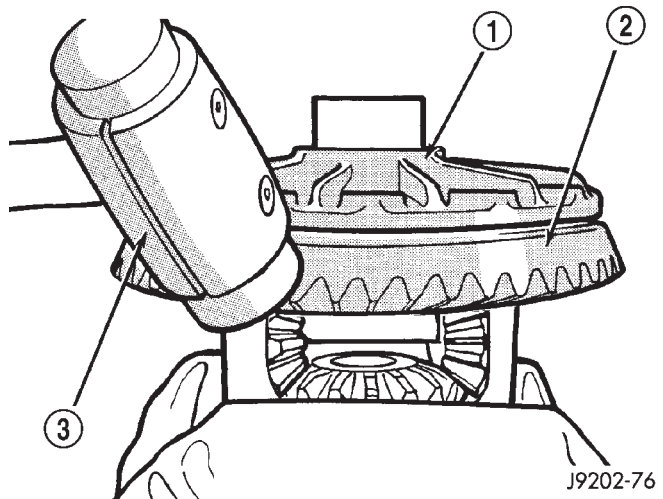
(2) Install differential into the housing.

## PINION GEAR/RING GEAR

## REMOVAL

**NOTE:** The ring gear and pinion are serviced as a matched set. Never replace ring gear without replacing the matched pinion gear.

- (1) Raise and support vehicle
- (2) Mark pinion companion flange and propeller shaft for installation alignment.
- (3) Remove propeller shaft from pinion companion flange and tie propeller shaft to underbody.
- (4) Remove axle assembly from the vehicle.
- (5) Remove differential from axle housing.
- (6) Place differential case in a vise with soft metal jaw (Fig. 46).
- (7) Remove bolts holding ring gear to differential case.
- (8) Driver ring gear off the differential case with a rawhide hammer (Fig. 46).

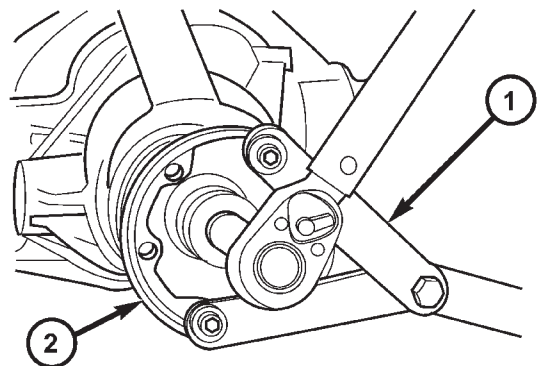


J9202-76

**Fig. 46 RING GEAR**

- 1 - DIFFERENTIAL CASE
- 2 - RING GEAR
- 3 - HAMMER

(9) With Spanner Wrench 6958 and a short length of 1 in. pipe, hold pinion companion flange and remove pinion nut (Fig. 47).



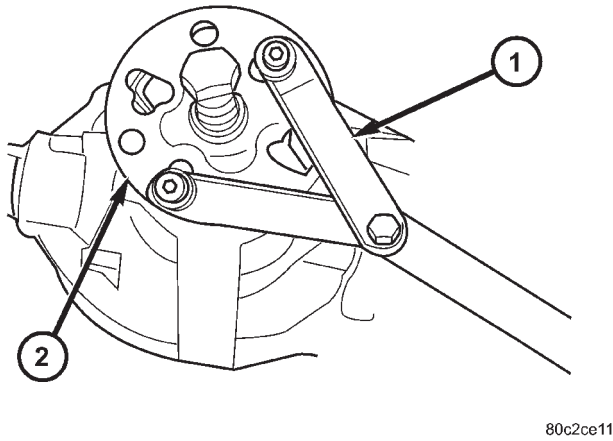
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**Fig. 47 PINION COMPANION FLANGE**

- 1 - SPANNER WRENCH
- 2 - PINION COMPANION FLANGE

PINION GEAR/RING GEAR (Continued)

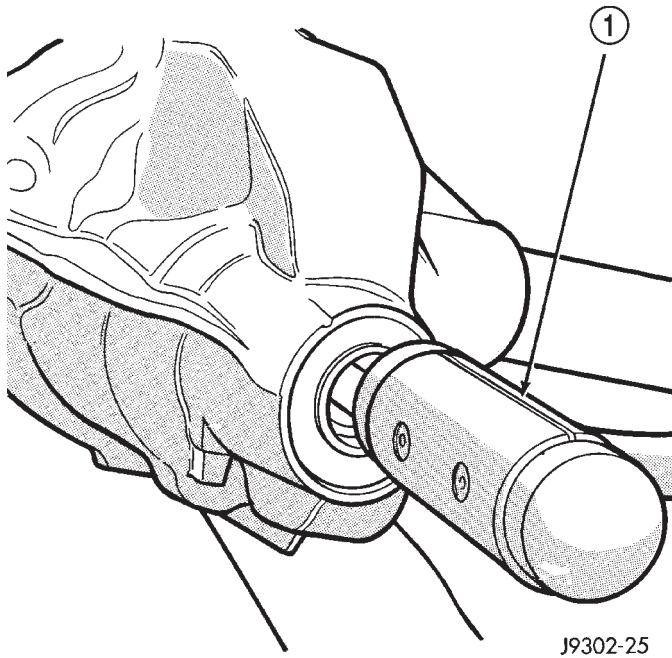
(10) Remove pinion companion flange from pinion shaft with Remover C-452 and Flange Wrench C-3281 (Fig. 48).



**Fig. 48 PINION FLANGE REMOVER**

- 1 - SPANNER WRENCH
- 2 - REMOVER

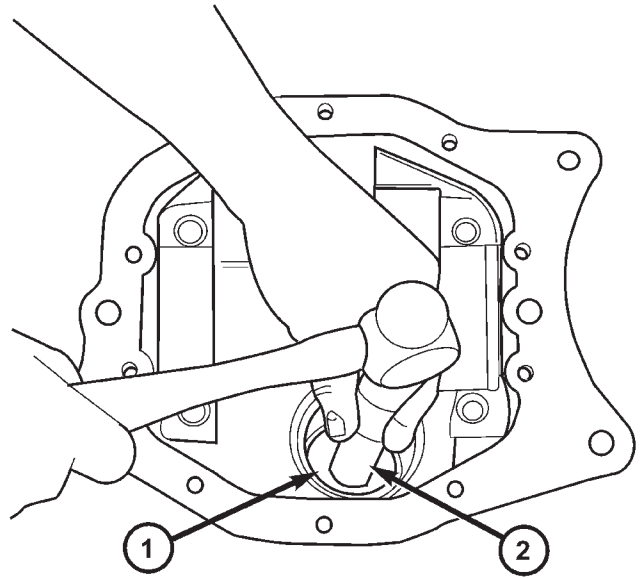
(11) Remove pinion gear and collapsible spacer from housing (Fig. 49).



**Fig. 49 PINION GEAR**

- 1 - RAWHIDE HAMMER

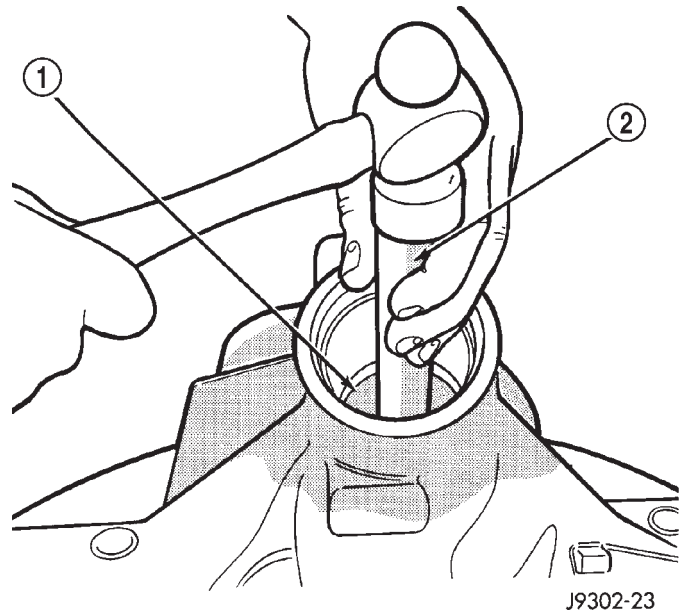
(12) Remove front pinion bearing cup, bearing, oil slinger and pinion seal with Remover C-149 and Handle C-4171 (Fig. 50).



**Fig. 50 FRONT PINION BEARING CUP**

- 1 - REMOVER
- 2 - HANDLE

(13) Remove rear pinion bearing cup (Fig. 51) with Remover C-4307 and Handle C-4171.

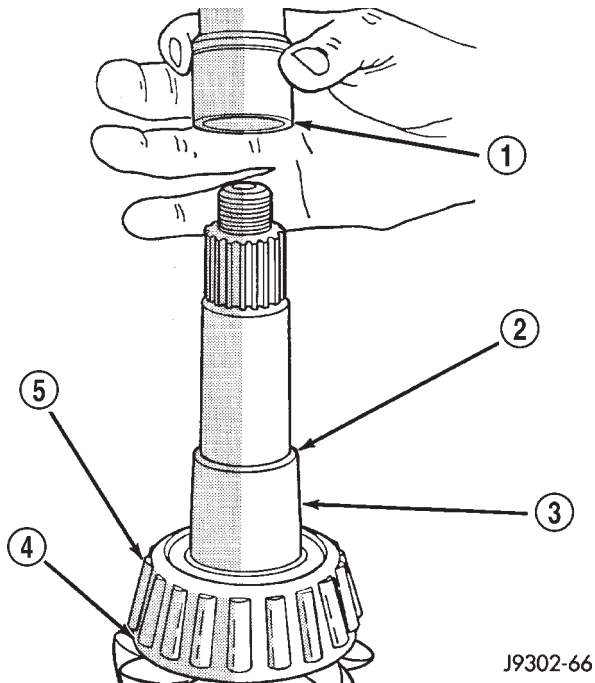


**Fig. 51 REAR PINION BEARING CUP**

- 1 - REMOVER
- 2 - HANDLE

## PINION GEAR/RING GEAR (Continued)

(14) Remove collapsible preload spacer from pinion gear (Fig. 52).



**Fig. 52 COLLAPSIBLE PRELOAD SPACER**

- 1 - COLLAPSIBLE SPACER
- 2 - SHOULDER
- 3 - PINION GEAR
- 4 - OIL SLINGER
- 5 - REAR BEARING

(15) Remove rear pinion bearing from the pinion with Puller/Press C-293-PA and Adapters C-293-39 (Fig. 53). Remove oil slinger/pinion depth shim from the pinion shaft and record thickness.

## INSTALLATION

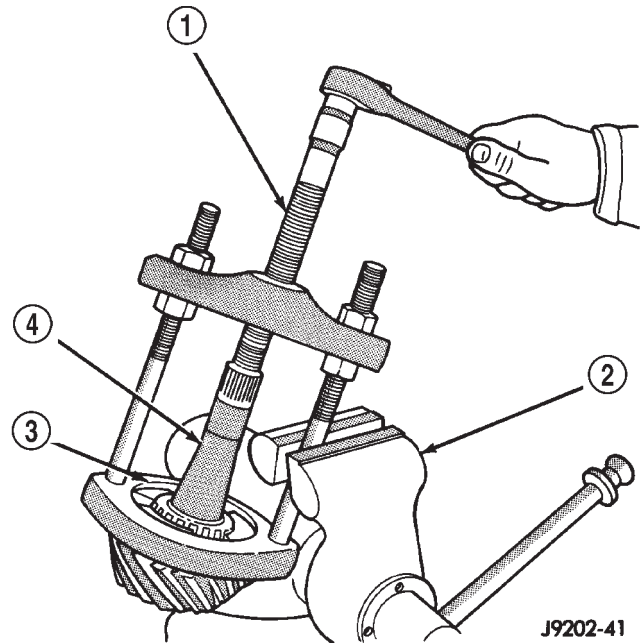
**NOTE:** Pinion depth shims are placed between the rear pinion bearing and the pinion gear head to achieve proper ring and pinion gear mesh. If ring and pinion gears are reused, the pinion oil slinger/depth shim should not require replacement. Refer to Adjustments (Pinion Gear Depth) to select the proper thickness shim before installing pinion gear.

(1) Apply Mopar Door Ease or equivalent lubricant to outside surface of pinion bearing cups.

(2) Install rear bearing cup with Installer C-4308 and Handle C-4171 and verify cup is seated.

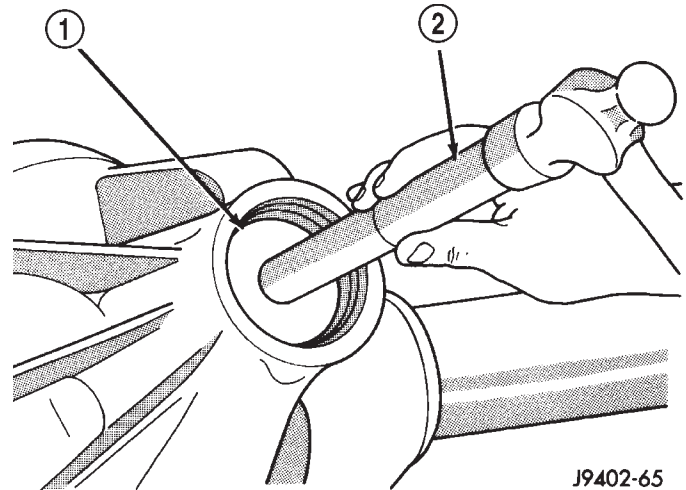
(3) Install front bearing cup with Installer D-146 and Handle C-4171 (Fig. 54) and verify cup is seated.

(4) Install front pinion bearing, and oil slinger if equipped.



**Fig. 53 REAR PINION BEARING**

- 1 - PULLER
- 2 - VISE
- 3 - ADAPTERS
- 4 - PINION GEAR SHAFT

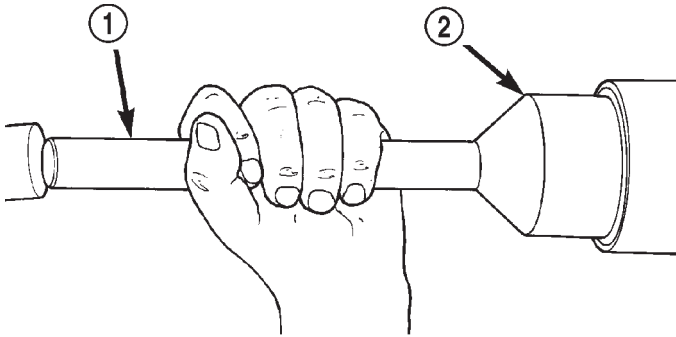


**Fig. 54 FRONT PINION BEARING CUP**

- 1 - INSTALLER
- 2 - HANDLE

PINION GEAR/RING GEAR (Continued)

(5) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with an appropriate installer (Fig. 55).

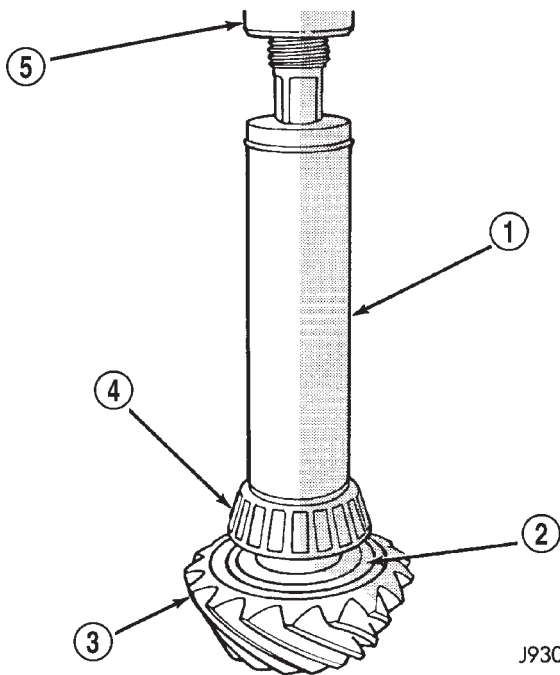


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**Fig. 55 PINION SEAL**

- 1 - HANDLE
- 2 - INSTALLER

(6) Install rear pinion bearing and oil slinger/depth shim onto the pinion shaft with Installer 6448 and a press (Fig. 56).

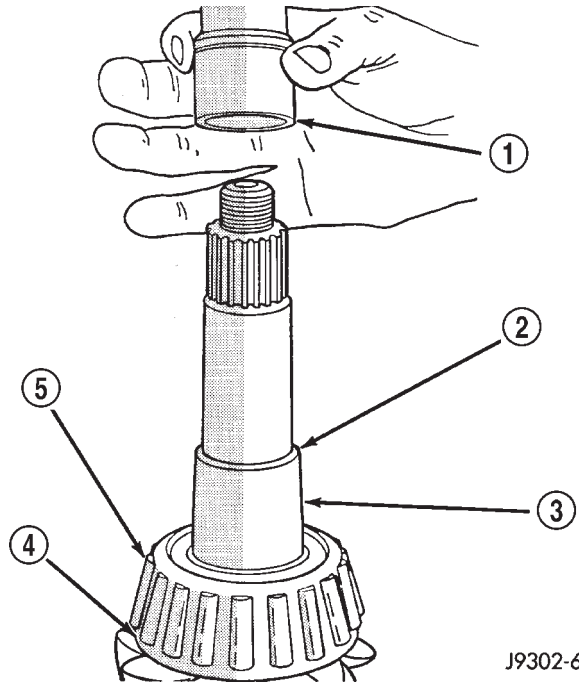


J9302-68

**Fig. 56 REAR PINION BEARING**

- 1 - INSTALLER
- 2 - OIL SLINGER
- 3 - PINION GEAR
- 4 - REAR PINION BEARING
- 5 - PRESS

(7) Install a **new** collapsible spacer on pinion shaft and install the pinion into the housing (Fig. 57).



J9302-66

**Fig. 57 COLLAPSIBLE PRELOAD SPACER**

- 1 - COLLAPSIBLE SPACER
- 2 - SHOULDER
- 3 - PINION GEAR
- 4 - OIL SLINGER
- 5 - REAR BEARING

(8) Install pinion companion flange, with Installer W-162-D, Cup 8109 and Spanner Wrench 6958.

(9) Install pinion a **new** nut onto the pinion gear and tighten the nut to 216 N·m (160 ft. lbs.). **Do not over-tighten.**

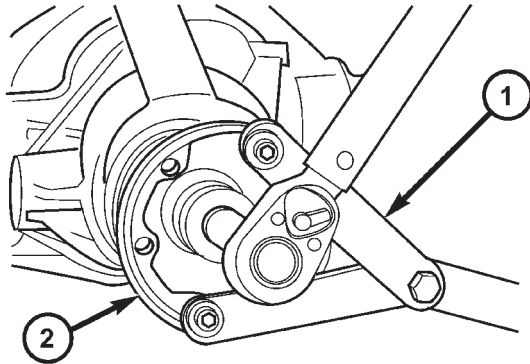
**CAUTION:** Never loosen pinion gear nut to decrease pinion rotating torque and never exceed specified preload torque. If preload torque is exceeded a new collapsible spacer must be installed.



## PINION GEAR/RING GEAR (Continued)

(10) Use Flange Wrench 6958, a length of 1 in. pipe and a torque wrench set at 678 N·m (500 ft. lbs.) and crush collapsible spacer until bearing end play is taken up (Fig. 58).

(11) Slowly tighten the nut in 6.8 N·m (5 ft. lb.) increments until the required rotating torque is achieved. Measure the rotating torque frequently to avoid over crushing the collapsible spacer (Fig. 59).



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**Fig. 58 PINION FLANGE NUT**

- 1 - SPANNER WRENCH  
2 - PINION COMPANION FLANGE

(12) Rotate the pinion a minimum of ten times. Verify pinion rotates smoothly and check rotating torque with an inch pound torque wrench (Fig. 59). Pinion gear rotating torque is:

- Original Bearings: 1 to 2.25 N·m (10 to 20 in. lbs.).
- New Bearings: 1.69 to 2.82 N·m (15 to 25 in. lbs.).

(13) Invert the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.

(14) Invert the differential case in the vise. Install **new** ring gear bolts and alternately tighten to 108 N·m (80 ft. lbs.) (Fig. 60).

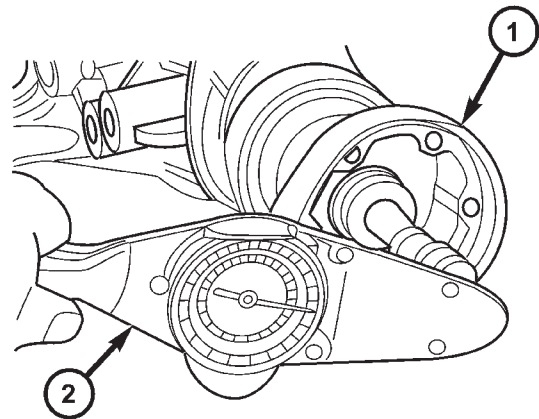
**CAUTION: Never reuse the ring gear bolts. The bolts can fracture causing extensive damage.**

(15) Install differential in housing and verify differential bearing preload, gear mesh and contact pattern. Refer to Adjustment for procedure.

(16) Install differential cover and fill with gear lubricant.

(17) Install propeller shaft with reference marks aligned.

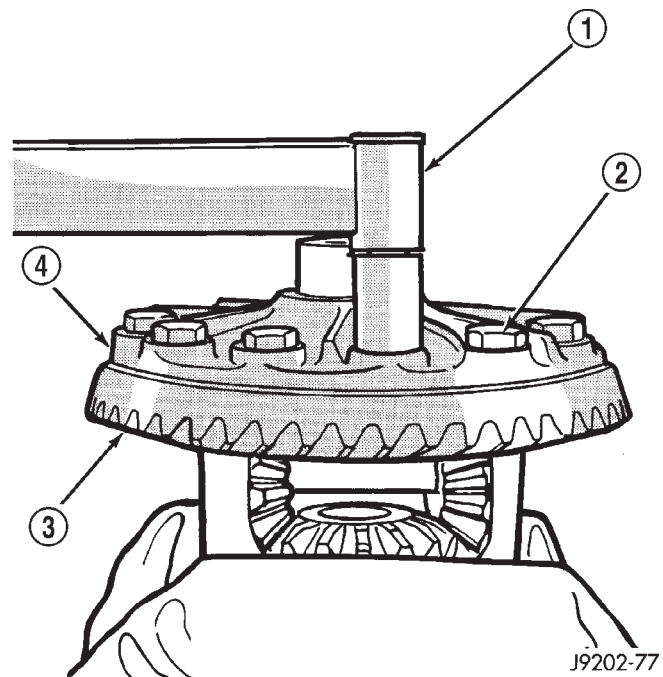
(18) Remove supports and lower vehicle.



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**Fig. 59 PINION ROTATING TORQUE**

- 1 - PINION COMPANION FLANGE  
2 - TORQUE WRENCH



J9202-77

**Fig. 60 RING GEAR BOLTS**

- 1 - TORQUE WRENCH  
2 - RING GEAR BOLTS  
3 - RING GEAR  
4 - DIFFERENTIAL CASE

## REAR AXLE - 198RBI

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## REAR AXLE - 198RBI

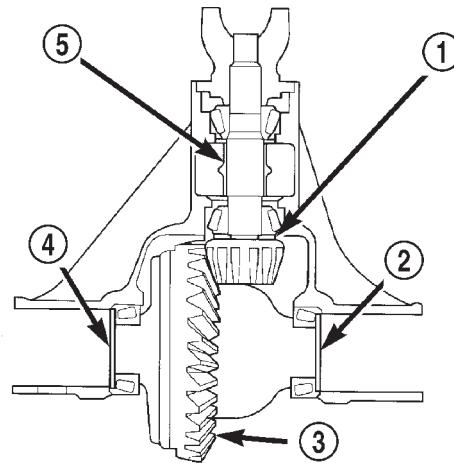
### DESCRIPTION

The Rear Beam-design Iron (RBI) axle housing has an iron center casting (differential housing) 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. The axles are equipped with semi-floating axle shafts, meaning that loads are supported by the axle shaft and bearings. The axle shafts are retained by the unit bearing, retainer plate and bolts.

The integral type, hypoid gear design, housing has the centerline of the pinion set below the centerline of the ring gear. The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded screw. Differential bearing preload and ring gear backlash is adjusted by the use of selective spacer shims. Pinion bearing preload is set and maintained by the use of a collapsible spacer (Fig. 1).

The cover provides a means for servicing the differential without removing the axle. The axle has a vent hose to relieve internal pressure caused by lubricant vaporization and internal expansion.

Axles equipped with a Trac-Lok® differential are optional. A Trac-Lok® differential has a one-piece dif-



**Fig. 1 SHIM LOCATIONS**

- 1 - PINION GEAR DEPTH SHIM
- 2 - DIFFERENTIAL BEARING SHIM-PINION GEAR SIDE
- 3 - RING GEAR
- 4 - DIFFERENTIAL BEARING SHIM-RING GEAR SIDE
- 5 - COLLAPSIBLE SPACER

ferential case, and the same internal components as a standard differential, plus two clutch disc packs.

### OPERATION

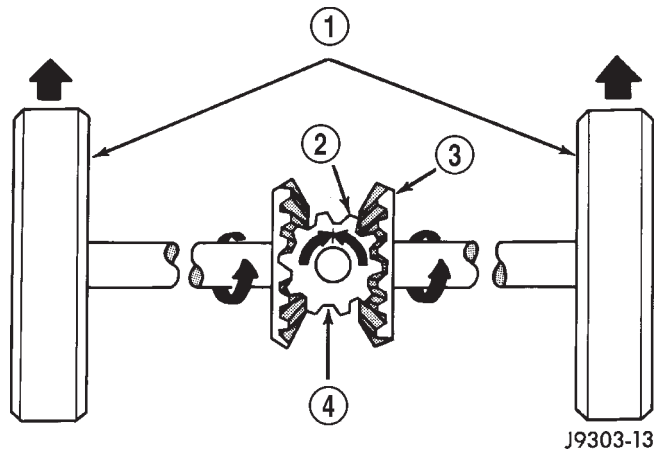
The axle receives power from the transmission/transfer case through the rear propeller shaft. The

REAR AXLE - 198RBI (Continued)

rear propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

**STANDARD DIFFERENTIAL**

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. 2).



J9303-13

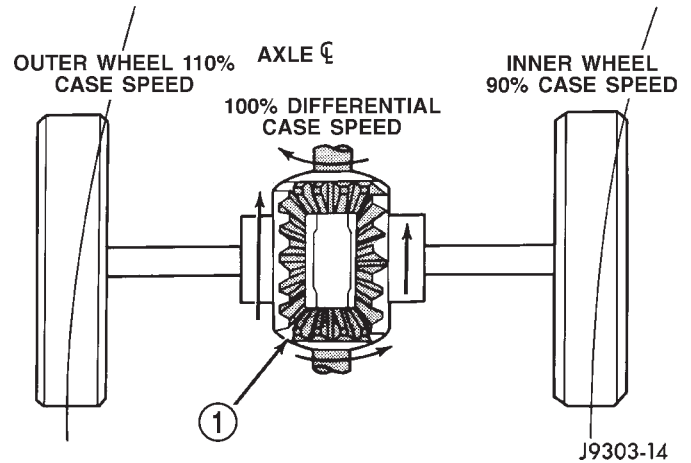
**Fig. 2 DIFFERENTIAL-STRAIGHT AHEAD DRIVING**

- 1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
- 2 - PINION GEAR
- 3 - SIDE GEAR
- 4 - PINION GEARS ROTATE WITH CASE

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. 3). 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™ DIFFERENTIAL**

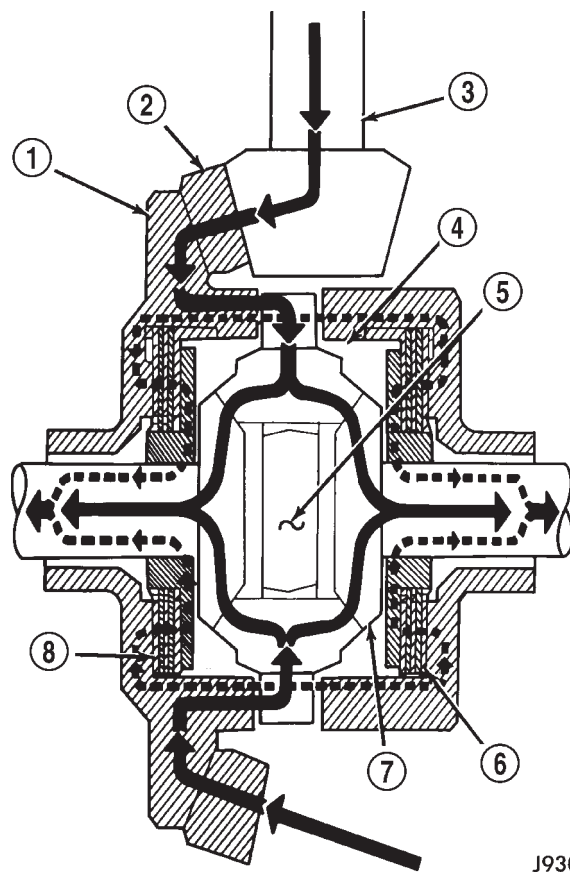
The Trac-lok™ clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 4).



J9303-14

**Fig. 3 DIFFERENTIAL-ON TURNS**

- 1 - PINION GEARS ROTATE ON PINION SHAFT



J9303-15

**Fig. 4 TRAC-LOK DIFFERENTIAL**

- 1 - CASE
- 2 - RING GEAR
- 3 - DRIVE PINION
- 4 - PINION GEAR
- 5 - MATE SHAFT
- 6 - CLUTCH PACK
- 7 - SIDE GEAR
- 8 - CLUTCH PACK

## REAR AXLE - 198RBI (Continued)

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 loses 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 loses traction. Pulling power is provided continuously until both wheels lose 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 - AXLE****GEAR NOISE**

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, incorrect pinion depth, tooth contact, worn/damaged gears, or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then 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 gears and pinions 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 shaft can also cause a snapping or a knocking noise.

**BEARING NOISE**

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched 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 differen-

tial 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 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.

**NOTE: All driveline components should be examined before starting any repair.**

**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.
- Transmission shift operation.
- 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 to 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.

## REAR AXLE - 198RBI (Continued)

## DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	<ol style="list-style-type: none"> <li>1. Wheel loose.</li> <li>2. Faulty, brinelled wheel bearing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten loose nuts.</li> <li>2. Replace bearing.</li> </ol>
Axle Shaft Noise	<ol style="list-style-type: none"> <li>1. Misaligned axle tube.</li> <li>2. Bent or sprung axle shaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inspect axle tube alignment. Correct as necessary.</li> <li>2. Inspect and correct as necessary.</li> </ol>
Axle Shaft Broke	<ol style="list-style-type: none"> <li>1. Misaligned axle tube.</li> <li>2. Vehicle overloaded.</li> <li>3. Erratic clutch operation.</li> <li>4. Grabbing clutch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the broken shaft after correcting tube mis-alignment.</li> <li>2. Replace broken shaft and avoid excessive weight on vehicle.</li> <li>3. Replace broken shaft and avoid or correct erratic clutch operation.</li> <li>4. Replace broken shaft and inspect and repair clutch as necessary.</li> </ol>
Differential Cracked	<ol style="list-style-type: none"> <li>1. Improper adjustment of the differential bearings.</li> <li>2. Excessive ring gear backlash.</li> <li>3. Vehicle overloaded.</li> <li>4. Erratic clutch operation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.</li> <li>2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.</li> <li>3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.</li> <li>4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.</li> </ol>
Differential Gears Scored	<ol style="list-style-type: none"> <li>1. Insufficient lubrication.</li> <li>2. Improper grade of lubricant.</li> <li>3. Excessive spinning of one wheel/tire.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace scored gears. Fill differential with the correct fluid type and quantity.</li> <li>2. Replace scored gears. Fill differential with the correct fluid type and quantity.</li> <li>3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.</li> </ol>

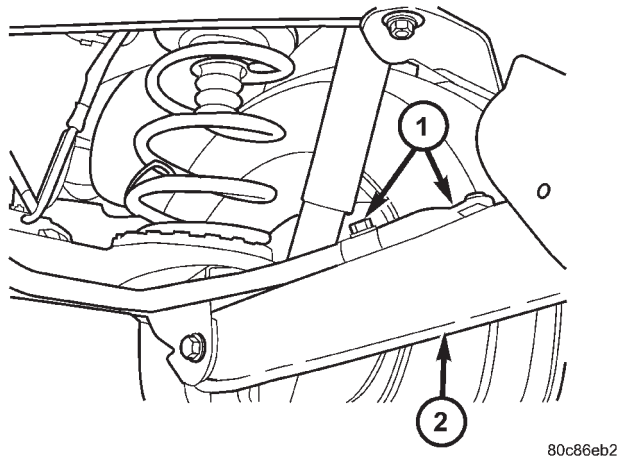
REAR AXLE - 198RBI (Continued)

Condition	Possible Causes	Correction
Loss Of Lubricant	<ol style="list-style-type: none"> <li>1. Lubricant level too high.</li> <li>2. Worn axle shaft seals.</li> <li>3. Cracked differential housing.</li> <li>4. Worn pinion seal.</li> <li>5. Worn/scored yoke.</li> <li>6. Axle cover not properly sealed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Drain lubricant to the correct level.</li> <li>2. Replace seals.</li> <li>3. Repair as necessary.</li> <li>4. Replace seal.</li> <li>5. Replace yoke and seal.</li> <li>6. Remove, clean, and re-seal cover.</li> </ol>
Axle Overheating	<ol style="list-style-type: none"> <li>1. Lubricant level low.</li> <li>2. Improper grade of lubricant.</li> <li>3. Bearing pre-loads too high.</li> <li>4. Insufficient ring gear backlash.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill differential to correct level.</li> <li>2. Fill differential with the correct fluid type and quantity.</li> <li>3. Re-adjust bearing pre-loads.</li> <li>4. Re-adjust ring gear backlash.</li> </ol>
Gear Teeth Broke	<ol style="list-style-type: none"> <li>1. Overloading.</li> <li>2. Erratic clutch operation.</li> <li>3. Ice-spotted pavement.</li> <li>4. Improper adjustments.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace gears. Examine other gears and bearings for possible damage.</li> <li>2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.</li> <li>3. Replace gears and examine remaining parts for damage.</li> <li>4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.</li> </ol>
Axle Noise	<ol style="list-style-type: none"> <li>1. Insufficient lubricant.</li> <li>2. Improper ring gear and pinion adjustment.</li> <li>3. Unmatched ring gear and pinion.</li> <li>4. Worn teeth on ring gear and/or pinion.</li> <li>5. Loose pinion bearings.</li> <li>6. Loose differential bearings.</li> <li>7. Mis-aligned or sprung ring gear.</li> <li>8. Loose differential bearing cap bolts.</li> <li>9. Housing not machined properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill differential with the correct fluid type and quantity.</li> <li>2. Check ring gear and pinion contact pattern. Adjust backlash or pinion depth.</li> <li>3. Replace gears with a matched ring gear and pinion.</li> <li>4. Replace ring gear and pinion.</li> <li>5. Adjust pinion bearing pre-load.</li> <li>6. Adjust differential bearing pre-load.</li> <li>7. Measure ring gear run-out. Replace components as necessary.</li> <li>8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued to the proper specification.</li> <li>9. Replace housing.</li> </ol>

## REAR AXLE - 198RBI (Continued)

**REMOVAL**

- (1) Raise and support the vehicle.
- (2) Position a lift/jack under the axle and secure axle to device.
- (3) Remove wheels and tires.
- (4) Mark propeller shaft and pinion yoke for installation reference.
- (5) Remove propeller shaft and suspend under the vehicle.
- (6) Remove brake drums, parking brake cables and speed sensor from the axle.
- (7) Disconnect the brake hose at the body junction block.
- (8) Remove brakes and backing plates.
- (9) Remove vent hose from the axle shaft tube.
- (10) Remove the stabilizer bar (Fig. 5).



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**Fig. 5 STABILIZER BAR MOUNTS**

- 1 - STABILIZER BAR MOUNTING BOLTS
- 2 - LOWER SUSPENSION ARM

(11) Remove upper control arm ball joint pinch bolt from bracket (Fig. 6).

(12) Remove shock absorbers from axle brackets (Fig. 7).

(13) Loosen all lower control arms mounting bolts (Fig. 8).

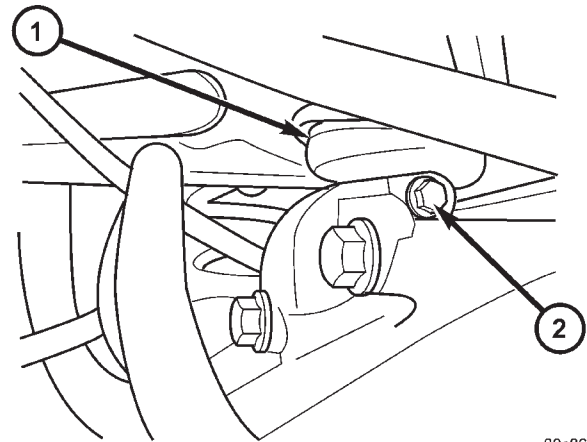
(14) Lower axle enough to remove coil springs and spring insulators.

(15) Remove lower control arm bolts from the axle brackets.

(16) Lower and remove the axle.

**INSTALLATION**

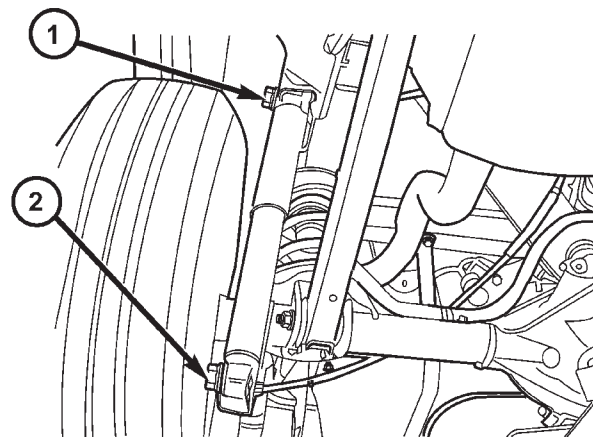
**CAUTION:** The weight of the vehicle must be supported by the springs before the lower control arms are tightened. This must be done to maintain vehicle ride height and prevent premature bushing failure.



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**Fig. 6 BALL JOINT PINCH BOLT**

- 1 - UPPER BALL JOINT
- 2 - PINCH BOLT



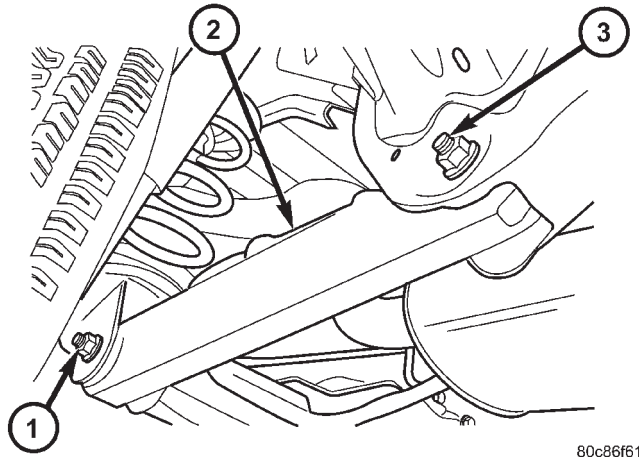
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**Fig. 7 SHOCK ABSORBER**

- 1 - UPPER MOUNTING BOLT
- 2 - LOWER MOUNTING BOLT

- (1) Raise the axle under the vehicle.
- (2) Install lower control arms onto the axle brackets and loosely install the mounting bolts.
- (3) Install coil spring isolators and spring.
- (4) Raise axle up until springs are seated.
- (5) Install upper control arm ball joint into axle bracket and tighten pinch bolt to torque specification.
- (6) Install shock absorbers and tighten nuts to torque specification.
- (7) Install stabilizer bar and tighten nuts to torque specification.
- (8) Install brake backing plates, parking brake cables, brake drums and speed sensor.
- (9) Install brake hose to the body junction block and bleed the brakes.

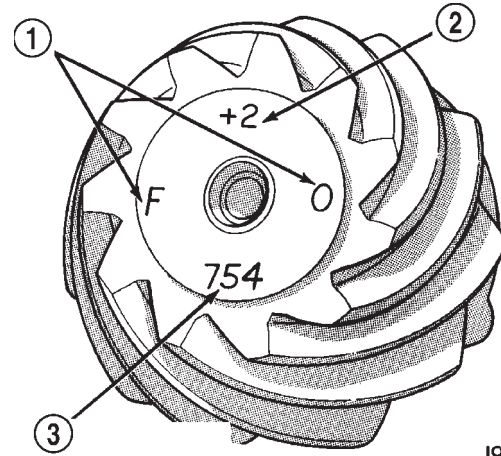
REAR AXLE - 198RBI (Continued)



**Fig. 8 LOWER SUSPENSION ARM**

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- 1 - AXLE BRACKET BOLT
- 2 - LOWER CONTROL ARM
- 3 - BODY BRACKET BOLT



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**Fig. 9 PINION GEAR ID NUMBERS**

- 1 - PRODUCTION NUMBERS
- 2 - PINION GEAR DEPTH VARIANCE
- 3 - GEAR MATCHING NUMBER

- (10) Install axle vent hose.
- (11) Install propeller shaft with reference marks.
- (12) Install the wheels and tires.
- (13) Add gear lubricant to specifications, if necessary.
- (14) Remove lifting device from axle and lower the vehicle.
- (15) Tighten the lower control arm bolts to torque specification.

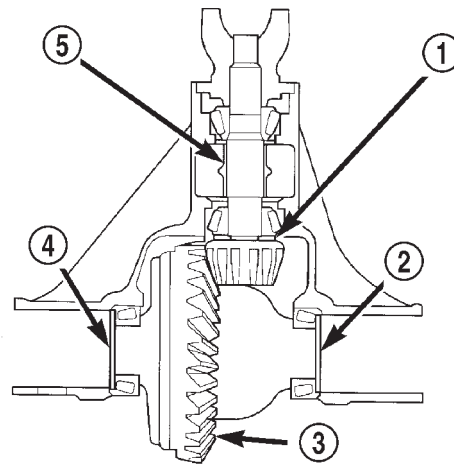
ADJUSTMENTS

ADJUSTMENT

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. 9). 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 96.850 mm (3.813 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. 10).

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.



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**Fig. 10 Shim Locations**

- 1 - PINION GEAR DEPTH SHIM
- 2 - DIFFERENTIAL BEARING SHIM
- 3 - RING GEAR
- 4 - DIFFERENTIAL BEARING SHIM
- 5 - COLLAPSIBLE SPACER

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.



REAR AXLE - 198RBI (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

PINION DEPTH MEASUREMENT

Measurements are taken with pinion cups and pinion bearings installed in the housing. Take measurements with a Pinion Gauge Set, Pinion Block 6735, Arbor Discs 6732 and Dial Indicator C-3339 (Fig. 11).

(1) Assemble Pinion Height Block 6739, Pinion

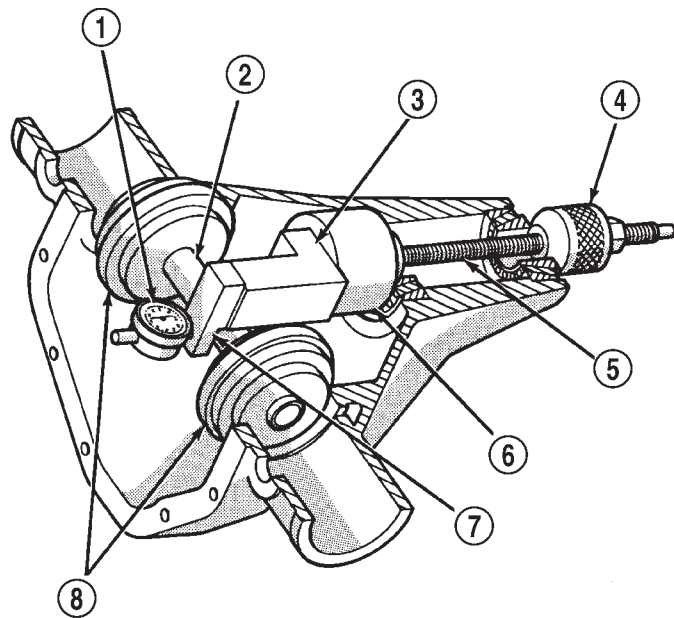


Fig. 11 PINION DEPTH TOOLS

- 1 - DIAL INDICATOR
- 2 - ARBOR
- 3 - PINION HEIGHT BLOCK
- 4 - CONE
- 5 - SCREW
- 6 - PINION BLOCK
- 7 - SCOOTER BLOCK
- 8 - ARBOR DISC

J9403-45

Block 6735 and rear pinion bearing onto Screw 6741 (Fig. 11).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through pinion bearing cups (Fig. 12).

(3) Install front pinion bearing and Cone 6740 hand tight.

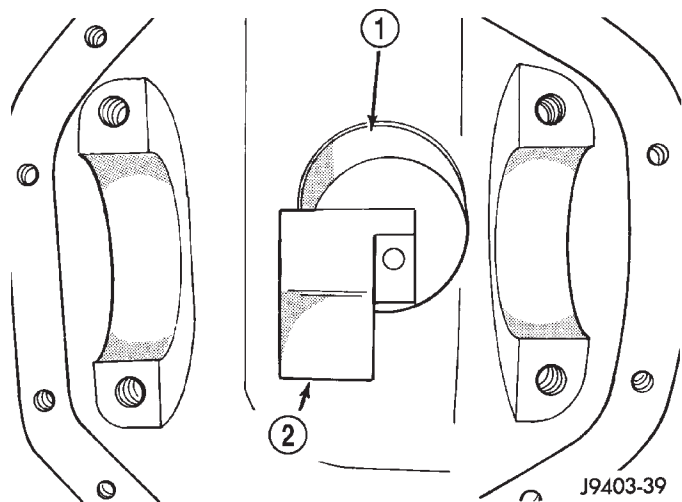


Fig. 12 PINION HEIGHT BLOCK

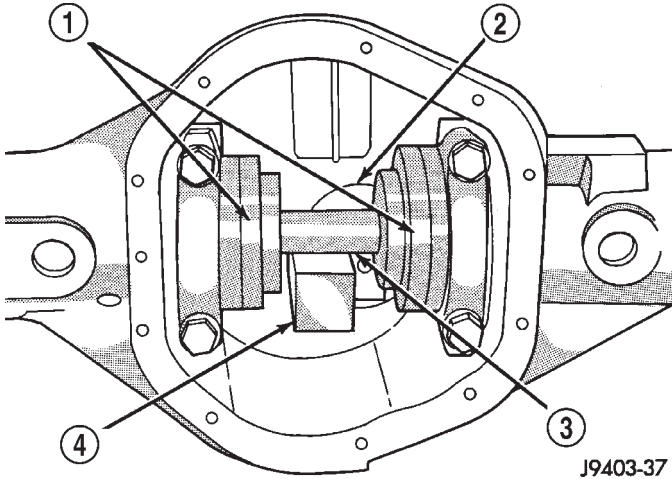
- 1 - PINION BLOCK
- 2 - PINION HEIGHT BLOCK

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(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 13). Install differential bearing caps on Arbor Discs and tighten cap bolts. Refer to the Torque Specifications.

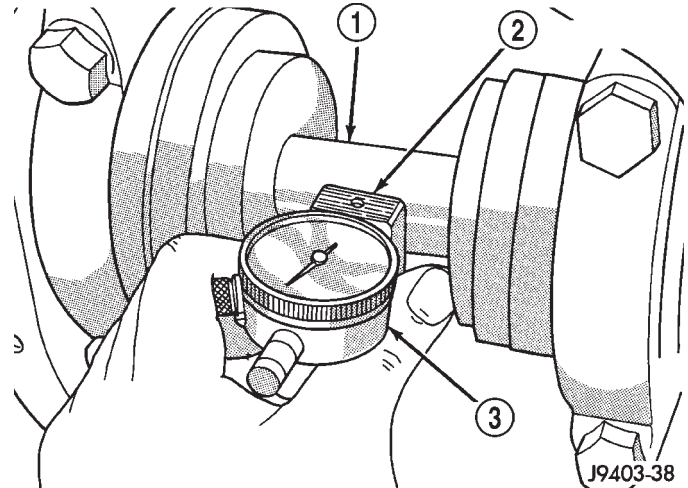
**NOTE:** Arbor Discs 6732 have different step diameters to fit other axle sizes. Pick correct size step for axle being serviced.

REAR AXLE - 198RBI (Continued)



**Fig. 13 GAUGE TOOLS IN HOUSING**

- 1 - ARBOR DISC
- 2 - PINION BLOCK
- 3 - ARBOR
- 4 - PINION HEIGHT BLOCK



**Fig. 14 Pinion Gear Depth Measurement**

- 1 - ARBOR
- 2 - SCOOTER BLOCK
- 3 - DIAL INDICATOR

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(6) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

(7) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 14). Move the scooter block till the dial indicator probe crests 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.

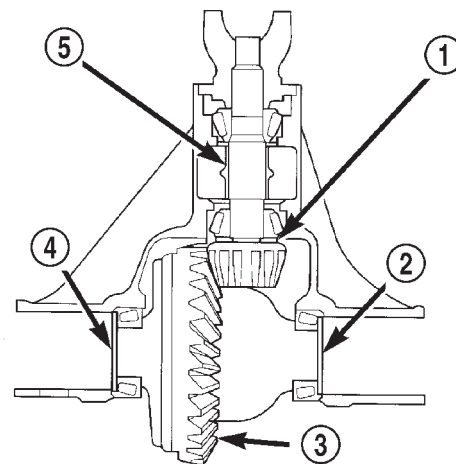
(8) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched in the face of the pinion gear (Fig. 9) using the opposite sign on the variance number. For example, if the depth variance is -2, add +0.002 in. to the dial indicator reading.

(9) Remove the pinion depth gauge components from the housing

**DIFFERENTIAL BEARING PRELOAD**

Differential side bearing preload and gear backlash is achieved by selective shims inserted between the bearing cup and the housing. The proper shim thickness can be determined using slip-fit Dummy Bearings D-348 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, starting point shim thickness and the pre-load 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. 15).



**Fig. 15 Shim Locations**

- 1 - PINION GEAR DEPTH SHIM
- 2 - DIFFERENTIAL BEARING SHIM
- 3 - RING GEAR
- 4 - DIFFERENTIAL BEARING SHIM
- 5 - COLLAPSIBLE SPACER

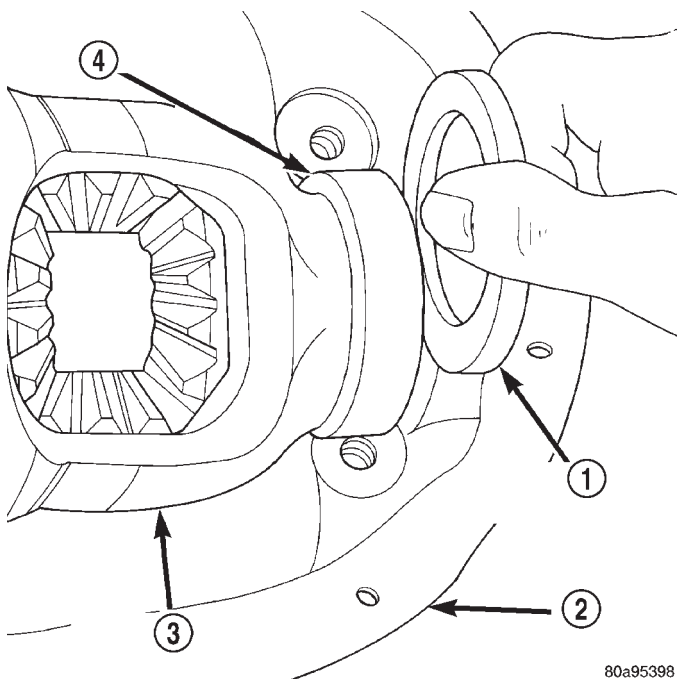
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## REAR AXLE - 198RBI (Continued)

## PRELOAD SHIM SELECTION

**NOTE:** It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings if necessary.

- (1) Remove side bearings from differential case.
- (2) Install ring gear, if necessary, on differential case and tighten bolts to specification.
- (3) Install Dummy Bearings D-348 on differential case.
- (4) Install differential case in the housing.
- (5) Insert Dummy Shims 8107 (0.118 in. / 3.0 mm) starting point shims between the dummy bearing and the housing (Fig. 16).



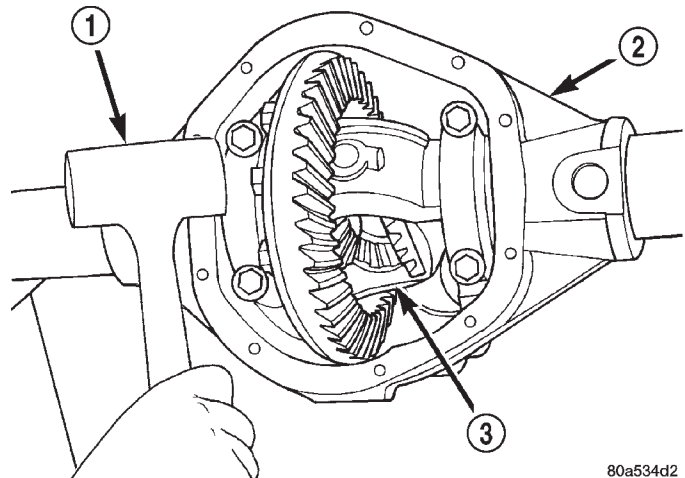
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**Fig. 16 DUMMY SHIMS**

- 1 - DUMMY SHIM
- 2 - DIFFERENTIAL HOUSING
- 3 - DIFFERENTIAL CASE
- 4 - DUMMY BEARINGS

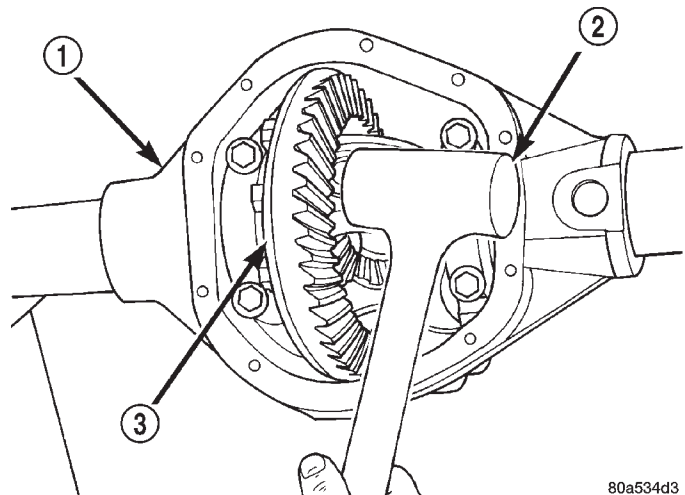
(6) Install bearing caps in their correct positions and snug the bolts.

(7) Use a dead-blow hammer to seat the differential dummy bearings to each side of the housing (Fig. 17) and (Fig. 18).



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**Fig. 17 SEAT DUMMY BEARING PINION GEAR SIDE**



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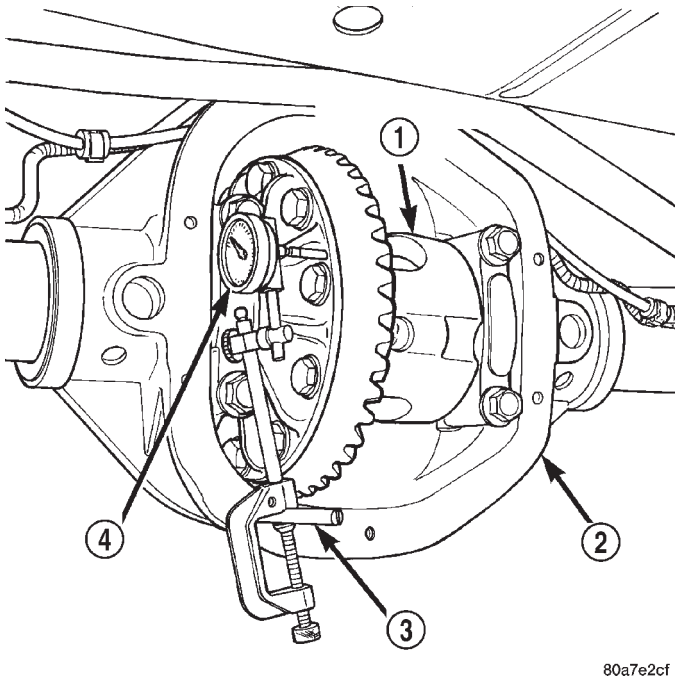
**Fig. 18 SEAT DUMMY BEARING RING GEAR SIDE**

- 1 - DIFFERENTIAL HOUSING
- 2 - DEAD-BLOW HAMMER
- 3 - DIFFERENTIAL CASE

REAR AXLE - 198RBI (Continued)

(8) Thread Pilot Stud C-3288-B into rear cover bolt hole below ring gear (Fig. 19).

(9) Attach Dial Indicator C-3339 to the pilot stud and position indicator plunger on a flat surface of the ring gear bolt head (Fig. 19).



**Fig. 19 DIFFERENTIAL SIDE PLAY**

- 1 - DIFFERENTIAL CASE
- 2 - DIFFERENTIAL HOUSING
- 3 - PILOT STUD
- 4 - DIAL INDICATOR

(10) Push the differential case firmly to the pinion gear side of the housing (Fig. 20) and zero dial indicator.

(11) Push differential case firmly to the ring gear side and record dial indicator reading (Fig. 21).

(12) Add the dial indicator reading to the starting point shim thickness to determine total shim thickness to achieve zero differential end play.

(13) Add 0.2 mm (0.008 in.) 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.

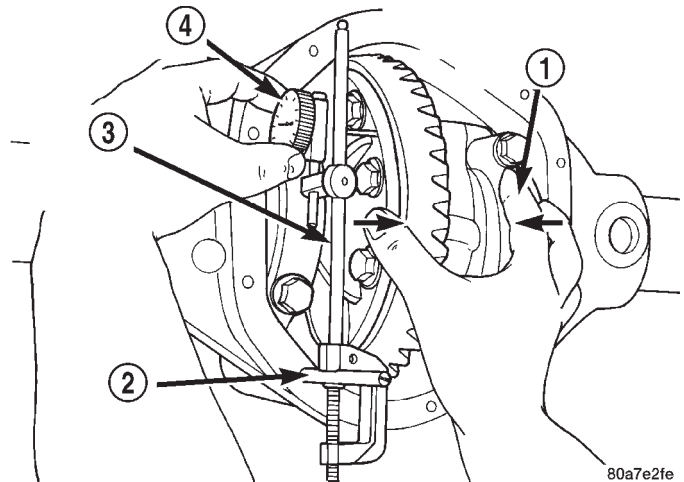
(14) Rotate dial indicator out of the way.

(15) Remove differential case, dummy bearings and starting point shims from the housing.

(16) Install pinion gear in the housing. Install the yoke and establish the correct pinion rotating torque.

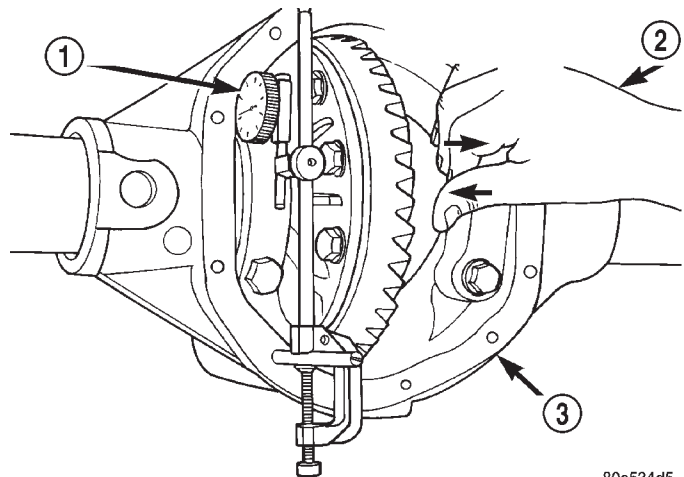
(17) Install differential case and dummy bearings in the housing (without shims) and tighten retaining cap bolts.

(18) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 19).



**Fig. 20 ZERO DIAL INDICATOR**

- 1 - FORCE CASE TO PINION SIDE
- 2 - PILOT STUD
- 3 - DIAL INDICATOR EXTENSION
- 4 - DIAL INDICATOR



**Fig. 21 RECORD DIAL INDICATOR**

- 1 - DIAL INDICATOR
- 2 - FORCE CASE TO RING GEAR SIDE
- 3 - DIFFERENTIAL HOUSING

(19) Push and hold differential case toward pinion gear.

(20) Zero dial indicator face to pointer.

(21) Push and hold differential case to ring gear side of the housing and record dial indicator reading.

(22) Subtract 0.05 mm (0.002 in.) from the dial indicator reading to compensate for backlash between ring and pinion gears. This total is the thickness of shim required to achieve proper backlash.

(23) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the housing.

## REAR AXLE - 198RBI (Continued)

(24) Rotate dial indicator out of the way on pilot stud.

(25) Remove differential case and dummy bearings from the housing.

(26) Install new side bearing cones and cups on differential case.

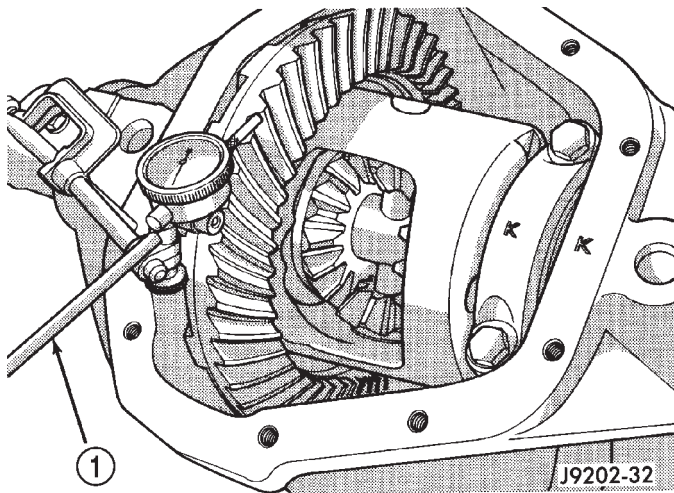
(27) Install spreader W-129-B and some components of Adapter Set 6987 on differential housing and spread axle opening enough to receive differential case.

(28) Place side bearing shims into the housing against the axle tubes.

(29) Install differential case in the housing.

(30) Rotate the differential case several times to seat the side bearings.

(31) Position the indicator plunger against a ring gear tooth (Fig. 22).



**Fig. 22 RING GEAR BACKLASH**

1 - DIAL INDICATOR

(32) Push and hold ring gear upward while not allowing the pinion gear to rotate.

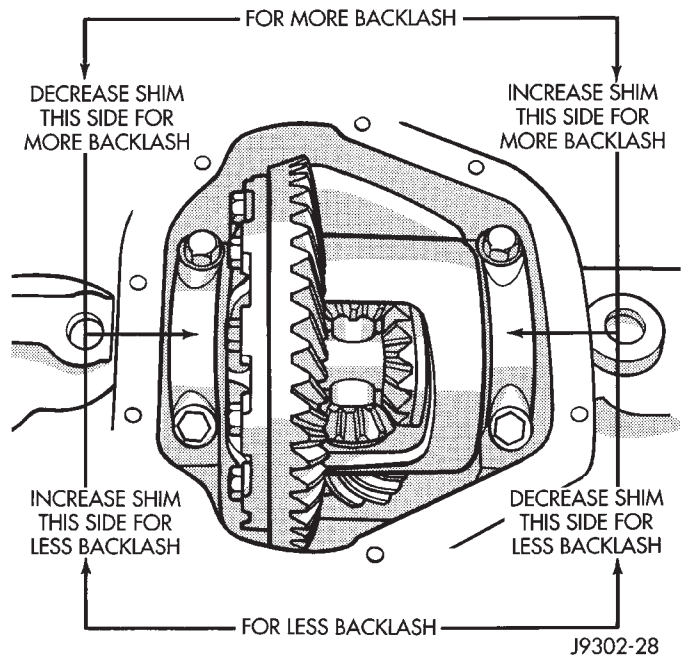
(33) Zero dial indicator face to pointer.

(34) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.13-0.20 mm (0.005-0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the differential housing to the other (Fig. 23).

(35) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at eight 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 the Gear Contact Pattern Analysis procedure.



**Fig. 23 BACKLASH SHIM**

### GEAR CONTACT PATTERN

The ring gear and pinion teeth contact patterns will show if the pinion depth is correct in the 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. This will provide a more distinct contact pattern.

(3) With 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 teeth will squeeze 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. 24) and adjust pinion depth and gear backlash as necessary.

REAR AXLE - 198RBI (Continued)

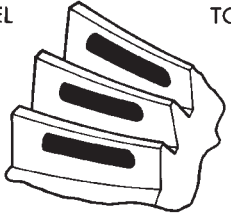
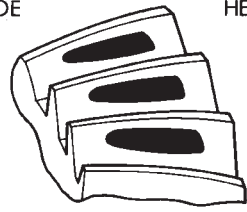
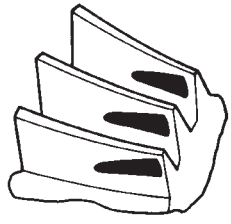
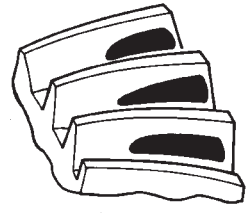
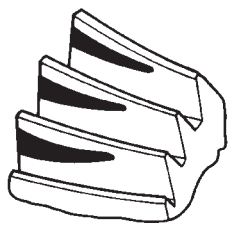
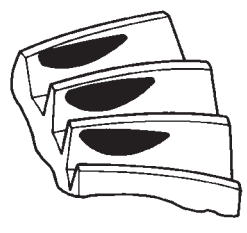
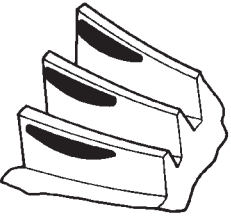
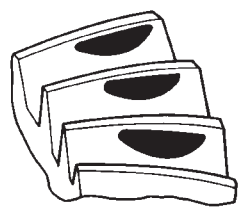
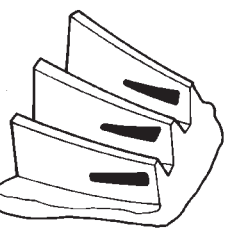
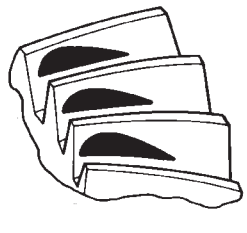
<p>DRIVE SIDE OF RING GEAR TEETH</p> <p>HEEL TOE</p> 	<p>COAST SIDE OF RING GEAR TEETH</p> <p>TOE HEEL</p> 	<p>DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.</p>
		<p>RING GEAR BACKLASH CORRECT. <b>THINNER</b> PINION GEAR DEPTH SHIM REQUIRED.</p>
		<p>RING GEAR BACKLASH CORRECT. <b>THICKER</b> PINION GEAR DEPTH SHIM REQUIRED.</p>
		<p>PINION GEAR DEPTH SHIM CORRECT. <b>DECREASE</b> RING GEAR BACKLASH.</p>
		<p>PINION GEAR DEPTH SHIM CORRECT. <b>INCREASE</b> RING GEAR BACKLASH.</p>

Fig. 24 GEAR TOOTH CONTACT PATTERNS

## REAR AXLE - 198RBI (Continued)

**DIFFERENTIAL BEARING PRELOAD CHECK**

The final check on the differential assembly before installing the axles is torque to rotate pinion and differential combined. This will verify the correct differential bearing preload.

Torque to rotate the differential and pinion is the torque to rotate the pinion plus:

Gear Ratio 3.73 . . . . . 0.45-0.76 N·m (4-7 in. lbs.)  
 Gear Ratio 4.10 . . . . . 0.41-0.69 N·m (3.6-6 in. lbs.)

**SPECIFICATIONS - REAR AXLE***SPECIFICATIONS*

DESCRIPTION	SPECIFICATION
Axle Ratio	3.73 4.10
Ring Gear Diameter	198 mm (7.795 in.)
Ring Gear Backlash	0.13-0.20 mm (0.005-0.008 in.)
Pinion Gear Standard Depth	96.85 mm (3.813 in.)
Pinion Bearing Preload - New Bearings	1.69-2.82 N·m (15-25 in. lbs.)
Differential Side Gear Clearance	0-0.15 mm (0-0.006 in.)
Differential Bearing Preload	0.20 mm (0.008 in.)
Differential Bearing Preload Added To Pinion Torque To Rotate	
3.73 Gear Ratio	0.45-0.76 N·m (4-7 in. lbs.)
4.10 Gear Ratio	0.41-0.69 N·m (3.6-6 in. lbs.)

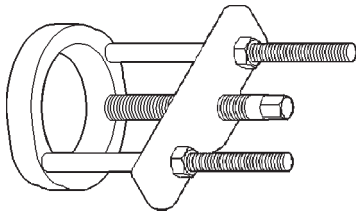
*TORQUE SPECIFICATIONS*

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Ring Gear Bolts	129-142	95-105	-
Differential Bearing Cap Bolts	64-91	47-67	-
Differential Cover Bolts	38-45	28-33	-
Pinion Nut (Minimum)	271	200	-
Cross Shaft Lock Screw	11-22	8-16	-

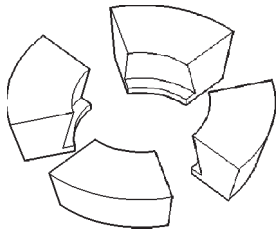
REAR AXLE - 198RBI (Continued)

SPECIAL TOOLS

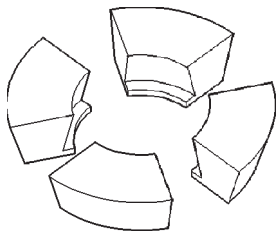
REAR AXLE



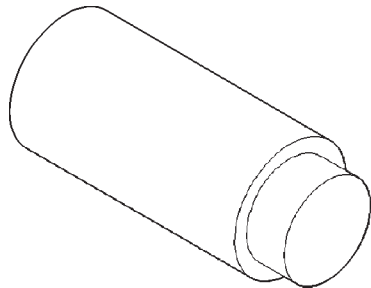
**PULLER C-293-PA**



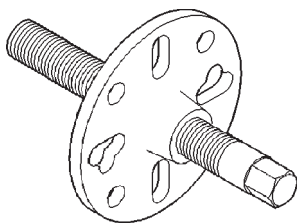
**ADAPTER 8352**



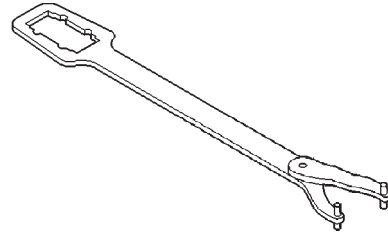
**ADAPTER C-293-39**



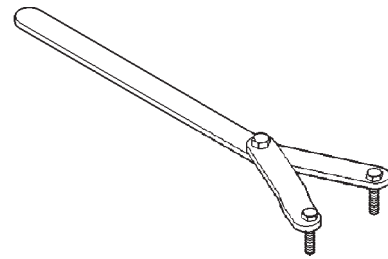
**PLUG SP-3289**



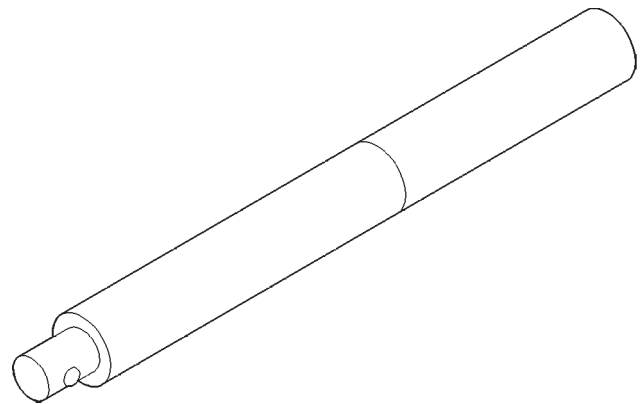
**PULLER C-452**



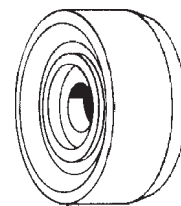
**WRENCH C-3281**



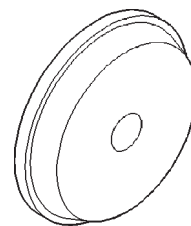
**SPANNER WRENCH 6958**



**HANDLE C-4171**



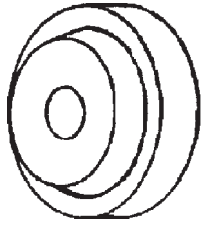
**INSTALLER C-3716-A**



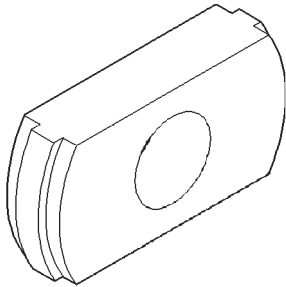
**INSTALLER D-130**



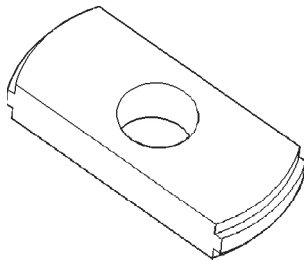
REAR AXLE - 198RBI (Continued)



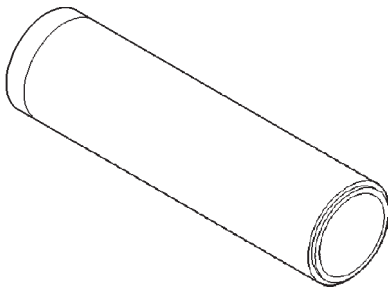
**INSTALLER D-146**



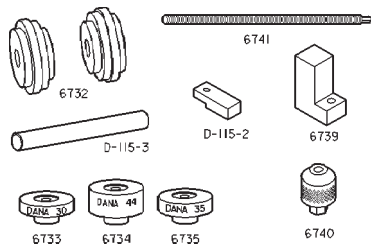
**REMOVER D-103**



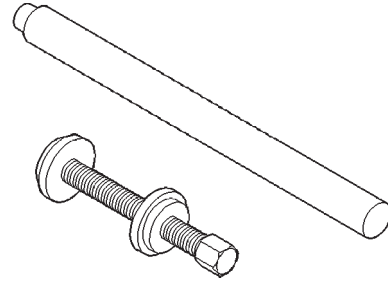
**REMOVER D-149**



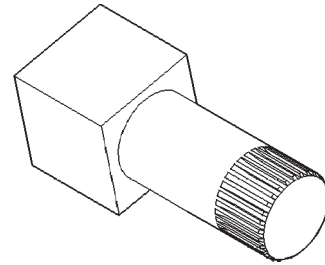
**INSTALLER W-262**



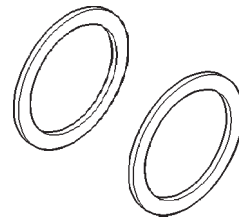
**PINION DEPTH 6774**



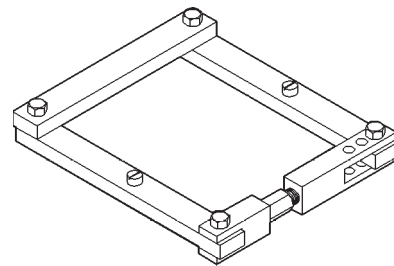
**TRAC-LOK TOOLS 6960**



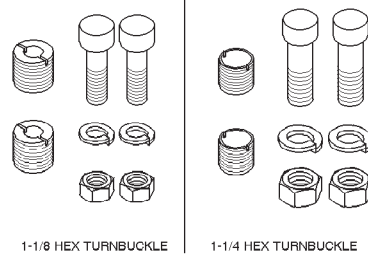
**FIXTURE 6965**



**SHIMS DUMMY 8107**

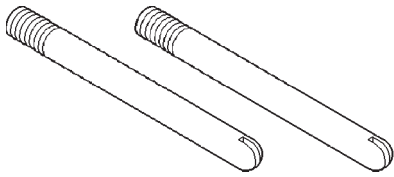
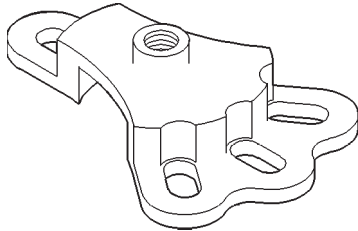
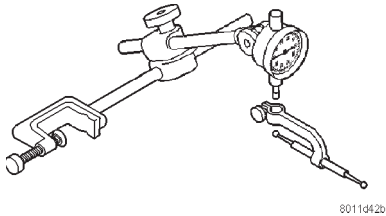
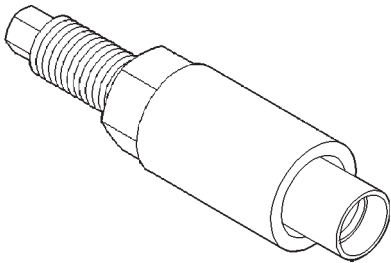


**SPREADER W-129-B**



**ADAPTER KIT 6987**

## REAR AXLE - 198RBI (Continued)

**PILOT STUDS C-3288-B****PULLER 6790****DIAL INDICATOR C-3339****INSTALLER C-3718**

## AXLE SHAFTS

### REMOVAL

- (1) Place transmission in neutral and raise and support vehicle.
- (2) Remove wheel and tire assembly.
- (3) Remove brake drum.
- (4) Remove axle retainer plate nuts from the rear of the axle flange.
- (5) Pull axle shaft from the axle with Slide Hammer 7420 and Adapter 6790. Mount the adapter to the axle with lug nuts.

**NOTE:** It is normal that the axle bearing race is loose in the axle tube.

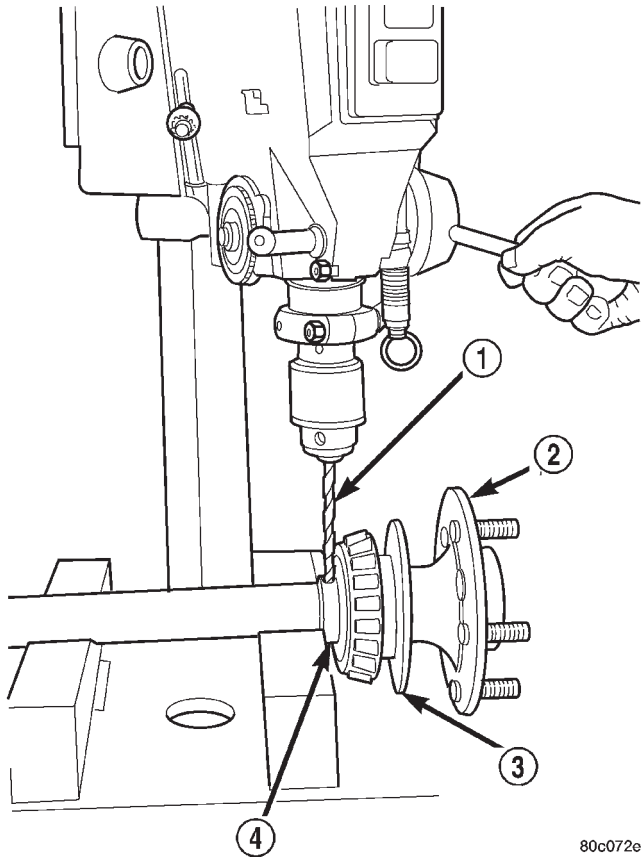
### INSTALLATION

- (1) Install axle into the axle tube with the flat area of the retainer plate upward.
- (2) Insert retaining plate studs into the brake backing plate and axle tube flange.
- (3) Install retainer nuts and tighten to 47-75 N·m (35-55 ft. lbs.).
- (4) Install the brake drum.
- (5) Install wheel and tire.
- (6) Check and fill the differential with gear lubricant.
- (7) Lower vehicle.

## AXLE BEARING/SEAL

### REMOVAL

- (1) Remove axle shaft from vehicle.
- (2) Drill a shallow hole into soft steel axle bearing retaining ring with a 3/8 in. drill bit (Fig. 25). Use a drill depth stop to avoid marking the axle.



**Fig. 25 DRILL RETAINING RING**

- 1 - DRILL BIT
- 2 - AXLE
- 3 - RETAINING PLATE
- 4 - RETAINING RING

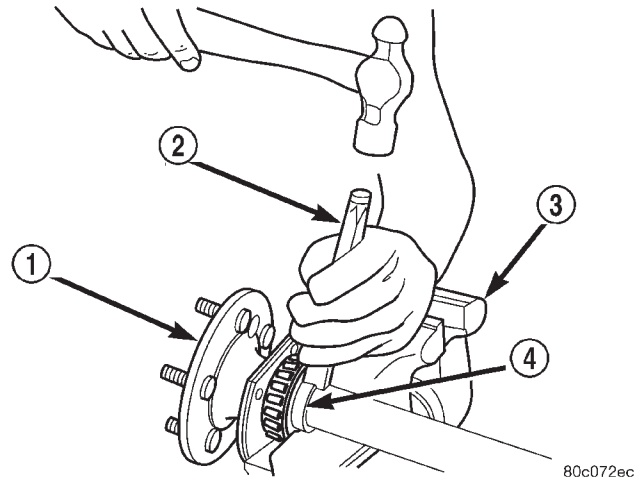
(3) With a cold chisel cut the retaining ring across drilled hole. (Fig. 26)

(4) Slide retaining ring from axle shaft.

(5) Remove axle bearing from the shaft with a press and Splitter 1130 placed between the seal and bearing (Fig. 27).

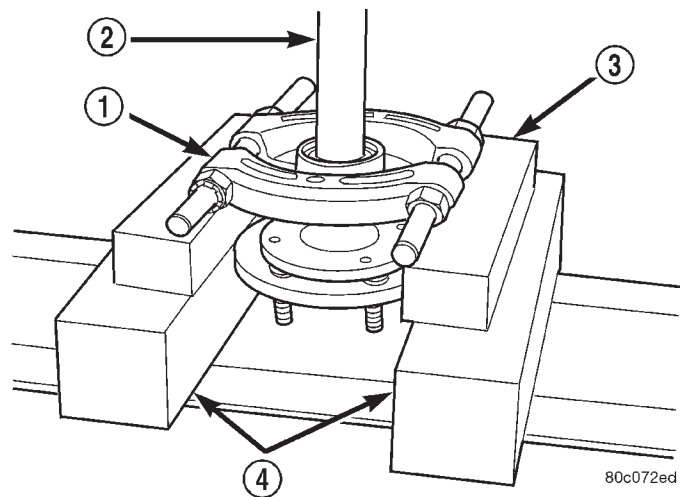
(6) Remove seal from axle.

(7) Remove retaining plate from axle shaft.



**Fig. 26 CUT RETAINING RING**

- 1 - AXLE
- 2 - COLD CHISEL
- 3 - VISE
- 4 - RETAINING RING



**Fig. 27 AXLE BEARING AND SEAL**

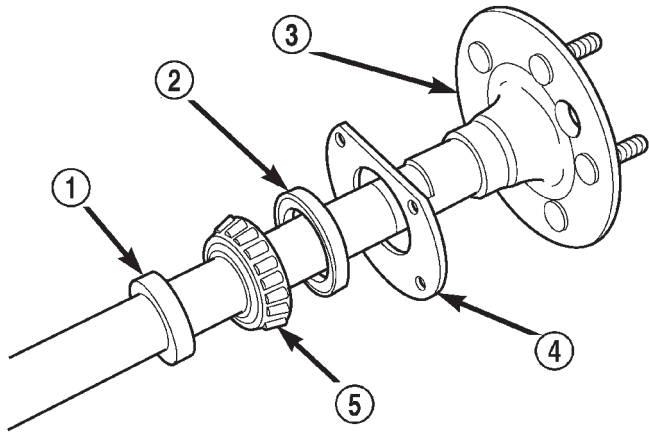
- 1 - SPLITTER
- 2 - AXLE SHAFT
- 3 - BLOCKS
- 4 - BLOCKS

AXLE BEARING/SEAL (Continued)

**INSTALLATION**

**NOTE:** Verify axle shaft retaining plate is flat with a straight edge. If the plate is warped replace the plate.

- (1) Install retaining plate on the axle shaft (Fig. 28).
- (2) Apply a coat of multi-purpose grease on sealing surface of axle seal.
- (3) Install seal on the axle shaft with cavity away from retaining plate (Fig. 28).



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**Fig. 28 AXLE BEARING AND SEAL COMPONENTS**

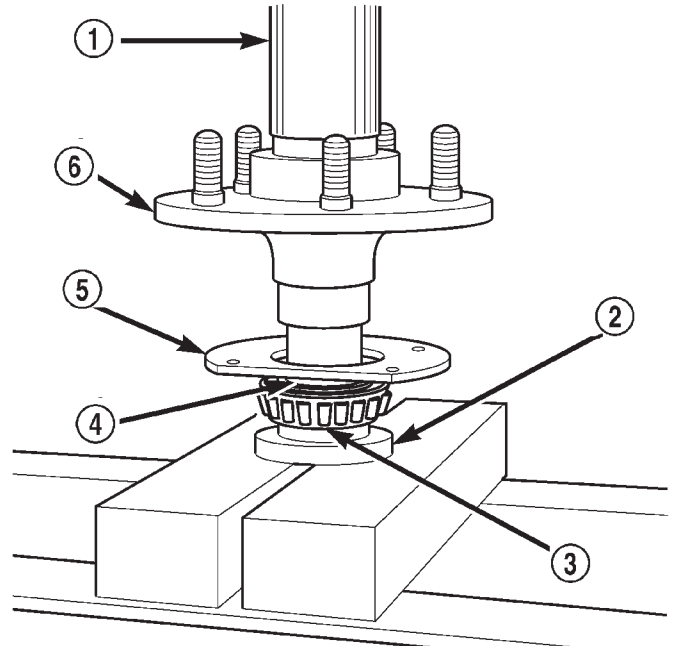
- 1 - RETAINING RING
- 2 - SEAL
- 3 - AXLE
- 4 - RETAINING PLATE
- 5 - AXLE BEARING

(4) Lubricate bearing with Mopar® Wheel Bearing Grease or equivalent. Wipe excess grease from the bearing.

(5) Install bearing on the axle shaft with Installer 7913 and a press (Fig. 29).

(6) Press retaining ring onto axle shaft with Installer 7913 and a press (Fig. 30).

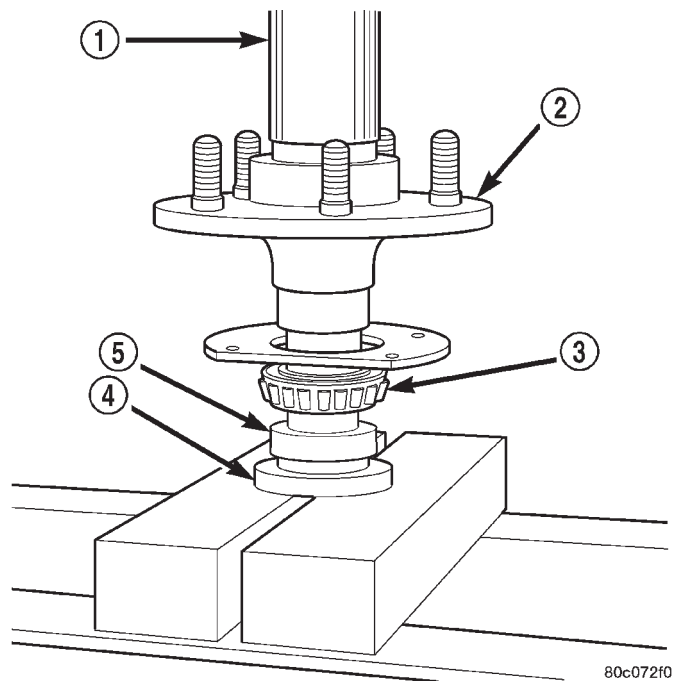
(7) Install axle in vehicle.



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**Fig. 29 BEARING ON AXLE**

- 1 - PRESS RAM
- 2 - INSTALLER - 7913
- 3 - AXLE BEARING
- 4 - SEAL
- 5 - RETAINING PLATE
- 6 - AXLE



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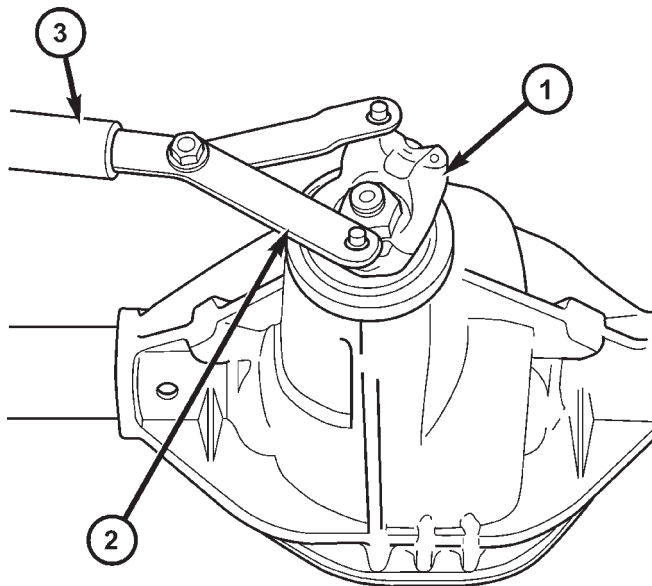
**Fig. 30 BEARING RETAINING RING ON AXLE**

- 1 - PRESS
- 2 - AXLE
- 3 - AXLE BEARING
- 4 - INSTALLER
- 5 - SOFT METAL RETAINING RING

## PINION SEAL

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove wheel and tire assemblies.
- (3) Remove rear brake rotors drums.
- (4) Mark propeller shaft and pinion yoke for installation reference.
- (5) Remove the propeller shaft from the yoke.
- (6) Rotate pinion gear three or four times and verify that pinion rotates smoothly.
- (7) Measure and record torque to rotate the pinion gear with an inch pound dial-type torque wrench.
- (8) With a short piece of pipe and Spanner Wrench 6958 remove the pinion nut and washer (Fig. 31).



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**Fig. 31 YOKE SPANNER WRENCH**

- 1 - PINION YOKE
- 2 - WRENCH
- 3 - PIPE

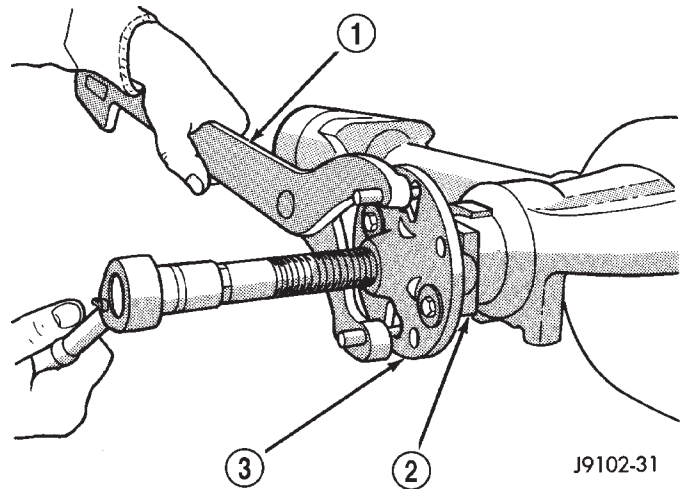
(9) Remove pinion companion flange with Remover C-452 and Flange Wrench C-3281. (Fig. 32)

(10) Remove pinion seal with Remover 7794-A and a slide hammer (Fig. 33).

### INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with an appropriate seal installer (Fig. 34).

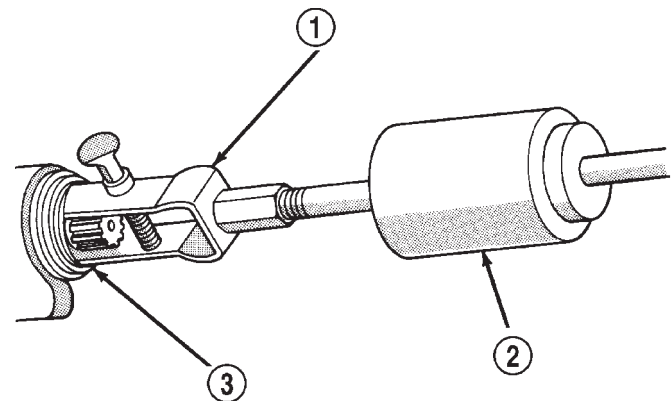
(2) Install yoke on the pinion gear with Installer C-3718 and Spanner Wrench 6958 (Fig. 35).



J9102-31

**Fig. 32 PINION YOKE REMOVER**

- 1 - WRENCH
- 2 - YOKE
- 3 - REMOVER



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**Fig. 33 PINION SEAL REMOVER**

- 1 - REMOVER
- 2 - SLIDE HAMMER
- 3 - PINION SEAL

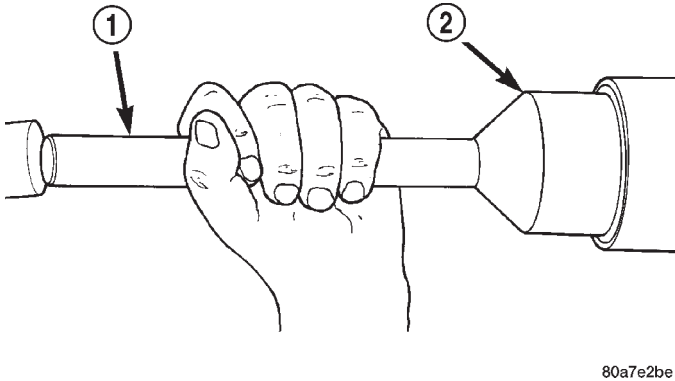
(3) Install a **new** nut on the pinion gear. **Tighten the nut only enough to remove the shaft end play.**

**CAUTION:** Do not exceed the minimum torque 271 N·m (200 ft. lbs.) when installing the pinion yoke retaining nut at this point. Damage to collapsible spacer or bearings may result.

(4) Rotate the pinion a minimum of ten times and verify pinion rotates smoothly.

(5) Measure and record pinion torque to rotate with an inch pound torque wrench. Torque to rotate should be equal to the reading recorded during removal, plus 0.56 N·m (5 in. lbs.) (Fig. 36).

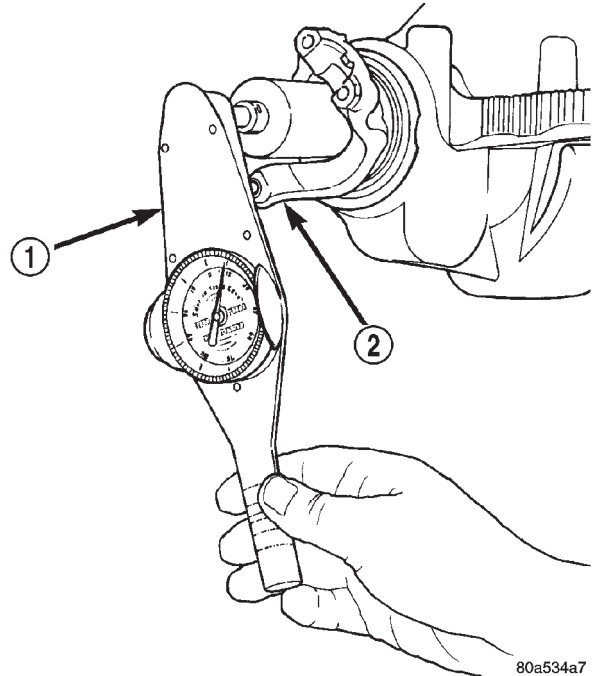
PINION SEAL (Continued)



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**Fig. 34 PINION SEAL INSTALLATION**

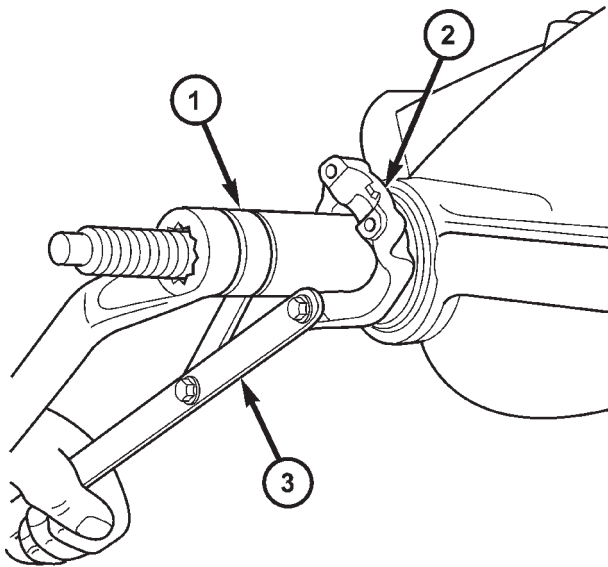
- 1 - HANDLE
- 2 - INSTALLER



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**Fig. 36 PINION GEAR ROTATING TORQUE**

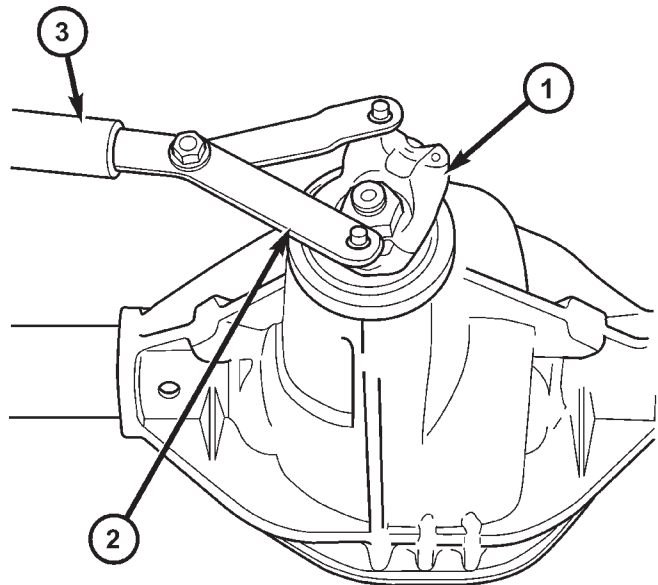
- 1 - TORQUE WRENCH
- 2 - PINION YOKE



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**Fig. 35 PINION YOKE INSTALLER**

- 1 - INSTALLER
- 2 - PINION YOKE
- 3 - WRENCH



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**Fig. 37 YOKE SPANNER WRENCH**

- 1 - PINION YOKE
- 2 - WRENCH
- 3 - PIPE

(6) If rotating torque is low, hold pinion yoke with Wrench 6958 (Fig. 37) and tighten pinion shaft nut in 6.8 N·m (5 ft. lbs.) increments until rotating torque is achieved.

**CAUTION:** If maximum tightening torque is reached prior to reaching the required rotating torque, the collapsible spacer may have been damaged. Replace the collapsible spacer.

(7) Align the installation reference marks on the propeller shaft and pinion yoke and install the propeller shaft.

## PINION SEAL (Continued)

- (8) Fill differential with gear lubricant.
- (9) Install the brake drums
- (10) Install wheel and tire assemblies.
- (11) Lower the vehicle.

## COLLAPSIBLE SPACER

## REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove wheel and tire assemblies.
- (3) Remove rear brake drums.
- (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 and record torque to rotate the pinion gear with an inch pound dial-type torque wrench.
- (8) Hold pinion yoke with Spanner Wrench 6958 and remove pinion nut and washer.
- (9) Remove the pinion yoke with Remover C-452 and Flange Wrench C-3281 (Fig. 38).

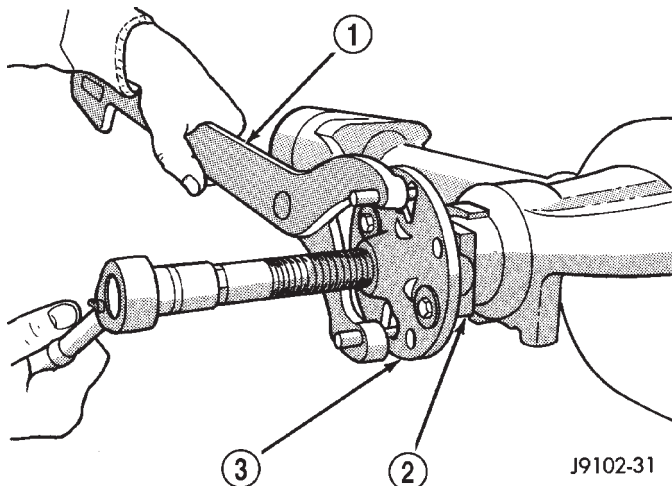


Fig. 38 PINION YOKE

- 1 - FLANGE WRENCH
- 2 - YOKE
- 3 - REMOVER

(10) Remove pinion shaft seal with a pry tool or a slide hammer mounted screw.

(11) Remove front pinion bearing using a pair of pick tools. Pull the bearing straight off the pinion gear shaft. If the bearing becomes bound on the pinion shaft, lightly tap the end of the pinion gear with a rawhide/rubber hammer.

(12) Remove the collapsible spacer.

## INSTALLATION

- (1) Install a **new** collapsible preload spacer on pinion shaft.
- (2) Install pinion front bearing.

(3) Apply a light coating of gear lubricant on the lip of pinion seal and install a **new** seal with an appropriate installer (Fig. 39).

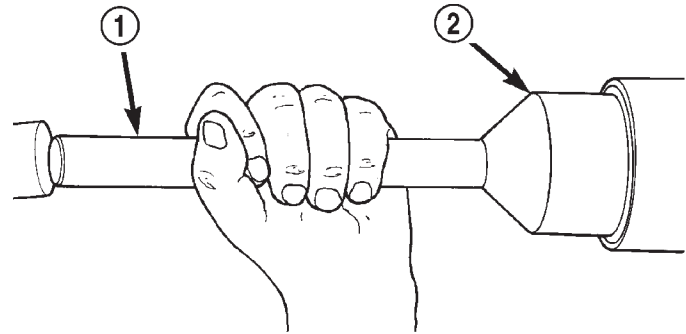


Fig. 39 PINION SEAL

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- 1 - HANDLE
- 2 - INSTALLER

(4) Install yoke with Screw 8112, Cup 8109 and Spanner Wrench 6958 (Fig. 40).

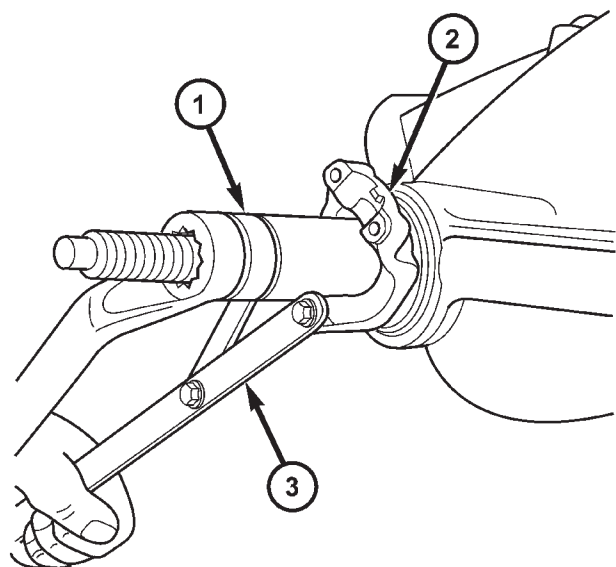


Fig. 40 PINION YOKE INSTALLER

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- 1 - INSTALLER
- 2 - PINION YOKE
- 3 - WRENCH

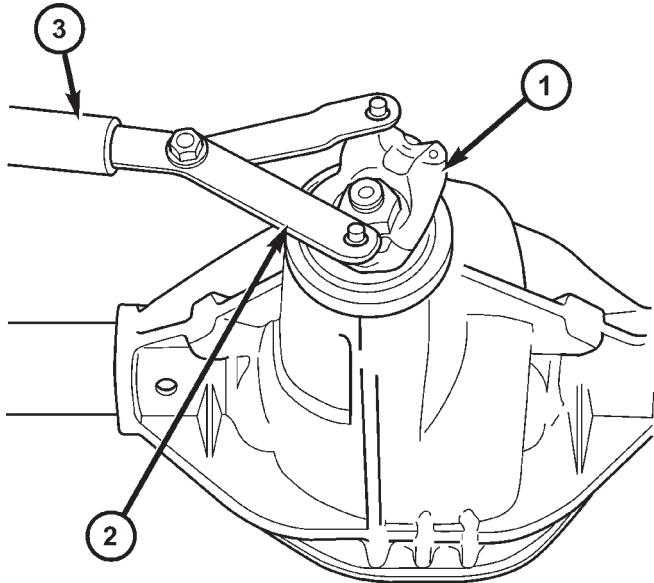
(5) Install yoke washer and **new** nut on the pinion gear. Tighten the nut to 271 N·m (200 ft. lbs.).

**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.

COLLAPSIBLE SPACER (Continued)

(6) Using yoke with Spanner Wrench 6958 and a torque wrench set at 474 N·m (350 ft. lbs.), (Fig. 41) 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. 42).

**NOTE:** If more than 474 N·m (350 ft. lbs.) torque is required to crush the collapsible spacer, the spacer is defective and must be replaced.



**Fig. 41 YOKE SPANNER WRENCH**

- 1 - PINION YOKE
- 2 - WRENCH
- 3 - PIPE

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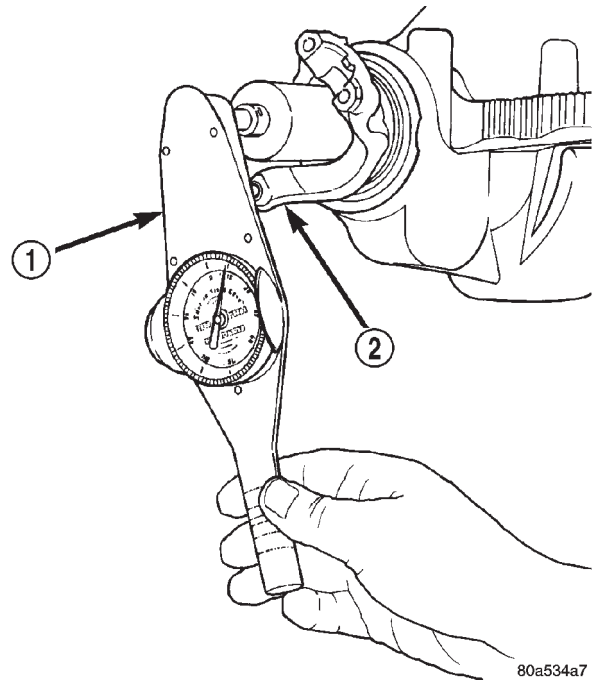
(7) Check rotating torque with an inch pound torque wrench (Fig. 42). The rotating torque of the pinion gear should be, the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.).

- (8) Install propeller shaft with reference marks aligned.
- (9) Install rear brake drums.
- (10) Add gear lubricant, if necessary.
- (11) Install wheel and tire assemblies.
- (12) Remove supports and lower vehicle.

**DIFFERENTIAL**

**REMOVAL**

- (1) Raise and support vehicle.
- (2) Remove differential cover and drain fluid.
- (3) Clean the housing cavity with flushing oil, light engine oil or lint free cloth.



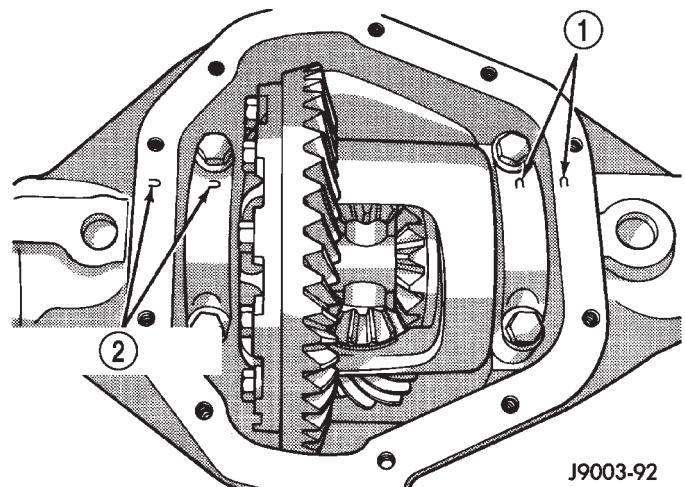
80a534a7

**Fig. 42 PINION ROTATING TORQUE**

- 1 - TORQUE WRENCH
- 2 - PINION YOKE

**NOTE:** Do not use water, steam, kerosene or gasoline for cleaning.

- (4) Remove axle shafts.
- (5) Note the reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 43).



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**Fig. 43 BEARING CAP IDENTIFICATION**

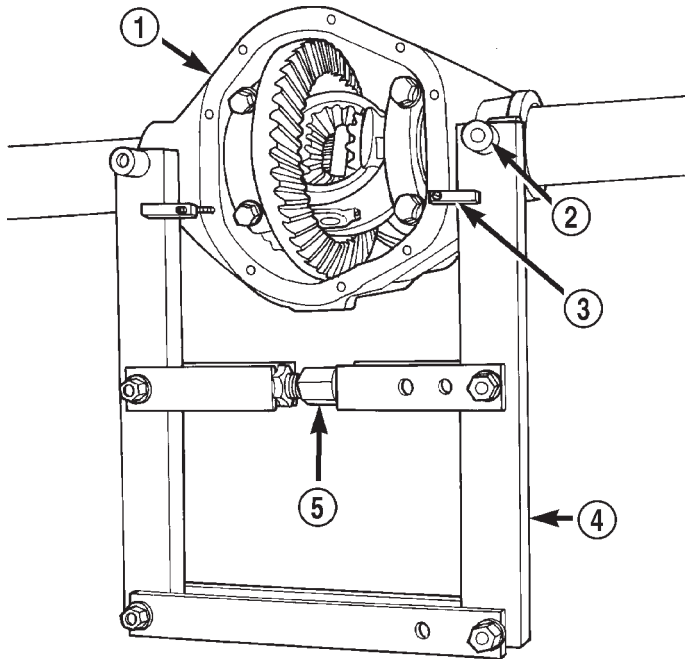
- 1 - REFERENCE LETTERS
- 2 - REFERENCE LETTERS



DIFFERENTIAL (Continued)

(6) Loosen the differential bearing cap bolts.

(7) With Spreader W-129-B and adapters from Adapter set 6987, position the adapters in the differential holes (Fig. 44). Install hold-down clamps and tighten the tool turnbuckle finger-tight.



**Fig. 44 SPREADER LOCATION**

- 1 - DIFFERENTIAL HOUSING
- 2 - ADAPTER
- 3 - SAFETY HOLD DOWN
- 4 - SPREADER
- 5 - TURNBUCKLE

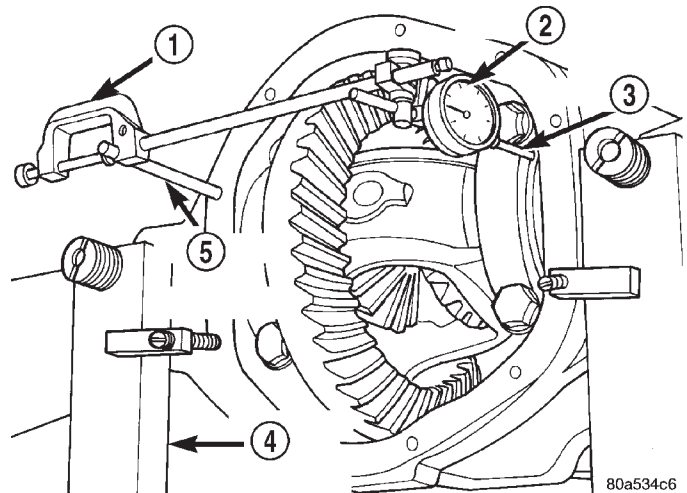
(8) Install Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 45) and zero the indicator.

(9) Spread the housing while measuring the distance with the dial indicator. Spread the housing enough to remove the differential case (Fig. 46).

**CAUTION:** Do not spread over 0.38 mm (0.015 in). If housing is over-spread, it could be distorted or damaged.

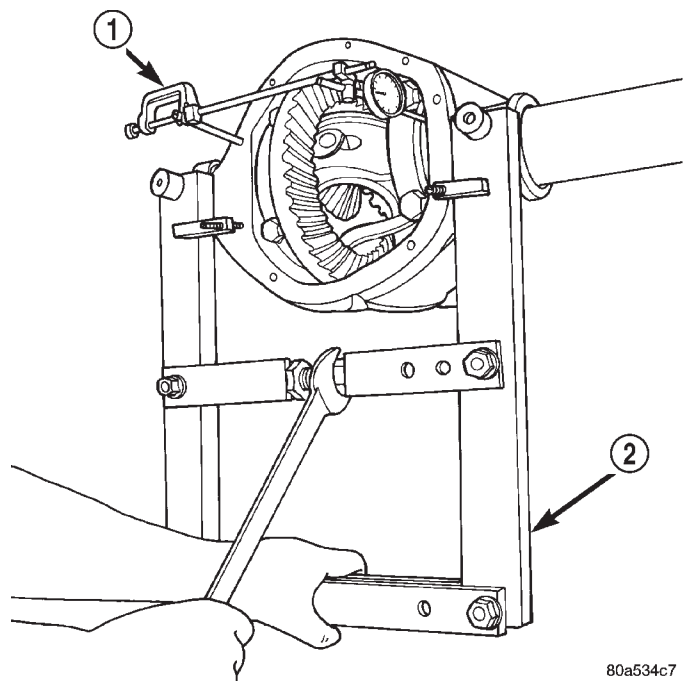
(10) Remove the dial indicator and pilot stud.

(11) Remove differential bearing cap bolts and caps while holding the case.



**Fig. 45 DIAL INDICATOR LOCATION**

- 1 - CLAMP
- 2 - DIAL INDICATOR
- 3 - LEVER ADAPTER
- 4 - SPREADER
- 5 - PILOT STUD

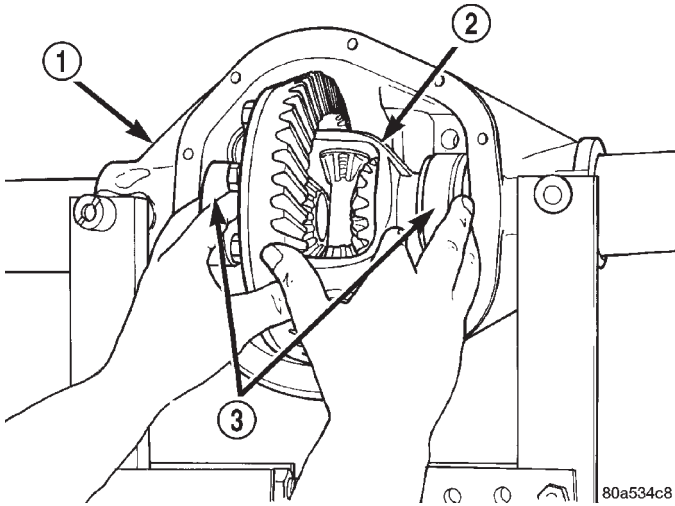


**Fig. 46 SPREAD DIFFERENTIAL HOUSING**

- 1 - DIAL INDICATOR
- 2 - SPREADER

DIFFERENTIAL (Continued)

(12) Remove differential from the housing. Ensure that the differential bearing cups remain in position on the differential bearings (Fig. 47).



**Fig. 47 DIFFERENTIAL CASE**

- 1 - DIFFERENTIAL HOUSING
- 2 - DIFFERENTIAL CASE
- 3 - BEARING CUPS

(13) Remove bearing cups from the differential and tag them to indicate their location.

(14) Remove differential case preload shims from the housing and tag them to indicate their location.

(15) Remove spreader from housing.

**INSTALLATION**

**NOTE:** If differential bearings or differential case are replaced, differential bearing preload shim requirements may change. Refer Adjustments (Differential Bearing Preload and Gear Backlash) to determine the proper shim selection.

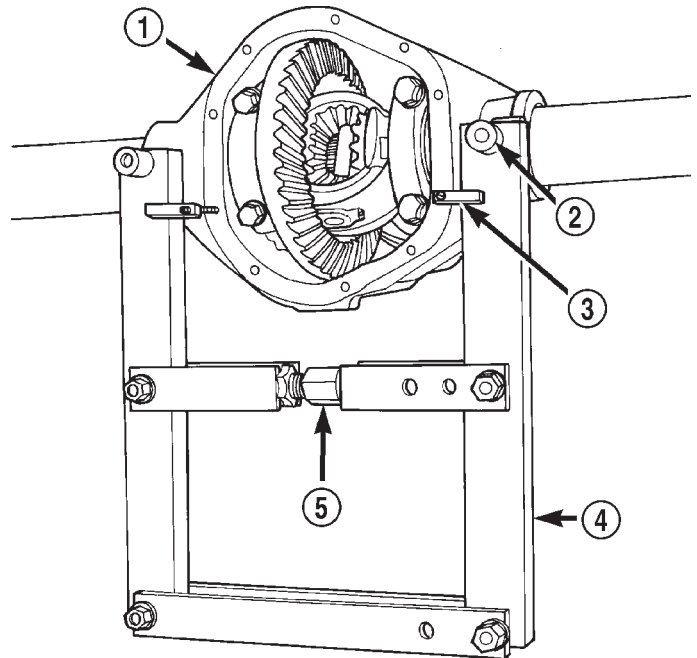
(1) With Spreader W-129-B and adapters from Adapter set 6987, position the adapters in the differential holes (Fig. 48). Install the hold-down clamps and tighten the tool turnbuckle finger-tight.

(2) Install a Pilot Stud C-3288-B at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load the indicator plunger against the opposite side of the housing and zero the indicator.

(3) Spread the housing while measuring the distance with the dial indicator. Spread the housing enough to install the differential case.

**CAUTION:** Do not spread over 0.38 mm (0.015 in). If the housing is over-spread, it could be distorted or damaged.

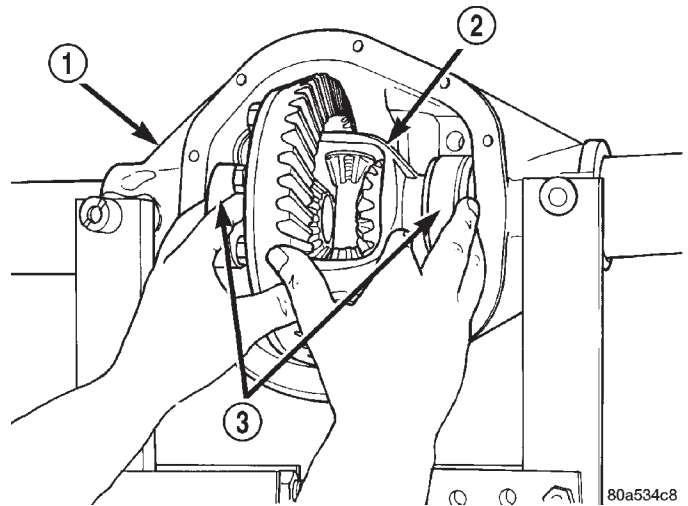
(4) Remove the dial indicator.



**Fig. 48 SPREADER LOCATION**

- 1 - DIFFERENTIAL HOUSING
- 2 - ADAPTER
- 3 - SAFETY HOLD DOWN
- 4 - SPREADER
- 5 - TURNBUCKLE

(5) Install differential case in the housing (Fig. 49) with bearing cups and preload shims in their original locations. Tap the differential case to ensure the bearings cups and shims are fully seated in the housing.

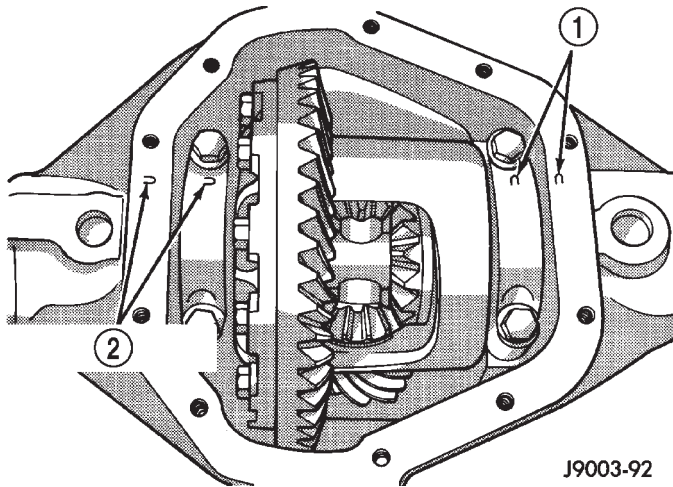


**Fig. 49 DIFFERENTIAL CASE**

- 1 - DIFFERENTIAL HOUSING
- 2 - DIFFERENTIAL CASE
- 3 - BEARING CUPS

## DIFFERENTIAL (Continued)

(6) Install the bearing caps in their original locations (Fig. 50).



**Fig. 50 BEARING CAP REFERENCE**

- 1 - REFERENCE LETTERS  
2 - REFERENCE LETTERS

- (7) Loosely install differential bearing cap bolts.  
(8) Remove axle housing spreader.  
(9) Tighten the bearing cap bolts to 64-91 N·m (47-67 ft. lbs.).  
(10) Install the axle shafts.  
(11) Apply a 6.35mm (1/4 in.) bead of red Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 51).

**CAUTION:** If cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

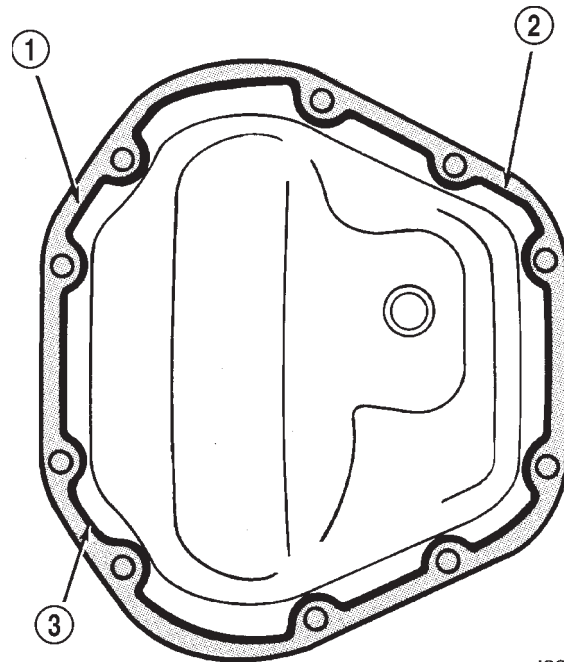
- (12) Install the cover and tighten cover bolts in a criss-cross pattern to 38-45 N·m (28-33 ft. lbs.).  
(13) Refill the differential with lubricant and install fill plug.  
(14) Remove support and lower the vehicle.

## DIFFERENTIAL - TRAC-LOK

## DIAGNOSIS AND TESTING - TRAC-LOK®

The most common problem is a chatter noise when turning corners. Before removing the unit for repair, drain, flush and refill the axle with the specified lubricant. 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.



**Fig. 51 DIFFERENTIAL COVER - TYPICAL**

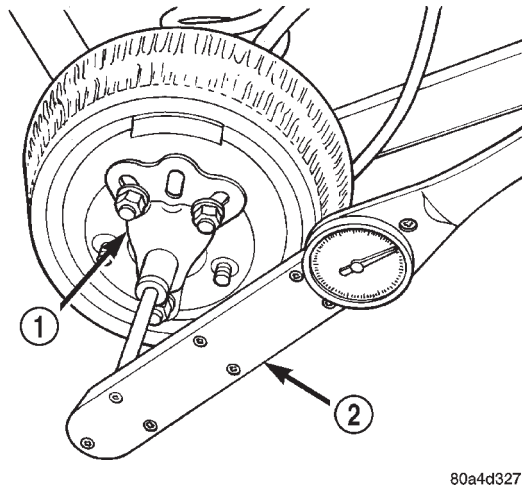
- 1 - SEALING SURFACE  
2 - SEALANT BEAD  
3 - SEALANT THICKNESS

## DIFFERENTIAL TEST

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 or equivalent tool to studs.
- (5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 52).
- (6) If rotating torque is less than 41 N·m (56 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

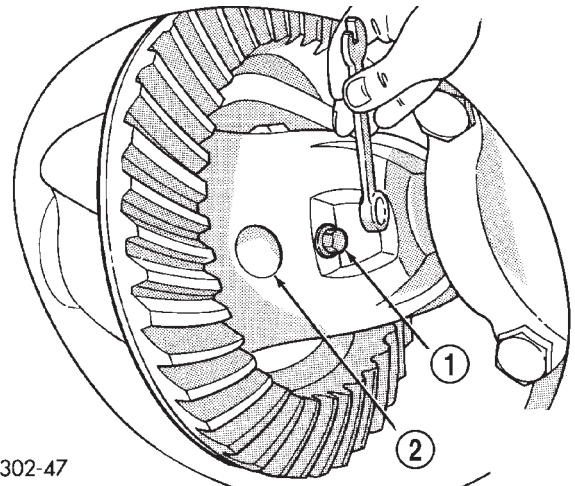
DIFFERENTIAL - TRAC-LOK (Continued)



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**Fig. 52 ROTATING TORQUE TEST**

- 1 - SPECIAL TOOL WITH BOLT IN CENTER HOLE
- 2 - TORQUE WRENCH



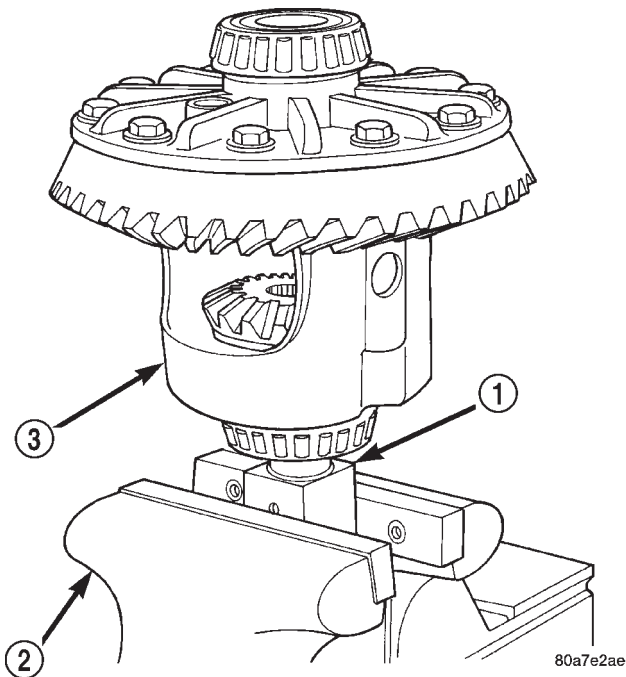
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**Fig. 54 MATE SHAFT LOCK SCREW**

- 1 - LOCK SCREW
- 2 - PINION GEAR MATE SHAFT

**DISASSEMBLY**

(1) Clamp side gear Fixture 6965 in a vise and set differential case on the fixture (Fig. 53).



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**Fig. 53 DIFFERENTIAL CASE FIXTURE**

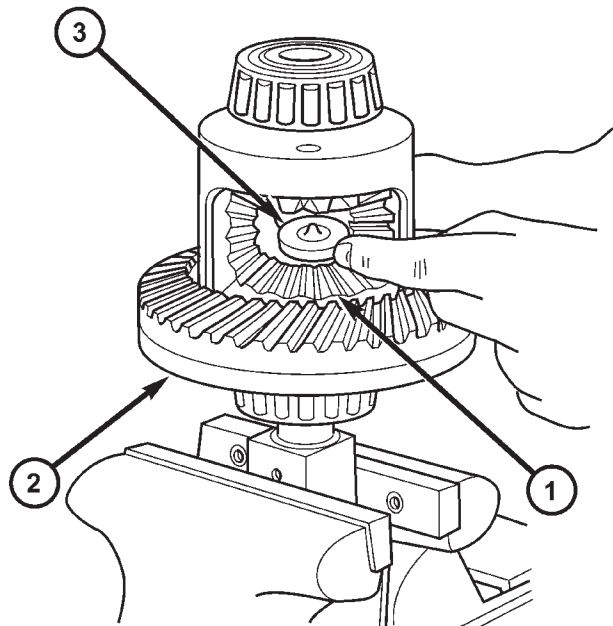
- 1 - HOLDING FIXTURE
- 2 - VISE
- 3 - DIFFERENTIAL

(2) Remove ring gear if the ring gear is to be replaced. The Trac-lok® differential can be serviced with the ring gear installed.

(3) Remove pinion gear mate shaft lock screw (Fig. 54).

(4) Remove pinion gear mate shaft with a drift and hammer.

(5) Install and lubricate Step Plate 6960-3 (Fig. 55).



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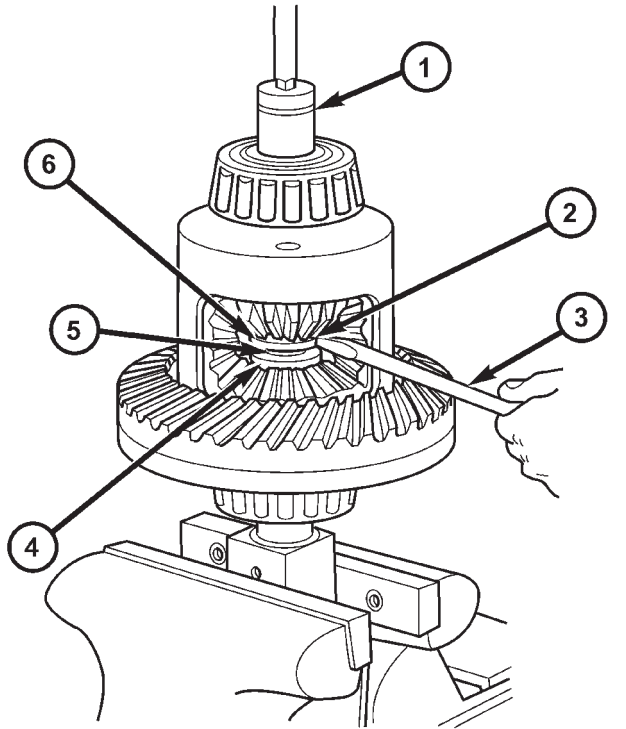
**Fig. 55 Step Plate**

- 1 - LOWER SIDE GEAR
- 2 - DIFFERENTIAL CASE
- 3 - STEP PLATE

DIFFERENTIAL - TRAC-LOK (Continued)

(6) Assemble Threaded Adapter 6960-1 into top side gear. Thread Forcing Screw C-6960-4 into adapter until it becomes centered in adapter plate.

(7) Position a small screw driver in slot of Threaded Adapter Disc 6960-3 (Fig. 56) to prevent adapter from turning.



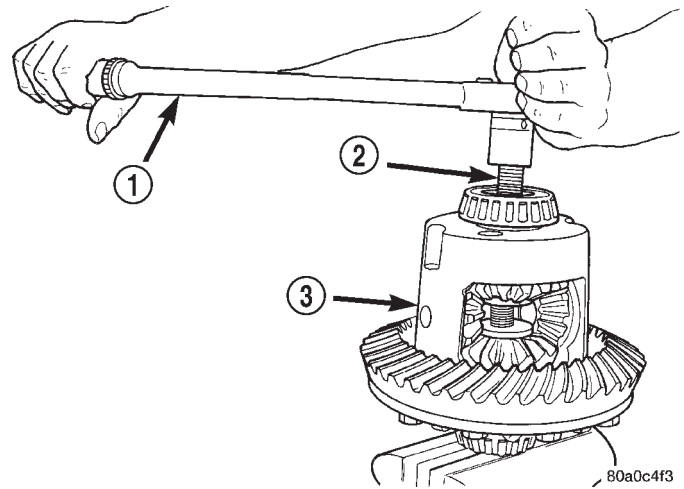
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**Fig. 56 THREAD ADAPTER DISC**

- 1 - SOCKET
- 2 - SLOT IN ADAPTER
- 3 - SCREWDRIVER
- 4 - STEP PLATE
- 5 - THREADED ROD
- 6 - ADAPTER DISC

(8) Install Forcing Screw 6960-4 and tighten screw to 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 57).

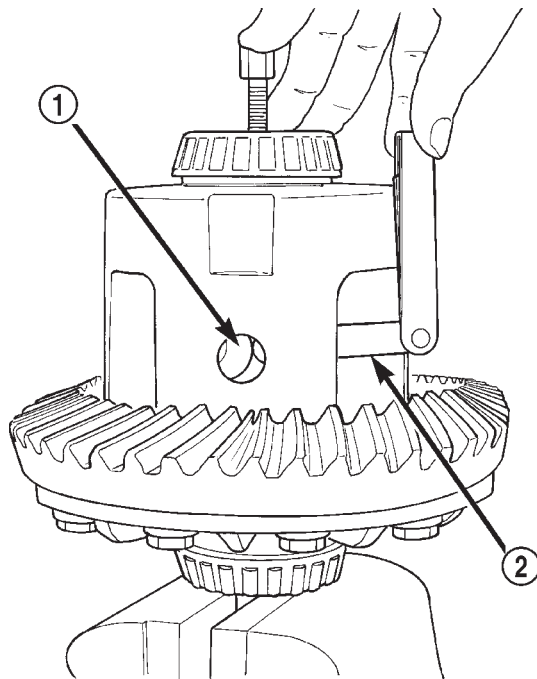
(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 58).



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**Fig. 57 COMPRESS BELLEVILLE SPRING**

- 1 - TORQUE WRENCH
- 2 - FORCING SCREW
- 3 - DIFFERENTIAL CASE



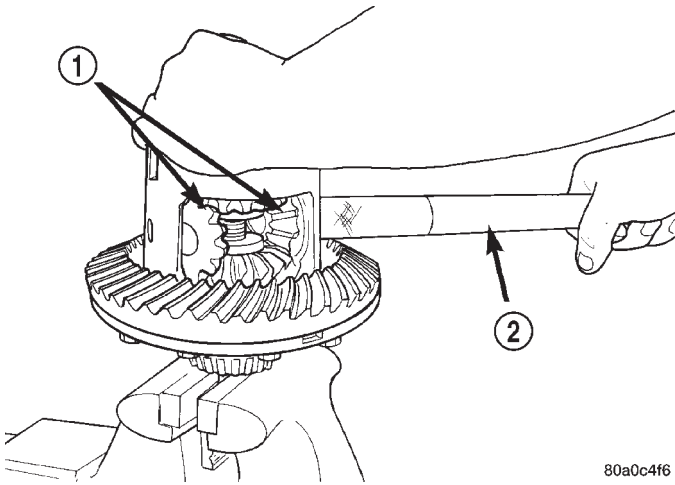
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**Fig. 58 PINION GEAR THRUST WASHER**

- 1 - THRUST WASHER
- 2 - FEELER GAUGE

DIFFERENTIAL - TRAC-LOK (Continued)

(10) Insert Turning Bar 6960-2 into the pinion mate shaft hole in the case (Fig. 59).



**Fig. 59 PINION GEARS**

- 1 - PINION GEARS
- 2 - TURNING BAR

(11) Loosen the Forcing Screw in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar.

(12) Rotate differential case until the pinion gears can be removed.

(13) Remove pinion gears from differential case.

(14) Remove Forcing Screw, Step Plate and Threaded Adapter.

(15) Remove top side gear, clutch pack retainer and clutch pack. Keep plates in order during removal (Fig. 60).

(16) Remove differential case from the Holding Fixture. Remove side gear, clutch pack retainer and clutch pack. Keep plates in order during removal.

**CLEANING**

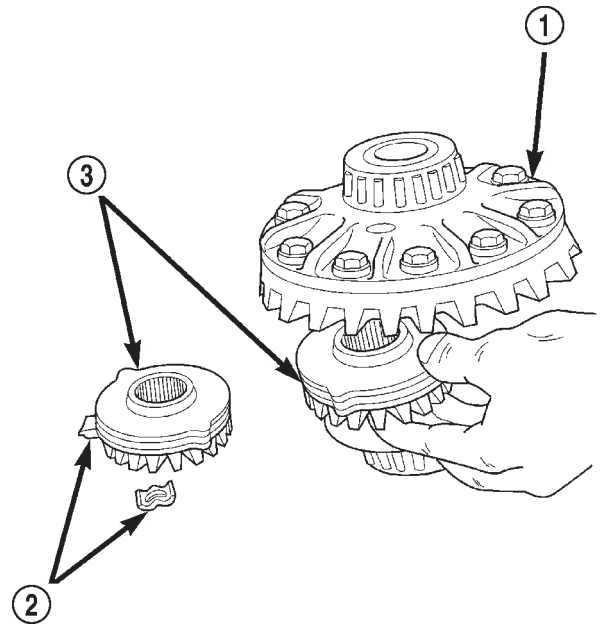
Clean all components in cleaning solvent and dry components with compressed air.

**INSPECTION**

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 for cracks chips or damage and replace as necessary. Inspect differential case and pinion shaft and replace if worn or damaged.

**ASSEMBLY**

**NOTE: New 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.**

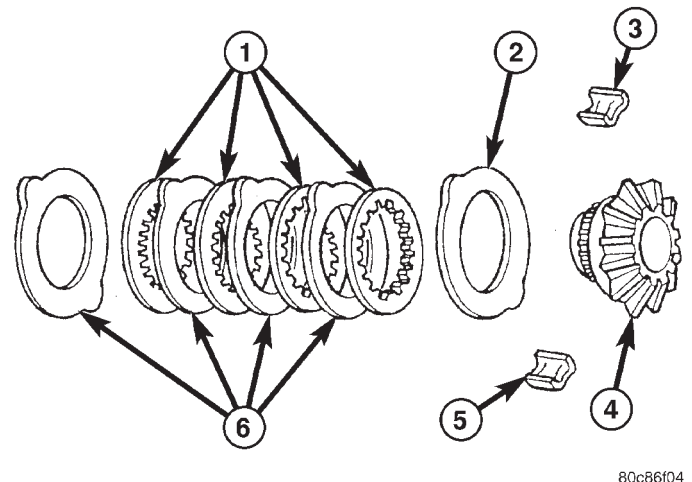


**Fig. 60 SIDE GEARS AND CLUTCH DISCS**

- 1 - DIFFERENTIAL CASE
- 2 - RETAINER
- 3 - SIDE GEAR AND CLUTCH DISC PACK

- (1) Lubricate components with gear lubricant.
- (2) Assemble clutch discs into packs and secure disc packs with retaining clips (Fig. 61).

**NOTE: Dished plate is position with the convex side against the side gear.**



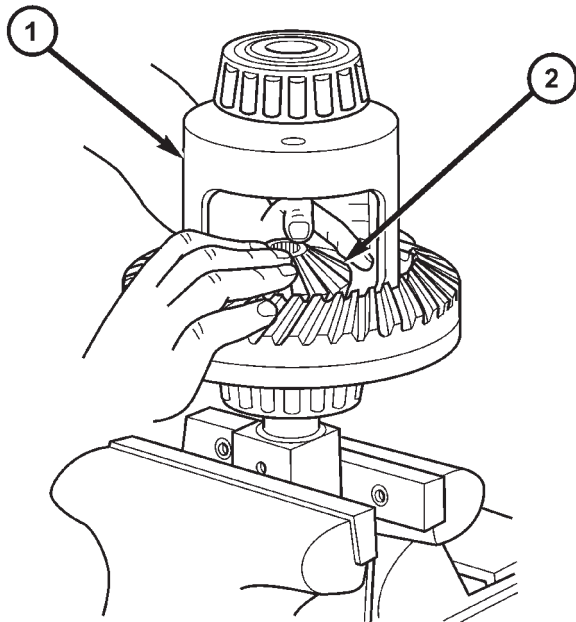
**Fig. 61 CLUTCH PACK**

- 1 - DISCS
- 2 - DISHED PLATE
- 3 - RETAINER
- 4 - SIDE GEAR
- 5 - RETAINER
- 6 - PLATES

## DIFFERENTIAL - TRAC-LOK (Continued)

(3) Position assembled clutch disc packs on the side gear hubs.

(4) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 62). **Verify clutch pack retaining clips are in position and seated in the case pockets.**



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**Fig. 62 CLUTCH PACK AND LOWER SIDE GEAR**

- 1 - DIFFERENTIAL CASE  
2 - SIDE GEAR AND CLUTCH PACK

(5) Position the differential case on the Holding Fixture 6965.

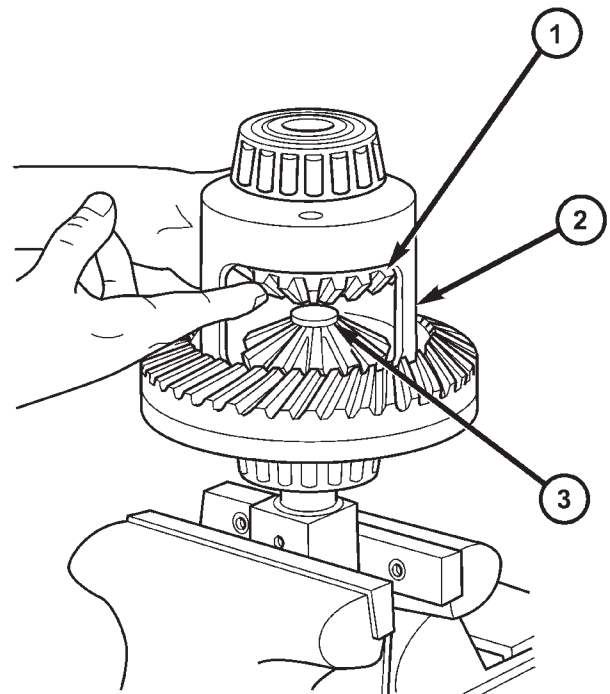
(6) Install lubricated Step Plate 6960-3 in lower side gear (Fig. 63).

(7) Install the upper side gear and clutch disc pack (Fig. 63).

(8) Hold assembly in position. Insert Threaded Adapter 6960-1 into top side gear.

(9) Install Forcing Screw 6960-4 and tighten screw to slightly compress clutch disc.

(10) Place pinion gears in position in side gears and verify that the pinion mate shaft hole is aligned.



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**Fig. 63 CLUTCH PACK AND UPPER SIDE GEAR**

- 1 - SIDE GEAR AND CLUTCH PACK  
2 - DIFFERENTIAL CASE  
3 - STEP PLATE

(11) Rotate case with Turning Bar 6960-2 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, Step Plate and Threaded Adapter.

(15) Install pinion gear mate shaft and align holes in shaft and case.

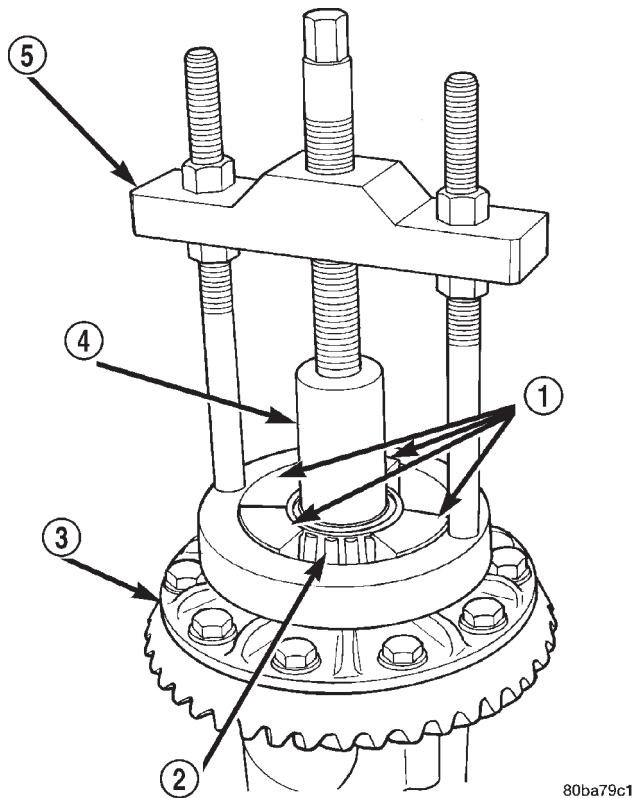
(16) Install pinion mate shaft lock screw finger tight to hold shaft during differential installation.

(17) Lubricate all differential components with hypoid gear lubricant.

## DIFFERENTIAL CASE BEARINGS

### REMOVAL

- (1) Remove differential case from axle housing.
- (2) Remove side bearings from the differential case with Puller/Press C-293-PA, Adapters 8352 and Plug SP-3289 (Fig. 64).



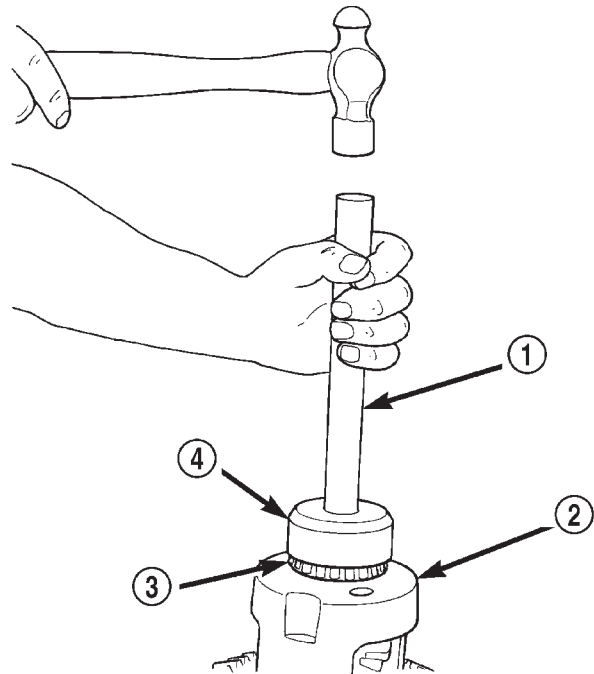
**Fig. 64 DIFFERENTIAL CASE BEARING**

- 1 - ADAPTERS
- 2 - BEARING
- 3 - DIFFERENTIAL
- 4 - PLUG
- 5 - PULLER

### INSTALLATION

**NOTE:** If differential side bearings or differential case are replaced, differential side bearing shim requirements may change. Refer to Adjustments (Differential Bearing Preload and Gear Backlash) for procedures.

- (1) Install differential side bearings with Installer C-3716-A and Handle C-4171 (Fig. 65).
- (2) Install differential case in housing.
- (3) Remove support and lower vehicle.



**Fig. 65 DIFFERENTIAL CASE BEARINGS**

- 1 - HANDLE
- 2 - DIFFERENTIAL
- 3 - BEARING
- 4 - INSTALLER

## PINION GEAR/RING GEAR/TONE RING

### REMOVAL

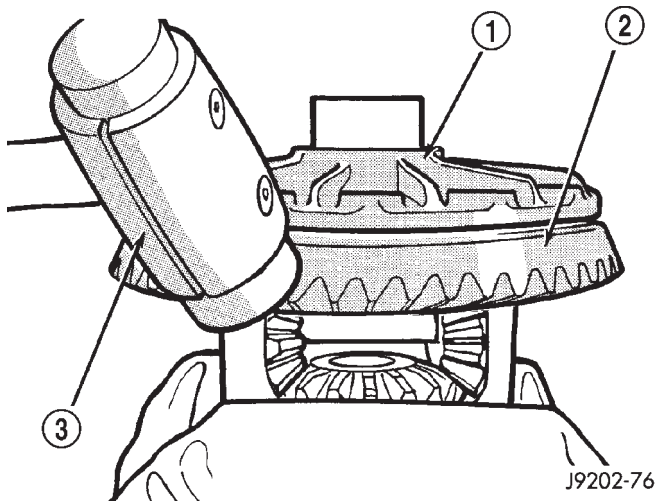
**NOTE:** The ring and pinion gears are serviced as a matched set. Never replace one gear without the other gear.

- (1) Raise and support vehicle.
- (2) Mark pinion yoke and propeller shaft for installation reference.
- (3) Disconnect propeller shaft from pinion yoke and tie shaft to underbody.
- (4) Remove differential from housing.
- (5) Place differential case in a vise with soft metal jaw.
- (6) Remove bolts holding ring gear to differential case.



PINION GEAR/RING GEAR/TONE RING (Continued)

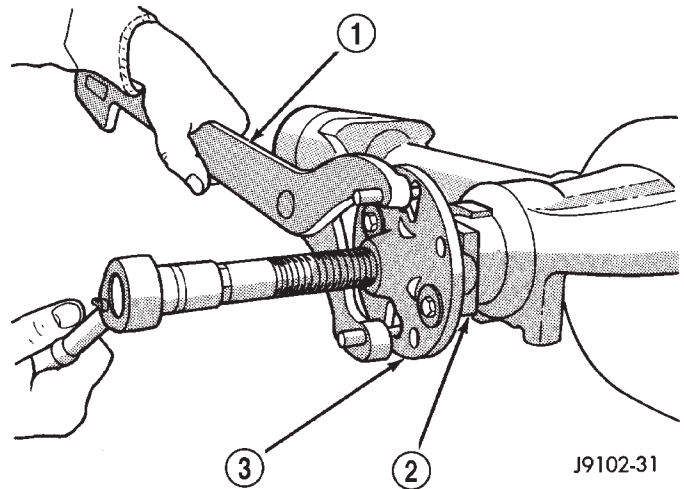
(7) Drive ring gear from differential case with a rawhide hammer (Fig. 66).



**Fig. 66 RING GEAR**

- 1 - DIFFERENTIAL CASE
- 2 - RING GEAR
- 3 - RAWHIDE HAMMER

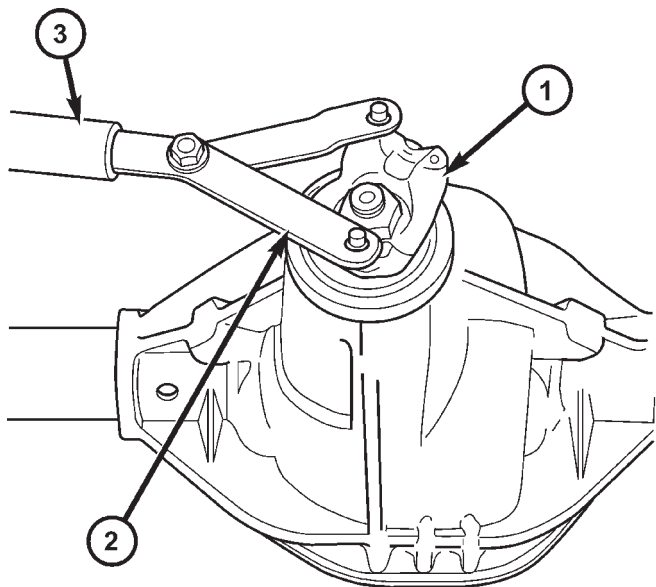
(9) Remove pinion yoke from pinion shaft with Remover C-452 and Wrench C-3281 (Fig. 68).



**Fig. 68 PINION YOKE REMOVER**

- 1 - WRENCH
- 2 - YOKE
- 3 - REMOVER

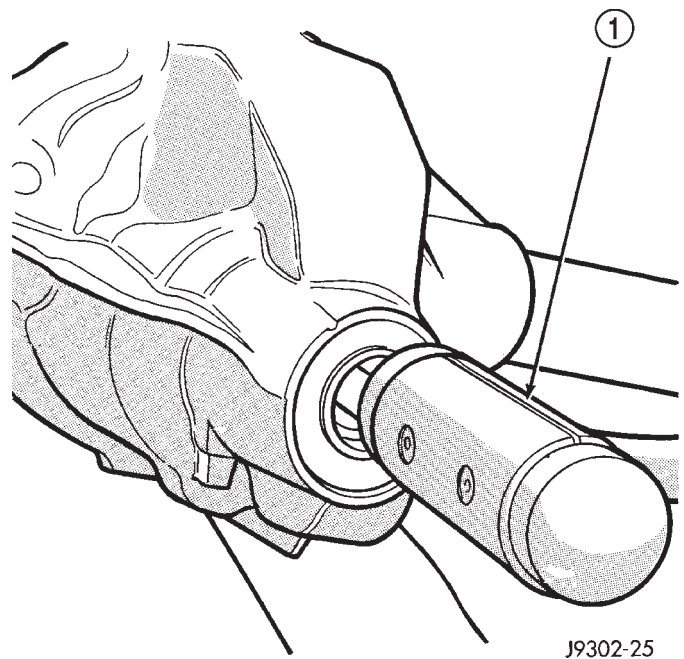
(8) Hold pinion yoke with Spanner Wrench 6958 and remove pinion yoke nut and washer (Fig. 67).



**Fig. 67 YOKE SPANNER WRENCH**

- 1 - PINION YOKE
- 2 - WRENCH
- 3 - PIPE

(10) Remove pinion gear from housing (Fig. 69).

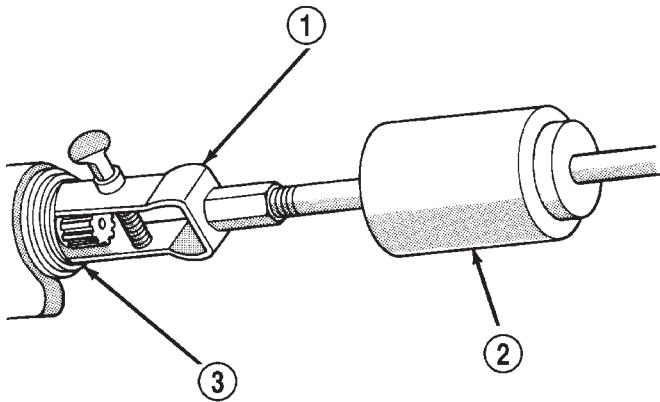


**Fig. 69 PINION GEAR**

- 1 - RAWHIDE HAMMER

PINION GEAR/RING GEAR/TONE RING (Continued)

(11) Remove pinion seal with Remover 7794-A and a slide hammer (Fig. 70).



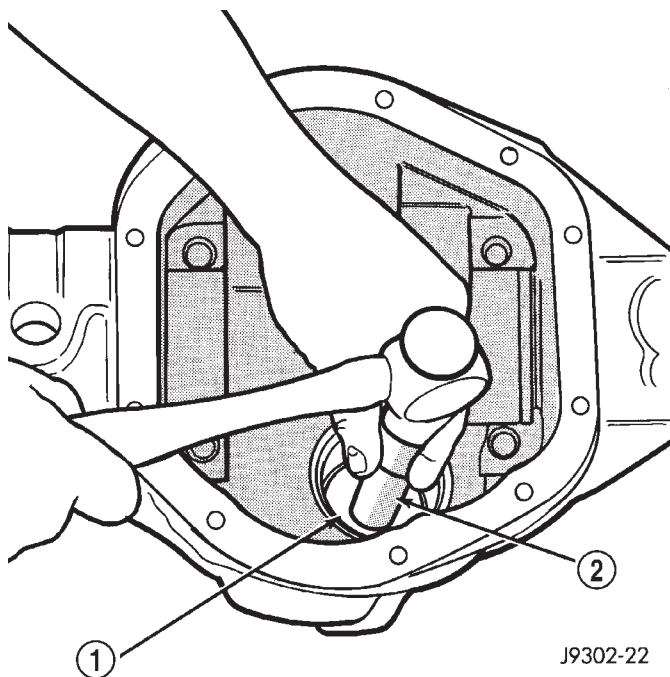
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**Fig. 70 PINION SEAL REMOVER**

- 1 - REMOVER
- 2 - SLIDE HAMMER
- 3 - PINION SEAL

(12) Remove oil slinger, if equipped, and front pinion bearing.

(13) Remove front pinion bearing cup with Remover D-103 and Handle C-4171 (Fig. 71).

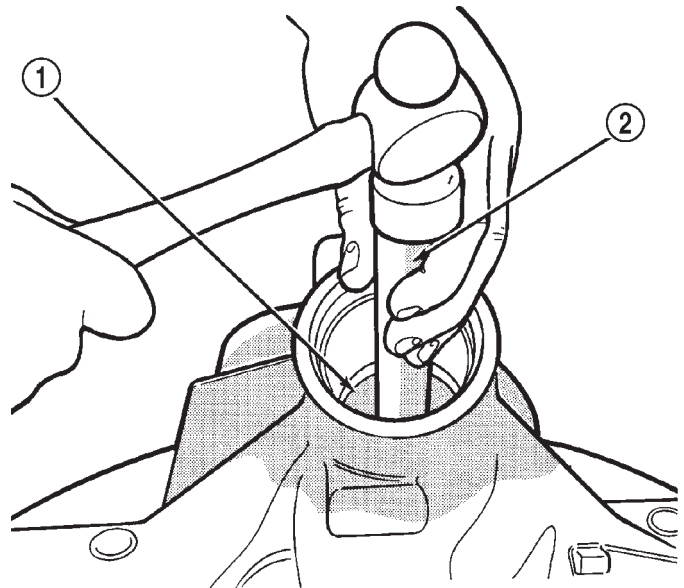


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**Fig. 71 FRONT PINION BEARING CUP**

- 1 - REMOVER
- 2 - HANDLE

(14) Remove rear bearing cup from housing (Fig. 72) with Remover D-149 and Handle C-4171.

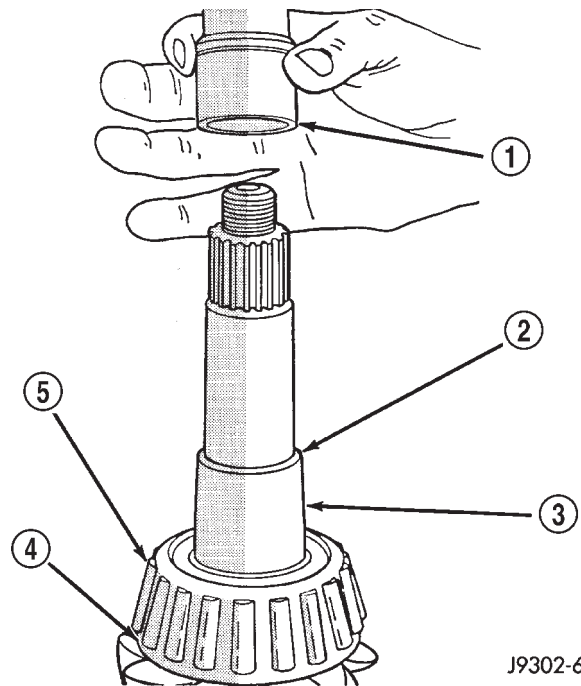


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**Fig. 72 REAR PINION BEARING CUP**

- 1 - DRIVER
- 2 - HANDLE

(15) Remove collapsible preload spacer (Fig. 73).



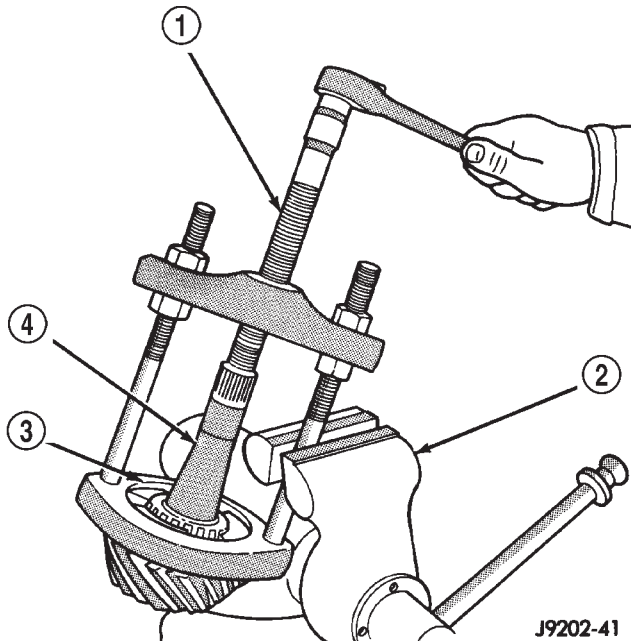
J9302-66

**Fig. 73 COLLAPSIBLE SPACER**

- 1 - COLLAPSIBLE SPACER
- 2 - SHOULDER
- 3 - PINION GEAR
- 4 - PINION DEPTH SHIM
- 5 - REAR BEARING

## PINION GEAR/RING GEAR/TONE RING (Continued)

(16) Remove rear bearing from the pinion with Puller/Press C-293-PA and Adapters C-293-39 (Fig. 74).



**Fig. 74 REAR PINION BEARING PULLER**

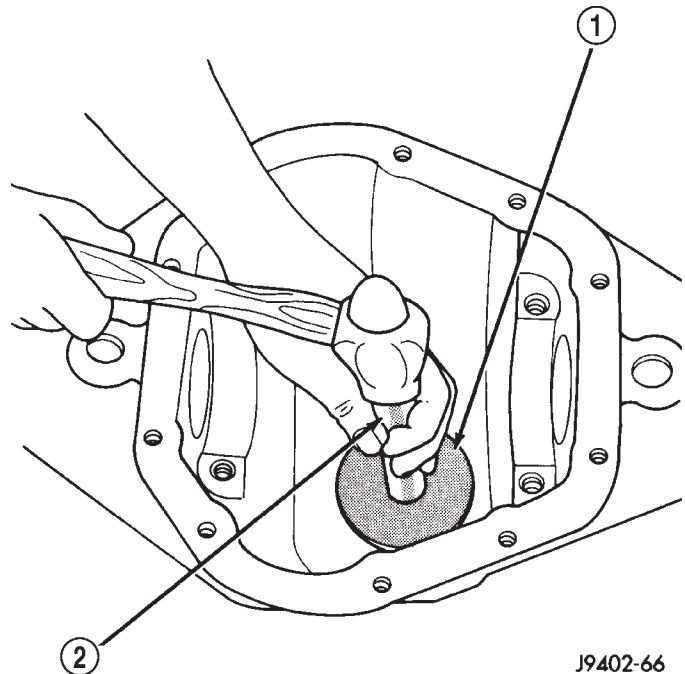
- 1 - PULLER
- 2 - VISE
- 3 - ADAPTERS
- 4 - PINION GEAR SHAFT

(17) Remove depth shims from pinion gear shaft and record shim thickness.

## INSTALLATION

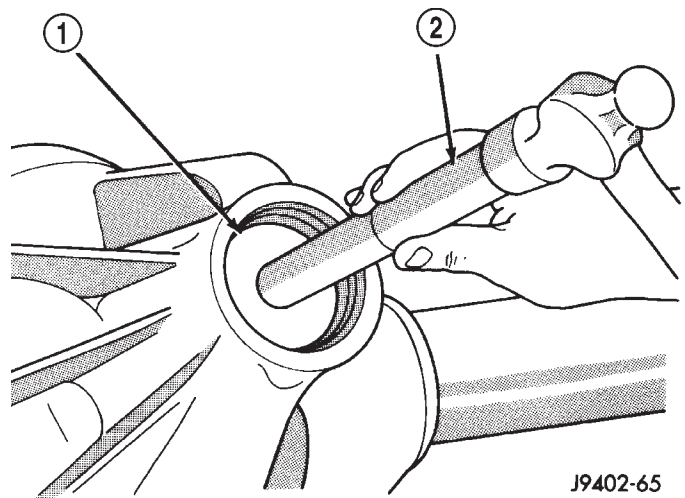
**NOTE:** A pinion depth shim/oil slinger is placed between the rear pinion bearing cone and the pinion head to achieve proper ring gear and pinion mesh. If ring gear and pinion are reused, the pinion depth shim/oil slinger should not require replacement. Refer to Adjustment (Pinion Gear Depth) to select the proper thickness shim/oil slinger if ring and pinion gears are replaced.

- (1) Apply Mopar® Door Ease or equivalent lubricant to outside surface of bearing cup.
- (2) Install pinion rear bearing cup with Installer C-146 and Driver Handle C-4171 (Fig. 75) and verify cup is seated.
- (3) Apply Mopar® Door Ease or equivalent lubricant to outside surface of bearing cup.
- (4) Install pinion front bearing cup with Installer D-130 and Handle C-4171 (Fig. 76) and verify cup is seated.
- (5) Install pinion front bearing and oil slinger, if equipped.



**Fig. 75 REAR PINION BEARING CUP**

- 1 - INSTALLER
- 2 - HANDLE

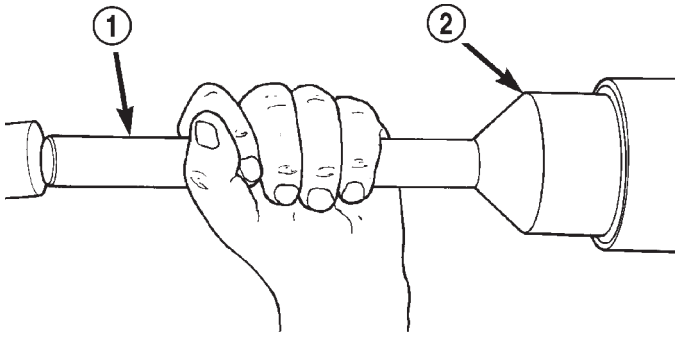


**Fig. 76 FRONT PINION BEARING CUP**

- 1 - INSTALLER
- 2 - HANDLE

PINION GEAR/RING GEAR/TONE RING (Continued)

(6) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with an appropriate installer (Fig. 77).

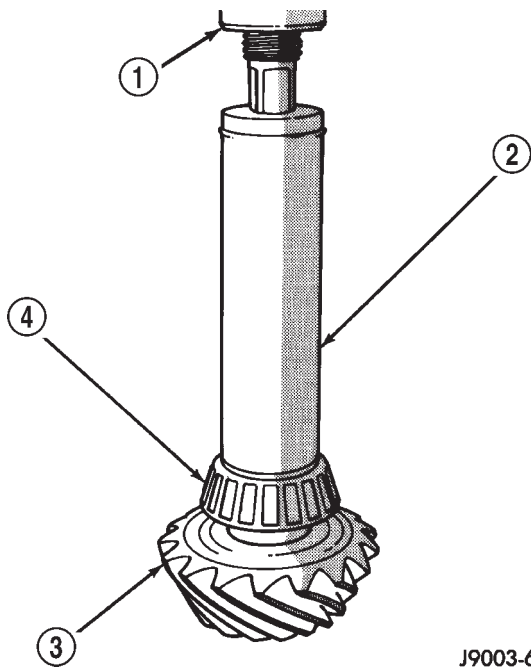


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**Fig. 77 PINION SEAL INSTALLER**

- 1 - HANDLE
- 2 - INSTALLER

(7) Install pinion depth shim on the pinion gear.  
 (8) Install rear bearing on the pinion gear with Installer W-262 and a press (Fig. 78).



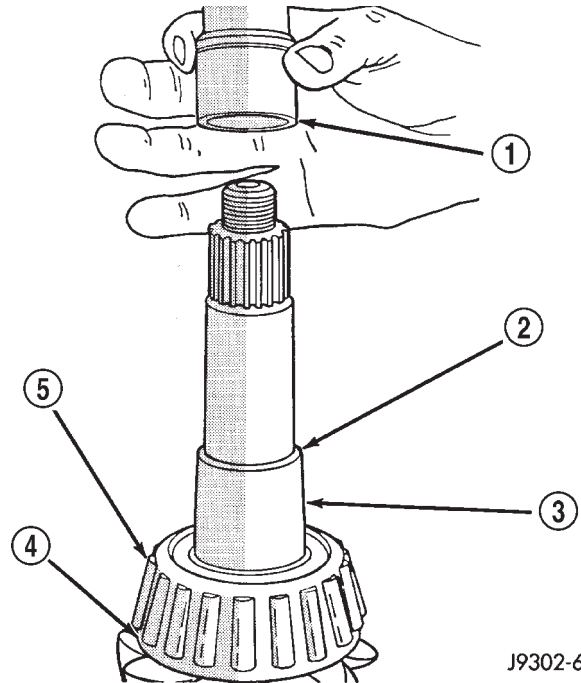
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**Fig. 78 REAR PINION BEARING**

- 1 - PRESS
- 2 - INSTALLER
- 3 - PINION GEAR
- 4 - PINION GEAR REAR BEARING

(9) Install a **new** collapsible preload spacer on pinion shaft and install pinion gear in the housing (Fig. 79).

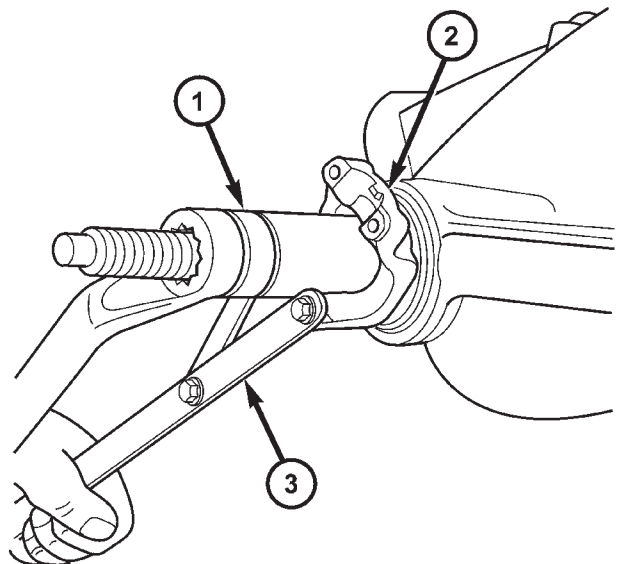
(10) Install yoke with Installer C-3718 and Spanner Wrench 6958 (Fig. 80).



J9302-66

**Fig. 79 COLLAPSIBLE SPACER**

- 1 - COLLAPSIBLE SPACER
- 2 - SHOULDER
- 3 - PINION GEAR
- 4 - PINION DEPTH SHIM
- 5 - REAR BEARING



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**Fig. 80 PINION YOKE INSTALLER**

- 1 - INSTALLER
- 2 - PINION YOKE
- 3 - WRENCH

## PINION GEAR/RING GEAR/TONE RING (Continued)

(11) Install the yoke washer and a new nut on the pinion gear and tighten the pinion nut until there is zero bearing end-play.

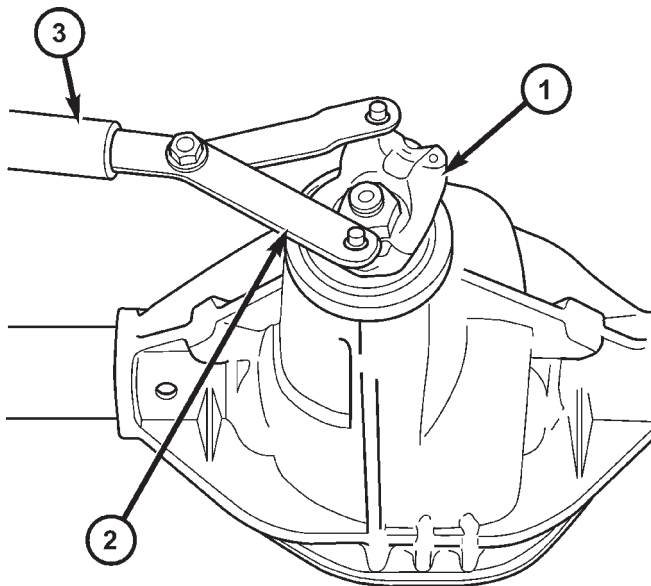
(12) Tighten the nut to 271 N·m (200 ft. lbs.).

**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.

(13) Using Spanner Wrench 6958 and a torque wrench set at 474 N·m (350 ft. lbs.), (Fig. 81) slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the rotating torque is achieved.

**CAUTION:** Measure torque to rotate frequently to avoid over crushing the collapsible spacer.

**NOTE:** If more than 474 N·m (350 ft. lbs.) torque is required to crush the collapsible spacer, the spacer is defective and must be replaced.



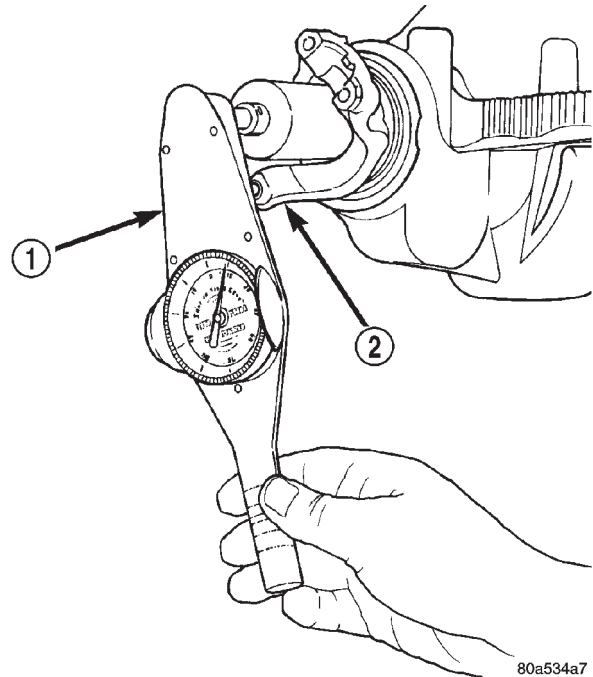
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**Fig. 81 YOKE SPANNER WRENCH**

- 1 - PINION YOKE
- 2 - WRENCH
- 3 - PIPE

(14) Check pinion torque to rotate with a inch pound torque wrench (Fig. 82). The pinion torque to rotate should be:

- Original Bearings: 1 to 2.25 N·m (10 to 20 in. lbs.).
- New Bearings: 1.69 to 2.82 N·m (15 to 25 in. lbs.).



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**Fig. 82 PINION GEAR ROTATING TORQUE**

- 1 - TORQUE WRENCH
- 2 - PINION YOKE

## PINION GEAR/RING GEAR/TONE RING (Continued)

(15) Invert the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.

(16) Invert the differential case in the vise.

(17) Install **new** ring gear bolts and alternately tighten to 129-142 N·m (95-105 ft. lbs.) (Fig. 83).

**CAUTION:** Do not reuse the bolts that held the ring gear to the differential case. The bolts can fracture causing extensive damage.

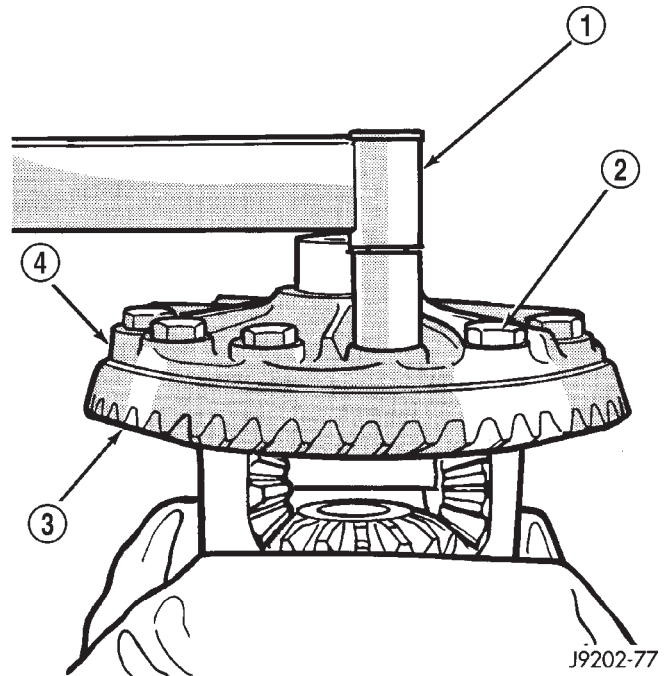
(18) Install differential in housing.

(19) Verify differential bearing preload, gear mesh and contact pattern. Refer to Adjustments for procedure.

(20) Install differential cover and fill with gear lubricant.

(21) Install the propeller shaft with the reference marks aligned.

(22) Remove supports and lower vehicle.



**Fig. 83 RING GEAR**

- 1 - TORQUE WRENCH
- 2 - RING GEAR BOLT
- 3 - RING GEAR
- 4 - CASE

## REAR AXLE - 8 1/4

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## REAR AXLE - 8 1/4

## DESCRIPTION

The axle housings consist of a cast iron center section with axle tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing. 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-locks in the differential side gears.

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.

The differential cover provides a means for inspection and service without removing the complete axle

from the vehicle. A vent hose is used to relieve internal pressure caused by lubricant vaporization and internal expansion.

Axles equipped with a Trac-Lok® differential are optional. A differential has a one-piece differential case, and the same internal components as a standard differential, plus two clutch disc packs.

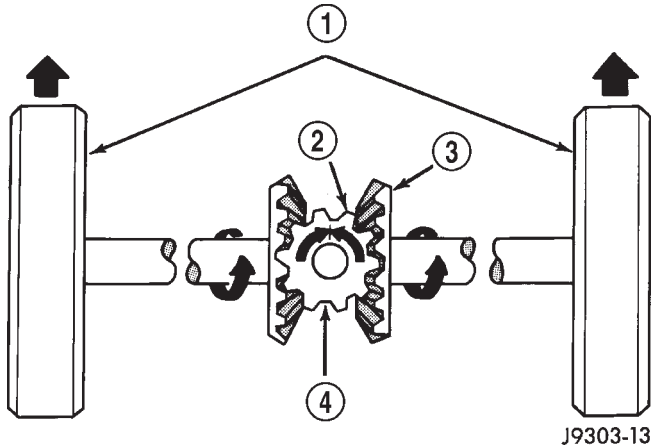
## OPERATION

The axle receives power from the transmission/transfer case through the rear propeller shaft. The rear propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

REAR AXLE - 8 1/4 (Continued)

**STANDARD DIFFERENTIAL**

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**

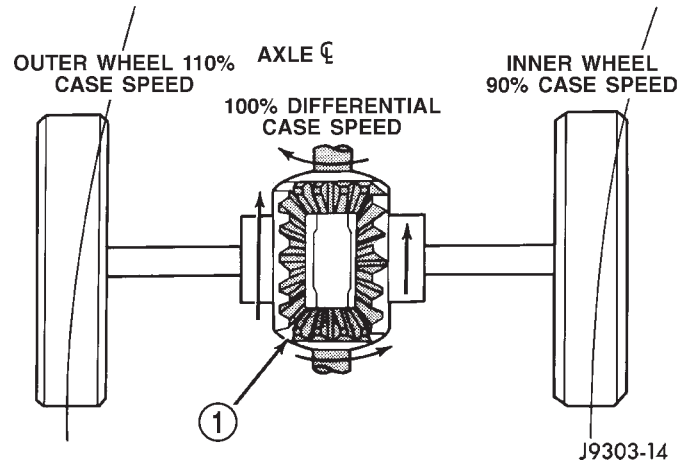
- 1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
- 2 - PINION GEAR
- 3 - SIDE GEAR
- 4 - PINION GEARS ROTATE WITH CASE

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.

**TRAC-LOK® DIFFERENTIAL**

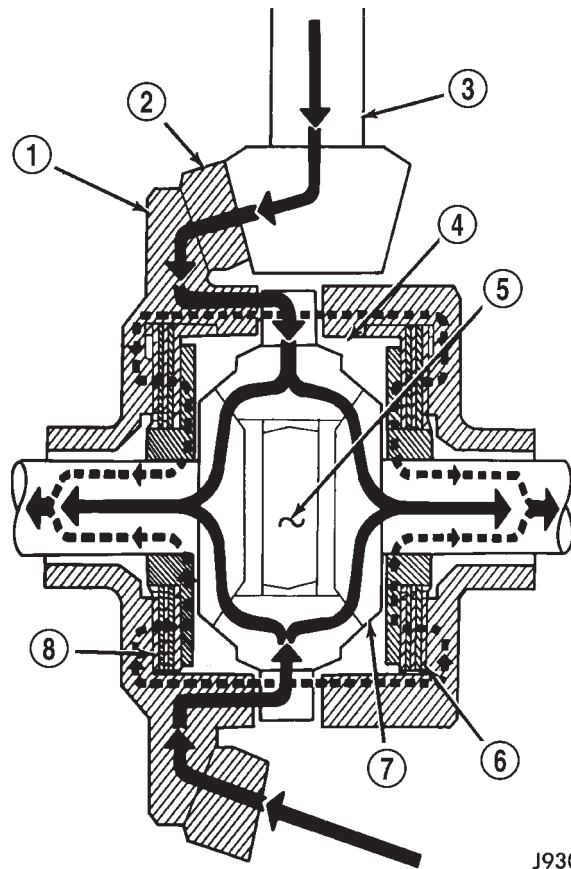
This differentials clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 3).

This design provides the differential action needed for turning corners and for driving straight ahead during periods of unequal traction. When one wheel loses traction, the clutch packs transfer additional torque to the wheel having the most traction. This differential resist wheel spin on bumpy roads and provide more pulling power when one wheel loses



**Fig. 2 Differential Operation - On Turns**

- 1 - PINION GEARS ROTATE ON PINION SHAFT



**Fig. 3 Trac-lok® Limited Slip Differential**

- 1 - CASE
- 2 - RING GEAR
- 3 - DRIVE PINION
- 4 - PINION GEAR
- 5 - MATE SHAFT
- 6 - CLUTCH PACK
- 7 - SIDE GEAR
- 8 - CLUTCH PACK



## REAR AXLE - 8 1/4 (Continued)

traction. Pulling power is provided continuously until both wheels lose 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 - AXLE****GEAR NOISE**

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, incorrect pinion depth, tooth contact, worn/damaged gears, or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then 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 gears and pinions 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 shaft can also cause a snapping or a knocking noise.

**BEARING NOISE**

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched 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 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.

**NOTE: All driveline components should be examined before starting any repair.**

**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.
- Transmission shift operation.
- 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 to 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.

REAR AXLE - 8 1/4 (Continued)

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	<ol style="list-style-type: none"> <li>1. Wheel loose.</li> <li>2. Faulty, brinelled wheel bearing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten loose nuts.</li> <li>2. Replace bearing.</li> </ol>
Axle Shaft Noise	<ol style="list-style-type: none"> <li>1. Misaligned axle tube.</li> <li>2. Bent or sprung axle shaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inspect axle tube alignment. Correct as necessary.</li> <li>2. Inspect and correct as necessary.</li> </ol>
Axle Shaft Broke	<ol style="list-style-type: none"> <li>1. Misaligned axle tube.</li> <li>2. Vehicle overloaded.</li> <li>3. Erratic clutch operation.</li> <li>4. Grabbing clutch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the broken shaft after correcting tube mis-alignment.</li> <li>2. Replace broken shaft and avoid excessive weight on vehicle.</li> <li>3. Replace broken shaft and avoid or correct erratic clutch operation.</li> <li>4. Replace broken shaft and inspect and repair clutch as necessary.</li> </ol>
Differential Cracked	<ol style="list-style-type: none"> <li>1. Improper adjustment of the differential bearings.</li> <li>2. Excessive ring gear backlash.</li> <li>3. Vehicle overloaded.</li> <li>4. Erratic clutch operation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.</li> <li>2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.</li> <li>3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.</li> <li>4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.</li> </ol>
Differential Gears Scored	<ol style="list-style-type: none"> <li>1. Insufficient lubrication.</li> <li>2. Improper grade of lubricant.</li> <li>3. Excessive spinning of one wheel/tire.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace scored gears. Fill differential with the correct fluid type and quantity.</li> <li>2. Replace scored gears. Fill differential with the correct fluid type and quantity.</li> <li>3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.</li> </ol>

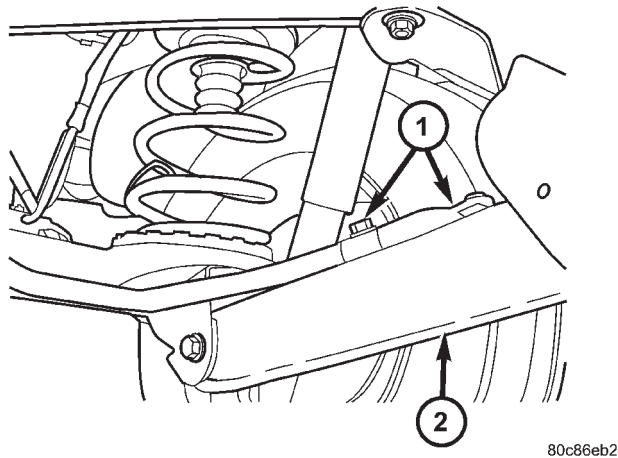
## REAR AXLE - 8 1/4 (Continued)

Condition	Possible Causes	Correction
Loss Of Lubricant	<ol style="list-style-type: none"> <li>1. Lubricant level too high.</li> <li>2. Worn axle shaft seals.</li> <li>3. Cracked differential housing.</li> <li>4. Worn pinion seal.</li> <li>5. Worn/scored yoke.</li> <li>6. Axle cover not properly sealed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Drain lubricant to the correct level.</li> <li>2. Replace seals.</li> <li>3. Repair as necessary.</li> <li>4. Replace seal.</li> <li>5. Replace yoke and seal.</li> <li>6. Remove, clean, and re-seal cover.</li> </ol>
Axle Overheating	<ol style="list-style-type: none"> <li>1. Lubricant level low.</li> <li>2. Improper grade of lubricant.</li> <li>3. Bearing pre-loads too high.</li> <li>4. Insufficient ring gear backlash.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill differential to correct level.</li> <li>2. Fill differential with the correct fluid type and quantity.</li> <li>3. Re-adjust bearing pre-loads.</li> <li>4. Re-adjust ring gear backlash.</li> </ol>
Gear Teeth Broke	<ol style="list-style-type: none"> <li>1. Overloading.</li> <li>2. Erratic clutch operation.</li> <li>3. Ice-spotted pavement.</li> <li>4. Improper adjustments.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace gears. Examine other gears and bearings for possible damage.</li> <li>2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.</li> <li>3. Replace gears and examine remaining parts for damage.</li> <li>4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.</li> </ol>
Axle Noise	<ol style="list-style-type: none"> <li>1. Insufficient lubricant.</li> <li>2. Improper ring gear and pinion adjustment.</li> <li>3. Unmatched ring gear and pinion.</li> <li>4. Worn teeth on ring gear and/or pinion.</li> <li>5. Loose pinion bearings.</li> <li>6. Loose differential bearings.</li> <li>7. Mis-aligned or sprung ring gear.</li> <li>8. Loose differential bearing cap bolts.</li> <li>9. Housing not machined properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill differential with the correct fluid type and quantity.</li> <li>2. Check ring gear and pinion contact pattern. Adjust backlash or pinion depth.</li> <li>3. Replace gears with a matched ring gear and pinion.</li> <li>4. Replace ring gear and pinion.</li> <li>5. Adjust pinion bearing pre-load.</li> <li>6. Adjust differential bearing pre-load.</li> <li>7. Measure ring gear run-out. Replace components as necessary.</li> <li>8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued to the proper specification.</li> <li>9. Replace housing.</li> </ol>

REAR AXLE - 8 1/4 (Continued)

**REMOVAL**

- (1) Raise and support the vehicle.
- (2) Position a lift/jack under the axle and secure axle to device.
- (3) Remove wheels and tires.
- (4) Mark propeller shaft and pinion yoke for installation reference.
- (5) Remove propeller shaft and suspend under the vehicle.
- (6) Remove brake drums, parking brake cables and speed sensor from the axle.
- (7) Disconnect the brake hose at the body junction block.
- (8) Remove brakes and backing plates.
- (9) Remove vent hose from the axle shaft tube.
- (10) Remove the stabilizer bar (Fig. 4).



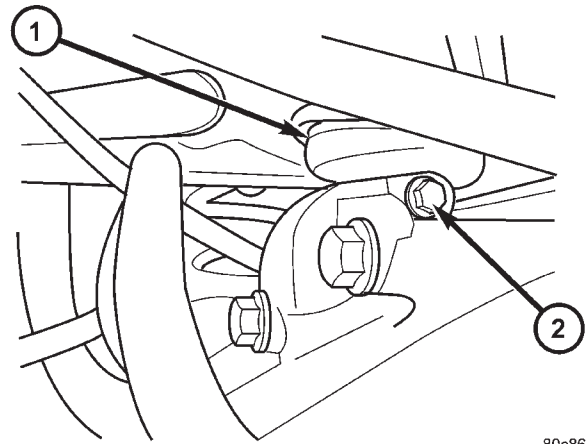
**Fig. 4 STABILIZER BAR MOUNTS**

- 1 - STABILIZER BAR MOUNTING BOLTS
- 2 - LOWER SUSPENSION ARM

- (11) Remove upper control arm ball joint pinch bolt from bracket (Fig. 5).
- (12) Remove shock absorbers from axle brackets (Fig. 6).
- (13) Loosen all lower control arms mounting bolts (Fig. 7).
- (14) Lower axle enough to remove coil springs and spring insulators.
- (15) Remove lower control arm bolts from the axle brackets.
- (16) Lower and remove the axle.

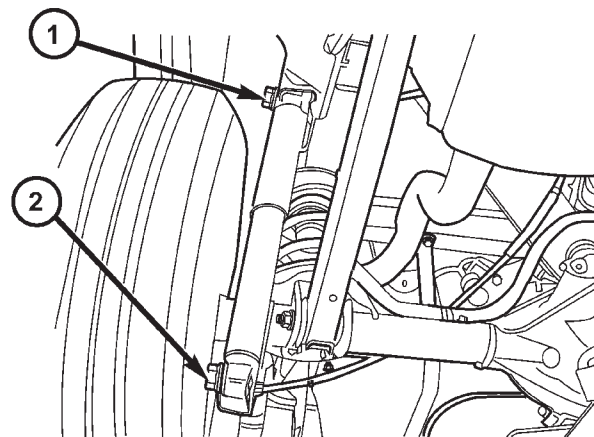
**INSTALLATION**

**CAUTION:** The weight of the vehicle must be supported by the springs before the lower control arms are tightened. This must be done to maintain vehicle ride height and prevent premature bushing failure.



**Fig. 5 BALL JOINT PINCH BOLT**

- 1 - UPPER BALL JOINT
- 2 - PINCH BOLT

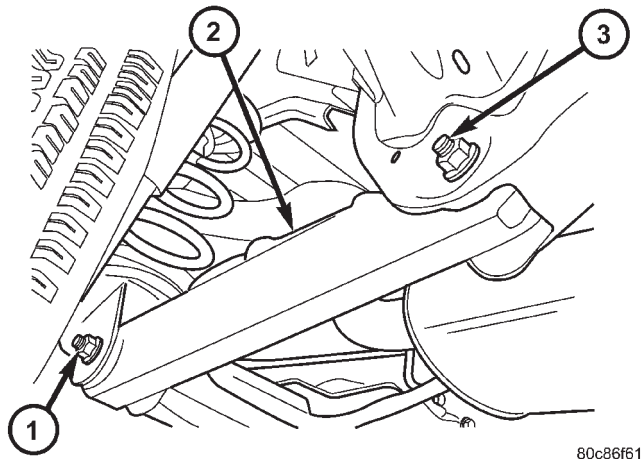


**Fig. 6 SHOCK ABSORBER**

- 1 - UPPER MOUNTING BOLT
- 2 - LOWER MOUNTING BOLT

- (1) Raise the axle under the vehicle.
- (2) Install lower control arms onto the axle brackets and loosely install the mounting bolts.
- (3) Install coil spring isolators and spring.
- (4) Raise axle up until springs are seated.
- (5) Install upper control arm ball joint into axle bracket and tighten pinch bolt to torque specification.
- (6) Install shock absorbers and tighten nuts to torque specification.
- (7) Install stabilizer bar and tighten nuts to torque specification.
- (8) Install brake backing plates, parking brake cables, brake drums and speed sensor.
- (9) Install brake hose to the body junction block and bleed the brakes.

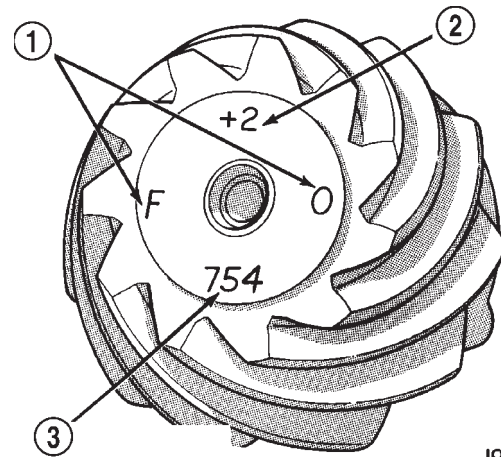
## REAR AXLE - 8 1/4 (Continued)



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**Fig. 7 LOWER SUSPENSION ARM**

- 1 - AXLE BRACKET BOLT
- 2 - LOWER CONTROL ARM
- 3 - BODY BRACKET BOLT



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**Fig. 8 Pinion Gear ID Numbers - Typical**

- 1 - PRODUCTION NUMBERS
- 2 - DRIVE PINION GEAR DEPTH VARIANCE
- 3 - GEAR MATCHING NUMBER (SAME AS RING GEAR NUMBER)

- (10) Install axle vent hose.
- (11) Install propeller shaft with reference marks.
- (12) Install the wheels and tires.
- (13) Add gear lubricant to specifications, if necessary.
- (14) Remove lifting device from axle and lower the vehicle.
- (15) Tighten the lower control arm bolts to torque specification.

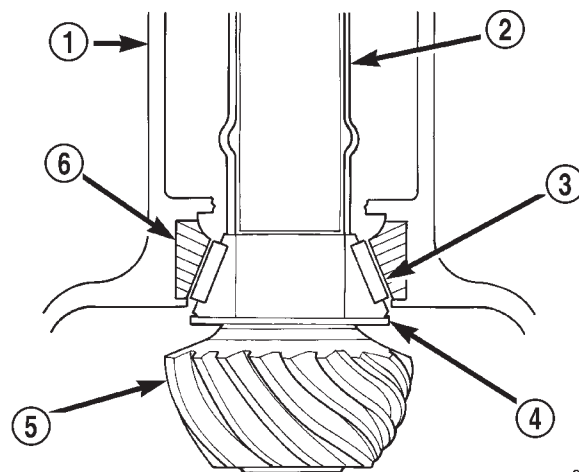
**ADJUSTMENTS**

Ring gears and pinions are supplied as matched sets only. The identifying numbers for the ring gear and pinion are etched/marked onto each gear (Fig. 8). A plus (+) number, minus (-) number or zero (0) is etched/marked on the face or shaft of the pinion. 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 depth provides the best gear tooth 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 behind the rear pinion bearing (Fig. 9).

If a new gear set is being installed, note the depth variance etched into both the original and replacement pinion. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance chart.

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus the amount needed.



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**Fig. 9 Adjustment Shim Locations**

- 1 - DIFFERENTIAL HOUSING
- 2 - COLLAPSIBLE SPACER
- 3 - REAR PINION BEARING
- 4 - PINION DEPTH SHIM
- 5 - PINION GEAR
- 6 - BEARING CUP

Note the etched number on the face of the pinion gear head (-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 shims. If the number is positive, subtract that value from the thickness of the depth shim. If the number is 0 no change is necessary.

REAR AXLE - 8 1/4 (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

PINION DEPTH MEASUREMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339.

(1) Assemble Pinion Height Block 6739, Pinion Block 8540 and rear pinion bearing onto Screw 6741 (Fig. 10).

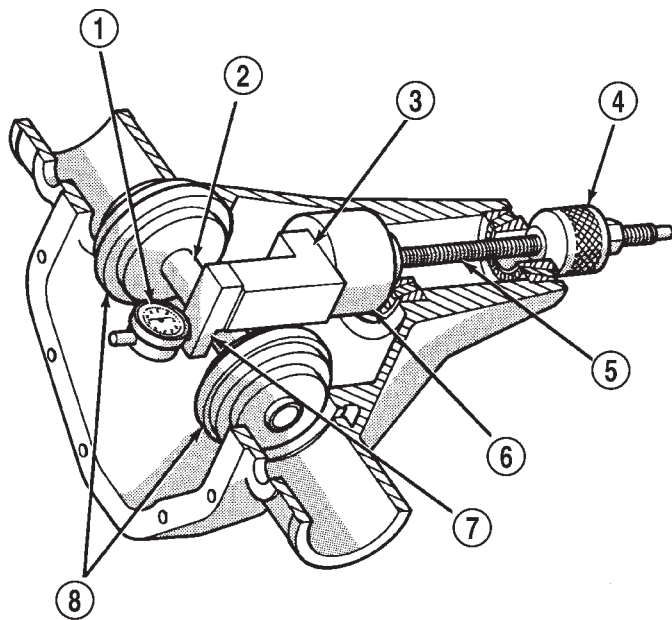


Fig. 10 Pinion Depth Gauge Tools J9403-45

- 1 - DIAL INDICATOR
- 2 - ARBOR
- 3 - PINION HEIGHT BLOCK
- 4 - CONE
- 5 - SCREW
- 6 - PINION BLOCK
- 7 - SCOOTER BLOCK
- 8 - ARBOR DISC

(2) Insert assembled height gauge components, rear bearing, and screw into the housing through pinion bearing cups (Fig. 11).

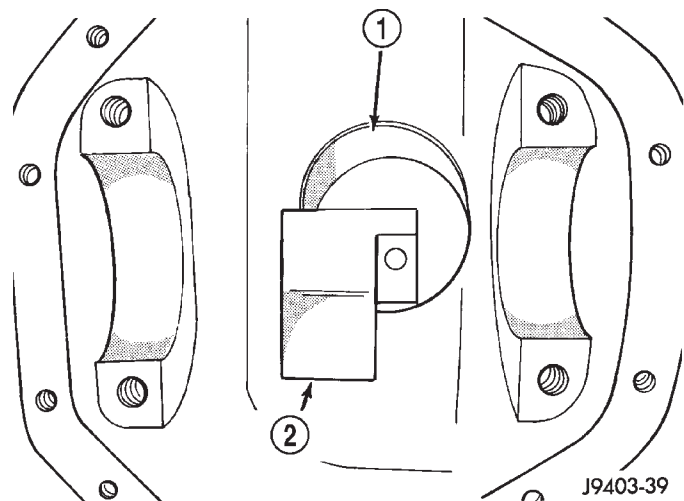


Fig. 11 Pinion Height Block

- 1 - PINION BLOCK
- 2 - PINION HEIGHT BLOCK

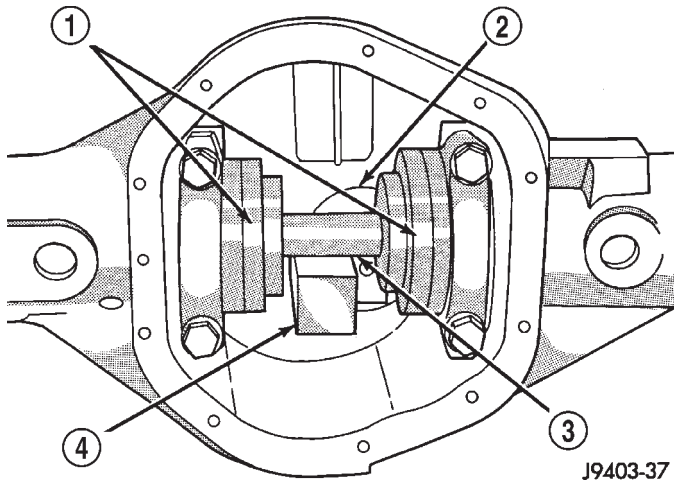
(3) Install front pinion bearing and Cone-Nut 6740 hand tight (Fig. 10).

(4) Place Arbor Disc 8541 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 12). Install differential bearing caps on Arbor Discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

**NOTE:** Arbor Discs 8541 has different step diameters to fit other axles. Choose proper step for axle being serviced.

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

REAR AXLE - 8 1/4 (Continued)



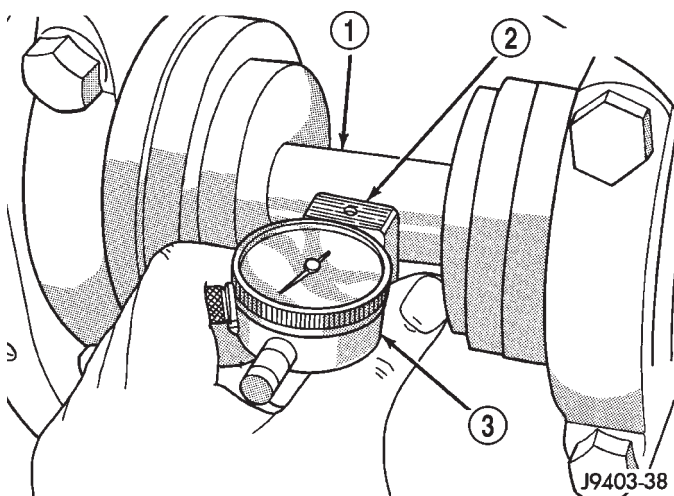
**Fig. 12 Gauge Tools In Housing**

- 1 - ARBOR DISC
- 2 - PINION BLOCK
- 3 - ARBOR
- 4 - PINION HEIGHT BLOCK

(6) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

(7) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 13). Move the scooter block till the dial indicator probe crests the arbor, then record the highest reading.

(8) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number etched/marked on the pinion (Fig. 8). For example, if the depth variance is -2, add +0.002 in. to the dial indicator reading.



**Fig. 13 Pinion Gear Depth Measurement**

- 1 - ARBOR
- 2 - SCOOTER BLOCK
- 3 - DIAL INDICATOR

**BEARING PRELOAD AND GEAR BACKLASH**

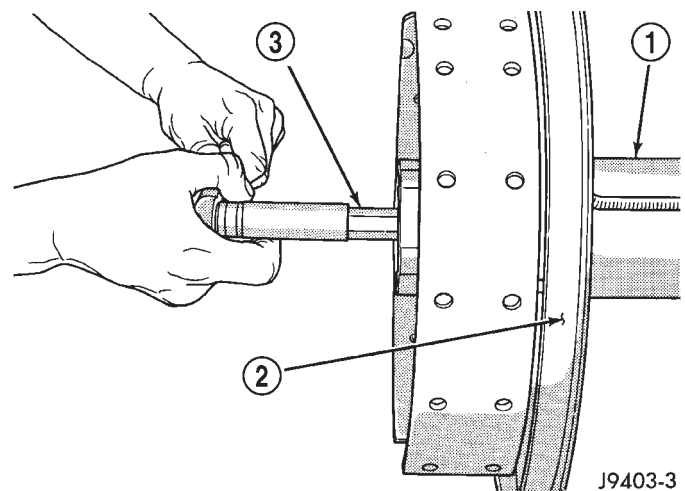
The following must be considered when adjusting bearing preload and gear backlash:

- The maximum ring gear backlash variation is 0.076 mm (0.003 inch).
- 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.

(1) Adjust each threaded adjuster inward with Wrench C-4164 until the differential bearing free-play is eliminated (Fig. 14). Allow some ring gear backlash, approximately 0.25 mm (0.01 in.) between the ring and pinion gear. Seat the bearing cups with the procedure described above.



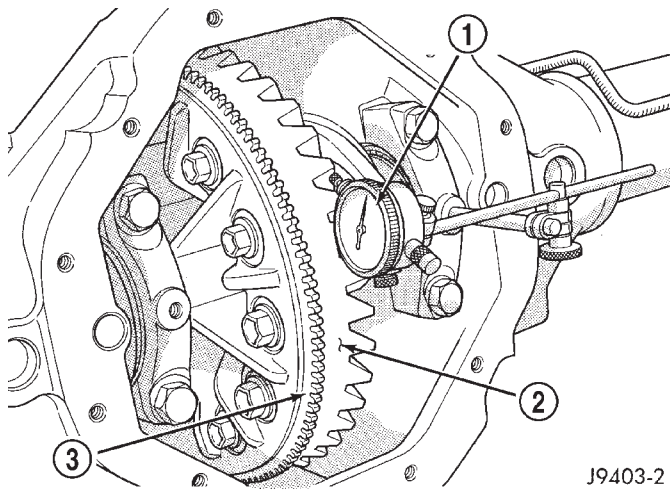
**Fig. 14 Threaded Adjuster**

- 1 - AXLE TUBE
- 2 - BACKING PLATE
- 3 - ADJUSTER WRENCH

## REAR AXLE - 8 1/4 (Continued)

(2) Install dial indicator and position the plunger against the drive side of a ring gear tooth (Fig. 15). 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. 15 Ring Gear Backlash**

- 1 - DIAL INDICATOR  
2 - RING GEAR  
3 - EXCITER RING

(4) Loosen the right-side, tighten the left-side threaded adjuster. Obtain backlash of 0.076 to 0.102 mm (0.003 to 0.004 in.) 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 in a criss-cross pattern to 95 N·m (70 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 0.15 to 0.203 mm (0.006 to 0.008 in.).

(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 Pattern procedure.

### GEAR CONTACT PATTERN

The ring gear and pinion teeth contact patterns will show if the pinion depth is correct in the 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. This will provide a more distinct contact pattern.

(3) With 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 teeth will squeeze 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. 16) and adjust pinion depth and gear backlash as necessary.



REAR AXLE - 8 1/4 (Continued)

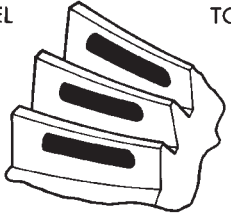
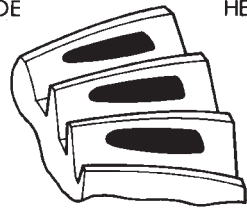
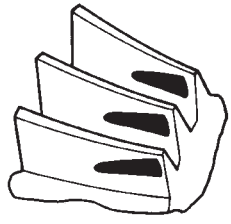
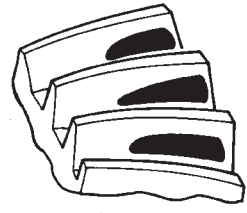
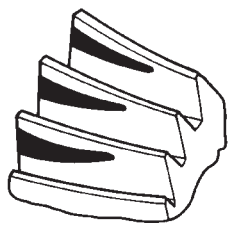
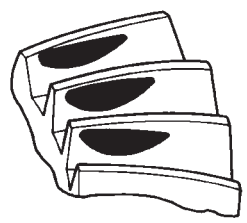
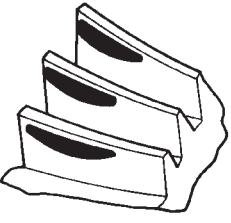
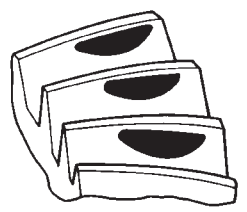
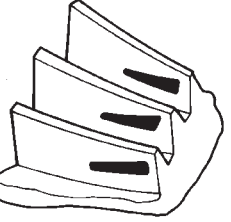
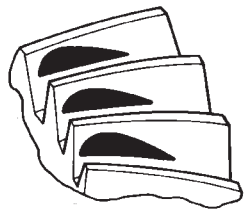
<p>DRIVE SIDE OF RING GEAR TEETH</p> <p>HEEL TOE</p> 	<p>COAST SIDE OF RING GEAR TEETH</p> <p>TOE HEEL</p> 	<p>DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND TOP OF THE TOOTH.</p>
		<p>RING GEAR BACKLASH CORRECT. <b>THINNER</b> PINION GEAR DEPTH SHIM REQUIRED.</p>
		<p>RING GEAR BACKLASH CORRECT. <b>THICKER</b> PINION GEAR DEPTH SHIM REQUIRED.</p>
		<p>PINION GEAR DEPTH SHIM CORRECT. <b>DECREASE</b> RING GEAR BACKLASH.</p>
		<p>PINION GEAR DEPTH SHIM CORRECT. <b>INCREASE</b> RING GEAR BACKLASH.</p>

Fig. 16 Gear Tooth Contact Patterns

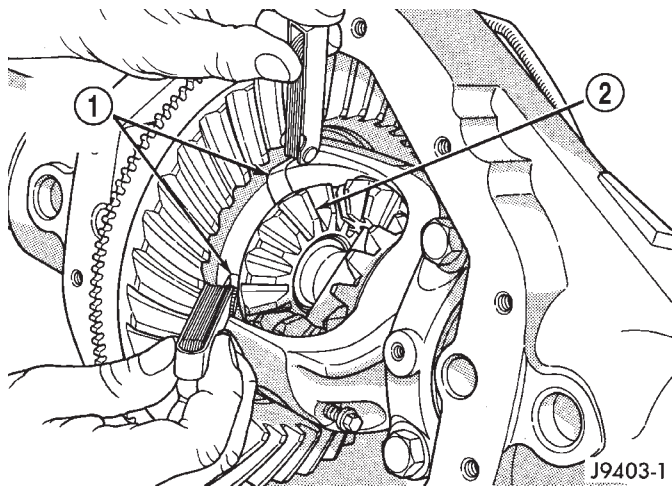
REAR AXLE - 8 1/4 (Continued)

**SIDE GEAR CLEARANCE**

**NOTE:** 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, C-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. 17).



**Fig. 17 Side Gear Clearance**

- 1 - FEELER GAUGE BLADES
- 2 - SIDE GEAR

(3) If side gear clearances is no more than 0.005 inch. Determine if the axle shaft is contacting the pinion 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 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. 18).

In some cases, the end of the axle shaft will move and contact the mate shaft when the feeler gauge is inserted. The C-lock is preventing the side gear from sliding on the axle shaft.

SIDE GEAR CLEARANCE	0.007
THRUST WASHER THICKNESS	+ 0.033
TOTAL	0.040
REPLACEMENT WASHER THICKNESS	0.040
NEW SIDE GEAR CLEARANCE	- 0.037
	0.003

J9203-31

**Fig. 18 Side Gear Calculations**

(5) If there is no side gear clearance, remove the C-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-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-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.

## REAR AXLE - 8 1/4 (Continued)

## SPECIFICATIONS

## REAR AXLE

## AXLE SPECIFICATIONS

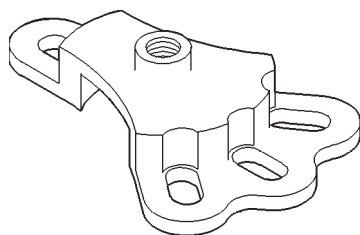
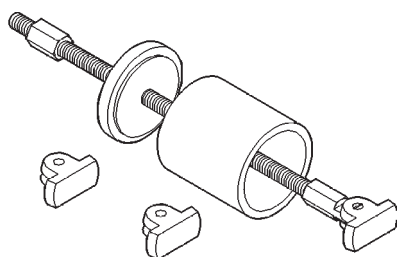
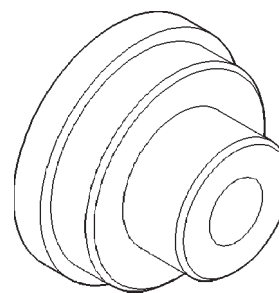
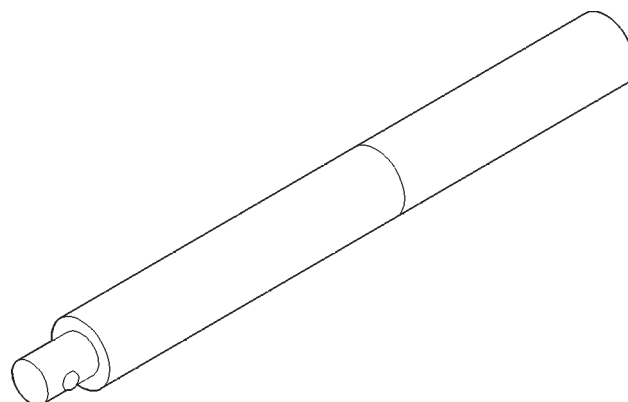
DESCRIPTION	SPECIFICATION
Axle Ratio	3.07, 3.55, 4.10
Differential Case Flange Runout	0.076 mm (0.003 in.)
Differential Case Clearance	0.12 mm (0.005 in.)
Ring Gear Diameter	209.5 mm (8.25 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Runout	0.12 mm (0.005 in.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload - New Bearings	1-3.4 N·m (10-30 in. lbs.)

## TORQUE SPECIFICATIONS

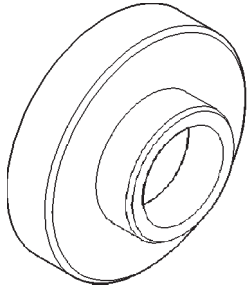
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	136	100	-
Ring Gear Bolts	95	70	-
Pinion Nut Minimum	285	210	-
Pinion Mate Shaft Screw	16.25	12	-

## SPECIAL TOOLS

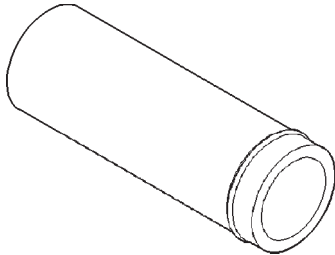
## 8 1/4 AXLE

**PULLER 6790****REMOVER 6310****INSTALLER C-4198****HANDLE C-4171**

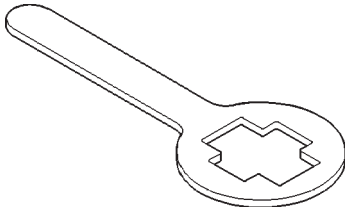
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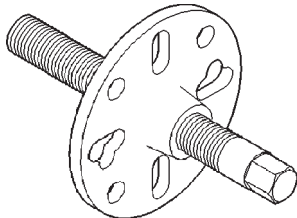
**INSTALLER C-4076-B**



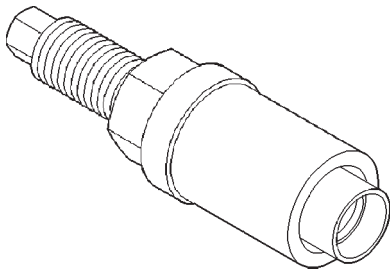
**HANDLE C-4735-1**



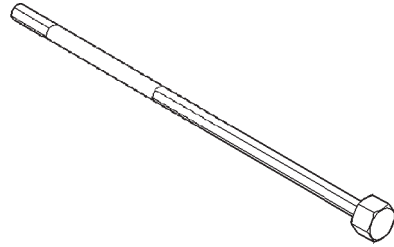
**HOLDER 6719**



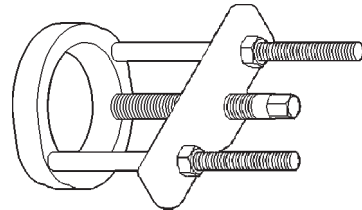
**PULLER C-452**



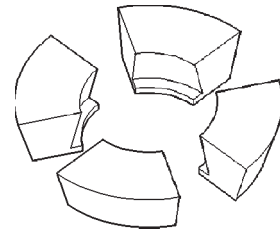
**INSTALLER C-3718**



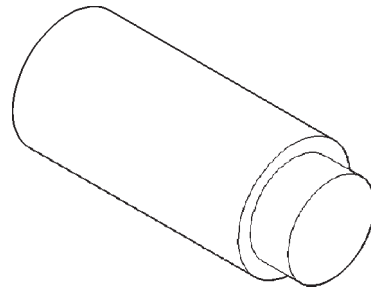
**ADJUSTMENT WRENCH C-4164**



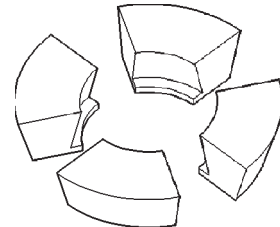
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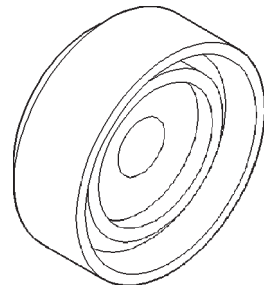
**ADAPTERS C-293-48**



**ADAPTER PLUG SP-3289**

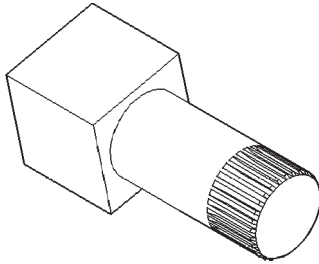


**ADAPTERS C-293-47**

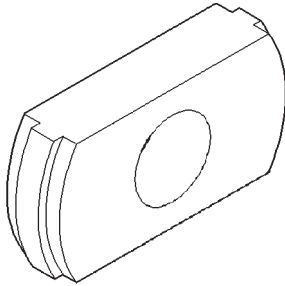


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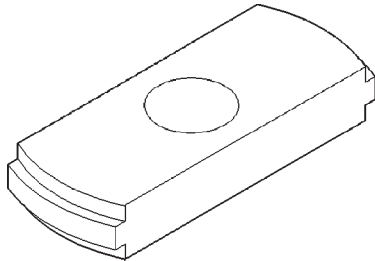
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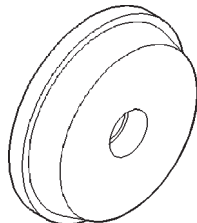
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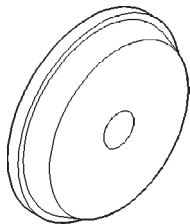
**INSTALLER C-4345**



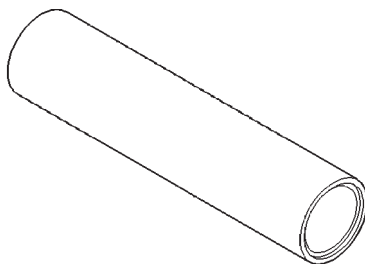
**REMOVER C-4307**



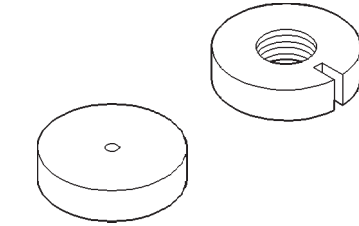
**INSTALLER C-4308**



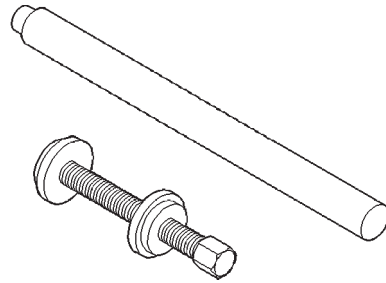
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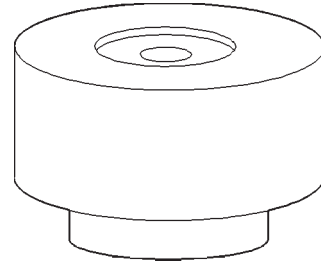
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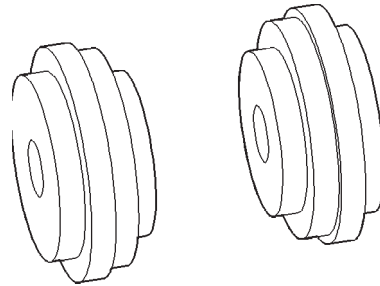
**TRAC-LOK™ TOOLS 8140**



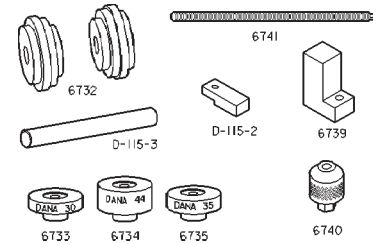
**TRAC-LOK™ TOOLS 6960**



**PINION BLOCK 8540**



**ARBOR DISCS 8541**

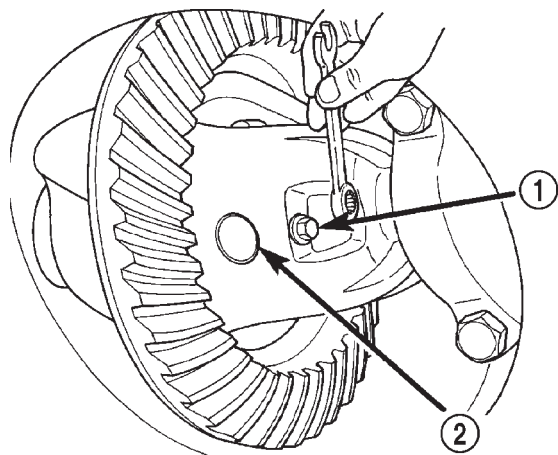


**PINION GAUGE SET**

## AXLE SHAFTS

### REMOVAL

- (1) Place the transmission in NEUTRAL and raise and support vehicle.
- (2) Remove wheel and tire assembly.
- (3) Remove brake drum.
- (4) Remove the housing cover and drain lubricant.
- (5) Rotate differential case to access the pinion shaft lock screw. Remove lock screw and pinion shaft from differential case (Fig. 19).

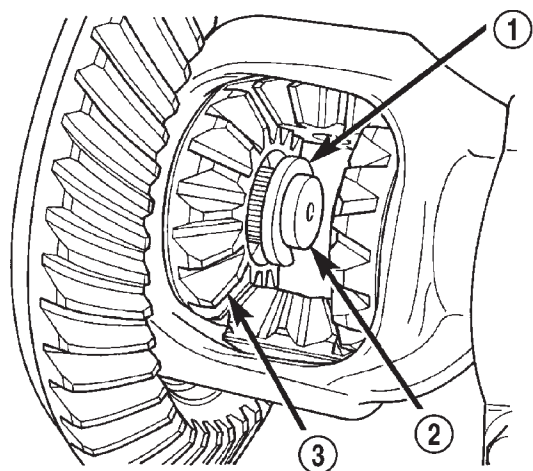


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**Fig. 19 Pinion Shaft Lock Screw**

- 1 - LOCK SCREW  
2 - PINION SHAFT

- (6) Push axle shaft inward then remove axle shaft C-lock (Fig. 20).



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**Fig. 20 Axle Shaft C-Lock**

- 1 - C-LOCK  
2 - AXLE SHAFT  
3 - SIDE GEAR

- (7) Remove axle shaft being careful not to damage shaft bearing and seal.
- (8) Inspect axle shaft seal for leakage or damage.
- (9) Inspect axle shaft bearing contact surface for signs of brinelling, galling and pitting.

### INSTALLATION

- (1) Lubricate bearing bore and seal lip with gear lubricant. Insert axle shaft through seal, bearing and engage it into side gear splines.

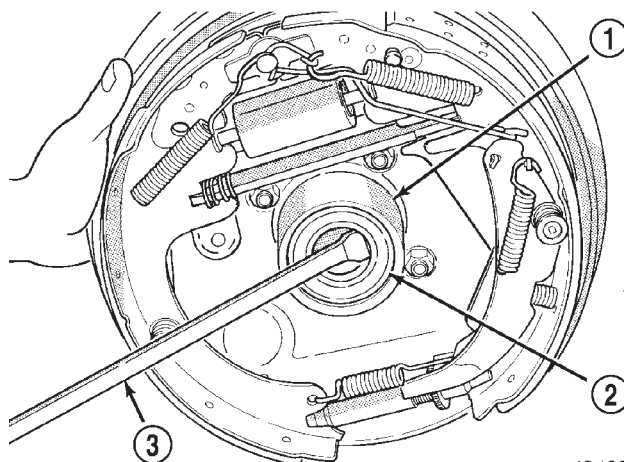
**NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.**

- (2) Insert C-lock in end of axle shaft. Push axle shaft outward to seat C-lock in side gear.
- (3) Insert pinion shaft into differential case and through thrust washers and differential pinions.
- (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.).
- (5) Install cover and fill with gear lubricant to the bottom of the fill plug hole.
- (6) Install brake drum.
- (7) Install wheel and tire assemblies.
- (8) Remove support and lower vehicle.

## AXLE SHAFT SEALS

### REMOVAL

- (1) Raise and support vehicle.
- (2) Remove axle shaft.
- (3) Remove axle shaft seal from the axle tube with a small pry bar (Fig. 21).



J9403-16

**Fig. 21 Axle Seal**

- 1 - AXLE TUBE  
2 - AXLE SEAL  
3 - PRY BAR

## AXLE SHAFT SEALS (Continued)

## INSTALLATION

- (1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.
- (2) 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.
- (3) Coat the lip of the seal with axle lubricant for protection prior to installing the axle shaft.
- (4) Install the axle shaft.
- (5) Check and fill gear lubricant.
- (6) Install wheel and tire assembly.
- (7) Remove support and lower vehicle.

## AXLE BEARINGS

## REMOVAL

- (1) Raise and support vehicle.
- (2) Remove axle shaft.
- (3) Remove axle shaft seal from the axle tube with a small pry bar (Fig. 22).

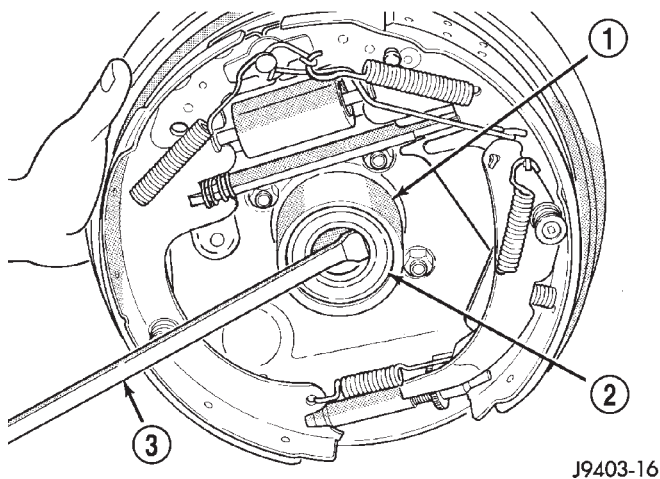


Fig. 22 Axle Seal

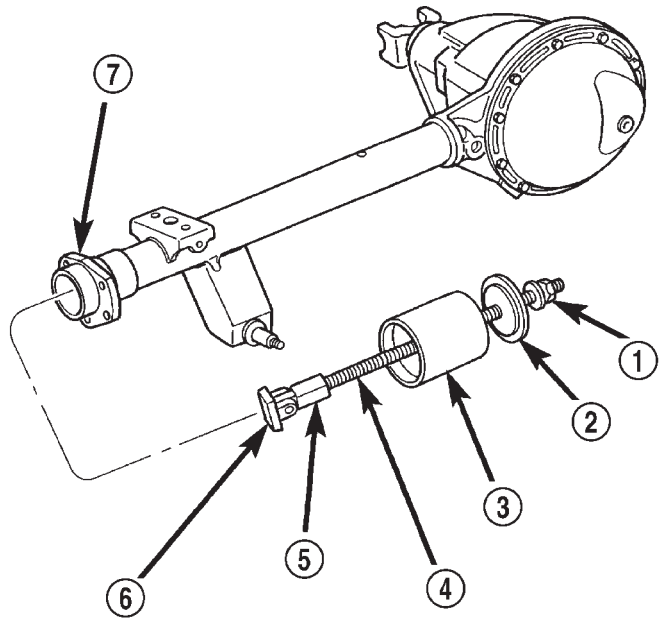
- 1 - AXLE TUBE
- 2 - AXLE SEAL
- 3 - PRY BAR

**NOTE:** The seal and bearing can be removed at the same time with the bearing removal tool.

- (4) Remove axle shaft bearing with Bearing Removal Tool Set 6310 and Adapter Foot 6310-9 (Fig. 23).

## INSTALLATION

- (1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.
- (2) Install axle shaft bearing with Installer C-4198 and Handle C-4171.



80be460E

Fig. 23 Axle Shaft Bearing

- 1 - NUT
- 2 - GUIDE PLATE
- 3 - GUIDE
- 4 - THREADED ROD
- 5 - ADAPTER
- 6 - FOOT
- 7 - AXLE TUBE

**NOTE:** Install bearing with part number against the installer.

- (3) Install a **new** axle seal with Installer C-4198 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.
- (6) Check and fill gear lubricant.
- (7) Install wheel and tire assembly.
- (8) Remove support and lower vehicle.

## PINION SEAL

## REMOVAL

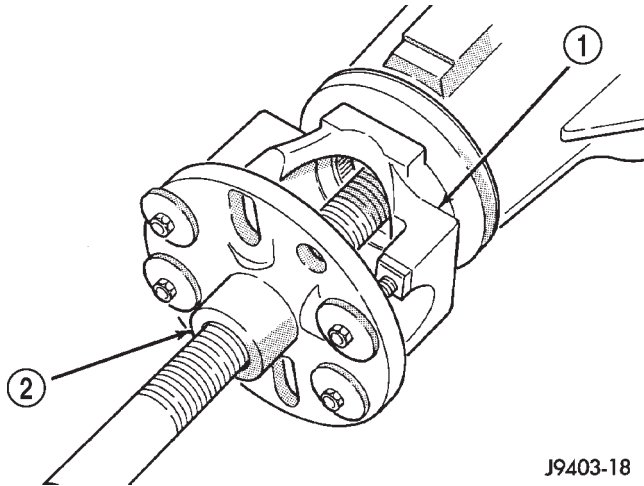
- (1) Raise and support the vehicle.
- (2) Mark the universal joint, pinion yoke and pinion shaft for installation reference.
- (3) Remove propeller shaft from pinion yoke.
- (4) Remove the wheel and tire assemblies.
- (5) Remove the brake drums.
- (6) Rotate the pinion yoke three or four times.

PINION SEAL (Continued)

(7) Measure rotating torque of the pinion gear with an inch pound torque wrench and record the reading for installation reference.

(8) Hold the pinion yoke with Holder 6719 and remove the pinion nut and washer.

(9) Remove yoke with Remover C-452 (Fig. 24).



J9403-18

**Fig. 24 Pinion Yoke**

- 1 - PINION YOKE
- 2 - REMOVER

(10) Remove pinion seal with a pry tool or screw mounted to a slide-hammer mounted.

**INSTALLATION**

(1) Apply a light coating of gear lubricant on the lip of pinion seal.

**NOTE:** The outer perimeter of the seal is pre-coated with a special sealant. An additional application of sealant is not required.

(2) Install the **new** pinion seal (Fig. 25) with Installer C-4076-A and Handle C-4735.

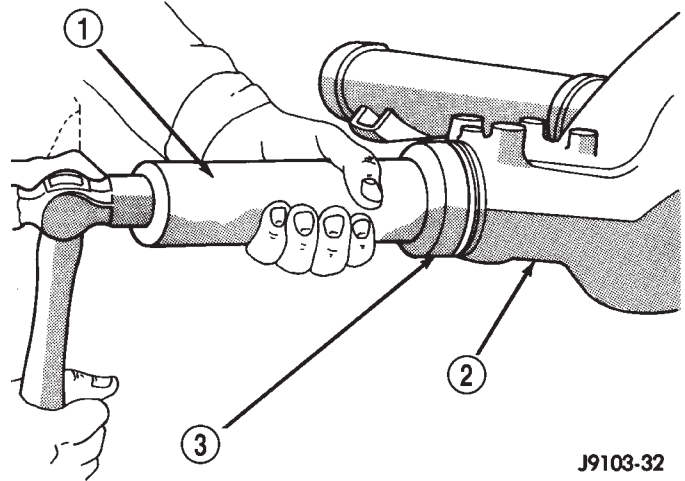
(3) Install pinion yoke on the shaft with the reference marks aligned.

(4) Seat yoke on pinion shaft with Installer C-3718 and Holder 6719A.

(5) Remove the tools and install the pinion yoke washer. The convex side of the washer must face outward.

(6) Using yoke Holder 6719A tighten shaft nut to 285 N·m (210 ft. lbs.) (Fig. 26). Rotate the pinion several revolutions to ensure the bearing rollers are seated.

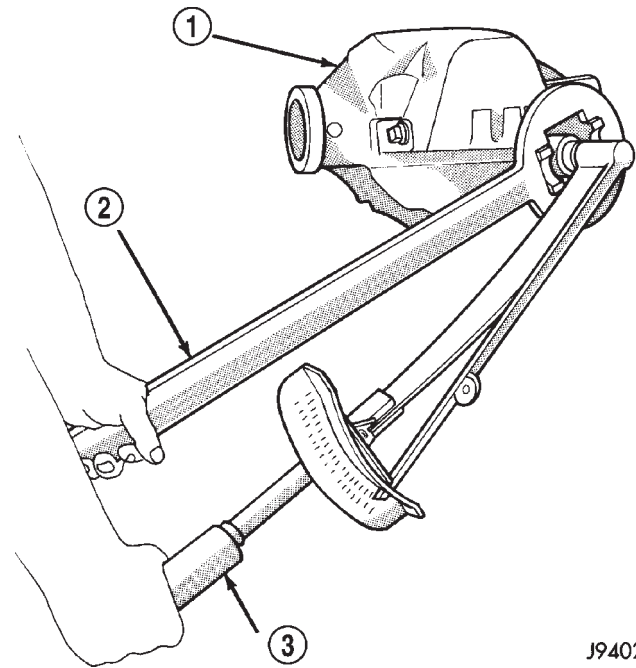
(7) Rotate the pinion using an inch pound torque wrench. Rotating torque should be equal to the reading recorded during removal, plus an additional 0.56 N·m (5 in. lbs.) (Fig. 27).



J9103-32

**Fig. 25 Pinion Seal Installer**

- 1 - HANDLE
- 2 - DIFFERENTIAL HOUSING
- 3 - INSTALLER



J9402-62

**Fig. 26 Tightening Pinion Nut**

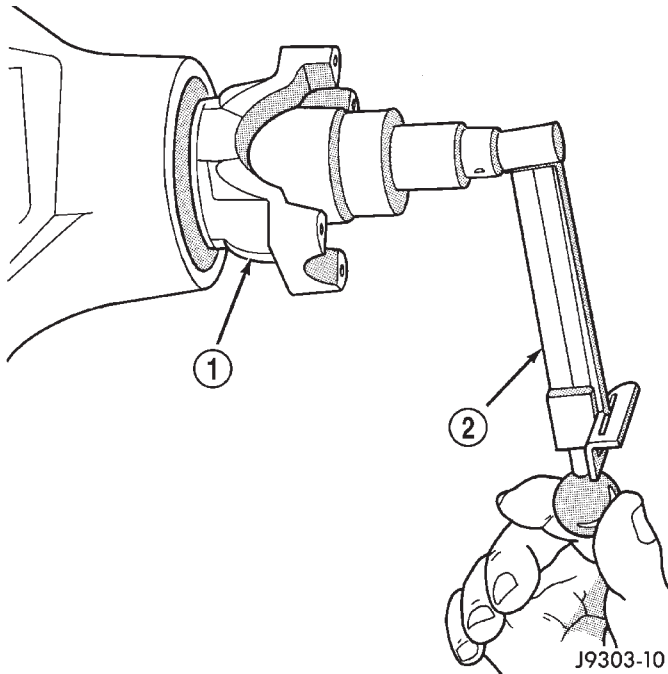
- 1 - DIFFERENTIAL HOUSING
- 2 - YOKE HOLDER
- 3 - TORQUE WRENCH

**CAUTION:** Never loosen pinion nut to decrease pinion rotating torque and never exceed specified preload torque. If preload torque is exceeded a new collapsible spacer must be installed.

(8) If the rotating torque is low, use Holder 6719A (Fig. 26) and tighten the pinion nut in 6.8 N·m (5 ft.



## PINION SEAL (Continued)

**Fig. 27 Pinion Rotation Torque**

- 1 - PINION YOKE  
2 - INCH POUND TORQUE WRENCH

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, it indicates a binding condition.

(9) The seal replacement is unacceptable if the final pinion nut torque is less than 285 N·m (210 ft. lbs.).

(10) Install the propeller shaft with the installation reference marks aligned.

(11) Install the brake drums.

(12) Check the differential housing lubricant level.

(13) Install wheel and tire assemblies and lower the vehicle.

## DIFFERENTIAL

### REMOVAL

(1) Raise and support vehicle.

(2) Remove fill hole plug from the differential housing cover.

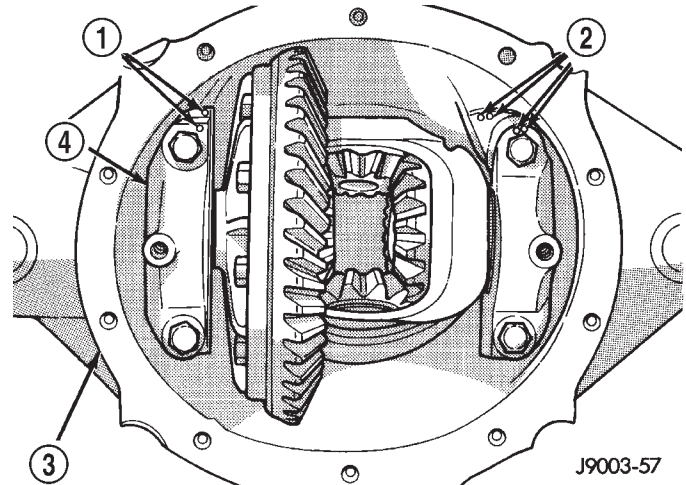
(3) Remove differential housing cover and drain housing.

(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 axle shafts.

**NOTE:** Side play resulting from bearing races being loose on case hubs requires replacement of the differential case.

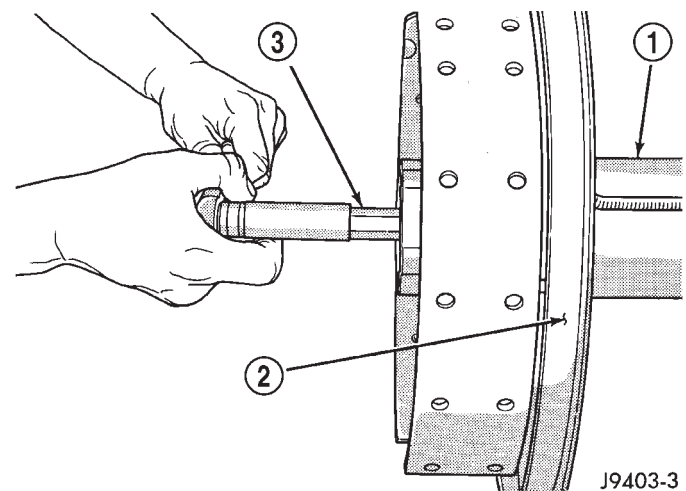
(6) Mark the differential housing and bearing caps for installation reference (Fig. 28).

**Fig. 28 Reference Mark**

- 1 - REFERENCE MARKS  
2 - REFERENCE MARKS  
3 - DIFFERENTIAL HOUSING  
4 - BEARING CAP

(7) Remove bearing threaded adjuster locks from each bearing cap.

(8) Loosen bearing cap bolts, then loosen the threaded adjusters with Wrench C-4164 (Fig. 29).

**Fig. 29 Threaded Adjuster**

- 1 - AXLE TUBE  
2 - BACKING PLATE  
3 - THREAD ADJUSTER WRENCH

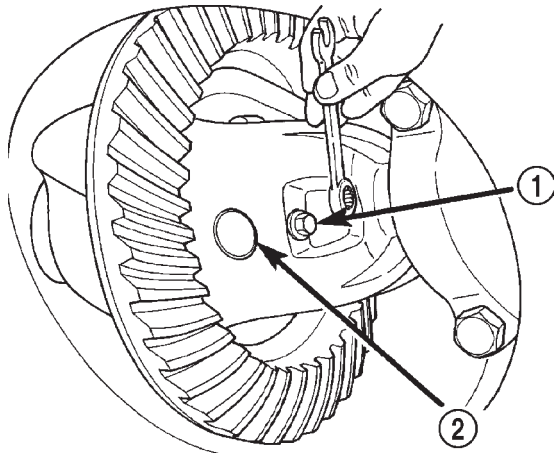
**DIFFERENTIAL (Continued)**

- (9) Hold the differential case while removing bearing caps and adjusters.
- (10) Remove the differential case.

**NOTE:** Tag bearing cups and threaded adjusters location, for installation reference.

**DISASSEMBLY**

- (1) Remove pinion shaft lock screw (Fig. 30).



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**Fig. 30 Pinion Shaft Lock Screw**

- 1 - LOCK SCREW
- 2 - PINION SHAFT

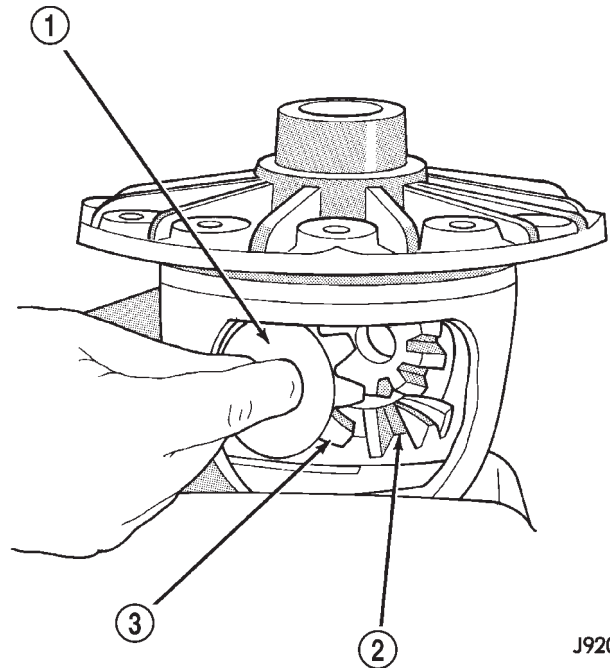
- (2) Remove pinion shaft.
- (3) Rotate differential side gears and remove differential pinions and thrust washers (Fig. 31).
- (4) Remove differential side gears and thrust washers.

**ASSEMBLY**

- (1) Install differential side gears and thrust washers.
- (2) Install differential pinion and thrust washers.
- (3) Install the pinion shaft.
- (4) Align the hole in the pinion shaft with the hole in the differential case and install the pinion shaft lock screw.
- (5) Lubricate all differential components with hypoid gear lubricant.

**INSTALLATION**

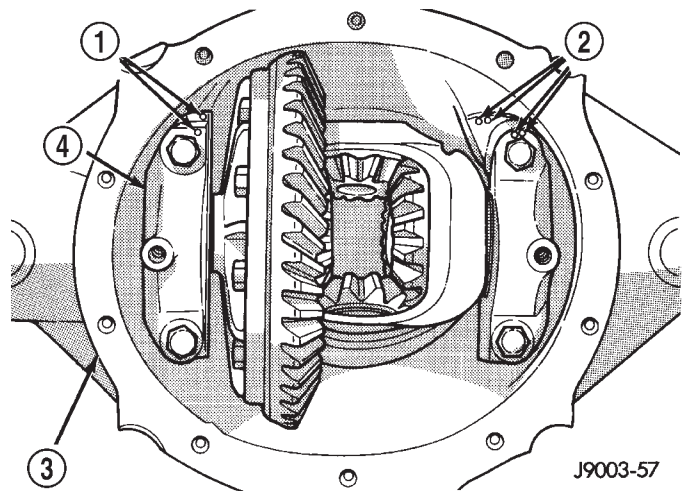
- (1) Apply a coating of hypoid gear lubricant to the differential bearings, bearing cups and threaded adjusters. A dab of grease can be used to keep the adjusters in position. Carefully position the assembled differential case in the housing.
- (2) Install differential bearing caps in their original locations (Fig. 32).



J9203-61

**Fig. 31 Differential Case**

- 1 - THRUST WASHER
- 2 - SIDE GEAR
- 3 - DIFFERENTIAL PINION



J9003-57

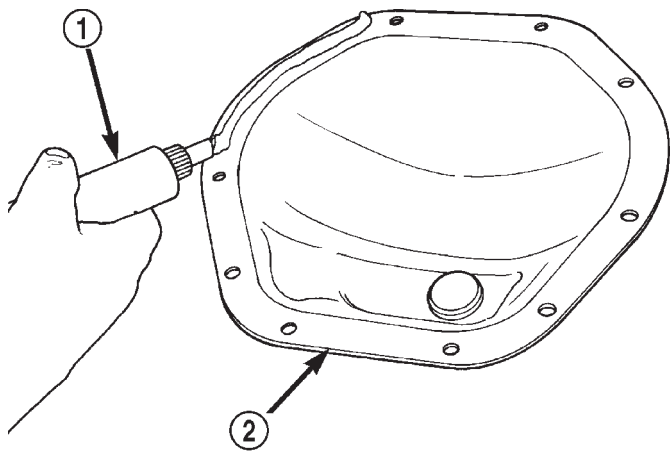
**Fig. 32 Bearing Caps & Bolts**

- 1 - REFERENCE MARKS
- 2 - REFERENCE MARKS
- 3 - DIFFERENTIAL HOUSING
- 4 - BEARING CAP

- (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) Tighten bearing cap bolts in a criss-cross pattern to 95 N·m (70 ft.lbs.).

## DIFFERENTIAL (Continued)

- (6) Install adjuster locks on the bearing caps.
- (7) Install axle shafts.
- (8) Apply a bead of red Mopar silicone rubber axle sealant or equivalent to the housing cover (Fig. 33).



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**Fig. 33 Differential Cover Sealant**

- 1 - SEALANT  
2 - DIFFERENTIAL COVER

**CAUTION:** If cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

- (9) Install cover and tighten bolts in a criss-cross pattern to 41 N·m (30 ft. lbs.).
- (10) Fill differential with gear lubricant to bottom of the fill plug hole.
- (11) Install the fill hole plug.
- (12) Install wheel and tire assemblies.
- (13) Remove support and lower vehicle.
- (14) 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.

## DIFFERENTIAL - TRAC-LOK

## DIAGNOSIS AND TESTING - TRAC-LOK®

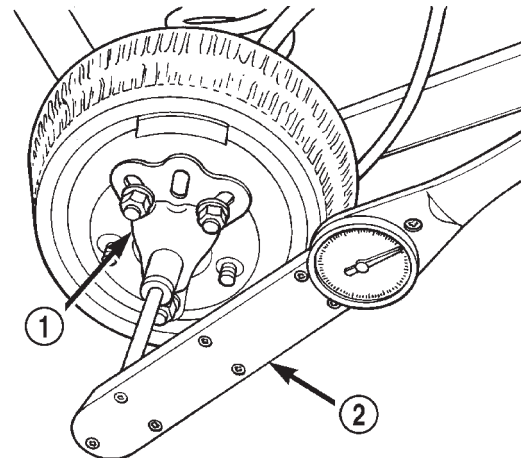
The most common problem is a chatter noise when turning corners. Before removing the unit for repair, drain, flush and refill the axle with the specified lubricant. A container of Mopar Trac-lok® Lubricant (friction modifier) should be added after repair service or during a lubricant change.

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.

## DIFFERENTIAL TEST

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 or equivalent tool to studs.
- (5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 34).



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**Fig. 34 ROTATING TORQUE TEST**

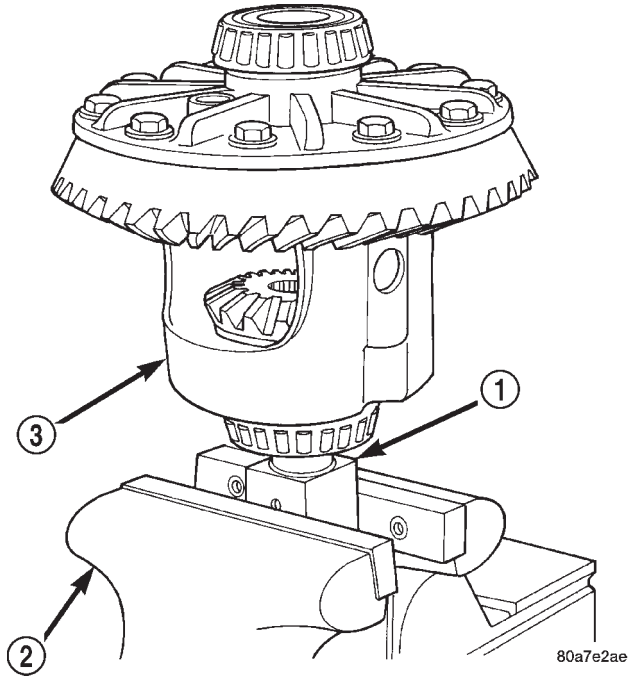
- 1 - SPECIAL TOOL WITH BOLT IN CENTER HOLE  
2 - TORQUE WRENCH

- (6) If rotating torque is less than 41 N·m (56 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

DIFFERENTIAL - TRAC-LOK (Continued)

**DISASSEMBLY**

(1) Clamp side gear Fixture 8138 in a vise and set differential case on the fixture (Fig. 35).



**Fig. 35 DIFFERENTIAL CASE FIXTURE**

- 1 - FIXTURE
- 2 - VISE
- 3 - DIFFERENTIAL

(2) Remove ring gear if the ring gear is to be replaced. The Trac-lok® differential can be serviced with the ring gear installed.

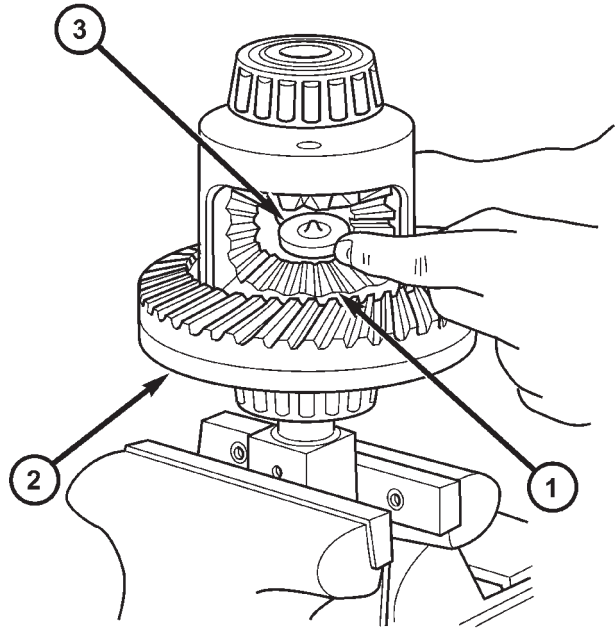
(3) Remove pinion gear mate shaft lock screw.

(4) Remove pinion gear mate shaft with a drift and hammer.

(5) Install Discs 8140 without threaded hole in the lower side gear (Fig. 36).

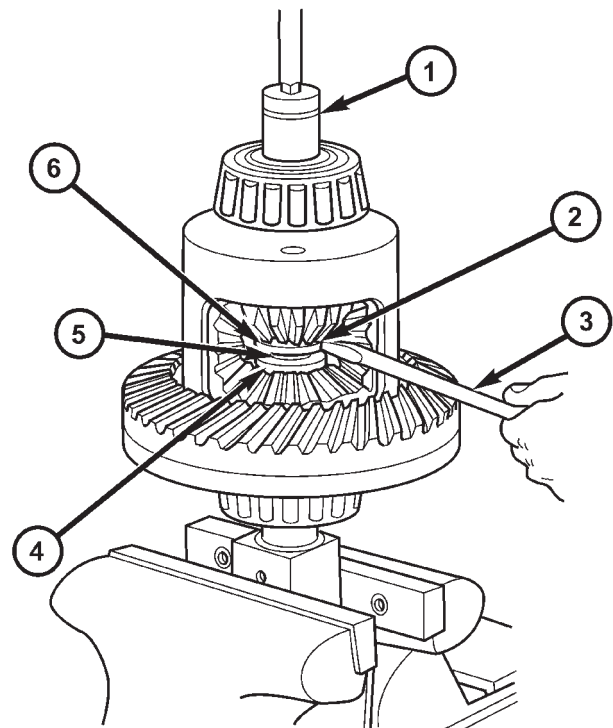
(6) Install Disc 8140 with threaded hole in the upper side gear. Thread Forcing Screw 6960-4 through the upper disc until it becomes centered in lower disc.

(7) Insert a screw driver in slot of upper disc (Fig. 37) to prevent disc from turning.



**Fig. 36 LOWER DISC**

- 1 - LOWER SIDE GEAR
- 2 - DIFFERENTIAL CASE
- 3 - DISC

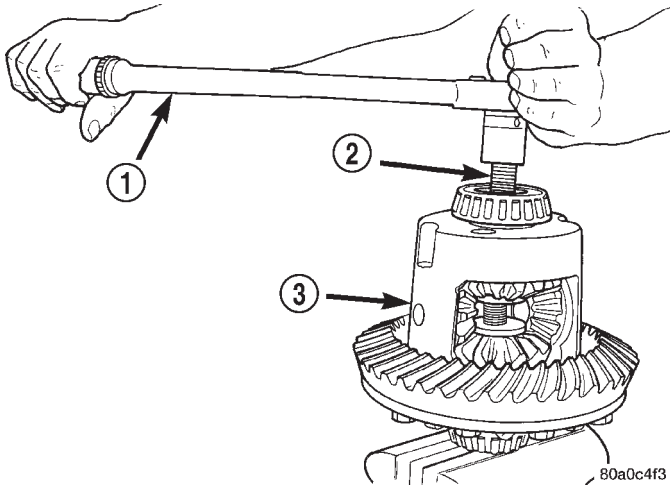


**Fig. 37 TRAK-LOC® TOOLS**

- 1 - SOCKET
- 2 - SLOT IN DISC
- 3 - SCREWDRIVER
- 4 - LOWER DISC
- 5 - THREADED ROD
- 6 - UPPER DISC

DIFFERENTIAL - TRAC-LOK (Continued)

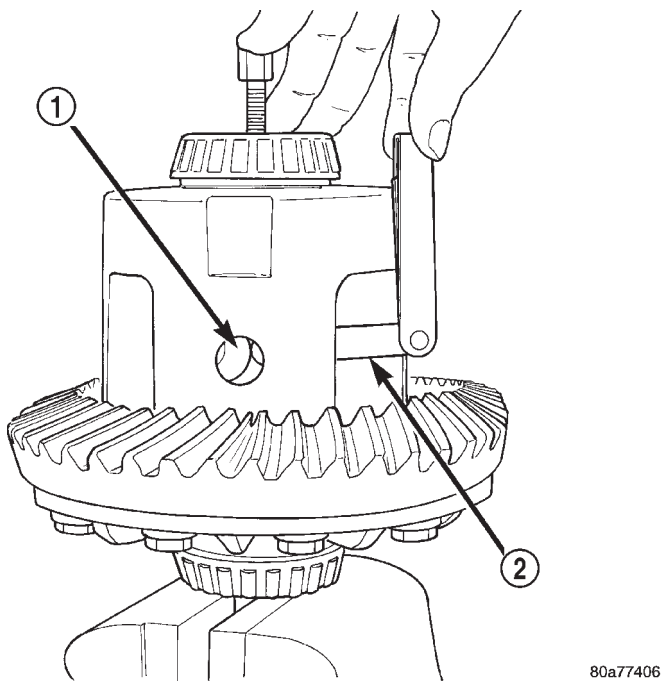
(8) Tighten forcing screw to 122 N-m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 38).



**Fig. 38 COMPRESS BELLEVILLE SPRING**

- 1 - TORQUE WRENCH
- 2 - FORCING SCREW
- 3 - DIFFERENTIAL CASE

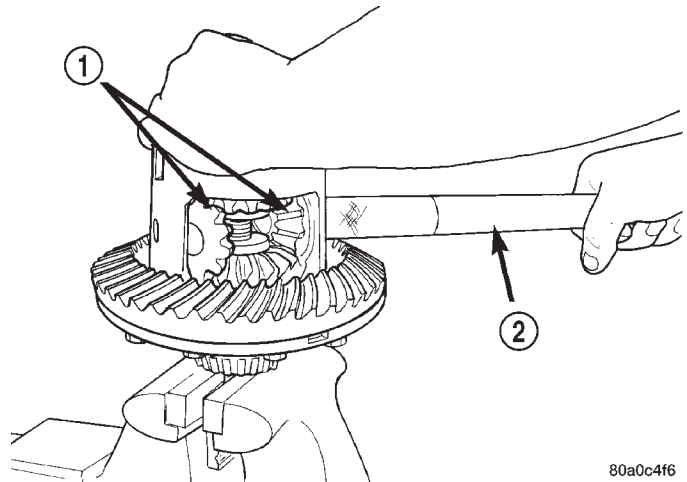
(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 39).



**Fig. 39 PINION GEAR THRUST WASHER**

- 1 - THRUST WASHER
- 2 - FEELER GAUGE

(10) Insert Turning Bar 6960-2 into the pinion mate shaft hole in the case (Fig. 40).



**Fig. 40 PINION GEARS**

- 1 - PINION GEARS
- 2 - TURNING BAR

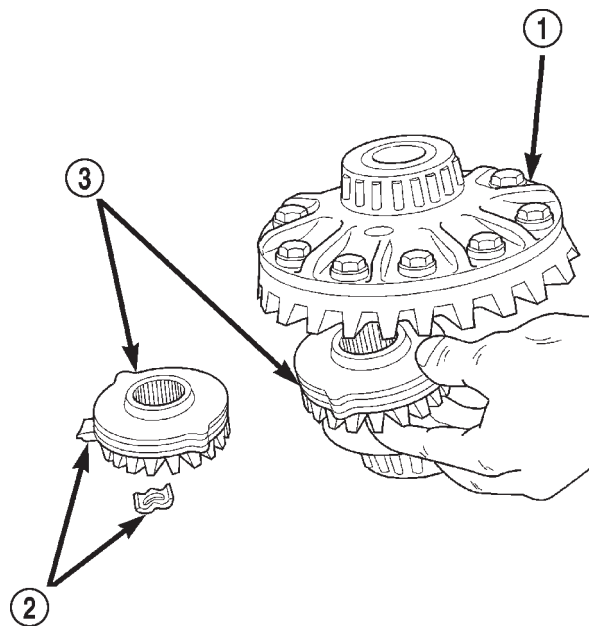
(11) Loosen the Forcing Screw in small increments until the clutch pack tension is relieved and the differential case can be turned using Turning Bar.

(12) Rotate differential case until the pinion gears can be removed.

(13) Remove pinion gears from differential case.

(14) Remove Forcing Screw and discs.

(15) Remove top side gear, clutch pack retainer and clutch pack. Keep plates in order during removal (Fig. 41).



**Fig. 41 SIDE GEARS AND CLUTCH DISCS**

- 1 - DIFFERENTIAL CASE
- 2 - RETAINER
- 3 - SIDE GEAR AND CLUTCH DISC PACK

DIFFERENTIAL - TRAC-LOK (Continued)

(16) Remove differential case from the fixture. Remove side gear, clutch pack retainer and clutch pack. Keep plates in order during removal.

**CLEANING**

Clean all components in cleaning solvent and dry components with compressed air.

**INSPECTION**

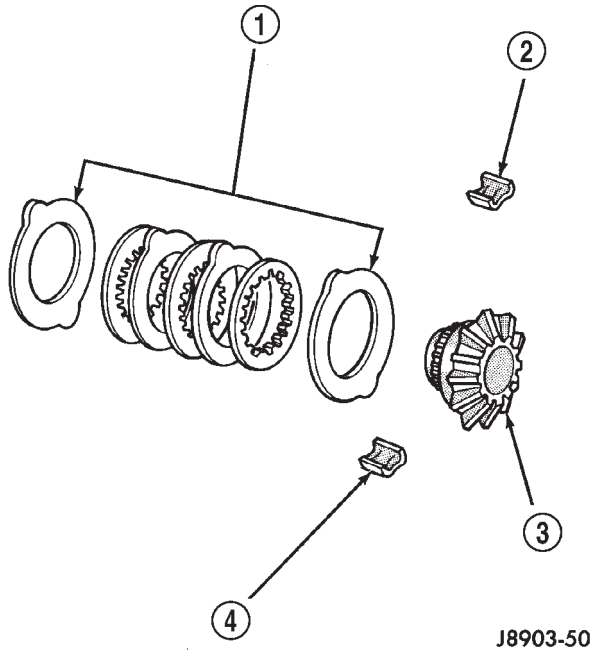
Inspect clutch pack plates for wear, scoring or damage. Replace both clutch packs if any one component in either pack is damaged. Inspect side and pinion gears for cracks chips or damage and replace as necessary. Inspect differential case and pinion shaft and replace if worn or damaged.

**ASSEMBLY**

Lubricate each component with gear lubricant before assembly.

**NOTE: New 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.**

(1) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 42).

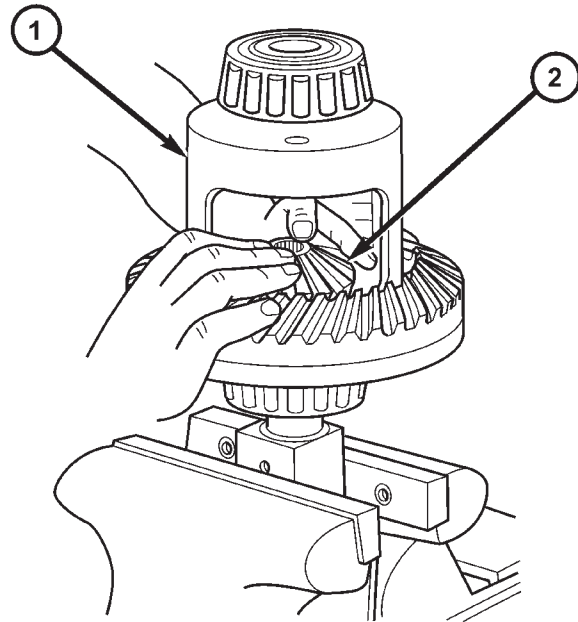


**Fig. 42 CLUTCH DISC PACK**

- 1 - CLUTCH PACK
- 2 - RETAINER
- 3 - SIDE GEAR
- 4 - RETAINER

(2) Install 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. 43). **Verify clutch pack retaining clips are in position and seated in the case pockets.**



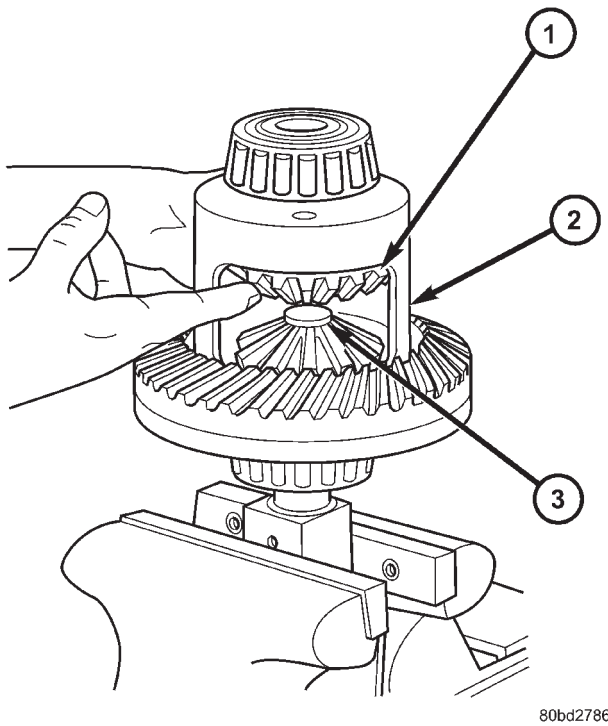
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**Fig. 43 CLUTCH PACK AND LOWER SIDE GEAR**

- 1 - DIFFERENTIAL CASE
- 2 - LOWER SIDE GEAR AND CLUTCH PACK

- (4) Set differential case on Fixture 8138.
- (5) Install lubricated Disc 8140 without the hole in lower side gear (Fig. 44).
- (6) Install the upper side gear and clutch disc pack (Fig. 44).
- (7) Hold assembly in position. Insert Disc 8140 with threaded hole into top side gear.
- (8) Install Forcing Screw 6960-4 and tighten screw to slightly compress clutch disc.
- (9) Place pinion gears in position in side gears and verify that the pinion mate shaft hole is aligned.
- (10) Rotate case with Turning Bar 6960-2 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.
- (11) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.
- (12) 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.
- (13) Remove forcing screw and discs.

## DIFFERENTIAL - TRAC-LOK (Continued)



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**Fig. 44 CLUTCH PACK AND UPPER SIDE GEAR**

- 1 - SIDE GEAR AND CLUTCH PACK
- 2 - DIFFERENTIAL CASE
- 3 - LOWER DISC

(14) Install pinion gear mate shaft and align holes in shaft and case.

(15) Install pinion mate shaft lock screw finger tight to hold shaft during differential installation.

(16) Lubricate all differential components with hypoid gear lubricant.

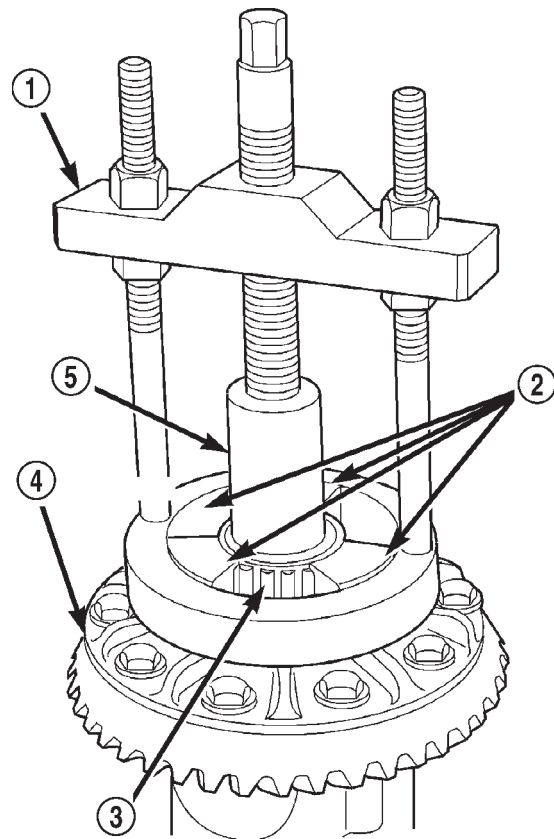
## DIFFERENTIAL CASE BEARINGS

### REMOVAL

- (1) Remove differential case from axle.
- (2) Remove differential bearings from the case with Puller/Press C-293-PA and Adapters C-293-48 and Plug SP-3289 (Fig. 45).

### INSTALLATION

- (1) Install differential side bearings with Installer C-4340 and Handle C-4171 (Fig. 46).
- (2) Install differential case in axle.



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**Fig. 45 Differential Bearing Puller**

- 1 - PULLER
- 2 - ADAPTERS
- 3 - BEARING
- 4 - DIFFERENTIAL
- 5 - PLUG

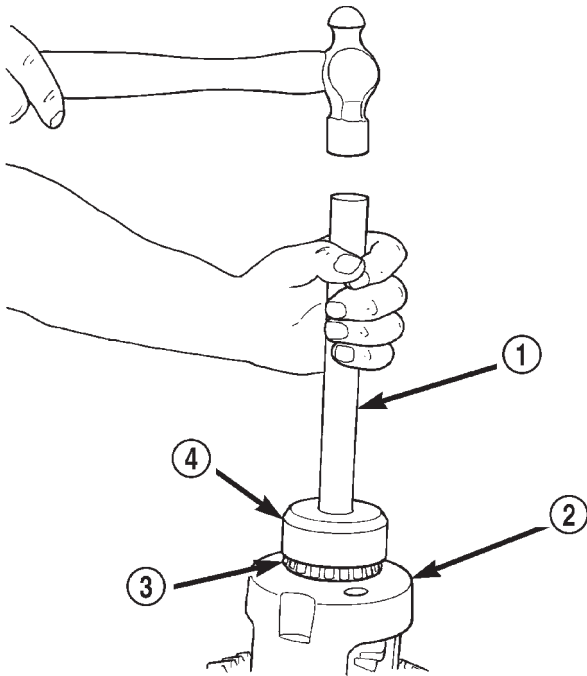
## PINION GEAR/RING GEAR/TONE RING

### REMOVAL

**CAUTION:** The ring and pinion gears are serviced in a matched set. Never replace one gear without replacing the other matched gear.

- (1) Mark pinion yoke and propeller shaft for installation reference.
- (2) Remove propeller shaft from pinion yoke and tie propeller shaft to underbody.
- (3) Remove differential from axle housing.
- (4) Place differential case in a vise with soft metal jaw (Fig. 47).
- (5) Remove bolts holding ring gear to differential case.
- (6) Drive ring gear from the differential case with a rawhide hammer.

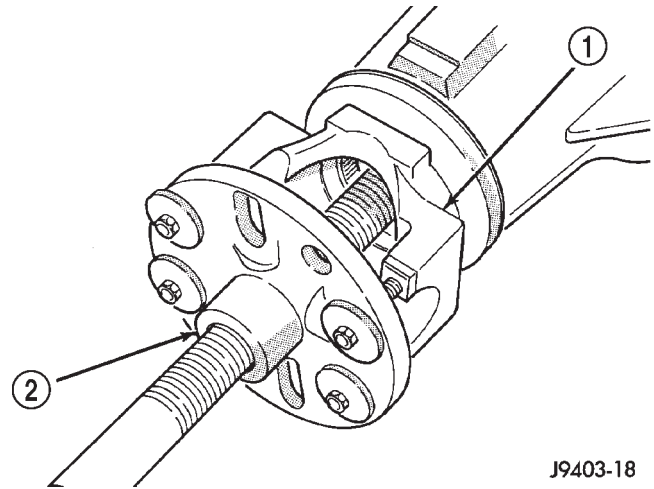
PINION GEAR/RING GEAR/TONE RING (Continued)



**Fig. 46 Differential Bearing Installer**

- 1 - HANDLE
- 2 - DIFFERENTIAL
- 3 - BEARING
- 4 - INSTALLER

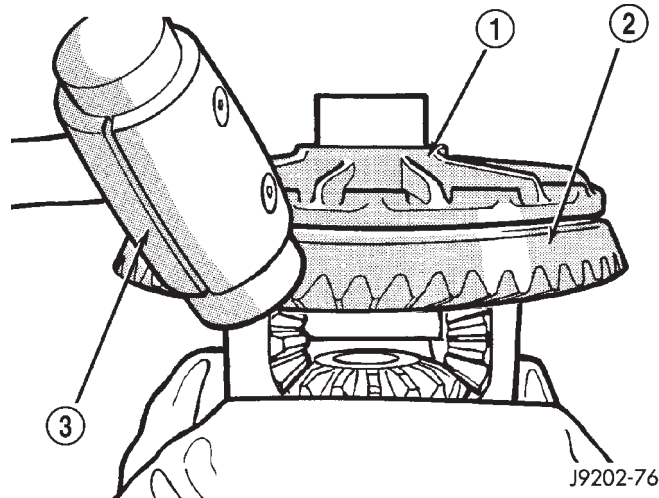
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J9403-18

**Fig. 48 Pinion Yoke**

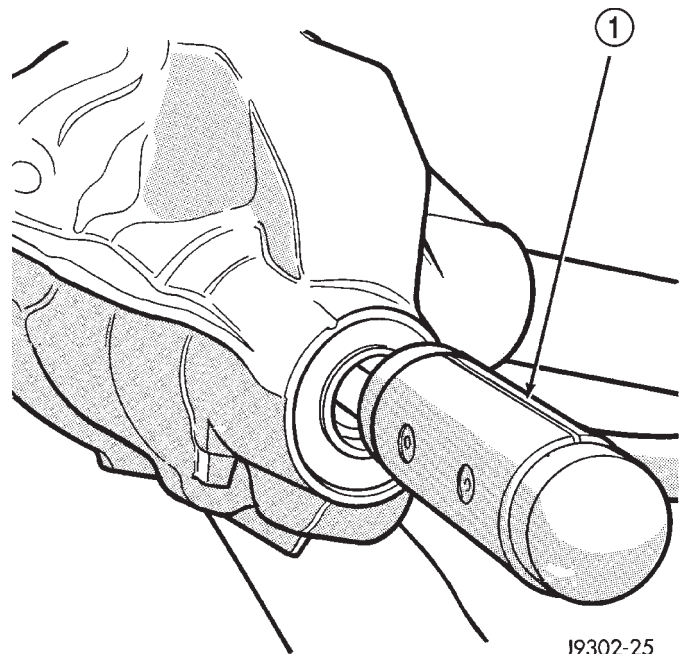
- 1 - PINION YOKE
- 2 - REMOVER



J9202-76

**Fig. 47 Ring Gear**

- 1 - CASE
- 2 - RING GEAR
- 3 - RAWHIDE HAMMER



J9302-25

**Fig. 49 Pinion Gear**

- 1 - RAWHIDE HAMMER

(7) Hold pinion yoke with Holder 6719A and remove pinion yoke nut and washer.

(8) Remove pinion yoke from pinion shaft with Remover C-452 (Fig. 48).

(9) Remove pinion from the housing (Fig. 49).

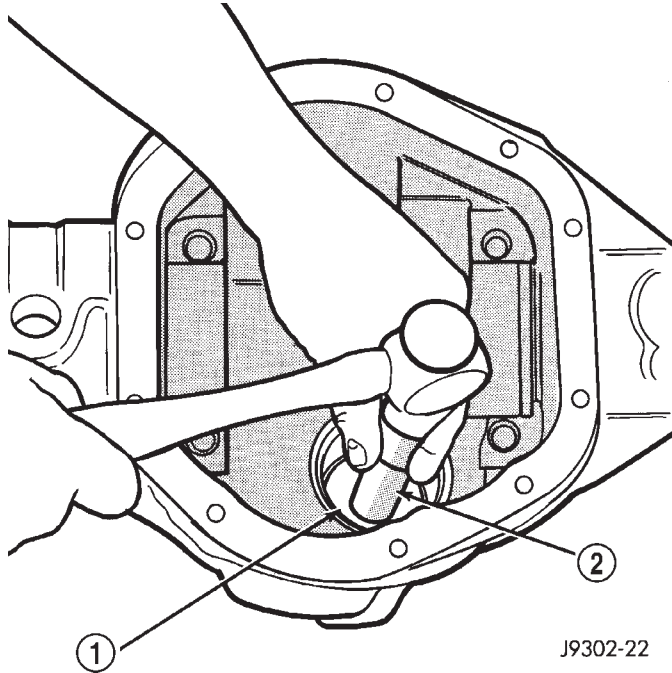


## PINION GEAR/RING GEAR/TONE RING (Continued)

(10) Remove pinion shaft seal with a pry tool or slide-hammer mounted screw.

(11) Remove oil slinger, if equipped, and front pinion bearing.

(12) Remove front pinion bearing cup with Remover C-4345 and Handle C-4171 (Fig. 50).



**Fig. 50 Front Pinion Bearing Cup**

- 1 - REMOVER
- 2 - HANDLE

(13) Remove rear bearing cup from housing (Fig. 51) with Remover C-4307 and Handle C-4171.

(14) Remove collapsible preload spacer (Fig. 52).

(15) Remove rear bearing from the pinion (Fig. 53) with Puller/Press C-293-PA and Adapters C-293-47.

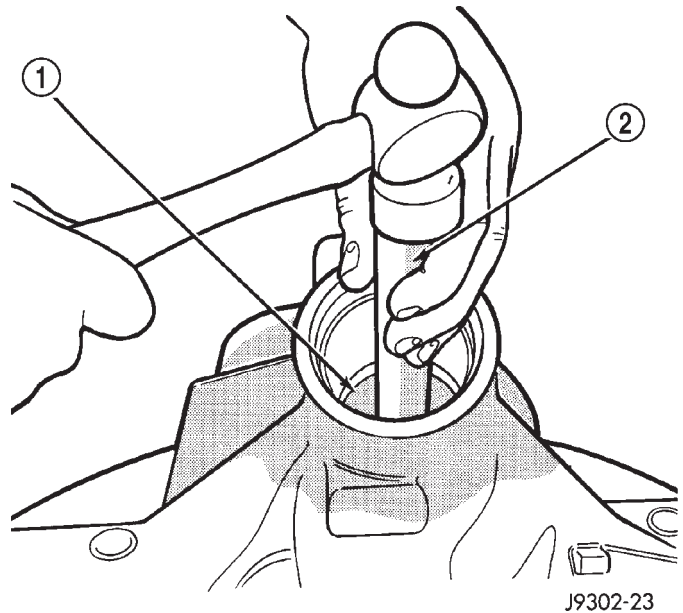
(16) Remove depth shims from the pinion shaft and record the shims thickness.

## INSTALLATION

**NOTE:** A pinion depth shim/oil baffle is placed between the rear pinion bearing cone and pinion gear. If the ring and pinion gears are reused, the original pinion depth shim/oil baffle can be used. Refer to Adjustments (Pinion Gear Depth) to select the proper shim thickness if ring and pinion gear are replaced.

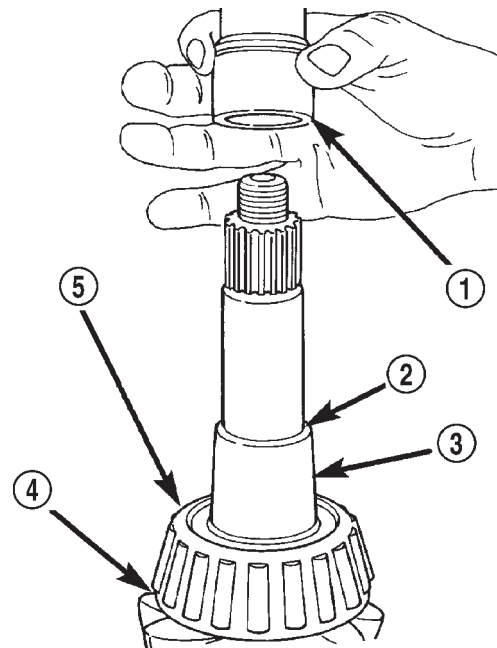
(1) Apply Mopar Door Ease or equivalent lubricant to outside surface of pinion bearing cups.

(2) Install rear pinion bearing cup (Fig. 54) with Installer C-4308 and Handle C-4171 and verify cup is seated.



**Fig. 51 Rear Pinion Bearing Cup**

- 1 - DRIVER
- 2 - HANDLE

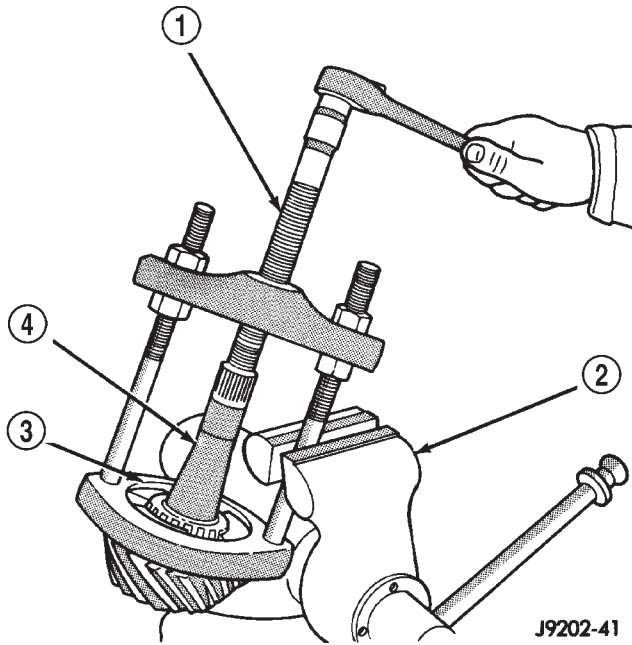


**Fig. 52 Collapsible Spacer**

- 1 - COLLAPSIBLE SPACER
- 2 - SHOULDER
- 3 - PINION
- 4 - PINION DEPTH SHIM
- 5 - REAR BEARING

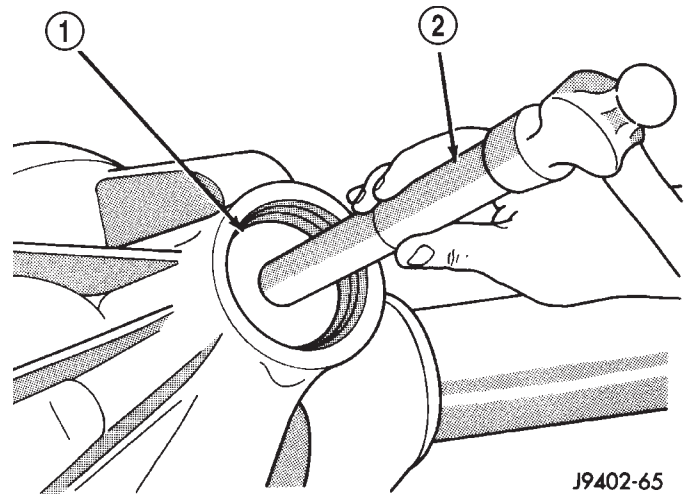
(3) Install front pinion bearing cup (Fig. 55) with Installer D-130 and Handle C-4171 and verify cup is seated.

PINION GEAR/RING GEAR/TONE RING (Continued)



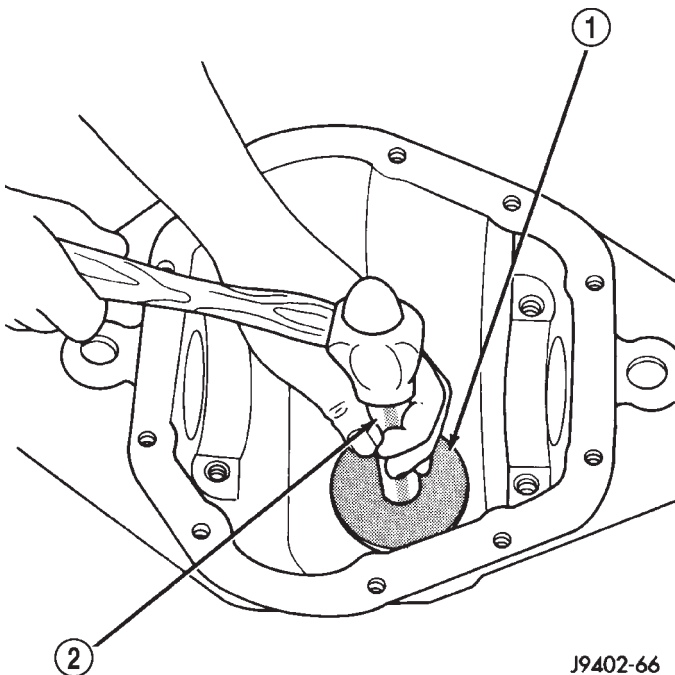
**Fig. 53 Rear Pinion Bearing Puller**

- 1 - PULLER
- 2 - VISE
- 3 - ADAPTERS
- 4 - PINION GEAR SHAFT



**Fig. 55 Front Bearing Cup**

- 1 - INSTALLER
- 2 - HANDLE

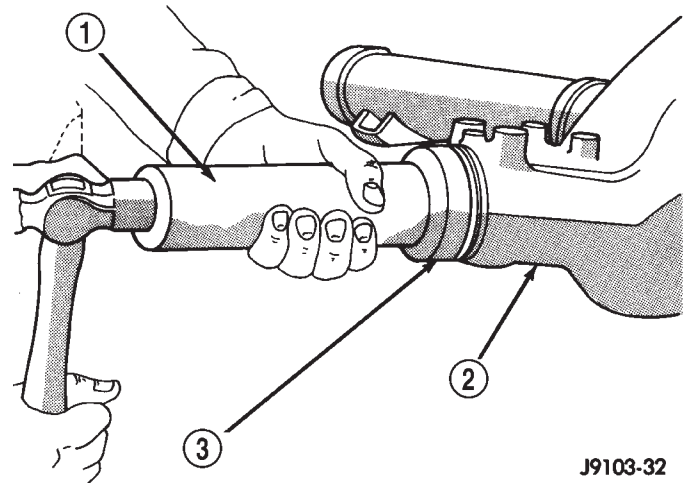


**Fig. 54 Rear Pinion Bearing Cup**

- 1 - INSTALLER
- 2 - HANDLE

(4) Install pinion front bearing and oil slinger, if equipped.

(5) Apply a light coating of gear lubricant on the lip of pinion seal and install seal with Installer C-4076-B and Handle C-4735 (Fig. 56).



**Fig. 56 Pinion Seal**

- 1 - HANDLE
- 2 - DIFFERENTIAL HOUSING
- 3 - INSTALLER

(6) Place proper thickness depth shim on the pinion.

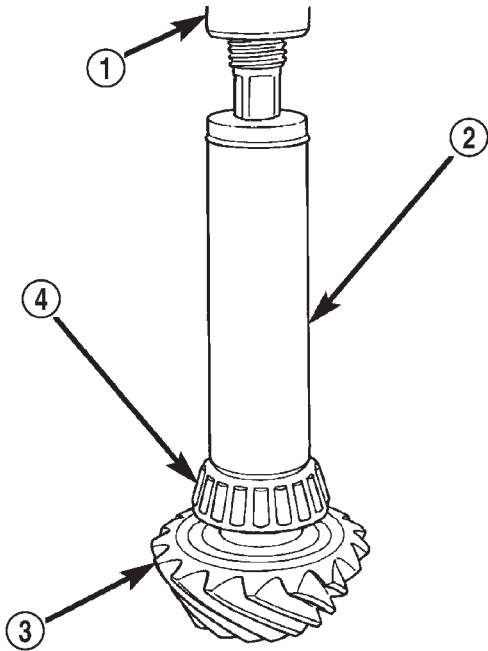
(7) Install rear bearing and slinger if equipped, on the pinion shaft (Fig. 57) with Installer 6448 and a press.

(8) Install a **new** collapsible preload spacer on pinion shaft and install pinion in housing (Fig. 58).

(9) Install pinion in housing.

(10) Install yoke with Installer C-3718 and Yoke Holder 6719A.

PINION GEAR/RING GEAR/TONE RING (Continued)



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**Fig. 57 Rear Pinion Bearing**

- 1 - PRESS
- 2 - INSTALLATION
- 3 - PINION GEAR
- 4 - REAR PINION BEARING

(11) Install yoke washer and a new nut on the pinion. The convex side of the washer must face outward.

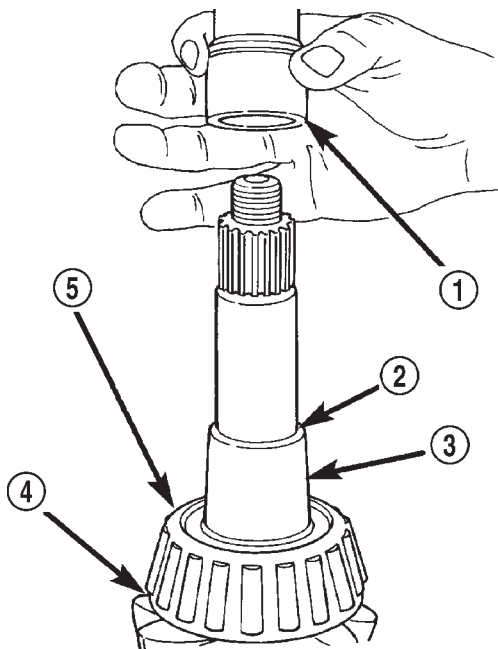
(12) Tighten the nut to 285 N·m (210 ft. lbs.).

**CAUTION: Never loosen pinion nut to decrease pinion rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed.**

(13) Holding the yoke with Holder 6719A 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 spacer (Fig. 59).

(14) Check bearing rotating torque with an inch pound torque wrench (Fig. 59). The pinion gear rotating torque should be:

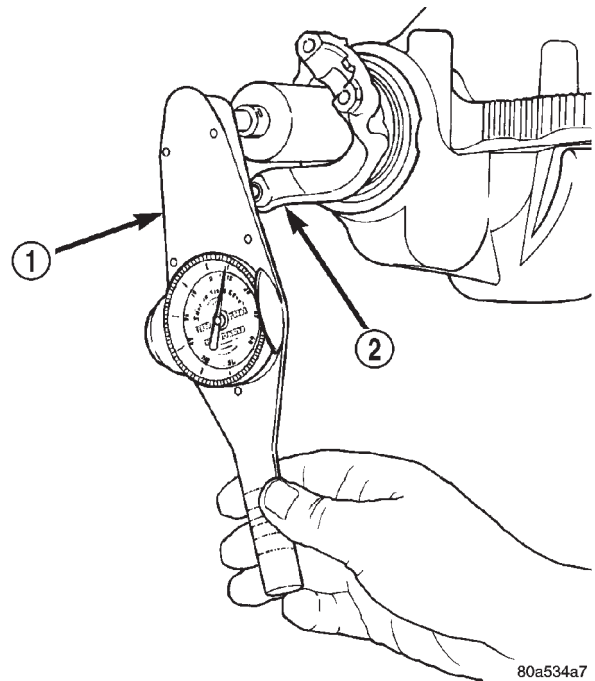
- Original Bearings: 1 to 2 N·m (10 to 20 in. lbs.).
- New Bearings: 1 to 5 N·m (10 to 30 in. lbs.).



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**Fig. 58 Collapsible Preload Spacer**

- 1 - COLLAPSIBLE SPACER
- 2 - SHOULDER
- 3 - PINION
- 4 - PINION DEPTH SHIM
- 5 - REAR BEARING



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**Fig. 59 Pinion Rotating Torque**

- 1 - TORQUE WRENCH
- 2 - PINION YOKE

## PINION GEAR/RING GEAR/TONE RING (Continued)

(15) Invert the differential case.

(16) Install ring gear on the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.

(17) Invert the differential case in the vise.

(18) Install **new** ring gear bolts and alternately tighten to 102 N-m (75 ft. lbs.) (Fig. 60).

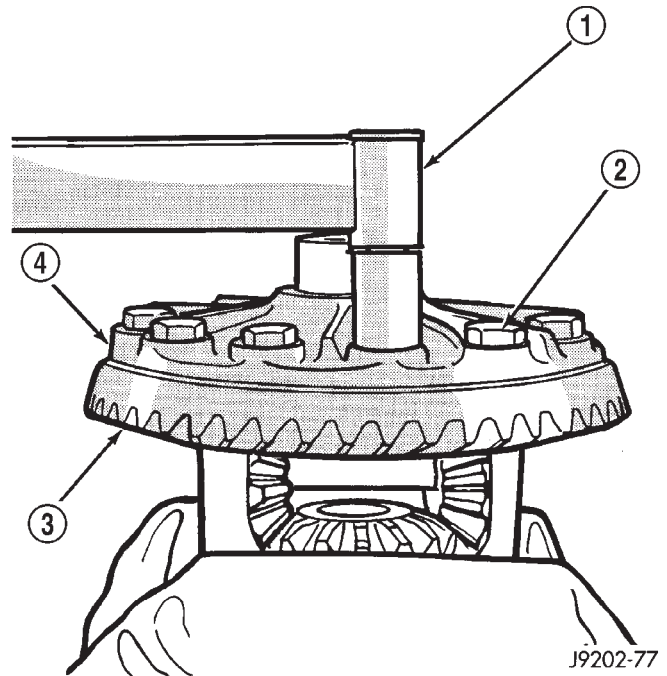
**CAUTION:** Never reuse the ring gear bolts. The bolts can fracture causing extensive damage.

(19) Install differential in axle housing and verify gear mesh refer to Adjustments (Gear Contact Pattern).

(20) Install differential cover fill with gear lubricant.

(21) Install the propeller shaft with reference marks aligned.

(22) Install wheel and tire assemblies and lower the vehicle.



**Fig. 60 Ring Gear**

- 1 - TORQUE WRENCH
- 2 - BOLTS
- 3 - RING GEAR
- 4 - DIFFERENTIAL CASE



# BRAKES

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## BRAKES - BASE

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## BRAKES - BASE

### DESCRIPTION

Power assist front disc and rear drum brakes are standard equipment. Disc brake components consist of single piston calipers and ventilated rotors. Rear drum brakes are dual shoe units with cast brake drums.

The parking brake mechanism is lever and cable operated. The cables are attached to levers on the rear drum brake secondary shoes. The parking brakes are operated by a hand lever.

A dual diaphragm vacuum power brake booster is used for all applications. All models have an aluminum master cylinder with plastic reservoir.

All models are equipped with a combination valve. The valve contains a pressure differential valve and switch and a fixed rate rear proportioning valve.

Factory brake lining on all models consists of an organic base material combined with metallic particles. The original equipment linings do not contain asbestos.

### WARNING

**WARNING: DUST AND DIRT ACCUMULATING ON BRAKE PARTS DURING NORMAL USE MAY CONTAIN ASBESTOS FIBERS FROM AFTERMARKET 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.**

## BRAKES - BASE (Continued)

**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 slide pins to ensure proper operation.

## 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.**

(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.

An internal leak in the ABS or RWAL system may also be the problem with no physical evidence.

### 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.



## BRAKES - BASE (Continued)

## 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.

- Long booster output rod.

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 - BASE (Continued)

### 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.

### 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.

## STANDARD PROCEDURE

### STANDARD PROCEDURE - PRESSURE 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

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.

## BRAKES - BASE (Continued)

**STANDARD PROCEDURE - MANUAL 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:

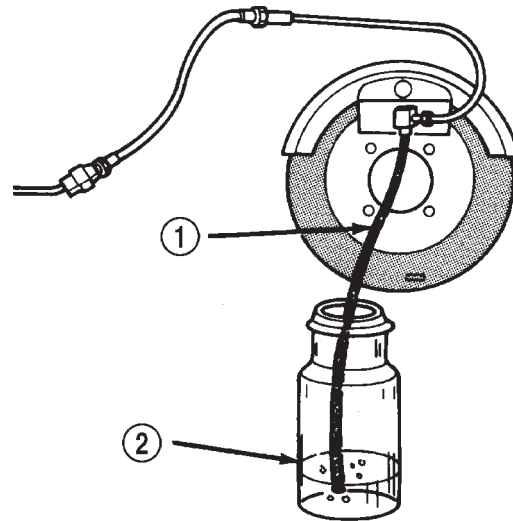
- Master Cylinder
- Combination Valve
- Right Rear Wheel
- Left Rear Wheel
- Right Front Wheel
- Left Front Wheel

(1) Remove reservoir filler caps and fill reservoir.

(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. 1). Be sure end of bleed hose is immersed in fluid.

(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.



J8905-18

**Fig. 1 Bleed Hose Setup**

1 - BLEED HOSE

2 - FLUID CONTAINER PARTIALLY FILLED WITH FLUID

**SPECIFICATIONS****BRAKE COMPONENTS***SPECIFICATIONS*

DESCRIPTION	SPECIFICATION
Disc Brake Rotor Ventilated	Max. Runout 0.12 mm (0.005 in.)
Disc Brake Rotor Ventilated	Max. Thickness Variation 0.013 mm (0.0005 in.)
Disc Brake Rotor Ventilated	Min. Thickness 22.7 mm (0.8937 in.)
Disc Brake Caliper	Sliding
Brake Drum	9 in. or 10 in.
Brake Booster	Dual Diaphragm

BRAKES - BASE (Continued)

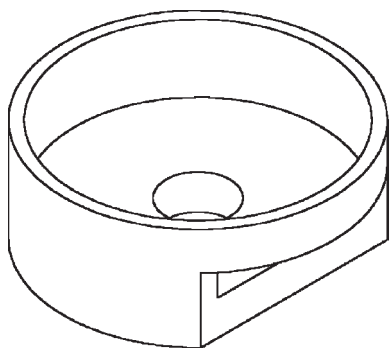
**TORQUE**

TORQUE SPECIFICATIONS

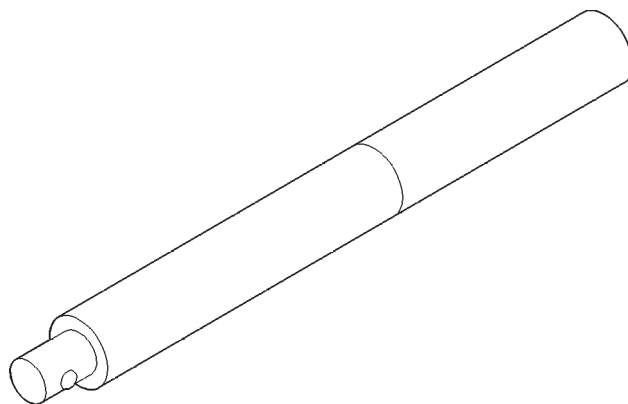
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Brake Pedal Pivot Bolt/Nut	35	26	—
Brake Booster Mounting Nuts	39	29	—
Brake Pedal to the Column Nut	22.6	—	200
Master Cylinder Mounting Nuts	25	—	220
Master Cylinder Brake Lines	20	15	180
Combination Valve Mounting Nuts	17.5	—	155
Combination Valve Brake Lines	20	15	180
Caliper Mounting Bolts	15	11	—
Caliper Brake Hose Bolt	31	23	—
Wheel Cylinder Mounting Bolts	10	7	—
Wheel Cylinder Brake Line	14	—	124
Parking Brake Lever Screws	10-14	7-10	—
Parking Brake Lever Bracket Screws	10-14	7-10	—

SPECIAL TOOLS

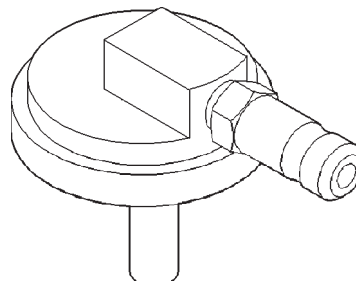
BASE BRAKES



*Installer Caliper Dust Boot 8280*



*Handle C-4171*



*Adapter Pressure Bleeder 6921*

## BRAKE LINES

### DESCRIPTION

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. Double inverted style and ISO style flares are used on the brake lines.

### DIAGNOSIS AND TESTING - 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.

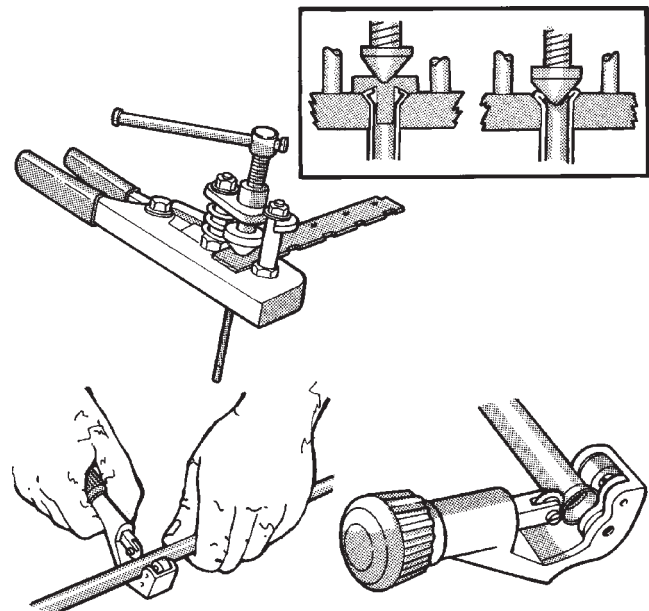
### STANDARD PROCEDURE

#### STANDARD PROCEDURE - DOUBLE INVERTED FLARING

A preformed metal brake tube is recommended and preferred for all repairs. However, double-wall steel tube can be used for emergency repair when factory replacement parts are not readily available.

Special bending tools are needed to avoid kinking or twisting of metal brake tubes. Special flaring tools are needed to make a double inverted flare or ISO flare.

- (1) Cut off damaged tube with Tubing Cutter.
- (2) Ream cut edges of tubing to ensure proper flare.
- (3) Install replacement tube nut on the tube.
- (4) Insert tube in flaring tool.
- (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) Tighten the tool bar on the tube
- (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. 2).
- (9) Tighten tool handle until plug gauge is squarely seated on jaws of flaring tool. This will start the inverted flare.
- (10) Remove the plug gauge and complete the inverted flare.



RH222

*Fig. 2 Inverted*

#### STANDARD PROCEDURE - ISO FLARING

A preformed metal brake tube is recommended and preferred for all repairs. However, double-wall steel tube can be used for emergency repair when factory replacement parts are not readily available.

Special bending tools are needed to avoid kinking or twisting of metal brake tubes. Special flaring tools are needed to make a double inverted flare or ISO flare.

To make a ISO flare use a ISO brake flaring tool or equivalent.

- (1) Cut off damaged tube with Tubing Cutter.
- (2) Remove any burrs from the inside of the tube.
- (3) Install tube nut on the tube.

**BRAKE LINES (Continued)**

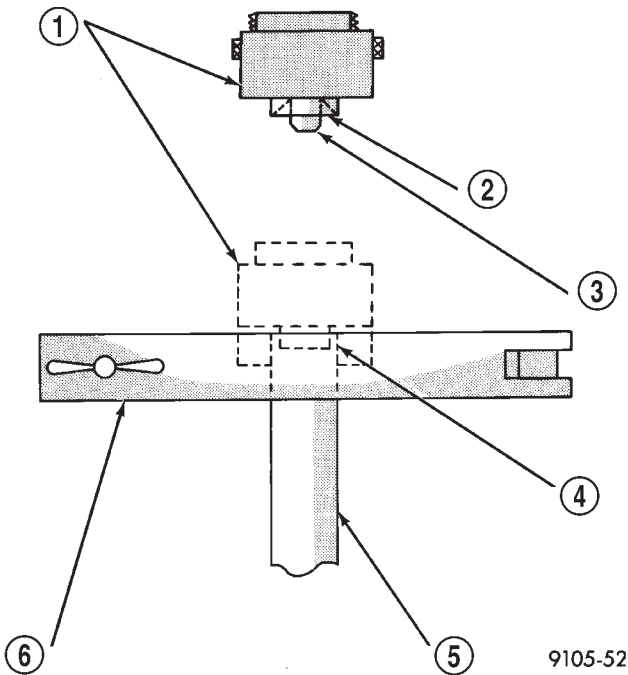
(4) Position the tube in the flaring tool flush with the top of the tool bar (Fig. 3). Then tighten the tool bar on the tube.

(5) Install the correct size adaptor on the flaring tool yoke screw.

(6) Lubricate the adaptor.

(7) Align the adaptor and yoke screw over the tube (Fig. 3).

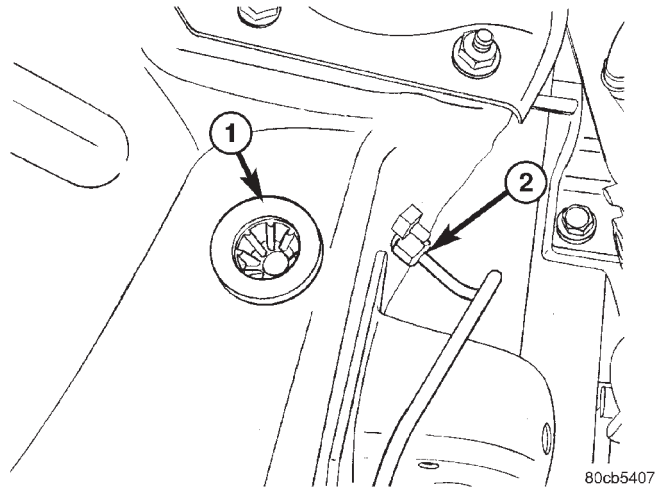
(8) Turn the yoke screw in until the adaptor is squarely seated on the tool bar.



**Fig. 3 ISO Flaring**

- 1 - ADAPTER
- 2 - LUBRICATE HERE
- 3 - PILOT
- 4 - FLUSH WITH BAR
- 5 - TUBING
- 6 - BAR ASSEMBLY

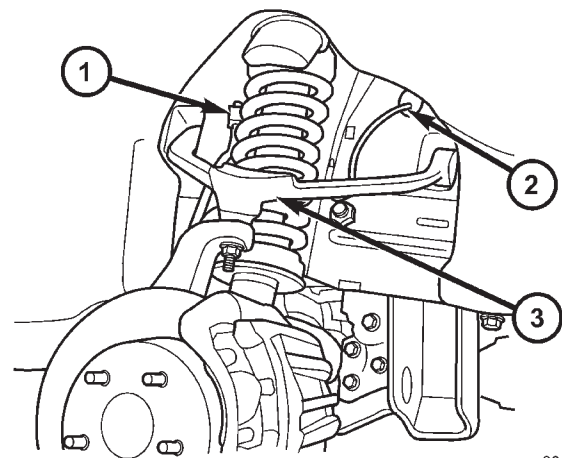
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**Fig. 4 INNER FENDER BRAKE LINE**

- 1 - GROMMET
- 2 - BRAKE LINE

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**Fig. 5 FRONT BRAKE HOSE**

- 1 - TOP OF FRONT BRAKE HOSE
- 2 - WHEEL SPEED SENSOR WIRE
- 3 - UPPER CONTROL ARM

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**REMOVAL**

**REMOVAL - FRONT HOSE**

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Remove the brake line from the brake hose inside the engine compartment by the front control arm bolt (Fig. 4).

(3) Raise and support vehicle.

(4) Remove the brake hose banjo bolt at the caliper.

(5) Remove the mounting bolt for the top of the brake hose at the vehicle (Fig. 5).

(6) Remove the hose.

**REMOVAL - REAR BRAKE HOSE**

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Raise and support the vehicle.

(3) Remove the brake line from the hose at the body (Fig. 6).

(4) Remove the brake hose mounting bolt at the top of the hose located at the body (Fig. 6).

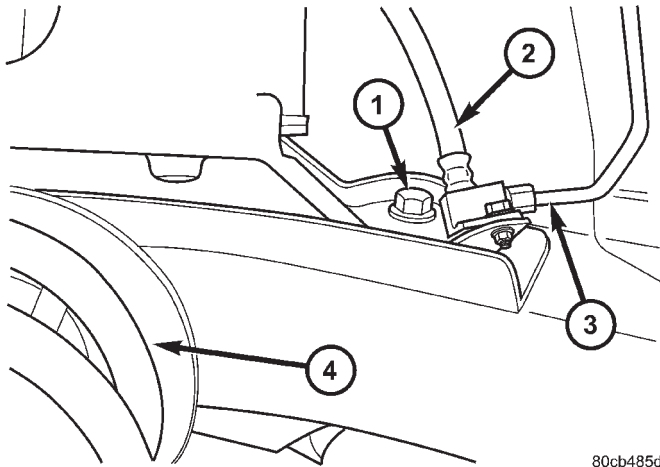
(5) Remove the vent tube (Fig. 7).

(6) Remove the two brake lines at the bottom of the hose located at the axle (Fig. 7).

(7) Remove the mounting bolt for the brake hose at the axle (Fig. 7).

(8) Remove the hose.

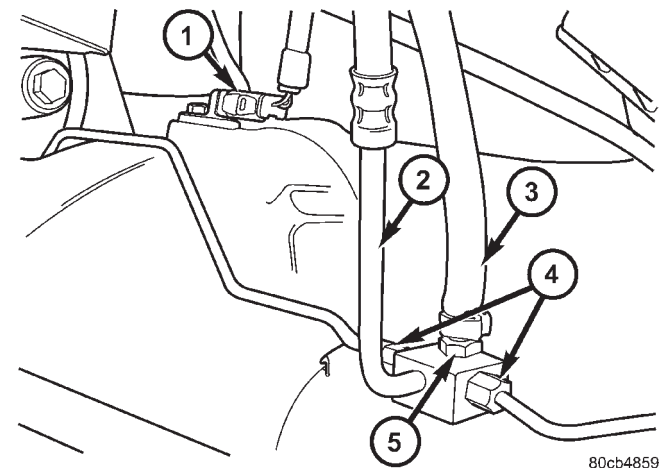
## BRAKE LINES (Continued)



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**Fig. 6 BRAKE HOSE AT THE BODY**

- 1 - MOUNTING BOLT
- 2 - BRAKE HOSE
- 3 - BRAKE LINE
- 4 - COIL SPRING



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**Fig. 7 BRAKE HOSE AT THE AXLE**

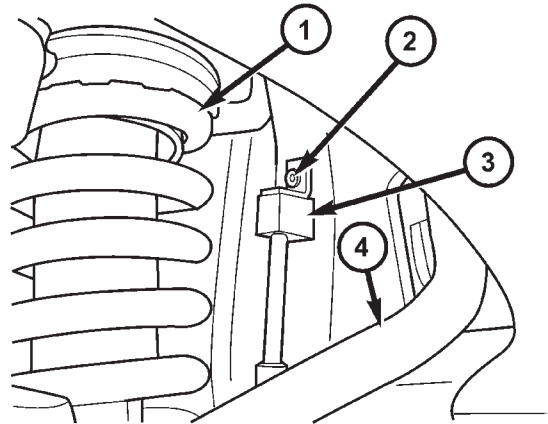
- 1 - REAR WHEEL SPEED SENSOR
- 2 - BRAKE HOSE
- 3 - VENT HOSE
- 4 - BRAKE LINES
- 5 - MOUNTING BOLT

## INSTALLATION

**INSTALLATION - FRONT BRAKE HOSE**

- (1) Install the hose.
- (2) Install the mounting bolt for the top of the brake hose at the vehicle (Fig. 8).

- (3) Install the brake hose banjo bolt at the caliper.
- (4) Lower the vehicle and remove the support.
- (5) Install the brake line to the brake hose inside the engine compartment by the front control arm bolt.
- (6) Remove the prop rod from the brake pedal.
- (7) Bleed the brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).



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**Fig. 8 BRAKE HOSE MOUNTED**

- 1 - COIL SPRING
- 2 - MOUNTING BOLT
- 3 - BRAKE HOSE
- 4 - FRONT OF THE UPPER CONTROL ARM

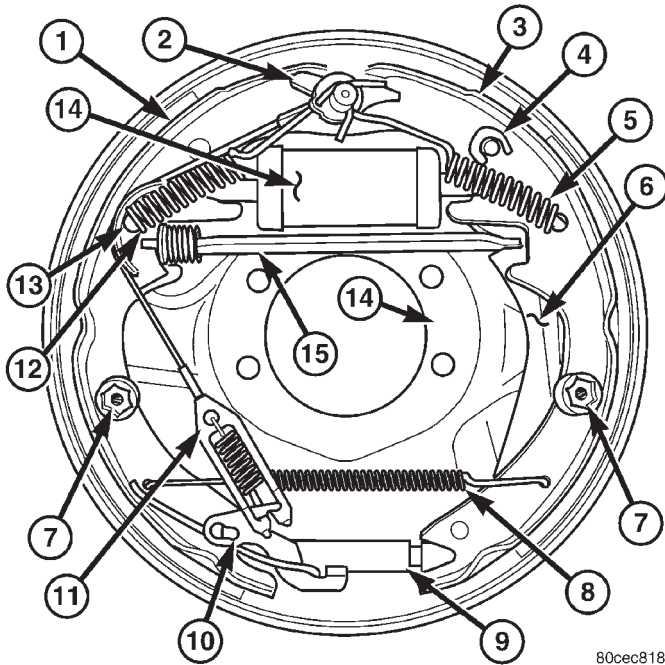
**INSTALLATION - REAR BRAKE HOSE**

- (1) Install the hose.
- (2) Install the mounting bolt for the brake hose at the axle (Fig. 7).
- (3) Install the two brake lines at the bottom of the hose located at the axle (Fig. 7).
- (4) Install the vent tube (Fig. 7).
- (5) Install the brake hose mounting bolt at the top of the hose located at the body (Fig. 6).
- (6) Install the brake line to the hose at the body (Fig. 6).
- (7) Lower the vehicle and remove the support.
- (8) Remove the prop rod.
- (9) Bleed the brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

**BRAKE PADS / SHOES****DESCRIPTION - REAR DRUM BRAKE**

The rear brakes use a leading shoe (primary) and trailing shoe (secondary) design (Right rear brake is shown) (Fig. 9).

## BRAKE PADS / SHOES (Continued)



**Fig. 9 BRAKE COMPONENTS**

- 1 - SECONDARY SHOE
- 2 - SHOE GUIDE PLATE
- 3 - PRIMARY SHOE
- 4 - HORSE SHOE RETAINING CLIP
- 5 - PRIMARY RETURN SPRING
- 6 - PARK BRAKE STRUT
- 7 - HOLD DOWN SPRING AND RETAINERS
- 8 - SHOE RETURN SPRING
- 9 - ADJUSTER SCREW ASSEMBLY
- 10 - ADJUSTER LEVER
- 11 - ADJUSTER CABLE
- 12 - SECONDARY RETURN SPRING
- 13 - CABLE GUIDE
- 14 - WHEEL CYLINDER
- 15 - PARK BRAKE STRUT AND SPRING
- 16 - SUPPORT PLATE

## OPERATION - REAR DRUM BRAKE

When the brake pedal is depressed hydraulic pressure pushes the rear brake wheel cylinder pistons outward. The wheel cylinder push rods then push the brake shoes outward against the brake drum. When the brake pedal is released return springs attached to the brake shoes pull the shoes back to their original position (Fig. 9).

## REMOVAL

### REMOVAL - FRONT BRAKE PADS

- (1) Raise and support the vehicle.
- (2) Remove the front wheel and tire assembly.
- (3) Drain a small amount of fluid from the master cylinder brake reservoir with a **clean** suction gun.

- (4) Bottom the caliper pistons into the caliper by prying the caliper over.
- (5) Remove the caliper mounting bolts.
- (6) Remove the disc brake caliper from the mount.

**CAUTION:** Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose will result. Provide a suitable support to hang the caliper securely.

- (7) Remove the inboard and outboard pads.

### REMOVAL - DRUM BRAKE SHOES

- (1) Raise the vehicle and remove the rear wheels.
- (2) Remove and discard the spring nuts securing drums to wheel studs.
- (3) Remove the brake drums. If drums prove difficult to remove, retract brake shoes. Remove the access hole plug at the rear of backing plate and back off adjuster screw with brake tool and screwdriver.
- (4) Clean the individual brake components, including the support plate and wheel cylinder exterior, with a fine mist of water. Then wipe the brake components clean with a dampened cloth.
- (5) Remove the primary and secondary return springs from anchor pin with the brake spring pliers.
- (6) Remove the U-clip and washer securing adjuster cable to the parking brake lever.
- (7) Remove the hold-down springs, retainers and pins with standard retaining spring tool.
- (8) Remove the parking brake strut and cable guide.
- (9) Remove the adjuster lever, adjuster screw and spring.
- (10) Remove the adjuster cable.
- (11) Remove the brake shoes.
- (12) Disconnect the cable from the parking brake lever and remove the lever ( if needed).

## INSTALLATION

### INSTALLATION - FRONT BRAKE PADS

- (1) Install the inboard and outboard pads.
- (2) Install the caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).
- (3) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

### INSTALLATION - DRUM BRAKE SHOES

Bonded linings should be replaced when worn to a thickness of 1.6 mm (1/16 in.).



## BRAKE PADS / SHOES (Continued)

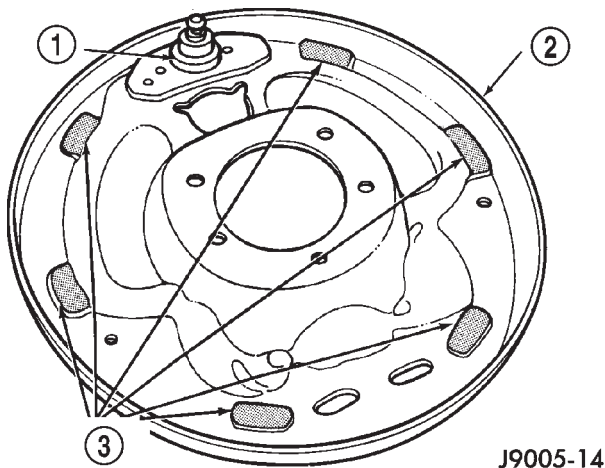
Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across its entire width. Shoes exhibiting contact only on one side should be replaced and the drum checked for runout or taper.

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.

- (1) Clean support plate with brake cleaner.
- (2) If new drums are being installed, remove protective coating with carburetor cleaner followed by final rinse with brake cleaner.
- (3) Clean and lubricate anchor pin with light coat of Mopar multi-mileage grease.
- (4) Apply Mopar multi-mileage grease to brake shoe contact surfaces of support plate (Fig. 10).



**Fig. 10 Shoe Contact Surfaces**

- 1 - ANCHOR PIN
- 2 - SUPPORT PLATE
- 3 - SHOE CONTACT SURFACES

(5) Lubricate the adjuster screw threads and pivot with spray lube.

(6) Attach parking brake lever to secondary brake shoe. Use new washer and U-clip to secure lever.

(7) Attach the parking brake cable to lever (if removed).

(8) Install the brake shoes on support plate. Secure shoes with new hold-down springs, pins and retainers.

(9) Install the parking brake strut and spring.

(10) Install the guide plate and adjuster cable on anchor pin.

(11) Install the adjuster cable guide on the shoe.

(12) Install the primary and secondary return springs.

(13) Lubricate and assemble adjuster screw.

(14) Install the adjuster screw, spring and lever and connect to adjuster cable.

(15) Adjust the shoes to the drum (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - ADJUSTMENTS).

(16) Install the brake drum.

(17) Install the wheel/tire assemblies and lower vehicle (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(18) Verify firm brake pedal before moving vehicle.

## ADJUSTMENTS

### ADJUSTMENT - 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. 11).
- (5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 12). If gauge does not fit (too loose/too tight), adjust shoes.

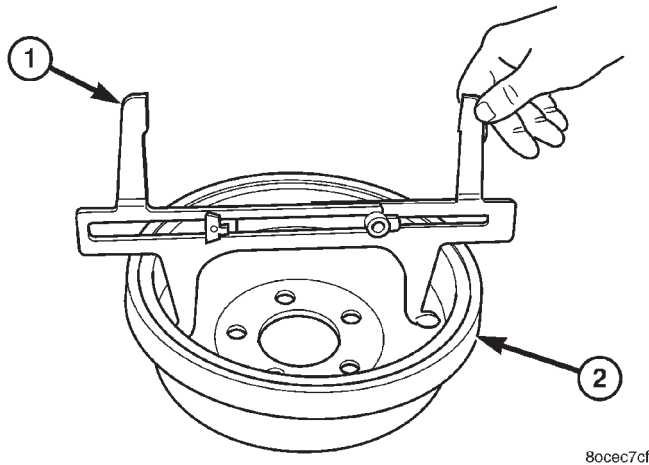
(6) Pull shoe adjuster lever away from adjuster screw star wheel.

(7) Turn adjuster screw star wheel (by hand) to expand or retract brake shoes. Continue adjustment until gauge outside legs are light drag-fit or 30 thousandths of an inch clearance on the shoes.

(8) Install brake drums and wheels and lower vehicle.

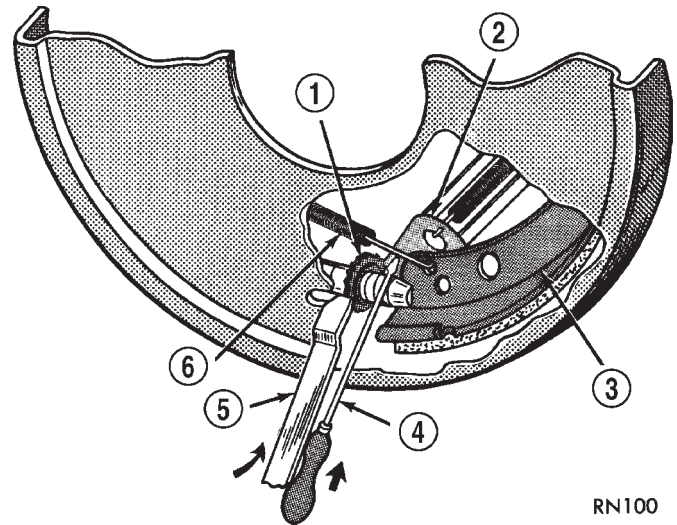
(9) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

BRAKE PADS / SHOES (Continued)



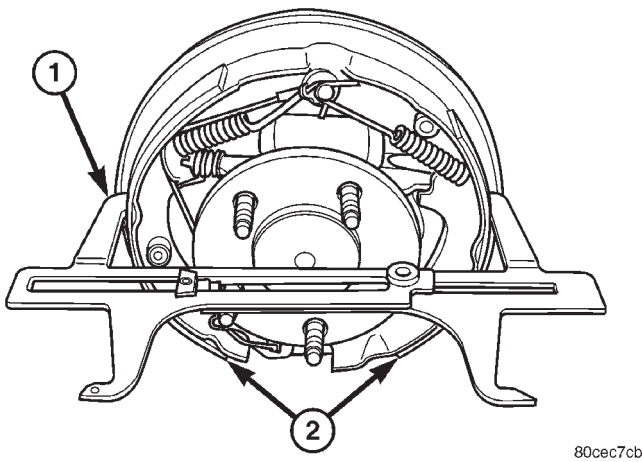
**Fig. 11 ADJUSTING GAUGE ON DRUM**

- 1 - BRAKE GAUGE
- 2 - BRAKE DRUM



**Fig. 13 Brake Adjustment**

- 1 - STAR WHEEL
- 2 - LEVER
- 3 - BRAKE SHOE WEB
- 4 - SCREWDRIVER
- 5 - ADJUSTING TOOL
- 6 - ADJUSTER SPRING



**Fig. 12 ADJUSTING GAUGE ON BRAKE SHOES**

- 1 - BRAKE GAUGE
- 2 - BRAKE SHOES

**NOTE:** Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

(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) 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. 13).

**DISC BRAKE CALIPERS**

**DESCRIPTION**

The calipers are a single piston type. The calipers are free to slide laterally, this allows continuous compensation for lining wear.

## DISC BRAKE CALIPERS (Continued)

## OPERATION

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. 14).

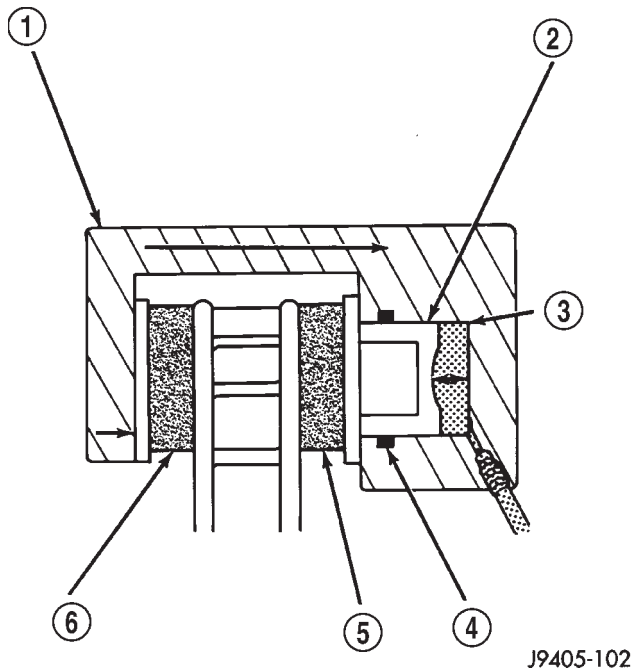


Fig. 14 Brake Caliper Operation

- 1 - CALIPER
- 2 - PISTON
- 3 - PISTON BORE
- 4 - SEAL
- 5 - INBOARD SHOE
- 6 - OUTBOARD SHOE

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 attempt to 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. 15). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

The amount of piston retraction is determined by the amount of seal deflection. Generally the amount is just enough to maintain contact between the piston and inboard brake shoe.

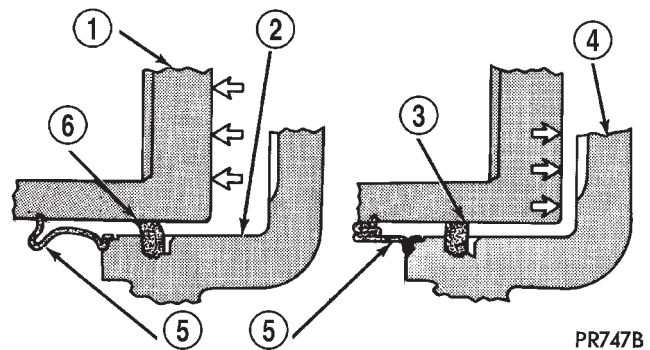


Fig. 15 Lining Wear Compensation By Piston Seal

- 1 - PISTON
- 2 - CYLINDER BORE
- 3 - PISTON SEAL BRAKE PRESSURE OFF
- 4 - CALIPER HOUSING
- 5 - DUST BOOT
- 6 - PISTON SEAL BRAKE PRESSURE ON

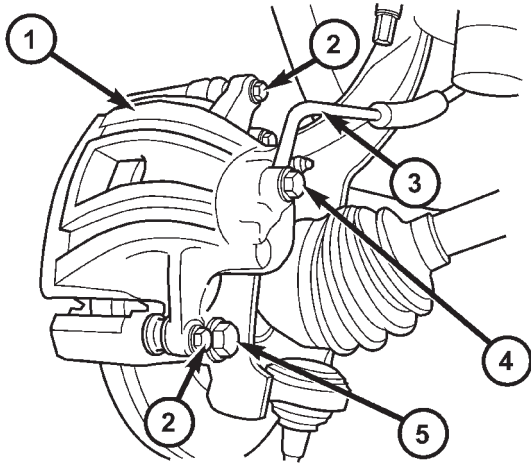
## REMOVAL

- (1) Install prop rod on the brake pedal to keep pressure on the brake system.
- (2) Raise and support vehicle.
- (3) Remove front wheel and tire assembly.
- (4) Drain small amount of fluid from master cylinder brake reservoir with suction gun.
- (5) Remove the brake hose banjo bolt if replacing caliper (Fig. 16).
- (6) Remove the caliper mounting slide pin bolts (Fig. 16).
- (7) Remove the caliper from vehicle.

## DISASSEMBLY

- (1) Remove brake shoes from caliper.
- (2) Drain brake fluid out of caliper.
- (3) Take a piece of wood and pad it with one-inch thickness of shop towels. Place this piece in the outboard shoe side of the caliper in front of the piston. This will cushion and protect caliper piston during removal (Fig. 17).

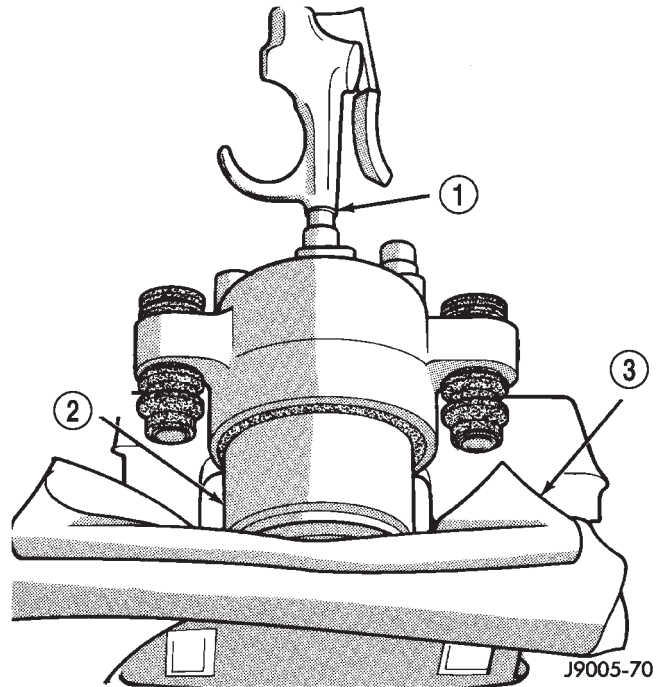
DISC BRAKE CALIPERS (Continued)



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**Fig. 16 DISC BRAKE CALIPER**

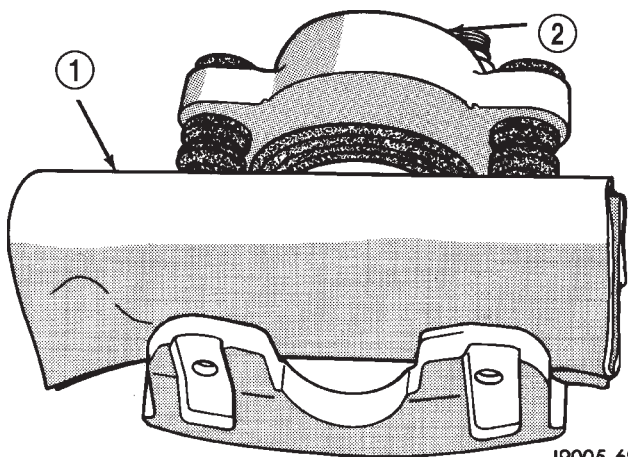
- 1 - DISC BRAKE CALIPER
- 2 - CALIPER SLIDE MOUNTING BOLTS
- 3 - BRAKE HOSE
- 4 - BANJO BOLT
- 5 - CALIPER ADAPTER MOUNTING BOLT



J9005-70

**Fig. 18 CALIPER PISTON REMOVAL - TYPICAL**

- 1 - AIR GUN
- 2 - CALIPER PISTON
- 3 - PADDING MATERIAL



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**Fig. 17 PADDING CALIPER INTERIOR - TYPICAL**

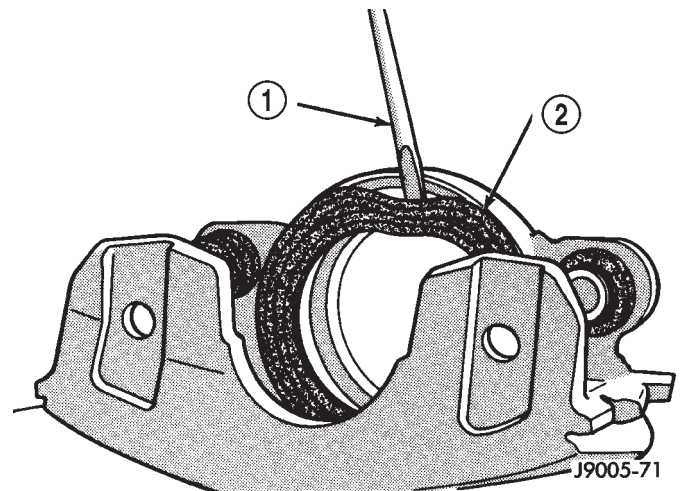
- 1 - SHOP TOWELS OR CLOTHS
- 2 - CALIPER

(4) Remove caliper piston with **short bursts** of low pressure compressed air. Direct air through fluid inlet port and ease piston out of bore (Fig. 18).

**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 MAY RESULT IN PERSONAL INJURY.

(5) Remove caliper piston dust boot with suitable pry tool (Fig. 19).



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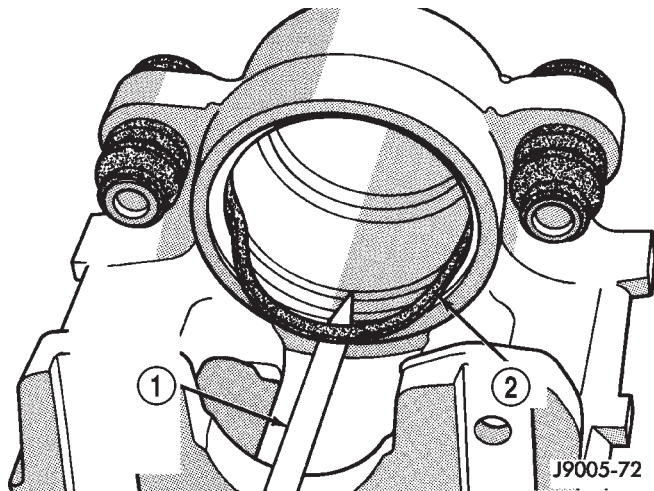
**Fig. 19 CALIPER PISTON DUST BOOT REMOVAL - TYPICAL**

- 1 - COLLAPSE BOOT WITH PUNCH OR SCREWDRIVER
- 2 - PISTON DUST BOOT

(6) Remove caliper piston seal with wood or plastic tool (Fig. 20). Do not use metal tools as they will scratch piston bore.

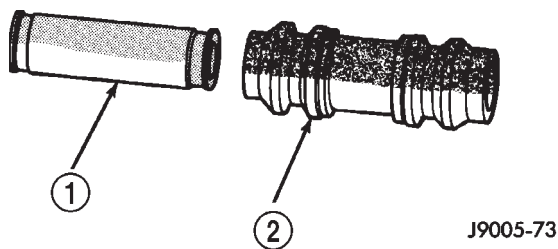
(7) Remove caliper mounting bolt bushings and boots (Fig. 21).

## DISC BRAKE CALIPERS (Continued)



**Fig. 20 PISTON SEAL REMOVAL - TYPICAL**

- 1 - REMOVE SEAL WITH WOOD PENCIL OR SIMILAR TOOL  
2 - PISTON SEAL



**Fig. 21 MOUNTING BOLT BUSHING AND BOOT - TYPICAL**

- 1 - CALIPER SLIDE BUSHING  
2 - BOOT

## CLEANING

Clean the caliper components with clean brake fluid or brake clean only. Wipe the caliper and piston 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

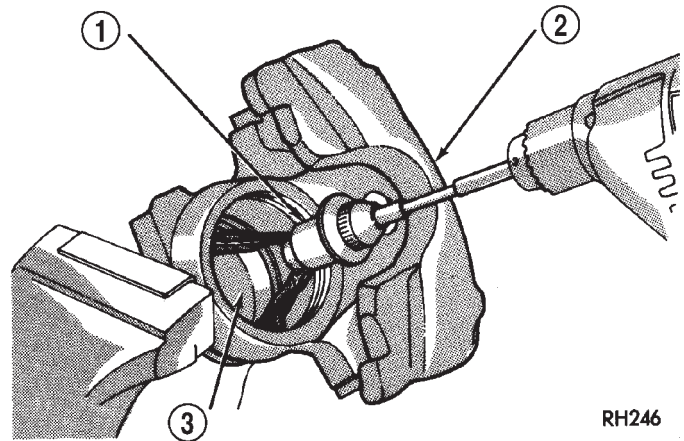
The piston is made from a phenolic resin (plastic material) and should be smooth and clean.

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. 22). 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. 22 POLISHING PISTON BORE - TYPICAL**

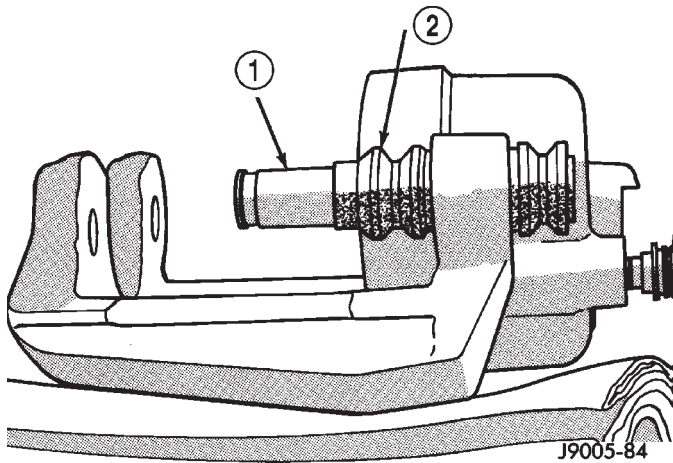
- 1 - SPECIAL HONE  
2 - CALIPER  
3 - PISTON BORE

## ASSEMBLY

**CAUTION:** Dirt, oil, and solvents can damage caliper seals. Insure assembly area is clean and dry.

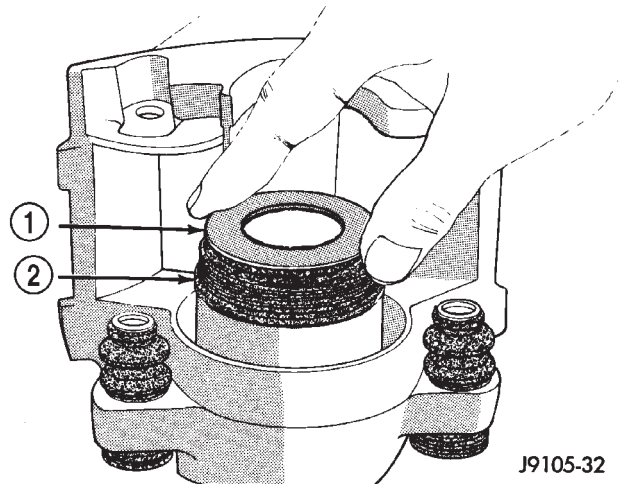
- (1) Lubricate caliper piston bore, new piston seal and piston with clean brake fluid.
- (2) Lubricate caliper bushings and interior of bushing boots with silicone grease.
- (3) Install bushing boots in caliper, then insert bushing into boot and push bushing into place (Fig. 23).
- (4) Install new piston seal into seal groove with finger (Fig. 24).
- (5) Install new dust boot on caliper piston and seat boot in piston groove (Fig. 25).
- (6) Press piston into caliper bore by hand, use a turn and push motion to work piston into seal (Fig. 26).
- (7) Press caliper piston to bottom of bore.
- (8) Seat dust boot in caliper with Installer Tool C-4842 and Tool Handle C-4171 (Fig. 27).
- (9) Replace caliper bleed screw if removed.

DISC BRAKE CALIPERS (Continued)



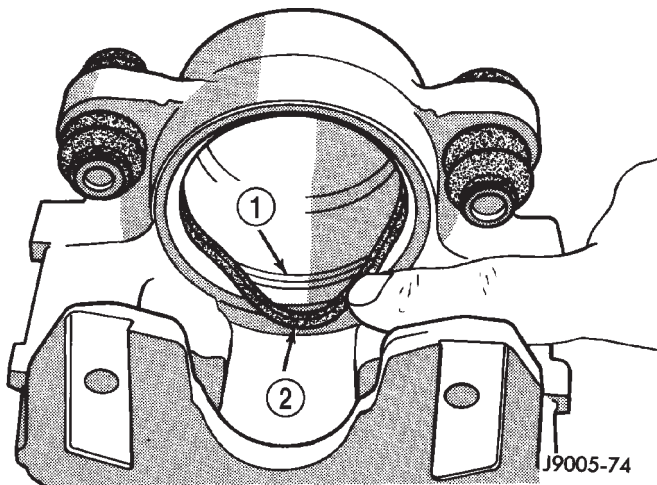
**Fig. 23 BUSHINGS AND BOOTS INSTALLATION - TYPICAL**

- 1 - BUSHING
- 2 - BOOT



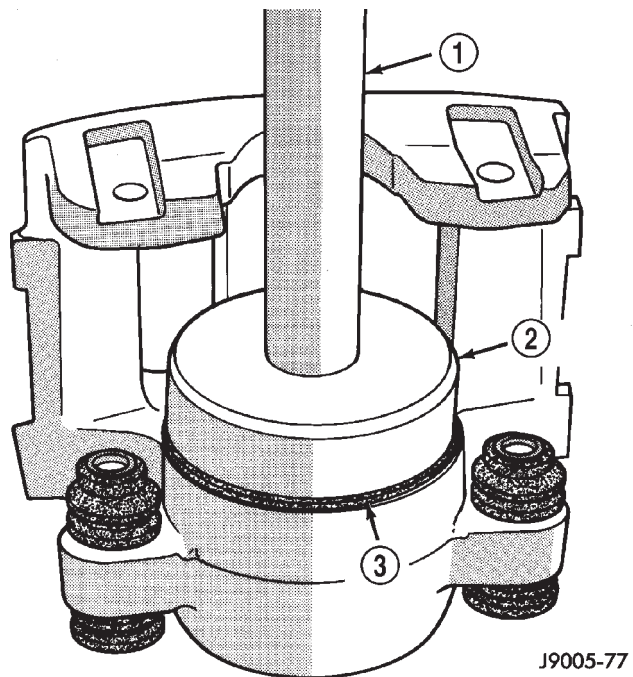
**Fig. 26 CALIPER PISTON INSTALLATION - TYPICAL**

- 1 - PISTON
- 2 - BOOT



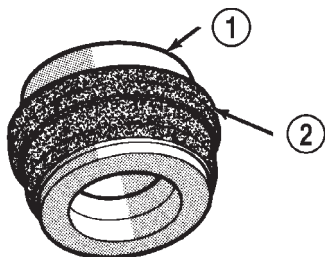
**Fig. 24 PISTON SEAL INSTALLATION - TYPICAL**

- 1 - SEAL GROOVE
- 2 - PISTON SEAL



**Fig. 27 PISTON DUST BOOT INSTALLATION - TYPICAL**

- 1 - HANDLE C-4171
- 2 - INSTALLER C-4842
- 3 - DUST BOOT



**Fig. 25 DUST BOOT ON PISTON - TYPICAL**

- 1 - PISTON
- 2 - DUST BOOT

**INSTALLATION**

- (1) Install caliper to the caliper adapter.
- (2) Coat the caliper mounting slide pin bolts with silicone grease. Begin with the bolt closet to the bleeder screws (top), Then install and tighten the bolts to 15 N·m (11 ft. lbs.).
- (3) Install the brake hose banjo bolt if removed.

## DISC BRAKE CALIPERS (Continued)

(4) Install the brake hose to the caliper with **new seal washers** and tighten fitting bolt to 31 N·m (23 ft. lbs.).

**CAUTION: Verify brake hose is not twisted or kinked before tightening fitting bolt.**

(5) Remove the prop rod from the vehicle.

(6) Bleed the base brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD PROCEDURE).

(7) Install the wheel and tire assemblies (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(8) Remove the supports and lower the vehicle.

(9) Verify a firm pedal before moving the vehicle.

## DISC BRAKE CALIPER ADAPTER

## REMOVAL

(1) Raise and support the vehicle.

(2) Remove the front wheel and tire assembly.

(3) Drain a small amount of fluid from master cylinder brake reservoir with a **clean** suction gun.

(4) Bottom the caliper pistons into the caliper by prying the caliper over.

(5) Remove the caliper mounting bolts (Fig. 16).

(6) Remove the disc brake caliper from the mount.

**CAUTION: Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose will result. Provide a suitable support to hang the caliper securely.**

(7) Remove the inboard and outboard brake pads. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - REMOVAL).

(8) Remove the caliper adapter mounting bolts (Fig. 16).

## INSTALLATION

(1) Install the caliper adapter mounting bolts. Tighten the mounting bolts to 135 N·m (100 ft.lbs).

(2) Install the inboard and outboard pads. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - INSTALLATION).

(3) Install the caliper mounting bolts.

(4) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

## ROTORS

## DIAGNOSIS AND TESTING - 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. 28). 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. The dial indicator should be positioned in the center of the rotor surface. Maximum allowable rotor runout is 0.102 mm (0.004 in.).

## ROTOR THICKNESS VARIATION

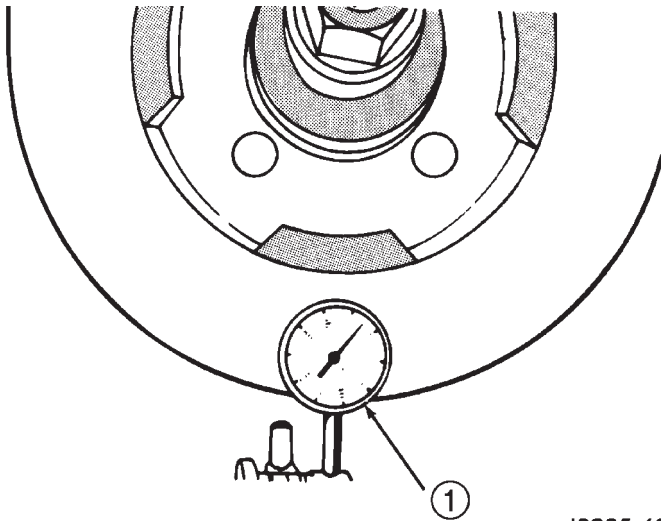
Variations in rotor thickness will cause pedal pulsation, noise and shudder.

Measure rotor thickness at 6 to 12 points around the rotor face (Fig. 29).

Position the micrometer approximately 25.4 mm (1 in.) from the rotor outer circumference for each measurement.

Thickness should not **vary** by more than 0.013 mm (0.0005 in.) from point-to-point on the rotor. Machine or replace the rotor if necessary.

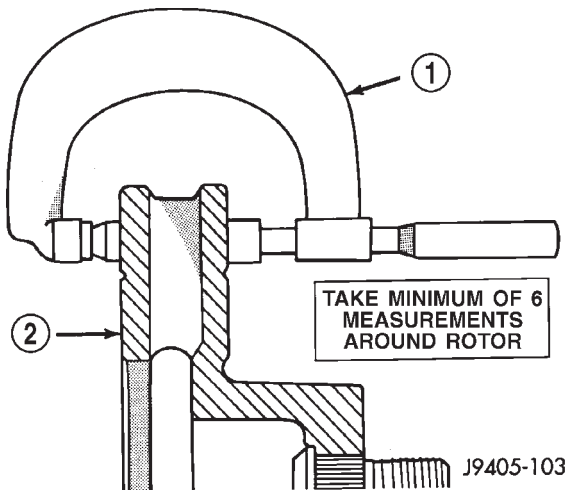
ROTORS (Continued)



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**Fig. 28 Checking Rotor Runout And Thickness Variation**

1 - DIAL INDICATOR



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**Fig. 29 Measuring Rotor Thickness**

1 - MICROMETER  
2 - ROTOR

**STANDARD PROCEDURE - DISC BRAKE ROTOR**

The disc brake rotor can be machined if scored or worn. The lathe must machine both sides of the rotor simultaneously with dual cutter heads. The rotor mounting surface must be clean before placing on the lathe. Equipment capable of machining only one side at a time may produce a tapered rotor. A hub mounted on-vehicle lathe is recommended. This type of lathe trues the rotor to the vehicles hub/bearing.

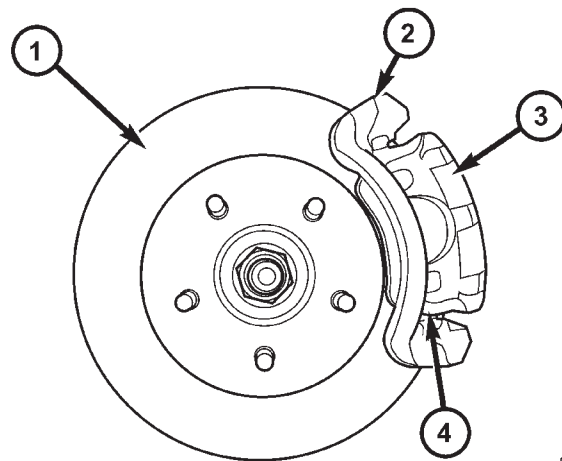
**CAUTION:** Brake rotors that do not meet minimum thickness specifications before or after machining must be replaced.

**REMOVAL**

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.
- (3) Remove the caliper adapter (Fig. 30). (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - REMOVAL).

**CAUTION:** Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose will result. Provide a suitable support to hang the caliper securely.

- (4) Remove the disc brake rotor.



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**Fig. 30 DISC BRAKE ROTOR**

1 - DISC BRAKE ROTOR  
2 - CALIPER ADAPTER  
3 - DISC BRAKE CALIPER  
4 - SHOES

**INSTALLATION**

- (1) Install the disc brake rotor to the hub.
- (2) Install the caliper mounting adapter. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - INSTALLATION).
- (3) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).



## JUNCTION BLOCK

### DESCRIPTION

The junction block and a rear brake proportioning valve. The valve is not repairable and must be replaced as an assembly if diagnosis indicates this is necessary.

### OPERATION

#### PROPORTIONING VALVE

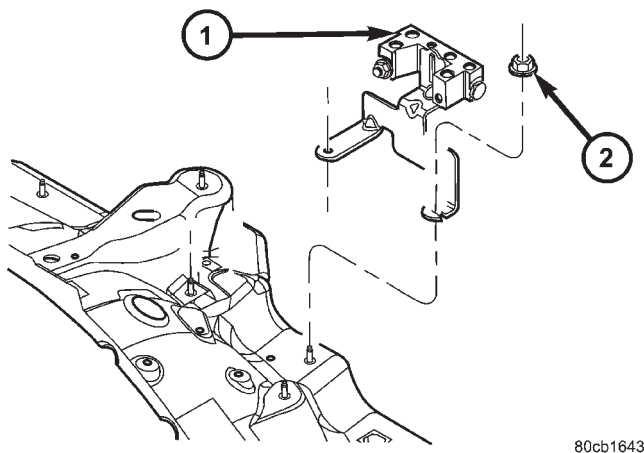
The proportioning valve is used to balance front-rear brake action at high decelerations. The valve allows normal fluid flow during moderate braking. The valve only controls fluid flow during high decelerations brake stops. If the primary brake hydraulic circuit cannot build pressure a by-pass feature is activated allowing full flow and pressure to the rear brakes.

#### DIAGNOSIS AND TESTING - PROPORTIONING VALVE

The valve controls fluid flow. If fluid enters the valve and does not exit the valve the combination valve must be replaced.

#### REMOVAL

- (1) Install prop rod on the brake pedal to keep pressure on the brake system.
- (2) Remove the brake lines from the junction block.
- (3) Remove mounting nuts and bolt and remove the junction block (Fig. 31).



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**Fig. 31 JUNCTION BLOCK**

- 1 - JUNCTION BLOCK  
2 - MOUNTING NUT

### INSTALLATION

- (1) Install the junction block on the mounting studs.
- (2) Install mounting nuts and bolt. Tighten to 14 N·m (125 in. lbs.).
- (3) Install brake lines to the junction block and tighten to 20 N·m (180 in. lbs.).
- (4) Bleed ABS brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

## PEDAL

### DESCRIPTION

A suspended-type brake pedal is used, the pedal pivots on a shaft mounted in the steering column support bracket. The bracket is attached to the dash panel. The unit is serviced as an assembly, except for the pedal pad.

### OPERATION

The brake pedal is attached to the booster push rod. When the pedal is depressed, the primary booster push rod is depressed which move the booster secondary rod. The booster secondary rod depress the master cylinder piston.

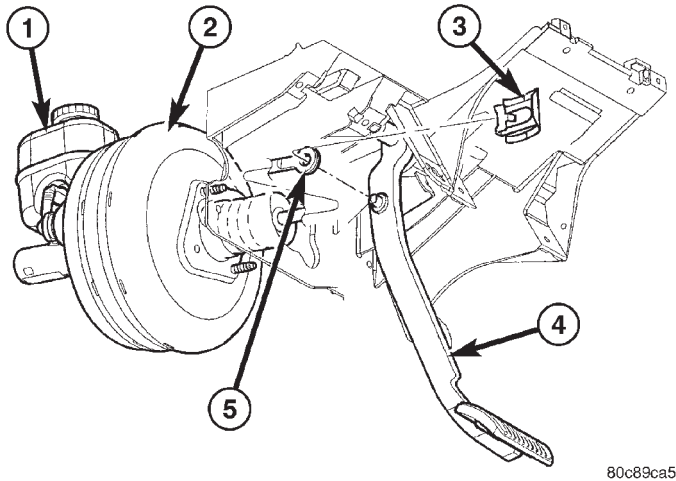
#### REMOVAL

- (1) Remove the knee blocker under the steering column,(Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).
- (2) Remove the retainer clip securing the booster push rod to pedal (Fig. 32).
- (3) Remove the brake lamp switch,(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).
- (4) Remove the nuts securing the pedal to the column bracket.
- (5) Remove the pedal from the vehicle.

#### INSTALLATION

- (1) Install the pedal into the vehicle.
- (2) Install the nuts securing the pedal to the column bracket.
- (3) Tighten the nuts to 22.6 N·m (200 in. lbs.).
- (4) Lubricate the brake pedal pin and bushings with Mopar multi-mileage grease.
- (5) Install the booster push rod on the pedal pin and install a new retainer clip (Fig. 32).
- (6) Install the brake lamp switch,(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - INSTALLATION).
- (7) Install the knee blocker,(Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

## PEDAL (Continued)



**Fig. 32 BOOSTER PUSH ROD**

- 1 - MASTER CYLINDER ASSEMBLY
- 2 - BRAKE BOOSTER
- 3 - CLIP
- 4 - BRAKE PEDAL
- 5 - BOOSTER ROD

## POWER BRAKE BOOSTER

### DESCRIPTION

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 connected to the booster primary push rod.

Two push rods are used in the booster. The primary push rod connects the booster to the brake pedal. The secondary push rod connects the booster to the master cylinder to stroke the cylinder pistons.

### OPERATION

The atmospheric inlet valve is opened and closed by the primary push rod. Booster vacuum supply is through a hose attached to an intake manifold fitting at one end and to the booster check valve at the other. The vacuum check valve in the booster housing 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 a filter and inlet valve at the rear of the housing (Fig. 33).

The chamber areas forward of the booster diaphragms are exposed to vacuum from the intake manifold. The chamber areas to the rear of the diaphragms, are exposed to normal atmospheric pressure of 101.3 kilopascals (14.7 pounds/square in.).

Brake pedal application causes the primary push rod to open the atmospheric inlet valve. This exposes the area behind the diaphragms to atmospheric pressure. The resulting pressure differential provides the extra apply force for power assist.

The booster check valve, check valve grommet and booster seals are serviceable.

### DIAGNOSIS AND TESTING - 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 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.

### POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 34).

(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.

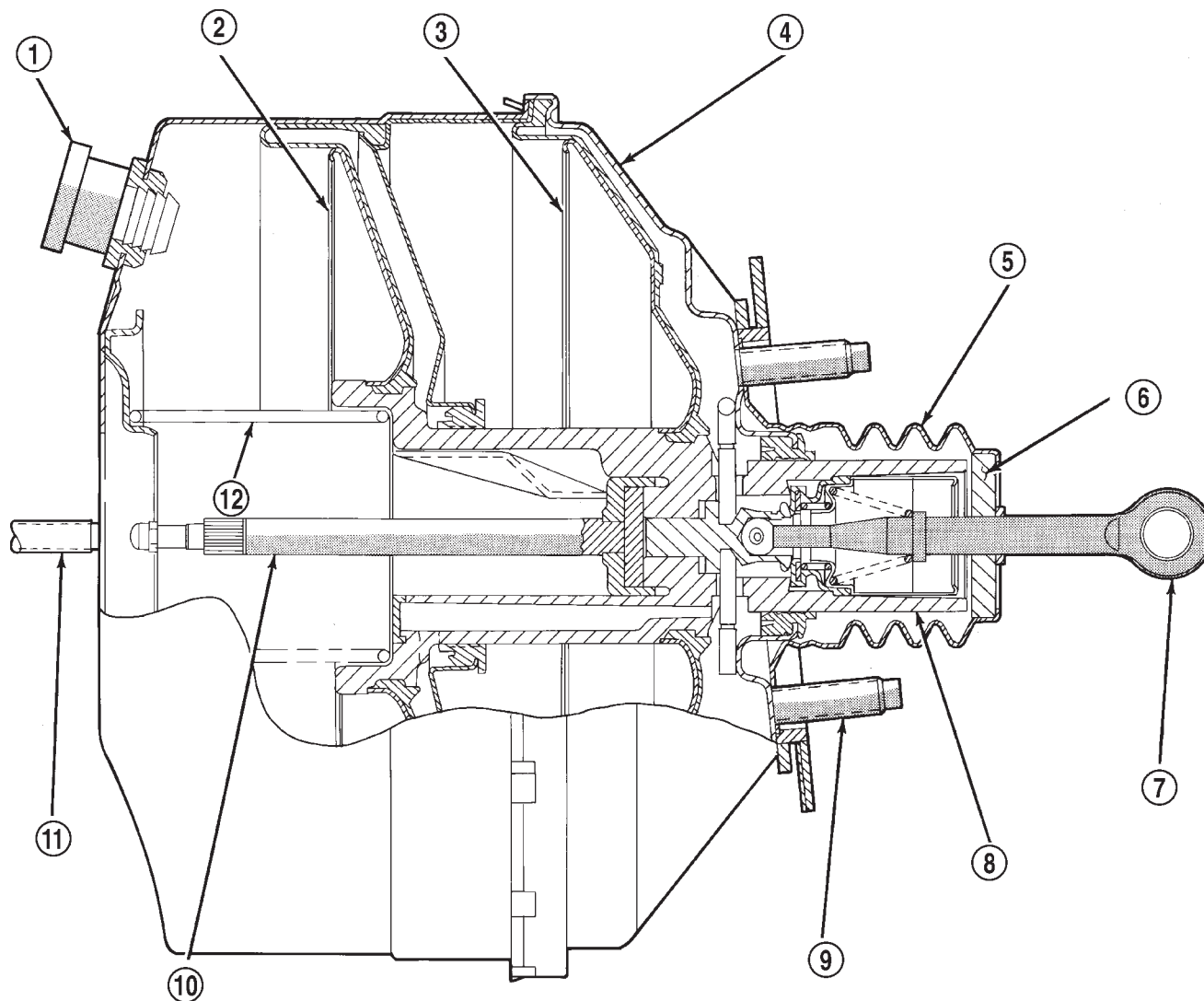
### POWER BOOSTER CHECK VALVE TEST

(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.

## POWER BRAKE BOOSTER (Continued)



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**Fig. 33 Power Brake Booster—Typical**

- 1 - VACUUM CHECK VALVE
- 2 - FRONT DIAPHRAGM
- 3 - REAR DIAPHRAGM
- 4 - HOUSING
- 5 - SEAL
- 6 - AIR FILTER

- 7 - PRIMARY PUSH ROD (TO BRAKE PEDAL)
- 8 - ATMOSPHERIC INLET VALVE ASSEMBLY
- 9 - BOOSTER MOUNTING STUDS (4)
- 10 - SECONDARY PUSH ROD (TO MASTER CYLINDER)
- 11 - MASTER CYLINDER MOUNTING STUD (2)
- 12 - SPRING

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 35).

(5) Vacuum should hold steady. If gauge on pump indicates vacuum loss, check valve is faulty and should be replaced.

**REMOVAL**

(1) Disconnect the wire to the fluid level switch at the bottom of the reservoir.

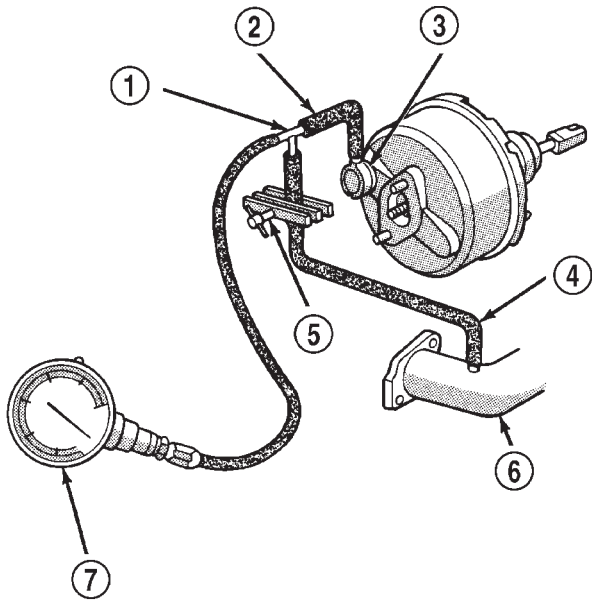
(2) Remove the master cylinder (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/MASTER CYLINDER - REMOVAL).

(3) Disconnect vacuum hose from booster check valve.

(4) Remove the brake lines from the master cylinder and the HCU (abs vehicles only) or the junction block for clearance.

(5) Disconnect the HCU from the mounts and move to the side for clearance of the booster.

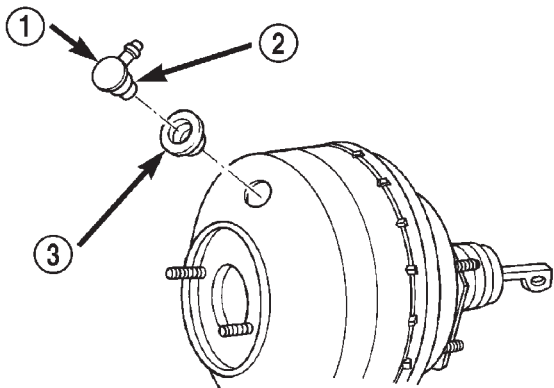
POWER BRAKE BOOSTER (Continued)



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**Fig. 34 Typical Booster Vacuum Test Connections**

- 1 - TEE FITTING
- 2 - SHORT CONNECTING HOSE
- 3 - CHECK VALVE
- 4 - CHECK VALVE HOSE
- 5 - CLAMP TOOL
- 6 - INTAKE MANIFOLD
- 7 - VACUUM GAUGE



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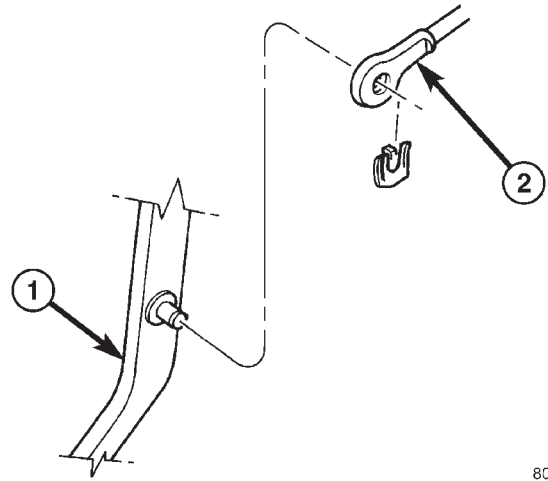
**Fig. 35 TYPICAL - VACUUM CHECK VALVE AND SEAL**

- 1 - BOOSTER CHECK VALVE
- 2 - APPLY TEST VACUUM HERE
- 3 - VALVE SEAL

(6) Remove knee blocker under the steering column. (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).

(7) Remove retaining clip that secures booster push rod to brake pedal (Fig. 36).

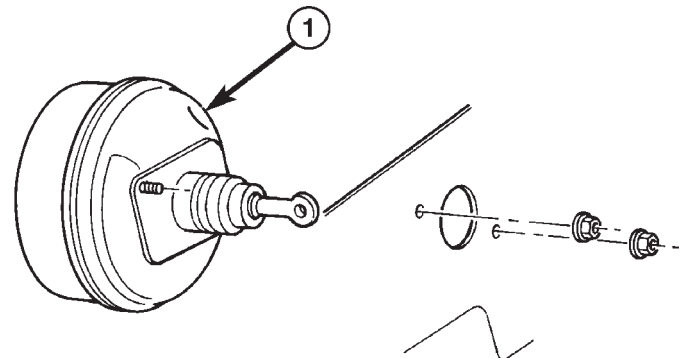
(8) Remove nuts attaching booster to the dash panel (Fig. 37).



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**Fig. 36 BOOSTER PUSH ROD**

- 1 - BRAKE PEDAL
- 2 - BOOSTER ROD



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**Fig. 37 BOOSTER MOUNTING**

- 1 - BRAKE BOOSTER

(9) In engine compartment, slide booster studs out of dash panel, tilt booster upward, and remove booster from engine compartment.

**INSTALLATION**

- (1) Align and position booster on the dash panel.
- (2) Install booster mounting nuts. Tighten nuts just enough to hold booster in place.

(3) Slide booster push rod onto the brake pedal. Then secure push rod to pedal pin with retaining clip.

**NOTE:** Lubricate the pedal pin and bushing with Mopar multi-mileage grease before installation.

## POWER BRAKE BOOSTER (Continued)

(4) Tighten booster mounting nuts to 22.6 N-m (200 ft. lbs.).

(5) Install the knee blocker,(Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

(6) If original master cylinder is being installed, check condition of seal at rear of master cylinder. Replace seal if cut, or torn.

(7) Clean cylinder mounting surface of brake booster. Use shop towel wetted with brake cleaner for this purpose. Dirt, grease, or similar materials will prevent proper cylinder seating and could result in vacuum leak.

(8) Align and install master cylinder on the booster studs. Install mounting nuts and tighten to 22.6 N-m (200 in. lbs.).

(9) Connect vacuum hose to booster check valve.

(10) Remount the HCU. Tighten bracket mounting nuts to 22.6 N-m (200 in. lbs.).

(11) Connect and secure the brake lines to HCU or junction block and master cylinder. Start all brake line fittings by hand to avoid cross threading.

(12) Connect the wire to fluid level switch at the bottom of the reservoir.

(13) Fill and bleed base brake system,(Refer to 5 - BRAKES - STANDARD PROCEDURE).

(14) Verify proper brake operation before moving vehicle.

(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 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.

**POWER BOOSTER VACUUM TEST**

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 38).

(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.

**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. 39).

(5) Vacuum should hold steady. If gauge on pump indicates vacuum loss, check valve is faulty and should be replaced.

**STANDARD 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.

(1) Mount master cylinder in vise.

**MASTER CYLINDER****DESCRIPTION**

The master cylinder has a removable nylon reservoir. The cylinder body is made of aluminum and contains a primary and secondary piston assembly. The cylinder body including the piston assemblies are not serviceable. If diagnosis indicates an internal problem with the cylinder body, it must be replaced as an assembly. The reservoir and grommets are the only replaceable parts on the master cylinder.

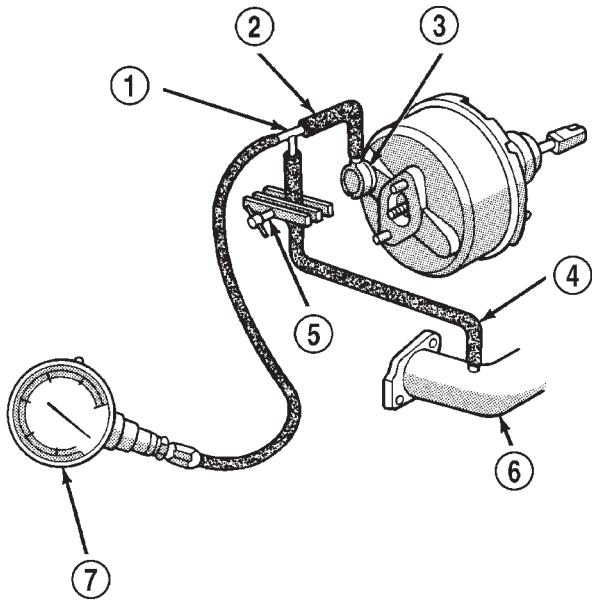
**OPERATION**

The master cylinder bore contains a primary and secondary piston. The primary piston supplies hydraulic pressure to the front brakes. The secondary piston supplies hydraulic pressure to the rear brakes. The master cylinder reservoir stores reserve brake fluid for the hydraulic brake circuits.

**DIAGNOSIS AND TESTING - 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.

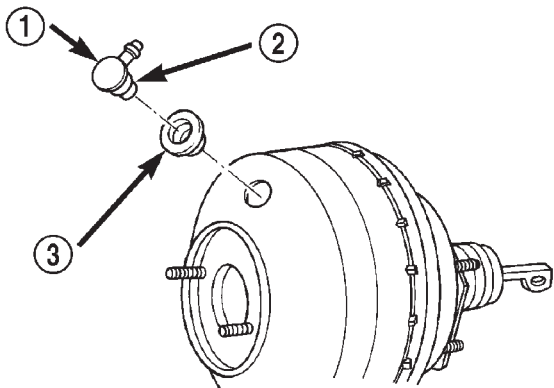
MASTER CYLINDER (Continued)



J9005-81

**Fig. 38 Typical Booster Vacuum Test Connections**

- 1 - TEE FITTING
- 2 - SHORT CONNECTING HOSE
- 3 - CHECK VALVE
- 4 - CHECK VALVE HOSE
- 5 - CLAMP TOOL
- 6 - INTAKE MANIFOLD
- 7 - VACUUM GAUGE



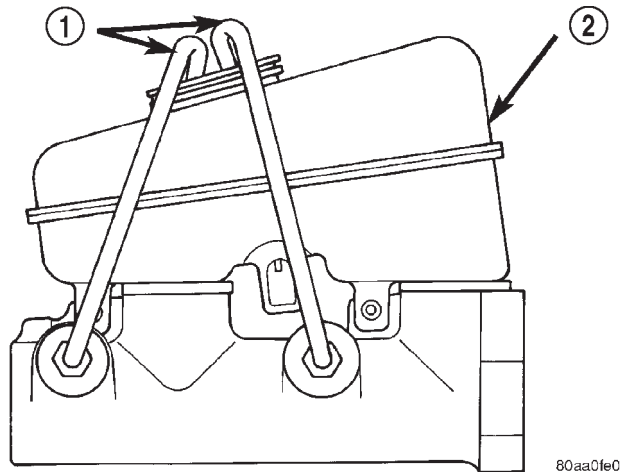
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**Fig. 39 TYPICAL - VACUUM CHECK VALVE AND SEAL**

- 1 - BOOSTER CHECK VALVE
- 2 - APPLY TEST VACUUM HERE
- 3 - VALVE SEAL

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end into reservoir (Fig. 40).  
 (3) Fill reservoir with fresh brake fluid.  
 (4) Press cylinder pistons inward with wood dowel. Then release pistons and allow them to return under

spring pressure. Continue bleeding operations until air bubbles are no longer visible in fluid.



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**Fig. 40 MASTER - TYPICAL**

- 1 - BLEEDING TUBES
- 2 - RESERVOIR

**REMOVAL**

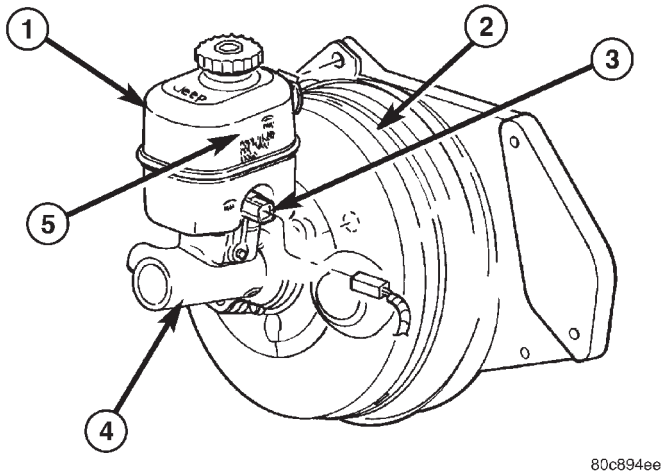
- (1) Siphon and drain the fluid from the reservoir.
- (2) Remove the brake lines at the master cylinder.
- (3) Disconnect the fluid level electrical connector from the reservoir.
- (4) Remove mounting nuts from the master cylinder.
- (5) Remove master cylinder.
- (6) Remove cylinder cover and drain the rest of the fluid.
- (7) If master cylinder reservoir requires service, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ FLUID RESERVOIR - REMOVAL). (Fig. 41)

**INSTALLATION**

**NOTE: If master cylinder is replaced, bleed cylinder before installation.**

- (1) Clean cylinder mounting surface of brake booster.
- (2) Install master cylinder onto brake booster studs.
- (3) Install mounting nuts and tighten to 25 N·m (220 in. lbs.).
- (4) Connect the brake lines to the master cylinder and tighten to 20 N·m (180 in. lbs.).
- (5) Connect fluid level electrical connector to the reservoir.
- (6) Fill and bleed base brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE).

## MASTER CYLINDER (Continued)



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**Fig. 41 MASTER CYLINDER**

- 1 - FLUID RESERVOIR
- 2 - BOOSTER
- 3 - FLUID LEVEL SWITCH
- 4 - MASTER CYLINDER
- 5 - FLUID LEVEL MARKS

## FLUID RESERVOIR

## REMOVAL

- (1) Install prop rod on brake pedal to keep pressure on the brake system.
- (2) Remove reservoir cap and siphon fluid into drain container.
- (3) Remove the electrical connector from the fluid level switch in the reservoir.
- (4) Remove the reservoir mounting bolt.
- (5) Remove the reservoir from the master cylinder by pulling upwards.
- (6) Remove old grommets from cylinder body.

## INSTALLATION

- (1) Fill and bleed master cylinder on bench before installation in vehicle.

**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.

- (2) Lubricate new grommets with clean brake fluid and install new grommets in cylinder body. Use finger pressure to install and seat grommets.
- (3) Start reservoir in grommets. Then rock reservoir back and forth while pressing downward to seat it in grommets.
- (4) Install the mounting bolt for the reservoir to the master cylinder.
- (5) Reconnect the electrical connector to the fluid reservoir level switch.

- (6) Remove the prop rod from the vehicle.
- (7) Fill and bleed base brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE).

## FLUID

## DIAGNOSIS AND TESTING - 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.

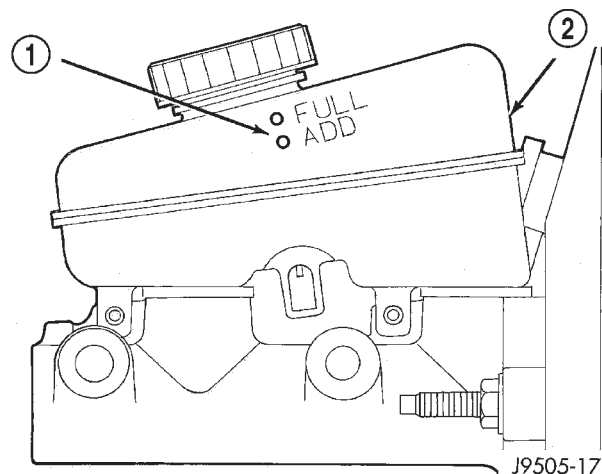
To test for contamination, put a small amount of drained brake fluid in clear glass jar. If fluid separates into layers, there is mineral oil or other fluid contamination of the brake fluid.

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.

## STANDARD PROCEDURES - MASTER CYLINDER FLUID LEVEL

Always clean the master cylinder reservoir and cap before adding fluid. This will prevent dirt from falling in the reservoir and contaminating the brake fluid.

The reservoir has a ADD and a FULL mark on the side (Fig. 42) fill to the FULL mark.



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**Fig. 42 TYPICAL - MASTER CYLINDER FLUID LEVEL**

- 1 - FLUID LEVEL MARKS
- 2 - RESERVOIR

FLUID (Continued)

## 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, etc.

## DRUM

### DIAGNOSIS AND TESTING - BRAKE DRUM

The maximum allowable diameter of the drum braking surface is indicated on the drum outer edge. Generally, a drum can be machined to a maximum of 1.52 mm (0.060 in.) oversize. Always 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.

### STANDARD PROCEDURES - 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.

**CAUTION:** Replace the drum if machining will cause the drum to exceed the maximum allowable diameter.

## SUPPORT PLATE

### REMOVAL

#### REMOVAL - 198 RBI AXLE

- (1) Remove wheel and tire assembly.
- (2) Remove the brake drum.
- (3) Remove the brake shoes.
- (4) Remove parking brake cable from parking brake lever.
- (5) Compress parking brake cable retainer tabs. Then push retainer and cable through and out of support plate.
- (6) Disconnect brake line at wheel cylinder.
- (7) Remove wheel cylinder from support plate, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/WHEEL CYLINDERS - REMOVAL).
- (8) Remove the four bolts attaching the support plate to axle and remove the support plate with the axle, bearing and seal.
- (9) Remove axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE/AXLE SHAFTS - REMOVAL).

#### REMOVAL - 8 1/4 AXLE

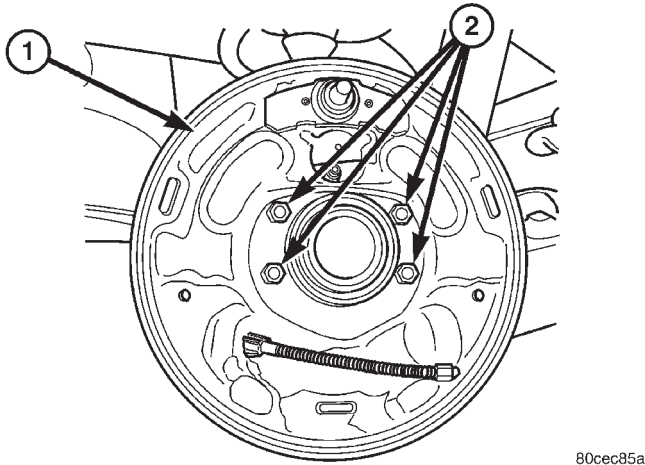
- (1) Remove the wheel and tire assembly.
- (2) Remove the brake drum.
- (3) Install the brake pedal prop rod.
- (4) Remove the brake shoes (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - REMOVAL).
- (5) Remove parking brake cable from parking brake lever.
- (6) Compress parking brake cable retainer tabs. Then push retainer and cable through and out of support plate.
- (7) Disconnect the brake line at wheel cylinder.
- (8) Remove the wheel cylinder from the support plate, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/WHEEL CYLINDERS - REMOVAL).



## SUPPORT PLATE (Continued)

(9) Remove the axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 8 1/4/AXLE SHAFTS - REMOVAL).

(10) Remove the bolts attaching the support plate to the axle and remove the support plate (Fig. 43).



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**Fig. 43 SUPPORT PLATE 8 1/4**

- 1 - SUPPORT PLATE  
2 - MOUNTING NUTS

## INSTALLATION

## INSTALLATION - 198 RBI AXLE

(1) Install the support plate on the axle flange. Tighten 75 N·m (55 ft. lbs.)

(2) Install the axle, bearing and seal into the housing and tighten the four attaching bolts to 61 N·m (45 ft. lbs.).

(3) Install the wheel cylinder, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/WHEEL CYLINDERS - INSTALLATION).

(4) Install the brake line in the wheel cylinder.

(5) Install the parking brake cable in the support plate.

(6) Connect parking brake cable to lever on secondary shoe and install brake shoes on support plate.

(7) Adjust the brake shoes to the drum with the brake gauge.

(8) Install the brake drum and wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Bleed brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD PROCEDURE).

## INSTALLATION - 8 1/4 AXLE

(1) Install the support plate on the axle flange. Tighten attaching bolts to 61 N·m (45 ft. lbs.) (Fig. 43).

(2) Install the wheel cylinder, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/WHEEL CYLINDERS - INSTALLATION).

(3) Install the brake line in the wheel cylinder and tighten the line to 14 N·m (124 in.lbs.).

(4) Remove the brake pedal prop rod.

(5) Install the parking brake cable in the support plate.

(6) Install the axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 8 1/4/AXLE SHAFTS - INSTALLATION).

(7) Connect the parking brake cable to the lever on the primary shoe and install the brake shoes on the support plate (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - INSTALLATION).

(8) Adjust the brake shoes to the drum with the brake gauge (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/BRAKE PADS/SHOES - ADJUSTMENTS).

(9) Install the brake drum.

(10) Install the wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(11) Bleed the brake system, (Refer to 5 - BRAKES - STANDARD PROCEDURE).

## WHEEL CYLINDERS

## REMOVAL

(1) Remove wheel and tire assembly.

(2) Remove brake drum.

(3) Install brake pedal prop rod.

(4) Disconnect wheel cylinder brake line.

(5) Remove brake shoe return springs and move shoes out of engagement with cylinder push rods.

(6) Remove cylinder attaching bolts and remove cylinder from support plate (Fig. 44).

## DISASSEMBLY

(1) Remove push rods and boots (Fig. 45).

(2) Press pistons, cups and spring and expander out of cylinder bore.

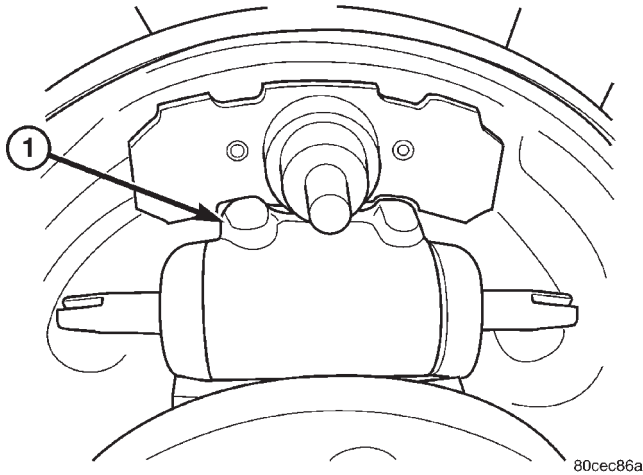
(3) Remove bleed screw.

## CLEANING

Clean the cylinder and pistons with clean brake fluid or brake cleaner only. Do not use any other cleaning agents.

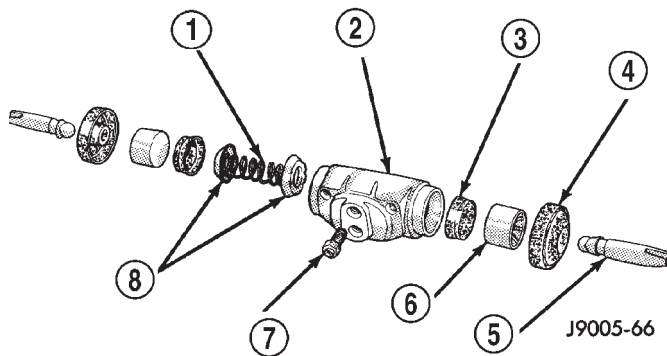
Dry the cylinder and pistons with compressed air. Do not use rags or shop towels to dry the cylinder components. Lint from cloth material will adhere to the cylinder bores and pistons.

WHEEL CYLINDERS (Continued)



**Fig. 44 WHEEL CYLINDER**

- 1 - WHEEL CYLINDER
- 2 - SUPPORT PLATE



**Fig. 45 Wheel Cylinder Components—Typical**

- 1 - SPRING
- 2 - CYLINDER
- 3 - PISTON CLIP
- 4 - BOOT
- 5 - PUSH ROD
- 6 - PISTON
- 7 - BLEED SCREW
- 8 - CUP EXPANDERS

**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 not 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.

**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.

**INSTALLATION**

- (1) Install cylinder mounting bolts and tighten to 20 N·m (15 ft. lbs.) (Fig. 44).
- (2) Connect brake line to cylinder and tighten to 14 N·m (124 in. lbs.).
- (3) Install the brake shoe return springs.
- (4) Remove the brake pedal prop rod.
- (5) Install the brake drum.
- (6) Install the wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
- (7) Bleed base brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

**PARKING BRAKE**

**DESCRIPTION**

The parking brake is a hand lever and cable operated system used to apply the rear brakes.

**OPERATION**

A hand operated lever in the passenger compartment is the main application device. The front cable is connected between the hand lever and the rear cables with an equalizer.

The rear cables are connected to the actuating lever on each primary brake shoe. The levers are attached to the brake shoes by a pin either pressed into, or welded to the lever. A clip is used to secure the pin in the brake shoe. The pin allows each lever to pivot independently of the brake shoe.

To apply the parking brakes, the hand lever is pulled upward. This pulls the rear brake shoe actuating levers forward, by means tensioner and cables. As the actuating lever is pulled forward, the parking brake strut (which is connected to both shoes), exerts

## PARKING BRAKE (Continued)

a linear force against the secondary brake shoe. This action presses the secondary shoe into contact with the drum. Once the secondary shoe contacts the drum, force is exerted through the strut. This force is transferred through the strut to the primary brake shoe causing it to pivot into the drum as well.

A gear type ratcheting mechanism is used to hold the lever in an applied position. Parking brake release is accomplished by the hand lever release button.

A parking brake switch is mounted on the parking brake lever and is actuated by movement of the lever. The switch, which is in circuit with the red warning light in the dash, will illuminate the warning light whenever the parking brakes are applied.

Parking brake is self-adjusting when the lever is pulled. The cable tensioner, once adjusted at the factory, should not need further adjustment under normal circumstances.

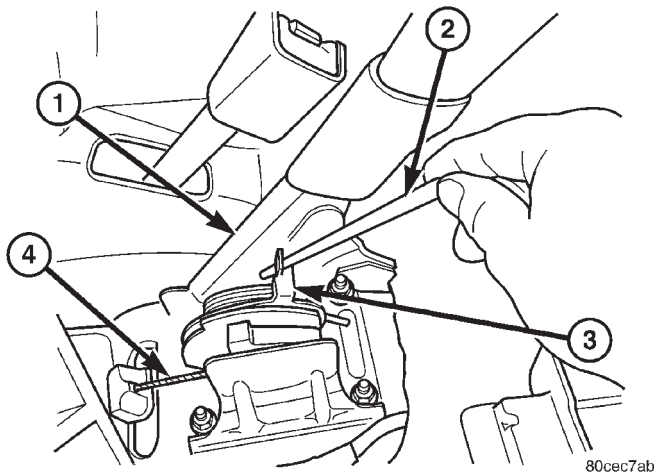
## ADJUSTMENTS

## ADJUSTMENT - LOCK OUT

**NOTE:** The parking brake is self-adjusting, It can not be adjusted.

(1) Remove the center floor console (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).

(2) Pull up on the spring until the tab on the lever passes the tab on the cable guide and install a punch in the hole on the side then release (Fig. 46).



**Fig. 46 LOCK OUT CABLES**

- 1 - PARKING BRAKE HANDLE
- 2 - PUNCH
- 3 - CABLE GUIDE
- 4 - CABLE

(3) The park brake system is now locked out to perform necessary repairs.

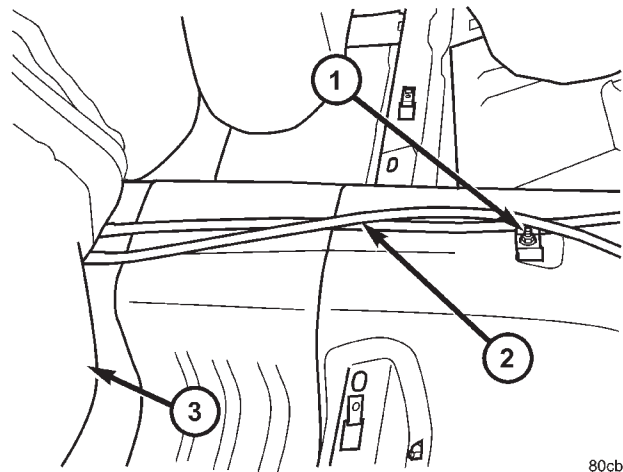
## CABLES

## REMOVAL

(1) Lock out the parking brake cables (Refer to 5 - BRAKES/PARKING BRAKE - ADJUSTMENTS) (Fig. 46).

(2) Remove the rear seat (Refer to 23 - BODY/SEATS/SEAT - REMOVAL).

(3) Remove the cable saddle bracket (Fig. 47).



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**Fig. 47 MOUNTING BRACKETS**

- 1 - MOUNTING SADDLE BRACKET
- 2 - PARK BRAKE CABLES
- 3 - CARPET

(4) Disconnect the two cables from the front mount (Fig. 48).

(5) Pull the carpet forward far enough in the rear to gain access to the two parking brake cables thru the floor (Fig. 47).

(6) Push the cables thru the floor with the grommets.

(7) Remove the primary brake shoe hold down spring and separate the shoes to gain access, Then disconnect the cable from lever on brake shoe.

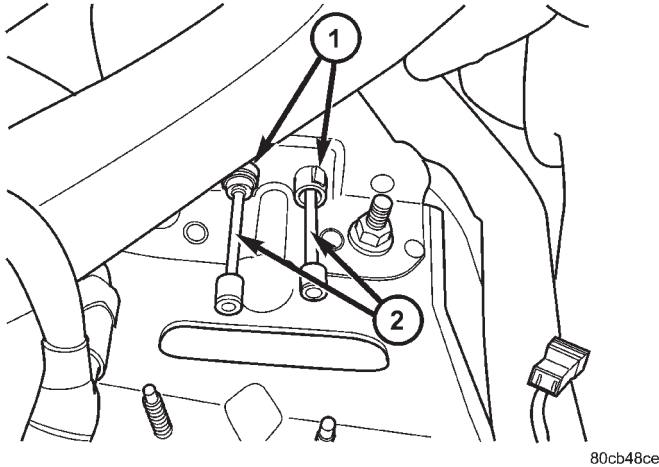
(8) Remove cables from backing plates by using a screw driver to break off the tangs on the cable or a proper sized box end wrench over the tangs.

## INSTALLATION

(1) Install the cables into the support plate.

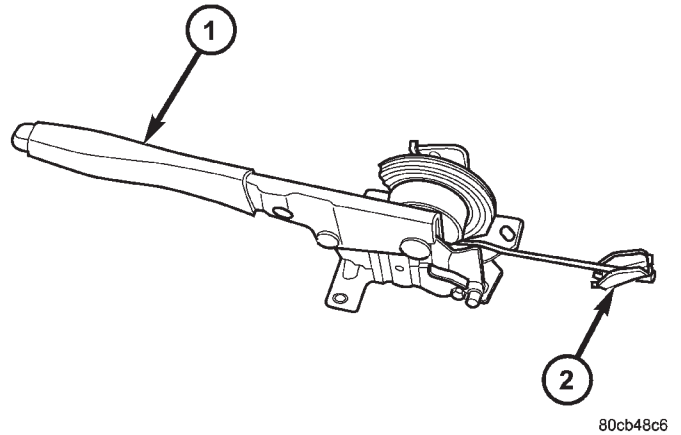
(2) Reconnect the cable to the lever on the brake shoe, Install the primary brake shoe hold down spring and the shoes.

CABLES (Continued)



**Fig. 48 CABLE FRONT MOUNT**

- 1 - RETAINER CLIPS
- 2 - CABLES



**Fig. 49 PARKING BRAKE LEVER**

- 1 - PARK BRAKE LEVER ASSEMBLY
- 2 - EQUALIZER

- (3) Push the cables thru the floor and seat the grommets.
- (4) Reconnect the two cables to the front mount.
- (5) Install the cable saddle bracket (Fig. 47).
- (6) Lay the carpet back down in the rear.
- (7) Install the rear seat (Refer to 23 - BODY/ SEATS/SEAT - INSTALLATION).
- (8) Remove the lock out device on the lever.
- (9) Test the parking brake.

- (4) Reconnect the parking brake lamp switch wire (Fig. 49).
- (5) If installing a new parking brake lever remove the pin that come on the lever when shipped.
- (6) If you are reinstalling the original park brake lever remove the lock out device at this time.
- (7) Test the parking brake lever. (Fig. 50).

LEVER

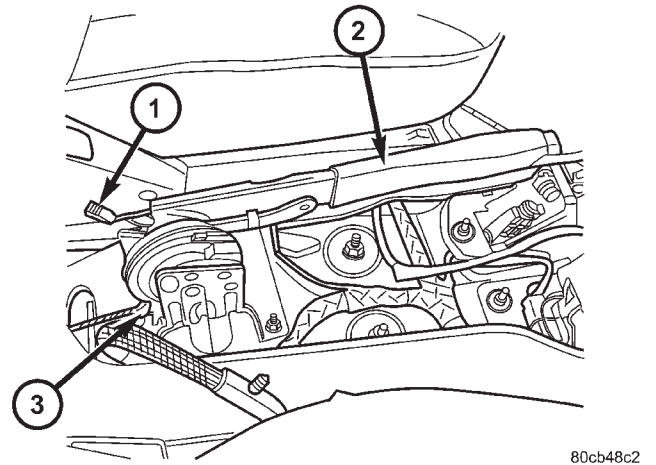
REMOVAL

The center floor console must be removed to service the parking brake lever,(Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL) .

- (1) Lock out the parking brakes (Refer to 5 - BRAKES/PARKING BRAKE - ADJUSTMENTS).
- (2) Disengage the front cables from the equalizer (Fig. 49).
- (3) Disconnect the parking brake lamp switch wire (Fig. 49).
- (4) Remove the parking brake lever assembly mounting bolts (Fig. 50).
- (5) Remove the lever assembly.

INSTALLATION

- (1) Install the parking brake lever assembly.
  - (2) Install the parking brake lever assembly to the mounting bolts. Tighten (Fig. 50).
- Install the center floor console, (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).
- (3) Engage the front cables to the equalizer (Fig. 49).



**Fig. 50 LEVER MOUNT**

- 1 - ELECTRICAL CONNECTOR
- 2 - PARK BRAKE LEVER ASSEMBLY
- 3 - CABLE

# BRAKES - ABS

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## BRAKES - ABS

### DESCRIPTION

#### ANTILOCK BRAKING SYSTEM

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.

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 check occurs after the ignition switch is turned to Run position. The dynamic check occurs when vehicle road speed reaches approximately 30 kph (18 mph). During the dynamic check, the CAB briefly cycles the pump and solenoids to verify operation.

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.

#### ELECTRONIC BRAKE DISTRIBUTION

The electronic brake distribution (EBD) functions like a rear proportioning valve. The EBD system uses

the ABS system to control the slip of the rear wheels in partial braking range. The braking force of the rear wheels is controlled electronically by using the inlet and outlet valves located in the HCU.

### OPERATION

#### ANTILOCK BRAKING SYSTEM

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.

During antilock braking fluid 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.

#### ELECTRONIC BRAKE DISTRIBUTION

Upon entry into EBD the inlet valve for the rear brake circuit is switched on so that the fluid supply from the master cylinder is shut off. In order to decrease the rear brake pressure the outlet valve for

**BRAKES - ABS (Continued)**

the rear brake circuit is pulsed. This allows fluid to enter the low pressure accumulator (LPA) in the HCU resulting in a drop in fluid pressure to the rear brakes. In order to increase the rear brake pressure the outlet valve is switched off and the inlet valve is pulsed. This increases the pressure to the rear brakes. This will continue until the required slip difference is obtained. At the end of EBD braking (no brake application) the fluid in the LPA drains back to the master cylinder by switching on the outlet valve and draining through the inlet valve check valve. At the same time the inlet valve is switched on to prevent a hydraulic short circuit in case of another brake application. The EBD will remain functional during many ABS fault modes. If the red and amber warning lamps are illuminated the EBD may have a fault.

**DIAGNOSIS AND TESTING - ANTILOCK BRAKING SYSTEM**

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.**

**SPECIFICATIONS**

*TORQUE SPECIFICATIONS*

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Hydraulic Control Unit/Controller Antilock Brakes Mounting Nuts	14.1	—	125
Hydraulic Control Unit/Controller Antilock Brakes Brake Lines	20.3	—	180
Controller Antilock Brakes Mounting Screws	1.8	—	16
Wheel Speed Sensors Front Mounting Bolt	12	—	132
Wheel Speed Sensor Rear Mounting Bolt	9	—	80

**NOTE: The MDS or DRB III scan tool is used to diagnose the ABS system. For additional information refer to the Electrical, Electronic Control Modules section. For test procedures refer to the Chassis Diagnostic Manual.**

**STANDARD PROCEDURE - ABS BRAKE BLEEDING**

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 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD 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 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD PROCEDURE).
- (5) Top off master cylinder fluid level and verify proper brake operation before moving vehicle.

## ELECTRICAL

### DESCRIPTION

Three wheel speed sensors are used. The front sensors are mounted to the steering knuckles. The rear sensor is mounted at the top of the rear axle differential carrier. Tone wheels are mounted to the out-board ends of the front axle shafts. The gear type tone wheel serves as the trigger mechanism for each sensor.

### OPERATION

The sensors convert wheel speed into a small digital signal. The CAB sends 12 volts to the sensors. The sensor has an internal magneto resistance bridge that alters the voltage and amperage of the signal circuit. This voltage and amperage is changed by magnetic induction when the toothed tone wheel passes the wheel speed sensor. This digital signal is sent to the CAB. The CAB measures the voltage and amperage of the digital signal for each wheel.

## FRONT WHEEL SPEED SENSOR

### REMOVAL

(1) Disconnect the front wheel speed sensor wire connector that is located on the inboard side of the respective wheel house.

(2) Raise and support the vehicle.

(3) Remove the tire and wheel assembly.

(4) Remove the caliper adapter. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - REMOVAL).

**CAUTION:** Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose with result. Provide a suitable support to hang the caliper securely.

(5) Remove the disc brake rotor. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

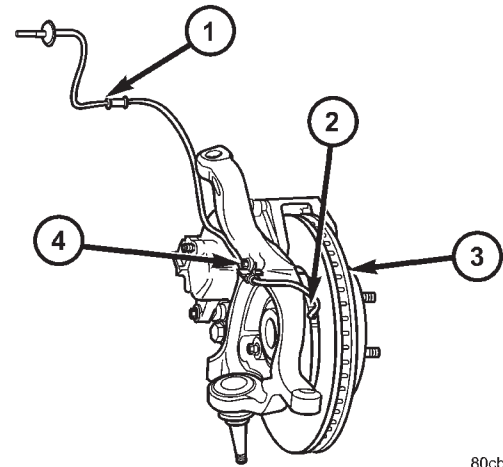
(6) Remove the wheel speed sensor mounting bolt to the hub (Fig. 1).

(7) Remove the wheel speed sensor wire from the hub/bearing (Fig. 1).

(8) Remove the wheel speed sensor wire hold down from the knuckle (Fig. 1).

(9) Remove the wheel speed sensor wire thru the wheel well.

(10) Remove the wheel speed sensor from the vehicle.



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**Fig. 1 FRONT WHEEL SPEED SENSOR**

- 1 - WHEEL SPEED SENSOR WIRE
- 2 - WHEEL SPEED SENSOR
- 3 - ROTOR
- 4 - WHEEL SPEED SENSOR WIRE HOLD DOWN

### INSTALLATION

(1) Install the wheel speed sensor to the vehicle.

(2) Install the wheel speed sensor wire thru the wheel well.

(3) Install the wheel speed sensor wire to the hub/bearing.

(4) Install the wheel speed sensor wire hold down to the knuckle.

(5) Install the wheel speed sensor mounting bolt to the hub. Tighten the mounting bolt to 14 N·m (10 ft.lbs.).

(6) Install the disc brake rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(7) Install the disc brake caliper adapter. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - INSTALLATION).

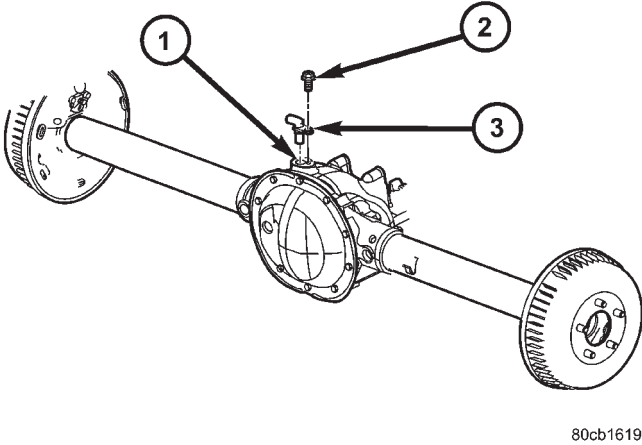
(8) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Reconnect the front wheel speed sensor wire connector to the inboard side of the wheel house being worked on.

## REAR WHEEL SPEED SENSOR

### REMOVAL

- (1) Raise vehicle on hoist.
- (2) Disconnect the sensor wire harness.
- (3) Remove mounting stud from the sensor (Fig. 2).



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**Fig. 2 REAR WHEEL SPEED SENSOR**

- 1 - DIFFERENTIAL HOUSING
- 2 - MOUNTING BOLT
- 3 - WHEEL SPEED SENSOR

- (4) 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 the sensor mounting stud and tighten to 9 N·m (80 in. lbs.).
- (5) Install the sensor electrical connector.
- (6) Lower vehicle.

## HCU (HYDRAULIC CONTROL UNIT)

### DESCRIPTION

The HCU consists of a valve body, pump motor, and wire harness.

### OPERATION

Accumulators in the valve body store extra fluid released to the system for ABS mode operation. The pump provides the fluid volume needed and is operated by a DC type motor. The motor is controlled by the CAB.

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.

During antilock braking, solenoid valve pressure modulation occurs in three stages, pressure increase, pressure hold, and pressure decrease. The valves are all contained in the valve body portion of the HCU.

### PRESSURE DECREASE

The outlet valve is opened and the inlet valve is closed 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 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.



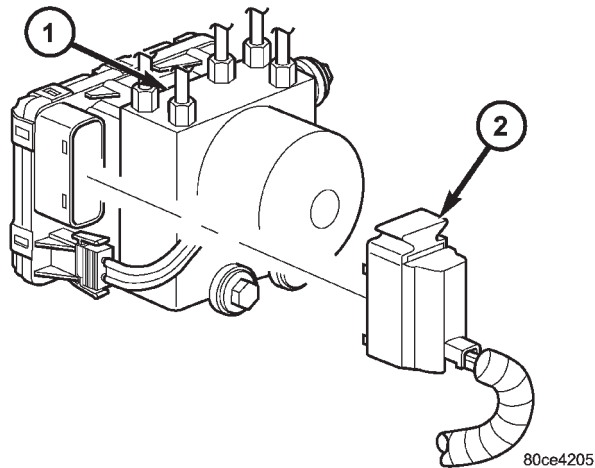
## HCU (HYDRAULIC CONTROL UNIT) (Continued)

**REMOVAL**

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Remove negative battery cable from the battery.

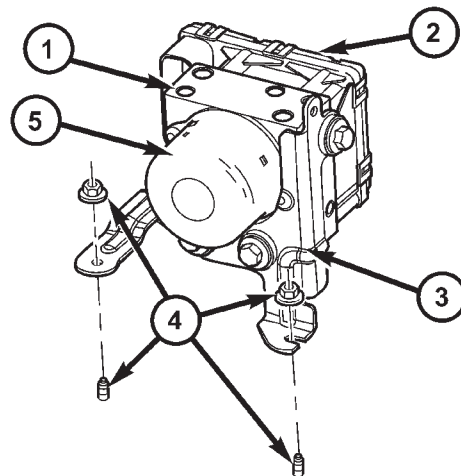
(3) Pull up on the CAB harness connector release (Fig. 3) and remove connector.



**Fig. 3 CAB HARNESS CONNECTOR RELEASE**

- 1 - ABS MODULE  
2 - ELECTRICAL CONNECTOR

(4) Remove brake lines from the HCU.  
(5) Remove HCU/CAB mounting nuts and bolt (Fig. 4) and remove HCU/CAB.



**Fig. 4 HCU/CAB MOUNTING**

- 1 - HCU  
2 - CAB  
3 - HCU/CAB BRACKET  
4 - MOUNTING NUTS AND STUDS  
5 - MOTOR

**INSTALLATION**

- (1) Install HCU/CAB on the mounting studs.  
(2) Install mounting nuts and bolt. Tighten to 11.5 N·m (102 in. lbs.).  
(3) Install brake lines to the HCU and tighten to 19 N·m (170 in. lbs.).  
(4) Install wiring harness connector to the CAB and push down on the release to secure the connector.  
(5) Install negative battery cable to the battery.  
(6) Bleed ABS brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

# BRAKES

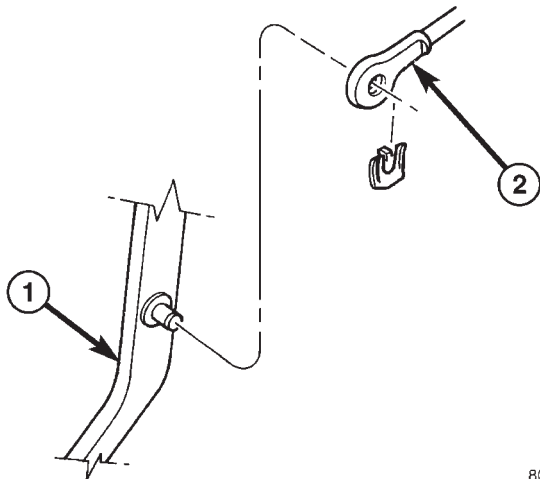
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REMOVAL - RHD	1		

## POWER BRAKE BOOSTER

### REMOVAL - RHD

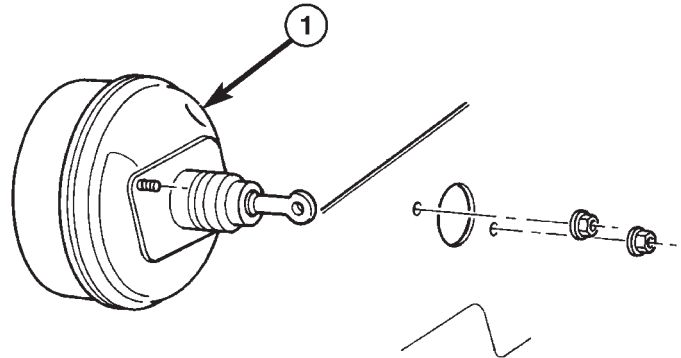
- (1) Remove the air box (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
- (2) Relocate the cruise control servo to gain access to the booster for removal.
- (3) Remove the brake lines from the master cylinder.
- (4) Remove the master cylinder (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/MASTER CYLINDER - REMOVAL).
- (5) Disconnect vacuum hose from booster check valve.
- (6) Remove knee blocker under the steering column.(Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).
- (7) Remove the brake light switch.(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL)
- (8) Remove retaining clip that secures booster push rod to brake pedal (Fig. 1).
- (9) Remove nuts attaching booster to the dash panel (Fig. 2).



**Fig. 1 BOOSTER PUSH ROD**

- 1 - BRAKE PEDAL
- 2 - BOOSTER ROD

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**Fig. 2 BOOSTER MOUNTING**

- 1 - BRAKE BOOSTER

- (10) In engine compartment, slide booster studs out of dash panel, tilt booster upward, and remove booster from engine compartment.

### INSTALLATION - RHD

- (1) Align and position booster on the dash panel.
- (2) Install booster mounting nuts. Tighten nuts just enough to hold booster in place.
- (3) Slide booster push rod onto the brake pedal. Then secure push rod to pedal pin with retaining clip.

**NOTE: Lubricate the pedal pin with Mopar multi-mileage grease before installation.**

- (4) Tighten booster mounting nuts to 39 N·m (29 ft. lbs.).
- (5) Install the brake light switch.
- (6) Install the knee blocker,(Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).
- (7) If original master cylinder is being installed, check condition of seal at rear of master cylinder. Replace seal if cut, or torn.
- (8) Clean cylinder mounting surface of brake booster. Use shop towel wetted with brake cleaner for

## POWER BRAKE BOOSTER (Continued)

this purpose. Dirt, grease, or similar materials will prevent proper cylinder seating and could result in vacuum leak.

(9) Align and install master cylinder on the booster studs. Install mounting nuts and tighten to 17.5 N·m (155 in. lbs.).

(10) Connect vacuum hose to booster check valve.

(11) Remount the cruise control servo to the original location. Tighten bracket mounting nuts to 17.5 N·m (155 in. lbs.).

(12) Connect and secure the brake lines to HCU and master cylinder. Start all brake line fittings by hand to avoid cross threading.

(13) Connect the wire to fluid reservoir.

(14) Install the air box.

(15) Fill and bleed base brake system,(Refer to 5 - BRAKES - STANDARD PROCEDURE).

(16) Verify proper brake operation before moving vehicle.

# CLUTCH

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## CLUTCH

### DESCRIPTION

The clutch mechanism consists of a flywheel, dry-type disc, diaphragm style pressure plate and hydraulic linkage. The flywheel is bolted to the rear flange of the crankshaft. The clutch pressure plate is bolted to the flywheel with the clutch disc between these two components. The clutch system provides the mechanical, link between the engine and the transmission. The system is designed to transfer the torque output of the engine, to the transmission while isolating the transmission from the engine firing pulses to minimize concerns such as gear rattle.

### OPERATION

The clutch operates with leverage, clamping force and friction. The disc serves as the friction element, the diaphragm spring and pressure plate provide the clamping force. The clutch pedal, hydraulic linkage, release lever and bearing provide the leverage.

The clutch master cylinder push rod is connected to the clutch pedal. When the clutch pedal is depressed, the slave cylinder is operated by the clutch master cylinder mounted on the dash panel. The release fork is actuated by the hydraulic slave cylinder mounted on the transmission housing. The release bearing is operated by a release fork pivoting on a ball stud mounted in the transmission housing. The release bearing then depresses the pressure plate spring fingers, thereby releasing pressure on the clutch disc and allowing the engine crankshaft to spin independently of the transmission input shaft.

## CLUTCH (Continued)

**WARNING**

**WARNING:: EXERCISE CARE WHEN SERVICING CLUTCH COMPONENTS. FACTORY INSTALLED CLUTCH DISCS DO NOT CONTAIN ASBESTOS FIBERS. DUST AND DIRT ON CLUTCH PARTS MAY CONTAIN ASBESTOS FIBERS FROM AFTERMARKET COMPONENTS. BREATHING EXCESSIVE CONCENTRATIONS OF THESE FIBERS CAN CAUSE SERIOUS BODILY HARM. WEAR A RESPIRATOR DURING SERVICE AND NEVER CLEAN CLUTCH COMPONENTS WITH COMPRESSED AIR OR WITH A DRY BRUSH. EITHER CLEAN THE COMPONENTS WITH A WATER DAMPENED RAGS OR USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR REMOVING ASBESTOS FIBERS AND DUST. DO NOT CREATE DUST BY SANDING A CLUTCH DISC. REPLACE THE DISC IF THE FRICTION MATERIAL IS DAMAGED OR CONTAMINATED. DISPOSE OF ALL DUST AND DIRT CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS. THIS WILL HELP MINIMIZE EXPOSURE TO YOURSELF AND TO OTHERS. FOLLOW ALL RECOMMENDED SAFETY PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND THE ENVIRONMENTAL SAFETY AGENCY (EPA), FOR THE HANDLING AND DISPOSAL OF PRODUCTS CONTAINING ASBESTOS.**

**DIAGNOSIS AND TESTING - CLUTCH**

Drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If the clutch chatters, grabs, slips or does not release properly, remove and inspect the clutch components. If the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault.

**NOTE: Vehicles equipped with a Dual Mass Flywheel may produce a rattle when the engine is shut off. This noise is considered normal.**

**CLUTCH CONTAMINATION**

Fluid contamination is a frequent cause of clutch malfunctions. Oil, water or clutch fluid on the clutch disc and pressure plate surfaces will cause chatter, slip and grab. Inspect components for oil, hydraulic fluid or water/road splash contamination.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Clutch fluid leaks are usually from damaged slave cylinder push rod seals. Heat buildup caused by slippage between the pressure plate, disc and flywheel can bake the oil residue onto the components. The glaze-like residue ranges in color from amber to black.

Road splash contamination is dirt/water entering the clutch housing due to loose bolts, housing cracks. Driving through deep water puddles can force water/road splash into the housing through such openings.

**IMPROPER RELEASE OR CLUTCH ENGAGEMENT**

Clutch release or engagement problems are caused by wear or damage clutch components. A visual inspection of the release components will usually reveal the problem part.

Release problems can result in hard shifting and noise. Look for leaks at the clutch cylinders and interconnecting line and loose slave cylinder bolts. Also worn/loose release fork, pivot stud, clutch disc, pressure plate or release bearing.

Engagement problems can result in slip, chatter/shudder and noisy operation. The causes may be clutch disc contamination, wear, distortion or flywheel damage. Visually inspect to determine the actual cause of the problem.

**CLUTCH MISALIGNMENT**

Clutch components must be in proper alignment with the crankshaft and transmission input shaft. Misalignment caused by excessive runout or warp of any clutch component will cause grab, chatter and improper clutch release.

**PRESSURE PLATE AND DISC RUNOUT**

Check the clutch disc before installation. Axial (face) runout of a **new** disc should not exceed 0.50 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.

Check condition of the clutch 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 (and consequent misalignment) is improper bolt tightening.

**FLYWHEEL RUNOUT**

Check flywheel runout whenever misalignment is suspected. 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 flywheel bolts.

CLUTCH (Continued)

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. 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 or equivalent. Tighten flywheel bolts to specified torque only. Over-tightening can distort the flywheel hub causing runout.

**DIAGNOSIS CHART**

The diagnosis charts Diagnosis Chart describe common clutch problems, causes and correction. Conditions, causes and corrective action are outlined in the indicated columns.

*DIAGNOSIS CHART*

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc facing worn out	<ol style="list-style-type: none"> <li>1. Normal wear.</li> <li>2. Driver frequently rides (slips) the clutch. Results in rapid overheating and wear.</li> <li>3. Insufficient clutch cover diaphragm spring tension.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace cover and disc.</li> <li>2. Replace cover and disc.</li> <li>3. Replace cover and disc.</li> </ol>
Clutch disc facing contaminated with oil, grease, or clutch fluid.	<ol style="list-style-type: none"> <li>1. Leak at rear main engine seal or transmission input shaft seal.</li> <li>2. Excessive amount of grease applied to the input shaft splines.</li> <li>3. Road splash, water entering housing.</li> <li>4. Slave cylinder leaking.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace appropriate seal.</li> <li>2. Remove grease and apply the correct amount of grease.</li> <li>3. Replace clutch disc. Clean clutch cover and reuse if in good condition.</li> <li>4. Replace hydraulic clutch linkage.</li> </ol>
Clutch is running partially disengaged.	<ol style="list-style-type: none"> <li>1. Release bearing sticking or binding and does not return to the normal running position.</li> </ol>	<ol style="list-style-type: none"> <li>1. Verify failure. Replace the release bearing and transmission front bearing retainer as necessary.</li> </ol>
Flywheel below minimum thickness specification.	<ol style="list-style-type: none"> <li>1. Improper flywheel machining. Flywheel has excessive taper or excessive material removal.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace flywheel.</li> </ol>
Clutch disc, cover and/or diaphragm spring warped or distorted.	<ol style="list-style-type: none"> <li>1. Rough handling. Impact bent cover, spring, or disc.</li> <li>2. Improper bolt tightening procedure.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace disc or cover as necessary.</li> <li>2. Tighten clutch cover using proper procedure.</li> </ol>

## CLUTCH (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Facing on flywheel side of disc torn, gouged, or worn.	<ol style="list-style-type: none"> <li>1. Flywheel surface scored or nicked.</li> <li>2. Clutch disc sticking or binding on transmission input shaft.</li> </ol>	<ol style="list-style-type: none"> <li>2. Correct surface condition if possible. Replace flywheel and disc as necessary.</li> <li>2. Lubricate splines with high temperature grease.</li> </ol>
Clutch disc facing burnt. Flywheel and cover pressure plate surfaces heavily glazed.	<ol style="list-style-type: none"> <li>1. Frequent operation under high loads or hard acceleration conditions.</li> <li>2. Driver frequently rides (slips) clutch. Results in rapid wear and overheating of disc and cover.</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause.</li> <li>2. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause.</li> </ol>
Clutch disc binds on input shaft splines.	<ol style="list-style-type: none"> <li>1. Clutch disc hub splines damaged during installation.</li> <li>2. Input shaft splines rough, damaged, or corroded.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean, smooth, and lubricate hub splines if possible. Replace disc if necessary.</li> <li>2. Clean, smooth, and lubricate shaft splines if possible. Replace input shaft if necessary.</li> </ol>
Clutch disc rusted to flywheel and/or pressure plate.	<ol style="list-style-type: none"> <li>1. Clutch not used for and extended period of time (e.g. long term vehicle storage).</li> </ol>	<ol style="list-style-type: none"> <li>1. Sand rusted surfaces with 180 grit sanding paper. Replace clutch cover and flywheel if necessary.</li> </ol>
Pilot bearing seized, loose, or rollers are worn.	<ol style="list-style-type: none"> <li>1. Bearing cocked during installation.</li> <li>2. Bearing defective.</li> <li>3. Bearing not lubricated.</li> <li>4. Clutch misalignment.</li> </ol>	<ol style="list-style-type: none"> <li>1. Install and lubricate a new bearing.</li> <li>2. Install and lubricate a new bearing.</li> <li>3. Install and lubricate a new bearing.</li> <li>4. Inspect clutch and correct as necessary. Install and lubricate a new bearing.</li> </ol>
Clutch will not disengage properly.	<ol style="list-style-type: none"> <li>1. Low clutch fluid level.</li> <li>2. Clutch cover loose.</li> <li>3. Clutch disc bent or distorted.</li> <li>4. Clutch cover diaphragm spring bent or warped.</li> <li>5. Clutch disc installed backwards.</li> <li>6. Release fork bent or fork pivot loose or damaged.</li> <li>7. Clutch master or slave cylinder failure.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace hydraulic linkage assembly.</li> <li>2. Follow proper bolt tightening procedure.</li> <li>3. Replace clutch disc.</li> <li>4. Replace clutch cover.</li> <li>5. Remove and install clutch disc correctly.</li> <li>6. Replace fork or pivot as necessary.</li> <li>7. Replace hydraulic linkage assembly.</li> </ol>

CLUTCH (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch pedal squeak.	<ol style="list-style-type: none"> <li>1. Pivot pin loose.</li> <li>2. Master cylinder bushing not lubricated.</li> <li>3. Pedal bushings worn out or cracked.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten pivot pin if possible. Replace clutch pedal if necessary.</li> <li>2. Lubricate master cylinder bushing.</li> <li>3. Replace and lubricate bushings.</li> </ol>
Clutch master or slave cylinder plunger dragging and/or binding	<ol style="list-style-type: none"> <li>1. Master or slave cylinder components worn or corroded.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace clutch hydraulic linkage assembly.</li> </ol>
Release bearing is noisy.	<ol style="list-style-type: none"> <li>1. Release bearing defective or damaged.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace release bearing.</li> </ol>
Contact surface of release bearing damaged.	<ol style="list-style-type: none"> <li>1. Clutch cover incorrect or release fingers bent or distorted.</li> <li>2. Release bearing defective or damaged.</li> <li>3. Release bearing misaligned.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace clutch cover and release bearing.</li> <li>2. Replace the release bearing.</li> <li>3. Check and correct runout of clutch components. Check front bearing sleeve for damage/alignment. Repair as necessary.</li> </ol>
Partial engagement of clutch disc. One side of disc is worn and the other side is glazed and lightly worn.	<ol style="list-style-type: none"> <li>1. Clutch pressure plate position incorrect.</li> <li>2. Clutch cover, spring, or release fingers bent or distorted.</li> <li>3. Clutch disc damaged or distorted.</li> <li>4. Clutch misalignment.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace clutch disc and cover.</li> <li>2. Replace clutch disc and cover.</li> <li>2. Replace clutch disc.</li> <li>4. Check alignment and runout of flywheel, disc, pressure plate, and/or clutch housing. Correct as necessary.</li> </ol>

**SPECIFICATIONS - CLUTCH**

*TORQUE SPECIFICATIONS*

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Pressure Plate Bolts - 2.4L	31	23	-
Pressure Plate Bolts - 3.7L	50	37	-
Clutch Cylinder Bolts	23	-	200
Flywheel Bolts - 2.4L	81	60	-
Flywheel Bolts - 3.7L	81	60	-



## CLUTCH DISC

### REMOVAL

- (1) Remove transmission.
- (2) Mark position of pressure plate on flywheel with paint or a scribe for assembly reference, if clutch is not being replaced.
- (3) Loosen pressure plate bolts evenly and in rotation to relieve spring tension and avoid warping the plate.
- (4) Remove pressure plate bolts and pressure plate and disc.

### INSTALLATION

- (1) Lightly scuff sand flywheel face with 180 grit emery cloth, then clean with a wax and grease remover.
- (2) Lubricate pilot bearing with Mopar high temperature bearing grease or equivalent.
- (3) Check runout and operation of **new** clutch disc.

**NOTE: Disc must slide freely on transmission input shaft splines.**

- (4) With the disc on the input shaft, check face runout with dial indicator. Check runout at disc hub 6 mm (1/4 in.) from outer edge of facing. Obtain another clutch disc if runout exceed 0.5 mm (0.020 in.).
- (5) Position clutch disc on flywheel with side marked flywheel against the flywheel.

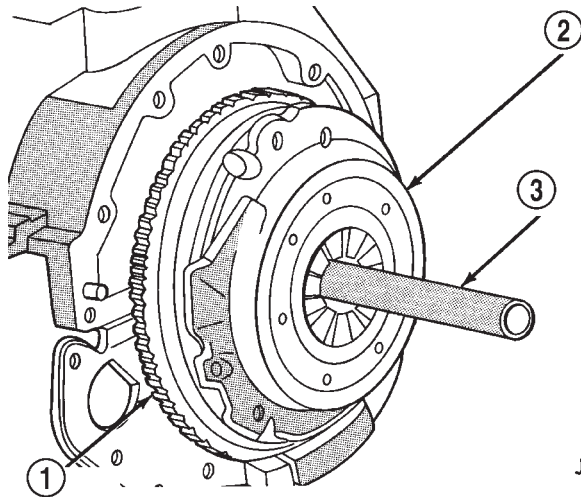
**NOTE: If not marked, the flat side of disc hub goes towards the flywheel on the 3.7L engine and towards the transmission on 2.4L engine.**

- (6) Insert clutch alignment tool through the clutch disc and into the pilot bearing (Fig. 1).
- (7) Position clutch pressure plate over disc and on the flywheel (Fig. 1).
- (8) Install pressure plate bolts finger tight.

**CAUTION: Use only the factory bolts to mount the pressure plate. The bolts must be the correct size. If bolts are too short, there isn't enough thread engagement, if too long bolts interfere with the Dual Mass Flywheel.**

- (9) Tighten pressure plate bolts evenly and in rotation a few threads at a time.

**CAUTION: The bolts must be tightened evenly and to specified torque to avoid distorting the pressure plate.**



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**Fig. 1 ALIGNING CLUTCH DISC**

- 1 - FLYWHEEL  
 2 - PRESSURE PLATE  
 3 - CLUTCH DISC ALIGNMENT TOOL

- (10) Tighten pressure plate bolts to 31 N·m (23 ft. lbs.) on 2.4L engines and 50 N·m (37ft. lbs.) on 3.7L engines.

- (11) Apply light coat of Mopar high temperature bearing grease or equivalent to clutch disc hub and splines of transmission input shaft.

**CAUTION: Do not over lubricate shaft splines. This will result in grease contamination of disc.**

- (12) Install transmission.

## CLUTCH RELEASE BEARING

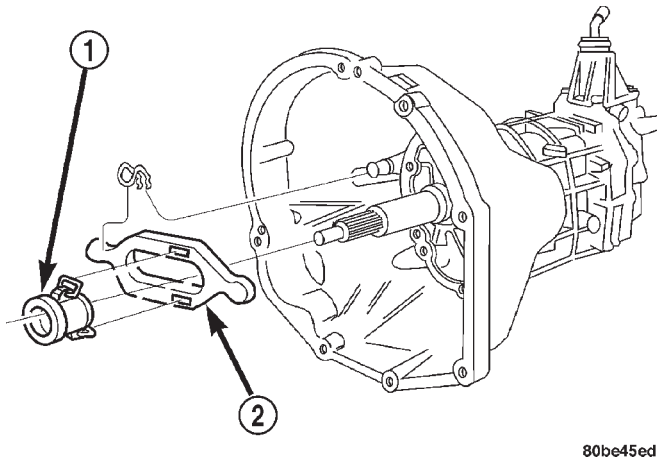
### REMOVAL

- (1) Remove transmission.
- (2) Disconnect release bearing from release lever and remove the bearing (Fig. 2).
- (3) Inspect bearing slide surface of transmission front bearing retainer. Replace retainer if slide surface is scored, worn, or cracked.
- (4) Inspect release fork and fork pivot. Be sure pivot is secure and in good condition. Be sure fork is not distorted or worn. Replace release fork retainer spring if bent or damaged.

### INSTALLATION

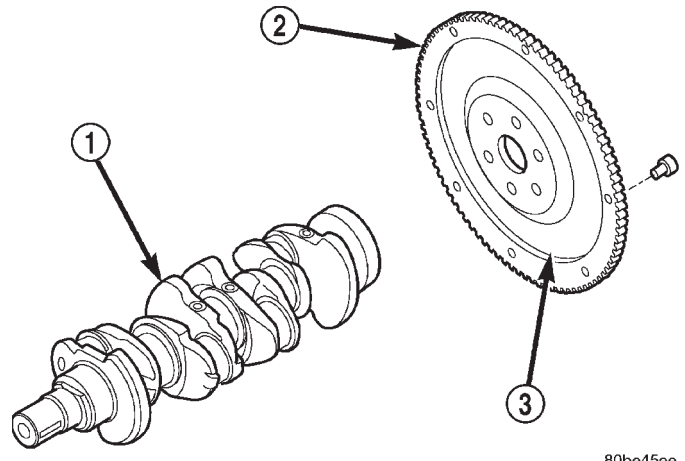
- (1) Lubricate crankshaft pilot bearing with Mopar high temperature bearing grease or equivalent. Apply grease to end of long shank, small diameter flat blade screwdriver. Then insert tool through clutch disc hub to reach bearing.

CLUTCH RELEASE BEARING (Continued)



**Fig. 2 CLUTCH RELEASE BEARING**

- 1 - RELEASE BEARING
- 2 - RELEASE FORK



**Fig. 3 FLYWHEEL**

- 1 - CRANKSHAFT
- 2 - RING GEAR
- 3 - FLYWHEEL

(2) Lubricate input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface.

(3) Install new release bearing. Be sure bearing is properly secured to release fork.

(4) Install transmission.

**FLYWHEEL**

**DESCRIPTION**

**STANDARD FLYWHEEL**

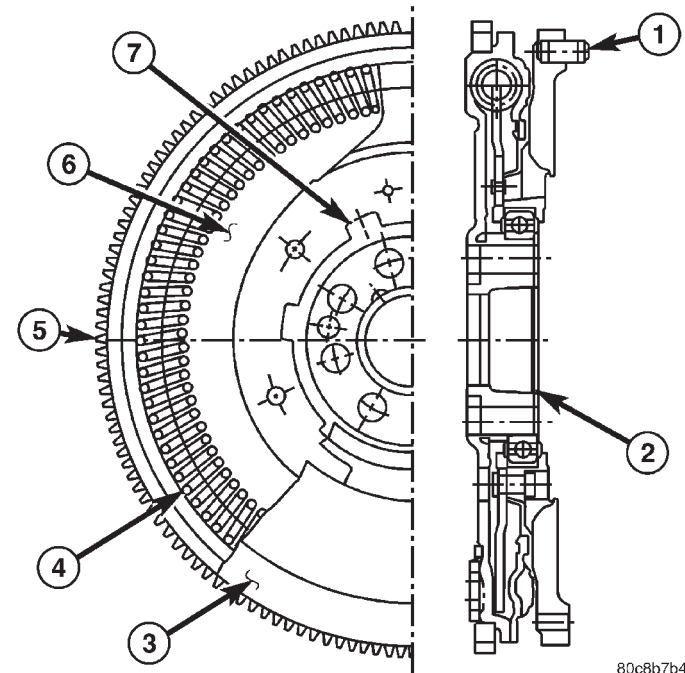
The standard flywheel is used on the 3.7L engine. The flywheel (Fig. 3) is a heavy plate bolted to the rear of the crankshaft. The flywheel incorporates the ring gear around the outer circumference to mesh with the starter to permit engine cranking. The rear face of the flywheel serves as the driving member to the clutch disc.

**DUAL MASS FLYWHEEL**

The Dual Mass Flywheel is used on the 2.4 l engine (Fig. 4). The flywheel incorporates the ring gear around the outer circumference to mesh with the starter to permit engine cranking. The primary flywheel side is bolted to the crankshaft. The secondary flywheel face serves as the driving member to the clutch disc. Internal springs between the flywheels are used to dampen energy.

**OPERATION**

The flywheel serves to dampen the engine firing pulses. The heavy weight of the flywheel relative to the rotating mass of the engine components serves to stabilize the flow of power to the remainder of the drivetrain. The crankshaft has the tendency to



**Fig. 4 DUAL MASS FLYWHEEL**

- 1 - LOCATING STUD
- 2 - BEARING
- 3 - SECONDARY FLYWHEEL
- 4 - DAMPER SPRING
- 5 - RING GEAR
- 6 - PRIMARY FLYWHEEL
- 7 - FRICTION DISC

attempt to speed up and slow down in response to the cylinder firing pulses. The flywheel dampens these impulses by absorbing energy when the crankshaft speeds and releasing the energy back into the system when the crankshaft slows down.

## FLYWHEEL (Continued)

On a Dual Mass Flywheel the additional secondary mass coupled to the transmission lowers the natural frequency of the transmission rotating elements. This decreases the transmission gear rattle. The damper springs between the two flywheel masses replace the clutch disc damper springs and assist in a smooth transfer of torque to the transmission.

**CAUTION:** The Dual Mass Flywheel is serviced as an assembly only and should never be taken apart.

## DIAGNOSIS AND TESTING - FLYWHEEL

Check flywheel runout whenever misalignment is suspected. 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 flywheel 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. 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 or equivalent. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

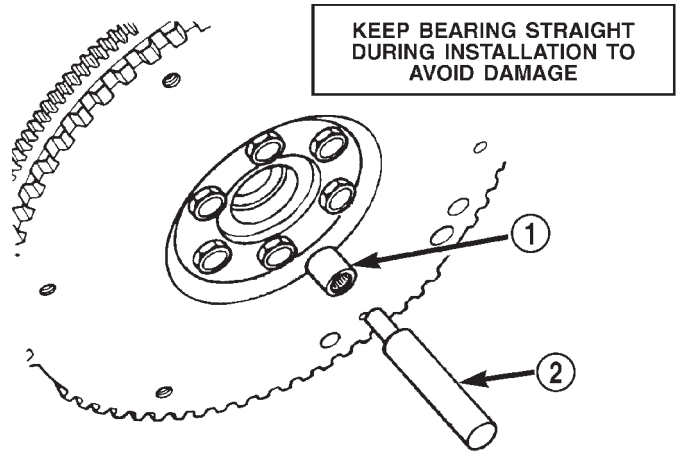
## PILOT BEARING

## REMOVAL

- (1) Remove the transmission.
- (2) Remove pressure plate and clutch disc.
- (3) Remove pilot bearing with an internal (blind hole) puller.

## INSTALLATION

- (1) Lubricate new bearing with Mopar high temperature bearing grease or equivalent.
- (2) Start new bearing into crankshaft by hand. Then seat bearing with clutch alignment tool (Fig. 5).



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**Fig. 5 Pilot Bearing Installer**

- 1 - PILOT BEARING
- 2 - ALIGNMENT TOOL

- (3) Lightly scuff sand flywheel surface with 180 grit emery cloth. Then clean surface with wax and grease remover.
- (4) Install clutch disc and pressure plate.
- (5) Install the transmission.

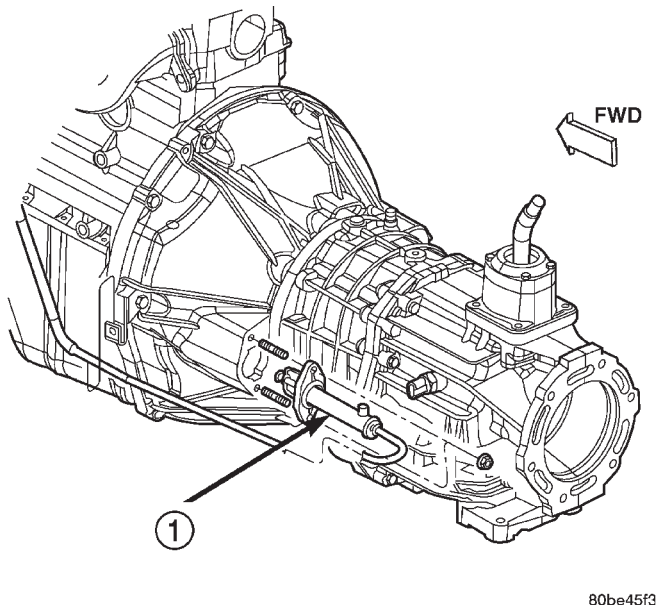
## LINKAGE

## REMOVAL

**NOTE:** The clutch master cylinder, slave cylinder and connecting line are serviced as an assembly only. The linkage components cannot be overhauled or serviced separately. The cylinders and connecting line are sealed units.

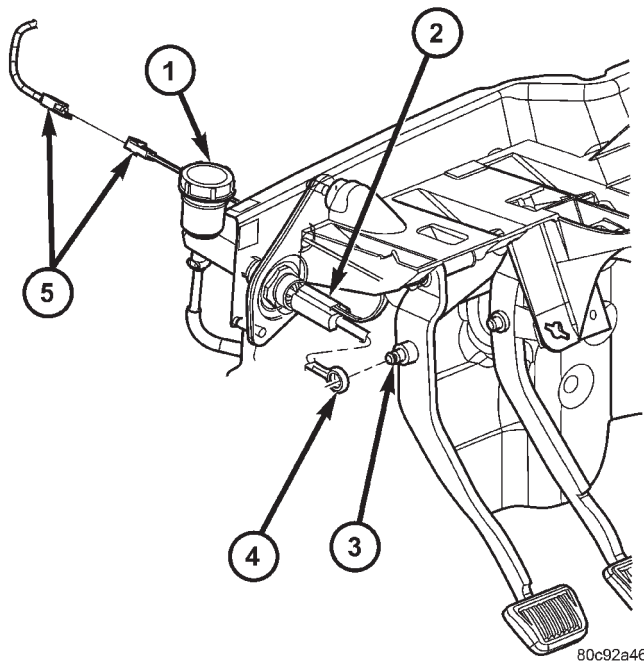
- (1) Raise vehicle.
- (2) Remove fasteners attaching slave cylinder to clutch housing.
- (3) Remove slave cylinder from clutch housing (Fig. 6).
- (4) Disengage clutch fluid line from body clips, if applicable.
- (5) Lower vehicle.
- (6) Verify cap on clutch master cylinder reservoir is tight to avoid spilling fluid during removal.
- (7) Remove clutch master cylinder attaching nuts (Fig. 7).
- (8) Disengage captured bushing on clutch master cylinder actuator from pivot pin on pedal arm.

LINKAGE (Continued)



**Fig. 6 SLAVE CYLINDER**

- 1 - CLUTCH SLAVE CYLINDER



**Fig. 7 CLUTCH PEDAL**

- 1 - CYLINDER
- 2 - ACTUATOR SHAFT
- 3 - ACTUATOR EYE
- 4 - PEDAL PIN
- 5 - CONNECTOR

- (9) Slide actuator off pivot pin.
- (10) Disconnect clutch interlock safety switch wires.

- (11) Remove clutch hydraulic linkage through engine compartment.

**INSTALLATION**

**NOTE:** The clutch master cylinder, slave cylinder and connecting line are serviced as an assembly only. The linkage components cannot be overhauled or serviced separately. The cylinders and connecting line are sealed units.

- (1) Be sure reservoir cover on clutch master cylinder is tight to avoid spills.
- (2) Position clutch linkage components in vehicle. Work connecting line and slave cylinder downward past engine and adjacent to clutch housing.
- (3) Position clutch master cylinder on dash panel.
- (4) Attach clutch master cylinder actuator to pivot pin on clutch pedal.
- (5) Install and tighten clutch master cylinder attaching nuts to 38 N·m (28 ft. lbs.).
- (6) Raise vehicle.
- (7) Insert slave cylinder push rod through clutch housing opening and into release lever. Be sure cap on end of rod is securely engaged in lever. Check this before installing cylinder attaching nuts.
- (8) Install and tighten slave cylinder attaching nuts to 23 N·m (17 ft. lbs.).
- (9) Secure clutch fluid line in body and transmission clips.
- (10) Lower vehicle.
- (11) Connect clutch interlock safety switch wires.

**MASTER CYLINDER**

**INSPECTION**

The clutch fluid reservoir, master cylinder, slave cylinder and fluid lines are pre-filled with fluid at the factory during assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. **The reservoir fluid level will actually increase as normal clutch wear occurs. Avoid overfilling or removing fluid from the reservoir.**

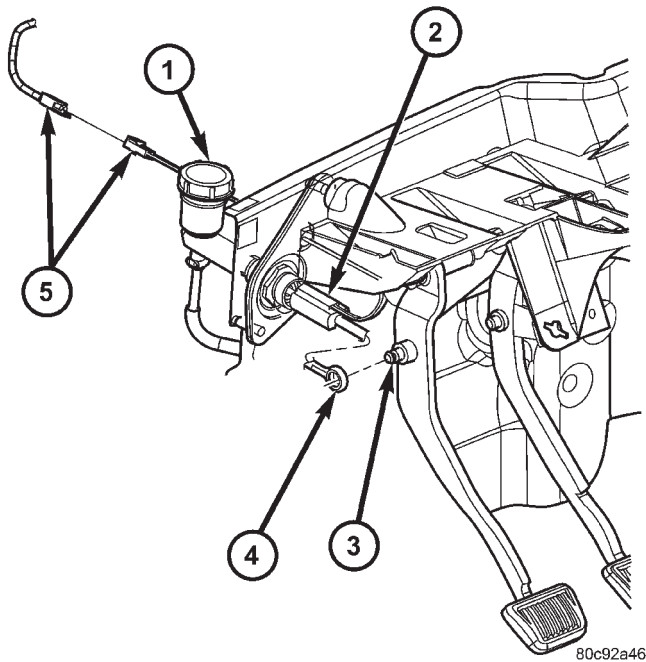
Clutch fluid level is checked at the master cylinder reservoir. An indicator ring is provided on the outside of the reservoir. With the cap and diaphragm removed, fluid level should not be above indicator ring.

To avoid contaminating the hydraulic fluid during inspection, wipe reservoir and cover clean before removing the cap.

## CLUTCH PEDAL

### REMOVAL

- (1) Remove steering column lower cover and knee blocker for access.
- (2) Disconnect clutch pedal position switch wires.
- (3) Disengage captured bushing lock tabs attaching clutch master cylinder actuator to pedal pivot.
- (4) Remove nuts attaching pedal and bracket to dash panel and upper cowl support (Fig. 8).
- (5) Separate pedal assemble from vehicle.



**Fig. 8 CLUTCH PEDAL**

- 1 - CYLINDER
- 2 - ACTUATOR SHAFT
- 3 - ACTUATOR EYE
- 4 - PEDAL PIN
- 5 - CONNECTOR

### INSTALLATION

- (1) Place clutch pedal and bracket over studs on dash panel and cowl support.
- (2) Install nuts to attach pedal and bracket to dash panel and upper cowl support. Tighten nuts to 39 N·m (29 ft. lbs.) torque
- (3) Engage captured bushing and actuator on brake pedal pivot.
- (4) Connect clutch pedal position switch wires.

## CLUTCH SWITCH OVERRIDE RELAY

### DESCRIPTION

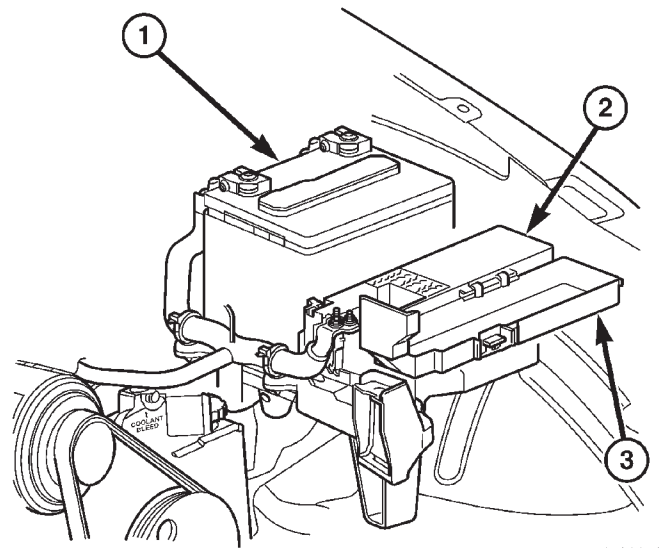
The clutch pedal position switch override relay is located in the Power Distribution Center (PDC). Refer to PDC cover label for location within PDC.

### OPERATION

Refer to Clutch Pedal Position Switch Operation for information.

### REMOVAL

The Clutch Switch Override Relay is located in the Power Distribution Center (PDC) (Fig. 9). Refer to label on PDC cover for relay location.



**Fig. 9 POWER DISTRIBUTION CENTER (PDC)**

- 1 - BATTERY
- 2 - PDC
- 3 - PDC COVER

- (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

The Clutch Switch Override Relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

- (1) Install relay to PDC.
- (2) Install cover to PDC.

## CLUTCH PEDAL POSITION SWITCH

### DESCRIPTION

The clutch pedal position switch is located under the instrument panel. It is attached to the clutch master cylinder push rod (Fig. 10). The wiring harness connection for the switch is made in the engine compartment (Fig. 10).

The clutch pedal position switch override relay is located in the Power Distribution Center (PDC). Refer to PDC cover label for location within PDC.

### OPERATION

The clutch pedal position switch is used to prevent starter motor engagement unless the clutch pedal is depressed.

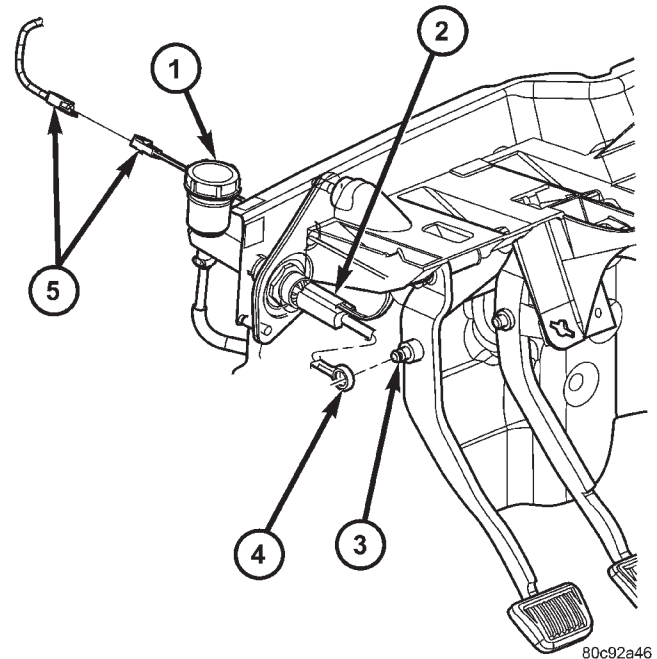
**4WD Feature:** The clutch pedal position switch override relay will inhibit operation of the position switch when the vehicle transfer case is in the four-wheel-drive (4WD) low-range position (only). This feature will allow operation of the starter motor, without the need for depressing the clutch pedal, for certain off-road applications. If any Diagnostic Trouble Codes (DTC's) for either the override relay or transfer case switch are stored, the override relay feature will be inhibited.

An input from this switch is also used to either shut down and/or prevent operation of the speed control system when the clutch pedal is depressed.

### DIAGNOSIS AND TESTING - CLUTCH PEDAL POSITION SWITCH

(1) Locate switch 2-wire electrical connector in engine compartment (Fig. 10). Disconnect wiring at this point.

(2) Check for switch continuity with an ohmmeter while operating clutch pedal up and down. Continu-



**Fig. 10 CLUTCH PEDAL POSITION SWITCH**

- 1 - CLUTCH MASTER CYLINDER
- 2 - CLUTCH PEDAL POSITION SWITCH
- 3 - CLUTCH PEDAL PIN
- 4 - MASTER CYLINDER PUSHROD
- 5 - ELECTRICAL CONNECTION (IN ENGINE COMPARTMENT)

ity should be broken and reapplied each time pedal is pressed.

(3) If continuity is not present, or is always present at any pedal position, replace switch. Switch is not serviced separately. Replace clutch master cylinder.



# COOLING

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## COOLING

### DESCRIPTION

#### DESCRIPTION - COOLING SYSTEM 3.7L

##### ENGINE

The cooling system consists of the following items:

- Electric cooling fan - Standard.
- Electric cooling fan and mechanical thermal viscous fan with low disengaged - Heavy duty cooling only

- Radiator
- Hot bottle pressure cap
- Thermostat
- Coolant reserve/overflow system
- Radiator in-tank transmission oil cooler (if equipped with an automatic transmission)
- Coolant
- Water pump
- Hoses and hose clamps



## COOLING (Continued)

**DESCRIPTION - COOLING SYSTEM ROUTING  
3.7L ENGINE**

For cooling system routing refer to (Fig. 1).

**DESCRIPTION - HOSE CLAMPS**

The cooling system utilizes spring type hose clamps. If a spring type clamp replacement is necessary, replace with the original Mopar® equipment spring type clamp.

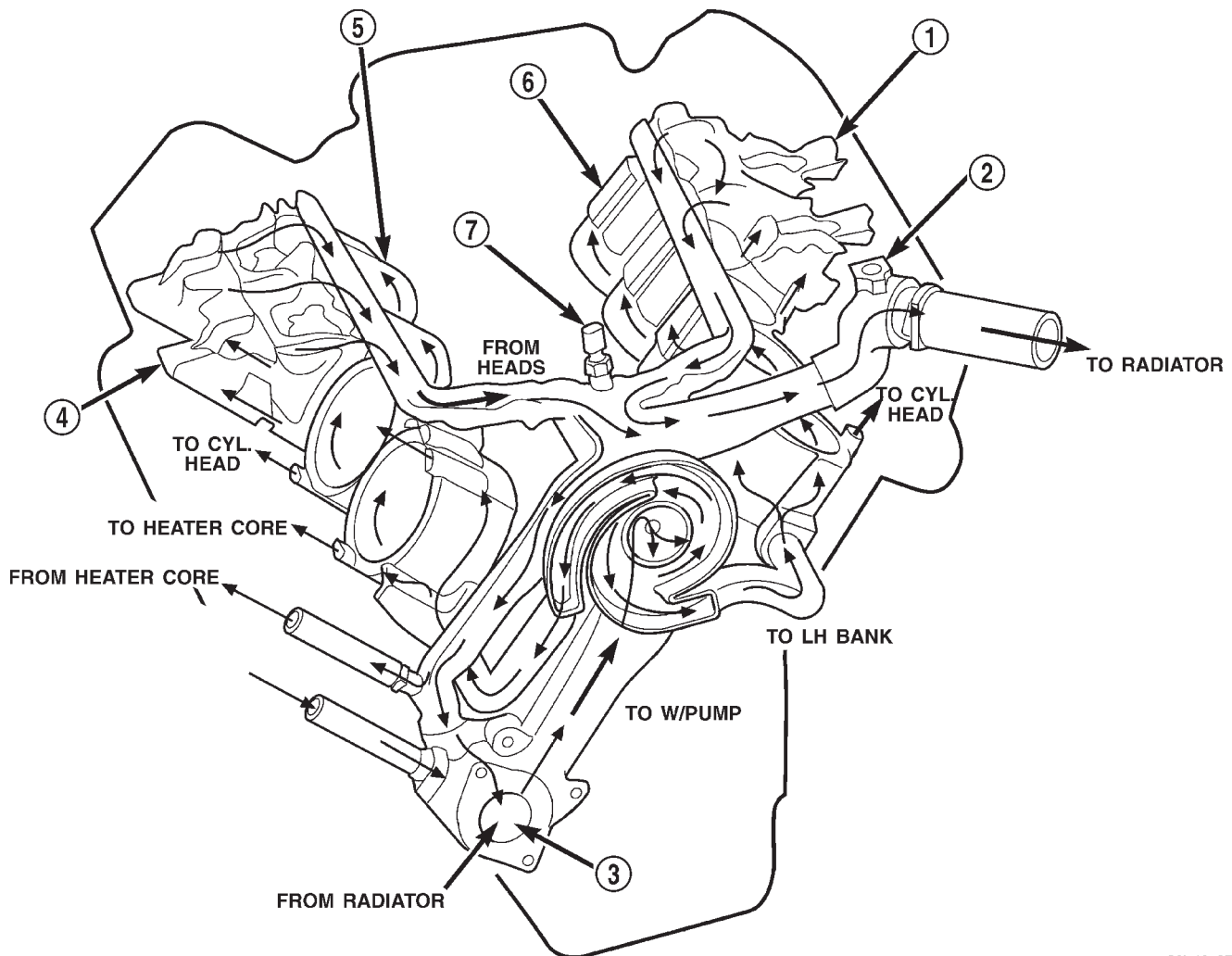
**WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 2). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS.**

**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 a original equipment clamp with matching number or letter (Fig. 2).**

**OPERATION****OPERATION - 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.

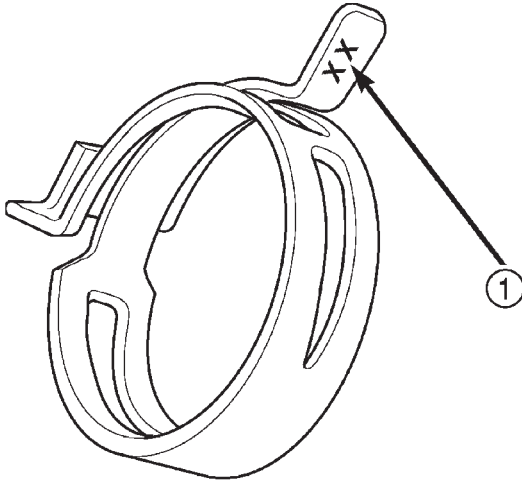


**Fig. 1 Engine Cooling System 3.7L Engine**

- 1 - LH CYL. HEAD
- 2 - AIR BLEED
- 3 - THERMOSTAT LOCATION
- 4 - RH CYL. HEAD

- 5 - RH BANK CYL. BLOCK
- 6 - LH BANK CYL. BLOCK
- 7 - COOLANT TEMP. SENSOR

## COOLING (Continued)



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**Fig. 2 Spring Clamp Size Location**

1 - SPRING CLAMP SIZE LOCATION

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 to circulate coolant throughout the system.

### OPERATION - HOSE CLAMPS

The spring type hose clamp applies constant tension on a hose connection. To remove a spring type hose clamp, only use constant tension clamp pliers designed to compress the hose clamp.

## DIAGNOSIS AND TESTING

### DIAGNOSIS AND TESTING - ON-BOARD DIAGNOSTICS (OBD)

#### COOLING SYSTEM RELATED DIAGNOSTICS

The powertrain control module (PCM) has been programmed to monitor certain 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 indicated 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 25 - EMISSIONS CONTROL - DESCRIPTION).

### ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

### ERASING TROUBLE CODES

After the problem has been repaired, use the DRB scan tool to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service information for operation of the DRB scan tool.

### 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:

- PROLONGED IDLE
- VERY HIGH AMBIENT TEMPERATURE
- SLIGHT TAIL WIND AT IDLE
- SLOW TRAFFIC
- TRAFFIC JAMS
- HIGH SPEED
- STEEP GRADES

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.

#### (1) TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

#### (2) 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.**

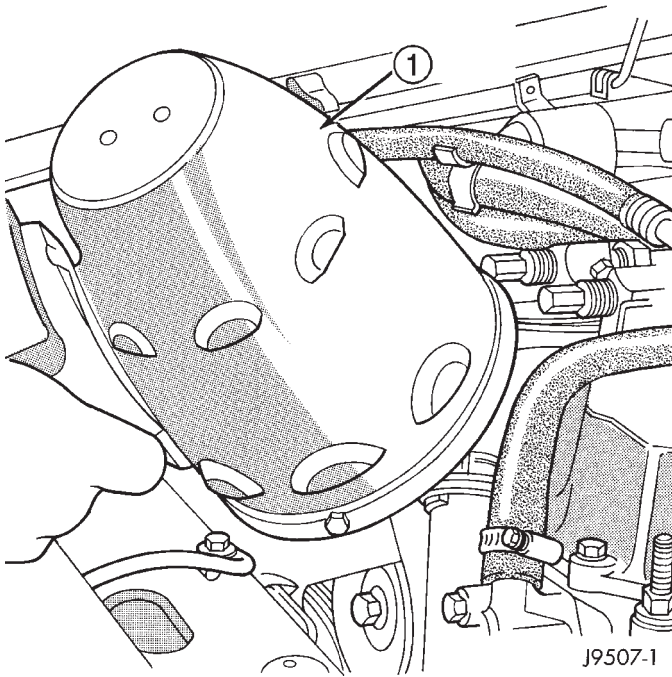
These charts are to be used as a quick-reference only. Refer to the group text for information.

## COOLING (Continued)

**DIAGNOSIS AND TESTING - COOLING SYSTEM LEAKS****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. 3).



**Fig. 3 Leak Detection Using Black Light - Typical**

1 - TYPICAL BLACK LIGHT TOOL

**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.

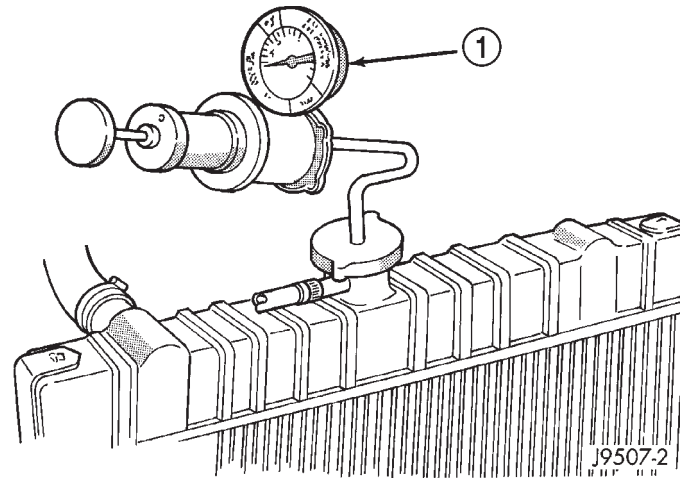
**WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.**

Carefully remove radiator pressure cap from pressure bottle 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, and dirt. 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 damaged, seating of pressure cap valve and tester seal will be affected.

Attach pressure tester (7700 or an equivalent) to radiator filler neck (Fig. 4).



**Fig. 4 Pressure Testing Cooling System - Typical**

1 - TYPICAL COOLING SYSTEM PRESSURE TESTER

Operate tester pump to apply 110 kPa (16 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 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.

**INTERNAL LEAKAGE INSPECTION**

Remove engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in

## COOLING (Continued)

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 RADIATOR PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 124 KPA (18 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 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 DRAIN-COCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.**

Drain sufficient coolant to allow thermostat removal. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL). Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

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 drain-cock immediately after test to eliminate boil over.**

Start engine and accelerate rapidly three times, to approximately 3000 rpm 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.

COOLING (Continued)

## DIAGNOSIS AND TESTING - COOLING SYSTEM DIAGNOSIS CHART

## COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	<ol style="list-style-type: none"> <li>1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?</li> <li>2. Is the temperature sending unit connected?</li> <li>3. Is the temperature gauge operating OK?</li> <li>4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.</li> <li>5. Improper operation of internal heater doors or heater controls.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for On-Board Diagnostics and DTC information. Replace thermostat if necessary.</li> <li>2. Check the temperature sensor connector. (Refer to 7 - COOLING/ ENGINE/ENGINE COOLANT TEMP SENSOR - DESCRIPTION). Repair connector if necessary.</li> <li>3. Check gauge operation. Repair as necessary.</li> <li>4. Check coolant level in the coolant pressure bottle and the radiator. Inspect system for leaks. Repair leaks as necessary.</li> <li>5. Inspect heater and repair as necessary. (Refer to 24 - HEATING &amp; AIR CONDITIONING - DIAGNOSIS AND TESTING)</li> </ol>
	<ol style="list-style-type: none"> <li>6. Electric fan functioning when not required.</li> </ol>	<ol style="list-style-type: none"> <li>6. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section. Refer to group 8W for electric cooling fan and relay circuit schematic data.</li> </ol>
	<ol style="list-style-type: none"> <li>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.</li> <li>2. Is the temperature gauge reading correctly?</li> <li>3. Is the temperature warning illuminating unnecessarily?</li> <li>4. Coolant low in coolant pressure bottle and radiator?</li> </ol>	<ol style="list-style-type: none"> <li>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.</li> <li>2. Check gauge. (Refer to Group 8J - INSTRUMENT CLUSTER). Repair as necessary.</li> <li>3. Check warning lamp operation. (Refer to Group 8J - INSTRUMENT CLUSTER). Repair as necessary.</li> <li>4. Check for coolant leaks and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</li> </ol>

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	<p>5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.</p> <p>6. Poor seals at the radiator cap.</p> <p>7. Coolant not flowing through system.</p> <p>8. Incorrect coolant concentration</p> <p>9. Fan installed backwards on viscous drive.</p> <p>10. Radiator or A/C condenser fins are dirty or clogged.</p> <p>11. Radiator core is corroded or plugged.</p> <p>12. Fuel or ignition system problems.</p> <p>13. Dragging brakes.</p> <p>14. Bug screen or cardboard is being used, reducing airflow.</p>	<p>5. Tighten cap</p> <p>6. (a) Check condition of cap and cap seals. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.</p> <p>7. (a) Check condition of pressure bottle cap and cap seals. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). (b) Check condition of radiator vent nipple. If neck is 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 pressure bottle/overflow tank and tanks hoses for blockage. Repair as necessary.</p> <p>8. Check coolant. (Refer to 7 - COOLING/ENGINE/COOLANT - DESCRIPTION) for correct coolant/water mixture ratio.</p> <p>9. Mount fan on drive correctly.</p> <p>10. Remove insects and debris. (Refer to 7 - COOLING/ENGINE/RADIATOR - CLEANING).</p> <p>11. Have radiator re-cored or replaced.</p> <p>12. Refer to FUEL and /or IGNITION CONTROL for diagnosis.</p> <p>13. Check and correct as necessary. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING) for correct procedures.</p> <p>14. Remove bug screen or cardboard.</p>

## COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	<p>15. Thermostat partially or completely shut.</p> <p>16. Viscous fan drive not operating properly.</p> <p>17. Cylinder head gasket leaking.</p> <p>18. Heater core leaking.</p> <p>19. Electric fan not functioning.</p>	<p>15. Check thermostat operation and replaces necessary. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - DIAGNOSIS AND TESTING).</p> <p>16. Check fan drive operation and replace as necessary. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING).</p> <p>17. Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING). For repair, (Refer to 9 - ENGINE/ CYLINDER HEAD - REMOVAL).</p> <p>18. Check heater core for leaks. (Refer to 24 - HEATING &amp; AIR CONDITIONING/PLUMBING/ HEATER CORE - REMOVAL). Repair as necessary.</p> <p>19. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section. Refer to Group 8W for electric cooling fan and relay circuit schematic data.</p>
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	<p>1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.</p> <p>2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.</p> <p>3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running)</p> <p>4. Gauge reading high after re-starting a warmed up (hot) engine.</p> <p>5. Coolant level low in cooling system (air will build up in the cooling system causing the thermostat to open late).</p>	<p>1. A normal condition. No correction is necessary.</p> <p>2. Check operation of gauge and repair if necessary. Refer to Group 8J, Instrument cluster.</p> <p>3. A normal condition. No correction is necessary. Gauge should return to normal range after vehicle is driven.</p> <p>4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.</p> <p>5. Check and correct coolant leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</p>

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	<p>6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.</p> <p>7. Water pump impeller loose on shaft.</p> <p>8. Loose accessory drive belt. (water pump slipping)</p> <p>9. Air leak on the suction side of the water pump allows air to build up in cooling system causing thermostat to open late.</p>	<p>6. (a) Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</p> <p>(b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary.</p> <p>7. Check water pump and replace as necessary. (Refer to 7 - COOLING/ENGINE/WATER PUMP - DIAGNOSIS AND TESTING).</p> <p>8. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING). Check and correct as necessary.</p> <p>9. Locate leak and repair as necessary.</p>
<p>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</p>	<p>1. Pressure relief valve in pressure bottle cap is defective.</p>	<p>1. Check condition of radiator cap and cap seals. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace cap as necessary.</p>
<p>COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE READING HIGH OR HOT</p>	<p>1. Coolant leaks in radiator, cooling system hoses, water pump or engine.</p>	<p>1. Pressure test and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</p>
<p>DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH</p>	<p>1. Engine overheating.</p> <p>2. Freeze point of coolant not correct. Mixture is too rich or too lean.</p>	<p>1. Check reason for overheating and repair as necessary.</p> <p>2. Check coolant concentration. (Refer to 7 - COOLING/ENGINE/COOLANT - DESCRIPTION) and adjust ratio as required.</p>



## COOLING (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.	<p>1. (a) Radiator cap relief valve stuck. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace if necessary</p> <p>(b) Hose between coolant reserve/overflow tank and radiator is kinked. Repair as necessary.</p> <p>(c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary.</p> <p>(d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.</p>
NOISY VISCOUS FAN/DRIVE	<p>1. Fan blades loose - 4.0L.</p> <p>2. Fan blades striking a surrounding object.</p> <p>3. Air obstructions at radiator or air conditioning condenser.</p> <p>4. Thermal viscous fan drive has defective bearing - 4.0L</p>	<p>1. Replace fan blade assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)</p> <p>2. Locate point of fan blade contact and repair as necessary.</p> <p>3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser.</p> <p>4. Replace fan drive. Bearing is not serviceable. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).</p>
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	<p>1. Has a Diagnostic trouble Code (DTC) been set?</p> <p>2. Coolant level low</p> <p>3. Obstructions in heater hose/ fittings</p> <p>4. Heater hose kinked</p> <p>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.</p>	<p>1. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for correct procedures and replace thermostat if necessary</p> <p>2. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</p> <p>3. Remove heater hoses at both ends and check for obstructions</p> <p>4. Locate kinked area and repair as necessary</p> <p>5. (Refer to 7 - COOLING/ENGINE/WATER PUMP - DIAGNOSIS AND TESTING). If a slipping belt is detected, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL). If heater core obstruction is detected, (Refer to 7 - COOLING - STANDARD PROCEDURE) for cooling system reverse flushing.</p>

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
<p>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</p>	<p>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 or condenser, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.</p>	<p>1. Occasional steam emitting from this area is normal. No repair is necessary.</p>
<p>COOLANT COLOR</p>	<p>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.</p>	<p>1. (Refer to 7 - COOLING/ENGINE/COOLANT - DESCRIPTION) for coolant concentration information. Adjust coolant mixture as necessary.</p>
<p>COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE</p>	<p>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.</p>	<p>1. A normal condition. No repair is necessary.</p>
<p>FAN RUNS ALL THE TIME</p>	<p>1. Fan control sensors inoperative. 2. Fan control solenoid stuck "on". 3. Fan control solenoid harness damaged. 4. Transmission temperature too high. 5. Engine coolant temperature too high.</p>	<p>1. Check for DTC's. Verify sensor readings. 2. Check fan operation speeds. Refer to fan speed operation table. 3. Check for DTC 1499. Repair as required. 4. Check for transmission over temp. DTC. 5. (a) Check coolant level. Correct level as required. (b) Thermostat stuck. Replace thermostat. (c) Water pump failed. Replace water pump. (d) Coolant flow restricted. Clean radiator. (e) Air flow over radiator obstructed. Remove obstruction.</p>

COOLING (Continued)

## STANDARD PROCEDURE

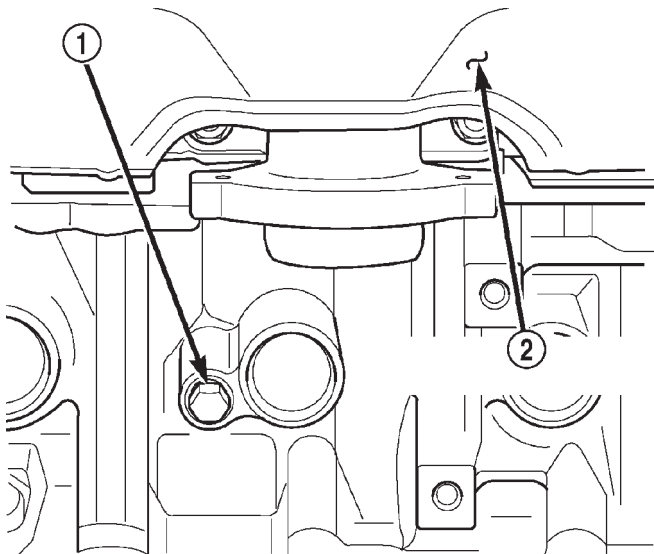
## STANDARD PROCEDURE - DRAINING COOLING SYSTEM 3.7L ENGINE

**WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS (Fig. 5) OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.**

(1) DO NOT remove radiator cap first. With engine cold, raise vehicle on a hoist and locate radiator draincock.

**NOTE:** Radiator draincock is located on the left/lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator. This will empty the coolant reserve/overflow tank. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture. When tank is empty, remove radiator cap and continue draining cooling system.



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**Fig. 5 Drain Plug - 3.7L Engine**

- 1 - CYLINDER BLOCK DRAIN PLUG  
2 - EXHAUST MANIFOLD AND HEAT SHIELD

## STANDARD PROCEDURE - REFILLING COOLING SYSTEM 3.7L ENGINE

(1) Tighten the radiator draincock and the cylinder block drain plug(s) (if removed).

**CAUTION:** Failure to purge air from the cooling system can result in an overheating condition and severe engine damage.

(2) Fill system using a 50/50 mixture of ethylene-glycol antifreeze and low mineral content water. Fill pressure bottle to service line and install cap.

**NOTE:** The engine cooling system will push any remaining air into the coolant bottle within about an hour of normal driving. As a result, a drop in coolant level in the pressure bottle may occur. If the engine cooling system overheats and pushes coolant into the overflow side of the coolant bottle, this coolant will be sucked back into the cooling system **ONLY IF THE PRESSURE CAP IS LEFT ON THE BOTTLE.** Removing the pressure cap breaks the vacuum path between the two bottle sections and the coolant will not return to cooling system.

(3) With heater control unit in the HEAT position, operate engine with pressure bottle cap in place.

(4) Add coolant to pressure bottle as necessary. **Only add coolant to the pressure bottle when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

**NOTE:** The coolant bottle has two chambers. Coolant will normally only be in the outboard (larger) of the two. The inboard chamber is only to recover coolant in the event of an overheat or after a recent service fill. The inboard chamber should normally be empty. If there is coolant in the overflow side of the coolant bottle (after several warm/cold cycles of the engine) and coolant level is above cold full when cold, disconnect the end of the overflow hose at the fill neck and lower it into a clean container. Allow coolant to drain into the container until emptied. Reconnect overflow hose to fill neck.

## STANDARD PROCEDURE - COOLING SYSTEM - REVERSE FLUSHING

**CAUTION:** The cooling system normally operates at 97-to-110 kPa (14-to -16 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Reverse flushing of the 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.

## CHEMICAL CLEANING

If visual inspection indicates the formation of sludge or scaly deposits, use a radiator cleaner

COOLING (Continued)

(Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

**CAUTION: Be sure instructions on the container are followed.**

**REVERSE FLUSHING RADIATOR**

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

**CAUTION: The cooling system normally operates at 97-to-110 kPa (14- to-16 psi) pressure. Exceeding this pressure may damage the radiator or hoses.**

Allow the radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

**REVERSE FLUSHING ENGINE**

Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE). Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump. Attach a lead away hose to the water pump inlet fitting.

**CAUTION: Be sure that the heater control valve is closed (heat off). This is done to prevent coolant flow with scale and other deposits from entering the heater core.**

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL). Install the thermostat and housing with a replacement gasket (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT -

INSTALLATION). Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture (Refer to 7 - COOLING - STANDARD PROCEDURE).

SPECIFICATIONS

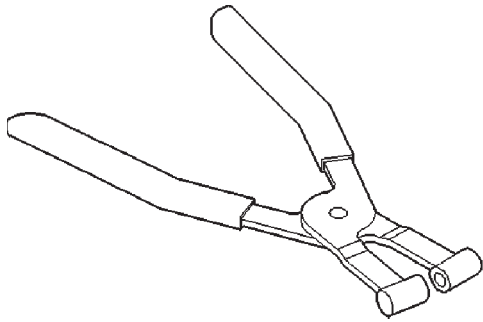
TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.	
Automatic Belt Tensioner to Mounting Bracket—Bolt	2.4L 4.7L	- 41	— 30	- —
Automatic Belt Tensioner Pulley— Bolt	(3.7L)	61	45	—
Block Heater—Bolt	2.4L 3.7L	- 2	— —	- 17
Condenser to Radiator Bolts	8		70	
Coolant Overflow Bottle to Plenum mounting bolts - 2.4L only	8.5		75	
Coolant Pressure Bottle to Plenum mounting bolts -3.7L only	8.5		75	
Electric Fan to Fan Shroud bolts	5.5		50	
Fan Blade Assy. to Viscous Drive Bolts 3.7L	23	—	210	
Fan Shroud to Radiator Mounting Bolts	8	—	70	
Radiator Upper Isolator to Crossmember - Bolts	9.5	—	85	
Thermostat Housing—Bolts	2.4L 4.7L	- 13	- —	— 115
Water Pump—Bolts	2.4L 4.7L	— 54	— 40	— —

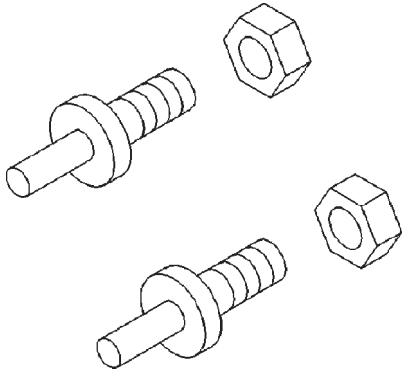
COOLING (Continued)

SPECIAL TOOLS

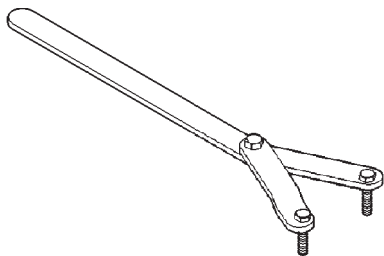
COOLING



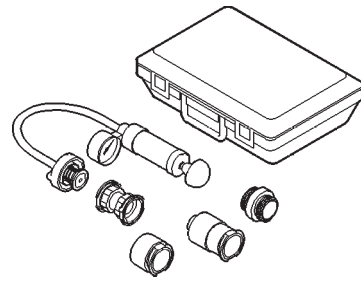
**Pliers 6094**



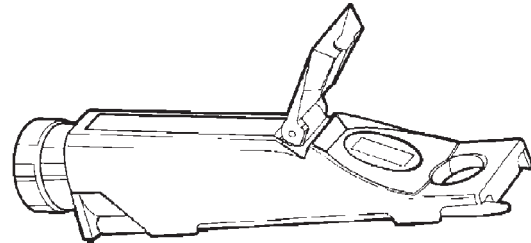
**Adapter Pins 8346**



**Spanner Wrench 6958 with 8346 adapter pins**



**Pressure Tester 7700-A**



**Coolant Refractometer 8286**

# ACCESSORY DRIVE

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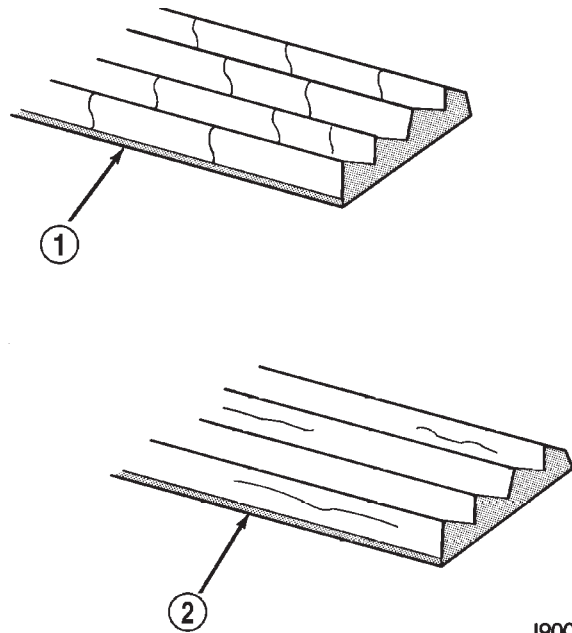
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## ACCESSORY DRIVE

### DIAGNOSIS AND TESTING - SERPENTINE DRIVE BELT

When diagnosing serpentine drive belts, small cracks that run across ribbed surface of belt from rib to rib (Fig. 1), are considered normal. These are not a reason to replace belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 1). Also replace belt if it has excessive wear, frayed cords or severe glazing.

Refer to SERPENTINE DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.



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**Fig. 1 Serpentine Accessory Drive Belt Wear Patterns**

- 1 - NORMAL CRACKS BELT OK
- 2 - NOT NORMAL CRACKS REPLACE BELT

## ACCESSORY DRIVE (Continued)

## SERPENTINE DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY)	<ol style="list-style-type: none"> <li>1. Foreign objects imbedded in pulley grooves.</li> <li>2. Installation damage.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove foreign objects from pulley grooves. Replace belt.</li> <li>2. Replace belt.</li> </ol>
RIB OR BELT WEAR	<ol style="list-style-type: none"> <li>1. Pulley(s) misaligned.</li> <li>2. Abrasive environment.</li> <li>3. Rusted pulley(s).</li> <li>4. Sharp or jagged pulley groove tips.</li> <li>5. Rubber deteriorated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Align pulley(s).</li> <li>2. Clean pulley(s). Replace belt if necessary.</li> <li>3. Clean rust from pulley(s).</li> <li>4. Replace pulley.</li> <li>5. Replace belt.</li> </ol>
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	<ol style="list-style-type: none"> <li>1. Belt has mistracked from pulley groove.</li> <li>2. Pulley groove tip has worn away rubber to tensile member.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace belt.</li> <li>2. Replace belt.</li> </ol>
BELT SLIPS	<ol style="list-style-type: none"> <li>1. Belt slipping because of insufficient tension.</li> <li>2. Belt routed incorrectly</li> <li>3. Incorrect belt.</li> <li>4. Belt or pulley subjected to substance (belt dressing, oil ethylene glycol) that has reduced friction.</li> <li>5. Driven component bearing failure.</li> <li>6. Belt glazed and hardened from heat and excessive slippage.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace automatic belt tensioner.</li> <li>2. Verify belt routing.</li> <li>3. Replace belt.</li> <li>4. Replace belt and clean pulleys.</li> <li>5. Replace faulty component bearing.</li> <li>6. Replace belt.</li> </ol>
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY)	<ol style="list-style-type: none"> <li>1. Belt tension either too high or too low.</li> <li>2. Belt routed incorrectly.</li> <li>3. Incorrect belt.</li> <li>4. Pulley(s) not within design tolerance.</li> <li>5. Foreign object(s) in grooves.</li> <li>6. Pulley misalignment.</li> <li>7. Belt cord line is broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace automatic belt tensioner.</li> <li>2. Verify belt routing.</li> <li>3. Replace belt.</li> <li>4. Replace pulley(s).</li> <li>5. Remove foreign objects from grooves.</li> <li>6. Check and replace.</li> <li>7. Replace belt.</li> </ol>

ACCESSORY DRIVE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	1. Excessive tension. 2. Incorrect belt. 3. Tensile member damaged during belt installation. 4. Severe misalignment. 5. Bracket, pulley, or bearing failure.	1. Replace belt and automatic belt tensioner. 2. Replace belt. 3. Replace belt. 4. Check and replace. 5. Replace defective component and belt.
NOISE (OBJECTIONABLE SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	1. Belt slippage. 2. Bearing noise. 3. Belt misalignment. 4. Belt-to-pulley mismatch.	1. Replace belt or automatic belt tensioner. 2. Locate and repair. 3. Replace belt. 4. Install correct belt.

BELT TENSIONERS

REMOVAL - 3.7L ENGINE

(1) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove tensioner assembly from engine front cover (Fig. 2).

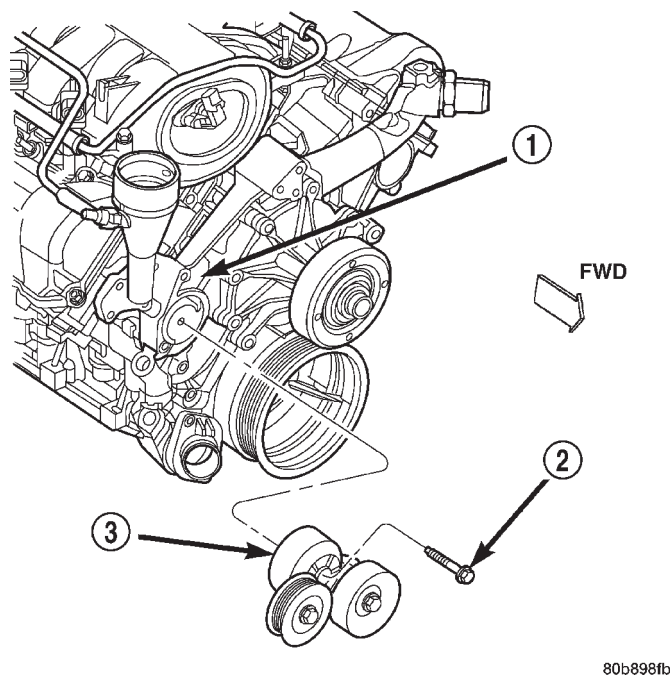


Fig. 2 Automatic Belt Tensioner

- 1 - TIMING CHAIN COVER
- 2 - BOLT TORQUE TO 41 N·m (30 FT LBS)
- 3 - AUTOMATIC BELT TENSIONER

**WARNING: BECAUSE OF HIGH SPRING TENSION, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY ON TENSIONER).**

(3) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION - 3.7L ENGINE

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) An indexing slot is located on back of tensioner. Align this slot to the head of the bolt on the front cover. Install the mounting bolt. Tighten bolt to 41 N·m (30 ft. lbs.).

(3) Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Check belt indexing marks (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

DRIVE BELTS - 3.7L

REMOVAL - 3.7L ENGINE

**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.**

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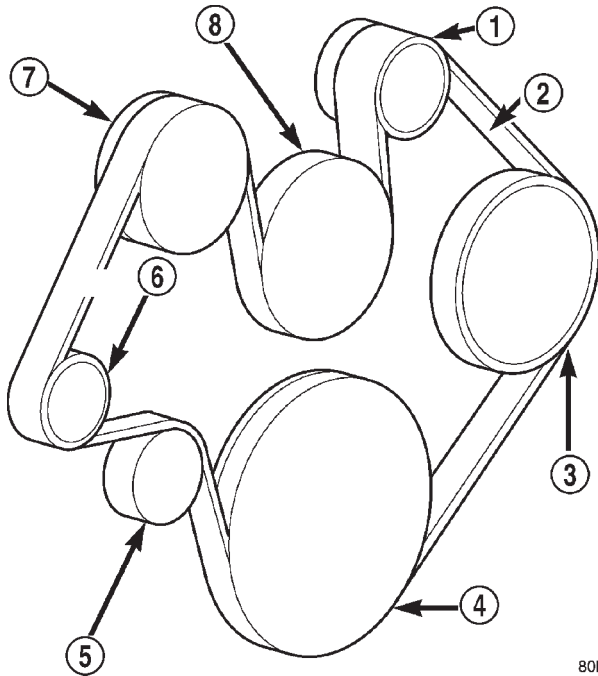


## DRIVE BELTS - 3.7L (Continued)

**CAUTION: DO NOT LET TENSIONER ARM SNAP BACK TO THE FREEARM POSITION, SEVERE DAMAGE MAY OCCUR TO THE TENSIONER.**

Belt tension is not adjustable. Belt adjustment is maintained by an automatic ( spring load ) belt tensioner.

- (1) Disconnect negative battery cable from battery.
- (2) Rotate belt tensioner until it contacts its stop. Remove belt, then slowly rotate the tensioner into the freearm position. (Fig. 3).



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**Fig. 3 Belt Routing - 3.7L**

- 1 - GENERATOR PULLEY
- 2 - ACCESSORY DRIVE BELT
- 3 - POWER STEERING PUMP PULLEY
- 4 - CRANKSHAFT PULLEY
- 5 - IDLER PULLEY
- 6 - TENSIONER
- 7 - A/C COMPRESSOR PULLEY
- 8 - WATER PUMP PULLEY

## INSTALLATION - 3.7L ENGINE

**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.

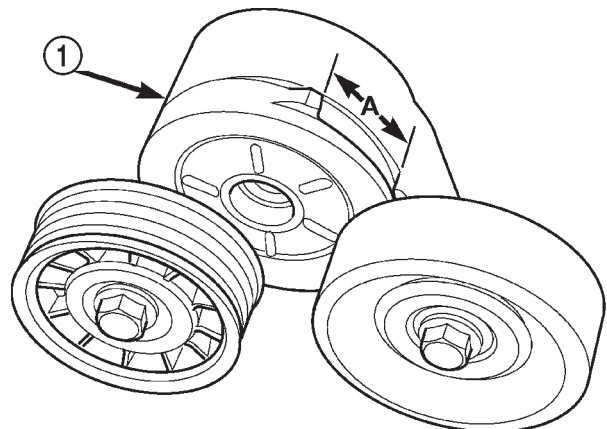
Belt tension is not adjustable. Belt adjustment is maintained by an automatic ( spring load ) belt tensioner.

- (1) Check condition of all pulleys.

**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 (Fig. 3).

- (2) Install new belt (Fig. 3). Route the belt around all pulleys except the idler pulley. Rotate the tensioner arm until it contacts its stop position. Route the belt around the idler and slowly let the tensioner rotate into the belt. Make sure the belt is seated onto all pulleys.

- (3) With the drive belt installed, inspect the belt wear indicator (Fig. 4). On 3.7L Engines the gap between the tang and the housing stop ( measurement A ) must not exceed 24 mm (.94 inches).



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**Fig. 4 Accessory Drive Belt Wear Indicator**

- 1 - AUTOMATIC TENSIONER ASSEMBLY

# ENGINE

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## COOLANT RECOVERY PRESS CONTAINER

### DESCRIPTION

This system works along with the radiator pressure cap. This is done by using thermal expansion and contraction of the coolant to keep the coolant free of trapped air. It provides:

- A volume for coolant expansion and contraction.
- A convenient and safe method for checking/adjusting coolant level at atmospheric pressure. This is done without removing the radiator pressure cap.
- Some reserve coolant 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.

The coolant reservoir/overflow system has a radiator mounted pressurized cap, an overflow tube, and a plastic coolant reservoir/overflow tank, mounted to the right side of the cowl. It is mounted to the cowl

with two nuts on top, and a slide bracket on the bottom.

### OPERATION

The pressure chamber keeps the coolant free of trapped air, provides a volume for expansion and contraction, and provides a convenient and safe method for checking and adjusting coolant level at atmospheric pressure. It also provides some reserve coolant to cover minor leaks, evaporation or boiling losses. The overflow chamber allows coolant recovery in case of an overheat.

## ENGINE COOLANT TEMPERATURE SENSOR

### DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to sense engine coolant temperature. The sensor protrudes into an engine water jacket.

## ENGINE COOLANT TEMPERATURE SENSOR (Continued)

The ECT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as engine coolant temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

## OPERATION

At key-on, the Powertrain Control Module (PCM) sends out a regulated 5 volt signal to the ECT sensor. The PCM then monitors the signal as it passes through the ECT sensor to the sensor ground (sensor return).

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.

The PCM uses inputs from the ECT sensor for the following calculations:

- for engine coolant temperature gauge operation through CCD or PCI (J1850) communications
- Injector pulse-width
- Spark-advance curves
- ASD relay shut-down times
- Idle Air Control (IAC) motor key-on steps
- Pulse-width prime-shot during cranking
- O2 sensor closed loop times
- Purge solenoid on/off times
- EGR solenoid on/off times (if equipped)
- Leak Detection Pump operation (if equipped)
- Radiator fan relay on/off times (if equipped)
- Target idle speed

## REMOVAL

## 2.4L

The Engine Coolant Temperature (ECT) sensor is installed into a water jacket at left front of cylinder head (Fig. 1).

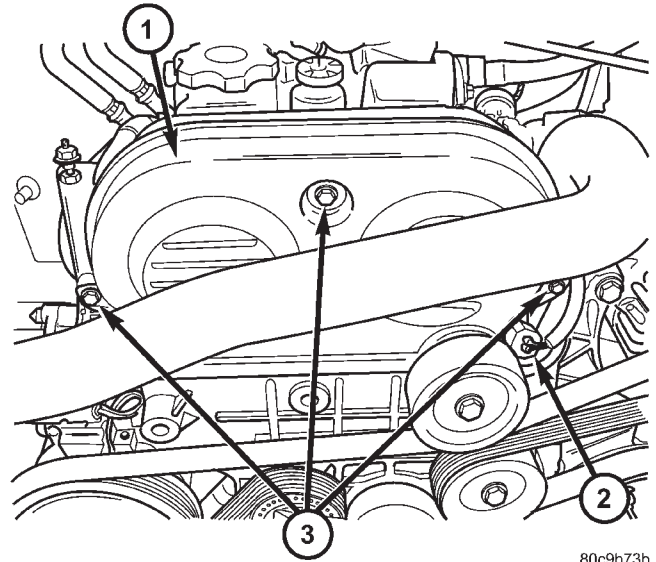
**WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.**

- (1) Partially drain cooling system.
- (2) Disconnect electrical connector from sensor.
- (3) Remove sensor from cylinder head.

## 3.7L

The Engine Coolant Temperature (ECT) sensor is installed into a water jacket at front of intake manifold near rear of generator (Fig. 2).

**WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.**

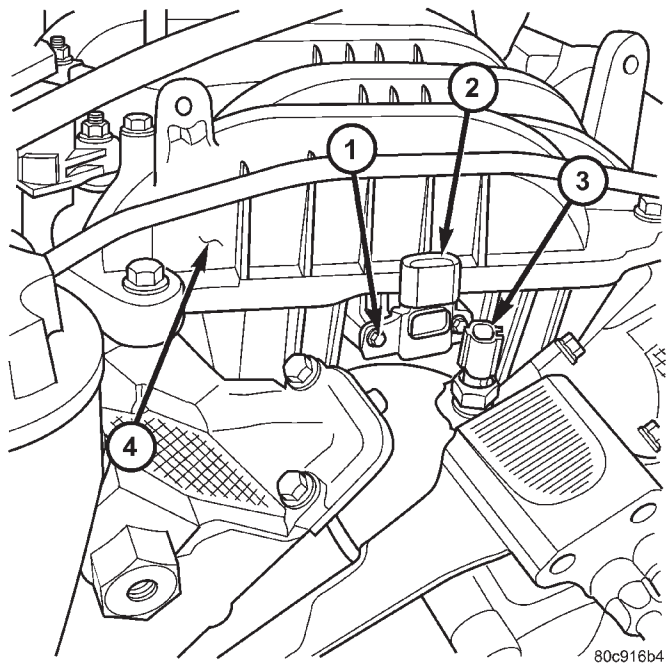


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**Fig. 1 ECT AND UPPER TIMING BELT COVER/  
BOLTS-2.4L**

- 1 - UPPER TIMING BELT COVER
- 2 - ELECTRICAL CONNECTOR (ECT)
- 3 - MOUNTING BOLTS (3)

- (1) Partially drain cooling system.
- (2) Disconnect electrical connector from sensor.
- (3) Remove sensor from intake manifold.



80c916b4

**Fig. 2 MAP SENSOR / ECT SENSOR - 3.7L**

- 1 - MOUNTING SCREWS
- 2 - MAP SENSOR
- 3 - ECT SENSOR

## ENGINE COOLANT TEMPERATURE SENSOR (Continued)

## INSTALLATION

- (1) Apply thread sealant to sensor threads.
- (2) Install sensor to engine.
- (3) Tighten sensor to 11 N·m (8 ft. lbs.) torque.
- (4) Replace any lost engine coolant.

## ENGINE COOLANT THERMOSTAT

## DESCRIPTION - 3.7L ENGINE

**CAUTION:** Do not operate an engine without a thermostat, except for servicing or testing.

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines the thermostat is closed below 195°F (90°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warm up and overall temperature control. On the 3.7L engine the thermostat is designed to block the flow of the coolant bypass journal by 50% instead of completely blocking the flow. This design controls coolant temperature more accurately (Fig. 3).

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 other problems. These are: longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation. This condensation can result in sludge formation.

## OPERATION

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.

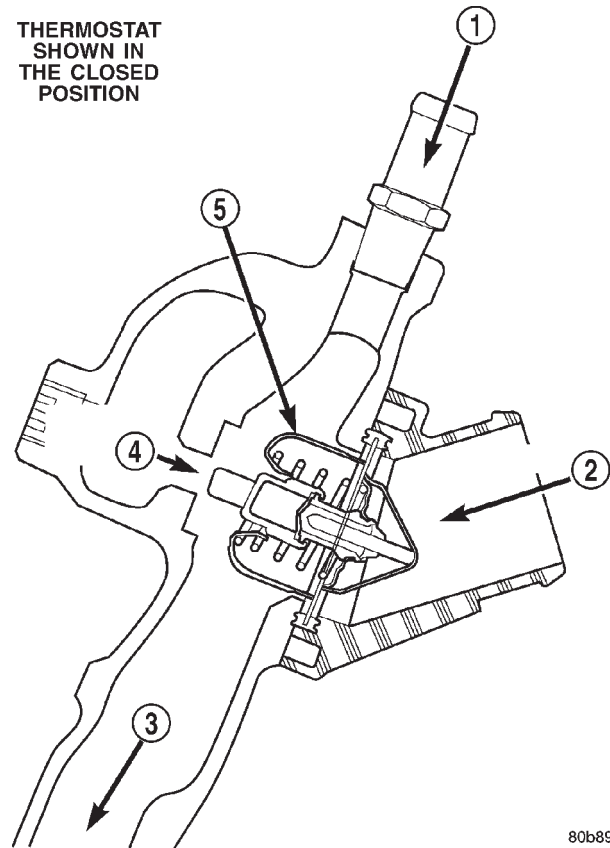
## DIAGNOSIS AND TESTING - THERMOSTAT

## ON-BOARD DIAGNOSTICS

All models are equipped with On-Board Diagnostics for certain cooling system components. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC). For other DTC numbers, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

The DTC can also be accessed through the DRB scan tool.

THERMOSTAT  
SHOWN IN  
THE CLOSED  
POSITION



80b897e4

**Fig. 3 Thermostat**

- 1 - FROM HEATER
- 2 - FROM RADIATOR
- 3 - TO WATER PUMP
- 4 - ENGINE BYPASS
- 5 - THERMOSTAT

## REMOVAL - 3.7L ENGINE

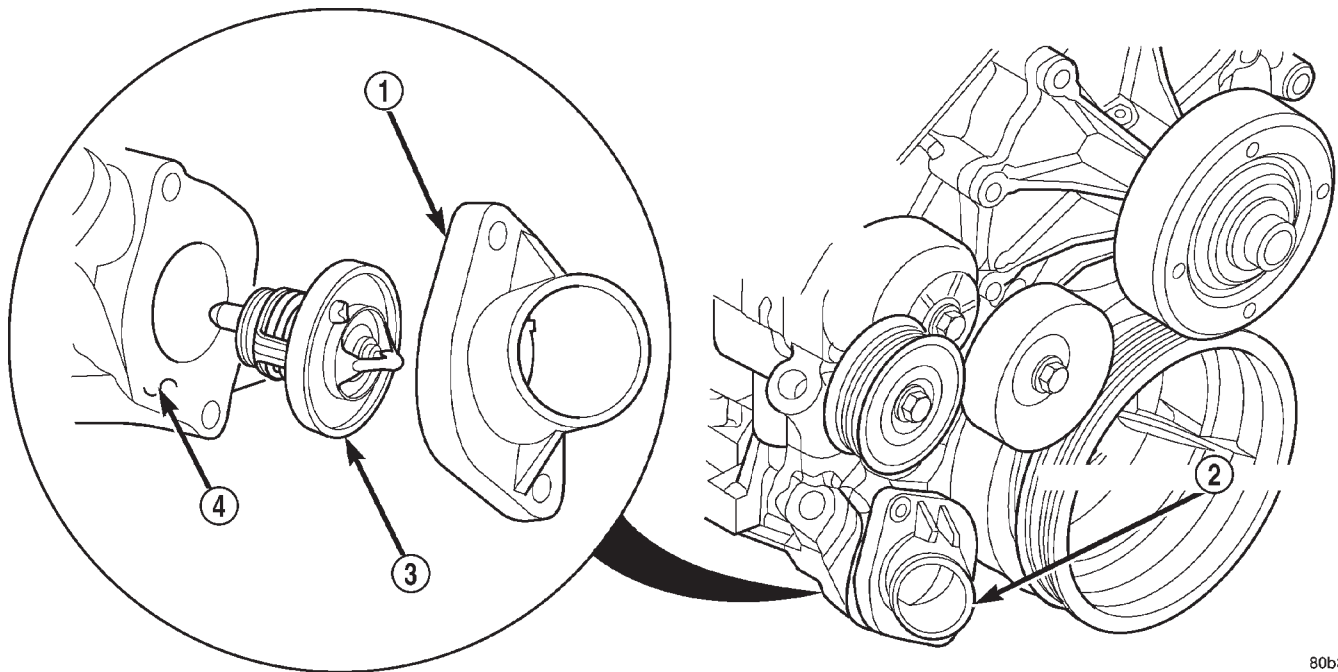
**WARNING:** DO NOT LOOSEN RADIATOR DRAIN-COCK WITH SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

If thermostat is being replaced, be sure that replacement is specified thermostat for vehicle model and engine type.

- (1) Disconnect negative battery cable at battery.
- (2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (3) Raise vehicle on hoist.
- (4) Remove splash shield.
- (5) Remove lower radiator hose clamp and lower radiator hose at thermostat housing.
- (6) Remove thermostat housing mounting bolts, thermostat housing and thermostat (Fig. 4).

## ENGINE COOLANT THERMOSTAT (Continued)

**Fig. 4 Thermostat and Thermostat Housing**

80b3b198

1 - THERMOSTAT HOUSING  
2 - THERMOSTAT LOCATION

3 - THERMOSTAT AND GASKET  
4 - TIMING CHAIN COVER

**INSTALLATION - 3.7L ENGINE**

(1) Clean mating areas of timing chain cover and thermostat housing.

(2) Install thermostat (spring side down) into recessed machined groove on timing chain cover (Fig. 4).

(3) Position thermostat housing on timing chain cover.

(4) Install two housing-to-timing chain cover bolts. Tighten bolts to 13 N·m (115 in. lbs.) torque.

**CAUTION:** Housing must be tightened evenly and thermostat must be centered into recessed groove in timing chain cover. If not, it may result in a cracked housing, damaged timing chain cover threads or coolant leaks.

(5) Install lower radiator hose on thermostat housing.

(6) Install splash shield.

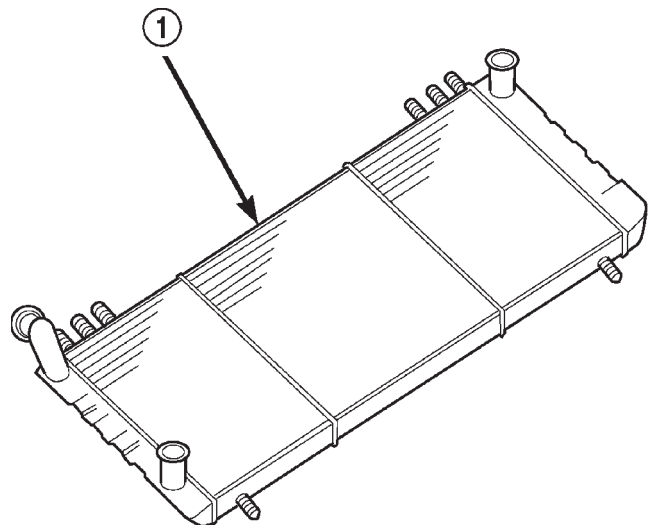
(7) Lower vehicle.

(8) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(9) Connect negative battery cable to battery.

(10) Start and warm the engine. Check for leaks.

Plastic tanks, while stronger than brass, are subject to damage by impact, such as from tools or wrenches. Handle radiator with care.



80be469f

**Fig. 5 Cross Flow Radiator - Typical**

1 - RADIATOR

**RADIATOR****DESCRIPTION**

All vehicles are equipped with a cross flow type radiator with plastic side tanks (Fig. 5).

RADIATOR (Continued)

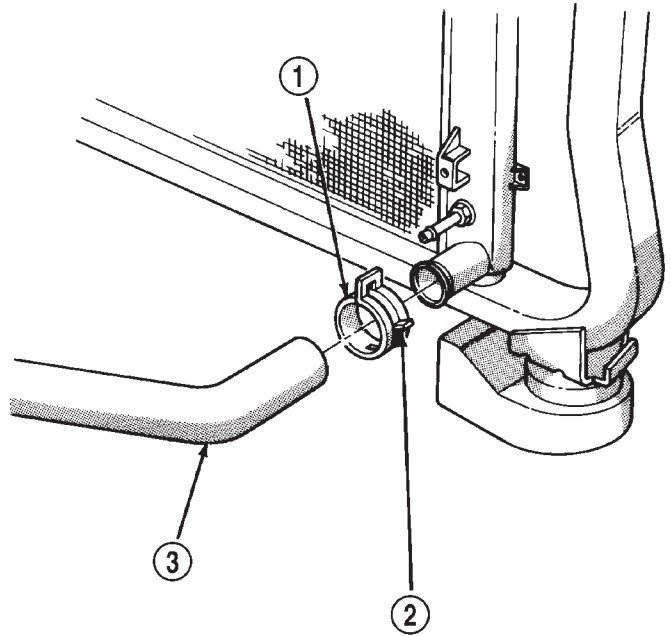
REMOVAL

**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. REFER TO COOLING SYSTEM DRAINING.**

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

**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. 6). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.**

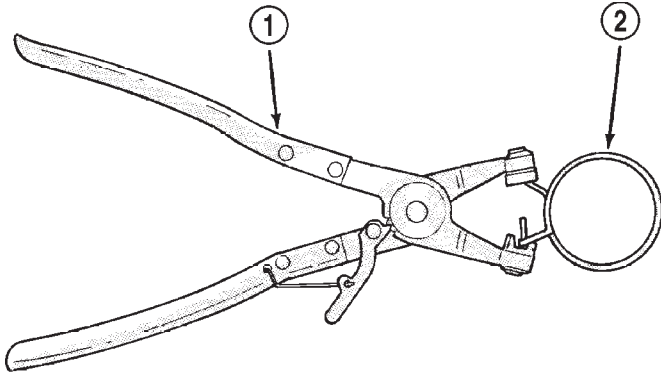
**CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 7). If replacement is necessary, use only an original equipment clamp with matching number or letter.**



J9407-39

**Fig. 7 Clamp Number/Letter Location - Typical**

- 1 - TYPICAL CONSTANT TENSION HOSE CLAMP
- 2 - CLAMP NUMBER/LETTER LOCATION
- 3 - TYPICAL HOSE

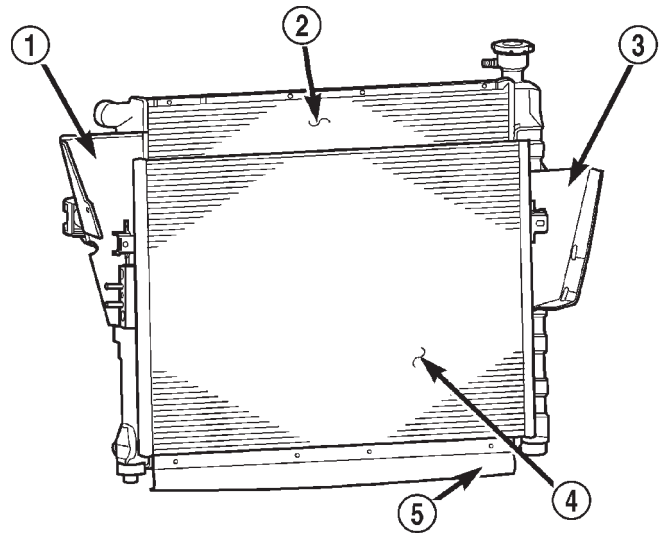


J9207-36

**Fig. 6 Hose Clamp Tool - Typical**

- 1 - HOSE CLAMP TOOL 6094
- 2 - HOSE CLAMP

**CAUTION: When removing the radiator or A/C condenser for any reason, note the location of all radiator-to-body and radiator-to-A/C condenser rubber air seals (Fig. 8). These are used at the top, bottom and sides of the radiator and A/C condenser. To prevent overheating, these seals must be installed to their original positions.**



80ba7898

**Fig. 8 Air Seals - Typical**

- 1 - AIR DAM
- 2 - RADIATOR
- 3 - AIR DAM
- 4 - A/C CONDENSER
- 5 - AIR SEAL

- (1) Disconnect the negative battery cable at battery.
- (2) Drain coolant from radiator (Refer to 7 - COOLING - STANDARD PROCEDURE).

## RADIATOR (Continued)

(3) Remove the front grill (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL).

(4) Remove the cooling fan from the engine, if equipped.

(5) Remove the two radiator mounting bolts.

(6) Disconnect both transmission cooler lines from radiator.

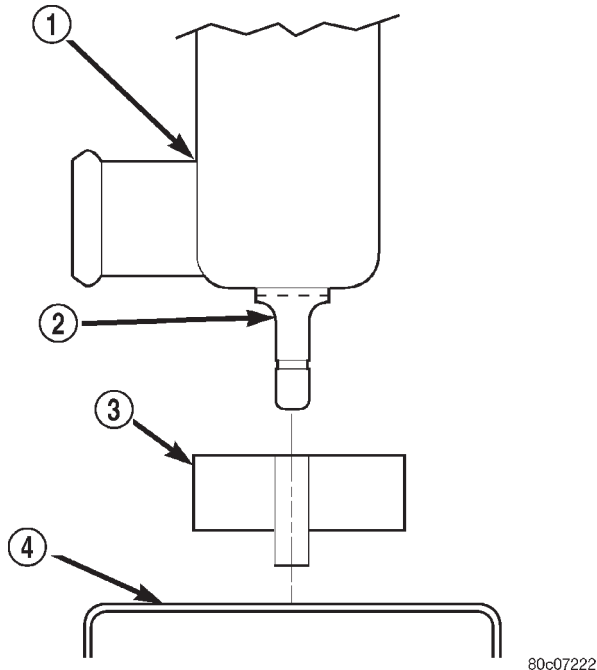
(7) Disconnect the connector for the electric fan.

(8) Disconnect the power steering cooler line from cooler.

(9) Disconnect the radiator upper and lower hoses.

(10) Disconnect the overflow hose from radiator.

(11) The lower part of radiator is equipped with two alignment dowel pins (Fig. 9). They are located on the bottom of radiator tank and fit into rubber grommets. These rubber grommets are pressed into the radiator lower crossmember.



**Fig. 9 Radiator Alignment Dowels - Typical**

- 1 - RADIATOR
- 2 - ALIGNMENT DOWEL
- 3 - RADIATOR LOWER ISOLATOR
- 4 - RADIATOR LOWER CROSSMEMBER

**WARNING: THE AIR CONDITIONING SYSTEM (IF EQUIPPED) IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN, HEATING AND AIR CONDITIONING BEFORE HANDLING ANY AIR CONDITIONING COMPONENT.**

**NOTE: The radiator and radiator cooling fan can be removed as an assembly. It is not necessary to**

**remove the cooling fan before removing or installing the radiator.**

(12) Gently lift up and remove radiator from vehicle. Be careful not to scrape the radiator fins against any other component. Also be careful not to disturb the air conditioning condenser (if equipped).

## CLEANING

Clean radiator fins 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.

## INSPECTION

The radiator cooling fins should be checked for damage or deterioration. Inspect cooling fins to make sure they are not bent or crushed, these areas result in reduced heat exchange causing the cooling system to operate at higher temperatures. Inspect the plastic end tanks for cracks, damage or leaks.

Inspect the radiator neck for damage or distortion.

## INSTALLATION

**CAUTION: Before installing the radiator or A/C condenser, be sure the radiator-to-body and radiator-to-A/C condenser rubber air seals are properly fastened to their original positions. These are used at the top, bottom and sides of the radiator and A/C condenser. To prevent overheating, these seals must be installed to their original positions.**

(1) Gently lower the radiator and fan shroud into the vehicle. Guide the two radiator alignment dowels into the rubber grommets located in lower radiator crossmember.

(2) Connect the radiator upper and lower hoses and hose clamps to radiator.

**CAUTION: The tangs on the hose clamps must be positioned straight down.**

(3) Install coolant reserve/overflow tank hose at radiator.

(4) Connect both transmission cooler lines at the radiator.

(5) Install both radiator mounting bolts.

(6) Reconnect the electric cooling fan.

(7) Install the grill (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION).

(8) Reinstall the cooling fan to the engine.

(9) Rotate the fan blades (by hand) and check for interference at fan shroud.

(10) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

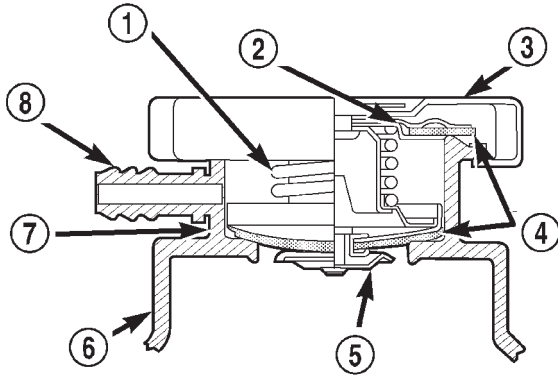
(11) Connect battery cable at battery.

(12) Start and warm engine. Check for leaks.

## RADIATOR PRESSURE CAP

### DESCRIPTION

The cooling system cap is located on the coolant pressure bottle. The cap construction includes; stainless steel swivel top, rubber seals and retainer, main spring, and a spring loaded valve (Fig. 10).



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**Fig. 10 PRESSURE CAP**

- 1 - MAIN SPRING
- 2 - GASKET RETAINER
- 3 - STAINLESS STEEL SWIVEL TOP
- 4 - RUBBER SEALS
- 5 - SPRING LOADED VALVE
- 6 - COOLANT PRESSURE BOTTLE
- 7 - FILLER NECK
- 8 - OVERFLOW NIPPLE

### OPERATION

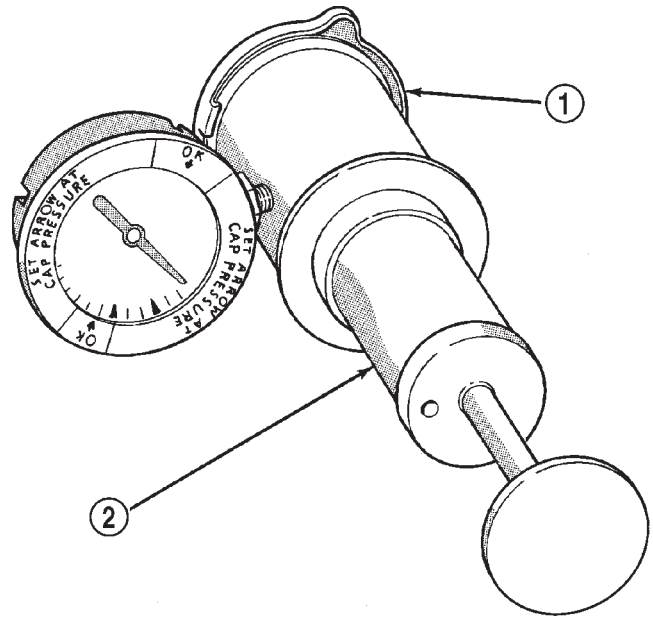
The pressure cap allows the cooling system to operate at higher than atmospheric pressure which raises the coolant boiling point, thus allowing increased radiator cooling capacity. The pressure cap releases pressure at some point within a range of 110 kPa  $\pm$  14 kPa (16 psi  $\pm$  2 psi).

A spring-loaded vent valve in the center of the cap allows the system to pressurize and depressurize without creating a vacuum. If the valve is stuck open, coolant will escape to the overflow hose. There is also a gasket in the cap to seal to the top of the filler neck.

**CAUTION:** Use only the pressure cap specified for this vehicle. Use of other pressure caps can lead to coolant loss and overheating.

### DIAGNOSIS AND TESTING - RADIATOR PRESSURE CAP

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install the cap on pressure tester (tool 7700 or an equivalent) (Fig. 11).



J9507-3

**Fig. 11 Pressure Testing Radiator Pressure Cap - Typical**

- 1 - PRESSURE CAP
- 2 - TYPICAL COOLING SYSTEM PRESSURE TESTER

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 124 to 145 kPa (18 to 21 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 124 to 145 kPa (18 to 21 psi) range for 30 seconds or more. If the pointer drops quickly, replace the cap.

**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.

### CLEANING

Clean the radiator pressure cap using a mild soap and water only.

### INSPECTION

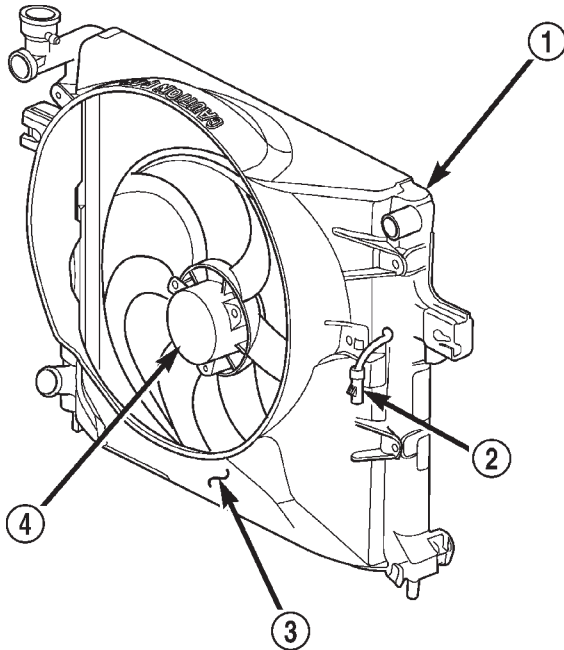
Visually inspect the pressure valve gasket on the cap. Replace cap if the gasket is swollen, torn or worn. Inspect the area around radiator filler neck for white deposits that indicate a leaking cap.



## RADIATOR FAN - ELECTRIC

### DESCRIPTION

The fan (Fig. 12) is electrically controlled by the powertrain control module (PCM) through the fan control relay. This relay is located on the left wheel house in the engine compartment.



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**Fig. 12 Radiator Cooling Fan - Typical**

- 1 - RADIATOR
- 2 - ELECTRIC COOLING FAN CONNECTOR
- 3 - FAN SHROUD
- 4 - ELECTRIC COOLING FAN

### OPERATION

The electric radiator cooling fan is controlled by the Powertrain Control Module (PCM) through the radiator cooling fan relay. The PCM regulates fan operation based on input from the engine coolant temperature sensor, battery temperature sensor, air conditioning select switch and vehicle speed.

The fan is not energized during engine cranking regardless of the electrical input from the temperature sensors and air conditioning switch. However, if engine operation conditions warrant fan engagement, the fan will run once engine starts.

**On vehicles NOT equipped with AC:** The relay is energized when the coolant temperature is above 80° C (176° F), or battery temperature sensor above -12° C (10° F). It will then de-energize when coolant temperature drops below 82° C (180° F), or battery temperature sensor below -9° C (16° F).

**Vehicles Equipped with AC:** In addition to using coolant temperature and battery temperature sensor

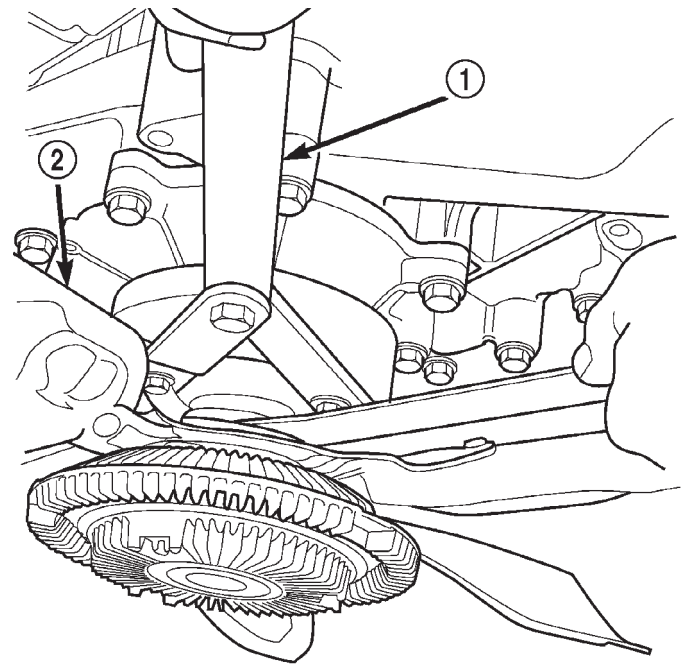
to control cooling fan operation, the cooling fan will also be engaged when the air conditioning system is activated. The relay is also energized when, air conditioning is selected and coolant temperature is above 95° C (203° F), or air conditioning is selected and battery temperature sensor is above 41° C (106° F). It will then de-energize when, air conditioning is selected and coolant temperature is below 92° C (198° F), or air conditioning is selected and battery temperature is below 38° C (100° F).

### REMOVAL

If the fan blade is bent, warped, cracked or damaged in any way, it must be replaced **only** with a replacement fan blade. **Do not attempt to repair a damaged fan blade.**

**NOTE:** For 3.7L Heavy Duty/Max Cool/Trailer Tow cooling package, the viscous fan cannot be removed separate from the shroud. Both fan and shroud must be removed together.

- (1) Disconnect battery negative cable.
- (2) Using special tool 6958 spanner wrench and 8346 adapters, remove the viscous fan from the water pump (Fig. 13).



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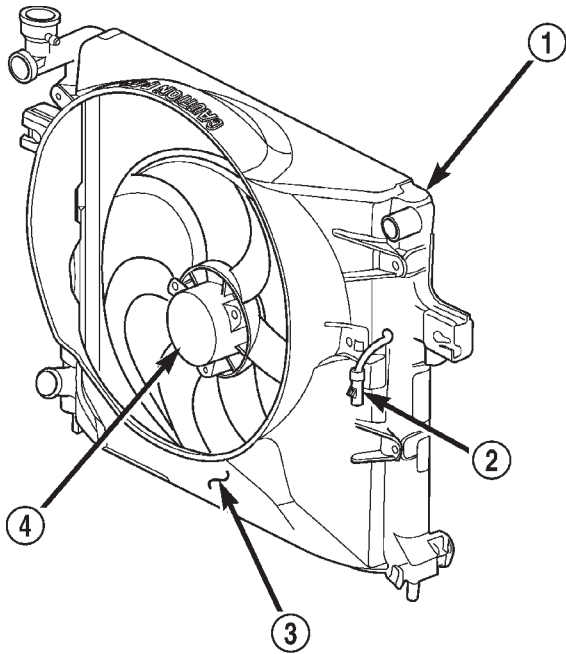
**Fig. 13 Viscous Fan and Fan Drive 3.7L**

- 1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
- 2 - FAN

- (3) Gently lay fan into shroud.
- (4) Disconnect the electrical connector for the electric fan, then disconnect connector from shroud.

RADIATOR FAN - ELECTRIC (Continued)

(5) Remove the two fan shroud mounting bolts connecting the fan shroud to the radiator (Fig. 14).



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**Fig. 14 Radiator Cooling Fan - Typical**

- 1 - RADIATOR
- 2 - ELECTRIC COOLING FAN CONNECTOR
- 3 - FAN SHROUD
- 4 - ELECTRIC COOLING FAN

(6) Remove the shroud and fan from the vehicle.

**INSTALLATION**

**NOTE:** For 3.7L Heavy Duty/Max Cool/Trailer Tow cooling package, the viscous fan cannot be installed separate from the shroud. Both fan and shroud must be installed together.

- (1) Gently lay viscous fan into shroud.
- (2) Install fan shroud assembly into the vehicle. Tighten fan shroud to radiator bolts to (5.5 N·m (50 in. lbs.)).
- (3) Using special tool 6958 spanner wrench and 8346 adapters, install the viscous fan on the water pump.
- (4) Connect fan motor wire connector to harness connector, and attach connector to shroud.
- (5) Connect battery negative cable.
- (6) Start engine and check fan operation.

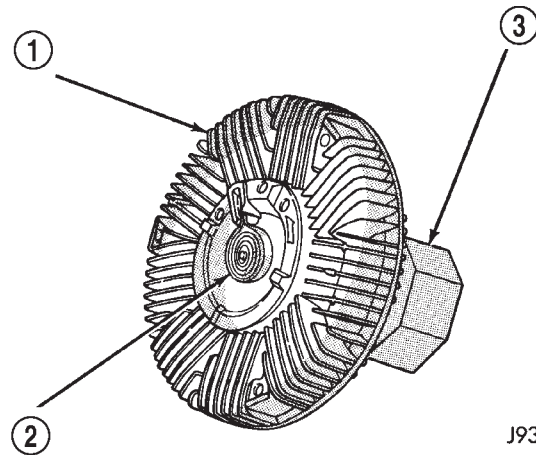
**RADIATOR - FAN - VISCOUS**

**DESCRIPTION**

**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.

The thermal viscous fan drive (Fig. 15) 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.

On the 3.7L engine, an electric fan is standard and the viscous fan is added on for trailer tow packages only.



J9307-31

**Fig. 15 Viscous Fan Drive - Typical**

- 1 - VISCOUS FAN DRIVE
- 2 - THERMOSTATIC SPRING
- 3 - MOUNTING NUT TO WATER PUMP HUB

**OPERATION**

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit. 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. Normally less than three hundred (300) rpm.**

## RADIATOR - FAN - VISCOUS (Continued)

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.

## DIAGNOSIS AND TESTING - VISCOUS FAN DRIVE

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 (timing light is to be used as a strobe light).

(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 93° C (200° F). Fan drive **engagement** should have started to occur at between 91° to 96° C (195° to 205° 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.

(7) When the air temperature reaches 93° C (200° F), remove the plastic sheet. Fan drive **disengagement** should have started to occur at between 62° to

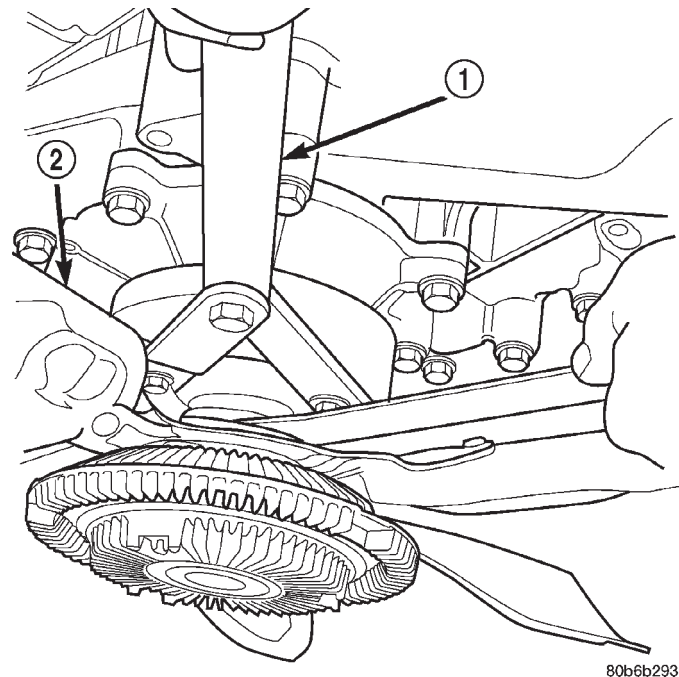
85° C (145° to 185° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

## REMOVAL

(1) Disconnect negative battery cable from battery.

**NOTE: The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft.**

(2) Remove fan blade/viscous fan drive assembly from water pump using special tool 6958 spanner wrench and 8346 adapters, by turning mounting nut counterclockwise as viewed from front (Fig. 16). Threads on viscous fan drive are **RIGHT HAND**.



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**Fig. 16 Viscous Fan and Fan Drive 3.7L**

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346

2 - FAN

(3) Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

(4) Do not unbolt fan blade assembly from viscous fan drive at this time.

(5) Remove fan shroud to radiator bolts.

(6) Remove fan shroud and fan blade/viscous fan drive assembly as a complete unit from vehicle.

(7) 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.

RADIATOR - FAN - VISCOUS (Continued)

**CAUTION:** Do not remove water pump pulley-to-water pump bolts. This pulley is under belt tension.

(8) Remove four bolts securing fan blade assembly to viscous fan drive.

**CLEANING**

Clean the fan blades using a mild soap and water. Do not use an abrasive to clean the blades.

**INSPECTION**

**WARNING:** DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF FAN IS NOT WITHIN SPECIFICATIONS.

**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.

(1) Remove fan blade assembly from viscous fan drive unit (four bolts).

(2) 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.

(3) Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

**INSTALLATION**

(1) Assemble fan blade to viscous fan drive. Tighten mounting bolts to 27 N·m (20 ft. lbs.) torque.

**NOTE:** The viscous fan and fan shroud must be installed as an assembly.

(2) Gently lay viscous fan into fan shroud.

(3) Install the fan shroud to radiator mounting bolts, torque bolts to (5.5N·M or 50 in-lbs).

(4) Thread the fan and fan drive onto the water pump pulley, and tighten nut using special tool 6958 spanner wrench and 8346 adapters.

(5) Connect the electrical connector for the electric fan.

**CAUTION:** When installing a 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 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) for correct belt routing.

**WATER PUMP**

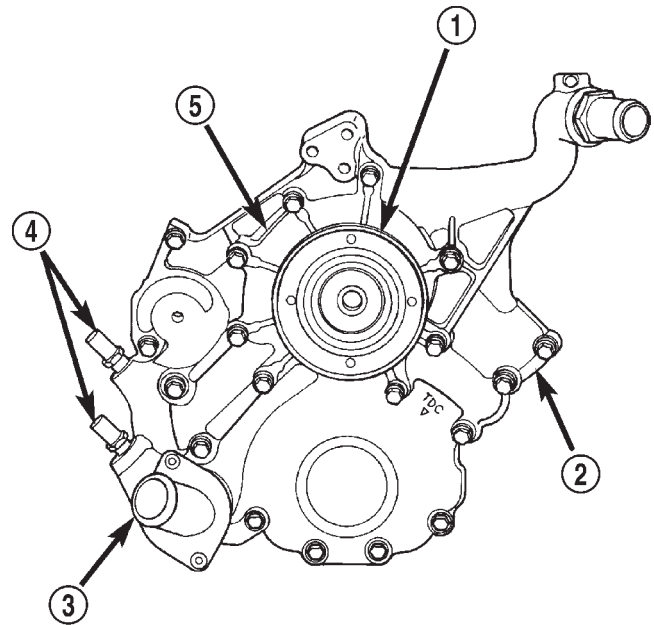
**DESCRIPTION**

**DESCRIPTION - WATER PUMP**

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 single serpentine drive belt.

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

Both heater hoses are connected to fittings on the timing chain front cover. The water pump is also mounted directly to the timing chain cover and is equipped with a non serviceable integral pulley (Fig. 17).



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**Fig. 17 Water Pump and Timing Chain Cover**

- 1 - INTEGRAL WATER PUMP PULLEY
- 2 - TIMING CHAIN COVER
- 3 - THERMOSTAT HOUSING
- 4 - HEATER HOSE FITTINGS
- 5 - WATER PUMP

**DESCRIPTION**

The 3.7L engine uses an internal water/coolant bypass system. The design uses galleries in the timing chain cover to circulate coolant during engine warm-up preventing the coolant from flowing

## WATER PUMP (Continued)

through the radiator. The thermostat uses a stub shaft located at the rear of the thermostat to control flow through the bypass gallery.

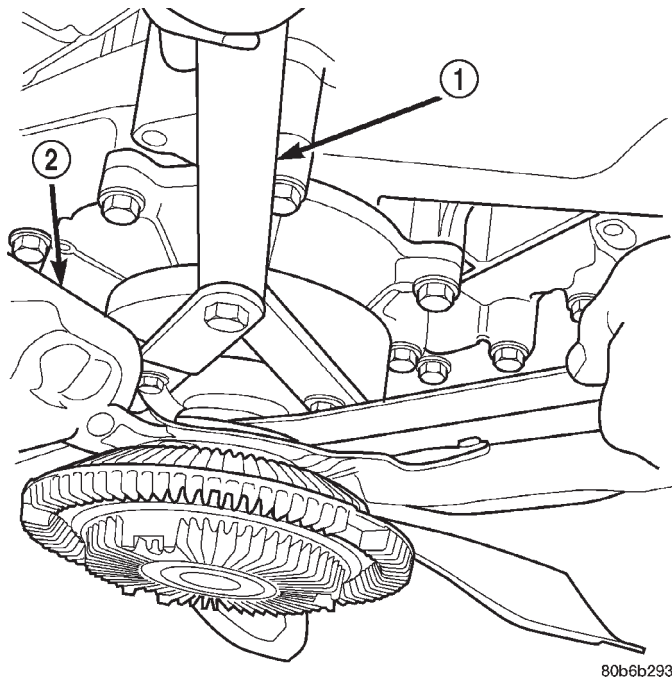
## OPERATION - WATER PUMP

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core, this coolant absorbs the heat generated when the engine is running. The pump is driven by the engine crankshaft via a drive belt.

## REMOVAL

The water pump on 3.7L engines is bolted directly to the engine timing chain case cover.

- (1) Disconnect negative battery cable from battery.
- (2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (3) Remove fan/viscous fan drive assembly from water pump (Fig. 18) (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL). Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.



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**Fig. 18 Viscous Fan and Fan Drive 3.7L**

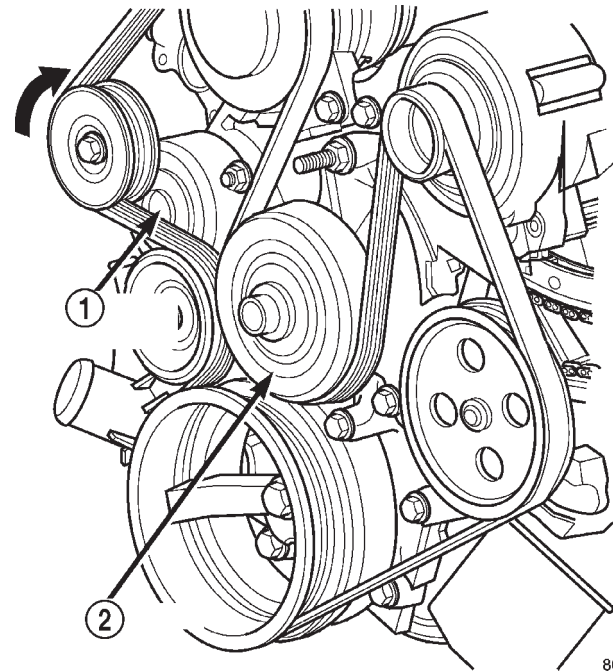
- 1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
- 2 - FAN

**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 matching number or letter.**

- (4) If water pump is being replaced, do not unbolt fan blade assembly from thermal viscous fan drive.
- (5) Remove two fan shroud-to-radiator screws, Disconnect the coolant overflow hose.
- (6) Remove upper fan shroud and fan blade/viscous fan drive assembly from vehicle.
- (7) After removing fan blade/viscous fan drive assembly, **do not** place thermal viscous fan drive in horizontal position. If stored horizontally, silicone fluid in viscous fan drive could drain into its bearing assembly and contaminate lubricant.
- (8) Remove accessory drive belt (Fig. 19) (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).



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**Fig. 19 Automatic Belt Tensioner—3.7L**

- 1 - AUTOMATIC TENSIONER
- 2 - WATER PUMP PULLEY

- (9) Remove lower radiator hose clamp and remove lower hose at water pump.
- (10) Remove seven water pump mounting bolts and one stud bolt.

WATER PUMP (Continued)

**CAUTION:** Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

(11) Remove water pump and gasket. Discard gasket.

**CLEANING**

Clean the gasket mating surface. Use caution not to damage the gasket sealing surface.

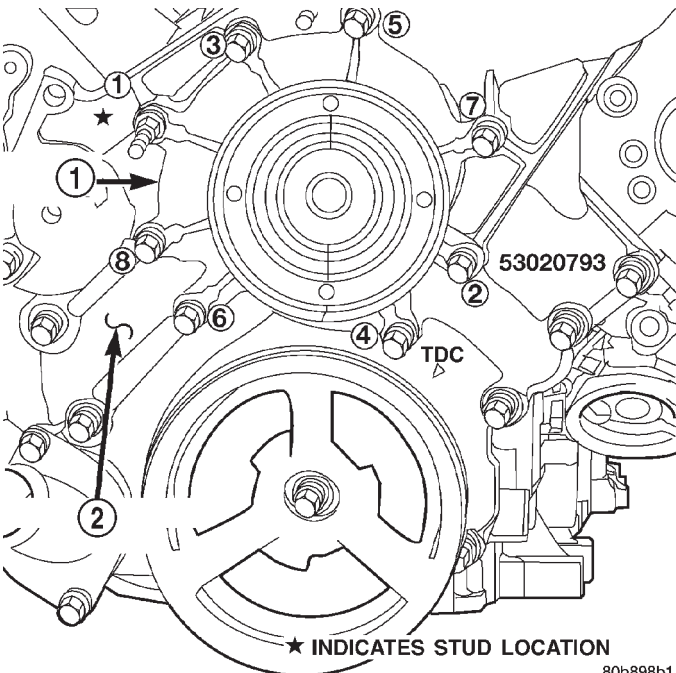
**INSPECTION**

Inspect the water pump assembly for cracks in the housing, Water leaks from shaft seal, Loose or rough turning bearing or Impeller rubbing either the pump body or timing chain case/cover.

**INSTALLATION**

The water pump on 3.7L engines is bolted directly to the engine timing chain case cover.

- (1) Clean gasket mating surfaces.
- (2) Using a new gasket, position water pump and install mounting bolts as shown. (Fig. 20). Tighten water pump mounting bolts to 54 N·m (40 ft. lbs.) torque.

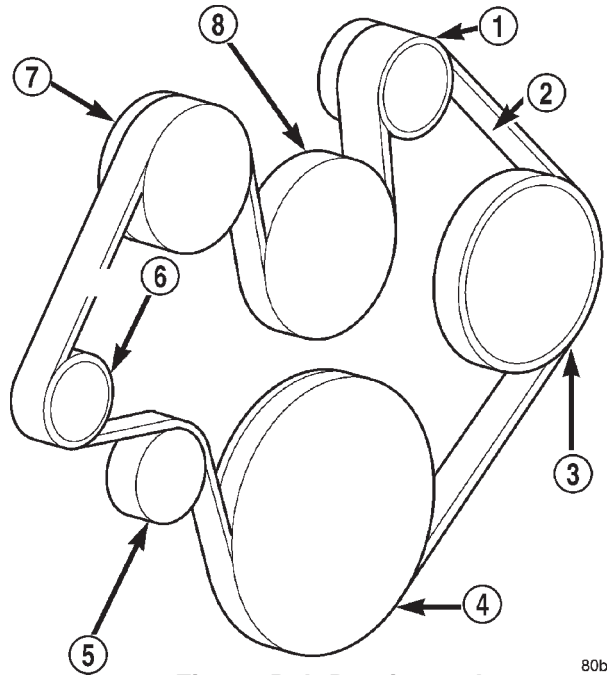


**Fig. 20 Water Pump Installation—3.7L**

- 1 - WATER PUMP
- 2 - TIMING CHAIN COVER

- (3) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.
- (4) Connect radiator lower hose to water pump.
- (5) Relax tension from belt tensioner. Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

**CAUTION:** When installing the serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 21) for correct belt routing. Or, refer to the Belt Routing Label located in the engine compartment. The correct belt with correct length must be used.



**Fig. 21 Belt Routing 3.7L**

- 1 - GENERATOR PULLEY
- 2 - ACCESSORY DRIVE BELT
- 3 - POWER STEERING PUMP PULLEY
- 4 - CRANKSHAFT PULLEY
- 5 - IDLER PULLEY
- 6 - TENSIONER
- 7 - A/C COMPRESSOR PULLEY
- 8 - WATER PUMP PULLEY

- (6) Position upper fan shroud and fan blade/viscous fan drive assembly.
- (7) Be sure the upper and lower portions of the fan shroud are firmly connected. All air must flow through the radiator.
- (8) Install two fan shroud-to-radiator screws.
- (9) Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.
- (10) Install fan blade/viscous fan drive assembly to water pump shaft (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).
- (11) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (12) Connect negative battery cable.
- (13) Start and warm the engine. Check for leaks.

# TRANSMISSION

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### TRANS COOLER

#### DESCRIPTION

An internal high capacity/high efficiency cooler is used on all vehicles, these coolers are an oil-to-cool-

ant type, which consists of plates mounted in the radiator outlet tank. Because the internal oil cooler is so efficient, no auxiliary oil cooler is offered. The cooler is not serviceable separately from the radiator.

# COOLING - 2.4L

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## COOLING - 2.4L

### DESCRIPTION

#### DESCRIPTION - COOLING SYSTEM 2.4L ENGINE

- The cooling system consists of the following items:
- Electric cooling fan - Standard.
  - Radiator
  - Hot bottle pressure cap
  - Thermostat
  - Coolant reserve/overflow system
  - Radiator in-tank transmission oil cooler (if equipped with an automatic transmission)
    - Coolant
    - Water pump
    - Hoses and hose clamps

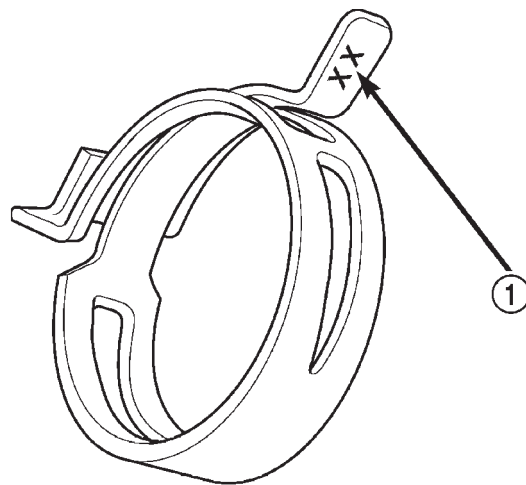
#### DESCRIPTION - HOSE CLAMPS

The cooling system utilizes spring type hose clamps. If a spring type clamp replacement is necessary, replace with the original Mopar® equipment spring type clamp.

**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. 1). 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 a original equipment clamp with matching number or letter (Fig. 1).**



**Fig. 1 Spring Clamp Size Location**

1 - SPRING CLAMP SIZE LOCATION



## COOLING - 2.4L (Continued)

## OPERATION

## OPERATION - 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 to circulate coolant throughout the system.

## OPERATION - HOSE CLAMPS

The spring type hose clamp applies constant tension on a hose connection. To remove a spring type hose clamp, only use constant tension clamp pliers designed to compress the hose clamp.

## DIAGNOSIS AND TESTING

## DIAGNOSIS AND TESTING - ON-BOARD DIAGNOSTICS (OBD)

## COOLING SYSTEM RELATED DIAGNOSTICS

The powertrain control module (PCM) has been programmed to monitor certain 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 indicated 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 25 - EMISSIONS CONTROL - DESCRIPTION).

## ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

## ERASING TROUBLE CODES

After the problem has been repaired, use the DRB scan tool to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service information for operation of the DRB scan tool.

## 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:

- PROLONGED IDLE
- VERY HIGH AMBIENT TEMPERATURE
- SLIGHT TAIL WIND AT IDLE
- SLOW TRAFFIC
- TRAFFIC JAMS
- HIGH SPEED
- STEEP GRADES

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.

(1) TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

(2) 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 refill (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.**

These charts are to be used as a quick-reference only. Refer to the group text for information.

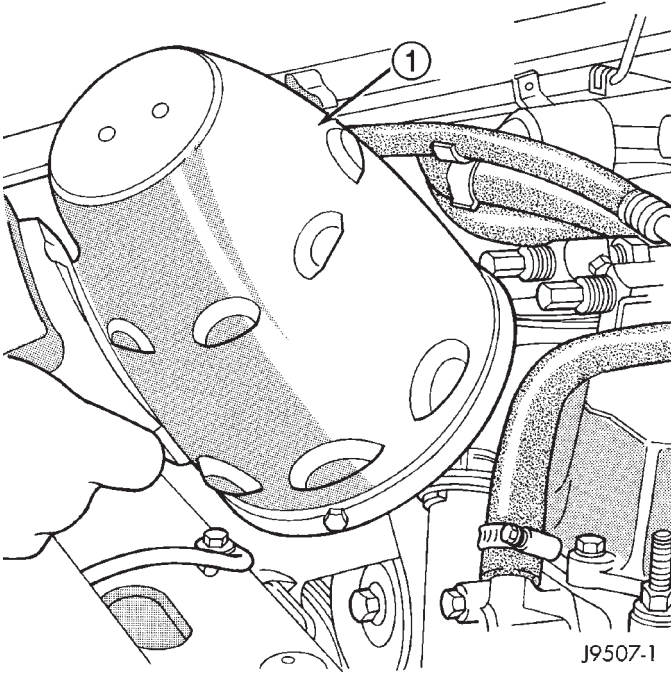
## DIAGNOSIS AND TESTING - COOLING SYSTEM LEAKS

## 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.

## COOLING - 2.4L (Continued)

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 2).



**Fig. 2 Leak Detection Using Black Light - Typical**

1 - TYPICAL BLACK LIGHT TOOL

### 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.

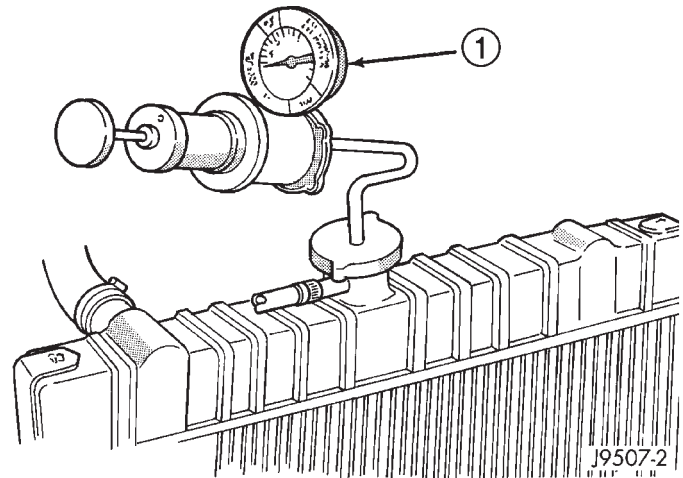
**WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.**

Carefully remove radiator pressure cap from pressure bottle 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, and dirt. 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 damaged, seating of pressure cap valve and tester seal will be affected.

Attach pressure tester (7700 or an equivalent) to radiator filler neck (Fig. 3).

Operate tester pump to apply 110 kPa (16 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. 3 Pressure Testing Cooling System - Typical**

1 - TYPICAL COOLING SYSTEM PRESSURE TESTER

**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.

### INTERNAL LEAKAGE INSPECTION

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.

## COOLING - 2.4L (Continued)

**WARNING: WITH RADIATOR PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 124 KPA (18 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 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 avail-

able 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 DRAIN-COCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.**

Drain sufficient coolant to allow thermostat removal. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL). Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

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 drain-cock immediately after test to eliminate boil over.**

Start engine and accelerate rapidly three times, to approximately 3000 rpm 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.

COOLING - 2.4L (Continued)

**DIAGNOSIS AND TESTING - COOLING SYSTEM  
DIAGNOSIS CHART**

*COOLING SYSTEM DIAGNOSIS CHART*

<b>CONDITION</b>	<b>POSSIBLE CAUSES</b>	<b>CORRECTION</b>
<p>TEMPERATURE GAUGE READS LOW</p>	<ol style="list-style-type: none"> <li>1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?</li>   <li>2. Is the temperature sending unit connected?</li>   <li>3. Is the temperature gauge operating OK?</li>   <li>4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.</li>   <li>5. Improper operation of internal heater doors or heater controls.</li>   <li>6. Electric fan functioning when not required.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for On-Board Diagnostics and DTC information. Replace thermostat if necessary.</li>   <li>2. Check the temperature sensor connector. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT TEMP SENSOR - DESCRIPTION). Repair connector if necessary.</li>   <li>3. Check gauge operation. Repair as necessary.</li>   <li>4. Check coolant level in the coolant pressure bottle and the radiator. Inspect system for leaks. Repair leaks as necessary.</li>   <li>5. Inspect heater and repair as necessary. (Refer to 24 - HEATING &amp; AIR CONDITIONING - DIAGNOSIS AND TESTING)</li>   <li>6. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section. Refer to group 8W for electric cooling fan and relay circuit schematic data.</li> </ol>

## COOLING - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
<p>TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM.</p>	<p>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.</p> <p>2. Is the temperature gauge reading correctly?</p> <p>3. Is the temperature warning illuminating unnecessarily?</p> <p>4. Coolant low in coolant pressure bottle and radiator?</p> <p>5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.</p> <p>6. Poor seals at the radiator cap.</p> <p>7. Coolant not flowing through system.</p>	<p>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.</p> <p>2. Check gauge. (Refer to Group 8J - INSTRUMENT CLUSTER). Repair as necessary.</p> <p>3. Check warning lamp operation. (Refer to Group 8J - INSTRUMENT CLUSTER). Repair as necessary.</p> <p>4. Check for coolant leaks and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</p> <p>5. Tighten cap</p> <p>6. (a) Check condition of cap and cap seals. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.</p> <p>7. (a) Check condition of pressure bottle cap and cap seals. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). (b) Check condition of radiator vent nipple. If neck is 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 pressure bottle/overflow tank and tanks hoses for blockage. Repair as necessary.</p>

COOLING - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	<p>8. Incorrect coolant concentration</p> <p>9. Fan installed backwards on viscous drive.</p> <p>10. Radiator or A/C condenser fins are dirty or clogged.</p> <p>11. Radiator core is corroded or plugged.</p> <p>12. Fuel or ignition system problems.</p> <p>13. Dragging brakes.</p> <p>14. Bug screen or cardboard is being used, reducing airflow.</p> <p>15. Thermostat partially or completely shut.</p> <p>16. Viscous fan drive not operating properly.</p> <p>17. Cylinder head gasket leaking.</p> <p>18. Heater core leaking.</p> <p>19. Electric fan not functioning.</p>	<p>8. Check coolant. (Refer to 7 - COOLING/ENGINE/COOLANT - DESCRIPTION) for correct coolant/water mixture ratio.</p> <p>9. Mount fan on drive correctly.</p> <p>10. Remove insects and debris. (Refer to 7 - COOLING/ENGINE/RADIATOR - CLEANING).</p> <p>11. Have radiator re-cored or replaced.</p> <p>12. Refer to FUEL and /or IGNITION CONTROL for diagnosis.</p> <p>13. Check and correct as necessary. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING) for correct procedures.</p> <p>14. Remove bug screen or cardboard.</p> <p>15. Check thermostat operation and replaces necessary. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - DIAGNOSIS AND TESTING).</p> <p>16. Check fan drive operation and replace as necessary. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING).</p> <p>17. Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING). For repair, (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).</p> <p>18. Check heater core for leaks. (Refer to 24 - HEATING &amp; AIR CONDITIONING/PLUMBING/HEATER CORE - REMOVAL). Repair as necessary.</p> <p>19. Inspect electric fan for proper operation. Refer to Electric Cooling Fan in this section. Refer to Group 8W for electric cooling fan and relay circuit schematic data.</p>

## COOLING - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	<ol style="list-style-type: none"> <li>1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.</li> <li>2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.</li> <li>3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running)</li> <li>4. Gauge reading high after re-starting a warmed up (hot) engine.</li> <li>5. Coolant level low in cooling system (air will build up in the cooling system causing the thermostat to open late).</li> <li>6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.</li> <li>7. Water pump impeller loose on shaft.</li> <li>8. Loose accessory drive belt. (water pump slipping)</li> <li>9. Air leak on the suction side of the water pump allows air to build up in cooling system causing thermostat to open late.</li> </ol>	<ol style="list-style-type: none"> <li>1. A normal condition. No correction is necessary.</li> <li>2. Check operation of gauge and repair if necessary. Refer to Group 8J, Instrument cluster.</li> <li>3. A normal condition. No correction is necessary. Gauge should return to normal range after vehicle is driven.</li> <li>4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.</li> <li>5. Check and correct coolant leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</li> <li>6. (a) Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING). (b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary.</li> <li>7. Check water pump and replace as necessary. (Refer to 7 - COOLING/ENGINE/WATER PUMP - DIAGNOSIS AND TESTING).</li> <li>8. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING). Check and correct as necessary.</li> <li>9. Locate leak and repair as necessary.</li> </ol>
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	<ol style="list-style-type: none"> <li>1. Pressure relief valve in pressure bottle cap is defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check condition of radiator cap and cap seals. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace cap as necessary.</li> </ol>

COOLING - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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 7 - COOLING - DIAGNOSIS AND TESTING).
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 7 - COOLING/ENGINE/COOLANT - DESCRIPTION) and adjust ratio as required.
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 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). 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.  2. Fan blades striking a surrounding object.  3. Air obstructions at radiator or air conditioning condenser.  4. Thermal viscous fan drive has defective bearing.	1. Replace fan blade assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)  2. Locate point of fan blade contact and repair as necessary.  3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser.  4. Replace fan drive. Bearing is not serviceable. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).



## COOLING - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	<ol style="list-style-type: none"> <li>1. Has a Diagnostic trouble Code (DTC) been set?</li> <li>2. Coolant level low</li> <li>3. Obstructions in heater hose/ fittings</li> <li>4. Heater hose kinked</li> <li>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.</li> </ol>	<ol style="list-style-type: none"> <li>1. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for correct procedures and replace thermostat if necessary</li> <li>2. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).</li> <li>3. Remove heater hoses at both ends and check for obstructions</li> <li>4. Locate kinked area and repair as necessary</li> <li>5. (Refer to 7 - COOLING/ENGINE/ WATER PUMP - DIAGNOSIS AND TESTING). If a slipping belt is detected, (Refer to 7 - COOLING/ ACCESSORY DRIVE/DRIVE BELTS - REMOVAL). If heater core obstruction is detected, (Refer to 7 - COOLING - STANDARD PROCEDURE) for cooling system reverse flushing.</li> </ol>
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	<ol style="list-style-type: none"> <li>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 or condenser, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.</li> </ol>	<ol style="list-style-type: none"> <li>1. Occasional steam emitting from this area is normal. No repair is necessary.</li> </ol>
COOLANT COLOR	<ol style="list-style-type: none"> <li>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.</li> </ol>	<ol style="list-style-type: none"> <li>1. (Refer to 7 - COOLING/ENGINE/ COOLANT - DESCRIPTION) for coolant concentration information. Adjust coolant mixture as necessary.</li> </ol>
COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	<ol style="list-style-type: none"> <li>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.</li> </ol>	<ol style="list-style-type: none"> <li>1. A normal condition. No repair is necessary.</li> </ol>

COOLING - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
FAN RUNS ALL THE TIME	1. Fan control sensors inoperative. 2. Fan control solenoid stuck "on". 3. Fan control solenoid harness damaged. 4. Transmission temperature too high. 5. Engine coolant temperature too high.	1. Check for DTC's. Verify sensor readings. 2. Check fan operation speeds. Refer to fan speed operation table. 3. Check for DTC 1499. Repair as required. 4. Check for transmission over temp. DTC. 5. (a) Check coolant level. Correct level as required. (b) Thermostat stuck. Replace thermostat. (c) Water pump failed. Replace water pump. (d) Coolant flow restricted. Clean radiator. (e) Air flow over radiator obstructed. Remove obstruction.

STANDARD PROCEDURE

STANDARD PROCEDURE - DRAINING COOLING SYSTEM

**WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS (Fig. 4) OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.**

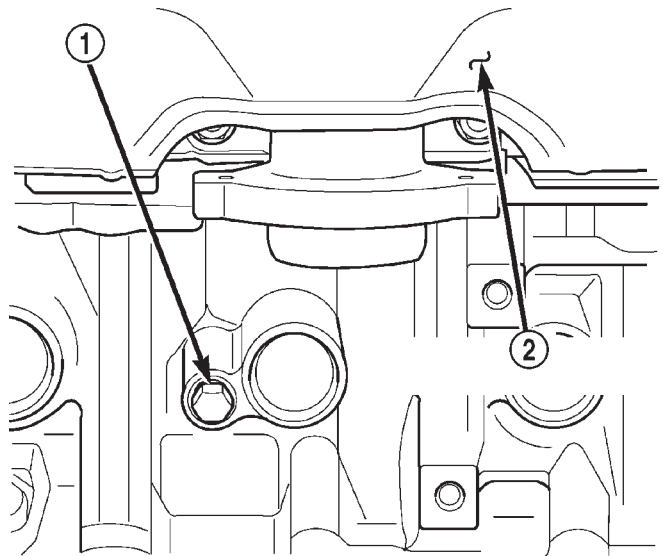
(1) DO NOT remove radiator cap first. With engine cold, raise vehicle on a hoist and locate radiator draincock.

**NOTE: Radiator draincock is located on the left/ lower side of radiator facing to rear of vehicle.**

(2) Attach one end of a hose to the draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator. This will empty the coolant reserve/overflow tank. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture. When tank is empty, remove radiator cap and continue draining cooling system.

STANDARD PROCEDURE - REFILLING COOLING SYSTEM

(1) Tighten the radiator draincock and the cylinder block drain plug(s) (if removed).



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**Fig. 4 Drain Plug - 3.7L Engine**

- 1 - CYLINDER BLOCK DRAIN PLUG
- 2 - EXHAUST MANIFOLD AND HEAT SHIELD

**CAUTION: Failure to purge air from the cooling system can result in an overheating condition and severe engine damage.**

(2) .Fill system using a 50/50 mixture of ethylene-glycol antifreeze and low mineral content water.Fill pressure bottle to service line.and install cap.

## COOLING - 2.4L (Continued)

**NOTE:** The engine cooling system will push any remaining air into the coolant bottle within about an hour of normal driving. As a result, a drop in coolant level in the pressure bottle may occur. If the engine cooling system overheats and pushes coolant into the overflow side of the coolant bottle, this coolant will be sucked back into the cooling system **ONLY IF THE PRESSURE CAP IS LEFT ON THE BOTTLE**. Removing the pressure cap breaks the vacuum path between the two bottle sections and the coolant will not return to cooling system.

(3) With heater control unit in the HEAT position, operate engine with pressure bottle cap in place.

(4) Add coolant to pressure bottle as necessary. **Only add coolant to the pressure bottle when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

**NOTE:** The coolant bottle has two chambers. Coolant will normally only be in the outboard (larger) of the two. The inboard chamber is only to recover coolant in the event of an overheat or after a recent service fill. The inboard chamber should normally be empty. If there is coolant in the overflow side of the coolant bottle (after several warm/cold cycles of the engine) and coolant level is above cold full when cold, disconnect the end of the overflow hose at the fill neck and lower it into a clean container. Allow coolant to drain into the container until emptied. Reconnect overflow hose to fill neck.

## STANDARD PROCEDURE - COOLING SYSTEM - REVERSE FLUSHING

**CAUTION:** The cooling system normally operates at 97-to-110 kPa (14-to -16 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Reverse flushing of the 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.

## CHEMICAL CLEANING

If visual inspection indicates the formation of sludge or scaly deposits, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

**CAUTION:** Be sure instructions on the container are followed.

## REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

**CAUTION:** The cooling system normally operates at 97-to-110 kPa (14- to-16 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

Allow the radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

## REVERSE FLUSHING ENGINE

Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE). Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump. Attach a lead away hose to the water pump inlet fitting.

**CAUTION:** Be sure that the heater control valve is closed (heat off). This is done to prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL). Install the thermostat and housing with a replacement gasket (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - INSTALLATION). Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture (Refer to 7 - COOLING - STANDARD PROCEDURE).

COOLING - 2.4L (Continued)

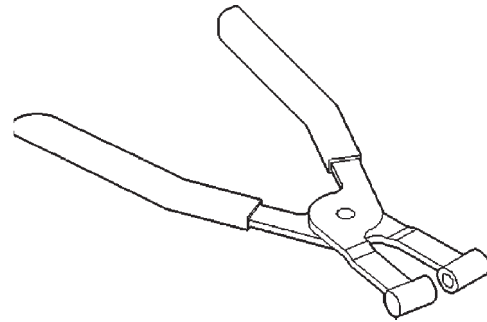
SPECIFICATIONS

TORQUE

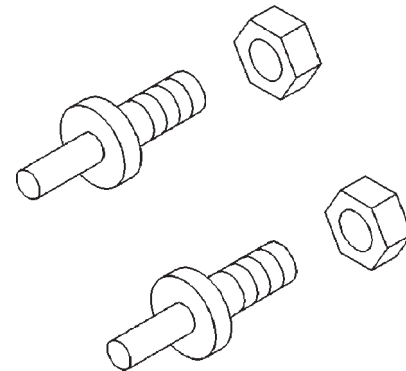
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Automatic Belt Tensioner to Mounting Bracket	2.4L	41	30 -
	3.7L	41	30 —
Automatic Belt Tensioner Pulley— Bolt	(2.4L)	61	45 —
	(3.7L)	61	45 —
Block Heater—Bolt	2.4L	2	— 17
	3.7L	2	— 17
Condenser to Radiator Bolts	8		70
Coolant Overflow Bottle to Plenum mounting bolts - 2.4L only	8.5		75
Coolant Pressure Bottle to Plenum mounting bolts -3.7L only	8.5		75
Electric Fan to Fan Shroud bolts	5.5		50
Fan Blade Assy. to Viscous Drive Bolts 3.7L	23	—	210
Fan Shroud to Radiator Mounting Bolts	8	—	70
Radiator Upper Isolator to Crossmember - Bolts	9.5	—	85
Thermostat Housing—Bolts	2.4L	28	- 250
	4.7L	13	— 115
Water Pump—Bolts	2.4L	12	— 105
	4.7L	54	40 —

SPECIAL TOOLS

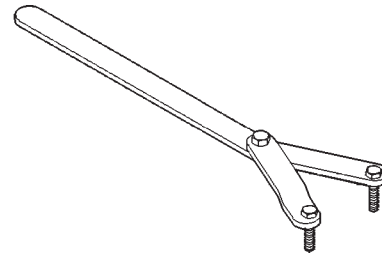
COOLING



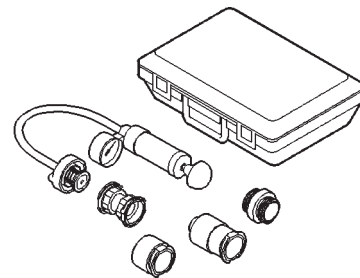
**Pliers 6094**



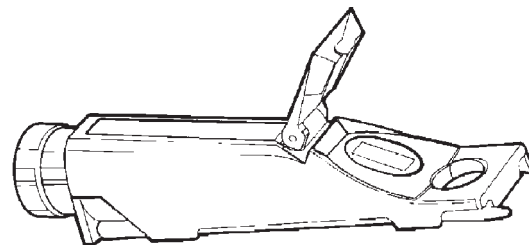
**Adapter Pins 8346**



**Spanner Wrench 6958 with 8346 adapter pins**



**Pressure Tester 7700-A**



**Coolant Refractometer 8286**

# ACCESSORY DRIVE

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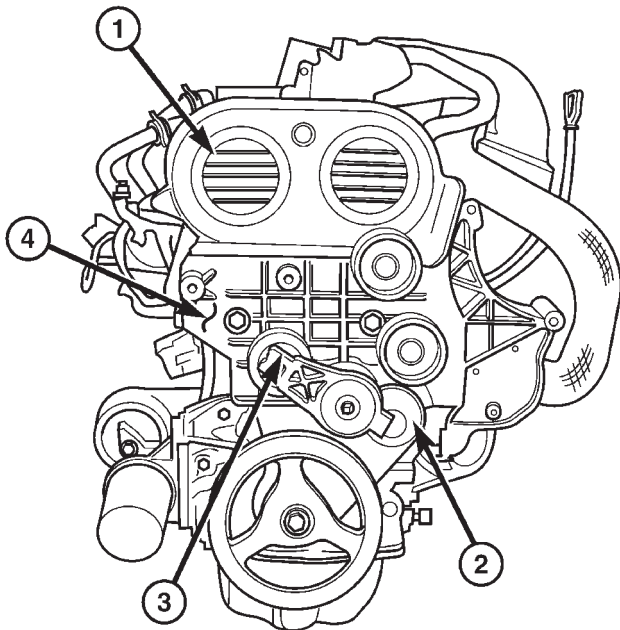
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## BELT TENSIONERS - 2.4L

### REMOVAL - 2.4L ENGINE

(1) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove tensioner assembly from engine accessory drive bracket (Fig. 1).



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**Fig. 1 ACCESSORY DRIVE BRACKET**

- 1- UPPER TIMING BELT COVER
- 2- LOWER TIMING BELT COVER
- 3- BELT TENSIONER
- 4- ACCESSORY DRIVE BRACKET

**WARNING: BECAUSE OF HIGH SPRING TENSION, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY ON TENSIONER).**

(3) Remove pulley bolt. Remove pulley from tensioner.

### INSTALLATION - 2.4L ENGINE

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) An indexing slot is located on back of tensioner. Align this slot to the head of the nut on the front cover. Install the mounting nut on the stud. Tighten stud to 41 N·m (30 ft. lbs.).

(3) Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

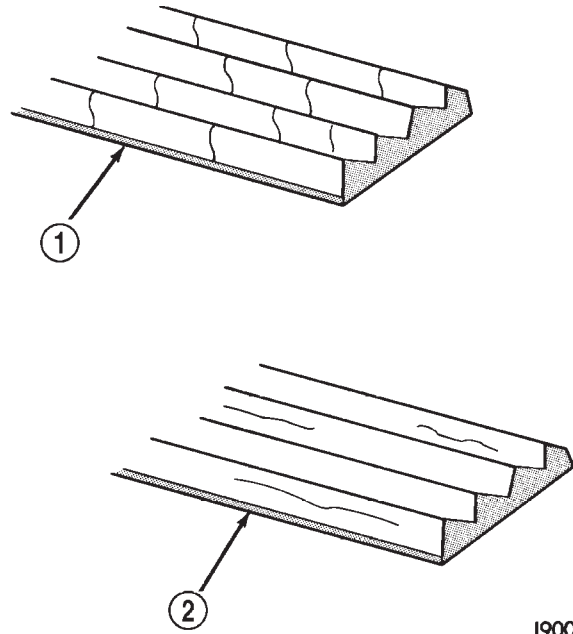
(4) Check belt indexing marks (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

## DRIVE BELTS -2.4L

### DIAGNOSIS AND TESTING - SERPENTINE DRIVE BELT DIAGNOSIS

When diagnosing serpentine drive belts, small cracks that run across ribbed surface of belt from rib to rib (Fig. 2), are considered normal. These are not a reason to replace belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 2). Also replace belt if it has excessive wear, frayed cords or severe glazing.

Refer to SERPENTINE DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.



J9007-44

**Fig. 2 Serpentine Accessory Drive Belt Wear Patterns**

- 1 - NORMAL CRACKS BELT OK
- 2 - NOT NORMAL CRACKS REPLACE BELT

### SERPENTINE DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY)	<ol style="list-style-type: none"> <li>1. Foreign objects imbedded in pulley grooves.</li> <li>2. Installation damage.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove foreign objects from pulley grooves. Replace belt.</li> <li>2. Replace belt.</li> </ol>
RIB OR BELT WEAR	<ol style="list-style-type: none"> <li>1. Pulley(s) misaligned.</li> <li>2. Abrasive environment.</li> <li>3. Rusted pulley(s).</li> <li>4. Sharp or jagged pulley groove tips.</li> <li>5. Rubber deteriorated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Align pulley(s).</li> <li>2. Clean pulley(s). Replace belt if necessary.</li> <li>3. Clean rust from pulley(s).</li> <li>4. Replace pulley.</li> <li>5. Replace belt.</li> </ol>
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	<ol style="list-style-type: none"> <li>1. Belt has mistracked from pulley groove.</li> <li>2. Pulley groove tip has worn away rubber to tensile member.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace belt.</li> <li>2. Replace belt.</li> </ol>

## DRIVE BELTS -2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BELT SLIPS	<ol style="list-style-type: none"> <li>1. Belt slipping because of insufficient tension.</li> <li>2. Belt routed incorrectly</li> <li>3. Incorrect belt.</li> <li>4. Belt or pulley subjected to substance (belt dressing, oil ethylene glycol) that has reduced friction.</li> <li>5. Driven component bearing failure.</li> <li>6. Belt glazed and hardened from heat and excessive slippage.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace automatic belt tensioner.</li> <li>2. Verify belt routing.</li> <li>3. Replace belt.</li> <li>4. Replace belt and clean pulleys.</li> <li>5. Replace faulty component bearing.</li> <li>6. Replace belt.</li> </ol>
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY)	<ol style="list-style-type: none"> <li>1. Belt tension either too high or too low.</li> <li>2. Belt routed incorrectly.</li> <li>3. Incorrect belt.</li> <li>4. Pulley(s) not within design tolerance.</li> <li>5. Foreign object(s) in grooves.</li> <li>6. Pulley misalignment.</li> <li>7. Belt cord line is broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace automatic belt tensioner.</li> <li>2. Verify belt routing.</li> <li>3. Replace belt.</li> <li>4. Replace pulley(s).</li> <li>5. Remove foreign objects from grooves.</li> <li>6. Check and replace.</li> <li>7. Replace belt.</li> </ol>
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	<ol style="list-style-type: none"> <li>1. Excessive tension.</li> <li>2. Incorrect belt.</li> <li>3. Tensile member damaged during belt installation.</li> <li>4. Severe misalignment.</li> <li>5. Bracket, pulley, or bearing failure.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace belt and automatic belt tensioner.</li> <li>2. Replace belt.</li> <li>3. Replace belt.</li> <li>4. Check and replace.</li> <li>5. Replace defective component and belt.</li> </ol>
NOISE (OBJECTIONABLE SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	<ol style="list-style-type: none"> <li>1. Belt slippage.</li> <li>2. Bearing noise.</li> <li>3. Belt misalignment.</li> <li>4. Belt-to-pulley mismatch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace belt or automatic belt tensioner.</li> <li>2. Locate and repair.</li> <li>3. Replace belt.</li> <li>4. Install correct belt.</li> </ol>

## REMOVAL - 2.4L ENGINE

**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 LET TENSIONER ARM SNAP BACK TO THE FREEARM POSITION, SEVERE DAMAGE MAY OCCUR TO THE TENSIONER.**

Belt tension is not adjustable. Belt adjustment is maintained by an automatic ( spring load ) belt tensioner.

- (1) Disconnect negative battery cable from battery.
- (2) Rotate belt tensioner until it contacts its stop. Remove belt, then slowly rotate the tensioner into the freearm position.

DRIVE BELTS -2.4L (Continued)

**INSTALLATION - 2.4L ENGINE**

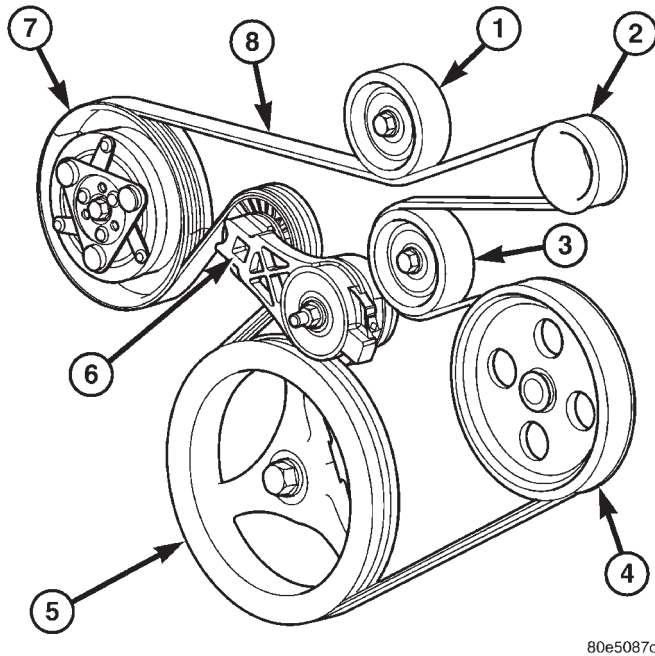
**NOTE:** The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label. This label is located in the engine compartment.

Belt tension is not adjustable. Belt adjustment is maintained by an automatic ( spring load ) belt tensioner.

(1) Check condition of all pulleys.

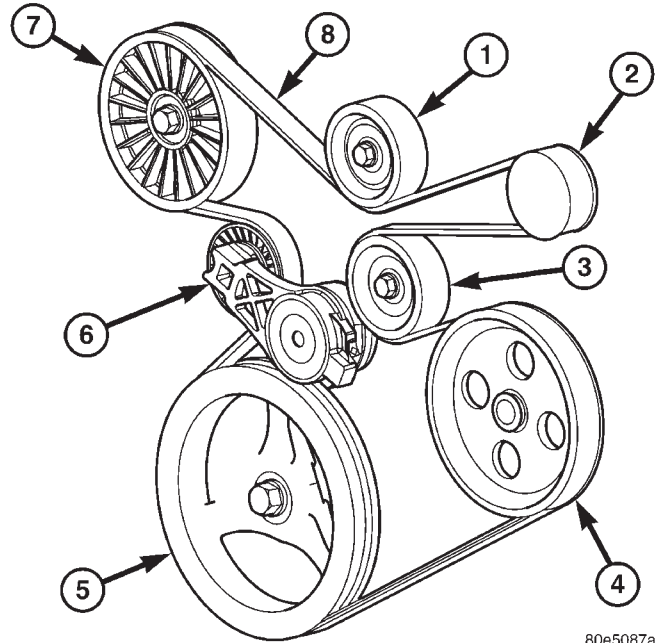
**CAUTION:** When installing the serpentine accessory drive belt, the belt **MUST** be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction.

(2) Install new belt (Fig. 3) or (Fig. 4). Route the belt around all pulleys except the idler pulley. Rotate the tensioner arm until it contacts its stop position. Route the belt around the idler and slowly let the tensioner rotate into the belt. Make sure the belt is seated onto all pulleys.



**Fig. 3 BELT ROUTING 2.4L WITH A/C**

- 1 - IDLER PULLEY
- 2 - GENERATOR PULLEY
- 3 - IDLER PULLEY
- 4 - POWER STEERING PUMP PULLEY
- 5 -CRANKSHAFT PULLEY
- 6 - TENSIONER
- 7 - A/C COMPRESSOR PULLEY
- 8 - ACCESSORY DRIVE BELT



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**Fig. 4 BELT ROUTING 2.4L WITHOUT A/C**

- 1 - IDLER PULLEY
- 2 - GENERATOR PULLEY
- 3 - IDLER PULLEY
- 4 - POWER STEERING PUMP PULLEY
- 5 -CRANKSHAFT PULLEY
- 6 - TENSIONER
- 7 - NON A/C IDLER PULLEY
- 8 - ACCESSORY DRIVE BELT

(3) With the drive belt installed, inspect the belt wear indicator. On 2.4L Engines the gap between the tang and the housing stop ( measurement A ) must not exceed 24 mm (.94 inches).



## ENGINE

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## COOLANT

## DESCRIPTION

## DESCRIPTION - HOAT COOLANT

**WARNING: ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASE COOLANT PROPERLY, CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE, PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN**

**ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED, PERSONAL INJURY CAN RESULT.**

**CAUTION: Use of Propylene Glycol based coolants is not recommended, as they provide less freeze protection and less corrosion protection.**

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769), or the equivalent ethylene glycol base coolant with organic corrosion inhibitors (called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% Ethylene Glycol and 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

## COOLANT (Continued)

**CAUTION:** Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769) may not be mixed with any other type of antifreeze. Mixing of coolants other than specified (non-HOAT or other HOAT), may result in engine damage that may not be covered under the new vehicle warranty, and decreased corrosion protection.

## COOLANT PERFORMANCE

The required ethylene-glycol (antifreeze) and water mixture depends upon climate and vehicle operating conditions. The coolant performance of various mixtures follows:

**Pure Water**-Water can absorb more heat than a mixture of water and ethylene-glycol. This is for purpose of heat transfer only. Water also freezes at a higher temperature and allows corrosion.

**100 percent Ethylene-Glycol**-The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°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°C (-8°F).

**50/50 Ethylene-Glycol and Water**-Is the recommended mixture, it provides protection against freezing to -37°C (-34°F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. If percentage is lower, engine parts may be eroded by cavitation. Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7°C (-90°F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because specific heat of antifreeze is lower than that of water.

**CAUTION:** Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

## COOLANT SELECTION AND ADDITIVES

The use of aluminum cylinder blocks, cylinder heads and water pumps requires special corrosion protection. Only Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (glycol base coolant with corrosion inhibitors called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

**CAUTION:** Do not use coolant additives that are claimed to improve engine cooling.

## DESCRIPTION - ENGINE COOLANT

## ETHYLENE-GLYCOL MIXTURES

**CAUTION:** Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

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.

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 MIXTURES

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 on a cooling system designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This can increase cylinder head temperatures under certain conditions.

## COOLANT (Continued)

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.

## OPERATION

Coolant flows through the engine block absorbing the heat from the engine, then flows to the radiator where the cooling fins in the radiator transfers the heat from the coolant to the atmosphere. During cold weather the ethylene-glycol coolant prevents water present in the cooling system from freezing within temperatures indicated by mixture ratio of coolant to water.

## COOLANT RECOVERY PRESS CONTAINER

## DESCRIPTION

This system works along with the radiator pressure cap. This is done by using thermal expansion and contraction of the coolant to keep the coolant free of trapped air. It provides:

- A volume for coolant expansion and contraction.
- A convenient and safe method for checking/adjusting coolant level at atmospheric pressure. This is done without removing the radiator pressure cap.
- Some reserve coolant 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.

The coolant reservoir/overflow system has a radiator mounted pressurized cap, an overflow tube, and a plastic coolant reservoir/overflow tank, mounted to the right side of the cowl. It is mounted to the cowl with two nuts on top, and a slide bracket on the bottom.

## OPERATION

The pressure chamber keeps the coolant free of trapped air, provides a volume for expansion and contraction, and provides a convenient and safe method for checking and adjusting coolant level at atmospheric pressure. It also provides some reserve coolant to cover minor leaks, evaporation or boiling losses. The overflow chamber allows coolant recovery in case of an overheat.

## ENGINE BLOCK HEATER - 2.4L

## DESCRIPTION

The block heater is operated by ordinary house current (110 Volt A.C.) through a power cord and connector located in the engine compartment. The heater is mounted in a core hole (in place of a core hole plug) in the engine block, with the heating element immersed in coolant.

**CAUTION: The power cord must be secured in its retainer clips, and not positioned so it could contact linkages or exhaust manifolds and become damaged.**

## OPERATION

The block heater element is submerged in the cooling system's coolant. When electrical power (110 volt A.C.) is applied to the element, it creates heat. This heat is transferred to the engine coolant. This provides easier engine starting and faster warm-up when vehicle is operated in areas having extremely low temperatures.

## REMOVAL - 2.4L

- (1) Drain cooling system (Refer to 7 - COOLING/ENGINE - STANDARD PROCEDURE).
- (2) Raise vehicle on hoist.
- (3) Detach power cord plug from heater.
- (4) Loosen screw in center of heater. Remove heater assembly.

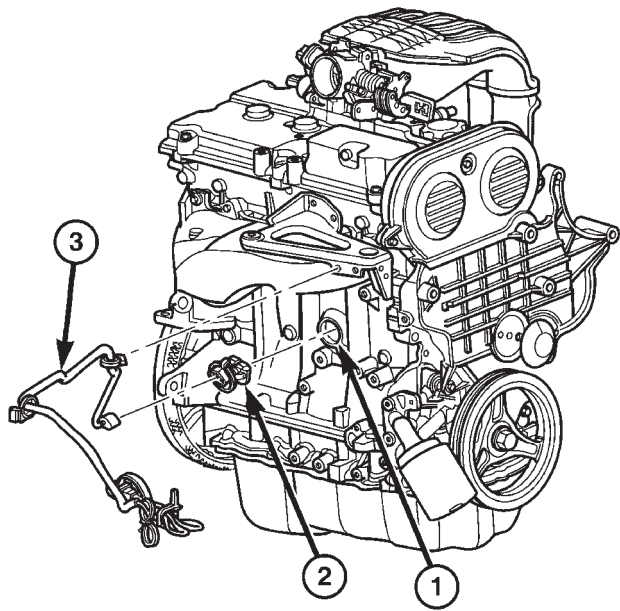
## INSTALLATION - 2.4L

- (1) Thoroughly clean core hole and heater seat.
- (2) Insert heater assembly (Fig. 1) with element loop positioned **upward**.
- (3) With heater seated, tighten center screw securely to assure a positive seal.

**CAUTION: To prevent damage, the power cord must be secured in it's retaining clips, and not positioned so it could contact linkages or exhaust manifold.**

- (4) Connect power cord to heater.
- (5) Lower vehicle.
- (6) Fill cooling system (Refer to 7 - COOLING/ENGINE - STANDARD PROCEDURE).

ENGINE BLOCK HEATER - 2.4L (Continued)



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**Fig. 1 ENGINE BLOCK HEATER 2.4L**

- 1 - CORE HOLE
- 2 - BLOCK HEATER
- 3 - POWER CORD

ENGINE COOLANT TEMPERATURE SENSOR

DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to sense engine coolant temperature. The sensor protrudes into an engine water jacket.

The ECT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as engine coolant temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

OPERATION

At key-on, the Powertrain Control Module (PCM) sends out a regulated 5 volt signal to the ECT sensor. The PCM then monitors the signal as it passes through the ECT sensor to the sensor ground (sensor return).

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.

The PCM uses inputs from the ECT sensor for the following calculations:

- for engine coolant temperature gauge operation through CCD or PCI (J1850) communications
- Injector pulse-width

- Spark-advance curves
- ASD relay shut-down times
- Idle Air Control (IAC) motor key-on steps
- Pulse-width prime-shot during cranking
- O2 sensor closed loop times
- Purge solenoid on/off times
- EGR solenoid on/off times (if equipped)
- Leak Detection Pump operation (if equipped)
- Radiator fan relay on/off times (if equipped)
- Target idle speed

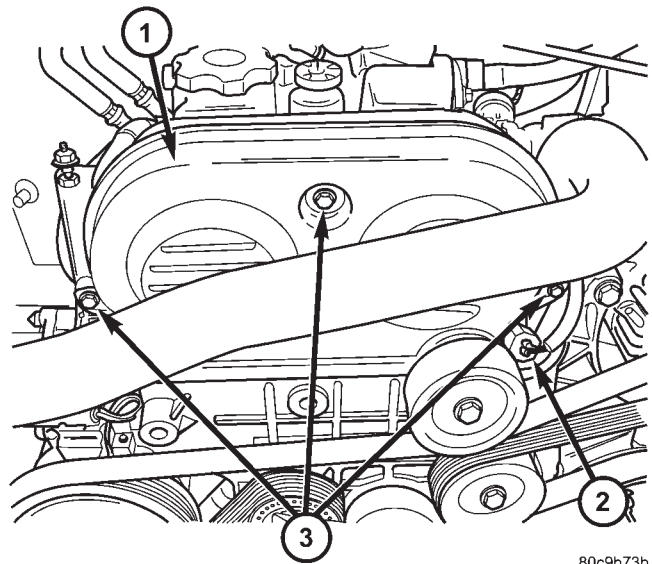
REMOVAL

2.4L

The Engine Coolant Temperature (ECT) sensor is installed into a water jacket at left front of cylinder head (Fig. 2).

**WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.**

- (1) Partially drain cooling system.
- (2) Disconnect electrical connector from sensor.
- (3) Remove sensor from cylinder head.



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**Fig. 2 ECT AND UPPER TIMING BELT COVER/ BOLTS-2.4L**

- 1 - UPPER TIMING BELT COVER
- 2 - ELECTRICAL CONNECTOR (ECT)
- 3 - MOUNTING BOLTS (3)

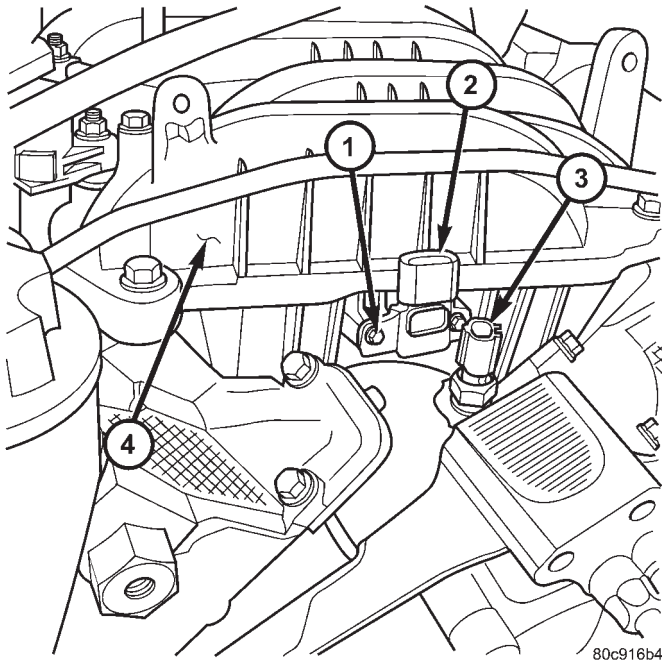
3.7L

The Engine Coolant Temperature (ECT) sensor is installed into a water jacket at front of intake manifold near rear of generator (Fig. 3).

## ENGINE COOLANT TEMPERATURE SENSOR (Continued)

**WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.**

- (1) Partially drain cooling system.
- (2) Disconnect electrical connector from sensor.
- (3) Remove sensor from intake manifold.



**Fig. 3 MAP SENSOR / ECT SENSOR - 3.7L**

- 1 - MOUNTING SCREWS
- 2 - MAP SENSOR
- 3 - ECT SENSOR

## INSTALLATION

- (1) Apply thread sealant to sensor threads.
- (2) Install sensor to engine.
- (3) Tighten sensor to 11 N·m (8 ft. lbs.) torque.
- (4) Replace any lost engine coolant.

## ENGINE COOLANT THERMOSTAT

## REMOVAL - 2.4L ENGINE

- (1) Drain cooling system below the thermostat level.
- (2) Remove radiator upper hose from the coolant outlet housing.
- (3) Remove coolant outlet housing bolts and housing.
- (4) Remove thermostat. Discard gasket and clean both gasket sealing surfaces.

## INSTALLATION - 2.4L ENGINE

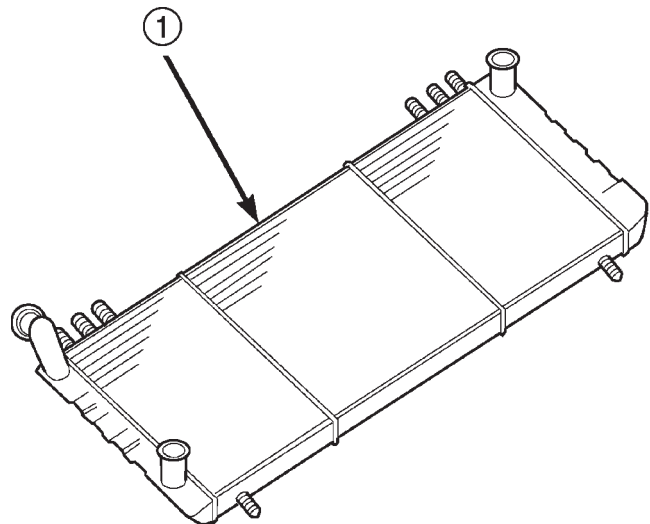
- (1) Place a new gasket (dipped in clean water) on the coolant outlet connector surface. Position thermostat with air bleed at the 12 o'clock position in thermostat housing.
- (2) Position the coolant outlet connector and gasket over the thermostat, making sure thermostat is seated in the thermostat housing.
- (3) Position outlet connector to thermostat housing and install bolts. Tighten bolts to 28 N·m (250 in. lbs.).
- (4) Install the radiator upper hose to coolant outlet housing.
- (5) Refill the cooling system.

## RADIATOR

## DESCRIPTION

All vehicles are equipped with a cross flow type radiator with plastic side tanks (Fig. 4).

Plastic tanks, while stronger than brass, are subject to damage by impact, such as from tools or wrenches. Handle radiator with care.



**Fig. 4 Cross Flow Radiator - Typical**

- 1 - RADIATOR

## REMOVAL

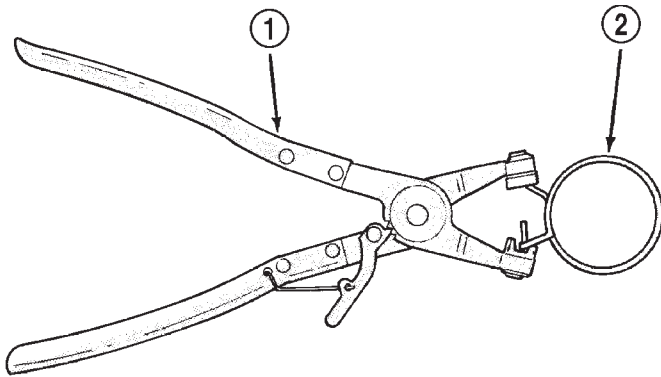
**WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR. REFER TO COOLING SYSTEM DRAINING.**

RADIATOR (Continued)

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

**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. 5). 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. 6). If replacement is necessary, use only an original equipment clamp with matching number or letter.**



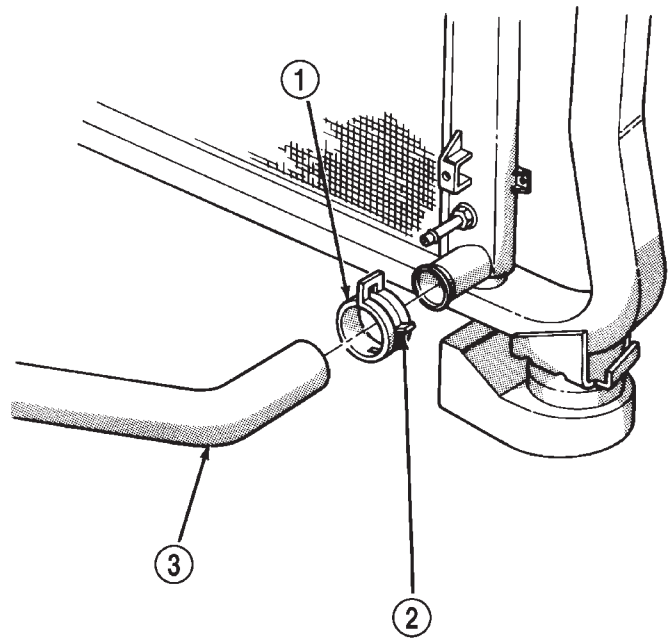
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**Fig. 5 Hose Clamp Tool - Typical**

- 1 - HOSE CLAMP TOOL 6094
- 2 - HOSE CLAMP

**CAUTION: When removing the radiator or A/C condenser for any reason, note the location of all radiator-to-body and radiator-to-A/C condenser rubber air seals (Fig. 7). These are used at the top, bottom and sides of the radiator and A/C condenser. To prevent overheating, these seals must be installed to their original positions.**

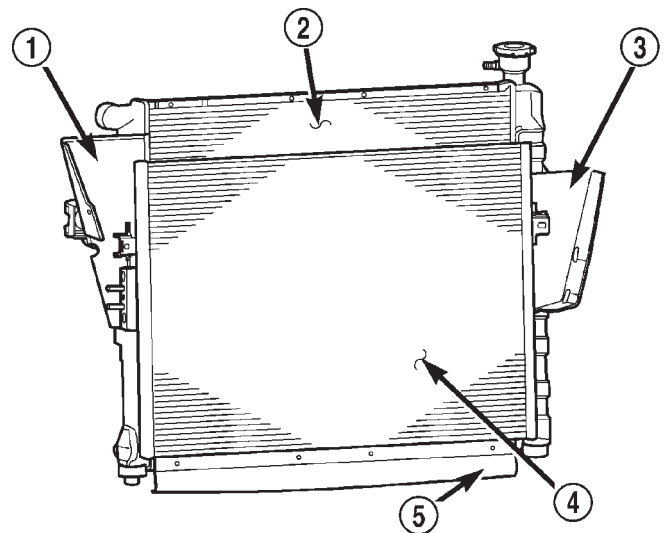
- (1) Disconnect the negative battery cable at battery.
- (2) Drain coolant from radiator (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (3) Remove the front grill (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL).
- (4) Remove the cooling fan from the engine, if equipped.
- (5) Remove the two radiator mounting bolts.



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**Fig. 6 Clamp Number/Letter Location - Typical**

- 1 - TYPICAL CONSTANT TENSION HOSE CLAMP
- 2 - CLAMP NUMBER/LETTER LOCATION
- 3 - TYPICAL HOSE



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**Fig. 7 Air Seals - Typical**

- 1 - AIR DAM
- 2 - RADIATOR
- 3 - AIR DAM
- 4 - A/C CONDENSER
- 5 - AIR SEAL

- (6) Disconnect both transmission cooler lines from radiator.
- (7) Disconnect the connector for the electric fan.

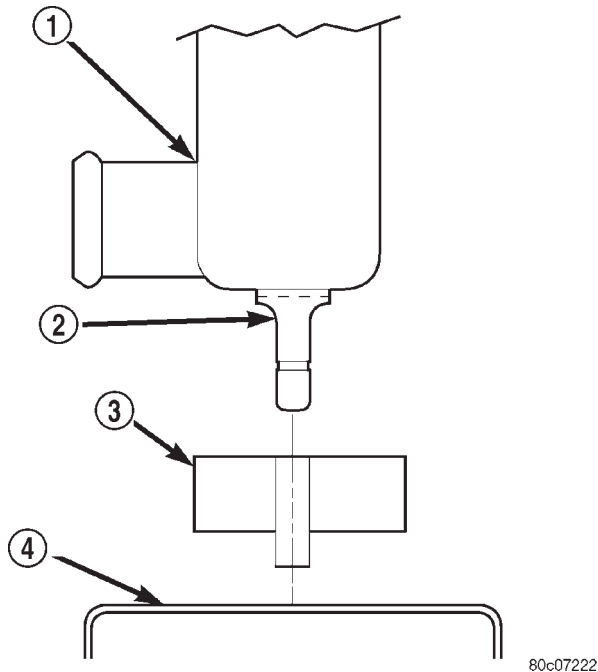
## RADIATOR (Continued)

(8) Disconnect the power steering cooler line from cooler.

(9) Disconnect the radiator upper and lower hoses.

(10) Disconnect the overflow hose from radiator.

(11) The lower part of radiator is equipped with two alignment dowel pins (Fig. 8). They are located on the bottom of radiator tank and fit into rubber grommets. These rubber grommets are pressed into the radiator lower crossmember.



**Fig. 8 Radiator Alignment Dowels - Typical**

- 1 - RADIATOR
- 2 - ALIGNMENT DOWEL
- 3 - RADIATOR LOWER ISOLATOR
- 4 - RADIATOR LOWER CROSSMEMBER

**WARNING: THE AIR CONDITIONING SYSTEM (IF EQUIPPED) IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN, HEATING AND AIR CONDITIONING BEFORE HANDLING ANY AIR CONDITIONING COMPONENT.**

**NOTE: The radiator and radiator cooling fan can be removed as an assembly. It is not necessary to remove the cooling fan before removing or installing the radiator.**

(12) Gently lift up and remove radiator from vehicle. Be careful not to scrape the radiator fins against any other component. Also be careful not to disturb the air conditioning condenser (if equipped).

## CLEANING

Clean radiator fins 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.

## INSPECTION

The radiator cooling fins should be checked for damage or deterioration. Inspect cooling fins to make sure they are not bent or crushed, these areas result in reduced heat exchange causing the cooling system to operate at higher temperatures. Inspect the plastic end tanks for cracks, damage or leaks.

Inspect the radiator neck for damage or distortion.

## INSTALLATION

**CAUTION: Before installing the radiator or A/C condenser, be sure the radiator-to-body and radiator-to-A/C condenser rubber air seals are properly fastened to their original positions. These are used at the top, bottom and sides of the radiator and A/C condenser. To prevent overheating, these seals must be installed to their original positions.**

(1) Gently lower the radiator and fan shroud into the vehicle. Guide the two radiator alignment dowels into the rubber grommets located in lower radiator crossmember.

(2) Connect the radiator upper and lower hoses and hose clamps to radiator.

**CAUTION: The tangs on the hose clamps must be positioned straight down.**

(3) Install coolant reserve/overflow tank hose at radiator.

(4) Connect both transmission cooler lines at the radiator.

(5) Install both radiator mounting bolts.

(6) Reconnect the electric cooling fan.

(7) Install the grill (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION).

(8) Reinstall the cooling fan to the engine.

(9) Rotate the fan blades (by hand) and check for interference at fan shroud.

(10) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

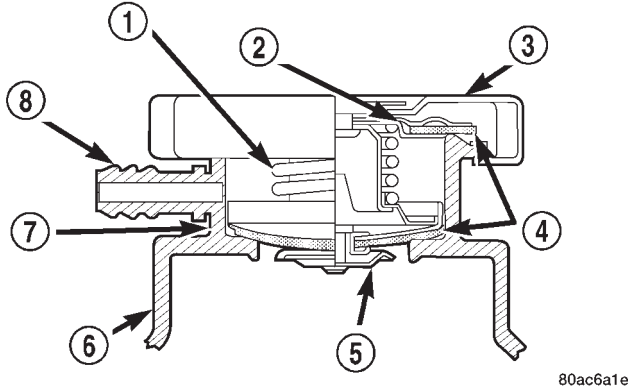
(11) Connect battery cable at battery.

(12) Start and warm engine. Check for leaks.

## RADIATOR PRESSURE CAP

### DESCRIPTION

The cooling system cap is located on the coolant pressure bottle. The cap construction includes; stainless steel swivel top, rubber seals and retainer, main spring, and a spring loaded valve (Fig. 9).



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**Fig. 9 PRESSURE CAP**

- 1 - MAIN SPRING
- 2 - GASKET RETAINER
- 3 - STAINLESS STEEL SWIVEL TOP
- 4 - RUBBER SEALS
- 5 - SPRING LOADED VALVE
- 6 - COOLANT PRESSURE BOTTLE
- 7 - FILLER NECK
- 8 - OVERFLOW NIPPLE

### OPERATION

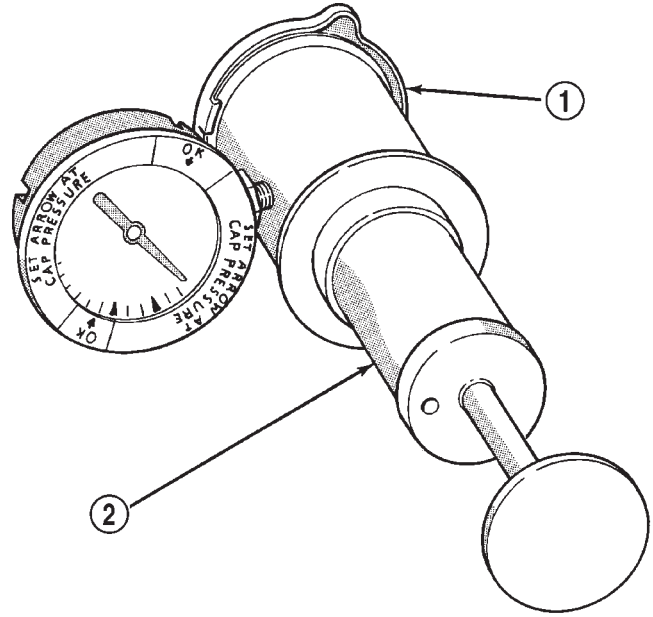
The pressure cap allows the cooling system to operate at higher than atmospheric pressure which raises the coolant boiling point, thus allowing increased radiator cooling capacity. The pressure cap releases pressure at some point within a range of 110 kPa ± 14 kPa (16 psi ± 2 psi).

A spring-loaded vent valve in the center of the cap allows the system to pressurize and depressurize without creating a vacuum. If the valve is stuck open, coolant will escape to the overflow hose. There is also a gasket in the cap to seal to the top of the filler neck.

**CAUTION:** Use only the pressure cap specified for this vehicle. Use of other pressure caps can lead to coolant loss and overheating.

### DIAGNOSIS AND TESTING - RADIATOR PRESSURE CAP

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install the cap on pressure tester (tool 7700 or an equivalent) (Fig. 10).



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**Fig. 10 Pressure Testing Radiator Pressure Cap - Typical**

- 1 - PRESSURE CAP
- 2 - TYPICAL COOLING SYSTEM PRESSURE TESTER

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 124 to 145 kPa (18 to 21 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 124 to 145 kPa (18 to 21 psi) range for 30 seconds or more. If the pointer drops quickly, replace the cap.

**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.

### CLEANING

Clean the radiator pressure cap using a mild soap and water only.

### INSPECTION

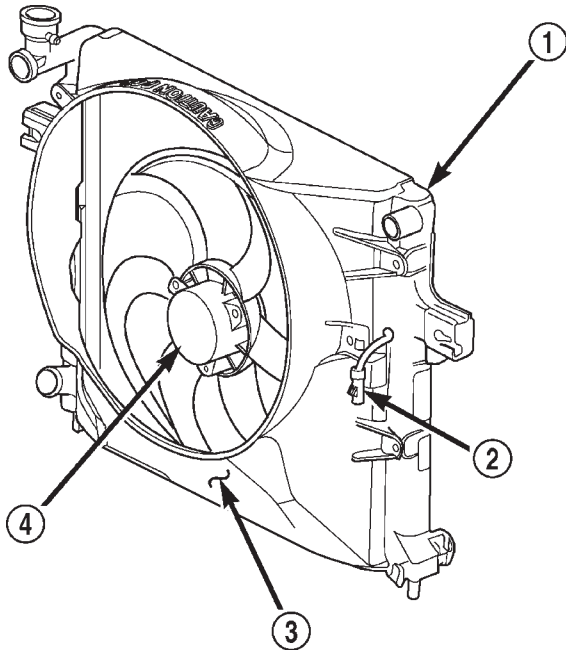
Visually inspect the pressure valve gasket on the cap. Replace cap if the gasket is swollen, torn or worn. Inspect the area around radiator filler neck for white deposits that indicate a leaking cap.



## RADIATOR FAN - ELECTRIC

### DESCRIPTION

The fan (Fig. 11) is electrically controlled by the powertrain control module (PCM) through the fan control relay. This relay is located on the left wheel house in the engine compartment.



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**Fig. 11 Radiator Cooling Fan - Typical**

- 1 - RADIATOR
- 2 - ELECTRIC COOLING FAN CONNECTOR
- 3 - FAN SHROUD
- 4 - ELECTRIC COOLING FAN

### OPERATION

The electric radiator cooling fan is controlled by the Powertrain Control Module (PCM) through the radiator cooling fan relay. The PCM regulates fan operation based on input from the engine coolant temperature sensor, battery temperature sensor, air conditioning select switch and vehicle speed.

The fan is not energized during engine cranking regardless of the electrical input from the temperature sensors and air conditioning switch. However, if engine operation conditions warrant fan engagement, the fan will run once engine starts.

**On vehicles NOT equipped with AC:** The relay is energized when the coolant temperature is above 80° C (176° F), or battery temperature sensor above -12° C (10° F). It will then de-energize when coolant temperature drops below 82° C (180° F), or battery temperature sensor below -9° C (16° F).

**Vehicles Equipped with AC:** In addition to using coolant temperature and battery temperature sensor

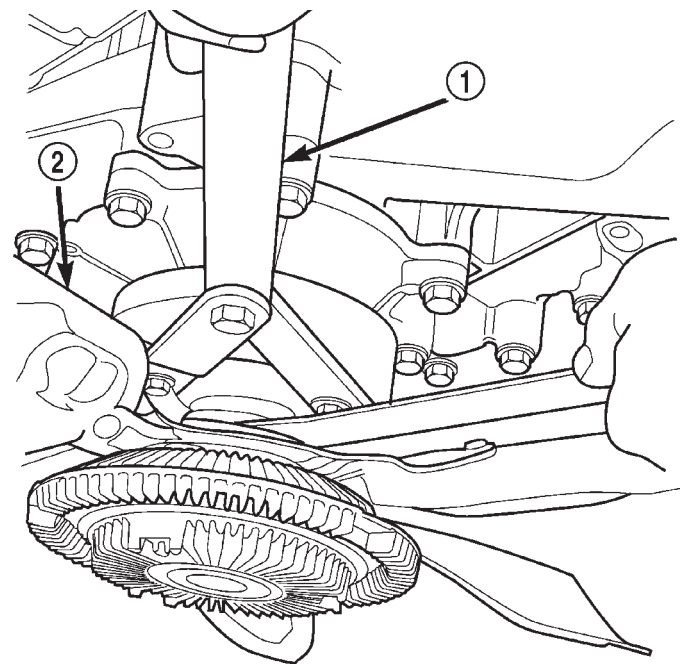
to control cooling fan operation, the cooling fan will also be engaged when the air conditioning system is activated. The relay is also energized when, air conditioning is selected and coolant temperature is above 95° C (203° F), or air conditioning is selected and battery temperature sensor is above 41° C (106° F). It will then de-energize when, air conditioning is selected and coolant temperature is below 92° C (198° F), or air conditioning is selected and battery temperature is below 38° C (100° F).

### REMOVAL

If the fan blade is bent, warped, cracked or damaged in any way, it must be replaced **only** with a replacement fan blade. **Do not attempt to repair a damaged fan blade.**

**NOTE:** For 3.7L Heavy Duty/Max Cool/Trailer Tow cooling package, the viscous fan cannot be removed separate from the shroud. Both fan and shroud must be removed together.

- (1) Disconnect battery negative cable.
- (2) Using special tool 6958 spanner wrench and 8346 adapters, remove the viscous fan from the water pump (Fig. 12).



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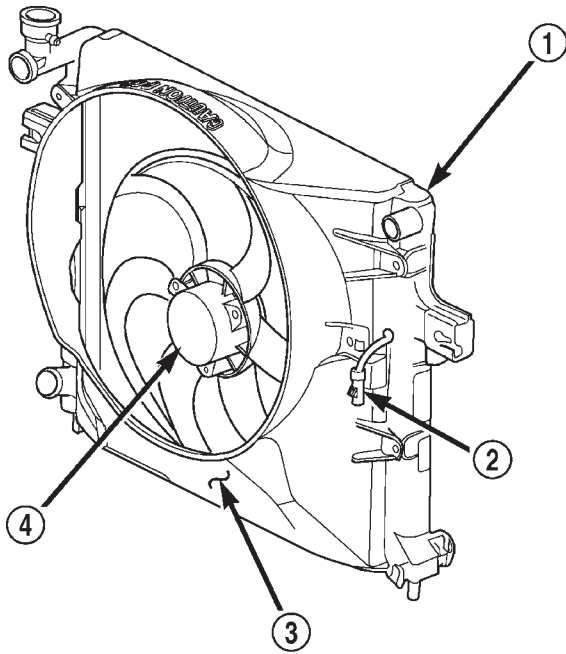
**Fig. 12 Viscous Fan and Fan Drive 3.7L**

- 1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
- 2 - FAN

- (3) Gently lay fan into shroud.
- (4) Disconnect the electrical connector for the electric fan, then disconnect connector from shroud.

RADIATOR FAN - ELECTRIC (Continued)

(5) Remove the two fan shroud mounting bolts connecting the fan shroud to the radiator (Fig. 13).



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**Fig. 13 Radiator Cooling Fan - Typical**

- 1 - RADIATOR
- 2 - ELECTRIC COOLING FAN CONNECTOR
- 3 - FAN SHROUD
- 4 - ELECTRIC COOLING FAN

(6) Remove the shroud and fan from the vehicle.

**INSTALLATION**

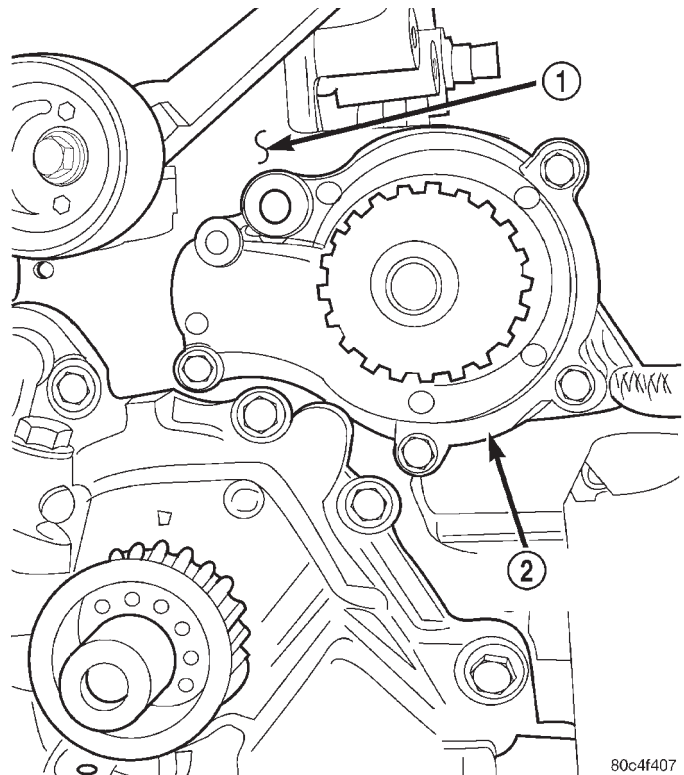
**NOTE:** For 3.7L Heavy Duty/Max Cool/Trailer Tow cooling package, the viscous fan cannot be installed separate from the shroud. Both fan and shroud must be installed together.

- (1) Gently lay viscous fan into shroud.
- (2) Install fan shroud assembly into the vehicle. Tighten fan shroud to radiator bolts to (5.5 N·m (50 in. lbs.)).
- (3) Using special tool 6958 spanner wrench and 8346 adapters, install the viscous fan on the water pump.
- (4) Connect fan motor wire connector to harness connector, and attach connector to shroud.
- (5) Connect battery negative cable.
- (6) Start engine and check fan operation.

**WATER PUMP - 2.4L**

**DESCRIPTION**

The water pump has a cast aluminum body and housing with a stamped steel impeller. The water pump bolts directly to the block (Fig. 14). The cylinder block to water pump seal is provided by a rubber O-ring. The water pump is driven by the engine timing belt.



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**Fig. 14 Water Pump**

- 1 - CYLINDER BLOCK
- 2 - WATER PUMP

**OPERATION**

The water pump is the heart of the cooling system. The coolant is pumped through the engine block, cylinder head, heater core, and radiator.

**REMOVAL - 2.4L ENGINE**

- (1) Disconnect negative cable from battery.
- (2) Raise vehicle on a hoist.
- (3) Remove the accessory drive belts (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
- (4) Remove the belt tensioner.
- (5) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (6) Remove the generator.
- (7) Remove the power steering pump.
- (8) Remove the A/C compressor.

## WATER PUMP - 2.4L (Continued)

(9) Remove the accessory drive bracket.

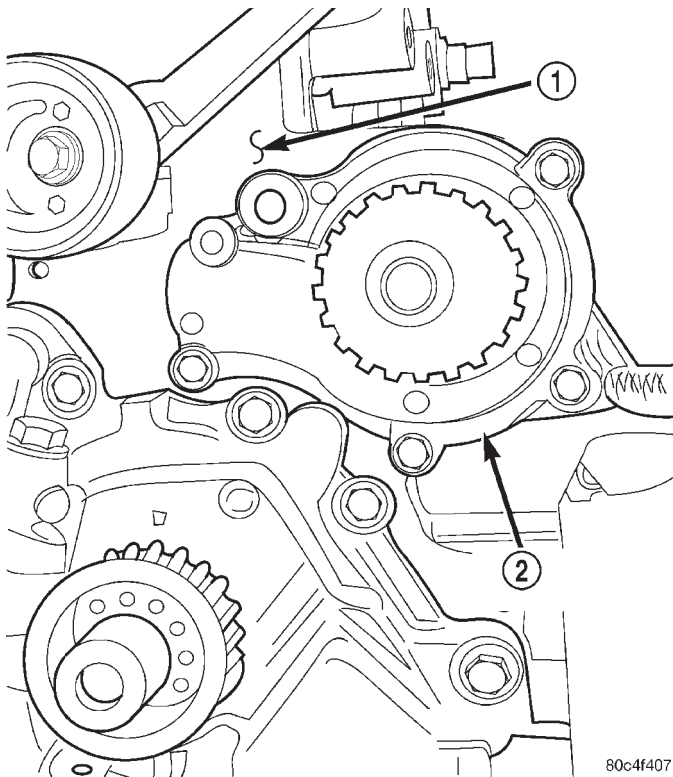
(10) Remove the timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKET(S) - REMOVAL).

(11) Remove timing belt idler pulley.

(12) Hold camshaft sprocket with Special tool C-4687 and adaptor C-4687-1 while removing bolt. Remove both cam sprockets.

(13) Remove the timing belt rear cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT COVER(S) - REMOVAL).

(14) Remove water pump to engine attaching screws (Fig. 15).



**Fig. 15 Water Pump - 2.4L**

- 1 - CYLINDER BLOCK  
2 - WATER PUMP

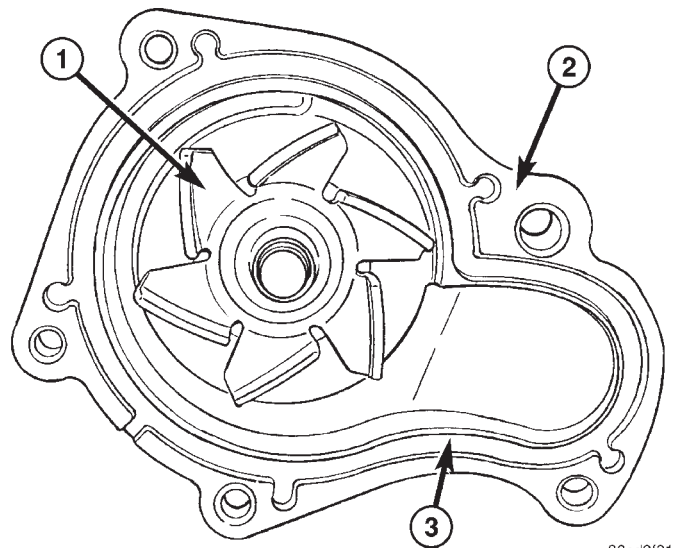
## INSPECTION

Replace water pump body assembly if it has any of these defects:

- (1) Cracks or damage on the body.
- (2) Coolant leaks from the shaft seal, evident by wet coolant traces on the pump body.
- (3) Loose or rough turning bearing.
- (4) Impeller rubs either the pump body or the engine block.
- (5) Impeller loose or damaged.
- (6) Sprocket or sprocket flange loose or damaged.

## INSTALLATION - 2.4L ENGINE

(1) Install new O-ring gasket in water pump body O-ring locating groove (Fig. 16).



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**Fig. 16 Water Pump Body**

- 1 - IMPELLER  
2 - WATER PUMP BODY  
3 - O-RING LOCATING GROOVE

**CAUTION:** Make sure O-ring is properly seated in water pump groove before tightening screws. An improperly located O-ring may be damaged and cause a coolant leak.

(2) Assemble pump body to block and tighten screws to 12 N·m (105 in. lbs.). Pressurize cooling system to 103.4 Kpa (15 psi) with pressure tester and check water pump shaft seal and O-ring for leaks.

(3) Rotate pump by hand to check for freedom of movement.

(4) Install the timing belt rear cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT COVER(S) - INSTALLATION).

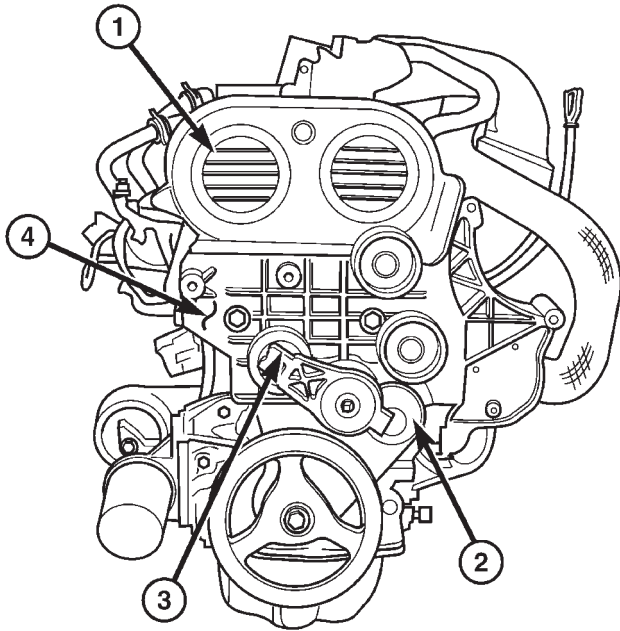
(5) Install camshaft sprockets and target ring. Torque bolts to 101 N·m (75 ft. lbs.) while holding camshaft sprocket with Special tool C-4687 and adaptor C-4687-1.

(6) Install timing belt idler pulley and torque mounting bolt to 61 N·m (45 ft. lbs.).

(7) Install the timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKET(S) - INSTALLATION).

## WATER PUMP - 2.4L (Continued)

(8) Install the accessory drive mounting bracket (Fig. 17).



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**Fig. 17 ACCESSORY DRIVE BRACKET**

- 1- UPPER TIMING BELT COVER
- 2- LOWER TIMING BELT COVER
- 3- BELT TENSIONER
- 4- ACCESSORY DRIVE BRACKET

- (9) Install the power steering pump.
- (10) Install the generator.
- (11) Install the A/C compressor.
- (12) Install the belt tensioner.
- (13) Install the accessory drive belts (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
- (14) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (15) Lower vehicle and connect battery cable.

# TRANSMISSION

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## TRANS COOLER

### DESCRIPTION

An internal high capacity/high efficiency cooler is used on all vehicles, these coolers are an oil-to-coolant type, which consists of plates mounted in the radiator outlet tank. Because the internal oil cooler is so efficient, no auxiliary oil cooler is offered. The cooler is not serviceable separately from the radiator.

### STANDARD PROCEDURE - FLUSHING COOLERS AND TUBES

When a transmission failure has contaminated the fluid, the oil cooler(s) must be flushed. 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-B 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.**

(1) Remove cover plate filler plug on Tool 6906-B. 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-B.
- (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.**

**NOTE: The converter drainback valve must be removed and an appropriate replacement hose installed to bridge the space between the transmission cooler line and the cooler fitting. Failure to remove the drainback valve will prevent reverse flushing the system. A suitable replacement hose can be found in the adapter kit supplied with the flushing tool.**

- (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.
- (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 +4, type 9602, 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.

# AUDIO

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## AUDIO

### DESCRIPTION

An audio system is standard factory-installed equipment on this model. Several combinations of radio receivers and speaker systems are offered on this model. The audio system uses an ignition switched source of battery current so that the system will only operate when the ignition switch is in the RUN or ACCESSORY positions.

The audio system includes the following components:

- Amplifier choke and relay
- Antenna
- Compact disc changer (if equipped)
- Power amplifier mounted to each front door speaker (with premium speaker system only)
  - Radio noise suppression components
  - Radio receiver
  - Remote radio switches (if equipped)
  - Speakers

Certain functions and features of the audio system rely upon resources shared with other electronic modules in the vehicle over the Programmable Communication Interface (PCI) bus network. The data bus network allows the sharing of sensor information. For diagnosis of these electronic modules or of the data bus network, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended.

Refer to the appropriate wiring information for complete standard and premium audio system circuit diagrams. The wiring information includes proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices, and grounds.

### OPERATION

The audio system components are designed to provide audio entertainment and information through the reception, tuning and amplification of locally broadcast radio signals in both the Amplitude Modu-

## AUDIO (Continued)

lating (AM) and Frequency Modulating (FM) commercial frequency ranges.

The audio system components operate on battery current received through a fuse in the Junction Block (JB) on a fused ignition switch output (run-acc) circuit so that the system will only operate when the ignition switch is in the Run or Accessory positions.

On vehicles that are equipped with the optional remote radio switches, the Body Control Module (BCM) receives hard wired resistor multiplexed inputs from the remote radio switches. The programming in the BCM allows it to process those inputs and send the proper messages to the radio receiver over the Programmable Communication Interface (PCI) bus network to control the radio volume up or down, station seek up or down, preset station advance, and mode advance functions.

Refer to the owner's manual for more information on the features, use and operation of each of the available audio systems.

**DIAGNOSIS AND TESTING - AUDIO**

**Any diagnosis of the Audio system should begin with the use of the DRB diagnostic tool.**

**For information on the use of the DRB, refer to the appropriate Diagnostic Service Manual.**

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

AUDIO SYSTEM DIAGNOSIS TABLE

CONDITION	POSSIBLE CAUSES	CORRECTION
NO AUDIO	1. Fuse faulty.	1. Check radio fuse and Ignition-Off Draw (IOD) fuse in Junction Block (JB). Replace fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for shorted or open wires. Repair wiring, if required.
	4. Radio ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Refer to appropriate Diagnostic Service Manual.
	6. Speakers faulty.	6. Replace speaker as necessary.
NO RADIO DISPLAY	1. Fuse faulty.	1. Check radio fuse and Ignition-Off Draw (IOD) fuse in Junction Block (JB). Replace fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Radio ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.

AUDIO (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	5. Radio faulty.	5. Refer to appropriate Diagnostic Service Manual.
CLOCK WILL NOT KEEP SET TIME	1. Fuse faulty.	1. Check Ignition-Off Draw (IOD) fuse in the Junction Block (JB). Replace fuse, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Radio ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Refer to appropriate Diagnostic Service Manual.
POOR RADIO RECEPTION	1. Antenna faulty.	1. (Refer to 8 - ELECTRICAL/AUDIO/ANTENNA BODY & CABLE - DIAGNOSIS AND TESTING).
	2. Radio ground faulty.	2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	3. Radio noise suppression faulty.	3. Repair or replace ground strap as necessary.
	4. Radio faulty.	4. Refer to appropriate Diagnostic Service Manual.
NO/POOR TAPE OPERATION	1. Faulty tape.	1. Insert known good tape and test operation.
	2. Foreign objects behind tape door.	2. Remove foreign objects and test operation.
	3. Dirty cassette tape head.	3. Clean head with Mopar Cassette Head Cleaner.
	4. Faulty tape deck.	4. Exchange or replace radio, if required.
NO COMPACT DISC OPERATION	1. Faulty CD.	1. Insert known good CD and test operation.
	2. Foreign material on CD.	2. Clean CD and test operation.
	3. Condensation on CD or optics.	3. Allow temperature of vehicle interior to stabilize and test operation.
	4. Faulty CD player.	4. Refer to appropriate Diagnostic Service Manual.

## AMPLIFIER CHOKE AND RELAY

### DESCRIPTION

Models equipped with the premium speaker package have a amplifier choke and relay. The amplifier choke and relay is mounted to the lower instrument panel above the accelerator pedal.

The amplifier choke and relay should be checked if there is no sound output from the speakers. The amplifier choke and relay can not be repaired or adjusted and, if faulty or damaged, the unit must be replaced.

### OPERATION

The amplifier choke and relay is used to control the supply of fused battery current to the front door speaker-mounted dual amplifiers. The speaker relay is energized by a fused 12 volt output from the radio receiver whenever the radio is turned on. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.



## AMPLIFIER CHOKE AND RELAY (Continued)

**DIAGNOSIS AND TESTING - AMPLIFIER CHOKE AND RELAY**

**Any diagnosis of the Audio system should begin with the use of the DRB diagnostic tool. For information on the use of the DRB, refer to the appropriate Diagnostic Service Manual.**

The amplifier choke and relay is used to switch power to the individual speaker amplifiers used with the premium speaker package. The amplifier choke and relay is serviced only as a unit. If all of the speakers are inoperative the amplifier choke and relay should be inspected. Before replacement, make the following inspections of the amplifier choke and relay circuits. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Check the fused B(+) 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 fused B(+) fuse in the junction block. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the battery as required.

(3) Disconnect the instrument panel wire harness connector from the amplifier choke and relay. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the junction block fuse as required.

(4) Probe the ground circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. Check for continuity to a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open ground circuit to ground as required.

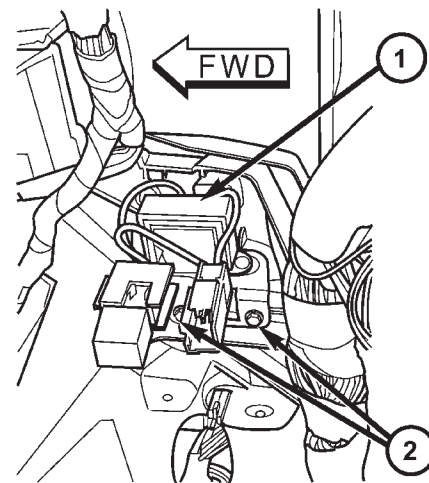
(5) Turn the ignition switch to the RUN position and turn the radio ON. Check for battery voltage at the radio 12-volt output circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. If OK, go to Step 6. If not OK, repair the open radio 12-volt output circuit to the radio as required.

(6) Turn the radio and ignition switches to the OFF position. Reconnect the instrument panel wire harness connector to the amplifier choke and relay. Check for battery voltage at the amplified speaker (+) circuit cavity of the instrument panel wire harness connector for the amplifier choke and relay. 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 open amplified speaker (+) circuits to the speaker-mounted ampli-

ers as required. If not OK, replace the faulty amplifier choke and relay.

**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove knee blocker cover and knee blocker.
- (3) Disconnect the electrical harness connector from the amplifier choke and relay (Fig. 1).



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**Fig. 1 RADIO CHOKE**

- 1 - RADIO CHOKE  
2 - MOUNTING SCREWS

- (4) Remove mounting screws and amplifier choke and relay.

**INSTALLATION**

- (1) Install the amplifier choke and relay.
- (2) Install the mounting screws.
- (3) Connect the electrical harness connector.
- (4) Install knee blocker cover and knee blocker.
- (5) Connect the battery negative cable.

**ANTENNA BODY & CABLE****DESCRIPTION**

The antenna body and cable is secured below the fender panel by the antenna cap nut through a mounting hole in the side of the right front fender. The primary coaxial antenna cable is then routed beneath the fender sheet metal and through a entry hole in the right cowl side panel into the interior of the vehicle. Inside the vehicle, the primary coaxial cable is connected to a secondary instrument panel antenna coaxial cable with an in-line connector that is located behind the right kick panel. The secondary coaxial cable is then routed behind the instrument panel to the back of the radio.

## ANTENNA BODY &amp; CABLE (Continued)

## OPERATION

The antenna body and cable connects the antenna mast to the radio. The radio antenna is an electromagnetic circuit component used to capture radio frequency signals that are broadcast by local commercial radio stations in both the Amplitude Modulating (AM) and Frequency Modulating (FM) frequency ranges. These electromagnetic radio frequency signals induce small electrical modulations into the antenna as they move past the mast. The antenna body transfers the weak electromagnetic radio waves induced into the rigid antenna mast into the center conductor of the flexible primary antenna coaxial cable. The braided outer shield of the antenna coaxial cable is grounded through both the antenna body and the radio chassis, effectively shielding the radio waves as they are conducted to the radio. The radio then tunes and amplifies the weak radio signals into stronger electrical signals in order to operate the audio system speakers.

## DIAGNOSIS AND TESTING - ANTENNA BODY AND CABLE

The following four tests are used to diagnose the antenna with an ohmmeter:

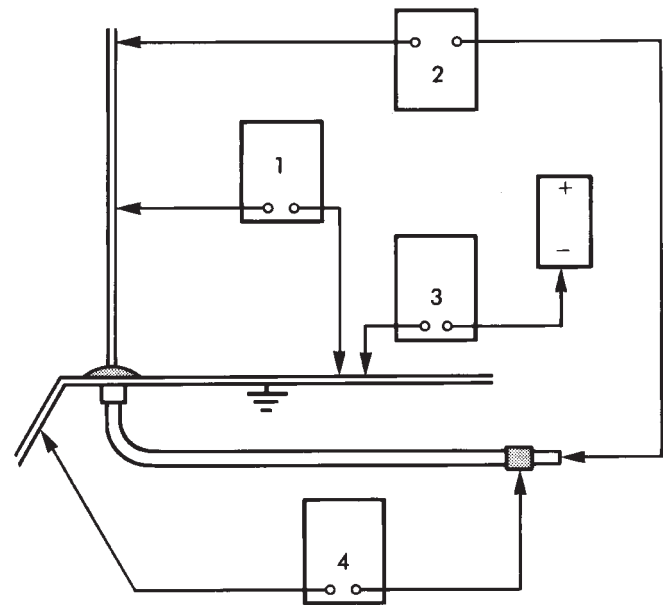
- **Test 1** - Mast to ground test
- **Test 2** - Tip-of-mast to tip-of-conductor test
- **Test 3** - Body ground to battery ground test
- **Test 4** - Body ground to antenna coaxial cable shield test.

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

The ohmmeter test lead connections for each test are shown in the illustration (Fig. 2).

**NOTE:** This model has a two-piece antenna coaxial cable. Tests 2 and 4 must be conducted in two steps to isolate an antenna cable problem. First, test the primary antenna cable (integral to the antenna body and cable) from the coaxial cable connector behind the right side kick panel to the antenna body. Then, test the secondary antenna

cable (instrument panel antenna cable) from the coaxial cable connector behind the right side kick panel to the coaxial cable connector at the radio.



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*Fig. 2 Antenna Tests - Typical*

## TEST 1

Test 1 determines if the antenna mast is insulated from ground. Proceed as follows:

- (1) Disconnect and isolate the antenna coaxial cable connector behind the right side kick panel.
- (2) Touch one ohmmeter test lead to the tip of the antenna mast. Touch the other test lead to known ground. Check the ohmmeter reading for continuity.
- (3) There should be no continuity. If OK, go to Test 2. If not OK, replace the faulty antenna body and cable.

## TEST 2

Test 2 checks the antenna conductor components for an open circuit. This test should be performed first on the entire antenna circuit, from the antenna mast to the center conductor of the coaxial cable connector at the radio. If an open circuit is detected, each of the three antenna conductor components (antenna mast, antenna body and cable, instrument panel antenna cable) should be isolated and tested individually to locate the exact component that is the source of the open circuit. To begin this test, proceed as follows:

- (1) Disconnect the instrument panel antenna cable coaxial connector from the back of the radio.
- (2) Touch one ohmmeter test lead to the tip of the antenna mast. Touch the other test lead to the center conductor pin of the instrument panel antenna cable coaxial connector for the radio. Check the ohmmeter reading for continuity.

## ANTENNA BODY &amp; CABLE (Continued)

(3) There should be continuity. The ohmmeter should register only a fraction of an ohm resistance. High or infinite resistance indicates a damaged or open antenna conductor. If OK, go to Test 3. If not OK, isolate and test each of the individual antenna conductor components. Replace only the faulty antenna conductor component.

## TEST 3

Test 3 checks the condition of the vehicle body ground connection. To begin this test, proceed as follows:

(1) This test must be performed with the battery positive cable disconnected from the battery. Disconnect and isolate both battery cables, negative cable first.

(2) Reconnect the battery negative cable.

(3) Touch one ohmmeter test lead to a good clean ground point on the vehicle fender. Touch the other test lead to the battery negative terminal post. Check the ohmmeter reading for continuity.

(4) There should be continuity. The ohmmeter should register less than one ohm resistance. High or infinite resistance indicates a loose, corroded, or damaged connection between the battery negative terminal and the vehicle body. If OK, go to Test 4. If not OK, check the battery negative cable connection to the vehicle body and the radio noise suppression ground strap connections to the engine and the vehicle body for being loose or corroded. Clean or tighten these connections as required.

## TEST 4

Test 4 checks the condition of the connection between the antenna coaxial cable shield and the vehicle body ground as follows:

(1) Disconnect and isolate the antenna coaxial cable connector behind the right side kick panel.

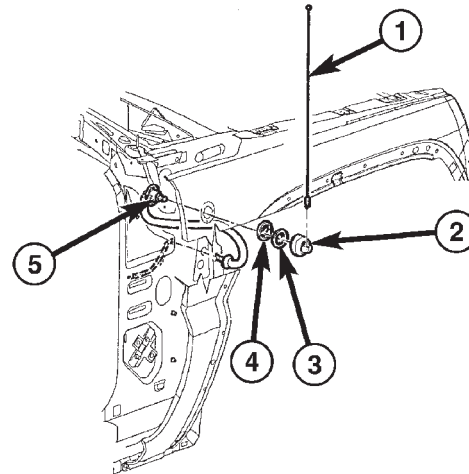
(2) Touch one ohmmeter test lead to a good clean ground point on the vehicle fender. Touch the other test lead to the outer crimp on the antenna coaxial cable connector. Check the ohmmeter reading for continuity.

(3) There should be continuity. The ohmmeter should register less than one ohm resistance. High or infinite resistance indicates a loose, corroded, or damaged connection between the antenna body and the vehicle body or between the antenna body and the antenna coaxial cable shield. If not OK, clean the antenna body to fender mating surfaces and tighten the antenna cap nut to specifications.

(4) Check the resistance again with an ohmmeter. If the resistance is still more than one ohm, replace the faulty antenna body and cable.

## REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the antenna mast.
- (3) Remove cover (Fig. 3).



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**Fig. 3 ANTENNA BODY AND CABLE**

- 1 - ANTENNA MAST
- 2 - ANTENNA COVER
- 3 - ANTENNA BASE MOUNTING NUT
- 4 - ANTENNA BEZEL ADAPTER
- 5 - ANTENNA BODY AND CABLE

- (4) Remove mounting nut.
- (5) Remove bezel adapter.
- (6) Remove right kick panel trim.
- (7) Disconnect antenna body and cable from the instrument panel cable. Attach a wire or string (approximately 2 feet in length) to the cable to aid in installation of the new cable.
- (8) Remove the upper fender mounting bolts. Loosen the two fender mounting bolts located near the upper door hinge (Refer to 23 - BODY/EXTERIOR/FRONT FENDER - REMOVAL).
- (9) Carefully pull fender out to access the antenna body and cable. Pull cable up through the opening with wire attached.

## INSTALLATION

- (1) Attached wire to new cable. Pull fender out and insert cable into opening.
- (2) Pull cable through hole in kick panel area using the attached wire.
- (3) Connect antenna body cable to the instrument panel cable.
- (4) Install right kick panel trim.
- (5) Install bezel adapter.
- (6) Install mounting nut. Tighten to 12 N·m (105 in. lbs.).
- (7) Install cover.

## ANTENNA BODY & CABLE (Continued)

- (8) Install antenna mast.
- (9) Tighten fender mounting bolts near door hinge area.
- (10) Install and tighten the upper fender mounting bolts (Refer to 23 - BODY/EXTERIOR/FRONT FENDER - INSTALLATION).
- (11) Connect the battery negative cable.

## CD CHANGER

### DESCRIPTION

A factory-installed Compact Disc (CD) changer featuring a six-CD magazine is an available option on this model. The CD changer is mounted in the cargo area of the passenger compartment on the right rear quarter panel.

The controls on the radio receiver operate the CD changer through messages sent over the Programmable Communications Interface (PCI) data bus network. For diagnosis of the messaging functions of the radio receiver and the CD changer, or of the PCI data bus, a DRB scan tool and the proper Diagnostic Procedures manual are required.

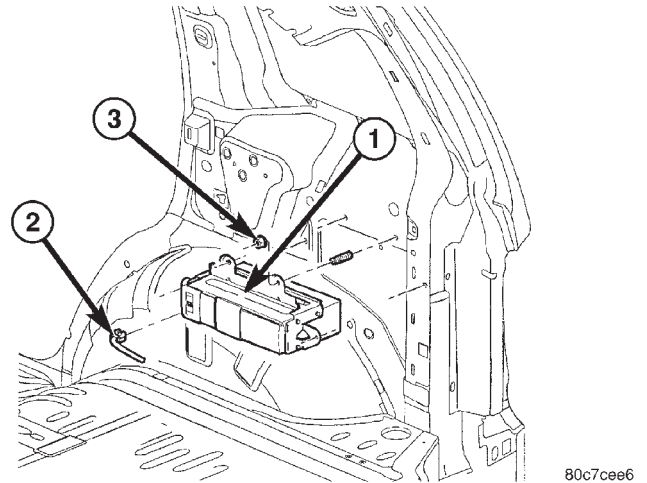
The CD changer can only be serviced by an authorized radio repair station. See the latest Warranty Policies and Procedures manual for a current listing of authorized radio repair stations. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

### OPERATION

The CD changer will only operate when the ignition switch is in the On or Accessory positions, and the radio is turned on. The six-CD magazine may be ejected with the ignition in the Off position. For more information on the features, loading procedures and radio control functions for the operation of the CD changer, refer to the owner's manual.

### REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the right rear quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).
- (3) Disconnect the electrical wire harness connector (Fig. 4).
- (4) Remove the mounting nuts.
- (5) Remove the CD Changer from the vehicle.



**Fig. 4 CD CHANGER**

- 1 - CD CHANGER
- 2 - WIRE HARNESS CONNECTOR
- 3 - MOUNTING NUT

### INSTALLATION

- (1) Install the CD Changer to the vehicle.
- (2) Install the mounting nuts. Tighten to 11.8 N·m (104 in. lbs.).
- (3) Connect the wire harness connector.
- (4) Install the right rear quarter trim panel (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).
- (5) Connect the battery negative cable.

## INSTRUMENT PANEL ANTENNA CABLE

### REMOVAL

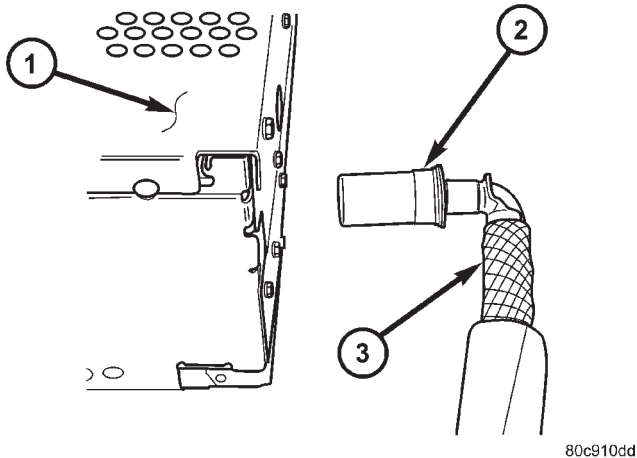
**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.

## INSTRUMENT PANEL ANTENNA CABLE (Continued)

(2) Remove the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(3) Disconnect the antenna cable from radio by pulling the locking antenna connector away from radio (Fig. 5).

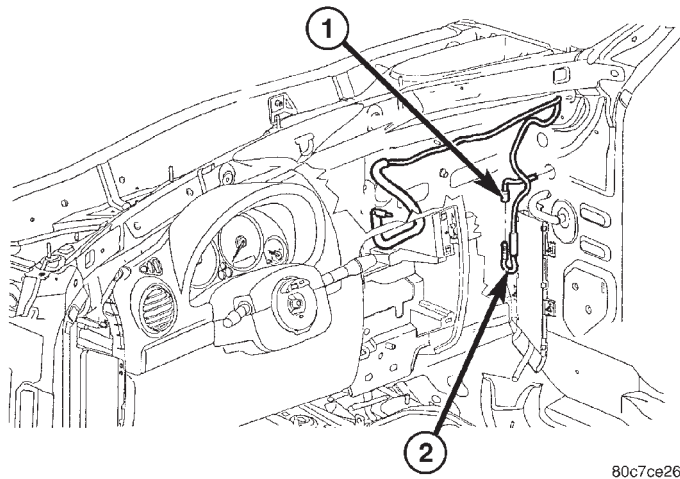


80c910dd

**Fig. 5 ANTENNA TO RADIO**

- 1 - RADIO  
2 - LOCKING ANTENNA CONNECTOR  
3 - INSTRUMENT PANEL ANTENNA CABLE

(4) Disengage each of the retainers that secure the cable to the instrument panel (Fig. 6).



80c7ce26

**Fig. 6 INSTRUMENT PANEL ANTENNA CABLE**

- 1 - INSTRUMENT PANEL ANTENNA CABLE  
2 - ANTENNA BODY AND CABLE

(5) Remove the cable from the instrument panel.

## INSTALLATION

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL,**

**STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the instrument panel antenna cable onto the instrument panel.

(2) Engage each of the retainers that secure the cable to the back side of the instrument panel.

(3) Connect cable to radio.

(4) Install instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Connect the battery negative cable.

## RADIO

## DESCRIPTION

Available factory-installed radio receivers for this model include an AM/FM/cassette with CD changer control feature (RBB sales code), an AM/FM/cassette/CD/graphic equalizer with CD changer control feature (RBP sales code), or an AM/FM/CD/ with CD changer control feature (RBK sales code). All factory-installed radio receivers can communicate on the Programmable Communications Interface (PCI) data bus network. All factory-installed receivers are stereo Electronically Tuned Radios (ETR) and include an electronic digital clock function.

These radio receivers can only be serviced by an authorized radio repair station. See the latest Warranty Policies and Procedures manual for a current listing of authorized radio repair stations.

## OPERATION

The radio receiver operates on ignition switched battery current that is available only when the ignition switch is in the On or Accessory positions. The electronic digital clock function of the radio operates on fused battery current supplied through the IOD fuse, regardless of the ignition switch position.

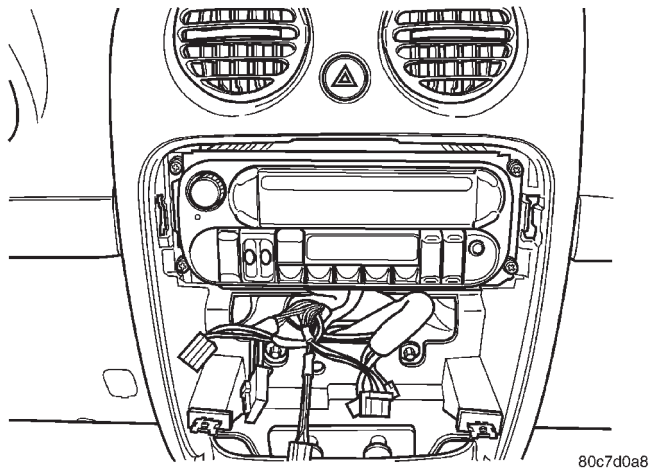
For more information on the features, setting procedures, and control functions for each of the available factory-installed radio receivers, refer to the owner's manual. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire har-

RADIO (Continued)

ness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

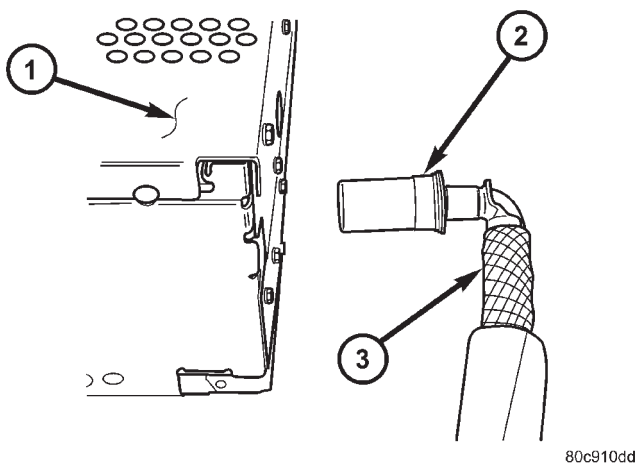
**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the instrument panel center trim panel.
- (3) Remove the radio mounting screws (Fig. 7).



**Fig. 7 RADIO**

- (4) Disconnect the antenna cable by pulling the locking antenna connector away from the radio (Fig. 8).



**Fig. 8 ANTENNA TO RADIO**

- 1 - RADIO
- 2 - LOCKING ANTENNA CONNECTOR
- 3 - INSTRUMENT PANEL ANTENNA CABLE

- (5) Disconnect the electrical harness connector(s).
- (6) Remove radio from instrument panel.

**INSTALLATION**

- (1) Connect the wire harness connector(s).
- (2) Connect the antenna cable.
- (3) Install the radio to the instrument panel.
- (4) Install the radio mounting screws.
- (5) Install the instrument panel center trim panel.
- (6) Connect the battery negative cable.

**RADIO NOISE SUPPRESSION GROUND STRAP**

**DESCRIPTION**

Radio noise suppression devices are factory-installed standard equipment on this vehicle. Radio Frequency Interference (RFI) and ElectroMagnetic Interference (EMI) can be produced by any on-board or external source of electromagnetic energy. These electromagnetic energy sources can radiate electromagnetic signals through the air, or conduct them through the vehicle electrical system.

When the audio system converts RFI or EMI to an audible acoustic wave form, it is referred to as radio noise. This undesirable radio noise is generally manifested in the form of "buzzing," "hissing," "popping," "clicking," "crackling," and/or "whirring" sounds. In most cases, RFI and EMI radio noise can be suppressed using a combination of vehicle and component grounding, filtering and shielding techniques. This vehicle is equipped with factory-installed radio noise suppression devices that were designed to minimize exposure to typical sources of RFI and EMI; thereby, minimizing radio noise complaints.

Factory-installed radio noise suppression is accomplished primarily through circuitry or devices that are integral to the factory-installed radios, audio power amplifiers and other on-board electrical components such as generators, wiper motors, blower motors, and fuel pumps that have been found to be potential sources of RFI or EMI. External radio noise suppression devices that are used on this vehicle to control RFI or EMI, and can be serviced, include the following:

- **Engine-to-body ground strap** - This length of braided ground strap has an eyelet terminal connector crimped to each end. One end is secured to the engine cylinder head(s). The other is secured to the plenum.

- **Resistor-type spark plugs** - This type of spark plug has an internal resistor connected in series between the spark plug terminal and the center electrode to help reduce the production of electromagnetic radiation that can result in radio noise.

## RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

## OPERATION

There are two common strategies that can be used to suppress Radio Frequency Interference (RFI) and ElectroMagnetic Interference (EMI) radio noise. The first suppression strategy involves preventing the production of RFI and EMI electromagnetic signals at their sources. The second suppression strategy involves preventing the reception of RFI and EMI electromagnetic signals by the audio system components.

The use of braided ground straps in key locations is part of the RFI and EMI prevention strategy. These ground straps ensure adequate ground paths, particularly for high current components such as many of those found in the starting, charging, ignition, engine control and transmission control systems. An insufficient ground path for any of these high current components may result in radio noise caused by induced voltages created as the high current seeks alternative ground paths through components or circuits intended for use by, or in close proximity to the audio system components or circuits.

Preventing the reception of RFI and EMI is accomplished by ensuring that the audio system components are correctly installed in the vehicle. Loose, corroded or improperly soldered wire harness connections, improperly routed wiring and inadequate audio system component grounding can all contribute to the reception of RFI and EMI. A properly grounded antenna body and radio chassis, as well as a shielded antenna coaxial cable with clean and tight connections will each help reduce the potential for reception of RFI and EMI.

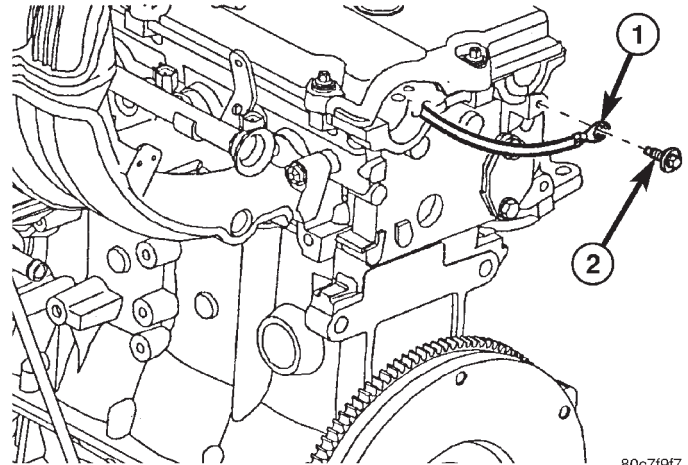
## REMOVAL

## 2.4L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the retaining bolt from the engine cylinder head (Fig. 9).

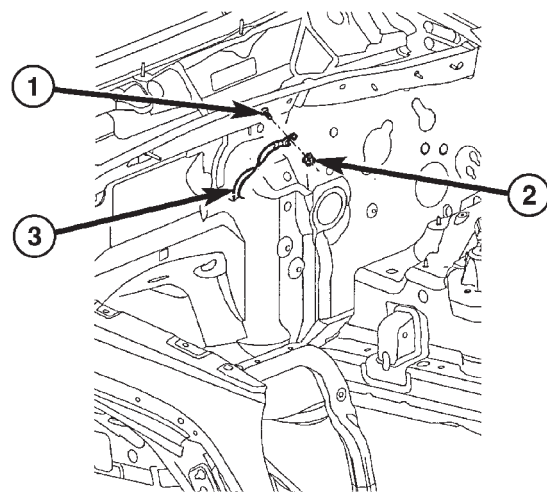
(3) Remove the retaining nut from the plenum (Fig. 10).



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**Fig. 9 GROUND STRAP TO ENGINE - 2.4L**

- 1 - GROUND STRAP  
2 - BOLT



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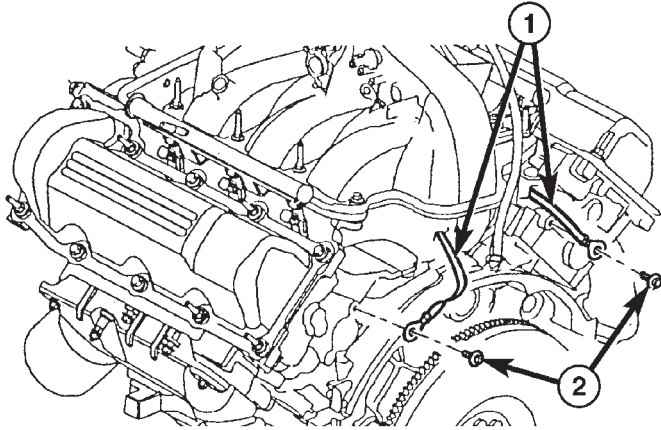
**Fig. 10 GROUND STRAP TO PLENUM - 2.4L**

- 1 - PLENUM  
2 - RETAINING NUT  
3 - GROUND STRAP

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

**3.7L ENGINE**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the retaining bolts from the engine cylinder heads (Fig. 11).

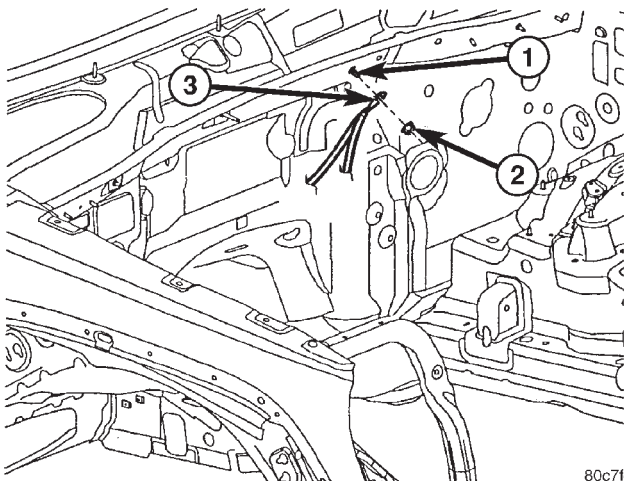


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**Fig. 11 GROUND STRAP TO ENGINE - 3.7L**

- 1 - GROUND STRAP
- 2 - RETAINING BOLTS

- (3) Remove the retaining nut from the plenum (Fig. 12).



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**Fig. 12 GROUND STRAP TO PLENUM - 3.7L**

- 1 - PLENUM
- 2 - RETAINING NUT
- 3 - GROUND STRAP

**INSTALLATION**

**2.4L ENGINE**

- (1) Install the retaining nut and ground strap to the plenum. Tighten to 12 N·m (106 in. lbs.).

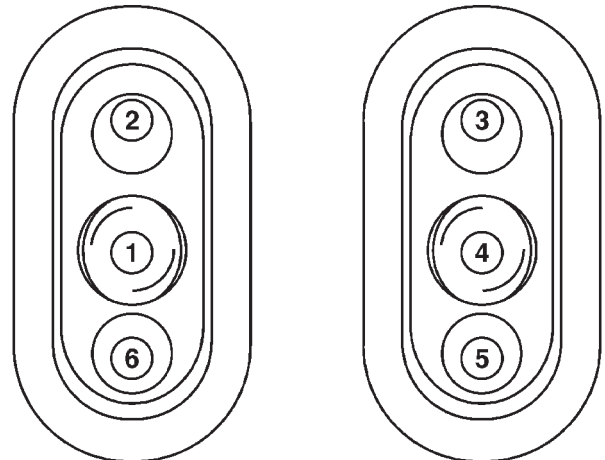
- (2) Install the retaining bolt and ground strap to the engine cylinder head. Tighten to 12 N·m (106 in. lbs.).
- (3) Connect the battery negative cable.

**3.7L ENGINE**

- (1) Install the retaining nut and ground strap to the plenum. Tighten to 12 N·m (106 in. lbs.).
- (2) Install the retaining bolts and ground strap to the engine cylinder heads. Tighten to 12 N·m (106 in. lbs.).
- (3) Connect the battery negative cable.

**REMOTE SWITCHES**

**DESCRIPTION**



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**Fig. 13 Remote Radio Switch Operational View**

- 1 - PRESET SEEK
- 2 - SEEK UP
- 3 - VOLUME UP
- 4 - MODE
- 5 - VOLUME DOWN
- 6 - SEEK DOWN

A remote radio control switch option is available on some models. Two rocker-type switches are mounted on the back (instrument panel side) of the steering wheel spokes (Fig. 13). The switch on the left spoke is the seek switch and has seek up, seek down, and preset station advance functions. The switch on the right spoke is the volume control switch and has volume up, and volume down functions. The switch on the right spoke also includes a “mode” control that allows the driver to sequentially select AM radio, FM radio, cassette player, CD player or CD changer (if equipped).



## REMOTE SWITCHES (Continued)

## OPERATION

The six switches in the two remote radio switch units are normally open, resistor multiplexed momentary switches that are hard wired to the Body Control Module (BCM) through the clockspring. The BCM sends a five volt reference signal to both switch units on one circuit, and senses the status of all of the switches by reading the voltage drop on a second circuit.

When the BCM senses an input (voltage drop) from any one of the remote radio switches, it sends the proper switch status messages on the Programmable Communication Interface (PCI) data bus network to the radio receiver. The electronic circuitry within the radio receiver is programmed to respond to these remote radio switch status messages by adjusting the radio settings as requested. For diagnosis of the BCM or the PCI data bus, the use of a DRB scan tool and the proper Diagnostic Procedures manual are recommended.

For more information on the features and control functions for each of the remote radio switches, refer to the owner's manual.

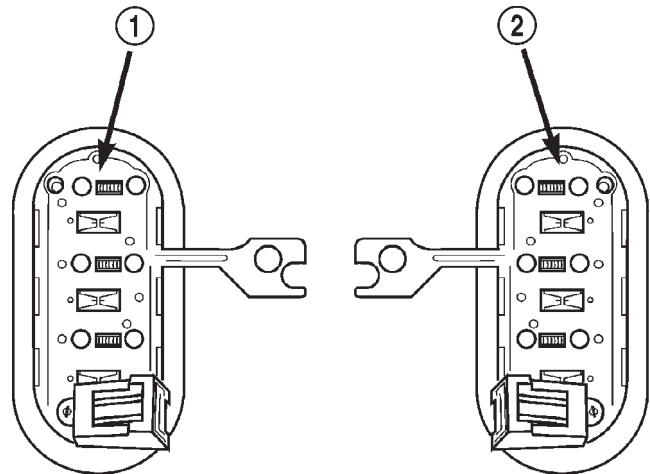
## DIAGNOSIS AND TESTING - REMOTE SWITCHES

**Any diagnosis of the Audio system should begin with the use of the DRB diagnostic tool. For information on the use of the DRB, refer to the appropriate Diagnostic Service Manual.**

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. 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 remote radio switch(es) (Fig. 14) from the steering wheel (Refer to 8 - ELECTRICAL/AUDIO/REMOTE SWITCHES - REMOVAL).



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**Fig. 14 Remote Radio Switches**

- 1 - BLACK (LEFT) SWITCH  
2 - WHITE (RIGHT) SWITCH

(2) Use an ohmmeter to check the switch resistances as shown in the Remote Radio Switch Test chart. If the remote radio switch resistances check OK, go to Step 3. If not OK, replace the faulty switch.

## REMOTE RADIO SWITCH TEST TABLE

Switch	Switch Position	Resistance
Right (White)	Volume Up	1.210 Kilohms $\pm$ 1%
Right (White)	Volume Down	3.010 Kilohms $\pm$ 1%
Right (White)	Mode Advance	0.0511 Kilohms $\pm$ 1%
Left (Black)	Seek Up	0.261 Kilohms $\pm$ 1%
Left (Black)	Seek Down	0.681 Kilohms $\pm$ 1%
Left (Black)	Pre-Set Station Advance	0.162 Kilohms $\pm$ 1%

(3) Reconnect the battery negative cable. Turn the ignition switch to the On position. Check for 5 volts at the radio control mux circuit cavities of the steering wheel wire harness connectors for both remote radio switches. If OK, go to Step 4. If not OK, repair the open or shorted radio control mux circuit to the Body Control Module (BCM) as required.

(4) Disconnect and isolate the battery negative cable. Disconnect the 22-way instrument panel wire harness connector from the BCM. Check for continuity between the remote radio switch ground circuit cavities of the steering wheel wire harness connectors for both remote radio switches and a good

## REMOTE SWITCHES (Continued)

ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted remote radio switch ground circuit to the BCM as required.

(5) Check for continuity between the remote radio switch ground circuit cavities of the steering wheel wire harness connectors for both remote radio switches and the 22-way instrument panel wire harness connector for the BCM. There should be continuity. If OK, refer to the proper Diagnostic Procedures manual to test the BCM and the PCI data bus. If not OK, repair the open remote radio switch ground circuit as required.

## REMOVAL

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. 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 driver side airbag module from the vehicle (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Remove the cruise control switches (Fig. 15).

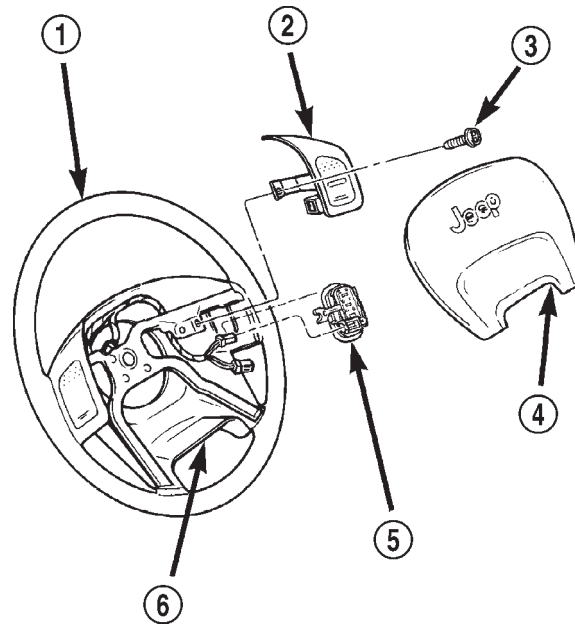
(4) Unplug the wire harness connector from the remote radio switch(es).

(5) Depress the tabs on each side of each switch and push the switch through the rear steering wheel cover.

## INSTALLATION

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Install remote radio switch to the steering wheel.



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Fig. 15 REMOTE SWITCH

- 1 - STEERING WHEEL
- 2 - SPEED CONTROL SWITCH
- 3 - SCREW
- 4 - DRIVER SIDE AIRBAG MODULE
- 5 - REMOTE RADIO SWITCH
- 6 - REAR TRIM COVER

(2) Connect the wire harness to the remote radio switch.

(3) Install the cruise control switches.

(4) Install the driver side airbag module (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

(5) Connect the battery negative cable.

## SPEAKER

## DESCRIPTION

## STANDARD

The standard equipment speaker system includes speakers in six locations. One 6.4 centimeter (2.50 inch) diameter speaker is installed on each end of the instrument panel top pad. One 16.5 centimeter (6.5 inch) full-range speaker is located in each front door. There is also one full-range 16.5 centimeter (6.5 inch) diameter full-range speaker located in each rear door.

## PREMIUM

The optional premium speaker system features six Premium model speakers in six locations. Each of the standard speakers is replaced with Premium model speakers. One 6.4 centimeter (2.50 inch) diameter

## SPEAKER (Continued)

speaker is installed on each end of the instrument panel top pad. One 16.5 centimeter (6.5 inch) Premium woofer is located in each front door. There is also one full-range 16.5 centimeter (6.5 inch) diameter Premium full-range speaker located in each rear door. The premium speaker system also includes a power amplifier mounted to each front door speaker. The total available power of the premium speaker system is about 160 watts.

## OPERATION

Two wires connected to each speaker, one feed circuit (+) and one return circuit (-), allow the audio output signal electrical current to flow through the voice coil. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

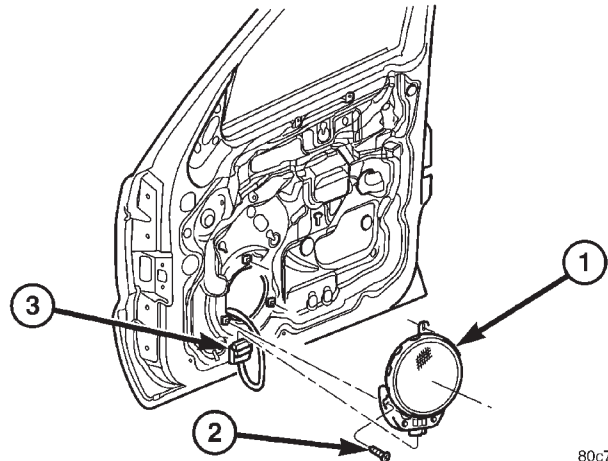
## REMOVAL

## FRONT DOOR

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the front door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).
- (3) Remove the speaker mounting screws (Fig. 16).
- (4) Remove the speaker from the door and disconnect the wire harness connector.

## INSTRUMENT PANEL

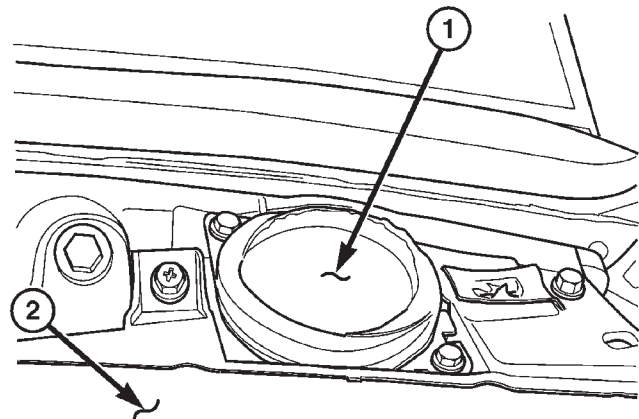
- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the A-pillar trim (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - REMOVAL).
- (3) Remove instrument panel top cover (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL).
- (4) Remove speaker mounting screws (Fig. 17).
- (5) Remove speaker and disconnect the wire harness connector.



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**Fig. 16 FRONT DOOR SPEAKER**

- 1 - FRONT DOOR SPEAKER
- 2 - MOUNTING SCREW
- 3 - WIRE HARNESS CONNECTOR



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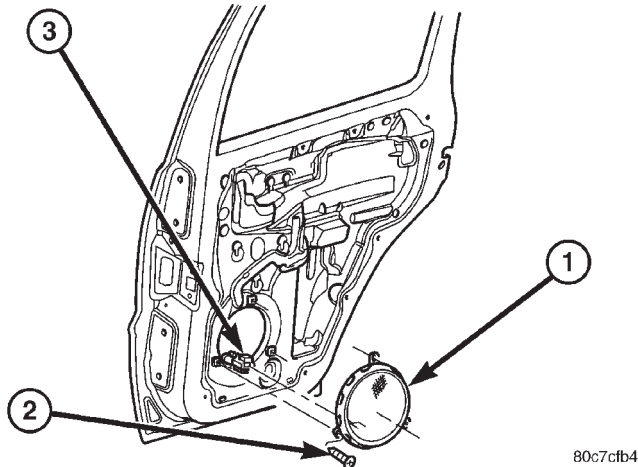
**Fig. 17 INSTRUMENT PANEL SPEAKER**

- 1 - INSTRUMENT PANEL SPEAKER
- 2 - INSTRUMENT PANEL

SPEAKER (Continued)

**REAR DOOR**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the rear door trim panel (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL).
- (3) Remove the speaker mounting screws (Fig. 18).



**Fig. 18 REAR DOOR SPEAKER**

- 1 - REAR DOOR SPEAKER
- 2 - MOUNTING SCREW
- 3 - WIRE HARNESS CONNECTOR

- (4) Remove the speaker from the door and disconnect the wire harness connector.

**INSTALLATION**

**FRONT DOOR**

- (1) Connect the wire harness connector and install the speaker to the door.
- (2) Install the speaker mounting screws. Tighten to 2 N·m (20 in. lbs.).
- (3) Install the front door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).
- (4) Connect the battery negative cable.

**INSTRUMENT PANEL**

- (1) Connect wire harness connector and install speaker.
- (2) Install speaker mounting screws. Tighten to 2 N·m (20 in. lbs.).
- (3) Install instrument panel top cover (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION).
- (4) Install the A-pillar trim (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION).
- (5) Connect the battery negative cable.

**REAR DOOR**

- (1) Connect the wire harness connector and install the speaker to the door.
- (2) Install the speaker mounting screws. Tighten to 2 N·m (20 in. lbs.).
- (3) Install the rear door trim panel (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION).
- (4) Connect the battery negative cable.



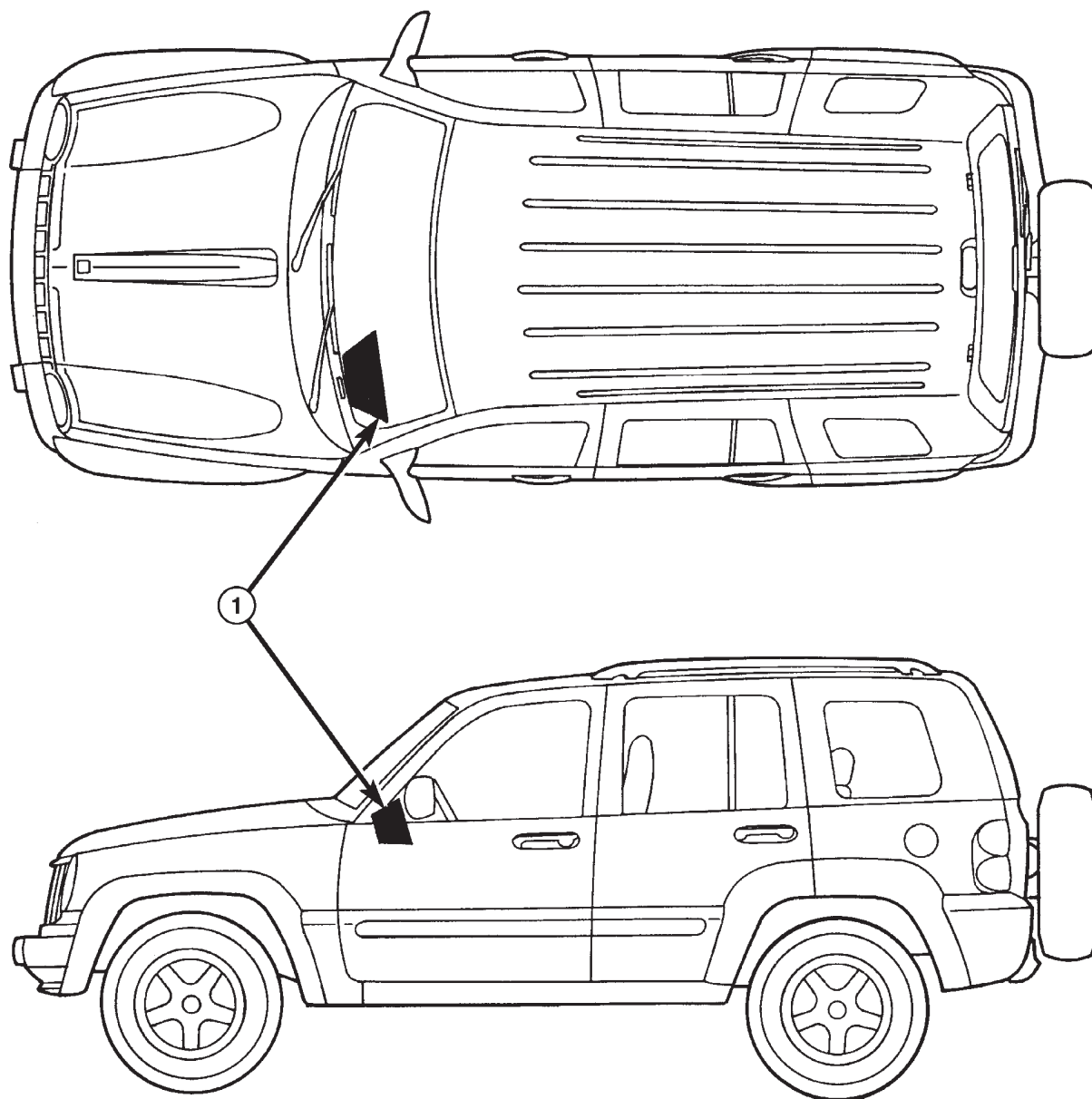
# CHIME/BUZZER

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DESCRIPTION .....	1	WARNING SYSTEM .....	6
OPERATION .....	2		

## CHIME WARNING SYSTEM

### DESCRIPTION



**Fig. 1 Chime Warning System**

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## CHIME WARNING SYSTEM (Continued)

A chime warning system is standard factory-installed equipment on this model. The chime warning system uses a single chime tone generator that is soldered onto the electronic circuit board that is integral to the ElectroMechanical Instrument Cluster (EMIC) to provide an audible indication of various vehicle conditions that may require the attention of the vehicle operator or occupants (Fig. 1). The microprocessor-based EMIC utilizes electronic chime request messages received from other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network along with hard wired inputs to the cluster microprocessor to monitor many sensors and switches throughout the vehicle. In response to those inputs, the integrated circuitry and internal programming of the EMIC allow it to control audible outputs that are produced through its on-board chime tone generator.

The EMIC circuitry and its chime tone generator are capable of producing each of the four following audible outputs:

- **Fixed Duration Beep** - A short, sharp, single tactile “beep-like” tone that is about 150 milliseconds in duration.
- **Single Chime Tone** - A single “bong-like” chime tone.
- **Slow Rate Repetitive Chime** - Repeated chime tones that are issued at a slow rate of about 50 “bong-like” tones per minute.
- **Fast Rate Repetitive Chime** - Repeated chime tones that are issued at a fast rate of about 180 “bong-like” tones per minute.

Hard wired circuitry connects the EMIC and the various chime warning system switch and sensor inputs to their electronic modules and to each other through the electrical system of the vehicle. These hard wired circuits are integral to numerous wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the chime warning system through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

The EMIC chime warning system circuitry and integral chime tone generator cannot be adjusted or repaired. If the EMIC or the chime tone generator are damaged or faulty, the EMIC unit must be replaced.

## OPERATION

The chime warning system is designed to provide an audible output as an indication of various conditions that may require the attention or awareness of the vehicle operator or occupants. The chime warning system components operate on battery current received through a fused B(+) fuse in the Junction Block (JB) on a non-switched fused B(+) circuit so that the system may operate regardless of the ignition switch position. However, the chime warning system also monitors the ignition switch position so that some chime features will only occur with ignition switch in the On position, while others occur regardless of the ignition switch position.

The chime warning system provides an audible indication to the vehicle operator or occupants under the following conditions:

- **Airbag Indicator Warning** - The ElectroMechanical Instrument Cluster (EMIC) chime tone generator will generate one, short, “bong-like” chime tone when the ignition switch is in the On position, and an electronic message is received over the Programmable Communications Interface (PCI) data bus from the Airbag Control Module (ACM) requesting “Airbag” indicator illumination. This warning will only occur following completion of the “Airbag” indicator bulb test, and will only occur once during an ignition cycle. The ACM uses internal programming, hard wired inputs from the front Supplemental Restraint System (SRS) components and, on vehicles so equipped, electronic messages received over the PCI data bus from each Side Impact Airbag Control Module (SIACM) to determine the proper “Airbag” indicator messages to send to the EMIC.

- **Anti-Lock Brake Indicator Warning** - The EMIC chime tone generator will generate one, short, “bong-like” chime tone when the ignition switch is in the On position, and an electronic message is received over the PCI data bus from the Controller Anti-lock Brake (CAB) requesting “Antilock Brake System (ABS)” indicator illumination. This warning will only occur following completion of the “ABS” indicator bulb test, and will only occur once during an ignition cycle. The CAB uses internal programming, hard wired inputs from the Antilock Brake System (ABS) components, and electronic messages received over the PCI data bus from the Powertrain Control Module (PCM) to determine the proper “ABS” indicator messages to send to the EMIC.

- **Compass Mini-Trip Computer Reset** - The EMIC chime tone generator will generate one, short, fixed duration “beep-like” chime tone when the ignition switch is in the On position, and an electronic message is received over the PCI data bus from the optional Compass Mini-Trip Computer (CMTTC) requesting that the CMTTC elapsed time, average fuel

## CHIME WARNING SYSTEM (Continued)

economy, and/or trip odometer data has been reset. The CMTC uses internal programming, hard wired inputs from the U.S./Metric and Reset switches, and electronic messages received from the Body Control Module (BCM) to determine the proper reset messages to send to the EMIC.

- **Door Ajar Warning** - The EMIC chime tone generator will generate a single “bong-like” chime tone when the ignition switch is in the On position, and electronic messages are received over the PCI data bus from the Body Control Module (BCM) indicating that the status of any door ajar input has changed from closed to not closed, and from the PCM indicating that the vehicle is moving. The BCM uses internal programming, and hard wired inputs from the door ajar switches and the ignition switch to determine the proper door ajar switch messages to send to the EMIC. The PCM uses internal programming and a hard wired vehicle speed pulse input received from the BCM to determine the proper vehicle distance messages to send to the EMIC.

- **Electrical System Voltage Low or High Warning** - Each time the ignition switch is turned to the On position, the EMIC chime tone generator will generate a single “bong-like” chime tone the first time an electronic message is received over the PCI data bus from the PCM requesting “Charging” indicator illumination. This warning would indicate that the monitored electrical system voltage is either too low or too high. This warning will only occur once during an ignition cycle. The PCM uses internal programming and hard wired inputs from the electrical and charging systems to determine the proper “Charging” indicator messages to send to the EMIC.

- **Engine Coolant Temperature High Warning** - Each time the ignition switch is turned to the On position, the EMIC chime tone generator will generate “bong-like” chime tones the first time an electronic message is received over the PCI data bus from the PCM indicating that the engine coolant temperature is too high. This chime will sound for five consecutive single tones, unless an electronic message is received from the PCM indicating that the engine coolant temperature is not too high, or unless the ignition switch is turned to the Off position before the five single tones have completed. The PCM uses internal programming and a hard wired input from the engine coolant temperature sensor to determine the proper engine coolant temperature messages to send to the EMIC.

- **Engine Oil Pressure Low Warning** - Each time the ignition switch is turned to the On position, the EMIC chime tone generator will generate a single “bong-like” chime tone the first time three sequential sets of electronic messages are received over the PCI data bus from the PCM indicating that

the engine oil pressure is too low with the engine running. The PCM uses internal programming and hard wired inputs from the oil pressure sensor and the crankshaft position sensor to determine the proper oil pressure and engine speed messages to send to the EMIC.

- **Fasten Seat Belt Warning** - Each time the ignition switch is turned to the On position, the EMIC chime tone generator will generate repetitive “bong-like” chime tones at a slow rate the first time an electronic message is received over the PCI data bus from the ACM requesting “Seatbelt” indicator illumination. The ACM uses internal programming and hard wired inputs from the driver side front seat belt switch and the ignition switch to determine that the driver side front seat belt is not fastened with the ignition switch in the On position. These chimes will continue to sound for a duration of about six seconds each time the ignition switch is turned to the On position, or until the driver side front seat belt is fastened, whichever occurs first. This audible warning occurs independent of the visual warning provided by the EMIC “Seatbelt” indicator.

- **Gate Ajar Warning** - The EMIC chime tone generator will generate a single “bong-like” chime tone when the ignition switch is in the On position, and electronic messages are received over the PCI data bus from the BCM indicating that the status of the tailgate ajar input has changed from closed to not closed, and from the PCM indicating that the vehicle is moving. The BCM uses internal programming, and hard wired inputs from the tailgate ajar switch and the ignition switch to determine the proper tailgate ajar switch messages to send to the EMIC. The PCM uses internal programming and a hard wired vehicle speed pulse input received from the BCM to determine the proper vehicle distance messages to send to the EMIC.

- **Glass Ajar Warning** - The EMIC chime tone generator will generate a single “bong-like” chime tone when the ignition switch is in the On position, and electronic messages are received over the PCI data bus from the BCM indicating that the status of the rear flip-up glass ajar input has changed from closed to not closed, and from the PCM indicating that the vehicle is moving. The BCM uses internal programming, and hard wired inputs from the flip-up glass ajar switch and the ignition switch to determine the proper flip-up glass ajar switch messages to send to the EMIC. The PCM uses internal programming and a hard wired vehicle speed pulse input received from the BCM to determine the proper vehicle distance messages to send to the EMIC.

- **Head/Park/Fog Lights-On Warning** - The EMIC chime tone generator will generate repetitive “bong-like” chime tones at a fast rate when the igni-



## CHIME WARNING SYSTEM (Continued)

tion switch is in any position except On, and electronic messages are received over the PCI data bus from the BCM indicating that the exterior lights are On with the ignition switch in any position except On, and the status of the driver side front door is not closed. The BCM uses internal programming and hard wired inputs from the left (lighting) control stalk of the multi-function switch, the ignition switch, and the driver side front door ajar switch to determine the proper messages to send to the EMIC. These chimes will continue to sound until the exterior lighting is turned Off, until the ignition switch is turned to the On position, or until the status of the driver side front door ajar input changes from not closed to closed, whichever occurs first.

- **Key-In-Ignition Warning** - The EMIC chime tone generator will generate repetitive “bong-like” chime tones at a fast rate when the ignition switch is in any position except On, and electronic messages are received over the PCI data bus from the BCM indicating that the key is in the ignition lock cylinder with the ignition switch in any position except On, and the driver side front door is not closed. The BCM internal programming and hard wired inputs from the key-in ignition circuitry of the ignition switch, the ignition switch, and the driver side front door ajar switch to determine the proper messages to send to the EMIC. These chimes will continue to sound until the key is removed from the ignition lock cylinder, until the ignition switch is turned to the On position, or until the status of the driver side front door ajar input changes from not closed to closed, whichever occurs first.

- **Low Coolant Warning** - On vehicles equipped with a diesel engine, the EMIC chime tone generator will generate a single “bong-like” chime tone when the ignition switch is first turned to the On position and a hard wired input from the engine coolant level sensor to the EMIC indicates that the coolant level is low for more than about one-quarter second. Any time after the ignition switch is first turned to the On position, the EMIC uses internal programming to check the status of the engine coolant level sensor inputs about once every second, then adjusts an internal counter up or down based upon the status of this input. When the counter accumulates thirty inputs indicating that the coolant level is low, a single chime tone is sounded. This strategy is intended to reduce the effect that coolant sloshing within the coolant reservoir can have on reliable chime warning operation. This warning will only occur once during an ignition cycle.

- **Low Fuel Warning** - Each time the ignition switch is turned to the On position, the EMIC chime tone generator will generate a single “bong-like” chime tone the first time an electronic message is

received over the PCI data bus from the PCM requesting “Low Fuel” indicator illumination. The chime will only occur a second time during the same ignition cycle if another electronic message has been received from the PCM indicating that there is an increase in the fuel level equal to about 3 liters (0.8 gallon), then a subsequent electronic message from the PCM requests “Low Fuel” indicator illumination. This strategy combined with filtering performed by the internal programming of the PCM on the fuel tank sending unit input is intended to reduce the possibility of fuel sloshing within the fuel tank causing multiple low fuel warning chimes during a given ignition cycle. The EMIC will also respond with the low fuel warning chime when electronic fuel level messages are received from the PCM indicating that the hard wired input to the PCM from the fuel tank sending unit is an open circuit (greater than full), or a short circuit (less than empty).

- **Low Washer Fluid Warning** - The EMIC chime tone generator will generate a single “bong-like” chime tone when the ignition switch is turned to the On position and a hard wired input from the washer fluid level switch to the EMIC indicates the washer fluid is low for more than about one-quarter second. Any time after the ignition switch is first turned to the On position, the EMIC uses internal programming to check the status of the washer fluid level switch inputs about once every second, then adjusts an internal counter up or down based upon the status of this input. When the counter accumulates thirty inputs indicating that the washer fluid level is low, a single chime tone is sounded. This strategy is intended to reduce the effect that fluid sloshing within the washer reservoir can have on reliable chime warning operation. This warning will only occur once during an ignition cycle.

- **Overspeed Warning** - The EMIC chime tone generator will generate repetitive “bong-like” chime tones at a slow rate when the ignition switch is in the On position, and an electronic message received over the PCI data bus from the PCM indicates that the vehicle speed is over a programmed speed value. The PCM uses internal programming and distance pulse information received over a hard wired vehicle speed pulse input from the BCM to determine the proper vehicle speed messages to send to the EMIC. The BCM uses an internally programmed electronic pinion factor and a hard wired input from the rear wheel speed sensor to calculate the proper distance pulse information to send to the PCM. The electronic pinion factor represents the proper tire size and axle ratio information for the vehicle. These chimes will continue to sound until the vehicle speed messages are below the programmed speed value, or until the ignition switch is turned to the Off position, which-

## CHIME WARNING SYSTEM (Continued)

ever occurs first. The overspeed warning feature is only enabled on a BCM that has been programmed with a Middle East Gulf Coast Country (GCC) country code.

- **No Airbag Indicator Message Warning** - The EMIC chime tone generator will generate one, short, “bong-like” chime tone and turn on the “Airbag” indicator when the ignition switch is in the On position, and a PCI data bus “Airbag” indicator on or off message is not received from the ACM for six consecutive seconds.

- **No Antilock Brake Indicator Message Warning** - The EMIC chime tone generator will generate one, short, “bong-like” chime tone and turn on the “ABS” indicator when the ignition switch is in the On position, and a PCI data bus “ABS” indicator on or off message is not received from the CAB for six consecutive seconds.

- **No Fuel Level Message Warning** - The EMIC chime tone generator will generate one, short, “bong-like” chime tone and turn on the “Low Fuel” indicator when the ignition switch is in the On position, and a PCI data bus fuel level message is not received from the PCM for twelve consecutive seconds.

- **Remote Keyless Entry Transmitter Programming** - On vehicles so equipped, the EMIC chime tone generator will generate a single “bong-like” chime tone when an electronic message is received over the PCI data bus from the BCM indicating that a Remote Keyless Entry (RKE) transmitter has been successfully programmed by the customer into the RKE module memory.

- **Sentry Key Immobilizer System Transponder Programming** - On vehicles so equipped, the EMIC chime tone generator will generate a single “bong-like” chime tone when an electronic message is received over PCI data bus message from the Sentry Key Immobilizer Module (SKIM) indicating that the Sentry Key Immobilizer System (SKIS) has been placed in the “Customer Learn” programming mode, and again each time a new SKIS transponder has been successfully programmed by the customer.

- **Turn Signal Cancel Warning** - The EMIC chime tone generator will generate repetitive “bong-like” chime tones at a slow rate when the vehicle is driven for a distance of about 3.2 kilometers (about two miles) with a turn signal indicator flashing. The EMIC uses an electronic message received over the PCI data bus from the PCM, and a hard wired input from the turn signal switch circuitry of the multi-function switch to determine when to sound the turn signal cancel warning. The PCM uses internal programming and distance pulse information received over a hard wired vehicle speed pulse input from the BCM to determine the proper vehicle speed messages to send to the EMIC. The BCM uses an internally

programmed electronic pinion factor and a hard wired input from the rear wheel speed sensor to calculate the proper distance pulse information to send to the PCM. The electronic pinion factor represents the proper tire size and axle ratio information for the vehicle. These chimes will continue to sound until the turn signal is turned Off, until the hazard warning system is turned On, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Water-In-Fuel Warning** - On vehicles equipped with a diesel engine, each time the ignition switch is turned to the On position, the EMIC chime tone generator will generate a single “bong-like” chime tone the first time an electronic message is received over the PCI data bus from the PCM requesting “Water-in-Fuel” indicator illumination. The PCM uses internal programming and a hard wired input from the water-in-fuel sensor to determine the proper water-in-fuel messages to send to the EMIC. This warning will only occur once during an ignition cycle.

The EMIC provides chime service for all available features in the chime warning system. The EMIC relies upon its internal programming and hard wired inputs from the turn signal (multi-function) switch, the washer fluid level switch, and the engine coolant level sensor (diesel engine only) to provide chime service for the turn signal cancel warning, the low washer fluid warning, and the low coolant warning respectively. The EMIC relies upon electronic message inputs received from other electronic modules over the PCI data bus network to provide chime service for all of the remaining chime warning system features. Upon receiving the proper inputs, the EMIC activates the integral chime tone generator to provide the audible chime warning to the vehicle operator. The internal programming of the EMIC determines the priority of each chime request input that is received, as well as the rate and duration of each chime tone that is to be generated. See the owner’s manual in the vehicle glove box for more information on the features provided by the chime warning system.

The hard wired chime warning system inputs to the EMIC, as well as other hard wired circuits for this system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the EMIC, the PCI data bus network, or the electronic message inputs used by the EMIC to provide chime warning system service. The most reliable, efficient, and accurate means to diagnose the EMIC, the PCI data bus network, and the electronic message inputs for the chime warning system requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## CHIME WARNING SYSTEM (Continued)

**DIAGNOSIS AND TESTING - CHIME WARNING SYSTEM**

The hard wired chime warning system inputs to the EMIC, as well as other hard wired circuits for this system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the EMIC, the PCI data bus network, or the electronic message inputs used by the EMIC to provide chime warning system service. The most reliable, efficient, and accurate means to diagnose the EMIC, the PCI data bus network, and the electronic message inputs for the chime warning system requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

The hard wired chime warning system inputs to the ElectroMechanical Instrument Cluster (EMIC), as well as other hard wired circuits for this system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the EMIC, the Programmable Communications Interface (PCI) data bus network, or the electronic message inputs used by the EMIC to provide chime warning system service. The most reli-

able, efficient, and accurate means to diagnose the EMIC, the PCI data bus network, and the electronic message inputs for the chime warning system requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

# ELECTRONIC CONTROL MODULES

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## ELECTRONIC CONTROL MODULES

### STANDARD PROCEDURE - PCM/SKIM PROGRAMMING

**NOTE:** Before replacing the PCM for a failed driver, control circuit, or ground circuit, be sure to check the related component/circuit integrity for failures not detected due to a double fault in the circuit. Most PCM driver/control circuit failures are caused by internal component failures (i.e. relays and solenoids) and shorted circuits (i.e. pull-ups, drivers, and switched circuits). These failures are difficult to detect when a double fault has occurred and only one DTC has been set.

When a PCM (JTEC) and the SKIM are replaced at the same time, perform the following steps in order:

- (1) Program the new PCM (JTEC).

- (2) Program the new SKIM.
- (3) Replace all ignition keys and program them to the new SKIM.

### PROGRAMMING THE PCM (JTEC)

The SKIS Secret Key is an ID code that is unique to each SKIM. This code is programmed and stored in the SKIM, the PCM, and the ignition key transponder chip(s). When replacing the PCM, it is necessary to program the secret key into the new PCM using the DRBIII® scan tool. Perform the following steps to program the secret key into the PCM.

- (1) Turn the ignition switch to the On position (transmission in Park/Neutral).
- (2) Use the DRBIII® and select THEFT ALARM, SKIM, then MISCELLANEOUS.
- (3) Select PCM REPLACED (GAS ENGINE).
- (4) Enter secured access mode by entering the vehicle four-digit PIN.
- (5) Select ENTER to update PCM VIN.

## ELECTRONIC CONTROL MODULES (Continued)

**NOTE:** If three attempts are made to enter secured access mode using an incorrect PIN, secured access mode will be locked out for one hour. To exit this lockout mode, turn the ignition switch to the ON position for one hour, then enter the correct PIN. (Ensure all accessories are turned off. Also monitor the battery state and connect a battery charger if necessary).

(6) Press ENTER to transfer the secret key (the SKIM will send the secret key to the PCM).

(7) Press PAGE BACK to get to the Select System menu and select ENGINE, MISCELLANEOUS, and SRI MEMORY CHECK.

(8) The DRBIII® will ask, "Is odometer reading between XX and XX?" Select the YES or NO button on the DRBIII®. If NO is selected, the DRBIII® will read, "Enter Odometer Reading (From I.P. odometer)". Enter the odometer reading from the instrument cluster and press ENTER.

### PROGRAMMING THE SKIM

(1) Turn the ignition switch to the On position (transmission in Park/Neutral).

(2) Use the DRBIII® and select THEFT ALARM, SKIM, then MISCELLANEOUS.

(3) Select PCM REPLACED (GAS ENGINE).

(4) Program the vehicle four-digit PIN into SKIM.

(5) Select COUNTRY CODE and enter the correct country.

**NOTE:** Be sure to enter the correct country code. If the incorrect country code is programmed into SKIM, it cannot be changed and the SKIM must be replaced.

(6) Select YES to update VIN (the SKIM will learn the VIN from the PCM).

(7) Press ENTER to transfer the secret key (the PCM will send the secret key to the SKIM).

(8) Program ignition keys to the SKIM.

**NOTE:** If the PCM and the SKIM are replaced at the same time, all vehicle ignition keys will need to be replaced and programmed to the new SKIM.

### PROGRAMMING IGNITION KEYS TO THE SKIM

(1) Turn the ignition switch to the On position (transmission in Park/Neutral).

(2) Use the DRBIII® and select THEFT ALARM, SKIM, then MISCELLANEOUS.

(3) Select PROGRAM IGNITION KEYS.

(4) Enter secured access mode by entering the vehicle four-digit PIN.

**NOTE:** A maximum of eight keys can be learned to each SKIM. Once a key is learned to a SKIM it (the key) cannot be transferred to another vehicle.

(5) Obtain ignition keys to be programmed from the customer (8 keys maximum).

(6) Using the DRBIII®, erase all ignition keys by selecting MISCELLANEOUS, and ERASE ALL CURRENT IGN. KEYS.

(7) Program all of the ignition keys.

If ignition key programming is unsuccessful, the DRBIII® will display one of the following messages:

- **Programming Not Attempted** - The DRBIII® attempts to read the programmed key status and there are no keys programmed into SKIM memory.

- **Programming Key Failed (Possible Used Key From Wrong Vehicle)** - SKIM is unable to program an ignition key transponder due to one of the following:

- The ignition key transponder is faulty.

- The ignition key transponder is or has been already programmed to another vehicle.

- **8 Keys Already Learned, Programming Not Done** - The SKIM transponder ID memory is full.

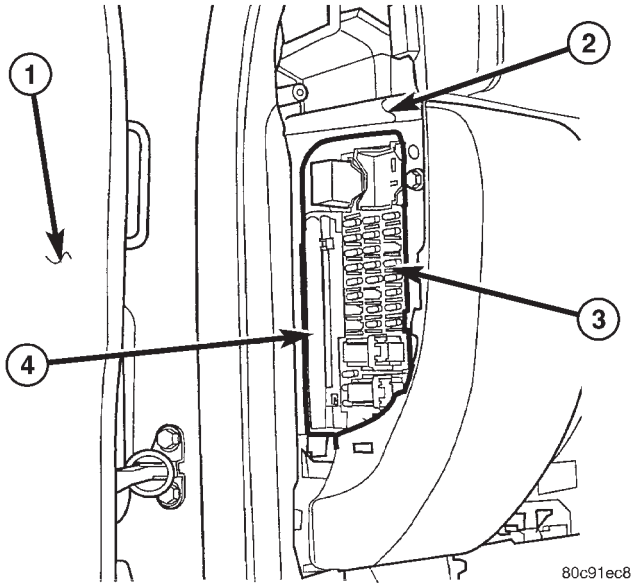
- **Learned Key In Ignition** - The ID for the ignition key transponder currently in the ignition lock cylinder is already programmed in SKIM memory.

## BODY CONTROL MODULE

### DESCRIPTION

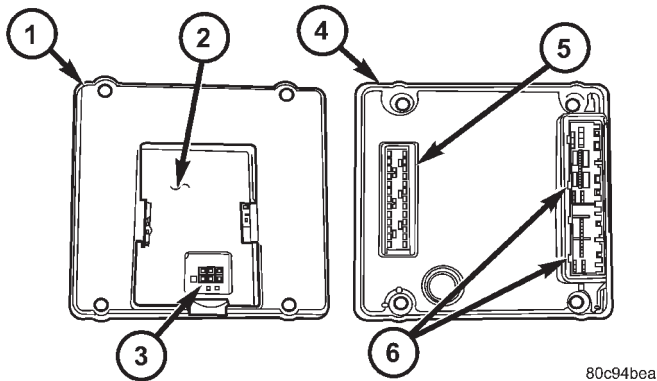
A Body Control Module (BCM) is concealed behind the driver side end of the instrument panel in the passenger compartment, where it is secured to the fuse panel side of the Junction Block (JB) with four screws (Fig. 1). The JB is the interface between the body, the instrument panel, and the headlamp and dash wire harnesses. The JB also contains the fuses and relays used for the interior electrical system of the vehicle. The BCM is enclosed in a molded plastic housing with two integral external connector receptacles that connect it to the vehicle electrical system through two take outs with connectors from the instrument panel wire harness (Fig. 2). The BCM also has an integral interface connector concealed on the back side of the unit that joins it through a connector receptacle that is integral to the JB housing to the circuitry within the JB. This connector is referred to as the JB-BCM connector. The combined BCM and JB are sometimes referred to as the Junction Block Module (JBM).

BODY CONTROL MODULE (Continued)



**Fig. 1 Body Control Module Location**

- 1 - DRIVER DOOR
- 2 - INSTRUMENT PANEL END BRACKET
- 3 - JUNCTION BLOCK
- 4 - BODY CONTROL MODULE



**Fig. 2 Body Control Module**

- 1 - BODY CONTROL MODULE (FRONT VIEW)
- 2 - REMOTE KEYLESS ENTRY MODULE RECEPTACLE
- 3 - BCM-RKE CONNECTOR
- 4 - BODY CONTROL MODULE (BACK VIEW)
- 5 - JB-BCM CONNECTOR
- 6 - CONNECTOR RECEPTACLE (2)

There are two different versions of the BCM: base and premium. The base BCM is a subset of the components in the premium version. Basically, the base version BCM does not support the following features: Compass Mini-Trip Computer (CMTC), fog lamps (front and/or rear), Remote Keyless Entry (RKE), remote radio switches, or Vehicle Theft Security System (VTSS). Both versions of the BCM utilize integrated circuitry and information carried on the Programmable Communications Interface (PCI) data

bus network along with many hard wired inputs to monitor many sensor and switch inputs throughout the vehicle. In response to those inputs, the internal circuitry and programming of the BCM allow it to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the PCI data bus. The electronic functions and features that the BCM supports or controls include the following:

- **A/C Select Switch Status** - The BCM monitors an input from, and transmits the status of the A/C switch on the heater-A/C control.
- **Ambient Temperature Data** - The premium BCM monitors and transmits the ambient temperature sensor input data.
- **Cargo Lamp Disable** - The BCM monitors an input from the cargo lamp switch to provide an interior lighting disable feature.
- **Chimes** - The chime tone generator is located on the ElectroMechanical Instrument Cluster (EMIC) circuit board, but the EMIC goes to sleep with the ignition switch in the Off position. The BCM provides a wake-up output to the EMIC based upon inputs from the key-in ignition switch or the exterior lighting switch, then sends electronic chime request messages to the EMIC for the headlamps-on warning and key-in ignition warning.
- **Door Lock Inhibit** - The BCM monitors the key-in ignition switch and the driver side front door ajar switch to provide a door lock inhibit feature.
- **Exterior Lamp Load Shedding** - The BCM provides a battery saver feature which will automatically turn off exterior lamps that remain on after a timed interval.
- **Exterior Lamp Status** - The BCM monitors the status of the park lamp, low beam, high beam or Daytime Running Lamp (DRL - Canada only), front fog lamp (optional), and rear fog lamp (in required markets only) relays.
- **Exterior Lighting Control** - The BCM provides exterior lamp control for standard head and park lamps, as well as Daytime Running Lamps (DRL - Canada only), front fog lamps (optional), and rear fog lamps (in required markets only). This includes support for features including optical horn (also known as flash-to-pass) and headlamp time delay.
- **Flip-Up Glass Control** - The BCM monitors the tailgate cylinder lock switch, the tailgate handle switch, the Remote Keyless Entry (RKE) module inputs and the rear wiper switch to provide control for the rear flip-up glass actuator.

## BODY CONTROL MODULE (Continued)

- **Fog Lamp Control** - The premium BCM provides fog lamp control for front fog lamps (optional), and rear fog lamps (in required markets only).
- **Front Wiper System Status** - The BCM monitors the status of the front wiper motor park switch.
- **Fuel Economy and Distance to Empty Calculations** - The BCM calculates and transmits the fuel economy and Distance To Empty (DTE) data.
- **Headlamp Time Delay** - The BCM provides a headlamp time delay feature with the ignition switch in the Off position.
- **Heated Rear Glass Control** - The BCM provides control and timer functions for the heated rear glass feature and transmits the system status.
- **Ignition On/Off Timer** - The BCM monitors and transmits the elapsed ignition On timer data and monitors the ignition Off time.
- **Ignition Switch Position Status** - The BCM monitors and transmits the status of the ignition switch.
- **Instrument Panel Dimming** - The BCM monitors and transmits the selected illumination intensity level of the panel lamps dimmer switch.
- **Interior Lamp Load Shedding** - The BCM provides a battery saver feature which will automatically turn off all interior lamps that remain on after a timed interval.
- **Interior Lighting Control** - The BCM monitors inputs from the interior lighting switch, the door ajar switches, the flip-up glass ajar switch, the tailgate ajar switch, the cargo lamp switch, the reading lamp switches, and the Remote Keyless Entry (RKE) module to provide courtesy lamp control. This includes support for timed illuminated entry with theater-style fade-to-off and courtesy illumination defeat features.
- **Intermittent Wipe and Front Wiper System Control** - The BCM monitors inputs from the front wiper and washer switch and the front wiper motor park switch to provide front wiper system control through the wiper on/off and high/low relays. This includes support for adjustable intermittent wipe, mist wipe (also known as pulse wipe), and wipe-after-wash features.
- **Key-In-Ignition Switch Status** - The BCM monitors and transmits the status of the key-in-ignition switch.
- **Panic Mode** - The BCM provides support for the Remote Keyless Entry (RKE) system panic mode feature.
- **Parade Mode** - The BCM provides a parade mode (also known as funeral mode) that allows the interior Vacuum Fluorescent Displays (VFD) to be illuminated at full intensity while driving in daylight with the exterior lamps On.
- **Power Locks** - The BCM monitors inputs from the power lock switches and the Remote Keyless Entry (RKE) module (optional) to provide control of the power lock motors through outputs to the lock, unlock, and driver unlock (RKE only) relays. This includes support for rolling door locks (also known as automatic door locks) and a door lock inhibit mode.
- **Programmable Features** - The BCM provides support for several standard and optional programmable features, including: rolling door locks, headlamp time delay interval, Remote Keyless Entry (RKE) driver-door-only or unlock-all-doors, RKE optical chirp, and RKE audible chirp.
- **Remote Keyless Entry** - The premium BCM provides the optional Remote Keyless Entry (RKE) system features, including support for the RKE Lock, Unlock (with optional driver-door-only unlock, and unlock-all-doors), rear flip-up glass control, Panic, audible chirp, optical chirp, and illuminated entry modes, as well as the ability to be programmed to recognize up to four RKE transmitters.
- **Rolling Door Locks** - The BCM provides support for the power lock system rolling door locks feature (also known as automatic door locks).
- **Tailgate and Flip-Up Glass Ajar Status** - The BCM monitors and transmits the status of the tailgate and rear flip-up glass ajar switches.
- **Remote Radio Switch Interface** - The premium BCM monitors and transmits the status of the optional remote radio switches.
- **Self-Diagnostics** - The BCM provides support for diagnostics through communication with the DRBIII® scan tool over the PCI data bus network. Each analog and digital input can be verified, and each output can be actuated through the use of this diagnostic protocol. The BCM also stores Diagnostic Trouble Codes (DTCs) to assist in troubleshooting this unit.
- **Vacuum Fluorescent Display Synchronization** - The BCM transmits panel lamp intensity data which allows modules with Vacuum Fluorescent Displays (VFD) to coordinate their illumination intensity.
- **Vehicle Speed System** - The BCM monitors a vehicle speed input from the vehicle speed sensor (without Antilock Brake System [ABS]) or from the Controller Antilock Brake (CAB)(with ABS), calculates the vehicle speed based upon a programmed axle ratio/tire size (electronic pinion factor), and transmits the vehicle speed information to the Powertrain Control Module (PCM) on a hard wired output circuit.
- **Vehicle Theft Security System** - The premium BCM monitors inputs from the door cylinder lock switches, the tailgate cylinder lock switch, the door ajar switches, the tailgate ajar switch, the

## BODY CONTROL MODULE (Continued)

flip-up glass ajar switch, the hood ajar switch (in required markets only), and the Remote Keyless Entry (RKE) module to control the features of the optional Vehicle Theft Security System (VTSS).

Hard wired circuitry connects the BCM to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the BCM through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

Many of the electronic features in the vehicle controlled or supported by the BCM are programmable using a customer programming procedure or the DRBIII® scan tool. In addition, the BCM software is Flash compatible, which means it can be reprogrammed using Flash reprogramming procedures. However, if any of the BCM hardware components is damaged or faulty, the entire BCM unit must be replaced.

## OPERATION

The microprocessor-based Body Control Module (BCM) monitors many hard wired switch and sensor inputs as well as those resources it shares with other electronic modules in the vehicle through its communication over the Programmable Communications Interface (PCI) data bus network. The internal programming and all of these inputs allow the BCM microprocessor to determine the tasks it needs to perform and their priorities, as well as both the standard and optional features that it should provide. The BCM programming then performs those tasks and provides those features through both PCI data bus communication with other electronic modules and through hard wired outputs through a number of driver circuits, relays, and actuators. These outputs allow the BCM the ability to control numerous accessory systems in the vehicle.

The BCM operates on battery current received through a fuse in the Junction Block (JB) on a non-switched fused B(+) circuit, through another fuse in the JB on a fused ignition switch output (run-start) circuit, and through a third fuse in the JB on a fused ignition switch output (run-acc) circuit. This arrangement allows the BCM to provide some features regardless of the ignition switch position, while other features will operate only with the ignition switch in

the On, Start, and/or Accessory positions. All of the battery current circuits are connected to the BCM through the JB/BCM connector. The BCM receives ground through five separate circuits. Three of these circuits are connected to the BCM through a connector and take out of the instrument panel wire harness on three separate ground circuits, while the other two circuits are connected to the BCM through the JB/BCM connector. All of these circuits are grounded through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the JB.

The BCM monitors its own internal circuitry as well as many of its input and output circuits, and will store a Diagnostic Trouble Code (DTC) in electronic memory for any failure it detects. These DTCs can be retrieved and diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**HARD WIRED INPUTS** The hard wired inputs to the BCM include the following:

- **A/C on/off control**
- **Ambient temperature sensor signal**
- **Body control module flash enable**
- **Door lock switch mux**
- **Driver door ajar switch sense**
- **Flip-up glass ajar switch sense**
- **Flip-up glass release switch sense**
- **Fog lamp switch sense**
- **Front wiper park switch sense**
- **Front wiper switch mux**
- **Front washer pump driver**
- **Fused B(+)**
- **Fused ignition switch output (run-acc)**
- **Fused ignition switch output (run-start)**
- **Headlamp switch mux**
- **High beam switch sense**
- **Hood ajar switch sense - premium with VTSS - in markets where required only**
  - **Key-in ignition switch sense**
  - **Left cylinder lock switch sense - premium with VTSS only - omitted in some markets as required**
- **Panel lamps dimmer switch mux**
- **Passenger doors ajar switch sense (input from three ajar switches connected in parallel)**
- **Radio control mux - premium with remote radio switches only**
- **Rear courtesy lamp control**
- **Rear window defogger control**
- **Rear wiper intermittent driver**
- **Rear wiper on driver**
- **Right cylinder lock switch sense - premium with VTSS only - omitted in some markets as required**



## BODY CONTROL MODULE (Continued)

- **RKE antenna (two circuits) - premium with RKE only**

- Tailgate ajar switch sense
- Tailgate cylinder lock switch sense
- Vehicle speed sensor

Refer to the appropriate wiring information for additional details.

**HARD WIRED OUTPUTS** The hard wired outputs of the BCM include the following:

- **Courtesy lamp driver**
- **Courtesy lamp load shed**
- **Door lock relay control**
- **Driver door unlock relay control - premium with RKE only**
- **Flip-up glass release motor driver**
- **Front fog lamp relay control - premium with front fog lamps only**
- **Front wiper high/low relay control**
- **Front wiper on/off relay control**
- **Hazard lamp control**
- **High beam relay control**
- **Horn relay control - premium with RKE only**

- **Instrument cluster wake up signal**
- **Low beam relay control**
- **Park lamp relay control**
- **Passenger door unlock relay control**
- **Rear fog lamp relay control - premium with rear fog lamps in markets where required only**
- **Rear window defogger relay control**
- **RKE supply - premium with RKE only**
- **Tailgate lock driver**
- **Tailgate unlock driver**
- **Vehicle speed output**
- **Vehicle speed sensor supply**
- **VTSS indicator driver - premium with VTSS only**

Refer to the appropriate wiring information for additional details.

**GROUNDS** The BCM receives ground through five separate circuits, and also supplies a ground path to several switches through the following hard wired circuits:

- **Ambient temperature sensor return**
- **Door lock switch ground**
- **Headlamp switch return**
- **Radio control mux return**
- **RKE ground - premium with RKE only**
- **Tailgate switch ground**

Refer to the appropriate wiring information for additional details.

**COMMUNICATION** Not including the two RKE antenna circuits (RKE antenna + and -), which merely pass through the premium BCM from the RKE module to the external RKE antenna in the

instrument panel wire harness, the BCM has the following communication circuits:

- **PCI bus**
- **RKE program serial data - premium with RKE only**
- **RKE transmit serial data - premium with RKE only**

Refer to the appropriate wiring information for additional details.

**MESSAGING** The BCM uses the following messages received from other electronic modules over the PCI data bus:

- **Battery Temperature (PCM)**
- **Compass Mini-Trip Computer Button Status (CMTTC) - premium only**
- **Coolant Temperature (PCM)**
- **Distance Pulses (PCM)**
- **Engine Speed (PCM)**
- **Fuel Tank Level (PCM)**
- **Fuel Used (PCM)**
- **Intrusion Transceiver Module Commands (ITM) - premium in markets where required only**
- **Manifold Absolute Pressure (PCM)**
- **OK to Lock - Rolling Locks (PCM)**
- **SKIS Status (SKIM)**
- **Vehicle Identification Number (PCM)**
- **Vehicle Speed (PCM)**

The BCM provides the following messages to other electronic modules over the PCI data bus:

- **A/C Select Switch Status (PCM)**
- **Country Code (EMIC, PCM, CMTTC)**
- **Distance to Empty (CMTTC) - premium only**
- **Door Ajar Status (EMIC)**
- **Exterior Lighting Status (EMIC)**
- **Flip-up Glass Ajar Status (EMIC)**
- **Fuel Economy (Average and Instantaneous) (CMTTC) - premium only**
- **Hood Ajar Status (ITM) - premium in markets where required only**
- **Ignition On Timer (CMTTC) - premium only**
- **Intrusion Transceiver Module Commands (ITM) - premium in markets where required only**
- **Key-In Ignition Switch Status (EMIC)**
- **Outside Temperature (CMTTC) - premium only**
- **Panel Lamp Intensity (CMTTC, Radio)**
- **Tailgate Ajar Status (EMIC)**
- **Radio Mode (Radio) - premium only**
- **Radio Preset Scan (Radio) - premium only**
- **Radio Seek Down (Radio) - premium only**
- **Radio Seek Up (Radio) - premium only**
- **Radio Volume Down (Radio) - premium only**
- **Radio Volume Up (Radio) - premium only**

## BODY CONTROL MODULE (Continued)

- **Vacuum Fluorescent Display Synchronization (CMTC, EMIC, Radio)**
- **Vehicle Theft Security System Status (PCM, ITM) - premium only**

Refer to the appropriate diagnostic information for additional details.

## DIAGNOSIS AND TESTING - BODY CONTROL MODULE

The hard wired inputs to and outputs from the Body Control Module (BCM), as well as other hard wired circuits for this module may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the BCM, the Programmable Communications Interface (PCI) data bus network, or the electronic messages received and transmitted by the BCM over the PCI data bus. The most reliable, efficient, and accurate means to diagnose the BCM and the PCI data bus network inputs to and outputs from this module requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER,**

**FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**NOTE: Before replacing a Body Control Module (BCM), use a DRBIII® scan tool to retrieve the current settings for the BCM programmable features and the axle ratio/tire size (electronic pinion factor). Refer to the appropriate diagnostic information. These settings should be duplicated in the replacement BCM using the DRBIII® scan tool before returning the vehicle to service.**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the Junction Block Module (JBM) from the instrument panel end bracket on the driver side of the vehicle. (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/JUNCTION BLOCK - REMOVAL).

(3) Remove the four screws that secure the BCM to the Junction Block (JB) (Fig. 3).

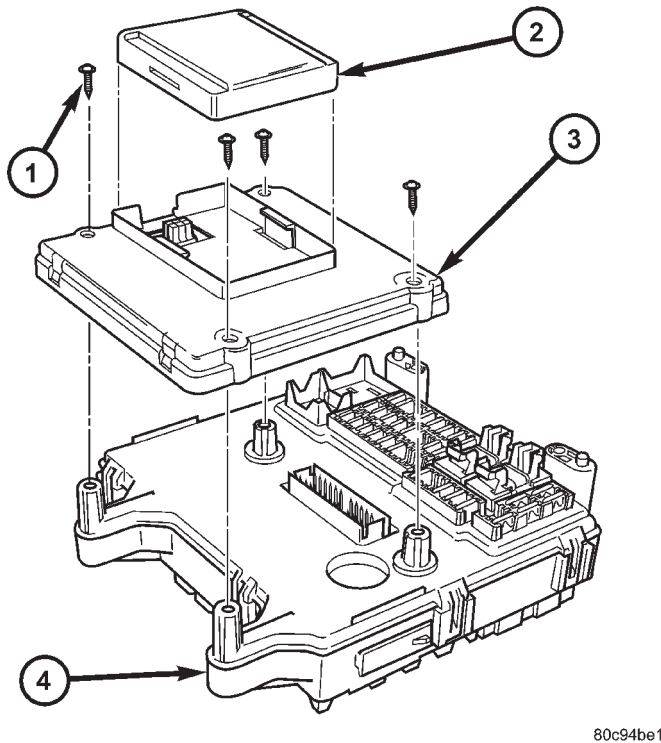
(4) Remove the BCM from the JB.

(5) If the vehicle is equipped with the optional Remote Keyless Entry (RKE) system, remove the RKE module from the receptacle on the BCM. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - REMOVAL).

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## BODY CONTROL MODULE (Continued)



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**Fig. 3 Body Control Module Remove/Install**

- 1 - SCREW (4)
- 2 - RKE MODULE
- 3 - BODY CONTROL MODULE
- 4 - JUNCTION BLOCK

**NOTE:** Before replacing a Body Control Module (BCM), use a DRBIII® scan tool to retrieve the current settings for the BCM programmable features and the axle ratio/tire size (electronic pinion factor). Refer to the appropriate diagnostic information. These settings should be duplicated in the replacement BCM using the DRBIII® scan tool before returning the vehicle to service.

(1) If the vehicle is equipped with the optional Remote Keyless Entry (RKE) system, reinstall the RKE module into the receptacle on the BCM. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - INSTALLATION).

(2) Position the BCM onto the Junction Block (JB) (Fig. 3).

(3) Install and tighten the four screws that secure the BCM to the JB. Tighten the screws to 2 N·m (18 in. lbs.).

(4) Reinstall the Junction Block Module (JBM) onto the instrument panel end bracket on the driver side of the vehicle. (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/JUNCTION BLOCK - INSTALLATION).

(5) Reconnect the battery negative cable.

## COMMUNICATION

### DESCRIPTION

The DaimlerChrysler Programmable Communication Interface (PCI) data bus system is a single wire multiplex system used for vehicle communications on many DaimlerChrysler Corporation vehicles. Multiplexing is a system that enables the transmission of several messages over a single channel or circuit. All DaimlerChrysler vehicles use this principle for communication between various microprocessor-based electronic control modules. The PCI data bus exceeds the Society of Automotive Engineers (SAE) J1850 Standard for Class B Multiplexing.

Many of the electronic control modules in a vehicle require information from the same sensing device. In the past, if information from one sensing device was required by several controllers, a wire from each controller needed to be connected in parallel to that sensor. In addition, each controller utilizing analog sensors required an Analog/Digital (A/D) converter in order to "read" these sensor inputs. Multiplexing reduces wire harness complexity, sensor current loads and controller hardware because each sensing device is connected to only one controller, which reads and distributes the sensor information to the other controllers over the data bus. Also, because each controller on the data bus can access the controller sensor inputs to every other controller on the data bus, more function and feature capabilities are possible.

In addition to reducing wire harness complexity, component sensor current loads and controller hardware, multiplexing offers a diagnostic advantage. A multiplex system allows the information flowing between controllers to be monitored using a diagnostic scan tool. The DaimlerChrysler system allows an electronic control module to broadcast message data out onto the bus where all other electronic control modules can "hear" the messages that are being sent. When a module hears a message on the data bus that it requires, it relays that message to its microprocessor. Each module ignores the messages on the data bus that are being sent to other electronic control modules.

### OPERATION

Data exchange between modules is achieved by serial transmission of encoded data over a single wire broadcast network. The wire colors used for the PCI data bus circuits are yellow with a violet tracer, or violet with a yellow tracer, depending upon the application. The PCI data bus messages are carried over the bus in the form of Variable Pulse Width Modulated (VPWM) signals. The PCI data bus speed is an average 10.4 Kilo-bits per second (Kbps). By compar-

## COMMUNICATION (Continued)

ison, the prior two-wire Chrysler Collision Detection (CCD) data bus system is designed to run at 7.8125 Kbps.

The voltage network used to transmit messages requires biasing and termination. Each module on the PCI data bus system provides its own biasing and termination. Each module (also referred to as a node) terminates the bus through a terminating resistor and a terminating capacitor. There are two types of nodes on the bus. The dominant node terminates the bus through a 1 KW resistor and a 3300 pF capacitor. The Powertrain Control Module (PCM) is the only dominant node for the PCI data bus system. A standard node terminates the bus through an 11 KW resistor and a 330 pF capacitor.

The modules bias the bus when transmitting a message. The PCI bus uses low and high voltage levels to generate signals. Low voltage is around zero volts and the high voltage is about seven and one-half volts. The low and high voltage levels are generated by means of variable-pulse width modulation to form signals of varying length. The Variable Pulse Width Modulation (VPWM) used in PCI bus messaging is a method in which both the state of the bus and the width of the pulse are used to encode bit information. A "zero" bit is defined as a short low pulse or a long high pulse. A "one" bit is defined as a long low pulse or a short high pulse. A low (passive) state on the bus does not necessarily mean a zero bit. It also depends upon pulse width. If the width is short, it stands for a zero bit. If the width is long, it stands for a one bit. Similarly, a high (active) state does not necessarily mean a one bit. This too depends upon pulse width. If the width is short, it stands for a one bit. If the width is long, it stands for a zero bit.

In the case where there are successive zero or one data bits, both the state of the bus and the width of the pulse are changed alternately. This encoding scheme is used for two reasons. First, this ensures that only one symbol per transition and one transition per symbol exists. On each transition, every transmitting module must decode the symbol on the bus and begin timing of the next symbol. Since timing of the next symbol begins with the last transition detected on the bus, all of the modules are re-synchronized with each symbol. This ensures that there

are no accumulated timing errors during PCI data bus communication.

The second reason for this encoding scheme is to guarantee that the zero bit is the dominant bit on the bus. When two modules are transmitting simultaneously on the bus, there must be some form of arbitration to determine which module will gain control. A data collision occurs when two modules are transmitting different messages at the same time. When a module is transmitting on the bus, it is reading the bus at the same time to ensure message integrity. When a collision is detected, the module that transmitted the one bit stops sending messages over the bus until the bus becomes idle.

Each module is capable of transmitting and receiving data simultaneously. The typical PCI bus message has the following four components:

- **Message Header** - One to three bytes in length. The header contains information identifying the message type and length, message priority, target module(s) and sending module.

- **Data Byte(s)** - This is the actual message that is being sent.

- **Cyclic Redundancy Check (CRC) Byte** - This byte is used to detect errors during a message transmission.

- **In-Frame Response (IFR) byte(s)** - If a response is required from the target module(s), it can be sent during this frame. This function is described in greater detail in the following paragraph.

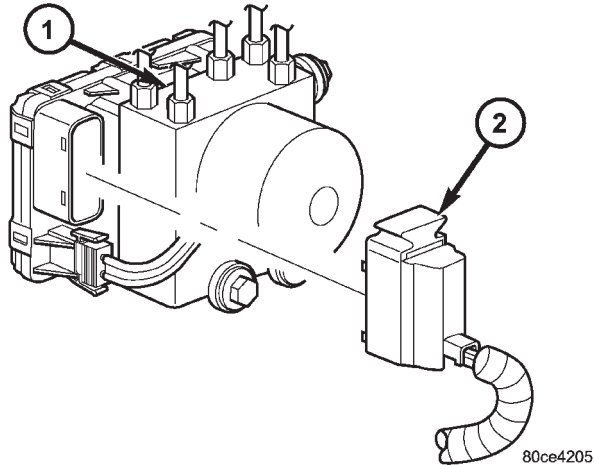
The IFR consists of one or more bytes, which are transmitted during a message. If the sending module requires information to be received immediately, the target module(s) can send data over the bus during the original message. This allows the sending module to receive time-critical information without having to wait for the target module to access the bus. After the IFR is received, the sending module broadcasts an End of Frame (EOF) message and releases control of the bus.

The PCI data bus can be monitored using the DRBIII® scan tool. It is possible, however, for the bus to pass all DRBIII® tests and still be faulty if the voltage parameters are all within the specified range and false messages are being sent.

## CONTROLLER ANTILOCK BRAKE

### REMOVAL

- (1) Install the prop rod on the brake pedal to keep pressure on the brake system.
- (2) Remove the negative battery cable from the battery.
- (3) Pull up on the CAB harness connector release (Fig. 4) and remove connector.



**Fig. 4 CAB HARNESS CONNECTOR RELEASE**

- 1 - ABS MODULE
- 2 - ELECTRICAL CONNECTOR

- (4) Remove the pump connector from the CAB.
- (5) Remove the CAB mounting bolts (Fig. 5).
- (6) Remove the CAB from the HCU (Fig. 6).

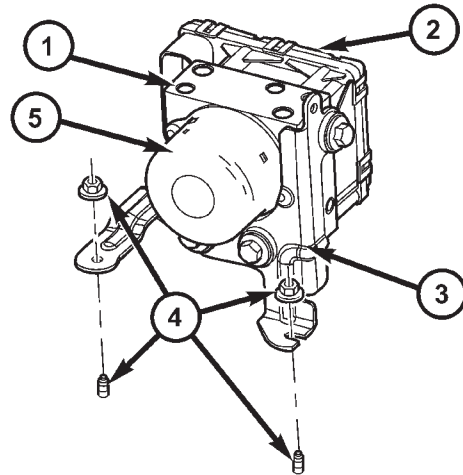
### INSTALLATION

- (1) Install CAB to the HCU (Fig. 6).
- (2) Install mounting bolts. Tighten to 2 N·m (16 in. lbs.).
- (3) Install the pump electrical connector to the CAB (Fig. 6).
- (4) Install the wiring harness connector to the CAB and push down on the release to secure the connector.
- (5) Install negative battery cable to the battery.
- (6) Remove the pushrod from the vehicle.

## DATA LINK CONNECTOR

### DESCRIPTION - DATA LINK CONNECTOR

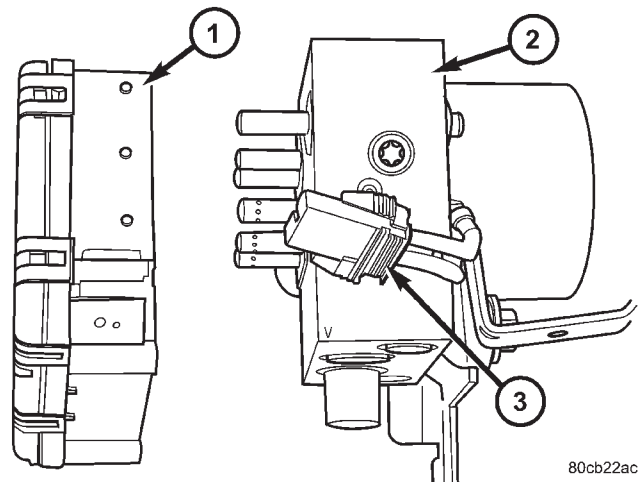
The data link connector is located at the lower edge of the instrument panel near the steering column (Fig. 7).



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**Fig. 5 HCU/CAB MOUNTING**

- 1 - HCU
- 2 - CAB
- 3 - HCU/CAB BRACKET
- 4 - MOUNTING NUTS AND STUDS
- 5 - MOTOR



80cb22ac

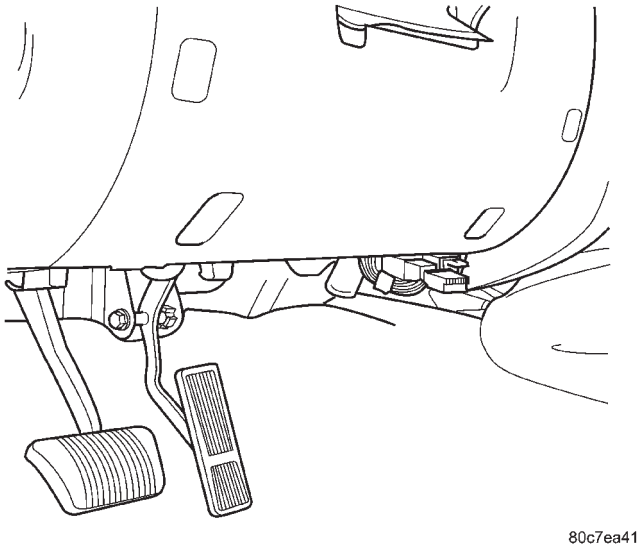
**Fig. 6 CONTROLLER AND HCU**

- 1 - CONTROLLER ANTILOCK BRAKE MODULE
- 2 - HYDRAULIC CONTROL UNIT (H.C.U)
- 3 - ELECTRICAL CONNECTOR

### OPERATION - DATA LINK CONNECTOR

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).

## DATA LINK CONNECTOR (Continued)



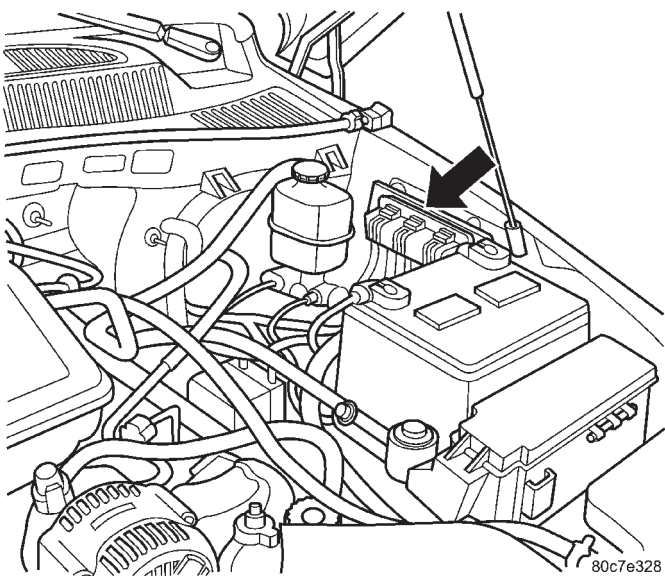
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**Fig. 7 DATA LINK CONNECTOR LOCATION**POWERTRAIN CONTROL  
MODULE

## DESCRIPTION

## DESCRIPTION - PCM

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 8). The PCM is referred to as JTEC.



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**Fig. 8 PCM LOCATION**

## DESCRIPTION - 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 PCM receives input signals and responds only according to preset PCM programming. Input from the oxygen (O<sub>2</sub>S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O<sub>2</sub>S) 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 O<sub>2</sub>S 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 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.

## POWERTRAIN CONTROL MODULE (Continued)

- 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 O<sub>2</sub>S sensor heater element is energized via the ASD or O<sub>2</sub>S heater relay. The O<sub>2</sub>S 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 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)
- 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 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 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
- 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 A/C compressor clutch relay. This is done if A/C has been selected by the vehicle operator and specified pressures are met at the high and low-pressure A/C switches. Refer to Heating and Air Conditioning for additional information.

- When engine has reached operating temperature, the PCM will begin monitoring O<sub>2</sub>S 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 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
- 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 O<sub>2</sub>S 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 A/C compressor clutch relay. This is done if A/C has been selected by the vehicle operator and specified pressures are met at the high and low-pressure A/C switches. Refer to Heating and Air Conditioning for additional information.

## CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

## POWERTRAIN CONTROL MODULE (Continued)

- 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
- Park/neutral switch (gear indicator signal—auto. trans. only)

- Oxygen (O<sub>2</sub>S) 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 O<sub>2</sub>S 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(s) 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 PCM recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The 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 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
- Park/neutral switch (gear indicator signal—auto. trans. only)

- Vehicle speed

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 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

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(s) 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 - 5 VOLT SUPPLIES**

Two different Powertrain Control Module (PCM) five volt supply circuits are used; primary and secondary.

**DESCRIPTION - IGNITION CIRCUIT SENSE**

This circuit ties the ignition switch to the Powertrain Control Module (PCM).

**DESCRIPTION - POWER GROUNDS**

The Powertrain Control Module (PCM) has 2 main grounds. Both of these grounds are referred to as power grounds. All of the high-current, noisy, electrical devices are connected to these grounds as well as all of the sensor returns. The sensor return comes into the sensor return circuit, passes through noise suppression, and is then connected to the power ground.

The power ground is used to control ground circuits for the following PCM loads:

- Generator field winding



## POWERTRAIN CONTROL MODULE (Continued)

- Fuel injectors
- Ignition coil(s)
- Certain relays/solenoids
- Certain sensors

**DESCRIPTION - SENSOR RETURN**

The Sensor Return circuits are internal to the Powertrain Control Module (PCM).

Sensor Return provides a low-noise ground reference for all engine control system sensors. Refer to Power Grounds for more information.

**OPERATION****OPERATION - PCM**

The PCM operates the fuel system. 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, power steering pump pressure, 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)
- A/C pressure transducer
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch

- J1850 bus (+) circuits
- J1850 bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connection for DRB scan tool
- Engine coolant temperature sensor
- Fuel level (through J1850 circuitry)
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
  - Intake manifold air temperature sensor
  - Knock sensors (2 on 3.7L engine)
  - Leak detection pump (switch) sense (if equipped)
  - Manifold absolute pressure (MAP) sensor
  - Oil pressure
  - Oxygen sensors
  - Park/neutral switch (auto. trans. only)
  - Power ground
  - Power steering pressure switch
  - Sensor return
  - Signal ground
  - Speed control multiplexed single wire input
  - Throttle position sensor
  - Transfer case switch (4WD range position)
  - Vehicle speed sensor

**NOTE: PCM Outputs:**

- A/C clutch relay
- Auto shutdown (ASD) relay
- J1850 bus (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
  - Clutch pedal position switch override relay
  - 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 (+)
  - Idle air control (IAC) motor
  - Ignition coil(s)
  - Leak detection pump (if equipped)
  - Malfunction indicator lamp (Check engine lamp). Driven through J1850 circuits.
    - Oxygen sensor heater relays
    - Oxygen sensors (pulse width modulated)
    - Radiator cooling fan relay (pulse width modulated)
    - Speed control vacuum solenoid
    - Speed control vent solenoid
    - Tachometer (if equipped). Driven through J1850 circuits.

## POWERTRAIN CONTROL MODULE (Continued)

- Transmission convertor clutch circuit. Driven through J1850 circuits.

**OPERATION - 5 VOLT SUPPLIES**

Primary 5-volt supply:

- supplies the required 5 volt power source to the Crankshaft Position (CKP) sensor.
- supplies the required 5 volt power source to the Camshaft Position (CMP) sensor.
- supplies a reference voltage for the Manifold Absolute Pressure (MAP) sensor.
- supplies a reference voltage for the Throttle Position Sensor (TPS) sensor.

Secondary 5-volt supply:

- supplies the required 5 volt power source to the oil pressure sensor.
- supplies the required 5 volt power source for the Vehicle Speed Sensor (VSS) (if equipped).
- supplies the 5 volt power source to the transmission pressure sensor (certain automatic transmissions).

**OPERATION - IGNITION CIRCUIT SENSE**

The ignition circuit sense input tells the PCM the ignition switch has energized the ignition circuit.

Battery voltage is also supplied to the PCM through the ignition switch when the ignition is in the RUN or START position. This is referred to as the "ignition sense" circuit and is used to "wake up" the PCM. Voltage on the ignition input can be as low as 6 volts and the PCM will still function. Voltage is supplied to this circuit to power the PCM's 8-volt regulator and to allow the PCM to perform fuel, ignition and emissions control functions.

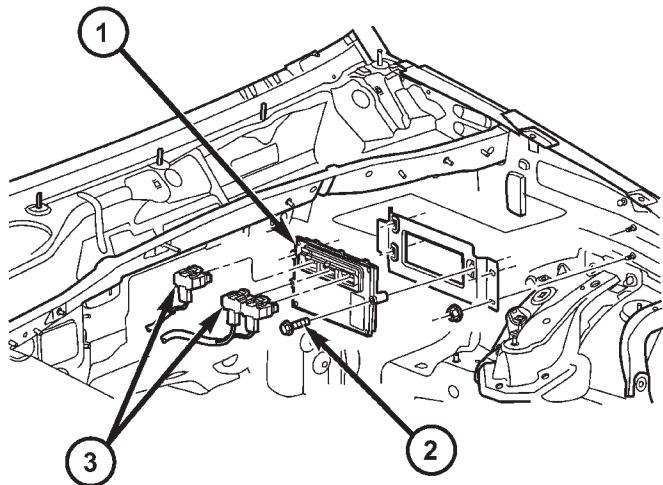
**REMOVAL**

**USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.**

The PCM is located in the engine compartment near the battery (Fig. 9).

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 at battery.
- (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.



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**Fig. 9 PCM REMOVE/INSTALL**

- 1 - PCM
- 2 - MOUNTING BOLTS (3)
- 3 - 32-WAY CONNECTORS

**INSTALLATION**

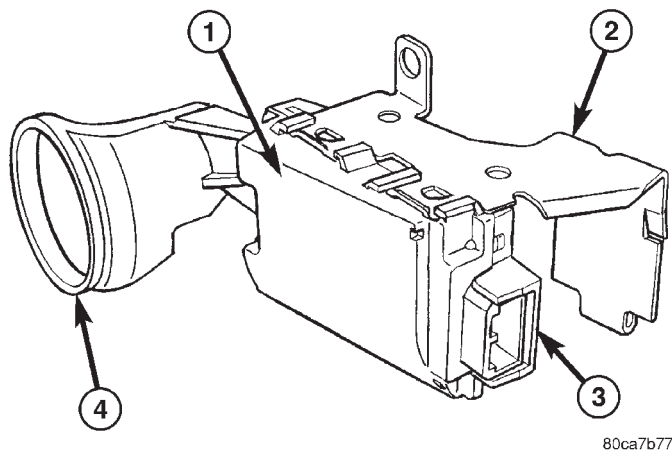
**USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.**

- (1) Install PCM and 3 mounting bolts to vehicle.
- (2) Tighten bolts. Refer to torque specifications.
- (3) Check pin connectors in the PCM and the three 32-way connectors for corrosion or damage. Also, the pin heights in connectors should all be same. Repair as necessary before installing connectors.
- (4) Install three 32-way connectors.
- (5) Install cover over electrical connectors. Cover snaps onto PCM.
- (6) Install battery cable.
- (7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage.

**SENTRY KEY IMMOBILIZER MODULE****DESCRIPTION**

The Sentry Key Immobilizer Module (SKIM) is the primary component of the Sentry Key Immobilizer System (SKIS) (Fig. 10). The SKIM is located on the right side of the steering column, below the ignition

## SENTRY KEY IMMOBILIZER MODULE (Continued)



**Fig. 10 Sentry Key Immobilizer Module**

- 1 - SKIM
- 2 - BRACKET
- 3 - CONNECTOR RECEPTACLE
- 4 - ANTENNA RING

lock cylinder housing and is concealed beneath the steering column shrouds. The molded black plastic housing for the SKIM has an integral molded plastic halo-like antenna ring that extends from one end. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the circumference of the ignition lock cylinder housing. A single integral connector receptacle containing six terminal pins is located on the opposite end of the SKIM housing from the antenna ring. A stamped metal mounting bracket secured to the SKIM housing has a U-shaped clip formation that is used to secure the unit to the right lower flange of the steering column jacket.

The SKIM cannot be adjusted or repaired. If faulty or damaged, the entire SKIM unit must be replaced.

## OPERATION

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a microprocessor. The SKIM transmits RF signals to, and receives RF signals from the Sentry Key transponder through a tuned antenna enclosed within the molded plastic antenna ring integral to the SKIM housing. If this antenna ring is not mounted properly around the ignition lock cylinder housing, communication problems between the SKIM and the transponder may arise. These communication problems will result in Sentry Key transponder-related faults. The SKIM also communicates over the Programmable Communications Interface (PCI) data bus with the Powertrain Control Module (PCM), the ElectroMechanical Instrument Cluster (EMIC) and/or the DRBIII® scan tool.

The SKIM retains in memory the ID numbers of any Sentry Key transponder that is programmed into it. A maximum of eight Sentry Key transponders can be programmed into the SKIM. For added system security, each SKIM is programmed with a unique Secret Key code. This code is stored in memory, sent over the PCI data bus to the PCM, and is encoded to the transponder of every Sentry Key that is programmed into the SKIM. Therefore, the Secret Key code is a common element that is found in every component of the Sentry Key Immobilizer System (SKIS). Another security code, called a PIN, is used to gain access to the SKIM Secured Access Mode. The Secured Access Mode is required during service to perform the SKIS initialization and Sentry Key transponder programming procedures. The SKIM also stores the Vehicle Identification Number (VIN) in its memory, which it learns through a PCI data bus message from the PCM during SKIS initialization.

In the event that a SKIM replacement is required, the Secret Key code can be transferred to the new SKIM from the PCM using the DRBIII® scan tool and the SKIS initialization procedure. Proper completion of the SKIS initialization will allow the existing Sentry Keys to be programmed into the new SKIM so that new keys will not be required. In the event that the original Secret Key code cannot be recovered, SKIM replacement will also require new Sentry Keys. The DRBIII® scan tool will alert the technician during the SKIS initialization procedure if new Sentry Keys are required.

When the ignition switch is turned to the On position, the SKIM transmits an RF signal to the transponder in the ignition key. The SKIM then waits for an RF signal response from the transponder. If the response received identifies the key as valid, the SKIM sends a valid key message to the PCM over the PCI data bus. If the response received identifies the key as invalid, or if no response is received from the key transponder, the SKIM sends an invalid key message to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages. It is important to note that the default condition in the PCM is an invalid key; therefore, if no message is received from the SKIM by the PCM, the engine will be disabled and the vehicle immobilized after two seconds of running.

The SKIM also sends SKIS indicator status messages to the EMIC over the PCI data bus to tell the EMIC how to operate the SKIS indicator. This indicator status message tells the EMIC to turn the indicator on for about three seconds each time the ignition switch is turned to the On position as a bulb test. After completion of the bulb test, the SKIM sends indicator status messages to the EMIC to turn the indicator off, turn the indicator on, or to flash the

## SENTRY KEY IMMOBILIZER MODULE (Continued)

indicator on and off. If the SKIS indicator flashes upon ignition On or stays on solid after the bulb test, it signifies a SKIS fault. If the SKIM detects a system malfunction and/or the SKIS has become inoperative, the SKIS indicator will stay on solid. If the SKIM detects an invalid key or if a key transponder-related fault exists, the SKIS indicator will flash. If the vehicle is equipped with the Customer Learn transponder programming feature, the SKIM will also send messages to the EMIC to flash the SKIS indicator and to generate a single audible chime tone whenever the Customer Learn programming mode is being utilized. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SENTRY KEY TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store fault information in the form of Diagnostic Trouble Codes (DTC's) in SKIM memory if a system malfunction is detected. The SKIM can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## REMOVAL

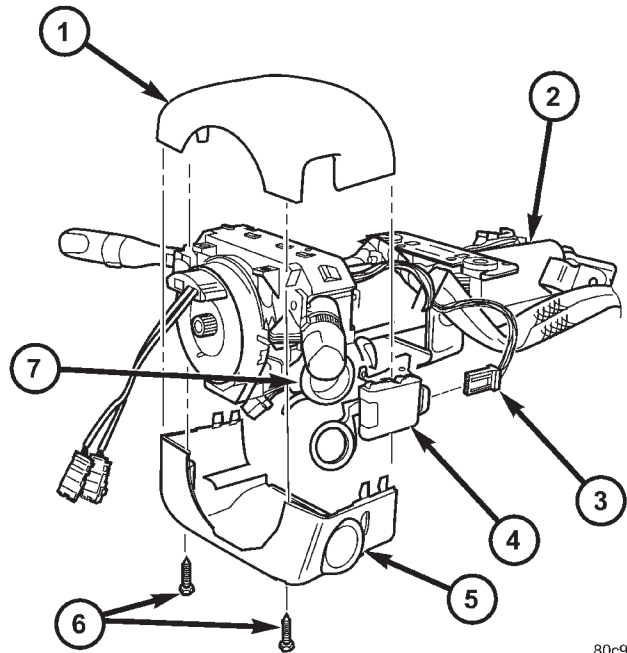
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(3) From below the steering column, remove the two screws that secure the lower shroud to the upper shroud (Fig. 11).

(4) Using hand pressure, push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the



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**Fig. 11 Sentry Key Immobilizer Module Remove/Install**

- 1 - UPPER SHROUD
- 2 - STEERING COLUMN
- 3 - WIRE HARNESS CONNECTOR
- 4 - SENTRY KEY IMMOBILIZER MODULE
- 5 - LOWER SHROUD
- 6 - SCREW (2)
- 7 - IGNITION LOCK CYLINDER HOUSING

snap features that secure the two halves to each other.

(5) Remove both the upper and lower shrouds from the steering column.

(6) Disconnect the instrument panel wire harness connector for the SKIM from the module connector receptacle.

(7) The SKIM mounting bracket features a clip formation that secures the SKIM to the right lower flange of the steering column jacket. Pull downward on the connector end of the SKIM mounting bracket to release this clip from the steering column jacket.

(8) Rotate the SKIM and its mounting bracket downwards and then to the side away from the steering column to slide the SKIM antenna ring from around the ignition switch lock cylinder housing. Lift the multi-function switch upward off of the upper steering column housing far enough to remove the SKIM antenna ring formation from between the ignition key release button and the multi-function switch housing.

(9) Remove the SKIM from the steering column.

## SENTRY KEY IMMOBILIZER MODULE (Continued)

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the Sentry Key Immobilizer Module (SKIM) to the right side of the steering column (Fig. 11). Lift the multi-function switch upward off of the upper steering column housing far enough to insert the SKIM antenna ring formation between the ignition key release button and the multi-function switch housing.

(2) Slide the SKIM antenna ring around the ignition switch lock cylinder housing, then rotate the SKIM and its mounting bracket upwards and toward the steering column.

(3) Align the SKIM mounting bracket clip formation with the right lower flange of the steering column jacket and, using hand pressure, push upward firmly and evenly on the connector end of the SKIM mounting bracket to engage this clip with the steering column jacket.

(4) Reconnect the instrument panel wire harness connector for the SKIM to the module connector receptacle.

(5) Position both the upper and lower shrouds onto the steering column.

(6) Align the snap features on the lower shroud with the receptacles on the upper shroud and apply hand pressure to snap them together.

(7) From below the steering column, install and tighten the two screws that secure the lower shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(8) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully raised position and secure it in place by moving the tilt release lever back to the locked (up) position.

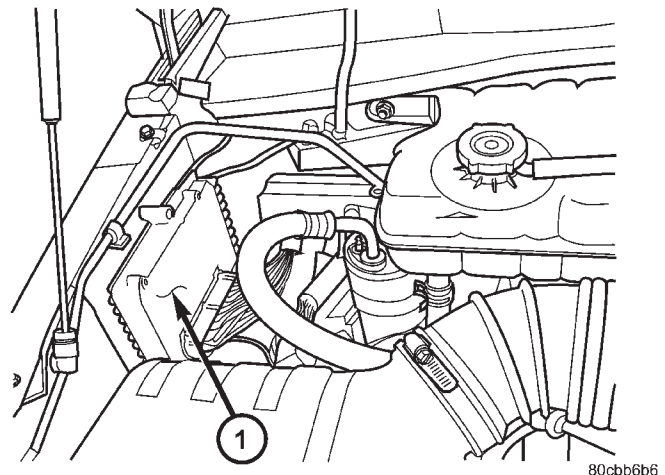
(9) Reconnect the battery negative cable.

**NOTE: If the SKIM has been replaced with a new unit, the Sentry Key Immobilizer System (SKIS) MUST be initialized before the vehicle can be operated. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - SKIS INITIALIZATION).**

## TRANSMISSION CONTROL MODULE

## DESCRIPTION

The Transmission Control Module (TCM) is located in the engine compartment on the right (passenger) side and is mounted to the inner fender (Fig. 12).



**Fig. 12 Transmission Control Module Location**

1 - Transmission Control Module

## OPERATION

The Transmission Control Module (TCM) is the controlling unit for all electronic operations of the transmission. The TCM receives information regarding vehicle operation from both direct and indirect inputs, and selects the operational mode of the transmission. Direct inputs are hardwired to, and used specifically by the TCM. Indirect inputs originate from other components/modules, and are shared with the TCM via the vehicle communication bus.

Some examples of **direct inputs** to the TCM are:

- Battery (B+) voltage
- Ignition "ON" voltage
- Transmission Control Relay (Switched B+)
- Throttle Position Sensor
- Crankshaft Position Sensor
- Transmission Range Sensor
- Pressure Switches
- Transmission Temperature Sensor
- Input Shaft Speed Sensor

TRANSMISSION CONTROL MODULE (Continued)

- Output Shaft Speed Sensor
- Line Pressure Sensor

Some examples of **indirect inputs** to the TCM are:

- Engine/Body Identification
- Manifold Pressure
- Target Idle
- Torque Reduction Confirmation
- Engine Coolant Temperature
- Ambient/Battery Temperature
- DRB® Scan Tool Communication

Based on the information received from these various inputs, the TCM determines the appropriate shift schedule and shift points, depending on the present operating conditions and driver demand. This is possible through the control of various direct and indirect outputs.

Some examples of TCM **direct outputs** are:

- Transmission Control Relay
- Solenoids
- Torque Reduction Request

Some examples of TCM **indirect outputs** are:

- Transmission Temperature (to PCM)
- PRNDL Position (to BCM)

In addition to monitoring inputs and controlling outputs, the TCM has other important responsibilities and functions:

- Storing and maintaining Clutch Volume Indexes (CVI)
- Storing and selecting appropriate Shift Schedules
- System self-diagnostics
- Diagnostic capabilities (with DRB® scan tool)

**NOTE: If the TCM has been replaced, the “Quick Learn Procedure” must be performed. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)**

**BATTERY FEED**

A fused, direct battery feed to the TCM is used for continuous power. This battery voltage is necessary to retain adaptive learn values in the TCM’s RAM (Random Access Memory). When the battery (B+) is disconnected, this memory is lost. When the battery (B+) is restored, this memory loss is detected by the TCM and a Diagnostic Trouble Code (DTC) is set.

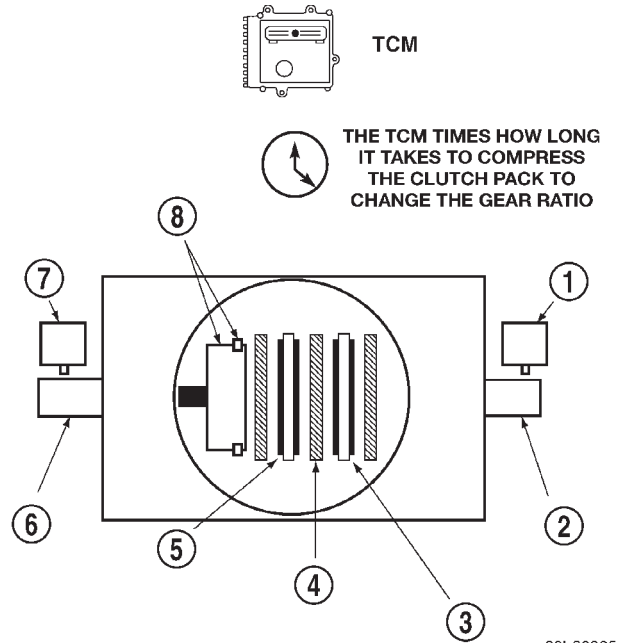
**CLUTCH VOLUME INDEXES (CVI)**

An important function of the TCM is to monitor Clutch Volume Indexes (CVI). CVIs represent the volume of fluid needed to compress a clutch pack.

The TCM monitors gear ratio changes by monitoring the Input and Output Speed Sensors. The Input, or Turbine Speed Sensor sends an electrical signal to the TCM that represents input shaft rpm. The Out-

put Speed Sensor provides the TCM with output shaft speed information.

By comparing the two inputs, the TCM can determine transmission gear position. This is important to the CVI calculation because the TCM determines CVIs by monitoring how long it takes for a gear change to occur (Fig. 13).



**Fig. 13 Example of CVI Calculation**

- 1 - OUTPUT SPEED SENSOR
- 2 - OUTPUT SHAFT
- 3 - CLUTCH PACK
- 4 - SEPARATOR PLATE
- 5 - FRICTION DISCS
- 6 - INPUT SHAFT
- 7 - INPUT SPEED SENSOR
- 8 - PISTON AND SEAL

Gear ratios can be determined by using the DRB® Scan Tool and reading the Input/Output Speed Sensor values in the “Monitors” display. Gear ratio can be obtained by dividing the Input Speed Sensor value by the Output Speed Sensor value.

For example, if the input shaft is rotating at 1000 rpm and the output shaft is rotating at 500 rpm, then the TCM can determine that the gear ratio is 2:1. In direct drive (3rd gear), the gear ratio changes to 1:1. The gear ratio changes as clutches are applied and released. By monitoring the length of time it takes for the gear ratio to change following a shift request, the TCM can determine the volume of fluid used to apply or release a friction element.

The volume of transmission fluid needed to apply the friction elements are continuously updated for adaptive controls. As friction material wears, the volume of fluid need to apply the element increases.

TRANSMISSION CONTROL MODULE (Continued)

Certain mechanical problems within the input clutch assembly (broken return springs, out of position snap rings, excessive clutch pack clearance, improper assembly, etc.) can cause inadequate or out-of-range element volumes. Also, defective Input/Output Speed Sensors and wiring can cause these conditions. The following chart identifies the appropriate clutch volumes and when they are monitored/updated:

CLUTCH VOLUMES		
Clutch	When Updated	Proper Clutch Volume
L/R	2-1 or 3-1 downshift	45 to 134
2C	3-2 kickdown shift	25 to 85
OD	2-3 upshift	30 to 100

CLUTCH VOLUMES		
4C	3-4 upshift	30 to 85
UD	4-3 kickdown shift	30 to 100

**SHIFT SCHEDULES**

As mentioned earlier, the TCM has programming that allows it to select a variety of shift schedules. Shift schedule selection is dependent on the following:

- Shift lever position
- Throttle position
- Engine load
- Fluid temperature
- Software level

As driving conditions change, the TCM appropriately adjusts the shift schedule. Refer to the following chart to determine the appropriate operation expected, depending on driving conditions.

Schedule	Condition	Expected Operation
<b>Extreme Cold</b>	Oil temperature below -16° F	-Park, Reverse, Neutral and 1st and 3rd gear only in D position, 2nd gear only in Manual 2 or L -No EMCC
<b>Super Cold</b>	Oil temperature between -12° F and 10° F	- Delayed 2-3 upshift - Delayed 3-4 upshift - Early 4-3 coastdown shift - High speed 4-2, 3-2, 2-1 kickdown shifts are prevented -Shifts at high throttle openings will be early. - No EMCC
<b>Cold</b>	Oil temperature between 10° F and 36° F	-Shift schedule is the same as Super Cold except that the 2-3 upshifts are not delayed.
<b>Warm</b>	Oil temperature between 40° F and 80° F	- Normal operation (upshift, kickdowns, and coastdowns) - No EMCC
<b>Hot</b>	Oil temperature between 80° F and 240° F	- Normal operation (upshift, kickdowns, and coastdowns) - Normal EMCC operation

TRANSMISSION CONTROL MODULE (Continued)

Schedule	Condition	Expected Operation
Overheat	Oil temperature above 240° F or engine coolant temperature above 244° F	- Delayed 2-3 upshift - Delayed 3-4 upshift - 3rd gear FEMCC from 30-48 mph - 3rd gear PEMCC above 35 mph - Above 25 mph the torque converter will not unlock unless the throttle is closed or if a wide open throttle 2nd PEMCC to 1 kickdown is made

**STANDARD PROCEDURE - TCM QUICK LEARN**

The quick learn procedure requires the use of the DRB® scan tool.

This program allows the electronic transmission system to recalibrate itself. This will provide the proper transmission operation. The quick learn procedure should be performed if any of the following procedures are performed:

- Transmission Assembly Replacement
- Transmission Control Module Replacement
- Solenoid Pack Replacement
- Clutch Plate and/or Seal Replacement
- Valve Body Replacement or Recondition

To perform the Quick Learn Procedure, the following conditions must be met:

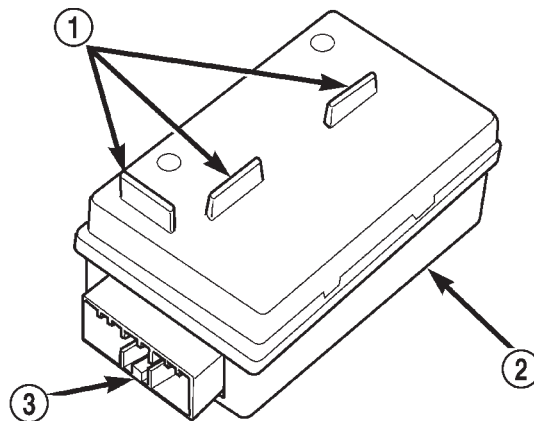
- The brakes must be applied
- The engine speed must be above 500 rpm
- The throttle angle (TPS) must be less than 3 degrees
- The shift lever position must stay in PARK until prompted to shift to overdrive
- The shift lever position must stay in overdrive after the Shift to Overdrive prompt until the DRB® indicates the procedure is complete
- The calculated oil temperature must be above 60° and below 200°

**HEATED SEAT MODULE**

**DESCRIPTION**

The heated seat module is also known as the Seat Heat Interface Module. The heated seat module (Fig. 14) is located under the left front seat cushion, where it is secured to a mounting bracket via two push-pin retainers. The heated seat module has a single connector receptacle that allows the module to be connected to all of the required inputs and outputs through the seat wire harness.

The heated seat module is an electronic microprocessor controlled device designed and programmed to use inputs from the heated seat relay, the two heated



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**Fig. 14 Heated Seat Module**

- 1 - Mounting Tabs (Not Used On KJ)
- 2 - Heated Seat Module
- 3 - Connector Receptacle

seat switches and the two heated seat sensors to operate and control the heated seat elements in both front seats and the two heated seat indicator lamp Light-Emitting Diodes (LEDs) in each heated seat switch. The heated seat module is also programmed to perform self-diagnosis of certain heated seat system functions and provide feedback of that diagnosis through the heated seat switch indicator lamps.

The heated seat module cannot be repaired. If the heated seat module is damaged or faulty, the entire module must be replaced.

**OPERATION**

The heated seat module operates on fused battery current received from a fuse in the junction block. The module is grounded at all times. Inputs to the module include a resistor multiplexed heated seat switch request circuit for each of the two heated seat switches and the heated seat sensor inputs from the seat cushions of each front seat. In response to those inputs, the heated seat module controls battery current to the heated seat elements and sensors, and



## HEATED SEAT MODULE (Continued)

controls the ground for the heated seat switch indicator lamps (LED's).

When a heated seat switch (Driver or Passenger) is depressed a signal is received by the heated seat module, the module energizes the proper indicator LED (Low or High) in the switch by grounding the indicator lamp circuit to indicate that the heated seat system is operating. At the same time, the heated seat module energizes the selected heated seat sensor circuit and the sensor provides the module with an input indicating the surface temperature of the selected seat cushion.

The Low heat set point is about 36° C (96.8° F), and the High heat set point is about 42° C (107.6° F). If the seat cushion surface temperature input is below the temperature set point for the selected temperature setting, the heated seat module energizes an N-channel Field Effect Transistor (N-FET) within the module which energizes the heated seat elements in the selected seat cushion and back. When the sensor input to the module indicates the correct temperature set point has been achieved, the module de-energizes the N-FET which de-energizes the heated seat elements. The heated seat module will continue to cycle the N-FET as needed to maintain the selected temperature set point.

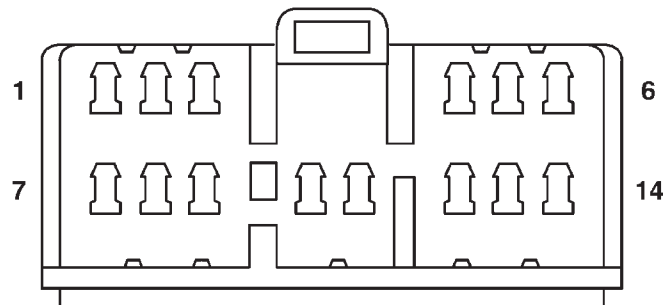
If the heated seat module detects a heated seat sensor value input that is out of range or a shorted or open heated seat element circuit, it will notify the vehicle operator or the repair technician of this condition by flashing the High and/or Low indicator lamps in the affected heated seat switch. Refer to **Diagnosis and Testing Heated Seat System** in Heated Systems for flashing LED diagnosis and testing procedures. Refer to **Diagnosis and Testing Heated Seat Module** in this section for heated seat module diagnosis and testing procedures. Also refer to the Body Diagnostic Manual for additional diagnosis and testing procedures.

## DIAGNOSIS AND TESTING - HEATED SEAT MODULE

If a heated seat fails to heat and one or both of the indicator lamps on a heated seat switch flash, refer to **Heated Seat System Diagnosis and Testing** in Heated Systems for flashing LED failure identification. Refer to **Wiring Diagrams** in for complete heated seat system wiring diagrams.

(1) Remove the heated seat module from its mounting location (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/MEMORY HEATED SEAT/MIRROR MODULE - REMOVAL).

**NOTE: ANY RESISTANCE VALUES (OHMS  $\Omega$ ) GIVEN IN THE FOLLOWING TEXT ARE SUPPLIED USING THE AUTOMATIC RANGE GENERATED BY A FLUKE® AUTOMOTIVE METER. IF ANOTHER TYPE OF MEASURING DEVICE IS USED THE VALUES GENERATED MAY NOT BE THE SAME AS THE RESULTS SHOWN HERE, OR MAY HAVE TO BE CONVERTED TO THE RANGE USED HERE.**



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**Fig. 15 Heated Seat Module Electrical Connector**

### RIGHT SEAT HEATER INOPERATIVE

(1) If a heated seat heats but one or both indicator lamps (LED's) on the heated seat switch fail to illuminate, check the driver circuit with the inoperative LED for a short to ground. If OK, replace the heated seat switch. If NOT OK repair the short to ground as required and then replace the heated seat switch.

**NOTE: IF THE RIGHT SEAT CUSHION IS ALREADY WARM THE FOLLOWING STEP WILL NOT PROVE CONCLUSIVE.**

(2) Back-probe the heated seat module wire harness connector (Fig. 15), do not disconnect. Check cavity #3 for battery voltage when the right heated seat switch is turned "ON", voltage should be present, If OK go to Step 3 If NOT OK, test the right heated seat switch (Refer to 8 - ELECTRICAL/HEATED SEATS/PASSENGER HEATED SEAT SWITCH - DIAGNOSIS AND TESTING). If the switch tests OK, check for continuity between the switch and control module on the MUX circuit, If OK replace the heated seat control module. If NOT OK, repair the open or shorted MUX circuit as required.

## HEATED SEAT MODULE (Continued)

**NOTE: BE CERTAIN THE BATTERY IS FULLY CHARGED BEFORE TESTING. FAILURE TO DO SO CAN RESULT IN INCORRECT READINGS.**

(3) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #10 for battery voltage, while observing the voltmeter depress the right heated seat switch **low** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 4. If NOT OK check for continuity between the switch and control module on the low heat driver circuit, If OK replace the heated seat control module.

(4) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #11 for battery voltage, while observing the voltmeter depress the right heated seat switch **high** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 5. If NOT OK check for continuity between the switch and control module on the high heat driver circuit, If OK replace the heated seat control module.

(5) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #2 for approx. 5v, voltage should be present, If OK go to Step 6. If NOT OK replace the heated seat control module.

(6) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #7 for a range in voltage from 1.72v (warm seat) – 3.0v (cold seat). It should be within this range, If OK replace the heated seat module. If NOT OK test the Heated Seat Sensor. If NOT OK, replace the right heated seat element and sensor assembly. If the heated seat sensor tests OK, check for continuity between the right heated seat cushion connector and control module connector on the 5v supply circuit, If NOT OK, repair the open or shorted 5v supply circuit as required. If OK check for continuity between the right heated seat cushion connector and control module connector on the temperature sensor input circuit. If NOT OK, repair the open or shorted temperature sensor input circuit as required. If OK replace the heated seat control module.

**LEFT SEAT HEATER INOPERATIVE**

(1) If a heated seat heats but one or both indicator lamps (LED's) on the heated seat switch fail to illuminate, check the driver circuit with the inoperative LED for a short to ground. If OK, replace the heated seat switch. If NOT OK repair the short to ground as required and then replace the heated seat switch.

**NOTE: IF THE LEFT SEAT CUSHION IS ALREADY WARM THE FOLLOWING STEP WILL NOT PROVE CONCLUSIVE.**

(2) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #5 for battery voltage when the left heated seat switch is turned "ON", voltage should be present, If OK go to Step 3 If NOT OK, test the left heated seat switch (Refer to 8 - ELECTRICAL/HEATED SEATS/DRIVER HEATED SEAT SWITCH - DIAGNOSIS AND TESTING). If the switch tests OK, check for continuity between the switch and control module on the MUX circuit, If OK replace the heated seat control module. If NOT OK, repair the open or shorted MUX circuit as required.

(3) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #12 for battery voltage, while observing the voltmeter depress the left heated seat switch **low** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 4. If NOT OK check for continuity between the switch and control module on the low heat driver circuit, If OK replace the heated seat control module.

(4) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #14 for battery voltage, while observing the voltmeter depress the left heated seat switch **high** setting twice, voltage should toggle between approx.12v and 8v, If OK go to Step 5. If NOT OK check for continuity between the switch and control module on the high heat driver circuit, If OK replace the heated seat control module.

(5) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #2 for approx. 5v, 5 voltage should be present, If OK go to Step 6. If NOT OK replace the heated seat control module.

(6) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #8 for a range in voltage from 1.72v (warm seat) – 3.0v (cold seat). It should be within this range, If OK replace the heated seat control module. If NOT OK, test the Heated Seat Sensor. If NOT OK, replace the left heated seat element and sensor assembly. If the heated seat sensor tests OK, check for continuity between the left heated seat cushion connector and control module connector on the 5v supply circuit, If NOT OK, repair the open or shorted 5v supply circuit as required. If OK check for continuity between the left heated seat cushion connector and control module connector on the temperature sensor input circuit. If NOT OK, repair the open or shorted temperature sensor input circuit as required. If OK replace the heated seat control module.

## HEATED SEAT MODULE (Continued)

**BOTH SEATS INOPERATIVE**

If both seats (driver and passenger) fail to heat and the indicator lamps on the heated seat switches for both seats fail to operate, test the heated seat fuses in the junction block. If the heated seat fuses check OK, go to Step 1.

(1) Back-probe the heated seat module wire harness connector, do not disconnect. Check for continuity between the ground circuit cavity #13 of the heated seat module connector and a good ground. If OK go to Step 2. If NOT OK, repair the open or shorted ground circuit as required.

(2) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #4 and #6 for battery voltage, voltage should be present, If OK go to Step 3. If NOT OK repair the open or shorted fused B(+) circuit as required.

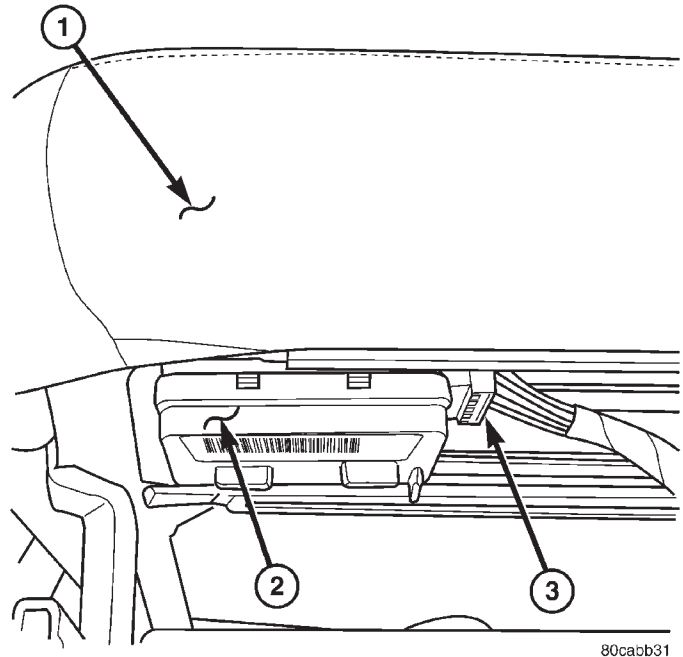
(3) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity #2 for approx. 5v, voltage should be present, replace the heated seat control module with a known good module and verify system operation.

**REMOVAL**

(1) Working under the front seat cushion (Fig. 16), remove the heated seat module from its mounting bracket by gently prying the module off of the two mounting pushpins.

(2) Disconnect the seat wire harness connector from the connector receptacle on the side of the heated seat module.

(3) Remove the heated seat module from the vehicle.



**Fig. 16 Heated Seat Module Location**

- 1 - Front Seat Cushion
- 2 - Heated Seat Module
- 3 - Electrical Connector

**INSTALLATION**

(1) Connect the seat wire harness connector to the connector receptacle on the side of the heated seat module.

(2) Install the heated seat module on its mounting bracket under the front seat.

(3) Verify heated seat system operation.

# ENGINE SYSTEMS

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# BATTERY SYSTEM

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## BATTERY SYSTEM

### DESCRIPTION

A single 12-volt battery system is standard factory-installed equipment on this model. All of the components of the battery system are located within the engine compartment of the vehicle. The service information for the battery system in this vehicle covers the following related components, which are covered in further detail elsewhere in this service manual:

- **Battery** - The storage battery provides a reliable means of storing a renewable source of electrical energy within the vehicle.
- **Battery Cable** - The battery cables connect the battery terminal posts to the vehicle electrical system.
- **Battery Holddown** - The battery holddown hardware secures the battery in the battery tray in the engine compartment.

## BATTERY SYSTEM (Continued)

- **Battery Thermal Guard** - The battery thermal guard insulates the battery to protect it from engine compartment temperature extremes.

- **Battery Tray** - The battery tray provides a secure mounting location in the vehicle for the battery and an anchor point for the battery holddown hardware.

For battery system maintenance schedules and jump starting procedures, see the owner's manual in the vehicle glove box. Optionally, refer to Lubrication and Maintenance for the proper battery jump starting procedures. While battery charging can be considered a maintenance procedure, the battery charging procedures and related information are located in the service procedures section of this service manual. This was done because the battery must be fully-charged before any battery system diagnosis or testing procedures can be performed. Refer to Standard Procedures for the proper battery charging procedures.

## OPERATION

The battery system is designed to provide a safe, efficient, reliable and mobile means of delivering and storing electrical energy. This electrical energy is required to operate the engine starting system, as well as to operate many of the other vehicle accessory systems for limited durations while the engine and/or the charging system are not operating. The battery system is also designed to provide a reserve of electrical energy to supplement the charging system for short durations while the engine is running and the electrical current demands of the vehicle exceed the output of the charging system. In addition to delivering, and storing electrical energy for the vehicle, the battery system serves as a capacitor and voltage stabilizer for the vehicle electrical system. It absorbs most abnormal or transient voltages caused by the switching of any of the electrical components or circuits in the vehicle.

## DIAGNOSIS AND TESTING - BATTERY SYSTEM

The battery, starting, and charging systems in the vehicle operate with one another and must be tested

as a complete system. In order for the engine to start and the battery to maintain its charge properly, all of the components that are used in these systems must perform within specifications. 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 battery discharge, overcharging or early battery failure must be diagnosed and corrected before a battery is replaced and before a vehicle is returned to service. The service information for these systems has been separated within this service manual to make it easier to locate the specific information you are seeking. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used for the battery, starting, and charging systems include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, a volt/ohmmeter, a battery charger, a carbon pile rheostat (load tester) and a 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 Charging System for the proper charging system on-board diagnostic test procedures.

## MIDTRONICS ELECTRICAL SYSTEM TESTER

The Midtronics® automotive battery and charging system tester is designed to help the dealership technicians diagnose the cause of a defective battery or charging system. Follow the instruction manual supplied with the tester to properly diagnose a vehicle. If the instruction manual is not available refer to the standard procedure in this section, which includes the directions for using the midtronics electrical system tester.

BATTERY SYSTEM (Continued)

BATTERY SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
THE BATTERY SEEMS WEAK OR DEAD WHEN ATTEMPTING TO START THE ENGINE.	<ol style="list-style-type: none"> <li>1. The electrical system ignition-off draw is excessive.</li> <li>2. The charging system is faulty.</li> <li>3. The battery is discharged.</li> <li>4. The battery terminal connections are loose or corroded.</li> <li>5. The battery has an incorrect size or rating for this vehicle.</li> <li>6. The battery is faulty.</li> <li>7. The starting system is faulty.</li> <li>8. The battery is physically damaged.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to the IGNITION-OFF DRAW TEST Standard Procedure for the proper test procedures. Repair the excessive ignition-off draw, as required.</li> <li>2. Determine if the charging system is performing to specifications using the Midtronics battery and charging system tester. Refer to Charging System for additional charging system diagnosis and testing procedures. Repair the faulty charging system, as required.</li> <li>3. Determine the battery state-of-charge using the Midtronics battery and charging system tester. Refer to the Standard Procedures in this section for additional test procedures. Charge the faulty battery, as required.</li> <li>4. Refer to Battery Cables for the proper battery cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.</li> <li>5. Refer to Battery System Specifications for the proper size and rating. Replace an incorrect battery, as required.</li> <li>6. Determine the battery cranking capacity using the Midtronics battery and charging system tester. Refer to the Standard Procedures in this section for additional test procedures. Replace the faulty battery, as required.</li> <li>7. Determine if the starting system is performing to specifications. Refer to Starting System for the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required.</li> <li>8. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the damaged battery, as required.</li> </ol>

## BATTERY SYSTEM (Continued)

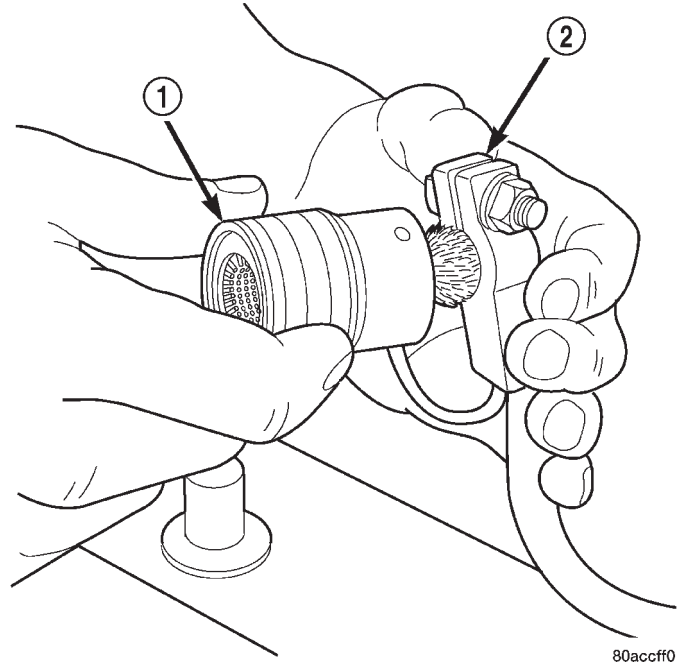
BATTERY SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
THE BATTERY STATE OF CHARGE CANNOT BE MAINTAINED.	<ol style="list-style-type: none"> <li>1. The battery has an incorrect size or rating for this vehicle.</li> <li>2. The battery terminal connections are loose or corroded.</li> <li>3. The electrical system ignition-off draw is excessive.</li> <li>4. The battery is faulty.</li> <li>5. The starting system is faulty.</li> <li>6. The charging system is faulty.</li> <li>7. Electrical loads exceed the output of the charging system.</li> <li>8. Slow driving or prolonged idling with high-amperage draw systems in use.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to Battery System Specifications for the proper specifications. Replace an incorrect battery, as required.</li> <li>2. Refer to Battery Cable for the proper cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.</li> <li>3. Refer to the IGNITION-OFF DRAW TEST Standard Procedure for the proper test procedures. Repair the faulty electrical system, as required.</li> <li>4. Test the battery using the Midtronics battery and charging system tester. Refer to Standard Procedures for additional test procedures. Replace the faulty battery, as required.</li> <li>5. Determine if the starting system is performing to specifications. Refer to Starting System for the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required.</li> <li>6. Determine if the charging system is performing to specifications using the Midtronics battery and charging system tester.. Refer to Charging System for additional charging system diagnosis and testing procedures. Repair the faulty charging system, as required.</li> <li>7. Inspect the vehicle for aftermarket electrical equipment which might cause excessive electrical loads.</li> <li>8. Advise the vehicle operator, as required.</li> </ol>
THE BATTERY WILL NOT ACCEPT A CHARGE.	<ol style="list-style-type: none"> <li>1. The battery is faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test the battery using the Midtronics battery and charging system tester.. Charge or replace the faulty battery, as required.</li> </ol>

BATTERY SYSTEM (Continued)

**ABNORMAL BATTERY DISCHARGING**

Any of the following conditions can result in abnormal battery discharging:

- A faulty or incorrect charging system component. Refer to Charging System for the proper charging system diagnosis and testing procedures.
- A faulty or incorrect battery. Refer to Standard Procedures for the proper battery diagnosis and testing procedures. Refer to Battery System Specifications for the proper specifications.
- A faulty circuit or component causing excessive ignition-off draw.
- Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
- A faulty or incorrect starting system component. Refer to Starting System for the proper starting system diagnosis and testing procedures.
- Corroded or loose battery posts and terminal clamps.
- A loose or worn generator drive belt.
- Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.



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**Fig. 1 Clean Battery Cable Terminal Clamp - Typical**

- 1 - TERMINAL BRUSH
- 2 - BATTERY CABLE

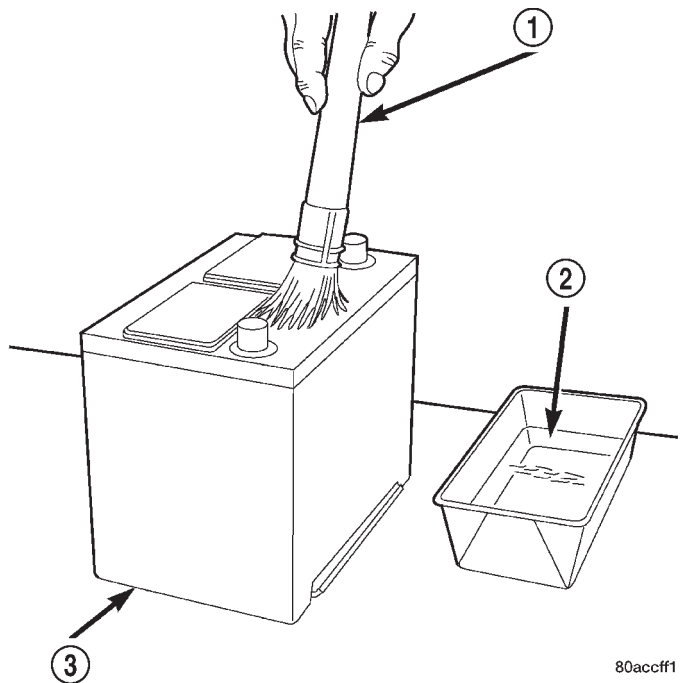
**CLEANING**

The following information details the recommended cleaning procedures for the battery and related components. In addition to the maintenance schedules found in this service manual and the owner's manual, it is recommended that these procedures be performed any time the battery or related components must be removed for vehicle service.

(1) Clean the battery cable terminal clamps of all corrosion. 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. 1).

(2) Clean the battery tray and battery holddown hardware of all corrosion. Remove any corrosion using a wire brush and a sodium bicarbonate (baking soda) and warm water cleaning solution. Paint any exposed bare metal.

(3) If the removed 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 using a stiff bristle parts cleaning brush to remove any acid film (Fig. 2). 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, refer to Battery System Specifications for the factory-installed battery specifications. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.



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**Fig. 2 Clean Battery - Typical**

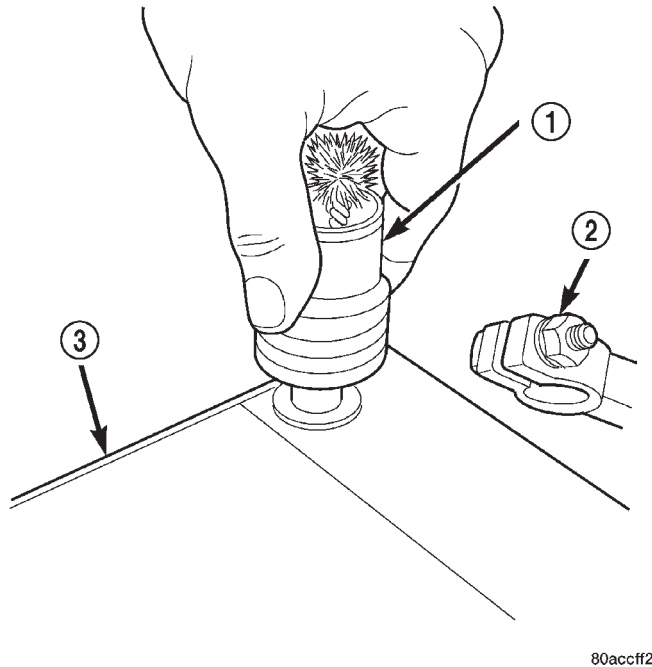
- 1 - CLEANING BRUSH
- 2 - WARM WATER AND BAKING SODA SOLUTION
- 3 - BATTERY



## BATTERY SYSTEM (Continued)

(4) Clean the battery thermal guard with a sodium bicarbonate (baking soda) and warm water cleaning solution using a stiff bristle parts cleaning brush to remove any acid film.

(5) 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. 3).



**Fig. 3 Clean Battery Terminal Post - Typical**

- 1 - TERMINAL BRUSH  
2 - BATTERY CABLE  
3 - BATTERY

## INSPECTION

The following information details the recommended inspection procedures for the battery and related components. In addition to the maintenance schedules found in this service manual and the owner's manual, it is recommended that these procedures be performed any time the battery or related components must be removed for vehicle service.

- (1) Inspect the battery cable terminal clamps for damage. Replace any battery cable that has a damaged or deformed terminal clamp.
- (2) Inspect the battery tray and battery holddown hardware for damage. Replace any damaged parts.
- (3) Slide the thermal guard off of the battery case. 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 terminal posts must be replaced.

(4) Inspect the battery thermal guard for tears, cracks, deformation or other damage. Replace any battery thermal guard that has been damaged.

(5) Inspect the battery built-in test indicator sight glass for an indication of the battery condition. If the battery is discharged, charge as required. Refer to Standard Procedures for the proper battery built-in indicator test procedures. Also refer to Standard Procedures for the proper battery charging procedures.

## SPECIFICATIONS

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. 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  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ). 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.

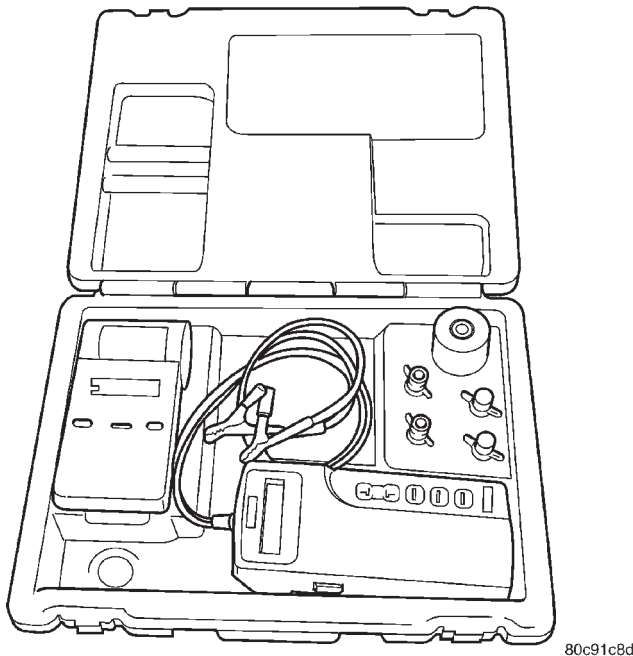
- **Reserve Capacity** - The Reserve Capacity (RC) rating specifies the time (in minutes) it takes for battery terminal voltage to fall below 10.5 volts, at a discharge rate of 25 amperes. RC is determined with the battery fully-charged at  $26.7^{\circ}\text{C}$  ( $80^{\circ}\text{F}$ ). This rating 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 identified as the twenty-hour discharge rating.

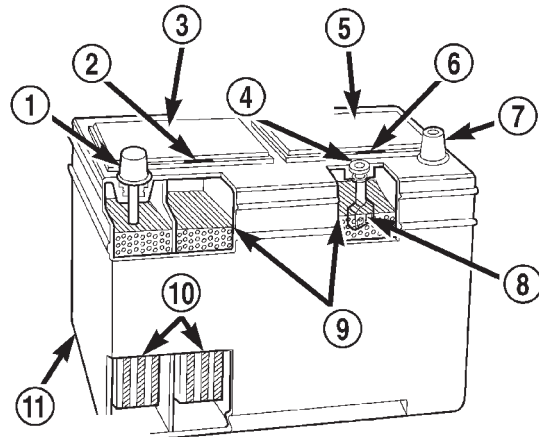
BATTERY SYSTEM (Continued)

BATTERY CLASSIFICATIONS & RATINGS					
Part Number	BCI Group Size Classification	Cold Cranking Amperage	Reserve Capacity	Ampere - Hours	Load Test Amperage
56041380AA	86	525	100 Minutes	60	250

SPECIAL TOOLS



**Fig. 4 MIDTRONICS BATTERY AND CHARGING SYSTEM TESTER - Micro420**



80accfel

**Fig. 5 Low-Maintenance Battery - Typical**

- 1 - POSITIVE POST
- 2 - VENT
- 3 - CELL CAP
- 4 - VENT
- 5 - CELL CAP
- 6 - VENT
- 7 - NEGATIVE POST
- 8 - GREEN BALL
- 9 - ELECTROLYTE LEVEL
- 10 - PLATE GROUPS
- 11 - LOW-MAINTENANCE BATTERY

BATTERY

DESCRIPTION

A large capacity, low-maintenance storage battery (Fig. 5) is standard factory-installed equipment on this model. Refer to Battery Specifications for the proper specifications of the factory-installed batteries available on this model. Male post type terminals made of a soft lead material protrude from the top of the molded plastic battery case to provide the means for connecting the battery to the vehicle electrical system. The battery positive terminal post is physically larger in diameter than the negative terminal post to ensure proper battery connection. The letters **POS** and **NEG** are also molded into the top of the battery case adjacent to their respective positive and negative terminal posts for identification confirmation. Refer to Battery Cables for more information on the battery cables that connect the battery to the vehicle electrical system.

The battery is made up of six individual cells that are connected in series. Each cell contains positively charged plate groups that are connected with lead

straps to the positive terminal post, and negatively charged plate groups that are connected with lead straps to the negative terminal post. Each plate consists of a stiff mesh framework or grid coated with lead dioxide (positive plate) or sponge lead (negative plate). Insulators or plate separators made of a non-conductive material are inserted between the positive and negative plates to prevent them from contacting or shorting against one another. These dissimilar metal plates are submerged in a sulfuric acid and water solution called an electrolyte.

The factory-installed battery has a built-in test indicator (hydrometer). The color visible in the sight glass of the indicator will reveal the battery condition. Refer to Standard Procedures for the proper built-in indicator test procedures. **The factory-installed low-maintenance battery has removable battery cell caps.** Distilled water can be added to this battery. The battery is not sealed and has vent holes in the cell caps. The chemical composition of the metal coated plates within the low-maintenance

## BATTERY (Continued)

battery reduces battery gassing and water loss, at normal charge and discharge rates. Therefore, the battery should not require additional water in normal service. If the electrolyte level in this battery does become low, water must be added. However, rapid loss of electrolyte can be caused by an overcharging condition. Be certain to diagnose the charging system after replenishing the water in the battery for a low electrolyte condition and before returning the vehicle to service. Refer to Charging System for the proper charging system diagnosis and testing procedures.

**DIAGNOSIS AND TESTING - BATTERY**

The battery must be completely charged and the top, posts and terminal clamps should be properly cleaned and inspected before diagnostic procedures are performed. Refer to Battery System Cleaning for the proper cleaning procedures, and Battery System Inspection for the proper battery inspection procedures. Refer to Standard Procedures for the proper battery charging procedures.

**WARNING: IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING OR LOOSE POSTS, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**

**WARNING: 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.**

**WARNING: 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.**

**WARNING: IF THE BATTERY IS EQUIPPED WITH REMOVABLE CELL CAPS, BE CERTAIN THAT EACH OF THE CELL CAPS ARE 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:

- **State-Of-Charge** - This can be determined by checking the specific gravity of the battery electrolyte (built-in indicator test or hydrometer test), or by

checking the battery voltage (open-circuit voltage test).

- **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, perform the built-in indicator test to determine the state-of-charge. If the battery has no built-in test indicator but does have removable cell caps, perform the hydrometer test to determine the state-of-charge. If the battery cell caps are not removable, or a hydrometer is not available, perform the open-circuit voltage test to determine the state-of-charge. Refer to open-circuit voltage test in the Standard Procedures section of this group.

Second, determine the battery cranking capacity by performing a load test. The battery must be charged before proceeding with a load test if:

- The battery built-in test indicator has a black or dark color visible.
- The temperature corrected specific gravity of the battery electrolyte is less than 1.235.
- The battery 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. Refer to Standard Procedures for the proper battery charging procedures.**

A battery is fully-charged when:

- All battery cells are gassing freely during charging.
- A green color is visible in the sight glass of the battery built-in test indicator.
- Three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity of the battery electrolyte.
- Open-circuit voltage of the battery is 12.4 volts or greater.

**STANDARD PROCEDURE****STANDARD PROCEDURE - BATTERY CHARGING**

Battery charging can be performed fast or slow, in terms of time. **Slow** battery charging is the best means of restoring a battery to full potential. Fast

## BATTERY (Continued)

battery charging should only be performed when absolutely necessary due to time restraints. A battery is fully-charged when:

- All of the battery cells are gassing freely during battery charging.
- A green color is visible in the sight glass of the battery built-in test indicator.
- Three hydrometer tests, taken at one-hour intervals, indicate no increase in the temperature-corrected specific gravity of the battery electrolyte.
- Open-circuit voltage of the battery is 12.65 volts or above.

**WARNING: NEVER EXCEED TWENTY AMPERES WHEN CHARGING A COLD (-1° C [30° F] OR LOWER) BATTERY. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.**

**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.**

**CAUTION: 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.**

**CAUTION: 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 and negative-to-negative). 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 battery charger and 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 battery charger will not operate. This makes it appear that the battery will not accept

charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

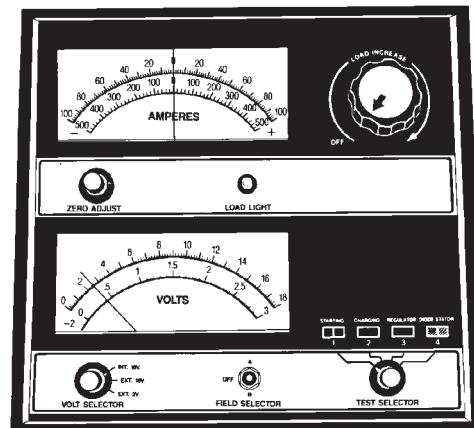
After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. Refer to Standard Procedures for the proper battery load test procedures. If the battery will endure a load test, return the battery to service. If the battery will not endure a load test, it is faulty and must be replaced.

Clean and inspect the battery hold downs, tray, terminals, posts, and top before completing battery service. Refer to Battery System Cleaning for the proper battery system cleaning procedures, and Battery System Inspection for the proper battery system inspection procedures.

### 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. 6). If the reading is below ten volts, the battery charging 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 battery chargers.



**Fig. 6 Voltmeter - 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 battery charger and 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 battery charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufac-

## BATTERY (Continued)

turer of the battery charger for details on how 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 charging current at various voltages is shown in the Charge Rate Table. If the charging current is still not measurable at the end of the charging time, the battery is faulty and must be replaced. If the charging current is measurable during the charging time, the battery may be good and the charging should be completed in the normal manner.

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  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) than at  $27^{\circ}\text{C}$  ( $80^{\circ}\text{F}$ ). When a fast battery 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 battery charger that supplies only five amperes will require a longer charging time. A battery 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.

The Battery Charging Time Table gives an indication of the time required to charge a typical battery at room temperature based upon the battery state-of-charge and the charger capacity.

Charging Amperage	5 Amps	10 Amps	20 Amps
Open Circuit Voltage	Hours Charging @ $21^{\circ}\text{C}$ ( $70^{\circ}\text{F}$ )		
12.25 to 12.49	6 hours	3 hours	1.5 hours
12.00 to 12.24	10 hours	5 hours	2.5 hours
10.00 to 11.99	14 hours	7 hours	3.5 hours
Below 10.00	18 hours	9 hours	4.5 hours

## STANDARD PROCEDURE - BUILT-IN INDICATOR TEST

An indicator (hydrometer) built into the top of the battery case provides visual information for battery testing (Fig. 7). Like a hydrometer, the built-in indicator measures the specific gravity of the battery electrolyte. The specific gravity of the electrolyte 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. Refer to Standard Procedures for the proper battery load test procedures.

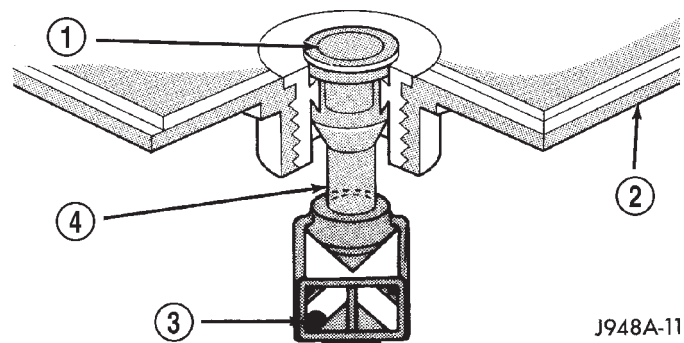


Fig. 7 Built-In Indicator

- 1 - SIGHT GLASS
- 2 - BATTERY TOP
- 3 - GREEN BALL
- 4 - PLASTIC ROD

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 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.**

BATTERY (Continued)

To read the built-in indicator, look into the sight glass and note the color of the indication (Fig. 8). The battery condition that each color indicates is described in the following list:

- **Green** - Indicates 75% to 100% battery state-of-charge. The battery is adequately charged for further testing or return to service. If the starter will not crank for a minimum of fifteen seconds with a fully-charged battery, the battery must be load tested. Refer to Standard Procedures for the proper battery load test procedures.

- **Black or Dark** - Indicates 0% to 75% battery 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. Refer to Standard Procedures for the proper battery charging procedures. Also refer to Diagnosis and Testing for more information on the possible causes of the discharged battery condition.

- **Clear or Bright** - Indicates a low battery electrolyte level. The electrolyte level in the battery is below the built-in 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. Refer to Standard Procedures for the proper battery filling procedures. A low electrolyte level may be caused by an overcharging condition. Refer to Charging System for the proper charging system diagnosis and testing procedures.

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 battery 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 satisfactory for the battery to be load tested and/or returned to service.

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 battery cell caps and check the electrolyte level. Add distilled water if the electrolyte level is below the top of the battery plates. Refer to Battery System Cleaning for the proper battery inspection procedures.

See the instructions provided by the manufacturer of the hydrometer for recommendations on the correct use of the hydrometer that you are using. 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. To read the hydrometer correctly, hold it with the top surface of the electrolyte at eye level (Fig. 9).

**CAUTION: Exercise care when inserting the tip of the hydrometer into a battery cell to avoid damaging the plate separators. Damaged plate separators can cause early battery failure.**

Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at 26.7° C. 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, which may also be identified as four points of specific gravity. For each 5.5° C above 26.7° C, add four points. For each 5.5° C below 26.7° C, subtract four points. Always correct the specific gravity for temperature variation.

**EXAMPLE:** A battery is tested at -12.2° C 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: **26.7° C + -12.2° C = 14.5° C below the 26.7° C specification**
- (2) Divide the result from Step 1 by 5.5° C: **14.5° C ÷ 5.5° C = 2.64**
- (3) Multiply the result from Step 2 by the temperature correction factor (0.004): **2.64 X 0.004 = 0.01**
- (4) The temperature at testing was below 26.7° C; therefore, the temperature correction factor is subtracted: **1.240 - 0.01 = 1.23**
- (5) The corrected specific gravity of the battery cell in this example is 1.23.

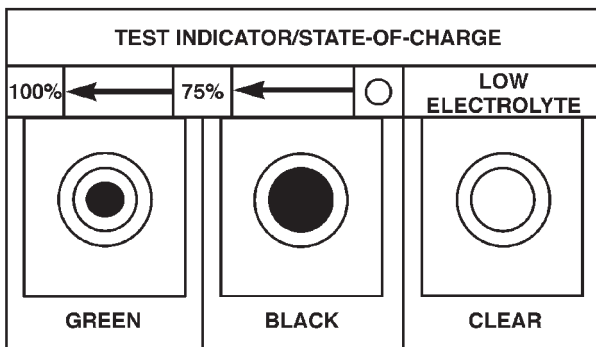


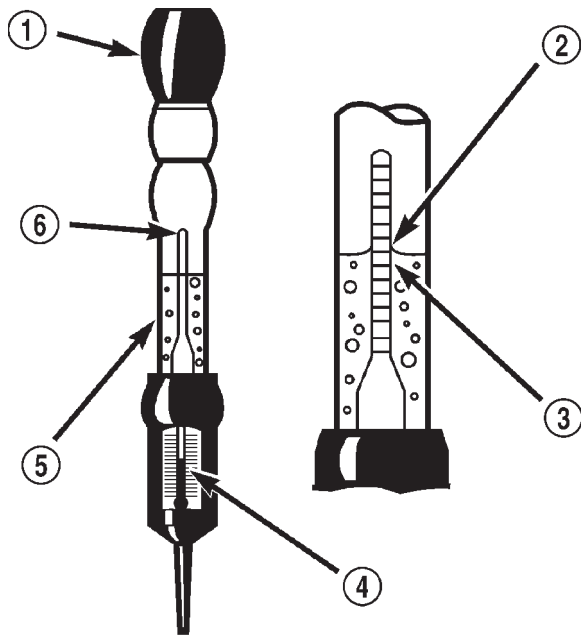
Fig. 8 Built-In Indicator Sight Glass Chart

**STANDARD PROCEDURE - 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, refer to Diagnosis and Testing for alternate methods of determining the battery state-of-charge.

Specific gravity is a comparison of the density of the battery electrolyte to the density of pure water.

BATTERY (Continued)



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Fig. 9 Hydrometer - Typical

- 1 - BULB
- 2 - SURFACE COHESION
- 3 - SPECIFIC GRAVITY READING
- 4 - TEMPERATURE READING
- 5 - HYDROMETER BARREL
- 6 - FLOAT

Test the specific gravity of the electrolyte in each battery cell. 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), the battery may be load tested to determine its cranking capacity. Refer to Standard Procedures for the proper battery load test procedures.

**STANDARD PROCEDURE - OPEN-CIRCUIT VOLTAGE TEST**

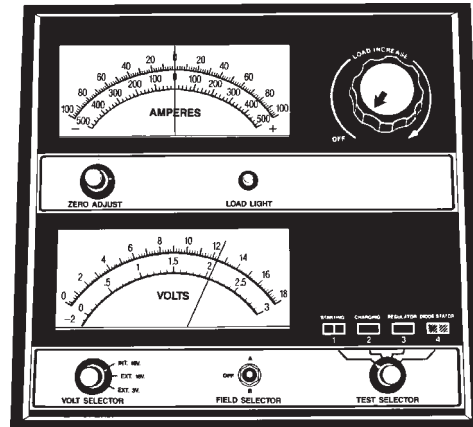
A battery open-circuit voltage (no load) test will show the approximate state-of-charge of a battery. This test can be used in place of the hydrometer test when a hydrometer is not available, or for maintenance-free batteries with non-removable cell caps.

Before proceeding with this test, completely charge the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery. Turn on the headlamps for fifteen seconds, then allow up to five minutes for the battery voltage to stabilize.

(2) Disconnect and isolate both battery cables, negative cable first.

(3) Using a voltmeter connected to the battery posts (see the instructions provided by the manufacturer of the voltmeter), measure the open-circuit voltage (Fig. 10).



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Fig. 10 Testing Open-Circuit Voltage - Typical

See the Open-Circuit Voltage Table. 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 (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

OPEN CIRCUIT VOLTAGE TABLE	
Open Circuit Voltage	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%

**STANDARD PROCEDURE - 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. To determine the battery CCA rating, see the label affixed to the battery case or refer to Battery Specifications for the proper factory-installed specifications.

Before proceeding with this test, completely charge the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

BATTERY (Continued)

(1) Disconnect and isolate both battery cables, negative cable first. The battery top and posts should be clean (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING).

(2) Connect a suitable volt-ammeter-load tester (Fig. 11) to the battery posts (Fig. 12). See the instructions provided by the manufacturer of the tester you are using. Check the open-circuit voltage (no load) of the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE). The battery open-circuit voltage must be 12.4 volts or greater.

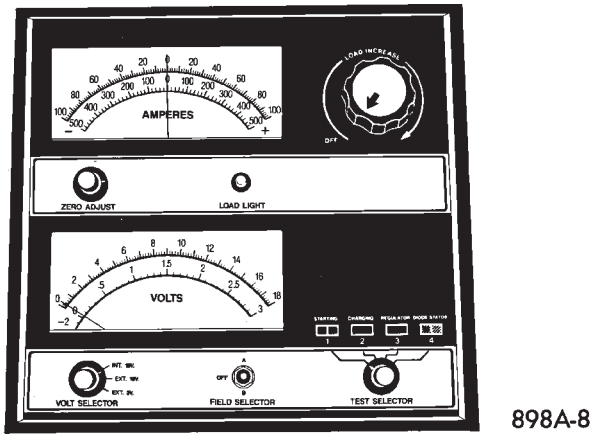


Fig. 11 Volt-Ammeter-Load Tester - Typical

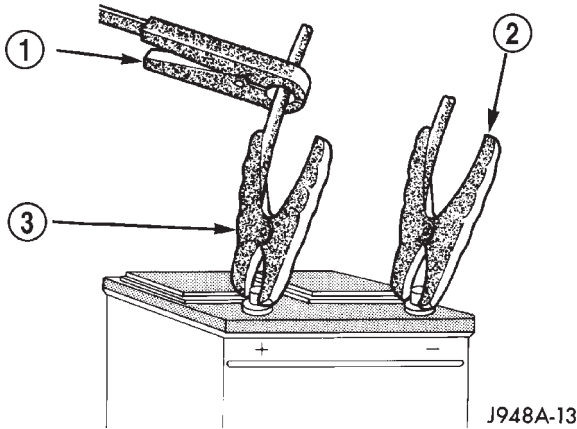


Fig. 12 Volt-Ammeter-Load

- 1 - INDUCTION AMMETER CLAMP
- 2 - NEGATIVE CLAMP
- 3 - POSITIVE CLAMP

(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. 13). This will remove the surface charge from the battery.

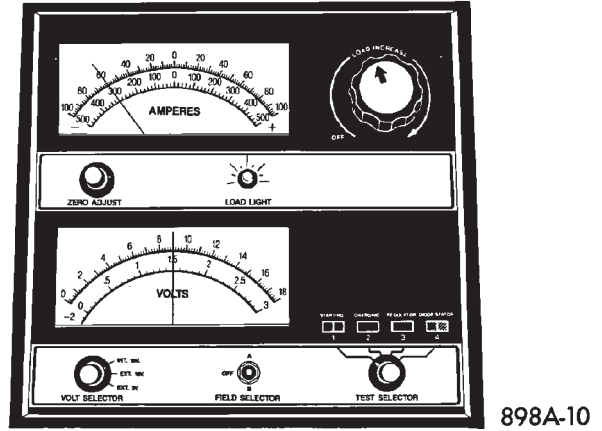


Fig. 13 Remove Surface Charge from Battery

(4) Allow the battery to stabilize to open-circuit voltage. It may take up to five minutes for the battery voltage to stabilize.

(5) Rotate the load control knob to maintain a load equal to 50% of the CCA rating of the battery (Fig. 14). After fifteen seconds, record the loaded voltage reading, then return the load control knob to the Off position.

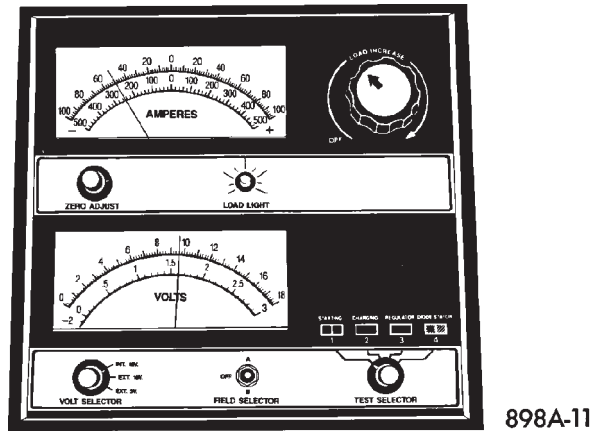


Fig. 14 Load 50% CCA Rating - Note Voltage - Typical

(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 Table for the proper loaded voltage reading.



## BATTERY (Continued)

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.

### STANDARD PROCEDURE - IGNITION-OFF DRAW TEST

The term Ignition-Off Draw (IOD) identifies a normal condition where power is being drained from the battery with the ignition switch in the Off position. A normal vehicle electrical system will draw from five to thirty-five milliamperes (0.005 to 0.035 ampere) with the ignition switch in the Off position, and all non-ignition controlled circuits in proper working order. Up to thirty-five milliamperes are needed to enable the memory functions for the Powertrain Con-

trol 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 Power Distribution Center (PDC). 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 thirty-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.

(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 an illuminated entry system or an electronically tuned radio, allow the electronic timer function of these systems to automatically shut off (time out). This may take up to three minutes. See the Electronic Module Ignition-Off Draw Table for more information.

Module	Time Out? (If Yes, Interval And Wake-Up Input)	IOD	IOD After Time Out
Radio	No	1 to 3 milliamperes	N/A
Audio Power Amplifier	No	up to 1 milliampere	N/A
Body Control Module (BCM)	No	4.75 milliamperes (max.)	N/A
Powertrain Control Module (PCM)	No	0.95 milliampere	N/A
ElectroMechanical Instrument Cluster (EMIC)	No	0.44 milliampere	N/A
Combination Flasher	No	0.08 milliampere	N/A
Automatic Transmission Controller (EATX)	Yes, 20 minutes	120 milliampere	0.70 ma

## BATTERY (Continued)

(2) Determine that the underhood lamp is operating properly, then disconnect 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 terminal 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 in the vehicle. The multi-meter leads must be securely clamped to the battery negative cable terminal clamp and the battery negative terminal post. If continuity between the battery negative terminal post and the negative cable terminal 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.

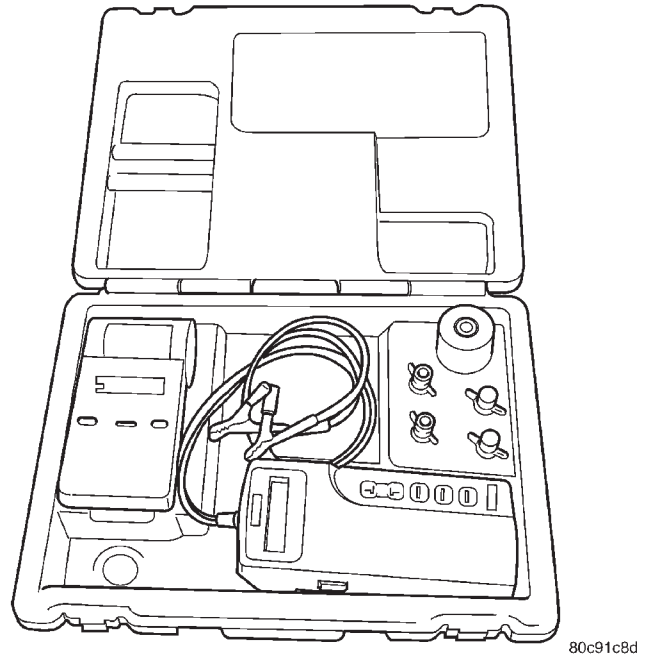
(5) After about three minutes, the high-amperage IOD reading on the multi-meter should become very low or nonexistent, depending upon the electrical equipment in the vehicle. If the amperage reading remains high, remove and replace each fuse or circuit breaker in the Power Distribution Center (PDC) and then in the Junction Block (JB), one at a time until the amperage reading becomes very low, or nonexistent. Refer to the appropriate wiring information in this service manual for complete PDC and JB fuse, circuit breaker, and circuit identification. This will isolate each circuit and identify the circuit that is the source of the high-amperage IOD. If the amperage reading remains high after removing and replacing each fuse and circuit breaker, disconnect the wire harness from the generator. If the amperage reading now becomes very low or nonexistent, refer to Charging System for the proper charging system diagnosis and testing procedures. 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 remove-and-replace process to identify and correct all sources of excessive IOD. It is now safe to select the lowest milliamperage 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 milliamperage scale selected, or the multi-meter may be damaged.

(6) Observe the multi-meter reading. The low-amperage IOD should not exceed thirty-five milliamperes (0.035 ampere). If the current draw exceeds thirty-five milliamperes, isolate each circuit using the fuse and circuit breaker remove-and-replace process

in Step 5. The multi-meter reading will drop to within the acceptable limit when the source of the excessive current draw is disconnected. Repair this circuit as required; whether a wiring short, incorrect switch adjustment, or a component failure is at fault.

## STANDARD PROCEDURE - USING MIDTRONICS ELECTRICAL TESTER



**Fig. 15 MIDTRONICS BATTERY AND CHARGING SYSTEM TESTER - Micro420**

Always use the Midtronics Instruction Manual that was supplied with the tester as a reference. If the Instruction Manual is not available the following procedure can be used:

**WARNING: ALWAYS WEAR APPROPRIATE EYE PROTECTION AND USE EXTREME CAUTION WHEN WORKING WITH BATTERIES.**

### BATTERY TESTING

(1) If testing the battery OUT-OF-VEHICLE, clean the battery terminals with a wire brush before testing. If the battery is equipped with side post terminals, install and tighten the supplied lead terminal stud adapters. Do not use steel bolts. Failure to properly install the stud adapters, or using stud adapters that are dirty or worn-out may result in false test readings.

(2) If testing the battery IN-THE-VEHICLE, make certain all of the vehicle accessory loads are OFF, including the ignition. **The preferred test position is at the battery terminal.** If the battery is not accessible, you may test using both the positive and

## BATTERY (Continued)

negative jumper posts. Select TESTING AT JUMPER POST when connecting to that location.

(3) Connect the tester to the battery or jumper posts, the red clamp to positive (+) and the black clamp to negative (-).

**NOTE: Multiple batteries connected in parallel must have the ground cable disconnected to perform a battery test. Failure to disconnect may result in false battery test readings.**

**NOTE: When testing the battery in a PT Cruiser, always test at the battery terminals**

(4) Using the ARROW key select **in** or **out** of vehicle testing and press ENTER to make a selection.

(5) If not selected, choose the Cold Cranking Amp (CCA) battery rating. Or select the appropriate battery rating for your area (see menu). The tester will then run its self programmed test of the battery and display the results. Refer to the test result table noted below.

**CAUTION: If REPLACE BATTERY is the result of the test, this may mean a poor connection between the vehicle's cables and battery exists. After disconnecting the vehicle's battery cables from the battery, retest the battery using the OUT-OF-VEHICLE test before replacing.**

(6) While viewing the battery test result, press the CODE button and the tester will prompt you for the last 4 digits of the VIN. Use the UP/DOWN arrow buttons to scroll to the correct character; then press ENTER to select and move to the next digit. Then press the ENTER button to view the SERVICE CODE. Pressing the CODE button a second time will return you to the test results.

BATTERY TEST RESULTS	
GOOD BATTERY	Return to service
GOOD - RECHARGE	Fully charge battery and return to service
CHARGE & RETEST	Fully charge battery and retest battery
REPLACE BATTERY	Replace the battery and retest complete system
BAD-CELL REPLACE	Replace the battery and retest complete system

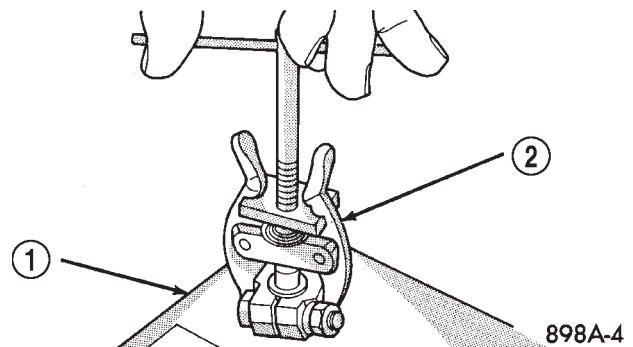
**NOTE: The SERVICE CODE is required on every warranty claim submitted for battery replacement.**

## REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post (Fig. 16).



**Fig. 16 Remove Battery Cable Terminal Clamp - Typical**

1 - BATTERY

2 - BATTERY TERMINAL PULLER

(4) Loosen the battery positive cable terminal clamp pinch-bolt hex nut.

(5) Disconnect the battery positive cable terminal clamp from the battery positive terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(6) Remove the battery holddowns from the battery. Refer to Battery Holddown for the proper battery holddown removal procedures.

**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.**

(7) Remove the battery and the battery thermal guard from the battery tray as a unit.

(8) Remove the battery thermal guard from the battery case. Refer to Thermal Guard for the proper battery thermal guard removal procedures.

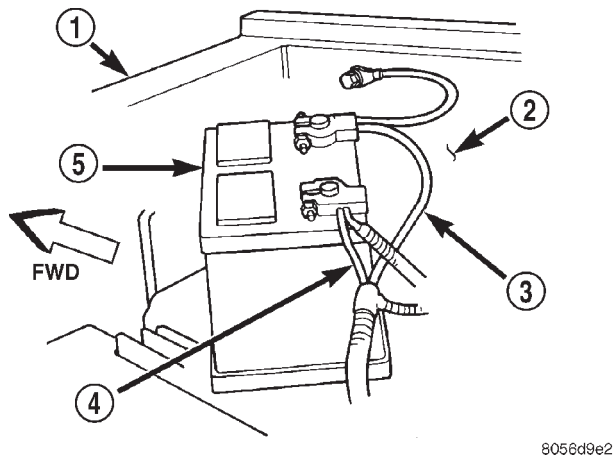
## INSTALLATION

(1) Clean and inspect all of the battery system components. Refer to Battery System Cleaning for the proper cleaning procedures, and refer to Battery System Inspection for the proper inspection procedures.

## BATTERY (Continued)

(2) Reinstall the battery thermal guard onto the battery case. Refer to Thermal Guard for the proper battery thermal guard installation procedures.

(3) Position the battery and the battery thermal guard onto the battery tray as a unit. Ensure that the battery positive and negative terminal posts are correctly positioned. The battery cable terminal clamps must reach the correct battery terminal post without stretching the cables (Fig. 17).



**Fig. 17 Battery Cables - Typical**

- 1 - RADIATOR CROSSMEMBER
- 2 - WHEELHOUSE INNER PANEL
- 3 - NEGATIVE CABLE
- 4 - POSITIVE CABLE
- 5 - BATTERY

(4) Reinstall the battery holddowns onto the battery. Refer to Battery Holddown for the proper installation procedure.

**CAUTION:** Be certain that the battery cable terminal clamps are connected to the correct battery terminal posts. Reversed battery polarity may damage electrical components of the vehicle.

(5) Clean the battery cable terminal clamps and the battery terminal posts. Refer to Battery System Cleaning for cleaning procedure.

(6) Reconnect the battery positive cable terminal clamp to the battery positive terminal post. Tighten the terminal clamp pinch-bolt hex nut to 45 in. lbs.

(7) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 45 in. lbs.

(8) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the battery cable terminal clamps and the battery terminal posts.

## BATTERY HOLDDOWN

## DESCRIPTION

The battery holddown hardware includes a plastic holddown bracket and retaining bolt. The battery holddown bracket meshes with the battery tray to secure the battery to the battery tray.

When installing a battery into the battery tray, it is important that the holddown hardware is properly installed and that the fastener is tightened to the proper specifications. Improper holddown fastener tightness, whether too loose or too tight, can result in damage to the battery, the vehicle, or both. Refer to Battery Holddown for the proper installation procedure, including the proper holddown fastener torque specifications.

## OPERATION

The battery holddown secures the battery in the battery tray. This holddown is designed to prevent battery movement during the most extreme vehicle operation conditions. Periodic removal and lubrication of the battery holddown hardware is recommended to prevent hardware seizure at a later date.

**CAUTION:** Never operate a vehicle without a battery holddown device properly installed. Damage to the vehicle, components and battery could result.

## REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post.

(4) Remove the battery hold down bracket retaining bolt from the threaded insert in the battery tray assembly.

## INSTALLATION

(1) Clean and inspect the battery hold down hardware. Refer to Battery Cleaning for the proper battery system component cleaning procedures, and Battery Inspection for the proper battery system component inspection procedures.

(2) Position the battery hold down bracket onto the battery tray.

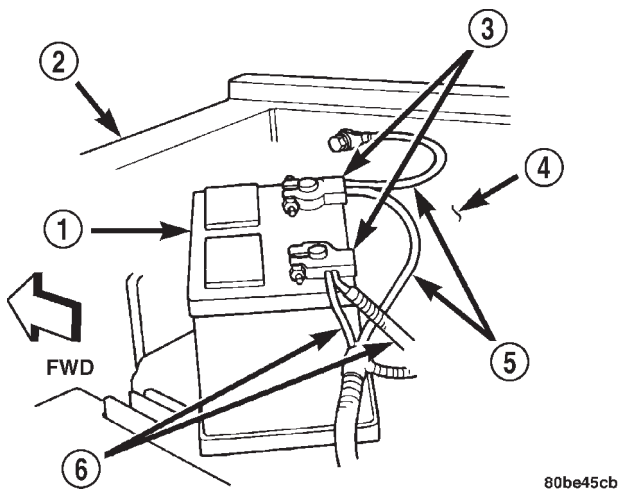
## BATTERY HOLDDOWN (Continued)

(3) Install and tighten the battery hold down bracket retaining bolt. Tighten the bolt to 4 N·m (20 in. lbs.).

(4) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 8.4 N·m (75 in. lbs.).

## BATTERY CABLES

## DESCRIPTION



**Fig. 18 Battery Cables - Typical**

- 1 - Battery
- 2 - Radiator Crossmember
- 3 - Terminal Clamps
- 4 - Fender Inner Shield
- 5 - Negative Cable
- 6 - Positive Cable

The battery cables (Fig. 18) are large gauge, stranded copper wires sheathed within a heavy plastic or synthetic rubber insulating jacket. The wire used in the battery cables combines excellent flexibility and reliability with high electrical current carrying capacity. The battery cables feature a clamping type female battery terminal made of soft lead that is die cast onto one end of the battery cable wire. A square headed pinch-bolt and hex nut are installed at the open end of the female battery terminal clamp. Large eyelet type terminals are crimped onto the opposite end of the battery cable wire and then solder-dipped. The battery positive cable wires have a red insulating jacket to provide visual identification

and feature a larger female battery terminal clamp to allow connection to the larger battery positive terminal post. The battery negative cable wires have a black insulating jacket and a smaller female battery terminal clamp.

The battery cables cannot be repaired and, if damaged or faulty they must be replaced. Both the battery positive and negative cables are available for service replacement only as a unit with the battery wire harness, which may include portions of the wiring circuits for the generator and other components on some models. Refer to the appropriate wiring information in this service manual for the location of the proper battery cable wire harness diagrams. The wiring information also includes proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## OPERATION

The battery cables connect the battery terminal posts to the vehicle electrical system. These cables also provide a path back to the battery for electrical current generated by the charging system for restoring the voltage potential of the battery. The female battery terminal clamps on the ends of the battery cable wires provide a strong and reliable connection of the battery cable to the battery terminal posts. The terminal pinch bolts allow the female terminal clamps to be tightened around the male terminal posts on the top of the battery. The eyelet terminals secured to the opposite ends of the battery cable wires from the female battery terminal clamps provide secure and reliable connection of the battery cables to the vehicle electrical system.

The battery positive cable terminal clamp is die cast onto the ends of two wires. One wire has an eyelet terminal that connects the battery positive cable to the B(+) terminal studs of the Power Distribution Center (PDC), and the other wire has an eyelet terminal that connects the battery positive cable to the B(+) terminal stud of the engine starter motor solenoid. The battery negative cable terminal clamp is also die cast onto the ends of two wires. One wire has an eyelet terminal that connects the battery negative cable to the vehicle powertrain through a stud on the left side of the engine cylinder block. The other wire has an eyelet terminal that connects the battery negative cable to the vehicle body through a ground stud on the left wheel house, near the battery.

BATTERY CABLES (Continued)

**DIAGNOSIS AND TESTING - BATTERY CABLES**

A voltage drop test will determine if there is excessive resistance in the battery cable terminal connections or the battery cable. If excessive resistance is found in the battery cable connections, the connection point should be disassembled, cleaned of all corrosion or foreign material, then reassembled. Following reassembly, check the voltage drop for the battery cable connection and the battery cable again to confirm repair.

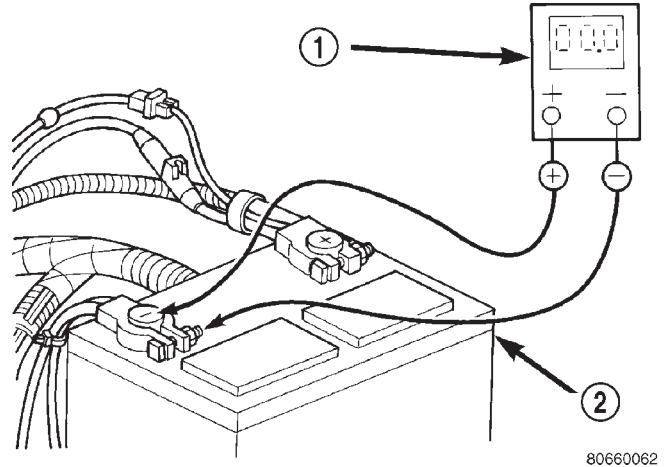
When performing the voltage drop test, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached. **EXAMPLE:** When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable terminal clamp and to the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud. If you probe the battery positive terminal post and the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud, you are reading the combined voltage drop in the battery positive cable terminal clamp-to-terminal post connection and the battery positive cable.

**VOLTAGE DROP TEST**

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing this test, be certain that the following procedures are accomplished:

- The battery is fully-charged and load tested. Refer to Standard Procedures for the proper battery charging and load test procedures.
- 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 block the clutch pedal in the fully depressed position.
- Verify that all lamps and accessories are turned off.
- To prevent the engine from starting, remove the Automatic Shut Down (ASD) relay. The ASD relay is located in the Power Distribution Center (PDC), in the engine compartment. See the fuse and relay layout label affixed to the underside of the PDC cover for ASD relay identification and location.

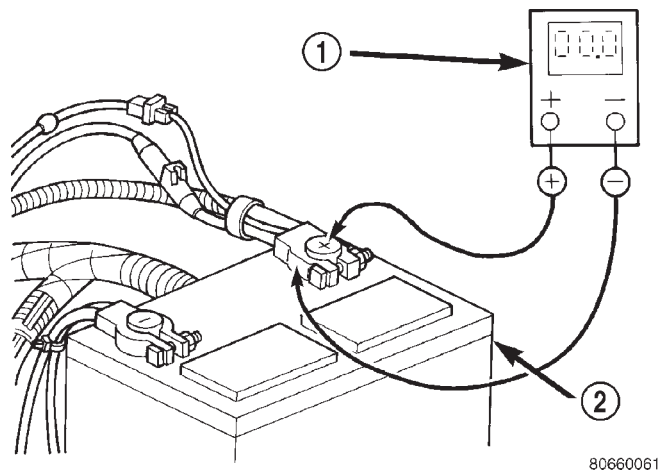
(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable terminal clamp (Fig. 19). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection between the battery negative cable terminal clamp and the battery negative terminal post.



**Fig. 19 TEST BATTERY NEGATIVE CONNECTION RESISTANCE - TYPICAL**

- 1 - VOLTMETER  
2 - BATTERY

(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 terminal clamp (Fig. 20). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection between the battery positive cable terminal clamp and the battery positive terminal post.



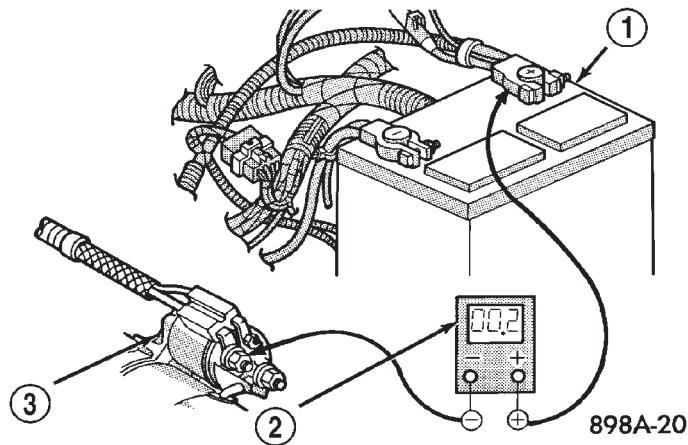
**Fig. 20 TEST BATTERY POSITIVE CONNECTION RESISTANCE - TYPICAL**

- 1 - VOLTMETER  
2 - BATTERY

(3) Connect the voltmeter to measure between the battery positive cable terminal clamp and the starter solenoid B(+) terminal stud (Fig. 21). 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 positive cable eyelet terminal con-

## BATTERY CABLES (Continued)

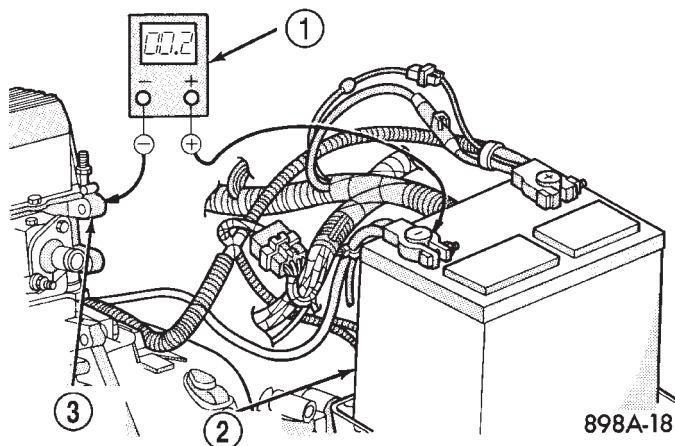
nection at the starter solenoid B(+) terminal stud. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.



**Fig. 21 TEST BATTERY POSITIVE CABLE RESISTANCE - TYPICAL**

- 1 - BATTERY
- 2 - VOLTMETER
- 3 - STARTER MOTOR

(4) Connect the voltmeter to measure between the battery negative cable terminal clamp and a good clean ground on the engine block (Fig. 22). 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 eyelet terminal connection to the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

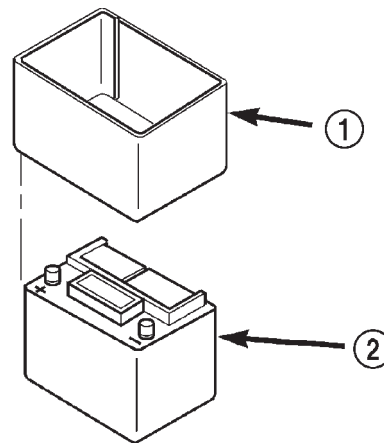


**Fig. 22 TEST GROUND CIRCUIT RESISTANCE - TYPICAL**

- 1 - VOLTMETER
- 2 - BATTERY
- 3 - ENGINE GROUND

## THERMAL GUARD

## DESCRIPTION



**Fig. 23 Battery Thermal guard**

- 1 - THERMAL GUARD
- 2 - BATTERY

A flexible plastic bubble-wrap style thermal guard (Fig. 23) slides over the battery case to enclose the sides of the battery. The thermal guard consists of a heavy black plastic outer skin and two lighter plies of plastic that have been formed into a sheet with hundreds of small air pockets entrapped between them. The resulting material is very similar to the bubble-wrap used to protect items in many parcel packaging and shipping applications.

## OPERATION

The thermal guard protects the battery from engine compartment temperature extremes. The temperature of the battery can affect battery performance. The air trapped between the plastic plies of the thermal guard create a dead air space, which helps to insulate the sides of the battery case from the air temperature found in the surrounding engine compartment.

## REMOVAL

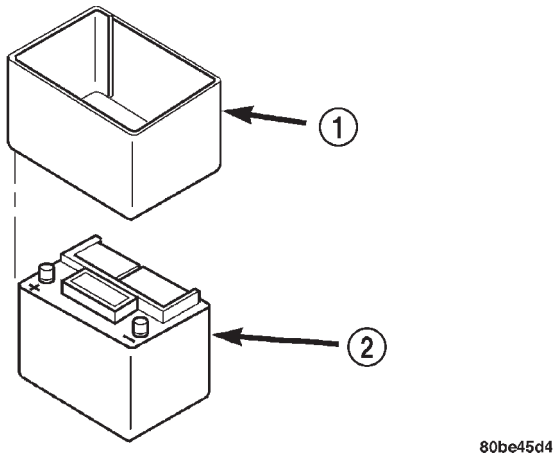
(1) Remove the battery and the battery thermal guard from the battery tray as a unit. Refer to Battery Removal for the proper battery removal procedures.

(2) Carefully and evenly slide the battery thermal guard up off of the battery case (Fig. 24).

## INSTALLATION

(1) Clean and inspect the battery thermal guard. Refer to Battery System Cleaning for the proper cleaning procedures, and refer to Battery System Inspection for the proper inspection procedures.

THERMAL GUARD (Continued)



**Fig. 24 Battery thermal guard**

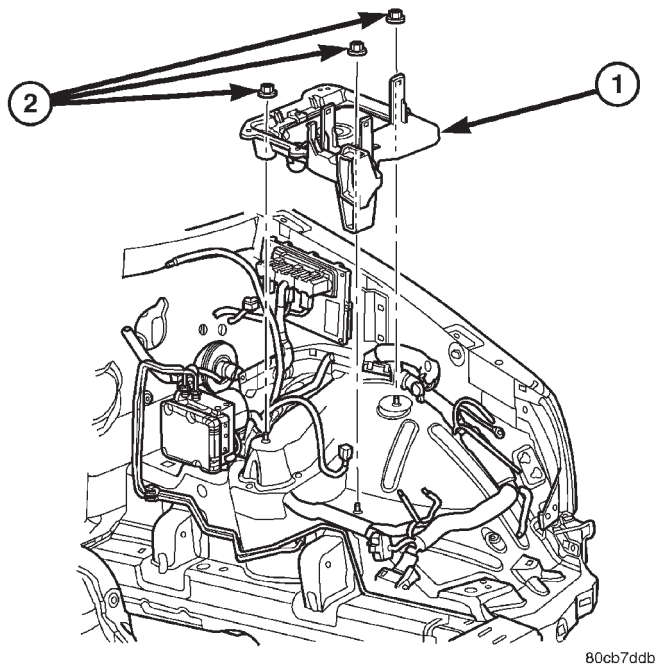
- 1 - THERMAL GUARD
- 2 - BATTERY

(2) Carefully and evenly slide the battery thermal guard down over the battery case.

(3) Install the battery and the battery thermal guard into the battery tray as a unit. Refer to Battery Installation for the proper battery installation procedures.

**BATTERY TRAY**

**DESCRIPTION**



**Fig. 25 Battery Tray Location**

- 1 - Battery Tray
- 2 - Battery Tray Retaining Nuts

The battery is placed in a molded plastic tray located in the left front corner of the engine compartment (Fig. 25). The battery hold down hardware is contained within the battery tray. A hole in the bottom of the battery tray is fitted with a battery temperature sensor. Refer to Charging System for more information on the battery temperature sensor. Refer to Battery Hold down for more information on hold down hardware.

**OPERATION**

The battery tray provides a secure mounting location and supports the battery. On some vehicles, the battery tray also provides the anchor point/s for the battery holddown hardware. The battery tray and the battery holddown hardware combine to secure and stabilize the battery in the engine compartment, which prevents battery movement during vehicle operation. Unrestrained battery movement during vehicle operation could result in damage to the vehicle, the battery, or both.

**REMOVAL**

(1) Remove the battery from the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(2) Unlatch and remove the PDC from the battery tray.

(3) Remove the battery temperature sensor from the battery tray (Refer to 8 - ELECTRICAL/CHARGING/BATTERY TEMPERATURE SENSOR - REMOVAL).

(4) Remove the three nuts that secure the battery tray to the weld studs on the front extension of the left front wheelhouse inner panel (Fig. 25).

(5) Remove the battery tray from the vehicle.

**INSTALLATION**

(1) Clean and inspect the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING).

(2) Position the battery tray onto the weld studs on the front extension of the left front wheelhouse inner panel.

(3) Install the battery temperature sensor onto the battery tray (Refer to 8 - ELECTRICAL/CHARGING/BATTERY TEMPERATURE SENSOR - INSTALLATION).

(4) Install and tighten the three nuts that secure the battery tray to the weld studs on the front extension of the left front wheelhouse inner panel. Tighten the nuts to 5 N·m (45 in. lbs.).

(5) Install the PDC on the battery tray.

(6) Install the battery onto the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).



# CHARGING SYSTEM

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## CHARGING SYSTEM

### DESCRIPTION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM)
- Ignition switch
- Battery (refer to 8, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)
- Check Gauges Lamp (if equipped)
- Wiring harness and connections (refer to 8, Wiring for information)

### OPERATION

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 is energized. 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 tempera-

ture. 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 electronic memory for certain failures it detects. Refer to Diagnostic Trouble Codes in; Powertrain Control Module; Electronic Control Modules 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 8, Instrument Cluster for additional information.

### DIAGNOSIS AND TESTING - CHARGING SYSTEM

The following procedures may be used to diagnose the charging system if:

- the check gauges lamp (if equipped) is illuminated with the engine running

CHARGING SYSTEM (Continued)

- 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. Refer to Ignition-Off Draw Test in 8, Battery for more information.

INSPECTION

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 charging system circuits are checked continuously, and some are checked only under certain conditions.

Refer to Diagnostic Trouble Codes in; Powertrain Control Module; Electronic Control Modules for more DTC information. This will include a complete list of DTC's including DTC's for the charging system.

To perform a complete test of the charging system, refer to the appropriate Powertrain Diagnostic Procedures service manual and the DRB® scan tool. Per-

form the following inspections before attaching the scan tool.

- (1) Inspect the battery condition. Refer to 8, 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.
- (5) Inspect generator drive belt condition and tension. Tighten or replace belt as required. Refer to Belt Tension Specifications in 7, Cooling System.
- (6) Inspect automatic belt tensioner (if equipped). Refer to 7, Cooling System for information.
- (7) Inspect generator electrical connections at generator field, battery output, and ground terminal (if equipped). Also check generator ground wire connection at engine (if equipped). They should all be clean and tight. Repair as required.

SPECIFICATIONS

TORQUE - EXCEPT DIESEL

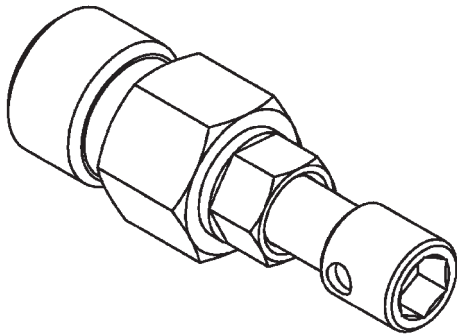
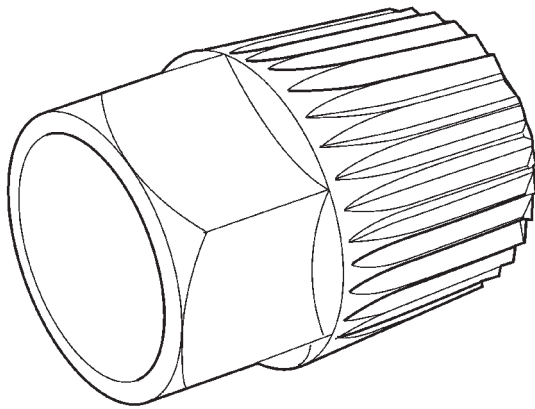
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Generator Horizontal Mounting Bolts - 3.7L	57	42	-
Generator Vertical Mounting Bolt - 3.7L	40	29	-
Generator Mounting Bolts - 2.4L	57	42	-
B+ Terminal Nut at Top of Generator	13	-	115
Generator Decoupler	110	81	-

GENERATOR RATINGS - GAS ENGINES

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	56044530AB	124	2.4L	88
DENSO	56044532AB	136	2.4L	96
DENSO	56041693AA	136	3.7L	96
DENSO	56029914AA	160	3.7L	112

## CHARGING SYSTEM (Continued)

## SPECIAL TOOLS

**GENERATOR DECOUPLER TOOL #8433**

80cb8152

**GENERATOR DECOUPLER TOOL #8823**

## BATTERY TEMPERATURE SENSOR

## DESCRIPTION

The Battery Temperature Sensor (BTS) is attached to the battery tray located under the battery.

## OPERATION

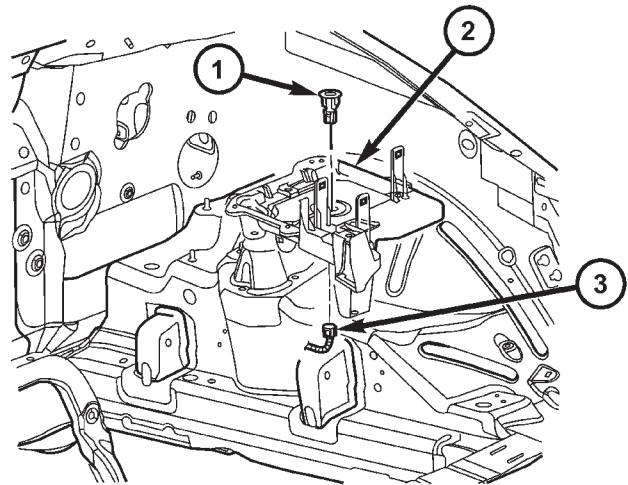
The BTS is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

The PCM sends 5 volts to the sensor and is grounded through the sensor return line. As temperature increases, resistance in the sensor decreases and the detection voltage at the PCM increases.

The BTS is also used for OBD II diagnostics. Certain faults and OBD II monitors are either enabled or disabled, depending upon BTS input (for example, disable purge and enable Leak Detection Pump (LDP) and O<sub>2</sub> sensor heater tests). Most OBD II monitors are disabled below 20 degrees F.

## REMOVAL

The battery temperature sensor is located under the vehicle battery (Fig. 1) and is attached to a mounting hole on battery tray.



80c7eb91

**Fig. 1 BATTERY TEMPERATURE SENSOR**

- 1 - BATTERY TEMPERATURE SENSOR
- 2 - BATTERY TRAY
- 3 - ELECTRICAL CONNECTOR

(1) Remove battery. Refer to 8, Battery for procedures.

(2) Disconnect sensor pigtail harness from engine wire harness electrical connector.

(3) Pry sensor straight up from battery tray mounting hole.

## INSTALLATION

The battery temperature sensor is located under vehicle battery and is attached to a mounting hole on battery tray.

(1) Feed pigtail harness through hole in top of battery tray and press sensor into top of battery tray.

(2) Connect pigtail harness.

(3) Install battery. Refer to 8, Battery for procedures.

# GENERATOR

## DESCRIPTION

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.

## OPERATION

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 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 terminal.

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 Specifications and see Generator Ratings 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.

## REMOVAL

### Gasoline Powered Engines

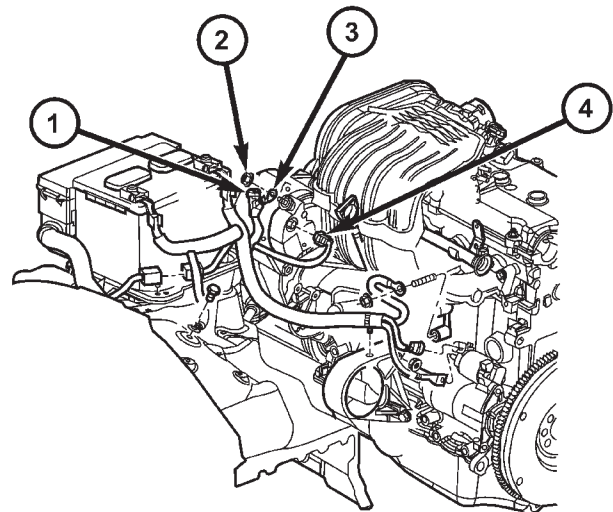
**CAUTION: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY.**

(1) Disconnect and isolate negative battery cable at battery.

**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 Cooling System.**

- (2) Remove generator drive belt. Refer to 7, Cooling System for procedures.
- (3) Unsnap plastic protective cover (Fig. 2) from B+ mounting stud.
- (4) Remove B+ terminal mounting nut (Fig. 2) at top of generator.
- (5) Disconnect field wire electrical connector at rear of generator (Fig. 2) by pushing on connector tab.
- (6) 2.4L Engine: Remove 2 generator mounting bolts (Fig. 3).
- (7) 3.7L Engine: Remove 1 vertical generator mounting bolt and 2 horizontal mounting bolts (Fig. 4).
- (8) Remove generator from vehicle.

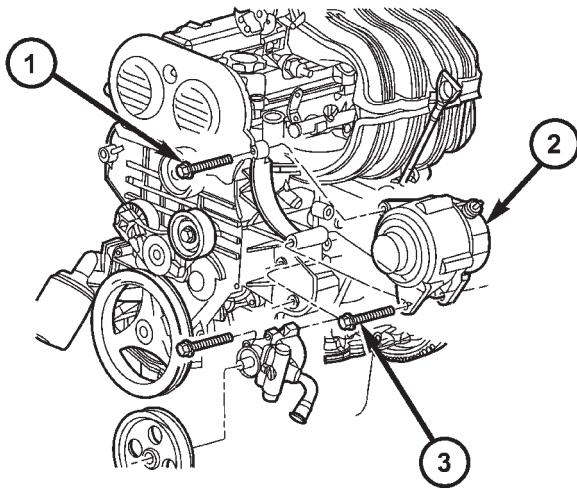


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**Fig. 2 GENERATOR ELECTRICAL CONNECTORS - TYPICAL**

- 1 - PROTECTIVE CAP
- 2 - B+ NUT
- 3 - B+ TERMINAL
- 4 - FIELD ELECTRICAL CONNECTOR

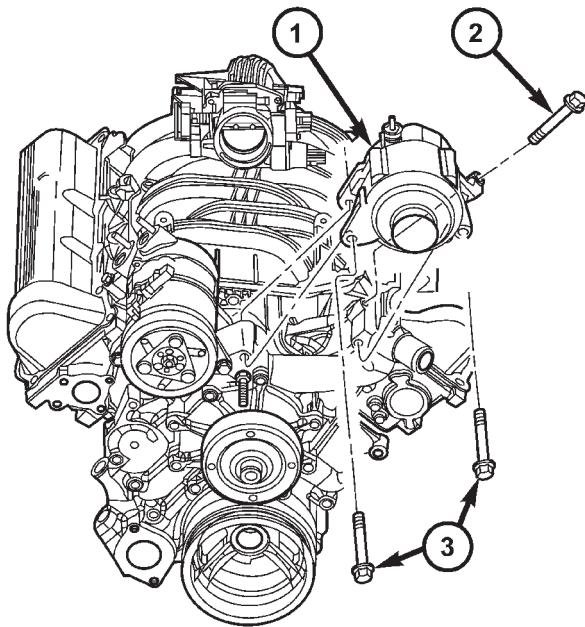
## GENERATOR (Continued)



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**Fig. 3 GENERATOR - 2.4L**

- 1 - UPPER MOUNTING BOLT
- 2 - GENERATOR
- 3 - LOWER MOUNTING BOLT



80c7ec46

**Fig. 4 GENERATOR - 3.7L**

- 1 - GENERATOR
- 2 - VERTICAL MOUNTING BOLT
- 3 - HORIZONTAL MOUNTING BOLTS

**INSTALLATION****Gasoline Powered Engines**

(1) 2.4L Engine: Position generator to engine and install 2 mounting bolts. Refer to torque specifications.

(2) 3.7L Engine: Position generator to engine and install 3 mounting bolts. Tighten 2 horizontal mounting bolts to specified torque. Tighten 1 vertical mounting bolt to specified torque. Refer to torque specifications.

(3) Snap field wire connector into rear of generator.

(4) Install B+ terminal and nut to generator mounting stud. Refer to torque specifications.

(5) Snap plastic protective cover to B+ terminal.

**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 7, Cooling System.

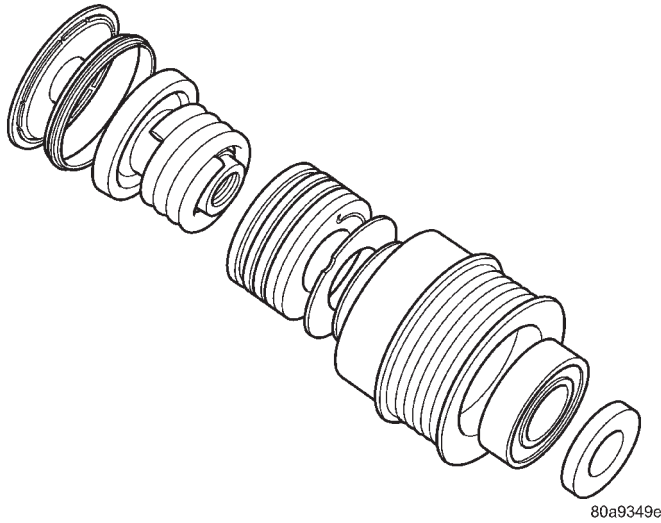
(6) Install drive belt Refer to 7, Cooling System for belt routing, belt adjustment and bolt tightening procedures.

(7) Install negative battery cable to battery.

**GENERATOR DECOUPLER PULLEY****DESCRIPTION**

The generator decoupler is used only with certain engines. The decoupler is used in place of the standard generator drive pulley (Fig. 5).

GENERATOR DECOUPLER PULLEY (Continued)



**Fig. 5 GENERATOR DECOUPLER PULLEY (TYPICAL)**

**OPERATION**

The generator decoupler is used only with certain engines. The decoupler (Fig. 5). is a one-way clutch designed to help reduce belt tension fluctuation, vibration, reduce fatigue loads, improve belt life, reduce hubloads on components, and reduce noise. Dry operation is used (no grease or lubricants). The decoupler is not temperature sensitive and also has a low sensitivity to electrical load. The decoupler is a non-serviceable item and is to be replaced as an assembly.

**DIAGNOSIS AND TESTING - GENERATOR DECOUPLER**

CONDITION	POSSIBLE CAUSES	CORRECTION
Does not drive generator (generator not charging)	Internal failure	Replace decoupler
Noise coming from decoupler	Internal failure	Replace decoupler

**REMOVAL**

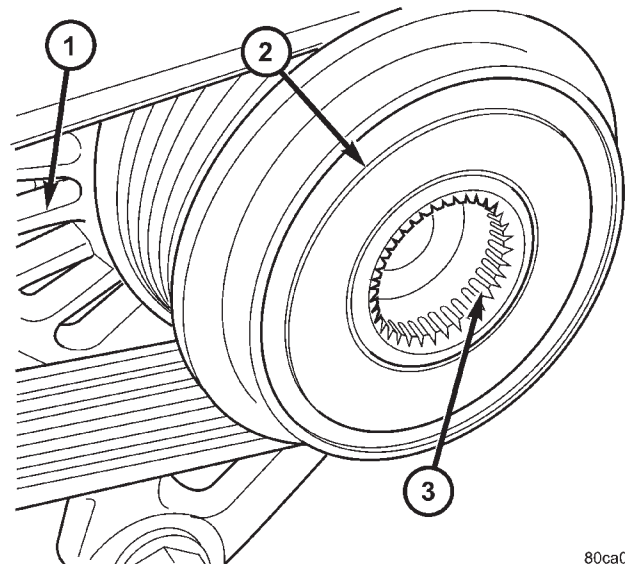
The generator decoupler is used only with certain engines.

Two different type generator decoupler pulleys are used. One can be identified by the use of machined splines (Fig. 6). The other can be identified by a hex opening (Fig. 7) and will not use splines.

Different special tools are required to service each different decoupler. Refer to following procedure.

**INA Decoupler**

- (1) Disconnect negative battery cable.
- (2) Remove generator and accessory drive belt. Refer to Generator Removal.
- (3) Position Special Tool #8823 (VM.1048) into decoupler (Fig. 8).
- (4) Determine if end of generator shaft is hex shaped (Fig. 9) or is splined (Fig. 10). If hex is used, insert a 10MM deep socket into tool #8823 (VM.1048) (Fig. 11). If splined, insert a 5/16" 6-point hex driver, or a 10MM 12-point triple square driver into tool #8823 (VM.1048) (Fig. 12).
- (5) The generator shaft uses conventional right-hand threads to attach decoupler. To break decoupler loose from generator threads, rotate end of tool clockwise (Fig. 11) or, (Fig. 12).



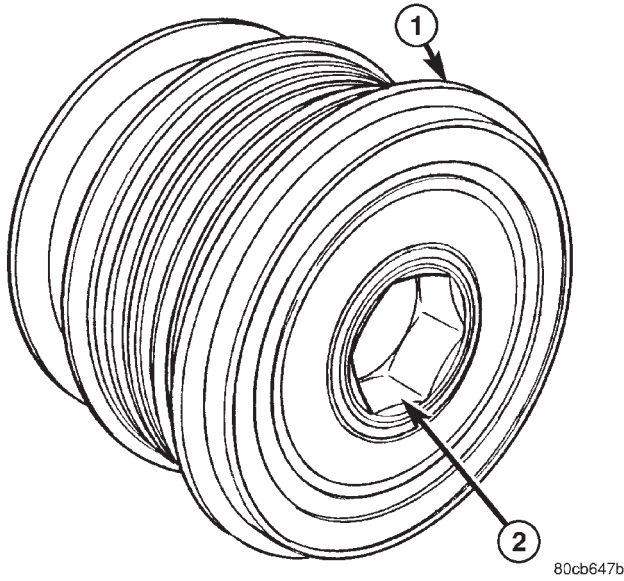
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**Fig. 6 GENERATOR DECOUPLER PULLEY (INA)**

- 1 - GENERATOR
- 2 - DECOUPLER (INA)
- 3 - MACHINED SPLINES

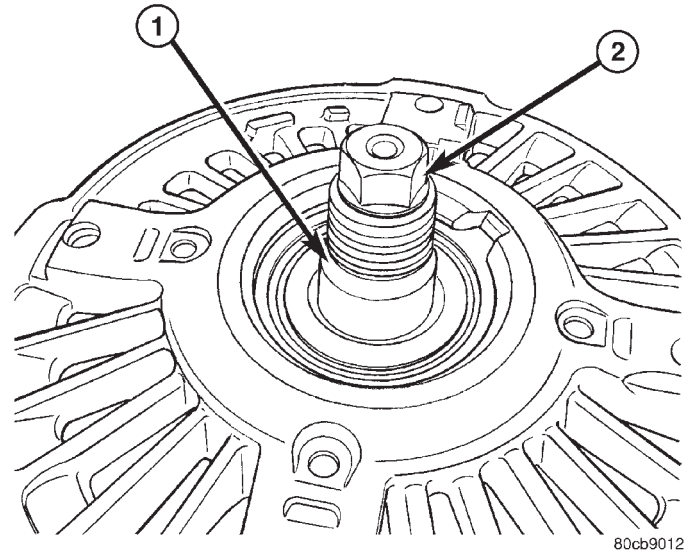
(6) After breaking loose with tool, unthread decoupler by hand from generator.

GENERATOR DECOUPLER PULLEY (Continued)



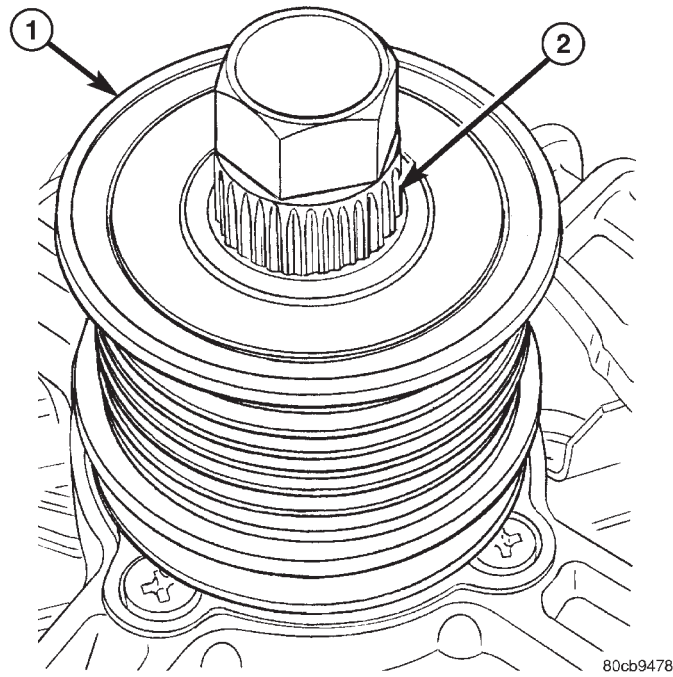
**Fig. 7 GENERATOR DECOUPLER PULLEY (LITENS)**

- 1 - DECOUPLER (LITENS)
- 2 - HEX OPENING



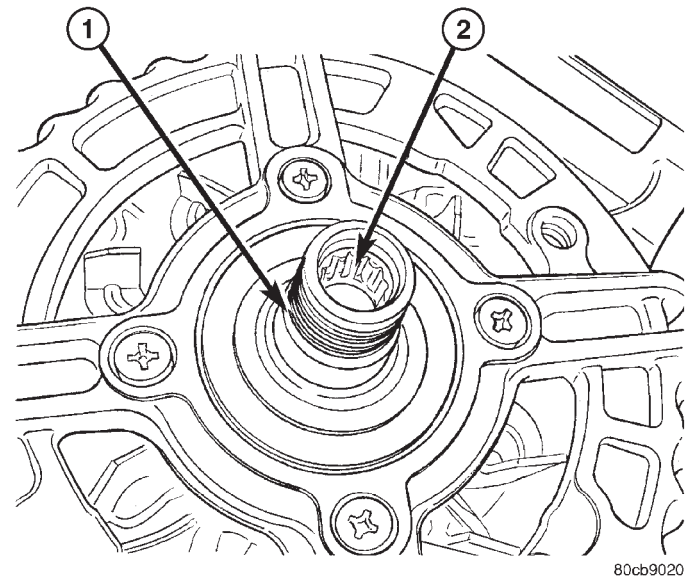
**Fig. 9 END OF GENERATOR SHAFT (HEX)**

- 1 - GENERATOR SHAFT
- 2 - HEX



**Fig. 8 #8823 (VM.1048) TOOL AND INA DECOUPLER**

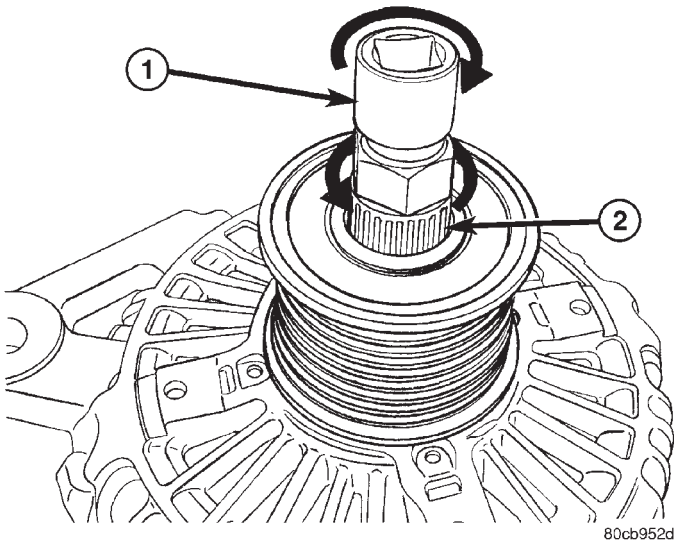
- 1 - INA DECOUPLER
- 2 - TOOL #8823 (VM.1048)



**Fig. 10 END OF GENERATOR SHAFT (SPLINED)**

- 1 - GENERATOR SHAFT
- 2 - SPLINES

GENERATOR DECOUPLER PULLEY (Continued)



**Fig. 11 DECOUPLER REMOVAL (INA-HEX)**

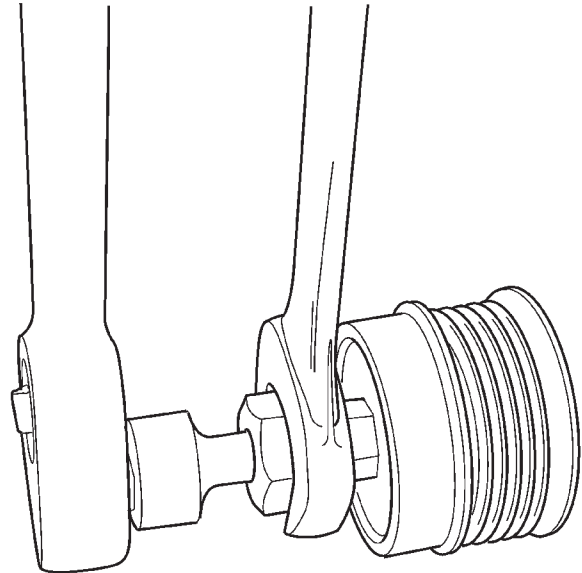
- 1 - DEEP 10 MM SOCKET
- 2 - TOOL #8823 (VM.1048)

(2) Remove generator and accessory drive belt. Refer to Generator Removal.

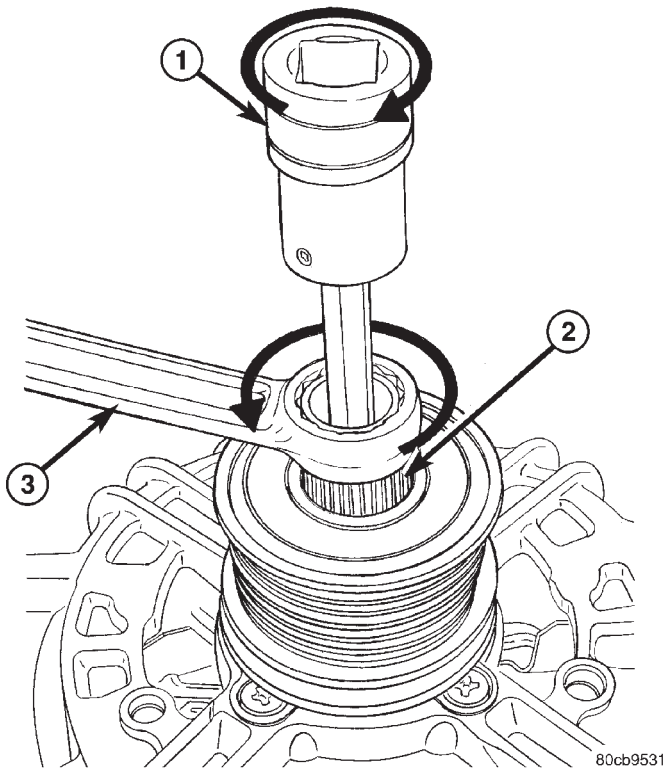
(3) Position Special Tool #8433 (Fig. 13) into decoupler. Align to hex end of generator shaft.

(4) The generator shaft uses conventional right-hand threads to attach decoupler. To break decoupler loose from generator threads, rotate end of tool clockwise (Fig. 14).

(5) After breaking loose with tool, unthread decoupler by hand from generator.

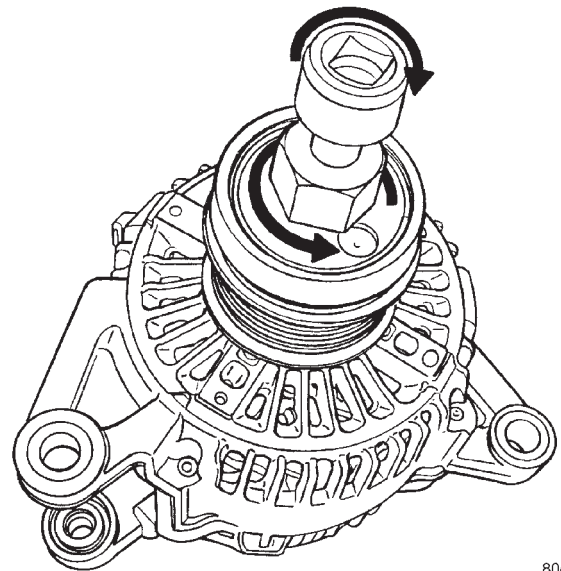


**Fig. 13 # 8433 TOOL AND LITENS DECOUPLER**



**Fig. 12 DECOUPLER REMOVAL (INA-SPLINED)**

- 1 - DRIVER
- 2 - TOOL #8823 (VM.1048)
- 3 - 17 MM WRENCH



**Fig. 14 DECOUPLER REMOVAL (LITENS)**

Litens Decoupler

- (1) Disconnect negative battery cable.



## GENERATOR DECOUPLER PULLEY (Continued)

## INSTALLATION

## INA Decoupler

(1) Thread decoupler pulley onto generator shaft by hand (right-hand threads).

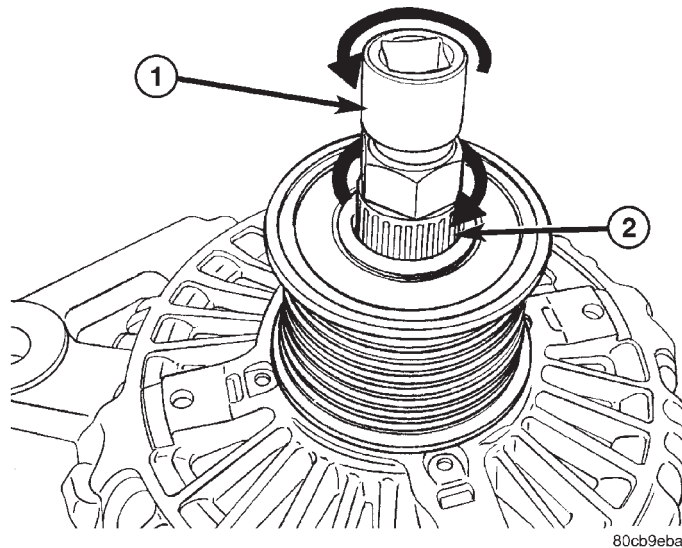
(2) Position Special Tool #8823 (VM.1048) into decoupler (Fig. 8).

(3) Determine if end of generator shaft is hex shaped (Fig. 9) or is splined (Fig. 10). If hex is used, insert a 10MM deep socket into tool #8823 (VM.1048) (Fig. 15). If splined, insert a 5/16" 6-point hex driver, or a 10MM 12-point triple square driver into tool #8823 (VM.1048) (Fig. 16).

(4) **Do not use an adjustable, ratcheting "click type" torque wrench. Most "click type" wrenches will only allow torque to be applied in a clockwise rotation. Use a dial-type or beam-type wrench.** Tighten in counter-clockwise rotation (Fig. 15) or, (Fig. 16). Refer to torque specifications.

(5) Install accessory drive belt, and generator. Refer to Generator Installation.

(6) Connect negative battery cable.



**Fig. 15 DECOUPLER INSTALLATION (INA-HEX)**

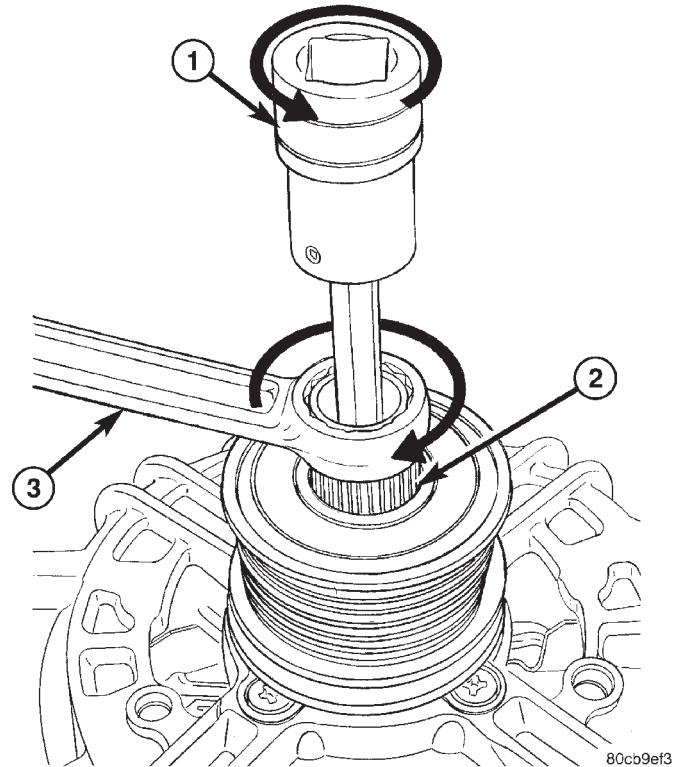
- 1 - 10MM DEEP SOCKET  
2 - TOOL # 8823 (VM.1048)

## Litens Decoupler

(1) Thread decoupler pulley onto generator shaft by hand (right-hand threads).

(2) Position Special Tool 8433 (Fig. 13) into decoupler. Align tool to hex end of generator shaft.

(3) **Do not use an adjustable, ratcheting "click type" torque wrench. Most "click type" wrenches will only allow torque to be applied in a clockwise rotation. Use a dial-type or**



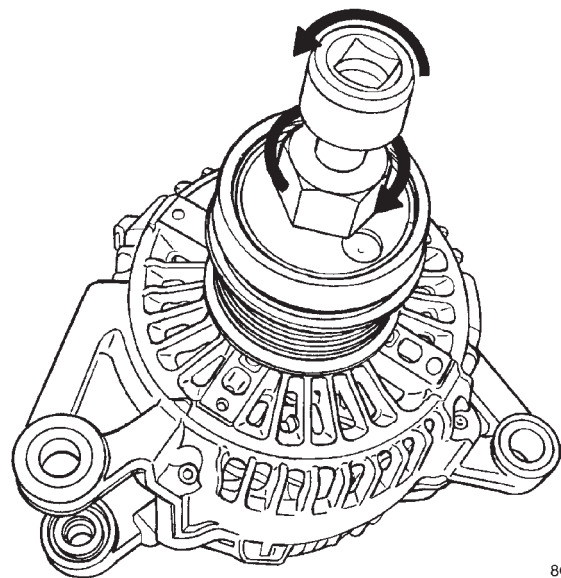
**Fig. 16 DECOUPLER INSTALLATION (INA SPLINED)**

- 1 - DRIVER  
2 - TOOL # 8823 (VM.1048)

**beam-type wrench.** Tighten in counter-clockwise rotation (Fig. 17). Refer to torque specifications.

(4) Install accessory drive belt, and generator. Refer to Generator Installation.

(5) Connect negative battery cable.



**Fig. 17 DECOUPLER INSTALLATION (Litens)**

## VOLTAGE REGULATOR

### DESCRIPTION

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 Powertrain Control Module (PCM). This circuitry is connected in series with the generator's 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 (B+) and battery temperature (refer to Battery Temperature Sensor for more information). It then determines a target charging voltage. If sensed battery voltage is 0.5 volts or lower than the target voltage, the PCM grounds the field winding until sensed battery voltage is 0.5 volts above target voltage. A circuit in the PCM cycles the ground side of the generator field up to 100 times per second (100Hz), but has the capability to ground the field control wire 100% of the time (full field) to achieve the target voltage. If the charging rate cannot be monitored (limp-in), a duty cycle of 25% is used by the PCM in order to have some generator output. Also refer to Charging Operation for additional information.

# STARTING SYSTEM

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## STARTING SYSTEM

### DESCRIPTION

The starting system consists of:

- Starter relay
  - Starter motor (including an integral starter solenoid)
- Other components to be considered as part of starting system are:
- Battery
  - Battery cables
  - Ignition switch and key lock cylinder
  - Clutch pedal position switch (manual transmission)
  - Park/neutral position switch (automatic transmission)
  - Wire harnesses and connections.

The Battery, Starting, and Charging systems operate in conjunction with one another, and must be tested as a complete system. For correct operation of starting/charging systems, all components used in these 3 systems must perform within specifications. When attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in each of 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 an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

Certain starting system components are monitored by the PCM and may produce a Diagnostic Trouble Code (DTC). Refer to Emission Control. See Diagnostic Trouble Codes for additional information and a list of codes.

### OPERATION

The starting system components form two separate circuits. A high-amperage feed circuit that feeds the starter motor between 150 and 350 amperes (700 amperes - diesel engine), and a low-amperage control circuit that operates on less than 20 amperes. The high-amperage feed circuit components include the battery, the battery cables, the contact disc portion of the starter solenoid, and the starter motor. The low-amperage control circuit components include the ignition switch, the clutch pedal position switch (manual transmission), the park/neutral position switch (automatic transmission), the starter relay, the electromagnetic windings of the starter solenoid, and the connecting wire harness components.

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 when the ignition switch is turned to the momentary Start position, unless the clutch pedal is depressed. This feature prevents starter motor 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.

STARTING SYSTEM (Continued)

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 momentary 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 and the starter motor from operating unless the automatic transmission gear selector is in the Neutral or Park positions.

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 motor. 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 or torque converter drive plate.

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 motor 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.

**DIAGNOSIS AND TESTING - STARTING SYSTEM**

The battery, starting, and charging systems operate in conjunction with one another, and must be tested as a complete system. For correct starting/charging system operation, all of the components involved in these 3 systems must perform within specifications.

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER FAILS TO OPERATE.	1. Battery discharged or faulty.	1. Refer to Battery. Charge or replace battery, if required.
	2. Starting circuit wiring faulty.	2. Refer to 8, Wiring Diagrams. Test and repair starter feed and/or control circuits, if required.
	3. Starter relay faulty.	3. Refer to Starter Relay in Diagnosis and Testing. Replace starter relay if required.
	4. Ignition switch faulty.	4. Refer to Ignition Switch and Key Lock Cylinder. Replace ignition switch if required.
	5. Clutch pedal position switch faulty.	5. Refer to Clutch Pedal Position Switch.
	6. Park/Neutral position switch faulty or misadjusted.	6. Refer to Park/Neutral Position Switch. Replace park/neutral position switch if required.
	7. Starter solenoid faulty.	7. Refer to Starter Motor. Replace starter motor assembly if required.
	8. Starter motor faulty.	8. If all other starting system components and circuits test OK, replace starter motor.

## STARTING SYSTEM (Continued)

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER ENGAGES, FAILS TO TURN ENGINE.	1. Battery discharged or faulty.	1. Refer to Battery. Charge or replace battery if required.
	2. Starting circuit wiring faulty.	2. Refer to 8, Wiring Diagrams. Test and repair starter feed and/or control circuits if required.
	3. Starter motor faulty.	3. If all other starting system components and circuits test OK, replace starter motor assembly.
	4. Engine seized.	4. Refer to Engine Diagnosis in the Diagnosis and Testing section of 9, Engine.
STARTER ENGAGES, SPINS OUT BEFORE ENGINE STARTS.	1. Starter ring gear faulty.	1. Refer to Starter Motor Removal and Installation. Remove starter motor to inspect starter ring gear. Replace starter ring gear if required.
	2. Starter motor faulty.	2. If all other starting system components and circuits test OK, replace starter motor assembly.
STARTER DOES NOT DISENGAGE.	1. Starter motor improperly installed.	1. Refer to Starter Motor Removal and Installation. Tighten starter mounting hardware to correct torque specifications.
	2. Starter relay faulty.	2. Refer to Starter Relay Diagnosis and Testing. Replace starter relay if required.
	3. Ignition switch faulty.	3. Refer to Ignition Switch and Key Lock Cylinder. Replace ignition switch if required.
	4. Starter motor faulty.	4. If all other starting system components and circuits test OK, replace starter motor.

## INSPECTION

For complete starter wiring circuit diagrams, refer to 8, Wiring Diagrams. Before removing any unit from starting system for repair or diagnosis, perform the following inspections:

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO 8, 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.**

- **Battery** - Visually inspect battery for indications of physical damage and loose or corroded cable connections. Determine state-of-charge and cranking capacity of battery. Charge or replace battery if required. Refer to **Battery** in 8, Battery. **Note: If equipped with diesel engine, a dual battery system may be used, and both batteries must be inspected.**

- **Ignition Switch** - Visually inspect ignition switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Ignition Switch and Key Lock Cylinder**.

- **Clutch Pedal Position Switch** - If equipped with manual transmission, visually inspect clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Clutch Pedal Position Switch** in 6, Clutch.

- **Park/Neutral Position Switch** - If equipped with automatic transmission, visually inspect park/neutral position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Park/Neutral Position Switch** in 21, Transmission.

- **Starter Relay** - Visually inspect starter relay for indications of physical damage and loose or corroded wire harness connections.

- **Starter Motor** - Visually inspect starter motor for indications of physical damage and loose or corroded wire harness connections.

- **Starter Solenoid** - Visually inspect starter solenoid for indications of physical damage and loose or corroded wire harness connections.

- **Wiring** - Visually inspect wire harnesses for damage. Repair or replace any faulty wiring, as required. Refer to 8, Wiring Diagrams.

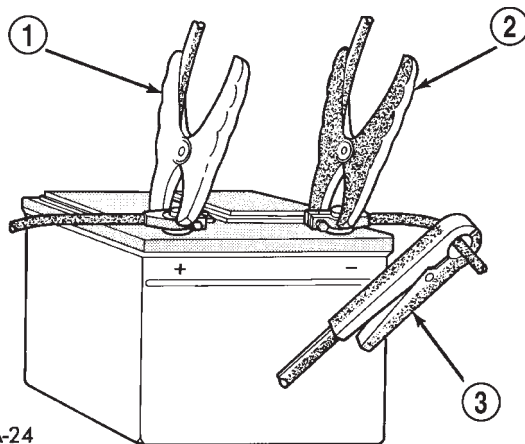
## STARTING SYSTEM (Continued)

## TESTING

## COLD CRANKING TEST

For complete starter wiring circuit diagrams, refer to 8, Wiring Diagrams. The battery must be fully-charged and load-tested before proceeding. Refer to **Battery** in 8, Battery.

(1) Connect volt-ampere tester to battery terminals (Fig. 1). See instructions provided by manufacturer of volt-ampere tester being used. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, tester should be connected to battery on left side of vehicle only. Also, tester current reading must be taken from positive battery cable lead that connects to starter motor.**



**Fig. 1** Volts-Amps Tester Connections - Typical

- 1 - POSITIVE CLAMP  
2 - NEGATIVE CLAMP  
3 - INDUCTION AMMETER CLAMP

(2) Fully engage parking brake.

(3) If equipped with manual transmission, place gearshift selector lever in Neutral position and block clutch pedal in fully depressed position. If equipped with automatic transmission, place gearshift selector lever in Park position.

(4) Verify that all lamps and accessories are turned off.

(5) To prevent a gasoline engine from starting, remove Automatic ShutDown (ASD) relay. To prevent a diesel engine from starting, remove Fuel Pump Relay. These relays are located in Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

**WARNING: IF EQUIPPED WITH DIESEL ENGINE, ATTEMPT TO START ENGINE A FEW TIMES BEFORE PROCEEDING WITH FOLLOWING STEP.**

(6) Rotate and hold ignition switch in Start position. Note cranking voltage and current (amperage) draw readings shown on volt-ampere tester.

(a) If voltage reads below 9.6 volts, refer to **Starter Motor** in Diagnosis and Testing. If starter motor is OK, refer to **Engine Diagnosis** in 9, Engine for further testing of engine. If starter motor is not OK, replace faulty starter motor.

(b) If voltage reads above 9.6 volts and current (amperage) draw reads below specifications, refer to **Feed Circuit Test** in this section.

(c) If voltage reads 12.5 volts or greater and starter motor does not turn, refer to **Control Circuit Testing** in this section.

(d) If voltage reads 12.5 volts or greater and starter motor turns very slowly, refer to **Feed Circuit Test** in this section.

**NOTE: A cold engine will increase starter current (amperage) draw reading, and reduce battery voltage reading.**

## FEED CIRCUIT TEST

The starter feed circuit test (voltage drop method) will determine if there is excessive resistance in high-amperage feed circuit. For complete starter wiring circuit diagrams, refer 8, Wiring Diagrams.

When performing these tests, it is important to remember that voltage drop is giving an indication of resistance between two points at which voltmeter probes are attached.

**Example:** When testing resistance of positive battery cable, touch voltmeter leads to positive battery cable clamp and cable connector at starter solenoid. If you probe positive battery terminal post and cable connector at starter solenoid, you are reading combined voltage drop in positive battery cable clamp-to-terminal post connection and positive battery cable.

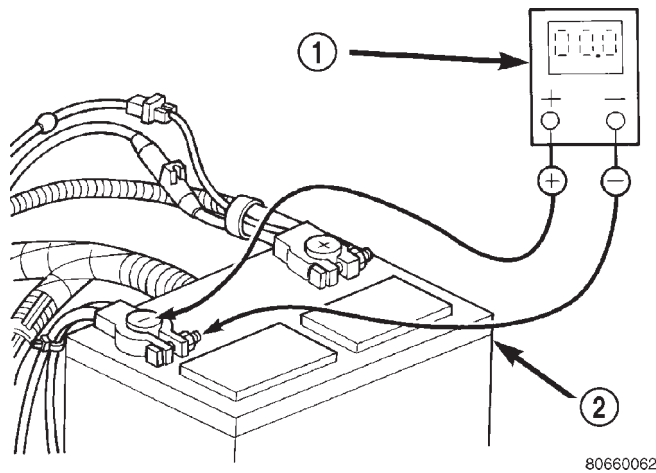
The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing tests, be certain that following procedures are accomplished:

- Battery is fully-charged and load-tested. Refer to **Battery** in 8, Battery.
- Fully engage parking brake.
- If equipped with manual transmission, place gearshift selector lever in Neutral position and block clutch pedal in fully depressed position. If equipped with automatic transmission, place gearshift selector lever in Park position.
- Verify that all lamps and accessories are turned off.
- To prevent a gasoline engine from starting, remove Automatic ShutDown (ASD) relay. To prevent a diesel engine from starting, remove Fuel Pump Relay. These relays are located in Power Distribution

## STARTING SYSTEM (Continued)

Center (PDC). Refer to label on PDC cover for relay location.

(1) Connect positive lead of voltmeter to negative battery cable terminal post. Connect negative lead of voltmeter to negative battery cable clamp (Fig. 2). Rotate and hold ignition switch in Start position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and terminal post. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, procedure must be performed twice, once for each battery.**



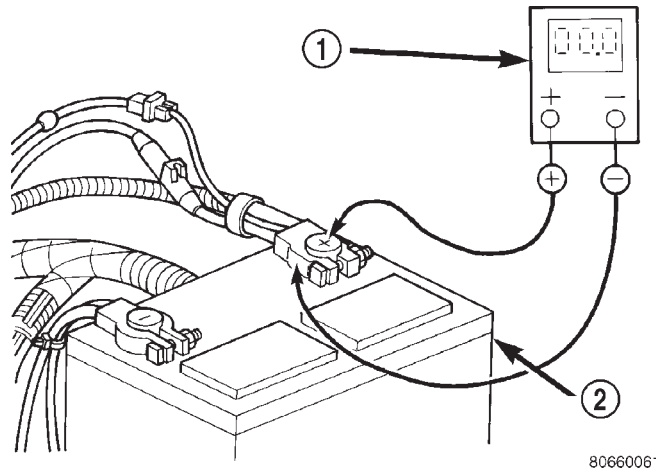
**Fig. 2 Test Negative Battery Cable Connection Resistance - Typical**

1 - VOLTMETER  
2 - BATTERY

(2) Connect positive lead of voltmeter to positive battery terminal post. Connect negative lead of voltmeter to battery positive cable clamp (Fig. 3). Rotate and hold ignition switch in Start position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and terminal post. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed twice, once for each battery.**

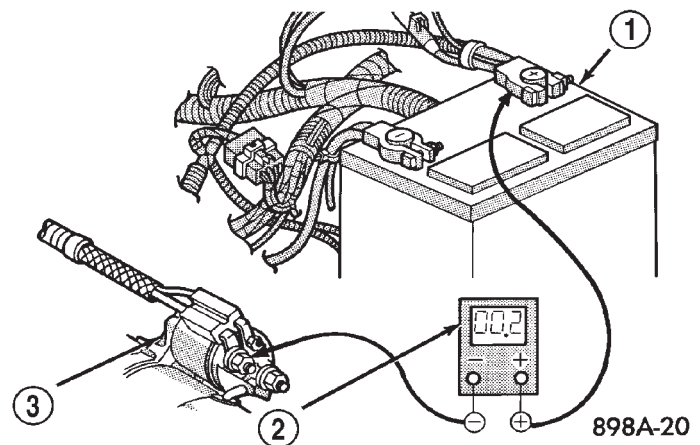
(3) Connect voltmeter to measure between battery positive terminal post and starter solenoid battery terminal stud (Fig. 4). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten battery cable connection at solenoid. Repeat test. If reading is still above 0.2 volt, replace faulty positive battery cable. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed on driver side battery only.**

(4) Connect voltmeter to measure between negative battery terminal post and a good clean ground



**Fig. 3 Test Positive Battery Cable Connection Resistance - Typical**

1 - VOLTMETER  
2 - BATTERY



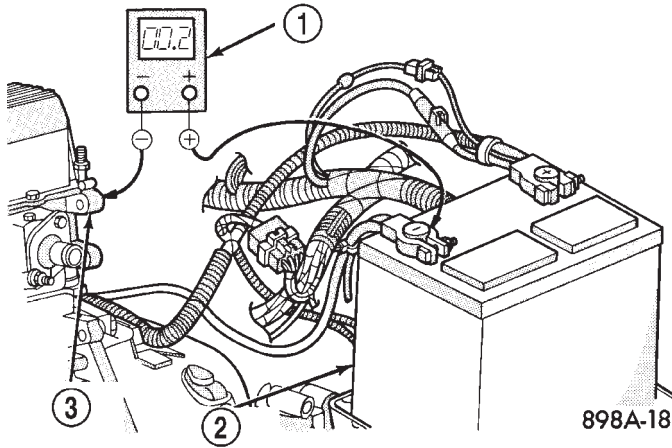
**Fig. 4 Test Positive Battery Cable**

1 - BATTERY  
2 - VOLTMETER  
3 - STARTER MOTOR

on engine block (Fig. 5). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten negative battery cable attachment on engine block. Repeat test. If reading is still above 0.2 volt, replace faulty negative battery cable. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed twice, once for each battery.**

(5) Connect positive lead of voltmeter to starter housing. Connect negative lead of voltmeter to negative battery terminal post (Fig. 6). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, correct poor starter to engine block ground contact. **Note: Certain diesel**

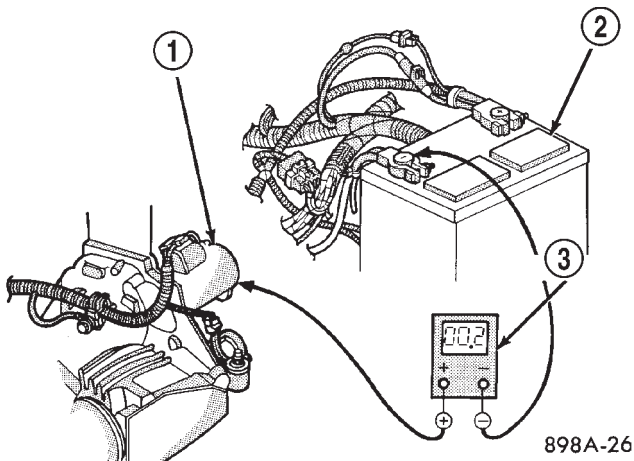
STARTING SYSTEM (Continued)



**Fig. 5 Test Ground Circuit Resistance - Typical**

- 1 - VOLTMETER
- 2 - BATTERY
- 3 - ENGINE GROUND

**equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed on driver side battery only.**



**Fig. 6 Test Starter Ground - Typical**

- 1 - STARTER MOTOR
- 2 - BATTERY
- 3 - VOLTMETER

(6) If equipped with dual battery system (certain diesel equipped models), connect positive lead of voltmeter to positive battery cable clamp on battery located on left side of vehicle. Connect negative lead of voltmeter to positive battery terminal post on battery located on right side of vehicle. Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten battery cables at both batteries. Repeat test. If reading is still above 0.2 volt, replace faulty positive battery cable.

If resistance tests detect no feed circuit problems, refer to **Starter Motor** in the Diagnosis and Testing.

**CONTROL CIRCUIT TESTING**

The starter control circuit components should be tested in the order in which they are listed, as follows:

- **Starter Relay** - Refer to **Starter Relay** Diagnosis and Testing.
- **Starter Solenoid** - Refer to **Starter Motor** Diagnosis and Testing.
- **Ignition Switch** - Refer to **Ignition Switch and Key Lock Cylinder**
- **Clutch Pedal Position Switch** - If equipped with manual transmission, refer to **Clutch Pedal Position Switch** in 6, Clutch.
- **Park/Neutral Position Switch** - If equipped with automatic transmission, refer to **Park/Neutral Position Switch** in 21, Transmission.
- **Wire harnesses and connections** - Refer to 8, Wiring Diagrams.

**INSPECTION - STARTING SYSTEM**

The following starting system components should be carefully inspected whenever any starting system problem is encountered.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE AIRBAG SYSTEM. FAILURE TO TAKE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**Battery**

- Visually inspect battery for indications of physical damage and loose or corroded cable connections. Determine state-of-charge and cranking capacity of battery. Charge or replace battery, if required. Refer to **Battery** for battery cleaning and inspection procedures.

**Ignition Switch**

- Visually inspect ignition switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Wiring Diagrams**. Refer to **Ignition Switch and Key Lock Cylinder** for ignition switch service procedures.



## STARTING SYSTEM (Continued)

**Clutch Pedal Position Switch**

- If vehicle is equipped with a manual transmission, visually inspect clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Clutch Hydraulic Linkage** for clutch pedal position switch service procedures.

**Park/Neutral Position Switch**

- If vehicle is equipped with an automatic transmission, visually inspect park/neutral position switch for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Park/Neutral Position Switch** for park/neutral position switch service procedures.

**Starter Relay**

- Visually inspect starter relay for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Starter Relay** for starter relay service procedures.

**Starter Motor**

- Visually inspect starter motor for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. If problem being diagnosed involves improper starter engagement, disengagement or noise complaints, starter motor should be removed. With starter motor removed, inspect starter pinion and ring gears for damaged or missing teeth. Replace faulty components as required. Refer to **Starter Motor** for removal/installation procedures.

**Starter Solenoid**

- Visually inspect starter solenoid for indications of physical damage and loose or corroded wire harness connections. Clean corroded connections as required. Refer to **Starter Motor** for starter solenoid service procedures.

**Wiring**

- Visually inspect starting system wire harnesses for indications of physical damage. Repair or replace any faulty wiring, as required. Refer to **Wiring Diagrams** for repair or connector and terminal service procedures.

## SPECIFICATIONS

## TORQUE - GAS POWERED

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Starter Solenoid Battery Cable Nut	11	-	100
Starter Mounting Bolts - 2.4L	54	40	-
Starter Mounting Bolts -3.7L	54	40	-
Starter Heat Shield Mounting Bolts	6	-	55

STARTING SYSTEM (Continued)

**STARTER MOTOR - GAS POWERED**

Starter Motor and Solenoid	
Manufacturer	Mitsubishi
Engine Application	2.4L / 3.7L
Power Rating	1.4 Kilowatt (1.9 Horsepower)
Voltage	12 Volts
** Number of Permanent Magnets	6
Number of Brushes	4
Drive Type	Planetary Gear Reduction
Free Running Test Voltage	11.2 Volts
Free Running Test Maximum Amperage Draw	90 Amperes
Free Running Test Minimum Speed	2400 rpm
Solenoid Closing Maximum Voltage Required	7.8 Volts
* Cranking Amperage Draw Test	160 Amperes
*Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.	
**The starter is equipped with permanent magnets. Never strike the starter case to attempt to loosen a sticking/ stuck armature as permanent magnets may crack or break.	

**STARTER MOTOR**

**DIAGNOSIS AND TESTING - STARTER MOTOR**

Correct starter motor operation can be confirmed by performing the following free running bench test. This test can only be performed with starter motor removed from vehicle. Refer to Specifications for starter motor specifications.

(1) Remove starter motor from vehicle. Refer to Starter Motor Removal and Installation.

(2) Mount starter motor securely in a soft-jawed bench vise. The vise jaws should be clamped on the mounting flange of starter motor. Never clamp on starter motor by field frame.

(3) Connect a suitable volt-ampere tester and a 12-volt battery to starter motor in series, and set ammeter to 100 ampere scale. See instructions provided by manufacturer of volt-ampere tester being used.

(4) Install jumper wire from solenoid terminal to solenoid battery terminal. The starter motor should operate. If starter motor fails to operate, replace faulty starter motor assembly.

(5) Adjust carbon pile load of tester to obtain free running test voltage. Refer to Specifications for starter motor free running test voltage specifications.

(6) Note reading on ammeter and compare reading to free running test maximum amperage draw. Refer to Specifications for starter motor free running test maximum amperage draw specifications.

(7) If ammeter reading exceeds maximum amperage draw specification, replace faulty starter motor assembly.

**STARTER SOLENOID**

This test can only be performed with starter motor removed from vehicle.

(1) Remove starter motor from vehicle. Refer to Starter Motor Removal and Installation.

(2) Disconnect wire from solenoid field coil terminal.

(3) Check for continuity between solenoid terminal and solenoid field coil terminal with a continuity tester (Fig. 7). There should be continuity. If OK, go to Step 4. If not OK, replace faulty starter motor assembly.

(4) Check for continuity between solenoid terminal and solenoid case (Fig. 8). There should be continuity. If not OK, replace faulty starter motor assembly.

**REMOVAL**

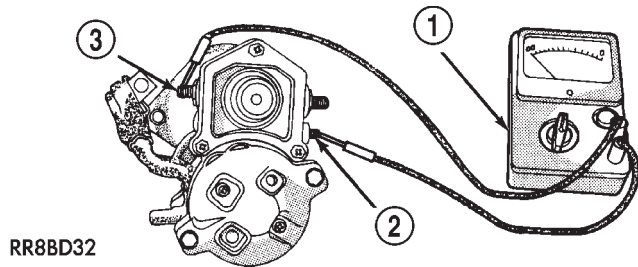
**2.4L 4-Cylinder**

(1) Disconnect and isolate negative battery cable.  
 (2) Raise and support vehicle.  
 (3) Remove solenoid wire from solenoid terminal (Fig. 11).

(4) Remove battery cable from stud on starter solenoid (Fig. 11).

(5) Remove 2 starter mounting bolts (Fig. 9) and remove starter from vehicle.

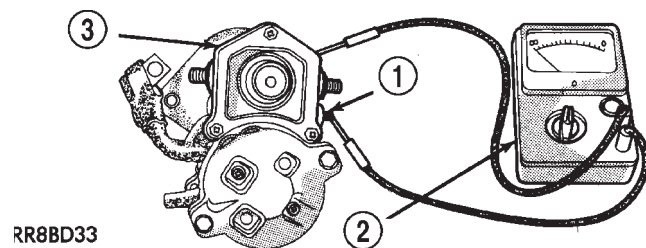
STARTER MOTOR (Continued)



RR8BD32

**Fig. 7 CONTINUITY BETWEEN SOLENOID AND FIELD COIL TERMINALS - TYPICAL**

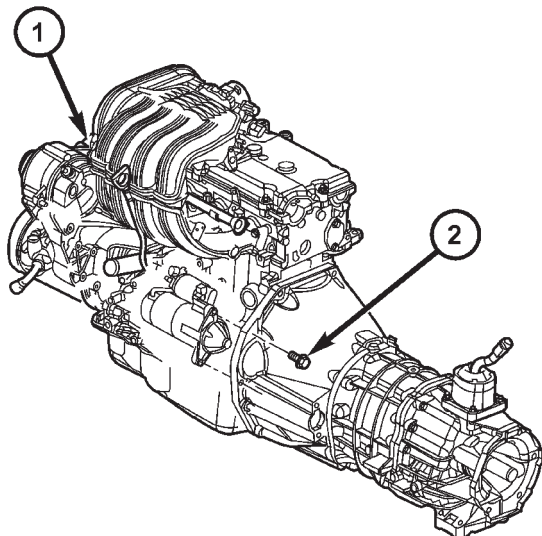
- 1 - OHMMETER
- 2 - SOLENOID TERMINAL
- 3 - FIELD COIL TERMINAL



RR8BD33

**Fig. 8 CONTINUITY BETWEEN SOLENOID TERMINAL AND CASE - TYPICAL**

- 1 - SOLENOID TERMINAL
- 2 - OHMMETER
- 3 - SOLENOID



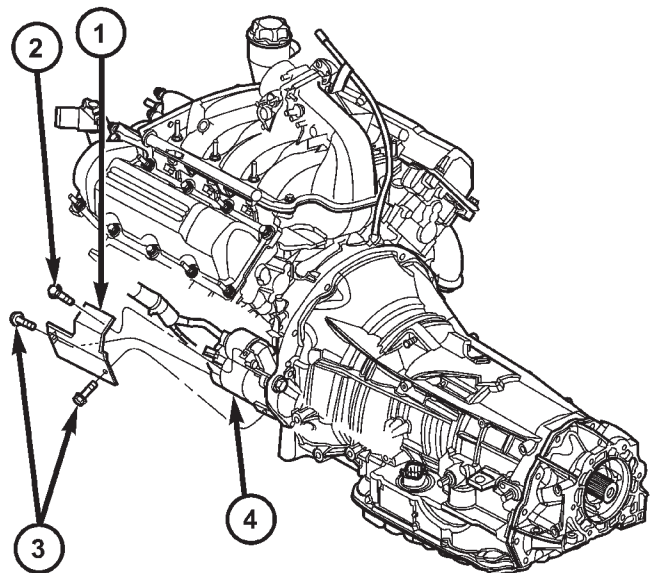
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**Fig. 9 STARTER - 2.4L**

- 1 - STARTER
- 2 - MOUNTING BOLTS (2)

**3.7L V-6**

- (1) Disconnect and isolate negative battery cable.
- (2) Raise and support vehicle.
- (3) Remove 2 flange bolts securing left exhaust downpipe to crossover pipe. Lower pipe slightly to allow front propeller shaft removal.
- (4) Remove front propeller shaft.
- (5) Remove 2 starter heat shield bolts at side of starter (Fig. 10).
- (6) Remove starter heat shield nut at front of starter (Fig. 10).



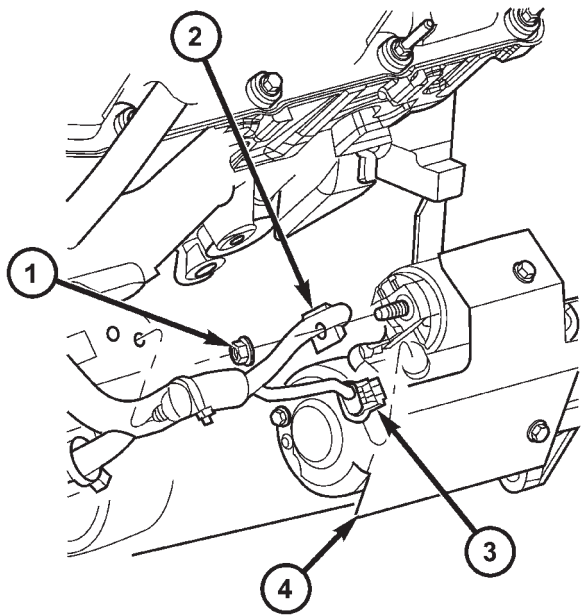
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**Fig. 10 STARTER HEAT SHIELD - 3.7L**

- 1 - STARTER HEAT SHIELD
- 2 - HEAT SHIELD BOLTS
- 3 - HEAT SHIELD BOLTS
- 4 - STARTER

- (7) Remove starter heat shield.
- (8) Remove solenoid wire from solenoid terminal (Fig. 11).
- (9) Remove battery cable from stud on starter solenoid (Fig. 11).
- (10) Remove 2 starter mounting bolts (Fig. 12).
- (11) Position front of starter to face rear of vehicle. Rotate starter until solenoid position is located below starter.
- (12) Remove starter from vehicle by passing it between exhaust pipe and transmission bellhousing.

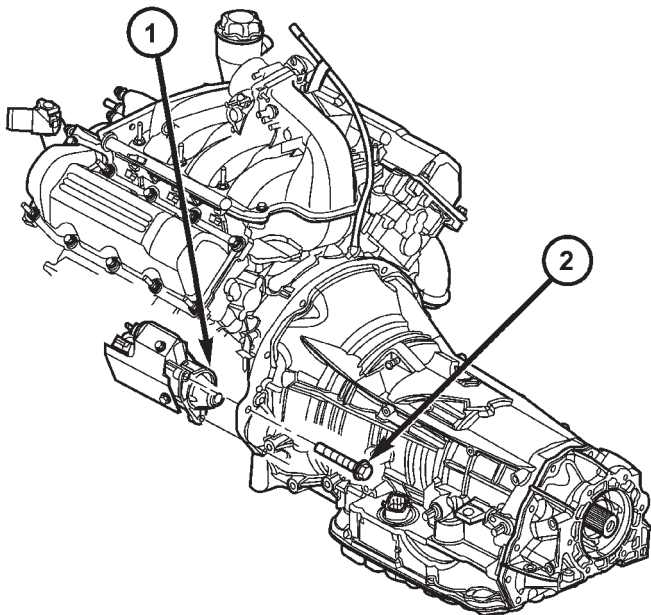
STARTER MOTOR (Continued)



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**Fig. 11 STARTER ELECTRICAL CONNECTORS - 2.4L/3.7L**

- 1 - BATTERY CABLE NUT
- 2 - BATTERY CABLE
- 3 - SOLENOID CONNECTOR
- 4 - HEAT SHIELD



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**Fig. 12 STARTER - 3.7L**

- 1 - STARTER
- 2 - MOUNTING BOLTS (2)

**INSTALLATION**

**2.4L 4-Cylinder**

- (1) Position starter into bellhousing and install 2 bolts. Refer to torque specifications.
- (2) Install battery cable and nut to stud on starter solenoid. Refer to torque specifications.
- (3) Install solenoid wire connector to solenoid terminal.
- (4) Lower vehicle.
- (5) Connect negative battery cable.

**3.7L V-6**

- (1) Position front of starter towards rear of vehicle with solenoid position rotated until it is located below starter. Install starter by passing it between exhaust pipe and transmission bellhousing.
- (2) Position starter into bellhousing and install 2 bolts. Refer to torque specifications.
- (3) Install battery cable and nut to stud on starter solenoid. Refer to torque specifications.
- (4) Install solenoid wire connector to solenoid terminal.
- (5) Position starter heat shield and install nut at front of starter.
- (6) Install 2 starter heat shield bolts at side of starter.
- (7) Install front propeller shaft.
- (8) Install 2 flange bolts securing left exhaust downpipe to crossover pipe.
- (9) Lower vehicle.
- (10) Connect negative battery cable.

**STARTER MOTOR RELAY**

**DESCRIPTION**

The starter relay is an electromechanical device that switches battery current to the pull-in coil of the starter solenoid when ignition switch is turned to Start position. The starter relay is located in the Power Distribution Center (PDC) in the engine compartment. See PDC cover for relay identification and location.

The starter relay is a International Standards Organization (ISO) relay. Relays conforming to ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The starter relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

## STARTER MOTOR RELAY (Continued)

## OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When electromagnetic coil is energized, it draws the movable contact away from normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When electromagnetic coil is de-energized, spring pressure returns movable contact to normally closed position. The resistor or diode is connected in parallel with electromagnetic coil within relay, and helps to dissipate voltage spikes produced when coil is de-energized.

## DIAGNOSIS AND TESTING - STARTER RELAY

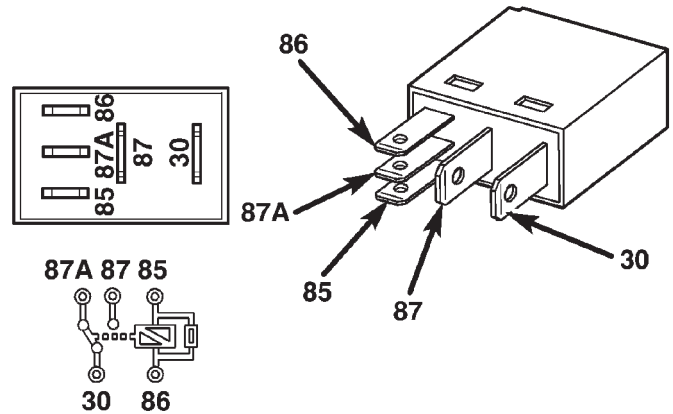
The starter relay is located in the Power Distribution Center (PDC) in engine compartment. Refer to label on PDC cover for relay location.

## RELAY TEST

- (1) Remove starter relay (Fig. 13) from PDC.
- (2) A relay in de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace faulty relay.
- (3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 5$  ohms. If OK, go to Step 4. If not OK, replace faulty relay.
- (4) 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, perform following Relay Circuit Test. If not OK, replace faulty 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 open circuit to fused B(+) fuse in PDC as required.
- (2) The relay normally closed terminal (87A) is connected to terminal 30 in de-energized position, but is not used for this application. Go to Step 3.
- (3) The relay normally open terminal (87) is connected to common feed terminal (30) in energized position. This terminal supplies battery voltage to starter solenoid field coil. There should be continuity between cavity for relay terminal 87 and starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair open engine starter motor relay output circuit to starter solenoid as required.
- (4) The coil battery terminal (86) is connected to electromagnet in relay. It is energized when ignition switch is held in Start position. On vehicles with a



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**Fig. 13 STARTER RELAY (ISO MICRO RELAY)**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

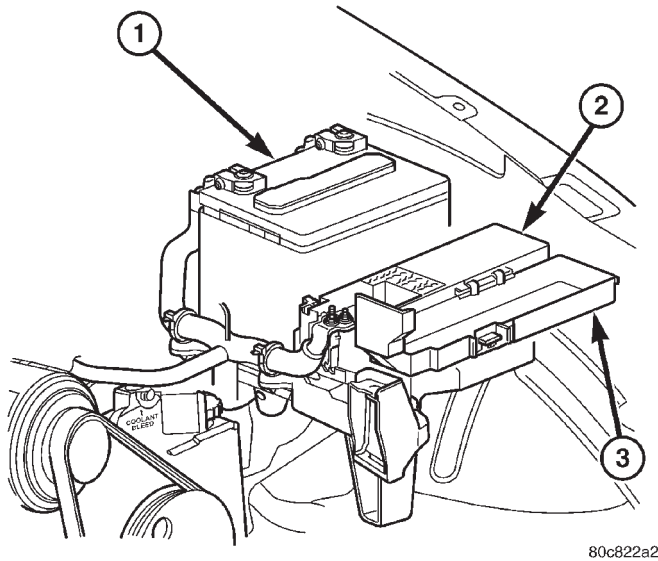
manual transmission, the clutch pedal must be blocked in fully depressed position for this test. Check for battery voltage at cavity for relay terminal 86 with ignition switch in Start position, and no voltage when ignition switch is released to On position. If OK, go to Step 5. If not OK with a manual transmission, disconnect clutch pedal position switch wire harness connector and install a jumper wire between two cavities in body half of connector and check for battery voltage again at cavity for relay terminal 86. If now OK, replace faulty clutch pedal position switch. If still not OK with a manual transmission or if not OK with an automatic transmission, check for open or shorted fused ignition switch output (start) circuit to ignition switch and repair as required. If fused ignition switch output (start) circuit is OK, refer to **Ignition Switch and Key Lock Cylinder**.

(5) The coil ground terminal (85) is connected to electromagnet in relay. On vehicles with manual transmission, it is grounded at all times. On vehicles with automatic transmission, it is grounded through park/neutral position switch only when gearshift selector lever is in Park or Neutral positions. Check for continuity to ground at cavity for relay terminal 85. If not OK with a manual transmission, repair open park/neutral position switch sense circuit to ground as required. If not OK with an automatic transmission, check for open or shorted park/neutral position switch sense circuit to park/neutral position switch and repair, as required. If park/neutral position switch sense circuit checks OK, refer to **Park/Neutral Position Switch**.

## STARTER MOTOR RELAY (Continued)

**REMOVAL**

The starter relay is located in the Power Distribution Center (PDC) (Fig. 14). Refer to label on PDC cover for relay location.



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**Fig. 14 POWER DISTRIBUTION CENTER (PDC)**

- 1 - BATTERY
- 2 - PDC
- 3 - PDC COVER

- (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) Refer to Power Distribution Center (PDC) cover for starter relay location.
- (2) Install relay to PDC.
- (3) Install cover to PDC.



# HEATED SYSTEMS

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# HEATED MIRRORS

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## HEATED MIRRORS

### DESCRIPTION

Vehicles equipped with the optional heated mirror package have an electric heating grid located behind the mirror glass of each outside rear view mirror. The heated mirrors are controlled by the rear window defogger switch. Electrical current is directed to the heating grid inside the mirror only when the rear window defogger switch is in the On position.

If the outside mirror heating grids and the rear window heating grid are all inoperative, (Refer to 8 - ELECTRICAL/HEATED GLASS - DIAGNOSIS AND TESTING). If the outside mirror heating grids are inoperative, but the rear window heating grid is operating as designed, (Refer to 8 - ELECTRICAL/HEATED MIRRORS - DIAGNOSIS AND TESTING).

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 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - REMOVAL) and (Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - INSTALLATION).

### OPERATION

The heated mirror is controlled by the rear window defogger switch. The only time that the heated mirror is on is when the rear window defogger is on. The mirror should become warm to the touch.

## DIAGNOSIS AND TESTING - HEATED MIRRORS

For circuit descriptions and diagrams (Refer to Appropriate Wiring Information).

(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 front door trim panel on the side of the vehicle with the inoperative mirror heating grid. 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 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. Turn on the rear window defogger system. Check for battery voltage at the rear window defogger relay output circuit cavity in the body half of the power mirror wire harness connector. If OK, go to Step 5. If not OK, repair the open circuit to the rear window defogger relay as required.



## HEATED MIRRORS (Continued)

(5) Check for continuity between the ground circuit and the rear window defogger relay 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(Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - REMOVAL) and (Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - INSTALLATION). If OK, check the resistance

through the electric heating grid circuit. Correct resistance through the electric 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(Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - REMOVAL) and (Refer to 8 - ELECTRICAL/POWER MIRRORS/SIDEVIEW MIRROR - INSTALLATION).

# WINDOW DEFOGGER

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## WINDOW DEFOGGER

### DESCRIPTION - REAR WINDOW DEFOGGER

The rear window defogger system will only operate when the ignition switch is in the run position. When the defogger switch is in the run position, an electric heater grid on the rear window glass is energized. Vehicles with the heated mirror options also have heater grids located behind the outside rear view mirror glass. Each of these grids produce heat to help clear the rear window glass and outside rear view mirrors of ice, snow, or fog.

### OPERATION - REAR WINDOW DEFOGGER

The rear window defogger system is controlled by a switch installed with the HVAC control assembly. An amber indicator lamp in the switch button will light to indicate when the rear window defogger system is turned on. The HVAC control head circuitry, which contains the defogger system timer logic, monitors the state of the defogger switch through a hard-wired input. The instrument cluster circuitry controls the

rear window defogger system through a hard-wired control output to the rear window defogger relay. The rear window defogger timer and logic circuitry cannot be adjusted or repaired and, if faulty or damaged, the HVAC control head assembly must be replaced.

The rear window defogger system will be automatically turned off after a programmed time interval of about ten minutes. After the initial time interval has expired, if the rear window defogger switch is turned on again during the same ignition cycle, the defogger system will automatically turn off after about five minutes.

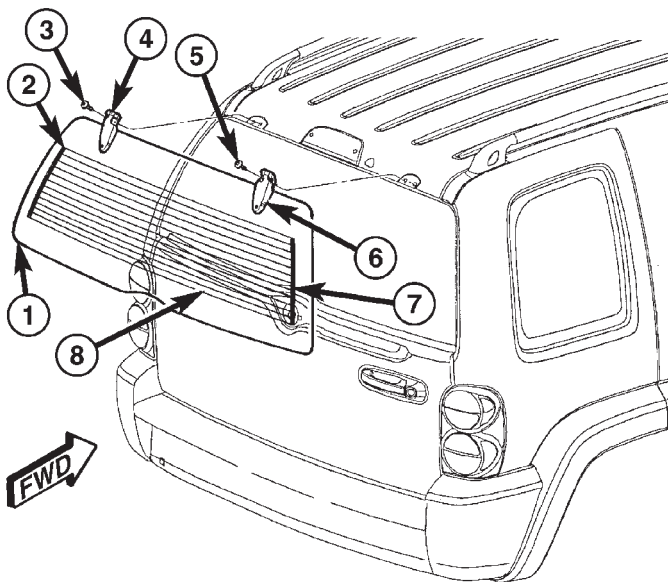
The rear window defogger system will automatically shut off if the ignition switch is turned to the Off position, or it can be turned off manually by depressing the instrument panel switch. Following are general descriptions of the major components in the rear window defogger system. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the defogger system.

## WINDOW DEFOGGER (Continued)

**DIAGNOSIS AND TESTING - REAR WINDOW DEFOGGER SYSTEM**

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). The operation of the electrically heated rear window defogger system can be confirmed in one of the following manners:

- Turn the ignition switch to the run position.
- Set the defogger switch in the run position. The rear window defogger operation can be checked by feeling the rear window or outside rear view mirror glass. A distinct difference in temperature between the grid lines and the adjacent clear glass or the mirror glass can be detected within three to four minutes of operation.
- Using a 12-volt DC voltmeter, contact the rear glass heating grid terminal B (right side) with the negative lead, and terminal A (left side) with the positive lead (Fig. 1). The voltmeter should read battery voltage.



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**Fig. 1 REAR WINDOW DEFOGGER**

- 1 - DEFOGGER BACKGLASS
- 2 - HEATED GLASS CONNECTOR "A"
- 3 - HINDGE MOUNTING SCREWS (2)
- 4 - HINDGE (LEFT SIDE)
- 5 - HINDGE MOUNTING SCREWS (2)
- 6 - HINDGE (RIGHT SIDE)
- 7 - HEATED GLASS CONNECTOR "B"
- 8 - BACKGLASS DEFOGGER GRID

The above checks will confirm system operation. Illumination of the defogger switch indicator lamp means that there is electrical current available at the output of the defogger relay, but does not confirm

that the electrical current is reaching the rear glass heating grid lines.

If the defogger system does not operate, the problem should be isolated in the following manner:

- (1) Confirm that the ignition switch is in the run position.
- (2) Ensure that the rear glass heating grid feed and ground wires are connected to the glass. Confirm that the ground wire has continuity to ground.
- (3) 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 rear glass or outside rear view mirror heating grid is still inoperative, one or more of the following is faulty:

- Defogger switch
- Defogger relay
- HVAC control head circuitry
- Rear window grid lines (all grid lines would have to be broken or one of the feed wires disconnected for the entire system to be inoperative)
- Outside rear view mirror heating grid.

If setting the defogger switch to the On position produces a severe voltmeter deflection, check for a short circuit between the defogger relay output and the rear glass or outside rear view mirror heating grids.

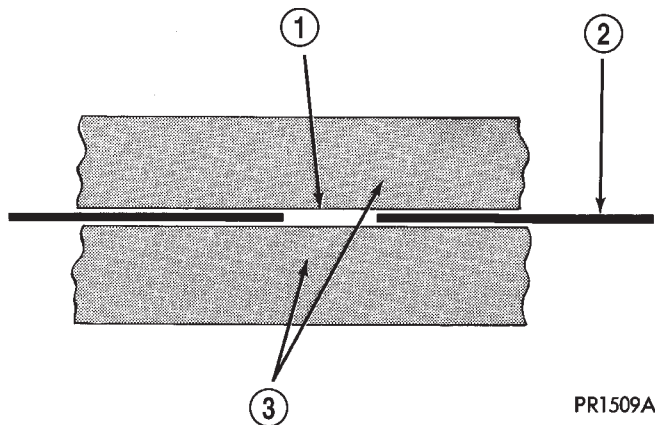
**STANDARD PROCEDURE - REAR GLASS HEATING GRID REPAIR**

Repair of the rear glass heating grid lines, bus bars, terminals or pigtail wires can be accomplished using a Mopar Rear Window Defogger Repair Kit (Part Number 4267922) or equivalent.

**WARNING: MATERIALS CONTAINED IN THE REPAIR KIT MAY CAUSE SKIN OR EYE IRRITATION. THE KIT CONTAINS EPOXY RESIN AND AMINE TYPE HARDENER, WHICH ARE HARMFUL IF SWALLOWED. AVOID CONTACT WITH THE SKIN AND EYES. FOR SKIN CONTACT, WASH THE AFFECTED AREAS WITH SOAP AND WATER. FOR CONTACT WITH THE EYES, FLUSH WITH PLENTY OF WATER. DO NOT TAKE INTERNALLY. IF TAKEN INTERNALLY, INDUCE VOMITING AND CALL A PHYSICIAN IMMEDIATELY. USE WITH ADEQUATE VENTILATION. DO NOT USE NEAR FIRE OR FLAME. CONTAINS FLAMMABLE SOLVENTS. KEEP OUT OF THE REACH OF CHILDREN.**

- (1) Mask the repair area so that the conductive epoxy can be applied neatly. Extend the epoxy application onto the grid line or the bus bar on each side of the break (Fig. 2).

## WINDOW DEFOGGER (Continued)



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**Fig. 2 GRID LINE REPAIR**

- 1 - BREAK
- 2 - GRID LINE
- 3 - MASKING TAPE

(2) Follow the instructions in the repair kit for preparing the damaged area.

(3) Remove the package separator clamp and mix the two conductive epoxy components thoroughly within the packaging. Fold the package in half and cut the center corner to dispense the epoxy.

(4) For grid line repairs, mask the area to be repaired with masking tape or a template.

(5) Apply the epoxy through the slit in the masking tape or template. Overlap both ends of the break by at least 19 millimeters (0.75 inch).

(6) For a terminal or pigtail wire replacement, mask the adjacent areas so the epoxy can be extended onto the adjacent grid line as well as the bus bar. Apply a thin layer of epoxy to the area where the terminal or pigtail wire was fastened and onto the adjacent grid line.

(7) Apply a thin layer of conductive epoxy to the terminal or bare wire end of the pigtail and place it in the proper location on the bus bar. To prevent the terminal or pigtail wire from moving while the epoxy is curing, it must be wedged or clamped.

(8) Carefully remove the masking tape or template.

**CAUTION: Do not allow the glass surface to exceed 204° C (400° F) or the glass may fracture.**

(9) Allow the epoxy to cure 24 hours at room temperature, or use a heat gun that will not over heat the glass. Hold the heat gun approximately 25.4 centimeters (10 inches) from the repair.

(10) After the conductive epoxy is properly cured, remove the wedge or clamp from the terminal or pigtail wire. Do not attach the wire harness connectors until the curing process is complete.

(11) Check the operation of the rear window defogger glass heating grid.

## REAR WINDOW DEFOGGER GRID

### DESCRIPTION

The heated rear window glass has two electrically conductive vertical bus bars and a series of 11 horizontal grid lines made of a silver-ceramic material, which is baked on and bonded to the inside surface of the glass. The grid lines and bus bars comprise a parallel electrical circuit.

### OPERATION

When the rear window defogger switch is placed in the On position, electrical current is directed to the rear window grid lines through the bus bars. The grid lines heat the rear window to clear the surface of fog or snow. Protection for the heated grid circuit is provided by a fuse in the Power Distribution Center (PDC).

The grid lines and bus bars are highly resistant to abrasion. However, it is possible for an open circuit to occur in an individual grid line, resulting in no current flow through the line.

The grid lines can be damaged or scraped off with sharp instruments. Care should be taken when cleaning the glass or removing foreign materials, decals, or stickers from the glass. Normal glass cleaning solvents or hot water used with rags or toweling is recommended.

A repair kit is available to repair the grid lines and bus bars, or to reinstall the heated glass pigtail wires.

### DIAGNOSIS AND TESTING - REAR WINDOW DEFOGGER GRID

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). To detect breaks in the grid lines, the following procedure is required:

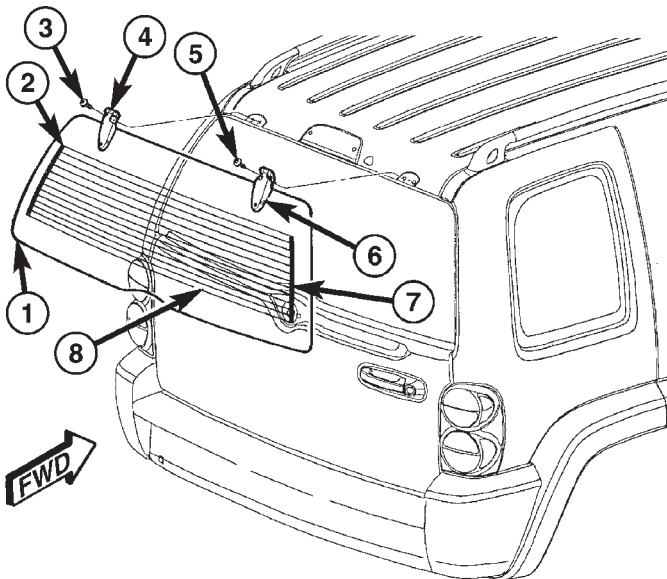
(1) Turn the ignition switch to the run position. Set the defogger switch in the On position. The indicator lamp should light. If OK, go to Step 2. If not OK, (Refer to 8 - ELECTRICAL/HEATED GLASS/REAR WINDOW DEFOGGER RELAY - DIAGNOSIS AND TESTING)

(2) Using a 12-volt DC voltmeter, contact the vertical bus bar on the right side of the vehicle with the negative lead. With the positive lead, contact the vertical bus bar on the left side of the vehicle. The voltmeter should read battery voltage. If OK, go to Step 3. If not OK, repair the open circuit to the defogger relay as required.

(3) With the negative lead of the voltmeter, contact a good body ground point. The voltage reading should not change. If OK, go to Step 4. If not OK, repair the circuit to ground as required.

## REAR WINDOW DEFOGGER GRID (Continued)

(4) Connect the negative lead of the voltmeter to the right side bus bar and touch each grid line at its midpoint with the positive lead (Fig. 3). A reading of approximately six volts indicates a line is good. A reading of zero volts indicates a break in the grid line between the midpoint of the grid line and the left side bus bar. A reading of ten to fourteen volts indicates a break between the midpoint of the grid line and the right side bus bar. Move the positive lead on the grid line towards the break and the voltage reading will change as soon as the break is crossed.



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**Fig. 3 REAR WINDOW DEFOGGER**

- 1 - DEFOGGER BACKGLASS
- 2 - HEATED GLASS CONNECTOR "A"
- 3 - HINDGE MOUNTING SCREWS (2)
- 4 - HINDGE (LEFT SIDE)
- 5 - HINDGE MOUNTING SCREWS (2)
- 6 - HINDGE (RIGHT SIDE)
- 7 - HEATED GLASS CONNECTOR "B"
- 8 - BACKGLASS DEFOGGER GRID

## REAR WINDOW DEFOGGER RELAY

### DESCRIPTION

The rear window defogger relay is a International Standards Organization (ISO)-type relay. The rear window defogger relay is a electromechanical device that switches fused battery current to the rear glass and outside mirror heating grids, and the indicator lamp of the defogger switch, when the HVAC control head rear window defogger timer and logic circuitry

grounds the relay coil. (Refer to 8 - ELECTRICAL/HEATED GLASS/REAR WINDOW DEFOGGER RELAY - DIAGNOSIS AND TESTING)

The rear window defogger relay is located in the junction block, on the left side of the instrument panel inboard to the center of the vehicle (just to the left and above the brake pedal or behind the knee blocker). The rear window defogger relay cannot be repaired and, if faulty or damaged, it must be replaced.

### OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

### DIAGNOSIS AND TESTING - REAR WINDOW DEFOGGER RELAY

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

### RELAY TEST

The defogger relay (Fig. 4) is located in the junction block, on the left side of the instrument panel inboard to the center of the vehicle (just to the right and above the brake pedal or behind the knee blocker). Remove the defogger relay from the junction block to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and

REAR WINDOW DEFOGGER RELAY (Continued)

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 60.7 to 80.3 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 the Relay Circuit Test in this group. If not OK, replace the faulty relay.

(4) The coil ground terminal (85) is connected to the electromagnet in the relay. This terminal is provided with ground by the instrument cluster rear window defogger timer and logic circuitry to energize the defogger relay. There should be continuity to ground at the cavity for relay terminal 85 when the defogger switch is turned On. However, with the defogger relay removed, the defogger switch indicator lamp will not light to show that the defogger system is turned On. Be certain that you depress the defogger switch at least twice to confirm that the system is turned on during this test. If OK, go to Step 5. If not OK, repair the open circuit to the HVAC control head as required.

(5) The coil battery terminal (86) is connected to the electromagnet in the relay. It is connected to fused ignition switch output voltage and should be hot when the ignition switch is in the run position. Check for battery voltage at the cavity for relay terminal 86 with the ignition switch in the run position. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, repair the open circuit to the fuse in the junction block as required.

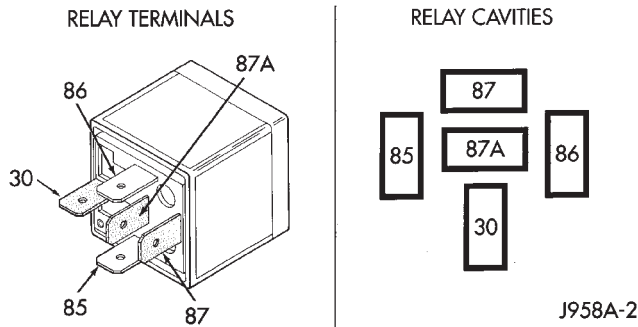


Fig. 4 DEFOGGER RELAY- TERMINAL LEGEND

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

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 rear glass and outside rear view mirror heating grids and the defogger switch indicator lamp. There should be continuity between the cavity for relay terminal 87 and the rear window defogger relay output circuit cavities of the rear glass heating grid connector, both outside rear view mirror heating grid connectors, and the defogger switch connector at all times. If OK, go to Step 4. If not OK, repair the open circuit(s) as required.

REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.
- (2) Unplug the rear window defogger relay from the junction block.

INSTALLATION

- (1) Install the rear window defogger relay by aligning the relay terminals with the cavities in the junction block and pushing the relay firmly into place.
- (2) Connect the battery negative cable.
- (3) Test the relay operation.

## REAR WINDOW DEFOGGER SWITCH

### DESCRIPTION

The rear window defogger switch is installed in the instrument panel HVAC control head assembly. The momentary-type switch provides a hard-wired ground signal to the HVAC control head each time it is depressed. The instrument cluster rear window defogger timer and logic circuitry responds by energizing or de-energizing the rear window defogger relay.

### OPERATION

Energizing the rear window defogger relay provides electrical current to the rear window defogger grid and, if the vehicle is so equipped, the outside rear view mirror heating grids. An amber indicator lamp in the defogger switch, which lights to indicate when the defogger system is turned On, is also powered by the defogger relay output.

The defogger switch illumination lamp and indicator lamp bulbs are serviceable. The defogger switch cannot be repaired and, if faulty or damaged the entire HVAC control head assembly must be replaced.

### DIAGNOSIS AND TESTING

#### DIAGNOSIS AND TESTING - REAR WINDOW DEFOGGER SWITCH

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

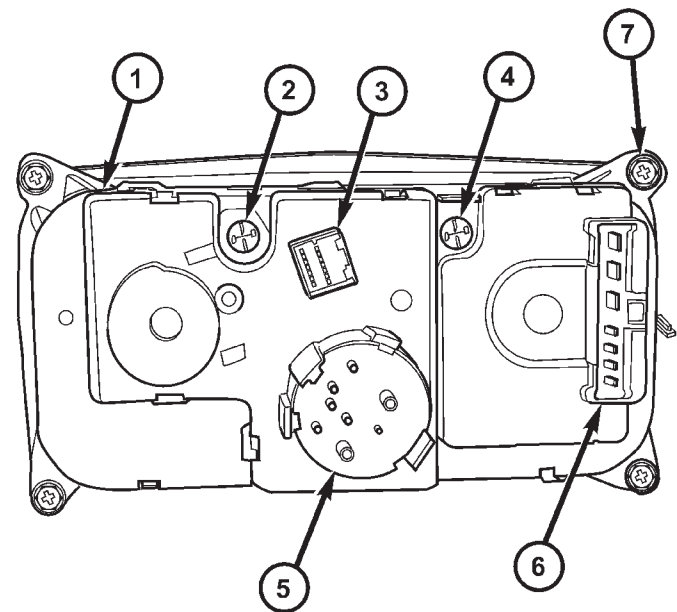
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable. Remove the HVAC control head assembly from the instrument panel and unplug the defogger switch wire harness connector-B.

(2) Check for continuity between the ground circuit cavity of the defogger switch wire harness con-

ductor and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit as required.

(3) Check for continuity between the ground circuit terminal and the rear window defogger switch sense circuit terminal on the back of the defogger switch housing (Fig. 5). There should be momentary continuity as the defogger switch button is depressed, and then no continuity. If OK, (Refer to 8 - ELECTRICAL/HEATED GLASS/REAR WINDOW DEFOGGER SWITCH - DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER REAR WINDOW DEFOGGER FUNCTION) If not OK, replace the faulty switch (Fig. 5).



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**Fig. 5 A/C HEATER CONTROL HEAD (Rear View)**

- 1 - A/C HEATER CONTROL HEAD
- 2 - A/C HEATER CONTROL HEAD LIGHT
- 3 - REAR WINDOW DEFOGGER SWITCH AND TEMPERATURE BLEND DOOR- CONNECTOR B (12 PIN)
- 4 - A/C HEATER CONTROL HEAD LIGHT
- 5 - MODE SELECT CONTROL
- 6 - BLOWER SPEED CONTROL- CONNECTOR A (7 PIN)
- 7 - MOUNTING SCREWS (4)

(4) Check switch position continuity between:

	CONTACT PINS
1 - OFF LAMPS	A-1 - A-7
2 - ON MOMENTARY	B-6 - B-8
3 - ILLUMINATION LAMP	A-7 - A-1
4 - INDICATOR LAMP	B-12 - B-7

## REAR WINDOW DEFOGGER SWITCH (Continued)

**DIAGNOSIS AND TESTING - REAR HVAC CONTROL ASSEMBLY WINDOW DEFOGGER FUNCTION**

Before performing this test, complete the Defogger Switch and Defogger Relay tests as described in this group. For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable. Remove the defogger relay from the junction block and unplug the defogger switch wire harness connector.

(2) Remove the HVAC control head from the instrument panel. This is accomplished by removing the ashtray and the screw behind the ashtray and unclipping the center bezel.

(3) Check for continuity between the rear window defogger switch sense circuit cavity of the cluster wire harness connector (connector B) 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 rear window defogger switch sense circuit cavity of the right instrument cluster wire harness connector (connector B) and the defogger switch wire harness connector. There should be continuity. If OK, go to Step 5. If not OK, repair the open circuit as required.

(5) Check for continuity between the rear window defogger relay control circuit cavity of the right 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 rear window defogger relay control circuit cavities of the right instrument cluster wire harness connector (connector B) and the defogger relay receptacle (the cavity for ISO relay terminal 85) in the junction block. There should be continuity. If OK, replace the faulty HVAC control head. If not OK, repair the open circuit as required.

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

(2) The Rear Window Defogger switch is part of the HVAC assembly and if damaged or inoperative the entire HVAC control assembly must be replaced(Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - REMOVAL).

**INSTALLATION**

(1) The Rear Window Defogger switch is part of the HVAC control assembly and if damaged or inoperative you must replace the entire HVEAC control head assembly(Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - INSTALLATION).

(2) Connect the battery negative cable.



# HEATED SEAT SYSTEM

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## HEATED SEAT SYSTEM

### DESCRIPTION

Individually controlled electrically heated front seats are available on models that are also equipped with the optional leather trim package. Vehicles with this option can be visually identified by the two separate heated seat switches mounted on the outboard seat cushion side shields. The heated seat system allows the front seat driver and passenger to select from two different levels of supplemental electrical seat heating, or no seat heating to suit their individual comfort requirements. The heated seat system for this vehicle includes the following major components:

- **Heated Seat Switches** - Two heated seat switches are used per vehicle, including two Light-Emitting Diode (LED) indicator lamps and an incandescent back lighting bulb for each switch. One switch for the driver and one for the passenger front seats. The switches are mounted on the outboard seat cushion side shields.

- **Heated Seat Module** - also referred to as the Seat Heat Interface Module (SHIM), this module contains the solid state electronic control and diagnostic logic circuitry for the heated seat system. One heated seat module is used per vehicle and is mounted under the left front seat cushion. Refer to the Electronic Control Modules section of the service manual for heated seat module information.

- **Heated Seat Elements** - Four heated seat elements are used per vehicle, one for each front seat back and one for each front seat cushion. The elements are integral to the individual front seat and

seat back cushions and cannot be removed from the cushions, once installed at the factory.

- **Heated Seat Sensors** - Two heated seat sensors are used per vehicle, one for each front seat. The sensors are integral to the individual front seat heating elements.

Following are general descriptions of the major components in the heated seat system. See the owner's manual in the vehicle glove box for more information on the features, use and operation of the heated seat system. Refer to **Wiring Diagrams** for the location of complete heated seat system wiring diagrams.

### OPERATION

The heated seat module receives fused battery current through fuse #29 in the Junction Block (JB) when the ignition switch is in the "ON" position. The heated seat switches receive battery current through fuse #25 in the Junction Block also, when the ignition switch is in the "ON" position. The heated seat module shares a common ground circuit with each of the heated seat elements. The heated seat elements will only operate when the surface temperature of the seat cushion is below the designed temperature set points of the system.

The heated seat system will also be turned off automatically whenever the ignition switch is turned to any position except On. If the ignition switch is turned to the Off position while a heated seat is turned ON, the heated seat will remain Off after the ignition switch is turned back "ON" until a heated seat switch is depressed again.

HEATED SEAT SYSTEM (Continued)

The heated seat module monitors inputs from the heated seat sensors and the heated seat switches. In response to these inputs the heated seat module uses its internal programming to control outputs to the heated seat elements in both front seats and to control the heated seat LED indicator lamps located in both of the heated seat switches. The heated seat module is also programmed to provide self-diagnostic capability. When the module detects certain failures within the heated seat system, it will provide a visual indication of the failure by flashing the indicator lamps in the affected heated seat switch. The heated seat module will automatically turn off the heated seat elements if it detects a short or open in the heated seat element circuit or a heated seat sensor value that is out of range.

**DIAGNOSIS AND TESTING - HEATED SEAT SYSTEM**

**HEATED SEAT SYSTEM SELF-DIAGNOSIS**

The heated seat system is capable of performing some self-diagnostics. The following table depicts the various monitored failures which will be reported to the vehicle operator or technician by flashing the individual heated seat switch Light Emitting Diode (LED) indicator lamps. Refer to the Heated Seat System Self-Diagnosis table for failure identification. The driver side heated seat switch indicator lamps will flash if a failure occurs in the driver side heated seat, and the passenger side heated seat switch indicator lamps will flash for a passenger side heated seat failure. If a monitored heated seat system failure occurs, the switch indicator lamps will flash at a pulse rate of about one-half second on, followed by about one-half second off for a duration of about one minute after the switch for the faulty heated seat is depressed in either the Low or High direction. This process will repeat every time the faulty heated seat switch is actuated until the problem has been corrected.

Heated Seat System Self-Diagnosis		
Monitored Failure	Switch High Indicator Lamp	Switch Low Indicator Lamp
Heated Seat Element Shorted	Flashing	Flashing
Heated Seat Element Open	Flashing	Off
Heated Seat Sensor Value Out of Range	Off	Flashing

If the heated seat system failure is identified by flashing heated seat switch indicator lamps, go to the appropriate diagnosis and testing procedure in this section and confirm the condition, using the step by step procedure. If the monitored failure is confirmed, replace the component. If the monitored failure is not confirmed, replace the heated seat module with a known good unit and retest the system.

**HEATED SEAT SYSTEM TESTING**

Refer to **Wiring Diagrams** for the location of complete heated seat system wiring diagrams. Before testing the individual components in the heated seat system, perform the following preliminary checks:

- If a single indicator lamp for one heated seat switch does not operate and the heated seat elements do heat, refer to **Diagnosis and Testing the Heated Seat Switch** in this section for the location of heated seat switch diagnosis and testing procedures.
- If both indicator lamps for a heated seat switch operate, but the heated seat elements do not heat, refer to **Diagnosis and Testing the Heated Seat Module** in Electronic Control Modules for the location of heated seat module diagnosis and testing procedures.
- If an indicator lamp on either heated seat switch remains illuminated after the heated seat has been turned Off, refer to **Diagnosis and Testing the Heated Seat Module** in Electronic Control Modules for the location of heated seat module diagnosis and testing procedures. Also refer to the Body Diagnostic Manual for additional diagnosis and testing procedures.

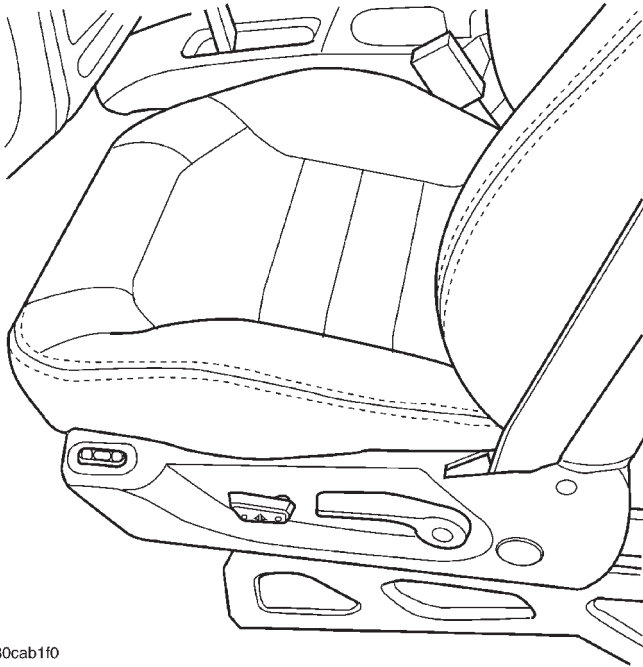
**DRIVER SEAT HEATER SWITCH**

**DESCRIPTION**

The heated seat switches are located on the out-board cushion side shield of the driver and passenger front seats (Fig. 1). The two, three-position rocker type switches provide a resistor multiplexed signal to the Heated Seat Module through separate hard wired circuits. Each switch has an Off, Low and High setting. Each switch contains two light emitting diodes (LED), one for each High and Low setting to let the occupant know that the seat heater system is on.

The heated seat switches and their LED's cannot be repaired. If either switch is faulty or damaged the entire switch must be replaced.

## DRIVER SEAT HEATER SWITCH (Continued)



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Fig. 1 KJ POWER / HEATED SEAT

## OPERATION

There are three positions that can be selected with each of the heated seat switches: Off, Low, and High. When the front of the switch rocker is fully depressed, the High position is selected and the high position LED indicator illuminates. When the rear of the switch rocker is fully depressed, the Low position is selected and the low position LED indicator illuminates. When the switch rocker is depressed a second time in either direction, Off is selected and both LED indicators are extinguished.

Both switches provide separate resistor multiplexed hard wire inputs to the Heated Seat Module to indicate the selected switch position. The heated seat module monitors the switch inputs and responds to the heated seat switch status messages by controlling the output to the seat heater elements of the selected seat. The Low heat position set point is about 36° C (97° F), and the High heat position set point is about 41° C (105° F).

## DIAGNOSIS AND TESTING - HEATED SEAT SWITCH

If a heated seat fails to heat and one or both of the indicator lamps on a heated seat switch flash, refer to **Heated Seat System Diagnosis and Testing** in this section for flashing LED failure identification. Refer to **Wiring Diagrams** for complete heated seat system wiring diagrams.

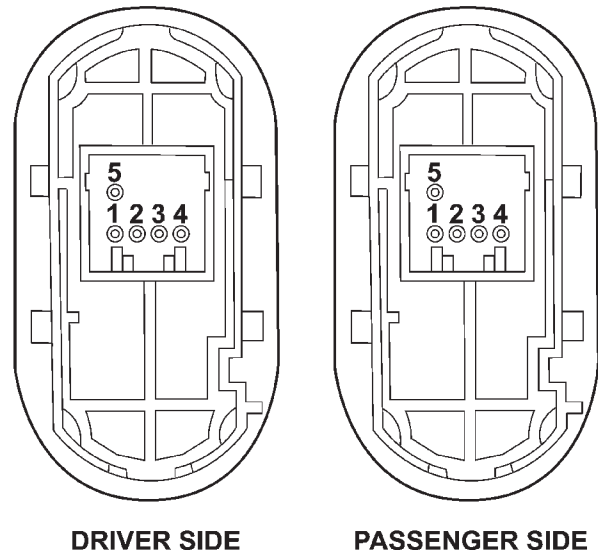
(1) If the problem being diagnosed involves a heated seat switch indicator lamp that remains illuminated after the heated seat has been turned Off,

refer to **Diagnosis and Testing the Heated Seat Module** in the Electronic Control Modules section for heated seat module diagnosis and testing procedures. If not, go to Step 2

(2) Remove the heated seat switch (Refer to 8 - ELECTRICAL/HEATED SEATS/DRIVER HEATED SEAT SWITCH - REMOVAL). Check for continuity between the ground circuit cavity #5 of the heated seat switch connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit as required.

(3) Turn the ignition switch to the ON position. Check for battery voltage at the fused ignition switch output circuit cavity #1 of the heated seat switch connector. If OK, go to Step 4. If not OK, repair the open fused ignition switch output circuit as required.

(4) Check the continuity between pin #1 and pin #3 of the heated seat switch (Fig. 2). If the readings do not correspond to those in the Heated Seat Switch Continuity table below, replace the heated seat switch. If OK, and the heated seat system is still not operating properly refer to **Diagnosis and Testing the Heated Seat Module**.



DRIVER SIDE

PASSENGER SIDE

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Fig. 2 Heated Seat Switches

**NOTE: ANY RESISTANCE VALUES (OHMS  $\Omega$ ) GIVEN IN THE FOLLOWING TEXT ARE SUPPLIED USING THE AUTOMATIC RANGE GENERATED BY A FLUKE® AUTOMOTIVE METER. IF ANOTHER TYPE OF MEASURING DEVICE IS USED, THE VALUES GENERATED MAY NOT BE THE SAME AS THE RESULTS SHOWN HERE, OR MAY HAVE TO BE CONVERTED TO THE RANGE USED HERE.**

DRIVER SEAT HEATER SWITCH (Continued)

HEATED SEAT SWITCH CONTINUITY

CONTINUITY BETWEEN	SWITCH POSITION	OHMS READING +/- 10%
PIN 1 AND 3	OFF	2.2 K (2200) OHMS
PIN 1 AND 3	LO	.415 K (415) OHMS
PIN 1 AND 3	HI	33 OHMS

**REMOVAL**

- (1) Disconnect and isolate the negative battery cable.
- (2) Remove the appropriate seat cushion side shield (Refer to 23 - BODY/SEATS/SEAT CUSHION SIDE COVERS - REMOVAL).
- (3) Disconnect the heated seat switch electrical connector. Depress the locking tab and pull straight apart.
- (4) Working from the underside of the switch, gently rock the switch back and forth out of its mounting location.

**INSTALLATION**

- (1) Gently rock the switch back and forth in to its mounting location.
- (2) Connect the heated seat switch electrical connector.
- (3) Install the appropriate seat cushion side shield. Refer to the Body section of the service manual for the procedure.
- (4) Connect the negative battery cable.

**HEATED SEAT ELEMENT**

**DESCRIPTION**

The heated seat system includes four seat heating elements. Two are located in each front seat, one for the seat cushion and the other for the seat back. All models use two resistor wire heating elements for each seat that are connected in series with the Heated Seat Module (HSM). The temperature sensor is a Negative Temperature Coefficient (NTC) thermistor. One temperature sensor is used for each seat, and it is located on the seat cushion heating element for all models.

The seat heating elements are permanently attached to the seat cushions. The heated seat elements and the temperature sensor cannot be adjusted or repaired and, if faulty or damaged, the seat cushions must be replaced. Refer to the Body section for the seat cushion service procedures.

**OPERATION**

The heated seat elements resist the flow of electrical current. When battery current is passed through the elements, the energy lost by the resistance of the elements to the current flow is released in the form of heat. When the temperature of the seat cushion cover rises, the resistance of the sensor decreases. The Heated Seat Module supplies a five-volt current to one side of each sensor, and monitors the voltage drop through the sensor on a return circuit. The Heated Seat Module uses this temperature sensor input to monitor the temperature of the seat, and regulates the current flow to the seat heating elements accordingly.

**DIAGNOSIS AND TESTING - HEATED SEAT ELEMENT**

**SEAT CUSHION ELEMENT**

- (1) Disconnect and isolate the battery negative cable. Disconnect the green heated seat cushion element wire harness connector from the power seat wire harness. The power seat wire harness connectors for the seat cushion heating elements are secured to a bracket located under the seat cushion frame. Refer to **Wiring** for connector pin information.
- (2) Check for continuity between the two heated seat element circuit cavities. There should be continuity. If OK, the elements within the seat assembly test OK, go to Step 3. If not OK, replace the faulty seat heating element and cushion assembly.
- (3) Test the seat wire harness between the heated seat module connector and the heated seat wire harness element connector for a shorted or open circuit. If OK, element is OK, proceed with testing the heated seat sensor and module. If not OK, repair the shorted or open seat wire harness as required.

**SEAT BACK ELEMENT**

- (1) Disconnect and isolate the battery negative cable. Disconnect the green heated seat back element wire harness connector from the power seat wire harness. The power seat wire harness connectors for the seat cushion heating elements are secured to a bracket located under the seat cushion frame. Refer to **Wiring** for connector pin information.
- (2) Check for continuity between the two heated seat element circuit cavities. There should be continuity. If OK, the elements within the seat assembly test OK, go to Step 3. If not OK, replace the faulty seat heating element and cushion assembly.
- (3) Test the seat wire harness between the heated seat module connector and the heated seat wire harness element connector for a shorted or open circuit. If OK, element is OK, proceed with testing the heated seat sensor and module. If not OK, repair the shorted or open seat wire harness as required.

## HEATED SEAT SENSOR

### DIAGNOSIS AND TESTING - HEATED SEAT SENSOR

For complete circuit diagrams, refer to **WIRING**.

**NOTE: ANY RESISTANCE VALUES (OHMS  $\Omega$ ) GIVEN IN THE FOLLOWING TEXT ARE SUPPLIED USING THE AUTOMATIC RANGE GENERATED BY A FLUKE® AUTOMOTIVE METER. IF ANOTHER TYPE OF MEASURING DEVICE IS USED THE VALUES GENERATED MAY NOT BE THE SAME AS THE RESULTS SHOWN HERE, OR MAY HAVE TO BE CONVERTED TO THE RANGE USED HERE.**

(1) Disconnect the heated seat wire harness connector from under the seat. Using an ohmmeter, check the resistance between the heated seat sensor input circuit cavity and the heated seat sensor feed circuit cavity in the heated seat wire harness connector. The heated seat sensor resistance should be between 1 kilohm and 100 kilohms. If OK, go to Step 2. If not OK, replace the faulty seat heating element assembly.

(2) Test the seat wire harness between the heated seat module connector and the heated seat wire harness connector for a shorted or open circuit. If OK, refer to **Diagnosis and Testing the Heated Seat Module** in Electronic Control Modules, for the proper heated seat module diagnosis and testing procedures. If not OK, repair the shorted or open heated seat wire harness as required.

## PASSENGER SEAT HEATER SWITCH

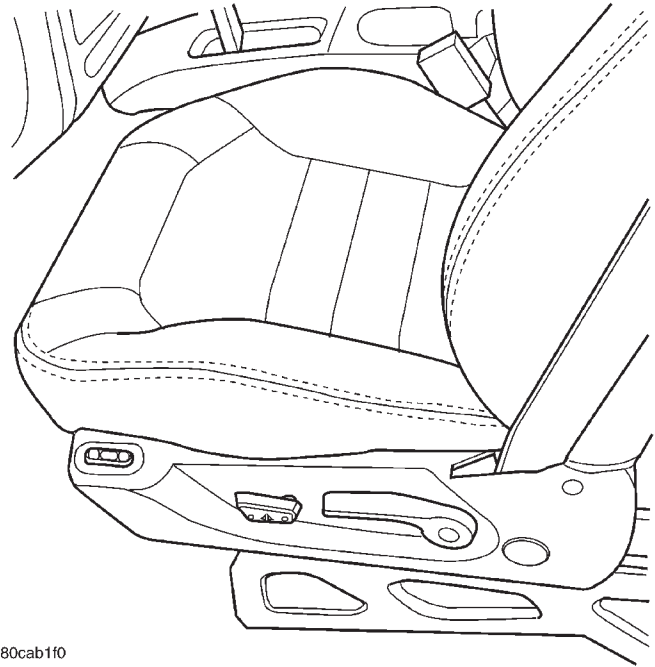
### DESCRIPTION

The heated seat switches are located on the outboard cushion side shield of the driver and passenger front seats (Fig. 3). The two, three-position rocker type switches provide a resistor multiplexed signal to the Heated Seat Module through separate hard wired circuits. Each switch has an Off, Low and High setting. Each switch contains two light emitting diodes (LED), one for each High and Low setting to let the occupant know that the seat heater system is on.

The heated seat switches and their LED's cannot be repaired. If either switch is faulty or damaged the entire switch must be replaced.

### OPERATION

There are three positions that can be selected with each of the heated seat switches: Off, Low, and High. When the front of the switch rocker is fully



**Fig. 3 KJ POWER / HEATED SEAT**

depressed, the High position is selected and the high position LED indicator illuminates. When the rear of the switch rocker is fully depressed, the Low position is selected and the low position LED indicator illuminates. When the switch rocker is depressed a second time in either direction, Off is selected and both LED indicators are extinguished.

Both switches provide separate resistor multiplexed hard wire inputs to the Heated Seat Module to indicate the selected switch position. The heated seat module monitors the switch inputs and responds to the heated seat switch status messages by controlling the output to the seat heater elements of the selected seat. The Low heat position set point is about 36° C (97° F), and the High heat position set point is about 41° C (105° F).

### DIAGNOSIS AND TESTING - HEATED SEAT SWITCH

If a heated seat fails to heat and one or both of the indicator lamps on a heated seat switch flash, refer to **Heated Seat System Diagnosis and Testing** in this section for flashing LED failure identification. Refer to **Wiring Diagrams** for complete heated seat system wiring diagrams.

(1) If the problem being diagnosed involves a heated seat switch indicator lamp that remains illuminated after the heated seat has been turned Off, refer to **Diagnosis and Testing the Heated Seat Module** in the Electronic Control Modules section for heated seat module diagnosis and testing procedures. If not, go to Step 2

PASSENGER SEAT HEATER SWITCH (Continued)

(2) Remove the heated seat switch (Refer to 8 - ELECTRICAL/HEATED SEATS/DRIVER HEATED SEAT SWITCH - REMOVAL). Check for continuity between the ground circuit cavity #5 of the heated seat switch connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit as required.

(3) Turn the ignition switch to the ON position. Check for battery voltage at the fused ignition switch output circuit cavity #1 of the heated seat switch connector. If OK, go to Step 4. If not OK, repair the open fused ignition switch output circuit as required.

(4) Check the continuity between pin #1 and pin #3 of the heated seat switch (Fig. 4). If the readings do not correspond to those in the Heated Seat Switch Continuity table below, replace the heated seat switch. If OK, and the heated seat system is still not operating properly refer to **Diagnosis and Testing the Heated Seat Module**.

**NOTE: ANY RESISTANCE VALUES (OHMS Ω) GIVEN IN THE FOLLOWING TEXT ARE SUPPLIED USING THE AUTOMATIC RANGE GENERATED BY A FLUKE® AUTOMOTIVE METER. IF ANOTHER TYPE OF MEASURING DEVICE IS USED, THE VALUES GENERATED MAY NOT BE THE SAME AS THE RESULTS SHOWN HERE, OR MAY HAVE TO BE CONVERTED TO THE RANGE USED HERE.**

HEATED SEAT SWITCH CONTINUITY

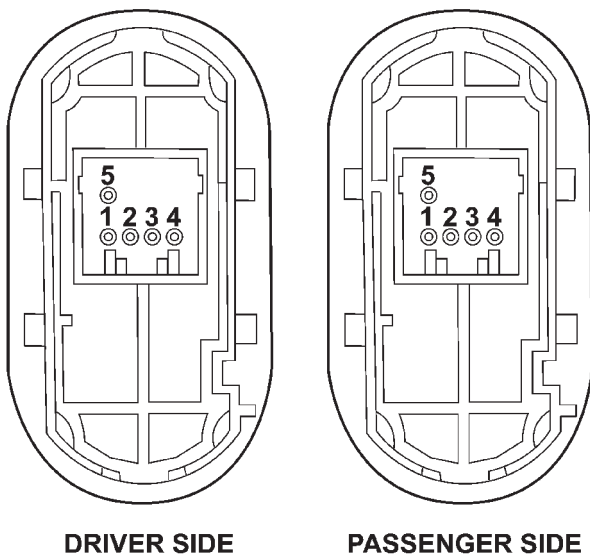
CONTINUITY BETWEEN	SWITCH POSITION	OHMS READING +/- 10%
PIN 1 AND 3	OFF	2.2 K (2200) OHMS
PIN 1 AND 3	LO	.415 K (415) OHMS
PIN 1 AND 3	HI	33 OHMS

REMOVAL

- (1) Disconnect and isolate the negative battery cable.
- (2) Remove the appropriate seat cushion side shield (Refer to 23 - BODY/SEATS/SEAT CUSHION SIDE COVERS - REMOVAL).
- (3) Disconnect the heated seat switch electrical connector. Depress the locking tab and pull straight apart.
- (4) Working from the underside of the switch, gently rock the switch back and forth out of its mounting location.

INSTALLATION

- (1) Gently rock the switch back and forth in to its mounting location.
- (2) Connect the heated seat switch electrical connector.
- (3) Install the appropriate seat cushion side shield. Refer to the Body section of the service manual for the procedure.
- (4) Connect the negative battery cable.



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Fig. 4 Heated Seat Switches



# HORN

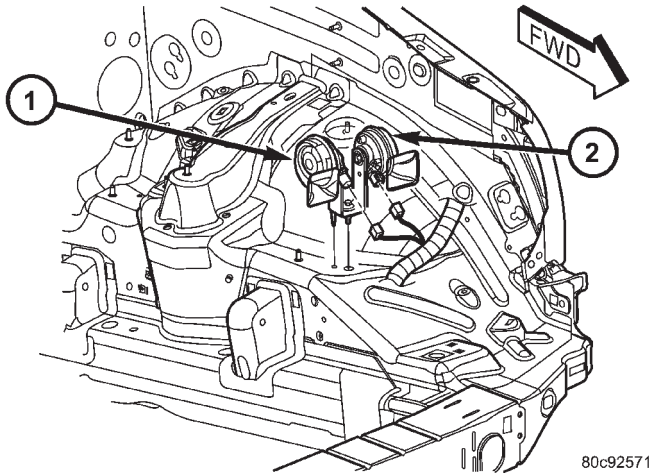
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## HORN SYSTEM

### DESCRIPTION

A dual-note electric horn system is standard factory-installed equipment on this model (Fig. 1).



**Fig. 1 HORN LOCATION**

- 1 - HIGH NOTE HORN
- 2 - LOW NOTE HORN

The dual-note horn system features dual electromagnetic horn units. The horn system includes the following major components:

- **Horn** - The two horns are located below the Power Distribution Center (PDC).
- **Horn Relay** - The horn relay is located in the Junction Block (JB).

- **Horn Switch** - The horn switch is molded into the driver airbag assembly.

### OPERATION

The horn system operates on battery current received through fuse 3 in the Junction Block (JB). The horn system circuit is designed so that the system will remain operational, regardless of the ignition switch position.

### DIAGNOSIS AND TESTING - HORN SYSTEM

In most cases, any problem involving continually sounding horns can be quickly alleviated by removing the horn relay from the Junction Block (JB). Refer to horn relay for the removal procedure. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



## HORN SYSTEM (Continued)

HORN SYSTEM DIAGNOSIS TABLE

CONDITION	POSSIBLE CAUSES	CORRECTION
BOTH HORNS INOPERATIVE	<ol style="list-style-type: none"> <li>1. Faulty fuse.</li> <li>2. Faulty horn relay.</li> <li>3. Faulty horn switch.</li> <li>4. Faulty horns.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the fuse in the Junction Block (JB). Replace the fuse and repair the shorted circuit or component, if required.</li> <li>2. Refer to horn relay for the proper diagnosis and testing procedures. Replace the horn relay or repair the open horn relay circuit, if required.</li> <li>3. Refer to horn switch for the proper diagnosis and testing procedure. Replace the horn switch or repair the open horn switch circuit, if required.</li> <li>4. Refer to horn for the proper diagnosis and testing procedure. Replace the horns or repair the open horn circuit, if required.</li> </ol>
ONE HORN INOPERATIVE	<ol style="list-style-type: none"> <li>1. Faulty horn.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to horn for the proper diagnosis and testing procedures. Replace the horn or repair the open horn circuit, if required.</li> </ol>
HORN SOUNDS CONTINUOUSLY	<ol style="list-style-type: none"> <li>1. Faulty horn relay.</li> <li>2. Faulty horn switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to horn relay for the proper diagnosis and testing procedure. Replace the horn relay or repair the shorted horn relay control circuit, if required.</li> <li>2. Refer to horn switch for the proper diagnosis and testing procedure. Replace the horn switch or repair the shorted horn switch circuit, if required.</li> </ol>

## HORN

## DIAGNOSIS AND TESTING - HORN

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect the wire harness connector from the horn. Measure the resistance between the horn ground circuit cavity of the wire harness connector and a good ground. There should be no measurable resistance. If OK, go to Step 2. If not OK, replace wiring as necessary.

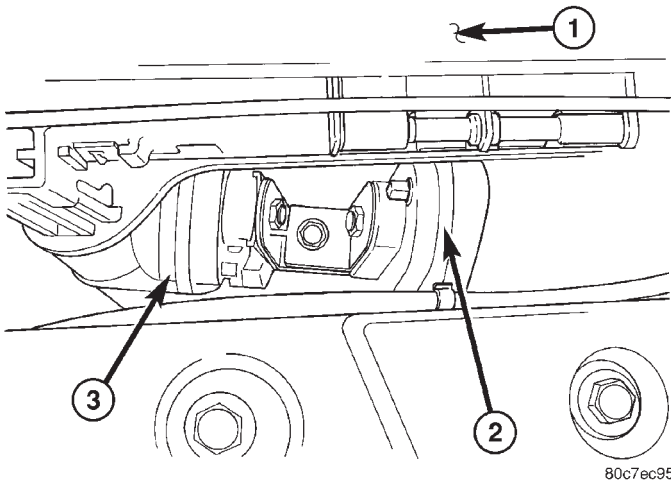
(2) Check for battery voltage at the horn relay output circuit cavity of the wire harness connector for the horn. There should be zero volts. If OK, go to Step 3. If not OK, refer to horn relay and horn relay circuit for the proper diagnosis and testing procedures.

(3) Depress the horn switch. There should now be battery voltage at the horn relay output circuit cavity of the wire harness connector for the horn. If OK, but the horn does not sound, replace the faulty horn. If not OK, refer to horn relay and horn relay circuit for the proper diagnosis and testing procedures.

HORN (Continued)

**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Disconnect the electrical harness connector from the horns.
- (3) Remove the mounting bolt (Fig. 2).
- (4) Remove the horns.



**Fig. 2 HORN MOUNTING**

- 1 - POWER DISTRIBUTION CENTER
- 2 - LOW NOTE HORN
- 3 - HIGH NOTE HORN

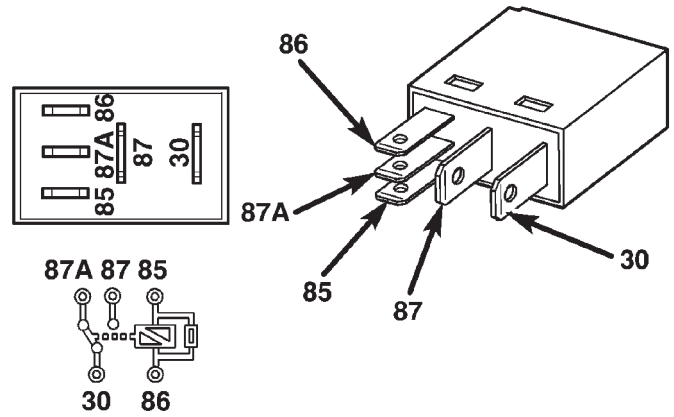
**INSTALLATION**

- (1) Install the horns.
- (2) Install the mounting bolt. Tighten bolt to 25 N·m (19 lb. ft.).
- (3) Connect the electrical harness connector to the horns
- (4) Connect the battery negative cable.

**HORN RELAY**

**DIAGNOSIS AND TESTING - HORN RELAY**

- (1) Remove horn relay (Refer to 8 - ELECTRICAL/HORN/HORN RELAY - REMOVAL).
- (2) Using ohmmeter, test between relay connector terminals 85 to 86 for  $75 \pm 8$  ohms resistance. If resistance not OK, replace relay (Fig. 3).
- (3) Test for continuity between ground and terminal 85 of horn relay.
  - (a) When the horn switch is not depressed, no continuity should be present.
  - (b) Continuity to ground when horn switch is depressed.
  - (c) If continuity is not correct replace horn switch or wiring as necessary, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.



**Fig. 3 Horn Relay**

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- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

ing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(4) Using voltmeter, test voltage at:  
 (a) Terminals 30 and 86 of the horn relay to body ground.

(b) If NO voltage check fuse 3 of the Junction Block (JB).

(c) If incorrect voltage, repair as necessary. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(5) Insert a jumper wire between terminal 30 and 87 of the Junction Block (JB).

(a) If horn sounds replace relay.

(b) If the horn does not sound, install horn relay and test horn (Refer to 8 - ELECTRICAL/HORN/HORN - DIAGNOSIS AND TESTING).

**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the instrument panel end cap.
- (3) Locate and pull the horn relay from the Junction Block (JB).

**INSTALLATION**

- (1) Locate proper connector, and press relay into position.
- (2) Install instrument panel end cap.
- (3) Connect battery negative cable.

## HORN SWITCH

### DESCRIPTION

The horn switch is molded into the driver airbag assembly. The horn switch can not be serviced separately. For service procedures, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

### DIAGNOSIS AND TESTING - HORN SWITCH

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

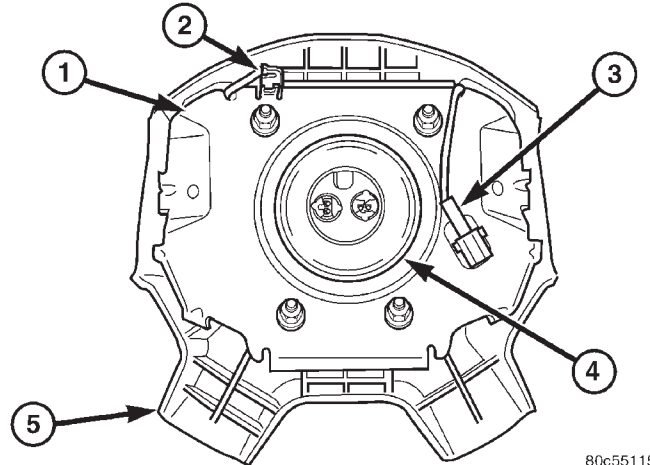
(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover.

(3) Check for continuity between the metal steering column jacket and a good ground. There should be continuity. If OK, go to Step 4. If not OK, (Refer to 19 - STEERING/COLUMN - INSTALLATION) for proper installation of the steering column.

(4) Remove the driver side airbag module from the steering wheel (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL). Disconnect the horn switch wire harness connectors from the driver side airbag module (Fig. 4).

(5) Remove the horn relay from the Junction Block (JB). Check for continuity between the steering col-



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**Fig. 4 Driver Airbag Housing**

- 1 - HOUSING
- 2 - HORN SWITCH GROUND WIRE
- 3 - HORN SWITCH FEED WIRE
- 4 - INFLATOR
- 5 - TRIM COVER

umn half of the horn switch feed wire harness connector and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted horn relay control circuit to the horn relay in the Junction Block as required.

(6) 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 Junction Block. There should be continuity. If OK, go to Step 7. If not OK, repair the open horn relay control circuit to the horn relay in the Junction Block as required.

(7) Check for continuity between the horn switch feed wire and the horn switch ground wire on the driver side airbag module. There should be no continuity. If OK, go to Step 8. If not OK, replace the faulty horn switch.

(8) Depress the center of the driver side airbag module trim cover and check for continuity between the horn switch feed wire and the horn switch ground wire on the driver side airbag module. There should now be continuity. If not OK, replace the faulty horn switch (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

# IGNITION CONTROL

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## IGNITION CONTROL

### DESCRIPTION

The ignition system consists of:

- Spark Plugs
- Ignition Coil(s)
- Powertrain Control Module (PCM)
- Crankshaft Position Sensor
- 2 Knock Sensors (3.7L only)
- Camshaft Position Sensor
- The MAP, TPS, IAC and ECT also have an effect

on the control of the ignition system.

### OPERATION

#### 2.4L

A common ignition coil divided into 2 halves is used. Secondary, high-tension spark plug cables are also used. One half of the coil fires two spark plugs simultaneously (one plug is the cylinder under com-

pression, and the other plug is the cylinder on the exhaust stroke). Coil half number one fires cylinders 1 and 4. Coil half number two fires cylinders 2 and 3. The PCM determines which of the coils to charge and fire at the correct time.

The Auto Shutdown (ASD) relay provides battery voltage to the ignition coil. The PCM provides a ground contact (circuit) for energizing the coil. When the PCM breaks the contact, the energy in the coil primary transfers to the secondary causing a spark. The PCM will de-energize the ASD relay if it does not receive inputs from either the crankshaft or camshaft position sensors.

A distributor is not used with the 2.4L engine.

#### 3.7L

The 3.7L V6 engine uses a separate ignition coil for each cylinder. The one-piece coil bolts directly to the cylinder head. Rubber boots seal the secondary terminal ends of the coils to the top of all 6 spark plugs. A separate electrical connector is used for each coil.

IGNITION CONTROL (Continued)

Because of coil design, spark plug cables (secondary cables) are not used. A distributor is not used with the 3.7L engine.

Two knock sensors (one for each cylinder bank) are used to help control spark knock.

The Auto Shutdown (ASD) relay provides battery voltage to each ignition coil. The Powertrain Control Module (PCM) provides a ground contact (circuit) for energizing each coil. When the PCM breaks the contact, the energy in the coil primary transfers to the secondary causing a spark. The PCM will de-energize the ASD relay if it does not receive inputs from either the crankshaft or camshaft position sensors.

SPECIFICATIONS

SPECIFICATIONS - IGNITION TIMING

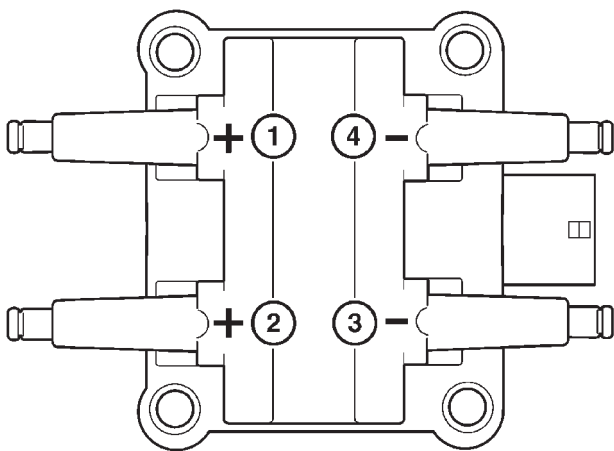
Ignition timing is not adjustable on any engine.

ENGINE FIRING ORDER - 2.4L 4-CYLINDER 1 - 3 - 4 - 2

ENGINE FIRING ORDER - 3.7L V-6 1 - 6 - 5 - 4 - 3 - 2

IGNITION COIL RESISTANCE - 2.4L

Engine	Coil Manufacture	Primary Resistance at 21°C-27°C (70°F-80°F)	Secondary Resistance at 21°C-27°C (70°F-80°F)
2.4L	Toyodenso or Diamond	0.51 to 0.61 Ohms	11,500 to 13,500 Ohms



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Fig. 1 IGNITION COIL - 2.4L

IGNITION CONTROL (Continued)

**IGNITION COIL RESISTANCE - 3.7L V-6**

PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
0.6 - 0.9 Ohms	6,000 - 9,000 Ohms

**SPARK PLUGS**

ENGINE	PLUG TYPE	ELECTRODE GAP
2.4L	RE14MCC5 (Champion #)	1.24 to 1.37 mm (0.048 to 0.053 in.)
3.7L V-6	2FR6F - 11G (NGK #)	1.1 mm (0.042 in.)

**SPARK PLUG CABLE RESISTANCE - 2.4L**

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

**TORQUE - IGNITION SYSTEM**

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Camshaft Position Sensor-2.4L	23	21	205
Camshaft Position Sensor-3.7L	12	-	106
Crankshaft Position Sensor Bolt-2.4L	12	-	106
Crankshaft Position Sensor Nut/Bolt-3.7L	23	21	205
* Knock Sensor Bolt - 3.7L	* 20	* 15	
Ignition Coil Mounting Bolts - 2.4L	11	-	105
Ignition Coil Mounting Nuts - 3.7L	8	-	70
Ignition Coil Capacitor Nuts- 3.7L	8	-	70
** Spark Plugs - 2.4L	** 15	** 11	-
Spark Plugs - 3.7L	27	20	-
* Do not apply any sealant, thread-locker or adhesive to bolts. Poor sensor performance may result.			
** Torque critical tapered design. Do not exceed 15 ft. lbs.			

## AUTO SHUT DOWN RELAY

### DESCRIPTION - PCM OUTPUT

The 5-pin, 12-volt, Automatic Shutdown (ASD) relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

### OPERATION

#### OPERATION - ASD SENSE - PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The relay is used to connect the oxygen sensor heater elements, oxygen sensor heater relay, ignition coil and fuel injectors to 12 volt + power supply.

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).

#### OPERATION - PCM OUTPUT

The ASD relay supplies battery voltage (12+ volts) to the fuel injectors and ignition coil(s). With certain emissions packages it also supplies 12-volts to the oxygen sensor heating elements and the oxygen sensor heater relay.

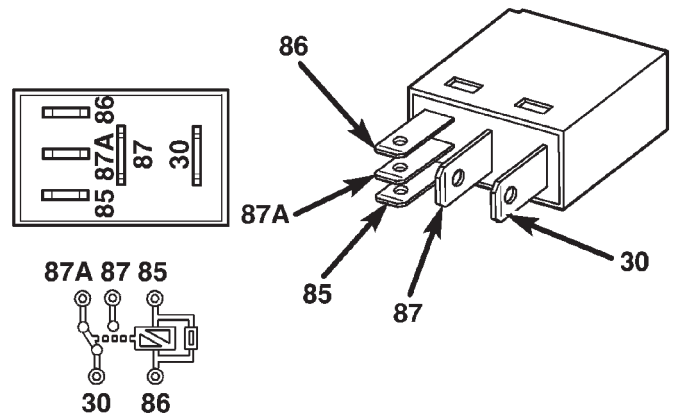
The ground circuit for the coil within the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM operates the ASD relay by switching its ground circuit on and off.

The ASD relay will be shut-down, meaning the 12-volt power supply to the ASD relay will be de-activated by the PCM if the ignition key is left in the ON position. This is if the engine has not been running for approximately 1.8 seconds.

### DIAGNOSIS AND TESTING - ASD AND FUEL PUMP RELAYS

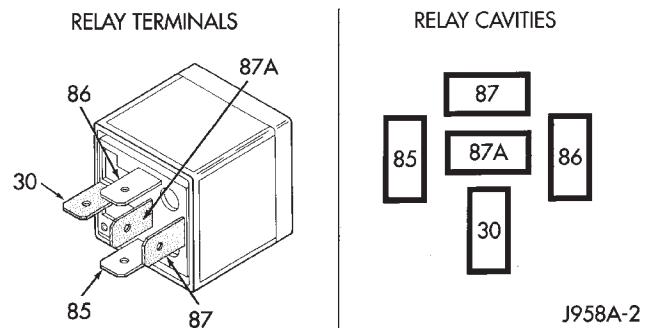
**The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays.** The terminals on the bottom of each relay are numbered. Two different types of relays may be used, (Fig. 2) or (Fig. 3).

- 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,



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**Fig. 2 TYPE 1 RELAY (ISO MICRO RELAY)**



J958A-2

**Fig. 3 ASD AND FUEL PUMP RELAY TERMINALS—TYPE 2**

#### TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

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.

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 ohms +/- 5 ohms.
- (3) Connect the ohmmeter between terminals 30 and 87A. The ohmmeter should show continuity between terminals 30 and 87A.

AUTO SHUT DOWN RELAY (Continued)

(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. DAMAGE TO OHMMETER MAY RESULT.**

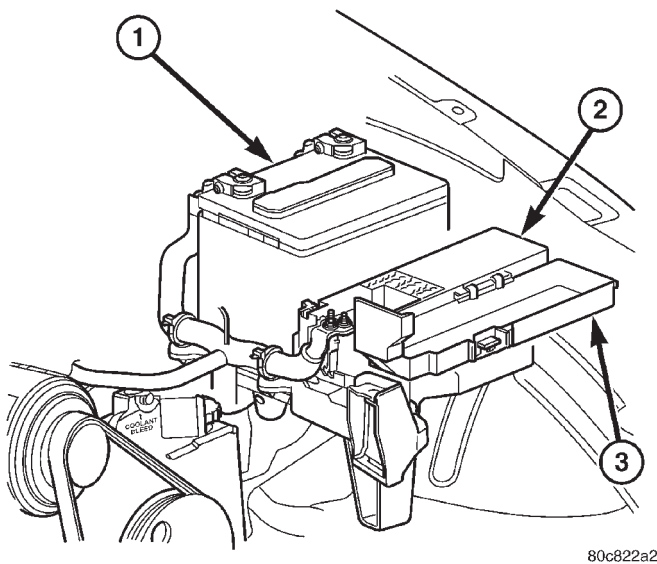
(7) Attach the other end of the jumper wire to relay terminal 86. This activates the relay. The ohmmeter should now show continuity between relay terminals 87 and 30. The ohmmeter should not show continuity between relay terminals 87A and 30.

(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 8, Wiring Diagrams.

**REMOVAL**

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 4). Refer to label on PDC cover for relay location.



**Fig. 4 POWER DISTRIBUTION CENTER (PDC)**

- 1 - BATTERY
- 2 - PDC
- 3 - PDC COVER

- (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**

The ASD relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

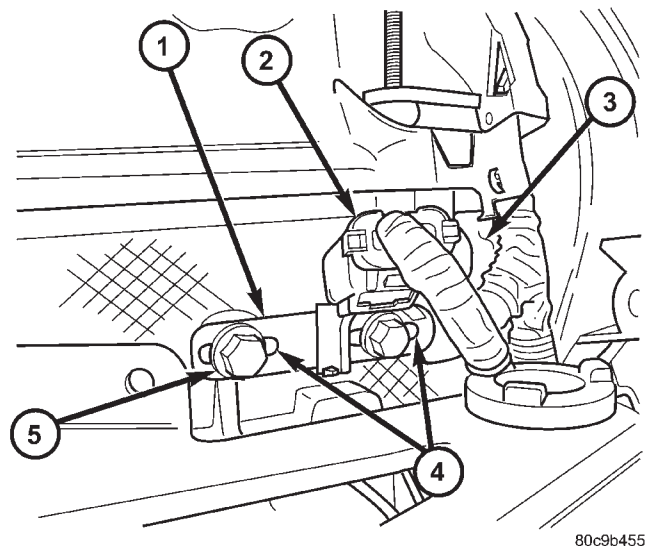
- (1) Install relay to PDC.
- (2) Install cover to PDC.

**CAMSHAFT POSITION SENSOR**

**DESCRIPTION**

**DESCRIPTION - 2.4L**

The Camshaft Position Sensor (CMP) on the 2.4L 4-cylinder engine is bolted to the right-front side of the cylinder head (Fig. 5).



**Fig. 5 CMP LOCATION - 2.4L**

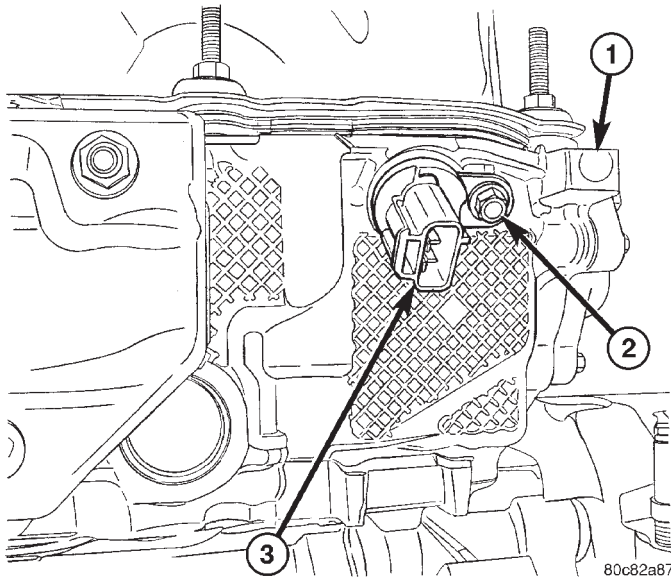
- 1 - CMP SENSOR
- 2 - ELECTRICAL CONNECTOR
- 3 - SLOTTED HOLES
- 4 - MOUNTING BOLTS (2)
- 5 - MOUNTING BOLTS (2)



## CAMSHAFT POSITION SENSOR (Continued)

## DESCRIPTION-3.7L

The Camshaft Position Sensor (CMP) on the 3.7L 6-cylinder engine is bolted to the right-front side of the right cylinder head (Fig. 6).



**Fig. 6 CAMSHAFT POSITION SENSOR - 3.7L**

- 1 - RIGHT/FRONT OF RIGHT CYLINDER HEAD
- 2 - CMP MOUNTING BOLT
- 3 - CMP LOCATION

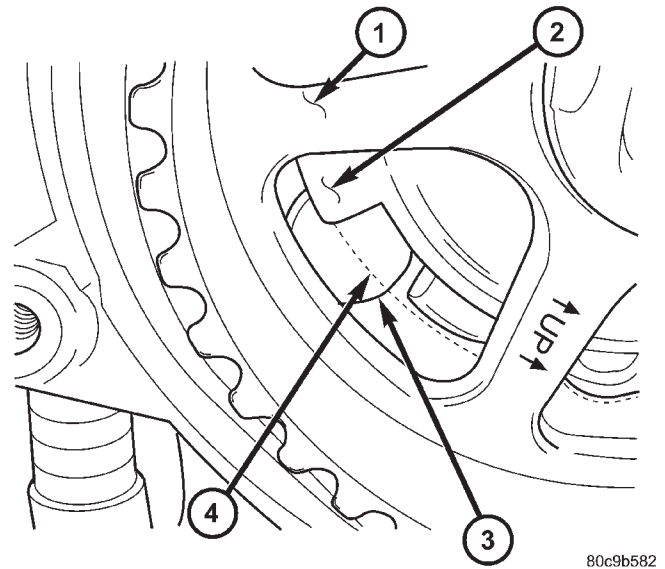
## OPERATION

## OPERATION - 2.4L

The Camshaft Position Sensor (CMP) sensor contains a hall effect device referred to as a sync signal generator. A rotating target wheel (tonewheel) for the CMP is located behind the exhaust valve-camshaft drive gear (Fig. 7). The target wheel is equipped with a cutout (notch) around 180 degrees of the wheel. The CMP detects this cutout every 180 degrees of camshaft gear rotation. Its signal is used in conjunction with the Crankshaft Position Sensor (CKP) 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 target wheel cutout enters the tip of the CMP, 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 target wheel cutout leaves the tip of the CMP, the change of the magnetic field causes the sync signal voltage to switch low to 0 volts.



**Fig. 7 CMP FACE AT TARGET WHEEL-2.4L**

- 1 - CAMSHAFT DRIVE GEAR
- 2 - TARGETWHEEL (TONEWHEEL)
- 3 - FACE OF CMP SENSOR
- 4 - CUTOUT (NOTCH)

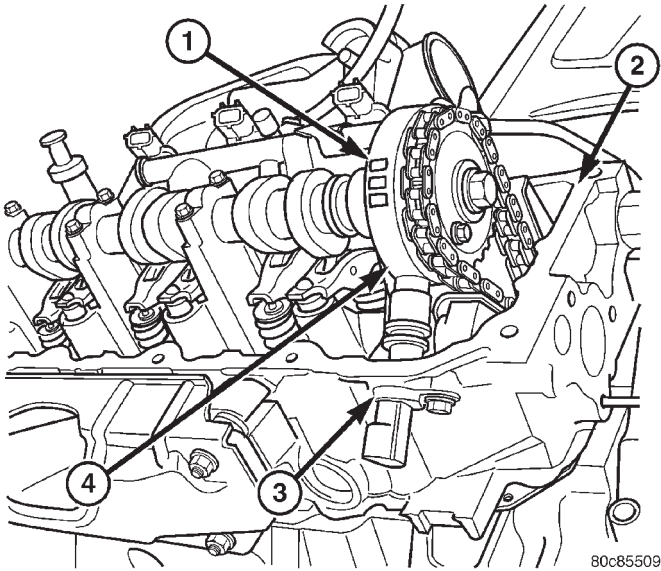
## OPERATION - 3.7L

The Camshaft Position Sensor (CMP) sensor contains a hall effect device referred to as a sync signal generator. A rotating target wheel (tonewheel) for the CMP is located at the front of the camshaft for the right cylinder head (Fig. 8). This sync signal generator detects notches located on a tonewheel. As the tonewheel rotates, the notches pass through the sync signal generator. The signal from the CMP sensor is used in conjunction with the Crankshaft Position Sensor (CKP) 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 tonewheel notch enters the tip of the CMP, the interruption of magnetic field causes the voltage to switch high, resulting in a sync signal of approximately 5 volts.

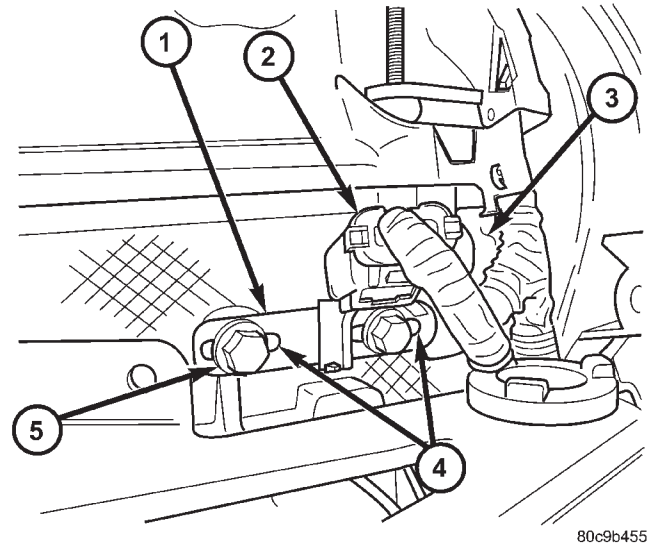
When the trailing edge of the tonewheel notch leaves then tip of the CMP, the change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

CAMSHAFT POSITION SENSOR (Continued)



**Fig. 8 CAMSHAFT POSITION SENSOR LOCATION - 3.7L**

- 1 - NOTCHES
- 2 - RIGHT CYLINDER HEAD
- 3 - CMP
- 4 - TONEWHEEL (TARGET WHEEL)



**Fig. 9 CMP LOCATION - 2.4L**

- 1 - CMP SENSOR
- 2 - ELECTRICAL CONNECTOR
- 3 -
- 4 - SLOTTED HOLES
- 5 - MOUNTING BOLTS (2)

**REMOVAL**

**2.4L**

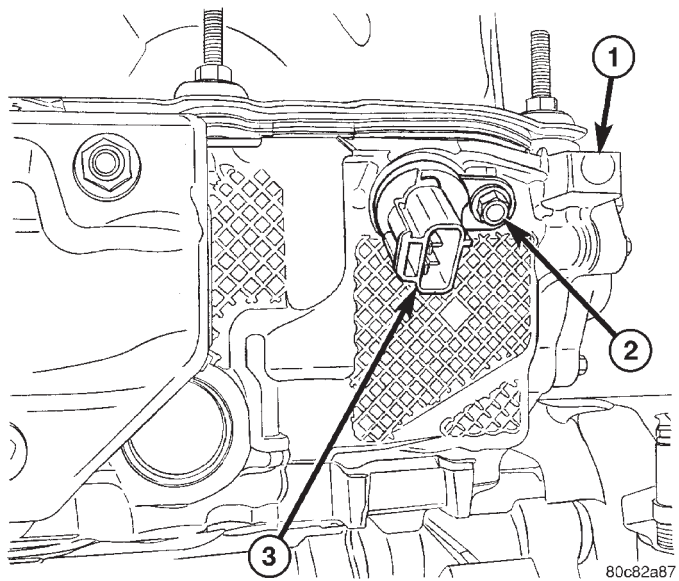
The Camshaft Position Sensor (CMP) on the 2.4L 4-cylinder engine is bolted to the right-front side of the cylinder head (Fig. 9). Sensor position (depth) is adjustable.

- (1) Disconnect electrical connector at CMP sensor.
- (2) Remove 2 sensor mounting bolts.
- (3) Remove sensor from cylinder head by sliding towards rear of engine.

**3.7L**

The Camshaft Position Sensor (CMP) on the 3.7L V-6 engine is bolted to the front/top of the right cylinder head (Fig. 10).

- (1) Disconnect electrical connector at CMP sensor.
- (2) Remove sensor mounting bolt (Fig. 10).
- (3) Carefully remove sensor from cylinder head in a rocking and twisting action. Twisting sensor eases removal.
- (4) Check condition of sensor o-ring.



**Fig. 10 CAMSHAFT POSITION SENSOR (CMP) - 3.7L**

- 1 - RIGHT/FRONT OF RIGHT CYLINDER HEAD
- 2 - CMP MOUNTING BOLT
- 3 - CMP LOCATION

## CAMSHAFT POSITION SENSOR (Continued)

## INSTALLATION

## 2.4L

The Camshaft Position Sensor (CMP) on the 2.4L 4-cylinder engine is bolted to the right-front side of the cylinder head. **Sensor position (depth) is adjustable.**

(1) Remove plastic, upper timing belt cover (timing gear cover) (Fig. 11) by removing 3 bolts. Before attempting to remove cover, remove electrical connector from Engine Coolant Temperature (ECT) sensor (Fig. 11). This will prevent damage to sensor.

(2) Rotate (bump over) engine until camshaft timing gear and target wheel (tonewheel) are positioned and aligned to face of sensor as shown in (Fig. 12). **If not positioned as shown in (Fig. 12), damage to both sensor and target wheel will occur when attempting to start engine. Face of sensor MUST be behind target wheel while adjusting.**

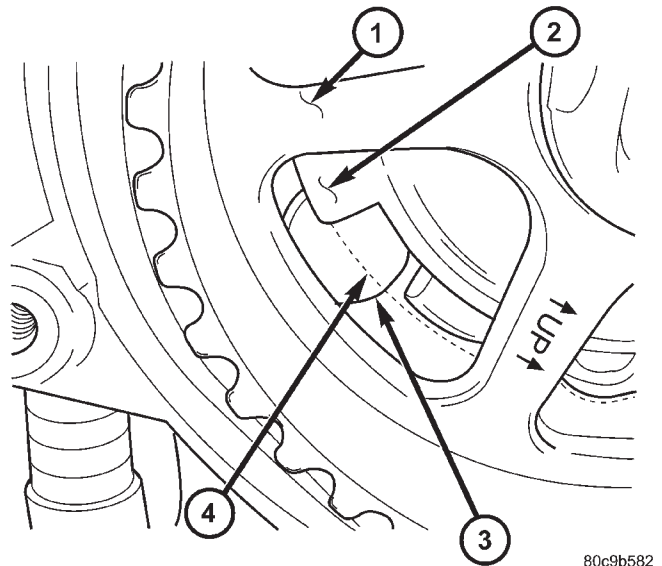
(3) Position sensor to cylinder head and install 2 sensor mounting bolts finger tight.

(4) **SENSOR AIR GAP: .030"** Set air gap between rear of target wheel and face of sensor to .030". This can best be accomplished using an L-shaped, wire-type spark plug gapping gauge (Fig. 13). A piece of .030" brass shim stock may also be used.

(5) Gently push sensor forward until it contacts gapping gauge. **Do not push hard on sensor.** Tighten 2 sensor mounting bolts. Refer to torque specifications.

**CAUTION:** After tightening sensor mounting bolts, recheck air gap and adjust as necessary. Retorque bolts.

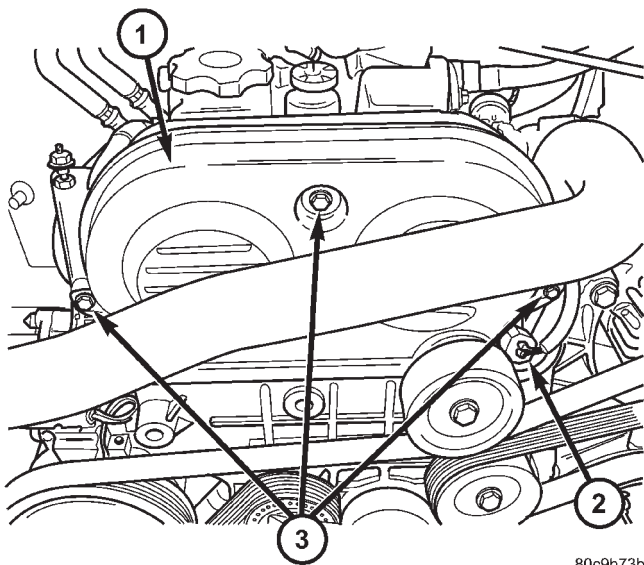
- (6) Install upper timing belt cover and 3 bolts.
- (7) Connect electrical connector to ECT sensor.
- (8) Connect electrical connector to CMP sensor.



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**Fig. 12 CMP FACE AT TARGET WHEEL-2.4L**

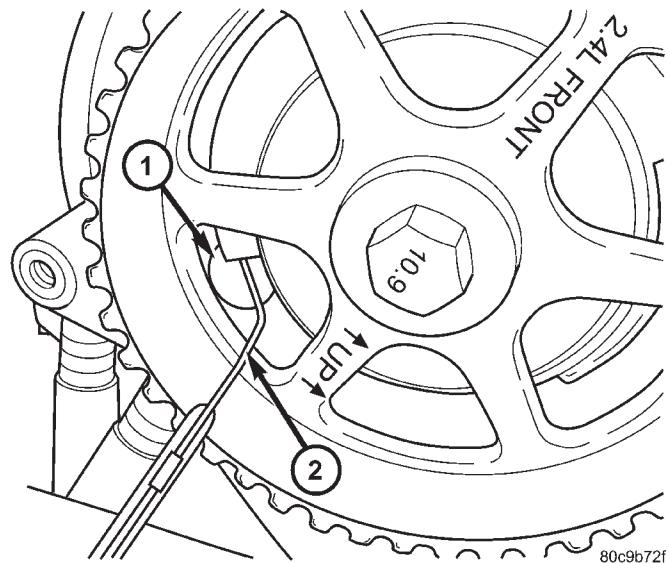
- 1 - CAMSHAFT DRIVE GEAR
- 2 - TARGETWHEEL (TONEWHEEL)
- 3 - FACE OF CMP SENSOR
- 4 - CUTOUT (NOTCH)



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**Fig. 11 UPPER TIMING BELT COVER/BOLTS-2.4L**

- 1 - UPPER TIMING BELT COVER
- 2 - ELECTRICAL CONNECTOR (ECT)
- 3 - MOUNTING BOLTS (3)



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**Fig. 13 CMP ADJUSTMENT - 2.4L**

- 1 - FACE OF SENSOR
- 2 - WIRE GAPPING TOOL

CAMSHAFT POSITION SENSOR (Continued)

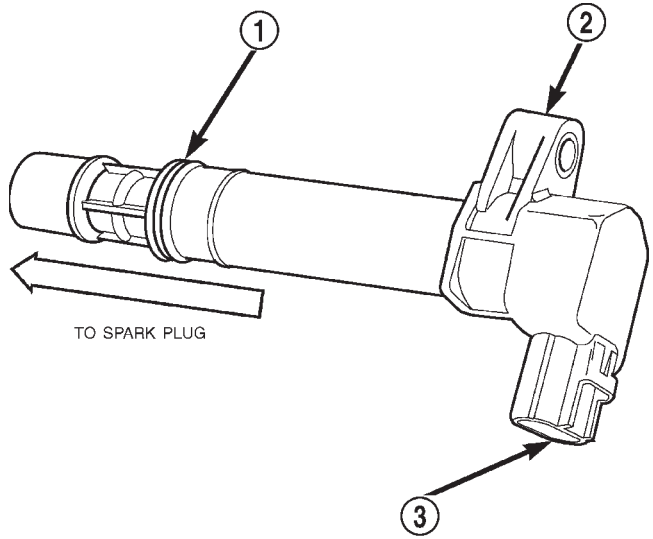
3.7L

The Camshaft Position Sensor (CMP) on the 3.7L V-6 engine is bolted to the front/top of the right cylinder head.

- (1) Clean out machined hole in cylinder head.
- (2) Apply a small amount of engine oil to sensor o-ring.
- (3) Install sensor into cylinder head with a slight rocking and twisting action.

**CAUTION:** Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder head. If sensor is not flush, damage to sensor mounting tang may result.

- (4) Install mounting bolt and tighten. Refer to torque specifications.
- (5) Connect electrical connector to sensor.



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**Fig. 15 IGNITION COIL - 3.7L**

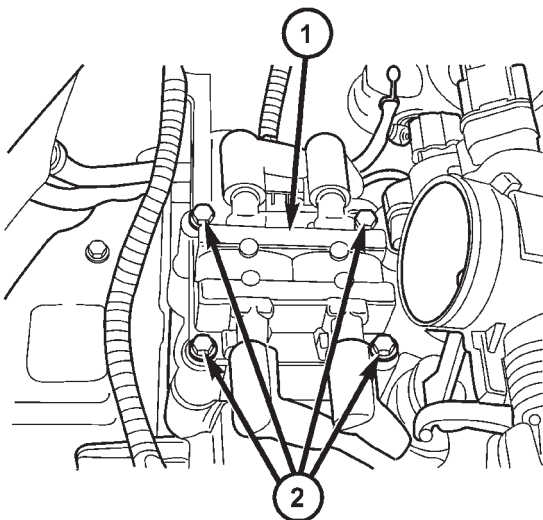
- 1 - O-RING
- 2 - IGNITION COIL
- 3 - ELECTRICAL CONNECTOR

IGNITION COIL

DESCRIPTION

2.4L

The coil assembly consists of 2 different coils molded together. The assembly is mounted to the top of the engine (Fig. 14).



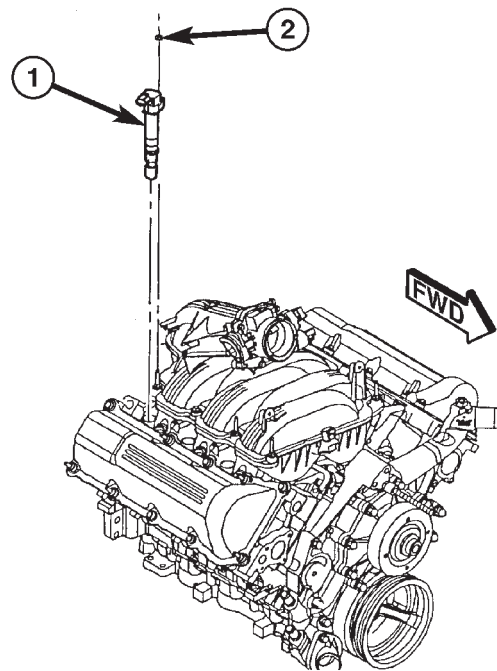
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**Fig. 14 IGNITION COIL - 2.4L**

- 1 - IGNITION COIL
- 2 - MOUNTING BOLTS (4)

3.7L

The 3.7L V-6 engine uses 6 dedicated, and individually fired coil for each spark plug (Fig. 15). Each coil is mounted directly into the cylinder head and onto the top of each spark plug (Fig. 16).



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**Fig. 16 IGNITION COIL LOCATION - 3.7L**

- 1 - IGNITION COIL
- 2 - COIL MOUNTING NUT

OPERATION

2.4L

The coil fires two spark plugs simultaneously. One plug is under compression, the other plug fires on the exhaust stroke (lost spark). Coil number one fires

## IGNITION COIL (Continued)

cylinders 1 and 4, and coil number two fires cylinders 2 and 3.

The Auto Shutdown (ASD) relay provides battery voltage to the ignition coil. The PCM provides a ground contact (circuit) for energizing the coil(s). The PCM will de-energize the ASD relay if it does not receive the crankshaft position sensor and camshaft position sensor inputs.

**Base ignition timing is not adjustable.** 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.

Spark plug cables (secondary wires or cables) are used with the 2.4L engine.

## 3.7L

Battery voltage is supplied to the 6 ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes each ignition coil ground circuit at a determined time for ignition coil operation.

**Base ignition timing is not adjustable.** 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.

Because of coil design, spark plug cables (secondary cables) are not used with the 3.7L engine.

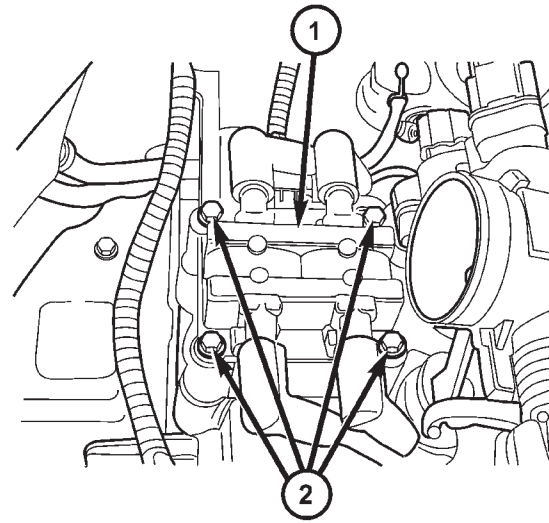
## REMOVAL

## 2.4L

- (1) Disconnect electrical connector at rear of coil.
- (2) Remove all secondary cables from coil.
- (3) Remove 4 coil mounting bolts (Fig. 17).
- (4) Remove coil from vehicle.

## 3.7L

An individual ignition coil is used for each spark plug (Fig. 19). The coil fits into machined holes in the cylinder head. A mounting stud/nut secures each coil to the top of the intake manifold (Fig. 18). The bottom of the coil is equipped with a rubber boot to seal the spark plug to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately. An o-ring (Fig.



80c9d64f

**Fig. 17 IGNITION COIL - 2.4L**

- 1 - IGNITION COIL
- 2 - MOUNTING BOLTS (4)

19) is used to seal the coil at the opening into the cylinder head.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Disconnect electrical connector from coil by pushing downward on release lock on top of connector and pull connector from coil.

(3) Clean area at base of coil with compressed air before removal.

(4) Remove coil mounting nut from mounting stud (Fig. 18).

(5) Carefully pull up coil from cylinder head opening with a slight twisting action.

(6) Remove coil from vehicle.

## INSTALLATION

## 2.4L

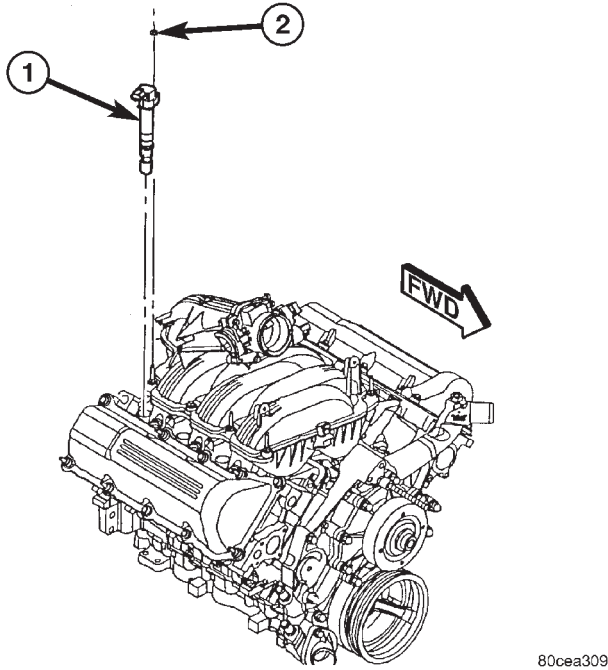
- (1) Position coil to engine.
- (2) Install 4 mounting bolts. Refer to torque specifications.
- (3) Install secondary cables.
- (4) Install electrical connector at rear of coil.
- (5) Install air cleaner tube and housing.

## 3.7L

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

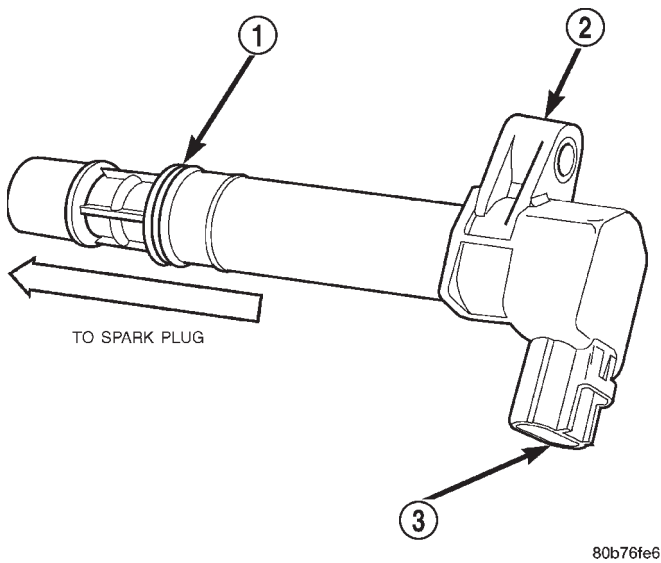
(2) Check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

IGNITION COIL (Continued)



**Fig. 18 IGNITION COIL LOCATION - 3.7L**

- 1 - IGNITION COIL
- 2 - COIL MOUNTING NUT



**Fig. 19 IGNITION COIL - 3.7L**

- 1 - O-RING
- 2 - IGNITION COIL
- 3 - ELECTRICAL CONNECTOR

(3) Position ignition coil into cylinder head opening and push onto spark plug. Do this while guiding coil base over mounting stud.

(4) Install coil mounting stud nut. Refer to torque specifications.

(5) Connect electrical connector to coil by snapping into position.

(6) If necessary, install throttle body air tube or box.

**KNOCK SENSOR**

**DESCRIPTION**

The 2 knock sensors are bolted into the cylinder block under the intake manifold. The sensors are used only with the 3.7L engine.

**OPERATION**

Two knock sensors are used on the 3.7L V-6 engine; one for each cylinder bank. When the knock sensor detects a knock in one of the cylinders on the corresponding bank, it sends an input signal to the Powertrain Control Module (PCM). In response, the PCM retards ignition timing for all cylinders by a scheduled amount.

Knock sensors contain a piezoelectric material which constantly vibrates and sends an input voltage (signal) to the PCM while the engine operates. As the intensity of the crystal's vibration increases, the knock sensor output voltage also increases.

The voltage signal produced by the knock sensor increases with the amplitude of vibration. The PCM receives the knock sensor voltage signal as an input. If the signal rises above a predetermined level, the PCM will store that value in memory and retard ignition timing to reduce engine knock. If the knock sensor voltage exceeds a preset value, the PCM retards ignition timing for all cylinders. It is not a selective cylinder retard.

The PCM ignores knock sensor input during engine idle conditions. Once the engine speed exceeds a specified value, knock retard is allowed.

Knock retard uses its own short term and long term memory program.

Long term memory stores previous detonation information in its battery-backed RAM. The maximum authority that long term memory has over timing retard can be calibrated.

Short term memory is allowed to retard timing up to a preset amount under all operating conditions (as long as rpm is above the minimum rpm) except at Wide Open Throttle (WOT). The PCM, using short term memory, can respond quickly to retard timing when engine knock is detected. Short term memory is lost any time the ignition key is turned off.

## KNOCK SENSOR (Continued)

**NOTE:** Over or under tightening the sensor mounting bolts will affect knock sensor performance, possibly causing improper spark control. Always use the specified torque when installing the knock sensors.

## REMOVAL

The 2 knock sensors are bolted into the cylinder block under the intake manifold (Fig. 20).

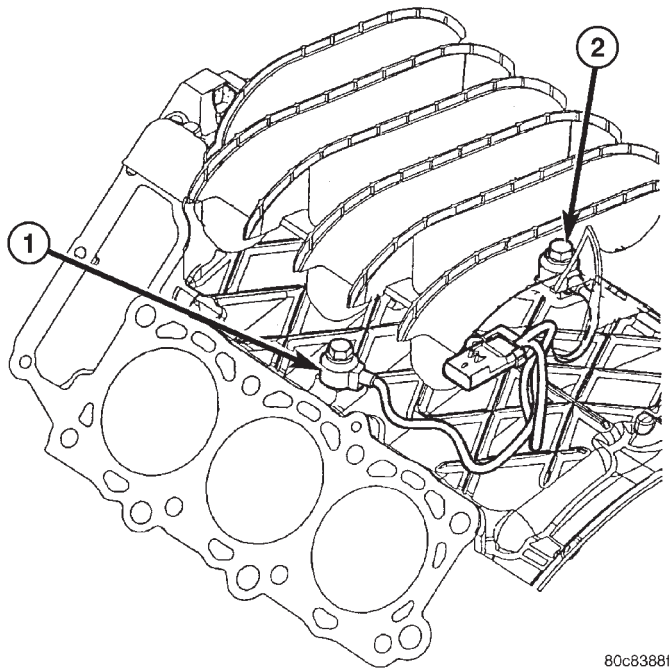
**NOTE:** The left sensor is identified by an identification tag (LEFT). It is also identified by a larger bolt head. The Powertrain Control Module (PCM) must have and know the correct sensor left/right positions. Do not mix the sensor locations.

(1) Disconnect knock sensor dual pigtail harness from engine wiring harness. this connection is made near rear of left valve cover (Fig. 20).

(2) Remove intake manifold. Refer to Engine section.

(3) Remove sensor mounting bolts (Fig. 20). Note foam strip on bolt threads. This foam is used only to retain the bolts to sensors for plant assembly. It is not used as a sealant. Do not apply any adhesive, sealant or thread locking compound to these bolts.

(4) Remove sensors from engine.



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**Fig. 20 KNOCK SENSOR LOCATION**

- 1 - KNOCK SENSORS (2)  
2 - MOUNTING BOLTS

## INSTALLATION

**NOTE:** The left sensor is identified by an identification tag (LEFT). It is also identified by a larger bolt head. The Powertrain Control Module (PCM) must have and know the correct sensor left/right positions. Do not mix the sensor locations.

- (1) Thoroughly clean knock sensor mounting holes.
- (2) Install sensors into cylinder block.

**NOTE:** Over or under tightening the sensor mounting bolts will affect knock sensor performance, possibly causing improper spark control. Always use the specified torque when installing the knock sensors. The torque for the knock sensor bolt is relatively light for an 8mm bolt.

**NOTE:** Note foam strip on bolt threads. This foam is used only to retain the bolts to sensors for plant assembly. It is not used as a sealant. Do not apply any adhesive, sealant or thread locking compound to these bolts.

(3) Install and tighten mounting bolts. Refer to torque specification.

(4) Install intake manifold. Refer to Engine section.

(5) Connect knock sensor wiring harness to engine harness at rear of intake manifold.

## SPARK PLUG

## DESCRIPTION

Resistor type spark plugs are used.

Spark plug resistance values range from 6,000 to 20,000 ohms (when checked with at least a 1000 volt spark plug tester). **Do not use an ohmmeter to check the resistance values of the spark plugs. Inaccurate readings will result.**

## OPERATION

To prevent possible pre-ignition and/or mechanical engine damage, the correct type/heat range/number spark plug must be used.

Always use the recommended torque when tightening spark plugs. This is especially true when plugs are equipped with tapered seats. Incorrect torque can distort the spark plug and change plug gap. It can also pull the plug threads and do possible damage to both the spark plug and the cylinder head.

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 sin-

SPARK PLUG (Continued)

gle plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in the Lubrication and Maintenance section.

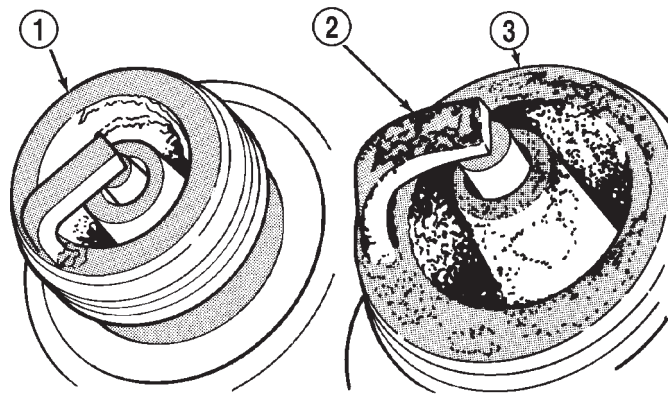
Spark plugs that have low mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Also refer to Spark Plug Conditions.

**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.

**DIAGNOSIS AND TESTING - 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. 21). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 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.



J908D-15

**Fig. 21 Normal Operation and Cold (Carbon) Fouling**

- 1 - NORMAL
- 2 - DRY BLACK DEPOSITS
- 3 - 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 com-

bustion chamber. Spark plug performance may be affected by MMT deposits.

**COLD FOULING/CARBON FOULING**

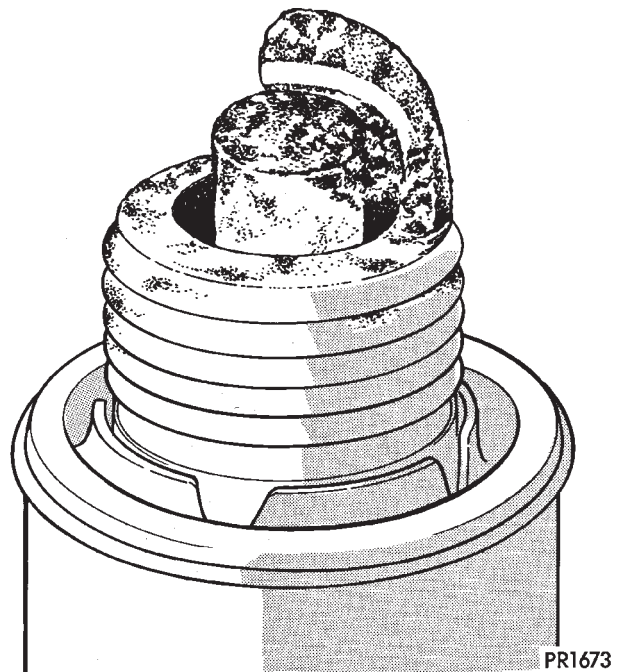
Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 21). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be 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. 22), evaluate engine condition for the cause of oil entry into that particular combustion chamber.



PR1673

**Fig. 22 Oil or Ash Encrusted**

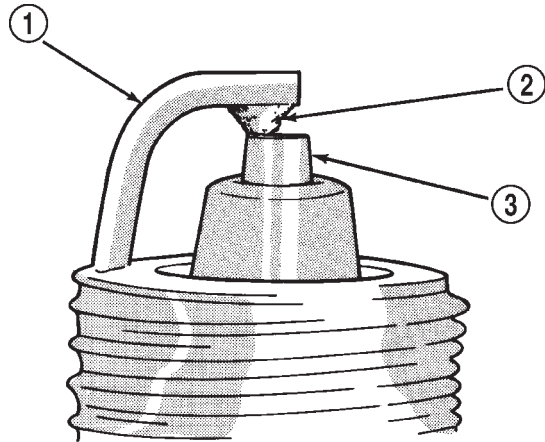
**ELECTRODE GAP BRIDGING**

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



## SPARK PLUG (Continued)

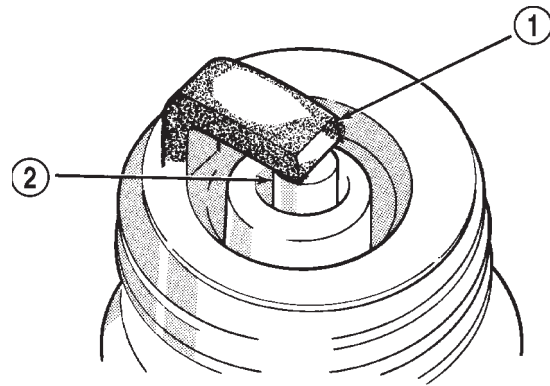
subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 23). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.



J908D-11

**Fig. 23 Electrode Gap Bridging**

- 1 - GROUND ELECTRODE
- 2 - DEPOSITS
- 3 - CENTER ELECTRODE



J908D-12

**Fig. 24 Scavenger Deposits**

- 1 - GROUND ELECTRODE COVERED WITH WHITE OR YELLOW DEPOSITS
- 2 - CENTER ELECTRODE

## SCAVENGER DEPOSITS

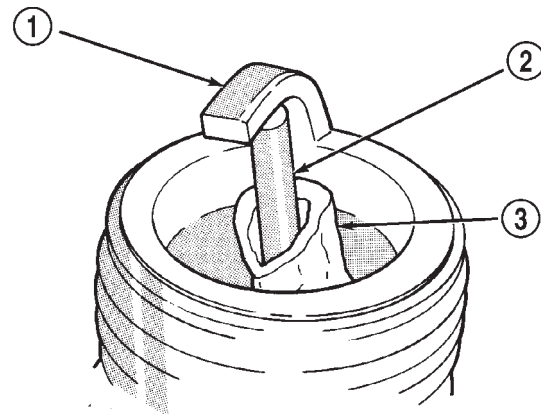
Fuel scavenger deposits may be either white or yellow (Fig. 24). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that 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.

## 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. 25). 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. 26). 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 over-



J908D-13

**Fig. 25 Chipped Electrode Insulator**

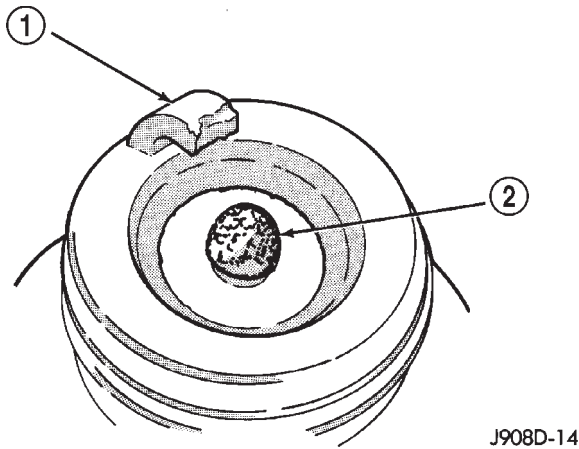
- 1 - GROUND ELECTRODE
- 2 - CENTER ELECTRODE
- 3 - CHIPPED INSULATOR

heating. (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.)

## SPARK PLUG OVERHEATING

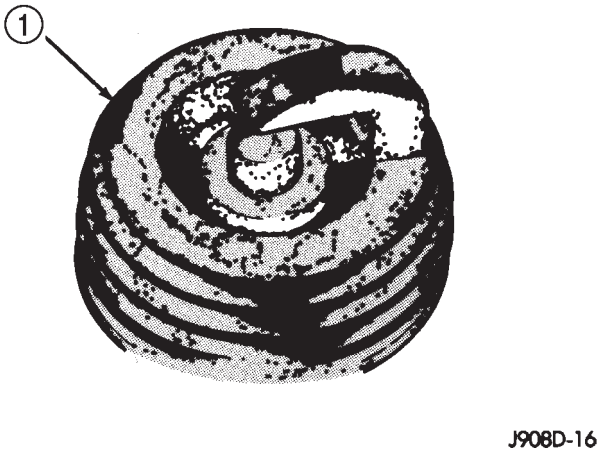
Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 27). The increase in electrode gap will be considerably in excess of 0.001 inch per 2000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

SPARK PLUG (Continued)



**Fig. 26 Preignition Damage**

- 1 - GROUND ELECTRODE STARTING TO DISSOLVE
- 2 - CENTER ELECTRODE DISSOLVED



**Fig. 27 Spark Plug Overheating**

- 1 - BLISTERED WHITE OR GRAY COLORED INSULATOR

**REMOVAL**

**2.4L**

If spark plug for #2 or #3 cylinder is being removed, throttle body must be removed. Refer to Throttle Body Removal.

- (1) Remove air cleaner tube and housing.
- (2) Twist secondary cable at cylinder head to break loose at spark plug. Remove cable from plug.
- (3) Prior to removing spark plug, spray compressed air into cylinder head opening. This will help prevent foreign material from entering combustion chamber.
- (4) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert.
- (5) Inspect spark plug condition. Refer to Spark Plug Conditions.

**3.7L**

Each individual spark plug is located under each ignition coil. Each individual ignition coil must be removed to gain access to each spark plug. Refer to Ignition Coil Removal/Installation.

- (1) Prior to removing ignition coil, spray compressed air around coil base at cylinder head.
- (2) Prior to removing spark plug, spray compressed air into cylinder head opening. This will help prevent foreign material from entering combustion chamber.
- (3) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert. Also check condition of ignition coil o-ring and replace as necessary.
- (4) Inspect spark plug condition. Refer to Spark Plug Conditions.

**CLEANING SPARK PLUGS**

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.

**INSTALLATION**

**2.4L**

**CAUTION:** Spark plug tightening on the 2.4L is torque critical. The plugs are equipped with tapered seats. Do not exceed 15 ft. lbs. torque.

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.

- (1) Start the spark plug into the cylinder head by hand to avoid cross threading.
- (2) Tighten spark plugs. Refer to torque specifications.
- (3) Install throttle body. Refer to Throttle Body Installation.
- (4) Install air cleaner tube and housing.

**3.7L**

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be

## SPARK PLUG (Continued)

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.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs. Refer to torque specifications.

(3) Before installing coil(s), check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(4) Install ignition coil(s). Refer to Ignition Coil Removal/Installation.

## IGNITION COIL CAPACITOR

### DESCRIPTION

One coil capacitor is used. It is located in the engine compartment and attached (clipped) to a wiring trough near the brake power booster.

### OPERATION

The coil capacitor(s) help dampen the amount of conducted electrical noise to the camshaft position sensor, crankshaft position sensor, and throttle position sensor. This noise is generated on the 12V supply wire to the ignition coils and fuel injectors.

### REMOVAL

The coil capacitor is located in the engine compartment and is attached (clipped) to a wiring harness trough near the brake power booster (graphic not available).

(1) Unclip capacitor from wiring harness trough.

(2) Disconnect electrical connector at capacitor.

### INSTALLATION

(1) Connect electrical connector to coil capacitor.

(2) Position capacitor into v-clip on wiring harness trough.

# INSTRUMENT CLUSTER

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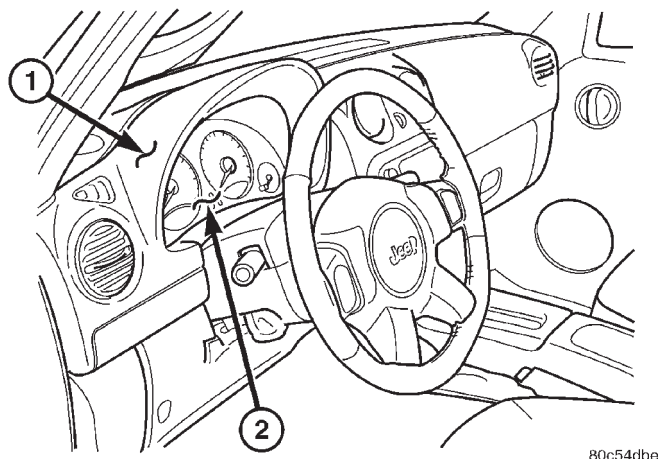
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## INSTRUMENT CLUSTER

### DESCRIPTION



**Fig. 1 Instrument Cluster**

- 1 - INSTRUMENT PANEL
- 2 - INSTRUMENT CLUSTER

The instrument cluster for this model is an ElectroMechanical Instrument Cluster (EMIC) module that is located in the instrument panel above the steering column opening, directly in front of the driver (Fig. 1). The remainder of the EMIC, including the mounts and the electrical connections, are concealed behind the cluster bezel. The EMIC gauges and indicators are protected by an integral clear plastic cluster lens, and are visible through a dedicated opening in the cluster bezel on the instrument panel. Just behind the cluster lens is the cluster hood and an integral cluster mask, which are constructed of molded black plastic. Two cluster masks are used; a base black version is used on base models, while a premium black version features a chrome trim ring around the perimeter of each gauge opening is used on premium models. The cluster hood serves as a visor and shields the face of the cluster from ambient light and reflections to reduce glare, while the cluster mask serves to separate and define the individual gauges and indicators of the EMIC. On the lower edge of the cluster lens just right of the speedometer, the black plastic odometer/trip odometer switch button protrudes through dedicated holes in the cluster

mask and the cluster lens. The molded plastic EMIC lens, hood and mask unit has three integral mounting tabs, one each on the lower outboard corners of the unit and one on the upper surface of the hood near the center. These mounting tabs are used to secure the EMIC to the molded plastic instrument panel cluster carrier with two screws at the top, and one screw at each outboard tab. A single molded connector receptacle located on the EMIC electronic circuit board is accessed from the back of the cluster housing and is connected to the vehicle electrical system through a single dedicated take out and connector of the instrument panel wire harness.

Behind the cluster lens, hood, and mask unit is the cluster overlay and gauges. The overlay is a laminated plastic unit. The dark, visible, outer surface of the overlay is marked with all of the gauge dial faces and graduations, but this layer is also translucent. The darkness of this outer layer prevents the cluster from appearing cluttered or busy by concealing the cluster indicators that are not illuminated, while the translucence of this layer allows those indicators and icons that are illuminated to be readily visible. The underlying layer of the overlay is opaque and allows light from the various indicators and illumination lamps behind it to be visible through the outer layer of the overlay only through predetermined cutouts. The orange gauge pointers are each illuminated internally. The EMIC electronic circuitry is protected by a molded plastic rear cover that features several round access holes for service of the cluster illumination lighting and a single rectangular access hole for the EMIC connector receptacle. The EMIC housing, circuit board, gauges, and overlay unit are sandwiched between the lens, hood, and mask unit and the rear cover with screws.

Twelve versions of the EMIC module are offered on this model, six base and six premium. These versions accommodate all of the variations of optional equipment and regulatory requirements for the various markets in which the vehicle will be offered. This module utilizes integrated circuitry and information carried on the Programmable Communications Interface (PCI) data bus network for control of all gauges and many of the indicators. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION - PCI BUS). The EMIC also uses several hard wired inputs in order to

## INSTRUMENT CLUSTER (Continued)

perform its many functions. The EMIC module incorporates a blue-green digital Vacuum Fluorescent Display (VFD) for displaying odometer and trip odometer information, as well as several warning messages and certain diagnostic information. In addition to instrumentation and indicators, the EMIC has the hardware and software needed to provide the following features:

- **Chime Warning Service** - A chime tone generator on the EMIC electronic circuit board provides audible alerts to the vehicle operator and eliminates the need for a separate chime module. (Refer to 8 - ELECTRICAL/CHIME WARNING SYSTEM - DESCRIPTION).

- **Panel Lamps Dimming Service** - The EMIC provides a hard wired 12-volt Pulse-Width Modulated (PWM) output that synchronizes the dimming level of the radio display, gear selector indicator, heater-air conditioner control, and all other dimmable lighting on the panel lamps dimmer circuit with that of the cluster illumination lamps and VFD.

The EMIC houses four analog gauges and has provisions for up to twenty-four indicators (Fig. 2). The EMIC includes the following analog gauges:

- **Coolant Temperature Gauge**
- **Fuel Gauge**
- **Speedometer**
- **Tachometer**

Some of the EMIC indicators are automatically configured when the EMIC is connected to the vehicle electrical system for compatibility with certain optional equipment or equipment required for regulatory purposes in certain markets. While each EMIC may have provisions for indicators to support every available option, the configurable indicators will not be functional in a vehicle that does not have the equipment that an indicator supports. The EMIC includes provisions for the following indicators (Fig. 2):

- **Airbag Indicator (with Airbag System only)**
- **Antilock Brake System (ABS) Indicator (with ABS only)**
- **Brake Indicator**
- **Charging Indicator**
- **Coolant Low Indicator (with Diesel Engine only)**
- **Cruise Indicator (with Speed Control System only)**
- **Four-Wheel Drive Full Time Indicator (with Selec-Trac Transfer Case only)**
- **Four-Wheel Drive Low Mode Indicator**
- **Four-Wheel Drive Part Time Indicator**
- **Front Fog Lamp Indicator (with Front Fog Lamps only)**
- **High Beam Indicator**
- **Low Fuel Indicator**

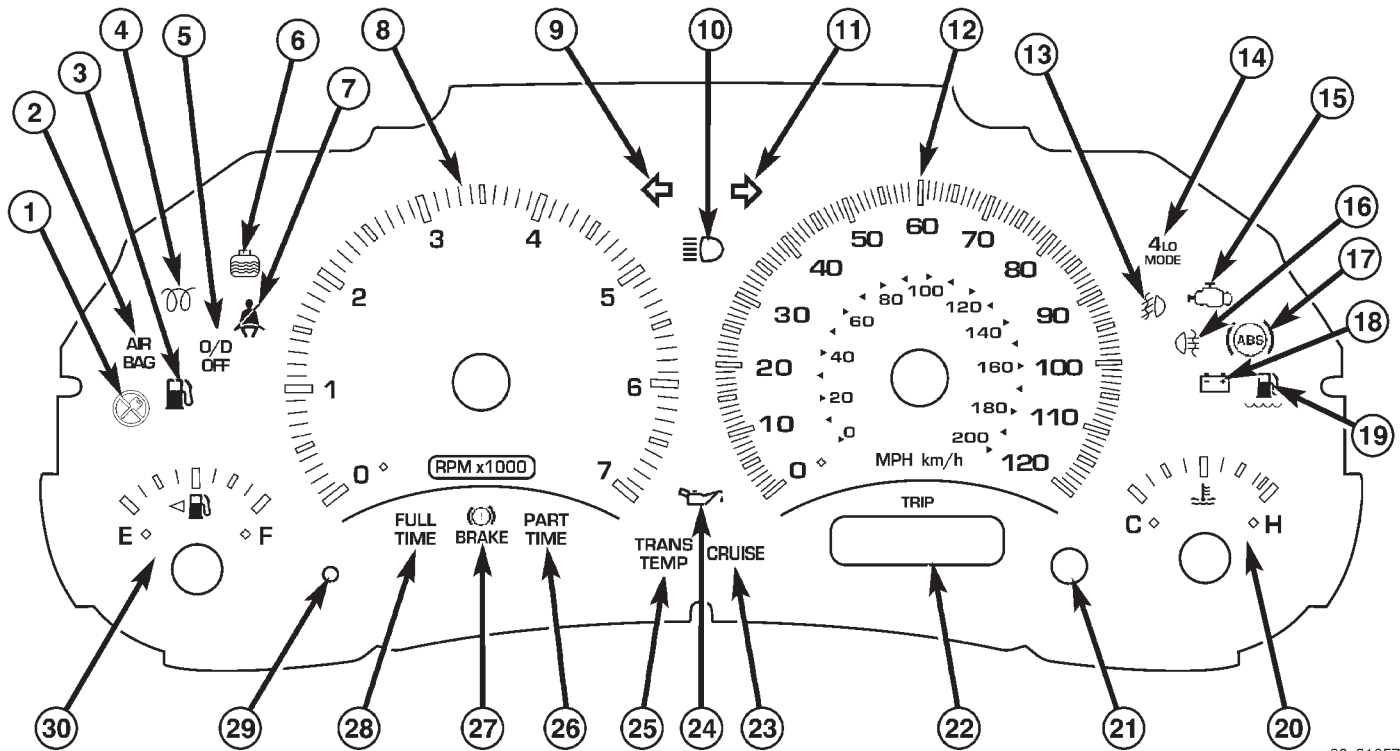
- **Low Oil Pressure Indicator**
- **Malfunction Indicator Lamp (MIL)**
- **Overdrive-Off Indicator (with Automatic Transmission only)**
- **Rear Fog Lamp Indicator (with Rear Fog Lamps only)**
- **Seatbelt Indicator**
- **Security Indicator (with Vehicle Theft Security System only)**
- **Sentry Key Immobilizer System (SKIS) Indicator (with SKIS only)**
- **Transmission Overtemp Indicator (with Automatic Transmission only)**
- **Turn Signal (Right and Left) Indicators**
- **Wait-To-Start Indicator (with Diesel Engine only)**
- **Water-In-Fuel Indicator (with Diesel Engine only)**

Each indicator in the EMIC is illuminated by a dedicated Light Emitting Diode (LED) that is soldered onto the EMIC electronic circuit board. The LEDs are not available for service replacement and, if damaged or faulty, the entire EMIC must be replaced. Cluster illumination is accomplished by dimmable incandescent back lighting, which illuminates the gauges for visibility when the exterior lighting is turned on. Each of the incandescent bulbs is secured by an integral bulb holder to the electronic circuit board from the back of the cluster housing. The incandescent bulb/bulb holder units are available for service replacement.

Hard wired circuitry connects the EMIC to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the EMIC through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

The EMIC modules for this model are serviced only as complete units. The EMIC module cannot be adjusted or repaired. If a gauge, an LED indicator, the VFD, the electronic circuit board, the circuit board hardware, the cluster overlay, or the EMIC housing are damaged or faulty, the entire EMIC module must be replaced. The cluster lens, hood and mask unit and the individual incandescent lamp bulbs with holders are available for service replacement.

## INSTRUMENT CLUSTER (Continued)



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**Fig. 2 EMIC Gauges & Indicators**

- |                                       |   |
|---------------------------------------|---|
| 1 - SKIS INDICATOR                    | 16 - REAR FOG LAMP INDICATOR              |
| 2 - AIRBAG INDICATOR                  | 17 - ABS INDICATOR                        |
| 3 - LOW FUEL INDICATOR                | 18 - CHARGING INDICATOR                   |
| 4 - WAIT-TO-START INDICATOR           | 19 - WATER-IN-FUEL INDICATOR              |
| 5 - OVERDRIVE-OFF INDICATOR           | 20 - ENGINE TEMPERATURE GAUGE             |
| 6 - COOLANT LOW INDICATOR             | 21 - ODOMETER/TRIP ODOMETER SWITCH BUTTON |
| 7 - SEATBELT INDICATOR                | 22 - ODOMETER/TRIP ODOMETER DISPLAY       |
| 8 - TACHOMETER                        | 23 - CRUISE INDICATOR                     |
| 9 - LEFT TURN INDICATOR               | 24 - LOW OIL PRESSURE INDICATOR           |
| 10 - HIGH BEAM INDICATOR              | 25 - TRANSMISSION OVERTEMP INDICATOR      |
| 11 - RIGHT TURN INDICATOR             | 26 - PART TIME 4WD INDICATOR              |
| 12 - SPEEDOMETER                      | 27 - BRAKE INDICATOR                      |
| 13 - FRONT FOG LAMP INDICATOR         | 28 - FULL TIME 4WD INDICATOR              |
| 14 - 4WD LOW MODE INDICATOR           | 29 - SECURITY INDICATOR                   |
| 15 - MALFUNCTION INDICATOR LAMP (MIL) | 30 - FUEL GAUGE                           |

## OPERATION

The ElectroMechanical Instrument Cluster (EMIC) is designed to allow the vehicle operator to monitor the conditions of many of the vehicle components and operating systems. The gauges and indicators in the EMIC provide valuable information about the various standard and optional powertrains, fuel and emissions systems, cooling systems, lighting systems, safety systems and many other convenience items. The EMIC is installed in the instrument panel so that all of these monitors can be easily viewed by the vehicle operator when driving, while still allowing relative ease of access for service. The microproces-

sor-based EMIC hardware and software uses various inputs to control the gauges and indicators visible on the face of the cluster. Some of these inputs are hard wired, but most are in the form of electronic messages that are transmitted by other electronic modules over the Programmable Communications Interface (PCI) data bus network. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - OPERATION).

The EMIC microprocessor smooths the input data using algorithms to provide gauge readings that are accurate, stable and responsive to operating conditions. These algorithms are designed to provide

## INSTRUMENT CLUSTER (Continued)

gauge readings during normal operation that are consistent with customer expectations. However, when abnormal conditions exist such as high coolant temperature, the algorithm can drive the gauge pointer to an extreme position and the microprocessor can sound a chime through the on-board chime tone generator to provide distinct visual and audible indications of a problem to the vehicle operator. The instrument cluster circuitry may also perform chime service for other electronic modules in the vehicle based upon electronic chime tone request messages received over the PCI data bus to provide the vehicle operator with an audible alert to supplement a visual indication. One such alert is a door ajar warning chime, which the EMIC provides by monitoring PCI bus messages from the Body Control Module (BCM).

The EMIC circuitry operates on battery current received through a fused B(+) fuse in the Junction Block (JB) on a non-switched fused B(+) circuit, and on battery current received through a fused ignition switch output (run-start) fuse in the JB on a fused ignition switch output (run-start) circuit. This arrangement allows the EMIC to provide some features regardless of the ignition switch position, while other features will operate only with the ignition switch in the On or Start positions. The EMIC receives a ground input from the BCM as a wake-up signal in order to provide the ignition-off features. The EMIC circuitry is grounded through a ground circuit and take out of the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud located on the left instrument panel end bracket.

The EMIC also has a self-diagnostic actuator test capability, which will test each of the PCI bus message-controlled functions of the cluster by lighting the appropriate indicators (except the airbag indicator), sweeping the gauge needles to several calibration points across the gauge faces, and stepping the odometer display sequentially from all ones through all nines. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). See the owner's manual in the vehicle glove box for more information on the features, use and operation of the EMIC.

**GAUGES** All gauges receive battery current through the EMIC circuitry when the ignition switch is in the On or Start positions. With the ignition switch in the Off position battery current is not supplied to any gauges, and the EMIC circuitry is programmed to move all of the gauge needles back to the low end of their respective scales. Therefore, the gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions. All of the EMIC gauges, except the odometer, are air core magnetic units. Two fixed electro-

magnetic coils are located within each 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 pivot shaft, while 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 EMIC circuitry in response to messages received over the PCI data bus. The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets.

The gauges are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control each gauge require the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for each gauge may be found elsewhere in this service information.

**VACUUM-FLUORESCENT DISPLAY** The Vacuum-Fluorescent Display (VFD) module is soldered to the EMIC circuit board. The display is active when the driver door is opened with the ignition switch in the Off or Accessory positions (Rental Car mode), and with the ignition switch in the On or Start positions. The VFD is inactive when the ignition switch is in the Off or Accessory positions and the driver door is closed. The illumination intensity of the VFD is controlled by the EMIC circuitry based upon electronic dimming level messages received from the BCM over the PCI data bus, and is synchronized with the illumination intensity of other VFDs in the vehicle. The BCM provides dimming level messages based upon internal programming and inputs it receives from the control knob and control ring on the left (lighting) control stalk of the multi-function switch on the steering column.

The VFD has several display capabilities including odometer, trip odometer, and warning messages whenever the appropriate conditions exist. The VFD warning messages include:

- **“door”** - indicating a door is ajar.
- **“gate”** - indicating the tailgate is ajar.
- **“glass”** - indicating the tailgate glass is ajar.
- **“lowash”** - indicating that the washer fluid level is low.
- **“no bus”** - indicating there is no PCI data bus communication detected.

An odometer/trip odometer switch on the EMIC circuit board is used to control the display modes. This switch is actuated manually by depressing the odom-



## INSTRUMENT CLUSTER (Continued)

eter/trip odometer switch button that extends through the lower edge of the cluster lens, just right of the speedometer. Actuating this switch momentarily with the ignition switch in the On position will toggle the VFD between the odometer and trip odometer modes. Depressing the switch button for about two seconds while the VFD is in the trip odometer mode will reset the trip odometer value to zero. Holding this switch depressed while turning the ignition switch from the Off position to the On position will initiate the EMIC self-diagnostic actuator test. The VFD will also display the cluster software version level near the completion of the EMIC self-diagnostic actuator test. Refer to the appropriate diagnostic information for additional details on this VFD function.

The VFD is diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control some of the VFD functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for the odometer, the trip odometer, and the various warning message functions of the VFD may be found elsewhere in this service information.

**INDICATORS** Indicators are located in various positions within the EMIC and are all connected to the EMIC circuit board. The turn signal indicators, security indicator, washer fluid indicator, and coolant low indicator (diesel engine only) use hard wired inputs to the EMIC. The brake indicator is controlled by PCI data bus messages from the Controller Antilock Brake (CAB) as well as by hard wired park brake switch and brake fluid level switch inputs to the EMIC. The Malfunction Indicator Lamp (MIL) is normally controlled by PCI data bus messages from the Powertrain Control Module (PCM); however, if the EMIC loses PCI data bus communication, the EMIC circuitry will automatically turn the MIL on until PCI data bus communication is restored. The EMIC uses PCI data bus messages from the Body Control Module (BCM), the PCM, the Airbag Control Module (ACM), and the CAB to control all of the remaining indicators.

The various indicators are controlled by different strategies; some receive fused ignition switch output from the EMIC circuitry and have a switched ground, others are grounded through the EMIC circuitry and have a switched battery feed, while still others are completely controlled by the EMIC microprocessor based upon various hard wired and electronic message inputs. Some indicators are illuminated at a fixed intensity, while the illumination intensity of

others is synchronized with that of the EMIC general illumination lamps.

In addition, certain indicators in this instrument cluster are automatically configured or self-configured. This feature allows the configurable indicators to be enabled by the EMIC circuitry for compatibility with certain optional equipment. The ABS indicator, airbag indicator, SKIS indicator are automatically configured by PCI data bus messages received by the EMIC from the CAB, ACM, or Sentry Key Immobilizer Module (SKIM) after the EMIC is installed in the vehicle. Once these configuration settings are learned by the EMIC, the DRBIII® scan tool must be used to remove these settings from the EMIC non-volatile memory. The self-configured indicators remain latent in each EMIC at all times and will be activated only when the EMIC receives the appropriate PCI message inputs for the optional system or equipment.

The hard wired indicators are diagnosed using conventional diagnostic methods. The EMIC and PCI bus message controlled indicators are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control each indicator require the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific details of the operation for each indicator may be found elsewhere in this service information.

**CLUSTER ILLUMINATION** The EMIC has several illumination lamps that are illuminated when the exterior lighting is turned on with the headlamp (multi-function) switch. The illumination intensity of these lamps is adjusted by a 12-volt Pulse Width Modulated (PWM) output of the EMIC when the interior lighting control ring on the left control stalk of the multi-function switch is rotated (down to dim, up to brighten) to one of six available minor detent positions. The BCM provides electronic dimming level messages based upon internal programming and inputs it receives from the control knob and control ring on the left (lighting) control stalk of the multi-function switch on the steering column, then provides a control output to energize or de-energize the park lamp relay as appropriate. The energized park lamp relay provides battery current to the EMIC on the hard wired fused park lamp relay output circuit, and the BCM provides the electronic dimming level message to the EMIC over the PCI data bus. The EMIC electronic circuitry provides the proper PWM output to the cluster illumination lamps and the VFD on the EMIC circuit board, then provides a synchronized PWM output on the hard wired

## INSTRUMENT CLUSTER (Continued)

fused panel lamps dimmer switch signal circuit. The cluster illumination lamps are grounded at all times.

In addition, the control ring on the left (lighting) control stalk of the multi-function switch has a Parade Mode position to provide a parade mode. The BCM monitors the request for this mode from the multi-function switch, then sends an electronic dimming level message to the EMIC over the PCI data bus to illuminate all VFDs in the vehicle at full intensity for easier visibility when driving in daylight with the exterior lighting turned On.

The hard wired cluster illumination lamp circuits may be diagnosed using conventional diagnostic methods. However, proper testing of the PWM output of the EMIC and the electronic dimming level messages sent by the BCM over the PCI data bus requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**CHIME WARNING SERVICE** The EMIC is programmed to provide chime service when certain indicators are illuminated. When the programmed conditions are met, the EMIC generates an electronic chime tone through its integral chime tone generator. In addition, the EMIC is programmed to provide chime service for other electronic modules in the vehicle when it receives the proper electronic chime request messages over the PCI data bus. Upon receiving the proper chime request message, the EMIC activates the integral chime tone generator to provide the audible chime tone to the vehicle operator. (Refer to 8 - ELECTRICAL/CHIME/BUZZER - OPERATION). Proper testing of the EMIC and the PCI data bus chime request message functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER

If all of the instrument cluster gauges and/or indicators are inoperative, refer to **PRELIMINARY DIAGNOSIS**. If an individual gauge or Programmable Communications Interface (PCI) data bus message-controlled indicator is inoperative, refer to **ACTUATOR TEST**. If an individual hard wired indicator is inoperative, refer to the diagnosis and testing information for that specific indicator. If the instrument cluster chime service is inoperative, refer to **CHIME SERVICE DIAGNOSIS**. If the instrument cluster illumination lighting is inoperative, refer to **CLUSTER ILLUMINATION DIAGNOSIS**. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**NOTE:** Certain indicators in this instrument cluster are automatically configured. This feature allows those indicators to be activated for compatibility with certain optional equipment. If the problem being diagnosed involves illumination of the ABS indicator, the airbag indicator, or the SKIS indicator when the vehicle does not have this equipment, a DRBIII® scan tool must be used to disable the erroneous indicator(s). Refer to the appropriate diagnostic information.

### PRELIMINARY DIAGNOSIS

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Check the fused B(+) fuse (Fuse 34 - 15 ampere) in the Junction Block (JB). 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 (Fuse 34 - 15 ampere) in the JB. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit between the JB and the Power Distribution Center (PDC) as required.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector for the instrument cluster. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit between the instrument cluster and the JB as required.

(4) Check the fused ignition switch output (run-start) fuse (Fuse 13 - 10 ampere) in the JB. If OK, go to Step 5. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(5) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-start) fuse (Fuse 13 - 10 ampere) in the JB. If OK, go to Step 6. If not OK, repair the open

## INSTRUMENT CLUSTER (Continued)

fused ignition switch output (run-start) circuit between the JB and the ignition switch as required.

(6) With the ignition switch still in the On position, check for battery voltage at the fused ignition switch output (run-start) circuit cavity of the instrument panel wire harness connector for the instrument cluster. If OK, go to Step 7. If not OK, repair the open fused ignition switch output circuit (run-start) between the instrument cluster and the JB as required.

(7) 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 instrument panel wire harness connector for the instrument cluster and a good ground. There should be continuity. If OK, refer to ACTUATOR TEST . If not OK, repair the open ground circuit between the instrument cluster and ground (G202) as required.

## ACTUATOR TEST

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

The instrument cluster actuator 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, the PCI data bus message controlled indicator lamps, and the chime tone generator are capable of operating as designed. During the actuator test the instrument cluster circuitry will sound the chime tone generator, position each of the gauge needles at various specified calibration points, illuminate each of the segments in the Vacu-

um-Fluorescent Display (VFD), and turn all of the PCI data bus message-controlled indicators on and off again.

Successful completion of the actuator test will confirm that the instrument cluster is operational. However, there may still be a problem with the PCI data bus, the Powertrain Control Module (PCM), the Airbag Control Module (ACM), the Sentry Key Immobilizer Module (SKIM), or the inputs to one of these electronic control modules. Use a DRBIII® scan tool to diagnose these components. Refer to the appropriate diagnostic information.

(1) Begin the test with the ignition switch in the Off position.

(2) Depress the odometer/trip odometer switch button.

(3) While still holding the odometer/trip odometer switch button depressed, turn the ignition switch to the On position, but do not start the engine.

(4) Release the odometer/trip odometer switch button.

(5) The instrument cluster will automatically begin the actuator test sequence, as follows:

(a) The cluster will turn on, then off again each of the PCI data bus message controlled indicators to confirm the functionality of the indicator and the cluster control circuitry:

(b) The cluster will sweep the needles for each of the gauges to several calibration points in sequence to confirm the functionality of the gauge and the cluster control circuitry:

(c) The cluster will sequentially step the odometer/trip odometer VFD display from all ones (111111) through all nines (999999) to confirm the functionality of all VFD segments and their control circuitry, then display the software version number.

(d) The cluster will generate five (5) chime tones to confirm the functionality of the chime tone generator and the chime control circuitry.

(6) The actuator 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 an engine rpm message indicating that the engine is running is received from the PCM over the PCI data bus during the test.

(7) Go back to Step 1 to repeat the test, if required.

## INSTRUMENT CLUSTER (Continued)

## CHIME SERVICE DIAGNOSIS

The most reliable, efficient, and accurate means to diagnose the Chime Service function of the instrument cluster requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## CLUSTER ILLUMINATION DIAGNOSIS

If the problem being diagnosed is a single inoperative illumination lamp, be certain that the bulb and bulb holder unit are properly installed in the instrument cluster electronic circuit board. If no installation problems are found replace the faulty bulb and bulb holder unit. If all of the cluster illumination lamps are inoperative, the most reliable, efficient, and accurate means to diagnose the cluster illumination function of the instrument cluster requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

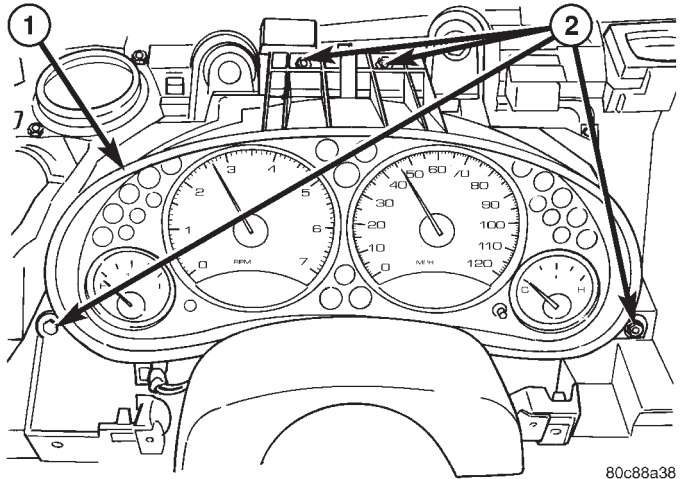
(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Remove the four screws that secure the instrument cluster to the instrument panel (Fig. 3).

(4) Pull the instrument cluster rearward far enough to access and disconnect the instrument panel wire harness connector for the cluster from the cluster connector receptacle.

(5) Remove the instrument cluster from the instrument panel.



**Fig. 3 Instrument Cluster Remove/Install**

- 1 - INSTRUMENT CLUSTER  
2 - SCREW (4)

## DISASSEMBLY

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include the incandescent instrument cluster illumination lamp bulbs (including the integral bulb holders), and the cluster lens, hood and mask unit. Following are the procedures for disassembling these components from the instrument cluster unit.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## INSTRUMENT CLUSTER (Continued)

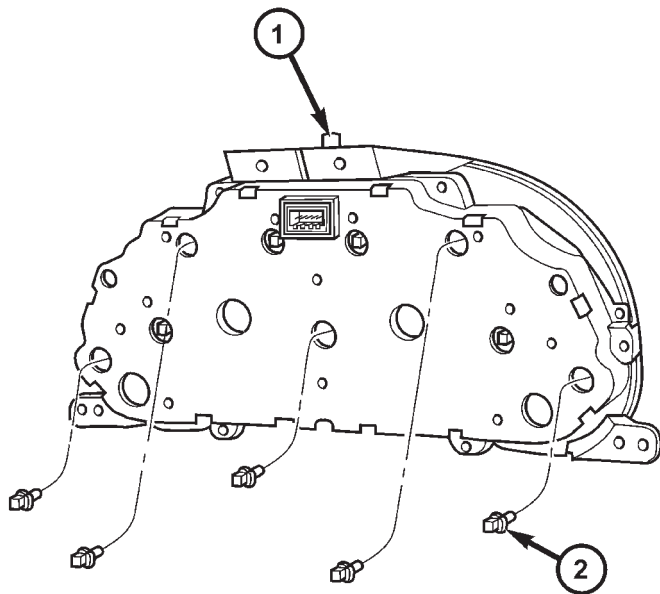
## CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp and bulb holder units.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Turn the bulb holder counterclockwise about sixty degrees on the cluster electronic circuit board (Fig. 4).



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**Fig. 4 Cluster Bulb Remove/Install**

- 1 - INSTRUMENT CLUSTER
- 2 - BULB & HOLDER (9)

(4) Pull the bulb and bulb holder unit straight back to remove it from the bulb mounting hole in the cluster electronic circuit board.

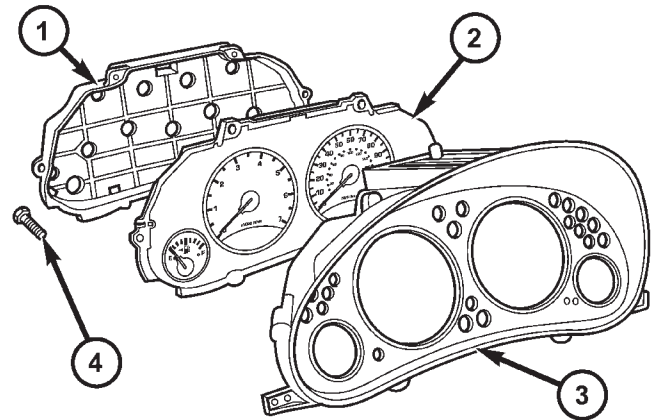
## CLUSTER LENS, HOOD, AND MASK

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) From the back of the instrument cluster, remove the six screws that secure the rear cover and the lens, hood, and mask unit to the cluster housing (Fig. 5).

(4) Remove the lens, hood, and mask unit from the face of the instrument cluster.



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**Fig. 5 Instrument Cluster Components**

- 1 - REAR COVER
- 2 - CLUSTER HOUSING
- 3 - LENS, HOOD & MASK
- 4 - SCREW (6)

## ASSEMBLY

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp and bulb holder units.

**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, the electronic circuit board and/or the gauges.**

(1) Insert the bulb and bulb holder unit straight into the correct bulb mounting hole in the cluster electronic circuit board (Fig. 4).

## INSTRUMENT CLUSTER (Continued)

(2) With the bulb holder fully seated against the cluster electronic circuit board, turn the bulb holder clockwise about sixty degrees to lock it into place.

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

## CLUSTER LENS, HOOD, AND MASK

(1) Position the cluster lens, hood, and mask unit over the face of the instrument cluster (Fig. 5). Be certain that the odometer/trip odometer switch button is inserted through the proper clearance holes in the mask and the lens.

(2) From the back of the instrument cluster, install and tighten the six screws that secure the rear cover and the lens, hood, and mask unit to the cluster housing. Tighten the screws to 1 N·m (10 in. lbs.).

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the instrument cluster to the instrument panel.

(2) Reconnect the instrument panel wire harness connector for the cluster to the cluster connector receptacle.

(3) Position the instrument cluster into the instrument panel.

(4) Install and tighten the four screws that secure the instrument cluster to the instrument panel (Fig. 3). Tighten the screws to 2 N·m (17 in. lbs.).

(5) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(6) Reconnect the battery negative cable.

**NOTE: Some of the indicators in this instrument cluster are self configured or automatically configured when the cluster is connected to the vehicle electrical system. This feature allows those indicators to be enabled for compatibility with certain optional equipment. However, if an instrument cluster was previously connected to another vehicle with different equipment options than the current vehicle, some of the automatically configured indicator settings may have to be disabled using a DRBIII® scan tool. Refer to the appropriate diagnostic information.**

## ABS INDICATOR

## DESCRIPTION

An Antilock Brake System (ABS) indicator is standard equipment on all instrument clusters. However, the instrument cluster is programmed to automatically enable this indicator only on vehicles equipped with the optional antilock brake system. The ABS indicator is located above the engine temperature gauge and to the right of the speedometer in the instrument cluster. The ABS indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Failure of Anti-lock Braking System" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The ABS indicator is serviced as a unit with the instrument cluster.

## OPERATION

The ABS indicator gives an indication to the vehicle operator when the ABS system is faulty or inoperative. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus. The ABS indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only

## ABS INDICATOR (Continued)

illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the ABS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the ABS indicator is illuminated by the cluster for about three seconds as a bulb test.

- **ABS Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the ABS indicator will be illuminated. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Communication Error** - If the cluster receives no lamp-on or lamp-off messages from the CAB for six consecutive seconds, the ABS indicator is illuminated. The indicator remains illuminated until the cluster receives a valid message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the ABS indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

- **ABS Diagnostic Test** - The ABS indicator is blinked on and off by lamp-on and lamp-off messages from the CAB during the performance of the ABS diagnostic 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 lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. The CAB will each store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the ABS indicator fails to light due to an open or short in the cluster ABS indicator circuit, the cluster sends a message notifying the CAB of the condition, then the instrument cluster and the CAB will each store a DTC. For proper diagnosis of the antilock brake system, the CAB, the PCI data bus, or the message inputs to the instrument cluster that control the ABS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## AIRBAG INDICATOR

## DESCRIPTION

An airbag indicator is standard equipment on all instrument clusters. However, the instrument cluster is programmed to automatically enable this indicator only on vehicles equipped with the airbag system, which is not available in some markets. The airbag indicator is located above the fuel gauge and to the left of the tachometer in the instrument cluster. The airbag indicator consists of a stencil-like cutout of the words "AIR BAG" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "AIR BAG" text to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The airbag indicator is serviced as a unit with the instrument cluster.

## OPERATION

The airbag indicator gives an indication to the vehicle operator when the airbag system is faulty or inoperative. The airbag indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Airbag Control Module (ACM) over the Programmable Communications Interface (PCI) data bus. The airbag indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the airbag indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the airbag indicator is illuminated for about six seconds. The entire six second bulb test is a function of the ACM.

- **ACM Lamp-On Message** - Each time the cluster receives a lamp-on message from the ACM, the airbag indicator will be illuminated. The indicator remains illuminated for about twelve seconds or until the cluster receives a lamp-off message from the ACM, whichever is longer.

- **Communication Error** - If the cluster receives no airbag messages for six consecutive seconds, the airbag indicator is illuminated. The indicator

## AIRBAG INDICATOR (Continued)

remains illuminated until the cluster receives a single lamp-off message from the ACM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the airbag indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry. The actuator test illumination of the airbag indicator is a function of the instrument cluster.

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 lamp-on or lamp-off messages to the instrument cluster. If the ACM sends a lamp-on message after the bulb test, it indicates that the ACM has detected a system malfunction and/or that the airbags and driver seat belt tensioner may not deploy when required, or may deploy when not required. The ACM will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the airbag indicator fails to illuminate due to an open or short in the cluster airbag indicator circuit, the cluster sends a message notifying the ACM of the condition, then the instrument cluster and the ACM will each store a DTC. For proper diagnosis of the airbag system, the ACM, the PCI data bus, or the message inputs to the instrument cluster that control the airbag indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## BRAKE/PARK BRAKE INDICATOR

### DESCRIPTION

A brake indicator is standard equipment on all instrument clusters. The brake indicator is located near the lower edge of the tachometer dial face in the instrument cluster. The brake indicator consists of stencil-like cutouts of the word "BRAKE" and the International Control and Display Symbol icon for "Brake Failure" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "BRAKE" text and the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The brake indicator is serviced as a unit with the instrument cluster.

### OPERATION

The brake indicator gives an indication to the vehicle operator when the parking brake is applied, when there are certain brake hydraulic system malfunctions as indicated by a low brake hydraulic fluid level condition, or when the brake fluid level switch is disconnected. On models equipped with an optional Antilock Brake System (ABS), the brake indicator can also give an indication when certain faults are detected in the ABS. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming, electronic messages received by the cluster from the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus (ABS only), and hard wired inputs from the park brake switch and the brake fluid level switch. The brake indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the brake indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the brake indicator is illuminated by the instrument cluster for about three seconds as a bulb test.

- **Brake Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the brake indicator will be illuminated. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Park Brake Switch Input** - Each time the cluster detects ground on the park brake switch sense circuit (park brake switch closed = park brake applied or not fully released) the brake indicator is illuminated. The indicator remains illuminated until the park brake switch sense input to the cluster is an open circuit (park brake switch open = park brake fully released), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Brake Fluid Level Switch Input** - Each time the cluster detects ground on the red brake warning indicator driver circuit (brake fluid level switch closed = brake hydraulic system fluid level low) the brake indicator is illuminated solid. The indicator remains illuminated until the status of the red brake warning indicator driver input to the cluster is off (brake fluid level switch off = brake hydraulic system



## BRAKE/PARK BRAKE INDICATOR (Continued)

fluid level is not low), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Brake Fluid Level Switch Input Fault** - The brake fluid level switch also features a 1 kilohm diagnostic resistor connected in parallel between the switch input and output to provide the cluster with verification that the red brake warning indicator driver circuit is not open. If the cluster does not see a proper input on the red brake warning indicator driver circuit, it will turn on the brake indicator. The indicator remains illuminated until the red brake warning indicator driver circuit fault is resolved, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the brake indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The park brake switch on the park brake pedal mechanism provides a hard wired ground input to the instrument cluster circuitry through the park brake switch sense circuit whenever the park brake is applied or not fully released. The brake fluid level switch on the brake master cylinder reservoir provides a hard wired ground input to the instrument cluster circuitry through the red brake warning indicator driver circuit whenever the fluid level in the reservoir becomes low. On models equipped with the optional ABS, the CAB sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a brake hydraulic system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects.

For further diagnosis of the brake indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). The park brake switch input to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the brake fluid level switch input to the instrument cluster, the antilock brake system, the CAB, the PCI data bus, or the electronic message inputs to the instrument cluster that control the brake indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

**DIAGNOSIS AND TESTING - BRAKE INDICATOR**

The diagnosis found here addresses an inoperative brake indicator condition. If there are problems with several indicators in the instrument cluster, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAG-

NOSIS AND TESTING). If the brake indicator stays on with the ignition switch in the On position and the park brake released, or comes on while driving, (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If no brake system problem is found, the following procedures will help to locate a shorted or open circuit, or a faulty park brake switch input. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

INDICATOR ILLUMINATES DURING BULB TEST, BUT DOES NOT WHEN PARK BRAKE APPLIED

- (1) Disconnect and isolate the battery negative cable. Disconnect the front body wire harness connector for the park brake switch from the switch terminal. Apply the parking brake. Check for continuity between the park brake switch terminal and a good ground. There should be continuity. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

- (2) Disconnect the instrument panel wire harness connector for the instrument cluster from the cluster connector receptacle. Check for continuity between the park brake switch sense circuit cavities of the front body wire harness connector for the park brake switch and the instrument panel wire harness connector for the instrument cluster. There should be continuity. If not OK, repair the open park brake switch sense circuit between the park brake switch and the instrument cluster as required.

INDICATOR REMAINS ILLUMINATED - BRAKE SYSTEM CHECKS OK

- (1) Disconnect and isolate the battery negative cable. Disconnect the front body wire harness connec-

## BRAKE/PARK BRAKE INDICATOR (Continued)

tor for the park brake switch from the switch terminal. Check for continuity between the terminal of the park brake switch and a good ground. There should be no continuity with the park brake released, and continuity with the park brake applied. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

(2) Disconnect the instrument panel wire harness connector for the instrument cluster from the cluster connector receptacle. Check for continuity between the park brake switch sense circuit cavity of the front body wire harness connector for the park brake switch and a good ground. There should be no continuity. If not OK, repair the shorted park brake switch sense circuit between the park brake switch and the instrument cluster as required.

## CHARGING INDICATOR

## DESCRIPTION

A charging indicator is standard equipment on all instrument clusters. The charging indicator is located above the engine temperature gauge and to the right of the speedometer in the instrument cluster. The charging indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Battery Charging Condition" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The charging indicator is serviced as a unit with the instrument cluster.

## OPERATION

The charging indicator gives an indication to the vehicle operator when the electrical system voltage is too low or too high. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The charging indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any posi-

tion except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the charging indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the charging indicator is illuminated by the instrument cluster for about three seconds as a bulb test.

- **Charge Fail Message** - Each time the cluster receives a charge fail message from the PCM (system voltage is nine volts or lower, the charging indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM indicating there is no charge fail condition (system voltage is twelve volts or higher, but lower than sixteen volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Voltage High Message** - Each time the cluster receives a message from the PCM indicating a voltage high condition (system voltage is sixteen volts or higher), the lamp will be illuminated. The lamp remains illuminated until the cluster receives a message from the PCM indicating there is no voltage high condition (system voltage is lower than sixteen volts, but higher than nine volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the charging indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the electrical system voltage to control the generator output. The PCM then sends the proper system voltage messages to the instrument cluster. If the instrument cluster turns on the indicator after the bulb test, it may indicate that the charging system requires service. For further diagnosis of the charging indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the charging system, the PCI data bus, or the electronic message inputs to the instrument cluster that control the charging indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## COOLANT LOW INDICATOR

## DESCRIPTION

A coolant low indicator is only found in the instrument clusters of vehicles equipped with an optional diesel engine. The coolant low indicator is located

## COOLANT LOW INDICATOR (Continued)

above the fuel gauge and to the left of the tachometer in the instrument cluster. The coolant low indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Low Engine Coolant" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The coolant low indicator is serviced as a unit with the instrument cluster.

## OPERATION

The coolant low indicator gives an indication to the vehicle operator when the diesel engine coolant level is low. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and a hard wired input received by the cluster from the engine coolant level switch. The coolant low indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the coolant low indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the coolant low indicator is illuminated for about three seconds as a bulb test.

- **Engine Coolant Level Switch Input** - Each time the cluster detects ground on the low coolant fluid level sense circuit (engine coolant level switch closed = engine coolant level low) the cluster applies an algorithm to confirm that the input is correct and not the result of coolant sloshing in the coolant bottle. The cluster tests the status of the circuit about seven milliseconds after ignition On, and about once every second thereafter, then uses an internal counter to count up or down. When the counter accumulates thirty ground inputs on the circuit, the coolant low indicator will be illuminated. The indicator remains illuminated until the low coolant fluid level sense input to the cluster is an open circuit (engine coolant level switch open = engine coolant level full), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Engine Coolant Level Switch Input Fault** - The engine coolant level switch also features a 3.3 kilohm diagnostic resistor connected in parallel between the switch input and output to provide the cluster with verification that the low coolant fluid level sense circuit is not open or shorted. If the cluster does not see a proper input on the low coolant fluid level sense circuit, it will suspend coolant low indicator operation. The indicator operation remains suspended until the low coolant fluid level sense circuit fault is resolved.

- **Actuator Test** - Each time the cluster is put through the actuator test, the coolant low indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The engine coolant level switch on the coolant bottle provides a hard wired ground input to the instrument cluster circuitry through the low coolant fluid level sense circuit whenever the level of the coolant in the bottle is low. For further diagnosis of the coolant low indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the engine coolant level switch input to the instrument cluster that control the coolant low indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## CRUISE INDICATOR

## DESCRIPTION

A cruise indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional speed control system. The cruise indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The cruise indicator consists of a stencil-like cutout of the word "CRUISE" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A green Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "CRUISE" text to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the cruise indicator is dimmable, which is adjusted using the panel lamps dimmer control ring on the left control stalk of the multi-function switch. The cruise indicator is serviced as a unit with the instrument cluster.

## CRUISE INDICATOR (Continued)

**OPERATION**

The cruise indicator gives an indication to the vehicle operator when the speed control system is turned On, regardless of whether the speed control is engaged. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The cruise indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the cruise indicator for the following reasons:

- **Cruise Lamp-On Message** - Each time the cluster receives a cruise lamp-on message from the PCM indicating the speed control system has been turned On, the cruise indicator is illuminated. The indicator remains illuminated until the cluster receives a cruise lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the cruise indicator will be turned on, then off again during the bulb check portion of the test in order to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the speed control switches to determine the proper outputs to the speed control servo. The PCM then sends the proper cruise indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the cruise indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the speed control system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the cruise indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

**DOOR AJAR INDICATOR****DESCRIPTION**

A door ajar indicator is standard equipment on all instrument clusters. The door ajar indicator consists of the word "door", which appears in place of the odometer/trip odometer information in the Vacuum-

Fluorescent Display (VFD) of the instrument cluster. The VFD is part of the cluster electronic circuit board, and is visible through a cutout located near the lower edge of the speedometer dial face in the instrument cluster. The dark outer layer of the overlay prevents the VFD from being clearly visible when it is not illuminated. The word "door" appears in the same blue-green color and at the same lighting level as the odometer/trip odometer information through the translucent outer layer of the overlay when it is illuminated by the instrument cluster electronic circuit board. The door ajar indicator is serviced as a unit with the instrument cluster.

**OPERATION**

The door ajar indicator gives an indication to the vehicle operator that one or more of the passenger compartment doors may be open or not completely latched. This indicator is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus. The door ajar indicator function of the Vacuum Fluorescent Display (VFD) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the VFD door ajar indication will always be off when the ignition switch is in any position except On or Start. The instrument cluster will turn on the door ajar indicator for the following reasons:

- **Door Ajar Lamp-On Message** - Each time the cluster receives a door ajar lamp-on message from the BCM indicating that a door is open or not completely latched, the door ajar indicator will be illuminated. If the vehicle is not moving when the door ajar lamp-on message is received, the VFD will repeatedly and sequentially cycle its indication in two second intervals with the odometer/trip odometer information, the door ajar warning, and any other active warnings including: gate ajar, glass ajar, and low washer fluid. If the vehicle is moving, or once the cluster of a non-moving vehicle receives an electronic vehicle speed message from the Powertrain Control Module (PCM) indicating a speed greater than zero, the warning sequence will consist of three complete display cycles, then revert to only the odometer/trip odometer display until the door ajar switch is cycled. The door ajar indicator will also be extinguished when the cluster receives a door ajar lamp-off message from the BCM, or if the ignition switch is turned to the Off position, whichever occurs first.

## DOOR AJAR INDICATOR (Continued)

The BCM continually monitors the door ajar switches that are integral to each door latch to determine the status of the doors. The BCM then sends the proper door ajar lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the door ajar indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the door ajar switches and circuits, the BCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the door ajar indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## ENGINE TEMPERATURE GAUGE

### DESCRIPTION

An engine coolant temperature gauge is standard equipment on all instrument clusters. The engine coolant temperature gauge is located in the right lower corner of the instrument cluster, to the right of the speedometer. The engine coolant temperature gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from "C" (or Cold) to "H" (or Hot) for all engines. An International Control and Display Symbol icon for "Engine Coolant Temperature" is located on the cluster overlay, in the center of the gauge directly above the hub of the gauge needle. The engine coolant temperature gauge graphics are dark blue and black against a beige field, except for a single light blue graduation at the far left (Cold) end of the gauge scale and a single red graduation at the far right (Hot) end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the blue graphics appear blue and the red graphics appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The engine coolant temperature gauge is serviced as a unit with the instrument cluster.

### OPERATION

The engine coolant temperature gauge gives an indication to the vehicle operator of the engine coolant temperature. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by

the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The engine coolant temperature gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Temperature Normal Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is within the normal operating range [up to about 124° C (255° F) for gasoline engines, or about 110° C (230° F) for diesel engines], the gauge needle is moved to the relative temperature position of the gauge scale.

- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is high [above about 127° C (260° F) for gasoline engines, or 112° C (233° F) for diesel engines], the gauge needle is moved into the center of the red warning zone on the gauge scale.

- **Engine Temperature Critical Message** - Each time the cluster receives a message from the PCM indicating the engine coolant temperature is critical [above about 132° C (269° F) for gasoline engines, or 115° C (239° F) for diesel engines], the gauge needle is moved to the high end of the red warning zone on the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to the gauge calibration points on the gauge scale in sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the engine coolant temperature sensor to determine the engine operating temperature. The PCM then sends the proper engine coolant temperature messages to the instrument cluster. For further diagnosis of the engine coolant temperature gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster moves the engine coolant temperature gauge needle to indicate a high or critical engine temperature, it may indicate that the engine or the engine cooling system requires service. For proper diagnosis of the engine coolant temperature sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the engine coolant temperature

## ENGINE TEMPERATURE GAUGE (Continued)

gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## FRONT FOG LAMP INDICATOR

## DESCRIPTION

A front fog lamp indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional front fog lamps. The front fog lamp indicator is located above the engine temperature gauge and to the right of the speedometer in the instrument cluster. The front fog lamp indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Front Fog Light” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A green Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the front fog lamp indicator is dimmable, which is adjusted using the panel lamps dimmer control ring on the left control stalk of the multi-function switch. The front fog lamp indicator is serviced as a unit with the instrument cluster.

## OPERATION

The front fog lamp indicator gives an indication to the vehicle operator whenever the front fog lamps are illuminated. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus. The front fog lamp indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the front fog lamp indicator for the following reasons:

- **Front Fog Lamp-On Message** - Each time the cluster receives a front fog lamp-on message from the BCM indicating the front fog lamps are turned On, the front fog lamp indicator will be illuminated. The

indicator remains illuminated until the cluster receives a front fog lamp-off message from the BCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the front fog lamp indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The BCM continually monitors the exterior lighting (multi-function) switch to determine the proper outputs to the front fog lamp relay. The BCM then sends the proper front fog lamp indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the front fog lamp indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the front fog lamp system, the BCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the front fog lamp indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## FUEL GAUGE

## DESCRIPTION

A fuel gauge is standard equipment on all instrument clusters. The fuel gauge is located in the left lower corner of the instrument cluster, to the left of the tachometer. The fuel gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from E (or Empty) to F (or Full). An International Control and Display Symbol icon for “Fuel” is located on the cluster overlay, in the center of the gauge directly above the hub of the gauge needle. An arrowhead pointed to the left side of the vehicle is imprinted on the cluster overlay next to the “Fuel” icon in the fuel gauge to provide the driver with a reminder as to the location of the fuel filler access. The fuel gauge graphics are dark blue and black against a beige field, except for a single red graduation at the far left (Empty) end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the blue graphics appear blue and the red graphics appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The fuel gauge is serviced as a unit with the instrument cluster.

## FUEL GAUGE (Continued)

**OPERATION**

The fuel gauge gives an indication to the vehicle operator of the level of fuel in the fuel tank. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The fuel gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full, the cluster moves the gauge needle to the relative fuel level position on the gauge scale. The PCM applies an algorithm to the input from the fuel tank sender to dampen gauge needle movement against the negative effect that fuel sloshing within the fuel tank can have on accurate inputs to the PCM.

- **Less Than 12.5 Percent Tank Full Message** - Each time the cluster receives messages from the PCM indicating the percent tank full is less than 12.5 (one-eighth), the gauge needle is moved to the proper position on the gauge scale and the low fuel indicator is illuminated. The low fuel indicator remains illuminated until the cluster receives messages from the PCM indicating that the percent tank full is greater than 12.5 (one-eighth), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Less Than Empty Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full is less than empty, the gauge needle is moved to the far left (low) end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is a short circuit.

- **More Than Full Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full is more than full, the gauge needle is moved to the far left (low) end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is an open circuit.

- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be

swept to the gauge calibration points on the gauge scale in sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the fuel tank sender input to determine the fuel level. The PCM then applies an algorithm to the input and sends the proper percent tank full messages to the instrument cluster. For further diagnosis of the fuel gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sender, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the fuel gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

**GATE AJAR INDICATOR****DESCRIPTION**

A gate ajar indicator is standard equipment on all instrument clusters. The gate ajar indicator consists of the word "gate", which appears in place of the odometer/trip odometer information in the Vacuum-Fluorescent Display (VFD) of the instrument cluster. The VFD is part of the cluster electronic circuit board, and is visible through a cutout located near the lower edge of the speedometer dial face in the instrument cluster. The dark outer layer of the overlay prevents the VFD from being clearly visible when it is not illuminated. The word "gate" appears in the same blue-green color and at the same lighting level as the odometer/trip odometer information through the translucent outer layer of the overlay when it is illuminated by the instrument cluster electronic circuit board. The gate ajar indicator is serviced as a unit with the instrument cluster.

**OPERATION**

The gate ajar indicator gives an indication to the vehicle operator that the rear tailgate may be open or not completely latched. This indicator is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus. The gate ajar indicator function of the Vacuum Fluorescent Display (VFD) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the VFD gate ajar indicator will always be off when the ignition switch is in any position except On or Start. The

## GATE AJAR INDICATOR (Continued)

instrument cluster will turn on the gate ajar indicator for the following reasons:

- **Gate Ajar Lamp-On Message** - Each time the cluster receives a gate ajar lamp-on message from the BCM indicating that the rear tailgate is open or not completely latched, the gate ajar indicator will be illuminated. If the vehicle is not moving when the gate ajar lamp-on message is received, the VFD will repeatedly and sequentially cycle its indication in two second intervals with the odometer/trip odometer information, the gate ajar warning, and any other active warnings including: door ajar, glass ajar, and low washer fluid. If the vehicle is moving, or once the cluster of a non-moving vehicle receives an electronic vehicle speed message from the Powertrain Control Module (PCM) indicating a speed greater than zero, the warning sequence will consist of three complete display cycles, then revert to only the odometer/trip odometer display until the tailgate ajar switch is cycled. The gate ajar indicator will also be extinguished when the cluster receives a gate ajar lamp-off message from the BCM, or if the ignition switch is turned to the Off position, whichever occurs first.

The BCM continually monitors the tailgate ajar switch that is integral to the tailgate latch to determine the status of the rear tailgate. The BCM then sends the proper gate ajar lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the gate ajar indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the tailgate ajar switch and circuit, the BCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the gate ajar indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## GLASS AJAR INDICATOR

### DESCRIPTION

A glass ajar indicator is standard equipment on all instrument clusters. The glass ajar indicator consists of the word "glass", which appears in place of the odometer/trip odometer information in the Vacuum-Fluorescent Display (VFD) of the instrument cluster. The VFD is part of the cluster electronic circuit board, and is visible through a cutout located near the lower edge of the speedometer dial face in the instrument cluster. The dark outer layer of the overlay prevents the VFD from being clearly visible when it is not illuminated. The word "glass" appears in the same blue-green color and at the same lighting level as the odometer/trip odometer information through the translucent outer layer of the overlay when it is

illuminated by the instrument cluster electronic circuit board. The glass ajar indicator is serviced as a unit with the instrument cluster.

### OPERATION

The glass ajar indicator gives an indication to the vehicle operator that the rear flip-up glass may be open or not completely latched. This indicator is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus. The glass ajar indicator function of the Vacuum Fluorescent Display (VFD) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the VFD glass ajar indicator will always be off when the ignition switch is in any position except On or Start. The instrument cluster will turn on the glass ajar indicator for the following reasons:

- **Glass Ajar Lamp-On Message** - Each time the cluster receives a glass ajar lamp-on message from the BCM indicating that the rear flip-up glass is open or not completely latched, the glass ajar indicator will be illuminated. If the vehicle is not moving when the glass ajar lamp-on message is received, the VFD will repeatedly and sequentially cycle its indication in two second intervals with the odometer/trip odometer information, the glass ajar warning, and any other active warnings including: door ajar, gate ajar, and low washer fluid. If the vehicle is moving, or once the cluster of a non-moving vehicle receives an electronic vehicle speed message from the Powertrain Control Module (PCM) indicating a speed greater than zero, the warning sequence will consist of three complete display cycles, then revert to only the odometer/trip odometer display until the glass ajar switch is cycled. The glass ajar indicator will also be extinguished when the cluster receives a glass ajar lamp-off message from the BCM, or if the ignition switch is turned to the Off position, whichever occurs first.

The BCM continually monitors the glass ajar switch that is integral to the flip-up glass latch to determine the status of the rear flip-up glass. The BCM then sends the proper glass ajar lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the glass ajar indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the glass ajar switch and circuit, the BCM, the PCI data bus, or the electronic mes-



## GLASS AJAR INDICATOR (Continued)

sage inputs to the instrument cluster that control the glass ajar indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## HIGH BEAM INDICATOR

### DESCRIPTION

A high beam indicator lamp is standard equipment on all instrument clusters. The high beam indicator is located near the upper edge of the instrument cluster overlay, between the tachometer and the speedometer. The high beam indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "High Beam" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when the it is not illuminated. A blue Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in blue through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The high beam indicator is serviced as a unit with the instrument cluster.

### OPERATION

The high beam indicator gives an indication to the vehicle operator whenever the headlamp high beams are illuminated. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus. The high beam indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the high beam indicator for the following reasons:

- **High Beam Headlamps-On Message** - Each time the cluster receives a high beam headlamps-on message from the BCM indicating the headlamp high beams are turned On, the high beam indicator will be illuminated. The indicator remains illuminated until the cluster receives a high beam headlamps-off message from the BCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the high beam indicator will be turned on, then off again during the bulb

check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The BCM continually monitors the exterior lighting (multi-function) switch to determine the proper outputs to the headlamp low beam and high beam relays. The BCM then sends the proper high beam indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the high beam indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the headlamp system, the BCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the high beam indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## LOW FUEL INDICATOR

### DESCRIPTION

A low fuel indicator is standard equipment on all instrument clusters. The low fuel indicator is located above the fuel gauge and to the left of the tachometer in the instrument cluster. The low fuel indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Fuel" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The low fuel indicator is serviced as a unit with the instrument cluster.

### OPERATION

The low fuel indicator gives an indication to the vehicle operator when the level of fuel in the fuel tank becomes low. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The low fuel indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates

## LOW FUEL INDICATOR (Continued)

when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the low fuel indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the low fuel indicator is illuminated for about three seconds as a bulb test.

- **Less Than 12.5 Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating that the percent tank full is less than 12.5 (one-eighth), the low fuel indicator is illuminated. The indicator remains illuminated until the cluster receives messages from the PCM indicating that the percent tank full has increased to greater than 12.5 (one-eighth). The PCM applies an algorithm to the input from the fuel tank sender to dampen the illumination of the low fuel indicator against the negative effect that fuel sloshing within the fuel tank can have on accurate inputs to the PCM.

- **Less Than Empty Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full is less than empty, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is a short circuit.

- **More Than Full Percent Tank Full Message** - Each time the cluster receives a message from the PCM indicating the percent tank full is more than full, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM is an open circuit.

- **Communication Error** - If the cluster fails to receive a percent tank full message for more than about twelve seconds, the cluster control circuitry will illuminate the low fuel indicator until a new percent tank full message is received, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the low fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the fuel tank sender input to determine the fuel level. The PCM then applies an algorithm to the input and sends the proper percent tank full messages to the instrument cluster. For further diagnosis of the low fuel indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sender, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the low fuel indi-

cator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## LOW OIL PRESSURE INDICATOR

## DESCRIPTION

A low oil pressure indicator is standard equipment on all instrument clusters. The low oil pressure indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The low oil pressure indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Engine Oil" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The low oil pressure indicator is serviced as a unit with the instrument cluster.

## OPERATION

The low oil pressure indicator gives an indication to the vehicle operator when the engine oil pressure is low. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The low oil pressure indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the low oil pressure indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the low oil pressure indicator is illuminated as a bulb test. The indicator will remain illuminated until the engine is started (engine speed is greater than 450 rpm), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Engine Oil Pressure Low Message** - Once the engine has been started (engine speed has been greater than 450 rpm), each time the cluster receives

## LOW OIL PRESSURE INDICATOR (Continued)

three consecutive messages from the PCM indicating that the engine oil pressure is about 4 kPa or lower (about 0.6 psi or lower), the low oil pressure indicator is illuminated. The indicator remains illuminated until the cluster receives a single message from the PCM indicating that the engine oil pressure is about 76 kPa or higher (about 11 psi or higher), or until the ignition switch is turned to the Off position, whichever occurs first. Once the cluster monitors and engine speed of greater than 450 rpm, the cluster logic will ignore engine speed in determining low oil pressure indicator operation for the remainder of the current ignition cycle.

- **Actuator Test** - Each time the cluster is put through the actuator test, the low oil pressure indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the engine oil pressure sensor to determine the engine oil pressure. The PCM then sends the proper engine oil pressure messages to the instrument cluster. For further diagnosis of the low oil pressure indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the indicator after the bulb test, it may indicate that the engine or the engine oiling system requires service. For proper diagnosis of the engine oil pressure sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the low oil pressure indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## MALFUNCTION INDICATOR LAMP (MIL)

### DESCRIPTION

A Malfunction Indicator Lamp (MIL) is standard equipment on all instrument clusters. The MIL is located above the coolant temperature gauge and to the right of the speedometer in the instrument cluster. The MIL consists of a stencil-like cutout of the International Control and Display Symbol icon for "Engine" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit

board. The MIL is serviced as a unit with the instrument cluster.

### OPERATION

The Malfunction Indicator Lamp (MIL) gives an indication to the vehicle operator 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. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the PCM over the Programmable Communications Interface (PCI) data bus. The MIL Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the MIL for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the MIL is illuminated for about seven seconds as a bulb test.

- **PCM Lamp-On Message** - Each time the cluster receives a malfunction indicator lamp-on message from the PCM, the indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM message. For some DTC's, if a problem does not recur, the PCM will send a lamp-off message automatically. Other DTC's may require that a fault be repaired and the PCM be reset before a lamp-off message will be sent. For more information on the PCM and the DTC set and reset parameters, (Refer to 25 - EMISSIONS CONTROL - OPERATION).

- **Communication Error** - If the cluster receives no malfunction indicator lamp-on or lamp-off message from the PCM for twenty consecutive seconds, the MIL is illuminated by the instrument cluster. The indicator remains controlled and illuminated by the cluster until a valid malfunction indicator lamp-on or lamp-off message is received from the PCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the MIL will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors each of the many fuel and emissions system circuits and sensors to decide whether the system is in good operating con-

## MALFUNCTION INDICATOR LAMP (MIL) (Continued)

dition. The PCM then sends the proper malfunction indicator lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the MIL or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the MIL after the bulb test, it may indicate that a malfunction has occurred and that the fuel and emissions system may require service. For proper diagnosis of the fuel and emissions systems, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the MIL, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## ODOMETER

## DESCRIPTION

An odometer and trip odometer are standard equipment in all instrument clusters. The odometer and trip odometer information are displayed in a common electronic, blue-green Vacuum Fluorescent Display (VFD), which is located in the lower edge of the speedometer dial face in the instrument cluster and, when illuminated, is visible through a small window cutout in the cluster overlay. However, the odometer and trip odometer information are not displayed simultaneously. The trip odometer reset switch on the instrument cluster electronic circuit board toggles the display between odometer and trip odometer modes by depressing the odometer/trip odometer switch knob that extends through the lower edge of the cluster lens, just right of the odometer VFD. Both the odometer and trip odometer information is stored in the instrument cluster memory.

All odometer and trip odometer distance information is stored in the instrument cluster. This distance information can be increased when the proper inputs are provided to the instrument cluster, but the distance information cannot be decreased. The odometer can display values up to 864,004 kilometers (536,870 miles). The odometer will not roll over, but will latch at the maximum value. The trip odometer can display values up to 9999.9 kilometers (9999.9 miles) before it rolls over to zero. The odometer display does not have a decimal point and will not show values less than a full unit (kilometer or mile), the trip odometer display does have a decimal point and will show tenths of a unit (kilometer or mile). When the trip odometer is active, the word "TRIP" will also illuminate near the bottom of the VFD. The unit of measure for the odometer and trip odometer display is not shown in the VFD. If the instrument cluster has a kilometers-per-hour primary speedometer scale, the odometer/trip odometer registers kilome-

ters; and if the cluster features a miles-per-hour primary speedometer scale, the odometer/trip odometer registers miles. In this instrument cluster, the odometer/trip odometer VFD is also used to display certain warning messages and diagnostic information.

The odometer/trip odometer has a "Rental Car" mode, which will illuminate the odometer information in the VFD whenever the driver side front door is opened with the ignition switch in the Off or Accessory positions. During daylight hours (exterior lamps Off) the VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the instrument cluster converts an electronic dimming level message received from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus to a digital dimming level signal for controlling the lighting level of the VFD. However, a "Parade" mode position of the panel lamps dimmer control ring on the multi-function switch left control stalk allows the VFD to be illuminated at full brightness if the exterior lamps are turned On during daylight hours.

The VFD, the trip odometer switch, and the trip odometer switch button are serviced as a unit with the instrument cluster.

## OPERATION

The odometer and trip odometer give an indication to the vehicle operator of the distance the vehicle has traveled. This gauge is controlled by the instrument cluster electronic circuitry based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The odometer and trip odometer information is displayed by the instrument cluster Vacuum Fluorescent Display (VFD). The VFD will display the odometer information whenever the driver side front door is opened with the ignition switch in the Off or Accessory positions, and will display the last previously selected odometer or trip odometer information when the ignition switch is in the On or Start positions. The instrument cluster circuitry controls the VFD and provides the following features:

- **Odometer/Trip Odometer Display Toggling** - Actuating the trip odometer reset switch momentarily with the VFD illuminated will toggle the display between the odometer and trip odometer information. Each time the VFD is illuminated with the ignition switch in the On or Start positions, the display will automatically return to the last mode previously selected (odometer or trip odometer).
- **Trip Odometer Reset** - When the trip odometer reset switch is pressed and held for longer than about two seconds with the ignitions switch in the

## ODOMETER (Continued)

On or Start positions, the trip odometer will be reset to 0.0 kilometers (miles). The VFD must be displaying the trip odometer information in order for the trip odometer information to be reset.

• **Warning Display** - The odometer or trip odometer information will be toggled at two second intervals with a warning display when certain monitored conditions are active. If multiple conditions are active, the VFD will toggle each active warning and the odometer/trip odometer information at two second intervals. Once the vehicle is moving and a vehicle speed input is received by the instrument cluster, each active warning will be displayed for three two-second intervals before the VFD reverts to displaying only the selected odometer or trip odometer information. The warnings and monitored conditions include:

- **“door”** - A door is open or not fully latched.
- **“gate”** - The tailgate is open or not fully latched.
- **“glass”** - The rear flip-up glass is open or not fully latched.
- **“lowash”** - The fluid level in the washer reservoir is low.
- **“no bus”** - The instrument cluster can detect no PCI bus communication. This message is illuminated solid when there is no PCI bus communication, and will override the display of all other active warning displays.

• **Communication Error** - If the cluster fails to receive a distance message during normal operation, it will hold and display the last data received until the ignition switch is turned to the Off position. If the cluster does not receive a distance message within one second after the ignition switch is turned to the On position, it will display the last distance message stored in the cluster memory. If the cluster is unable to display distance information due to an error internal to the cluster, “error” will be displayed in the VFD.

• **Actuator Test** - Each time the cluster is put through the actuator test, the VFD will step sequentially through a display of “111111” through “999999”, then display the cluster software version number to confirm the functionality of the VFD and the cluster control circuitry.

The PCM continually monitors the vehicle speed pulse information received from the Body Control Module (BCM), then sends the proper distance messages to the instrument cluster. For further diagnosis of the odometer/trip odometer or the instrument cluster circuitry that controls these functions, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the BCM, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the odometer/trip

odometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## OVERDRIVE OFF INDICATOR

## DESCRIPTION

An overdrive off indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional overdrive automatic transmission. The overdrive off indicator is located above the fuel gauge and to the left of the tachometer in the instrument cluster. The overdrive off indicator consists of a stencil-like cutout of the text “O/D OFF” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “O/D OFF” text to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the overdrive off indicator is dimmable, which is adjusted using the panel lamps dimmer control ring on the left control stalk of the multi-function switch. The overdrive off indicator is serviced as a unit with the instrument cluster.

## OPERATION

The overdrive off indicator gives an indication to the vehicle operator when the Off position of the overdrive off switch has been selected, disabling the electronically controlled overdrive feature of the automatic transmission. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The overdrive off indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the overdrive off indicator for the following reasons:

• **Overdrive Off Lamp-On Message** - Each time the cluster receives an overdrive off lamp-on message

## OVERDRIVE OFF INDICATOR (Continued)

from the PCM indicating that the Off position of the overdrive off switch has been selected, the overdrive off indicator will be illuminated. The indicator remains illuminated until the cluster receives an overdrive off lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the overdrive off indicator will be turned on, then off again during the bulb check portion of the test in order to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the overdrive off switch to determine the proper outputs to the automatic transmission. The PCM then sends the proper overdrive off lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the overdrive off indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the overdrive control system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the overdrive off indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## REAR FOG LAMP INDICATOR

### DESCRIPTION

A rear fog lamp indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional rear fog lamps, which are available only in certain markets where they are required. The rear fog lamp indicator is located above the engine temperature gauge and to the right of the speedometer in the instrument cluster. The rear fog lamp indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Rear Fog Light" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the rear fog lamp indicator is dimmable, which is adjusted using the panel lamps dimmer control ring on the left control stalk of the multi-function switch. The rear fog lamp indicator is serviced as a unit with the instrument cluster.

### OPERATION

The rear fog lamp indicator gives an indication to the vehicle operator whenever the rear fog lamps are illuminated. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus. The rear fog lamp indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the rear fog lamp indicator for the following reasons:

- **Rear Fog Lamp-On Message** - Each time the cluster receives a rear fog lamp-on message from the BCM indicating the rear fog lamps are turned On, the rear fog lamp indicator will be illuminated. The indicator remains illuminated until the cluster receives a rear fog lamp-off message from the BCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the rear fog lamp indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The BCM continually monitors the exterior lighting (multi-function) switch to determine the proper outputs to the rear fog lamp relay. The BCM then sends the proper rear fog lamp indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the rear fog lamp indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the rear fog lamp system, the BCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the rear fog lamp indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## SEATBELT INDICATOR

### DESCRIPTION

A seatbelt indicator is standard equipment on all instrument clusters. The seatbelt indicator is located above the fuel gauge and to the right of the tachometer in the instrument cluster. The seatbelt indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Seat Belt" in the opaque layer of the instrument cluster overlay.

## SEATBELT INDICATOR (Continued)

The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The seatbelt indicator is serviced as a unit with the instrument cluster.

**OPERATION**

The seatbelt indicator gives an indication to the vehicle operator of the status of the driver side front seatbelt. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Airbag Control Module (ACM) over the Programmable Communications Interface (PCI) data bus. The seatbelt indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the seatbelt indicator for the following reasons:

- **Seatbelt Reminder Function** - Each time the cluster receives a battery current input on the fused ignition switch output (run-start) circuit, the indicator will be illuminated as a seatbelt reminder for about seven seconds, or until the ignition switch is turned to the Off position, whichever occurs first. This reminder function will occur regardless of the status of the electronic seat belt lamp-on or lamp-off messages received by the cluster from the ACM.

- **Seat Belt Lamp-On Message** - Following the seatbelt reminder function, each time the cluster receives a seat belt lamp-on message from the ACM indicating the driver side front seat belt is not fastened with the ignition switch in the Start or On positions, the indicator will be illuminated. The seatbelt indicator remains illuminated until the cluster receives a seat belt lamp-off message, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the seatbelt indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The ACM continually monitors the status of both front seat belt switches to determine the proper airbag system response to a frontal impact of the vehicle. The ACM then sends the proper seatbelt indicator lamp-on and lamp-off messages to the instrument cluster based upon the status of the driver side front seat belt switch input. For further diagnosis of the seatbelt indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the seatbelt switches, the ACM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the seatbelt indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

**SECURITY INDICATOR****DESCRIPTION**

A security indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional Vehicle Theft Security System (VTSS). The security indicator is located near the lower edge of the instrument cluster below the tachometer and to the right of the fuel gauge. The security indicator consists of a small stencil-like round cutout in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the indicator to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The security indicator is serviced as a unit with the instrument cluster.

**OPERATION**

The security indicator gives an indication to the vehicle operator when the Vehicle Theft Alarm (VTA) portion of the Vehicle Theft Security System (VTSS) is arming or is armed. This indicator is controlled on the instrument cluster circuit board based upon a hard wired input to the cluster from the Body Control Module (BCM) on the VTSS indicator driver circuit. The security indicator Light Emitting Diode (LED) receives battery current on the instrument cluster electronic circuit board through the fused B(+) circuit at all times; therefore, the LED will remain functional regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the BCM. The security

## SECURITY INDICATOR (Continued)

indicator will be illuminated for the following reasons:

- **VTSS Indication** - During the sixteen second VTA pre-arming function, the BCM will flash the security indicator on and off repeatedly at a steady, fast rate to indicate that the VTA is in the process of arming. Following successful VTA arming, the BCM flashes the security indicator on and off continuously at a slower rate to indicate that the VTA is armed. The security indicator continues flashing at the slower rate until the VTA is disarmed.

The BCM provides a hard wired ground input to the instrument cluster circuitry through the VTSS indicator driver circuit whenever the ignition switch is in the Off position and the VTA is arming, armed, or triggered. The VTSS indicator driver circuit between the BCM and the instrument cluster can be diagnosed using conventional diagnostic tools and methods. However, for proper diagnosis of the VTA and the BCM, or the hard wired inputs to the instrument cluster that control the security indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## SHIFT INDICATOR (TRANSFER CASE)

## DESCRIPTION

## DESCRIPTION - PART TIME INDICATOR

A part time indicator is standard equipment on all instrument clusters. The part time indicator is located near the lower edge of the tachometer dial face in the instrument cluster. The part time indicator consists of a stencil-like cutout of the words "PART TIME" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "PART TIME" text to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the part time indicator is dimmable, which is adjusted using the panel lamps dimmer control ring on the left control stalk of the multi-function switch. The part time indicator is serviced as a unit with the instrument cluster.

## DESCRIPTION - FULL TIME INDICATOR

A full time indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with the optional Selec-Trac four-wheel drive system. The full time indicator is located near the lower edge of the tachometer dial face in the instrument cluster. The full time indicator consists of a stencil-like cutout of the words "FULL TIME" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A green Light Emitting Diode (LED) behind the cutout in the opaque layer of the cluster overlay causes the "FULL TIME" text to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. When the exterior lighting is turned On, the illumination intensity of the full time indicator is dimmable, which is adjusted using the panel lamps dimmer control ring on the left control stalk of the multi-function switch. The full time indicator is serviced as a unit with the instrument cluster.

## DESCRIPTION - FOUR LOW MODE INDICATOR

A four low mode indicator is standard equipment on all instrument clusters. The four low mode indicator is located above the coolant temperature gauge and to the right of the speedometer in the instrument cluster. The four low mode indicator consists of a stencil-like cutout of the words "4 LO MODE" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "4 LO MODE" text to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The four low mode indicator is serviced as a unit with the instrument cluster.

## OPERATION

## OPERATION - PART TIME INDICATOR

The part time indicator gives an indication to the vehicle operator that a four-wheel drive part time operating mode of the transfer case is selected. On vehicles equipped with the standard Command-Trac four-wheel drive system, the part time indicator lights when the transfer case is engaged in the 4H or 4L positions. On vehicles equipped with the optional Selec-Trac four-wheel drive system, the part time



## SHIFT INDICATOR (TRANSFER CASE) (Continued)

indicator lights when the transfer case is engaged in the 4 X 4 Part Time position. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The instrument cluster must be configured for the type of transfer case in the vehicle using a DRBIII® scan tool in order to provide proper operation of the part time indicator. The part time indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the part time indicator for the following reasons:

- **Part Time Lamp-On Message** - Each time the cluster receives a part time lamp-on message from the PCM indicating that a four-wheel drive part time position of the transfer case has been selected, the part time indicator will be illuminated. The indicator remains illuminated until the cluster receives a part time lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the part time indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the transfer case switch to determine the driveline operating mode. The PCM then sends the proper part time lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the part time indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transfer case switch, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the part time indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## OPERATION - FULL TIME INDICATOR

The full time indicator gives an indication to the vehicle operator that a four-wheel drive full time operating mode of the transfer case is selected. On vehicles equipped with the optional Selec-Trac four-

wheel drive system, the full time indicator lights when the transfer case is engaged in the 4 X 4 Full Time position. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The instrument cluster must be configured for the type of transfer case in the vehicle using a DRBIII® scan tool in order to provide proper operation of the full time indicator. The full time indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the full time indicator for the following reasons:

- **Full Time Lamp-On Message** - Each time the cluster receives a full time lamp-on message from the PCM indicating that a four-wheel drive full time position of the transfer case has been selected, the full time indicator will be illuminated. The indicator remains illuminated until the cluster receives a full time lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the full time indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the transfer case switch to determine the driveline operating mode. The PCM then sends the proper full time lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the full time indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transfer case switch, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the full time indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## OPERATION - FOUR LOW MODE INDICATOR

The four low mode indicator gives an indication to the vehicle operator that a four-wheel drive low operating mode of the transfer case is selected. On vehicles equipped with the standard Command-Trac four-

## SHIFT INDICATOR (TRANSFER CASE) (Continued)

wheel drive system, the four low mode indicator lights when the transfer case is engaged in the 4L position. On vehicles equipped with the optional Selec-Trac four-wheel drive system, the four low mode indicator lights when the transfer case is engaged in the 4 Lo position. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The instrument cluster must be configured for the type of transfer case in the vehicle using a DRBIII® scan tool in order to provide proper operation of the four low mode indicator. The four low mode indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the four low mode indicator for the following reasons:

- **Four Low Mode Lamp-On Message** - Each time the cluster receives a four low mode lamp-on message from the PCM indicating that a four-wheel drive low position of the transfer case has been selected, the four low mode indicator will be illuminated. The indicator remains illuminated until the cluster receives a four low mode lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the four low mode indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the transfer case switch to determine the driveline operating mode. The PCM then sends the proper four low mode lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the four low mode indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transfer case switch, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the four low mode indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## SKIS INDICATOR

## DESCRIPTION

A Sentry Key Immobilizer System (SKIS) indicator is standard equipment on all instrument clusters, but is only operational on vehicles equipped with the optional SKIS. The SKIS indicator is located above the fuel gauge and to the left of the tachometer in the instrument cluster. The SKIS indicator consists of a stencil-like cutout of a graphical representation or icon of a key that is circled and crossed-out in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the indicator to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The SKIS indicator is serviced as a unit with the instrument cluster.

## OPERATION

The Sentry Key Immobilizer System (SKIS) indicator gives an indication to the vehicle operator of the status of the SKIS. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Sentry Key Immobilizer Module (SKIM) over the Programmable Communications Interface (PCI) data bus. The SKIS indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is switched to ground by the instrument cluster transistor. The instrument cluster will turn on the SKIS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position, the SKIM tells the cluster to illuminate the SKIS indicator for about three seconds as a bulb test.

- **SKIS Lamp-On Message** - Each time the cluster receives a SKIS lamp-on message from the SKIM, the SKIS indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the SKIM message. For more information on the SKIS and the SKIS indicator control parameters, (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - OPERATION). The indicator remains illuminated until the cluster receives a SKIS lamp-off

## SKIS INDICATOR (Continued)

message from the SKIM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Communication Error** - If the cluster receives no SKIS lamp-on or lamp-off messages from the SKIM for twenty consecutive seconds, the SKIS indicator is illuminated by the instrument cluster. The indicator remains controlled and illuminated by the cluster until a valid SKIS lamp-on or lamp-off message is received from the SKIM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the SKIS indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The SKIM performs a self-test each time the ignition switch is turned to the On position to decide whether the system is in good operating condition and whether a valid key is present in the ignition lock cylinder. The SKIM then sends the proper SKIS lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the SKIS indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster flashes the SKIS indicator upon ignition On, or turns on the SKIS indicator solid after the bulb test, it indicates that a SKIS malfunction has occurred or that the SKIS is inoperative. For proper diagnosis of the SKIS, the PCI data bus, or the electronic message inputs to the instrument cluster that control the SKIS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## SPEEDOMETER

## DESCRIPTION

A speedometer is standard equipment on all instrument clusters. The speedometer is located to the right of the tachometer in the instrument cluster. The speedometer consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry, and a fixed 255 degree primary scale on the gauge dial face that reads left-to-right either from 0 to 120 mph, or from 0 to 240 km/h, depending upon the market for which the vehicle is manufactured. Most models also have a smaller secondary inner scale on the gauge dial face that provides the equivalent opposite measurement units from the primary scale. Text appearing on the cluster overlay just below the hub of the speedometer needle abbreviates the unit of measure for the primary scale first (i.e.: MPH or km/h), followed by the unit of measure for the secondary scale (i.e.: MPH or km/h). The speedometer graphics are dark blue (primary scale) and

light blue (secondary scale) against a beige field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, both the dark blue and light blue graphics retain their blue colors. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The speedometer is serviced as a unit with the instrument cluster.

## OPERATION

The speedometer gives an indication to the vehicle operator of the vehicle road speed. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The speedometer is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Vehicle Speed Message** - Each time the cluster receives a vehicle speed message from the PCM it will calculate the correct vehicle speed reading and position the gauge needle at that speed position on the gauge scale. The cluster will receive a new vehicle speed message and reposition the gauge pointer accordingly about every 86 milliseconds. The gauge needle will continue to be positioned at the actual vehicle speed position on the gauge scale until the ignition switch is turned to the Off position.

- **Communication Error** - If the cluster fails to receive a speedometer message, it will hold the gauge needle at the last indication for about six seconds, or until the ignition switch is turned to the Off position, whichever occurs first. If a new speed message is not received after about six seconds, the gauge needle will return to the far left (low) end of the scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the vehicle speed information received from the Body Control Module (BCM) to determine the vehicle road speed, then

## SPEEDOMETER (Continued)

sends the proper vehicle speed messages to the instrument cluster. For further diagnosis of the speedometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the BCM, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the speedometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## TACHOMETER

### DESCRIPTION

A tachometer is standard equipment on all instrument clusters. The tachometer is located to the left of the speedometer in the instrument cluster. The tachometer consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry, and a fixed 255 degree scale on the gauge dial face that reads left-to-right from 0 to 7 for gasoline engines, or from 0 to 5 for diesel engines. The text "RPM X 1000" imprinted on the cluster overlay directly below the hub of the tachometer needle identifies that each number on the tachometer scale is to be multiplied by 1000 rpm. The gasoline engine tachometer has a red zone beginning at 5800 RPM, while the red zone for the diesel engine tachometer begins at 4300 RPM. The tachometer graphics are dark blue and red against a beige field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the dark blue graphics appear blue and the red graphics appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The tachometer is serviced as a unit with the instrument cluster.

### OPERATION

The tachometer gives an indication to the vehicle operator of the engine speed. This gauge is controlled by the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The tachometer is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to

move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Speed Message** - Each time the cluster receives an engine speed message from the PCM it will calculate the correct engine speed reading and position the gauge needle at that speed position on the gauge scale. The cluster will receive a new engine speed message and reposition the gauge pointer accordingly about every 86 milliseconds. The gauge needle will continue to be positioned at the actual engine speed position on the gauge scale until the ignition switch is turned to the Off position.

- **Communication Error** - If the cluster fails to receive an engine speed message, it will hold the gauge needle at the last indication for about six seconds, or until the ignition switch is turned to the Off position, whichever occurs first. If a new engine speed message is not received after about six seconds, the gauge needle will return to the far left (low) end of the scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the gauge needle will be swept to several calibration points on the gauge scale in sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the crankshaft position sensor to determine the engine speed, then sends the proper engine speed messages to the instrument cluster. For further diagnosis of the tachometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the crankshaft position sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the tachometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## TRANS TEMP INDICATOR

### DESCRIPTION

A transmission over-temperature indicator is standard equipment on all instrument clusters, but is only functional on vehicles equipped with an optional automatic transmission. The transmission over-temperature indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The transmission over-temperature indicator consists of a stencil-like cutout of the words "TRANS TEMP" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly vis-

## TRANS TEMP INDICATOR (Continued)

ible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "TRANS TEMP" text to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The transmission over-temperature indicator is serviced as a unit with the instrument cluster.

## OPERATION

The transmission over-temperature indicator gives an indication to the vehicle operator when the transmission fluid temperature is excessive, which may lead to accelerated transmission component wear or failure. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The transmission over-temperature indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the transmission over-temperature indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the transmission over-temperature indicator is illuminated for about three seconds as a bulb test.

- **Trans Over-Temp Lamp-On Message** - Each time the cluster receives a trans over-temp lamp-on message from the PCM indicating that the transmission fluid temperature is 135° C (275° F) or higher, the indicator will be illuminated. The indicator remains illuminated until the cluster receives a trans over-temp lamp-off message from the PCM, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the trans over-temp indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the transmission temperature sensor to determine the transmission operating condition. The PCM then sends the proper trans over-temp lamp-on and lamp-off messages to the instrument cluster. If the instrument cluster

turns on the transmission over-temperature indicator due to a high transmission oil temperature condition, it may indicate that the transmission and/or the transmission cooling system are being overloaded or that they require service. For further diagnosis of the transmission over-temperature indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transmission temperature sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the transmission over-temperature indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## TURN SIGNAL INDICATOR

### DESCRIPTION

Two turn signal indicators, one right and one left, are standard equipment on all instrument clusters. The turn signal indicators are located near the upper edge of the instrument cluster, between the speedometer and the tachometer. Each turn signal indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Turn Warning" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents these icons from being clearly visible when they are not illuminated. A green Light-Emitting Diode (LED) behind each cutout in the opaque layer of the cluster overlay causes the indicator to appear in green through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The turn signal indicators are serviced as a unit with the instrument cluster.

### OPERATION

The turn signal indicators give an indication to the vehicle operator that the turn signal (left or right indicator flashing) or hazard warning (both left and right indicators flashing) have been selected and are operating. These indicators are controlled by two individual hard wired inputs from the combination flasher circuitry within the hazard switch to the instrument cluster electronic circuit board. Each turn signal indicator Light Emitting Diode (LED) is grounded on the instrument cluster electronic circuit board at all times; therefore, these indicators remain functional regardless of the ignition switch position. Each LED will only illuminate when it is provided battery current by the combination flasher circuitry of the hazard switch.

## TURN SIGNAL INDICATOR (Continued)

The turn signal indicators are connected in parallel with the other turn signal circuits. This arrangement allows the turn signal indicators to remain functional, regardless of the condition of the other circuits in the turn signal and hazard warning systems. The combination flasher outputs of the hazard switch to the instrument cluster turn signal indicator inputs can be diagnosed using conventional diagnostic tools and methods. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HAZARD SWITCH - DESCRIPTION) for more information on the combination flasher and hazard switch operation.

## WAIT-TO-START INDICATOR

### DESCRIPTION

A wait-to-start indicator is only found in the instrument clusters of vehicles equipped with an optional diesel engine. The wait-to-start indicator is located above the fuel gauge and to the left of the tachometer in the instrument cluster. The wait-to-start indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Diesel Preheat" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The wait-to-start indicator is serviced as a unit with the instrument cluster.

### OPERATION

The wait-to-start indicator gives an indication to the vehicle operator when the diesel engine glow plugs are energized in their pre-heat operating mode. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon the cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The wait-to-start indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will

turn on the wait-to-start indicator for the following reasons:

- **Wait-To-Start Lamp-On Message** - Each time the cluster receives a wait-to-start lamp-on message from the PCM indicating the glow plugs are heating and the driver must wait to start the engine, the wait-to-start indicator will be illuminated. The indicator remains illuminated until the cluster receives a wait-to-start lamp-off message, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the wait-to-start indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the ambient temperature and the glow plug pre-heater circuits to determine how long the glow plugs must be heated in the pre-heat operating mode. The PCM then sends the proper wait-to-start lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the wait-to-start indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the glow plug pre-heater control circuits, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the wait-to-start indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## WASHER FLUID INDICATOR

### DESCRIPTION

A washer fluid indicator is standard equipment on all instrument clusters. The washer fluid indicator consists of the text "lowash", which appears in place of the odometer/trip odometer information in the Vacuum-Fluorescent Display (VFD) of the instrument cluster. The VFD is part of the cluster electronic circuit board, and is visible through a cutout located near the lower edge of the speedometer dial face in the instrument cluster. The dark outer layer of the overlay prevents the VFD from being clearly visible when it is not illuminated. The text message "lowash" appears in the same blue-green color and at the same lighting level as the odometer/trip odometer information through the translucent outer layer of the overlay when it is illuminated by the instrument cluster electronic circuit board. The washer fluid indicator is serviced as a unit with the instrument cluster.

## WASHER FLUID INDICATOR (Continued)

**OPERATION**

The washer fluid indicator gives an indication to the vehicle operator that the fluid level in the washer reservoir is low. This indicator is controlled by the instrument cluster electronic circuit board based upon cluster programming and a hard wired input received by the cluster from the washer fluid level switch mounted on the washer reservoir. The washer fluid indicator function of the Vacuum Fluorescent Display (VFD) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The instrument cluster will turn on the washer fluid indicator for the following reasons:

- **Washer Fluid Level Switch Input** - Each time the cluster detects ground on the low washer fluid sense circuit (washer fluid level switch closed = washer fluid level low) the cluster applies an algorithm to confirm that the input is correct and not the result of fluid sloshing in the washer reservoir. The cluster tests the status of the circuit about seven milliseconds after ignition On, and about once every second thereafter, then uses an internal counter to count up or down. When the counter accumulates thirty ground inputs on the circuit, the washer fluid indicator will be illuminated. If the vehicle is not moving when the washer fluid level switch input counter reaches thirty, the VFD will repeatedly and sequentially cycle its indication in two second intervals with the odometer/trip odometer information, the low washer fluid warning, and any other active warnings including: door ajar, gate ajar, and glass ajar. If the vehicle is moving, or once the cluster of a non-moving vehicle receives an electronic vehicle speed message from the Powertrain Control Module (PCM) indicating a speed greater than zero, the warning sequence will consist of three complete display cycles, then revert to only the odometer/trip odometer display. Once the washer fluid indicator warning has completed, the washer fluid indicator is extinguished and will not repeat until the ignition switch is cycled.

The instrument cluster continually monitors the washer fluid level switch in the washer reservoir to determine the status of the washer fluid level. For further diagnosis of the washer fluid indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). The washer fluid level switch and circuits can be diagnosed using conventional diagnostic tools and methods. The washer fluid level switch also features a 3.3

kilohm diagnostic resistor connected in parallel between the switch input and output to provide the cluster with verification that the low washer fluid sense circuit is not open or shorted. This input can be monitored using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**DIAGNOSIS AND TESTING - WASHER FLUID INDICATOR**

The diagnosis found here addresses an inoperative washer fluid indicator condition. If the problem being diagnosed is related to indicator accuracy, be certain to confirm that the problem is with the indicator or washer fluid level switch input and not with a damaged or empty washer fluid reservoir, or inoperative instrument cluster indicator control circuitry. Inspect the washer fluid reservoir for proper fluid level and signs of damage or distortion that could affect washer fluid level switch performance and perform the instrument cluster actuator test before you proceed with the following diagnosis. If no washer fluid reservoir or instrument cluster control circuitry problem is found, the following procedure will help to locate a short or open in the washer fluid switch sense circuit. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**INDICATOR DOES NOT ILLUMINATE WITH WASHER RESERVOIR EMPTY**

(1) Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the washer fluid level switch connector receptacle. Check for continuity between the ground circuit cav-

## WASHER FLUID INDICATOR (Continued)

ity of the headlamp and dash wire harness connector for the washer fluid level switch and a good ground. There should be continuity. If OK, go to Step 2. If not OK, repair the open ground circuit to ground (G111) as required.

(2) Remove the instrument cluster from the instrument panel. Check for continuity between the washer fluid sense circuit cavities of the headlamp and dash wire harness connector for the washer fluid level switch and the instrument panel wire harness connector (Connector C2) for the instrument cluster. If OK, replace the faulty washer fluid level switch. If not OK, repair the open washer fluid switch sense circuit between the washer fluid level switch and the instrument cluster as required.

### INDICATOR STAYS ILLUMINATED WITH WASHER RESERVOIR FULL

(1) Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the washer fluid level switch connector receptacle. Check for continuity between the ground circuit terminal and the washer fluid sense terminal in the washer fluid level switch connector receptacle. There should be no continuity. If OK, go to Step 2. If not OK, replace the faulty washer fluid level switch.

(2) Remove the instrument cluster from the instrument panel. Check for continuity between the washer fluid sense circuit cavity of the headlamp and dash wire harness connector for the washer fluid level switch and a good ground. There should be no continuity. If not OK, repair the shorted washer fluid switch sense circuit between the washer fluid level switch and the instrument cluster as required.

## WATER-IN-FUEL INDICATOR

### DESCRIPTION

A water-in-fuel indicator is only found in the instrument clusters of vehicles equipped with an optional diesel engine. The water-in-fuel indicator is located above the coolant temperature gauge and to the right of the speedometer in the instrument cluster. The water-in-fuel indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Water In Fuel" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The

water-in-fuel indicator is serviced as a unit with the instrument cluster.

### OPERATION

The water-in-fuel indicator gives an indication to the vehicle operator when there is excessive water in the fuel system. This indicator is controlled by a transistor on the instrument cluster electronic circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The water-in-fuel indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the water-in-fuel indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the water-in-fuel indicator is illuminated for about three seconds as a bulb test.
- **Water-In-Fuel Lamp-On Message** - Each time the cluster receives a water-in-fuel lamp-on message from the PCM indicating there is excessive water in the diesel fuel system, the water-in-fuel indicator will be illuminated. The indicator remains illuminated until the cluster receives a water-in-fuel lamp-off message, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the water-in-fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the water-in-fuel sensor to determine whether there is excessive water in the diesel fuel. The PCM then sends the proper water-in-fuel lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the water-in-fuel indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the water-in-fuel-sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the water-in-fuel indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.





# LAMPS

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## LAMPS/LIGHTING - EXTERIOR

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## LAMPS/LIGHTING - EXTERIOR

### DESCRIPTION

The exterior lighting system for this model includes the following exterior lamps (Fig. 1):

- **Backup Lamps** - The backup (or reverse) lamps are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle.

- **Brake Lamps** - The brake (or stop) lamps include a lamp that is integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate, and the Center High Mounted Stop Lamp (CHMSL) that is centered on the rear edge of the roof panel above the flip-up glass opening at the rear of the vehicle.

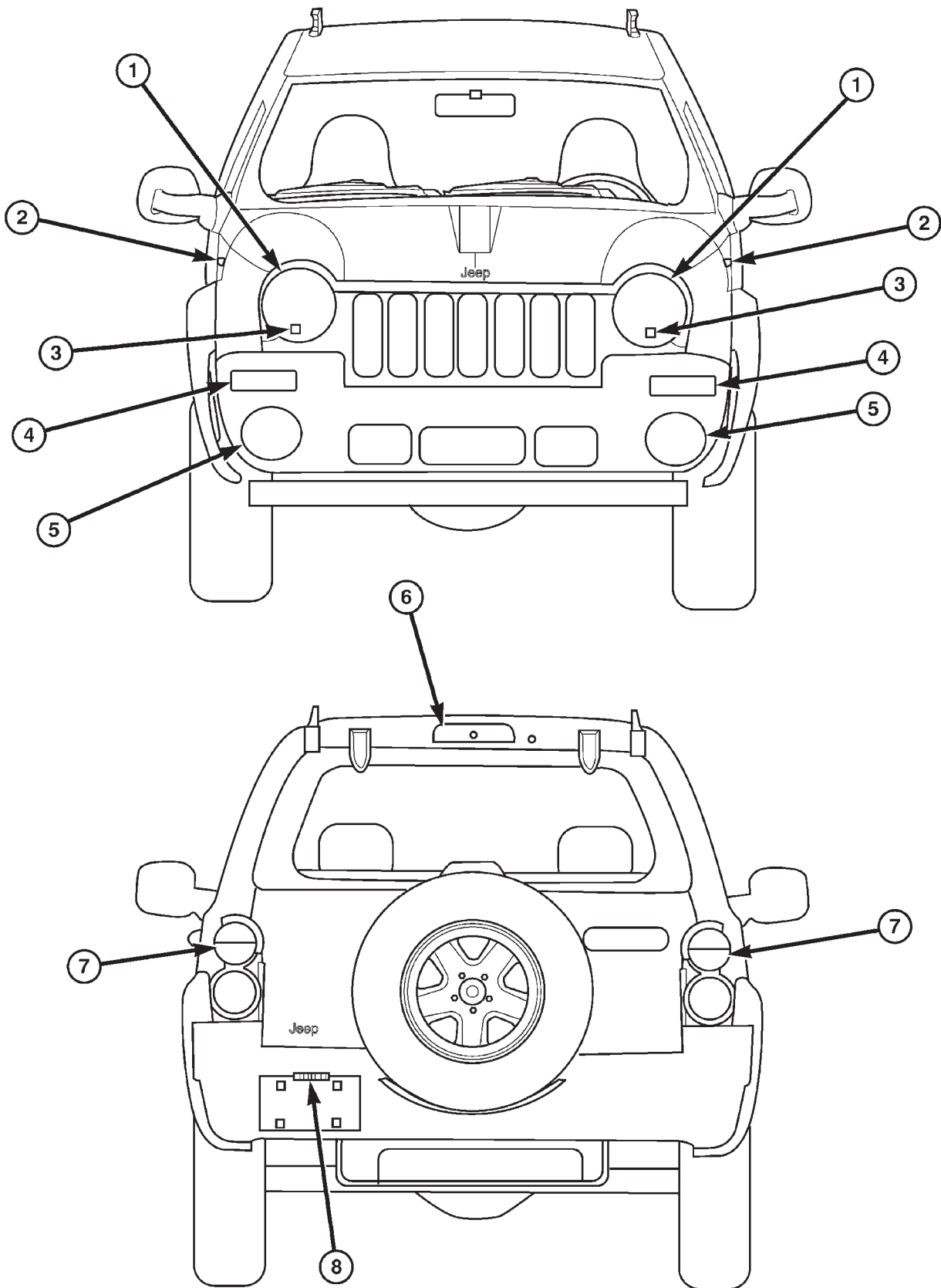
- **Daytime Running Lamps** - Vehicles manufactured for sale in Canada illuminate the high beam filament in each headlamp bulb serves as the Daytime Running Lamps (DRL).

- **Front Fog Lamps** - Optional front fog lamps include a single round front fog lamp unit with an adjustable reflector and a removable bulb that is secured behind a dedicated opening on each forward-facing end of the front bumper fascia.

- **Hazard Warning Lamps** - The hazard warning lamps include all of the right and left turn signal lamps.

- **Headlamps** - A single round headlamp housing with a fixed lens, an adjustable reflector, and a single removable halogen bulb is secured to the grille opening panel on each side of the grille opening at the

LAMPS/LIGHTING - EXTERIOR (Continued)



**Fig. 1 Exterior Lamps**

## LAMPS/LIGHTING - EXTERIOR (Continued)

- 1 - HEADLAMP UNIT (2)
- 2 - REPEATER LAMP UNIT (2)
- 3 - FRONT POSITION LAMP (2)
- 4 - FRONT LAMP UNIT (2)
- 5 - FRONT FOG LAMP (2)

- 6 - CENTER HIGH MOUNTED STOP LAMP UNIT
- 7 - REAR LAMP UNIT
- 8 - LICENSE PLATE LAMP UNIT

front of the vehicle. In certain markets where required, a headlamp leveling actuator motor is included on each headlamp.

- **Park Lamps** - The park lamps include the front park lamps and front side marker lamps that are integral to the front lamp units mounted at each end of the bumper fascia at the front of the vehicle, as well as the rear park lamps and rear side marker lamps that are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle. The park lamps include a license plate lamp or lamps, depending upon the requirements of the market for which the vehicle is manufactured. Vehicles with a license plate tub located near the left end of the rear bumper fascia have a single lamp, while vehicles with a license plate module located on the spare tire carrier have two license plate lamps. In certain markets where required, a front position lamp that is integral to each headlamp unit is illuminated instead of the front park lamps and front side marker lamps in the park lamps circuit; and, a rectangular, red reflector is located on the rear bumper fascia just inboard and below each rear lamp unit.

- **Rear Fog Lamps** - Rear fog lamps are available only in certain markets where they are required equipment. The rear fog lamps are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle.

- **Turn Signal Lamps** - The turn signal lamps include the front turn signal and front side marker lamps that are integral to the front lamp units mounted at each end of the bumper fascia at the front of the vehicle, as well as rear turn signal lamps that are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle. In certain markets where required, a repeater lamp unit mounted to each front fender just behind the front wheel opening is illuminated instead of the front side marker lamp in each turn signal lamp circuit.

Other components of the exterior lighting system for this model include:

- **Combination Flasher** - An electronic combination flasher is integral to the hazard warning switch in the center of the instrument panel.

- **Backup Lamp Switch** - Vehicles equipped with a manual transmission have a plunger-type backup lamp switch located on the transmission housing. A

Transmission Range Sensor (TRS) integral to the solenoid pack on the valve body of the optional electronic automatic transmission performs the backup lamp switch function on models that are so equipped.

- **Brake Lamp Switch** - A plunger-type brake lamp switch is located on the steering column support bracket under the instrument panel and actuated by the brake pedal arm.

- **Body Control Module** - The Body Control Module (BCM) is located on the Junction Block (JB) under the driver side outboard end of the instrument panel. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL MODULE - DESCRIPTION).

- **Daytime Running Lamp Relay** - Vehicles manufactured for sale in Canada use a solid state Daytime Running Lamps (DRL) relay installed in the Junction Block (JB) instead of the conventional high beam relay.

- **Front Fog Lamp Relay** - Vehicles equipped with the optional front fog lamps have a front fog lamp relay located in the Junction Block (JB).

- **Hazard Switch** - The hazard switch is located near the center of the instrument panel and includes the integral electronic combination flasher circuitry for the hazard warning system and the turn signal system.

- **Headlamp Leveling Motor** - A headlamp leveling actuator motor is located on the back of each headlamp housing of vehicles manufactured for certain markets where this equipment is required.

- **Headlamp Leveling Switch** - A thumbwheel actuated headlamp leveling switch is mounted in the driver side inboard instrument panel trim bezel of vehicles manufactured for certain markets where this equipment is required.

- **High Beam Relay** - A high beam relay is located in the Junction Block (JB) of all vehicles except those that are manufactured for sale in Canada. Canadian vehicles have a solid state Daytime Running Lamps (DRL) relay in the JB instead of the high beam relay.

- **Low Beam Relay** - A low beam relay is located in the Junction Block (JB) of all vehicles.

- **Multi-Function Switch** - The multi-function switch is located on the top of the steering column, just below the steering wheel. The multi-function switch includes a left (lighting) control stalk and a right (wiper) control stalk. The left control stalk is dedicated to providing almost all of the driver con-

## LAMPS/LIGHTING - EXTERIOR (Continued)

trols for both the exterior and interior lighting systems.

- **Park Lamp Relay** - A park lamp relay is located in the Junction Block (JB) of all vehicles.

- **Rear Fog Lamp Relay** - Vehicles manufactured for certain markets where rear fog lamps are required equipment have a rear fog lamp relay located in the Junction Block (JB).

- **Trailer Tow Adapter** - Vehicles equipped with a factory-installed trailer towing package have an adapter provided that adapts the factory-installed heavy duty 7-way trailer tow connector to a conventional 4-way light duty connector.

- **Trailer Tow Connector** - Vehicles equipped with a factory-installed trailer towing package have a heavy duty 7-way trailer tow connector installed in a bracket on the trailer hitch receiver.

- **Trailer Tow Relays** - Vehicles equipped with a factory-installed trailer towing package have a connector bank containing four relays located behind the right quarter trim panel and over the right rear wheel housing. The four relays are used to supply fused ignition switch output (run), brake lamps, right turn signal, and left turn signal outputs to a trailer through the trailer tow wiring and connectors.

Hard wired circuitry connects the exterior lighting system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the exterior lighting system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## OPERATION

Following are paragraphs that briefly describe the operation of each of the major exterior lighting systems. The hard wired circuits and components of the exterior lighting systems may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), the Powertrain Control Module (PCM), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, the PCM, and the PCI data bus

network inputs and outputs related to the various exterior lighting systems requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## BACKUP LAMPS

The backup (or reverse) lamps have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the base of the right D-pillar behind the quarter trim panel. The backup lamps receive battery current from a fused ignition switch output (run) fuse in the Junction Block (JB) on the back-up lamp feed circuit only when the backup lamp switch (manual transmission), or backup lamp switch circuit of the Transmission Range Sensor (TRS - electronic automatic transmission) is closed by the gearshift mechanism within the transmission.

## BRAKE LAMPS

The brake (or stop) lamps have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a screw to the base of the right D-pillar behind the quarter trim panel. The Center High Mounted Stop Lamp (CHMSL) has a path to ground at all times through its connection to the rear body wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the driver side D-pillar (left side D-pillar for left-hand drive, right side D-pillar for right-hand drive) behind the quarter trim panel. The brake lamps and CHMSL receive battery current from a fused B(+) fuse in the Junction Block (JB) on the brake lamp switch output circuit only when the brake lamp switch circuit of the brake lamp switch is closed by the brake pedal arm.

## DAYTIME RUNNING LAMPS

Vehicles manufactured for sale in Canada illuminate the high beam filament at a reduced intensity when the engine is running and the exterior lamps are turned off. This feature is enabled by the Body Control Module (BCM) and a solid state Daytime Running Lamps (DRL) relay, which is installed in the Junction Block (JB) and the high beam relay is omitted. When the BCM monitors an engine speed signal of greater than 450 RPM and the status of the exterior lighting switch input from the multi-function switch is Off, the BCM duty cycles the DRL relay to produce illumination of the headlamp high beam filaments at a reduced intensity. The BCM also provides normal headlamp high beam operation through the DRL relay on vehicles so equipped. When the

## LAMPS/LIGHTING - EXTERIOR (Continued)

DRL relay is energized, it provides battery current from a fused B(+) fuse in the JB to the headlamp high beam filament through the DRL relay output circuit.

## FRONT FOG LAMPS

Vehicles equipped with optional front fog lamps have a premium Body Control Module (BCM), a front fog lamp relay installed in the Junction Block (JB), and a front fog lamp switch integral to the left (lighting) control stalk of the multi-function switch. The front fog lamps have a path to ground at all times through their connection to the front fascia wire harness from two take outs of the headlamp and dash wire harness with eyelet terminal connectors that are secured by ground screws to the left inner fender shield in the engine compartment. The BCM controls front fog lamp operation by monitoring the exterior lighting switch input from the multi-function switch, then energizing or de-energizing the front fog lamp relay control coil; and, by sending the appropriate electronic message to the instrument cluster over the Programmable Communications Interface (PCI) data bus to turn the front fog lamp indicator on or off. When the front fog lamp relay is energized, it provides battery current from a fused B(+) fuse in the JB to the front fog lamps through the front fog lamp relay output circuit. The BCM provides a battery saver (load shedding) feature for the front fog lamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position. In certain markets where required, the front fog lamps are also turned off by the BCM whenever the headlamp high beams are selected. Each front fog lamp includes an integral adjustment screw to be used for static aiming the fog lamp beams.

## HAZARD WARNING LAMPS

With the hazard switch in the On position, the hazard warning system is activated causing the hazard switch button illumination lamp, the right and left turn signal indicators, and the right and left turn signal lamps to flash on and off. When the hazard warning system is activated, the circuitry within the hazard switch and electronic combination flasher unit will repeatedly energize and de-energize two internal relays that switch battery current from a fused B(+) fuse in the Junction Block (JB) to the right side and left side turn signal indicators, and turn signal lamps through the right and left turn signal circuits. The flashing of the hazard switch button illumination lamp is performed internally by the hazard switch and combination flasher unit circuit board. The hazard warning lamps can also be energized by the Body Control Module (BCM) through a

hazard lamp control circuit input to the hazard switch and combination flasher unit.

## HEADLAMPS

The headlamp system includes the Body Control Module (BCM), a low beam relay installed in the Junction Block (JB), a high beam relay installed in the JB (except Canada), a solid state Daytime Running Lamps (DRL) relay installed in the JB (Canada only), and the exterior lighting (headlamp and dimmer) switches integral to the left (lighting) control stalk of the multi-function switch. The headlamp bulbs have a path to ground at all times through their connection to the grille opening reinforcement wire harness from two take outs of the headlamp and dash wire harness with eyelet terminal connectors that are secured by ground screws to the left inner fender shield in the engine compartment. The BCM controls the headlamp operation by monitoring the exterior lighting switch inputs from the multi-function switch, then energizing or de-energizing the control coils of the low beam relay, the high beam relay, or the solid state circuitry of the DRL relay; and, by sending the appropriate electronic message to the instrument cluster over the Programmable Communications Interface (PCI) data bus to turn the high beam indicator on or off. When each respective relay is energized, it provides battery current from a fused B(+) fuse in the Power Distribution Center (PDC) through a relay (low beam, high beam, or DRL) output circuit and four separate fuses in the JB through individual fused right and left, low and high beam output circuits to the appropriate headlamp bulb filaments. The BCM provides a battery saver (load shedding) feature for the headlamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position; and, a headlamp delay feature with a DRBIII® scan tool programmable delay interval. Each headlamp includes an integral adjustment screw to be used for static aiming of the headlamp beams.

## HEADLAMP LEVELING

In certain markets where required, a headlamp leveling system is provided on the vehicle. The headlamp leveling system includes unique headlamp units equipped with a headlamp leveling actuator motor, and a rotary thumbwheel actuated headlamp leveling switch on the instrument panel. The headlamp leveling system allows the headlamp beams to be adjusted to one of four vertical positions to compensate for changes in inclination caused by the loading of the vehicle suspension. The actuator motors are mechanically connected through an integral pushrod to an adjustable headlamp reflector. The headlamp

## LAMPS/LIGHTING - EXTERIOR (Continued)

leveling switch is a resistor multiplexed unit that provides one of four voltage outputs to the headlamp leveling motors. The headlamp leveling motors will move the headlamps to the selected position based upon the voltage input received from the switch. The headlamp leveling motors and switch have a path to ground at all times. The headlamp leveling components operate on battery current received through the fused park lamp relay output circuit so that the system will only operate when the exterior lighting is turned on.

**PARK LAMPS**

The park lamps system includes the Body Control Module (BCM), a park lamp relay installed in the Junction Block (JB), and the exterior lighting switch integral to the left (lighting) control stalk of the multi-function switch. The front park lamp and side marker or, if equipped, the front position lamp bulbs each have a path to ground at all times through their connections to the grille opening reinforcement wire harness from two take outs of the headlamp and dash wire harness with eyelet terminal connectors that are secured by ground screws to the left inner fender shield in the engine compartment. The rear park lamp bulbs and license plate lamp have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the base of the right D-pillar behind the quarter trim panel. The BCM controls the park lamp operation by monitoring the exterior lighting switch inputs from the multi-function switch, then energizing or de-energizing the control coil of the park lamp relay. When the park lamp relay is energized, it provides battery current from a fused B(+) fuse in the Power Distribution Center (PDC) through a park lamp relay output circuit and a separate fuse in the JB through a fused park lamp relay output circuit to the appropriate lamp bulb filaments. The BCM provides a battery saver (load shedding) feature for the park lamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position.

**REAR FOG LAMPS**

Rear fog lamps are installed on vehicles manufactured for certain markets where they are required. The rear fog lamp system includes a premium Body Control Module (BCM), a rear fog lamp relay installed in the Junction Block (JB), and a rear fog lamp switch integral to the left (lighting) control stalk of the multi-function switch. The rear fog lamps have a path to ground at all times through their connection to the rear lighting wire harness from a take

out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the base of the right D-pillar behind the quarter trim panel. The BCM controls rear fog lamp operation by monitoring the exterior lighting switch input from the multi-function switch, then energizing or de-energizing the rear fog lamp relay control coil; and, by sending the appropriate electronic message to the instrument cluster over the Programmable Communications Interface (PCI) data bus to turn the rear fog lamp indicator on or off. When the rear fog lamp relay is energized, it provides battery current from a fused B(+) fuse in the JB to the rear fog lamps through the rear fog lamp relay output circuit. The BCM provides a battery saver (load shedding) feature for the rear fog lamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position.

**TURN SIGNAL LAMPS**

When the left control stalk of the multi-function switch is moved up (right turn) or down (left turn), the turn signal system is activated causing the selected right or left turn signal indicator, and right or left turn signal lamps to flash on and off. When the turn signal system is activated, the circuitry within the turn signal switch and the hazard switch/electronic combination flasher unit will repeatedly energize and de-energize one of two internal relays that switch battery current from a fused ignition switch output (run) fuse in the Junction Block (JB) to the right side or left side turn signal indicators and turn signal lamps through the right or left turn signal circuits. The ElectroMechanical Instrument Cluster (EMIC) chime tone generator will generate an audible turn signal cancel warning each time the vehicle is driven for a distance of about 3.2 kilometers (about two miles) with a turn signal indicator flashing. The EMIC uses Programmable Communications Interface (PCI) data bus distance messages from the Powertrain Control Module (PCM) and a hard wired input from the turn signal switch circuitry of the multi-function switch to determine when to sound the turn signal cancel warning.

**DIAGNOSIS AND TESTING - LAMPS/LIGHTING - EXTERIOR**

The hard wired circuits and components of the exterior lighting systems may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), the Powertrain Control Module (PCM), or the Programmable Communications Interface (PCI) data bus network. The most



## LAMPS/LIGHTING - EXTERIOR (Continued)

reliable, efficient, and accurate means to diagnose the BCM, the EMIC, the PCM, and the PCI data bus network inputs and outputs related to the various exterior lighting systems requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

When diagnosing the exterior lighting circuits, remember that high generator output can burn out bulbs rapidly and repeatedly; and, that dim or flickering bulbs can be caused by low generator output or poor battery condition. If one of these symptoms is a problem on the vehicle being diagnosed, be certain to diagnose and repair the battery and charging system as required. Also keep in mind that a good ground is necessary for proper lighting operation. If a lighting problem is being diagnosed that involves multiple symptoms, systems, or components the problem can often be traced to a loose, corroded, or open ground. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector

repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## BACKUP LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
BACKUP LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty switch.</li> <li>4. Faulty ground circuit.</li> <li>5. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace backup lamp fuse as required.</li> <li>2. Test and replace backup lamp bulb as required.</li> <li>3. Test and replace backup lamp switch (manual transmission) or transmission range sensor (automatic transmission) as required.</li> <li>4. Test and repair backup lamp ground circuit as required.</li> <li>5. Test and repair open back-up lamp feed circuit as required.</li> </ol>
BACKUP LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty switch.</li> <li>2. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace backup lamp switch (manual transmission) or transmission range sensor (automatic transmission) as required.</li> <li>2. Test and repair shorted back-up lamp feed circuit as required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

**BRAKE LAMPS**

CONDITION	POSSIBLE CAUSES	CORRECTION
BRAKE LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty switch.</li> <li>4. Faulty ground circuit.</li> <li>5. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace brake lamp fuse as required.</li> <li>2. Test and replace brake lamp bulb as required.</li> <li>3. Test and replace brake lamp switch as required.</li> <li>4. Test and repair brake lamp ground circuit as required.</li> <li>5. Test and repair open brake lamp switch output circuit as required.</li> </ol>
BRAKE LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty switch.</li> <li>2. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace brake lamp switch as required.</li> <li>2. Test and repair shorted brake lamp switch output circuit as required.</li> </ol>

**DAYTIME RUNNING LAMPS**

Before performing the following tests, determine whether the headlamp low and high beams operate.

If the headlamp high and low beams are also inoperative, diagnose and repair that problem before attempting to repair the Daytime Running Lamps.

CONDITION	POSSIBLE CAUSES	CORRECTION
DAYTIME RUNNING LAMPS WILL NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. High beam relay installed.</li> <li>2. Faulty or missing DRL relay.</li> <li>3. Incorrect BCM programming.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove high beam relay as required.</li> <li>2. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.</li> <li>3. Use a DRBIII® scan tool to check and program correct country code into BCM as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs or outputs. Refer to the appropriate diagnostic information.</li> </ol>

## LAMPS/LIGHTING - EXTERIOR (Continued)

## FRONT FOG LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT FOG LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace front fog lamp fuse as required.</li> <li>2. Test and replace front fog lamp bulb as required.</li> <li>3. Test and replace front fog lamp relay as required.</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair front fog lamp ground circuit as required.</li> <li>6. Test and repair open front fog lamp relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
FRONT FOG LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace front fog lamp relay as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted front fog lamp relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## HAZARD WARNING LAMPS

Before performing the following tests, confirm whether the left and right turn signals operate satisfactorily. If the turn signals are inoperative or oper-

ate improperly, diagnose and repair that problem before attempting to repair the Hazard Warning Lamps.

CONDITION	POSSIBLE CAUSES	CORRECTION
HAZARD WARNING LAMPS DO NOT FLASH	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty switch/flasher.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace hazard warning fuse as required.</li> <li>2. Test and repair hazard switch ground circuit as required.</li> <li>3. Test and repair open hazard switch fused B(+) circuit as required.</li> <li>4. Replace hazard switch/combination flasher with a known good unit and check operation. Replace hazard switch/combination flasher unit if required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

HEADLAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace headlamp fuse as required.</li> <li>2. Test and replace headlamp bulb as required.</li> <li>3. Test and replace low beam or high beam relay as required. (Note: Vehicles with a DRL relay do not use a high beam relay. The DRL relay cannot be tested. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.)</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair open headlamp ground circuit as required.</li> <li>6. Test and repair open headlamp low beam, high beam, or DRL relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
HEADLAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace low beam or high beam relay as required. (Note: Vehicles with a DRL relay do not use a high beam relay. The DRL relay cannot be tested. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.)</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted headlamp low beam, high beam, or DRL relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
HEADLAMPS WILL NOT SWITCH FROM HIGH TO LOW BEAMS, OR FROM LOW TO HIGH BEAMS	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace low beam or high beam relay as required. (Note: Vehicles with a DRL relay do not use a high beam relay. The DRL relay cannot be tested. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.)</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## LAMPS/LIGHTING - EXTERIOR (Continued)

## HEADLAMP LEVELING

Before performing the following tests, confirm whether the park lamps operate satisfactorily. If the

park lamps are inoperative, diagnose and repair that problem before attempting to repair the Headlamp Leveling System.

CONDITION	POSSIBLE CAUSES	CORRECTION
ONE LEVELING MOTOR IS INOPERATIVE	<ol style="list-style-type: none"> <li>1. Faulty ground circuit.</li> <li>2. Faulty feed circuit.</li> <li>3. Faulty signal circuit.</li> <li>4. Faulty motor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open leveling motor ground circuit as required.</li> <li>2. Test and repair open leveling motor feed circuit as required.</li> <li>3. Test and repair open headlamp adjust signal circuit as required.</li> <li>4. Test and replace headlamp leveling motor as required.</li> </ol>
BOTH LEVELING MOTORS ARE INOPERATIVE	<ol style="list-style-type: none"> <li>1. Faulty switch ground circuit.</li> <li>2. Faulty motor ground circuit.</li> <li>3. Faulty switch feed circuit.</li> <li>4. Faulty motor feed circuit.</li> <li>5. Faulty signal circuit.</li> <li>6. Faulty switch.</li> <li>7. Faulty motors.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open leveling switch ground circuit as required.</li> <li>2. Test and repair open leveling motor ground circuit as required.</li> <li>3. Test and repair open leveling switch feed circuit as required.</li> <li>4. Test and repair open leveling motor feed circuit as required.</li> <li>5. Test and repair open or shorted leveling motor signal circuit as required.</li> <li>6. Test and replace leveling switch as required.</li> <li>7. Test and replace leveling motors as required.</li> </ol>

## PARK LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
PARK LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace park lamp fuse as required.</li> <li>2. Test and replace park lamp bulb as required.</li> <li>3. Test and replace park lamp relay as required.</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair open park lamp ground circuit as required.</li> <li>6. Test and repair open park lamp relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
PARK LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace park lamp relay as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted park lamp relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

REAR FOG LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
REAR FOG LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace rear fog lamp fuse as required.</li> <li>2. Test and replace rear fog lamp bulb as required.</li> <li>3. Test and replace rear fog lamp relay as required.</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair open rear fog lamp ground circuit as required.</li> <li>6. Test and repair open rear fog lamp relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
REAR FOG LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace rear fog lamp relay as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted rear fog lamp relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## LAMPS/LIGHTING - EXTERIOR (Continued)

## TURN SIGNAL LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
ONE TURN SIGNAL LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing bulb.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace turn signal bulb as required.</li> <li>2. Test and repair open ground circuit as required.</li> <li>3. Test and repair open right or left turn signal circuit as required.</li> </ol>
ALL RIGHT SIDE AND/OR ALL LEFT SIDE TURN SIGNAL LAMPS DO NOT FLASH	<ol style="list-style-type: none"> <li>1. Faulty sense circuit.</li> <li>2. Faulty switch.</li> <li>3. Faulty flasher.</li> <li>4. Faulty signal circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open right or left turn switch sense circuit as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Replace hazard switch/combination flasher with a known good unit and check operation. Replace hazard switch/combination flasher unit as required.</li> <li>4. Test and repair open right or left turn signal circuit as required.</li> </ol>
ALL RIGHT SIDE OR ALL LEFT SIDE TURN SIGNALS FLASH TOO RAPIDLY (MORE THAN 100 FLASHES PER MINUTE)	<ol style="list-style-type: none"> <li>1. Faulty or missing bulb.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty signal circuit</li> <li>4. Faulty flasher.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace faulty bulb as required.</li> <li>2. Test and repair open ground circuit as required.</li> <li>3. Test and repair open right or left turn signal circuit as required.</li> <li>4. Replace hazard switch/combination flasher with a known good unit and check operation. Replace hazard switch/combination flasher unit as required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

**SPECIFICATIONS - LAMPS/LIGHTING - EXTERIOR**

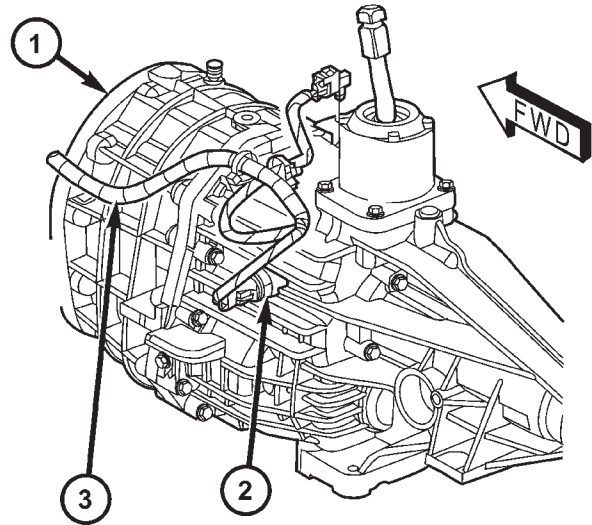
*BULB SPECIFICATIONS*

LAMP	BULB
Backup	3157 P27/7W
Brake	3157 P27/7W
Center High Mounted Stop	921/W16W
Front Fog	9145
Front Park	3157 P27/7W
Front Position	W5W
Front Side Marker	168
Front Turn	3157 P27/7W
Headlamp (North America)	9007QL
Headlamp (Rest-Of-World)	H-4 W0W6
License Plate (North America)	168
License Plate (Rest-Of-World)	W5W
Rear Fog	3157 P27/7W
Rear Park/Tail	3157 P27/7W
Rear Turn	3157 P27/7W
Side Repeater	W5W

**BACKUP LAMP SWITCH**

**DESCRIPTION**

Vehicles equipped with a manual transmission have a normally open, spring-loaded plunger type back-up lamp switch (Fig. 2). The backup lamp switch is located in a threaded hole on the side of the manual transmission housing, beneath the floor panel of the vehicle. The backup lamp switch has a threaded body and a hex formation near the plunger end of the switch, and an integral connector receptacle at the opposite end of the switch. When installed, only the connector receptacle and the hex formation are visible on the outside of the transmission housing. Vehicles with an optional electronic automatic transmission have a Transmission Range Sensor (TRS) that is used to perform several functions, including that of the backup lamp switch. The TRS is described in further detail elsewhere in this service information. The backup lamp switch cannot be adjusted or repaired and, if faulty or damaged, the entire switch unit must be replaced.



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**Fig. 2 Backup Lamp Switch - Typical**

- 1 - MANUAL TRANSMISSION
- 2 - BACKUP LAMP SWITCH
- 3 - ENGINE WIRE HARNESS

**OPERATION**

The backup lamp switch controls the flow of battery current to the backup lamp bulbs at the back of the vehicle through an output on the back-up lamp feed circuit. The switch plunger is mechanically actuated by the gearshift mechanism within the transmission, which will depress the switch plunger and close the switch contacts whenever the reverse gear has been selected. The switch receives battery current through a fuse in the Junction Block (JB) on a fused ignition switch output (run) circuit whenever the ignition switch is in the On position. A take out of the engine wire harness connects the backup lamp switch to the vehicle electrical system. The backup lamp switch and circuits can be tested using conventional diagnostic tools and methods.

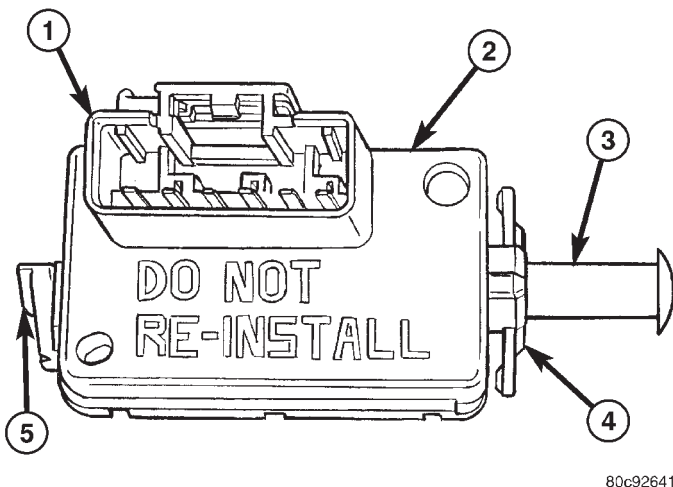
**DIAGNOSIS AND TESTING - BACKUP LAMP SWITCH**

- (1) Disconnect and isolate the battery negative cable.
- (2) Raise and support the vehicle.
- (3) Locate and disconnect the engine wire harness connector for the backup lamp switch from the switch connector receptacle.
- (4) Check for continuity between the two terminal pins in the backup lamp switch connector receptacle.
  - (a) With the gear selector lever in the Reverse position, there should be continuity.
  - (b) With the gear selector lever in any position other than Reverse, there should be no continuity.



## BRAKE LAMP SWITCH

### DESCRIPTION



**Fig. 3 Brake Lamp Switch**

- 1 - CONNECTOR RECEPTACLE
- 2 - BRAKE LAMP SWITCH
- 3 - PLUNGER
- 4 - COLLAR
- 5 - LEVER

The brake lamp switch is a three circuit, spring-loaded plunger actuated switch that is secured to the steering column support bracket under the driver side of the instrument panel (Fig. 3). The brake lamp switch is contained within a rectangular molded plastic housing with an integral connector receptacle featuring six terminal pins and a red plastic Connector Position Assurance (CPA) lock. The switch is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. The switch plunger extends through a mounting collar on one end of the switch housing. The plunger has a one time telescoping self-adjustment feature that is achieved after the switch is installed by moving an adjustment release lever on the opposite end of the switch housing clockwise, until it locks in a position that is parallel to the connector receptacle. The brake lamp switch self-adjustment is a one time feature. Once the feature has been used, the switch cannot be readjusted. A "DO NOT RE-INSTALL" warning is molded into the switch housing below the connector receptacle.

An installed brake lamp switch cannot be readjusted or repaired. If the switch is damaged, faulty, or removed from its mounting position for any reason, it must be replaced with a new unit.

### OPERATION

The brake lamp switch controls three different circuits, one normally open and two normally closed. These circuits are described as follows:

- **Brake Lamp Switch Circuit** - A normally open brake lamp switch circuit receives battery current on a fused B(+) circuit from a fuse in the Junction Block (JB), and supplies battery current to the brake lamps and the Controller Antilock Brake (CAB) on a brake lamp switch output circuit when the brake pedal is depressed (brake lamp switch plunger released).

- **Brake Lamp Switch Signal Circuit** - A normally closed brake lamp switch signal circuit receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB). This circuit supplies a ground input to the Powertrain Control Module (PCM) on a brake lamp switch sense circuit when the brake pedal is released (brake lamp switch plunger is depressed).

- **Speed Control Circuit** - A normally closed speed control circuit receives battery current from the Powertrain Control Module on a speed control supply circuit, and supplies battery current to the speed control servo solenoids (dump, vacuum, and vent) on a speed control brake switch output circuit when the speed control system is turned on and the brake pedal is released (brake lamp switch plunger is depressed).

Concealed within the brake lamp switch housing the components of the self-adjusting brake switch plunger consist of a two-piece telescoping plunger, a split plunger locking collar, and a release wedge. The release lever has an integral shaft with a wedge that spreads the plunger locking collar to an open or released position. After the switch is installed and the brake pedal is released, the plunger telescopes to the correct adjustment position. When the release lever is moved to the release position, the wedge is disengaged from the locking collar causing the collar to apply a clamping pressure to the two plunger halves fixing the plunger length.

The brake lamp switch can be diagnosed using conventional diagnostic tools and methods.

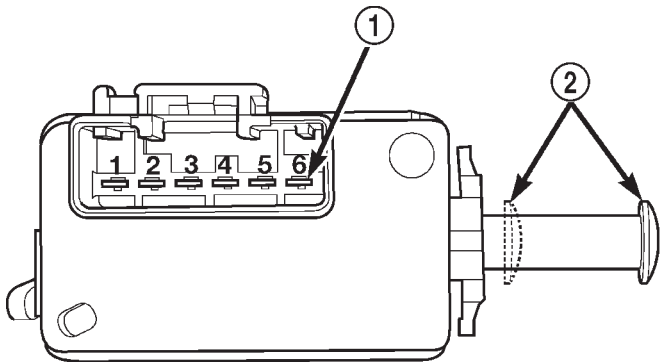
BRAKE LAMP SWITCH (Continued)

**DIAGNOSIS AND TESTING - BRAKE LAMP SWITCH**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the brake lamp switch from the switch connector receptacle.

(2) Using an ohmmeter, perform the continuity tests at the terminal pins in the brake lamp switch connector receptacle (Fig. 4) as shown in the Brake Lamp Switch Tests table.



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**Fig. 4 Brake Lamp Switch Terminal Identification**

- 1 - TERMINAL PINS
- 2 - PLUNGER TEST POSITIONS

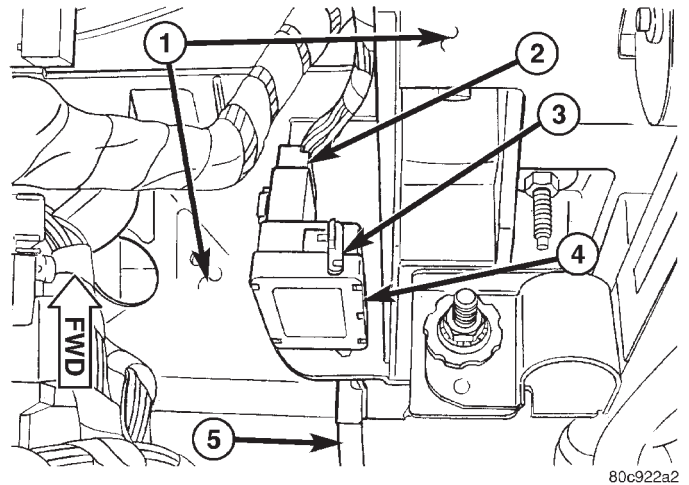
BRAKE LAMP SWITCH TESTS	
PLUNGER POSITION	CONTINUITY BETWEEN
Released (Extended)	Pins 1 & 2
Compressed (Retracted)	Pins 3 & 4, 5 & 6

(3) If the switch fails any of the continuity tests, replace the faulty brake lamp switch as required.

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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) Disconnect the instrument panel wire harness connector for the brake lamp switch from the switch connector receptacle (Fig. 5).



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**Fig. 5 Brake Lamp Switch Remove/Install**

- 1 - STEERING COLUMN SUPPORT
- 2 - WIRE HARNESS CONNECTOR
- 3 - LEVER
- 4 - BRAKE LAMP SWITCH
- 5 - BRAKE PEDAL ARM

(3) Grasp the brake lamp switch housing firmly and rotate the switch counterclockwise about 30 degrees to align the tabs on the locking collar with the keyed mounting hole in the steering column support bracket.

(4) Pull the switch straight back from the mounting hole to remove it from the steering column support bracket.

## BRAKE LAMP SWITCH (Continued)

- (5) Discard the removed brake lamp switch.

**CAUTION:** Always replace a removed brake lamp switch with a new unit. This is a one time component and is not intended for reinstallation.

## INSTALLATION

**WARNING:** ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

**CAUTION:** Always replace a removed brake lamp switch with a new unit. This is a one time component and is not intended for reinstallation.

- (1) While holding the brake pedal depressed, align the tabs on the brake lamp switch locking collar with the keyed mounting hole in the steering column support bracket (Fig. 5).

- (2) Still holding the brake pedal depressed, insert the tabs on the brake lamp switch housing through the keyed mounting hole in the steering column support bracket until the switch is firmly seated against the bracket.

- (3) Still holding the brake pedal depressed, rotate the switch clockwise about 30 degrees to lock the tabs on the brake lamp switch locking collar to the keyed mounting hole in the steering column support bracket.

- (4) Release the brake pedal.

**CAUTION:** Do not pull up on the brake pedal before the switch plunger adjustment has been completed.

- (5) Rotate the plunger adjustment release lever clockwise until it locks into place parallel to the brake lamp switch connector receptacle. This action will set the switch plunger length to a final adjustment position and cannot be undone. If not performed properly the first time, a new brake lamp switch **must** be installed.

- (6) Reconnect the instrument panel wire harness connector for the brake lamp switch to the switch connector receptacle.

- (7) Reconnect the battery negative cable.

## CENTER HIGH MOUNTED STOP LAMP BULB

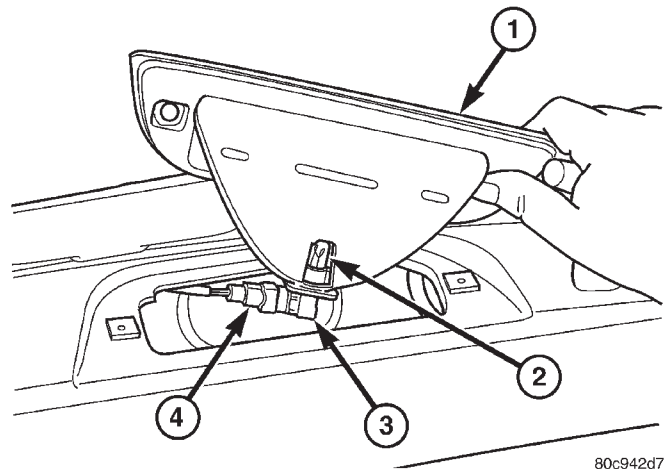
## REMOVAL

- (1) Disconnect and isolate the battery negative cable.

- (2) Remove the Center High Mounted Stop Lamp (CHMSL) unit from the roof panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UNIT - REMOVAL).

- (3) Firmly grasp the socket on the back of the CHMSL unit housing.

- (4) Rotate the socket on the back of the CHMSL unit housing counterclockwise about 30 degrees (Fig. 6).



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**Fig. 6 Center High Mounted Stop Lamp Bulb Remove/Install**

- 1 - CHMSL UNIT
- 2 - BULB
- 3 - SOCKET
- 4 - BODY WIRE HARNESS CONNECTOR

- (5) Pull the socket and bulb straight out of the back of CHMSL unit housing.

- (6) Pull the bulb straight out of the CHMSL unit socket.

## CENTER HIGH MOUNTED STOP LAMP BULB (Continued)

## INSTALLATION

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Align the base of the bulb with the receptacle in the Center High Mounted Stop Lamp (CHMSL) unit socket.

(2) Push the bulb straight into the CHMSL unit socket until it is firmly seated.

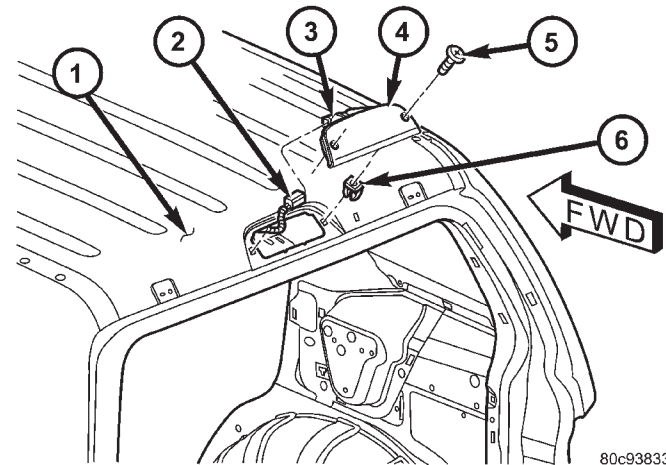
(3) Align the socket and bulb with the socket opening on the back of CHMSL unit housing.

(4) Push the socket and bulb straight into the CHMSL unit housing until it is firmly seated (Fig. 6).

(5) Rotate the socket on the back of the CHMSL unit housing clockwise about 30 degrees.

(6) Reinstall the CHMSL unit onto the roof panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UNIT - INSTALLATION).

(7) Reconnect the battery negative cable.



**Fig. 7 Center High Mounted Stop Lamp Remove/Install**

- 1 - ROOF PANEL
- 2 - BODY WIRE HARNESS CONNECTOR
- 3 - BULB SOCKET
- 4 - CHMSL
- 5 - SCREW (2)
- 6 - PLASTIC NUT (2)

## CENTER HIGH MOUNTED STOP LAMP UNIT

## REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws that secure the Center High Mounted Stop Lamp (CHMSL) unit to the rear of the roof panel (Fig. 7).

(3) Pull the CHMSL unit away from the roof panel far enough to access and disconnect the wire harness connector for the CHMSL unit from the lamp socket pigtail wire.

(4) Remove the CHMSL unit from the roof panel.

## INSTALLATION

(1) Position the Center High Mounted Stop Lamp (CHMSL) unit to the roof panel.

(2) Reconnect the wire harness connector for the CHMSL unit to the lamp socket pigtail wire (Fig. 7).

(3) Position the CHMSL unit into the roof panel opening.

(4) Install and tighten the two screws that secure the CHMSL unit to the rear of the roof panel. Tighten the screws to 2 N·m (21 in. lbs.).

(5) Reconnect the battery negative cable.

## COMBINATION FLASHER

## DESCRIPTION

The combination flasher for this model is integral to the hazard switch located in the center of the instrument panel, just above the radio. The combination flasher is a smart relay that functions as both the turn signal system and the 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.

The combination flasher cannot be repaired or adjusted and, if faulty or damaged, the hazard switch unit must be replaced.

## OPERATION

The combination flasher has the following inputs and outputs: fused B(+), fused ignition switch output, right turn signal sense, left turn signal sense, and one output each for the right and left turn signal circuits. The combination flasher also receives an internal input through the closed contacts of the hazard switch and, on vehicles equipped with the optional Vehicle Theft Security System (VTSS), the flasher receives an input from the Body Control Module (BCM) in order to flash the turn signal lamps as an optical alert feature of that system. Con-

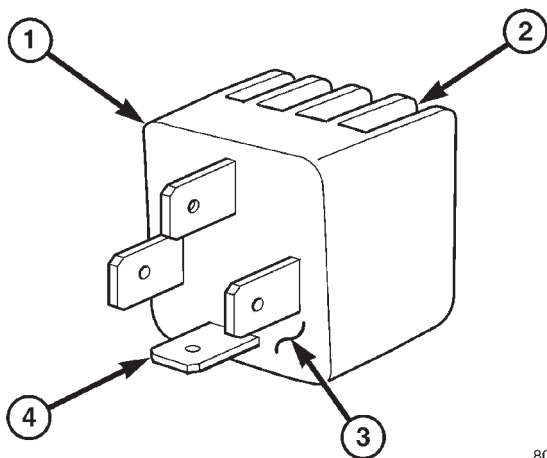
## COMBINATION FLASHER (Continued)

stant battery voltage is 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. The Integrated Circuit (IC) within the combination flasher contains the logic that controls the flasher operation and the flash rate. The IC receives separate sense ground inputs from the multi-function switch for the right and left turn signals, and from the hazard switch contacts or the BCM for the hazard warning signals. 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).

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. Then replace the hazard switch with a known good unit to confirm system operation.

## DAYTIME RUNNING LAMP RELAY

## DESCRIPTION



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**Fig. 8 Daytime Running Lamp Relay**

- 1 - DRL RELAY
- 2 - HEAT SINK
- 3 - POTTING MATERIAL
- 4 - TERMINAL (4)

The Daytime Running Lamp (DRL) relay (Fig. 8) is a solid state relay that is used only on vehicles manufactured for sale in Canada. The DRL relay features a die cast aluminum housing with integral cooling fins that act as a heat sink for the solid state DRL circuitry. Four male spade terminals extend from the base of the relay through a potting material that encloses and protects the DRL circuitry. Although the DRL relay has four terminals that are laid out in a footprint that is similar to that of a conventional International Standards Organization (ISO) relay, a standard ISO relay should never be installed in place of the DRL relay. The DRL relay is installed in the Junction Block (JB) on the driver side outboard end of the instrument panel. Vehicles equipped with this relay do not have a headlamp high beam relay installed in the JB.

The DRL relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The Daytime Running Lamp (DRL) relay is a solid state relay that controls the flow of battery current to the high beam filaments of both headlamp bulbs based upon a duty cycled control input received from the Body Control Module (BCM) of vehicles equipped with the DRL feature. By cycling the DRL relay output, the BCM controls the illumination intensity of the high beam filaments. The DRL relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the DRL relay include:

- **Battery Current Input** - The DRL relay receives battery current on a fused B(+) circuit from a fuse in the Power Distribution Center (PDC).

- **Ground Input** - The DRL relay receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB).

- **Control Input** - The DRL relay control input is received from the BCM and/or the momentary optical horn (flash-to-pass) output of the multi-function switch through a high beam relay control circuit.

- **Control Output** - The DRL relay supplies battery current output to the headlamp high beam filaments through the high beam relay output circuit.

Because of active electronic elements within the DRL relay, it cannot be tested with conventional automotive electrical test equipment. If the DRL relay is believed to be faulty, replace the relay with a known good unit to confirm system operation.

DAYTIME RUNNING LAMP RELAY (Continued)

REMOVAL

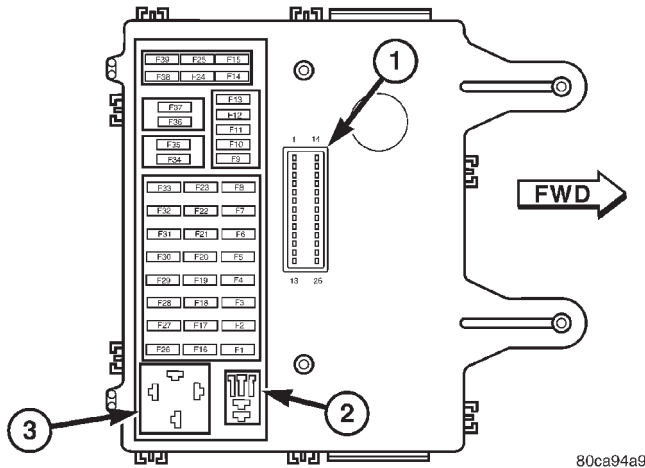
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 end cap from the driver side outboard end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL).
- (3) Remove the Daytime Running Lamp (DRL) relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 9).

INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Position the Daytime Running Lamp (DRL) relay to the proper receptacle in the Junction Block (JB) (Fig. 9).
- (2) Align the DRL relay terminals with the terminal cavities in the JB receptacle.
- (3) Push firmly and evenly on the top of the DRL relay until the terminals are fully seated in the terminal cavities in the JB receptacle.
- (4) Reinstall the end cap onto the driver side outboard end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - INSTALLATION).
- (5) Reconnect the battery negative cable.



**Fig. 9 Junction Block - Outboard Side (RHD Shown - Rotate 180° for LHD)**

- 1 - JB/BCM CONNECTOR
- 2 - HIGH BEAM RELAY
- 3 - DRL RELAY

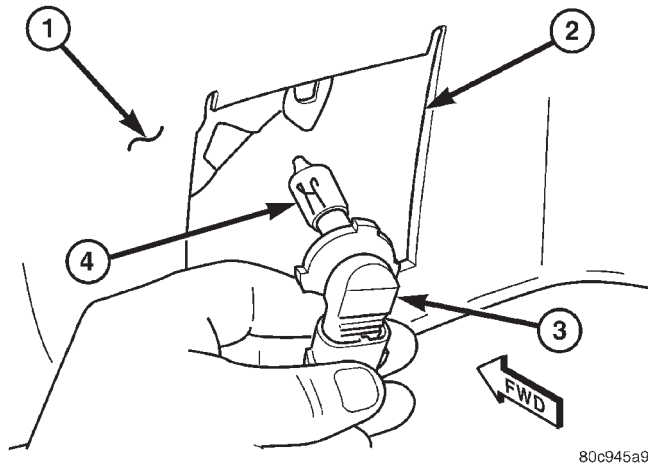
FRONT FOG LAMP BULB

REMOVAL

- (1) Turn the front wheels full lock in the direction of the fog lamp bulb that is to be changed.
- (2) Disconnect and isolate the battery negative cable.
- (3) Reach into the front wheel opening to unsnap and lift the cover over the access hole at the front of the front wheelhouse splash shield (Fig. 10).
- (4) Reach through the access hole and firmly grasp the socket on the back of the front fog lamp unit housing.
- (5) Rotate the socket on the back of the front fog lamp unit housing counterclockwise about 30 degrees.

**CAUTION: Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.**

## FRONT FOG LAMP BULB (Continued)



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**Fig. 10 Front Fog Lamp Bulb Remove/Install**

- 1 - FRONT WHEELHOUSE SPLASH SHIELD
- 2 - ACCESS HOLE
- 3 - SOCKET
- 4 - BULB

(6) Pull the socket and bulb straight out of the front fog lamp unit housing and through the access hole into the front wheel opening area.

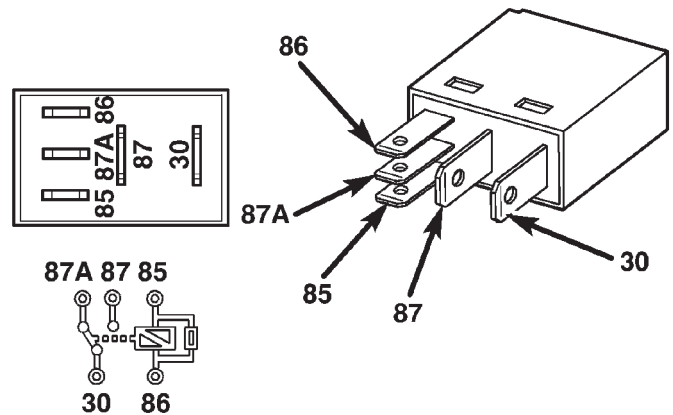
(7) Pull the bulb straight out of the front fog lamp unit socket.

**INSTALLATION**

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

- (1) Align the base of the bulb with the receptacle in the front fog lamp unit socket.
- (2) Push the bulb straight into the front fog lamp unit socket until it is firmly seated.
- (3) Position the socket and bulb through the access hole in the front wheelhouse splash shield and align it with the socket opening on the back of the front fog lamp unit housing (Fig. 10).
- (4) Push the socket and bulb straight into the front fog lamp unit housing until it is firmly seated.
- (5) Rotate the socket on the back of the front fog lamp unit housing clockwise about 30 degrees.
- (6) Lower and snap shut the access cover over the hole at the front of the front wheelhouse splash shield.
- (7) Reconnect the battery negative cable.

**FRONT FOG LAMP RELAY****DESCRIPTION**

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**Fig. 11 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The front fog lamp relay is located in the Junction Block (JB) on the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The front fog lamp relay is a conventional International Standards Organization (ISO) micro relay (Fig. 11). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The front fog lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

**OPERATION**

The front fog lamp relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the front fog lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact

## FRONT FOG LAMP RELAY (Continued)

point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The front fog lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the front fog lamp relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.

- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the premium Body Control Module (BCM) through a front fog lamp relay control circuit. The BCM controls front fog lamp operation by controlling a ground path through this circuit.

- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.

- **Normally Open Terminal** - The normally open terminal (87) is connected to the front fog lamps through a front fog lamp relay output circuit and provides battery current to the front fog lamps whenever the relay is energized.

- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

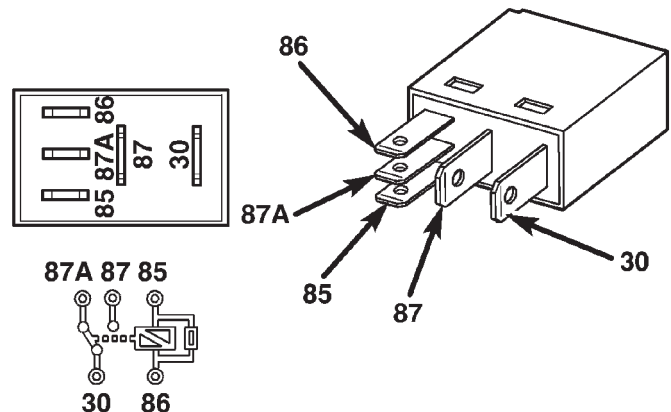
The front fog lamp relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - FRONT FOG LAMP RELAY

The front fog lamp relay (Fig. 12) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACI-**

**TOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



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**Fig. 12 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the front fog lamp relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT FOG LAMP RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.



## FRONT FOG LAMP RELAY (Continued)

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

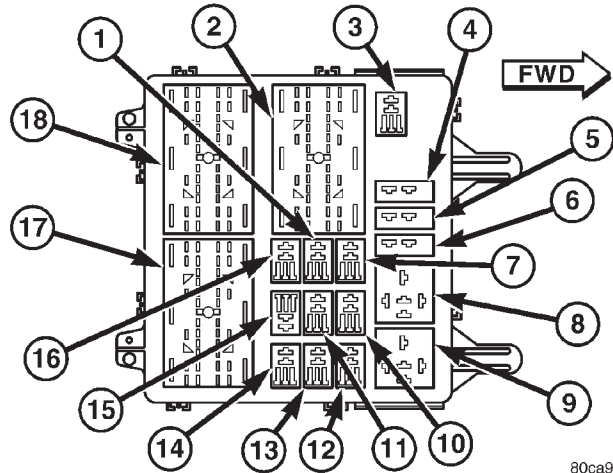
(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the front fog lamp relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 13).

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



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**Fig. 13 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

(1) Position the front fog lamp relay to the proper receptacle in the Junction Block (JB) (Fig. 13).

(2) Align the front fog lamp relay terminals with the terminal cavities in the JB receptacle.

(3) Push firmly and evenly on the top of the front fog lamp relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

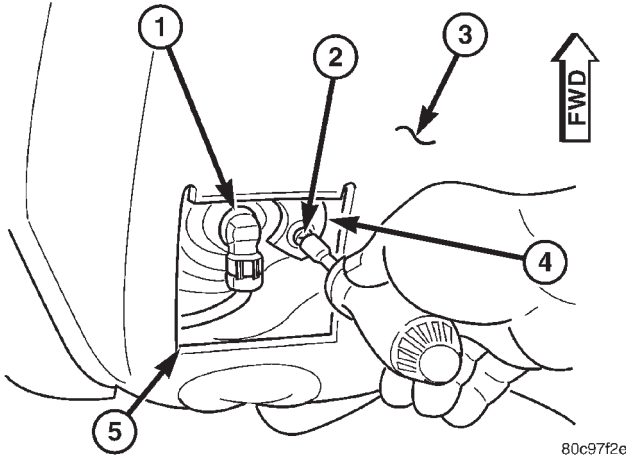
(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.

## FRONT FOG LAMP UNIT

### REMOVAL

- (1) Turn the front wheels full lock in the direction of the fog lamp bulb that is to be changed.
- (2) Disconnect and isolate the battery negative cable.
- (3) Reach into the front wheel opening to unsnap and lift the cover over the access hole at the front of the front wheelhouse splash shield (Fig. 14).



**Fig. 14 Front Fog Lamp Unit Remove/Install**

- 1 - FRONT FOG LAMP UNIT
- 2 - SCREW (3)
- 3 - FRONT WHEELHOUSE SPLASH SHIELD
- 4 - FRONT BUMPER FASCIA
- 5 - ACCESS HOLE

(4) Reach through the access hole to remove the three screws that secure the front fog lamp unit to the front bumper fascia.

(5) From the front of the vehicle, pull the front fog lamp unit out of the front bumper fascia far enough to access and disconnect the wire harness connector for the front fog lamp unit from the lamp socket connector receptacle (Fig. 15).

(6) Remove the front fog lamp unit from the front bumper fascia.

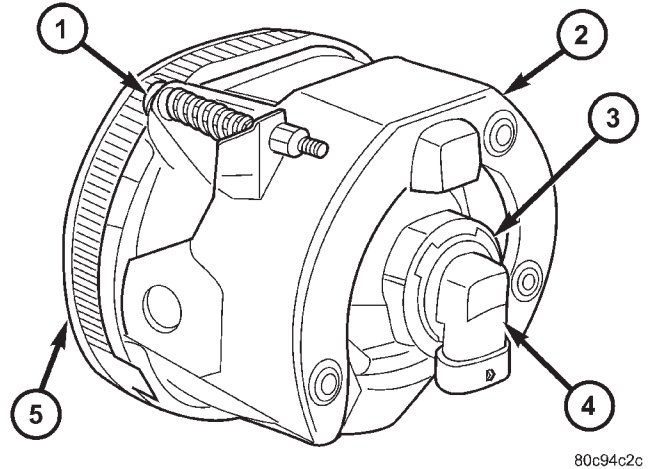
### INSTALLATION

(1) Position the front fog lamp unit to the front bumper fascia.

(2) Reconnect the wire harness connector for the front fog lamp to the lamp socket connector receptacle (Fig. 15).

(3) Position the front fog lamp unit into the front bumper fascia.

(4) Reach into the front wheel opening and through the access hole to install and tighten the three screws that secure the front fog lamp unit



**Fig. 15 Front Fog Lamp Unit**

- 1 - ADJUSTING SCREW
- 2 - MOUNTING BRACKET
- 3 - HOUSING
- 4 - SOCKET & BULB
- 5 - LENS

housing to the front bumper fascia (Fig. 14). Tighten the screws to 3 N·m (25 in. lbs.).

(5) Lower and snap shut the cover over the access hole at the front of the front wheelhouse splash shield.

(6) Reconnect the battery negative cable.

(7) Confirm proper front fog lamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT FOG LAMP UNIT - ADJUSTMENTS).

## ADJUSTMENTS

### ADJUSTMENT - FRONT FOG LAMP UNIT

#### VEHICLE PREPARATION FOR FOG LAMP ALIGNMENT

- (1) Repair or replace any faulty or damaged components that could hinder proper lamp alignment.
- (2) Verify proper tire inflation.
- (3) Clean the front fog lamp lenses.
- (4) Verify that the cargo area is not heavily loaded.
- (5) The fuel tank should be Full. Add 2.94 kilograms (6.5 pounds) of weight over the fuel tank for each estimated gallon of missing fuel.

#### FOG LAMP ALIGNMENT

Prepare an alignment screen as illustrated. A properly aligned front fog lamp will project a pattern on the alignment screen 100 millimeters (4 inches) below the fog lamp centerline and straight ahead of the lamp.

## FRONT FOG LAMP UNIT (Continued)

(1) Position the vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 feet) away from the front of the front fog lamp lens (Fig. 16). If necessary, tape a line on the floor 7.62 meters (25 feet) away from and parallel to the wall.

(2) Measure up on the wall 1.27 meters (5 feet) from the floor and tape a vertical line on the alignment screen at the centerline of the vehicle. Sight along the centerline of the vehicle (from the rear of the vehicle forward) to verify the accuracy of the centerline placement.

(3) Rock the vehicle from side-to-side three times to allow the suspension to stabilize, then jounce the front suspension three times by pushing downward on the front bumper and releasing. Measure the distance from the center of the front fog lamp lens to the floor. Transfer this measurement to the alignment screen and tape a horizontal line on the wall at this mark. This line will be used for up-and-down adjustment reference.

(4) Measure the distance from the centerline of the vehicle to the center of each front fog lamp being

aligned. Transfer these measurements to the alignment screen and tape a vertical line this distance to each side of the vehicle centerline. These lines will be used for left/right reference.

(5) Rotate the front fog lamp adjusting screws to adjust the beam height as required (Fig. 17).

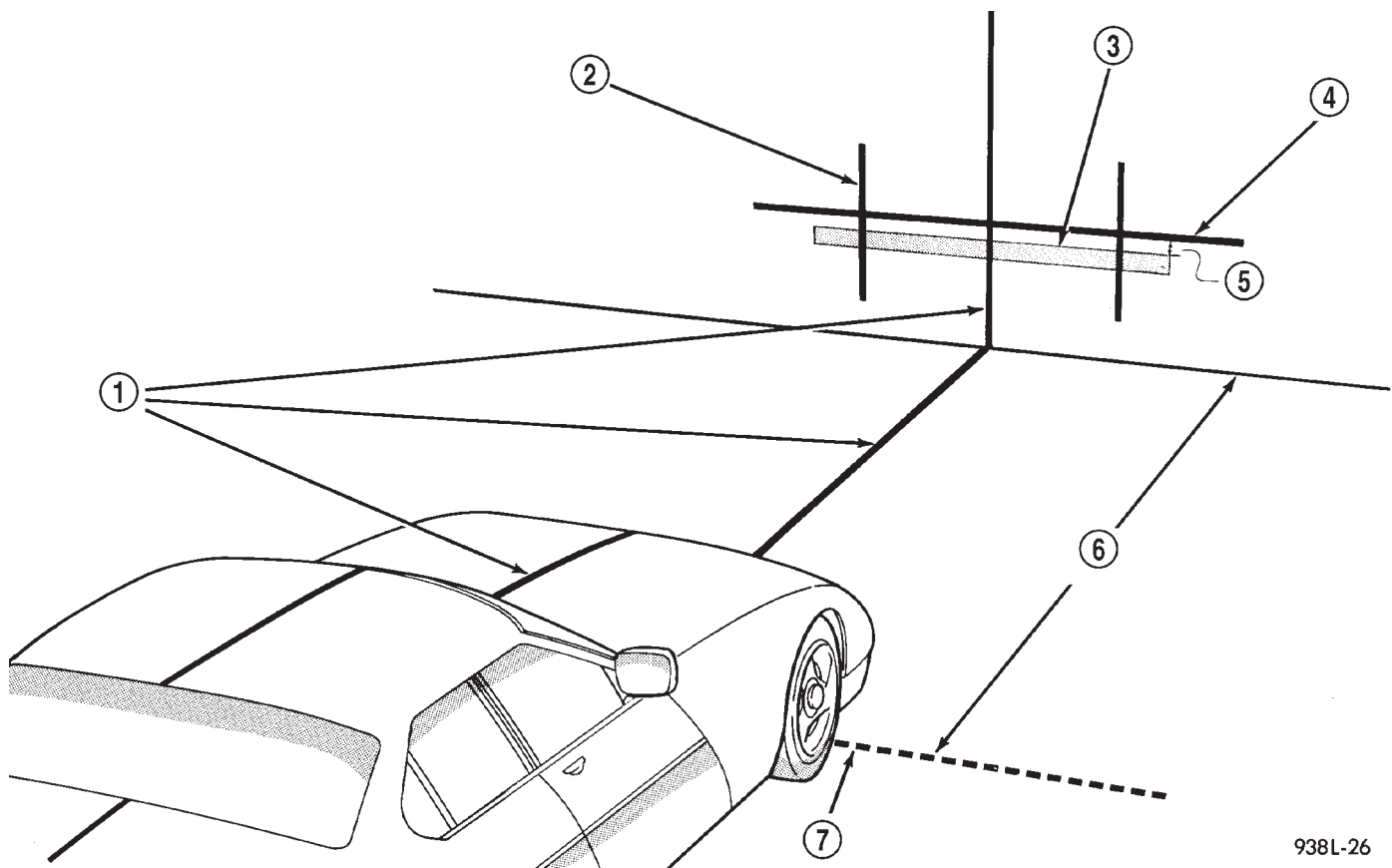
## FRONT LAMP BULB

## REMOVAL

The front lamp unit may contain either one or two bulbs, depending upon the market for which the vehicle was manufactured. The service procedures for one bulb or for both bulbs is the same, only the bulb sizes and types may differ. Be certain any removed bulb is replaced with the same bulb size and type that was removed.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the front lamp unit from the front bumper fascia. (Refer to 8 - ELECTRICAL/LAMPS/



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**Fig. 16 Front Fog Lamp Alignment - Typical**

1 - VEHICLE CENTERLINE

2 - CENTER OF VEHICLE TO CENTER OF FOG LAMP LENS

3 - HIGH-INTENSITY AREA

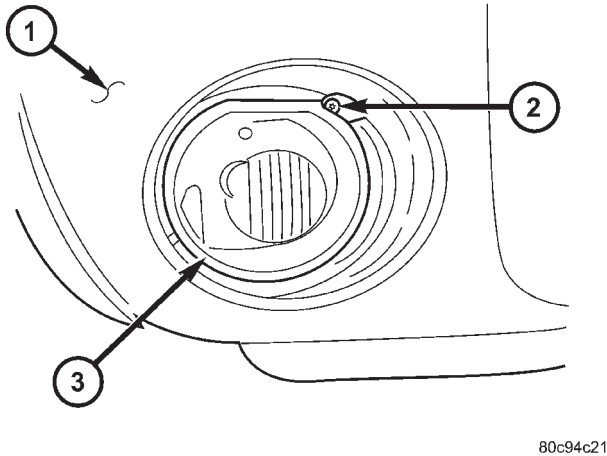
4 - FLOOR TO CENTER OF FOG LAMP LENS

5 - 100 MILLIMETERS (4 INCHES)

6 - 7.62 METERS (25 FEET)

7 - FRONT OF FOG LAMP

FRONT LAMP BULB (Continued)

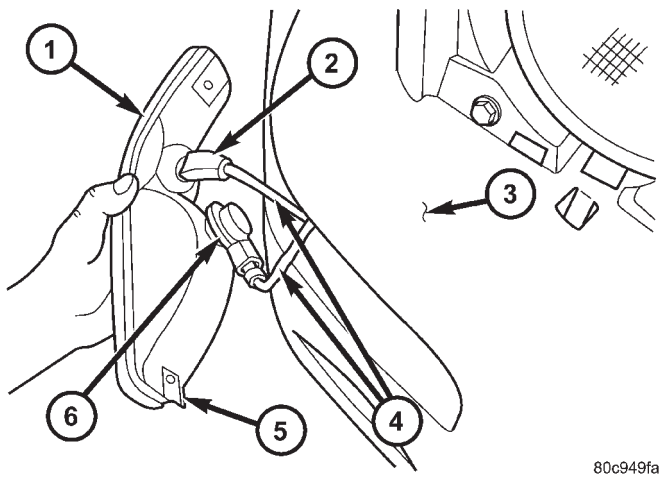


**Fig. 17 Front Fog Lamp Adjusting Screw**

- 1 - FRONT BUMPER FASCIA
- 2 - ADJUSTING SCREW
- 3 - FRONT FOG LAMP UNIT

LIGHTING - EXTERIOR/FRONT LAMP UNIT - REMOVAL).

(3) Firmly grasp the socket on the back of the front lamp unit housing for the bulb that is being removed (Fig. 18).



**Fig. 18 Front Lamp Bulb Remove/Install**

- 1 - FRONT LAMP UNIT
- 2 - SIDE MARKER SOCKET
- 3 - FRONT FASCIA
- 4 - HEADLAMP & DASH WIRE HARNESS
- 5 - MOUNTING TAB
- 6 - PARK/TURN SIGNAL SOCKET

(4) Rotate the socket on the back of the front lamp unit housing counterclockwise about 30 degrees.

(5) Pull the socket and bulb straight out of the back of the front lamp unit housing.

(6) Pull the bulb straight out of the front lamp unit socket.

INSTALLATION

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Align the base of the bulb with the receptacle in the front lamp unit socket.

(2) Push the bulb straight into the front lamp unit socket until it is firmly seated.

(3) Align the socket and bulb with the socket opening on the back of the front lamp unit housing (Fig. 18).

(4) Push the socket and bulb straight into the front lamp unit housing until it is firmly seated.

(5) Rotate the socket on the back of the front lamp unit housing clockwise about 30 degrees.

(6) Reinstall the front lamp unit into the front bumper fascia. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT LAMP UNIT - INSTALLATION).

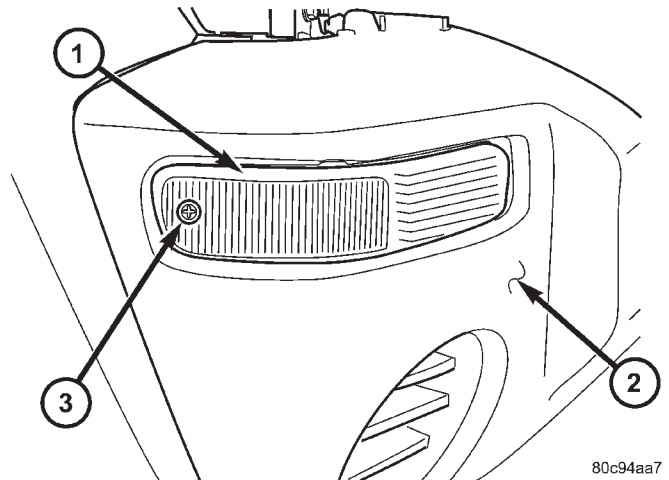
(7) Reconnect the battery negative cable.

FRONT LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the screw that secures the outboard end of the front lamp unit to the front bumper fascia (Fig. 19).



**Fig. 19 Front Lamp Unit Remove/Install**

- 1 - FRONT LAMP UNIT
- 2 - FRONT BUMPER FASCIA
- 3 - SCREW (1)

(3) Pull the outboard end of the front lamp unit away from the front bumper fascia far enough to dis-

## FRONT LAMP UNIT (Continued)

engage the tab on the inboard end of the front lamp unit housing from the receptacle in the fascia.

(4) Pull the front lamp unit away from the front bumper fascia far enough to access and disconnect the wire harness connector(s) for the front lamp unit from the lamp socket pigtail wire(s).

(5) Remove the front lamp unit from the front bumper fascia.

## INSTALLATION

(1) Position the front lamp unit to the front bumper fascia.

(2) Reconnect the wire harness connector(s) for the front lamp unit to the lamp socket pigtail wire(s).

(3) Engage the tab on the inboard end of the front lamp unit housing into the receptacle in the front bumper fascia.

(4) Position the outboard end of the front lamp unit housing to the front bumper fascia.

(5) Install and tighten the screw that secures the outboard end of the front lamp unit housing to the front bumper fascia (Fig. 19). Tighten the screw to 2 N·m (20 in. lbs.).

(6) Reconnect the battery negative cable.

## FRONT POSITION LAMP BULB

## REMOVAL

The front position lamps are integral to the headlamp units on vehicles manufactured for certain markets where these lamps are required.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the headlamp unit from the front grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL).

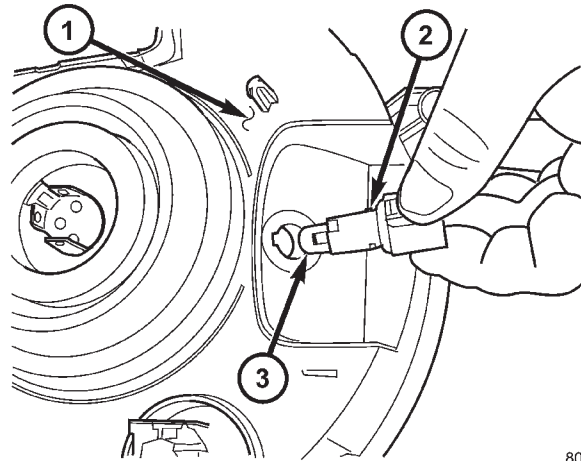
(3) Rotate the front position lamp socket near the bottom of the headlamp unit housing counterclockwise about 30 degrees (Fig. 20).

(4) Pull the socket and bulb straight out of the headlamp unit housing.

(5) Pull the bulb straight out of the front position lamp socket.

## INSTALLATION

The front position lamps are integral to the headlamp units on vehicles manufactured for certain markets where these lamps are required.



80c9ba39

**Fig. 20 Front Position Lamp Bulb Remove/Install**

1 - HEADLAMP HOUSING

2 - SOCKET

3 - BULB

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Align the base of the bulb with the receptacle in the front position lamp socket.

(2) Push the bulb straight into the front position lamp socket until it is firmly seated.

(3) Align the socket and bulb with the socket opening near the bottom of the headlamp unit housing (Fig. 20).

(4) Push the socket and bulb straight into the headlamp unit housing until it is firmly seated.

(5) Rotate the front position lamp socket near the bottom of the headlamp unit housing clockwise about 30 degrees.

(6) Reinstall the headlamp unit onto the grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION).

(7) Reconnect the battery negative cable.

(8) Confirm proper headlamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS).

## HAZARD SWITCH

### DESCRIPTION

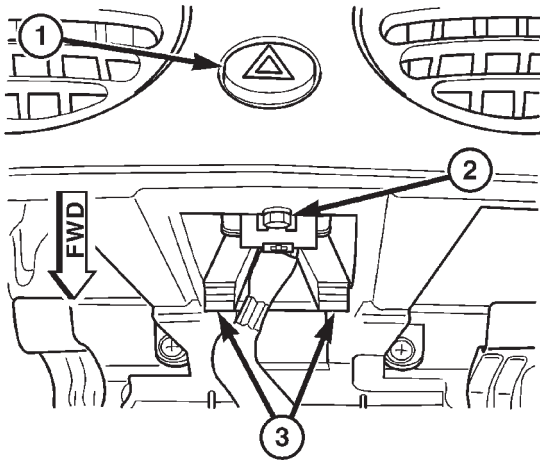


Fig. 21 Hazard Switch

80c880ef

- 1 - HAZARD SWITCH BUTTON
- 2 - SCREW (1)
- 3 - MOUNTING BRACKET TABS

The hazard switch is integral to the hazard switch module, which is secured near the center of instrument panel just above the radio (Fig. 21). Only the hazard switch button is visible through a dedicated, round, beveled opening on the outer surface of the instrument panel between the two center panel outlets of the heater and air conditioning system. A red, stencil-like International Control and Display Symbol icon for "Hazard Warning" identifies the hazard switch button. On the opposite end of the black, molded plastic hazard switch module housing from the switch button is an integral connector receptacle and a stamped steel mounting bracket with two latch feature tabs that extend downward, while a short dowel-like alignment pin is integral to each side of the housing just below the switch button. The switch module is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. Within the hazard switch module housing is the hazard switch circuitry and an electronic circuit board with the integral combination flasher circuitry. The electronic combination flasher circuitry performs both the hazard flasher and turn signal flasher functions.

The hazard switch module cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

### OPERATION

The hazard switch button is slightly recessed in the instrument panel when the switch is in the Off position, and latches at a position that is flush with the outer surface of the instrument panel when in the On posi-

tion. The hazard switch module produces an audible clicking sound that emulates the sound of a conventional flasher whenever the turn signals or the hazard warning system are activated. The hazard switch module receives battery current on a fused B(+) circuit from a fuse in the Junction Block (JB) at all times for operation of the hazard warning, and on a fused ignition switch output (run) circuit from another fuse in the JB whenever the ignition switch is in the On position for operation of the turn signals. The module receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the JB. Inputs to and outputs from the hazard switch module include:

- **Panel Lamps Dimmer Input** - A non-serviceable incandescent bulb soldered onto the hazard switch module circuit board provides illumination of the switch button when the exterior lighting is turned On through an input received on the fused panel lamps dimmer switch signal circuit. However, this bulb flashes on and off at full intensity whenever the hazard switch button is in the On position, regardless of the status of the exterior lighting.

- **Hazard Switch Input** - The combination flasher circuitry of the hazard switch module receives an internal ground input from the hazard switch to request hazard flasher operation.

- **Multi-Function Switch Input** - The combination flasher circuitry of the hazard switch module receives separate ground inputs from the turn signal switch circuitry of the multi-function switch on right and left turn switch sense circuits to request right or left turn signal flasher operation.

- **Body Control Module Input** - The Body Control Module (BCM) can request hazard flasher operation by providing a ground path to the combination flasher circuitry of the hazard switch module through a hazard lamp control circuit.

- **Turn Signal Output** - The combination flasher circuitry within the hazard switch module responds to the flasher request inputs by energizing and de-energizing two miniature relays on the module circuit board. These relays control the switch output through the right and left turn signal circuits. One relay controls the right lamps, while the other controls the left.

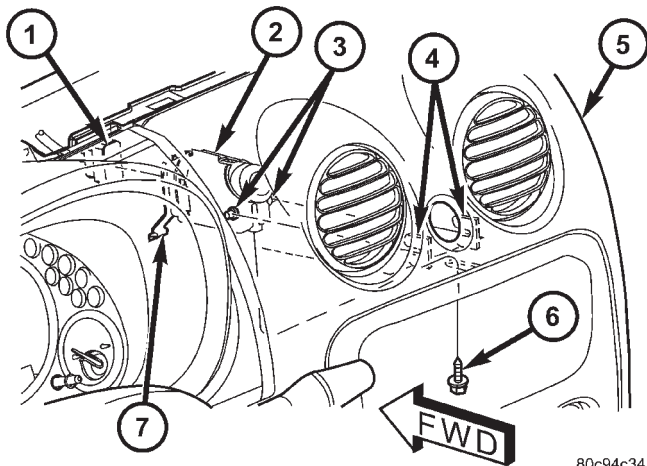
Because of active electronic elements within the hazard switch module, it cannot be tested with conventional automotive electrical test equipment. If the hazard switch module is believed to be faulty, replace the switch with a known good unit to confirm system operation.

## HAZARD SWITCH (Continued)

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 radio from the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).
- (3) Remove the screw at the top of the instrument panel radio opening that secures the hazard switch to the instrument panel trim (Fig. 22).



**Fig. 22 Hazard Switch Remove/Install**

- 1 - WIRE HARNESS CONNECTOR
- 2 - HAZARD SWITCH
- 3 - ALIGNMENT PIN (2)
- 4 - STANCHION (2)
- 5 - INSTRUMENT PANEL
- 6 - SCREW (1)
- 7 - MOUNTING BRACKET LATCH TAB (2)

(4) Reach through and above the instrument panel radio opening to access the two latch tabs of the stamped metal hazard switch mounting bracket.

(5) Using two fingertips, pull rearward and downward on the latch tabs on the back of the hazard switch until it is disengaged from the instrument panel trim.

(6) Push the hazard switch button through the button opening of the instrument panel far enough to disengage the alignment pins on each side of the switch housing from the saddle formations of the two stanchions on the back of the instrument panel trim, just below and to either side of the button opening.

(7) Disconnect the instrument panel wire harness connector for the hazard switch from the switch connector receptacle.

(8) Remove the hazard switch through the instrument panel radio opening.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the hazard switch through the instrument panel radio opening.

(2) Reconnect the instrument panel wire harness connector for the hazard switch to the switch connector receptacle.

(3) Reach through and above the instrument panel radio opening to position the hazard switch for installation.

(4) Guide the hazard switch button through the button opening of the instrument panel, which will engage the alignment pins on each side of the switch housing with the saddle formations of the two stanchions on the back of the instrument panel trim, just below and to either side of the button opening.

(5) Using hand pressure, press upward on the back of the hazard switch until the latch tabs of the mounting bracket on the back of the switch are both engaged with the instrument panel trim (Fig. 22).

(6) Install and tighten the screw at the top of the instrument panel radio opening that secures the hazard switch to the instrument panel trim. Tighten the screw to 2 N·m (17 in. lbs.).

(7) Reinstall the radio into the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(8) Reconnect the battery negative cable.

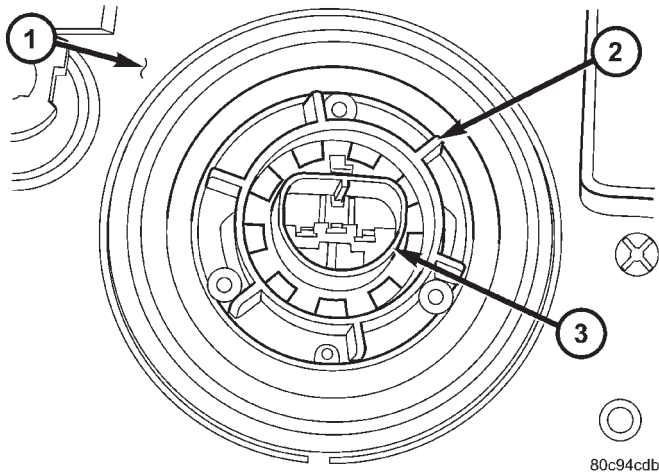
# HEADLAMP BULB

## REMOVAL

### NORTH AMERICA

(1) Disconnect and isolate the battery negative cable.

(2) Reach behind the headlamp unit from the engine compartment side of the upper radiator cross-member to access the headlamp bulb lock ring (Fig. 23).



**Fig. 23 Headlamp Bulb Lock Ring**

- 1 - HEADLAMP UNIT HOUSING
- 2 - LOCK RING
- 3 - SOCKET & BULB

(3) Firmly grasp the lock ring on the back of the headlamp unit housing.

(4) Rotate the lock ring on the back of the headlamp unit housing counterclockwise about 30 degrees.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

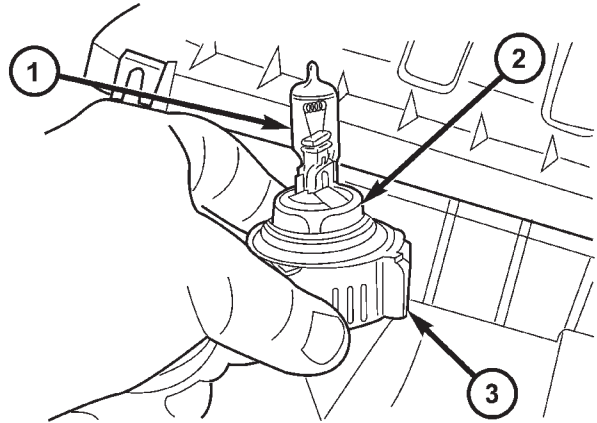
(5) Pull the lock ring, socket, and bulb straight out of the headlamp unit housing and up from behind the upper radiator crossmember (Fig. 24).

(6) Disconnect the grille opening reinforcement wire harness connector for the headlamp bulb from the connector receptacle on the bulb socket.

(7) Remove the bulb and bulb socket from the lock ring as a unit.

### REST-OF-WORLD

(1) Disconnect and isolate the battery negative cable.

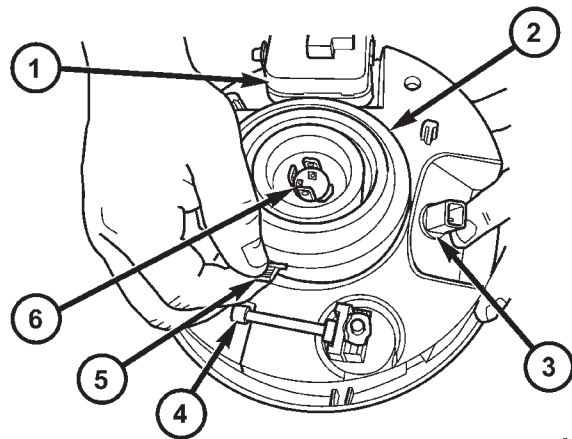


**Fig. 24 Headlamp Bulb Remove/Install**

- 1 - HEADLAMP BULB
- 2 - SOCKET
- 3 - LOCK RING

(2) Remove the headlamp unit from the grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL).

(3) Firmly grasp the tab of the headlamp boot seal on the back of the headlamp unit housing (Fig. 25).



**Fig. 25 Headlamp Bulb Boot Seal Remove**

- 1 - LEVELING MOTOR (IF EQUIPPED)
- 2 - BOOT SEAL
- 3 - FRONT POSITION LAMP
- 4 - ADJUSTING SCREW
- 5 - TAB
- 6 - BULB BASE

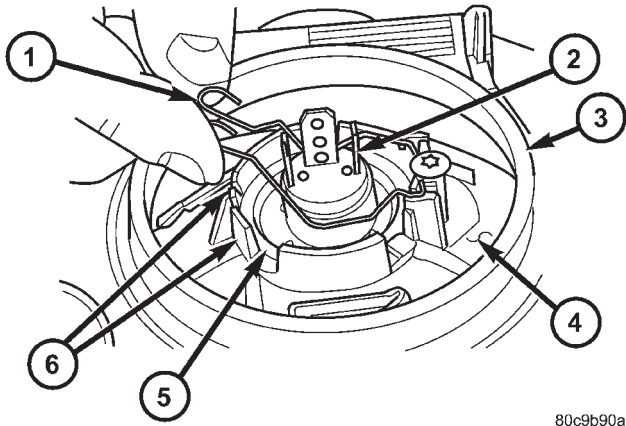
(4) Pull the tab away from the back of the headlamp unit housing to remove the boot seal from the housing and the bulb base.



## HEADLAMP BULB (Continued)

(5) Pinch the two hooked ends of the wire headlamp bulb retainer clip together and disengage them from the slots in the flange of the reflector (Fig. 26).

(6) Pivot the headlamp bulb retainer clip up off of



**Fig. 26 Headlamp Bulb Retainer Clip Engage/Disengage**

- 1 - RETAINER CLIP
- 2 - BULB BASE
- 3 - HEADLAMP HOUSING
- 4 - REFLECTOR
- 5 - BULB FLANGE
- 6 - RETAINER SLOTS

the bulb flange and out of the way.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

(7) Pull the bulb straight out of the headlamp unit reflector (Fig. 27).

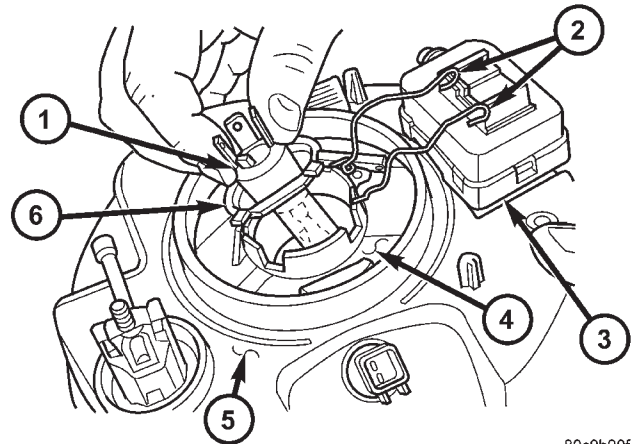
## INSTALLATION

### NORTH AMERICA

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

(1) Position the headlamp bulb and socket unit into the lock ring (Fig. 24).



**Fig. 27 Headlamp Bulb Remove/Install**

- 1 - BULB BASE
- 2 - RETAINER CLIP
- 3 - LEVELING MOTOR (IF EQUIPPED)
- 4 - REFLECTOR
- 5 - HEADLAMP HOUSING
- 6 - BULB FLANGE

(2) Reconnect the grille opening reinforcement wire harness connector for the headlamp bulb to the connector receptacle on the bulb socket.

(3) Position the lock ring, socket, and bulb down behind the upper radiator crossmember and align them with the socket opening on the back of the headlamp unit housing.

(4) Push the socket and bulb straight into the headlamp unit housing until they are firmly seated.

(5) Position the lock ring over the socket and engage it with the flange on the back of the headlamp unit housing (Fig. 23).

(6) Rotate the lock ring on the back of the headlamp unit housing clockwise about 30 degrees.

(7) Reconnect the battery negative cable.

### REST-OF-WORLD

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

(1) Position the bulb into the headlamp unit reflector (Fig. 27).

(2) Pivot the headlamp bulb retainer clip back over the bulb flange.

HEADLAMP BULB (Continued)

(3) Pinch the two hooked ends of the wire headlamp bulb retainer clip together and engage them into the slots in the flange of the reflector (Fig. 26).

(4) Position the center opening of the boot seal over the base of the headlamp bulb and pull it downward until the seal is fully engaged over the bulb base (Fig. 25).

(5) Position the outer circumference of the boot seal over the flange on the back of the headlamp unit housing and pull it downward until the seal is fully engaged over the flange.

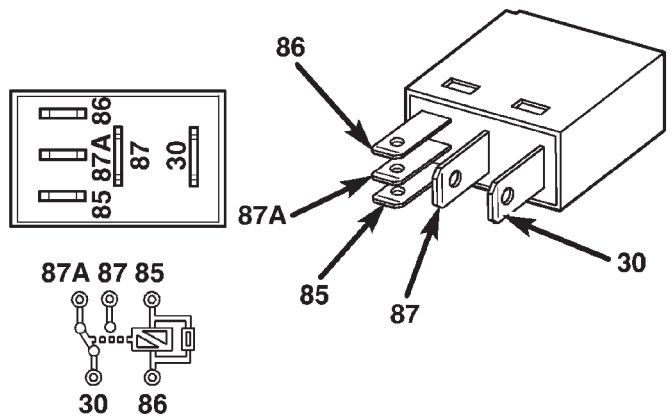
(6) Reinstall the headlamp unit onto the grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION).

(7) Reconnect the battery negative cable.

(8) Confirm proper headlamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS).

HEADLAMP HIGH BEAM RELAY

DESCRIPTION



80ce807b

Fig. 28 ISO Micro Relay

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The headlamp high beam relay is located in the Junction Block (JB) on the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The headlamp high beam relay is omitted from vehicles manufactured for sale in Canada, which have a Daytime Running Lamp (DRL) solid state relay installed in the JB that also per-

forms the function of the headlamp high beam relay. The headlamp high beam relay is a conventional International Standards Organization (ISO) micro relay (Fig. 28). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The headlamp high beam relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

The headlamp high beam relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the headlamp high beam filaments. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The headlamp high beam relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the headlamp high beam relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) receives battery current at all times from a fuse in the PDC through a fused B(+) circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) is connected to a control output of the Body Control Module (BCM) and to the momentary optical horn (flash-to-pass) output of the multi-function switch through a high beam relay control circuit. The BCM and/or the multi-function switch controls headlamp high beam operation by controlling a ground path through this circuit.

## HEADLAMP HIGH BEAM RELAY (Continued)

• **Normally Open Terminal** - The normally open terminal (87) is connected to the headlamp high beam filaments through the high beam relay output circuit and provides battery current to the headlamp high beams whenever the relay is energized.

• **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

The headlamp high beam relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - HEADLAMP HIGH BEAM RELAY

The headlamp high beam relay (Fig. 29) is located in the Junction Block (JB) on the driver side out-board end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

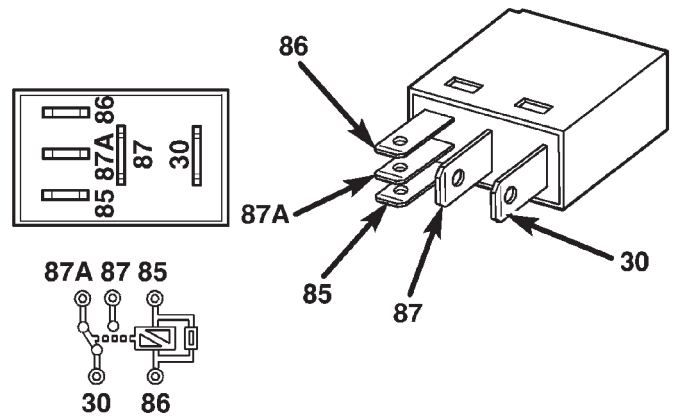
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the headlamp high beam relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP HIGH BEAM RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII®



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**Fig. 29 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

scan tool to perform further testing. Refer to the appropriate diagnostic information.

## REMOVAL

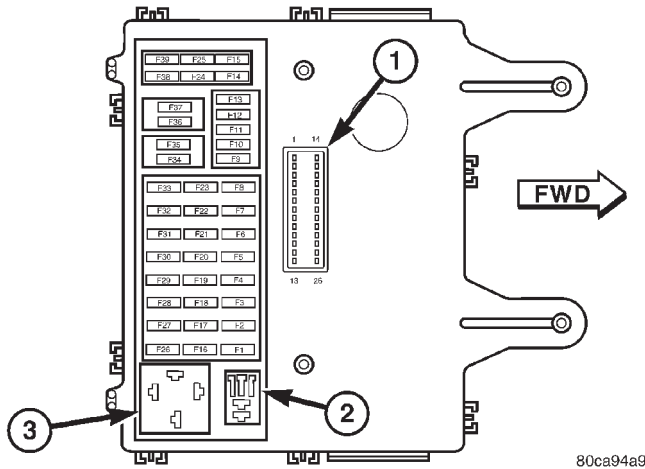
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 end cap from the driver side out-board end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL).

(3) Remove the headlamp high beam relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 30).

HEADLAMP HIGH BEAM RELAY (Continued)



80ca94a9

**Fig. 30 Junction Block - Outboard Side (RHD Shown - Rotate 180° for LHD)**

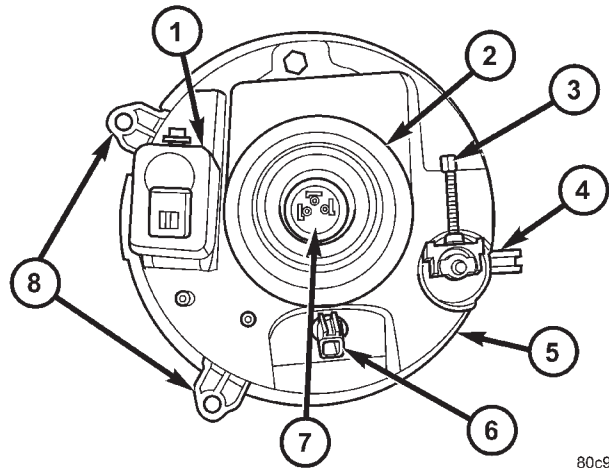
- 1 - JB/BCM CONNECTOR
- 2 - HIGH BEAM RELAY
- 3 - DRL RELAY

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Position the headlamp high beam relay to the proper receptacle in the Junction Block (JB) (Fig. 30).
- (2) Align the headlamp high beam relay terminals with the terminal cavities in the JB receptacle.
- (3) Push firmly and evenly on the top of the headlamp high beam relay until the terminals are fully seated in the terminal cavities in the JB receptacle.
- (4) Reinstall the end cap onto the driver side outboard end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - INSTALLATION).
- (5) Reconnect the battery negative cable.

**HEADLAMP LEVELING MOTOR DESCRIPTION**



80c9be96

**Fig. 31 Headlamp Unit - With Leveling**

- 1 - LEVELING MOTOR (IF EQUIPPED)
- 2 - BOOT SEAL
- 3 - ADJUSTING SCREW
- 4 - LOCATOR TAB
- 5 - HOUSING
- 6 - FRONT POSITION LAMP SOCKET & BULB
- 7 - HEADLAMP BULB
- 8 - MOUNTING TAB (2)

The headlamp leveling motor is located on the rear inboard side of each headlamp unit on models equipped with the headlamp leveling system, which is available only in certain markets where required (Fig. 31). The motor is encased within a molded plastic housing and is secured by an integral wedge-type mounting boss on its forward surface to a flanged receptacle on the back of the headlamp unit housing. A rubber seal around the circumference of the mounting boss is compressed and seals the motor to the headlamp unit when the boss is properly installed in the flanged receptacle. The outside of the motor housing features an integral molded connector receptacle on its rearward surface, a hex-headed adjusting screw extends from the top of the housing, and a plastic pushrod with a ball formation on its free end extends from the center of the mounting boss at the front. Within the motor housing is a 12-volt Direct Current (DC) servo motor, an electronic controller board that includes the motor logic circuits, and an integral screw-drive transmission. The headlamp leveling motor is connected to the vehicle electrical system through a dedicated take out and connector of the front fascia wire harness.

The headlamp leveling motor cannot be repaired and, if faulty or damaged, the unit must be replaced.

## HEADLAMP LEVELING MOTOR (Continued)

## OPERATION

The controller board and logic circuitry of the headlamp leveling motor will energize the motor and extend or retract the motor pushrod through the integral screw-drive transmission based upon the voltage signal input received from the resistor multiplexed headlamp leveling switch. The ball formation on the end of the headlamp leveling motor pushrod is snapped into a socket formation on the back of the movable reflector within the headlamp unit housing. The headlamp leveling motors and switch have a path to ground at all times. The headlamp leveling components operate on battery current received through the fused park lamp relay output circuit so that the system will only operate when the exterior lighting is turned On.

Because of active electronic elements within the headlamp leveling motor, it cannot be tested with conventional automotive electrical test equipment. If the headlamp leveling motor is believed to be faulty, replace the motor with a known good unit to confirm system operation.

## REMOVAL

The headlamp leveling motors are integral to the headlamp units on vehicles manufactured for certain markets where headlamp leveling is required.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the headlamp bulb from the headlamp unit housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP BULB - REMOVAL).

(3) Rotate the headlamp leveling motor on the back of the headlamp unit housing counterclockwise about 30 degrees (Fig. 32).

(4) Firmly grasp the motor with one hand while stabilizing the headlamp unit housing with the other hand.

(5) Firmly, steadily, and forcefully pull the headlamp leveling motor straight away from the back of the headlamp unit housing to unsnap the ball formation on the end of the motor pushrod from the socket on the headlamp unit reflector (Fig. 33).

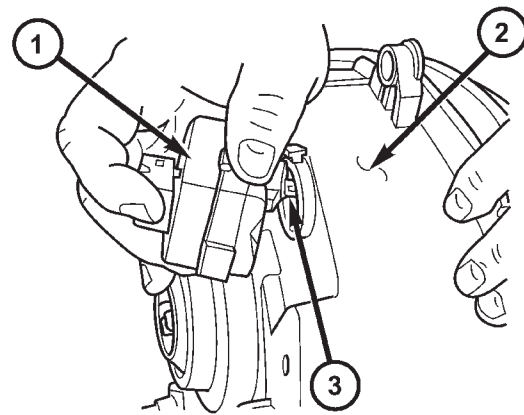
(6) Remove the headlamp leveling motor and pushrod from the back of the headlamp unit housing.

## INSTALLATION

The headlamp leveling motors are integral to the headlamp units on vehicles manufactured for certain markets where headlamp leveling is required.

(1) Position the headlamp leveling motor and pushrod from to the mounting hole on the back of the headlamp unit housing.

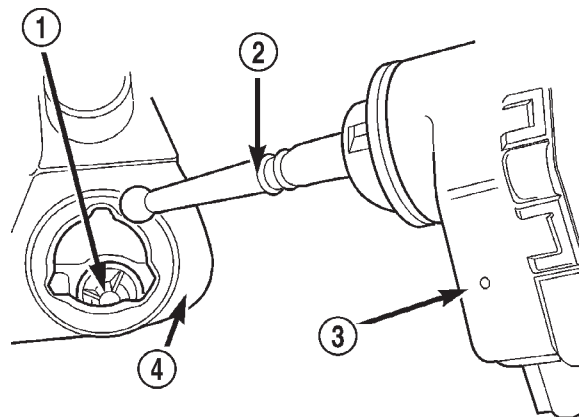
(2) Insert two fingers through the bulb mounting hole in the center of the headlamp reflector and pull



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**Fig. 32 Headlamp Leveling Motor Remove/Install**

- 1 - LEVELING MOTOR
- 2 - HEADLAMP HOUSING
- 3 - PUSHROD



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**Fig. 33 Leveling Motor Pushrod - Typical**

- 1 - REFLECTOR PUSHROD SOCKET
- 2 - PUSHROD
- 3 - LEVELING MOTOR
- 4 - HEADLAMP HOUSING

the reflector upwards toward the headlamp leveling motor.

(3) Align the ball formation on the end of the leveling motor pushrod with the socket on the headlamp unit reflector (Fig. 33).

(4) While continuing to pulling the reflector toward the motor, firmly, steadily, and forcefully push the headlamp leveling motor straight into the back of the headlamp unit housing to snap the ball formation on the end of the motor pushrod into the socket on the headlamp unit reflector.

(5) After the pushrod is engaged to the reflector, remove your fingers from the bulb mounting hole in

## HEADLAMP LEVELING MOTOR (Continued)

the center of the headlamp reflector and thoroughly clean any fingerprints from the reflector.

(6) Push the mounting flange of the headlamp leveling motor into the mounting hole on the back of headlamp unit housing unit the motor is firmly seated (Fig. 32).

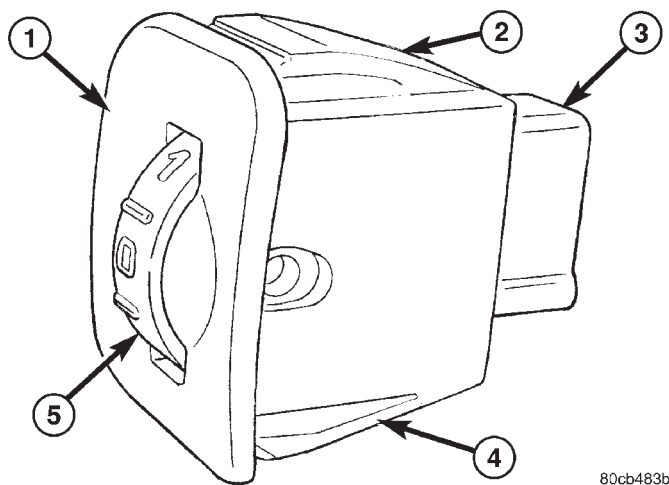
(7) Rotate the headlamp leveling motor on the back of the headlamp unit housing clockwise about 30 degrees.

(8) Reinstall the headlamp bulb into the headlamp unit housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP BULB - INSTALLATION).

(9) Reconnect the battery negative cable.

## HEADLAMP LEVELING SWITCH

## DESCRIPTION



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**Fig. 34 Headlamp Leveling Switch**

- 1 - SWITCH
- 2 - UPPER LATCH FEATURE (1)
- 3 - CONNECTOR RECEPTACLE
- 4 - LOWER LATCH FEATURE (2)
- 5 - THUMBWHEEL

The headlamp leveling switch (Fig. 34) is used only on vehicles manufactured for certain markets where the headlamp leveling system is required. The headlamp leveling switch is mounted in the driver side inboard trim bezel on the instrument panel, where it is secured by molded latch features that are integral to the switch housing. Only the switch bezel and thumbwheel are visible on the outer surface of the instrument panel trim bezel. The black plastic switch thumbwheel is marked with white numbers "0," "1," "2," and "3," each of which indicates one of the four switch detent positions. Each higher number repre-

sents a lower aiming position of the headlamp beam relative to the road surface. The black, molded plastic switch housing has an integral connector receptacle on the back, a single latch feature on the top, and two latch features (one on each side) on the bottom. The switch is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. Within the switch housing is the leveling switch circuitry including the switch contacts and a series resistor configuration.

The headlamp leveling switch cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The headlamp leveling switch receives battery current on a fused park lamp relay output circuit from a fuse in the Junction Block (JB) whenever the park lamp relay is energized (park lamps are turned On). The switch receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the JB. The only output from the switch is a voltage signal that it provides to the headlamp leveling motors on a headlamp adjust signal circuit. Each switch position selects a different tap on a series resistor within the switch to provide a different voltage signal to the leveling motors. The higher the switch position number, the higher the output voltage level.

The headlamp leveling switch can be tested using conventional diagnostic tools and methods.

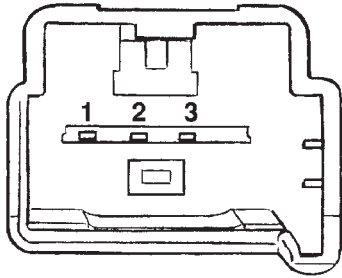
## DIAGNOSIS AND TESTING - HEADLAMP LEVELING SWITCH

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## HEADLAMP LEVELING SWITCH (Continued)

(1) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the headlamp leveling switch from the switch connector receptacle.

(2) Using an ohmmeter, perform the resistance tests at the terminal pins in the headlamp leveling switch connector receptacle (Fig. 35) as shown in the Headlamp Leveling Switch Tests table.



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**Fig. 35 Headlamp Leveling Switch Connector Receptacle**

HEADLAMP LEVELING SWITCH TESTS	
SWITCH POSITION	RESISTANCE (OHMS) BETWEEN PINS 1 & 3
0	0.5 ± 0.5
1	301 ± 1
2	595 ± 1
3	739 ± 1

(3) If the switch fails any of the resistance tests, replace the faulty headlamp leveling switch as required.

## REMOVAL

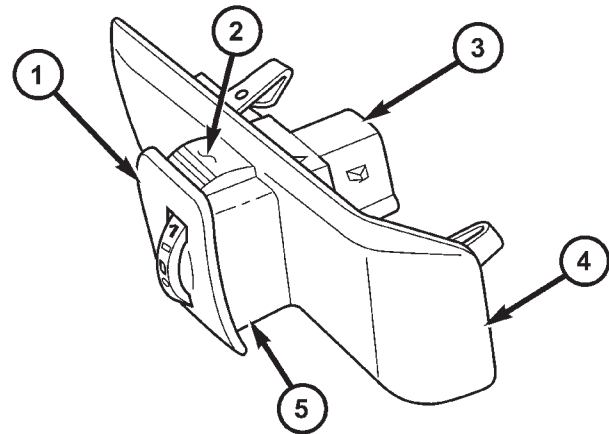
The headlamp leveling switch is used only on vehicles manufactured for certain markets where headlamp leveling is required.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 driver side inboard bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVER SIDE BEZEL - REMOVAL).

(3) Disconnect the instrument panel wire harness connector for the headlamp leveling switch from the switch connector receptacle (Fig. 36).



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**Fig. 36 Headlamp Leveling Switch Remove/Install**

- 1 - HEADLAMP LEVELING SWITCH
- 2 - UPPER LATCH TAB
- 3 - RECEPTACLE
- 4 - DRIVER SIDE INBOARD BEZEL
- 5 - LOWER LATCH TAB (2)

(4) From the back of the trim bezel, depress the two lower latch features on the headlamp leveling switch housing and rock the bottom of the switch out through the face of the bezel.

(5) From the back of the trim bezel, depress the upper latch feature on the headlamp leveling switch housing and push the switch out through the face of the bezel.

## INSTALLATION

The headlamp leveling switch is used only on vehicles manufactured for certain markets where headlamp leveling is required.

## HEADLAMP LEVELING SWITCH (Continued)

**WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) From the face of the driver side inboard bezel, align the headlamp leveling switch housing to the mounting hole in the bezel (Fig. 36).

(2) Push the headlamp leveling switch into the mounting hole until it is fully seated and the upper latch and two lower latch features on the switch housing are engaged on the back of the bezel.

(3) Position the switch and bezel unit to the instrument panel.

(4) Reconnect the instrument panel wire harness connector for the headlamp leveling switch to the switch connector receptacle.

(5) Reinstall the driver side inboard bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVER SIDE BEZEL - INSTALLATION).

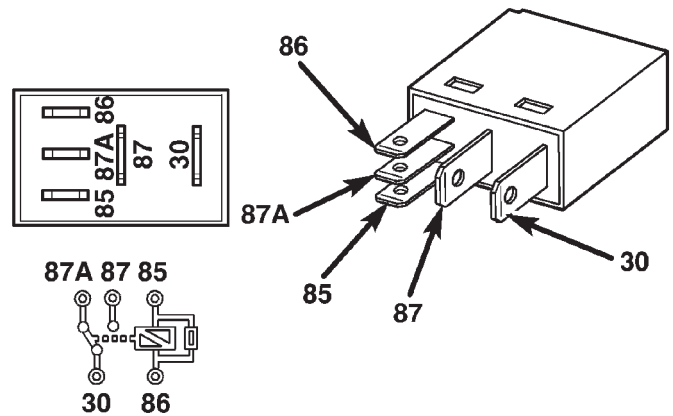
(6) Reconnect the battery negative cable.

## HEADLAMP LOW BEAM RELAY

### DESCRIPTION

The headlamp low beam relay is located in the Junction Block (JB) below the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The headlamp low beam relay is a conventional International Standards Organization (ISO) micro relay (Fig. 37). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The headlamp low beam relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.



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**Fig. 37 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

### OPERATION

The headlamp low beam relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the headlamp low beam filaments. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The headlamp low beam relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the headlamp low beam relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) receives battery current at all times from a fuse in the PDC through a fused B(+) circuit.



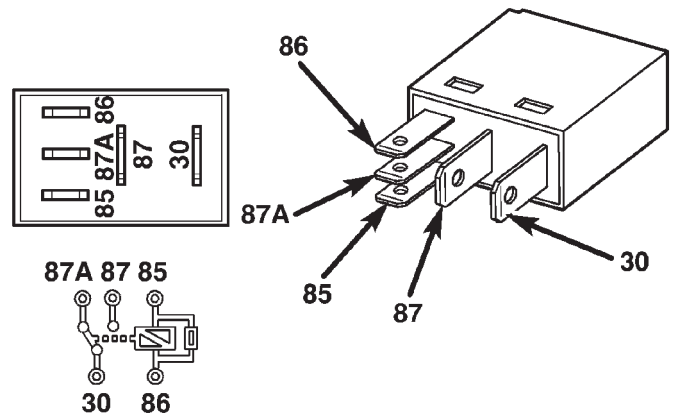
## HEADLAMP LOW BEAM RELAY (Continued)

- **Coil Battery Terminal** - The coil battery terminal (86) is connected to a control output of the Body Control Module (BCM) through a low beam relay control circuit. The BCM controls headlamp low beam operation by controlling a ground path through this circuit.

- **Normally Open Terminal** - The normally open terminal (87) is connected to the headlamp low beam filaments through the low beam relay output circuit and provides battery current to the headlamp low beams whenever the relay is energized.

- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

The headlamp low beam relay can be diagnosed using conventional diagnostic tools and methods.



80ce807b

**Fig. 38 ISO Micro Relay**

## DIAGNOSIS AND TESTING - HEADLAMP LOW BEAM RELAY

The headlamp low beam relay (Fig. 38) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the headlamp low beam relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP LOW BEAM RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

HEADLAMP LOW BEAM RELAY (Continued)

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the headlamp low beam relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 39).

**OTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

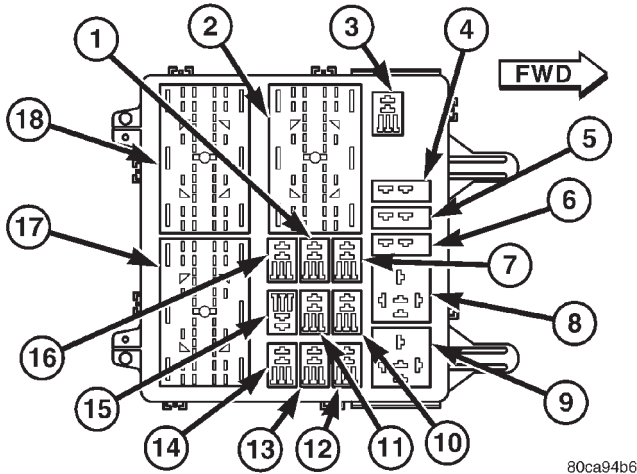
(1) Position the headlamp low beam relay to the proper receptacle in the Junction Block (JB) (Fig. 39).

(2) Align the headlamp low beam relay terminals with the terminal cavities in the JB receptacle.

(3) Push firmly and evenly on the top of the headlamp low beam relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.



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**Fig. 39 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FUR-**

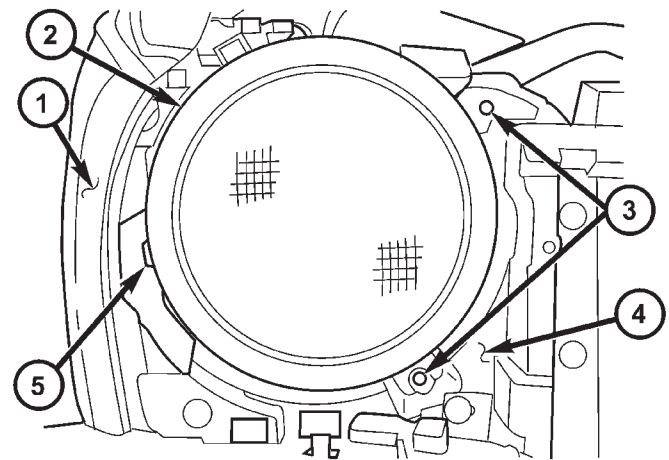
**HEADLAMP UNIT**

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the grille panel from the grille opening reinforcement. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL).

(3) Remove the two screws that secure the mounting tabs on the inboard side of the headlamp unit housing to the grille opening reinforcement (Fig. 40).



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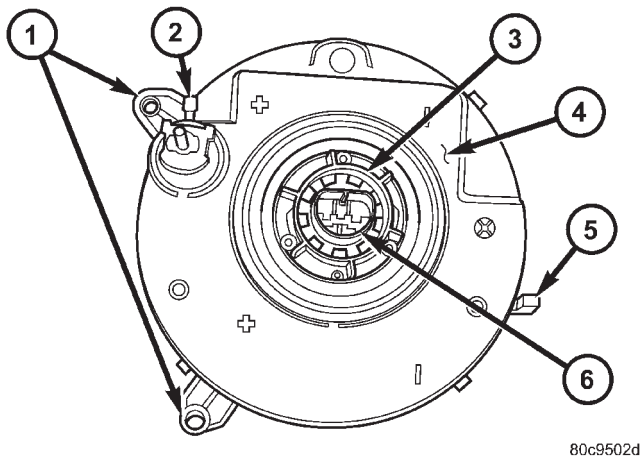
**Fig. 40 Headlamp Unit Remove/Install**

- 1 - FENDER PANEL
- 2 - HEADLAMP UNIT
- 3 - MOUNTING TAB (2)
- 4 - MOUNTING PANEL
- 5 - LOCATOR TAB

(4) Pull the inboard side of the headlamp unit away from the grille opening reinforcement far

## HEADLAMP UNIT (Continued)

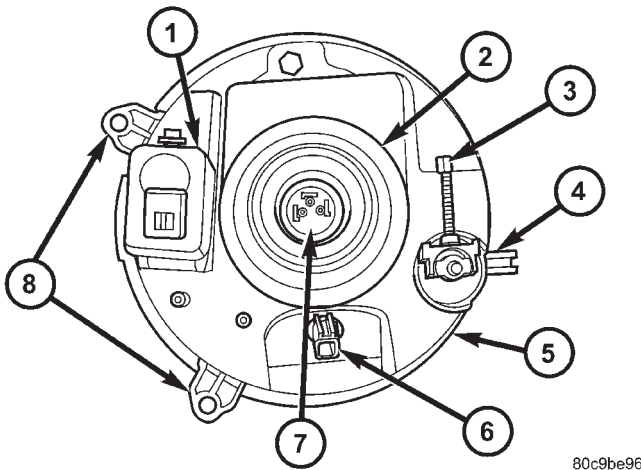
enough to disengage the locator tab on the outboard side of the unit (Fig. 41) or (Fig. 42) from the engagement slot in the outboard edge of the reinforcement.



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**Fig. 41 Headlamp Unit - North America**

- 1 - MOUNTING TAB (2)
- 2 - ADJUSTING SCREW
- 3 - LOCK RING
- 4 - HOUSING
- 5 - LOCATOR TAB
- 6 - SOCKET & BULB



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**Fig. 42 Headlamp Unit - Rest-Of-World**

- 1 - LEVELING MOTOR (IF EQUIPPED)
- 2 - BOOT SEAL
- 3 - ADJUSTING SCREW
- 4 - LOCATOR TAB
- 5 - HOUSING
- 6 - FRONT POSITION LAMP SOCKET & BULB
- 7 - HEADLAMP BULB
- 8 - MOUNTING TAB (2)

(5) Pull the headlamp unit away from the grille opening reinforcement far enough to disconnect the wire harness connectors from the headlamp bulb

socket (North America), the headlamp bulb base (Rest-Of-World), the front position lamp socket (if equipped), and the headlamp leveling motor (if equipped).

(6) Remove the headlamp unit from the grille opening reinforcement.

## INSTALLATION

(1) Position the headlamp unit to the grille opening reinforcement.

(2) Reconnect the wire harness connectors to the headlamp bulb socket (North America), the headlamp bulb base (Rest-Of-World), the front position lamp socket (if equipped), and the headlamp leveling motor (if equipped) (Fig. 41) or (Fig. 42).

(3) Engage the locator tab on the outboard side of the headlamp unit into the engagement slot in the outboard edge of the grille opening reinforcement.

(4) Align the two mounting tabs on the inboard side of the headlamp unit housing to the mounting holes in the grille opening reinforcement (Fig. 40).

(5) Install and tighten the two screws that secure the mounting tabs on the inboard side of the headlamp unit housing to the grille opening reinforcement. Tighten the screws to 3 N·m (30 in. lbs.).

(6) Reinstall the grille panel onto the grille opening reinforcement. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION).

(7) Reconnect the battery negative cable.

(8) Confirm proper headlamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS).

## ADJUSTMENTS

### ADJUSTMENT - HEADLAMP UNIT

#### VEHICLE PREPARATION FOR HEADLAMP ALIGNMENT

(1) Verify headlamp dimmer (multi-function) switch and high beam indicator operation.

(2) If the vehicle is equipped with headlamp leveling, be certain that the headlamp leveling switch is in the "0" position.

(3) Repair or replace any faulty or damaged components that could hinder proper lamp alignment.

(4) Verify proper tire inflation.

(5) Clean headlamp lenses.

(6) Verify that cargo area is not heavily loaded.

(7) The fuel tank should be Full. Add 2.94 kilograms (6.5 pounds) of weight over the fuel tank for each estimated gallon of missing fuel.

#### HEADLAMP ALIGNMENT SCREEN PREPARATION

Prepare an alignment screen as illustrated.

(1) Position the vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 feet) away from

HEADLAMP UNIT (Continued)

the front of the headlamp lens for North American vehicles, or 10.0 meters (32.81 feet) away from the front of the headlamp lens for Rest-Of-World vehicles (Fig. 43). If necessary, tape a line on the floor at the appropriate distance away from and parallel to the wall.

(2) Measure up on the wall 1.27 meters (5 feet) from the floor and tape a vertical line on the alignment screen at the centerline of the vehicle. Sight along the centerline of the vehicle (from the rear of the vehicle forward) to verify the accuracy of the centerline placement.

(3) Rock the vehicle from side-to-side three times to allow the suspension to stabilize, then jounce the front suspension three times by pushing downward on the front bumper and releasing. Measure the distance from the center of the headlamp lens to the floor. Transfer this measurement to the alignment screen and tape a horizontal line on the wall at this mark. This line will be used for up-and-down adjustment reference.

(4) Measure the distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer these measurements to the alignment screen and tape a vertical line this distance to each side of the vehicle centerline. These lines will be used for left/right reference.

HEADLAMP ADJUSTMENT

A properly aligned headlamp will project a pattern on the alignment screen from just below horizontal to 75 millimeters (3 inches) below the headlamp centerline for vehicles in North America, or from just below horizontal to 125 millimeters (5 inches) below the headlamp horizontal centerline for vehicles in Rest-Of-World.

(1) Vehicles for all markets except Japan should have the headlamp low beams selected with the dimmer (multi-function) switch during the adjustment procedure. Vehicles for the Japanese market should have the headlamp high beams selected.

(2) Cover the lens of the headlamp that is not being adjusted.

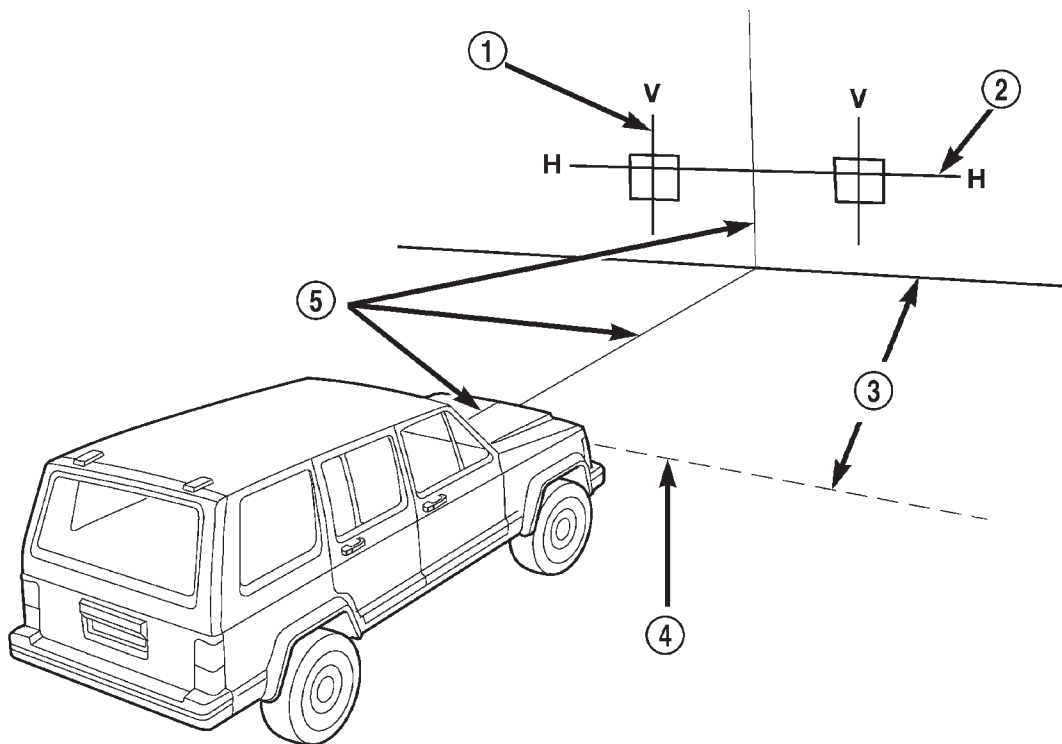


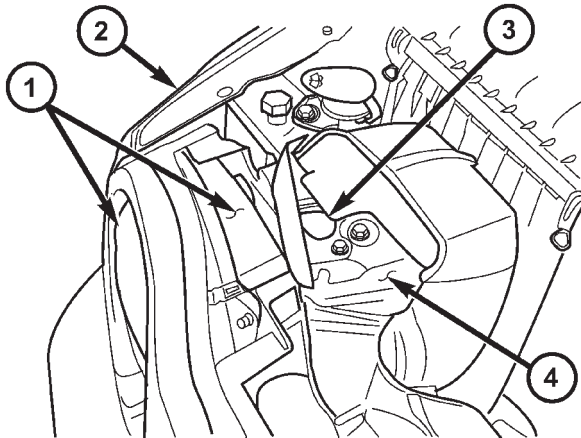
Fig. 43 Headlamp Alignment Screen - Typical

- 1 - CENTER OF VEHICLE TO CENTER OF HEADLAMP LENS
- 2 - FLOOR TO CENTER OF HEADLAMP LENS
- 3 - 7.62 METERS (25 FEET) NORTH AMERICA/10.0 METERS (32.81 FEET) REST-OF-WORLD

- 4 - FRONT OF HEADLAMP
- 5 - VEHICLE CENTERLINE

## HEADLAMP UNIT (Continued)

(3) Turn the adjusting screw (Fig. 44) until the top edge of the beam intensity pattern is positioned from just below horizontal to 75 millimeters (3 inches) below the headlamp horizontal centerline for vehicles in North America, or from just below horizontal to 125 millimeters (5 inches) below the headlamp horizontal centerline for vehicles in Rest-Of-World.



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**Fig. 44 Headlamp Adjusting Screw**

- 1 - HEADLAMP UNIT
- 2 - FENDER PANEL
- 3 - ADJUSTING SCREW ACCESS HOLE
- 4 - UPPER RADIATOR CROSSMEMBER

(4) Repeat the adjustment procedure for the opposite headlamp.

## LICENSE PLATE LAMP BULB

## REMOVAL

## NORTH AMERICA

(1) Disconnect and isolate the battery negative cable.

(2) Reach through the opening in the rear bumper fascia between the license plate and the lamp to access and firmly grasp the socket on the back of the license plate lamp unit housing (Fig. 45).

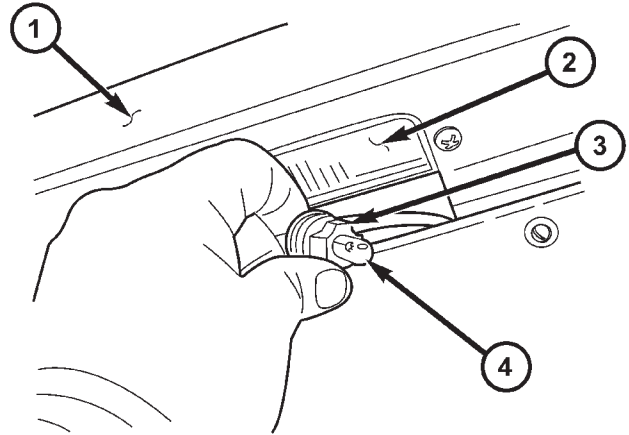
(3) Pull the socket and bulb straight out of the back of the license plate lamp unit housing.

(4) Pull the bulb straight out of the license plate lamp unit socket.

## REST-OF-WORLD

(1) Disconnect and isolate the battery negative cable.

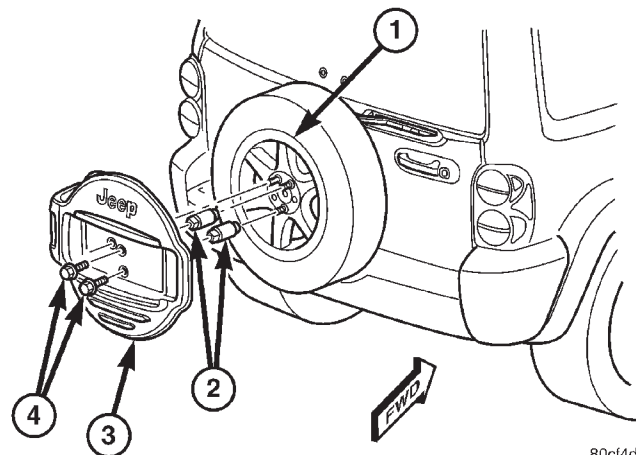
(2) Unsnap and lift up the bottom of the license mounting plate far enough to access and remove the two screws that secure the license plate bracket to the special lug nuts on the spare tire (Fig. 46).



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**Fig. 45 License Plate Lamp Bulb Remove/Install - North America**

- 1 - REAR BUMPER FASCIA
- 2 - LICENSE PLATE LAMP
- 3 - SOCKET
- 4 - BULB



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**Fig. 46 License Plate Bracket - Rest-Of-World**

- 1 - SPARE TIRE
- 2 - SPECIAL LUG NUT (2)
- 3 - LICENSE PLATE BRACKET
- 4 - SCREW (2)

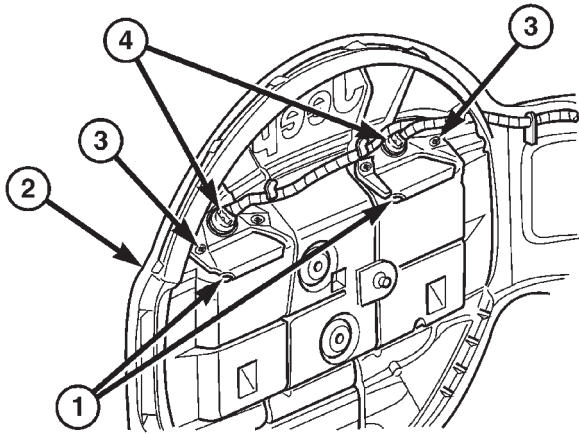
(3) Swing the license plate bracket away from the spare tire far enough to access the license plate lamp bulb sockets.

(4) Firmly grasp the socket on the top of the license plate lamp unit housing for the bulb that is being removed (Fig. 47).

(5) Rotate the socket on the top of the license plate lamp unit housing counterclockwise about 30 degrees.

(6) Pull the socket and bulb straight out of the top of the license plate lamp unit housing.

LICENSE PLATE LAMP BULB (Continued)



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**Fig. 47 License Plate Lamp Bulb Remove/Install - Rest-Of-World**

- 1 - LAMP UNIT (2)
- 2 - LICENSE PLATE BRACKET
- 3 - SCREW (4)
- 4 - BULB & SOCKET (2)

(7) Pull the bulb straight out of the license plate lamp unit socket.

**INSTALLATION**

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**NORTH AMERICA**

- (1) Align the base of the bulb with the receptacle in the license plate lamp unit socket.
- (2) Push the bulb straight into the license plate lamp unit socket until it is firmly seated.
- (3) Reach through the opening in the rear bumper fascia between the license plate and the lamp to align the socket and bulb with the socket opening on the back of the lamp unit housing (Fig. 45).
- (4) Push the socket and bulb straight into the license plate lamp unit housing until it is firmly seated.
- (5) Reconnect the battery negative cable.

**REST-OF-WORLD**

- (1) Align the base of the bulb with the receptacle in the license plate lamp unit socket.
- (2) Push the bulb straight into the license plate lamp unit socket until it is firmly seated.
- (3) Align the socket and bulb with the socket opening on the top of the license plate lamp unit housing (Fig. 47).

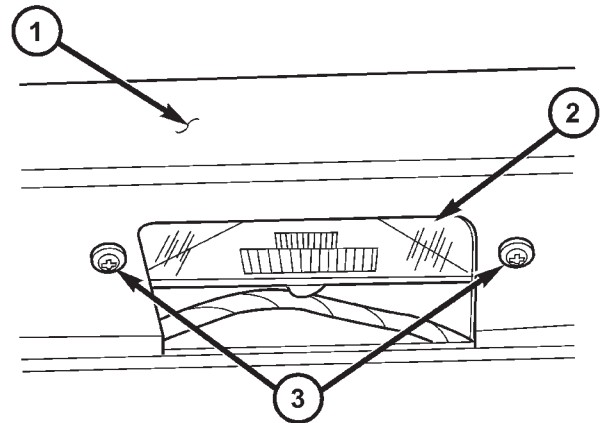
- (4) Push the socket and bulb straight into the license plate lamp unit housing until it is firmly seated.
- (5) Rotate the socket on the top of the license plate lamp unit housing clockwise about 30 degrees.
- (6) Swing the license plate bracket back against the spare tire (Fig. 46).
- (7) Lift up the bottom of the license mounting plate far enough to install and tighten the two screws that secure the license plate bracket to the special lug nuts on the spare tire. Tighten the screws to 28 N·m (21 ft. lbs.).
- (8) Lower the bottom of the license mounting plate and, using hand pressure, snap it into place on the license plate bracket.
- (9) Reconnect the battery negative cable.

**LICENSE PLATE LAMP UNIT**

**REMOVAL**

**NORTH AMERICA**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the two screws that secure the license plate lamp unit to the rear bumper fascia (Fig. 48).



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**Fig. 48 License Plate Lamp Unit Remove/Install**

- 1 - REAR BUMPER FASCIA
- 2 - LICENSE PLATE LAMP UNIT
- 3 - SCREW (2)

- (3) Pull the license plate lamp unit down and out through the mounting hole in the rear bumper fascia far enough to access and disconnect the wire harness connector for the lamp socket pigtail wire.
- (4) Remove the license plate lamp unit from the rear bumper fascia.

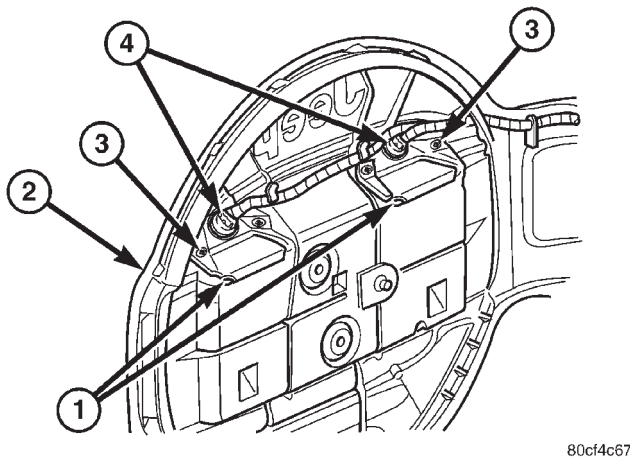
## LICENSE PLATE LAMP UNIT (Continued)

## REST-OF-WORLD

(1) Disconnect and isolate the battery negative cable.

(2) Remove the bulb and socket unit from the license plate lamp unit housing that is being removed. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LICENSE PLATE LAMP BULB - REMOVAL - REST-OF-WORLD).

(3) Remove the two screws that secure the license plate lamp unit to the back of the license plate bracket (Fig. 49).



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**Fig. 49 License Plate Lamp Bulb Remove/Install - Rest-Of-World**

- 1 - LAMP UNIT (2)  
 2 - LICENSE PLATE BRACKET  
 3 - SCREW (4)  
 4 - BULB & SOCKET (2)

(1) Remove the license plate lamp unit from the back of the license plate bracket.

## INSTALLATION

## NORTH AMERICA

(1) Position the license plate lamp unit to the rear bumper fascia.

(2) Reconnect the wire harness connector for the license plate lamp unit to the lamp socket pigtail wire.

(3) Position the license plate lamp unit into the mounting hole in the rear bumper fascia (Fig. 48).

(4) Install and tighten the two screws that secure the license plate lamp unit housing to the rear bumper fascia. Tighten the screws to 2 N·m (20 in. lbs.).

(5) Reconnect the battery negative cable.

## REST-OF-WORLD

(1) Position the license plate lamp unit onto the back of the license plate bracket (Fig. 49).

(2) Install and tighten the two screws that secure the license plate lamp unit to the back of the license plate bracket. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reinstall the bulb and socket unit into the license plate lamp unit housing that is being replaced. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LICENSE PLATE LAMP BULB - INSTALLATION - REST-OF-WORLD).

(4) Reconnect the battery negative cable.

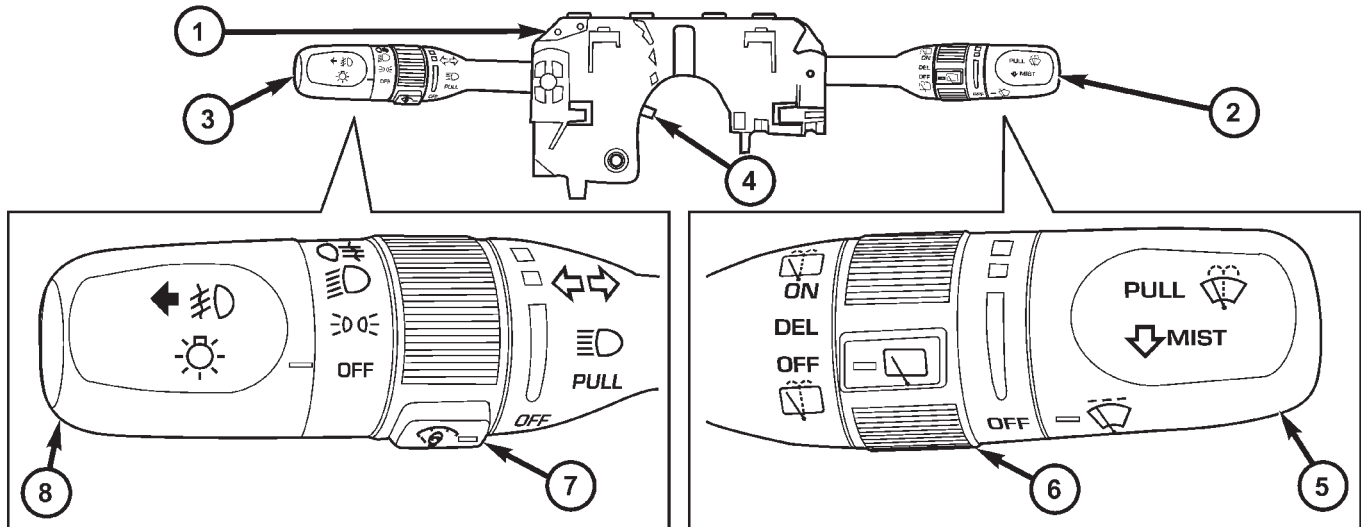
## MULTI-FUNCTION SWITCH

## DESCRIPTION

The multi-function switch is located on the steering column, just below the steering wheel (Fig. 50). The only visible components of the multi-function switch are two levers, or control stalks that extend through dedicated openings in each side of the steering column shrouds. The remainder of the switch, its mounting provisions, and its electrical connections are all concealed beneath the steering column shrouds. The switch housing and controls are constructed of molded black plastic. A saddle-like formation in the center of the multi-function switch housing straddles the steering column tube just below the column lock housing, and two posts integral to the lower surface of the switch housing engage two holes on the forward-facing side of the lock housing. Two integral ledge-like locating tabs near the top of the rearward facing switch housing surface are supported and located by two upright stanchions that extend upward from the top of the lock housing. Also on the rearward facing switch housing surface near the center, an integral ledge-like mounting tab rests on a similar ledge-like tab that extends from each side of the steering column lock housing. When the steering column shrouds are installed on the column, the switch mounting tabs are clamped along with the mounting tabs of the clockspring between the integral mounting stanchions of the upper shroud and the lock housing tabs, and are secured to the steering column lock housing by the same two screws that secure the two shroud halves to each other and the column.

There are several versions of the multi-function switch to support both optional equipment and equipment that is required only in certain markets. Each multi-function switch control stalk has both white nomenclature and International Control and Display Symbol graphics applied to it, which clearly identify its many functions. Each control stalk has a control knob on its end with a flattened face to allow it to be easily rotated. On vehicles equipped with optional front fog lamps, the knob on the end of left control

## MULTI-FUNCTION SWITCH (Continued)



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**Fig. 50 Multi-Function Switch**

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| 1 - MULTI-FUNCTION SWITCH         | 6 - RIGHT (WIPER) CONTROL RING   |
| 2 - RIGHT (WIPER) CONTROL STALK   | 7 - LEFT (LIGHTING) CONTROL RING |
| 3 - LEFT (LIGHTING) CONTROL STALK | 8 - LEFT (LIGHTING) CONTROL KNOB |
| 4 - TURN SIGNAL CANCEL ACTUATOR   |                                  |
| 5 - RIGHT (WIPER) CONTROL KNOB    |                                  |

stalk can also be pulled outward to select those lamps. Each control stalk also features a knurled control ring located just below the control knob. The left control stalk is dedicated to providing driver controls for the interior and exterior lighting systems, while the right control stalk is dedicated to providing driver controls for the front and rear wiper systems. Two integral connector receptacles on the forward facing surface of the multi-function switch housing connect the switch to the vehicle electrical system through two take outs and connectors of the instrument panel wire harness. The left connector receptacle contains nine terminal pins for the lighting control circuits of the switch, while the right connector receptacle contains six terminal pins for the wiper control circuits of the switch. The multi-function switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

**LEFT CONTROL STALK** The left (lighting) control stalk of the multi-function switch supports the following functions and features:

- **Front Fog Lamps** - For vehicles so equipped, the internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the optional front fog lamps.

- **Headlamps** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the headlamps.

- **Headlamp Beam Selection** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for selection of the headlamp high or low beams.

- **Headlamp Optical Horn** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk includes momentary switching of the headlamp high beam circuits to provide an optical horn feature (sometimes referred to as flash-to-pass), which allows the vehicle operator to momentarily flash the headlamp high beams as an optical signalling device.

- **Interior Lamps Defeat** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching to defeat the illumination of all interior courtesy lamps when a door, the rear flip-up glass, or the tailgate are opened.

- **Interior Lamps On** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching to simultaneously illuminate all interior courtesy lamps.

- **Panel Lamps Dimming** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide simultaneous adjustable control of the illumination intensity of all instrument panel lighting at one of six available illumination intensity levels.

- **Parade Mode** - The internal circuitry and hardware of the multi-function switch left (lighting) con-



## MULTI-FUNCTION SWITCH (Continued)

trol stalk provide detent switching for a parade mode that maximizes the illumination intensity of all instrument panel lighting for visibility when driving in daylight with the exterior lamps turned on.

- **Park Lamps** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the park lamps.

- **Rear Fog Lamps** - For vehicles so equipped, the internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the optional rear fog lamps. Rear fog lamps are optional only for vehicles manufactured for certain markets, where they are required.

- **Turn Signal Control** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide both momentary non-detent switching and detent switching with automatic cancellation for both the left and right turn signal lamps.

**RIGHT CONTROL STALK** The right (wiper) control stalk of the multi-function switch supports the following functions and features:

- **Continuous Front Wipe Modes** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide two continuous front wipe switch positions, low speed or high speed.

- **Continuous Rear Wipe Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide one continuous rear wipe switch position.

- **Front Washer Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk switch provide front washer system operation.

- **Front Wipe-After-Wash Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide a wipe-after-wash mode.

- **Front Wiper Mist Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide a front wiper system mist mode.

- **Intermittent Front Wipe Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide an intermittent front wipe mode with five delay interval positions.

- **Intermittent Rear Wipe Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide one fixed interval intermittent rear wipe mode switch position.

- **Rear Washer Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide rear washer system operation.

## OPERATION

The multi-function switch uses a combination of resistor multiplexed and conventionally switched outputs to control the many functions and features it provides. The switch receives battery current on a fused ignition switch output (run-acc) circuit from a fuse in the Junction Block (JB) whenever the ignition switch is in the On or Accessory positions. The switch receives a path to ground at all times through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB). Following are descriptions of how each of the two multi-function switch control stalks operate to control the functions and features they provide.

**LEFT CONTROL STALK** The left (lighting) control stalk of the multi-function switch operates as follows:

- **Front Fog Lamps** - For vehicles so equipped, the control knob on the end of the multi-function switch left (lighting) control stalk is pulled outward to activate the optional front fog lamps. The control knob is mechanically keyed so that it cannot be pulled outward unless it is first rotated to turn on the exterior lighting. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a fog lamp switch sense circuit, and the BCM responds by energizing or de-energizing the front fog lamp relay in the Junction Block (JB) as required.

- **Headlamps** - The control knob on the end of the multi-function switch left (lighting) control stalk is rotated forward (counterclockwise) to its second detent position to activate the headlamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a headlamp switch sense circuit, and the BCM responds by energizing or de-energizing the selected low or high beam relay (Daytime Running Lamp relay in Canadian vehicles) in the Junction Block (JB) as required.

- **Headlamp Beam Selection** - The left (lighting) control stalk of the multi-function switch is pulled towards the steering wheel past a detent to actuate the integral beam select switch circuitry. Each time the control stalk is activated in this manner, the opposite headlamp beam from what is currently selected will be energized. The multi-function switch provides a ground output to the Body Control Module (BCM) on a high beam switch sense circuit, and the BCM responds by energizing or de-energizing the selected low or high beam relay (Daytime Running Lamp relay in Canadian vehicles) in the Junction Block (JB) as required.

- **Headlamp Optical Horn** - The left (lighting) control stalk of the multi-function switch is pulled

## MULTI-FUNCTION SWITCH (Continued)

towards the steering wheel to just before a detent, to momentarily activate the headlamp optical horn feature. The high beams will remain illuminated until the control stalk is released. The multi-function switch provides a ground output on a high beam relay control circuit to energize the headlamp high beam relay (Daytime Running Lamp relay in Canadian vehicles) in the Junction Block (JB) as required.

- **Interior Lamps Defeat** - The control ring on the multi-function switch left (lighting) control stalk is rotated to a full rearward (clockwise) detent to defeat the illumination of all interior courtesy lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by de-energizing its internal courtesy lamp driver circuit.

- **Interior Lamps On** - The control ring on the multi-function switch left (lighting) control stalk is rotated to a full forward (counterclockwise) detent to illuminate all interior courtesy lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by energizing its internal courtesy lamp driver circuit.

- **Panel Lamps Dimming** - The control ring on the multi-function switch left (lighting) control stalk is rotated to one of six minor intermediate detents to simultaneously select the desired illumination intensity of all adjustable instrument panel and instrument cluster lighting. The control ring is rotated rearward (clockwise) to dim, or forward (counterclockwise) to brighten. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by sending an electronic panel lamps dimming level message to the ElectroMechanical Instrument Cluster (EMIC) over the Programmable Communications Interface (PCI) data bus. The EMIC electronic circuitry then provides the proper PWM output to the cluster illumination lamps and the VFD on the EMIC circuit board, then provides a matching PWM output on the hard wired fused panel lamps dimmer switch signal circuit.

- **Parade Mode** - The control ring on the multi-function switch left (lighting) control stalk is rotated to an intermediate detent that is one detent rearward (clockwise) from the full forward (counterclockwise) detent to select the Parade mode. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by sending an electronic panel lamps dimming level message to the ElectroMechanical Instru-

ment Cluster (EMIC) over the Programmable Communications Interface (PCI) data bus. The EMIC electronic circuitry then provides the proper PWM output to the cluster illumination lamps and the VFD on the EMIC circuit board, then provides a matching PWM output on the hard wired fused panel lamps dimmer switch signal circuit to illuminate all lamps at full (daylight) intensity with the exterior lamps turned On.

- **Park Lamps** - The control knob on the end of the multi-function switch left (lighting) control stalk is rotated forward (counterclockwise) to its first detent from the Off position to activate the park lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a headlamp switch sense circuit, and the BCM responds by energizing or de-energizing the park lamp relay in the Junction Block (JB) as required.

- **Rear Fog Lamps** - For vehicles so equipped, the control knob on the end of the multi-function switch left (lighting) control stalk is rotated forward (counterclockwise) to its third detent position to activate the rear fog lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a headlamp switch sense circuit, and the BCM responds by energizing or de-energizing the rear fog lamp relay in the Junction Block (JB) as required. Rear fog lamps are optional only for vehicles manufactured for certain markets, where they are required.

- **Turn Signal Control** - The left (lighting) control stalk of the multi-function switch is moved upward to activate the right turn signal circuitry, and, downward to activate the left turn signal circuitry. The turn signal 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 left multi-function switch control stalk is released. When the control stalk is moved to a turn signal switch detent position, the cancel actuator extends toward the center of the steering column. A turn signal cancel cam that is integral to the clockspring rotates with the steering wheel and the cam lobes contact the cancel actuator when it is extended from the left multi-function switch. When the steering wheel is rotated during a turning maneuver, one of the two turn signal cancel cam lobes will contact the turn signal cancel actuator. The cancel actuator latches against the cancel cam rotation in the direction opposite that which is signaled. In other words, if the left turn signal detent is selected, the lobes of the cancel cam will ratchet past the cancel actuator when the steering wheel is rotated to the left, but will unlatch the cancel actua-

## MULTI-FUNCTION SWITCH (Continued)

tor as the steering wheel rotates to the right and returns to center, which will cancel the turn signal event and release the control stalk from the detent so it returns to the neutral Off position. When a turn signal is activated, the multi-function switch provides a ground output on a right or left turn switch sense circuit to the combination flasher circuitry within the hazard switch, and the combination flasher flashes the turn signal lamps.

**RIGHT CONTROL STALK** The right (wiper) control stalk of the multi-function switch operates as follows:

- **Continuous Front Wipe Modes** - The control knob on the end of the multi-function switch right (wiper) control stalk is rotated to an intermediate detent that is one detent rearward (counterclockwise) from the full forward (clockwise) detent to select the low speed continuous front wiper mode, or to its full forward (clockwise) detent to select the high speed continuous front wiper mode. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a front wiper switch mux circuit, and the BCM responds by energizing the wiper on/off relay in the Power Distribution Center (PDC) for the front low speed continuous wipe mode, or the wiper on/off relay and the wiper high/low relay in the PDC for the front high speed continuous wipe mode as required.

- **Continuous Rear Wipe Mode** - The control ring on the multi-function switch right (wiper) control stalk is rotated to the most forward (clockwise) detent to select the continuous rear wiper mode. The multi-function switch provides a battery current output to the rear wiper motor on a rear wiper on driver circuit to signal the rear wiper motor to operate in the continuous wipe mode.

- **Front Washer Mode** - The right (wiper) control stalk of the multi-function switch is pulled towards the steering wheel to momentarily activate the washer pump in the front washer mode. The washer pump will continue to operate in the front washer mode until the control stalk is released. The multi-function switch provides a ground output on a washer pump sense circuit, and battery current on a washer pump driver circuit to energize the washer pump in the front washer mode.

- **Front Wiper Mist Mode** - The right (wiper) control stalk of the multi-function switch is pushed towards the floor to momentarily activate the front wiper motor in the mist mode. The front wiper motor will continue to operate in the mist mode until the control stalk is released. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a front wiper switch mux circuit, and the BCM responds by energizing the wiper on/off relay in the Power Distribution Center

(PDC) to operate the front wiper motor momentarily at low speed to provide the front wiper mist mode.

- **Intermittent Front Wipe Mode** - The control knob on the end of the multi-function switch right (wiper) control stalk is rotated to one of five minor intermediate detents to select the desired intermittent front wipe delay interval. The control knob is rotated rearward (counterclockwise) to increase the delay, or forward (clockwise) to decrease the delay. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a front wiper switch mux circuit, and the BCM responds by energizing the wiper on/off relay in the Power Distribution Center (PDC) to operate the front wiper motor at the selected delay intervals.

- **Intermittent Rear Wipe Mode** - The control ring on the multi-function switch right (wiper) control stalk is rotated to the center detent to select the intermittent rear wiper mode. The multi-function switch provides a battery current output to the rear wiper motor on a rear wiper intermittent driver circuit to signal the rear wiper motor to operate in the intermittent wipe mode.

- **Rear Washer Mode** - The control ring on the multi-function switch right (wiper) control stalk is rotated to either the full forward (clockwise) or full rearward (counterclockwise) momentary positions to activate the washer pump in the rear washer mode. The washer pump will continue to operate in the rear washer mode until the control ring is released. The multi-function switch provides a ground output on a washer pump driver circuit, and battery current on a washer pump sense circuit to energize the washer pump in the rear washer mode.

## DIAGNOSIS AND TESTING - MULTI-FUNCTION SWITCH

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

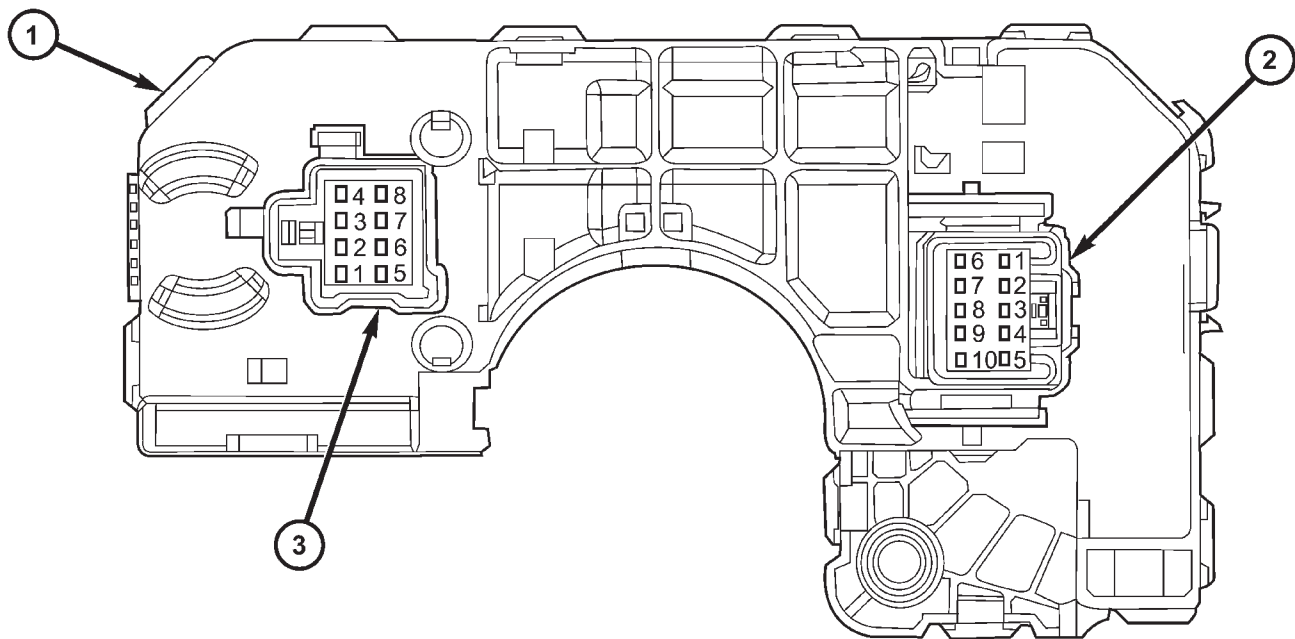
MULTI-FUNCTION SWITCH (Continued)

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 multi-function switch from the steering column. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - REMOVAL).

(3) Using an ohmmeter, perform the continuity and resistance tests at the terminals (Fig. 51) in the multi-function switch connector receptacles as shown in the Multi-Function Switch Tests table.



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**Fig. 51 Multi-Function Switch Connector Receptacle Pin-Out**

1 - MULTI-FUNCTION SWITCH

2 - C-1 (LIGHTING) CONNECTOR RECEPTACLE

3 - C-2 (WIPER) CONNECTOR RECEPTACLE

## MULTI-FUNCTION SWITCH (Continued)

MULTI-FUNCTION SWITCH TESTS		
EXTERIOR LIGHTING FUNCTIONS		
SWITCH POSITION	CONNECTOR C-1 PINS	RESISTANCE (OHMS) $\pm 10\%$
Off	4 & 5	3781
Park Lamps On	4 & 5	911
Headlamp Low Beams On	4 & 5	349
Rear Fog Lamps On	4 & 5	75
Headlamp High Beams On	8 & 9	0 - 1
Front Fog Lamps On	2 & 4	0 - 1
Optical Horn (Flash-to-Pass) On	7 & 8	0 - 1
Turn Signal Neutral	6 & 8, 8 & 10	Infinite (Open)
Turn Signal Left	6 & 8	0 - 1
Turn Signal Right	8 & 10	0 - 1
INTERIOR LIGHTING FUNCTIONS		
SWITCH POSITION	CONNECTOR C-1 PINS	RESISTANCE (OHMS) $\pm 10\%$
Off (Courtesy Disable)	1 & 4	63
Dimming 1	1 & 4	200
Dimming 2	1 & 4	557
Dimming 3	1 & 4	914
Dimming 4	1 & 4	1271
Dimming 5	1 & 4	1628
Dimming 6	1 & 4	1985
Parade Mode On	1 & 4	3565
Courtesy On	1 & 4	7885
FRONT WIPER FUNCTIONS		
SWITCH POSITION	CONNECTOR C-1 & C-2 PINS	RESISTANCE (OHMS) $\pm 10\%$
Front Wiper Off	C-1 Pin 4 & C-2 Pin 4	4587
Delay 1	C-1 Pin 4 & C-2 Pin 4	1267
Delay 2	C-1 Pin 4 & C-2 Pin 4	792
Delay 3	C-1 Pin 4 & C-2 Pin 4	531
Delay 4	C-1 Pin 4 & C-2 Pin 4	369
Delay 5	C-1 Pin 4 & C-2 Pin 4	262
Front Wiper Low	C-1 Pin 4 & C-2 Pin 4	125
Front Wiper High	C-1 Pin 4 & C-2 Pin 4	38
Front Wiper Mist	C-1 Pin 4 & C-2 Pin 4	125
Front Washer On	C-2 Pins 5 & 7	0 - 1
REAR WIPER FUNCTIONS		
SWITCH POSITION	CONNECTOR C-2 PINS	RESISTANCE (OHMS) $\pm 10\%$
Rear Wiper Off	1 & 5, 2 & 5	Infinite (Open)
Rear Wiper Intermittent	2 & 5	0 - 1
Rear Wiper On	1 & 5	0 - 1
Rear Washer On	2 & 5, 3 & 5	0 - 1

## MULTI-FUNCTION SWITCH (Continued)

(4) If the multi-function switch fails any of the continuity or resistance tests, replace the faulty switch unit as required.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(3) From below the steering column, remove the two screws that secure the lower shroud to the upper shroud (Fig. 52).

(4) Using hand pressure, push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure the two halves to each other.

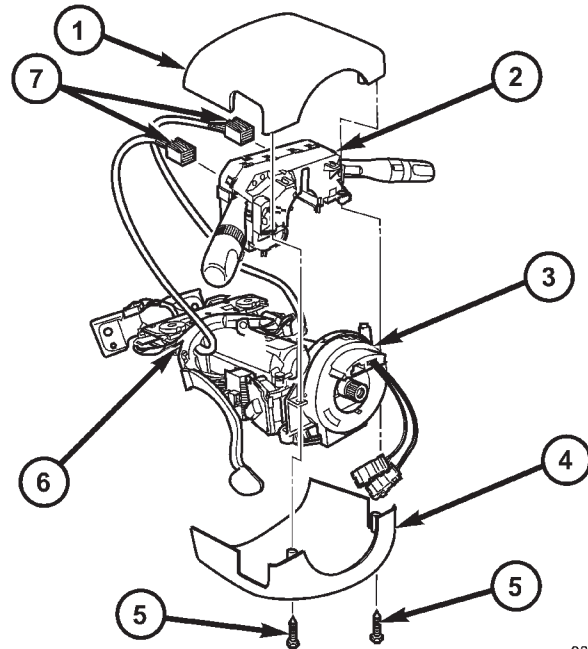
(5) Remove both the upper and lower shrouds from the steering column.

(6) Disconnect the two instrument panel wire harness connectors for the multi-function switch from the two connector receptacles on the back of the switch housing.

(7) Remove the multi-function switch from the steering column lock housing by carefully rocking the switch and pulling the switch housing upward far enough to disengage its alignment posts and locator tabs from the lock housing.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER,**



80c96010

**Fig. 52 Multi-Function Switch Remove/Install**

- 1 - UPPER SHROUD
- 2 - MULTI-FUNCTION SWITCH
- 3 - CLOCKSPrING
- 4 - LOWER SHROUD
- 5 - SCREW (2)
- 6 - STEERING COLUMN
- 7 - WIRE HARNESS CONNECTOR (2)

**FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Before attempting to install the multi-function switch, be certain that the left control stalk is in the neutral turn signal position and the turn signal cancel actuator is in the retracted (neutral) position.**

(1) Position the multi-function switch to the steering column.

(2) Reconnect the two instrument panel wire harness connectors for the multi-function switch to the two connector receptacles on the back of the switch housing (Fig. 52).

## MULTI-FUNCTION SWITCH (Continued)

(3) Position the multi-function switch onto the steering column lock housing. Be certain that the switch alignment posts and locator tabs are fully seated on the lock housing.

(4) Position the upper and lower shrouds onto the steering column.

(5) Align the snap features on the lower shroud with the receptacles on the upper shroud and apply hand pressure to snap them together.

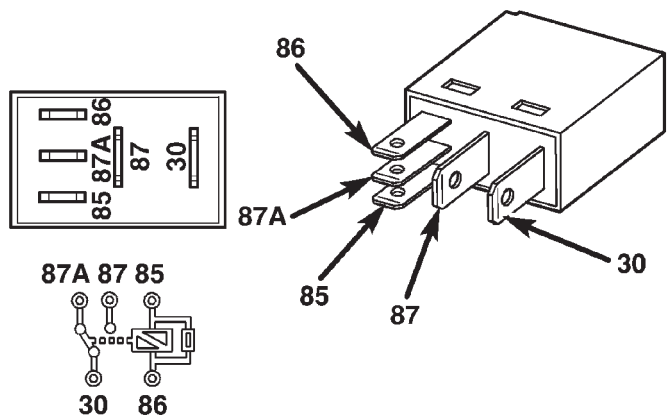
(6) From below the steering column, install and tighten the two screws that secure the lower shroud to the upper shroud. Tighten the screws to 2 N-m (20 in. lbs.).

(7) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column back to the fully raised position and move the tilt release lever into the locked (up) position.

(8) Reconnect the battery negative cable.

## PARK LAMP RELAY

## DESCRIPTION



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**Fig. 53 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The park lamp relay is located in the Junction Block (JB) below the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The park lamp relay is a conventional International Standards Organization (ISO) micro relay (Fig. 53). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the

required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The park lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The park lamp relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the park lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The park lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the headlamp low beam relay include:

- **Common Feed Terminal** - The common feed terminal (30) is connected to the park lamps through the park lamp relay output circuit and provides ground to the park lamps when the relay is de-energized, and battery current to the park lamps whenever the relay is energized.

- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Body Control Module (BCM) through a park lamp relay control circuit. The BCM controls park lamp operation by controlling a ground path through this circuit.

- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the PDC through a fused B(+) circuit.

- **Normally Open Terminal** - The normally open terminal (87) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.

- **Normally Closed Terminal** - The normally closed terminal (87A) is connected to ground at all times through a ground circuit that receives ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the

## PARK LAMP RELAY (Continued)

driver side instrument panel end bracket near the Junction Block (JB).

The park lamp relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - PARK LAMP RELAY

The park lamp relay (Fig. 54) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

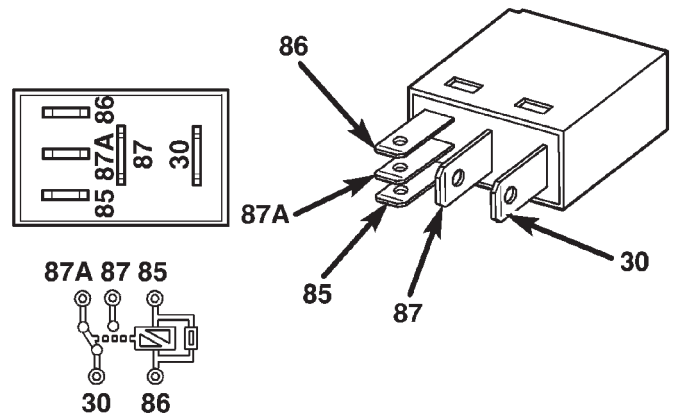
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the park lamp relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/PARK LAMP RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.



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**Fig. 54 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

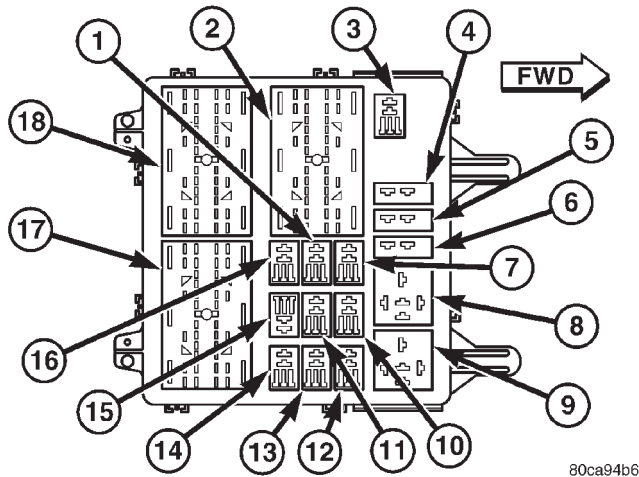
(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the park lamp relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 55).



## PARK LAMP RELAY (Continued)



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**Fig. 55 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the park lamp relay to the proper receptacle in the Junction Block (JB) (Fig. 55).

(2) Align the park lamp relay terminals with the terminal cavities in the JB receptacle.

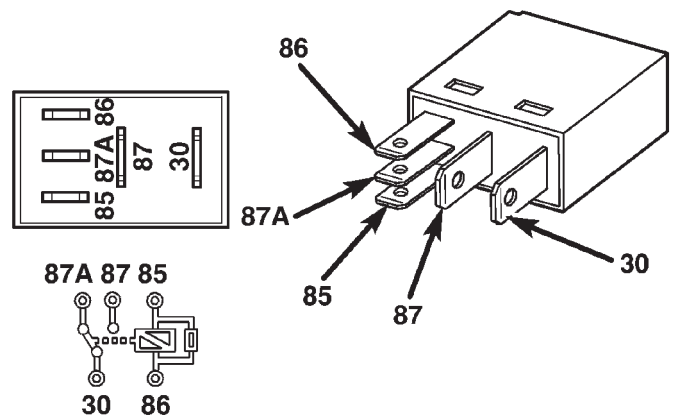
(3) Push firmly and evenly on the top of the park lamp relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.

## REAR FOG LAMP RELAY

## DESCRIPTION



80ce807b

**Fig. 56 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The rear fog lamp relay is located in the Junction Block (JB) on the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The rear fog lamp relay is a conventional International Standards Organization (ISO) micro relay (Fig. 56). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The rear fog lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## REAR FOG LAMP RELAY (Continued)

## OPERATION

The rear fog lamp relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the rear fog lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The rear fog lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the rear fog lamp relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.

- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the premium Body Control Module (BCM) through a rear fog lamp relay control circuit. The BCM controls rear fog lamp operation by controlling a ground path through this circuit.

- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.

- **Normally Open Terminal** - The normally open terminal (87) is connected to the rear fog lamps through a rear fog lamp relay output circuit and provides battery current to the rear fog lamps whenever the relay is energized.

- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

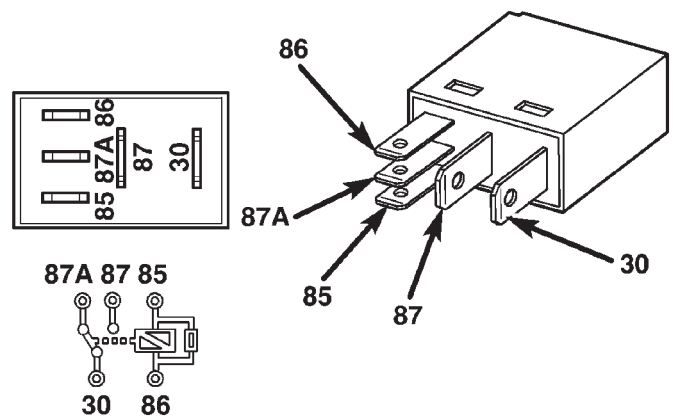
The rear fog lamp relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - REAR FOG LAMP RELAY

The rear fog lamp relay (Fig. 57) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location

views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



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Fig. 57 ISO Micro Relay

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the rear fog lamp relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR FOG LAMP RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A

## REAR FOG LAMP RELAY (Continued)

and 30. If OK, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

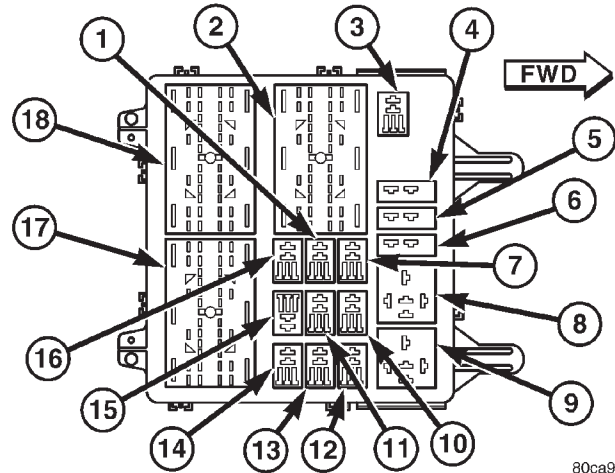
(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the rear fog lamp relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 58).

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the rear fog lamp relay to the proper receptacle in the Junction Block (JB) (Fig. 58).



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**Fig. 58 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

(2) Align the rear fog lamp relay terminals with the terminal cavities in the JB receptacle.

(3) Push firmly and evenly on the top of the rear fog lamp relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.

## REAR LAMP BULB

## REMOVAL

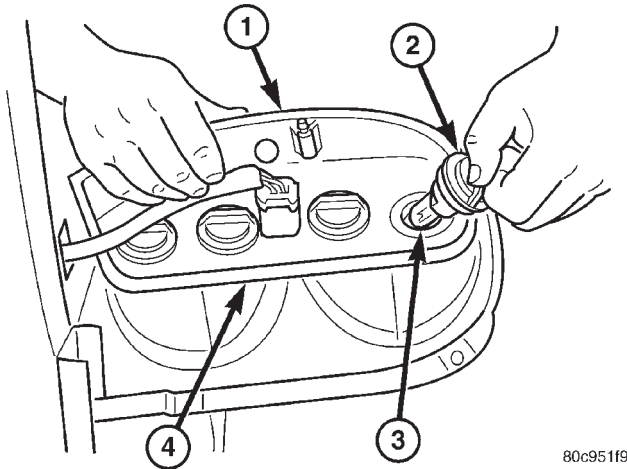
The rear lamp unit may contain up to four bulbs, depending upon the market for which the vehicle was manufactured. The service procedures for each bulb is the same, only the bulb sizes and types may differ.

REAR LAMP BULB (Continued)

Be certain any removed bulb is replaced with the same bulb size and type that was removed.

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the rear lamp unit from the end of the quarter panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR LAMP UNIT - REMOVAL).
- (3) Firmly grasp the socket on the socket plate at the back of the rear lamp unit housing for the bulb that is being removed (Fig. 59).

- (4) Push the socket and bulb straight into the rear lamp unit housing until the socket is firmly seated against the socket plate.
- (5) Rotate the socket on the socket plate at the back of the rear lamp unit housing clockwise about 30 degrees.
- (6) Reinstall the rear lamp unit onto the end of the quarter panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR LAMP UNIT - INSTALLATION).
- (7) Reconnect the battery negative cable.



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**Fig. 59 Rear Lamp Bulb Remove/Install**

- 1 - REAR LAMP HOUSING
- 2 - BULB HOLDER
- 3 - BULB
- 4 - SOCKET PLATE

- (4) Rotate the socket on the socket plate at the back of the rear lamp unit housing counterclockwise about 30 degrees.
- (5) Pull the socket and bulb straight out of the back of the rear lamp unit housing.
- (6) Pull the bulb straight out of the rear lamp unit socket.

**INSTALLATION**

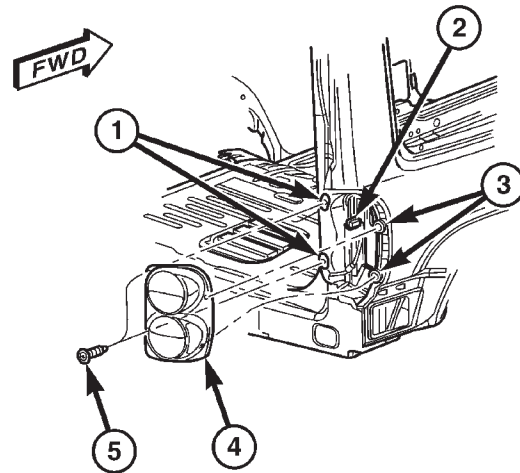
**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

- (1) Align the base of the bulb with the receptacle in the rear lamp unit socket.
- (2) Push the bulb straight into the rear lamp unit socket until it is firmly seated.
- (3) Align the socket and bulb with the opening in the socket plate on the back of the rear lamp unit housing (Fig. 59).

**REAR LAMP UNIT**

**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Open the tailgate to access and remove the two screws that secure the inboard side of the rear lamp unit to the side jamb of the tailgate opening (Fig. 60).
- (3) Pull the outboard side of the rear lamp unit



80c95299

**Fig. 60 Rear Lamp Unit Remove/Install**

- 1 - PLASTIC NUT (2)
- 2 - WIRE HARNESS CONNECTOR
- 3 - PLASTIC NUT (2)
- 4 - REAR LAMP UNIT
- 5 - SCREW (2)

rearward (away from the end of the quarter panel) far enough to unsnap the two ball studs on the outboard side of the lamp housing from the plastic nuts in the quarter panel.

- (4) Pull the rear lamp unit away from the quarter panel far enough to access and disconnect the wire harness connector for the lamp unit from the connector receptacle on the lamp socket plate.
- (5) Remove the rear lamp unit from the quarter panel.

## REAR LAMP UNIT (Continued)

(6) Remove the plastic nuts from the quarter panel and discard.

## INSTALLATION

(1) Install new plastic nuts into the quarter panel (Fig. 60).

(2) Position the rear lamp unit to the quarter panel.

(3) Reconnect the wire harness connector for the rear lamp unit to the connector receptacle on the lamp socket plate.

(4) Align the two ball studs on the outboard side of the rear lamp unit housing with the plastic nuts in the quarter panel.

(5) Using hand pressure, push the outboard side of the rear lamp unit forward (towards the end of the quarter panel) far enough to snap the two ball studs on the outboard side of the lamp housing into the plastic nuts in the quarter panel.

(6) Align the mounting holes on the inboard side of the rear lamp unit housing with the plastic nuts in the side jamb of the tailgate opening.

(7) Install and tighten the two screws that secure the inboard side of the rear lamp unit housing to the plastic nuts in the side jamb of the tailgate opening. Tighten the screws to 2 N·m (20 in. lbs.).

(8) Reconnect the battery negative cable.

## REPEATER LAMP BULB

## REMOVAL

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the repeater lamp unit from the front fender panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REPEATER LAMP UNIT - REMOVAL).

(3) Rotate the repeater lamp socket in the lamp lens counterclockwise about 30 degrees (Fig. 61).

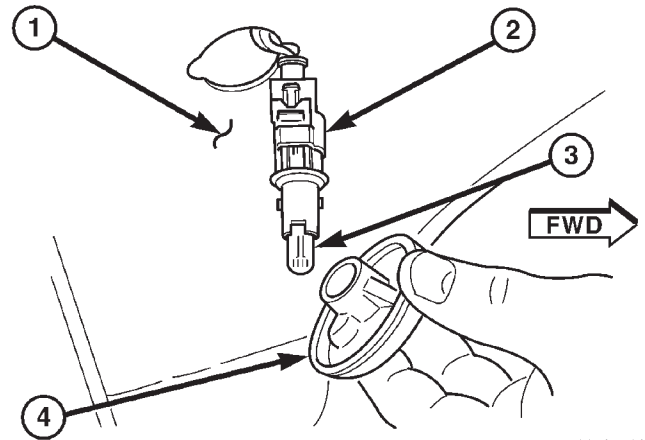
(4) Pull the socket and bulb straight out of the repeater lamp lens.

(5) Pull the bulb straight out of the repeater lamp socket.

## INSTALLATION

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type



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**Fig. 61 Repeater Lamp Bulb Remove/Install**

- 1 - FRONT FENDER
- 2 - SOCKET
- 3 - BULB
- 4 - LENS

may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Align the base of the bulb with the receptacle in the repeater lamp socket.

(2) Push the bulb straight into the repeater lamp socket until it is firmly seated.

(3) Align the socket and bulb with the socket opening in the repeater lamp lens (Fig. 61).

(4) Push the socket and bulb straight into the repeater lamp lens until it is firmly seated

(5) Rotate the repeater lamp socket in the lamp lens clockwise about 30 degrees.

(6) Reinstall the repeater lamp unit onto the front fender panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REPEATER LAMP UNIT - INSTALLATION).

(7) Reconnect the battery negative cable.

## REPEATER LAMP UNIT

## REMOVAL

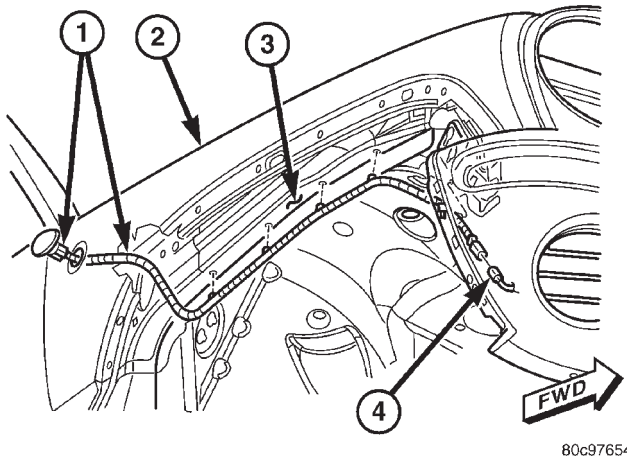
Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat-bladed tool, carefully pry at the clearance notch in the lower edge of the repeater lamp lens to disengage the snap features of the lens from the mounting hole in the front fender panel (Fig. 62).

(3) Pull the repeater lamp unit out from the front fender panel far enough to access and disconnect the

REPEATER LAMP UNIT (Continued)



80c97654

**Fig. 62 Repeater Lamp Unit Remove/Install**

- 1 - REPEATER LAMP UNIT
- 2 - FRONT FENDER PANEL
- 3 - INNER FENDER
- 4 - FRONT FASCIA WIRE HARNESS

repeater lamp wire harness connector from the connector receptacle on the back of the repeater lamp unit socket.

(4) Remove the repeater lamp unit from the front fender panel.

**INSTALLATION**

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

(1) Position the repeater lamp unit to the front fender panel (Fig. 62).

(2) Reconnect the repeater lamp wire harness connector to the connector receptacle on the back of the repeater lamp unit socket.

(3) Position the repeater lamp unit into the mounting hole in the front fender panel. Be certain that the clearance notch on the edge of the repeater lamp lens is oriented toward the bottom.

(4) Using hand pressure, press on the repeater lamp unit firmly and evenly until the snap features of the lens are fully engaged in the mounting hole of the front fender panel.

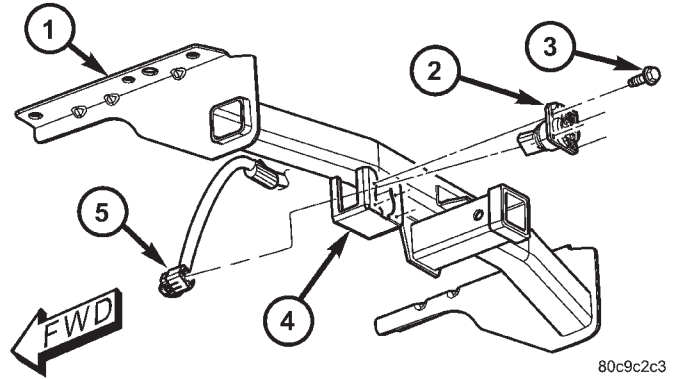
(5) Reconnect the battery negative cable.

**TRAILER TOW CONNECTOR**

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the four screws that secure the trailer tow connector to the bracket on the trailer hitch receiver (Fig. 63).



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**Fig. 63 Trailer Tow Connector Remove/Install**

- 1 - HITCH RECEIVER
- 2 - 7-WAY TRAILER TOW CONNECTOR
- 3 - SCREW (4)
- 4 - BRACKET
- 5 - WIRE HARNESS CONNECTOR

(3) Pull the trailer tow connector rearward from the bracket on the trailer hitch receiver far enough to access and disconnect the rear body wire harness connector from the receptacle on the back of the trailer tow connector.

(4) Remove the trailer tow connector from the trailer hitch receiver.

**INSTALLATION**

(1) Position the trailer tow connector to the trailer hitch receiver (Fig. 63).

(2) Reconnect the rear body wire harness connector to the receptacle on the back of the trailer tow connector.

(3) Position the trailer tow connector into the bracket on the trailer hitch receiver.

(4) Install and tighten the four screws that secure the trailer tow connector to the bracket on the trailer hitch receiver. Tighten the screws to 4 N-m (35 in. lbs.).

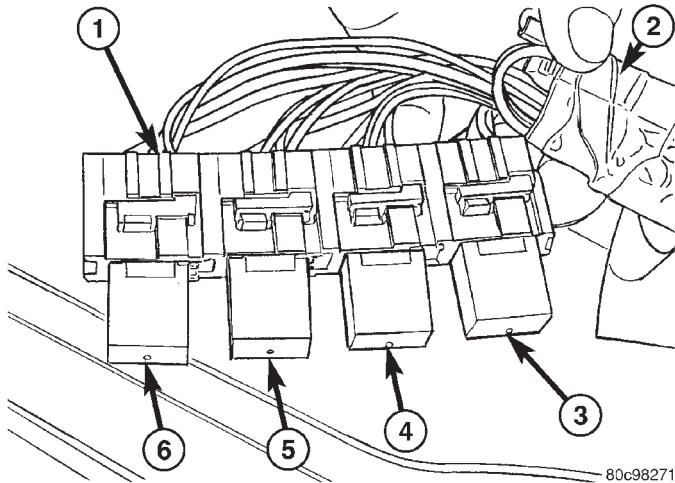
(5) Reconnect the battery negative cable.

**TRAILER TOW RELAY**

**DESCRIPTION**

The trailer tow relays are located in a connector bank above the right rear wheelhouse and behind the quarter trim panel on vehicles equipped with the optional factory-installed trailer towing package. Four individual relays are used, one each for fused ignition switch output (run), brake lamps, right turn signal, and left turn signal outputs to a trailer through the rear body wiring and connectors. The trailer tow relays are conventional International Standards Organization (ISO) micro relays (Fig. 64).

## TRAILER TOW RELAY (Continued)



**Fig. 64 Trailer Tow Relays**

- 1 - RELAY CONNECTOR BANK
- 2 - REAR BODY WIRE HARNESS
- 3 - LEFT TURN RELAY
- 4 - RIGHT TURN RELAY
- 5 - BRAKE LAMP RELAY
- 6 - FUSED IGNITION SWITCH OUTPUT (RUN) RELAY

Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The trailer tow relays cannot be adjusted or repaired and, if faulty or damaged, the inoperative relay must be replaced.

### OPERATION

The trailer tow relays are electromechanical switches. The relays each use an input from the circuit that they isolate from the trailer wiring to control a high current output to the trailer. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The terminals of each trailer tow relay are connected to the vehicle electrical system through a con-

ductor bank in the rear lighting wire harness above the right rear wheelhouse. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds. The trailer tow relays can be diagnosed using conventional diagnostic tools and methods.

### DIAGNOSIS AND TESTING - TRAILER TOW RELAY

The trailer tow relays (Fig. 65) are located in a connector bank above the right rear wheelhouse. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

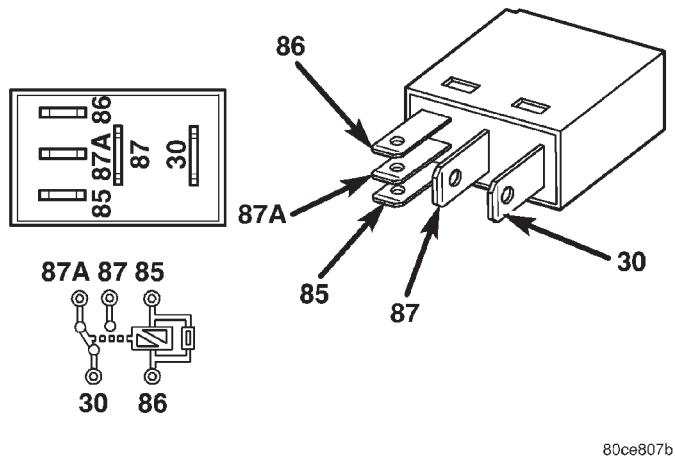
(1) Remove the trailer tow relay from the connector bank. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TRAILER TOW RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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 input and output circuits of the relay. Refer to the appropriate wiring information.

TRAILER TOW RELAY (Continued)



**Fig. 65 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

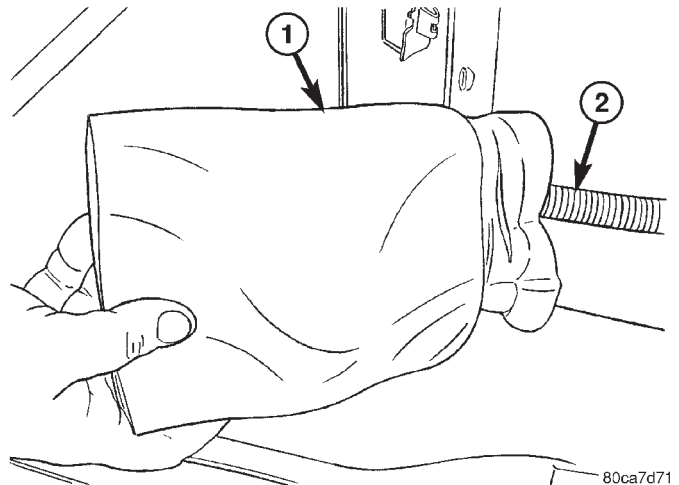
**REMOVAL**

The trailer tow relay bank contains four relays. The service procedures for each relay are the same. Be certain any removed relay is replaced with the same relay size and type that was removed.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 from the right side quarter inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).
- (3) Reach through the access hole in the quarter inner panel behind the right rear wheelhouse to locate and retrieve the trailer tow relay connector bank, which is enveloped in foam rubber and placed

on the top of the right rear wheelhouse between the quarter inner and outer panels (Fig. 66).



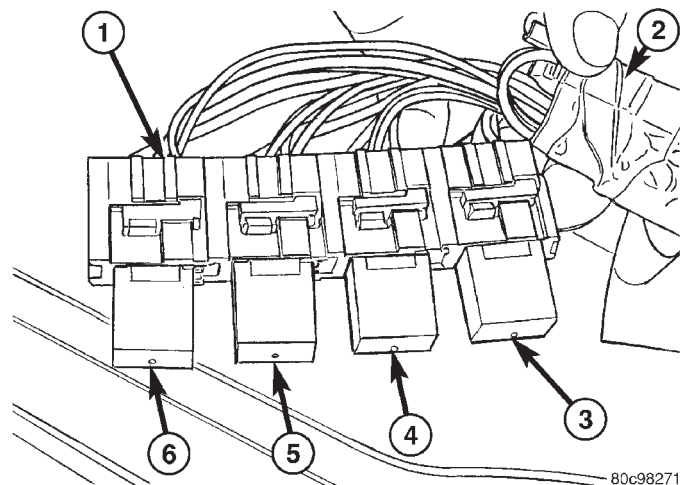
**Fig. 66 Trailer Tow Relay Wrap**

- 1 - FOAM WRAP
- 2 - REAR BODY WIRE HARNESS

(4) Pull the trailer tow relay connector bank into the cargo area far enough to access the unit for service.

(5) Carefully remove the trailer tow relay connector bank from the foam wrap.

(6) Remove the trailer tow relay by grasping it firmly and pulling it straight out from the connector bank (Fig. 67).



**Fig. 67 Trailer Tow Relay Remove/Install**

- 1 - RELAY CONNECTOR BANK
- 2 - REAR BODY WIRE HARNESS
- 3 - LEFT TURN RELAY
- 4 - RIGHT TURN RELAY
- 5 - BRAKE LAMP RELAY
- 6 - FUSED IGNITION SWITCH OUTPUT (RUN) RELAY



## TRAILER TOW RELAY (Continued)

## INSTALLATION

The trailer tow relay bank contains four relays. The service procedures for each relay are the same. Be certain any removed relay is replaced with the same relay size and type that was removed.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the trailer tow relay to the proper connector in the connector bank (Fig. 67).

(2) Align the trailer tow relay terminals with the terminal cavities in the connector.

(3) Push firmly and evenly on the top of the trailer tow relay until the terminals are fully seated in the terminal cavities in the connector.

(4) Carefully restore the foam wrap around the trailer tow relay connector bank (Fig. 66).

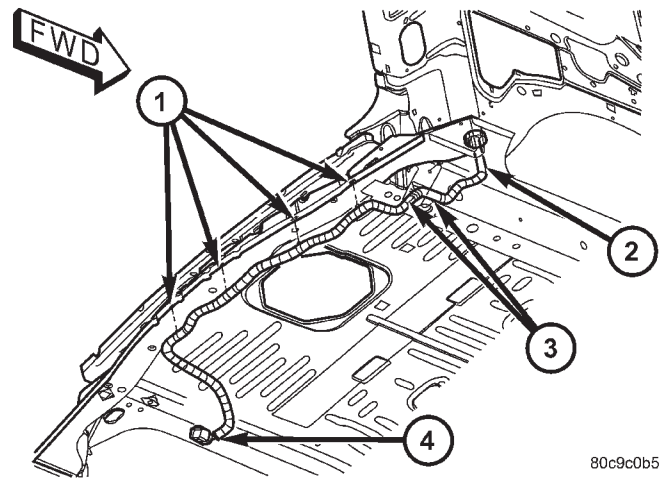
(5) Reach through the access hole in the quarter inner panel behind the right rear wheelhouse to place the trailer tow relay connector bank on the top of the right rear wheelhouse between the quarter inner and outer panels.

(6) Reinstall the trim onto the right side quarter inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).

(7) Reconnect the battery negative cable.

## TRAILER TOW WIRING

## DESCRIPTION



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**Fig. 68 Trailer Tow Wiring**

- 1 - RETAINER CLIP (4)
- 2 - REAR BODY HARNESS (TRAILER TOW TAKE OUT)
- 3 - RETAINER CLIP (2)
- 4 - WIRE HARNESS CONNECTOR

Vehicles equipped with an optional factory-installed (not dealer-installed or port-installed) trailer towing package have a rear body wire harness that includes an integral trailer tow wiring take out that connects to a heavy duty, sealed, 7-pin trailer tow connector located on a bracket on the trailer hitch receiver (Fig. 68). This harness includes a second take out with a trailer tow relay connector bank and four trailer tow relays that isolate the right turn signal, left turn signal, and brake lamp circuits of the vehicle from the electrical system of the trailer. The fourth relay in the connector bank provides a fused ignition switch output (run) source of battery current to the trailer tow connector through a trailer tow relay output circuit. The package also includes an adapter harness (stored beneath the left rear seat cushion of the vehicle when it is shipped from the factory) that adapts the 7-pin trailer tow connector to a standard, light-duty, 4-pin trailer tow connector. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## LAMPS/LIGHTING - INTERIOR

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## LAMPS/LIGHTING - INTERIOR

### DESCRIPTION

The interior lighting system (Fig. 1) for this model includes the following incandescent interior lamps:

- **Ash Receiver Lamp** - An available ash receiver lamp is located above the ash receiver housing behind the instrument panel center bezel, and is controlled by the panel lamps dimmer circuit.
- **Cargo Lamp** - An available cargo lamp with an integral lens-actuated courtesy disable switch is located in the headliner near the rear roof header, and is controlled by the courtesy lamp circuit.
- **Courtesy Lamps** - Available courtesy lamps are located below both the right and left side of the instrument panel, and are controlled by the courtesy lamp circuit.

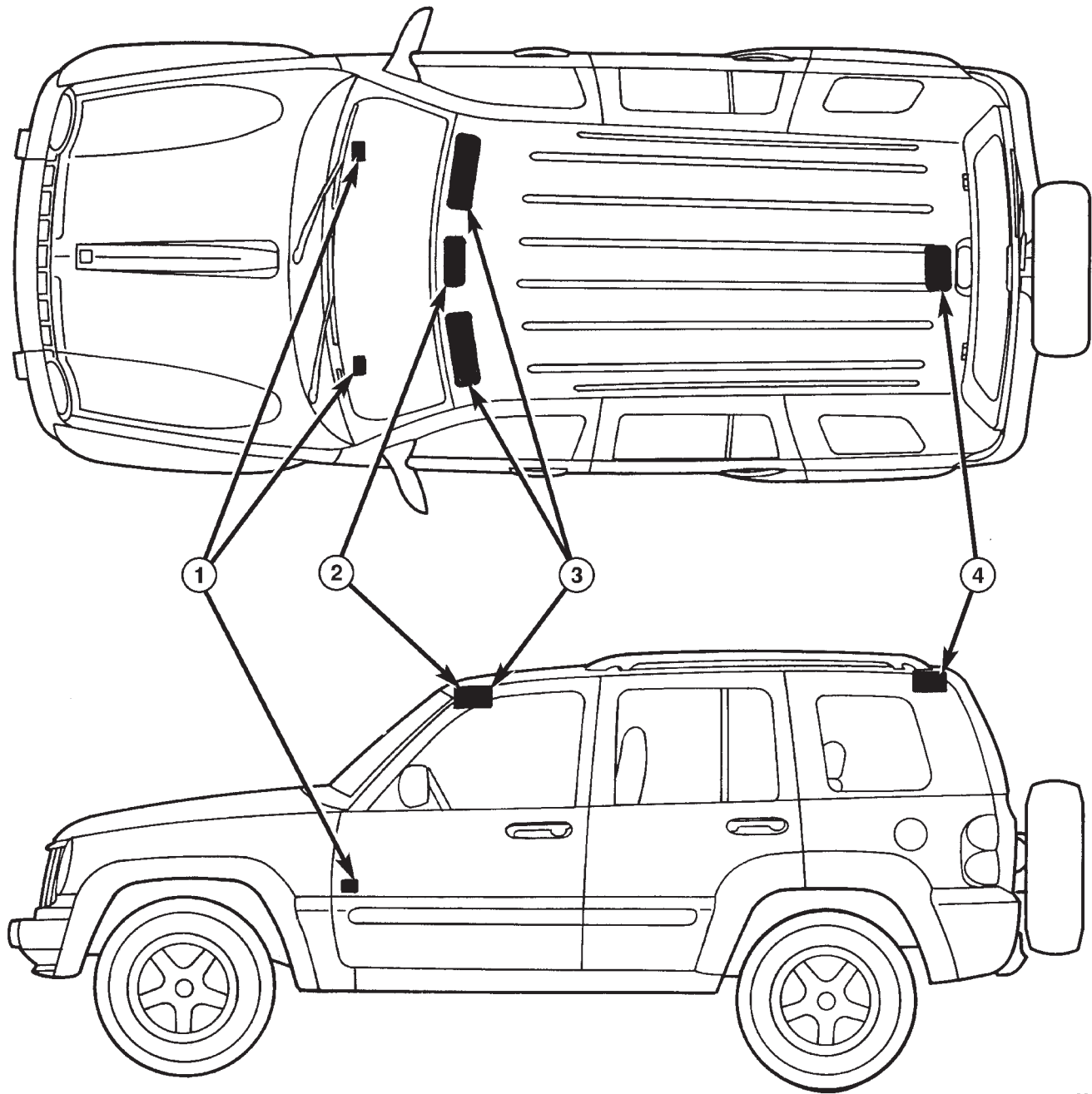
- **Compass Mini-Trip Control Illumination Lamps** - The optional Compass Mini-Trip Computer (CMTC) has three replaceable control illumination bulb/bulb holder units on its circuit board that are controlled by the panel lamps dimmer circuit.

- **Dome Lamp** - A standard front dome lamp that does not include an on-off switch is located in the headliner near the windshield header, and is controlled by the courtesy lamp circuit.

- **Hazard Switch Illumination/Indicator Lamp** - The hazard switch control button has a non-replaceable illumination/indicator bulb soldered onto its circuit board that is controlled by both the hazard switch circuitry and the panel lamps dimmer circuit. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HAZARD SWITCH - DESCRIPTION).

- **Heater-Air Conditioner Control Illumination Lamps** - The heater-air conditioner control has

LAMPS/LIGHTING - INTERIOR (Continued)



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**Fig. 1 Courtesy Lamps**

- 1 - COURTESY LAMP (2)
- 2 - DOME OR READING LAMP

- 3 - VANITY LAMP (2)
- 4 - CARGO LAMP

two replaceable control illumination bulb/bulb holder units on its circuit board that are controlled by the panel lamps dimmer circuit.

• **Instrument Cluster Illumination Lamps** - The ElectroMechanical Instrument Cluster (EMIC) has nine replaceable general illumination bulb/bulb holder units on its circuit board that are controlled by the panel lamps dimmer circuit. (Refer to 8 -

ELECTRICAL/INSTRUMENT CLUSTER - DESCRIPTION).

• **Reading Lamps** - Available front seat driver side and passenger side reading lamps located in the headliner near the windshield header are controlled by both the courtesy lamp circuit and independent lens-actuated switches.

• **Transmission Range Indicator Illumination Lamp** - Vehicles equipped with an automatic trans-

## LAMPS/LIGHTING - INTERIOR (Continued)

mission have an illuminated transmission range indicator integral to the console mounted gearshift mechanism, and controlled by the panel lamps dimmer circuit.

- **Vanity Lamps** - Available single intensity vanity lamps are located on each side of a covered mirror on both the right and left sun visors, and are controlled by an integral vanity mirror cover-actuated switch on the courtesy lamp circuit.

Other components of the interior lighting system for this model include:

- **Body Control Module** - The Body Control Module (BCM) is located on the Junction Block (JB) under the driver side outboard end of the instrument panel. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL MODULE - DESCRIPTION).

- **Door Ajar Switches** - A door ajar switch is integral to the door latch mechanism of each front and rear door.

- **Flip-Up Glass Ajar Switch** - A flip-up glass ajar switch is integral to the flip-up glass latch mechanism on the top of the tailgate inner panel.

- **Multi-Function Switch** - The multi-function switch is located on the top of the steering column, just below the steering wheel. The multi-function switch includes a left (lighting) control stalk and a right (wiper) control stalk. The left control stalk is dedicated to providing almost all of the driver controls for both the exterior and interior lighting systems. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION).

- **Tailgate Ajar Switch** - A tailgate ajar switch is integral to the latch mechanism of the tailgate.

Hard wired circuitry connects the interior lighting system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the interior lighting system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## OPERATION

The interior lighting systems can be divided into two general classifications based upon the circuit that controls their operation: The courtesy lamp cir-

cuit, or the panel lamps dimmer circuit. Following are paragraphs that briefly describe the operation of each of the major interior lighting systems. The hard wired circuits and components of the interior lighting systems may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, and the PCI data bus network inputs and outputs related to the various interior lighting systems requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**COURTESY LAMP CIRCUIT** Depending upon the selected vehicle options the courtesy lamp circuit may include the courtesy lamps located below the instrument panel, the dome or map/reading lamps located in the headliner near the windshield, the cargo lamp located in the headliner near the rear roof header, and the vanity lamps located in the sun visors. The lamps in the courtesy lamp circuit are provided with battery current at all times from a fused B(+) fuse in the Junction Block (JB) through a fused B(+) circuit. The Body Control Module (BCM) controls the ground path for these lamps using an internal driver through the courtesy lamp driver circuit based upon hard wired inputs from the door ajar switches, the flip-up glass ajar switch, and the tailgate ajar switch. After all of the ajar switch inputs to the BCM transition to open, the BCM will keep the lamps illuminated for about 27 seconds, then fade the lamps to off (theater dimming) over about three seconds.

The BCM also provides courtesy lamp operation based upon a resistor multiplexed input from the interior lighting control ring on the left (lighting) control stalk of the multi-function switch through the headlamp switch mux circuit, and in response to certain inputs from the optional Remote Keyless Entry (RKE) system. A resistor multiplexed courtesy lamp defeat input from the control ring on the left (lighting) control stalk of the multi-function switch will cause the BCM to override normal courtesy lamp operation based upon inputs from all of the ajar switches. A hard wired input from the courtesy lamp defeat switch in the optional cargo lamp through a rear courtesy lamp control circuit will cause the BCM to override normal courtesy lamp operation based upon inputs from only the flip-up glass and tailgate ajar switches.

For those lamps on the courtesy lamp circuit with independent switching, such as the optional reading lamps and vanity lamps, the BCM provides a ground

## LAMPS/LIGHTING - INTERIOR (Continued)

path to the switches using another internal driver through the courtesy lamp load shed circuit. The BCM provides a battery saver (load shedding) feature for all courtesy lamps, which will automatically turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position.

**PANEL LAMPS DIMMER CIRCUIT** The panel lamps dimmer circuit includes the ElectroMechanical Instrument Cluster (EMIC), heater-air conditioner control, hazard switch and, depending upon the selected vehicle options, ash receiver, and automatic transmission range indicator illumination lamps. All lamps in the panel lamps dimmer circuit are provided a path to ground at all times through a hard wired ground circuit. These lamps illuminate based upon inputs to the Body Control Module (BCM) from the exterior lighting control knob and the interior lighting control ring on the left (lighting) control stalk of the multi-function switch. The control knob on the left control stalk of the multi-function switch selects the exterior lights, while the control ring selects the panel lamps intensity (dimming) level.

When the exterior lighting is turned On, the BCM energizes the park lamp relay and provides an electronic dimming level message to the ElectroMechanical Instrument Cluster (EMIC), the radio, and the Compass Mini-Trip Computer (CMTC) over the Programmable Communications Interface (PCI) data bus. The energized park lamp relay provides a hard wired battery current signal input to the EMIC on the park lamp relay output circuit. The EMIC responds to these inputs by supplying a 12-volt Pulse Width Modulated (PWM) output to all of the incandescent lamps in the panel lamps dimmer circuit over the fused panel lamps dimmer switch signal circuit. This shared PWM output synchronizes the selected illumination intensity level of all of the incandescent lamps in the panel lamps dimmer circuit.

The EMIC and the radio each use the electronic dimming level message from the BCM to control and synchronize the illumination intensity of their own Vacuum Fluorescent Display (VFD), while the CMTC uses the dimming level message to control the illumination intensity of both its VFD and its incandescent lighting. In addition, when the control ring on the left (lighting) control stalk of the multi-function switch is moved to the Parade Mode detent position, all of the VFDs are illuminated at their full intensity levels for increased visibility when the vehicle is driven during daylight hours with the exterior lights turned On.

**DIAGNOSIS AND TESTING - LAMPS/LIGHTING - INTERIOR**

The hard wired circuits and components of the interior lighting system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, and the PCI data bus network inputs and outputs related to the various interior lighting systems requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

When diagnosing the interior lighting circuits, remember that high generator output can burn out bulbs rapidly and repeatedly; and, that dim or flickering bulbs can be caused by low generator output or poor battery condition. If one of these symptoms is a problem on the vehicle being diagnosed, be certain to diagnose and repair the battery and charging system as required. Also keep in mind that a good ground is necessary for proper lighting operation. If a lighting problem is being diagnosed that involves multiple symptoms, systems, or components the problem can often be traced to a loose, corroded, or open ground. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

LAMPS/LIGHTING - INTERIOR (Continued)

COURTESY LAMP CIRCUIT

CONDITION	POSSIBLE CAUSES	CORRECTION
<p>A SINGLE LAMP IN THE COURTESY LAMP CIRCUIT DOES NOT ILLUMINATE</p>	<ol style="list-style-type: none"> <li>1. Faulty or missing bulb.</li> <li>2. Faulty lamp switch.</li> <li>3. Faulty ground circuit.</li> <li>4. Faulty ground circuit (independently switched lamps only).</li> <li>5. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace the courtesy lamp bulb as required.</li> <li>2. Test and replace a faulty map/reading lamp switch, cargo lamp switch, or sunvisor (vanity lamp switch) as required.</li> <li>3. Test and repair the open courtesy lamp driver circuit as required.</li> <li>4. Test and repair the open courtesy lamp load shed circuit as required.</li> <li>5. Test and repair the open fused B(+) circuit as required.</li> </ol>
<p>ALL LAMPS IN THE COURTESY LAMP CIRCUIT DO NOT ILLUMINATE</p>	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty cargo lamp (courtesy defeat) switch.</li> <li>5. Faulty rear courtesy lamp control circuit.</li> <li>6. Faulty multi-function switch.</li> <li>7. Faulty Body Control Module (BCM), BCM input, or BCM output.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace the fused B(+) fuse (IOD) in the Junction Block (JB) as required.</li> <li>2. Test and repair the open courtesy lamp driver circuit as required.</li> <li>3. Test and repair the open fused B(+) circuit as required.</li> <li>4. Test and replace the cargo lamp switch as required.</li> <li>5. Test and repair the shorted courtesy lamp control circuit as required.</li> <li>6. Test and replace the multi-function switch as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM, its inputs, and its outputs. Refer to the appropriate diagnostic information.</li> </ol>
<p>A SINGLE LAMP IN THE COURTESY LAMP CIRCUIT DOES NOT EXTINGUISH</p>	<ol style="list-style-type: none"> <li>1. Faulty lamp switch.</li> <li>2. Faulty ground circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace a faulty map/reading lamp switch, cargo lamp switch, or sunvisor (vanity lamp switch) as required.</li> <li>2. Test and repair the shorted courtesy lamp driver circuit as required.</li> </ol>
<p>ALL LAMPS IN THE COURTESY LAMP CIRCUIT DO NOT EXTINGUISH</p>	<ol style="list-style-type: none"> <li>1. Faulty ajar switch.</li> <li>2. Faulty ajar switch sense circuit.</li> <li>3. Faulty ground circuit.</li> <li>4. Faulty Body Control Module (BCM), BCM input, or BCM output.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace a faulty door, tailgate, or liftglass ajar switch as required.</li> <li>2. Test and repair the shorted ajar switch sense circuit as required.</li> <li>3. Test and repair the shorted courtesy lamp driver circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM, its inputs, and its outputs. Refer to the appropriate diagnostic information.</li> </ol>

## LAMPS/LIGHTING - INTERIOR (Continued)

## PANEL LAMPS DIMMER CIRCUIT

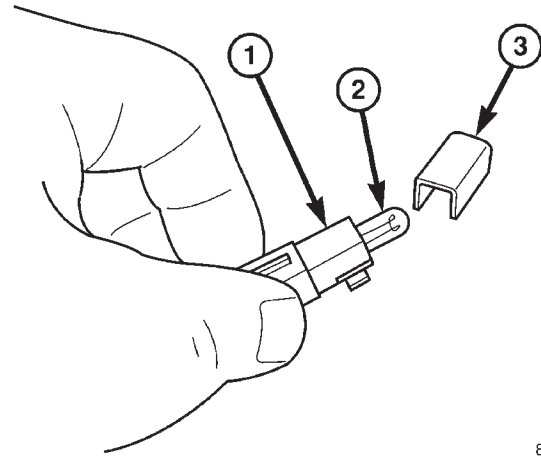
CONDITION	POSSIBLE CAUSES	CORRECTION
A SINGLE LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing bulb.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace lamp bulb as required.</li> <li>2. Test and repair lamp ground circuit as required.</li> <li>3. Test and repair open fused panel lamps dimmer switch signal circuit as required.</li> </ol>
A SINGLE LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair shorted fused panel lamps dimmer switch signal circuit as required.</li> </ol>
ALL LAMPS DO NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty fused park lamp relay output circuit.</li> <li>2. Faulty or missing park lamp relay.</li> <li>3. Faulty fused panel lamps dimmer switch signal circuit.</li> <li>4. Faulty Body Control Module (BCM), BCM input, or BCM output.</li> <li>5. Faulty ElectroMechanical Instrument Cluster (EMIC), EMIC input, or EMIC output.</li> <li>6. Faulty multi-function switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open fused park lamp relay output circuit as required.</li> <li>2. Test and replace park lamp relay as required.</li> <li>3. Test and repair open fused panel lamps dimmer switch signal circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM, its inputs, and its outputs. Refer to the appropriate diagnostic information.</li> <li>5. Use a DRBIII® scan tool to test the EMIC, its inputs, and its outputs. Refer to the appropriate diagnostic information.</li> <li>6. Test and replace the multi-function switch as required.</li> </ol>
ALL LAMPS EXCEPT CLUSTER ILLUMINATION DO NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair shorted fused panel lamps dimmer switch signal circuit as required.</li> </ol>

LAMPS/LIGHTING - INTERIOR (Continued)

**SPECIFICATIONS - LAMPS/LIGHTING - INTERIOR**

*BULB SPECIFICATIONS*

LAMP	BULB
Ash Receiver	161
Cargo	214-2
Cluster Illumination	103
Compass Mini-Trip Illumination	MOPAR 4437661
Courtesy	906
Heater-A/C Control Illumination	74
Map/Reading	192
Transmission Range Indicator Illumination	S14V
Vanity Mirror	MOPAR 6501966



**Fig. 2 Ash Receiver Lamp Bulb Remove/Install**

- 1 - SOCKET
- 2 - BULB
- 3 - HOOD

**ASH RECEIVER LAMP BULB**

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 ash receiver lamp unit from the top of the ash receiver housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/ASH RECEIVER LAMP UNIT - REMOVAL).
- (3) Carefully disengage the ash receiver lamp hood from the integral snap features on each side of the lamp unit socket and remove the hood (Fig. 2).
- (4) Pull the ash receiver lamp bulb straight out of the lamp unit socket.

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

- (1) Align the base of the ash receiver lamp bulb with the receptacle in the lamp unit socket.
- (2) Push the ash receiver lamp bulb straight into the lamp unit socket until it is firmly seated (Fig. 2).
- (3) Carefully slide the ash receiver lamp hood onto the lamp unit socket until it is fully engaged with the integral snap features on each side of the socket.
- (4) Reinstall the ash receiver lamp unit onto the top of the ash receiver housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/ASH RECEIVER LAMP UNIT - INSTALLATION).
- (5) Reconnect the battery negative cable.

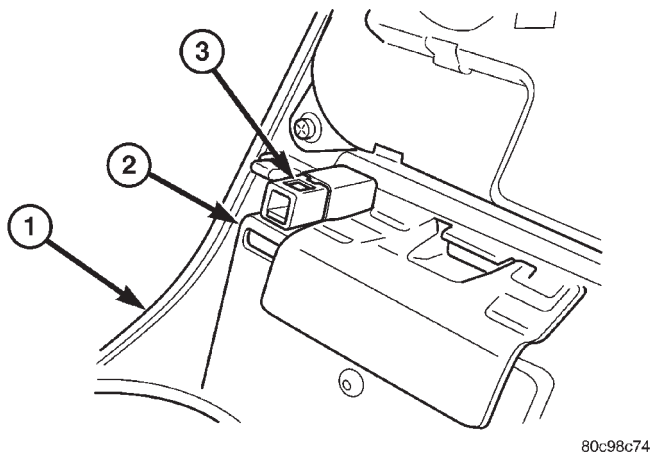


## ASH RECEIVER LAMP UNIT

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 center bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).
- (3) While pulling the ash receiver lamp unit away from the top of the ash receiver housing, from inside the housing carefully release the four integral latches that secure the lamp unit to the mounting hole in the top of the housing.
- (4) Remove the ash receiver lamp unit from the top of the ash receiver housing (Fig. 3).



**Fig. 3 Ash Receiver Lamp Unit Remove/Install**

- 1 - CENTER BEZEL
- 2 - ASH RECEIVER HOUSING
- 3 - ASH RECEIVER LAMP UNIT

### INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

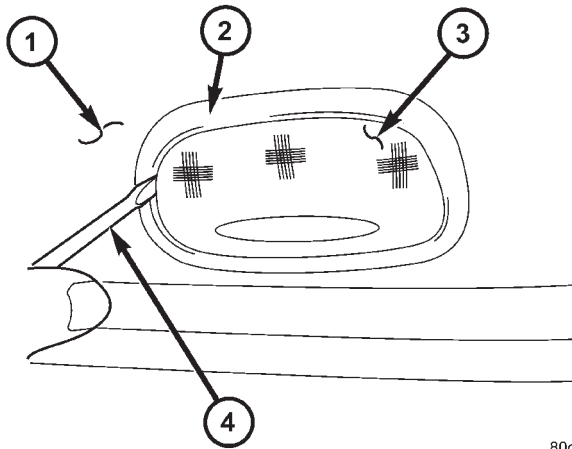
- (1) Align the four integral latches of the ash receiver lamp unit to the mounting hole on the top of the ash receiver housing (Fig. 3).
- (2) Using hand pressure, press firmly and evenly on the ash receiver lamp unit until the four integral latches snap into place in the ash receiver housing mounting hole.
- (3) Reinstall the center bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).
- (4) Reconnect the battery negative cable.

## CARGO LAMP BULB

### REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Using a small thin-bladed screwdriver, gently pry outward on either side near the top of the cargo lamp lens until the lens pivot unsnaps from the pivot pin within the lamp unit housing (Fig. 4).
- (3) Move the cargo lamp lens upward far enough to disengage the switch tab at the bottom of the lens from between the switch plunger and the lamp unit housing.
- (4) Remove the cargo lamp lens from the lamp unit housing.
- (5) Firmly grasp the cargo lamp bulb and pull each end outward until it is disengaged from its respective bulb holder within the lamp unit housing (Fig. 5).
- (6) Remove the cargo lamp bulb from the lamp unit housing.

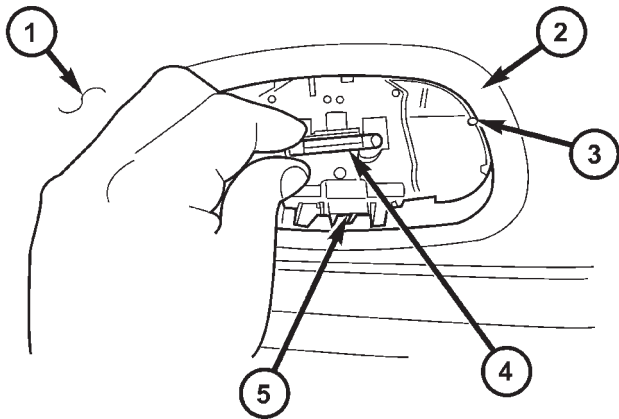
CARGO LAMP BULB (Continued)



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**Fig. 4 Cargo Lamp Lens Remove**

- 1 - HEADLINER
- 2 - CARGO LAMP
- 3 - LENS
- 4 - SCREWDRIVER



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**Fig. 5 Cargo Lamp Bulb Remove/Install**

- 1 - HEADLINER
- 2 - CARGO LAMP
- 3 - LENS PIVOT PIN
- 4 - BULB
- 5 - SWITCH

**INSTALLATION**

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Position the cargo lamp bulb into the lamp unit housing.

(2) Align the ends of the cargo lamp bulb with each of the bulb holders within the lamp unit housing (Fig. 5).

(3) Using hand pressure, press firmly and evenly on both ends of the cargo lamp bulb until they snap into their respective bulb holders within the lamp unit housing.

(4) Position the cargo lamp lens to the lamp unit housing.

(5) Insert the switch tab at the bottom of the cargo lamp lens between the switch plunger and the lamp unit housing.

(6) Align the pivots on each side near the top of the cargo lamp lens with the pivot pins within the lamp unit housing.

(7) Using hand pressure, press firmly and evenly on the cargo lamp lens over both pivots until they snap into place over the pivot pins within the lamp unit housing.

(8) Reconnect the battery negative cable.

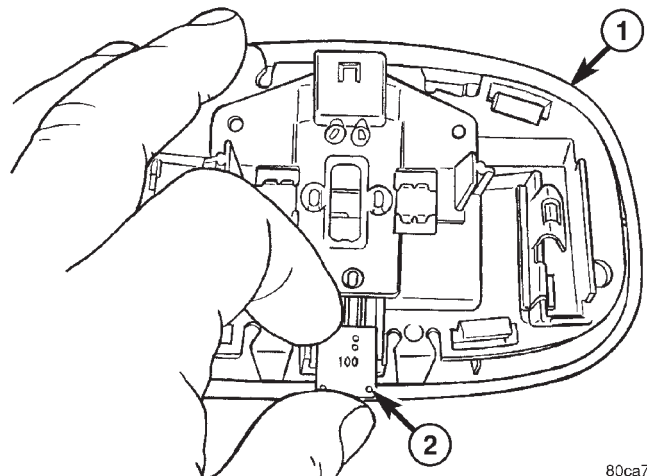
**CARGO LAMP SWITCH**

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cargo lamp unit from the headliner near the rear roof header. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/CARGO LAMP UNIT - REMOVAL).

(3) From the back of the cargo lamp unit housing, firmly grasp the switch body (Fig. 6).



80ca7de4

**Fig. 6 Cargo Lamp Switch Remove/Install**

- 1 - CARGO LAMP UNIT HOUSING
- 2 - SWITCH

## CARGO LAMP SWITCH (Continued)

(4) Using hand pressure, pull the cargo lamp switch toward the outside of the lamp unit housing until it unsnaps from the housing.

(5) Continue sliding the cargo lamp switch away from the terminal pins and out of the lamp unit housing.

## INSTALLATION

(1) Align the terminal receptacles in the cargo lamp switch with the terminal pins of the lamp unit housing (Fig. 6).

(2) Using hand pressure, push the cargo lamp switch toward the terminals of the lamp unit housing until it snaps into the housing.

(3) Reinstall the cargo lamp unit onto the headliner near the rear roof header. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/CARGO LAMP UNIT - INSTALLATION).

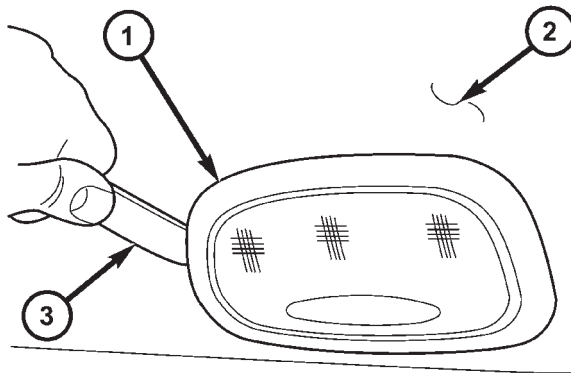
(4) Reconnect the battery negative cable.

## CARGO LAMP UNIT

## REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry between the flange around the edge of the cargo lamp unit housing and the headliner to release the metal snap clip on each side of the housing from the receptacles in the rear roof header (Fig. 7).



80c996ba

**Fig. 7 Cargo Lamp Unit Remove/Install**

- 1 - CARGO LAMP UNIT
- 2 - HEADLINER
- 3 - TRIM STICK

(3) Pull the cargo lamp unit away from the headliner far enough to access and disconnect the rear body wire harness connector for the lamp from the connector receptacle on the lamp unit housing.

(4) Remove the cargo lamp unit from the mounting hole in the headliner.

## INSTALLATION

(1) Position the cargo lamp unit to the mounting hole in the headliner.

(2) Reconnect the rear body wire harness connector for the cargo lamp to the connector receptacle on the lamp unit housing.

(3) With the finger depression in the cargo lamp lens oriented towards the rear of the vehicle, position the cargo lamp unit housing into the headliner mounting hole and align the metal snap clip on each side of the housing with their receptacles in the rear roof header (Fig. 7).

(4) Using hand pressure, press upward firmly and evenly on both ends of the cargo lamp unit until both snap clips are fully engaged in their receptacles.

(5) Reconnect the battery negative cable.

COMPASS MINI-TRIP  
ILLUMINATION BULB

## REMOVAL

The Compass Mini-Trip Computer (CMTC) in the overhead console includes either two or three incandescent illumination bulb and bulb holder units. Three bulbs are used only on models that also feature the optional Universal Garage Door Opener (UGDO).

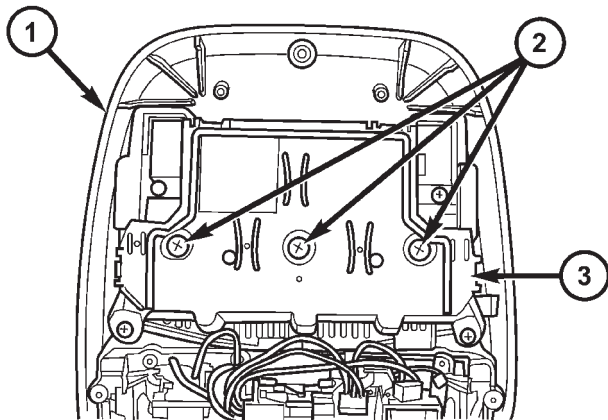
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## COMPASS MINI-TRIP ILLUMINATION BULB (Continued)

(1) Disconnect and isolate the battery negative cable.

(2) Remove the overhead console from the headliner. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(3) From the back of the unit, use a small thin-bladed screwdriver to rotate the compass mini-trip illumination bulb holder counterclockwise about 30 degrees on the circuit board (Fig. 8).



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**Fig. 8 Compass Mini-Trip Illumination Bulb Remove/Install**

- 1 - OVERHEAD CONSOLE  
2 - BULB & HOLDER (3)  
3 - COMPASS MINI-TRIP COMPUTER

(4) Pull the compass mini-trip illumination bulb holder and bulb unit straight out of the circuit board bulb mounting hole.

## INSTALLATION

The Compass Mini-Trip Computer (CMTC) in the overhead console includes either two or three incandescent illumination bulb and bulb holder units. Three bulbs are used only on models that also feature the optional Universal Garage Door Opener (UGDO).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL**

**RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

(1) Align the compass mini-trip illumination bulb holder and bulb unit with the circuit board bulb mounting hole.

(2) Insert the compass mini-trip illumination bulb holder and bulb unit straight into the circuit board bulb mounting hole until it is firmly seated (Fig. 8).

(3) Using a small thin-bladed screwdriver, rotate the compass mini-trip illumination bulb holder clockwise about 30 degrees on the circuit board.

(4) Reinstall the overhead console onto the headliner. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION).

(5) Reconnect the battery negative cable.

## COURTESY LAMP BULB

### REMOVAL

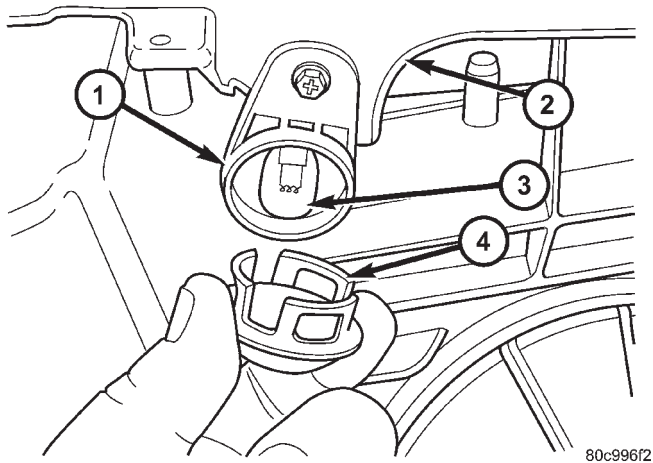
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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) Support the courtesy lamp unit housing with one hand while firmly grasping the flange on the outer circumference of the lens with the other hand, then pull the lens straight down to unsnap it from the housing (Fig. 9).

(3) Pull the courtesy lamp bulb straight out of the lamp unit socket.

## COURTESY LAMP BULB (Continued)



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**Fig. 9 Courtesy Lamp Lens Remove/Install**

- 1 - COURTESY LAMP
- 2 - LOWER INSTRUMENT PANEL
- 3 - BULB
- 4 - LENS

## INSTALLATION

**WARNING:** ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

- (1) Align the base of the courtesy lamp bulb with the receptacle in the lamp unit socket.
- (2) Push the courtesy lamp bulb straight into the lamp unit socket until it is firmly seated (Fig. 9).
- (3) Align the courtesy lamp lens with the lamp unit housing.
- (4) Support the courtesy lamp unit housing with one hand while firmly and evenly pushing the lens

into the housing with the other hand, until the lens snaps into place.

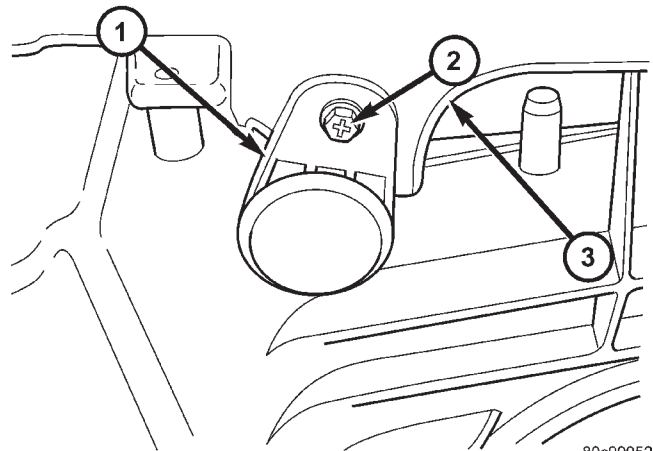
- (5) Reconnect the battery negative cable.

## COURTESY LAMP UNIT

## REMOVAL

**WARNING:** ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 screw that secures the integral mounting tab of the courtesy lamp unit to the lower instrument panel (Fig. 10).



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**Fig. 10 Courtesy Lamp Unit Remove/Install**

- 1 - COURTESY LAMP UNIT
- 2 - SCREW (1)
- 3 - LOWER INSTRUMENT PANEL

- (3) Pull the courtesy lamp unit down from the lower instrument panel far enough to access and disconnect the instrument panel wire harness connector

## COURTESY LAMP UNIT (Continued)

for the courtesy lamp from the connector receptacle on the back of the lamp unit housing.

(4) Remove the courtesy lamp unit from under the instrument panel.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the courtesy lamp unit under the instrument panel.

(2) Reconnect the instrument panel wire harness connector for the courtesy lamp to the connector receptacle on the back of the lamp unit housing.

(3) Position the courtesy lamp unit to the lower instrument panel (Fig. 10).

(4) Install and tighten the screw that secures the integral mounting tab of the courtesy lamp unit to the lower instrument panel.

(5) Reconnect the battery negative cable.

## DOOR AJAR SWITCH

### DESCRIPTION

This vehicle has four door ajar switches, one for each door. Each switch is concealed within and integral to its respective door latch unit. The switches are momentary leaf contact-type units that are actuated by the door latch mechanisms. A short pigtail wire and connector on each door latch connects the door ajar switch to the vehicle electrical system through its respective door wire harness. The door ajar switches cannot be adjusted or repaired and, if faulty or damaged, the door latch unit must be replaced. (Refer to 23 - BODY/DOOR - FRONT/LATCH - REMOVAL) or (Refer to 23 - BODY/DOOR - REAR/LATCH - REMOVAL).

### OPERATION

The door ajar switches are actuated by the door latch mechanisms. When a door is closed and properly latched, its door ajar switch is an open circuit. When a door is open or only partially latched, the door ajar switch is a closed circuit. The door ajar switches are hard wired between a body ground and the Body Control Module (BCM). The driver side front door ajar switch is connected to the BCM through a driver door ajar switch sense circuit, while the remaining three door ajar switches are connected to the BCM through a passenger door ajar switch sense circuit in a parallel-series arrangement. The BCM reads the door ajar switch status through an internal pull-up, then uses these inputs to control many electronic functions and features of the vehicle. The door ajar switches can be diagnosed using conventional diagnostic tools and methods; however, for proper diagnosis of the BCM, and both the hard wired and electronic BCM outputs affected by the door ajar switch inputs, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## FLIP-UP GLASS AJAR SWITCH

### DESCRIPTION

A flip-up glass ajar switch is standard equipment in this vehicle. This switch is concealed within and integral to the flip-up glass latch unit. The switch is a momentary leaf contact-type unit that is actuated by the flip-up glass latch mechanism. A dedicated connector receptacle on the flip-up glass latch unit connects the flip-up glass ajar switch to the vehicle electrical system through the tailgate wire harness. The flip-up glass ajar switch cannot be adjusted or repaired and, if faulty or damaged, the flip-up glass latch unit must be replaced. (Refer to 23 - BODY/SWING GATE/FLIP-UP GLASS LATCH - REMOVAL).

### OPERATION

The flip-up glass ajar switch is actuated by the flip-up glass latch mechanism. When the flip-up glass is closed and properly latched, the flip-up glass ajar switch is an open circuit. When the flip-up glass is open or only partially latched, the flip-up glass ajar switch is a closed circuit. The flip-up glass ajar switch is hard wired between a body ground, the Body Control Module (BCM), and the rear wiper motor. The output of the switch is connected to the BCM and rear wiper motor through a flip-up glass ajar switch sense circuit. The BCM reads the flip-up glass ajar switch status through an internal pull-up, then uses this input to control many electronic func-

## FLIP-UP GLASS AJAR SWITCH (Continued)

tions and features of the vehicle. The rear wiper motor uses this input to restrict rear wiper operation when the flip-up glass is ajar. The flip-up glass ajar switch can be diagnosed using conventional diagnostic tools and methods; however, for proper diagnosis of the BCM, and both the hard wired and electronic BCM outputs affected by the flip-up glass ajar switch input, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## HEATER-A/C CONTROL ILLUMINATION BULB

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

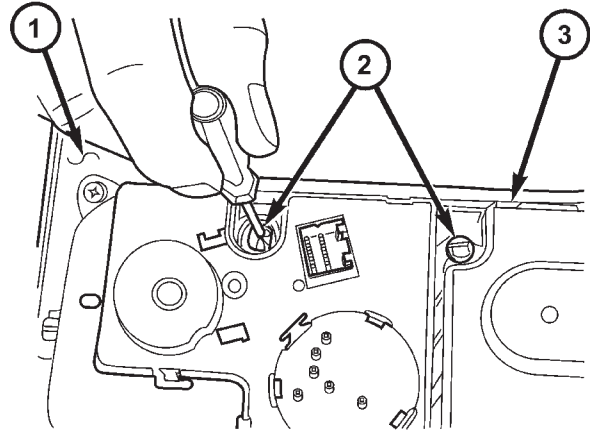
(2) Remove the center bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(3) From the back of the center bezel, use a small thin-bladed screwdriver to rotate the heater-A/C control illumination bulb holder counterclockwise about 30 degrees on the circuit board (Fig. 11).

(4) Pull the heater-A/C illumination bulb holder and bulb unit straight out of the circuit board bulb mounting hole.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG,**



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**Fig. 11 Heater-A/C Control Illumination Bulb Remove/Install**

- 1 - CENTER BEZEL
- 2 - BULB HOLDER & BULB (2)
- 3 - HEATER-A/C CONTROL

**OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

(1) Align the heater-A/C control illumination bulb holder and bulb unit with the circuit board bulb mounting hole.

(2) Insert the heater-A/C control illumination bulb holder and bulb unit straight into the circuit board bulb mounting hole until it is firmly seated (Fig. 11).

(3) Using a small thin-bladed screwdriver, rotate the heater-A/C control illumination bulb holder clockwise about 30 degrees on the circuit board.

(4) Reinstall the center bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(5) Reconnect the battery negative cable.

## READING LAMP BULB

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 not equipped with the optional Compass Mini-Trip Computer (CMTC), remove the reading lamp unit from the headliner mounting hole. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/READING LAMP UNIT - REMOVAL). If the vehicle is equipped with the optional CMTC, remove the overhead console from the headliner. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

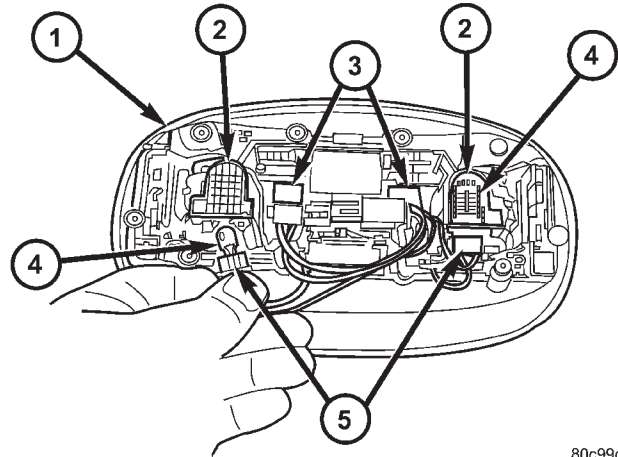
(3) From the back of the unit while pulling the reading lamp socket away from the outside of the lamp unit bulb housing, use a small thin-bladed screwdriver to release the integral latch tabs of the socket from the inside of the bulb housing (Fig. 12).

(4) Pull the reading lamp socket and bulb unit straight out from the lamp unit bulb housing.

(5) Pull the ash reading lamp bulb straight out of the lamp unit socket.

### INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FUR-**



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**Fig. 12 Reading Lamp Bulb Remove/Install**

- 1 - BEZEL
- 2 - BULB HOUSING
- 3 - SWITCH (2)
- 4 - BULB (2)
- 5 - SOCKET (2)

**OTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

(1) Align the base of the reading lamp bulb with the receptacle in the lamp unit socket.

(2) Push the reading lamp bulb straight into the lamp unit socket until it is firmly seated.

(3) Align the reading lamp socket and bulb unit with the mounting hole in the bulb housing (Fig. 12).

(4) Push the reading lamp socket and bulb unit straight into the bulb housing until it is firmly seated and the integral socket latches are engaged within the bulb housing.

(5) If the vehicle is not equipped with the optional Compass Mini-Trip Computer (CMTC), reinstall the reading lamp unit into the headliner mounting hole. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/READING LAMP - INSTALLATION). If the vehicle is equipped with the optional CMTC, reinstall the overhead console onto the headliner. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION).

(6) Reconnect the battery negative cable.



## READING LAMP SWITCH

### REMOVAL

The reading lamp switches are serviced as a unit with the reading lamp sockets, wire harness, and connector.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 both reading lamp sockets and their bulbs from the lamp unit housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/READING LAMP BULB - REMOVAL).

(3) From the back of the reading lamp unit housing, carefully depress the blocking tab that engages the terminal end of the reading lamp wire harness connector, then slide the connector over the tab and off of the mount near the center of the lamp unit housing.

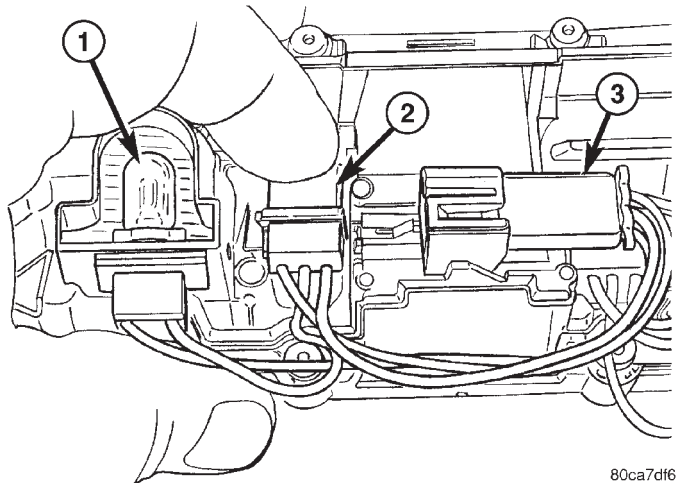
(4) From the back of the reading lamp unit housing, firmly press each switch body toward the large end of the keyed hole into which it is secured until it unsnaps from the housing (Fig. 13).

(5) Remove the connector, wire harness, both sockets, and both switches from the back of the reading lamp unit housing.

### INSTALLATION

The reading lamp switches are serviced as a unit with the reading lamp sockets, wire harness, and connector.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG,**



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**Fig. 13 Reading Lamp Switch Remove/Install**

- 1 - READING LAMP BULB
- 2 - SWITCH
- 3 - WIRE HARNESS CONNECTOR

**OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the connector, wire harness, both sockets, and both switches onto the back of the reading lamp unit housing.

(2) Insert the plunger of each switch into the large end of the keyed hole in the reading lamp unit housing.

(3) Firmly press each switch body toward the small end of the keyed hole into which it is secured until it snaps into the housing (Fig. 13).

(4) Engage the wire end of the reading lamp wire harness connector onto the connector mount near the center of the lamp unit housing, then slide the connector over the mount until the blocking tab snaps up into place.

(5) Reinstall both reading lamp bulbs and their sockets into the lamp unit housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/READING LAMP BULB - INSTALLATION).

(6) Reconnect the battery negative cable.

## READING LAMP UNIT

### REMOVAL

If the vehicle is equipped with an optional Compass Mini-Trip Computer (CMTC), the reading lamps are housed in the overhead console. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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) Using a trim stick or another suitable wide flat-bladed tool, gently pry between the flange around the edge of the reading lamp unit housing and the headliner to release the metal snap clip on each side of the housing from the receptacles in the mounting bracket above the headliner (Fig. 14).

(3) Pull the reading lamp unit away from the headliner far enough to access and disconnect the body wire harness connector for the lamp from the connector on the lamp unit housing.

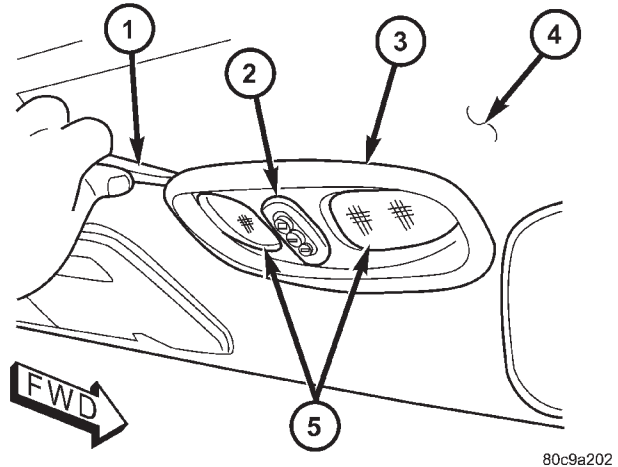
(4) If the vehicle is equipped with an optional power sunroof, disconnect the body wire harness connector for the sunroof switch from the connector receptacle on the back of the switch.

(5) Remove the reading lamp unit from the mounting hole in the headliner.

### INSTALLATION

If the vehicle is equipped with an optional Compass Mini-Trip Computer (CMTC), the reading lamps are housed in the overhead console. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING**



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**Fig. 14 Reading Lamp Unit Remove/Install**

- 1 - TRIM STICK
- 2 - SUNROOF SWITCH
- 3 - READING LAMP UNIT
- 4 - HEADLINER
- 5 - LENS (2)

**WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the reading lamp unit to the mounting hole in the headliner.

(2) If the vehicle is equipped with an optional power sunroof, reconnect the body wire harness connector for the sunroof switch to the connector receptacle on the back of the switch.

(3) Reconnect the body wire harness connector for the reading lamp to the connector on the lamp unit housing.

(4) With the curved corners of the reading lamp lenses oriented towards the rear of the vehicle, position the reading lamp unit housing into the headliner mounting hole and align the metal snap clip on each side of the housing with their receptacles in the mounting bracket above the headliner (Fig. 14).

(5) Using hand pressure, press upward firmly and evenly on both ends of the reading lamp unit until both snap clips are fully engaged in their receptacles.

(6) Reconnect the battery negative cable.

## TAILGATE AJAR SWITCH

### DESCRIPTION

A tailgate ajar switch is standard equipment in this vehicle. This switch is concealed within and integral to the tailgate latch unit. The switch is a momentary leaf contact-type unit that is actuated by the tailgate latch mechanism. A pigtail wire harness and connector on the tailgate latch unit connects the tailgate ajar switch to the vehicle electrical system through the tailgate wire harness. The tailgate ajar switch cannot be adjusted or repaired and, if faulty or damaged, the tailgate latch unit must be replaced. (Refer to 23 - BODY/SWING GATE/LATCH - REMOVAL).

### OPERATION

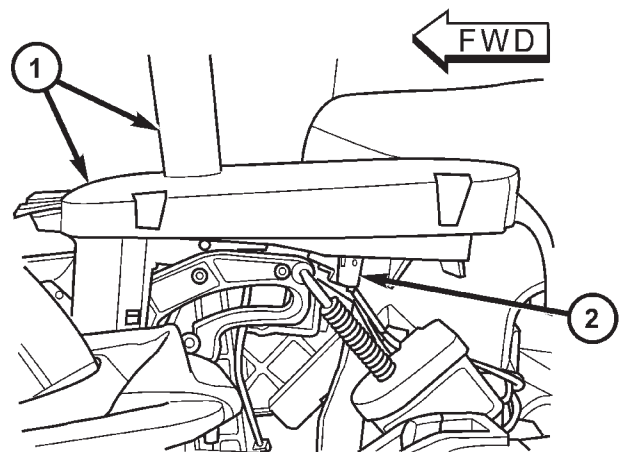
The tailgate switch is actuated by the tailgate latch mechanism. When the tailgate is closed and properly latched, the tailgate ajar switch is an open circuit. When the tailgate is open or only partially latched, the tailgate ajar switch is a closed circuit. The tailgate ajar switch is hard wired between a body ground and the Body Control Module (BCM). The output of the switch is connected to the BCM through a tailgate ajar switch sense circuit. The BCM reads the tailgate ajar switch status through an internal pull-up, then uses this input to control many electronic functions and features of the vehicle. The tailgate ajar switch can be diagnosed using conventional diagnostic tools and methods; however, for proper diagnosis of the BCM, and both the hard wired and electronic BCM outputs affected by the tailgate ajar switch input, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## TRANSMISSION RANGE INDICATOR ILLUMINATION BULB

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 center console from the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).
- (3) From the left side of the vehicle, reach between transmission range indicator and the floor panel transmission tunnel to grasp the illumination lamp socket (Fig. 15).



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**Fig. 15 Transmission Range Indicator Illumination Bulb Remove/Install**

- 1 - AUTOMATIC TRANSMISSION SHIFT MECHANISM
- 2 - ILLUMINATION LAMP SOCKET

## TRANSMISSION RANGE INDICATOR ILLUMINATION BULB (Continued)

(4) Rotate the transmission range indicator illumination lamp socket counterclockwise about 30 degrees on the bottom of the range indicator.

(5) Pull the transmission range indicator illumination lamp socket and bulb unit straight out of the bulb mounting hole in the bottom of the indicator.

(6) Pull the transmission range indicator illumination lamp bulb straight out of the socket.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

(1) Align the base of the transmission range indicator illumination lamp bulb with the receptacle in the lamp socket.

(2) Push the transmission range indicator illumination lamp bulb straight into the lamp socket until it is firmly seated.

(3) Align the transmission range indicator illumination lamp socket and bulb unit with the mounting hole on the bottom of the indicator (Fig. 15).

(4) Push the transmission range indicator illumination lamp socket and bulb unit straight into the bottom of the indicator until it is firmly seated.

(5) Rotate the transmission range indicator illumination lamp socket clockwise about 30 degrees on the bottom of the indicator.

(6) Reinstall the center console onto the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).

(7) Reconnect the battery negative cable.

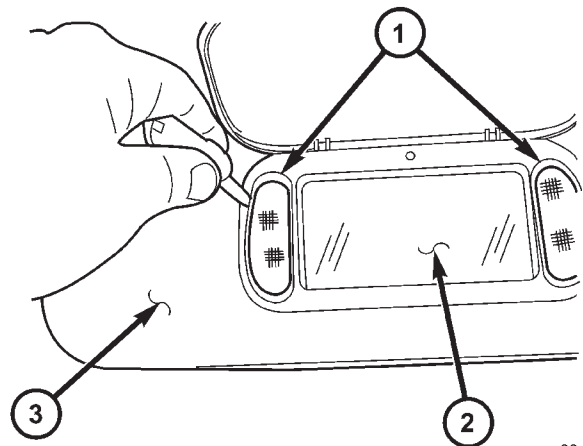
## VANITY LAMP BULB

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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) Using a small thin-bladed tool, gently pry outward on either side near the top or bottom of the vanity lamp lens until the lens unsnaps from the lamp unit housing (Fig. 16).



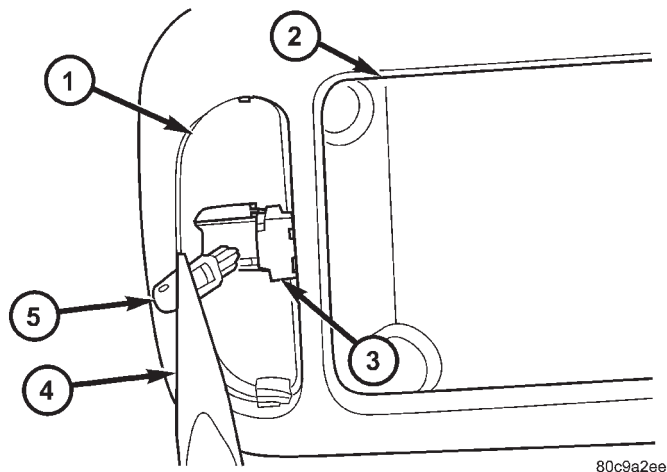
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**Fig. 16 Vanity Lamp Lens Remove**

- 1 - LENS (2)
- 2 - MIRROR
- 3 - SUN VISOR

## VANITY LAMP BULB (Continued)

(3) Using small needle-nose pliers, carefully pull the vanity lamp bulb straight out from the lamp socket (Fig. 17).



**Fig. 17 Vanity Lamp Bulb Remove/Install**

- 1 - HOUSING
- 2 - MIRROR
- 3 - SOCKET
- 4 - NEEDLE-NOSE PLIERS
- 5 - BULB

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

(1) Using small needle-nose pliers, carefully grasp the vanity lamp bulb and align the base of the bulb with the receptacle in the lamp socket (Fig. 17).

(2) Carefully push the vanity lamp bulb base straight into the lamp socket until it is fully seated.

(3) Insert one tab on the top or the bottom of the vanity lamp lens into the proper slot in the lamp unit housing.

(4) Carefully flex the vanity lamp lens far enough to engage the loose tab into its slot in the lamp unit housing.

(5) Reconnect the battery negative cable.

# LAMPS

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## LAMPS/LIGHTING - EXTERIOR

### DESCRIPTION

The exterior lighting system for this model includes the following exterior lamps (Fig. 1):

- **Backup Lamps** - The backup (or reverse) lamps are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle.

- **Brake Lamps** - The brake (or stop) lamps include a lamp that is integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate, and the Center High Mounted Stop Lamp (CHMSL) that is centered on the rear edge of the roof panel above the flip-up glass opening at the rear of the vehicle.

- **Daytime Running Lamps** - Vehicles manufactured for sale in Canada illuminate the high beam filament in each headlamp bulb serves as the Daytime Running Lamps (DRL).

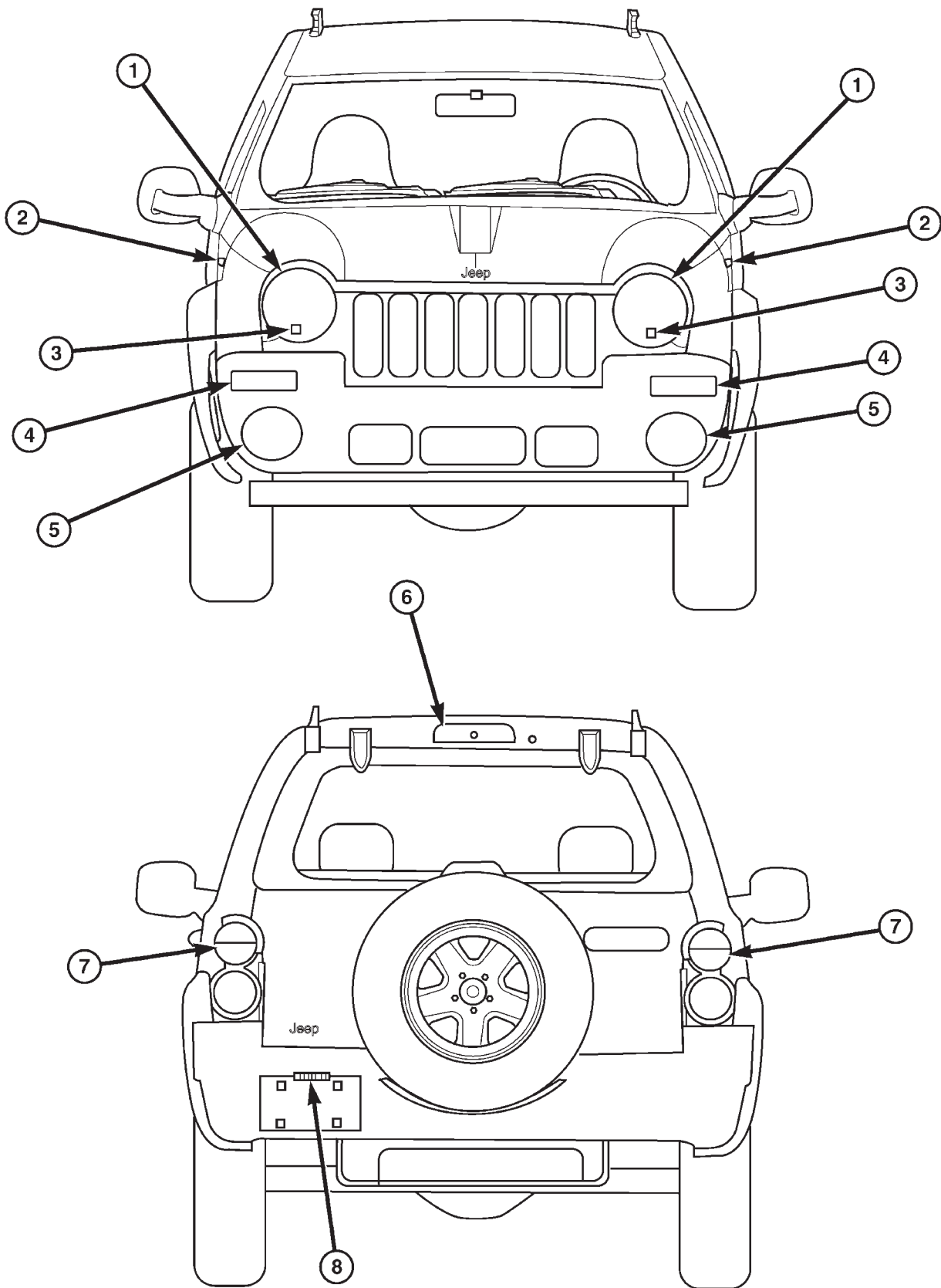
- **Front Fog Lamps** - Optional front fog lamps include a single round front fog lamp unit with an adjustable reflector and a removable bulb that is secured behind a dedicated opening on each forward-facing end of the front bumper fascia.

- **Hazard Warning Lamps** - The hazard warning lamps include all of the right and left turn signal lamps.

- **Headlamps** - A single round headlamp housing with a fixed lens, an adjustable reflector, and a single removable halogen bulb is secured to the grille opening panel on each side of the grille opening at the front of the vehicle. In certain markets where required, a headlamp leveling actuator motor is included on each headlamp.

- **Park Lamps** - The park lamps include the front park lamps and front side marker lamps that are integral to the front lamp units mounted at each end of the bumper fascia at the front of the vehicle, as well as the rear park lamps and rear side marker lamps that are integral to the rear lamp units

LAMPS/LIGHTING - EXTERIOR (Continued)



**Fig. 1 Exterior Lamps**



## LAMPS/LIGHTING - EXTERIOR (Continued)

- 1 - HEADLAMP UNIT (2)
- 2 - REPEATER LAMP UNIT (2)
- 3 - FRONT POSITION LAMP (2)
- 4 - FRONT LAMP UNIT (2)

- 5 - FRONT FOG LAMP (2)
- 6 - CENTER HIGH MOUNTED STOP LAMP UNIT
- 7 - REAR LAMP UNIT
- 8 - LICENSE PLATE LAMP UNIT

mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle. The park lamps include a license plate lamp or lamps, depending upon the requirements of the market for which the vehicle is manufactured. Vehicles with a license plate tub located near the left end of the rear bumper fascia have a single lamp, while vehicles with a license plate module located on the spare tire carrier have two license plate lamps. In certain markets where required, a front position lamp that is integral to each headlamp unit is illuminated instead of the front park lamps and front side marker lamps in the park lamps circuit; and, a rectangular, red reflector is located on the rear bumper fascia just inboard and below each rear lamp unit.

- **Rear Fog Lamps** - Rear fog lamps are available only in certain markets where they are required equipment. The rear fog lamps are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle.

- **Turn Signal Lamps** - The turn signal lamps include the front turn signal and front side marker lamps that are integral to the front lamp units mounted at each end of the bumper fascia at the front of the vehicle, as well as rear turn signal lamps that are integral to the rear lamp units mounted to the back of the quarter panel on each side of the tailgate at the rear of the vehicle. In certain markets where required, a repeater lamp unit mounted to each front fender just behind the front wheel opening is illuminated instead of the front side marker lamp in each turn signal lamp circuit.

Other components of the exterior lighting system for this model include:

- **Combination Flasher** - An electronic combination flasher is integral to the hazard warning switch in the center of the instrument panel.

- **Backup Lamp Switch** - Vehicles equipped with a manual transmission have a plunger-type backup lamp switch located on the transmission housing. A Transmission Range Sensor (TRS) integral to the solenoid pack on the valve body of the optional electronic automatic transmission performs the backup lamp switch function on models that are so equipped.

- **Brake Lamp Switch** - A plunger-type brake lamp switch is located on the steering column support bracket under the instrument panel and actuated by the brake pedal arm.

- **Body Control Module** - The Body Control Module (BCM) is located on the Junction Block (JB) under the driver side outboard end of the instrument panel. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL MODULE - DESCRIPTION).

- **Daytime Running Lamp Relay** - Vehicles manufactured for sale in Canada use a solid state Daytime Running Lamps (DRL) relay installed in the Junction Block (JB) instead of the conventional high beam relay.

- **Front Fog Lamp Relay** - Vehicles equipped with the optional front fog lamps have a front fog lamp relay located in the Junction Block (JB).

- **Hazard Switch** - The hazard switch is located near the center of the instrument panel and includes the integral electronic combination flasher circuitry for the hazard warning system and the turn signal system.

- **Headlamp Leveling Motor** - A headlamp leveling actuator motor is located on the back of each headlamp housing of vehicles manufactured for certain markets where this equipment is required.

- **Headlamp Leveling Switch** - A thumbwheel actuated headlamp leveling switch is mounted in the driver side inboard instrument panel trim bezel of vehicles manufactured for certain markets where this equipment is required.

- **High Beam Relay** - A high beam relay is located in the Junction Block (JB) of all vehicles except those that are manufactured for sale in Canada. Canadian vehicles have a solid state Daytime Running Lamps (DRL) relay in the JB instead of the high beam relay.

- **Low Beam Relay** - A low beam relay is located in the Junction Block (JB) of all vehicles.

- **Multi-Function Switch** - The multi-function switch is located on the top of the steering column, just below the steering wheel. The multi-function switch includes a left (lighting) control stalk and a right (wiper) control stalk. The left control stalk is dedicated to providing almost all of the driver controls for both the exterior and interior lighting systems.

- **Park Lamp Relay** - A park lamp relay is located in the Junction Block (JB) of all vehicles.

- **Rear Fog Lamp Relay** - Vehicles manufactured for certain markets where rear fog lamps are required equipment have a rear fog lamp relay located in the Junction Block (JB).

## LAMPS/LIGHTING - EXTERIOR (Continued)

- **Trailer Tow Adapter** - Vehicles equipped with a factory-installed trailer towing package have an adapter provided that adapts the factory-installed heavy duty 7-way trailer tow connector to a conventional 4-way light duty connector.

- **Trailer Tow Connector** - Vehicles equipped with a factory-installed trailer towing package have a heavy duty 7-way trailer tow connector installed in a bracket on the trailer hitch receiver.

- **Trailer Tow Relays** - Vehicles equipped with a factory-installed trailer towing package have a connector bank containing four relays located behind the right quarter trim panel and over the right rear wheel housing. The four relays are used to supply fused ignition switch output (run), brake lamps, right turn signal, and left turn signal outputs to a trailer through the trailer tow wiring and connectors.

Hard wired circuitry connects the exterior lighting system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the exterior lighting system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## OPERATION

Following are paragraphs that briefly describe the operation of each of the major exterior lighting systems. The hard wired circuits and components of the exterior lighting systems may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), the Powertrain Control Module (PCM), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, the PCM, and the PCI data bus network inputs and outputs related to the various exterior lighting systems requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## BACKUP LAMPS

The backup (or reverse) lamps have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the base of the right D-pillar behind the quarter trim panel. The backup lamps receive battery current from a fused ignition switch output (run) fuse in the Junction Block (JB) on the back-up lamp feed circuit only when the backup lamp switch (manual transmission), or backup lamp switch circuit of the Transmission Range Sensor (TRS - electronic automatic transmission) is closed by the gearshift mechanism within the transmission.

## BRAKE LAMPS

The brake (or stop) lamps have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a screw to the base of the right D-pillar behind the quarter trim panel. The Center High Mounted Stop Lamp (CHMSL) has a path to ground at all times through its connection to the rear body wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the driver side D-pillar (left side D-pillar for left-hand drive, right side D-pillar for right-hand drive) behind the quarter trim panel. The brake lamps and CHMSL receive battery current from a fused B(+) fuse in the Junction Block (JB) on the brake lamp switch output circuit only when the brake lamp switch circuit of the brake lamp switch is closed by the brake pedal arm.

## DAYTIME RUNNING LAMPS

Vehicles manufactured for sale in Canada illuminate the high beam filament at a reduced intensity when the engine is running and the exterior lamps are turned off. This feature is enabled by the Body Control Module (BCM) and a solid state Daytime Running Lamps (DRL) relay, which is installed in the Junction Block (JB) and the high beam relay is omitted. When the BCM monitors an engine speed signal of greater than 450 RPM and the status of the exterior lighting switch input from the multi-function switch is Off, the BCM duty cycles the DRL relay to produce illumination of the headlamp high beam filaments at a reduced intensity. The BCM also provides normal headlamp high beam operation through the DRL relay on vehicles so equipped. When the DRL relay is energized, it provides battery current from a fused B(+) fuse in the JB to the headlamp high beam filament through the DRL relay output circuit.

## LAMPS/LIGHTING - EXTERIOR (Continued)

## FRONT FOG LAMPS

Vehicles equipped with optional front fog lamps have a premium Body Control Module (BCM), a front fog lamp relay installed in the Junction Block (JB), and a front fog lamp switch integral to the left (lighting) control stalk of the multi-function switch. The front fog lamps have a path to ground at all times through their connection to the front fascia wire harness from two take outs of the headlamp and dash wire harness with eyelet terminal connectors that are secured by ground screws to the left inner fender shield in the engine compartment. The BCM controls front fog lamp operation by monitoring the exterior lighting switch input from the multi-function switch, then energizing or de-energizing the front fog lamp relay control coil; and, by sending the appropriate electronic message to the instrument cluster over the Programmable Communications Interface (PCI) data bus to turn the front fog lamp indicator on or off. When the front fog lamp relay is energized, it provides battery current from a fused B(+) fuse in the JB to the front fog lamps through the front fog lamp relay output circuit. The BCM provides a battery saver (load shedding) feature for the front fog lamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position. In certain markets where required, the front fog lamps are also turned off by the BCM whenever the headlamp high beams are selected. Each front fog lamp includes an integral adjustment screw to be used for static aiming the fog lamp beams.

## HAZARD WARNING LAMPS

With the hazard switch in the On position, the hazard warning system is activated causing the hazard switch button illumination lamp, the right and left turn signal indicators, and the right and left turn signal lamps to flash on and off. When the hazard warning system is activated, the circuitry within the hazard switch and electronic combination flasher unit will repeatedly energize and de-energize two internal relays that switch battery current from a fused B(+) fuse in the Junction Block (JB) to the right side and left side turn signal indicators, and turn signal lamps through the right and left turn signal circuits. The flashing of the hazard switch button illumination lamp is performed internally by the hazard switch and combination flasher unit circuit board. The hazard warning lamps can also be energized by the Body Control Module (BCM) through a hazard lamp control circuit input to the hazard switch and combination flasher unit.

## HEADLAMPS

The headlamp system includes the Body Control Module (BCM), a low beam relay installed in the Junction Block (JB), a high beam relay installed in the JB (except Canada), a solid state Daytime Running Lamps (DRL) relay installed in the JB (Canada only), and the exterior lighting (headlamp and dimmer) switches integral to the left (lighting) control stalk of the multi-function switch. The headlamp bulbs have a path to ground at all times through their connection to the grille opening reinforcement wire harness from two take outs of the headlamp and dash wire harness with eyelet terminal connectors that are secured by ground screws to the left inner fender shield in the engine compartment. The BCM controls the headlamp operation by monitoring the exterior lighting switch inputs from the multi-function switch, then energizing or de-energizing the control coils of the low beam relay, the high beam relay, or the solid state circuitry of the DRL relay; and, by sending the appropriate electronic message to the instrument cluster over the Programmable Communications Interface (PCI) data bus to turn the high beam indicator on or off. When each respective relay is energized, it provides battery current from a fused B(+) fuse in the Power Distribution Center (PDC) through a relay (low beam, high beam, or DRL) output circuit and four separate fuses in the JB through individual fused right and left, low and high beam output circuits to the appropriate headlamp bulb filaments. The BCM provides a battery saver (load shedding) feature for the headlamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position; and, a headlamp delay feature with a DRBIII® scan tool programmable delay interval. Each headlamp includes an integral adjustment screw to be used for static aiming of the headlamp beams.

## HEADLAMP LEVELING

In certain markets where required, a headlamp leveling system is provided on the vehicle. The headlamp leveling system includes unique headlamp units equipped with a headlamp leveling actuator motor, and a rotary thumbwheel actuated headlamp leveling switch on the instrument panel. The headlamp leveling system allows the headlamp beams to be adjusted to one of four vertical positions to compensate for changes in inclination caused by the loading of the vehicle suspension. The actuator motors are mechanically connected through an integral pushrod to an adjustable headlamp reflector. The headlamp leveling switch is a resistor multiplexed unit that provides one of four voltage outputs to the headlamp leveling motors. The headlamp leveling motors will

## LAMPS/LIGHTING - EXTERIOR (Continued)

move the headlamps to the selected position based upon the voltage input received from the switch. The headlamp leveling motors and switch have a path to ground at all times. The headlamp leveling components operate on battery current received through the fused park lamp relay output circuit so that the system will only operate when the exterior lighting is turned on.

### PARK LAMPS

The park lamps system includes the Body Control Module (BCM), a park lamp relay installed in the Junction Block (JB), and the exterior lighting switch integral to the left (lighting) control stalk of the multi-function switch. The front park lamp and side marker or, if equipped, the front position lamp bulbs each have a path to ground at all times through their connections to the grille opening reinforcement wire harness from two take outs of the headlamp and dash wire harness with eyelet terminal connectors that are secured by ground screws to the left inner fender shield in the engine compartment. The rear park lamp bulbs and license plate lamp have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the base of the right D-pillar behind the quarter trim panel. The BCM controls the park lamp operation by monitoring the exterior lighting switch inputs from the multi-function switch, then energizing or de-energizing the control coil of the park lamp relay. When the park lamp relay is energized, it provides battery current from a fused B(+) fuse in the Power Distribution Center (PDC) through a park lamp relay output circuit and a separate fuse in the JB through a fused park lamp relay output circuit to the appropriate lamp bulb filaments. The BCM provides a battery saver (load shedding) feature for the park lamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position.

### REAR FOG LAMPS

Rear fog lamps are installed on vehicles manufactured for certain markets where they are required. The rear fog lamp system includes a premium Body Control Module (BCM), a rear fog lamp relay installed in the Junction Block (JB), and a rear fog lamp switch integral to the left (lighting) control stalk of the multi-function switch. The rear fog lamps have a path to ground at all times through their connection to the rear lighting wire harness from a take out of the rear body wire harness with an eyelet terminal connector that is secured by a ground screw to the base of the right D-pillar behind the quarter trim

panel. The BCM controls rear fog lamp operation by monitoring the exterior lighting switch input from the multi-function switch, then energizing or de-energizing the rear fog lamp relay control coil; and, by sending the appropriate electronic message to the instrument cluster over the Programmable Communications Interface (PCI) data bus to turn the rear fog lamp indicator on or off. When the rear fog lamp relay is energized, it provides battery current from a fused B(+) fuse in the JB to the rear fog lamps through the rear fog lamp relay output circuit. The BCM provides a battery saver (load shedding) feature for the rear fog lamps, which will turn these lamps off if they are left on for more than about eight minutes with the ignition switch in the Off position.

### TURN SIGNAL LAMPS

When the left control stalk of the multi-function switch is moved up (right turn) or down (left turn), the turn signal system is activated causing the selected right or left turn signal indicator, and right or left turn signal lamps to flash on and off. When the turn signal system is activated, the circuitry within the turn signal switch and the hazard switch/electronic combination flasher unit will repeatedly energize and de-energize one of two internal relays that switch battery current from a fused ignition switch output (run) fuse in the Junction Block (JB) to the right side or left side turn signal indicators and turn signal lamps through the right or left turn signal circuits. The ElectroMechanical Instrument Cluster (EMIC) chime tone generator will generate an audible turn signal cancel warning each time the vehicle is driven for a distance of about 3.2 kilometers (about two miles) with a turn signal indicator flashing. The EMIC uses Programmable Communications Interface (PCI) data bus distance messages from the Powertrain Control Module (PCM) and a hard wired input from the turn signal switch circuitry of the multi-function switch to determine when to sound the turn signal cancel warning.

## DIAGNOSIS AND TESTING - LAMPS/LIGHTING - EXTERIOR

The hard wired circuits and components of the exterior lighting systems may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), the Powertrain Control Module (PCM), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, the PCM, and the PCI data bus network inputs and outputs related to the various

## LAMPS/LIGHTING - EXTERIOR (Continued)

exterior lighting systems requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

When diagnosing the exterior lighting circuits, remember that high generator output can burn out bulbs rapidly and repeatedly; and, that dim or flickering bulbs can be caused by low generator output or poor battery condition. If one of these symptoms is a problem on the vehicle being diagnosed, be certain to diagnose and repair the battery and charging system as required. Also keep in mind that a good ground is necessary for proper lighting operation. If a lighting problem is being diagnosed that involves multiple symptoms, systems, or components the problem can often be traced to a loose, corroded, or open ground. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and

location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## BACKUP LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
BACKUP LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty switch.</li> <li>4. Faulty ground circuit.</li> <li>5. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace backup lamp fuse as required.</li> <li>2. Test and replace backup lamp bulb as required.</li> <li>3. Test and replace backup lamp switch (manual transmission) or transmission range sensor (automatic transmission) as required.</li> <li>4. Test and repair backup lamp ground circuit as required.</li> <li>5. Test and repair open back-up lamp feed circuit as required.</li> </ol>
BACKUP LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty switch.</li> <li>2. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace backup lamp switch (manual transmission) or transmission range sensor (automatic transmission) as required.</li> <li>2. Test and repair shorted back-up lamp feed circuit as required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

**BRAKE LAMPS**

CONDITION	POSSIBLE CAUSES	CORRECTION
BRAKE LAMP DOES NOT ILLUMINATE	1. Faulty or missing fuse. 2. Faulty or missing bulb. 3. Faulty switch. 4. Faulty ground circuit. 5. Faulty feed circuit.	1. Test and replace brake lamp fuse as required. 2. Test and replace brake lamp bulb as required. 3. Test and replace brake lamp switch as required. 4. Test and repair brake lamp ground circuit as required. 5. Test and repair open brake lamp switch output circuit as required.
BRAKE LAMP DOES NOT EXTINGUISH	1. Faulty switch. 2. Faulty feed circuit.	1. Test and replace brake lamp switch as required. 2. Test and repair shorted brake lamp switch output circuit as required.

**DAYTIME RUNNING LAMPS**

Before performing the following tests, determine whether the headlamp low and high beams operate.

If the headlamp high and low beams are also inoperative, diagnose and repair that problem before attempting to repair the Daytime Running Lamps.

CONDITION	POSSIBLE CAUSES	CORRECTION
DAYTIME RUNNING LAMPS WILL NOT ILLUMINATE	1. High beam relay installed. 2. Faulty or missing DRL relay. 3. Incorrect BCM programming. 4. Faulty BCM inputs or outputs.	1. Remove high beam relay as required. 2. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required. 3. Use a DRBIII® scan tool to check and program correct country code into BCM as required. 4. Use a DRBIII® scan tool to test the BCM inputs or outputs. Refer to the appropriate diagnostic information.

## LAMPS/LIGHTING - EXTERIOR (Continued)

## FRONT FOG LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT FOG LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace front fog lamp fuse as required.</li> <li>2. Test and replace front fog lamp bulb as required.</li> <li>3. Test and replace front fog lamp relay as required.</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair front fog lamp ground circuit as required.</li> <li>6. Test and repair open front fog lamp relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
FRONT FOG LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace front fog lamp relay as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted front fog lamp relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## HAZARD WARNING LAMPS

Before performing the following tests, confirm whether the left and right turn signals operate satisfactorily. If the turn signals are inoperative or oper-

ate improperly, diagnose and repair that problem before attempting to repair the Hazard Warning Lamps.

CONDITION	POSSIBLE CAUSES	CORRECTION
HAZARD WARNING LAMPS DO NOT FLASH	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty switch/flasher.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace hazard warning fuse as required.</li> <li>2. Test and repair hazard switch ground circuit as required.</li> <li>3. Test and repair open hazard switch fused B(+) circuit as required.</li> <li>4. Replace hazard switch/combination flasher with a known good unit and check operation. Replace hazard switch/combination flasher unit if required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

HEADLAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace headlamp fuse as required.</li> <li>2. Test and replace headlamp bulb as required.</li> <li>3. Test and replace low beam or high beam relay as required. (Note: Vehicles with a DRL relay do not use a high beam relay. The DRL relay cannot be tested. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.)</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair open headlamp ground circuit as required.</li> <li>6. Test and repair open headlamp low beam, high beam, or DRL relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
HEADLAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace low beam or high beam relay as required. (Note: Vehicles with a DRL relay do not use a high beam relay. The DRL relay cannot be tested. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.)</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted headlamp low beam, high beam, or DRL relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>



## LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS WILL NOT SWITCH FROM HIGH TO LOW BEAMS, OR FROM LOW TO HIGH BEAMS	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace low beam or high beam relay as required. (Note: Vehicles with a DRL relay do not use a high beam relay. The DRL relay cannot be tested. Replace DRL relay with a known good unit and check operation. Replace DRL relay as required.)</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## HEADLAMP LEVELING

Before performing the following tests, confirm whether the park lamps operate satisfactorily. If the

park lamps are inoperative, diagnose and repair that problem before attempting to repair the Headlamp Leveling System.

CONDITION	POSSIBLE CAUSES	CORRECTION
ONE LEVELING MOTOR IS INOPERATIVE	<ol style="list-style-type: none"> <li>1. Faulty ground circuit.</li> <li>2. Faulty feed circuit.</li> <li>3. Faulty signal circuit.</li> <li>4. Faulty motor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open leveling motor ground circuit as required.</li> <li>2. Test and repair open leveling motor feed circuit as required.</li> <li>3. Test and repair open headlamp adjust signal circuit as required.</li> <li>4. Test and replace headlamp leveling motor as required.</li> </ol>
BOTH LEVELING MOTORS ARE INOPERATIVE	<ol style="list-style-type: none"> <li>1. Faulty switch ground circuit.</li> <li>2. Faulty motor ground circuit.</li> <li>3. Faulty switch feed circuit.</li> <li>4. Faulty motor feed circuit.</li> <li>5. Faulty signal circuit.</li> <li>6. Faulty switch.</li> <li>7. Faulty motors.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open leveling switch ground circuit as required.</li> <li>2. Test and repair open leveling motor ground circuit as required.</li> <li>3. Test and repair open leveling switch feed circuit as required.</li> <li>4. Test and repair open leveling motor feed circuit as required.</li> <li>5. Test and repair open or shorted leveling motor signal circuit as required.</li> <li>6. Test and replace leveling switch as required.</li> <li>7. Test and replace leveling motors as required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

PARK LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
PARK LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace park lamp fuse as required.</li> <li>2. Test and replace park lamp bulb as required.</li> <li>3. Test and replace park lamp relay as required.</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair open park lamp ground circuit as required.</li> <li>6. Test and repair open park lamp relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>
PARK LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace park lamp relay as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted park lamp relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

REAR FOG LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
REAR FOG LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing fuse.</li> <li>2. Faulty or missing bulb.</li> <li>3. Faulty or missing relay.</li> <li>4. Faulty switch.</li> <li>5. Faulty ground circuit.</li> <li>6. Faulty feed circuit.</li> <li>7. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace rear fog lamp fuse as required.</li> <li>2. Test and replace rear fog lamp bulb as required.</li> <li>3. Test and replace rear fog lamp relay as required.</li> <li>4. Test and replace multi-function switch as required.</li> <li>5. Test and repair open rear fog lamp ground circuit as required.</li> <li>6. Test and repair open rear fog lamp relay output circuit as required.</li> <li>7. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
REAR FOG LAMP DOES NOT EXTINGUISH	<ol style="list-style-type: none"> <li>1. Faulty relay.</li> <li>2. Faulty switch.</li> <li>3. Faulty feed circuit.</li> <li>4. Faulty BCM inputs or outputs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace rear fog lamp relay as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Test and repair shorted rear fog lamp relay output circuit as required.</li> <li>4. Use a DRBIII® scan tool to test the BCM inputs and outputs. Refer to the appropriate diagnostic information.</li> </ol>

## TURN SIGNAL LAMPS

CONDITION	POSSIBLE CAUSES	CORRECTION
ONE TURN SIGNAL LAMP DOES NOT ILLUMINATE	<ol style="list-style-type: none"> <li>1. Faulty or missing bulb.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty feed circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace turn signal bulb as required.</li> <li>2. Test and repair open ground circuit as required.</li> <li>3. Test and repair open right or left turn signal circuit as required.</li> </ol>
ALL RIGHT SIDE AND/OR ALL LEFT SIDE TURN SIGNAL LAMPS DO NOT FLASH	<ol style="list-style-type: none"> <li>1. Faulty sense circuit.</li> <li>2. Faulty switch.</li> <li>3. Faulty flasher.</li> <li>4. Faulty signal circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and repair open right or left turn switch sense circuit as required.</li> <li>2. Test and replace multi-function switch as required.</li> <li>3. Replace hazard switch/combination flasher with a known good unit and check operation. Replace hazard switch/combination flasher unit as required.</li> <li>4. Test and repair open right or left turn signal circuit as required.</li> </ol>
ALL RIGHT SIDE OR ALL LEFT SIDE TURN SIGNALS FLASH TOO RAPIDLY (MORE THAN 100 FLASHES PER MINUTE)	<ol style="list-style-type: none"> <li>1. Faulty or missing bulb.</li> <li>2. Faulty ground circuit.</li> <li>3. Faulty signal circuit</li> <li>4. Faulty flasher.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test and replace faulty bulb as required.</li> <li>2. Test and repair open ground circuit as required.</li> <li>3. Test and repair open right or left turn signal circuit as required.</li> <li>4. Replace hazard switch/combination flasher with a known good unit and check operation. Replace hazard switch/combination flasher unit as required.</li> </ol>

LAMPS/LIGHTING - EXTERIOR (Continued)

**SPECIFICATIONS - LAMPS/LIGHTING - EXTERIOR**

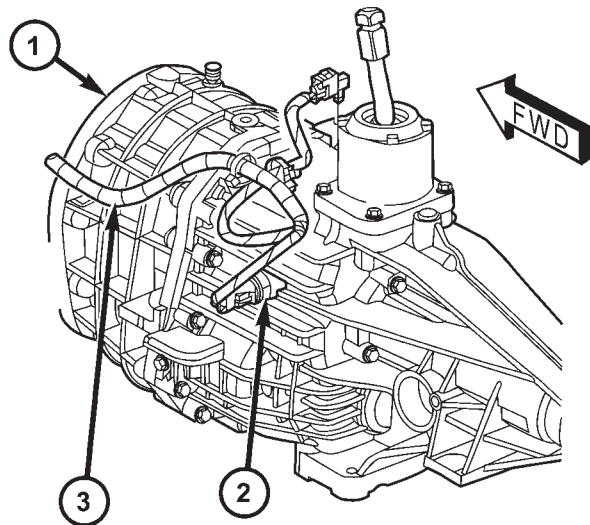
*BULB SPECIFICATIONS*

LAMP	BULB
Backup	3157 P27/7W
Brake	3157 P27/7W
Center High Mounted Stop	921/W16W
Front Fog	9145
Front Park	3157 P27/7W
Front Position	W5W
Front Side Marker	168
Front Turn	3157 P27/7W
Headlamp (North America)	9007QL
Headlamp (Rest-Of-World)	H-4 W0W6
License Plate (North America)	168
License Plate (Rest-Of-World)	W5W
Rear Fog	3157 P27/7W
Rear Park/Tail	3157 P27/7W
Rear Turn	3157 P27/7W
Side Repeater	W5W

**BACKUP LAMP SWITCH**

**DESCRIPTION**

Vehicles equipped with a manual transmission have a normally open, spring-loaded plunger type back-up lamp switch (Fig. 2). The backup lamp switch is located in a threaded hole on the side of the manual transmission housing, beneath the floor panel of the vehicle. The backup lamp switch has a threaded body and a hex formation near the plunger end of the switch, and an integral connector receptacle at the opposite end of the switch. When installed, only the connector receptacle and the hex formation are visible on the outside of the transmission housing. Vehicles with an optional electronic automatic transmission have a Transmission Range Sensor (TRS) that is used to perform several functions, including that of the backup lamp switch. The TRS is described in further detail elsewhere in this service information. The backup lamp switch cannot be adjusted or repaired and, if faulty or damaged, the entire switch unit must be replaced.



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**Fig. 2 Backup Lamp Switch - Typical**

- 1 - MANUAL TRANSMISSION
- 2 - BACKUP LAMP SWITCH
- 3 - ENGINE WIRE HARNESS

**OPERATION**

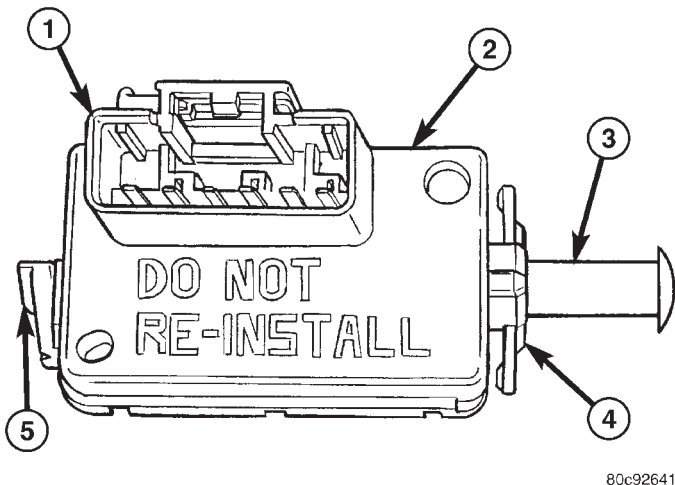
The backup lamp switch controls the flow of battery current to the backup lamp bulbs at the back of the vehicle through an output on the back-up lamp feed circuit. The switch plunger is mechanically actuated by the gearshift mechanism within the transmission, which will depress the switch plunger and close the switch contacts whenever the reverse gear has been selected. The switch receives battery current through a fuse in the Junction Block (JB) on a fused ignition switch output (run) circuit whenever the ignition switch is in the On position. A take out of the engine wire harness connects the backup lamp switch to the vehicle electrical system. The backup lamp switch and circuits can be tested using conventional diagnostic tools and methods.

**DIAGNOSIS AND TESTING - BACKUP LAMP SWITCH**

- (1) Disconnect and isolate the battery negative cable.
- (2) Raise and support the vehicle.
- (3) Locate and disconnect the engine wire harness connector for the backup lamp switch from the switch connector receptacle.
- (4) Check for continuity between the two terminal pins in the backup lamp switch connector receptacle.
  - (a) With the gear selector lever in the Reverse position, there should be continuity.
  - (b) With the gear selector lever in any position other than Reverse, there should be no continuity.

## BRAKE LAMP SWITCH

### DESCRIPTION



**Fig. 3 Brake Lamp Switch**

- 1 - CONNECTOR RECEPTACLE
- 2 - BRAKE LAMP SWITCH
- 3 - PLUNGER
- 4 - COLLAR
- 5 - LEVER

The brake lamp switch is a three circuit, spring-loaded plunger actuated switch that is secured to the steering column support bracket under the driver side of the instrument panel (Fig. 3). The brake lamp switch is contained within a rectangular molded plastic housing with an integral connector receptacle featuring six terminal pins and a red plastic Connector Position Assurance (CPA) lock. The switch is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. The switch plunger extends through a mounting collar on one end of the switch housing. The plunger has a one time telescoping self-adjustment feature that is achieved after the switch is installed by moving an adjustment release lever on the opposite end of the switch housing clockwise, until it locks in a position that is parallel to the connector receptacle. The brake lamp switch self-adjustment is a one time feature. Once the feature has been used, the switch cannot be readjusted. A "DO NOT RE-INSTALL" warning is molded into the switch housing below the connector receptacle.

An installed brake lamp switch cannot be readjusted or repaired. If the switch is damaged, faulty, or removed from its mounting position for any reason, it must be replaced with a new unit.

### OPERATION

The brake lamp switch controls three different circuits, one normally open and two normally closed. These circuits are described as follows:

- **Brake Lamp Switch Circuit** - A normally open brake lamp switch circuit receives battery current on a fused B(+) circuit from a fuse in the Junction Block (JB), and supplies battery current to the brake lamps and the Controller Antilock Brake (CAB) on a brake lamp switch output circuit when the brake pedal is depressed (brake lamp switch plunger released).

- **Brake Lamp Switch Signal Circuit** - A normally closed brake lamp switch signal circuit receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB). This circuit supplies a ground input to the Powertrain Control Module (PCM) on a brake lamp switch sense circuit when the brake pedal is released (brake lamp switch plunger is depressed).

- **Speed Control Circuit** - A normally closed speed control circuit receives battery current from the Powertrain Control Module on a speed control supply circuit, and supplies battery current to the speed control servo solenoids (dump, vacuum, and vent) on a speed control brake switch output circuit when the speed control system is turned on and the brake pedal is released (brake lamp switch plunger is depressed).

Concealed within the brake lamp switch housing the components of the self-adjusting brake switch plunger consist of a two-piece telescoping plunger, a split plunger locking collar, and a release wedge. The release lever has an integral shaft with a wedge that spreads the plunger locking collar to an open or released position. After the switch is installed and the brake pedal is released, the plunger telescopes to the correct adjustment position. When the release lever is moved to the release position, the wedge is disengaged from the locking collar causing the collar to apply a clamping pressure to the two plunger halves fixing the plunger length.

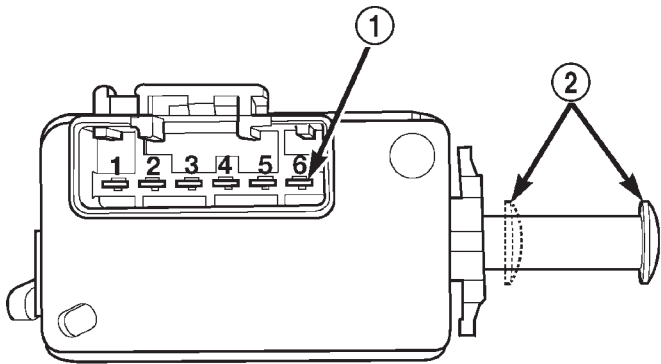
The brake lamp switch can be diagnosed using conventional diagnostic tools and methods.

BRAKE LAMP SWITCH (Continued)

**DIAGNOSIS AND TESTING - BRAKE LAMP SWITCH**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the brake lamp switch from the switch connector receptacle.
- (2) Using an ohmmeter, perform the continuity tests at the terminal pins in the brake lamp switch connector receptacle (Fig. 4) as shown in the Brake Lamp Switch Tests table.



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**Fig. 4 Brake Lamp Switch Terminal Identification**

- 1 - TERMINAL PINS
- 2 - PLUNGER TEST POSITIONS

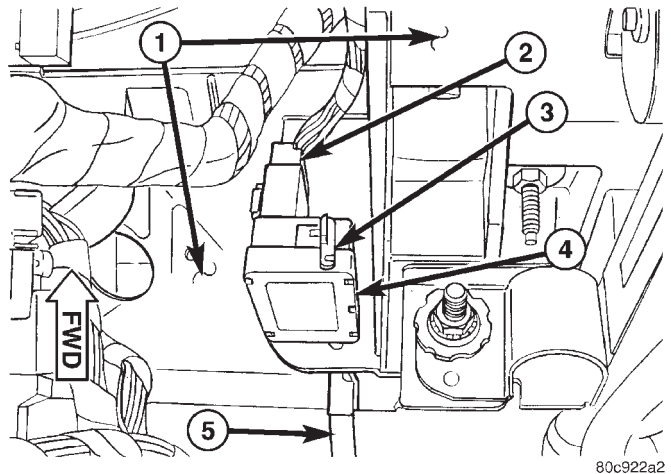
BRAKE LAMP SWITCH TESTS	
PLUNGER POSITION	CONTINUITY BETWEEN
Released (Extended)	Pins 1 & 2
Compressed (Retracted)	Pins 3 & 4, 5 & 6

- (3) If the switch fails any of the continuity tests, replace the faulty brake lamp switch as required.

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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) Disconnect the instrument panel wire harness connector for the brake lamp switch from the switch connector receptacle (Fig. 5).



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**Fig. 5 Brake Lamp Switch Remove/Install**

- 1 - STEERING COLUMN SUPPORT
- 2 - WIRE HARNESS CONNECTOR
- 3 - LEVER
- 4 - BRAKE LAMP SWITCH
- 5 - BRAKE PEDAL ARM

- (3) Grasp the brake lamp switch housing firmly and rotate the switch counterclockwise about 30 degrees to align the tabs on the locking collar with the keyed mounting hole in the steering column support bracket.
- (4) Pull the switch straight back from the mounting hole to remove it from the steering column support bracket.
- (5) Discard the removed brake lamp switch.

## BRAKE LAMP SWITCH (Continued)

**CAUTION:** Always replace a removed brake lamp switch with a new unit. This is a one time component and is not intended for reinstallation.

## INSTALLATION

**WARNING:** ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

**CAUTION:** Always replace a removed brake lamp switch with a new unit. This is a one time component and is not intended for reinstallation.

(1) While holding the brake pedal depressed, align the tabs on the brake lamp switch locking collar with the keyed mounting hole in the steering column support bracket (Fig. 5).

(2) Still holding the brake pedal depressed, insert the tabs on the brake lamp switch housing through the keyed mounting hole in the steering column support bracket until the switch is firmly seated against the bracket.

(3) Still holding the brake pedal depressed, rotate the switch clockwise about 30 degrees to lock the tabs on the brake lamp switch locking collar to the keyed mounting hole in the steering column support bracket.

(4) Release the brake pedal.

**CAUTION:** Do not pull up on the brake pedal before the switch plunger adjustment has been completed.

(5) Rotate the plunger adjustment release lever clockwise until it locks into place parallel to the brake lamp switch connector receptacle. This action will set the switch plunger length to a final adjustment position and cannot be undone. If not performed properly the first time, a new brake lamp switch **must** be installed.

(6) Reconnect the instrument panel wire harness connector for the brake lamp switch to the switch connector receptacle.

(7) Reconnect the battery negative cable.

## CENTER HIGH MOUNTED STOP LAMP BULB

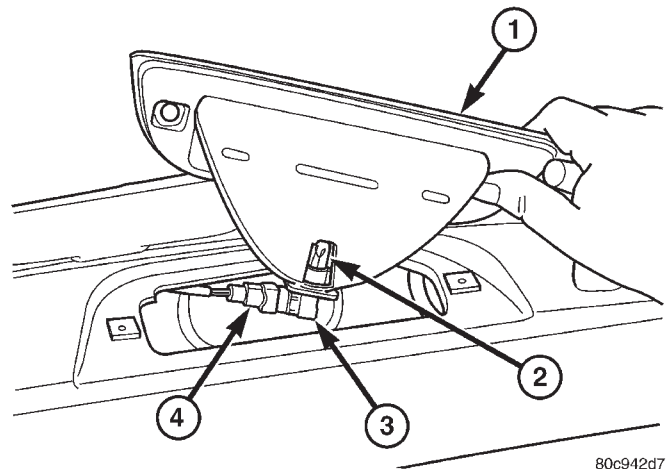
## REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the Center High Mounted Stop Lamp (CHMSL) unit from the roof panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UNIT - REMOVAL).

(3) Firmly grasp the socket on the back of the CHMSL unit housing.

(4) Rotate the socket on the back of the CHMSL unit housing counterclockwise about 30 degrees (Fig. 6).



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**Fig. 6 Center High Mounted Stop Lamp Bulb Remove/Install**

- 1 - CHMSL UNIT
- 2 - BULB
- 3 - SOCKET
- 4 - BODY WIRE HARNESS CONNECTOR

(5) Pull the socket and bulb straight out of the back of CHMSL unit housing.

(6) Pull the bulb straight out of the CHMSL unit socket.

## CENTER HIGH MOUNTED STOP LAMP BULB (Continued)

## INSTALLATION

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Align the base of the bulb with the receptacle in the Center High Mounted Stop Lamp (CHMSL) unit socket.

(2) Push the bulb straight into the CHMSL unit socket until it is firmly seated.

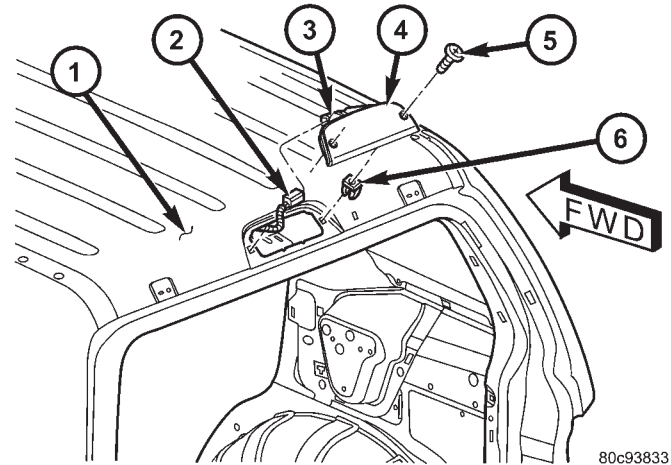
(3) Align the socket and bulb with the socket opening on the back of CHMSL unit housing.

(4) Push the socket and bulb straight into the CHMSL unit housing until it is firmly seated (Fig. 6).

(5) Rotate the socket on the back of the CHMSL unit housing clockwise about 30 degrees.

(6) Reinstall the CHMSL unit onto the roof panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UNIT - INSTALLATION).

(7) Reconnect the battery negative cable.



**Fig. 7 Center High Mounted Stop Lamp Remove/Install**

- 1 - ROOF PANEL
- 2 - BODY WIRE HARNESS CONNECTOR
- 3 - BULB SOCKET
- 4 - CHMSL
- 5 - SCREW (2)
- 6 - PLASTIC NUT (2)

## CENTER HIGH MOUNTED STOP LAMP UNIT

## REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the two screws that secure the Center High Mounted Stop Lamp (CHMSL) unit to the rear of the roof panel (Fig. 7).

(3) Pull the CHMSL unit away from the roof panel far enough to access and disconnect the wire harness connector for the CHMSL unit from the lamp socket pigtail wire.

(4) Remove the CHMSL unit from the roof panel.

## INSTALLATION

(1) Position the Center High Mounted Stop Lamp (CHMSL) unit to the roof panel.

(2) Reconnect the wire harness connector for the CHMSL unit to the lamp socket pigtail wire (Fig. 7).

(3) Position the CHMSL unit into the roof panel opening.

(4) Install and tighten the two screws that secure the CHMSL unit to the rear of the roof panel. Tighten the screws to 2 N·m (21 in. lbs.).

(5) Reconnect the battery negative cable.

## COMBINATION FLASHER

## DESCRIPTION

The combination flasher for this model is integral to the hazard switch located in the center of the instrument panel, just above the radio. The combination flasher is a smart relay that functions as both the turn signal system and the 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.

The combination flasher cannot be repaired or adjusted and, if faulty or damaged, the hazard switch unit must be replaced.

## OPERATION

The combination flasher has the following inputs and outputs: fused B(+), fused ignition switch output, right turn signal sense, left turn signal sense, and one output each for the right and left turn signal circuits. The combination flasher also receives an internal input through the closed contacts of the hazard switch and, on vehicles equipped with the optional Vehicle Theft Security System (VTSS), the flasher receives an input from the Body Control Module (BCM) in order to flash the turn signal lamps as an optical alert feature of that



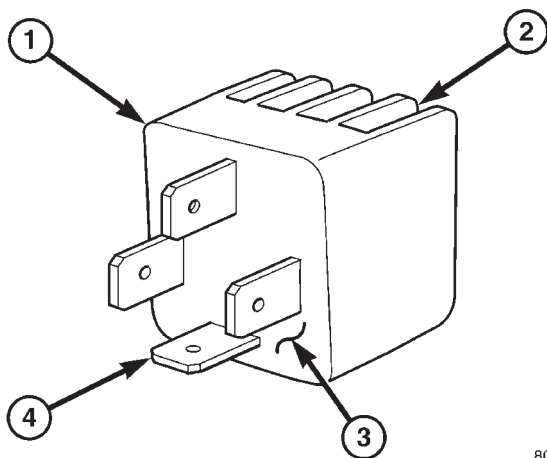
## COMBINATION FLASHER (Continued)

system. Constant battery voltage is 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. The Integrated Circuit (IC) within the combination flasher contains the logic that controls the flasher operation and the flash rate. The IC receives separate sense ground inputs from the multi-function switch for the right and left turn signals, and from the hazard switch contacts or the BCM for the hazard warning signals. 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).

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. Then replace the hazard switch with a known good unit to confirm system operation.

## DAYTIME RUNNING LAMP RELAY

### DESCRIPTION



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**Fig. 8 Daytime Running Lamp Relay**

- 1 - DRL RELAY
- 2 - HEAT SINK
- 3 - POTTING MATERIAL
- 4 - TERMINAL (4)

a die cast aluminum housing with integral cooling fins that act as a heat sink for the solid state DRL circuitry. Four male spade terminals extend from the base of the relay through a potting material that encloses and protects the DRL circuitry. Although the DRL relay has four terminals that are laid out in a footprint that is similar to that of a conventional International Standards Organization (ISO) relay, a standard ISO relay should never be installed in place of the DRL relay. The DRL relay is installed in the Junction Block (JB) on the driver side outboard end of the instrument panel. Vehicles equipped with this relay do not have a headlamp high beam relay installed in the JB.

The DRL relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

### OPERATION

The Daytime Running Lamp (DRL) relay is a solid state relay that controls the flow of battery current to the high beam filaments of both headlamp bulbs based upon a duty cycled control input received from the Body Control Module (BCM) of vehicles equipped with the DRL feature. By cycling the DRL relay output, the BCM controls the illumination intensity of the high beam filaments. The DRL relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the DRL relay include:

- **Battery Current Input** - The DRL relay receives battery current on a fused B(+) circuit from a fuse in the Power Distribution Center (PDC).

- **Ground Input** - The DRL relay receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB).

- **Control Input** - The DRL relay control input is received from the BCM and/or the momentary optical horn (flash-to-pass) output of the multi-function switch through a high beam relay control circuit.

- **Control Output** - The DRL relay supplies battery current output to the headlamp high beam filaments through the high beam relay output circuit.

Because of active electronic elements within the DRL relay, it cannot be tested with conventional automotive electrical test equipment. If the DRL relay is believed to be faulty, replace the relay with a known good unit to confirm system operation.

The Daytime Running Lamp (DRL) relay (Fig. 8) is a solid state relay that is used only on vehicles manufactured for sale in Canada. The DRL relay features

DAYTIME RUNNING LAMP RELAY (Continued)

**REMOVAL**

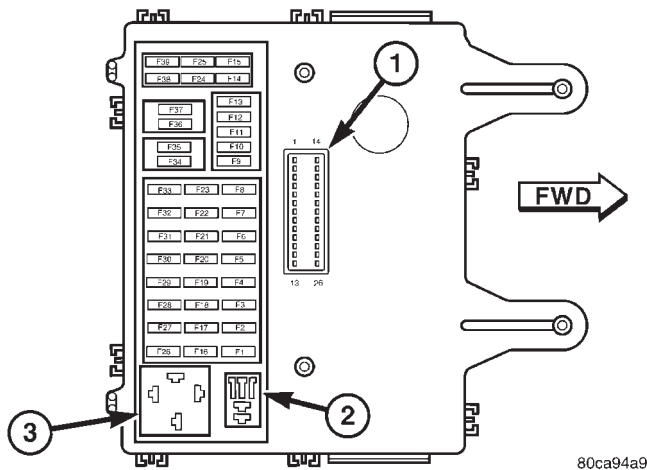
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 end cap from the driver side outboard end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL).
- (3) Remove the Daytime Running Lamp (DRL) relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 9).

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Position the Daytime Running Lamp (DRL) relay to the proper receptacle in the Junction Block (JB) (Fig. 9).
- (2) Align the DRL relay terminals with the terminal cavities in the JB receptacle.
- (3) Push firmly and evenly on the top of the DRL relay until the terminals are fully seated in the terminal cavities in the JB receptacle.
- (4) Reinstall the end cap onto the driver side outboard end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - INSTALLATION).
- (5) Reconnect the battery negative cable.



**Fig. 9 Junction Block - Outboard Side (RHD Shown - Rotate 180° for LHD)**

- 1 - JB/BCM CONNECTOR
- 2 - HIGH BEAM RELAY
- 3 - DRL RELAY

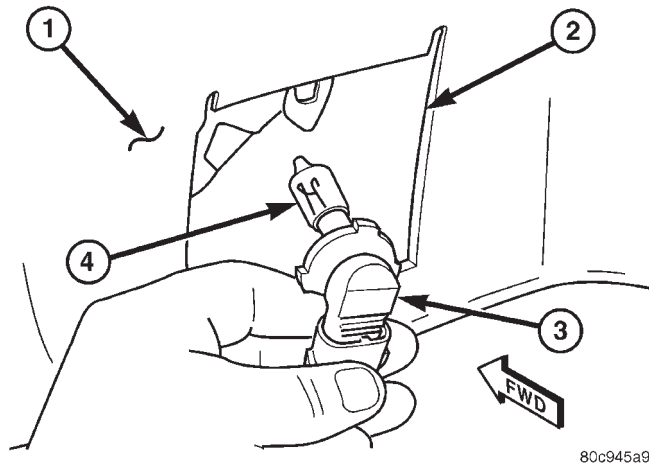
**FRONT FOG LAMP BULB**

**REMOVAL**

- (1) Turn the front wheels full lock in the direction of the fog lamp bulb that is to be changed.
- (2) Disconnect and isolate the battery negative cable.
- (3) Reach into the front wheel opening to unsnap and lift the cover over the access hole at the front of the front wheelhouse splash shield (Fig. 10).
- (4) Reach through the access hole and firmly grasp the socket on the back of the front fog lamp unit housing.
- (5) Rotate the socket on the back of the front fog lamp unit housing counterclockwise about 30 degrees.

**CAUTION: Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.**

## FRONT FOG LAMP BULB (Continued)



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**Fig. 10 Front Fog Lamp Bulb Remove/Install**

- 1 - FRONT WHEELHOUSE SPLASH SHIELD
- 2 - ACCESS HOLE
- 3 - SOCKET
- 4 - BULB

(6) Pull the socket and bulb straight out of the front fog lamp unit housing and through the access hole into the front wheel opening area.

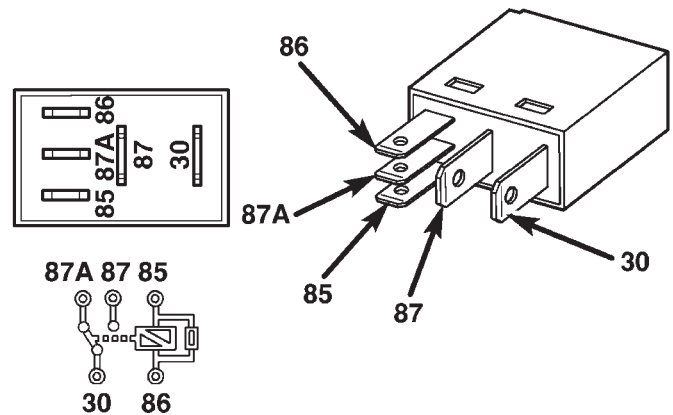
(7) Pull the bulb straight out of the front fog lamp unit socket.

**INSTALLATION**

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

- (1) Align the base of the bulb with the receptacle in the front fog lamp unit socket.
- (2) Push the bulb straight into the front fog lamp unit socket until it is firmly seated.
- (3) Position the socket and bulb through the access hole in the front wheelhouse splash shield and align it with the socket opening on the back of the front fog lamp unit housing (Fig. 10).
- (4) Push the socket and bulb straight into the front fog lamp unit housing until it is firmly seated.
- (5) Rotate the socket on the back of the front fog lamp unit housing clockwise about 30 degrees.
- (6) Lower and snap shut the access cover over the hole at the front of the front wheelhouse splash shield.
- (7) Reconnect the battery negative cable.

**FRONT FOG LAMP RELAY****DESCRIPTION**

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**Fig. 11 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The front fog lamp relay is located in the Junction Block (JB) on the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The front fog lamp relay is a conventional International Standards Organization (ISO) micro relay (Fig. 11). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The front fog lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

**OPERATION**

The front fog lamp relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the front fog lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact

FRONT FOG LAMP RELAY (Continued)

point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The front fog lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the front fog lamp relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the premium Body Control Module (BCM) through a front fog lamp relay control circuit. The BCM controls front fog lamp operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.
- **Normally Open Terminal** - The normally open terminal (87) is connected to the front fog lamps through a front fog lamp relay output circuit and provides battery current to the front fog lamps whenever the relay is energized.
- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

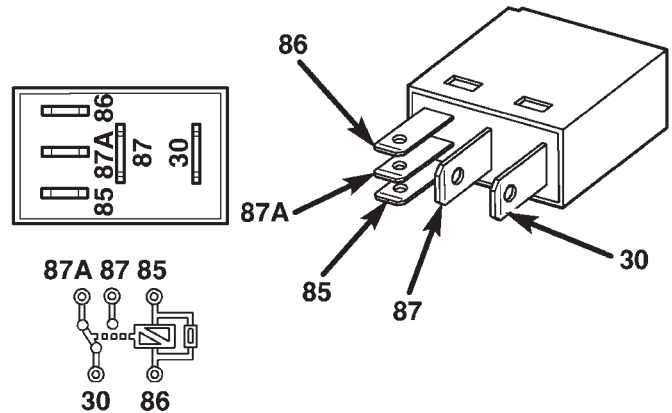
The front fog lamp relay can be diagnosed using conventional diagnostic tools and methods.

**DIAGNOSIS AND TESTING - FRONT FOG LAMP RELAY**

The front fog lamp relay (Fig. 12) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACI-**

**TOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



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**Fig. 12 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the front fog lamp relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT FOG LAMP RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

## FRONT FOG LAMP RELAY (Continued)

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the front fog lamp relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 13).

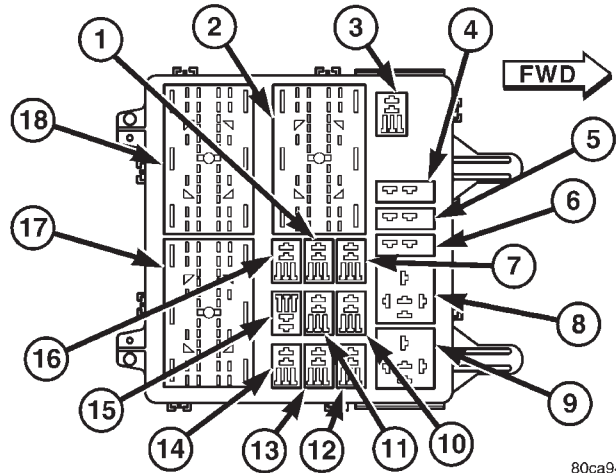
## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the front fog lamp relay to the proper receptacle in the Junction Block (JB) (Fig. 13).

(2) Align the front fog lamp relay terminals with the terminal cavities in the JB receptacle.

(3) Push firmly and evenly on the top of the front fog lamp relay until the terminals are fully seated in the terminal cavities in the JB receptacle.



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**Fig. 13 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.

## FRONT FOG LAMP UNIT

## REMOVAL

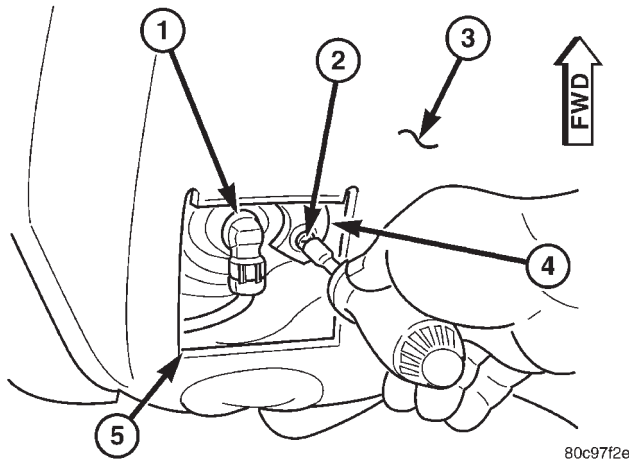
(1) Turn the front wheels full lock in the direction of the fog lamp bulb that is to be changed.

(2) Disconnect and isolate the battery negative cable.

(3) Reach into the front wheel opening to unsnap and lift the cover over the access hole at the front of the front wheelhouse splash shield (Fig. 14).

(4) Reach through the access hole to remove the three screws that secure the front fog lamp unit to the front bumper fascia.

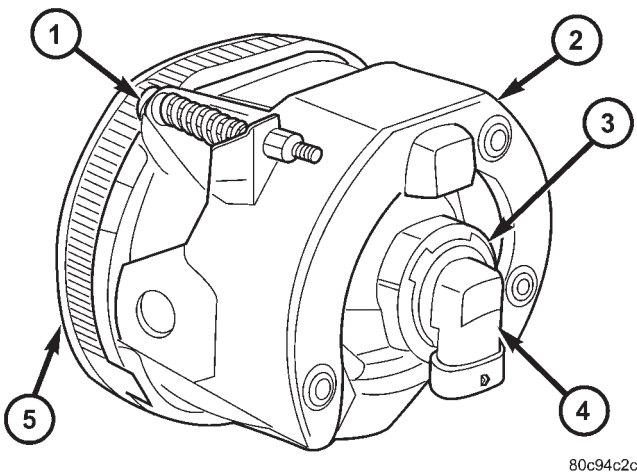
FRONT FOG LAMP UNIT (Continued)



**Fig. 14 Front Fog Lamp Unit Remove/Install**

- 1 - FRONT FOG LAMP UNIT
- 2 - SCREW (3)
- 3 - FRONT WHEELHOUSE SPLASH SHIELD
- 4 - FRONT BUMPER FASCIA
- 5 - ACCESS HOLE

(5) From the front of the vehicle, pull the front fog lamp unit out of the front bumper fascia far enough to access and disconnect the wire harness connector for the front fog lamp unit from the lamp socket connector receptacle (Fig. 15).



**Fig. 15 Front Fog Lamp Unit**

- 1 - ADJUSTING SCREW
- 2 - MOUNTING BRACKET
- 3 - HOUSING
- 4 - SOCKET & BULB
- 5 - LENS

(6) Remove the front fog lamp unit from the front bumper fascia.

**INSTALLATION**

- (1) Position the front fog lamp unit to the front bumper fascia.
- (2) Reconnect the wire harness connector for the front fog lamp to the lamp socket connector receptacle (Fig. 15).
- (3) Position the front fog lamp unit into the front bumper fascia.
- (4) Reach into the front wheel opening and through the access hole to install and tighten the three screws that secure the front fog lamp unit housing to the front bumper fascia (Fig. 14). Tighten the screws to 3 N·m (25 in. lbs.).
- (5) Lower and snap shut the cover over the access hole at the front of the front wheelhouse splash shield.
- (6) Reconnect the battery negative cable.
- (7) Confirm proper front fog lamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT FOG LAMP UNIT - ADJUSTMENTS).

**ADJUSTMENTS**

**ADJUSTMENT - FRONT FOG LAMP UNIT**

**VEHICLE PREPARATION FOR FOG LAMP ALIGNMENT**

- (1) Repair or replace any faulty or damaged components that could hinder proper lamp alignment.
- (2) Verify proper tire inflation.
- (3) Clean the front fog lamp lenses.
- (4) Verify that the cargo area is not heavily loaded.
- (5) The fuel tank should be Full. Add 2.94 kilograms (6.5 pounds) of weight over the fuel tank for each estimated gallon of missing fuel.

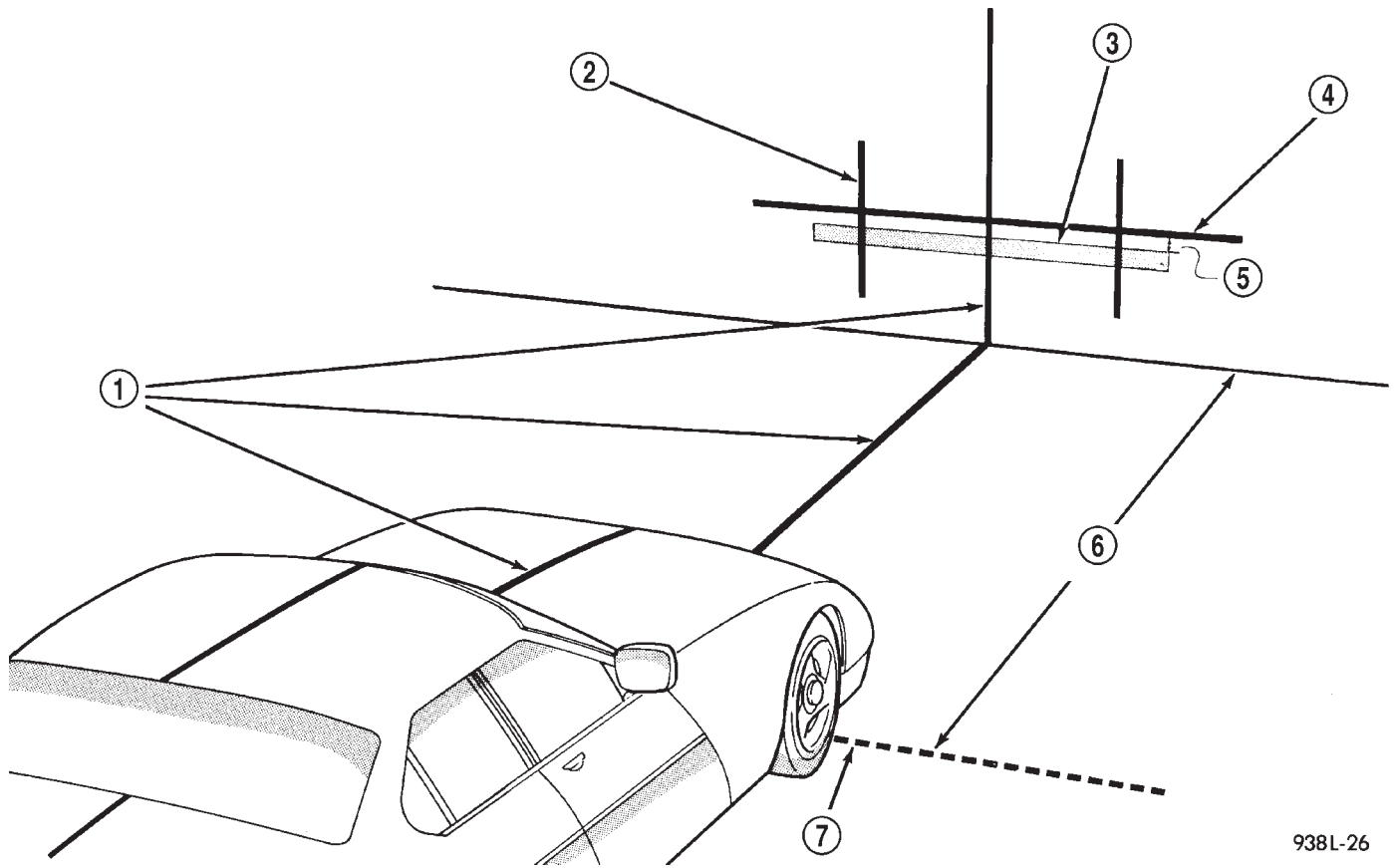
**FOG LAMP ALIGNMENT**

Prepare an alignment screen as illustrated. A properly aligned front fog lamp will project a pattern on the alignment screen 100 millimeters (4 inches) below the fog lamp centerline and straight ahead of the lamp.

(1) Position the vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 feet) away from the front of the front fog lamp lens (Fig. 16). If necessary, tape a line on the floor 7.62 meters (25 feet) away from and parallel to the wall.

(2) Measure up on the wall 1.27 meters (5 feet) from the floor and tape a vertical line on the alignment screen at the centerline of the vehicle. Sight along the centerline of the vehicle (from the rear of the vehicle forward) to verify the accuracy of the centerline placement.

FRONT FOG LAMP UNIT (Continued)



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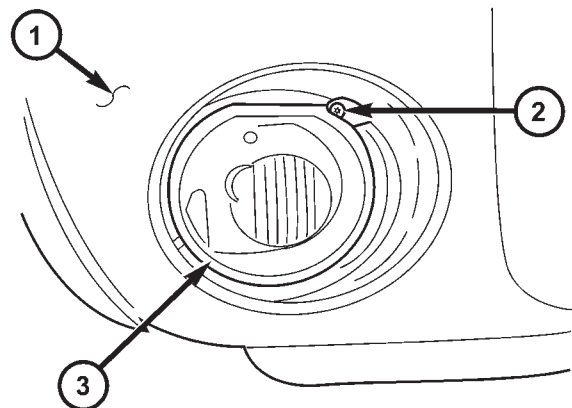
**Fig. 16 Front Fog Lamp Alignment - Typical**

- 1 - VEHICLE CENTERLINE
- 2 - CENTER OF VEHICLE TO CENTER OF FOG LAMP LENS
- 3 - HIGH-INTENSITY AREA
- 4 - FLOOR TO CENTER OF FOG LAMP LENS
- 5 - 100 MILLIMETERS (4 INCHES)
- 6 - 7.62 METERS (25 FEET)
- 7 - FRONT OF FOG LAMP

(3) Rock the vehicle from side-to-side three times to allow the suspension to stabilize, then jounce the front suspension three times by pushing downward on the front bumper and releasing. Measure the distance from the center of the front fog lamp lens to the floor. Transfer this measurement to the alignment screen and tape a horizontal line on the wall at this mark. This line will be used for up-and-down adjustment reference.

(4) Measure the distance from the centerline of the vehicle to the center of each front fog lamp being aligned. Transfer these measurements to the alignment screen and tape a vertical line this distance to each side of the vehicle centerline. These lines will be used for left/right reference.

(5) Rotate the front fog lamp adjusting screws to adjust the beam height as required (Fig. 17).



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**Fig. 17 Front Fog Lamp Adjusting Screw**

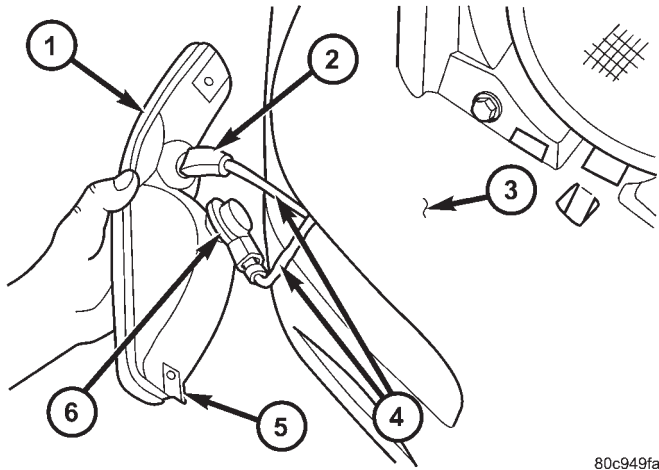
- 1 - FRONT BUMPER FASCIA
- 2 - ADJUSTING SCREW
- 3 - FRONT FOG LAMP UNIT

## FRONT LAMP BULB

### REMOVAL

The front lamp unit may contain either one or two bulbs, depending upon the market for which the vehicle was manufactured. The service procedures for one bulb or for both bulbs is the same, only the bulb sizes and types may differ. Be certain any removed bulb is replaced with the same bulb size and type that was removed.

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the front lamp unit from the front bumper fascia. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT LAMP UNIT - REMOVAL).
- (3) Firmly grasp the socket on the back of the front lamp unit housing for the bulb that is being removed (Fig. 18).



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**Fig. 18 Front Lamp Bulb Remove/Install**

- 1 - FRONT LAMP UNIT
- 2 - SIDE MARKER SOCKET
- 3 - FRONT FASCIA
- 4 - HEADLAMP & DASH WIRE HARNESS
- 5 - MOUNTING TAB
- 6 - PARK/TURN SIGNAL SOCKET

- (4) Rotate the socket on the back of the front lamp unit housing counterclockwise about 30 degrees.
- (5) Pull the socket and bulb straight out of the back of the front lamp unit housing.
- (6) Pull the bulb straight out of the front lamp unit socket.

### INSTALLATION

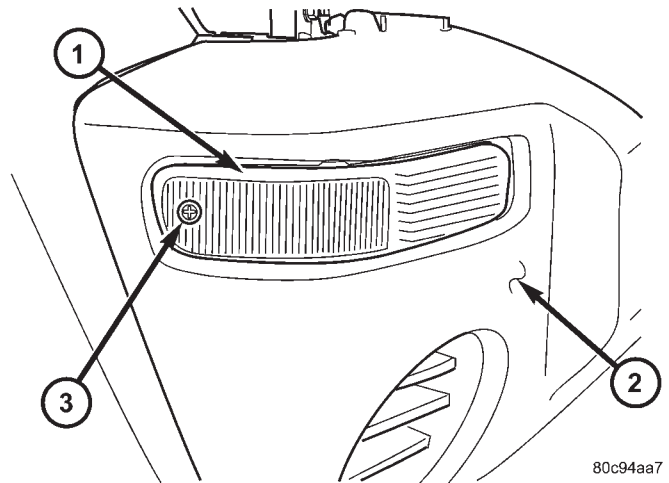
**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

- (1) Align the base of the bulb with the receptacle in the front lamp unit socket.
- (2) Push the bulb straight into the front lamp unit socket until it is firmly seated.
- (3) Align the socket and bulb with the socket opening on the back of the front lamp unit housing (Fig. 18).
- (4) Push the socket and bulb straight into the front lamp unit housing until it is firmly seated.
- (5) Rotate the socket on the back of the front lamp unit housing clockwise about 30 degrees.
- (6) Reinstall the front lamp unit into the front bumper fascia. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT LAMP UNIT - INSTALLATION).
- (7) Reconnect the battery negative cable.

## FRONT LAMP UNIT

### REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the screw that secures the outboard end of the front lamp unit to the front bumper fascia (Fig. 19).



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**Fig. 19 Front Lamp Unit Remove/Install**

- 1 - FRONT LAMP UNIT
- 2 - FRONT BUMPER FASCIA
- 3 - SCREW (1)

- (3) Pull the outboard end of the front lamp unit away from the front bumper fascia far enough to disengage the tab on the inboard end of the front lamp unit housing from the receptacle in the fascia.
- (4) Pull the front lamp unit away from the front bumper fascia far enough to access and disconnect the wire harness connector(s) for the front lamp unit from the lamp socket pigtail wire(s).
- (5) Remove the front lamp unit from the front bumper fascia.



## FRONT LAMP UNIT (Continued)

## INSTALLATION

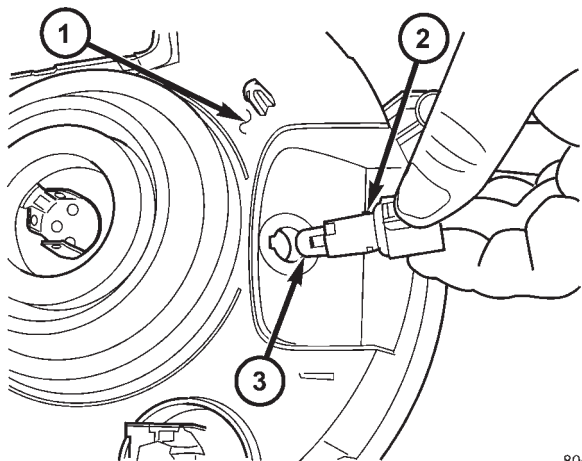
- (1) Position the front lamp unit to the front bumper fascia.
- (2) Reconnect the wire harness connector(s) for the front lamp unit to the lamp socket pigtail wire(s).
- (3) Engage the tab on the inboard end of the front lamp unit housing into the receptacle in the front bumper fascia.
- (4) Position the outboard end of the front lamp unit housing to the front bumper fascia.
- (5) Install and tighten the screw that secures the outboard end of the front lamp unit housing to the front bumper fascia (Fig. 19). Tighten the screw to 2 N·m (20 in. lbs.).
- (6) Reconnect the battery negative cable.

## FRONT POSITION LAMP BULB

## REMOVAL

The front position lamps are integral to the headlamp units on vehicles manufactured for certain markets where these lamps are required.

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the headlamp unit from the front grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL).
- (3) Rotate the front position lamp socket near the bottom of the headlamp unit housing counterclockwise about 30 degrees (Fig. 20).



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**Fig. 20 Front Position Lamp Bulb Remove/Install**

- 1 - HEADLAMP HOUSING
- 2 - SOCKET
- 3 - BULB

- (4) Pull the socket and bulb straight out of the headlamp unit housing.

- (5) Pull the bulb straight out of the front position lamp socket.

## INSTALLATION

The front position lamps are integral to the headlamp units on vehicles manufactured for certain markets where these lamps are required.

**CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.**

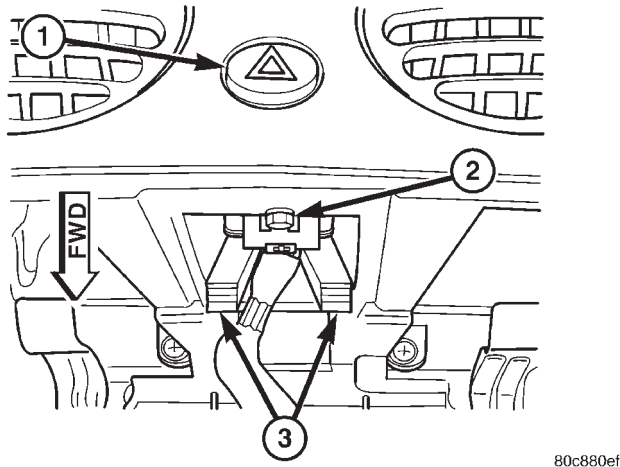
- (1) Align the base of the bulb with the receptacle in the front position lamp socket.
- (2) Push the bulb straight into the front position lamp socket until it is firmly seated.
- (3) Align the socket and bulb with the socket opening near the bottom of the headlamp unit housing (Fig. 20).
- (4) Push the socket and bulb straight into the headlamp unit housing until it is firmly seated.
- (5) Rotate the front position lamp socket near the bottom of the headlamp unit housing clockwise about 30 degrees.
- (6) Reinstall the headlamp unit onto the grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION).
- (7) Reconnect the battery negative cable.
- (8) Confirm proper headlamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS).

## HAZARD SWITCH

## DESCRIPTION

The hazard switch is integral to the hazard switch module, which is secured near the center of instrument panel just above the radio (Fig. 21). Only the hazard switch button is visible through a dedicated, round, beveled opening on the outer surface of the instrument panel between the two center panel outlets of the heater and air conditioning system. A red, stencil-like International Control and Display Symbol icon for "Hazard Warning" identifies the hazard switch button. On the opposite end of the black, molded plastic hazard switch module housing from the switch button is an integral connector receptacle and a stamped steel mounting bracket with two latch feature tabs that extend downward, while a short dowel-like alignment pin is integral to each side of the housing just below the switch button. The switch module is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. Within the hazard

## HAZARD SWITCH (Continued)



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**Fig. 21 Hazard Switch**

- 1 - HAZARD SWITCH BUTTON
- 2 - SCREW (1)
- 3 - MOUNTING BRACKET TABS

switch module housing is the hazard switch circuitry and an electronic circuit board with the integral combination flasher circuitry. The electronic combination flasher circuitry performs both the hazard flasher and turn signal flasher functions.

The hazard switch module cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

**OPERATION**

The hazard switch button is slightly recessed in the instrument panel when the switch is in the Off position, and latches at a position that is flush with the outer surface of the instrument panel when in the On position. The hazard switch module produces an audible clicking sound that emulates the sound of a conventional flasher whenever the turn signals or the hazard warning system are activated. The hazard switch module receives battery current on a fused B(+) circuit from a fuse in the Junction Block (JB) at all times for operation of the hazard warning, and on a fused ignition switch output (run) circuit from another fuse in the JB whenever the ignition switch is in the On position for operation of the turn signals. The module receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the JB. Inputs to and outputs from the hazard switch module include:

- **Panel Lamps Dimmer Input** - A non-serviceable incandescent bulb soldered onto the hazard switch module circuit board provides illumination of the switch button when the exterior lighting is turned On through an input received on the fused

panel lamps dimmer switch signal circuit. However, this bulb flashes on and off at full intensity whenever the hazard switch button is in the On position, regardless of the status of the exterior lighting.

- **Hazard Switch Input** - The combination flasher circuitry of the hazard switch module receives an internal ground input from the hazard switch to request hazard flasher operation.

- **Multi-Function Switch Input** - The combination flasher circuitry of the hazard switch module receives separate ground inputs from the turn signal switch circuitry of the multi-function switch on right and left turn switch sense circuits to request right or left turn signal flasher operation.

- **Body Control Module Input** - The Body Control Module (BCM) can request hazard flasher operation by providing a ground path to the combination flasher circuitry of the hazard switch module through a hazard lamp control circuit.

- **Turn Signal Output** - The combination flasher circuitry within the hazard switch module responds to the flasher request inputs by energizing and de-energizing two miniature relays on the module circuit board. These relays control the switch output through the right and left turn signal circuits. One relay controls the right lamps, while the other controls the left.

Because of active electronic elements within the hazard switch module, it cannot be tested with conventional automotive electrical test equipment. If the hazard switch module is believed to be faulty, replace the switch with a known good unit to confirm system operation.

**REMOVAL**

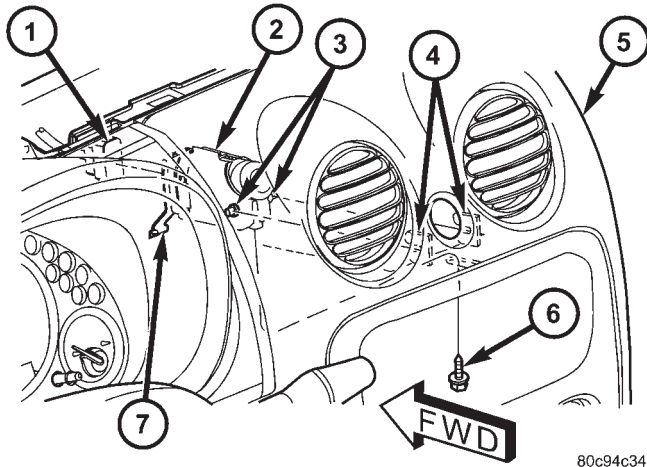
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

## HAZARD SWITCH (Continued)

(2) Remove the radio from the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).

(3) Remove the screw at the top of the instrument panel radio opening that secures the hazard switch to the instrument panel trim (Fig. 22).



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**Fig. 22 Hazard Switch Remove/Install**

- 1 - WIRE HARNESS CONNECTOR
- 2 - HAZARD SWITCH
- 3 - ALIGNMENT PIN (2)
- 4 - STANCHION (2)
- 5 - INSTRUMENT PANEL
- 6 - SCREW (1)
- 7 - MOUNTING BRACKET LATCH TAB (2)

(4) Reach through and above the instrument panel radio opening to access the two latch tabs of the stamped metal hazard switch mounting bracket.

(5) Using two fingertips, pull rearward and downward on the latch tabs on the back of the hazard switch until it is disengaged from the instrument panel trim.

(6) Push the hazard switch button through the button opening of the instrument panel far enough to disengage the alignment pins on each side of the switch housing from the saddle formations of the two stanchions on the back of the instrument panel trim, just below and to either side of the button opening.

(7) Disconnect the instrument panel wire harness connector for the hazard switch from the switch connector receptacle.

(8) Remove the hazard switch through the instrument panel radio opening.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG,**

**PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the hazard switch through the instrument panel radio opening.

(2) Reconnect the instrument panel wire harness connector for the hazard switch to the switch connector receptacle.

(3) Reach through and above the instrument panel radio opening to position the hazard switch for installation.

(4) Guide the hazard switch button through the button opening of the instrument panel, which will engage the alignment pins on each side of the switch housing with the saddle formations of the two stanchions on the back of the instrument panel trim, just below and to either side of the button opening.

(5) Using hand pressure, press upward on the back of the hazard switch until the latch tabs of the mounting bracket on the back of the switch are both engaged with the instrument panel trim (Fig. 22).

(6) Install and tighten the screw at the top of the instrument panel radio opening that secures the hazard switch to the instrument panel trim. Tighten the screw to 2 N·m (17 in. lbs.).

(7) Reinstall the radio into the instrument panel. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(8) Reconnect the battery negative cable.

## HEADLAMP BULB

### REMOVAL

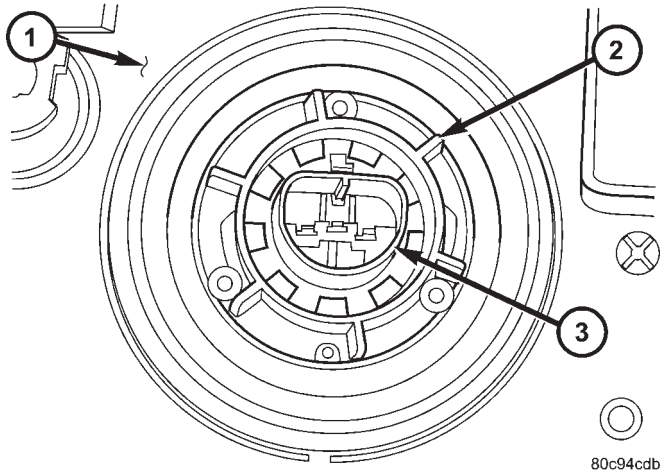
#### NORTH AMERICA

(1) Disconnect and isolate the battery negative cable.

(2) Reach behind the headlamp unit from the engine compartment side of the upper radiator cross-member to access the headlamp bulb lock ring (Fig. 23).

(3) Firmly grasp the lock ring on the back of the headlamp unit housing.

HEADLAMP BULB (Continued)



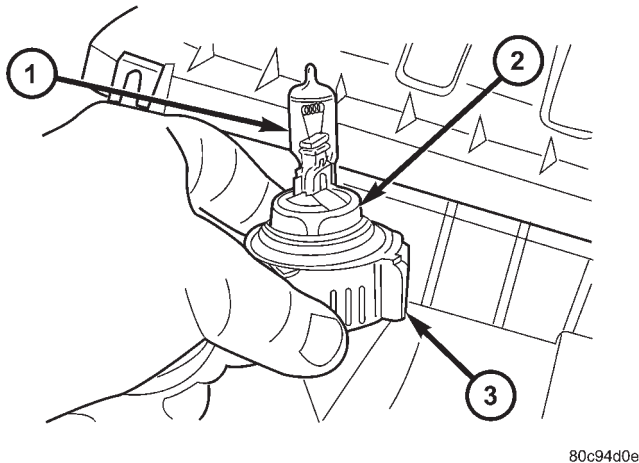
**Fig. 23 Headlamp Bulb Lock Ring**

- 1 - HEADLAMP UNIT HOUSING
- 2 - LOCK RING
- 3 - SOCKET & BULB

(4) Rotate the lock ring on the back of the headlamp unit housing counterclockwise about 30 degrees.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

(5) Pull the lock ring, socket, and bulb straight out of the headlamp unit housing and up from behind the upper radiator crossmember (Fig. 24).



**Fig. 24 Headlamp Bulb Remove/Install**

- 1 - HEADLAMP BULB
- 2 - SOCKET
- 3 - LOCK RING

(6) Disconnect the grille opening reinforcement wire harness connector for the headlamp bulb from the connector receptacle on the bulb socket.

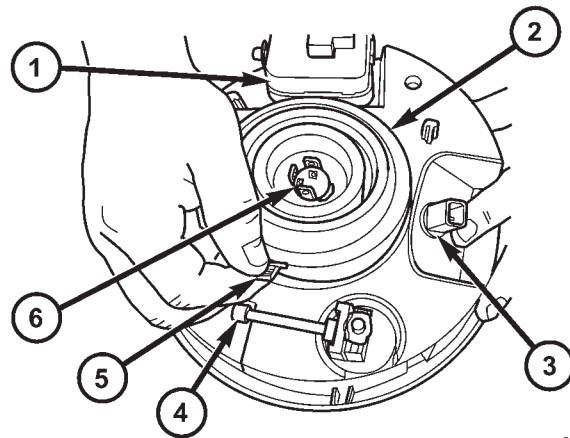
(7) Remove the bulb and bulb socket from the lock ring as a unit.

**REST-OF-WORLD**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the headlamp unit from the grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL).

(3) Firmly grasp the tab of the headlamp boot seal on the back of the headlamp unit housing (Fig. 25).



**Fig. 25 Headlamp Bulb Boot Seal Remove**

- 1 - LEVELING MOTOR (IF EQUIPPED)
- 2 - BOOT SEAL
- 3 - FRONT POSITION LAMP
- 4 - ADJUSTING SCREW
- 5 - TAB
- 6 - BULB BASE

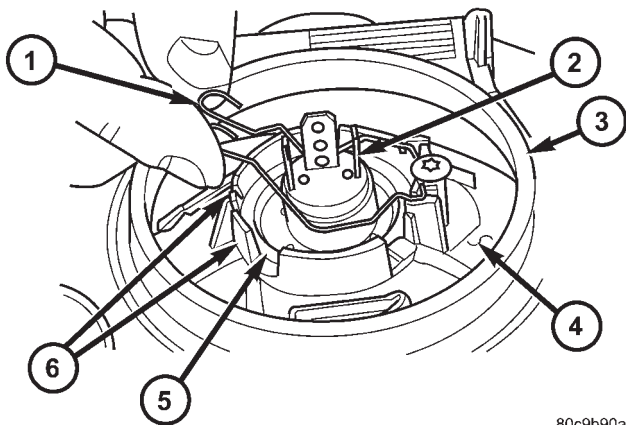
(4) Pull the tab away from the back of the headlamp unit housing to remove the boot seal from the housing and the bulb base.

(5) Pinch the two hooked ends of the wire headlamp bulb retainer clip together and disengage them from the slots in the flange of the reflector (Fig. 26).

(6) Pivot the headlamp bulb retainer clip up off of the bulb flange and out of the way.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

## HEADLAMP BULB (Continued)

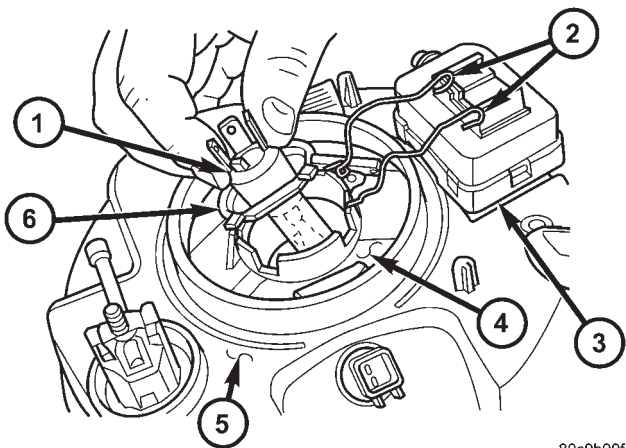


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**Fig. 26 Headlamp Bulb Retainer Clip Engage/Disengage**

- 1 - RETAINER CLIP
- 2 - BULB BASE
- 3 - HEADLAMP HOUSING
- 4 - REFLECTOR
- 5 - BULB FLANGE
- 6 - RETAINER SLOTS

(7) Pull the bulb straight out of the headlamp unit reflector (Fig. 27).



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**Fig. 27 Headlamp Bulb Remove/Install**

- 1 - BULB BASE
- 2 - RETAINER CLIP
- 3 - LEVELING MOTOR (IF EQUIPPED)
- 4 - REFLECTOR
- 5 - HEADLAMP HOUSING
- 6 - BULB FLANGE

## INSTALLATION

## NORTH AMERICA

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

(1) Position the headlamp bulb and socket unit into the lock ring (Fig. 24).

(2) Reconnect the grille opening reinforcement wire harness connector for the headlamp bulb to the connector receptacle on the bulb socket.

(3) Position the lock ring, socket, and bulb down behind the upper radiator crossmember and align them with the socket opening on the back of the headlamp unit housing.

(4) Push the socket and bulb straight into the headlamp unit housing until they are firmly seated.

(5) Position the lock ring over the socket and engage it with the flange on the back of the headlamp unit housing (Fig. 23).

(6) Rotate the lock ring on the back of the headlamp unit housing clockwise about 30 degrees.

(7) Reconnect the battery negative cable.

## REST-OF-WORLD

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**CAUTION:** Do not contaminate the bulb glass by touching it with your fingers or by allowing it to contact other oily surfaces. Shortened bulb life will result.

(1) Position the bulb into the headlamp unit reflector (Fig. 27).

(2) Pivot the headlamp bulb retainer clip back over the bulb flange.

(3) Pinch the two hooked ends of the wire headlamp bulb retainer clip together and engage them into the slots in the flange of the reflector (Fig. 26).

(4) Position the center opening of the boot seal over the base of the headlamp bulb and pull it downward until the seal is fully engaged over the bulb base (Fig. 25).

## HEADLAMP BULB (Continued)

(5) Position the outer circumference of the boot seal over the flange on the back of the headlamp unit housing and pull it downward until the seal is fully engaged over the flange.

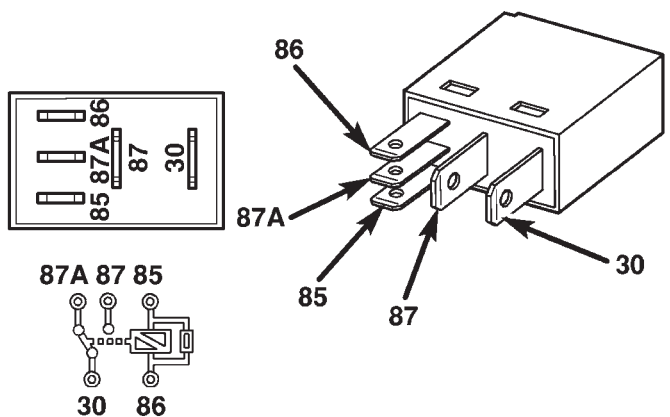
(6) Reinstall the headlamp unit onto the grille opening reinforcement. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION).

(7) Reconnect the battery negative cable.

(8) Confirm proper headlamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS).

## HEADLAMP HIGH BEAM RELAY

## DESCRIPTION



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**Fig. 28 ISO Micro Relay**

- 30 - COMMON FEED  
 85 - COIL GROUND  
 86 - COIL BATTERY  
 87 - NORMALLY OPEN  
 87A - NORMALLY CLOSED

The headlamp high beam relay is located in the Junction Block (JB) on the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The headlamp high beam relay is omitted from vehicles manufactured for sale in Canada, which have a Daytime Running Lamp (DRL) solid state relay installed in the JB that also performs the function of the headlamp high beam relay. The headlamp high beam relay is a conventional International Standards Organization (ISO) micro relay (Fig. 28). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular,

molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The headlamp high beam relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The headlamp high beam relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the headlamp high beam filaments. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The headlamp high beam relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the headlamp high beam relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Body Control Module (BCM) through a head lamp relay control circuit. The BCM controls head lamp operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) is connected to a control output of the Body Control Module (BCM) and to the momentary optical horn (flash-to-pass) output of the multi-function switch through a high beam relay control circuit. The BCM and/or the multi-function switch controls headlamp high beam operation by controlling a ground path through this circuit.
- **Normally Open Terminal** - The normally open terminal (87) is connected to the headlamp high beam filaments through the high beam relay output circuit and provides battery current to the headlamp high beams whenever the relay is energized.

## HEADLAMP HIGH BEAM RELAY (Continued)

• **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

The headlamp high beam relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - HEADLAMP HIGH BEAM RELAY

The headlamp high beam relay (Fig. 29) is located in the Junction Block (JB) on the driver side out-board end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

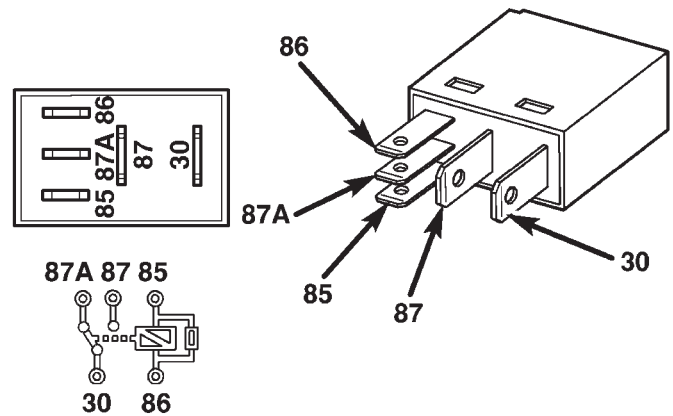
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the headlamp high beam relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP HIGH BEAM RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.



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**Fig. 29 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

## REMOVAL

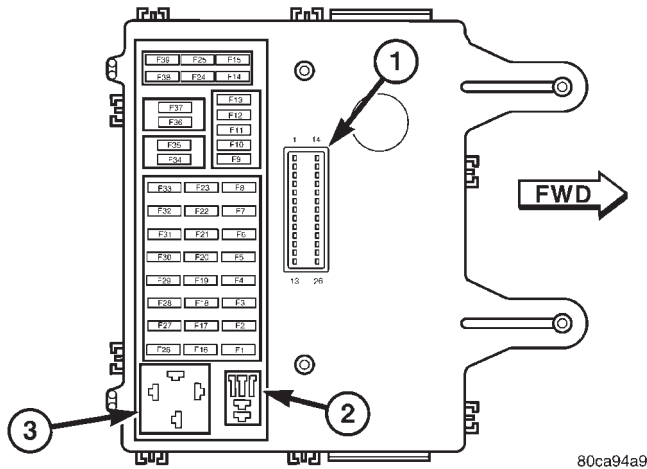
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 end cap from the driver side out-board end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL).

(3) Remove the headlamp high beam relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 30).

HEADLAMP HIGH BEAM RELAY (Continued)



80ca94a9

**Fig. 30 Junction Block - Outboard Side (RHD Shown - Rotate 180° for LHD)**

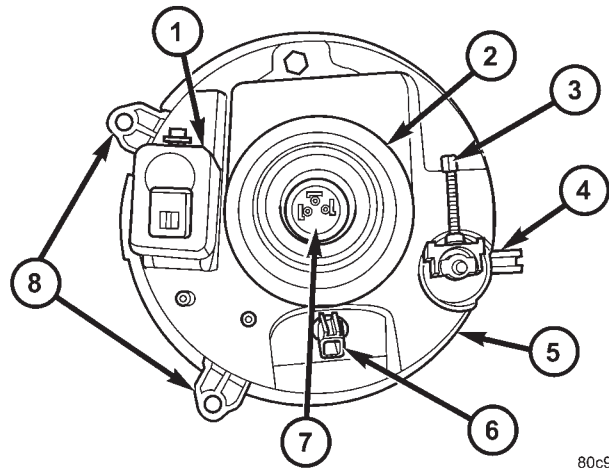
- 1 - JB/BCM CONNECTOR
- 2 - HIGH BEAM RELAY
- 3 - DRL RELAY

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Position the headlamp high beam relay to the proper receptacle in the Junction Block (JB) (Fig. 30).
- (2) Align the headlamp high beam relay terminals with the terminal cavities in the JB receptacle.
- (3) Push firmly and evenly on the top of the headlamp high beam relay until the terminals are fully seated in the terminal cavities in the JB receptacle.
- (4) Reinstall the end cap onto the driver side outboard end of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - INSTALLATION).
- (5) Reconnect the battery negative cable.

**HEADLAMP LEVELING MOTOR DESCRIPTION**



80c9be96

**Fig. 31 Headlamp Unit - With Leveling**

- 1 - LEVELING MOTOR (IF EQUIPPED)
- 2 - BOOT SEAL
- 3 - ADJUSTING SCREW
- 4 - LOCATOR TAB
- 5 - HOUSING
- 6 - FRONT POSITION LAMP SOCKET & BULB
- 7 - HEADLAMP BULB
- 8 - MOUNTING TAB (2)

The headlamp leveling motor is located on the rear inboard side of each headlamp unit on models equipped with the headlamp leveling system, which is available only in certain markets where required (Fig. 31). The motor is encased within a molded plastic housing and is secured by an integral wedge-type mounting boss on its forward surface to a flanged receptacle on the back of the headlamp unit housing. A rubber seal around the circumference of the mounting boss is compressed and seals the motor to the headlamp unit when the boss is properly installed in the flanged receptacle. The outside of the motor housing features an integral molded connector receptacle on its rearward surface, a hex-headed adjusting screw extends from the top of the housing, and a plastic pushrod with a ball formation on its free end extends from the center of the mounting boss at the front. Within the motor housing is a 12-volt Direct Current (DC) servo motor, an electronic controller board that includes the motor logic circuits, and an integral screw-drive transmission. The headlamp leveling motor is connected to the vehicle electrical system through a dedicated take out and connector of the front fascia wire harness.

The headlamp leveling motor cannot be repaired and, if faulty or damaged, the unit must be replaced.



## HEADLAMP LEVELING MOTOR (Continued)

## OPERATION

The controller board and logic circuitry of the headlamp leveling motor will energize the motor and extend or retract the motor pushrod through the integral screw-drive transmission based upon the voltage signal input received from the resistor multiplexed headlamp leveling switch. The ball formation on the end of the headlamp leveling motor pushrod is snapped into a socket formation on the back of the movable reflector within the headlamp unit housing. The headlamp leveling motors and switch have a path to ground at all times. The headlamp leveling components operate on battery current received through the fused park lamp relay output circuit so that the system will only operate when the exterior lighting is turned On.

Because of active electronic elements within the headlamp leveling motor, it cannot be tested with conventional automotive electrical test equipment. If the headlamp leveling motor is believed to be faulty, replace the motor with a known good unit to confirm system operation.

## REMOVAL

The headlamp leveling motors are integral to the headlamp units on vehicles manufactured for certain markets where headlamp leveling is required.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the headlamp bulb from the headlamp unit housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP BULB - REMOVAL).

(3) Rotate the headlamp leveling motor on the back of the headlamp unit housing counterclockwise about 30 degrees (Fig. 32).

(4) Firmly grasp the motor with one hand while stabilizing the headlamp unit housing with the other hand.

(5) Firmly, steadily, and forcefully pull the headlamp leveling motor straight away from the back of the headlamp unit housing to unsnap the ball formation on the end of the motor pushrod from the socket on the headlamp unit reflector (Fig. 33).

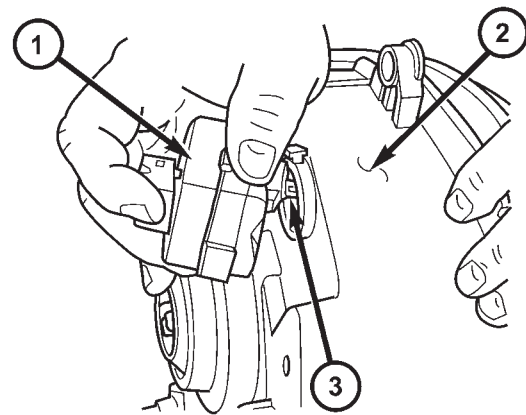
(6) Remove the headlamp leveling motor and pushrod from the back of the headlamp unit housing.

## INSTALLATION

The headlamp leveling motors are integral to the headlamp units on vehicles manufactured for certain markets where headlamp leveling is required.

(1) Position the headlamp leveling motor and pushrod from to the mounting hole on the back of the headlamp unit housing.

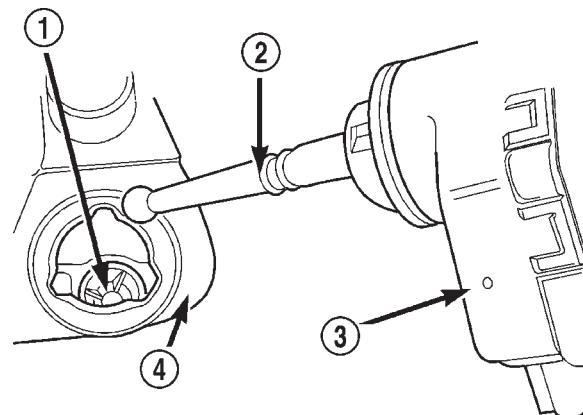
(2) Insert two fingers through the bulb mounting hole in the center of the headlamp reflector and pull



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**Fig. 32 Headlamp Leveling Motor Remove/Install**

- 1 - LEVELING MOTOR
- 2 - HEADLAMP HOUSING
- 3 - PUSHROD



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**Fig. 33 Leveling Motor Pushrod - Typical**

- 1 - REFLECTOR PUSHROD SOCKET
- 2 - PUSHROD
- 3 - LEVELING MOTOR
- 4 - HEADLAMP HOUSING

the reflector upwards toward the headlamp leveling motor.

(3) Align the ball formation on the end of the leveling motor pushrod with the socket on the headlamp unit reflector (Fig. 33).

(4) While continuing to pulling the reflector toward the motor, firmly, steadily, and forcefully push the headlamp leveling motor straight into the back of the headlamp unit housing to snap the ball formation on the end of the motor pushrod into the socket on the headlamp unit reflector.

(5) After the pushrod is engaged to the reflector, remove your fingers from the bulb mounting hole in

## HEADLAMP LEVELING MOTOR (Continued)

the center of the headlamp reflector and thoroughly clean any fingerprints from the reflector.

(6) Push the mounting flange of the headlamp leveling motor into the mounting hole on the back of headlamp unit housing unit the motor is firmly seated (Fig. 32).

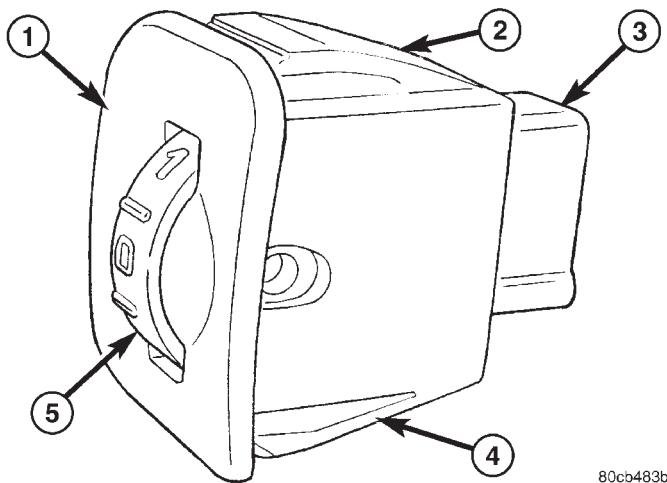
(7) Rotate the headlamp leveling motor on the back of the headlamp unit housing clockwise about 30 degrees.

(8) Reinstall the headlamp bulb into the headlamp unit housing. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP BULB - INSTALLATION).

(9) Reconnect the battery negative cable.

## HEADLAMP LEVELING SWITCH

## DESCRIPTION



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**Fig. 34 Headlamp Leveling Switch**

- 1 - SWITCH
- 2 - UPPER LATCH FEATURE (1)
- 3 - CONNECTOR RECEPTACLE
- 4 - LOWER LATCH FEATURE (2)
- 5 - THUMBWHEEL

The headlamp leveling switch (Fig. 34) is used only on vehicles manufactured for certain markets where the headlamp leveling system is required. The headlamp leveling switch is mounted in the driver side inboard trim bezel on the instrument panel, where it is secured by molded latch features that are integral to the switch housing. Only the switch bezel and thumbwheel are visible on the outer surface of the instrument panel trim bezel. The black plastic switch thumbwheel is marked with white numbers "0," "1," "2," and "3," each of which indicates one of the four switch detent positions. Each higher number repre-

sents a lower aiming position of the headlamp beam relative to the road surface. The black, molded plastic switch housing has an integral connector receptacle on the back, a single latch feature on the top, and two latch features (one on each side) on the bottom. The switch is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. Within the switch housing is the leveling switch circuitry including the switch contacts and a series resistor configuration.

The headlamp leveling switch cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The headlamp leveling switch receives battery current on a fused park lamp relay output circuit from a fuse in the Junction Block (JB) whenever the park lamp relay is energized (park lamps are turned On). The switch receives a path to ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the JB. The only output from the switch is a voltage signal that it provides to the headlamp leveling motors on a headlamp adjust signal circuit. Each switch position selects a different tap on a series resistor within the switch to provide a different voltage signal to the leveling motors. The higher the switch position number, the higher the output voltage level.

The headlamp leveling switch can be tested using conventional diagnostic tools and methods.

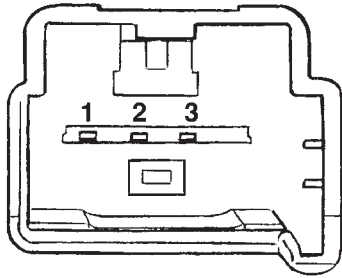
## DIAGNOSIS AND TESTING - HEADLAMP LEVELING SWITCH

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## HEADLAMP LEVELING SWITCH (Continued)

(1) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the headlamp leveling switch from the switch connector receptacle.

(2) Using an ohmmeter, perform the resistance tests at the terminal pins in the headlamp leveling switch connector receptacle (Fig. 35) as shown in the Headlamp Leveling Switch Tests table.



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**Fig. 35 Headlamp Leveling Switch Connector Receptacle**

HEADLAMP LEVELING SWITCH TESTS	
SWITCH POSITION	RESISTANCE (OHMS) BETWEEN PINS 1 & 3
0	0.5 ± 0.5
1	301 ± 1
2	595 ± 1
3	739 ± 1

(3) If the switch fails any of the resistance tests, replace the faulty headlamp leveling switch as required.

## REMOVAL

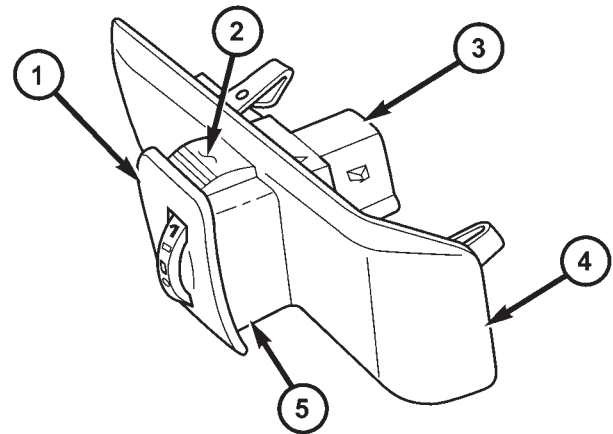
The headlamp leveling switch is used only on vehicles manufactured for certain markets where headlamp leveling is required.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 driver side inboard bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVER SIDE BEZEL - REMOVAL).

(3) Disconnect the instrument panel wire harness connector for the headlamp leveling switch from the switch connector receptacle (Fig. 36).



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**Fig. 36 Headlamp Leveling Switch Remove/Install**

- 1 - HEADLAMP LEVELING SWITCH
- 2 - UPPER LATCH TAB
- 3 - RECEPTACLE
- 4 - DRIVER SIDE INBOARD BEZEL
- 5 - LOWER LATCH TAB (2)

(4) From the back of the trim bezel, depress the two lower latch features on the headlamp leveling switch housing and rock the bottom of the switch out through the face of the bezel.

(5) From the back of the trim bezel, depress the upper latch feature on the headlamp leveling switch housing and push the switch out through the face of the bezel.

## INSTALLATION

The headlamp leveling switch is used only on vehicles manufactured for certain markets where headlamp leveling is required.

## HEADLAMP LEVELING SWITCH (Continued)

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) From the face of the driver side inboard bezel, align the headlamp leveling switch housing to the mounting hole in the bezel (Fig. 36).

(2) Push the headlamp leveling switch into the mounting hole until it is fully seated and the upper latch and two lower latch features on the switch housing are engaged on the back of the bezel.

(3) Position the switch and bezel unit to the instrument panel.

(4) Reconnect the instrument panel wire harness connector for the headlamp leveling switch to the switch connector receptacle.

(5) Reinstall the driver side inboard bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVER SIDE BEZEL - INSTALLATION).

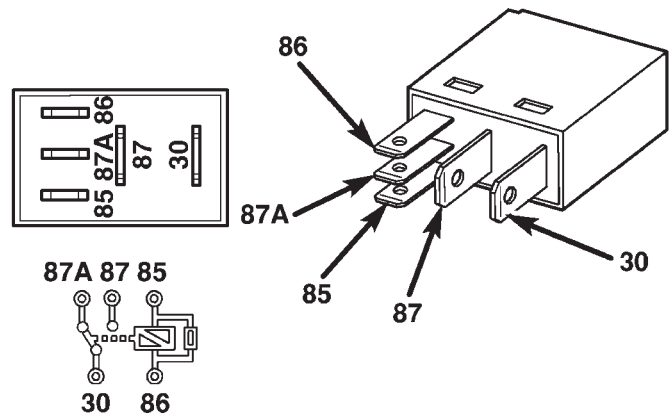
(6) Reconnect the battery negative cable.

## HEADLAMP LOW BEAM RELAY

### DESCRIPTION

The headlamp low beam relay is located in the Junction Block (JB) below the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The headlamp low beam relay is a conventional International Standards Organization (ISO) micro relay (Fig. 37). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The headlamp low beam relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.



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**Fig. 37 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

### OPERATION

The headlamp low beam relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the headlamp low beam filaments. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The headlamp low beam relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the headlamp low beam relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) receives battery current at all times from a fuse in the PDC through a fused B(+) circuit.

## HEADLAMP LOW BEAM RELAY (Continued)

- **Coil Battery Terminal** - The coil battery terminal (86) is connected to a control output of the Body Control Module (BCM) through a low beam relay control circuit. The BCM controls headlamp low beam operation by controlling a ground path through this circuit.

- **Normally Open Terminal** - The normally open terminal (87) is connected to the headlamp low beam filaments through the low beam relay output circuit and provides battery current to the headlamp low beams whenever the relay is energized.

- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

The headlamp low beam relay can be diagnosed using conventional diagnostic tools and methods.

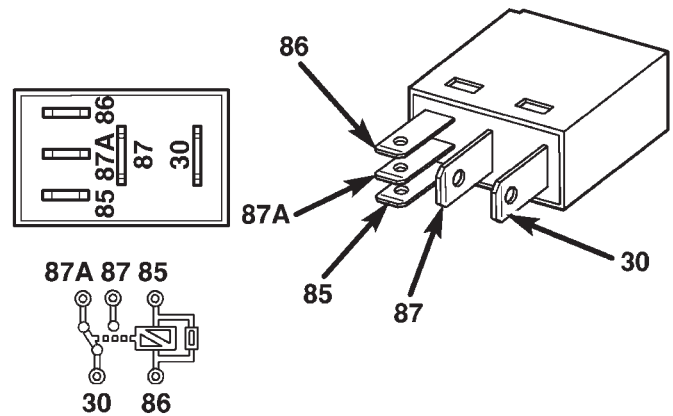
## DIAGNOSIS AND TESTING - HEADLAMP LOW BEAM RELAY

The headlamp low beam relay (Fig. 38) is located in the Junction Block (JB) under the driver side out-board end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the headlamp low beam relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP LOW BEAM RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.



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**Fig. 38 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

HEADLAMP LOW BEAM RELAY (Continued)

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the headlamp low beam relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 39).

**OTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

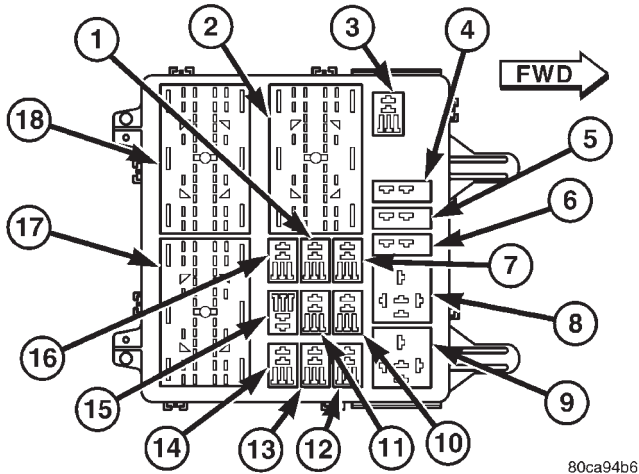
(1) Position the headlamp low beam relay to the proper receptacle in the Junction Block (JB) (Fig. 39).

(2) Align the headlamp low beam relay terminals with the terminal cavities in the JB receptacle.

(3) Push firmly and evenly on the top of the headlamp low beam relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.



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**Fig. 39 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FUR-**

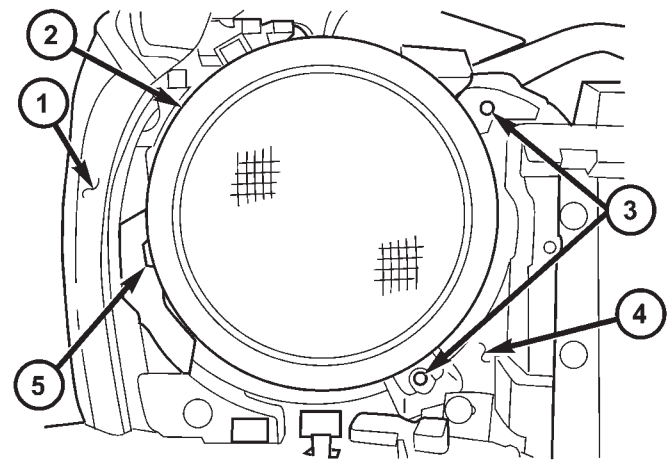
**HEADLAMP UNIT**

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the grille panel from the grille opening reinforcement. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL).

(3) Remove the two screws that secure the mounting tabs on the inboard side of the headlamp unit housing to the grille opening reinforcement (Fig. 40).



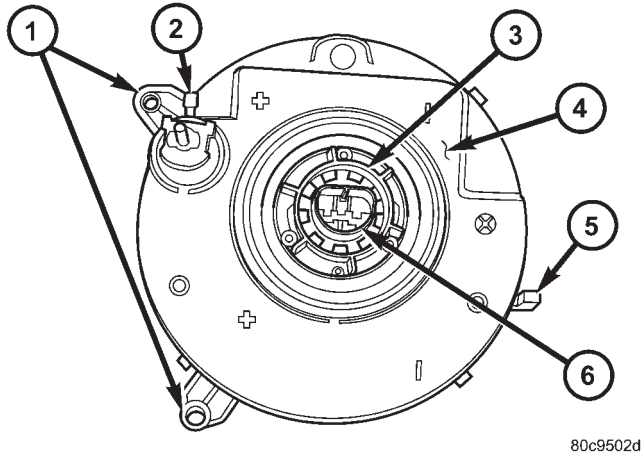
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**Fig. 40 Headlamp Unit Remove/Install**

- 1 - FENDER PANEL
- 2 - HEADLAMP UNIT
- 3 - MOUNTING TAB (2)
- 4 - MOUNTING PANEL
- 5 - LOCATOR TAB

## HEADLAMP UNIT (Continued)

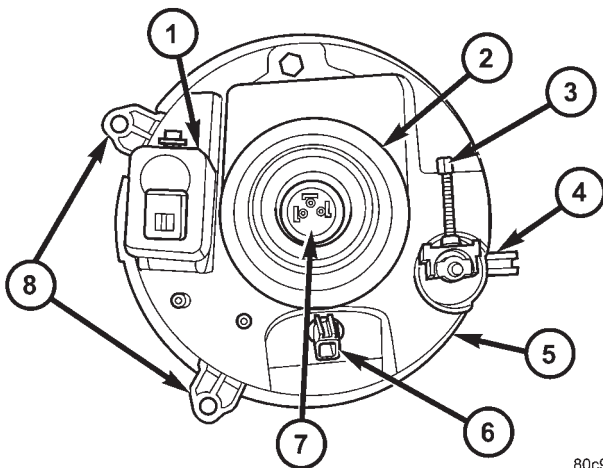
(4) Pull the inboard side of the headlamp unit away from the grille opening reinforcement far enough to disengage the locator tab on the outboard side of the unit (Fig. 41) or (Fig. 42) from the engagement slot in the outboard edge of the reinforcement.



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**Fig. 41 Headlamp Unit - North America**

- 1 - MOUNTING TAB (2)
- 2 - ADJUSTING SCREW
- 3 - LOCK RING
- 4 - HOUSING
- 5 - LOCATOR TAB
- 6 - SOCKET & BULB



80c9be96

**Fig. 42 Headlamp Unit - Rest-Of-World**

- 1 - LEVELING MOTOR (IF EQUIPPED)
- 2 - BOOT SEAL
- 3 - ADJUSTING SCREW
- 4 - LOCATOR TAB
- 5 - HOUSING
- 6 - FRONT POSITION LAMP SOCKET & BULB
- 7 - HEADLAMP BULB
- 8 - MOUNTING TAB (2)

(5) Pull the headlamp unit away from the grille opening reinforcement far enough to disconnect the wire harness connectors from the headlamp bulb socket (North America), the headlamp bulb base (Rest-Of-World), the front position lamp socket (if equipped), and the headlamp leveling motor (if equipped).

(6) Remove the headlamp unit from the grille opening reinforcement.

## INSTALLATION

(1) Position the headlamp unit to the grille opening reinforcement.

(2) Reconnect the wire harness connectors to the headlamp bulb socket (North America), the headlamp bulb base (Rest-Of-World), the front position lamp socket (if equipped), and the headlamp leveling motor (if equipped) (Fig. 41) or (Fig. 42).

(3) Engage the locator tab on the outboard side of the headlamp unit into the engagement slot in the outboard edge of the grille opening reinforcement.

(4) Align the two mounting tabs on the inboard side of the headlamp unit housing to the mounting holes in the grille opening reinforcement (Fig. 40).

(5) Install and tighten the two screws that secure the mounting tabs on the inboard side of the headlamp unit housing to the grille opening reinforcement. Tighten the screws to 3 N·m (30 in. lbs.).

(6) Reinstall the grille panel onto the grille opening reinforcement. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION).

(7) Reconnect the battery negative cable.

(8) Confirm proper headlamp unit alignment. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - ADJUSTMENTS).

## ADJUSTMENTS

### ADJUSTMENT - HEADLAMP UNIT

#### VEHICLE PREPARATION FOR HEADLAMP ALIGNMENT

(1) Verify headlamp dimmer (multi-function) switch and high beam indicator operation.

(2) If the vehicle is equipped with headlamp leveling, be certain that the headlamp leveling switch is in the "0" position.

(3) Repair or replace any faulty or damaged components that could hinder proper lamp alignment.

(4) Verify proper tire inflation.

(5) Clean headlamp lenses.

(6) Verify that cargo area is not heavily loaded.

(7) The fuel tank should be Full. Add 2.94 kilograms (6.5 pounds) of weight over the fuel tank for each estimated gallon of missing fuel.

HEADLAMP UNIT (Continued)

**HEADLAMP ALIGNMENT SCREEN PREPARATION**

Prepare an alignment screen as illustrated.

(1) Position the vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 feet) away from the front of the headlamp lens for North American vehicles, or 10.0 meters (32.81 feet) away from the front of the headlamp lens for Rest-Of-World vehicles (Fig. 43). If necessary, tape a line on the floor at the appropriate distance away from and parallel to the wall.

(2) Measure up on the wall 1.27 meters (5 feet) from the floor and tape a vertical line on the alignment screen at the centerline of the vehicle. Sight along the centerline of the vehicle (from the rear of the vehicle forward) to verify the accuracy of the centerline placement.

(3) Rock the vehicle from side-to-side three times to allow the suspension to stabilize, then jounce the front suspension three times by pushing downward on the front bumper and releasing. Measure the distance from the center of the headlamp lens to the floor. Transfer this measurement to the alignment screen and tape a horizontal line on the wall at this mark. This line will be used for up-and-down adjustment reference.

(4) Measure the distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer these measurements to the alignment screen and tape a vertical line this distance to each side of the vehicle centerline. These lines will be used for left/right reference.

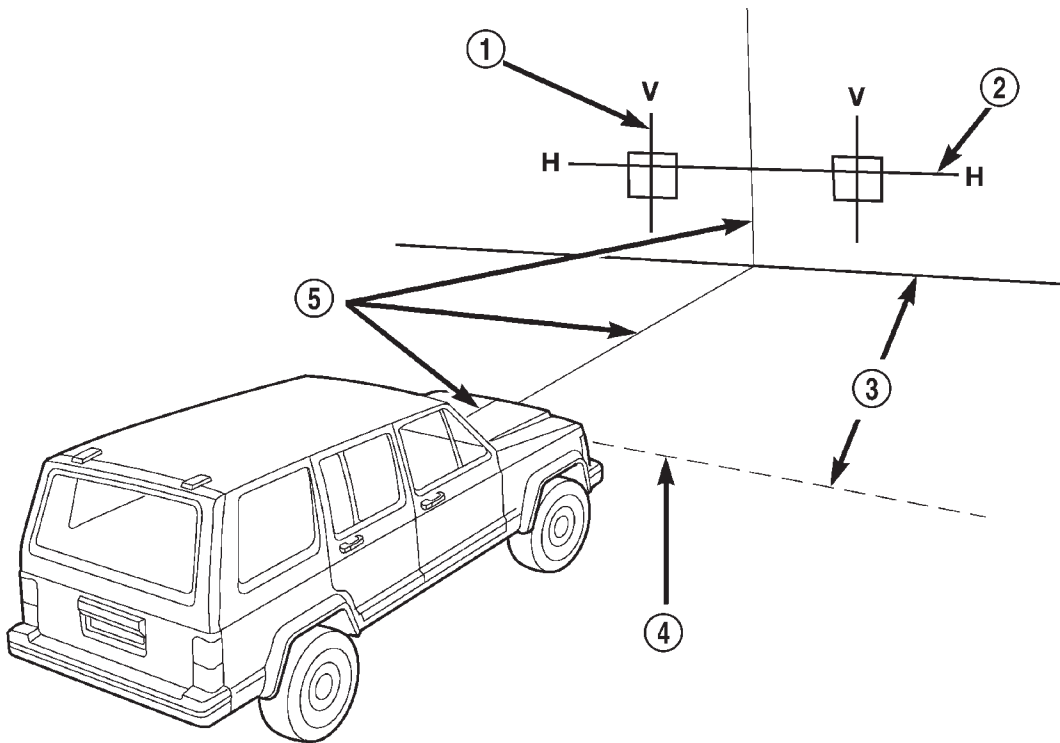
**HEADLAMP ADJUSTMENT**

A properly aligned headlamp will project a pattern on the alignment screen from just below horizontal to 75 millimeters (3 inches) below the headlamp centerline for vehicles in North America, or from just below horizontal to 125 millimeters (5 inches) below the headlamp horizontal centerline for vehicles in Rest-Of-World.

(1) Vehicles for all markets except Japan should have the headlamp low beams selected with the dimmer (multi-function) switch during the adjustment procedure. Vehicles for the Japanese market should have the headlamp high beams selected.

(2) Cover the lens of the headlamp that is not being adjusted.

(3) Turn the adjusting screw (Fig. 44) until the top edge of the beam intensity pattern is positioned from just below horizontal to 75 millimeters (3 inches)



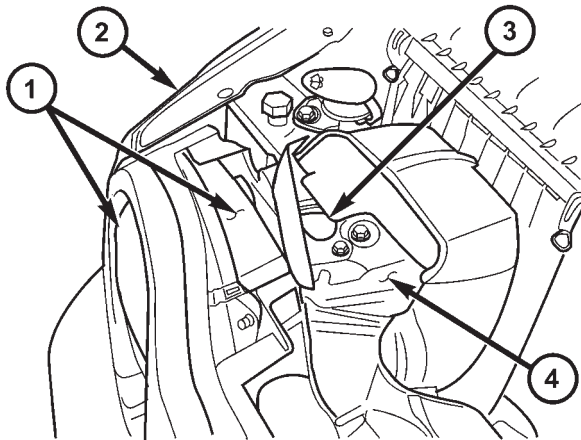
**Fig. 43 Headlamp Alignment Screen - Typical**

- |  |                        |
|--|------------------------|
| 1 - CENTER OF VEHICLE TO CENTER OF HEADLAMP LENS                               | 4 - FRONT OF HEADLAMP  |
| 2 - FLOOR TO CENTER OF HEADLAMP LENS   | 5 - VEHICLE CENTERLINE |
| 3 - 7.62 METERS (25 FEET) NORTH AMERICA/10.0 METERS (32.81 FEET) REST-OF-WORLD |                        |



## HEADLAMP UNIT (Continued)

below the headlamp horizontal centerline for vehicles in North America, or from just below horizontal to 125 millimeters (5 inches) below the headlamp horizontal centerline for vehicles in Rest-Of-World.



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**Fig. 44 Headlamp Adjusting Screw**

- 1 - HEADLAMP UNIT
- 2 - FENDER PANEL
- 3 - ADJUSTING SCREW ACCESS HOLE
- 4 - UPPER RADIATOR CROSSMEMBER

(4) Repeat the adjustment procedure for the opposite headlamp.

## LICENSE PLATE LAMP BULB

## REMOVAL

## NORTH AMERICA

(1) Disconnect and isolate the battery negative cable.

(2) Reach through the opening in the rear bumper fascia between the license plate and the lamp to access and firmly grasp the socket on the back of the license plate lamp unit housing (Fig. 45).

(3) Pull the socket and bulb straight out of the back of the license plate lamp unit housing.

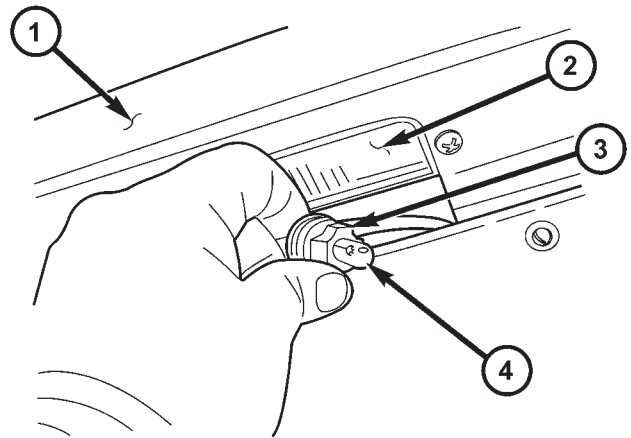
(4) Pull the bulb straight out of the license plate lamp unit socket.

## REST-OF-WORLD

(1) Disconnect and isolate the battery negative cable.

(2) Unsnap and lift up the bottom of the license mounting plate far enough to access and remove the two screws that secure the license plate bracket to the special lug nuts on the spare tire (Fig. 46).

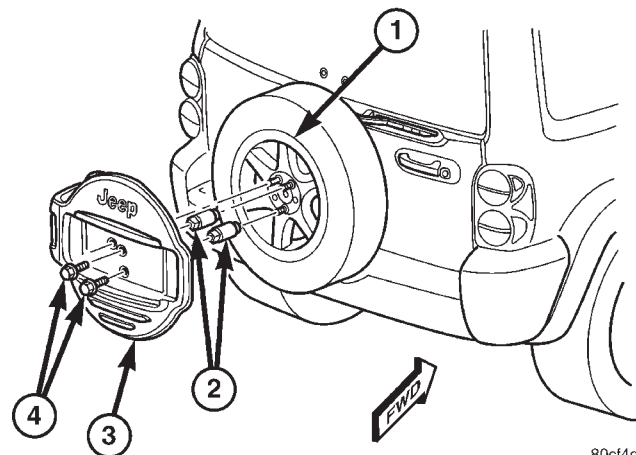
(3) Swing the license plate bracket away from the spare tire far enough to access the license plate lamp bulb sockets.



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**Fig. 45 License Plate Lamp Bulb Remove/Install - North America**

- 1 - REAR BUMPER FASCIA
- 2 - LICENSE PLATE LAMP
- 3 - SOCKET
- 4 - BULB



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**Fig. 46 License Plate Bracket - Rest-Of-World**

- 1 - SPARE TIRE
- 2 - SPECIAL LUG NUT (2)
- 3 - LICENSE PLATE BRACKET
- 4 - SCREW (2)

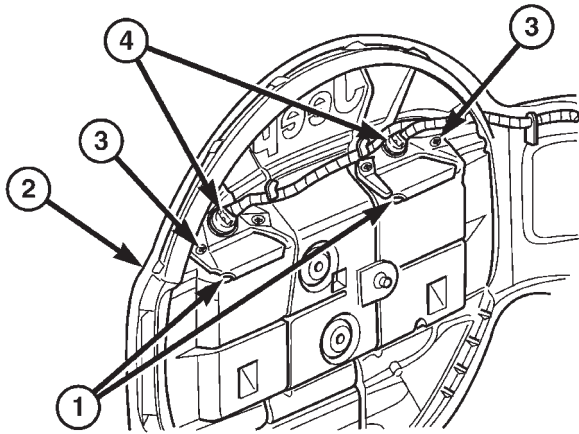
(4) Firmly grasp the socket on the top of the license plate lamp unit housing for the bulb that is being removed (Fig. 47).

(5) Rotate the socket on the top of the license plate lamp unit housing counterclockwise about 30 degrees.

(6) Pull the socket and bulb straight out of the top of the license plate lamp unit housing.

(7) Pull the bulb straight out of the license plate lamp unit socket.

LICENSE PLATE LAMP BULB (Continued)



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**Fig. 47 License Plate Lamp Bulb Remove/Install - Rest-Of-World**

- 1 - LAMP UNIT (2)
- 2 - LICENSE PLATE BRACKET
- 3 - SCREW (4)
- 4 - BULB & SOCKET (2)

**INSTALLATION**

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

**NORTH AMERICA**

- (1) Align the base of the bulb with the receptacle in the license plate lamp unit socket.
- (2) Push the bulb straight into the license plate lamp unit socket until it is firmly seated.
- (3) Reach through the opening in the rear bumper fascia between the license plate and the lamp to align the socket and bulb with the socket opening on the back of the lamp unit housing (Fig. 45).
- (4) Push the socket and bulb straight into the license plate lamp unit housing until it is firmly seated.
- (5) Reconnect the battery negative cable.

**REST-OF-WORLD**

- (1) Align the base of the bulb with the receptacle in the license plate lamp unit socket.
- (2) Push the bulb straight into the license plate lamp unit socket until it is firmly seated.
- (3) Align the socket and bulb with the socket opening on the top of the license plate lamp unit housing (Fig. 47).
- (4) Push the socket and bulb straight into the license plate lamp unit housing until it is firmly seated.

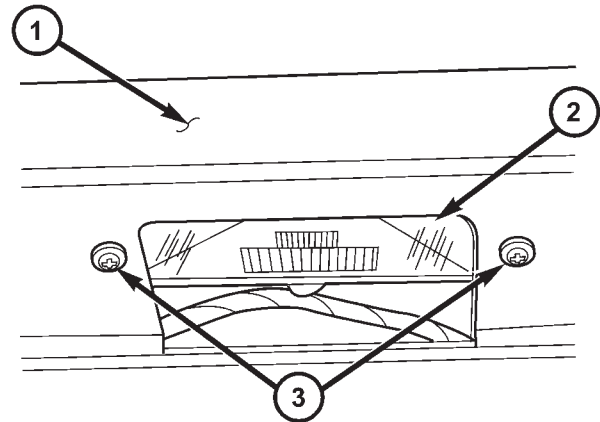
- (5) Rotate the socket on the top of the license plate lamp unit housing clockwise about 30 degrees.
- (6) Swing the license plate bracket back against the spare tire (Fig. 46).
- (7) Lift up the bottom of the license mounting plate far enough to install and tighten the two screws that secure the license plate bracket to the special lug nuts on the spare tire. Tighten the screws to 28 N·m (21 ft. lbs.).
- (8) Lower the bottom of the license mounting plate and, using hand pressure, snap it into place on the license plate bracket.
- (9) Reconnect the battery negative cable.

**LICENSE PLATE LAMP UNIT**

**REMOVAL**

**NORTH AMERICA**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the two screws that secure the license plate lamp unit to the rear bumper fascia (Fig. 48).



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**Fig. 48 License Plate Lamp Unit Remove/Install**

- 1 - REAR BUMPER FASCIA
- 2 - LICENSE PLATE LAMP UNIT
- 3 - SCREW (2)

- (3) Pull the license plate lamp unit down and out through the mounting hole in the rear bumper fascia far enough to access and disconnect the wire harness connector for the lamp socket pigtail wire.
- (4) Remove the license plate lamp unit from the rear bumper fascia.

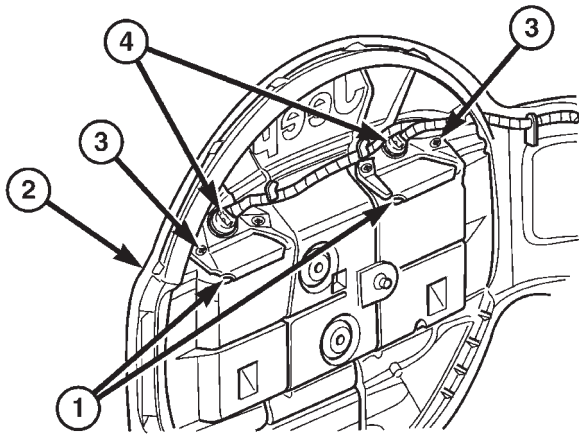
## LICENSE PLATE LAMP UNIT (Continued)

## REST-OF-WORLD

(1) Disconnect and isolate the battery negative cable.

(2) Remove the bulb and socket unit from the license plate lamp unit housing that is being removed. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LICENSE PLATE LAMP BULB - REMOVAL - REST-OF-WORLD).

(3) Remove the two screws that secure the license plate lamp unit to the back of the license plate bracket (Fig. 49).



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**Fig. 49 License Plate Lamp Bulb Remove/Install - Rest-Of-World**

- 1 - LAMP UNIT (2)  
 2 - LICENSE PLATE BRACKET  
 3 - SCREW (4)  
 4 - BULB & SOCKET (2)

(1) Remove the license plate lamp unit from the back of the license plate bracket.

## INSTALLATION

## NORTH AMERICA

(1) Position the license plate lamp unit to the rear bumper fascia.

(2) Reconnect the wire harness connector for the license plate lamp unit to the lamp socket pigtail wire.

(3) Position the license plate lamp unit into the mounting hole in the rear bumper fascia (Fig. 48).

(4) Install and tighten the two screws that secure the license plate lamp unit housing to the rear bumper fascia. Tighten the screws to 2 N-m (20 in. lbs.).

(5) Reconnect the battery negative cable.

## REST-OF-WORLD

(1) Position the license plate lamp unit onto the back of the license plate bracket (Fig. 49).

(2) Install and tighten the two screws that secure the license plate lamp unit to the back of the license plate bracket. Tighten the screws to 2 N-m (20 in. lbs.).

(3) Reinstall the bulb and socket unit into the license plate lamp unit housing that is being replaced. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LICENSE PLATE LAMP BULB - INSTALLATION - REST-OF-WORLD).

(4) Reconnect the battery negative cable.

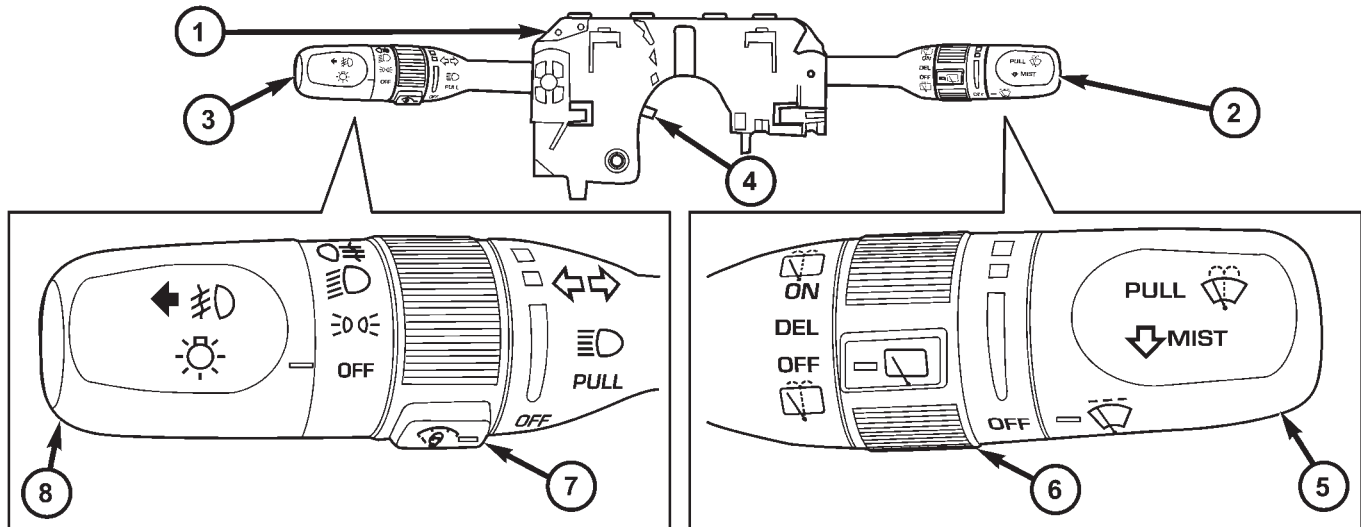
## MULTI-FUNCTION SWITCH

## DESCRIPTION

The multi-function switch is located on the steering column, just below the steering wheel (Fig. 50). The only visible components of the multi-function switch are two levers, or control stalks that extend through dedicated openings in each side of the steering column shrouds. The remainder of the switch, its mounting provisions, and its electrical connections are all concealed beneath the steering column shrouds. The switch housing and controls are constructed of molded black plastic. A saddle-like formation in the center of the multi-function switch housing straddles the steering column tube just below the column lock housing, and two posts integral to the lower surface of the switch housing engage two holes on the forward-facing side of the lock housing. Two integral ledge-like locating tabs near the top of the rearward facing switch housing surface are supported and located by two upright stanchions that extend upward from the top of the lock housing. Also on the rearward facing switch housing surface near the center, an integral ledge-like mounting tab rests on a similar ledge-like tab that extends from each side of the steering column lock housing. When the steering column shrouds are installed on the column, the switch mounting tabs are clamped along with the mounting tabs of the clockspring between the integral mounting stanchions of the upper shroud and the lock housing tabs, and are secured to the steering column lock housing by the same two screws that secure the two shroud halves to each other and the column.

There are several versions of the multi-function switch to support both optional equipment and equipment that is required only in certain markets. Each multi-function switch control stalk has both white nomenclature and International Control and Display Symbol graphics applied to it, which clearly identify its many functions. Each control stalk has a control

## MULTI-FUNCTION SWITCH (Continued)



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**Fig. 50 Multi-Function Switch**

- 1 - MULTI-FUNCTION SWITCH
- 2 - RIGHT (WIPER) CONTROL STALK
- 3 - LEFT (LIGHTING) CONTROL STALK
- 4 - TURN SIGNAL CANCEL ACTUATOR

- 5 - RIGHT (WIPER) CONTROL KNOB
- 6 - RIGHT (WIPER) CONTROL RING
- 7 - LEFT (LIGHTING) CONTROL RING
- 8 - LEFT (LIGHTING) CONTROL KNOB

knob on its end with a flattened face to allow it to be easily rotated. On vehicles equipped with optional front fog lamps, the knob on the end of left control stalk can also be pulled outward to select those lamps. Each control stalk also features a knurled control ring located just below the control knob. The left control stalk is dedicated to providing driver controls for the interior and exterior lighting systems, while the right control stalk is dedicated to providing driver controls for the front and rear wiper systems. Two integral connector receptacles on the forward facing surface of the multi-function switch housing connect the switch to the vehicle electrical system through two take outs and connectors of the instrument panel wire harness. The left connector receptacle contains nine terminal pins for the lighting control circuits of the switch, while the right connector receptacle contains six terminal pins for the wiper control circuits of the switch. The multi-function switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

**LEFT CONTROL STALK** The left (lighting) control stalk of the multi-function switch supports the following functions and features:

- **Front Fog Lamps** - For vehicles so equipped, the internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the optional front fog lamps.
- **Headlamps** - The internal circuitry and hardware of the multi-function switch left (lighting) con-

trol stalk provide detent switching for the headlamps.

- **Headlamp Beam Selection** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for selection of the headlamp high or low beams.

- **Headlamp Optical Horn** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk includes momentary switching of the headlamp high beam circuits to provide an optical horn feature (sometimes referred to as flash-to-pass), which allows the vehicle operator to momentarily flash the headlamp high beams as an optical signalling device.

- **Interior Lamps Defeat** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching to defeat the illumination of all interior courtesy lamps when a door, the rear flip-up glass, or the tailgate are opened.

- **Interior Lamps On** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching to simultaneously illuminate all interior courtesy lamps.

- **Panel Lamps Dimming** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide simultaneous adjustable control of the illumination intensity of all instrument panel lighting at one of six available illumination intensity levels.

## MULTI-FUNCTION SWITCH (Continued)

- **Parade Mode** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for a parade mode that maximizes the illumination intensity of all instrument panel lighting for visibility when driving in daylight with the exterior lamps turned on.

- **Park Lamps** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the park lamps.

- **Rear Fog Lamps** - For vehicles so equipped, the internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide detent switching for the optional rear fog lamps. Rear fog lamps are optional only for vehicles manufactured for certain markets, where they are required.

- **Turn Signal Control** - The internal circuitry and hardware of the multi-function switch left (lighting) control stalk provide both momentary non-detent switching and detent switching with automatic cancellation for both the left and right turn signal lamps.

**RIGHT CONTROL STALK** The right (wiper) control stalk of the multi-function switch supports the following functions and features:

- **Continuous Front Wipe Modes** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide two continuous front wipe switch positions, low speed or high speed.

- **Continuous Rear Wipe Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide one continuous rear wipe switch position.

- **Front Washer Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk switch provide front washer system operation.

- **Front Wipe-After-Wash Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide a wipe-after-wash mode.

- **Front Wiper Mist Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide a front wiper system mist mode.

- **Intermittent Front Wipe Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide an intermittent front wipe mode with five delay interval positions.

- **Intermittent Rear Wipe Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide one fixed interval intermittent rear wipe mode switch position.

- **Rear Washer Mode** - The internal circuitry and hardware of the multi-function switch right (wiper) control stalk provide rear washer system operation.

## OPERATION

The multi-function switch uses a combination of resistor multiplexed and conventionally switched outputs to control the many functions and features it provides. The switch receives battery current on a fused ignition switch output (run-acc) circuit from a fuse in the Junction Block (JB) whenever the ignition switch is in the On or Accessory positions. The switch receives a path to ground at all times through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB). Following are descriptions of how each of the two multi-function switch control stalks operate to control the functions and features they provide.

**LEFT CONTROL STALK** The left (lighting) control stalk of the multi-function switch operates as follows:

- **Front Fog Lamps** - For vehicles so equipped, the control knob on the end of the multi-function switch left (lighting) control stalk is pulled outward to activate the optional front fog lamps. The control knob is mechanically keyed so that it cannot be pulled outward unless it is first rotated to turn on the exterior lighting. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a fog lamp switch sense circuit, and the BCM responds by energizing or de-energizing the front fog lamp relay in the Junction Block (JB) as required.

- **Headlamps** - The control knob on the end of the multi-function switch left (lighting) control stalk is rotated forward (counterclockwise) to its second detent position to activate the headlamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a headlamp switch sense circuit, and the BCM responds by energizing or de-energizing the selected low or high beam relay (Daytime Running Lamp relay in Canadian vehicles) in the Junction Block (JB) as required.

- **Headlamp Beam Selection** - The left (lighting) control stalk of the multi-function switch is pulled towards the steering wheel past a detent to actuate the integral beam select switch circuitry. Each time the control stalk is activated in this manner, the opposite headlamp beam from what is currently selected will be energized. The multi-function switch provides a ground output to the Body Control Module (BCM) on a high beam switch sense circuit, and the BCM responds by energizing or de-energizing the selected low or high beam relay (Daytime Running Lamp relay in Canadian vehicles) in the Junction Block (JB) as required.

## MULTI-FUNCTION SWITCH (Continued)

- **Headlamp Optical Horn** - The left (lighting) control stalk of the multi-function switch is pulled towards the steering wheel to just before a detent, to momentarily activate the headlamp optical horn feature. The high beams will remain illuminated until the control stalk is released. The multi-function switch provides a ground output on a high beam relay control circuit to energize the headlamp high beam relay (Daytime Running Lamp relay in Canadian vehicles) in the Junction Block (JB) as required.

- **Interior Lamps Defeat** - The control ring on the multi-function switch left (lighting) control stalk is rotated to a full rearward (clockwise) detent to defeat the illumination of all interior courtesy lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by de-energizing its internal courtesy lamp driver circuit.

- **Interior Lamps On** - The control ring on the multi-function switch left (lighting) control stalk is rotated to a full forward (counterclockwise) detent to illuminate all interior courtesy lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by energizing its internal courtesy lamp driver circuit.

- **Panel Lamps Dimming** - The control ring on the multi-function switch left (lighting) control stalk is rotated to one of six minor intermediate detents to simultaneously select the desired illumination intensity of all adjustable instrument panel and instrument cluster lighting. The control ring is rotated rearward (clockwise) to dim, or forward (counterclockwise) to brighten. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM responds by sending an electronic panel lamps dimming level message to the ElectroMechanical Instrument Cluster (EMIC) over the Programmable Communications Interface (PCI) data bus. The EMIC electronic circuitry then provides the proper PWM output to the cluster illumination lamps and the VFD on the EMIC circuit board, then provides a matching PWM output on the hard wired fused panel lamps dimmer switch signal circuit.

- **Parade Mode** - The control ring on the multi-function switch left (lighting) control stalk is rotated to an intermediate detent that is one detent rearward (clockwise) from the full forward (counterclockwise) detent to select the Parade mode. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a panel lamps dimmer switch mux circuit, and the BCM

responds by sending an electronic panel lamps dimming level message to the ElectroMechanical Instrument Cluster (EMIC) over the Programmable Communications Interface (PCI) data bus. The EMIC electronic circuitry then provides the proper PWM output to the cluster illumination lamps and the VFD on the EMIC circuit board, then provides a matching PWM output on the hard wired fused panel lamps dimmer switch signal circuit to illuminate all lamps at full (daylight) intensity with the exterior lamps turned On.

- **Park Lamps** - The control knob on the end of the multi-function switch left (lighting) control stalk is rotated forward (counterclockwise) to its first detent from the Off position to activate the park lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a headlamp switch sense circuit, and the BCM responds by energizing or de-energizing the park lamp relay in the Junction Block (JB) as required.

- **Rear Fog Lamps** - For vehicles so equipped, the control knob on the end of the multi-function switch left (lighting) control stalk is rotated forward (counterclockwise) to its third detent position to activate the rear fog lamps. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a headlamp switch sense circuit, and the BCM responds by energizing or de-energizing the rear fog lamp relay in the Junction Block (JB) as required. Rear fog lamps are optional only for vehicles manufactured for certain markets, where they are required.

- **Turn Signal Control** - The left (lighting) control stalk of the multi-function switch is moved upward to activate the right turn signal circuitry, and, downward to activate the left turn signal circuitry. The turn signal 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 left multi-function switch control stalk is released. When the control stalk is moved to a turn signal switch detent position, the cancel actuator extends toward the center of the steering column. A turn signal cancel cam that is integral to the clockspring rotates with the steering wheel and the cam lobes contact the cancel actuator when it is extended from the left multi-function switch. When the steering wheel is rotated during a turning maneuver, one of the two turn signal cancel cam lobes will contact the turn signal cancel actuator. The cancel actuator latches against the cancel cam rotation in the direction opposite that which is signaled. In other words, if the left turn signal detent is selected, the lobes of the cancel cam will ratchet past

## MULTI-FUNCTION SWITCH (Continued)

the cancel actuator when the steering wheel is rotated to the left, but will unlatch the cancel actuator as the steering wheel rotates to the right and returns to center, which will cancel the turn signal event and release the control stalk from the detent so it returns to the neutral Off position. When a turn signal is activated, the multi-function switch provides a ground output on a right or left turn switch sense circuit to the combination flasher circuitry within the hazard switch, and the combination flasher flashes the turn signal lamps.

**RIGHT CONTROL STALK** The right (wiper) control stalk of the multi-function switch operates as follows:

- **Continuous Front Wipe Modes** - The control knob on the end of the multi-function switch right (wiper) control stalk is rotated to an intermediate detent that is one detent rearward (counterclockwise) from the full forward (clockwise) detent to select the low speed continuous front wiper mode, or to its full forward (clockwise) detent to select the high speed continuous front wiper mode. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a front wiper switch mux circuit, and the BCM responds by energizing the wiper on/off relay in the Power Distribution Center (PDC) for the front low speed continuous wipe mode, or the wiper on/off relay and the wiper high/low relay in the PDC for the front high speed continuous wipe mode as required.

- **Continuous Rear Wipe Mode** - The control ring on the multi-function switch right (wiper) control stalk is rotated to the most forward (clockwise) detent to select the continuous rear wiper mode. The multi-function switch provides a battery current output to the rear wiper motor on a rear wiper on driver circuit to signal the rear wiper motor to operate in the continuous wipe mode.

- **Front Washer Mode** - The right (wiper) control stalk of the multi-function switch is pulled towards the steering wheel to momentarily activate the washer pump in the front washer mode. The washer pump will continue to operate in the front washer mode until the control stalk is released. The multi-function switch provides a ground output on a washer pump sense circuit, and battery current on a washer pump driver circuit to energize the washer pump in the front washer mode.

- **Front Wiper Mist Mode** - The right (wiper) control stalk of the multi-function switch is pushed towards the floor to momentarily activate the front wiper motor in the mist mode. The front wiper motor will continue to operate in the mist mode until the control stalk is released. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a front wiper switch mux

circuit, and the BCM responds by energizing the wiper on/off relay in the Power Distribution Center (PDC) to operate the front wiper motor momentarily at low speed to provide the front wiper mist mode.

- **Intermittent Front Wipe Mode** - The control knob on the end of the multi-function switch right (wiper) control stalk is rotated to one of five minor intermediate detents to select the desired intermittent front wipe delay interval. The control knob is rotated rearward (counterclockwise) to increase the delay, or forward (clockwise) to decrease the delay. The multi-function switch provides a resistor multiplexed output to the Body Control Module (BCM) on a front wiper switch mux circuit, and the BCM responds by energizing the wiper on/off relay in the Power Distribution Center (PDC) to operate the front wiper motor at the selected delay intervals.

- **Intermittent Rear Wipe Mode** - The control ring on the multi-function switch right (wiper) control stalk is rotated to the center detent to select the intermittent rear wiper mode. The multi-function switch provides a battery current output to the rear wiper motor on a rear wiper intermittent driver circuit to signal the rear wiper motor to operate in the intermittent wipe mode.

- **Rear Washer Mode** - The control ring on the multi-function switch right (wiper) control stalk is rotated to either the full forward (clockwise) or full rearward (counterclockwise) momentary positions to activate the washer pump in the rear washer mode. The washer pump will continue to operate in the rear washer mode until the control ring is released. The multi-function switch provides a ground output on a washer pump driver circuit, and battery current on a washer pump sense circuit to energize the washer pump in the rear washer mode.

## DIAGNOSIS AND TESTING - MULTI-FUNCTION SWITCH

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

MULTI-FUNCTION SWITCH (Continued)

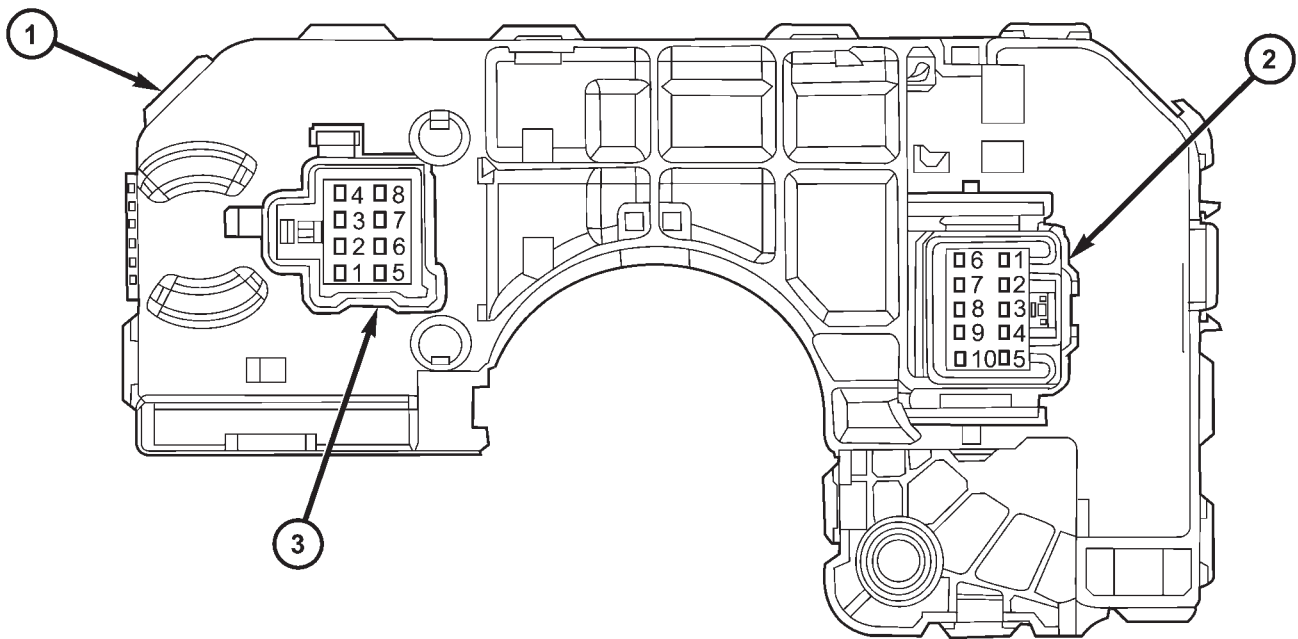
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 multi-function switch from the steering column. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - REMOVAL).

(3) Using an ohmmeter, perform the continuity and resistance tests at the terminals (Fig. 51) in the multi-function switch connector receptacles as shown in the Multi-Function Switch Tests table.



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**Fig. 51 Multi-Function Switch Connector Receptacle Pin-Out**

1 - MULTI-FUNCTION SWITCH  
2 - C-1 (LIGHTING) CONNECTOR RECEPTACLE

3 - C-2 (WIPER) CONNECTOR RECEPTACLE



## MULTI-FUNCTION SWITCH (Continued)

MULTI-FUNCTION SWITCH TESTS		
EXTERIOR LIGHTING FUNCTIONS		
SWITCH POSITION	CONNECTOR C-1 PINS	RESISTANCE (OHMS) $\pm 10\%$
Off	4 & 5	3781
Park Lamps On	4 & 5	911
Headlamp Low Beams On	4 & 5	349
Rear Fog Lamps On	4 & 5	75
Headlamp High Beams On	8 & 9	0 - 1
Front Fog Lamps On	2 & 4	0 - 1
Optical Horn (Flash-to-Pass) On	7 & 8	0 - 1
Turn Signal Neutral	6 & 8, 8 & 10	Infinite (Open)
Turn Signal Left	6 & 8	0 - 1
Turn Signal Right	8 & 10	0 - 1
INTERIOR LIGHTING FUNCTIONS		
SWITCH POSITION	CONNECTOR C-1 PINS	RESISTANCE (OHMS) $\pm 10\%$
Off (Courtesy Disable)	1 & 4	63
Dimming 1	1 & 4	200
Dimming 2	1 & 4	557
Dimming 3	1 & 4	914
Dimming 4	1 & 4	1271
Dimming 5	1 & 4	1628
Dimming 6	1 & 4	1985
Parade Mode On	1 & 4	3565
Courtesy On	1 & 4	7885
FRONT WIPER FUNCTIONS		
SWITCH POSITION	CONNECTOR C-1 & C-2 PINS	RESISTANCE (OHMS) $\pm 10\%$
Front Wiper Off	C-1 Pin 4 & C-2 Pin 4	4587
Delay 1	C-1 Pin 4 & C-2 Pin 4	1267
Delay 2	C-1 Pin 4 & C-2 Pin 4	792
Delay 3	C-1 Pin 4 & C-2 Pin 4	531
Delay 4	C-1 Pin 4 & C-2 Pin 4	369
Delay 5	C-1 Pin 4 & C-2 Pin 4	262
Front Wiper Low	C-1 Pin 4 & C-2 Pin 4	125
Front Wiper High	C-1 Pin 4 & C-2 Pin 4	38
Front Wiper Mist	C-1 Pin 4 & C-2 Pin 4	125
Front Washer On	C-2 Pins 5 & 7	0 - 1
REAR WIPER FUNCTIONS		
SWITCH POSITION	CONNECTOR C-2 PINS	RESISTANCE (OHMS) $\pm 10\%$
Rear Wiper Off	1 & 5, 2 & 5	Infinite (Open)
Rear Wiper Intermittent	2 & 5	0 - 1
Rear Wiper On	1 & 5	0 - 1
Rear Washer On	2 & 5, 3 & 5	0 - 1

## MULTI-FUNCTION SWITCH (Continued)

(4) If the multi-function switch fails any of the continuity or resistance tests, replace the faulty switch unit as required.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

(3) From below the steering column, remove the two screws that secure the lower shroud to the upper shroud (Fig. 52).

(4) Using hand pressure, push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure the two halves to each other.

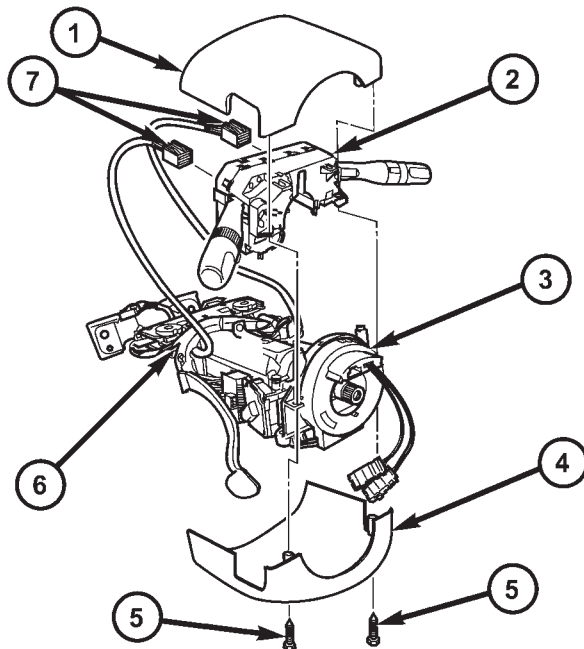
(5) Remove both the upper and lower shrouds from the steering column.

(6) Disconnect the two instrument panel wire harness connectors for the multi-function switch from the two connector receptacles on the back of the switch housing.

(7) Remove the multi-function switch from the steering column lock housing by carefully rocking the switch and pulling the switch housing upward far enough to disengage its alignment posts and locator tabs from the lock housing.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER,**



80c96010

**Fig. 52 Multi-Function Switch Remove/Install**

- 1 - UPPER SHROUD
- 2 - MULTI-FUNCTION SWITCH
- 3 - CLOCKSPrING
- 4 - LOWER SHROUD
- 5 - SCREW (2)
- 6 - STEERING COLUMN
- 7 - WIRE HARNESS CONNECTOR (2)

**FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Before attempting to install the multi-function switch, be certain that the left control stalk is in the neutral turn signal position and the turn signal cancel actuator is in the retracted (neutral) position.**

(1) Position the multi-function switch to the steering column.

(2) Reconnect the two instrument panel wire harness connectors for the multi-function switch to the two connector receptacles on the back of the switch housing (Fig. 52).

## MULTI-FUNCTION SWITCH (Continued)

(3) Position the multi-function switch onto the steering column lock housing. Be certain that the switch alignment posts and locator tabs are fully seated on the lock housing.

(4) Position the upper and lower shrouds onto the steering column.

(5) Align the snap features on the lower shroud with the receptacles on the upper shroud and apply hand pressure to snap them together.

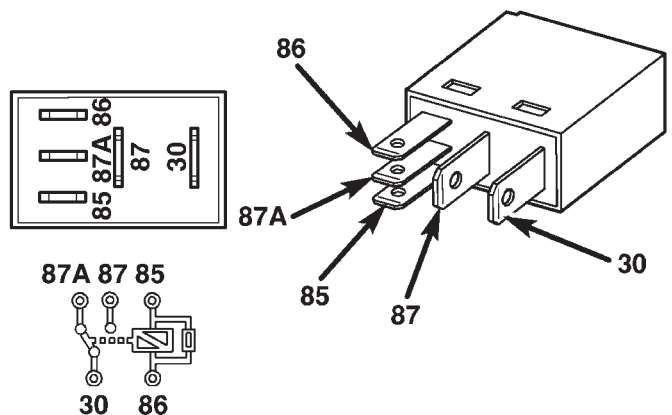
(6) From below the steering column, install and tighten the two screws that secure the lower shroud to the upper shroud. Tighten the screws to 2 N-m (20 in. lbs.).

(7) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column back to the fully raised position and move the tilt release lever into the locked (up) position.

(8) Reconnect the battery negative cable.

## PARK LAMP RELAY

## DESCRIPTION



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**Fig. 53 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The park lamp relay is located in the Junction Block (JB) below the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The park lamp relay is a conventional International Standards Organization (ISO) micro relay (Fig. 53). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the

required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The park lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The park lamp relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the park lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The park lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the park lamp relay include:

- **Common Feed Terminal** - The common feed terminal (30) is connected to the park lamps through the park lamp relay output circuit and provides ground to the park lamps when the relay is de-energized, and battery current to the park lamps whenever the relay is energized.

- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Body Control Module (BCM) through a park lamp relay control circuit. The BCM controls park lamp operation by controlling a ground path through this circuit.

- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the PDC through a fused B(+) circuit.

- **Normally Open Terminal** - The normally open terminal (87) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.

- **Normally Closed Terminal** - The normally closed terminal (87A) is connected to ground at all times through a ground circuit that receives ground through a splice block located in the instrument panel wire harness with an eyelet terminal connector that is secured by a nut to a ground stud on the driver side instrument panel end bracket near the Junction Block (JB).

PARK LAMP RELAY (Continued)

The park lamp relay can be diagnosed using conventional diagnostic tools and methods.

**DIAGNOSIS AND TESTING - PARK LAMP RELAY**

The park lamp relay (Fig. 54) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the park lamp relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/PARK LAMP RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

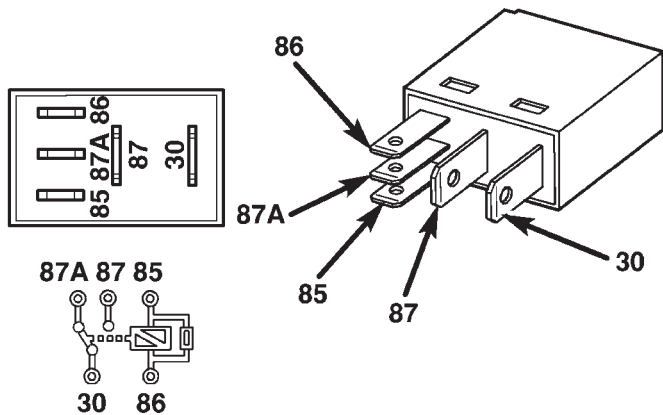
**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the park lamp relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 55).

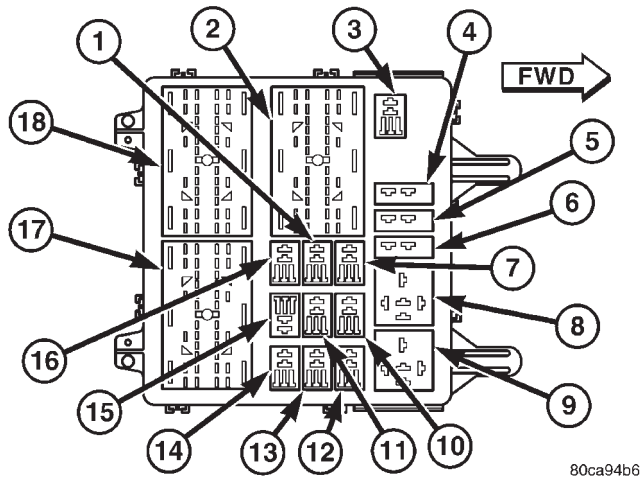


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**Fig. 54 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

## PARK LAMP RELAY (Continued)



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**Fig. 55 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the park lamp relay to the proper receptacle in the Junction Block (JB) (Fig. 55).

(2) Align the park lamp relay terminals with the terminal cavities in the JB receptacle.

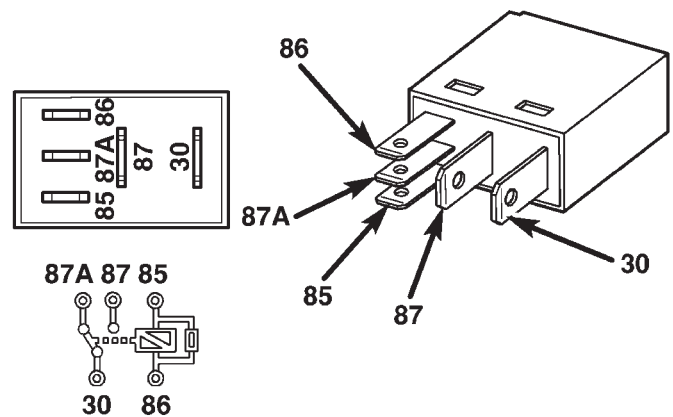
(3) Push firmly and evenly on the top of the park lamp relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(5) Reconnect the battery negative cable.

## REAR FOG LAMP RELAY

### DESCRIPTION



80ce807b

**Fig. 56 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The rear fog lamp relay is located in the Junction Block (JB) on the driver side outboard end of the instrument panel in the passenger compartment of the vehicle. The rear fog lamp relay is a conventional International Standards Organization (ISO) micro relay (Fig. 56). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The rear fog lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## REAR FOG LAMP RELAY (Continued)

## OPERATION

The rear fog lamp relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the rear fog lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The rear fog lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Junction Block (JB). The inputs and outputs of the rear fog lamp relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.

- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the premium Body Control Module (BCM) through a rear fog lamp relay control circuit. The BCM controls rear fog lamp operation by controlling a ground path through this circuit.

- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the JB through a fused B(+) circuit.

- **Normally Open Terminal** - The normally open terminal (87) is connected to the rear fog lamps through a rear fog lamp relay output circuit and provides battery current to the rear fog lamps whenever the relay is energized.

- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

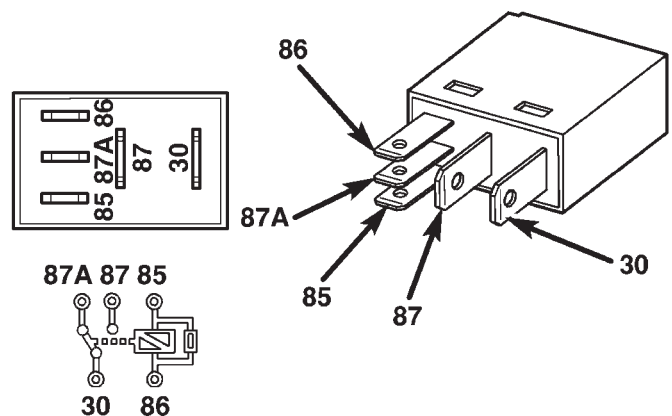
The rear fog lamp relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - REAR FOG LAMP RELAY

The rear fog lamp relay (Fig. 57) is located in the Junction Block (JB) under the driver side outboard end of the instrument panel. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location

views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



80ce807b

Fig. 57 ISO Micro Relay

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the rear fog lamp relay from the JB. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR FOG LAMP RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

## REAR FOG LAMP RELAY (Continued)

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

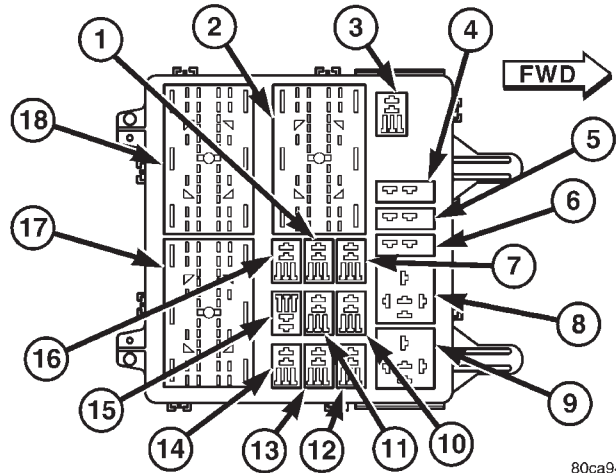
(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the rear fog lamp relay by grasping it firmly and pulling it straight out from the receptacle in the Junction Block (JB) (Fig. 58).

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



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**Fig. 58 Junction Block - Inboard Side (LHD Shown - Rotate 180° for RHD)**

- 1 - PASSENGER DOOR UNLOCK RELAY
- 2 - JB C3 CONNECTOR RECEPTACLE
- 3 - LOW BEAM RELAY
- 4 - CIRCUIT BREAKER #1
- 5 - CIRCUIT BREAKER #2
- 6 - CIRCUIT BREAKER #3
- 7 - DOOR LOCK RELAY
- 8 - DEFOGGER RELAY
- 9 - SPARE
- 10 - FRONT FOG LAMP RELAY
- 11 - HORN RELAY
- 12 - SPARE
- 13 - SPARE
- 14 - REAR FOG LAMP RELAY
- 15 - PARK LAMP RELAY
- 16 - DRIVER DOOR UNLOCK RELAY
- 17 - JB C1 CONNECTOR RECEPTACLE
- 18 - JB C2 CONNECTOR RECEPTACLE

(1) Position the rear fog lamp relay to the proper receptacle in the Junction Block (JB) (Fig. 58).

(2) Align the rear fog lamp relay terminals with the terminal cavities in the JB receptacle.

(3) Push firmly and evenly on the top of the rear fog lamp relay until the terminals are fully seated in the terminal cavities in the JB receptacle.

(4) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

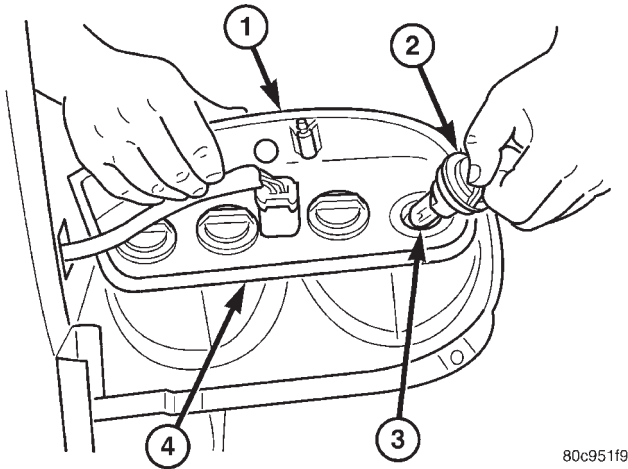
(5) Reconnect the battery negative cable.

## REAR LAMP BULB

### REMOVAL

The rear lamp unit may contain up to four bulbs, depending upon the market for which the vehicle was manufactured. The service procedures for each bulb is the same, only the bulb sizes and types may differ. Be certain any removed bulb is replaced with the same bulb size and type that was removed.

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the rear lamp unit from the end of the quarter panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR LAMP UNIT - REMOVAL).
- (3) Firmly grasp the socket on the socket plate at the back of the rear lamp unit housing for the bulb that is being removed (Fig. 59).



**Fig. 59 Rear Lamp Bulb Remove/Install**

- 1 - REAR LAMP HOUSING
- 2 - BULB HOLDER
- 3 - BULB
- 4 - SOCKET PLATE

- (4) Rotate the socket on the socket plate at the back of the rear lamp unit housing counterclockwise about 30 degrees.
- (5) Pull the socket and bulb straight out of the back of the rear lamp unit housing.
- (6) Pull the bulb straight out of the rear lamp unit socket.

### INSTALLATION

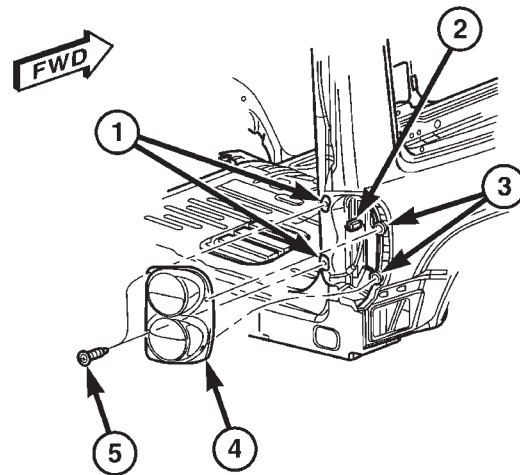
**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

- (1) Align the base of the bulb with the receptacle in the rear lamp unit socket.
- (2) Push the bulb straight into the rear lamp unit socket until it is firmly seated.
- (3) Align the socket and bulb with the opening in the socket plate on the back of the rear lamp unit housing (Fig. 59).
- (4) Push the socket and bulb straight into the rear lamp unit housing until the socket is firmly seated against the socket plate.
- (5) Rotate the socket on the socket plate at the back of the rear lamp unit housing clockwise about 30 degrees.
- (6) Reinstall the rear lamp unit onto the end of the quarter panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR LAMP UNIT - INSTALLATION).
- (7) Reconnect the battery negative cable.

## REAR LAMP UNIT

### REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Open the tailgate to access and remove the two screws that secure the inboard side of the rear lamp unit to the side jamb of the tailgate opening (Fig. 60).



**Fig. 60 Rear Lamp Unit Remove/Install**

- 1 - PLASTIC NUT (2)
- 2 - WIRE HARNESS CONNECTOR
- 3 - PLASTIC NUT (2)
- 4 - REAR LAMP UNIT
- 5 - SCREW (2)

- (3) Pull the outboard side of the rear lamp unit rearward (away from the end of the quarter panel) far enough to unsnap the two ball studs on the outboard side of the lamp housing from the plastic nuts in the quarter panel.



## REAR LAMP UNIT (Continued)

(4) Pull the rear lamp unit away from the quarter panel far enough to access and disconnect the wire harness connector for the lamp unit from the connector receptacle on the lamp socket plate.

(5) Remove the rear lamp unit from the quarter panel.

(6) Remove the plastic nuts from the quarter panel and discard.

## INSTALLATION

(1) Install new plastic nuts into the quarter panel (Fig. 60).

(2) Position the rear lamp unit to the quarter panel.

(3) Reconnect the wire harness connector for the rear lamp unit to the connector receptacle on the lamp socket plate.

(4) Align the two ball studs on the outboard side of the rear lamp unit housing with the plastic nuts in the quarter panel.

(5) Using hand pressure, push the outboard side of the rear lamp unit forward (towards the end of the quarter panel) far enough to snap the two ball studs on the outboard side of the lamp housing into the plastic nuts in the quarter panel.

(6) Align the mounting holes on the inboard side of the rear lamp unit housing with the plastic nuts in the side jamb of the tailgate opening.

(7) Install and tighten the two screws that secure the inboard side of the rear lamp unit housing to the plastic nuts in the side jamb of the tailgate opening. Tighten the screws to 2 N·m (20 in. lbs.).

(8) Reconnect the battery negative cable.

## REPEATER LAMP BULB

## REMOVAL

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

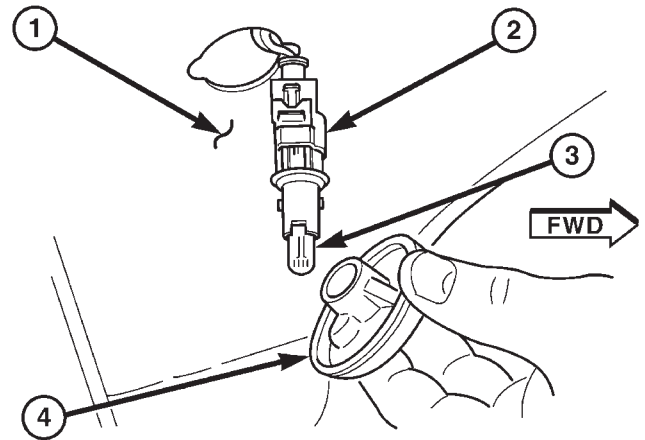
(1) Disconnect and isolate the battery negative cable.

(2) Remove the repeater lamp unit from the front fender panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REPEATER LAMP UNIT - REMOVAL).

(3) Rotate the repeater lamp socket in the lamp lens counterclockwise about 30 degrees (Fig. 61).

(4) Pull the socket and bulb straight out of the repeater lamp lens.

(5) Pull the bulb straight out of the repeater lamp socket.



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**Fig. 61 Repeater Lamp Bulb Remove/Install**

- 1 - FRONT FENDER
- 2 - SOCKET
- 3 - BULB
- 4 - LENS

## INSTALLATION

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

**CAUTION:** Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the lamp, the socket and/or the lamp wiring.

(1) Align the base of the bulb with the receptacle in the repeater lamp socket.

(2) Push the bulb straight into the repeater lamp socket until it is firmly seated.

(3) Align the socket and bulb with the socket opening in the repeater lamp lens (Fig. 61).

(4) Push the socket and bulb straight into the repeater lamp lens until it is firmly seated

(5) Rotate the repeater lamp socket in the lamp lens clockwise about 30 degrees.

(6) Reinstall the repeater lamp unit onto the front fender panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REPEATER LAMP UNIT - INSTALLATION).

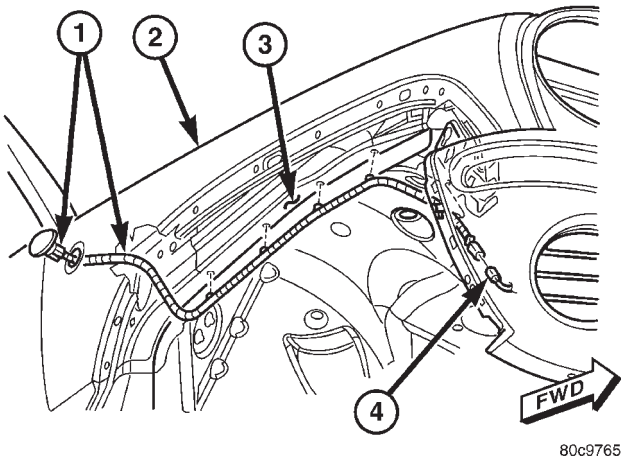
(7) Reconnect the battery negative cable.

## REPEATER LAMP UNIT

### REMOVAL

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

- (1) Disconnect and isolate the battery negative cable.
- (2) Using a trim stick or another suitable wide flat-bladed tool, carefully pry at the clearance notch in the lower edge of the repeater lamp lens to disengage the snap features of the lens from the mounting hole in the front fender panel (Fig. 62).



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**Fig. 62 Repeater Lamp Unit Remove/Install**

- 1 - REPEATER LAMP UNIT
- 2 - FRONT FENDER PANEL
- 3 - INNER FENDER
- 4 - FRONT FASCIA WIRE HARNESS

(3) Pull the repeater lamp unit out from the front fender panel far enough to access and disconnect the repeater lamp wire harness connector from the connector receptacle on the back of the repeater lamp unit socket.

(4) Remove the repeater lamp unit from the front fender panel.

### INSTALLATION

Side repeater lamps are used only on vehicles manufactured for certain markets where these lamps are required.

- (1) Position the repeater lamp unit to the front fender panel (Fig. 62).
- (2) Reconnect the repeater lamp wire harness connector to the connector receptacle on the back of the repeater lamp unit socket.
- (3) Position the repeater lamp unit into the mounting hole in the front fender panel. Be certain that the clearance notch on the edge of the repeater lamp lens is oriented toward the bottom.

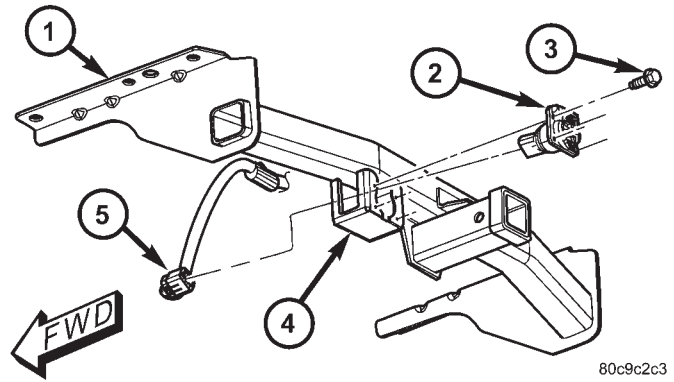
(4) Using hand pressure, press on the repeater lamp unit firmly and evenly until the snap features of the lens are fully engaged in the mounting hole of the front fender panel.

(5) Reconnect the battery negative cable.

## TRAILER TOW CONNECTOR

### REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the four screws that secure the trailer tow connector to the bracket on the trailer hitch receiver (Fig. 63).



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**Fig. 63 Trailer Tow Connector Remove/Install**

- 1 - HITCH RECEIVER
- 2 - 7-WAY TRAILER TOW CONNECTOR
- 3 - SCREW (4)
- 4 - BRACKET
- 5 - WIRE HARNESS CONNECTOR

(3) Pull the trailer tow connector rearward from the bracket on the trailer hitch receiver far enough to access and disconnect the rear body wire harness connector from the receptacle on the back of the trailer tow connector.

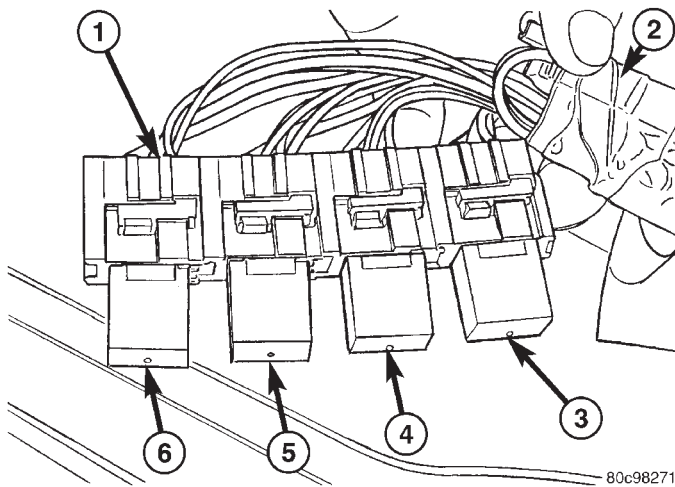
(4) Remove the trailer tow connector from the trailer hitch receiver.

### INSTALLATION

- (1) Position the trailer tow connector to the trailer hitch receiver (Fig. 63).
- (2) Reconnect the rear body wire harness connector to the receptacle on the back of the trailer tow connector.
- (3) Position the trailer tow connector into the bracket on the trailer hitch receiver.
- (4) Install and tighten the four screws that secure the trailer tow connector to the bracket on the trailer hitch receiver. Tighten the screws to 4 N-m (35 in. lbs.).
- (5) Reconnect the battery negative cable.

## TRAILER TOW RELAY

### DESCRIPTION



**Fig. 64 Trailer Tow Relays**

- 1 - RELAY CONNECTOR BANK
- 2 - REAR BODY WIRE HARNESS
- 3 - LEFT TURN RELAY
- 4 - RIGHT TURN RELAY
- 5 - BRAKE LAMP RELAY
- 6 - FUSED IGNITION SWITCH OUTPUT (RUN) RELAY

The trailer tow relays are located in a connector bank above the right rear wheelhouse and behind the quarter trim panel on vehicles equipped with the optional factory-installed trailer towing package. Four individual relays are used, one each for fused ignition switch output (run), brake lamps, right turn signal, and left turn signal outputs to a trailer through the rear body wiring and connectors. The trailer tow relays are conventional International Standards Organization (ISO) micro relays (Fig. 64). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The trailer tow relays cannot be adjusted or repaired and, if faulty or damaged, the inoperative relay must be replaced.

### OPERATION

The trailer tow relays are electromechanical switches. The relays each use an input from the circuit that they isolate from the trailer wiring to control a high current output to the trailer. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure.

When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

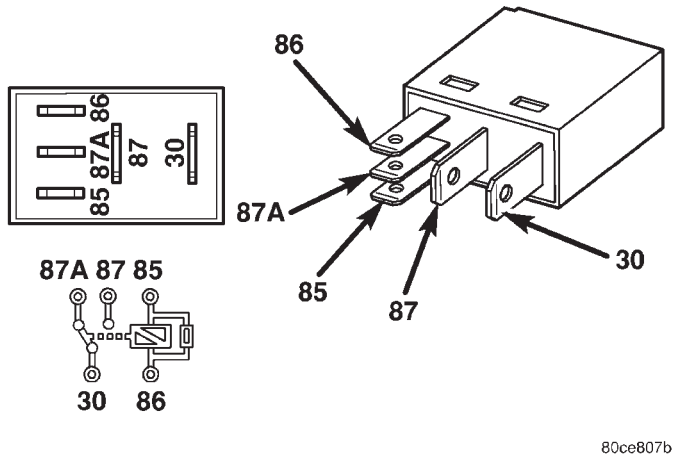
The terminals of each trailer tow relay are connected to the vehicle electrical system through a connector bank in the rear lighting wire harness above the right rear wheelhouse. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds. The trailer tow relays can be diagnosed using conventional diagnostic tools and methods.

### DIAGNOSIS AND TESTING - TRAILER TOW RELAY

The trailer tow relays (Fig. 65) are located in a connector bank above the right rear wheelhouse. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

TRAILER TOW RELAY (Continued)



**Fig. 65 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the trailer tow relay from the connector bank. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TRAILER TOW RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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 input and output circuits of the relay. Refer to the appropriate wiring information.

**REMOVAL**

The trailer tow relay bank contains four relays. The service procedures for each relay are the same. Be certain any removed relay is replaced with the same relay size and type that was removed.

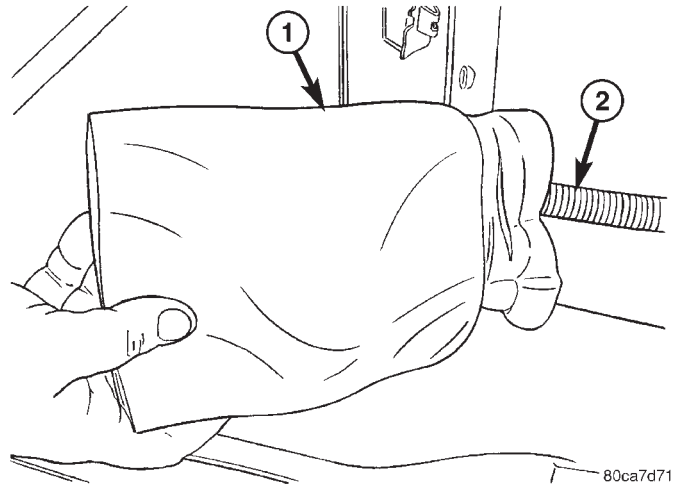
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN**

**WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 from the right side quarter inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).

(3) Reach through the access hole in the quarter inner panel behind the right rear wheelhouse to locate and retrieve the trailer tow relay connector bank, which is enveloped in foam rubber and placed on the top of the right rear wheelhouse between the quarter inner and outer panels (Fig. 66).



**Fig. 66 Trailer Tow Relay Wrap**

- 1 - FOAM WRAP
- 2 - REAR BODY WIRE HARNESS

(4) Pull the trailer tow relay connector bank into the cargo area far enough to access the unit for service.

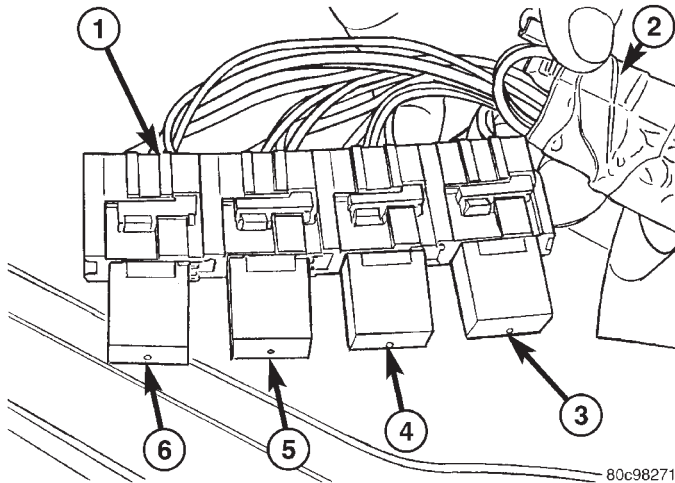
(5) Carefully remove the trailer tow relay connector bank from the foam wrap.

(6) Remove the trailer tow relay by grasping it firmly and pulling it straight out from the connector bank (Fig. 67).

**INSTALLATION**

The trailer tow relay bank contains four relays. The service procedures for each relay are the same. Be certain any removed relay is replaced with the same relay size and type that was removed.

## TRAILER TOW RELAY (Continued)



**Fig. 67 Trailer Tow Relay Remove/Install**

- 1 - RELAY CONNECTOR BANK
- 2 - REAR BODY WIRE HARNESS
- 3 - LEFT TURN RELAY
- 4 - RIGHT TURN RELAY
- 5 - BRAKE LAMP RELAY
- 6 - FUSED IGNITION SWITCH OUTPUT (RUN) RELAY

**WARNING: ON VEHICLES EQUIPPED WITH AIR-BAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the trailer tow relay to the proper connector in the connector bank (Fig. 67).

(2) Align the trailer tow relay terminals with the terminal cavities in the connector.

(3) Push firmly and evenly on the top of the trailer tow relay until the terminals are fully seated in the terminal cavities in the connector.

(4) Carefully restore the foam wrap around the trailer tow relay connector bank (Fig. 66).

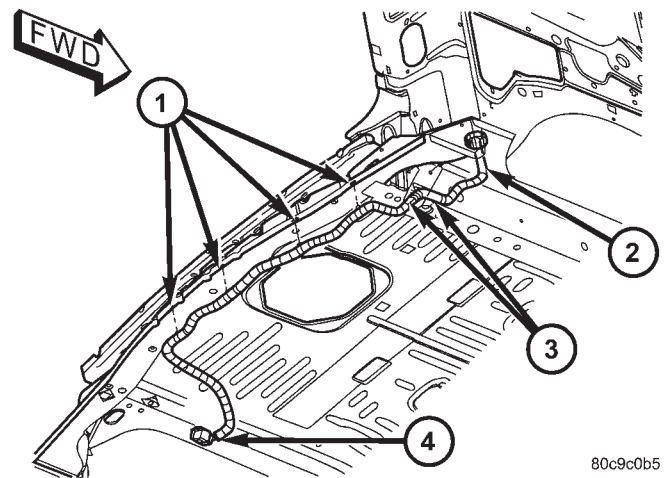
(5) Reach through the access hole in the quarter inner panel behind the right rear wheelhouse to place the trailer tow relay connector bank on the top of the right rear wheelhouse between the quarter inner and outer panels.

(6) Reinstall the trim onto the right side quarter inner panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).

(7) Reconnect the battery negative cable.

## TRAILER TOW WIRING

## DESCRIPTION



**Fig. 68 Trailer Tow Wiring**

- 1 - RETAINER CLIP (4)
- 2 - REAR BODY HARNESS (TRAILER TOW TAKE OUT)
- 3 - RETAINER CLIP (2)
- 4 - WIRE HARNESS CONNECTOR

Vehicles equipped with an optional factory-installed (not dealer-installed or port-installed) trailer towing package have a rear body wire harness that includes an integral trailer tow wiring take out that connects to a heavy duty, sealed, 7-pin trailer tow connector located on a bracket on the trailer hitch receiver (Fig. 68). This harness includes a second take out with a trailer tow relay connector bank and four trailer tow relays that isolate the right turn signal, left turn signal, and brake lamp circuits of the vehicle from the electrical system of the trailer. The fourth relay in the connector bank provides a fused ignition switch output (run) source of battery current to the trailer tow connector through a trailer tow relay output circuit. The package also includes an adapter harness (stored beneath the left rear seat cushion of the vehicle when it is shipped from the factory) that adapts the 7-pin trailer tow connector to a standard, light-duty, 4-pin trailer tow connector. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## LAMP BAR

### DESCRIPTION

The lamp bar is used to better illuminate the drivers field of vision under certain driving conditions. It consists of a cover, two or four lamp assemblies (depending upon which market), and a wiring harness. These components are mounted to a reinforcement, then sealed and secured to the roof panel. Lamp bar illumination is controlled by a manually operated momentary rocker switch, mounted to the instrument panel. The lamps are adjustable in the vertical position only.

### OPERATION

Battery and ignition voltage are supplied to the lamp bar switch assembly. When the switch is in the on position the internal relay contacts close, completing the circuit through the lamp bar bulbs, to ground. The lamp bar assembly is grounded to the chassis. The hard wired circuits of the lamp bar may be diagnosed and tested using conventional methods and procedures.

### DIAGNOSIS AND TESTING - LAMP BAR

CONDITION	POSSIBLE CAUSES	CORRECTION
LAMP BAR LAMPS INOPERATIVE	Faulty or missing fuse Faulty feed circuit Faulty ground circuit Faulty lamp bar sense circuit Faulty switch	Test and replace lamp bar fuse as required Test and repair open battery or ignition feed circuit. Test and repair high resistance or open lamp bar ground circuit Test and repair short to voltage in lamp bar sense circuit Test and replace lamp bar switch
LAMP BAR LAMPS ON AT ALL TIMES	Faulty switch Lamp bar feed circuit	Test and replace lamp bar switch Test and repair short to voltage in lamp bar feed circuit
ONE OR MORE LAMPS INOPERATIVE	Faulty or missing bulb Faulty lamp bar wiring harness	Test and repair lamp bar lamp bulb(s) as required Test and repair short/open lamp bar wiring harness

### STANDARD PROCEDURE - LAMP BAR AIMING

**NOTE:** The lamp bar lamps are adjustable to the vertical position only.

- (1) Remove lamp bar cover.
- (2) Using a fairly dark and level area, drive the vehicle perpendicular to and 25 ft. away from a wall.
- (3) Measure up the wall 7ft. 9in. and place tape on the wall parallel to the ground.
- (4) Turn on the lamp bar lamps.
- (5) Using the adjustment screw in the rear of each lamp, adjust the lamp beam to the center of the tape.

### REMOVAL

#### REMOVAL - LAMP BAR

- (1) Disconnect the negative battery cable.
- (2) Remove the lamp bar cover retaining screws, slide the cover forward and up to remove.
- (3) Disconnect lamp electrical connector.
- (4) Remove the lamp bar reinforcement to roof stud retainers.

**CAUTION:** The reinforcement is held to the roof by protective tape. Remove the tape carefully to prevent damage to roof panel. After removal, the area must be cleaned with the appropriate solvent.

## LAMP BAR (Continued)

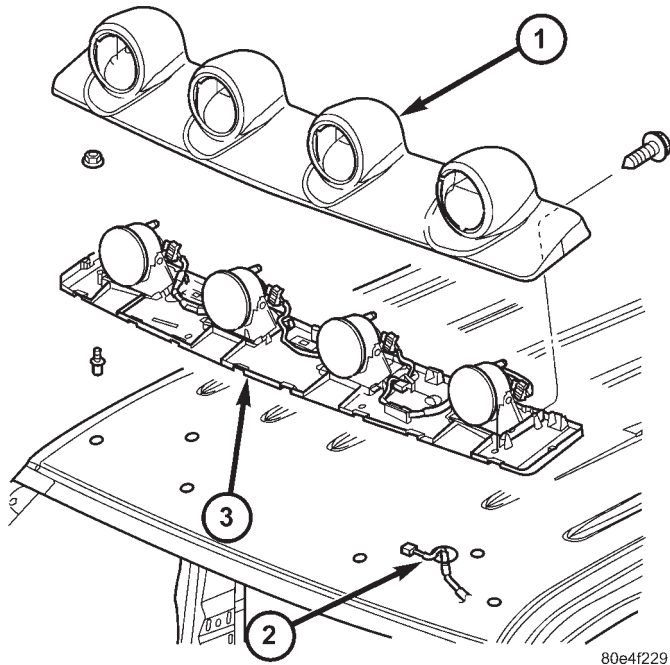


Fig. 69 LAMP BAR

- 1 - Cover
- 2 - Electrical Connector
- 3 - Lamp Bar

- (5) Remove lamp bar reinforcement from roof.

## REMOVAL - LAMP

- (1) Disconnect negative battery cable.
- (2) Remove the lamp bar cover screws, slide the cover forward and up to remove (Fig. 69).

**NOTE:** There is a hook arrangement for the forward lamp attachment. Pick the lamp up by the bulb connector.

- (3) Remove the lamp to base retaining screws.
- (4) Lift the lamp up and slide backward to remove.

## INSTALLATION

## INSTALLATION - LAMP BAR

**NOTE:** Lamp bar is held to roof by protective tape. Mounting area must be clean and dry before installation.

- (1) Remove tape protective strips on new lamp bar.
- (2) Position lamp bar over roof studs (Fig. 69).
- (3) Press the lamp bar reinforcement into place making sure the tape strips are securely seated on roof.
- (4) Install the reinforcement nuts and tighten to 20 lbs. in.
- (5) Connect electrical connector.
- (6) Reconnect negative battery cable.
- (7) Aim lamps (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LAMP BAR - STANDARD PROCEDURE) .
- (8) Position the cover over lamp bar, slide rearward and secure with screws.

## INSTALLATION - LAMP

**NOTE:** There is a hook arrangement for the forward lamp attachment. Pick the lamp up by the bulb connector.

- (1) Position the lamp assembly on the base (Fig. 69).
- (2) Slide the lamp forward and seat.
- (3) Install the lamp retaining screws.
- (4) Reconnect negative battery cable.
- (5) Align the lamps (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/LAMP BAR - STANDARD PROCEDURE).
- (6) Install the lamp bar cover.

## LAMP BAR SWITCH

### DESCRIPTION

The lamp bar switch is intended to close the electrical circuit which feeds the lamp bar. The switch assembly contains a relay unit that is energized or de-energized by a manually operated momentary rocker switch. The switch is mounted on the instrument panel left of the steering wheel.

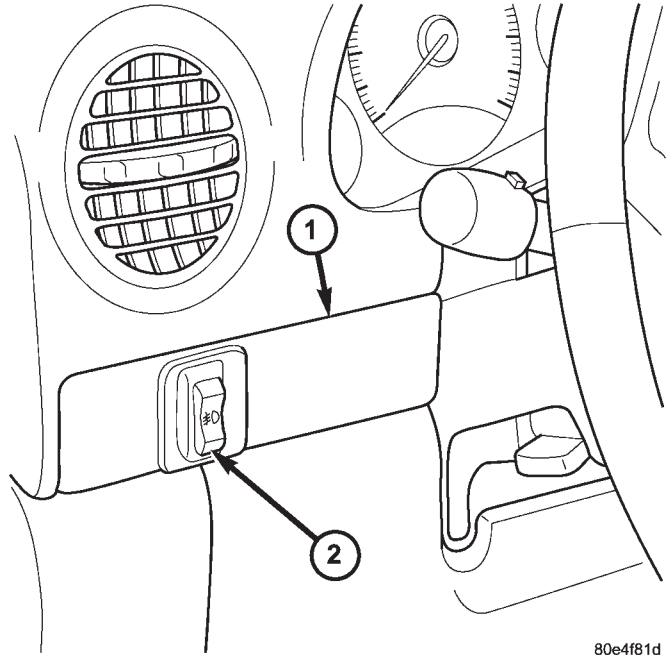
### REMOVAL

**CAUTION:** Care must be taken not to damage the dash or instrument panel when removing the lamp bar switch bezel.

- (1) Disconnect negative battery cable.
- (2) Using a suitable pry tool, carefully remove the lamp bar switch bezel from the instrument panel.
- (3) Disconnect the electrical connector.
- (4) Depress the lamp bar switch retaining tabs and remove the switch from the bezel.

### INSTALLATION

- (1) Press the lamp bar switch into the instrument panel bezel and assure that the switch is seated properly (Fig. 70).
- (2) Connect the electrical connector.
- (3) Press the instrument panel bezel into position and seat the bezel retaining clips.



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**Fig. 70 LAMP BAR SWITCH**

- 1 - Bezel
- 2 - Lamp Bar Switch

- (4) Reconnect negative battery cable.





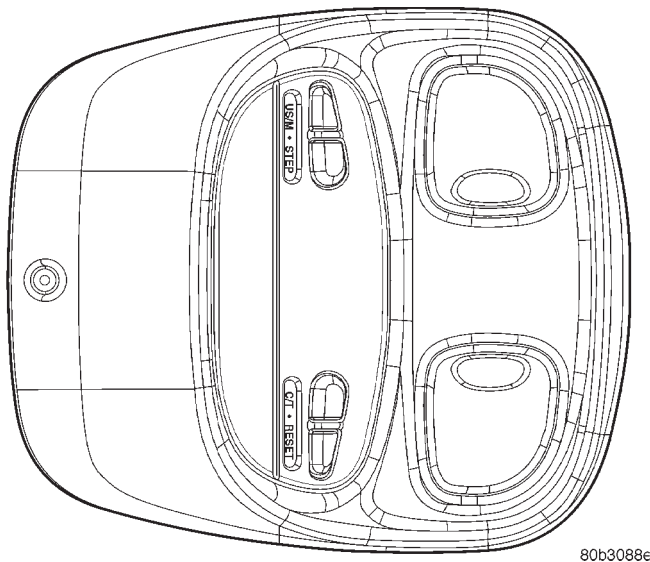
# MESSAGE SYSTEMS

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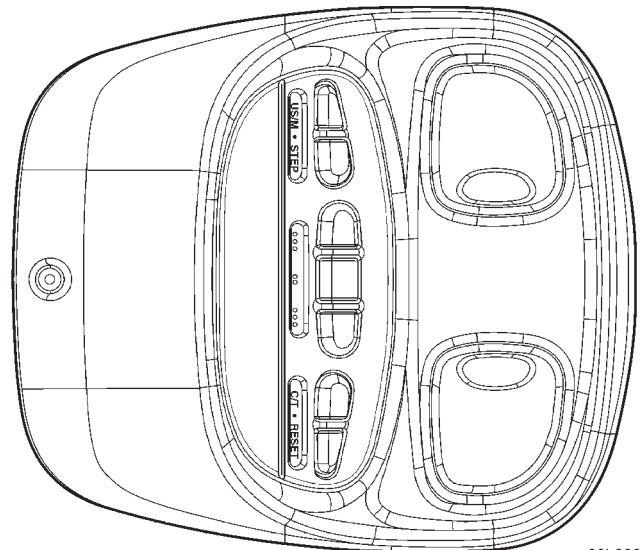
## OVERHEAD CONSOLE

### DESCRIPTION



**Fig. 1 Overhead Console Without Universal Transmitter**

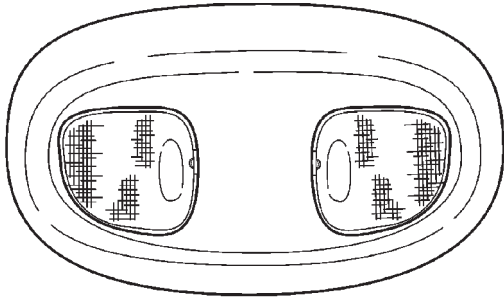
An overhead console is standard factory-installed equipment on this model. The available overhead



**Fig. 2 Overhead Console With Universal Transmitter**

consoles can include the Compass Mini-Trip Computer with universal transmitter (Fig. 2), without the universal transmitter (Fig. 1), or base console with only two reading and courtesy lamps (Fig. 3). All overhead consoles are equipped with two reading and courtesy lamps. On vehicles equipped with a power

## OVERHEAD CONSOLE (Continued)



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**Fig. 3 Base Console**

sunroof, the sunroof switch is located between the two reading and courtesy lamps. The overhead console is mounted with one screw and two snap clips to a molded plastic retainer bracket located above the headliner.

**OPERATION**

Refer to the vehicle Owner's Manual for specific operation of each overhead console and its systems.

**STANDARD PROCEDURE****STANDARD PROCEDURE - CMTc LAMP REPLACEMENT**

- (1) Open hood, disconnect and isolate the negative battery cable.
- (2) Remove overhead console (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).
- (3) Using a flat blade screwdriver twist out the lamp socket.
- (4) Replace lamp(s) as necessary.

**STANDARD PROCEDURE - COURTESY LAMP REPLACEMENT**

- (1) Open hood, disconnect and isolate the negative battery cable.
- (2) Remove the overhead console from the headliner (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).
- (3) Remove the lamp and socket assembly from the overhead console.
- (4) Remove the lamp bulb by pulling it straight out of its socket.

**STANDARD PROCEDURE - 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. If the compass readings appear to be erratic or out of calibration, perform the following calibration procedure. Also, new service replacement Compass Mini-Trip Computer (CMTc) modules must have their compass calibrated using this procedure. Do not attempt to calibrate the compass near large metal objects such as other vehicles, large buildings, or bridges; or, near overhead or underground power lines.

**NOTE:** Whenever the compass is calibrated manually, the variance number must also be reset. Refer to Compass Variation Adjustment in this group.

Calibrate the compass manually as follows:

- (1) Turn the ignition switch to the On position. If the compass/thermometer data is not currently being displayed, momentarily depress and release the C/T push button to reach the compass/thermometer display.
- (2) Depress the Reset push button and hold the button down until "CAL" appears in the display. This takes about ten seconds, and appears about five seconds after "VARIANCE = XX" is displayed.
- (3) Release the Reset push button.
- (4) Drive the vehicle on a level surface, away from large metal objects and power lines, through three or more complete circles at between five and eight kilometers-per-hour (three and five miles-per-hour) 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 calibration procedure 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.

**STANDARD PROCEDURE - COMPASS DEMAGNETIZING**

A degaussing tool (Special Tool 6029) is used to demagnetize, or degauss, the overhead console forward mounting screw and the roof panel above the overhead console. Equivalent units must be rated as

## OVERHEAD CONSOLE (Continued)

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.

To demagnetize the roof panel and the overhead console forward mounting screw, proceed as follows:

(1) Be certain that the ignition switch is in the Off position, before you begin the demagnetizing procedure.

(2) Connect the degaussing tool to an electrical outlet, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(3) Slowly approach the head of the overhead console forward mounting screw with the degaussing tool connected.

(4) Contact the head of the screw with the plastic coated tip of the degaussing tool for about two seconds.

(5) With the degaussing tool still energized, slowly back it away from the screw. When the tip of the tool is at least 61 centimeters (2 feet) from the screw head, disconnect the tool.

(6) 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. 4). The purpose of the paper is to protect the roof panel from scratches, and to define the area to be demagnetized.

(7) Connect the degaussing tool to an electrical outlet, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(8) Slowly approach the center line of the roof panel at the windshield header, with the degaussing tool connected.

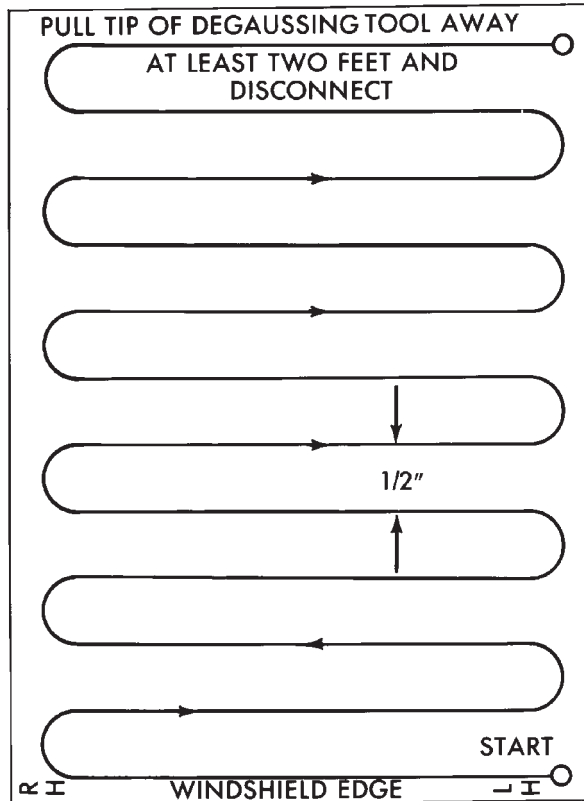
(9) Contact the roof panel with the plastic coated tip of the degaussing tool. Be sure that the template is in place to avoid scratching the roof panel. Using a slow, back-and-forth sweeping motion, and allowing 13 millimeters (0.50 inch) between passes, move the tool at least 11 centimeters (4 inches) to each side of the roof center line, and 28 centimeters (11 inches) back from the windshield header.

(10) 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, disconnect the tool.

(11) Calibrate the compass and adjust the compass variance (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - STANDARD PROCEDURE).

## STANDARD PROCEDURE - COMPASS VARIATION ADJUSTMENT

Compass variance, also known as magnetic declination, is the difference in angle between magnetic north and true geographic north. In some geographic locations, the difference between magnetic and geographic north is great enough to cause the compass



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**Fig. 4 Roof Demagnetizing Pattern**

to give false readings. If this problem occurs, the compass variance setting may need to be changed.

To set the compass variance:

(1) Using the Variance Settings map, find your geographic location and note the zone number (Fig. 5).

(2) Turn the ignition switch to the On position. If the compass/thermometer data is not currently being displayed, momentarily depress and release the C/T push button to reach the compass/thermometer display.

(3) Depress the Reset push button and hold the button down until "VARIANCE = XX" appears in the display. This takes about five seconds.

(4) Release the Reset push button. "VARIANCE = XX" will remain in the display. "XX" equals the current variance zone setting.

(5) Momentarily depress and release the Step push button to step through the zone numbers, until the zone number for your geographic location appears in the display.

(6) Momentarily depress and release the Reset push button to enter the displayed zone number into the CMTC module memory.

(7) Confirm that the correct directions are now indicated by the compass.

## OVERHEAD CONSOLE (Continued)

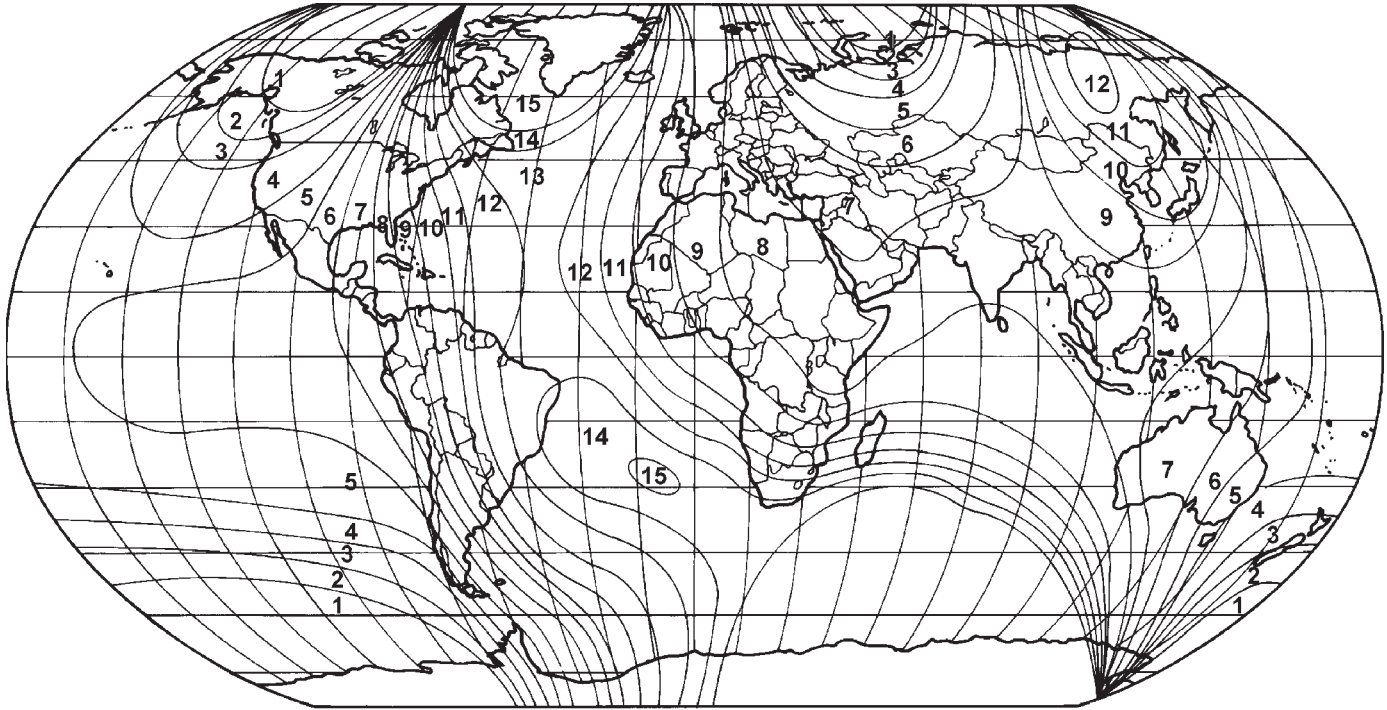


Fig. 5 Variance Settings

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## REMOVAL

## OVERHEAD CONSOLE - REMOVAL

- (1) Disconnect and isolate the negative battery cable.
- (2) Remove the overhead console retaining screw, located in the front of console near the windshield.
- (3) Using your fingertips, grasp the sides of the overhead console and pull straight down evenly to disengage the two snap clips at the rear of the unit.
- (4) Lower the overhead console far enough to access the wire harness connectors.
- (5) Disconnect the control module, courtesy lamps and power sunroof switch electrical connectors, if equipped.
- (6) Remove the overhead console assembly from the vehicle.

## INSTALLATION

- (1) Position the overhead console in the vehicle and connect the wire harness connectors.
- (2) Connect the control module, courtesy lamps and power sunroof switch electrical connectors, if equipped.
- (3) Grasp the sides of the overhead console and push straight up evenly to engage the two snap clips at the rear of the unit.
- (4) Install the overhead console retaining screw, located in the front of console near the windshield. Torque the screw to 1.2 N-m (10 in. lbs.).
- (5) Connect the negative battery cable.

COMPASS/MINI-TRIP  
COMPUTER

## DESCRIPTION

The Compass Mini-Trip Computer (CMTC) is located in the overhead console on models equipped with this option. The Compass Mini-Trip Computer module features a large Vacuum Fluorescent Display (VFD) screen for displaying information, and four back-lit push button function switches labeled C/T (compass/thermometer), RESET, STEP, and US/M (United States/Metric Scale).

The Compass Mini-Trip Computer module contains a central processing unit and interfaces with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network. The PCI 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 Compass Mini-Trip Computer module contains six informational displays which can be displayed using the four outer buttons on the overhead console. When the vehicle is first turned ON:

- CMTC blanks the display for a half second
- Displays whatever was being viewed when the ignition was last turned OFF

## COMPASS/MINI-TRIP COMPUTER (Continued)

The CMTC may also be integrated with the Universal Transmitter. If so, your CMTC module will have three buttons centered together between the outer four buttons. Below the three buttons are corresponding dots to indicate which button you are using.

The Compass Mini-Trip Computer includes the following display options:

- **Compass and thermometer** - provides the outside temperature and one of eight compass readings to indicate the direction the vehicle is facing.
- **Average fuel economy** - shows the average fuel economy since the last trip computer reset.
- **Distance to empty** - shows the estimated distance that can be travelled with the fuel remaining in the fuel tank. This estimated distance is computed using the average miles-per-gallon from the last 30 gallons of fuel used.
- **Instant fuel economy** - shows the present fuel economy based upon the current vehicle distance and fuel used information.
- **Trip odometer** - shows the distance travelled since the last trip computer reset.
- **Elapsed time** - shows the accumulated ignition-on time since the last trip computer reset.
- **Blank screen** - the CMTC compass/thermometer/trip computer VFD is turned off.

If the vehicle is equipped with the optional Universal Transmitter transceiver, the CMTC will also display messages and an icon indicating when the Universal Transmitter is being trained, which of the three transmitter buttons is transmitting, and when the transceiver is cleared.

Data input for all CMTC functions, including VFD dimming level, is received through PCI data bus messages. The CMTC module uses its internal programming and all of its data inputs to calculate and display the requested data. If the data displayed is incorrect, perform the self-diagnostic tests as described in this group. If these tests prove inconclusive, the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual are recommended for further testing of the CMTC module and the PCI data bus.

The CMTC module cannot be repaired, and is available for service only as a unit. This unit includes the push button switches and the plastic module and display lens. If any of these components is faulty or damaged, the complete CMTC module must be replaced. The incandescent bulbs used for CMTC push button back-lighting are available for service replacement.

#### DESCRIPTION - COMPASS

While in the compass/thermometer mode, 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). 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 at 5 to 8 kilometers-per-hour (3 to 5 miles-per-hour), on level ground, in not less than forty-eight 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.

#### DESCRIPTION - THERMOMETER

The thermometer displays the outside ambient temperature in whole degrees. The temperature display can be toggled from Fahrenheit to Celsius by using the U.S./Metric button. 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 Body Control Module (BCM) unit memory. When the ignition switch is turned to the On position again, the CMTC 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 Body Control Module (BCM). The BCM sends temperature status messages to the CMTC module over the PCI data bus network. The ambient temperature sensor is available as a separate service item, refer to additional information later in this section.

#### OPERATION

The compass mini-trip computer operates when the ignition is in the ON position. The VFD will display the last display before ignition was turned OFF. The four outer buttons operate:

## COMPASS/MINI-TRIP COMPUTER (Continued)

- STEP
- C/T - Compass/Temperature
- US/M - English/Metric
- RESET

**1. STEP BUTTON**

Pressing the STEP button selects one of the following 6 displays:

- Average fuel economy
- Distance to empty
- Instantaneous fuel economy
- Trip odometer
- Elapsed time
- Blank Screen

**2. C/T (COMPASS/TEMPERATURE) BUTTON**

Pressing the C/T button selects the Compass/Temperature display.

**3. US/M (ENGLISH/METRIC MEASUREMENT) BUTTON**

Pressing the US/M button switches the display units between English and Metric readings.

**4. RESET BUTTON**

Pressing the RESET button resets the function on the display, provided that function can be reset. The functions which can be reset are Average fuel economy, Trip odometer and Elapsed time.

**Global Reset** This feature allows all three displays (Average fuel economy, Trip odometer and Elapsed time) to be reset easily, by pressing the RESET button twice within three seconds with any of the screens in display. This eliminates the need to reset each display individually.

The RESET button is also used to set the variance and/or calibrate the compass. Refer to the Variance Procedure and Calibration Procedure in this section.

For more information on the features, control functions and setting procedures for the CMTC module, see the owner's manual in the vehicle glove box.

**DIAGNOSIS AND TESTING - COMPASS MINI-TRIP COMPUTER**

The following diagnostic procedure can be used if the compass mini-trip computer is not operational in any way. If the problem is specific to a individual CMTC display, go to the appropriate display title noted below and diagnose using the information provided on how these displays are generated.

(1) Remove the overhead console from the headliner (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(2) Using a ohmmeter, check the ground circuit cavity of the compass mini-trip computer electrical

connector for proper continuity to ground. Continuity should be present, If OK go to Step 3, If not OK repair the open or shorted ground circuit as required.

**NOTE: Connect the negative battery cable before proceeding.**

(3) Using a voltmeter, check the fused (B+) circuit cavity of the compass mini-trip computer electrical connector for 12v. Voltage should be present, If OK go to Step 4, If not OK repair the open or shorted fused (B+) circuit as required.

(4) Using a voltmeter, check the fused ignition switch output circuit cavity of the compass mini-trip computer electrical connector for 12v with Key ON. Voltage should be present, If OK, replace the inoperative CMTC module, If not OK repair the open or shorted fused ignition switch output circuit as required.

**TEMPERATURE**

The compass mini-trip computer receives Programmable Communications Interface bus (PCI bus) messages from the Body Control Module (BCM) for all displayed information except the compass display. If a dash (-) is displayed, the compass mini-trip computer is not receiving a PCI bus message from the BCM. To check out the PCI bus line and the BCM, use the DRB III® scan tool and proper Body Diagnostic Procedure Manual.

If the compass mini-trip computer displays a temperature more than 54° C (130° F), check for a short circuit between the temperature sensor and the BCM.

If the compass mini-trip computer displays a temperature less than -40° C (-67° F), check for an open circuit between the temperature sensor and the BCM.

**AVERAGE FUEL ECONOMY**

The compass mini-trip computer receives average fuel economy information from the BCM over the PCI bus line. If the compass mini-trip computer displays -.- instead of an average fuel economy value, it is not receiving a PCI bus message for the average fuel economy from the BCM. To check out the PCI bus line and the BCM use the DRB III® scan tool and proper Body Diagnostic Procedure Manual.

**DISTANCE TO EMPTY**

The compass mini-trip computer receives distance to empty information from the BCM over the PCI bus line. If compass mini-trip computer displays a dash (-) instead of a distance to empty value, it is not receiving a PCI bus message for the distance to empty from the BCM. To check out the PCI bus line

COMPASS/MINI-TRIP COMPUTER (Continued)

and the BCM use the DRB III® scan tool and proper Body Diagnostic Procedure Manual.

**INSTANTANEOUS FUEL ECONOMY**

The compass mini-trip computer receives instantaneous fuel economy information from the BCM over the PCI bus line. If compass mini-trip computer displays a dash (-) instead of an instantaneous fuel economy value, it is not receiving a PCI bus message for the instantaneous fuel economy from the BCM. To check out the PCI bus line and the BCM use the DRB III® scan tool and proper Body Diagnostic Procedure Manual.

**TRIP ODOMETER**

The compass mini-trip computer receives trip odometer information from the Cluster over the PCI bus line. If compass mini-trip computer displays dashes - - instead of the trip odometer value, it is not receiving a PCI bus message for the trip odometer from the cluster. To check out the PCI bus line and the Cluster, use the DRB III® scan tool and proper Body Diagnostic Procedure Manual.

**ELAPSED TIME**

The compass mini-trip computer receives a PCI bus message containing elapsed time information. If compass mini-trip computer displays dashes -- instead of the elapsed time, it is not receiving a PCI bus message for the elapsed time from the BCM. To check out the PCI bus line and the BCM, use the DRB III® scan tool and proper Body Diagnostic Procedure Manual.

**COMPASS DISPLAY**

To display the vehicle direction, the compass mini-trip computer processes information from a sensor internal to the module. The compass mini-trip computer is self-calibrating and requires only variance adjustments dependent upon location. The compass mini-trip computer displays the label CAL whenever the compass is in the fast calibration mode.

If all three of the following conditions listed below occur, the vehicle must be demagnetized.

- Compass portion of the display is blank
- Temperature portion of the display is OK
- The label CAL is illuminated

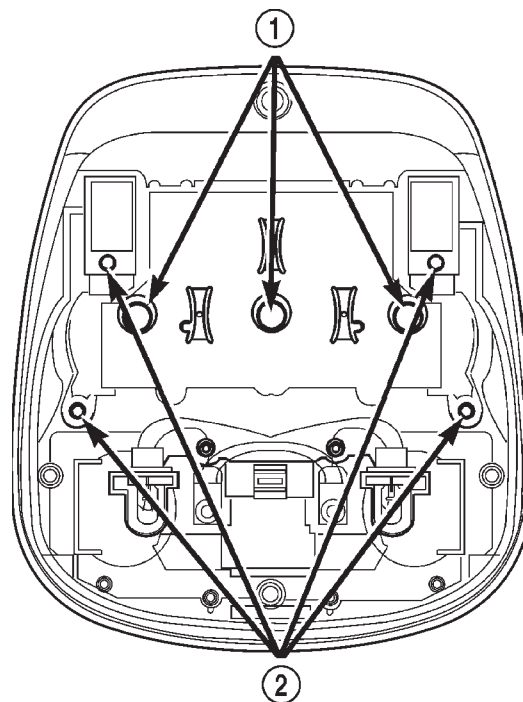
If demagnetizing the vehicle is needed, refer to the demagnetizing procedure in this section. After demagnetizing, to calibrate the compass refer to Calibration Procedure and to set the variance refer to Variance Procedure, both within this section. If the compass portion of the display is still blank, replace the compass mini-trip computer.

**COMPASS MINI-TRIP COMPUTER - SELF DIAGNOSTIC TEST**

- (1) With the ignition switch in the OFF position simultaneously press the C/T and STEP buttons and hold.
- (2) Turn the ignition switch ON, then release C/T and STEP buttons.
- (3) The Compass mini-trip computer should light all segments on the VF Display Screen for 2-4 seconds. Check for segments that are not illuminated.
- (4) If the compass mini-trip computer displays PASS, the module is OK.
- (5) If the compass mini-trip computer displays FAIL, replace the module.
- (6) If the compass mini-trip computer displays bUS, check for an open or a short on the PCI bus communication circuit.
- (7) Press the C/T or the STEP button to exit the self-diagnostic test.

**REMOVAL**

- (1) Remove overhead console, refer to Console Removal and Installation in this section.
- (2) Remove mounting screws and release the map lamp wire connector from the compass mini-trip computer. (Fig. 6).



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**Fig. 6 Compass Mini-Trip Computer Retaining Screws**

- 1 - LAMPS
- 2 - MOUNTING SCREWS



## COMPASS/MINI-TRIP COMPUTER (Continued)

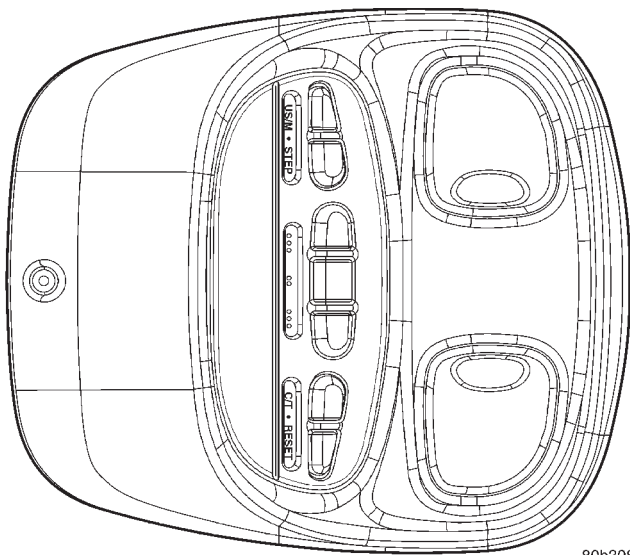
(3) Remove the compass mini-trip computer from the overhead console.

**INSTALLATION**

(1) Install the compass mini-trip computer in the overhead console. Align the compass mini-trip computer guides on the housing with the grooves of the console.

(2) Install the mounting screws and install the map lamp wire connector on the compass mini-trip computer. Make sure the LOOP of wire that was clipped into the compass mini-trip computer module housing is properly clipped into the new module before the console is placed back into the headliner.

(3) Install the overhead console, refer to Console Installation in this section.

**UNIVERSAL TRANSMITTER****DESCRIPTION**

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**Fig. 7 Overhead Console With Universal Transmitter**

On some KJ models a Universal Transmitter transmitter is standard factory-installed equipment. The universal transmitter transceiver is integral to the Compass Mini-Trip Computer (CMTC), which is located in the overhead console. The only visible component of the universal transmitter are the three transmitter push buttons (Fig. 7) centered between the four CMTC push buttons located just rearward of the CMTC display screen in the overhead console. The three universal transmitter push buttons are identified with one, two or three light indicators so that they be easily identified by sight or by feel.

Each of the three universal transmitter push buttons controls an independent radio transmitter channel. Each of these three channels can be trained to

transmit a different radio frequency signal for the remote operation of garage door openers, motorized gate openers, home or office lighting, security systems or just about any other device that can be equipped with a radio receiver in the 286 to 399 MegaHertz (MHz) frequency range for remote operation. The universal transmitter is capable of operating systems using either rolling code or non-rolling code technology.

The CMTC module displays messages and a small house-shaped icon with one, two or three dots corresponding to the three transmitter buttons to indicate the status of the Universal Transmitter.

The Universal Transmitter cannot be repaired, and is available for service only as a unit with the CMTC module. This unit includes the push button switches and the plastic module and display lens. If any of these components is faulty or damaged, the complete CMTC module must be replaced.

**OPERATION**

The universal transmitter operates on a non-switched source of battery current so the unit will remain functional, regardless of the ignition switch position. For more information on the features, programming procedures and operation of the universal transmitter, see the owner's manual in the vehicle glove box.

**DIAGNOSIS AND TESTING - UNIVERSAL TRANSMITTER**

If the Universal Transmitter is inoperative, but the Compass Mini-Trip Computer (CMTC) is operating normally, see the owner's manual in the vehicle glove box for instructions on training the universal transmitter. Retrain the universal transmitter with a known good transmitter as instructed in the owner's manual and test the universal transmitter operation again. If the unit is still inoperative, replace the faulty universal transmitter and CMTC module as a unit. If both the universal transmitter and the CMTC module are inoperative, refer to **Diagnosis and Testing the Compass Mini-Trip Computer** in this section for further diagnosis. For complete circuit diagrams, refer to **Overhead Console** in Wiring Diagrams.

**STANDARD PROCEDURE****STANDARD PROCEDURE - ERASING TRANSMITTER CODES**

To erase the universal transmitter codes, simply hold down buttons 1 and 3 until the two green dots below the house symbol begin to flash.

## UNIVERSAL TRANSMITTER (Continued)

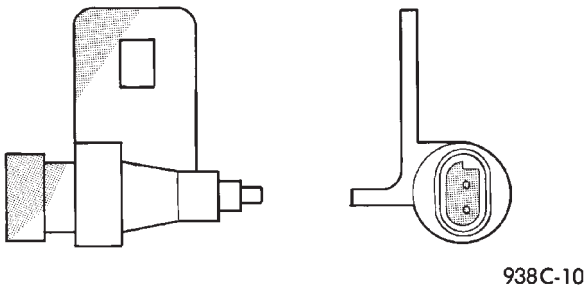
**NOTE:** Individual channels cannot be erased. Erasing the transmitter codes will erase ALL programmed codes.

### STANDARD PROCEDURE - SETTING TRANSMITTER CODES

- (1) Turn off the engine.
- (2) Erase the factory test codes by pressing buttons 1 and 3. Release the buttons when the two green lights begin to flash (about 20 seconds).
- (3) Choose one of the three buttons to train. Place the hand-held transmitter within one inch of the universal transmitter and push the buttons on both transmitters. The green dot below the house symbol will begin to flash slowly.
- (4) When the red light on the universal transmitter begins to flash rapidly (this may take as long as 60 seconds), release both buttons. Your universal transmitter is now "trained". To train the other buttons, repeat Step 3 and Step 4. Be sure to keep your hand-held transmitter in case you need to retrain the universal transmitter.

## AMBIENT TEMP SENSOR

### DESCRIPTION



**Fig. 8 Ambient Temperature Sensor**

Ambient air temperature is monitored by the Compass Mini-Trip Computer (CMTC) through ambient temperature sensor messages received from the Body Control Module (BCM) over the Programmable Communications Interface (PCI) data bus network. The BCM receives a hard wired input from the ambient temperature sensor. The ambient temperature sensor (Fig. 8) is a variable resistor mounted in front the radiator, behind the grille, near the center of the vehicle.

Refer to **Body Control Module** in Electronic Control Modules. For complete circuit diagrams, refer to the appropriate wiring information. The ambient temperature sensor cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

### OPERATION

The ambient temperature sensor is a variable resistor that operates on a five-volt reference signal sent to it by the BCM. The resistance in the sensor changes as temperature changes, changing the temperature sensor signal circuit voltage to the BCM. Based upon the resistance in the sensor, the BCM senses a specific voltage on the temperature sensor signal circuit, which it is programmed to correspond to a specific temperature. The BCM then sends the proper ambient temperature messages to the CMTC over the PCI data bus.

The thermometer function is supported by the ambient temperature sensor, a wiring circuit, the Body Control Module (BCM), the Programmable Communications Interface (PCI) data bus, and a portion of the Compass Mini-Trip Computer module.

The ambient temperature sensor circuit can also be diagnosed by referring to **Diagnosis and Testing - Ambient Temperature Sensor, and Diagnosis and Testing - Ambient Temperature Sensor Circuit**. If the temperature sensor and circuit are confirmed to be OK, but the temperature display is inoperative or incorrect, refer to **Diagnosis and Testing - Compass Mini-Trip Computer** in this section. For complete circuit diagrams, refer to the appropriate wiring information.

## DIAGNOSIS AND TESTING

### DIAGNOSIS AND TESTING - AMBIENT TEMPERATURE SENSOR

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector.

(2) Measure the resistance of the ambient temperature sensor. At  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ), the sensor resistance is 336 kilohms. At  $55^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ), the sensor resistance is 2.488 kilohms. The sensor resistance should read between these two values. If OK, refer to **Diagnosis and Testing - Ambient Temperature Sensor Circuit** in this group. If not OK, replace the faulty ambient temperature sensor.

### DIAGNOSIS AND TESTING - AMBIENT TEMPERATURE SENSOR CIRCUIT

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector and the Body Control Module wire harness connector.

(2) Connect a jumper wire between the two terminals in the body half of the ambient temperature sensor wire harness connector.

## AMBIENT TEMP SENSOR (Continued)

(3) Check for continuity between the sensor return circuit and the ambient temperature sensor signal circuit cavities of the BCM wire harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open sensor return circuit or ambient temperature sensor signal circuit to the ambient temperature sensor as required.

(4) Remove the jumper wire from the body half of the ambient temperature sensor wire harness connector. Check for continuity between the sensor return circuit cavity of the BCM wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted sensor return circuit as required.

(5) Check for continuity between the ambient temperature sensor signal circuit cavity of the BCM wire harness connector and a good ground. There should be no continuity. If OK, refer to **Diagnosis and Testing - Compass Mini-Trip Computer** in this group. If not OK, repair the shorted ambient temperature sensor signal circuit as required.

**REMOVAL**

(1) Open hood, disconnect and isolate the negative battery cable.

(2) Remove the grille from the vehicle (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL).

(3) Disconnect the ambient temperature sensor electrical connector.

(4) Remove the ambient temperature sensor retaining screw and remove the sensor from the vehicle.

**INSTALLATION**

(1) Position the ambient temperature sensor and install the retaining screw.

(2) Connect the ambient temperature sensor electrical connector.

(3) Install the grille on the vehicle (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION).

(4) Connect the negative battery cable.

# POWER SYSTEMS

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# POWER LOCKS

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## POWER LOCKS

### DESCRIPTION

#### POWER LOCKS

A power operated door and tailgate lock system is available factory-installed equipment on this model. The power lock system allows all of the doors and the

tailgate to be locked or unlocked electrically by operating a switch on either front door trim panel. The power lock system receives non-switched battery current through a fuse in the Junction Block (JB), so that the power locks remain operational, regardless of the ignition switch position.

The Body Control Module (BCM) locks the doors and tailgate automatically when the vehicle is driven beyond the speed of 25.7 Km/h (15 mph), all doors

## POWER LOCKS (Continued)

are closed and the accelerator pedal is depressed. The rolling door lock feature can be disabled if desired.

This vehicle also offers several customer programmable features, which allows the selection of several optional electronic features to suit individual preferences.

The power lock system for this vehicle can also be operated remotely using the available Remote Keyless Entry (RKE) system radio frequency transmitters, if equipped.

Certain functions and features of the power lock system rely upon resources shared with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network. For proper diagnosis of these electronic modules or of the PCI data bus network, the use of a DRBIII® scan tool and the appropriate diagnostic information are required.

### REMOTE KEYLESS ENTRY

A Radio Frequency (RF) type Remote Keyless Entry (RKE) system is an available factory-installed option on this model. The RKE system allows the use of a remote battery-powered radio transmitter to signal the Body Control Module (BCM) to actuate the power lock system. The RKE receiver operates on non-switched battery current through a fuse in the Junction Block (JB), so that the system remains operational, regardless of the ignition switch position.

The RKE transmitters are also equipped with a Panic button. If the Panic button on the RKE transmitter is depressed, the horn will sound and the exterior lights will flash on the vehicle for about three minutes, or until the Panic button is depressed a second time. A vehicle speed of about 25.7 kilometers-per-hour (15 miles-per-hour) will also cancel the panic event.

The RKE system can also perform other functions on this vehicle. If the vehicle is equipped with the optional Vehicle Theft Security System (VTSS), the RKE transmitter will arm the VTSS when the Lock button is depressed, and disarm the VTSS when the Unlock button is depressed.

The RKE system includes two transmitters when the vehicle is shipped from the factory, but the system can retain the vehicle access codes of up to four transmitters. The transmitter codes are retained in the RKE receiver memory, even if the battery is disconnected. If an RKE transmitter is faulty or lost, new transmitter vehicle access codes can be programmed into the system using a DRBIII® scan tool.

This vehicle also offers several customer programmable features, which allows the selection of several optional electronic features to suit individual prefer-

ences. Customer programmable feature options affecting the RKE system include:

- **Remote Unlock Sequence** - Allows the option of having only the driver side front door unlock when the RKE transmitter Unlock button is depressed the first time. The remaining doors and the tailgate unlock when the button is depressed a second time within 5 seconds of the first unlock press. Another option is having all doors and the tailgate unlock upon the first depression of the RKE transmitter Unlock button.

- **Sound Horn on Lock** - Allows the option of having the horn sound a short chirp as an audible verification that the RKE system received a valid Lock request from the RKE transmitter, or having no audible verification.

- **Flash Lights with Lock and Unlock** - Allows the option of having the lights flash as an optical verification that the RKE system received a valid Lock request or Unlock request from the RKE transmitter, or having no optical verification.

- **Programming Additional Transmitters** - Allows up to four transmitter vehicle access codes to be stored in the receiver memory.

Certain functions and features of the RKE system rely upon resources shared with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network. The PCI data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, internal controller hardware, and component sensor current loads. For diagnosis of these electronic modules or of the PCI data bus network, the use of a DRBIII® scan tool and the appropriate diagnostic information are required.

### TAILGATE / FLIP-UP GLASS POWER RELEASE SYSTEM

A power operated tailgate / flip-up glass release system is standard factory installed equipment on this model. The entire system is controlled by the Body Control Module (BCM). The tailgate / flip-up glass power release system allows the flip-up glass latch to be released electrically by actuating a switch located integral to the outside tailgate handle. By pulling the handle to the first detent or turning the key cylinder to unlock, the flip-up glass will open. Pulling the handle to the second detent will allow the tailgate to open.

The tailgate / flip-up glass release 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. However, the BCM prevents the flip-up glass latch from being actuated when the tailgate latch is locked.

## POWER LOCKS (Continued)

The tailgate will lock and can not be unlocked if the rear wiper switch is activated. The tailgate will also lock if battery power is lost and then restored.

The tailgate/flip-up glass will not function with the battery discharged or disconnected.

### COMBINATION FLASHER

This flasher can be energized by the BCM to flash all of the park/turn signal lamps as a optical alert for the RKE panic function and, if the Flash Lights with Lock programmable feature is enabled, as an optical verification for the RKE lock event.

### HORN RELAY

This relay can be energized by the BCM to sound the horns as an audible alert for the RKE panic function and, if the Sound Horn on Lock programmable feature is enabled, as an audible verification for the RKE lock event.

### LOW BEAM HEADLAMP RELAY

This relay can be energized by the BCM to flash the headlamp low beams as an optical alert for the RKE panic function.

## OPERATION

### POWER LOCKS

The Body Control Module (BCM) locks or unlocks the doors when an actuation input signal from a door lock switch or Remote Keyless Entry Module (RKE) is received. The BCM turns on the output drivers and provides a voltage level to the door lock motor for a specified time. All passenger doors can be locked or unlocked using a mechanical button mounted on the door trim panel. The front passenger doors and tailgate can be locked or unlocked by using the key cylinder (tailgate cylinder does not lock/unlock vehicle. It only unlocks the tailgate). The tailgate will lock and can not be unlocked if the rear wiper switch is activated (this prevents the wiper from operating when the tailgate is ajar). The tailgate will also lock if battery power is lost and then restored.

### AUTOMATIC DOOR LOCKS

When the automatic door locks are ENABLED the door locks will lock when the vehicle is moving at about 25.7 Km/h (15 mph), all doors are closed and the accelerator pedal is depressed. This feature can be switched ON or OFF as desired. When the system is DISABLED the door locks will operate normally, but will not lock automatically when the vehicle is rolling. Once the automatic door locks have been actuated, they will not try to lock the doors again until a door is opened.

### DOOR LOCK INHIBIT

If the key is in the ignition, in any position, and either front door is ajar, the doors can not be locked, but the unlock function still operates. Pressing the RKE lock/unlock button under these conditions will result in a normal lock/unlock activation.

After the key is removed from the Ignition Switch, or the doors are closed, the power door locks will operate normally.

### DOOR LOCK CIRCUIT PROTECTION

The BCM controls the door lock relays. If the door lock switch is actuated continuously for more than five seconds the BCM will turn the output driver OFF (the BCM would consider the switch stuck). Each lock motor is protected with a Positive Temperature Coefficient device that prevents motor burn out.

### REMOTE KEYLESS ENTRY

- **LOCK:** Pressing the LOCK button locks all doors, sounds horn (chirp) if enabled, and arms the Vehicle Theft Security System, if enabled. The chirp verifies that the RKE receiver has sent a message to the BCM for door lock operation. If a door has not been closed before pressing the LOCK button, the vehicle may not be secured and the VTSS (if equipped) will not arm until the door is closed.

- **UNLOCK:** Pressing the UNLOCK button once will unlock the driver's door and activate the illuminated entry system and disarm Vehicle Theft Security System, if equipped. Pressing the UNLOCK button twice within five seconds will unlock all doors.

- **TAILGATE:** Pressing the TAILGATE BUTTON unlocks the tailgate remotely and opens the flip-up glass.

- **PANIC:** Pressing the PANIC button sounds the horns at half second intervals, flashes the exterior lamps, and turns ON the interior lamps. The panic alarm will remain on for three minutes, or until the PANIC button is actuated again or the ignition switch is turned to the RUN position.

The Remote Keyless Entry Module is capable of retaining the transmitter Vehicle Access Code(s) in its memory even after vehicle power has been interrupted.

## DIAGNOSIS AND TESTING - POWER LOCKS

**The Body Control Module (BCM) enters a reduced power mode after the key is turned OFF. All diagnosis and testing of the power lock system must be done with the key in the ON position unless otherwise stated.**

**The most reliable, efficient, and accurate means to diagnose the power lock system requires the use of a DRBIII® scan tool and the**

POWER LOCKS (Continued)

**proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the power lock motors are being sent the proper hard wired outputs by the relays for them to perform their power lock system functions.**

Following are tests that will help to diagnose the hard wired components and circuits of the power lock system. However, these tests may not prove conclusive in the diagnosis of this system. In order to obtain conclusive testing of the power lock system, the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to, or receive outputs from the power lock system components must be checked.

The Body Control Module (BCM) will set Diagnostic Trouble Codes (DTC) for the power lock system.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**PRELIMINARY DIAGNOSIS**

As a preliminary diagnosis for the power lock system, note the system operation while you actuate both the Lock and Unlock functions with the power lock switches and with the Remote Keyless Entry (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 fused B(+) fuse in the junction Block (JB).

- If the power lock system functions with both power lock switches, but not with the RKE transmitter, proceed to diagnosis of the Remote Keyless Entry (RKE) system. (Refer to 8 - ELECTRICAL/POWER LOCKS/KEYLESS ENTRY TRANSMITTER - DIAGNOSIS AND TESTING) or (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - DIAGNOSIS AND TESTING).

- If the power lock system functions with the RKE transmitter, but not with one or both power lock switches, proceed to diagnosis of the door lock switches. (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK SWITCH - DIAGNOSIS AND TESTING).

- If the driver side power lock switch operates only the driver side front door power lock motor, but all other power lock motors operate with the passenger side power lock switch or the RKE transmitter, use a DRBIII® scan tool and the appropriate diagnos-

tic information to diagnose the Programmable Communications Interface (PCI) data bus.

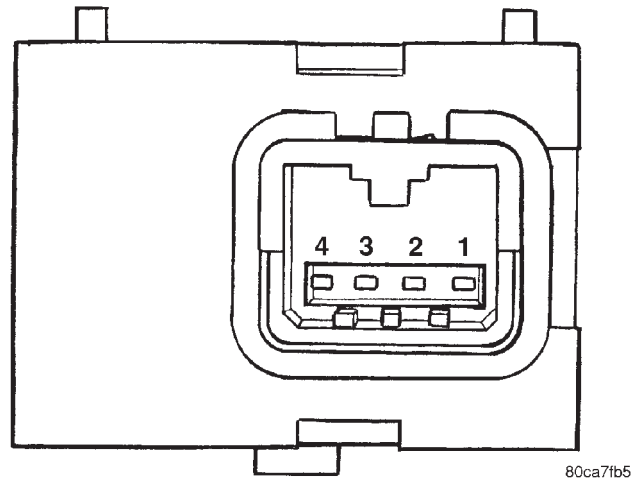
- If only one power lock motor fails to operate with both power lock switches and the RKE transmitter, proceed to diagnosis of the power lock motor. (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK MOTOR - DIAGNOSIS AND TESTING).

**DOOR LOCK / UNLOCK SWITCH**

**DIAGNOSIS AND TESTING - DOOR LOCK/ UNLOCK SWITCH**

(1) Remove the switch to be tested (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK SWITCH - REMOVAL).

(2) Using an ohmmeter, Test switch for resistance values (Fig. 1).



**Fig. 1 DOOR LOCK/UNLOCK SWITCH**  
DOOR LOCK SWITCH TEST

SWITCH POSITION	PINS	RESISTANCE VALUE
UNACTUATED	1 AND 4	5.0K OHM ± 10 %
LOCK	1 AND 4	1.4K OHM ± 10 %
UNLOCK	1 AND 4	426 OHM ± 10 %

(3) If test results are not obtained as shown in the test table, replace the switch.

**REMOVAL**

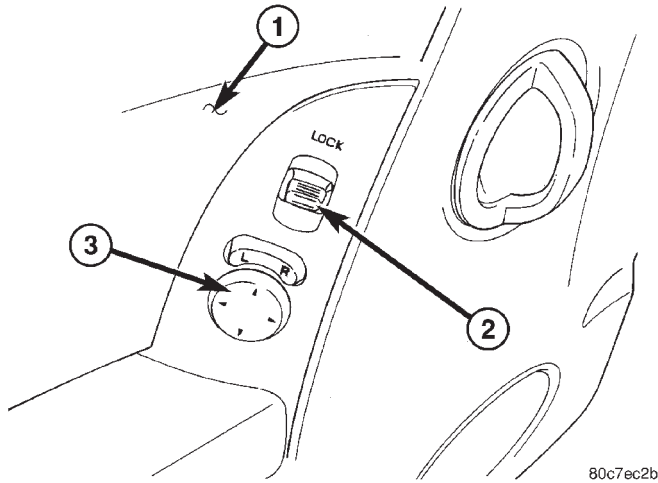
(1) Disconnect and isolate the battery negative cable.

DOOR LOCK / UNLOCK SWITCH (Continued)

(2) Remove the door trim panel (Fig. 2) (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Install the door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(4) Connect the battery negative cable.



**Fig. 2 DOOR LOCK SWITCH**

- 1 - DOOR TRIM PANEL
- 2 - DOOR LOCK SWITCH
- 3 - POWER MIRROR SWITCH

(3) Disconnect electrical harness connector from switch.

(4) From behind the door trim panel, gently pry the switch from the door trim panel (Fig. 3).

DOOR LOCK MOTOR

DESCRIPTION

The lock mechanisms are actuated by a reversible electric motor mounted within each door and tailgate. The power lock motors are integral to the door latch units.

The power lock motors cannot be adjusted or repaired and, if faulty or damaged, the door latch unit must be replaced.

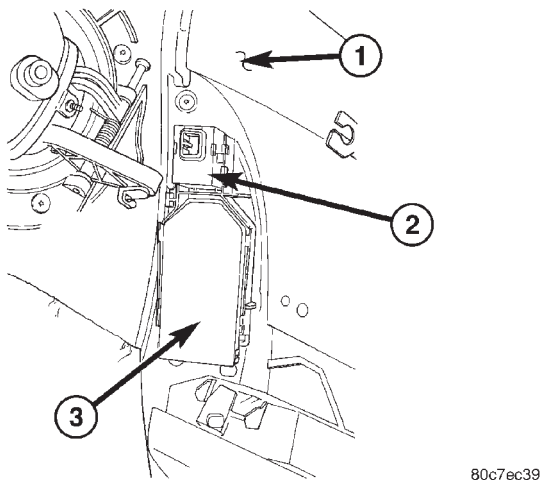
OPERATION

The door lock motors are controlled by relays. A positive and negative battery connection to the two motor terminals will cause the motor to move in one direction. Reversing the current will cause the motor to move in the opposite direction.

DIAGNOSIS AND TESTING - DOOR LOCK MOTOR

The most reliable, efficient, and accurate means to diagnose the power lock system requires the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the power lock motors are being sent the proper hard wired outputs by the door modules for them to perform their power lock system functions.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.



**Fig. 3 DOOR LOCK/MIRROR SWITCH**

- 1 - DOOR TRIM PANEL
- 2 - DOOR LOCK SWITCH
- 3 - POWER MIRROR SWITCH

INSTALLATION

(1) Press the switch into place.  
 (2) Connect the electrical harness connector to the switch.

FLIP-UP GLASS RELEASE SWITCH

DIAGNOSIS AND TESTING - FLIP-UP GLASS RELEASE SWITCH

(1) Disconnect and isolate the battery negative cable.

(2) Remove the tailgate trim panel (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/TRIM PANEL - REMOVAL).

(3) Disconnect the wire harness connector.



## FLIP-UP GLASS RELEASE SWITCH (Continued)

(4) Using an ohmmeter, check for continuity between the pins of the wire harness connector while pulling on the tailgate handle.

(5) If no continuity is found, replace the tailgate handle assembly (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/EXTERIOR HANDLE - REMOVAL).

## DOOR LOCK RELAY

### DESCRIPTION

The power door lock system uses the following relays for the front and rear passenger doors only:

- Driver door unlock relay
- Door lock relay
- Passenger Doors unlock relay

The tailgate uses outputs from the Body Control Module (BCM).

The relays are electromechanical devices that switch battery current to the door lock circuit when the Body Control Module (BCM) grounds the relay coil. These relays are located in the Junction Block (JB). For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

The relays are a International Standards Organization (ISO) micro-relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The ISO micro-relay terminal functions are the same as a conventional ISO relay. However, the ISO micro-relay terminal pattern (or footprint) is different, the current capacity is lower, and the physical dimensions are smaller than those of the conventional ISO relay.

The relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

### OPERATION

The ISO relay consists of an electromagnetic coil, a resistor and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

### DIAGNOSIS AND TESTING - DOOR LOCK RELAY

The power lock relays (Fig. 4) are located in the Junction Block (JB) under the instrument panel. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

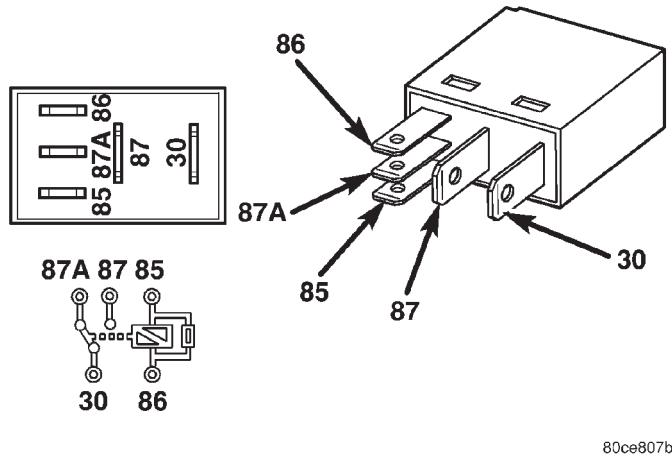
**WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Remove suspected faulty relay from the (JB).
- (2) 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 3. If not OK, replace the faulty relay.
- (3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.
- (4) 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 not OK, replace the faulty relay.

### REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Reach up under instrument panel and remove the relay from Junction Block (JB).

DOOR LOCK RELAY (Continued)



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**Fig. 4 Power Lock Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

**INSTALLATION**

- (1) Position the horn relay in the proper receptacle in the Junction Block (JB).
- (2) Push down firmly on the relay until the terminals are fully seated.
- (3) Connect the battery negative cable.

**REMOTE KEYLESS ENTRY MODULE**

**DESCRIPTION**

When an RKE lock message is sent to the Body Control Module (BCM), the BCM actuates the doors and the tailgate lock, the interior lighting is turned off, the horn chirps (if this feature is enabled), the exterior lamps flash (if this feature is enabled) and, if the vehicle is so equipped, the Vehicle Theft Security System (VTSS) is armed. When an RKE unlock message is sent to the BCM, the BCM actuates the driver side front door (or all doors and the tailgate if this feature is enabled) unlock, the interior lighting is turned on and, if the vehicle is so equipped, the VTSS is disarmed.

When an RKE panic message is sent to the BCM, the BCM actuates the driver side front door (or all doors and the tailgate if this feature is enabled) unlock, the interior lighting is turned on and, if the vehicle is so equipped, the VTSS is disarmed. The panic message will also cause the exterior lamps (including the headlights) to flash, and the horn to pulse for about three minutes, or until a second panic message is sent to the BCM. A vehicle speed of about 25.7 kilometers-per-hour (15 miles-per-hour) will also cancel the panic event.

Refer to the owner's manual for more information on the features, use and operation of the RKE system.

**OPERATION**

Whenever the vehicle battery power is interrupted, the Remote Keyless Module (RKE) Module will retain all vehicle access codes in its memory. When replacing or adding a key fob transmitter (maximum of 4) a DRB III® scan tool is required to program the RKE Module to accept the new Vehicle Access Code if a customer owned transmitter is not available.

If a functioning transmitter is available, (Refer to 8 - ELECTRICAL/POWER LOCKS/KEYLESS ENTRY TRANSMITTER - STANDARD PROCEDURE)

**DIAGNOSIS AND TESTING - REMOTE KEYLESS ENTRY MODULE**

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. Refer to the proper Body Diagnostic Procedures Manual for testing the Remote Keyless Entry system using a DRB III® scan tool.

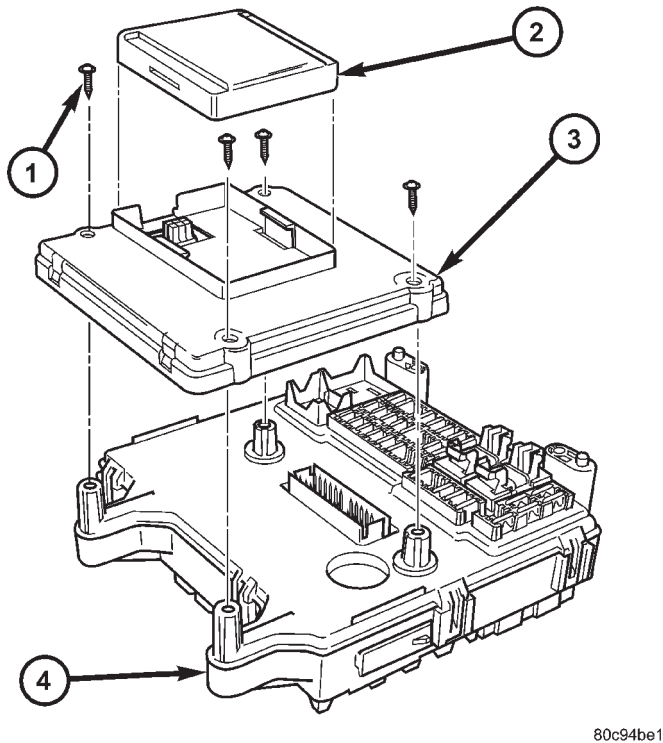
**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the Junction Block (JB) (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/JUNCTION BLOCK - REMOVAL).
- (3) Remove Remote Keyless Entry module from Body Control Module (Fig. 5).

**INSTALLATION**

- (1) Install Remote Keyless Entry module to Body Control Module.
- (2) Install Junction Block (JB) (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/JUNCTION BLOCK - INSTALLATION).
- (3) Connect the battery negative cable.

## REMOTE KEYLESS ENTRY MODULE (Continued)



80c94be1

**Fig. 5 RKE Module Remove/Install**

- 1 - SCREW (4)
- 2 - RKE MODULE
- 3 - BODY CONTROL MODULE
- 4 - JUNCTION BLOCK

## REMOTE KEYLESS ENTRY TRANSMITTER

### DIAGNOSIS AND TESTING - REMOTE KEYLESS ENTRY TRANSMITTER

The most reliable, efficient, and accurate means to diagnose the remote keyless entry transmitter requires the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, and that all of the electronic modules are sending and receiving the proper messages on the PCI data bus.

### STANDARD PROCEDURE

#### STANDARD PROCEDURE - RKE TRANSMITTER BATTERIES

The Remote Keyless Entry (RKE) transmitter case snaps open and shut for battery access. To replace the RKE transmitter batteries:

(1) Using a thin coin, gently pry at the notch in the center seam of the RKE transmitter case halves near the key ring until the two halves unsnap.

(2) Lift the back half of the transmitter case off of the RKE transmitter.

(3) Remove the two batteries from the RKE transmitter.

(4) Replace the two batteries with new Panasonic 2016, or equivalent. Be certain that the batteries are installed with their polarity correctly oriented.

(5) Align the two RKE transmitter case halves with each other, and squeeze them firmly and evenly together until they snap back into place.

### STANDARD PROCEDURE - RKE TRANSMITTER CUSTOMER PREFERENCES

#### AUTOMATIC (ROLLING) LOCKS

The rolling locks feature can be toggled ON/OFF by using the DRB III® only.

#### HORN CHIRP DISABLING / ENABLING

The horn chirp can be toggled using a DRB III® or by using the Remote Keyless Entry (RKE) transmitter.

To DISABLE (cancel) the horn chirp feature, press and hold the transmitter LOCK button for four to ten seconds. While pressing the LOCK button in, press the UNLOCK button. Release both buttons.

To ENABLE the horn chirp feature, repeat the above procedure.

#### OPTICAL CHIRP (FLASH) DISABLING / ENABLING

The optical chirp can be toggled using a DRB III® or by using the Remote Keyless Entry (RKE) transmitter.

To DISABLE (cancel) the optical chirp feature, press and hold the transmitter LOCK button for four to ten seconds. While pressing the LOCK button in, press the TAILGATE RELEASE button. Release both buttons.

To ENABLE the optical chirp feature, repeat the above procedure.

#### TAIL GATE RELEASE DELAY

Press the UNLOCK button for four to ten seconds. While pressing the UNLOCK button, press the TAIL GATE RELEASE button. Release both buttons.

This will toggle between PRESS AND HOLD and PRESS (no delay).

#### UNLOCK SEQUENCE

The unlock sequence can be toggled using a DRB III® or by using the Remote Keyless Entry (RKE) transmitter.

## REMOTE KEYLESS ENTRY TRANSMITTER (Continued)

Press and hold the transmitter UNLOCK button for four to ten seconds. While pressing the UNLOCK button in, press the LOCK button. Release both buttons.

This will toggle between Driver door first and Unlock all doors function.

**STANDARD PROCEDURE - RKE TRANSMITTER PROGRAMING**

New Remote Keyless Entry (RKE) transmitters can be programed using the DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, and that all of the electronic modules are sending and receiving the proper messages on the PCI data bus.

The following procedure can be used as long as one functioning transmitter is available:

- (1) Using the original transmitter, press the UNLOCK button for 4 to 10 seconds.
- (2) Without releasing the UNLOCK button, press the PANIC button (within the 4 to 10 second interval).
- (3) Release both buttons.
- (4) Press LOCK and UNLOCK simultaneously on the original transmitter.
- (5) Release both buttons.
- (6) Press any button on the ORIGINAL transmitter. A chime tone from the instrument cluster will confirm the programming of the ORIGINAL transmitter.
- (7) On NEW transmitter, press LOCK and UNLOCK simultaneously.
- (8) Release both buttons.
- (9) Press any button on the NEW transmitter. A chime tone from the instrument cluster will confirm the programming of the NEW transmitter.
- (10) Up to four transmitters can be programed for one vehicle.

**SPECIFICATIONS - REMOTE KEYLESS ENTRY TRANSMITTER****RANGE**

Normal operation range is up to a distance of 3 to 7 meters (10 to 23 ft.) of the vehicle. Range may be better or worse depending on the environment around the vehicle.

**TAILGATE CYLINDER LOCK SWITCH****DESCRIPTION**

The tailgate cylinder lock switch is integral to the key lock cylinder inside the tailgate. The tailgate cylinder lock switch is a normally-open momentary switch that is hard wired directly to the Body Control Module (BCM), and closes a path to ground through an internal resistor when the lock cylinder is rotated to the unlock or lock position.

The tailgate cylinder lock switch cannot be adjusted or repaired.

**OPERATION**

The tailgate cylinder lock switch is actuated when the key is inserted in the lock cylinder and turned to the unlock or lock position. The tailgate cylinder lock switch closes a path to ground through an internal resistor for the Body Control Module (BCM) when the tailgate key lock cylinder is in the lock or unlock position, and opens the ground path when the lock cylinder is in the neutral position. The BCM reads the switch status, then sends the proper switch status messages to other electronic modules over the Programmable Communications Interface (PCI) data bus network. The tailgate cylinder lock switch unlock status message is used by the BCM as an input for Vehicle Theft Security System (VTSS) operation and to tell the BCM to lock or unlock the tailgate. There is no mechanical linkage between the tailgate key cylinder and the latches.

**DIAGNOSIS AND TESTING - TAILGATE CYLINDER LOCK SWITCH**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove tailgate trim panel (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/TRIM PANEL - REMOVAL).
- (3) Disconnect tailgate cylinder lock switch harness connector.
- (4) Using a ohmmeter, test for resistances as shown in the Tailgate Cylinder Lock Switch Table.

## TAILGATE CYLINDER LOCK SWITCH (Continued)

## TAILGATE CYLINDER LOCK SWITCH TABLE

SWITCH POSITION	RESISTANCE
NEUTRAL	0 OHMS
LOCK (CLOCKWISE)	2 K OHMS $\pm$ 10 %
UNLOCK (COUNTER-CLOCKWISE)	470 OHMS $\pm$ 10 %

(5) If switch resistance is not correct, replace switch.

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the tailgate trim panel.(Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/TRIM PANEL - REMOVAL).

(3) Remove the retainer clip from the pin on the back of the door lock cylinder (Fig. 6).

(4) Remove the washer from the pin on the back of the door lock cylinder.

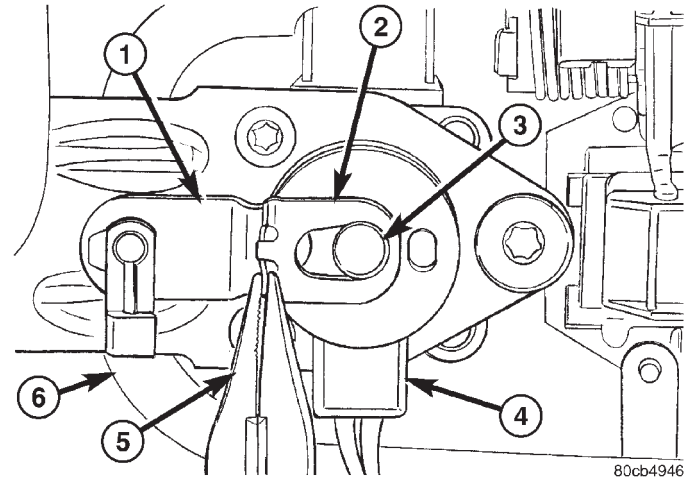
(5) Remove the door cylinder lock switch from the back of the lock cylinder.

**INSTALLATION**

(1) Position the tailgate cylinder lock switch onto the back of the lock cylinder with the wire harness oriented toward the bottom.

(2) Position the washer over the switch.

(3) Install the retainer clip onto the pin on the back of the tailgate lock cylinder. Be certain that the



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**Fig. 6 Lock Cylinder Switch Remove/Install -Typical**

- 1 - LEVER
- 2 - RETAINER
- 3 - LOCK CYLINDER
- 4 - SWITCH
- 5 - PLIERS
- 6 - OUTSIDE DOOR HANDLE

center tab of the retainer is engaged in the retention hole on the lock lever.

(4) Install the trim panel (Refer to 23 - BODY/DECKLID/HATCH/LIFTGATE/TAILGATE/TRIM PANEL - INSTALLATION).

(5) Connect the battery negative cable.

# POWER MIRRORS

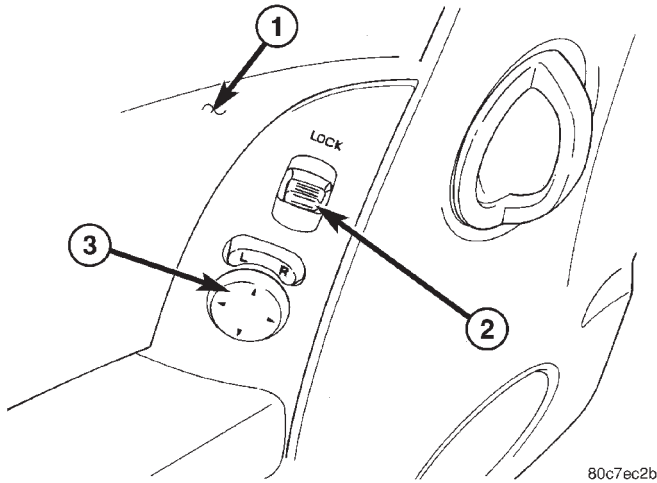
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## POWER MIRRORS

### DESCRIPTION

The available power operated sideview mirrors allow the driver to adjust both outside mirrors electrically from the drivers seat by operating a switch on the driver side front door trim panel (Fig. 1).



**Fig. 1 POWER MIRROR SWITCH**

- 1 - DOOR TRIM PANEL
- 2 - DOOR LOCK SWITCH
- 3 - POWER MIRROR SWITCH

### OPERATION

The power mirrors receive ignition current through a fuse in the junction block, and will only operate when the ignition switch is in the Run position.

## DIAGNOSIS AND TESTING - POWER MIRRORS

### WIRING VOLTAGE TEST

The following wiring test determines whether or not voltage is continuous through the body harness to switch.

- (1) Remove the power mirror switch (Refer to 8 - ELECTRICAL/POWER MIRRORS/POWER MIRROR SWITCH - REMOVAL).
- (2) Disconnect wire connector from back of power mirror switch.
- (3) Switch ignition to the RUN position.
- (4) Connect the clip end of a 12 volt test light to Pin 5 in the harness connector at the mirror switch. Touch the test light probe to Pin 3.

If the test light illuminates, the wiring circuit between the battery and switch is OK.

If the lamp does not illuminate, first check fuse 25 in the Junction Block (JB). If fuse 25 is OK, then check for a broken wire.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

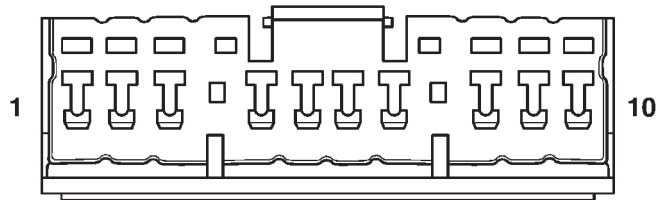
### POWER MIRROR MOTOR TEST

If the power mirror switch is receiving proper current and ground and mirrors do not operate, proceed with power mirror motor test. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

POWER MIRRORS (Continued)

- (1) Remove front door trim panel to gain access to power mirror wire connector (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).
- (2) Disconnect wire harness connector to power mirror switch (Fig. 2).
- (3) Using two jumper wires:
  - Connect one to a 12 volt source
  - Connect the other to a good body ground
  - Refer to the Mirror Motor Test Chart for proper wire connections at the switch connector

- (2) Disconnect wiring harness connector from switch.
- (3) Using a ohmmeter, test for continuity between the terminals of the switch (Fig. 3).
- (4) If results shown in the table are not obtained, replace the switch.



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**Fig. 2 POWER MIRROR SWITCH CONNECTOR**  
MIRROR MOTOR TEST CHART

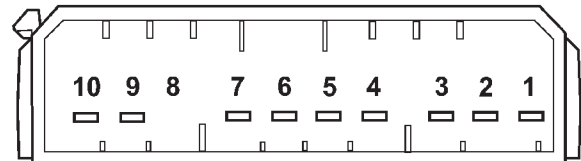
12 VOLTS	GROUND	MIRROR REACTION	
SWITCH CONNECTOR		RIGHT	LEFT
PIN 2	PIN 6	-	UP
PIN 6	PIN 1	-	LEFT
PIN 6	PIN 2	-	DOWN
PIN 1	PIN 6	-	RIGHT
PIN 9	PIN 6	UP	-
PIN 6	PIN 10	LEFT	-
PIN 6	PIN 9	DOWN	-
PIN 10	PIN 6	RIGHT	-

(4) If results shown in table are not obtained, check for open or shorted circuit. Replace mirror assembly as necessary.

POWER MIRROR SWITCH

DIAGNOSIS AND TESTING - POWER MIRROR SWITCH

- (1) Remove power mirror switch (Refer to 8 - ELECTRICAL/POWER MIRRORS/POWER MIRROR SWITCH - REMOVAL).



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**Fig. 3 POWER MIRROR SWITCH**  
POWER MIRROR SWITCH TEST

SWITCH POSITION	CONTINUITY BETWEEN
MIRROR SELECT SWITCH IN "LEFT" POSITION	
UP	5 AND 2
	3 AND 6
DOWN	5 AND 6
	3 AND 2
LEFT	5 AND 6
	3 AND 1
RIGHT	5 AND 1
	3 AND 6
MIRROR SELECT SWITCH IN "RIGHT" POSITION	
UP	5 AND 9
	3 AND 6
DOWN	5 AND 6
	3 AND 9
LEFT	5 AND 6
	3 AND 10
RIGHT	5 AND 10
	3 AND 6

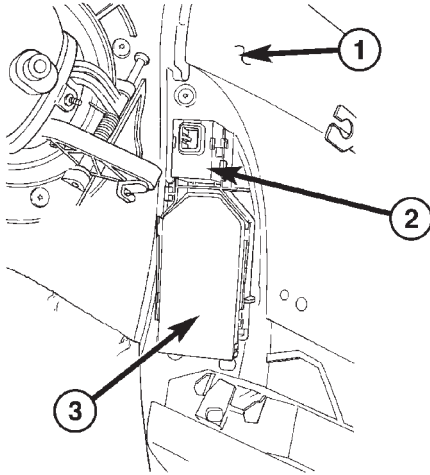
## POWER MIRROR SWITCH (Continued)

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Disconnect wire harness connector from switch (Fig. 4).



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**Fig. 4 DOOR LOCK/MIRROR SWITCH**

- 1 - DOOR TRIM PANEL
- 2 - DOOR LOCK SWITCH
- 3 - POWER MIRROR SWITCH

(4) Remove switch from door trim panel.

**INSTALLATION**

(1) Install switch to door trim panel.

(2) Connect wire harness connector to switch.

(3) Install door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(4) Connect battery negative cable.

**SIDEVIEW MIRROR****REMOVAL**

(1) For removal procedures, (Refer to 23 - BODY/EXTERIOR/SIDE VIEW MIRROR - REMOVAL).



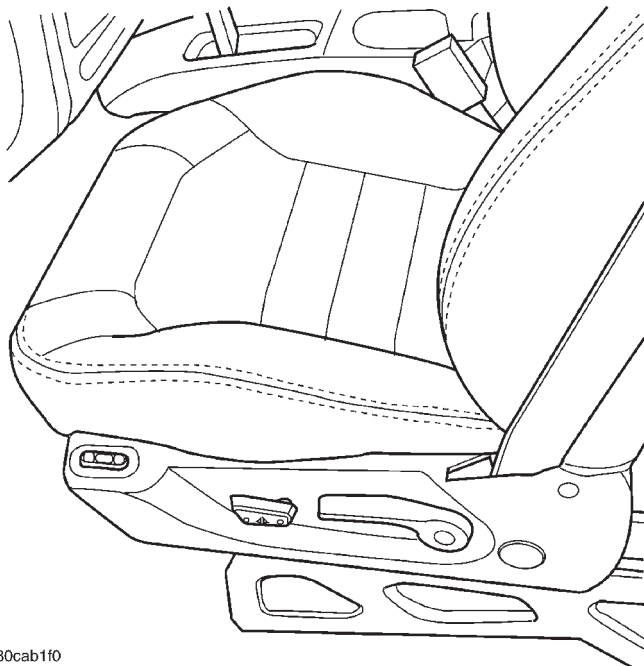
# POWER SEATS

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## POWER SEATS

### DESCRIPTION



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**Fig. 1 KJ Heated/Power Seat**

Individually controlled, electrically powered front seats are available as factory-installed equipment on this model. Vehicles with this option can be visually identified by the two separate power seat switches, mounted on each of the front seat cushion side shields (Fig. 1). The power seat system option allows the front seating positions to be electrically adjusted

for optimum vehicle control and comfort. The power seat cushion can be adjusted forward, rearward, front up, front down, rear up, or rear down. The power seat system for this vehicle includes the following major components, which are described in further detail later in this section:

- **Power Seat Switches** - Two power seat switches are used per vehicle, one for the driver and one for the front seat passenger. Refer to the left and right power seat switch information later in this section.
- **Power Seat Tracks** - Two power seat tracks are used per vehicle, one for the driver and one for the front seat passenger seats. Refer to the power seat track information later in this section.
- **Circuit Breaker** - An automatic resetting circuit breaker (# 1) is located in the Junction Block and is used to protect the power seat system from current overload.

Hard wired circuitry connects the power seat system components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the power seat system components through the use of a combination of soldered splices, splice block connectors and many different types of wire harness terminal connectors and insulators. Refer to the **Wiring** section of this manual for more information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## POWER SEATS (Continued)

**OPERATION**

The power seat system receives battery current through a fuse in the Power Distribution Center (PDC) and a circuit breaker in the Junction Block, regardless of the ignition switch position.

When a power seat switch control knob or knobs are actuated, a battery feed and a ground path are applied through the switch contacts to the appropriate power seat track adjuster motor. The selected adjuster motor operates to move the seat track through its drive unit in the selected direction until the switch is released, or until the travel limit of the seat track 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 adjuster motor to run in the opposite direction.

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.

**DIAGNOSIS AND TESTING - POWER SEATS**

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. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and joint connector location views for the various wire harness connectors, splices and grounds.

(1) If all power seats are inoperative, check the automatic resetting circuit breaker in the Junction Block. (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/CIRCUIT BREAKER - DIAGNOSIS AND TESTING).

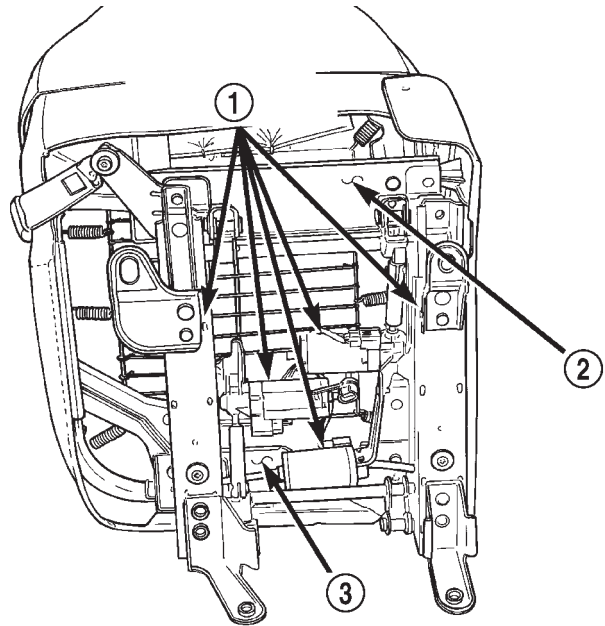
(2) With the dome lamp on, apply the power seat switch in the direction of the failure.

(3) If the dome lamp dims, the seat or the power seat track may be jammed. Check under and behind the seat for binding or obstructions.

(4) If the dome lamp does not dim, proceed with testing of the individual power seat system components and circuits.

**SEAT TRACK****DESCRIPTION**

The six-way power seat option includes a power seat track assembly located under each front seat (Fig. 2). The power seat track assembly replaces the standard manually operated seat tracks. The lower half of the power seat track is secured at the front



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**Fig. 2 Power Seat Track - Typical**

- 1 - POWER SEAT ADJUSTER AND MOTORS
- 2 - SEAT CUSHION FRAME
- 3 - POWER SEAT TRACK ASSEMBLY

with two bolts to the floor panel seat cross member, and at the rear with one bolt and one nut to the floor panel. Four bolts secure the bottom of the seat cushion frame to the upper half of the power seat track unit.

The power seat track assembly cannot be repaired, and is serviced only as a complete assembly. If any component in this assembly is faulty or damaged, the entire power seat track must be replaced.

**OPERATION**

The power seat track unit includes three reversible electric motors that are secured to the upper half of the track unit. Each motor moves the seat adjuster through a combination of worm-drive gearboxes and screw-type drive units. Each of the three driver side power seat track motors also has a position potentiometer integral to the motor assembly, which electronically monitors the motor position.

The front and rear of the seat are operated by two separate vertical adjustment motors. These motors can be operated independently of each other, tilting the entire seat assembly forward or rearward; or, they can be operated in unison by selecting the proper power seat switch functions, which will raise or lower the entire seat assembly. The third motor is the horizontal adjustment motor, which moves the seat track in the forward and rearward directions.

SEAT TRACK (Continued)

**DIAGNOSIS AND TESTING - SEAT TRACK**

(1) Remove the power seat switch from the seat (Refer to 8 - ELECTRICAL/POWER SEATS/DRIVER SEAT SWITCH - REMOVAL).

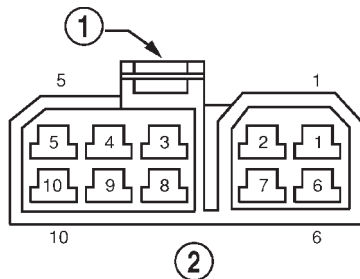
(2) Checking the body harness side of the power seat switch electrical connector (Fig. 3), check Pin 1 for ground and Pin 5 for battery voltage. If either of these two are not present repair the body harness as required.

(3) To test the seat motors and verify proper seat responses, refer to the Seat Motor Test table below. Using two jumper wires, connect one to a battery supply and the second to a ground. Connect the other ends to the seat wire harness connector as described in the Seat Motor Test table.

SEAT MOTOR TEST

SEAT SWITCH CONNECTOR			
CONNECT JUMPER		SEAT ACTION	
B(+)	B(-)	LEFT SIDE	RIGHT SIDE
PIN 9	PIN 8	FRONT RISER UP	FRONT RISER DOWN
PIN 8	PIN 9	FRONT RISER DOWN	FRONT RISER UP
PIN 3	PIN 6	FORWARD	FORWARD
PIN 6	PIN 3	REARWARD	REARWARD
PIN 10	PIN 7	REAR RISER UP	REAR RISER DOWN
PIN 7	PIN 10	REAR RISER DOWN	REAR RISER UP

**REMOVAL**



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**Fig. 3 POWER SEAT SWITCH HARNESS PIN IDENTIFICATION**

- 1 - CONNECTOR RETAINING TAB
- 2 - VIEWED FROM BODY HARNESS END

(1) Remove the appropriate seat from the vehicle. (Refer to 23 - BODY/SEATS/SEAT - REMOVAL).

(2) Remove the seat cushion side shield from the seat (Refer to 23 - BODY/SEATS/SEAT CUSHION SIDE COVERS - REMOVAL).

(3) Remove four seat track mounting bolts from cushion pan.

(4) Disconnect the power seat electrical and remove the seat track from the seat cushion.

**INSTALLATION**

(1) Position the seat track and install the retaining bolts in the seat cushion pan. Torque the bolts to 45-60 N·m.

(2) Route and connect the power seat electrical on the seat track and cushion pan.

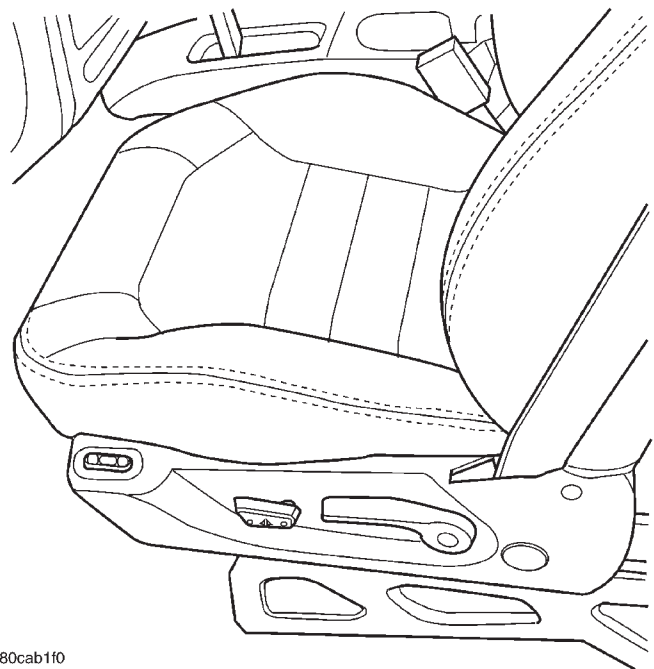
(3) Install the seat cushion side shield on the seat. Refer to the Body section for the procedure.

(4) Install the seat in the vehicle (Refer to 23 - BODY/SEATS/SEAT - INSTALLATION).

(5) Connect the negative battery cable.

**LEFT POWER SEAT SWITCH**

**DESCRIPTION**



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**Fig. 4 KJ Heated/Power Seat**

Vehicles equipped with the power seat option utilize a six-way power seat switch. This six-way power seat switch features one seat cushion shaped knob, visible on the outboard seat cushion side shield (Fig. 4).

The switch is secured to the back of the seat cushion side shield with two screws. However, the control knob must be removed before the seat switch can be removed from the side shield.

LEFT POWER SEAT SWITCH (Continued)

The individual switches internal to the power seat switch cannot be repaired. If one switch is damaged or faulty, the entire power seat switch unit must be replaced.

**OPERATION**

The power seat tracks can be adjusted in six different ways using the power seat switches. See the owner's manual in the vehicle glove box for more information on the power seat switch functions and the seat adjusting procedures.

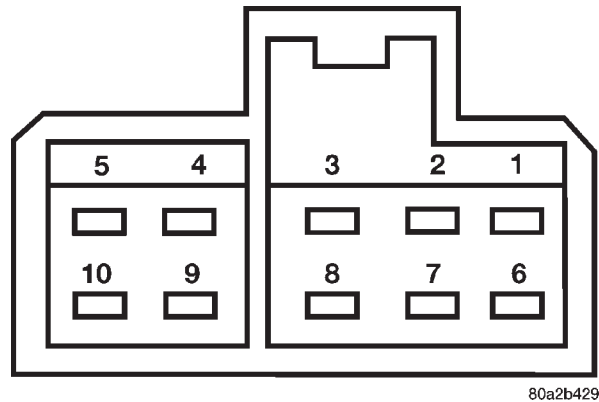
When a power seat switch control knob or knobs are actuated, a battery feed and a ground path are applied through the switch contacts to the power seat track adjuster motor. The selected adjuster motor operates to move the seat track through its drive unit in the selected direction until the switch is released, or until the travel limit of the seat track 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 adjuster motor to run in the opposite direction.

No power seat switch should be held applied in any direction after the seat track has reached its travel limit. The power seat adjuster motors each contain a self-resetting circuit breaker to protect them from overload. However, consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged.

**DIAGNOSIS AND TESTING - LEFT POWER SEAT SWITCH**

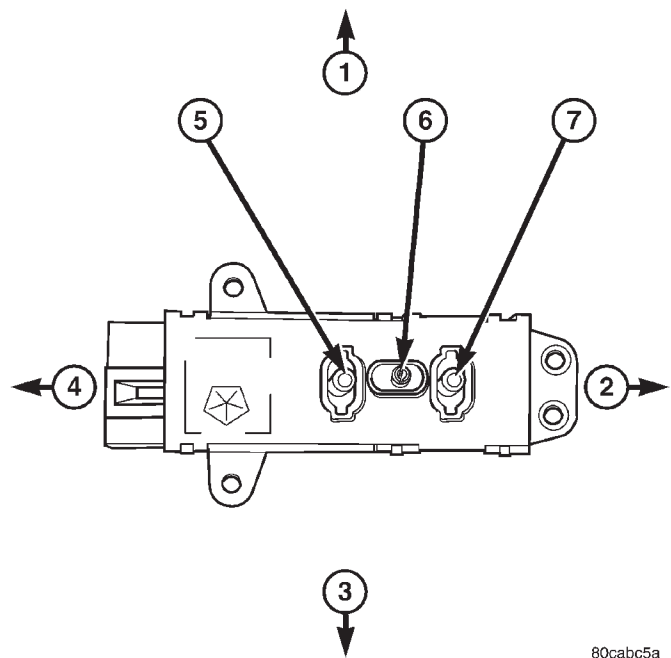
For complete circuit diagrams, refer to **Power Seat** in Wiring Diagrams.

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the power seat switch from the outboard seat cushion side shield.
- (3) Use an ohmmeter to test the continuity of the power seat switch in each switch position. See the Power Seat Switch Continuity chart (Fig. 5) and switch (Fig. 6) below. If OK, refer to **Diagnosis and Testing the Power Seat Track** in this section. If not OK, replace the faulty power seat switch unit.



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**Fig. 5 SIX-WAY POWER SEAT SWITCH CONTINUITY**



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**Fig. 6 DIAGNOSING POWER SEAT SWITCH**

- 1 - UP
- 2 - REARWARD
- 3 - DOWN
- 4 - FORWARD
- 5 - FRONT RISER SWITCH
- 6 - CENTER SEAT SWITCH
- 7 - REAR RISER SWITCH

## LEFT POWER SEAT SWITCH (Continued)

SWITCH POSITION	CONTINUITY BETWEEN PINS	
	DRIVER SEAT	PASSENGER SEAT
OFF	PIN 1 to 3	PIN 1 to 3
	PIN 1 to 6	PIN 1 to 6
	PIN 1 to 7	PIN 1 to 7
	PIN 1 to 8	PIN 1 to 8
	PIN 1 to 9	PIN 1 to 9
	PIN 1 to 10	PIN 1 to 10
FRONT RISER UP	PIN 1 to 8	PIN 1 to 8
	PIN 5 to 9	PIN 5 to 9
FRONT RISER DOWN	PIN 1 to 9	PIN 1 to 9
	PIN 5 to 8	PIN 5 to 8
CENTER SWITCH FORWARD	PIN 1 to 6	PIN 1 to 6
	PIN 5 to 3	PIN 5 to 3
CENTER SWITCH REARWARD	PIN 1 to 3	PIN 1 to 3
	PIN 5 to 6	PIN 5 to 6
REAR RISER UP	PIN 1 to 7	PIN 1 to 7
	PIN 5 to 10	PIN 5 to 10
REAR RISER DOWN	PIN 1 to 10	PIN 1 to 10
	PIN 5 to 7	PIN 5 to 7

**REMOVAL**

(1) Disconnect and isolate the negative battery cable.

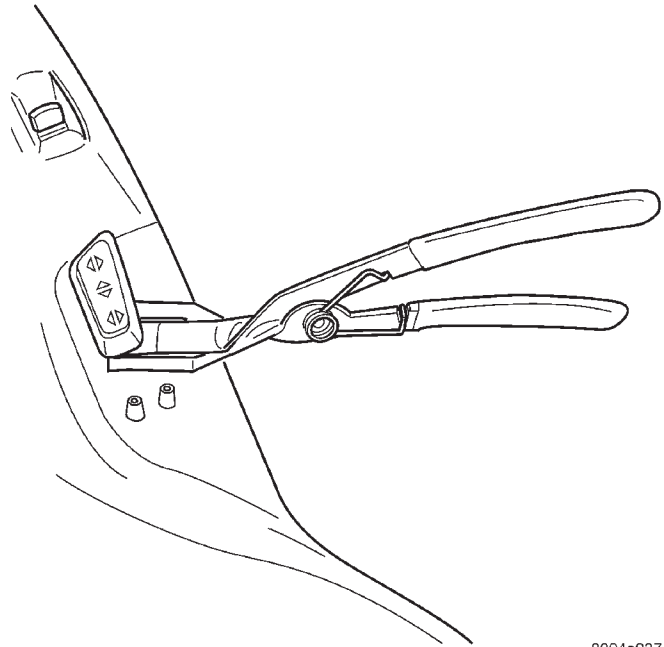
(2) Using a push pin remover or another suitable wide flat-bladed tool, gently pry the power seat switch knob off of the switch control levers (Fig. 7).

(3) Remove the two forward-most screws that secure the outboard seat cushion side shield to the seat cushion frame.

(4) Remove the recliner handle retaining screw and remove the recliner handle.

(5) Pull the outboard seat cushion side shield away from the seat cushion frame far enough to access the power seat switch wire harness tiestrap and connector. Cut the tiestrap, if equipped.

(6) Disconnect the power seat wire harness connector from the power seat switch connector receptacle. Depress the connector retaining tab and pull straight apart.



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**Fig. 7 REMOVING SWITCH CONTROL KNOB - TYPICAL**

(7) Using a very short phillips-headed screwdriver, remove the two screws that secure the power seat switch to the inside of the outboard seat cushion side shield.

(8) Remove the power seat switch from the outboard seat cushion side shield.

**INSTALLATION**

(1) Reconnect the power seat wire harness connector to the power seat switch connector receptacle.

(2) Position the power seat switch onto the outboard seat cushion side shield. Make certain the alignment dowel is inserted into the corresponding hole in the power seat switch.

(3) Install and tighten the two screws that secure the power seat switch to the inside of the outboard seat cushion side shield. Tighten the screws to 1.5 N·m (14 in. lbs.).

(4) Position the outboard seat cushion side shield onto the seat cushion frame

(5) Install and tighten the two screws that secure the outboard seat cushion side shield to the seat cushion frame. Tighten the screws to 1.5 N·m (14 in. lbs.).

(6) Install the recliner handle and retaining screw. Tighten the screws to 1.5 N·m (14 in. lbs.).

(7) Position the power seat switch knob onto the switch control levers and push firmly and evenly until it snaps into place.

(8) Reconnect the battery negative cable.

## RIGHT POWER SEAT SWITCH

### DESCRIPTION

Vehicles equipped with the power seat option utilize a six-way power seat switch. This six-way power seat switch features one seat cushion shaped knob, visible on the outboard seat cushion side shield.

The switch is secured to the back of the seat cushion side shield with two screws. However, the control knob must be removed before the seat switch can be removed from the side shield.

The individual switches internal to the power seat switch cannot be repaired. If one switch is damaged or faulty, the entire power seat switch unit must be replaced.

### OPERATION

The power seat tracks can be adjusted in six different ways using the power seat switches. See the owner's manual in the vehicle glove box for more information on the power seat switch functions and the seat adjusting procedures.

When a power seat switch control knob or knobs are actuated, a battery feed and a ground path are applied through the switch contacts to the power seat track adjuster motor. The selected adjuster motor operates to move the seat track through its drive unit in the selected direction until the switch is released, or until the travel limit of the seat track 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 adjuster motor to run in the opposite direction.

No power seat switch should be held applied in any direction after the seat track has reached its travel limit. The power seat adjuster motors each contain a self-resetting circuit breaker to protect them from overload. However, consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged.

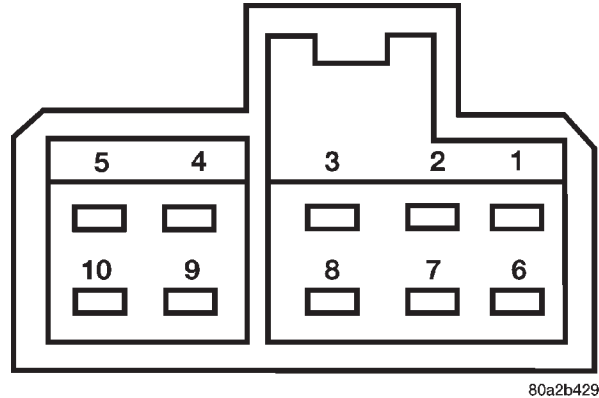
### DIAGNOSIS AND TESTING - RIGHT POWER SEAT SWITCH

For complete circuit diagrams, refer to **Power Seat** in Wiring Diagrams.

(1) Disconnect and isolate the battery negative cable.

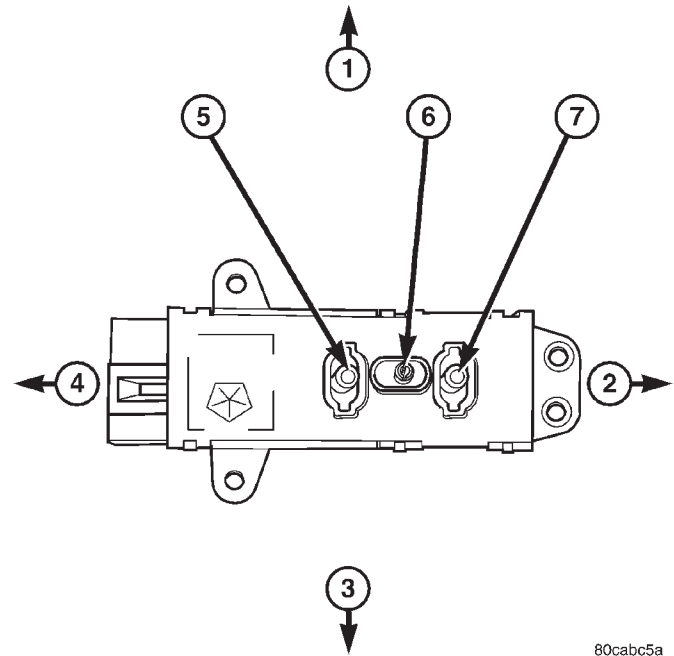
(2) Remove the power seat switch from the outboard seat cushion side shield.

(3) Use an ohmmeter to test the continuity of the power seat switch in each switch position. See the Power Seat Switch Continuity chart (Fig. 8) and switch (Fig. 9) below. If OK, refer to **Diagnosis and Testing the Power Seat Track** in this section. If not OK, replace the faulty power seat switch unit.



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Fig. 8 SIX-WAY POWER SEAT SWITCH CONTINUITY



80cab5a

Fig. 9 DIAGNOSING POWER SEAT SWITCH

- 1 - UP
- 2 - REARWARD
- 3 - DOWN
- 4 - FORWARD
- 5 - FRONT RISER SWITCH
- 6 - CENTER SEAT SWITCH
- 7 - REAR RISER SWITCH

## RIGHT POWER SEAT SWITCH (Continued)

SWITCH POSITION	CONTINUITY BETWEEN PINS	
	DRIVER SEAT	PASSENGER SEAT
OFF	PIN 1 to 3	PIN 1 to 3
	PIN 1 to 6	PIN 1 to 6
	PIN 1 to 7	PIN 1 to 7
	PIN 1 to 8	PIN 1 to 8
	PIN 1 to 9	PIN 1 to 9
	PIN 1 to 10	PIN 1 to 10
FRONT RISER UP	PIN 1 to 8	PIN 1 to 8
	PIN 5 to 9	PIN 5 to 9
FRONT RISER DOWN	PIN 1 to 9	PIN 1 to 9
	PIN 5 to 8	PIN 5 to 8
CENTER SWITCH FORWARD	PIN 1 to 6	PIN 1 to 6
	PIN 5 to 3	PIN 5 to 3
CENTER SWITCH REARWARD	PIN 1 to 3	PIN 1 to 3
	PIN 5 to 6	PIN 5 to 6
REAR RISER UP	PIN 1 to 7	PIN 1 to 7
	PIN 5 to 10	PIN 5 to 10
REAR RISER DOWN	PIN 1 to 10	PIN 1 to 10
	PIN 5 to 7	PIN 5 to 7

**REMOVAL**

(1) Disconnect and isolate the negative battery cable.

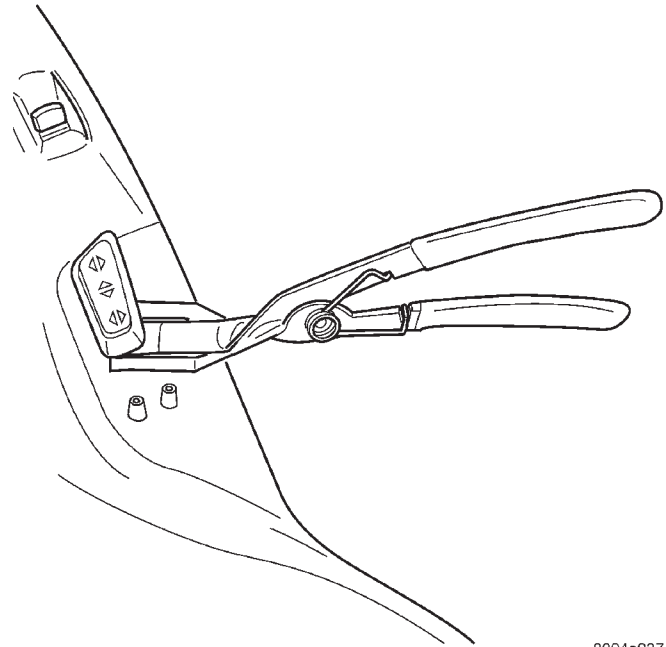
(2) Using a push pin remover or another suitable wide flat-bladed tool, gently pry the power seat switch knob off of the switch control levers (Fig. 10).

(3) Remove the two forward-most screws that secure the outboard seat cushion side shield to the seat cushion frame.

(4) Remove the recliner handle retaining screw and remove the recliner handle.

(5) Pull the outboard seat cushion side shield away from the seat cushion frame far enough to access the power seat switch wire harness tiestrap and connector. Cut the tiestrap, if equipped.

(6) Disconnect the power seat wire harness connector from the power seat switch connector receptacle. Depress the connector retaining tab and pull straight apart.



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**Fig. 10 REMOVING SWITCH CONTROL KNOB - TYPICAL**

(7) Using a very short phillips-headed screwdriver, remove the two screws that secure the power seat switch to the inside of the outboard seat cushion side shield.

(8) Remove the power seat switch from the outboard seat cushion side shield.

**INSTALLATION**

(1) Reconnect the power seat wire harness connector to the power seat switch connector receptacle.

(2) Position the power seat switch onto the outboard seat cushion side shield. Make certain the alignment dowel is inserted into the corresponding hole in the power seat switch.

(3) Install and tighten the two screws that secure the power seat switch to the inside of the outboard seat cushion side shield. Tighten the screws to 1.5 N·m (14 in. lbs.).

(4) Position the outboard seat cushion side shield onto the seat cushion frame

(5) Install and tighten the two screws that secure the outboard seat cushion side shield to the seat cushion frame. Tighten the screws to 1.5 N·m (14 in. lbs.).

(6) Install the recliner handle and retaining screw. Tighten the screws to 1.5 N·m (14 in. lbs.).

(7) Position the power seat switch knob onto the switch control levers and push firmly and evenly until it snaps into place.

(8) Reconnect the battery negative cable.

# POWER WINDOWS

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## POWER WINDOWS

### DESCRIPTION

The power window system allows each of the door windows to be raised and lowered electrically by actuating a switch on the center console. A master switch on the front of the center console allows the driver to raise or lower each of the passenger door windows and to lock out the individual switches on the rear of the center console from operation. The power window system receives battery feed through fuse 13 in the Power Distribution Center (PDC), only when the ignition switch is in the RUN or ACCESSORY position.

### OPERATION

#### WINDOW SWITCH

The power window switches control the battery and ground feeds to the power window motors. Both of the rear door power window switches receive their battery and ground feeds through the circuitry of the front window switch. When the power window lock-out switch is in the Lock position, the battery feed for the rear door window switches is interrupted.

#### WINDOW MOTOR

Front door window lift motors use permanent type magnets. The B+ and ground applied at the motor terminal pins will cause the motor to rotate in one direction. Reversing current through the motor terminals will cause the motor to rotate in the opposite direction.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

## DIAGNOSIS AND TESTING - POWER WINDOWS

### WIRING VOLTAGE TEST

The following wiring test determines whether or not voltage is continuous through the body harness to the front switch.

(1) Remove the power window switch and bezel (Refer to 8 - ELECTRICAL/POWER WINDOWS/POWER WINDOW SWITCH - REMOVAL).

(2) Disconnect wire connector from back of power window switch.

(3) Switch ignition to the ON position.

(4) Connect the clip end of a 12 volt test light to Pin 14 of the window switch harness connector. Touch the test light probe to Pin 10.

- If the test light illuminates, the wiring circuit between the battery and switch is OK.
- If the lamp does not illuminate, first check fuse 13 in the Power Distribution Center (PDC). If fuse 13 is OK, then check for a broken wire.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

### POWER WINDOW MOTOR TEST

If the power window motor is receiving proper current and ground and does not operate, proceed with motor test. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Remove front door trim panel as necessary to gain access to power window motor wire connector



POWER WINDOWS (Continued)

(Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(2) Disconnect power window motor wire connector from door harness.

(3) Using two jumper wires, connect one to a battery (+) source and the other to a good ground (-).

(4) Connect the Negative (-) jumper probe to one of the motor connector terminals.

(5) Momentarily touch the Positive (+) jumper probe to the other motor connector terminal.

When positive probe is connected the motor should rotate in one direction to either move window up or down. If window is all the way up or down the motor will grunt and the inner door panel will flex when actuated in that one direction.

(6) Reverse jumper probes at the motor connector terminals and window should now move in opposite direction. If window does not move or grunt, replace the motor.

If window moved completely up or down, reverse the jumper probes and cycle window to the opposite position to verify full operation.

If motor grunts and does not move, verify that regulator is not binding.

WINDOW MOTOR

REMOVAL

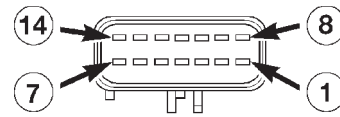
The window motor is incorporated into the window regulator assembly. If the window motor requires replacement, the window regulator must be replaced. (Refer to 23 - BODY/DOOR - FRONT/WINDOW REGULATOR - REMOVAL) or (Refer to 23 - BODY/DOORS - REAR/WINDOW REGULATOR - REMOVAL).

WINDOW SWITCH

DIAGNOSIS AND TESTING - WINDOW SWITCH

(1) Remove the switch to be tested (Refer to 8 - ELECTRICAL/POWER WINDOWS/POWER WINDOW SWITCH - REMOVAL).

(2) Using an ohmmeter, Test front switch for continuity (Fig. 1).



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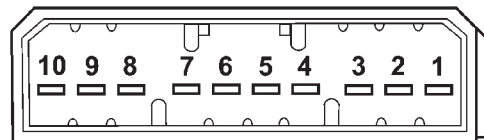
Fig. 1 FRONT WINDOW SWITCH

POWER WINDOW FRONT SWITCH TEST

SWITCH POSITION	CONTINUITY BETWEEN
OFF	14 AND 4
	14 AND 5
	14 AND 6
	14 AND 7
	14 AND 9
	14 AND 11
	14 AND 12
	14 AND 13
LEFT FRONT UP	10 AND 11
LEFT FRONT DOWN	10 AND 9
RIGHT FRONT UP	10 AND 12
RIGHT FRONT DOWN	10 AND 13
LEFT REAR UP	10 AND 5
LEFT REAR DOWN	10 AND 4
RIGHT REAR UP	10 AND 7
RIGHT REAR DOWN	10 AND 6
LOCKOUT (LOCKED)	NO CONTINUITY BETWEEN 10 AND 2
LOCKOUT (UNLOCKED)	10 AND 2

(3) If the proper results are not obtained, replace the front window switch.

(4) Test rear switch for continuity (Fig. 2).



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Fig. 2 REAR WINDOW SWITCH

WINDOW SWITCH (Continued)

POWER WINDOW REAR SWITCH TEST

SWITCH POSITION	CONTINUITY BETWEEN
OFF	1 AND 3
	4 AND 2
	7 AND 10
	8 AND 9
LEFT UP	10 AND 6
LEFT DOWN	6 AND 8
RIGHT UP	5 AND 2
RIGHT DOWN	5 AND 3

(5) If the proper results are not obtained, replace the rear window switch.

The power window master switch has a Auto-Down feature on both front windows. The switch is equipped with two detent positions when actuating the power window OPEN. The first detent position allows the window to roll down and stop when the switch is released. The second detent position actuates an integral express roll down relay that rolls the window down after the switch is released. When the express down circuit senses stall current (window has reached end of down travel), the switch will turn current off to the motor. The AUTO feature can be cancelled by actuating the switch UP or DOWN while window is in motion. If the electronic circuit in the switch fails to detect a stall current, the auto down circuit will time out within 9 to 14 seconds.

REMOVAL

FRONT

- (1) Disconnect and isolate the battery negative cable.
- (2) Using a trim stick, gently pry the switch from the console (Fig. 3).
- (3) Disconnect electrical harness connector.

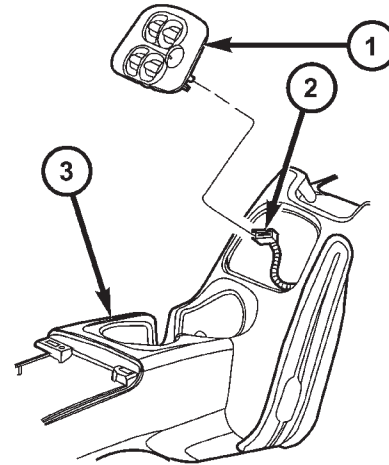
REAR

- (1) Disconnect and isolate the battery negative cable.
- (2) Using a trim stick, gently pry the switch from the console (Fig. 4).
- (3) Disconnect electrical harness connector.

INSTALLATION

FRONT

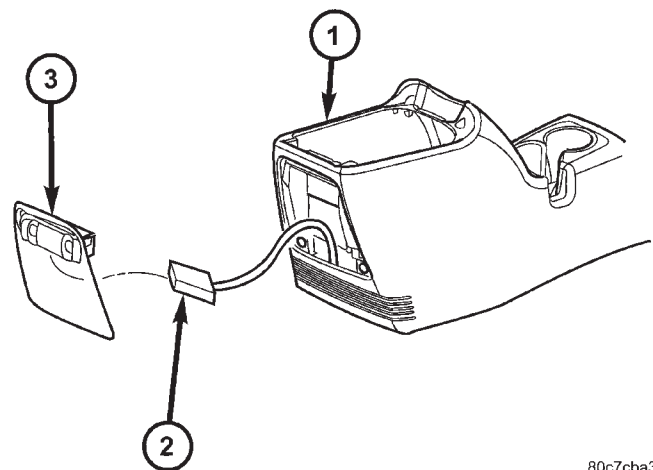
- (1) Connect electrical harness connector to switch. Slide connector lock into position.
- (2) Install switch into opening in console and press into place.



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Fig. 3 FRONT WINDOW SWITCH

- 1 - FRONT WINDOW SWITCH
- 2 - ELECTRICAL CONNECTOR
- 3 - CENTER CONSOLE



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Fig. 4 REAR WINDOW SWITCH

- 1 - CENTER CONSOLE
- 2 - ELECTRICAL CONNECTOR
- 3 - REAR WINDOW SWITCH

- (3) Connect battery negative cable.

REAR

- (1) Connect electrical harness connector to switch.
- (2) Install switch into opening in console and press into place.
- (3) Connect battery negative cable.



# RESTRAINTS

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## RESTRAINTS

## DESCRIPTION



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**Fig. 1 Supplemental Restraint System**

1 - FRONT IMPACT SENSOR (2)  
 2 - AIRBAG CONTROL MODULE  
 3 - PASSENGER AIRBAG  
 4 - DRIVER AIRBAG

5 - SIDE CURTAIN AIRBAG (2)  
 6 - DRIVER SEAT BELT TENSIONER  
 7 - SIDE IMPACT AIRBAG CONTROL MODULE (2)

## RESTRAINTS (Continued)

An occupant restraint system is standard factory-installed safety equipment on this model. Available occupant restraints for this model include both active and passive types. Active restraints are those which require the vehicle occupants to take some action to employ, such as fastening a seat belt; while passive restraints require no action by the vehicle occupants to be employed (Fig. 1).

**ACTIVE RESTRAINTS** The active restraints for this model include:

- **Front Seat Belts** - Both front seating positions are equipped with three-point seat belt systems employing a lower B-pillar mounted inertia latch-type retractor, height-adjustable upper B-pillar mounted turning loops, a traveling lower seat belt anchor secured to the outboard side of the seat frame, and a traveling end-release seat belt buckle secured to the inboard side of the seat frame. Both front seat belt buckles include an integral Hall-effect seat belt switch that detects whether its respective seat belt has been fastened.

- **Rear Seat Belts** - All three rear seating positions are equipped with three-point seat belt systems. The outboard seating position belts employ a lower C-pillar mounted inertia latch-type retractor, a fixed position upper C-pillar mounted turning loop, and a fixed lower seat belt anchor secured to the floor panel. The rear seat center seating position belt has an inertia latch-type retractor that is integral to the rear seat back panel, and a cable from the seat back latch locks the center belt retractor spool unless the seat back is fully latched. The rear seat center seating position belt lower anchor is secured to the floor panel. All three rear seat belts have fixed end-release seat belt buckles secured to the floor panel, a single buckle unit on the right side and a double buckle unit on the left side.

- **Child Seat Tether Anchors** - All vehicles are equipped with three, fixed-position, child seat tether anchors. Two anchors are integral to the back of the right rear seat back panel, and one is integral to the left rear seat back panel.

**PASSIVE RESTRAINTS** The passive restraints available for this model include the following:

- **Dual Front Airbags** - Multistage driver and front passenger airbags are available for this model. This airbag system is a passive, inflatable, Supplemental Restraint System (SRS) and vehicles with this equipment can be readily identified by the "SRS - AIRBAG" logo molded into the driver airbag trim cover in the center of the steering wheel and also into the passenger airbag door on the instrument panel above the glove box (Fig. 2). Vehicles with the airbag system can also be identified by the airbag indicator, which will illuminate in the instrument cluster for about seven seconds as a bulb test each

time the ignition switch is turned to the On position. A pyrotechnic-type seat belt tensioner is integral to the driver side front seat belt retractor mounted on the lower B-pillar of all models equipped with dual front airbags.

- **Side Curtain Airbags** - Optional side curtain airbags are available for this model when it is also equipped with dual front airbags. This airbag system is a passive, inflatable, Supplemental Restraint System (SRS) and vehicles with this equipment can be readily identified by a molded identification trim button with the "SRS - AIRBAG" logo located on the headliner above each B-pillar (Fig. 2).



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*Fig. 2 SRS Logo*

The supplemental restraint system includes the following major components, which are described in further detail elsewhere in this service information:

- **Airbag Control Module** - The Airbag Control Module (ACM) is also sometimes referred to as the Occupant Restraint Controller (ORC). The ACM is located on a mount on the floor panel transmission tunnel, below the center of the instrument panel.

- **Airbag Indicator** - The airbag indicator is integral to the ElectroMechanical Instrument Cluster (EMIC), which is located on the instrument panel in front of the driver.

- **Clockspring** - The clockspring is located near the top of the steering column, directly beneath the steering wheel.

- **Driver Airbag** - The driver airbag is located in the center of the steering wheel, beneath the driver airbag trim cover.

- **Driver Knee Blocker** - The driver knee blocker is a structural unit secured to the back side of and integral to the instrument panel steering column opening cover.

- **Front Impact Sensor** - Two front impact sensors are used on vehicles equipped with dual front airbags, one left side and one right side. One sensor

## RESTRAINTS (Continued)

is located on the back side of each vertical member of the radiator support.

- **Passenger Airbag** - The passenger airbag is located on the instrument panel, beneath the passenger airbag door on the instrument panel above the glove box on the passenger side of the vehicle.

- **Passenger Knee Blocker** - The passenger knee blocker is a structural reinforcement that is integral to and concealed within the glove box door.

- **Seat Belt Tensioner** - The seat belt tensioner is integral to the driver side front seat belt retractor unit on vehicles equipped with dual front airbags.

- **Side Impact Airbag Control Module** - Two Side Impact Airbag Control Modules (SIACM) are used on vehicles with the optional side curtain airbags, one left side and one right side. One SIACM is located behind the B-pillar trim near the base of each B-pillar.

- **Side Curtain Airbag** - In vehicles equipped with this option, a side curtain airbag is located on each inside roof side rail above the headliner, and extends from the A-pillar to just beyond the C-pillar.

The ACM, both SIACMs, and the EMIC each contain a central processing unit and programming that allow them to communicate with each other using the Programmable Communication Interface (PCI) data bus network. This method of communication is used by the ACM for control of the airbag indicator on all models equipped with dual front airbags. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION).

Hard wired circuitry connects the supplemental restraint system components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system, and to the supplemental restraint system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

## OPERATION

**ACTIVE RESTRAINTS** The primary passenger restraints in this or any other vehicle are the standard equipment factory-installed seat belts. Seat belts are referred to as an active restraint because the vehicle occupants are required to physically fas-

ten and properly adjust these restraints in order to benefit from them. See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed active restraints.

**PASSIVE RESTRAINTS** The passive restraints system is referred to as a supplemental restraint system because they were designed and are intended to enhance the protection for the vehicle occupants of the vehicle **only** when used in conjunction with the seat belts. They are referred to as passive systems because the vehicle occupants are not required to do anything to make them operate; however, the vehicle occupants must be wearing their seat belts in order to obtain the maximum safety benefit from the factory-installed supplemental restraint systems.

The supplemental restraint system electrical circuits are continuously monitored and controlled by a microprocessor and software contained within the Airbag Control Module (ACM) and, on vehicles equipped with the side curtain airbags, both Side Impact Airbag Control Modules (SIACM). An airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) illuminates for about seven seconds as a bulb test each time the ignition switch is turned to the On or Start positions. Following the bulb test, the airbag indicator is turned on or off by the ACM to indicate the status of the supplemental restraint system. If the airbag indicator comes on at any time other than during the bulb test, it indicates that there is a problem in the supplemental restraint system electrical circuits. Such a problem may cause airbags not to deploy when required, or to deploy when not required.

Deployment of the supplemental restraints depends upon the angle and severity of an impact. Deployment is not based upon vehicle speed; rather, deployment is based upon the rate of deceleration as measured by the forces of gravity (G force) upon the impact sensors. When an impact is severe enough, the microprocessor in the ACM or the SIACM signals the inflator unit of the airbag module to deploy the airbag. The seat belt tensioner is provided with a deployment signal by the ACM in conjunction with the driver airbag. During a frontal vehicle impact, the knee blockers work in concert with properly fastened and adjusted seat belts to restrain both the driver and the front seat passenger in the proper position for an airbag deployment. The knee blockers also absorb and distribute the crash energy from the driver and the front seat passenger to the structure of the instrument panel. The seat belt tensioner removes the slack from the driver side front seat belt to provide further assurance that the driver is properly positioned and restrained for an airbag deployment.

## RESTRAINTS (Continued)

Typically, the vehicle occupants recall more about the events preceding and following a collision than they have of an airbag deployment itself. This is because the airbag deployment and deflation occur so rapidly. In a typical 48 kilometer-per-hour (30 mile-per-hour) barrier impact, from the moment of impact until the airbags are fully inflated takes about 40 milliseconds. Within one to two seconds from the moment of impact, the airbags are almost entirely deflated. The times cited for these events are approximations, which apply only to a barrier impact at the given speed. Actual times will vary somewhat, depending upon the vehicle speed, impact angle, severity of the impact, and the type of collision.

When the ACM monitors a problem in any of the dual front airbag system circuits or components, including the seat belt tensioner, it stores a fault code or Diagnostic Trouble Code (DTC) in its memory circuit and sends an electronic message to the EMIC to turn on the airbag indicator. When the SIACM monitors a problem in any of the side curtain airbag system circuits or component, it stores a fault code or Diagnostic Trouble Code (DTC) in its memory circuit and sends an electronic message to the ACM, and the ACM sends an electronic message to the EMIC to turn on the airbag indicator. Proper testing of the airbag system components, the Programmable Communication Interface (PCI) data bus, the data bus message inputs to and outputs from the EMIC, the SIACM, or the ACM, as well as the retrieval or erasure of a DTC from the ACM, SIACM, or EMIC requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed passive restraints.

**WARNING - RESTRAINT SYSTEM**

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSOR, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: AN AIRBAG INFLATOR UNIT MAY CONTAIN SODIUM AZIDE AND POTASSIUM NITRATE. THESE MATERIALS ARE POISONOUS AND EXTREMELY FLAMMABLE. CONTACT WITH ACID, WATER, OR HEAVY METALS MAY PRODUCE HARMFUL AND IRRITATING GASES (SODIUM HYDROXIDE IS FORMED IN THE PRESENCE OF MOISTURE) OR COMBUSTIBLE COMPOUNDS. AN AIRBAG INFLATOR UNIT MAY ALSO CONTAIN A GAS CANISTER PRESSURIZED TO OVER 2500 PSI. DO NOT ATTEMPT TO DISMANTLE AN AIRBAG UNIT 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).**

**WARNING: WHEN HANDLING A SEAT BELT TENSIONER RETRACTOR, PROPER CARE SHOULD BE EXERCISED TO KEEP FINGERS OUT FROM UNDER THE RETRACTOR COVER AND AWAY FROM THE SEAT BELT WEBBING WHERE IT EXITS FROM THE RETRACTOR COVER.**

**WARNING: REPLACE ALL RESTRAINT SYSTEM COMPONENTS ONLY WITH PARTS SPECIFIED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION.**



## RESTRAINTS (Continued)

**WARNING: THE FASTENERS, SCREWS, AND BOLTS ORIGINALLY USED FOR THE RESTRAINT SYSTEM COMPONENTS HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE RESTRAINT 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 DAIMLERCHRYSLER MOPAR PARTS CATALOG.**

**WARNING: WHEN A STEERING COLUMN HAS AN AIRBAG UNIT ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG UNIT FACE DOWN.**

### DIAGNOSIS AND TESTING - SUPPLEMENTAL RESTRAINT SYSTEM

Proper diagnosis and testing of the supplemental restraint system components, the PCI data bus, the data bus message inputs to and outputs from the ElectroMechanical Instrument Cluster (EMIC), the Airbag Control Module (ACM), or the Side Impact Airbag Control Module (SIACM) as well as the retrieval or erasure of a Diagnostic Trouble Code (DTC) from the ACM or SIACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

### STANDARD PROCEDURE

#### STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS

At no time should any source of electricity be permitted near the inflator on the back of a non-deployed airbag or seat belt tensioner. When carrying a non-deployed airbag, the trim cover or airbag cushion side of the unit should be pointed away from the body to minimize injury in the event of an accidental deployment. If the airbag unit is placed on a bench or any other surface, the trim cover or airbag cushion side of the unit should be face up to minimize movement in the event of an accidental deployment. When handling a non-deployed seat belt tensioner, take proper care to keep fingers out from under the retractor cover and away from the seat belt webbing where it exits from the retractor cover. In addition, the supplemental restraint system should be disarmed whenever any steering wheel, steering column, seat belt tensioner, driver airbag, passenger airbag, front impact sensor, side curtain airbag, or instrument panel components require diagnosis or service. Failure to observe this warning could result in accidental airbag deployment and possible personal injury.

All damaged, faulty or non-deployed airbags and seat belt tensioners which are replaced on vehicles are to be handled and disposed of properly. If an airbag or seat belt tensioner unit is faulty or damaged and non-deployed, refer to the Hazardous Substance Control System for proper disposal. Dispose of all non-deployed and deployed airbags and seat belt tensioners in a manner consistent with state, provincial, local and federal regulations.

#### SUPPLEMENTAL RESTRAINT STORAGE

Airbags and seat belt tensioners must be stored in their original, special container until they are used for service. Also, they must be stored in a clean, dry environment; away from sources of extreme heat, sparks, and high electrical energy. Always place or store any airbag on a surface with its trim cover or airbag cushion side facing up, to minimize movement in case of an accidental deployment.

#### STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT

Any vehicle which is to be returned to use following a supplemental restraint deployment, must have the deployed restraints replaced. In addition, if the driver airbag has been deployed, the clockspring must be replaced. If the passenger airbag is deployed, the passenger airbag door and both passenger airbag mounting brackets must be replaced. If a side curtain airbag has been deployed, the complete

RESTRAINTS (Continued)

airbag unit, the headliner, as well as the upper A, B, and C-pillar trim must be replaced. These components are not intended for reuse and will be damaged or weakened as a result of a supplemental restraint deployment, which may or may not be obvious during a visual inspection.

On vehicles with an optional sunroof, the sunroof drain tubes and hoses must be closely inspected following a side curtain airbag deployment. It is also critical that the mounting surfaces and/or mounting brackets for the Airbag Control Module (ACM), Side Impact Airbag Control Module (SIACM), and front impact sensors be closely inspected and restored to their original conditions following any vehicle impact damage. Because the ACM, SIACM, and each front impact sensor are used by the supplemental restraint system to monitor or confirm the direction and severity of a vehicle impact, improper orientation or insecure fastening of these components may cause airbags not to deploy when required, or to deploy when not required. All other vehicle components should be closely inspected following any other supplemental restraint deployment, but are to be replaced only as required by the extent of the visible damage incurred.

**AIRBAG SQUIB STATUS**

Multistage airbags with multiple initiators (squibs) must be checked to determine that all squibs were used during the deployment event. The driver and passenger airbags in this model are deployed by electrical signals generated by the Airbag Control Module (ACM) through the driver or passenger squib 1 and squib 2 circuits to the two initiators in the airbag inflators. Typically, both initiators are used and

all potentially hazardous chemicals are burned during an airbag deployment event. However, it is possible for only one initiator to be used due to an airbag system fault; therefore, it is always necessary to confirm that both initiators have been used in order to avoid the improper handling or disposal of potentially live pyrotechnic or hazardous materials. The following procedure should be performed using a DRBIII® scan tool to verify the status of both airbag squibs before either deployed airbag is removed from the vehicle for disposal.

**CAUTION: Deployed front airbags having two initiators (squibs) in the airbag inflator may or may not have live pyrotechnic material within the inflator. Do not dispose of these airbags unless you are sure of complete deployment. Refer to the Hazardous Substance Control System for proper disposal procedures. Dispose of all non-deployed and deployed airbags in a manner consistent with state, provincial, local, and federal regulations.**

(1) Be certain that the DRBIII® scan tool contains the latest version of the proper DRBIII® software. Connect the DRBIII® to the 16-way Data Link Connector (DLC). The DLC is located on the driver side lower edge of the instrument panel, outboard of the steering column.

(2) Turn the ignition switch to the On position.

(3) Using the DRBIII®, read and record the active (current) Diagnostic Trouble Code (DTC) data.

Using the active DTC information, refer to the **Airbag Squib Status** table to determine the status of both driver and/or passenger airbag squibs.

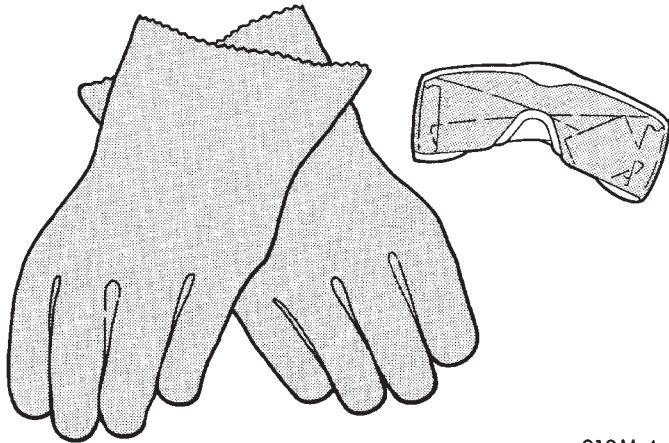
AIRBAG SQUIB STATUS		
IF the Active DTC is:	Conditions	Squib Status
Driver or Passenger Squib 1 open	<b>AND</b> the stored DTC minutes for both Driver or Passenger squibs are within 15 minutes of each other	Both Squib 1 and 2 were used.
Driver or Passenger Squib 2 open		
Driver or Passenger Squib 1 open	<b>AND</b> the stored DTC minutes for Driver or Passenger Squib 2 open is <b>GREATER</b> than the stored DTC minutes for Driver or Passenger Squib 1 by 15 minutes or more	Squib 1 was used; Squib 2 is live.
Driver or Passenger Squib 2 open		
Driver or Passenger Squib 1 open	<b>AND</b> the stored DTC minutes for Driver or Passenger Squib 1 open is <b>GREATER</b> than the stored DTC minutes for Driver or Passenger Squib 2 by 15 minutes or more	Squib 1 is live; Squib 2 was used.
Driver or Passenger Squib 2 open		
Driver or Passenger Squib 1 open	<b>AND</b> Driver or Passenger Squib 2 open is <b>NOT</b> an active code	Squib 1 was used; Squib 2 is live.
Driver or Passenger Squib 2 open	<b>AND</b> Driver or Passenger Squib 1 open is <b>NOT</b> an active code	Squib 1 is live; Squib 2 was used.

## RESTRAINTS (Continued)

If none of the Driver or Passenger Squib 1 or 2 open are active codes, the status of the airbag squibs is unknown. In this case the airbag should be handled and disposed of as if the squibs were both live.

## CLEANUP PROCEDURE

Following a supplemental restraint deployment, the vehicle interior will contain a powdery residue. This residue consists primarily of harmless particulate by-products of the small pyrotechnic charge that initiates the propellant used to deploy a supplemental restraint. However, this residue may also contain traces of sodium hydroxide powder, a chemical by-product of the propellant material that is used to generate the inert gas that inflates the airbag. Since sodium hydroxide powder can irritate the skin, eyes, nose, or throat, be sure to wear safety glasses, rubber gloves, and a long-sleeved shirt during cleanup (Fig. 3).



918M-4

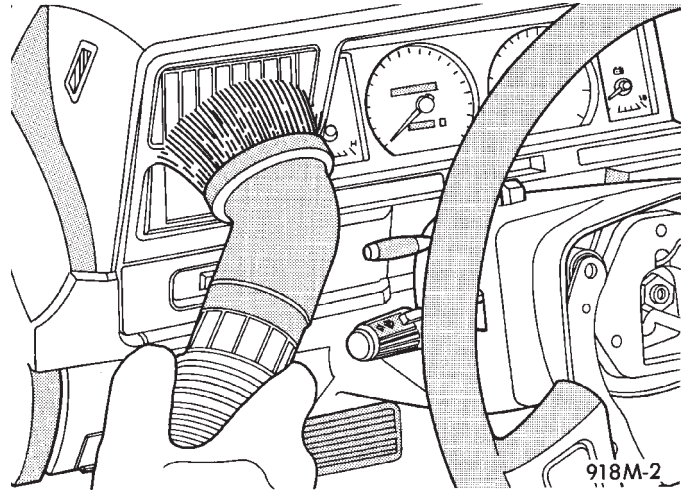
**Fig. 3 Wear Safety Glasses and Rubber Gloves - Typical**

**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.**

(1) Begin the cleanup by using 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.

(2) Be certain to vacuum the heater and air conditioning outlets as well (Fig. 4). Run the heater and air conditioner blower on the lowest speed setting and vacuum any powder expelled from the outlets.

**CAUTION: Deployed front airbags having two initiators (squibs) in the airbag inflator may or may not have live**



**Fig. 4 Vacuum Heater and A/C Outlets - Typical**

pyrotechnic material within the inflator. Do not dispose of these airbags unless you are sure of complete deployment. Refer to AIRBAG SQUIB STATUS. Refer to the Hazardous Substance Control System for proper disposal procedures. Dispose of all non-deployed and deployed airbags in a manner consistent with state, provincial, local, and federal regulations.

(3) Next, remove the deployed supplemental restraints from the vehicle. Refer to the appropriate service removal procedures.

(4) You may need to vacuum the interior of the vehicle a second time to recover all of the powder.

## STANDARD PROCEDURE - VERIFICATION TEST

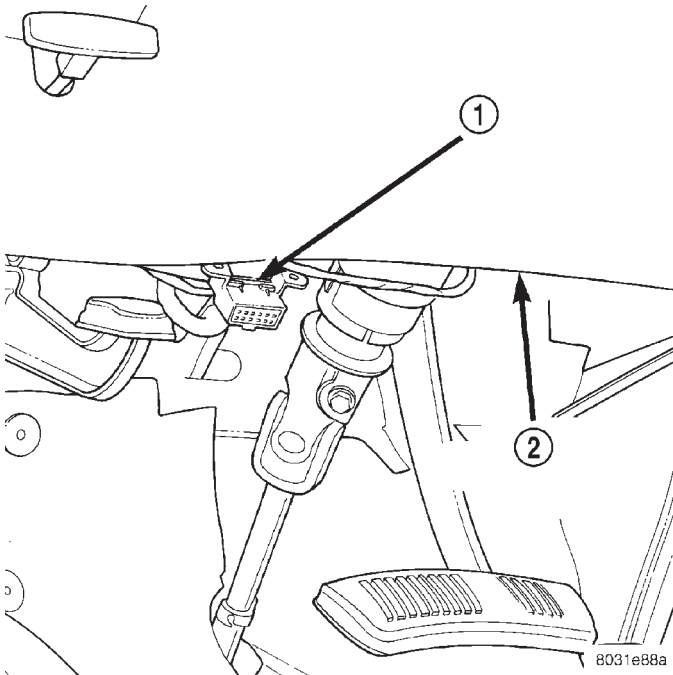
The following procedure should be performed using a DRBIII® scan tool to verify proper supplemental restraint system operation following the service or replacement of any supplemental restraint system component.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

RESTRAINTS (Continued)

(1) During the following test, the battery negative cable remains disconnected and isolated, as it was during the airbag component removal and installation procedures.

(2) Be certain that the DRBIII® scan tool contains the latest version of the proper DRBIII® software. Connect the DRBIII® to the 16-way Data Link Connector (DLC). The DLC is located on the driver side lower edge of the instrument panel, outboard of the steering column (Fig. 5).



**Fig. 5 16-Way Data Link Connector - Typical**

- 1 - 16-WAY DATA LINK CONNECTOR
- 2 - BOTTOM OF INSTRUMENT PANEL

(3) Turn the ignition switch to the On position and exit the vehicle with the DRBIII® scan tool.

(4) Check to be certain that nobody is in the vehicle, then reconnect the battery negative cable.

(5) Using the DRBIII®, read and record the active (current) Diagnostic Trouble Code (DTC) data.

(6) Next, use the DRBIII® to read and record any stored (historical) DTC data.

(7) If any DTC is found in Step 5 or Step 6, refer to the appropriate diagnostic information.

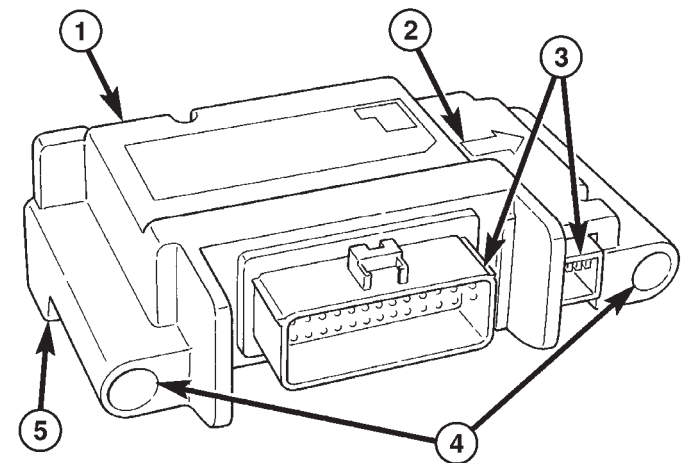
(8) Use the DRBIII® to erase the stored DTC data. If any problems remain, the stored DTC data will not erase. Refer to the appropriate diagnostic information to diagnose any stored DTC that will not erase. If the stored DTC information is successfully erased, go to Step 9.

(9) Turn the ignition switch to the Off position for about fifteen seconds, and then back to the On position. Observe the airbag indicator in the instrument cluster. It should illuminate for six to eight seconds,

and then go out. This indicates that the supplemental restraint system is functioning normally and that the repairs are complete. If the airbag indicator fails to light, or lights and stays on, there is still an active supplemental restraint system fault or malfunction. Refer to the appropriate diagnostic information to diagnose the problem.

**AIRBAG CONTROL MODULE**

**DESCRIPTION**



80c58f3d

**Fig. 6 Airbag Control Module**

- 1 - AIRBAG CONTROL MODULE
- 2 - ORIENTATION ARROW
- 3 - CONNECTOR RECEPTACLES
- 4 - MOUNTING HOLES
- 5 - GROUND LUG

The Airbag Control Module (ACM) is also sometimes referred to as the Occupant Restraint Controller (ORC) (Fig. 6). The ACM is secured with two long screws within a tray-like stamped steel mounting bracket welded onto the top of the floor panel transmission tunnel forward of the instrument panel center support bracket and below the instrument panel center stack in the passenger compartment of the vehicle.

Concealed within a hollow in the center of the die cast aluminum ACM housing is the electronic circuitry of the ACM which includes a microprocessor, an electronic impact sensor, an electromechanical safing sensor, and an energy storage capacitor. A stamped metal cover plate is secured to the bottom of the ACM housing with four screws to enclose and protect the internal electronic circuitry and components. An arrow cast into the top of the ACM housing near the front provides a visual verification of the proper orientation of the unit, and should always be pointed toward the front of the vehicle.

## AIRBAG CONTROL MODULE (Continued)

The ACM housing also has an integral ground lug with a tapped hole that protrudes from the lower left rear corner of the unit. This lug provides a case ground to the ACM when a ground screw is installed through the left side of the mounting bracket. Two molded plastic electrical connector receptacles exit the right side of the ACM housing. The smaller of the two receptacles contains twelve terminal pins, while the larger one contains twenty-three. These terminal pins connect the ACM to the vehicle electrical system through two dedicated take outs and connectors of the instrument panel wire harness.

A molded rubber protective cover is installed loosely over the ACM to protect the unit from condensation or coolant leaking from a damaged or faulty heater-air conditioner unit housing. An integral flange on the left side of the cover is secured to the floor panel transmission tunnel with a short piece of double-faced tape as an assembly aid during the manufacturing process, but this tape does not require replacement following service removal.

The impact sensor and safing sensor internal to the ACM are calibrated for the specific vehicle, and are only serviced as a unit with the ACM. The ACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced. The ACM cover is available for separate service replacement.

## OPERATION

The microprocessor in the Airbag Control Module (ACM) contains the front supplemental restraint system logic circuits and controls all of the front supplemental restraint system components. The ACM uses On-Board Diagnostics (OBD) and can communicate with other electronic modules in the vehicle as well as with the DRBIII® scan tool using the Programmable Communications Interface (PCI) data bus network. This method of communication is used for control of the airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) and for supplemental restraint system diagnosis and testing through the 16-way data link connector located on the driver side lower edge of the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/AIRBAG INDICATOR - OPERATION).

The ACM microprocessor continuously monitors all of the front supplemental restraint system electrical circuits to determine the system readiness. If the ACM detects a monitored system fault, it sets an active and stored Diagnostic Trouble Code (DTC) and sends electronic messages to the EMIC over the PCI data bus to turn on the airbag indicator. An active fault only remains for the duration of the fault or in some cases the duration of the current ignition switch cycle, while a stored fault causes a DTC to be stored in memory by the ACM. For some DTCs, if a

fault does not recur for a number of ignition cycles, the ACM will automatically erase the stored DTC. For other internal faults, the stored DTC is latched forever.

On models equipped with optional side curtain airbags, the ACM communicates with both the left and right Side Impact Airbag Control Modules (SIACM) over the PCI data bus. The SIACM notifies the ACM when it has detected a monitored system fault and stored a DTC in memory for its respective side curtain airbag system, and the ACM sets a DTC and controls the airbag indicator operation accordingly. The ACM also monitors a Hall effect-type seat belt switch located in the buckle of each front seat belt to determine whether the seatbelts are buckled, and provides an input to the EMIC over the PCI data bus to control the seatbelt indicator operation based upon the status of the driver side front seat belt switch.

The ACM receives battery current through two circuits; a fused ignition switch output (run) circuit through a fuse in the Junction Block (JB), and a fused ignition switch output (run-start) circuit through a second fuse in the JB. The ACM has a case ground through a lug on the bottom of the ACM housing that is secured with a ground screw to the left side of the ACM mounting bracket. The ACM also receives a power ground through a ground circuit and take out of the instrument panel wire harness. This take out has a single eyelet terminal connector that is secured by a second ground screw to the left side of the ACM mounting bracket. These connections allow the ACM to be operational whenever the ignition switch is in the Start or On positions. The ACM also contains an energy-storage capacitor. When the ignition switch is in the Start or On positions, this capacitor is continually being charged with enough electrical energy to deploy the airbags for up to one second following a battery disconnect or failure. The purpose of the capacitor is to provide backup supplemental restraint system protection in case there is a loss of battery current supply to the ACM during an impact.

Two sensors are contained within the ACM, an electronic impact sensor and a safing sensor. The ACM also monitors inputs from two remote front impact sensors located on the back of the right and left vertical members of the radiator support near the front of the vehicle. The electronic impact sensors are accelerometers that sense the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. The safing sensor is an electromechanical sensor within the ACM that provides an additional logic input to the ACM microprocessor. The safing sensor is a normally open switch that is used to verify the need for an airbag deployment by detecting impact energy of a lesser

AIRBAG CONTROL MODULE (Continued)

magnitude than that of the electronic impact sensors, and must be closed in order for the airbags/seat belt tensioner to deploy. A pre-programmed decision algorithm in the ACM microprocessor determines when the deceleration rate as signaled by the impact sensors and the safing sensor indicate an impact that is severe enough to require front supplemental restraint system protection and, based upon the status of the seatbelt switch inputs and the severity of the monitored impact, determines what combination of driver seat belt tensioner and/or front airbag deployment is required for each front seating position. When the programmed conditions are met, the ACM sends the proper electrical signals to deploy the driver seat belt tensioner and/or the multistage dual front airbags at the programmed force levels.

The hard wired inputs and outputs for the ACM may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the ACM, the PCI data bus network, or the electronic message inputs to and outputs from the ACM. The most reliable, efficient, and accurate means to diagnose the ACM, the PCI data bus network, and the electronic message inputs to and outputs from the ACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

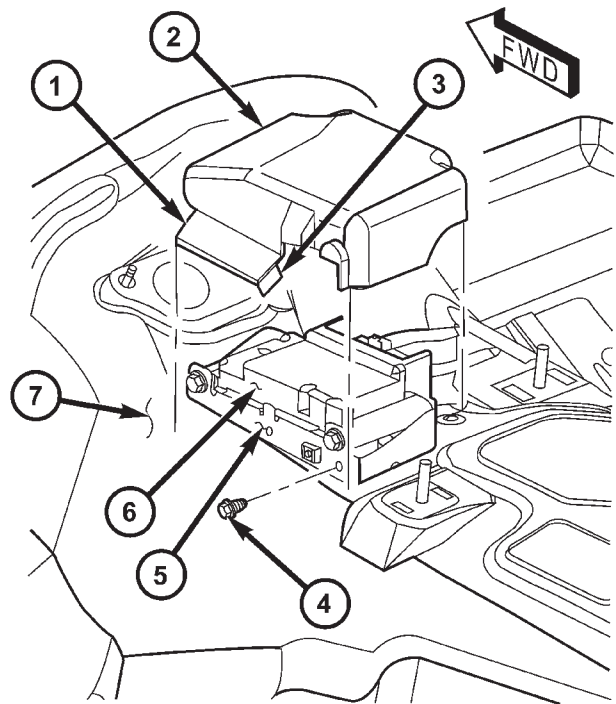
**WARNING: THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE FRONT SUPPLEMENTAL RESTRAINTS. NEVER STRIKE OR DROP THE AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF AN AIRBAG CONTROL MODULE IS**

**ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER FRONT SUPPLEMENTAL RESTRAINT DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the center console from the top of the floor panel transmission tunnel. (Refer to 23 - BODY/ INTERIOR/FLOOR CONSOLE - REMOVAL).

(3) From the left side of the floor panel transmission tunnel, remove the Airbag Control Module (ACM) cover from the ACM (Fig. 7). The cover flange is secured to the silencer pad on the floor panel transmission tunnel with double-faced tape.



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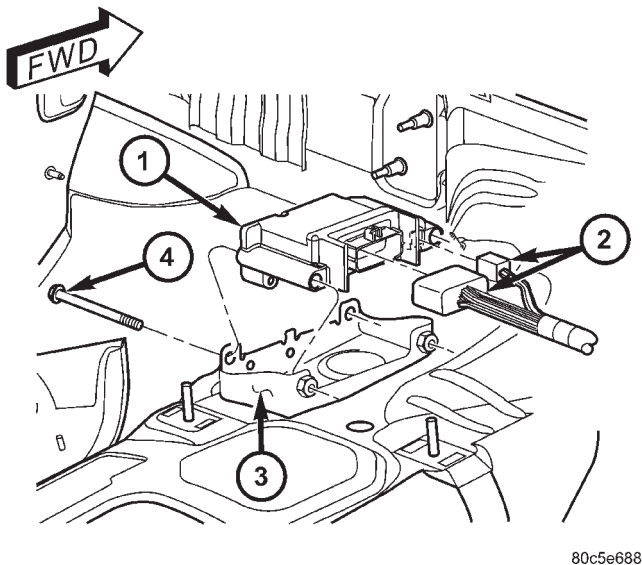
**Fig. 7 ACM Cover Remove/Install**

- 1 - FLANGE
- 2 - COVER
- 3 - TAPE
- 4 - SCREW
- 5 - BRACKET
- 6 - AIRBAG CONTROL MODULE
- 7 - FLOOR PANEL TRANSMISSION TUNNEL

(4) Remove the ground screw that secures the ground lug on the left rear corner of the ACM housing to the ACM bracket on the floor panel transmission tunnel.

## AIRBAG CONTROL MODULE (Continued)

(5) Remove the two screws that secure the ACM to the ACM bracket that is welded onto the top of the floor panel transmission tunnel (Fig. 8).



80c5e688

**Fig. 8 Airbag Control Module Remove/Install**

- 1 - AIRBAG CONTROL MODULE
- 2 - WIRE HARNESS CONNECTOR (2)
- 3 - BRACKET
- 4 - SCREW (2)

(6) Lift the ACM from the ACM bracket on the top of the floor panel transmission tunnel and move the unit to the left far enough to access the ACM wire harness connectors.

(7) Disconnect the two instrument panel wire harness connectors for the ACM from the ACM connector receptacles on the right side of the module. To disconnect the large instrument panel wire harness connector from the ACM:

(a) Slide the red Connector Position Assurance (CPA) lock on the top of the connector toward the side of the connector.

(b) Depress the connector latch tab and pull the connector straight away from the ACM connector receptacle.

(8) Remove the ACM from the left side of the floor panel transmission tunnel.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE**

**BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE FRONT SUPPLEMENTAL RESTRAINTS. NEVER STRIKE OR DROP 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. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER FRONT SUPPLEMENTAL RESTRAINT DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

(1) Position the Airbag Control Module (ACM) to the left side of the floor panel transmission tunnel near the ACM bracket (Fig. 8).

(2) Reconnect the instrument panel wire harness connectors for the ACM to the ACM connector receptacles on the right side of the module. Be certain that the latches on both connectors and the red Connector Position Assurance (CPA) lock on the large connector are each fully engaged.

(3) Carefully position the ACM into the ACM bracket on the top of the floor panel transmission tunnel. When the ACM is correctly positioned, the arrow on the ACM housing will be pointed forward in the vehicle.

(4) Install and tighten the two screws that secure the ACM to the ACM bracket that is welded onto the floor panel transmission tunnel. Tighten the screws to 36 N·m (26 ft. lbs.).

(5) Install and tighten the ground screw that secures the ground lug on the left rear corner of the ACM housing to the ACM bracket on the floor panel transmission tunnel (Fig. 7). Tighten the screw to 12 N·m (105 in. lbs.).

(6) From the left side of the floor panel transmission tunnel, carefully position the ACM cover back over the top of the ACM.

AIRBAG CONTROL MODULE (Continued)

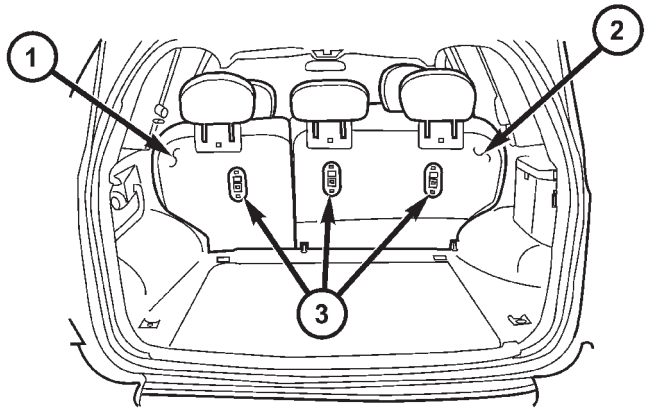
**NOTE:** The integral flange on the left side of the ACM cover is secured to the floor panel transmission tunnel with a short piece of double-faced tape as an assembly aid during the manufacturing process, but this tape does not require replacement following service removal.

(7) Reinstall the center console onto the top of the floor panel transmission tunnel. (Refer to 23 - BODY/ INTERIOR/FLOOR CONSOLE - INSTALLATION).

(8) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

CHILD TETHER ANCHOR

DESCRIPTION



80c9ece3

**Fig. 9 Child Tether Anchors**

- 1 - REAR SEAT BACK (LEFT)
- 2 - REAR SEAT BACK (RIGHT)
- 3 - CHILD TETHER ANCHOR (3)

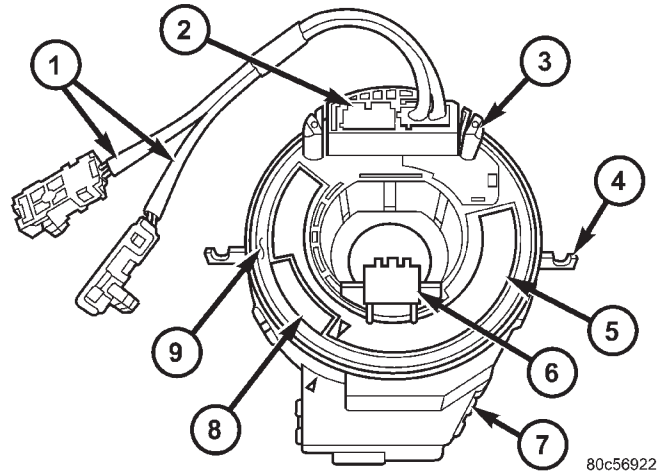
All vehicles are equipped with three, fixed-position, child seat tether anchors (Fig. 9). Two anchors are integral to the back of the right rear seat back panel, and one is integral to the left rear seat back panel. The child seat tether anchors cannot be adjusted or repaired and, if faulty or damaged, they must be replaced as a unit with the rear seat back panel.

OPERATION

See the owner's manual in the vehicle glove box for more information on the proper use of the factory-installed child seat tether anchors.

CLOCKSPRING

DESCRIPTION



80c56922

**Fig. 10 Clockspring**

- 1 - PIGTAIL WIRE (2)
- 2 - UPPER CONNECTOR RECEPTACLE
- 3 - BUMPER (2)
- 4 - BRACKET (2)
- 5 - LABEL
- 6 - SHIELD
- 7 - CASE
- 8 - WINDOW
- 9 - ROTOR

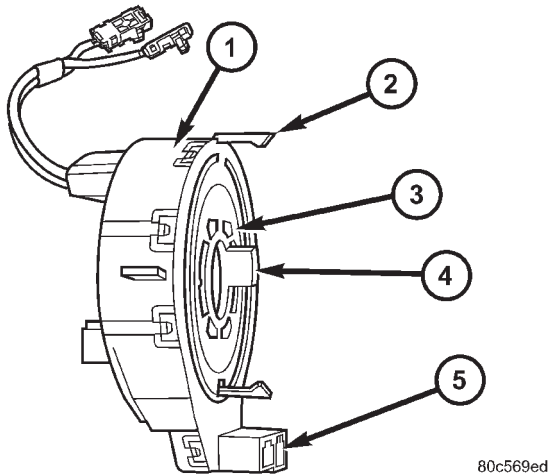
The clockspring assembly is secured with two integral plastic latches onto the upper steering column housing near the top of the steering column behind the steering wheel (Fig. 10). The clockspring consists of a flat, round molded plastic case with a stubby tail that hangs below the steering column and contains two connector receptacles that face toward the instrument panel (Fig. 11). Within the plastic housing is a spool-like molded plastic rotor with a large exposed hub and several plastic rollers. The upper surface of the rotor hub has a large center hole, a release button, a clear plastic inspection window, two short pigtail wires with connectors, and a connector receptacle that faces toward the steering wheel. Two versions of the clockspring are used on this model, one is a seven circuit unit for vehicles not equipped with optional remote radio switches on the steering wheel and can be visually identified by the use of yellow heat-shrink tubing on the pigtail wires, while the other is a nine circuit unit for vehicles with remote radio switches and can be visually identified by the use of black heat-shrink tubing on the pigtail wires.

A rubber bumper block is located on each side of the tower formation that contains the connector receptacle and pigtail wires on the upper surface of the rotor hub. The lower surface of the rotor hub has



## CLOCKSPRING (Continued)

a molded plastic turn signal cancel cam with a single lobe that is integral to the rotor. Within the plastic case and wound around the rotor spool is a long ribbon-like tape that consists of several thin copper wire leads sandwiched between two thin plastic membranes. The outer end of the tape terminates at the connector receptacles that face the instrument panel, while the inner end of the tape terminates at the pigtail wires and connector receptacle on the hub of the clockspring rotor that face the steering wheel.



**Fig. 11 Clockspring Latches**

- 1 - CASE
- 2 - LATCH (2)
- 3 - ROTOR
- 4 - CANCEL CAM
- 5 - LOWER CONNECTOR RECEPTACLE (2)

Service replacement clocksprings are shipped pre-centered and with a molded plastic shield that snaps onto the rotor over the release button. The release button secures the centered clockspring rotor to the clockspring case and the shield prevents the release button from being inadvertently depressed during shipment and handling, but the shield must be removed from the clockspring after it is installed on the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

The clockspring cannot be repaired. If the clockspring is faulty, damaged, or if the driver airbag has been deployed, the clockspring must be replaced.

## OPERATION

The clockspring is a mechanical electrical circuit component that is used to provide continuous electrical continuity between the fixed instrument panel wire harness and the electrical components mounted on or in the rotating steering wheel. On this model the rotating electrical components include the driver airbag, the horn switch, the speed control switches,

and the remote radio switches, if the vehicle is so equipped. The clockspring case is positioned and secured to the upper steering column housing near the top of the steering column. The connector receptacles on the tail of the fixed clockspring case connect the clockspring to the vehicle electrical system through two take outs with connectors from the instrument panel wire harness. The clockspring rotor is movable and is keyed by the tower formation that is molded onto the upper surface of the rotor hub to an opening that is cast into the steering wheel armature. Rubber bumper blocks on either side of the clockspring tower formation eliminate contact noise between the clockspring tower and the steering wheel. The lobe of the turn signal cancel cam on the lower surface of the clockspring rotor hub contacts a turn signal cancel actuator of the multi-function switch to provide automatic turn signal cancellation. The yellow-sleeved pigtail wires on the upper surface of the clockspring rotor connect the clockspring to the driver airbag, while a steering wheel wire harness connects the connector receptacle on the upper surface of the clockspring rotor to the horn switch and, if the vehicle is so equipped, to the optional speed control switches and remote radio switches on the steering wheel.

Like the clockspring in a timepiece, the clockspring tape has travel limits and can be damaged by being wound too tightly during full stop-to-stop steering wheel rotation. To prevent this from occurring, the clockspring is centered when it is installed on the steering column. Centering the clockspring indexes the clockspring tape to the movable steering components so that the tape can operate within its designed travel limits. However, if the clockspring is removed from the steering column or if the steering shaft is disconnected from the steering gear, the clockspring spool can change position relative to the movable steering components and must be re-centered following completion of the service or the tape may be damaged. Service replacement clocksprings are shipped pre-centered and with a plastic shield installed over the clockspring release button. This shield should not be removed and the release button should not be depressed until the clockspring has been installed on the steering column. If the release button is depressed before the clockspring is installed on a steering column, the clockspring centering procedure must be performed. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

## STANDARD PROCEDURE - CLOCKSPRING CENTERING

The clockspring is designed to wind and unwind when the steering wheel is rotated, but is only

## CLOCKSPRING (Continued)

designed to rotate the same number of turns (about five complete rotations) as the steering wheel can be turned from stop to stop. Centering the clockspring indexes the clockspring tape to other steering components so that it can operate within its designed travel limits. The rotor of a centered clockspring can be rotated two and one-half turns in either direction from the centered position, without damaging the clockspring tape.

However, if the clockspring is removed for service or if the steering column is disconnected from the steering gear, the clockspring tape can change position relative to the other steering components. The clockspring must then be re-centered following completion of such service or the clockspring tape may be damaged. Service replacement clocksprings are shipped pre-centered, with the release button engaged (raised) and a molded plastic shield installed over the release button. This release button should not be disengaged and the shield should not be removed until the clockspring has been installed on the steering column. If the release button is disengaged before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

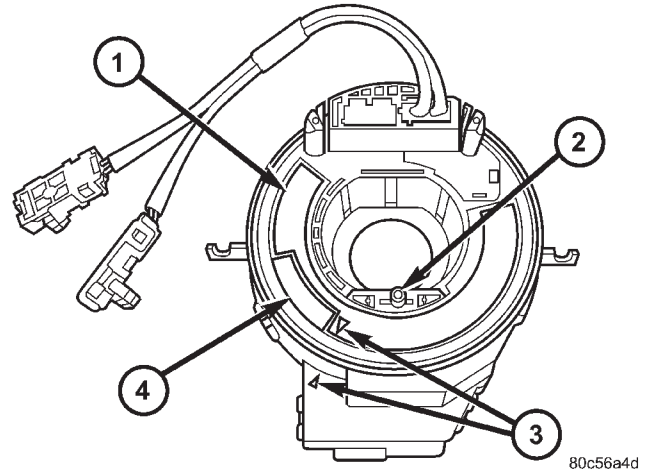
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.**

(1) Place the front wheels in the straight-ahead position.

(2) Remove the clockspring from the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

(3) Depress the release button (Fig. 12).



**Fig. 12 Clockspring Centering**

- 1 - ROTOR LABEL
- 2 - RELEASE BUTTON
- 3 - ALIGNMENT ARROWS
- 4 - INSPECTION WINDOW

(4) Keeping the release button depressed, rotate the clockspring rotor clockwise to the end of its travel. **Do not apply excessive torque.**

(5) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise, then release the release button. The clockspring tower formation with the pigtail wires for the driver airbag and the connector receptacle for the steering wheel wire harness should end up at the top, the blue roller should be visible through the inspection window, and the printed arrow on the label of the clockspring rotor should be aligned with the arrow molded into the clockspring case. The clockspring is now centered.

(6) The front wheels should still be in the straight-ahead position. Reinstall the clockspring onto the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

## REMOVAL

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

## CLOCKSPRING (Continued)

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**NOTE:** Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(1) Place the front wheels in the straight ahead position.

(2) Remove the driver airbag from the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Disconnect the steering wheel wire harness connector from the upper clockspring connector receptacle.

(4) Remove the steering wheel from the steering column. (Refer to 19 - STEERING/COLUMN/STEERING WHEEL - REMOVAL).

(5) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column to the fully lowered position and leave the tilt release lever in the released (down) position.

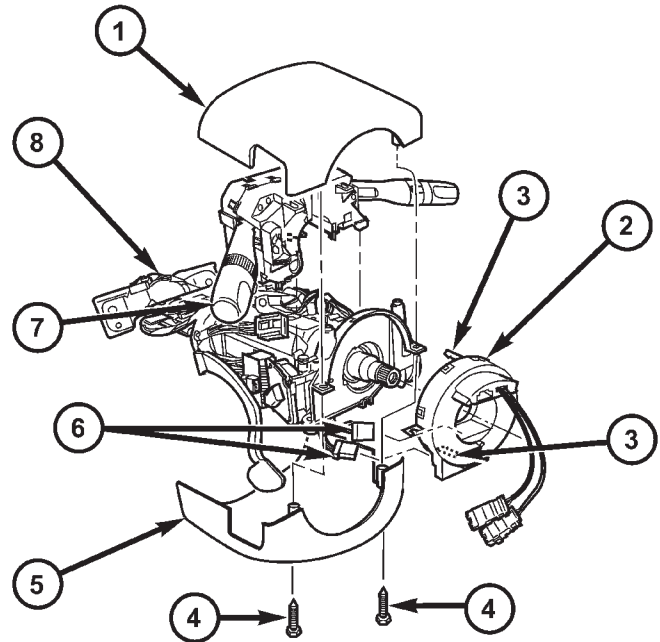
(6) From below the steering column, remove the two screws that secure the lower shroud to the upper shroud (Fig. 13).

(7) Using hand pressure, push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure the two halves to each other.

(8) Remove both the upper and lower shrouds from the steering column.

(9) Disconnect the two instrument panel wire harness connectors for the clockspring from the two connector receptacles below the steering column on the back of the clockspring housing.

(10) Using a small thin-bladed screwdriver, release the two integral plastic latches that secure the back of the clockspring housing to the steering column lock housing.



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**Fig. 13 Clockspring Remove/Install**

- 1 - UPPER SHROUD
- 2 - CLOCKSPRING
- 3 - LATCH (2)
- 4 - SCREW (2)
- 5 - LOWER SHROUD
- 6 - WIRE HARNESS CONNECTOR (2)
- 7 - MULTI-FUNCTION SWITCH
- 8 - STEERING COLUMN

(11) Remove the clockspring from the steering column lock housing. The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

(12) If the removed clockspring is to be reused, be certain that the release button on the clockspring rotor is raised and latched to secure the rotor to the clockspring case to maintain clockspring centering until it is reinstalled on the steering column. If clockspring centering is not maintained, the clockspring must be centered again before it is reinstalled. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

## INSTALLATION

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

If the clockspring is not properly centered in relation to the steering wheel, steering shaft and steering gear, it may be damaged. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CEN-

## CLOCKSPRING (Continued)

TERING). Service replacement clocksprings are shipped pre-centered, with the release button engaged (raised) and a molded plastic shield installed over the release button. This release button should not be disengaged and the shield should not be removed until the clockspring has been installed on the steering column. If the release button is disengaged before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.**

(1) Carefully slide the centered clockspring down over the steering column upper shaft until the two integral plastic latches on the back of the clockspring housing are fully engaged through their openings in the steering column lock housing (Fig. 13).

(2) Reconnect the two instrument panel wire harness connectors for the clockspring to the two connector receptacles below the steering column on the back of the clockspring housing.

(3) Position the upper and lower shrouds onto the steering column.

(4) Align the snap features on the lower shroud with the receptacles on the upper shroud and apply hand pressure to snap them together.

(5) From below the steering column, install and tighten the two screws that secure the lower shroud to the upper shroud. Tighten the screws to 2 N·m (18 in. lbs.).

(6) If the vehicle is equipped with the optional tilt steering column, move the tilt steering column back to the fully raised position and move the tilt release lever back to the locked (up) position.

(7) Reinstall the steering wheel onto the steering column. (Refer to 19 - STEERING/COLUMN/STEERING WHEEL - INSTALLATION).

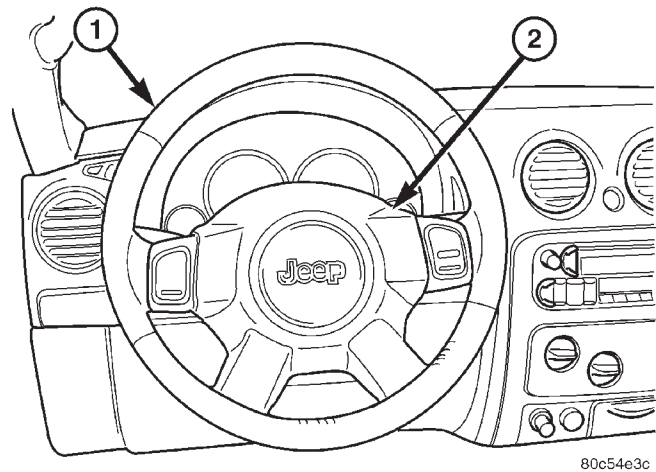
**NOTE: Be certain that the steering wheel mounting screw is tightened to the proper torque specification to ensure proper clockspring operation.**

(8) Reconnect the steering wheel wire harness connector to the upper clockspring connector receptacle.

(9) Reinstall the driver airbag onto the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

## DRIVER AIRBAG

## DESCRIPTION



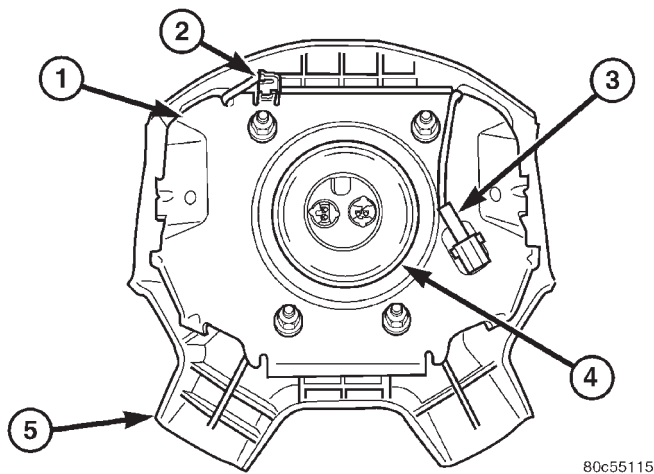
**Fig. 14 Driver Airbag Trim Cover**

- 1 - STEERING WHEEL  
2 - TRIM COVER

The black, injection molded, thermoplastic driver airbag protective trim cover is the most visible part of the driver airbag (Fig. 14). The driver airbag is located in the center of the steering wheel, where it is secured with two screws to the two horizontal spokes of the four-spoke steering wheel armature. Base models have a Jeep® logo embossed in the center of the trim cover, while premium models feature a stamped, satin polished emblem with the Jeep® logo applied to the center of the trim cover. Concealed beneath the driver airbag trim cover are the horn switch, the folded airbag cushion, the airbag retainer or housing, the airbag inflator, and the retainers that secure the inflator to the airbag housing. The airbag cushion, housing, and inflator are secured within an integral receptacle molded into the back of the trim cover.

## DRIVER AIRBAG (Continued)

The resistive membrane-type horn switch is secured with heat stakes to the inside surface of the driver airbag trim cover, between the trim cover and the folded airbag cushion. The horn switch ground pigtail wire has a female spade terminal connector that receives a path to ground through a male spade terminal that is integral to the driver airbag housing stamping and is located near the upper right corner on the back of the housing (Fig. 15). The horn switch feed pigtail wire has a white, molded plastic insulator that is secured by an integral retainer to a mounting hole located near the lower left corner on the back of the housing, and is connected to the vehicle electrical system through a take out and connector of the steering wheel wire harness.



**Fig. 15 Driver Airbag Housing**

- 1 - HOUSING
- 2 - HORN SWITCH GROUND WIRE
- 3 - HORN SWITCH FEED WIRE
- 4 - INFLATOR
- 5 - TRIM COVER

The airbag used in this model is a multistage, Next Generation-type that complies with revised federal airbag standards to deploy with less force than those used in some prior models. A 67 centimeter (26.5 inch) diameter, radial deploying fabric cushion with tethers is used. The airbag inflator is a dual-initiator, non-azide, pyrotechnic-type unit with four mounting studs and is secured to the stamped metal airbag housing using four hex nuts with washers. Two keyed and color-coded connector receptacles on the driver airbag inflator connect the two inflator initiators to the vehicle electrical system through two yellow-jacketed, two-wire pigtail harnesses of the clockspring. The driver airbag and horn switch unit cannot be repaired, and must be replaced if deployed or in any way damaged.

## OPERATION

The multistage driver airbag is deployed by electrical signals generated by the Airbag Control Module (ACM) through the driver airbag squib 1 and squib 2 circuits to the two initiators in the airbag inflator. By using two initiators, the airbag can be deployed at multiple levels of force. The force level is controlled by the ACM to suit the monitored impact conditions by providing one of three delay intervals between the electrical signals provided to the two initiators. The longer the delay between these signals, the less forcefully the airbag will deploy. When the ACM sends the proper electrical signals to each initiator, the electrical energy generates enough heat to initiate a small pyrotechnic charge which, in turn ignites chemical pellets within the inflator. Once ignited, these chemical pellets burn rapidly and produce a large quantity of nitrogen gas. The inflator is sealed to the back of the airbag housing and a diffuser in the inflator directs all of the nitrogen gas into the airbag cushion, causing the cushion to inflate. As the cushion inflates, the driver airbag trim cover will split at pre-determined breakout lines, then fold back out of the way along with the horn switch unit. Following an airbag deployment, the airbag cushion quickly deflates by venting the nitrogen gas towards the instrument panel through vent holes within the fabric used to construct the back (steering wheel side) panel of the airbag cushion.

Some of the chemicals used to create the nitrogen gas may be considered hazardous while in their solid state before they are burned, but they are securely sealed within the airbag inflator. Typically, both initiators are used and all potentially hazardous chemicals are burned during an airbag deployment event. However, it is possible for only one initiator to be used during a deployment due to an airbag system fault; therefore, it is necessary to always confirm that both initiators have been used in order to avoid the improper disposal of potentially live pyrotechnic or hazardous materials. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT). The nitrogen gas that is produced when the chemicals are burned is harmless. However, a small amount of residue from the burned chemicals may cause some temporary discomfort if it contacts the skin, eyes, or breathing passages. If skin or eye irritation is noted, rinse the affected area with plenty of cool, clean water. If breathing passages are irritated, move to another area where there is plenty of clean, fresh air to breathe. If the irritation is not alleviated by these actions, contact a physician.

DRIVER AIRBAG (Continued)

**REMOVAL**

The following procedure is for replacement of a faulty or damaged driver airbag. If the driver airbag has been deployed, review the recommended procedures for service after a passive restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY**

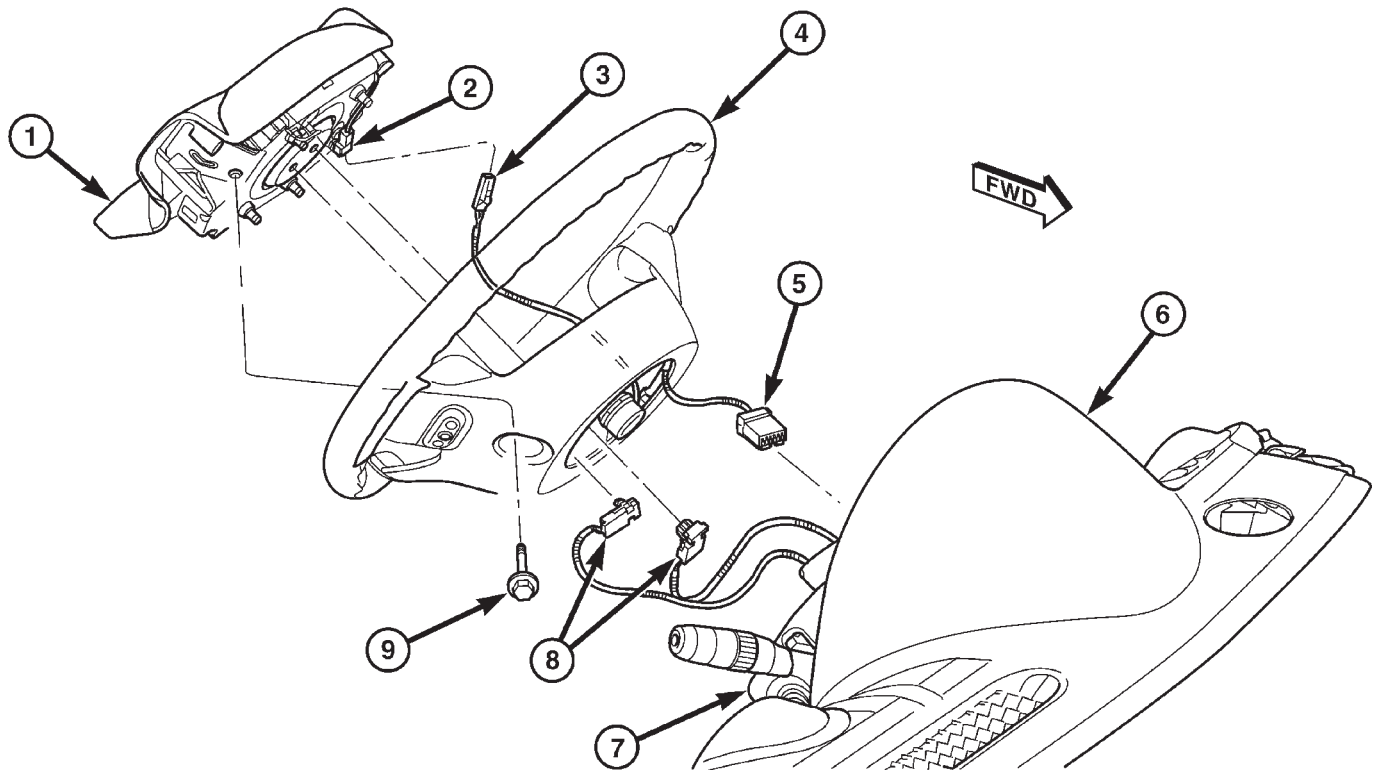
**SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG CUSHION AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

(1) Disconnect and isolate the battery negative cable. 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 airbag to the steering wheel armature (Fig. 16).

(3) Pull the driver airbag away from the steering wheel far enough to access the three electrical connections on the back of the airbag housing.



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**Fig. 16 Driver Airbag Remove/Install**

- |                                     |  |
|-------------------------------------|--|
| 1 - DRIVER AIRBAG                   | 6 - INSTRUMENT PANEL                       |
| 2 - HORN SWITCH FEED WIRE CONNECTOR | 7 - STEERING COLUMN                        |
| 3 - WIRE HARNESS CONNECTOR          | 8 - CLOCKSPRING PIGTAIL WIRE CONNECTOR (2) |
| 4 - STEERING WHEEL                  | 9 - SCREW (2)                              |
| 5 - TO CLOCKSPRING                  |  |

## DRIVER AIRBAG (Continued)

(4) Disconnect the steering wheel wire harness connector for the horn switch from the horn switch feed pigtail wire connector, which is located on the back of the driver airbag housing.

**CAUTION:** Do not pull on the clockspring pigtail wires or pry on the connector insulator to disengage the connector from the driver airbag inflator connector receptacle. Improper removal of these pigtail wires and their connector insulators can result in damage to the airbag circuits or connector insulators.

(5) The clockspring driver airbag pigtail wire connectors are secured by integral latches to the airbag inflator connector receptacles, which are located on the back of the driver airbag housing. Depress the latches on each side of each connector insulator and pull the insulators straight out from the airbag inflator to disconnect them from the connector receptacles.

(6) Remove the driver airbag from the steering wheel.

(7) If the driver airbag has been deployed, the clockspring must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

## INSTALLATION

The following procedure is for replacement of a faulty or damaged driver airbag. If the driver airbag has been deployed, the clockspring must also be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE DRIVER AIRBAG CUSHION AND THE DRIVER AIRBAG TRIM COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

**WARNING: THE DRIVER AIRBAG TRIM COVER MUST NEVER BE PAINTED. REPLACEMENT AIRBAGS ARE SERVICED IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE TRIM COVER RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

(1) Position the driver airbag close enough to the steering wheel to reconnect all three electrical connections on the back of the airbag housing.

(2) When installing the driver airbag, reconnect the two clockspring driver airbag pigtail wire connectors to the airbag inflator connector receptacles by pressing straight in on the connectors (Fig. 16). Be certain to engage each keyed and color-coded connector to the matching connector receptacle. You can be certain that each connector is fully engaged in its receptacle by listening carefully for a distinct, audible click as the connector latches snap into place.

(3) Reconnect the steering wheel wire harness connector for the horn switch to the horn switch feed pigtail wire connector, which is located at the back of the driver airbag housing.

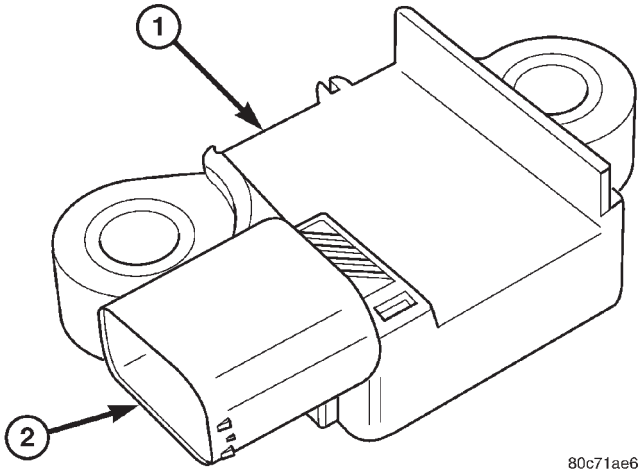
(4) Carefully position the driver airbag in the steering wheel. Be certain that the clockspring pigtail wires and steering wheel wire harness in the steering wheel hub area are not pinched between the driver airbag and the steering wheel armature.

(5) From the underside of the steering wheel, install and tighten the two screws that secure the driver airbag to the steering wheel armature. Tighten the screws to 10 N·m (90 in. lbs.).

(6) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

# FRONT IMPACT SENSOR

## DESCRIPTION



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**Fig. 17 Front Impact Sensor**

- 1 - SENSOR
- 2 - CONNECTOR RECEPTACLE

Two front impact sensors are used on this model, one each for the left and right sides of the vehicle (Fig. 17). These sensors are mounted remotely from the impact sensor that is internal to the Airbag Control Module (ACM). Each front sensor is secured with two screws to the backs of the right and left vertical members of the radiator support within the engine compartment. The sensor housing has an integral connector receptacle and two integral mounting points each with a metal sleeve to provide crush protection.

The right and left front impact sensors are identical in construction and calibration with two exceptions:

- On models equipped with an optional 2.4L gasoline engine, the left front impact sensor includes a shim that moves the sensor three millimeters toward the rear of the vehicle on the left vertical member of the radiator support for additional clearance that is required for that application.
- On models equipped with an optional diesel engine, the left front impact sensor includes a stamped metal mounting bracket that rotates the

connector receptacle end of the sensor toward the outboard side of the vehicle for additional clearance that is required for that application.

A cavity in the center of the molded black plastic impact sensor housing contains the electronic circuitry of the sensor which includes an electronic communication chip and an electronic impact sensor. Potting material fills the cavity to seal and protect the internal electronic circuitry and components. The front impact sensors are each connected to the vehicle electrical system through a dedicated take out and connector of the headlamp and dash wire harness.

The impact sensors cannot be repaired or adjusted and, if damaged or faulty, they must be replaced. The mounting bracket for the left front impact sensor on models with a diesel engine is serviced as a unit with that sensor.

## OPERATION

The front impact sensors are electronic accelerometers that sense the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. Each sensor also contains an electronic communication chip that allows the unit to communicate the sensor status as well as sensor fault information to the microprocessor in the Airbag Control Module (ACM). The ACM microprocessor continuously monitors all of the front passive restraint system electrical circuits to determine the system readiness. If the ACM detects a monitored system fault, it sets a Diagnostic Trouble Code (DTC) and controls the airbag indicator operation accordingly.

The impact sensors each receive battery current and ground through dedicated left and right sensor plus and minus circuits from the ACM. The impact sensors and the ACM communicate by modulating the voltage in the sensor plus circuit. The hard wired circuits between the front impact sensors and the ACM may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the ACM or the impact sensors. The most reliable, efficient, and accurate means to diagnose the impact sensors, the ACM, and the electronic message communication between the sensors and the ACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.



## FRONT IMPACT SENSOR (Continued)

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: THE FRONT IMPACT SENSOR ENABLES THE SYSTEM TO DEPLOY THE FRONT SUPPLEMENTAL RESTRAINTS. NEVER STRIKE OR DROP THE FRONT IMPACT SENSOR, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF AN IMPACT SENSOR IS ACCIDENTALLY DROPPED DURING SERVICE, THE SENSOR MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER FRONT SUPPLEMENTAL RESTRAINT DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

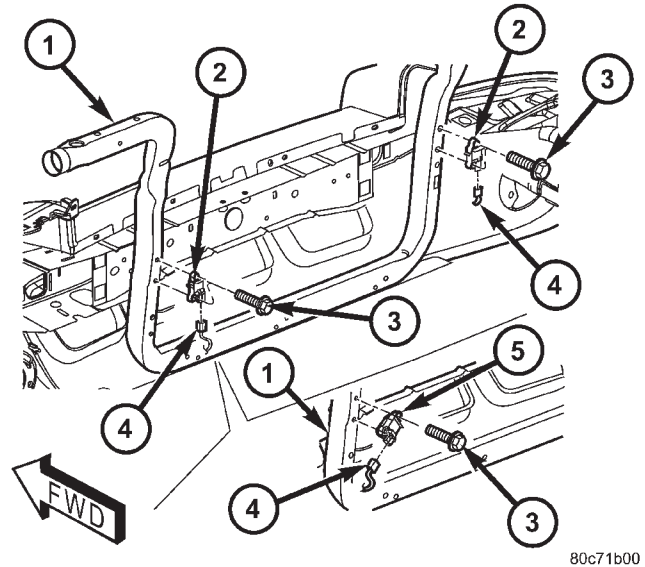
(2) Remove the two screws that secure the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left impact sensor and bracket unit (diesel engine only) to the back of the right or left radiator support vertical member (Fig. 18).

(3) Disconnect the headlamp and dash wire harness connector for the front impact sensor from the sensor connector receptacle.

(4) Remove the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left impact sensor and bracket unit (diesel engine only) from the engine compartment.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG,**



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**Fig. 18 Front Impact Sensor Remove/Install**

- 1 - RADIATOR SUPPORT
- 2 - IMPACT SENSOR OR LEFT IMPACT SENSOR & SHIM (2.4L ENGINE ONLY)
- 3 - SCREW (4)
- 4 - WIRE HARNESS CONNECTOR
- 5 - LEFT IMPACT SENSOR & BRACKET (DIESEL ENGINE ONLY)

**PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: THE FRONT IMPACT SENSOR ENABLES THE SYSTEM TO DEPLOY THE FRONT SUPPLEMENTAL RESTRAINTS. NEVER STRIKE OR DROP THE FRONT IMPACT SENSOR, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF AN IMPACT SENSOR IS ACCIDENTALLY DROPPED DURING SERVICE, THE SENSOR MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER FRONT SUPPLEMENTAL RESTRAINT DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

(1) Position the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left

FRONT IMPACT SENSOR (Continued)

impact sensor and bracket unit (diesel engine only) into the engine compartment (Fig. 18).

(2) Reconnect the headlamp and dash wire harness connector for the front impact sensor to the sensor connector receptacle.

(3) Position the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left impact sensor and bracket unit (diesel engine only) onto the back of the right or left radiator support vertical member.

(4) Loosely install the upper screw that secures the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left impact sensor and bracket unit (diesel engine only) to the back of the right or left radiator support vertical member.

(5) Install and tighten the lower screw that secures the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left impact sensor and bracket unit (diesel engine only) to the back of the right or left radiator support vertical member. Tighten the screw to 7 N·m (65 in. lbs.).

(6) Tighten the upper screw that secures the right or left front impact sensor, left impact sensor and shim (2.4L engine only), or left impact sensor and bracket unit (diesel engine only) to the back of the right or left radiator support vertical member. Tighten the screw to 7 N·m (65 in. lbs.).

(7) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any airbag system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Adjust the front seat to its most forward position for easiest access to the front seat belt lower anchor and the B-pillar trim.

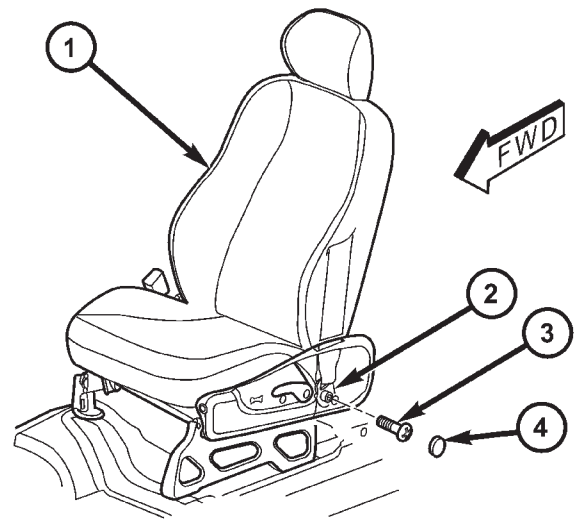
(2) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry the plug that covers the front seat belt lower anchor screw to remove it from the rear of the outboard seat side shield (Fig. 19).

FRONT SEAT BELT & RETRACTOR

REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



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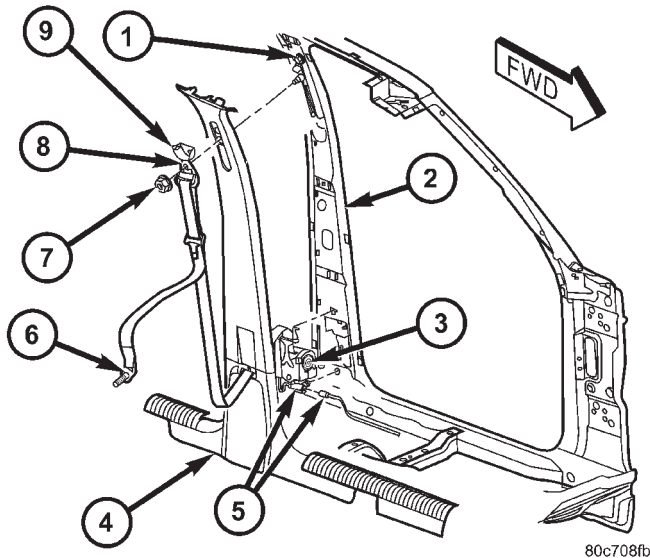
**Fig. 19 Front Seat Belt Lower Anchor Remove/Install**

- 1 - FRONT SEAT
- 2 - LOWER ANCHOR
- 3 - SCREW
- 4 - PLUG

## FRONT SEAT BELT &amp; RETRACTOR (Continued)

(4) Remove the screw that secures the lower anchor to the bracket on the outboard side of the front seat cushion frame.

(5) Unsnap and lift the trim cover to access the nut that secures the front seat belt turning loop to the height adjuster on the upper B-pillar (Fig. 20).



**Fig. 20 Front Seat Belt Retractor Remove/Install**

- 1 - ADJUSTER
- 2 - B-PILLAR
- 3 - RETRACTOR
- 4 - B-PILLAR TRIM
- 5 - CONNECTOR (DRIVER SIDE ONLY)
- 6 - LOWER ANCHOR
- 7 - NUT
- 8 - TURNING LOOP
- 9 - COVER

(6) Remove the nut that secures the seat belt turning loop to the height adjuster stud on the upper B-pillar.

(7) Remove the seat belt turning loop from the height adjuster stud.

(8) Remove the upper and lower trim from the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL) and (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL).

(9) On the driver side only, disconnect the seat belt tensioner pigtail wire connector from the body wire harness connector.

(10) Remove the screw that secures the lower retractor bracket to the lower B-pillar.

(11) Disengage the engagement tab on the upper retractor bracket/seat belt web guide from the engagement slot in the lower B-pillar.

(12) Remove the front seat belt and retractor from the B-pillar as a unit.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Position the front seat belt and retractor to the B-pillar as a unit (Fig. 20). Be certain to engage the engagement tab on the upper retractor bracket/seat belt web guide into the engagement slot in the lower B-pillar.

(2) Install and tighten the screw that secures the lower retractor bracket to the lower B-pillar. Tighten the screw to 43 N-m (32 ft. lbs.).

(3) On the driver side only, reconnect the seat belt tensioner pigtail wire connector to the body wire harness connector.

(4) Reinstall the upper and lower trim onto the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION) and (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION).

(5) Position the seat belt turning loop onto the height adjuster stud on the upper B-pillar.

FRONT SEAT BELT & RETRACTOR (Continued)

(6) Install and tighten the nut that secures the seat belt turning loop to the height adjuster stud. Tighten the nut to 34 N·m (25 ft. lbs.).

(7) Fold and snap the trim cover back into place to conceal the nut that secures the front seat belt turning loop to the height adjuster on the upper B-pillar.

(8) Position the front seat belt lower anchor to the bracket on the outboard side of the front seat cushion frame (Fig. 19).

(9) Install and tighten the screw that secures the lower anchor to the bracket on the outboard side of the front seat cushion frame. Tighten the screw to 43 N·m (32 ft. lbs.).

(10) Align the plug that covers the front seat belt lower anchor screw with the hole near the rear of the outboard seat side shield. Using hand pressure, press firmly and evenly on the plug until it snaps into place.

(11) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

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(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

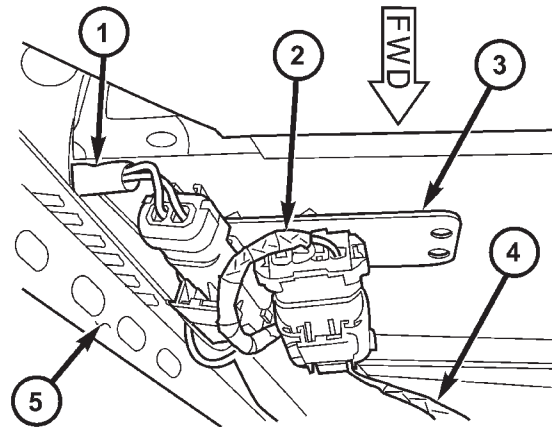
(2) Remove the front seat and seat track from the floor panel as a unit. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL).

(3) Disconnect the seat belt switch pigtail wire connector from the seat wire harness connector on the seat cushion frame bracket located under the rear edge of the seat cushion near the inboard side of the seat (Fig. 21).

FRONT SEAT BELT BUCKLE

REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



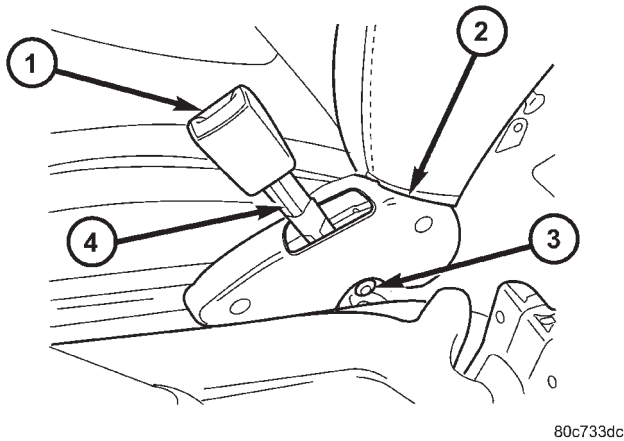
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**Fig. 21 Seat Belt Switch Connector**

- 1 - PIGTAIL WIRE
- 2 - SEAT WIRE HARNESS
- 3 - SEAT CUSHION FRAME BRACKET
- 4 - BODY WIRE HARNESS
- 5 - INBOARD SEAT TRACK

## FRONT SEAT BELT BUCKLE (Continued)

(4) Remove the screw that secures the front seat belt buckle anchor to the bracket near the rear of the inboard seat track (Fig. 22).



**Fig. 22 Front Seat Belt Buckle Remove/Install**

- 1 - FRONT SEAT BELT BUCKLE
- 2 - INBOARD SIDE SHIELD
- 3 - SCREW
- 4 - PIGTAIL WIRE

(5) Remove the two screws that secure the inboard seat cushion side shield to the seat cushion frame.

(6) Remove the two screws that secure the inboard seat track to the rear inboard corner of the seat cushion frame.

(7) Disconnect the seat belt switch pigtail wire routing clip from the locating hole in the seat cushion frame.

(8) Remove the seat belt switch pigtail wire from between the seat cushion frame and the seat track by gently prying the inboard seat track away from the inboard rear corner of the seat cushion frame far enough to slide the pigtail wire from between them.

(9) Remove the front seat belt buckle from the inboard seat cushion side shield.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN**

## ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Position the front seat belt buckle to the inboard seat cushion side shield (Fig. 22).

(2) Position the seat belt switch pigtail wire between the seat cushion frame and the seat track by gently prying the inboard seat track away from the inboard rear corner of the seat cushion frame far enough to slide the pigtail wire into position between them.

(3) Engage the seat belt switch pigtail wire routing clip into the locating hole in the seat cushion frame.

(4) Install and tighten the two screws that secure the inboard seat track to the rear inboard corner of the seat cushion frame. Tighten the screws to 28 N·m (21 ft. lbs.).

(5) Position the inboard seat cushion side shield to the seat cushion frame.

(6) Install and tighten the two screws that secure the inboard seat cushion side shield to the seat cushion frame. Tighten the screws to 1 N·m (9 in. lbs.).

(7) Position the front seat belt buckle anchor to the bracket on the inboard side of the seat track.

(8) Install and tighten the screw that secures the front seat belt buckle anchor to the bracket on the inboard side of the seat track. Tighten the screw to 43 N·m (32 ft. lbs.).

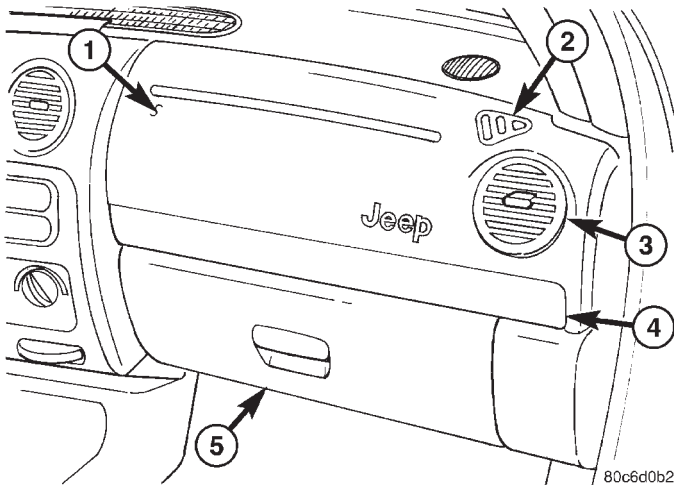
(9) Reconnect the seat belt switch pigtail wire connector to the seat wire harness connector on the seat cushion frame bracket located under the rear edge of the seat cushion near the inboard side of the seat (Fig. 21).

(10) Reinstall the front seat and seat track to the floor panel as a unit. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION).

(11) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

# PASSENGER AIRBAG

## DESCRIPTION

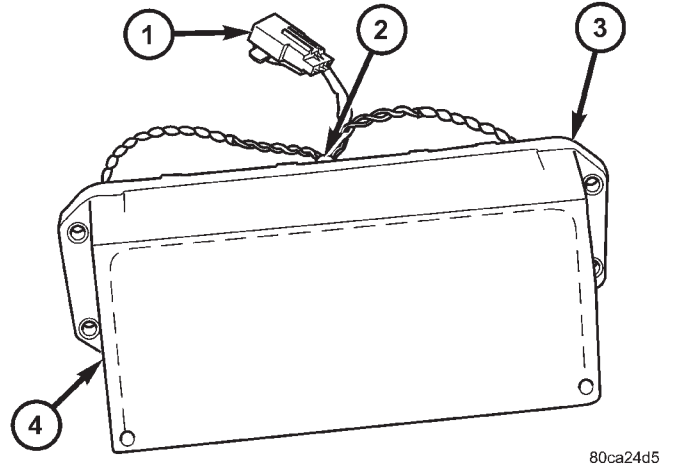


**Fig. 23 Passenger Airbag Door**

- 1 - PASSENGER AIRBAG DOOR
- 2 - DEMISTER OUTLET
- 3 - PANEL OUTLET
- 4 - BEZEL
- 5 - GLOVE BOX

The rearward facing surface of the injection molded, thermoplastic passenger airbag door is the most visible part of the passenger airbag (Fig. 23). The passenger airbag door is located above the glove box opening in front of the front seat passenger seating position on the instrument panel. The integral upper mounting flange is secured with five screws and the lower mounting flange with six screws to the instrument panel structural support. The passenger airbag door includes an integral air conditioning panel outlet housing and an integral side window demister outlet. An integral stamped metal bracket that reinforces the upper airbag door mounting flange is secured to the back of the door unit with heat stakes. The upper airbag door fasteners and mounting flange are concealed beneath the instrument panel top cover, while the lower fasteners and mounting flange are concealed beneath a bezel on the instrument panel above the glove box opening.

Located behind the passenger airbag door within the instrument panel is the passenger airbag unit (Fig. 24). The passenger airbag unit used in this model is a multistage, Next Generation-type that complies with revised federal airbag standards to deploy with less force than those used in some prior models. The passenger airbag unit consists of a molded, glass-filled nylon plastic housing, a molded plastic inner airbag cushion cover, the airbag cushion, and the airbag inflator. The airbag housing con-



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**Fig. 24 Passenger Airbag Unit**

- 1 - PIGTAIL WIRE CONNECTOR
- 2 - RETAINER
- 3 - HOUSING
- 4 - INNER COVER

tains the airbag inflator, while the inner cover contains the folded airbag cushion. The inner cover completely encloses the airbag cushion and is permanently retained to the housing. The passenger airbag unit is secured by two screws on each side to two stamped metal mounting brackets that are fastened with screws to the instrument panel structural support. The airbag cushion is constructed of a coated nylon fabric. The airbag inflator is a dual-initiator, hybrid-type unit that is secured to and sealed within the airbag housing. A short four-wire pigtail harness with a keyed, yellow connector insulator connects the two inflator initiators to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness.

The passenger airbag cannot be repaired, and must be replaced if deployed, faulty, or in any way damaged. The passenger airbag door and the passenger airbag mounting brackets are available for separate service replacement.

## OPERATION

The multistage passenger airbag is deployed by electrical signals generated by the Airbag Control Module (ACM) through the passenger airbag squib 1 and squib 2 circuits to the two initiators in the airbag inflator. By using two initiators, the airbag can be deployed at multiple levels of force. The force level is controlled by the ACM to suit the monitored impact conditions by providing one of three delay intervals between the electrical signals provided to the two initiators. The longer the delay between these signals, the less forcefully the airbag will deploy.

## PASSENGER AIRBAG (Continued)

The hybrid-type inflator assembly includes a small canister of highly compressed gas. When the ACM sends the proper electrical signal to the airbag inflator, the initiator converts the electrical energy into chemical energy. This chemical energy opens up a burst disk to allow the inert gas to flow into the airbag cushion. The inflator is sealed to the airbag cushion so that all of the released inert gas is directed into the airbag cushion, causing the cushion to inflate. As the cushion inflates, the passenger airbag door will split at predetermined tear seam lines on the inside surface of the door and the door will pivot downwards out of the way. Following a passenger airbag deployment, the airbag cushion quickly deflates by venting the inert gas through vent holes within the fabric used to construct the sides of the airbag cushion.

Typically, both initiators are used during an airbag deployment event. However, it is possible for only one initiator to be used during a deployment due to an airbag system fault; therefore, it is necessary to always confirm that both initiators have been used in order to avoid the improper disposal of potentially live pyrotechnic materials. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

**REMOVAL**

The following procedure is for replacement of a faulty or damaged passenger airbag. If the passenger airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

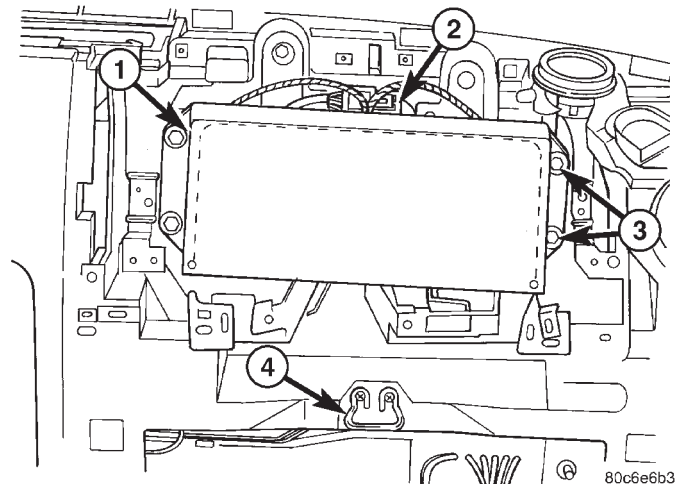
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the passenger airbag door from the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG DOOR - REMOVAL).

(3) Remove the two screws on each side of the passenger airbag that secure the passenger airbag to the metal brackets on the instrument panel support structure (Fig. 25).



**Fig. 25 Passenger Airbag Remove/Install**

- 1 - PASSENGER AIRBAG
- 2 - WIRE HARNESS CONNECTOR
- 3 - SCREW (4)
- 4 - GLOVE BOX LATCH STRIKER

(4) Disengage the passenger airbag wire harness connector from the retainer securing the connector to the metal bracket on the instrument panel support structure above the airbag by sliding both halves of the connector to the left.

(5) Disconnect the passenger airbag pigtail wire connector from the instrument panel wire harness connector for the airbag. To disconnect the connector:

(a) Slide the red Connector Position Assurance (CPA) lock on the top of the connector toward the side of the connector.

(b) Depress the connector latch tab and pull the two halves of the connector straight away from each other.

## PASSENGER AIRBAG (Continued)

(6) Remove the passenger airbag from the instrument panel as a unit.

(7) If the passenger airbag has been deployed, both passenger airbag mounting brackets on the instrument panel must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG MOUNTING BRACKET - REMOVAL).

**INSTALLATION**

The following procedure is for replacement of a faulty or damaged passenger airbag. If the passenger airbag has been deployed, both passenger airbag mounting brackets on the instrument panel must also be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG MOUNTING BRACKET - INSTALLATION).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

**WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE PASSENGER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE PASSENGER AIRBAG CUSHION AND THE PASSENGER AIRBAG DOOR. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

(1) Position the passenger airbag unit into the instrument panel (Fig. 25).

(2) Reconnect the passenger airbag pigtail wire connector to the instrument panel wire harness connector for the airbag. Be certain that the latch on the connector and the red Connector Position Assurance (CPA) lock are each fully engaged.

(3) Engage the passenger airbag wire harness connector onto the retainer that secures the connector to the metal bracket on the instrument panel support structure above the airbag by aligning the right end of the connector slot with the left end of the retainer and sliding both halves of the connector to the right.

(4) Carefully position the passenger airbag unit onto the two metal brackets on the instrument panel support structure, being certain that the alignment pin features on each side of the airbag are engaged in the alignment holes in the metal brackets.

(5) Install and tighten the two screws on each side of the passenger airbag that secure the passenger airbag to the metal brackets on the instrument panel support structure. Tighten the screws to 6 N·m (55 in. lbs.).

(6) Reinstall the passenger airbag door onto the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG DOOR - INSTALLATION).

(7) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

**PASSENGER AIRBAG DOOR****REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



## PASSENGER AIRBAG DOOR (Continued)

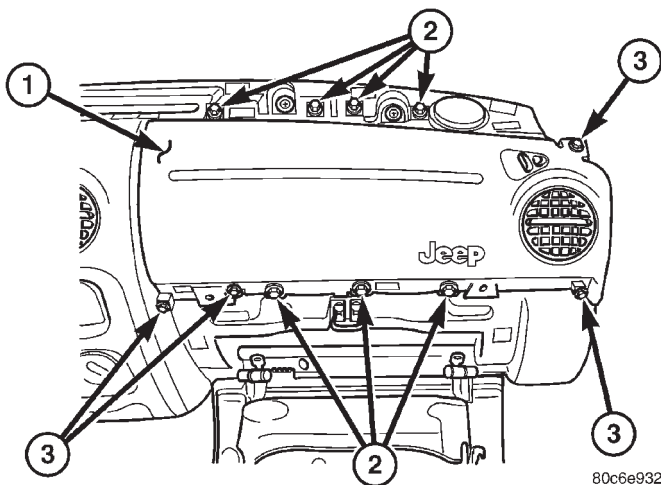
**WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the top cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL).

(3) Remove the passenger side bezel from the upper glove box opening of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/IP PASSENGER SIDE BEZEL - REMOVAL).

(4) Remove the three small screws that secure the passenger airbag door to the glove box opening upper reinforcement (Fig. 26).



**Fig. 26 Passenger Airbag Door Remove/Install**

- 1 - PASSENGER AIRBAG DOOR  
2 - LARGE SCREW (7)  
3 - SMALL SCREW (4)

(5) Remove the three large screws that secure the passenger airbag door to the glove box opening upper reinforcement.

(6) Remove the one small screw that secures the passenger airbag door to the top of the instrument panel.

(7) Remove the four large screws that secure the passenger airbag door to the top of the instrument panel.

(8) Remove the passenger airbag door from the instrument panel.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: THE PASSENGER AIRBAG DOOR MUST NEVER BE PAINTED. REPLACEMENT PASSENGER AIRBAG DOORS ARE SERVICED IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE AIRBAG DOOR RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

(1) Position the passenger airbag door onto the instrument panel (Fig. 26).

(2) Install and tighten the four large screws that secure the passenger airbag door to the top of the instrument panel. Tighten the screws to 4 N·m (35 in. lbs.).

(3) Install and tighten the one small screw that secures the passenger airbag door to the top of the instrument panel. Tighten the screw to 2 N·m (20 in. lbs.).

(4) Install and tighten the three large screws that secure the passenger airbag door to the glove box opening upper reinforcement. Tighten the screws to 4 N·m (35 in. lbs.).

(5) Install and tighten the three small screws that secure the passenger airbag door to the glove box opening upper reinforcement. Tighten the screws to 2 N·m (20 in. lbs.).

(6) Reinstall the passenger side bezel onto the upper glove box opening of the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/IP PASSENGER SIDE BEZEL - INSTALLATION).

(7) Reinstall the top cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION).

(8) Reconnect the battery negative cable.

## PASSENGER AIRBAG MOUNTING BRACKET

### REMOVAL

The passenger airbag mounting brackets cannot be repaired. They must be replaced if faulty or damaged, or if the passenger airbag has been deployed.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the passenger airbag from the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG - REMOVAL).

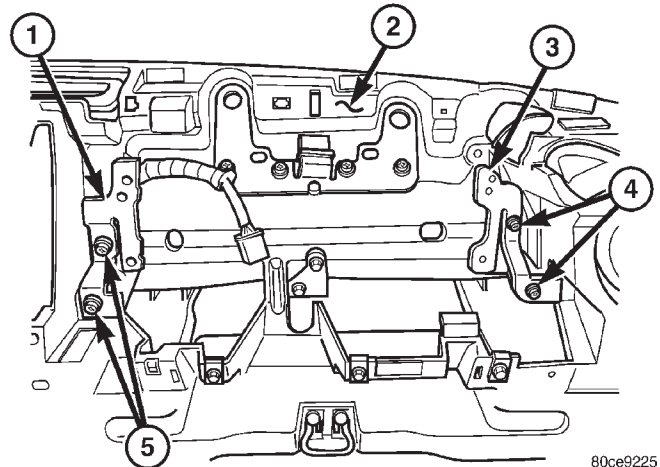
(2) Remove the two screws that secure the inboard and/or outboard passenger airbag mounting bracket(s) to the instrument panel support structure (Fig. 27).

(3) Remove the inboard and/or outboard passenger airbag mounting bracket(s) from the instrument panel support structure.

### INSTALLATION

The passenger airbag mounting brackets cannot be repaired. They must be replaced if faulty or damaged, or if the passenger airbag has been deployed.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG,**



**Fig. 27 Passenger Airbag Mounting Brackets Remove/Install**

- 1 - INBOARD BRACKET
- 2 - I/P SUPPORT STRUCTURE
- 3 - OUTBOARD BRACKET
- 4 - SCREW (2)
- 5 - SCREW (2)

**OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the inboard and/or outboard passenger airbag mounting bracket(s) to the instrument panel support structure (Fig. 27).

(2) Install and tighten the two screws that secure the inboard and/or outboard passenger airbag mounting bracket(s) to the instrument panel support structure. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reinstall the passenger airbag to the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/PASSENGER AIRBAG - INSTALLATION).

## REAR CENTER SEAT BELT & RETRACTOR

### REMOVAL

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Remove the right center seat belt buckle unit from the floor panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/REAR SEAT BELT BUCKLE - REMOVAL).

(2) Unlatch and fold the right rear seat back forward and separate the cargo area carpet from the base of the seat back panel.

(3) Reach between the base of the right rear seat back and the forward edge of the rear cargo floor to access and remove the screw that secures the rear center seat belt lower anchor to the floor panel (Fig. 28).

(4) Lift the rear center seat belt lower anchor off of the stud on the rear floor panel.

(5) Remove the two screws that secure the belt web guide to the top of the right rear seat back panel.

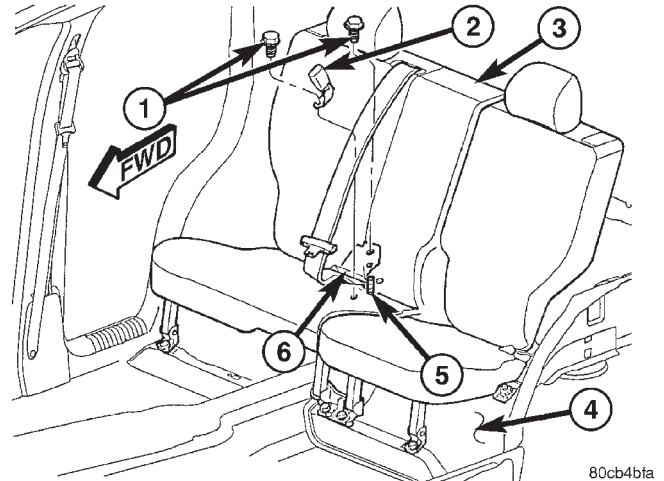
(6) Remove the right rear seat back panel from the vehicle. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - REMOVAL).

(7) Remove the two screws that secure the belt web guide to the top of the right rear seat back panel.

(8) Remove the trim from the right rear seat back. (Refer to 23 - BODY/SEATS/SEAT BACK COVER - REAR - REMOVAL).

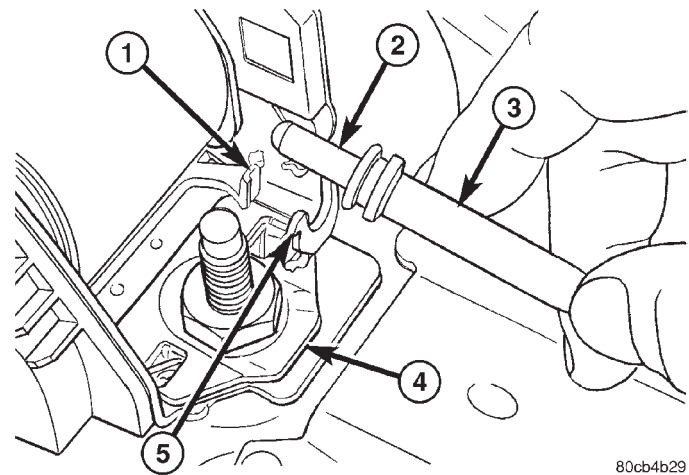
(9) Route the rear seat belt lower anchor and belt web guide through the top of the seat back panel.

(10) Disengage the seat back latch cable fitting from the cable support on the retractor, which is a light snap fit (Fig. 29).



**Fig. 28 Rear Center Seat Belt Anchor Plate Remove/Install**

- 1 - SCREW (2)
- 2 - BUCKLE UNIT
- 3 - REAR SEAT BACK
- 4 - REAR FLOOR PANEL
- 5 - STUD (1)
- 6 - ANCHOR PLATE

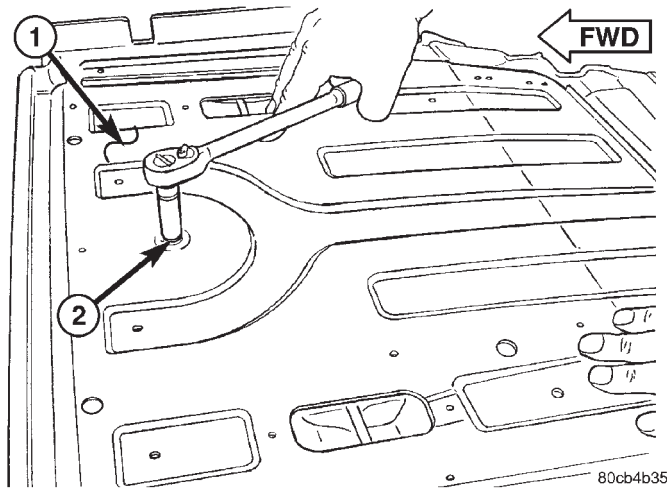


**Fig. 29 Seat Back Latch Cable Disengage/Engage**

- 1 - LEVER
- 2 - PLUNGER
- 3 - LATCH CABLE FITTING
- 4 - REAR CENTER RETRACTOR
- 5 - SUPPORT

## REAR CENTER SEAT BELT &amp; RETRACTOR (Continued)

(11) Remove the screw that secures the retractor to the rear seat back panel (Fig. 30).



**Fig. 30 Rear Center Retractor Remove/Install**

- 1 - REAR SEAT BACK PANEL  
2 - SCREW (1)

(12) Remove the rear center seat belt and retractor unit from the seat back panel.

## INSTALLATION

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

- (1) Position the rear center seat belt and retractor unit onto the seat back panel.
- (2) Install and tighten the screw that secures the retractor to the rear seat back panel (Fig. 30). Tighten the screw to 27 N·m (20 ft. lbs.).
- (3) Position the seat back latch cable plunger against the retractor latch lever, then engage the cable fitting into the cable support on the retractor, which is a light snap fit (Fig. 29).
- (4) Route the rear seat belt lower anchor and belt web guide through the top of the seat back panel.

(5) Reinstall the trim onto the right rear seat back. (Refer to 23 - BODY/SEATS/SEAT BACK COVER - REAR - INSTALLATION).

(6) Install and tighten the two screws that secure the belt web guide to the top of the right rear seat back panel. Tighten the screws to 2 N·m (20 in. lbs.).

(7) Reinstall the right rear seat back panel into the vehicle. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - INSTALLATION).

(8) Position the rear center seat belt lower anchor off of the stud on the rear floor panel (Fig. 28).

(9) Reach between the base of the right rear seat back and the forward edge of the rear cargo floor to install and tighten the screw that secures the rear center seat belt lower anchor to the floor panel. Tighten the screw to 43 N·m (32 ft. lbs.).

(10) Restore the cargo area carpet to the base of the seat back panel and unfold the right rear seat back to its upright position.

(11) Reinstall the right center seat belt buckle unit onto the floor panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT BUCKLE - INSTALLATION).

## REAR OUTBOARD SEAT BELT & RETRACTOR

### REMOVAL

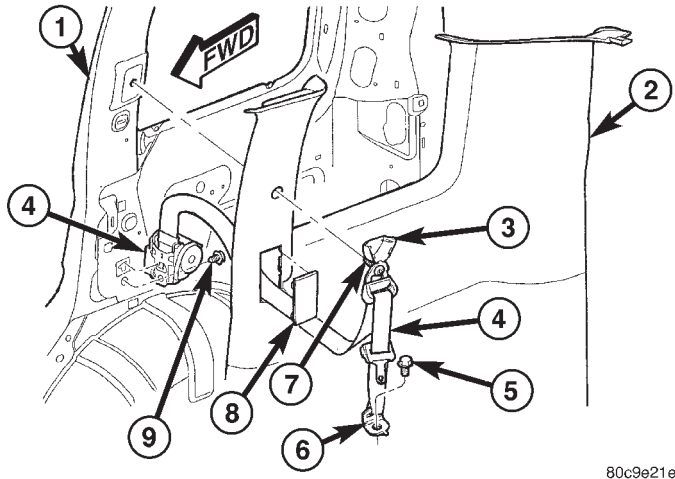
**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Unsnap and lift the trim cover to access the screw that secures the rear outboard seat belt turning loop to the upper C-pillar (Fig. 31).

(2) Remove the screw that secures the seat belt turning loop to the upper C-pillar.

(3) Remove the screw that secures the lower seat belt anchor to the bracket on the outboard side of the rear seat cushion frame.

## REAR OUTBOARD SEAT BELT &amp; RETRACTOR (Continued)



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**Fig. 31 Rear Outboard Seat Belt & Retractor  
Remove/Install**

- 1 - C-PILLAR
- 2 - QUARTER TRIM PANEL
- 3 - COVER
- 4 - SEAT BELT & RETRACTOR
- 5 - SCREW (1)
- 6 - LOWER ANCHOR
- 7 - SCREW (1)
- 8 - ACCESS COVER
- 9 - SCREW (1)

(4) Remove the quarter trim panel from the C-pillar. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL).

(5) Route the seat belt lower anchor and turning loop through the access hole in the quarter trim panel.

(6) Remove the screw that secures the retractor bracket to the lower C-pillar.

(7) Lift the retractor upward far enough to disengage the retractor tab from the engagement hole in the lower C-pillar.

(8) Remove the rear outboard seat belt and retractor from the C-pillar as a unit.

## INSTALLATION

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR**

**FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Position the rear outboard seat belt and retractor to the C-pillar as a unit (Fig. 31).

(2) Engage the retractor tab into the engagement hole in the lower C-pillar.

(3) Install and tighten the screw that secures the retractor bracket to the lower C-pillar. Tighten the screw to 43 N-m (32 ft. lbs.).

(4) Route the seat belt lower anchor and turning loop through the access hole in the quarter trim panel.

(5) Reinstall the quarter trim panel onto the C-pillar. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION).

(6) Position the lower seat belt anchor to the bracket on the outboard side of the rear seat cushion frame. Be certain that the anti-rotation tab on the anchor is engaged in the slot in the seat bracket.

(7) Install and tighten the screw that secures the lower seat belt anchor to the bracket on the outboard side of the rear seat cushion frame. Tighten the screw to 43 N-m (32 ft. lbs.).

(8) Position the seat belt turning loop to the upper C-pillar.

(9) Install and tighten the screw that secures the seat belt turning loop to the upper C-pillar. Tighten the screw to 43 N-m (32 ft. lbs.).

(10) Fold and snap the trim cover back into place to conceal the screw that secures the rear outboard seat belt turning loop to the upper C-pillar.

## REAR SEAT BELT BUCKLE

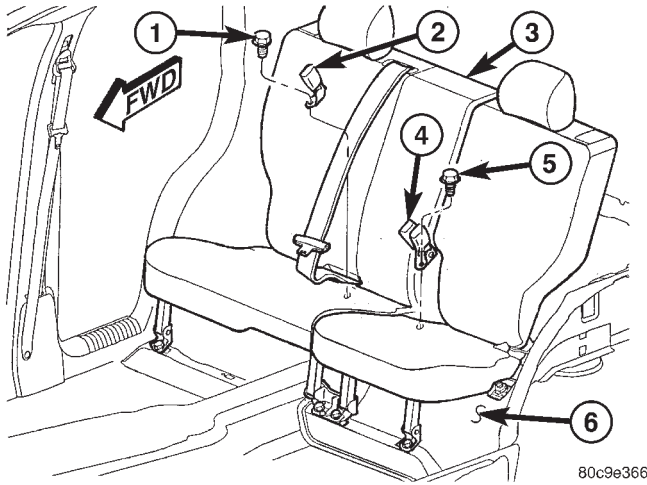
### REMOVAL

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR**

REAR SEAT BELT BUCKLE (Continued)

(1) Unlatch the rear seat back and fold it forward far enough to access the screw that secures the rear seat belt buckle anchor to the rear floor panel between the rear seat back and the rear seat cushion.

(2) Remove the screw that secures the rear seat belt buckle anchor to the rear floor panel (Fig. 32).



**Fig. 32 Rear Seat Belt Buckle Remove/Install**

- 1 - SCREW (1)
- 2 - BUCKLE (SINGLE)
- 3 - REAR SEAT
- 4 - BUCKLE (DOUBLE)
- 5 - SCREW (1)
- 6 - REAR FLOOR PANEL

(3) Lift the rear seat belt buckle anchor off of the stud on the rear floor panel.

(4) Remove the rear seat belt buckle and anchor from between the rear seat back and the rear seat cushion as a unit.

**INSTALLATION**

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Unlatch the rear seat back and fold it forward far enough to access the mounting location for the rear seat belt buckle anchor to the rear floor panel between the rear seat back and the rear seat cushion.

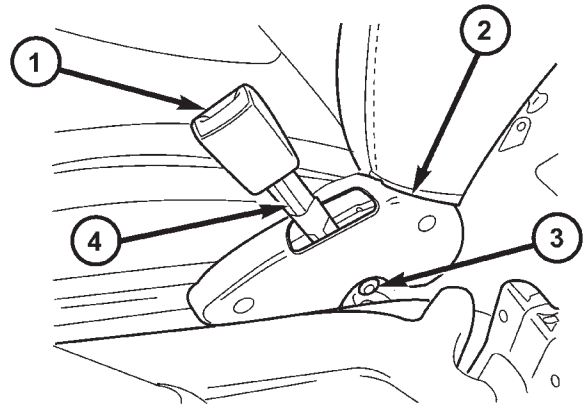
(2) Position the rear seat belt buckle and anchor between the rear seat back and the rear seat cushion as a unit (Fig. 32).

(3) Lower the rear seat belt buckle anchor over the stud on the rear floor panel.

(4) Install and tighten the screw that secures the rear seat belt buckle anchor to the rear floor panel. Tighten the screw to 43 N-m (32 ft. lbs.).

**SEAT BELT SWITCH**

**DESCRIPTION**



**Fig. 33 Front Seat Belt Buckle**

- 1 - FRONT SEAT BELT BUCKLE
- 2 - INBOARD SIDE SHIELD
- 3 - SCREW
- 4 - PIGTAIL WIRE

The seat belt switch for this model is actually a Hall Effect-type sensor. This sensor consists of a fixed-position, Hall Effect Integrated Circuit (IC) chip and a small, movable, permanent magnet that are integral to each front seat belt buckle. The front seat belt buckles are each located on a stamped steel stanchion secured with a screw to the inboard side of each front seat cushion frame between the seat and the floor panel transmission tunnel (Fig. 33). The seat belt switches are connected to the vehicle electrical system through a two-lead pigtail wire and connector on the seat belt buckle-half, which is connected to a wire harness connector and take out of the seat wire harness beneath the rear edge of the seat cushion frame. A diagnostic resistor is connected

## SEAT BELT SWITCH (Continued)

in parallel with the IC where the two pigtail wire leads connect to the IC pins.

The seat belt switch cannot be adjusted or repaired and, if faulty or damaged, the entire seat belt buckle-half unit must be replaced.

## OPERATION

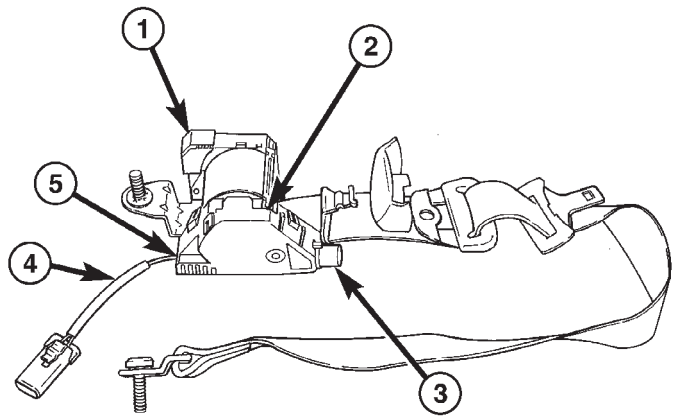
The seat belt switches are designed to provide a status signal to the seat belt switch sense inputs of the Airbag Control Module (ACM) indicating whether the front seat belts are fastened. The ACM uses the seat belt switch inputs as a factor in determining what level of force with which it should deploy the multistage driver and passenger airbags. In addition, the ACM sends electronic messages to the ElectroMechanical Instrument Cluster (EMIC) to control the seat belt indicator based upon the status of the driver side front seat belt switch. A spring-loaded plastic slide with a small, enclosed permanent magnet is integral to the buckle latch mechanism. When a seat belt tip-half is inserted and latched into the seat belt buckle, the slide is pushed downward and into close proximity of the Hall Effect Integrated Circuit (IC) chip within the buckle, which induces a current within the chip. The chip provides this induced current as an output to the ACM, which monitors the current to determine the status of the front seat belts. When the seat belt is unbuckled, the spring-loaded slide and permanent magnet move upward and away from the IC, causing the output current from the seat belt switch to be reduced.

The seat belt switch receives a supply current from the ACM, and the ACM senses the status of the front seat belts through its pigtail wire connection to the seat wire harness. The ACM also monitors the condition of the seat belt switch circuits through circuit resistance created by the diagnostic resistor. The ACM will illuminate the airbag indicator in the EMIC and store a Diagnostic Trouble Code (DTC) for any fault that is detected in either seat belt switch circuit. For proper diagnosis of the seat belt switches, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

## SEAT BELT TENSIONER

## DESCRIPTION

A driver side seat belt tensioner supplements the driver airbag system for all versions of this model (Fig. 34). The seat belt tensioner is integral to the driver side front seat belt and retractor unit, which is secured to the B-pillar on the left side of the vehicle. The retractor is concealed beneath the molded plastic B-pillar trim. The seat belt tensioner consists primarily of a molded plastic tensioner housing, a tubular



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**Fig. 34 Seat Belt Tensioner**

- 1 - RETRACTOR
- 2 - TENSIONER HOUSING
- 3 - PISTON HOUSING
- 4 - PIGTAIL WIRE
- 5 - GAS GENERATOR

metal piston housing, a piston, a short rack gear, a set of pinion gears, a pyrotechnically activated gas generator, and a short pigtail wire. All of these components are located on one side of the retractor spool on the outside of the retractor housing. The seat belt tensioner is controlled by the Airbag Control Module (ACM) and is connected to the vehicle electrical system through a dedicated take out of the body wire harness by a keyed and latching molded plastic connector insulator to ensure a secure connection.

The seat belt tensioner cannot be repaired and, if faulty or damaged, the entire driver side front seat belt and retractor unit must be replaced. The seat belt tensioner is not intended for reuse and must be replaced following a deployment. A locked retractor that will not allow the seat belt webbing to be retracted or extracted is a sure indication that the seat belt tensioner has been deployed and requires replacement. (Refer to 8 - ELECTRICAL/RESTRAINTS/Front Seat Belt & Retractor - Removal).

## OPERATION

The seat belt tensioner is deployed by a signal generated by the Airbag Control Module (ACM) through the driver seat belt tensioner line 1 and line 2 (or squib) circuits. When the ACM sends the proper electrical signal to the tensioner, the electrical energy generates enough heat to initiate a small pyrotechnic gas generator. The gas generator is installed in one end of the tubular metal piston housing, which contains a piston and a small rack gear. As the gas expands, it pushes the piston and the rack gear

SEAT BELT TENSIONER (Continued)

through the tube. The rack gear engages a pinion gear that drives a gear set in the tensioner housing, which drives the seat belt retractor spool causing the slack to be removed from the driver side front seat belt. Removing excess slack from the driver side front seat belt not only keeps the occupant properly positioned for an airbag deployment following a frontal impact of the vehicle, but also helps to reduce injuries that the occupant of the driver side front seat might experience in these situations as a result of a harmful contact with the steering wheel and/or steering column. Also, the seat belt tensioner has a torsion bar mechanism that is designed to deform in order to control the loading being applied to the occupant of the driver side front seat by the seat belt during a frontal impact, further reducing the potential for occupant injuries.

The ACM monitors the condition of the seat belt tensioner through circuit resistance, and will illuminate the airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) and store a Diagnostic Trouble Code (DTC) for any fault that is detected. For proper diagnosis of the seat belt tensioner, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SEAT BELT TURNING LOOP ADJUSTER

REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT**

**THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

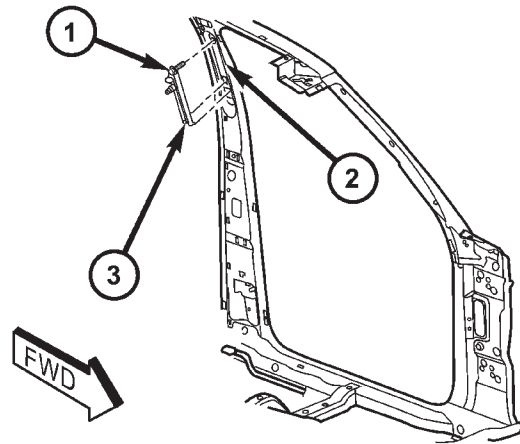
(2) Unsnap and lift the trim cover to access the nut that secures the front seat belt turning loop to the height adjuster on the upper B-pillar.

(3) Remove the nut that secures the seat belt turning loop to the height adjuster stud on the upper B-pillar.

(4) Remove the seat belt turning loop from the height adjuster stud.

(5) Remove the upper trim from the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL).

(6) Remove the screw that secures the seat belt turning loop adjuster to the upper B-pillar (Fig. 35).



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**Fig. 35 Seat Belt Turning Loop Adjuster Remove/ Install**

- 1 - SCREW
- 2 - B-PILLAR
- 3 - ADJUSTER

(7) Pull the upper end of the turning loop adjuster away from the B-pillar far enough to disengage the hooks on the lower end of the adjuster from the slots in the B-pillar.

(8) Remove the seat belt turning loop adjuster from the B-pillar.



## SEAT BELT TURNING LOOP ADJUSTER (Continued)

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.**

(1) Position the seat belt turning loop adjuster to the B-pillar (Fig. 35).

(2) Engage the hooks on the lower end of the adjuster into the slots in the B-pillar.

(3) Tilt the upper end of the turning loop adjuster up into position against the B-pillar.

(4) Install and tighten the screw that secures the seat belt turning loop adjuster to the upper B-pillar. Tighten the screw to 34 N·m (25 ft. lbs.).

(5) Reinstall the upper trim onto the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION).

(6) Position the seat belt turning loop onto the height adjuster stud on the upper B-pillar.

(7) Install and tighten the nut that secures the seat belt turning loop to the height adjuster stud. Tighten the nut to 34 N·m (25 ft. lbs.).

(8) Fold and snap the trim cover back into place to conceal the nut that secures the front seat belt turning loop to the height adjuster on the upper B-pillar.

(9) Reconnect the battery negative cable.

## SIDE CURTAIN AIRBAG

## DESCRIPTION



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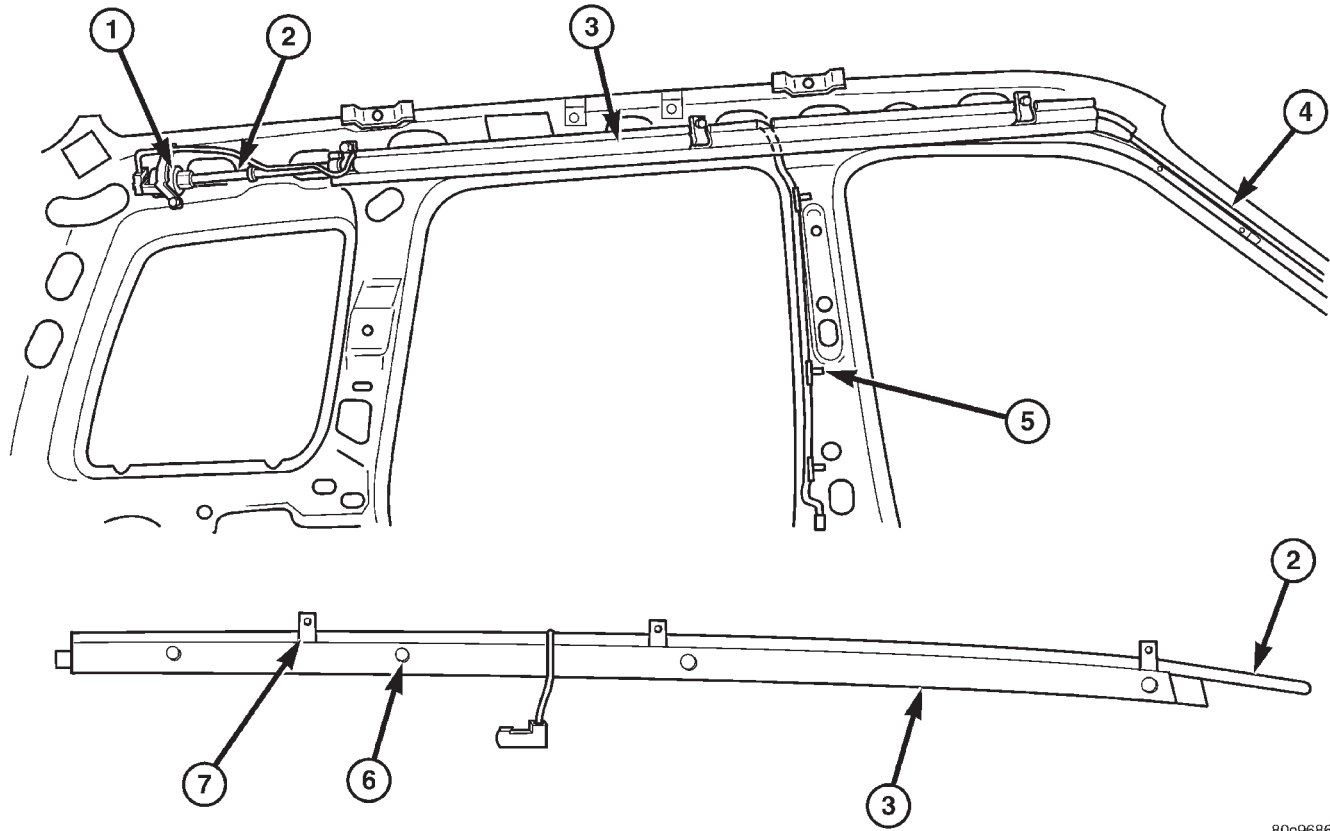
*Fig. 36 SRS Logo*

Optional side curtain airbags are available for this model when it is also equipped with dual front airbags. These airbags are passive, inflatable, Supplemental Restraint System (SRS) components, and vehicles with this equipment can be readily identified by a molded identification trim button with the "SRS - AIRBAG" logo located on the headliner above each B-pillar (Fig. 36). This system is designed to reduce injuries to the vehicle occupants in the event of a side impact collision.

Vehicles equipped with side curtain airbags have two individually controlled curtain airbag units. These airbag units are concealed and mounted above the headliner where they are each secured to one of the roof side rails (Fig. 37). Each folded airbag cushion is contained within a long extruded plastic channel that extends along the roof rail from the A-pillar at the front of the vehicle to just behind the C-pillar at the rear of the vehicle. The channel is secured with plastic push-in fasteners to the roof rail. A tether extends down the A-pillar from the front of the airbag cushion, where it is retained to the pillar with plastic push-in routing clips and it is secured to the base of the A-pillar near the belt line with a screw.

The hybrid-type inflator for each airbag is secured to the roof rail at the rear of the airbag unit between the C-pillar and the D-pillar, and is connected to the airbag cushion by a long tubular manifold. The bracket holding the inflator and three other brackets holding the manifold are secured to the roof rail with

SIDE CURTAIN AIRBAG (Continued)



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**Fig. 37 Side Curtain Airbag**

- 1 - INFLATOR
- 2 - MANIFOLD
- 3 - CHANNEL
- 4 - TETHER

- 5 - PIGTAIL WIRE RETAINER (3)
- 6 - PUSH-IN FASTENER (4)
- 7 - BRACKET (3)

screws. A two-wire pigtail harness is routed forward from the airbag inflator through a trough along the top of the plastic airbag channel on the roof rail and down the B-pillar, where it is retained by three routing clips. The pigtail harness is connected to a take out and connector of the body wire harness on the B-pillar, which connects to the respective right or left Side Impact Airbag Control Module (SIACM) on the sill panel at the base of the B-pillar.

The side curtain airbag unit cannot be adjusted or repaired and must be replaced if deployed, faulty, or in any way damaged. Once a side curtain airbag has been deployed, the complete airbag unit, the headliner, the upper A, B, and C-pillar trim, and all other visibly damaged components must be replaced.

**OPERATION**

Each side curtain airbag is deployed individually by an electrical signal generated by the left or right Side Impact Airbag Control Module (SIACM) to which it is connected through left or right curtain airbag line 1 and line 2 (or squib) circuits. The hybrid-type inflator

assembly for each airbag contains a small canister of highly compressed helium gas. When the SIACM sends the proper electrical signal to the airbag inflator, the electrical energy creates enough heat to ignite chemical pellets within the inflator. Once ignited, these chemicals burn rapidly and produce the pressure necessary to rupture a containment disk in the helium gas canister. The inflator and helium gas canister are sealed and connected to a tubular manifold so that all of the released gas is directed into the folded curtain airbag cushion, causing the cushion to inflate.

As the airbag cushion inflates it will drop down from the roof rail between the edge of the headliner and the side glass/body pillars to form a curtain-like cushion to protect the vehicle occupants during a side impact collision. The front tether keeps the front portion of the bag taut, thus ensuring that the bag will deploy in the proper position. Following the airbag deployment, the airbag cushion quickly deflates by venting the helium gas through the loose weave of the cushion fabric, and the deflated cushion hangs down loosely from the roof rail.

## SIDE CURTAIN AIRBAG (Continued)

**REMOVAL**

The following procedure is for replacement of a faulty or damaged side curtain airbag. If the side curtain airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

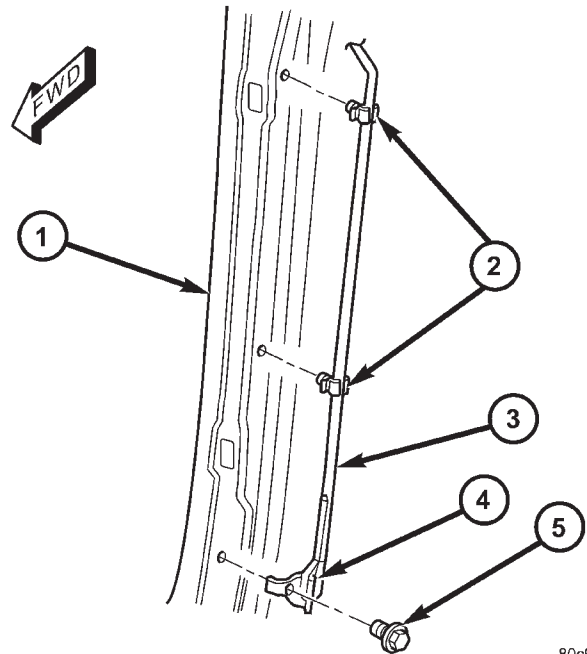
**WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE SIDE CURTAIN AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE SIDE CURTAIN AIRBAG CUSHION AND THE HEADLINER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the lower trim from the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL).

(3) Remove the headliner from the vehicle. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL).

(4) Remove the screw that secures the side curtain airbag tether retainer to the base of the A-pillar near the belt line (Fig. 38).



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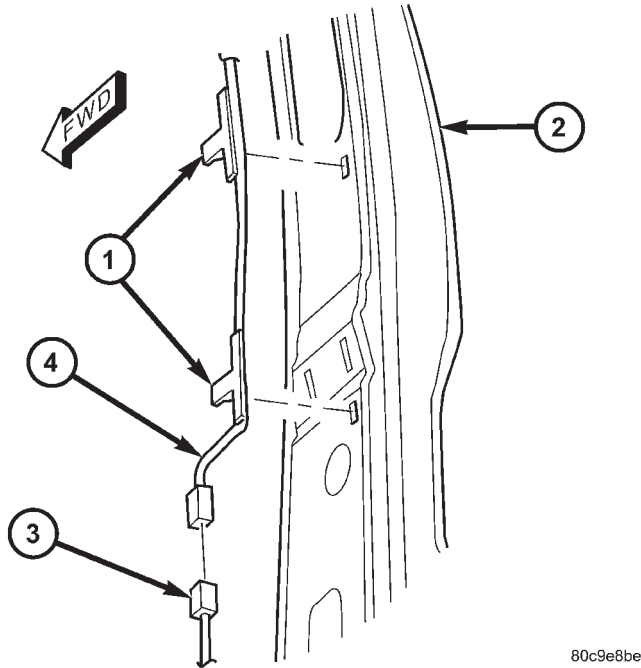
**Fig. 38 Side Curtain Airbag Tether Remove/Install**

- 1 - A-PILLAR
- 2 - CLIP (2)
- 3 - TETHER
- 4 - RETAINER (1)
- 5 - SCREW (1)

SIDE CURTAIN AIRBAG (Continued)

(5) Disengage the two side curtain airbag tether plastic retainer clips from the A-pillar.

(6) Disconnect the side curtain airbag pigtail wire connector from the body wire harness connector near the base of the B-pillar (Fig. 39).



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**Fig. 39 Side Curtain Airbag Pigtail Wire Remove/Install**

- 1 - RETAINER (3)
- 2 - B-PILLAR
- 3 - WIRE HARNESS CONNECTOR
- 4 - PIGTAIL WIRE

(7) Disengage the three side curtain airbag pigtail wire retainer clips from the B-pillar.

(8) Remove the three screws that secure the side curtain airbag manifold tube brackets to the U-nuts in the roof rail (Fig. 40) and (Fig. 41).

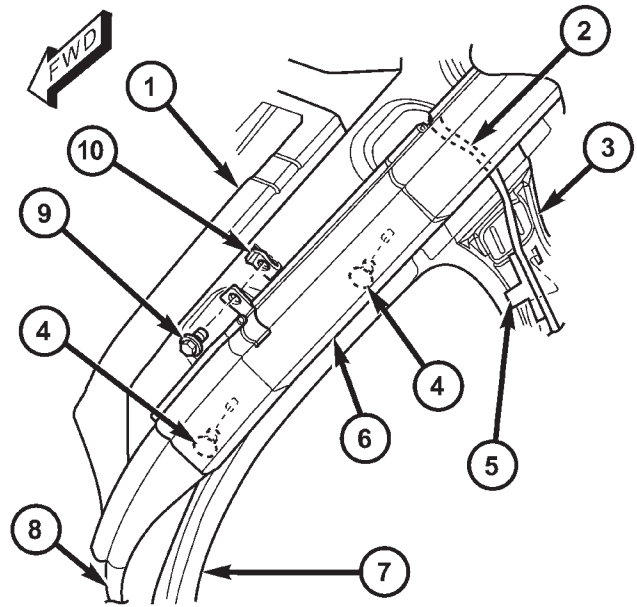
(9) Remove the two screws that secure the side curtain airbag inflator bracket to the U-nuts in the roof rail (Fig. 42).

(10) Grasp the extruded plastic side curtain airbag channel firmly and pull it straight away from the roof rail far enough to disengage all four plastic push-in fasteners that secure it.

(11) Remove the side curtain airbag from the vehicle as a unit.

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER,**



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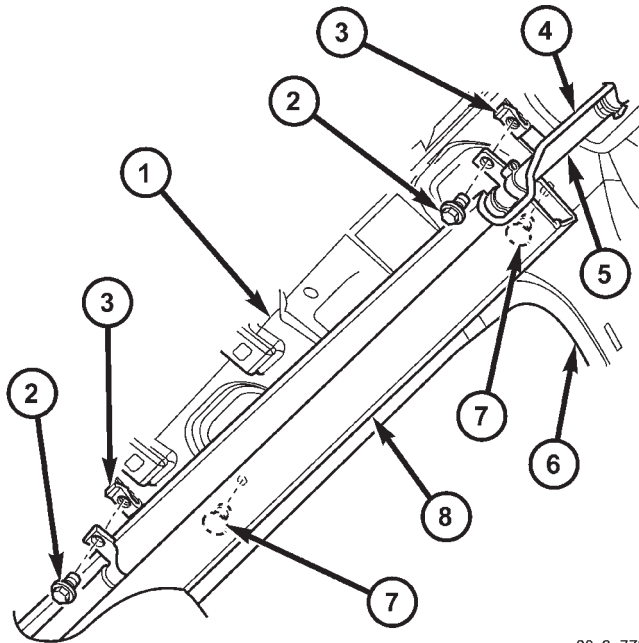
**Fig. 40 Side Curtain Airbag (Front) Remove/Install**

- 1 - ROOF PANEL
- 2 - PIGTAIL WIRE
- 3 - B-PILLAR
- 4 - PUSH-IN FASTENER (4)
- 5 - RETAINER
- 6 - CHANNEL
- 7 - A-PILLAR
- 8 - TETHER
- 9 - SCREW (3)
- 10 - U-NUT (5)

**FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.**

## SIDE CURTAIN AIRBAG (Continued)



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**Fig. 41 Side Curtain Airbag (Rear) Remove/Install**

- 1 - ROOF PANEL
- 2 - SCREW (3)
- 3 - U-NUT (5)
- 4 - PIGTAIL WIRE
- 5 - MANIFOLD
- 6 - C-PILLAR
- 7 - PUSH-IN FASTENER (4)
- 8 - CHANNEL

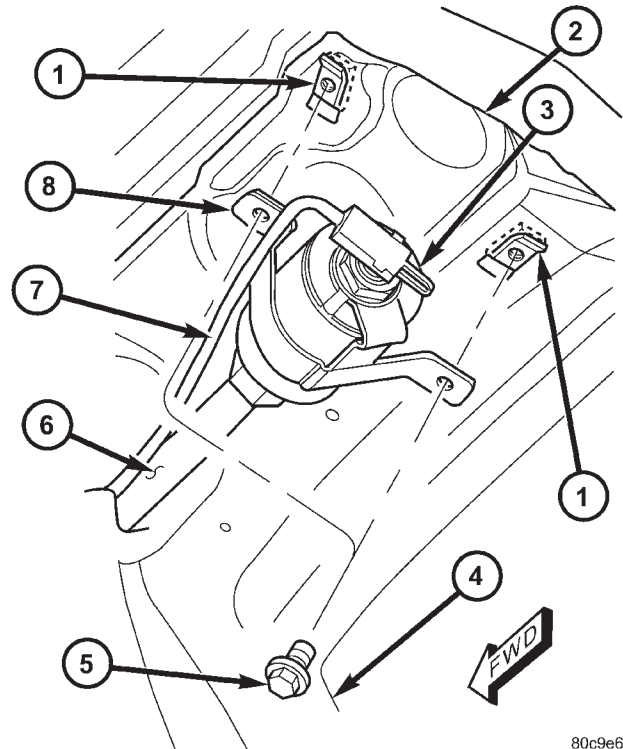
**WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE SIDE CURTAIN AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE SIDE CURTAIN AIRBAG CUSHION AND THE HEADLINER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.**

(1) Position the side curtain airbag into the vehicle as a unit.

(2) Align all four plastic push-in fasteners that secure the extruded plastic side curtain airbag channel with their holes in the roof side rail and push them straight into the roof rail until they are fully seated (Fig. 40) and (Fig. 41).

(3) Install and tighten the upper screw that secures the side curtain airbag inflator bracket to the U-nut in the roof rail, followed by the lower screw (Fig. 42). Tighten the screws to 12 N·m (105 in. lbs.).

(4) Working from the rear of the vehicle to the front, install and tighten each of the three screws that secure the side curtain airbag manifold tube brackets to the U-nuts in the roof rail. Tighten the screws to 12 N·m (105 in. lbs.).



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**Fig. 42 Side Curtain Airbag Inflator Remove/Install**

- 1 - U-NUT (5)
- 2 - ROOF PANEL
- 3 - INFLATOR
- 4 - C-PILLAR
- 5 - SCREW (2)
- 6 - MANIFOLD
- 7 - PIGTAIL WIRE
- 8 - BRACKET

(5) Route the side curtain airbag pigtail wire through the trough along the top of the extruded plastic airbag channel on the roof side rail, then between the channel and the body down the B-pillar.

**NOTE: Be certain that the side curtain airbag pigtail wire is routed behind the airbag channel, between the channel and the body above the B-pillar.**

(6) Engage the three side curtain airbag pigtail wire retainer clips into the B-pillar (Fig. 39).

(7) Reconnect the side curtain airbag pigtail wire connector to the body wire harness connector near the base of the B-pillar.

(8) Engage the two side curtain airbag tether plastic retainer clips into the A-pillar (Fig. 38).

(9) Install and tighten the screw that secures the side curtain airbag tether retainer to the base of the A-pillar near the belt line. Tighten the screw to 14 N·m (120 in. lbs.).

SIDE CURTAIN AIRBAG (Continued)

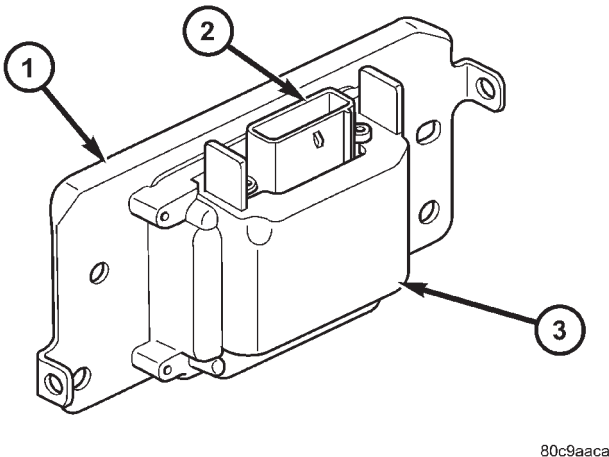
(10) Reinstall the headliner into the vehicle. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION).

(11) Reinstall the lower trim onto the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION).

(12) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

## SIDE IMPACT AIRBAG CONTROL MODULE

### DESCRIPTION



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**Fig. 43 Side Impact Airbag Control Module**

- 1 - BRACKET (RIGHT SHOWN)
- 2 - CONNECTOR RECEPTACLE
- 3 - SIACM

On vehicles equipped with the optional side curtain airbags, a Side Impact Airbag Control Module (SIACM) and its mounting bracket are secured with four screws to the sill panel at the base of each B-pillar behind the lower B-pillar trim (Fig. 43). Concealed within a hollow in the center of the die cast aluminum SIACM housing is the electronic circuitry of the SIACM which includes a microprocessor and an electronic impact sensor. The SIACM housing is secured to a stamped steel mounting bracket, which is unique for the right or left side application of this component. The SIACM should never be removed from its mounting bracket. The housing also receives a case ground through this mounting bracket when it is secured to the vehicle. A molded plastic electrical connector receptacle that exits the top of the SIACM

housing connects the unit to the vehicle electrical system through a dedicated take out and connector of the body wire harness. Both the SIACM housing and its electrical connection are sealed to protect the internal electronic circuitry and components against moisture intrusion.

The impact sensor internal to the SIACM is calibrated for the specific vehicle, and is only serviced as a unit with the SIACM. The SIACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced.

### OPERATION

The microprocessor in the Side Impact Airbag Control Module (SIACM) contains the side curtain airbag system logic circuits and controls all of the features of only the side curtain airbag mounted on the same side of the vehicle as the SIACM. The SIACM uses On-Board Diagnostics (OBD) and can communicate with other electronic modules in the vehicle as well as with the DRBIII® scan tool using the Programmable Communications Interface (PCI) data bus network. This method of communication is used by the SIACM to communicate with the Airbag Control Module (ACM) and for supplemental restraints system diagnosis and testing through the 16-way data link connector located on the driver side lower edge of the instrument panel. The ACM communicates with both the left and right SIACM over the PCI data bus.

The SIACM microprocessor continuously monitors all of the side curtain airbag electrical circuits to determine the system readiness. If the SIACM detects a monitored system fault, it sets an active and stored Diagnostic Trouble Code (DTC) and sends electronic messages to the ACM over the PCI data bus. The ACM will respond by sending an electronic message to the EMIC to turn on the airbag indicator, and by storing a DTC that will indicate whether the left or the right SIACM has stored the DTC that initiated the airbag indicator illumination. An active fault only remains for the current ignition switch cycle, while a stored fault causes a DTC to be stored in memory by the SIACM. For some DTCs, if a fault does not recur for a number of ignition cycles, the SIACM will automatically erase the stored DTC. For other internal faults, the stored DTC is latched forever.

The SIACM receives battery current on a fused ignition switch output (run-start) circuit through a fuse in the Junction Block (JB). The SIACM has a case ground through its mounting bracket and also receives a power ground through a ground circuit and take out of the body wire harness. This take out has a single eyelet terminal connector that is secured by a ground screw to the front seat front crossmem-

## SIDE IMPACT AIRBAG CONTROL MODULE (Continued)

ber beneath the respective right or left front seat. These connections allow the SIACM to be operational whenever the ignition switch is in the Start or On positions. An electronic impact sensor is contained within the SIACM. The electronic impact sensor is an accelerometer that senses the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. A pre-programmed decision algorithm in the SIACM microprocessor determines when the deceleration rate as signaled by the impact sensor indicates a side impact that is severe enough to require side curtain airbag protection. When the programmed conditions are met, the SIACM sends the proper electrical signals to deploy the side curtain airbag.

The hard wired inputs and outputs for the SIACM may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the SIACM, the PCI data bus network, or the electronic message inputs to and outputs from the SIACM. The most reliable, efficient, and accurate means to diagnose the SIACM, the PCI data bus network, and the electronic message inputs to and outputs from the SIACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: THE SIDE IMPACT AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE SIDE CURTAIN AIRBAGS. NEVER STRIKE OR DROP THE SIDE IMPACT AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF A SIDE IMPACT AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DUR-**

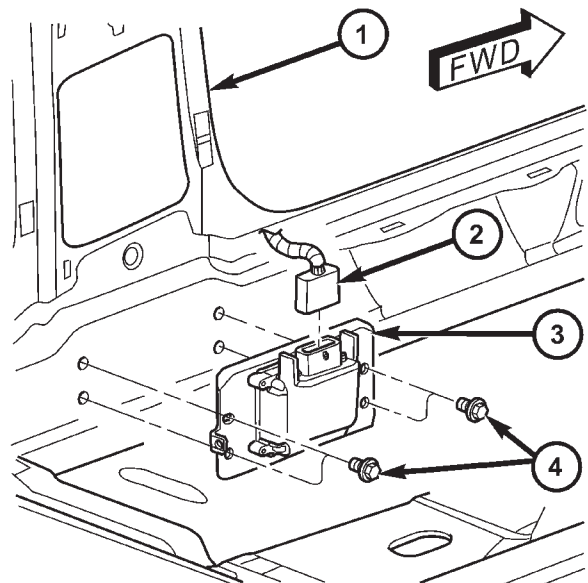
**ING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER SIDE CURTAIN AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

(1) Adjust the front seat to its most forward position for easiest access to the lower B-pillar trim.

(2) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(3) Remove the lower trim from the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL).

(4) Disconnect the body wire harness connector for the Side Impact Airbag Control Module (SIACM) from the module connector receptacle (Fig. 44).



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**Fig. 44 Side Impact Airbag Control Module Remove/Install**

- 1 - B-PILLAR
- 2 - WIRE HARNESS CONNECTOR
- 3 - SIACM
- 4 - SCREW (4)

(5) Disengage the body wire harness retainer from the tab on the SIACM mounting bracket.

(6) Remove the four screws that secure the SIACM mounting bracket to the sill panel at the base of the B-pillar.

(7) Remove the SIACM and its mounting bracket from the sill panel as a unit.

## SIDE IMPACT AIRBAG CONTROL MODULE (Continued)

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: THE SIDE IMPACT AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE SIDE CURTAIN AIRBAGS. NEVER STRIKE OR DROP THE SIDE IMPACT AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF A SIDE IMPACT AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED**

**AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER SIDE CURTAIN AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.**

(1) Position the Side Impact Airbag Control Module (SIACM) and its mounting bracket to the sill panel as a unit (Fig. 44).

(2) Loosely install the four screws that secure the SIACM mounting bracket to the sill panel at the base of the B-pillar.

(3) Tighten the four screws that secure the SIACM mounting bracket to the sill panel in the following sequence: upper front, upper rear, lower front, lower rear. Tighten the screws to 12 N·m (105 in. lbs.).

(4) Engage the body wire harness retainer to the tab on the SIACM mounting bracket.

(5) Reconnect the body wire harness connector for the SIACM to the module connector receptacle.

(6) Reinstall the lower trim onto the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION).

(7) Do not reconnect the battery negative cable at this time. The airbag system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).





# SPEED CONTROL

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## SPEED CONTROL

### DESCRIPTION

The speed control system is electronically controlled and vacuum operated. Electronic control of the speed control system is integrated into the Powertrain Control Module (PCM). The controls consist of two steering wheel mounted switches. The switches are labeled: ON/OFF, RES/ACCEL, SET, COAST, and CANCEL.

The system is designed to operate at speeds above 30 mph (50 km/h).

**WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.**

### OPERATION

When speed control is selected by depressing the ON switch, the PCM allows a set speed to be stored in PCM RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:

- Stepping on the brake pedal
- Depressing the OFF switch

- Depressing the CANCEL switch.
- Depressing the clutch pedal (if equipped).

**NOTE: Depressing the OFF switch or turning off the ignition switch will erase the set speed stored in the PCM.**

For added safety, the speed control system is programmed to disengage for any of the following conditions:

- An indication of Park or Neutral
- A rapid increase rpm (indicates that the clutch has been disengaged)
- Excessive engine rpm (indicates that the transmission may be in a low gear)
- The speed signal increases at a rate of 10 mph per second (indicates that the coefficient of friction between the road surface and tires is extremely low)
- The speed signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)

Once the speed control has been disengaged, depressing the RES/ACCEL switch (when speed is greater than 30 mph) restores the vehicle to the target speed that was stored in the PCM.

While the speed control is engaged, the driver can increase the vehicle speed by depressing the RES/ACCEL switch. The new target speed is stored in the PCM when the RES/ACCEL is released. The PCM also has a "tap-up" feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the RES/ACCEL switch.

## SPEED CONTROL (Continued)

A “tap down” feature is used to decelerate without disengaging the speed control system. To decelerate from an existing recorded target speed, momentarily depress the COAST switch. For each switch activation, speed will be lowered approximately 1 mph.

## OVERSHOOT/UNDERSHOOT

If the vehicle operator repeatedly presses and releases the SET button with their foot off of the accelerator (referred to as a “lift foot set”), the vehicle may accelerate and exceed the desired set speed by up to 5 mph (8 km/h). It may also decelerate to less than the desired set speed, before finally achieving the desired set speed.

The Speed Control System 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 accordingly. If the “lift foot sets” are continually used, a 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 using the accelerator pedal (not decelerating or accelerating), and then turning 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.

## 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 8J, Instrument Cluster 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.

## SPECIFICATIONS

## TORQUE - SPEED CONTROL

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Servo Mounting Bracket-to-Servo Nuts	9	-	75
Servo Mounting Bracket-to-Body Bolts	12	-	105
Speed Control Switch Mounting Screws	1.5	-	14
Vacuum Reservoir Mounting Screws	3	-	20

## CABLE

### DESCRIPTION

The speed control servo cable is connected between the speed control vacuum servo diaphragm and the throttle body control linkage.

### OPERATION

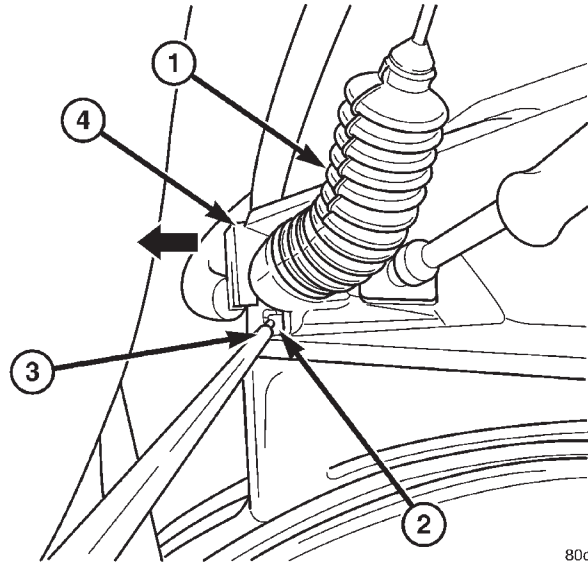
This cable causes the throttle control linkage to open or close the throttle valve in response to movement of the vacuum servo diaphragm.

### REMOVAL - 3.7L

- (1) Disconnect negative battery cable at battery.
- (2) Remove air filter resonator at throttle body.

The accelerator cable must be partially removed to gain access to speed control cable.

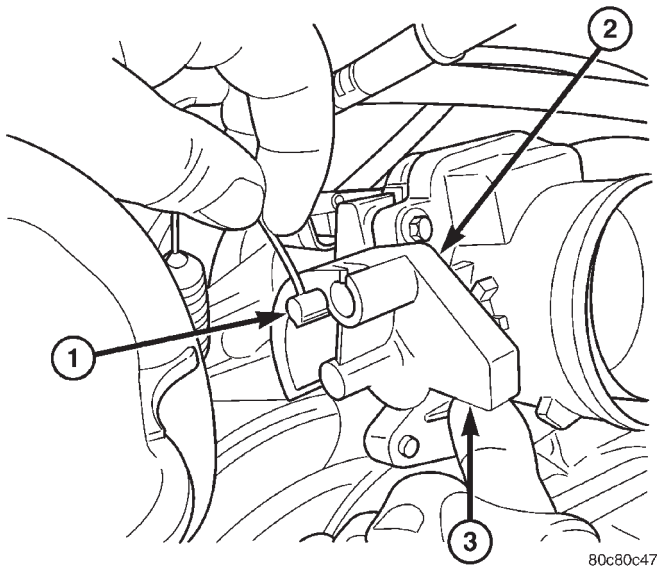
(3) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 1) from throttle body bellcrank.



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**Fig. 2 THROTTLE CABLE RELEASE TAB**

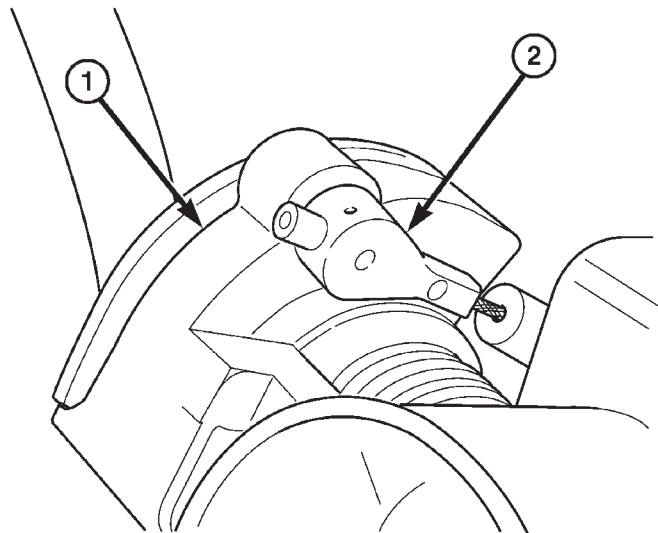
- 1 - THROTTLE CABLE
- 2 - RELEASE TAB
- 3 - PICK OR SCREWDRIVER
- 4 - PLASTIC CABLE MOUNT



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**Fig. 1 THROTTLE CABLE PIN**

- 1 - THROTTLE CABLE PIN
- 2 - THROTTLE BODY BELLCRANK
- 3 - PUSH UP HERE



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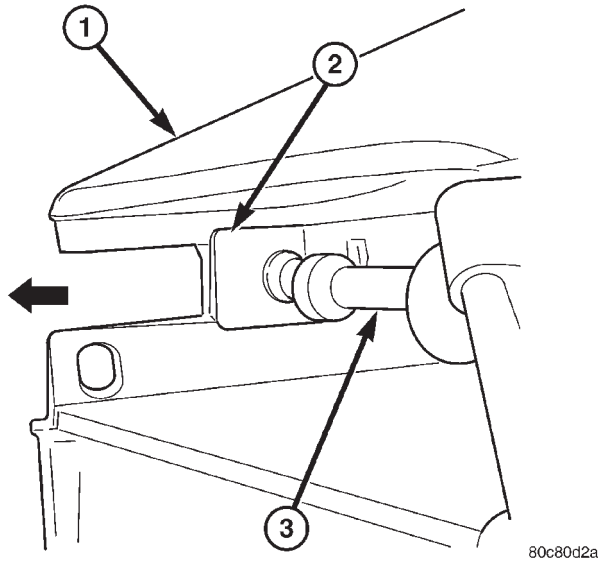
**Fig. 3 SPEED CONTROL CABLE AT BELLCRANK**

- 1 - THROTTLE BODY BELLCRANK
- 2 - SPEED CONTROL CABLE CONNECTOR

(4) Using a pick or small screwdriver, press release tab (Fig. 2) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 2) towards right side of vehicle to remove throttle cable from throttle body bracket.

(5) Using finger pressure only, disconnect servo cable connector (Fig. 3) at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle. **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

## CABLE (Continued)



**Fig. 4 SPEED CONTROL CABLE AT BRACKET**

- 1 - THROTTLE CABLE BRACKET  
 2 - PLASTIC CABLE MOUNT  
 3 - SPEED CONTROL CABLE

(6) Slide speed control cable plastic mount towards right of vehicle to remove cable from throttle body bracket (Fig. 4).

(7) Remove servo cable from servo. Refer to Servo Removal/Installation.

### INSTALLATION - 3.7L

(1) Install end of cable to speed control servo. Refer to Servo Removal/Installation.

(2) Slide speed control cable plastic mount into throttle body bracket.

(3) Install speed control cable connector onto throttle body bellcrank pin (push rearward to snap into location).

(4) Slide throttle (accelerator) cable plastic mount into throttle body bracket. Continue sliding until cable release tab is aligned to hole in throttle body mounting bracket.

(5) While holding throttle to wide open position, place throttle cable pin into throttle body bellcrank.

(6) Install air filter resonator box to throttle body.

(7) Connect negative battery cable at battery.

(8) Before starting engine, operate accelerator pedal to check for any binding.

## SERVO

### DESCRIPTION

The servo unit consists of a solenoid valve body, and a vacuum chamber. The solenoid valve body contains three solenoids:

- Vacuum
- Vent
- Dump

The vacuum chamber contains a diaphragm with a cable attached to control the throttle linkage.

### OPERATION

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. The servo unit cannot be repaired and is serviced only as a complete assembly.

Power is supplied to the servo's by the PCM through the brake switch. The PCM controls the ground path for the vacuum and vent solenoids.

The dump solenoid is energized anytime it receives power. If power to the dump solenoid is interrupted, the solenoid dumps vacuum in the servo. This provides a safety backup to the vent and vacuum solenoids.

The vacuum and vent solenoids must be grounded at the PCM to operate. When the PCM grounds the vacuum servo solenoid, the solenoid allows vacuum to enter the servo and pull open the throttle plate using the cable. When the PCM breaks the ground, the solenoid closes and no more vacuum is allowed to enter the servo. The PCM also operates the vent solenoid via ground. The vent solenoid opens and closes a passage to bleed or hold vacuum in the servo as required.

The PCM duty cycles the vacuum and vent solenoids to maintain the set speed, or to accelerate and decelerate the vehicle. To increase throttle opening, the PCM grounds the vacuum and vent solenoids. To decrease throttle opening, the PCM removes the grounds from the vacuum and vent solenoids. When the brake is released, if vehicle speed exceeds 30 mph to resume, 35 mph to set, and the RES/ACCEL switch has been depressed, ground for the vent and vacuum circuits is restored.

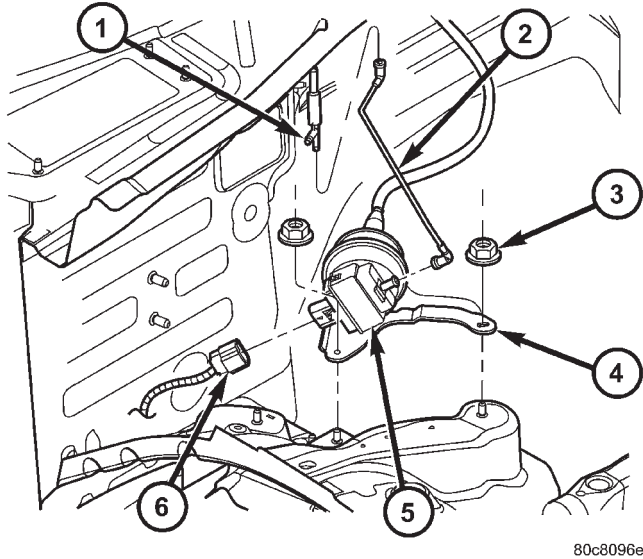
### REMOVAL

- (1) Disconnect negative battery cable at battery.
- (2) Disconnect vacuum line at servo (Fig. 5).
- (3) Disconnect electrical connector at servo (Fig. 5).
- (4) Remove coolant bottle nuts/bolts. Position bottle forward a few inches.
- (5) Disconnect servo cable at throttle body. Refer to Servo Cable Removal/Installation.
- (6) Remove servo bracket mounting nuts (Fig. 5).
- (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

SERVO (Continued)

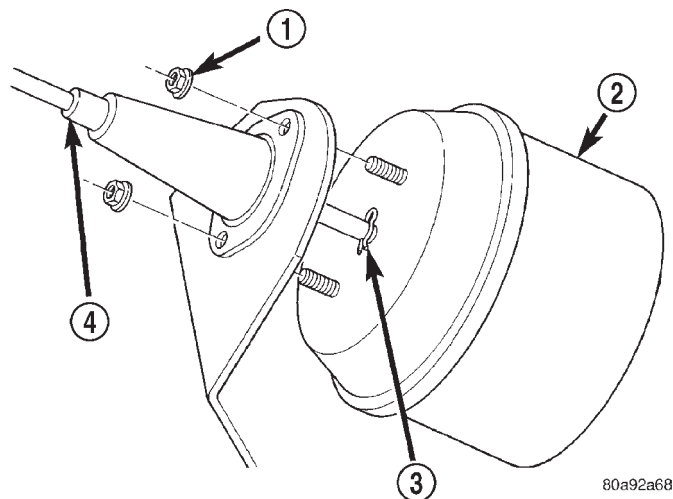
mounting bracket displayed in (Fig. 6) is a typical bracket and may/may not be applicable to this model vehicle.

(9) Remove servo from mounting bracket. While removing, note orientation of servo to bracket.



**Fig. 5 SPEED CONTROL SERVO**

- 1 - "T" FITTING
- 2 - VACUUM LINE
- 3 - SERVO BRACKET MOUNTING NUTS
- 4 - SERVO MOUNTING BRACKET
- 5 - SERVO
- 6 - SERVO ELECTRICAL CONNECTOR



**Fig. 6 SERVO CABLE CLIP REMOVE/INSTALL TYPICAL**

- 1 - SERVO MOUNTING NUTS (2)
- 2 - SERVO
- 3 - CABLE RETAINING CLIP
- 4 - SERVO CABLE AND SLEEVE

**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 mounting studs through holes in servo mounting bracket.
- (4) Install servo-to-mounting bracket nuts and tighten. Refer to torque specifications.
- (5) Install servo mounting bracket-to-body nuts and tighten. Refer to torque specifications.
- (6) Connect vacuum line at servo.
- (7) Connect electrical connector at servo.
- (8) Connect servo cable to throttle body. Refer to servo Cable Removal/Installation.
- (9) Install coolant bottle.
- (10) Connect negative battery cable to battery.
- (11) Before starting engine, operate accelerator pedal to check for any binding.

**SWITCH**

**DESCRIPTION**

There are two separate switch pods that operate the speed control system. The steering-wheel-mounted switches use multiplexed circuits to provide inputs to the PCM for ON, OFF, RESUME, ACCELERATE, SET, DECEL and CANCEL modes. 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 switch fails, the entire switch module must be replaced.

**OPERATION**

When speed control is selected by depressing the ON, OFF switch, the PCM allows a set speed to be stored in its RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between approximately 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:

- Stepping on the brake pedal
- Depressing the OFF switch
- Depressing the CANCEL switch.

The speed control can be disengaged also by any of the following conditions:

- An indication of Park or Neutral
- The VSS signal increases at a rate of 10 mph per second (indicates that the co-efficient of friction between the road surface and tires is extremely low)
  - Depressing the clutch pedal.
  - Excessive engine rpm (indicates that the transmission may be in a low gear)

## SWITCH (Continued)

- The VSS signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)

- If the actual speed is not within 20 mph of the set speed

The previous disengagement conditions are programmed for added safety.

Once the speed control has been disengaged, depressing the ACCEL switch restores the vehicle to the target speed that was stored in the PCM's RAM.

**NOTE:** Depressing the OFF switch will erase the set speed stored in the PCM's RAM.

If, while the speed control is engaged, the driver wishes to increase vehicle speed, the PCM is programmed for an acceleration feature. With the ACCEL switch held closed, the vehicle accelerates slowly to the desired speed. The new target speed is stored in the PCM's RAM when the ACCEL switch is released. The PCM also has a "tap-up" feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the ACCEL switch.

The PCM also provides a means to decelerate without disengaging speed control. To decelerate from an existing recorded target speed, depress and hold the COAST switch until the desired speed is reached. Then release the switch. The ON, OFF switch operates two components: the PCM's ON, OFF input, and the battery voltage to the brake switch, which powers the speed control servo.

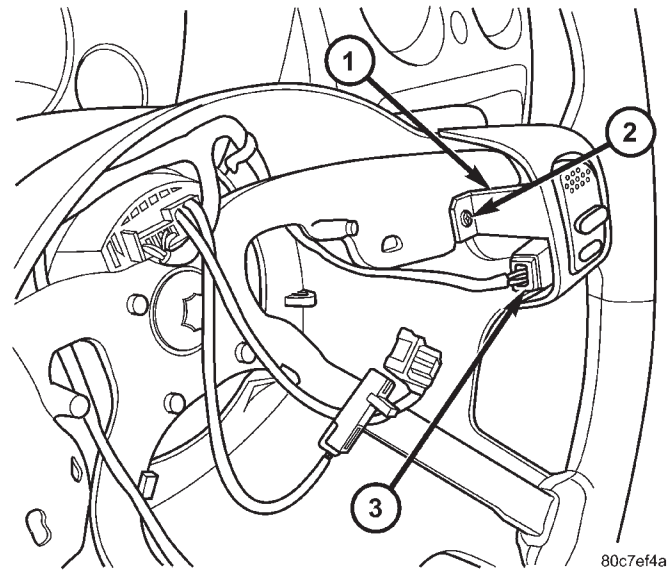
### Multiplexing

The PCM sends out 5 volts through a fixed resistor and monitors the voltage change between the fixed resistor and the switches. If none of the switches are depressed, the PCM will measure 5 volts at the sensor point (open circuit). If a switch with no resistor is closed, the PCM will measure 0 volts (grounded circuit). Now, if a resistor is added to a switch, then the PCM will measure some voltage proportional to the size of the resistor. By adding a different resistor to each switch, the PCM will see a different voltage depending on which switch is pushed.

Another resistor has been added to the 'at rest circuit' causing the PCM to never see 5 volts. This was done for diagnostic purposes. If the switch circuit should open (bad connection), then the PCM will see the 5 volts and know the circuit is bad. The PCM will then set an open circuit fault.

### REMOVAL

**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 NEGATIVE (GROUND) BATTERY CABLE. WAIT 2 MINUTES FOR SYSTEM CAPACITOR TO DISCHARGE BEFORE FURTHER SYSTEM SERVICE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



**Fig. 7 SPEED CONTROL SWITCH**

- 1 - SWITCH
- 2 - SCREW
- 3 - ELECTRICAL CONNECTOR

- (1) Disconnect and isolate negative battery cable from battery.
- (2) Remove airbag module. Refer to Restraint Systems.
- (3) Unplug electrical connector (Fig. 7).
- (4) Remove speed control switch mounting screw (Fig. 7) and remove switch from steering wheel.

### INSTALLATION

- (1) Position switch to steering wheel.
- (2) Install switch mounting screw and tighten. Refer to torque specifications.
- (3) Plug electrical connector into switch.
- (4) Install airbag module. Refer to Restraint Systems.
- (5) Connect negative battery cable to battery.

## VACUUM RESERVOIR

### DESCRIPTION

The vacuum reservoir is a plastic storage tank connected to an engine vacuum source by vacuum lines.

### OPERATION

The 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.

### DIAGNOSIS AND TESTING - VACUUM RESERVOIR

(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. 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. **Certain models may be equipped with 2 check-valves.**

(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.

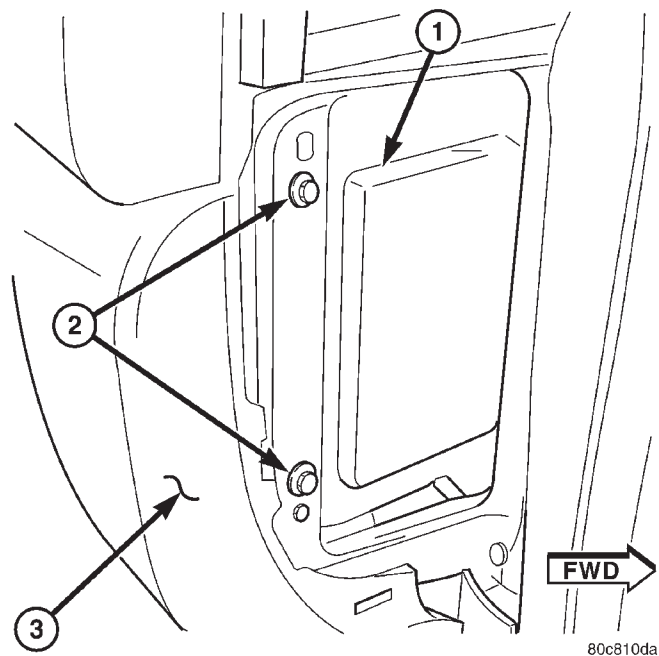
(b) Connect a hand-operated vacuum pump to reservoir end of check valve. Apply vacuum. Vacuum should not bleed off. If vacuum is being lost, replace one-way check valve.

(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 apply vacuum. If vacuum will not hold, diaphragm within check valve has ruptured. Replace valve.

### REMOVAL

The vacuum reservoir is located behind, and at the outer end of the instrument panel (Fig. 8). To gain access for testing or removal, remove glovebox assembly. Also remove fuse box access cover panel at end of instrument panel. On vehicles equipped with LHD (Left Hand Drive), this fuse access panel is located at right end of instrument panel. On vehicles equipped with RHD (Right Hand Drive), this access panel is located at left end of instrument panel.



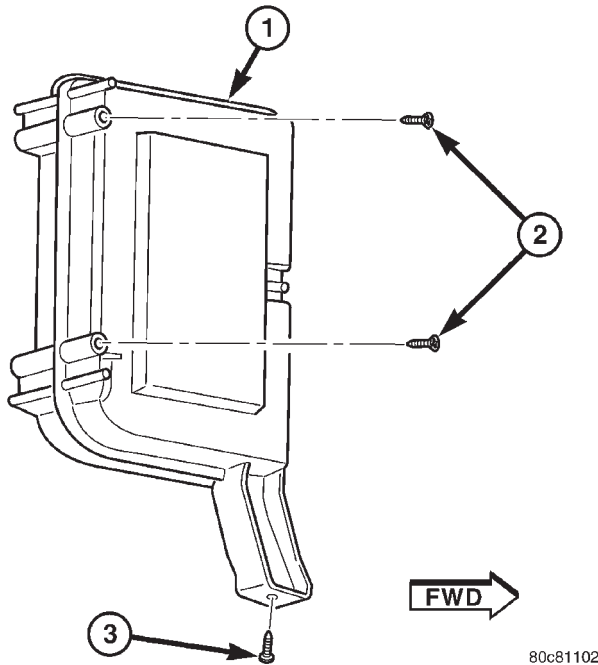
**Fig. 8 VACUUM RESERVOIR LOCATION**

- 1 - VACUUM RESERVOIR
- 2 - HORIZONTAL MOUNTING SCREWS
- 3 - OUTBOARD END OF I.P.

- (1) Remove glovebox assembly. Access to reservoir vacuum line and fitting can now be made.
- (2) Remove vacuum line at reservoir.
- (3) Remove fuse access cover panel at end of instrument panel.
- (4) Through fuse access opening, remove 2 horizontally mounted screws (Fig. 8).
- (5) From bottom of instrument panel, remove 1 vertically mounted screw (Fig. 9).
- (6) Remove reservoir from instrument panel.



## VACUUM RESERVOIR (Continued)

**INSTALLATION**

The vacuum reservoir is located behind, and at the outer end of the instrument panel. To gain access for testing or removal, remove glovebox assembly. Also remove fuse box access cover panel at end of instrument panel. On vehicles equipped with LHD (Left Hand Drive), this fuse access panel is located at right end of instrument panel. On vehicles equipped with RHD (Right Hand Drive), this access panel is located at left end of instrument panel.

- (1) Position reservoir to instrument panel.
- (2) Install 3 mounting screws and tighten. Refer to torque specifications.
- (3) Connect vacuum line to reservoir fitting.
- (4) Install glovebox assembly.
- (5) Install fuse box access cover panel.

**Fig. 9 VACUUM RESERVOIR REMOVE/INSTALL**

- 1 - VACUUM RESERVOIR
- 2 - HORIZONTAL MOUNTING SCREWS (2)
- 3 - VERTICAL MOUNTING SCREW (1)

# VEHICLE THEFT SECURITY

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## VEHICLE THEFT SECURITY

### DESCRIPTION

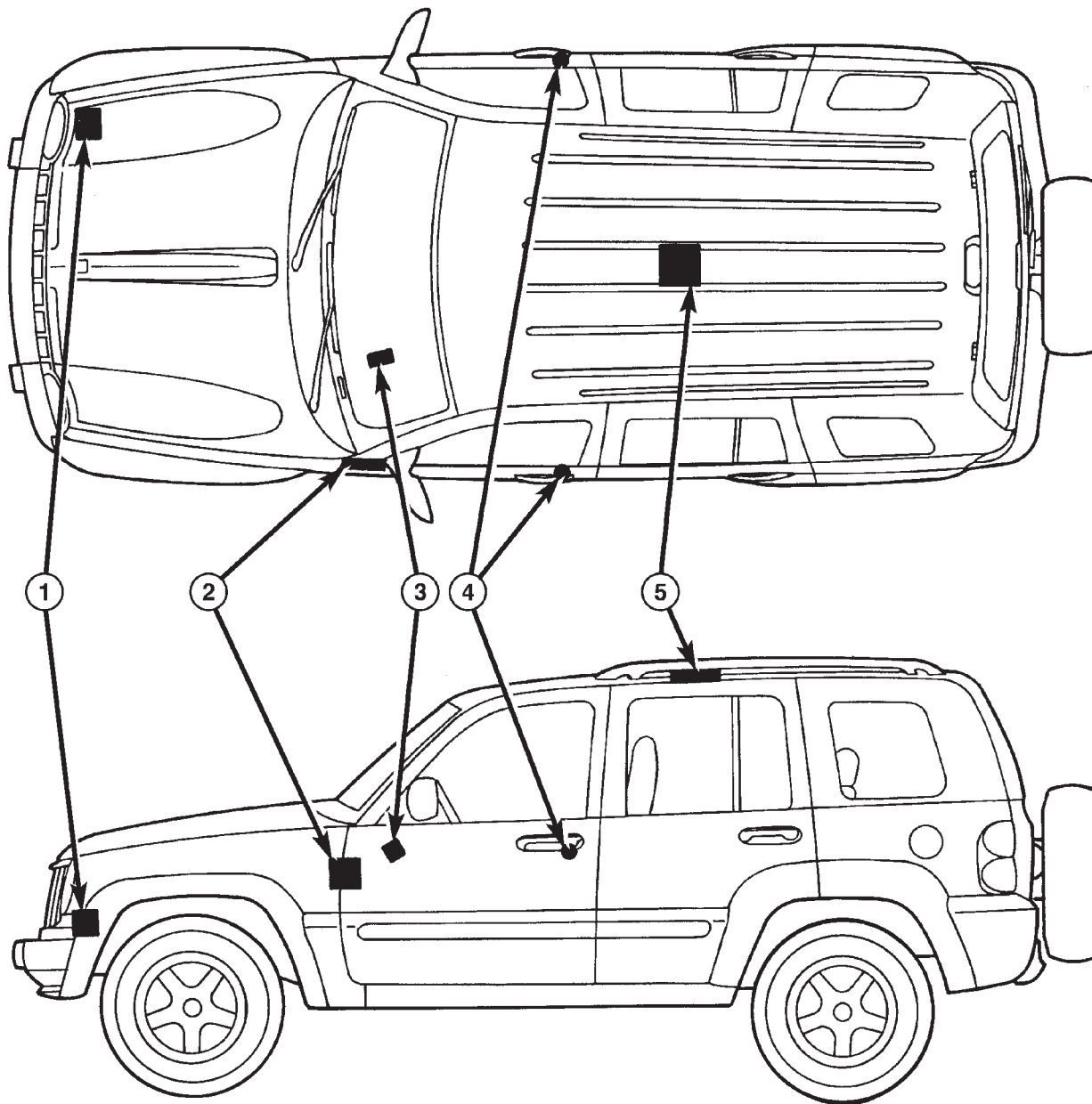
The Vehicle Theft Security System (VTSS) is an available factory-installed option on this model (Fig. 1). The VTSS is comprised of two primary subsystems: Vehicle Theft Alarm (VTA) and Sentry Key Immobilizer System (SKIS). The VTA is an active system that provides visual and audible responses as deterrents to and warnings of unauthorized vehicle tampering. The SKIS is a passive system that effectively immobilizes the vehicle against unauthorized operation. Following are paragraphs which describe the various components that are included in each of these subsystems of the VTSS.

Hard wired circuitry connects many of the VTSS components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the VTSS components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors

and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

**VEHICLE THEFT ALARM** The VTA is available in two different configurations for this vehicle: One configuration is designed for vehicles manufactured for sale in North America; while, the other configuration is designed for vehicles manufactured for sale in markets outside of North America, also referred to as Rest-Of-World or ROW. In addition, the VTA for ROW is available in two versions: base and premium. All vehicles equipped with VTA are also equipped with the Remote Keyless Entry (RKE) system and the Sentry Key Immobilizer System (SKIS), regardless of their market destination. The North American and ROW base version of the VTA provides perimeter vehicle protection by monitoring the vehicle doors, the tailgate, the rear flip-up glass and, for vehicles built for certain markets where it is required equipment, the hood. If unauthorized vehicle use or tampering is detected, these systems respond by pulsing the horn and flashing certain exterior lamps. The ROW premium version of the VTA is only available

## VEHICLE THEFT SECURITY (Continued)



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**Fig. 1 Vehicle Theft Security System**

- 1 - SIREN MODULE
- 2 - BODY CONTROL MODULE
- 3 - SENTRY KEY IMMOBILIZER MODULE

- 4 - DOOR CYLINDER LOCK SWITCH (2)
- 5 - INTRUSION TRANSCIEVER MODULE

in vehicles manufactured for sale in certain markets where it is required equipment. The ROW premium version of the VTA provides the same perimeter protection features as the base version, but adds interior vehicle intrusion protection. The ROW premium VTA also replaces the pulsing horn feature of the base version with an alarm siren as the audible deterrent, while retaining the flashing exterior lamps visual deterrent.

The VTA includes the following major components, which are described in further detail elsewhere in this service information:

- **Body Control Module** - The Body Control Module (BCM) is located on the Junction Block (JB) under the driver side outboard end of the instrument panel. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL MODULE - DESCRIPTION).

## VEHICLE THEFT SECURITY (Continued)

- **Combination Flasher** - An electronic combination flasher is integral to the hazard switch located in the center of the instrument panel above the radio. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/COMBINATION FLASHER - DESCRIPTION).

- **Door Ajar Switch** - A door ajar switch is integral to the latch of each door in the vehicle. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOOR AJAR SWITCH - DESCRIPTION).

- **Door Cylinder Lock Switch** - For North American vehicles only, a door cylinder lock switch is located on the back of the lock cylinder of each front door. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/DOOR CYLINDER LOCK SWITCH - DESCRIPTION).

- **Flip-Up Glass Ajar Switch** - A flip-up glass ajar switch is integral to the rear flip-up glass latch, located on the top of the tailgate near the center. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/FLIP-UP GLASS AJAR SWITCH - DESCRIPTION).

- **Hood Ajar Switch** - A hood ajar switch is located beneath the hood panel on the right inner fender side shield of vehicles built for sale in certain markets where it is required equipment. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/HOOD AJAR SWITCH - DESCRIPTION).

- **Horn Relay** - A horn relay is located on the Junction Block (JB) under the driver side outboard end of the instrument panel. (Refer to 8 - ELECTRICAL/HORN/HORN RELAY - DESCRIPTION).

- **Intrusion Transceiver Module** - An Intrusion Transceiver Module (ITM) is located near the center of the headliner in the passenger compartment of vehicles built for sale in certain markets where it is required equipment. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/UK SECURITY SYSTEM MODULE - DESCRIPTION).

- **Security Indicator** - A security indicator is located in the ElectroMechanical Instrument Cluster (EMIC) on the instrument panel in front of the driver side front seat. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/SECURITY INDICATOR - DESCRIPTION).

- **Siren** - An alarm siren is located on the front extension of the right front wheel house panel in the engine compartment of vehicles built for sale in certain markets where it is required equipment. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/SIREN - DESCRIPTION).

- **Tailgate Ajar Switch** - A tailgate ajar switch is integral to the latch for the tailgate in the vehicle. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/TAILGATE AJAR SWITCH - DESCRIPTION).

**SENTRY KEY IMMOBILIZER SYSTEM** The Sentry Key Immobilizer System (SKIS) is available as a factory-installed option on this model. Vehicles equipped with the Vehicle Theft Alarm (VTA) are also equipped with SKIS. The SKIS provides passive vehicle protection by preventing the engine from operating unless a valid electronically encoded key is detected in the ignition lock cylinder. The SKIS includes the following major components, which are described in further detail elsewhere in this service information:

- **Powertrain Control Module** - The Powertrain Control Module (PCM) is located on the left inner fender shield in the engine compartment near the dash panel. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/POWERTRAIN CONTROL MODULE - DESCRIPTION).

- **Sentry Key Immobilizer Module** - The Sentry Key Immobilizer Module (SKIM) is located beneath the steering column shrouds on the right side of the steering column near the ignition lock cylinder housing. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/SENTRY KEY IMMOBILIZER MODULE - DESCRIPTION).

- **Sentry Key Transponder** - The Sentry Key transponder is molded into the head of the ignition key, and concealed by a gray molded rubber cap. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/TRANSPONDER KEY - DESCRIPTION).

- **SKIS Indicator** - The SKIS indicator is located in the ElectroMechanical Instrument Cluster (EMIC) on the instrument panel in front of the driver side front seat. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/SPEED CONTROL INDICATOR - DESCRIPTION).

## OPERATION

The Vehicle Theft Security System (VTSS) is divided into two basic subsystems: Vehicle Theft Alarm (VTA) and Sentry Key Immobilizer System (SKIS). Following are paragraphs that briefly describe the operation of each of these two subsystems.

**VEHICLE THEFT ALARM** The Body Control Module (BCM) is used on this model to control and integrate many of the electronic functions and features included in the Vehicle Theft Alarm (VTA). The BCM receives hard wired inputs indicating the status of the door ajar switches, the door cylinder lock switches, the ignition switch, the tailgate ajar switch, the tailgate cylinder lock switch, the flip-up glass ajar switch, the power lock switches and, in vehicles built for certain markets where it is required, the hood ajar switch. The programming in the BCM allows it to process the information from all of these inputs and send control outputs to energize or de-en-

## VEHICLE THEFT SECURITY (Continued)

ergize the combination flasher, the horn relay (except vehicles with the Rest-Of-World or ROW premium version of the VTA), and the security indicator. In addition, in vehicles built for certain markets where the ROW premium version of the VTA is required, the BCM also exchanges electronic messages with the Intrusion Transceiver Module (ITM) over the Programmable Communications Interface (PCI) data bus network to provide the features found in this version of the VTA.

The hard wired circuits and components of the VTA may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), the Intrusion Transceiver Module (ITM), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, the ITM, and the PCI data bus network inputs and outputs related to the VTA requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Following are paragraphs that briefly describe the operation of each of the VTA features. See the owner's manual in the vehicle glove box for more information on the features, use and operation of the VTA.

- **ENABLING** - The BCM must have the VTA function electronically enabled in order for the VTA to perform as designed. The logic in the BCM keeps its VTA function dormant until it is enabled using a DRBIII® scan tool. The VTA function of the BCM is enabled on vehicles equipped with the VTA option at the factory, but a service replacement BCM must be VTA-enabled by the dealer using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

- **PRE-ARMING** - The VTA has a pre-arming sequence. Pre-arming occurs when a door, the tailgate, or the flip-up glass is open when the vehicle is locked using a power lock switch, or when the "Lock" button on the Remote Keyless Entry (RKE) transmitter is depressed. The power lock switch will not initiate the pre-arming sequence if the key is in the ignition switch. When the VTA is pre-armed, the arming sequence is delayed until all of the doors, the tailgate, and the flip-up glass are closed.

- **ARMING** - Passive arming of the VTA occurs when the vehicle is exited with the key removed from the ignition switch and the doors are locked while they are open using the power lock switch (see Pre-Arming). Active arming of the VTA occurs when the "Lock" button on the Remote Keyless Entry (RKE) transmitter is depressed to lock the vehicle after all of the doors, the tailgate, and the flip-up glass are closed. The VTA will not arm if the doors are locked

using the key in a lock cylinder or using a mechanical lock button. Once the VTA begins the passive or active arming sequence, the security indicator in the instrument cluster will flash rapidly for about sixteen seconds. This indicates that the VTA arming sequence is in progress. If the ignition switch is turned to the On position, if a door is unlocked with the power lock switch or the RKE transmitter, or if the tailgate is unlocked by any means during the sixteen second arming sequence, the security indicator will stop flashing and the VTA arming sequence will abort. On vehicles equipped with the hood ajar switch, the VTA arming sequence will occur regardless of whether the hood is open or closed, but the underhood area will not be protected unless the hood is closed when the VTA arming sequence begins. Also, if the status of the hood ajar switch changes from open (hood closed) to closed (hood open) during the sixteen second arming sequence, the security indicator will stop flashing and the VTA arming sequence will abort. Once the sixteen second arming sequence is successfully completed, the security indicator will flash at a slower rate, indicating that the VTA is armed.

- **DISARMING** - For vehicles built for the North American market, disarming of the VTA occurs when the vehicle is unlocked using the key to unlock a door or the tailgate. Disarming of the VTA for any market also occurs when the vehicle is unlocked by depressing the "Unlock" button of the Remote Keyless Entry (RKE) transmitter, or by turning the ignition switch to the On position using a valid Sentry Key Immobilizer System (SKIS) key. Once the alarm has been activated, any of these disarming methods will also deactivate the alarm.

- **POWER-UP MODE** - When the armed VTA senses that the battery has been disconnected and reconnected, it enters its power-up mode. In the power-up mode the alarm system returns to the mode that was last selected prior to the battery failure or disconnect. If the VTA was armed prior to the battery disconnect or failure, the technician or vehicle operator will have to actively or passively disarm the system 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 then attempted. The VTA will remain armed until the technician or vehicle operator has actively or passively disarmed the system. If the VTA is in the disarmed mode prior to a battery disconnect or failure, it will remain disarmed after the battery is reconnected or replaced, or if jump-starting is attempted.

- **ALARM** - The VTA alarm output varies by the version of the VTA with which the vehicle is equipped. In all cases, the alarm provides both visual and audible outputs; however, the time intervals of

## VEHICLE THEFT SECURITY (Continued)

these outputs vary by the requirements of the market for which the vehicle is manufactured. In all cases, the visual output will be a flashing on and off of the exterior lamps. For vehicles equipped with the North American or the ROW base version of the VTA, the audible output will be a pulsing of the horn. For vehicles with the ROW premium version of the VTA, the audible output will be a cycling of the alarm siren. See the owner's manual in the vehicle glove box for details of the alarm output requirements of the specific market for which the vehicle was manufactured. The inputs that will trigger the alarm include the door ajar switches, the tailgate ajar switch, the flip-up glass ajar switch, and in vehicles built for certain markets where they are required, the hood ajar switch and the Intrusion Transceiver Module (ITM).

- **TAMPER ALERT** - The VTA tamper alert feature will pulse the horn (or the alarm siren for the ROW premium version of the VTA) three times upon VTA disarming, if the alarm was triggered and has since timed-out. This feature alerts the vehicle operator that the VTA alarm was activated while the vehicle was unattended.

- **INTRUSION ALARM** - The intrusion alarm is an exclusive feature of the ROW premium version of the VTA, which is only available in certain markets where it is required. When the VTA is armed, a motion sensor in the Intrusion Transceiver Module (ITM) monitors the interior of the vehicle for movement. If motion is detected, the ITM sends an electronic message to the BCM over the PCI data bus to invoke the visual alarm feature, and sends an electronic message to the alarm siren in the engine compartment over a dedicated serial bus to invoke the audible alarm feature. The motion detect feature of the ITM can be disabled by depressing the "Lock" button on the RKE transmitter three times within fifteen seconds during VTA arming, while the security indicator is still flashing rapidly. The VTA provides a single short siren "chirp" as an audible confirmation that the motion detect disable request has been received. The ITM must be electronically enabled in order for the intrusion alarm to perform as designed. The logic in the ITM keeps its intrusion alarm function dormant until it is enabled using a DRBIII® scan tool. The intrusion alarm function of the ITM is enabled on vehicles equipped with this

option at the factory, but a service replacement ITM must be configured and enabled by the dealer using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**SENTRY KEY IMMOBILIZER SYSTEM** The Sentry Key Immobilizer System (SKIS) is designed to provide passive protection against unauthorized vehicle use by disabling the engine after about two seconds of running, whenever any method other than a valid Sentry Key is used to start the vehicle. The SKIS is considered a passive protection system because it is always active when the ignition system is energized and does not require any customer intervention. The SKIS uses Radio Frequency (RF) communication to obtain confirmation that the key in the ignition switch is a valid key for operating the vehicle. The microprocessor-based SKIS hardware and software also use electronic messages to communicate with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - OPERATION).

Pre-programmed Sentry Key transponders are provided with the vehicle from the factory. Each Sentry Key Immobilizer Module (SKIM) will recognize a maximum of eight Sentry Keys. If the customer would like additional keys other than those provided with the vehicle, they may be purchased from any authorized dealer. These additional keys must be programmed to the SKIM in the vehicle in order for the system to recognize them as valid keys. This can be done by the dealer using a DRBIII® scan tool or, if Customer Learn programming is an available SKIS feature in the market where the vehicle was purchased, the customer can program the additional keys, as long as at least two valid Sentry Keys are already available. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store fault information in the form of Diagnostic Trouble Codes (DTC's) if a system malfunction is detected. The SKIS can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## VEHICLE THEFT SECURITY (Continued)

**DIAGNOSIS AND TESTING - VEHICLE THEFT SECURITY SYSTEM**

The Vehicle Theft Security System (VTSS) is divided into two basic subsystems: Vehicle Theft Alarm (VTA) and Sentry Key Immobilizer System (SKIS). Following are the recommended procedures for diagnosis and testing of each of these two subsystems.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**VEHICLE THEFT ALARM**

Models equipped with the Rest-Of-World (ROW) premium version of the Vehicle Theft Alarm (VTA) provide some preliminary diagnostic feedback by illu-

minating the security indicator located in the ElectroMechanical Instrument Cluster (EMIC). If the security indicator illuminates with the ignition switch in the On position, it indicates that there is a communication problem between the Intrusion Transceiver Module (ITM) and the Body Control Module (BCM), or between the ITM and the siren module. The BCM will also turn on the security indicator if it receives a message from the ITM indicating that the ITM has stored a Diagnostic Trouble Code (DTC) for a siren module fault.

The hard wired circuits and components of the VTA may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), the ElectroMechanical Instrument Cluster (EMIC), the Intrusion Transceiver Module (ITM), or the Programmable Communications Interface (PCI) data bus network. The most reliable, efficient, and accurate means to diagnose the BCM, the EMIC, the ITM, and the PCI data bus network inputs and outputs related to the VTA requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

VEHICLE THEFT SECURITY (Continued)

SENTRY KEY IMMOBILIZER SYSTEM

SENTRY KEY IMMOBILIZER SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
SKIS INDICATOR FAILS TO LIGHT DURING BULB TEST	1. SKIS indicator faulty. 2. Fuse faulty. 3. Ground circuit faulty. 4. Fused B(+) circuit faulty. 5. Fused ignition switch output circuit faulty.	1. Test and replace the instrument cluster as required. 2. Test and replace the SKIM fused B(+) and fused ignition switch output (run-start) fuses in the Junction Block (JB) as required. 3. Test and repair the SKIM ground circuit as required. 4. Test and repair the SKIM fused B(+) circuit as required. 5. Test and repair the SKIM fused ignition switch output (run-start) circuit as required.
SKIS INDICATOR FLASHES WHEN IGNITION SWITCH IS TURNED TO "ON" POSITION	1. Invalid key in ignition switch lock cylinder. 2. Key-related fault.	1. Replace the key with a known valid key. 2. Use a DRBIII® scan tool to diagnose the key-related fault. Refer to the appropriate diagnostic information.
SKIS INDICATOR LIGHTS SOLID FOLLOWING BULB TEST	1. SKIS system malfunction/fault detected. 2. SKIS system inoperative.	1. Use a DRBIII® scan tool to diagnose the SKIS. Refer to the appropriate diagnostic information. 2. Use a DRBIII® scan tool to diagnose the SKIS. Refer to the appropriate diagnostic information.

**SKIS INDICATOR FAILS TO LIGHT DURING BULB TEST**

If the Sentry Key Immobilizer System (SKIS) indicator in the instrument cluster fails to illuminate for about three seconds after the ignition switch is turned to the On position (bulb test), perform the instrument cluster actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the SKIS indicator still fails to light during the bulb test, a wiring problem resulting in the loss of battery current or ground to the Sentry Key Immobilizer Module (SKIM) should be suspected, and the following procedure should be used for diagnosis. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**NOTE:** The following tests may not prove conclusive in the diagnosis of this system. The most reliable, efficient, and accurate means to diagnose the Sentry Key Immobilizer System requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

(1) Check the fused B(+) fuse (Fuse 33 - 10 ampere) in the Junction Block (JB). 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 (Fuse 33 - 10 ampere) in the JB. If OK, go to Step 3. If not OK, repair the open B(+) circuit between the JB and the battery as required.

(3) Check the fused ignition switch output (run-start) fuse (Fuse 15 - 10 ampere) in the JB. 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-start) fuse (Fuse 15 - 10 ampere) in the JB. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run-start) circuit between the JB and the ignition switch as required.

(5) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the Sentry Key Immobilizer Module (SKIM) from the SKIM connector receptacle. Check for continuity between each of the two ground circuit cavities of the instrument panel wire harness connector for the SKIM and a good ground. There should be



## VEHICLE THEFT SECURITY (Continued)

continuity. If OK, go to Step 6. If not OK, repair the open ground circuit(s) to ground (G202) as required.

(6) Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector for the SKIM. If OK, go to Step 7. If not OK, repair the open fused B(+) circuit between the SKIM and the JB 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 instrument panel wire harness connector for the SKIM. If OK, use a DRBIII® scan tool to complete the diagnosis of the SKIS. Refer to the appropriate diagnostic information. If not OK, repair the open fused ignition switch output (run-start) circuit between the SKIM and the JB as required.

**SKIS INDICATOR FLASHES UPON IGNITION "ON" OR LIGHTS SOLID FOLLOWING BULB TEST**

A SKIS indicator that flashes following the ignition switch being turned to the On position indicates that an invalid key has been detected, or that a key-related fault has been set. A SKIS indicator that lights solid following a successful bulb test indicates that the SKIM has detected a system malfunction or that the SKIS is inoperative. In either case, fault information will be stored in the SKIM memory. For retrieval of this fault information and further diagnosis of the SKIS, the PCI data bus, the SKIM electronic message outputs to the instrument cluster that control the SKIS indicator and chime, or the electronic message inputs and outputs between the SKIM and the Powertrain Control Module (PCM) that control engine operation, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information. Following are preliminary troubleshooting guidelines to be followed during diagnosis using a DRBIII® scan tool:

(1) Using the DRBIII® scan tool, read and record the faults as they exist in the SKIM when you first begin your diagnosis of the vehicle. It is important to document these faults because the SKIM does not differentiate between historical faults (those that have occurred in the past) and active faults (those that are currently present). If this problem turns out to be an intermittent condition, this information may become invaluable to your diagnosis.

(2) Using the DRBIII® scan tool, erase all of the faults from the SKIM.

(3) Cycle the ignition switch to the Off position, then back to the On position.

(4) Using the DRBIII® scan tool, read any faults that are now present in the SKIM. These are the active faults.

(5) Using this active fault information, refer to the proper procedure in the appropriate diagnostic information for the specific additional diagnostic steps.

**STANDARD PROCEDURE****STANDARD PROCEDURE - SKIS  
INITIALIZATION**

The Sentry Key Immobilizer System (SKIS) must be initialized following a Sentry Key Immobilizer Module (SKIM) replacement. SKIS initialization requires the use of a DRBIII® scan tool. Initialization will also require that you have access to the unique four-digit PIN code that was assigned to the original SKIM. The PIN code **must** be used to enter the Secured Access Mode in the SKIM. This PIN number may be obtained from the vehicle owner, from the original vehicle invoice, or from the DaimlerChrysler Customer Center. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES - STANDARD PROCEDURE - PCM/SKIM PROGRAMMING).

**NOTE:** If a Powertrain Control Module (PCM) is replaced on a vehicle equipped with the Sentry Key Immobilizer System (SKIS), the unique Secret Key data must be transferred from the Sentry Key Immobilizer Module (SKIM) to the new PCM using the PCM replacement procedure. This procedure also requires the use of a DRBIII® scan tool and the unique four-digit PIN code to enter the Secured Access Mode in the SKIM. Refer to the appropriate diagnostic information for the proper PCM replacement procedures.

**STANDARD PROCEDURE - SENTRY KEY  
TRANSPONDER PROGRAMMING**

All Sentry Keys included with the vehicle are pre-programmed to work with the Sentry Key Immobilizer System (SKIS) when it is shipped from the factory. The Sentry Key Immobilizer Module (SKIM) can be programmed to recognize up to a total of eight Sentry Keys. When programming a blank Sentry Key transponder, the key must first be cut to match the ignition switch lock cylinder in the vehicle for which it will be used. Once the additional or new key has been cut, the SKIM must be programmed to recognize it as a valid key. There are two possible methods to program the SKIM to recognize a new or additional valid key, the Secured Access Method and the Customer Learn Method. Following are the details of these two programming methods.

## VEHICLE THEFT SECURITY (Continued)

## SECURED ACCESS METHOD

The Secured Access method applies to all vehicles. This method requires the use of a DRBIII® scan tool. This method will also require that you have access to the unique four-digit PIN code that was assigned to the original SKIM. The PIN code **must** be used to enter the Secured Access Mode in the SKIM. This PIN number may be obtained from the vehicle owner, from the original vehicle invoice, or from the DaimlerChrysler Customer Center. Refer to the appropriate diagnostic information for the proper Secured Access method programming procedures.

## CUSTOMER LEARN METHOD

The Customer Learn feature is only available on domestic vehicles, or those vehicles which have a U.S. country code designator. This programming method also requires access to at least two valid Sentry Keys. If two valid Sentry Keys are not available, or if the vehicle does not have a U.S. country code designator, the Secured Access Method **must** be used to program new or additional valid keys to the SKIM. The Customer Learn programming method procedures are as follows:

(1) Obtain the blank Sentry Key(s) that are to be programmed as valid keys for the vehicle. Cut the blank key(s) to match the ignition switch lock cylinder mechanical key codes.

(2) Insert one of the two valid Sentry Keys into the ignition switch and turn the ignition switch to the On position.

(3) After the ignition switch has been in the On position for longer than three seconds, but no more than fifteen seconds, cycle the ignition switch back to the Off position. Replace the first valid Sentry Key in the ignition switch lock cylinder with the second valid Sentry Key and turn the ignition switch back to the On position. The second valid Sentry Key must be inserted in the lock cylinder within fifteen seconds of removing the first valid key.

(4) About ten seconds after the completion of Step 3, the SKIS indicator in the instrument cluster will start to flash and a single audible chime tone will sound to indicate that the system has entered the Customer Learn programming mode.

(5) Within sixty seconds of entering the Customer Learn programming mode, turn the ignition switch to the Off position, replace the valid Sentry Key with a blank Sentry Key transponder, and turn the ignition switch back to the On position.

(6) About ten seconds after the completion of Step 5, a single audible chime tone will sound and the SKIS indicator will stop flashing, stay on solid for three seconds, then turn off to indicate that the blank Sentry Key has been successfully programmed. The SKIS will immediately exit the Customer Learn programming

mode and the vehicle may now be started using the newly programmed valid Sentry Key.

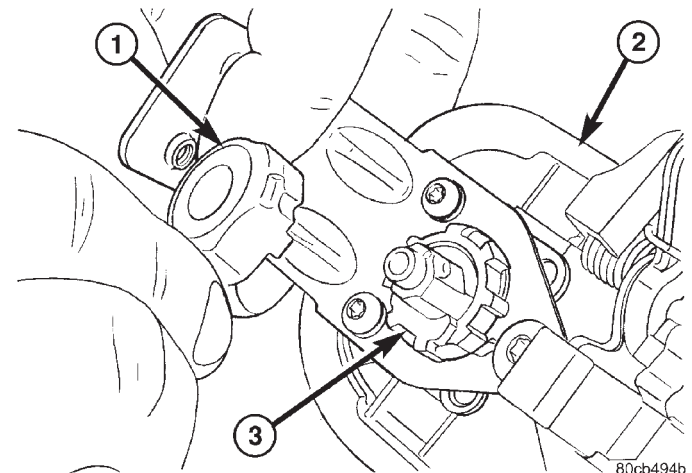
Each of these steps must be repeated and completed in their entirety for each additional Sentry Key that is to be programmed. If the above steps are not completed in the given sequence, or within the allotted time, the SKIS will exit the Customer Learn programming mode and the programming will be unsuccessful. The SKIS will also automatically exit the Customer Learn programming mode if it sees a non-blank Sentry Key transponder when it should see a blank, if it has already programmed eight (8) valid Sentry Keys, or if the ignition switch is turned to the Off position for more than about fifty seconds.

**NOTE:** If an attempt is made to start the vehicle while in the Customer Learn mode (SKIS indicator flashing), the SKIS will respond as though the vehicle were being started with an invalid key. In other words, the engine will stall after about two seconds of operation. No faults will be set.

**NOTE:** Once a Sentry Key has been programmed as a valid key to a vehicle, it cannot be programmed as a valid key for use on any other vehicle.

## DOOR CYLINDER LOCK SWITCH

## DESCRIPTION



**Fig. 2 Door Cylinder Lock Switch**

- 1 - SWITCH
- 2 - OUTSIDE DOOR HANDLE
- 3 - DOOR LOCK CYLINDER

Vehicles manufactured for North American markets that are equipped with the optional Vehicle

## DOOR CYLINDER LOCK SWITCH (Continued)

Theft Security System (VTSS) have a door cylinder lock switch secured to the back of the key lock cylinder inside each front door (Fig. 2). The door cylinder lock switch is a resistor multiplexed momentary switch that is hard wired in series between the door lock switch ground and right or left cylinder lock switch mux circuits of the Body Control Module (BCM) through the front door wire harness. The door cylinder lock switches are driven by the key lock cylinders and contain two internal resistors. One resistor value is used for the Lock position, and one for the Unlock position.

The door cylinder lock switches cannot be adjusted or repaired and, if faulty or damaged, they must be replaced.

**OPERATION**

The door cylinder lock switches are actuated by the key lock cylinder when the key is inserted in the lock cylinder and turned to the lock or unlock positions. The door cylinder lock switch close a circuit between the door lock switch ground circuit and the left or right cylinder lock switch mux circuits through one of two internal resistors for the Body Control Module (BCM) when either front door key lock cylinder is in the Lock, or Unlock positions. The BCM reads the switch status through an internal pull-up, then uses this information as an input for the Vehicle Theft Security System (VTSS) operation.

The door cylinder lock switches and circuits can be diagnosed using conventional diagnostic tools and methods.

**DIAGNOSIS AND TESTING - DOOR CYLINDER LOCK SWITCH**

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect the door cylinder lock switch pigtail wire connector from the door wire harness connector.

(2) Using a ohmmeter, check the switch resistance checks between the two terminals in the door cylinder lock switch pigtail wire connector. Actuate the switch by rotating the key in the door lock cylinder to test for the proper resistance values in each of the two switch positions, as shown in the Door Cylinder Lock Switch Test table.

DOOR CYLINDER LOCK SWITCH TEST		
Switch Position		Resistance (±10%)
Left Side	Right Side	
Lock (Clockwise)	Unlock (Counterclockwise)	473 Ohms
Unlock (Counterclockwise)	Lock (Clockwise)	1.994 Kilohms

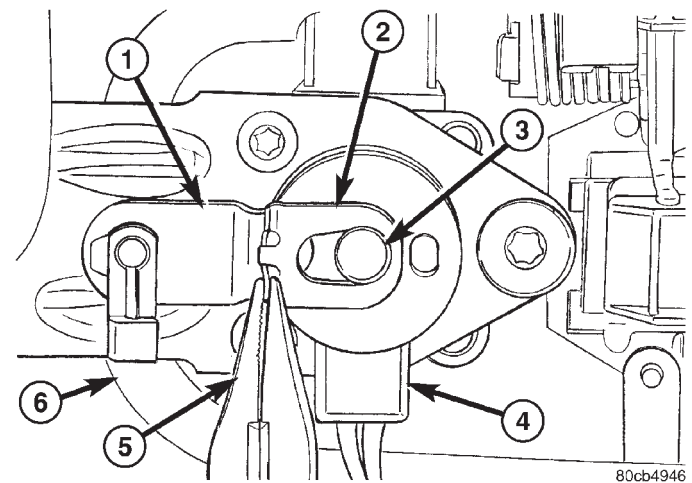
(3) If a door cylinder lock switch fails either of the resistance tests, replace the faulty switch.

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the outside door handle unit from the outer door panel. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - REMOVAL).

(3) Remove the retainer clip from the pin on the back of the door lock cylinder (Fig. 3).



**Fig. 3 Lock Cylinder Lever Retainer Remove/Install**

- 1 - LEVER
- 2 - RETAINER
- 3 - LOCK CYLINDER
- 4 - SWITCH
- 5 - PLIERS
- 6 - OUTSIDE DOOR HANDLE

(4) Remove the lock lever from the pin on the back of the door lock cylinder.

(5) Remove the door cylinder lock switch from the back of the lock cylinder.

**INSTALLATION**

(1) Position the door cylinder lock switch onto the back of the lock cylinder with its pigtail wire harness oriented toward the bottom (Fig. 3).

DOOR CYLINDER LOCK SWITCH (Continued)

(2) Position the lock lever onto the pin on the back of the door lock cylinder with the lever oriented toward the rear.

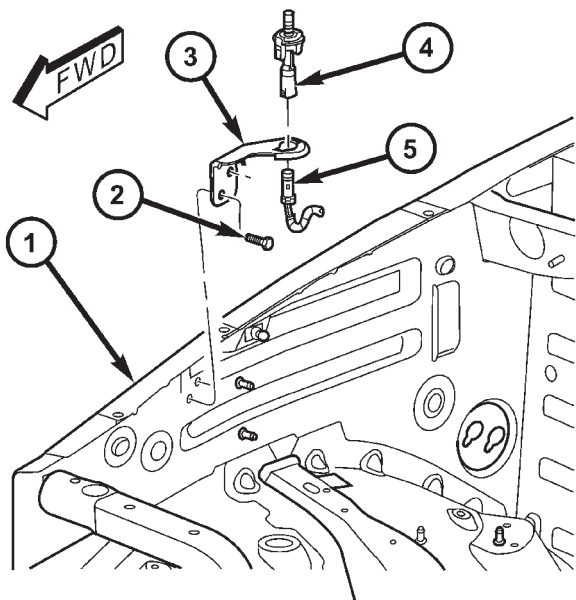
(3) Install the retainer clip onto the pin on the back of the door lock cylinder. Be certain that the center tab of the retainer is engaged in the retention hole on the lock lever.

(4) Reinstall the outside door handle unit onto the outer door panel. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - INSTALLATION).

(5) Reconnect the battery negative cable.

HOOD AJAR SWITCH

DESCRIPTION



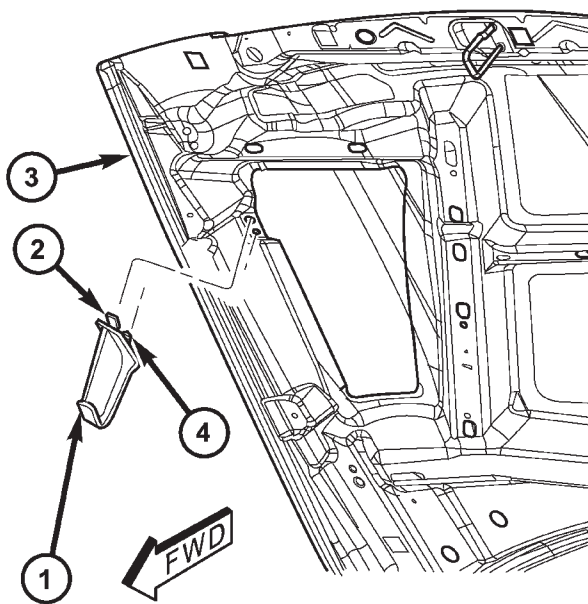
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**Fig. 4 Hood Ajar Switch**

- 1 - INNER FENDER
- 2 - SCREW (2)
- 3 - BRACKET
- 4 - HOOD AJAR SWITCH
- 5 - WIRE HARNESS CONNECTOR

The hood ajar switch is a normally closed, single pole momentary switch that is used only on vehicles equipped with the Vehicle Theft Security System (VTSS) for sale in certain markets where it is required equipment (Fig. 4). This switch consists of a molded plastic body with a molded plastic mounting bezel. The switch body has an integral molded con-

ductor receptacle on the lower end, while the spring-loaded switch plunger extends from the upper end. Two external latches integral to the mounting bezel lock the switch into a keyed mounting hole in the stamped steel switch mounting bracket. The mounting bracket is fastened with two screws to the right inner fender shield near the fender ledge in the engine compartment. A molded plastic striker with an integral retainer and mounting tab is secured to the underside of the hood panel inner reinforcement to actuate the switch plunger as the hood panel is closed (Fig. 5). A single take out of the headlamp and dash wire harness connects the switch to the vehicle electrical system. The switch receives a path to ground at all times through another take out of the headlamp and dash wire harness with an eyelet terminal connector that is secured by a ground screw to the left inner fender shield in the engine compartment.



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**Fig. 5 Hood Ajar Switch Striker**

- 1 - STRIKER
- 2 - TAB
- 3 - INNER HOOD REINFORCEMENT
- 4 - RETAINER

The hood ajar switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced. The hood ajar switch striker is not intended for reuse. If the striker is removed from the hood inner reinforcement for any reason, it must be replaced with a new unit.

## HOOD AJAR SWITCH (Continued)

## OPERATION

The hood ajar switch is normally held open as the spring-loaded switch plunger is depressed by the striker on the hood panel when the hood panel is closed and latched. When the hood is opened, the spring-loaded switch plunger extends from the switch body and the switch contacts are closed. The hood ajar switch is connected in series between ground and the hood ajar switch sense input of the Body Control Module (BCM). The BCM uses an internal resistor pull up to monitor the state of the hood ajar switch contacts. The hood ajar switch can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - HOOD AJAR SWITCH

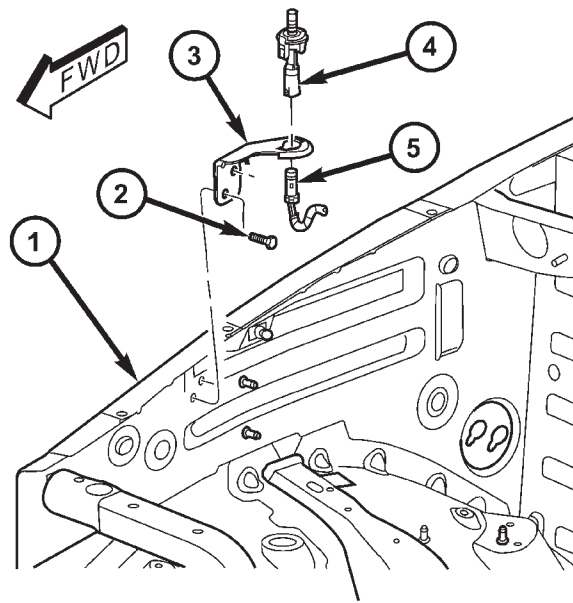
Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect the headlamp and dash wire harness connector for the hood ajar switch from the switch connector receptacle.

(2) Check for continuity between the two terminals in the connector receptacle of the hood ajar switch. There should be continuity with the switch plunger extended, and no continuity with the switch plunger depressed. If not OK, replace the faulty hood ajar switch.

## REMOVAL

- (1) Unlatch and open the hood.
- (2) Disconnect and isolate the battery negative cable.
- (3) From the top of the hood ajar switch mounting bracket, squeeze the two switch latch tabs together and pull the switch upward (Fig. 6).
- (4) Pull the hood ajar switch up through the hole in the mounting bracket far enough to access and disconnect the headlamp and dash wire harness connector for the hood ajar switch from the switch connector receptacle.



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**Fig. 6 Hood Ajar Switch Remove/Install**

- 1 - INNER FENDER
- 2 - SCREW (2)
- 3 - BRACKET
- 4 - HOOD AJAR SWITCH
- 5 - WIRE HARNESS CONNECTOR

(5) Remove the hood ajar switch from the mounting bracket.

## INSTALLATION

- (1) Position the hood ajar switch near the hole in the mounting bracket (Fig. 6).
- (2) Reconnect the headlamp and dash wire harness connector for the hood ajar switch to the switch connector receptacle.
- (3) From the top of the hood ajar switch mounting bracket, use hand pressure to press the switch downward into the mounting bracket until the latch tabs lock it into place.
- (4) Reconnect the battery negative cable.
- (5) Close and latch the hood.

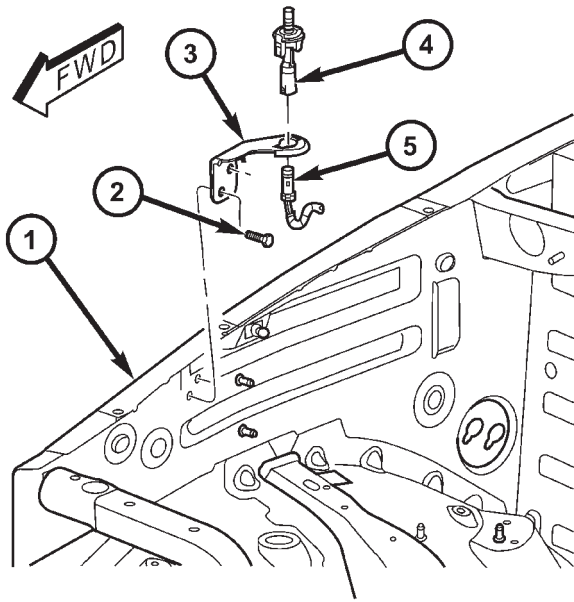
## HOOD AJAR SWITCH BRACKET

### REMOVAL

(1) Remove the hood ajar switch from the mounting bracket. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/HOOD AJAR SWITCH - REMOVAL).

(2) If necessary, remove and set aside the engine air cleaner housing for access to the hood ajar switch mounting bracket screws.

(3) Remove the two screws that secure the hood ajar switch bracket to the right fender inner shield (Fig. 7).



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**Fig. 7 Hood Ajar Switch Bracket Remove/Install**

- 1 - INNER FENDER
- 2 - SCREW (2)
- 3 - BRACKET
- 4 - HOOD AJAR SWITCH
- 5 - WIRE HARNESS CONNECTOR

(4) Remove the hood ajar switch bracket from the right fender inner shield.

### INSTALLATION

(1) Position the hood ajar switch bracket onto the right fender inner shield (Fig. 7).

(2) Install and tighten the two screws that secure the hood ajar switch bracket to the right fender inner shield. Tighten the screws to 7 N·m (60 in. lbs.).

(3) If removed, reinstall the engine air cleaner housing.

(4) Reinstall the hood ajar switch into the mounting bracket. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/HOOD AJAR SWITCH - INSTALLATION).

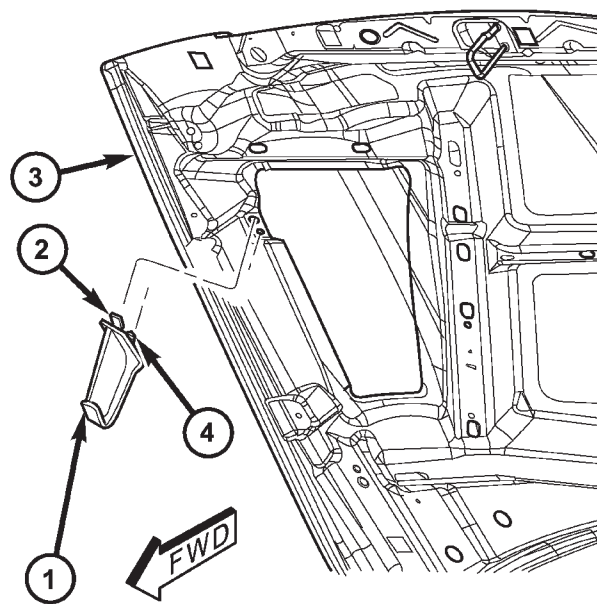
## HOOD AJAR SWITCH STRIKER

### REMOVAL

The hood ajar switch striker is not intended for reuse. If the striker is removed from the hood inner reinforcement for any reason, it must be replaced with a new unit.

(1) Unlatch and open the hood.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry the rearward end of the hood ajar switch striker away from the inner hood panel reinforcement far enough to disengage the integral retainer from its mounting hole (Fig. 8).



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**Fig. 8 Hood Ajar Switch Striker Remove/Install**

- 1 - STRIKER
- 2 - TAB
- 3 - INNER HOOD REINFORCEMENT
- 4 - RETAINER

(3) Move the hood ajar switch striker slightly rearward to disengage the integral mounting tab from the forward mounting hole.

(4) Remove the hood ajar switch striker from the inner hood panel reinforcement and discard.

## HOOD AJAR SWITCH STRIKER (Continued)

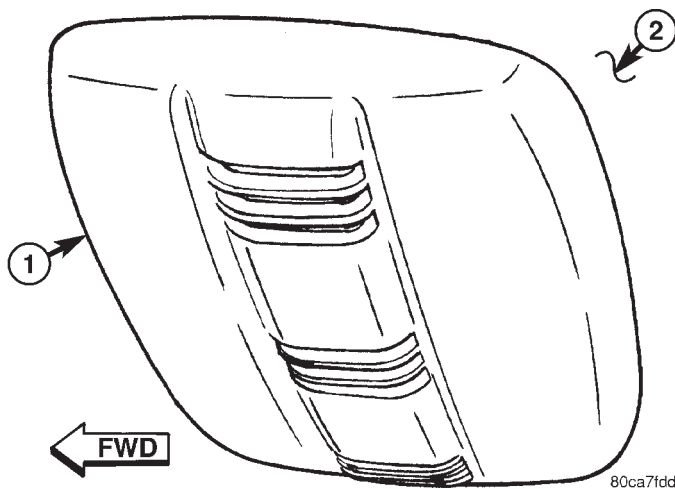
## INSTALLATION

The hood ajar switch striker is not intended for reuse. If the striker is removed from the hood inner reinforcement for any reason, it must be replaced with a new unit.

- (1) Position the new hood ajar switch striker to the inner hood panel reinforcement (Fig. 8).
- (2) Insert the integral mounting tab on the front of the hood ajar switch striker into the forward mounting hole in the inner hood panel reinforcement.
- (3) Align the integral retainer on the rear of the hood ajar switch striker with the rearward mounting hole in the inner hood panel reinforcement.
- (4) Using hand pressure, firmly press the hood ajar switch striker rearward and upward against the inner hood panel reinforcement until the hood ajar switch striker retainer is fully engaged in the rearward mounting hole in the inner hood panel reinforcement.
- (5) Close and latch the hood.

## INTRUSION TRANSCEIVER MODULE

## DESCRIPTION



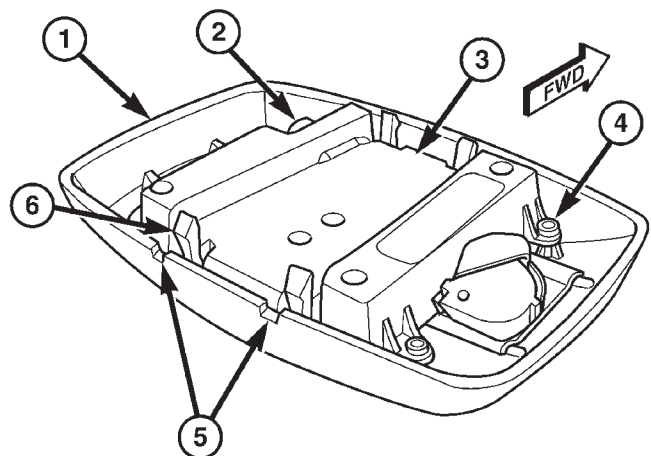
**Fig. 9 Intrusion Transceiver Module**

- 1 - ITM
- 2 - HEADLINER

An Intrusion Transceiver Module (ITM) is part of the Rest-Of-World (ROW) premium version of the Vehicle Theft Alarm (VTA) in the Vehicle Theft Security System (VTSS) (Fig. 9). The ROW premium version of the VTA is only available in vehicles built for certain markets, where the additional features offered by this system are required. The ITM is located in the passenger compartment, on the lower surface of the headliner near the center of the vehi-

cle. This unit is designed to provide interior motion detection, and serve as an interface between the Body Control Module (BCM) and the alarm siren module.

The ITM is concealed beneath a dedicated molded plastic trim cover that approximates the size and shape of a typical dome lamp housing. However, rather than a lens, the ITM features three sets of louvered openings in a molded lateral center rib formation. One set of louvered openings is located at each outboard end of the center rib, while the third set is centered. Each of the louvered openings is covered on the inside by a single molded black plastic sight shield that extends the length of the center rib for appearance. The module is secured to a molded plastic mounting bracket above the headliner by four latch features that are integral to the underside of the module housing. Besides the ITM, the trim cover also conceals two plastic pins integral to the mounting bracket that are used to secure the bracket to the headliner with two stamped nuts that are installed from below. An adhesive-backed foam pad is installed above the ITM bracket between the headliner and the roof panel to provide additional headliner stabilization and support for the ITM mounting. Two small notch-like service holes on the rear edge of the trim cover afford access to the two integral rear latches of the ITM for service removal (Fig. 10).



**Fig. 10 Intrusion Transceiver Module**

- 1 - TRIM COVER
- 2 - CONNECTOR RECEPTACLE
- 3 - HOUSING
- 4 - SCREW (4)
- 5 - SERVICE HOLE (2)
- 6 - LATCH FEATURE (4)

The ITM circuitry is contained within a black molded plastic housing with four integral mounting tabs that are secured to the back of the trim cover with four screws. Concealed within the housing is the

## INTRUSION TRANSCIEVER MODULE (Continued)

electronic circuitry of the ITM which includes a microprocessor, and an ultrasonic receive transducer. A molded plastic connector receptacle containing six terminal pins that is soldered to a small circuit board and extends through a clearance hole in the left front corner of the ITM housing, and an ultrasonic transmit transducer housing extends from the center of the right side of the ITM housing. Both the transmit transducer on the right side of the module and the receive transducer on the ITM circuit board are aimed through two small round holes in the sight shield of the trim cover. The ITM is connected to the vehicle electrical system by a dedicated take out and connector of the overhead wire harness that is integral to the headliner.

The ITM unit cannot be adjusted or repaired and, if faulty or damaged, it must be replaced. The ITM is serviced as a unit with the trim cover.

## OPERATION

The microprocessor in the Intrusion Transceiver Module (ITM) contains the motion sensor logic circuits and controls all of the features of the premium version of the Vehicle Theft Alarm (VTA). The ITM uses On-Board Diagnostics (OBD) and can communicate with other electronic modules in the vehicle as well as with the DRBIII® scan tool using the Programmable Communications Interface (PCI) data bus network. This method of communication is used by the ITM to communicate with the Body Control Module (BCM) and for diagnosis and testing through the 16-way data link connector located on the driver side lower edge of the instrument panel. The ITM also communicates with the alarm siren over a dedicated serial bus circuit.

The ITM microprocessor continuously monitors inputs from its on-board motion sensor circuitry as well as inputs from the BCM and the alarm siren module. The on-board ITM motion sensor circuitry transmits ultrasonic signals into the vehicle cabin through a transmit transducer, then listens to the returning signals as the bounce off of objects in the vehicle interior. If an object is moving in the interior, a detection circuit in the ITM senses this movement through the modulation of the returning ultrasonic signals that occurs due to the Doppler effect. The motion detect function of the ITM can be disabled by depressing the "Lock" button on the Remote Keyless Entry (RKE) transmitter three times within fifteen seconds, while the security indicator is still flashing rapidly. The ITM will signal the alarm siren module to provide a single siren "chirp" as an audible confirmation that the motion sensor function has been disabled.

If movement is detected, the ITM sends an electronic message to the BCM over the PCI data bus to

flash the exterior lighting and sends an electronic message to the alarm siren module over a dedicated serial bus line to sound the siren. When the BCM detects a breach in the perimeter protection through a door, tailgate, flip-up glass, or hood ajar switch input, it sends an electronic message to the ITM and the ITM sends an electronic message to the BCM over the PCI data bus to flash the exterior lighting and sends an electronic message to the alarm siren module over a dedicated serial bus line to sound the siren. The ITM also monitors inputs from the alarm siren module for siren battery or siren input/output circuit tamper alerts, and siren battery condition alerts, then sets active and stored Diagnostic Trouble Codes (DTC) for any monitored system faults it detects. An active fault only remains for the current ignition switch cycle, while a stored fault causes a DTC to be stored in memory by the ITM. If a fault does not recur for fifty ignition cycles, the ITM will automatically erase the stored DTC.

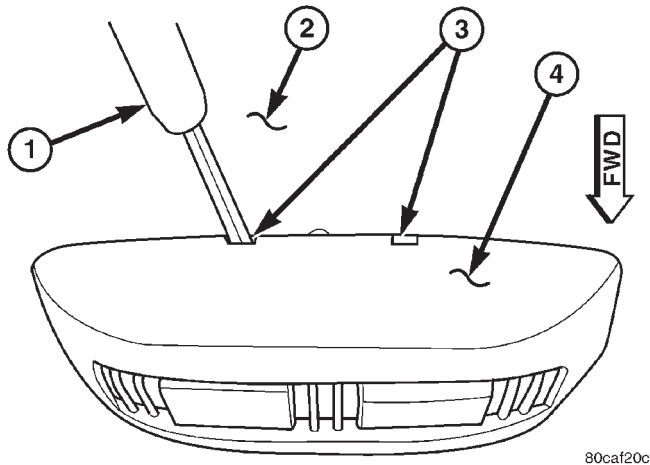
The ITM is connected to the vehicle electrical system through a dedicated take out and connector of the overhead wire harness. The ITM receives battery current on a fused B(+) circuit through a fuse in the Junction Block (JB), and receives ground through a ground circuit and take out of the body wire harness. This ground take out has a single eyelet terminal connector that is secured by a ground screw to the base of the left D-pillar behind the quarter trim panel. These connections allow the ITM to remain operational, regardless of the ignition switch position. The hard wired inputs and outputs for the ITM may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the ITM, the PCI data bus network, or the electronic message inputs to and outputs from the ITM. The most reliable, efficient, and accurate means to diagnose the ITM, the PCI data bus network, and the electronic message inputs to and outputs from the ITM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) While pulling downward lightly on either rear corner of the Intrusion Transceiver Module (ITM) trim cover, insert a small thin-bladed screwdriver through each of the service holes on the rear edge of the trim cover to depress and release the two integral rear latch features of the module from the mounting bracket above the headliner (Fig. 11).
- (3) Pull the ITM trim cover rearward far enough to disengage the two integral front latch features of

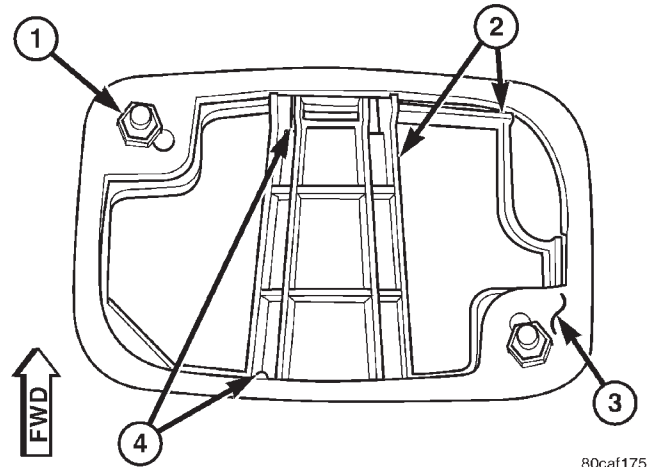


## INTRUSION TRANSCIEVER MODULE (Continued)



**Fig. 11 Intrusion Transceiver Module Remove**

- 1 - SMALL SCREWDRIVER
- 2 - HEADLINER
- 3 - SERVICE HOLES
- 4 - ITM



**Fig. 12 Intrusion Transceiver Module Mounting Bracket**

- 1 - STAMPED NUT (2)
- 2 - MOUNTING BRACKET
- 3 - HEADLINER
- 4 - LATCH RECEPTACLES (4)

the module from the mounting bracket above the headliner.

(4) Pull the ITM and trim cover down from the headliner far enough to access and disconnect the overhead wire harness connector for the ITM from the module connector receptacle.

(5) Remove the ITM from the headliner.

### INSTALLATION

(1) Position the Intrusion Transceiver Module (ITM) to the headliner.

(2) Reconnect the overhead wire harness connector for the ITM to the module connector receptacle.

(3) Align the two integral front latch features of the ITM with the two front latch receptacles of the mounting bracket above the headliner (Fig. 12).

(4) Push the ITM trim cover forward far enough to insert the two integral rear latch features of the module into the two rear latch receptacles of the mounting bracket above the headliner.

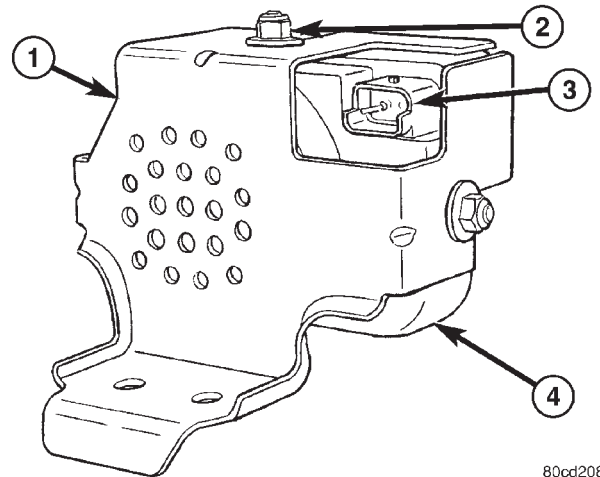
(5) Push upward firmly and evenly on the rear edge of the ITM trim cover until the two integral rear latch features of the module are engaged in the latch receptacles of the mounting bracket above the headliner.

(6) Reconnect the battery negative cable.

**NOTE:** If the Intrusion Transceiver Module (ITM) has been replaced with a new unit, the new ITM **MUST** be initialized before the Vehicle Theft Security System can operate as designed. The use of a DRBIII® scan tool is required to initialize the ITM. Refer to the appropriate diagnostic information.

## SIREN

### DESCRIPTION



**Fig. 13 Siren Module**

- 1 - BRACKET
- 2 - NUT (3)
- 3 - CONNECTOR RECEPTACLE
- 4 - SIREN MODULE

An alarm siren module is part of the Rest-Of-World (ROW) premium version of the Vehicle Theft Alarm (VTA) in the Vehicle Theft Security System (VTSS) (Fig. 13). The ROW premium version of the VTA is only available in vehicles built for certain markets, where the additional features offered by this system are required. The alarm siren module is located in

## SIREN (Continued)

the engine compartment, on the front extension of the right front wheel house panel below and behind the right headlamp. This unit is designed to provide the audible alert requirements for the ROW premium VTA.

The alarm siren module consists of microprocessor-based electronic control circuitry, the siren, and a nickel metal hydride backup battery. All of the alarm module components are protected and sealed within a black molded plastic housing. A stamped steel mounting bracket is secured to the module with three stud plates and nuts that fit into slotted holes at the top and each side of the bracket. The front surface of the bracket features a tightly grouped series of small holes that serves as an outlet for the audible output of the alarm siren. The bottom of the mounting bracket is bent at a right angle and has an integral locating tab feature. Two mounting holes in the horizontal surface of the bracket are used to secure the alarm siren module to the wheel house extension with two screws. An integral connector receptacle extends forward from the upper left corner of the alarm siren housing, and connects the unit to the vehicle electrical system through a dedicated take out and connector of the headlamp and dash wire harness.

The alarm siren module cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

## OPERATION

The microprocessor within the alarm siren module performs the tasks required to provide the siren unit features and functions based upon internal programming and electronic arm and disarm message inputs received from the Intrusion Transceiver Module (ITM) over a dedicated serial bus communication circuit. The alarm siren module will self-detect problems with its internal and external power supply and communication circuits, then send electronic messages indicating the problem to the ITM upon receiving a request from the ITM. The ITM will store a Diagnostic Trouble Code (DTC) for a detected alarm siren module fault that can be retrieved with the DRBIII® scan tool over the Programmable Communications Interface (PCI) data bus network through the 16-way data link connector located on the driver side lower edge of the instrument panel.

When the Rest-Of-World (ROW) premium version of the Vehicle Theft Alarm (VTA) is armed, the alarm siren module microprocessor continuously monitors inputs from the ITM for messages to sound its internal siren and enters its auto-detect mode. While in the auto-detect mode, if the alarm siren module detects that its power supply or communication circuits are being tampered with or have been sabo-

taged, it will sound an alarm and continue to operate through its on-board backup battery. If the arm siren module is in its disarmed mode when its power supply or communication circuits are interrupted, the siren will not sound. The alarm module will also notify the ITM when the backup battery requires charging, and the ITM will send a message that will allow the backup battery to be charged through the battery current and ground circuits to the alarm module only when the ignition switch is in the On position and the engine is running. This will prevent the charging of the alarm backup battery from depleting the charge in the main vehicle battery while the vehicle is not being operated.

The alarm siren module receives battery current on a fused B(+) circuit through a fuse in the Power Distribution Center (PDC), and receives ground through a ground circuit and take out of the headlamp and dash wire harness. This ground take out has a single eyelet terminal connector that is secured by a ground screw to the left inner fender shield in the engine compartment. These connections allow the alarm siren module to remain operational, regardless of the ignition switch position. The hard wired inputs and outputs for the alarm siren module may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the internal circuitry or the backup battery of the alarm siren module, the ITM, the serial bus communication line, or the electronic message inputs to and outputs from the alarm siren module. The most reliable, efficient, and accurate means to diagnose the alarm siren module, the ITM, the serial bus communication line, and the electronic message inputs to and outputs from the alarm siren module requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

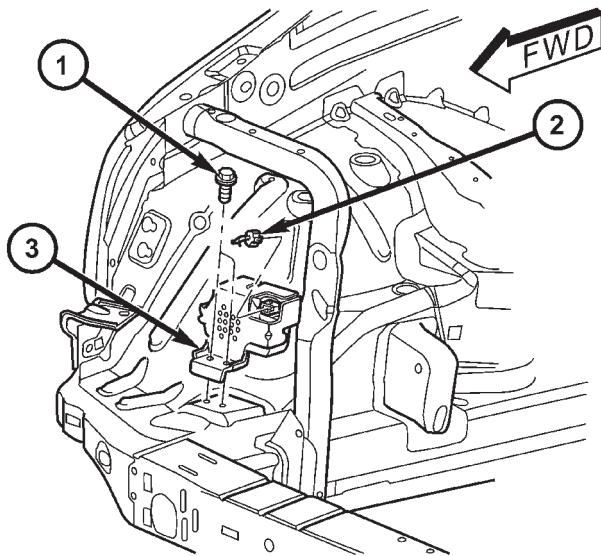
## REMOVAL

- (1) Disconnect and isolate the battery negative cable.
- (2) Disconnect the headlamp and dash wire harness connector for the alarm siren module from the module connector receptacle (Fig. 14).
- (3) Remove the two screws that secure the alarm siren module to the front extension of the right front wheel house panel.
- (4) Remove the alarm siren module from the front extension of the right front wheel house panel.

## INSTALLATION

- (1) Position the alarm siren module onto the front extension of the right front wheel house panel (Fig. 14).

## SIREN (Continued)



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**Fig. 14 Siren Remove/Install**

- 1 - SCREW (2)
- 2 - WIRE HARNESS CONNECTOR
- 3 - SIREN

(2) Install and tighten the two screws that secure the alarm siren module to the front extension of the right front wheel house panel. Tighten the screws to 6 N·m (50 in. lbs.).

(3) Reconnect the headlamp and dash wire harness connector for the alarm siren module to the module connector receptacle.

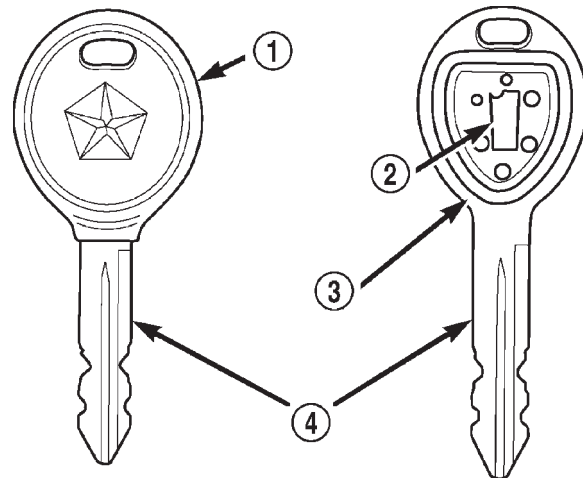
(4) Reconnect the battery negative cable.

**NOTE:** If the alarm siren module has been replaced with a new unit, the new unit **MUST** be configured in the Intrusion Transceiver Module (ITM) before the Vehicle Theft Security System can operate as designed. The use of a DRBIII® scan tool is required to configure the alarm siren module settings in the ITM. Refer to the appropriate diagnostic information.

## TRANSPONDER KEY

### DESCRIPTION

Each ignition key used in the Sentry Key Immobilizer System (SKIS) has an integral transponder chip (Fig. 15). Ignition keys with this feature can be readily identified by a gray rubber cap molded onto the head of the key, while conventional ignition keys have a black molded rubber cap. The transponder



80b5cb75

**Fig. 15 Sentry Key Immobilizer Transponder**

- 1 - MOLDED CAP
- 2 - TRANSPONDER CHIP
- 3 - MOLDED CAP REMOVED
- 4 - TRANSPONDER KEY

chip is concealed beneath the molded rubber cap, where it is molded within a plastic mount into the head of the metal key. In addition to being cut to match the mechanical coding of the ignition lock cylinder, each new Sentry Key has a unique transponder identification code permanently programmed into it by the manufacturer. The Sentry Key transponder cannot be adjusted or repaired. If faulty or damaged, the entire key must be replaced.

### OPERATION

When the ignition switch is turned to the On position, the Sentry Key Immobilizer Module (SKIM) communicates through its antenna with the Sentry Key transponder using a Radio Frequency (RF) signal. The SKIM then listens for a RF response from the transponder through the same antenna. The Sentry Key transponder chip is within the range of the SKIM transceiver antenna ring when it is inserted into the ignition lock cylinder. The SKIM determines whether a valid key is present in the ignition lock cylinder based upon the response from the transponder. If a valid key is detected, that fact is communicated by the SKIM to the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus, and the PCM allows the engine to continue running. If the PCM receives an invalid key message, or receives no message from the SKIM over the PCI data bus, the engine will be disabled after about two seconds of operation. The ElectroMechanical Instrument Cluster (EMIC) will also respond to the invalid key message on the PCI data bus by flashing the SKIS indicator on and off.

## TRANSPONDER KEY (Continued)

Each Sentry Key has a unique transponder identification code permanently programmed into it by the manufacturer. Likewise, the SKIM has a unique Secret Key code programmed into it by the manufacturer. When a Sentry Key is programmed into the memory of the SKIM, the SKIM stores the transponder identification code from the Sentry Key, and the Sentry Key learns the Secret Key code from the SKIM. Once the Sentry Key learns the Secret Key code of the SKIM, it is permanently stored in the memory of the transponder. Therefore, once a Sentry Key has been programmed to a particular vehicle, it cannot be used on any other vehicle. (Refer to 8 -

ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE - TRANSPONDER PROGRAMMING).

The SKIS performs a self-test each time the ignition switch is turned to the On position, and will store key-related fault information in the form of Diagnostic Trouble Codes (DTC's) in SKIM memory if a Sentry Key transponder problem is detected. The Sentry Key transponder chip can be diagnosed, and any stored DTC's can be retrieved using a DRBIII® scan tool. Refer to the appropriate diagnostic information.



# WIPERS/WASHERS

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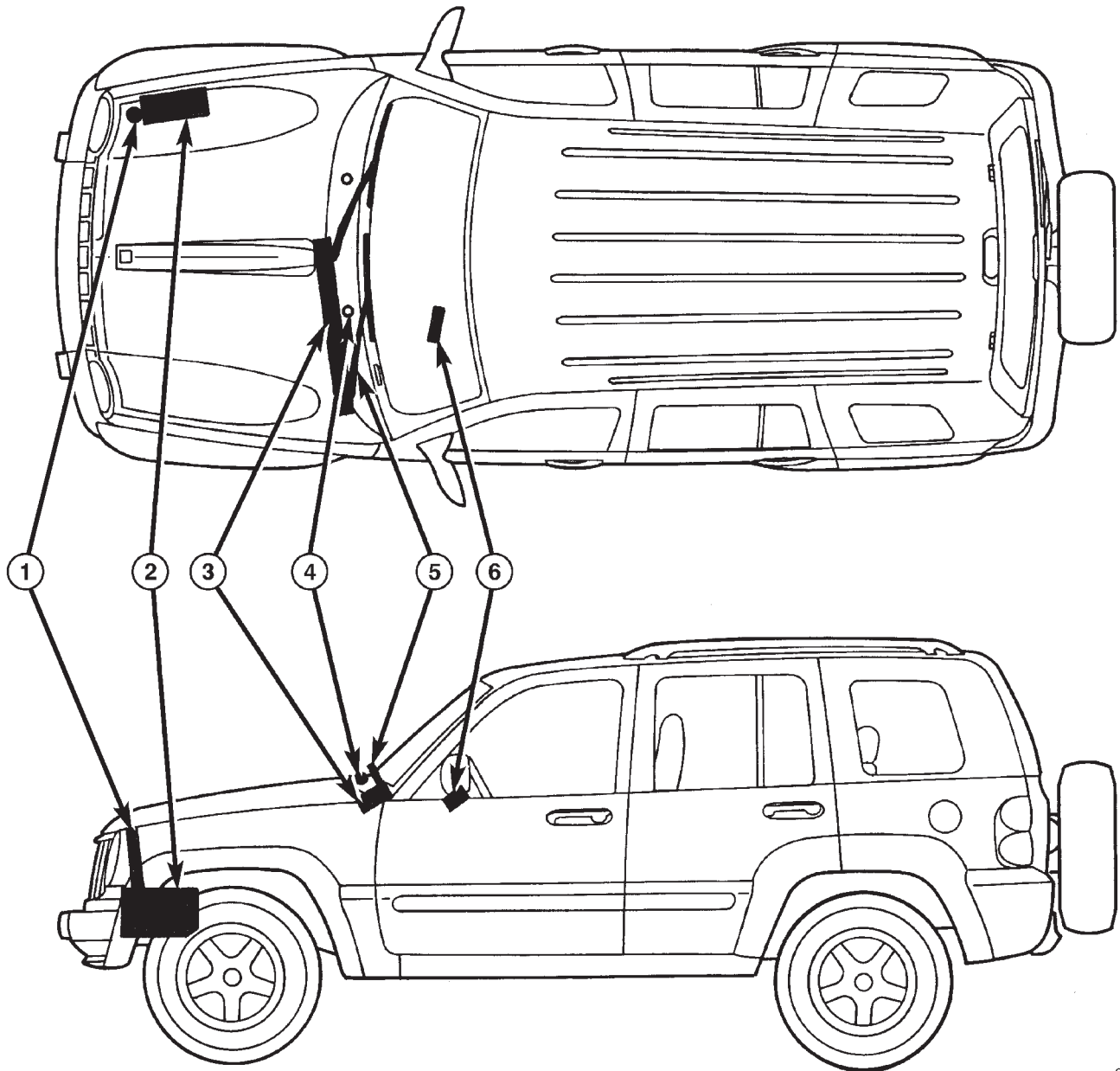
## FRONT WIPERS/WASHERS

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## FRONT WIPERS/WASHERS

## DESCRIPTION



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**Fig. 1 Front Wiper & Washer System**

- 1 - WASHER RESEVOIR FILLER TUBE
- 2 - WASHER RESERVOIR, PUMP/MOTOR, FLUID LEVEL SWITCH
- 3 - WIPER MODULE
- 4 - WASHER NOZZLE (2)

- 5 - WIPER ARM & BLADE (2)
- 6 - MULTI-FUNCTION SWITCH RIGHT (WIPER) CONTROL STALK

## FRONT WIPERS/WASHERS (Continued)

An electrically operated intermittent front wiper and washer system is standard factory-installed safety equipment on this model (Fig. 1). The front wiper and washer system includes the following major components, which are described in further detail elsewhere in this service information:

- **Body Control Module** - The Body Control Module (BCM) is located on the Junction Block (JB) under the driver side outboard end of the instrument panel. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/BODY CONTROL MODULE - DESCRIPTION).

- **Front Check Valve** - The front washer system check valve is integral to the wye fitting located in the washer plumbing between the cowl plenum washer hose and the front washer nozzles, and is concealed beneath the cowl plenum cover/grille panel at the base of the windshield.

- **Front Washer Nozzle** - Two fluidic front washer nozzles are secured with integral snap features to dedicated openings in the cowl plenum cover/grille panel located near the base of the windshield.

- **Front Washer Plumbing** - The plumbing for the front washer system consists of rubber hoses and molded plastic fittings. The plumbing is routed along the right side of the engine compartment from the washer reservoir, and through the dash panel into the cowl plenum to the front washer nozzle fittings beneath the cowl plenum cover/grille panel.

- **Front Wiper Arm** - The two front wiper arms are secured with nuts to the threaded studs on the ends of the two wiper pivot shafts, which extend through the cowl plenum cover/grille panel located near the base of the windshield.

- **Front Wiper Blade** - The two front wiper blades are secured to the two front wiper arms with an integral latch, and are parked on the glass near the bottom of the windshield when the front wiper system is not in operation.

- **Front Wiper Module** - The front wiper pivot shafts are the only visible components of the front wiper module. The remainder of the module is concealed within the cowl plenum area beneath the cowl plenum cover/grille panel. The front wiper module includes the wiper module bracket, four rubber-isolated wiper module mounts, the front wiper motor, the wiper motor crank arm, the two wiper drive links, and the two front wiper pivots.

- **Multi-Function Switch** - The multi-function switch is located on the top of the steering column, just below the steering wheel. The multi-function switch includes a left (lighting) control stalk and a right (wiper) control stalk. The right control stalk is dedicated to providing all of the driver controls for both the front and rear wiper systems. (Refer to 8 -

ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION).

- **Washer Fluid Level Switch** - The washer fluid level switch is located in a dedicated hole near the center of the rearward facing surface of the washer reservoir, behind the right front wheel house splash shield.

- **Washer Pump/Motor** - The reversible electric washer pump/motor unit is located in a dedicated hole on the lower outboard side of the washer reservoir, behind the right front wheel house splash shield. This single reversible washer pump/motor provides washer fluid to either the front or rear washer system plumbing, depending upon the direction of the pump motor rotation.

- **Washer Reservoir** - The washer reservoir is concealed behind the right front wheel house splash shield ahead of the right front wheel. The washer reservoir filler neck is the only visible portion of the reservoir, and it is accessed from the right front corner of the engine compartment.

- **Wiper High-Low Relay** - The wiper high-low relay is an International Standards Organization (ISO) micro relay located in the Power Distribution Center (PDC) in the engine compartment near the battery.

- **Wiper On-Off Relay** - The wiper on-off relay is an International Standards Organization (ISO) micro relay located in the Power Distribution Center (PDC) in the engine compartment near the battery.

Hard wired circuitry connects the front wiper and washer system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the front wiper and washer system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

**OPERATING MODES** The components of the front wiper and washer system are designed to work in concert to provide the following operating modes:

- **Continuous Wipe Mode** - The control knob on the right (wiper) control stalk of the multi-function switch has two continuous wipe positions, Low and High. When selected, these switch positions will cause the two-speed front wiper motor to operate in a continuous low or high speed cycle.



## FRONT WIPERS/WASHERS (Continued)

- **Intermittent Wipe Mode** - The control knob on the right (wiper) control stalk of the multi-function switch has five minor detent intermittent wipe positions. When selected, these switch positions will cause the front wiper system to operate with one of five delay intervals between complete wipe cycles.

- **Mist Wipe Mode** - The right (wiper) control stalk of the multi-function switch has a momentary Mist position. When selected, this switch position will operate the front wipers in a low speed continuous cycle for as long as the switch is held closed, then will complete the current wipe cycle and park the front wiper blades near the base of the windshield when the switch is released.

- **Washer Mode** - When the momentary front wash position of the right (wiper) control stalk of the multi-function switch is selected with the front wiper system operating in a continuous wipe mode, washer fluid will be dispensed onto the windshield glass through the washer nozzles for as long as the washer switch is held closed. When the front washer switch is actuated with the front wiper system operating in an intermittent wipe mode, washer fluid is still dispensed until the switch is released; however, the front wipers will operate in a low speed continuous cycle from the time the washer switch is closed until several wipe cycles after the switch is released, before returning to the selected intermittent wipe mode.

- **Wipe-After-Wash Mode** - When the momentary front wash position of the right (wiper) control stalk of the multi-function switch is selected with the front wiper system turned Off, the internal circuitry of the BCM provides a wipe-after-wash feature. When selected, this feature will operate the washer pump/motor and the front wipers for as long as the front washer switch is held closed, then provide several additional wipe cycles after the switch is released before parking the front wiper blades near the base of the windshield.

## OPERATION

The front wiper and washer system is designed to provide the vehicle operator with a convenient, safe, and reliable means of maintaining visibility through the windshield glass. The various components of this system are designed to convert electrical energy produced by the vehicle electrical system into the mechanical action of the wiper blades to wipe the outside surface of the glass, as well as into the hydraulic action of the washer system to apply washer fluid stored in an on-board reservoir to the area of the glass to be wiped. When combined, these components provide the means to effectively maintain clear visibility for the vehicle operator by removing excess accumulations of rain, snow, bugs, mud, or

other minor debris from the outside windshield glass surface that might be encountered while driving the vehicle under numerous types of inclement operating conditions.

The vehicle operator initiates all front wiper and washer system functions with the right (wiper) control stalk of the multi-function switch that extends from the right side of the steering column, just below the steering wheel. Rotating the control knob on the end of the control stalk, selects the Off, Delay, Low, or High front wiper system operating modes. In the Delay mode, the control knob also allows the vehicle operator to select from one of five intermittent wipe Delay intervals. Pulling the right control stalk downwards actuates the momentary front wiper system Mist mode switch, while pulling the right control stalk towards the steering wheel actuates the momentary front washer system switch. The multi-function switch provides hard wired resistor multiplexed inputs to the Body Control Module (BCM) for all of the front wiper system functions, as well as a separate hard wired sense input to the BCM for the front washer system function.

The front wiper and washer system will only operate when the ignition switch is in the Accessory or On positions. Battery current is directed from a B(+) fuse in the Power Distribution Center (PDC) to the wiper and washer system circuit breaker in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit. The automatic resetting circuit breaker then provides battery current through a fused ignition switch output (run-acc) circuit to the wiper high/low relay, the wiper on/off relay, and the park switch within the front wiper motor. A separate fuse in the JB provides battery current through another fused ignition switch output (run-acc) circuit to the multi-function switch. The multi-function switch circuitry uses this battery feed and a ground circuit input to directly control the operation and direction of the reversible electric washer pump/motor unit. The BCM uses low side drivers to control front wiper system operation by energizing or de-energizing the wiper high/low and wiper on/off relays.

The hard wired circuits and components of the front wiper and washer system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), or the inputs to or outputs from the BCM that control the front wiper and washer system operating modes. The most reliable, efficient, and accurate means to diagnose the BCM, or the BCM inputs and outputs related to the various front wiper and washer system operating modes requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

## FRONT WIPERS/WASHERS (Continued)

Following are paragraphs that briefly describe the operation of each of the front wiper and washer system operating modes.

**CONTINUOUS WIPE MODE** When the Low position of the control knob on the right (wiper) control stalk of the multi-function switch is selected, the Body Control Module (BCM) energizes the wiper on/off relay. This directs battery current through the normally open contacts of the energized wiper on/off relay and the normally closed contacts of the de-energized wiper high/low relay to the low speed brush of the front wiper motor, causing the front wipers to cycle at low speed. When the High position of the control knob is selected, the BCM energizes both the wiper on/off relay and the wiper high/low relay. This directs battery current through the normally open contacts of the energized wiper on/off relay and the normally open contacts of the energized wiper high/low relay to the high speed brush of the front wiper motor, causing the front wipers to cycle at high speed.

When the Off position of the control knob is selected, the BCM de-energizes both the wiper on/off and wiper high low relays, then one of two events will occur. The event that occurs depends upon the position of the wiper blades on the windshield at the moment that the control knob Off position is selected. If the wiper blades are in the down position on the windshield when the Off position is selected, the park switch that is integral to the front wiper motor is closed to ground and the wiper motor ceases to operate. If the wiper blades are not in the down position on the windshield at the moment the Off position is selected, the park switch is closed to battery current from the fused ignition switch output (run-acc) circuit of the front wiper motor. The park switch directs this battery current to the low speed brush of the wiper motor through the wiper park switch sense circuit and the normally closed contacts of the de-energized wiper on/off and wiper high/low relays. This causes the wiper motor to continue running at low speed until the wiper blades are in the down position on the windshield and the park switch is again closed to ground.

**INTERMITTENT WIPE MODE** When the control knob on the right (wiper) control stalk of the multi-function switch is moved to one of the Delay interval positions, the BCM electronic intermittent wipe logic circuit responds by calculating the correct length of time between wiper sweeps based upon the selected delay interval input. The BCM monitors the changing state of the wiper motor park switch through a hard wired front wiper park switch sense circuit input. This input allows the BCM to determine the proper intervals at which to energize and de-energize the wiper on/off relay to operate the front wiper

motor intermittently for one low speed cycle at a time. The BCM logic is also programmed to provide an immediate wipe cycle and begin a new delay interval timing cycle each time a shorter delay interval is selected, and to add the remaining delay timing interval to the new delay interval timing before the next wipe cycle occurs each time a longer delay interval is selected.

**MIST WIPE MODE** When the right (wiper) control stalk of the multi-function switch is moved to the momentary Mist position, the BCM energizes the wiper on/off relay for as long as the Mist switch is held closed, then de-energizes the relay when the state of the Mist switch input changes to open. The BCM can operate the front wiper motor in this mode for only one low speed cycle at a time, or for an indefinite number of sequential low speed cycles, depending upon how long the Mist switch is held closed.

**WASH MODE** When the right (wiper) control stalk of the multi-function switch is moved to the momentary front Wash position while the control knob is in the Low or High positions, the circuitry within the switch directs battery current and ground to the washer pump/motor unit. This will cause the washer pump/motor unit to be energized for as long as the front Wash switch is held closed, and to de-energize when the front Wash switch is released. When the right (wiper) control stalk of the multi-function switch is moved to the momentary front Wash position while the control knob is in one of the Delay interval positions, the front washer pump/motor operation is the same. However, the BCM energizes the wiper on/off relay to override the selected delay interval and operate the front wiper motor in a continuous low speed mode for as long as the front Wash switch is held closed, then de-energizes the relay and reverts to the selected delay mode interval several wipe cycles after the front Wash switch is released. The BCM detects the front Wash switch state through a hard wired washer pump driver circuit input from the multi-function switch.

**WIPE-AFTER-WASH MODE** When the right (wiper) control stalk of the multi-function switch is moved to the momentary front Wash position while the control knob is in the Off position, the BCM detects that switch state through a hard wired washer pump driver circuit input from the multi-function switch. The BCM responds to this input by energizing the wiper on/off relay for as long as the Wash switch is held closed, then de-energizes the relay several wipe cycles after the front Wash switch is released. The BCM monitors the changing state of the wiper motor park switch through a hard wired front wiper park switch sense circuit input. This input allows the BCM to count the number of wipe

## FRONT WIPERS/WASHERS (Continued)

cycles that occur after the front Wash switch state changes to open, and to determine the proper interval at which to de-energize the wiper on/off relay to complete the wipe-after-wash mode cycle.

**DIAGNOSIS AND TESTING - FRONT WIPER & WASHER SYSTEM****FRONT WIPER SYSTEM**

If the front wiper motor operates, but the wipers do not move on the windshield, replace the faulty front wiper module. If the wipers operate, but chatter, lift, or do not clear the glass, clean and inspect the front wiper system components as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - INSPECTION) and (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING). For diagnosis and testing of the multi-function switch (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

The hard wired circuits and components of the front wiper and washer system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the Body Control Module (BCM), or the inputs to or outputs from the BCM that control the various front wiper and washer system operating modes. The most reliable, efficient, and accurate means to diagnose the BCM, or the BCM inputs and outputs related to the various front wiper and washer system operating modes requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD**

**RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.****FRONT WASHER SYSTEM**

The diagnosis found here addresses an electrically inoperative front washer system. If the washer pump/motor operates, but no washer fluid is emitted from the front washer nozzles, be certain to check the fluid level in the reservoir. Also inspect the front washer system components as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - INSPECTION). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 control knob on the right (wiper) control stalk of the multi-function switch to the On position. Check whether the front wiper system is operating. If OK, go to Step 2. If not OK, test and repair the front wiper system before continuing with these tests. Refer to FRONT WIPER SYSTEM .

(2) Turn the control ring on the right (wiper) control stalk of the multi-function switch to the rear Wash position. Check whether the rear washer system is operating. If OK, test the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If the multi-function switch tests OK, go to Step 3. If the multi-function switch does not test OK, replace the faulty switch.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the washer pump/motor unit from the pump/motor unit connector receptacle. Check for continuity between the washer pump driver circuit cav-

## FRONT WIPERS/WASHERS (Continued)

ity of the headlamp and dash wire harness connector for the washer pump/motor unit and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted washer pump driver circuit between the washer pump/motor unit and the multi-function switch as required.

(4) Check for continuity between the washer pump driver circuit cavities of the headlamp and dash wire harness connector for the washer pump/motor unit and the instrument panel wire harness connector for the multi-function switch (Connector C-2). There should be continuity. If OK, go to Step 5. If not OK, repair the open washer pump driver circuit between the washer pump/motor unit and the multi-function switch as required.

(5) Check for continuity between the washer pump sense circuit cavity of the headlamp and dash wire harness connector for the washer pump/motor unit and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted washer pump sense circuit between the washer pump/motor unit and the multi-function switch as required.

(6) Check for continuity between the washer pump sense circuit cavities of the headlamp and dash wire harness connector for the washer pump/motor unit and the instrument panel wire harness connector for the multi-function switch (Connector C-2). There should be continuity. If OK, replace the faulty washer pump/motor unit. If not OK, repair the open washer pump sense circuit between the washer pump/motor unit and the multi-function switch as required.

## CLEANING - FRONT WIPER & WASHER SYSTEM

### FRONT WIPER SYSTEM

The squeegees of wiper blades exposed to the elements for a long time tend to lose their wiping effectiveness. Periodic cleaning of the squeegees is suggested to remove any deposits of salt or road film. The wiper blades, arms, and windshield glass should only be cleaned using a sponge or soft cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the wiper blades continue to leave streaks, smears, hazing, or beading on the glass after thorough cleaning of the squeegees and the glass, the entire wiper blade assembly must be replaced.

**CAUTION:** Protect the rubber squeegees of the wiper blades from any petroleum-based cleaners, solvents, or contaminants. These products can rapidly deteriorate the rubber squeegees.

### FRONT WASHER SYSTEM

If the washer system is contaminated with foreign material, drain the washer reservoir by removing the washer pump/motor from the reservoir. Clean foreign material from the inside of the washer pump/motor inlet filter screen and the washer reservoir using clean washer fluid, a mild detergent, or a non-abrasive cleaner. Flush foreign material from the washer system plumbing by first disconnecting the washer hoses from the washer nozzles, then running the washer pump/motor to run clean washer fluid or water through the system. Plugged or restricted washer nozzles should be carefully back-flushed using compressed air. If the washer nozzle obstruction cannot be cleared, replace the washer nozzle.

**CAUTION:** Never introduce petroleum-based cleaners, solvents, or contaminants into the washer system. These products can rapidly deteriorate the rubber seals and hoses of the washer system, as well as the rubber squeegees of the wiper blades.

**CAUTION:** Never use compressed air to flush the washer system plumbing. Compressed air pressures are too great for the washer system plumbing components and will result in further system damage. Never use sharp instruments to clear a plugged washer nozzle or damage to the nozzle orifice and improper nozzle spray patterns will result.

## INSPECTION - FRONT WIPER & WASHER SYSTEM

### FRONT WIPER SYSTEM

The front wiper blades and wiper arms should be inspected periodically, not just when wiper performance problems are experienced. This inspection should include the following points:

(1) Inspect the wiper arms for any indications of damage, or contamination. If the wiper arms are contaminated with any foreign material, clean them as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING). If a wiper arm is damaged or corrosion is evident, replace the wiper arm with a new unit. Do not attempt to repair a wiper arm that is damaged or corroded.

(2) Carefully lift the wiper blade off of the glass. Note the action of the wiper arm hinge. The wiper arm should pivot freely at the hinge, but with no lateral looseness evident. If there is any binding evident in the wiper arm hinge, or there is evident lateral play in the wiper arm hinge, replace the wiper arm.

## FRONT WIPERS/WASHERS (Continued)

**CAUTION:** Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(3) Once proper hinge action of the wiper arm is confirmed, check the hinge for proper spring tension. Remove the wiper blade from the wiper arm. Either place a small postal scale between the blade end of the wiper arm and the glass, or carefully lift the blade end of the arm away from the glass using a small fish scale. Compare the scale readings between the right and left wiper arms. Replace a wiper arm if it has comparatively lower spring tension, as evidenced by a lower scale reading.

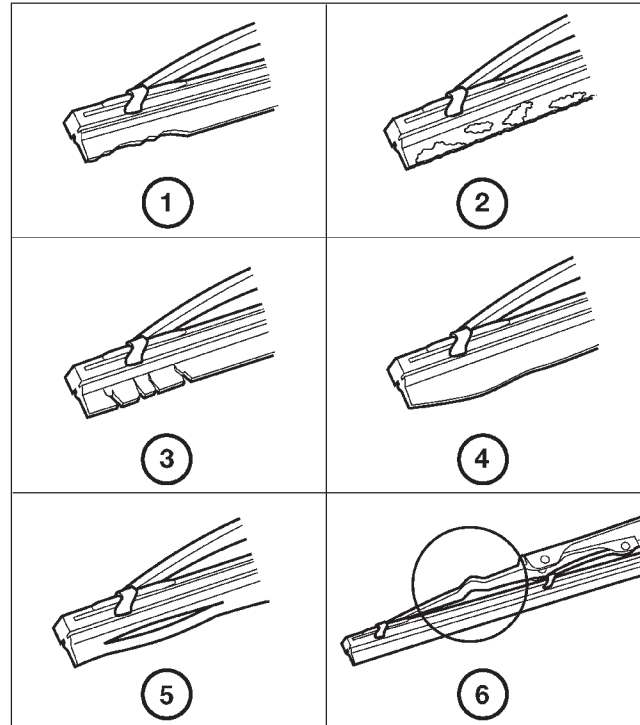
(4) Inspect the wiper blades and squeegees for any indications of damage, contamination, or rubber deterioration (Fig. 2). If the wiper blades or squeegees are contaminated with any foreign material, clean them and the glass as required. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING). After cleaning the wiper blade and the glass, if the wiper blade still fails to clear the glass without smearing, streaking, chattering, hazing, or beading, replace the wiper blade. Also, if a wiper blade is damaged or the squeegee rubber is damaged or deteriorated, replace the wiper blade with a new unit. Do not attempt to repair a wiper blade that is damaged.

## FRONT WASHER SYSTEM

The washer system components should be inspected periodically, not just when washer performance problems are experienced. This inspection should include the following points:

(1) Check for ice or other foreign material in the washer reservoir. If contaminated, clean and flush the washer system. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS - CLEANING).

(2) Inspect the washer plumbing for pinched, leaking, deteriorated, or incorrectly routed hoses and damaged or disconnected hose fittings. Replace damaged or deteriorated hoses and hose fittings. Leaking washer hoses can sometimes be repaired by cutting the hose at the leak and splicing it back together using an in-line connector fitting. Similarly, sections of deteriorated hose can be cut out and replaced by splicing in new sections of hose using in-line connector fittings. Whenever routing a washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts. Also, sharp bends that might pinch the washer hose must be avoided.



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**Fig. 2 Wiper Blade Inspection**

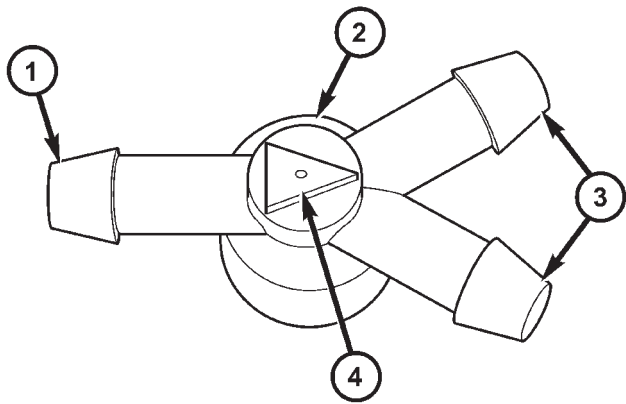
- 1 - WORN OR UNEVEN EDGES
- 2 - ROAD FILM OR FOREIGN MATERIAL DEPOSITS
- 3 - HARD, BRITTLE, OR CRACKED
- 4 - DEFORMED OR FATIGUED
- 5 - SPLIT
- 6 - DAMAGED SUPPORT COMPONENTS

## FRONT CHECK VALVE

## DESCRIPTION

A front washer system check valve (Fig. 3) is standard equipment on this model. The front check valve is integral to the front washer nozzle plumbing wye fitting located in the cowl plenum area beneath on the back of the cowl plenum cover/grille panel near the base of the windshield. The check valve consists of a molded plastic body with a round center section. An arrow formation molded into the center section of the valve body indicates the direction of flow through the valve. Three barbed hose nipples are formed in a wye configuration on the outside circumference of the center section of the valve body. The front check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

## FRONT CHECK VALVE (Continued)



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**Fig. 3 Front Check Valve**

- 1 - INLET NIPPLE
- 2 - FRONT CHECK VALVE
- 3 - OUTLET NIPPLE (2)
- 4 - FLOW DIRECTION ARROW

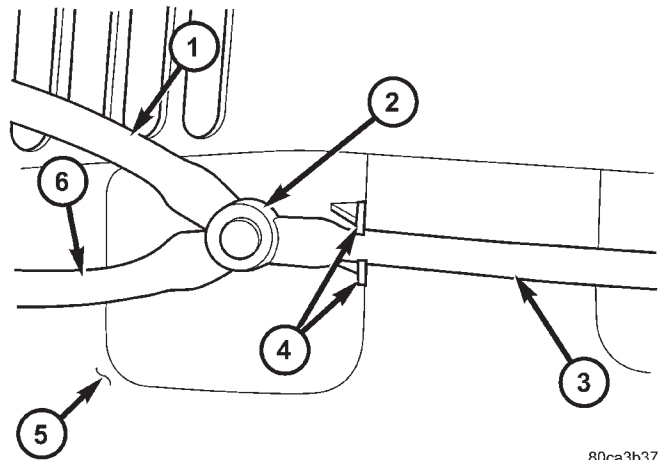
**OPERATION**

The front check valve provides more than one function in this application. It serves as a wye connector fitting between the cowl grille panel and washer nozzle sections of the front washer supply hose. It also prevents washer fluid from draining out of the front washer supply hoses back to the washer reservoir. This drain-back would result in a lengthy delay when the front washer switch is actuated until washer fluid was dispensed through the front washer nozzles, because the washer pump would have to refill the front washer plumbing from the reservoir to the nozzles. Finally, the front check valve prevents washer fluid from siphoning through the front washer nozzles after the front washer system is turned Off.

Within the check valve body, a small check valve is held in place against a seat by a small coiled spring to restrict flow through the unit until the valve is unseated by a predetermined inlet fluid pressure. When the washer pump pressurizes and pumps washer fluid from the reservoir through the front washer plumbing, the fluid pressure overrides the spring pressure applied to the check valve and unseats the valve, allowing washer fluid to flow toward the front washer nozzles. When the washer pump stops operating, spring pressure seats the check valve and fluid flow in either direction within the front washer plumbing is prevented.

**REMOVAL**

- (1) Unlatch and open the hood.
- (2) Remove both front wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - FRONT/FRONT WIPER ARM - REMOVAL).
- (3) Remove the cowl plenum cover/grille panel from over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).
- (4) From the underside of the cowl plenum cover/grille panel, disconnect the cowl plenum and washer nozzle hoses from the three barbed nipples of the front check valve (Fig. 4).



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**Fig. 4 Front Check Valve Remove/Install**

- 1 - WASHER NOZZLE HOSE (RIGHT)
- 2 - FRONT CHECK VALVE
- 3 - COWL PLENUM WASHER HOSE
- 4 - ROUTING CLIP
- 5 - COWL GRILLE COVER (UNDERSIDE)
- 6 - WASHER NOZZLE HOSE (LEFT)

- (5) Remove the front check valve from the underside of the cowl plenum cover/grille panel.

**INSTALLATION**

(1) Position the front check valve to the underside of the cowl plenum cover/grille panel (Fig. 4). Be certain that the flow direction arrow molded into the front check valve body is oriented towards the front washer nozzles.

(2) From the underside of the cowl plenum cover/grille panel, reconnect the cowl plenum and washer nozzle hoses to the three barbed nipples of the front check valve.

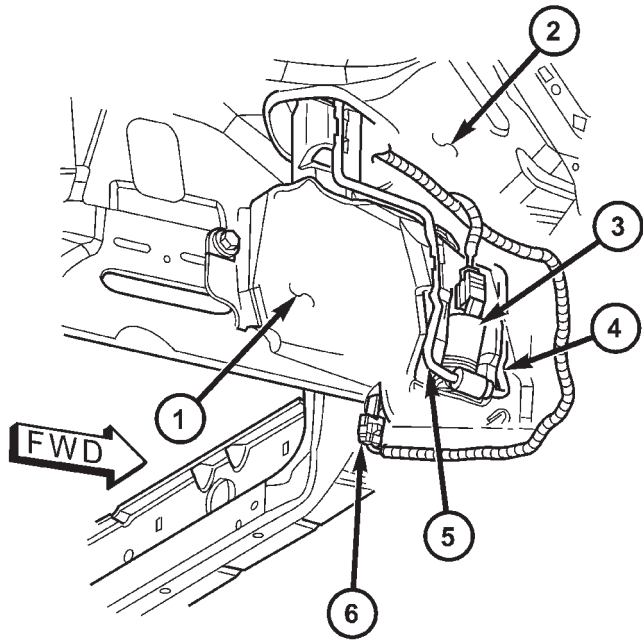
(3) Reinstall the cowl plenum cover/grille panel over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(4) Reinstall both front wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER ARM - INSTALLATION).

- (5) Close and latch the hood.

## FRONT WASHER HOSES/ TUBES

### DESCRIPTION

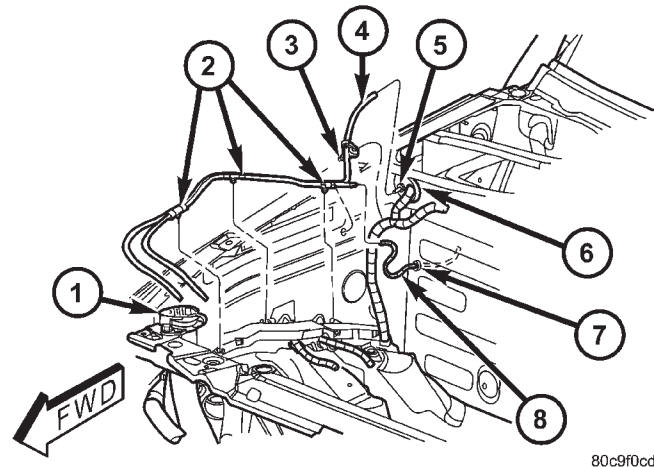


**Fig. 5 Reservoir Washer Hose**

- 1 - WASHER RESERVOIR
- 2 - RIGHT FRONT WHEEL HOUSE
- 3 - WASHER PUMP
- 4 - FRONT WASHER HOSE
- 5 - RESERVOIR REAR WASHER HOSE
- 6 - WASHER FLUID LEVEL SWITCH

The front washer plumbing consists of a small diameter rubber hose that is routed from the barbed outlet nipple of the reversible electric washer pump/motor unit on the washer reservoir through a trough molded into the reservoir forward of the washer pump and along the reservoir filler neck into the engine compartment (Fig. 5). Within the engine compartment, the front washer hose is routed side by side with the engine compartment rear washer hose along the top of the right front fender wheel house to the dash panel. Molded plastic routing clips secure the hoses to the headlamp and dash wire harness in the engine compartment (Fig. 6).

The front washer hose is connected in the engine compartment to the barbed nipple of a molded plastic in-line fitting installed through a rubber grommet in a hole in the right side of the dash plenum panel. The barbed nipple of the in-line fitting protrudes through the other side of the rubber grommet into the cowl plenum area, where the cowl plenum washer hose joins the front washer hose to the front



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**Fig. 6 Engine Compartment Washer Hose**

- 1 - RESERVOIR FILLER CAP
- 2 - ROUTING CLIP (3)
- 3 - ROUTING CLIP (1)
- 4 - FRONT WASHER HOSE
- 5 - IN-LINE HOSE FITTING
- 6 - PLENUM PANEL GROMMET
- 7 - DASH PANEL GROMMET
- 8 - REAR WASHER HEADLINER HOSE

check valve/wye fitting. The cowl plenum washer hose is routed through integral routing clips on the underside of the cowl plenum cover/grille panel to the molded plastic wye fitting. The cowl plenum washer hose is connected to one nipple on the wye fitting and the two washer nozzle hoses are connected to the other two wye fitting nipples. The washer nozzle hoses are then routed along the underside of the cowl plenum cover/grille panel to the two front washer nozzles.

Washer hose is available for service only as roll stock, which must then be cut to length. The molded plastic washer hose fittings cannot be repaired. If these fittings are faulty or damaged, they must be replaced.

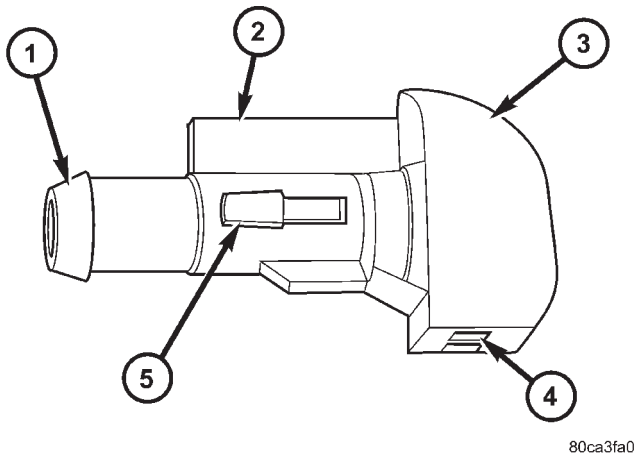
### OPERATION

Washer fluid in the washer reservoir is pressurized and fed by the washer pump/motor through the front washer system plumbing and fittings to the two front washer nozzles. Whenever routing the washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts; and, sharp bends that might pinch the hose must be avoided.

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## FRONT WASHER NOZZLE

### DESCRIPTION



**Fig. 7 Front Washer Nozzle**

- 1 - NIPPLE
- 2 - ANTI-ROTATION TAB
- 3 - FRONT WASHER NOZZLE
- 4 - ORIFICE
- 5 - LATCH (2)

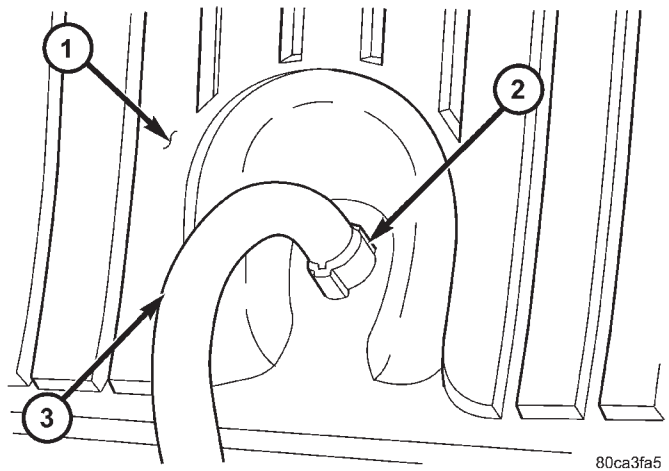
The two front washer nozzles have integral snap features and an anti-rotation tab that secure them in dedicated holes in the cowl plenum cover/grille panel located near the base of the windshield (Fig. 7). The domed upper surface of the washer nozzle is visible on the top of the plenum cover/grille panel, and the nozzle orifice is oriented towards the windshield glass. The washer plumbing fittings for the washer nozzles are concealed beneath the cowl plenum cover/grille panel. These fluidic washer nozzles are constructed of molded plastic. The cowl plenum cover/grille panel must be removed from the vehicle to access the nozzles for service. The washer nozzles cannot be adjusted or repaired. If faulty or damaged, they must be replaced.

### OPERATION

The two front washer nozzles are designed to dispense washer fluid into the wiper pattern area on the outside of the windshield glass. Pressurized washer fluid is fed to each nozzle from the washer reservoir by the washer pump/motor unit through a single hose, which is attached to a barbed nipple on each front washer nozzle below the cowl plenum cover/grille panel. The washer nozzles incorporate a fluidic design, which causes the nozzle to emit the pressurized washer fluid as an oscillating stream to more effectively cover a larger area of the glass area to be cleaned.

### REMOVAL

- (1) Unlatch and open the hood.
- (2) Remove both front wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/FRONT WIPER ARM - REMOVAL).
- (3) Remove the cowl plenum cover/grille panel from over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).
- (4) From the underside of the cowl plenum cover/grille panel, disconnect the washer nozzle hose from the barbed nipple of the front washer nozzle (Fig. 8).
- (5) From the underside of the cowl grille cover, release the integral snap features of the front washer nozzle and push the nozzle out through the mounting hole toward the top side of the cowl plenum cover/grille panel.



**Fig. 8 Front Washer Nozzle Remove/Install**

- 1 - COWL GRILLE COVER (UNDERSIDE)
- 2 - FRONT WASHER NOZZLE
- 3 - WASHER NOZZLE HOSE

- (6) Remove the front washer nozzle from the top of the cowl plenum cover/grille panel.

### INSTALLATION

- (1) From the top of the cowl plenum cover/grille panel, position the nipple end of the front washer nozzle through the mounting hole and engage the anti-rotation tab of the nipple into the anti-rotation notch in the mounting hole.
- (2) Push firmly and evenly on the top of the front washer nozzle until the integral snap features lock into place on the underside of the cowl plenum cover/grille panel.
- (3) From the underside of the cowl grille cover, reconnect the washer hose to the barbed nipple of the front washer nozzle (Fig. 8).
- (4) Reinstall the washer hose for the front washer nozzle into its routing clips on the underside of the cowl plenum cover/grille panel.



## FRONT WASHER NOZZLE (Continued)

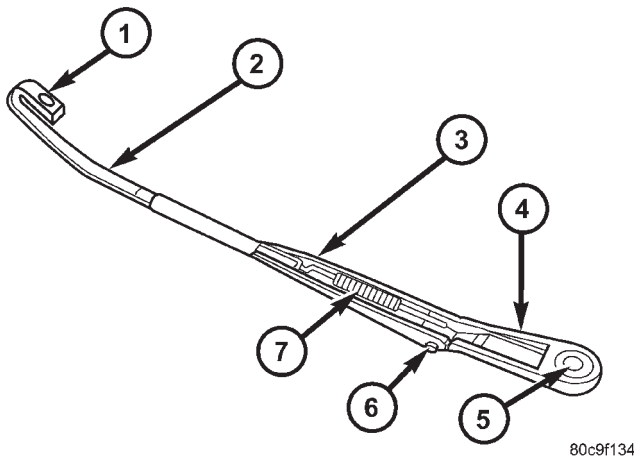
(5) Reinstall the cowl plenum cover/grille panel over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(6) Reinstall both front wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER ARM - INSTALLATION).

(7) Close and latch the hood.

## FRONT WIPER ARM

## DESCRIPTION



**Fig. 9 Front Wiper Arm**

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- 1 - HOOK
- 2 - STRAP
- 3 - CHANNEL
- 4 - PIVOT END
- 5 - PIVOT HOLE
- 6 - HINGE PIN
- 7 - TENSION SPRING

The front wiper arms are the rigid members located between the wiper pivots that protrude from the cowl plenum cover/grille panel near the base of the windshield and the wiper blades on the windshield glass (Fig. 9). These wiper arms feature an over-center hinge that allows easy access to the windshield glass for cleaning. The wiper arm has a die cast metal pivot end with a large tapered mounting hole at one end. A molded black plastic cap fits over the wiper arm retaining nut to conceal the nut and this mounting hole following wiper arm installation. The wide end of a tapered, stamped steel channel hinges on and is secured with a hinge pin to the blade end of the wiper arm pivot end. One end of a long, rigid, stamped steel strap, with a small hole near its pivot end, is riveted and crimped within the narrow end of the stamped steel channel. The tip of the wiper blade end of this strap is bent back under itself to form a small hook. Concealed within the stamped steel channel, one end of a long spring is engaged with a wire hook on the underside of the die

cast pivot end, while the other end of the spring is hooked through the small hole in the steel strap. The entire wiper arm has a satin black finish applied to all of its visible surfaces.

A wiper arm cannot be adjusted or repaired. If damaged or faulty, the entire wiper arm unit must be replaced.

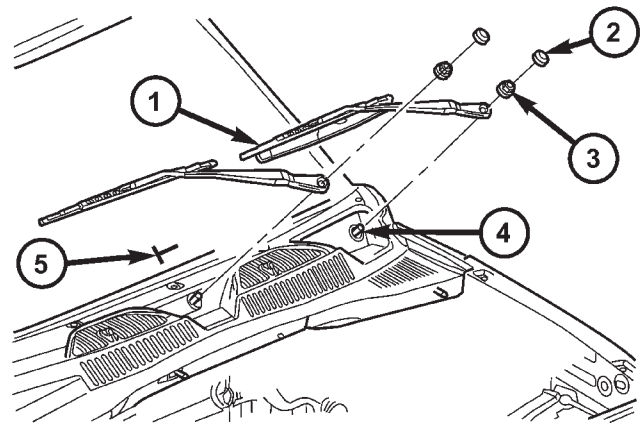
## OPERATION

The front wiper arms are designed to mechanically transmit the motion from the wiper pivots to the wiper blades. The wiper arm must be properly indexed to the wiper pivot in order to maintain the proper wiper blade travel on the glass. The tapered mounting hole in the wiper arm pivot end interlocks with the serrations on the tapered outer circumference of the wiper pivot shaft, allowing positive engagement and finite adjustment of this connection. The mounting nut locks the wiper arm to the threaded stud of the wiper pivot shaft. The spring-loaded wiper arm hinge controls the down-force applied through the tip of the wiper arm to the wiper blade on the glass. The hook formation on the tip of the wiper arm provides a cradle for securing and latching the wiper blade pivot block to the wiper arm.

## REMOVAL

(1) Lift the front wiper arm to its over-center position to hold the wiper blade off of the glass and relieve the spring tension on the wiper arm to wiper pivot shaft connection.

(2) Carefully pry the plastic nut cap off of the pivot end of the wiper arm (Fig. 10).



**Fig. 10 Front Wiper Arm Remove/Install**

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- 1 - FRONT WIPER BLADE & ARM (2)
- 2 - CAP (2)
- 3 - NUT (2)
- 4 - PIVOT SHAFT (2)
- 5 - T-SHAPED ALIGNMENT MARK (2)

(3) Remove the nut that secures the wiper arm to the wiper pivot shaft.

FRONT WIPER ARM (Continued)

(4) If necessary, use a suitable battery terminal puller to disengage the wiper arm from the wiper pivot shaft (Fig. 11).

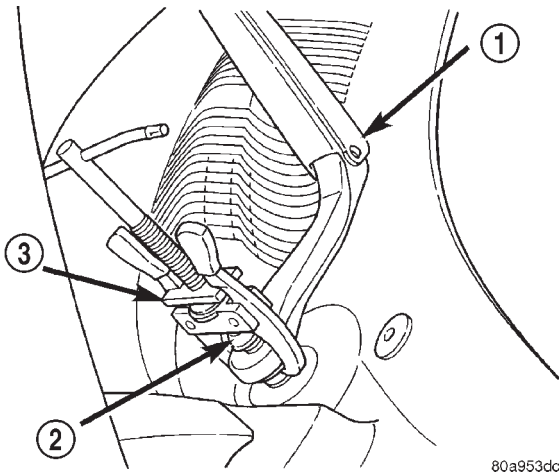


Fig. 11 Wiper Arm Puller - Typical

- 1 - WIPER ARM
- 2 - WIPER PIVOT SHAFT
- 3 - BATTERY TERMINAL PULLER

(5) Remove the front wiper arm pivot end from the wiper pivot shaft.

INSTALLATION

**NOTE:** Be certain that the wiper motor is in the park position before attempting to install the front wiper arms. Turn the ignition switch to the On position and move the control knob on the right (wiper) control stalk of the multi-function switch to its Off position. If the wiper pivots move, wait until they stop moving, then turn the ignition switch back to the Off position. The wiper motor is now in its park position.

(1) The front wiper arms must be indexed to the wiper pivot shafts with the wiper motor in the park position to be properly installed. Position the front wiper arm pivot ends onto the wiper pivot shafts so that the tip of the wiper blade is aligned with the T-shaped wiper alignment lines located in the lower edge of the windshield glass (Fig. 10).

(2) Once the wiper blade is aligned, lift the wiper arm away from the windshield slightly to relieve the spring tension on the pivot end and push the pivot hole on the end of the wiper arm down firmly and evenly over the wiper pivot shaft.

(3) Install and tighten the nut that secures the wiper arm to the wiper pivot shaft. Tighten the nut to 24 N-m (18 ft. lbs.).

(4) Wet the windshield glass, then operate the front wipers. Turn the front wipers Off, then check

for the correct wiper arm position and readjust as required.

(5) Reinstall the plastic nut cap onto the wiper arm pivot nut.

FRONT WIPER BLADE

DESCRIPTION

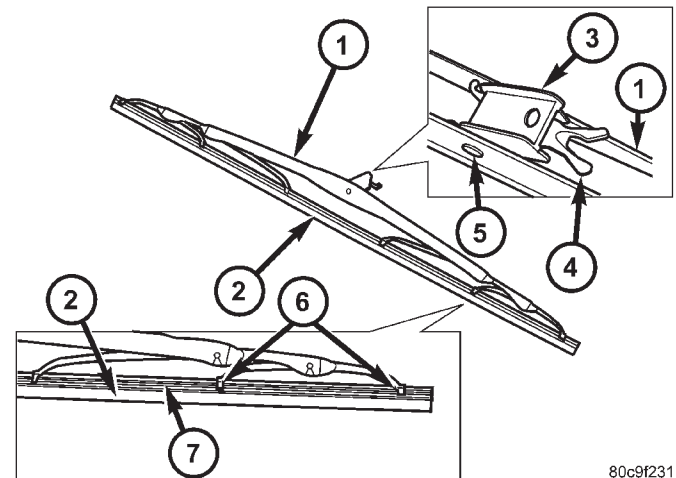


Fig. 12 Front Wiper Blade

- 1 - SUPERSTRUCTURE
- 2 - ELEMENT
- 3 - PIVOT BLOCK
- 4 - RELEASE TAB
- 5 - PIVOT PIN
- 6 - CLAWS
- 7 - FLEXOR

Each front wiper blade is secured by an integral latching pivot block to the hook formation on the tip of the front wiper arms, and rests on the glass near the base of the windshield when the wipers are not in operation (Fig. 12). The wiper blade consists of the following components:

- **Superstructure** - The superstructure includes several stamped steel bridges and links with claw formations that grip the wiper blade element. Also included in this unit is the latching, molded plastic pivot block that secures the superstructure to the wiper arm. The driver side front wiper blade has an additional molded black plastic airfoil secured to the superstructure, which is oriented toward the base of the windshield when the front wipers are in their parked position. All of the metal components of the wiper blade have a satin black finish applied.

- **Element** - The wiper element or squeegee is the resilient rubber member of the wiper blade that contacts the glass.

- **Flexor** - The flexor is a rigid metal component running along the length of each side of the wiper

## FRONT WIPER BLADE (Continued)

element where it is gripped by the claws of the superstructure.

All models have two 47.50 centimeter (18.70 inch) long front wiper blades with non-replaceable rubber elements (squeegees). The wiper blades cannot be adjusted or repaired. If faulty, worn, or damaged the entire wiper blade unit must be replaced.

## OPERATION

The wiper blades are moved back and forth across the glass by the wiper arms when the wipers are being operated. The wiper blade superstructure is the flexible frame that grips the wiper blade element and evenly distributes the force of the spring-loaded wiper arm along the length of the element. The combination of the wiper arm force and the flexibility of the superstructure makes the element conform to and maintain proper contact with the glass, even as the blade is moved over the varied curvature that may be encountered across the glass surface. The wiper element flexor provides the claws of the blade superstructure with a rigid, yet flexible component on the element which can be gripped. The rubber element is designed to be stiff enough to maintain an even cleaning edge as it is drawn across the glass, yet resilient enough to conform to the glass surface and flip from one cleaning edge to the other each time the wiper blade changes directions. The airfoil used on the driver side wiper blade is designed to reduce the lifting effect caused by air moving over the vehicle at higher highway speeds.

## REMOVAL

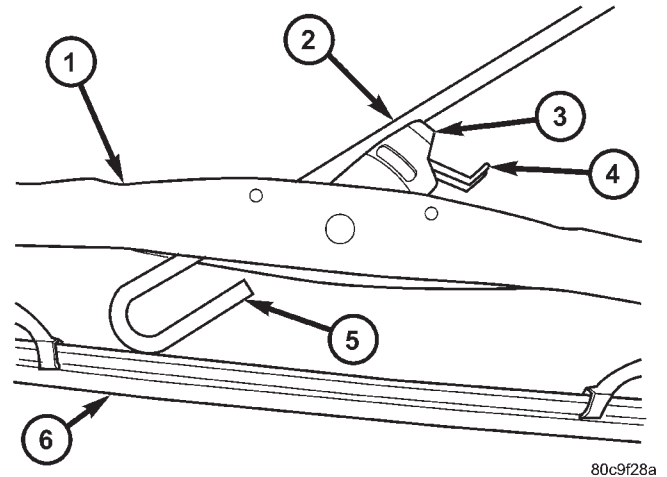
**NOTE:** The notched end of the wiper element flexor should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Lift the front wiper arm to raise the wiper blade and element off of the glass, until the wiper arm hinge is in its over-center position.

(2) To remove the wiper blade from the wiper arm, depress the pivot block latch release tab under the tip of the arm and slide the blade away from the tip towards the pivot end of the arm far enough to disengage the pivot block from the hook formation on the end of the arm (Fig. 13).

(3) Extract the hook formation on the tip of the wiper arm through the opening in the wiper blade superstructure just ahead of the wiper blade pivot block/latch unit.

**CAUTION:** Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.



**Fig. 13 Front Wiper Blade Remove/Install**

- 1 - SUPERSTRUCTURE
- 2 - WIPER ARM
- 3 - PIVOT BLOCK
- 4 - RELEASE TAB
- 5 - HOOK
- 6 - ELEMENT

(4) Gently lower the tip of the wiper arm onto the glass.

## INSTALLATION

**NOTE:** The notched end of the wiper element flexor should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Lift the front wiper arm off of the windshield glass, until the wiper arm hinge is in its over-center position.

(2) Position the front wiper blade near the hook formation on the tip of the arm with the notched end of the wiper element flexor oriented towards the end of the wiper arm that is nearest to the wiper pivot.

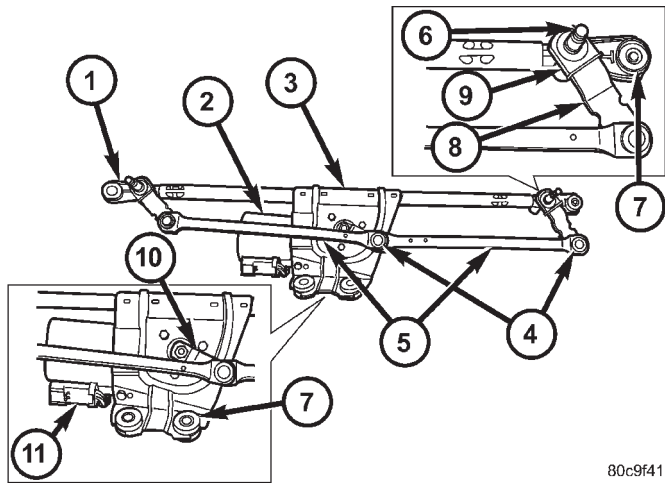
(3) Insert the hook formation on the tip of the wiper arm through the opening in the wiper blade superstructure ahead of the wiper blade pivot block/latch unit far enough to engage the pivot block into the hook (Fig. 13).

(4) Slide the wiper blade pivot block/latch up into the hook formation on the tip of the wiper arm until the latch release tab snaps into its locked position. Latch engagement will be accompanied by an audible click.

(5) Gently lower the wiper blade onto the glass.

# FRONT WIPER MODULE

## DESCRIPTION



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**Fig. 14 Front Wiper Module**

- 1 - PIVOT BRACKET (2)
- 2 - MOTOR COVER
- 3 - MOTOR BRACKET
- 4 - LINKAGE BUSHING (4)
- 5 - DRIVE LINK (2)
- 6 - PIVOT SHAFT (2)
- 7 - INSULATOR (4)
- 8 - PIVOT CRANK ARM (2)
- 9 - PIVOT COVER
- 10 - MOTOR CRANK ARM
- 11 - PIGTAIL WIRE CONNECTOR

The front wiper module bracket is secured with two nuts below the wiper motor through rubber insulators to two weld studs on the bottom of the cowl plenum panel beneath the cowl plenum cover/grille panel (Fig. 14). Two screws secure the top of the module bracket to the cowl plenum panel through rubber insulators located on the outboard end of each pivot bracket. The ends of the wiper pivot shafts that protrude through dedicated openings in the cowl plenum cover/grille panel to drive the wiper arms and blades are the only visible components of the front wiper module. The front wiper module consists of the following major components:

- **Bracket** - The front wiper module bracket consists of a long tubular steel main member that has a die cast pivot bracket formation near each end where the two wiper pivots are secured. A stamped steel mounting plate for the wiper motor is secured with welds near the center of the main member. A short stamped steel tab that extends laterally from one side of the mounting plate provides a mounting location for the wiper motor pigtail wire connector.

- **Crank Arm** - The front wiper motor crank arm is a stamped steel unit with a slotted hole on the

driven end that is secured to the wiper motor output shaft with a nut, and has a ball stud secured to the drive end.

- **Linkage** - Two stamped steel drive links connect the wiper motor crank arm to the wiper pivot lever arms. The right side drive link has a plastic socket-type bushing on each end. The left 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 lever arm of its respective pivot. The left side drive link sleeve-type bushing end is then fit over the motor crank arm ball stud, and the other socket-type bushing of the right side drive link is snap-fit over the exposed end of the wiper motor crank arm ball stud.

- **Motor** - The front wiper motor is secured with three screws to the motor mounting plate near the center of the wiper module bracket. 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. The two-speed permanent magnet wiper motor features an integral transmission, an internal park switch, and an internal automatic resetting circuit breaker. A molded plastic shield covers the top of the motor.

- **Pivots** - The two front wiper pivots are secured within the die cast pivot brackets on the outboard ends of the wiper module main member. The lever arms that extend from the center of the pivot shafts each have a ball stud on their end. The upper end of each pivot shaft where the wiper arms will be fastened each is tapered and serrated with a threaded stud formation at the tip. The lower ends of the pivot shafts are installed through lubricated bushings in the pivot brackets and are secured with snap rings. A molded plastic shield covers each pivot shaft where it enters the pivot bracket.

The front wiper module cannot be adjusted or repaired. If any component of the module is faulty or damaged, the entire front wiper module unit must be replaced.

## OPERATION

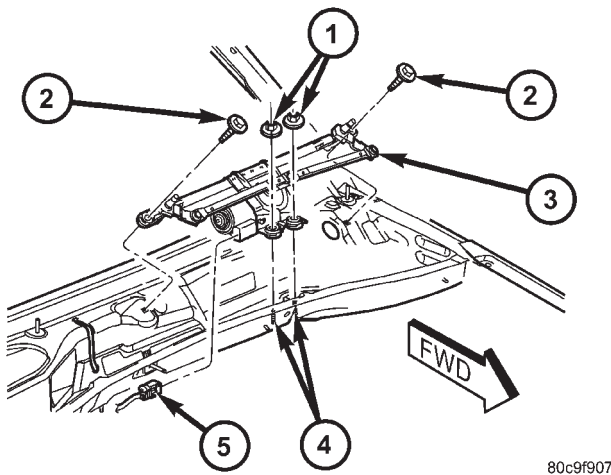
The front wiper module operation is controlled by the battery current inputs received by the wiper motor from the wiper on/off and wiper high/low relays. The wiper motor speed is controlled by current flow to either the low speed or the high speed set of brushes. The park switch is a single pole, single throw, momentary switch within the wiper motor that is mechanically actuated by the wiper motor transmission components. The park switch alternately closes the wiper park switch sense circuit to ground or to battery current, depending upon the position of the wipers on the glass. This feature

## FRONT WIPER MODULE (Continued)

allows the motor to complete its current wipe cycle after the wiper system has been turned Off, and to park the wiper blades in the lowest portion of the wipe pattern. The automatic resetting circuit breaker protects the motor from overloads. The wiper motor crank arm, the two wiper linkage members, and the two wiper pivots mechanically convert the rotary output of the wiper motor to the back and forth wiping motion of the wiper arms and blades on the glass.

**REMOVAL**

- (1) Unlatch and open the hood.
- (2) Disconnect and isolate the battery negative cable.
- (3) Remove both front wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - FRONT/FRONT WIPER ARM - REMOVAL).
- (4) Remove the cowl plenum cover/grille panel from over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).
- (5) Disconnect the headlamp and dash wire harness connector for the front wiper motor from the motor pigtail wire connector (Fig. 15).



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**Fig. 15 Front Wiper Module Remove/Install**

- 1 - NUT (2)
- 2 - SCREW (2)
- 3 - FRONT WIPER MODULE
- 4 - STUD (2)
- 5 - WIRE HARNESS CONNECTOR

(6) Remove the two screws that secure the front wiper module to the top of the cowl plenum panel at the pivot brackets.

(7) Remove the two nuts that secure the front wiper module to the two weld studs on the bottom of the cowl plenum panel.

(8) Lift the front wiper module up from the cowl plenum panel far enough to disengage the two lower insulators from the weld studs on the bottom of the plenum panel.

(9) Remove the front wiper module from the cowl plenum panel as a unit.

**INSTALLATION**

- (1) Position the front wiper module to the cowl plenum as a unit (Fig. 15).
- (2) Lower the front wiper module lower mounting insulators over the two weld studs on the bottom of the cowl plenum panel.
- (3) Install the two screws that secure the front wiper module to the top of the cowl plenum panel at the pivot brackets. Tighten the screw on the driver side, followed by the screw on the passenger side. Tighten the screws to 8 N·m (72 in. lbs.).
- (4) Install and tighten the two nuts that secure the front wiper module to the two weld studs on the bottom of the cowl plenum panel. Tighten the nuts to 8 N·m (72 in. lbs.).
- (5) Reconnect the headlamp and dash wire harness connector for the front wiper motor to the motor pigtail wire connector.
- (6) Reinstall the cowl plenum cover/grille panel over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).
- (7) Close and latch the hood.
- (8) Reinstall both front wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/FRONT WIPER ARM - INSTALLATION).
- (9) Reconnect the battery negative cable.

**FRONT WIPER/WASHER SWITCH****DESCRIPTION**

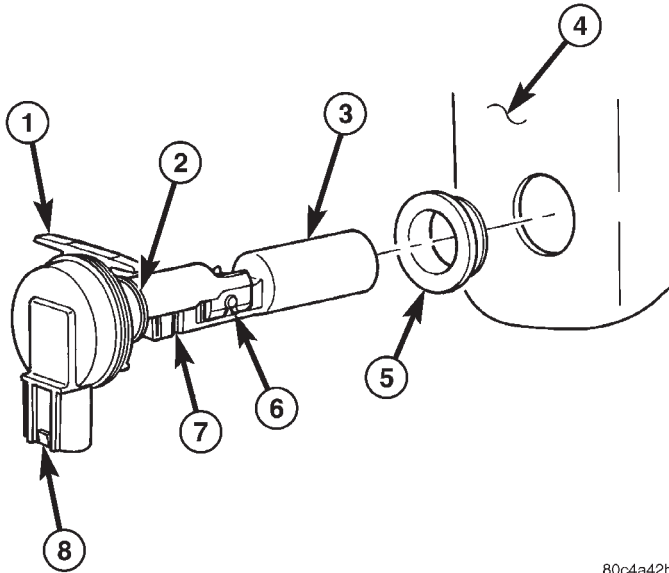
The front wiper and washer switches are integral to the right (wiper) control stalk of the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION).

**OPERATION**

The front wiper and washer switches are integral to the right (wiper) control stalk of the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - OPERATION).

## WASHER FLUID LEVEL SWITCH

### DESCRIPTION



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**Fig. 16 Washer Fluid Level Switch**

- 1 - MOUNTING FLANGE
- 2 - BARBED NIPPLE
- 3 - FLOAT
- 4 - RESERVOIR
- 5 - GROMMET SEAL
- 6 - PIVOT
- 7 - MAGNET
- 8 - CONNECTOR RECEPTACLE

The washer fluid level switch is a single pole, single throw reed-type switch mounted at the rear of the sump area near the bottom of the washer reservoir (Fig. 16). Only the molded plastic switch mounting flange and the integral connector receptacle are visible when the switch is installed in the reservoir. A short nipple formation extends from the inner surface of the switch mounting flange, and a barb on the nipple near the switch mounting flange is pressed through a rubber grommet seal installed in the mounting hole of the reservoir. A small, molded plastic float has two pivot pins near its center that are snapped into two receptacles near the ends of two stanchions that extend toward the float from the switch nipple formation. A small magnet is secured within the end of the float nearest the switch nipple formation, and a reed switch is concealed within the nipple. A diagnostic resistor is connected between the two switch terminals within the switch mounting flange. The washer fluid level switch cannot be adjusted or repaired. If faulty or damaged, the switch must be replaced.

### OPERATION

The washer fluid level switch uses a pivoting, oblong float to monitor the level of the washer fluid in the washer reservoir. The float contains a small magnet. When the float pivots, the proximity of this magnet to a stationary reed switch within the nipple formation of the switch changes. When the fluid level in the washer reservoir is at or above the float level, the float moves to a vertical position, the influence of the float magnetic field is removed from the reed switch, and the normally open reed switch contacts open. When the fluid level in the washer reservoir falls below the level of the pivoting float, the float moves to a horizontal position, the influence of the float magnetic field is applied to the reed switch, and the contacts of the normally open reed switch close.

The washer fluid level switch is connected to the vehicle electrical system through a dedicated take out and connector of the headlamp and dash wire harness. The switch is connected in series between ground and the washer fluid switch sense input to the ElectroMechanical Instrument Cluster (EMIC). The switch receives a path to ground at all times through another take out of the headlamp and dash wire harness with a single eyelet terminal connector that is secured under a ground screw near the front of the left front fender inner shield in the engine compartment. When the switch closes, the EMIC senses the ground on the washer fluid switch sense circuit. The EMIC is programmed to respond to this input by illuminating the washer fluid indicator and by sounding an audible chime tone warning.

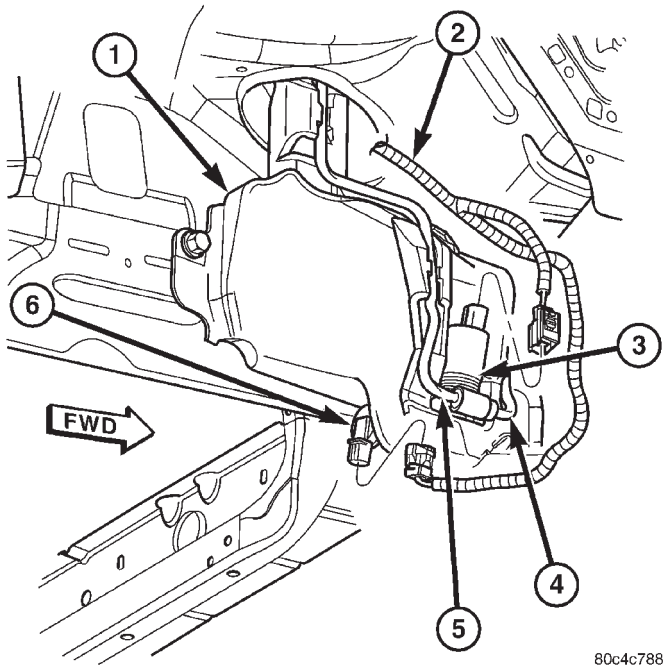
The washer fluid level switch input to the EMIC can be diagnosed using conventional diagnostic tools and methods. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/WASHER FLUID INDICATOR - DIAGNOSIS AND TESTING).

### REMOVAL

The washer fluid level switch can be removed from the washer reservoir without removing the reservoir from the vehicle.

- (1) Disconnect and isolate the battery negative cable.
- (2) Raise and support the vehicle.
- (3) Remove the splash shield from the right front fender wheel house. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - REMOVAL).
- (4) Disconnect the front or rear washer hose from one of the barbed outlet nipples of the washer pump/motor unit and allow the washer fluid to drain into a clean container for reuse.
- (5) Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the switch connector receptacle (Fig. 17).

## WASHER FLUID LEVEL SWITCH (Continued)



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**Fig. 17 Washer Fluid Level Switch Remove/Install**

- 1 - WASHER RESERVOIR
- 2 - WIRE HARNESS
- 3 - WASHER PUMP/MOTOR
- 4 - FRONT WASHER HOSE
- 5 - REAR WASHER HOSE
- 6 - WASHER FLUID LEVEL SWITCH

**NOTE:** The pivoting float of the washer fluid level switch must be in a horizontal position within the reservoir in order to be removed. With the reservoir empty and in an upright position, the pivoting float will orient itself to the horizontal position when the switch connector receptacle is pointed straight downwards.

(6) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed nipple of the washer fluid level switch out of the rubber grommet seal on the back of the reservoir sump. Care must be taken not to damage the reservoir.

(7) Remove the washer fluid level switch from the washer reservoir.

(8) Remove the rubber grommet seal from the washer fluid level switch mounting hole in the washer reservoir and discard.

## INSTALLATION

(1) Install a new rubber grommet seal into the washer fluid level switch mounting hole in the washer reservoir. Always use a new rubber grommet seal on the reservoir.

(2) Insert the float of the washer fluid level switch through the rubber grommet seal and into the

washer reservoir. The connector receptacle of the washer fluid level switch should be pointed downward.

(3) Using hand pressure, press firmly and evenly on the washer fluid level switch mounting flange until the barbed nipple is fully seated in the rubber grommet seal in the washer reservoir mounting hole.

(4) Reconnect the headlamp and dash wire harness connector for the washer fluid level switch to the switch connector receptacle (Fig. 17).

(5) Reconnect the removed washer hose to the barbed outlet nipple of the washer pump/motor unit.

(6) Reinstall the splash shield into the right front fender wheel house. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - INSTALLATION).

(7) Lower the vehicle.

(8) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(9) Reconnect the battery negative cable.

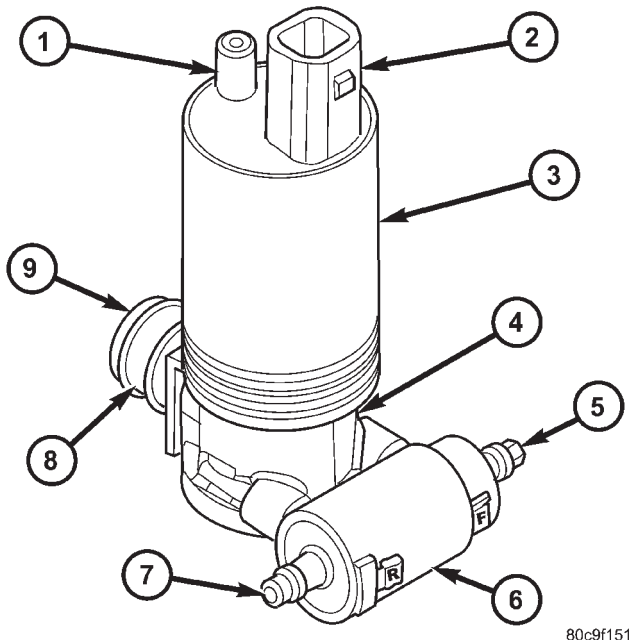
## WASHER PUMP/MOTOR

### DESCRIPTION

The washer pump/motor unit (Fig. 18) is located on the outboard side of the washer reservoir, on the outboard side of the right front frame rail behind the right front wheel house splash shield. A small permanently lubricated and sealed reversible electric motor is coupled to the rotor-type washer pump. The use of an integral shuttle valve allows the washer pump/motor unit to provide washer fluid to either the front or the rear washer systems, depending upon the direction of the motor/pump impeller rotation. A seal flange with a barbed inlet nipple on the pump housing passes through a rubber grommet seal installed in a dedicated mounting hole of the washer reservoir. When the pump is installed in the reservoir the front barbed outlet nipple on the pump shuttle valve housing connects the unit to the front washer hose and the rear barbed outlet nipple connects the unit to the rear washer hose. The letters "F" and "R" molded into the shuttle valve housing adjacent to each nipple provide further clarification of the nipple assignments.

The washer pump/motor unit is retained on the reservoir by the interference fit between the barbed pump inlet nipple and the grommet seal, which is a light press fit. The top of the washer pump is also secured to the washer reservoir by the use of a snap post on the motor and a snap post receptacle molded into the reservoir that allows for mounting of the washer pump without the use of fasteners. An integral connector receptacle on the top of the motor

WASHER PUMP/MOTOR (Continued)



**Fig. 18 Washer Pump/Motor**

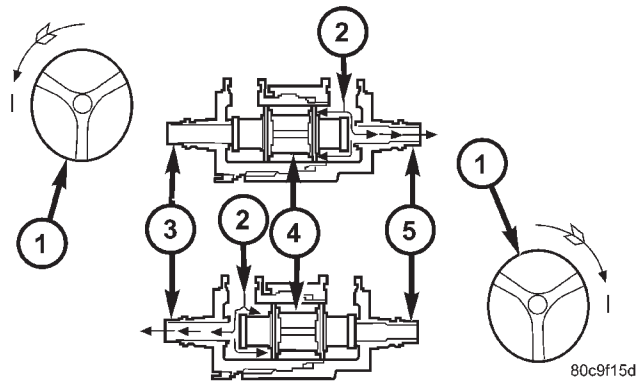
- 1 - SNAP POST
- 2 - CONNECTOR RECEPTACLE
- 3 - MOTOR
- 4 - PUMP
- 5 - FRONT WASHER OUTLET NIPPLE
- 6 - SHUTTLE VALVE
- 7 - REAR WASHER OUTLET NIPPLE
- 8 - INLET NIPPLE
- 9 - FILTER SCREEN

housing connects the unit to the vehicle electrical system through a dedicated take out and connector of the headlamp and dash wire harness. The washer pump/motor unit cannot be repaired. If faulty or damaged, the entire washer pump/motor unit must be replaced.

**OPERATION**

The washer pump/motor unit features a reversible electric motor. The direction of the motor is controlled by hard wired outputs from the momentary front and rear washer switch circuitry contained within the right (wiper) control stalk of the multi-function switch. When battery current and ground are applied to the two pump motor terminals, the motor rotates in one direction. When the polarity of these connections is reversed, the motor rotates in the opposite direction. When the pump motor is energized, the rotor-type pump pressurizes the washer fluid and forces it through one of the two pump outlet nipples, and into the front or rear washer plumbing.

Washer fluid is gravity-fed from the washer reservoir to the inlet port of the washer pump housing. An integral shuttle valve is located in a housing on the outlet port side of the pump housing (Fig. 19). This shuttle valve controls which washer system plumbing receives the washer fluid being pressurized by the pump. When the pump impeller rotates in the counterclockwise direction (viewed from the bottom), pressurized washer fluid is pushed out the front washer system port and biases the shuttle valve to the left, sealing off the rear washer system outlet nipple. When the pump impeller rotates in the clockwise direction (viewed from the bottom), pressurized washer fluid is pushed out the rear washer system port and biases the shuttle valve to the right, sealing off the front washer system outlet nipple.



**Fig. 19 Washer Pump Fluid Flow**

- 1 - IMPELLER ROTATION (VIEWED FROM BOTTOM)
- 2 - IMPELLER OUTPUT
- 3 - REAR WASHER OUTLET NIPPLE
- 4 - SHUTTLE VALVE
- 5 - FRONT WASHER OUTLET NIPPLE

The washer pump/motor unit can be diagnosed using conventional diagnostic tools and methods.

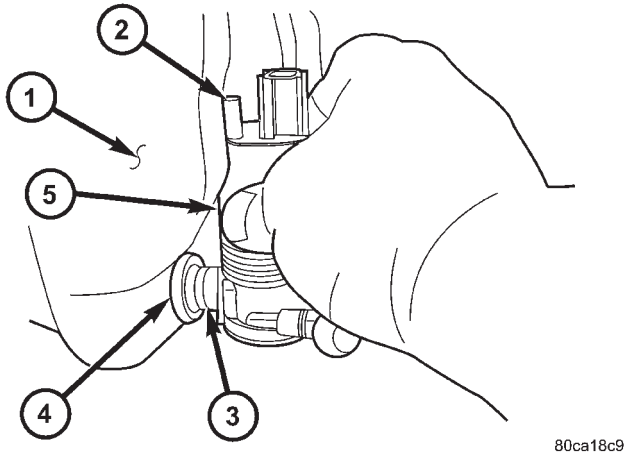
**REMOVAL**

- (1) Turn the front wheels full lock to the right.
- (2) Disconnect and isolate the battery negative cable.
- (3) Raise and support the vehicle.
- (4) Unsnap and lift the cover over the access hole at the front of the right front wheel house splash shield.
- (5) Place a clean container on the floor beneath the washer pump/motor location to catch any washer fluid that is spilled during the following procedure.
- (6) Reach through the access hole and firmly grasp the top of the washer pump/motor housing.



## WASHER PUMP/MOTOR (Continued)

(7) Pull lightly outward on the top of the washer pump/motor housing away from the washer reservoir far enough to disengage the snap post on the top of the motor from the receptacle in the reservoir (Fig. 20).



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**Fig. 20 Washer Pump/Motor Remove/Install**

- 1 - WASHER RESERVOIR
- 2 - SNAP POST
- 3 - INLET NIPPLE
- 4 - GROMMET SEAL
- 5 - WASHER PUMP/MOTOR

(8) Pull the washer pump/motor unit straight out from the washer reservoir far enough to disengage the barbed pump inlet nipple from the rubber grommet seal in the reservoir.

(9) Disconnect the headlamp and dash wire harness connector from the washer pump/motor unit connector receptacle on the top of the motor housing (Fig. 21).

(10) Disconnect the two washer hoses from the two washer pump/motor unit outlet nipples.

(11) Remove washer pump/motor unit through the access hole at the front of the right front fender wheel house splash shield.

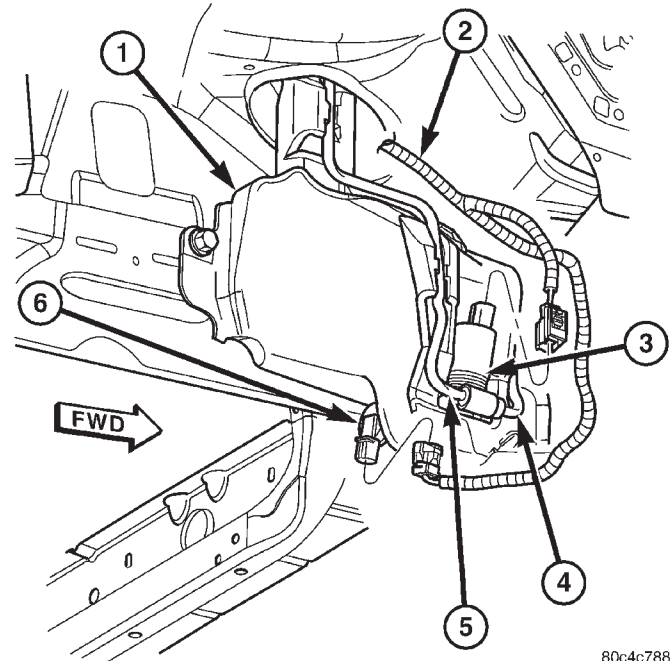
(12) Remove the rubber grommet seal from the washer reservoir and discard.

## INSTALLATION

(1) Install a new rubber grommet seal into the washer pump mounting hole in the washer reservoir. Always use a new rubber grommet seal on the reservoir.

(2) Position the barbed inlet nipple of the washer pump to the rubber grommet seal in the washer reservoir (Fig. 20).

(3) Using hand pressure, press on the washer pump/motor unit firmly and evenly until the barbed inlet nipple is fully seated in the rubber grommet seal in the washer reservoir mounting hole.



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**Fig. 21 Washer Pump/Motor Connections**

- 1 - WASHER RESERVOIR
- 2 - WIRE HARNESS
- 3 - WASHER PUMP/MOTOR
- 4 - FRONT WASHER HOSE
- 5 - REAR WASHER HOSE
- 6 - WASHER FLUID LEVEL SWITCH

(4) Align the washer pump/motor snap post on the top of the motor housing with the snap post receptacle in the washer reservoir.

(5) Using hand pressure, press firmly and evenly on the top of washer pump/motor unit until the snap post snaps into the washer reservoir receptacle.

(6) Reconnect the headlamp and dash wire harness connector for the washer pump/motor unit to the connector receptacle on the top of the motor housing (Fig. 21).

(7) Reconnect the front and rear washer hoses to the two barbed pump outlet nipples. Be certain that the hose in the trough of the reservoir behind the pump is connected to the rear nipple, and the hose in the trough in front of the pump is connected to the front nipple.

(8) Lower and snap shut the cover over the access hole at the front of the right front wheel house splash shield.

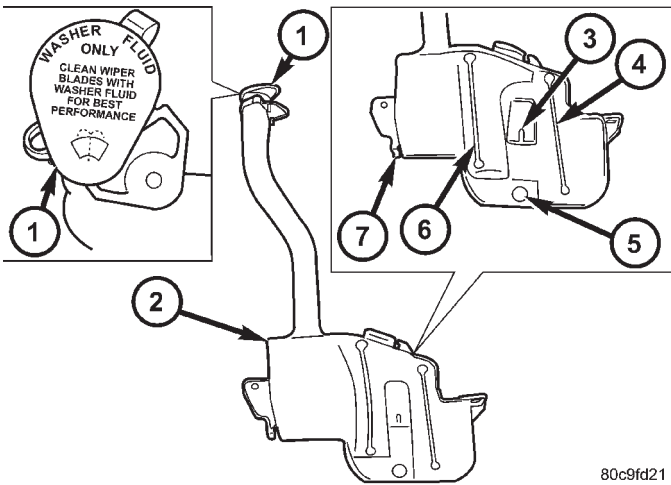
(9) Lower vehicle.

(10) Reconnect the battery negative cable.

(11) Refill the washer reservoir with clean washer fluid.

# WASHER RESERVOIR

## DESCRIPTION



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**Fig. 22 Washer Reservoir**

- 1 - CAP
- 2 - RESERVOIR
- 3- SNAP POST RECEPTACLE
- 4 - FRONT HOSE TROUGH
- 5 - WASHER PUMP HOLE
- 6 - REAR HOSE TROUGH
- 7 - HOOK

A single washer fluid reservoir is used for both the front and rear washer systems (Fig. 22). The molded plastic washer fluid reservoir is mounted on the outboard side of the right front frame rail in front of the right front wheel, where it is concealed by the right front wheel house splash shield. The only visible component of the washer reservoir is the filler neck and cap unit, which extends through a hole in the right front wheel house extension panel into the engine compartment. A bright yellow plastic filler cap with an integral bail strap and filler neck mounting bracket is labeled with an International Control and Display Symbol icon for "Windshield Washer" and the text "Washer Fluid Only" molded into it. The cap snaps over the open end of the filler neck.

There is a dedicated hole on the outboard side of the reservoir provided for the mounting of the washer pump/motor unit, and another dedicated hole on the rear of the reservoir for the washer fluid level switch. A snap post receptacle molded into the reservoir allows for mounting of the washer pump without the use of fasteners. The reservoir also features integral hose routing troughs on its outboard side and integral routing clips along its top. The washer reservoir is secured to the outboard side of the right front frame rail by two screws and an integral molded tab that engages in a slot in the right front frame rail. Another screw secures the reservoir filler

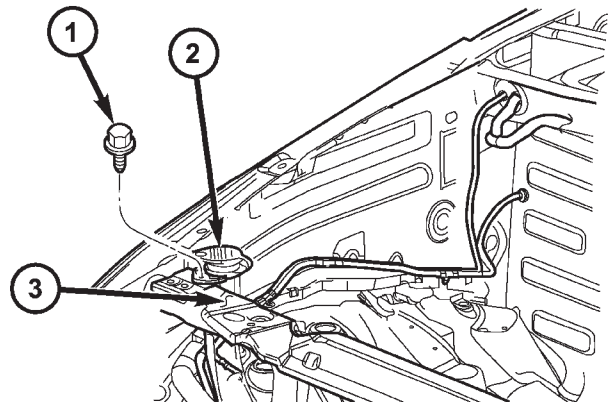
neck to the upper radiator crossmember in the front of the engine compartment. The right front fender wheel house splash shield must be removed to access the washer reservoir for service.

## OPERATION

The washer fluid reservoir provides a secure, on-vehicle storage location for a large reserve of washer fluid for operation of the front and rear washer systems. The washer reservoir filler neck provides a clearly marked and readily accessible point from which to add washer fluid to the reservoir. The washer/pump motor unit is located in a sump area near the front of the reservoir to be certain that washer fluid will be available to the pump as the fluid level in the reservoir becomes depleted. The washer pump/motor unit is mounted in the lowest position in the sump. The washer fluid level switch is mounted just above the sump area of the reservoir so that there will be adequate warning to the vehicle operator that the washer fluid level is low, before the washer system will no longer operate.

## REMOVAL

- (1) Turn the front wheels full lock to the right.
- (2) Unlatch and open the hood.
- (3) Disconnect and isolate the battery negative cable.
- (4) Remove the air cleaner housing from the top of the right front fender wheel house. (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
- (5) Remove the screw that secures the washer reservoir filler neck support to upper radiator crossmember (Fig. 23).



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**Fig. 23 Washer Reservoir Cap Remove/Install**

- 1 - SCREW (1)
- 2 - CAP
- 3 - UPPER RADIATOR CROSSMEMBER

## WASHER RESERVOIR (Continued)

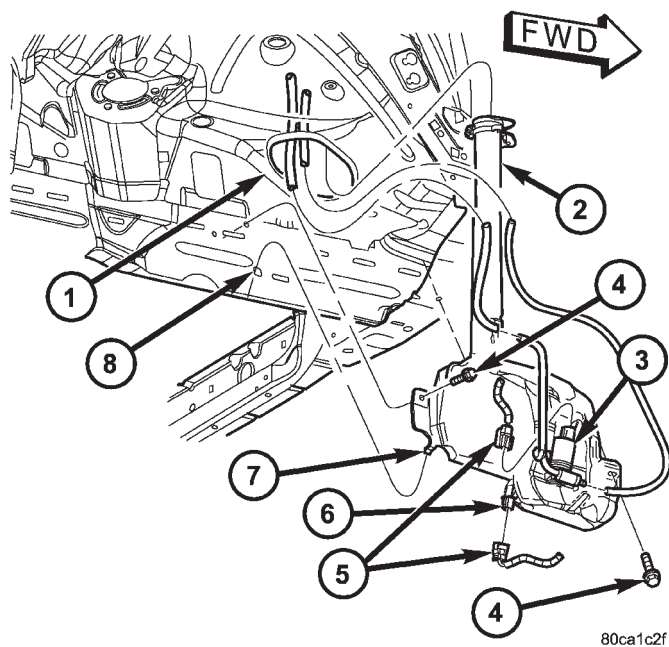
(6) Raise and support the vehicle.

(7) Remove the splash shield from the right front fender wheel house. (Refer to 23 - BODY/EXTERIOR/WHEELHOUSE SPLASH SHIELD - REMOVAL).

(8) Release the "W" clip that secures the front bumper fascia to the front bumper support. This clip is located behind the bumper support and below the right front lamp unit.

(9) Place a clean container on the floor beneath the washer pump/motor location to catch any washer fluid that is spilled during the following procedure.

(10) Disconnect the front and rear washer hoses from the washer pump/motor unit outlet nipples and allow the washer fluid to drain into the container for reuse (Fig. 24).



**Fig. 24 Washer Reservoir Remove/Install**

- 1 - FRONT WHEEL HOUSE INNER PANEL
- 2 - WASHER RESERVOIR
- 3 - WASHER PUMP/MOTOR
- 4 - SCREW (2)
- 5 - WIRE HARNESS CONNECTOR (2)
- 6 - WASHER FLUID LEVEL SWITCH
- 7 - MOUNTING TAB
- 8 - SLOT

(11) Disconnect the headlamp and dash wire harness connector for the washer pump/motor unit from the connector receptacle on the top of the motor housing.

(12) Disconnect the headlamp and dash wire harness connector for the washer fluid level switch from the connector receptacle on the bottom of the switch.

(13) Disengage the front and rear washer hoses from the integral washer reservoir troughs and routing clips.

(14) Using a long extension with a swivel socket and pulling forward on the front bumper fascia, remove the screw that secures the washer reservoir to the right front frame rail.

(15) Remove the screw that secures the rear of the washer reservoir to the right front frame rail.

(16) Disengage the mounting tab at the back of the washer reservoir from the slot in the right front frame rail.

(17) Lower the washer reservoir far enough for the filler neck to be removed from the clearance hole in the right front fender wheel house panel extension.

(18) Remove the washer reservoir from the right front fender wheel house.

## INSTALLATION

(1) Position the washer reservoir into the right front fender wheel house.

(2) Insert the washer reservoir filler neck through the clearance hole in the right front fender wheel house panel extension (Fig. 24).

(3) Raise the washer reservoir far enough to engage the mounting tab at the back of the reservoir into the slot in the right front frame rail.

(4) Install and tighten the screw that secures the rear of the washer reservoir to the right front frame rail. Tighten the screw to 7 N·m (65 in. lbs.).

(5) Using a long extension with a swivel socket and pulling forward on the front bumper fascia, install and tighten the screw that secures the washer reservoir to the right front frame rail. Tighten the screw to 7 N·m (65 in. lbs.).

(6) Engage the front and rear washer hoses into the integral washer reservoir troughs and routing clips. Be certain that the rear washer hose is routed rearward of the washer pump/motor unit, and the front washer hose is routed forward of the washer pump/motor unit. The rear washer hose can be identified by an in-line hose connector that joins the reservoir hose to the engine compartment hose located near the top of main body of the reservoir.

(7) Reconnect the headlamp and dash wire harness connector for the washer fluid level switch to the connector receptacle on the bottom of the switch.

(8) Reconnect the headlamp and dash wire harness connector for the washer pump/motor unit to the connector receptacle on the top of the motor housing.

(9) Reconnect the front and rear washer hoses to the washer pump/motor unit outlet nipples. Be certain that the rear washer hose in the trough rearward of the washer pump/motor unit is connected to the rear nipple, and the hose in the trough forward

WASHER RESERVOIR (Continued)

of the washer pump/motor unit is connected to the front nipple.

(10) Engage the “W” clip that secures the front bumper fascia to the front bumper support. This clip is located behind the bumper support and below the right front lamp unit.

(11) Reinstall the splash shield into the right front fender wheel house. (Refer to 23 - BODY/EXTERIOR/WHEELHOUSE SPLASH SHIELD - INSTALLATION).

(12) Lower the vehicle.

(13) Install and tighten the screw that secures the washer reservoir filler neck support to upper radiator crossmember (Fig. 23). Tighten the screw to 7 N·m (65 in. lbs.).

(14) Reinstall the air cleaner housing onto the top of the right front fender wheel house. (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - INSTALLATION).

(15) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(16) Reconnect the battery negative cable.

ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The wiper high/low relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

**OPERATION**

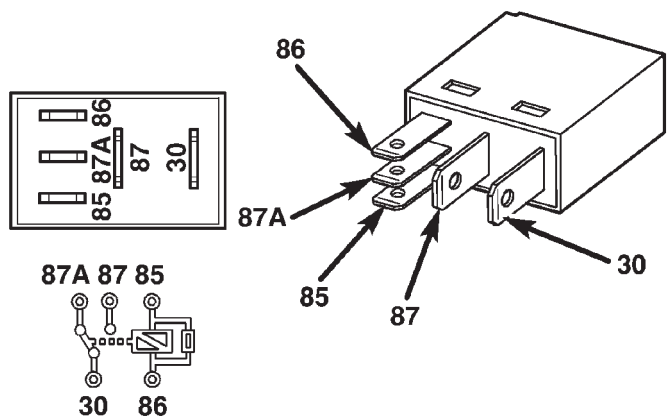
The wiper high/low relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current output to the front wiper motor. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The wiper high/low relay terminals are connected to the vehicle electrical system through a connector receptacle in the Power Distribution Center (PDC). The inputs and outputs of the wiper high/low relay include:

- **Common Feed Terminal** - The common feed terminal (30) is connected to the output of the wiper on/off relay at all times through the wiper on/off relay output circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Body Control Module (BCM) through a front wiper high/low relay control circuit. The BCM controls front wiper motor operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a circuit breaker in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit.
- **Normally Open Terminal** - The normally open terminal (87) is connected to the high speed brush of the front wiper motor through a front wiper high/low relay high speed output circuit, and is connected to the high speed brush whenever the relay is energized.

WIPER HIGH/LOW RELAY

DESCRIPTION



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**Fig. 25 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The wiper high/low relay is located in the Power Distribution Center (PDC) in the engine compartment near the battery. The wiper high/low relay is a conventional International Standards Organization (ISO) micro relay (Fig. 25). Relays conforming to the

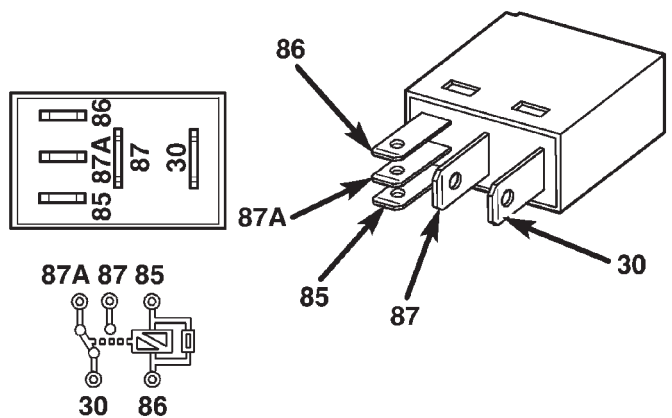
## WIPER HIGH/LOW RELAY (Continued)

• **Normally Closed Terminal** - The normally closed terminal (87A) is connected to the low speed brush of the front wiper motor through a front wiper high/low relay low speed output circuit, and is connected to the low speed brush whenever the relay is de-energized.

The wiper high/low relay can be diagnosed using conventional diagnostic tools and methods.

## DIAGNOSIS AND TESTING - WIPER HIGH/LOW RELAY

The wiper high/low relay (Fig. 26) is located in the Power Distribution Center (PDC) in the engine compartment near the battery. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.



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Fig. 26 ISO Micro Relay

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the wiper high/low relay from the PDC. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER HIGH/LOW RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

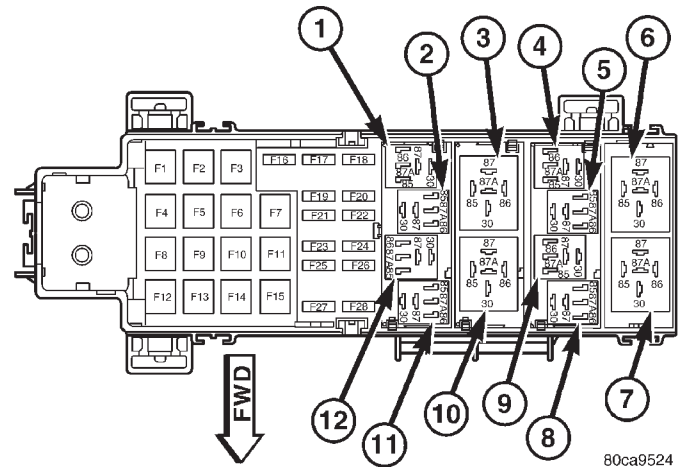
(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals

30 and 87, and no continuity between terminals 87A and 30. If OK, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

## REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 27).



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Fig. 27 Power Distribution Center

- 1 - FUEL PUMP RELAY
- 2 - STARTER MOTOR RELAY
- 3 - BLOWER MOTOR RELAY
- 4 - A/C COMPRESSOR CLUTCH RELAY
- 5 - OXYGEN SENSOR DOWNSTREAM RELAY
- 6 - AUTO SHUT DOWN RELAY
- 7 - SPARE
- 8 - SPARE
- 9a - (M/T) CLUTCH INTERLOCK RELAY
- 9b - (A/T) TRANSMISSION CONTROL RELAY
- 10 - SPARE
- 11 - WIPER HIGH/LOW RELAY
- 12 - WIPER ON/OFF RELAY

(3) Remove the wiper high/low relay by grasping it firmly and pulling it straight out from the receptacle in the PDC.

## INSTALLATION

(1) Position the wiper high/low relay to the proper receptacle in the Power Distribution Center (PDC) (Fig. 27).

(2) Align the wiper high/low relay terminals with the terminal cavities in the PDC receptacle.

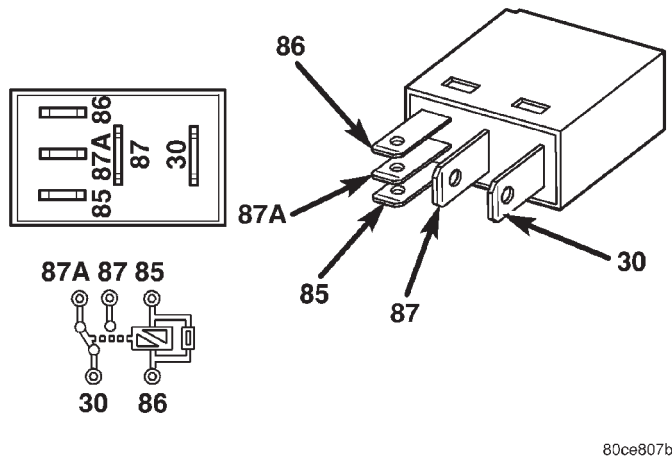
(3) Push firmly and evenly on the top of the wiper high/low relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(4) Reinstall the cover onto the PDC.

(5) Reconnect the battery negative cable.

# WIPER ON/OFF RELAY

## DESCRIPTION



**Fig. 28 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

The wiper on/off relay is located in the Power Distribution Center (PDC) in the engine compartment near the battery. The wiper on/off relay is a conventional International Standards Organization (ISO) micro relay (Fig. 28). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The wiper on/off relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

## OPERATION

The wiper on/off relay is an electromechanical switch that uses a low current input from the Body Control Module (BCM) to control a high current out-

put to the front wiper motor. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The wiper on/off relay terminals are connected to the vehicle electrical system through a connector receptacle in the Power Distribution Center (PDC). The inputs and outputs of the wiper on/off relay include:

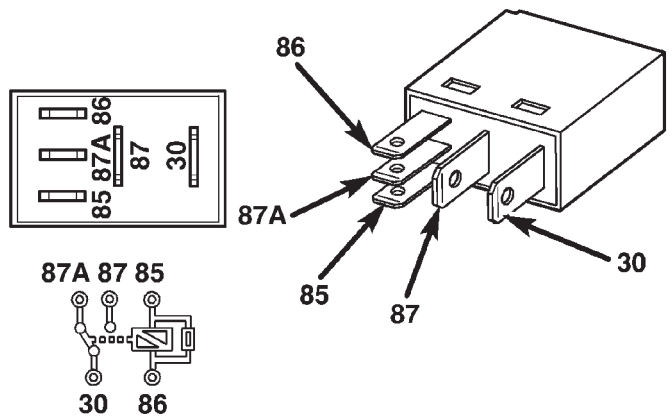
- **Common Feed Terminal** - The common feed terminal (30) is connected to the common feed terminal of the wiper high/low relay at all times through the wiper on/off relay output circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Body Control Module (BCM) through a front wiper on/off relay control circuit. The BCM controls front wiper motor operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a circuit breaker in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit.
- **Normally Open Terminal** - The normally open terminal (87) receives battery current at all times from a circuit breaker in the Junction Block (JB) through a fused ignition switch output (run-acc) circuit, and provides battery current to the front wiper on/off relay output circuit whenever the relay is energized.
- **Normally Closed Terminal** - The normally closed terminal (87A) is connected to the wiper park switch in the front wiper motor through the front wiper park switch sense circuit, and is connected to the wiper park switch whenever the relay is de-energized.

The wiper on/off relay can be diagnosed using conventional diagnostic tools and methods.

## WIPER ON/OFF RELAY (Continued)

**DIAGNOSIS AND TESTING - WIPER ON/OFF RELAY**

The wiper on/off relay (Fig. 29) is located in the Power Distribution Center (PDC) in the engine compartment near the battery. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**Fig. 29 ISO Micro Relay**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

(1) Remove the wiper on/off relay from the PDC. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ON/OFF RELAY - REMOVAL).

(2) 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 3. If not OK, replace the faulty relay.

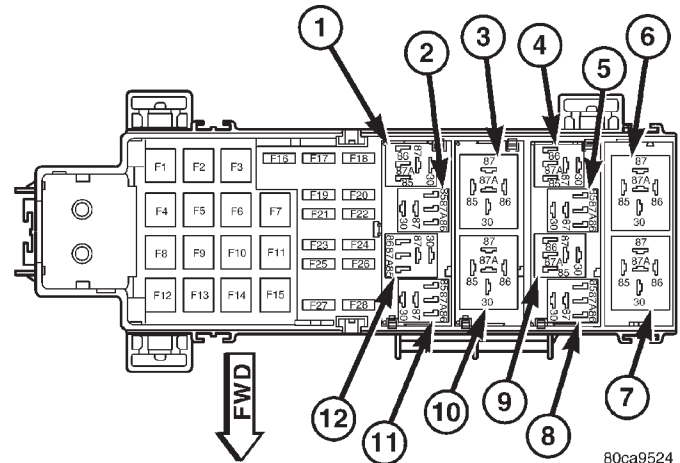
(3) Resistance between terminals 85 and 86 (electromagnet) should be  $75 \pm 8$  ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) 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, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC) (Fig. 30).

**Fig. 30 Power Distribution Center**

- 1 - FUEL PUMP RELAY
- 2 - STARTER MOTOR RELAY
- 3 - BLOWER MOTOR RELAY
- 4 - A/C COMPRESSOR CLUTCH RELAY
- 5 - OXYGEN SENSOR DOWNSTREAM RELAY
- 6 - AUTO SHUT DOWN RELAY
- 7 - SPARE
- 8 - SPARE
- 9a - (M/T) CLUTCH INTERLOCK RELAY
- 9b - (A/T) TRANSMISSION CONTROL RELAY
- 10 - SPARE
- 11 - WIPER HIGH/LOW RELAY
- 12 - WIPER ON/OFF RELAY

(3) Remove the wiper on/off relay by grasping it firmly and pulling it straight out from the receptacle in the PDC.

**INSTALLATION**

(1) Position the wiper on/off relay to the proper receptacle in the Power Distribution Center (PDC) (Fig. 30).

(2) Align the wiper on/off relay terminals with the terminal cavities in the PDC receptacle.

(3) Push firmly and evenly on the top of the wiper on/off relay until the terminals are fully seated in the terminal cavities in the PDC receptacle.

(4) Reinstall the cover onto the PDC.

(5) Reconnect the battery negative cable.

# REAR WIPERS/WASHERS

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## REAR WIPERS/WASHERS

### DESCRIPTION

An electrically operated fixed interval intermittent rear wiper and washer system is standard factory-installed equipment on this model (Fig. 1). The rear wiper and washer system includes the following major components, which are described in further detail elsewhere in this service information:

- **Multi-Function Switch** - The multi-function switch is located on the top of the steering column, just below the steering wheel. The multi-function switch includes a left (lighting) control stalk and a right (wiper) control stalk. The right control stalk is dedicated to providing all of the driver controls for both the front and rear wiper systems. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION).

- **Rear Check Valve** - The rear washer system check valve is located in the washer plumbing between the rear roof header and the roof outer panel near the rear washer nozzle.

- **Rear Washer Nozzle** - The rear washer nozzle is secured by a snap fit into a mounting hole in the roof outer panel above the rear flip-up glass opening.

- **Rear Washer Plumbing** - The plumbing for the rear washer system consists of rubber hoses and molded plastic fittings. The plumbing is routed along the right side of the engine compartment from the washer reservoir, through the dash into the passenger compartment, up the right cowl side and A-pillar to the headliner, and above the headliner to the rear washer nozzle fitting within the rear roof header.

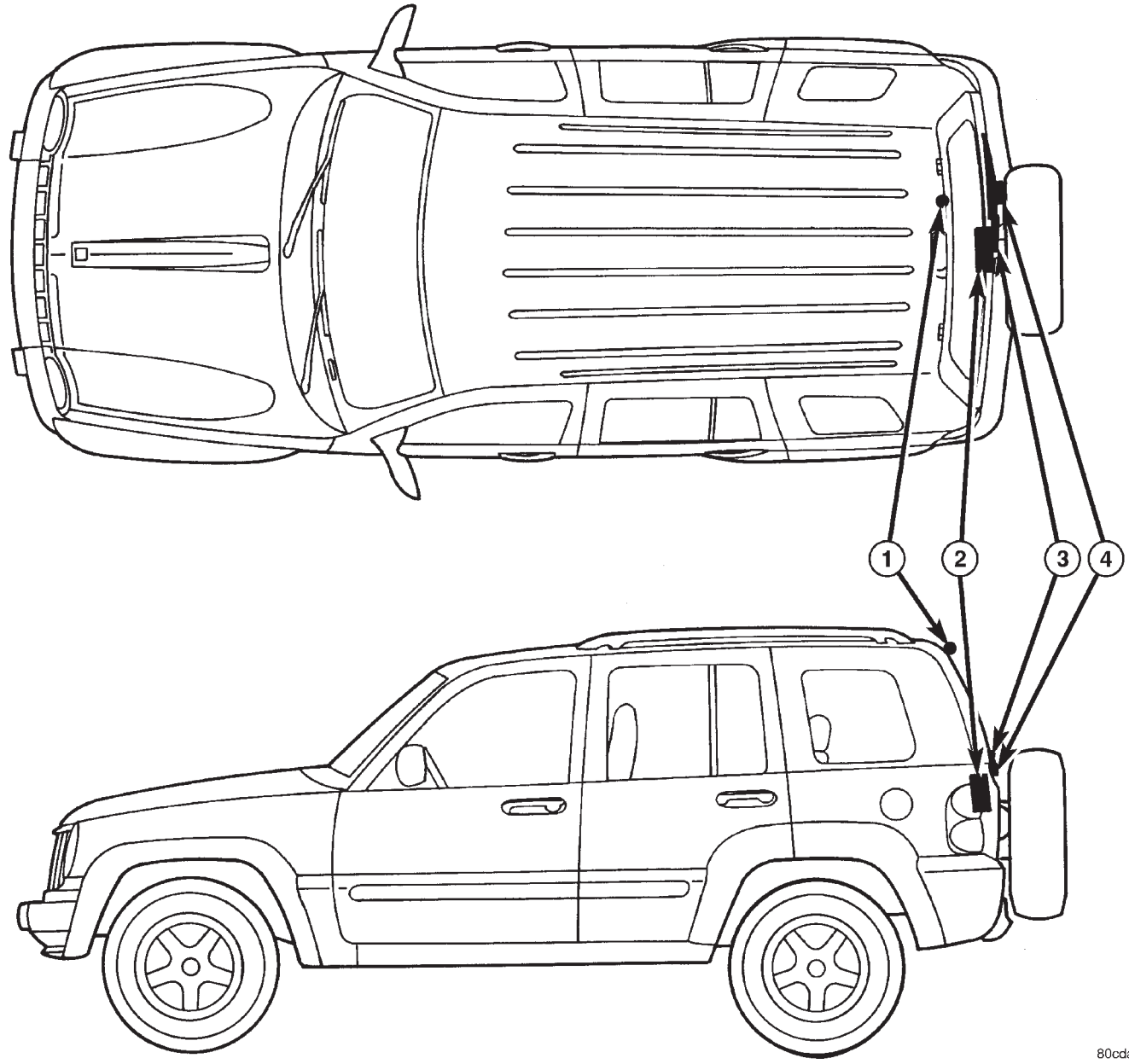
- **Rear Wiper Arm** - The single rear wiper arm is secured by a nut directly to the rear wiper motor output shaft, which extends through the center of the tailgate outer panel near the base of the rear flip-up glass.

- **Rear Wiper Arm Park Ramp** - The molded rubber rear wiper arm park ramp is secured with a screw to the tailgate outer panel to the right of the rear wiper motor output shaft bezel. When the rear wiper system is not in operation, the rear wiper arm is parked off of the rear flip-up glass on this ramp so that it will not interfere with or be damaged by the flip-up glass operation.

- **Rear Wiper Blade** - The single rear wiper blade is secured to the rear wiper arm with an integral latch, and is parked off of the rear flip-up glass when the rear wiper system is not in operation.



REAR WIPERS/WASHERS (Continued)



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**Fig. 1 Rear Wiper & Washer System**

- 1 - WASHER NOZZLE
- 2 - WIPER MODULE

- 3 - WIPER ARM & BLADE
- 4 - PARK RAMP

## REAR WIPERS/WASHERS (Continued)

- **Rear Wiper Module** - The rear wiper motor output shaft is the only visible component of the rear wiper module. The remainder of the module is concealed within the tailgate below the rear flip-up glass opening. The rear wiper module includes the module bracket, the rear wiper motor, and the rear wiper electronic control circuitry.

- **Washer Pump/Motor** - The reversible electric washer pump/motor unit is located in a dedicated hole on the lower outboard side of the washer reservoir, behind the right front wheel house splash shield. This single reversible washer pump/motor provides washer fluid to either the front or rear washer system plumbing, depending upon the direction of the pump motor rotation. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/WASHER PUMP MOTOR - DESCRIPTION).

- **Washer Reservoir** - The washer reservoir is concealed behind the right front wheel house splash shield ahead of the right front wheel. The washer reservoir filler neck is the only visible portion of the reservoir, and it is accessed from the right front corner of the engine compartment. This single washer reservoir is shared by both the front and rear washer systems. (Refer to 8 - ELECTRICAL/FRONT WIPERS/WASHERS/WASHER RESERVOIR - DESCRIPTION).

Hard wired circuitry connects the rear wiper and washer system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the rear wiper and washer system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

**OPERATING MODES** The components of the rear wiper and washer system are designed to work in concert to provide the following operating modes:

- **Continuous Wipe Mode** - The control ring on the right (wiper) control stalk of the multi-function switch has an On position. When selected, this switch position will cause the rear wiper motor to operate in a continuous manner at a fixed wipe cycle speed.

- **Intermittent Wipe Mode** - The control ring on the right (wiper) control stalk of the multi-function switch has a Delay position. When selected, this

switch position will cause the rear wiper motor to operate in an intermittent manner at a fixed interval wipe cycle speed.

- **Washer Mode** - The control ring on the right (wiper) control stalk of the multi-function switch has two momentary Wash positions, one at the end of each direction of control ring rotation. When the control ring is rotated to the downward (counterclockwise) Wash position, the rear washer system will dispense washer fluid onto the flip-up glass and the rear wiper motor will operate in a continuous mode for as long as the switch is held closed, then provide several additional wipe cycles after the washer switch is released (wipe-after-wash mode). When the control ring is rotated to the upward (clockwise) Wash position, the rear washer system will dispense washer fluid onto the flip-up glass and the rear wiper motor will operate in a continuous mode for as long as the switch is held closed, then return to fixed wipe mode operation after the washer switch is released.

- **Wipe-After-Wash Mode** - The control ring on the right (wiper) control stalk of the multi-function switch has two momentary Wash positions, one at the end of each direction of control ring rotation. When the control ring is rotated to the downward (counterclockwise) Wash position, the rear washer system will dispense washer fluid onto the flip-up glass and the rear wiper motor will operate in a continuous mode for as long as the switch is held closed, then provide several additional wipe cycles after the washer switch is released.

## OPERATION

The rear wiper and washer system is designed to provide the vehicle operator with a convenient, safe, and reliable means of maintaining visibility through the rear flip-up glass. The various components of this system are designed to convert electrical energy produced by the vehicle electrical system into the mechanical action of the wiper blade to wipe the outside surface of the glass, as well as into the hydraulic action of the washer system to apply washer fluid stored in an on-board reservoir to the area of the glass to be wiped. When combined, these components provide the means to effectively maintain clear visibility for the vehicle operator by removing excess accumulations of rain, snow, bugs, mud, or other minor debris from the swing gate flip up glass surface that might be encountered while driving the vehicle under numerous types of inclement operating conditions.

The vehicle operator initiates all rear wiper and washer system functions with the right (wiper) control stalk of the multi-function switch that extends from the right side of the steering column, just below the steering wheel. Rotating the control ring on the

## REAR WIPERS/WASHERS (Continued)

control stalk to a detent position selects the Off, Delay, or On rear wiper system operating modes. Rotating the control ring on the control stalk to either of two Wash positions actuates the momentary rear washer system switch. The multi-function switch provides hard wired outputs to the rear wiper module and the washer pump/motor unit for all rear wiper and washer system functions.

The rear wiper and washer system will only operate when the ignition switch is in the Accessory or On positions, and the rear flip-up glass and tailgate ajar switches are closed. Battery current is directed from a fuse in the Junction Block (JB) to the multi-function switch through a fused ignition switch output (run-acc) circuit. The internal circuitry of the right (wiper) control stalk of the multi-function switch then provides battery current signals through a rear wiper on driver circuit and a rear wiper intermittent driver circuit to the rear wiper module and to the Body Control Module (BCM). The BCM uses these rear wiper system inputs as a signal to lock the rear flip-up glass and the tailgate to prevent the rear flip-up glass or tailgate from being opened for as long as the rear wiper is operating. The multi-function switch circuitry also uses this battery current and a ground circuit input to directly control the operation and direction of the reversible electric washer pump/motor unit.

A separate fuse in the JB provides battery current to the electronic control circuitry of the rear wiper module through a fused B(+) circuit. The rear wiper module uses this fused B(+) input to park the rear wiper blade off of the rear flip-up glass if the ignition switch is turned to the Off position while the rear wiper is operating, or if the ignition switch is turned to the Off position before the rear wiper blade has parked. However, if the ignition switch is turned to the Off position while the rear wiper is operating, then turned back On, the rear wiper switch must be cycled to the Off position and back to the On or Delay position before the rear wiper will operate again. In addition, the rear wiper module receives an input from the rear flip-up glass ajar switch on a flip-up glass ajar switch sense circuit, which prevents the rear wiper from operating when the flip-up glass is not closed or fully latched.

The hard wired circuits and components of the rear wiper and washer system may be diagnosed and tested using conventional diagnostic tools and procedures. Following are paragraphs that briefly describe the operation of each of the rear wiper and washer system operating modes.

**CONTINUOUS WIPE MODE** When the On position of the control ring on the right (wiper) control stalk of the multi-function switch is selected, the multi-function switch circuitry directs a battery cur-

rent signal to the rear wiper module through the rear wiper on driver circuit, causing the rear wiper to cycle continuously at a fixed speed.

**INTERMITTENT WIPE MODE** When the Delay position of the control ring on the right (wiper) control stalk of the multi-function switch is selected, the multi-function switch circuitry directs a battery current signal to the rear wiper module through the rear wiper intermittent driver circuit, causing the rear wiper to cycle intermittently at a fixed delay interval.

**WASH MODE** When the momentary Wash (after On) position of the control ring on the right (wiper) control stalk of the multi-function switch is selected, the multi-function switch circuitry directs both battery current and ground to the washer pump/motor unit, and a battery current signal to be provided to the rear wiper module through the rear wiper on driver circuit. This will cause the washer pump/motor unit to be energized and the rear wiper to cycle continuously at a fixed speed for as long as the rear Wash switch is held closed.

**WIPE-AFTER-WASH MODE** When the momentary Wash (before Off) position of the control ring on the right (wiper) control stalk of the multi-function switch is selected, the multi-function switch circuitry directs both battery current and ground to the washer pump/motor unit, and a battery current signal to be provided to the rear wiper module through the rear wiper on driver circuit. This will cause the washer pump/motor unit to be energized and the rear wiper to cycle continuously at a fixed speed for as long as the rear Wash switch is held closed. When the control ring is released to the Off position, the washer pump/motor is de-energized, but the circuitry within the rear wiper module will provide several additional wipe cycles to complete the wipe-after-wash mode cycle.

## DIAGNOSIS AND TESTING - REAR WIPER & WASHER SYSTEM

### REAR WIPER SYSTEM

The diagnosis found here addresses an electrically inoperative rear wiper system. If the rear wiper motor operates, but the wiper does not move on the rear flip-up glass, inspect the mechanical connection between the rear wiper arm and the rear wiper motor output shaft. If OK, replace the faulty rear wiper module. If the wiper operates, but chatters, lifts, or does not clear the glass, clean and inspect the rear wiper system components as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - INSPECTION) and (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING). Refer to the appropriate wiring information. The wiring infor-

## REAR WIPERS/WASHERS (Continued)

mation includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Check that the interior lighting switch on the left (lighting) control stalk of the multi-function switch is not in the dome lamp disable position. With all four doors and the tailgate closed, open the rear flip-up glass. The interior lamps should light. Close the rear flip-up glass. Note whether the interior lamps remain lighted. They should turn off after about thirty seconds. If OK, go to Step 2. If not OK, go to Step 9.

(2) Check the fused B(+) fuse (Fuse 17 - 15 ampere) in the Junction Block (JB). 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 fused B(+) fuse (Fuse 17 - 15 ampere) in the JB. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit between the JB and the Power Distribution Center (PDC) as required.

(4) Check the fused ignition switch output (run-acc) fuse (Fuse 22 - 10 ampere) in the JB. If OK, go to Step 5. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(5) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run-acc) fuse (Fuse 22 - 10 ampere) in the JB. If OK, turn the ignition switch to the Off position and go to Step 6. If not OK, repair the open fused ignition switch output (run-acc) circuit between the JB and the ignition switch as required.

(6) Disconnect and isolate the battery negative cable. Disconnect the instrument panel wire harness connector for the multi-function switch (Connector C-2) from the switch connector receptacle. Reconnect the battery negative cable. Turn the ignition switch

to the On position. Check for battery voltage at the fused ignition switch output (run-acc) circuit cavity of the instrument panel wire harness connector for the multi-function switch (Connector C-2). If OK, go to Step 7. If not OK, repair the open fused ignition switch output (run-acc) circuit between the multi-function switch and the JB as required.

(7) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Test the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If the multi-function switch tests OK, reconnect the instrument panel wire harness connectors for the multi-function switch to the switch connector receptacles and go to Step 8. If the multi-function switch does not test OK, replace the faulty switch.

(8) Remove the tailgate inner trim panel. Disconnect the tailgate wire harness connector for the rear wiper module from the module connector receptacle. Check for continuity between the ground circuit cavity of the tailgate wire harness connector for the rear wiper module and a good ground. There should be continuity. If OK, go to Step 9. If not OK, repair the open ground circuit to ground (G312) as required.

(9) Check for continuity between the flip-up glass ajar switch sense circuit cavity of the tailgate wire harness connector for the rear wiper module and a good ground. There should be continuity with the rear flip-up glass open, and no continuity with the rear flip-up glass closed. If OK, go to Step 10. If not OK, repair the open flip-up glass ajar circuit between the rear wiper module and the flip-up glass ajar switch as required.

(10) Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the tailgate wire harness connector for the rear wiper module. If OK, go to Step 11. If not OK, repair the open fused B(+) circuit between the rear wiper module and the JB as required.

(11) Turn the ignition switch to the On position. Turn the control ring on the right (wiper) control stalk of the multi-function switch to the Delay position. Check for battery voltage at the rear wiper intermittent driver circuit cavity of the tailgate wire harness connector for the rear wiper module. If OK, go to Step 12. If not OK, repair the open rear wiper intermittent driver circuit between the rear wiper module and the multi-function switch as required.

(12) Turn the control ring on the right (wiper) control stalk of the multi-function switch to the On position. Check for battery voltage at the rear wiper on driver circuit cavity of the tailgate wire harness connector for the rear wiper module. If OK, replace the faulty rear wiper module. If not OK, repair the open

## REAR WIPERS/WASHERS (Continued)

rear wiper on driver circuit between the rear wiper module and the multi-function switch as required.

## REAR WASHER SYSTEM

The diagnosis found here addresses an electrically inoperative rear washer system. If the washer pump/motor operates, but no washer fluid is emitted from the rear washer nozzle, be certain to check the fluid level in the reservoir. Also inspect the rear washer system components as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - INSPECTION). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. 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 control ring on the right (wiper) control stalk of the multi-function switch to the On position. Check whether the rear wiper system is operating. If OK, go to Step 2. If not OK, test and repair the rear wiper system before continuing with these tests. Refer to REAR WIPER SYSTEM .

(2) Pull the right (wiper) control stalk of the multi-function switch toward the steering wheel. Check whether the front washer system is operating. If OK, test the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). If the multi-function switch tests OK, go to Step 3. If the multi-function switch does not test OK, replace the faulty switch.

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the headlamp and dash wire harness connector for the washer pump/motor unit from the pump/motor unit connector receptacle. Check for continuity between the washer pump driver circuit cav-

ity of the headlamp and dash wire harness connector for the washer pump/motor unit and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted washer pump driver circuit between the washer pump/motor unit and the multi-function switch as required.

(4) Check for continuity between the washer pump driver circuit cavities of the headlamp and dash wire harness connector for the washer pump/motor unit and the instrument panel wire harness connector for the multi-function switch (Connector C-2). There should be continuity. If OK, go to Step 5. If not OK, repair the open washer pump driver circuit between the washer pump/motor unit and the multi-function switch as required.

(5) Check for continuity between the washer pump sense circuit cavity of the headlamp and dash wire harness connector for the washer pump/motor unit and a good ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted washer pump sense circuit between the washer pump/motor unit and the multi-function switch as required.

(6) Check for continuity between the washer pump sense circuit cavities of the headlamp and dash wire harness connector for the washer pump/motor unit and the instrument panel wire harness connector for the multi-function switch (Connector C-2). There should be continuity. If OK, replace the faulty washer pump/motor unit. If not OK, repair the open washer pump sense circuit between the washer pump/motor unit and the multi-function switch as required.

## CLEANING - REAR WIPER &amp; WASHER SYSTEM

## REAR WIPER SYSTEM

The squeegee of a wiper blade exposed to the elements for a long time tends to lose its wiping effectiveness. Periodic cleaning of the squeegee is suggested to remove any deposits of salt or road film. The wiper blade, arm, and rear flip-up glass should only be cleaned using a sponge or soft cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the wiper blade continues to leave streaks, smears, hazing, or beading on the glass after thorough cleaning of the squeegees and the glass, the entire wiper blade assembly must be replaced.

**CAUTION: Protect the rubber squeegee of the wiper blade from any petroleum-based cleaners, solvents, or contaminants. These products can rapidly deteriorate the rubber squeegee.**

REAR WIPERS/WASHERS (Continued)

REAR WASHER SYSTEM

If the washer system is contaminated with foreign material, drain the washer reservoir by removing the washer pump/motor from the reservoir. Clean foreign material from the inside of the washer pump/motor inlet filter screen and the washer reservoir using clean washer fluid, a mild detergent, or a non-abrasive cleaner. Flush foreign material from the washer system plumbing by first disconnecting the washer hose from the washer nozzle, then running the washer pump/motor to run clean washer fluid or water through the system. A plugged or restricted washer nozzle should be carefully back-flushed using compressed air. If the washer nozzle obstruction cannot be cleared, replace the washer nozzle.

**CAUTION:** Never introduce petroleum-based cleaners, solvents, or contaminants into the washer system. These products can rapidly deteriorate the rubber seals and hoses of the washer system, as well as the rubber squeegee of the wiper blade.

**CAUTION:** Never use compressed air to flush the washer system plumbing. Compressed air pressures are too great for the washer system plumbing components and will result in further system damage. Never use sharp instruments to clear a plugged washer nozzle or damage to the nozzle orifice and improper nozzle spray patterns will result.

INSPECTION - REAR WIPER & WASHER SYSTEM

REAR WIPER SYSTEM

The rear wiper blade and wiper arm should be inspected periodically, not just when wiper performance problems are experienced. This inspection should include the following points:

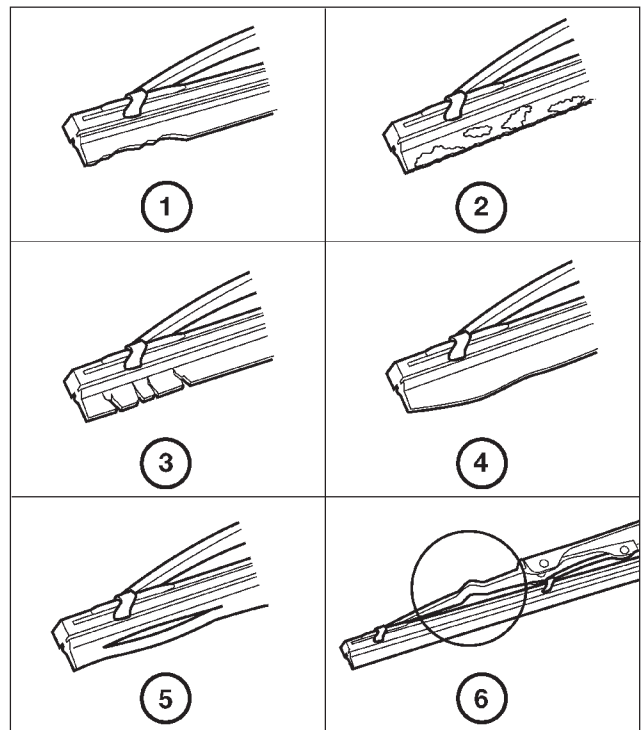
(1) Inspect the wiper arm for any indications of damage, or contamination. If the wiper arm is contaminated with any foreign material, clean as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING). If a wiper arm is damaged or corrosion is evident, replace the wiper arm with a new unit. Do not attempt to repair a wiper arm that is damaged or corroded.

(2) Carefully lift the wiper arm off of the park ramp. Note the action of the wiper arm hinge. The wiper arm should pivot freely at the hinge, but with no lateral looseness evident. If there is any binding evident in the wiper arm hinge, or there is evident lateral play in the wiper arm hinge, replace the wiper arm.

**CAUTION:** Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(3) Once proper hinge action of the wiper arm is confirmed, check the hinge for proper spring tension. The spring tension of the wiper arm should be sufficient to cause the rubber squeegee to conform to the curvature of the glass. Replace a wiper arm if it has low or no spring tension.

(4) Inspect the wiper blade and squeegee for any indications of damage, contamination, or rubber deterioration (Fig. 2). If the wiper blade or squeegee is contaminated with any foreign material, clean them and the glass as required. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING). If after cleaning the wiper blade and the glass, the wiper blade fails to clear the glass without smearing, streaking, chattering, hazing, or beading, replace the wiper blade. Also, if a wiper blade is damaged or if the squeegee rubber is damaged or deteriorated, replace the wiper blade with a new unit. Do not attempt to repair a wiper blade that is damaged.



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**Fig. 2 Wiper Blade Inspection**

- 1 - WORN OR UNEVEN EDGES
- 2 - ROAD FILM OR FOREIGN MATERIAL DEPOSITS
- 3 - HARD, BRITTLE, OR CRACKED
- 4 - DEFORMED OR FATIGUED
- 5 - SPLIT
- 6 - DAMAGED SUPPORT COMPONENTS

## REAR WIPERS/WASHERS (Continued)

## REAR WASHER SYSTEM

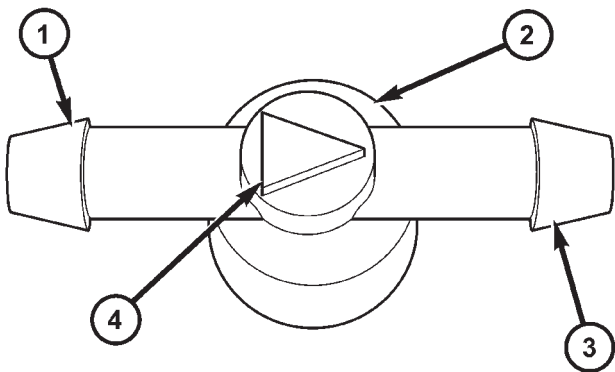
The washer system components should be inspected periodically, not just when washer performance problems are experienced. This inspection should include the following points:

(1) Check for ice or other foreign material in the washer reservoir. If contaminated, clean and flush the washer system. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS - CLEANING).

(2) Inspect the washer plumbing for pinched, leaking, deteriorated, or incorrectly routed hoses and damaged or disconnected hose fittings. Replace damaged or deteriorated hoses and hose fittings. Leaking washer hoses can sometimes be repaired by cutting the hose at the leak and splicing it back together using an in-line connector fitting. Similarly, sections of deteriorated hose can be cut out and replaced by splicing in new sections of hose using in-line connector fittings. Whenever routing a washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts. Also, sharp bends that might pinch the washer hose must be avoided.

## REAR CHECK VALVE

## DESCRIPTION



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**Fig. 3 Rear Check Valve**

- 1 - INLET NIPPLE
- 2 - REAR CHECK VALVE
- 3 - OUTLET NIPPLE
- 4 - FLOW DIRECTION ARROW

A rear washer system check valve is standard equipment on this model (Fig. 3). The rear check valve is located in the washer plumbing between the rear roof header and the roof outer panel near the rear washer nozzle. The rear check valve consists of a molded plastic body with a round center section

and barbed hose nipples at each end. An arrow formation molded into the center section of the valve body indicates the direction of flow through the valve. The rear check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

## OPERATION

The rear check valve prevents washer fluid from draining out of the rear washer supply hoses back to the washer reservoir. This drain-back would result in a lengthy delay from when the rear washer switch is actuated until washer fluid was dispensed through the rear washer nozzle, because the washer pump would have to refill the rear washer plumbing from the reservoir to the nozzle. The check valve also prevents washer fluid from siphoning through the rear washer nozzle after the rear washer system is turned Off.

Within the check valve body, a small check valve is held in place against a seat by a small coiled spring to restrict flow through the unit until the valve is unseated by a predetermined inlet fluid pressure. When the washer pump pressurizes and pumps washer fluid from the reservoir through the rear washer plumbing, the fluid pressure overrides the spring pressure applied to the check ball within the valve and unseats the valve, allowing washer fluid to flow toward the rear washer nozzle. When the washer pump stops operating, spring pressure seats the check valve and fluid flow in either direction within the rear washer plumbing is prevented.

## REMOVAL

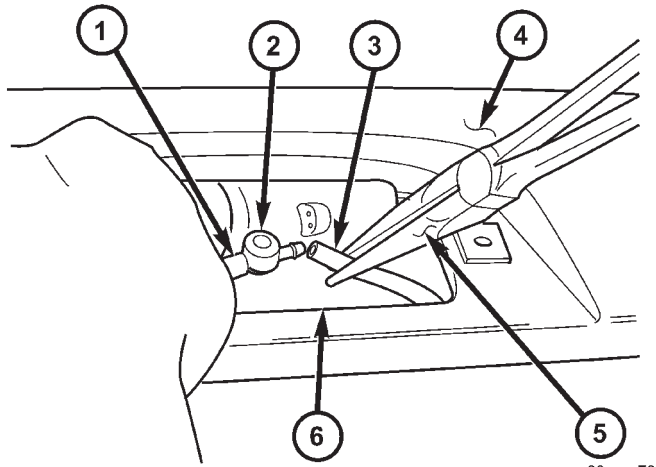
- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the Center High Mounted Stop Lamp (CHMSL) unit from the rear of the roof panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UNIT - REMOVAL).

**WARNING: THE EDGES OF THE SHEET METAL AROUND THE CENTER HIGH MOUNTED STOP LAMP MOUNTING HOLE IN THE ROOF PANEL. TAKE THE PROPER PRECAUTIONS TO AVOID PERSONAL INJURY.**

(3) Reach through the CHMSL unit mounting hole in the rear of the roof panel to access and disconnect the rear washer hose at the barbed nipple of the rear washer nozzle (Fig. 4).

(4) Pull the rear washer hose through the CHMSL unit mounting hole far enough to access and disconnect the headliner washer hose from the barbed nipple of the rear check valve.

REAR CHECK VALVE (Continued)



**Fig. 4 Rear Check Valve Remove/Install**

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- 1 - WASHER NOZZLE HOSE
- 2 - REAR CHECK VALVE
- 3 - HEADLINER HOSE
- 4 - ROOF PANEL
- 5 - NEEDLE NOSE PLIERS
- 6 - CHMSL MOUNTING HOLE

(5) Remove the rear check valve and rear washer nozzle hose as a unit through the CHMSL mounting hole.

(6) Disconnect the rear washer nozzle hose from the barbed nipple of the rear check valve.

**INSTALLATION**

(1) Reconnect the rear washer nozzle hose to the barbed nipple of the rear check valve. Be certain that the flow direction arrow molded into the rear check valve body is oriented towards the rear washer nozzle hose.

**WARNING: THE EDGES OF THE SHEET METAL AROUND THE CENTER HIGH MOUNTED STOP LAMP MOUNTING HOLE IN THE ROOF PANEL. TAKE THE PROPER PRECAUTIONS TO AVOID PERSONAL INJURY.**

(2) Reach through the CHMSL unit mounting hole in the rear of the roof panel to access and pull the headliner washer hose into the Center High Mounted Stop Lamp (CHMSL) unit mounting hole (Fig. 4).

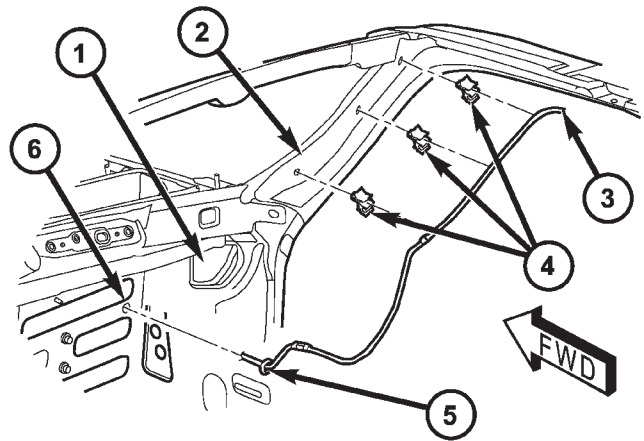
(3) Reconnect the headliner washer hose to the barbed nipple of the rear check valve.

(4) Reach through the CHMSL unit mounting hole in the rear of the roof panel to access and reconnect the rear washer nozzle hose to the barbed nipple of the rear washer nozzle.

(5) Reinstall the CHMSL unit to the rear of the roof panel. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UNIT - INSTALLATION).

(6) Reconnect the battery negative cable.

REAR WASHER HOSES/TUBES  
DESCRIPTION



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**Fig. 5 Rear Washer Headliner Hose**

- 1 - COWL SIDE INNER PANEL
- 2 - A-PILLAR
- 3 - HEADLINER HOSE
- 4 - CLIP (3)
- 5 - GROMMET
- 6 - DASH PANEL

The rear washer plumbing consists of small diameter rubber hose routed from the barbed outlet nipple of the reversible electric washer pump/motor unit on the washer reservoir through a trough molded into the reservoir rearward of the washer pump up to the top of the reservoir. Near the base of the reservoir filler neck an in-line plastic fitting connects the reservoir rear washer hose to the engine compartment rear washer hose, which is routed through the reservoir filler neck opening in the front extension of the right front fender wheel house panel in to the engine compartment. The engine compartment rear washer hose is routed side by side with the front washer hose along the top of the right front fender wheel house to the dash panel. Molded plastic routing clips secure the hoses to the headlamp and dash wire harness in the engine compartment.

The engine compartment rear washer hose is connected to the headliner washer hose near the right side of the dash panel with a molded plastic in-line fitting (Fig. 5). The headliner hose has a rubber grommet that allows it to pass through the dash panel from the passenger compartment into the engine compartment. The headliner hose is routed below the instrument panel in the passenger compartment near the right cowl side inner panel. The hose is routed up the right A-pillar to the headliner. Mounting clips secure the hose to the A-pillar. The



## REAR WASHER HOSES/TUBES (Continued)

headliner hose is glued to top of the headliner and routed along the right roof side rail to the rear of the vehicle. At the rear of the vehicle, the headliner hose passes through a hole at the rear portion of the roof rear inner header panel and is connected to the rear check valve. From the rear check valve, there is a short section of hose that connects the rear check valve to the rear washer nozzle.

Washer hose is available for service only as roll stock, which must then be cut to length. The headliner washer hose is integral to the headliner unit and, if faulty or damaged, the headliner unit must be replaced. However, the headliner hose is marked with a white cut line on the A-pillar where the hose should be cut and spliced with a plastic in-line connector fitting to facilitate headliner removal without the need to remove the instrument panel. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL AND INSTALLATION). The molded plastic washer hose fittings cannot be repaired. If these fittings are faulty or damaged, they must be replaced.

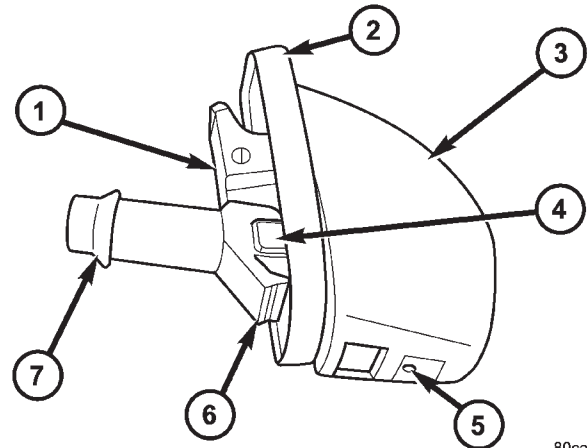
## OPERATION

Washer fluid in the washer reservoir is pressurized and fed by the washer pump/motor through the rear washer system plumbing and fittings to the rear washer nozzle located on the roof panel above the rear flip-up glass opening. Whenever routing the washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts; and, sharp bends that might pinch the hose must be avoided.

## REAR WASHER NOZZLE

## DESCRIPTION

The rear washer nozzle is a fluidic-type unit constructed of molded plastic (Fig. 6). The nozzle is secured by a snap fit in a dedicated mounting hole located in the rear edge of the roof panel above the rear flip-up glass opening and to the right of the Center High Mounted Stop Lamp (CHMSL) unit. A rubber gasket on the back of the nozzle seals the nozzle to the roof panel opening. The back of the nozzle includes an integral alignment feature on the left side, an integral engagement tab on the top, an integral latch feature on the bottom, and the washer plumbing nipple which are all concealed between the outer roof panel and the rear roof inner header. The rear washer nozzle latch feature is a one time component, and will be damaged if the nozzle is removed from its mounting hole for service. The rear washer nozzle cannot be adjusted or repaired. If faulty or damaged, the entire nozzle unit must be replaced.



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**Fig. 6 Rear Washer Nozzle**

- 1 - ENGAGEMENT TAB (TOP)
- 2 - GASKET
- 3 - REAR WASHER NOZZLE
- 4 - ALIGNMENT FEATURE
- 5 - ORIFICE
- 6 - LATCH FEATURE (BOTTOM)
- 7 - NIPPLE

## OPERATION

The rear washer nozzle is designed to dispense washer fluid into the wiper pattern area on the outside of the rear flip-up glass. Pressurized washer fluid is fed to the nozzle from the washer reservoir by the washer pump/motor through a single hose, which is attached to a barbed nipple on the back of the rear washer nozzle. The rear washer nozzle incorporates a fluidic design, which causes the nozzle to emit the pressurized washer fluid as an oscillating stream to more effectively cover a larger area of the glass area to be cleaned.

## REMOVAL

**NOTE:** The rear washer nozzle latch feature is a one time component, and will be damaged if the nozzle is removed from its mounting hole for service. If removed from its mounting hole for any reason, the rear washer nozzle must be replaced with a new unit.

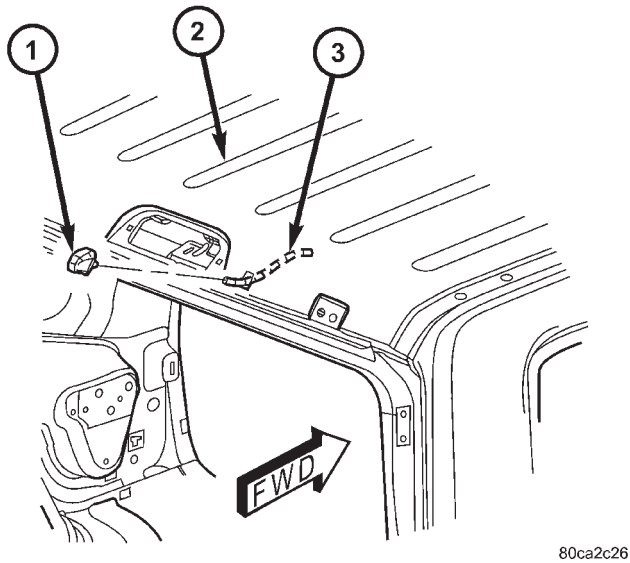
(1) Using a trim stick or another suitable wide flat-bladed tool, gently pry the bottom of the rear washer nozzle away from the roof panel until the latch feature at the bottom of the nozzle that secures it in the mounting hole of the roof panel snaps.

(2) Pull the rear washer nozzle out from the roof panel far enough to access the washer hose (Fig. 7).

(3) Disconnect the washer hose from the barbed nipple on the back of the rear washer nozzle.

(4) Discard the rear washer nozzle.

## REAR WASHER NOZZLE (Continued)



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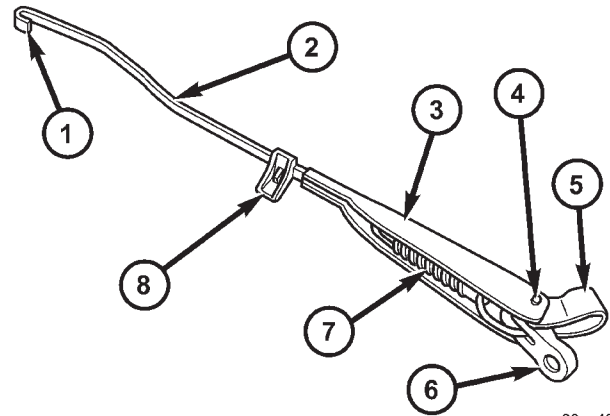
**Fig. 7 Rear Washer Nozzle Remove/Install**

- 1 - NOZZLE
- 2 - ROOF PANEL
- 3 - HEADLINER HOSE

**INSTALLATION**

**NOTE:** The rear washer nozzle latch feature is a one time component, and will be damaged if the nozzle is removed from its mounting hole for service. If removed from its mounting hole for any reason, the rear washer nozzle must be replaced with a new unit.

- (1) Position the new rear washer nozzle to the roof panel (Fig. 7). Be certain that a new rubber gasket is in position on the back of the nozzle.
- (2) Reconnect the washer hose to the barbed nipple on the back of the rear washer nozzle.
- (3) Insert the rear washer nozzle supply hose and nipple into the mounting hole in the roof panel and align the nozzle with the hole.
- (4) Engage the tab at the top of the nozzle behind the sheet metal at the top of the roof panel mounting hole.
- (5) Using hand pressure, press firmly and evenly on the hood of the rear washer nozzle until the lower latch feature snaps into place behind the sheet metal at the bottom of the roof panel mounting hole.

**REAR WIPER ARM****DESCRIPTION**

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**Fig. 8 Rear Wiper Arm**

- 1 - HOOK
- 2 - STRAP
- 3 - CHANNEL
- 4 - HINGE PIN
- 5 - COVER
- 6 - PIVOT END
- 7 - TENSION SPRING
- 8 - SUPPORT

The rear wiper arm is the rigid member located between the rear wiper motor output shaft that protrudes from the outer tailgate panel near the base of the rear flip-up glass opening and the rear wiper blade (Fig. 8). This wiper arm features an over-center hinge that allows easy access to the tailgate and rear flip-up glass for cleaning, after the spare tire is removed. The wiper arm has a die cast metal pivot end with a large tapered mounting hole at one end. A molded plastic pivot cover is secured loosely to and pivots on the wiper arm hinge pin to conceal the wiper arm retaining nut. The wide end of a tapered, stamped steel channel is secured with a hinge pin to the pivot end of the wiper arm. One end of a long, rigid, stamped steel strap, with a small hole near its pivot end, is riveted and crimped within the narrow end of the stamped steel channel. The tip of the wiper blade end of this strap is bent back under itself to form a small hook. Concealed within the stamped steel channel, one end of a long spring is engaged with a wire hook on the underside of the die cast pivot end, while the other end of the spring is hooked through the small hole in the steel strap. A molded plastic wiper arm support is snapped onto the wiper arm strap where it exits the channel. The entire wiper arm has a satin black finish applied to all of its visible surfaces.

## REAR WIPER ARM (Continued)

A wiper arm cannot be adjusted or repaired. If damaged or faulty, the entire wiper arm unit must be replaced.

## OPERATION

The rear wiper arm is designed to mechanically transmit the motion from the rear wiper motor output shaft to the rear wiper blade. The wiper arm must be properly indexed to the motor output shaft in order to maintain the proper wiper blade travel on the glass. The wiper arm support is designed to lift and support the rear wiper arm and blade off of the glass when the rear wiper blade is parked. This support and the park ramp on the tailgate outer panel below the glass also provide an alignment reference to ensure accurate rear wiper arm and blade installation. The tapered hole in the wiper arm pivot end interlocks with the serrations on the outer circumference of the tapered motor output shaft, allowing positive engagement and finite adjustment of this connection. A hex nut secures the wiper arm pivot end to the threads on the rear wiper motor output shaft and the pivot cover hinges and snaps over this connection for a neat appearance. The spring-loaded wiper arm hinge controls the down-force applied through the tip of the wiper arm to the wiper blade on the glass. The hook formation on the tip of the wiper arm provides a cradle for securing and latching the wiper blade pivot block to the wiper arm.

## REMOVAL

(1) Lift the rear wiper arm pivot cover by lifting it at the rear wiper motor output shaft end of the arm (Fig. 9).

(2) Remove the nut that secures the rear wiper arm to the rear wiper motor output shaft.

(3) If necessary, use a battery terminal puller to disengage the wiper arm from the rear wiper motor output shaft splines (Fig. 10).

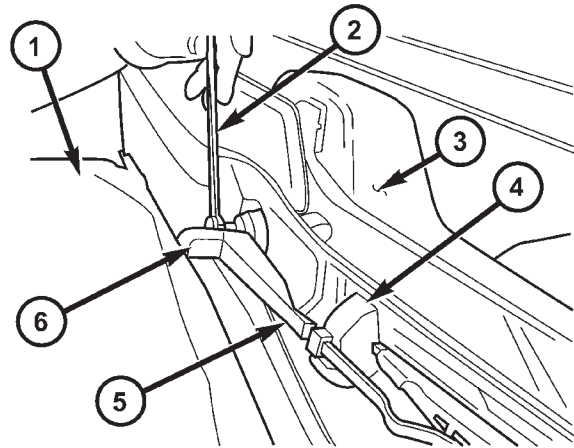
**NOTE:** Depending upon the size and type of puller used, it may be necessary to remove the spare tire from the tailgate. Refer to the owner's manual in the vehicle glove box for information on removing the spare tire from the tailgate.

(4) Remove the rear wiper arm pivot end from the motor output shaft.

## INSTALLATION

**NOTE:** Always install the wiper arm and blade with the wiper motor in the Park position.

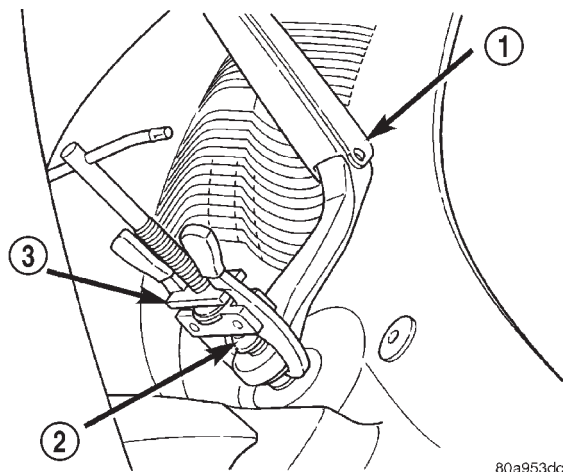
(1) The rear wiper arm must be indexed to the motor output shaft with the rear wiper motor in the park position to be properly installed. Place the



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**Fig. 9 Rear Wiper Arm Remove/Install**

- 1 - SPARE TIRE
- 2 - WRENCH
- 3 - FLIP-UP GLASS
- 4 - PARK RAMP
- 5 - REAR WIPER ARM
- 6 - PIVOT COVER



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**Fig. 10 Wiper Arm Puller - Typical**

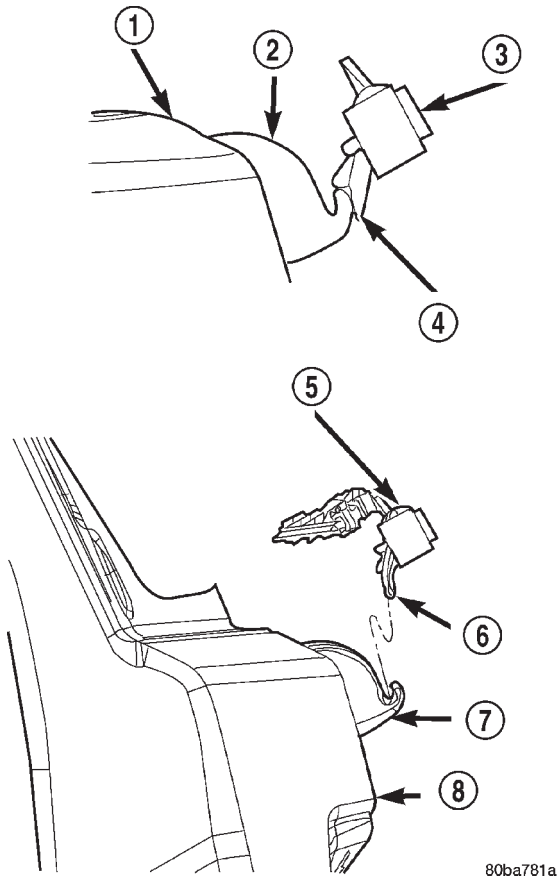
- 1 - WIPER ARM
- 2 - WIPER PIVOT
- 3 - BATTERY TERMINAL PULLER

wiper arm onto the tailgate with the wiper arm support positioned on the park ramp and the tapered mounting hole on the pivot end of the arm positioned over the rear wiper motor output shaft.

(2) Position the tab on the back of the rear wiper arm support on the tailgate park ramp in the Installation Position (Fig. 11).

(3) With the wiper arm in the Installation Position, push the tapered mounting hole on the pivot end of the wiper arm down over the rear wiper motor output shaft.

REAR WIPER ARM (Continued)



**Fig. 11 Rear Wiper Arm Installation**

- 1 - TAILGATE
- 2 - PARK RAMP
- 3 - REAR WIPER ARM
- 4 - INSTALLATION POSITION
- 5 - REAR WIPER ARM AND BLADE
- 6 - PARK POSITION
- 7 - PARK RAMP
- 8 - TAILGATE

(4) Install and tighten the nut that secures the rear wiper arm to the rear wiper motor output shaft. Tighten the nut to 18 N·m (13 ft. lbs.).

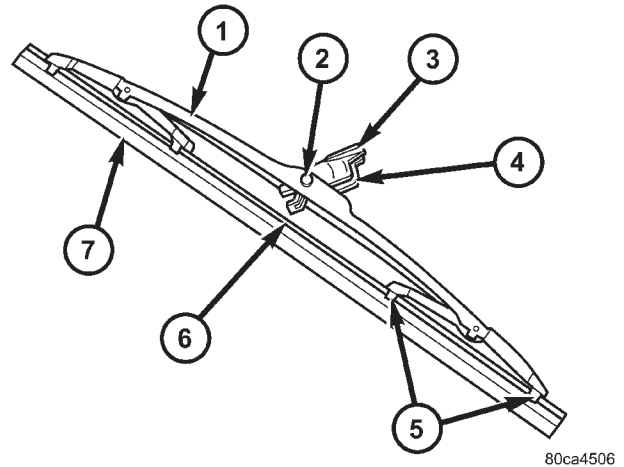
(5) Close the rear wiper arm pivot cover.

(6) Lift the rear wiper arm support away from the park ramp, then place the wiper arm support in the park ramp in the Park Position (Fig. 11).

REAR WIPER BLADE

DESCRIPTION

The rear wiper blade is secured by an integral latching pivot block to the hook formation on the tip of the rear wiper arm, and rests off the glass on a park ramp on the tailgate near the base of the rear flip-up glass opening when the wiper is not in oper-



**Fig. 12 Rear Wiper Blade**

- 1 - SUPERSTRUCTURE
- 2 - PIVOT PIN
- 3 - LATCH RELEASE
- 4 - PIVOT BLOCK
- 5 - CLAW
- 6 - FLEXOR
- 7 - ELEMENT

ation (Fig. 12). The rear wiper blade consists of the following components:

- **Superstructure** - The superstructure includes a stamped steel bridge and plastic links with claw formations that grip the wiper blade element. Also included in this unit is the latching, molded plastic pivot block that secures the superstructure to the wiper arm. All of the metal components of the wiper blade have a satin black finish applied.

- **Element** - The wiper element or squeegee is the resilient rubber member of the wiper blade that contacts the glass.

- **Flexor** - The flexor is a rigid metal component running along the length of each side of the wiper element where it is gripped by the claws of the superstructure.

All models have a single 28.00 centimeter (11.00 inch) rear wiper blade with a non-replaceable rubber element (squeegee). The wiper blade cannot be adjusted or repaired. If faulty, worn, or damaged the entire wiper blade unit must be replaced.

OPERATION

The wiper blade is moved back and forth across the glass by the wiper arm when the wiper system is in operation. The wiper blade superstructure is the flexible frame that grips the wiper blade element and evenly distributes the force of the spring-loaded wiper arm along the length of the element. The combination of the wiper arm force and the flexibility of the superstructure makes the element conform to

## REAR WIPER BLADE (Continued)

and maintain proper contact with the glass, even as the blade is moved over the varied curvature found across the glass surface. The wiper element flexor provides the claws of the blade superstructure with a rigid, yet flexible component on the element which can be gripped. The rubber element is designed to be stiff enough to maintain an even cleaning edge as it is drawn across the glass, but resilient enough to conform to the glass surface and flip from one cleaning edge to the other each time the wiper blade changes directions.

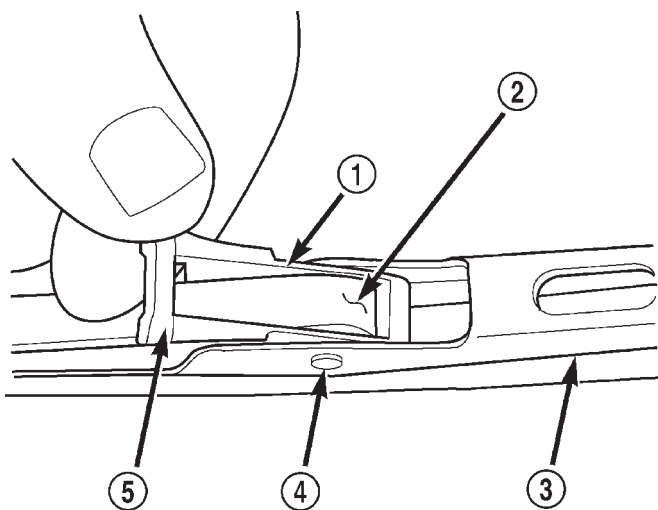
## REMOVAL

**NOTE:** The notched end of the wiper element flexor should always be oriented towards the end of the wiper blade that is nearest to the wiper motor output shaft.

(1) Disengage the rear wiper arm support from the rear wiper arm park ramp on the right side of the tailgate just below the rear flip-up glass.

(2) Lift the rear wiper arm to raise the wiper blade and element off of the tailgate and the rear flip-up glass.

(3) To remove the wiper blade from the wiper arm, carefully lift up the pivot block latch release tab on the top of the wiper arm to unlatch it from the arm (Fig. 13).

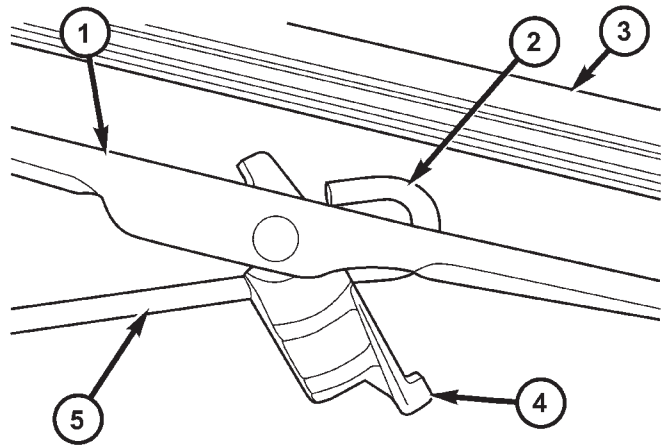


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**Fig. 13 Rear Wiper Blade Release**

- 1 - PIVOT BLOCK WINDOW
- 2 - TIP OF REAR WIPER ARM
- 3 - SUPERSTRUCTURE
- 4 - PIVOT BLOCK HINGE PIN
- 5 - LATCH RELEASE TAB

(4) Raise the pivot block latch release tab until it is perpendicular to the rear wiper blade superstructure (Fig. 14).



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**Fig. 14 Rear Wiper Blade Remove/Install**

- 1 - SUPERSTRUCTURE
- 2 - HOOK
- 3 - ELEMENT
- 4 - LATCH RELEASE
- 5 - REAR WIPER ARM

(5) Slide the rear wiper blade away from the tip of the arm towards the pivot end of the arm far enough to disengage the pivot block from the hook formation on the end of the arm.

(6) Extract the hook formation on the tip of the wiper arm from the window in the wiper blade pivot block/latch unit.

**CAUTION:** Do not allow the wiper arm to spring back against the tailgate or the flip-up glass without the wiper blade in place or they may be damaged.

(7) Gently lower the wiper arm and place the arm support in the park ramp.

## INSTALLATION

**NOTE:** The notched end of the wiper element flexor should always be oriented towards the end of the wiper blade that is nearest to the wiper motor output shaft.

(1) Lift the rear wiper arm support out of the tailgate park ramp.

(2) Position the rear wiper blade near the hook formation on the tip of the arm with the notched end of the wiper element flexor oriented towards the end of the wiper arm that is nearest to the wiper motor output shaft.

## REAR WIPER BLADE (Continued)

(3) Raise the pivot block latch release tab until it is perpendicular to the rear wiper blade superstructure (Fig. 14).

(4) Insert the hook formation on the tip of the wiper arm through the window in the wiper blade pivot block/latch unit.

(5) Slide the wiper blade pivot block/latch up into the hook formation on the tip of the wiper arm until the hook is firmly seated against the pivot block.

(6) Press the pivot block latch release tab downward until it snaps into its locked position over the top of the wiper arm.

(7) Gently lower the wiper arm and place the arm support in the tailgate park ramp.

## REAR WIPER MOTOR

## DESCRIPTION

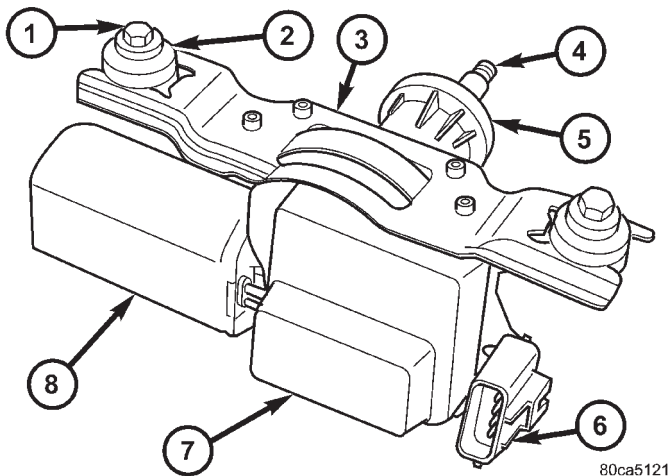


Fig. 15 Rear Wiper Motor

- 1 - SCREW (2)
- 2 - INSULATOR (2)
- 3 - BRACKET
- 4 - OUTPUT SHAFT
- 5 - SEAL
- 6 - CONNECTOR RECEPTACLE
- 7 - COVER
- 8 - MOTOR

The rear wiper motor is concealed within the tailgate, below the rear flip-up glass opening and behind the tailgate inner trim panel. The end of the motor output shaft that protrudes through the tailgate outer panel to drive the rear wiper arm and blade is the only visible component of the rear wiper motor (Fig. 15). A rubber gasket, a bezel, and a nut secure and seal the motor output shaft to the tailgate outer panel. A molded plastic nut cover snaps onto the bezel to conceal the nut and improve appearance. An integral connector receptacle connects the rear wiper

motor to the vehicle electrical system through a dedicated take out and connector of the tailgate wire harness. The rear wiper motor consists of the following major components:

- **Bracket** - The rear wiper motor bracket consists of a stamped steel mounting plate for the wiper motor that is secured with screws through two rubber insulators to the tailgate inner panel.

- **Rear Wiper Module** - The rear wiper motor electronic controls are concealed beneath a molded plastic cover and includes the rear wiper system electronic logic and rear wiper motor electronic controls.

- **Motor** - The permanent magnet rear wiper motor is secured with screws to the rear wiper motor bracket. The wiper motor includes an integral transmission, and the motor output shaft.

The rear wiper motor cannot be adjusted or repaired. If any component of the motor is faulty or damaged, the entire rear wiper motor unit must be replaced. The motor output shaft gasket, bezel, nut, and nut cover are available for service replacement.

## OPERATION

The rear wiper motor receives non-switched battery current through a fuse in the Junction Block (JB) on a fused B(+) circuit and is connected to ground at all times. The rear wiper motor operation is controlled by the vehicle operator through battery current signal inputs received by the rear wiper motor electronic control module from the rear wiper switch circuitry that is integral to the right (wiper) control stalk of the multi-function switch on the steering column. The module also receives an external control input from the flip-up glass ajar switch sense circuit. If the rear wiper module senses that the flip-up glass is ajar, it will not allow the rear wiper motor to operate.

The rear wiper module electronic control logic uses these inputs, its internal inputs, and its programming to provide a continuous wipe mode, an intermittent wipe mode, a wipe-after-wash mode, and off-the-glass wiper blade parking. The wiper blade cycling is controlled by the internal electronic controls of the module. The module controls current flow to the wiper motor brushes and provides an electronic speed control that speeds the wiper blade near the center of the glass, but slows the wiper blade during directional reversals at each end of the wipe pattern and during wiper blade off-the-glass parking for quieter operation. The wiper motor transmission converts the rotary output of the wiper motor to the back and forth wiping motion of the rear wiper arm and blade on the rear flip-up glass.

## REAR WIPER MOTOR (Continued)

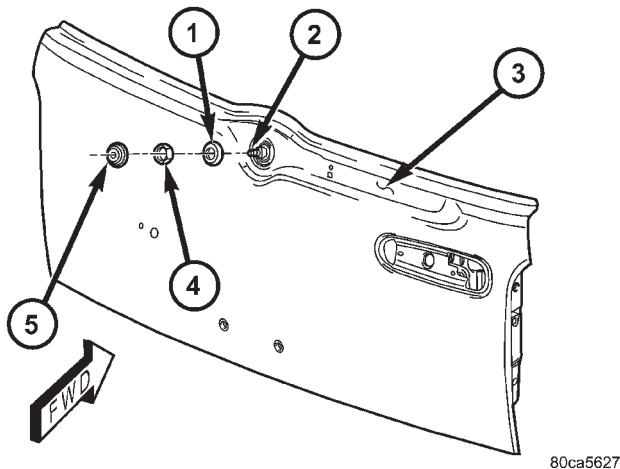
## REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the rear wiper arm from the rear wiper motor output shaft. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS/REAR WIPER ARM - REMOVAL).

(3) Using a small thin-bladed tool, gently pry at the notch in the base of the rear wiper motor output shaft bezel to unsnap the nut cover from the bezel (Fig. 16). **Be certain to take proper precautions to protect the outer tailgate panel and its paint finish from damage during this procedure.**

(4) Remove the nut that secures the rear wiper motor output shaft to the outer swing gate panel (Fig. 16).



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**Fig. 16 Rear Wiper Motor Output Shaft Nut Remove/Install**

- 1 - BEZEL AND GASKET
- 2 - OUTPUT SHAFT
- 3 - TAILGATE OUTER PANEL
- 4 - NUT
- 5 - NUT COVER

(5) Remove the bezel and gasket from the rear wiper motor output shaft.

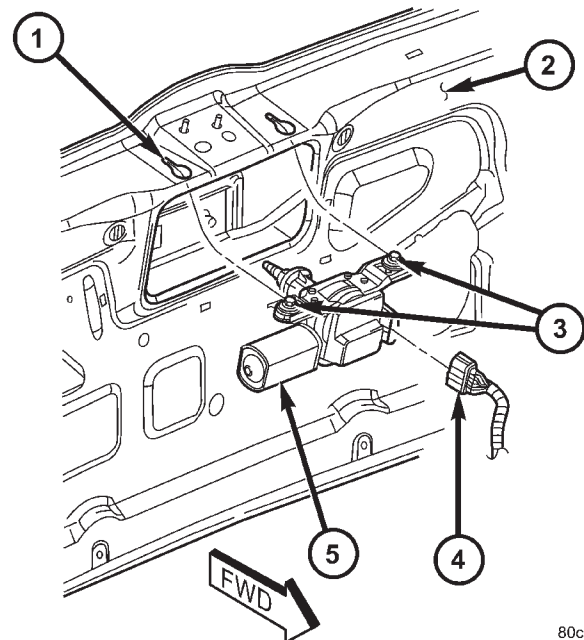
(6) Remove the trim panel from the tailgate inner panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - REMOVAL).

(7) Disconnect the tailgate wire harness connector for the flip-up glass ajar switch from the flip-up glass latch connector receptacle.

(8) Disconnect the tailgate wire harness connector for the rear wiper motor from the motor connector receptacle (Fig. 17).

(9) Loosen the two screws that secure the rear wiper motor mounting bracket to the top of the tailgate inner panel.

(10) Slide the rear wiper motor and mounting bracket back far enough to disengage the two mount-



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**Fig. 17 Rear Wiper Motor Remove/Install**

- 1 - KEYED SLOT (2)
- 2 - SWING GATE INNER PANEL
- 3 - SCREW (2)
- 4 - REAR WIPER MOTOR ELECTRICAL CONNECTOR
- 5 - REAR WIPER MOTOR

ing screws from the keyed slots in the top of the tailgate inner panel.

(11) Remove the rear wiper motor and mounting bracket from the tailgate as a unit.

## INSTALLATION

(1) Position the rear wiper motor and bracket into the tailgate as a unit (Fig. 17).

(2) Insert the rear wiper motor output shaft through the hole in the tailgate outer panel and engage the two mounting screws into the keyed slots in the top of tailgate inner panel.

(3) From the outside of the tailgate, center the rear wiper motor output shaft in the tailgate outer panel clearance hole and install the gasket and bezel over the centered shaft (Fig. 16).

(4) Install and tighten the nut that secures the rear wiper motor output shaft to the outer tailgate panel. Tighten the nut to 5 N·m (43 in. lbs.).

(5) From the inside of the tailgate, tighten the two screws that secure the rear wiper motor mounting bracket to the top of the tailgate inner panel. Tighten the screws to 6 N·m (57 in. lbs.).

(6) Reconnect the tailgate wire harness connector for the rear wiper motor to the motor connector receptacle.

## REAR WIPER MOTOR (Continued)

(7) Reconnect the tailgate wire harness connector for the flip-up glass ajar switch to the flip-up glass latch connector receptacle.

(8) Reinstall the trim panel onto the tailgate inner panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - INSTALLATION).

(9) From the outside of the tailgate, press the nut cover firmly and evenly over the rear wiper motor output shaft bezel using hand pressure until it snaps into place.

(10) Reinstall the rear wiper arm onto the rear wiper motor output shaft. (Refer to 8 - ELECTRICAL/REAR WIPERS/WASHERS/REAR WIPER ARM - INSTALLATION).

(11) Reconnect the battery negative cable.

## REAR WIPER/WASHER SWITCH

## DESCRIPTION

The rear wiper and washer switches are integral to the right (wiper) control stalk of the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION).

## OPERATION

The rear wiper and washer switches are integral to the right (wiper) control stalk of the multi-function switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - OPERATION).

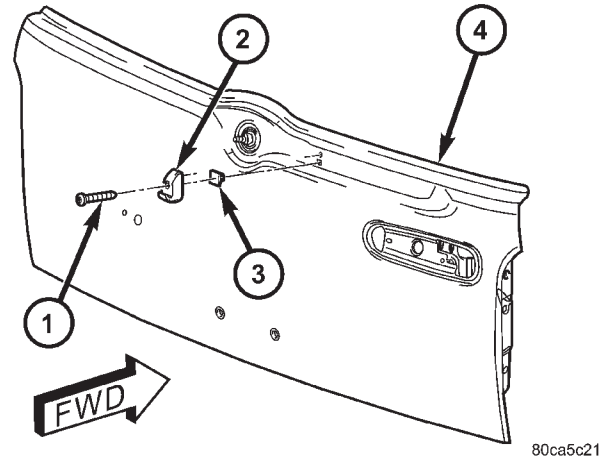
## WIPER ARM PARK RAMP

## REMOVAL

(1) Disengage the rear wiper arm support from the wiper arm park ramp on the right side of the tailgate just below the rear flip-up glass.

(2) Lift the wiper arm and blade away from the tailgate until the wiper arm hinge is in its over-center position.

Remove the screw that secures the wiper arm park ramp to the tailgate outer panel (Fig. 18).



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**Fig. 18 Wiper Arm Park Ramp Remove/Install**

- 1 - SCREW (1)
- 2 - PARK RAMP
- 3 - RIVET NUT (1)
- 4 - TAILGATE OUTER PANEL

(3) Remove the wiper arm park ramp from the tailgate outer panel.

## INSTALLATION

(1) Position the wiper arm park ramp onto the tailgate outer panel (Fig. 18).

(2) Install and tighten the screw that secures the wiper arm park ramp to the tailgate outer panel. Tighten the screw to 5 N·m (45 in. lbs.).

(3) Lower the rear wiper arm and blade and place the wiper arm support onto the wiper arm park ramp.





# WIRING

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## 8W-01 WIRING DIAGRAM INFORMATION

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## WIRING DIAGRAM INFORMATION

### DESCRIPTION

#### DESCRIPTION - HOW TO USE WIRING DIAGRAMS

DaimlerChrysler Corporation wiring diagrams are designed to provide information regarding the vehicles wiring content. In order to effectively use the wiring diagrams to diagnose and repair DaimlerChrysler Corporation vehicles, 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 (Fig. 1).

All switches, components, and modules are shown in the at rest position with the doors closed and the key removed from the ignition (Fig. 2).

Components are shown two ways. A solid line around a component indicates that the component is complete. A dashed line around the component indicates that the component is being shown is not complete. Incomplete components have a reference number to indicate the page where the component is shown complete.

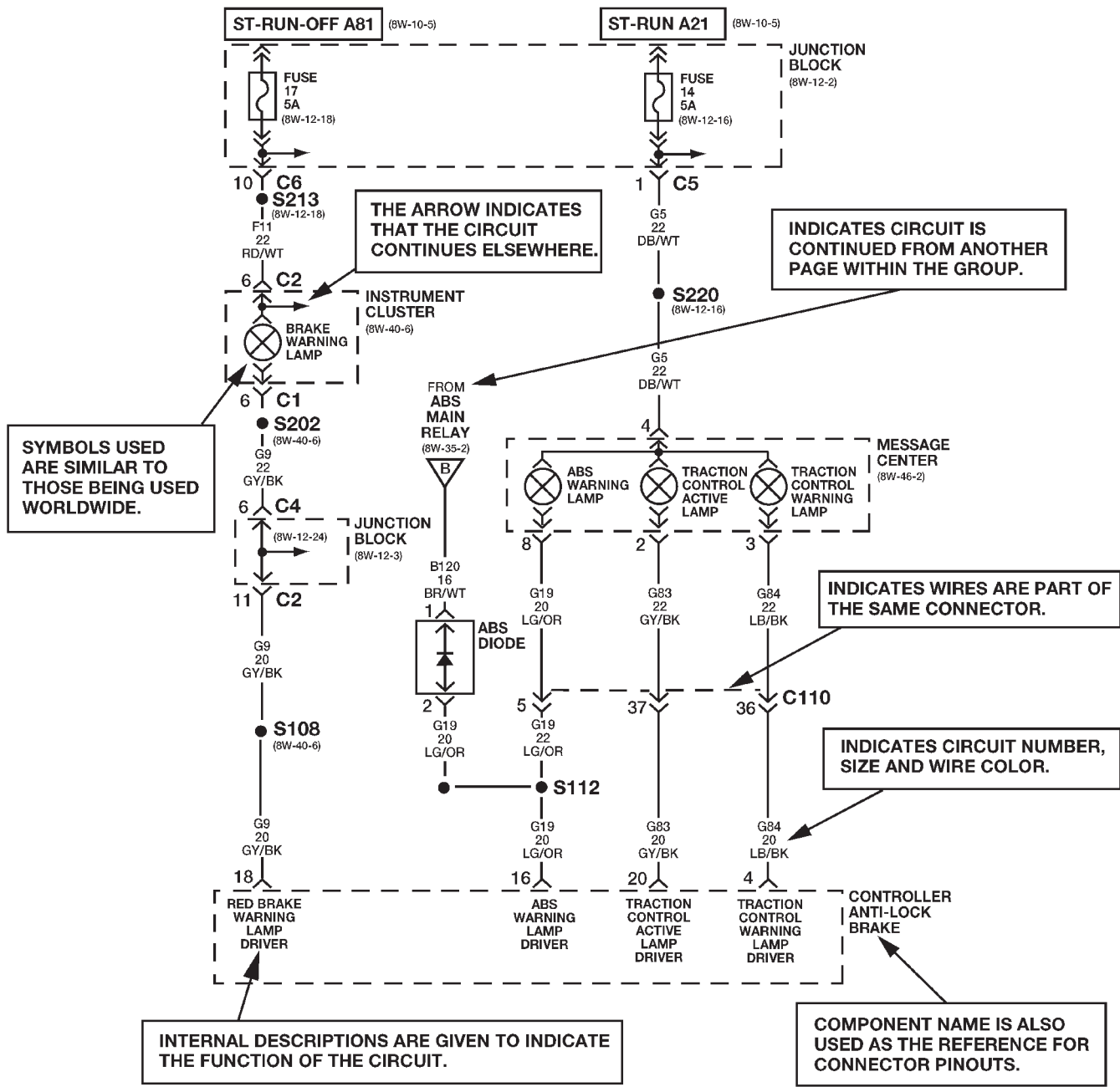
It is important to realize that no attempt is made on the diagrams to represent components and wiring as they appear on the vehicle. For example, a short piece of wire is treated the same as a long one. In addition, switches and other components are shown as simply as possible, with regard to function only.

#### SYMBOLS

International symbols are used throughout the wiring diagrams. These symbols are consistent with those being used around the world (Fig. 3).

WIRING DIAGRAM INFORMATION (Continued)

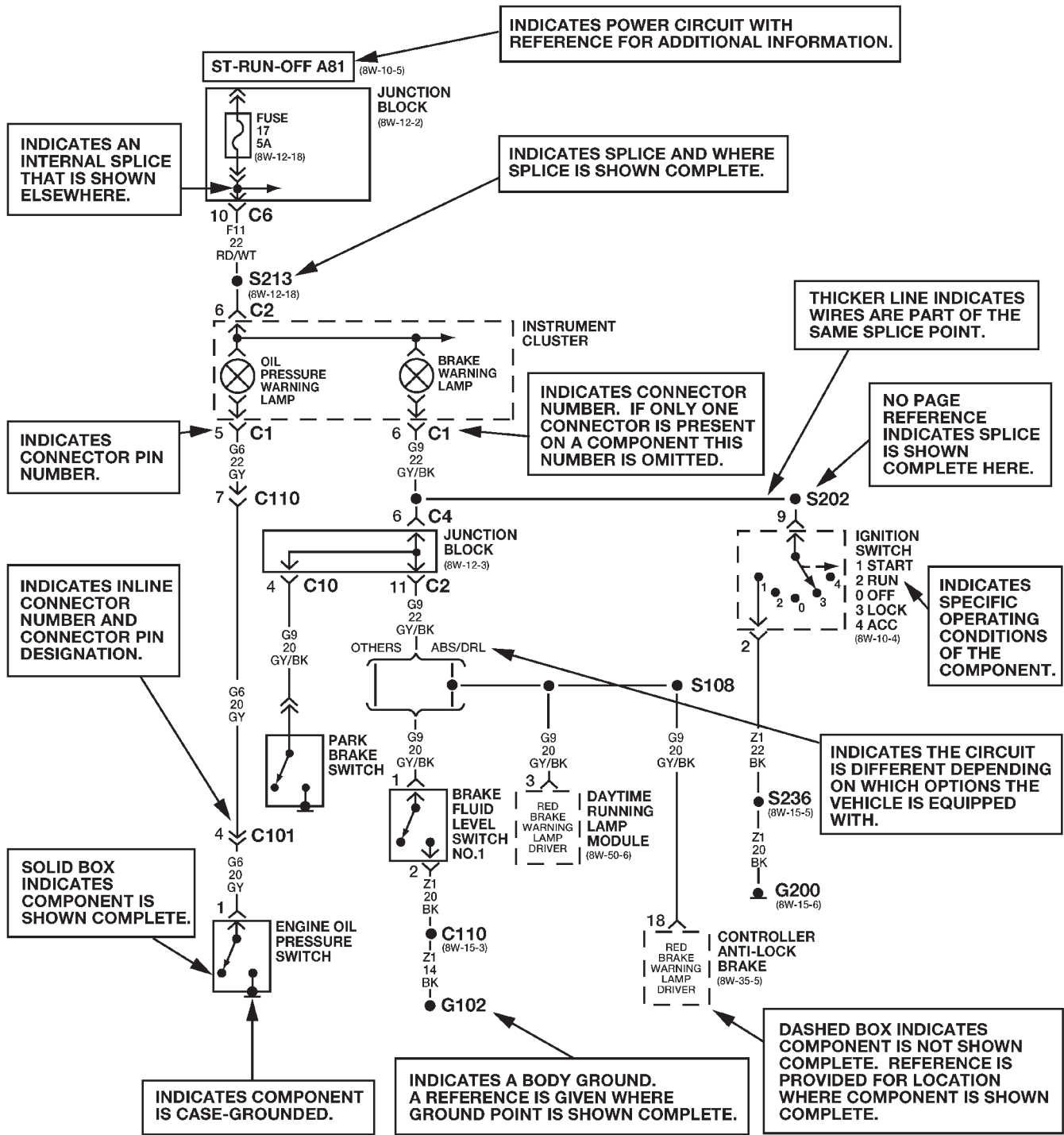
DIAGRAMS ARE ARRANGED WITH THE POWER B+ SIDE OF THE CIRCUIT NEAR THE TOP OF THE PAGE, AND THE GROUND SIDE OF THE CIRCUIT NEAR THE BOTTOM OF THE PAGE.



The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

Fig. 1 WIRING DIAGRAM EXAMPLE 1

WIRING DIAGRAM INFORMATION (Continued)



The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

Fig. 2 WIRING DIAGRAM EXAMPLE 2

WIRING DIAGRAM INFORMATION (Continued)

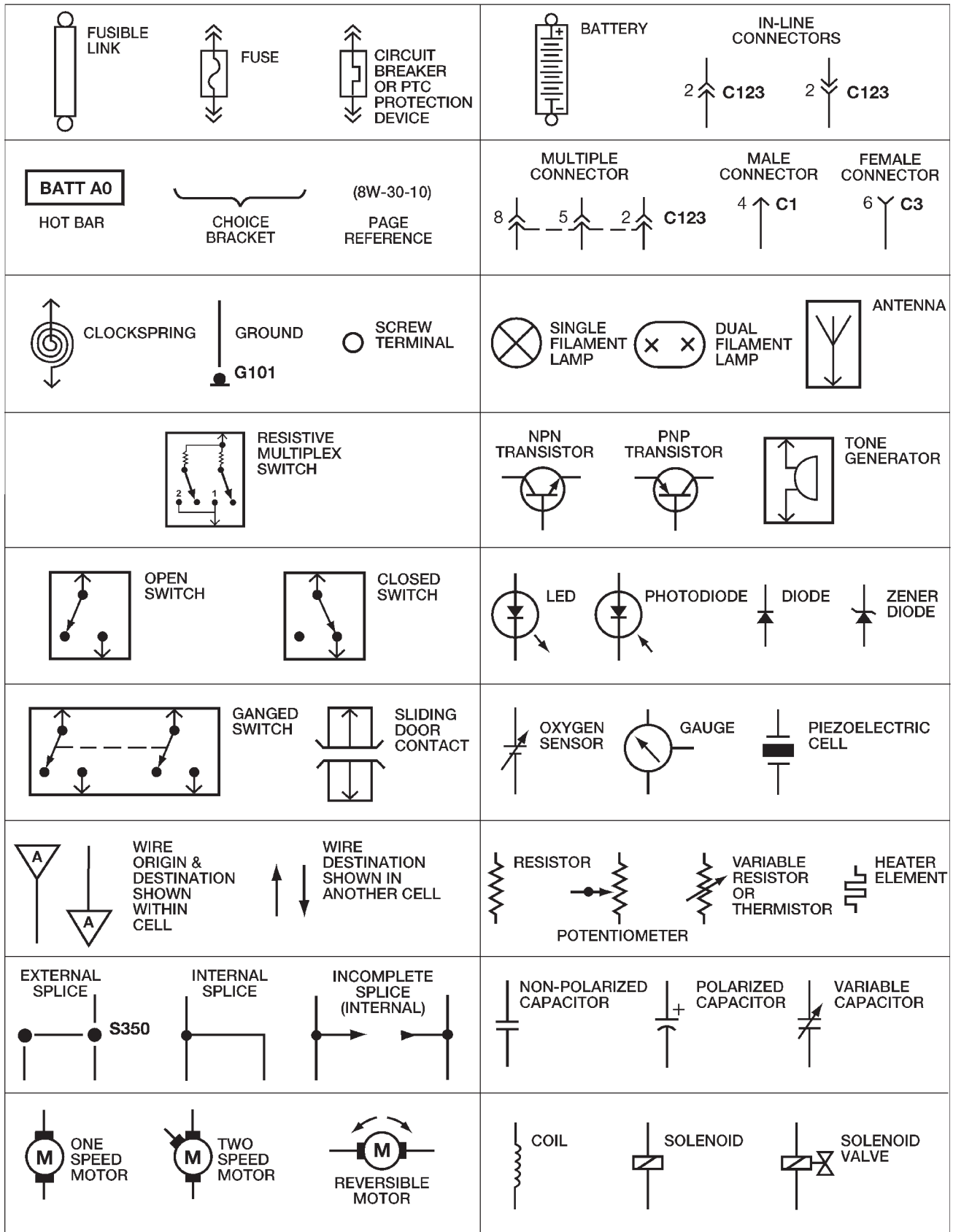


Fig. 3 WIRING DIAGRAM SYMBOLS

WIRING DIAGRAM INFORMATION (Continued)

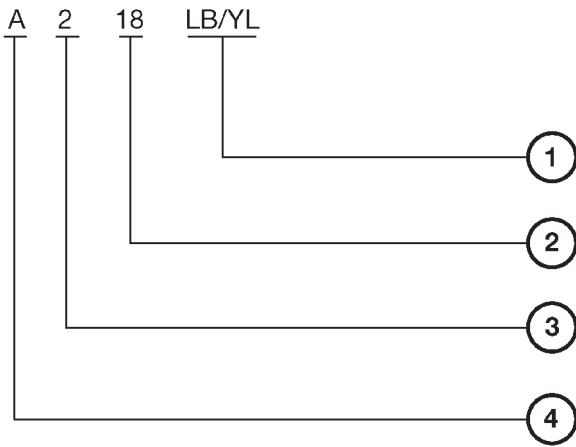
**TERMINOLOGY**

This is a list of terms and definitions used in the wiring diagrams.

- LHD . . . . . Left Hand Drive Vehicles
- RHD . . . . . Right Hand Drive Vehicles
- ATX . . . Automatic Transmissions-Front Wheel Drive
- MTX . . . Manual Transmissions-Front Wheel Drive
- AT . . . . Automatic Transmissions-Rear Wheel Drive
- MT . . . . Manual Transmissions-Rear Wheel Drive
- SOHC . . . . . Single Over Head Cam Engine
- DOHC . . . . . Double Over Head Cam Engine
- Built-Up-Export . . . . . Vehicles Built For Sale In  
Markets Other Than North America
- Except-Built-Up-Export . . Vehicles Built For Sale In  
North America

**DESCRIPTION - 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. 4).



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**Fig. 4 WIRE CODE IDENTIFICATION**

- 1 - COLOR OF WIRE (LIGHT BLUE WITH YELLOW TRACER)
- 2 - GAGE OF WIRE (18 GAGE)
- 3 - PART OF MAIN CIRCUIT (VARIES DEPENDING ON EQUIPMENT)
- 4 - MAIN CIRCUIT IDENTIFICATION

*WIRE COLOR CODE CHART*

COLOR CODE	COLOR
BL	BLUE
BK	BLACK
BR	BROWN
DB	DARK BLUE
DG	DARK GREEN
GY	GRAY
LB	LIGHT BLUE
LG	LIGHT GREEN

COLOR CODE	COLOR
OR	ORANGE
PK	PINK
RD	RED
TN	TAN
VT	VIOLET
WT	WHITE
YL	YELLOW
*	WITH TRACER

**DESCRIPTION - CIRCUIT FUNCTIONS**

All circuits in the diagrams use an alpha/numeric code to identify the wire and it's 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 IDENTIFICATION CODE CHART*

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



## WIRING DIAGRAM INFORMATION (Continued)

CIRCUIT	FUNCTION
U	OPEN
V	SPEED CONTROL, WIPER/ WASHER
W	OPEN
X	AUDIO SYSTEMS
Y	OPEN
Z	GROUNDS

**DESCRIPTION - SECTION IDENTIFICATION AND INFORMATION**

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.

Splice diagrams in Section 8W-70 show the entire splice and provide references to other sections the splice serves. Section 8W-70 only contains splice diagrams that are not shown in their entirety somewhere else in the wiring diagrams.

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.

*WIRING SECTION CHART*

GROUP	TOPIC
8Wa-01 thru 8W-09	General information and Diagram Overview
8Wa-10 thru 8W-19	Main Sources of Power and Vehicle Grounding
8Wa-20 thru 8W-29	Starting and Charging
8Wa-30 thru 8W-39	Powertrain/Drivetrain Systems
8Wa-40 thru 8W-49	Body Electrical items and A/C
8Wa-50 thru 8W-59	Exterior Lighting, Wipers and Trailer Tow
8Wa-60 thru 8W-69	Power Accessories
8Wa-70	Splice Information
8Wa-80	Connector Pin Outs
8Wa-91	Connector, Ground and Splice Locations

**DESCRIPTION - CONNECTOR, GROUND AND SPLICE 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 in the engine compartment are C100 series numbers
- In-line connectors located in the Instrument Panel area are C200 series numbers.
- In-line connectors located in the body 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 connectors.
- Splices are identified with an "S" and follow the same series numbering as the in-line connectors.
- Component connectors are identified by the component name instead of a number. Multiple connectors on a component use a C1, C2, etc. identifier.

**LOCATIONS**

Section 8W-91 contains connector/ground/splice location illustrations. The illustrations contain the connector name (or number)/ground number/splice number and component identification. Connector/ground/splice location charts in section 8W-91 reference the figure numbers of the illustrations.

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. The abbreviation N/S means Not Shown in the illustrations

**WARNINGS - GENERAL**

**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.**

## WIRING DIAGRAM INFORMATION (Continued)

**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.**

**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 AVOID LOOSE CLOTHING.**

## DIAGNOSIS AND TESTING - WIRING HARNESS

### 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.

**WARNING: NEVER USE A JUMPER WIRE ACROSS A LOAD, SUCH AS A MOTOR, CONNECTED BETWEEN A BATTERY FEED AND GROUND.**

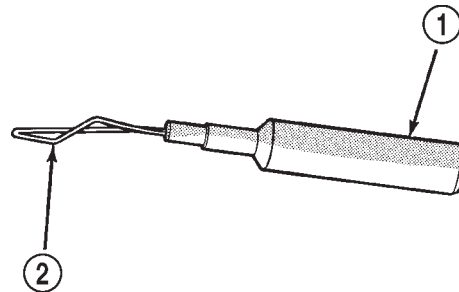
- **Voltmeter** - Used to check for voltage on a circuit. Always connect the black lead to a known good ground and the red lead to the positive side of the circuit.

**CAUTION: Most of the electrical components used in today's vehicles 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 vehicles 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's 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.



948W-233

**Fig. 5 PROBING TOOL**

- 1 - SPECIAL TOOL 6801  
2 - PROBING END

## 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 into position
  - 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 or moisture
  - Wire insulation that has rubbed through causing a short to ground
  - Some or all of the wiring strands broken inside of the insulation
  - Wiring broken inside of the insulation

## WIRING DIAGRAM INFORMATION (Continued)

**TROUBLESHOOTING WIRING PROBLEMS**

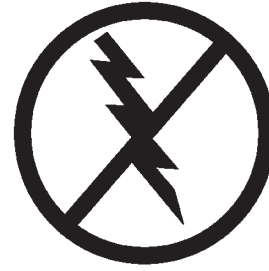
When troubleshooting wiring problems there are six steps which can aid in the procedure. The steps are listed and explained below. Always check for non-factory items added to the vehicle before doing any diagnosis. If the vehicle is equipped with these items, disconnect them to verify these add-on items 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 area.
- (6) Verify the proper operation. For this step, check for proper operation of all items on the repaired circuit. Refer to the wiring diagrams.

**STANDARD PROCEDURE****STANDARD PROCEDURE - ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES**

All ESD sensitive components are solid state and a symbol (Fig. 6) 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.

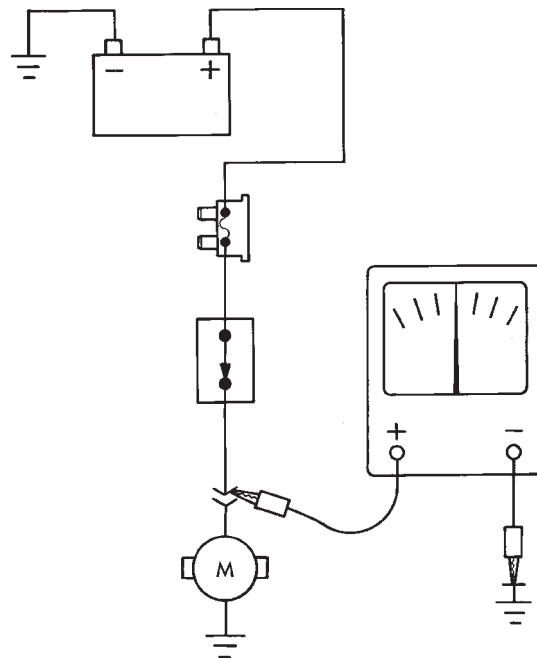
- (1) Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position, or walking a distance.
- (2) Avoid touching electrical terminals of the part, unless instructed to do 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.



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**Fig. 6 ELECTROSTATIC DISCHARGE SYMBOL****STANDARD PROCEDURE - TESTING OF VOLTAGE POTENTIAL**

- (1) Connect the ground lead of a voltmeter to a known good ground (Fig. 7).
- (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.

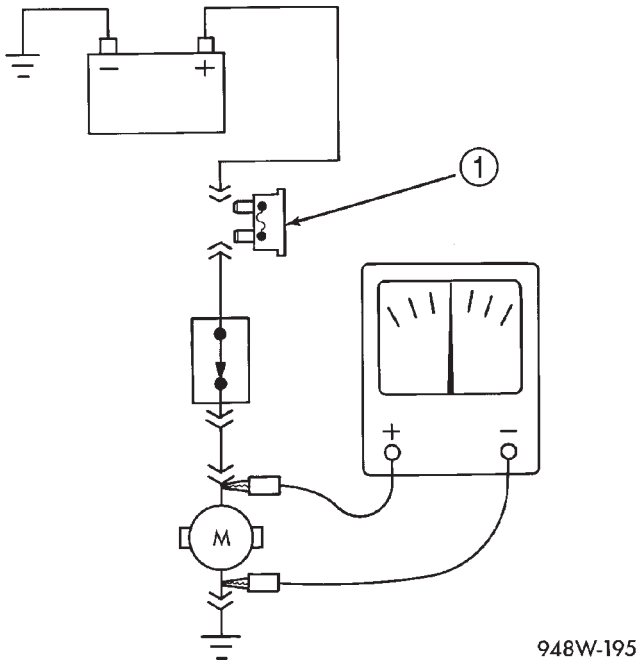


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**Fig. 7 TESTING FOR VOLTAGE POTENTIAL****STANDARD PROCEDURE - TESTING FOR CONTINUITY**

- (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. 8).
- (3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

WIRING DIAGRAM INFORMATION (Continued)



948W-195

**Fig. 8 TESTING FOR CONTINUITY**

1 - FUSE REMOVED FROM CIRCUIT

**STANDARD PROCEDURE - TESTING FOR A SHORT TO GROUND**

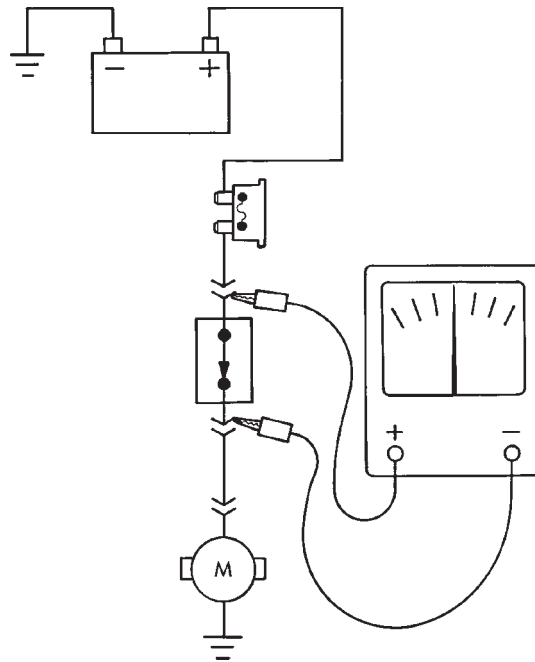
- (1) Remove the fuse and disconnect all items involved with the fuse.
- (2) Connect a test light or a voltmeter across the terminals of the fuse.
- (3) Starting at the fuse block, wiggle the wiring harness about six to eight inches apart and watch the voltmeter/test lamp.
- (4) If the voltmeter registers voltage or the test lamp glows, there is a short to ground in that general area of the wiring harness.

**STANDARD PROCEDURE - 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.
- (3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.
- (4) Start connecting or energizing the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

**STANDARD PROCEDURE - TESTING FOR A VOLTAGE DROP**

- (1) Connect the positive lead of the voltmeter to the side of the circuit closest to the battery (Fig. 9).
- (2) Connect the other lead of the voltmeter to the other side of the switch, component or circuit.
- (3) Operate the item.
- (4) The voltmeter will show the difference in voltage between the two points.



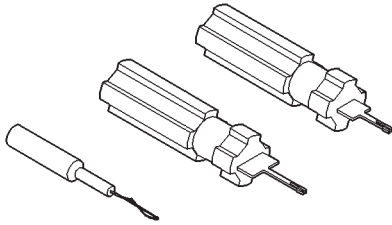
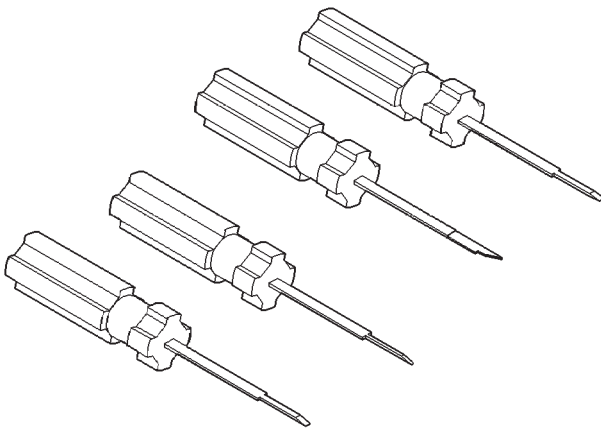
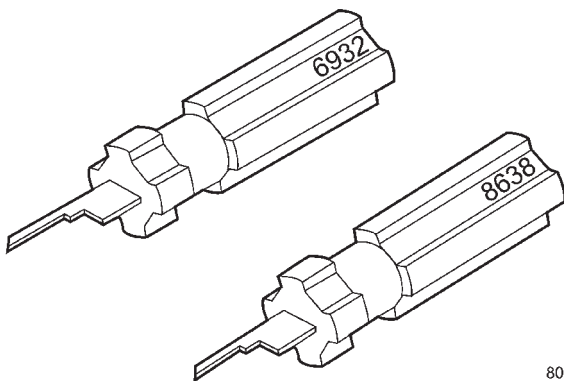
948W-196

**Fig. 9 TESTING FOR VOLTAGE DROP**

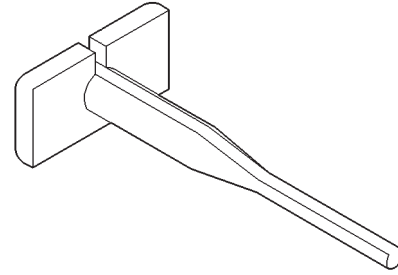
## WIRING DIAGRAM INFORMATION (Continued)

## SPECIAL TOOLS

## WIRING/TERMINAL

**PROBING TOOL PACKAGE 6807****TERMINAL PICK TOOL SET 6680**

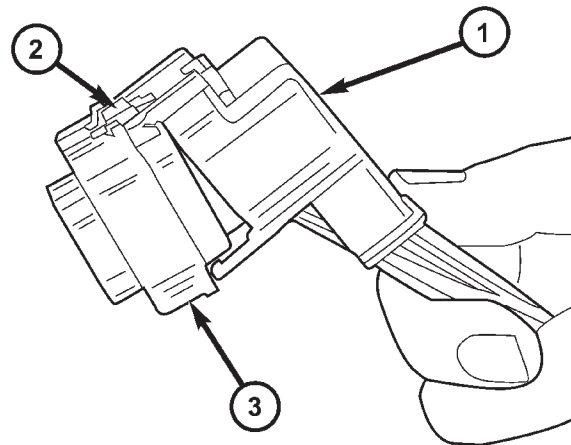
8091c8da

**TERMINAL REMOVING TOOLS 6932 AND 8638****TERMINAL REMOVING TOOL 6934**

## CONNECTOR

## REMOVAL

- (1) Disconnect battery.
- (2) Release Connector Lock (Fig. 10).
- (3) Disconnect the connector being repaired from its mating half/component.
- (4) Remove the dress cover (if applicable) (Fig. 10).



80c97bac

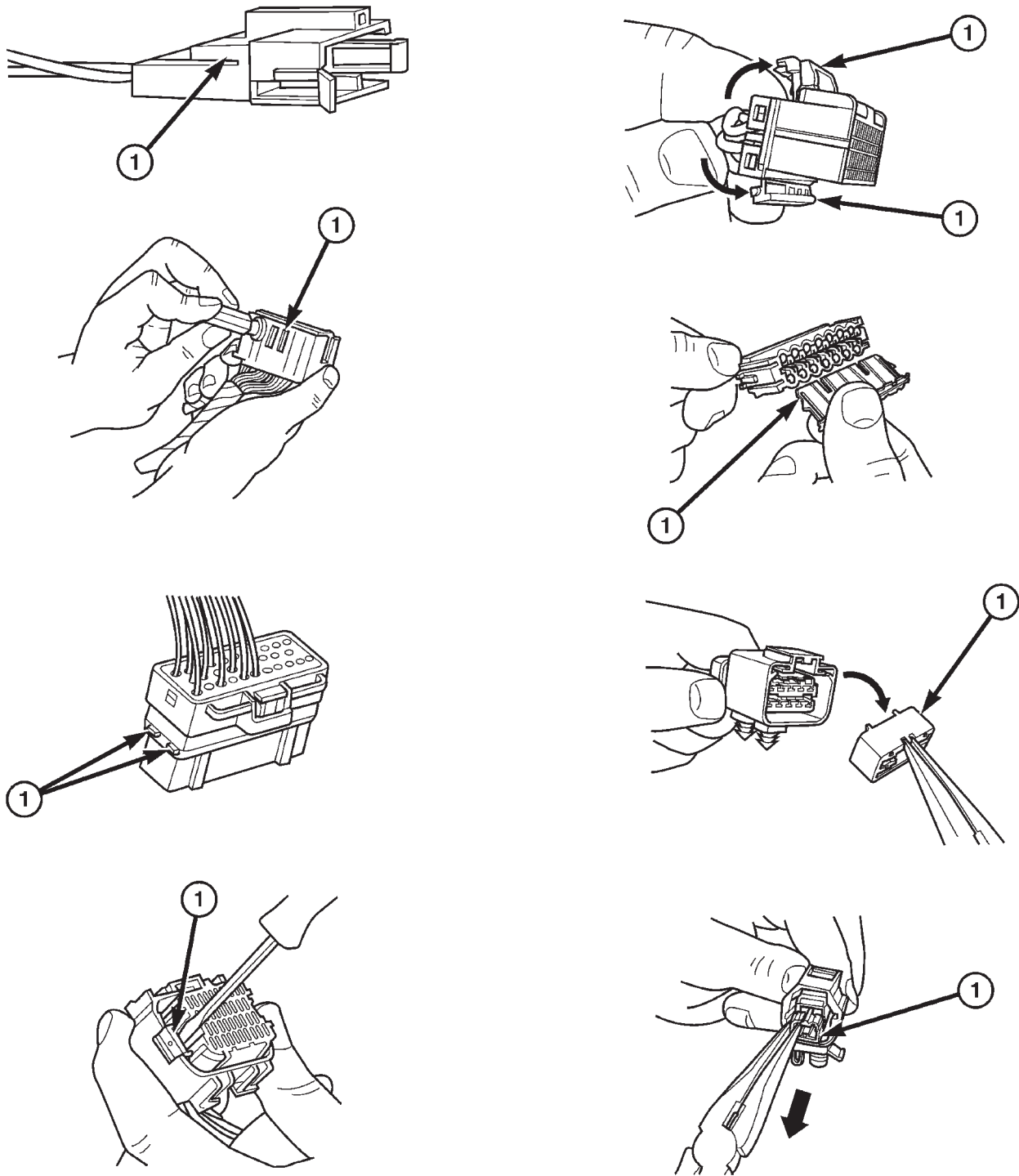
**Fig. 10 REMOVAL OF DRESS COVER**

- 1 - DRESS COVER
- 2 - CONNECTOR LOCK
- 3 - CONNECTOR

(5) Release the Secondary Terminal Lock, if required (Fig. 11).

(6) Position the connector locking finger away from the terminal using the proper special tool. Pull on the wire to remove the terminal from the connector (Fig. 12).

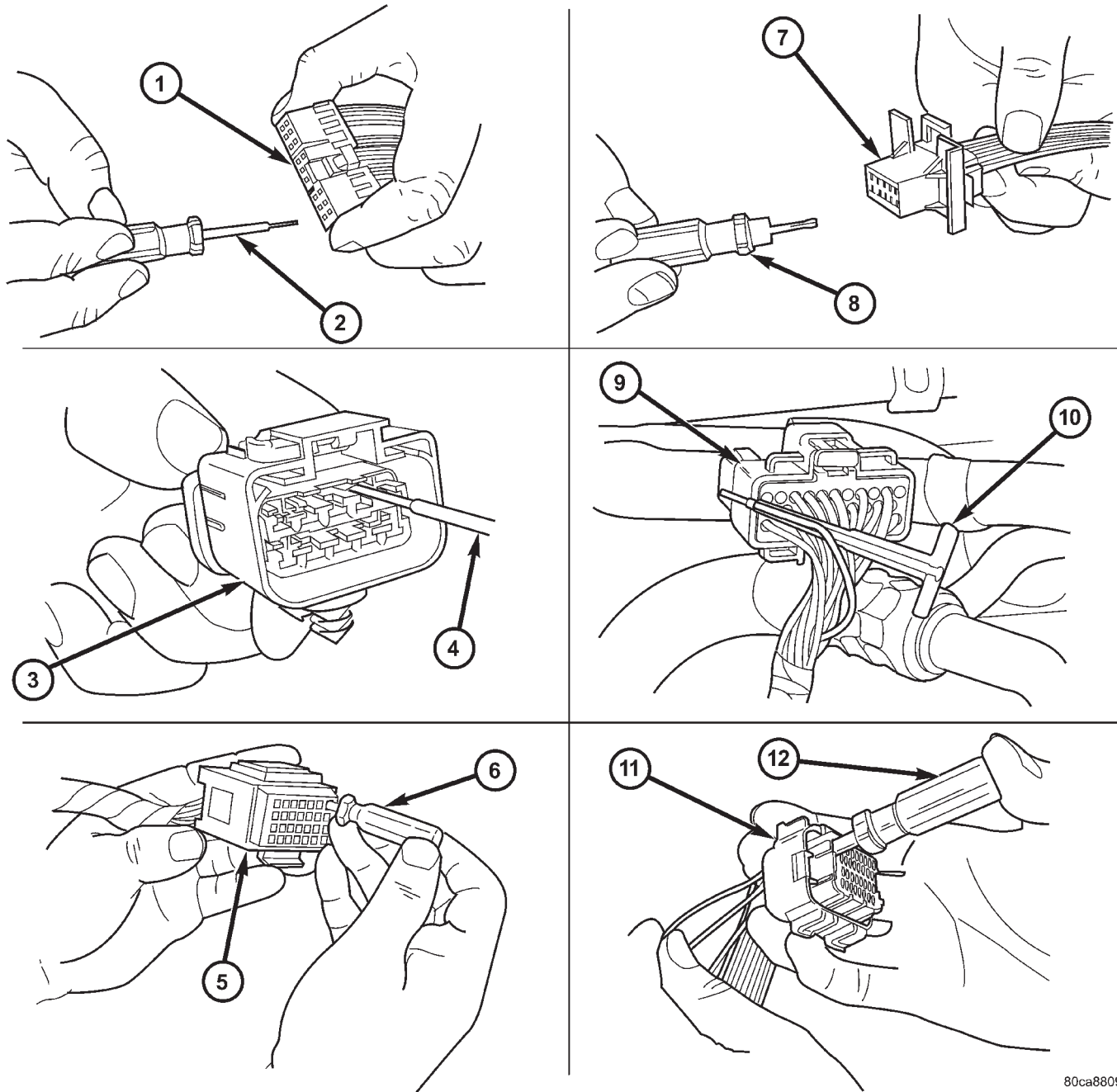
CONNECTOR (Continued)



80ca8802

**Fig. 11 EXAMPLES OF CONNECTOR SECONDARY TERMINAL LOCKS**

## CONNECTOR (Continued)



80ca8809

**Fig. 12 TERMINAL REMOVAL**

- 1 - TYPICAL CONNECTOR
- 2 - PICK FROM SPECIAL TOOL KIT 6680
- 3 - APEX CONNECTOR
- 4 - PICK FROM SPECIAL TOOL KIT 6680
- 5 - AUGAT CONNECTOR
- 6 - SPECIAL TOOL 6932
- 7 - MOLEX CONNECTOR

- 8 - SPECIAL TOOL 6742
- 9 - THOMAS AND BETTS CONNECTOR
- 10 - SPECIAL TOOL 6934
- 11 - TYCO CONNECTOR
- 12 - SPECIAL TOOL 8638

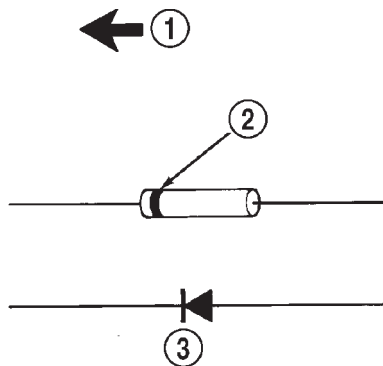
## CONNECTOR (Continued)

**INSTALLATION**

- (1) Insert the removed terminal in the same cavity on the repair connector.
- (2) Repeat steps for each terminal 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.
- (3) When the connector is re-assembled, the secondary terminal lock must be placed in the locked position to prevent terminal push out.
- (4) Replace dress cover (if applicable).
- (5) Connect connector to its mating half/component.
- (6) Connect battery and test all affected systems.

**DIODE****REMOVAL**

- (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. 13).



948W-197

**Fig. 13 DIODE IDENTIFICATION**

- 1 - CURRENT FLOW  
 2 - BAND AROUND DIODE INDICATES CURRENT FLOW  
 3 - DIODE AS SHOWN IN THE DIAGRAMS

**INSTALLATION**

- (1) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(2) Install the new diode in the harness, making sure current flow is correct. If necessary, refer to the appropriate wiring diagram for current flow (Fig. 13).

(3) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(4) Tape the diode to the harness using electrical tape. Make sure the diode is completely sealed from the elements.

(5) Re-connect the battery and test affected systems.

**TERMINAL****REMOVAL**

- (1) Follow steps for removing terminals described in the connector removal section.
- (2) Cut the wire 6 inches from the back of the connector.

**INSTALLATION**

(1) Select a wire from the terminal repair kit that best matches the color and gage of the wire being repaired.

(2) Cut the repair wire to the proper length and remove one-half (1/2) inch of insulation.

(3) Splice the repair wire to the wire harness (see wire splicing procedure).

(4) Insert the repaired wire into the connector.

(5) Install the connector locking wedge, if required, and reconnect the connector to its mating half/component.

(6) Re-tape the wire harness starting at 1-1/2 inches behind the connector and 2 inches past the repair.

(7) Connect battery and test all affected systems.

**WIRE****STANDARD PROCEDURE - WIRE SPLICING**

When splicing a wire, it is important that the correct gage be used as shown in the wiring diagrams.

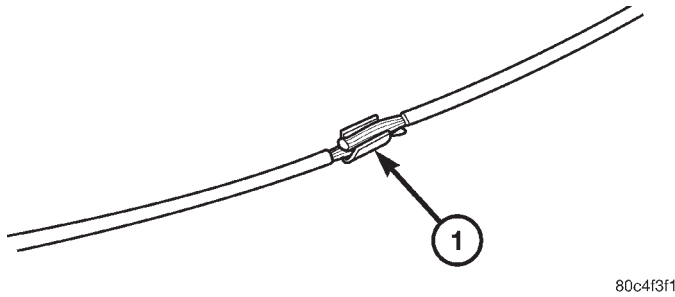
(1) Remove one-half (1/2) inch of insulation from each wire that needs to be spliced.

(2) Place a piece of adhesive lined heat shrink tubing on one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.



WIRE (Continued)

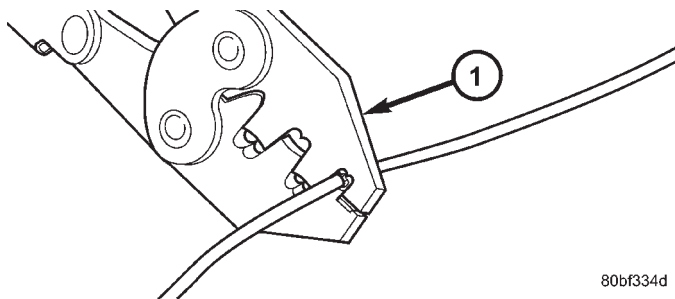
(3) Place the strands of wire overlapping each other inside of the splice clip (Fig. 14).



**Fig. 14 SPLICE BAND**

- 1 - SPLICE BAND

(4) Using crimping tool, Mopar p/n 05019912AA, crimp the splice clip and wires together (Fig. 15).

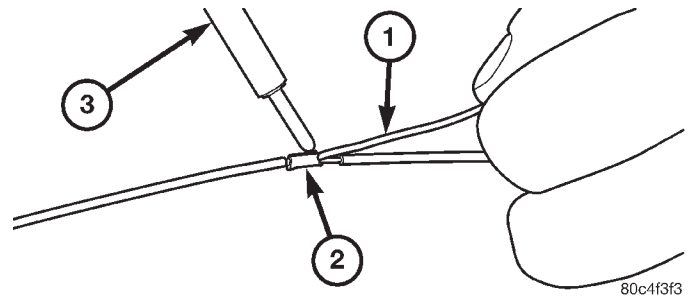


**Fig. 15 CRIMPING TOOL**

- 1 - CRIMPING TOOL

(5) Solder the connection together using rosin core type solder only (Fig. 16).

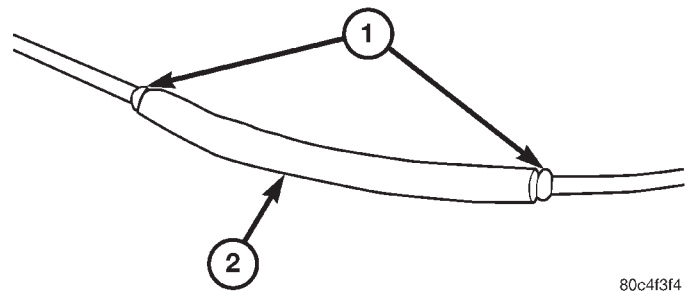
**CAUTION: DO NOT USE ACID CORE SOLDER.**



**Fig. 16 SOLDER SPLICE**

- 1 - SOLDER
- 2 - SPLICE BAND
- 3 - SOLDERING IRON

(6) 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 (Fig. 17).



**Fig. 17 HEAT SHRINK TUBE**

- 1 - SEALANT
- 2 - HEAT SHRINK TUBE

## 8W-02 COMPONENT INDEX

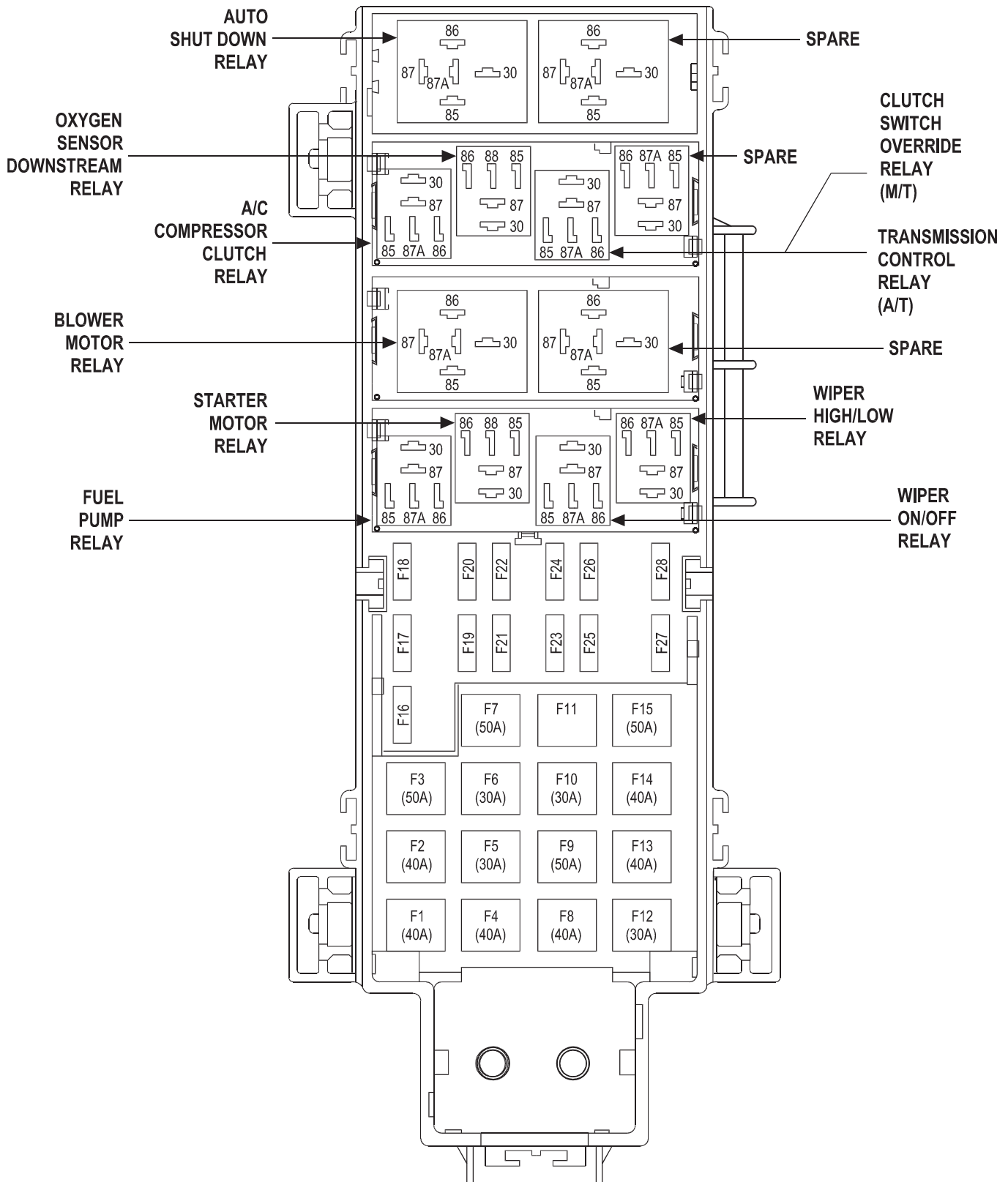
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C Compressor Clutch Relay	8Wa-42	Door Lock Switches	8Wa-61
A/C Compressor Clutch	8Wa-42	Door Speakers	8Wa-47
A/C-Heater Control	8Wa-42	Driver Airbag Squib 1	8Wa-43
A/C High Pressure Switch	8Wa-42	Driver Airbag Squib 2	8Wa-43
A/C Low Pressure Switch	8Wa-42	Driver Door Unlock Relay	8Wa-61
A/C Pressure Transducer	8Wa-42	Driver Seat Belt Switch	8Wa-40
Accelerator Pedal Position Sensor	8Wa-30	Driver Seat Belt Tensioner	8Wa-43
Airbag Control Module	8Wa-43	EGR Solenoid	8Wa-30
Ambient Temperature Sensor	8Wa-45	Electric Brake Provision	8Wa-54
Antenna Module	8Wa-47	Engine Control Module	8Wa-30
Antenna	8Wa-47	Engine Coolant Level Sensor	8Wa-40
Ash Receiver Lamp	8Wa-44	Engine Coolant Temperature Sensor	8Wa-30
Auto Shut Down Relay	8Wa-30	Engine Oil Pressure Sensor	8Wa-30
Back-Up Lamp Switch	8Wa-31	EVAP/Purge Solenoid	8Wa-30
Battery Temperature Sensor	8Wa-20, 30	Flip-Up Glass Release Motor	8Wa-61
Battery	8Wa-20	Flip-Up Glass Release Switch	8Wa-61
Blend Door Actuator	8Wa-42	Fog Lamps	8Wa-50
Blower Motor Relay	8Wa-42	Front Fog Lamp Relay	8Wa-50
Blower Motor Resistor Block	8Wa-42	Front Wiper Motor	8Wa-53
Blower Motor	8Wa-42	Fuel Heater Relay	8Wa-30
Body Control Module	8Wa-45	Fuel Heater	8Wa-30
Boost Pressure Sensor	8Wa-30	Fuel Injectors	8Wa-30
Brake Lamp Switch	8Wa-33	Fuel Pressure Sensor	8Wa-30
Brake Pressure Switch	8Wa-35	Fuel Pressure Solenoid	8Wa-30
Cabin Heater Relay	8Wa-42	Fuel Pump Module	8Wa-30
Cabin Heater	8Wa-42	Fuel Pump Relay	8Wa-30
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Capacitor	8Wa-30	Fusible Link	8Wa-20
Cargo Lamp	8Wa-44	Grounds	8Wa-15
CD Changer	8Wa-47	Generator	8Wa-20
Center High Mounted Stop Lamp	8Wa-51	Glow Plugs	8Wa-30
Cigar Lighter	8Wa-41	Hazard Switch/Combination Flasher	8Wa-52
Circuit Breakers	8Wa-12	Headlamp Leveling Switch	8Wa-50
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Clutch Switch Override Relay	8Wa-21	High Beam Relay	8Wa-50
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Coil Rail	8Wa-30	Hood Ajar Switch	8Wa-45
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Controller Antilock Brake	8Wa-35	Ignition Switch	8Wa-10
Courtesy Lamps	8Wa-44	Impact Sensors	8Wa-43
Crankshaft Position Sensor	8Wa-30	Input Speed Sensor	8Wa-31
Curtain Airbags	8Wa-43	Instrument Cluster	8Wa-40
Cylinder Lock Switches	8Wa-61	Instrument Panel Speakers	8Wa-47
Data Link Connector	8Wa-18	Intake Air Temperature Sensor	8Wa-30
Daytime Running Lamp Relay	8Wa-50	Intrusion Sensor	8Wa-49
Defogger Relay	8Wa-48	Junction Block	8Wa-12
Diagnostic Junction Port	8Wa-18	Knock Sensor	8Wa-30
Dome Lamp	8Wa-44	Leak Detection Pump	8Wa-30
Door Ajar Switches	8Wa-45	Leveling Motors	8Wa-50
Door Lock Motor/Ajar Switches	8Wa-61	License Lamp	8Wa-51
Door Lock Relay	8Wa-61	Line Pressure Sensor	8Wa-31

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
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Manifold Absolute Pressure Sensor . . . . .	8Wa-30	Remote Radio Switches . . . . .	8Wa-47
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Passenger Seat Belt Switch . . . . .	8Wa-40	Starter Motor . . . . .	8Wa-21
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Power Distribution Center . . . . .	8Wa-10	Tail/Stop Lamps . . . . .	8Wa-51
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Power Outlet . . . . .	8Wa-41	Tailgate Flip-Up Ajar Switch . . . . .	8Wa-61
Power Seats . . . . .	8Wa-63	Tailgate Lock Motor/Ajar Switch . . . . .	8Wa-61
Power Steering Pressure Switch . . . . .	8Wa-30	Throttle Position Sensor . . . . .	8Wa-30
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Radiator Fans . . . . .	8Wa-30	Transmission Control Module . . . . .	8Wa-31
Radio Choke . . . . .	8Wa-47	Transmission Control Relay . . . . .	8Wa-31
Radio . . . . .	8Wa-47	Transmission Solenoid/TRS Assembly . . . . .	8Wa-31
Rear Fog Lamp Relay . . . . .	8Wa-51	Visor/Vanity Lamps . . . . .	8Wa-44
Rear Power Outlet . . . . .	8Wa-41	Washer Fluid Level Switch . . . . .	8Wa-53
Rear Power Window Switch . . . . .	8Wa-60	Washer Pump . . . . .	8Wa-53
Rear Wheel Speed Sensor . . . . .	8Wa-35	Water In Fuel Sensor . . . . .	8Wa-30
Rear Window Defogger . . . . .	8Wa-48	Wheel Speed Sensors . . . . .	8Wa-35
Rear Wiper Motor . . . . .	8Wa-53	Wiper High/Low Relay . . . . .	8Wa-53
Red Brake Warning Indicator Switch . . . . .	8Wa-40		

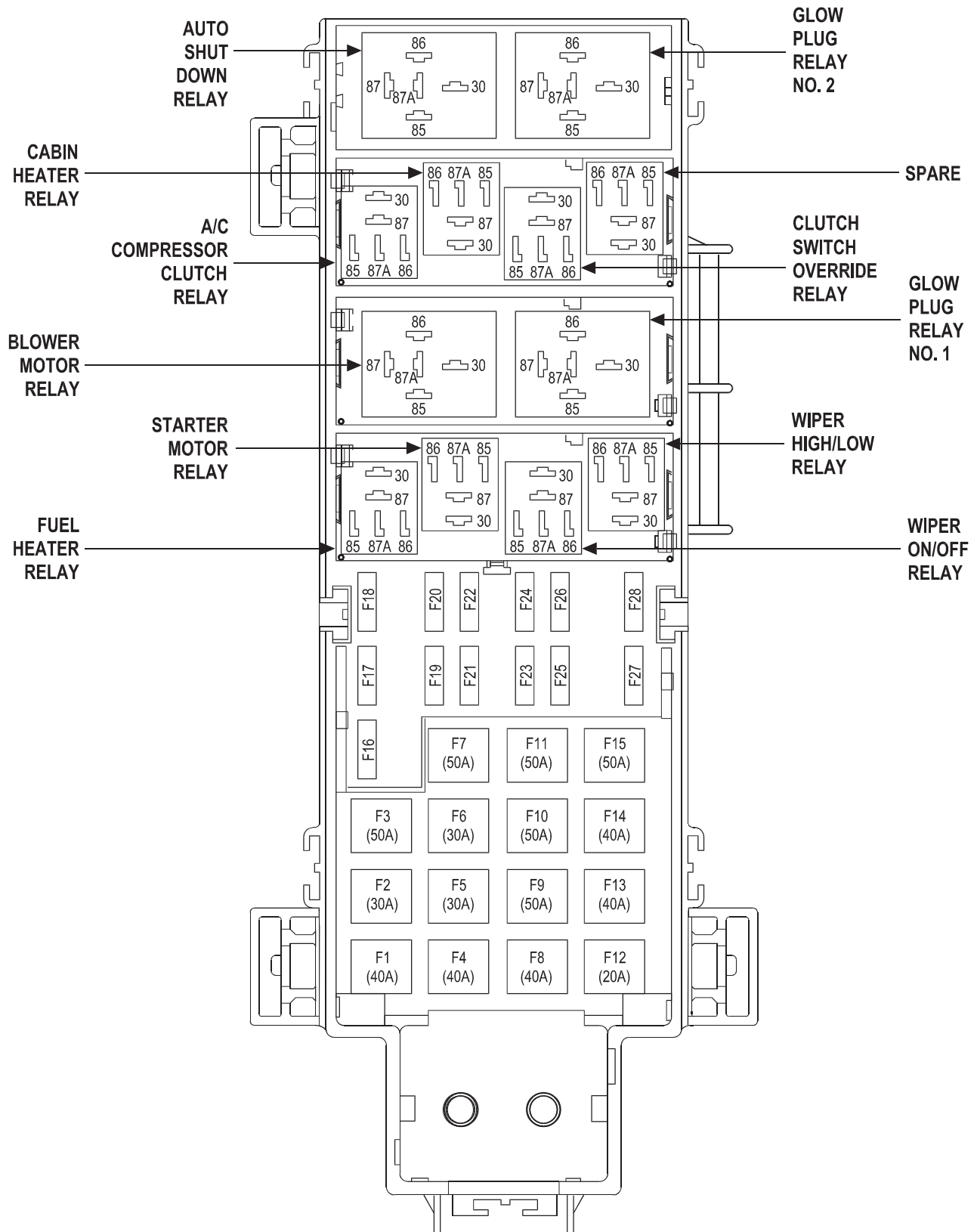
## 8W-10 POWER DISTRIBUTION

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A/C Compressor Clutch Relay . . .	8Wa-10-11, 13, 22, 26	Fuse 16 . . . . .	8Wa-10-19, 20, 22, 24
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Auto Shut Down Relay . . . . .	8Wa-10-10, 12, 19, 22	Fuse 18 . . . . .	8Wa-10-24
Battery . . . . .	8Wa-10-10, 12	Fuse 19 . . . . .	8Wa-10-11, 13, 24
Blower Motor Relay . . . . .	8Wa-10-10, 12, 14	Fuse 20 . . . . .	8Wa-10-27
Blower Motor . . . . .	8Wa-10-14	Fuse 21 . . . . .	8Wa-10-11, 13, 26
Body Control Module . . . . .	8Wa-10-23	Fuse 22 . . . . .	8Wa-10-27
Cabin Heater Relay . . . . .	8Wa-10-13, 22, 26	Fuse 24 . . . . .	8Wa-10-11, 26, 29
Cabin Heater . . . . .	8Wa-10-26	Fuse 25 . . . . .	8Wa-10-11, 13, 14, 29
Camshaft Position Sensor . . . . .	8Wa-10-22	Fuse 26 . . . . .	8Wa-10-12, 19, 20, 22
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Circuit Breaker No. 1 . . . . .	8Wa-10-16	Fuse 29 . . . . .	8Wa-10-15
Circuit Breaker No. 3 (JB) . . . . .	8Wa-10-27	Fuse 30 . . . . .	8Wa-10-24
Clutch Interlock Switch . . . . .	8Wa-10-28	Fuse 31 . . . . .	8Wa-10-27
Clutch Switch Override Relay . . . . .	8Wa-10-28	Fuse 32 . . . . .	8Wa-10-27
Coil On Plug No. 1 . . . . .	8Wa-10-21	Fuse 33 . . . . .	8Wa-10-16
Coil On Plug No. 2 . . . . .	8Wa-10-21	Fuse 34 . . . . .	8Wa-10-15
Coil On Plug No. 3 . . . . .	8Wa-10-21	Fuse 36 . . . . .	8Wa-10-27
Coil On Plug No. 4 . . . . .	8Wa-10-21	Fuse 37 . . . . .	8Wa-10-29
Coil On Plug No. 5 . . . . .	8Wa-10-21	Fuse 38 . . . . .	8Wa-10-29
Coil On Plug No. 6 . . . . .	8Wa-10-21	Fuse 39 . . . . .	8Wa-10-29
Coil Rail . . . . .	8Wa-10-19	Fusible Link . . . . .	8Wa-10-10, 12
Controller Antilock Brake .	8Wa-10-10, 11, 12, 13, 14	G202 . . . . .	8Wa-10-23
Daytime Running Lamp Relay . . . . .	8Wa-10-16	Generator . . . . .	8Wa-10-10, 12, 22
Defogger Relay . . . . .	8Wa-10-24	Glow Plug Assembly . . . . .	8Wa-10-18
EGR Solenoid . . . . .	8Wa-10-22	Glow Plug Relay No. 1 . . . . .	8Wa-10-13, 18, 22
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Fuel Heater . . . . .	8Wa-10-18	Horn Relay . . . . .	8Wa-10-25
Fuel Injector No. 1 . . . . .	8Wa-10-20	Ignition Switch . . .	8Wa-10-10, 11, 12, 13, 23, 27, 29
Fuel Injector No. 2 . . . . .	8Wa-10-20	Junction Block . . .	8Wa-10-10, 11, 12, 13, 15, 16, 24, 25, 27, 29
Fuel Injector No. 3 . . . . .	8Wa-10-20	Low Beam Relay . . . . .	8Wa-10-25
Fuel Injector No. 4 . . . . .	8Wa-10-20	Oxygen Sensor 1/1 Upstream . . . . .	8Wa-10-19
Fuel Injector No. 5 . . . . .	8Wa-10-20	Oxygen Sensor 1/2 Downstream . . . . .	8Wa-10-19, 20
Fuel Injector No. 6 . . . . .	8Wa-10-20	Oxygen Sensor 2/1 Upstream . . . . .	8Wa-10-19
Fuel Pressure Solenoid . . . . .	8Wa-10-22	Oxygen Sensor 2/2 Downstream . . . . .	8Wa-10-20
Fuel Pump Module . . . . .	8Wa-10-26	Oxygen Sensor Downstream Relay . .	8Wa-10-19, 20
Fuel Pump Relay . . . . .	8Wa-10-11, 26	Park Lamp Relay . . . . .	8Wa-10-16
Fuse 1 . . . . .	8Wa-10-10, 12, 14, 25	Power Distribution Center .	8Wa-10-2, 3, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27, 28
Fuse 2 . . . . .	8Wa-10-10, 12, 14, 15	Power Window Master Switch . . . . .	8Wa-10-29
Fuse 3 . . . . .	8Wa-10-10, 12, 16, 25	Powertrain Control Module . .	8Wa-10-11, 19, 26, 28
Fuse 4 . . . . .	8Wa-10-10, 12, 14	Radiator Fan Relay . . . . .	8Wa-10-10, 14
Fuse 5 . . . . .	8Wa-10-10, 12, 17, 18	Starter Motor Relay . . . . .	8Wa-10-23, 28
Fuse 6 . . . . .	8Wa-10-10, 12, 19, 22, 24	Starter Motor . . . . .	8Wa-10-23
Fuse 7 . . . . .	8Wa-10-10, 12, 15	Trailer Tow Circuit Breaker . . . . .	8Wa-10-10, 12, 15
Fuse 8 . . . . .	8Wa-10-10, 12, 23	Trailer Tow Circuit Breaker . . . . .	8Wa-10-15
Fuse 9 . . . . .	8Wa-10-10, 12, 13, 24	Trailer Tow Connector . . . . .	8Wa-10-15
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Fuse 11 . . . . .	8Wa-10-13, 15, 18	Transmission Control Module . . .	8Wa-10-10, 17, 28
Fuse 12 . . . . .	8Wa-10-10, 11, 13, 15, 17, 18	Transmission Control Relay . . . . .	8Wa-10-10, 17
Fuse 13 . . . . .	8Wa-10-10, 11, 13, 23, 27	Transmission Solenoid/TRS Assembly . . .	8Wa-10-17
Fuse 14 . . . . .	8Wa-10-11, 13, 23		
Fuse 15 . . . . .	8Wa-10-11, 13, 25, 27		

POWER DISTRIBUTION CENTER  
GAS



POWER DISTRIBUTION CENTER  
DIESEL



**FUSES  
(GAS)**

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	40A	A122 12OR	FUSED B(+)
2	40A	C24 12DB/PK	FUSED B(+)
3	50A	A13 10PK/WT	FUSED B(+)
4	40A	A10 12RD/DG ■	FUSED B(+)
5	30A	A30 14RD/WT ■■	FUSED B(+)
		A30 14RD/WT ■■	FUSED B(+)
6	30A	A9 14RD/YL	FUSED B(+)
7	50A	A7 10RD/BK	FUSED B(+)
8	40A	A2 12PK/BK	FUSED B(+)
9	50A	A18 10PK	FUSED B(+)
10	30A	A99 14RD/VT	FUSED B(+)
11	-	-	-
12	30A	A32 14RD/DB ■■■	FUSED B(+)
13	40A	A25 12DB	FUSED B(+)
14	40A	A1 12RD	FUSED B(+)
15	50A	A12 10RD/TN	FUSED B(+)
16	15A	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
		A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
17	-	-	-
18	-	-	-
19	30A	A4 12BK/PK	FUSED B(+)
20	-	-	-
21	20A	A17 18RD/BK	FUSED B(+)
22	-	-	-
23	-	-	-
24	20A	A14 16RD/WT	FUSED B(+)
		A14 16RD/WT	FUSED B(+)
25	20A	A20 12RD/DB ■	FUSED B(+)
26	15A	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
		F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
27	-	-	-
28	15A	F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)
		F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)

■ ABS  
 ■■ A/T  
 ■■■ SECURITY A/T

**FUSES  
(DIESEL)**

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	40A	A122 12OR	FUSED B(+)
2	30A	A99 14RD/VT	FUSED B(+)
3	50A	A13 10PK/WT	FUSED B(+)
4	40A	A10 12RD/DG	FUSED B(+)
5	30A	A32 14RD/DB	FUSED B(+)
6	30A	A9 14RD/YL	FUSED B(+)
		A9 14RD/YL	FUSED B(+)
7	50A	A7 10RD/BK	FUSED B(+)
8	40A	A2 12PK/BK	FUSED B(+)
9	50A	A18 10PK	FUSED B(+)
10	50A	A54 10RD	FUSED B(+)
11	50A	A58 10RD/GY	FUSED B(+)
12	20A	A34 16LB/RD	FUSED B(+)
13	40A	A25 12DB	FUSED B(+)
14	40A	A1 12RD	FUSED B(+)
15	50A	A12 10RD/TN	FUSED B(+)
16	15A	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
17	-	-	-
18	-	-	-
19	30A	A4 12BK/PK	FUSED B(+)
20	-	-	-
21	20A	A17 18RD/BK	FUSED B(+)
		A17 18RD/BK	FUSED B(+)
22	-	-	-
23	-	-	-
24	-	-	-
25	20A	A20 12RD/DB	FUSED B(+)
26	10A	F92 18YL/BR	FUSED B(+)
27	-	-	-
28	15A	F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)
		F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)



A/C  
COMPRESSOR  
CLUTCH  
RELAY

CAVITY	CIRCUIT	FUNCTION
30	A17 18RD/BK	FUSED B(+)
85	C13 18DG $\Delta \Delta$	A/C COMPRESSOR CLUTCH RELAY CONTROL
85	C13 18DB/OR $\Delta$	A/C COMPRESSOR CLUTCH RELAY CONTROL
86	F1 18DB $\bullet$	FUSED IGNITION SWITCH OUTPUT (RUN-START)
	F1 18DB $\bullet$	FUSED IGNITION SWITCH OUTPUT (RUN-START)
86	A71 18DG/RD $\bullet \bullet$	FUSED AUTO SHUT DOWN RELAY OUTPUT
87	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
87A	-	-

AUTO  
SHUT  
DOWN  
RELAY

CAVITY	CIRCUIT	FUNCTION
30	A9 14RD/YL	FUSED B(+)
	A9 14RD/YL $\bullet \bullet$	FUSED B(+)
85	K51 18DB/YL	AUTO SHUT DOWN RELAY CONTROL
86	F1 18DB $\bullet$	FUSED IGNITION SWITCH OUTPUT (RUN-START)
	F1 18DB $\bullet$	FUSED IGNITION SWITCH OUTPUT (RUN-START)
86	A9 14RD/YL $\bullet \bullet$	FUSED B(+)
87	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
	A142 14DG/OR $\bullet \bullet$	AUTO SHUT DOWN RELAY OUTPUT
87A	-	-

BLOWER  
MOTOR  
RELAY

CAVITY	CIRCUIT	FUNCTION
30	A122 12OR	FUSED B(+)
85	Z142 18BK/WT	GROUND
86	F20 18WT	FUSED IGNITION SWITCH OUTPUT (RUN)
	F20 18WT $\bullet \bullet$	FUSED IGNITION SWITCH OUTPUT (RUN)
87	A111 12RD/LB	BLOWER MOTOR RELAY OUTPUT
87A	-	-

CABIN  
HEATER  
RELAY  
(DIESEL)

CAVITY	CIRCUIT	FUNCTION
30	A17 18RD/BK	FUSED B(+)
85	K132 18DG/LB	CABIN HEATER RELAY CONTROL
86	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
87	C151 18DB/WT	CABIN HEATER RELAY OUTPUT
87A	-	-

$\Delta$  RHD A/T  
 $\Delta \Delta$  EXCEPT RHD A/T

$\bullet$  GAS  
 $\bullet \bullet$  DIESEL

**CLUTCH SWITCH  
OVERRIDE  
RELAY  
(M/T)**

CAVITY	CIRCUIT	FUNCTION
30	F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)
	F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)
85	K90 18TN	CLUTCH SWITCH OVERRIDE RELAY CONTROL
86	A21 12RD/DB	IGNITION SWITCH OUTPUT (RUN-START)
87	T141 18YL/RD	CLUTCH SWITCH OVERRIDE RELAY OUTPUT
	T141 18YL/RD	CLUTCH SWITCH OVERRIDE RELAY OUTPUT
87A	-	-

**FUEL  
HEATER  
RELAY  
(DIESEL)**

CAVITY	CIRCUIT	FUNCTION
30	A34 16LB/RD	FUSED B(+)
85	Z142 18BK/WT	GROUND
86	F20 18WT	FUSED IGNITION SWITCH OUTPUT (RUN)
87	A93 16RD/BK	FUEL HEATER RELAY OUTPUT
87A	-	-

**FUEL  
PUMP  
RELAY  
(GAS)**

CAVITY	CIRCUIT	FUNCTION
30	A14 16RD/WT	FUSED B(+)
85	K31 18BR	FUEL PUMP RELAY CONTROL
86	F1 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
	F1 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
87	A141 16DG/WT	FUEL PUMP RELAY OUTPUT
87A	-	-

**GLOW  
PLUG  
RELAY NO. 1  
(DIESEL)**

CAVITY	CIRCUIT	FUNCTION
30	A54 10RD	FUSED B(+)
85	K152 18WT	GLOW PLUG RELAY NO. 1 CONTROL
86	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
87	K154 10GY	GLOW PLUG RELAY NO. 1 OUTPUT
87A	-	-

**GLOW  
PLUG  
RELAY NO. 2  
(DIESEL)**

CAVITY	CIRCUIT	FUNCTION
30	A58 10RD/GY	FUSED B(+)
85	K236 18GY/PK	GLOW PLUG RELAY NO. 2 CONTROL
86	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
87	K104 10RD/WT	GLOW PLUG RELAY NO. 2 OUTPUT
87A	-	-

**OXYGEN  
SENSOR  
DOWNSTREAM  
RELAY  
(GAS)**

CAVITY	CIRCUIT	FUNCTION
30	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
85	K512 18RD/YL	OXYGEN SENSOR DOWNSTREAM RELAY CONTROL
86	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
87	F18 18LG/BK	OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT
87A	-	-

**STARTER  
MOTOR  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	A2 12PK/BK	FUSED B(+)
85	T41 18BK/WT ■	PARK/NEUTRAL POSITION SWITCH SENSE
	Z142 18BK/WT ■■	GROUND
86	F45 18YL/BR ■	FUSED IGNITION SWITCH OUTPUT (START)
86	T141 18YL/RD ■■	CLUTCH INTERLOCK RELAY OUTPUT
	T141 18YL/RD ■■	CLUTCH INTERLOCK RELAY OUTPUT
87	T40 12BR	STARTER MOTOR RELAY OUTPUT
87A	-	-

■ A/T  
■■ M/T

**TRANSMISSION  
CONTROL  
RELAY  
(A/T)**

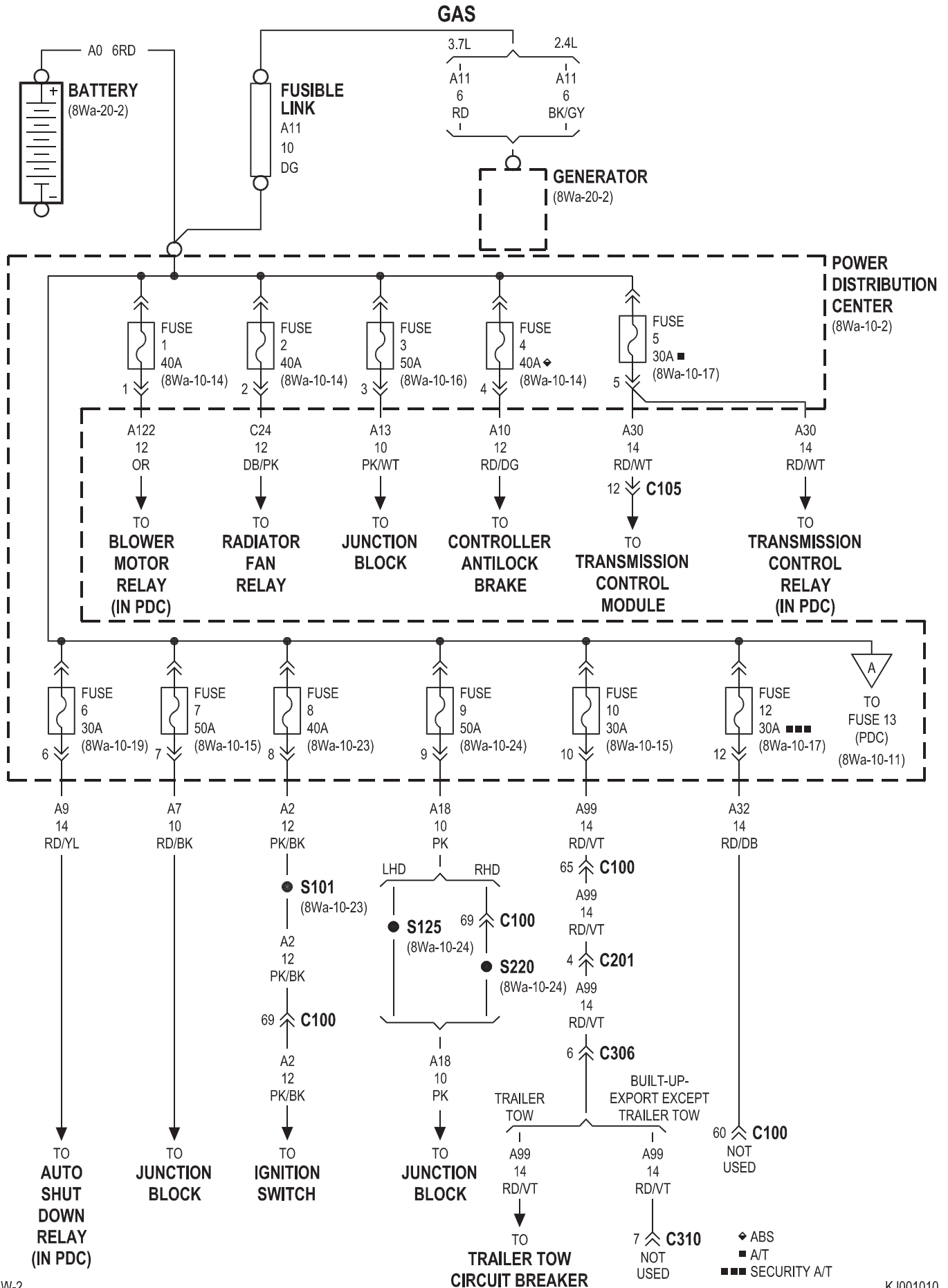
CAVITY	CIRCUIT	FUNCTION
30	A30 14RD/WT	FUSED B(+)
85	Z142 18BK/WT	GROUND
86	K30 18PK	TRANSMISSION CONTROL RELAY CONTROL
87	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
87A	-	-

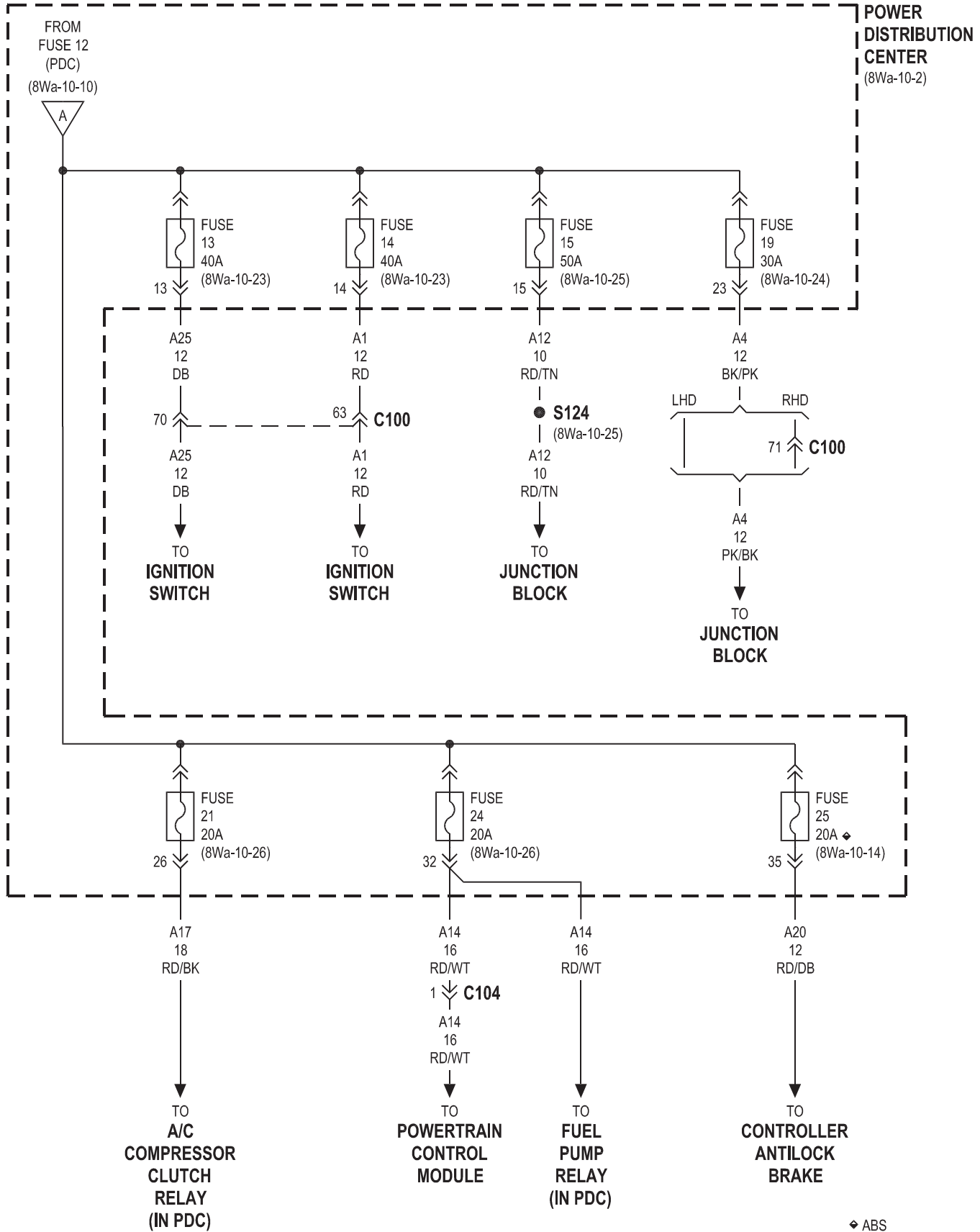
**WIPER  
HIGH/LOW  
RELAY**

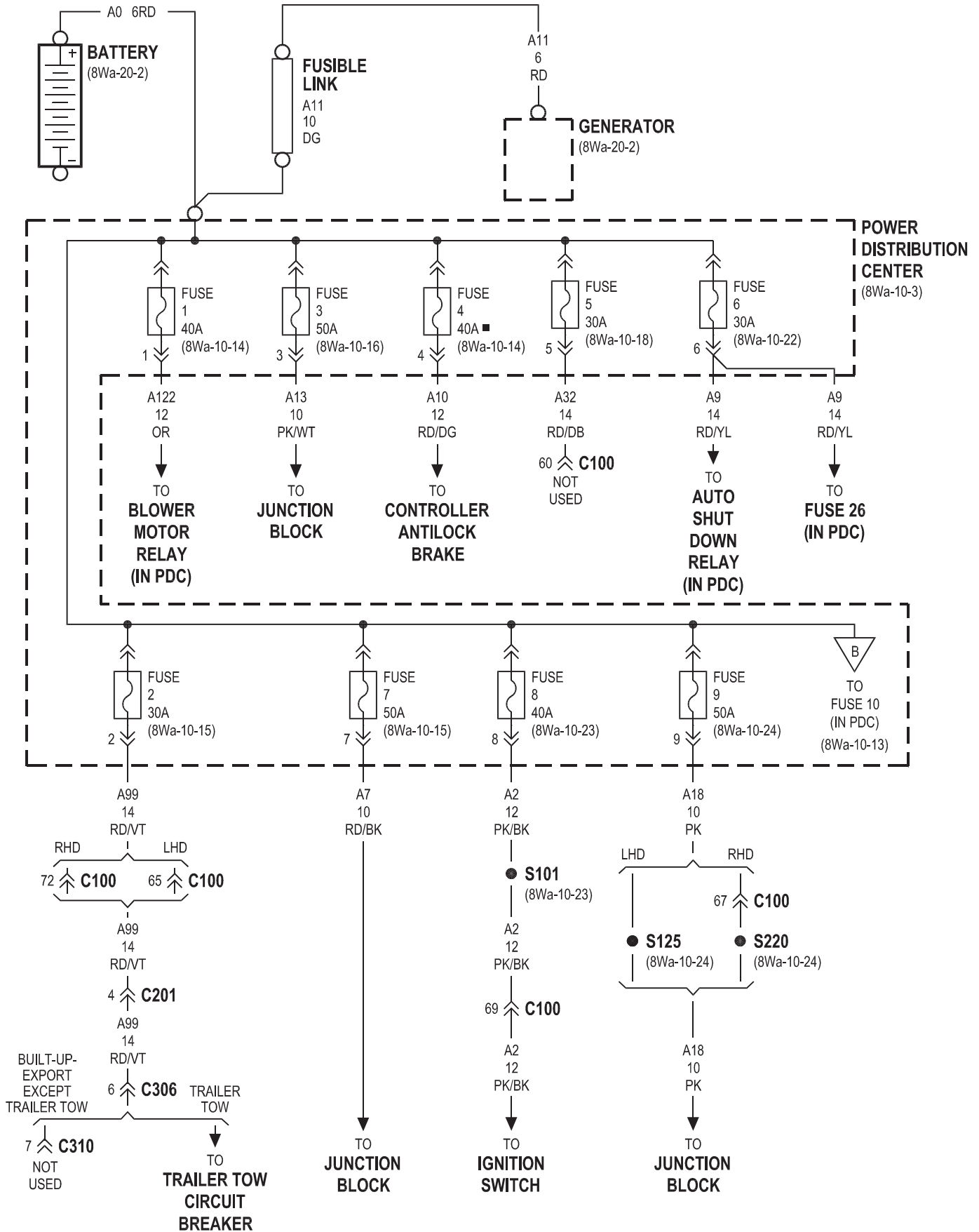
CAVITY	CIRCUIT	FUNCTION
30	V60 16YL/DG	FRONT WIPER ON/OFF RELAY OUTPUT
85	V16 18VT/YL	FRONT WIPER HIGH/LOW RELAY CONTROL
86	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
87	V4 14RD/YL	FRONT WIPER HIGH/LOW RELAY HIGH SPEED OUTPUT
87A	V3 14BR/WT	FRONT WIPER HIGH/LOW RELAY LOW SPEED OUTPUT

**WIPER  
ON/OFF  
RELAY**

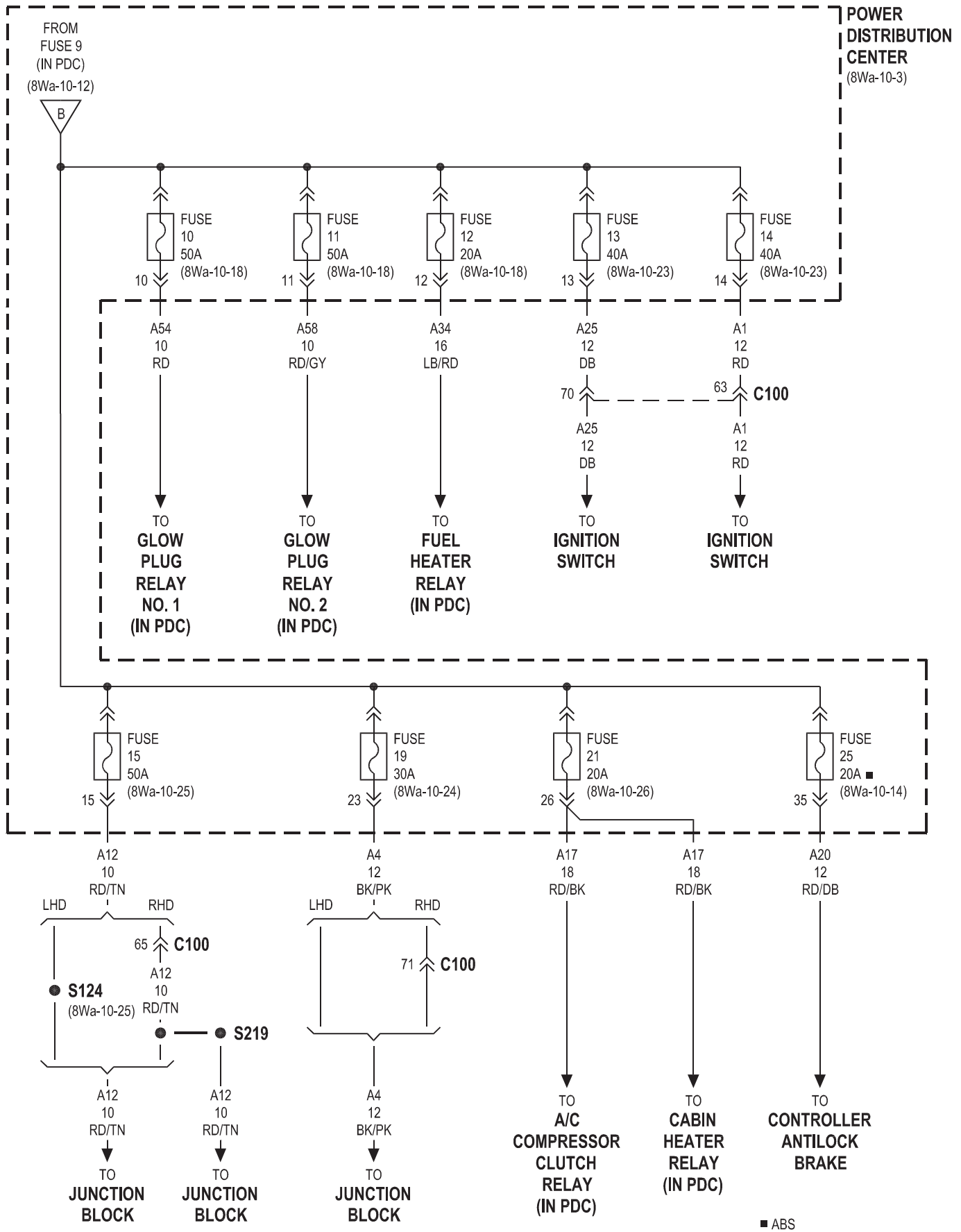
CAVITY	CIRCUIT	FUNCTION
30	V60 16YL/DG	FRONT WIPER ON/OFF RELAY OUTPUT
85	V14 18RD/VT	FRONT WIPER ON/OFF RELAY CONTROL
86	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
87	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
87A	V55 16TN/RD	FRONT WIPER PARK SWITCH SENSE
	V55 16TN/RD	FRONT WIPER PARK SWITCH SENSE



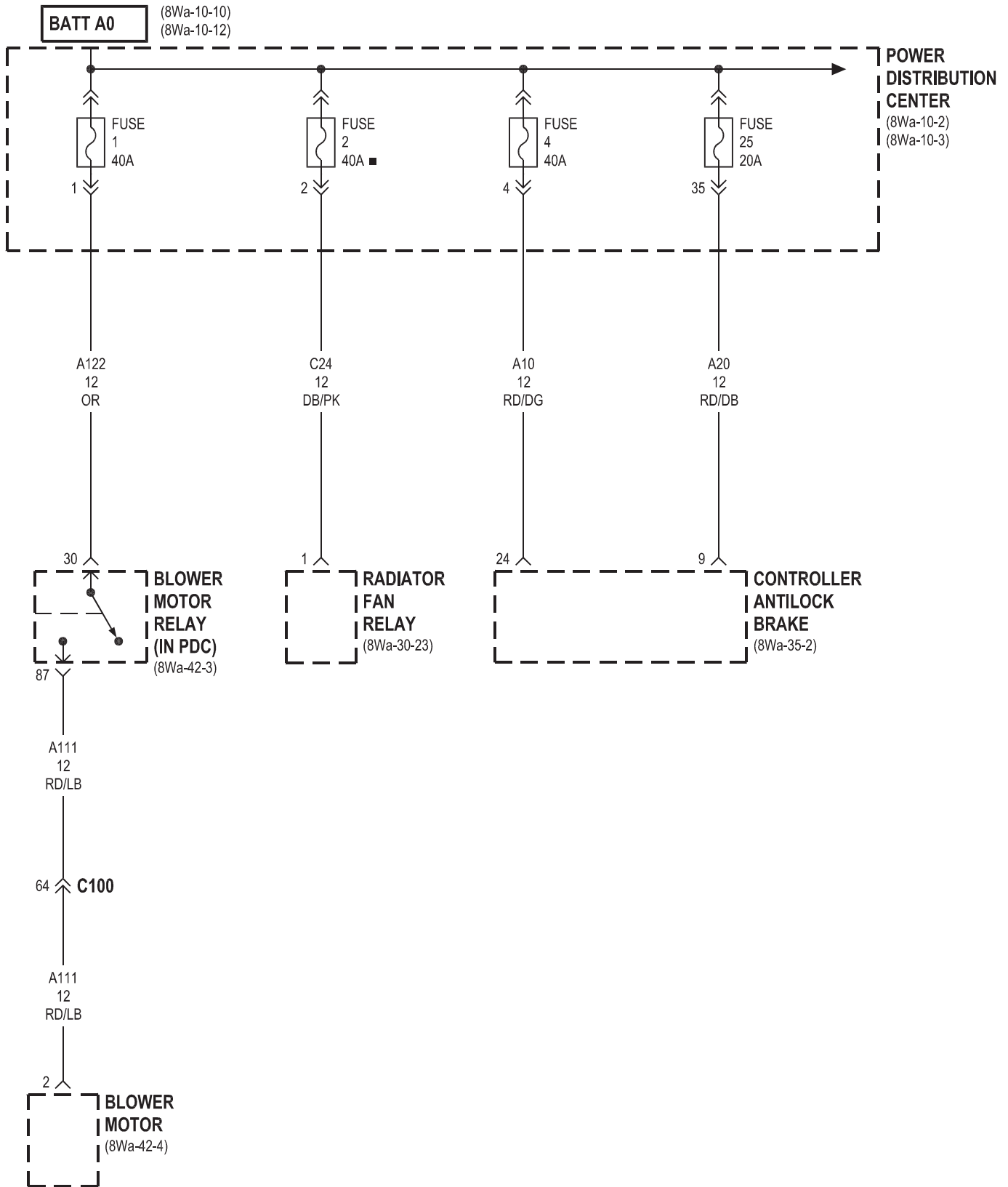




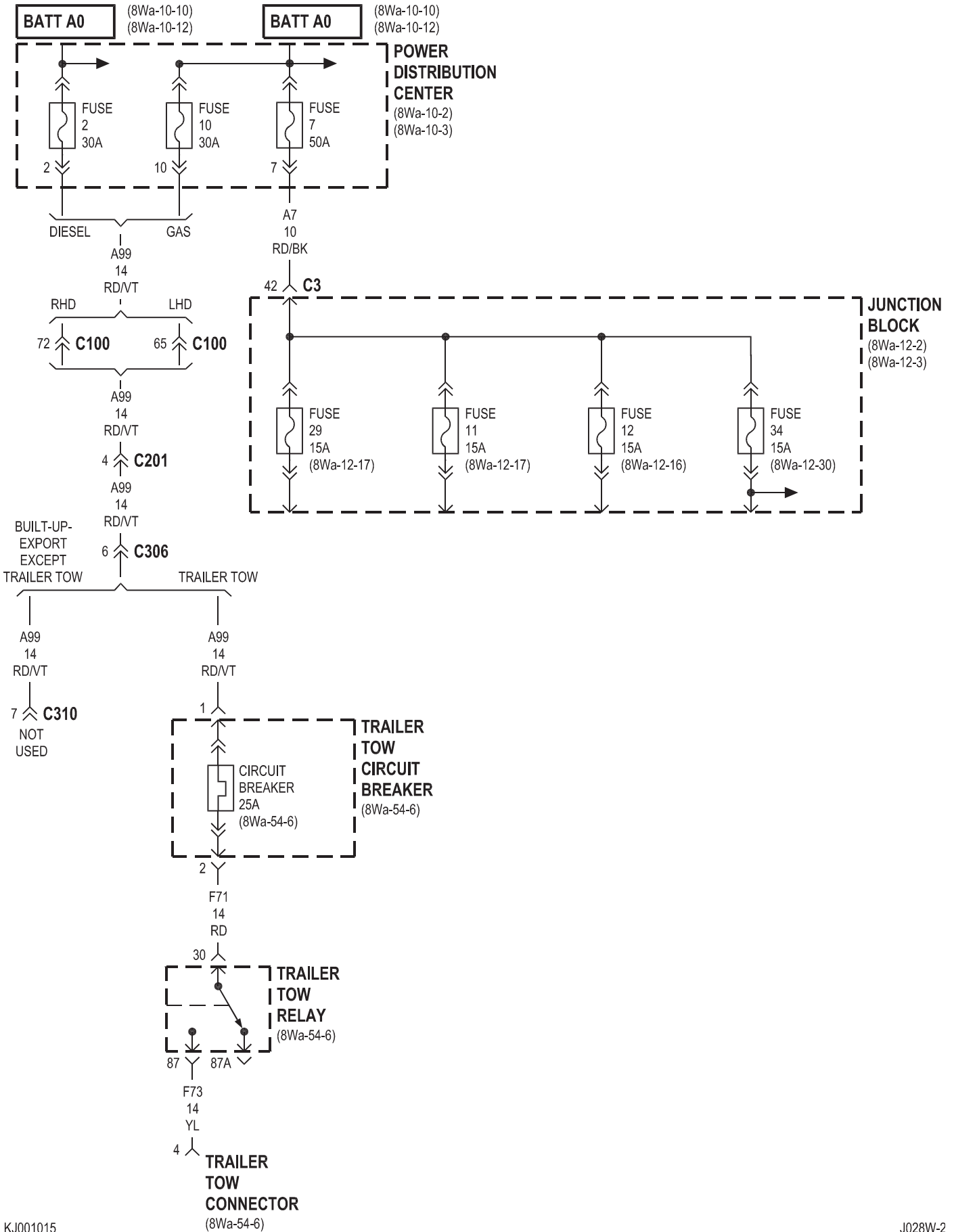
■ ABS

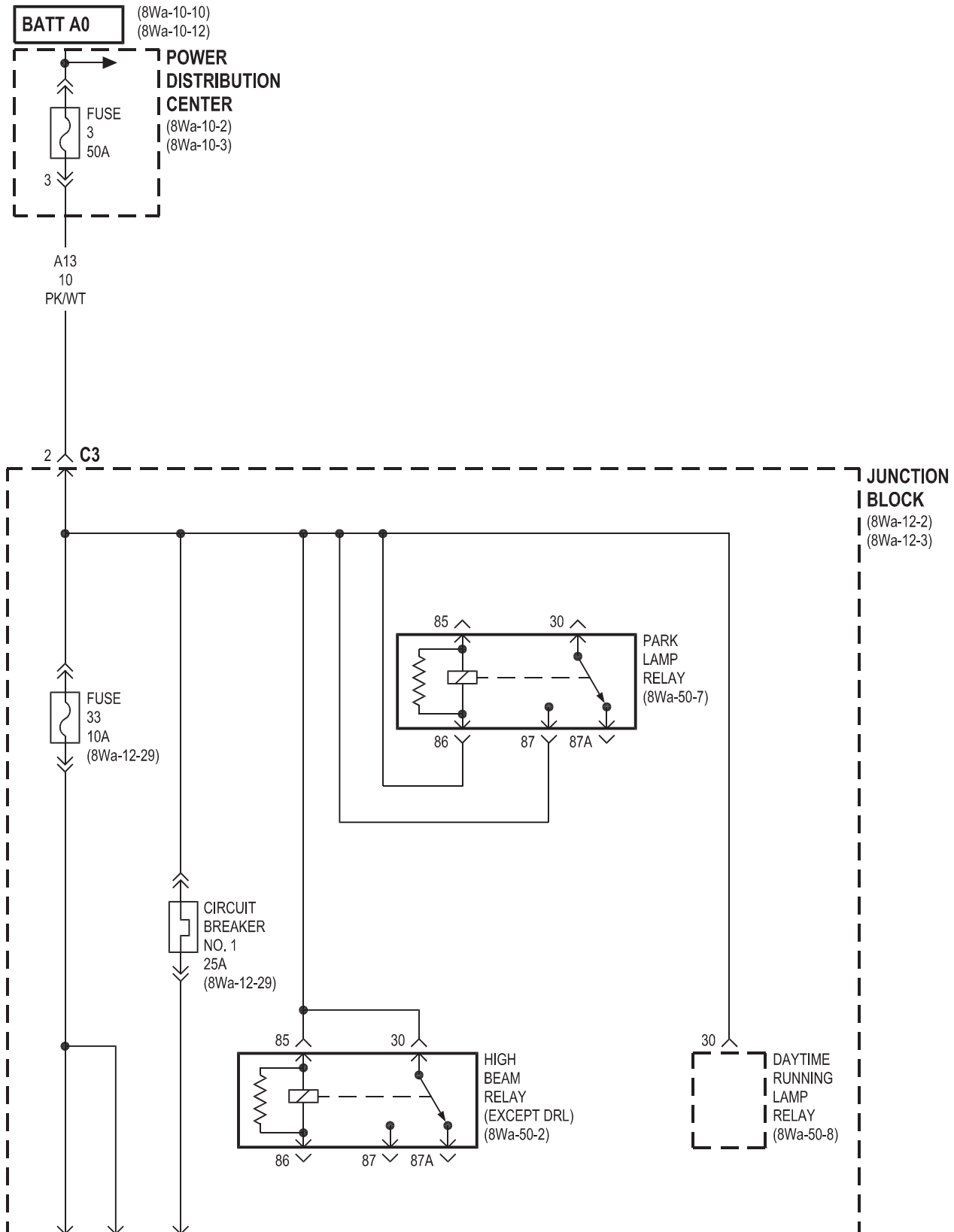


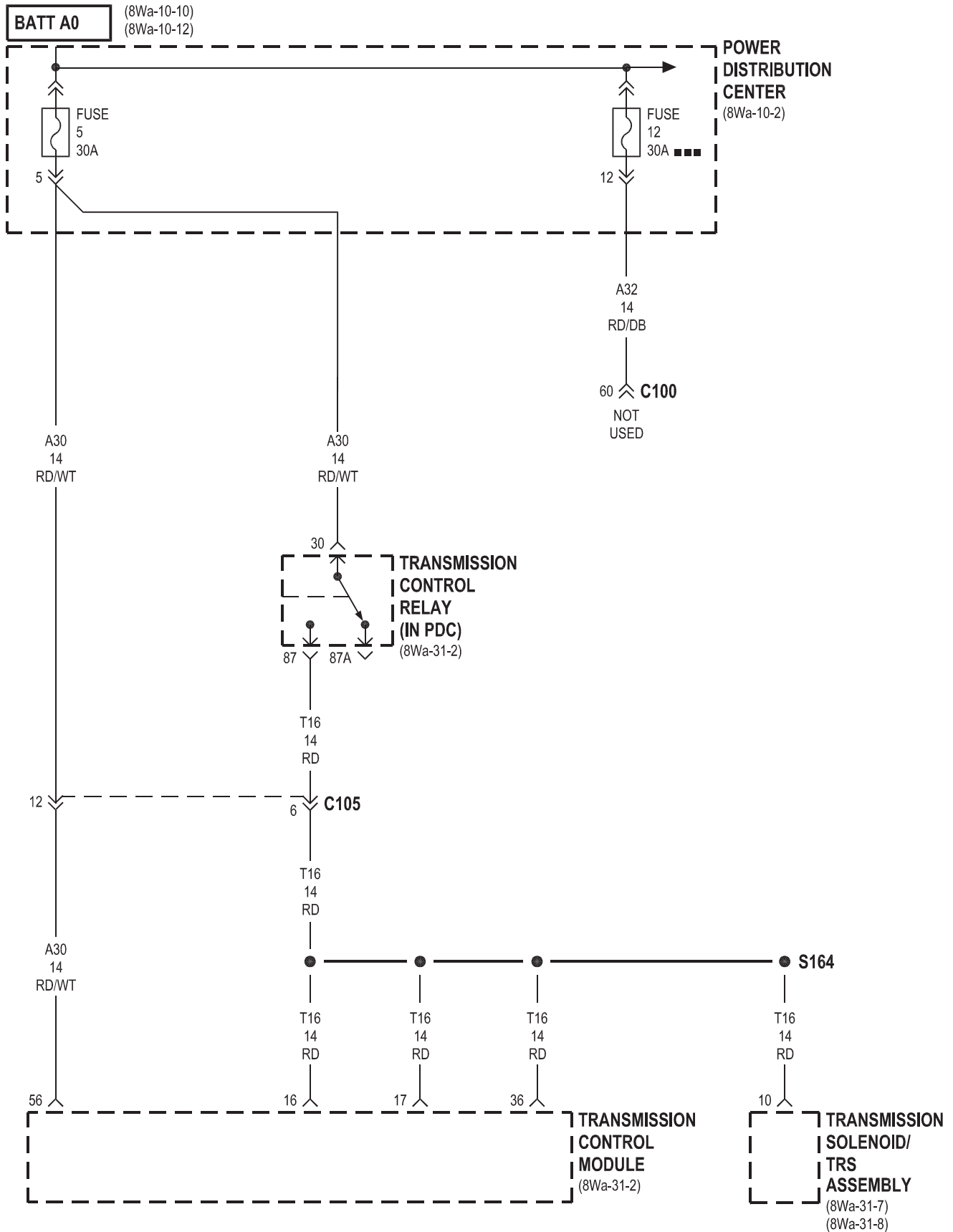




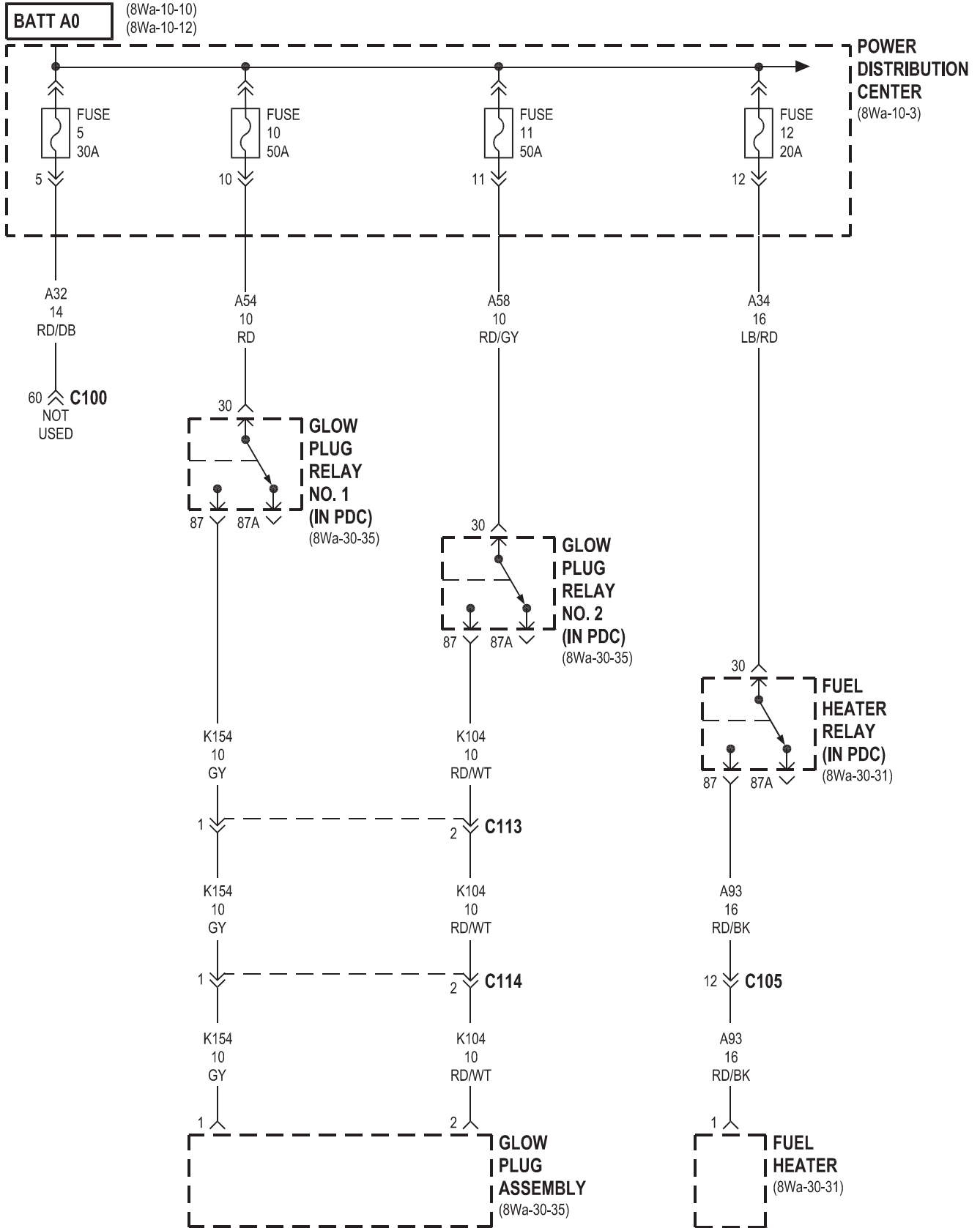
■ GAS

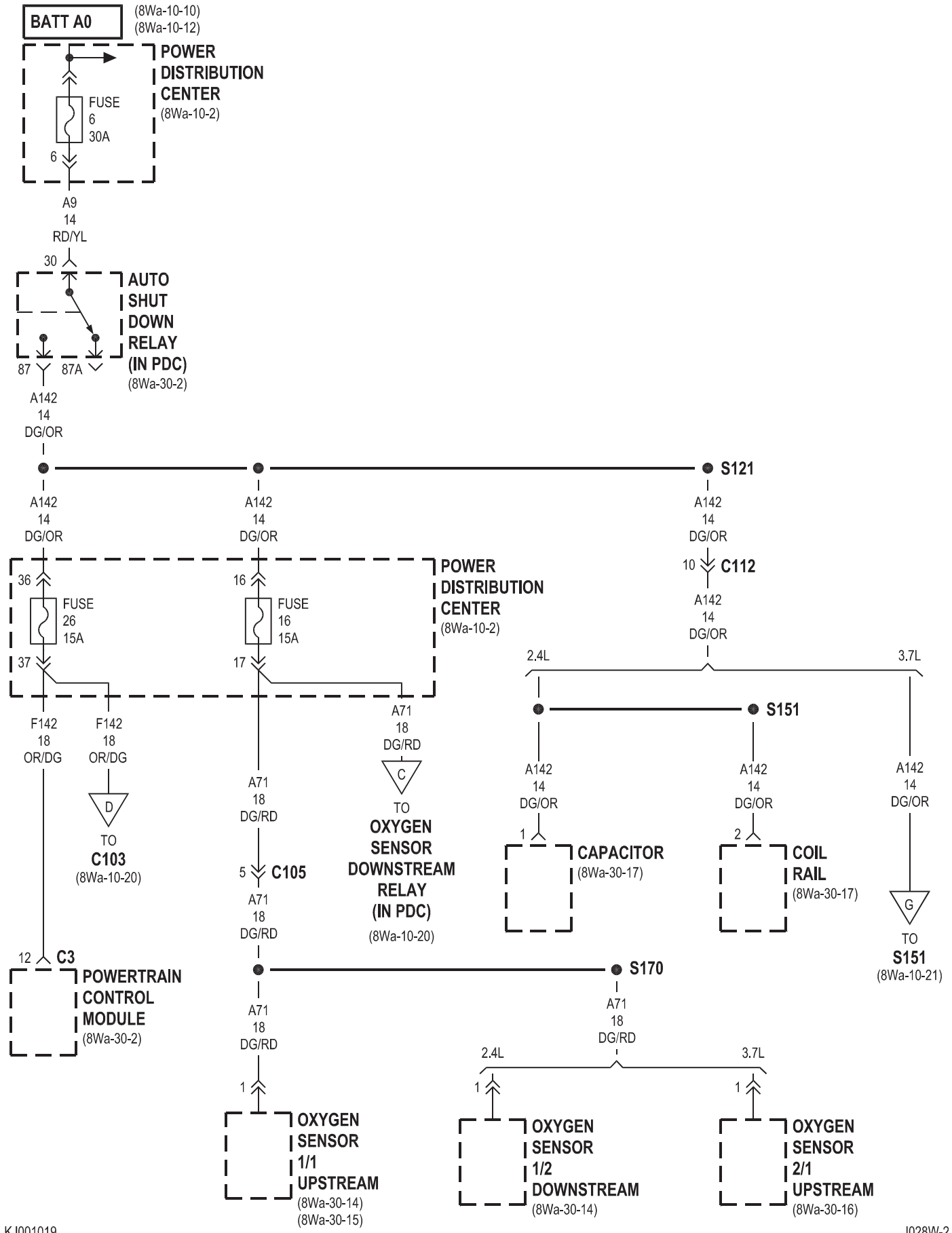


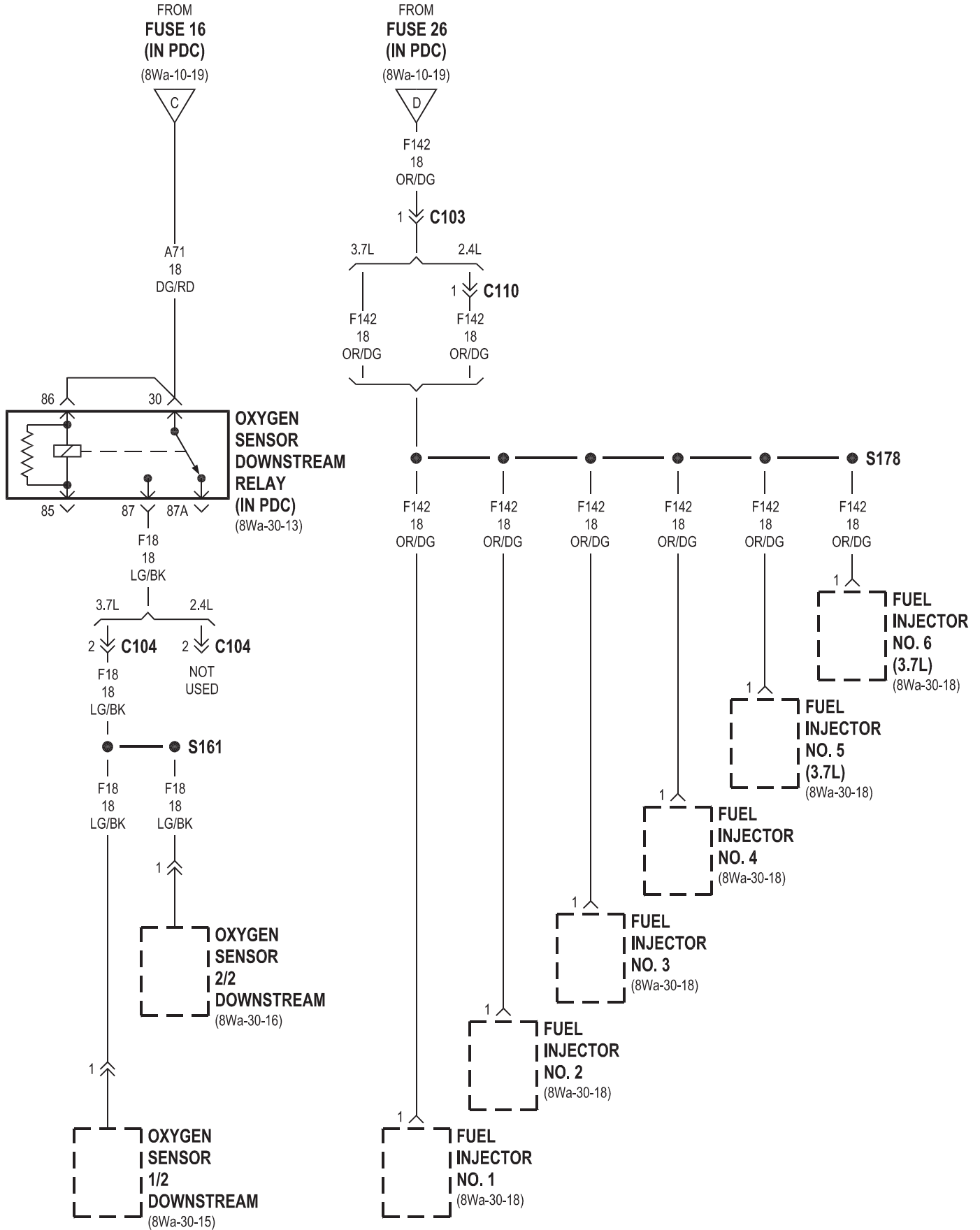




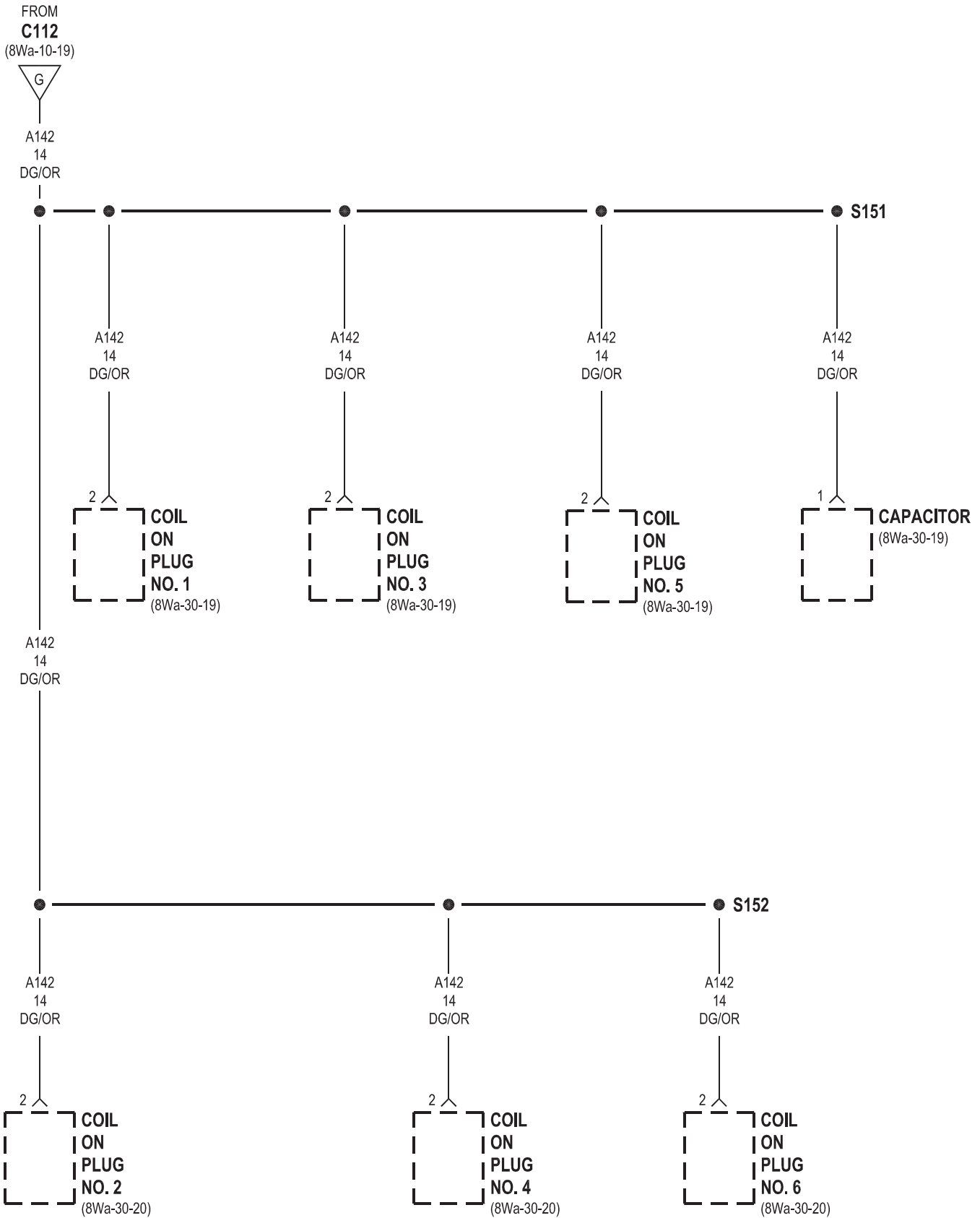
■■■ SECURITY A/T



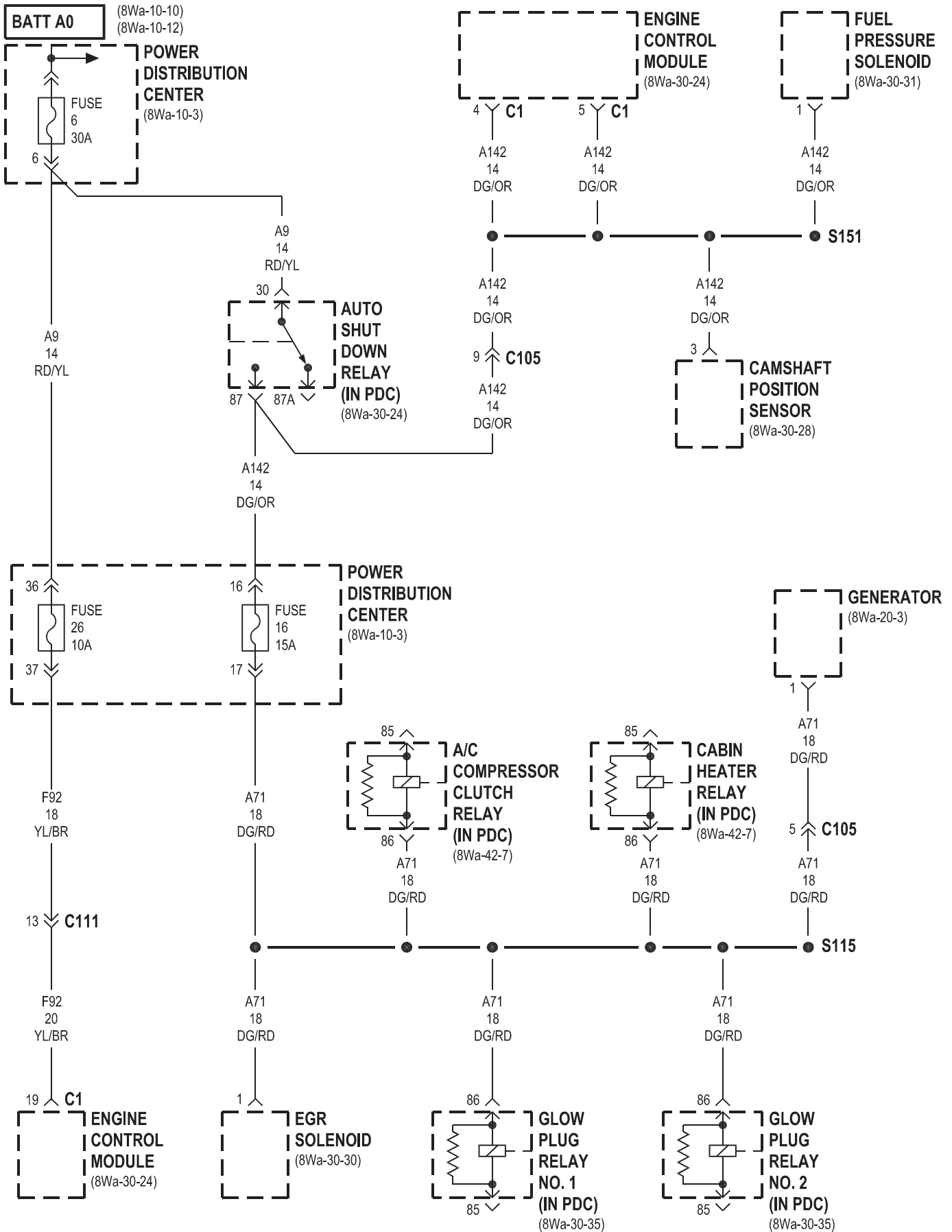


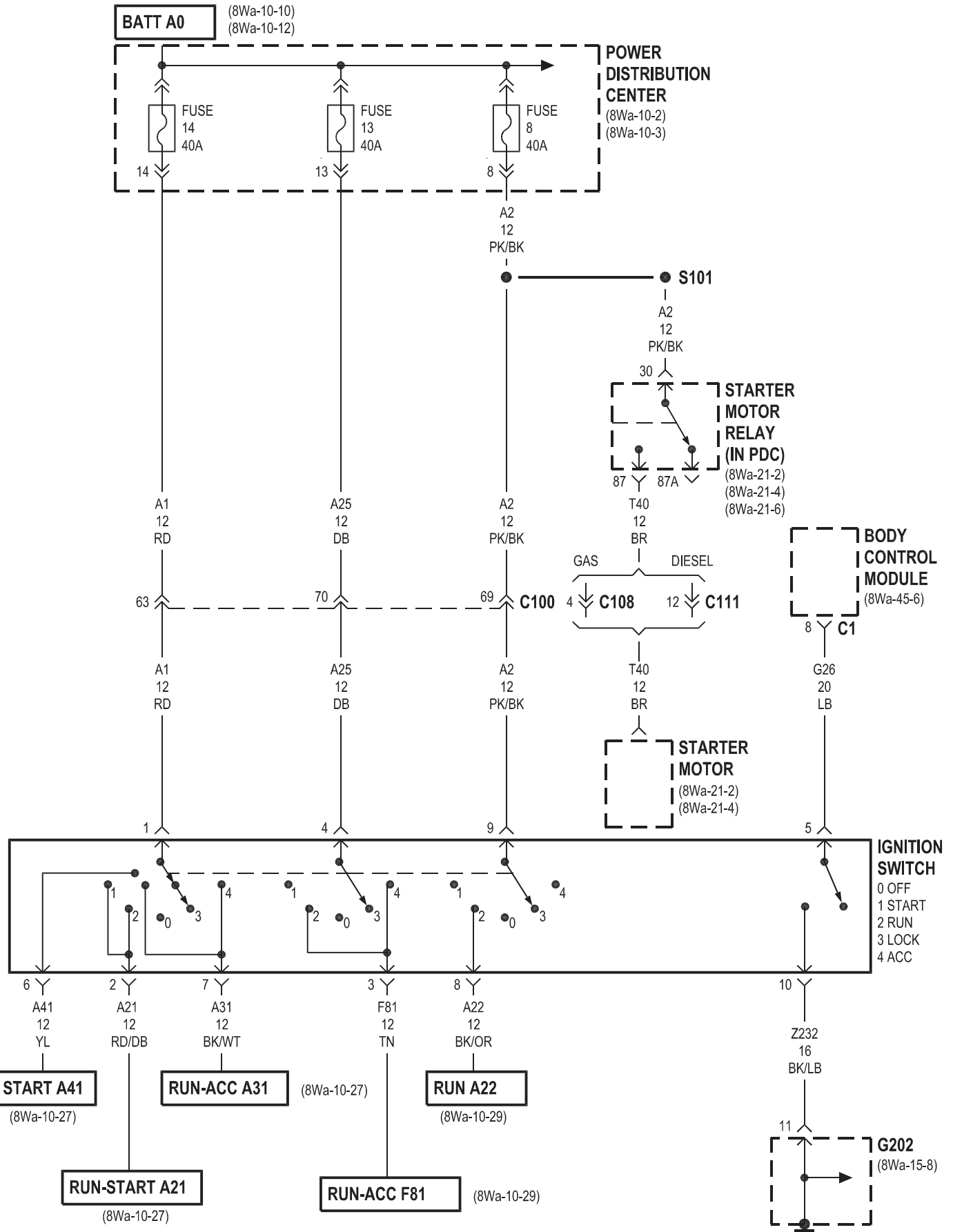


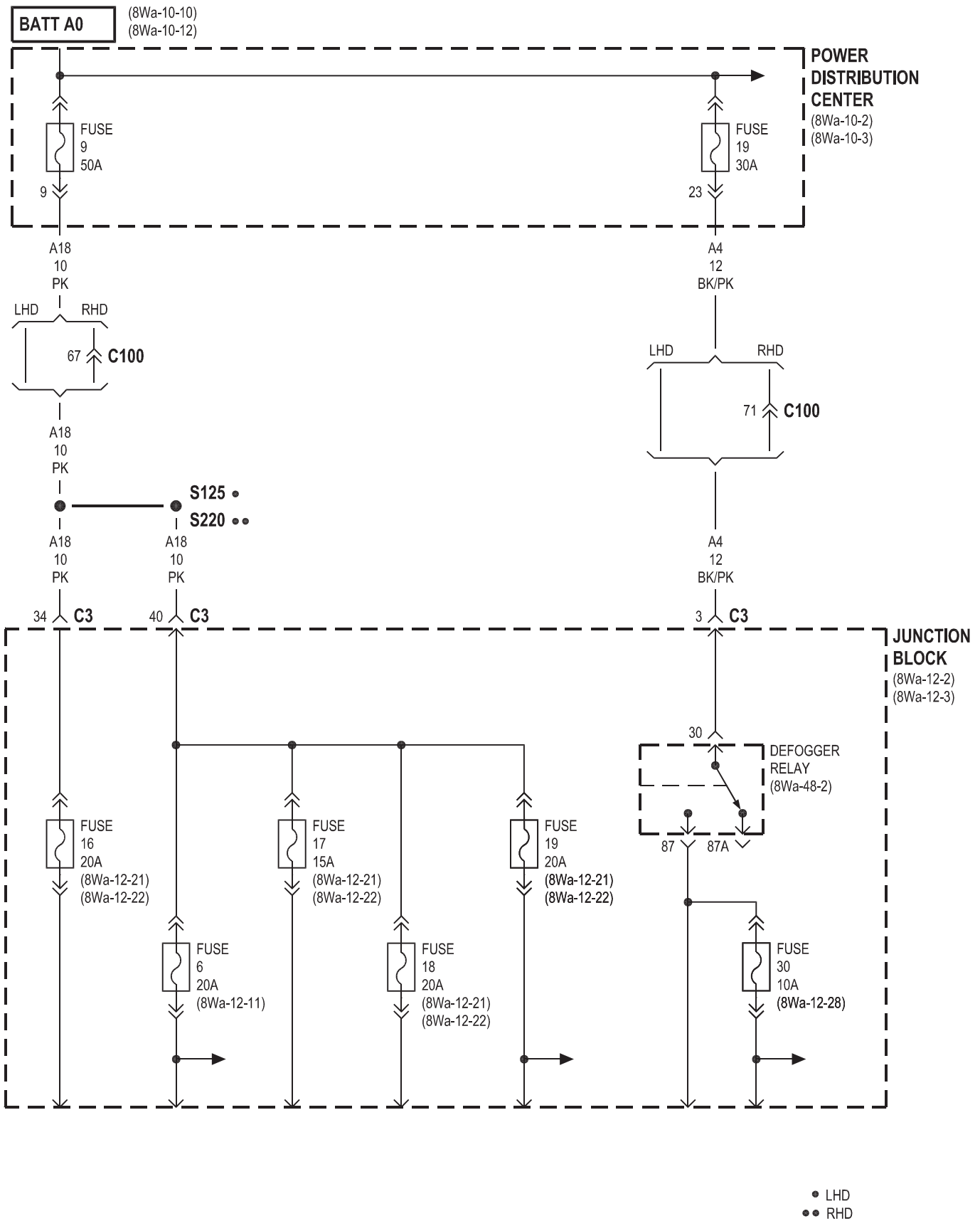
**KJ** **8W-10 POWER DISTRIBUTION** **8Wa - 10 - 21**  
**GAS**

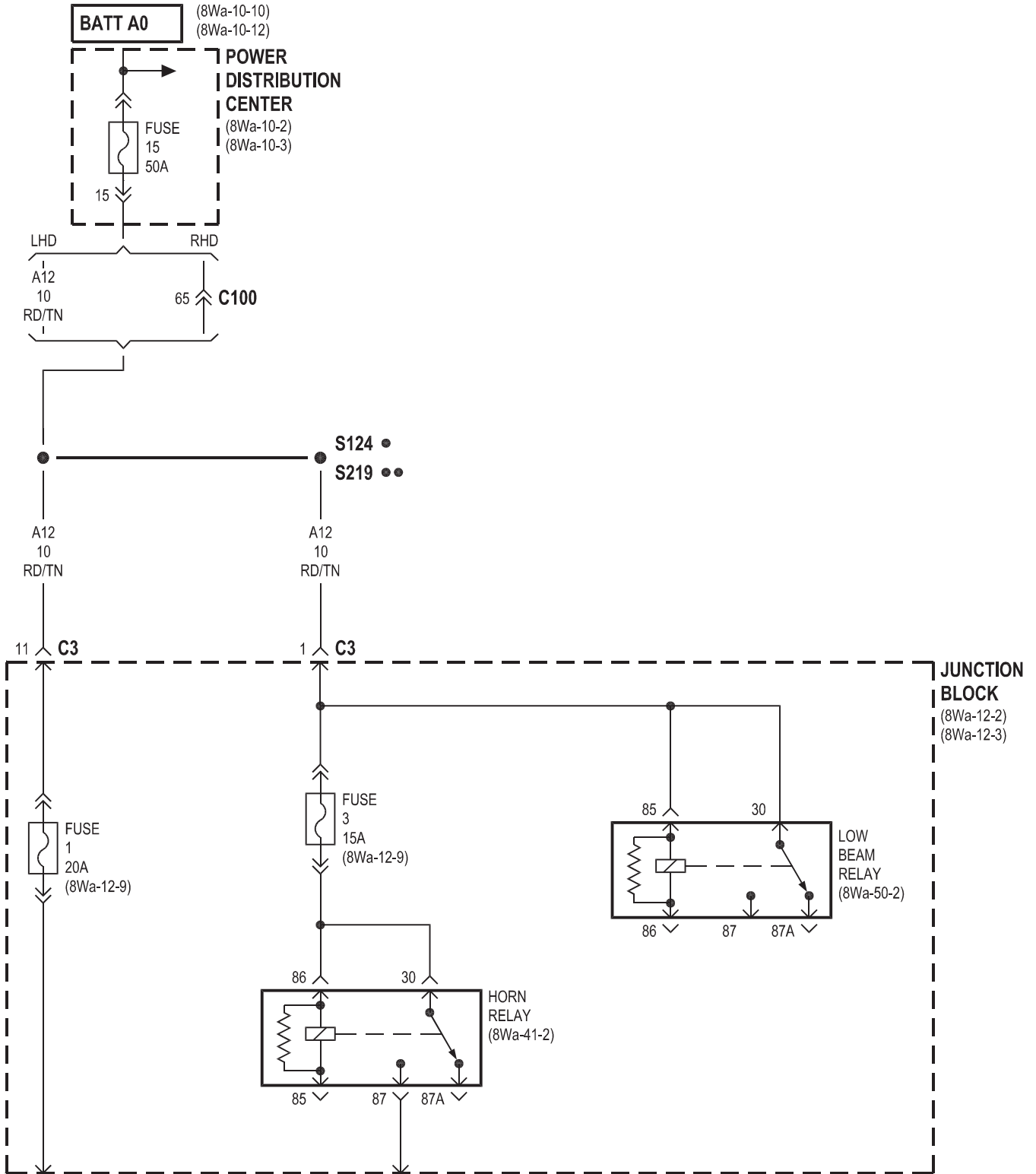




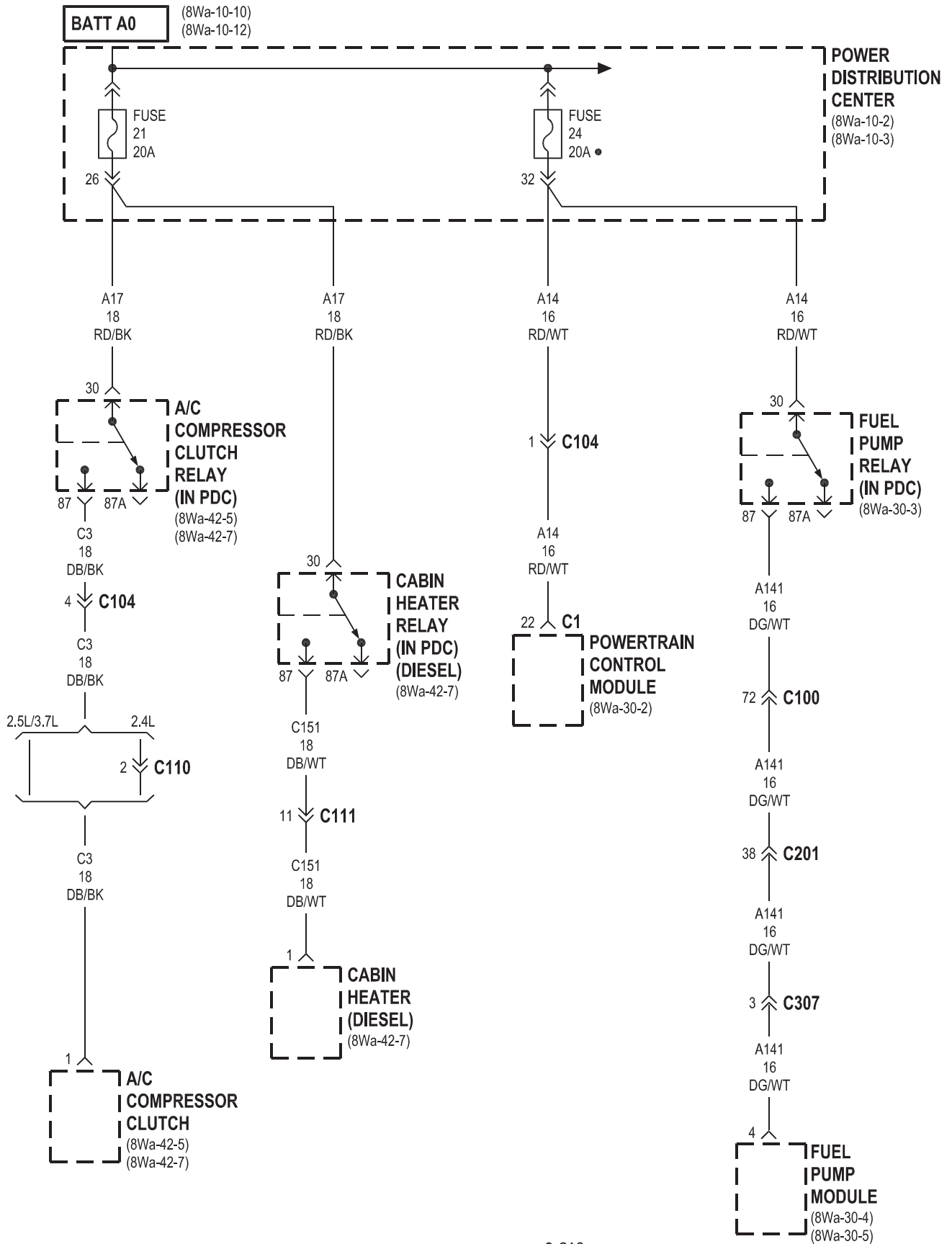


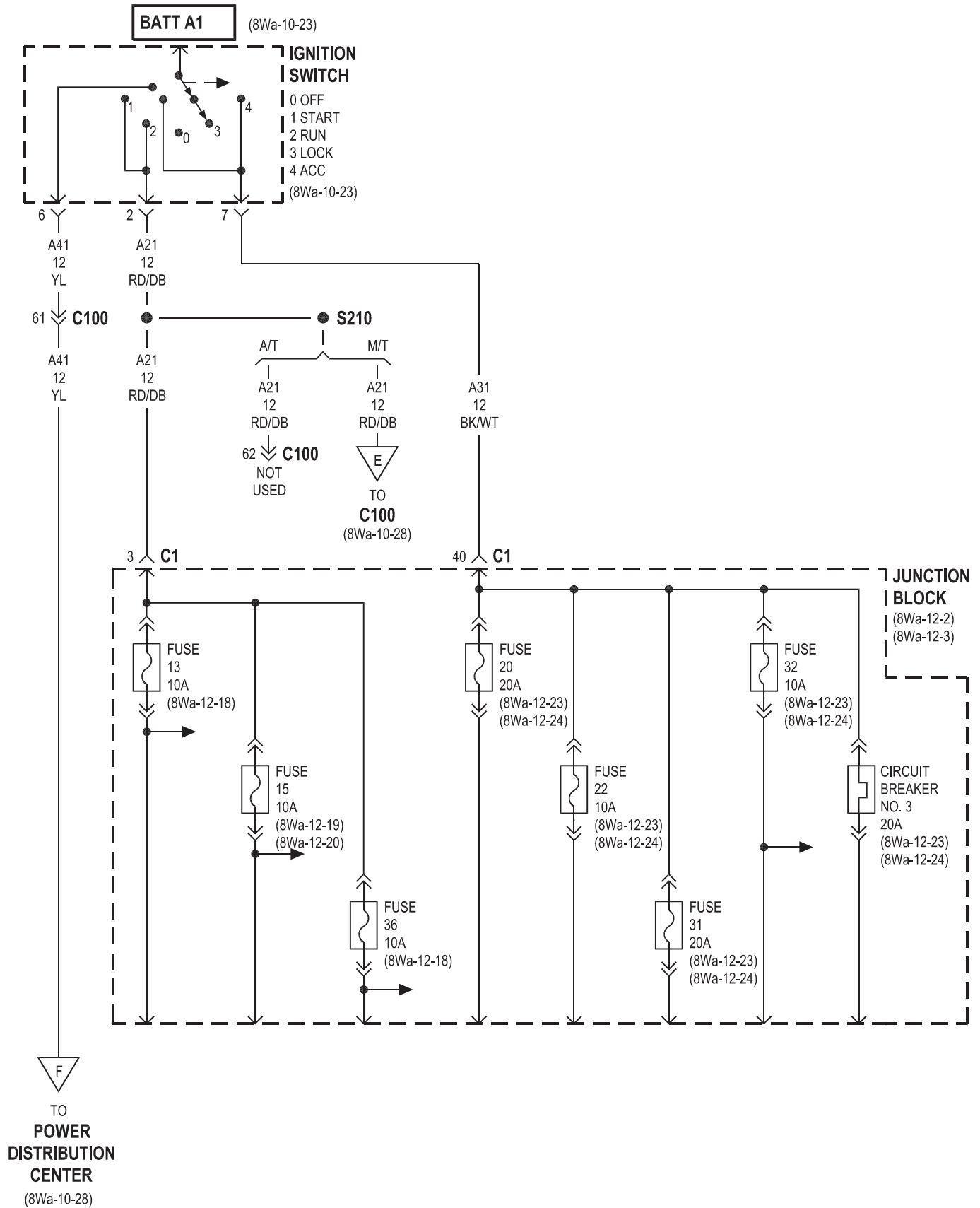


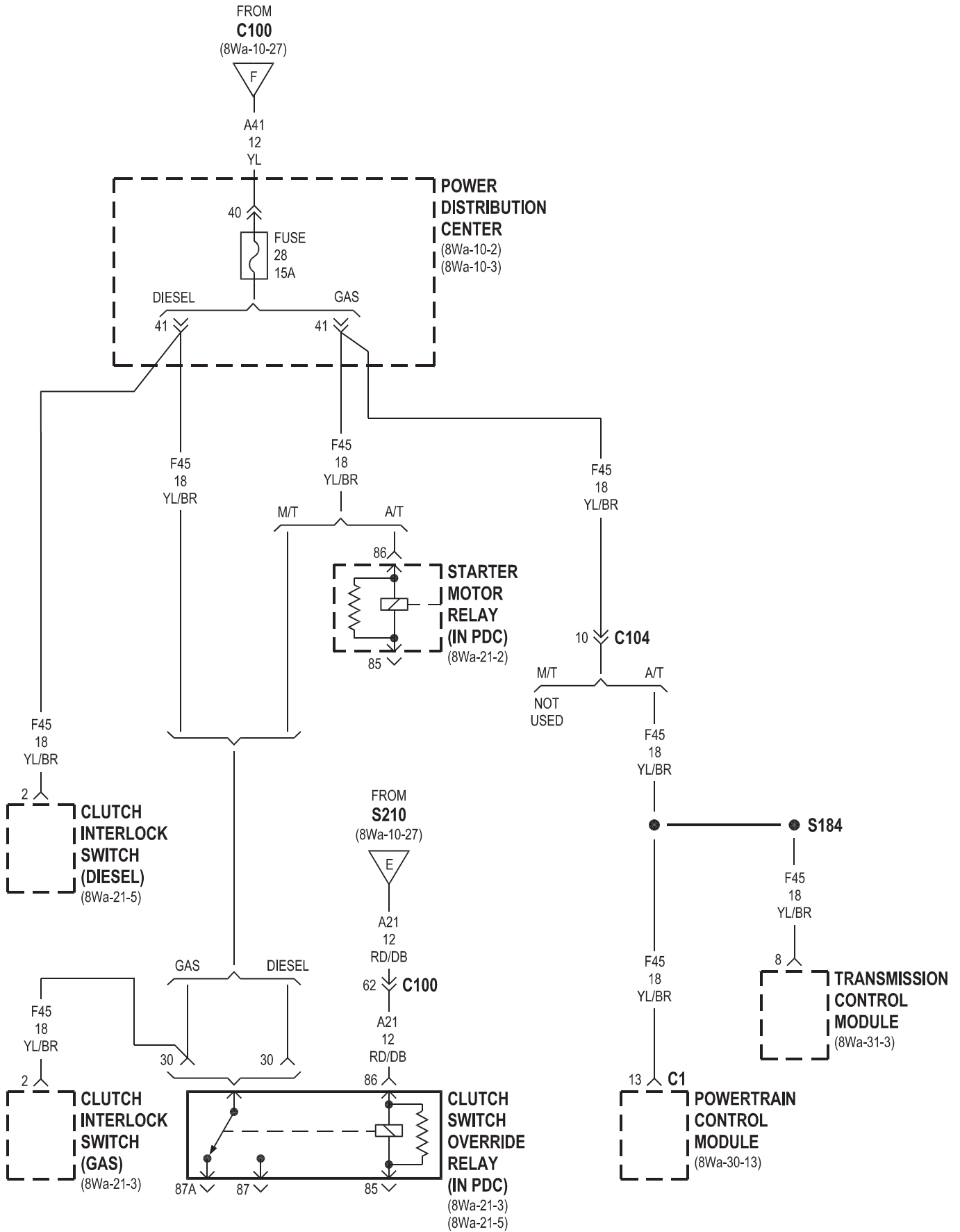


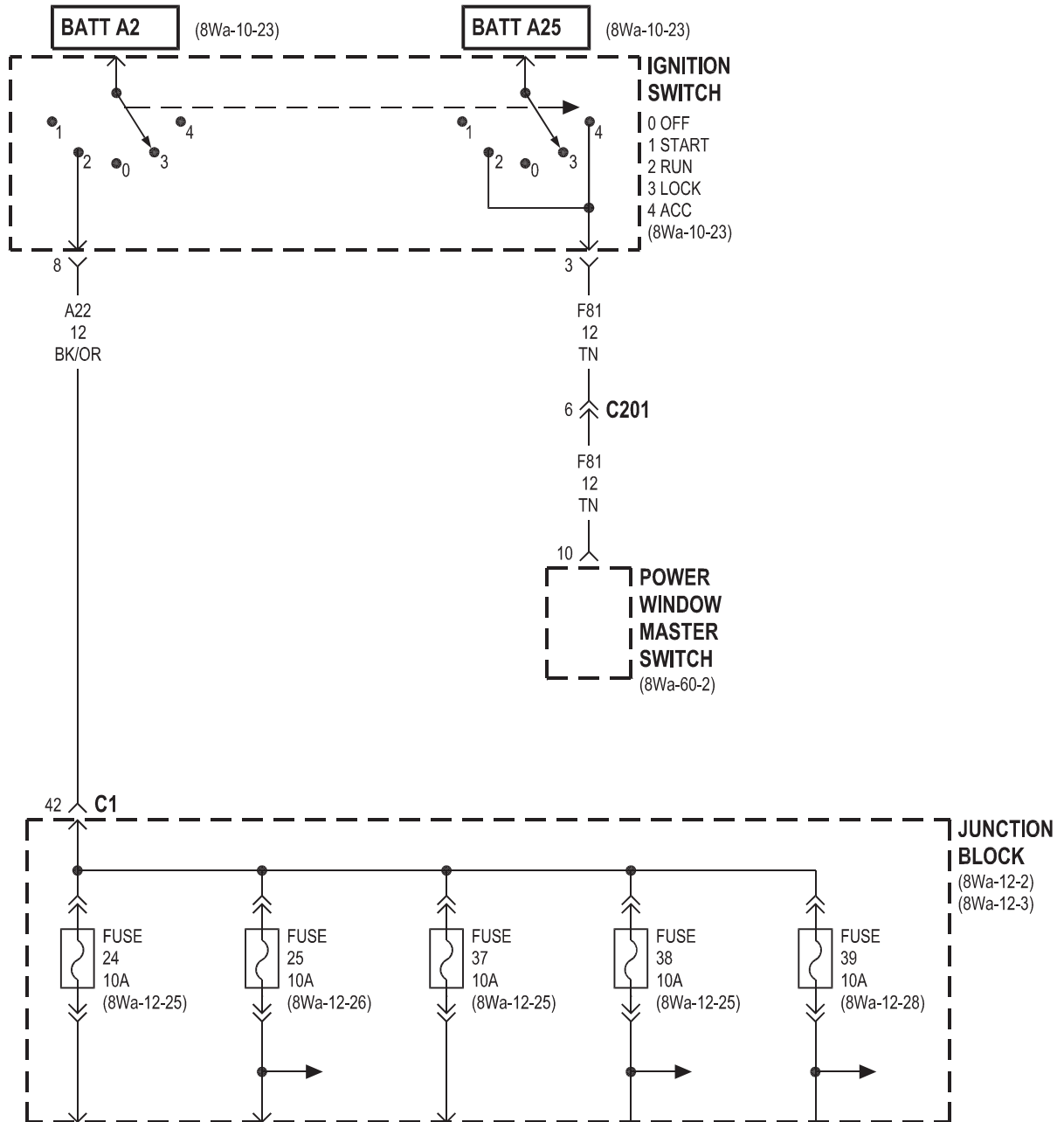


● LHD  
●● RHD









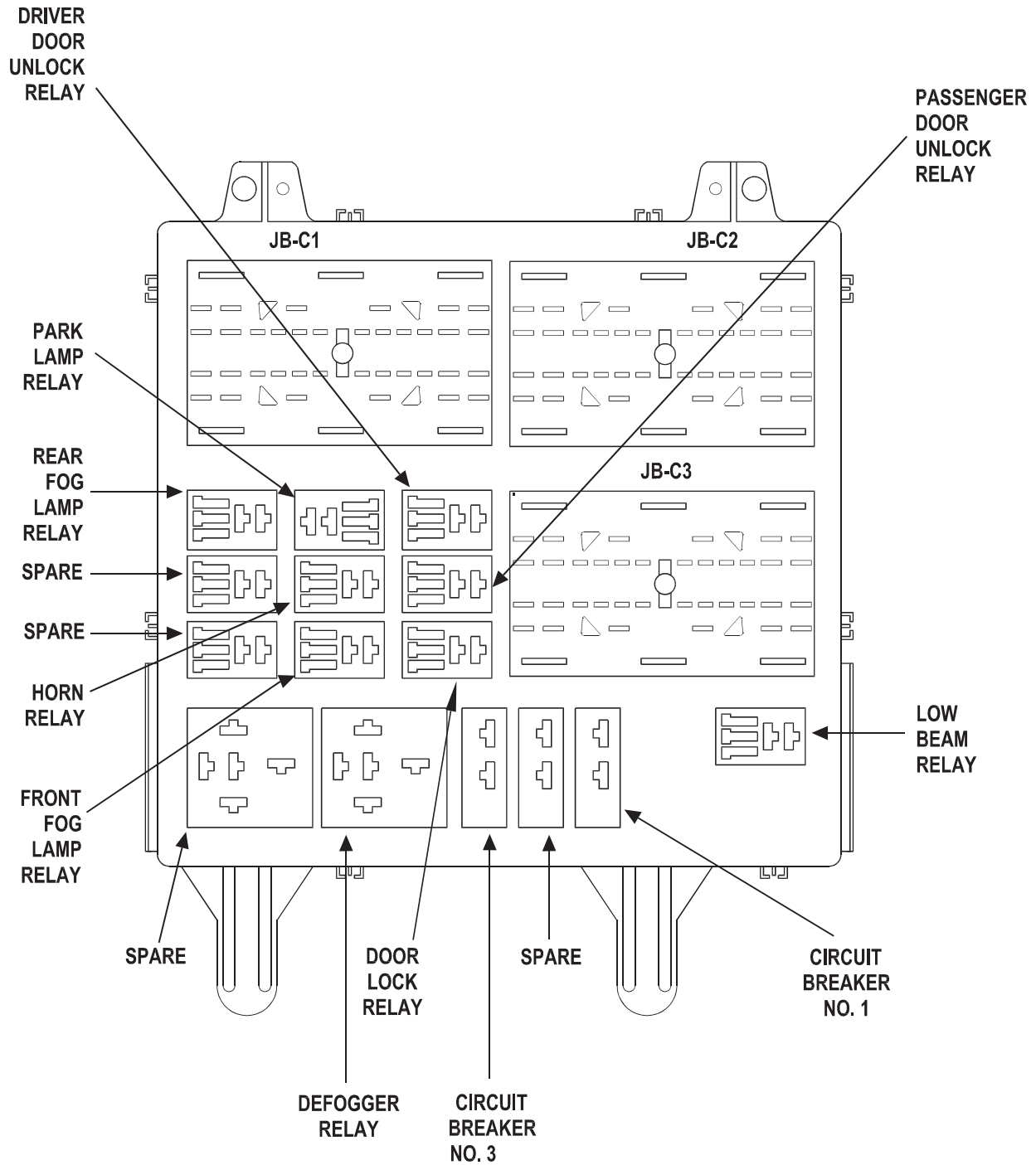


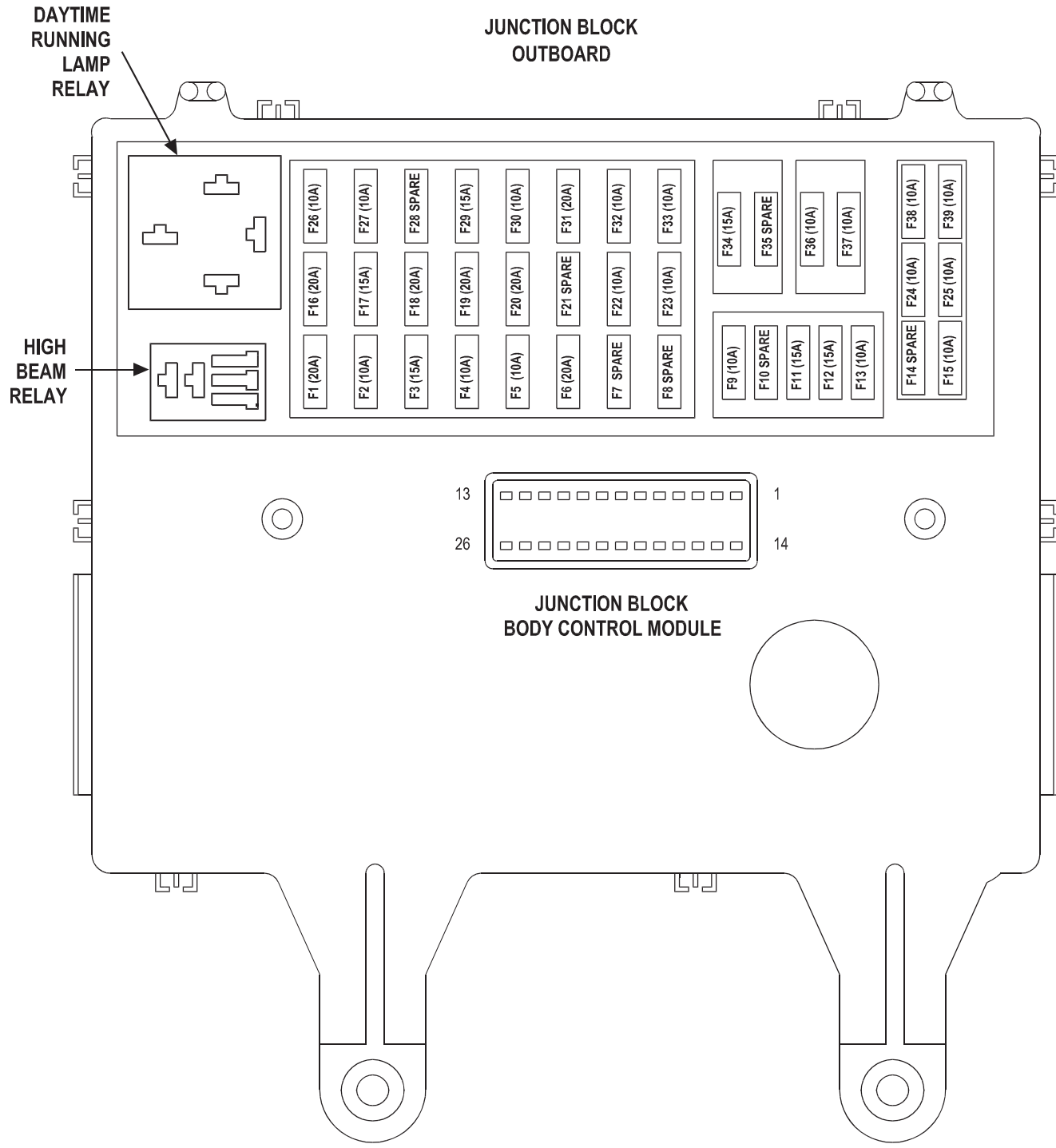


## 8W-12 JUNCTION BLOCK

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C Compressor Clutch Relay	8Wa-12-19	High Note Horn	8Wa-12-9
A/C-Heater Control	8Wa-12-26, 28, 35	Horn Relay	8Wa-12-9
Airbag Control Module	8Wa-12-18, 25	Horn Switch	8Wa-12-9
Antenna Module	8Wa-12-23, 24	Instrument Cluster	8Wa-12-13, 14, 15, 18, 30, 35
Ash Receiver Lamp	8Wa-12-35	Intrusion Sensor	8Wa-12-30
Auto Shut Down Relay	8Wa-12-19	Junction Block	8Wa-12-2, 3, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35,
Back-Up Lamp Switch	8Wa-12-28	Left Courtesy Lamp	8Wa-12-30, 34
Blend Door Actuator	8Wa-12-26	Left Cylinder Lock Switch	8Wa-12-33
Blower Motor Relay	8Wa-12-25	Left Door Lock Switch	8Wa-12-23, 24, 31, 33
Body Control Module	8Wa-12-9, 10, 11, 13, 14, 15, 18, 21, 22, 23, 24, 27, 28, 30, 31, 32, 33, 34	Left Fog Lamp	8Wa-12-21, 22
Brake Lamp Switch	8Wa-12-16	Left Front Door Lock Motor/Ajar Switch	8Wa-12-11, 12
Brake Pressure Switch	8Wa-12-25	Left Front Park/Turn Signal Lamp	8Wa-12-13
Cargo Lamp	8Wa-12-30, 34	Left Headlamp	8Wa-12-10, 27
Center High Mounted Stop Lamp	8Wa-12-16	Left Heated Seat Switch	8Wa-12-26
Cigar Lighter	8Wa-12-23, 24	Left Position Lamp	8Wa-12-14, 15
Circuit Breaker No. 1	8Wa-12-29	Left Power Mirror	8Wa-12-28
Circuit Breaker No. 3 (JB)	8Wa-12-23, 24	Left Power Seat Switch	8Wa-12-29
Clockspring	8Wa-12-9	Left Rear Door Lock Motor/Ajar Switch	8Wa-12-12
Compass Mini-Trip Computer	8Wa-12-18, 30	Left Side Impact Airbag Control Module	8Wa-12-18
Controller Antilock Brake	8Wa-12-16, 25	Left Side Marker Lamp	8Wa-12-13
Data Link Connector	8Wa-12-29	Left Tail/Stop Lamp	8Wa-12-13, 14, 15, 16
Daytime Running Lamp Relay	8Wa-12-27	Left Visor/Vanity Lamp	8Wa-12-30
Defogger Relay	8Wa-12-28	Left Visor/Vanity Lamp	8Wa-12-31
Dome Lamp	8Wa-12-30, 34	License Lamp	8Wa-12-13, 14, 15
Door Lock Relay	8Wa-12-11	Low Beam Relay	8Wa-12-10
Driver Door Unlock Relay	8Wa-12-11	Low Note Horn	8Wa-12-9
Engine Control Module	8Wa-12-20	Multi-Function Switch	8Wa-12-23, 24, 27
EVAP/Purge Solenoid	8Wa-12-19	Overhead Map/Reading Lamp	8Wa-12-30, 31, 34
Front Fog Lamp Relay	8Wa-12-21, 22	Park Lamp Relay	8Wa-12-13, 14, 15
Front Wiper Motor	8Wa-12-32	Passenger Door Unlock Relay	8Wa-12-11
Fuel Pump Relay	8Wa-12-19	Power Distribution Center	8Wa-12-16, 21, 22, 31, 32
Fuse 1	8Wa-12-9	Power Mirror Switch	8Wa-12-26
Fuse 2	8Wa-12-10	Power Outlet	8Wa-12-9
Fuse 3	8Wa-12-9	Powertrain Control Module	8Wa-12-19
Fuse 4	8Wa-12-10	Radio Choke	8Wa-12-21, 22
Fuse 5	8Wa-12-10	Radio	8Wa-12-23, 24, 30, 35
Fuse 6	8Wa-12-11	Rear Fog Lamp Relay	8Wa-12-10
Fuse 7	8Wa-12-16	Rear Power Outlet	8Wa-12-21, 22
Fuse 9	8Wa-12-13, 14, 15, 21, 22	Rear Window Defogger	8Wa-12-28
Fuse 11	8Wa-12-17	Rear Wiper Motor	8Wa-12-21, 22
Fuse 12	8Wa-12-16	Right Courtesy Lamp	8Wa-12-30, 34
Fuse 13	8Wa-12-18	Right Cylinder Lock Switch	8Wa-12-33
Fuse 15	8Wa-12-19, 20	Right Door Lock Switch	8Wa-12-23, 24, 31, 33
Fuse 16	8Wa-12-21, 22	Right Fog Lamp	8Wa-12-21, 22
Fuse 17	8Wa-12-21, 22	Right Front Door Lock Motor/Ajar Switch	8Wa-12-11, 12
Fuse 18	8Wa-12-21, 22	Right Front Park/Turn Signal Lamp	8Wa-12-13
Fuse 19	8Wa-12-21, 22	Right Headlamp	8Wa-12-10, 27
Fuse 20	8Wa-12-23, 24	Right Heated Seat Switch	8Wa-12-26
Fuse 22	8Wa-12-23, 24	Right Position Lamp	8Wa-12-14, 15
Fuse 23	8Wa-12-13, 14, 15	Right Power Mirror	8Wa-12-28
Fuse 24	8Wa-12-25	Right Power Seat Switch	8Wa-12-29
Fuse 25	8Wa-12-26	Right Rear Door Lock Motor/Ajar Switch	8Wa-12-12
Fuse 26	8Wa-12-27	Right Side Impact Airbag Control Module	8Wa-12-18
Fuse 27	8Wa-12-27	Right Side Marker Lamp	8Wa-12-13
Fuse 29	8Wa-12-17	Right Tail/Stop Lamp	8Wa-12-10, 13, 14, 15, 16
Fuse 30	8Wa-12-28	Right Visor/Vanity Lamp	8Wa-12-30, 31
Fuse 31	8Wa-12-23, 24	Sentry Key Immobilizer Module	8Wa-12-19, 20, 29
Fuse 32	8Wa-12-23, 24	Shifter Assembly	8Wa-12-25, 35
Fuse 33	8Wa-12-29	Siren	8Wa-12-30
Fuse 34	8Wa-12-30	Sunroof Motor	8Wa-12-23, 24
Fuse 36	8Wa-12-18	Tailgate Lock Motor/Ajar Switch	8Wa-12-32
Fuse 37	8Wa-12-25	Trailer Tow Brake Lamp Relay	8Wa-12-16, 21, 22
Fuse 38	8Wa-12-25	Trailer Tow Connector	8Wa-12-13, 14, 15
Fuse 39	8Wa-12-28	Trailer Tow Relay	8Wa-12-26
G202	8Wa-12-11, 13, 14, 15, 27, 32	Transmission Control Module	8Wa-12-19
Hazard Switch/Combination Flasher	8Wa-12-17, 28, 35	Transmission Solenoid/TRS Assembly	8Wa-12-28
Headlamp Leveling Switch	8Wa-12-14, 15	Wiper On/Off Relay	8Wa-12-23, 24, 31, 32
Heated Seat Module	8Wa-12-17		
High Beam Relay	8Wa-12-27		

JUNCTION BLOCK  
INBOARD





## FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	20A	F38 16RD/WT	FUSED B(+)
2	10A	INTERNAL	FUSED B(+)
3	15A	INTERNAL	FUSED B(+)
4	10A	L44 18VT/RD	FUSED B(+)
5	10A	L43 18VT	FUSED (B+)
6	20A	INTERNAL	FUSED B(+)
7	-	SPARE	-
8	-	SPARE	-
9	10A	INTERNAL	FUSED PARK LAMP RELAY OUTPUT
10	-	SPARE	-
11	15A	A15 18PK/OR	FUSED B(+)
12	15A	F32 18PK/DB	FUSED B(+)
13	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
14	-	SPARE	-
15	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
16	20A	F41 16PK/VT	FUSED B(+)
17	15A	F70 18PK/BK	FUSED B(+)
18	20A	F60 16DG/RD	FUSED B(+)
19	20A	INTERNAL	FUSED B(+)
20	20A	F85 16VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
21	-	SPARE	-
22	10A	F88 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
23	10A	INTERNAL	FUSED PARK LAMP RELAY OUTPUT
24	10A	F20 18WT	FUSED IGNITION SWITCH OUTPUT (RUN)
25	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
26	10A	L34 18RD/OR	FUSED RIGHT HIGH BEAM OUTPUT
27	10A	L33 18LG/BR	FUSED LEFT HIGH BEAM OUTPUT
28	-	SPARE	-
29 ○○	15A	A3 16RD/WT	FUSED B(+)
30	10A	INTERNAL	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT

○○ HIGHLINE

**FUSES (CONTINUED)**

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
31	20A	F30 16RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
32	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
33	10A	INTERNAL	FUSED B(+)
34	15A	INTERNAL	FUSED B(+)
35	-	SPARE	-
36	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
37	10A	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
38	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
39	10A	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)

**CIRCUIT BREAKERS**

C.B.	AMPS	FUSED CIRCUIT	FUNCTION
1	25A	F37 14RD/LB	FUSED B(+)
2	-	SPARE	-
3	20A	V6 18VT/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)

**DAYTIME  
RUNNING  
LAMP RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	GROUND
86	INTERNAL	HIGH BEAM RELAY CONTROL
87	INTERNAL	DAYTIME RUNNING LAMP RELAY OUTPUT
87A	-	-

**DEFOGGER  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	REAR WINDOW DEFOGGER RELAY CONTROL
86	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
87	INTERNAL	REAR WINDOW DEFOGGER RELAY OUTPUT
87A	-	-

**DOOR  
LOCK  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	P33 18OR/BK	DOOR LOCK RELAY OUTPUT
85	INTERNAL	FUSED B(+)
86	INTERNAL	DOOR LOCK RELAY CONTROL
87	INTERNAL	FUSED B(+)
87A	INTERNAL	GROUND

**DRIVER  
DOOR  
UNLOCK RELAY**

CAVITY	CIRCUIT	FUNCTION
30	P34 18PK/BK	DRIVER DOOR UNLOCK RELAY OUTPUT
85	INTERNAL	DRIVER DOOR UNLOCK RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	INTERNAL	FUSED B(+)
87A	INTERNAL	GROUND

**FRONT FOG  
LAMP  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FRONT FOG LAMP RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	L39 16LB	FRONT FOG LAMP RELAY OUTPUT
87A	-	-

**HIGH  
BEAM  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	HIGH BEAM RELAY CONTROL
87	INTERNAL	HIGH BEAM RELAY OUTPUT
87A	-	-

**HORN  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	HORN RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	X2 18DG/RD	HORN RELAY OUTPUT
87A	-	-



**LOW  
BEAM  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	LOW BEAM RELAY CONTROL
87	INTERNAL	LOW BEAM RELAY OUTPUT
87A	-	-

**PARK  
LAMP  
RELAY**

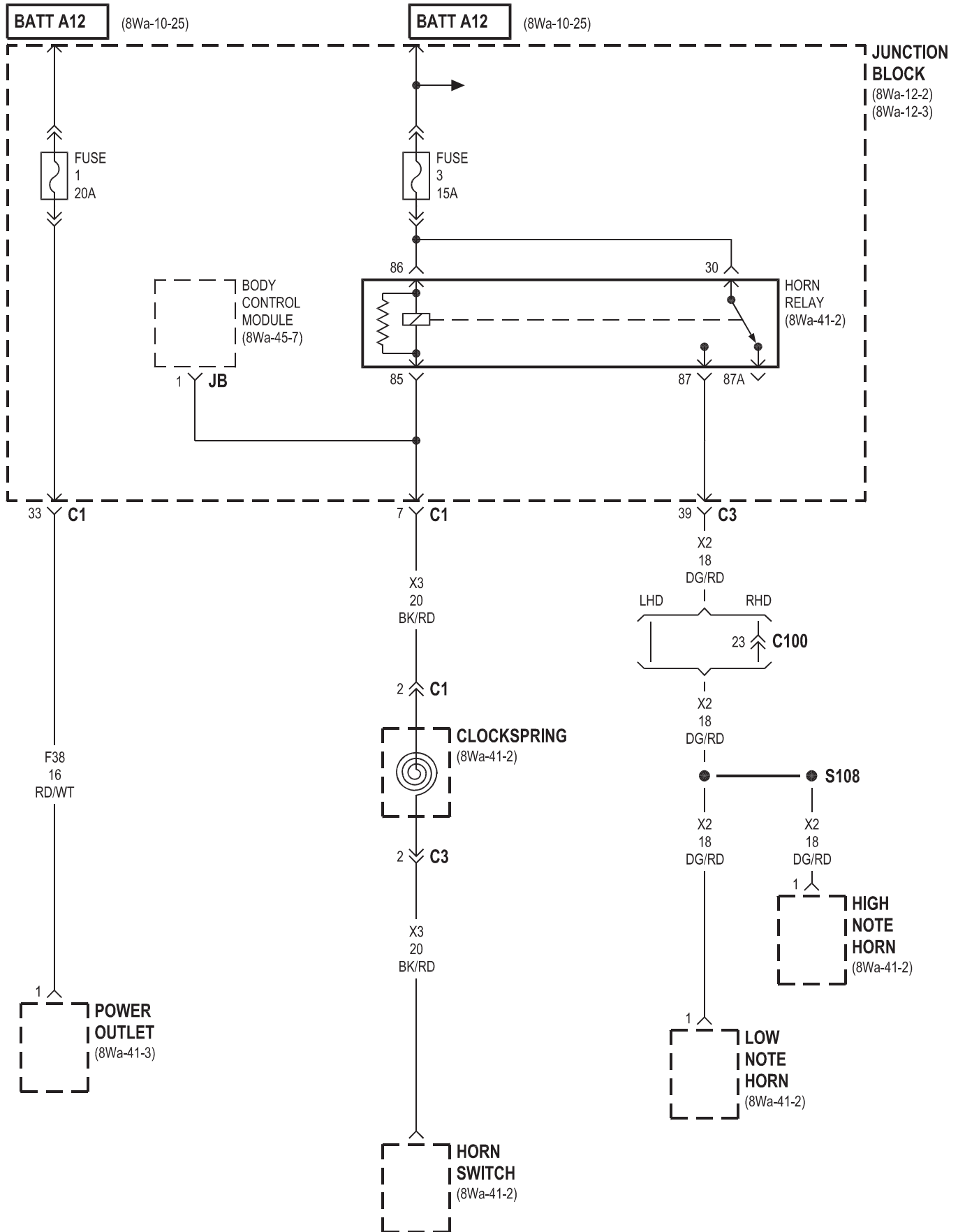
CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	PARK LAMP RELAY OUTPUT
85	INTERNAL	PARK LAMP RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	INTERNAL	FUSED B(+)
87A	INTERNAL	GROUND

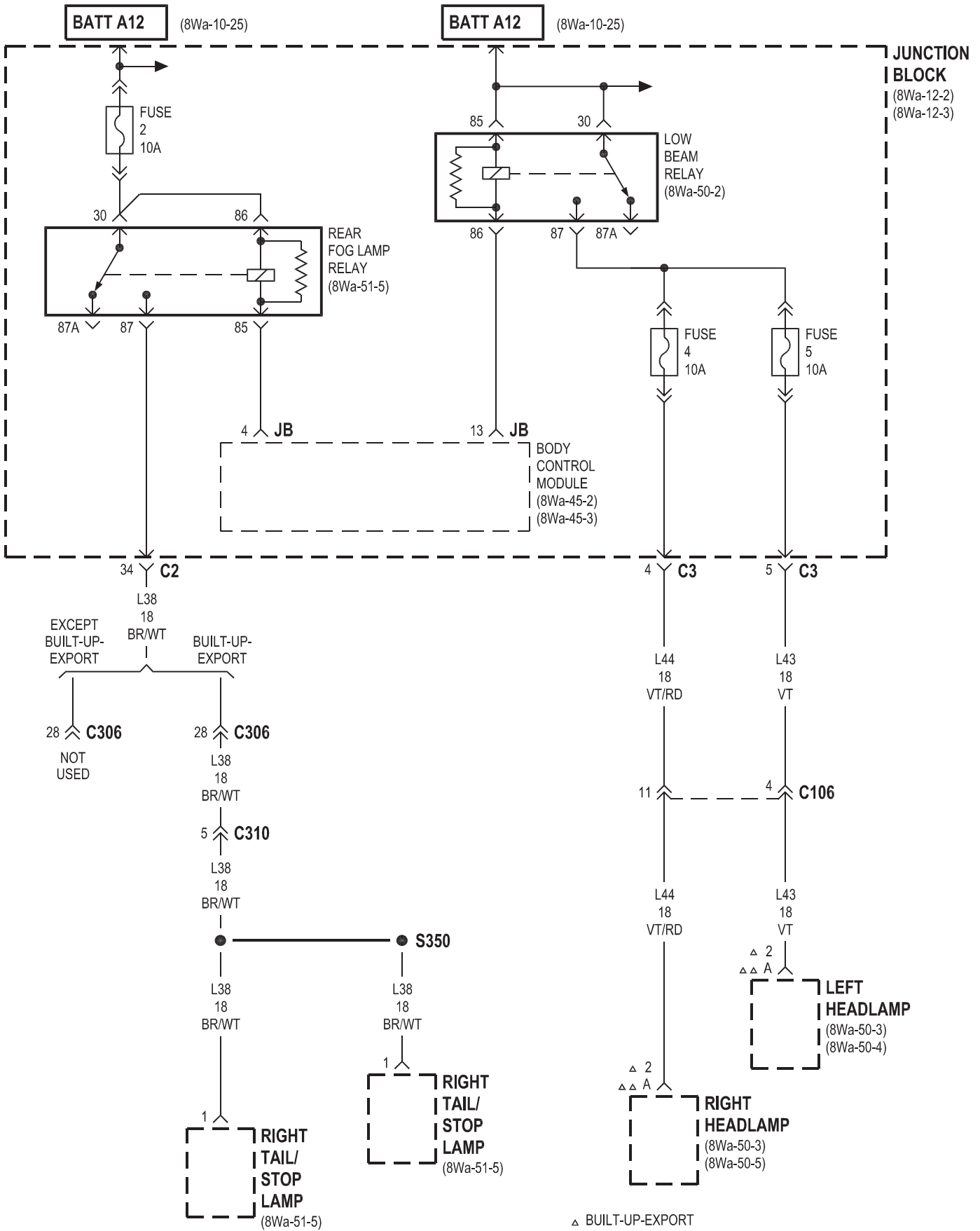
**PASSENGER  
DOOR  
UNLOCK  
RELAY**

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	PASSENGER DOOR UNLOCK RELAY OUTPUT
85	INTERNAL	PASSENGER DOOR UNLOCK RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	INTERNAL	FUSED B(+)
87A	INTERNAL	GROUND

**REAR  
FOG LAMP  
RELAY**

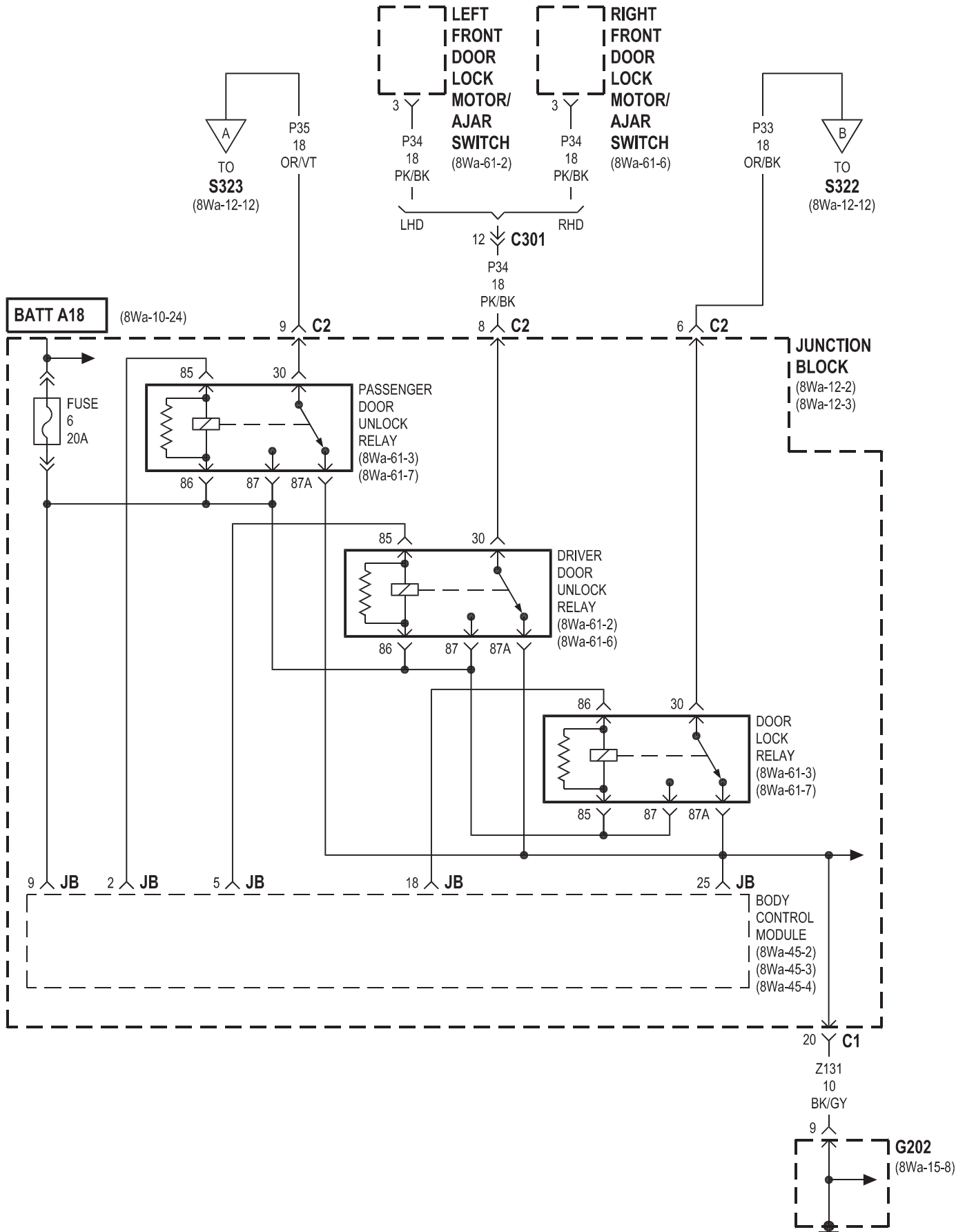
CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	REAR FOG LAMP RELAY CONTROL
86	INTERNAL	FUSED B(+)
86	INTERNAL	FUSED B(+)
87	L38 18BR/WT	REAR FOG LAMP RELAY OUTPUT
87A	-	-

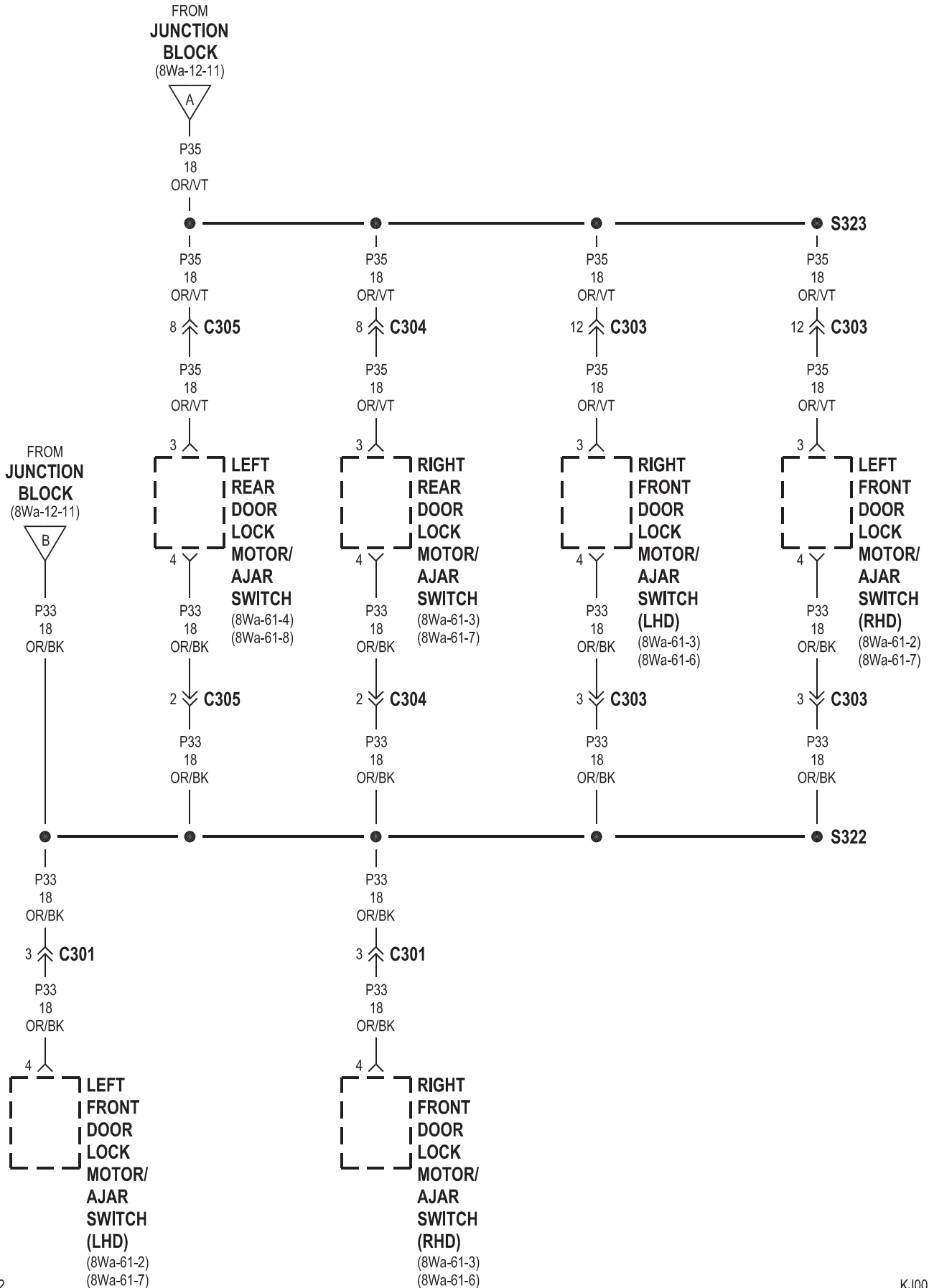


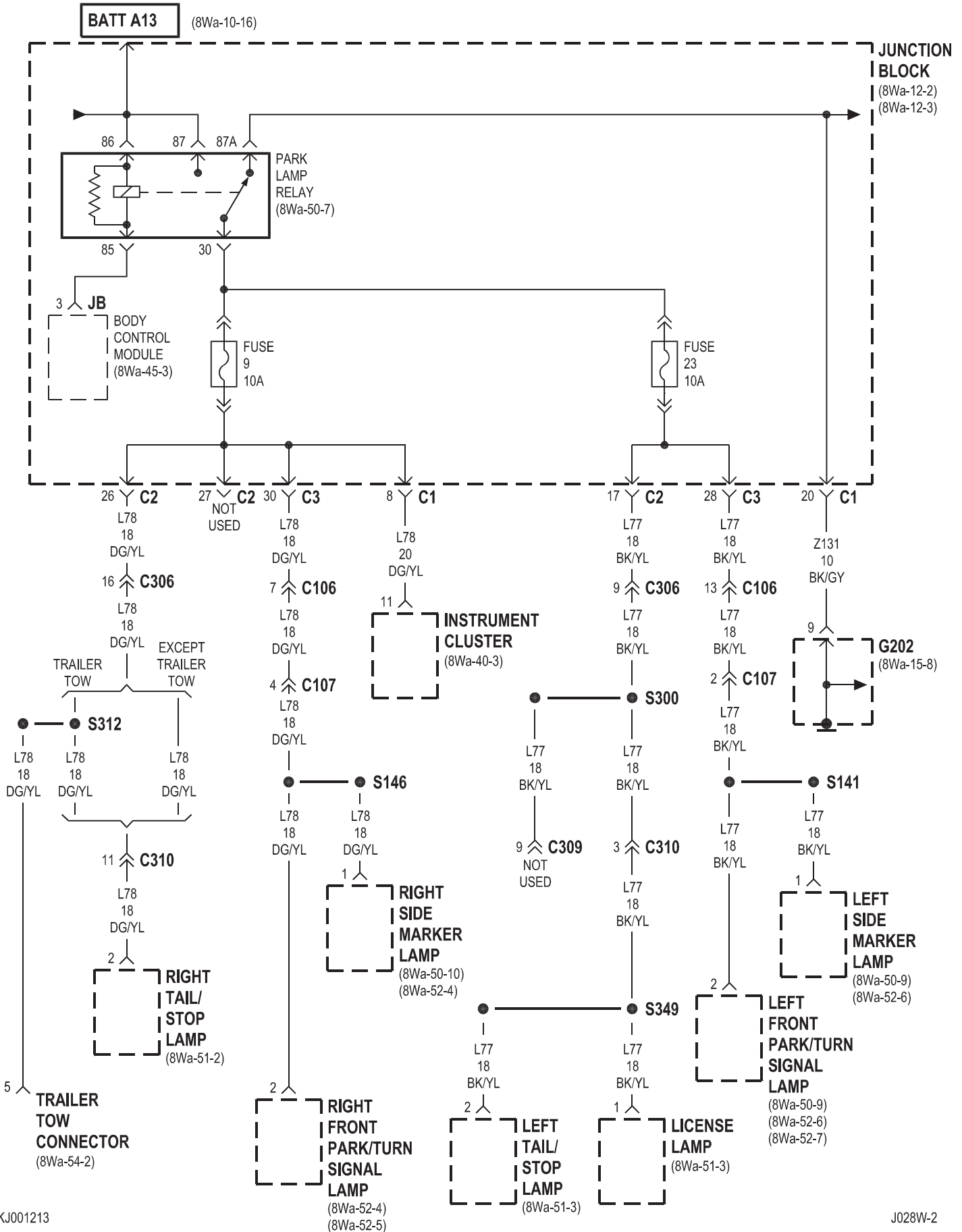


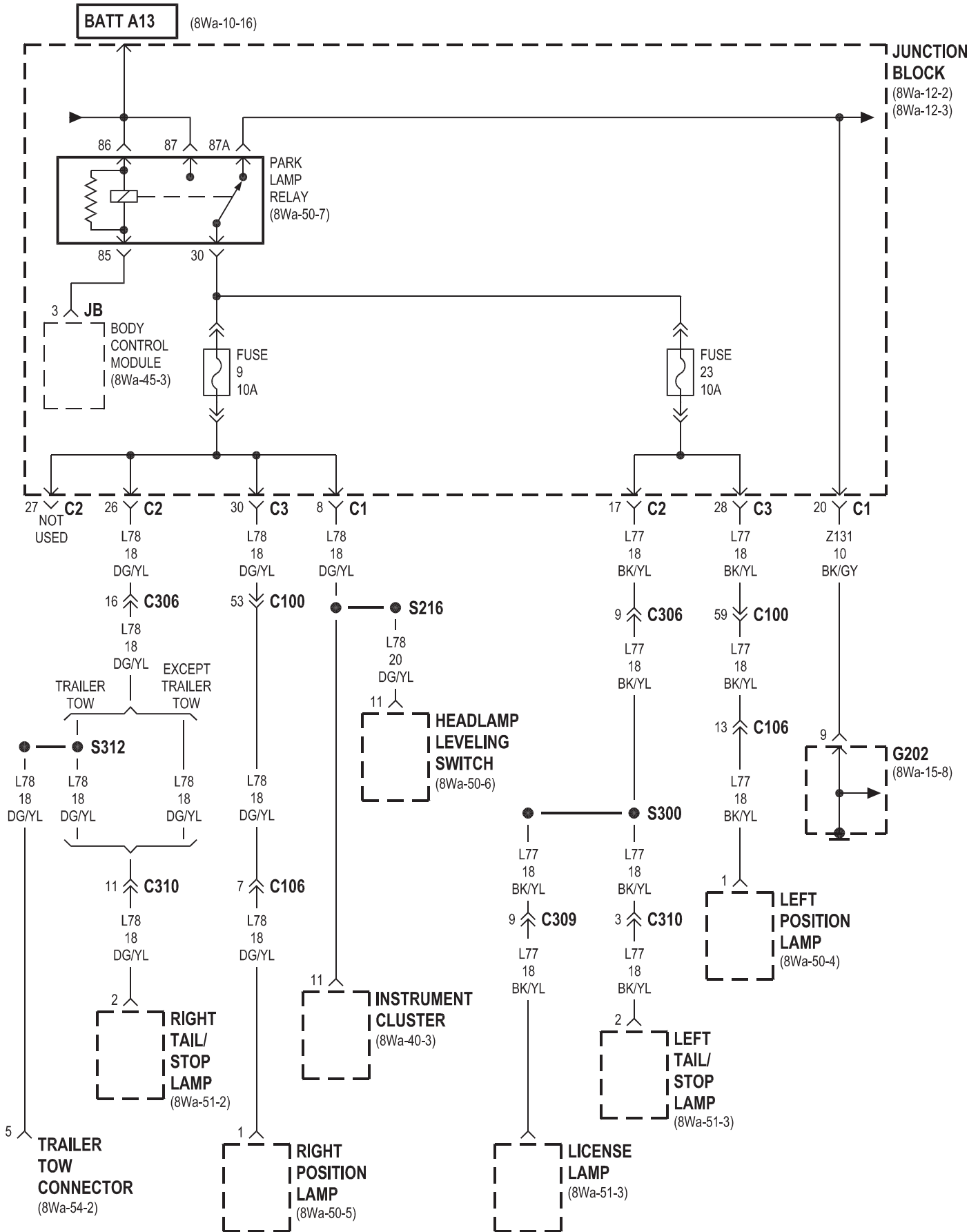
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 △△ EXCEPT BUILT-UP-EXPORT

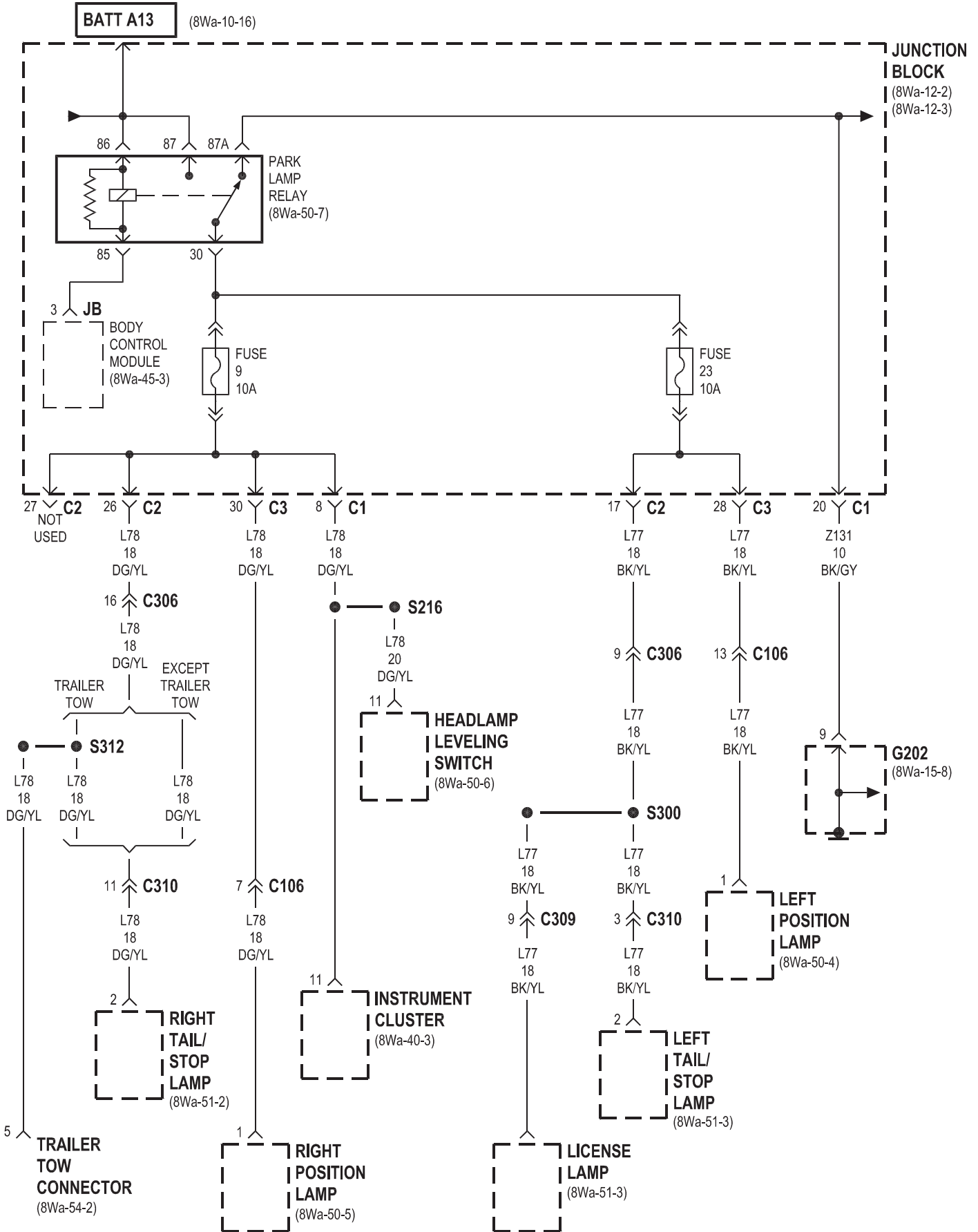
### 8W-12 JUNCTION BLOCK EXCEPT BASE



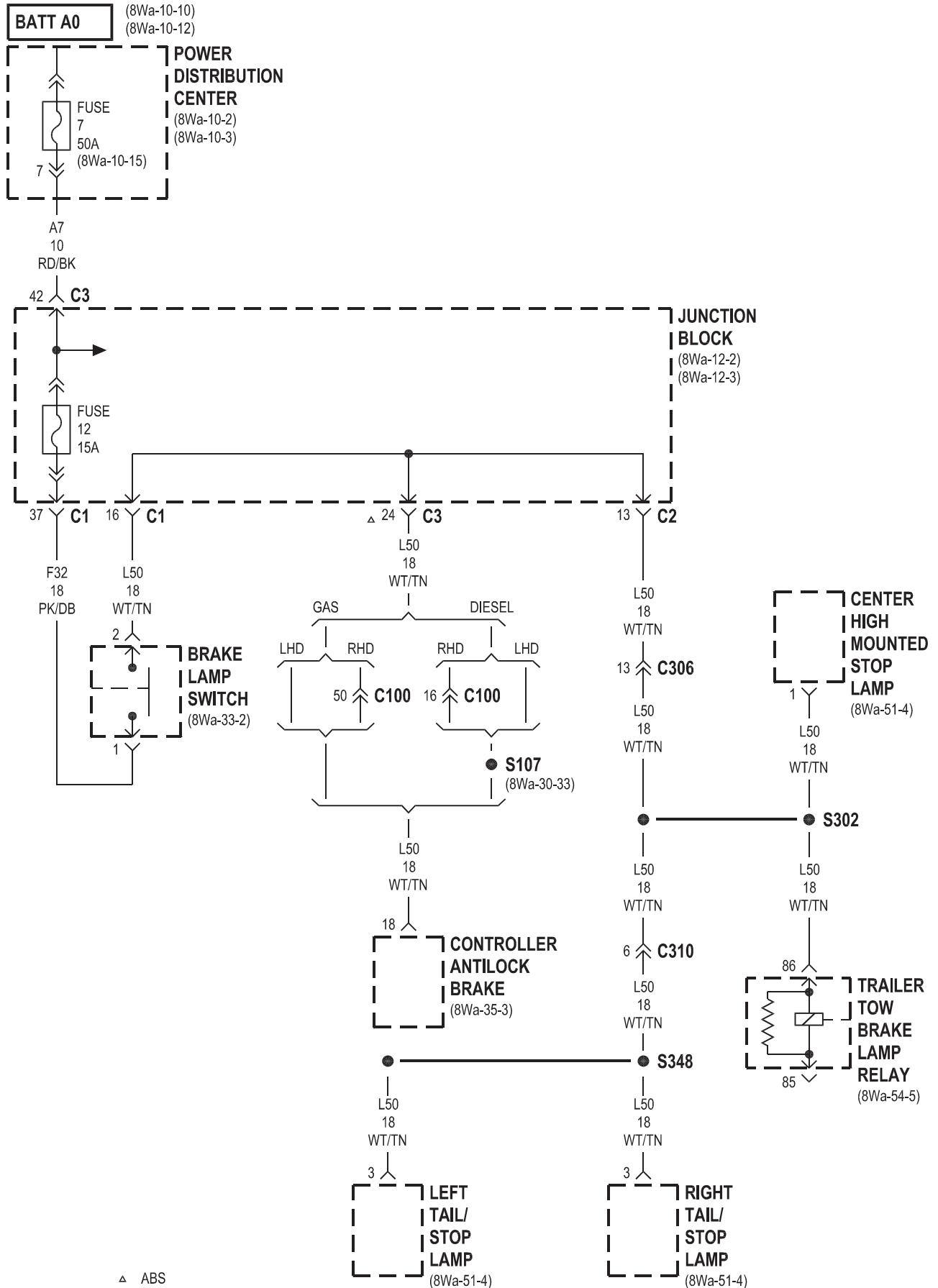


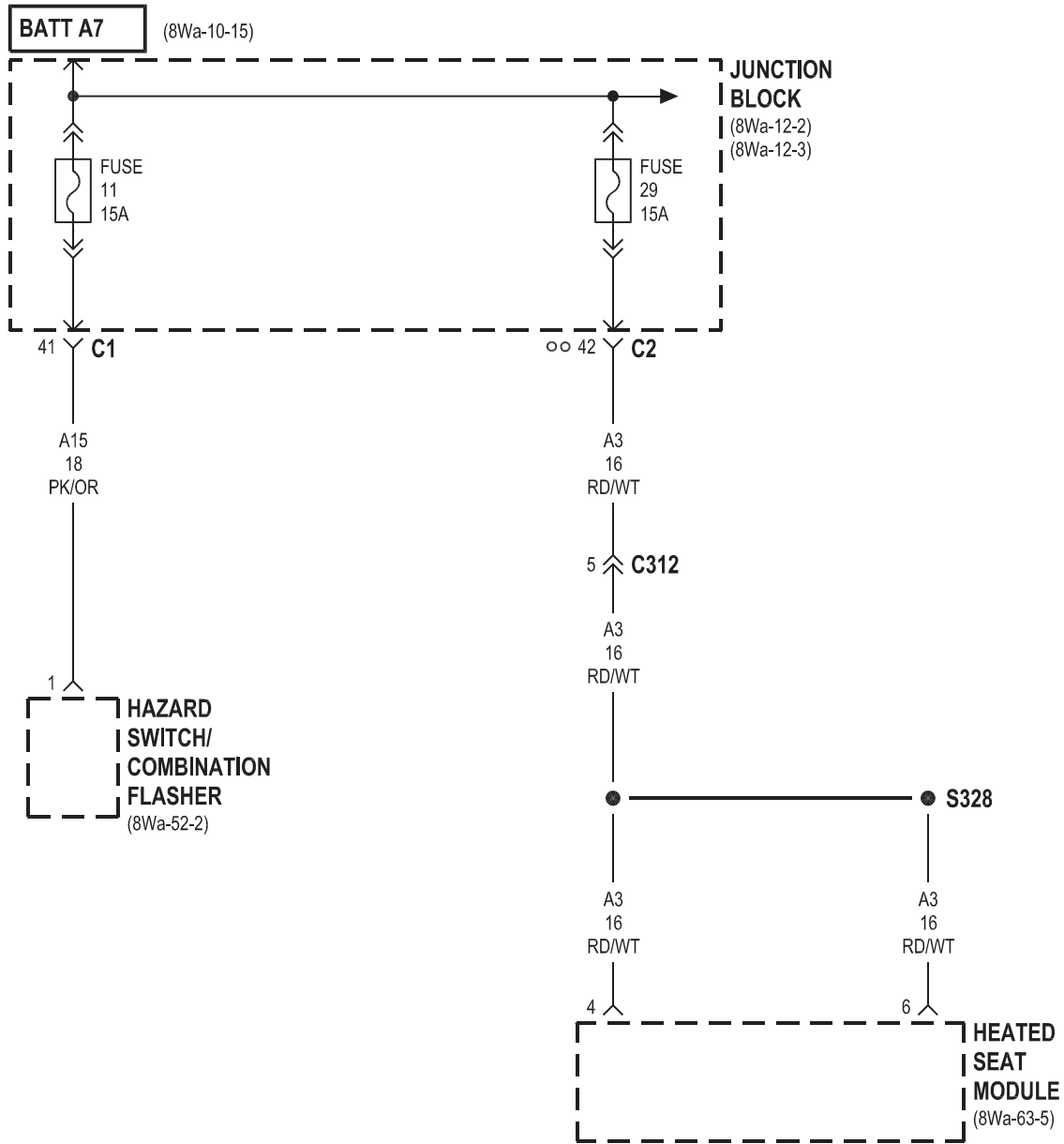




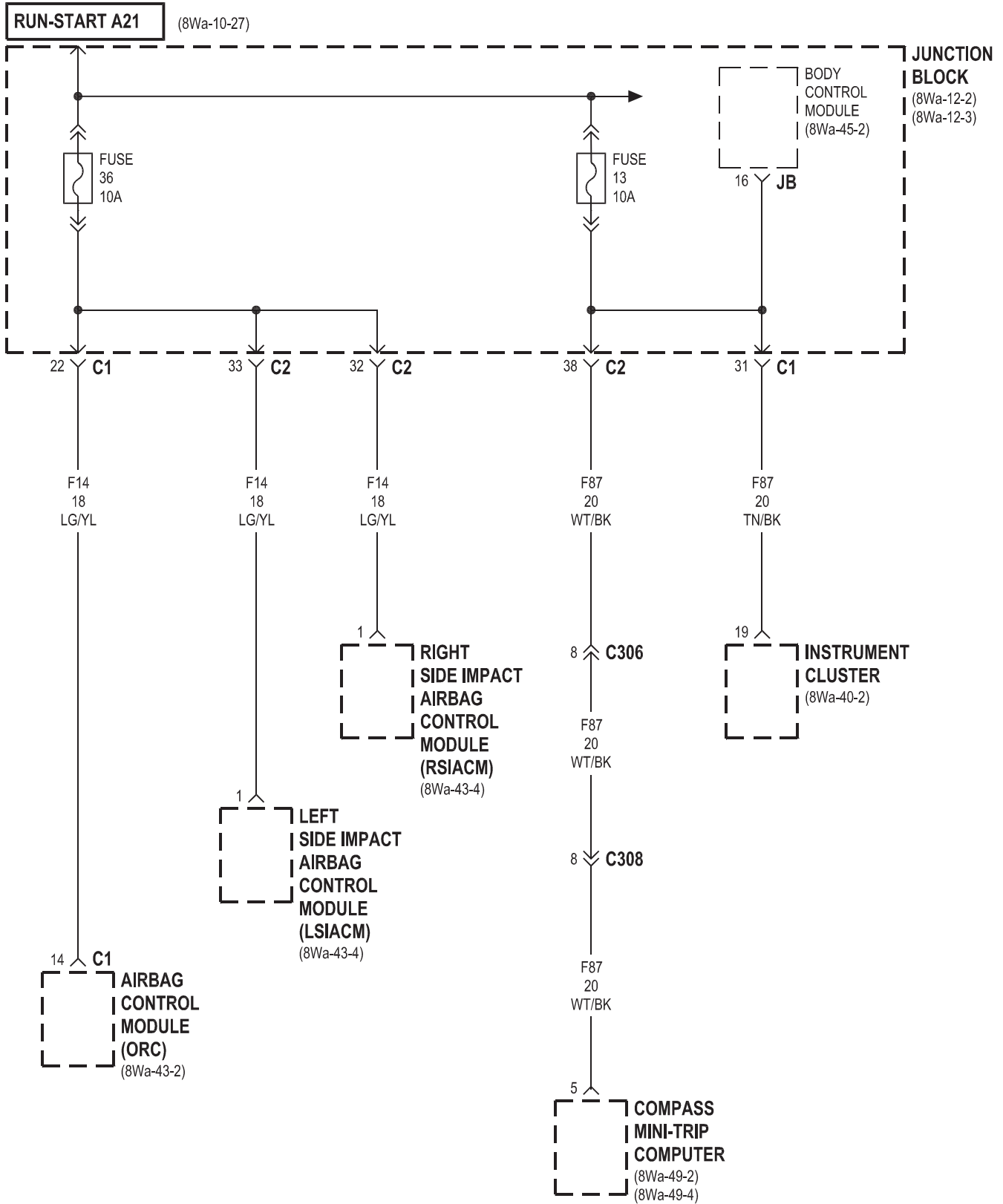


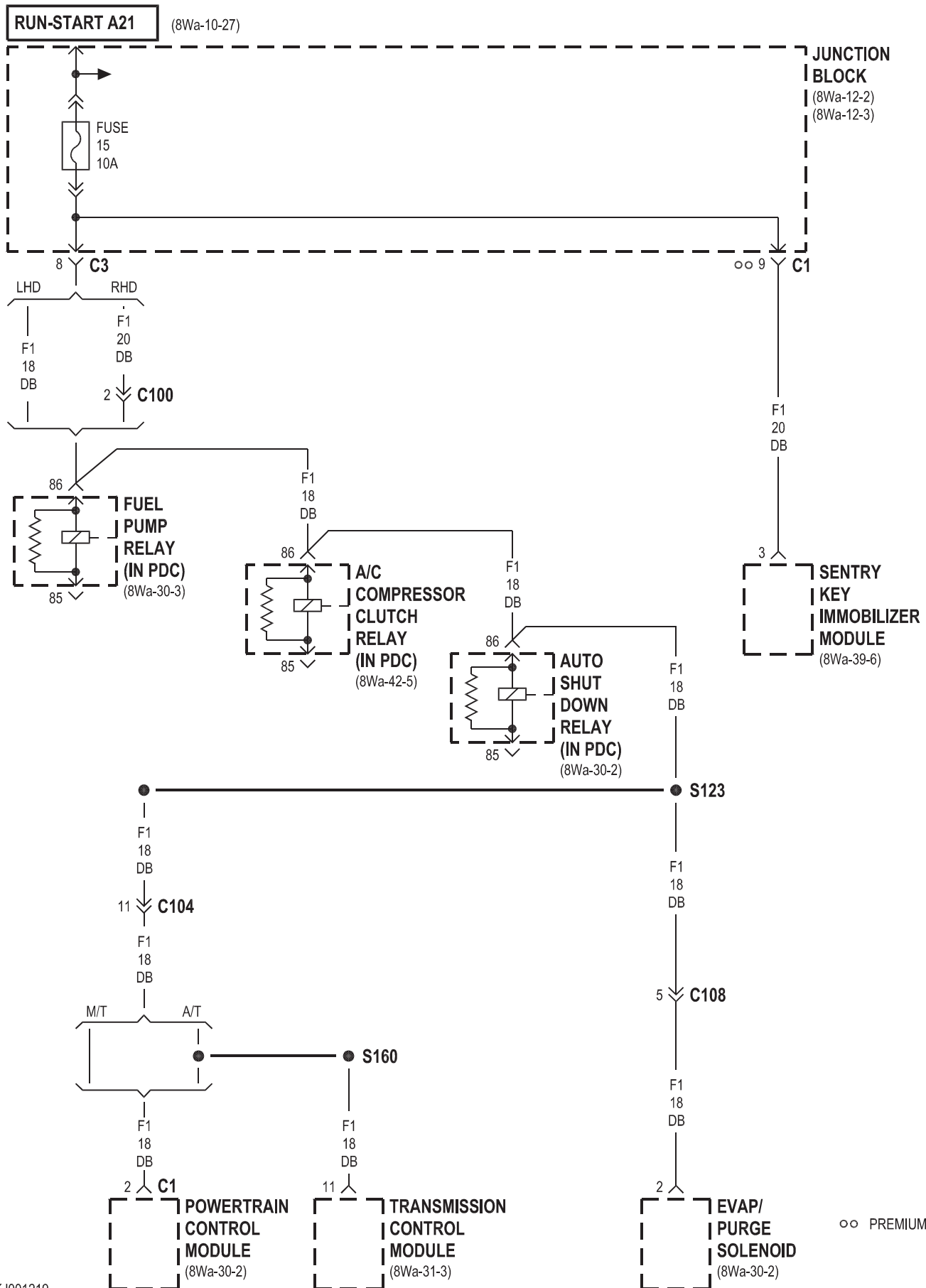


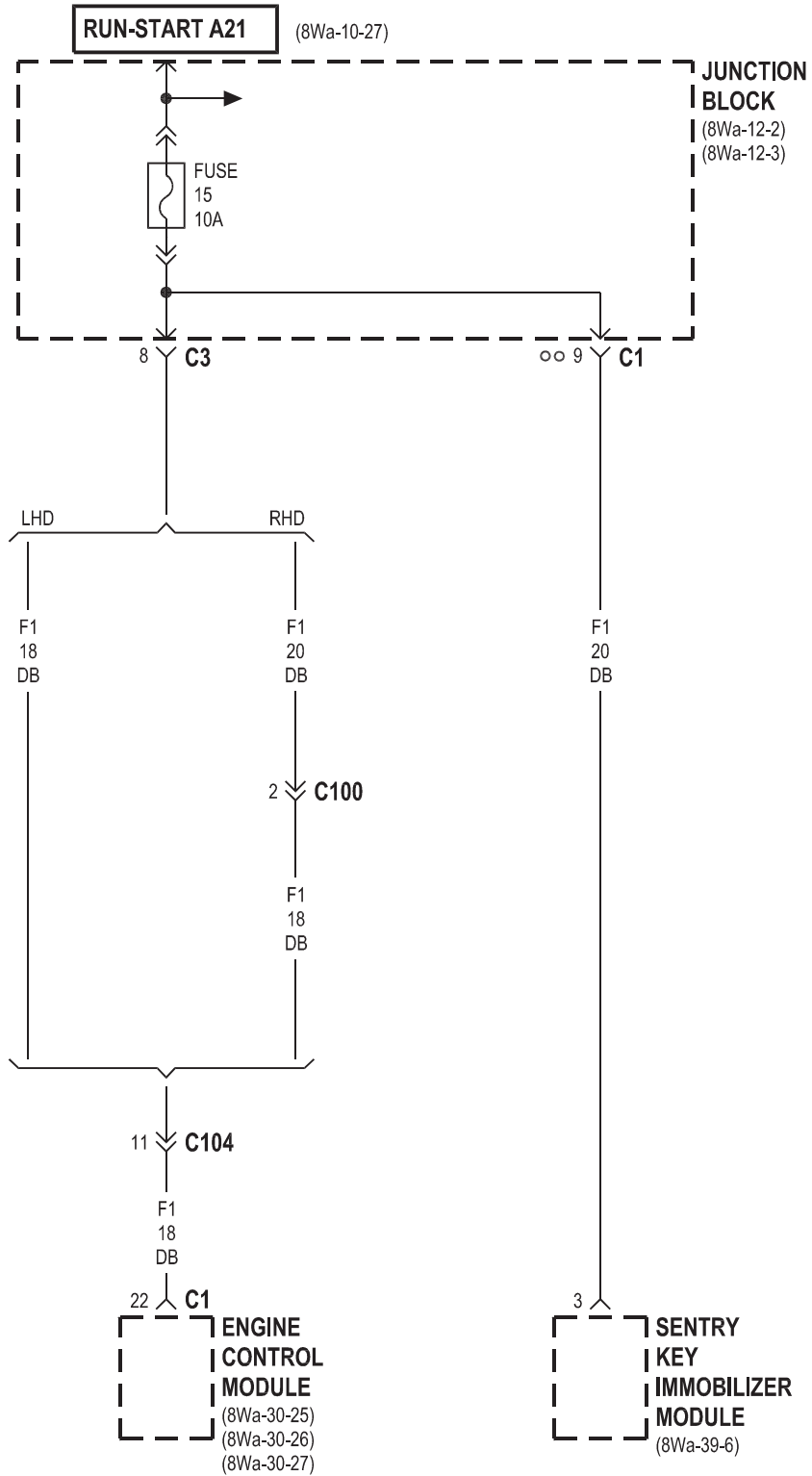




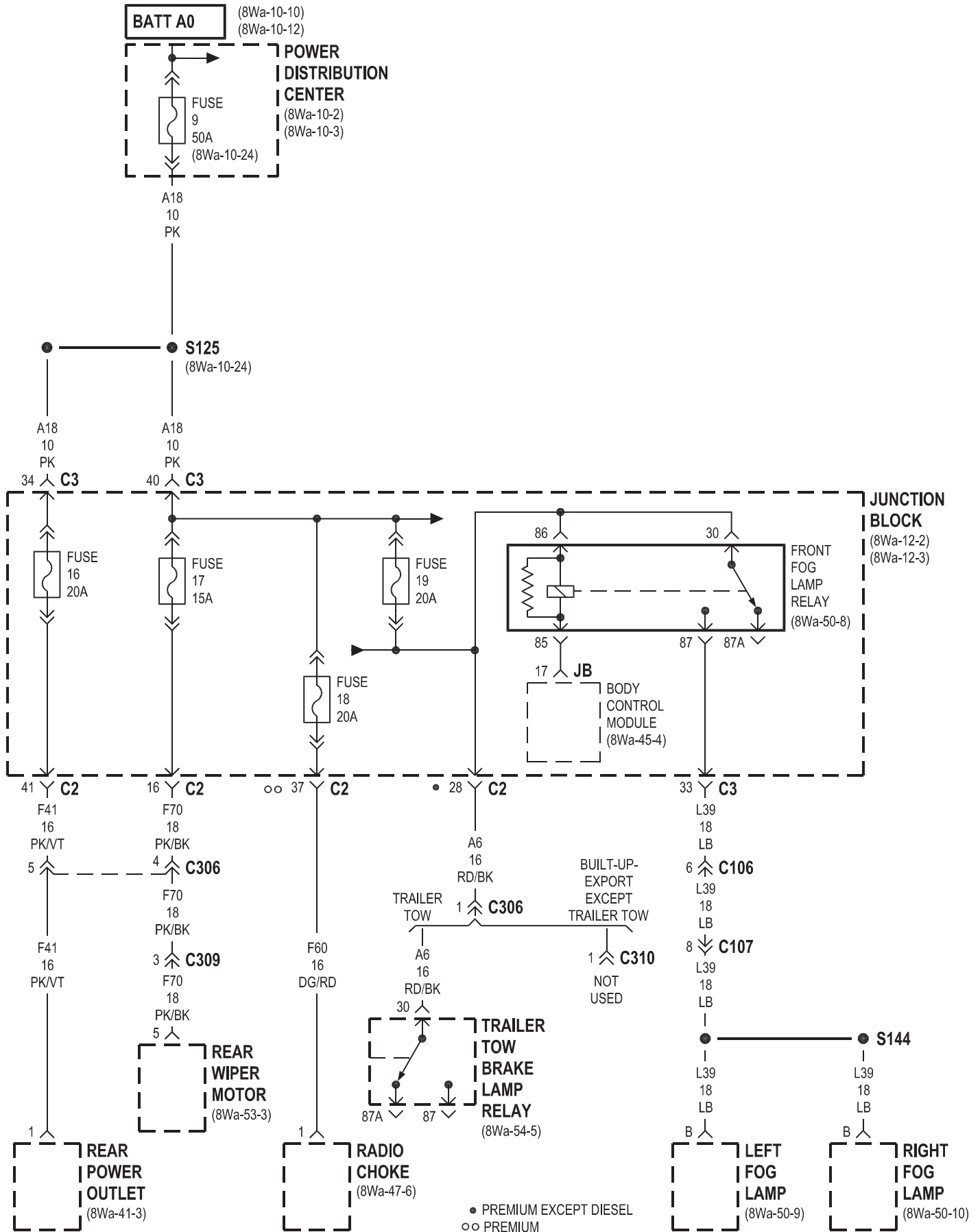
○○ HIGHLINE



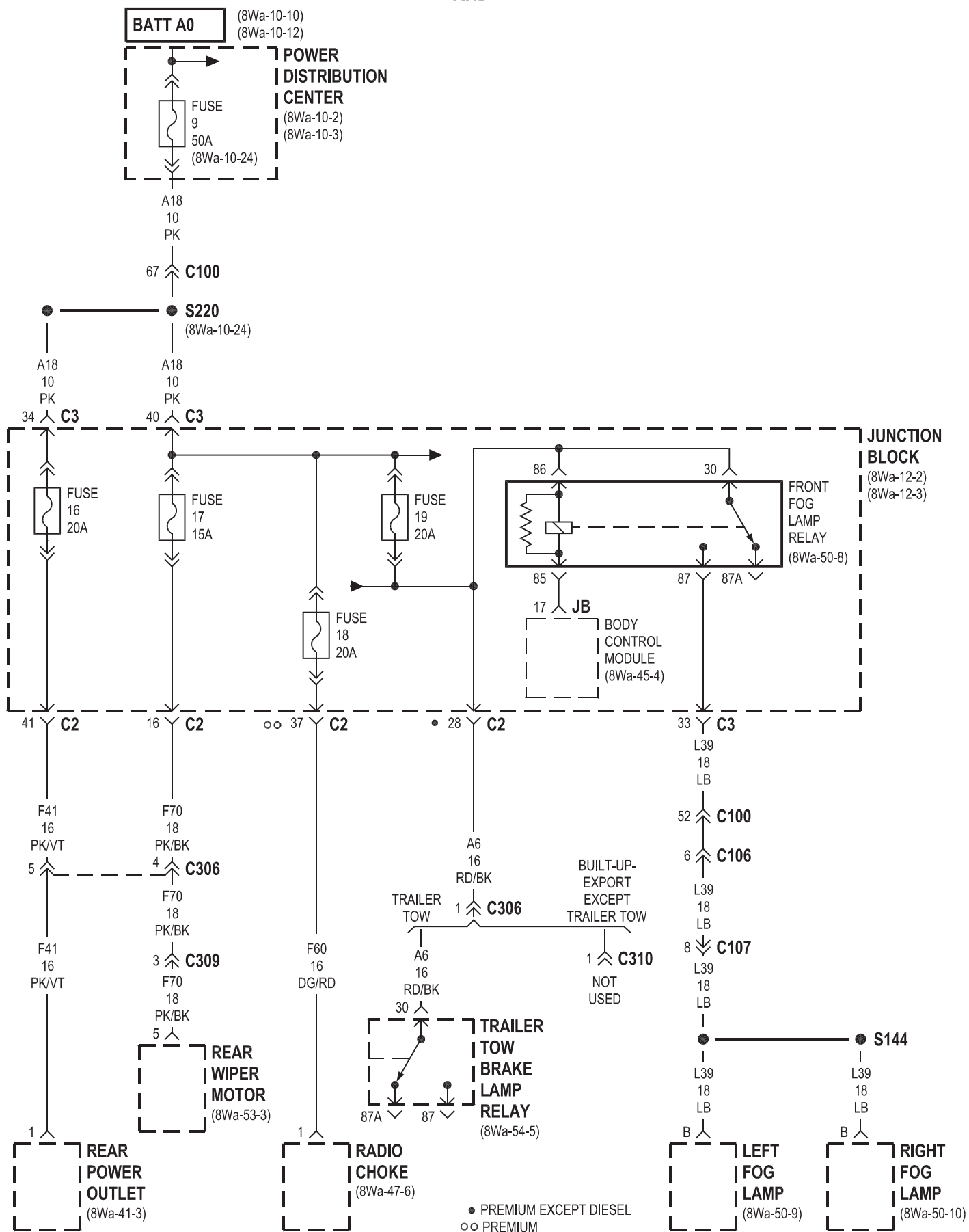


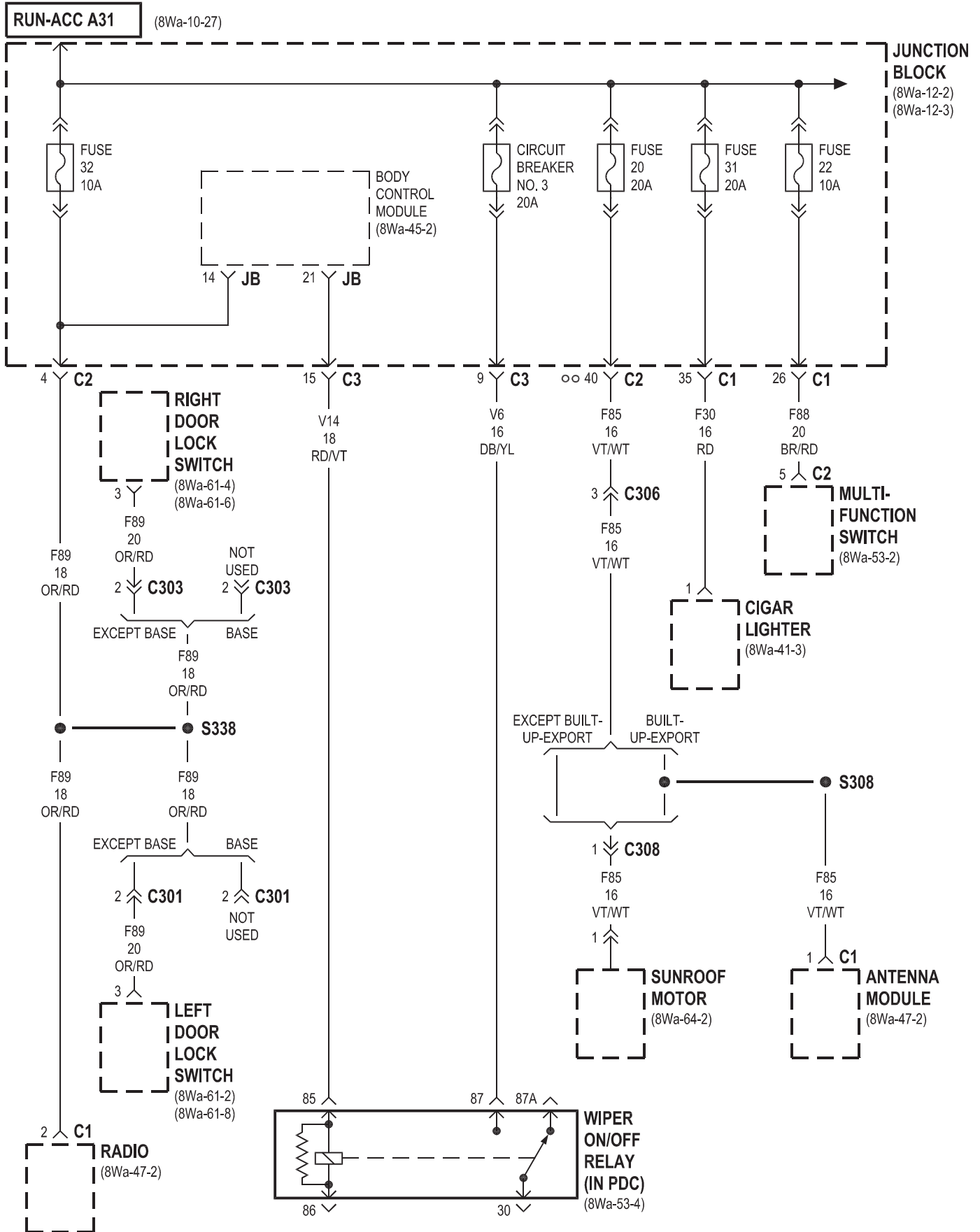


◊◊ PREMIUM

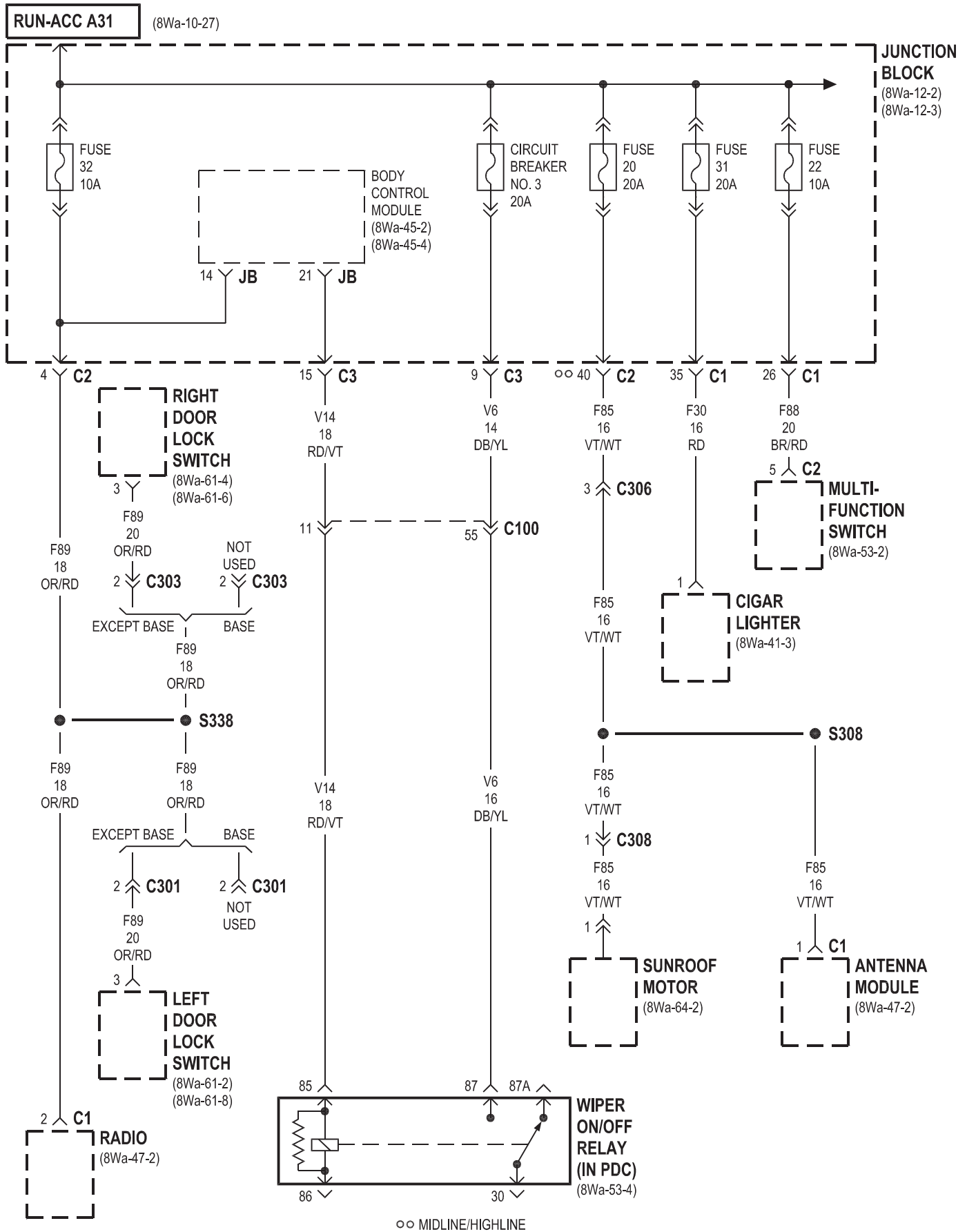


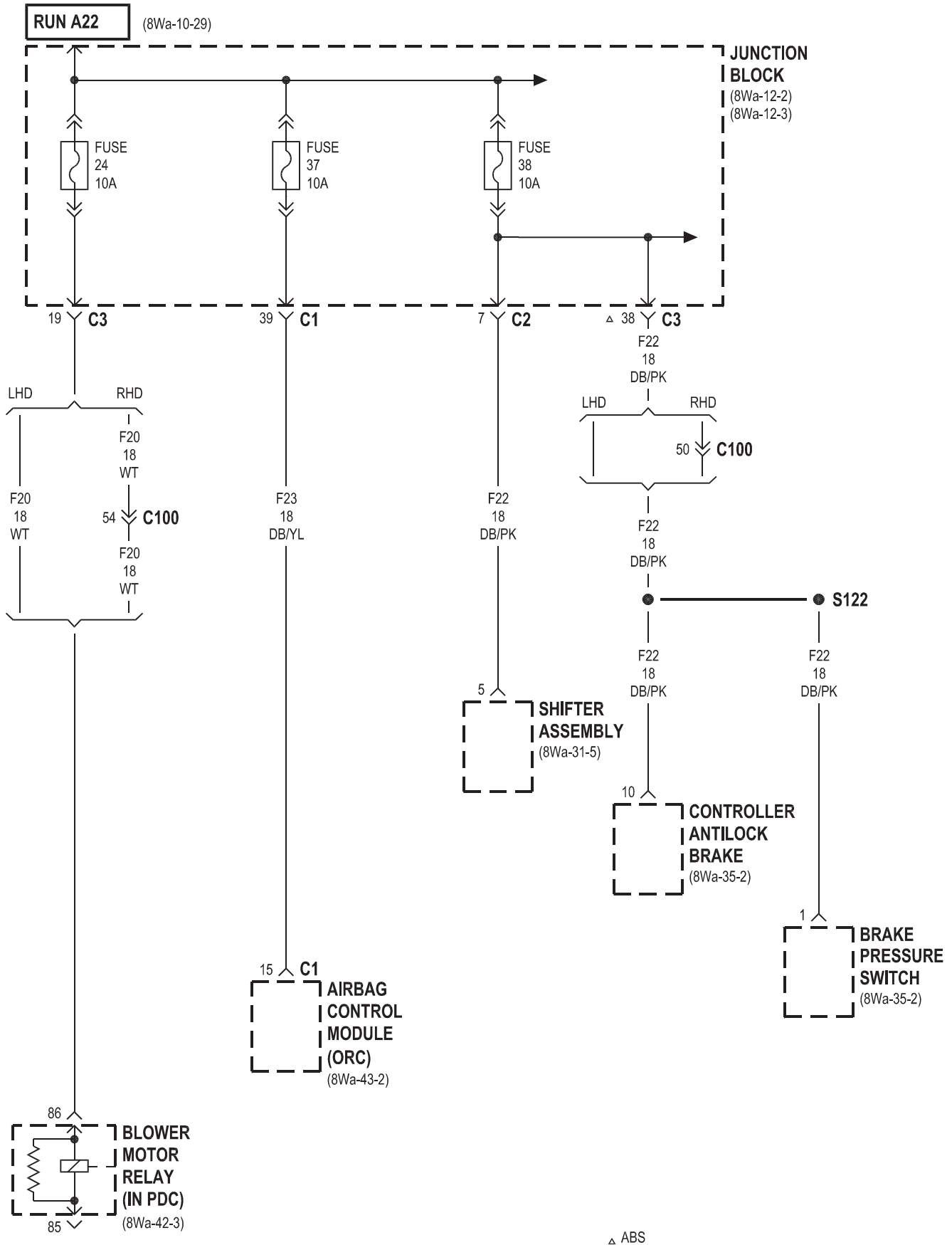
RHD

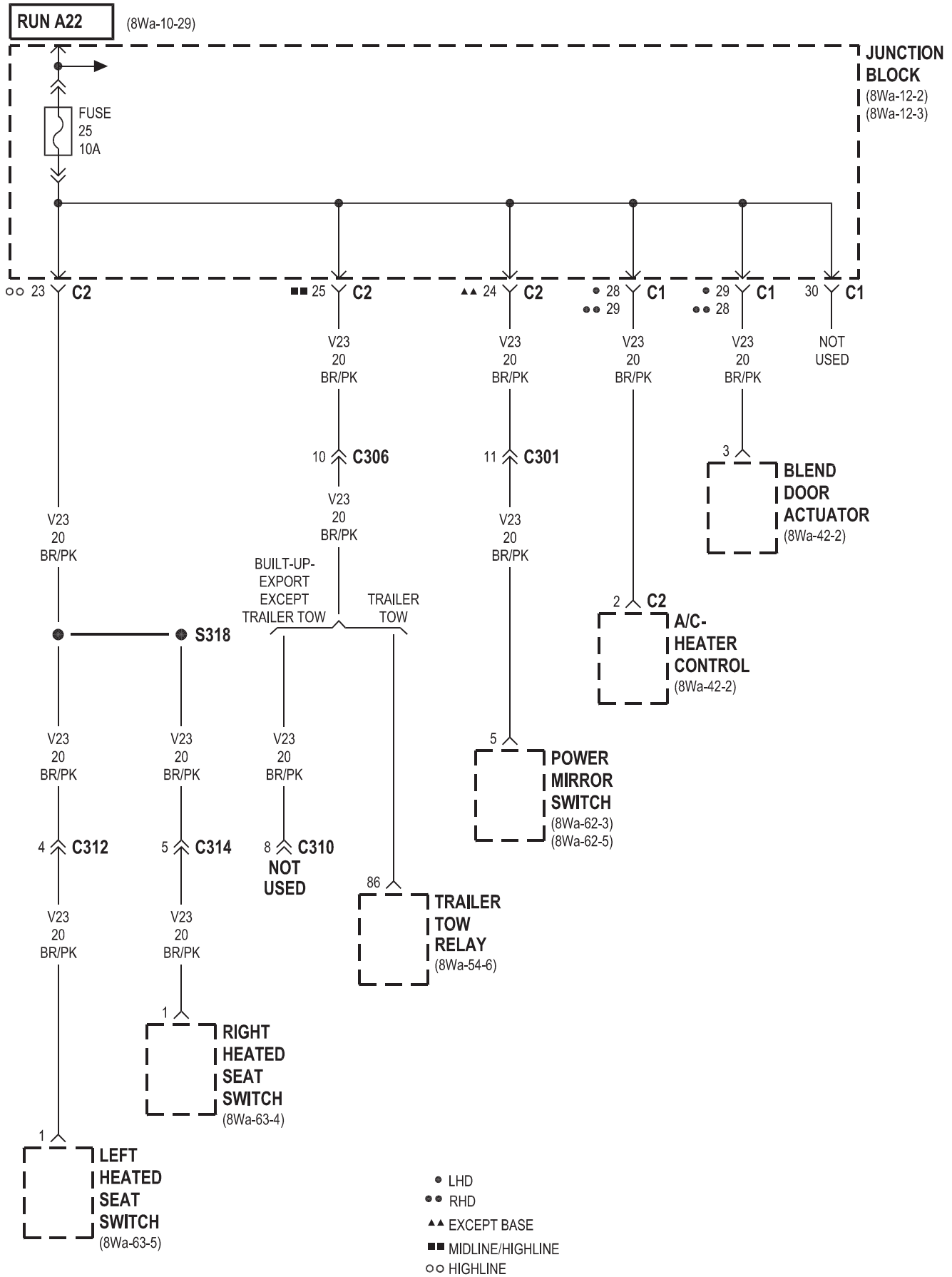


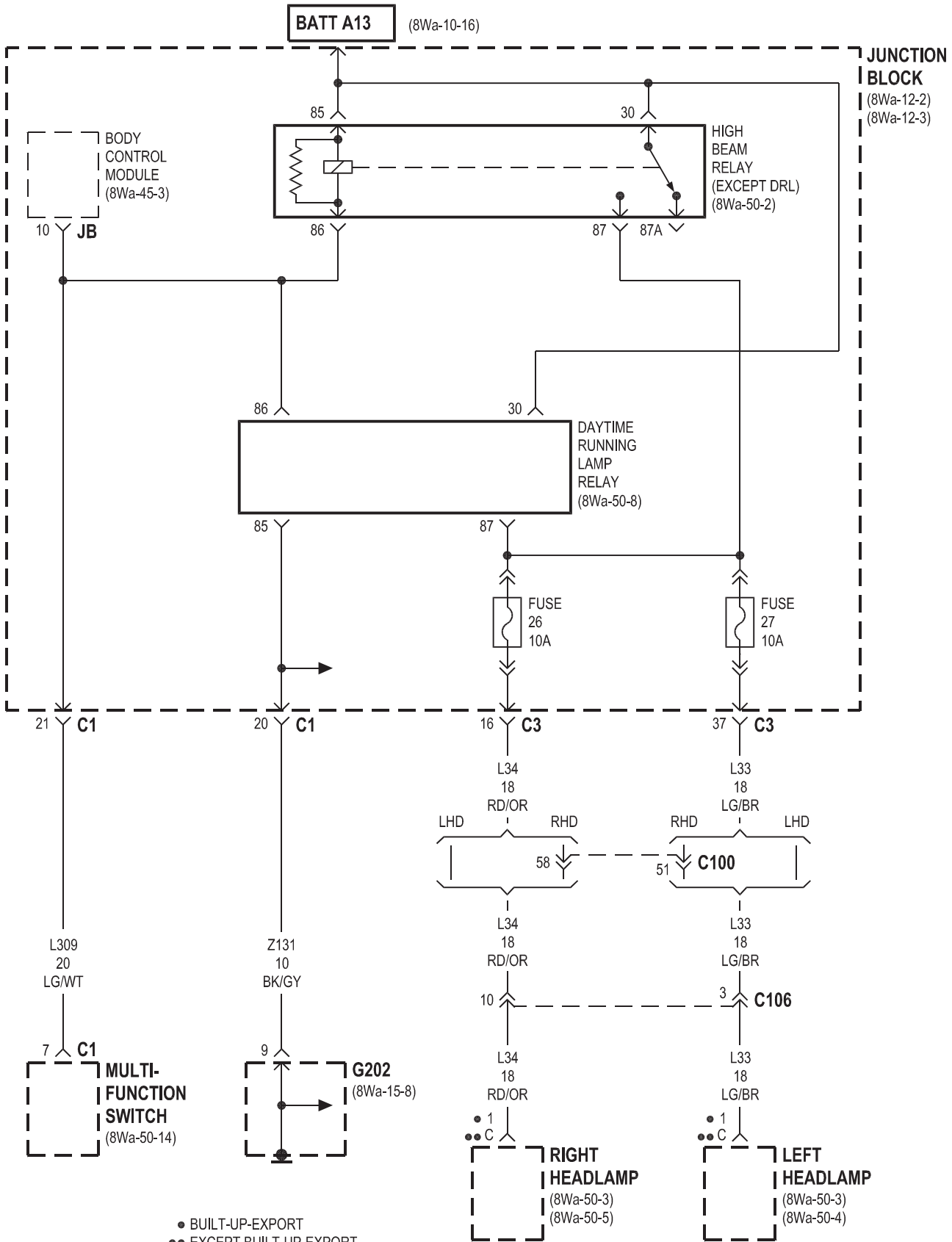




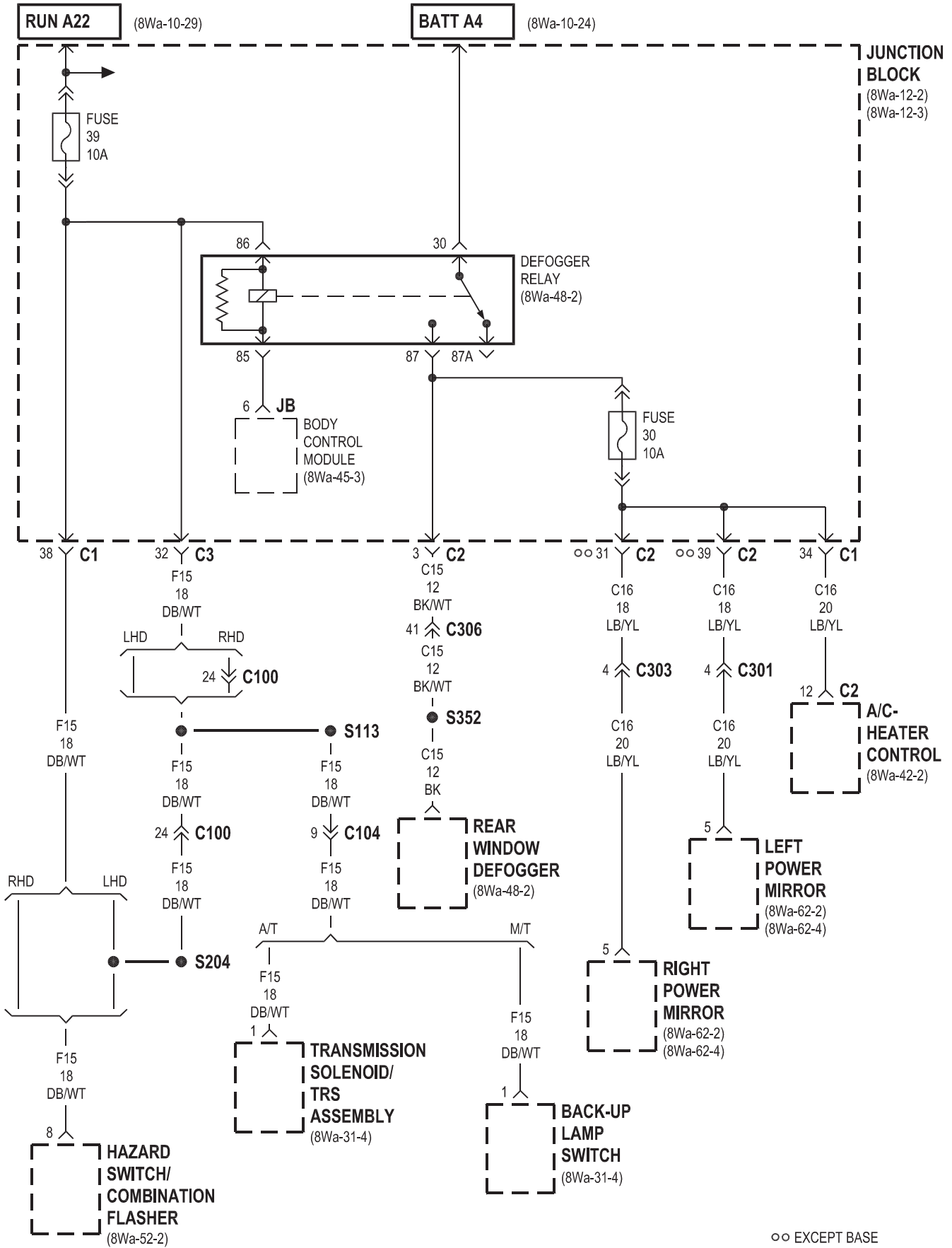


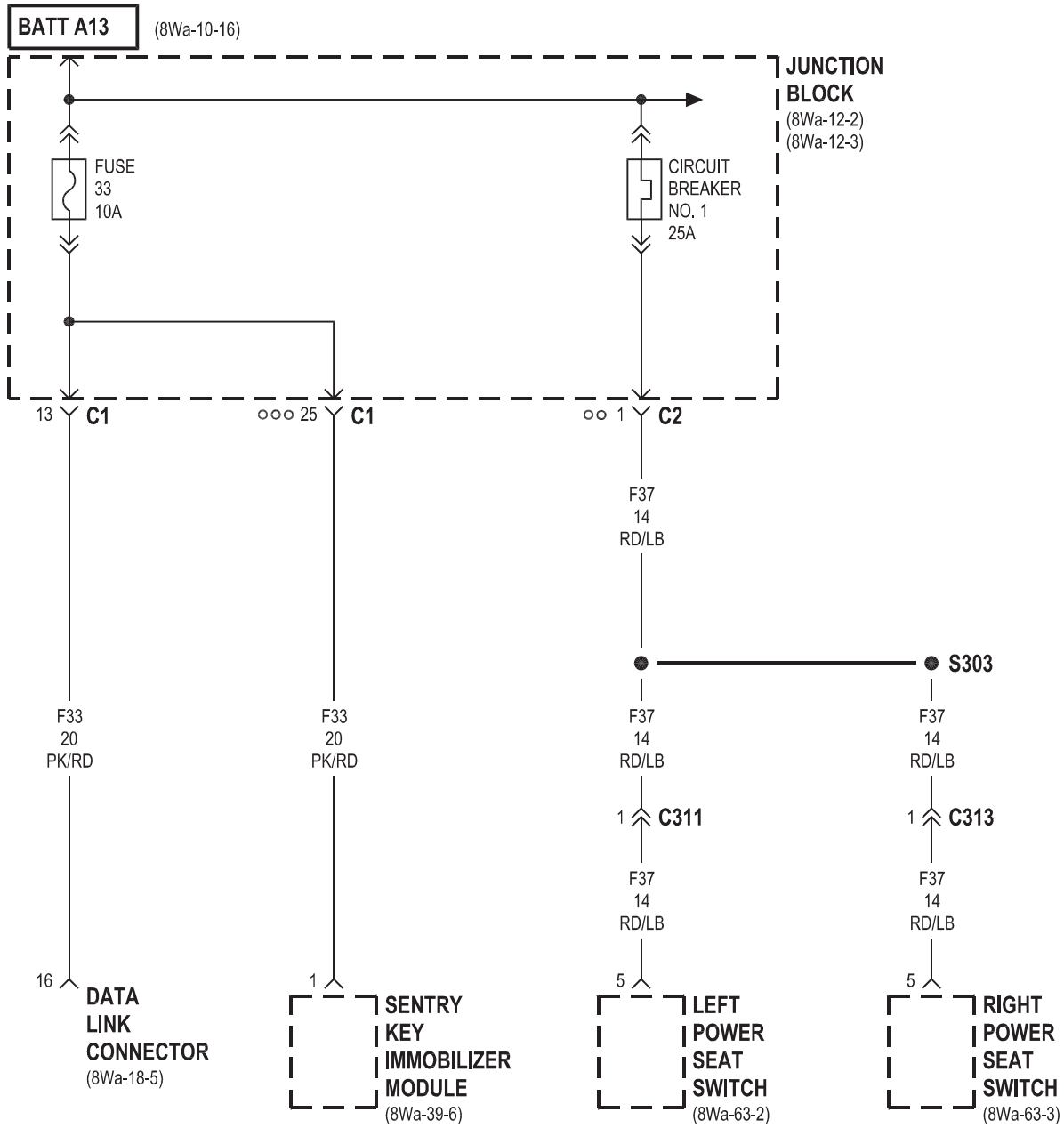




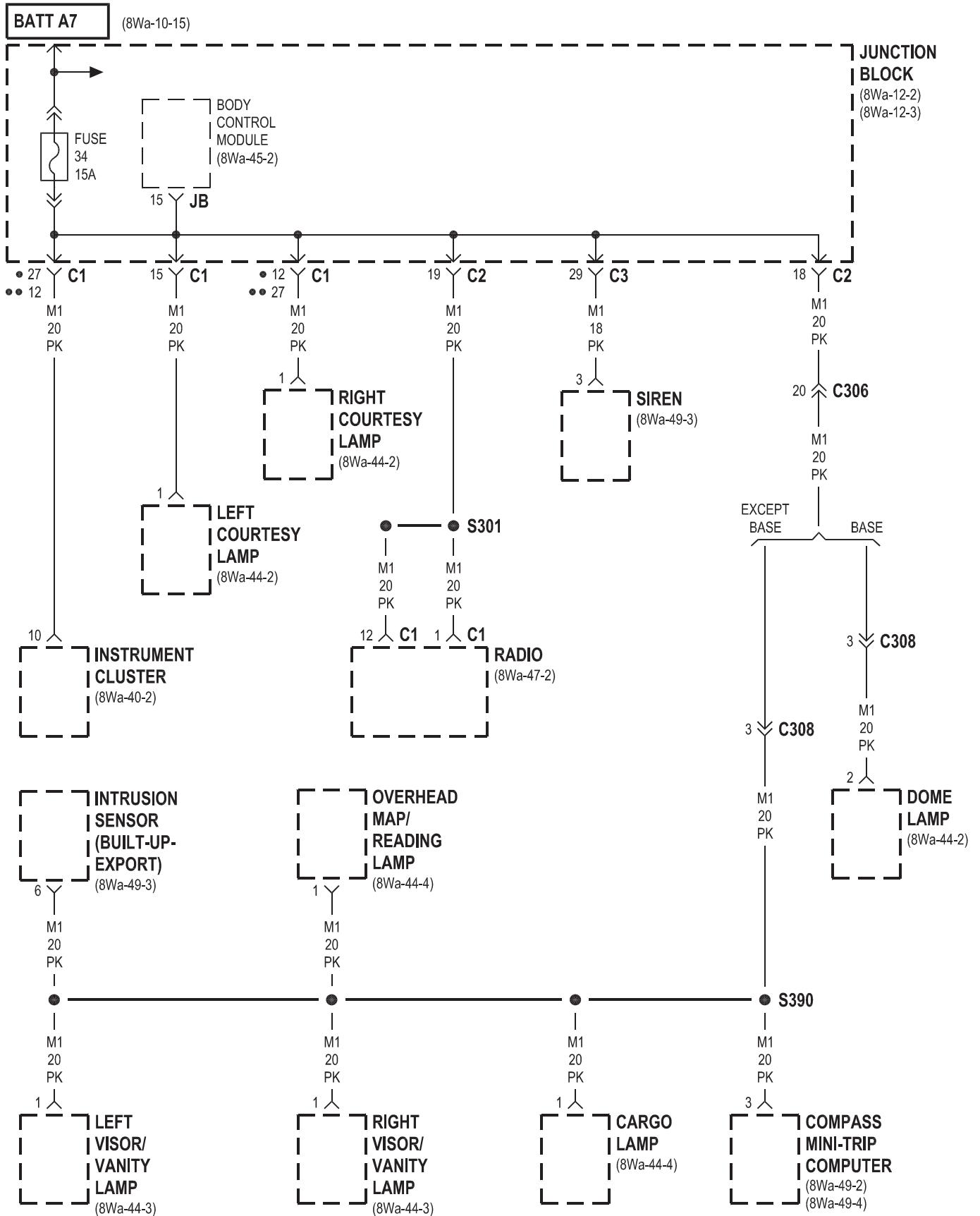


- BUILT-UP-EXPORT
- EXCEPT BUILT-UP-EXPORT

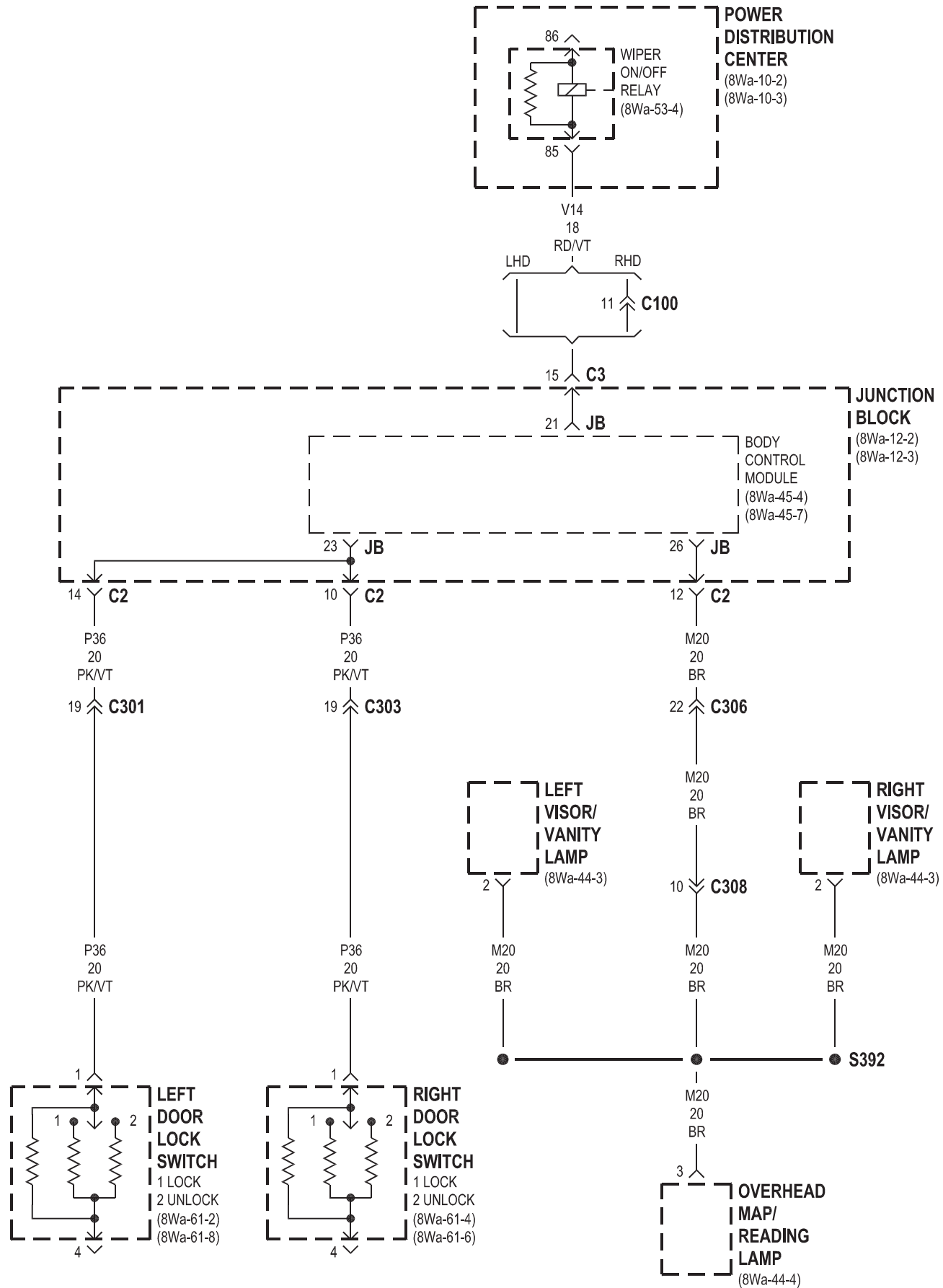




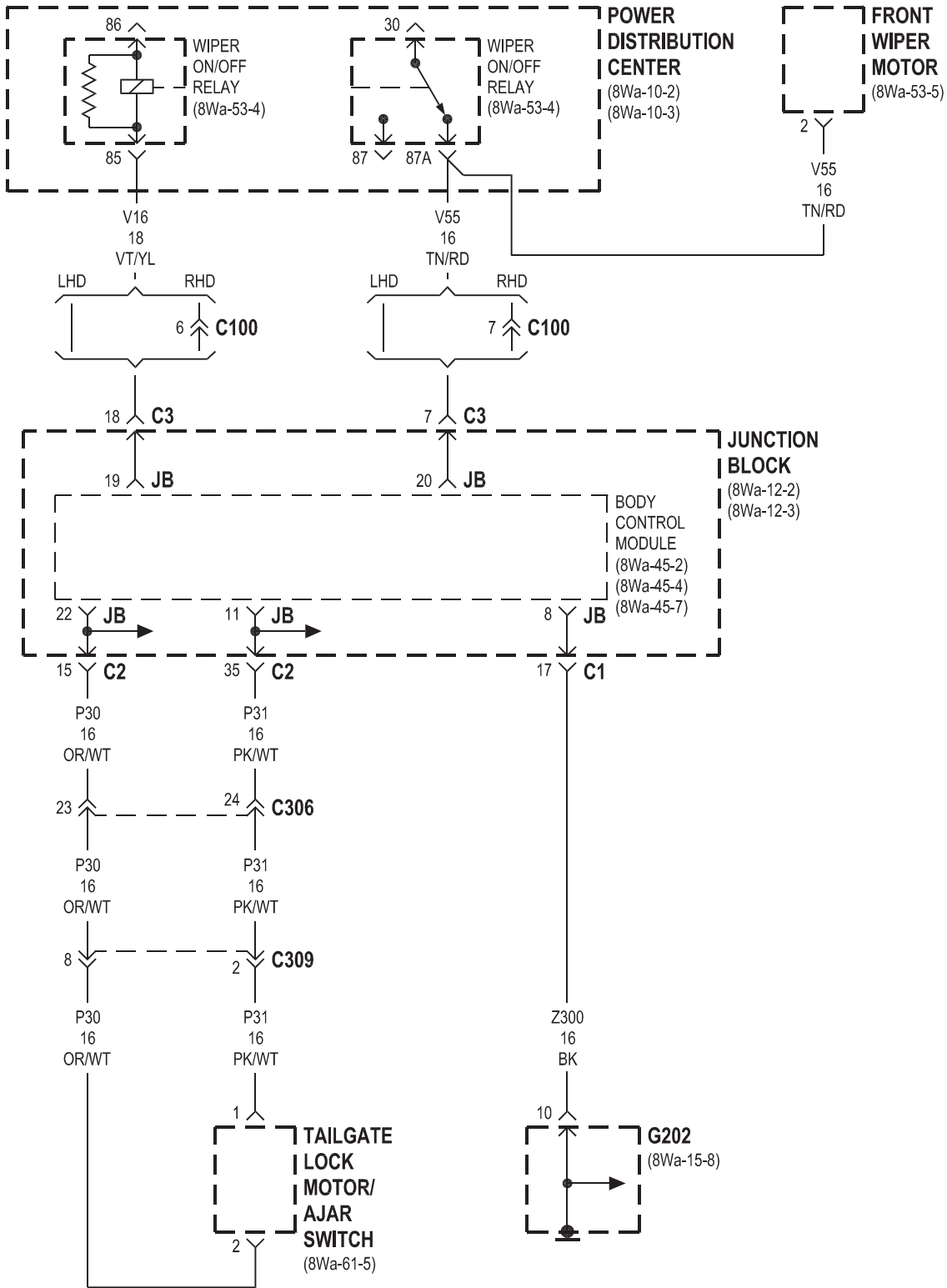
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 ○ ○ ○ PREMIUM

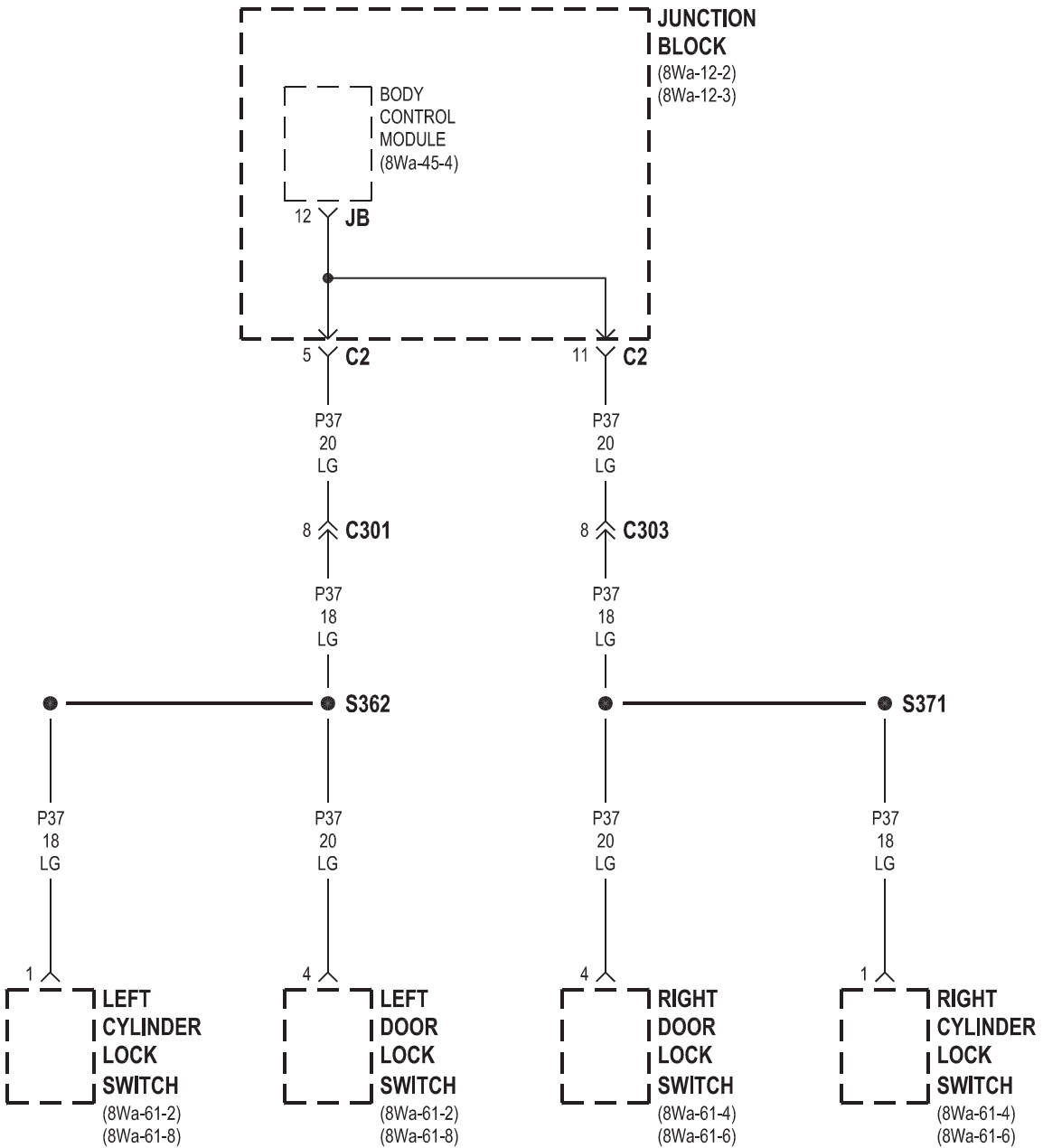


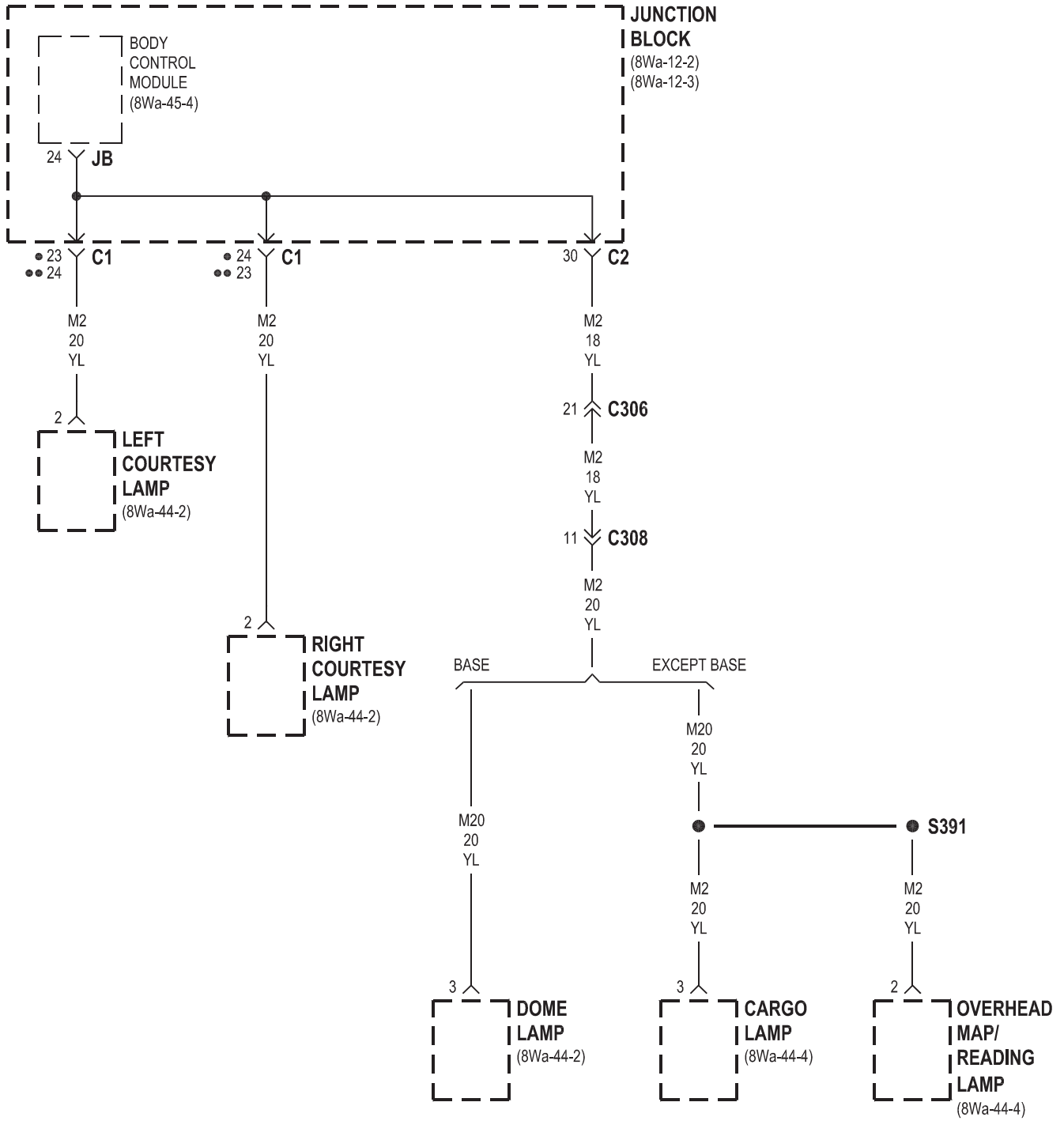
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- RHD



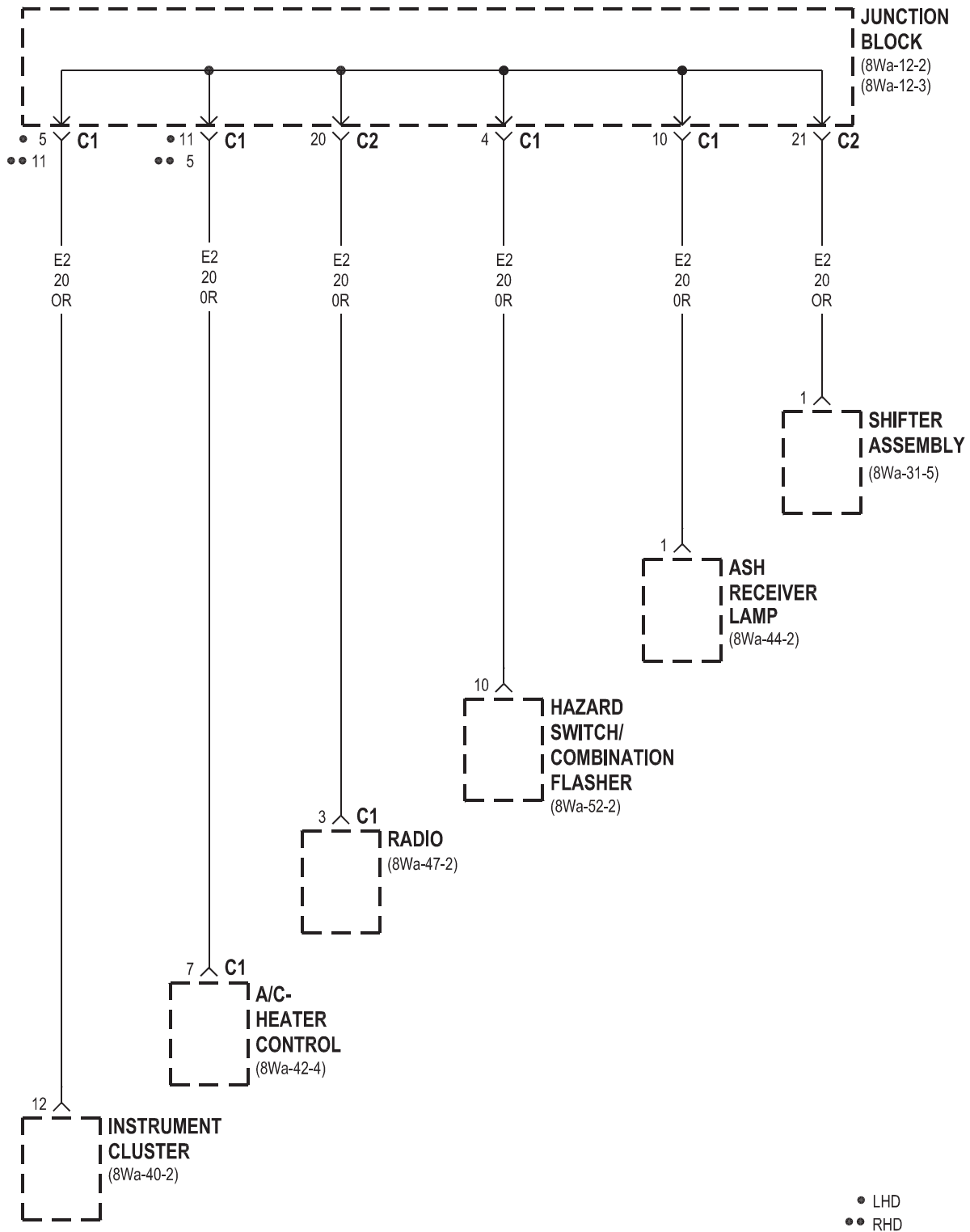








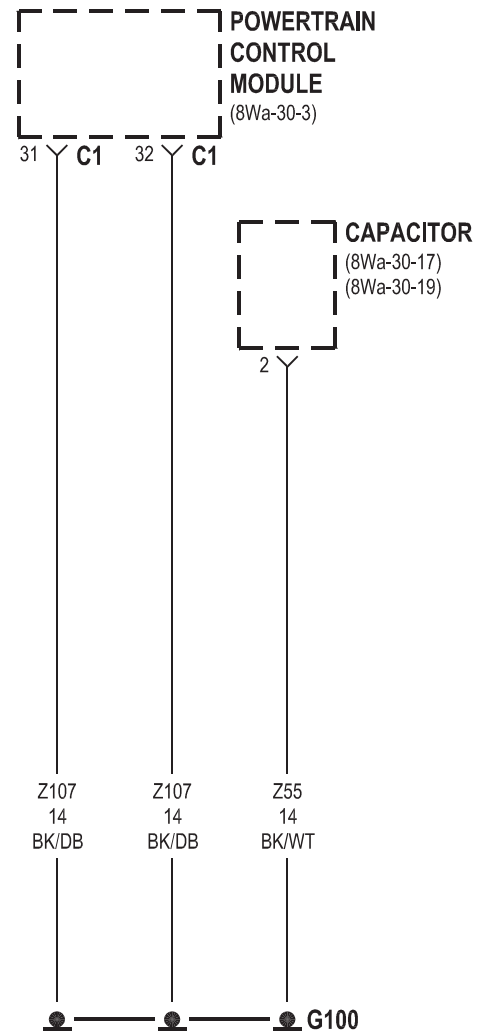
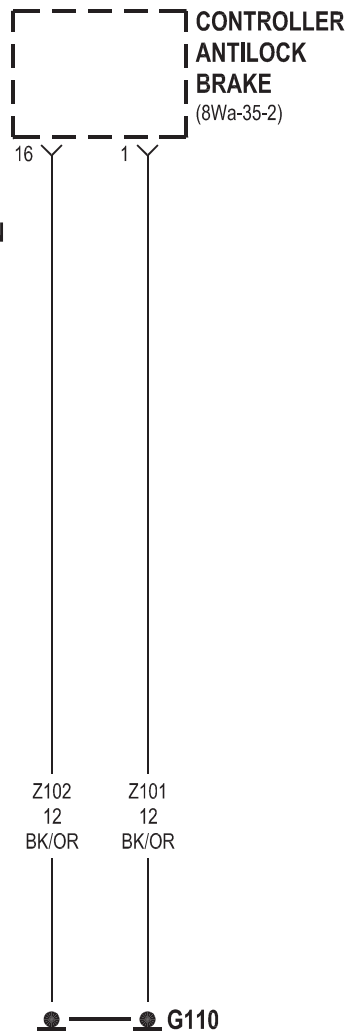
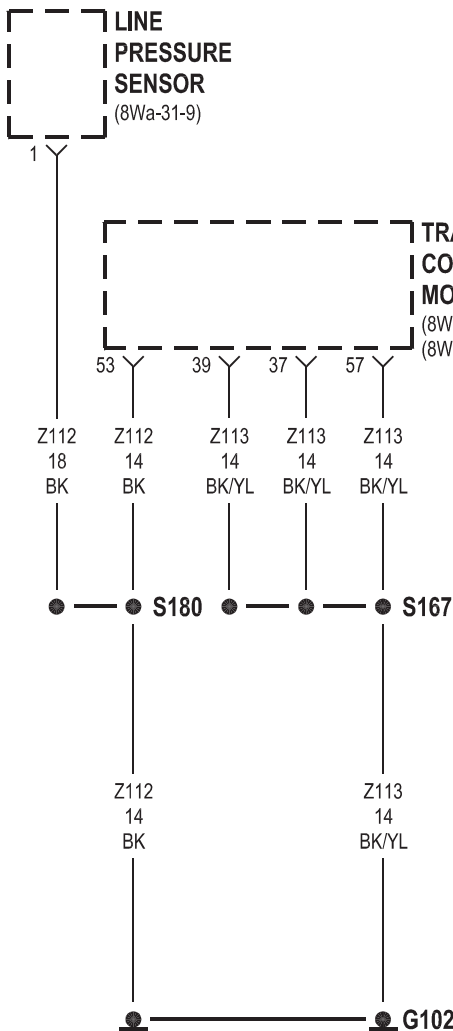
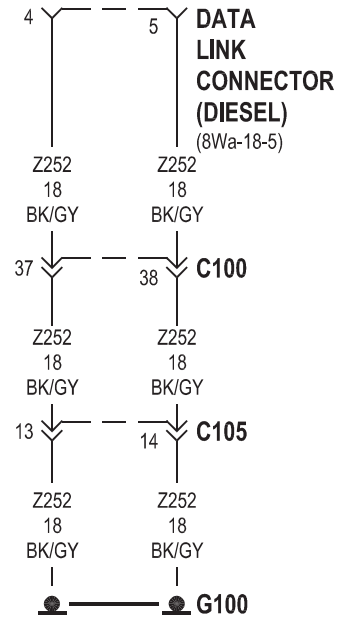
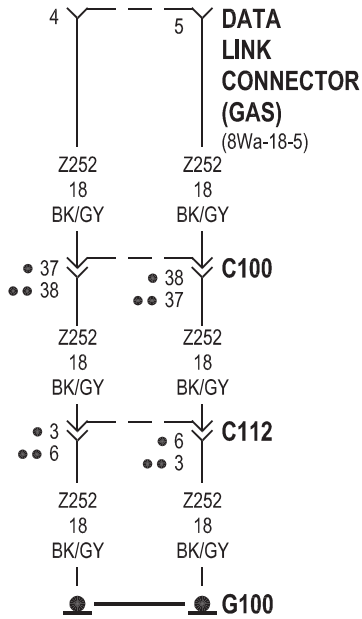
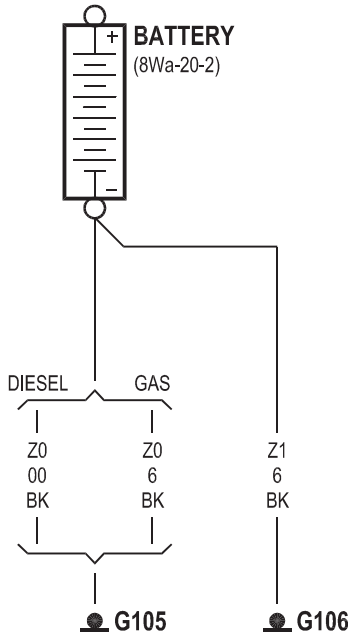
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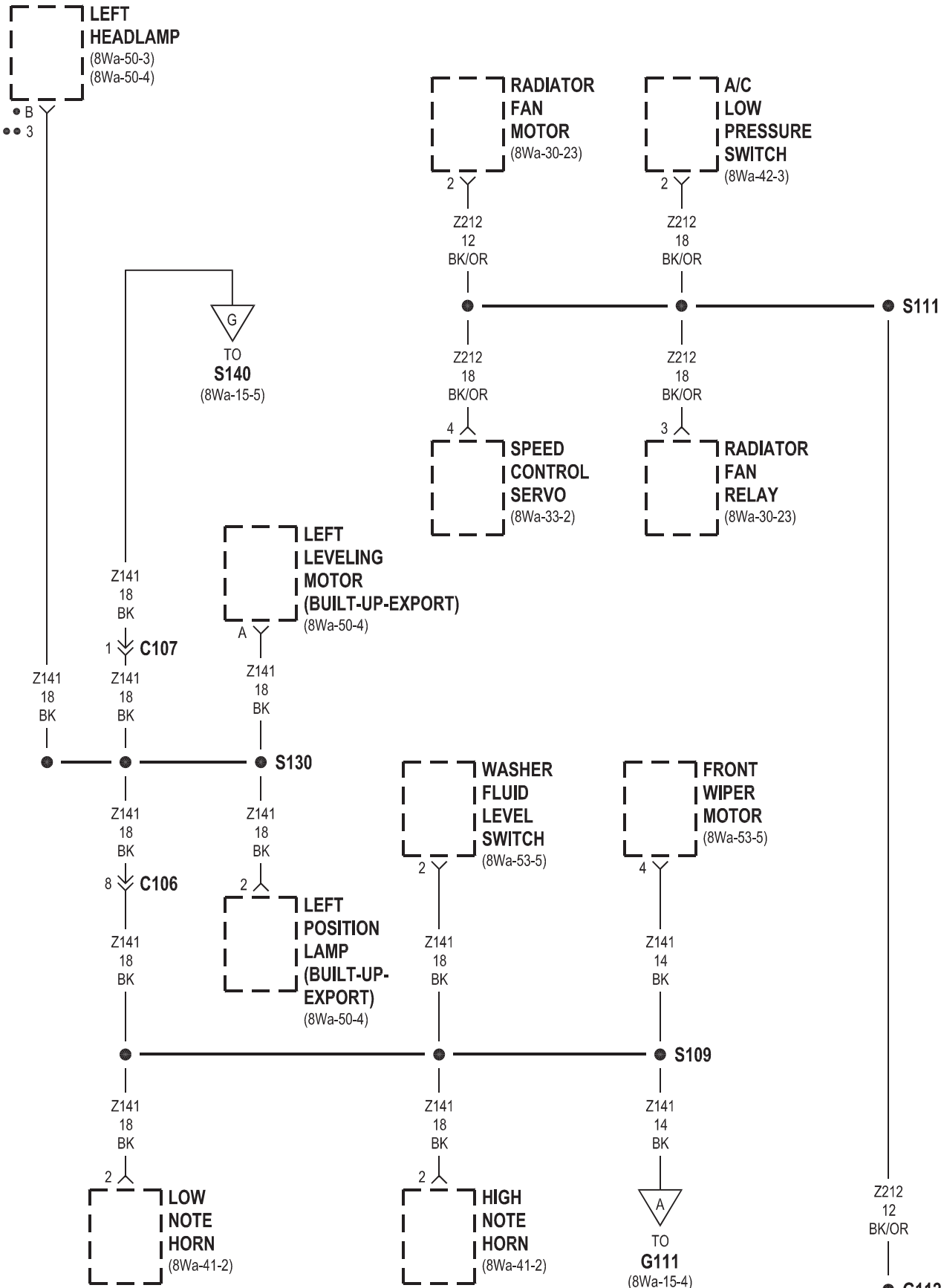


## 8W-15 GROUND DISTRIBUTION

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C Compressor Clutch . . . . .	8Wa-15-6	Left Leveling Motor . . . . .	8Wa-15-3
A/C Low Pressure Switch . . . . .	8Wa-15-3	Left Position Lamp . . . . .	8Wa-15-3
A/C- Heater Control . . . . .	8Wa-15-7, 8	Left Power Mirror . . . . .	8Wa-15-11
Airbag Control Module . . . . .	8Wa-15-7	Left Power Seat Switch . . . . .	8Wa-15-10
Ash Receiver Lamp . . . . .	8Wa-15-8	Left Rear Door Ajar Switch . . . . .	8Wa-15-11
Battery . . . . .	8Wa-15-2	Left Rear Door Lock Motor/Ajar Switch . . . . .	8Wa-15-11
Blend Door Actuator . . . . .	8Wa-15-8	Left Side Impact Airbag Control Module . . . . .	8Wa-15-9
Blower Motor Relay . . . . .	8Wa-15-4	Left Side Repeater Lamp . . . . .	8Wa-15-5
Body Control Module . . . . .	8Wa-15-8	Left Tail/Stop Lamp . . . . .	8Wa-15-15
Brake Lamp Switch . . . . .	8Wa-15-8	License Lamp . . . . .	8Wa-15-15
Cabin Heater . . . . .	8Wa-15-6	Line Pressure Sensor . . . . .	8Wa-15-2
Capacitor . . . . .	8Wa-15-2	Low Note Horn . . . . .	8Wa-15-3
Center High Mounted Stop Lamp . . . . .	8Wa-15-14	Multi- Function Switch . . . . .	8Wa-15-8
Cigar Lighter . . . . .	8Wa-15-8	Oxygen Sensor 1/2 Downstream . . . . .	8Wa-15-6
Compass Mini-Trip Computer . . . . .	8Wa-15-14	Oxygen Sensor 2/2 Downstream . . . . .	8Wa-15-6
Controller Antilock Brake . . . . .	8Wa-15-2	Power Mirror Switch . . . . .	8Wa-15-11, 12
Data Link Connector . . . . .	8Wa-15-2	Power Outlet . . . . .	8Wa-15-8
Engine Control Module . . . . .	8Wa-15-7	Power Steering Pressure Switch . . . . .	8Wa-15-6
Engine Coolant Level Sensor . . . . .	8Wa-15-6	Power Window Master Switch . . . . .	8Wa-15-10
Flip-Up Glass Release Motor . . . . .	8Wa-15-14	Powertrain Control Module . . . . .	8Wa-15-2
Front Wiper Motor . . . . .	8Wa-15-3	Radiator Fan Motor . . . . .	8Wa-15-3
Fuel Heater . . . . .	8Wa-15-6	Radiator Fan Relay . . . . .	8Wa-15-3
Fuel Heater Relay . . . . .	8Wa-15-4	Radio . . . . .	8Wa-15-7
Fuel Pump Module . . . . .	8Wa-15-15	Radio Choke . . . . .	8Wa-15-9
G100 . . . . .	8Wa-15-2, 7	Rear Power Outlet . . . . .	8Wa-15-15
G101 . . . . .	8Wa-15-6	Rear Window Defogger . . . . .	8Wa-15-14
G102 . . . . .	8Wa-15-2	Rear Wiper Motor . . . . .	8Wa-15-14
G103 . . . . .	8Wa-15-6	Red Brake Warning Indicator Switch . . . . .	8Wa-15-4
G104 . . . . .	8Wa-15-7	Right Door Lock Switch . . . . .	8Wa-15-12
G105 . . . . .	8Wa-15-2	Right Fog Lamp . . . . .	8Wa-15-5
G106 . . . . .	8Wa-15-2	Right Front Door Ajar Switch . . . . .	8Wa-15-12
G110 . . . . .	8Wa-15-2	Right Front Door Lock Motor/Ajar Switch . . . . .	8Wa-15-12
G111 . . . . .	8Wa-15-3, 4	Right Front Door Speaker . . . . .	8Wa-15-7
G112 . . . . .	8Wa-15-3	Right Front Park/Turn Signal Lamp . . . . .	8Wa-15-5
G200 . . . . .	8Wa-15-7	Right Headlamp . . . . .	8Wa-15-4
G201 . . . . .	8Wa-15-7	Right Heated Seat Assembly . . . . .	8Wa-15-10
G202 . . . . .	8Wa-15-8	Right Heated Seat Switch . . . . .	8Wa-15-10
G300 . . . . .	8Wa-15-9, 11	Right Leveling Motor . . . . .	8Wa-15-4
G301 . . . . .	8Wa-15-9, 10	Right Position Lamp . . . . .	8Wa-15-4
G302 . . . . .	8Wa-15-9, 12	Right Power Mirror . . . . .	8Wa-15-12
G310 . . . . .	8Wa-15-13, 14, 15	Right Power Seat Switch . . . . .	8Wa-15-10
G311 . . . . .	8Wa-15-14	Right Rear Door Ajar Switch . . . . .	8Wa-15-12
G312 . . . . .	8Wa-15-14	Right Rear Door Lock Motor/Ajar Switch . . . . .	8Wa-15-12
G320 . . . . .	8Wa-15-15	Right Side Impact Airbag Control Module . . . . .	8Wa-15-9
Hazard Switch/Combination Flasher . . . . .	8Wa-15-8	Right Side Repeater Lamp . . . . .	8Wa-15-5
Headlamp Leveling Switch . . . . .	8Wa-15-8	Right Tail/Stop Lamp . . . . .	8Wa-15-15
Heated Seat Module . . . . .	8Wa-15-10	Sentry Key Immobilizer Module . . . . .	8Wa-15-8
High Note Horn . . . . .	8Wa-15-3	Shifter Assembly . . . . .	8Wa-15-9
Hood Ajar Switch . . . . .	8Wa-15-4	Siren . . . . .	8Wa-15-4
Ignition Switch . . . . .	8Wa-15-8	Speed Control Servo . . . . .	8Wa-15-3
Instrument Cluster . . . . .	8Wa-15-8	Starter Motor Relay . . . . .	8Wa-15-4
Intrusion Sensor . . . . .	8Wa-15-14	Sunroof Motor . . . . .	8Wa-15-14
Junction Block . . . . .	8Wa-15-8	Tailgate Flip-Up Ajar Switch . . . . .	8Wa-15-14
Left Door Lock Switch . . . . .	8Wa-15-11	Trailer Tow Brake Lamp Relay . . . . .	8Wa-15-13
Left Fog Lamp . . . . .	8Wa-15-5	Trailer Tow Connector . . . . .	8Wa-15-13
Left Front Door Ajar Switch . . . . .	8Wa-15-11	Trailer Tow Left Turn Relay . . . . .	8Wa-15-13
Left Front Door Lock Motor/Ajar Switch . . . . .	8Wa-15-11	Trailer Tow Relay . . . . .	8Wa-15-13
Left Front Door Speaker . . . . .	8Wa-15-7	Trailer Tow Right Turn Relay . . . . .	8Wa-15-13
Left Front Park/Turn Signal Lamp . . . . .	8Wa-15-5	Transmission Control Module . . . . .	8Wa-15-2
Left Headlamp . . . . .	8Wa-15-3	Transmission Control Relay . . . . .	8Wa-15-4
Left Heated Seat Assembly . . . . .	8Wa-15-10	Washer Fluid Level Switch . . . . .	8Wa-15-3
Left Heated Seat Switch . . . . .	8Wa-15-10		

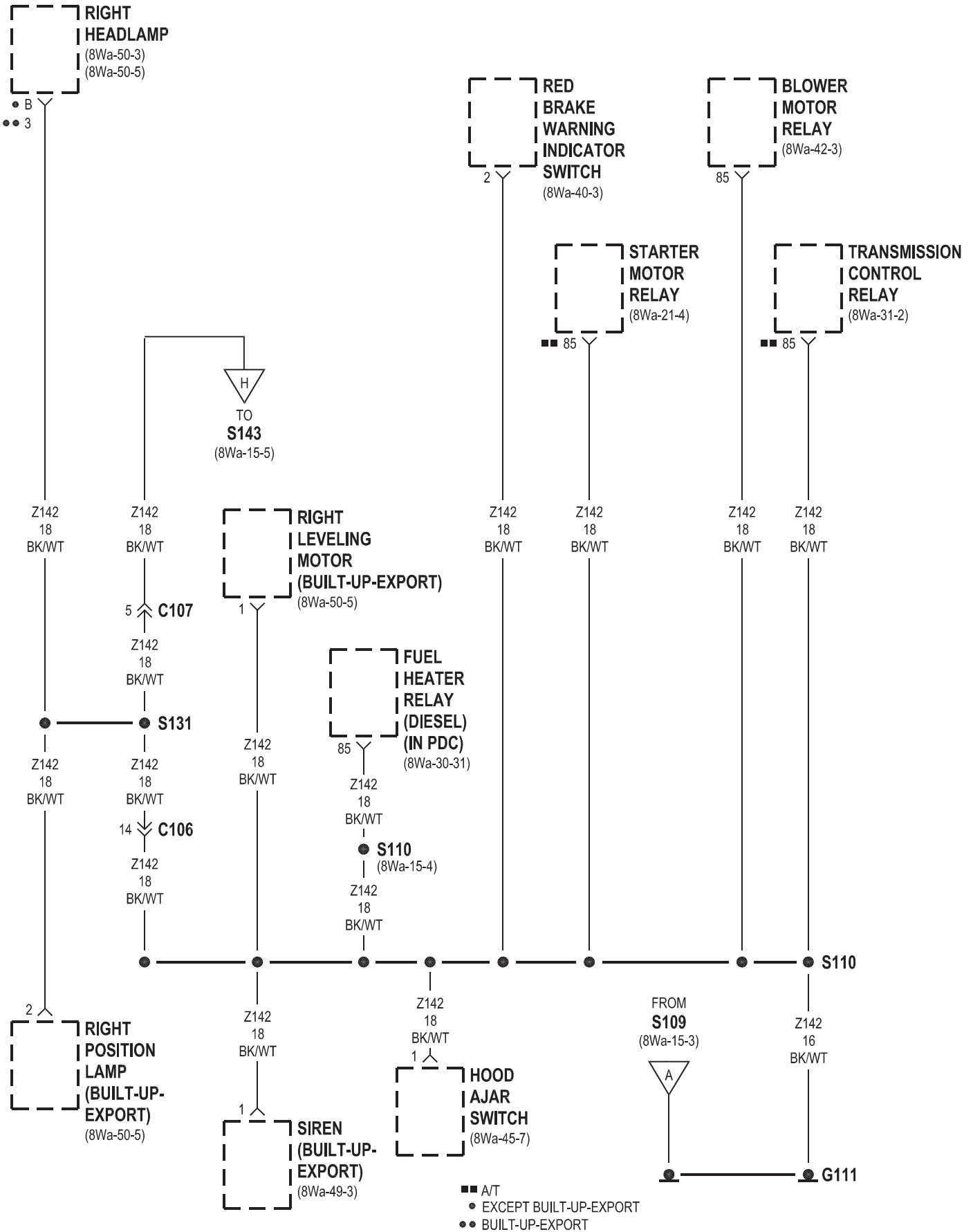


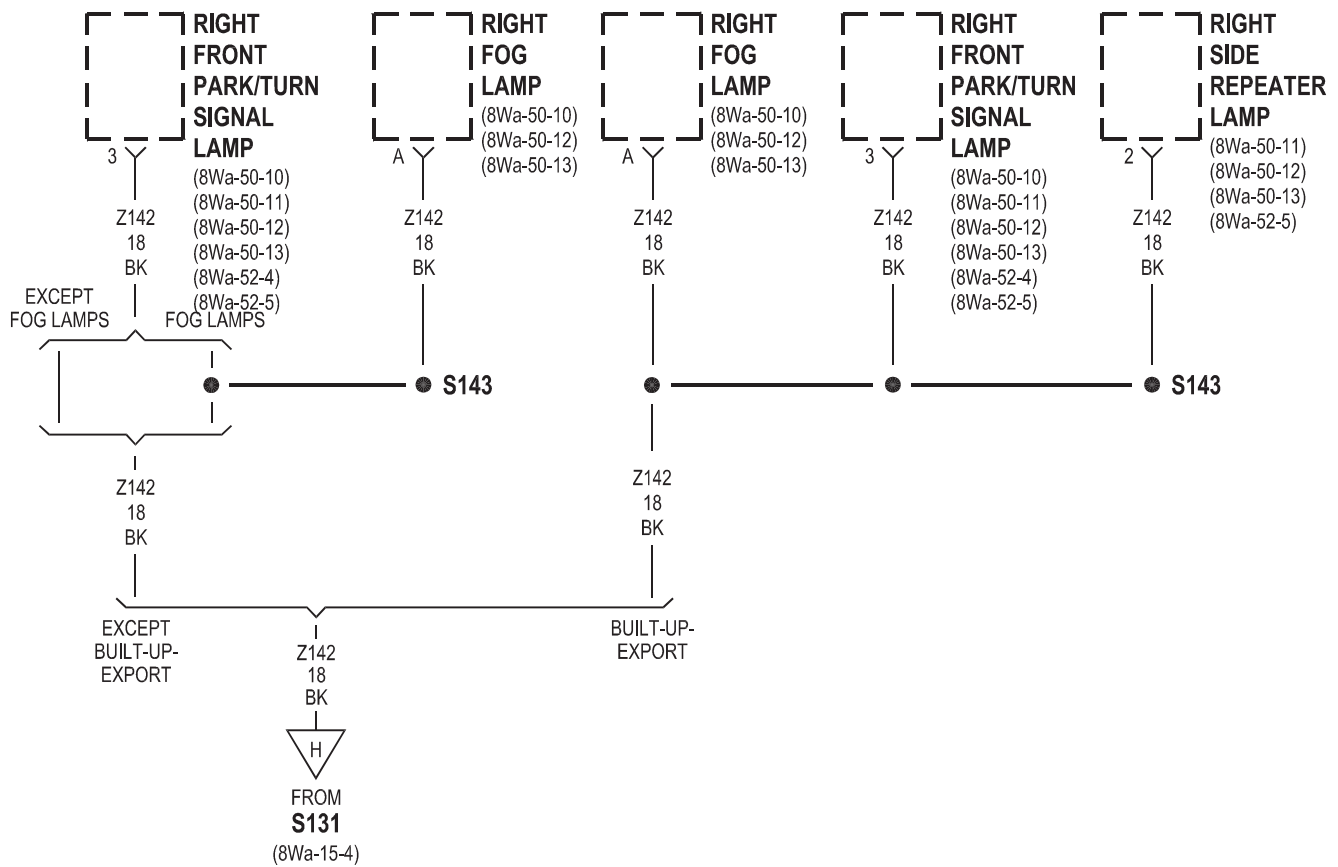
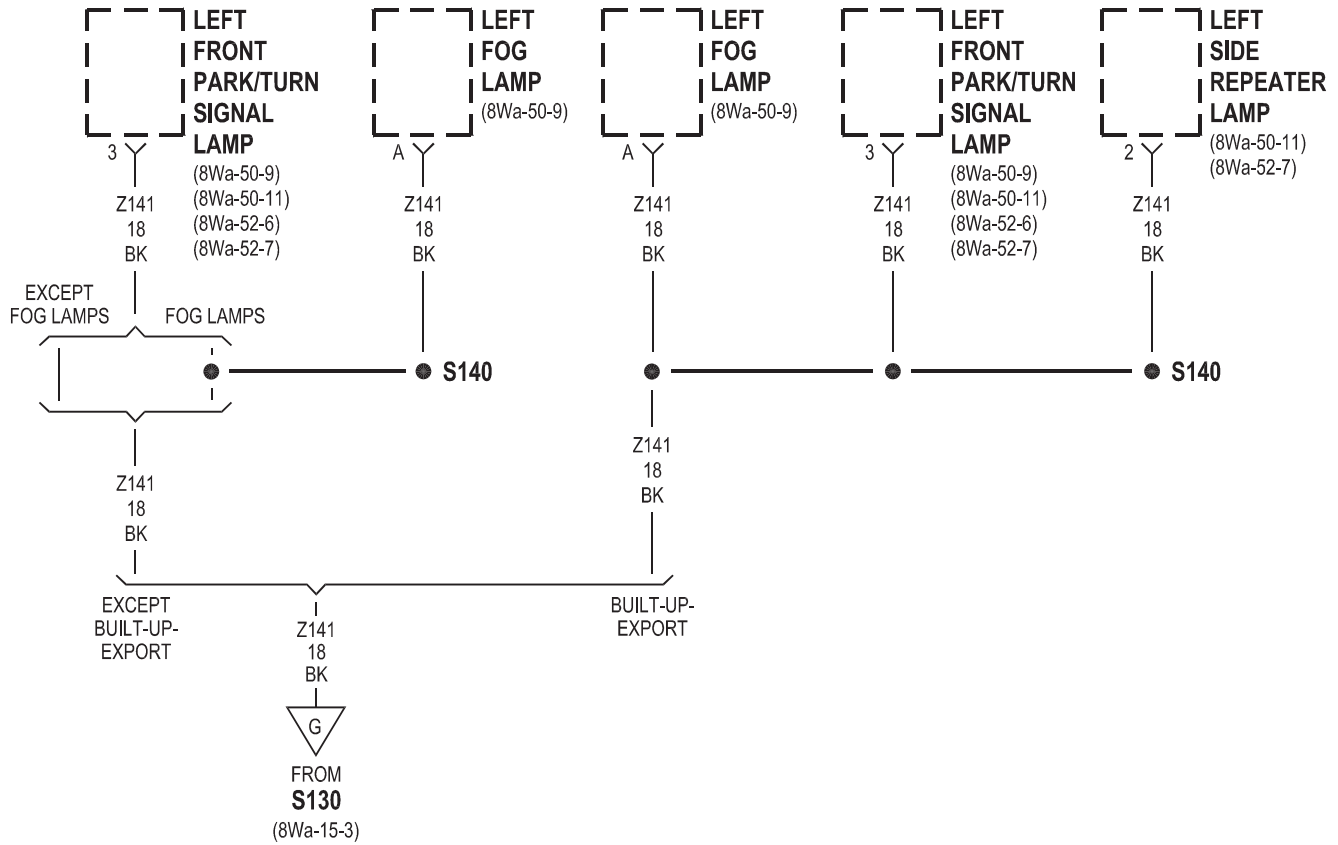
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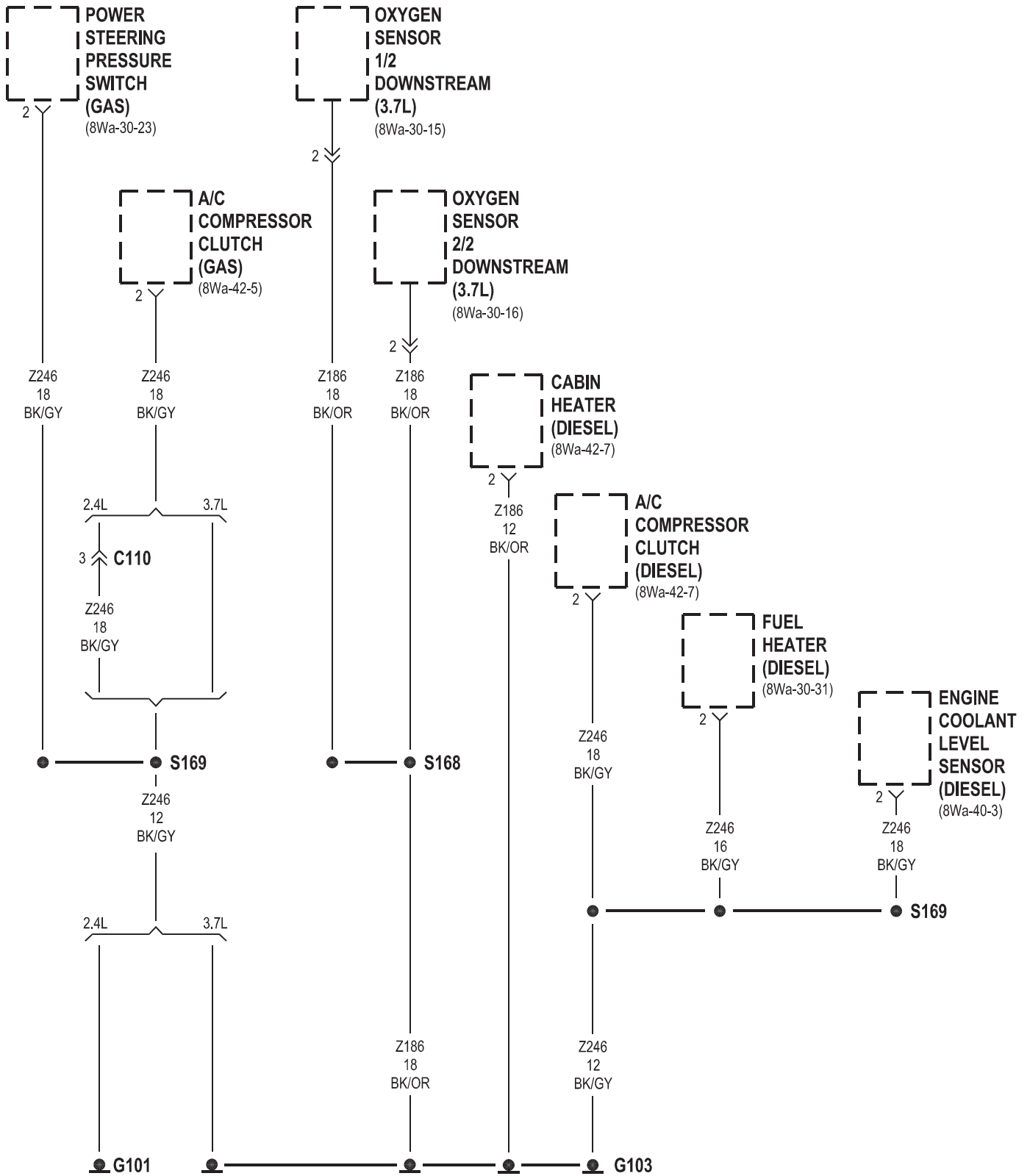


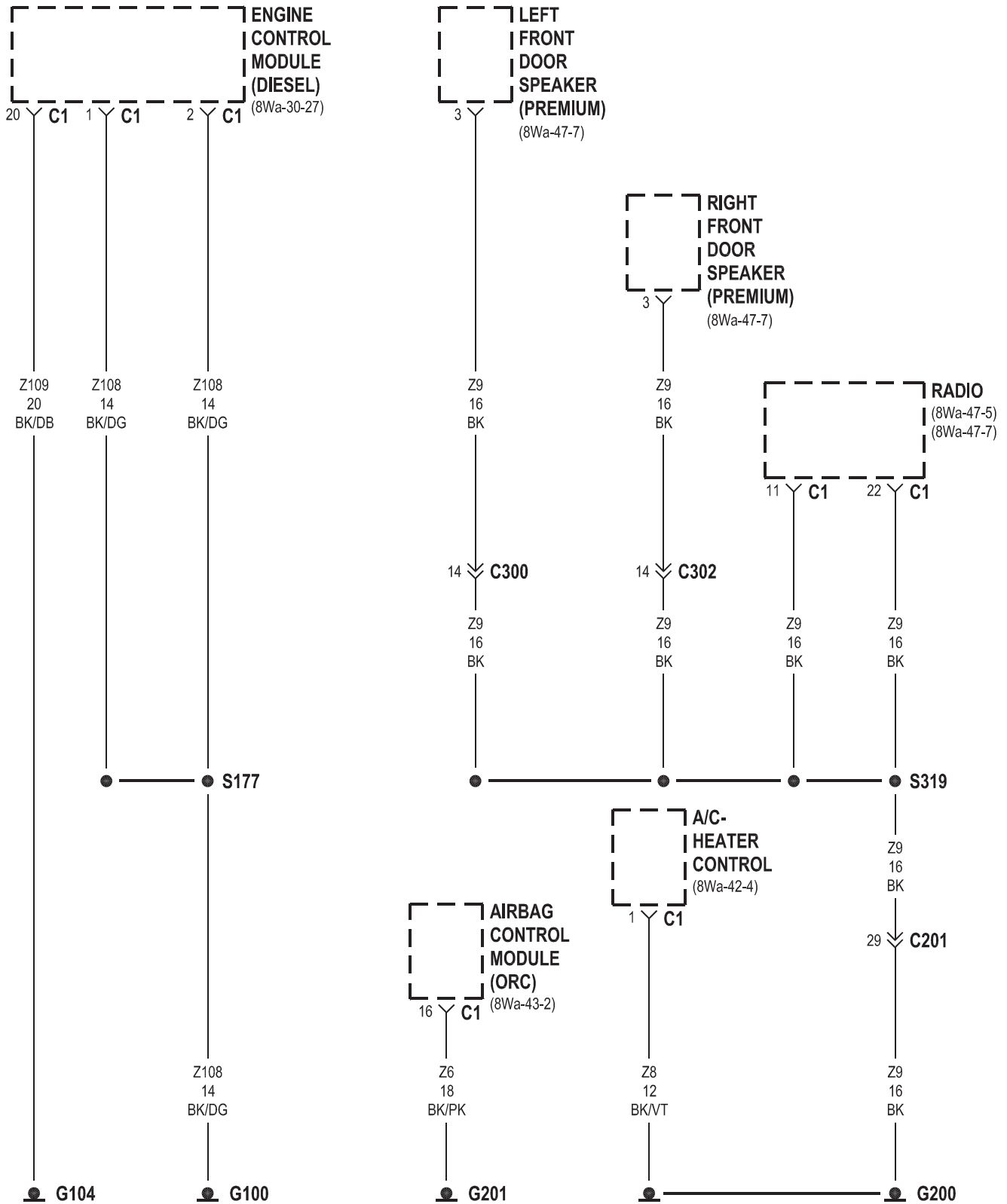
● EXCEPT BUILT-UP-EXPORT  
 ●● BUILT-UP-EXPORT

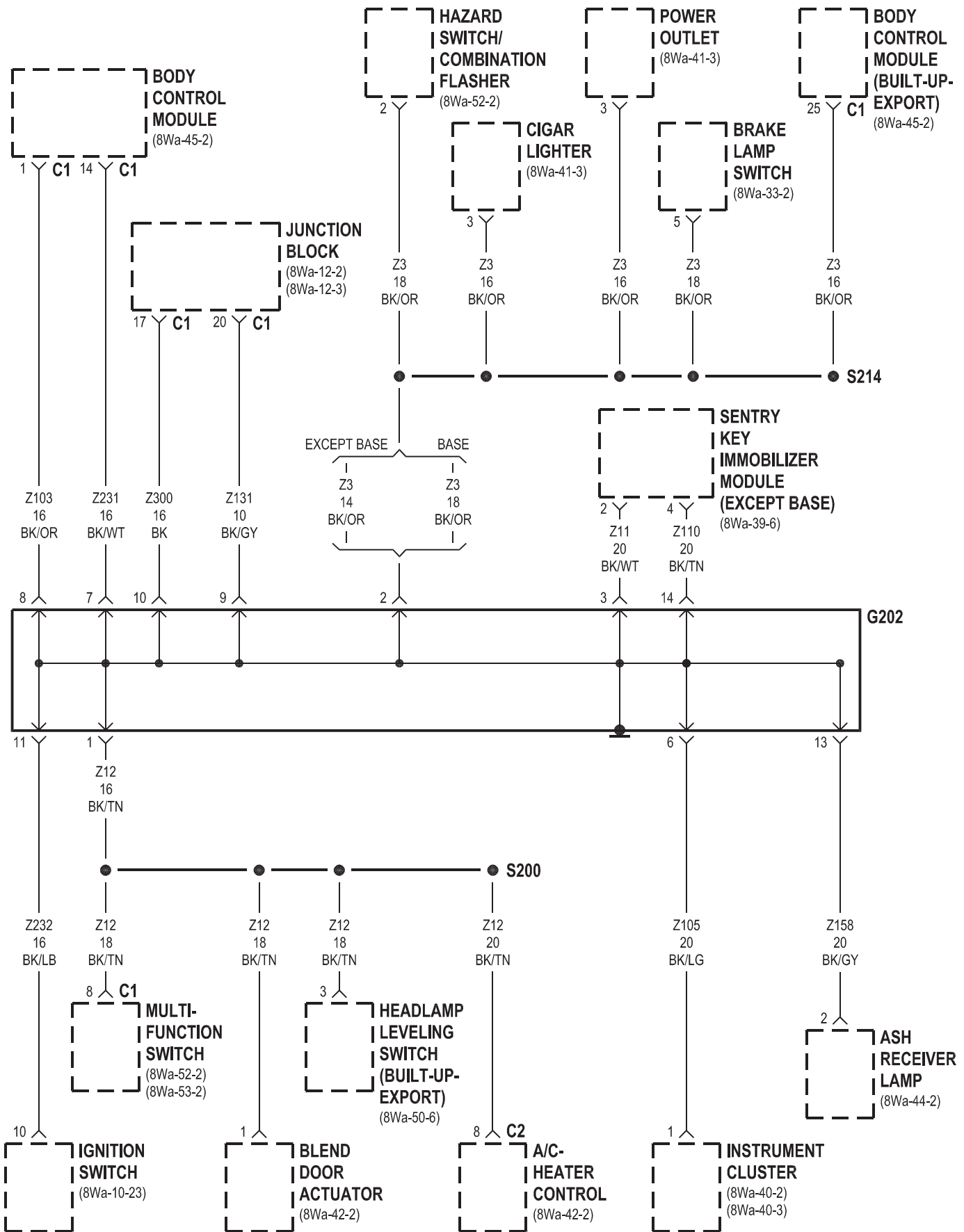


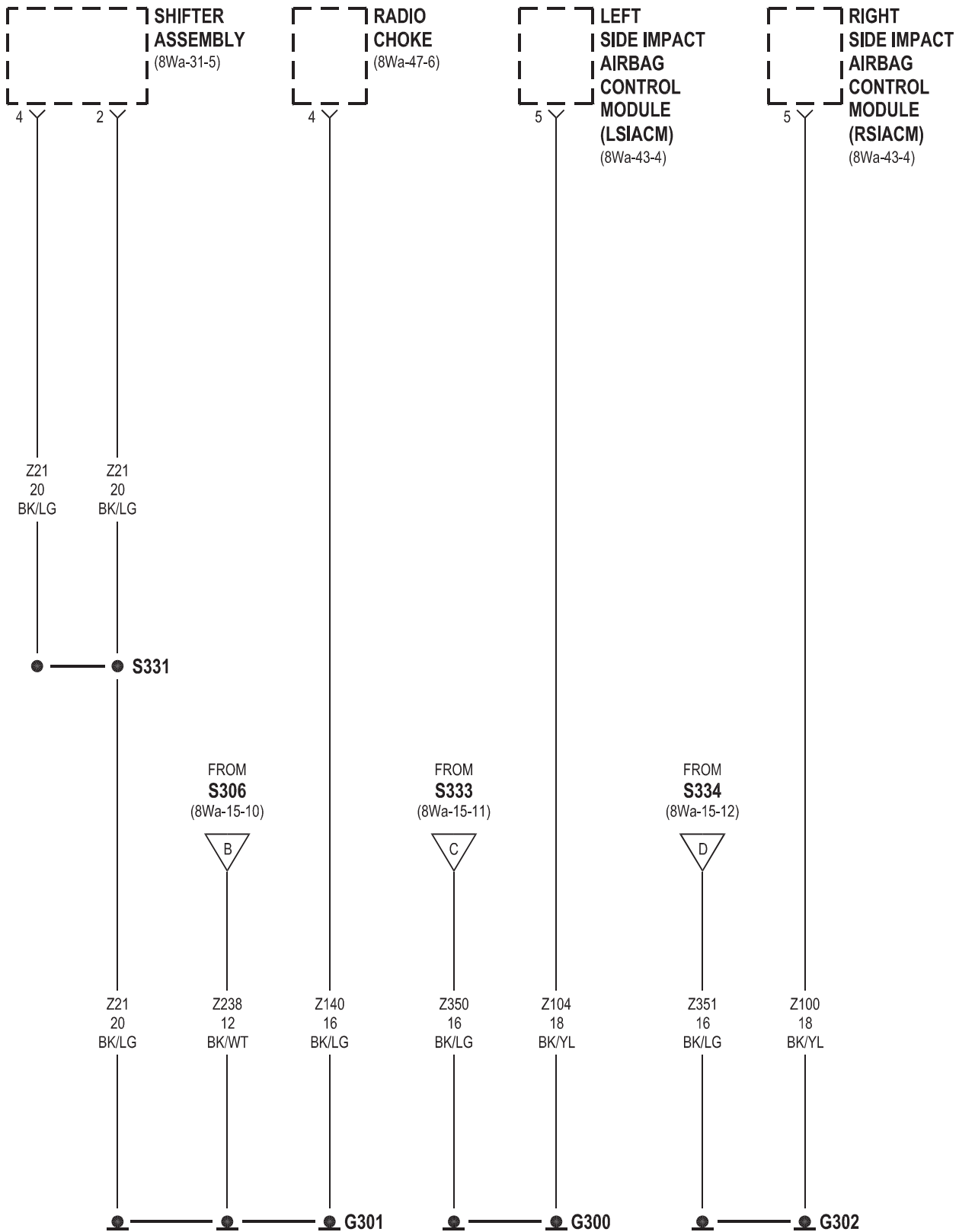


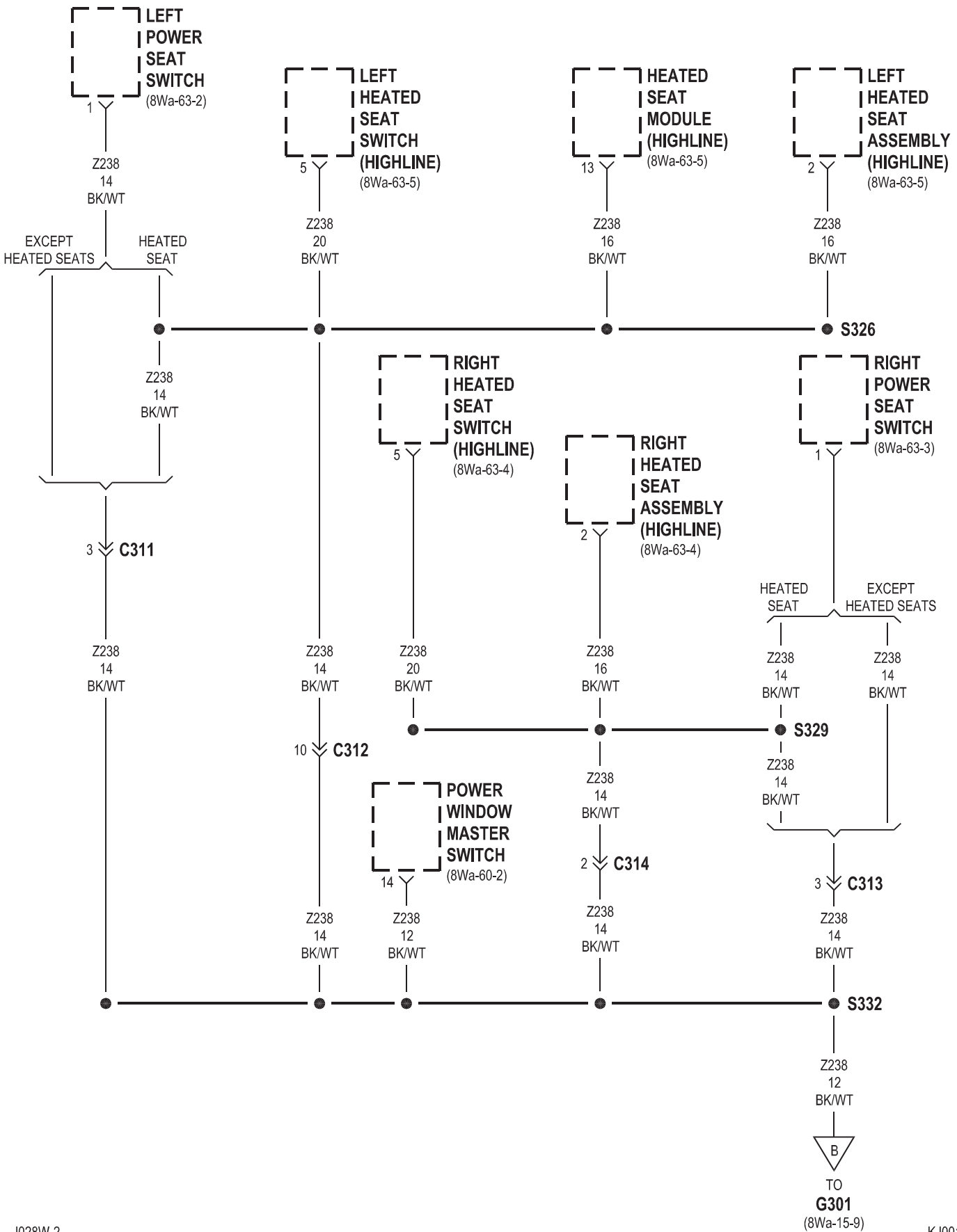


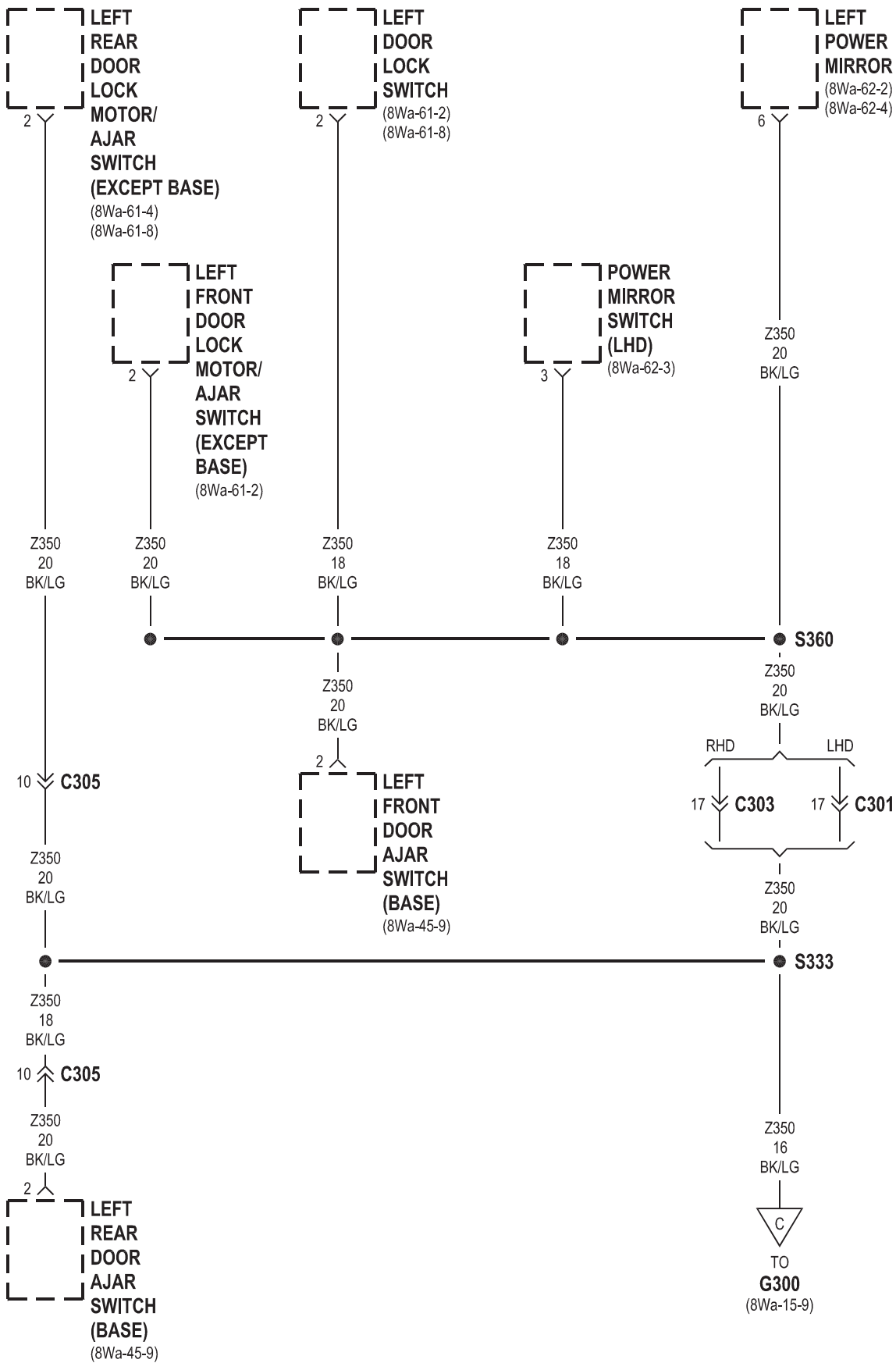




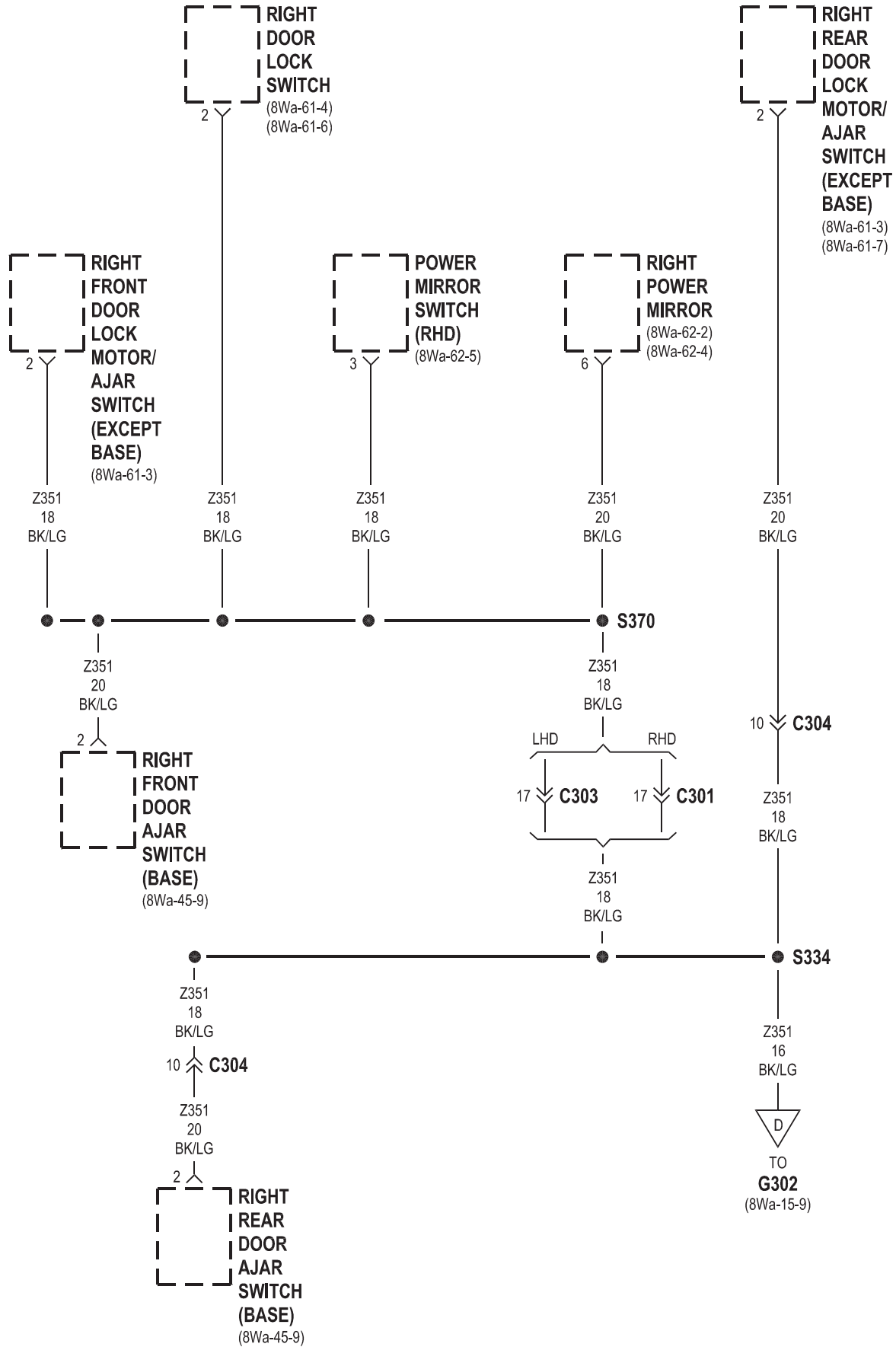


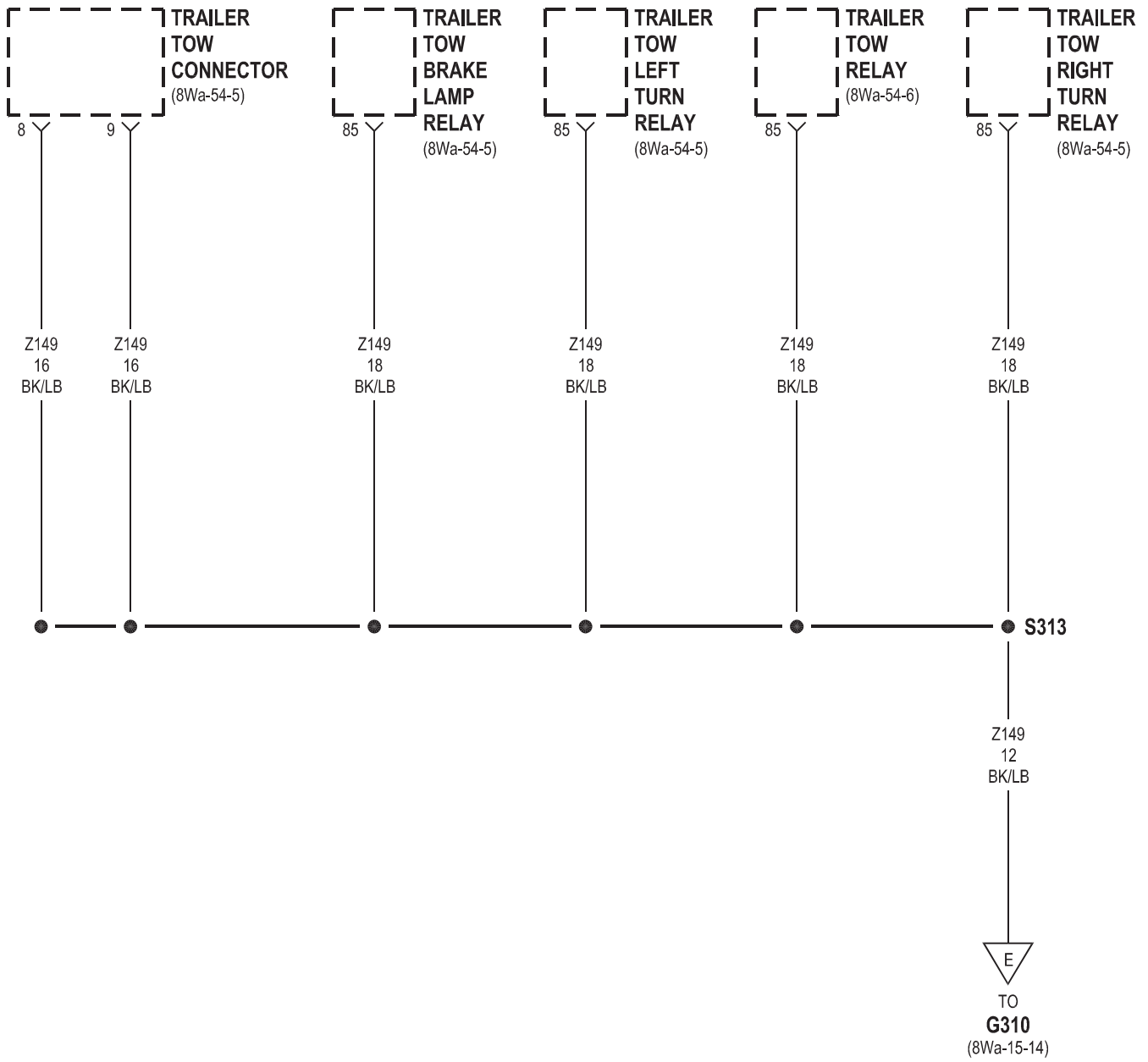


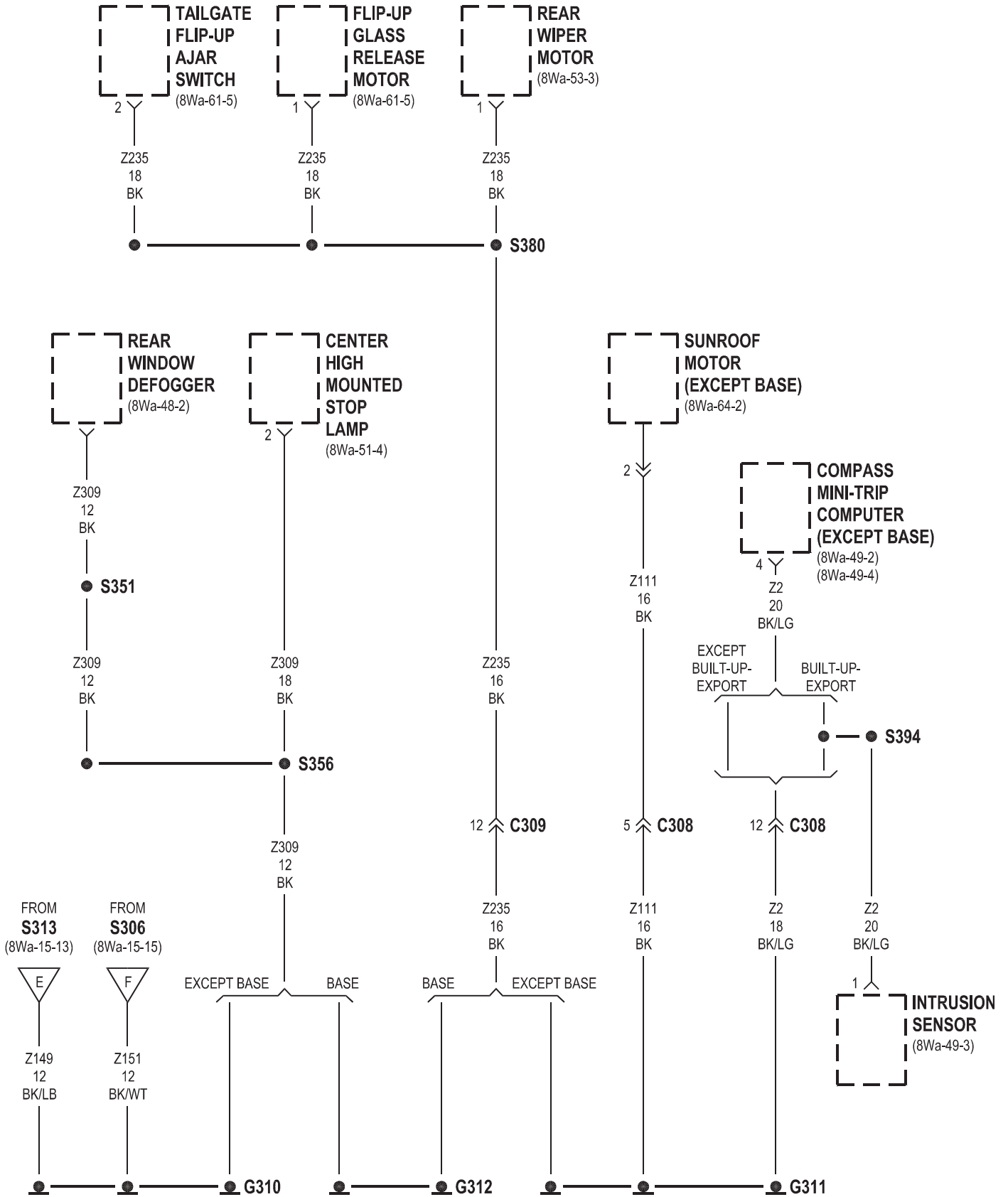


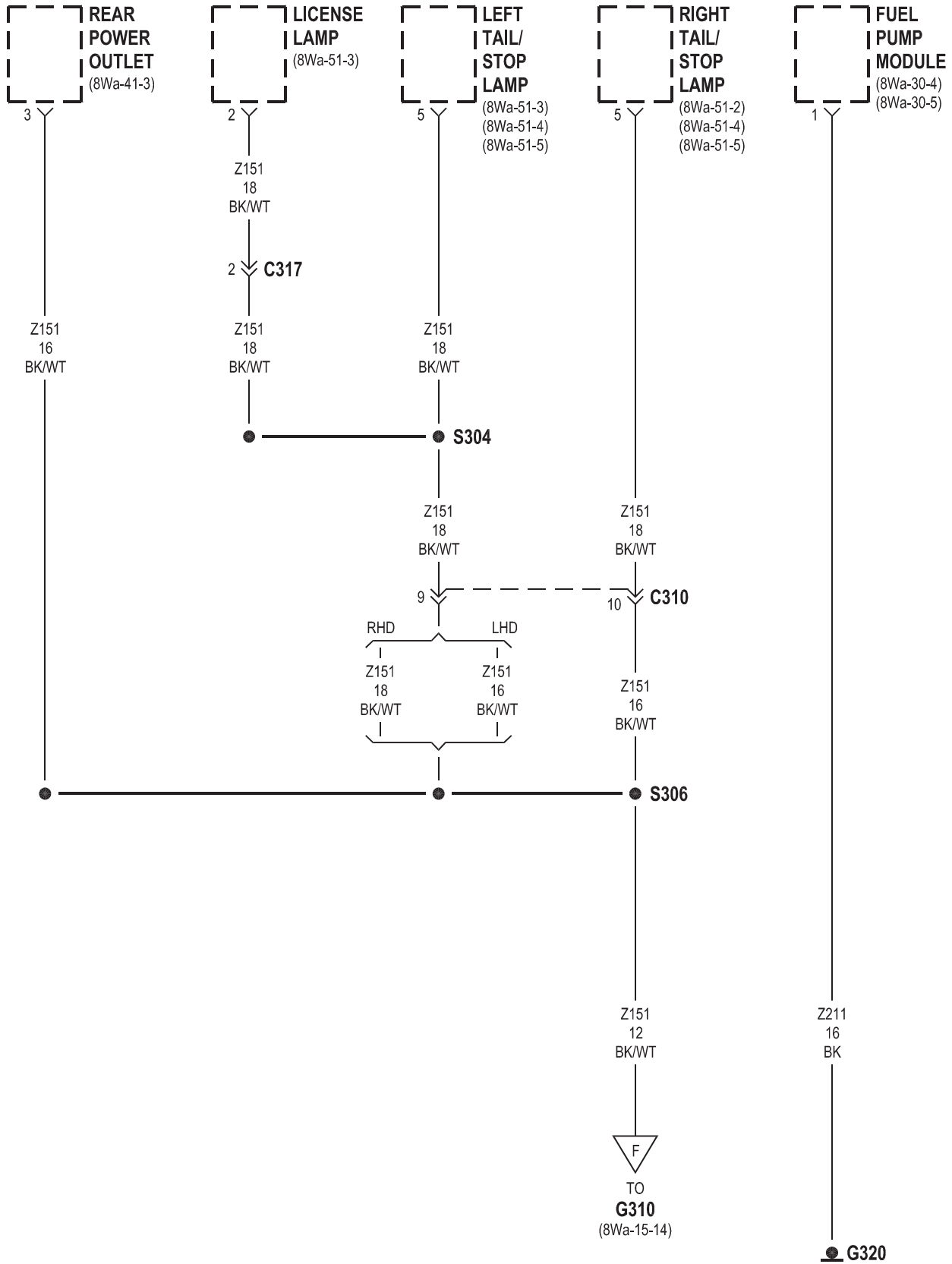








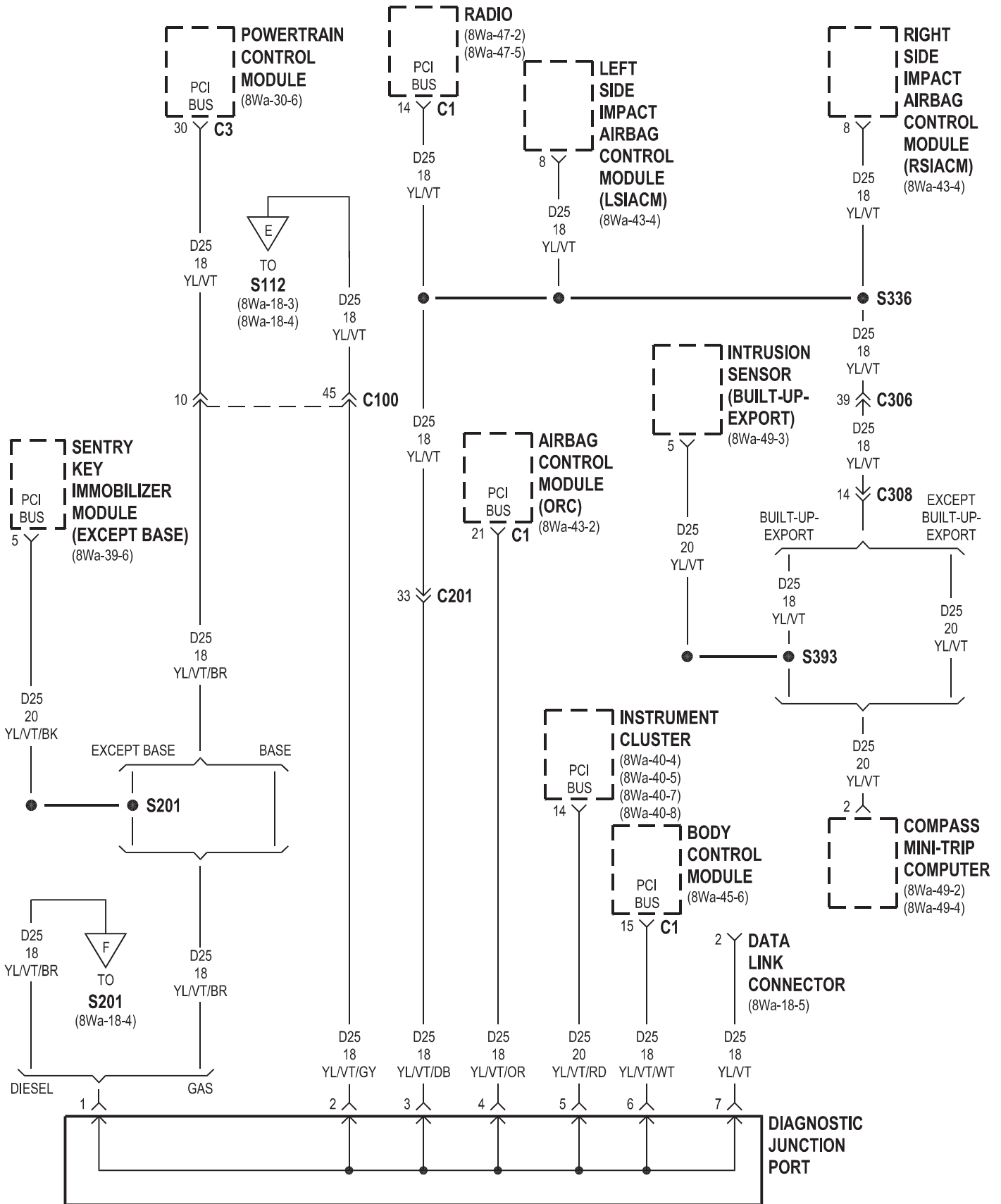


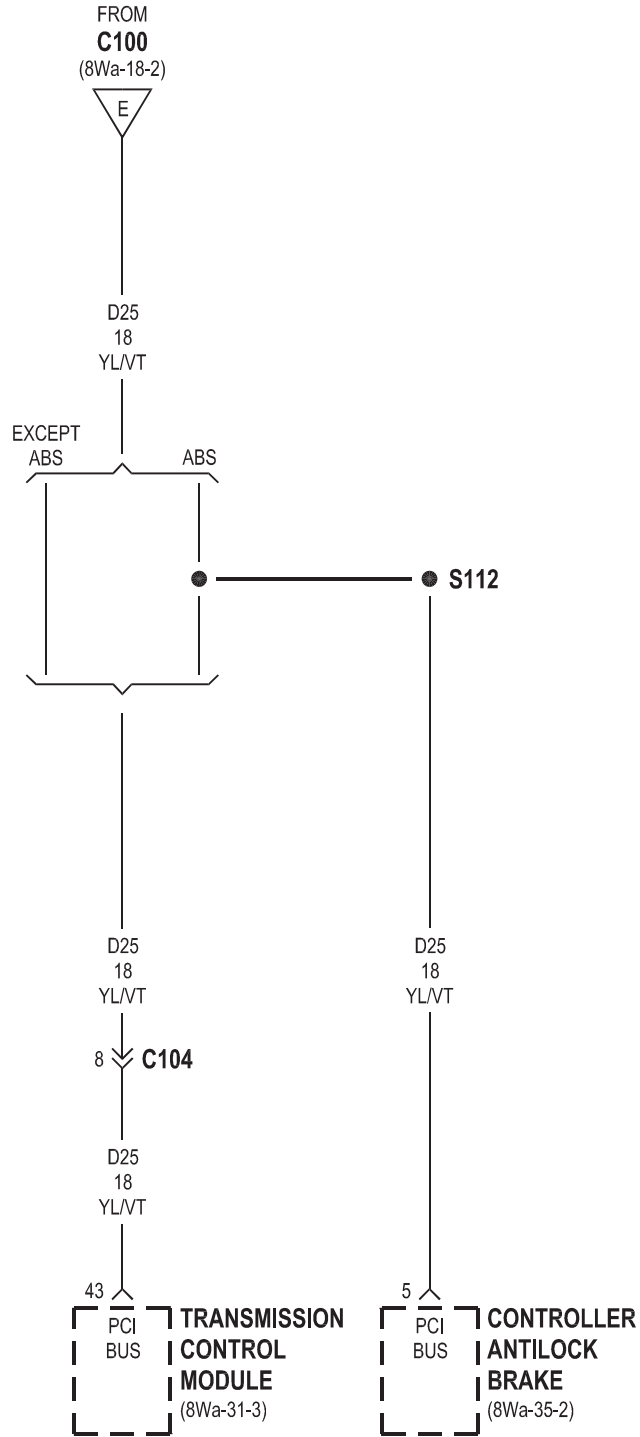




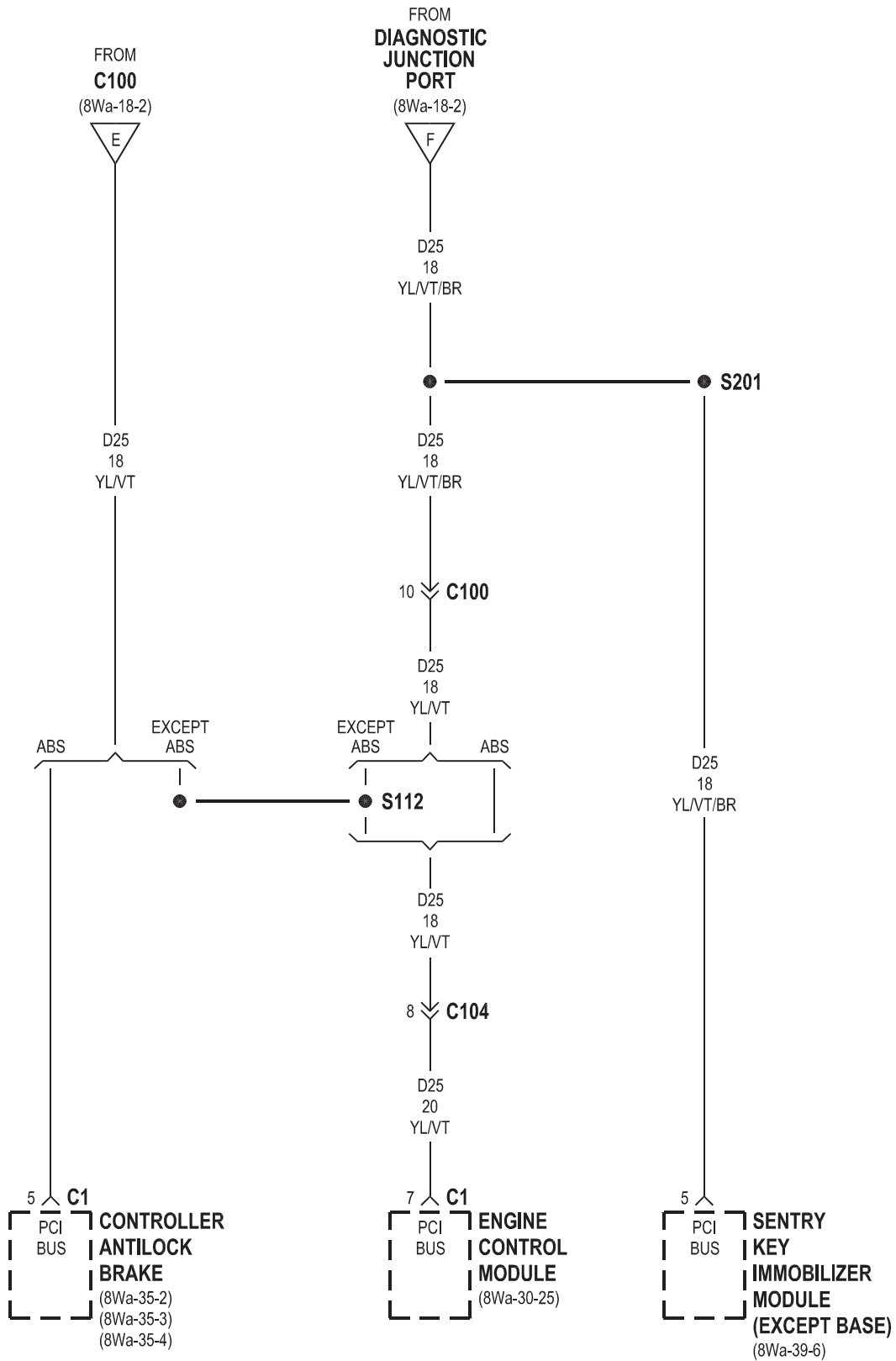
## 8W-18 BUS COMMUNICATIONS

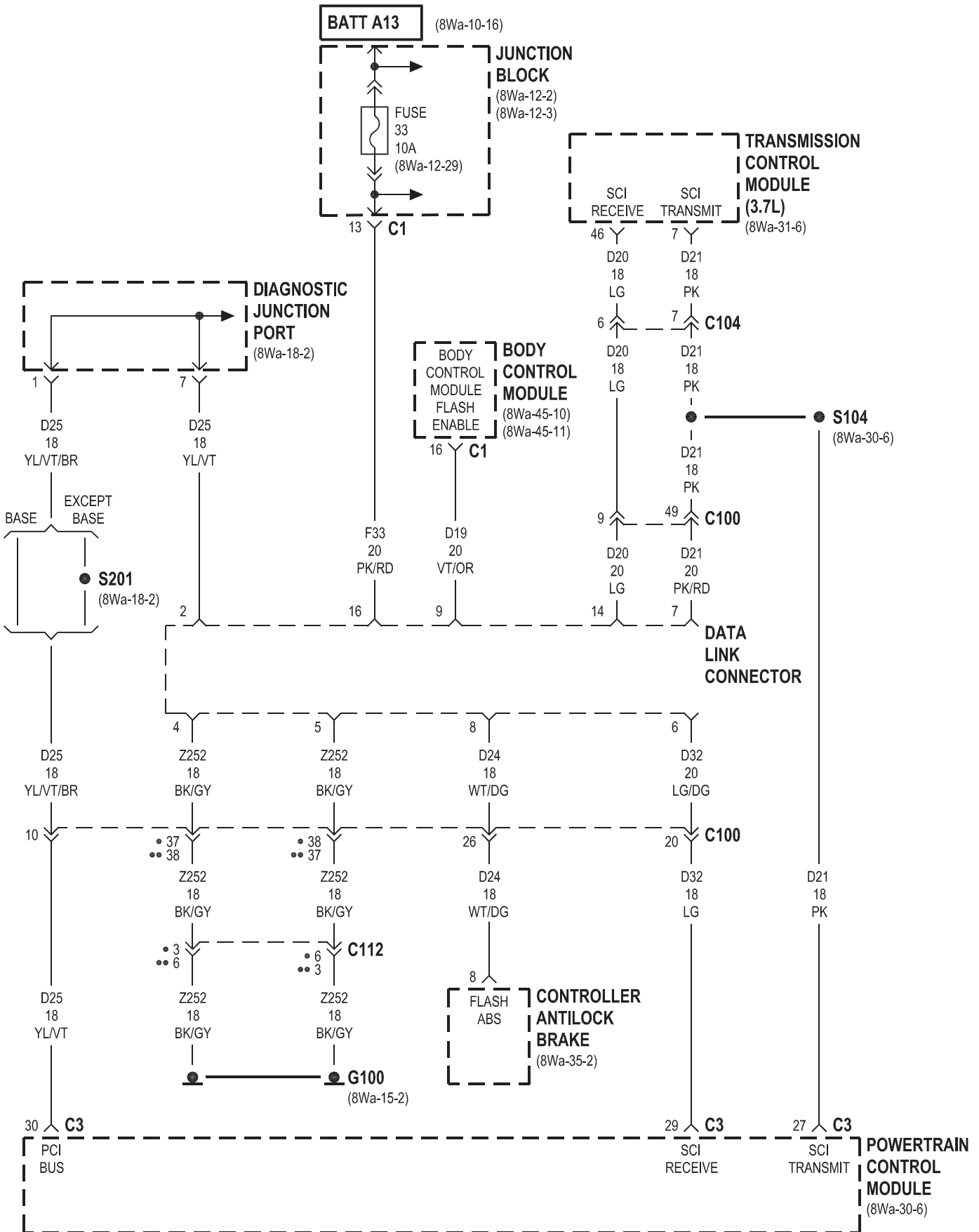
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Airbag Control Module . . . . .	8Wa-18-2	Instrument Cluster . . . . .	8Wa-18-2
Body Control Module . . . . .	8Wa-18-2, 5, 6	Intrusion Sensor . . . . .	8Wa-18-2
Compass Mini-Trip Computer . . . . .	8Wa-18-2	Junction Block . . . . .	8Wa-18-5, 6
Controller Antilock Brake . . . . .	8Wa-18-3, 4, 5, 6	Left Side Impact Airbag Control Module . .	8Wa-18-2
Data Link Connector . . . . .	8Wa-18-2, 5, 6	Powertrain Control Module . . . . .	8Wa-18-2, 5
Diagnostic Junction Port . . . . .	8Wa-18-2, 4, 5, 6	Radio . . . . .	8Wa-18-2
Engine Control Module . . . . .	8Wa-18-4, 6	Right Side Impact Airbag Control Module .	8Wa-18-2
Fuse 33 . . . . .	8Wa-18-5, 6	Sentry Key Immobilizer Module . . . . .	8Wa-18-2, 4
G100 . . . . .	8Wa-18-5, 6	Transmission Control Module . . . . .	8Wa-18-3, 5



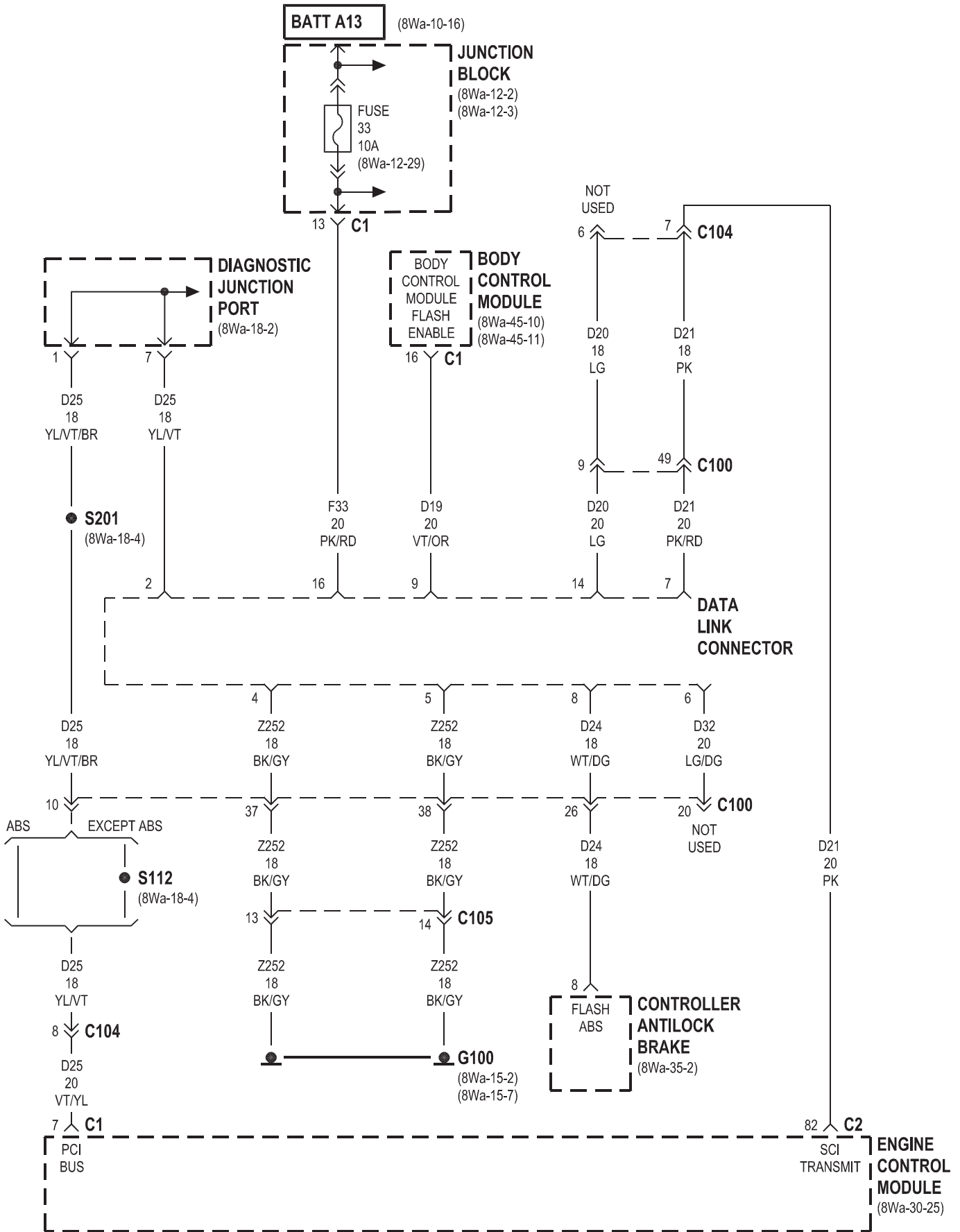








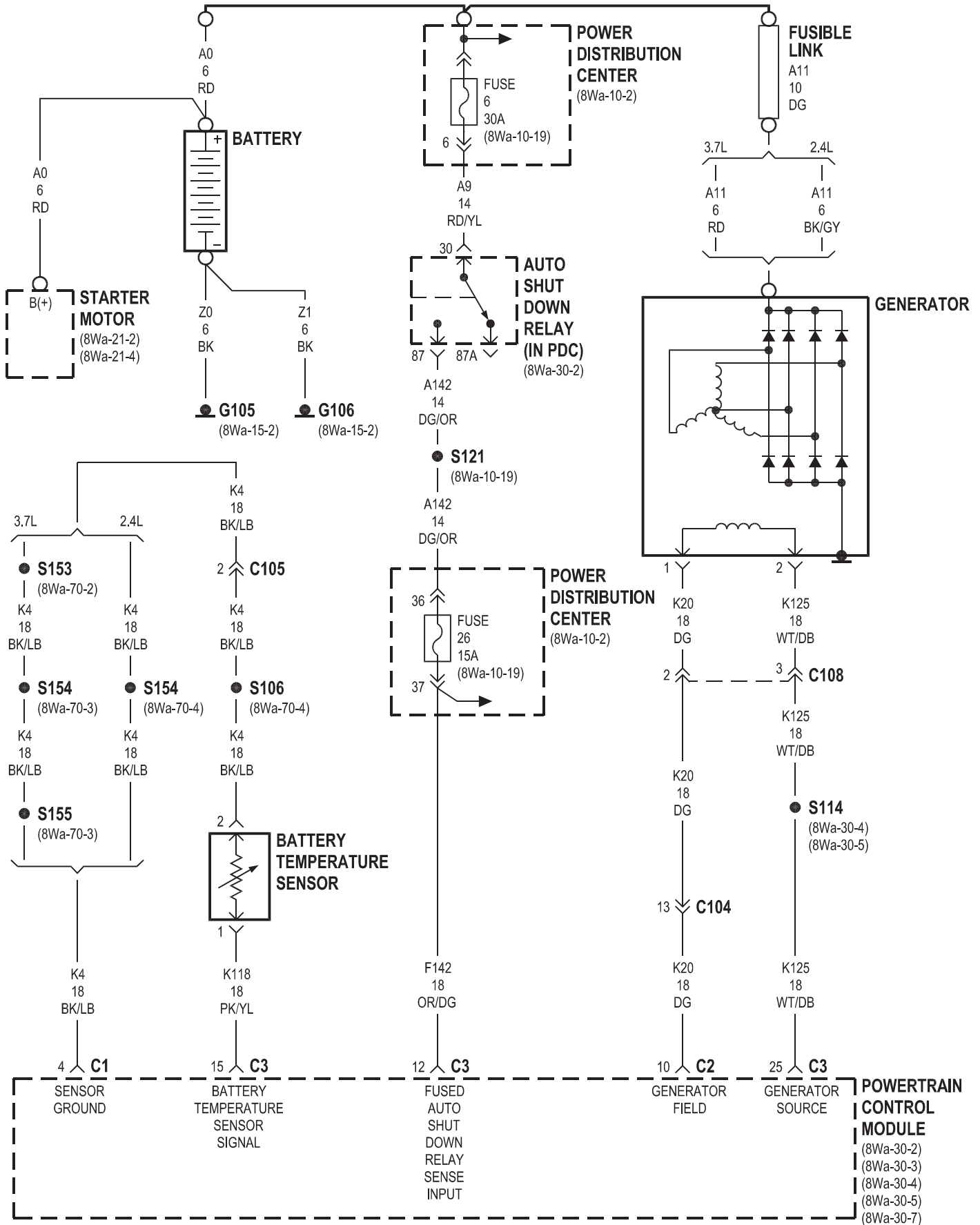
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 •• RHD



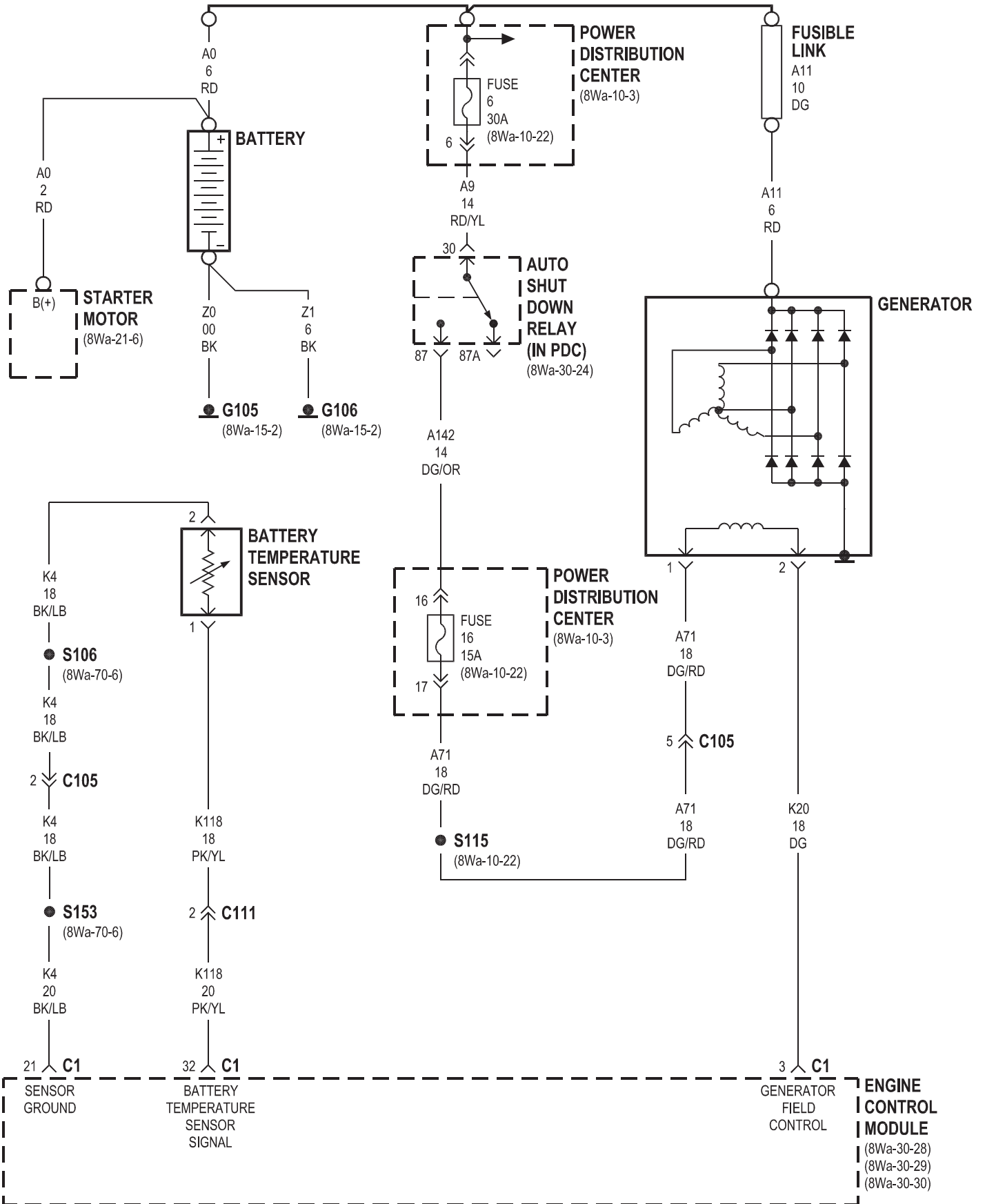
## 8W-20 CHARGING SYSTEM

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Auto Shut Down Relay . . . . .	8Wa-20-2, 3	Fusible Link . . . . .	8Wa-20-2, 3
Battery . . . . .	8Wa-20-2, 3	G105 . . . . .	8Wa-20-2, 3
Battery Temperature Sensor . . . . .	8Wa-20-2, 3	G106 . . . . .	8Wa-20-2, 3
Engine Control Module . . . . .	8Wa-20-3	Generator . . . . .	8Wa-20-2, 3
Fuse 6 . . . . .	8Wa-20-2, 3	Power Distribution Center . . . . .	8Wa-20-2, 3
Fuse 16 . . . . .	8Wa-20-3	Powertrain Control Module . . . . .	8Wa-20-2
Fuse 26 . . . . .	8Wa-20-2	Starter Motor . . . . .	8Wa-20-2, 3

GAS



DIESEL



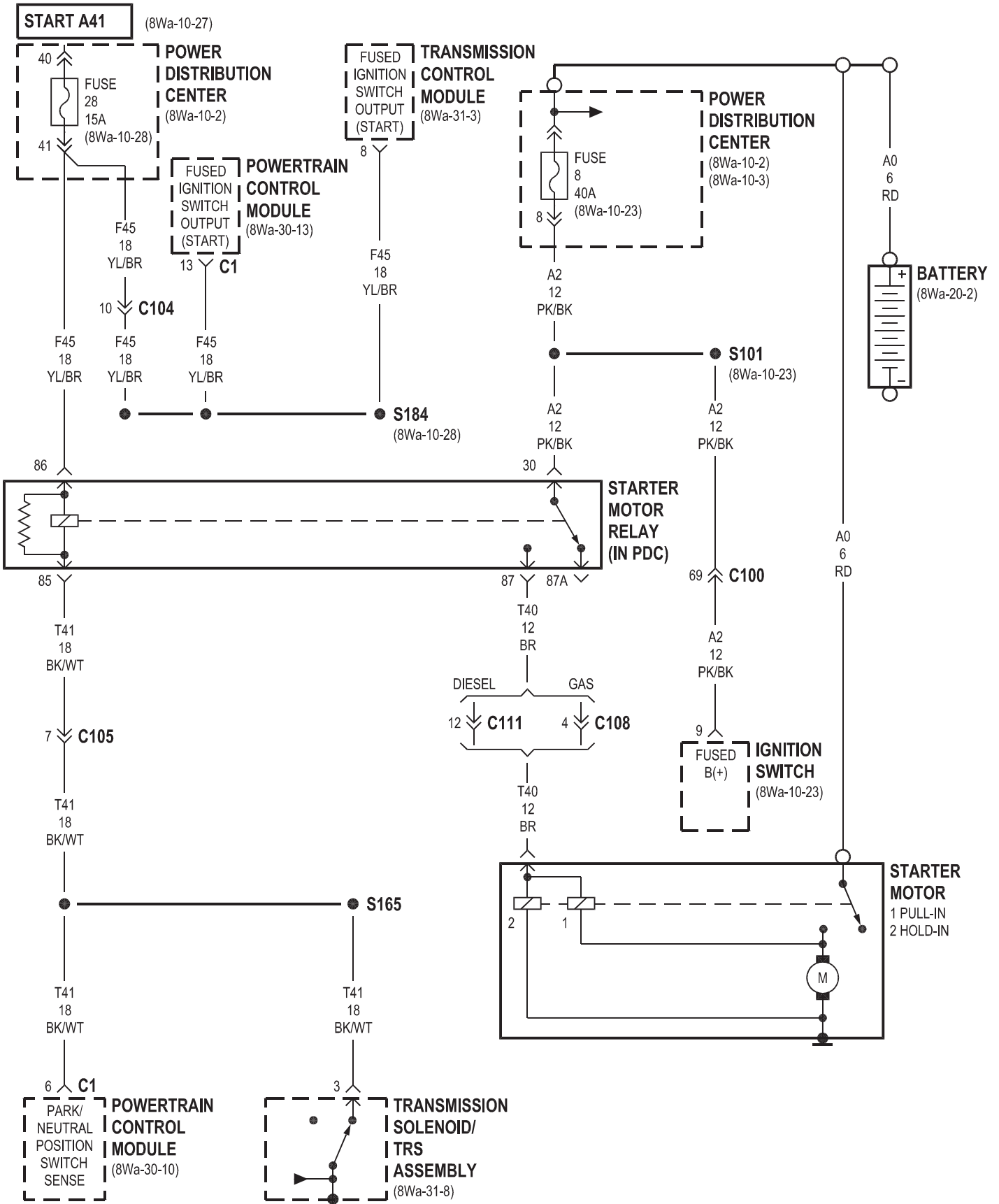


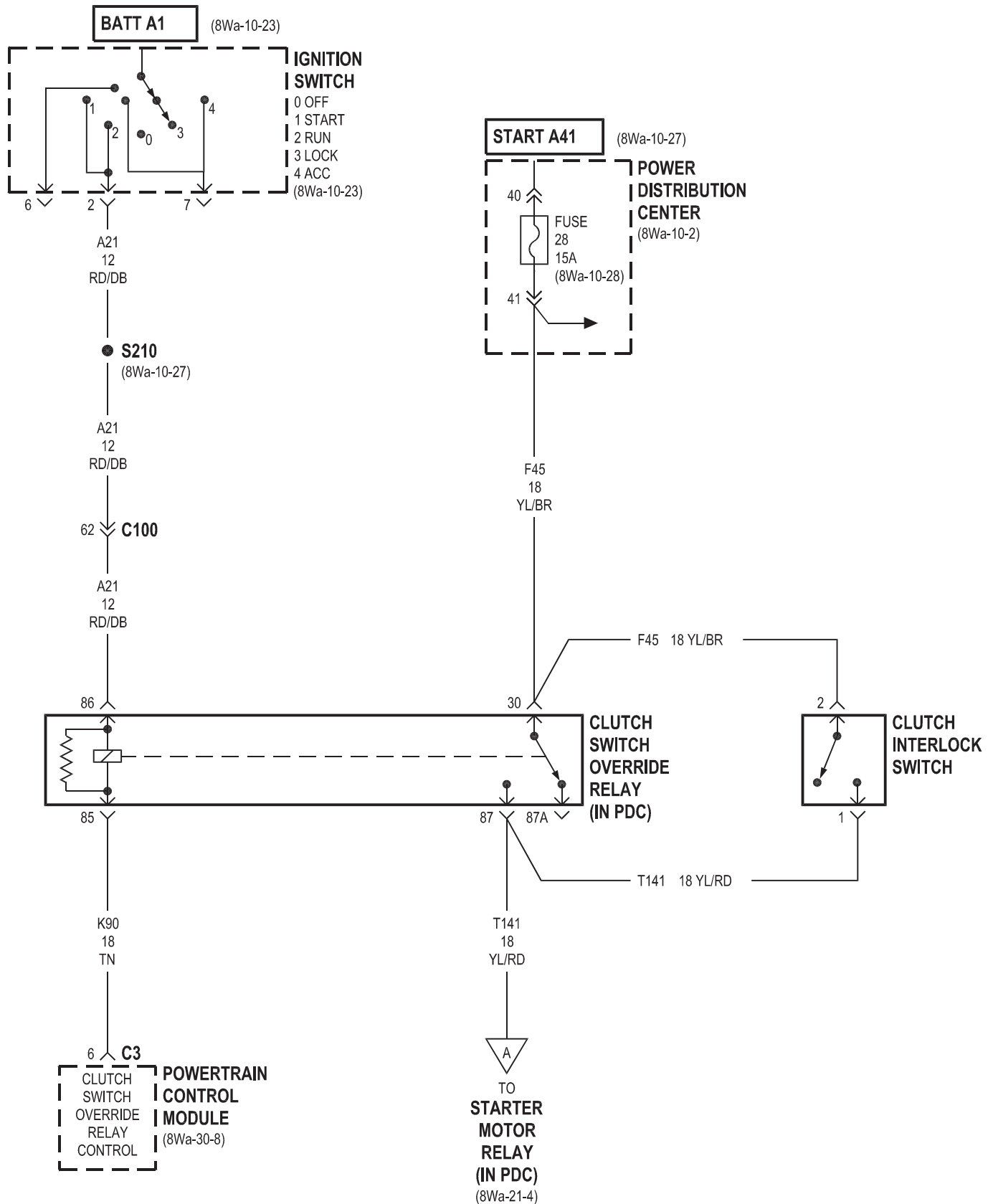
## 8W-21 STARTING SYSTEM

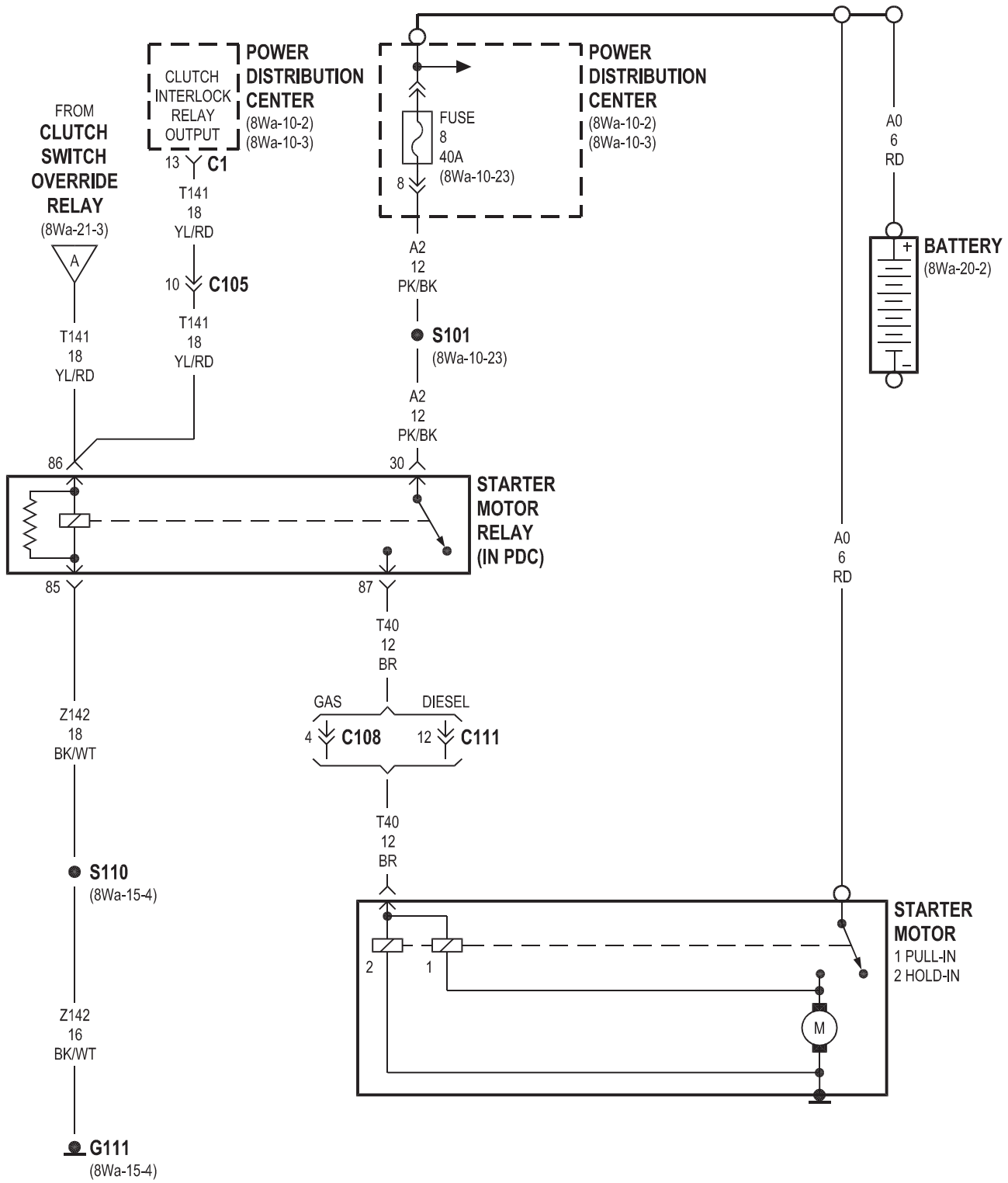
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Battery .....	8Wa-21-2, 4, 6	Ignition Switch .....	8Wa-21-2, 3, 5
Clutch Interlock Switch.....	8Wa-21-3, 5	Power Distribution Center.....	8Wa-21-2, 3, 4, 5, 6
Clutch Switch Override Relay ....	8Wa-21-3, 4, 5, 6	Powertrain Control Module .....	8Wa-21-2, 3
Engine Control Module .....	8Wa-21-5	Starter Motor .....	8Wa-21-2, 4, 6
Fuse 8 .....	8Wa-21-2, 4, 6	Starter Motor Relay.....	8Wa-21-2, 3, 4, 5, 6
Fuse 28 .....	8Wa-21-2, 3, 5	Transmission Control Module .....	8Wa-21-2
G111 .....	8Wa-21-4, 6	Transmission Solenoid/Trs Assembly.....	8Wa-21-2

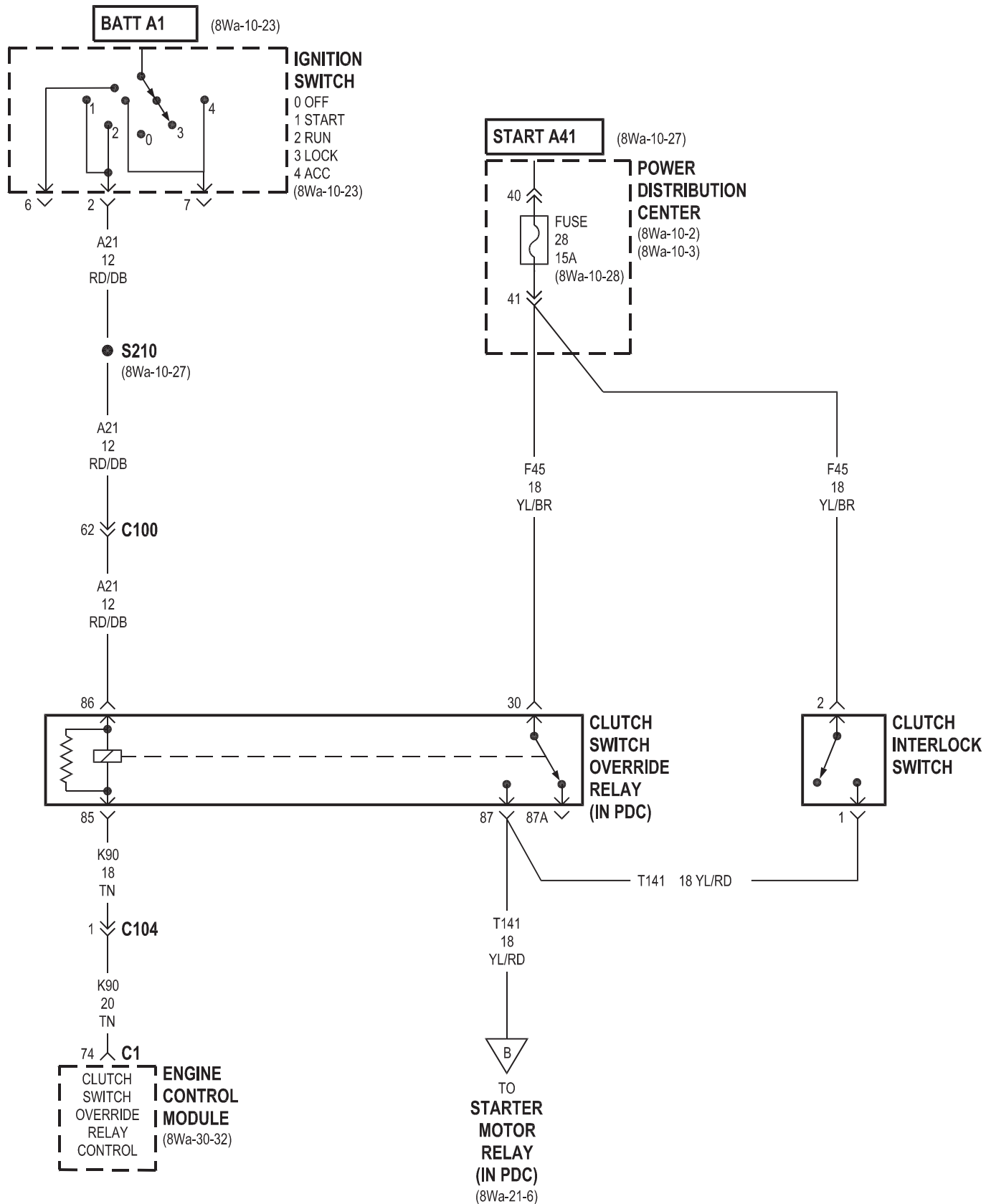


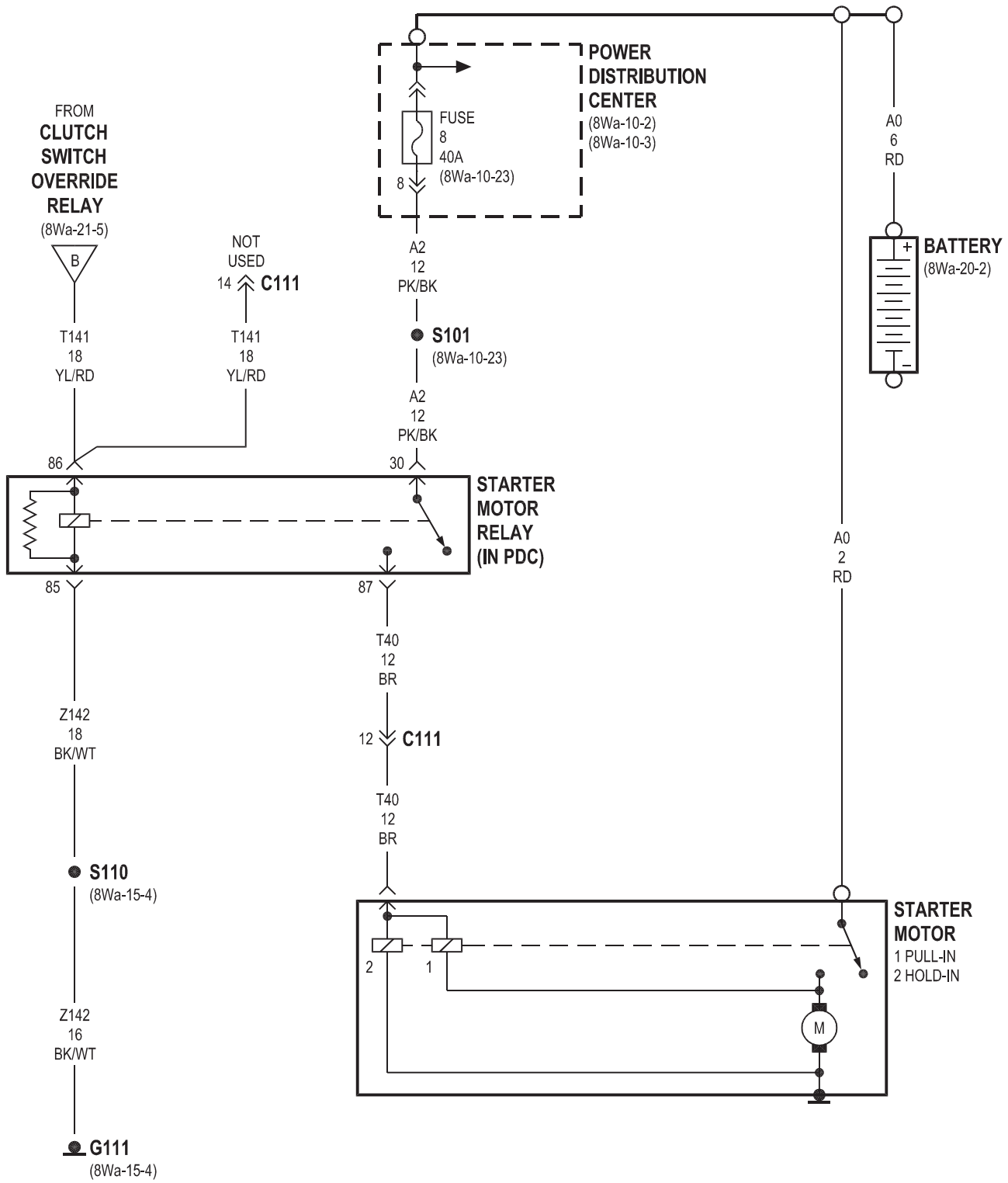
A/T





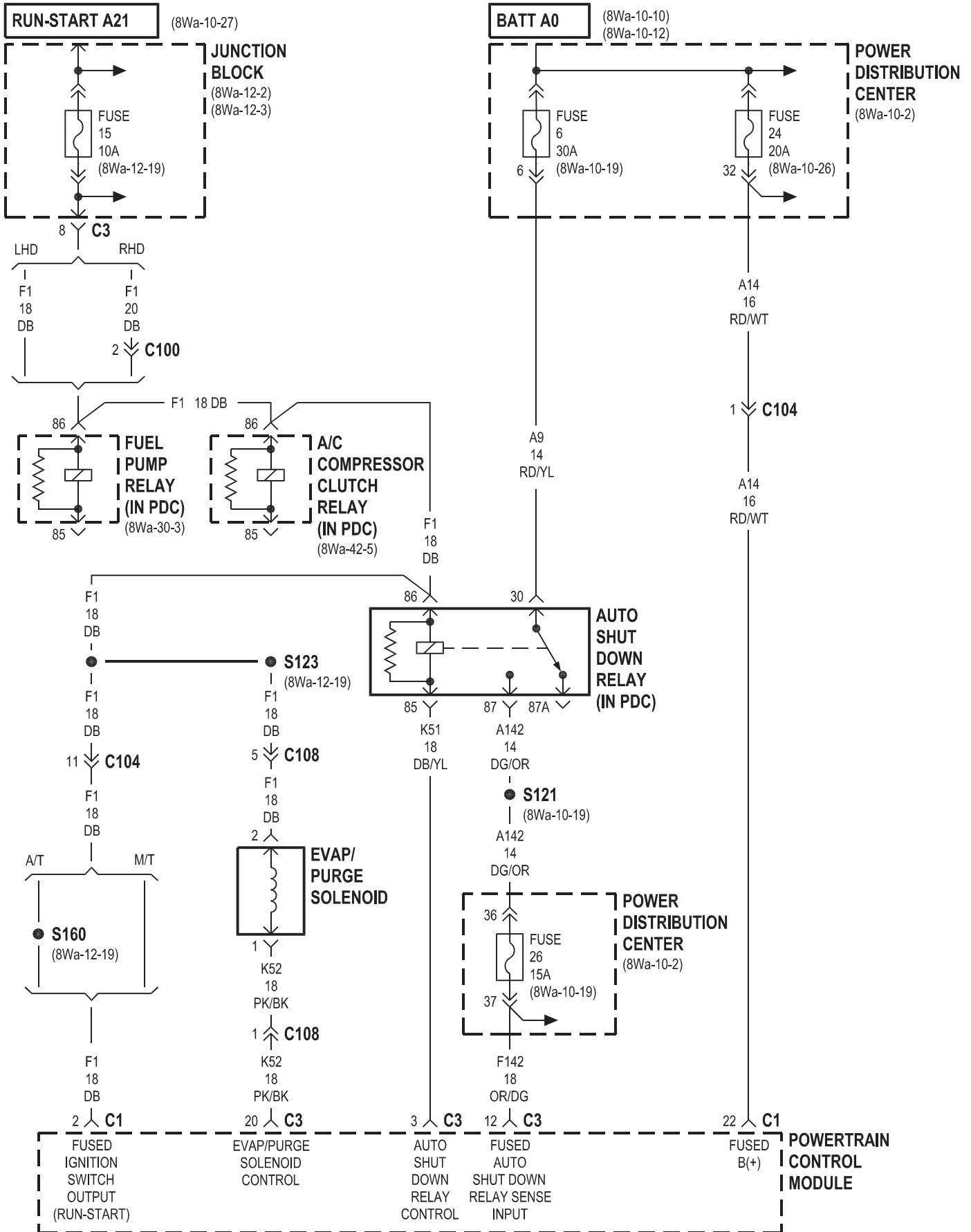


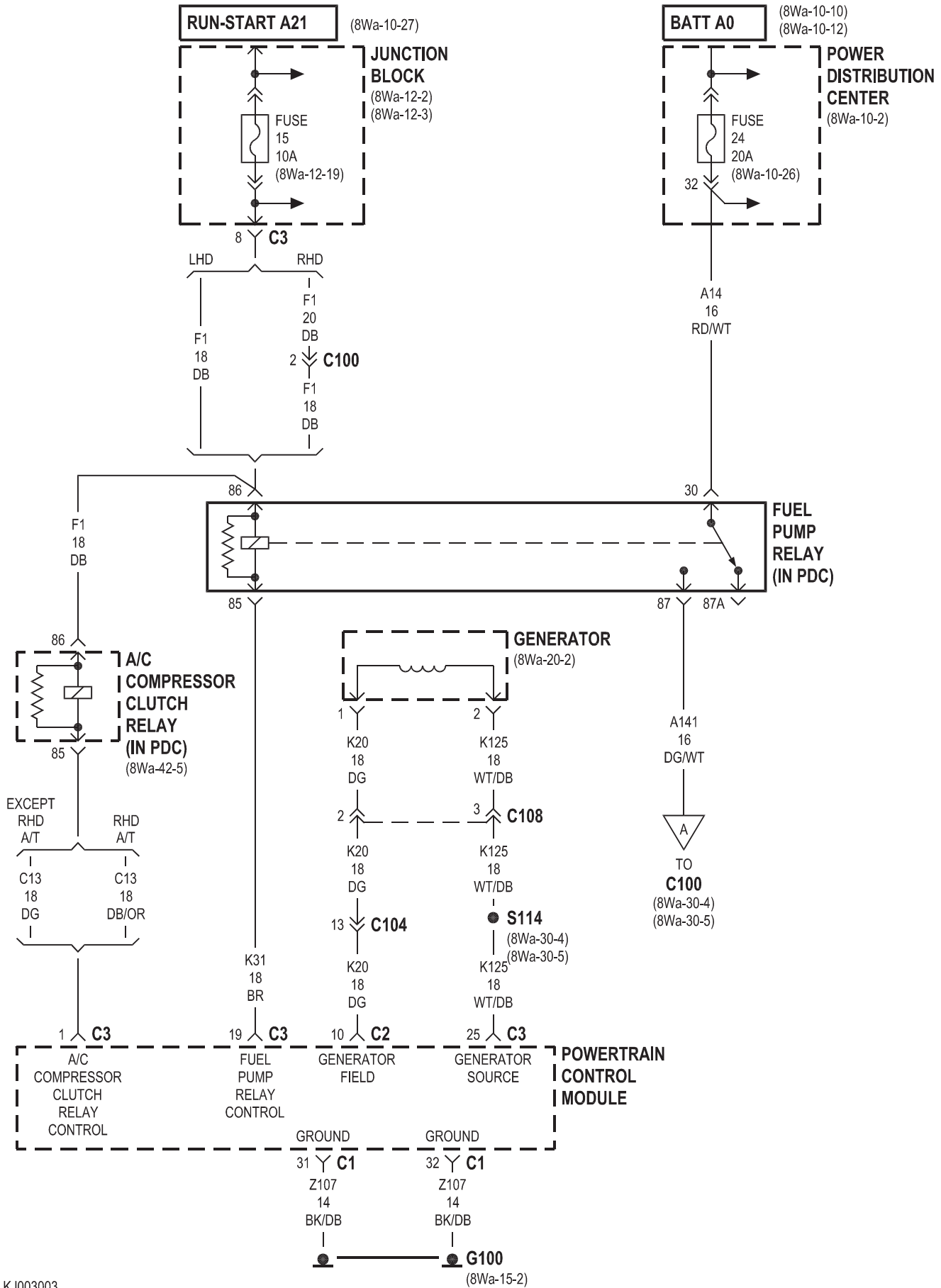




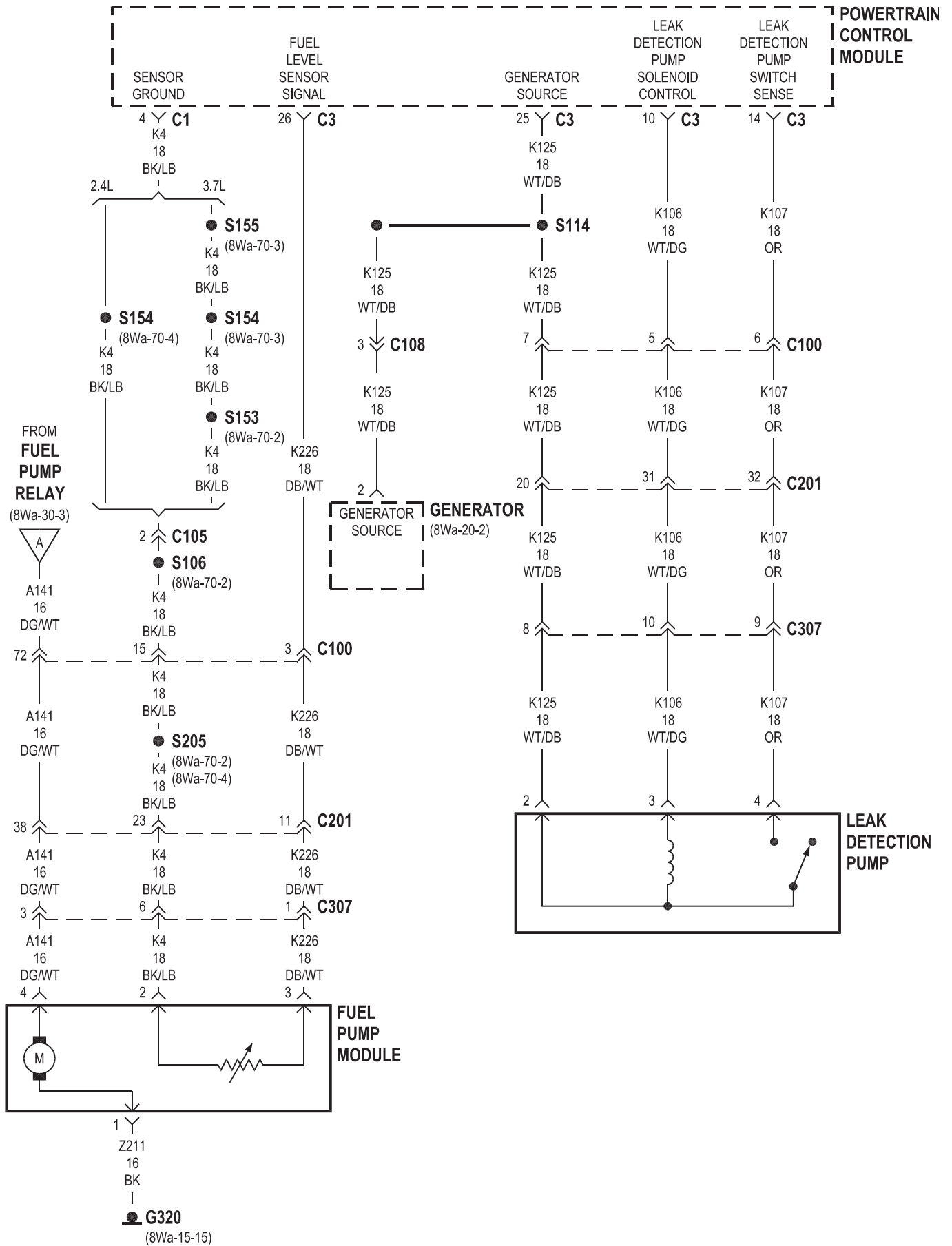
## 8W-30 FUEL/IGNITION SYSTEM

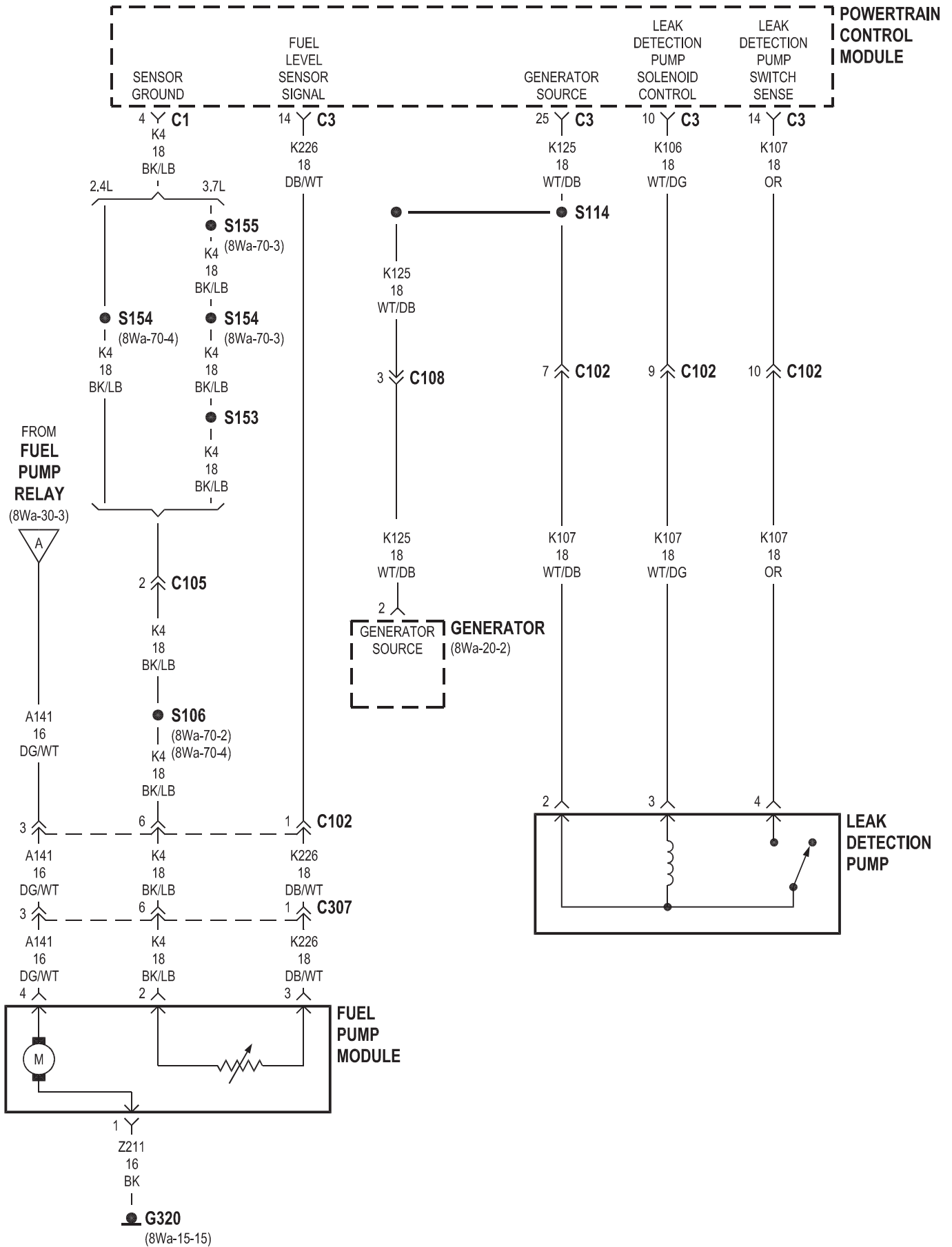
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C Compressor Clutch . . . . .	8Wa-30-34	Fuse 10 . . . . .	8Wa-30-35
A/C Compressor Clutch Relay . . . . .	8Wa-30-34, 2, 3	Fuse 11 . . . . .	8Wa-30-35
A/C High Pressure Switch . . . . .	8Wa-30-29	Fuse 12 . . . . .	8Wa-30-31, 33
A/C Low Pressure Switch . . . . .	8Wa-30-8, 29	Fuse 15 . . . . .	8Wa-30-25, 2, 3
A/C Pressure Transducer . . . . .	8Wa-30-11, 23, 12	Fuse 16 . . . . .	8Wa-30-13, 14, 15, 24, 30, 34, 35, 16
Accelerator Pedal Position Sensor . . . . .	8Wa-30-27	Fuse 21 . . . . .	8Wa-30-34
Auto Shut Down Relay . . . . .	8Wa-30-13, 14, 15, 24, 28, 31, 16, 17, 2	Fuse 24 . . . . .	8Wa-30-31, 2, 3
Battery Temperature Sensor . . . . .	8Wa-30-30, 7	Fuse 26 . . . . .	8Wa-30-18, 24, 17, 2
Blower Motor Relay . . . . .	8Wa-30-31	Fuse 28 . . . . .	8Wa-30-13
Body Control Module . . . . .	8Wa-30-8, 33	G100 . . . . .	8Wa-30-19, 27, 17, 3
Boost Pressure Sensor . . . . .	8Wa-30-26, 28	G101 . . . . .	8Wa-30-23
Brake Lamp Switch . . . . .	8Wa-30-8, 32, 33	G103 . . . . .	8Wa-30-15, 23, 31, 34, 16
Cabin Heater . . . . .	8Wa-30-34	G104 . . . . .	8Wa-30-27
Cabin Heater Relay . . . . .	8Wa-30-34	G111 . . . . .	8Wa-30-31
Camshaft Position Sensor . . . . .	8Wa-30-10, 9, 28	G112 . . . . .	8Wa-30-8, 23
Capacitor . . . . .	8Wa-30-19, 17	G320 . . . . .	8Wa-30-4, 5
Clockspring . . . . .	8Wa-30-33, 7	Generator . . . . .	8Wa-30-24, 4, 3, 5
Clutch Switch Override Relay . . . . .	8Wa-30-13, 8, 32	Glow Plug Assembly . . . . .	8Wa-30-35
Coil On Plug No. 1 . . . . .	8Wa-30-19	Glow Plug Relay No. 1 . . . . .	8Wa-30-35
Coil On Plug No. 2 . . . . .	8Wa-30-20	Glow Plug Relay No. 2 . . . . .	8Wa-30-35
Coil On Plug No. 3 . . . . .	8Wa-30-19	Idle Air Control Motor . . . . .	8Wa-30-21, 22
Coil On Plug No. 4 . . . . .	8Wa-30-20	Ignition Switch . . . . .	8Wa-30-32
Coil On Plug No. 5 . . . . .	8Wa-30-19	Intake Air Temperature Sensor . . . . .	8Wa-30-11, 12
Coil On Plug No. 6 . . . . .	8Wa-30-20	Junction Block . . . . .	8Wa-30-25, 31, 33, 2, 3
Coil Rail . . . . .	8Wa-30-17	Knock Sensor . . . . .	8Wa-30-8
Controller Antilock Brake . . . . .	8Wa-30-33	Leak Detection Pump . . . . .	8Wa-30-4, 5
Crankshaft Position Sensor . . . . .	8Wa-30-10, 9, 27	Left Speed Control Switch . . . . .	8Wa-30-33, 7
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Diagnostic Junction Port . . . . .	8Wa-30-25, 6	Oxygen Sensor 1/1 Upstream . . . . .	8Wa-30-14, 15
EGR Solenoid . . . . .	8Wa-30-30	Oxygen Sensor 1/2 Downstream . . . . .	8Wa-30-13, 14, 15
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Engine Oil Pressure Sensor . . . . .	8Wa-30-11, 28, 12	Oxygen Sensor Downstream Relay . . . . .	8Wa-30-13, 15, 16
Evap/Purge Solenoid . . . . .	8Wa-30-2	Power Distribution Center . . . . .	8Wa-30-13, 14, 15, 23, 24, 28, 30, 31, 34, 35, 16, 17, 2, 3
Fuel Heater . . . . .	8Wa-30-31	Power Steering Pressure Switch . . . . .	8Wa-30-23
Fuel Heater Relay . . . . .	8Wa-30-31	Powertrain Control Module . . . . .	8Wa-30-10, 13, 20, 8, 11, 14, 15, 18, 19, 21, 9, 23, 4, 12, 16, 17, 2, 22, 3, 6, 7, 5
Fuel Injector No. 1 . . . . .	8Wa-30-18, 36	Radiator Fan Motor . . . . .	8Wa-30-23
Fuel Injector No. 2 . . . . .	8Wa-30-18, 36	Radiator Fan Relay . . . . .	8Wa-30-23
Fuel Injector No. 3 . . . . .	8Wa-30-18, 36	Right Speed Control Switch . . . . .	8Wa-30-33, 7
Fuel Injector No. 4 . . . . .	8Wa-30-18, 36	Shifter Assembly . . . . .	8Wa-30-8, 32
Fuel Injector No. 5 . . . . .	8Wa-30-18	Speed Control Servo . . . . .	8Wa-30-8
Fuel Injector No. 6 . . . . .	8Wa-30-18	Starter Motor Relay . . . . .	8Wa-30-13
Fuel Pressure Sensor . . . . .	8Wa-30-36	Throttle Position Sensor . . . . .	8Wa-30-21, 22
Fuel Pressure Solenoid . . . . .	8Wa-30-31	Transfer Case Position Sensor . . . . .	8Wa-30-9, 23, 32
Fuel Pump Module . . . . .	8Wa-30-30, 4, 5	Transmission Control Module . . . . .	8Wa-30-10, 8, 22, 6
Fuel Pump Relay . . . . .	8Wa-30-4, 2, 3, 5	Transmission Solenoid/Trs Assembly . . . . .	8Wa-30-10
Fuse 2 . . . . .	8Wa-30-23	Water In Fuel Sensor . . . . .	8Wa-30-29
Fuse 6 . . . . .	8Wa-30-24, 28, 31, 2		

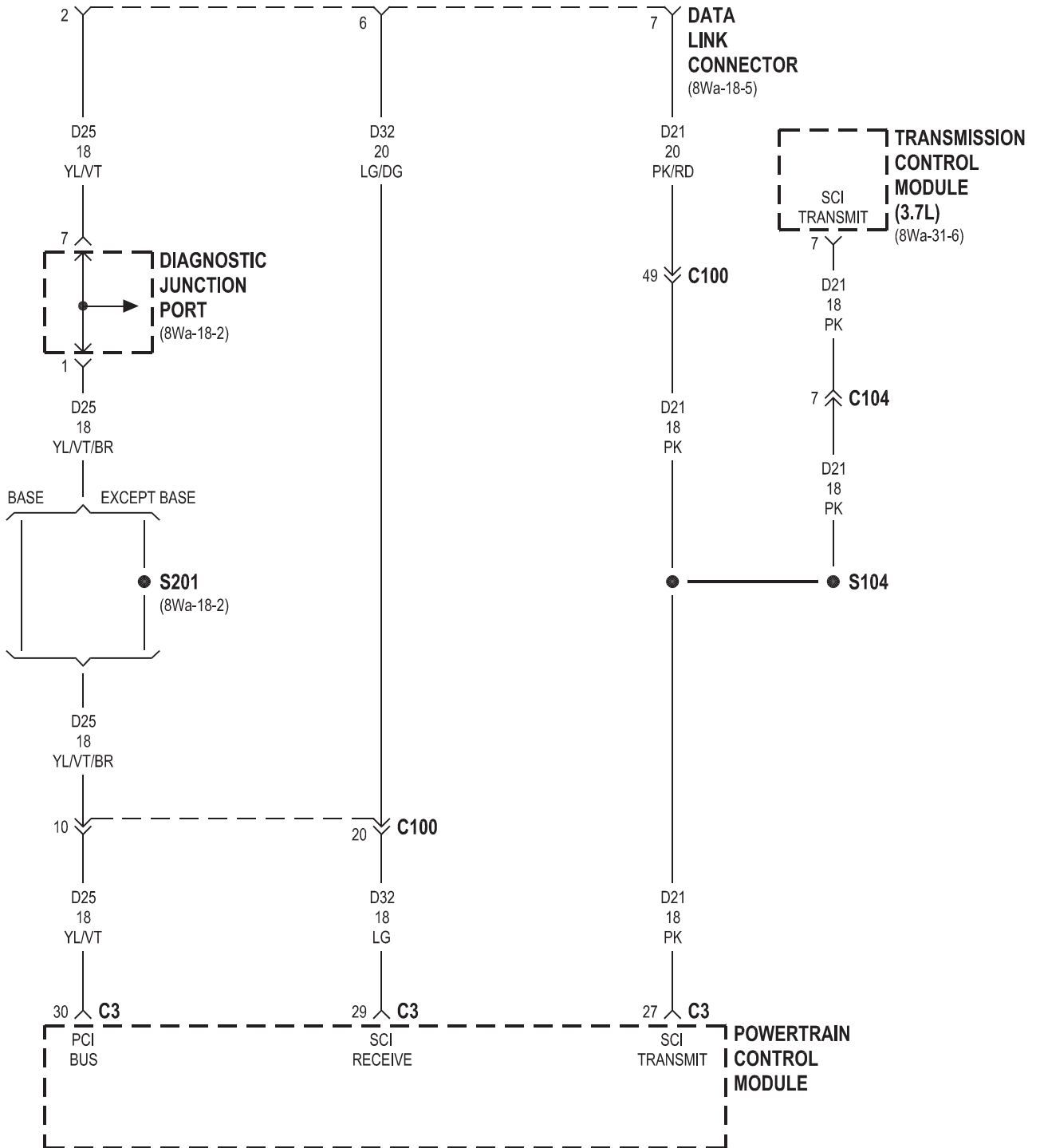


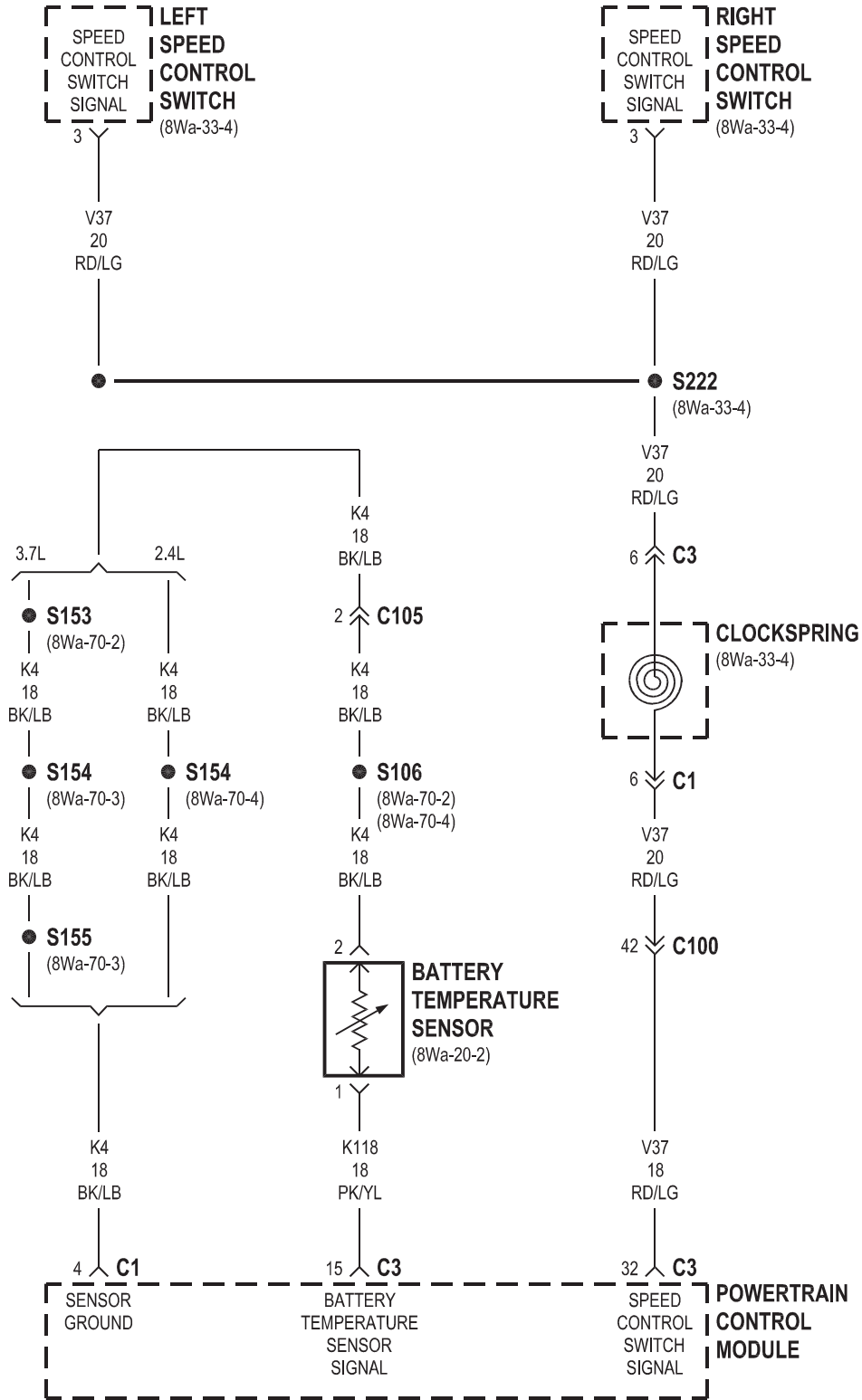




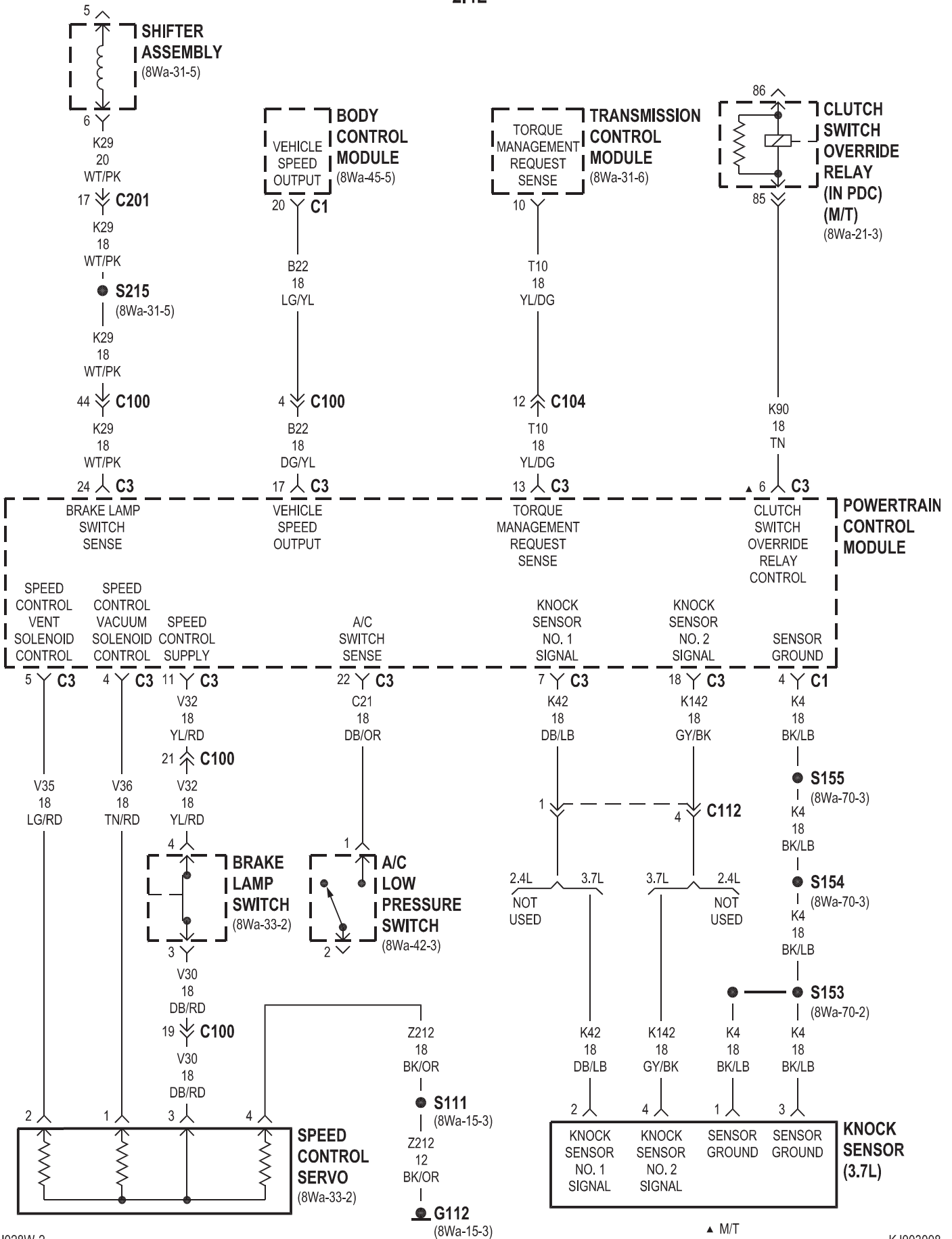


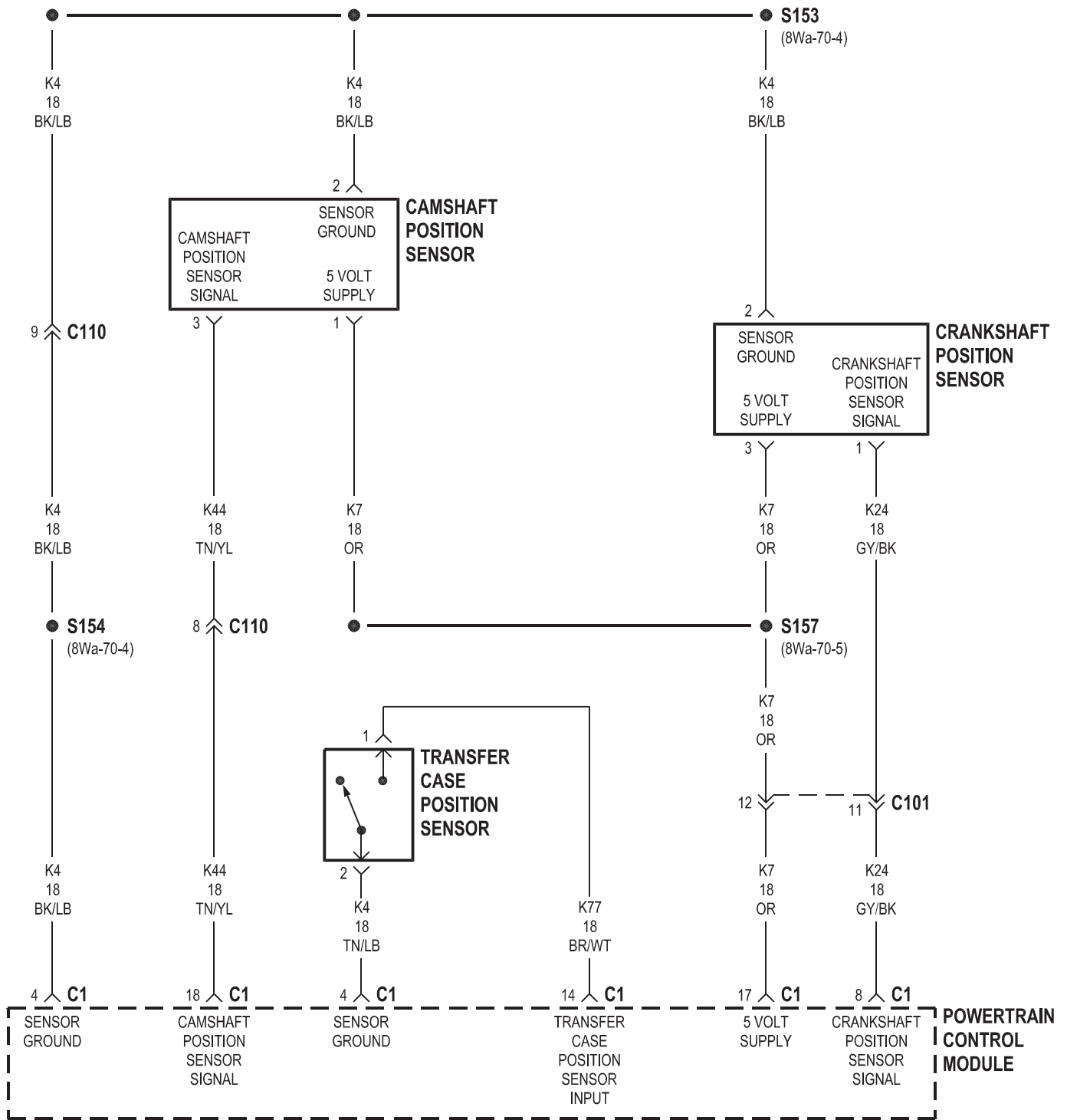


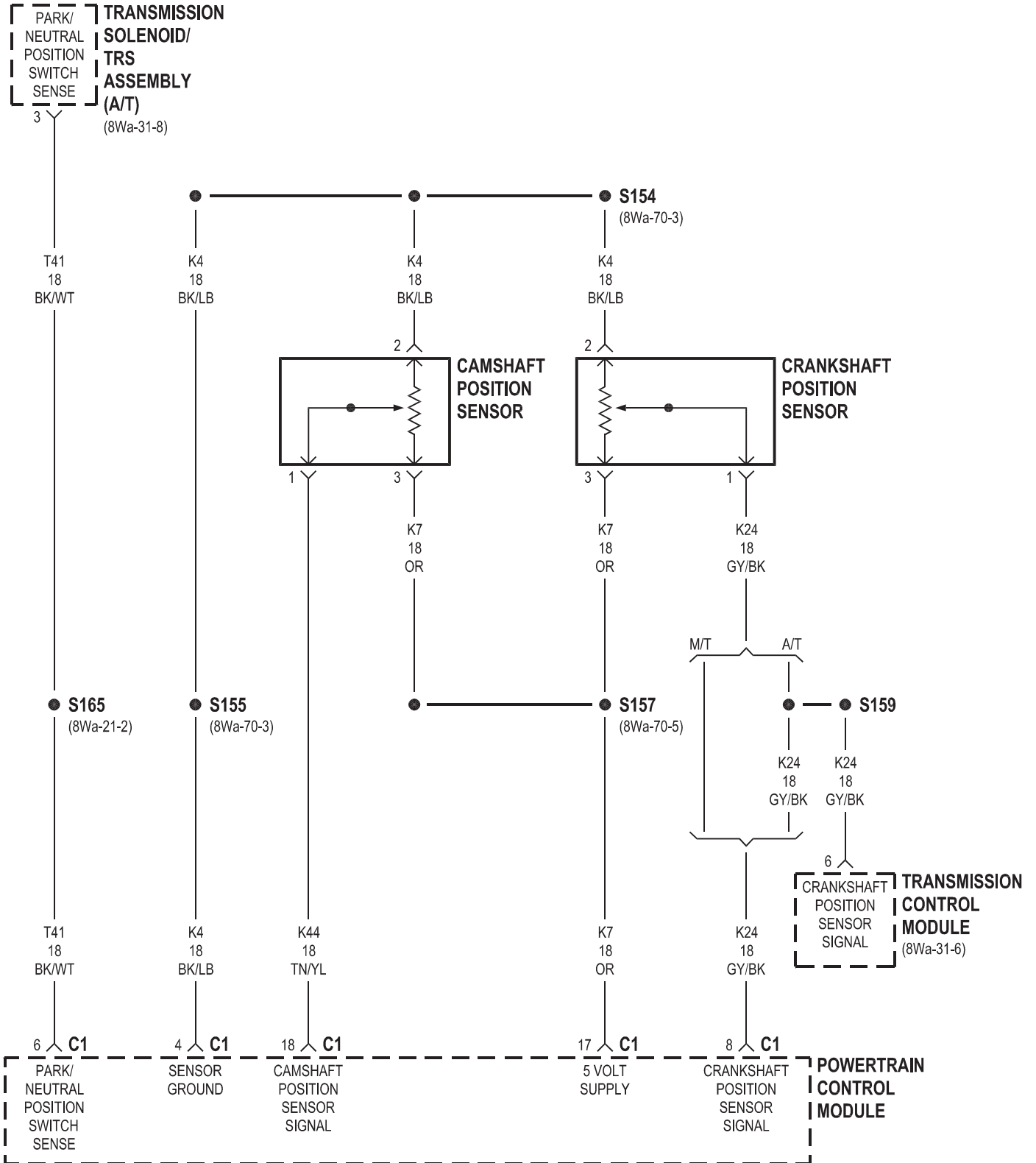


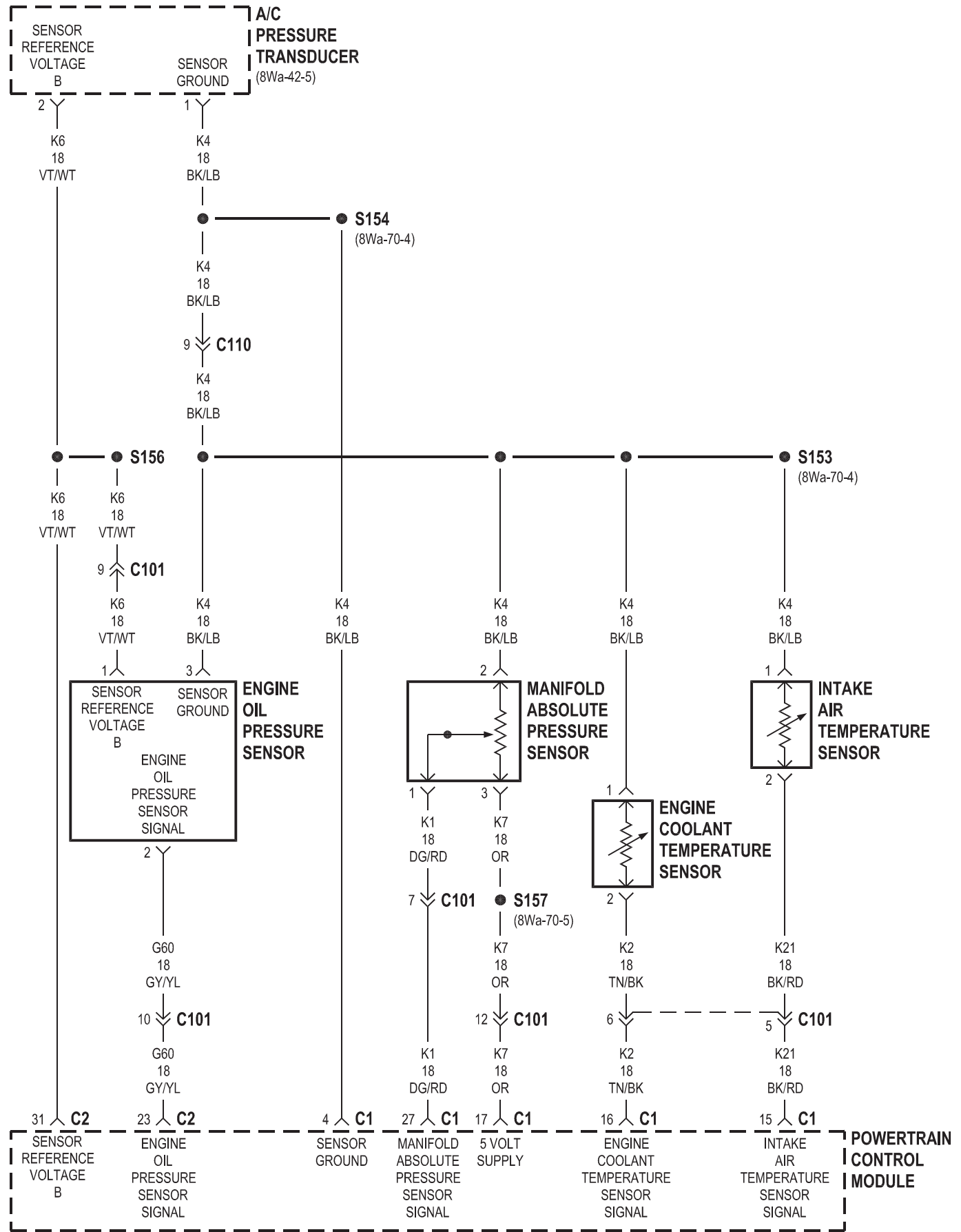


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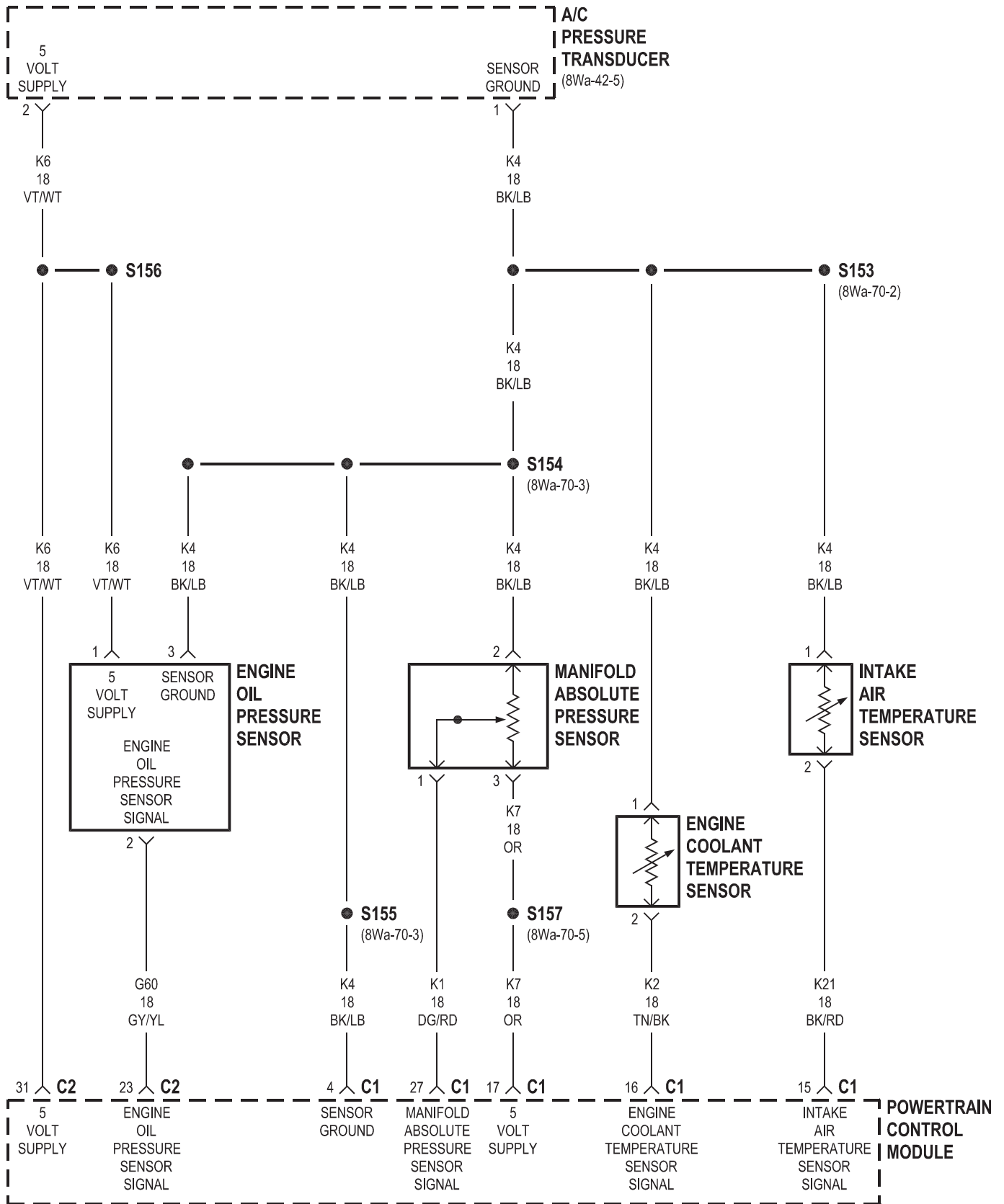




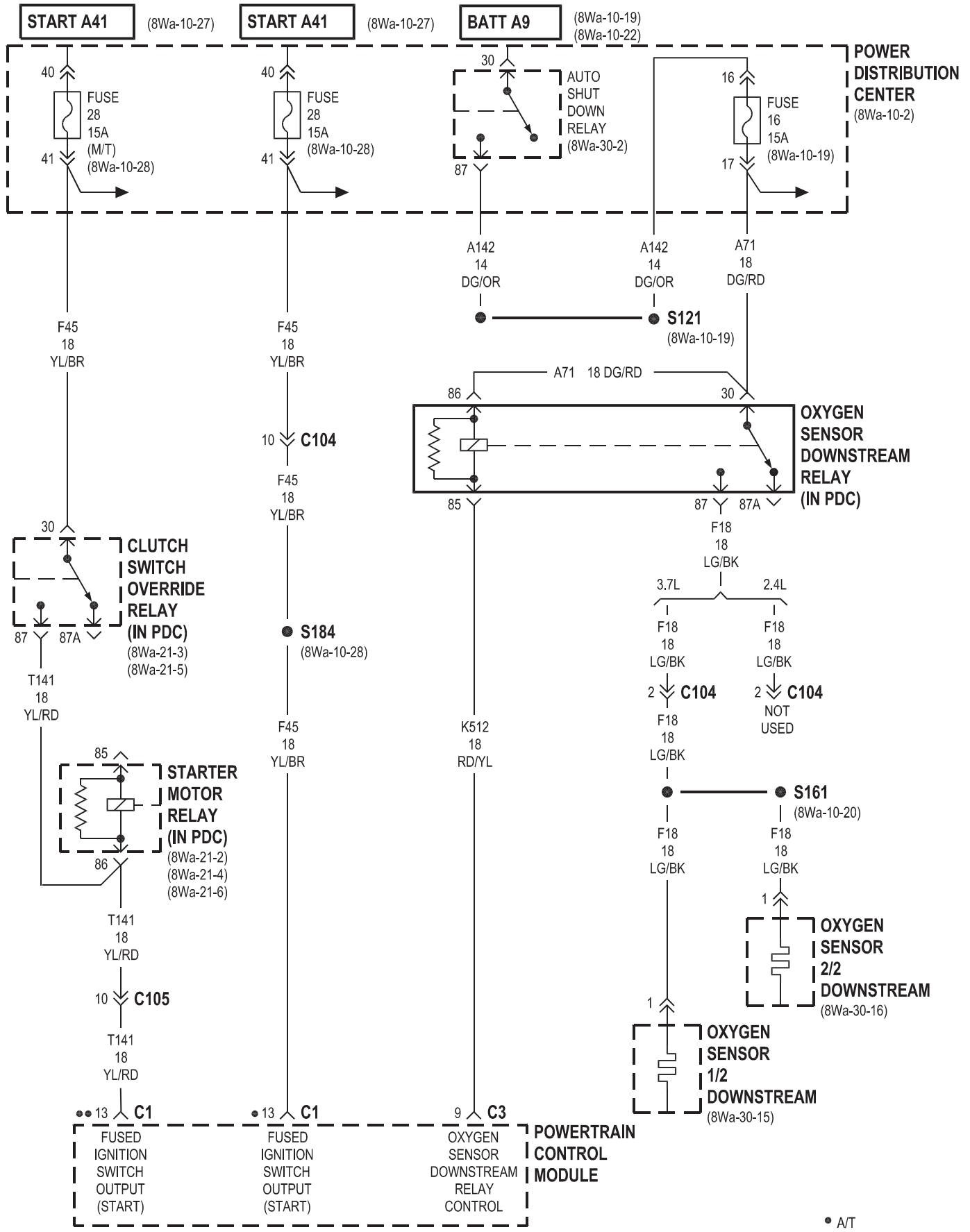


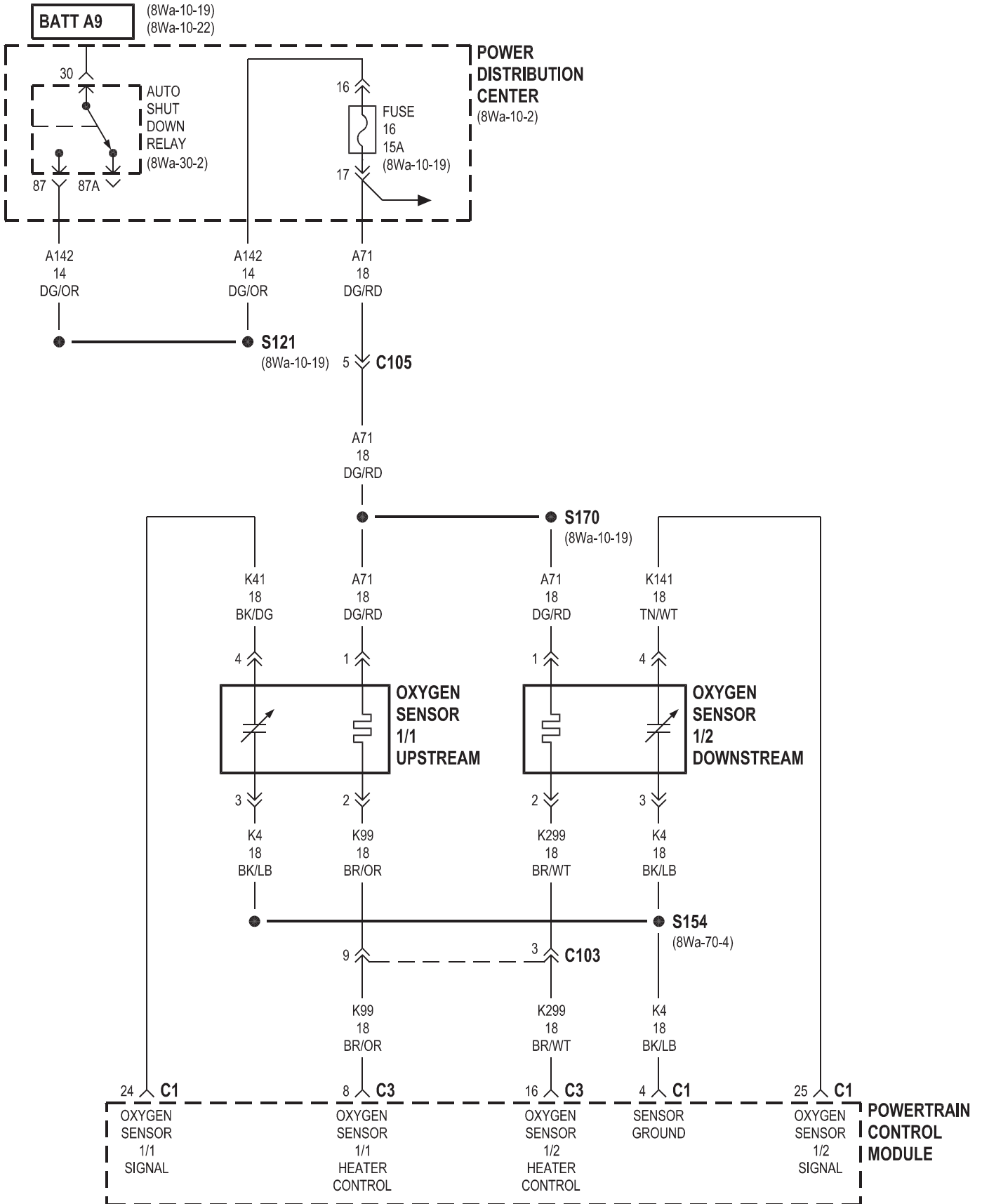


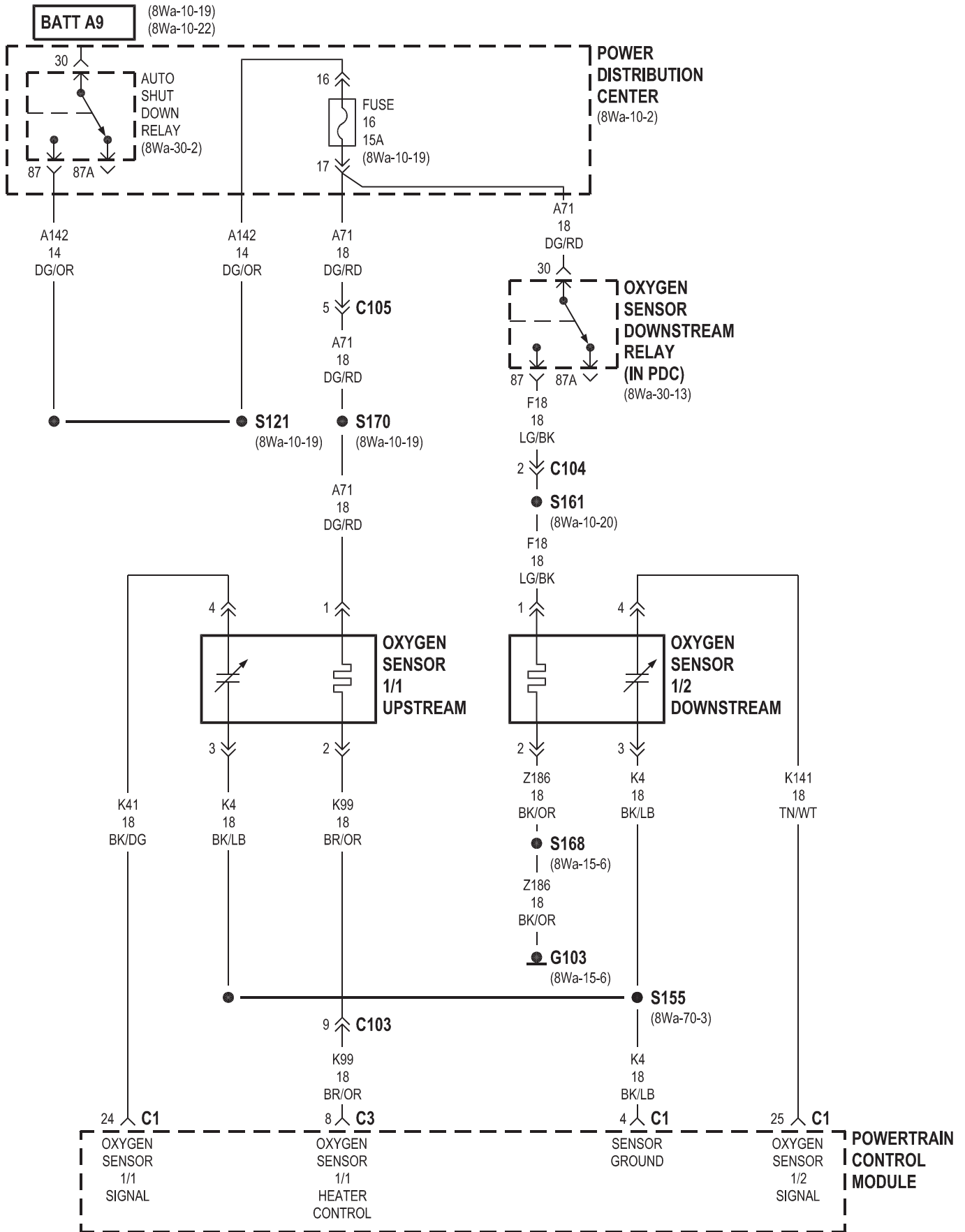


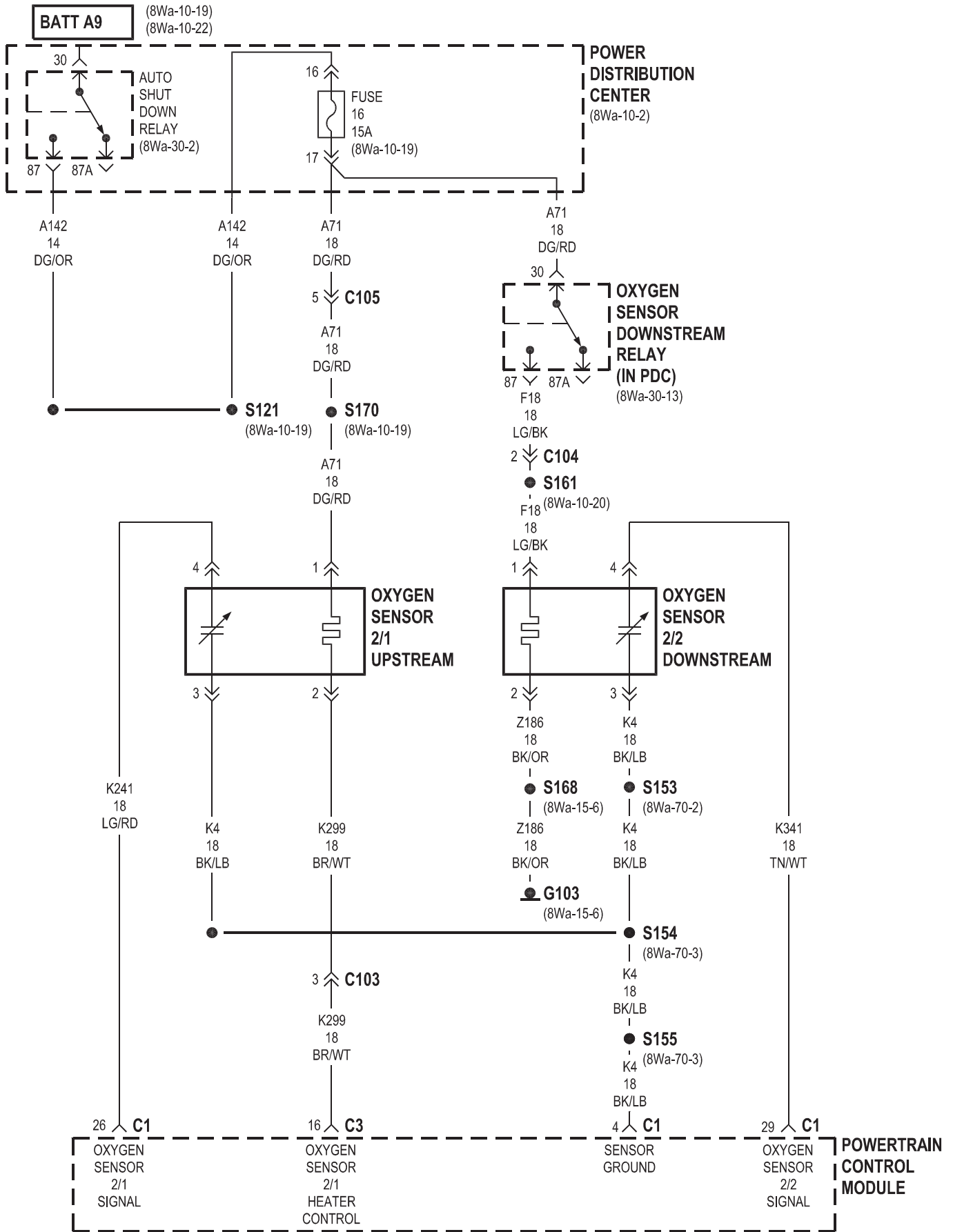


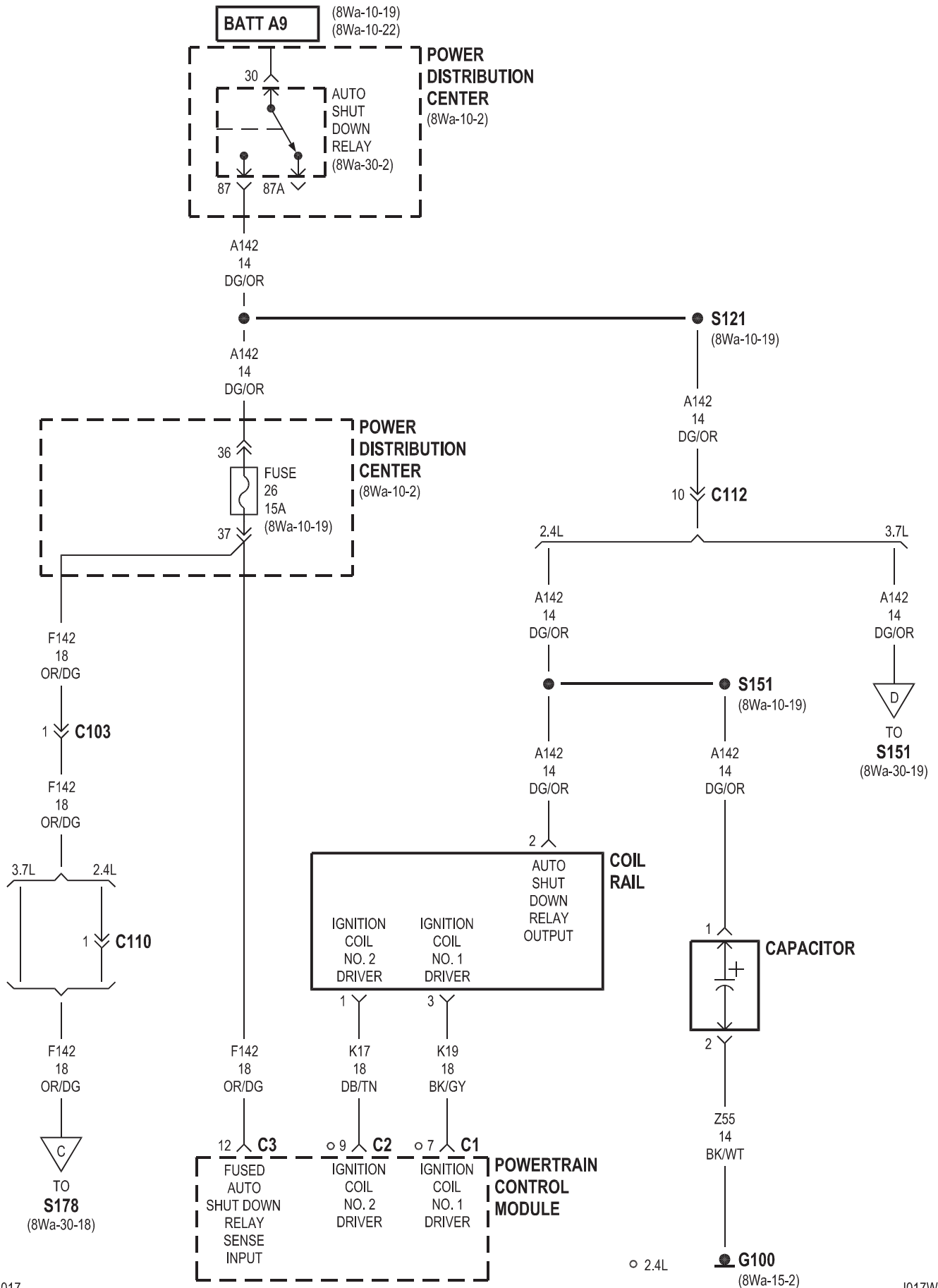
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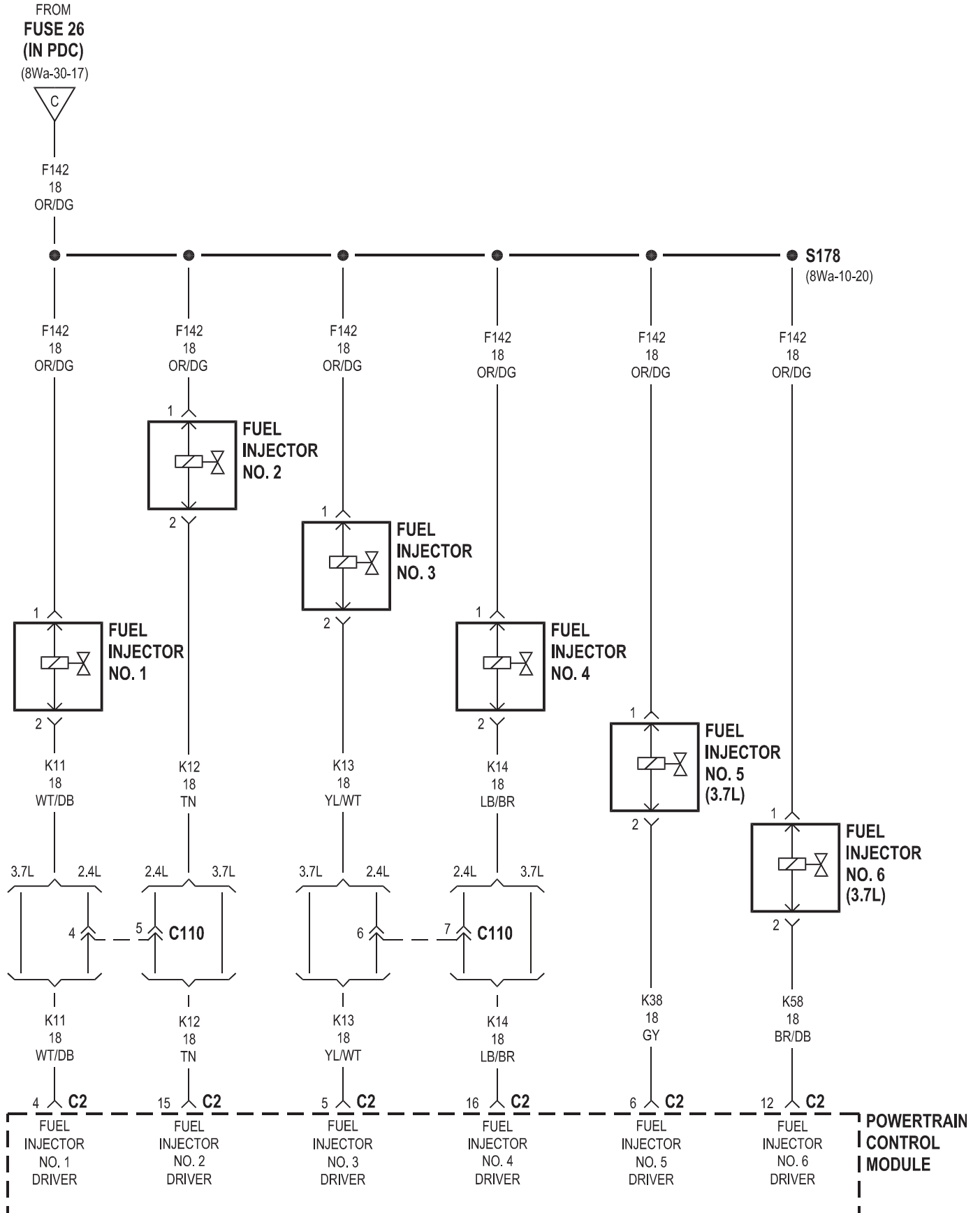


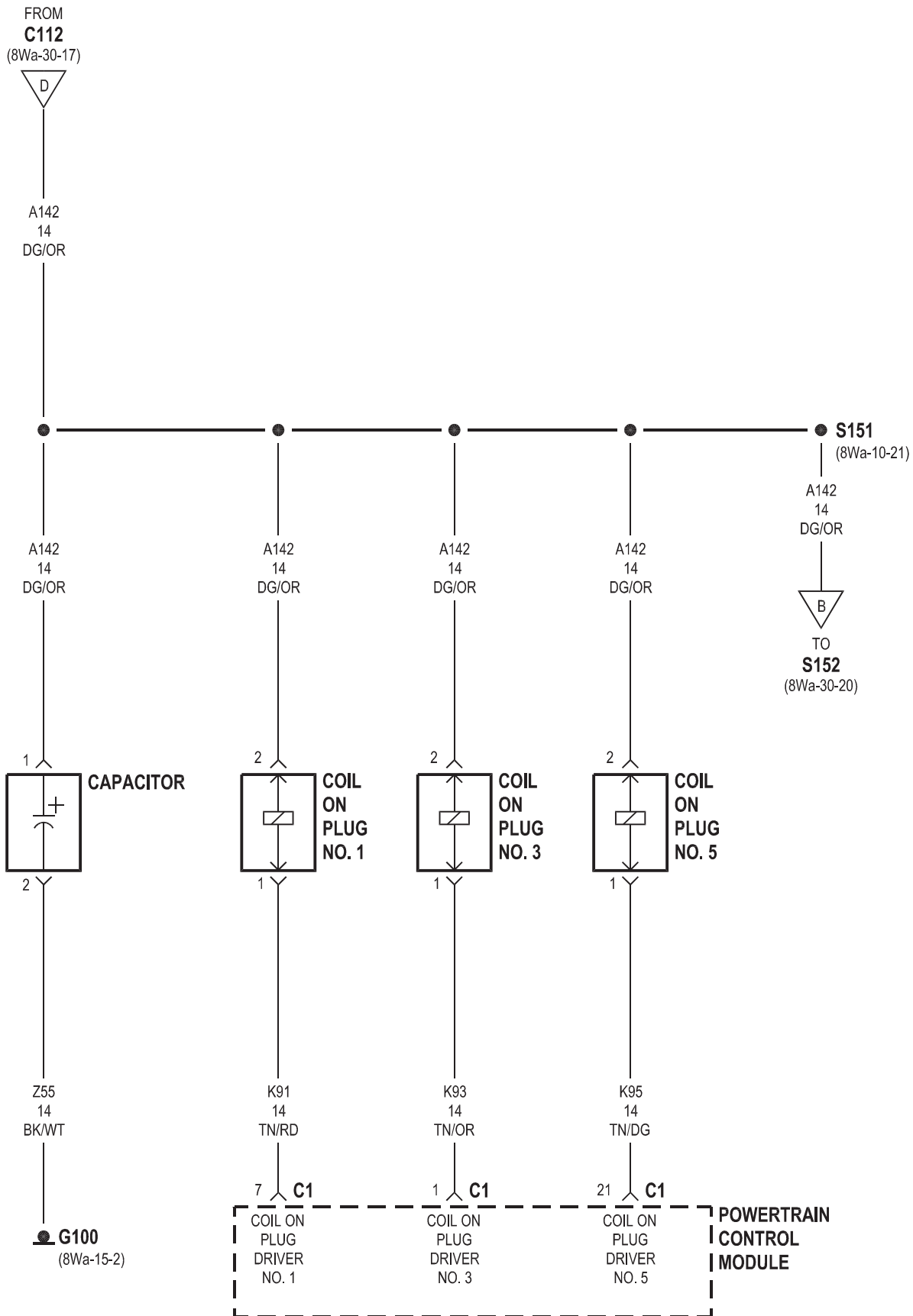




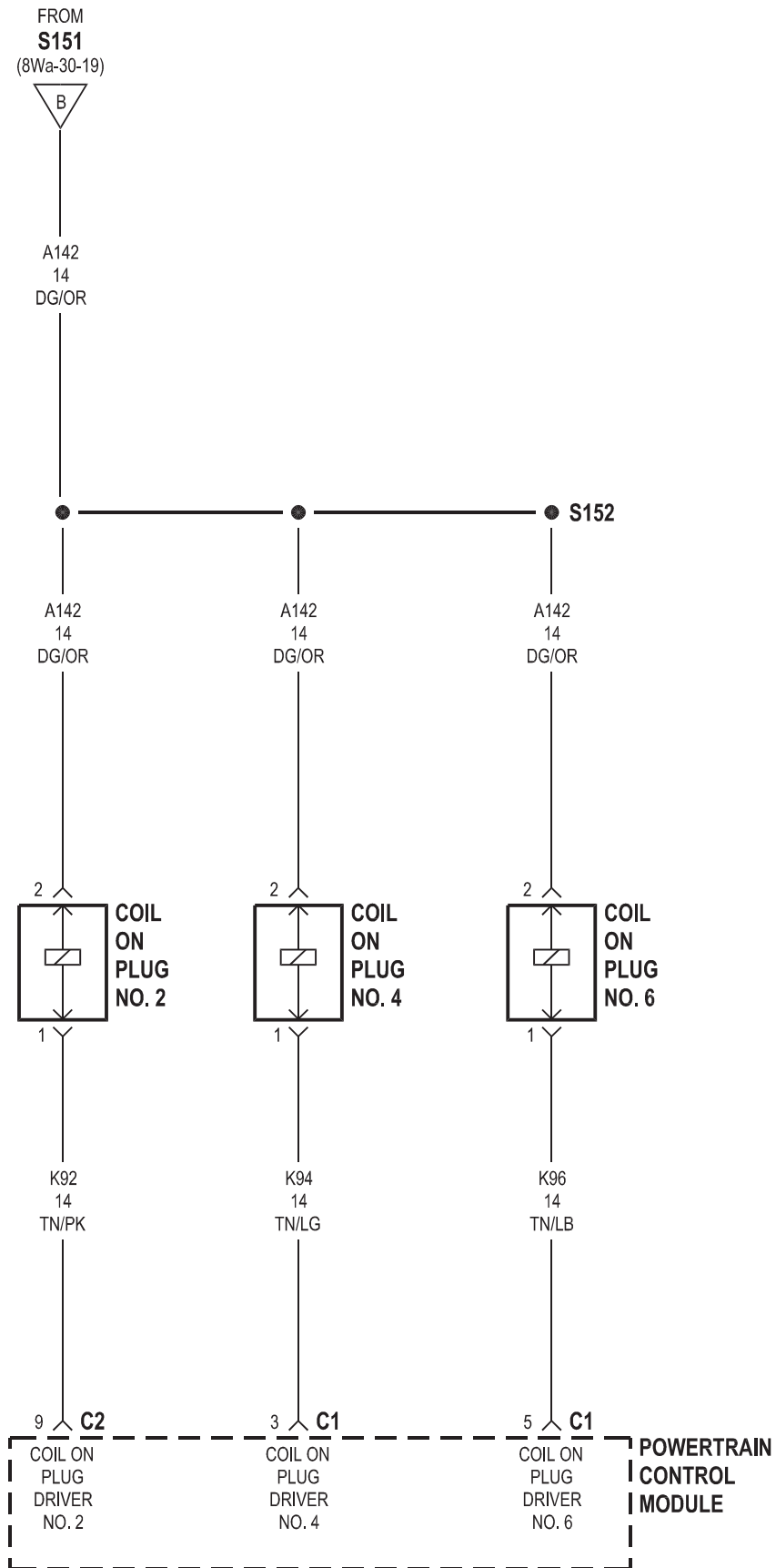


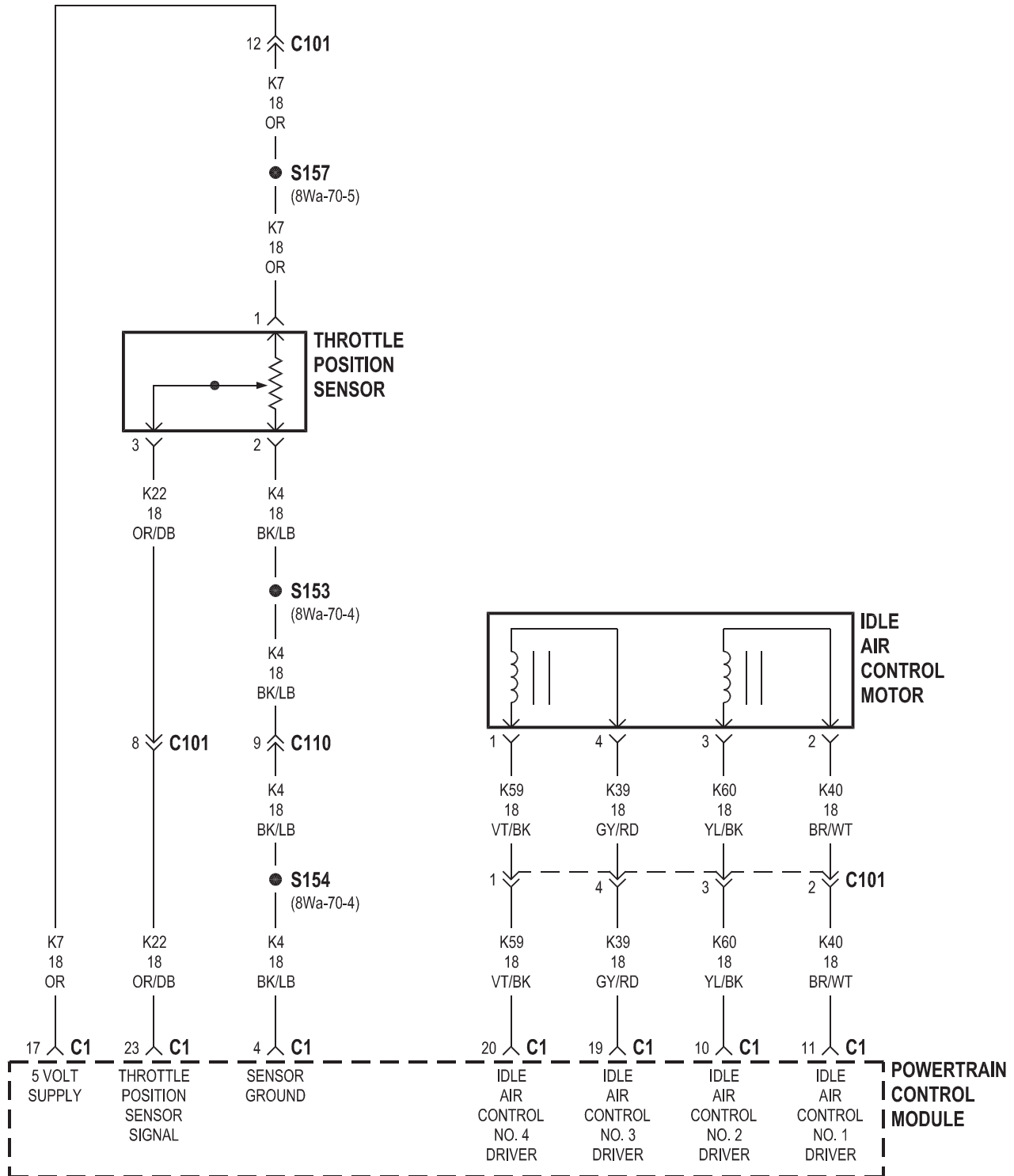


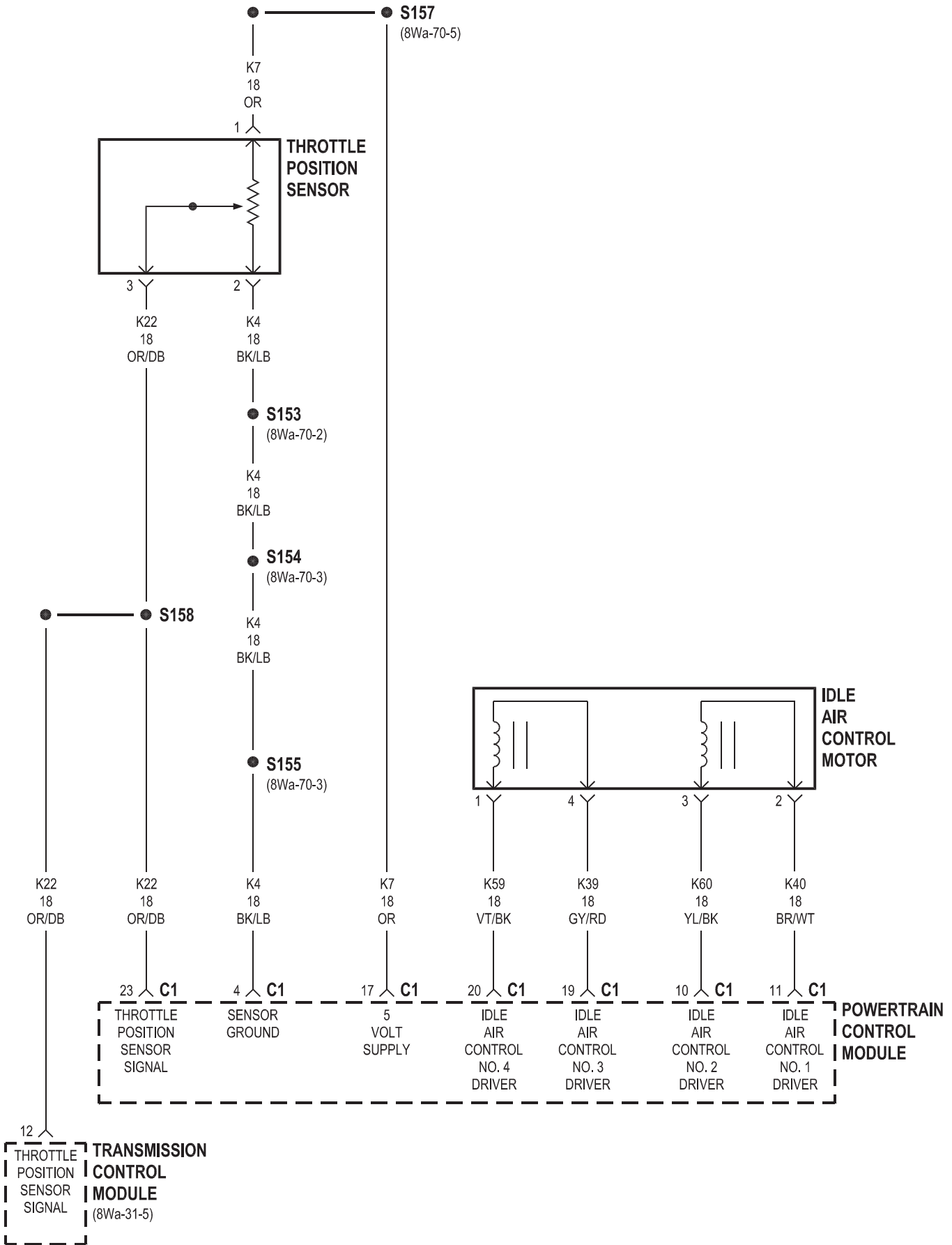


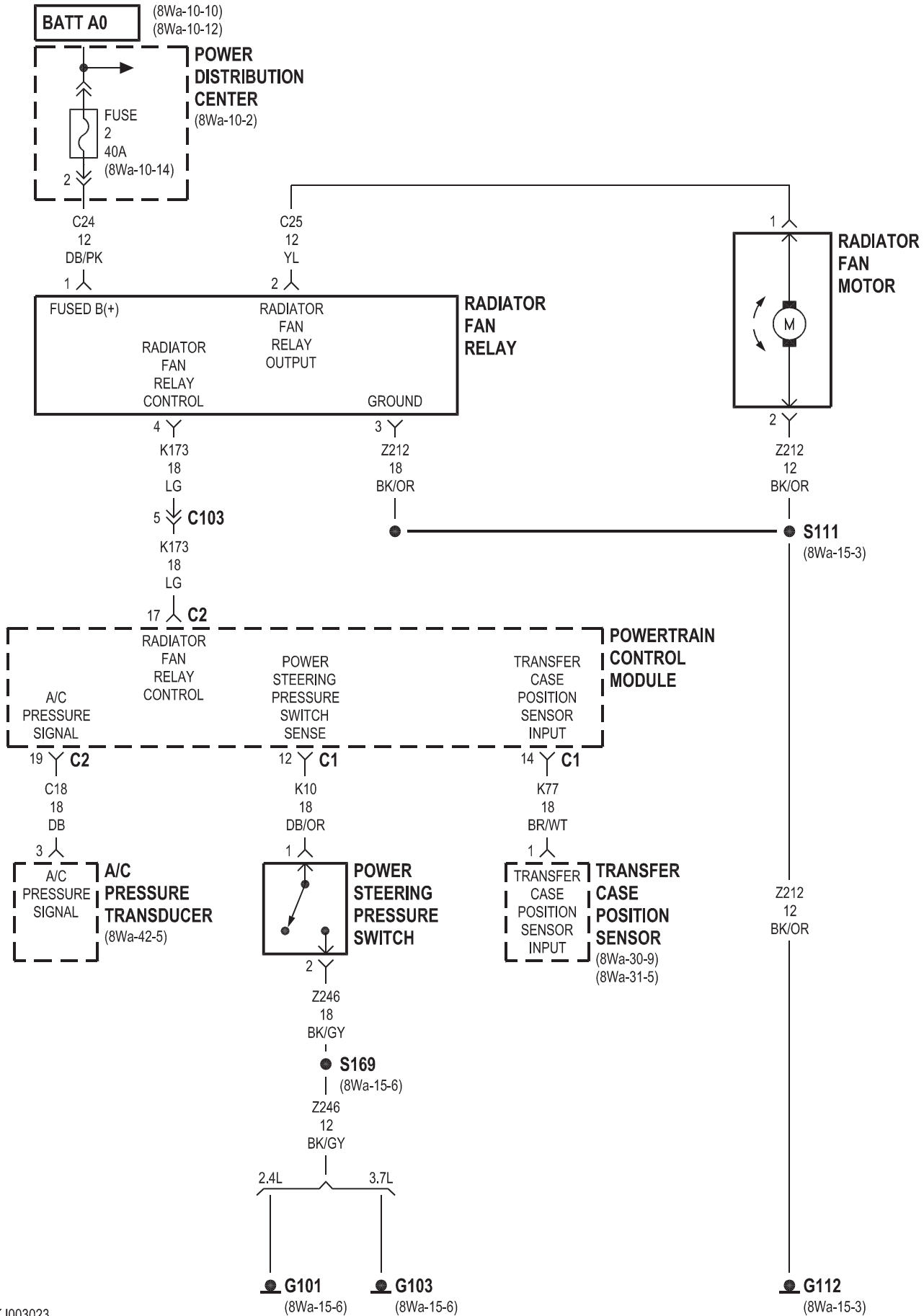


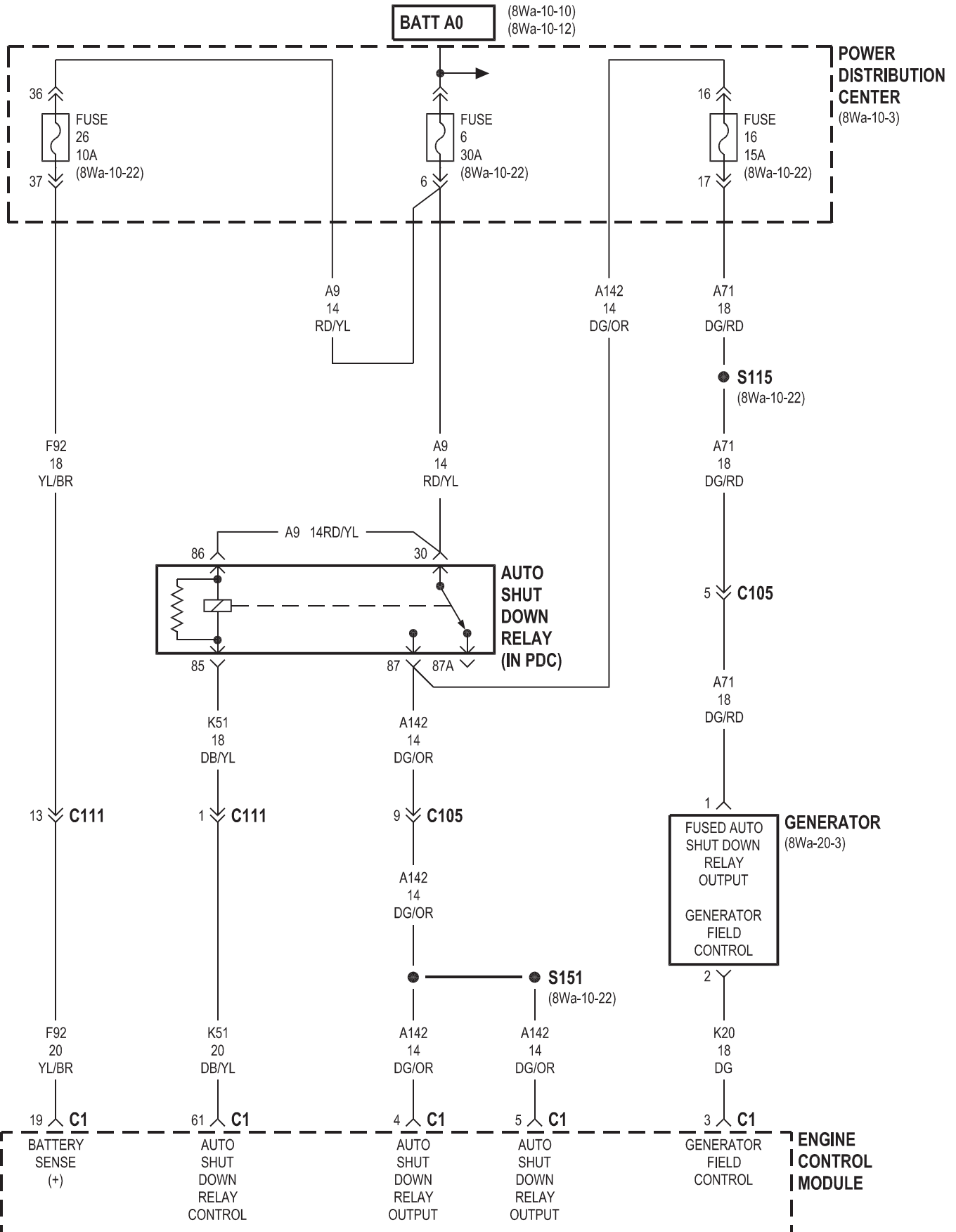


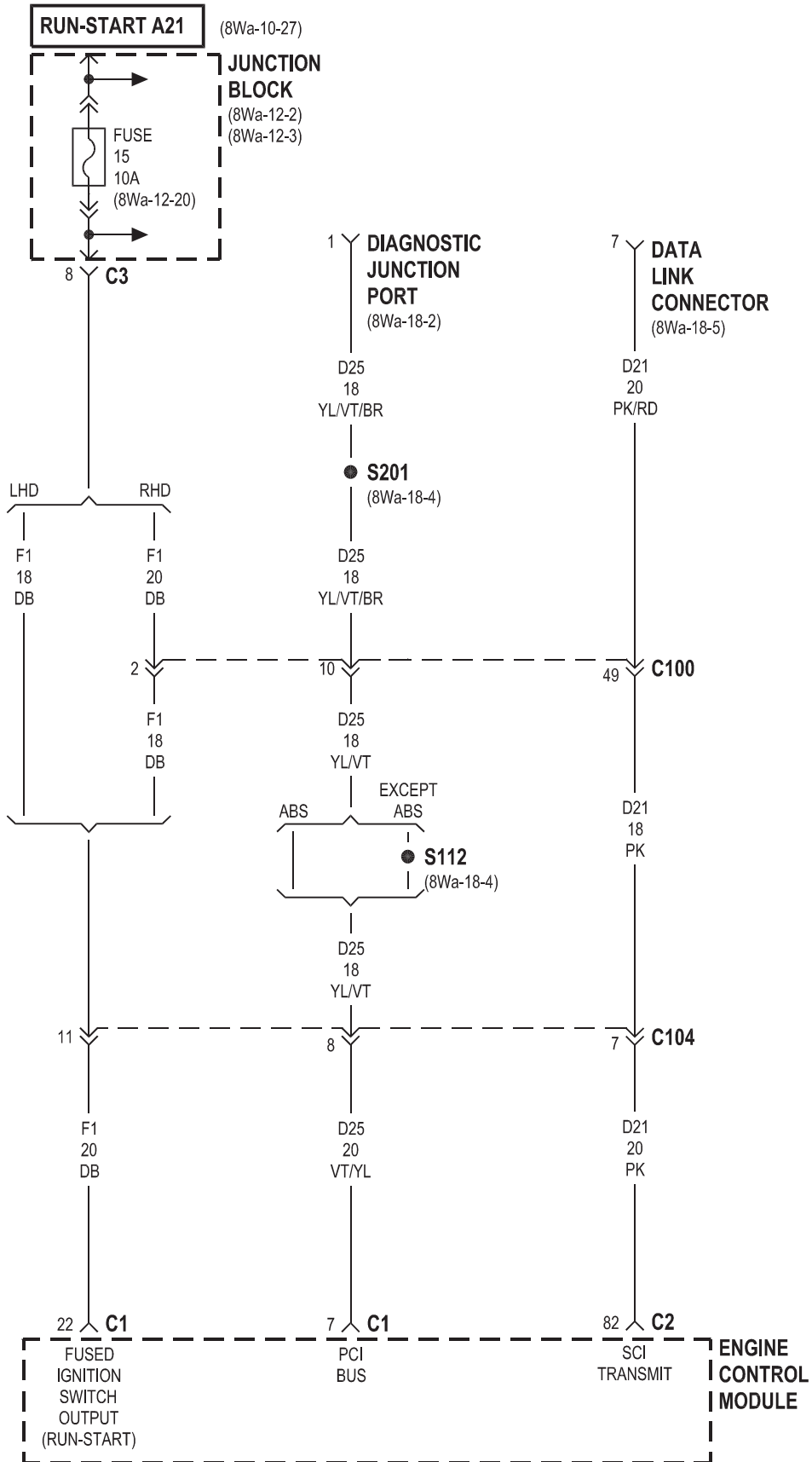


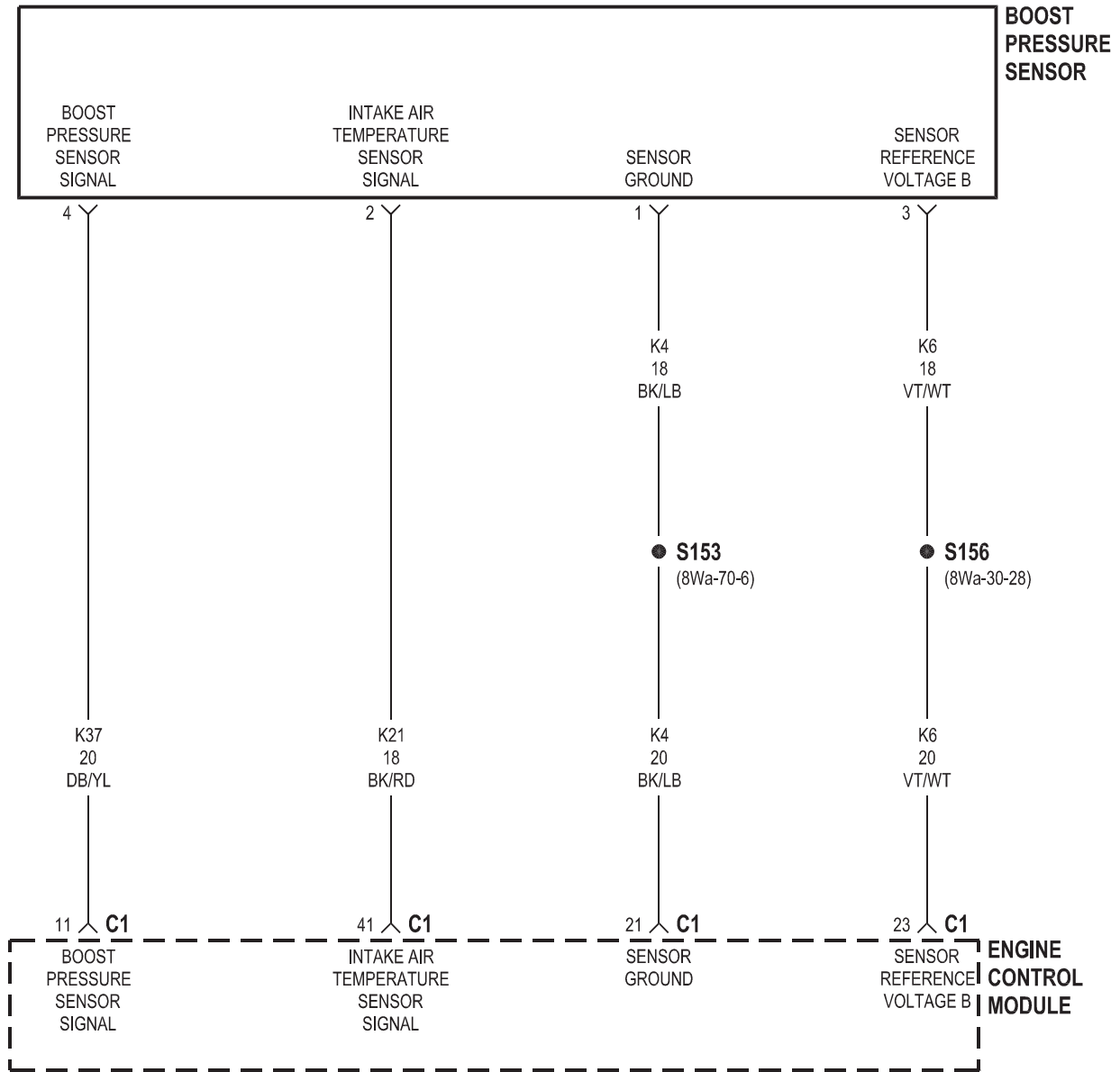


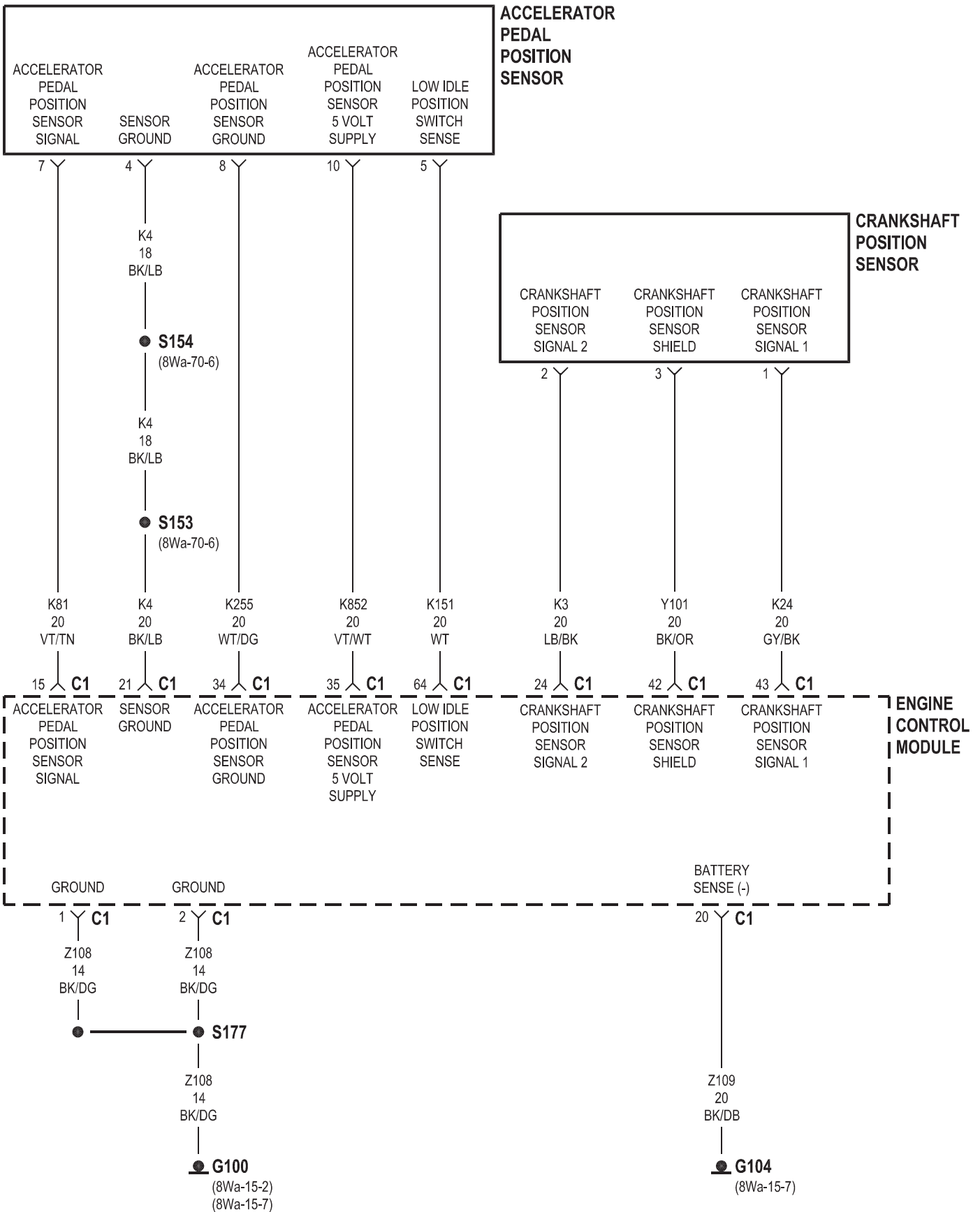




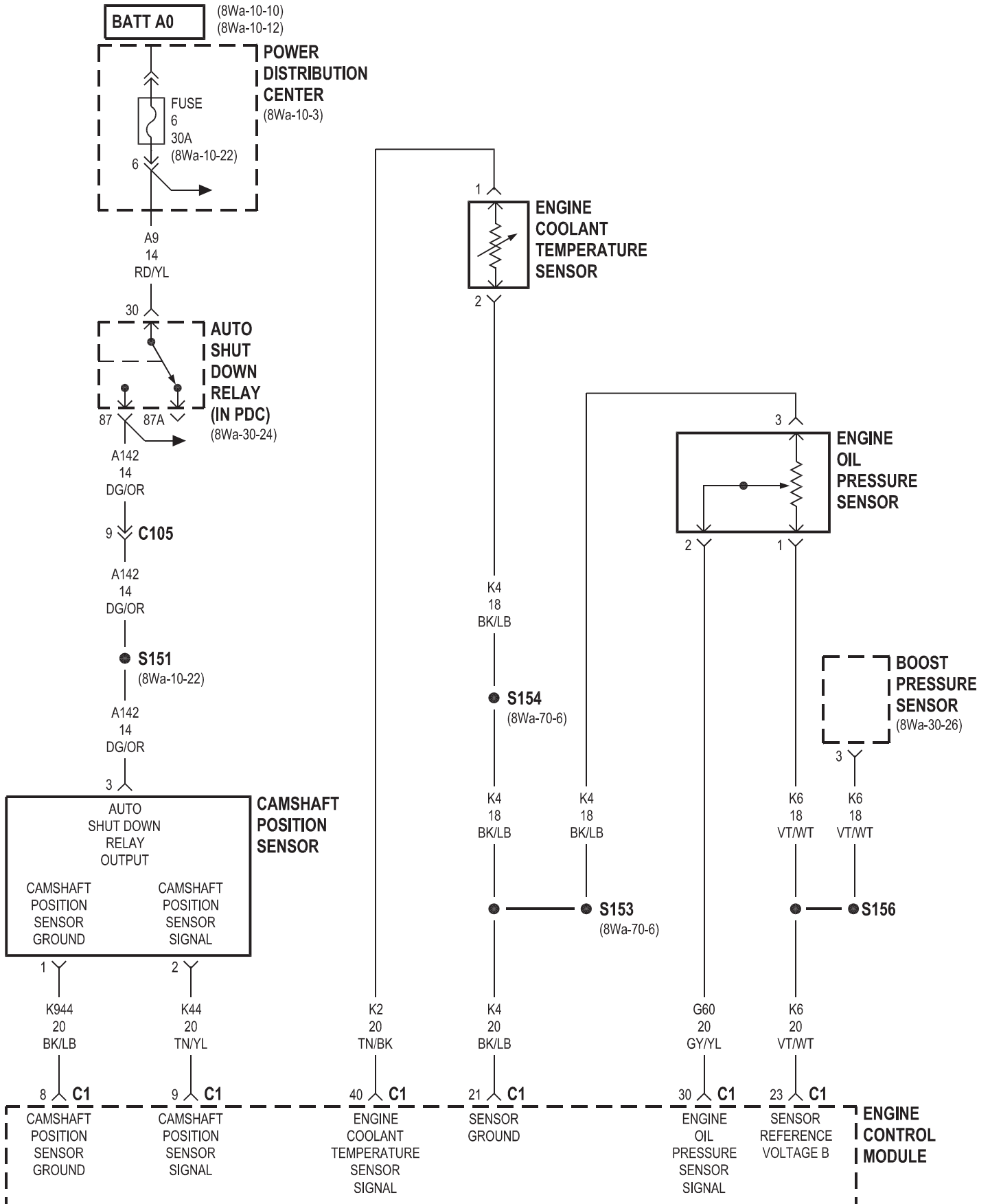


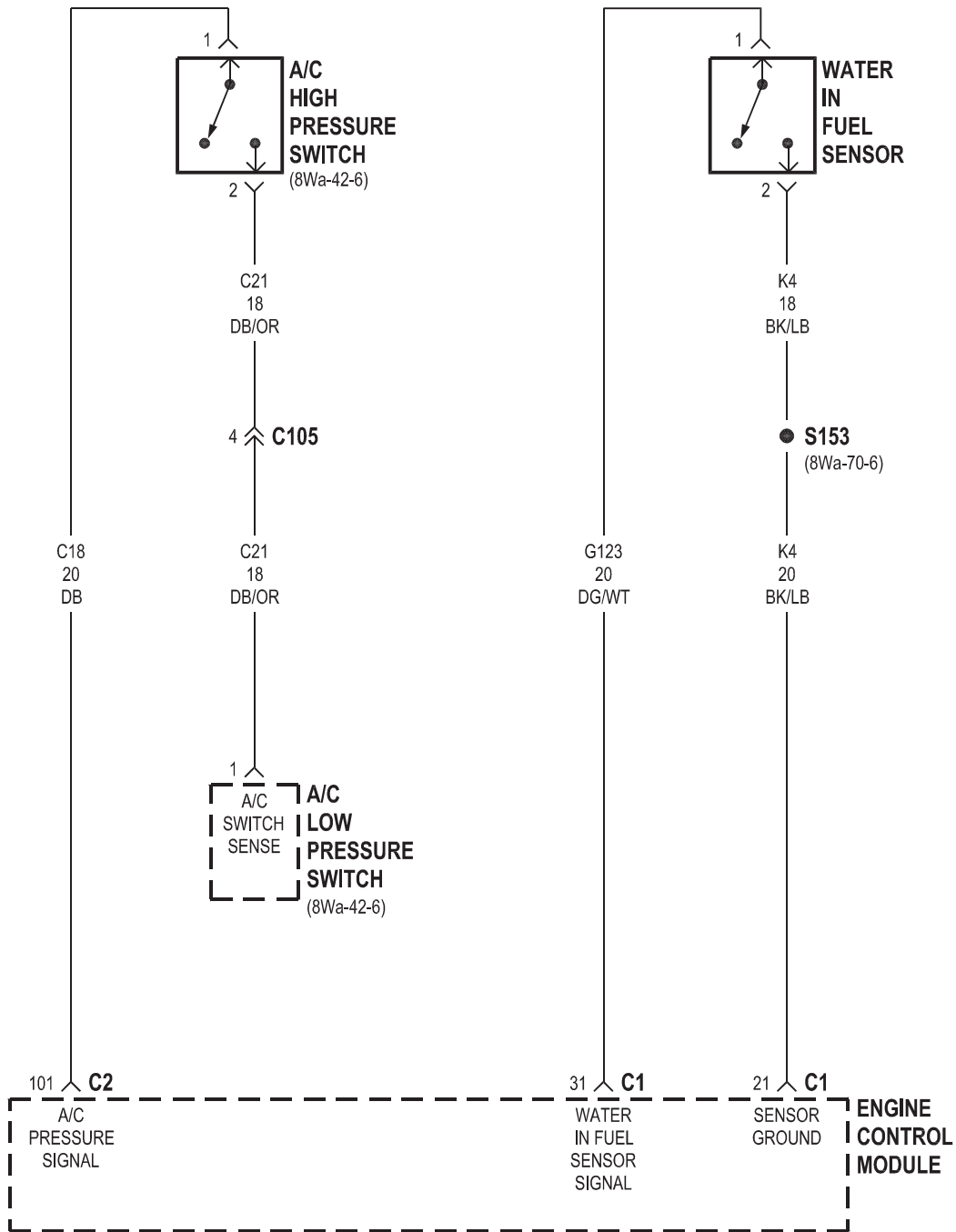


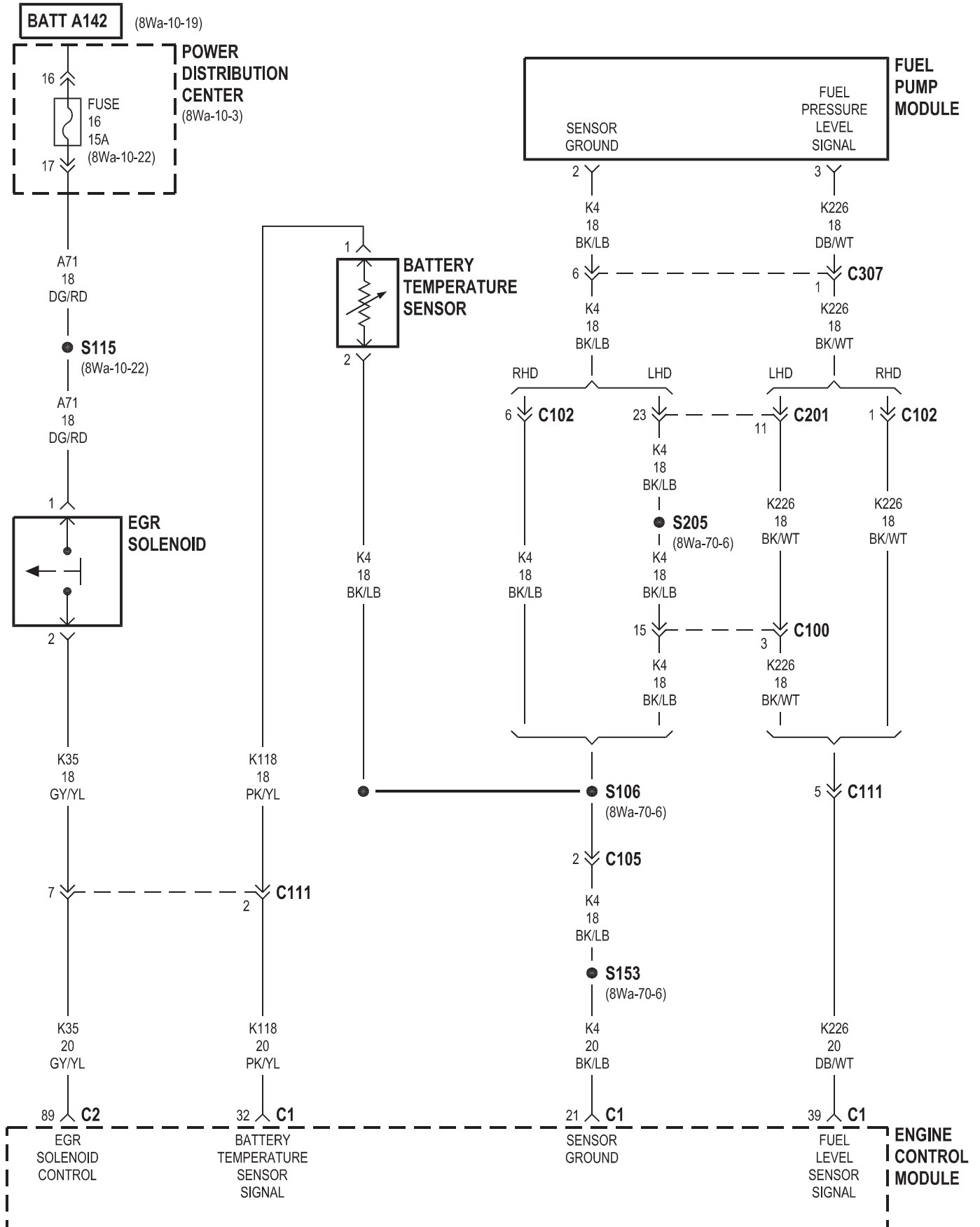


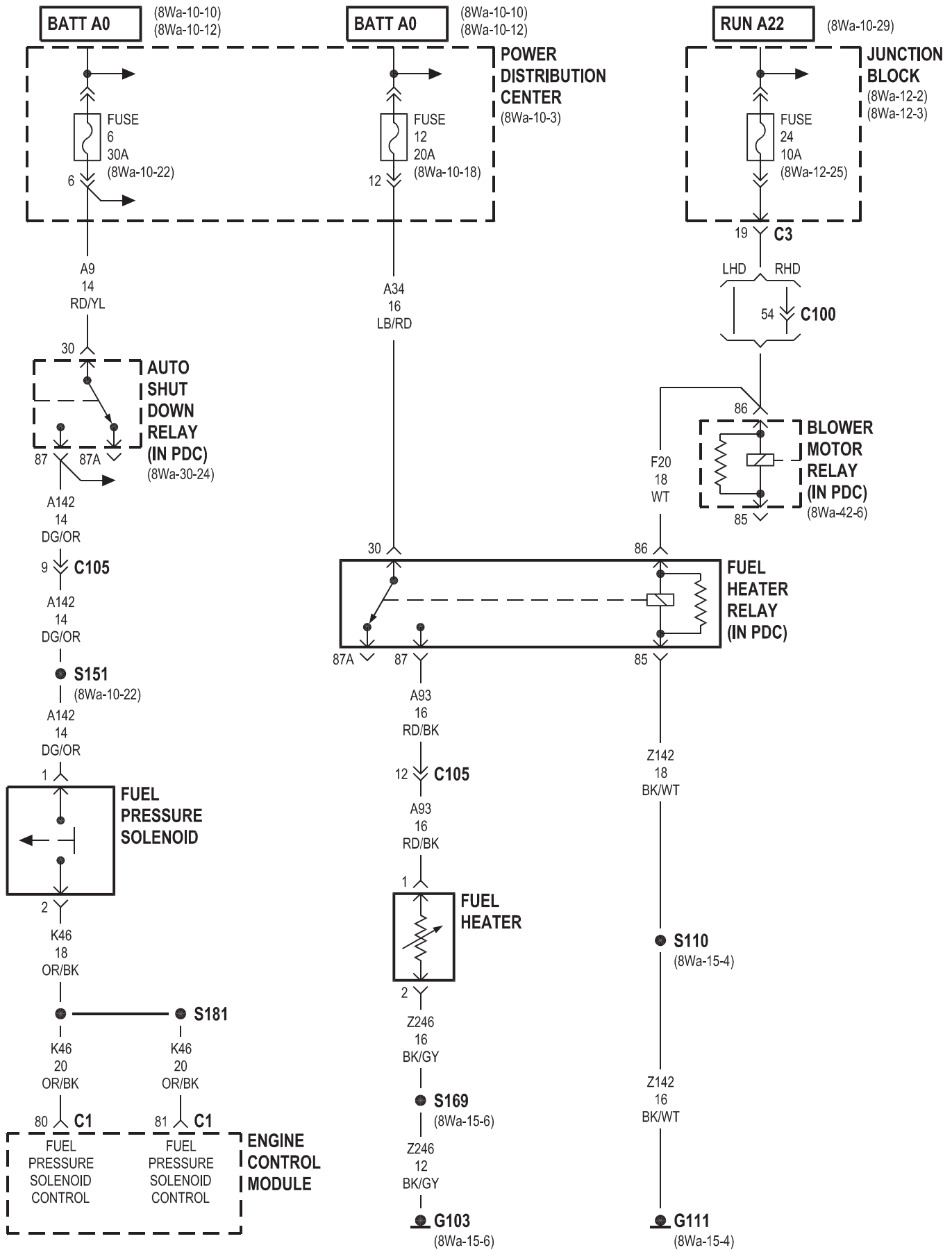


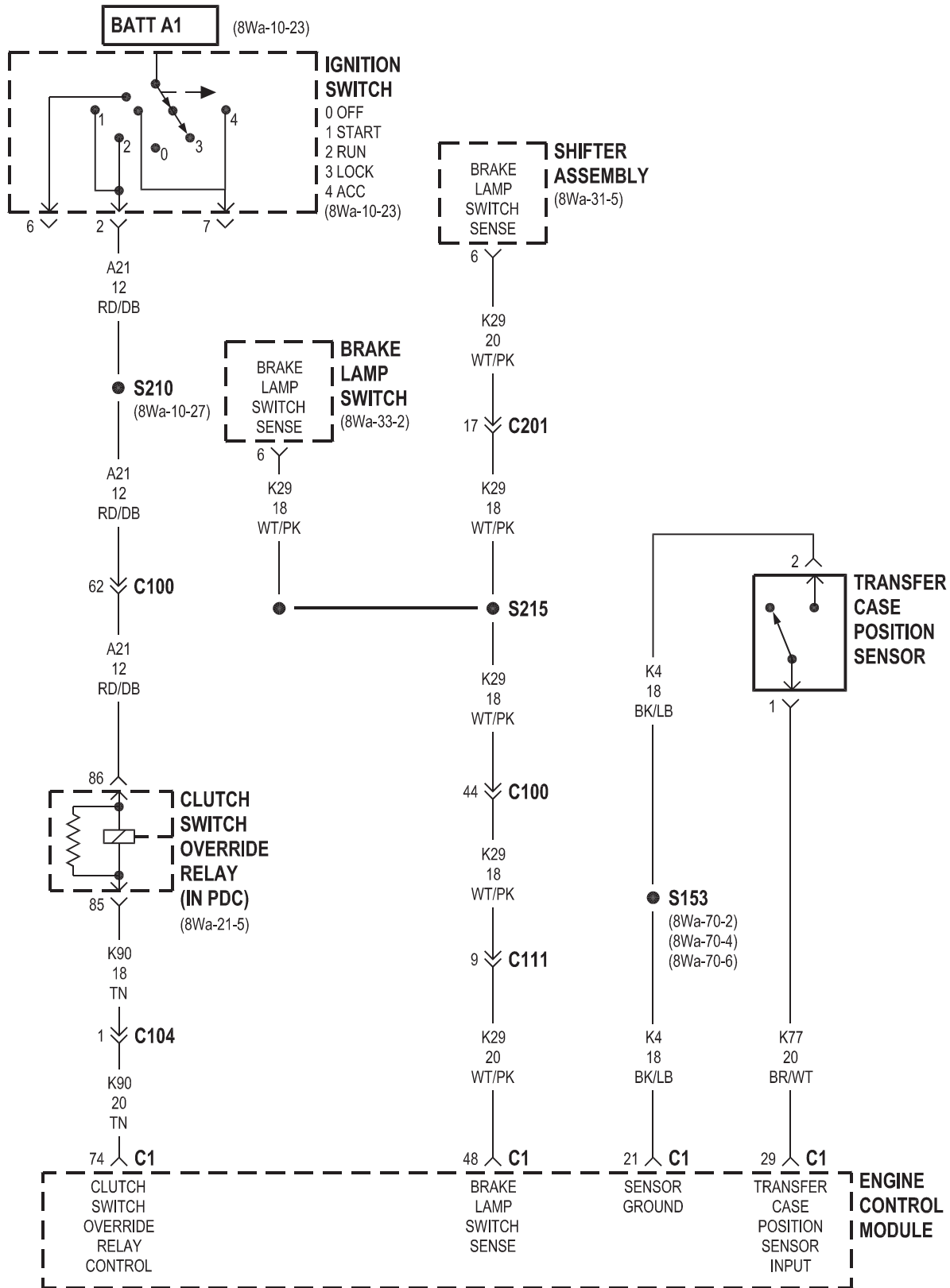


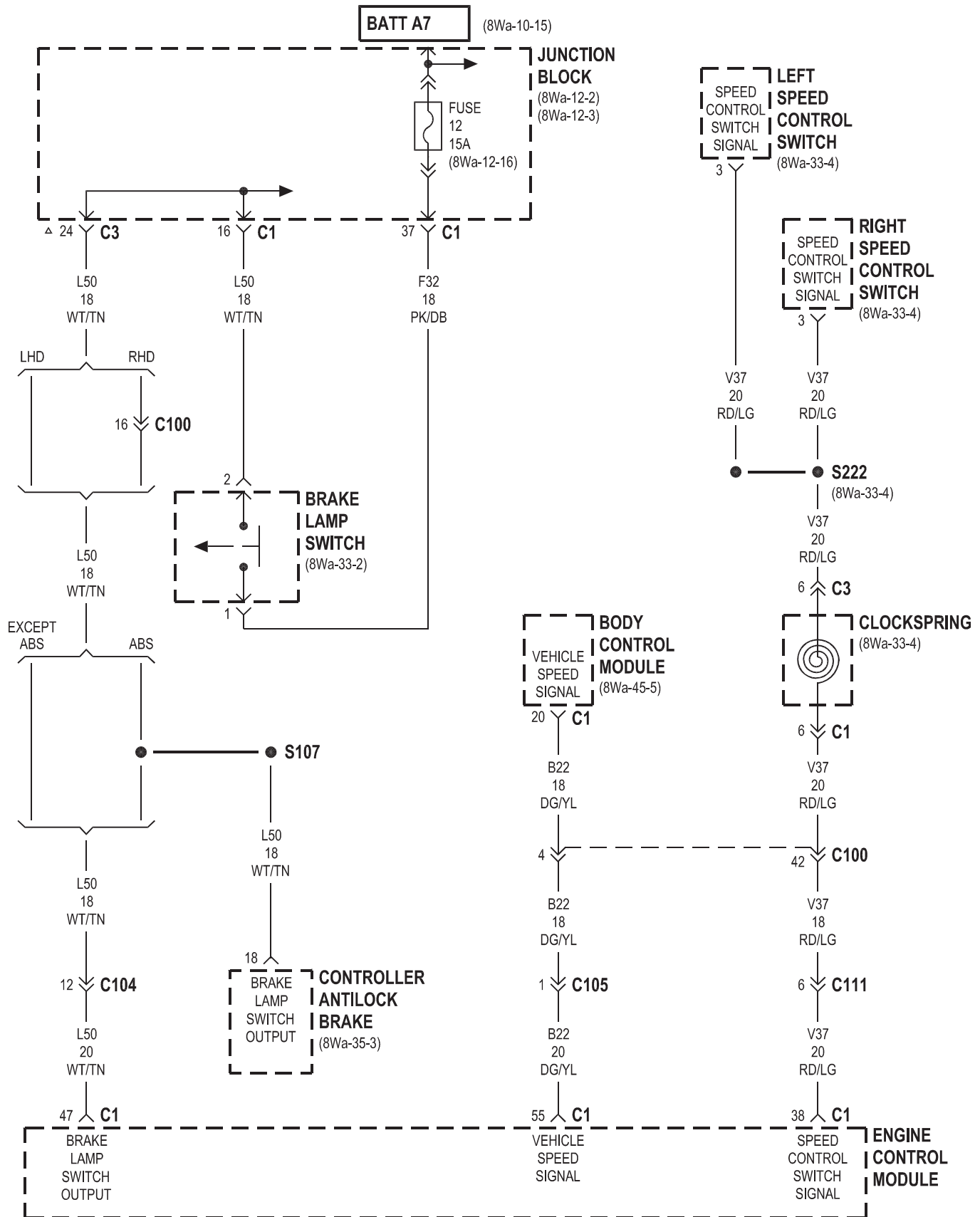




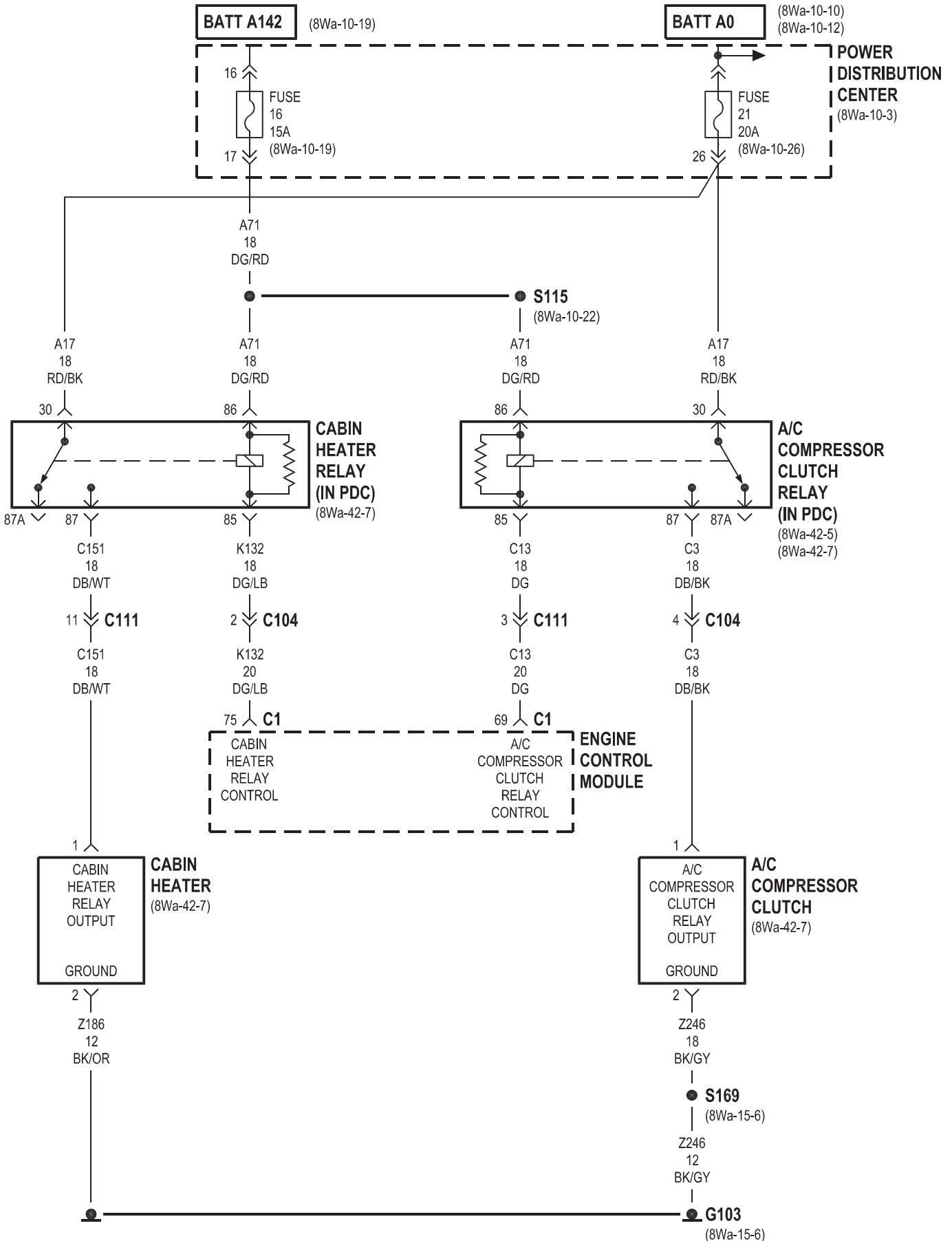


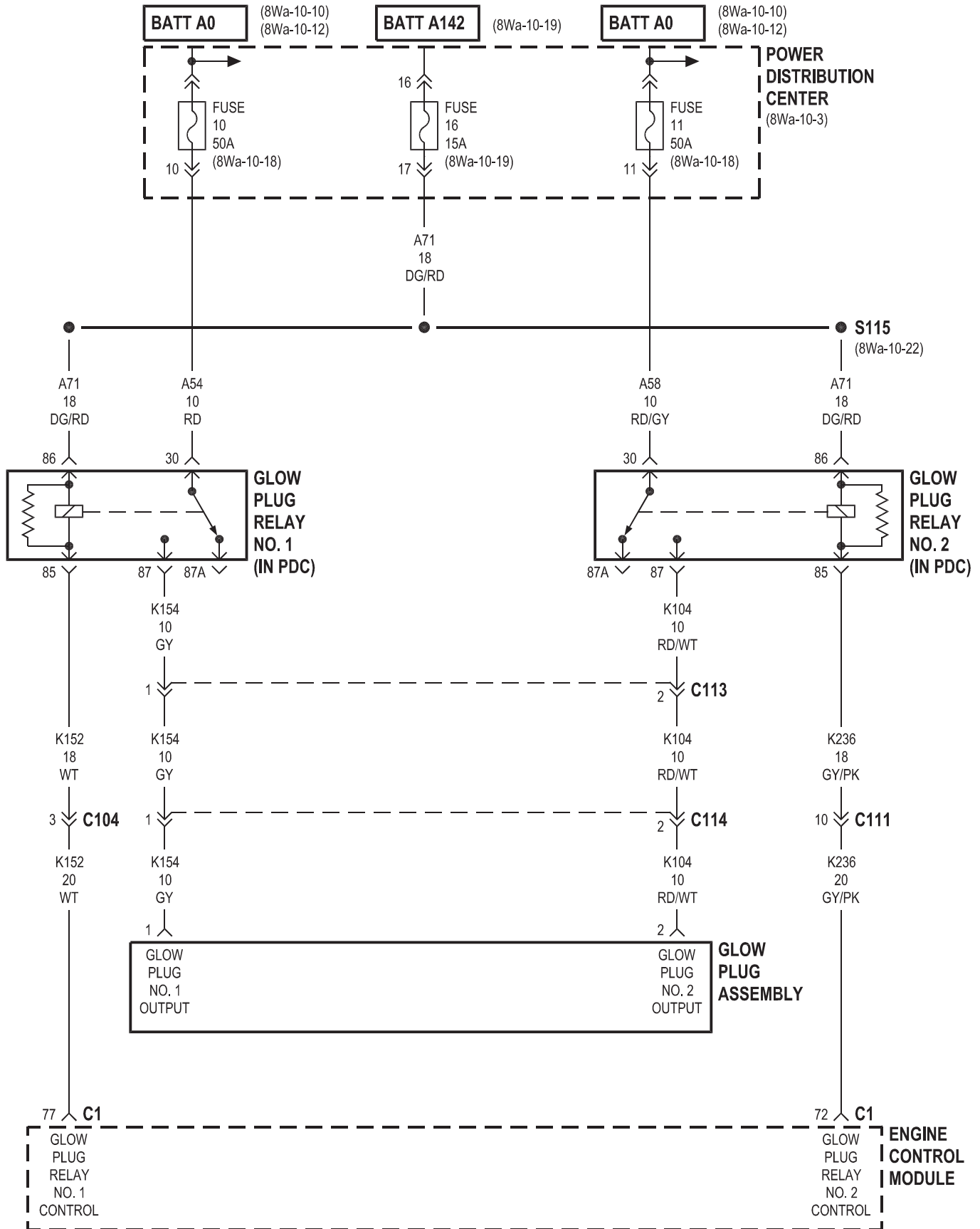




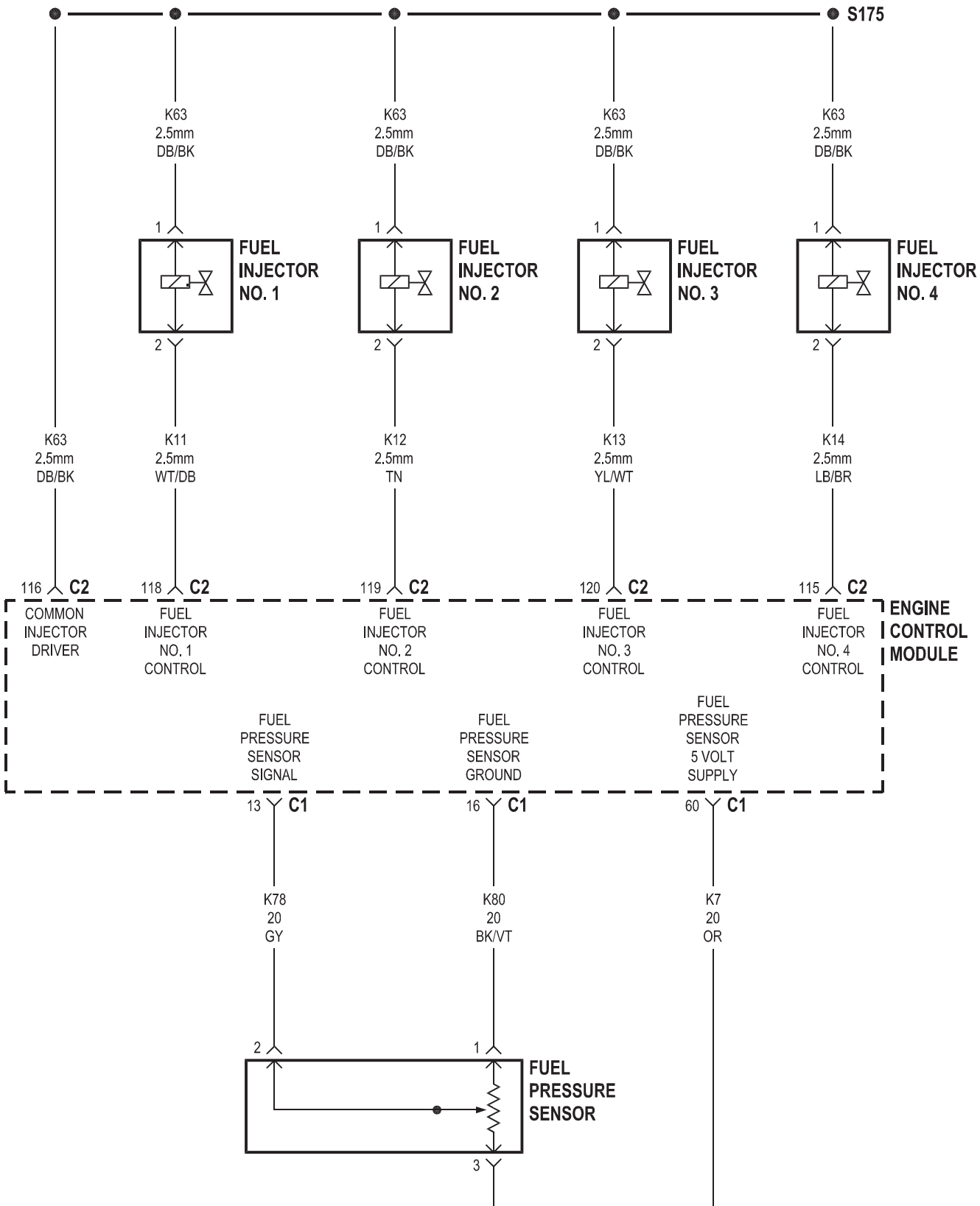


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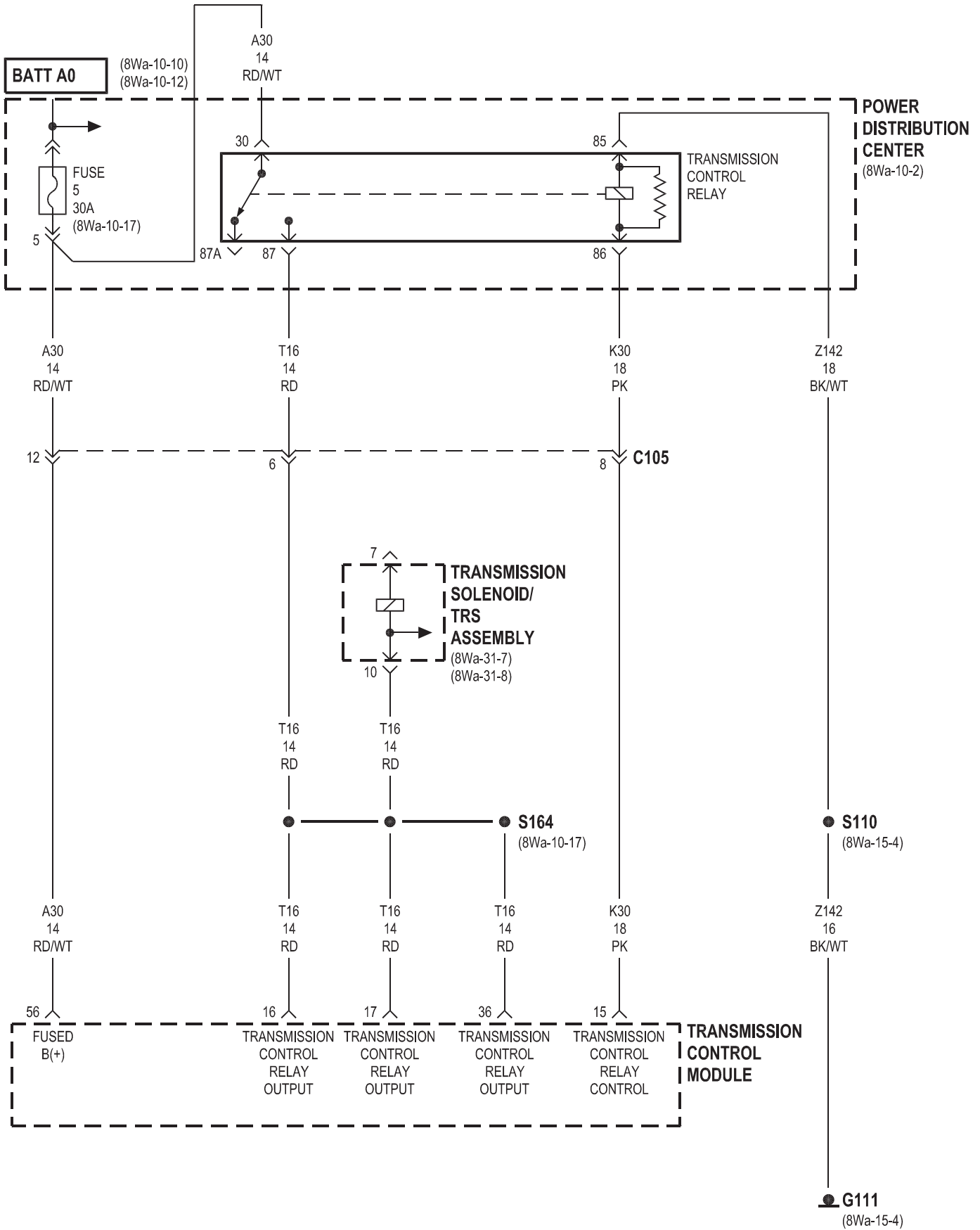


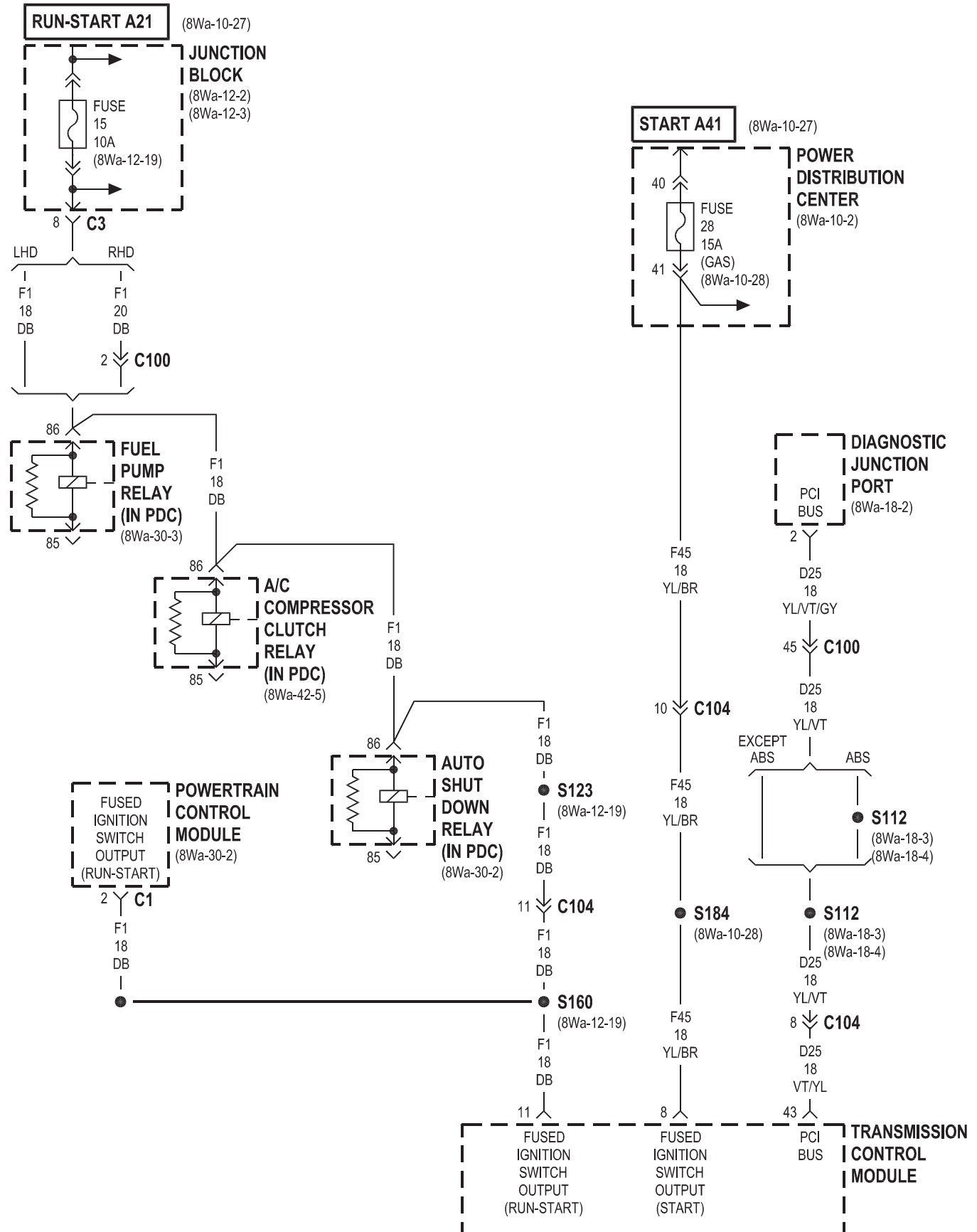


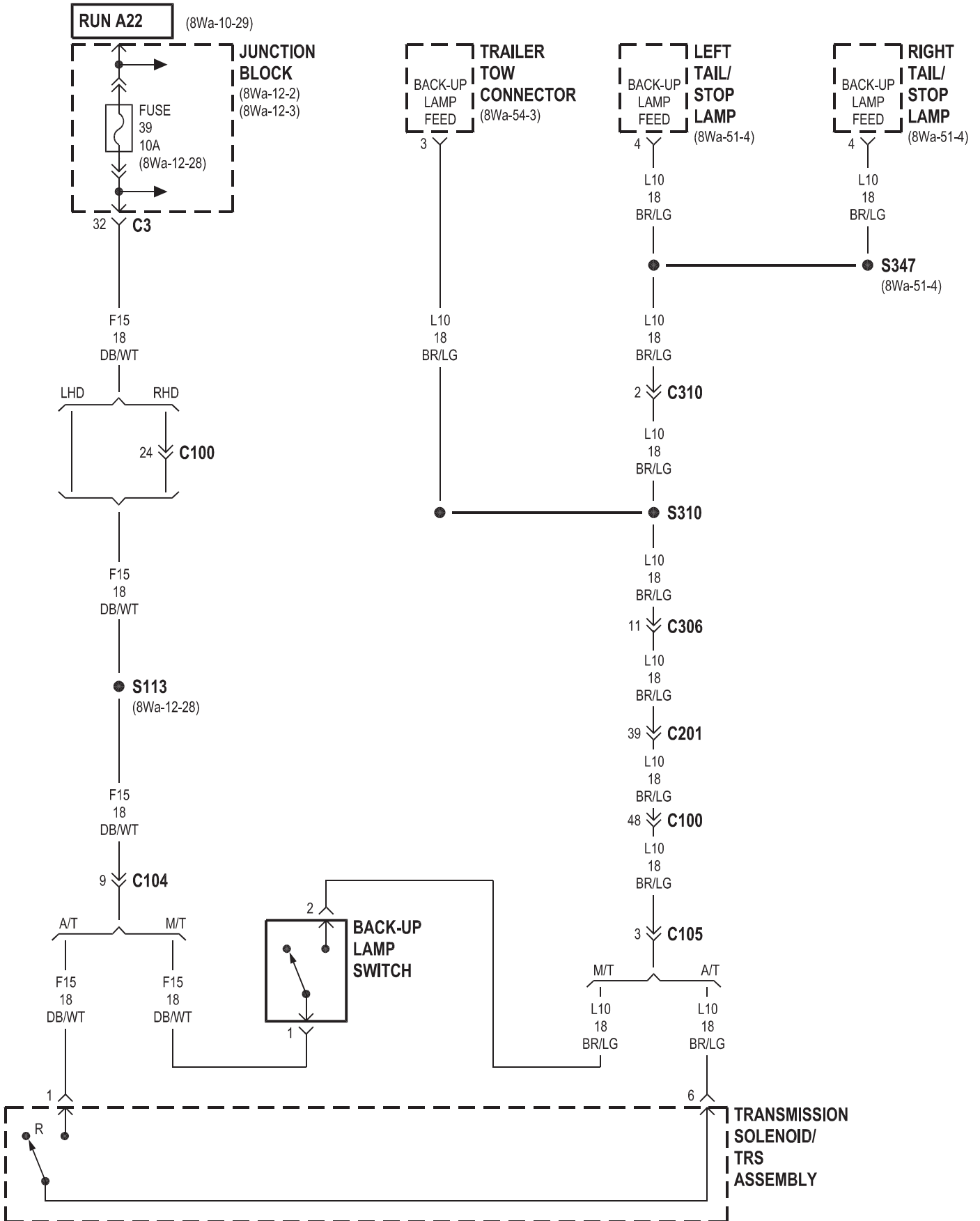


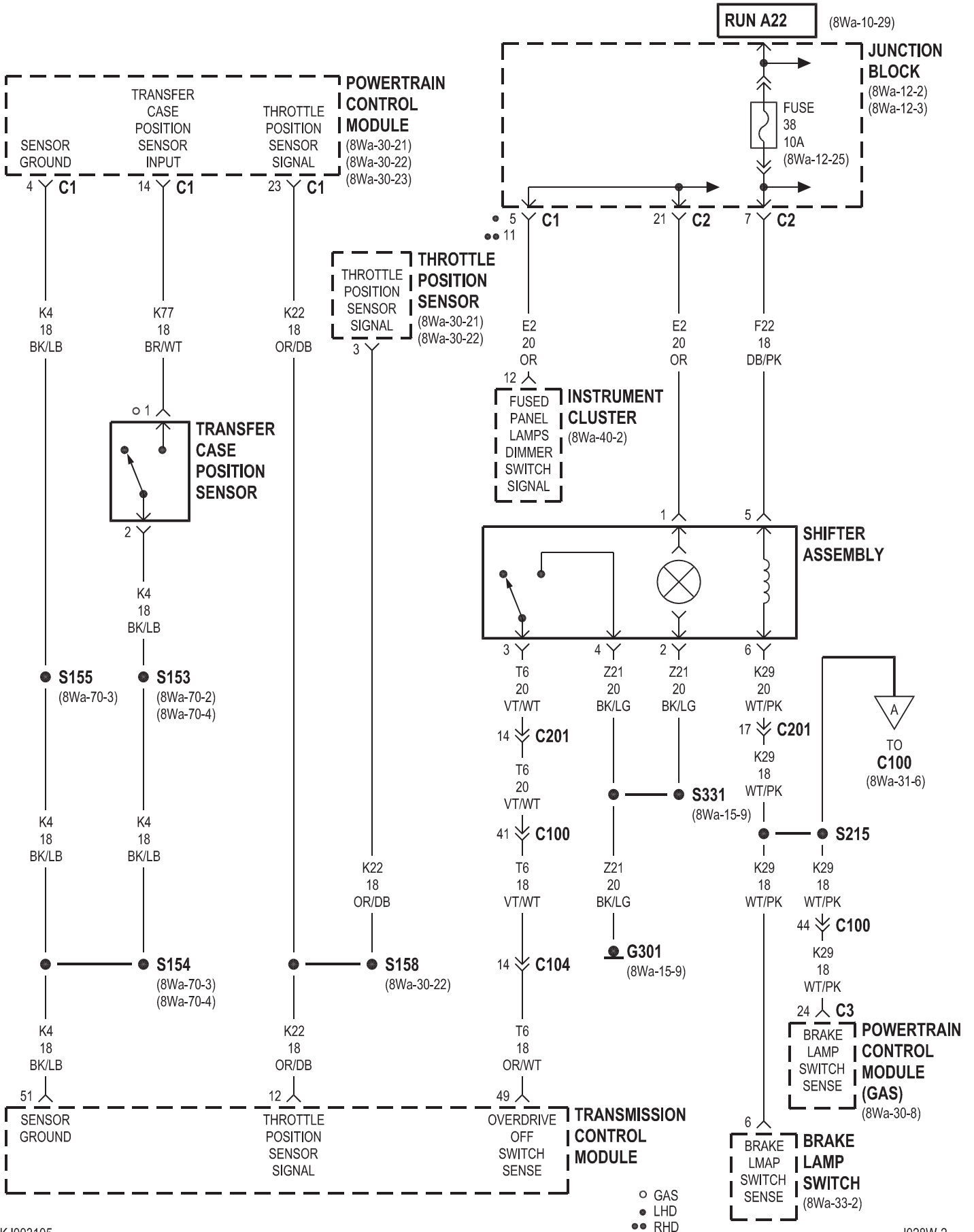
## 8W-31 TRANSMISSION CONTROL SYSTEM

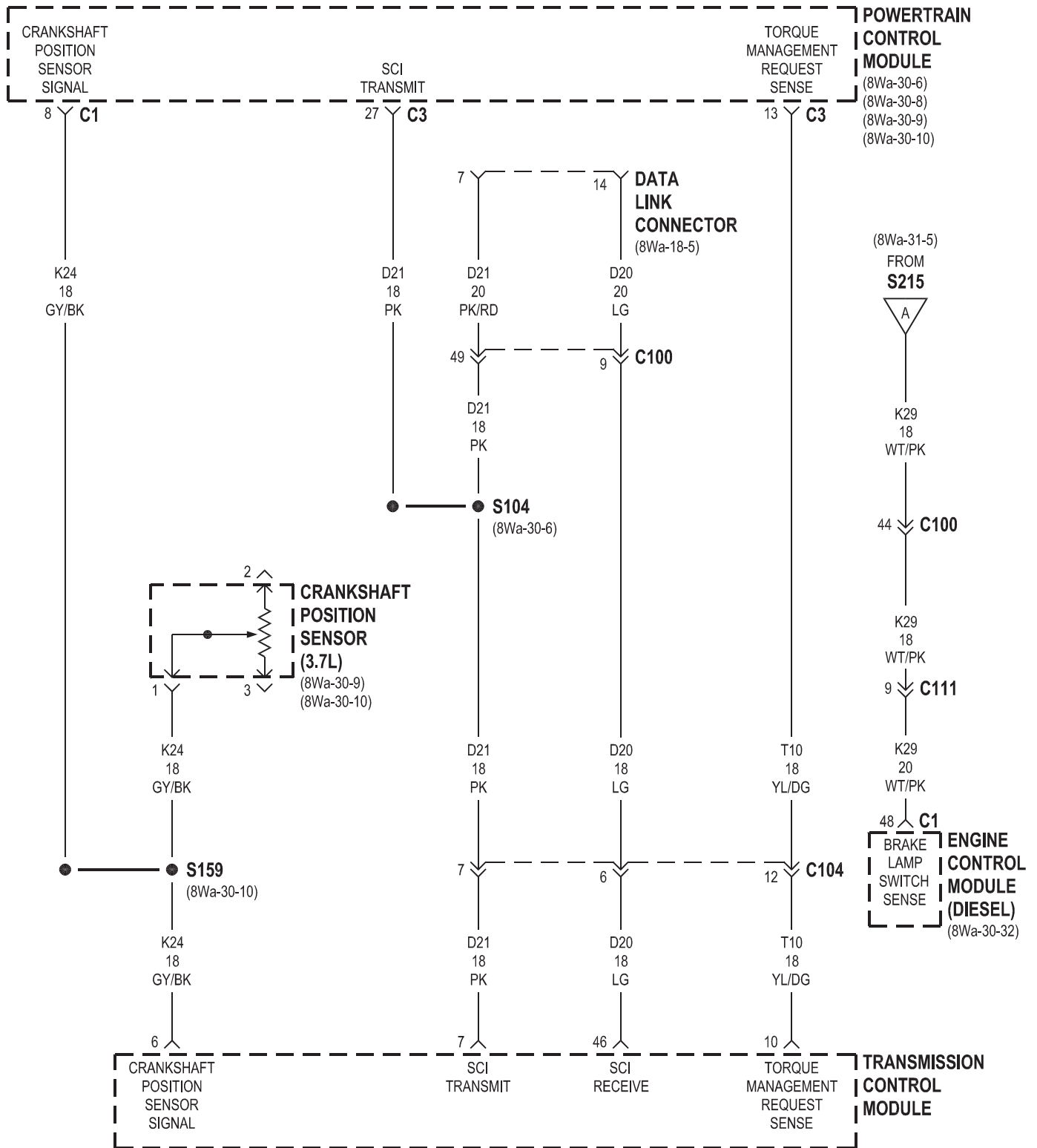
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C Compressor Clutch Relay . . . . .	8Wa-31-3	Instrument Cluster . . . . .	8Wa-31-5
Auto Shut Down Relay . . . . .	8Wa-31-3	Junction Block . . . . .	8Wa-31-3, 4, 5
Back-Up Lamp Switch . . . . .	8Wa-31-4	Left Tail/Stop Lamp . . . . .	8Wa-31-4
Brake Lamp Switch . . . . .	8Wa-31-5	Line Pressure Sensor . . . . .	8Wa-31-9
Crankshaft Position Sensor . . . . .	8Wa-31-6	Output Speed Sensor . . . . .	8Wa-31-9
Data Link Connector . . . . .	8Wa-31-6	Power Distribution Center . . . . .	8Wa-31-2, 3
Diagnostic Junction Port . . . . .	8Wa-31-3	Powertrain Control Module . . . . .	8Wa-31-3, 5, 6
Engine Control Module . . . . .	8Wa-31-6	Right Tail/Stop Lamp . . . . .	8Wa-31-4
Fuel Pump Relay . . . . .	8Wa-31-3	Shifter Assembly . . . . .	8Wa-31-5
Fuse 5 . . . . .	8Wa-31-2	Starter Motor Relay . . . . .	8Wa-31-8
Fuse 15 . . . . .	8Wa-31-3	Throttle Position Sensor . . . . .	8Wa-31-5
Fuse 28 . . . . .	8Wa-31-3	Trailer Tow Connector . . . . .	8Wa-31-4
Fuse 38 . . . . .	8Wa-31-5	Transfer Case Position Sensor . . . . .	8Wa-31-5
Fuse 39 . . . . .	8Wa-31-4	Transmission Control Module . . . . .	8Wa-31-2, 3, 5, 6, 7, 8, 9
G102 . . . . .	8Wa-31-7, 9	Transmission Control Relay . . . . .	8Wa-31-2, 7, 8
G111 . . . . .	8Wa-31-2	Transmission Solenoid/Trs Assembly . . . . .	8Wa-31-2, 4, 7, 8, 9
G301 . . . . .	8Wa-31-5		
Input Speed Sensor . . . . .	8Wa-31-9		

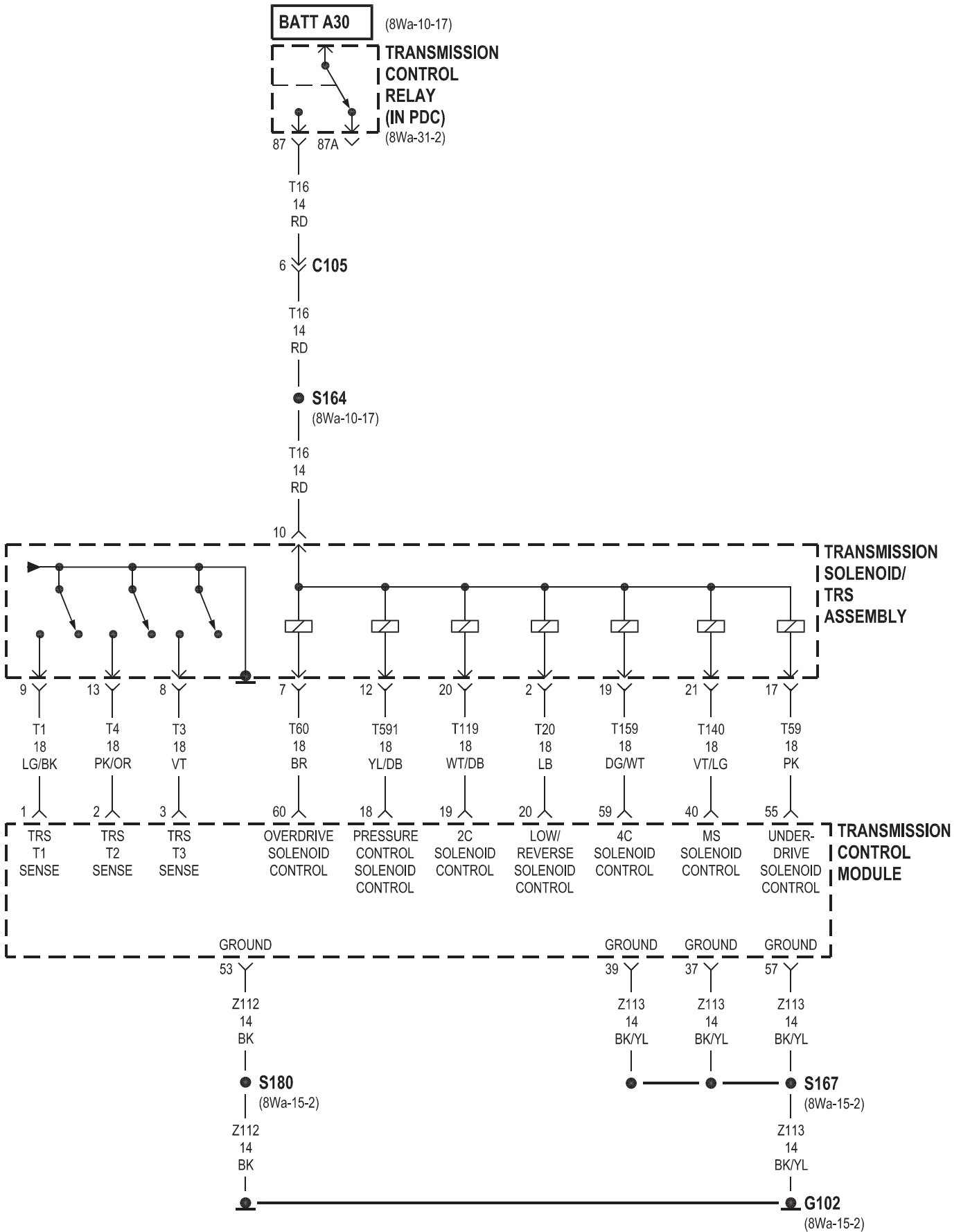




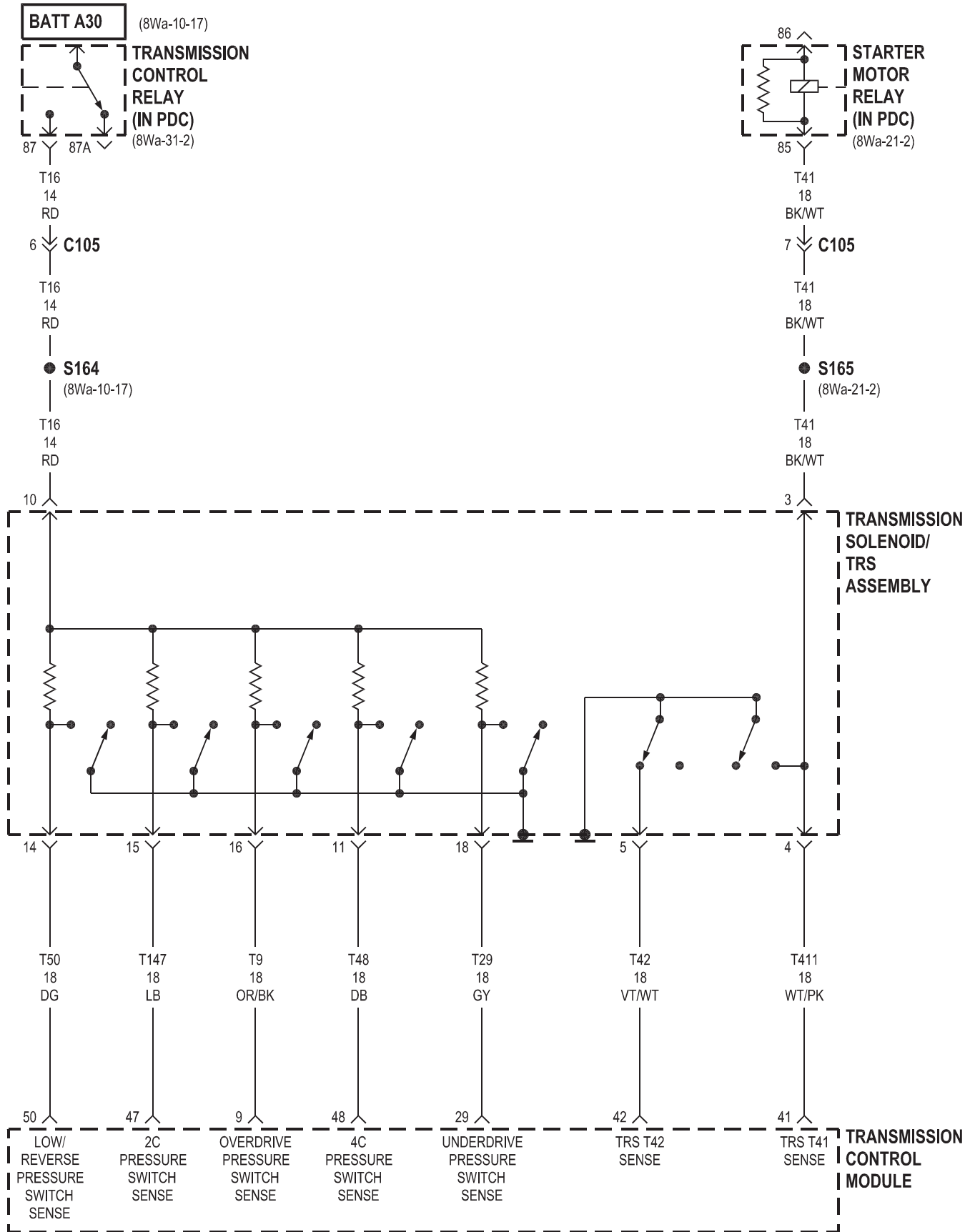


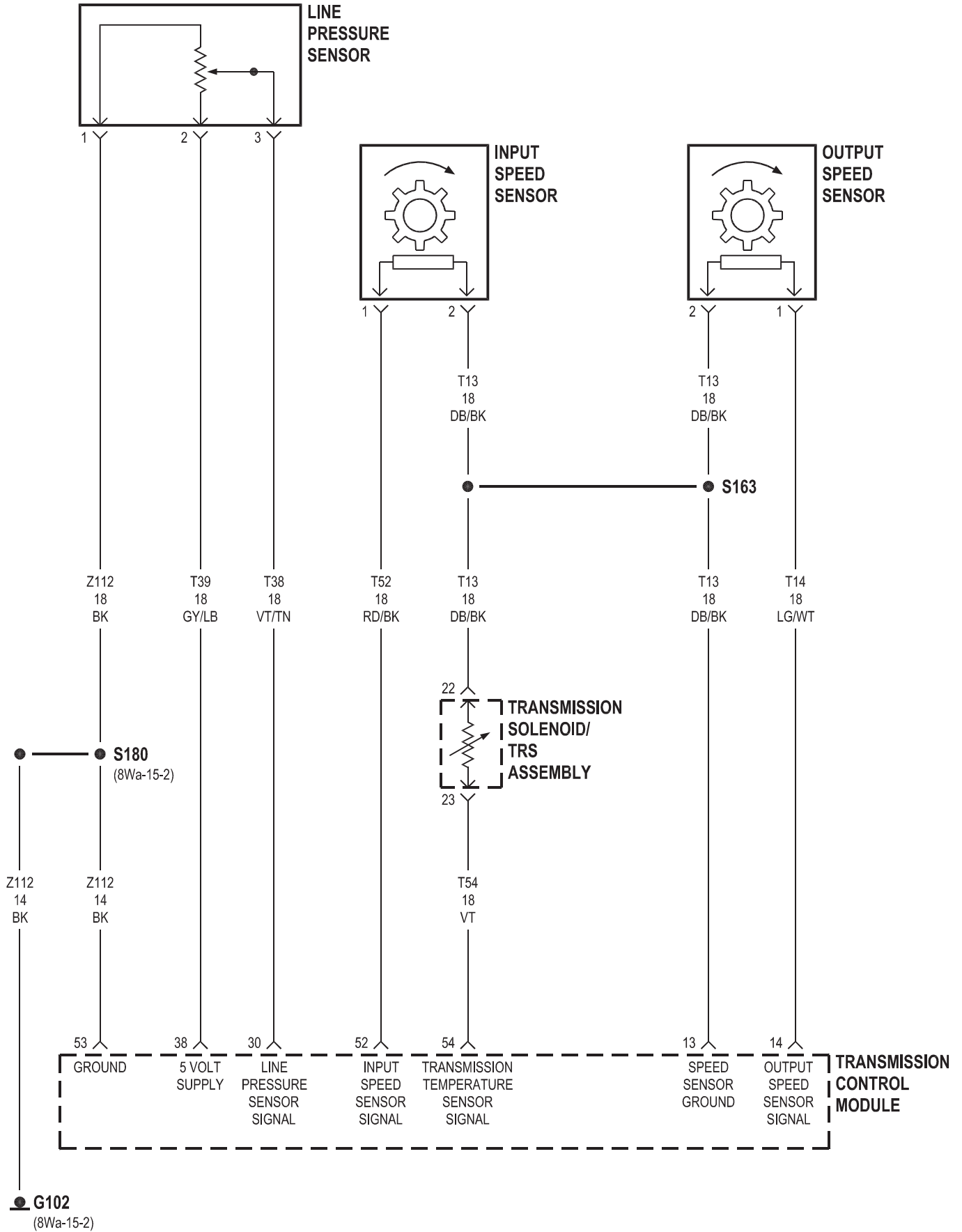








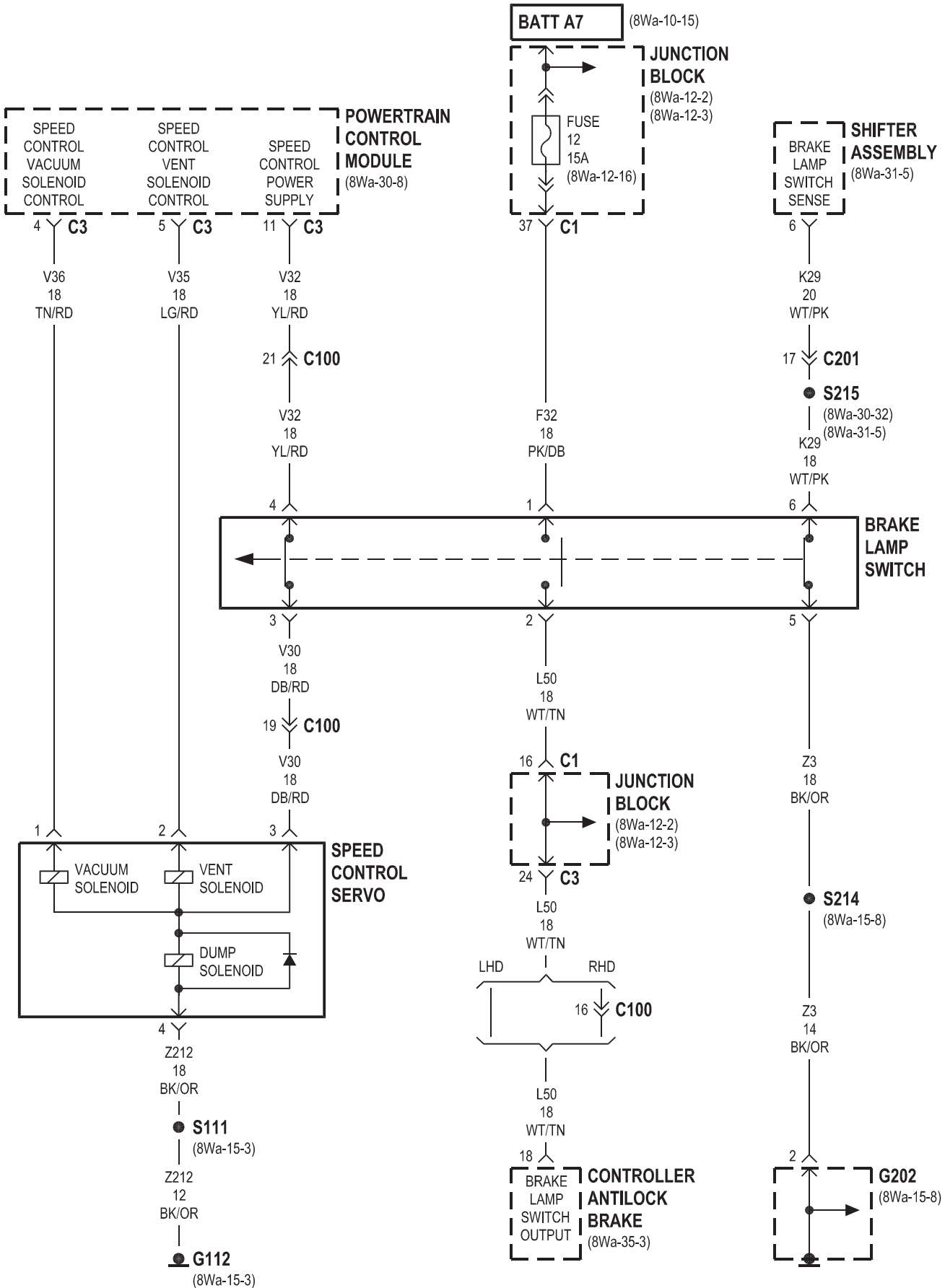


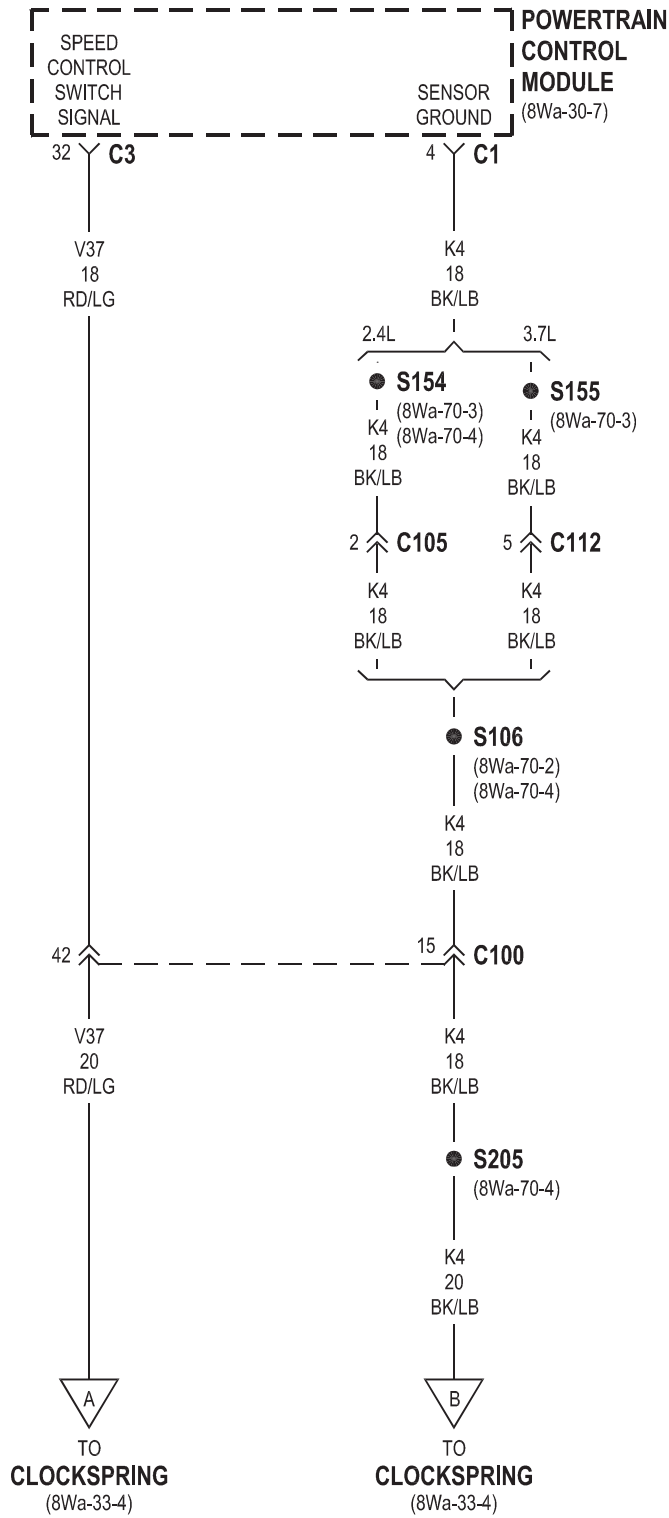


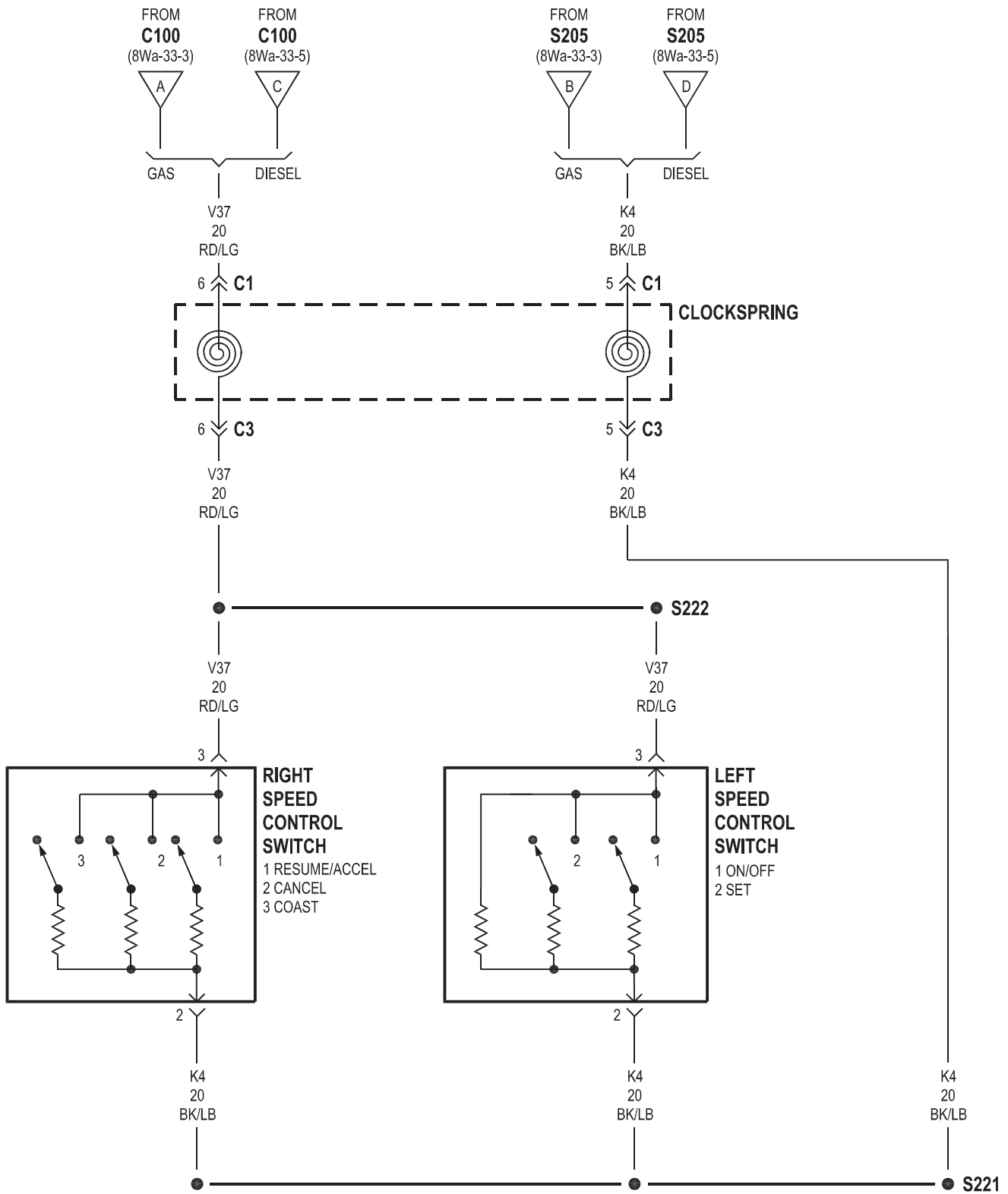


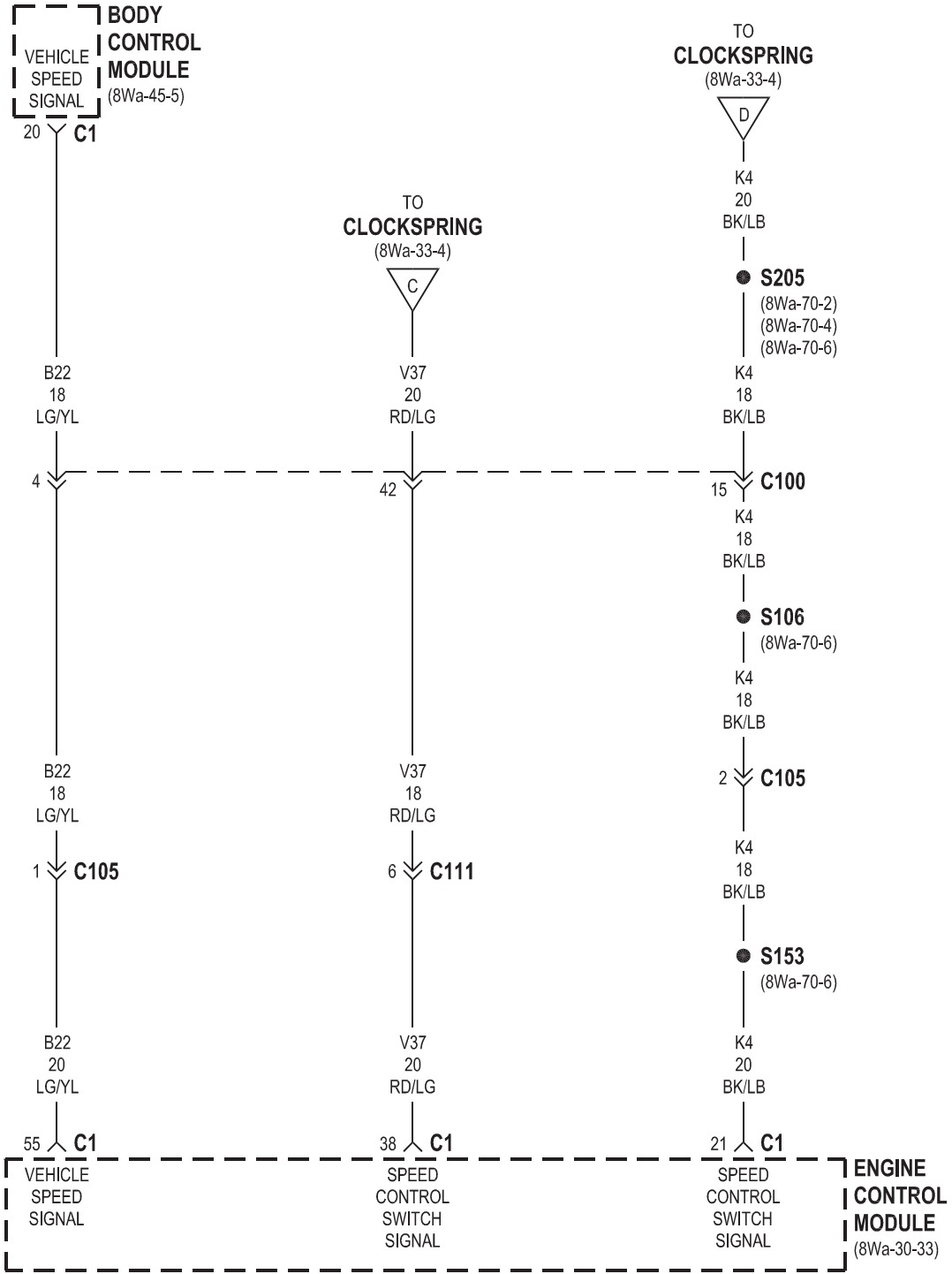
## 8W-33 VEHICLE SPEED CONTROL

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module .....	8Wa-33-5	G202 .....	8Wa-33-2
Brake Lamp Switch .....	8Wa-33-2	Junction Block .....	8Wa-33-2
Clockspring .....	8Wa-33-3, 4, 5	Left Speed Control Switch.....	8Wa-33-4
Controller Antilock Brake .....	8Wa-33-2	Powertrain Control Module .....	8Wa-33-2, 3
Engine Control Module .....	8Wa-33-5	Right Speed Control Switch .....	8Wa-33-4
Fuse 12 .....	8Wa-33-2	Shifter Assembly .....	8Wa-33-2
G112 .....	8Wa-33-2	Speed Control Servo .....	8Wa-33-2







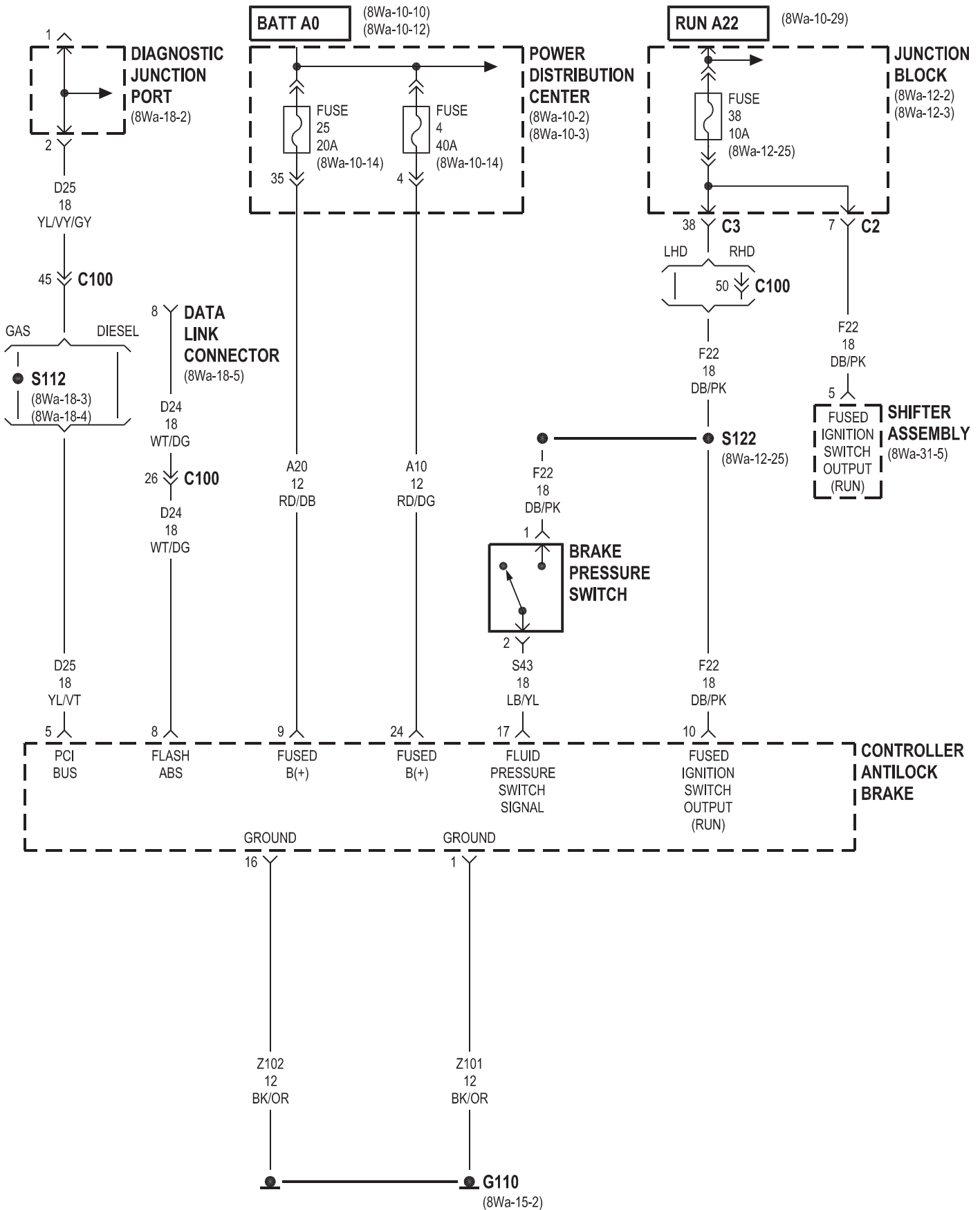


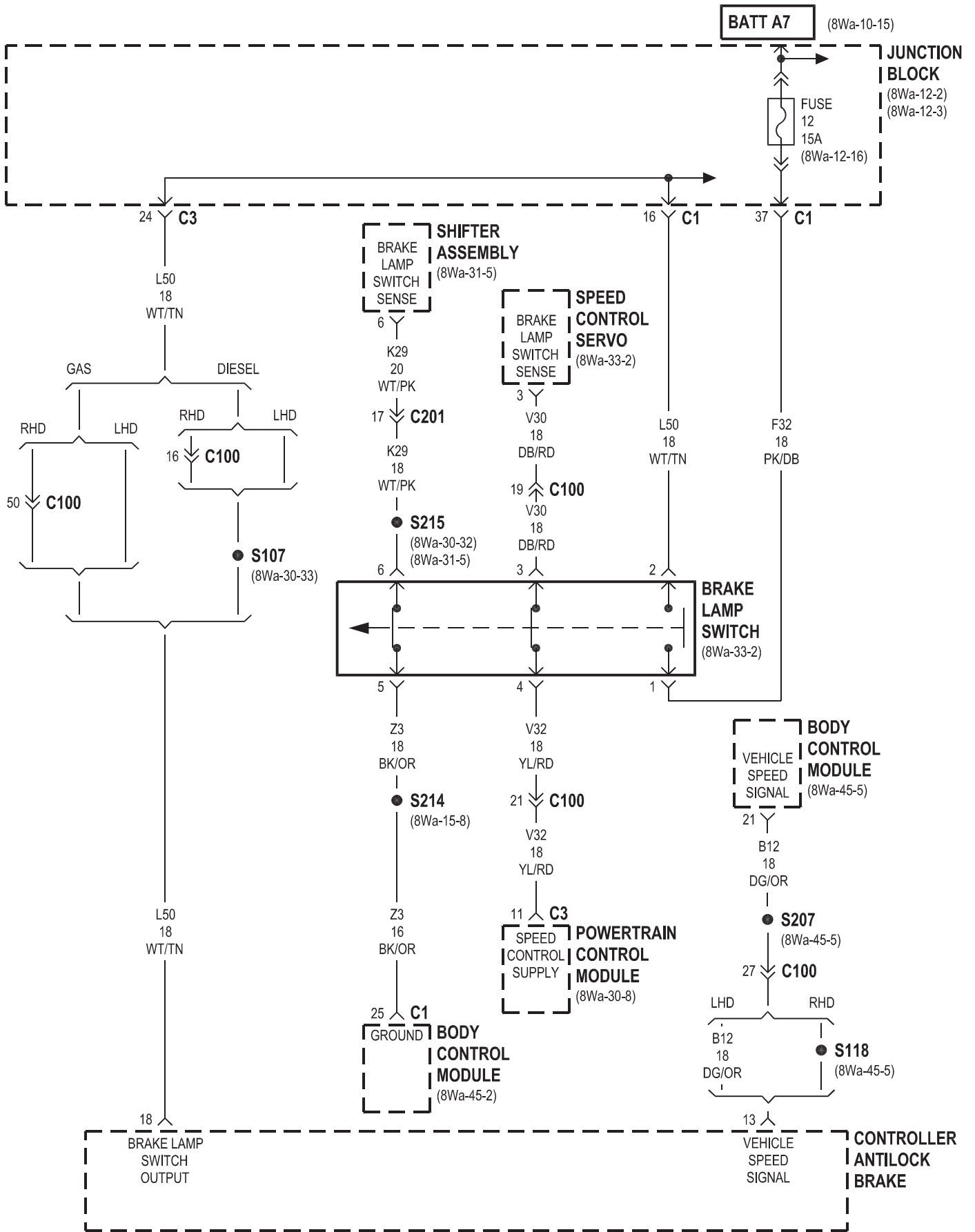


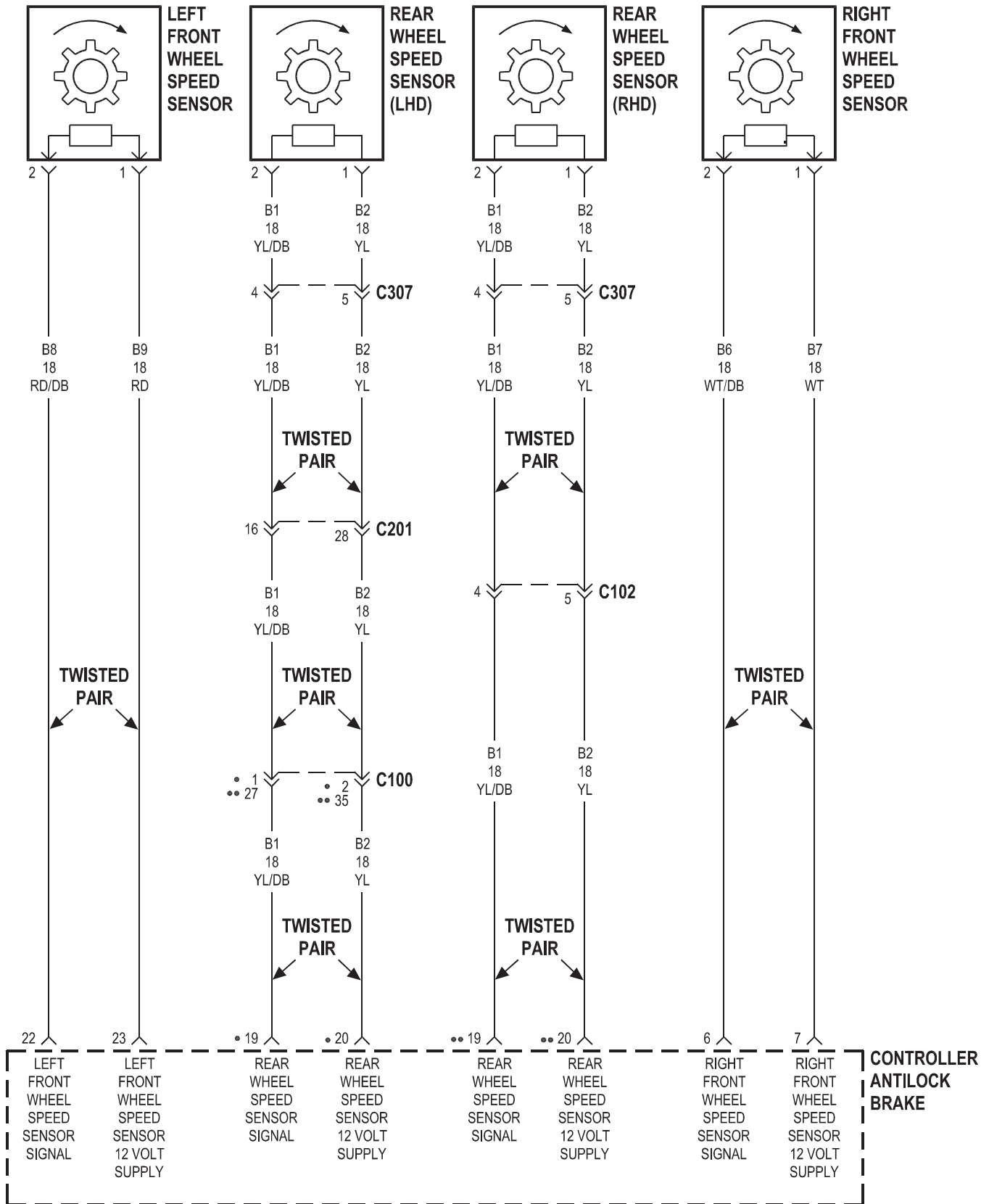


## 8W-35 ANTILOCK BRAKES

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module . . . . .	8Wa-35-3	G110 . . . . .	8Wa-35-2
Brake Lamp Switch . . . . .	8Wa-35-3	Junction Block . . . . .	8Wa-35-2, 3
Brake Pressure Switch . . . . .	8Wa-35-2	Left Front Wheel Speed Sensor . . . . .	8Wa-35-4
Controller Antilock Brake . . . . .	8Wa-35-2, 3, 4	Power Distribution Center . . . . .	8Wa-35-2
Data Link Connector . . . . .	8Wa-35-2	Powertrain Control Module . . . . .	8Wa-35-3
Diagnostic Junction Port . . . . .	8Wa-35-2	Rear Wheel Speed Sensor . . . . .	8Wa-35-4
Fuse 4 . . . . .	8Wa-35-2	Right Front Wheel Speed Sensor . . . . .	8Wa-35-4
Fuse 12 . . . . .	8Wa-35-3	Shifter Assembly . . . . .	8Wa-35-2, 3
Fuse 25 . . . . .	8Wa-35-2	Speed Control Servo . . . . .	8Wa-35-3
Fuse 38 . . . . .	8Wa-35-2		

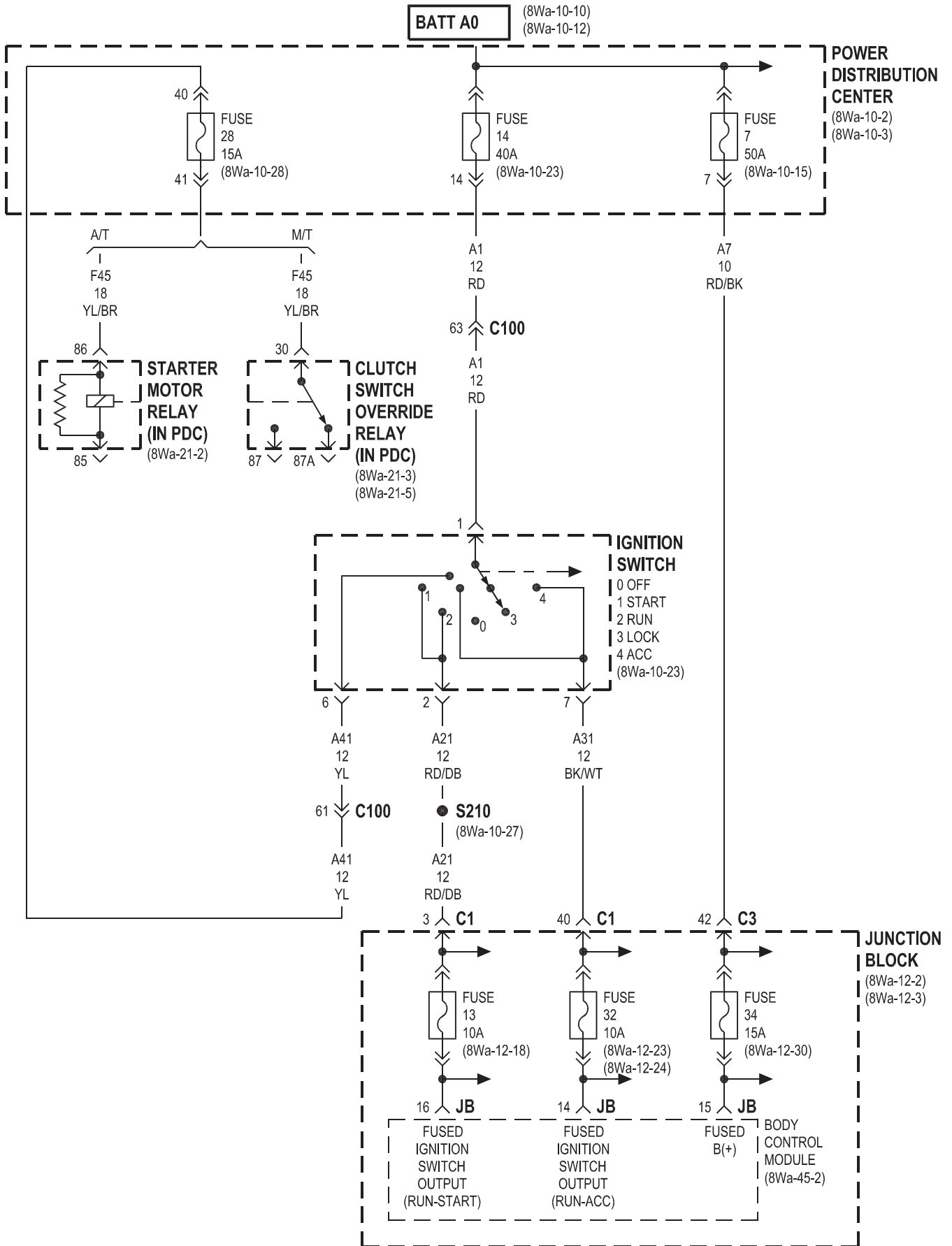


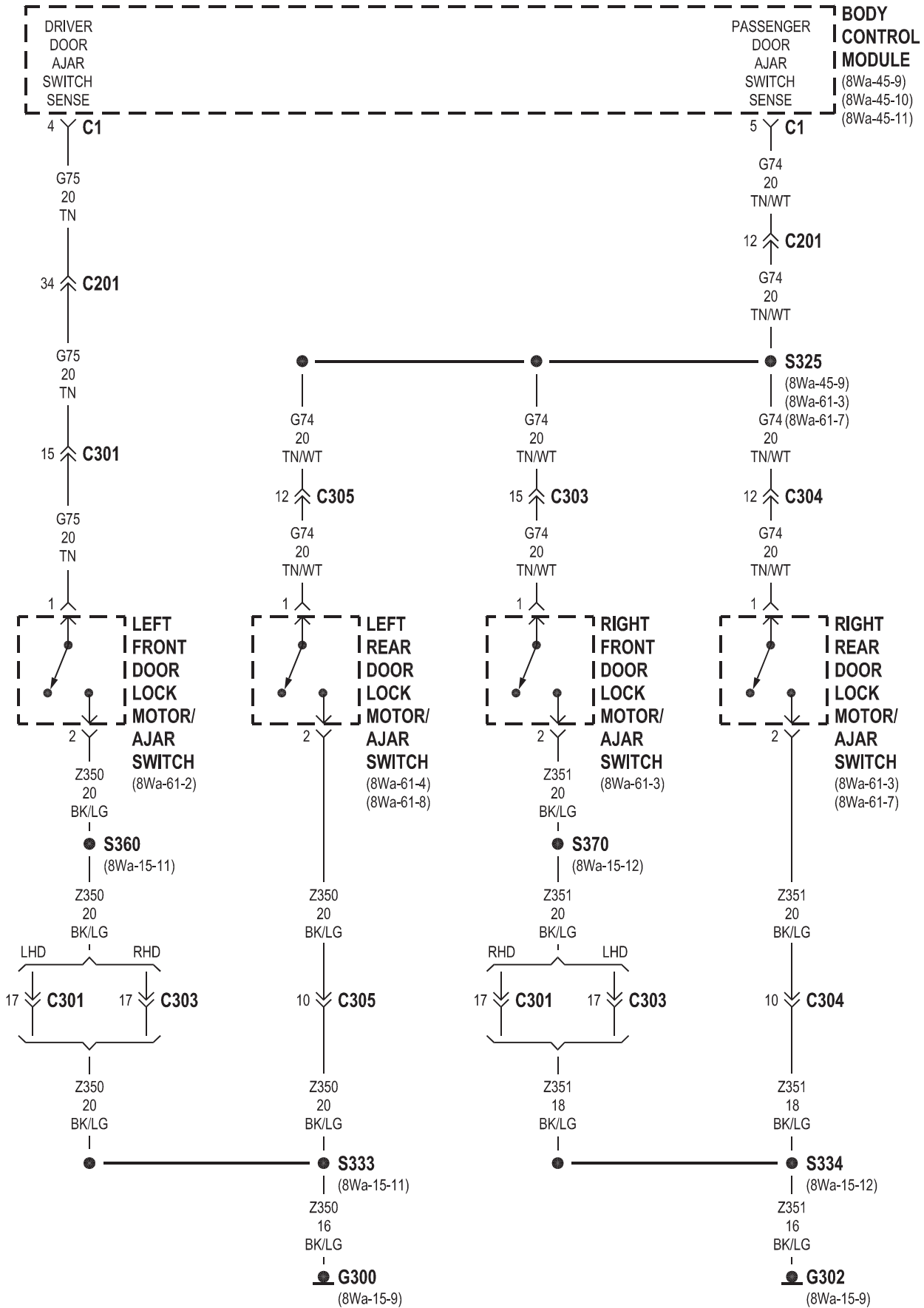




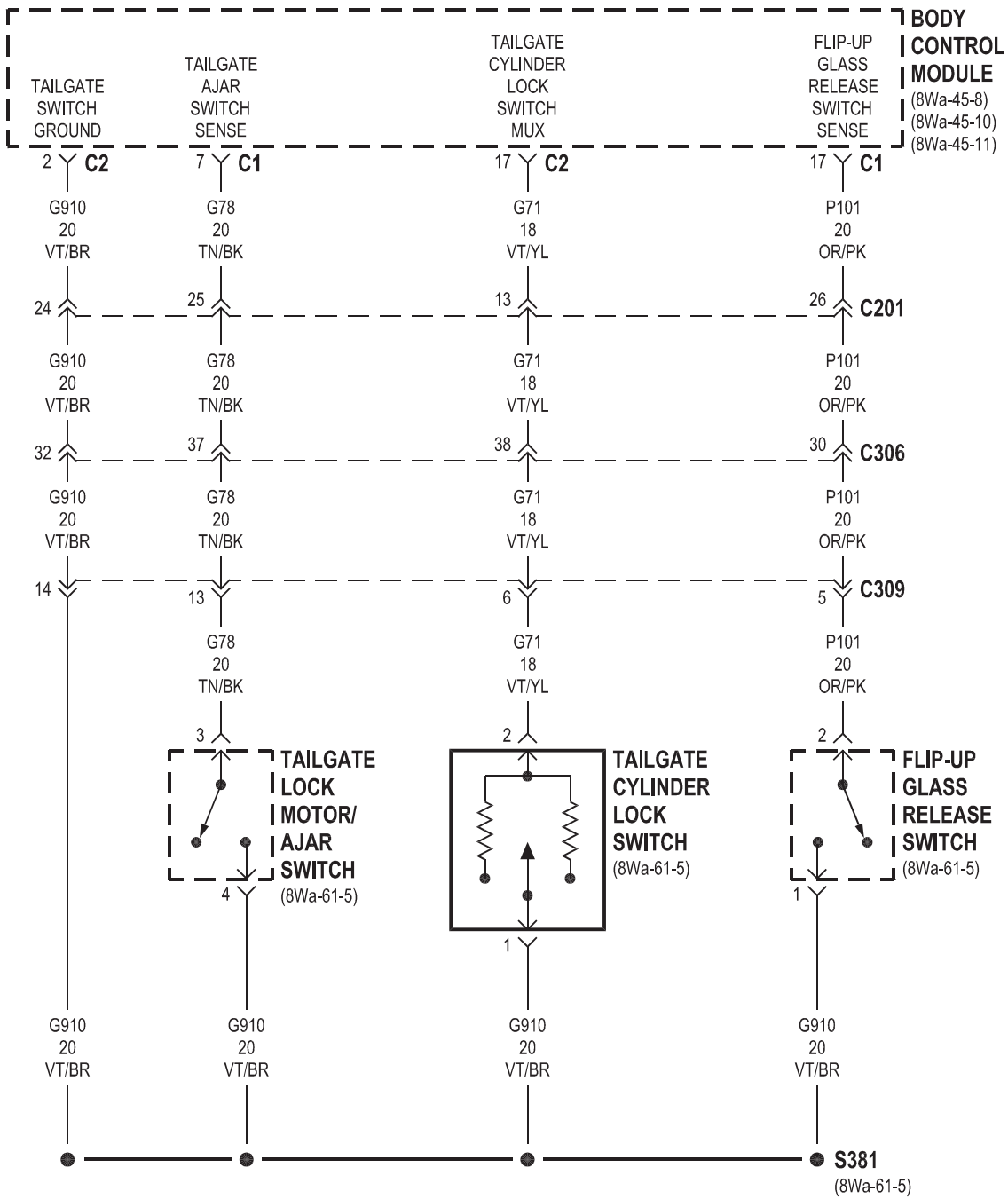
## 8W-39 VEHICLE THEFT SECURITY SYSTEM

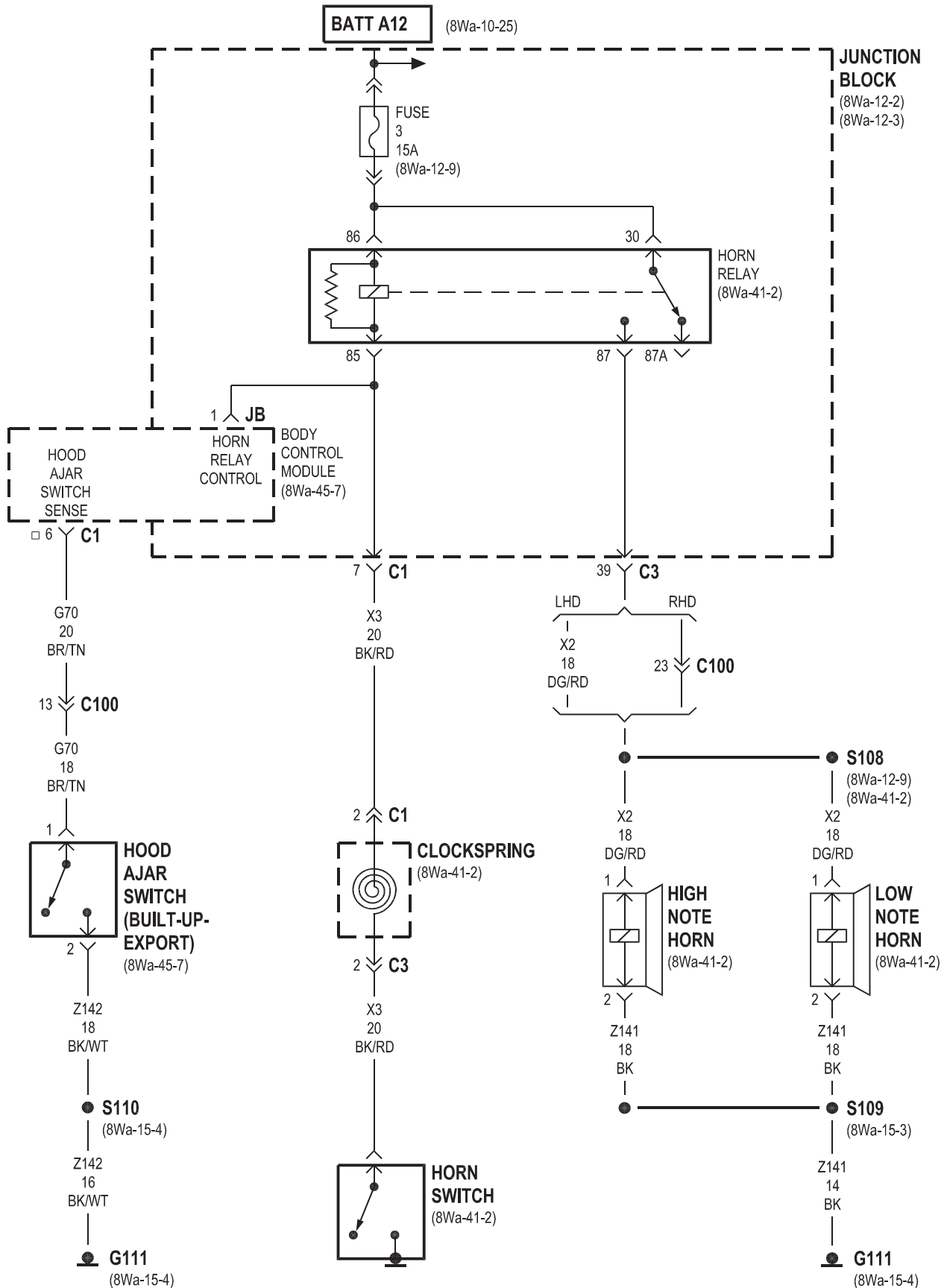
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module . . . . .	8Wa-39-2, 3, 4, 5, 9	Hood Ajar Switch . . . . .	8Wa-39-5
Clockspring . . . . .	8Wa-39-5	Horn Relay . . . . .	8Wa-39-5
Clutch Switch Override Relay . . . . .	8Wa-39-2	Horn Switch . . . . .	8Wa-39-5
Compass Mini-Trip Computer . . . . .	8Wa-39-8	Ignition Switch . . . . .	8Wa-39-2
Diagnostic Junction Port . . . . .	8Wa-39-6, 8	Intrusion Sensor . . . . .	8Wa-39-7, 8
Flip-Up Glass Release Switch . . . . .	8Wa-39-4	Junction Block . . . . .	8Wa-39-2, 5, 6, 7, 8, 9
Fuse 3 . . . . .	8Wa-39-5	Left Cylinder Lock Switch . . . . .	8Wa-39-9
Fuse 7 . . . . .	8Wa-39-2	Left Door Lock Switch . . . . .	8Wa-39-9
Fuse 13 . . . . .	8Wa-39-2, 8	Left Front Door Lock Motor/Ajar Switch . .	8Wa-39-3
Fuse 14 . . . . .	8Wa-39-2	Left Rear Door Lock Motor/Ajar Switch . .	8Wa-39-3
Fuse 15 . . . . .	8Wa-39-6	Low Note Horn . . . . .	8Wa-39-5
Fuse 28 . . . . .	8Wa-39-2	Power Distribution Center . . . . .	8Wa-39-2
Fuse 32 . . . . .	8Wa-39-2	Right Cylinder Lock Switch . . . . .	8Wa-39-9
Fuse 33 . . . . .	8Wa-39-6	Right Door Lock Switch . . . . .	8Wa-39-9
Fuse 34 . . . . .	8Wa-39-2, 7, 8	Right Front Door Lock Motor/Ajar Switch .	8Wa-39-3
G111 . . . . .	8Wa-39-5, 7	Right Rear Door Lock Motor/Ajar Switch .	8Wa-39-3
G202 . . . . .	8Wa-39-6	Sentry Key Immobilizer Module . . . . .	8Wa-39-6
G300 . . . . .	8Wa-39-3	Siren . . . . .	8Wa-39-7
G302 . . . . .	8Wa-39-3	Starter Motor Relay . . . . .	8Wa-39-2
G311 . . . . .	8Wa-39-8	Tailgate Cylinder Lock Switch . . . . .	8Wa-39-4
High Note Horn . . . . .	8Wa-39-5	Tailgate Lock Motor/Ajar Switch . . . . .	8Wa-39-4

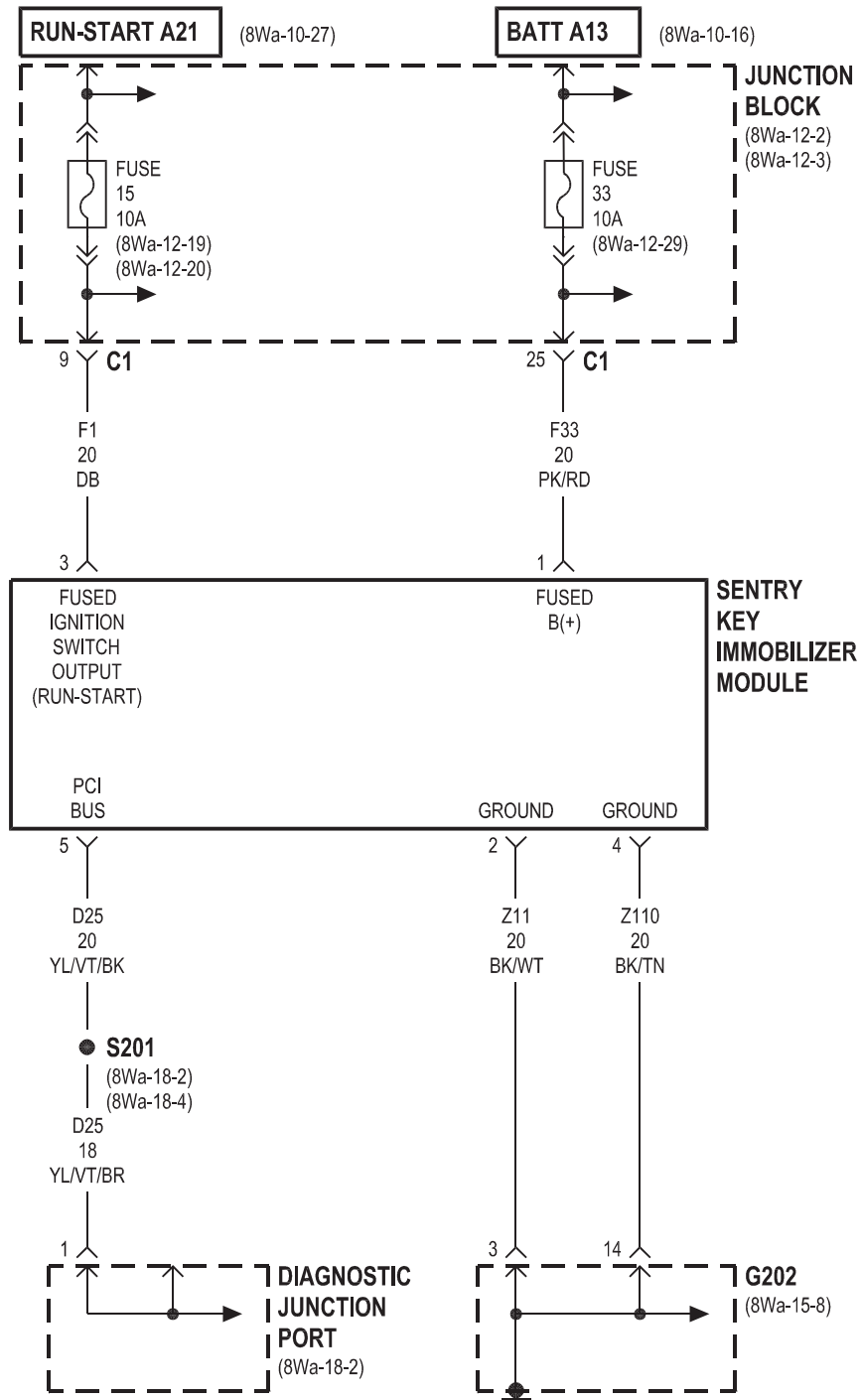


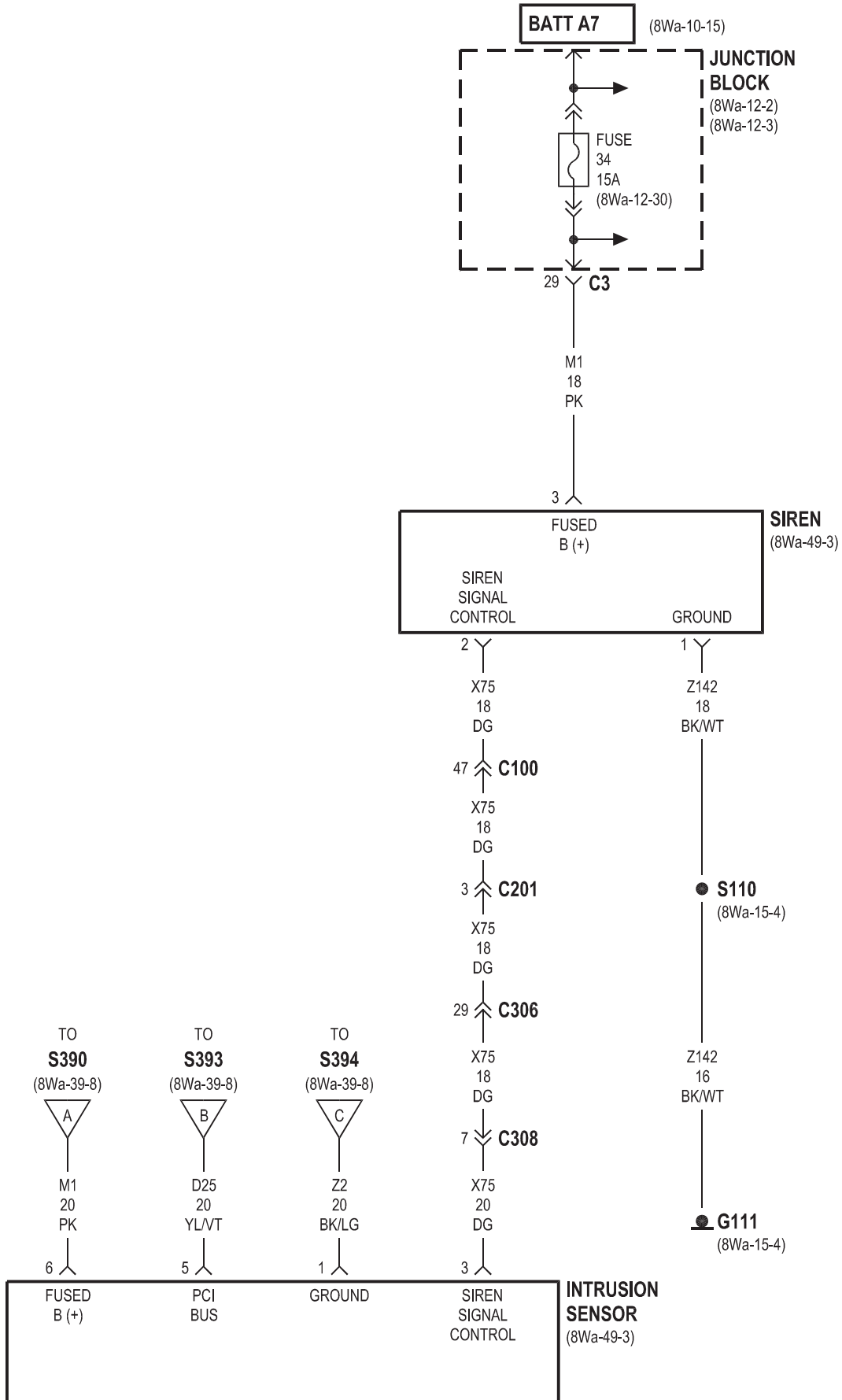


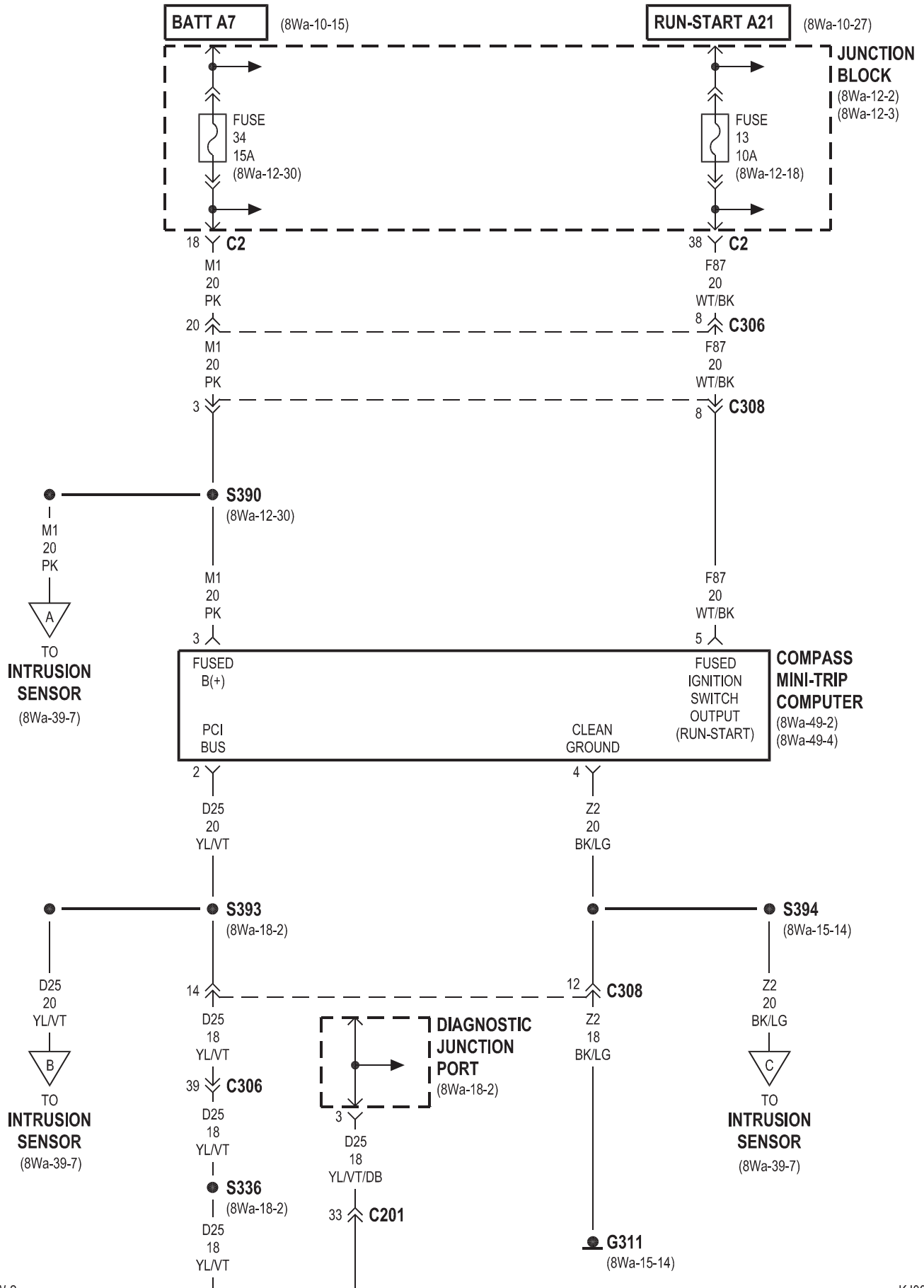


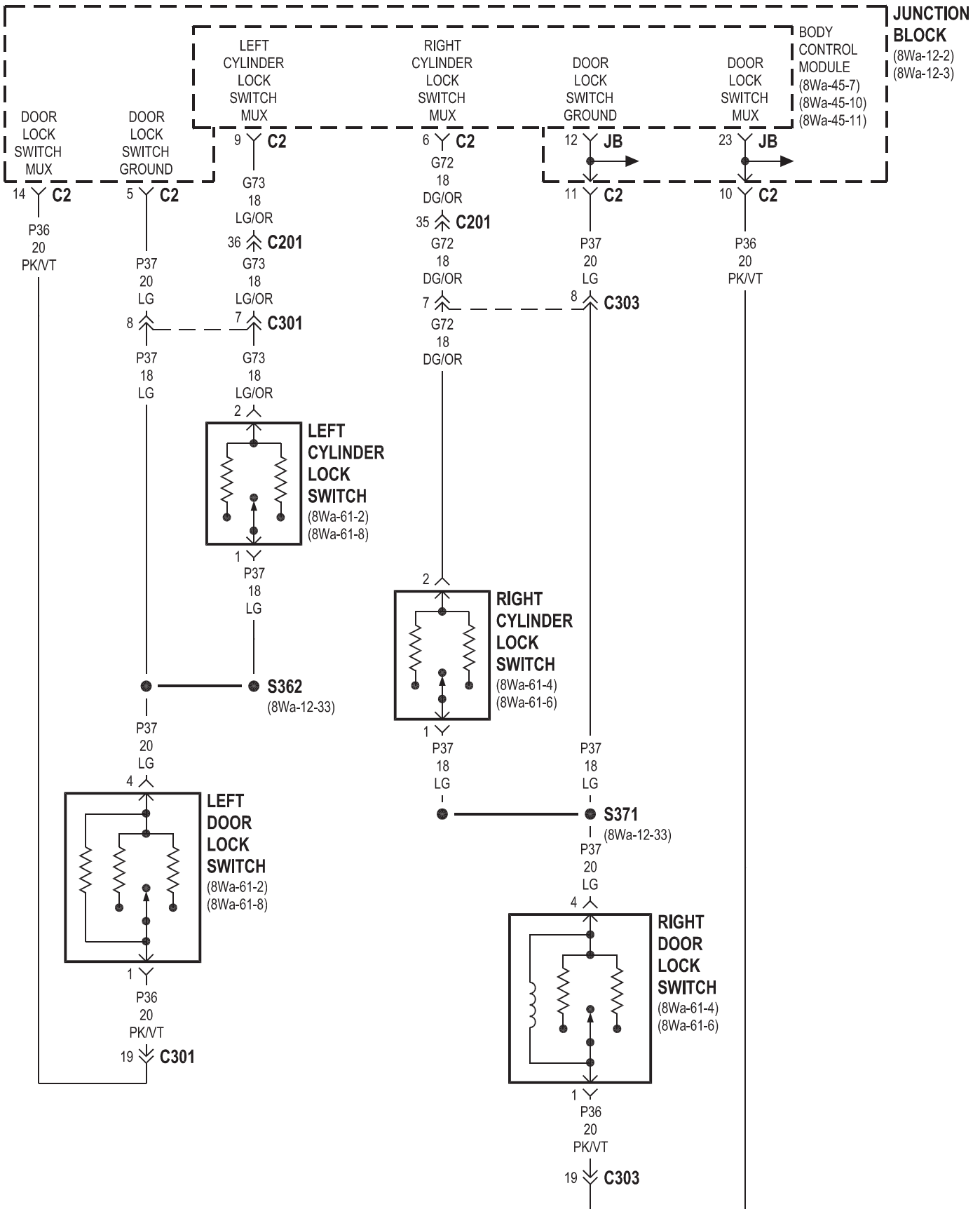










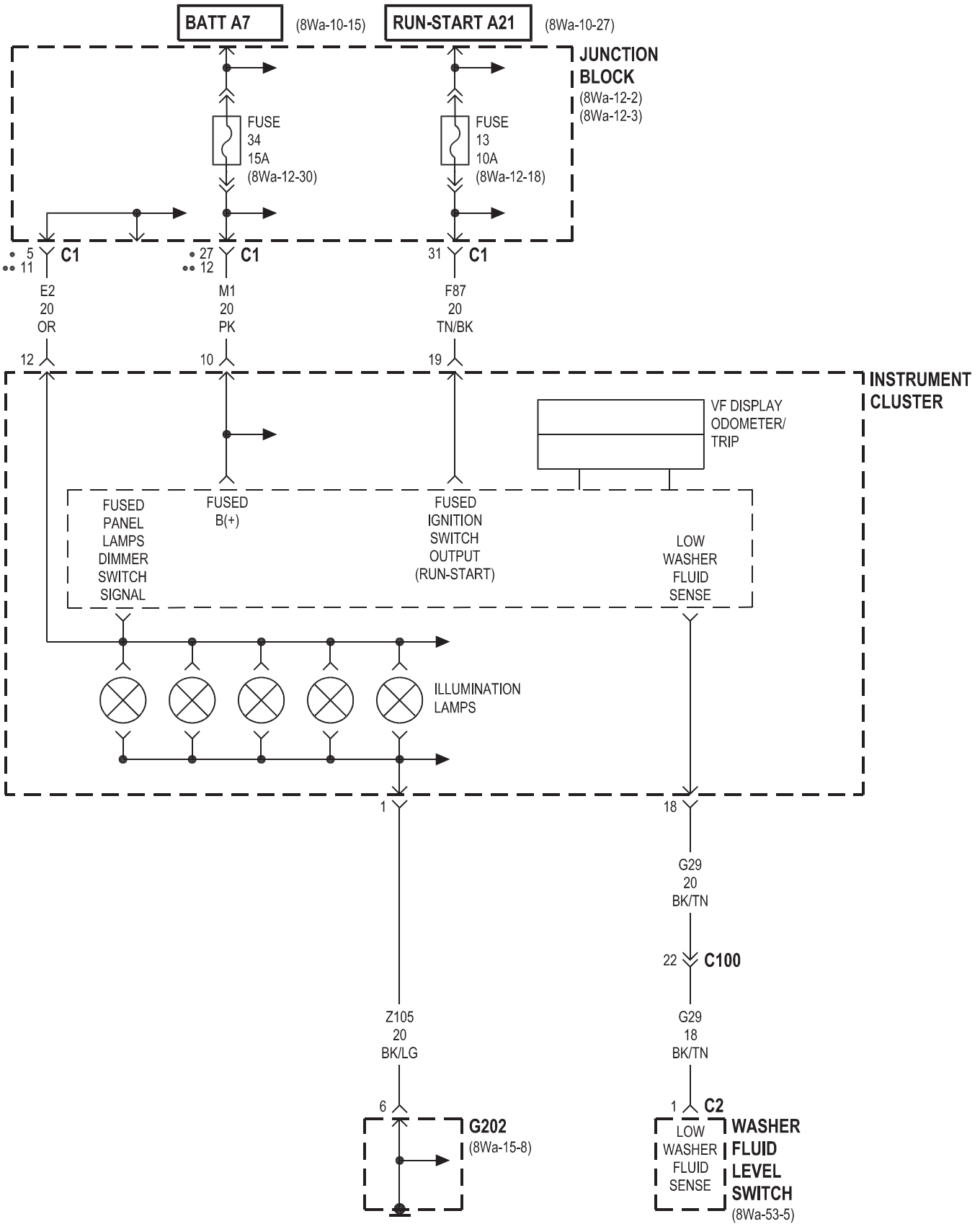




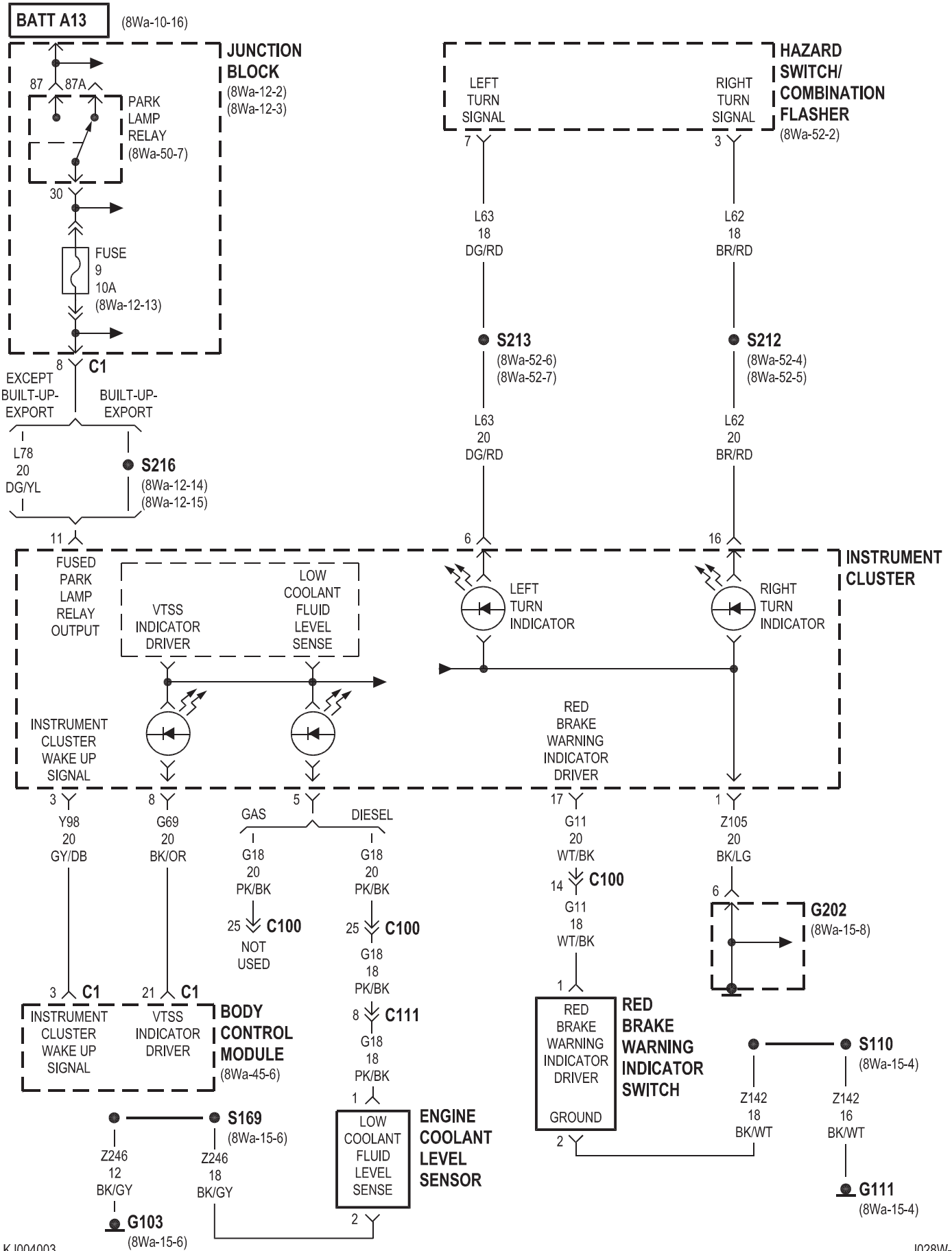
## 8W-40 INSTRUMENT CLUSTER

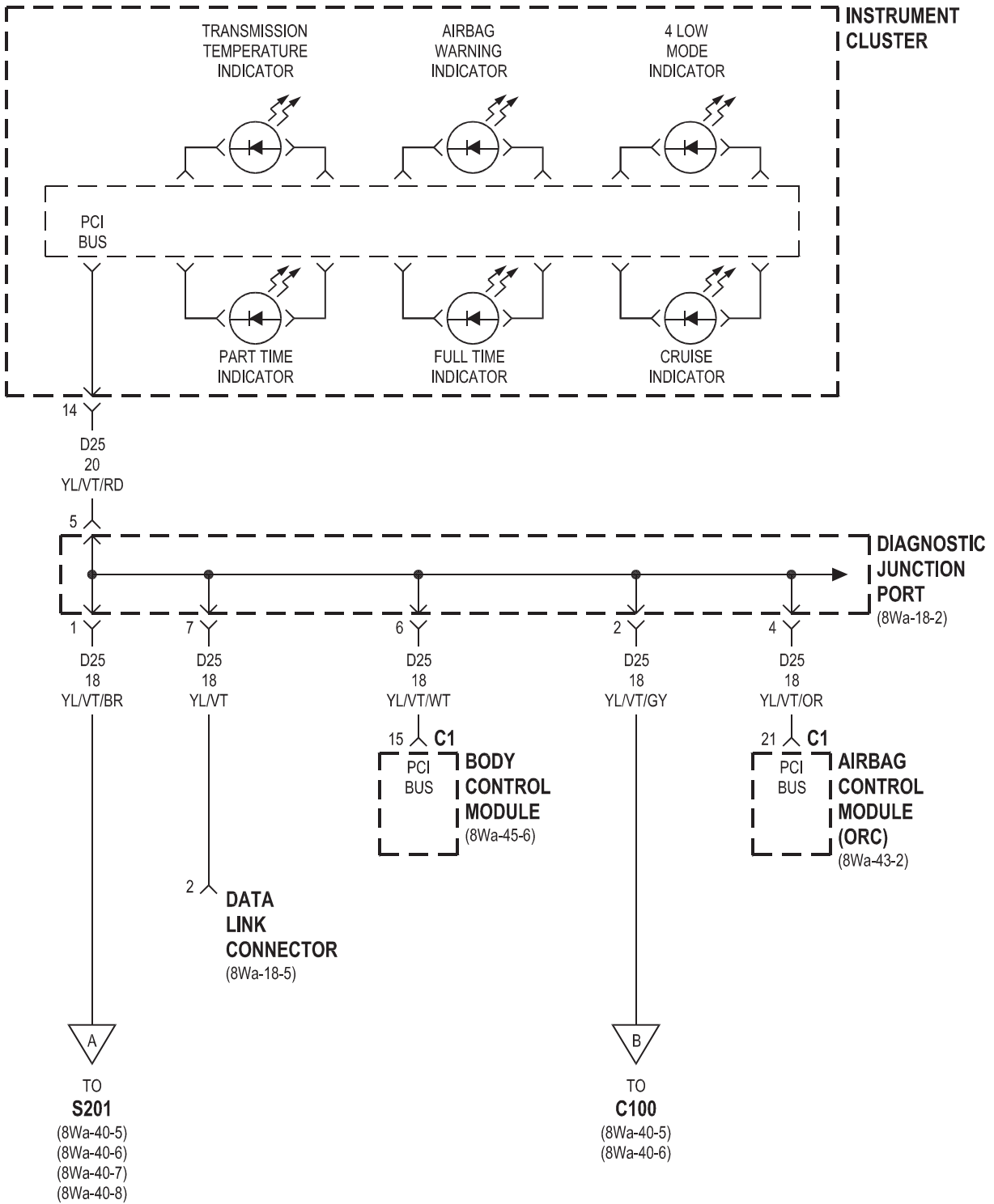
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Airbag Control Module . . . . .	8Wa-40-4, 8	G111 . . . . .	8Wa-40-3
Body Control Module . . . . .	8Wa-40-3, 4, 5, 8	G202 . . . . .	8Wa-40-2, 3
Controller Antilock Brake . . . . .	8Wa-40-6	Hazard Switch/Combination Flasher . . . . .	8Wa-40-3
Data Link Connector . . . . .	8Wa-40-4	Instrument Cluster . . . . .	8Wa-40-2, 3, 4, 5, 7, 8
Diagnostic Junction Port . . . . .	8Wa-40-4, 5, 6, 7, 8	Junction Block . . . . .	8Wa-40-2, 3
Driver Seat Belt Switch . . . . .	8Wa-40-8	Park Brake Switch . . . . .	8Wa-40-5
Engine Control Module . . . . .	8Wa-40-6	Park Lamp Relay . . . . .	8Wa-40-3
Engine Coolant Level Sensor . . . . .	8Wa-40-3	Passenger Seat Belt Switch . . . . .	8Wa-40-8
Fuse 9 . . . . .	8Wa-40-3	Powertrain Control Module . . . . .	8Wa-40-6
Fuse 13 . . . . .	8Wa-40-2	Red Brake Warning Indicator Switch . . . . .	8Wa-40-3
Fuse 34 . . . . .	8Wa-40-2	Transmission Control Module . . . . .	8Wa-40-6
G103 . . . . .	8Wa-40-3	Washer Fluid Level Switch . . . . .	8Wa-40-2

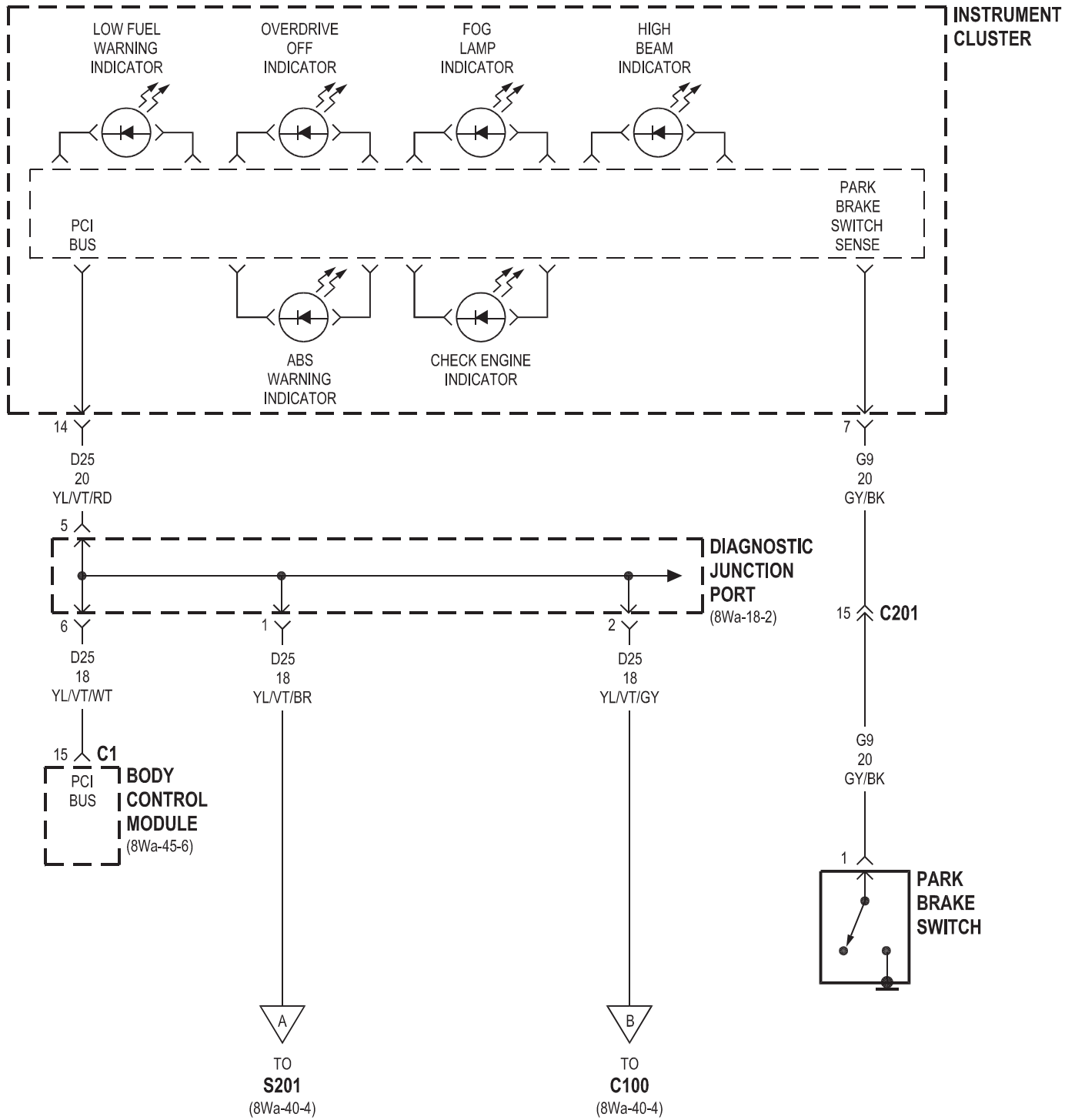


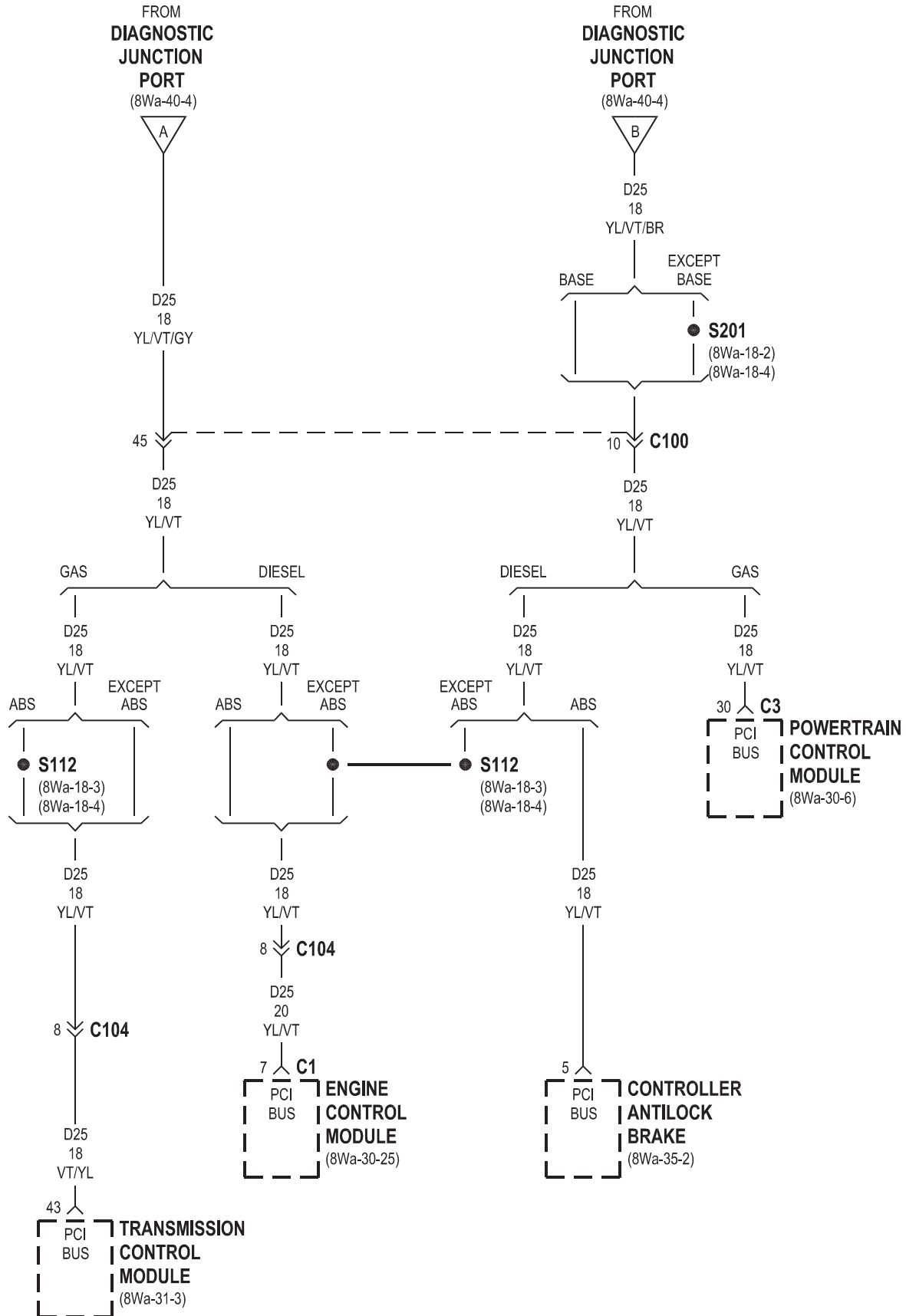


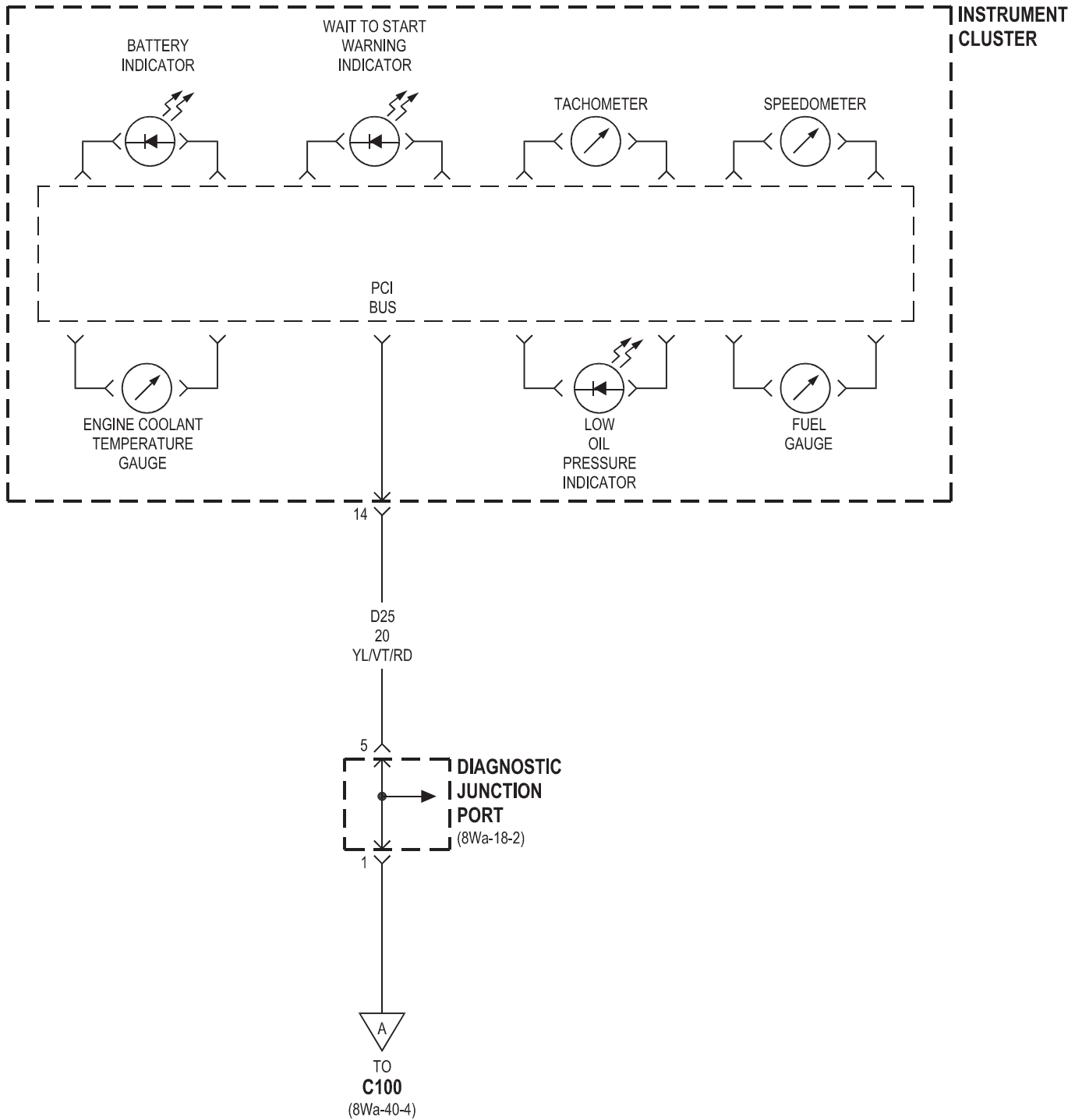
- LHD
- RHD

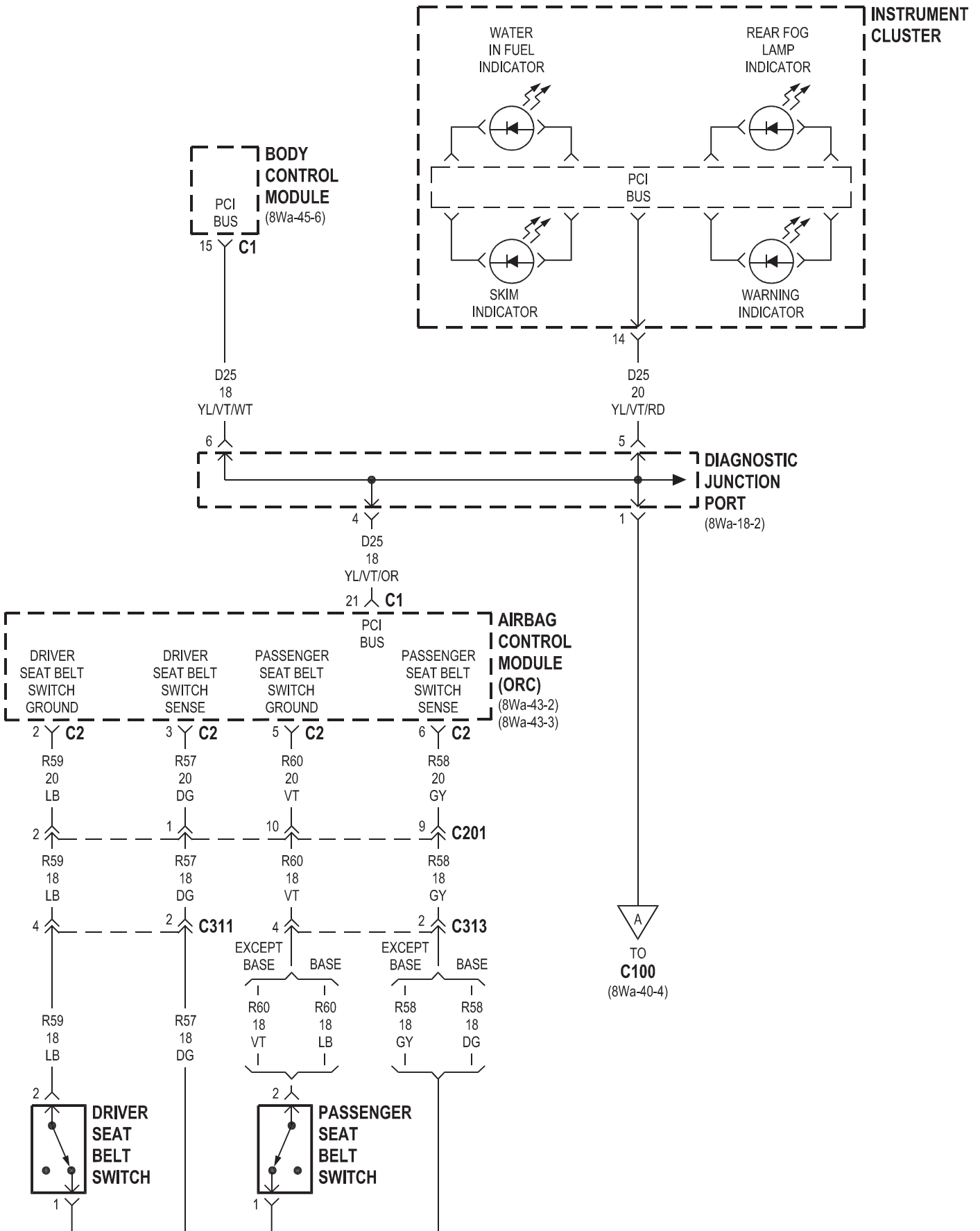








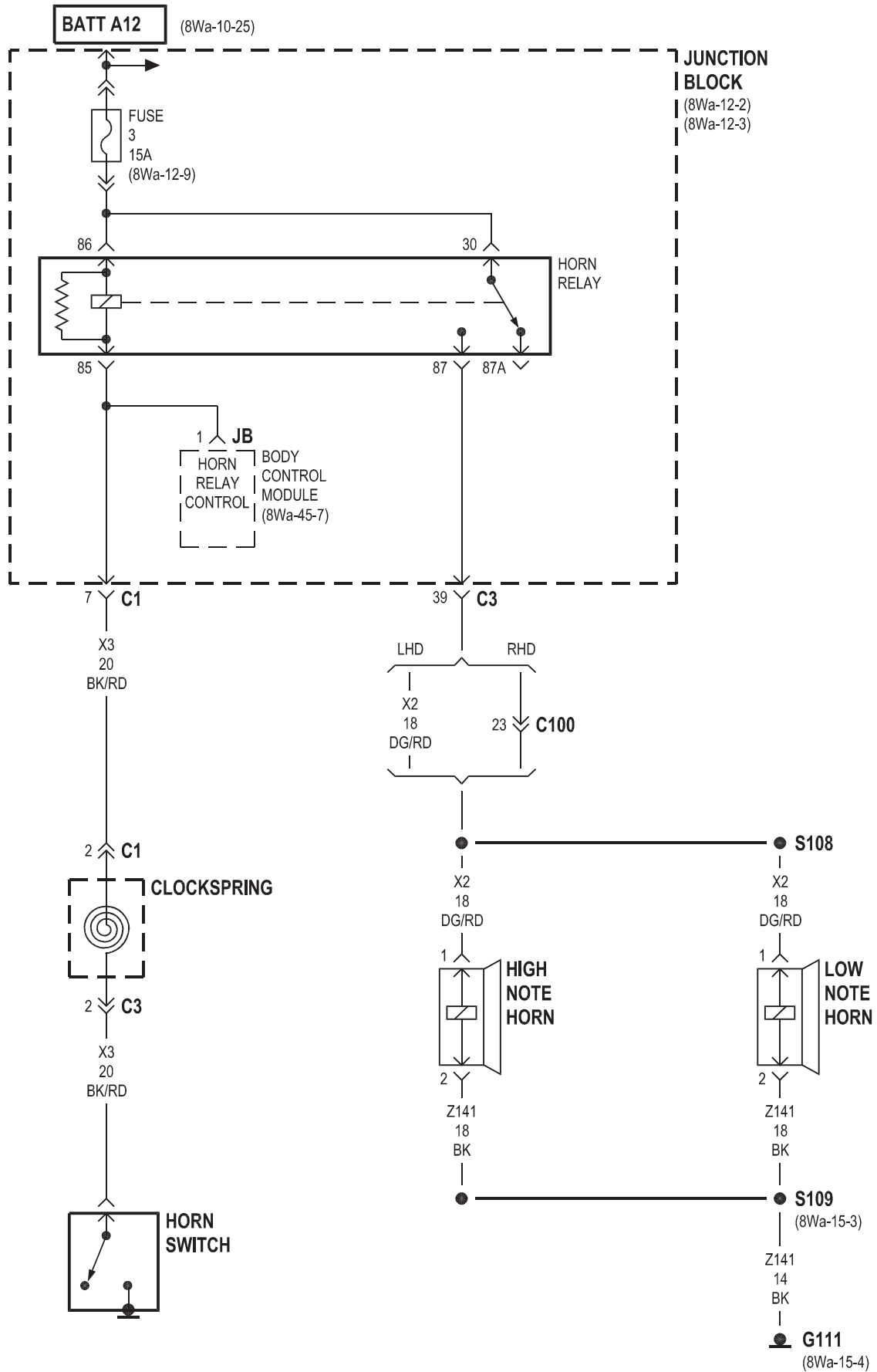


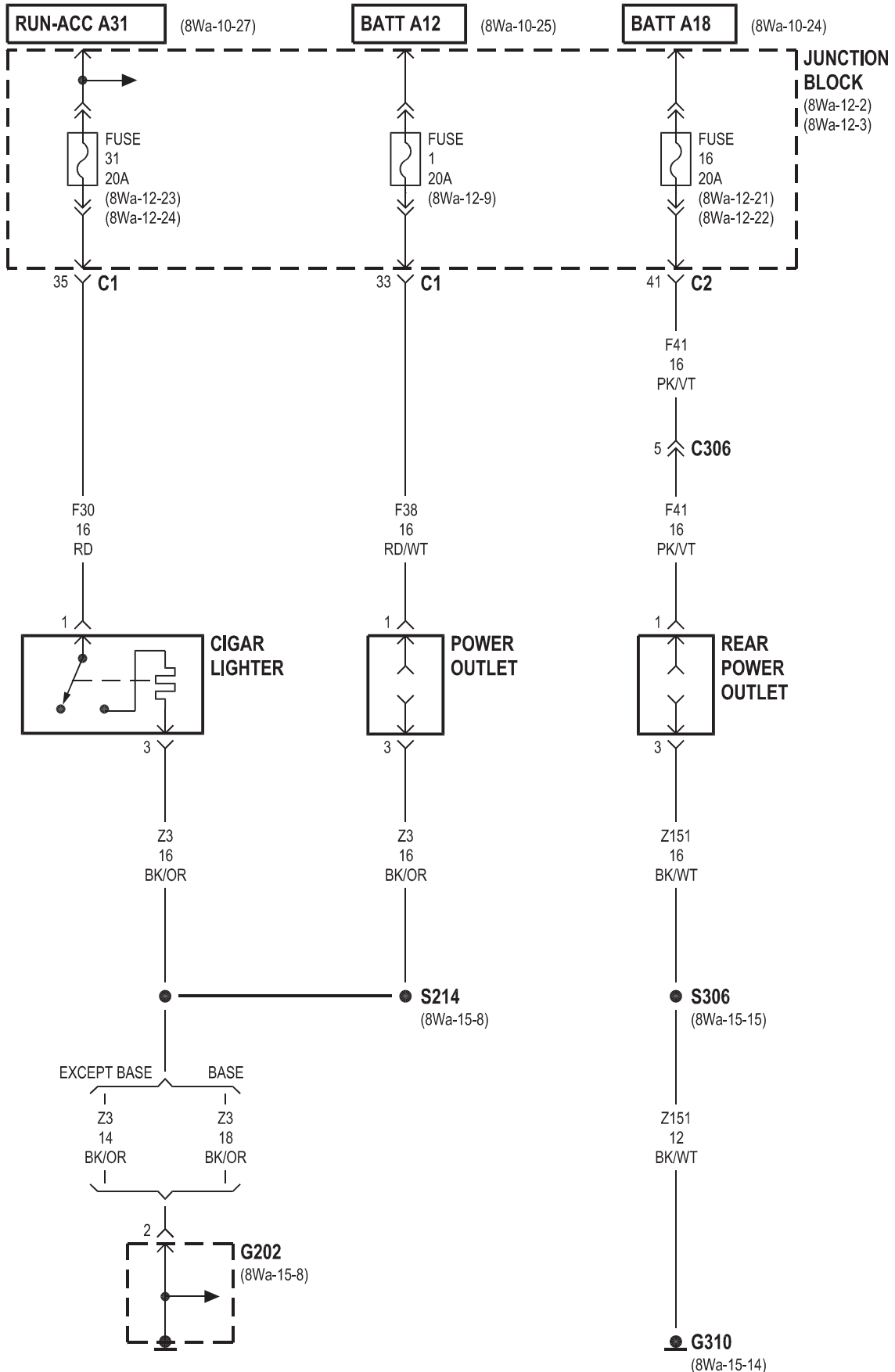


## 8W-41 HORN/CIGAR LIGHTER/POWER OUTLET

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module .....	8Wa-41-2	G310 .....	8Wa-41-3
Cigar Lighter .....	8Wa-41-3	High Note Horn .....	8Wa-41-2
Clockspring .....	8Wa-41-2	Horn Relay .....	8Wa-41-2
Fuse 1 .....	8Wa-41-3	Horn Switch .....	8Wa-41-2
Fuse 3 .....	8Wa-41-2	Junction Block.....	8Wa-41-2, 3
Fuse 16 .....	8Wa-41-3	Low Note Horn .....	8Wa-41-2
Fuse 31 .....	8Wa-41-3	Power Outlet .....	8Wa-41-3
G111 .....	8Wa-41-2	Rear Power Outlet .....	8Wa-41-3
G202 .....	8Wa-41-3		



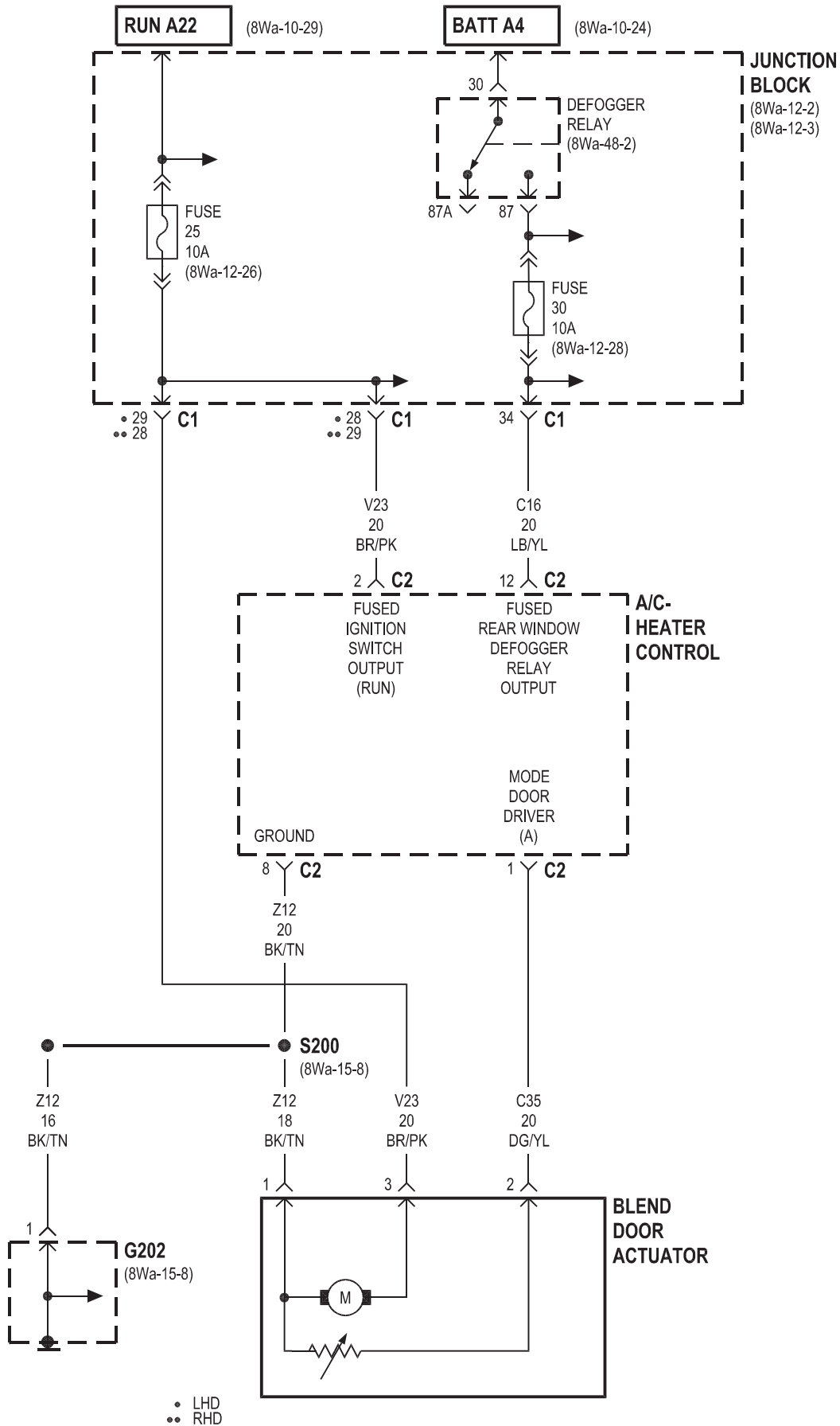


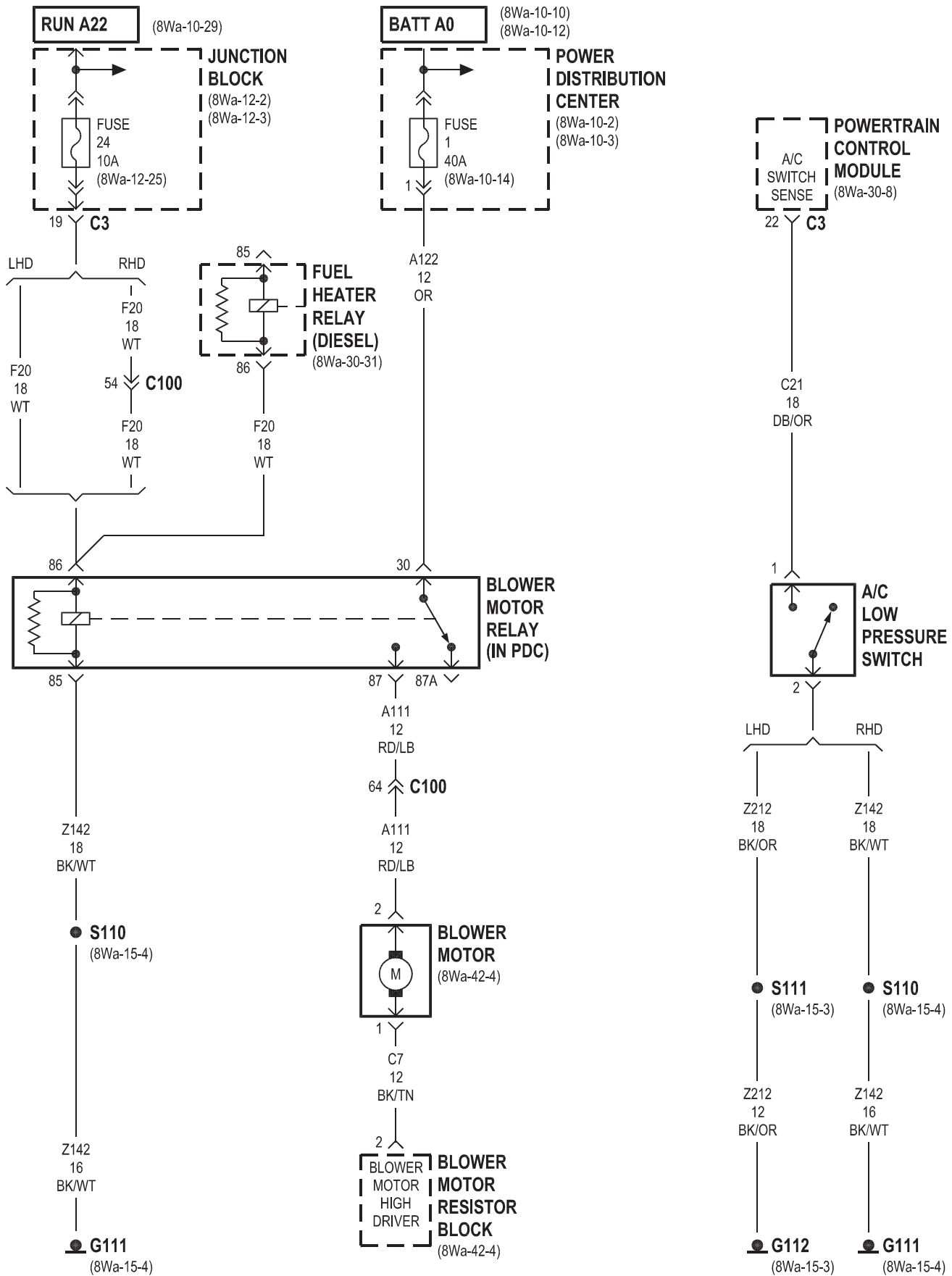


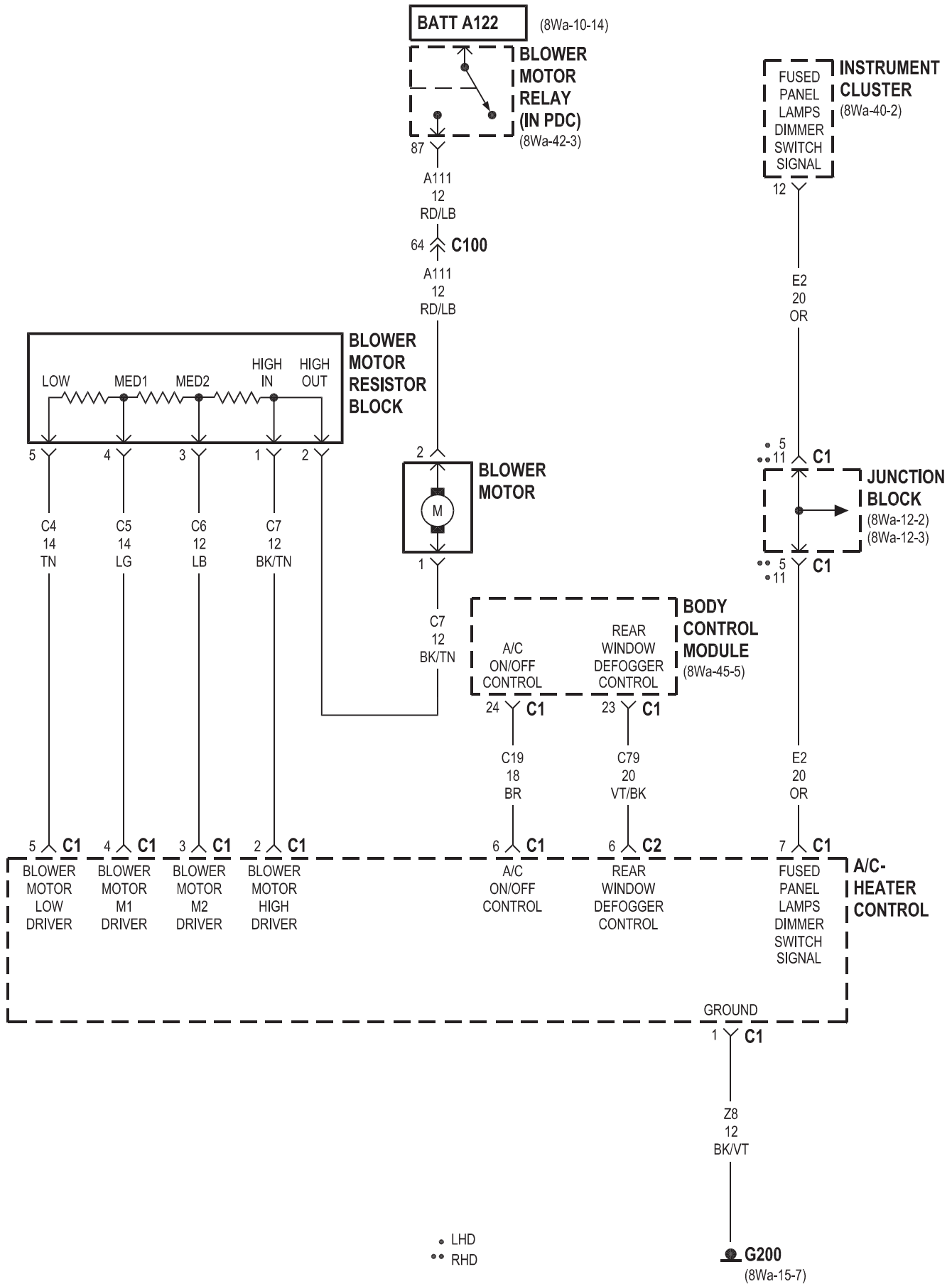


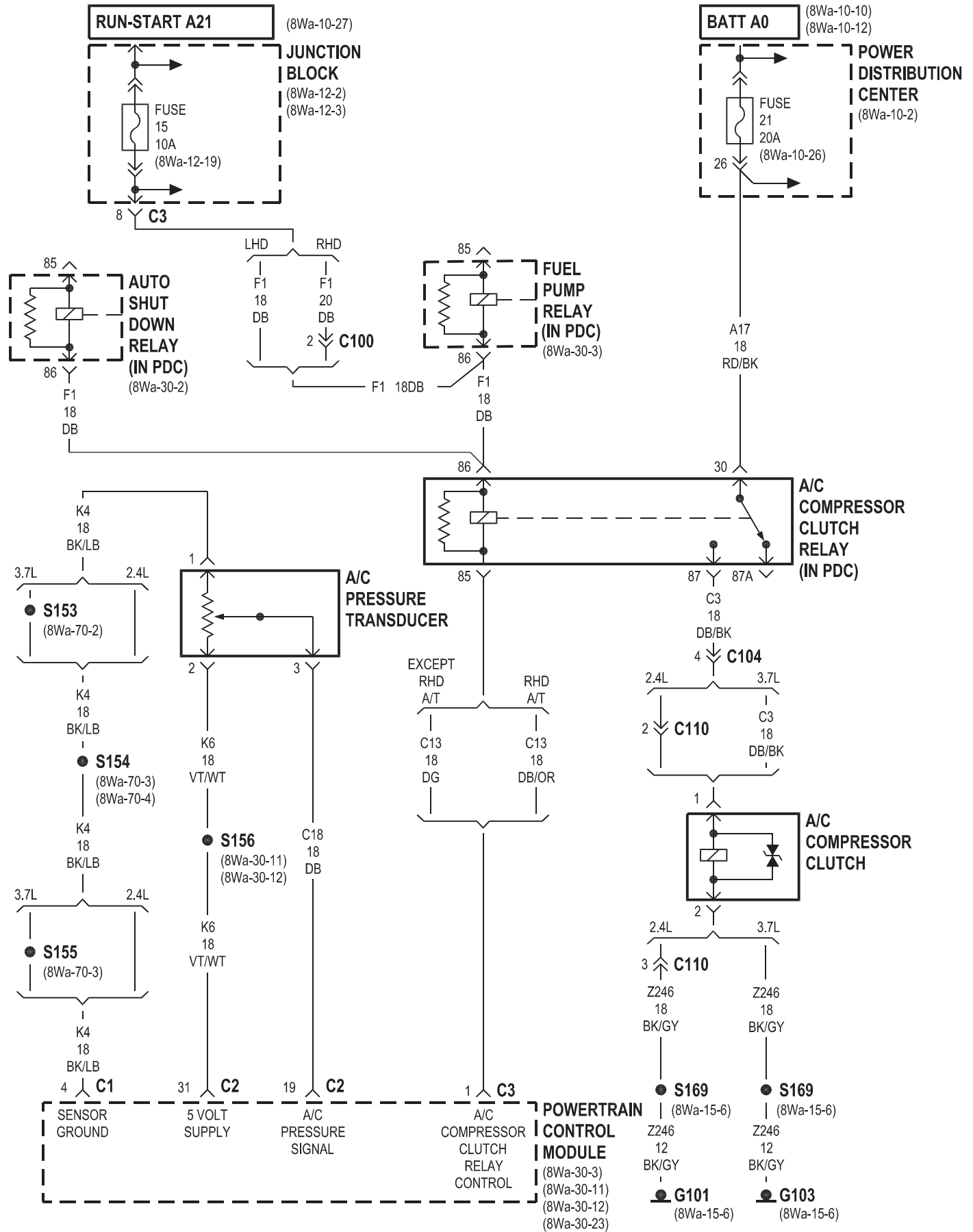
## 8W-42 AIR CONDITIONING-HEATER

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C Compressor Clutch . . . . .	8Wa-42-5, 7	Fuse 1 . . . . .	8Wa-42-3, 6
A/C Compressor Clutch Relay . . . . .	8Wa-42-5, 7	Fuse 15 . . . . .	8Wa-42-5
A/C High Pressure Switch . . . . .	8Wa-42-6	Fuse 16 . . . . .	8Wa-42-7
A/C Low Pressure Switch . . . . .	8Wa-42-3, 6	Fuse 19 . . . . .	8Wa-42-6
A/C Pressure Transducer . . . . .	8Wa-42-5	Fuse 21 . . . . .	8Wa-42-5, 7
A/C- Heater Control . . . . .	8Wa-42-2, 4	Fuse 24 . . . . .	8Wa-42-3
Auto Shut Down Relay . . . . .	8Wa-42-5	Fuse 25 . . . . .	8Wa-42-2
Blend Door Actuator . . . . .	8Wa-42-2	Fuse 30 . . . . .	8Wa-42-2
Blower Motor . . . . .	8Wa-42-3, 4, 6	G101 . . . . .	8Wa-42-5
Blower Motor Relay . . . . .	8Wa-42-3, 4, 6	G103 . . . . .	8Wa-42-5, 7
Blower Motor Resistor Block . . . . .	8Wa-42-3, 4, 6	G111 . . . . .	8Wa-42-3, 6
Body Control Module . . . . .	8Wa-42-4	G112 . . . . .	8Wa-42-3, 6
Cabin Heater . . . . .	8Wa-42-7	G200 . . . . .	8Wa-42-4
Cabin Heater Relay . . . . .	8Wa-42-7	G202 . . . . .	8Wa-42-2
Defogger Relay . . . . .	8Wa-42-2	Instrument Cluster . . . . .	8Wa-42-4
Engine Control Module . . . . .	8Wa-42-6, 7	Junction Block . . . . .	8Wa-42-2, 3, 4, 5, 6
Fuel Heater Relay . . . . .	8Wa-42-3, 6	Power Distribution Center . . . . .	8Wa-42-3, 5, 6, 7
Fuel Pump Relay . . . . .	8Wa-42-5	Powertrain Control Module . . . . .	8Wa-42-3, 5

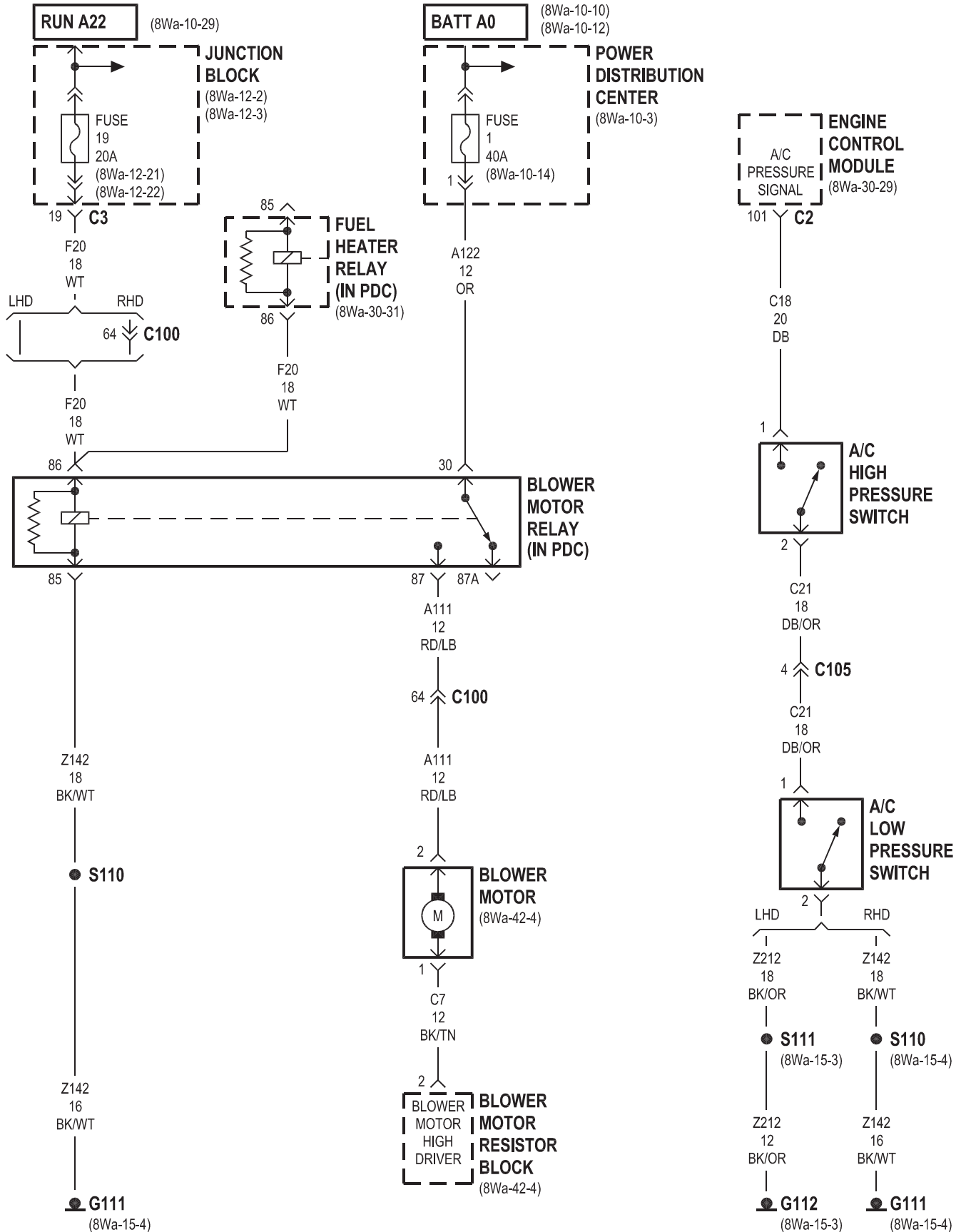


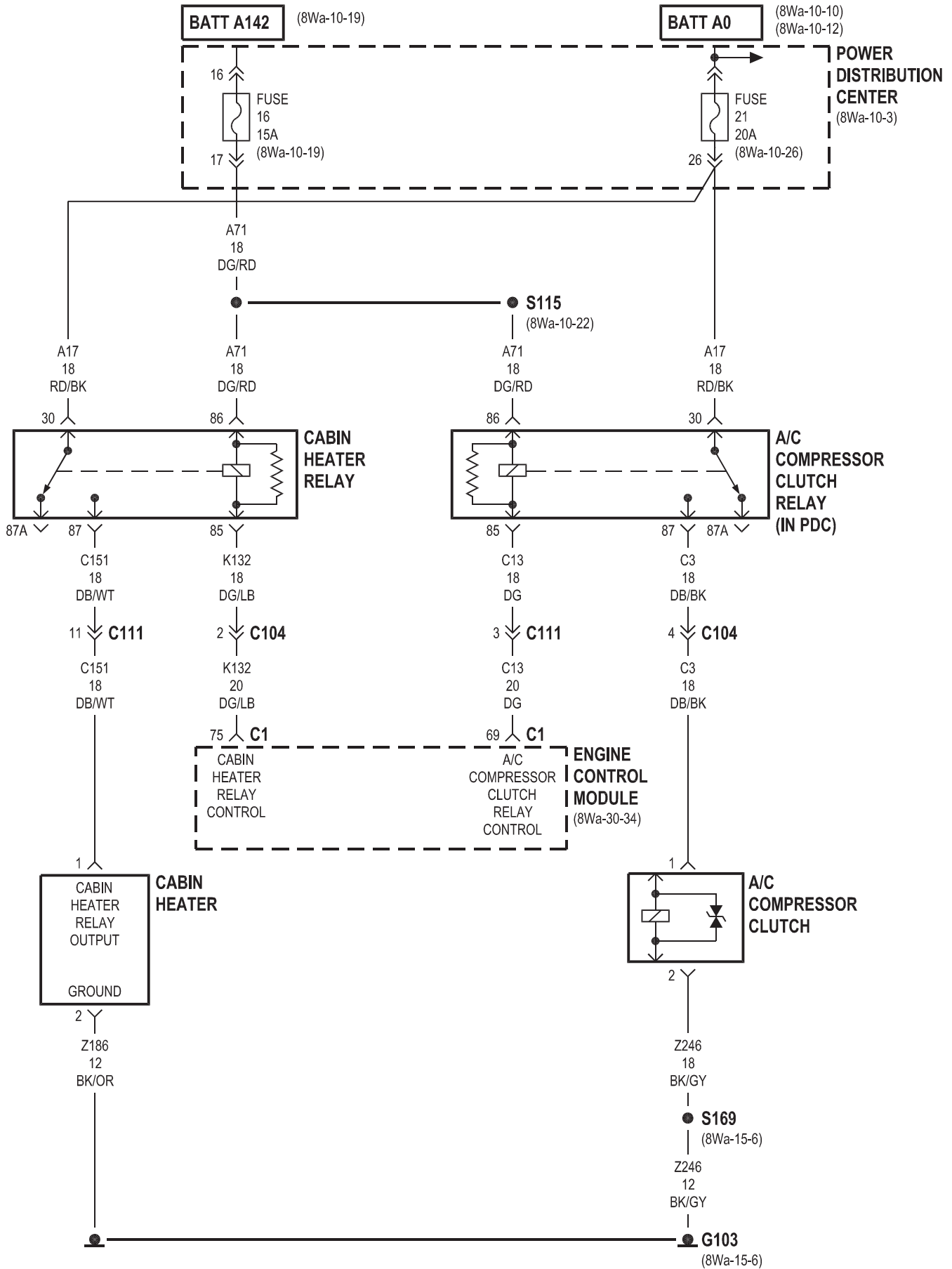








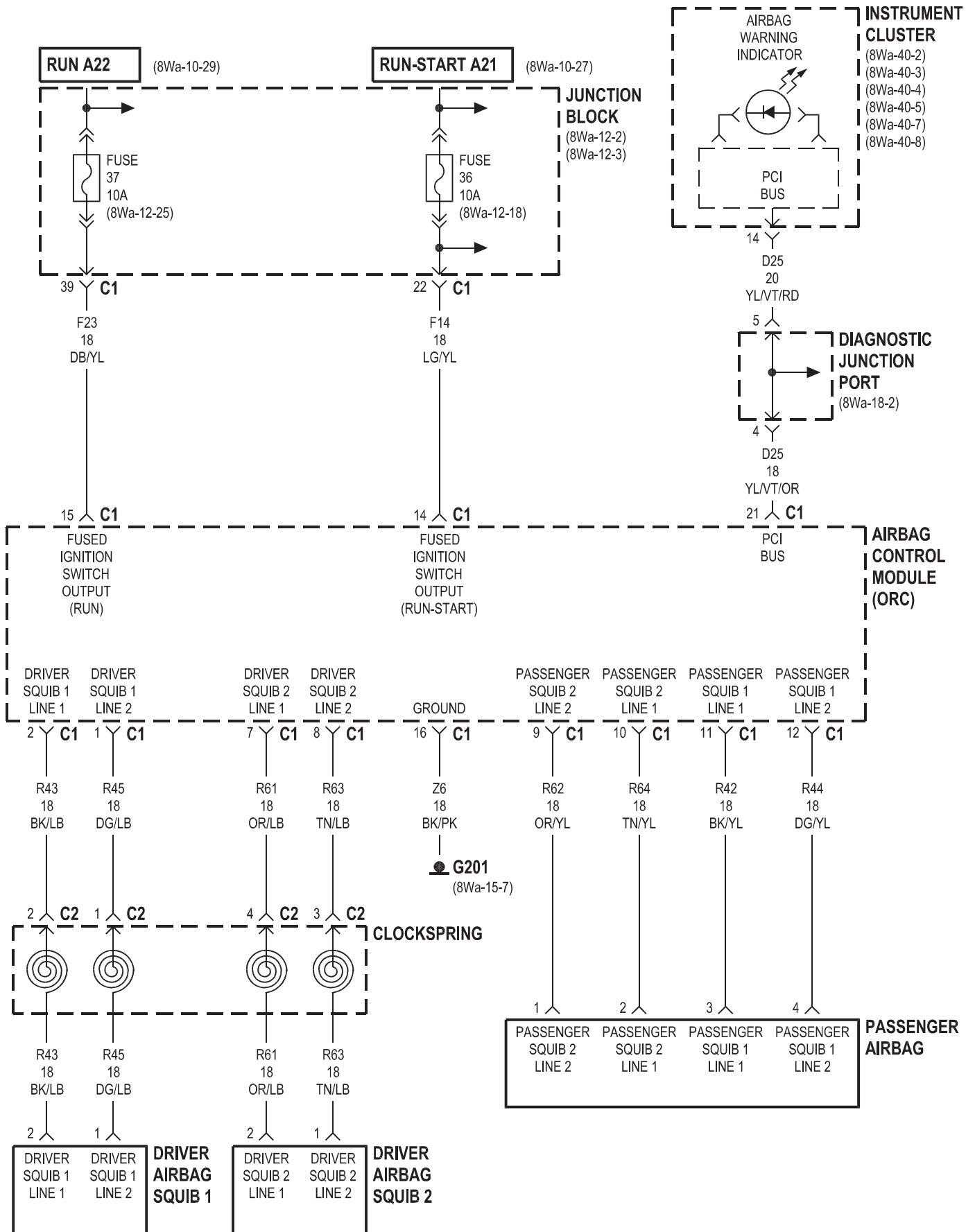


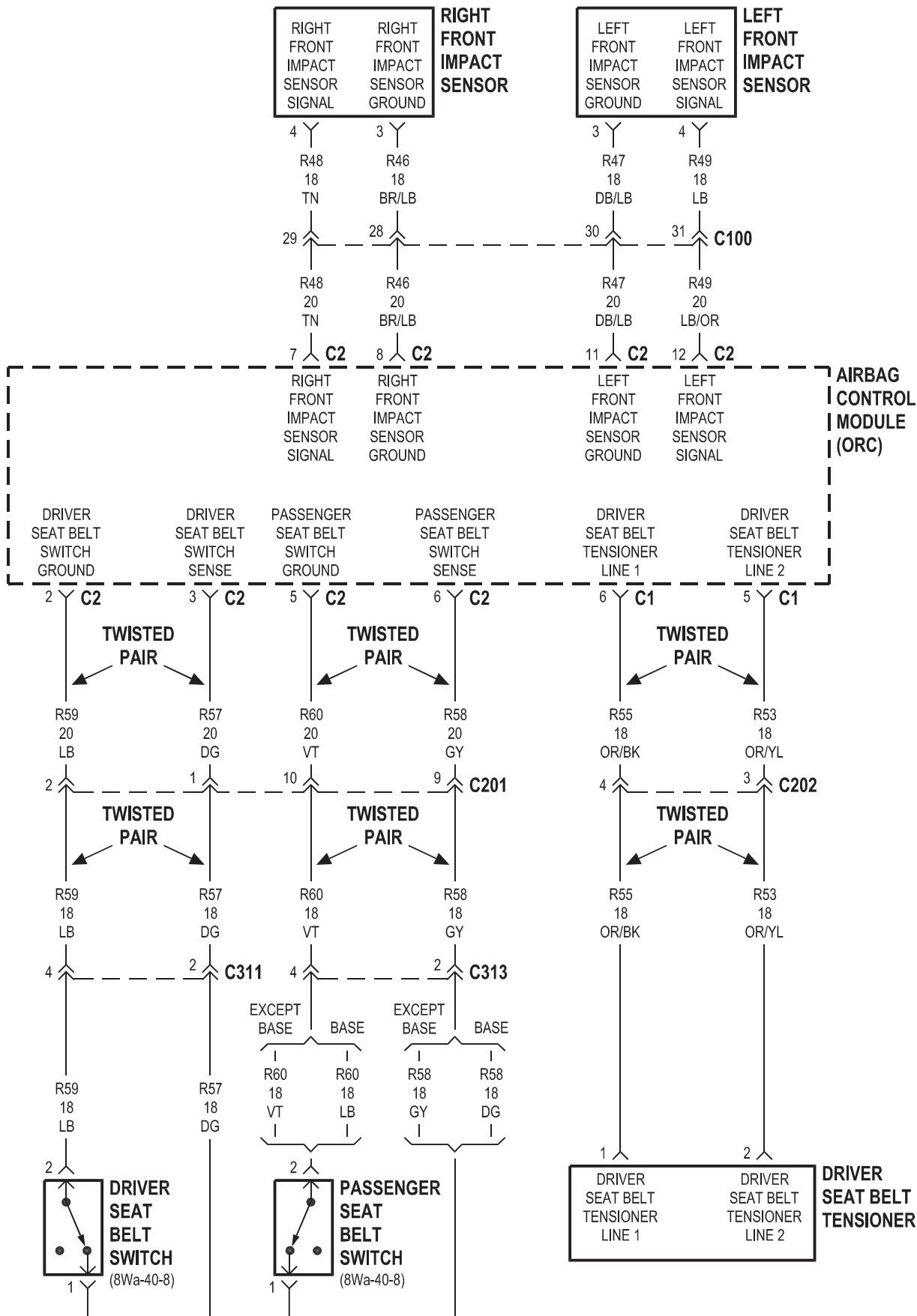


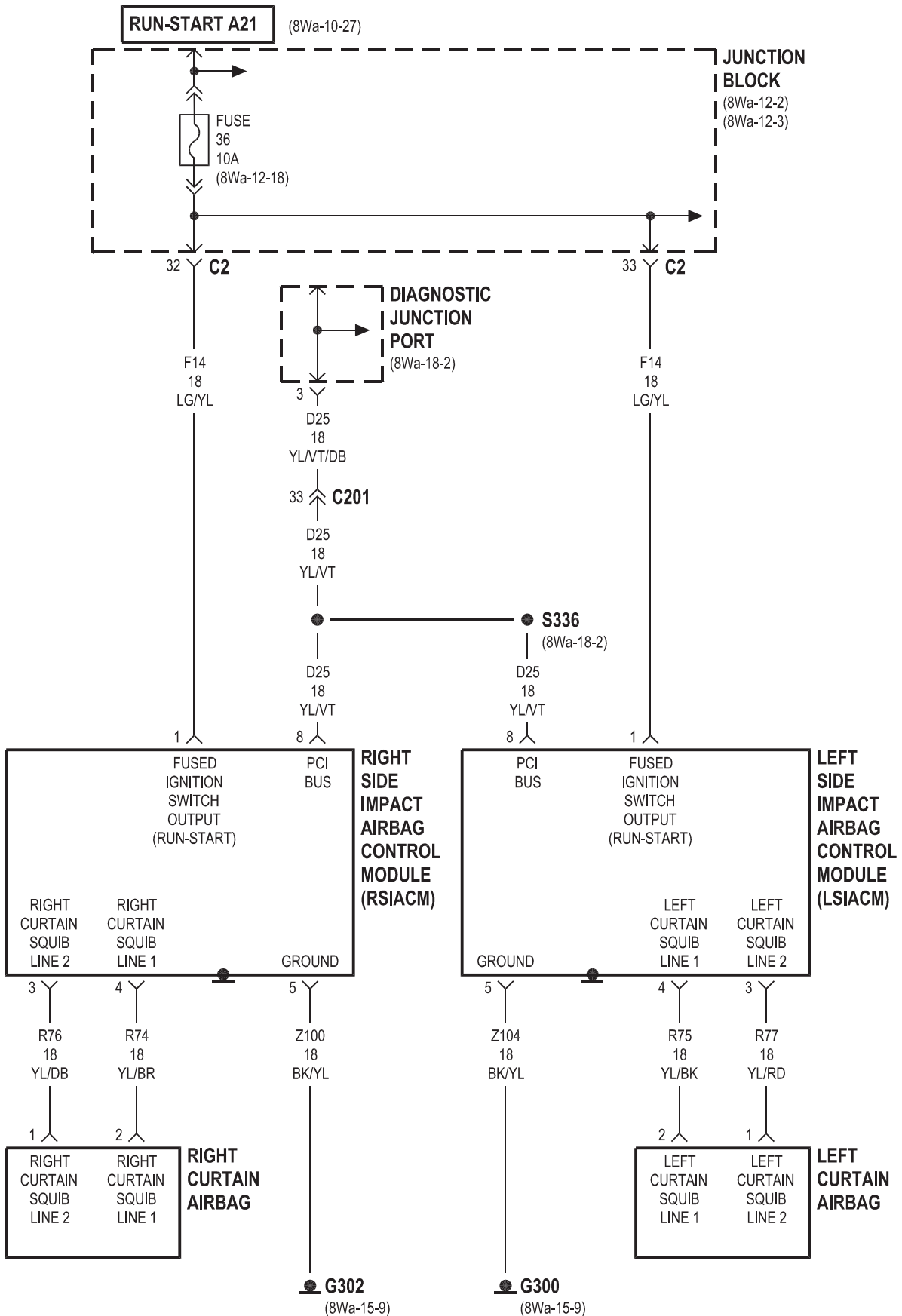


## 8W-43 AIRBAG SYSTEM

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Airbag Control Module . . . . .	8Wa-43-2, 3	G302 . . . . .	8Wa-43-4
Clockspring . . . . .	8Wa-43-2	Instrument Cluster . . . . .	8Wa-43-2
Diagnostic Junction Port . . . . .	8Wa-43-2, 4	Junction Block . . . . .	8Wa-43-2, 4
Driver Airbag Squib 1 . . . . .	8Wa-43-2	Left Curtain Airbag . . . . .	8Wa-43-4
Driver Airbag Squib 2 . . . . .	8Wa-43-2	Left Front Impact Sensor . . . . .	8Wa-43-3
Driver Seat Belt Switch . . . . .	8Wa-43-3	Left Side Impact Airbag Control Module . .	8Wa-43-4
Driver Seat Belt Tensioner . . . . .	8Wa-43-3	Passenger Airbag . . . . .	8Wa-43-2
Fuse 36 . . . . .	8Wa-43-2, 4	Passenger Seat Belt Switch . . . . .	8Wa-43-3
Fuse 37 . . . . .	8Wa-43-2	Right Curtain Airbag . . . . .	8Wa-43-4
G201 . . . . .	8Wa-43-2	Right Front Impact Sensor . . . . .	8Wa-43-3
G300 . . . . .	8Wa-43-4	Right Side Impact Airbag Control Module .	8Wa-43-4



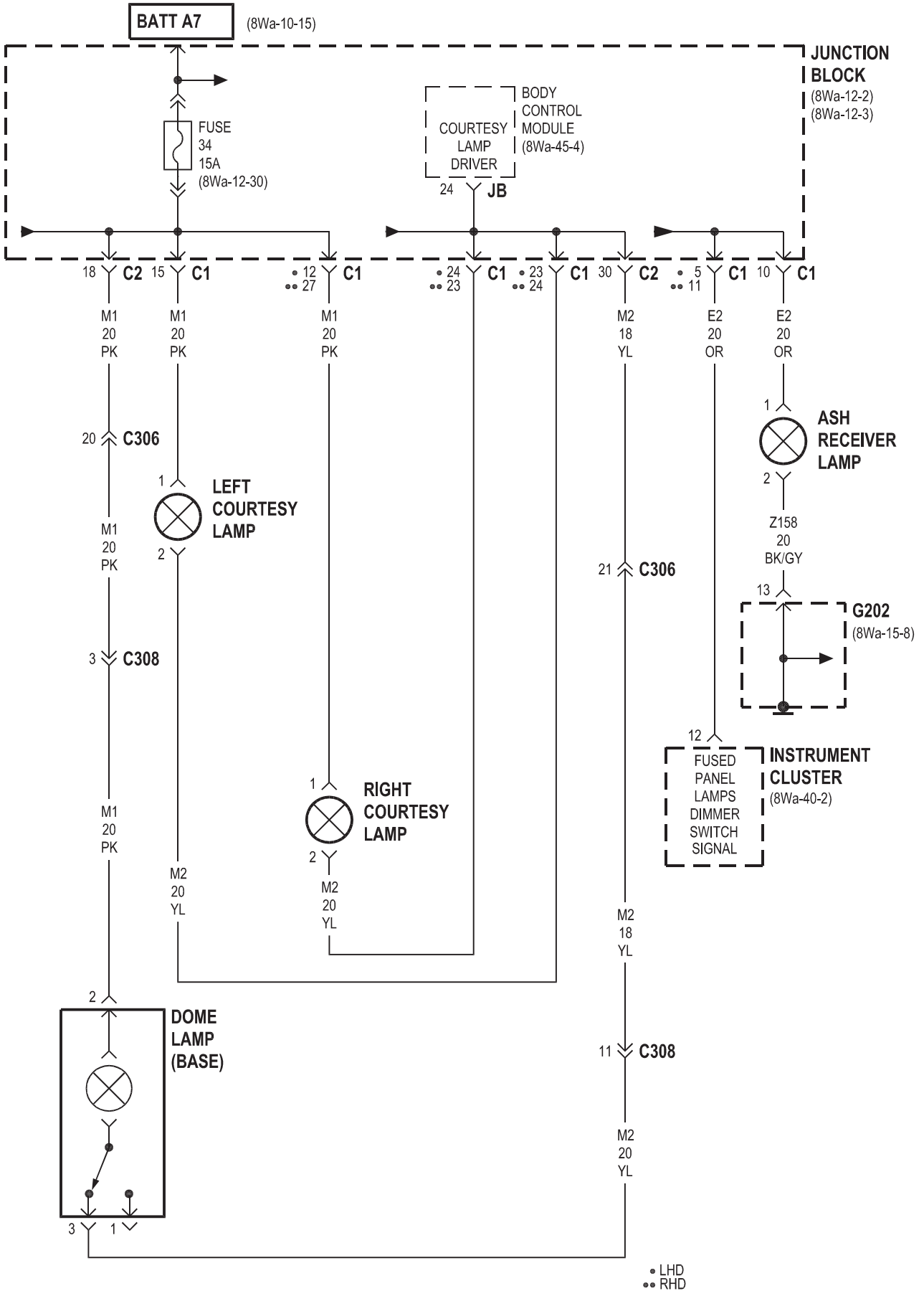


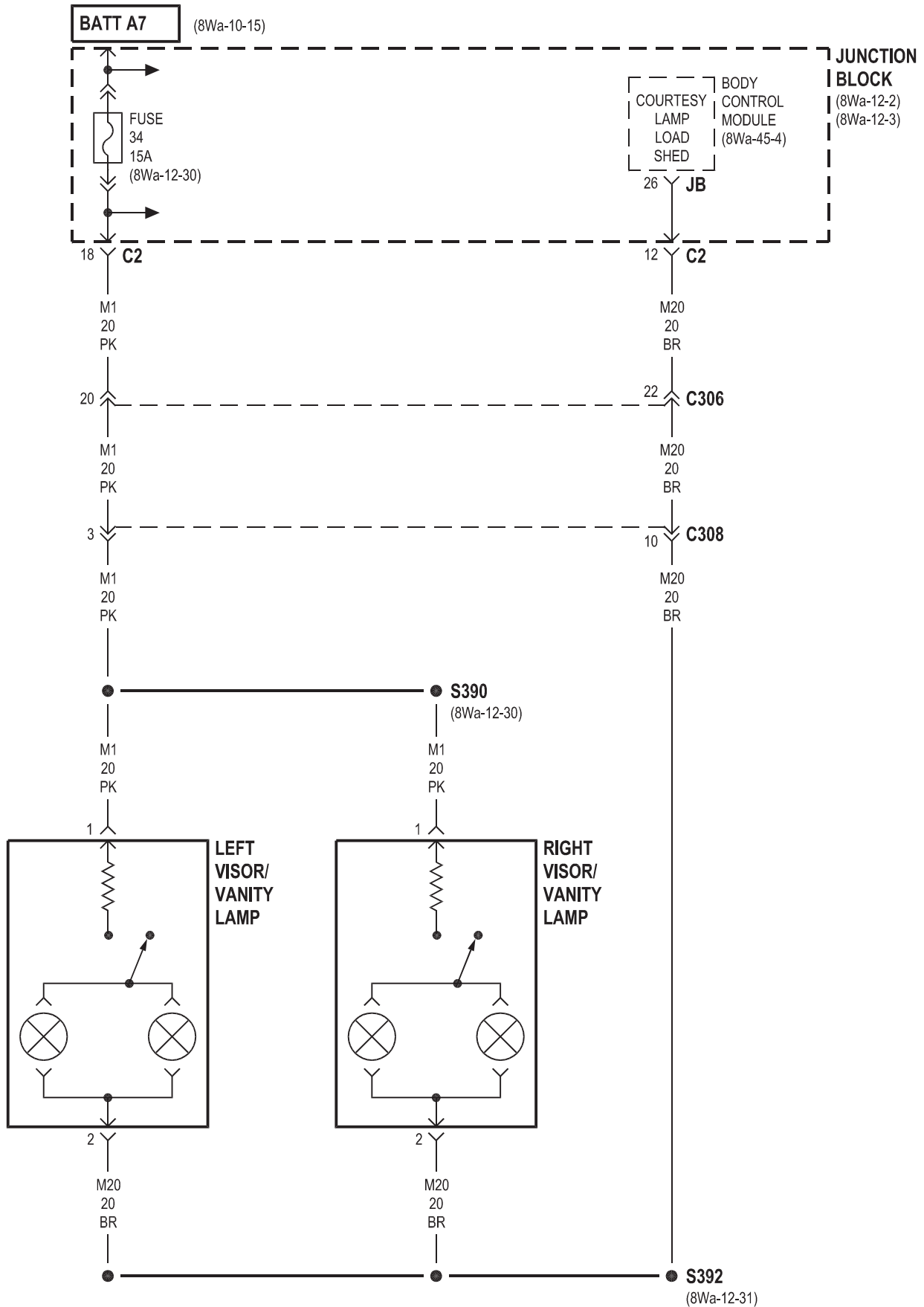


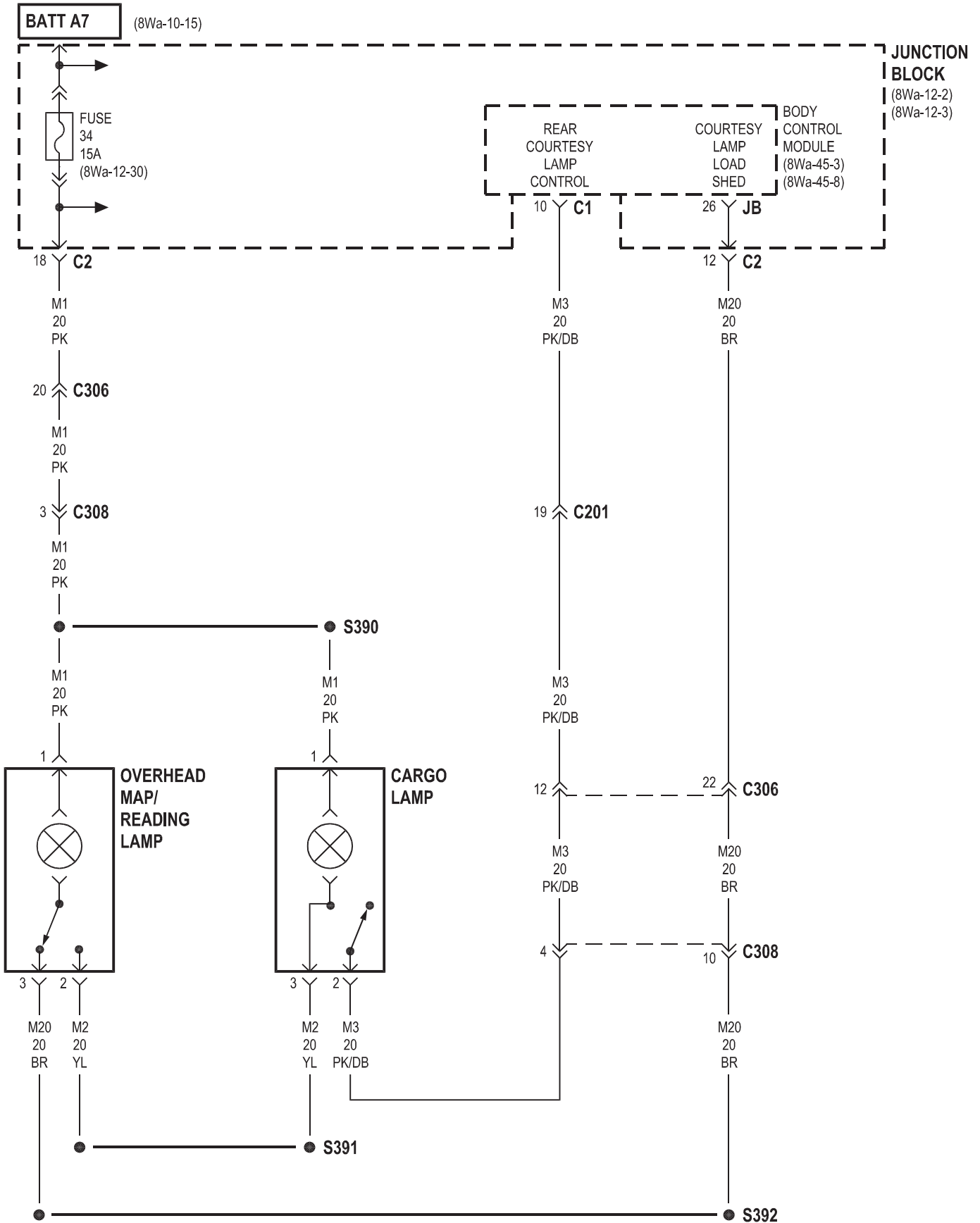
## 8W-44 INTERIOR LIGHTING

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Ash Receiver Lamp . . . . .	8Wa-44-2	Junction Block . . . . .	8Wa-44-2, 3, 4
Body Control Module . . . . .	8Wa-44-2, 3, 4	Left Courtesy Lamp . . . . .	8Wa-44-2
Cargo Lamp . . . . .	8Wa-44-4	Left Visor/Vanity Lamp . . . . .	8Wa-44-3
Dome Lamp . . . . .	8Wa-44-2	Overhead Map/Reading Lamp . . . . .	8Wa-44-4
Fuse 34 . . . . .	8Wa-44-2, 3, 4	Right Courtesy Lamp . . . . .	8Wa-44-2
G202 . . . . .	8Wa-44-2	Right Visor/Vanity Lamp . . . . .	8Wa-44-3
Instrument Cluster . . . . .	8Wa-44-2		



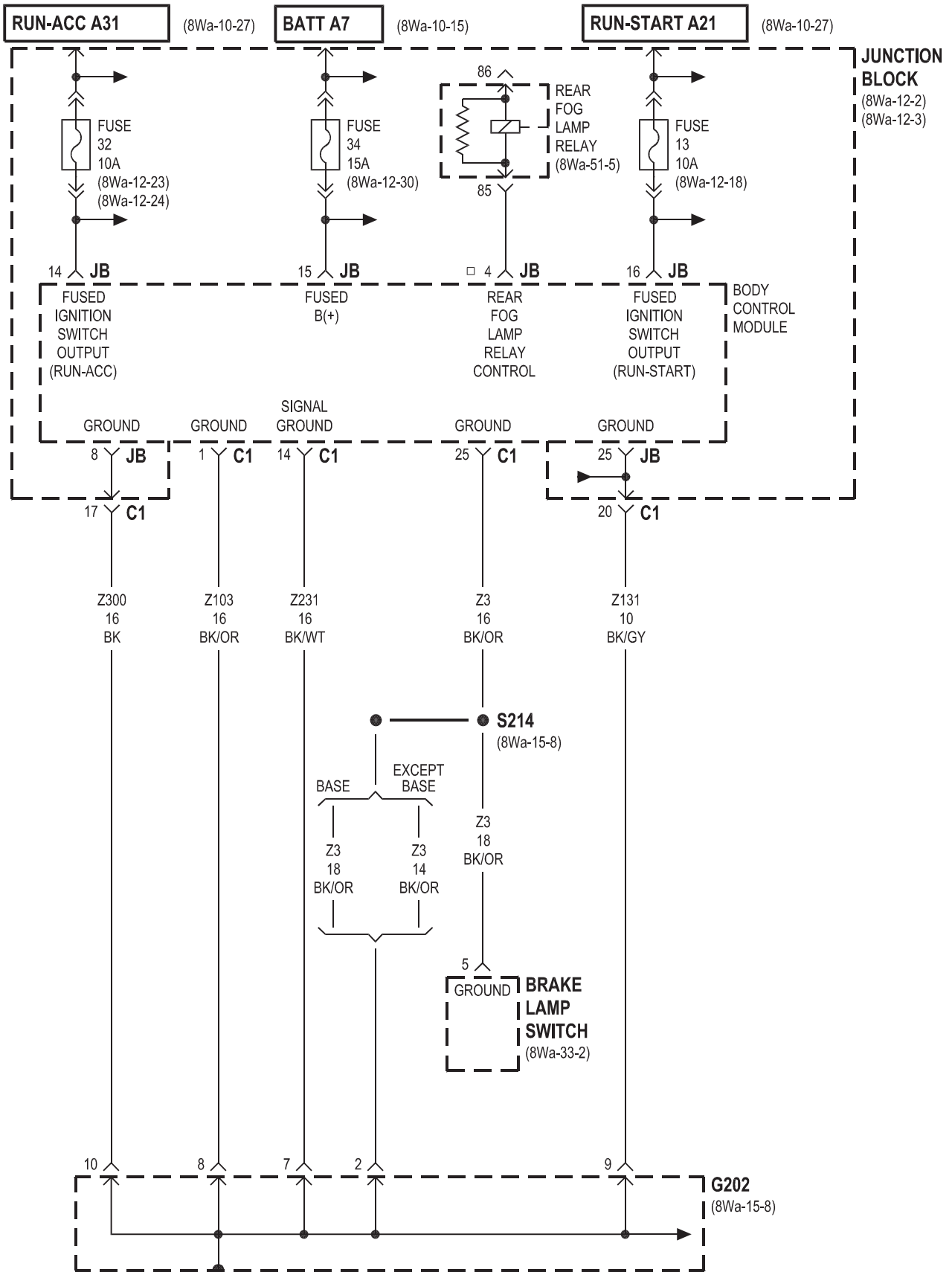


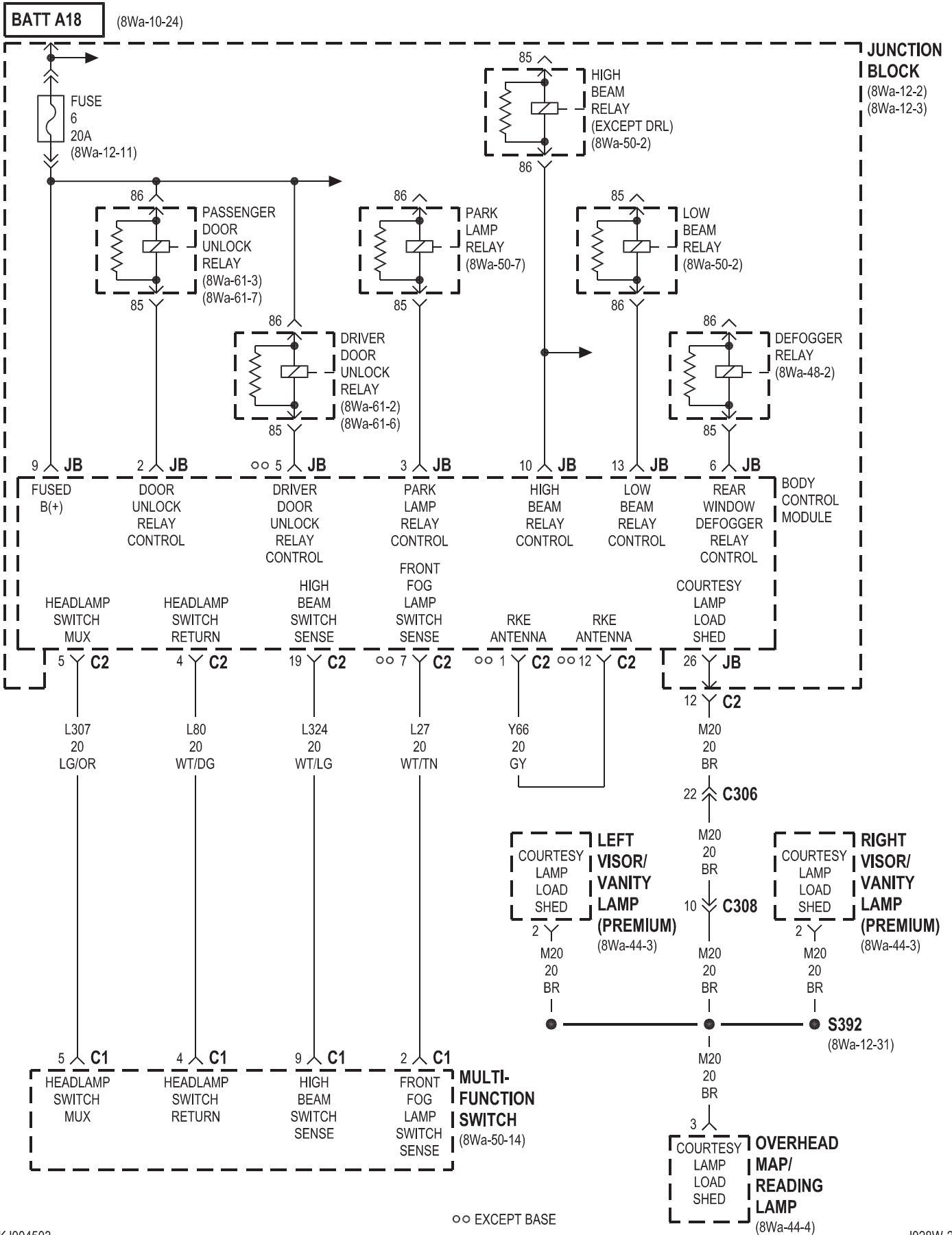


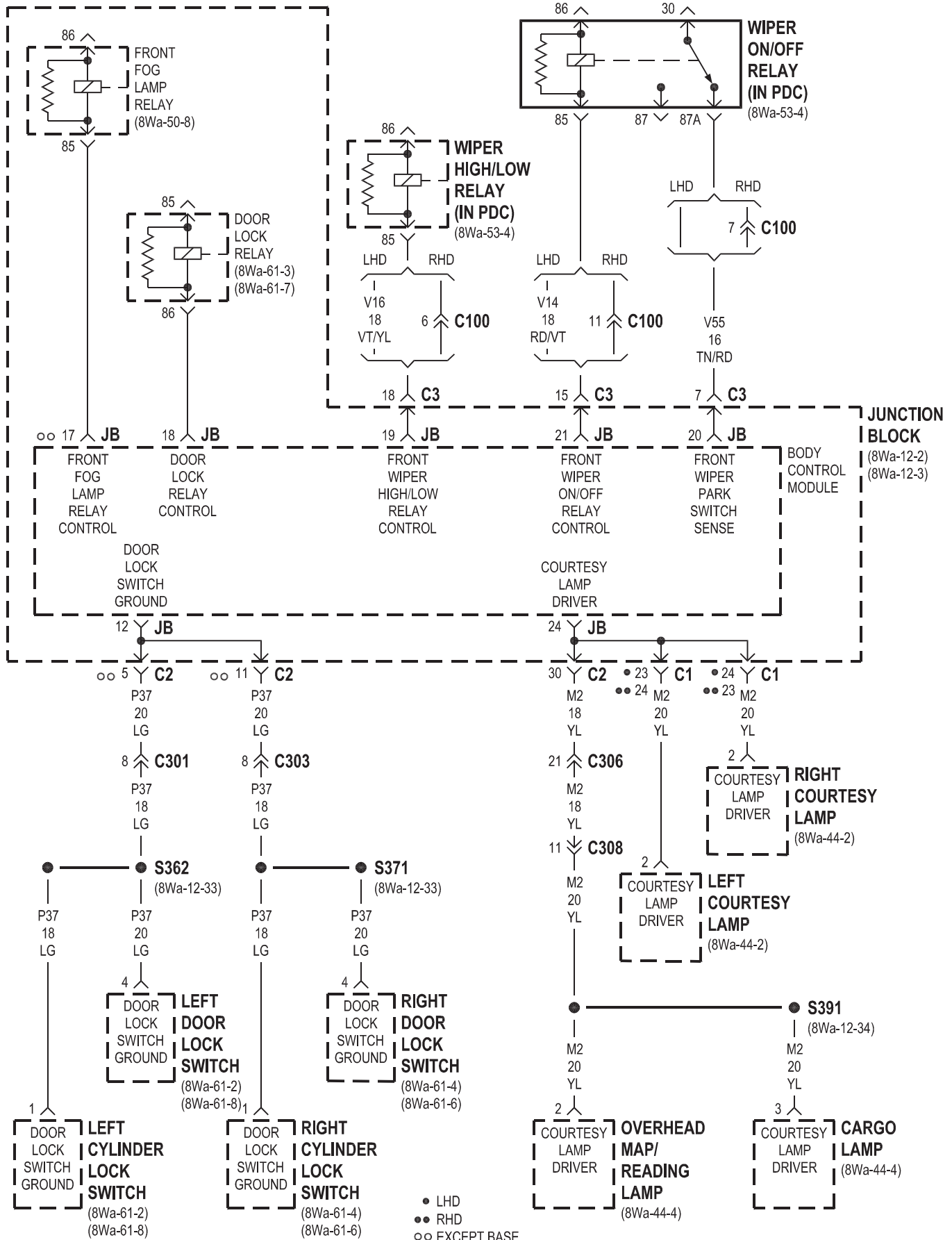


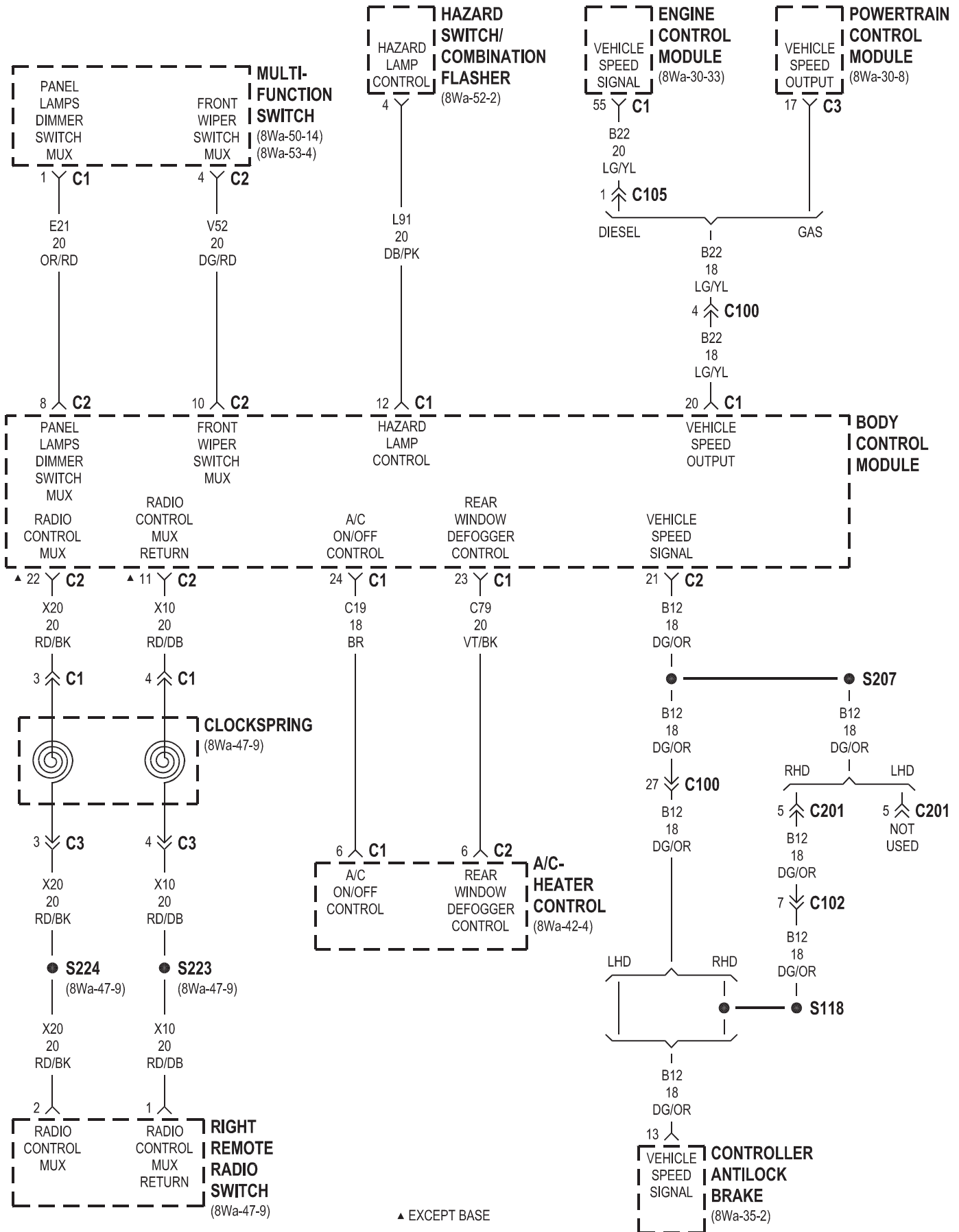
## 8W-45 BODY CONTROL MODULE

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C- Heater Control . . . . .	8Wa-45-5	Junction Block . . . . .	8Wa-45-2, 3, 4, 7, 8
Ambient Temperature Sensor . . . . .	8Wa-45-7	Left Courtesy Lamp . . . . .	8Wa-45-4
Body Control Module . 8Wa-45-10, 11, 2, 3, 4, 5, 6, 7, 8, 9		Left Cylinder Lock Switch . . . . .	8Wa-45-10, 11, 4
Brake Lamp Switch . . . . .	8Wa-45-2	Left Door Lock Switch . . . . .	8Wa-45-4, 7
Cargo Lamp . . . . .	8Wa-45-4, 8	Left Front Door Ajar Switch . . . . .	8Wa-45-9
Clockspring . . . . .	8Wa-45-5	Left Front Door Lock Motor/Ajar Switch . . . . .	8Wa-45-10, 11
Controller Antilock Brake . . . . .	8Wa-45-5	Left Rear Door Ajar Switch . . . . .	8Wa-45-9
Data Link Connector . . . . .	8Wa-45-10, 11	Left Visor/Vanity Lamp . . . . .	8Wa-45-3
Defogger Relay . . . . .	8Wa-45-3	Low Beam Relay . . . . .	8Wa-45-3
Diagnostic Junction Port . . . . .	8Wa-45-6	Multi- Function Switch . . . . .	8Wa-45-3, 5, 6
Door Lock Relay . . . . .	8Wa-45-4	Overhead Map/Reading Lamp . . . . .	8Wa-45-3, 4
Driver Door Unlock Relay . . . . .	8Wa-45-3	Park Lamp Relay . . . . .	8Wa-45-3
Engine Control Module . . . . .	8Wa-45-5	Passenger Door Unlock Relay . . . . .	8Wa-45-3
Flip-Up Glass Release Motor . . . . .	8Wa-45-8	Powertrain Control Module . . . . .	8Wa-45-5
Flip-Up Glass Release Switch . . . . .	8Wa-45-8	Rear Fog Lamp Relay . . . . .	8Wa-45-2
Front Fog Lamp Relay . . . . .	8Wa-45-4	Rear Wiper Motor . . . . .	8Wa-45-6, 8
Fuse 3 . . . . .	8Wa-45-7	Remote Keyless Entry Module . . . . .	8Wa-45-8
Fuse 6 . . . . .	8Wa-45-3	Right Courtesy Lamp . . . . .	8Wa-45-4
Fuse 13 . . . . .	8Wa-45-2	Right Cylinder Lock Switch . . . . .	8Wa-45-10, 11, 4
Fuse 32 . . . . .	8Wa-45-2	Right Door Lock Switch . . . . .	8Wa-45-4, 7
Fuse 34 . . . . .	8Wa-45-2	Right Front Door Ajar Switch . . . . .	8Wa-45-9
G111 . . . . .	8Wa-45-7	Right Front Door Lock Motor/Ajar Switch . . . . .	8Wa-45-10, 11
G202 . . . . .	8Wa-45-2, 6	Right Rear Door Ajar Switch . . . . .	8Wa-45-9
G300 . . . . .	8Wa-45-9	Right Remote Radio Switch . . . . .	8Wa-45-5
G302 . . . . .	8Wa-45-9	Right Visor/Vanity Lamp . . . . .	8Wa-45-3
Hazard Switch/Combination Flasher . . . . .	8Wa-45-5	Tailgate Cylinder Lock Switch . . . . .	8Wa-45-10, 11, 8
High Beam Relay . . . . .	8Wa-45-3	Tailgate Lock Motor/Ajar Switch . . . . .	8Wa-45-7, 8
Hood Ajar Switch . . . . .	8Wa-45-7	Washer Pump . . . . .	8Wa-45-6
Horn Relay . . . . .	8Wa-45-7	Wiper High/Low Relay . . . . .	8Wa-45-4
Ignition Switch . . . . .	8Wa-45-6	Wiper On/Off Relay . . . . .	8Wa-45-4
Instrument Cluster . . . . .	8Wa-45-6		



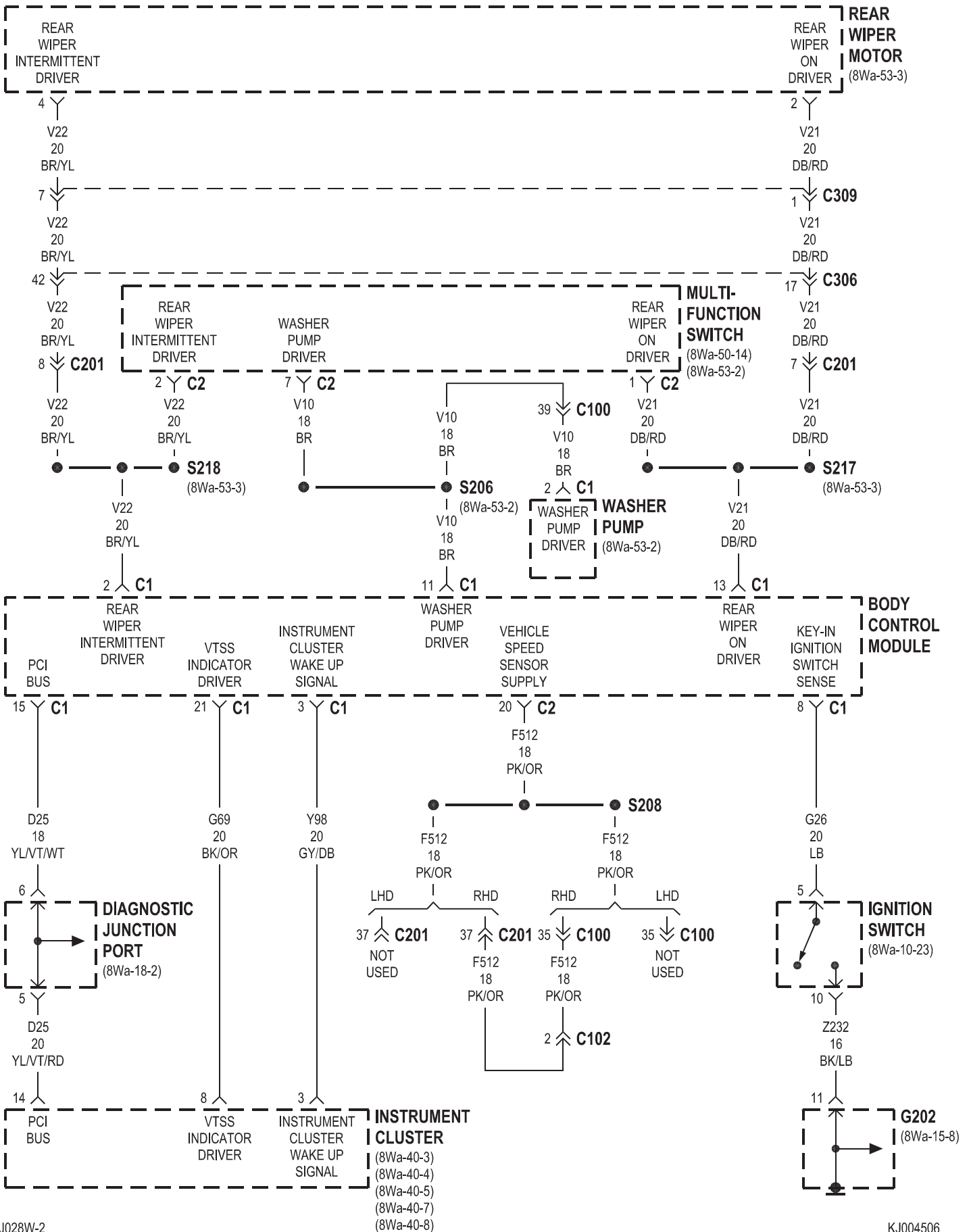


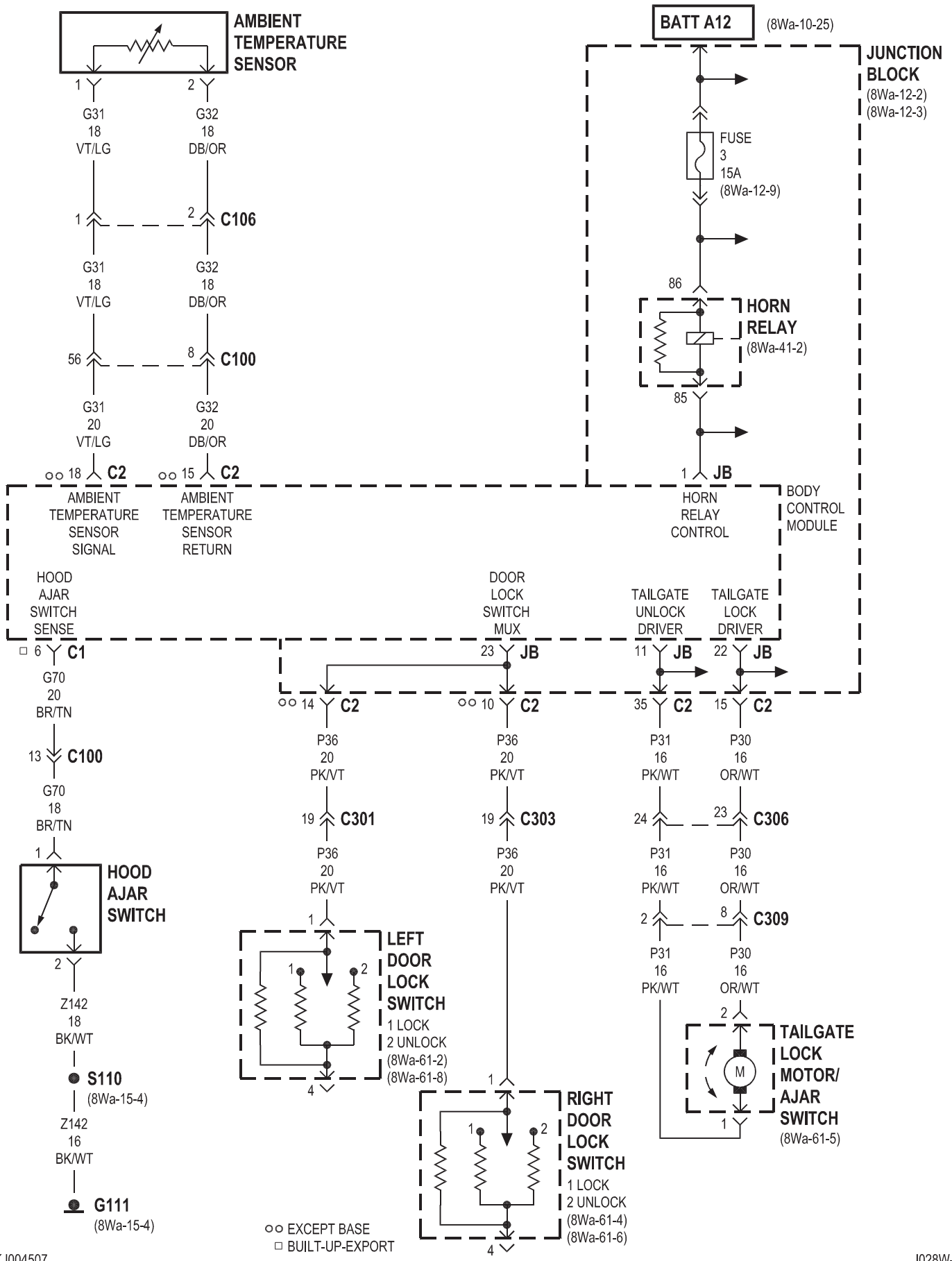


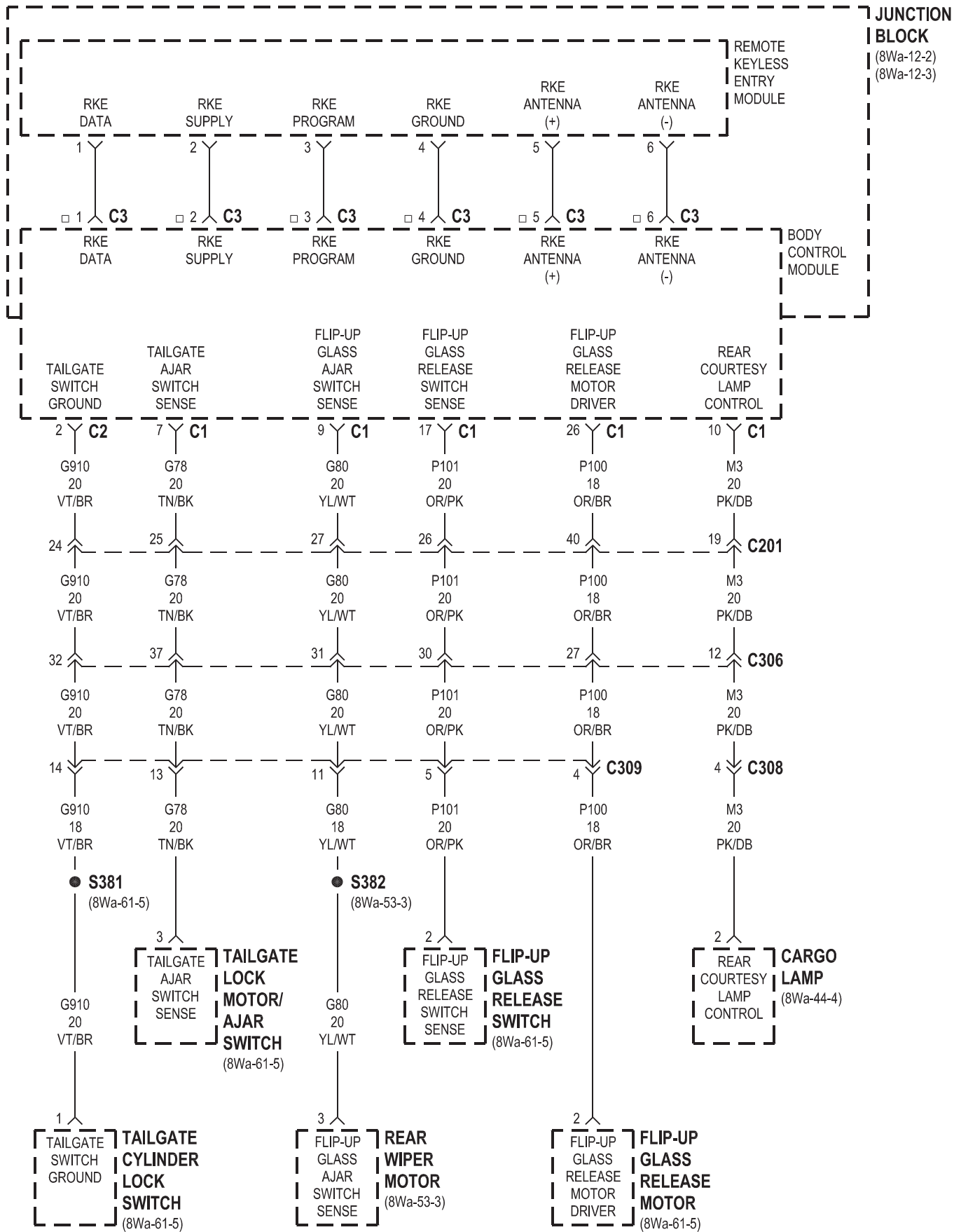


▲ EXCEPT BASE

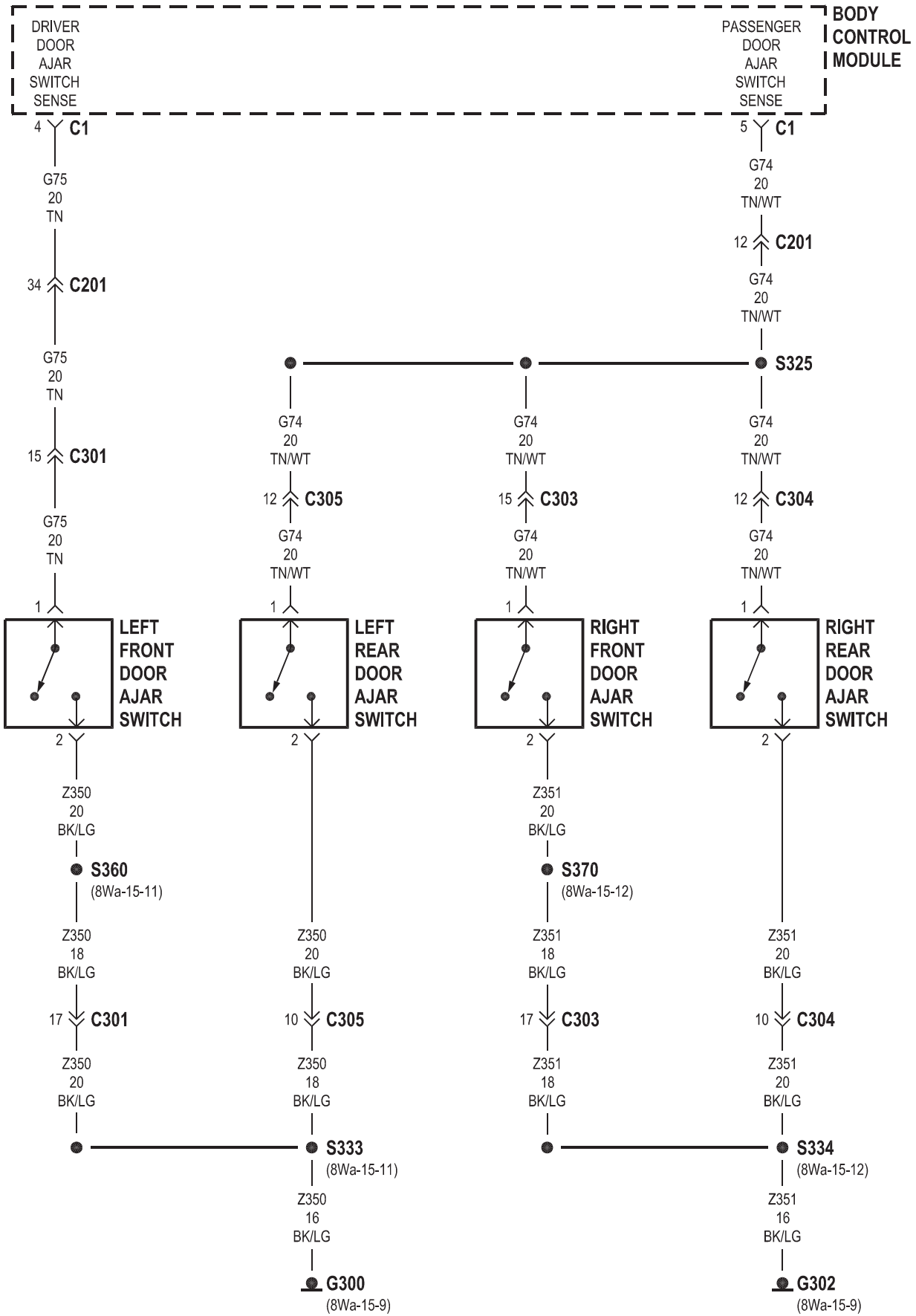


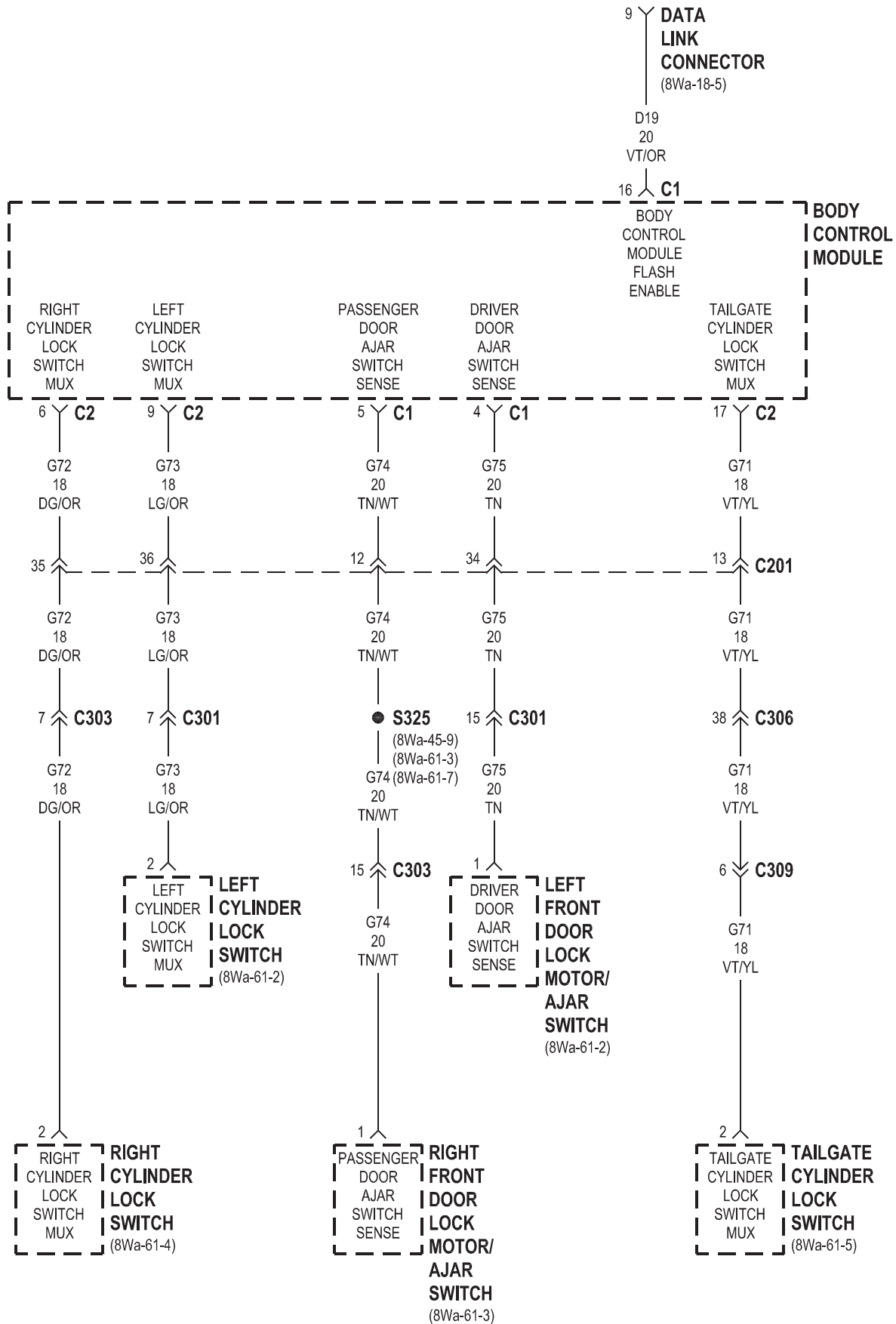


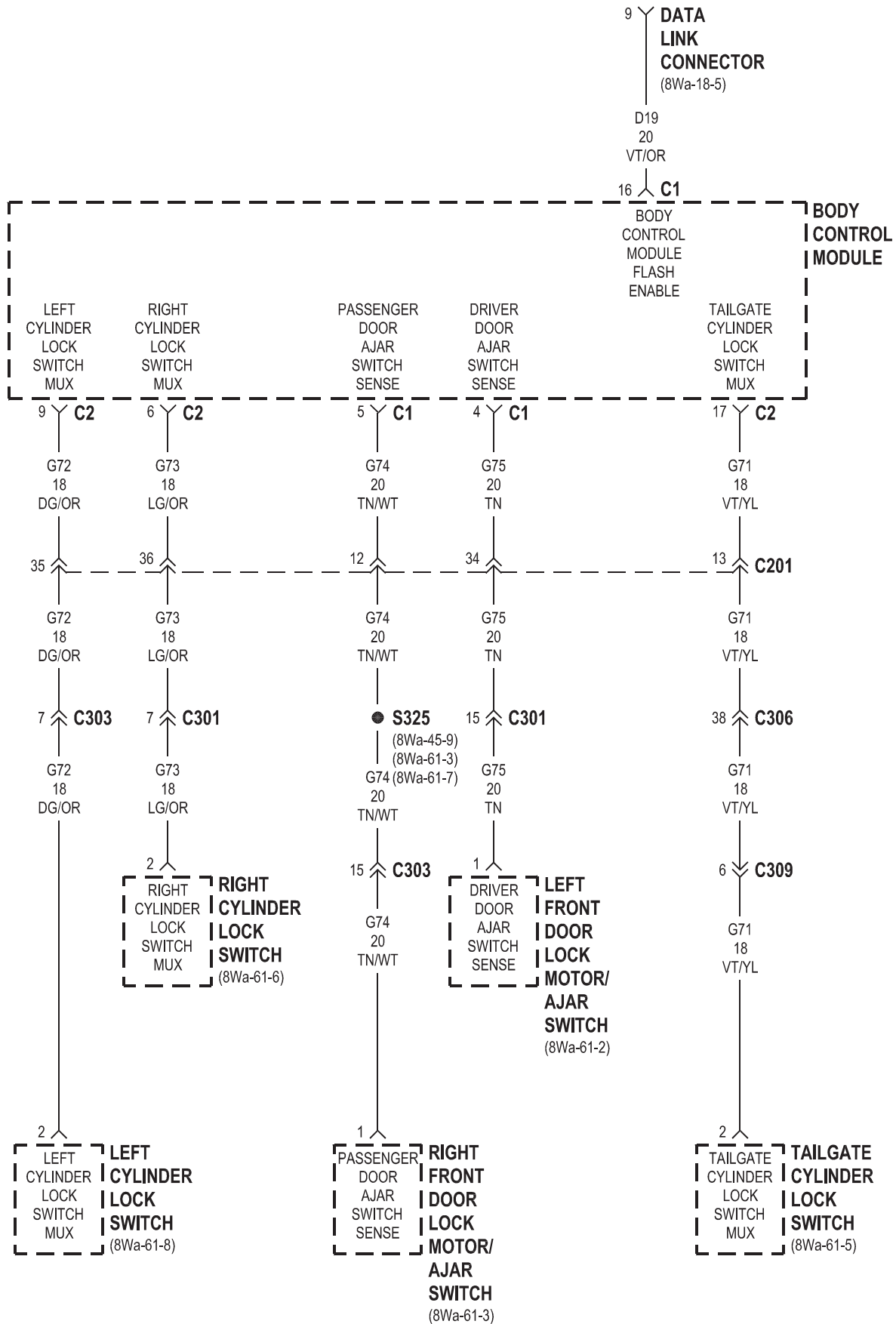




□ PREMIUM





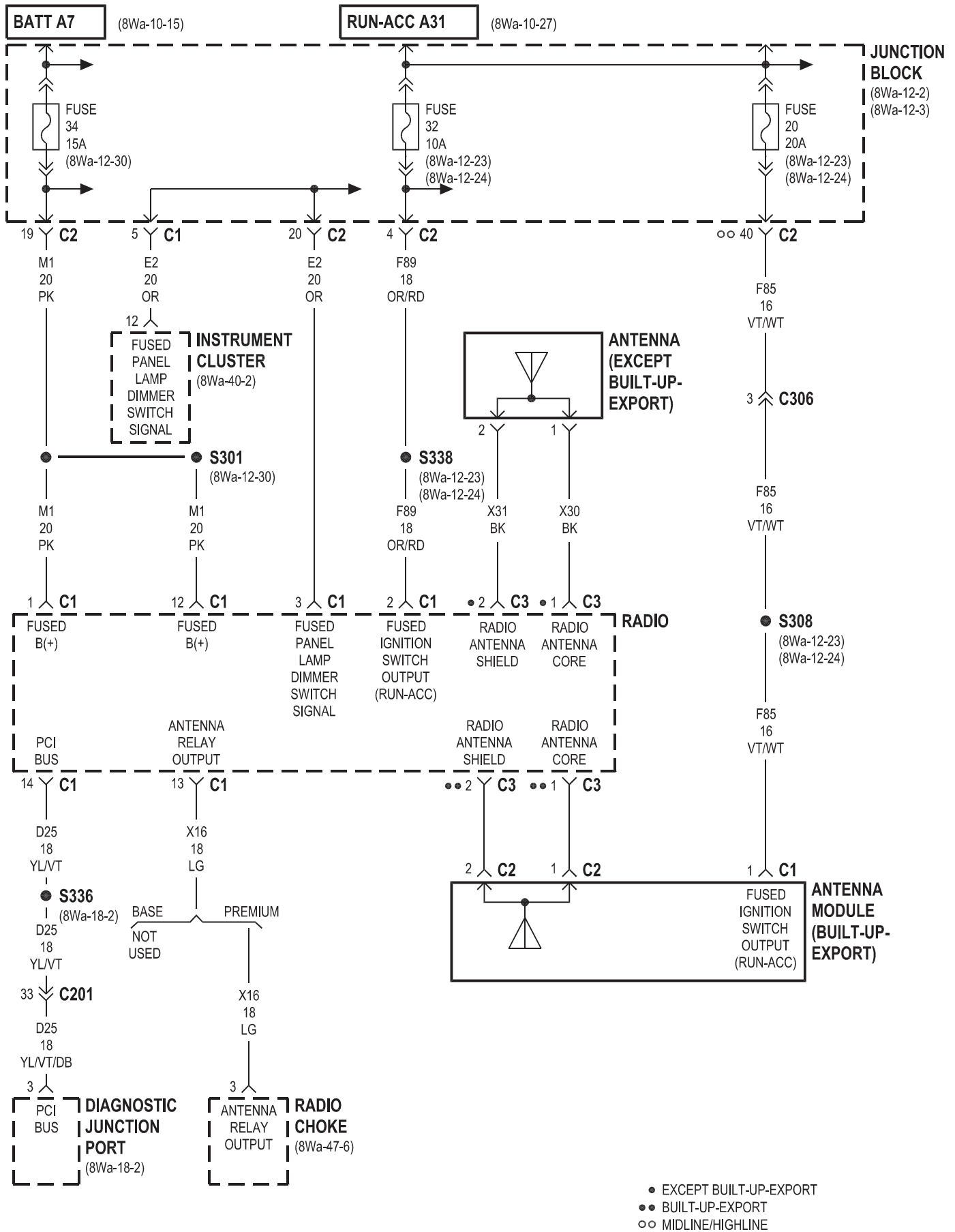


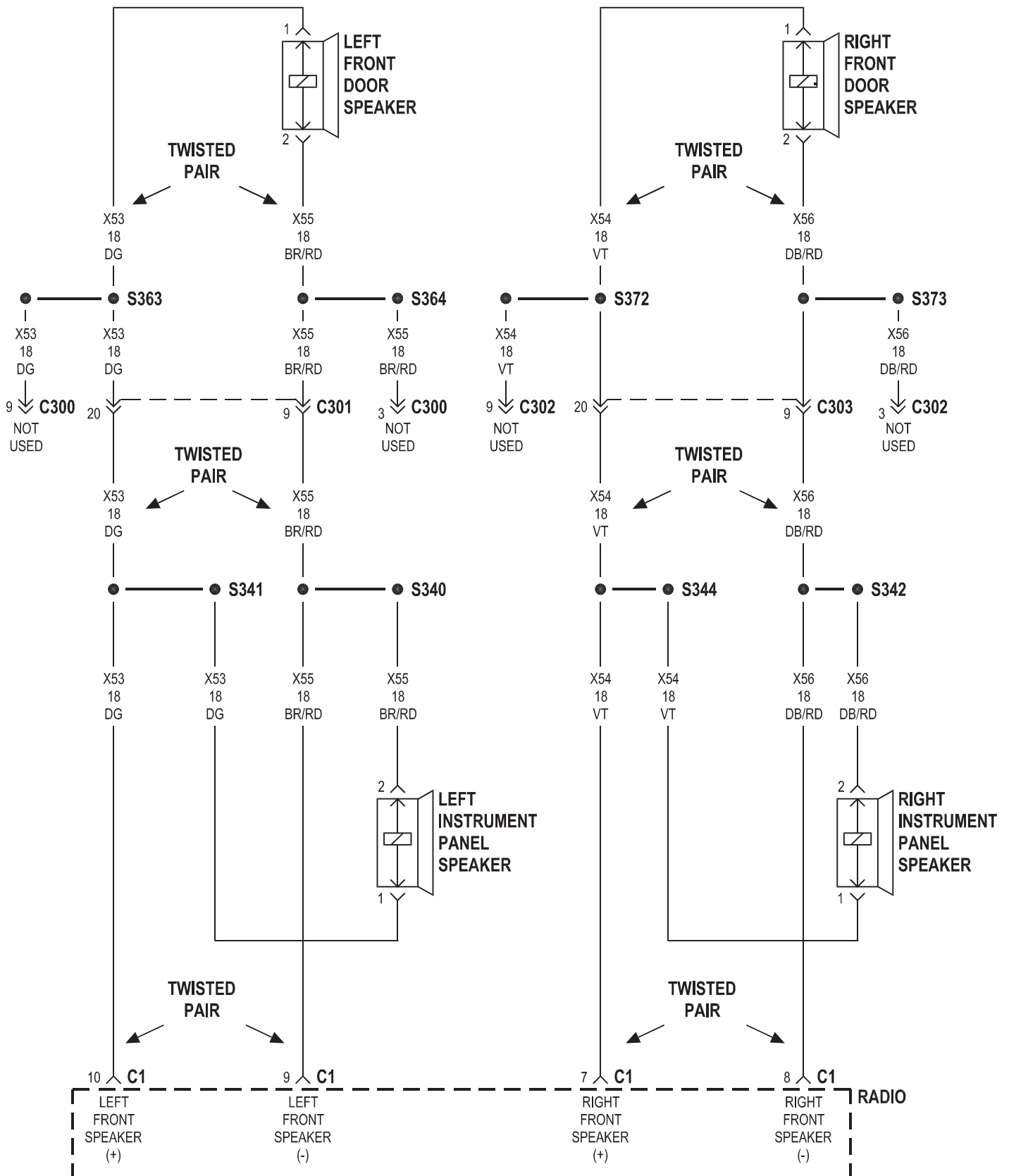


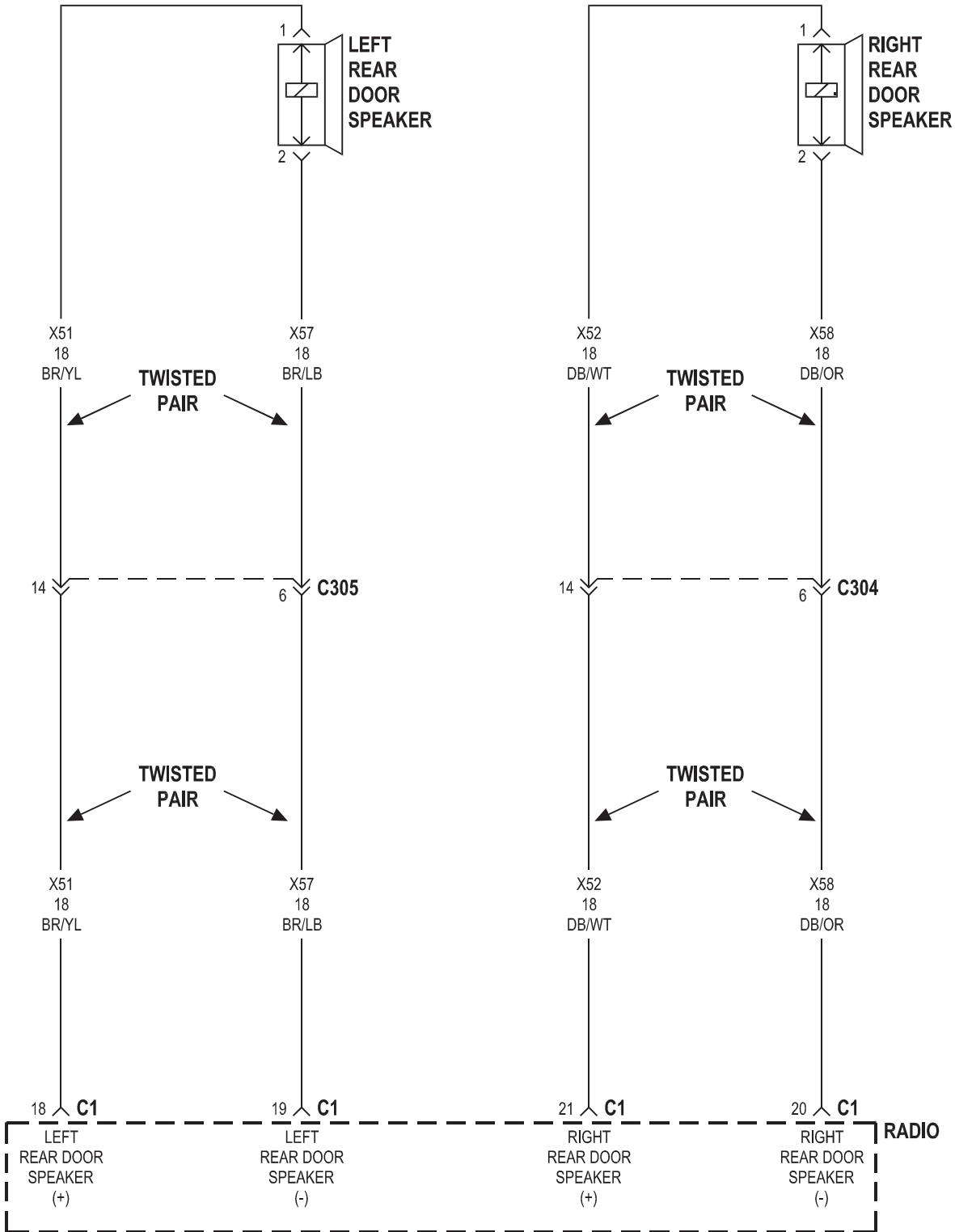
## 8W-47 AUDIO SYSTEM

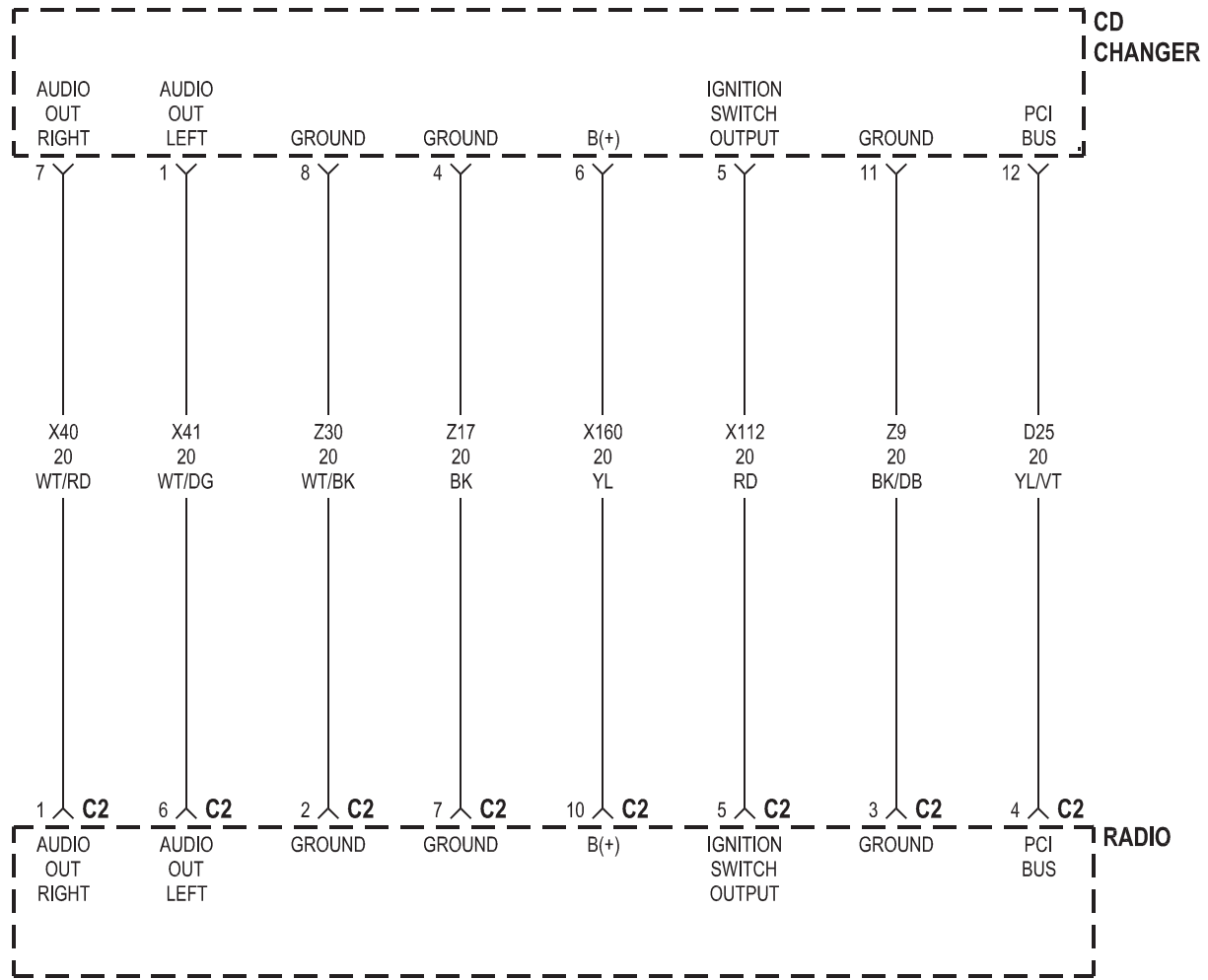
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Antenna . . . . .	8Wa-47-2	Instrument Cluster . . . . .	8Wa-47-2
Antenna Module . . . . .	8Wa-47-2	Junction Block . . . . .	8Wa-47-2, 6
Body Control Module . . . . .	8Wa-47-9	Left Front Door Speaker . . . . .	8Wa-47-3, 7, 8
Cd Changer . . . . .	8Wa-47-5	Left Instrument Panel Speaker . . . . .	8Wa-47-3, 7
Clockspring . . . . .	8Wa-47-9	Left Rear Door Speaker . . . . .	8Wa-47-4, 8
Diagnostic Junction Port . . . . .	8Wa-47-2, 9	Left Remote Radio Switch . . . . .	8Wa-47-9
Fuse 18 . . . . .	8Wa-47-6	Radio . . . . .	8Wa-47-2, 3, 4, 5, 6, 7, 8, 9
Fuse 20 . . . . .	8Wa-47-2	Radio Choke . . . . .	8Wa-47-2, 6, 7
Fuse 32 . . . . .	8Wa-47-2	Right Front Door Speaker . . . . .	8Wa-47-3, 7, 8
Fuse 34 . . . . .	8Wa-47-2	Right Instrument Panel Speaker . . . . .	8Wa-47-3, 7
G200 . . . . .	8Wa-47-7	Right Rear Door Speaker . . . . .	8Wa-47-4, 8
G301 . . . . .	8Wa-47-6	Right Remote Radio Switch . . . . .	8Wa-47-9

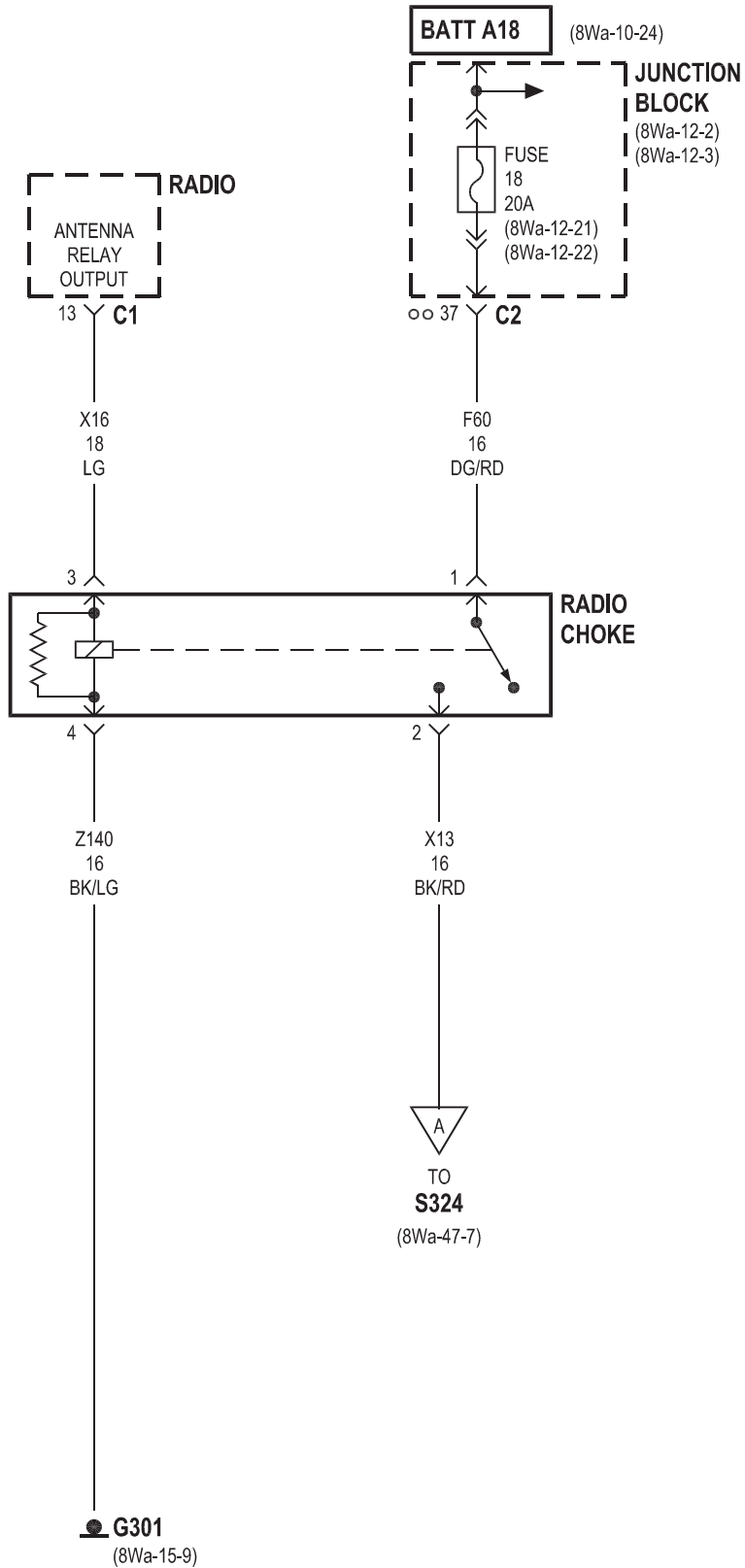


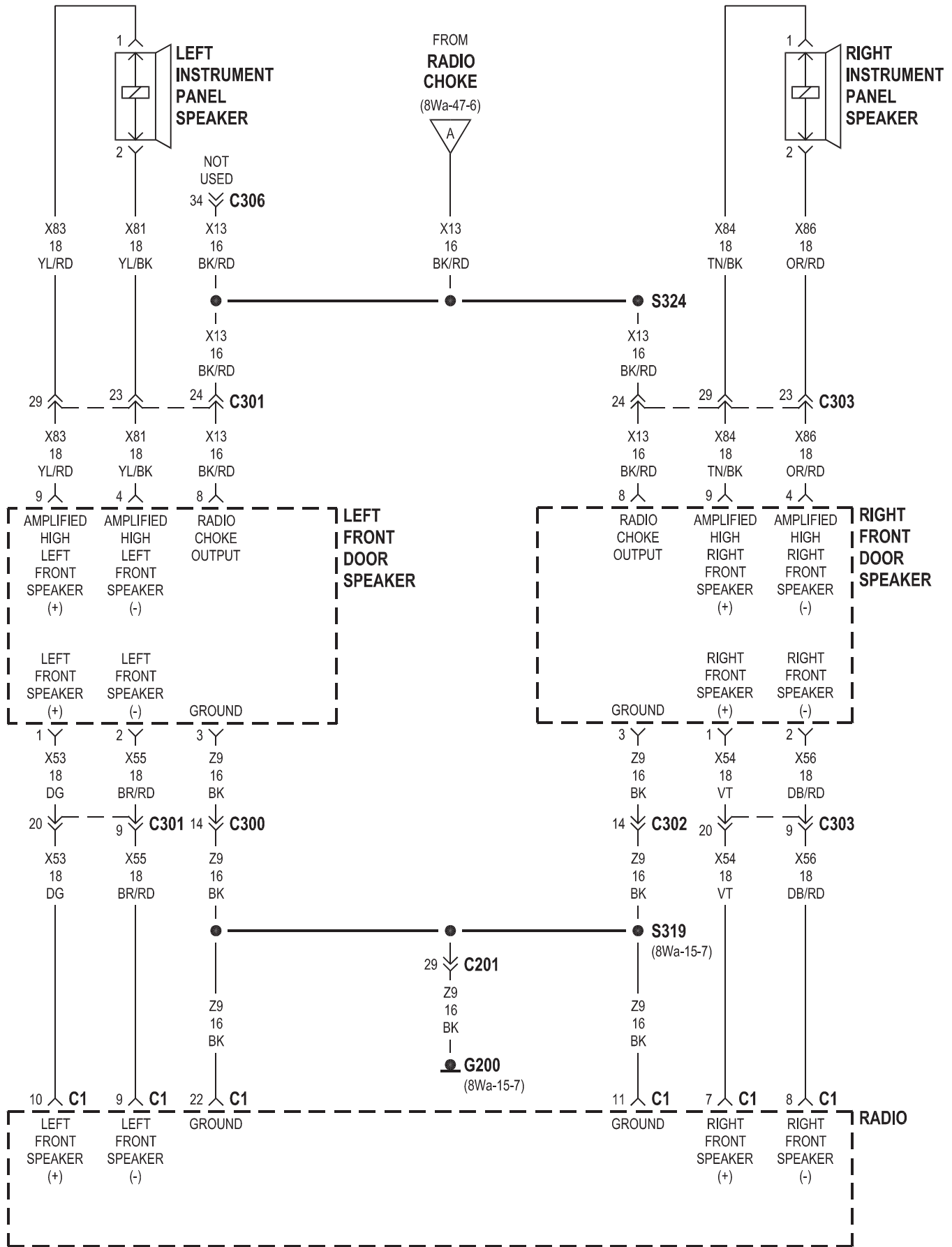


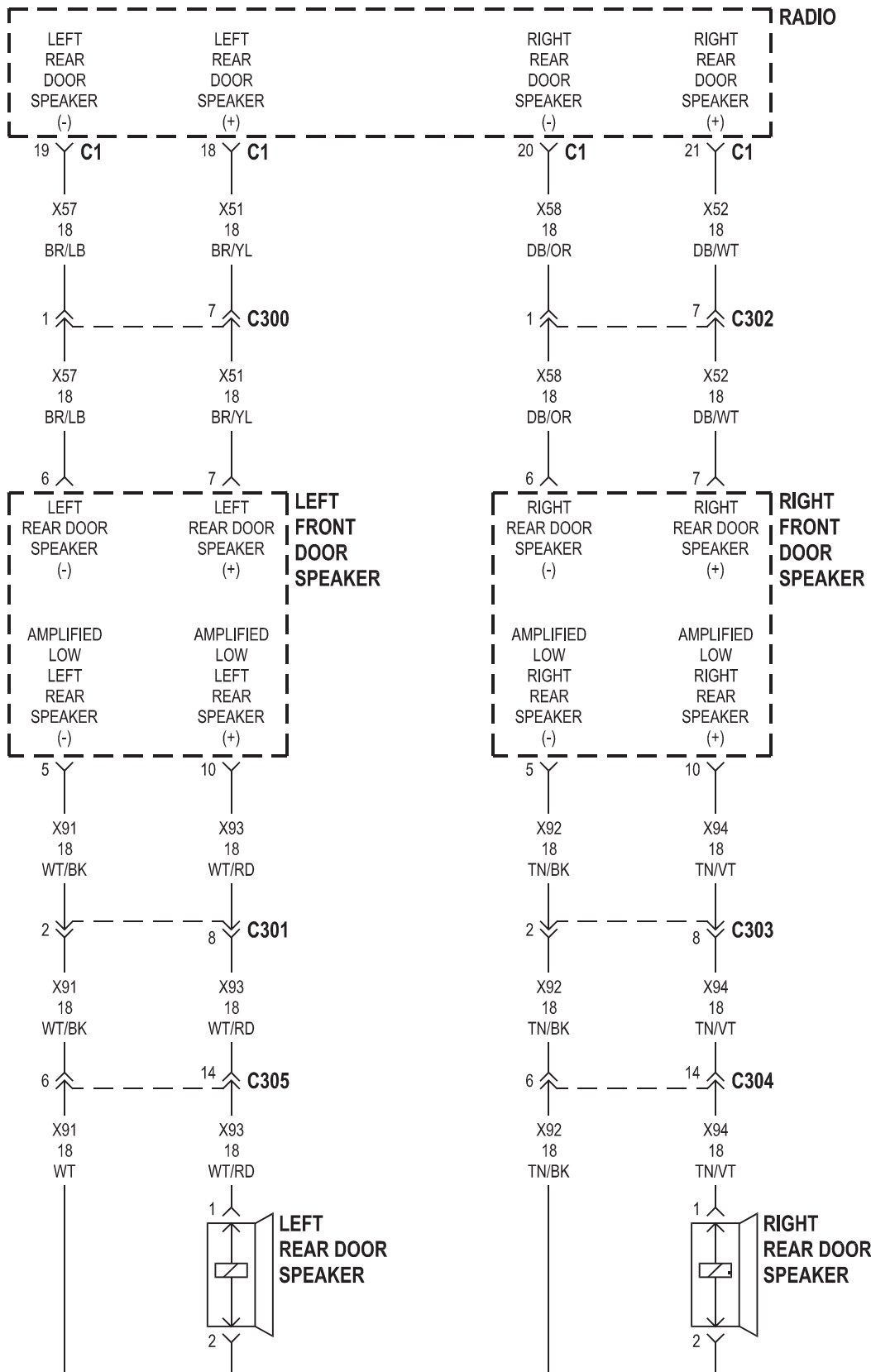


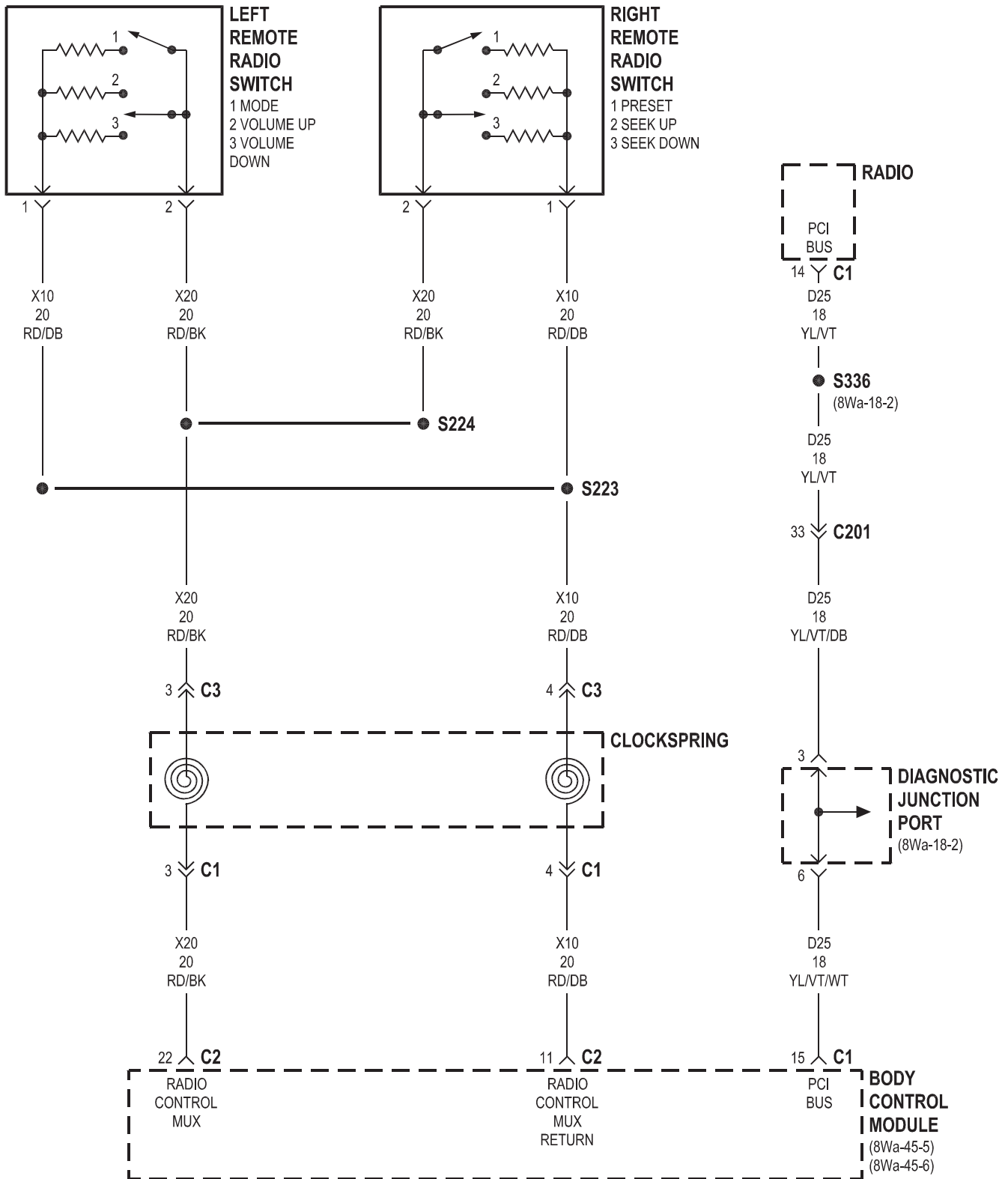










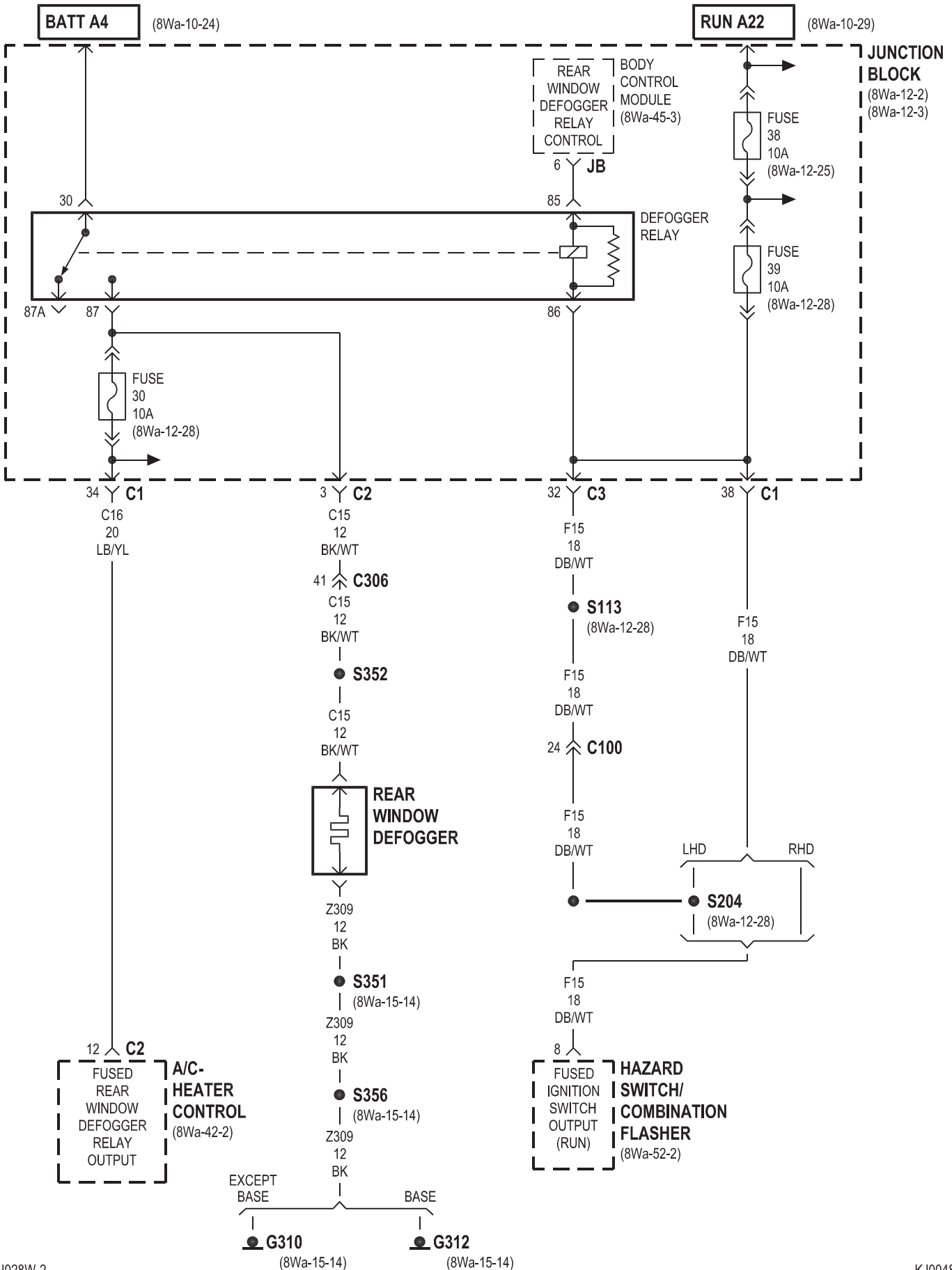






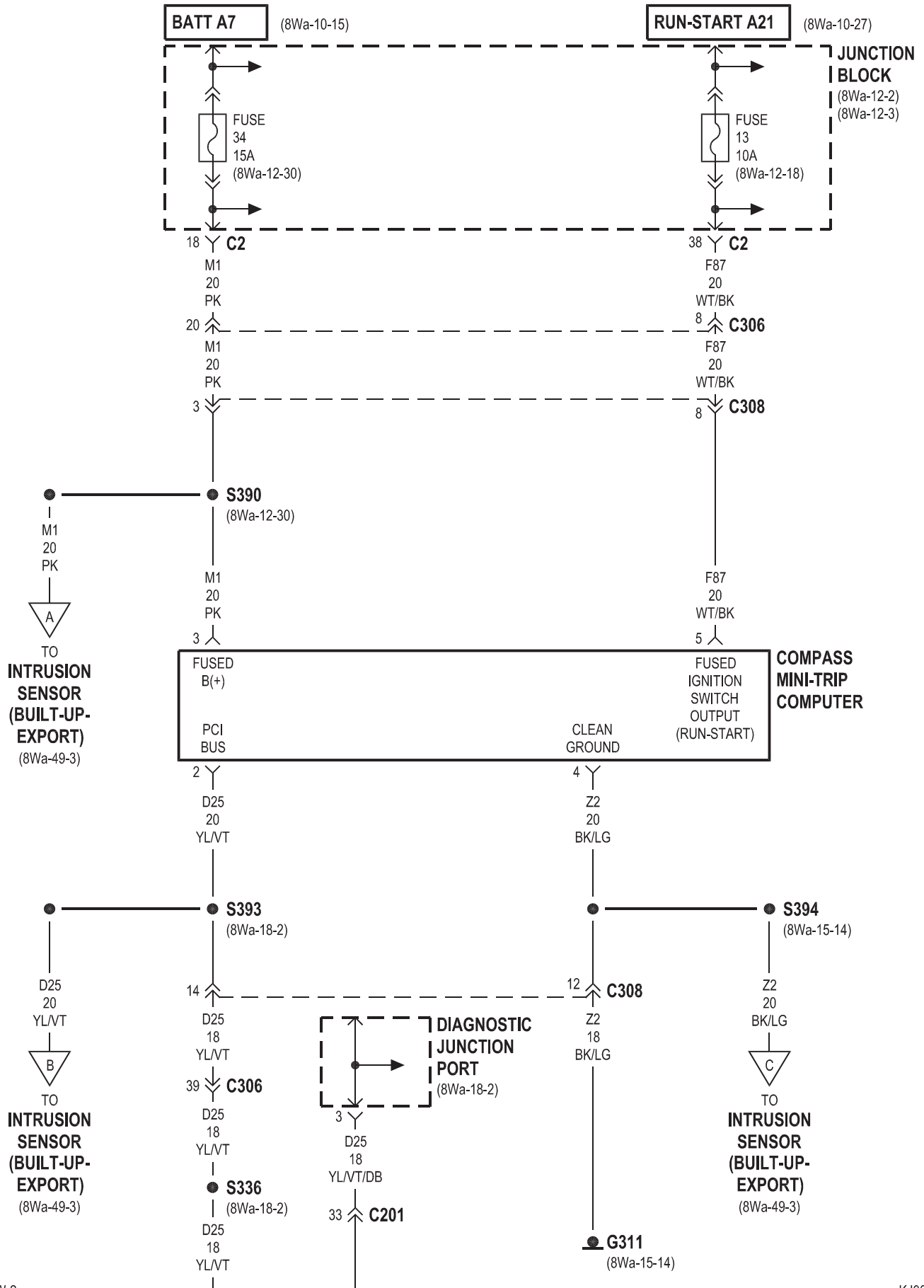
## 8W-48 REAR WINDOW DEFOGGER

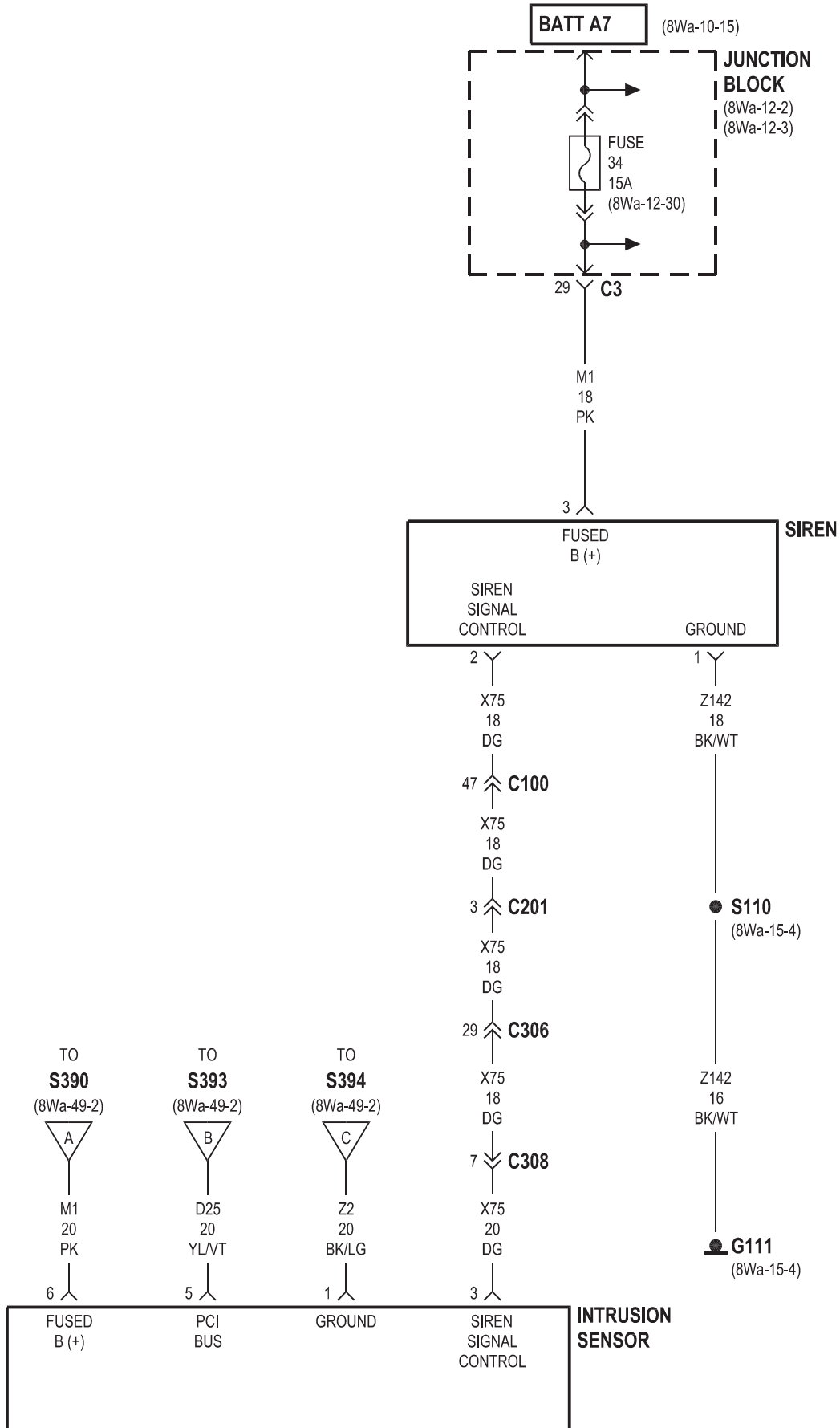
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
A/C- Heater Control .....	8Wa-48-2	G310 .....	8Wa-48-2
Body Control Module .....	8Wa-48-2	G312 .....	8Wa-48-2
Defogger Relay .....	8Wa-48-2	Hazard Switch/Combination Flasher .....	8Wa-48-2
Fuse 30 .....	8Wa-48-2	Junction Block .....	8Wa-48-2
Fuse 38 .....	8Wa-48-2	Rear Window Defogger .....	8Wa-48-2
Fuse 39 .....	8Wa-48-2		

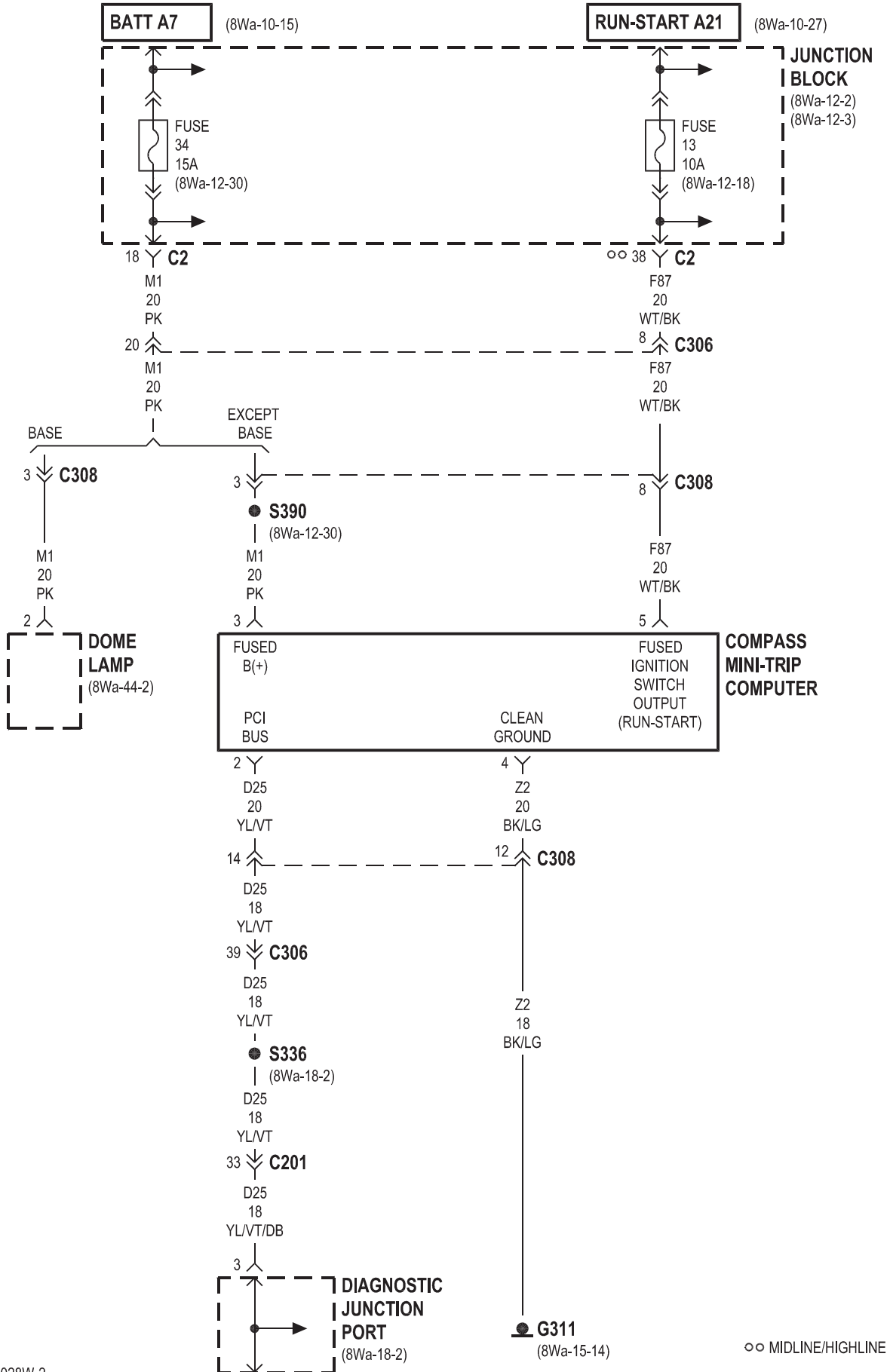


## 8W-49 OVERHEAD CONSOLE

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Compass Mini-Trip Computer . . . . .	8Wa-49-2, 4	G111 . . . . .	8Wa-49-3
Diagnostic Junction Port . . . . .	8Wa-49-2, 4	G311 . . . . .	8Wa-49-2, 4
Dome Lamp . . . . .	8Wa-49-4	Intrusion Sensor . . . . .	8Wa-49-2, 3
Fuse 13 . . . . .	8Wa-49-2, 4	Junction Block . . . . .	8Wa-49-2, 3, 4
Fuse 34 . . . . .	8Wa-49-2, 3, 4	Siren . . . . .	8Wa-49-3



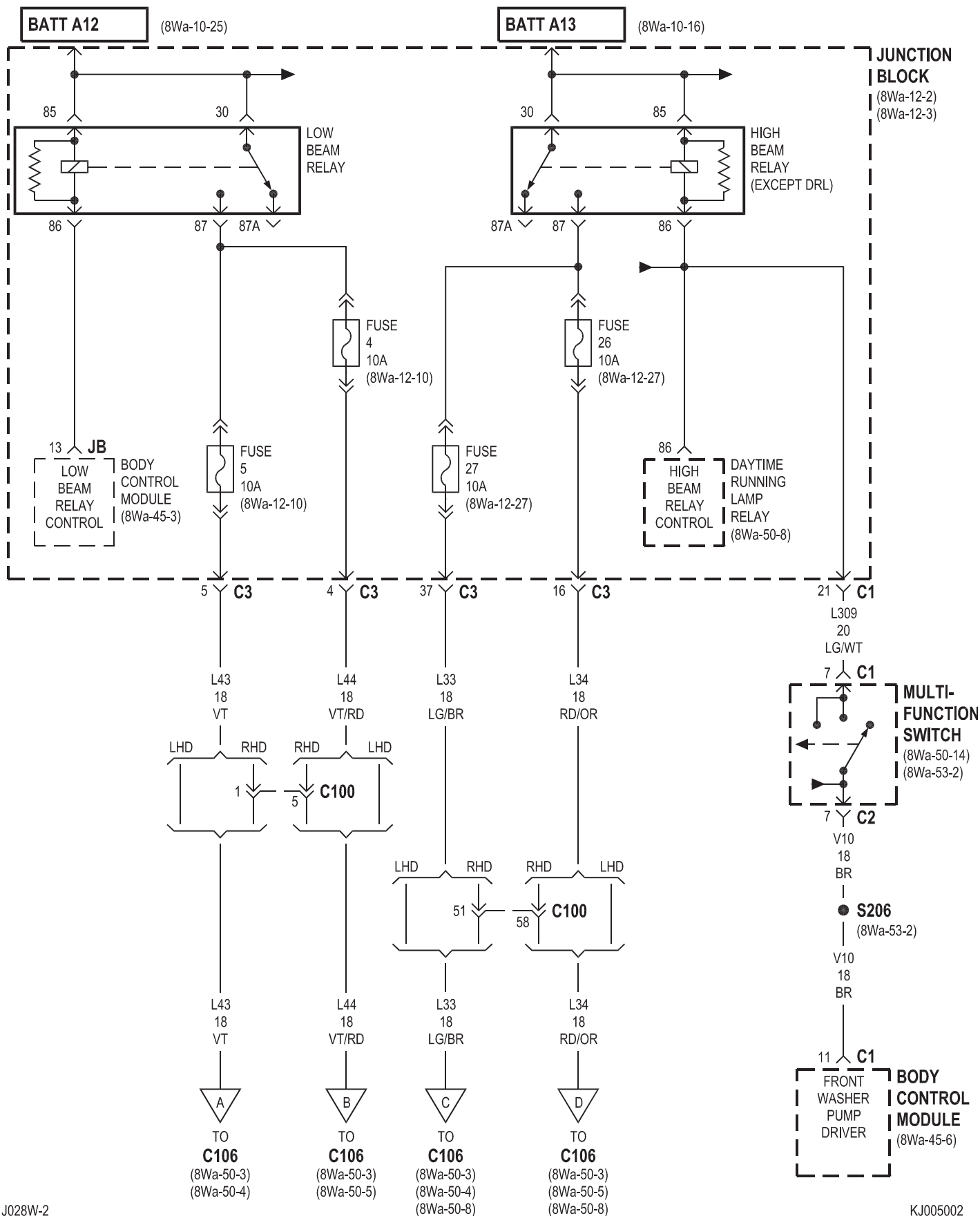


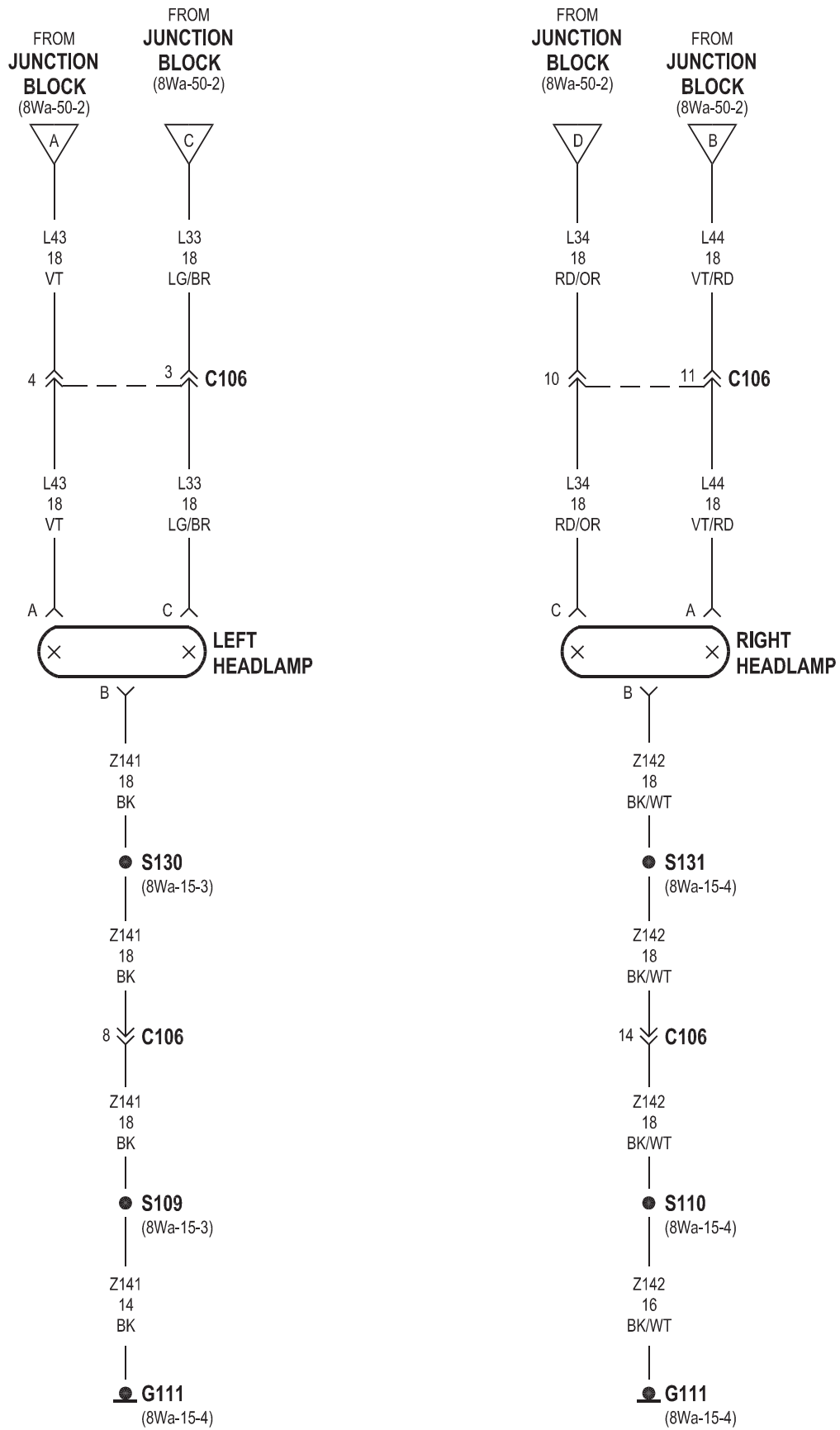


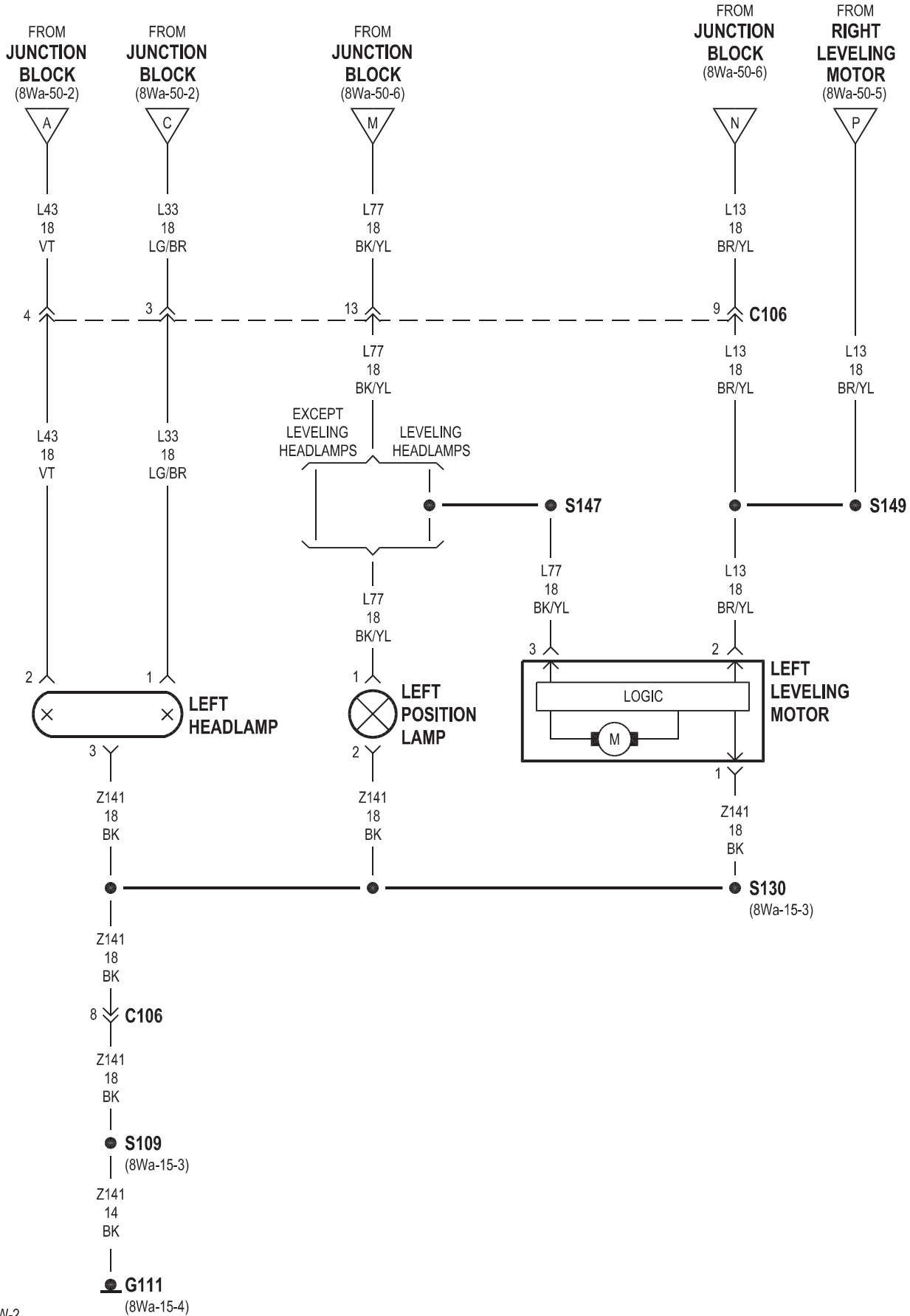
## 8W-50 FRONT LIGHTING

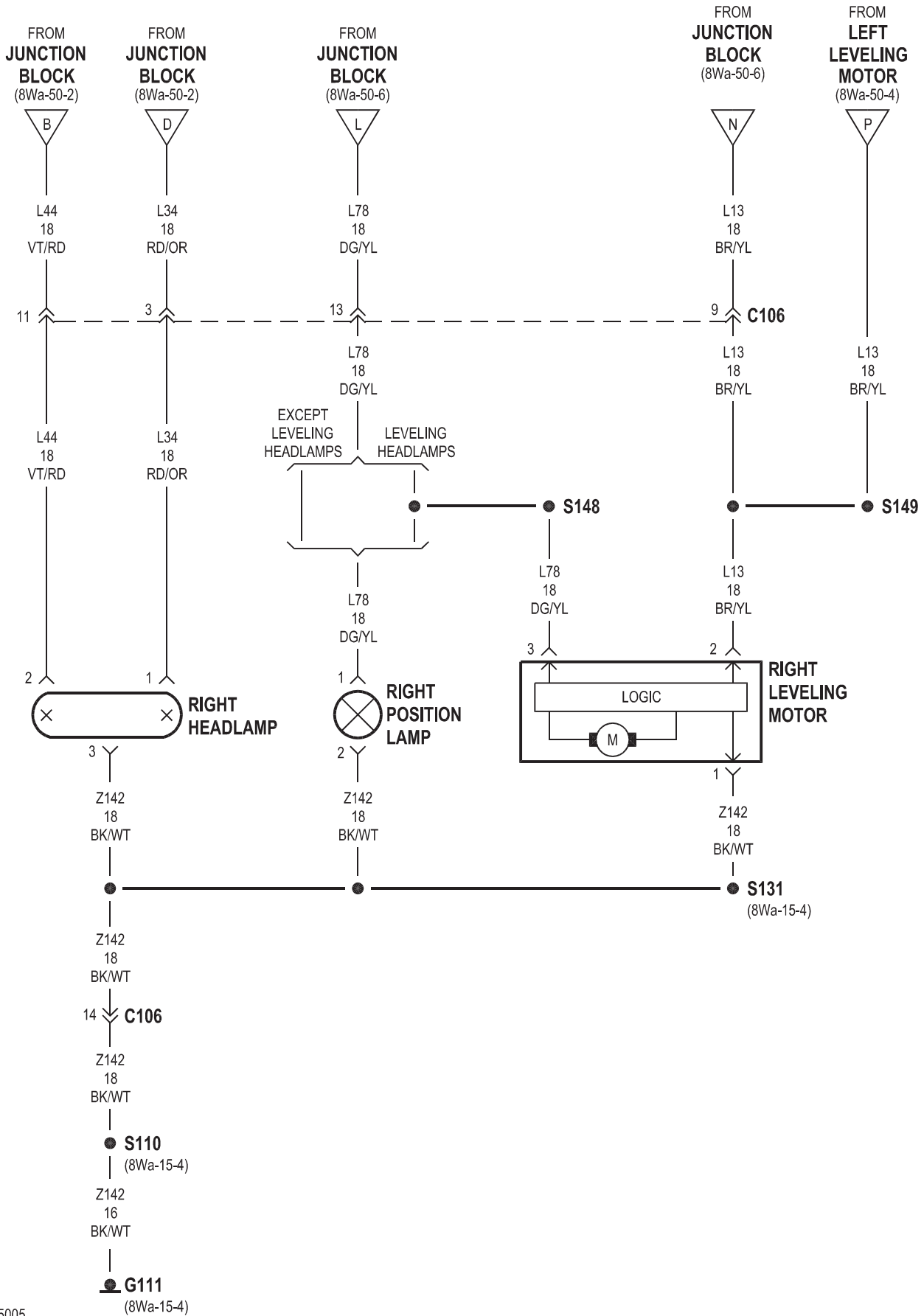
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module . . . . .	8Wa-50-14, 2, 7, 8	Left Front Park/Turn Signal Lamp . . .	8Wa-50-11, 9
Daytime Running Lamp Relay . . . .	8Wa-50-14, 2, 8	Left Headlamp . . . . .	8Wa-50-3, 4
Front Fog Lamp Relay . . . . .	8Wa-50-8	Left Leveling Motor . . . . .	8Wa-50-4, 5
Fuse 3 . . . . .	8Wa-50-8	Left Position Lamp . . . . .	8Wa-50-4
Fuse 4 . . . . .	8Wa-50-2	Left Side Marker Lamp . . . . .	8Wa-50-9
Fuse 5 . . . . .	8Wa-50-2	Left Side Repeater Lamp . . . . .	8Wa-50-11
Fuse 9 . . . . .	8Wa-50-6, 7, 8	Low Beam Relay . . . . .	8Wa-50-2
Fuse 19 . . . . .	8Wa-50-8	Multi- Function Switch . . . . .	8Wa-50-14, 2
Fuse 23 . . . . .	8Wa-50-6, 7	Park Lamp Relay . . . . .	8Wa-50-6, 7
Fuse 26 . . . . .	8Wa-50-2, 8	Power Distribution Center . . . . .	8Wa-50-8
Fuse 27 . . . . .	8Wa-50-2, 8	Right Fog Lamp . . . . .	8Wa-50-10, 12, 13, 8
G111 . . . . .	8Wa-50-10, 11, 12, 13, 3, 4, 5, 9	Right Front Park/Turn Signal Lamp .	8Wa-50-10, 11, 12, 13
G202 . . . . .	8Wa-50-6	Right Headlamp . . . . .	8Wa-50-3, 5
Hazard Switch/Combination Flasher . . . . .	8Wa-50-7	Right Leveling Motor . . . . .	8Wa-50-4, 5
Headlamp Leveling Switch . . . . .	8Wa-50-6	Right Position Lamp . . . . .	8Wa-50-5
High Beam Relay . . . . .	8Wa-50-14, 2	Right Side Marker Lamp . . . . .	8Wa-50-10
Junction Block .	8Wa-50-10, 11, 12, 13, 14, 2, 3, 4, 5, 6, 7, 8, 9	Right Side Repeater Lamp . . . . .	8Wa-50-11, 12, 13
Left Fog Lamp . . . . .	8Wa-50-8, 9		

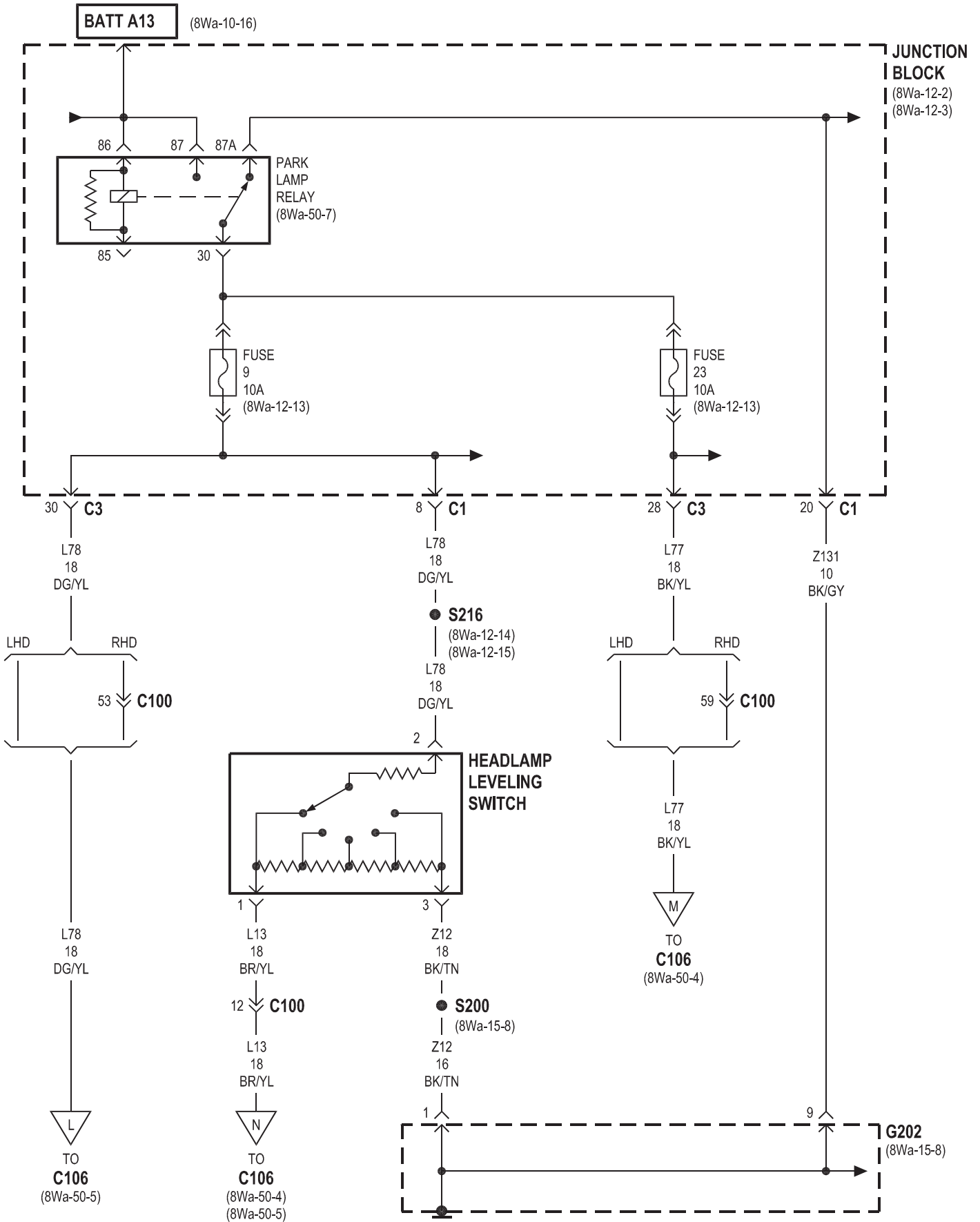


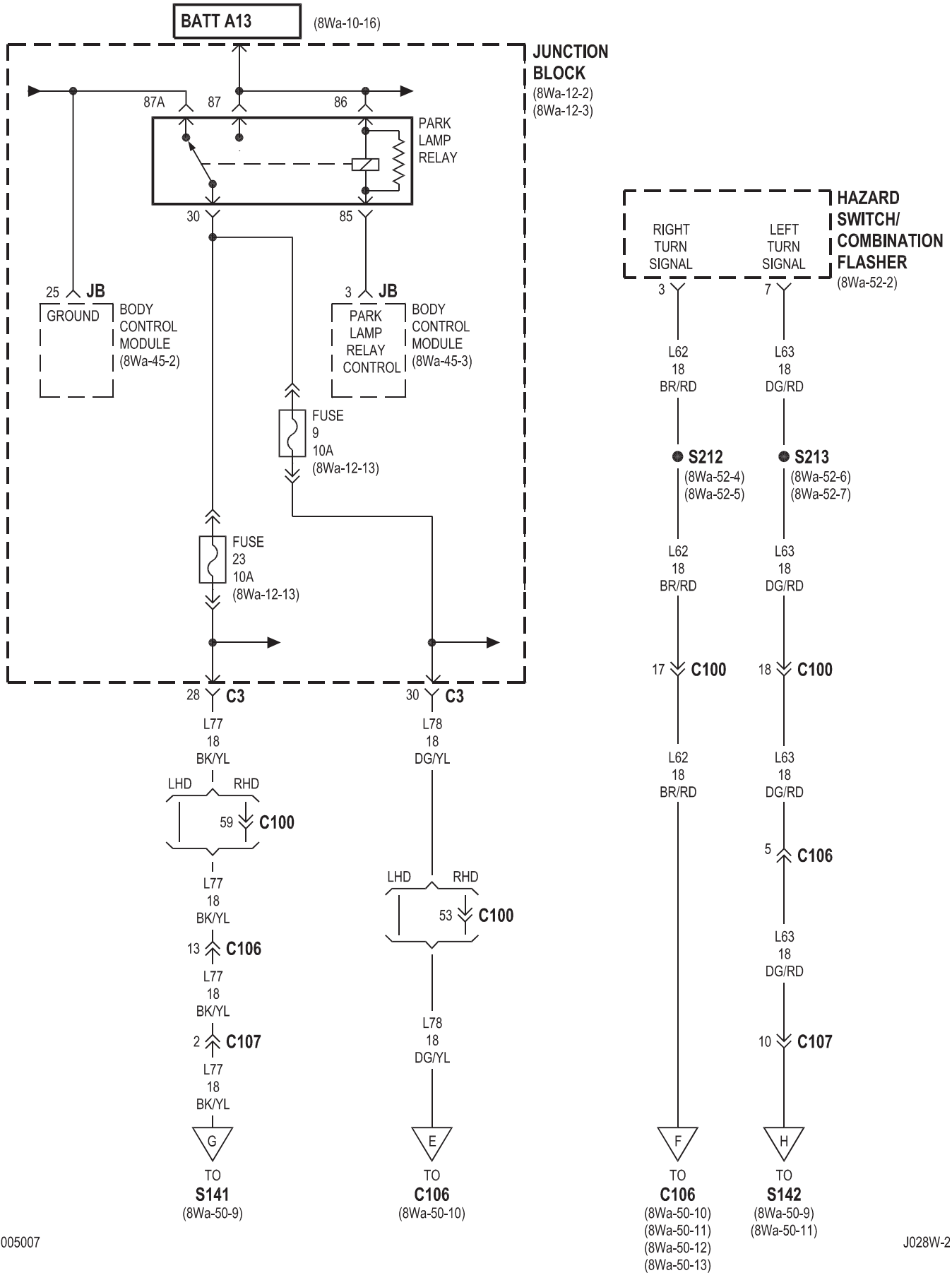


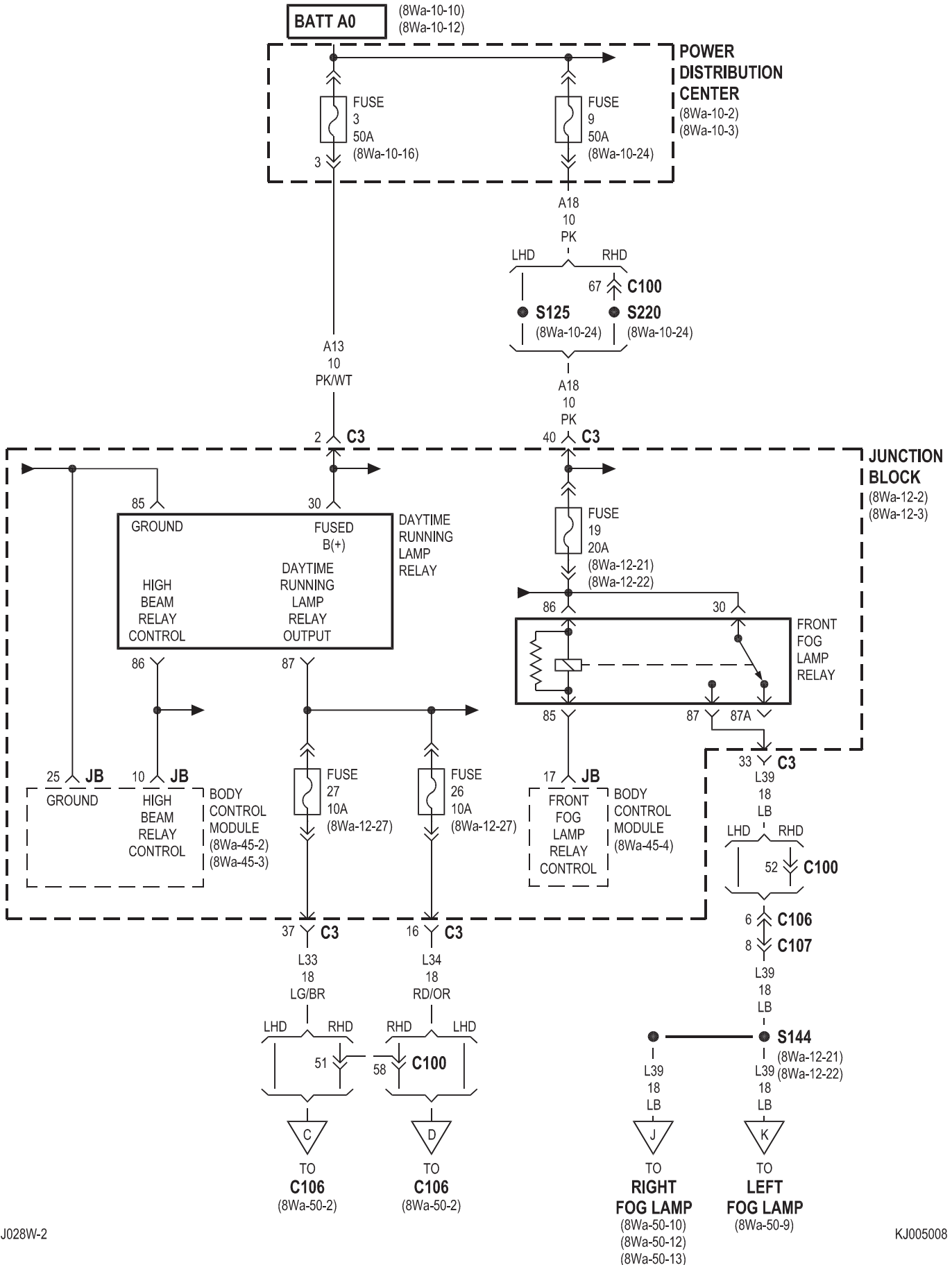




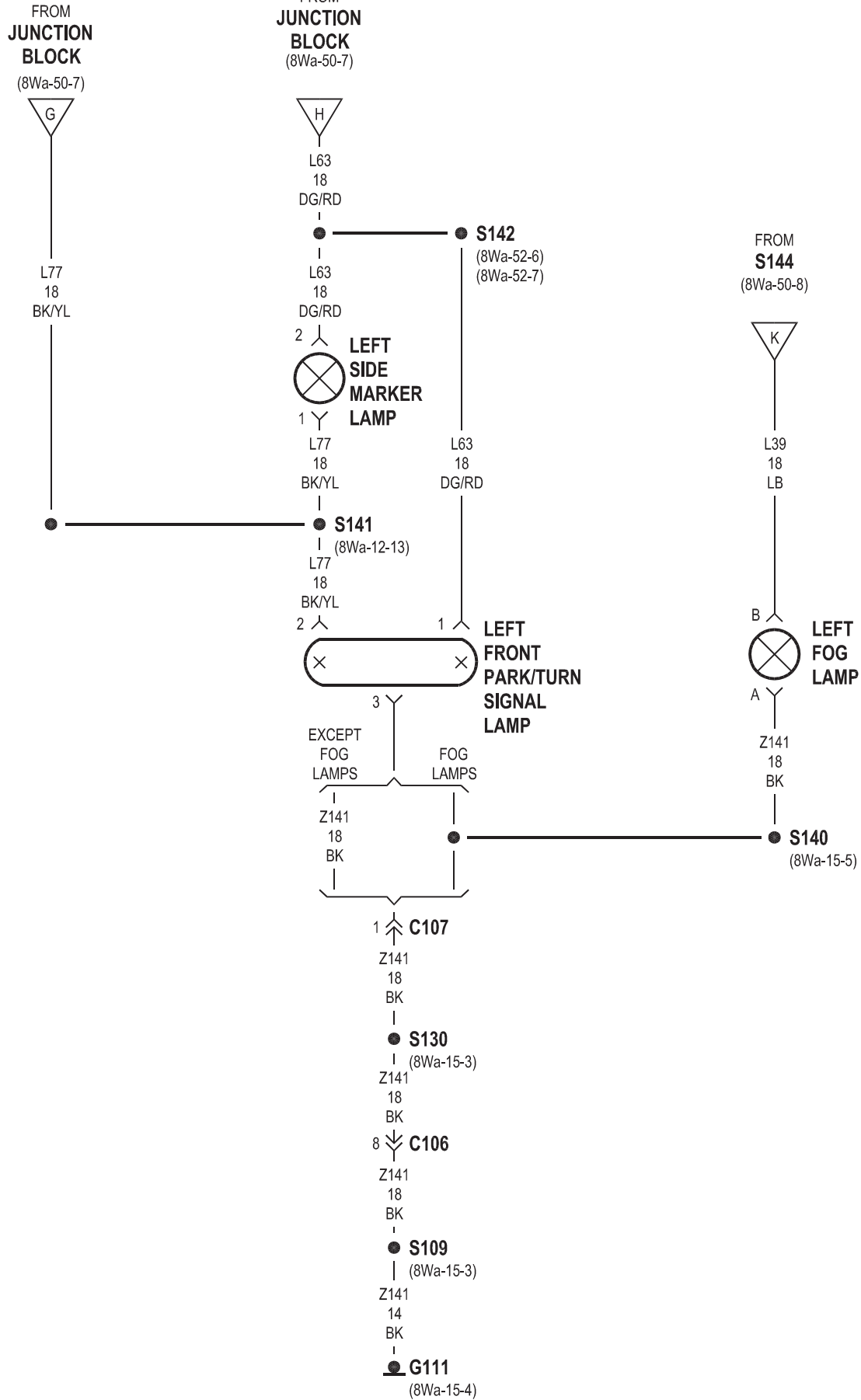




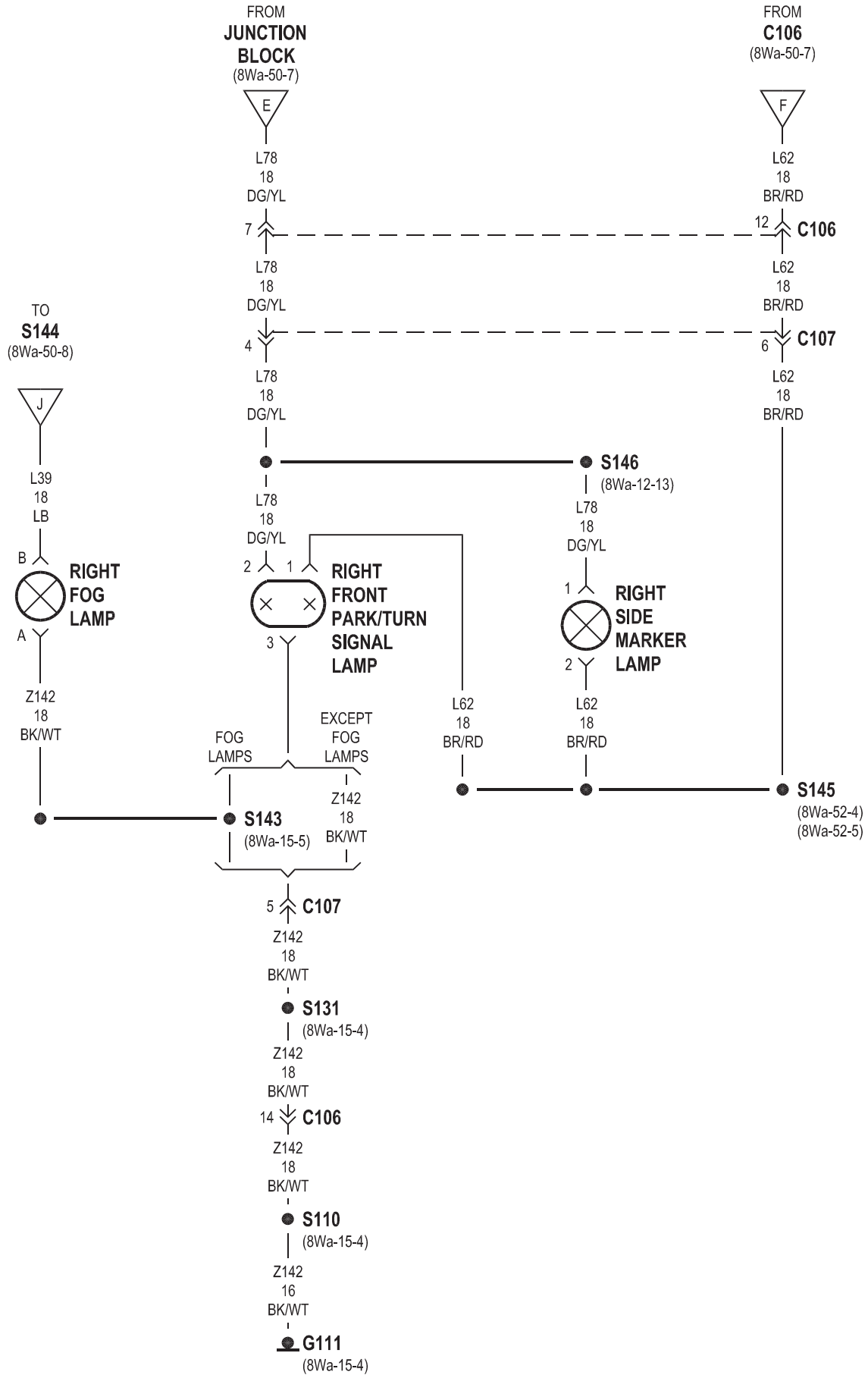


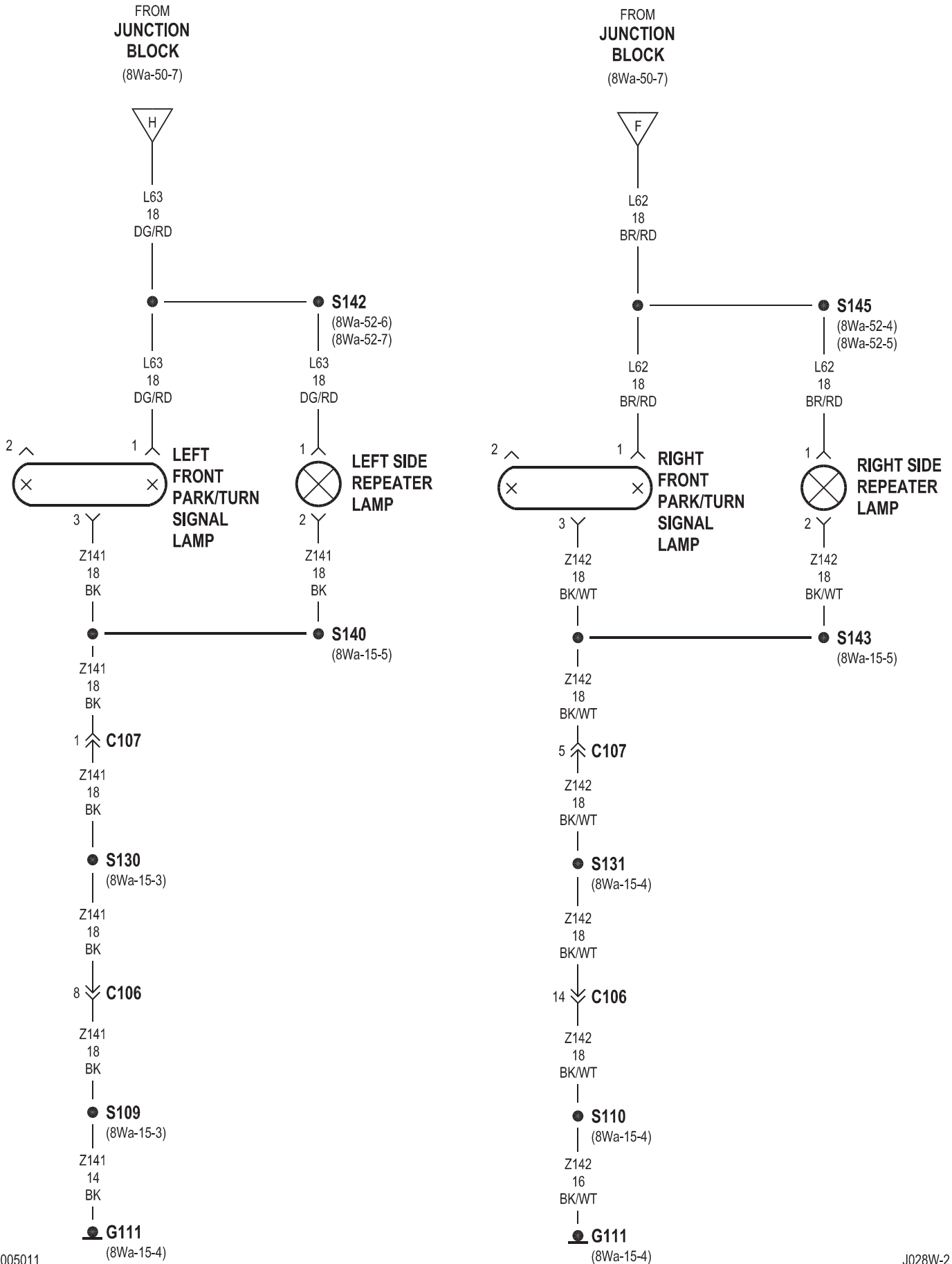


# 8W-50 FRONT LIGHTING EXCEPT BUILT-UP-EXPORT



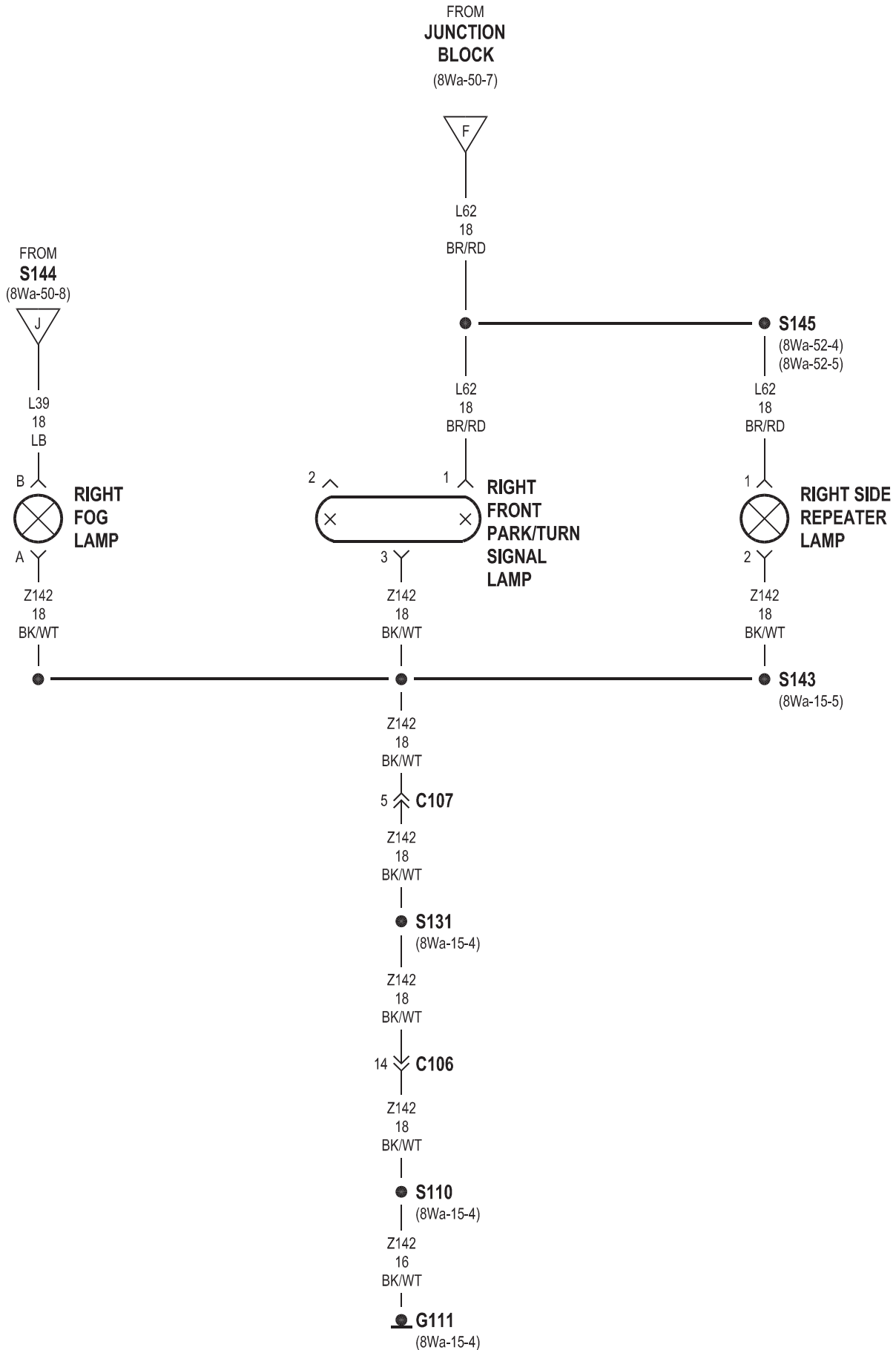


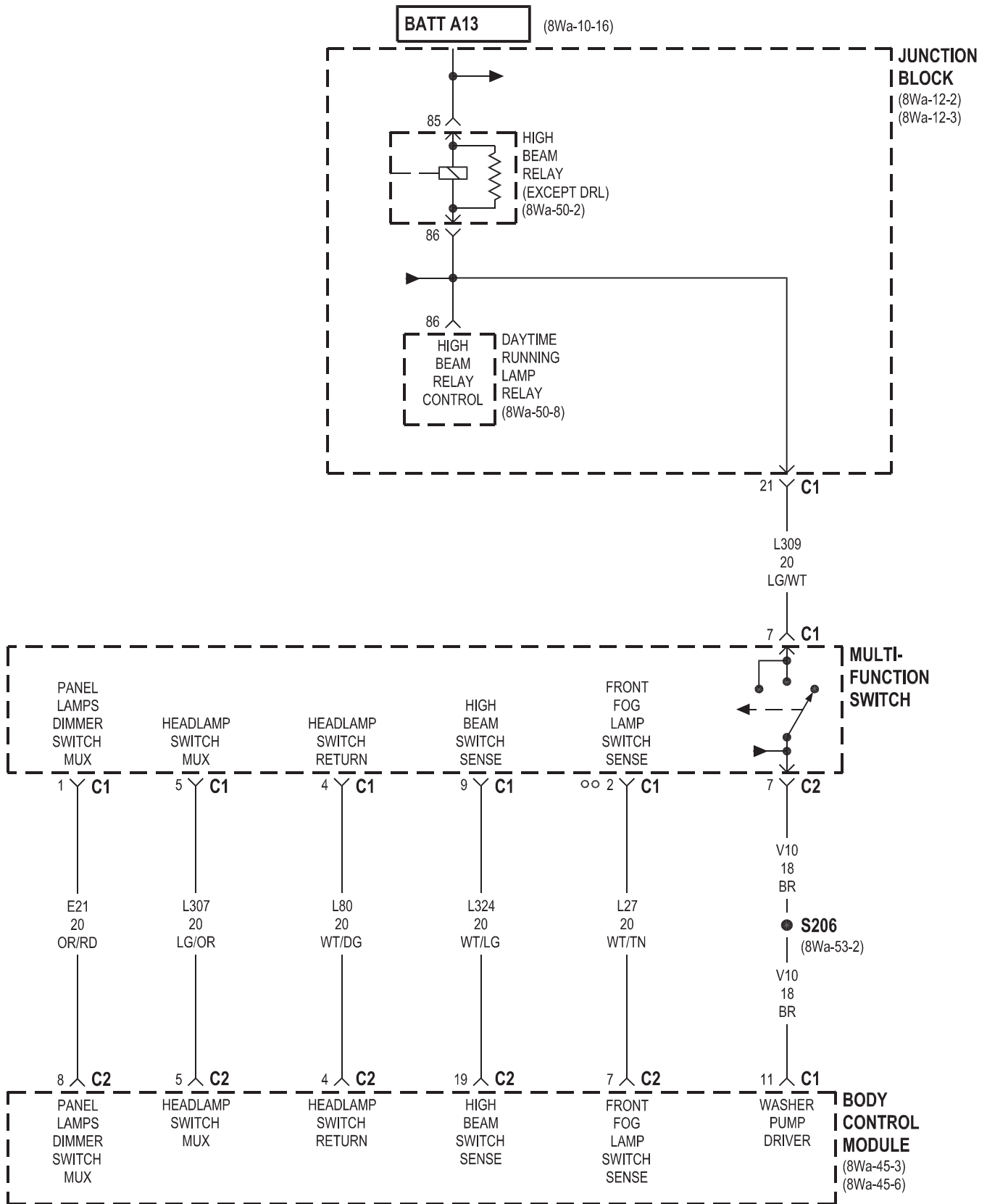






# 8W-50 FRONT LIGHTING BUILT-UP-EXPORT FOG LAMPS

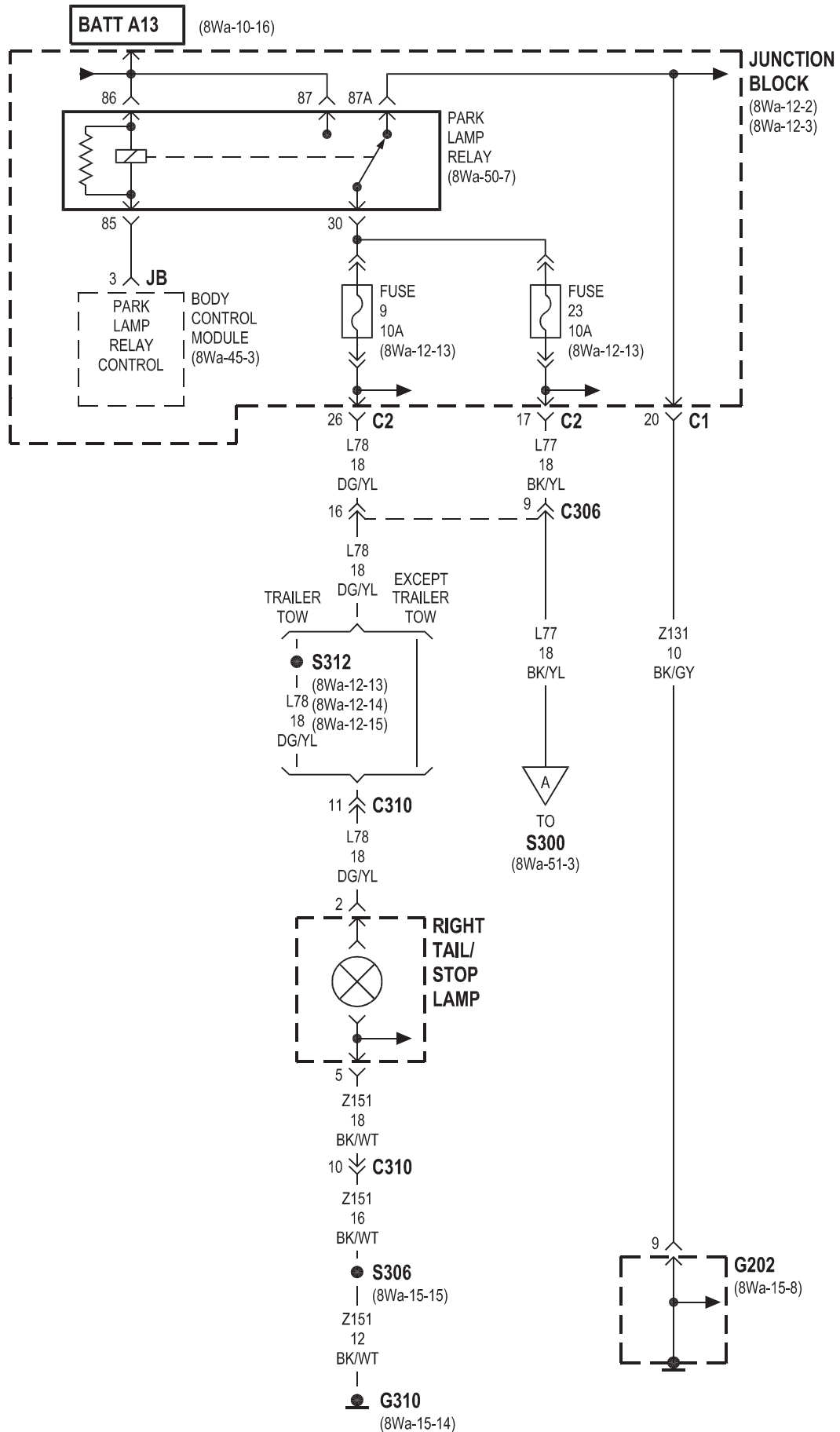


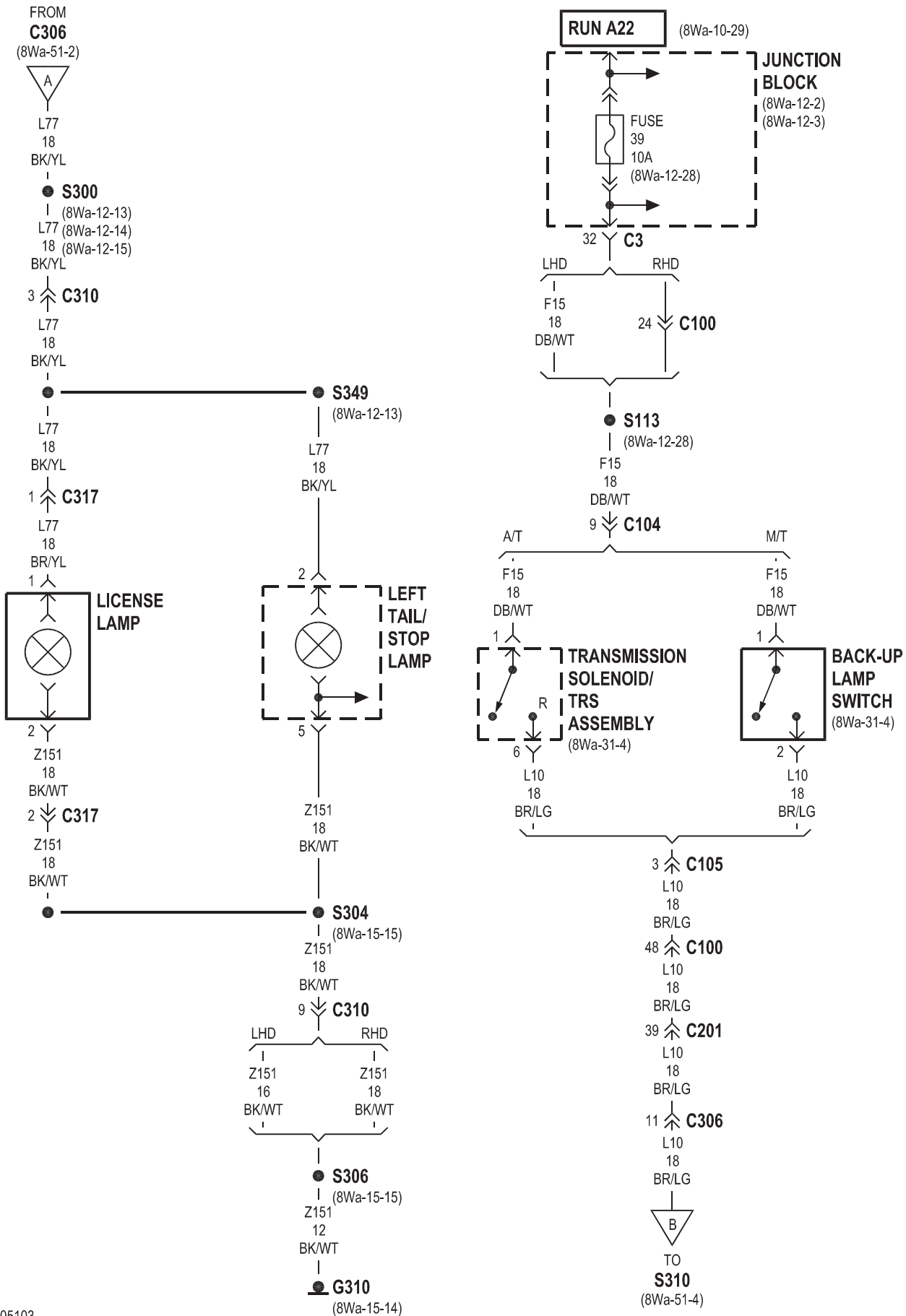


○ ○ EXCEPT BASE

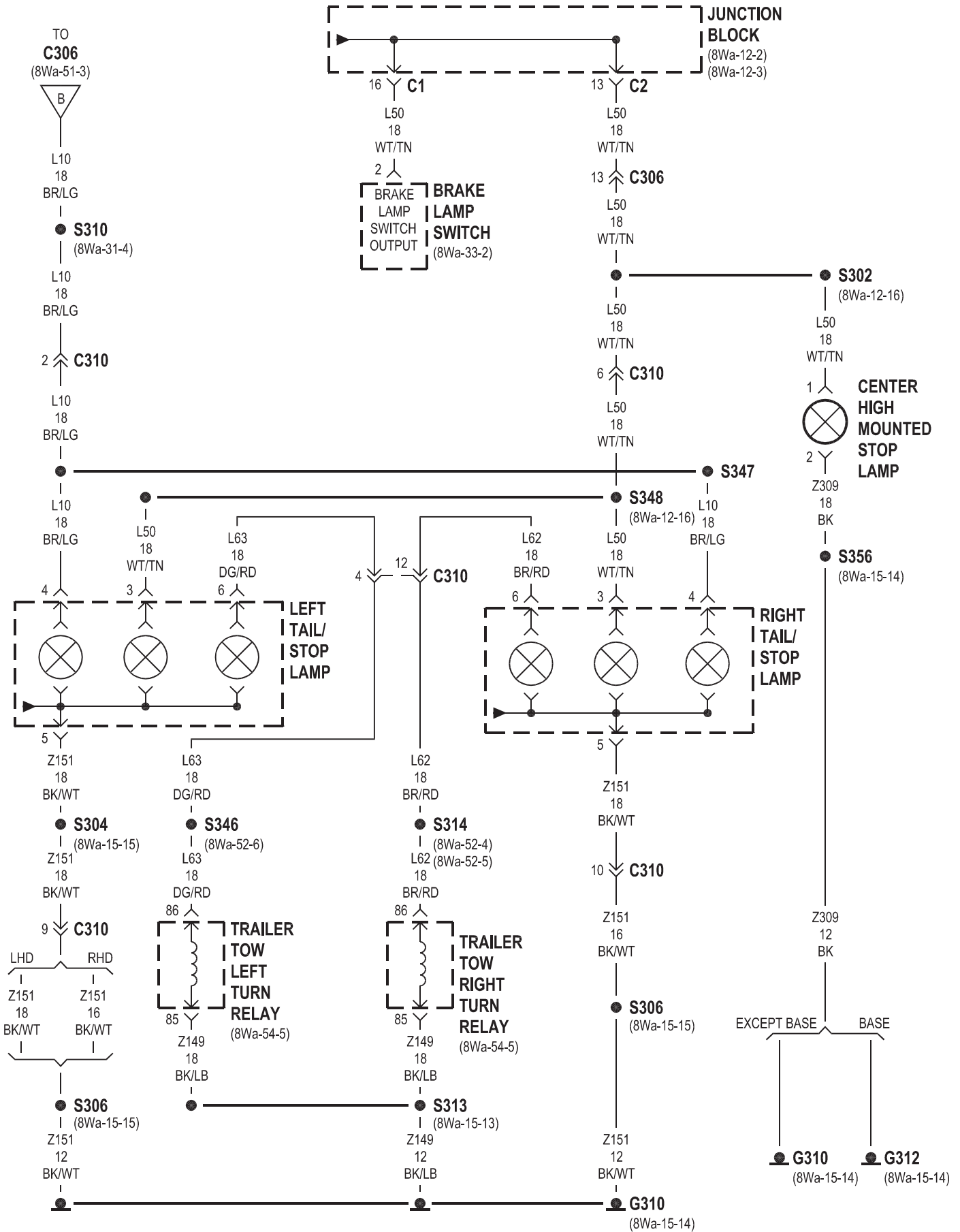
## 8W-51 REAR LIGHTING

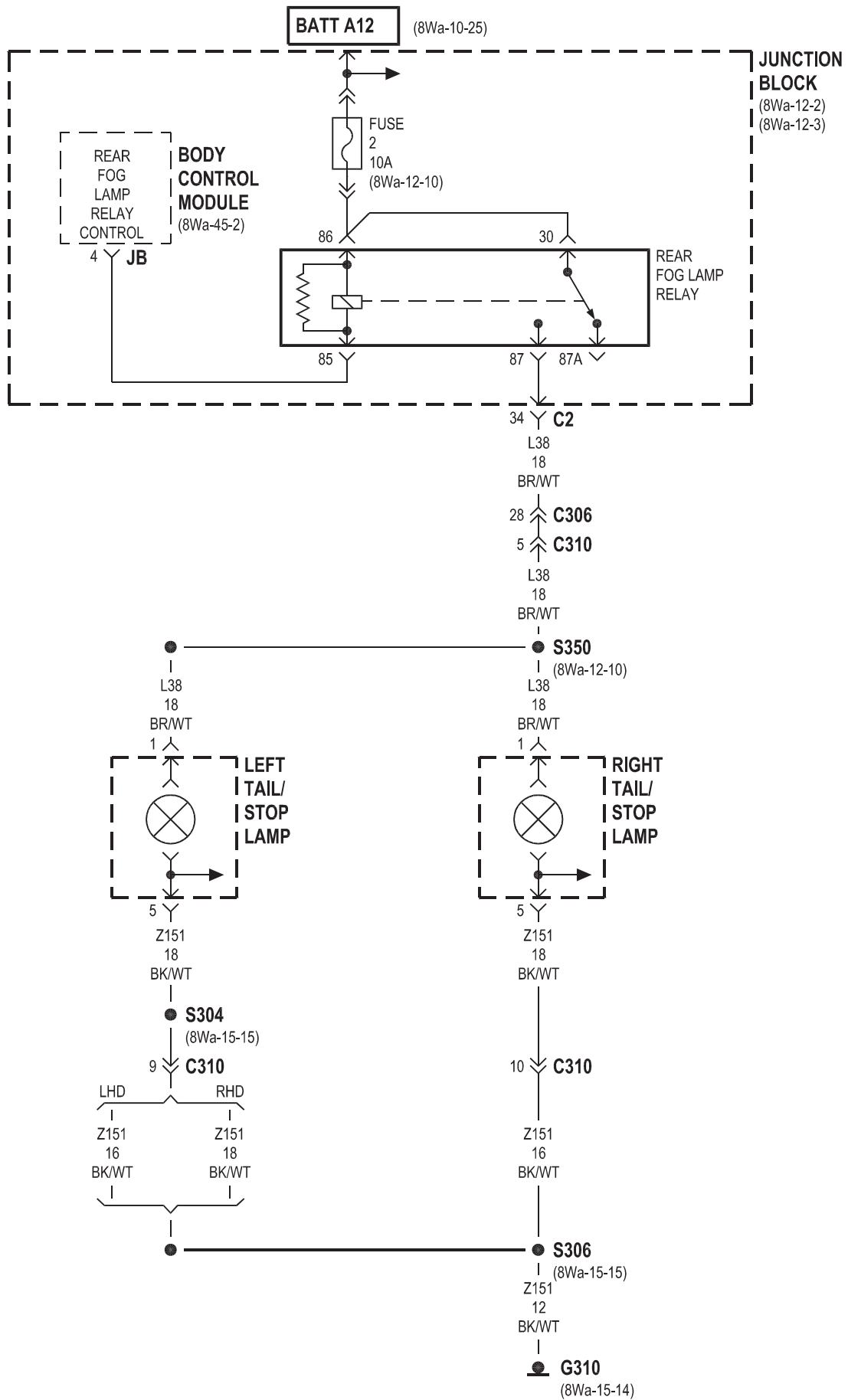
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Back-Up Lamp Switch . . . . .	8Wa-51-3	G312 . . . . .	8Wa-51-4
Body Control Module . . . . .	8Wa-51-2, 5	Junction Block . . . . .	8Wa-51-2, 3, 4, 5
Brake Lamp Switch . . . . .	8Wa-51-4	Left Tail/Stop Lamp . . . . .	8Wa-51-3, 4, 5
Center High Mounted Stop Lamp . . . . .	8Wa-51-4	License Lamp . . . . .	8Wa-51-3
Fuse 2 . . . . .	8Wa-51-5	Park Lamp Relay . . . . .	8Wa-51-2
Fuse 9 . . . . .	8Wa-51-2	Rear Fog Lamp Relay . . . . .	8Wa-51-5
Fuse 23 . . . . .	8Wa-51-2	Right Tail/Stop Lamp . . . . .	8Wa-51-2, 4, 5
Fuse 39 . . . . .	8Wa-51-3	Trailer Tow Left Turn Relay . . . . .	8Wa-51-4
G202 . . . . .	8Wa-51-2	Trailer Tow Right Turn Relay . . . . .	8Wa-51-4
G310 . . . . .	8Wa-51-2, 3, 4, 5	Transmission Solenoid/Trs Assembly . . . . .	8Wa-51-3







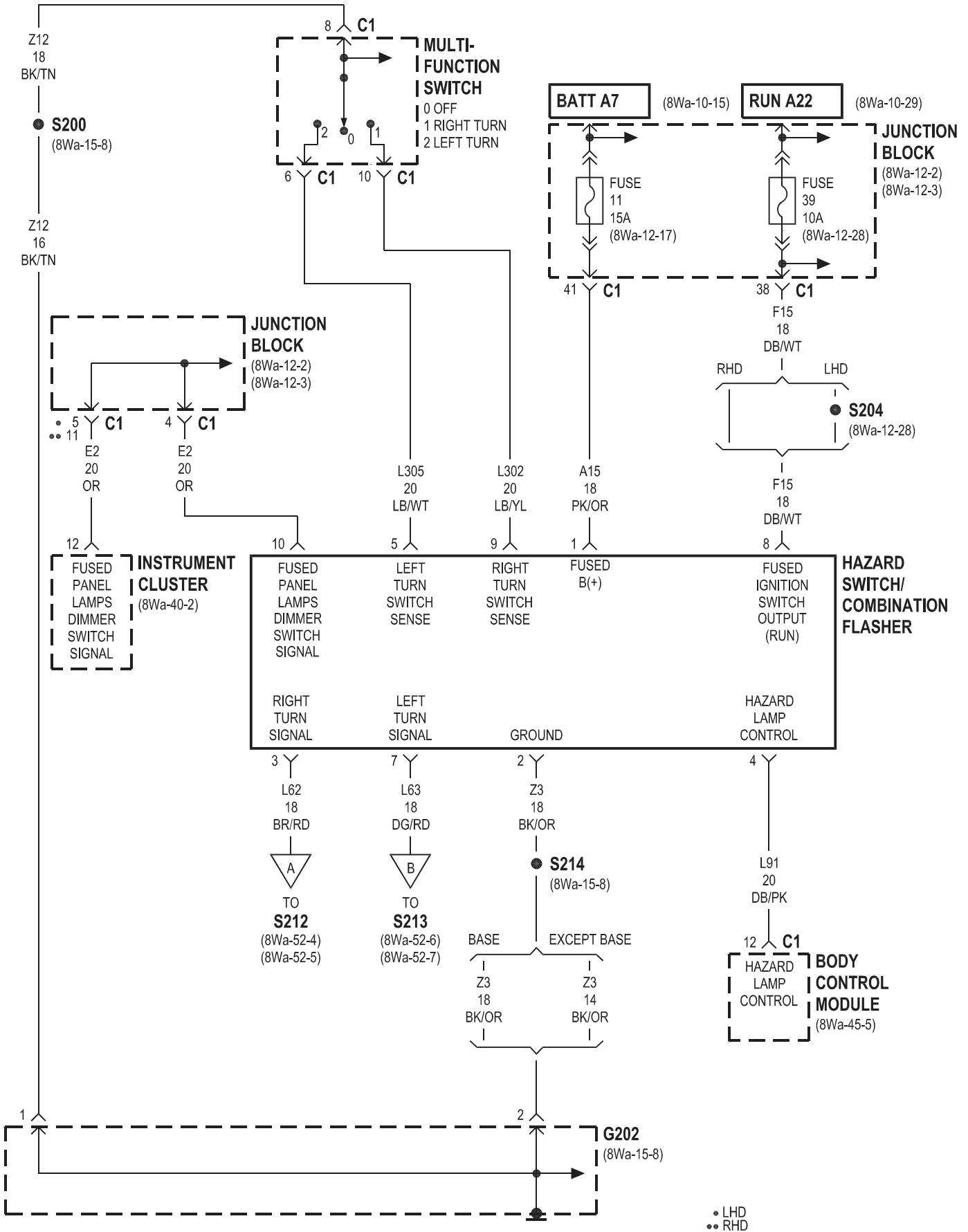


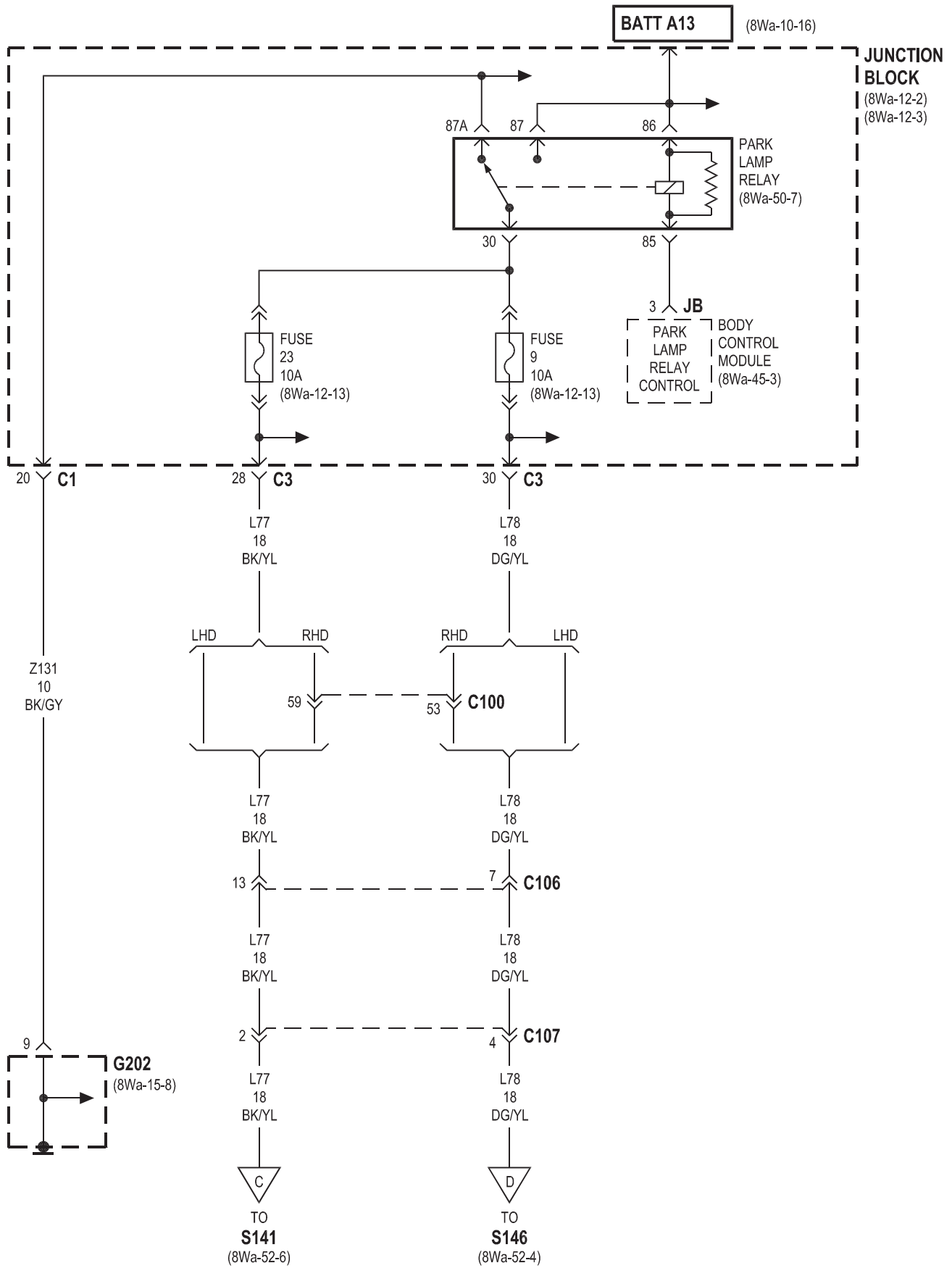


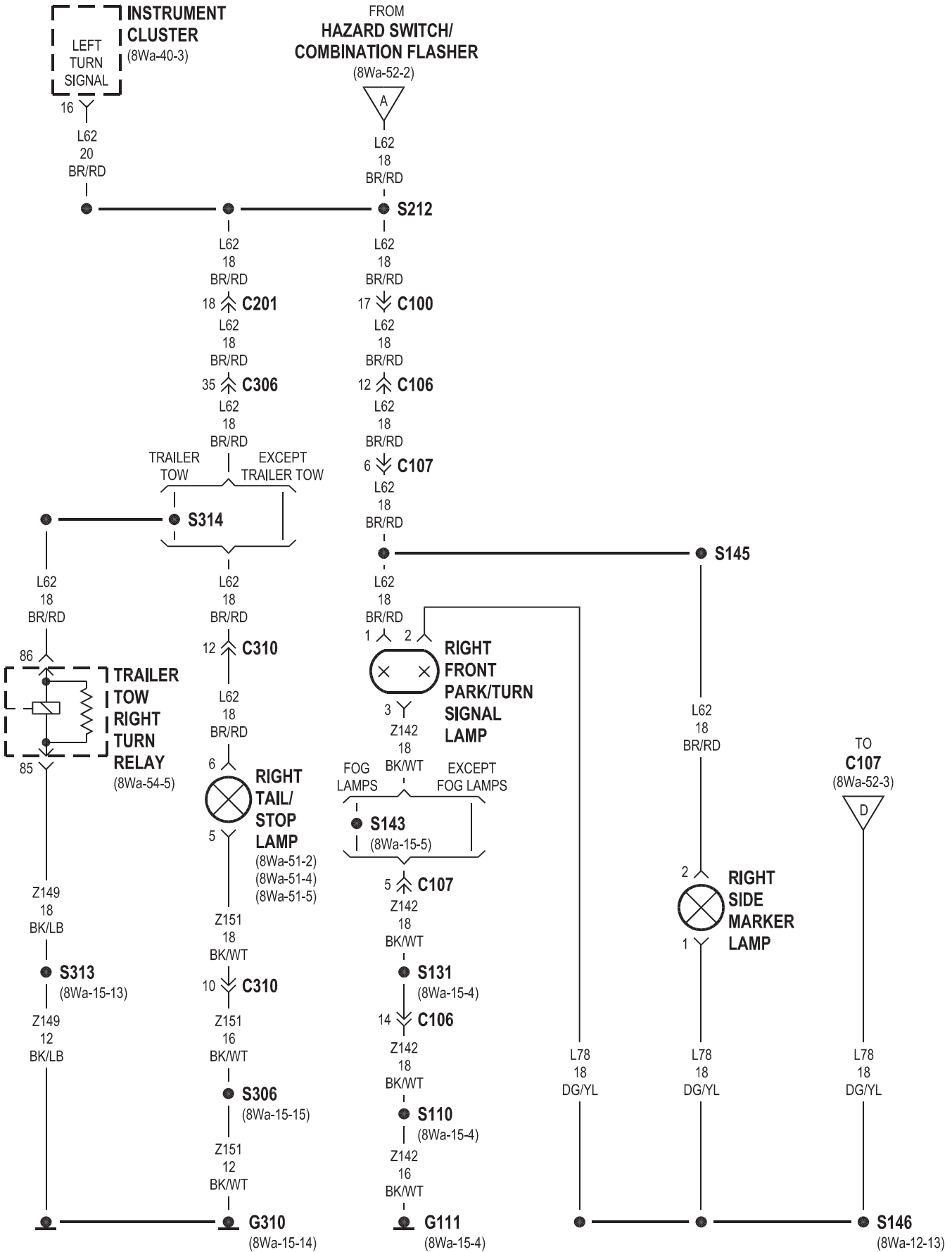


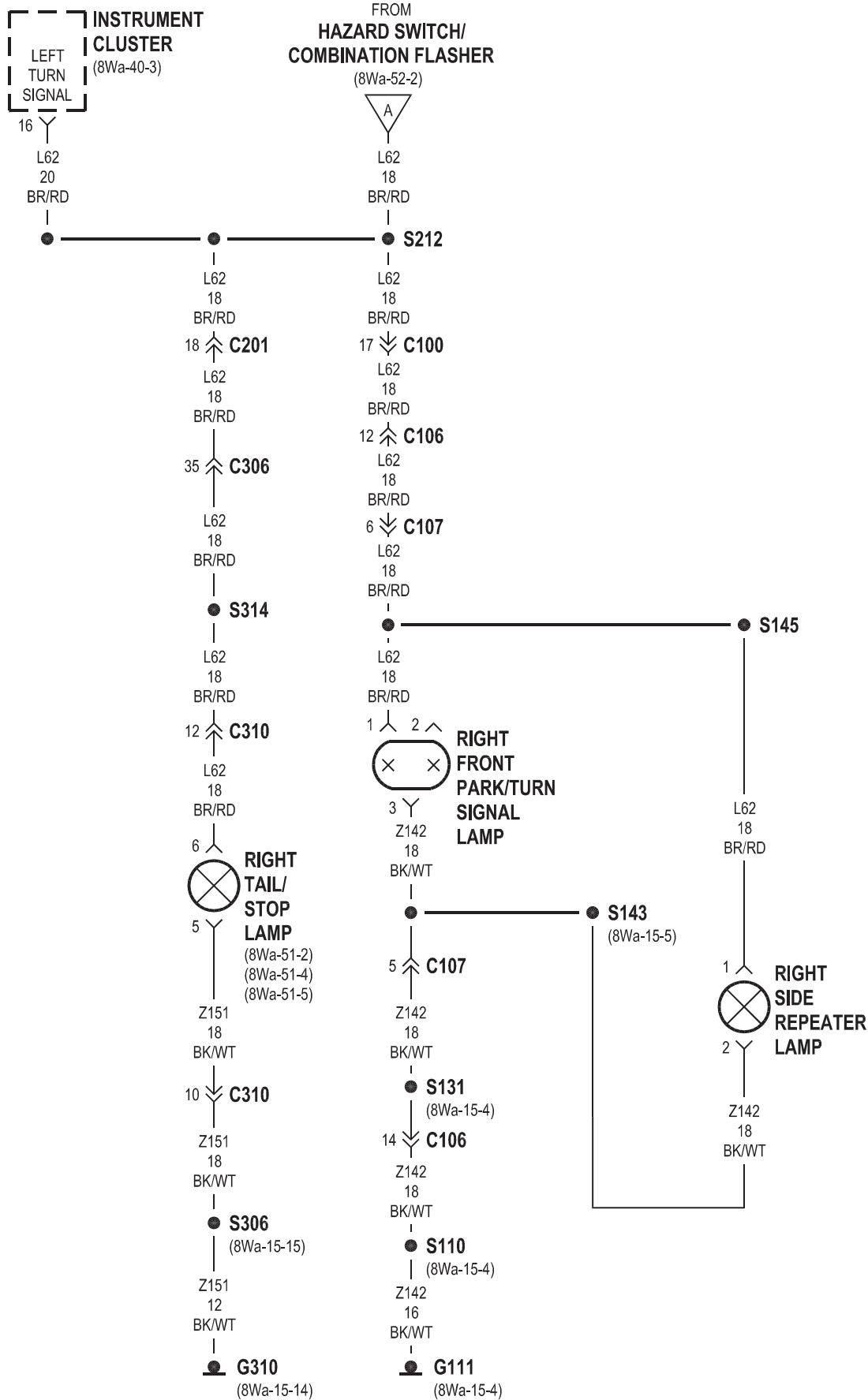
## 8W-52 TURN SIGNALS

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module . . . . .	8Wa-52-2, 3	Left Front Park/Turn Signal Lamp . . . . .	8Wa-52-6, 7
Fuse 9 . . . . .	8Wa-52-3	Left Side Marker Lamp . . . . .	8Wa-52-6
Fuse 11 . . . . .	8Wa-52-2	Left Side Repeater Lamp . . . . .	8Wa-52-7
Fuse 23 . . . . .	8Wa-52-3	Left Tail/Stop Lamp . . . . .	8Wa-52-6, 7
Fuse 39 . . . . .	8Wa-52-2	Multi- Function Switch . . . . .	8Wa-52-2
G111 . . . . .	8Wa-52-4, 5, 6, 7	Park Lamp Relay . . . . .	8Wa-52-3
G202 . . . . .	8Wa-52-2, 3	Right Front Park/Turn Signal Lamp . . . . .	8Wa-52-4, 5
G310 . . . . .	8Wa-52-4, 5, 6, 7	Right Side Marker Lamp . . . . .	8Wa-52-4
Hazard Switch/Combination Flasher . . . . .	8Wa-52-2, 4, 5, 6, 7	Right Side Repeater Lamp . . . . .	8Wa-52-5
Instrument Cluster . . . . .	8Wa-52-2, 4, 5, 6, 7	Right Tail/Stop Lamp . . . . .	8Wa-52-4, 5
Junction Block . . . . .	8Wa-52-2, 3, 6	Trailer Tow Left Turn Relay . . . . .	8Wa-52-6
		Trailer Tow Right Turn Relay . . . . .	8Wa-52-4

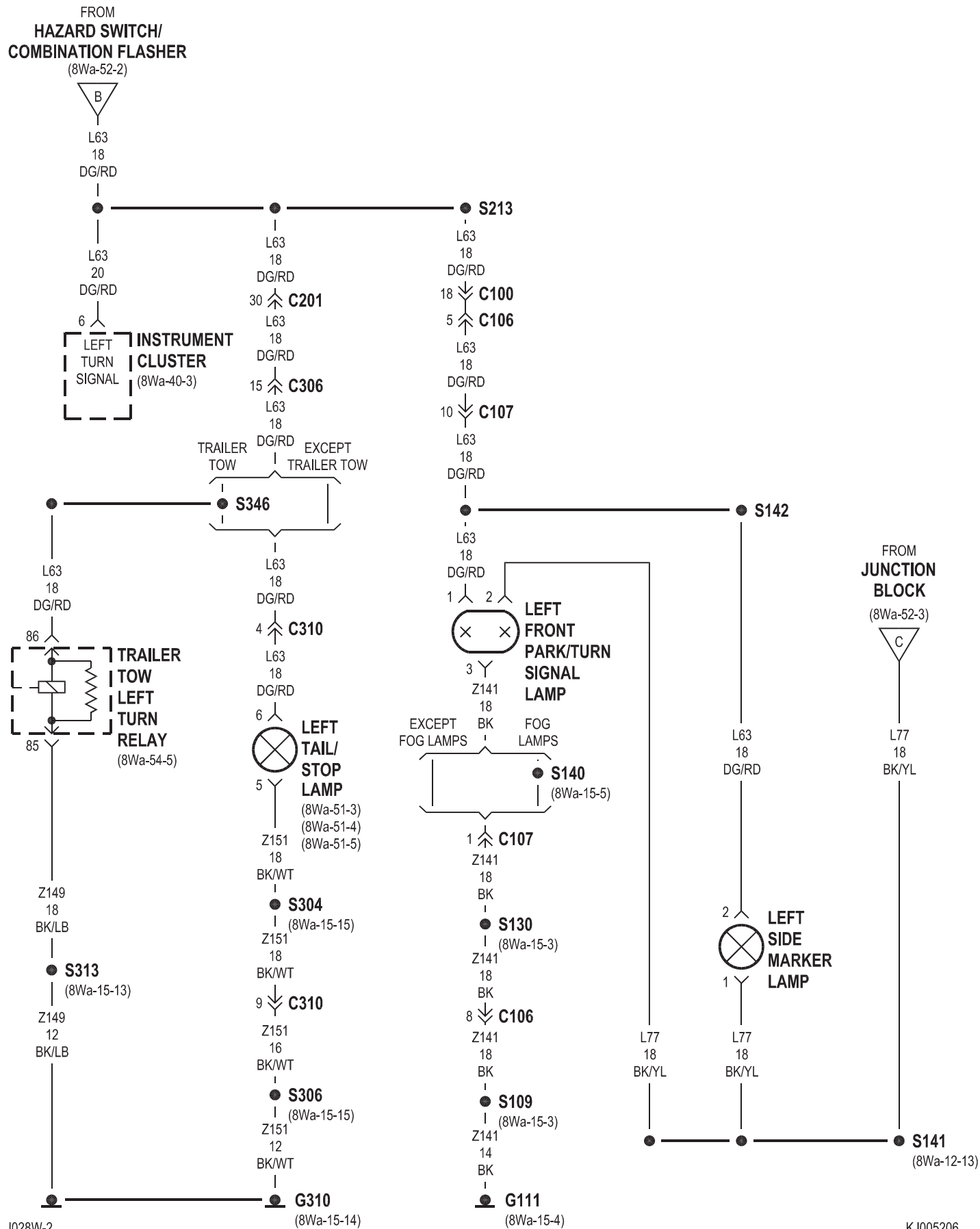




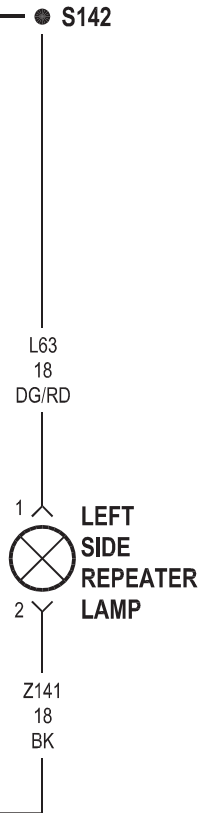
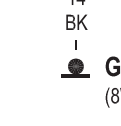
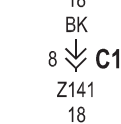
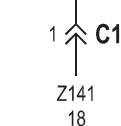
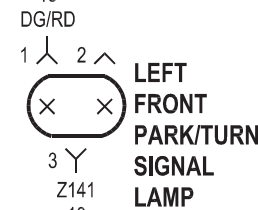
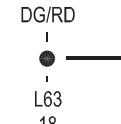
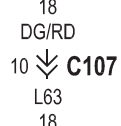
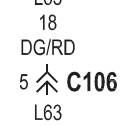
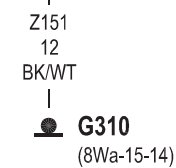
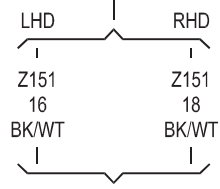
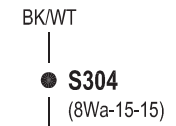
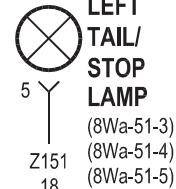
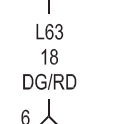
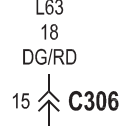
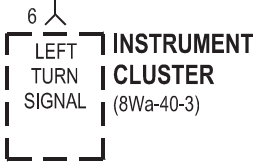
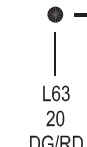
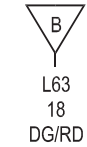








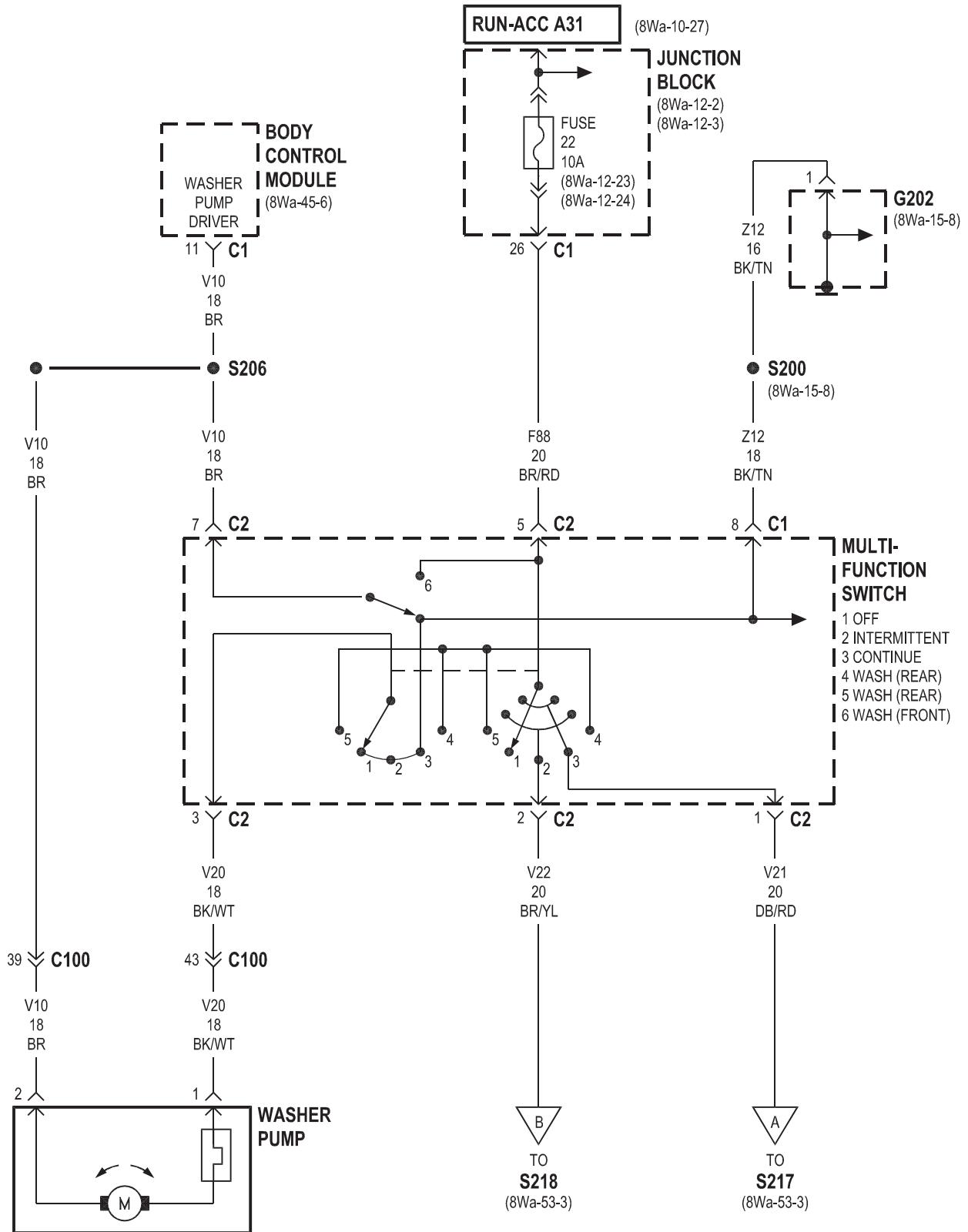
FROM  
HAZARD SWITCH/  
COMBINATION FLASHER  
(8Wa-52-2)

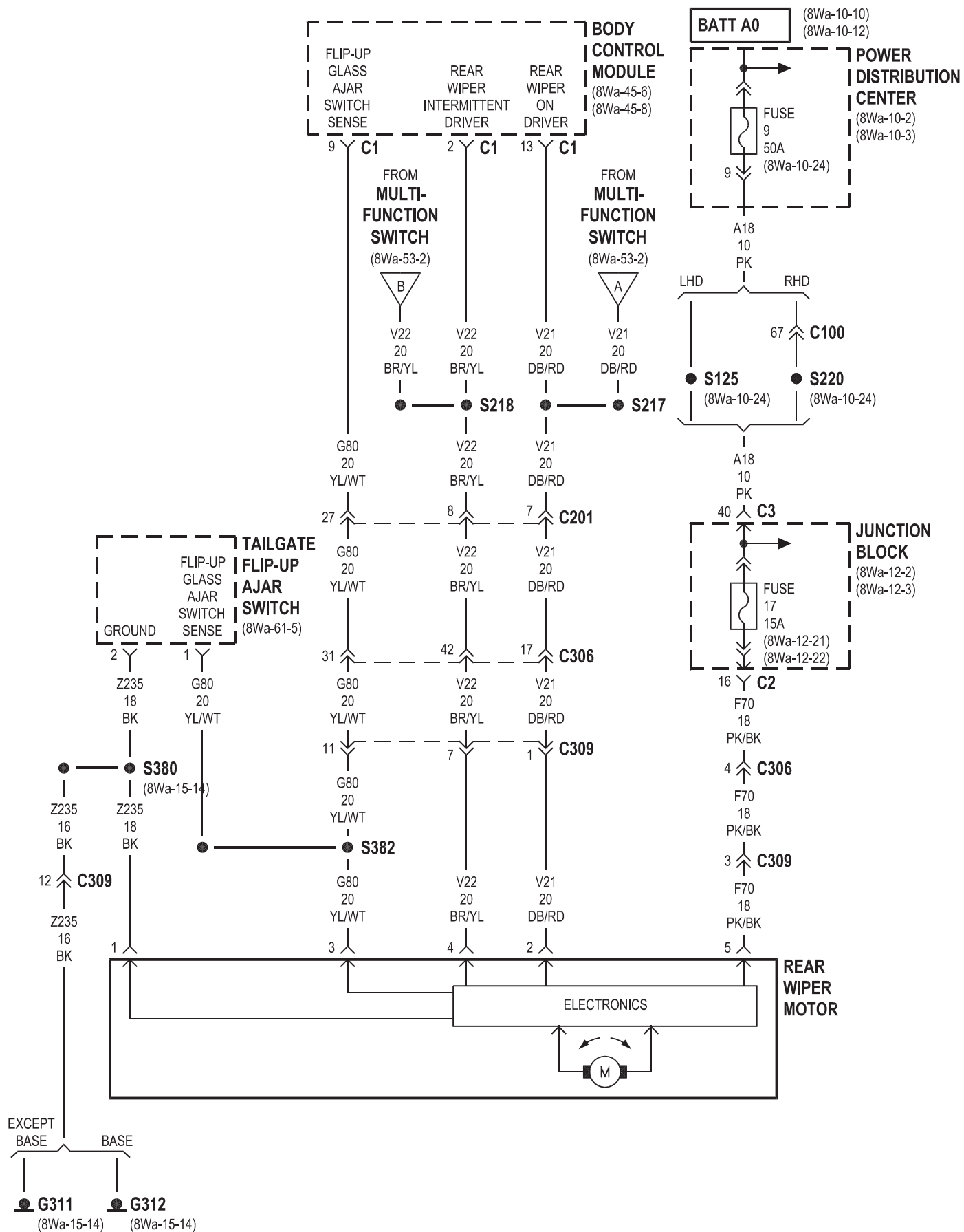


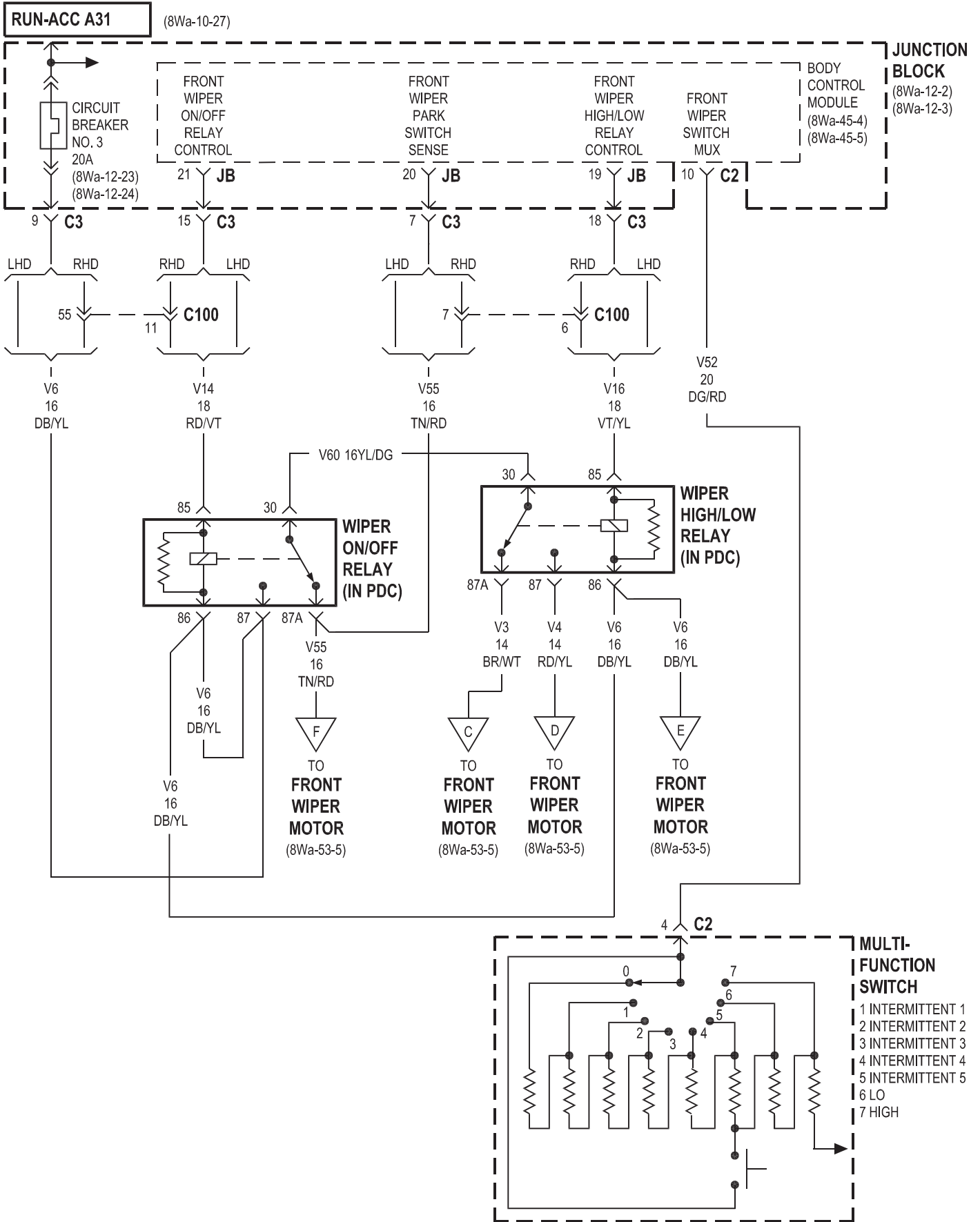


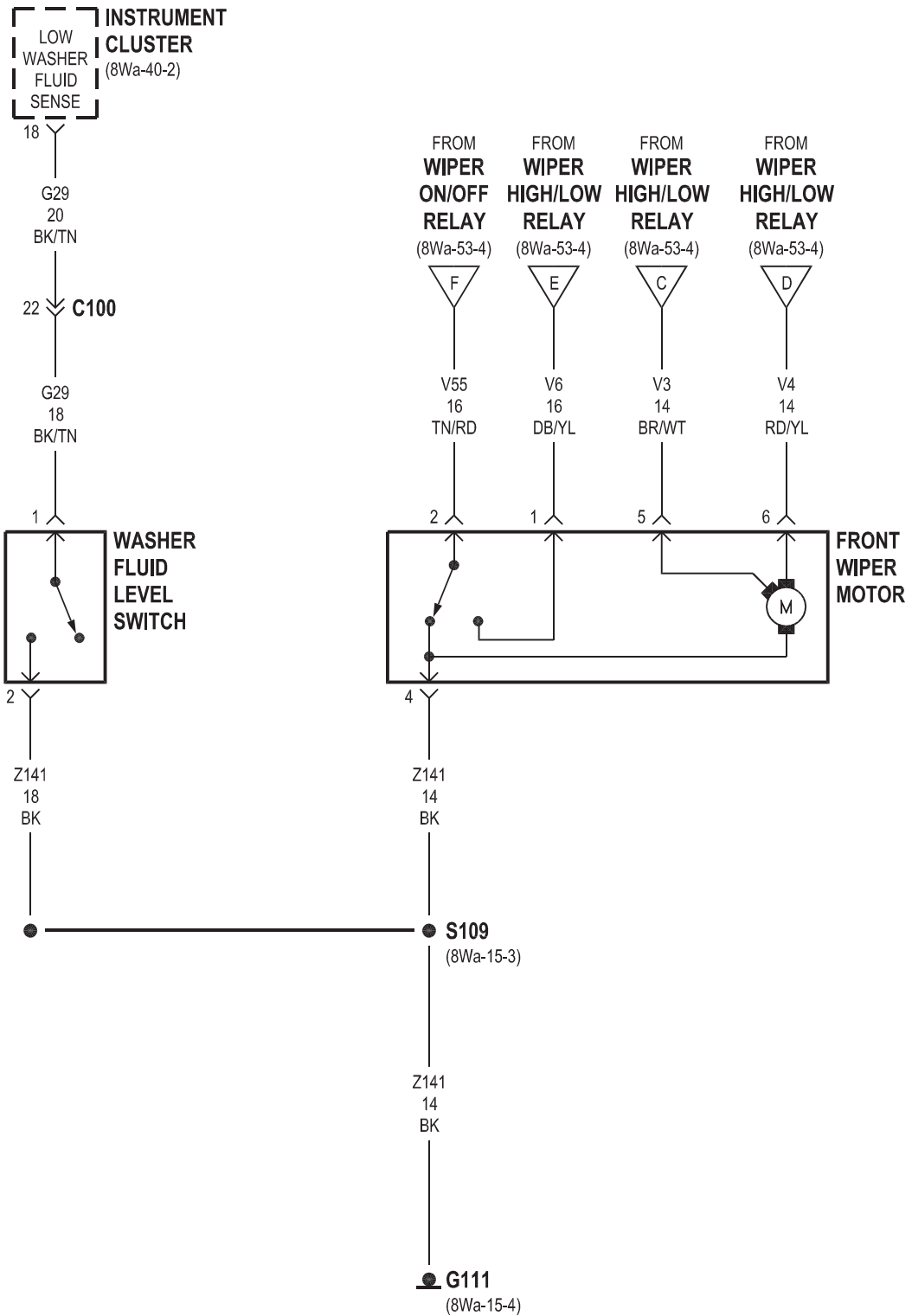
## 8W-53 WIPERS

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module . . . . .	8Wa-53-2, 3, 4	Instrument Cluster . . . . .	8Wa-53-5
Circuit Breaker No. 3 (JB) . . . . .	8Wa-53-4	Junction Block . . . . .	8Wa-53-2, 3, 4
Front Wiper Motor . . . . .	8Wa-53-4, 5	Multi- Function Switch . . . . .	8Wa-53-2, 3, 4
Fuse 9 . . . . .	8Wa-53-3	Power Distribution Center . . . . .	8Wa-53-3
Fuse 17 . . . . .	8Wa-53-3	Rear Wiper Motor . . . . .	8Wa-53-3
Fuse 22 . . . . .	8Wa-53-2	Tailgate Flip-Up Ajar Switch . . . . .	8Wa-53-3
G111 . . . . .	8Wa-53-5	Washer Fluid Level Switch . . . . .	8Wa-53-5
G202 . . . . .	8Wa-53-2	Washer Pump . . . . .	8Wa-53-2
G311 . . . . .	8Wa-53-3	Wiper High/Low Relay . . . . .	8Wa-53-4, 5
G312 . . . . .	8Wa-53-3	Wiper On/Off Relay . . . . .	8Wa-53-4, 5







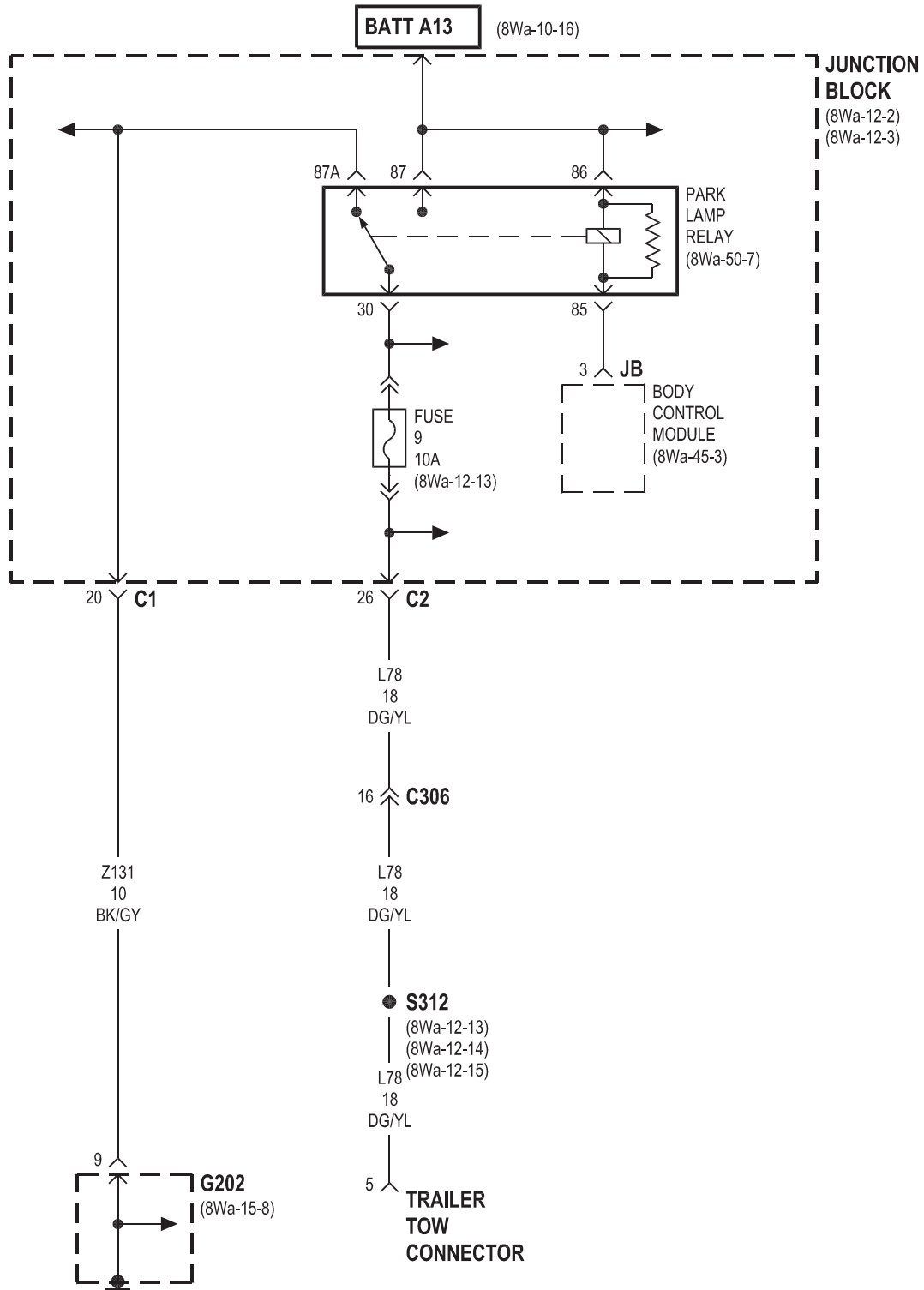


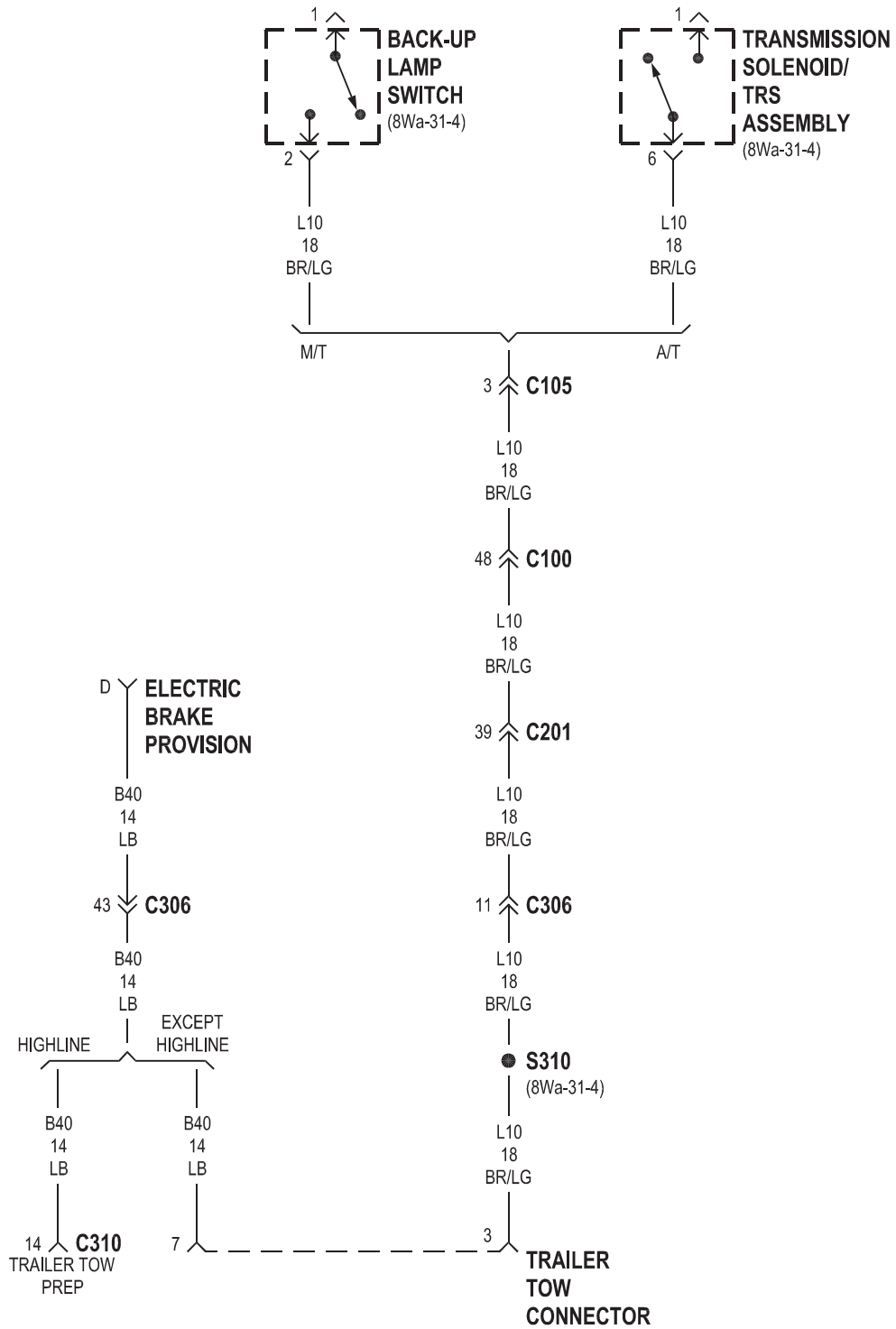


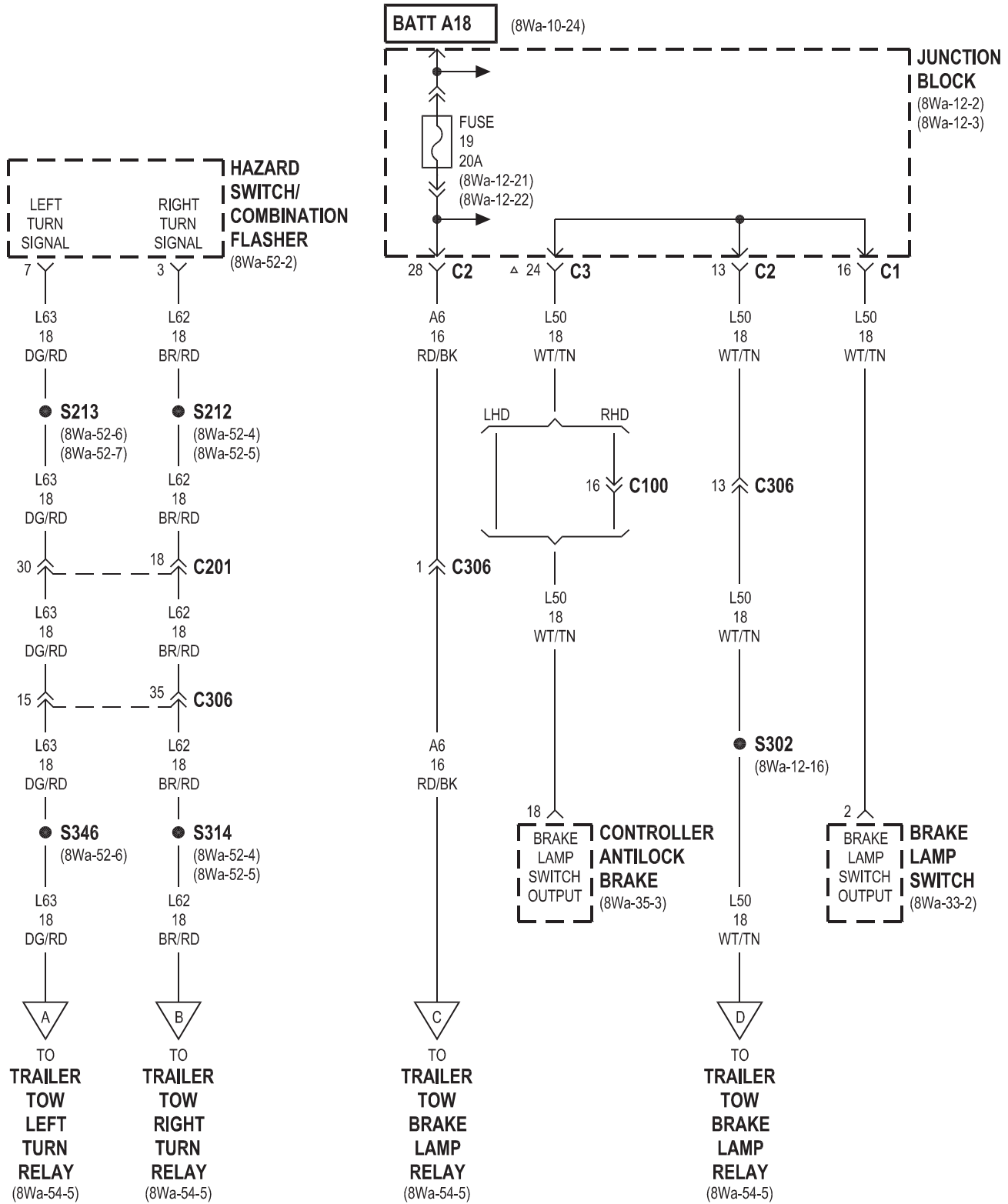


## 8W-54 TRAILER TOW

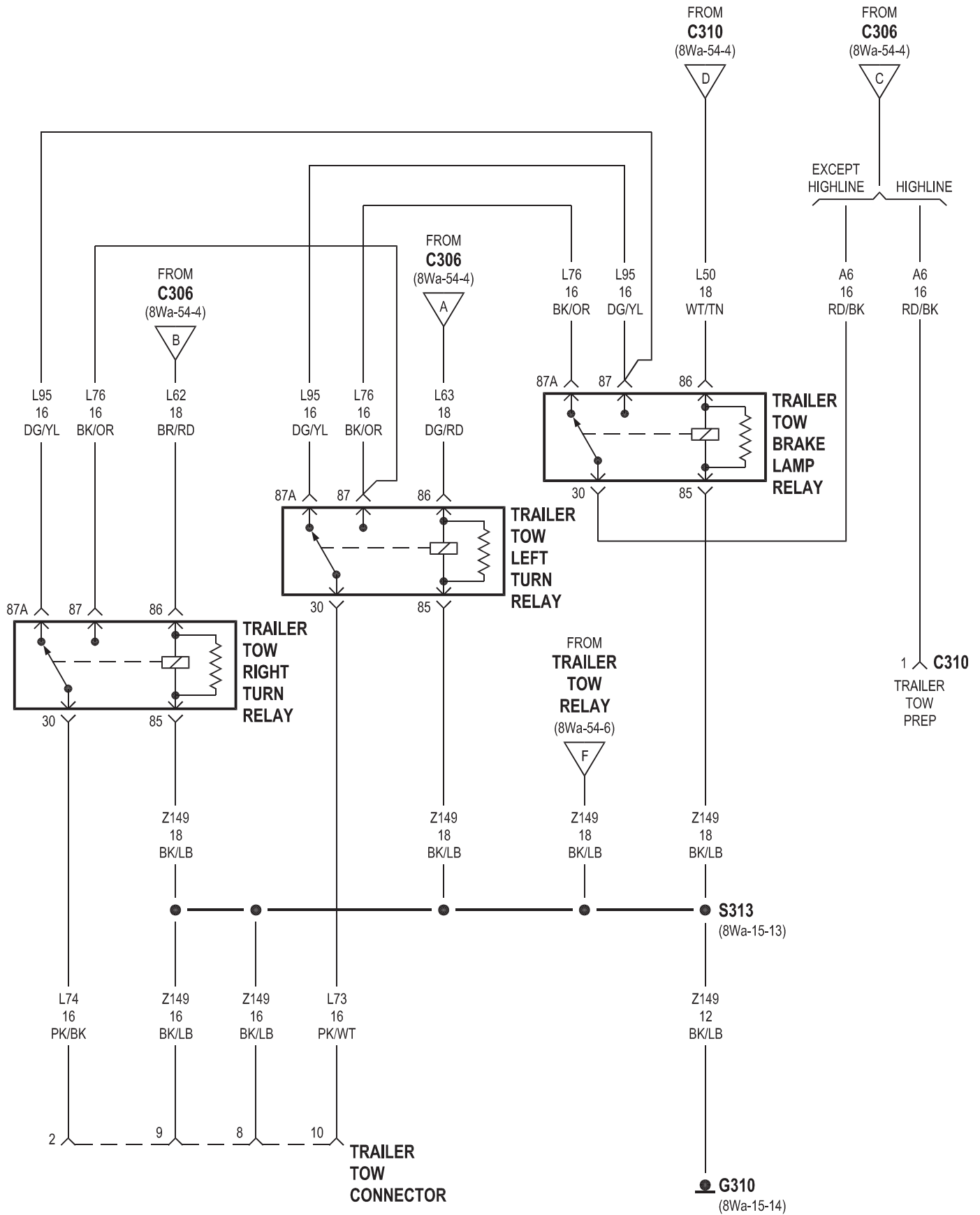
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Back-Up Lamp Switch . . . . .	8Wa-54-3	G310 . . . . .	8Wa-54-5
Body Control Module . . . . .	8Wa-54-2	Hazard Switch/Combination Flasher . . . . .	8Wa-54-4
Brake Lamp Switch . . . . .	8Wa-54-4	Junction Block . . . . .	8Wa-54-2, 4, 6
Trailer Tow Circuit Breaker . . . . .	8Wa-54-6	Park Lamp Relay . . . . .	8Wa-54-2
Controller Antilock Brake . . . . .	8Wa-54-4	Power Distribution Center . . . . .	8Wa-54-6
Electric Brake Provision . . . . .	8Wa-54-3	Trailer Tow Brake Lamp Relay . . . . .	8Wa-54-4, 5
Fuse 2 . . . . .	8Wa-54-6	Trailer Tow Circuit Breaker . . . . .	8Wa-54-6
Fuse 9 . . . . .	8Wa-54-2	Trailer Tow Connector . . . . .	8Wa-54-2, 3, 5, 6
Fuse 10 . . . . .	8Wa-54-6	Trailer Tow Left Turn Relay . . . . .	8Wa-54-4, 5
Fuse 19 . . . . .	8Wa-54-4	Trailer Tow Relay . . . . .	8Wa-54-5, 6
Fuse 25 . . . . .	8Wa-54-6	Trailer Tow Right Turn Relay . . . . .	8Wa-54-4, 5
G202 . . . . .	8Wa-54-2	Transmission Solenoid/Trs Assembly . . . . .	8Wa-54-3

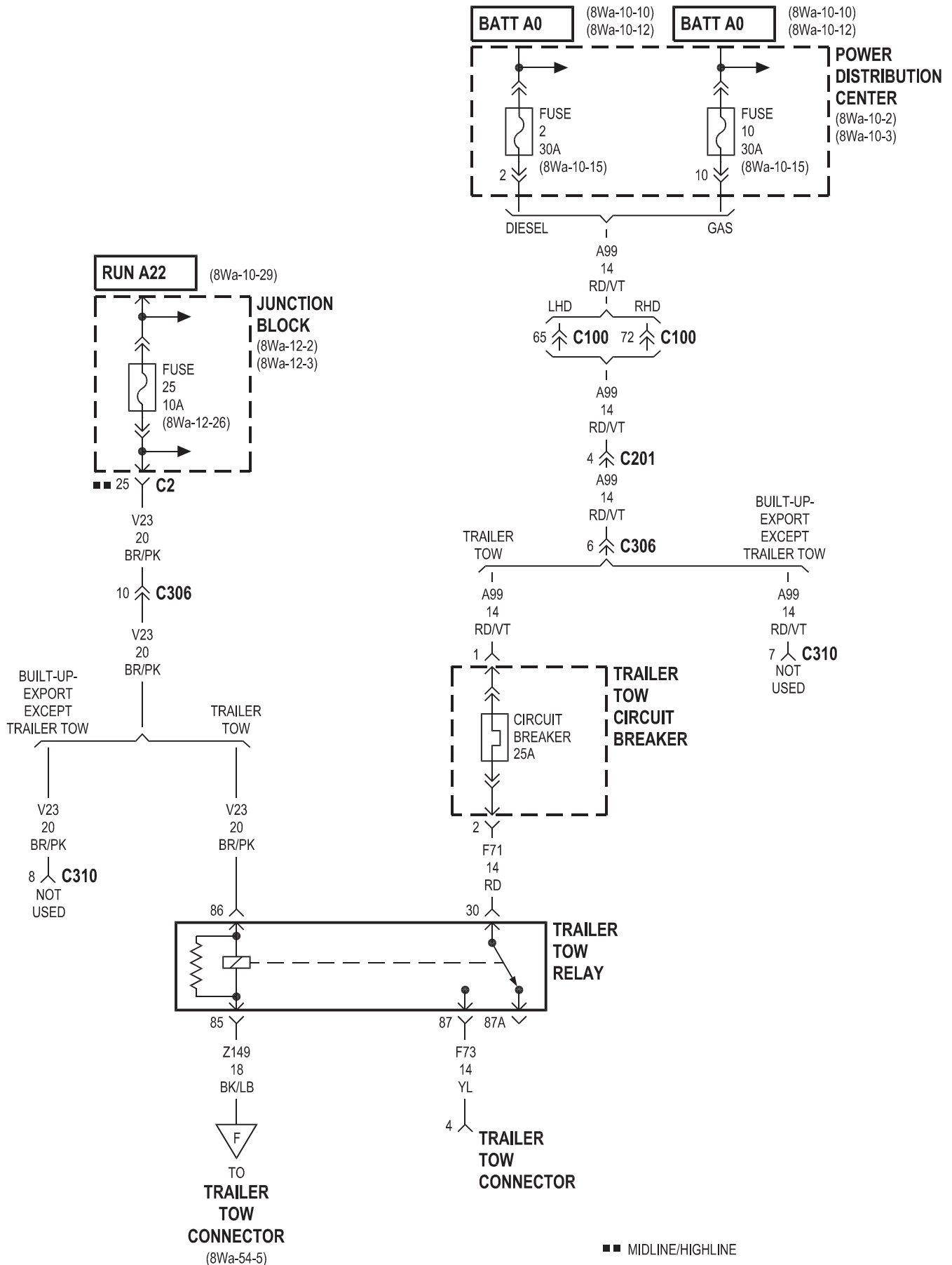






△ ABS

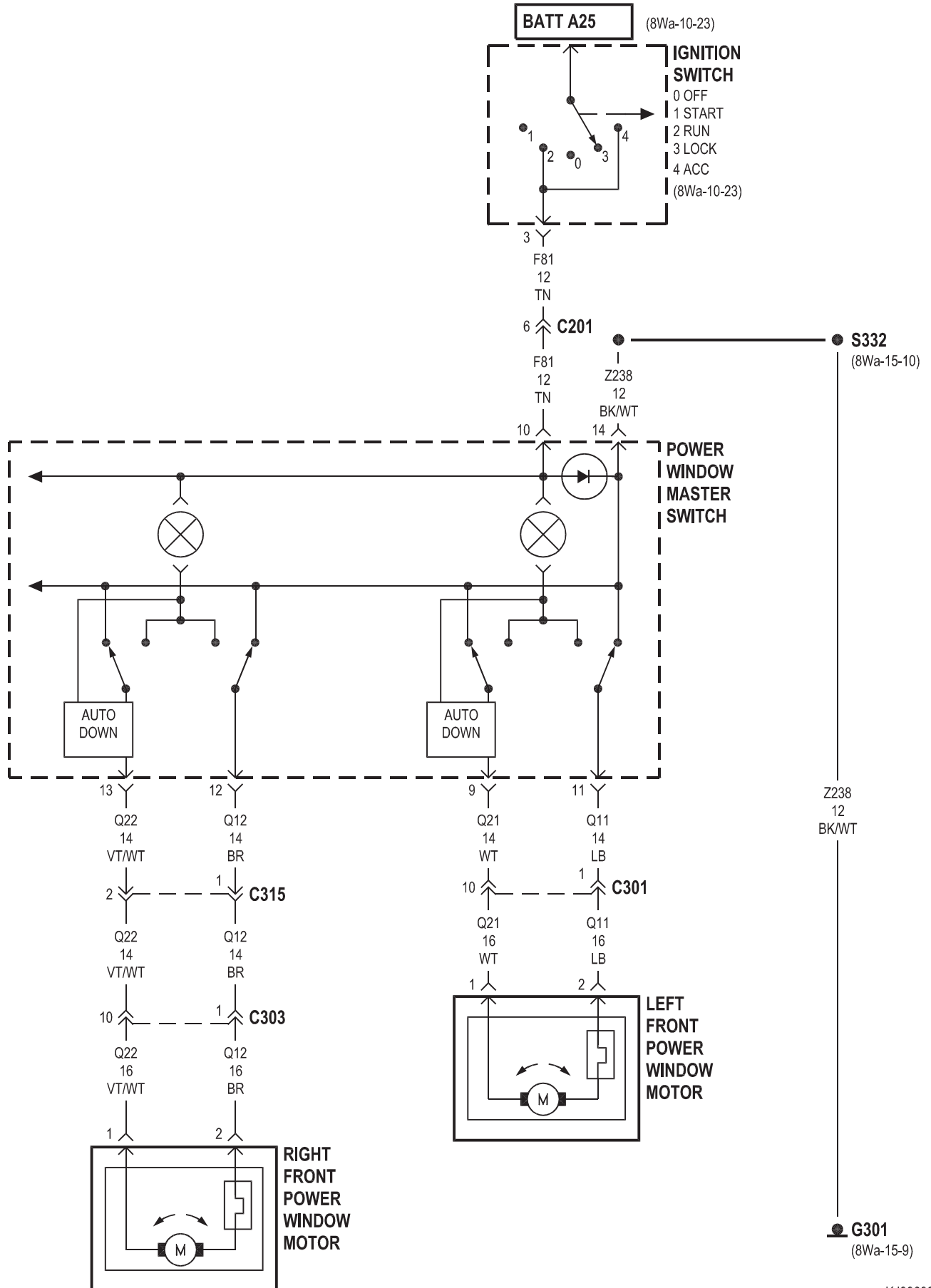


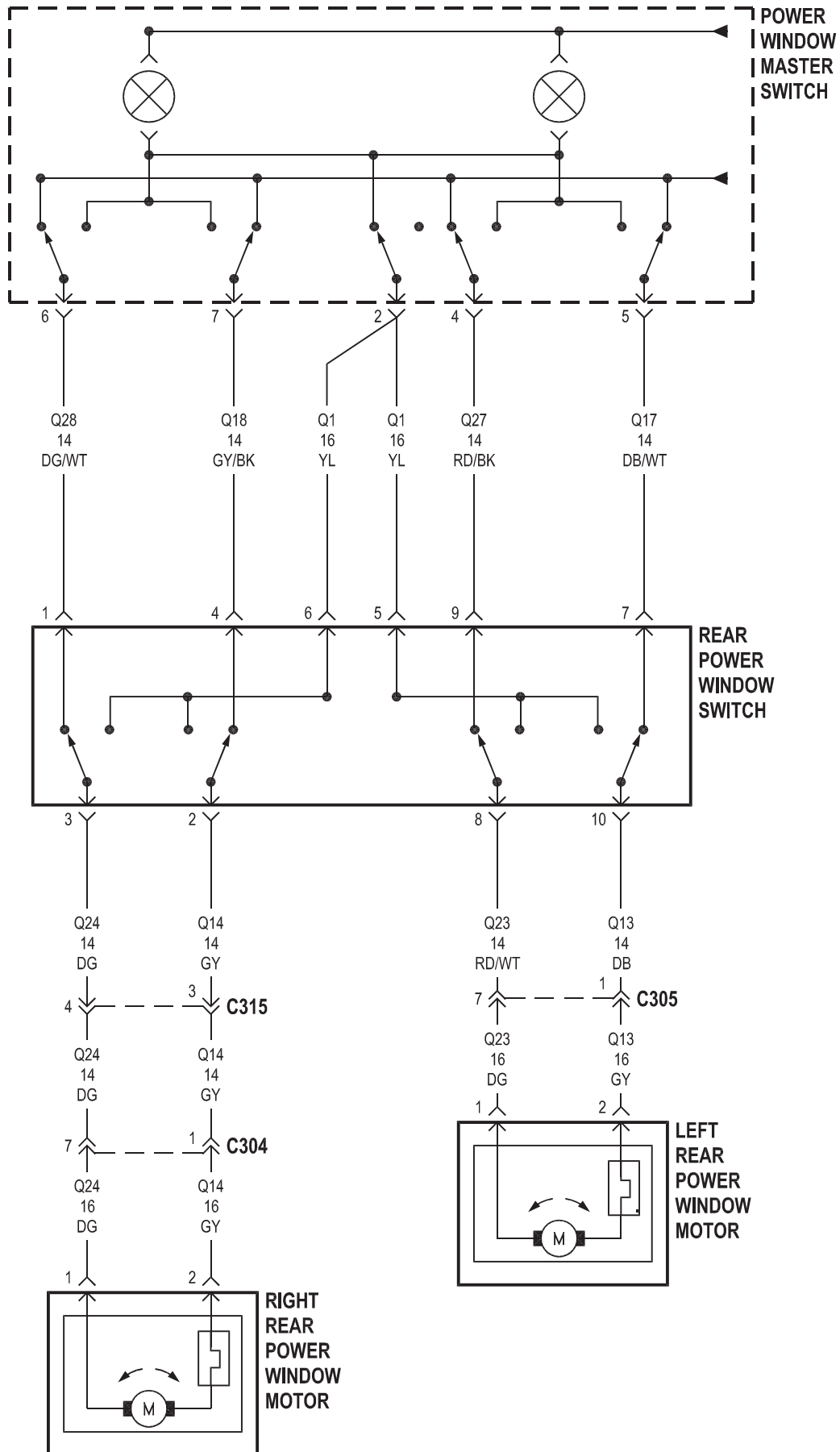


## 8W-60 POWER WINDOWS

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
G301 .....	8Wa-60-2	Power Window Master Switch .....	8Wa-60-2, 3
Ignition Switch .....	8Wa-60-2	Rear Power Window Switch .....	8Wa-60-3
Left Front Power Window Motor .....	8Wa-60-2	Right Front Power Window Motor .....	8Wa-60-2
Left Rear Power Window Motor .....	8Wa-60-3	Right Rear Power Window Motor .....	8Wa-60-3







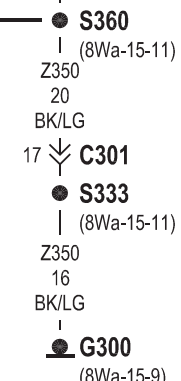
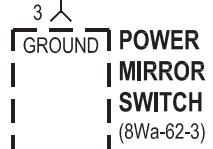
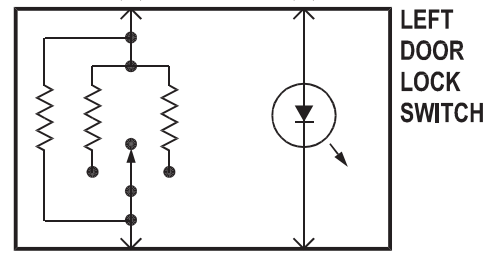
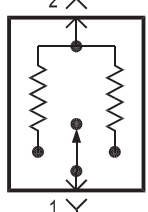
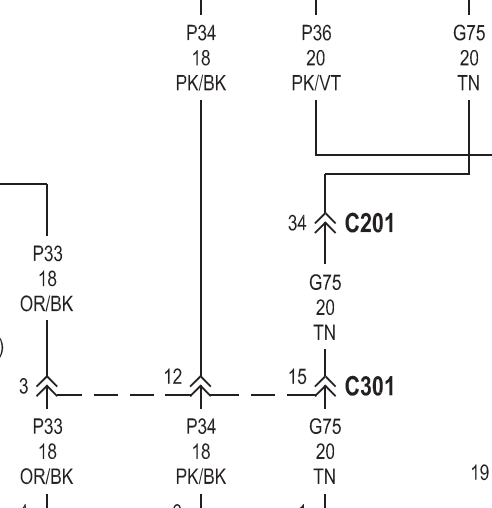
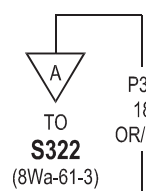
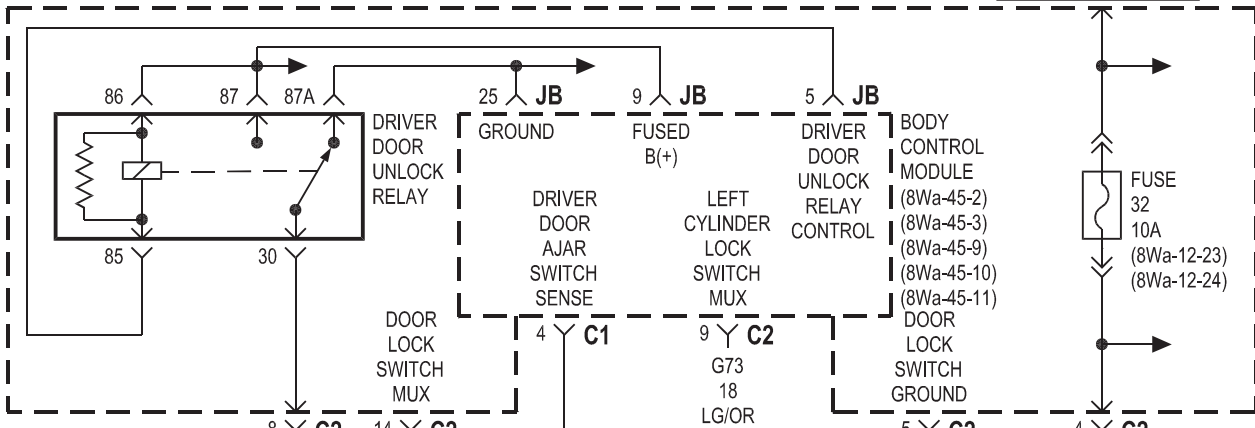


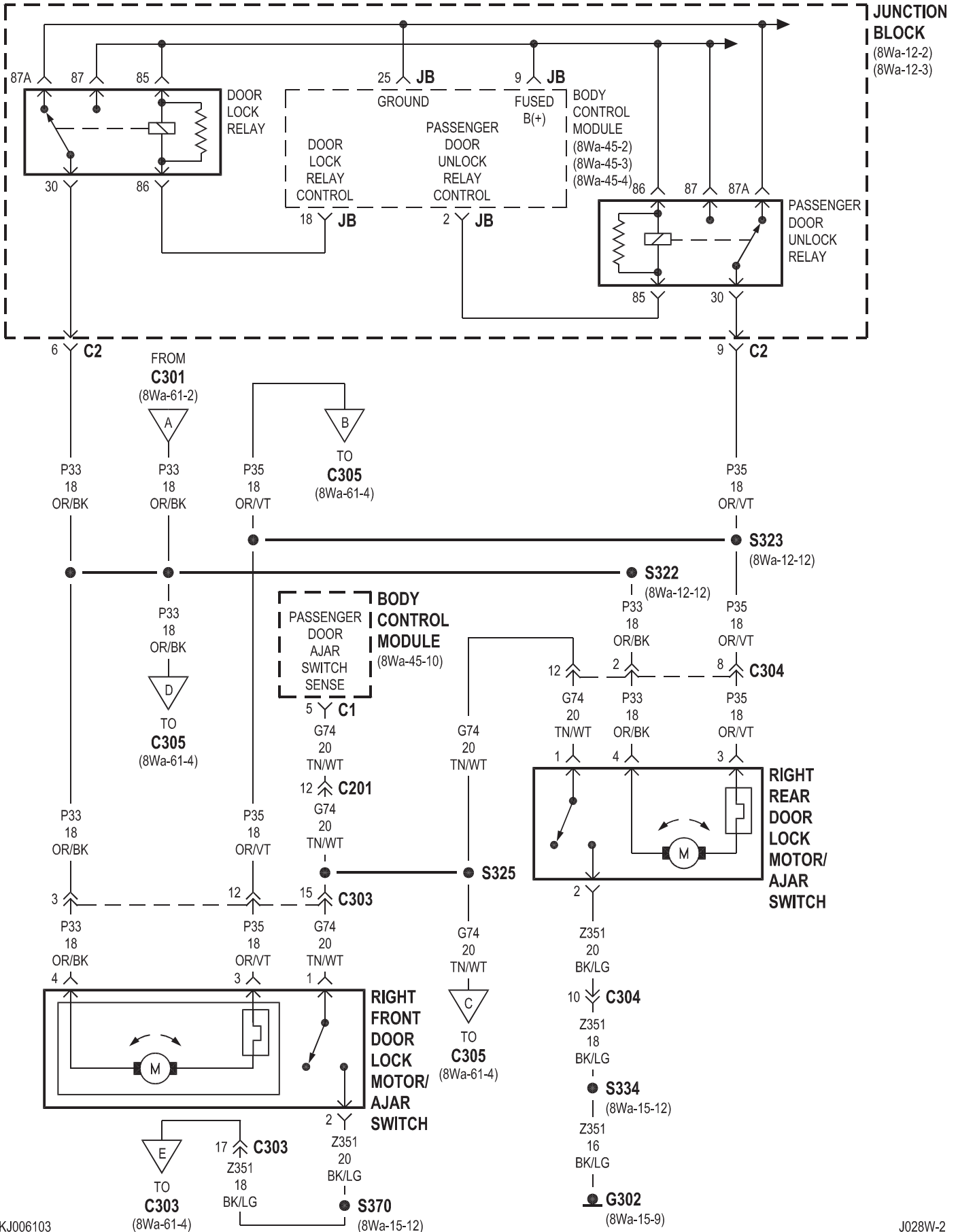
## 8W-61 POWER DOOR LOCKS

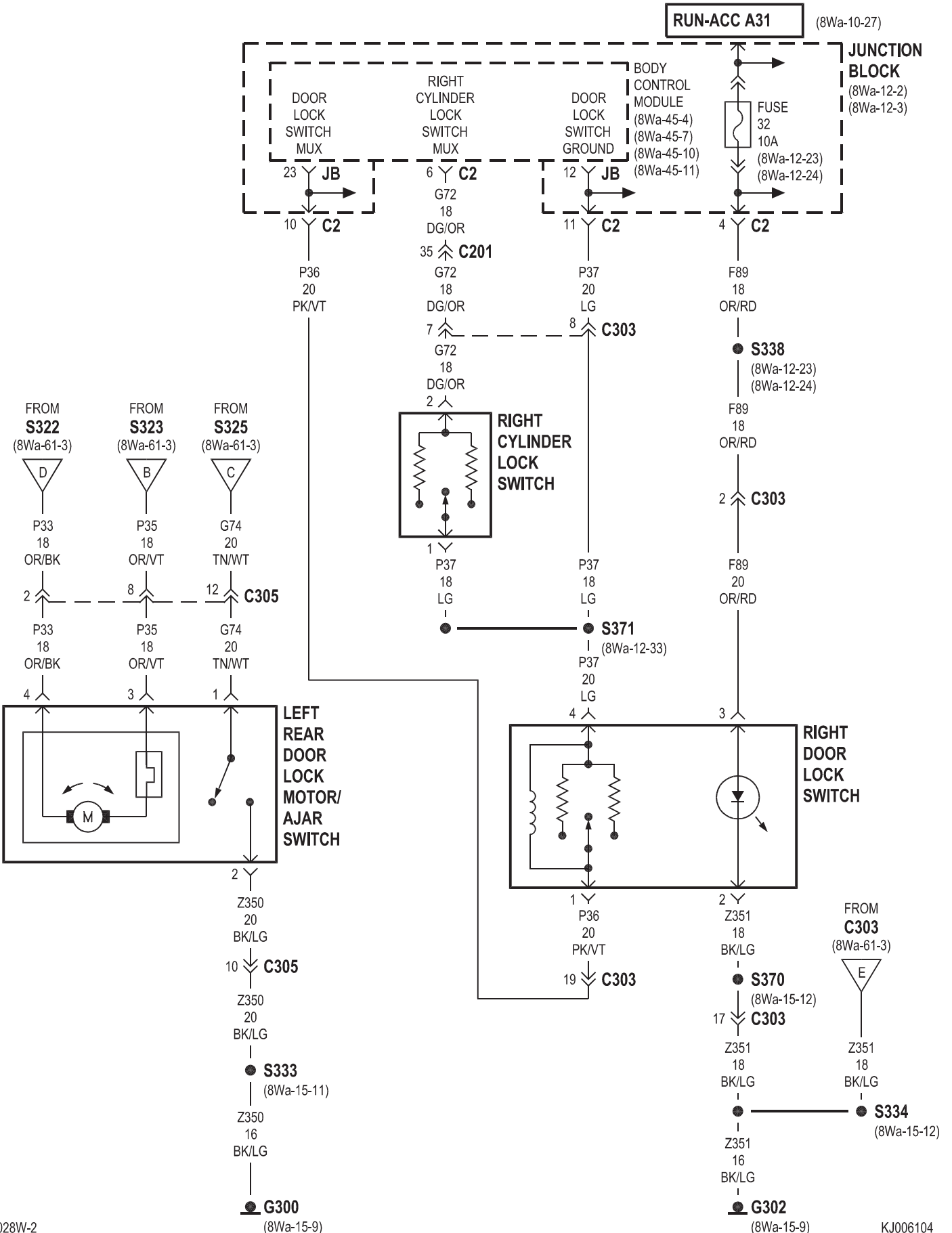
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Body Control Module . . . . .	8Wa-61-2, 3, 4, 5, 6, 7, 8	Left Power Mirror . . . . .	8Wa-61-2
Door Lock Relay . . . . .	8Wa-61-3, 7	Left Rear Door Lock Motor/Ajar Switch . . . . .	8Wa-61-4, 8
Driver Door Unlock Relay . . . . .	8Wa-61-2, 6	Passenger Door Unlock Relay . . . . .	8Wa-61-3, 7
Flip-Up Glass Release Motor . . . . .	8Wa-61-5	Power Mirror Switch . . . . .	8Wa-61-2
Flip-Up Glass Release Switch . . . . .	8Wa-61-5	Right Cylinder Lock Switch . . . . .	8Wa-61-4, 6
Fuse 32 . . . . .	8Wa-61-2, 4, 6, 8	Right Door Lock Switch . . . . .	8Wa-61-4, 6
G300 . . . . .	8Wa-61-2, 4, 7, 8	Right Front Door Lock Motor/Ajar Switch . . . . .	8Wa-61-3, 6
G302 . . . . .	8Wa-61-3, 4, 6, 7	Right Rear Door Lock Motor/Ajar Switch . . . . .	8Wa-61-3, 7
G311 . . . . .	8Wa-61-5	Tailgate Cylinder Lock Switch . . . . .	8Wa-61-5
G312 . . . . .	8Wa-61-5	Tailgate Flip-Up Ajar Switch . . . . .	8Wa-61-5
Junction Block . . . . .	8Wa-61-2, 3, 4, 5, 6, 7, 8	Tailgate Lock Motor/Ajar Switch . . . . .	8Wa-61-5
Left Cylinder Lock Switch . . . . .	8Wa-61-2, 8		
Left Door Lock Switch . . . . .	8Wa-61-2, 8		
Left Front Door Lock Motor/Ajar Switch . . . . .	8Wa-61-2, 7		

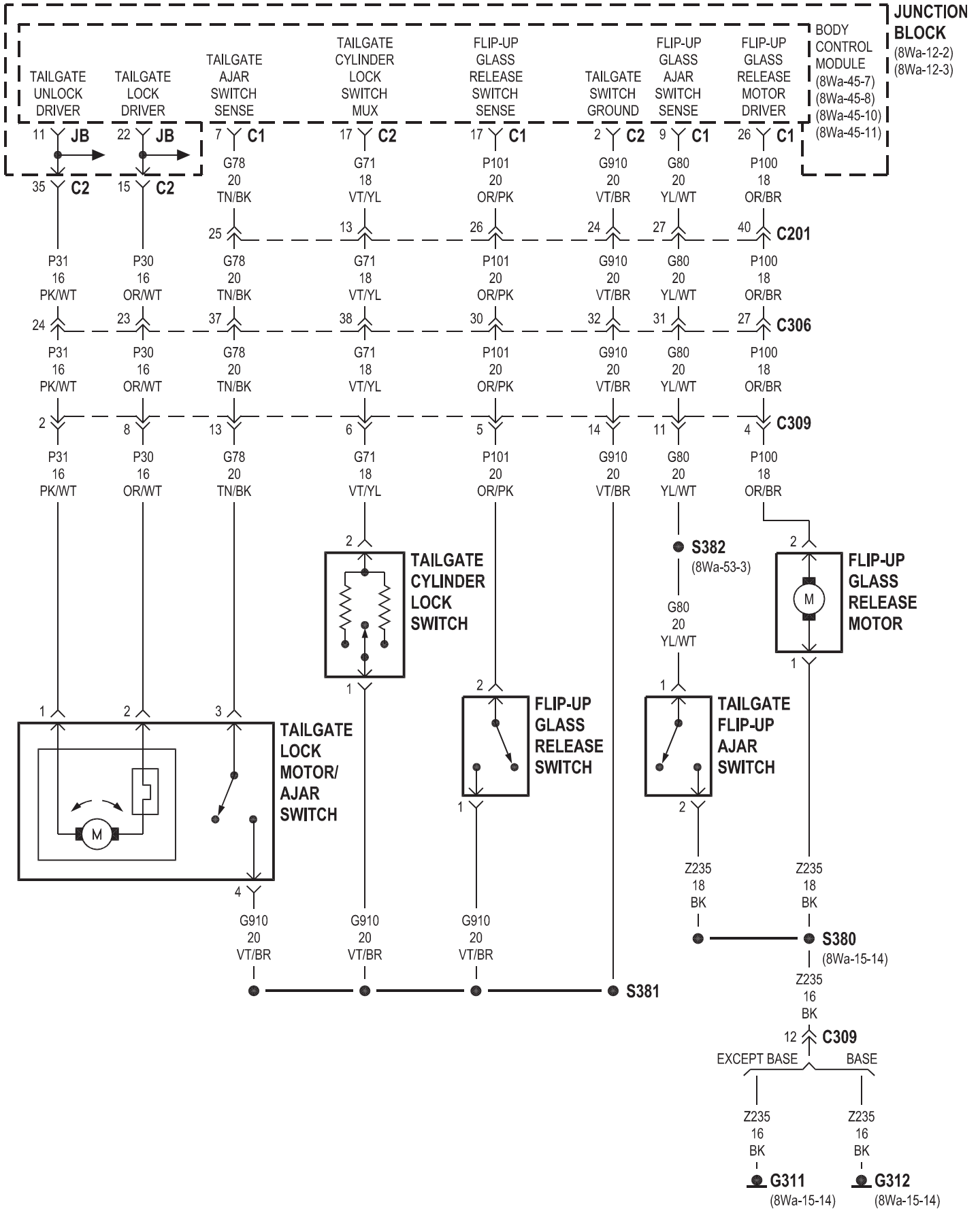
**RUN-ACC A31** (8Wa-10-27)

**JUNCTION BLOCK**  
(8Wa-12-2)  
(8Wa-12-3)

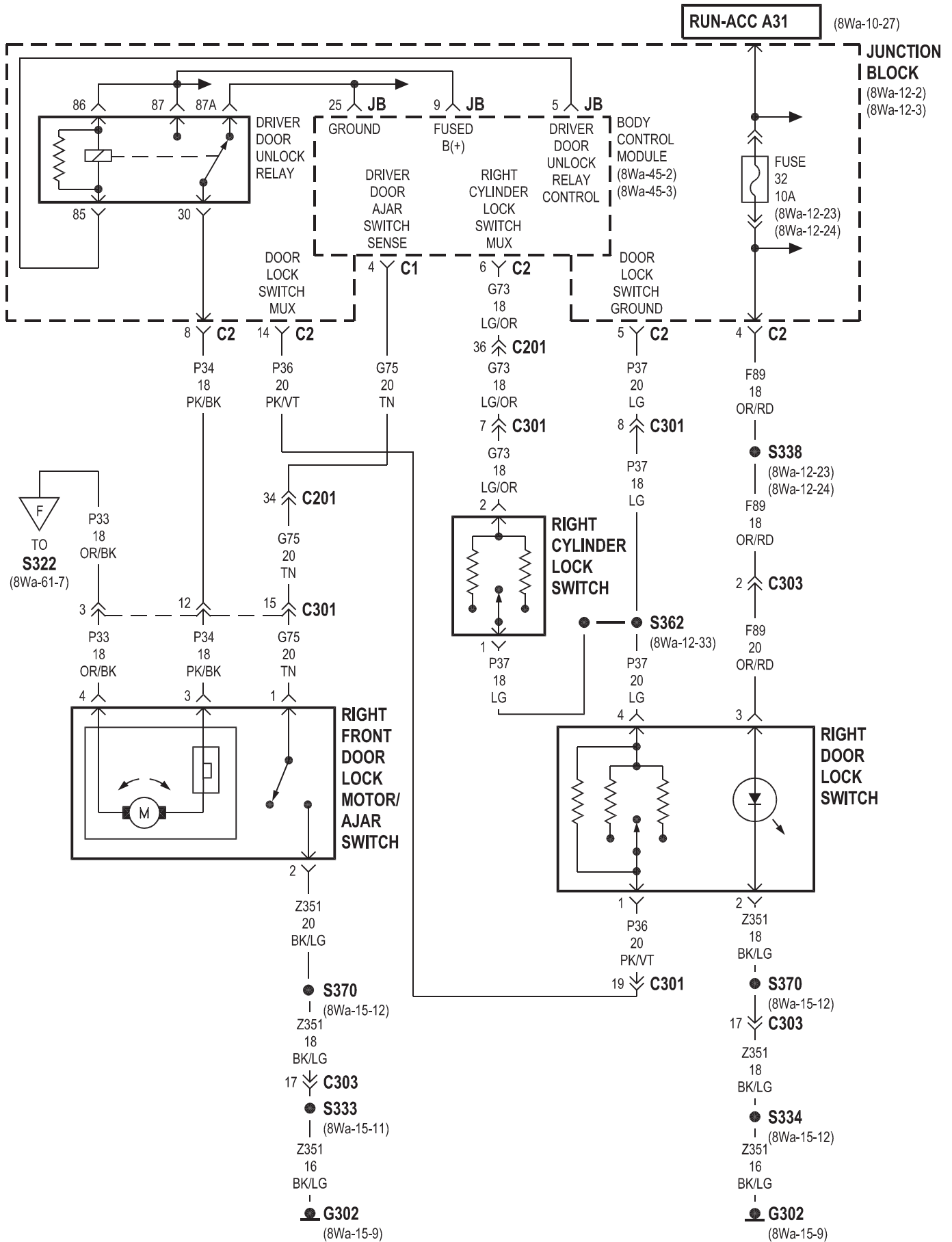


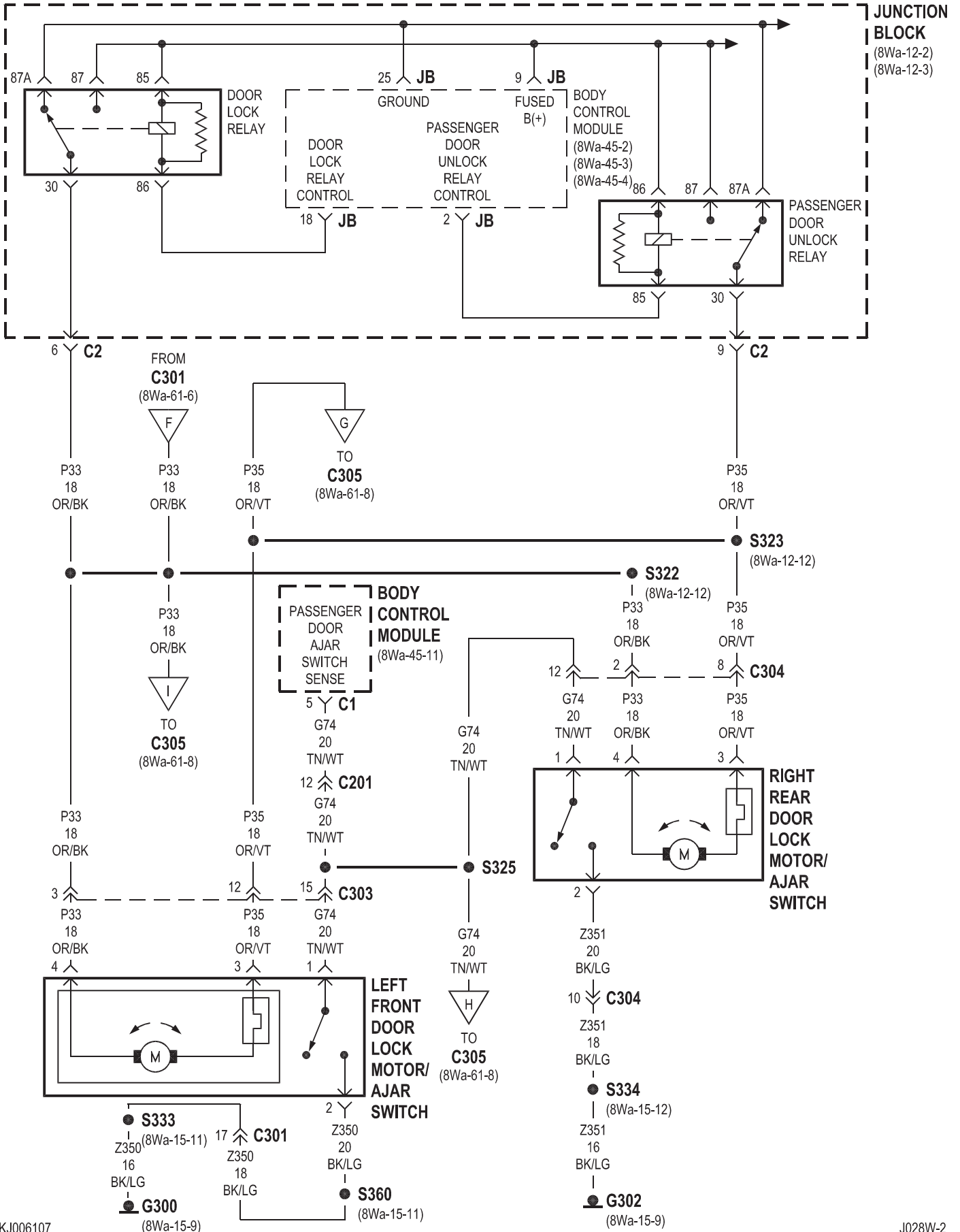


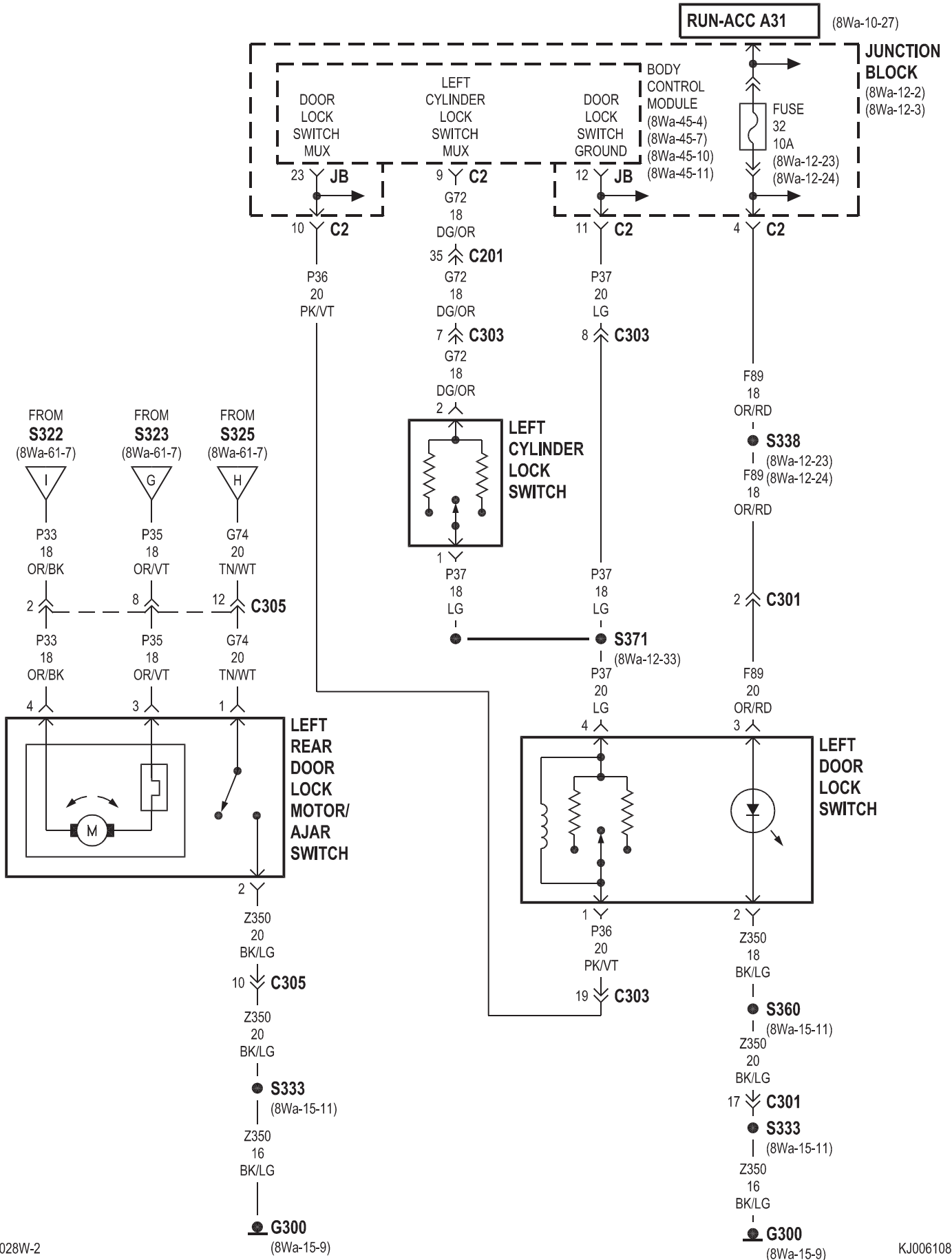






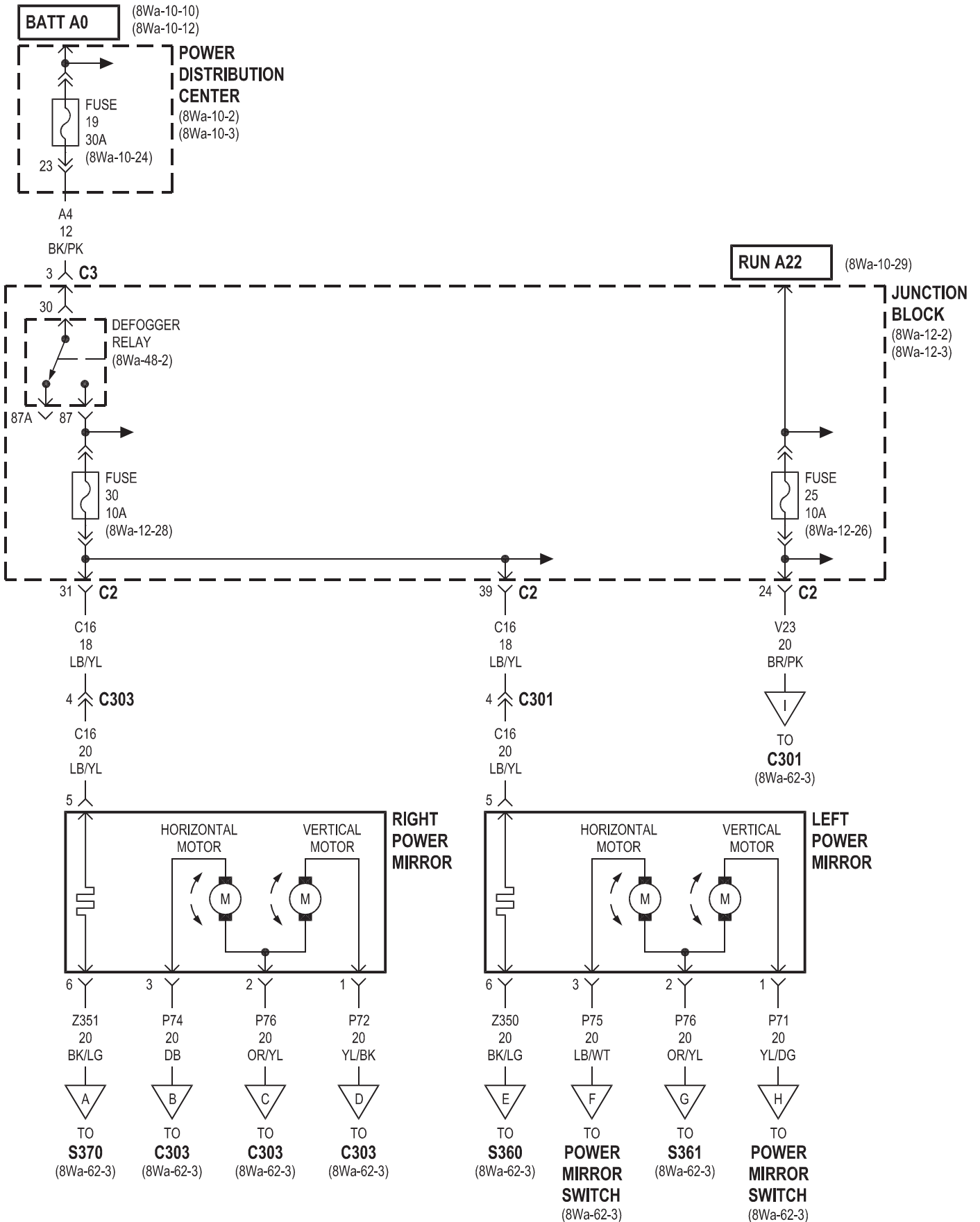


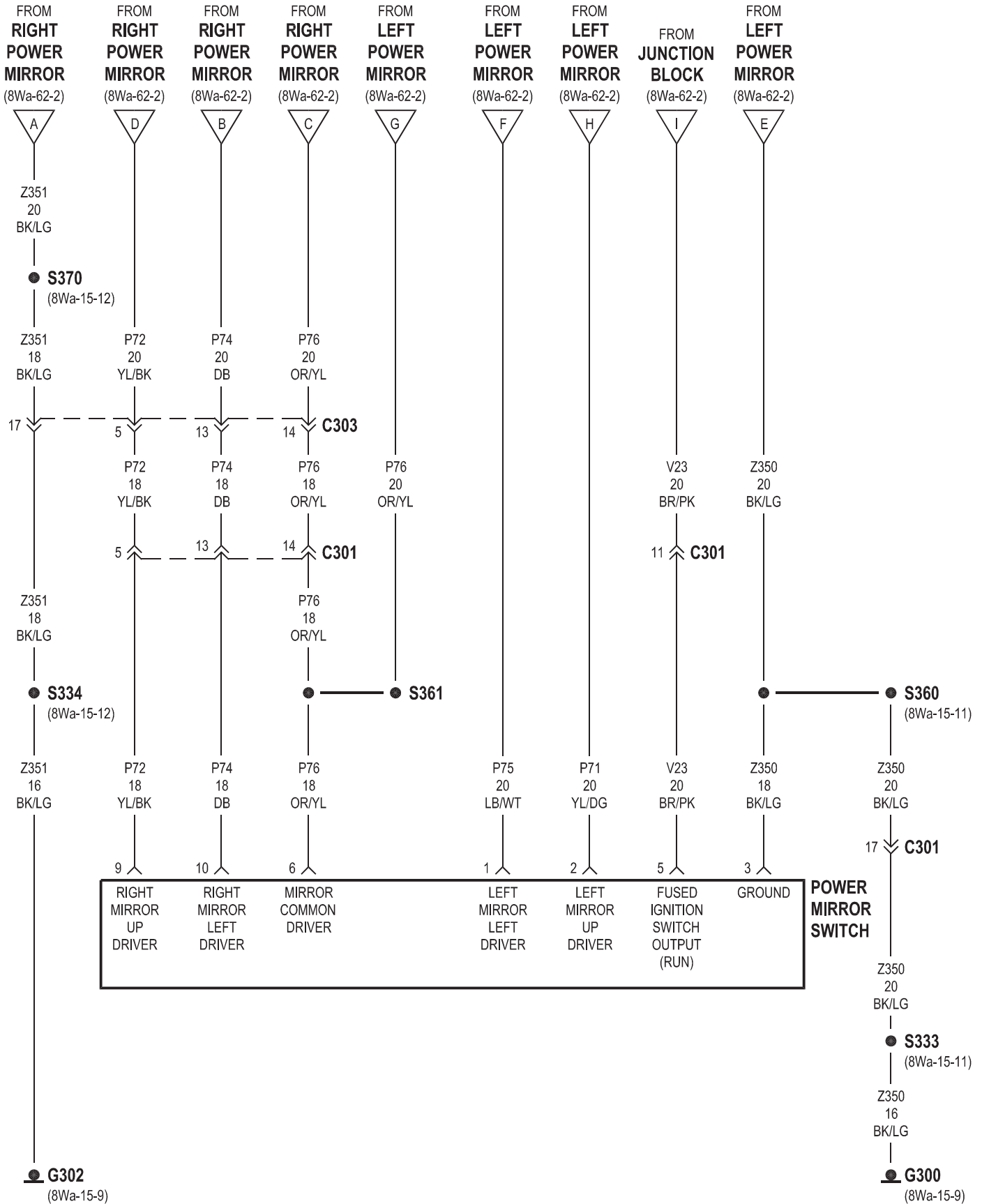


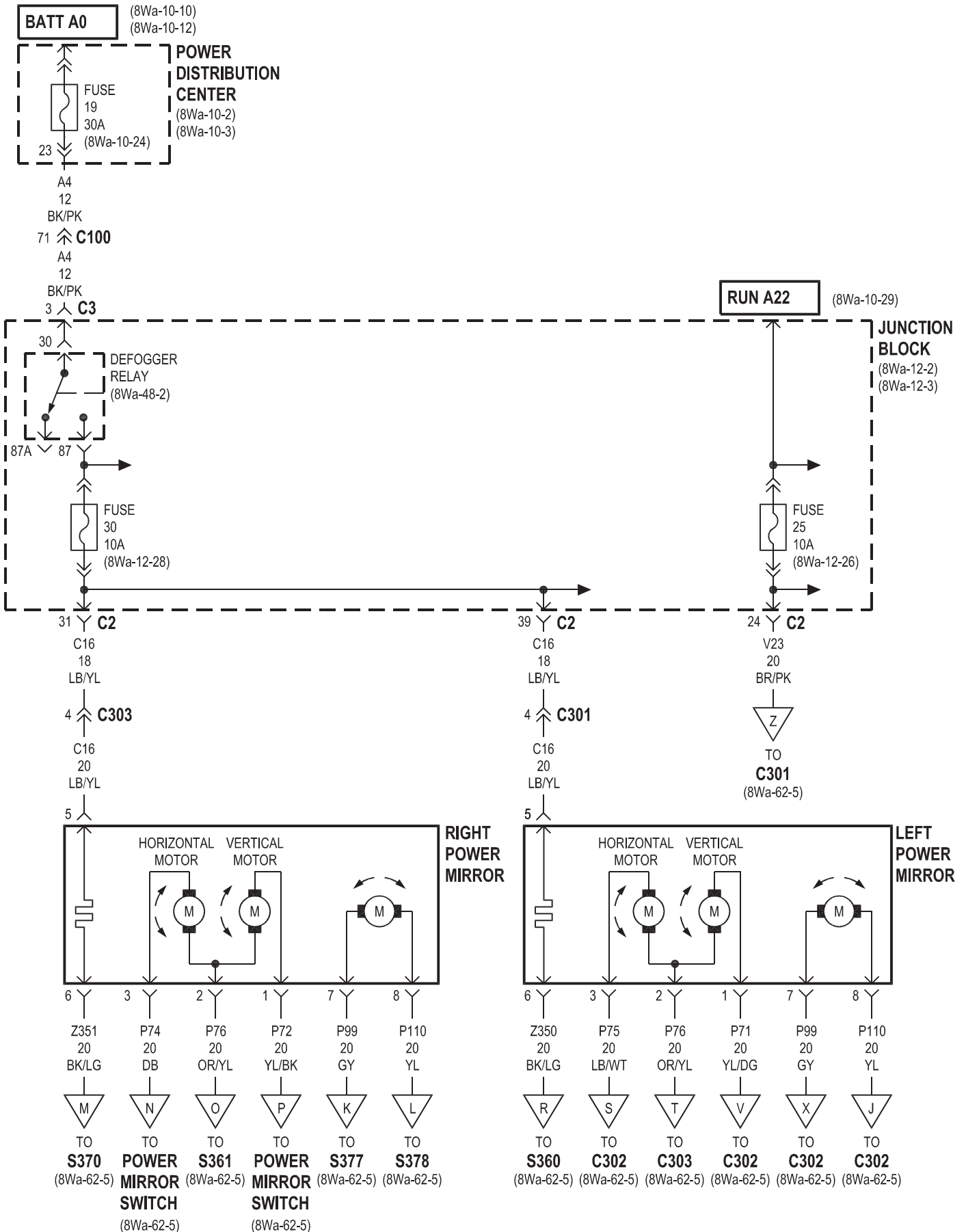


## 8W-62 POWER MIRRORS

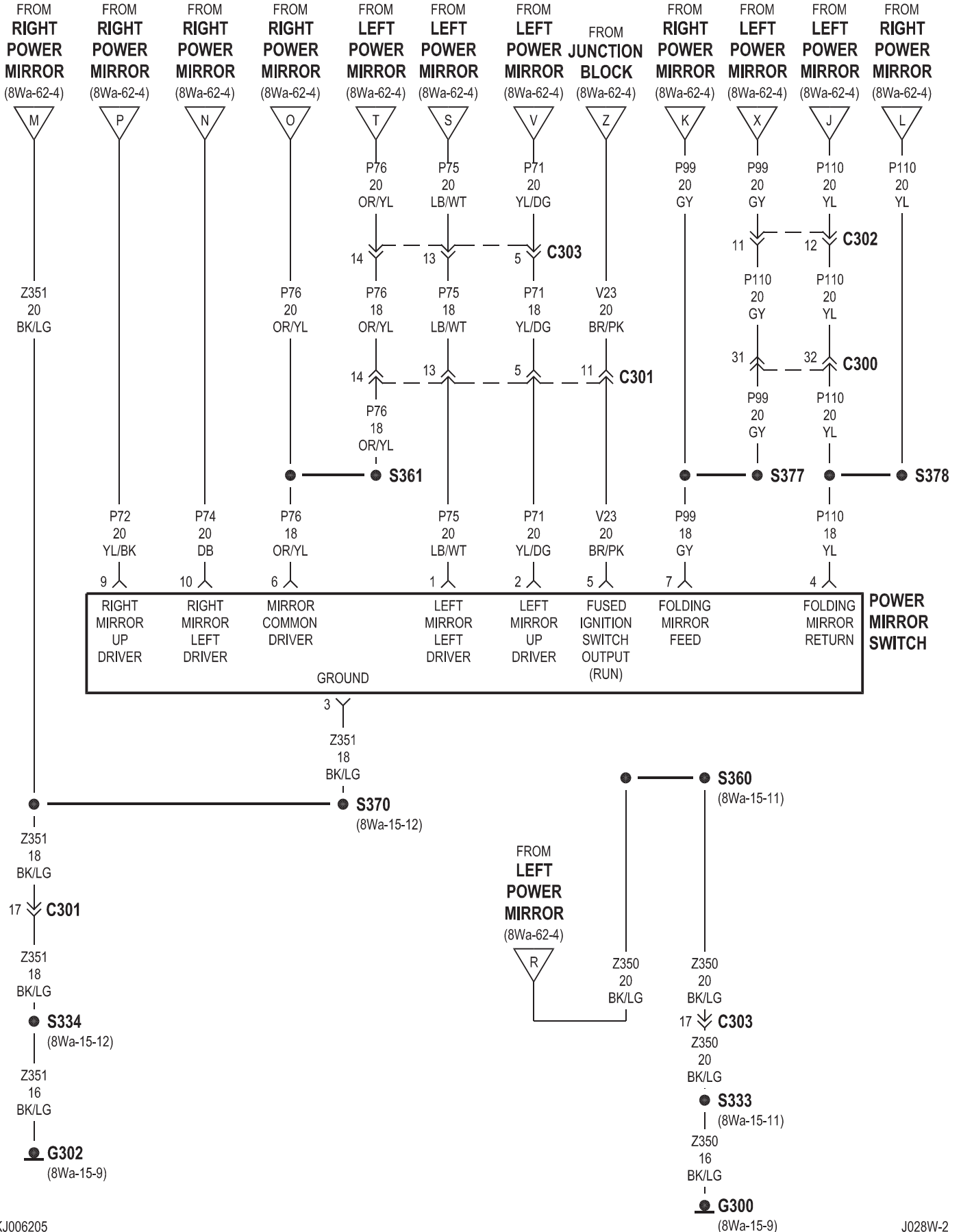
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Defogger Relay . . . . .	8Wa-62-2, 4	Junction Block . . . . .	8Wa-62-2, 3, 4, 5
Fuse 19 . . . . .	8Wa-62-2, 4	Left Power Mirror . . . . .	8Wa-62-2, 3, 4, 5
Fuse 25 . . . . .	8Wa-62-2, 4	Power Distribution Center . . . . .	8Wa-62-2, 4
Fuse 30 . . . . .	8Wa-62-2, 4	Power Mirror Switch . . . . .	8Wa-62-2, 3, 4, 5
G300 . . . . .	8Wa-62-3, 5	Right Power Mirror . . . . .	8Wa-62-2, 3, 4, 5
G302 . . . . .	8Wa-62-3, 5		







**KJ** **8W-62 POWER MIRRORS** **8Wa - 62 - 5**  
**RHD EXCEPT BASE**

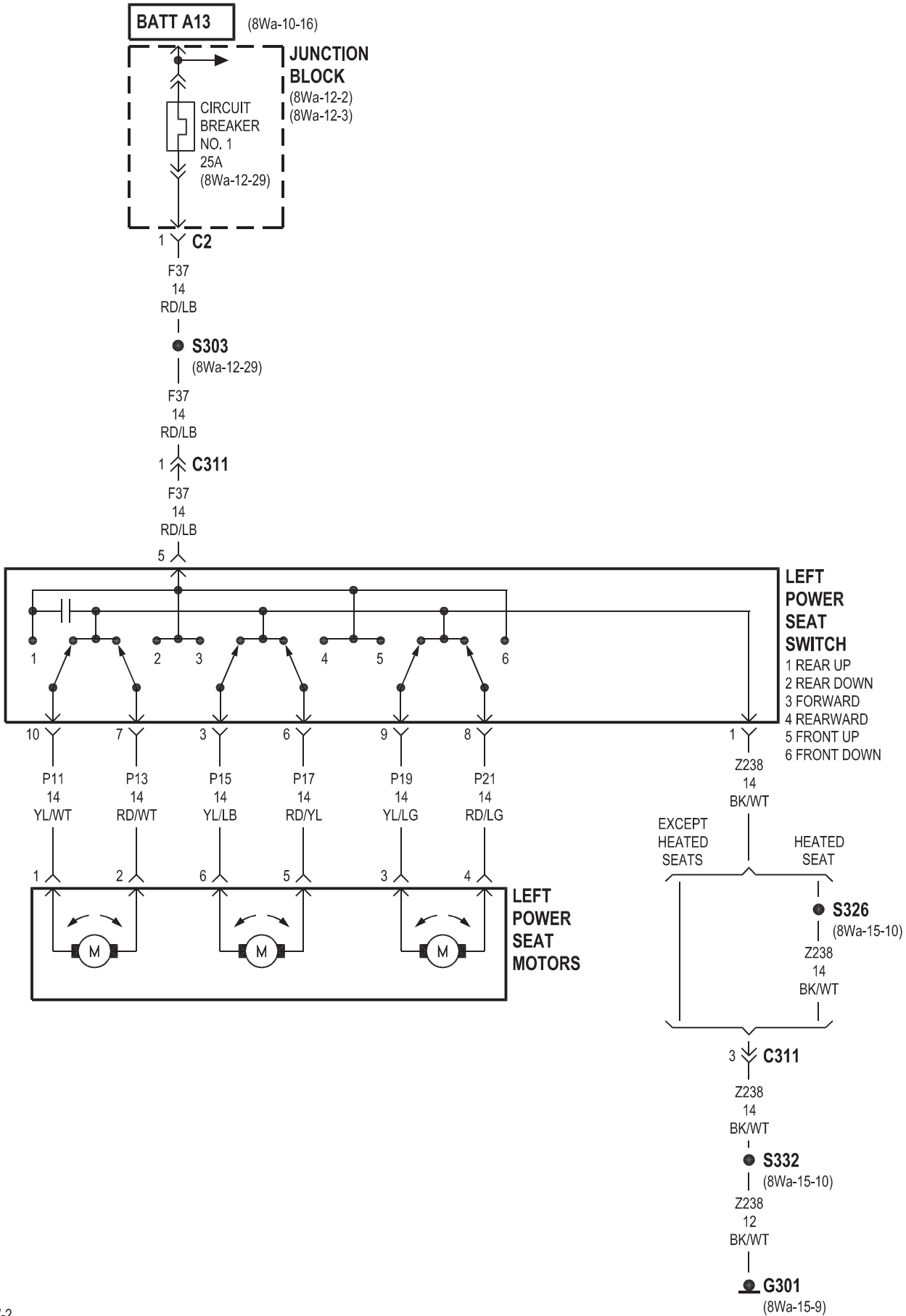


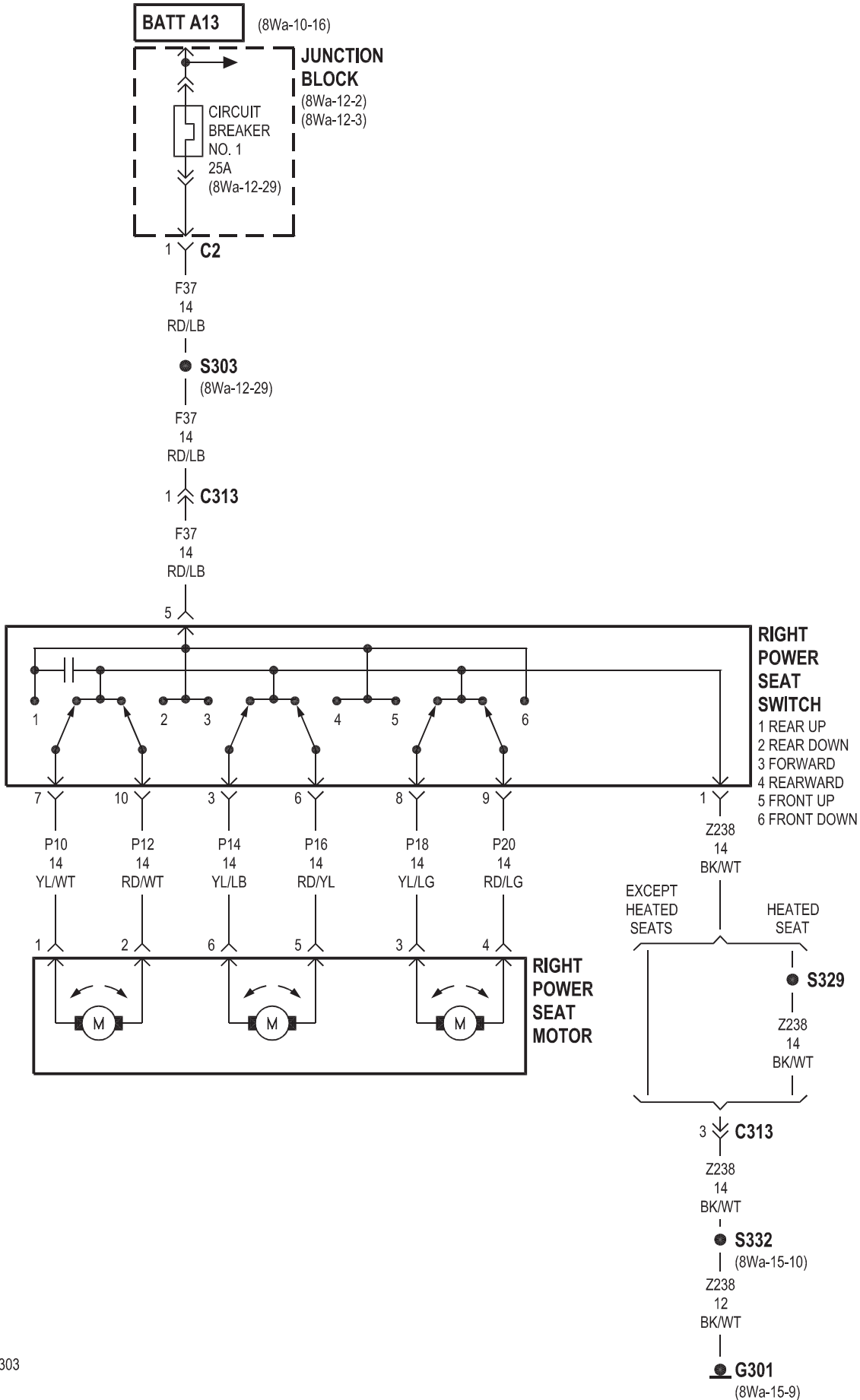


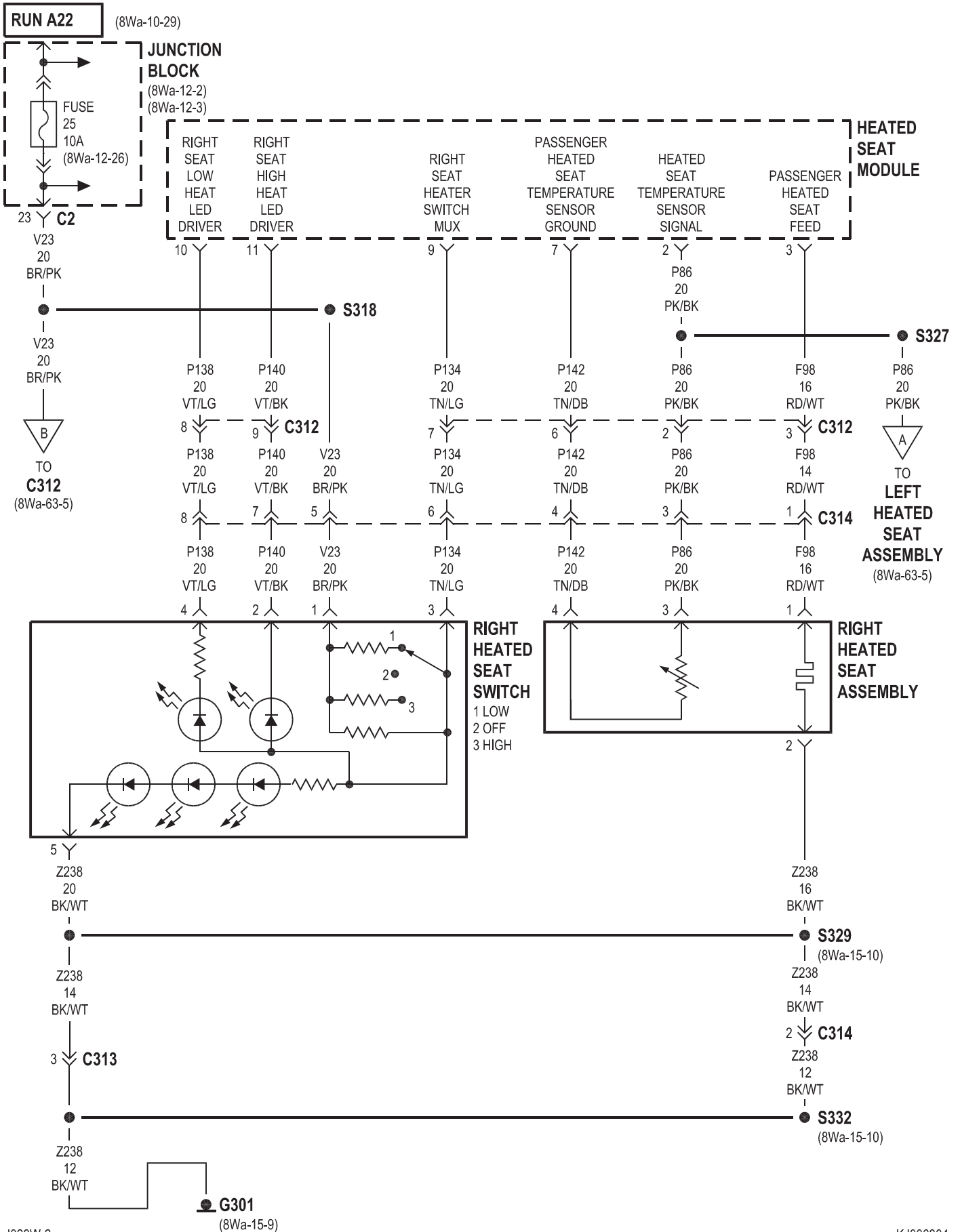


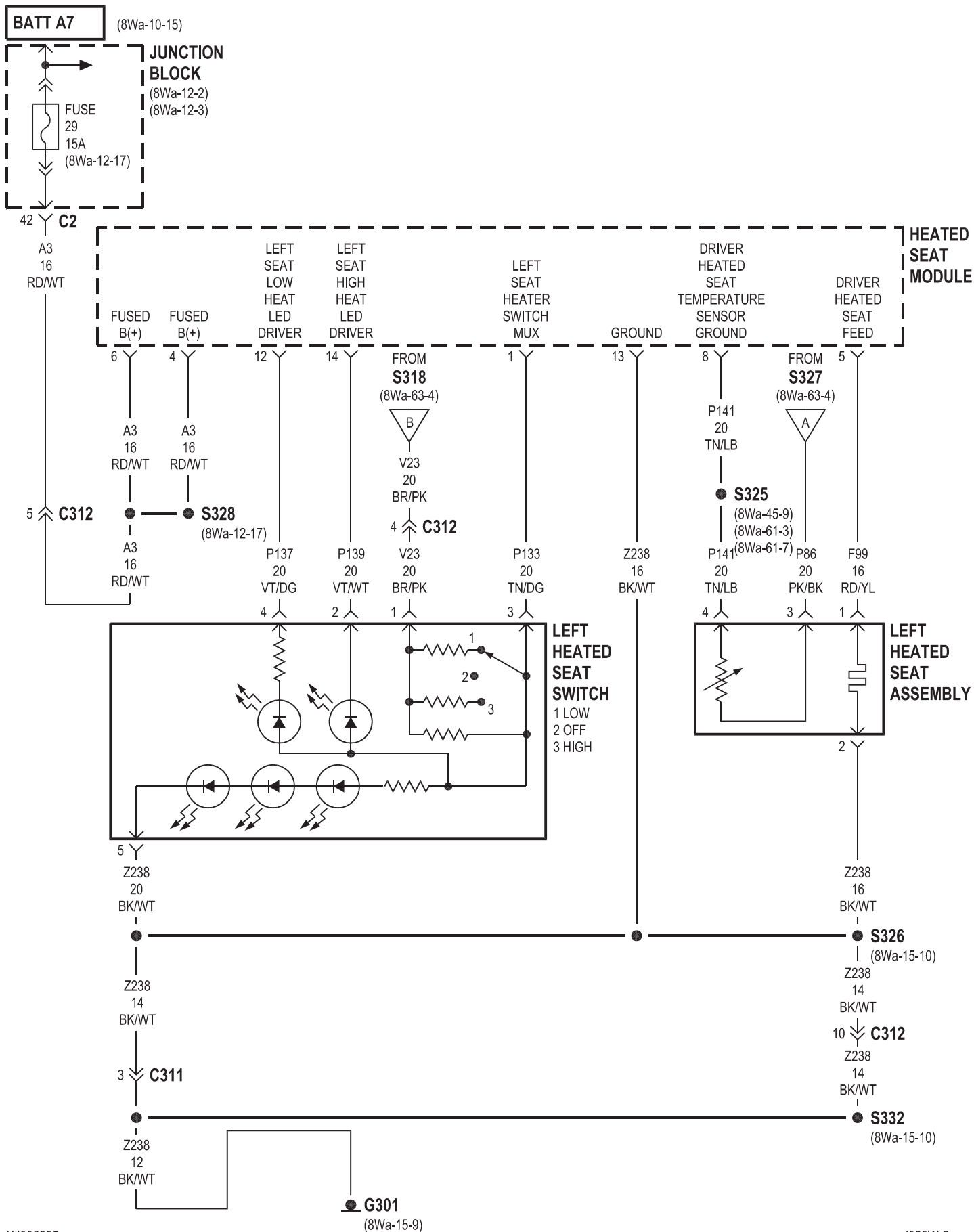
## 8W-63 POWER SEAT

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Circuit Breaker No. 1 . . . . .	8Wa-63-2, 3	Left Heated Seat Switch . . . . .	8Wa-63-5
Fuse 25 . . . . .	8Wa-63-4	Left Power Seat Motors . . . . .	8Wa-63-2
Fuse 29 . . . . .	8Wa-63-5	Left Power Seat Switch . . . . .	8Wa-63-2
G301 . . . . .	8Wa-63-2, 3, 4, 5	Right Heated Seat Assembly . . . . .	8Wa-63-4
Heated Seat Module . . . . .	8Wa-63-4, 5	Right Heated Seat Switch . . . . .	8Wa-63-4
Junction Block . . . . .	8Wa-63-2, 3, 4, 5	Right Power Seat Motor . . . . .	8Wa-63-3
Left Heated Seat Assembly . . . . .	8Wa-63-4, 5	Right Power Seat Switch . . . . .	8Wa-63-3







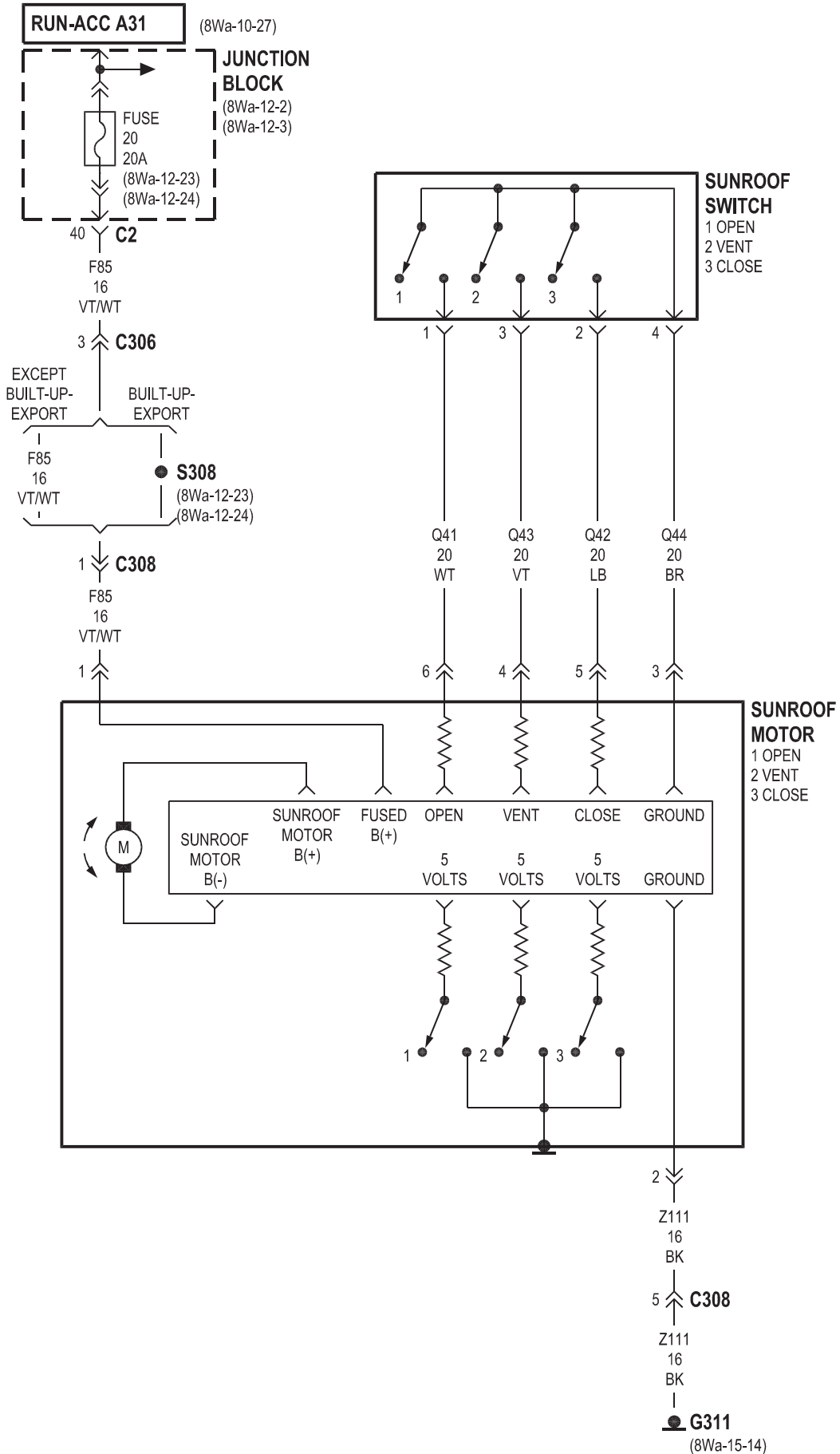




## 8W-64 POWER SUNROOF

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Fuse 20 .....	8Wa-64-2	Sunroof Motor .....	8Wa-64-2
G311 .....	8Wa-64-2	Sunroof Switch .....	8Wa-64-2
Junction Block .....	8Wa-64-2		

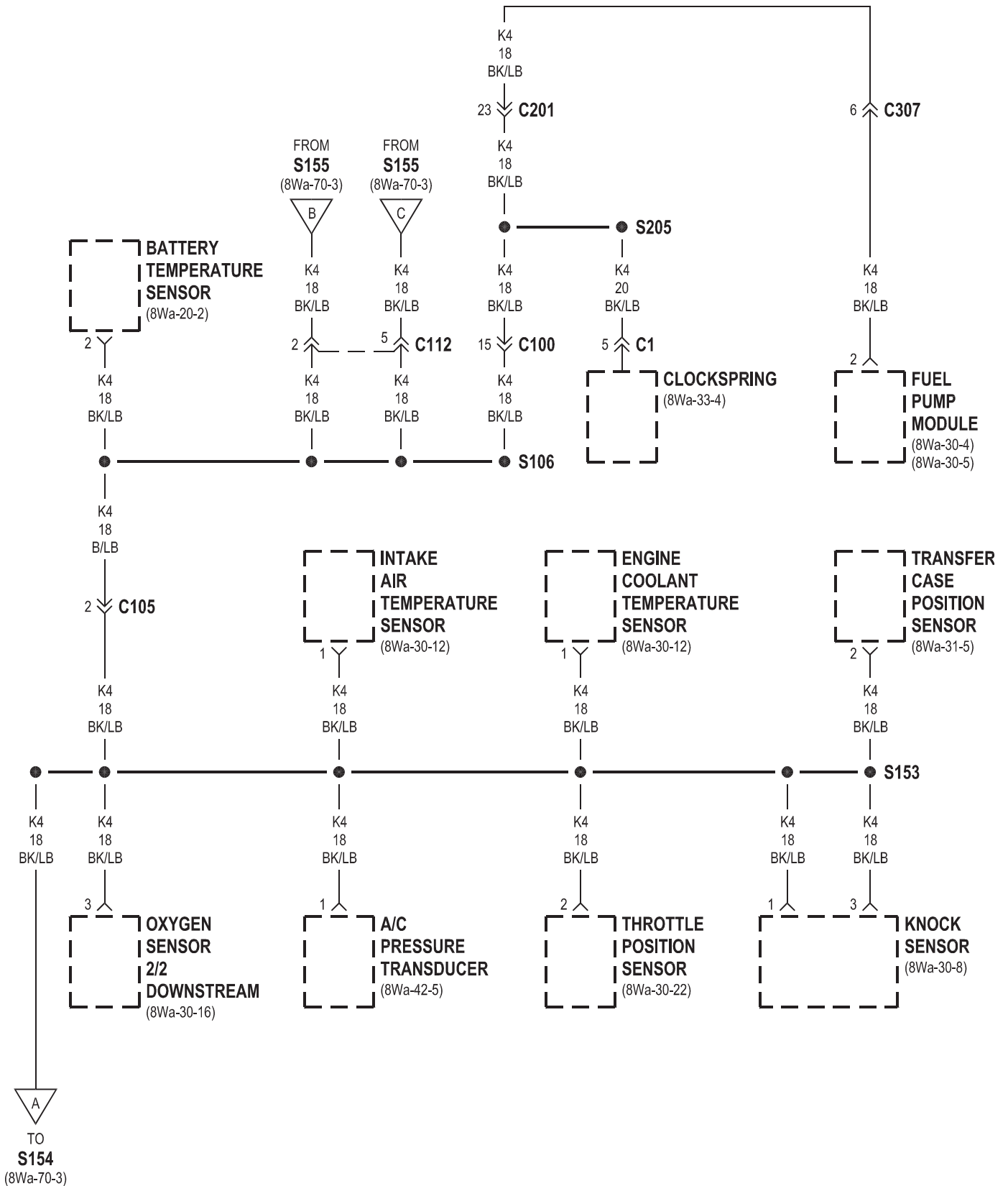


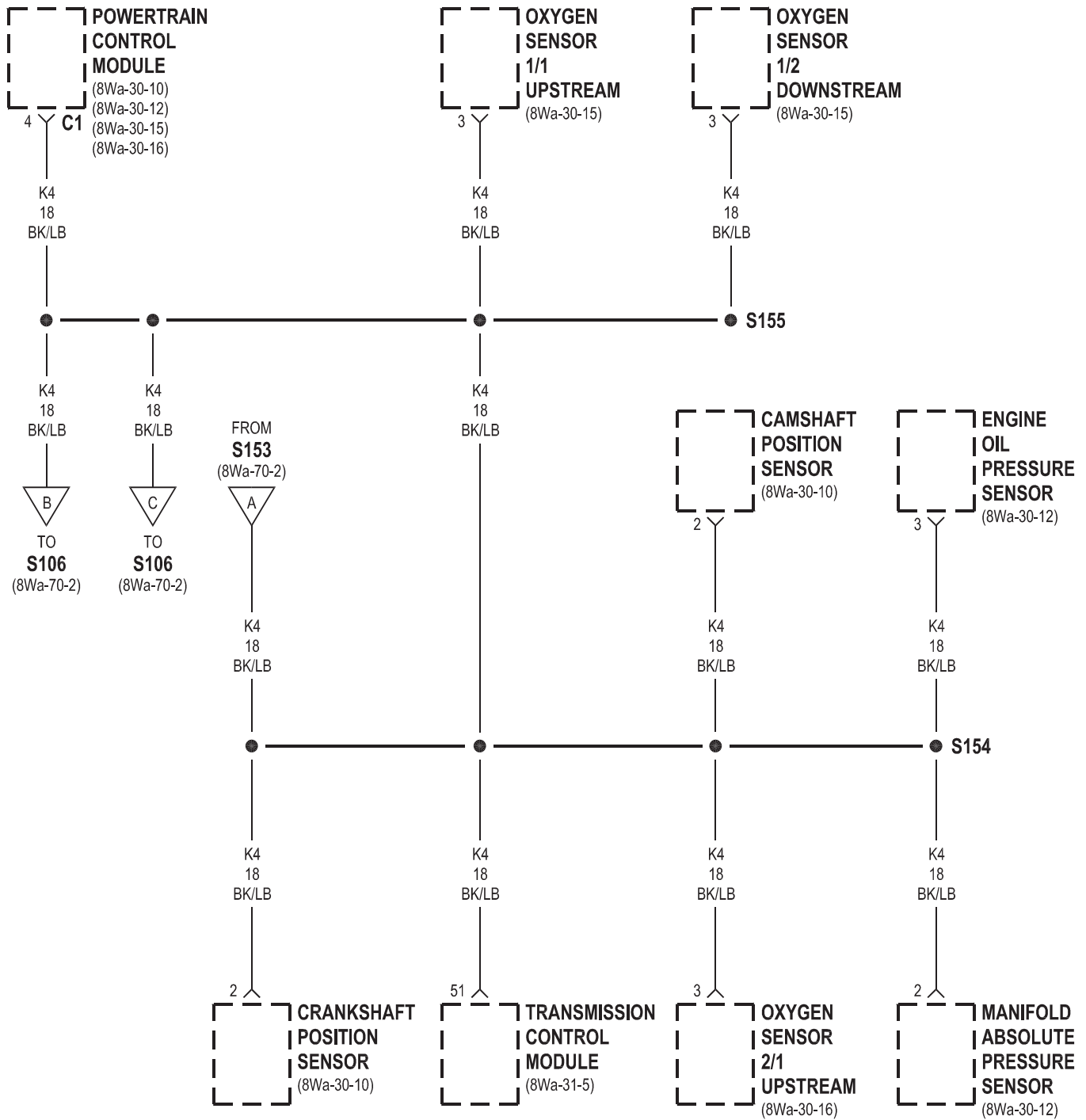


## 8W-70 SPLICE INFORMATION

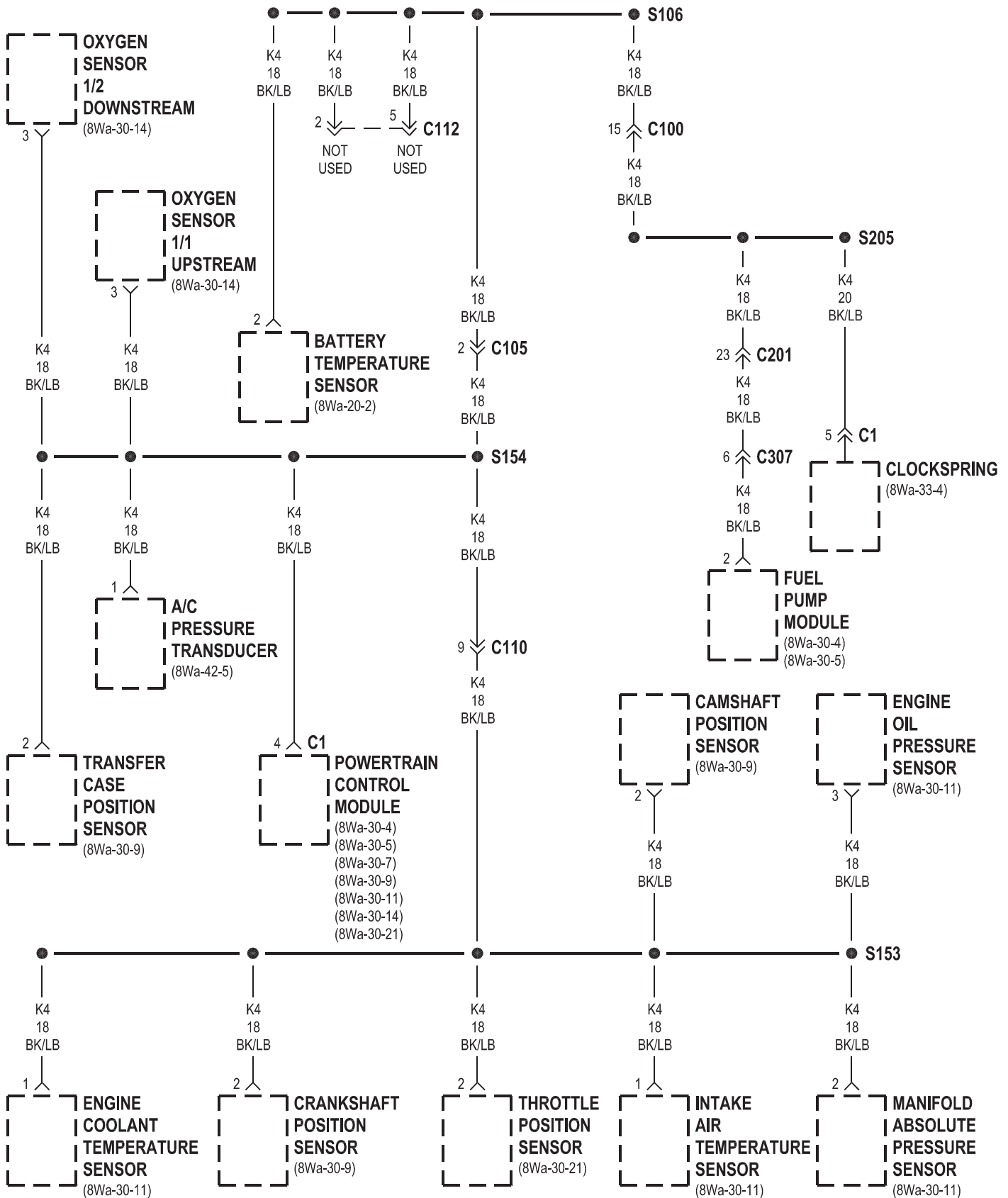
Component	Page	Component	Page
S101	8Wa-10-23	S217	8Wa-53-3
S104	8Wa-30-6	S218	8Wa-53-3
S106	8Wa-70-2, 4, 6	S219	8Wa-10-13, 25
S107	8Wa-30-33	S220	8Wa-10-24
S108	8Wa-12-9	S221	8Wa-33-4
S108	8Wa-41-2	S222	8Wa-33-4
S109	8Wa-15-3	S223	8Wa-47-9
S110	8Wa-15-4	S224	8Wa-47-9
S111	8Wa-15-3	S300	8Wa-12-13, 14, 15
S112	8Wa-18-3, 4	S301	8Wa-12-30
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S114	8Wa-30-4, 5	S303	8Wa-12-29
S115	8Wa-10-22	S304	8Wa-15-15
S118	8Wa-45-5	S306	8Wa-15-15
S121	8Wa-10-19	S308	8Wa-12-23, 24
S122	8Wa-12-25	S310	8Wa-31-4
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S125	8Wa-10-24	S314	8Wa-52-4, 5
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S131	8Wa-15-4	S318	8Wa-63-4
S140	8Wa-15-5	S319	8Wa-15-7
S141	8Wa-12-13	S322	8Wa-12-12
S142	8Wa-52-6, 7	S323	8Wa-12-12
S143	8Wa-15-5	S324	8Wa-47-7
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S153	8Wa-70-2, 4, 6	S333	8Wa-15-11
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S155	8Wa-70-3	S336	8Wa-18-2
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S157	8Wa-70-5	S340	8Wa-47-3
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S167	8Wa-15-2	S350	8Wa-12-10
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S169	8Wa-15-6	S352	8Wa-12-28
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S210	8Wa-10-27	S382	8Wa-53-3
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S215	8Wa-30-32	S393	8Wa-18-2
S215	8Wa-31-5	S394	8Wa-15-14
S216	8Wa-12-14, 15		

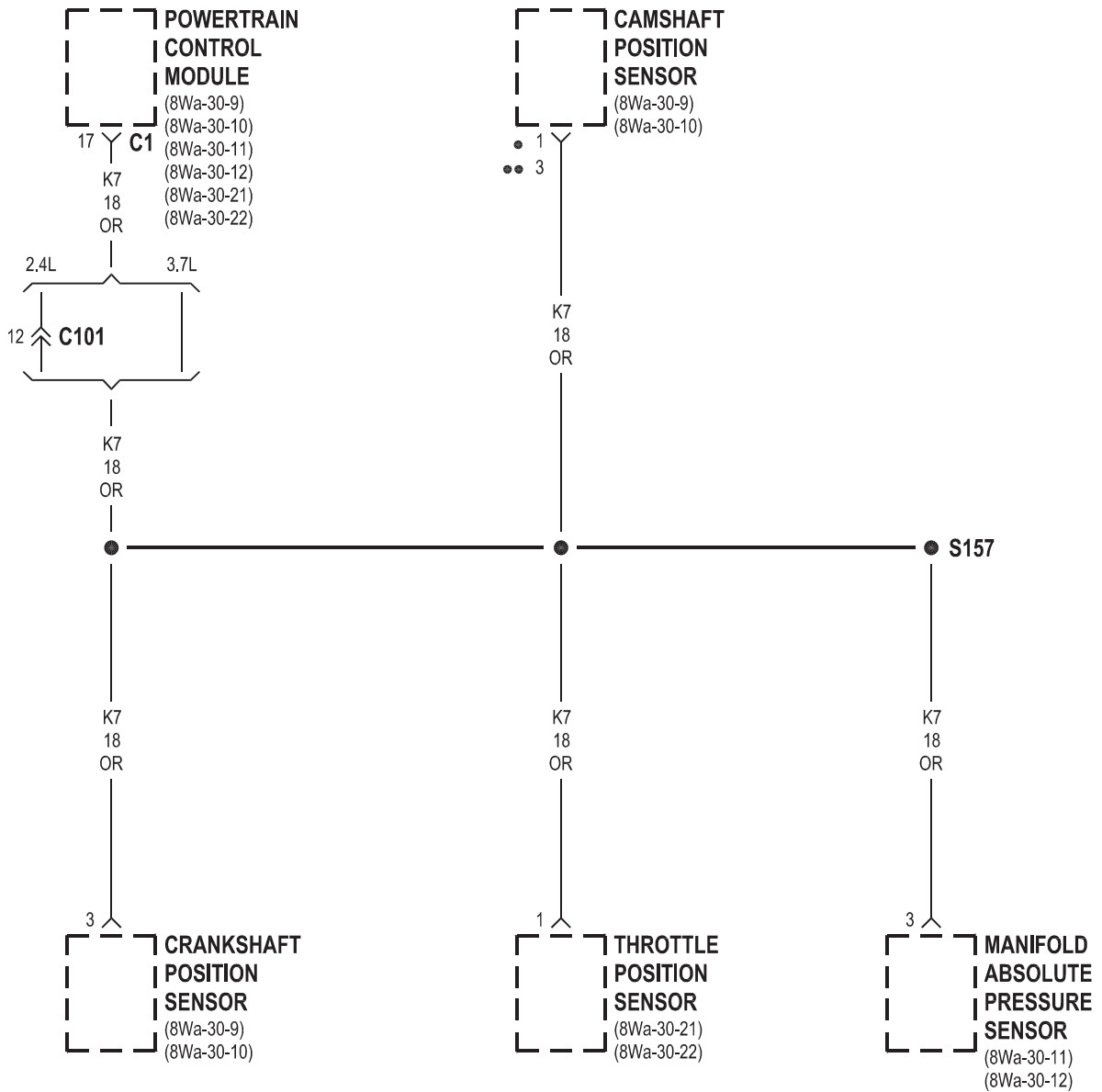
3.7L



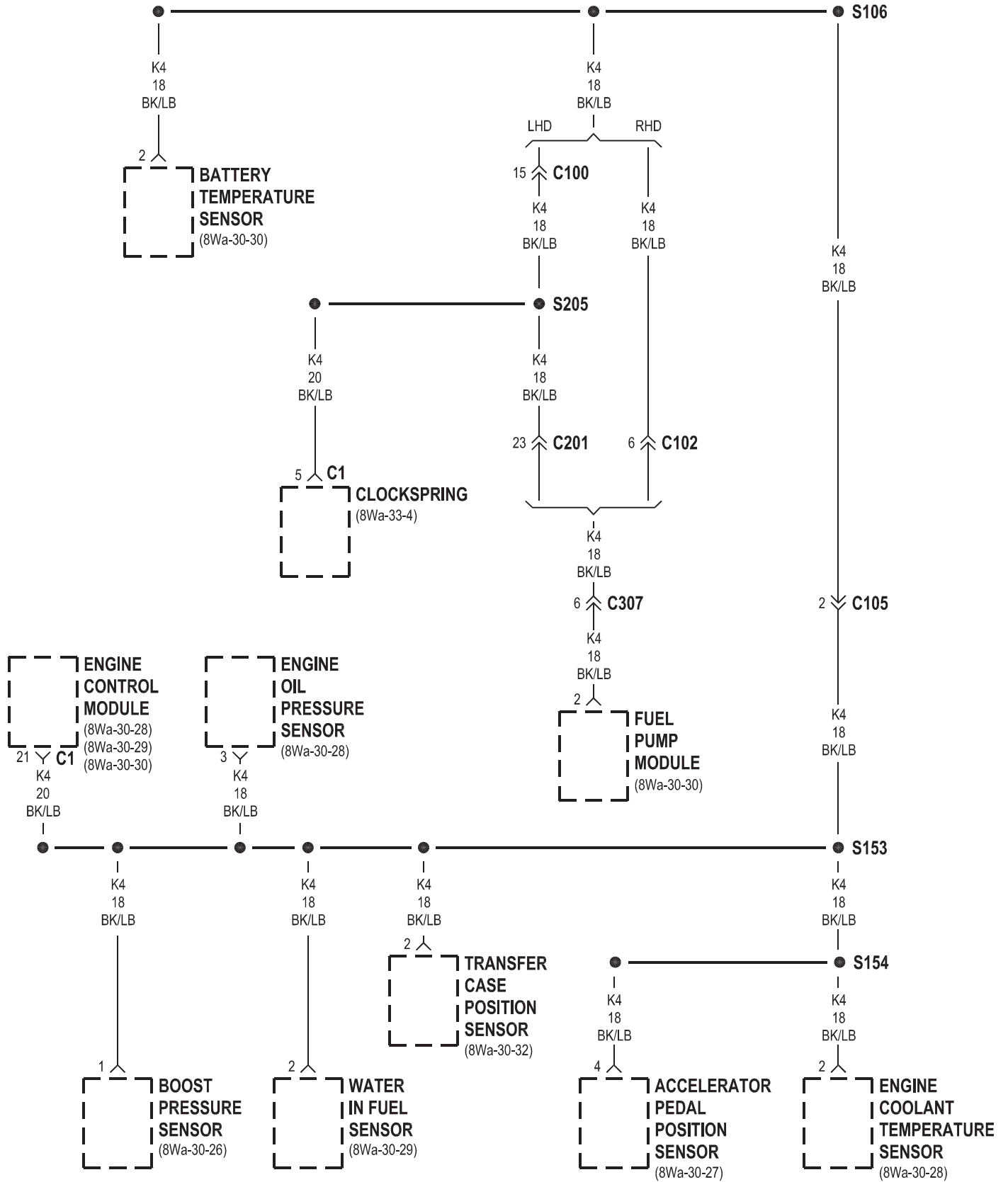


2.4L





- 2.4L
- 3.7L



## 8W-80 CONNECTOR PIN-OUTS

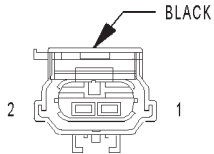
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A/C Compressor Clutch . . . . .	8Wa-80-5	C111 (Diesel) . . . . .	8Wa-80-25
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A/C Low Pressure Switch . . . . .	8Wa-80-5	C112 (Gas) . . . . .	8Wa-80-26
A/C Pressure Transducer (Gas) . . . . .	8Wa-80-5	C112 (Gas) . . . . .	8Wa-80-26
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Airbag Control Module C2 (ORC C2) . . . . .	8Wa-80-7	C201 . . . . .	8Wa-80-27
Ambient Temperature Sensor . . . . .	8Wa-80-7	C201 . . . . .	8Wa-80-28
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Antenna Module C2 (Built-Up-Export) . . . . .	8Wa-80-8	C300 (LHD) . . . . .	8Wa-80-29
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Back-Up Lamp Switch (M/T) . . . . .	8Wa-80-8	C300 (RHD) . . . . .	8Wa-80-30
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C100 (LHD) . . . . .	8Wa-80-13	C303 (RHD) . . . . .	8Wa-80-36
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C100 (RHD) . . . . .	8Wa-80-16	C304 . . . . .	8Wa-80-37
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C101 (2.4L) . . . . .	8Wa-80-18	C305 . . . . .	8Wa-80-38
C102 (RHD) . . . . .	8Wa-80-18	C305 . . . . .	8Wa-80-38
C102 (RHD) . . . . .	8Wa-80-18	C306 . . . . .	8Wa-80-39
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C103 (Gas) . . . . .	8Wa-80-19	C307 . . . . .	8Wa-80-40
C104 (Diesel) . . . . .	8Wa-80-19	C307 . . . . .	8Wa-80-41
C104 (Diesel) . . . . .	8Wa-80-20	C308 . . . . .	8Wa-80-41
C104 (Gas) . . . . .	8Wa-80-20	C308 . . . . .	8Wa-80-41
C104 (Gas) . . . . .	8Wa-80-20	C309 . . . . .	8Wa-80-42
C105 (Diesel) . . . . .	8Wa-80-21	C309 . . . . .	8Wa-80-42
C105 (Diesel) . . . . .	8Wa-80-21	C310 . . . . .	8Wa-80-43
C105 (Gas) . . . . .	8Wa-80-22	C310 . . . . .	8Wa-80-43
C105 (Gas) . . . . .	8Wa-80-22	C311 . . . . .	8Wa-80-43
C106 . . . . .	8Wa-80-22	C311 . . . . .	8Wa-80-44
C106 . . . . .	8Wa-80-23	C312 (Highline) . . . . .	8Wa-80-44
C107 . . . . .	8Wa-80-23	C312 (Highline) . . . . .	8Wa-80-44
C107 . . . . .	8Wa-80-23	C313 . . . . .	8Wa-80-44
C108 (Gas) . . . . .	8Wa-80-24	C313 . . . . .	8Wa-80-45
C108 (Gas) . . . . .	8Wa-80-24	C314 (Highline) . . . . .	8Wa-80-45
C110 (2.4L) . . . . .	8Wa-80-24	C314 (Highline) . . . . .	8Wa-80-45
C110 (2.4L) . . . . .	8Wa-80-25	C315 (Midline/Highline) . . . . .	8Wa-80-46
		C315 (Midline/Highline) . . . . .	8Wa-80-46



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C316 (Built-Up-Export) . . . . .	8Wa-80-46	Fuel Injector No. 3 (Gas) . . . . .	8Wa-80-60
C317 (Except Built-Up-Export) . . . . .	8Wa-80-47	Fuel Injector No. 4 (Diesel) . . . . .	8Wa-80-60
C317 (Except Built-Up-Export) . . . . .	8Wa-80-47	Fuel Injector No. 4 (Gas) . . . . .	8Wa-80-60
Cabin Heater (Diesel) . . . . .	8Wa-80-47	Fuel Injector No. 5 (3.7L) . . . . .	8Wa-80-61
Camshaft Position Sensor (2.4L) . . . . .	8Wa-80-47	Fuel Injector No. 6 (3.7L) . . . . .	8Wa-80-61
Camshaft Position Sensor (3.7L) . . . . .	8Wa-80-47	Fuel Pressure Sensor (Diesel) . . . . .	8Wa-80-61
Camshaft Position Sensor (Diesel) . . . . .	8Wa-80-48	Fuel Pressure Solenoid (Diesel) . . . . .	8Wa-80-61
Capacitor . . . . .	8Wa-80-48	Fuel Pump Module . . . . .	8Wa-80-61
Cargo Lamp (Except Base) . . . . .	8Wa-80-48	G202 . . . . .	8Wa-80-61
CD Changer . . . . .	8Wa-80-48	Generator . . . . .	8Wa-80-62
Center High Mounted Stop Lamp . . . . .	8Wa-80-49	Glow Plug Assembly (Diesel) . . . . .	8Wa-80-62
Cigar Lighter . . . . .	8Wa-80-49	Hazard Switch/Combination Flasher . . . . .	8Wa-80-62
Clockspring C1 . . . . .	8Wa-80-49	Headlamp Leveling Switch (Built-Up-Export) . . . . .	8Wa-80-63
Clockspring C2 . . . . .	8Wa-80-49	Heated Seat Module (Highline) . . . . .	8Wa-80-63
Clockspring C3 . . . . .	8Wa-80-49	High Note Horn . . . . .	8Wa-80-63
Clutch Interlock Switch (M/T) . . . . .	8Wa-80-50	Hood Ajar Switch (Except Base) . . . . .	8Wa-80-63
Coil On Plug No. 1 (3.7L) . . . . .	8Wa-80-50	Idle Air Control Motor . . . . .	8Wa-80-64
Coil On Plug No. 2 (3.7L) . . . . .	8Wa-80-50	Ignition Switch . . . . .	8Wa-80-64
Coil On Plug No. 3 (3.7L) . . . . .	8Wa-80-50	Input Speed Sensor (3.7L) . . . . .	8Wa-80-64
Coil On Plug No. 4 (3.7L) . . . . .	8Wa-80-50	Instrument Cluster . . . . .	8Wa-80-64
Coil On Plug No. 5 (3.7L) . . . . .	8Wa-80-51	Intake Air Temperature Sensor (Gas) . . . . .	8Wa-80-65
Coil On Plug No. 6 (3.7L) . . . . .	8Wa-80-51	Intrusion Sensor (Built-Up-Export) . . . . .	8Wa-80-65
Coil Rail (2.4L) . . . . .	8Wa-80-51	Junction Block Body Control Module-JB . . . . .	8Wa-80-65
Compass Mini-Trip Computer (Premium) . . . . .	8Wa-80-51	Junction Block C1 . . . . .	8Wa-80-66
Controller Antilock Brake . . . . .	8Wa-80-52	Junction Block C2 . . . . .	8Wa-80-67
Crankshaft Position Sensor (2.4L) . . . . .	8Wa-80-52	Junction Block C3 . . . . .	8Wa-80-68
Crankshaft Position Sensor (3.7L) . . . . .	8Wa-80-52	Knock Sensor (3.7L) . . . . .	8Wa-80-69
Crankshaft Position Sensor (Diesel) . . . . .	8Wa-80-53	Leak Detection Pump . . . . .	8Wa-80-69
Data Link Connector . . . . .	8Wa-80-53	Left Courtesy Lamp . . . . .	8Wa-80-69
Diagnostic Junction Port . . . . .	8Wa-80-53	Left Curtain Airbag . . . . .	8Wa-80-69
Dome Lamp (Base) . . . . .	8Wa-80-54	Left Cylinder Lock Switch (Except Base) . . . . .	8Wa-80-69
Driver Airbag Squib 1 . . . . .	8Wa-80-54	Left Door Lock Switch (Except Base) . . . . .	8Wa-80-70
Driver Airbag Squib 2 . . . . .	8Wa-80-54	Left Fog Lamp . . . . .	8Wa-80-70
Driver Seat Belt Switch . . . . .	8Wa-80-54	Left Front Door Ajar Switch (Base) . . . . .	8Wa-80-70
Driver Seat Belt Tensioner . . . . .	8Wa-80-54	Left Front Door Lock Motor/Ajar Switch (Except Base) . . . . .	8Wa-80-70
EGR Solenoid (Diesel) . . . . .	8Wa-80-55	Left Front Door Speaker (Base) . . . . .	8Wa-80-70
Engine Control Module C1 . . . . .	8Wa-80-55	Left Front Door Speaker (Premium) . . . . .	8Wa-80-71
Engine Control Module C2 . . . . .	8Wa-80-56	Left Front Impact Sensor . . . . .	8Wa-80-71
Engine Coolant Level Sensor (Diesel) . . . . .	8Wa-80-57	Left Front Park/Turn Signal Lamp . . . . .	8Wa-80-71
Engine Coolant Temp Sensor (Diesel) . . . . .	8Wa-80-57	Left Front Power Window Motor (Midline/Highline) . . . . .	8Wa-80-71
Engine Coolant Temperature Sensor (Gas) . . . . .	8Wa-80-58	Left Front Wheel Speed Sensor (ABS) . . . . .	8Wa-80-72
Engine Oil Pressure Sensor . . . . .	8Wa-80-58	Left Headlamp (Built-Up-Export) . . . . .	8Wa-80-72
Evap/Purge Solenoid . . . . .	8Wa-80-58	Left Headlamp (Except Built-Up-Export) . . . . .	8Wa-80-72
Flip-Up Glass Release Motor . . . . .	8Wa-80-58	Left Heated Seat Assembly (Highline) . . . . .	8Wa-80-72
Flip-Up Glass Release Switch . . . . .	8Wa-80-58	Left Heated Seat Switch (Highline) . . . . .	8Wa-80-72
Front Wiper Motor . . . . .	8Wa-80-59	Left Instrument Panel Speaker . . . . .	8Wa-80-73
Fuel Heater (Diesel) . . . . .	8Wa-80-59	Left Leveling Motor (Built-Up-Export) . . . . .	8Wa-80-73
Fuel Injector No. 1 (Diesel) . . . . .	8Wa-80-59	Left Position Lamp (Built-Up-Export) . . . . .	8Wa-80-73
Fuel Injector No. 1 (Gas) . . . . .	8Wa-80-59	Left Power Mirror (Except Base) . . . . .	8Wa-80-73
Fuel Injector No. 2 (Diesel) . . . . .	8Wa-80-59		
Fuel Injector No. 2 (Gas) . . . . .	8Wa-80-60		

<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Left Power Seat Motors (Midline/Highline) . . . . .	8Wa-80-74	Rear Wiper Motor . . . . .	8Wa-80-86
Left Power Seat Switch (Midline/Highline) . . . . .	8Wa-80-74	Red Brake Warning Indicator Switch . . .	8Wa-80-86
Left Rear Door Ajar Switch (Base) . . . . .	8Wa-80-74	Remote Keyless Entry Module (Except Base) . . . . .	8Wa-80-86
Left Rear Door Lock Motor/Ajar Switch (Except Base) . . . . .	8Wa-80-74	Right Courtesy Lamp . . . . .	8Wa-80-87
Left Rear Door Speaker . . . . .	8Wa-80-75	Right Curtain Airbag . . . . .	8Wa-80-87
Left Rear Power Window Motor (Midline/Highline) . . . . .	8Wa-80-75	Right Cylinder Lock Switch (Except Base) . . . . .	8Wa-80-87
Left Remote Radio Switch (Premium) . . .	8Wa-80-75	Right Door Lock Switch (Except Base) . .	8Wa-80-87
Left Side Impact Airbag Control Module (LSIACM) . . . . .	8Wa-80-75	Right Fog Lamp . . . . .	8Wa-80-87
Left Side Marker Lamp (Except Built-Up-Export) . . . . .	8Wa-80-76	Right Front Door Ajar Switch (Base) . . .	8Wa-80-88
Left Side Repeater Lamp (Built-Up-Export) . . . . .	8Wa-80-76	Right Front Door Lock Motor/Ajar Switch (Except Base) . . . . .	8Wa-80-88
Left Speed Control Switch (Except Base) .	8Wa-80-76	Right Front Door Speaker (Base) . . . . .	8Wa-80-88
Left Tail/Stop Lamp . . . . .	8Wa-80-76	Right Front Door Speaker (Premium) . . .	8Wa-80-88
Left Visor/Vanity Lamp (Except Base) . . .	8Wa-80-76	Right Front Impact Sensor . . . . .	8Wa-80-88
License Lamp (Built-Up-Export) . . . . .	8Wa-80-77	Right Front Park/ Turn Signal Lamp . . .	8Wa-80-89
License Lamp (Except Built-Up-Export) .	8Wa-80-77	Right Front Power Window Motor (Midline/Highline) . . . . .	8Wa-80-89
Line Pressure Sensor (3.7L) . . . . .	8Wa-80-77	Right Front Wheel Speed Sensor (ABS) .	8Wa-80-89
Low Note Horn . . . . .	8Wa-80-77	Right Headlamp (Built-Up-Export) . . . .	8Wa-80-89
Manifold ABSolute Pressure Sensor . . . .	8Wa-80-77	Right Headlamp (Except Built-Up-Export)	8Wa-80-89
Multi-Function Switch C1 . . . . .	8Wa-80-78	Right Heated Seat Assembly (Highline) .	8Wa-80-90
Multi-Function Switch C2 . . . . .	8Wa-80-78	Right Heated Seat Switch (Highline) . . .	8Wa-80-90
Output Speed Sensor (3.7L) . . . . .	8Wa-80-78	Right Instrument Panel Speaker . . . . .	8Wa-80-90
Overhead Map/Reading Lamp (Except Base) . . . . .	8Wa-80-78	Right Leveling Motor (Built-Up-Export) .	8Wa-80-90
Oxygen Sensor 1/1 Upstream . . . . .	8Wa-80-79	Right Position Lamp (Built-Up-Export) . .	8Wa-80-91
Oxygen Sensor 1/2 Downstream . . . . .	8Wa-80-79	Right Power Mirror (Except Base) . . . . .	8Wa-80-91
Oxygen Sensor 2/1 Upstream (3.7L) . . . .	8Wa-80-79	Right Power Seat Motors (Midline/Highline) . . . . .	8Wa-80-91
Oxygen Sensor 2/2 Downstream (3.7L) . .	8Wa-80-79	Right Power Seat Switch (Midline/Highline) . . . . .	8Wa-80-91
Passenger Airbag . . . . .	8Wa-80-79	Right Rear Door Ajar Switch (Base) . . . .	8Wa-80-92
Passenger Seat Belt Switch . . . . .	8Wa-80-80	Right Rear Door Lock Motor/Ajar Switch (Except Base) . . . . .	8Wa-80-92
Power Mirror Switch (Except Base) . . . . .	8Wa-80-80	Right Rear Door Speaker . . . . .	8Wa-80-92
Power Outlet . . . . .	8Wa-80-80	Right Rear Power Window Motor (Midline/Highline) . . . . .	8Wa-80-92
Power Steering Pressure Switch . . . . .	8Wa-80-80	Right Remote Radio Switch (Premium) . .	8Wa-80-92
Power Window Master Switch (Midline/Highline) . . . . .	8Wa-80-81	Right Side Impact Airbag Control Module (RSIACM) . . . . .	8Wa-80-93
Powertrain Control Module-C1 (2.4L) . . .	8Wa-80-81	Right Side Marker Lamp (Except Built-Up-Export) . . . . .	8Wa-80-93
Powertrain Control Module-C1 (3.7L) . . .	8Wa-80-82	Right Side Repeater Lamp (Built-Up-Export) . . . . .	8Wa-80-93
Powertrain Control Module-C2 (Gas) . . .	8Wa-80-82	Right Speed Control Switch (Except Base) . . . . .	8Wa-80-93
Powertrain Control Module-C3 (Gas) . . .	8Wa-80-83	Right Tail/Stop Lamp . . . . .	8Wa-80-93
Radiator Fan Motor . . . . .	8Wa-80-84	Right Visor/Vanity Lamp (Except Base) .	8Wa-80-94
Radiator Fan Relay . . . . .	8Wa-80-84	Sentry Key Immobilizer Module (Except Base) . . . . .	8Wa-80-94
Radio C1 . . . . .	8Wa-80-84	Shifter Assembly . . . . .	8Wa-80-94
Radio C2 . . . . .	8Wa-80-85	Siren (Built-Up-Export) . . . . .	8Wa-80-94
Radio C3 . . . . .	8Wa-80-85	Speed Control Servo . . . . .	8Wa-80-94
Radio Choke (Premium) . . . . .	8Wa-80-85	Sunroof Motor . . . . .	8Wa-80-95
Rear Power Outlet . . . . .	8Wa-80-85		
Rear Power Window Switch (Midline/Highline) . . . . .	8Wa-80-86		
Rear Wheel Speed Sensor . . . . .	8Wa-80-86		

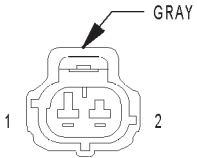
<b>Component</b>	<b>Page</b>	<b>Component</b>	<b>Page</b>
Sunroof Switch . . . . .	8Wa-80-95	Trailer Tow Relay . . . . .	8Wa-80-97
Tailgate Cylinder Lock Switch . . . . .	8Wa-80-95	Trailer Tow Right Turn Relay . . . . .	8Wa-80-97
Tailgate Flip-Up Ajar Switch . . . . .	8Wa-80-95	Transfer Case Position Sensor . . . . .	8Wa-80-97
Tailgate Lock Motor/Ajar Switch . . . . .	8Wa-80-95	Transmission Control Module (3.7L) . . . . .	8Wa-80-98
Throttle Position Sensor . . . . .	8Wa-80-96	Transmission Solenoid/TRS Assembly (3.7L) . . . . .	8Wa-80-99
Trailer Tow Brake Lamp Relay . . . . .	8Wa-80-96	Washer Fluid Level Switch . . . . .	8Wa-80-99
Trailer Tow Circuit Breaker . . . . .	8Wa-80-96	Washer Pump . . . . .	8Wa-80-100
Trailer Tow Connector . . . . .	8Wa-80-96	Water In Fuel Sensor (Diesel) . . . . .	8Wa-80-100
Trailer Tow Left Turn Relay . . . . .	8Wa-80-97		



A/C  
COMPRESSOR  
CLUTCH

A/C COMPRESSOR CLUTCH - BLACK 2 WAY

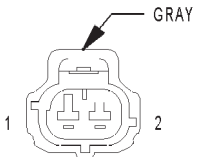
CAV	CIRCUIT	FUNCTION
1	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
2	Z246 18BK/GY	GROUND



A/C HIGH  
PRESSURE  
SWITCH  
(DIESEL)

A/C HIGH PRESSURE SWITCH (DIESEL) - GRAY 2 WAY

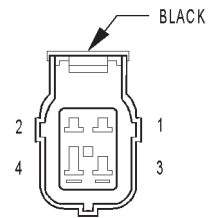
CAV	CIRCUIT	FUNCTION
1	C18 20DB	A/C PRESSURE SIGNAL
2	C21 18DB/OR	A/C SWITCH SENSE



A/C LOW  
PRESSURE  
SWITCH

A/C LOW PRESSURE SWITCH - GRAY 2 WAY

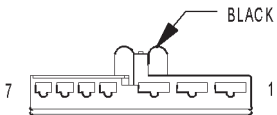
CAV	CIRCUIT	FUNCTION
1	C21 18DB/OR	A/C SWITCH SENSE
2	Z142 18BK/WT (RHD)	GROUND
2	Z212 18BK/OR (LHD)	GROUND



A/C  
PRESSURE  
TRANSDUCER  
(GAS)

A/C PRESSURE TRANSDUCER (GAS) - BLACK 4 WAY

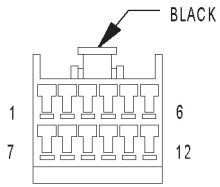
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K6 18VT/WT	5 VOLT SUPPLY
3	C18 18DB	A/C PRESSURE SIGNAL
4	-	-



A/C-HEATER  
CONTROL  
C1

A/C-HEATER CONTROL C1 - BLACK 7 WAY

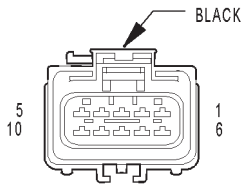
CAV	CIRCUIT	FUNCTION
1	Z8 12BK/VT	GROUND
2	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER
3	C6 12LB	BLOWER MOTOR M2 DRIVER
4	C5 14LG	BLOWER MOTOR M1 DRIVER
5	C4 14TN	BLOWER MOTOR LOW DRIVER
6	C19 18BR	A/C ON/OFF CONTROL
7	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



A/C-HEATER CONTROL C2

A/C-HEATER CONTROL C2 - BLACK 12 WAY

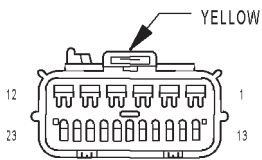
CAV	CIRCUIT	FUNCTION
1	C35 20DG/YL	MODE DOOR DRIVER (A)
2	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
3	-	-
4	-	-
5	-	-
6	C79 20VT/BK	REAR WINDOW DEFOGGER CONTROL
7	-	-
8	Z12 20BK/TN	GROUND
9	-	-
10	-	-
11	-	-
12	C16 20LB/YL	FUSED REAR WINDOW DEFOGGER RELAY OUTPUT



ACCELERATOR PEDAL POSITION SENSOR (DIESEL)

ACCELERATOR PEDAL POSITION SENSOR (DIESEL) - BLACK 10 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	K4 18BK/LB	SENSOR GROUND
5	K151 20WT	LOW IDLE POSITION SWITCH SENSE
6	-	-
7	K81 20VT/TN	ACCELERATOR PEDAL POSITION SENSOR SIGNAL
8	K255 20WT/DG	ACCELERATOR PEDAL POSITION SENSOR GROUND
9	-	-
10	K852 20VT/WT	ACCELERATOR PEDAL POSITION SENSOR 5 VOLT SUPPLY



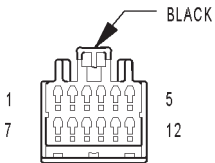
AIRBAG CONTROL MODULE C1 (ORC C1)

AIRBAG CONTROL MODULE C1 (ORC C1) - YELLOW 23 WAY

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
2	R43 18BK/LB	DRIVER SQUIB 1 LINE 1
3	-	-
4	-	-
5	R53 18OR/YL	DRIVER SEAT BELT TENSIONER LINE 2
6	R55 18OR/BK	DRIVER SEAT BELT TENSIONER LINE 1
7	R61 18OR/LB	DRIVER SQUIB 2 LINE 1
8	R63 18TN/LB	DRIVER SQUIB 2 LINE 2
9	R62 18OR/YL	PASSENGER SQUIB 2 LINE 2
10	R64 18TN/YL	PASSENGER SQUIB 2 LINE 1
11	R42 18BK/YL	PASSENGER SQUIB 1 LINE 1
12	R44 18DG/YL	PASSENGER SQUIB 1 LINE 2
13	-	-
14	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
15	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
16	Z6 18BK/PK	GROUND

AIRBAG CONTROL MODULE C1 (ORC C1) - YELLOW 23 WAY

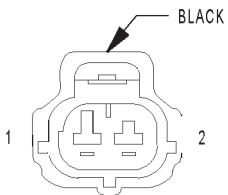
CAV	CIRCUIT	FUNCTION
17	-	-
18	-	-
19	-	-
20	-	-
21	D25 18YL/VT/OR	PCI BUS
22	-	-
23	-	-



AIRBAG CONTROL MODULE C2 (ORC C2)

AIRBAG CONTROL MODULE C2 (ORC C2) - BLACK 12 WAY

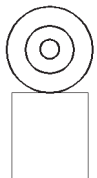
CAV	CIRCUIT	FUNCTION
1	-	-
2	R59 20LB	DRIVER SEAT BELT SWITCH GROUND
3	R57 20DG	DRIVER SEAT BELT SWITCH SENSE
4	-	-
5	R60 20VT	PASSENGER SEAT BELT SWITCH GROUND
6	R58 20GY	PASSENGER SEAT BELT SWITCH SENSE
7	R48 20TN	RIGHT FRONT IMPACT SENSOR SIGNAL
8	R46 20BR/LB	RIGHT FRONT IMPACT SENSOR GROUND
9	-	-
10	-	-
11	R47 20DB/LB	LEFT FRONT IMPACT SENSOR GROUND
12	R49 20LB/OR	LEFT FRONT IMPACT SENSOR SIGNAL



AMBIENT TEMPERATURE SENSOR

AMBIENT TEMPERATURE SENSOR - BLACK 2 WAY

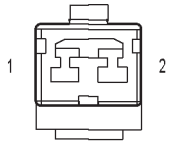
CAV	CIRCUIT	FUNCTION
1	G31 18VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
2	G32 18DB/OR	AMBIENT TEMPERATURE SENSOR RETURN



ANTENNA (EXCEPT BUILT-UP-EXPORT)

ANTENNA (EXCEPT BUILT-UP-EXPORT) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	X30 BK	RADIO ANTENNA CORE
2	X31 BK	RADIO ANTENNA SHIELD



ANTENNA  
MODULE  
C1  
(BUILT-UP-EXPORT)

ANTENNA MODULE C1 (BUILT-UP-EXPORT) - 2 WAY

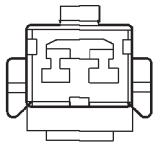
CAV	CIRCUIT	FUNCTION
1	F85 16VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN--ACC)
2	-	-

CONNECTOR VIEW  
NOT  
AVAILABLE

ANTENNA  
MODULE  
C2  
(BUILT-UP-EXPORT)

ANTENNA MODULE C2 (BUILT-UP-EXPORT) - 2 WAY

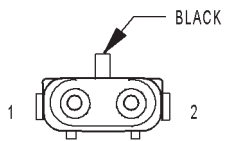
CAV	CIRCUIT	FUNCTION
1	X30 BK	RADIO ANTENNA CORE
2	X31 BK	RADIO ANTENNA SHIELD



ASH RECEIVER  
LAMP

ASH RECEIVER LAMP - 2 WAY

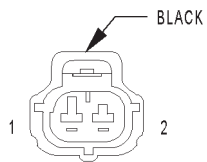
CAV	CIRCUIT	FUNCTION
1	E2 200R	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	Z158 20BK/GY	GROUND



BACK-UP LAMP  
SWITCH  
(M/T)

BACK-UP LAMP SWITCH (M/T) - BLACK 2 WAY

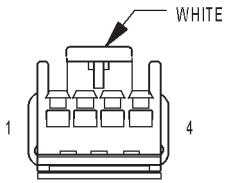
CAV	CIRCUIT	FUNCTION
1	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
2	L10 18BR/LG	BACK-UP LAMP FEED



BATTERY  
TEMPERATURE  
SENSOR

BATTERY TEMPERATURE SENSOR - BLACK 2 WAY

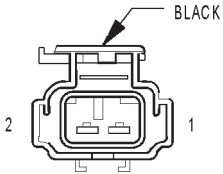
CAV	CIRCUIT	FUNCTION
1	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND



BLEND  
DOOR  
ACTUATOR

BLEND DOOR ACTUATOR - WHITE 4 WAY

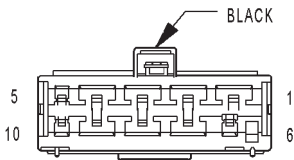
CAV	CIRCUIT	FUNCTION
1	Z12 18BK/TN	GROUND
2	C35 20DG/YL	MODE DOOR DRIVER (A)
3	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
4	-	-



BLOWER  
MOTOR

BLOWER MOTOR - BLACK 2 WAY

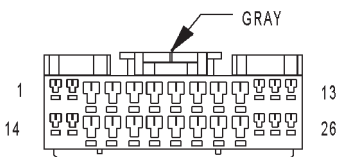
CAV	CIRCUIT	FUNCTION
1	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER
2	A111 12RD/LB	BLOWER MOTOR RELAY OUTPUT



BLOWER MOTOR  
RESISTOR BLOCK

BLOWER MOTOR RESISTOR BLOCK - BLACK 10 WAY

CAV	CIRCUIT	FUNCTION
1	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER
2	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER
3	C6 12LB	BLOWER MOTOR M2 DRIVER
4	C5 14LG	BLOWER MOTOR M1 DRIVER
5	C4 14TN	BLOWER MOTOR LOW DRIVER
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-



BODY  
CONTROL  
MODULE C1

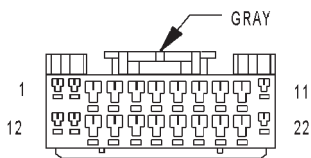
BODY CONTROL MODULE C1 - GRAY 26 WAY

CAV	CIRCUIT	FUNCTION
1	Z103 16BK/OR	GROUND
2	V22 20BR/YL	REAR WIPER INTERMITTENT DRIVER
3	Y98 20GY/DB	INSTRUMENT CLUSTER WAKE UP SIGNAL
4	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
5	G74 20TN/WT	PASSENGER DOOR AJAR SWITCH SENSE
6	G70 20BR/TN (EXCEPT BASE)	HOOD AJAR SWITCH SENSE
7	G78 20TN/BK	TAILGATE AJAR SWITCH SENSE
8	G26 20LB	KEY-IN IGNITION SWITCH SENSE
9	G80 20YL/WT	FLIP-UP GLASS AJAR SWITCH SENSE
10	M3 20PK/DB	REAR COURTESY LAMP CONTROL
11	V10 18BR	WASHER PUMP DRIVER
12	L91 20DB/PK	HAZARD LAMP CONTROL
13	V21 20DB/RD	REAR WIPER ON DRIVER
14	Z231 16BK/WT	SIGNAL GROUND
15	D25 18YL/VT/WT	PCI BUS



BODY CONTROL MODULE C1 - GRAY 26 WAY

CAV	CIRCUIT	FUNCTION
16	D19 20VT/OR	BODY CONTROL MODULE FLASH ENABLE
17	P101 20OR/PK	FLIP-UP GLASS RELEASE SWITCH SENSE
18	-	-
19	-	-
20	B22 18LG/YL	VEHICLE SPEED OUTPUT
21	G69 20BK/OR	VTSS INDICATOR DRIVER
22	-	-
23	C79 20VT/BK	REAR WINDOW DEFOGGER CONTROL
24	C19 18BR	A/C ON/OFF CONTROL
25	Z3 16BK/OR	GROUND
26	P100 18OR/BR	FLIP-UP GLASS RELEASE MOTOR DRIVER



BODY CONTROL MODULE C2

BODY CONTROL MODULE C2 - GRAY 22 WAY

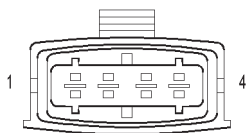
CAV	CIRCUIT	FUNCTION
1	Y66 20GY (EXCEPT BASE)	RKE ANTENNA
2	G910 20VT/BR	TAILGATE SWITCH GROUND
3	-	-
4	L80 20WT/DG	HEADLAMP SWITCH RETURN
5	L307 20LG/OR	HEADLAMP SWITCH MUX
6	G72 18DG/OR (LHD PREMIUM)	RIGHT CYLINDER LOCK SWITCH MUX
6	G73 18LG/OR (RHD)	RIGHT CYLINDER LOCK SWITCH MUX
7	L27 20WT/TN (EXCEPT BASE)	FRONT FOG LAMP SWITCH SENSE
8	E21 20OR/RD	PANEL LAMPS DIMMER SWITCH MUX
9	G72 18DG/OR (RHD)	LEFT CYLINDER LOCK SWITCH MUX
9	G73 18LG/OR (LHD PREMIUM)	LEFT CYLINDER LOCK SWITCH MUX
10	V52 20DG/RD	FRONT WIPER SWITCH MUX
11	X10 20RD/DB (EXCEPT BASE)	RADIO CONTROL MUX RETURN
12	Y66 20GY (EXCEPT BASE)	RKE ANTENNA
13	-	-
14	-	-
15	G32 20DB/OR (EXCEPT BASE)	AMBIENT TEMPERATURE SENSOR RETURN
16	-	-
17	G71 18VT/YL	TAILGATE CYLINDER LOCK SWITCH MUX
18	G31 20VT/LG (EXCEPT BASE)	AMBIENT TEMPERATURE SENSOR SIGNAL
19	L324 20WT/LG	HIGH BEAM SWITCH SENSE
20	F512 18PK/OR	VEHICLE SPEED SENSOR SUPPLY
21	B12 18DG/OR	VEHICLE SPEED SIGNAL
22	X20 20RD/BK (EXCEPT BASE)	RADIO CONTROL MUX

CONNECTOR VIEW NOT AVAILABLE

BODY CONTROL MODULE C3 (PREMIUM)

BODY CONTROL MODULE C3 (PREMIUM) - 6 WAY

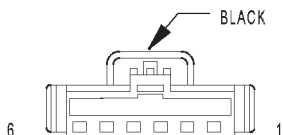
CAV	CIRCUIT	FUNCTION
1	Y60	RKE DATA
2	Y62	RKE SUPPLY
3	Y61	RKE PROGRAM
4	Y63	RKE GROUND
5	Y64	RKE ANTENNA (+)
6	Y65	RKE ANTENNA (-)



BOOST PRESSURE SENSOR (DIESEL)

BOOST PRESSURE SENSOR (DIESEL) - 4 WAY

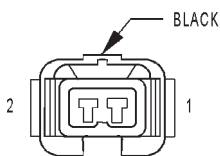
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
3	K6 18VT/WT	SENSOR REFERENCE VOLTAGE B
4	K37 20DB/YL	BOOST PRESSURE SENSOR SIGNAL



BRAKE LAMP SWITCH

BRAKE LAMP SWITCH - BLACK 6 WAY

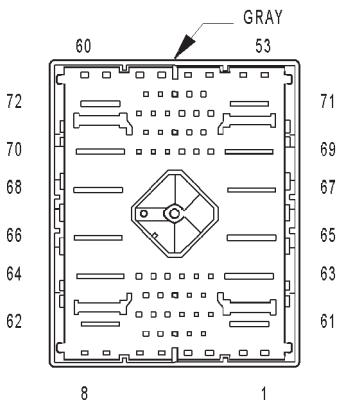
CAV	CIRCUIT	FUNCTION
1	F32 18PK/DB	FUSED B(+)
2	L50 18WT/TN (GAS)	BRAKE LAMP SWITCH OUTPUT
2	L50 18WT/TN (DIESEL)	PRIMARY BRAKE SWITCH SIGNAL
3	V30 18DB/RD	SPEED CONTROL BRAKE SWITCH OUTPUT
4	V32 18YL/RD	SPEED CONTROL SUPPLY
5	Z3 18BK/OR	GROUND
6	K29 18WT/PK (GAS)	BRAKE SWITCH SENSE
6	K29 18WT/PK (DIESEL)	SECONDARY BRAKE SWITCH SIGNAL



BRAKE PRESSURE SWITCH (ABS)

BRAKE PRESSURE SWITCH (ABS) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	F22 18DB/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
2	S43 18LB/YL	FLUID PRESSURE SWITCH SIGNAL



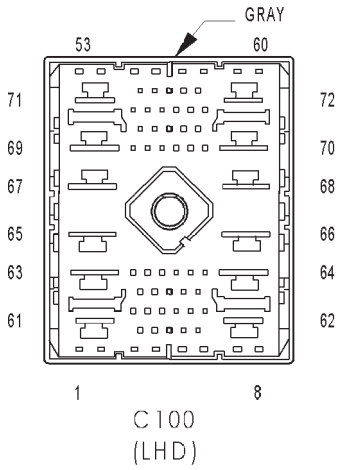
C100 (RHD)

C100 (RHD) - GRAY (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	L43 18VT
2	F1 20DB
3	M1 18PK
4	B22 18LG/YL
5	L44 18VT/RD
6	V16 18VT/YL
7	V55 16TN/RD
8	G32 20DB/OR
9	D20 20LG
10	D25 18YL/VT/BR
11	V14 18RD/VT
12	L13 18BR/YL
13	G70 20BR/TN
14	G11 20WT/BK
15	K4 20BK/LB
16	L50 18WT/TN
17	L62 18BR/RD

C100 (RHD) - GRAY (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
18	L62 18DG/RD
19	V30 18DB/RD
20	D32 20LG/DG
21	V32 18YL/RD
22	G29 20BK/TN
23	X2 18DG/RD
24	F15 18DB/WT
25	G18 20PK/BK
26	D24 18WT/DG
27	B12 18DG/OR
28	R46 20BR/LB
29	R48 20TN
30	R47 20DB/LB
31	R49 20LB/OR
32	-
33	-
34	-
35	F512 18PK/OR
36	-
37	Z252 18BK/GY
38	Z252 18BK/GY
39	V10 18BR
40	-
41	T6 20VT/WT
42	V37 20RD/LG
43	V20 18BK/WT
44	K29 18WT/PK
45	D25 18YL/VT/GY
46	-
47	X75 18DG
48	L10 18BR/LG
49	D21 20PK/RD
50	F22 18DB/PK
51	L33 18LG/BR
52	L39 18LB
53	L78 18DG/YL
54	F20 18WT
55	V6 14DB/YL
56	G31 20VT/LG
57	-
58	L34 18RD/OR
59	L77 18BK/YL
60	-
61	A41 12YL
62	A21 12RD/DB
63	A1 12RD
64	A111 12RD/LB
65	A12 10RD/TN
66	A13 10PK/WT
67	A18 10PK
68	A7 10RD/BK
69	A2 12PK/BK
70	A25 12DB
71	A4 12BK/PK
72	A99 14RD/VT

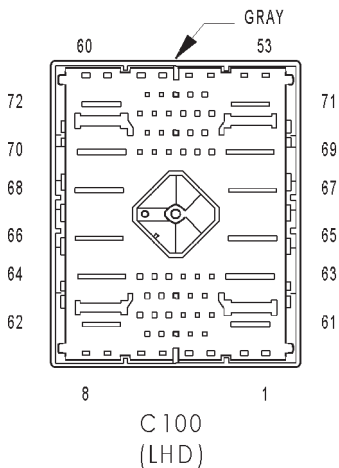


C100 (LHD) - GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	B1 18YL/DB
2	B2 18YL
3	K226 18DB/WT
4	B22 18DG/YL
5	K106 18WT/DG (GAS)
6	K107 18OR (GAS)
7	K125 18WT/DB (GAS)
8	G32 18DB/OR
9	D20 18LG (GAS)
10	D25 18YL/VT
11	-
12	L13 18BR/YL (BUILT-UP-EXPORT)
13	G70 18BR/TN (BUILT-UP-EXPORT)
14	G11 18WT/BK
15	K4 18BK/LB
16	-
17	L62 18BR/RD
18	L63 18DG/RD
19	V30 18DB/RD (GAS)
20	D32 18LG (GAS)
21	V32 18YL/RD (GAS)
22	G29 18BK/TN
23	-
24	F15 18DB/WT
25	G18 18PK/BK (DIESEL)
26	D24 18WT/DG (ABS)
27	B12 18DG/OR (ABS)
27	B1 18YL/DB (EXCEPT ABS)
28	R46 18BR/LB
29	R48 18TN
30	R47 18DB/LB
31	R49 18LB
32	-
33	-
34	-
35	B2 18YL (EXCEPT ABS)
36	-
37	Z252 18BK/GY
38	Z252 18BK/GY
39	V10 18BR
40	T138 18GY/LB (DIESEL)(M/T)
41	T6 18VT/WT (GAS)
42	V37 18RD/LG
43	V20 18BK/WT
44	K29 18WT/PK
45	D25 18YL/VT
46	-
47	X75 18DG (BUILT-UP-EXPORT)
48	L10 18BR/LG
49	D21 18PK
50	-
51	-
52	-

C100 (LHD) - GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
53	-
54	-
55	-
56	G31 18VT/LG
57	-
58	-
59	-
60	A32 14RD/DB (A/T)
61	A41 12YL
62	A21 12RD/DB (M/T)
63	A1 12RD
64	A111 12RD/LB
65	A99 14RD/VT
66	-
67	-
68	-
69	A2 12PK/BK
70	A25 12DB
71	-
72	A141 16DG/WT (GAS)

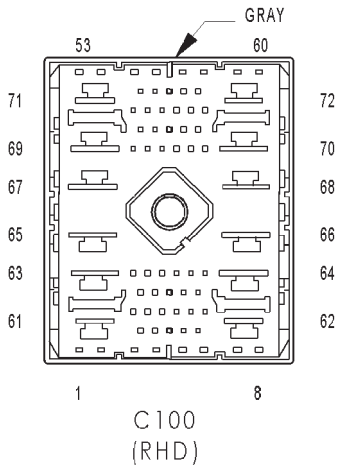


C100 (LHD) - GRAY (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	B1 18YL/DB
2	B2 18YL
3	K226 18DB/WT
4	B22 18LG/YL
5	K106 18WT/DG
6	K107 18OR
7	K125 18WT/DB
8	G32 20DB/OR (EXCEPT BASE)
9	D20 20LG
10	D25 18YL/VT/BR
11	-
12	L13 18BR/YL (BUILT-UP-EXPORT)
13	G70 20BR/TN (EXCEPT BASE)
14	G11 20WT/BK
15	K4 18BK/LB
16	-
17	L62 18BR/RD
18	L63 18DG/RD
19	V30 18DB/RD
20	D32 20LG/DG
21	V32 18YL/RD
22	G29 20BK/TN
23	-
24	F15 18DB/WT
25	G18 20PK/BK
26	D24 18WT/DG
27	B12 18DG/OR

C100 (LHD) - GRAY (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
28	R46 20BR/LB
29	R48 20TN
30	R47 20DB/LB
31	R49 20LB/OR
32	-
33	-
34	-
35	F512 18PK/OR
36	-
37	Z252 18BK/GY
38	Z252 18BK/GY
39	V10 18BR
40	-
41	T6 20VT/WT
42	V37 20RD/LG
43	V20 18BK/WT
44	K29 18WT/PK
45	D25 18YL/VT/GY
46	-
47	X75 18 DG (EXCEPT BASE)
48	L10 18BR/LG
49	D21 20PK/RD
50	-
51	-
52	-
53	-
54	-
55	-
56	G31 20VT/LG (EXCEPT BASE)
57	-
58	-
59	--
60	-
61	A41 12YL
62	A21 12 RD/DB
63	A1 12RD
64	A111 12RD/LB
65	A99 14RD/VT
66	-
67	-
68	-
69	A2 12PK/BK
70	A25 12DB
71	-
72	A141 16DG/WT

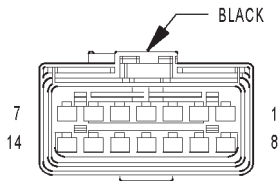


C100 (RHD) - GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	L43 18VT
2	F1 18DB
3	M1 18PK
4	B22 18DG/YL
5	L44 18VT/RD
6	V16 18VT/YL
7	V55 16TN/RD
8	G32 18DB/OR
9	D20 18LG
10	D25 18YL/VT
11	V14 18RD/VT
12	L13 18BR/YL
13	G70 18BR/TN
14	G11 18WT/BK
15	K4 18BK/LB
16	L50 18WT/TN (ABS)
17	L62 18BR/RD
18	L63 18DG/RD
19	V30 18DB/RD
20	D32 18LG
21	V32 18YL/RD
22	G29 18BK/TN
23	X2 18DG/RD
24	F15 18DB/WT
25	-
26	D24 18WT/DG (ABS)
27	B1 18YL/DB (EXCEPT ABS)
27	B12 18DG/OR (ABS)
28	R46 18BR/LB
29	R48 18TN
30	R47 18DB/LB
31	R49 18LB
32	-
33	-
34	-
35	B2 18YL (EXCEPT ABS)
35	F512 18PK/OR (ABS)
36	-
37	Z252 18BK/GY
38	Z252 18BK/GY
39	V10 18BR
40	-
41	T6 18VT/WT
42	V37 18RD/LG
43	V20 18BK/WT
44	K29 18WT/PK
45	D25 18YL/VT (ABS)
45	D25 18YL/VT (EXCEPT ABS)
46	-
47	X75 18DG
48	L10 18BR/LG
49	D21 18PK
50	F22 18DB/PK (ABS)

C100 (RHD) - GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
51	L33 18LG/BR
52	L39 18LB
53	L78 18DG/YL
54	F20 18WT
55	V6 16DB/YL
56	G31 18VT/LG
57	-
58	L34 18RD/OR
59	L77 18BK/YL
60	A32 14RD/DB (A/T)
61	A41 12YL
62	A21 12RD/DB (M/T)
63	A1 12RD
64	A111 12RD/LB
65	A12 10RD/TN
66	A13 10PK/WT
67	A18 10PK
68	A7 10RD/BK
69	A2 12PK/BK
70	A25 12DB
71	A4 12BK/PK
72	A99 14RD/VT

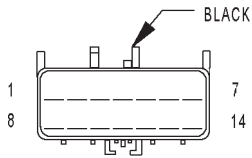


C101  
(2.4L)

C101 (2.4L) - BLACK (ENGINE TO HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	K59 18VT/BK
2	K40 18BR/WT
3	K60 18YL/BK
4	K39 18GY/RD
5	K21 18BK/RD
6	K2 18TN/BK
7	K1 18DG/RD
8	K22 18OR/DB
9	K6 18VT/WT
10	G60 18GY/YL
11	K24 18GY/BK
12	K7 18OR
13	-
14	-

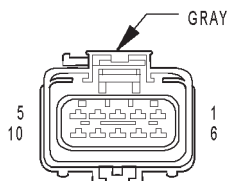




C 101  
(2.4L)

C101 (2.4L) - BLACK (ENGINE TO FUEL INJECTOR SIDE)

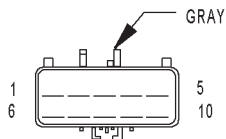
CAV	CIRCUIT
1	K59 18VT/BK
2	K40 18BR/WT
3	K60 18YL/BK
4	K39 18GY/RD
5	K21 18BK/RD
6	K2 18TN/BK
7	K1 18DG/RD
8	K22 18OR/DB
9	K6 18VT/WT
10	G60 18GY/YL
11	K24 18GY/BK
12	K7 18OR
13	-
14	-



C 102  
(RHD)

C102 (RHD) - GRAY (HEADLAMP AND DASH SIDE)

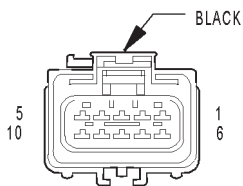
CAV	CIRCUIT
1	K226 18DB/WT
2	K512 18PK/OR
3	A141 16DG/WT (GAS)
4	B1 18YL/DB
5	B2 18YL
6	K4 18BK/LB
7	B12 18DG/OR
8	K125 18WT/DB (GAS)
9	K107 18OR (GAS)
10	K106 18WT/DG (GAS)



C 102  
(RHD)

C102 (RHD) - GRAY (FRONT BODY SIDE)

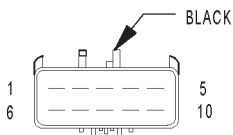
CAV	CIRCUIT
1	K226 18DB/WT
2	F512 18PK/OR
3	A141 16DG/WT
4	B1 18YL/DB
5	B2 18YL
6	K4 18BK/LB
7	B12 18DG/OR
8	K125 18WT/DB
9	K107 18OR
10	K105 18WT/DG



C 103  
(GAS)

C103 (GAS) - BLACK (ENGINE SIDE)

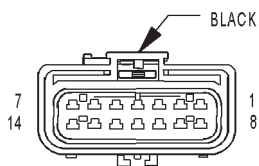
CAV	CIRCUIT
1	F142 18OR/DG
2	-
3	K299 18BR/WT
4	-
5	K173 18LG
6	-
7	-
8	-
9	K99 18BR/OR
10	-



C 103  
(GAS)

C103 (GAS) - BLACK (HEADLAMP AND DASH SIDE)

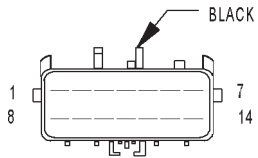
CAV	CIRCUIT
1	F142 18OR/DG
2	-
3	K299 18BR/WT
4	-
5	K173 18LG
6	-
7	-
8	-
9	K99 18BR/OR
10	-



C 104  
(DIESEL)

C104 (DIESEL) - BLACK (ENGINE SIDE)

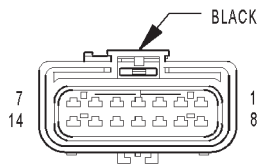
CAV	CIRCUIT
1	K90 20TN
2	K132 20DG/LB
3	K152 20WT
4	C3 18DB/BK
5	-
6	-
7	D21 20PK
8	D25 20VT/YL
9	F15 18DB/WT
10	-
11	F1 20DB
12	L50 20WT/TN
13	-
14	-



C104  
(DIESEL)

C104 (DIESEL) - BLACK (HEADLAMP AND DASH SIDE)

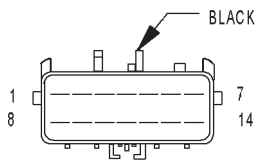
CAV	CIRCUIT
1	K90 18TN
2	K132 18DG/LB
3	K152 18WT
4	C3 18DB/BK
5	-
6	-
7	-
8	-
9	F15 18DB/WT
10	-
11	F1 18DB
12	L50 18WT/TN
13	-
14	-



C104  
(GAS)

C104 (GAS) - BLACK (ENGINE SIDE)

CAV	CIRCUIT
1	A14 16RD/WT
2	F18 18LG/BK (3.7L)
3	-
4	C3 18DB/BK
5	-
6	D20 18LG (A/T)
7	D21 18PK (A/T)
8	D25 18VT/YL (A/T)
9	F15 18DB/WT
10	F45 18YL/BR (A/T)
11	F1 18DB
12	T10 18YL/DG (A/T)
13	K20 18DG
14	T6 18OR/WT (A/T)



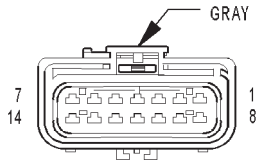
C104  
(GAS)

C104 (GAS) - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	A14 16RD/WT (GAS)
2	F18 18LG/BK (GAS)
3	-
4	C3 18DB/BK
5	-
6	D20 18LG
7	D21 18PK
8	D25 18YL/VT
9	F15 18DB/WT

C104 (GAS) - BLACK (HEADLAMP AND DASH SIDE)

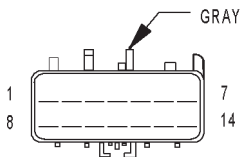
CAV	CIRCUIT
10	F45 18YL/BR
11	F1 18DB
12	T10 18YL/DG
13	K20 18DG
14	T6 18VT/WT



C 105  
(DIESEL)

C105 (DIESEL) - GRAY (ENGINE SIDE)

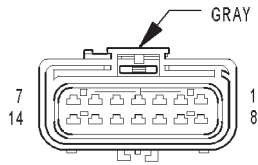
CAV	CIRCUIT
1	B22 20DG/YL
2	K4 18BK/LB
3	L10 18BR/LG
4	C21 18DB/OR
5	A71 18DG/RD
6	-
7	-
8	-
9	A142 14DG/OR
10	-
11	-
12	A93 16RD/BK
13	Z252 18BK/GY
14	Z252 18BK/GY



C 105  
(DIESEL)

C105 (DIESEL) - GRAY (HEADLAMP AND DASH SIDE)

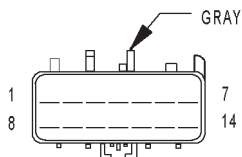
CAV	CIRCUIT
1	B22 18DG/YL
2	K4 18BK/LB
3	L10 18BR/LG
4	C21 18DB/OR
5	A71 18DG/RD
6	-
7	-
8	-
9	A142 16DG/OR
10	T138 18GY/LB
11	-
12	A93 16RD/BK
13	Z252 18BK/GY
14	Z252 18BK/GY



C105  
(GAS)

C105 (GAS) - GRAY (ENGINE SIDE)

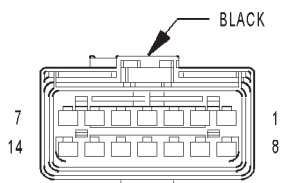
CAV	CIRCUIT
1	-
2	K4 18BK/LB
3	L10 18BR/LG
4	-
5	A71 18DG/RD
6	T16 14RD (A/T)
7	T41 18BK/WT (A/T)
8	K30 18PK (A/T)
9	-
10	T141 18YL/RD (M/T)
11	-
12	A30 14RD/WT (A/T)
13	-
14	-



C105  
(GAS)

C105 (GAS) - GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	-
2	K4 18BK/LB
3	L10 18BR/LG
4	-
5	A71 18DG/RD
6	T16 14RD (A/T)
7	T41 18BK/WT (A/T)
8	K30 18PK (A/T)
9	-
10	T141 18YL/RD (M/T)
11	-
12	A30 14RD/WT (A/T)
13	-
14	-



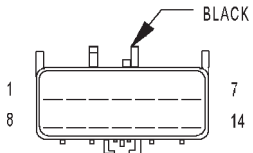
C106

C106 - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	G31 18VT/LG
2	G32 18DB/OR
3	L33 18LG/BR
4	L43 18VT
5	L63 18DG/RD
6	L39 18LB
7	L78 18DG/YL
8	Z141 18BK
9	L13 18BR/YL (BUILT-UP-EXPORT))
10	L34 18RD/OR

C106 - BLACK (HEADLAMP AND DASH SIDE)

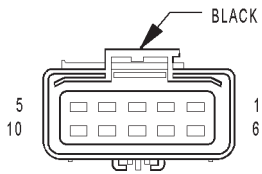
CAV	CIRCUIT
11	L44 18VT/RD
12	L62 18BR/RD
13	L77 18BK/YL
14	Z142 18BK/WT



C 106

C106 - BLACK (FRONT END LIGHTING SIDE)

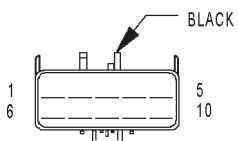
CAV	CIRCUIT
1	G31 18VT/LG
2	G32 18DB/OR
3	L33 18LG/BR
4	L43 18VT
5	L63 18DG/RD
6	L39 18LB
7	L78 18DG/YL
8	Z141 18BK
9	-
10	L34 18RD/OR
11	L44 18VT/RD
12	L62 18BR/RD
13	L77 18BK/YL
14	Z142 18BK/WT



C 107

C107 - BLACK (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	Z141 18BK
2	L77 18BK/YL
3	-
4	L78 18DG/YL
5	Z142 18BK/WT
6	L62 18BR/RD
7	-
8	L39 18LB
9	-
10	L63 18DG/RD



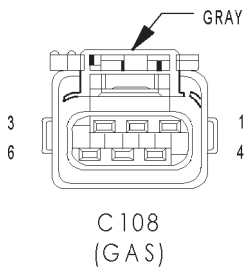
C 107

C107 - BLACK (FRONT END LIGHTING SIDE)

CAV	CIRCUIT
1	Z141 18BK
2	L77 18BK/YL
3	-
4	L78 18DG/YL
5	Z142 18BK/WT

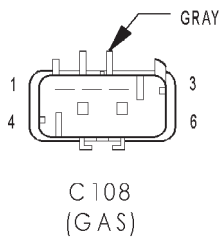
C107 - BLACK (FRONT END LIGHTING SIDE)

CAV	CIRCUIT
6	L62 18BR/RD
7	-
8	L39 18LB (FOG LAMPS)
9	-
10	L63 18DG/RD



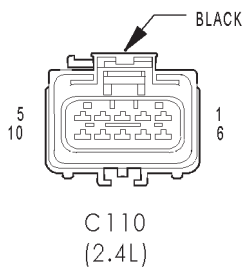
C108 (GAS) - GRAY (BATTERY SIDE)

CAV	CIRCUIT
1	K52 18PK/BK
2	K20 18DG
3	K125 18WT/DB
4	T40 12BR
5	F1 18DB
6	-



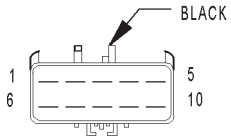
C108 (GAS) - GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	K52 18PK/BK
2	K20 18DG
3	K125 18WT/DB
4	T40 12BR
5	F1 18DB
6	-



C110 (2.4L) - BLACK (ENGINE TO HEADLAMP AND DASH SIDE)

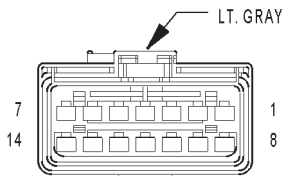
CAV	CIRCUIT
1	F142 18OR/DG
2	C3 18DB/BK
3	Z246 18BK/GY
4	K11 18WT/DB
5	K12 18TN
6	K13 18YL/WT
7	K14 18LB/BR
8	K44 18TN/YL
9	K4 18BK/LB
10	-



C110  
(2.4L)

C110 (2.4L) - BLACK (ENGINE TO FUEL INJECTORS SIDE)

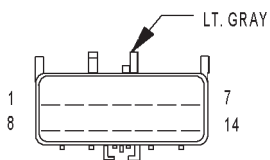
CAV	CIRCUIT
1	F142 18OR/DG
2	C3 18DB/BK
3	Z246 18BK/GY
4	K11 18WT/DB
5	K12 18TN
6	K13 18YL/WT
7	K14 18LB/BR
8	K44 18TN/YL
9	K4 18BK/LB
10	-



C111  
(DIESEL)

C111 (DIESEL) - LT. GRAY (ENGINE SIDE)

CAV	CIRCUIT
1	K51 20DB/YL
2	K118 20PK/YL
3	C13 20DG
4	-
5	K226 20DB/WT
6	V37 20RD/LG
7	K35 20GY/YL
8	G18 18PK/BK
9	K29 20WT/PK
10	K236 20GY/PK
11	C151 18DB/WT
12	T40 12BR
13	F92 20YL/BR
14	-

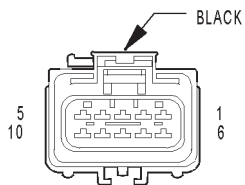


C111  
(DIESEL)

C111 (DIESEL) - LT. GRAY (HEADLAMP AND DASH SIDE)

CAV	CIRCUIT
1	K51 18DB/YL
2	K118 18PK/YL
3	C13 18DG
4	-
5	K226 18DB/WT
6	V37 18RD/LG
7	K35 18GY/YL
8	G18 18PK/BK
9	K29 18WT/PK
10	K236 18GY/PK
11	C151 18DB/WT
12	T40 12BR
13	F92 18YL/BR
14	T141 14YL/RD

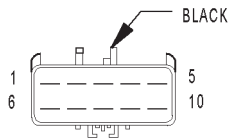




C112  
(GAS)

C112 (GAS) - BLACK (ENGINE SIDE)

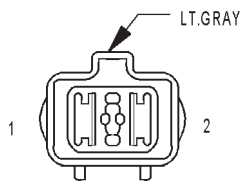
CAV	CIRCUIT
1	K42 18DB/LB (3.7L)
2	K4 18BK/LB (3.7L)
3	Z252 18BK/GY
4	K142 18GY/BK (3.7L)
5	K4 18BK/LB (3.7L)
6	Z252 18BK/GY
7	-
8	-
9	-
10	A142 14DG/OR



C112  
(GAS)

C112 (GAS) - BLACK (HEADLAMP AND DASH SIDE)

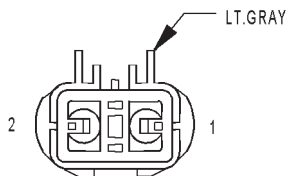
CAV	CIRCUIT
1	K42 18DB/LB
2	K4 18BK/LB
3	Z252 18BK/GY
4	K142 18GY/BK
5	K4 18BK/LB
6	Z252 18BK/GY
7	-
8	-
9	-
10	A142 14DG/OR



C113  
(DIESEL)

C113 (DIESEL) - LT.GRAY (GLOW PLUG SIDE)

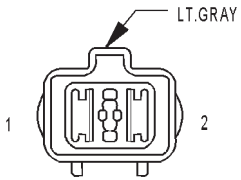
CAV	CIRCUIT
1	K154 10GY
2	K104 10RD/WT



C113  
(DIESEL)

C113 (DIESEL) - LT.GRAY (BATTERY SIDE)

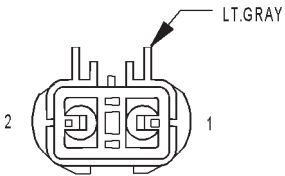
CAV	CIRCUIT
1	K154 10GY
2	K104 10RD/WT



C 114  
(DIESEL)

C114 (DIESEL) - LT. GRAY (BATTERY SIDE)

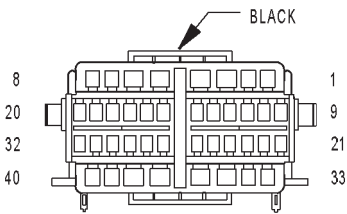
CAV	CIRCUIT
1	K154 10GY
2	K104 10RD/WT



C 114  
(DIESEL)

C114 (DIESEL) - LT. GRAY (GLOW PLUG SIDE)

CAV	CIRCUIT
1	K154 10GY
2	K104 10RD/WT



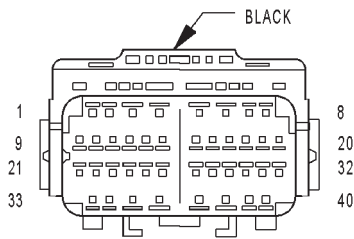
C 201

C201 - BLACK (INSTRUMENT PANEL SIDE)

CAV	CIRCUIT
1	R57 20DG
2	R59 20LB
3	X75 18DG (EXCEPT BASE)
4	A99 14RD/VT
5	B12 18DG/OR
6	F81 12TN
7	V21 20DB/RD
8	V22 20BR/YL
9	R58 20GY
10	R60 20VT
11	K226 18DB/WT (LHD)
12	G74 20TN/WT
13	G71 18VT/YL
14	T6 20VT/WT
15	G9 20GY/BK
16	B1 18YL/DB (LHD)
17	K29 18WT/PK
18	L62 18BR/RD
19	M3 20PK/DB
20	K125 18WT/DB (LHD)
21	-
22	-
23	K4 18BK/LB (LHD)
24	G910 20VT/BR
25	G78 20TN/BK
26	P101 20OR/PK
27	G80 20YL/WT
28	B2 18YL (LHD)
29	Z9 16BK
30	L63 18DG/RD
31	K106 18WT/DG (LHD)
32	K107 18OR (LHD)
33	D25 18YL/VT/DB
34	G75 20TN
35	G72 18DG/OR (PREMIUM)

C201 - BLACK (INSTRUMENT PANEL SIDE)

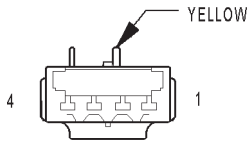
CAV	CIRCUIT
36	G73 18LG/OR (PREMIUM)
37	F512 18PK/OR
38	A141 16DG/WT (LHD)
39	L10 18BR/LG
40	P100 18OR/BR



C 201

C201 - BLACK (BODY SIDE)

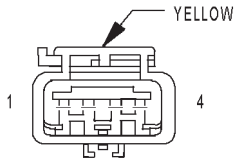
CAV	CIRCUIT
1	R57 18DG
2	R59 18LB
3	X75 18DG (HIGHLINE)
4	A99 14RD/VT (MIDLINE/HIGHLINE)
5	B12 18DG/OR (RHD)
6	F81 12TN (MIDLINE/HIGHLINE)
7	V21 20DB/RD
8	V22 20BR/YL
9	R58 18GY
10	R60 18VT
11	K226 18DB/WT (LHD)
12	G74 20TN/WT
13	G71 18VT/YL
14	T6 20VT/WT
15	G9 20GY/BK
16	B1 18YL/DB (LHD)
17	K29 20WT/PK
18	L62 18BR/RD
19	M3 20PK/DB
20	K125 18WT/DB (LHD)
21	-
22	-
23	K4 18BK/LB (LHD)
24	G910 20VT/BR
25	G78 20TN/BK
26	P101 20OR/PK
27	G80 20YL/WT
28	B2 18YL (LHD)
29	Z9 16BK
30	L63 18DG/RD
31	K106 18WT/DG (LHD)
32	K107 18OR (LHD)
33	D25 18YL/VT
34	G75 20TN
35	G72 18DG/OR (MIDLINE/HIGHLINE)
36	G73 18LG/OR (MIDLINE/HIGHLINE)
37	F512 18PK/OR (RHD)
38	A141 16DG/WT (LHD)
39	L10 18BR/LG
40	P100 18OR/BR



C 202

C202 - YELLOW (INSTRUMENT PANEL SIDE)

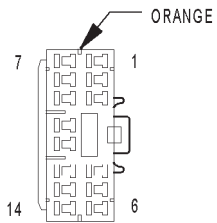
CAV	CIRCUIT
1	-
2	-
3	R53 180R/YL
4	R55 180R/BK



C 202

C202 - YELLOW (MAIN BODY SIDE)

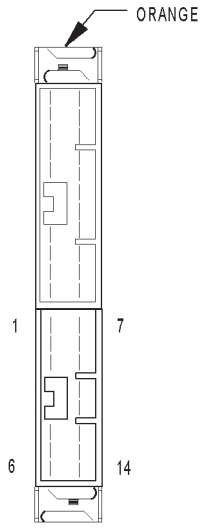
CAV	CIRCUIT
1	-
2	-
3	R53 180R/YL
4	R55 180R/BK



C 300  
(LHD)

C300 (LHD) - ORANGE (MAIN BODY SIDE)

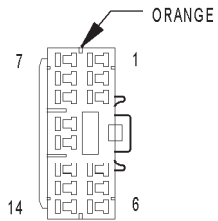
CAV	CIRCUIT
1	X57 18BR/LB (MIDLINE/HIGHLINE)
2	X91 18WT/BK (MIDLINE/HIGHLINE)
3	X81 18YL/BK (MIDLINE/HIGHLINE)
4	X13 16BK/RD (MIDLINE/HIGHLINE)
5	-
6	-
7	X51 18BR/YL (MIDLINE/HIGHLINE)
8	X93 18WT/RD (MIDLINE/HIGHLINE)
9	X83 18YL/RD (MIDLINE/HIGHLINE)
10	-
11	-
12	-
13	-
14	Z9 16BK (MIDLINE/HIGHLINE)



C 300  
(LHD)

C300 (LHD) - ORANGE (DRIVER DOOR SIDE)

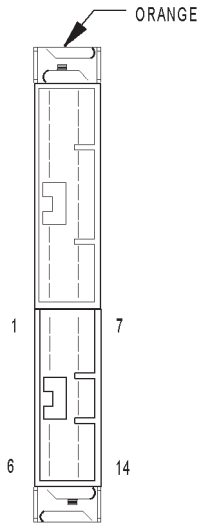
CAV	CIRCUIT
1	X57 18BR/LB
2	X57 18BR/LB (BASE)
2	X91 18WT/BK (PREMIUM)
3	X55 18BR/RD (BASE)
3	X81 18YL/BK (PREMIUM)
4	X13 16BK/RD (PREMIUM)
5	-
6	-
7	X51 18BR/YL
8	X93 18WT/RD (PREMIUM)
8	X51 18BR/YL (BASE)
9	X53 18DG (BASE)
9	X83 18YL/RD (PREMIUM)
10	-
11	-
12	-
13	-
14	Z9 16BK (PREMIUM)



C 300  
(RHD)

C300 (RHD) - ORANGE (MAIN BODY SIDE)

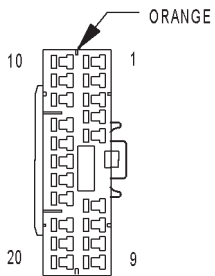
CAV	CIRCUIT
1	X58 18DB/OR
2	X92 18TN/BK
3	X86 18OR/RD
4	X13 16BK/RD
5	-
6	-
7	X52 18DB/WT
8	X94 18TN/VT
9	X84 18TN/BK
10	-
11	P99 18GY
12	P110 18YL
13	-
14	Z9 16BK



C 300  
(RHD)

C300 (RHD) - ORANGE (DRIVER DOOR SIDE)

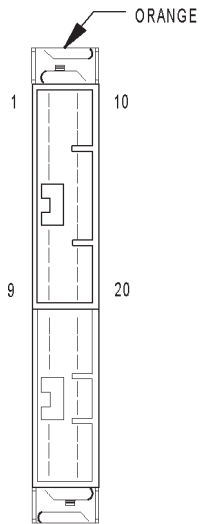
CAV	CIRCUIT
1	X58 18DB/OR
2	X58 18DB/OR (BASE)
2	X92 18TN/BK (PREMIUM)
3	X56 18DB/RD (BASE)
3	X86 18OR/RD (PREMIUM)
4	X13 16BK/RD (PREMIUM)
5	-
6	-
7	X52 18DB/WT
8	X94 18TN/VT (PREMIUM)
8	X52 18DB/WT (BASE)
9	X54 18VT (BASE)
9	X84 18TN/BK (PREMIUM)
10	-
11	P99 18GY
12	P110 18YL
13	-
14	Z9 16BK (PREMIUM)



C 301  
(LHD)

C301 (LHD) - ORANGE (MAIN BODY SIDE)

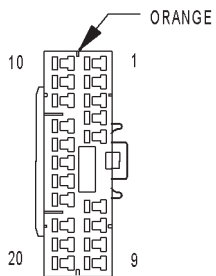
CAV	CIRCUIT
1	Q11 14LB (MIDLINE/HIGHLINE)
2	F89 18OR/RD (EXCEPT BASE)
3	P33 18OR/BK (EXCEPT BASE)
4	C16 18LB/YL (EXCEPT BASE)
5	P72 18YL/BK (EXCEPT BASE)
6	-
7	G73 18LG/OR (MIDLINE/HIGHLINE)
8	P37 20LG (EXCEPT BASE)
9	X55 18BR/RD
10	Q21 14WT (MIDLINE/HIGHLINE)
11	V23 20BR/PK (EXCEPT BASE)
12	P34 18PK/BK (EXCEPT BASE)
13	P74 18DB (EXCEPT BASE)
14	P76 18OR/YL (EXCEPT BASE)
15	G75 20TN
16	Z21 20BK/LG (MIDLINE/HIGHLINE)
17	Z350 20BK/LG
18	-
19	P36 20PK/VT (EXCEPT BASE)
20	X53 18DG



C 301  
(LHD)

C301 (LHD) - ORANGE (DRIVER DOOR SIDE)

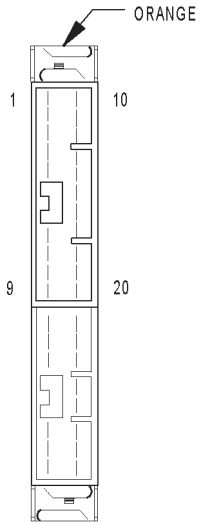
CAV	CIRCUIT
1	Q11 16LB (POWER WINDOWS)
2	F89 20OR/RD (EXCEPT BASE)
3	P33 18OR/BK (EXCEPT BASE)
4	C16 20LB/YL (EXCEPT BASE)
5	P72 18YL/BK (EXCEPT BASE)
6	-
7	G73 18LG/OR (EXCEPT BASE)
8	P37 18LG (EXCEPT BASE)
9	X55 18BR/RD
10	Q21 16WT (POWER WINDOWS)
11	V23 20BR/PK (EXCEPT BASE)
12	P34 18PK/BK (EXCEPT BASE)
13	P74 18DB (EXCEPT BASE)
14	P76 18OR/YL (EXCEPT BASE)
15	G75 20TN
16	-
17	Z350 20BK/LG
18	-
19	P36 20PK/VT (EXCEPT BASE)
20	X53 18DG



C 301  
(RHD)

C301 (RHD) - ORANGE (MAIN BODY SIDE)

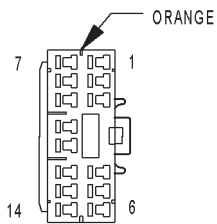
CAV	CIRCUIT
1	Q12 14BR
2	F89 18OR/RD
3	P33 18OR/BK
4	C16 18LB/YL
5	P71 18YL/DG
6	-
7	G73 18LG/OR
8	P37 20LG
9	X56 18DB/RD
10	Q22 14VT/WT
11	V23 20BR/PK
12	P34 18PK/BK
13	P75 18LB/WT
14	P76 18OR/YL
15	G75 20TN
16	-
17	Z351 18BK/LG
18	-
19	P36 20PK/VT
20	X54 18VT



C 301  
(RHD)

C301 (RHD) - ORANGE (DRIVER DOOR SIDE)

CAV	CIRCUIT
1	Q12 16BR
2	F89 20OR/RD
3	P33 18OR/BK
4	C16 20LB/YL
5	P71 20YL/DG
6	-
7	G73 18LG/OR
8	P37 18LG
9	X56 18BR/RD
10	Q22 16VT/WT
11	V23 20BR/PK
12	P34 18PK/BK
13	P75 20LB/WT
14	P76 18OR/YL
15	G75 20TN
16	-
17	Z351 18BK/LG
18	-
19	P36 20PK/VT
20	X54 18VT

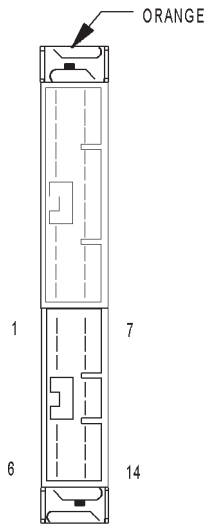


C 302  
(LHD)

C302 (LHD) - ORANGE (MAIN BODY SIDE)

CAV	CIRCUIT
1	X58 18DB/OR (MIDLINE/HIGHLINE)
2	X92 18TN/BK (MIDLINE/HIGHLINE)
3	X86 18OR/RD (MIDLINE/HIGHLINE)
4	X13 16BK/RD (MIDLINE/HIGHLINE))
5	-
6	-
7	X52 18DB/WT (MIDLINE/HIGHLINE)
8	X94 18TN/VT (MIDLINE/HIGHLINE)
9	X84 18TN/BK (MIDLINE/HIGHLINE)
10	-
11	-
12	-
13	-
14	Z9 16BK (MIDLINE/HIGHLINE)

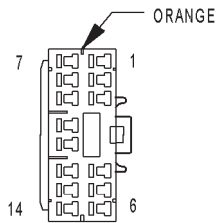




C 302  
(LHD)

C302 (LHD) - ORANGE (PASSENGER DOOR  
SIDE)

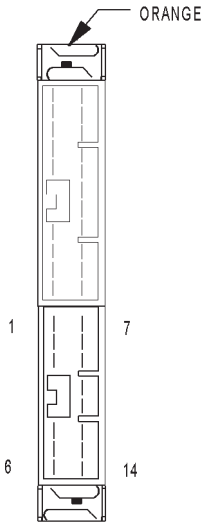
CAV	CIRCUIT
1	X58 18DB/OR
2	X58 18DB/OR (BASE)
2	X92 18TN/BK (PREMIUM)
3	X56 18DB/RD (BASE)
3	X86 18OR/RD (PREMIUM)
4	X13 16BK/RD (PREMIUM)
5	-
6	-
7	X52 18DB/WT
8	X94 18TN/VT (PREMIUM)
8	X52 18DB/WT (BASE)
9	X54 18VT (BASE)
9	X84 18TN/BK (PREMIUM)
10	-
11	-
12	-
13	-
14	Z9 16BK (PREMIUM)



C 302  
(RHD)

C302 (RHD) - ORANGE (MAIN BODY SIDE)

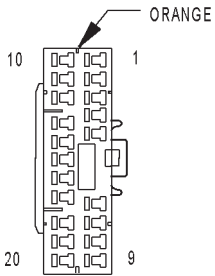
CAV	CIRCUIT
1	X57 18BR/LB
2	X91 18WT/BK
3	X81 18YL/BK
4	X13 16BK/RD
5	-
6	-
7	X51 18BR/YL
8	X93 18WT/RD
9	X83 18YL/RD
10	-
11	P99 18GY
12	P110 18YL
13	-
14	Z9 16BK



C 302  
(RHD)

C302 (RHD) - ORANGE (PASSENGER DOOR SIDE)

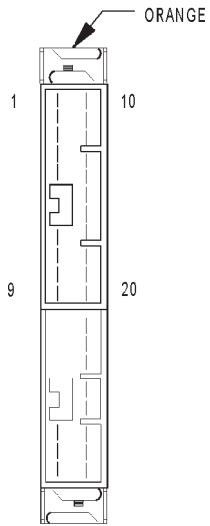
CAV	CIRCUIT
1	X57 18BR/LB
2	X57 18BR/LB (BASE)
2	X91 18WT/BK (PREMIUM)
3	X55 18BR/RD (BASE)
3	X81 18YL/BK (PREMIUM)
4	X13 16BK/RD (PREMIUM)
5	-
6	-
7	X51 18BR/YL
8	X93 18WT/RD (PREMIUM)
8	X51 18BR/YL (BASE)
9	X53 18DG (BASE)
9	X83 18YL/RD (PREMIUM)
10	-
11	P99 20GY
12	P110 20YL
13	-
14	Z9 16BK (PREMIUM)



C 303  
(LHD)

C303 (LHD) - ORANGE (MAIN BODY SIDE)

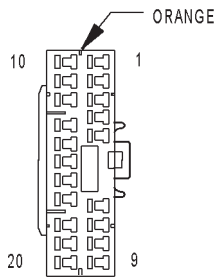
CAV	CIRCUIT
1	Q12 14BR (MIDLINE/HIGHLINE)
2	F89 18OR/RD (EXCEPT BASE)
3	P33 18OR/BK (EXCEPT BASE)
4	C16 18LB/YL (EXCEPT BASE)
5	P72 18YL/BK (EXCEPT BASE)
6	-
7	G72 18DG/OR (MIDLINE/HIGHLINE)
8	P37 20LG (EXCEPT BASE)
9	X56 18DB/RD
10	Q22 14VT/WT (MIDLINE/HIGHLINE)
11	-
12	P35 18OR/VT (EXCEPT BASE)
13	P74 18DB (EXCEPT BASE)
14	P76 18OR/YL (EXCEPT BASE)
15	G74 20TN/WT
16	-
17	Z351 18BK/LG
18	-
19	P36 20PK/VT (EXCEPT BASE)
20	X54 18VT



C303 (LHD)

C303 (LHD) - ORANGE (PASSENGER DOOR SIDE)

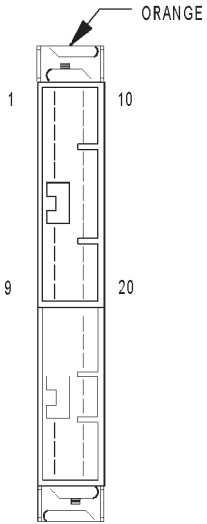
CAV	CIRCUIT
1	Q12 16BR (POWER WINDOWS)
2	F89 200R/RD (EXCEPT BASE)
3	P33 180R/BK (EXCEPT BASE)
4	C16 20LB/YL (EXCEPT BASE)
5	P72 20YL/BK (EXCEPT BASE)
6	-
7	G72 18DG/OR (EXCEPT BASE)
8	P37 18LG (EXCEPT BASE)
9	X56 18DB/RD
10	Q22 16VT/WT (POWER WINDOWS)
11	-
12	P35 180R/VT (EXCEPT BASE)
13	P74 20DB (EXCEPT BASE)
14	P76 200R/YL (EXCEPT BASE)
15	G74 20TN/WT
16	-
17	Z351 18BK/LG
18	-
19	P36 20PK/VT (EXCEPT BASE)
20	X54 18VT



C303 (RHD)

C303 (RHD) - ORANGE (MAIN BODY SIDE)

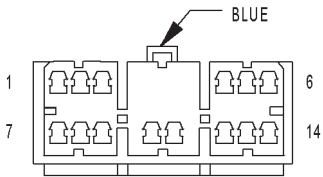
CAV	CIRCUIT
1	Q11 14LB
2	F89 180R/RD
3	P33 180R/BK
4	C16 18LB/YL
5	P71 18YL/DG
6	-
7	G72 18DG/OR
8	P37 20LG
9	X55 18BR/RD
10	Q21 14WT
11	-
12	P35 180R/VT
13	P75 18LB/WT
14	P76 180R/YL
15	G74 20TN/WT
16	Z21 20BK/LG
17	Z350 18BK/LG
18	-
19	P36 20PK/VT
20	X53 18DG



C303 (RHD)

C303 (RHD) - ORANGE (PASSENGER DOOR SIDE)

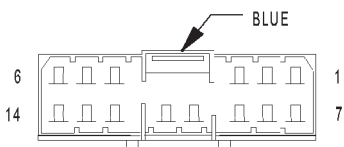
CAV	CIRCUIT
1	Q11 16LB
2	F89 20OR/RD
3	P33 18OR/BK
4	C16 20LB/YL
5	P71 20YL/DG
6	-
7	G72 18DG/OR
8	P37 18LG
9	X55 18BR/RD
10	Q21 16WT
11	-
12	P35 18OR/VT
13	P75 20LB/WT
14	P76 20OR/YL
15	G74 20TN/WT
16	-
17	Z350 18BK/LB
18	-
19	P36 20PK/VT
20	X53 18DG



C304

C304 - BLUE (MAIN BODY SIDE)

CAV	CIRCUIT
1	Q14 14GY (MIDLINE/HIGHLINE)
2	P33 18OR/BK (EXCEPT BASE)
3	-
4	-
5	-
6	X92 18TN/BK (MIDLINE/HIGHLINE)
6	X58 18DB/OR (BASE/LOWLINE)
7	Q24 14DG (MIDLINE/HIGHLINE)
8	P35 18OR/VT (EXCEPT BASE)
9	-
10	Z351 20BK/LG
11	-
12	G74 20TN/WT
13	-
14	X94 18TN/VT (MIDLINE/HIGHLINE)
14	X52 18DB/WT (BASE/LOWLINE)



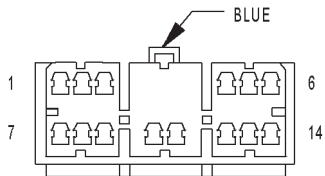
C304

C304 - BLUE (RIGHT REAR DOOR SIDE)

CAV	CIRCUIT
1	Q14 16GY (MIDLINE II/HIGHLINE)
2	P33 18OR/BK (EXCEPT BASE)
3	-
4	-

C304 - BLUE (RIGHT REAR DOOR SIDE)

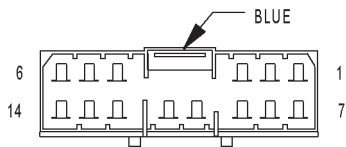
CAV	CIRCUIT
5	-
6	X92 18TN/BK (PREMIUM)
6	X58 18DB/OR (BASE)
7	Q24 16DG (MIDLINE II/HIGHLINE)
8	P35 18OR/VT (EXCEPT BASE)
9	-
10	Z351 20BK/LG
11	-
12	G74 20TN/WT
13	-
14	X94 18TN/VT (PREMIUM)
14	X52 18DB/WT (BASE)



C 305

C305 - BLUE (MAIN BODY SIDE)

CAV	CIRCUIT
1	Q13 14DB (MIDLINE/HIGHLINE)
2	P33 18OR/BK (EXCEPT BASE)
3	-
4	-
5	-
6	X91 18WT/BK (MIDLINE/HIGHLINE)
6	X57 18BR/LB (BASE/LOWLINE)
7	Q23 14RD/WT (MIDLINE/HIGHLINE)
8	P35 18OR/VT (EXCEPT BASE)
9	-
10	Z350 20BK/LG (RHD)
10	Z350 18BK/LG (LHD)
11	-
12	G74 20TN/WT
13	-
14	X93 18WT/RD (MIDLINE/HIGHLINE)
14	X51 18BR/YL (BASE/LOWLINE)



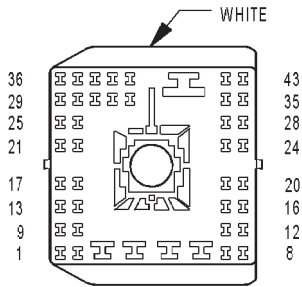
C 305

C305 - BLUE (LEFT REAR DOOR SIDE)

CAV	CIRCUIT
1	Q13 16GY (MIDLINE II/HIGHLINE)
2	P33 18OR/BK (EXCEPT BASE)
3	-
4	-
5	-
6	X91 18TN/BK (PREMIUM)
6	X57 18DB/OR (BASE)
7	Q23 16DG (MIDLINE II/HIGHLINE)
8	P35 18OR/VT (EXCEPT BASE)
9	-
10	Z350 20BK/LG
11	-

C305 - BLUE (LEFT REAR DOOR SIDE)

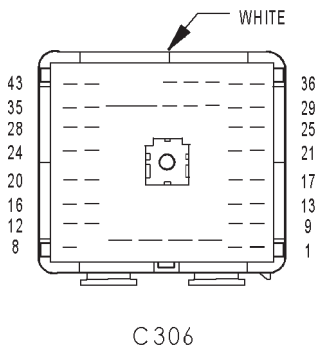
CAV	CIRCUIT
12	G74 20TN/WT
13	-
14	X93 18TN/VT (PREMIUM)
14	X51 18DB/WT (BASE)



C 306

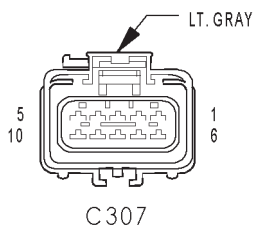
C306 - WHITE (MAIN BODY SIDE)

CAV	CIRCUIT
1	A6 16RD/BK (MIDLINE/HIGHLINE)
2	-
3	F85 16VT/WT (MIDLINE/HIGHLINE)
4	F70 18PK/BK
5	F41 16PK/VT
6	A99 14RD/VT (MIDLINE/HIGHLINE)
7	-
8	F87 20WT/BK (EXCEPT BASE)
9	L77 18BK/YL
10	V23 20BR/PK (MIDLINE/HIGHLINE)
11	L10 18BR/LG
12	M3 20PK/DB
13	L50 18WT/TN
14	-
15	L63 18DG/RD
16	L78 18DG/YL
17	V21 20DB/RD
18	-
19	-
20	M1 20PK
21	M2 18YL
22	M20 20BR
23	P30 16OR/WT
24	P31 16PK/WT
25	-
26	-
27	P100 18OR/BR
28	L38 18BR/WT (HIGHLINE)
29	X75 18DG (HIGHLINE)
30	P101 20OR/PK
31	G80 20YL/WT
32	G910 20VT/BR
33	-
34	X13 16BK/RD (HIGHLINE)
35	L62 18BR/RD
36	-
37	G78 20TN/BK
38	G71 18VT/YL
39	D25 18YL/VT (MIDLINE/HIGHLINE)
40	-
41	C15 12BK/WT
42	V22 20BR/YL
43	B40 14LB (MIDLINE/HIGHLINE)



C306 - WHITE (REAR BODY SIDE)

CAV	CIRCUIT
1	A6 16RD/BK (EXCEPT BASE)
2	-
3	F85 16VT/WT (EXCEPT BASE)
4	F70 18PK/BK
5	F41 16PK/VT
6	A99 14RD/VT (EXCEPT BASE)
7	-
8	F87 20WT/BK (EXCEPT BASE)
9	L77 18BK/YL
10	V23 20BR/PK (EXCEPT BASE)
11	L10 18BR/LG
12	M3 20PK/DB
13	L50 18WT/TN
14	-
15	L63 18DG/RD
16	L78 18DG/YL
17	V21 20DB/RD
18	-
19	-
20	M1 20PK
21	M2 18YL
22	M20 20BR
23	P30 16OR/WT
24	P31 16PK/WT
25	-
26	-
27	P100 18OR/BR
28	L38 18BR/WT (BUILT-UP-EXPORT)
29	X75 18DG (EXCEPT BASE)
30	P101 20OR/PK
31	G80 20YL/WT
32	G910 20VT/BR
33	-
34	-
35	L62 18BR/RD
36	-
37	G78 20TN/BK
38	G71 18VT/YL
39	D25 18YL/VT (EXCEPT BASE)
40	-
41	C15 12BK/WT
42	V22 20BR/YL
43	B40 14LB (EXCEPT BASE)

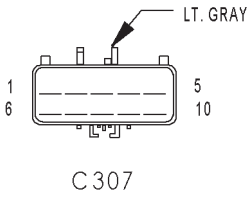


C307 - LT. GRAY (MAIN BODY SIDE)

CAV	CIRCUIT
1	K226 18DB/WT
2	F512 18PK/OR (RHD)
3	A141 16DG/WT

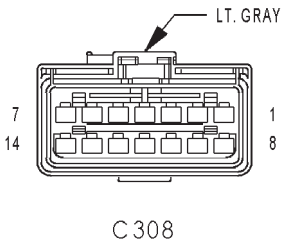
C307 - LT. GRAY (MAIN BODY SIDE)

CAV	CIRCUIT
4	B1 18YL/DB
5	B2 18YL
6	K4 18BK/LB
7	B12 18DG/OR (RHD)
8	K125 18WT/DB
9	K107 18OR
10	K106 18WT/DG



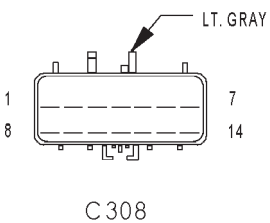
C307 - LT. GRAY (FUEL TANK SIDE)

CAV	CIRCUIT
1	K226 18DB/WT
2	-
3	A141 16DG/WT (GAS)
4	B1 18YL/DB
5	B2 18YL
6	K4 18BK/LB
7	-
8	K125 18WT/DB (GAS)
9	K107 18OR (GAS)
10	K106 18WT/DG (GAS)



C308 - LT. GRAY (OVERHEAD SIDE)

CAV	CIRCUIT
1	F85 16VT/WT (SUNROOF)
2	-
3	M1 20PK
4	M3 20PK/DB (EXCEPT BASE)
5	Z111 16BK (SUNROOF)
6	-
7	X75 20GY/LG (BUILT-UP-EXPORT)
8	F87 20WT/BK (HIGHLINE)
9	-
10	M20 20BR (EXCEPT BASE)
11	M2 20YL
12	Z2 20BK/LG (HIGHLINE)
13	-
14	D25 20YL/VT (HIGHLINE)



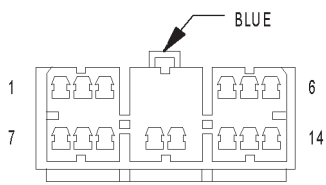
C308 - LT. GRAY (REAR BODY SIDE)

CAV	CIRCUIT
1	F85 16VT/WT (EXCEPT BASE)
2	-
3	M1 20PK
4	M3 20PK/DB



C308 - LT. GRAY (REAR BODY SIDE)

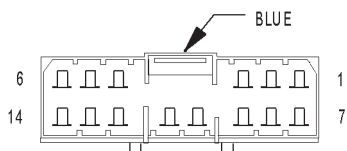
CAV	CIRCUIT
5	Z111 16BK (EXCEPT BASE)
6	-
7	X75 18DG (EXCEPT BASE)
8	F87 20WT/BK (EXCEPT BASE)
9	-
10	M20 20BR
11	M2 18YL
12	Z2 18BK/LG (EXCEPT BASE)
13	-
14	D25 18YL/VT (EXCEPT BASE)



C 309

C309 - BLUE (REAR BODY SIDE)

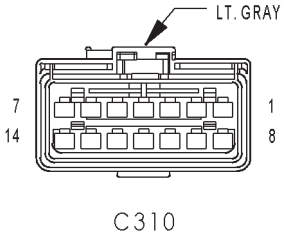
CAV	CIRCUIT
1	V21 20DB/RD
2	P31 16PK/WT
3	F70 18PK/BK
4	P100 18OR/BR
5	P101 20OR/PK
6	G71 18VT/YL
7	V22 20BR/YL
8	P30 16OR/WT
9	L77 18BK/YL
10	-
11	G80 20YL/WT
12	Z235 16BK
13	G78 20TN/BK
14	G910 20VT/BR



C 309

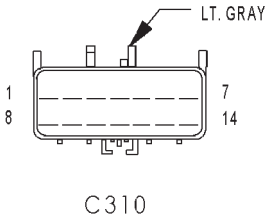
C309 - BLUE (SPLITGATE SIDE)

CAV	CIRCUIT
1	V21 20DB/RD
2	P31 16PK/WT
3	F70 18PK/BK
4	P100 18OR/BR
5	P101 20OR/PK
6	G71 18VT/YL
7	V22 20BR/YL
8	P30 16OR/WT
9	L77 18BK/YL (BUILT-UP-EXPORT)
10	-
11	G80 20YL/WT
12	Z235 16BK
13	G78 20TN/BK
14	G910 20VT/BR



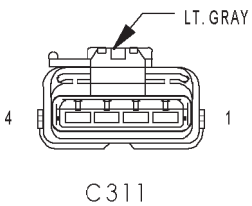
C310 - LT. GRAY (REAR BODY SIDE)

CAV	CIRCUIT
1	A6 16RD/BK (BUILT-UP-EXPORT)
2	L10 18BR/LG
3	L77 18BK/YL
4	L63 18DG/RD
5	L38 18BR/WT (BUILT-UP-EXPORT)
6	L50 18WT/TN
7	A99 14RD/VT (BUILT-UP-EXPORT)
8	V23 20BR/PK (BUILT-UP-EXPORT)
9	Z151 16BK/WT (LHD)
9	Z151 18BK/WT (RHD)
10	Z151 18BK/WT (RHD)
10	Z151 16BK/WT (LHD)
11	L78 18DG/YL
12	L62 18BR/RD
13	-
14	B40 14LB (BUILT-UP-EXPORT)



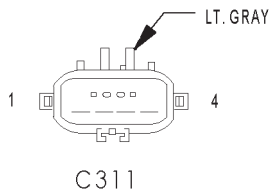
C310 - LT. GRAY (REAR LIGHTING SIDE)

CAV	CIRCUIT
1	-
2	L10 18BR/LG
3	L77 18BK/YL
4	L63 18DG/RD
5	L38 18BR/WT (BUILT-UP-EXPORT)
6	L50 18WT/TN
7	-
8	-
9	Z151 18BK/WT
10	Z151 18BK/WT
11	L78 18DG/YL
12	L62 18BR/RD
13	-
14	-



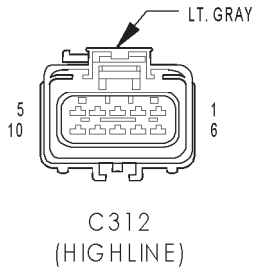
C311 - LT. GRAY (MAIN BODY SIDE)

CAV	CIRCUIT
1	F37 14RD/LB (MIDLINE/HIGHLINE)
2	R58 18GY (RHD)
2	R57 18DG (LHD)
3	Z238 14BK/WT (MIDLINE/HIGHLINE)
4	R60 18VT (RHD)
4	R59 18LB (LHD)



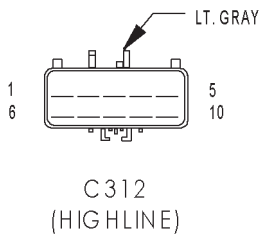
C311 - LT. GRAY (LEFT FRONT SEAT SIDE)

CAV	CIRCUIT
1	F37 18RD/LB (EXCEPT BASE)
2	R58 18GY (RHD)
2	R57 18DG (LHD)
3	Z238 14BK/WT (EXCEPT BASE)
4	R60 18VT (RHD)
4	R59 18LB (LHD)



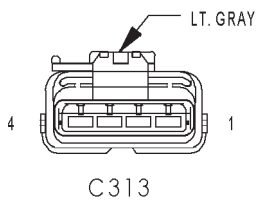
C312 (HIGHLINE) - LT. GRAY (MAIN BODY SIDE)

CAV	CIRCUIT
1	-
2	P86 20PK/BK
3	F98 14RD/WT
4	V23 20BR/PK
5	A3 16RD/WT
6	P142 20TN/DB
7	P134 20TN/LG
8	P138 20VT/LG
9	P140 20VT/BK
10	Z238 14BK/WT



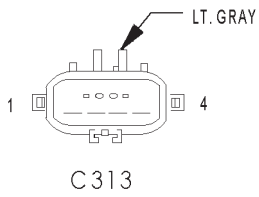
C312 (HIGHLINE) - LT. GRAY (LEFT FRONT SEAT SIDE)

CAV	CIRCUIT
1	P141 20TN/LB
2	P86 20PK/BK
3	F98 16RD/WT
4	V23 1BR/PK
5	A3 20RD/WT
6	P142 20TN/DB
7	P134 20TN/LG
8	P138 20VT/LG
9	P140 20VT/BK
10	Z238 14BK/WT



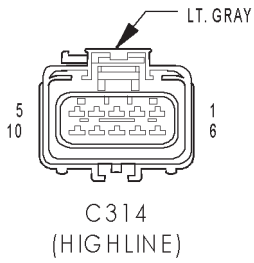
C313 - LT. GRAY (MAIN BODY SIDE)

CAV	CIRCUIT
1	F37 14RD/LB (HIGHLINE)
2	R57 18DG (RHD)
2	R58 18GY (LHD)
3	Z238 14BK/WT (HIGHLINE)
4	R59 18LB (RHD)
4	R60 18VT (LHD)



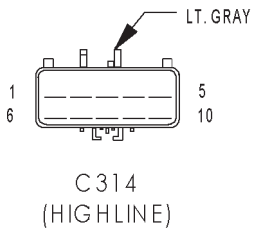
C313 - LT. GRAY (RIGHT FRONT SEAT SIDE)

CAV	CIRCUIT
1	F34 14RD/LB (HIGHLINE)
2	R58 18DG (LHD BASE)
2	R57 DG (RHD)
2	R58 18GY (LHD EXCEPT BASE)
3	Z238 14BK/WT (HIGHLINE)
4	R60 18LB (LHD BASE)
4	R59 18LB (RHD)
4	R60 18VT (LHD EXCEPT BASE))



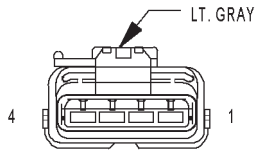
C314 (HIGHLINE) - LT. GRAY (MAIN BODY SIDE)

CAV	CIRCUIT
1	F98 14RD/WT
2	Z238 14BK/WT
3	P86 18PK/BK
4	P142 20TN/DB
5	V23 20BR/PK
6	P134 20TN/LG
7	P140 20VT/BK
8	P138 20VT/LG
9	-
10	-



C314 (HIGHLINE) - LT. GRAY (RIGHT FRONT SEAT SIDE)

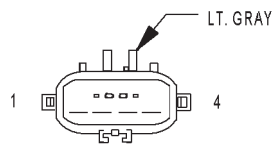
CAV	CIRCUIT
1	F98 16RD/WT
2	Z238 14BK/WT
3	P86 20PK/BK
4	P142 20TN/DB
5	V23 20BR/PK
6	P134 20TN/LG
7	P140 20VT/BK
8	P138 20VT/LG
9	-
10	-



C315  
(MIDLINE/HIGHLINE)

C315 (MIDLINE/HIGHLINE) - LT. GRAY (RIGHT SIDE)

CAV	CIRCUIT
1	Q12 14BR (LHD)
1	Q11 14LB (RHD)
2	Q22 14VT/WT (LHD)
2	Q21 14WT (RHD)
3	Q14 14GY (LHD)
3	Q13 14DB (RHD)
4	Q24 14DG (LHD)
4	Q23 14RD/WT (RHD)



C315  
(MIDLINE/HIGHLINE)

C315 (MIDLINE/HIGHLINE) - LT. GRAY (LEFT SIDE)

CAV	CIRCUIT
1	Q12 14BR (LHD)
1	Q11 14LB (RHD)
2	Q22 14VT/WT (LHD)
2	Q21 14WT (RHD)
3	Q14 14GY (LHD)
3	Q13 14DB (RHD)
4	Q24 14DG (LHD)
4	Q23 14RD/WT (RHD)

CONNECTOR VIEW  
NOT  
AVAILABLE

C316  
(BUILT-UP-EXPORT)

C316 (BUILT-UP-EXPORT) - (MAIN BODY SIDE)

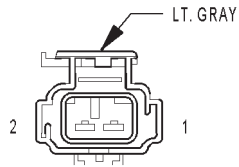
CAV	CIRCUIT
1	X30 10BK
2	X31 10BK

CONNECTOR VIEW  
NOT  
AVAILABLE

C316  
(BUILT-UP-EXPORT)

C316 (BUILT-UP-EXPORT) - (REAR BODY SIDE)

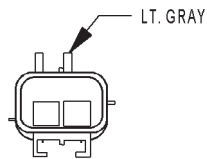
CAV	CIRCUIT
1	X30 BK
2	X31 BK



C317  
(EXCEPT BUILT-UP-EXPORT)

C317 (EXCEPT BUILT-UP-EXPORT) - LT. GRAY  
(REAR LIGHTING SIDE)

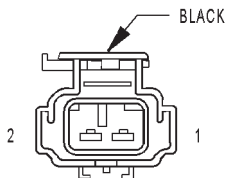
CAV	CIRCUIT
1	L77 18BK/YL
2	Z151 18BK/WT



C317  
(EXCEPT BUILT-UP-EXPORT)

C317 (EXCEPT BUILT-UP-EXPORT) - LT. GRAY  
(LICENSE LAMP SIDE)

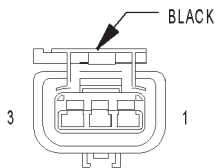
CAV	CIRCUIT
1	L77 18BR/YL
2	Z151 18BK/WT



CABIN  
HEATER  
(DIESEL)

CABIN HEATER (DIESEL) - BLACK 2 WAY

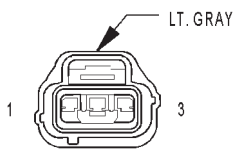
CAV	CIRCUIT	FUNCTION
1	C151 18DB/WT	CABIN HEATER RELAY OUTPUT
2	Z186 12BK/OR	GROUND



CAMSHAFT  
POSITION  
SENSOR  
(2.4L)

CAMSHAFT POSITION SENSOR (2.4L) - BLACK 3 WAY

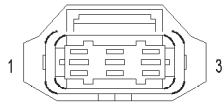
CAV	CIRCUIT	FUNCTION
1	K7 18OR	5 VOLT SUPPLY
2	K4 18BK/LB	SENSOR GROUND
3	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL



CAMSHAFT  
POSITION  
SENSOR  
(3.7L)

CAMSHAFT POSITION SENSOR (3.7L) - LT. GRAY 3 WAY

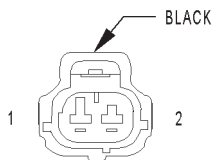
CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND
3	K7 18OR	5 VOLT SUPPLY



CAMSHAFT  
POSITION  
SENSOR  
(DIESEL)

CAMSHAFT POSITION SENSOR (DIESEL) - 3 WAY

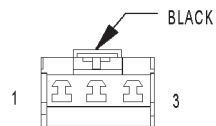
CAV	CIRCUIT	FUNCTION
1	K944 20BK/LB	CAMSHAFT POSITION SENSOR GROUND
2	K44 20TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
3	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT



CAPACITOR

CAPACITOR - BLACK 2 WAY

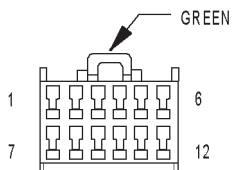
CAV	CIRCUIT	FUNCTION
1	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	Z55 14BK/WT	GROUND



CARGO  
LAMP  
(EXCEPT BASE)

CARGO LAMP (EXCEPT BASE) - BLACK 3 WAY

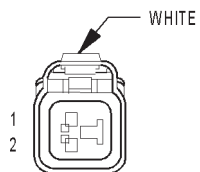
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M3 20PK/DB	REAR COURTESY LAMP CONTROL
3	M2 20YL	COURTESY LAMP DRIVER



CD  
CHANGER

CD CHANGER - GREEN 12 WAY

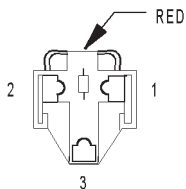
CAV	CIRCUIT	FUNCTION
1	X41 20WT/DG	AUDIO OUT LEFT
2	-	-
3	-	-
4	Z17 20BK	GROUND
5	X112 20RD	IGNITION SWITCH OUTPUT
6	X160 20YL	B(+)
7	X40 20WT/RD	AUDIO OUT RIGHT
8	Z30 20WT/BK	GROUND
9	-	-
10	-	-
11	Z9 20BK/DB	GROUND
12	D25 20YL/VT	PCI BUS



CENTER HIGH MOUNTED STOP LAMP

CENTER HIGH MOUNTED STOP LAMP - WHITE 2 WAY

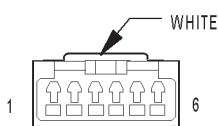
CAV	CIRCUIT	FUNCTION
1	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
2	Z309 18BK	GROUND



CIGAR LIGHTER

CIGAR LIGHTER - RED 3 WAY

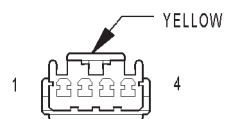
CAV	CIRCUIT	FUNCTION
1	F30 16RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	-	-
3	Z3 16BK/OR	GROUND



CLOCKSPRING C1

CLOCKSPRING C1 - WHITE 6 WAY

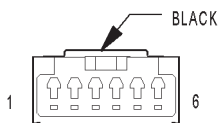
CAV	CIRCUIT	FUNCTION
1	-	-
2	X3 20BK/RD	HORN RELAY CONTROL
3	X20 20RD/BK (PREMIUM)	RADIO CONTROL MUX
4	X10 20RD/DB (PREMIUM)	RADIO CONTROL MUX RETURN
5	K4 20BK/LB	SENSOR GROUND
6	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL



CLOCKSPRING C2

CLOCKSPRING C2 - YELLOW 4 WAY

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
2	R43 18BK/LB	DRIVER SQUIB 1 LINE 1
3	R63 18TN/LB	DRIVER SQUIB 2 LINE 2
4	R61 18OR/LB	DRIVER SQUIB 2 LINE 1

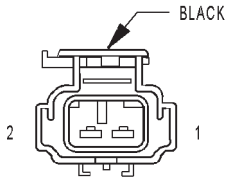


CLOCKSPRING C3

CLOCKSPRING C3 - BLACK 6 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	X3 20BK/RD	HORN RELAY CONTROL
3	X20 20RD/BK (PREMIUM)	RADIO CONTROL MUX
4	X10 20RD/DB (PREMIUM)	RADIO CONTROL MUX RETURN
5	K4 20BK/LB (EXCEPT BASE)	SENSOR GROUND
6	V37 20RD/LG (EXCEPT BASE)	SPEED CONTROL SWITCH SIGNAL

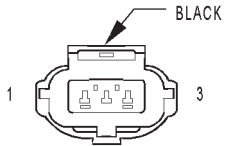




CLUTCH INTERLOCK SWITCH (M/T)

CLUTCH INTERLOCK SWITCH (M/T) - BLACK 2 WAY

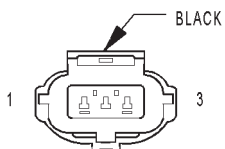
CAV	CIRCUIT	FUNCTION
1	T141 18YL/RD	CLUTCH SWITCH OVERRIDE RELAY OUTPUT
2	F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)



COIL ON PLUG NO. 1 (3.7L)

COIL ON PLUG NO. 1 (3.7L) - BLACK 3 WAY

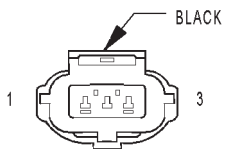
CAV	CIRCUIT	FUNCTION
1	K91 14TN/RD	COIL ON PLUG DRIVER NO.1
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	-	-



COIL ON PLUG NO. 2 (3.7L)

COIL ON PLUG NO. 2 (3.7L) - BLACK 3 WAY

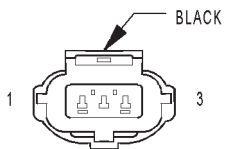
CAV	CIRCUIT	FUNCTION
1	K92 14TN/PK	COIL ON PLUG DRIVER NO. 2
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	-	-



COIL ON PLUG NO. 3 (3.7L)

COIL ON PLUG NO. 3 (3.7L) - BLACK 3 WAY

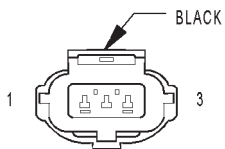
CAV	CIRCUIT	FUNCTION
1	K93 14TN/OR	COIL ON PLUG DRIVER NO. 3
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	-	-



COIL ON PLUG NO. 4 (3.7L)

COIL ON PLUG NO. 4 (3.7L) - BLACK 3 WAY

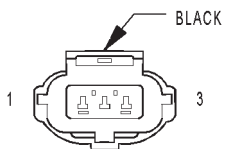
CAV	CIRCUIT	FUNCTION
1	K94 14TN/LG	COIL ON PLUG DRIVER NO. 4
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	-	-



COIL ON PLUG NO. 5 (3.7L)

COIL ON PLUG NO. 5 (3.7L) - BLACK 3 WAY

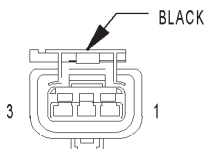
CAV	CIRCUIT	FUNCTION
1	K95 14TN/DG	COIL ON PLUG DRIVER NO. 5
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	-	-



COIL ON PLUG NO. 6 (3.7L)

COIL ON PLUG NO. 6 (3.7L) - BLACK 3 WAY

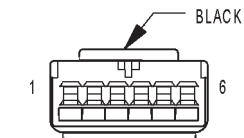
CAV	CIRCUIT	FUNCTION
1	K96 14TN/LB	COIL ON PLUG DRIVER NO. 6
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	-	-



COIL RAIL (2.4L)

COIL RAIL (2.4L) - BLACK 3 WAY

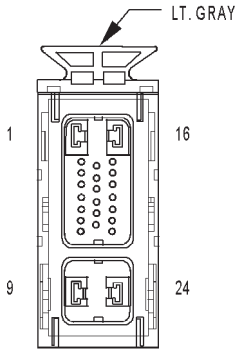
CAV	CIRCUIT	FUNCTION
1	K17 18DB/TN	IGNITION COIL DRIVER NO. 2
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	K19 18BK/GY	IGNITION COIL DRIVER NO. 1



COMPASS MINI-TRIP COMPUTER (PREMIUM)

COMPASS MINI-TRIP COMPUTER (PREMIUM) - BLACK 6 WAY

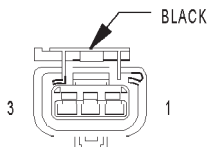
CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20YL/VT	PCI BUS
3	M1 20PK	FUSED B(+)
4	Z2 20BK/LG	CLEAN GROUND
5	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
6	-	-



CONTROLLER ANTILOCK BRAKE

CONTROLLER ANTILOCK BRAKE - LT.GRAY 24 WAY

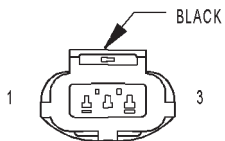
CAV	CIRCUIT	FUNCTION
1	Z101 12BK/OR	GROUND
2	-	-
3	-	-
4	-	-
5	D25 18YL/VT	PCI BUS
6	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR SIGNAL
7	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR 12 VOLT SUPPLY
8	D24 18WT/DG	FLASH ABS
9	A20 12RD/DB	FUSED B(+)
10	F22 18DB/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
11	-	-
12	-	-
13	B12 18DG/OR	VEHICLE SPEED SIGNAL
14	-	-
15	-	-
16	Z102 12BK/OR	GROUND
17	S43 18LB/YL	FLUID PRESSURE SWITCH SIGNAL
18	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
19	B1 18YL/DB	REAR WHEEL SPEED SENSOR SIGNAL
20	B2 18YL	REAR WHEEL SPEED SENSOR 12 VOLT SUPPLY
21	-	-
22	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR SIGNAL
23	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR 12 VOLT SUPPLY
24	A10 12RD/DG	FUSED B(+)



CRANKSHAFT POSITION SENSOR (2.4L)

CRANKSHAFT POSITION SENSOR (2.4L) - BLACK 3 WAY

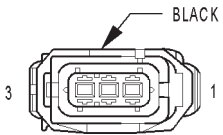
CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND
3	K7 18OR	5 VOLT SUPPLY



CRANKSHAFT POSITION SENSOR (3.7L)

CRANKSHAFT POSITION SENSOR (3.7L) - BLACK 3 WAY

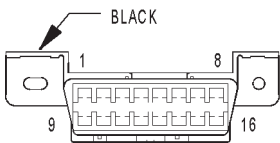
CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND
3	K7 18OR	5 VOLT SUPPLY



CRANKSHAFT  
POSITION  
SENSOR  
(DIESEL)

CRANKSHAFT POSITION SENSOR (DIESEL) - BLACK 3 WAY

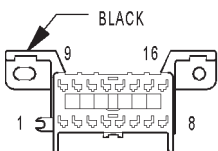
CAV	CIRCUIT	FUNCTION
1	K24 20GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL 1
2	K3 20LB/BK	CRANKSHAFT POSITION SENSOR SIGNAL 2
3	Y101 20BK/OR	CRANKSHAFT POSITION SENSOR SHIELD



DATA  
LINK  
CONNECTOR

DATA LINK CONNECTOR - BLACK 16 WAY

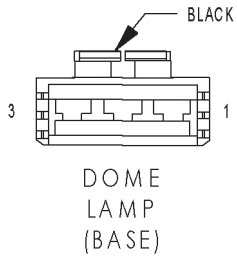
CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 18YL/VT	PCI BUS
3	-	-
4	Z252 18BK/GY	GROUND
5	Z252 18BK/GY	GROUND
6	D32 20LG/DG (GAS)	SCI RECEIVE
6	D32 20LG/DG (DIESEL)	NOT USED
7	D21 20PK/RD	SCI TRANSMIT
8	D24 18WT/DG	FLASH ABS
9	D19 20VT/OR	BODY CONTROL MODULE FLASH ENABLE
10	-	-
11	-	-
12	-	-
13	-	-
14	D20 20LG (DIESEL)	NOT USED
14	D20 20LG (GAS)	SCI RECEIVE
15	-	-
16	F33 20PK/RD	FUSED B(+)



DIAGNOSTIC  
JUNCTION  
PORT

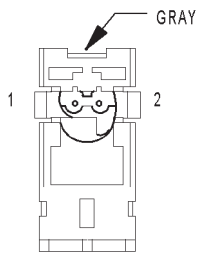
DIAGNOSTIC JUNCTION PORT - BLACK 16 WAY

CAV	CIRCUIT	FUNCTION
1	D25 18YL/VT/BR	PCI BUS (PCM TCM CAB SKIM)
2	D25 18YL/VT/GY	PCI BUS (PCM TCM CAB SKIM)
3	D25 18YL/VT/DB	PCI BUS (O/C RADIO LSIACM RSIACM)
4	D25 18YL/VT/OR	PCI BUS (ACM)
5	D25 20YL/VT/RD	PCI BUS (EMIC)
6	D25 18YL/VT/WT	PCI BUS (BCM)
7	D25 18YL/VT	PCI BUS (DLC)
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-



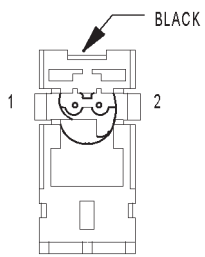
DOME LAMP (BASE) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	M1 20PK	FUSED B(+)
3	M2 20YL	COURTESY LAMP DRIVER



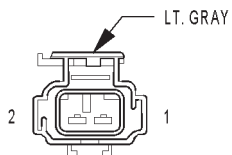
DRIVER AIRBAG SQUIB 1 - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
2	R43 18BK/LB	DRIVER SQUIB 1 LINE 1



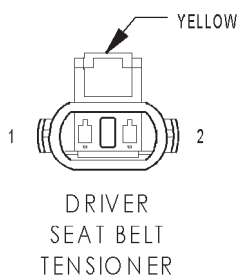
DRIVER AIRBAG SQUIB 2 - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	R63 18TN/LB	DRIVER SQUIB 2 LINE 2
2	R61 18OR/LB	DRIVER SQUIB 2 LINE 1



DRIVER SEAT BELT SWITCH - LT. GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	R57 18DG	DRIVER SEAT BELT SWITCH SENSE
2	R59 18LB	DRIVER SEAT BELT SWITCH GROUND

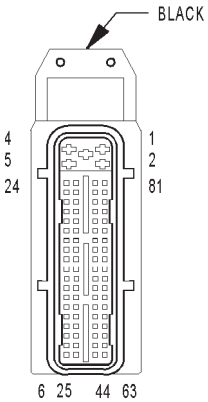


DRIVER SEAT BELT TENSIONER - YELLOW 2 WAY

CAV	CIRCUIT	FUNCTION
1	R55 18OR/BK	DRIVER SEAT BELT TENSIONER LINE 1
2	R53 18OR/YL	DRIVER SEAT BELT TENSIONER LINE 2

CONNECTOR VIEW  
NOT  
AVAILABLE

EGR  
SOLENOID  
(DIESEL)



ENGINE  
CONTROL  
MODULE C1  
(DIESEL)

EGR SOLENOID (DIESEL) - 2 WAY

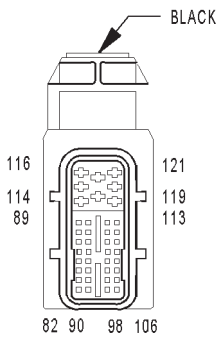
CAV	CIRCUIT	FUNCTION
1	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K35 18GY/YL	EGR SOLENOID CONTROL

ENGINE CONTROL MODULE C1 (DIESEL) - BLACK 81 WAY

CAV	CIRCUIT	FUNCTION
1	Z108 14BK/DG	GROUND
2	Z108 14BK/DG	GROUND
3	K20 18DG	GENERATOR FIELD CONTROL
4	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
5	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
6	-	-
7	D25 20VT/YL	PCI BUS
8	K944 20BK/LB	CAMSHAFT POSITION SENSOR GROUND
9	K44 20TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
10	-	-
11	K37 20DB/YL	BOOST PRESSURE SENSOR SIGNAL
12	-	-
13	K78 20GY	FUEL PRESSURE SENSOR SIGNAL
14	-	-
15	K81 20VT/TN	ACCELERATOR PEDAL POSITION SENSOR SIGNAL
16	K80 20BK/VT	FUEL PRESSURE SENSOR GROUND
17	-	-
18	-	-
19	F92 20YL/BR	BATTERY SENSE (+)
20	Z109 20BK/DB	BATTERY SENSE (-)
21	K4 20BK/LB	SENSOR GROUND
22	F1 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
23	K6 20VT/WT	SENSOR REFERENCE VOLTAGE B
24	K3 20LB/BK	CRANKSHAFT POSITION SENSOR SIGNAL 2
25	-	-
26	-	-
27	-	-
28	-	-
29	K77 20BR/WT	TRANSFER CASE POSITION SENSOR INPUT
30	G60 20GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
31	G123 20DG/WT	WATER IN FUEL SENSOR SIGNAL
32	K118 20PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
33	-	-
34	K255 20WT/DG	ACCELERATOR PEDAL POSITION SENSOR GROUND
35	K852 20VT/WT	ACCELERATOR PEDAL POSITION SENSOR 5 VOLT SUPPLY
36	-	-
37	-	-
38	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
39	K226 20DB/WT	FUEL LEVEL SENSOR SIGNAL
40	K2 20TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
41	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
42	Y101 20BK/OR	CRANKSHAFT POSITION SENSOR SHIELD
43	K24 20GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL 1

ENGINE CONTROL MODULE C1 (DIESEL) - BLACK 81 WAY

CAV	CIRCUIT	FUNCTION
44	-	-
45	-	-
46	-	-
47	L50 20WT/TN	BRAKE LAMP SWITCH OUTPUT
48	K29 20WT/PK	BRAKE SWITCH SENSE
49	-	-
50	-	-
51	-	-
52	-	-
53	-	-
54	-	-
55	B22 20DG/YL	VEHICLE SPEED SIGNAL
56	-	-
57	-	-
58	-	-
59	-	-
60	K7 20OR	FUEL PRESSURE SENSOR 5 VOLT SUPPLY
61	K51 20DB/YL	AUTO SHUT DOWN RELAY CONTROL
62	-	-
63	-	-
64	K151 20WT	LOW IDLE POSITION SWITCH SENSE
65	-	-
66	-	-
67	-	-
68	-	-
69	C13 20DG	A/C COMPRESSOR CLUTCH RELAY CONTROL
70	-	-
71	-	-
72	K236 20GY/PK	GLOW PLUG RELAY RELAY NO. 2 CONTROL
73	-	-
74	K90 20TN	CLUTCH SWITCH OVERRIDE RELAY CONTROL
75	K132 20DG/LB	CABIN HEATER RELAY CONTROL
76	-	-
77	K152 20WT	GLOW PLUG RELAY NO. 1 CONTROL
78	-	-
79	-	-
80	K46 20OR/BK	FUEL PRESSURE SOLENOID CONTROL
81	K46 20OR/BK	FUEL PRESSURE SOLENOID CONTROL



ENGINE CONTROL MODULE C2 (DIESEL)

ENGINE CONTROL MODULE C2 (DIESEL) - BLACK 40 WAY

CAV	CIRCUIT	FUNCTION
82	D21 20PK	SCI TRANSMIT
83	-	-
84	-	-
85	-	-
86	-	-
87	-	-
88	-	-
89	K35 20GY/YL	EGR SOLENOID CONTROL
90	-	-
91	-	-
92	-	-
93	-	-

ENGINE CONTROL MODULE C2 (DIESEL) - BLACK 40 WAY

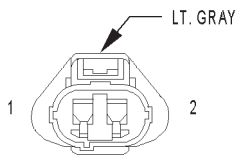
CAV	CIRCUIT	FUNCTION
94	-	-
95	-	-
96	-	-
97	-	-
98	-	-
99	-	-
100	-	-
101	C18 20DB	A/C PRESSURE SIGNAL
102	-	-
103	-	-
104	-	-
105	-	-
106	-	-
107	-	-
108	-	-
109	-	-
110	-	-
111	-	-
112	-	-
113	-	-
114	-	-
115	K14 2.5mmLB/BR	FUEL INJECTOR NO. 4 CONTROL
116	K63 2.5mmDB/BK	COMMON INJECTOR DRIVER
117	-	-
118	K11 2.5mmWT/DB	FUEL INJECTOR NO. 1 CONTROL
119	K12 2.5mmTN	FUEL INJECTOR NO. 2 CONTROL
120	K13 2.5mmYL/WT	FUEL INJECTOR NO. 3 CONTROL
121	-	-

ENGINE COOLANT LEVEL SENSOR (DIESEL) - LT. GRAY 2 WAY

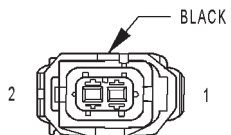
CAV	CIRCUIT	FUNCTION
1	G18 18PK/BK	COOLANT LEVEL SENSOR SIGNAL
2	Z246 18BK/GY	SENSOR GROUND

ENGINE COOLANT TEMP SENSOR (DIESEL) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K2 20TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND

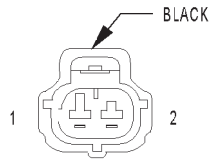


ENGINE COOLANT  
LEVEL  
SENSOR  
(DIESEL)



ENGINE COOLANT  
TEMP  
SENSOR  
(DIESEL)

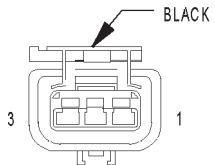




ENGINE COOLANT TEMPERATURE SENSOR (GAS)

ENGINE COOLANT TEMPERATURE SENSOR (GAS) - BLACK 2 WAY

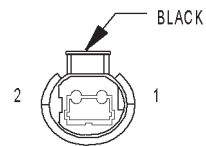
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



ENGINE OIL PRESSURE SENSOR

ENGINE OIL PRESSURE SENSOR - BLACK 3 WAY

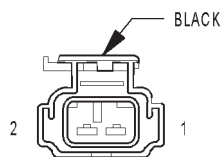
CAV	CIRCUIT	FUNCTION
1	K6 18VT/WT	SENSOR REFERENCE VOLTAGE B
2	G60 20GY/YL (DIESEL)	ENGINE OIL PRESSURE SENSOR SIGNAL
2	G60 18GY/YL (GAS)	ENGINE OIL PRESSURE SENSOR SIGNAL
3	K4 18BK/LB	SENSOR GROUND



EVAP/PURGE SOLENOID

EVAP/PURGE SOLENOID - BLACK 2 WAY

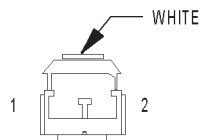
CAV	CIRCUIT	FUNCTION
1	K52 18PK/BK	EVAP/PURGE SOLENOID CONTROL
2	F1 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)



FLIP-UP GLASS RELEASE MOTOR

FLIP-UP GLASS RELEASE MOTOR - BLACK 2 WAY

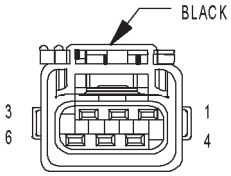
CAV	CIRCUIT	FUNCTION
1	Z235 18BK	GROUND
2	P100 18OR/BR	FLIP-UP GLASS RELEASE MOTOR DRIVER



FLIP-UP GLASS RELEASE SWITCH

FLIP-UP GLASS RELEASE SWITCH - WHITE 2 WAY

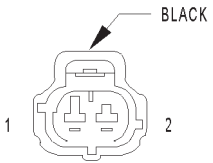
CAV	CIRCUIT	FUNCTION
1	G910 20VT/BR	TAILGATE SWITCH GROUND
2	P101 20OR/PK	FLIP-UP GLASS RELEASE SWITCH SENSE



FRONT WIPER MOTOR

FRONT WIPER MOTOR - BLACK 6 WAY

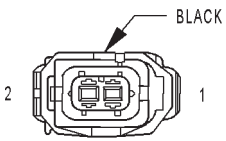
CAV	CIRCUIT	FUNCTION
1	V6 16DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	V55 16TN/RD	FRONT WIPER PARK SWITCH SENSE
3	-	-
4	Z141 14BK	GROUND
5	V3 14BR/WT	FRONT WIPER HIGH/LOW RELAY LOW SPEED OUTPUT
6	V4 14RD/YL	FRONT WIPER HIGH/LOW RELAY HIGH SPEED OUTPUT



FUEL HEATER (DIESEL)

FUEL HEATER (DIESEL) - BLACK 2 WAY

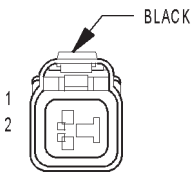
CAV	CIRCUIT	FUNCTION
1	A93 16RD/BK	FUEL HEATER RELAY OUTPUT
2	Z246 16BK/GY	GROUND



FUEL INJECTOR NO. 1 (DIESEL)

FUEL INJECTOR NO. 1 (DIESEL) - BLACK 2 WAY

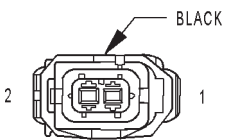
CAV	CIRCUIT	FUNCTION
1	K63 2.5mmDB/BK	COMMON INJECTOR DRIVER
2	K11 2.5mmWT/DB	FUEL INJECTOR NO. 1 CONTROL



FUEL INJECTOR NO. 1 (GAS)

FUEL INJECTOR NO. 1 (GAS) - BLACK 2 WAY

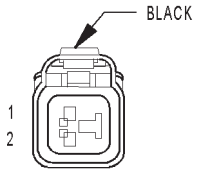
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER



FUEL INJECTOR NO. 2 (DIESEL)

FUEL INJECTOR NO. 2 (DIESEL) - BLACK 2 WAY

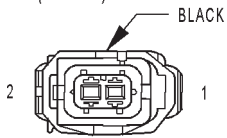
CAV	CIRCUIT	FUNCTION
1	K63 2.5mmDB/BK	COMMON INJECTOR DRIVER
2	K12 2.5mmTN	FUEL INJECTOR NO. 2 CONTROL



FUEL INJECTOR NO. 2 (GAS)

FUEL INJECTOR NO. 2 (GAS) - BLACK 2 WAY

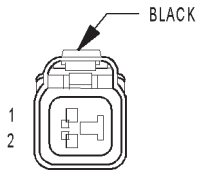
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K12 18TN	FUEL INJECTOR NO. 2 DRIVER



FUEL INJECTOR NO. 3 (DIESEL)

FUEL INJECTOR NO. 3 (DIESEL) - BLACK 2 WAY

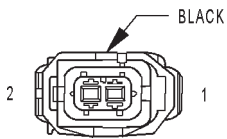
CAV	CIRCUIT	FUNCTION
1	K63 2.5mmDB/BK	COMMON INJECTOR DRIVER
2	K13 2.5mmYL/WT	FUEL INJECTOR NO. 3 CONTROL



FUEL INJECTOR NO. 3 (GAS)

FUEL INJECTOR NO. 3 (GAS) - BLACK 2 WAY

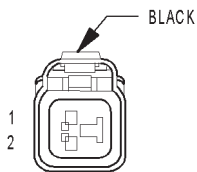
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER



FUEL INJECTOR NO. 4 (DIESEL)

FUEL INJECTOR NO. 4 (DIESEL) - BLACK 2 WAY

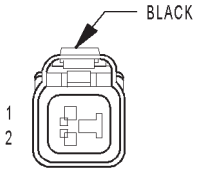
CAV	CIRCUIT	FUNCTION
1	K63 2.5mmDB/BK	COMMON INJECTOR DRIVER
2	K14 2.5mmLB/BR	FUEL INJECTOR NO. 4 CONTROL



FUEL INJECTOR NO. 4 (GAS)

FUEL INJECTOR NO. 4 (GAS) - BLACK 2 WAY

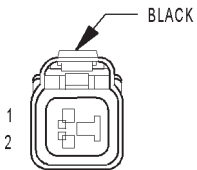
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER



FUEL INJECTOR NO. 5 (3.7L)

FUEL INJECTOR NO. 5 (3.7L) - BLACK 2 WAY

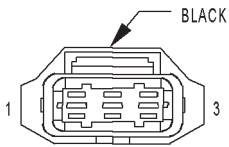
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K38 18GY	FUEL INJECTOR NO. 5 DRIVER



FUEL INJECTOR NO. 6 (3.7L)

FUEL INJECTOR NO. 6 (3.7L) - BLACK 2 WAY

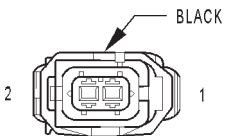
CAV	CIRCUIT	FUNCTION
1	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K58 18BR/DB	FUEL INJECTOR NO. 6 DRIVER



FUEL PRESSURE SENSOR (DIESEL)

FUEL PRESSURE SENSOR (DIESEL) - BLACK 3 WAY

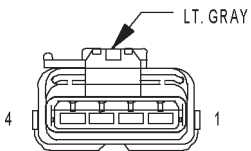
CAV	CIRCUIT	FUNCTION
1	K80 20BK/VT	FUEL PRESSURE SENSOR GROUND
2	K78 20GY	FUEL PRESSURE SENSOR SIGNAL
3	K7 20OR	FUEL PRESSURE SENSOR 5 VOLT SUPPLY



FUEL PRESSURE SOLENOID (DIESEL)

FUEL PRESSURE SOLENOID (DIESEL) - BLACK 2 WAY

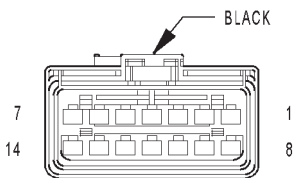
CAV	CIRCUIT	FUNCTION
1	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K46 18OR/BK	FUEL PRESSURE SOLENOID CONTROL



FUEL PUMP MODULE

FUEL PUMP MODULE - LT. GRAY 4 WAY

CAV	CIRCUIT	FUNCTION
1	Z211 16BK (GAS)	GROUND
2	K4 18BK/LB	SENSOR GROUND
3	K226 18DB/WT	FUEL LEVEL SENSOR SIGNAL
4	A141 16DG/WT (GAS)	FUEL PUMP RELAY OUTPUT



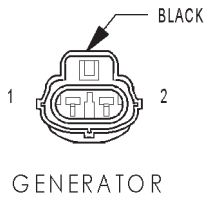
G 202

G 202 - BLACK 14 WAY

CAV	CIRCUIT	FUNCTION
1	Z12 16BK/TN	GROUND
2	Z3 18BK/OR (BASE)	GROUND
2	Z3 14BK/OR (EXCEPT BASE)	GROUND
3	Z11 20BK/WT (EXCEPT BASE)	GROUND

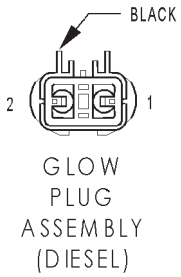
G 202 - BLACK 14 WAY

CAV	CIRCUIT	FUNCTION
4	-	-
5	-	-
6	Z105 20BK/LG	GROUND
7	Z231 16BK/WT	GROUND
8	Z103 16BK/OR	GROUND
9	Z131 10BK/GY	GROUND
10	Z300 16BK	GROUND
11	Z232 16BK/LB	GROUND
12	-	-
13	Z158 20BK/GY	GROUND
14	Z110 20BK/TN (EXCEPT BASE)	GROUND



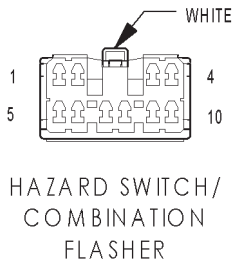
GENERATOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	A71 18DG/RD (DIESEL)	FUSED AUTO SHUT DOWN RELAY OUTPUT
1	K20 18DG (GAS)	GENERATOR FIELD DRIVER
2	K20 18DG (DIESEL)	GENERATOR FIELD CONTROL
2	K125 18WT/DB (GAS)	GENERATOR SOURCE



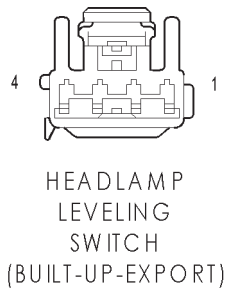
GLOW PLUG ASSEMBLY (DIESEL) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K154 10GY	GLOW PLUG RELAY NO. 1 OUTPUT
2	K104 10RD/WT	GLOW PLUG RELAY NO. 2 OUTPUT



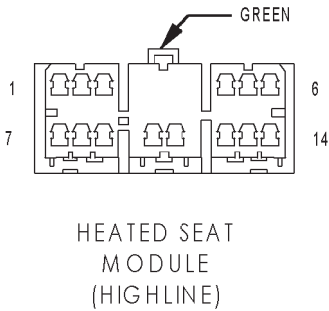
HAZARD SWITCH/COMBINATION FLASHER - WHITE 10 WAY

CAV	CIRCUIT	FUNCTION
1	A15 18PK/OR	FUSED B(+)
2	Z3 18BK/OR	GROUND
3	L62 18BR/RD	RIGHT TURN SIGNAL
4	L91 20DB/PK	HAZARD LAMP CONTROL
5	L305 20LB/WT	LEFT TURN SWITCH SENSE
6	-	-
7	L63 18DG/RD	LEFT TURN SIGNAL
8	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
9	L302 20LB/YL	RIGHT TURN SWITCH SENSE
10	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL



HEADLAMP LEVELING SWITCH (BUILT-UP-EXPORT) - 4 WAY

CAV	CIRCUIT	FUNCTION
1	L13 18BR/YL	HEADLAMP ADJUST SIGNAL
2	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
3	Z12 18BK/TN	GROUND
4	-	-



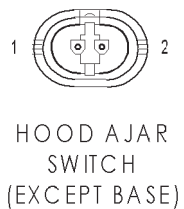
HEATED SEAT MODULE (HIGHLINE) - GREEN 14 WAY

CAV	CIRCUIT	FUNCTION
1	P133 20TN/DG	LEFT SEAT HEATER SWITCH MUX
2	P86 20PK/BK	HEATED SEAT TEMPERATURE SENSOR SIGNAL
3	F98 16RD/WT	PASSENGER HEATED SEAT FEED
4	A3 16RD/WT	FUSED B(+)
5	F99 16RD/YL	DRIVER HEATED SEAT FEED
6	A3 16RD/WT	FUSED B(+)
7	P142 20TN/DB	PASSENGER HEATED SEAT TEMPERATURE SENSOR GROUND
8	P141 20TN/LB	DRIVER HEATED SEAT TEMPERATURE SENSOR GROUND
9	P134 20TN/LG	RIGHT SEAT HEATER SWITCH MUX
10	P138 20VT/LG	RIGHT SEAT LOW HEAT LED DRIVER
11	P140 20VT/BK	RIGHT SEAT HIGH HEAT LED DRIVER
12	P137 20VT/DG	LEFT SEAT LOW HEAT LED DRIVER
13	Z238 16BK/WT	GROUND
14	P139 20VT/WT	LEFT SEAT HIGH HEAT LED DRIVER



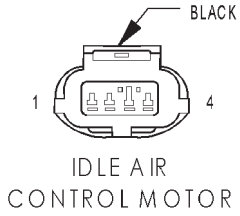
HIGH NOTE HORN - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z141 18BK	GROUND



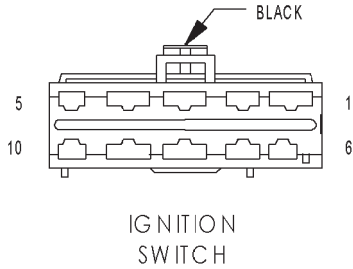
HOOD AJAR SWITCH (EXCEPT BASE) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	G70 18BR/TN	HOOD AJAR SWITCH SENSE
2	Z142 18BK/WT	GROUND



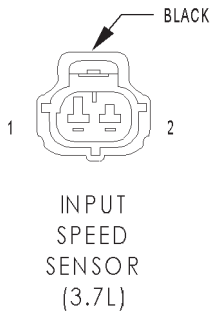
IDLE AIR CONTROL MOTOR - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	K59 18VT/BK	IDLE AIR CONTROL MOTOR NO. 4 DRIVER
2	K40 18BR/WT	IDLE AIR CONTROL MOTOR NO. 1 DRIVER
3	K60 18YL/BK	IDLE AIR CONTROL MOTOR NO. 2 DRIVER
4	K39 18GY/RD	IDLE AIR CONTROL MOTOR NO. 3 DRIVER



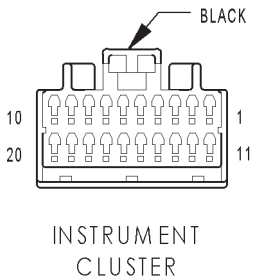
IGNITION SWITCH - BLACK 10 WAY

CAV	CIRCUIT	FUNCTION
1	A1 12RD	FUSED (+)
2	A21 12RD/DB	IGNITION SWITCH OUTPUT (RUN-START)
3	F81 12TN	IGNITION SWITCH OUTPUT (RUN-ACC)
4	A25 12DB	FUSED B(+)
5	G26 20LB	KEY-IN IGNITION SWITCH SENSE
6	A41 12YL	IGNITION SWITCH OUTPUT (START)
7	A31 12BK/WT	IGNITION SWITCH OUTPUT (RUN-ACC)
8	A22 12BK/OR	IGNITION SWITCH OUTPUT (RUN)
9	A2 12PK/BK	FUSED B (+)
10	Z232 16BK/LB	GROUND



INPUT SPEED SENSOR (3.7L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	T52 18RD/BK	INPUT SPEED SENSOR SIGNAL
2	T13 18DB/BK	SPEED SENSOR GROUND



INSTRUMENT CLUSTER - BLACK 20 WAY

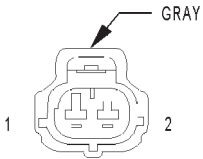
CAV	CIRCUIT	FUNCTION
1	Z105 20BK/LG	GROUND
2	-	-
3	Y98 20GY/DB	INSTRUMENT CLUSTER WAKE UP SIGNAL
4	-	-
5	G18 20PK/BK	LOW COOLANT FLUID LEVEL SENSE
6	L63 20DG/RD	LEFT TURN SIGNAL
7	G9 20GY/BK	PARK BRAKE SWITCH SENSE
8	G69 20BK/OR	VTSS INDICATOR DRIVER
9	-	-
10	M1 20PK	FUSED B(+)
11	L78 20DG/YL	FUSED PARK LAMP RELAY OUTPUT
12	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
13	-	-
14	D25 20YL/VT/RD	PCI BUS
15	-	-

INSTRUMENT CLUSTER - BLACK 20 WAY

CAV	CIRCUIT	FUNCTION
16	L62 20BR/RD	RIGHT TURN SIGNAL
17	G11 20WT/BK	RED BRAKE WARNING INDICATOR DRIVER
18	G29 20BK/TN	LOW WASHER FLUID SENSE
19	F87 20TN/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
20	-	-

INTAKE AIR TEMPERATURE SENSOR (GAS) - GRAY 2 WAY

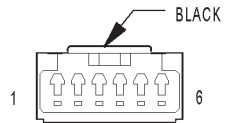
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL



1 2  
INTAKE AIR TEMPERATURE SENSOR (GAS)

INTRUSION SENSOR (BUILT-UP-EXPORT) - BLACK 6 WAY

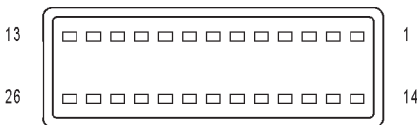
CAV	CIRCUIT	FUNCTION
1	Z2 20BK/LG	GROUND
2	-	-
3	X75 20DG	SIREN SIGNAL CONTROL
4	-	-
5	D25 20YL/VT	PCI BUS
6	M1 20PK	FUSED B(+)



1 6  
INTRUSION SENSOR (BUILT-UP-EXPORT)

JUNCTION BLOCK BODY CONTROL MODULE-JB - 26 WAY

CAV	CIRCUIT	FUNCTION
1	X3 (PREMIUM)	HORN RELAY CONTROL
2	P334	DOOR UNLOCK RELAY CONTROL
3	L308	PARK LAMP RELAY CONTROL
4	L96 (PREMIUM)	REAR FOG LAMP RELAY CONTROL
5	P109 (EXCEPT BASE)	DRIVER DOOR UNLOCK RELAY CONTROL
6	C80	REAR WINDOW DEFOGGER RELAY CONTROL
7	-	-
8	Z300	GROUND
9	F35	FUSED B(+)
10	L309	HIGH BEAM RELAY CONTROL
11	P31	TAILGATE UNLOCK DRIVER
12	P37	DOOR LOCK SWITCH GROUND
13	L94	LOW BEAM RELAY CONTROL
14	F89	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
15	M1	FUSED B(+)
16	F87	FUSED IGNITION SWITCH OUTPUT (RUN-START)
17	L26 (EXCEPT BASE)	FRONT FOG LAMP RELAY CONTROL
18	P333	DOOR LOCK RELAY CONTROL
19	V16	FRONT WIPER HIGH/LOW RELAY CONTROL
20	V55	FRONT WIPER PARK SWITCH SENSE

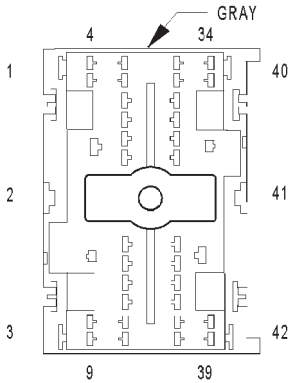


13 1 14 26  
JUNCTION BLOCK BODY CONTROL MODULE-JB



JUNCTION BLOCK BODY CONTROL MODULE-JB - 26 WAY

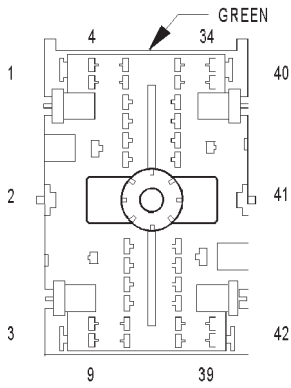
CAV	CIRCUIT	FUNCTION
21	V14	FRONT WIPER ON/OFF RELAY CONTROL
22	P30	TAILGATE LOCK DRIVER
23	P36	DOOR LOCK SWITCH MUX
24	M2	COURTESY LAMP DRIVER
25	Z131	GROUND
26	M20	COURTESY LAMP LOAD SHED



JUNCTION BLOCK C1

JUNCTION BLOCK C1 - GRAY 42 WAY

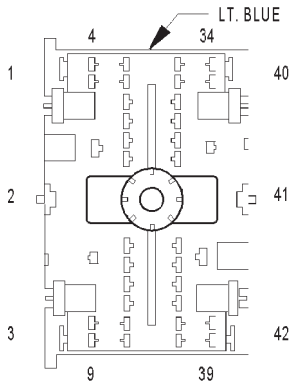
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	A21 12RD/DB	IGNITION SWITCH OUTPUT (RUN-START)
4	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
5	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
6	-	-
7	X3 20BK/RD	HORN RELAY CONTROL
8	L78 20DG/YL (EXCEPT BUILT-UP-EXPORT)	FUSED PARK LAMP RELAY OUTPUT
8	L78 18DG/YL (BUILT-UP-EXPORT)	FUSED PARK LAMP RELAY OUTPUT
9	F1 20DB (PREMIUM)	FUSED IGNITION SWITCH OUTPUT (RUN-START)
10	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
11	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
12	M1 20PK	FUSED B(+)
13	F33 20PK/RD	FUSED B(+)
14	-	-
15	M1 20PK	FUSED B(+)
16	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
17	Z300 16BK	GROUND
18	-	-
19	-	-
20	Z131 10BK/GY	GROUND
21	L309 20LG/WT	HIGH BEAM RELAY CONTROL
22	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
23	M2 20YL	COURTESY LAMP DRIVER
24	M2 20YL	COURTESY LAMP DRIVER
25	F33 20PK/RD (PREMIUM)	FUSED B(+)
26	F88 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
27	M1 20PK	FUSED B(+)
28	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
29	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
30	-	-
31	F87 20TN/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
32	-	-
33	F38 16RD/WT	FUSED B(+)
34	C16 20LB/YL	FUSED DEFOGGER RELAY OUTPUT
35	F30 16RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
36	-	-
37	F32 18PK/DB	FUSED B(+)
38	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
39	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
40	A31 12BK/WT	IGNITION SWITCH OUTPUT (RUN-ACC)
41	A15 18PK/OR	FUSED B(+)
42	A22 12BK/OR	IGNITION SWITCH OUTPUT (RUN)



JUNCTION BLOCK C2

JUNCTION BLOCK C2 - GREEN 42 WAY

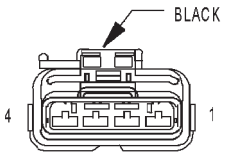
CAV	CIRCUIT	FUNCTION
1	F37 14RD/LB (MIDLINE/HIGHLINE)	FUSED B(+)
2	-	-
3	C15 12BK/WT	DEFOGGER RELAY OUTPUT
4	F89 18OR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
5	P37 20LG (EXCEPT BASE)	DOOR LOCK SWITCH GROUND
6	P33 18OR/BK (EXCEPT BASE)	DOOR LOCK RELAY OUTPUT
7	F22 18DB/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
8	P34 18PK/BK (EXCEPT BASE)	DRIVER DOOR UNLOCK RELAY OUTPUT
9	P35 18OR/VT (EXCEPT BASE)	PASSENGER DOOR UNLOCK RELAY OUTPUT
10	P36 20PK/VT (EXCEPT BASE)	DOOR LOCK SWITCH MUX
11	P37 20LG (EXCEPT BASE)	DOOR LOCK SWITCH GROUND
12	M20 20BR	COURTESY LAMP LOAD SHED
13	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
14	P36 20PK/VT (EXCEPT BASE)	DOOR LOCK SWITCH MUX
15	P30 16OR/WT	TAILGATE LOCK DRIVER
16	F70 18PK/BK	FUSED B(+)
17	L77 18BK/YL	FUSED LEFT INBOARD TAIL LAMP
18	M1 20PK	FUSED B(+)
19	M1 20PK	FUSED B(+)
20	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
21	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
22	-	-
23	V23 20BR/PK (HIGHLINE)	FUSED IGNITION SWITCH OUTPUT (RUN)
24	V23 20BR/PK (EXCEPT BASE)	FUSED IGNITION SWITCH OUTPUT (RUN)
25	V23 20BR/PK (MIDLINE/HIGHLINE)	FUSED IGNITION SWITCH OUTPUT (RUN)
26	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
27	-	-
28	A6 16RD/BK (PREMIUM GAS)	FUSED B(+)
29	-	-
30	M2 18YL	COURTESY LAMP DRIVER
31	C16 18LB/YL (EXCEPT BASE)	FUSED DEFOGGER RELAY OUTPUT
32	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
33	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
34	L38 18BR/WT (HIGHLINE)	REAR FOG LAMP RELAY OUTPUT
35	P31 16PK/WT	TAILGATE UNLOCK DRIVER
36	-	-
37	F60 16DG/RD (PREMIUM)	FUSED B(+)
38	F87 20WT/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
39	C16 18LB/YL (EXCEPT BASE)	FUSED DEFOGGER RELAY OUTPUT
40	F85 16VT/WT (MIDLINE/HIGHLINE)	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
41	F41 16PK/VT	FUSED B(+)
42	A3 16RD/WT (HIGHLINE)	FUSED B(+)



JUNCTION BLOCK C3

JUNCTION BLOCK C3 - LT. BLUE 42 WAY

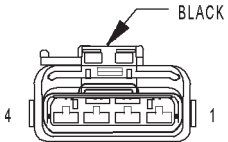
CAV	CIRCUIT	FUNCTION
1	A12 10RD/TN	FUSED B(+)
2	A13 10PK/WT	FUSED B(+)
3	A4 12BK/PK	FUSED B(+)
4	L44 18VT/RD	FUSED RIGHT LOW BEAM OUTPUT
5	L43 18VT	FUSED LEFT LOW BEAM OUTPUT
6	-	-
7	V55 16TN/RD	FRONT WIPER PARK SWITCH SENSE
8	F1 18DB (LHD)	FUSED IGNITION SWITCH OUTPUT (RUN-START)
8	F1 20DB (RHD)	FUSED IGNITION SWITCH OUTPUT (RUN-START)
9	V6 14DB/YL (RHD)	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
9	VG 16DB/YL (LHD)	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	-	-
11	A12 10RD/TN	FUSED B(+)
12	-	-
13	-	-
14	-	-
15	V14 18RD/VT	FRONT WIPER ON/OFF RELAY CONTROL
16	L34 18RD/OR	FUSED RIGHT HIGH BEAM OUTPUT
17	-	-
18	V16 18VT/YL	WIPER HIGH/LOW RELAY CONTROL
19	F20 18WT	FUSED IGNITION SWITCH OUTPUT (RUN)
20	-	-
21	-	-
22	-	-
23	-	-
24	L50 18WT/TN (ABS)	BRAKE LAMP SWITCH OUTPUT
25	-	-
26	-	-
27	-	-
28	L77 18BK/YL	FUSED LEFT INBOARD TAIL LAMP
29	M1 18PK	FUSED B(+)
30	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
31	-	-
32	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
33	L39 18LB	FRONT FOG LAMP RELAY OUTPUT
34	A18 10PK	FUSED B(+)
35	-	-
36	-	-
37	L33 18LG/BR	FUSED LEFT HIGH BEAM OUTPUT
38	F22 18DB/PK (ABS)	FUSED IGNITION SWITCH OUTPUT (RUN)
39	X2 18DG/RD	HORN RELAY OUTPUT
40	A18 10PK	FUSED B(+)
41	-	-
42	A7 10RD/BK	FUSED B(+)



KNOCK  
SENSOR  
(3.7L)

KNOCK SENSOR (3.7L) - BLACK 4 WAY

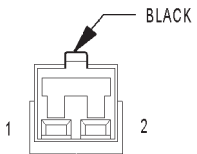
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K42 18DB/LB	KNOCK SENSOR NO. 1 SIGNAL
3	K4 18BK/LB	SENSOR GROUND
4	K142 18GY/BK	KNOCK SENSOR NO. 2 SIGNAL



LEAK DETECTION  
PUMP

LEAK DETECTION PUMP - BLACK 4 WAY

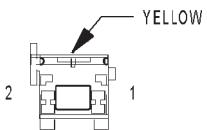
CAV	CIRCUIT	FUNCTION
1	-	-
2	K125 18WT/DB	GENERATOR SOURCE
3	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
4	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE



LEFT  
COURTESY  
LAMP

LEFT COURTESY LAMP - BLACK 2 WAY

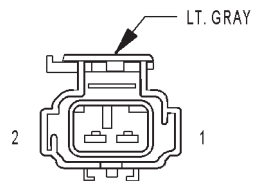
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M2 20YL	COURTESY LAMP DRIVER



LEFT  
CURTAIN  
AIRBAG

LEFT CURTAIN AIRBAG - YELLOW 2 WAY

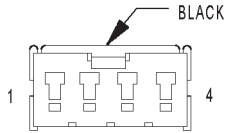
CAV	CIRCUIT	FUNCTION
1	R77 18YL/RD	LEFT CURTAIN SQUIB LINE 2
2	R75 18YL/BK	LEFT CURTAIN SQUIB LINE 1



LEFT  
CYLINDER LOCK  
SWITCH  
(EXCEPT BASE)

LEFT CYLINDER LOCK SWITCH (EXCEPT BASE) - LT. GRAY 2 WAY

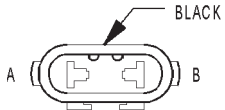
CAV	CIRCUIT	FUNCTION
1	P37 18LG	DOOR LOCK SWITCH GROUND
2	G73 18LG/OR (LHD)	LEFT CYLINDER LOCK SWITCH MUX
2	G72 18DG/OR (RHD)	LEFT CYLINDER LOCK SWITCH MUX



LEFT  
DOOR LOCK  
SWITCH  
(EXCEPT BASE)

LEFT DOOR LOCK SWITCH (EXCEPT BASE) - BLACK 4 WAY

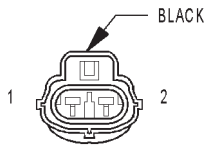
CAV	CIRCUIT	FUNCTION
1	P36 20PK/VT	DOOR LOCK SWITCH MUX
2	Z350 18BK/LG	GROUND
3	F89 200R/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
4	P37 20LG	DOOR LOCK SWITCH GROUND



LEFT  
FOG LAMP

LEFT FOG LAMP - BLACK 2 WAY

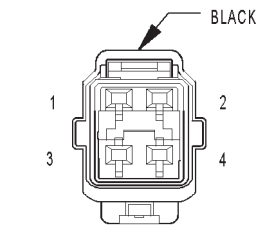
CAV	CIRCUIT	FUNCTION
A	Z141 18BK	GROUND
B	L39 18LB	FRONT FOG LAMP RELAY OUTPUT



LEFT FRONT  
DOOR AJAR  
SWITCH  
(BASE)

LEFT FRONT DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
2	Z350 20BK/LG	GROUND



LEFT FRONT  
DOOR LOCK MOTOR/  
AJAR SWITCH  
(EXCEPT BASE)

LEFT FRONT DOOR LOCK MOTOR/AJAR SWITCH (EXCEPT BASE) - BLACK 4 WAY

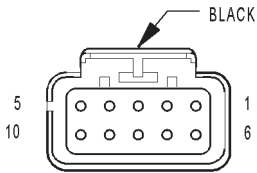
CAV	CIRCUIT	FUNCTION
1	G74 20TN/WT (RHD)	PASSENGER DOOR AJAR SWITCH SENSE
1	G75 20TN (LHD)	DRIVER DOOR AJAR SWITCH SENSE
2	Z350 20BK/LG	GROUND
3	P35 180R/VT (RHD)	PASSENGER DOOR UNLOCK RELAY OUTPUT
3	P34 18PK/BK (LHD)	DRIVER DOOR UNLOCK RELAY OUTPUT
4	P33 180R/BK	DOOR LOCK RELAY OUTPUT



LEFT FRONT  
DOOR SPEAKER  
(BASE)

LEFT FRONT DOOR SPEAKER (BASE) - 2 WAY

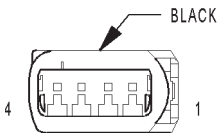
CAV	CIRCUIT	FUNCTION
1	X53 18DG	LEFT FRONT SPEAKER (+)
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)



LEFT FRONT  
DOOR SPEAKER  
(PREMIUM)

LEFT FRONT DOOR SPEAKER (PREMIUM) - BLACK 10 WAY

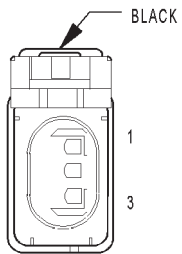
CAV	CIRCUIT	FUNCTION
1	X53 18DG	LEFT FRONT SPEAKER (+)
2	X55 18BR/RD	LEFT FRONT SPEAKER (-)
3	Z9 16BK	GROUND
4	X81 18YL/BK	AMPLIFIED HIGH LEFT FRONT SPEAKER (-)
5	X91 18WT/BK	AMPLIFIED LOW LEFT REAR SPEAKER (-)
6	X57 18BR/LB	LEFT REAR SPEAKER (-)
7	X51 18BR/YL	LEFT REAR SPEAKER (+)
8	X13 16BK/RD	RADIO CHOKE OUTPUT
9	X83 18YL/RD	AMPLIFIED HIGH LEFT FRONT SPEAKER (+)
10	X93 18WT/RD	AMPLIFIED LOW LEFT REAR SPEAKER (+)



LEFT FRONT  
IMPACT  
SENSOR

LEFT FRONT IMPACT SENSOR - BLACK 4 WAY

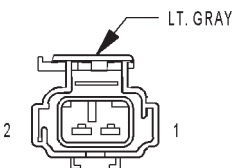
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	R47 18DB/LB	LEFT FRONT IMPACT SENSOR GROUND
4	R49 18LB	LEFT FRONT IMPACT SENSOR SIGNAL



LEFT FRONT  
PARK/TURN  
SIGNAL LAMP

LEFT FRONT PARK/TURN SIGNAL LAMP - BLACK 3 WAY

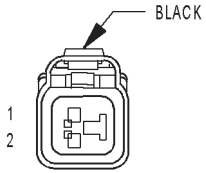
CAV	CIRCUIT	FUNCTION
1	L63 18DG/RD	LEFT TURN SIGNAL
2	L77 18BK/YL (EXCEPT BUILT-UP-EXPORT)	PARK LAMP RELAY OUTPUT
3	Z141 18BK	GROUND



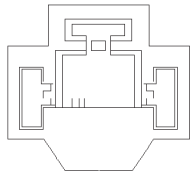
LEFT FRONT  
POWER WINDOW  
MOTOR  
(MIDLINE/HIGHLINE)

LEFT FRONT POWER WINDOW MOTOR (MIDLINE/HIGHLINE) - LT. GRAY 2 WAY

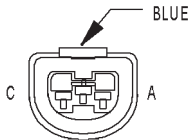
CAV	CIRCUIT	FUNCTION
1	Q21 16WT	LEFT FRONT WINDOW DRIVER DOWN
2	Q11 16LB	LEFT FRONT WINDOW DRIVER UP



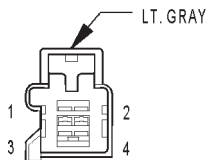
LEFT FRONT WHEEL SPEED SENSOR (ABS)



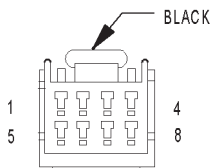
LEFT HEADLAMP (BUILT-UP-EXPORT)



LEFT HEADLAMP (EXCEPT BUILT-UP-EXPORT)



LEFT HEATED SEAT ASSEMBLY (HIGHLINE)



LEFT HEATED SEAT SWITCH (HIGHLINE)

LEFT FRONT WHEEL SPEED SENSOR (ABS) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	B9 18RD	LEFT FRONT WHEEL SPEED SENSOR 12 VOLT SUPPLY
2	B8 18RD/DB	LEFT FRONT WHEEL SPEED SENSOR SIGNAL

LEFT HEADLAMP (BUILT-UP-EXPORT) - 3 WAY

CAV	CIRCUIT	FUNCTION
1	L33 18LG/BR	FUSED LEFT HIGH BEAM OUTPUT
2	L43 18VT	FUSED LEFT LOW BEAM OUTPUT
3	Z141 18BK	GROUND

LEFT HEADLAMP (EXCEPT BUILT-UP-EXPORT) - BLUE 3 WAY

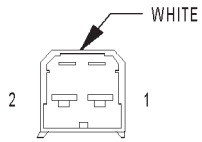
CAV	CIRCUIT	FUNCTION
A	L43 18VT	FUSED LEFT LOW BEAM OUTPUT
B	Z141 18BK	GROUND
C	L33 18LG/BR	FUSED LEFT HIGH BEAM OUTPUT

LEFT HEATED SEAT ASSEMBLY (HIGHLINE) - LT. GRAY 4 WAY

CAV	CIRCUIT	FUNCTION
1	F99 16RD/YL	DRIVER HEATED SEAT FEED
2	Z238 16BK/WT	GROUND
3	P86 20PK/BK	HEATED SEAT TEMPERATURE SENSOR SIGNAL
4	P141 20TN/LB	DRIVER HEATED SEAT TEMPERATURE SENSOR GROUND

LEFT HEATED SEAT SWITCH (HIGHLINE) - BLACK 8 WAY

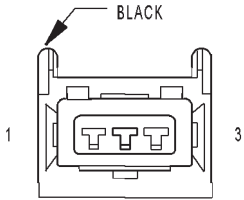
CAV	CIRCUIT	FUNCTION
1	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
2	P139 20VT/WT	LEFT SEAT HIGH HEAT LED DRIVER
3	P133 20TN/DG	LEFT SEAT HEATER SWITCH MUX
4	P137 20VT/DG	LEFT SEAT LOW HEAT LED DRIVER
5	Z238 20BK/WT	GROUND
6	-	-
7	-	-
8	-	-



LEFT INSTRUMENT  
PANEL SPEAKER

LEFT INSTRUMENT PANEL SPEAKER - WHITE 2 WAY

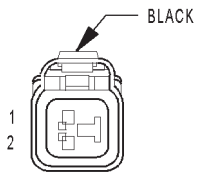
CAV	CIRCUIT	FUNCTION
1	X53 18DG (BASE)	LEFT FRONT SPEAKER (+)
1	X83 18YL/RD (PREMIUM)	AMPLIFIED HIGH LEFT FRONT SPEAKER (+)
2	X55 18BR/RD (BASE)	LEFT FRONT SPEAKER (-)
2	X81 18YL/BK (PREMIUM)	AMPLIFIED HIGH LEFT FRONT SPEAKER (-)



LEFT  
LEVELING  
MOTOR  
(BUILT-UP-EXPORT)

LEFT LEVELING MOTOR (BUILT-UP-EXPORT) - BLACK 3 WAY

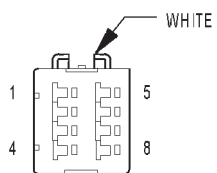
CAV	CIRCUIT	FUNCTION
1	Z141 18BK	GROUND
2	L13 18BR/YL	HEADLAMP ADJUST SIGNAL
3	L77 18BK/YL	FUSED PARK LAMP RELAY OUTPUT



LEFT  
POSITION  
LAMP  
(BUILT-UP-EXPORT)

LEFT POSITION LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	L77 18BK/YL	FUSED PARK LAMP RELAY OUTPUT
2	Z141 18BK	GROUND

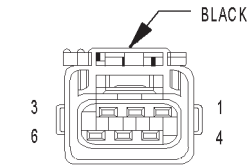


LEFT POWER  
MIRROR  
(EXCEPT BASE)

LEFT POWER MIRROR (EXCEPT BASE) - WHITE 8 WAY

CAV	CIRCUIT	FUNCTION
1	P71 20YL/DG	LEFT MIRROR UP DRIVER
2	P76 20OR/YL	MIRROR COMMON DRIVER
3	P75 20LB/WT	LEFT MIRROR LEFT DRIVER
4	-	-
5	C16 20LB/YL	FUSED DEFOGGER RELAY OUTPUT
6	Z350 20BK/LG	GROUND
7	P99 20GY (WITH FOLD)	FOLDING MIRROR FEED
8	P110 20YL (WITH FOLD)	FOLDING MIRROR RETURN

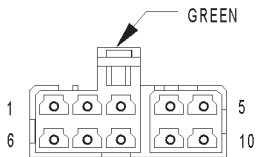




LEFT  
POWER SEAT  
MOTORS  
(MIDLINE/HIGHLINE)

LEFT POWER SEAT MOTORS (MIDLINE/HIGHLINE) - BLACK 6 WAY

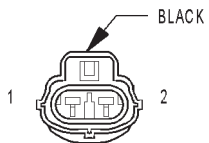
CAV	CIRCUIT	FUNCTION
1	P11 14YL/WT	DRIVER SEAT REAR UP DRIVER
2	P13 14RD/WT	DRIVER SEAT REAR DOWN DRIVER
3	P19 14YL/LG	DRIVER SEAT FRONT UP DRIVER
4	P21 14RD/LG	DRIVER SEAT FRONT DOWN DRIVER
5	P17 14RD/YL	DRIVER SEAT HORIZONTAL REARWARD DRIVER
6	P15 14YL/LB	DRIVER SEAT HORIZONTAL FORWARD DRIVER



LEFT  
POWER SEAT  
SWITCH  
(MIDLINE/HIGHLINE)

LEFT POWER SEAT SWITCH (MIDLINE/HIGHLINE) - GREEN 10 WAY

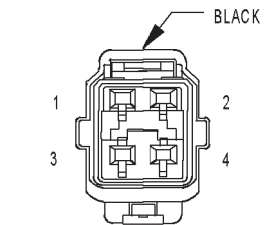
CAV	CIRCUIT	FUNCTION
1	Z238 14BK/WT	GROUND
2	-	-
3	P15 14YL/LB	DRIVER SEAT HORIZONTAL FORWARD DRIVER
4	-	-
5	F37 14RD/LB	FUSED B(+)
6	P17 14RD/YL	DRIVER SEAT HORIZONTAL REARWARD DRIVER
7	P13 14RD/WT	DRIVER SEAT REAR DOWN DRIVER
8	P21 14RD/LG	DRIVER SEAT FRONT DOWN DRIVER
9	P19 14YL/LG	DRIVER SEAT FRONT UP DRIVER
10	P11 14YL/WT	DRIVER SEAT REAR UP DRIVER



LEFT REAR  
DOOR AJAR  
SWITCH  
(BASE)

LEFT REAR DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

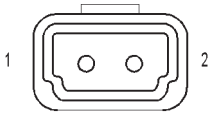
CAV	CIRCUIT	FUNCTION
1	G74 20TN/WT	PASSENGER DOOR AJAR SWITCH SENSE
2	Z350 20BK/LG	GROUND



LEFT REAR  
DOOR LOCK MOTOR/  
AJAR SWITCH  
(EXCEPT BASE)

LEFT REAR DOOR LOCK MOTOR/AJAR SWITCH (EXCEPT BASE) - BLACK 4 WAY

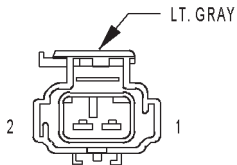
CAV	CIRCUIT	FUNCTION
1	G74 20TN/WT	PASSENGER DOOR AJAR SWITCH SENSE
2	Z350 20BK/LG	GROUND
3	P35 180R/VT	PASSENGER DOOR UNLOCK RELAY OUTPUT
4	P33 180R/BK	DOOR LOCK RELAY OUTPUT



LEFT REAR DOOR SPEAKER

LEFT REAR DOOR SPEAKER - 2 WAY

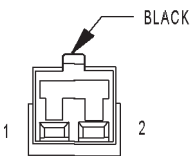
CAV	CIRCUIT	FUNCTION
1	X51 18BR/YL (BASE)	LEFT REAR DOOR SPEAKER (+)
1	X93 18WT/RD (PREMIUM)	AMPLIFIED LOW LEFT REAR SPEAKER (+)
2	X57 18BR/LB (BASE)	LEFT REAR DOOR SPEAKER (-)
2	X91 18WT (PREMIUM)	AMPLIFIED LOW LEFT REAR SPEAKER (-)



LEFT REAR POWER WINDOW MOTOR (MIDLINE/HIGHLINE)

LEFT REAR POWER WINDOW MOTOR (MIDLINE/HIGHLINE) - LT. GRAY 2 WAY

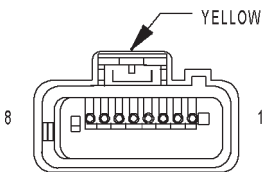
CAV	CIRCUIT	FUNCTION
1	Q23 16DG	LEFT REAR WINDOW DRIVER DOWN
2	Q13 16GY	LEFT REAR WINDOW DRIVER UP



LEFT REMOTE RADIO SWITCH (PREMIUM)

LEFT REMOTE RADIO SWITCH (PREMIUM) - BLACK 2 WAY

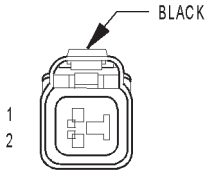
CAV	CIRCUIT	FUNCTION
1	X10 20RD/DB	RADIO CONTROL MUX RETURN
2	X20 20RD/BK	RADIO CONTROL MUX



LEFT SIDE IMPACT AIRBAG CONTROL MODULE (LSIACM)

LEFT SIDE IMPACT AIRBAG CONTROL MODULE (LSIACM) - YELLOW 8 WAY

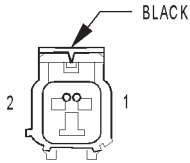
CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	-	-
3	R77 18YL/RD	LEFT CURTAIN SQUIB LINE 2
4	R75 18YL/BK	LEFT CURTAIN SQUIB LINE 1
5	Z104 18BK/YL	GROUND
6	-	-
7	-	-
8	D25 18YL/VT	PCI BUS



LEFT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT)

LEFT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT) - BLACK 2 WAY

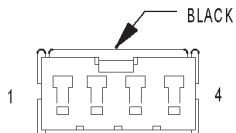
CAV	CIRCUIT	FUNCTION
1	L77 18BK/YL	FUSED PARK LAMP RELAY OUTPUT
2	L63 18DG/RD	LEFT TURN SIGNAL



LEFT SIDE REPEATER LAMP (BUILT-UP-EXPORT)

LEFT SIDE REPEATER LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

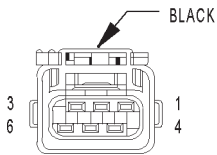
CAV	CIRCUIT	FUNCTION
1	L63 18DG/RD	LEFT TURN SIGNAL
2	Z141 18BK	GROUND



LEFT SPEED CONTROL SWITCH (EXCEPT BASE)

LEFT SPEED CONTROL SWITCH (EXCEPT BASE) - BLACK 4 WAY

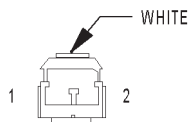
CAV	CIRCUIT	FUNCTION
1	-	-
2	K4 20BK/LB	SENSOR GROUND
3	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
4	-	-



LEFT TAIL/STOP LAMP

LEFT TAIL/STOP LAMP - BLACK 6 WAY

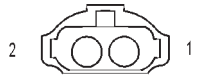
CAV	CIRCUIT	FUNCTION
1	L38 18BR/WT (BUILT-UP-EXPORT)	REAR FOG LAMP RELAY OUTPUT
2	L77 18BK/YL	FUSED PARK LAMP RELAY OUTPUT
3	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
4	L10 18BR/LG	BACK-UP LAMP FEED
5	Z151 18BK/WT	GROUND
6	L63 18DG/RD	LEFT TURN SIGNAL



LEFT VISOR/VANITY LAMP (EXCEPT BASE)

LEFT VISOR/VANITY LAMP (EXCEPT BASE) - WHITE 2 WAY

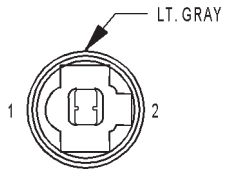
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M20 20BR	COURTESY LAMP LOAD SHED



LICENSE LAMP  
(BUILT-UP-EXPORT)

LICENSE LAMP (BUILT-UP-EXPORT) - 2 WAY

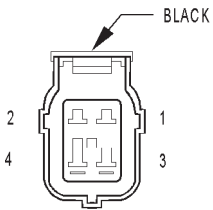
CAV	CIRCUIT	FUNCTION
1	L77 18BK/YL	FUSED LEFT INBOARD TAIL LAMP
2	Z235 18BK	GROUND



LICENSE LAMP  
(EXCEPT BUILT-UP-EXPORT)

LICENSE LAMP (EXCEPT BUILT-UP-EXPORT) - LT. GRAY 2 WAY

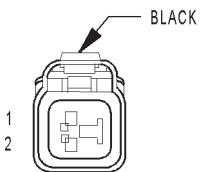
CAV	CIRCUIT	FUNCTION
1	L77 18BR/YL	FUSED PARK LAMP RELAY OUTPUT
2	Z151 18BK/WT	GROUND



LINE PRESSURE SENSOR  
(3.7L)

LINE PRESSURE SENSOR (3.7L) - BLACK 4 WAY

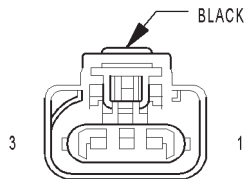
CAV	CIRCUIT	FUNCTION
1	Z112 18BK	GROUND
2	T39 18GY/LB	5 VOLT SUPPLY
3	T38 18VT/TN	LINE PRESSURE SENSOR SIGNAL
4	-	-



LOW NOTE HORN

LOW NOTE HORN - BLACK 2 WAY

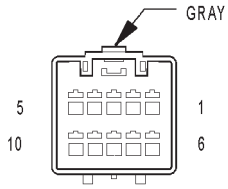
CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z141 18BK	GROUND



MANIFOLD ABSOLUTE PRESSURE SENSOR

MANIFOLD ABSOLUTE PRESSURE SENSOR - BLACK 3 WAY

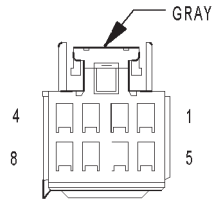
CAV	CIRCUIT	FUNCTION
1	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND
3	K7 18OR	5 VOLT SUPPLY



MULTI-FUNCTION SWITCH C1

MULTI-FUNCTION SWITCH C1 - GRAY 10 WAY

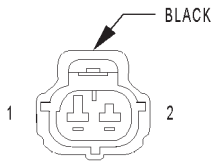
CAV	CIRCUIT	FUNCTION
1	E21 20OR/RD	PANEL LAMPS DIMMER SWITCH MUX
2	L27 20WT/TN (EXCEPT BASE)	FRONT FOG LAMP SWITCH SENSE
3	-	-
4	L80 20WT/DG	HEADLAMP SWITCH RETURN
5	L307 20LG/OR	HEADLAMP SWITCH MUX
6	L305 20LB/WT	LEFT TURN SWITCH SENSE
7	L309 20LG/WT	HIGH BEAM RELAY CONTROL
8	Z12 18BK/TN	GROUND
9	L324 20WT/LG	HIGH BEAM SWITCH SENSE
10	L302 20LB/YL	RIGHT TURN SWITCH SENSE



MULTI-FUNCTION SWITCH C2

MULTI-FUNCTION SWITCH C2 - GRAY 8 WAY

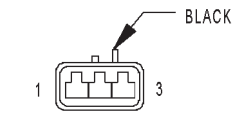
CAV	CIRCUIT	FUNCTION
1	V21 20DB/RD	REAR WIPER ON DRIVER
2	V22 20BR/YL	REAR WIPER INTERMITTENT DRIVER
3	V20 18BK/WT	WASHER MOTOR SENSE
4	V52 20DG/RD	FRONT WIPER SWITCH MUX
5	F88 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
6	-	-
7	V10 18BR	WASHER PUMP DRIVER
8	-	-



OUTPUT SPEED SENSOR (3.7L)

OUTPUT SPEED SENSOR (3.7L) - BLACK 2 WAY

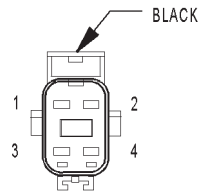
CAV	CIRCUIT	FUNCTION
1	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
2	T13 18DB/BK	SPEED SENSOR GROUND



OVERHEAD MAP/READING LAMP (EXCEPT BASE)

OVERHEAD MAP/READING LAMP (EXCEPT BASE) - BLACK 3 WAY

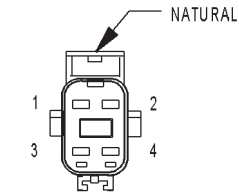
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M2 20YL	REAR COURTESY LAMP CONTROL
3	M20 20BR	COURTESY LAMPS LOAD SHEED



OXYGEN  
SENSOR 1/1  
UPSTREAM

OXYGEN SENSOR 1/1 UPSTREAM - BLACK 4 WAY

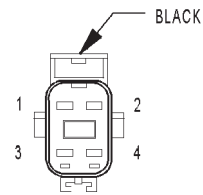
CAV	CIRCUIT	FUNCTION
1	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K99 18BR/OR	OXYGEN SENSOR 1/1 HEATER CONTROL
3	K4 18BK/LB	SENSOR GROUND
4	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL



OXYGEN  
SENSOR 1/2  
DOWNSTREAM

OXYGEN SENSOR 1/2 DOWNSTREAM - NATURAL 4 WAY

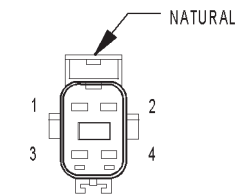
CAV	CIRCUIT	FUNCTION
1	A71 18DG/RD (2.4L)	FUSED AUTO SHUT DOWN RELAY OUTPUT
1	F18 18LG/BK (3.7L)	OXYGEN SENSOR DOWNSTREAM RELAY
2	K299 18BR/WT (2.4L)	OXYGEN SENSOR 1/2 HEATER CONTROL
2	Z186 18BK/OR (3.7L)	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL



OXYGEN  
SENSOR 2/1  
UPSTREAM  
(3.7L)

OXYGEN SENSOR 2/1 UPSTREAM (3.7L) - BLACK 4 WAY

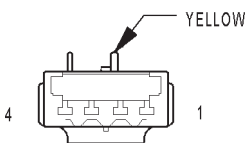
CAV	CIRCUIT	FUNCTION
1	A71 18DG/RD	FUSED AUTO SHUT DOWN RELAY OUTPUT
2	K299 18BR/WT	OXYGEN SENSOR 2/1 HEATER CONTROL
3	K4 18BK/LB	SENSOR GROUND
4	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL



OXYGEN  
SENSOR 2/2  
DOWNSTREAM  
(3.7L)

OXYGEN SENSOR 2/2 DOWNSTREAM (3.7L) - NATURAL 4 WAY

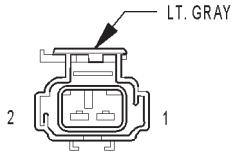
CAV	CIRCUIT	FUNCTION
1	F18 18LG/BK	OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT
2	Z186 18BK/OR	GROUND
3	K4 18BK/LB	SENSOR GROUND
4	K341 18TN/WT	OXYGEN SENSOR 2/2 SIGNAL



PASSENGER  
AIRBAG

PASSENGER AIRBAG - YELLOW 4 WAY

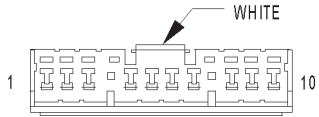
CAV	CIRCUIT	FUNCTION
1	R62 18OR/YL	PASSENGER SQUIB 2 LINE 2
2	R64 18TN/YL	PASSENGER SQUIB 2 LINE 1
3	R42 18BK/YL	PASSENGER SQUIB 1 LINE 1
4	R44 18DG/YL	PASSENGER SQUIB 1 LINE 2



PASSENGER SEAT BELT SWITCH

PASSENGER SEAT BELT SWITCH - LT. GRAY 2 WAY

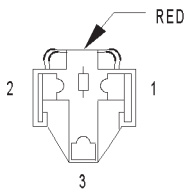
CAV	CIRCUIT	FUNCTION
1	R58 18GY (EXCEPT BASE)	PASSENGER SEAT BELT SWITCH SENSE
1	R58 18DG (BASE)	PASSENGER SEAT BELT SWITCH SENSE
2	R60 18LB (BASE)	PASSENGER SEAT BELT SWITCH GROUND
2	R60 18VT (EXCEPT BASE)	PASSENGER SEAT BELT SWITCH GROUND



POWER MIRROR SWITCH (EXCEPT BASE)

POWER MIRROR SWITCH (EXCEPT BASE) - WHITE 10 WAY

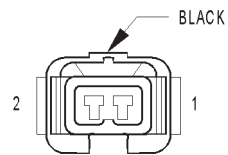
CAV	CIRCUIT	FUNCTION
1	P75 20LB/WT	LEFT MIRROR LEFT DRIVER
2	P71 20YL/DG	LEFT MIRROR UP DRIVER
3	Z351 18BK/LG (RHD)	GROUND
3	Z350 18BK/LG (LHD)	GROUND
4	P110 18YL (FOLD)	FOLDING MIRROR RETURN
5	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
6	P76 18OR/YL	MIRROR COMMON DRIVER
7	P99 18GY (FOLD)	FOLDING MIRROR FEED
8	-	-
9	P72 20YL/BK (FOLD)	RIGHT MIRROR UP DRIVER
9	P72 18YL/BK (WITHOUT FOLD)	RIGHT MIRROR UP DRIVER
10	P74 20DB (FOLD)	RIGHT MIRROR LEFT DRIVER
10	P74 18DB (WITHOUT FOLD)	RIGHT MIRROR LEFT DRIVER



POWER OUTLET

POWER OUTLET - RED 3 WAY

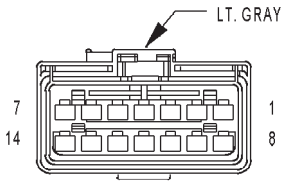
CAV	CIRCUIT	FUNCTION
1	F38 16RD/WT	FUSED B(+)
1	F41 16PK/VT	FUSED B(+)
2	-	-
2	-	-
3	Z3 16BK/OR	GROUND
3	Z151 16BK/WT	GROUND



POWER STEERING PRESSURE SWITCH

POWER STEERING PRESSURE SWITCH - BLACK 2 WAY

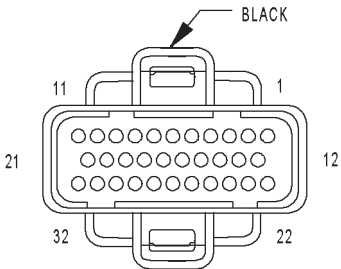
CAV	CIRCUIT	FUNCTION
1	K10 18DB/OR	POWER STEERING PRESSURE SWITCH SENSE
2	Z246 18BK/GY	GROUND



POWER WINDOW  
MASTER  
SWITCH  
(MIDLINE/HIGHLINE)

POWER WINDOW MASTER SWITCH (MIDLINE/HIGHLINE) - LT. GRAY 14 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	Q1 16YL	POWER WINDOW SWITCH FEED
2	Q1 16YL	POWER WINDOW SWITCH FEED
3	-	-
4	Q27 14RD/BK	LEFT REAR WINDOW DRIVER DOWN
5	Q17 14DB/WT	LEFT REAR WINDOW DRIVER UP
6	Q28 14DG/WT	RIGHT REAR WINDOW DRIVER DOWN
7	Q18 14GY/BK	RIGHT REAR WINDOW DRIVER UP
8	-	-
9	Q21 14WT	LEFT FRONT WINDOW DRIVER DOWN
10	F81 12TN	FUSED B(+)
11	Q11 14LB	LEFT FRONT WINDOW DRIVER UP
12	Q12 14BR	RIGHT FRONT WINDOW DRIVER UP
13	Q22 14VT/WT	RIGHT FRONT WINDOW DRIVER DOWN
14	Z238 12BK/WT	GROUND

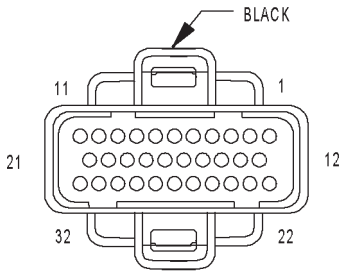


POWERTRAIN  
CONTROL  
MODULE-C1  
(2.4L)

POWERTRAIN CONTROL MODULE-C1 (2.4L) - BLACK 32 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	F1 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	-	-
4	K4 18BK/LB	SENSOR GROUND
5	-	-
6	-	-
7	K19 18BK/GY	IGNITION COIL NO. 1 DRIVER
8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
9	-	-
10	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
11	K40 18BR/WT	IDLE AIR CONTROL NO. 1 DRIVER
12	K10 18DB/OR	POWER STEERING PRESSURE SWITCH SENSE
13	-	-
14	K77 18BR/WT	TRANSFER CASE POSITION SENSOR INPUT
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K7 18OR	5 VOLT SUPPLY
18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
19	K39 18GY/RD	IDLE AIR CONTROL NO. 3 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	OXYGEN SENSOR 1/1 SIGNAL
25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
26	-	-
27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
28	-	-
29	-	-
30	-	-
31	Z107 14BK/DB	GROUND
32	Z107 14BK/DB	GROUND

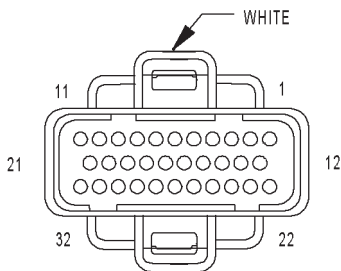




POWERTRAIN CONTROL MODULE-C1 (3.7L)

POWERTRAIN CONTROL MODULE-C1 (3.7L) - BLACK 32 WAY

CAV	CIRCUIT	FUNCTION
1	K93 14TN/OR	COIL ON PLUG DRIVER NO. 3
2	F1 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	K94 14TN/LG	COIL ON PLUG DRIVER NO. 4
4	K4 18BK/LB	SENSOR GROUND
5	K96 14TN/LB	COIL ON PLUG DRIVER NO. 6
6	T41 18BK/WT (A/T)	PARK/NEUTRAL POSITION SWITCH SENSE
7	K91 14TN/RD	COIL ON PLUG DRIVER NO.1
8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
9	-	-
10	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
11	K40 18BR/WT	IDLE AIR CONTROL NO. 1 DRIVER
12	K10 18DB/OR	POWER STEERING PRESSURE SWITCH SENSE
13	T141 18 YL/RD (M/T)	FUSED IGNITION SWITCH OUTPUT (START)
13	F45 18YL/BR (A/T)	FUSED IGNITION SWITCH OUTPUT (START)
14	K77 18BR/WT	TRANSFER CASE POSITION SENSOR INPUT
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K7 18OR	5 VOLT SUPPLY
18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
19	K39 18GY/RD	IDLE AIR CONTROL NO. 3 DRIVER
20	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
21	K95 14TN/DG	COIL ON PLUG DRIVER NO. 5
22	A14 16RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
26	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL
27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
28	-	-
29	K341 18TN/WT	OXYGEN SENSOR 2/2 SIGNAL
30	-	-
31	Z107 14BK/DB	GROUND
32	Z107 14BK/DB	GROUND



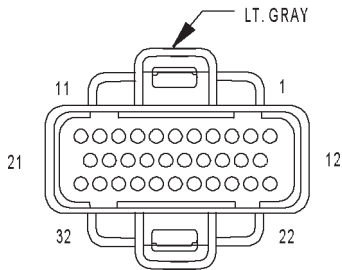
POWERTRAIN CONTROL MODULE-C2 (GAS)

POWERTRAIN CONTROL MODULE-C2 (GAS) - WHITE 32 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER
5	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
6	K38 18GY (3.7L)	FUEL INJECTOR NO. 5 DRIVER
7	-	-
8	-	-
9	K92 14TN/PK (3.7L)	COIL ON PLUG DRIVER NO. 2
9	K17 18DB/TN (2.4L)	IGNITION COIL NO. 2 DRIVER
10	K20 18DG	GENERATOR FIELD
11	-	-
12	K58 18BR/DB (3.7L)	FUEL INJECTOR NO. 6 DRIVER

POWERTRAIN CONTROL MODULE-C2 (GAS) - WHITE 32 WAY

CAV	CIRCUIT	FUNCTION
13	-	-
14	-	-
15	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
16	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
17	K173 18LG	RADIATOR FAN RELAY CONTROL
18	-	-
19	C18 18DB	A/C PRESSURE SIGNAL
20	-	-
21	-	-
22	-	-
23	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	-	-
26	-	-
27	-	-
28	-	-
29	-	-
30	-	-
31	K6 18VT/WT	5 VOLT SUPPLY
32	-	-



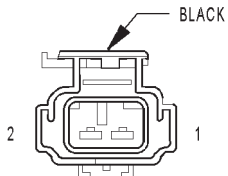
POWERTRAIN  
CONTROL  
MODULE-C3  
(GAS)

POWERTRAIN CONTROL MODULE-C3 (GAS) - LT. GRAY 32 WAY

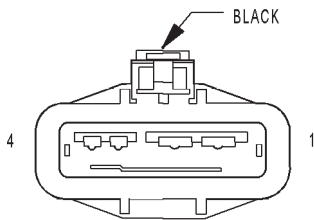
CAV	CIRCUIT	FUNCTION
1	C13 18DG	A/C COMPRESSOR CLUTCH RELAY CONTROL
2	-	-
3	K51 18DB/YL	AUTO SHUT DOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	K90 18TN (M/T)	CLUTCH INTERLOCK RELAY CONTROL
7	K42 18DB/LB (3.7L)	KNOCK SENSOR NO. 1 SIGNAL
7	K42 18DB/LB (2.4L)	NOT USED
8	K99 18BR/OR	OXYGEN SENSOR 1/1 HEATER CONTROL
9	K512 18RD/YL	OXYGEN SENSOR DOWNSTREAM RELAY CONTROL
10	K106 18WT/DG	LEAK DETECTION PUMP SOLENOID CONTROL
11	V32 18YL/RD	SPEED CONTROL SUPPLY
12	F142 18OR/DG	FUSED AUTO SHUT DOWN RELAY SENSE INPUT
13	T10 18YL/DG	TORQUE MANAGEMENT REQUEST SENSE
14	K107 18OR	LEAK DETECTION PUMP SWITCH SENSE
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	K299 18BR/WT (2.4L)	OXYGEN SENSOR 1/2 HEATER CONTROL
16	K299 18BR/WT (3.7L)	OXYGEN SENSOR 2/1 HEATER CONTROL
17	B22 18DG/YL	VEHICLE SPEED OUTPUT
18	K142 18GY/BK (2.4L)	NOT USED
18	K142 18GY/BK (3.7L)	KNOCK SENSOR NO. 2 SIGNAL
19	K31 18BR	FUEL PUMP RELAY CONTROL
20	K52 18PK/BK	EVAP PURGE/SOLENOID CONTROL
21	-	-
22	C21 18DB/OR	A/C SWITCH SENSE
23	-	-
24	K29 18WT/PK	BRAKE LAMP SWITCH SENSE
25	K125 18WT/DB	GENERATOR SOURCE

POWERTRAIN CONTROL MODULE-C3 (GAS) - LT. GRAY 32 WAY

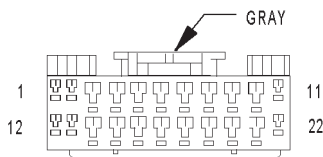
CAV	CIRCUIT	FUNCTION
26	K226 18DB/WT	FUEL LEVEL SENSOR SIGNAL
27	D21 18PK	SCI TRANSMIT
28	-	-
29	D32 18LG	SCI RECEIVE (PCM)
30	D25 18YL/VT	PCI BUS
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL



RADIATOR FAN MOTOR



RADIATOR FAN RELAY



RADIO C 1

RADIATOR FAN MOTOR - BLACK 2 WAY

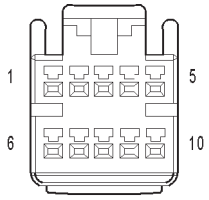
CAV	CIRCUIT	FUNCTION
1	C25 12YL	RADIATOR FAN RELAY OUTPUT
2	Z212 12BK/OR	GROUND

RADIATOR FAN RELAY - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	C24 12DB/PK	FUSED B(+)
2	C25 12YL	RADIATOR FAN RELAY OUTPUT
3	Z212 18BK/OR	GROUND
4	K173 18LG	RADIATOR FAN RELAY CONTROL

RADIO C1 - GRAY 22 WAY

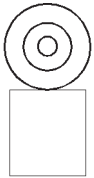
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	F89 18OR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
3	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
4	-	-
5	-	-
6	-	-
7	X54 18VT	RIGHT FRONT DOOR SPEAKER (+)
8	X56 18DB/RD	RIGHT FRONT DOOR SPEAKER (-)
9	X55 18BR/RD	LEFT FRONT DOOR SPEAKER (-)
10	X53 18DG	LEFT FRONT DOOR SPEAKER (+)
11	Z9 16BK	GROUND
12	M1 20PK	FUSED B(+)
13	X16 18LG (PREMIUM)	ANTENNA RELAY OUTPUT
14	D25 18YL/VT	PCI BUS
15	-	-
16	-	-
17	-	-
18	X51 18BR/YL	LEFT REAR SPEAKER (+)
19	X57 18BR/LB	LEFT REAR SPEAKER (-)
20	X58 18DB/OR	RIGHT REAR SPEAKER (-)
21	X52 18DB/WT	RIGHT REAR SPEAKER (+)
22	Z9 16BK	GROUND



RADIO C2

RADIO C2 - 10 WAY

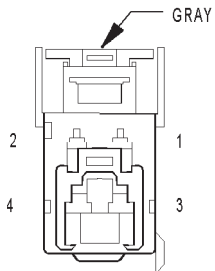
CAV	CIRCUIT	FUNCTION
1	X40 20WT/RD	AUDIO OUT RIGHT
2	Z30 20WT/BK	GROUND
3	Z9 20BK/DB	GROUND
4	D25 20YL/VT	PCI BUS
5	X112 20RD	IGNITION SWITCH OUTPUT
6	X41 20WT/DG	AUDIO OUT LEFT
7	Z17 20BK	GROUND
8	-	-
9	-	-
10	X160 20YL	B(+)



RADIO C3

RADIO C3 - 2 WAY

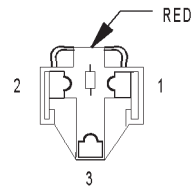
CAV	CIRCUIT	FUNCTION
1	X30 BK	RADIO ANTENNA CORE
2	X31 BK	RADIO ANTENNA SHIELD



RADIO CHOKE (PREMIUM)

RADIO CHOKE (PREMIUM) - GRAY 4 WAY

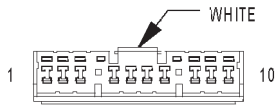
CAV	CIRCUIT	FUNCTION
1	F60 16DG/RD	FUSED B(+)
2	X13 16BK/RD	RADIO CHOKE OUTPUT
3	X16 18LG	ANTENNA RELAY OUTPUT
4	Z140 16BK/LG	GROUND



REAR POWER OUTLET

REAR POWER OUTLET - RED 3 WAY

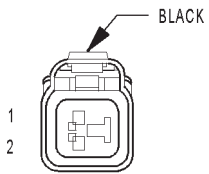
CAV	CIRCUIT	FUNCTION
1	F41 16PK/VT	FUSED B(+)
2	-	-
3	Z151 16BK/WT	GROUND



REAR POWER WINDOW SWITCH (MIDLINE/HIGHLINE)

REAR POWER WINDOW SWITCH (MIDLINE/HIGHLINE) - WHITE 10 WAY

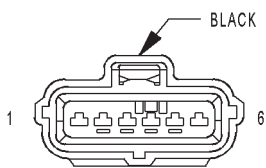
CAV	CIRCUIT	FUNCTION
1	Q28 14DG/WT	RIGHT REAR WINDOW DRIVER DOWN
2	Q14 14GY	RIGHT REAR WINDOW DRIVER UP
3	Q24 14DG	RIGHT REAR WINDOW DRIVER DOWN
4	Q18 14GY/BK	RIGHT REAR WINDOW DRIVER UP
5	Q1 16YL	POWER WINDOW SWITCH FEED
6	Q1 16YL	POWER WINDOW SWITCH FEED
7	Q17 14DB/WT	LEFT REAR WINDOW DRIVER UP
8	Q23 14RD/WT	LEFT REAR WINDOW DRIVER DOWN
9	Q27 14RD/BK	LEFT REAR WINDOW DRIVER DOWN
10	Q13 14DB	LEFT REAR WINDOW DRIVER UP



REAR WHEEL SPEED SENSOR

REAR WHEEL SPEED SENSOR - BLACK 2 WAY

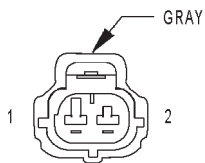
CAV	CIRCUIT	FUNCTION
1	B2 18YL	REAR WHEEL SPEED SENSOR 12 VOLT SUPPLY
2	B1 18YL/DB	REAR WHEEL SPEED SENSOR SIGNAL



REAR WIPER MOTOR

REAR WIPER MOTOR - BLACK 6 WAY

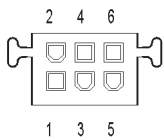
CAV	CIRCUIT	FUNCTION
1	Z235 18BK	GROUND
2	V21 20DB/RD	REAR WIPER ON DRIVER
3	G80 20YL/WT	FLIP-UP GLASS AJAR SWITCH SENSE
4	V22 20BR/YL	REAR WIPER INTERMITTENT DRIVER
5	F70 18PK/BK	FUSED B(+)
6	-	-



RED BRAKE WARNING INDICATOR SWITCH

RED BRAKE WARNING INDICATOR SWITCH - GRAY 2 WAY

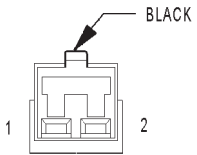
CAV	CIRCUIT	FUNCTION
1	G11 18WT/BK	RED BRAKE WARNING INDICATOR DRIVER
2	Z142 18BK/WT	GROUND



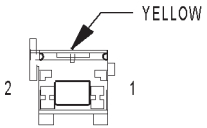
REMOTE KEYLESS ENTRY MODULE (EXCEPT BASE)

REMOTE KEYLESS ENTRY MODULE (EXCEPT BASE) - 6 WAY

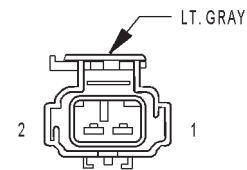
CAV	CIRCUIT	FUNCTION
1	Y60	RKE DATA
2	Y62	RKE SUPPLY
3	Y61	RKE PROGRAM
4	Y63	RKE GROUND
5	Y64	RKE ANTENNA (+)
6	Y65	RKE ANTENNA (-)



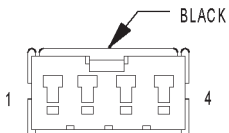
RIGHT COURTESY LAMP



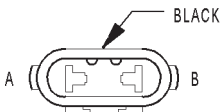
RIGHT CURTAIN AIRBAG



RIGHT CYLINDER LOCK SWITCH (EXCEPT BASE)



RIGHT DOOR LOCK SWITCH (EXCEPT BASE)



RIGHT FOG LAMP

RIGHT COURTESY LAMP - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M2 20YL	COURTESY LAMP DRIVER

RIGHT CURTAIN AIRBAG - YELLOW 2 WAY

CAV	CIRCUIT	FUNCTION
1	R76 18YL/DB	RIGHT CURTAIN SQUIB LINE 2
2	R74 18YL/BR	RIGHT CURTAIN SQUIB LINE 1

RIGHT CYLINDER LOCK SWITCH (EXCEPT BASE) - LT. GRAY 2 WAY

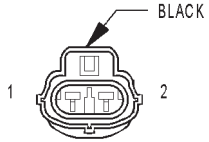
CAV	CIRCUIT	FUNCTION
1	P37 18LG	DOOR LOCK SWITCH GROUND
2	G72 18DG/OR (LHD)	RIGHT CYLINDER LOCK SWITCH MUX
2	G73 18LG/OR (RHD)	RIGHT CYLINDER LOCK SWITCH MUX

RIGHT DOOR LOCK SWITCH (EXCEPT BASE) - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	P36 20PK/VT	DOOR LOCK SWITCH MUX
2	Z351 18BK/LG	GROUND
3	F89 20OR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
4	P37 20LG	DOOR LOCK SWITCH GROUND

RIGHT FOG LAMP - BLACK 2 WAY

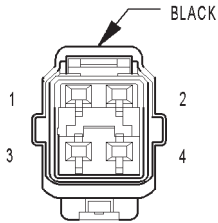
CAV	CIRCUIT	FUNCTION
A	Z142 18BK/WT	GROUND
B	L39 18LB	FOG LAMP RELAY OUTPUT



RIGHT FRONT DOOR AJAR SWITCH (BASE)

RIGHT FRONT DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

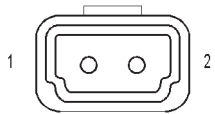
CAV	CIRCUIT	FUNCTION
1	G74 20TN/WT	PASSENGER DOOR AJAR SWITCH SENSE
2	Z351 20BK/LG	GROUND



RIGHT FRONT DOOR LOCK MOTOR/AJAR SWITCH (EXCEPT BASE)

RIGHT FRONT DOOR LOCK MOTOR/AJAR SWITCH (EXCEPT BASE) - BLACK 4 WAY

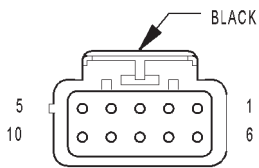
CAV	CIRCUIT	FUNCTION
1	G75 20TN (RHD)	DRIVER DOOR AJAR SWITCH SENSE
1	G74 20TN/WT (LHD)	PASSENGER DOOR AJAR SWITCH SENSE
2	Z351 20BK/LG	GROUND
3	P34 18PK/BK (RHD)	DRIVER DOOR UNLOCK RELAY OUTPUT
3	P35 18OR/VT (LHD)	PASSENGER DOOR UNLOCK RELAY OUTPUT
4	P33 18OR/BK	DOOR LOCK RELAY OUTPUT



RIGHT FRONT DOOR SPEAKER (BASE)

RIGHT FRONT DOOR SPEAKER (BASE) - 2 WAY

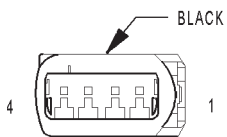
CAV	CIRCUIT	FUNCTION
1	X54 18VT	RIGHT FRONT SPEAKER (+)
2	X56 18DB/RD	RIGHT FRONT SPEAKER (-)



RIGHT FRONT DOOR SPEAKER (PREMIUM)

RIGHT FRONT DOOR SPEAKER (PREMIUM) - BLACK 10 WAY

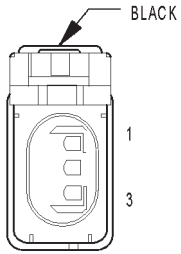
CAV	CIRCUIT	FUNCTION
1	X54 18VT	RIGHT FRONT SPEAKER (+)
2	X56 18DB/RD	RIGHT FRONT SPEAKER (-)
3	Z9 16BK	GROUND
4	X86 18OR/RD	AMPLIFIED HIGH RIGHT FRONT SPEAKER (-)
5	X92 18TN/BK	AMPLIFIED LOW RIGHT REAR SPEAKER (-)
6	X58 18DB/OR	RIGHT REAR DOOR SPEAKER (-)
7	X52 18DB/WT	RIGHT REAR DOOR SPEAKER (+)
8	X13 16BK/RD	RADIO CHOKE OUTPUT
9	X84 18TN/BK	AMPLIFIED HIGH RIGHT FRONT SPEAKER (+)
10	X94 18TN/VT	AMPLIFIED LOW RIGHT REAR SPEAKER (+)



RIGHT FRONT IMPACT SENSOR

RIGHT FRONT IMPACT SENSOR - BLACK 4 WAY

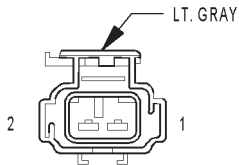
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	R46 18BR/LB	RIGHT FRONT IMPACT SENSOR GROUND
4	R48 18TN	RIGHT FRONT IMPACT SENSOR SIGNAL



RIGHT FRONT  
PARK/TURN  
SIGNAL LAMP

RIGHT FRONT PARK/ TURN SIGNAL LAMP - BLACK 3 WAY

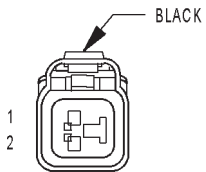
CAV	CIRCUIT	FUNCTION
1	L62 18BR/RD	RIGHT TURN SIGNAL
2	L78 18DG/YL (EXCEPT BUILT-UP-EXPORT)	FUSED PARK LAMP RELAY OUTPUT
3	Z142 18BK/WT	GROUND



RIGHT FRONT  
POWER WINDOW  
MOTOR  
(MIDLINE/HIGHLINE)

RIGHT FRONT POWER WINDOW MOTOR (MIDLINE/HIGHLINE) - LT. GRAY 2 WAY

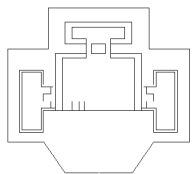
CAV	CIRCUIT	FUNCTION
1	Q22 16VT/WT	RIGHT FRONT WINDOW DRIVER DOWN
2	Q12 16BR	RIGHT FRONT WINDOW DRIVER UP



RIGHT FRONT  
WHEEL SPEED  
SENSOR  
(ABS)

RIGHT FRONT WHEEL SPEED SENSOR (ABS) - BLACK 2 WAY

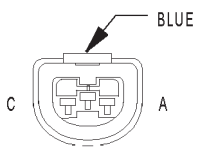
CAV	CIRCUIT	FUNCTION
1	B7 18WT	RIGHT FRONT WHEEL SPEED SENSOR 12 VOLT SUPPLY
2	B6 18WT/DB	RIGHT FRONT WHEEL SPEED SENSOR SIGNAL



RIGHT  
HEADLAMP  
(BUILT-UP-EXPORT)

RIGHT HEADLAMP (BUILT-UP-EXPORT) - 3 WAY

CAV	CIRCUIT	FUNCTION
1	L34 18RD/OR	FUSED RIGHT HIGH BEAM OUTPUT
2	L44 18VT/RD	FUSED RIGHT LOW BEAM OUTPUT
3	Z142 18BK/WT	GROUND

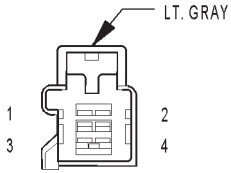


RIGHT  
HEADLAMP  
(EXCEPT  
BUILT-UP-EXPORT)

RIGHT HEADLAMP (EXCEPT BUILT-UP-EXPORT) - BLUE 3 WAY

CAV	CIRCUIT	FUNCTION
A	L44 18VT/RD	FUSED RIGHT LOW BEAM OUTPUT
B	Z142 18BK/WT	GROUND
C	L34 18RD/OR	FUSED RIGHT HIGH BEAM OUTPUT

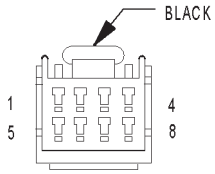




RIGHT HEATED SEAT ASSEMBLY (HIGHLINE)

RIGHT HEATED SEAT ASSEMBLY (HIGHLINE) - LT. GRAY 4 WAY

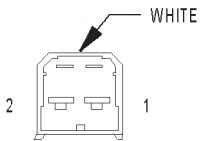
CAV	CIRCUIT	FUNCTION
1	F98 16RD/WT	PASSENGER HEATED SEAT FEED
2	Z238 16BK/WT	GROUND
3	P86 20PK/BK	HEATED SEAT TEMPERATURE SENSOR SIGNAL
4	P142 20TN/DB	PASSENGER HEATED SEAT TEMPERATURE SENSOR GROUND



RIGHT HEATED SEAT SWITCH (HIGHLINE)

RIGHT HEATED SEAT SWITCH (HIGHLINE) - BLACK 8 WAY

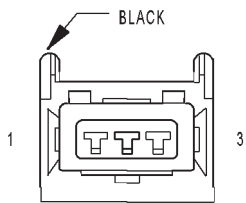
CAV	CIRCUIT	FUNCTION
1	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
2	P140 20VT/BK	RIGHT SEAT HIGH HEAT LED DRIVER
3	P134 20TN/LG	RIGHT SEAT HEATER SWITCH MUX
4	P138 20VT/LG	RIGHT SEAT LOW HEAT LED DRIVER
5	Z238 20BK/WT	GROUND
6	-	-
7	-	-
8	-	-



RIGHT INSTRUMENT PANEL SPEAKER

RIGHT INSTRUMENT PANEL SPEAKER - WHITE 2 WAY

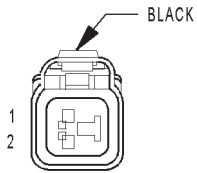
CAV	CIRCUIT	FUNCTION
1	X84 18TN/BK (PREMIUM)	AMPLIFIED HIGH RIGHT FRONT SPEAKER (+)
1	X54 18VT (BASE)	RIGHT FRONT SPEAKER (+)
2	X86 18OR/RD (PREMIUM)	AMPLIFIED HIGH RIGHT FRONT SPEAKER (-)
2	X56 18DB/RD (BASE)	RIGHT FRONT SPEAKER (-)



RIGHT LEVELING MOTOR (BUILT-UP-EXPORT)

RIGHT LEVELING MOTOR (BUILT-UP-EXPORT) - BLACK 3 WAY

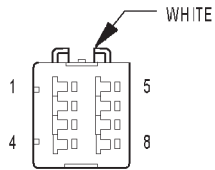
CAV	CIRCUIT	FUNCTION
1	Z142 18BK/WT	GROUND
2	L13 18BR/YL	HEADLAMP ADJUST SIGNAL
3	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT



RIGHT POSITION LAMP (BUILT-UP-EXPORT)

RIGHT POSITION LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

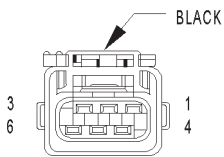
CAV	CIRCUIT	FUNCTION
1	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
2	Z142 18BK/WT	GROUND



RIGHT POWER MIRROR (EXCEPT BASE)

RIGHT POWER MIRROR (EXCEPT BASE) - WHITE 8 WAY

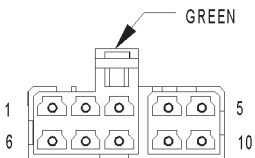
CAV	CIRCUIT	FUNCTION
1	P72 20YL/BK	RIGHT MIRROR UP DRIVER
2	P76 20OR/YL	MIRROR COMMON DRIVER
3	P74 20DB	RIGHT MIRROR LEFT DRIVER
4	-	-
5	C16 20LB/YL	FUSED DEFOGGER RELAY OUTPUT
6	Z351 20BK/LG	GROUND
7	P99 20GY (WITH FOLD)	FOLDING MIRROR FEED
8	P110 20YL (WITH FOLD)	FOLDING MIRROR RETURN



RIGHT POWER SEAT MOTORS (MIDLINE/HIGHLINE)

RIGHT POWER SEAT MOTORS (MIDLINE/HIGHLINE) - BLACK 6 WAY

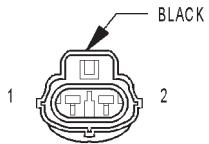
CAV	CIRCUIT	FUNCTION
1	P10 14YL/WT	PASSENGER SEAT REAR UP DRIVER
2	P12 14RD/WT	PASSENGER SEAT REAR DOWN DRIVER
3	P18 14YL/LG	PASSENGER SEAT FRONT UP DRIVER
4	P20 14RD/LG	PASSENGER SEAT FRONT DOWN DRIVER
5	P16 14RD/YL	PASSENGER SEAT HORIZONTAL REARWARD DRIVER
6	P14 14YL/LB	PASSENGER SEAT HORIZONTAL FORWARD DRIVER



RIGHT POWER SEAT SWITCH (MIDLINE/HIGHLINE)

RIGHT POWER SEAT SWITCH (MIDLINE/HIGHLINE) - GREEN 10 WAY

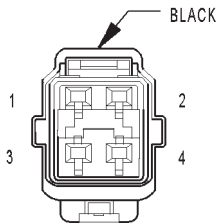
CAV	CIRCUIT	FUNCTION
1	Z238 14BK/WT	GROUND
2	-	-
3	P14 14YL/LB	PASSENGER SEAT HORIZONTAL FORWARD DRIVER
4	-	-
5	F37 14RD/LB	FUSED B(+)
6	P16 14RD/YL	PASSENGER SEAT HORIZONTAL REARWARD DRIVER
7	P10 14YL/WT	PASSENGER SEAT REAR UP DRIVER
8	P18 14YL/LG	PASSENGER SEAT FRONT UP DRIVER
9	P20 14RD/LG	PASSENGER SEAT FRONT DOWN DRIVER
10	P12 14RD/WT	PASSENGER SEAT REAR DOWN DRIVER



RIGHT REAR  
DOOR AJAR  
SWITCH  
(BASE)

RIGHT REAR DOOR AJAR SWITCH (BASE) - BLACK 2 WAY

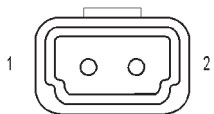
CAV	CIRCUIT	FUNCTION
1	G74 20TN/WT	PASSENGER DOOR AJAR SWITCH SENSE
2	Z351 20BK/LG	GROUND



RIGHT REAR  
DOOR LOCK MOTOR/  
AJAR SWITCH  
(EXCEPT BASE)

RIGHT REAR DOOR LOCK MOTOR/AJAR SWITCH (EXCEPT BASE) - BLACK 4 WAY

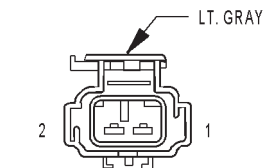
CAV	CIRCUIT	FUNCTION
1	G74 20TN/WT	PASSENGER DOOR AJAR SWITCH SENSE
2	Z351 20BK/LG	GROUND
3	P35 18OR/VT	PASSENGER DOOR UNLOCK RELAY OUTPUT
4	P33 18OR/BK	DOOR LOCK RELAY OUTPUT



RIGHT REAR  
DOOR SPEAKER

RIGHT REAR DOOR SPEAKER - 2 WAY

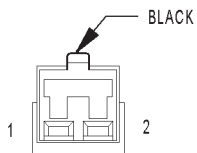
CAV	CIRCUIT	FUNCTION
1	X52 18DB/WT (BASE)	RIGHT REAR DOOR SPEAKER (+)
1	X94 18TN/VT (PREMIUM)	AMPLIFIED LOW RIGHT REAR SPEAKER (+)
2	X58 18DB/OR (BASE)	RIGHT REAR DOOR SPEAKER (-)
2	X92 18TN/BK (PREMIUM)	AMPLIFIED LOW RIGHT REAR SPEAKER (-)



RIGHT REAR  
POWER WINDOW  
MOTOR  
(MIDLINE/HIGHLINE)

RIGHT REAR POWER WINDOW MOTOR (MIDLINE/HIGHLINE) - LT. GRAY 2 WAY

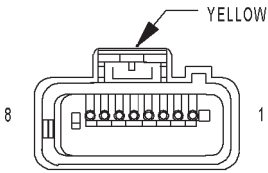
CAV	CIRCUIT	FUNCTION
1	Q24 16DG	RIGHT REAR WINDOW DRIVER DOWN
2	Q14 16GY	RIGHT REAR WINDOW DRIVER UP



RIGHT  
REMOTE RADIO  
SWITCH  
(PREMIUM)

RIGHT REMOTE RADIO SWITCH (PREMIUM) - BLACK 2 WAY

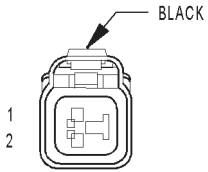
CAV	CIRCUIT	FUNCTION
1	X10 20RD/DB	RADIO CONTROL MUX RETURN
2	X20 20RD/BK	RADIO CONTROL MUX



RIGHT SIDE IMPACT AIRBAG CONTROL MODULE (RSIACM)

RIGHT SIDE IMPACT AIRBAG CONTROL MODULE (RSIACM) - YELLOW 8 WAY

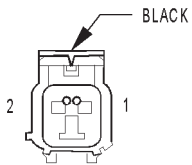
CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	-	-
3	R76 18YL/DB	RIGHT CURTAIN SQUIB LINE 2
4	R74 18YL/BR	RIGHT CURTAIN SQUIB LINE 1
5	Z100 18BK/YL	GROUND
6	-	-
7	-	-
8	D25 18YL/VT	PCI BUS



RIGHT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT)

RIGHT SIDE MARKER LAMP (EXCEPT BUILT-UP-EXPORT) - BLACK 2 WAY

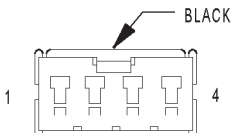
CAV	CIRCUIT	FUNCTION
1	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
2	L62 18BR/RD	RIGHT TURN SIGNAL



RIGHT SIDE REPEATER LAMP (BUILT-UP-EXPORT)

RIGHT SIDE REPEATER LAMP (BUILT-UP-EXPORT) - BLACK 2 WAY

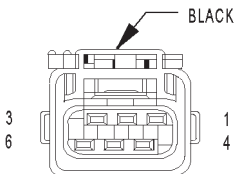
CAV	CIRCUIT	FUNCTION
1	L62 18BR/RD	RIGHT TURN SIGNAL
2	Z142 18BK/WT	GROUND



RIGHT SPEED CONTROL SWITCH (EXCEPT BASE)

RIGHT SPEED CONTROL SWITCH (EXCEPT BASE) - BLACK 4 WAY

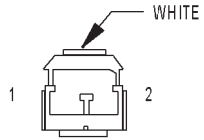
CAV	CIRCUIT	FUNCTION
1	-	-
2	K4 20BK/LB	SENSOR GROUND
3	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
4	-	-



RIGHT TAIL/ STOP LAMP

RIGHT TAIL/STOP LAMP - BLACK 6 WAY

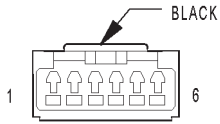
CAV	CIRCUIT	FUNCTION
1	L38 18BR/WT (BUILT-UP-EXPORT)	REAR FOG LAMP RELAY OUTPUT
2	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
3	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
4	L10 18BR/LG	BACK-UP LAMP FEED
5	Z151 18BK/WT	GROUND
6	L62 18BR/RD	RIGHT TURN SIGNAL



RIGHT VISOR/  
VANITY LAMP  
(EXCEPT BASE)

RIGHT VISOR/VANITY LAMP (EXCEPT BASE) - WHITE 2 WAY

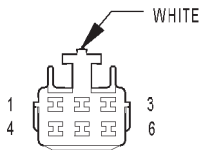
CAV	CIRCUIT	FUNCTION
1	M1 20PK	FUSED B(+)
2	M20 20BR	COURTESY LAMP LOAD SHED



SENTRY KEY  
IMMOBILIZER  
MODULE  
(EXCEPT BASE)

SENTRY KEY IMMOBILIZER MODULE (EXCEPT BASE) - BLACK 6 WAY

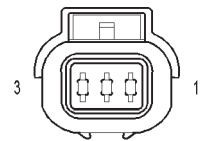
CAV	CIRCUIT	FUNCTION
1	F33 20PK/RD	FUSED B(+)
2	Z11 20BK/WT	GROUND
3	F1 20DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
4	Z110 20BK/TN	GROUND
5	D25 20YL/VT/BK	PCI BUS
6	-	-



SHIFTER  
ASSEMBLY

SHIFTER ASSEMBLY - WHITE 6 WAY

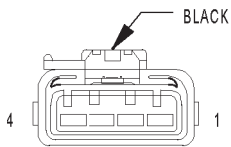
CAV	CIRCUIT	FUNCTION
1	E2 20OR	FUSED PANEL LAMPS DIMMER SWITCH SIGNAL
2	Z21 20BK/LG	GROUND
3	T6 20VT/WT	OVERDRIVE OFF SWITCH SENSE
4	Z21 20BK/LG	GROUND
5	F22 18DB/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
6	K29 20WT/PK	BRAKE SWITCH SENSE



SIREN  
(BUILT-UP-EXPORT)

SIREN (BUILT-UP-EXPORT) - 3 WAY

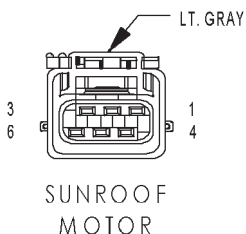
CAV	CIRCUIT	FUNCTION
1	Z142 18BK/WT	GROUND
2	X75 18DG	SIREN SIGNAL CONTROL
3	M1 18PK	FUSED B(+)



SPEED  
CONTROL  
SERVO

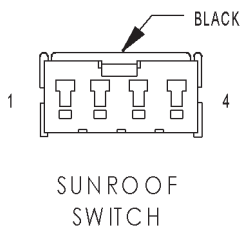
SPEED CONTROL SERVO - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
2	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
3	V30 18DB/RD	SPEED CONTROL BRAKE SWITCH OUTPUT
4	Z212 18BK/OR	GROUND



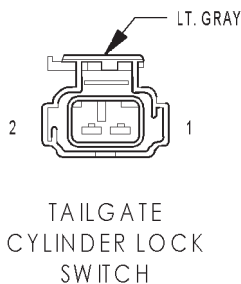
SUNROOF MOTOR - LT. GRAY 6 WAY

CAV	CIRCUIT	FUNCTION
1	F85 16VT/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	Z111 16BK	GROUND
3	Q44 20BR	SUNROOF SWITCH GROUND
4	Q43 20VT	SUNROOF VENT
5	Q42 20LB	SUNROOF CLOSE
6	Q41 20WT	SUNROOF OPEN



SUNROOF SWITCH - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	Q41 20WT	SUNROOF OPEN
2	Q42 20LB	SUNROOF CLOSE
3	Q43 20VT	SUNROOF VENT
4	Q44 20BR	SUNROOF SWITCH GROUND



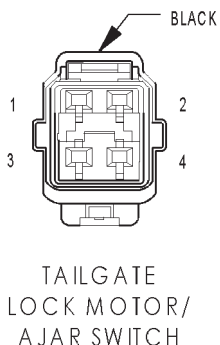
TAILGATE CYLINDER LOCK SWITCH - LT. GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	G910 20VT/BR	TAILGATE SWITCH GROUND
2	G71 18VT/YL	TAILGATE CYLINDER LOCK SWITCH MUX



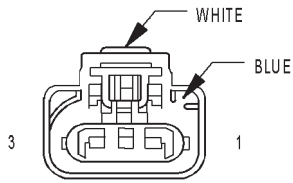
TAILGATE FLIP-UP AJAR SWITCH - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	G80 20YL/WT	FLIP-UP GLASS AJAR SWITCH SENSE
2	Z235 18BK	GROUND



TAILGATE LOCK MOTOR/AJAR SWITCH - BLACK 4 WAY

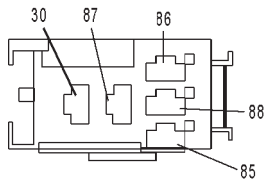
CAV	CIRCUIT	FUNCTION
1	P31 16PK/WT	TAILGATE UNLOCK DRIVER
2	P30 16OR/WT	TAILGATE LOCK DRIVER
3	G78 20TN/BK	TAILGATE AJAR SWITCH SENSE
4	G910 20VT/BR	TAILGATE SWITCH GROUND



THROTTLE POSITION SENSOR

THROTTLE POSITION SENSOR - WHITE/BLUE 3 WAY

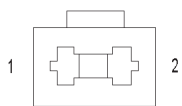
CAV	CIRCUIT	FUNCTION
1	K7 180R	5 VOLT SUPPLY
2	K4 18BK/LB	SENSOR GROUND
3	K22 180R/DB	THROTTLE POSITION SENSOR SIGNAL



TRAILER TOW BRAKE LAMP RELAY

TRAILER TOW BRAKE LAMP RELAY - 5 WAY

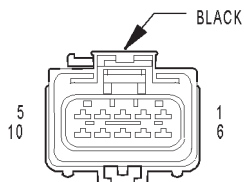
CAV	CIRCUIT	FUNCTION
30	A6 16RD/BK	FUSED B(+)
85	Z149 18BK/LB	GROUND
86	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
87	L95 16DG/YL	TRAILER TOW BRAKE LAMP RELAY OUTPUT
87A	L76 16BK/OR	TRAILER TOW BRAKE LAMP RELAY OUTPUT
87	L95 16DG/YL	TRAILER TOW BRAKE LAMP RELAY OUTPUT



TRAILER TOW CIRCUIT BREAKER

TRAILER TOW CIRCUIT BREAKER - 2 WAY

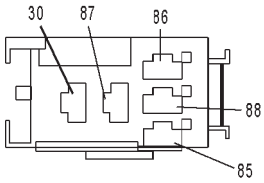
CAV	CIRCUIT	FUNCTION
1	A99 14RD/VT	FUSED B(+)
2	F71 14RD	FUSED B(+)



TRAILER TOW CONNECTOR

TRAILER TOW CONNECTOR - BLACK 10 WAY

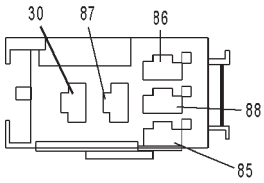
CAV	CIRCUIT	FUNCTION
1	-	-
2	L74 16PK/BK	RIGHT TURN SIGNAL
3	L10 18BR/LG	BACK-UP LAMP FEED
4	F73 14YL	TRAILER TOW RELAY OUTPUT
5	L78 18DG/YL	FUSED PARK LAMP RELAY OUTPUT
6	-	-
7	B40 14LB	TRAILER TOW BRAKE B(+)
8	Z149 16BK/LB	GROUND
9	Z149 16BK/LB	GROUND
10	L73 16PK/WT	LEFT TURN SIGNAL



TRAILER  
TOW LEFT  
TURN RELAY

TRAILER TOW LEFT TURN RELAY - 5 WAY

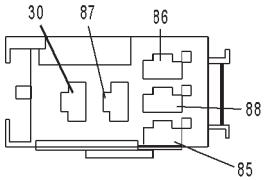
CAV	CIRCUIT	FUNCTION
30	L73 16PK/WT	LEFT TURN SIGNAL
85	Z149 18BK/LB	GROUND
86	L63 18DG/RD	LEFT TURN SIGNAL
87	L76 16BK/OR	TRAILER TOW BRAKE LAMP RELAY OUTPUT
87A	L95 16DG/YL	TRAILER TOW BRAKE LAMP RELAY OUTPUT
87	L76 16BK/OR	TRAILER TOW BRAKE LAMP RELAY OUTPUT



TRAILER  
TOW  
RELAY

TRAILER TOW RELAY - 5 WAY

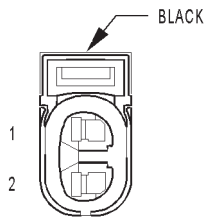
CAV	CIRCUIT	FUNCTION
30	F71 14RD	FUSED B(+)
85	Z149 18BK/LB	GROUND
86	V23 20BR/PK	FUSED IGNITION SWITCH OUTPUT (RUN)
87A	-	-
87	F73 14YL	TRAILER TOW RELAY OUTPUT



TRAILER  
TOW RIGHT  
TURN RELAY

TRAILER TOW RIGHT TURN RELAY - 5 WAY

CAV	CIRCUIT	FUNCTION
30	L74 16PK/BK	RIGHT TURN SIGNAL
85	Z149 18BK/LB	GROUND
86	L62 18BR/RD	RIGHT TURN SIGNAL
87A	L95 16DG/YL	TRAILER TOW BRAKE LAMP RELAY OUTPUT
87	L76 16BK/OR	TRAILER TOW BRAKE LAMP RELAY OUTPUT

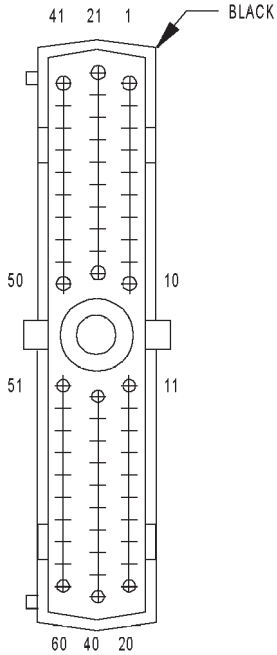


TRANSFER CASE POSITION SENSOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K77 20BR/WT (DIESEL)	TRANSFER CASE POSITION SENSOR INPUT
1	K77 18BR/WT (GAS)	TRANSFER CASE POSITION SENSOR INPUT
2	K4 18BK/LB	SENSOR GROUND

TRANSFER CASE  
POSITION  
SENSOR





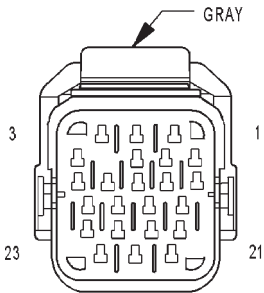
TRANSMISSION CONTROL MODULE

TRANSMISSION CONTROL MODULE (3.7L) - BLACK 60 WAY

CAV	CIRCUIT	FUNCTION
1	T1 18LG/BK	TRS T1 SENSE
2	T4 18PK/OR	TRS T2 SENSE
3	T3 18VT	TRS T3 SENSE
4	-	-
5	-	-
6	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
7	D21 18PK	SCI TRANSMIT
8	F45 18YL/BR	FUSED IGNITION SWITCH OUTPUT (START)
9	T9 18OR/BK	OVERDRIVE PRESSURE SWITCH SENSE
10	T10 18YL/DG	TORQUE MANAGEMENT REQUEST SENSE
11	F1 18DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
13	T13 18DB/BK	SPEED SENSOR GROUND
14	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
15	K30 18PK	TRANSMISSION CONTROL RELAY CONTROL
16	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
17	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
18	T591 18YL/DB	PRESSURE CONTROL SOLENOID CONTROL
19	T119 18WT/DB	2C SOLENOID CONTROL
20	T20 18LB	LOW/REVERSE SOLENOID CONTROL
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	-	-
28	-	-
29	T29 18GY	UNDERDRIVE PRESSURE SWITCH SENSE
30	T38 18VT/TN	LINE PRESSURE SENSOR SIGNAL
31	-	-
32	-	-
33	-	-
34	-	-
35	-	-
36	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
37	Z113 14BK/YL	GROUND
38	T39 18GY/LB	5 VOLT SUPPLY
39	Z113 14BK/YL	GROUND
40	T140 18VT/LG	MS SOLENOID CONTROL
41	T411 18WT/PK	TRS T41 SENSE
42	T42 18VT/WT	TRS T42 SENSE
43	D25 18VT/YL	PCI BUS
44	-	-
45	-	-
46	D20 18LG	SCI RECEIVE
47	T147 18LB	2C PRESSURE SWITCH SENSE
48	T48 18DB	4C PRESSURE SWITCH SENSE
49	T6 18OR/WT	OVERDRIVE OFF SWITCH SENSE
50	T50 18DG	LOW/REVERSE PRESSURE SWITCH SENSE
51	K4 18BK/LB	SENSOR GROUND
52	T52 18RD/BK	INPUT SPEED SENSOR SIGNAL
53	Z112 14BK	GROUND

TRANSMISSION CONTROL MODULE (3.7L) - BLACK 60 WAY

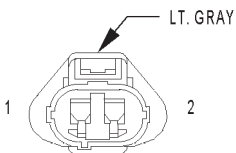
CAV	CIRCUIT	FUNCTION
54	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
55	T59 18PK	UNDERDRIVE SOLENOID CONTROL
56	A30 14RD/WT	FUSED B(+)
57	Z113 14BK/YL	GROUND
58	-	-
59	T159 18DG/WT	4C SOLENOID CONTROL
60	T60 18BR	OVERDRIVE SOLENOID CONTROL



TRANSMISSION SOLENOID/TRS ASSEMBLY (3.7L)

TRANSMISSION SOLENOID/TRS ASSEMBLY (3.7L) - GRAY 23 WAY

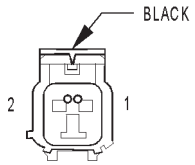
CAV	CIRCUIT	FUNCTION
1	F15 18DB/WT	FUSED IGNITION SWITCH OUTPUT (RUN)
2	T20 18LB	LOW/REVERSE SOLENOID CONTROL
3	T41 18BK/WT	PARK/NEUTRAL POSITION SWITCH SENSE
4	T411 18WT/PK	TRS T41 SENSE
5	T42 18VT/WT	TRS T42 SENSE
6	L10 18BR/LG	BACK-UP LAMP FEED
7	T60 18BR	OVERDRIVE SOLENOID CONTROL
8	T3 18VT	TRS T3 SENSE
9	T1 18LG/BK	TRS T1 SENSE
10	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
11	T48 18DB	4C PRESSURE SWITCH SENSE
12	T591 18YL/DB	PRESSURE CONTROL SOLENOID CONTROL
13	T4 18PK/OR	TRS T2 SENSE
14	T50 18DG	LOW/REVERSE PRESSURE SWITCH SENSE
15	T147 18LB	2C PRESSURE SWITCH SENSE
16	T9 18OR/BK	OVERDRIVE PRESSURE SWITCH SENSE
17	T59 18PK	UNDERDRIVE SOLENOID CONTROL
18	T29 18GY	UNDERDRIVE PRESSURE SWITCH SENSE
19	T159 18DG/WT	4C SOLENOID CONTROL
20	T119 18WT/DB	2C SOLENOID CONTROL
21	T140 18VT/LG	MS SOLENOID CONTROL
22	T13 18DB/BK	SPEED SENSOR GROUND
23	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL



WASHER FLUID LEVEL SWITCH

WASHER FLUID LEVEL SWITCH - LT. GRAY 2 WAY

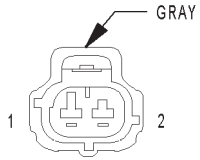
CAV	CIRCUIT	FUNCTION
1	G29 18BK/TN	LOW WASHER FLUID SENSE
2	Z141 18BK	GROUND



WASHER PUMP

WASHER PUMP - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	V20 18BK/WT	WASHER MOTOR SENSE
2	V10 18BR	WASHER PUMP DRIVER



WATER IN FUEL SENSOR (DIESEL)

WATER IN FUEL SENSOR (DIESEL) - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	G123 20DG/WT	WATER IN FUEL SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND

## 8W-91 CONNECTOR/GROUND/SPLICE LOCATION

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## CONNECTOR/GROUND/SPLICE LOCATION

### DESCRIPTION

This section provides illustrations identifying connector, ground, and splice locations in the vehicle.

Connector, ground, and splice indexes are provided. Use the wiring diagrams in each section for connector, ground, and splice identification. Refer to the appropriate index for the proper figure number. For items that are not shown in this section N/S is placed in the Fig. column.

### CONNECTORS

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
A/C Compressor Clutch	BK	At A/C Compressor	2, 20
A/C Heater Control C1	BK	Center of Dash, Behind A/C-Heater Controls	N/S
A/C Heater Control C2	WT	Center of Dash, Behind A/C-Heater Controls	N/S
A/C High Pressure Switch (Diesel)	GY	Left Front Side of Engine Compartment	20
A/C Low Pressure Switch (LHD)	GY	Left Rear Side of Engine Compartment	31
A/C Low Pressure Switch (RHD)	GY	Right Rear Side of Engine Compartment	24
A/C Pressure Transducer (2.4L)	BK	Front Side of Engine	12, 15
A/C Pressure Transducer (3.7L)	BK	Front Side of Engine	2
Accelerator Pedal Position Sensor (Diesel)	BK	Left Rear Side of Engine Compartment	19
Airbag Control Module C1 (ORC C1)	YL	Under Center Console	33, 37
Airbag Control Module C2 (ORC C2)	BK	Under Center Console	33, 37
Ambient Temperature Sensor	BK	Front of Engine Compartment	N/S
Antenna Module C1 (BUX)		Above Right Quarter Window	44, 45
Antenna Module C2 (BUX)		Above Right Quarter Window	N/S
Ash Receiver Lamp		Center of Dash	N/S
Back-Up Lamp Switch (2.4L)	BK	Right Side of Transmission	12
Back-Up Lamp Switch (M/T) (3.7L) (Diesel)	BK	Left Side of Transmission	7, 22
Battery Temperature Sensor	BK	Left Side of Engine Compartment	30

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Blend Door Actuator	BK	Behind Right Side of Instrument Panel	N/S
Blower Motor	BK	Behind Right Side of Instrument Panel	N/S
Blower Motor Resistor Block	BK	Behind Right Side of Instrument Panel	N/S
Body Control Module C1	GY	Under Left Side of Instrument Panel	N/S
Body Control Module C2	GY	Under Left Side of Instrument Panel	N/S
Body Control Module C3 (Premium)		Under Left Side of Instrument Panel	N/S
Boost Pressure Sensor (Diesel)		Left Side of Engine	22
Brake Lamp Switch	BK	At Brake Pedal	N/S
Brake Pressure Switch (ABS)	BK	On Master Cylinder	N/S
C100	GY	Left Kick Panel	32, 33, 37
C101 (2.4L)	BK	Left Side of Engine Compartment	11, 12
C102 (RHD)		Left Kick Panel	32
C103 (Gas)	BK	Right Rear Side of Engine Compartment	8, 9, 10, 13, 14, 16
C104	BK	Right Rear Side of Engine Compartment	8, 9, 10, 13, 14, 16, 17, 18
C105	GY	Right Rear Side of Engine Compartment	8, 9, 10, 13, 14, 16, 17, 18
C106	BK	Left Front Side of Engine Compartment	29
C107	BK	Left Front Side of Engine Compartment	N/S
C108 (Gas)	GY	Left Front Side of Engine	30
C110 (2.4L)	BK	Left Side of Engine	11, 12
C111 (Diesel)	LG	Right Rear Side of Engine Compartment	17, 18
C112 (Gas)	BK	Right Side of Engine Compartment	8, 9, 10, 13, 14, 31
C113 (Diesel)	LG	Left Rear Side of Engine Compartment	N/S
C114 (Diesel)	LG	Top of Engine	N/S
C201	BK	Behind Center of Instrument Panel	N/S
C202	YL	Behind Center of Instrument Panel	N/S
C300 (LHD)	OR	Left A-Pillar	35, 41
C300 (RHD)	OR	Right A-Pillar	39, 41
C301 (LHD)	OR	Left A-Pillar	35, 41
C301 (RHD)	OR	Right A-Pillar	39, 41

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
C302 (LHD)	OR	Right A-Pillar	34, 41, 42
C302 (RHD)	OR	Left A-Pillar	38, 41
C303 (LHD)	OR	Right A-Pillar	34, 41, 42
C303 (RHD)	OR	Left A-Pillar	38, 41
C304	DB	Right Mid B-Pillar	34, 39
C305	DB	Left Mid B-Pillar	35, 38
C306 (LHD)	WT	Left Lower B-Pillar	35, 43
C306 (RHD)	WT	Right Lower B-Pillar	39, 45
C307 (LHD)	LG	Left Lower B-Pillar	35, 38, 44
C308	LG	Left Rear Quarter Panel	43
C309	DB	Left Rear Quarter Panel	43, 46
C310	LG	Right Rear Quarter Panel	44, 45, 47
C311	LG	Left Front Seat	35, 38
C312 (Highline)	LG	Left Front Seat	35, 38
C313	LG	Right Front Seat	36, 39, 40
C314	LG	Right Front Seat	36, 39, 40
C315 (Midline/Highline) (LHD)	LG	Right Front Seat	34
C315 (Midline/Highline) (RHD)	LG	Left Front Seat	38
C317 (Except BUX)	LG	On Rear Bumper	45
Cabin Heater (Diesel)	BK	Right Front Side of Engine	21
Camshaft Position Sensor (2.4L)	BK	Top of Engine	N/S
Camshaft Position Sensor (3.7L)	LG	Right Side of Engine	4
Camshaft Position Sensor (Diesel)		Top of Engine	22
Capacitor (3.7L)	BK	Rear Side of Engine Compartment	9, 10
Capacitor (2.4L)	BK	Left Rear Side of Engine	11, 12
CD Changer	GN	At CD Changer	N/S
Center High Mounted Stop Lamp	WT	At Lamp	46
Cigar Lighter	RD	Behind Cigar Lighter	N/S
Clockspring C1	WT	Behind Steering Wheel	N/S
Clockspring C2	YL	Behind Steering Wheel	N/S
Clockspring C3	BK	At Steering Wheel	N/S
Clutch Interlock Switch (LHD)	BK	Left Rear Side of Engine Compartment	31
Clutch Interlock Switch (RHD)	BK	Right Rear Side of Engine Compartment	26
Coil On Plug No.1 (3.7L)	BK	Left Side of Engine Near Fuel Injector No.1	1
Coil On Plug No.2 (3.7L)	BK	Right Side of Engine Near Fuel Injector No.2	2
Coil On Plug No.3 (3.7L)	BK	Left Side of Engine Near Fuel Injector No.3	1
Coil On Plug No.4 (3.7L)	BK	Right Side of Engine Near Fuel Injector No.4	2

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Coil On Plug No.5 (3.7L)	BK	Left Side of Engine Near Fuel Injector No.5	1
Coil On Plug No.6 (3.7L)	BK	Right Side of Engine Near Fuel Injector No.6	2
Coil Rail (2.4L)	BK	Right Side of Engine	11, 12
Combination Flasher	WT	Under Left Side of Instrument Panel	N/S
Compass Mini-Trip Computer	BK	At Overhead Console	N/S
Controller Antilock Brake	BK	Left Side of Engine Compartment	30
Crankshaft Position Sensor (2.4L)	BK	Top of Engine	N/S
Crankshaft Position Sensor (3.7L)	BK	Right Lower Side of Engine	4
Crankshaft Position Sensor (Diesel)	BK	Right Rear Side of Engine	17
Data Link Connector	BK	Under Center of Instrument Panel	N/S
Diagnostic Junction Port	BK	Under Center of Instrument Panel	49
Dome Lamp (Base)	BK	On Headliner	N/S
Driver Airbag Squib 1	GY	In Steering Wheel	N/S
Driver Airbag Squib 2	BK	In Steering Wheel	N/S
Driver Seat Belt Switch	LG	At Drive Seat	N/S
Driver Seat Belt Tensioner (LHD)	YL	Lower Left B-Pillar	35
Driver Seat Belt Tensioner (RHD)	YL	Lower Right B-Pillar	39
EGR Solenoid		Right Rear Side of Engine Compartment	27
Engine Control Module C1	BK	Left Rear Side of Engine Compartment	19
Engine Control Module C2	BK	Left Rear Side of Engine Compartment	19
Engine Coolant Level Sensor (Diesel)	LG	Rear Side of Engine Compartment	18
Engine Coolant Temperature Sensor (Diesel)	BK	Left Side of Engine	20
Engine Coolant Temperature Sensor (Gas)	BK	Front Side of Engine	2
Engine Oil Pressure Sensor (2.4L)	BK	Top of Engine	N/S
Engine Oil Pressure Sensor (3.7L)	BK	Left Front Side of Engine	3
Engine Oil Pressure Sensor (Diesel)	BK	Right Rear Side of Engine	17
Engine Starter Motor		Right Front Side of Engine	20
Evap/Purge Solenoid	BK	At Solenoid	N/S
Flip-Up Glass Release Motor	BK	In Tailgate	46
Flip-Up Glass Release Switch	WT	In Tailgate	46
Front Washer Pump	BK	Right Front Side of Engine Compartment	28
Front Wiper Motor (LHD)	BK	Left Side of Cowl	24

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Front Wiper Motor (RHD)	BK	Right Side of Cowl	24
Fuel Heater (Diesel)	BK	Left Rear Side of Engine Compartment	19
Fuel Injector No.1 (Diesel)	BK	At Fuel Injector	23
Fuel Injector No.1 (Gas)	BK	At Fuel Injector	1
Fuel Injector No.2 (Diesel)	BK	At Fuel Injector	23
Fuel Injector No.2 (Gas)	BK	At Fuel Injector	2
Fuel Injector No.3 (Diesel)	BK	At Fuel Injector	23
Fuel Injector No.3 (Gas)	BK	At Fuel Injector	1
Fuel Injector No.4 (Diesel)	BK	At Fuel Injector	22
Fuel Injector No.4 (Gas)	BK	At Fuel Injector	2
Fuel Injector No.5 (3.7L)	BK	At Fuel Injector	1
Fuel Injector No.6 (3.7L)	BK	At Fuel Injector	2
Fuel Pressure Sensor (Diesel)		Left Side of Engine	22
Fuel Pressure Solenoid (Diesel)	BK	Left Side of Engine	20
Fuel Pump Module	LG	At Fuel Tank	N/S
Generator	BK	Left Front Side of Engine	20
Glow Plug Assembly (Diesel)		Top of Engine	N/S
Headlamp Leveling Switch (BUX)	BK	Center of Instrument Panel	N/S
Heated Seat Module (Highline)	GN	At Left Seat	N/S
High Note Horn	BK	Left Front Side of Engine Compartment	29
Hood Ajar Switch		Right Side of Engine Compartment	25
Idle Air Control Motor	BK	On Throttle Body	1
Ignition Switch		At Steering Column	N/S
Input Speed Sensor (3.7L)	BK	Left Side of Transmission	5
Instrument Cluster	BK	Rear of Cluster	N/S
Intake Air Temperature Sensor	GY	Left Side of Intake Manifold	1
Intrusion Sensor (BUX)	BK	Overhead Console	N/S
Junction Block Body Control Module - JB		Under Left Side of Instrument Panel	N/S
Junction Block C1	GY	Under Left Side of Instrument Panel	N/S
Junction Block C2	GN	Under Left Side of Instrument Panel	N/S
Junction Block C3	LB	Under Left Side of Instrument Panel	N/S
Knock Sensor (3.7L)	BK	Near Fuel Injector No.5	1
Leak Detection Pump	BK	Near Fuel Tank	N/S
Left Curtain Airbag	YL	Left Mid B-Pillar	35, 38
Left Cylinder Lock Switch	LG	In Left Front Door	41
Left Door Lock Switch	BK	In Left Front Door	41
Left Fog Lamp	BK	Left Side of Front Bumper	N/S



## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Left Front Door Ajar Switch (Base)	BK	In Left Front Door	N/S
Left Front Door Lock Motor/Ajar Switch (Except Base)	BK	In Left Front Door	41
Left Front Door Speaker	BK	Behind Left Front Door Panel	41
Left Front Impact Sensor	BK	Front Side of Engine Compartment	28
Left Front Park/Turn Signal Lamp	BK	Behind Left Turn Signal Lamp	N/S
Left Front Power Window Motor	LG	In Left Front Door	41
Left Front Wheel Speed Sensor	BK	Left Side of Engine Compartment	30
Left Headlamp (BUX)		Behind Left Headlamp	N/S
Left Headlamp (Except BUX)	DB	Behind Left Headlamp	N/S
Left Heated Seat Assembly	LG	At Left Seat	N/S
Left Heated Seat Switch	BK	At Left Seat	N/S
Left Instrument Panel Lamp	BK	Left Side of Instrument Panel	N/S
Left Instrument Panel Speaker	BK	Left Side of Instrument Panel	33, 37
Left Leveling Motor (BUX)	BK	At Left Headlamp	N/S
Left Position Lamp (BUX)	BK	Left Front Side of Vehicle	N/S
Left Power Mirror	WT	In Left Front Door	41
Left Power Seat Motors	BK	At Left Seat	N/S
Left Power Seat Switch	GN	At Left Seat	N/S
Left Rear Door Ajar Switch (Base)	BK	In Left Rear Door	N/S
Left Rear Door Lock Motor/Ajar Switch (Except Base)	BK	In Left Rear Door	N/S
Left Rear Door Speaker		In Left Rear Door	
Left Rear Power Window Motor	LG	In Left Rear Door	N/S
Left Remote Radio Switch	BK	On Steering Wheel	N/S
Left Side Impact Airbag Control Module (LSIACM)	YL	Left Lower B-Pillar	35, 38
Left Side Marker Lamp	BK	Left Front Fender	N/S
Left Side Repeater Lamp (BUX)	BK	Left Front Fender	N/S
Left Speed Control Switch	BK	On Steering Wheel	N/S
Left Tail/Stop Lamp	BK	Left Rear Quarter Panel	45
Left Visor/Vanity Lamp	WT	Left Front of Headliner	N/S
License Lamp (BUX)	LG	In Tailgate	46
License Lamp (Except BUX)	LG	On Bumper	N/S
Line Pressure Sensor (3.7L)	BK	Right Side of Transmission	6
Low Note Horn	BK	Left Front Side of Engine Compartment	29
Manifold Absolute Pressure Sensor	BK	Front Side of Engine	2
Mass Air Flow Sensor (Diesel)		Top of Engine	21
Multi-Function Switch C1	GY	At Steering Column	N/S
Multi-Function Switch C2	GY	At Steering Column	N/S

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Output Speed Sensor	BK	Left Side of Transmission	5
Overhead Map/Courtesy Lamp	BK	Overhead Console	N/S
Oxygen Sensor 1/1 Upstream (2.4L)	BK	Right Side of Engine	12
Oxygen Sensor 1/1 Upstream (3.7L)	BK	Lower Left Side of Engine	3
Oxygen Sensor 1/2 Downstream (2.4L)	NAT	Right Side of Transmission	11, 12
Oxygen Sensor 1/2 Downstream (3.7L)	NAT	Left Side of Transmission	5, 7
Oxygen Sensor 2/1 Upstream (3.7L)	BK	Lower Right Side of Engine	4
Oxygen Sensor 2/2 Downstream (3.7L)	NAT	Right Side of Transmission	6
Park Brake Switch	BK	Center Console	36, 40
Passenger Airbag	YL	Right Side Instrument Panel	N/S
Passenger Seat Belt Switch	LG	At Passenger Seat	N/S
Power Mirror Switch	WT	In Left Front Door	41
Power Outlet	RD	Center of Instrument Panel	N/S
Power Steering Pressure Switch	BK	Left Front Side of Engine	3, 15
Power Window Master Switch	LG	Center Console	36, 40
Powertrain Control Module C1 (2.4L)	BK	At Powertrain Control Module	13, 14
Powertrain Control Module C1 (3.7L)	BK	At Powertrain Control Module	8, 9, 10
Powertrain Control Module C2	WT	At Powertrain Control Module	8, 9, 10, 13, 14
Powertrain Control Module C3	GY	At Powertrain Control Module	31
Radiator Fan Motor	BK	Right Front Side of Engine Compartment	28
Radiator Fan Relay	BK	Left Front Side of Engine Compartment	29
Radio C1	GY	Rear of Radio	N/S
Radio C2		Rear of Radio	N/S
Radio C3		Rear of Radio	N/S
Radio Choke	GY	Center of Instrument Panel	N/S
Rear Map/Reading Lamp	BK	Overhead Console	N/S
Rear Power Outlet	RD	Right Rear Quarter Panel	44, 45, 48
Rear Power Window Switch	WT	Center Console	36, 40
Rear Wheel Speed Sensor	BK	On Rear Axle	N/S
Rear Window Defogger	BK	At Rear Window	46
Rear Wiper Motor	BK	In Tailgate	46
Red Brake Warning Indicator Switch (LHD)	GY	Left Rear Side of Engine Compartment	31
Red Brake Warning Indicator Switch (RHD)	GY	Right Rear Side of Engine Compartment	26
Right Curtain Airbag	YL	Right Mid B-Pillar	34, 39
Right Cylinder Lock Switch (Except Base)	LG	In Right Front Door	41

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Right Door Lock Switch (Except Base)	BK	In Right Front Door	41
Right Fog Lamp	BK	Right Side of Bumper	N/S
Right Front Door Ajar Switch (Base)	BK	In Right Front Door	N/S
Right Front Door Lock Motor/Ajar Switch (Except Base)	BK	In Right Front Door	41
Right Front Door Speaker	BK	In Right Front Door	41
Right Front Impact Sensor	BK	Right Front Side of Engine Compartment	28
Right Front Park/Turn Signal Lamp	BK	At Lamp	N/S
Right Front Power Window Motor	LG	In Right Front Door	41
Right Front Wheel Speed Sensor	BK	Right Rear Lower Side of Engine Compartment	25
Right Headlamp (BUX)		Right Front Side of Engine Compartment	N/S
Right Headlamp (Except BUX)	DB	Right Front Side of Engine Compartment	N/S
Right Heated Seat Assembly	LG	At Right Seat	N/S
Right Heated Seat Switch	BK	At Right Seat	N/S
Right Instrument Panel Lamp	BK	Right Side of Instrument Panel	N/S
Right Instrument Panel Speaker	WT	Right Side of Instrument Panel	33, 37
Right Leveling Motor (BUX)	BK	At Right Headlamp	N/S
Right Position Lamp (BUX)	BK	Right Front Corner of Vehicle	N/S
Right Power Mirror	WT	In Right Front Door	41
Right Power Seat Motors	BK	At Right Seat	N/S
Right Power Seat Switch	GN	At Right Seat	N/S
Right Rear Door Ajar Switch (Base)	BK	In Right Rear Door	N/S
Right Rear Door Lock Motor/Ajar Switch (Except Base)	BK	In Right Rear Door	42
Right Rear Door Speaker		At Speaker	42
Right Rear Power Window Motor	LG	In Right Rear Door	42
Right Remote Radio Switch	BK	On Steering Wheel	N/S
Right Side Impact Airbag Control Module (RSIACM)	YL	Lower Right B-Pillar	34, 39
Right Side Marker Lamp	BK	Right Front Fender	N/S
Right Side Repeater Lamp (BUX)	BK	Right Front Fender	N/S
Right Speed Control Switch	WT	On Steering Wheel	N/S
Right Tail/Stop Lamp	BK	Right Rear Quarter Panel	45
Right Visor/Vanity Lamp	WT	On Visor	N/S
Sentry Key Immobilizer Module	BK	Under Left Side of Instrument Panel	N/S
Shifter Assembly	WT	Center Console	36, 40

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Siren (BUX)		Right Front Side of Engine Compartment	28
Speed Control Servo	BK	Right Rear Side of Engine Compartment	27
Sunroof Motor	LG	Overhead Console	N/S
Sunroof Switch	BK	Overhead Console	N/S
Tailgate Cylinder Lock Switch	LG	In Tailgate	46
Tailgate Flip-Up Ajar Switch	GY	In Tailgate	46
Tailgate Lock Motor/Ajar Switch	BK	In Tailgate	46
Throttle Position Sensor	WT	On Throttle Body	1
Trailer Tow Brake Lamp Relay		Right Quarter Panel	47
Trailer Tow Circuit Breaker		Right Quarter Panel	N/S
Trailer Tow Connector	BK	At Trailer Hitch	47, 48
Trailer Tow Right Turn Relay		Right Quarter Panel	47
Trailer Tow Relay		Right Quarter Panel	47
Trailer Tow Left Turn Relay		Right Quarter Panel	47
Transfer Case Position Sensor	BK	Rear Side of Transmission	5, 7, 11, 12, 22
Transmission Control Module (3.7L) (LHD)	BK	Right Rear Side of Engine Compartment	8, 9
Transmission Control Module (3.7L) (RHD)	BK	Left Rear Side of Engine Compartment	10
Transmission Solenoid/TRS Assembly (3.7L)	GY	Left Side of Transmission	5
Under Hood Lamp	BK	Underside of Hood	24
Washer Fluid Level Switch	LG	At Washer Fluid Reservoir	28
Water In Fuel Sensor (Diesel)		Left Rear Side of Engine Compartment	19

## GROUNDS

GROUND NUMBER	LOCATION	FIG.
G100	Left Side of Engine Compartment	8, 9, 10, 14, 19
G101 (2.4L)	Left Side of Engine Compartment	11
G102 (LHD)	Right Rear Side of Engine Compartment	9
G102 (RHD)	Left Rear Side of Engine Compartment	10
G103 (3.7L)	Right Front Side of Engine	4
G103 (Diesel)	Right Front Side of Engine	20
G104	Near Engine Control Module C2	19
G105	Left Side of Engine Compartment	N/S
G106	Left Side of Engine Compartment	N/S
G110	Left Side of Engine Compartment	30
G111	Left Front Side of Engine Compartment	29
G112	Left Front Side of Engine Compartment	29
G200	Near Body Control Module	N/S

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

GROUND NUMBER	LOCATION	FIG.
G201	Under Center Console	33, 37
G202	Left Kick Panel (Black Connector)	N/S
G203	Under Center of Instrument Panel	N/S
G300	Left Front Seat	35
G301	Under Center Console	N/S
G302	Right Front Seat	39
G310	Right Quarter Panel	44, 45
G311	Left Quarter Panel	43
G312	Left Quarter Panel	N/S
G320	At Fuel Tank	N/S

## SPLICES

SPLICE NUMBER	LOCATION	FIG.
S101	Near T/O to Power Distribution Center	N/S
S104	Near T/O to Power Distribution Center	N/S
S106	Near T/O for G112	N/S
S107 (Diesel)	In T/O for C100	32
S108	Near T/O for C106	29
S109	In Trough Near T/O for Radiator Fan Relay	N/S
S110	Near T/O for C106	29
S111	In Trough Near T/O for Radiator Fan Relay	N/S
S112	Near T/O to Power Distribution Center	N/S
S113 (LHD)	In T/O for C100	32
S114	In T/O for C100	N/S
S115	Near T/O for Engine Control Module	N/S
S118	In T/O for C100	32
S121	Near T/O to Power Distribution Center	N/S
S122	In T/O for Controller Antilock Brake	30
S123	In Trough, Front of Engine Compartment	N/S
S124	In T/O for Junction Block C3	N/S
S125	In T/O for Junction Block C3	N/S
S130	Near T/O for Left Headlamp	N/S
S131	In T/O for Right Headlamp	N/S
S140	Near T/O for Left Front Park/Turn Signal Lamp	N/S
S141	Near T/O for Left Fog Lamp	N/S
S142	Near T/O for Left Front Park/Turn Signal Lamp	N/S
S143	Near T/O for Right Front Park/Turn Signal Lamp	N/S
S144	Near T/O for Left Fog Lamp	N/S
S145	Near T/O for Right Front Park/Turn Signal Lamp	N/S
S146	Near T/O for Right Front Park/Turn Signal Lamp	N/S
S151 (2.4L)	Near T/O for C110	11, 12
S151 (3.7L)	In Trough Near T/O for Fuel Injector No.3	1

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

SPLICE NUMBER	LOCATION	FIG.
S151 (Diesel)	In Trough Near T/O for Accelerator Pedal Position Sensor	19
S152	In Trough Near T/O for Fuel Injector No.4	2
S153 (2.4L)	Near T/O for Coil Rail	11, 12
S153 (3.7L)	Near T/O for Idle Air Control Motor	1
S153 (Diesel)	In Trough Near T/O for Generator	20, 23
S154	Near T/O for Engine Starter Motor	2, 4, 20
S155	Near T/O for Knock Sensor	1
S156 (2.4L)	In Trough Near T/O for C112	13, 14
S156 (3.7L)	Near T/O for Powertrain Control Module C1	8
S156 (Diesel)	Near T/O for A/C Compressor Clutch	20
S157	Near T/O for Oxygen Sensor 2/2 Downstream	N/S
S158	In Trough Near T/O for C112	8
S159	Near T/O for Knock Sensor	1, 8
S160	In T/O for C104	10
S161	Near T/O for Oxygen Sensor 1/2 Downstream	5, 7
S163	In T/O for Transmission Control Module	10
S164	In Trough on Right Rear Side of Engine Compartment	10
S165	In Trough on Right Rear Side of Engine Compartment	10
S167	In T/O for Transmission Control Module	10
S168	Near T/O for Fuel Injector No.6	2
S169 (2.4L)	Near T/O for C101	11
S169 (3.7L)	Near T/O for Oxygen Sensor 1/1 Upstream	1, 3
S169 (Diesel)	Near T/O for Generator	20
S170	Near T/O for C103	8, 13, 16
S175	In Trough on Top of Engine	22, 23
S177	In Trough Near T/O for G100	19
S178	Near T/O for Oxygen Sensor 2/2 Downstream	6
S180	Near T/O for C103	8
S181	In Trough Near T/O for G100	19
S184	Near T/O for Powertrain Control Module C1	8
S200	Near T/O for C201	N/S
S201	Near T/O for Left Instrument Panel Lamp	N/S
S204	Near T/O for Data Link Connector	N/S
S205	In T/O for C100	N/S
S206	Near T/O for Multifunction Switch C2	N/S
S207	In T/O for C100	N/S
S208	Near T/O for G202	N/S
S210	Near T/O for Left Instrument Panel Lamp	N/S
S212	Near T/O for Diagnostic Junction Port	N/S
S213	Near T/O for Diagnostic Junction Port	N/S
S214	Near T/O for Airbag Control Module C1 (ORC C1)	N/S
S215	Near T/O for Multifunction Switch C2	N/S

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

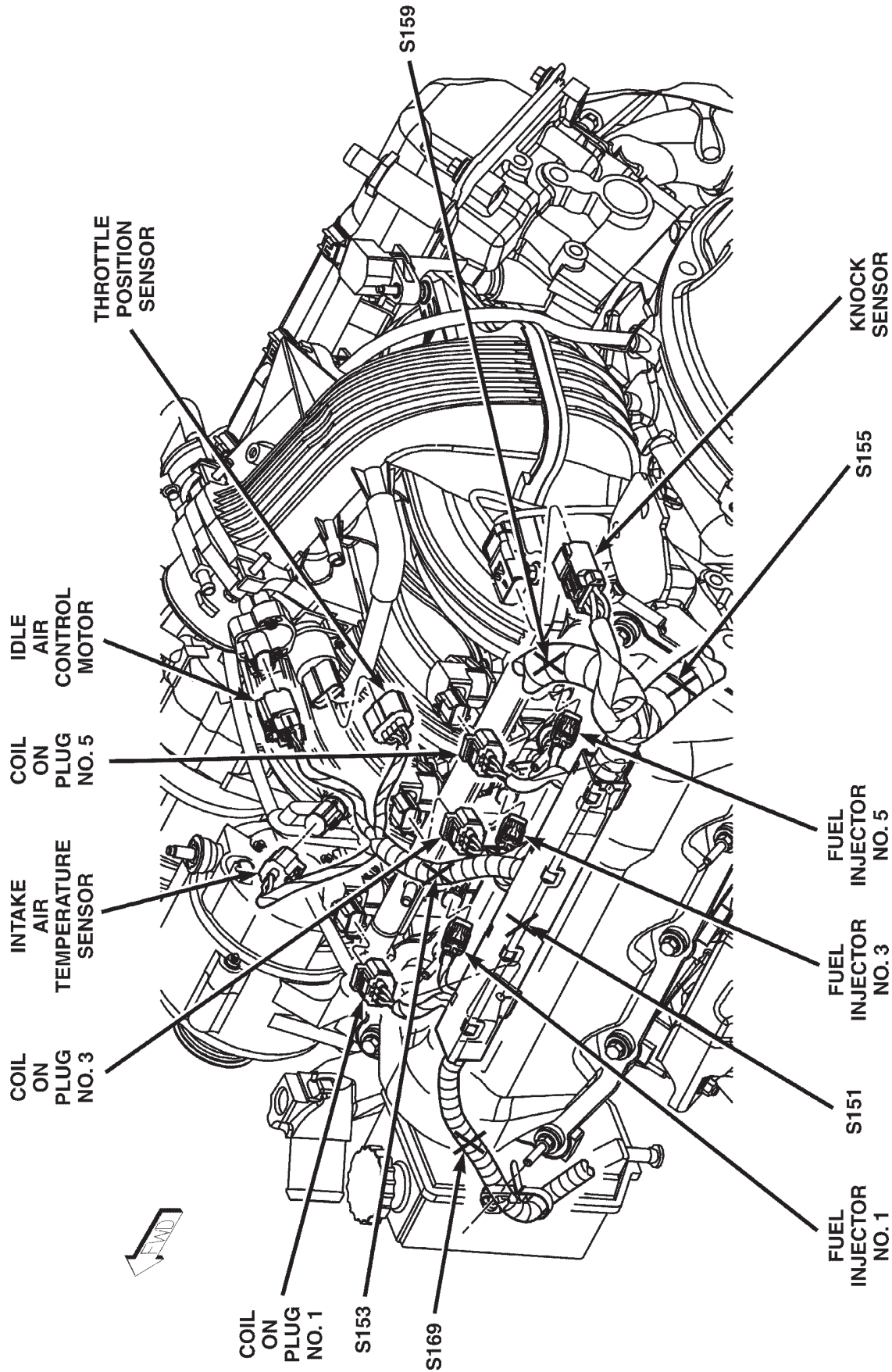
SPLICE NUMBER	LOCATION	FIG.
S216	In T/O for Instrument Cluster	N/S
S217	Near T/O for Multifunction Switch C2	N/S
S218	Near T/O for Multifunction Switch C2	N/S
S219	In T/O for Junction Block C3	N/S
S220	In T/O for Junction Block C3	N/S
S221	Near T/O for Left Speed Control Switch	N/S
S222	Near T/O for Right Speed Control Switch	N/S
S223	Near T/O for Left Remote Radio Switch	N/S
S224	Near T/O for Right Remote Radio Switch	N/S
S300 (LHD)	Near T/O for C309	43
S300 (RHD)	Near T/O for C310	45
S301	In T/O For Radio C1	N/S
S302	Near T/O for Rear Power Outlet	45
S303	Near T/O for Shifter Assembly	36
S304	Near T/O for License Lamp	45
S306 (LHD)	Near T/O for G315	44
S306 (RHD)	In T/O for C319	45
S308 (LHD)	Near T/O for C309	43
S308 (RHD)	Near T/O for Rear Power Outlet	45
S310	Near T/O for C310	N/S
S312	Near T/O for G315	N/S
S313	In T/O for Trailer Tow Relays	47
S314	In T/O for Trailer Tow Relays	47
S318 (LHD)	Near T/O for G309	35
S318 (RHD)	In T/O for C201	39
S319 (LHD)	Near T/O for C201	33
S319 (RHD)	Near T/O for Left Instrument Panel	37
S322	Near T/O for Left Instrument Panel	33, 37
S323 (LHD)	Near T/O for Left Instrument Panel	33
S323 (RHD)	Near T/O for Right Instrument Panel Speaker	37
S324 (Premium)	Near T/O for Right Instrument Panel Speaker	33, 37
S325	Near T/O for C201	33, 37
S326	Near T/O for Heated Seat Module	N/S
S327	Near T/O for Left Heated Seat Assembly	N/S
S328	In T/O for Heated Seat Module	N/S
S329	Near T/O for Right Heated Seat Switch	N/S
S330	Near T/O for Heated Seat Module	N/S
S331	Near T/O for Shifter Assembly	N/S
S333 (LHD)	Near T/O for G300	35
S333 (RHD)	Near T/O for C307	38
S334	Near T/O for G302	34, 39
S336 (LHD)	Near T/O for Left Instrument Panel	33

## CONNECTOR/GROUND/SPLICE LOCATION (Continued)

SPLICE NUMBER	LOCATION	FIG.
S336 (RHD)	Near T/O for Right Instrument Panel Speaker	37
S338	Near T/O for C201	33, 37
S340	Near T/O for C201	33
S341	Near T/O for C201	33
S342 (Base)	Near T/O for Right Instrument Panel Speaker	33
S344	Near T/O for Right Instrument Panel Speaker	33
S346	In T/O for Trailer Tow Relays	47
S347	Near T/O for Right Tail/Stop Lamp	45
S348	Near T/O for Right Tail/Stop Lamp	45
S349	Near T/O for License Lamp	45
S350	Near T/O for License Lamp	45
S351	In T/O for Rear Window Defogger	46
S352	In T/O for Rear Window Defogger	N/S
S356	Near T/O for Center High Mounted Stop Lamp	N/S
S360	Near T/O for Left Power Mirror	41
S361	Near T/O for Left Power Mirror	41
S362	Near T/O for Power Mirror Switch	41
S363	Near T/O for Left Front Door Speaker	N/S
S364	Near T/O for Left Front Door Speaker	N/S
S370	Near T/O for Right Power Mirror	41
S371	Near T/O for Right Door Lock Switch	41
S372	Near T/O for Right Front Door Speaker	N/S
S373	Near T/O for Right Front Door Speaker	N/S
S380	Near T/O for Rear Wiper Motor	N/S
S381	Near T/O for Tailgate Cylinder Lock Switch	N/S
S382	Near T/O for License Lamp	N/S
S390	Near T/O for Intrusion Sensor	N/S
S391	Near T/O for Left Visor/Vanity Lamp	N/S
S392	Near T/O for Left Visor/Vanity Lamp	N/S
S393	Near T/O for Intrusion Sensor	N/S



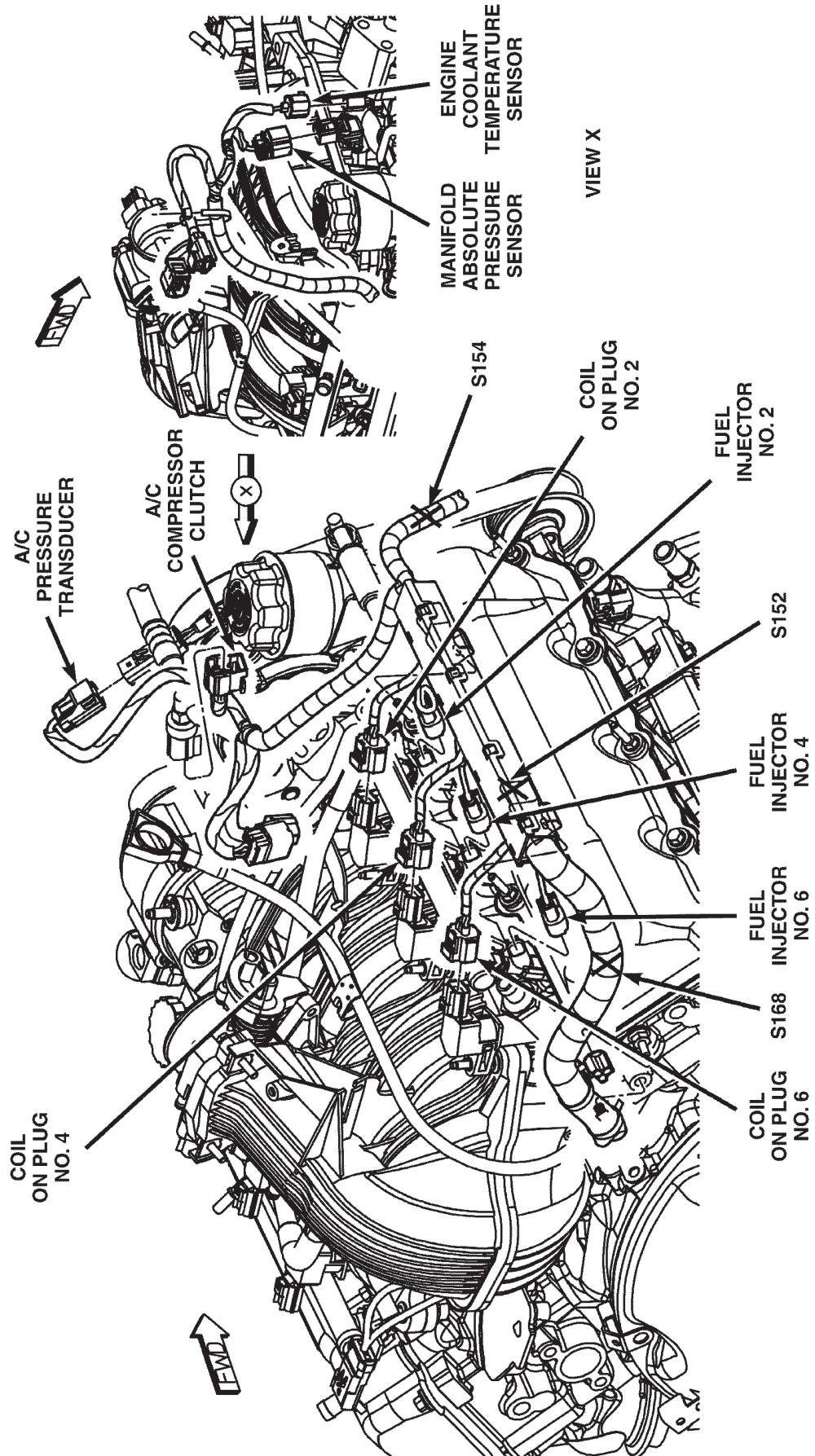
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce3664

Fig. 1 LEFT SIDE ENGINE, 3.7L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4ce9

Fig. 2 RIGHT SIDE ENGINE, 3.7L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ce4ced

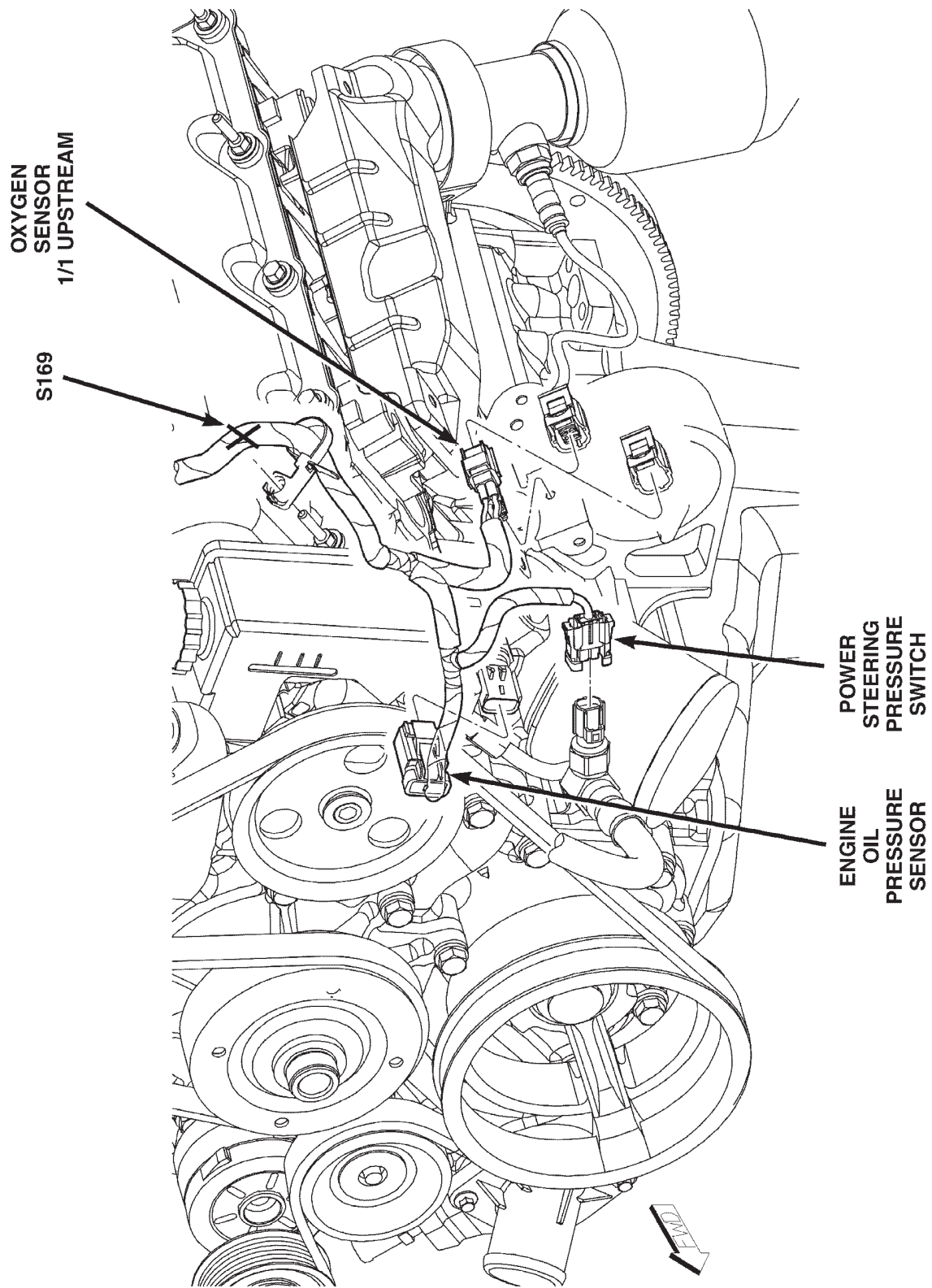


Fig. 3 LOWER LEFT ENGINE, 3.7L

80ce4d1a

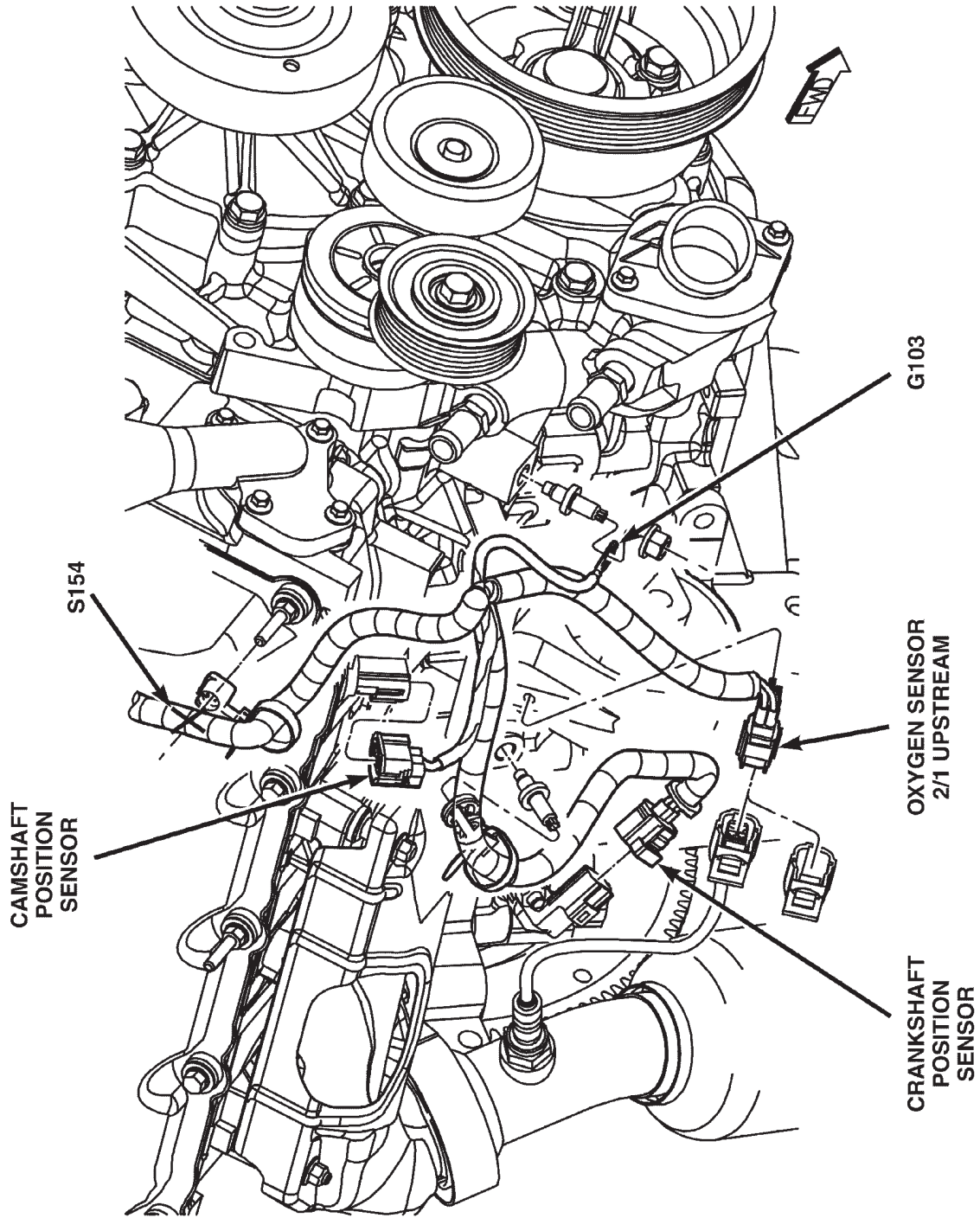
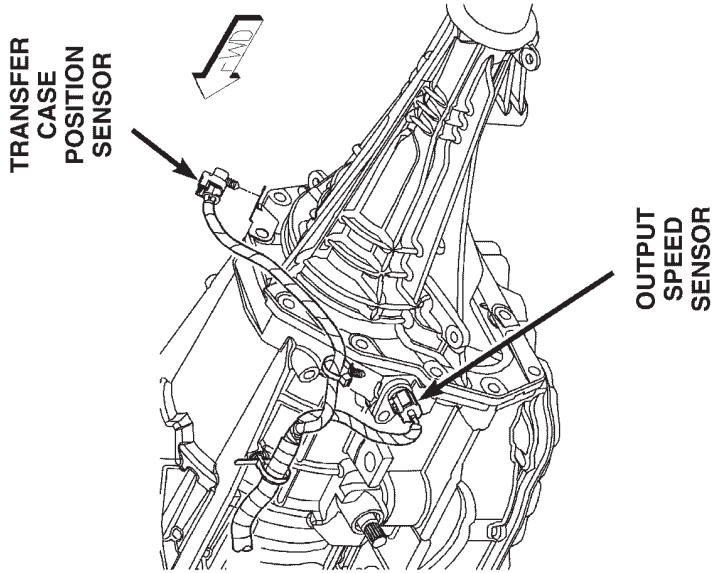


Fig. 4 LOWER RIGHT ENGINE, 3.7L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4d5d

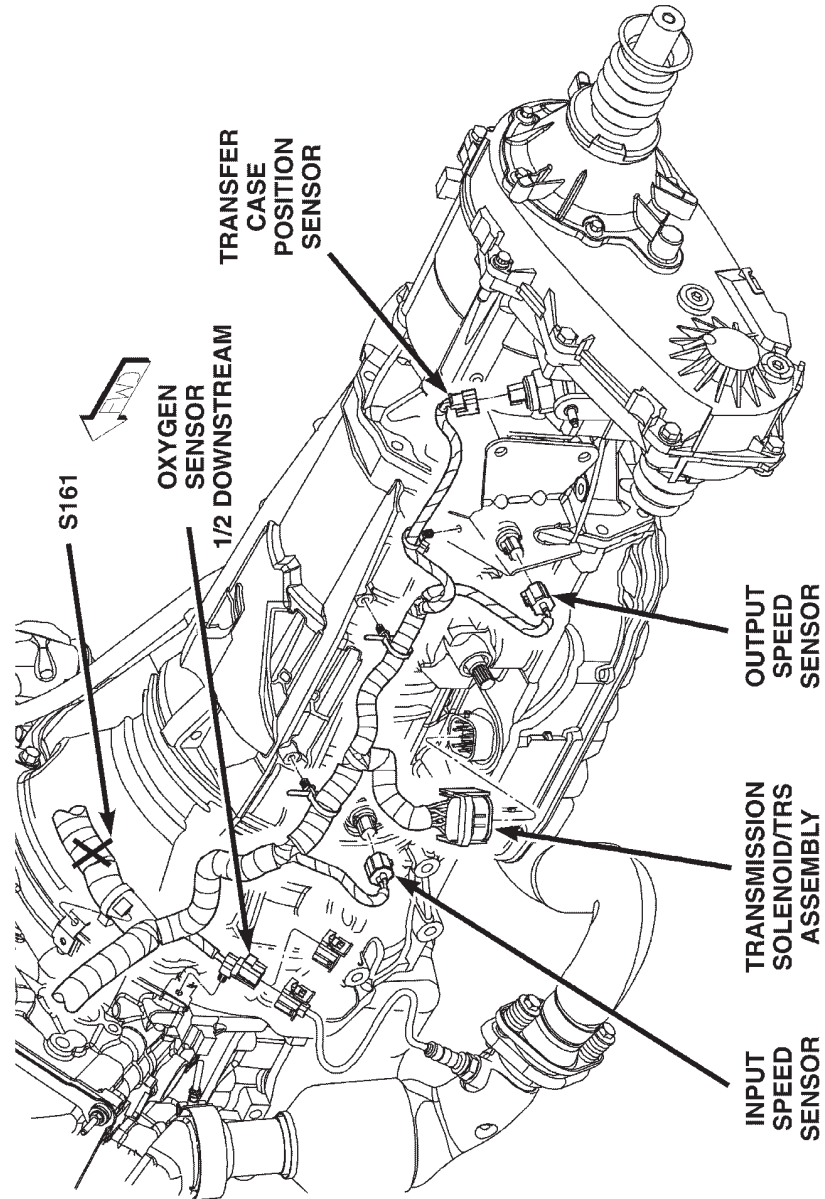
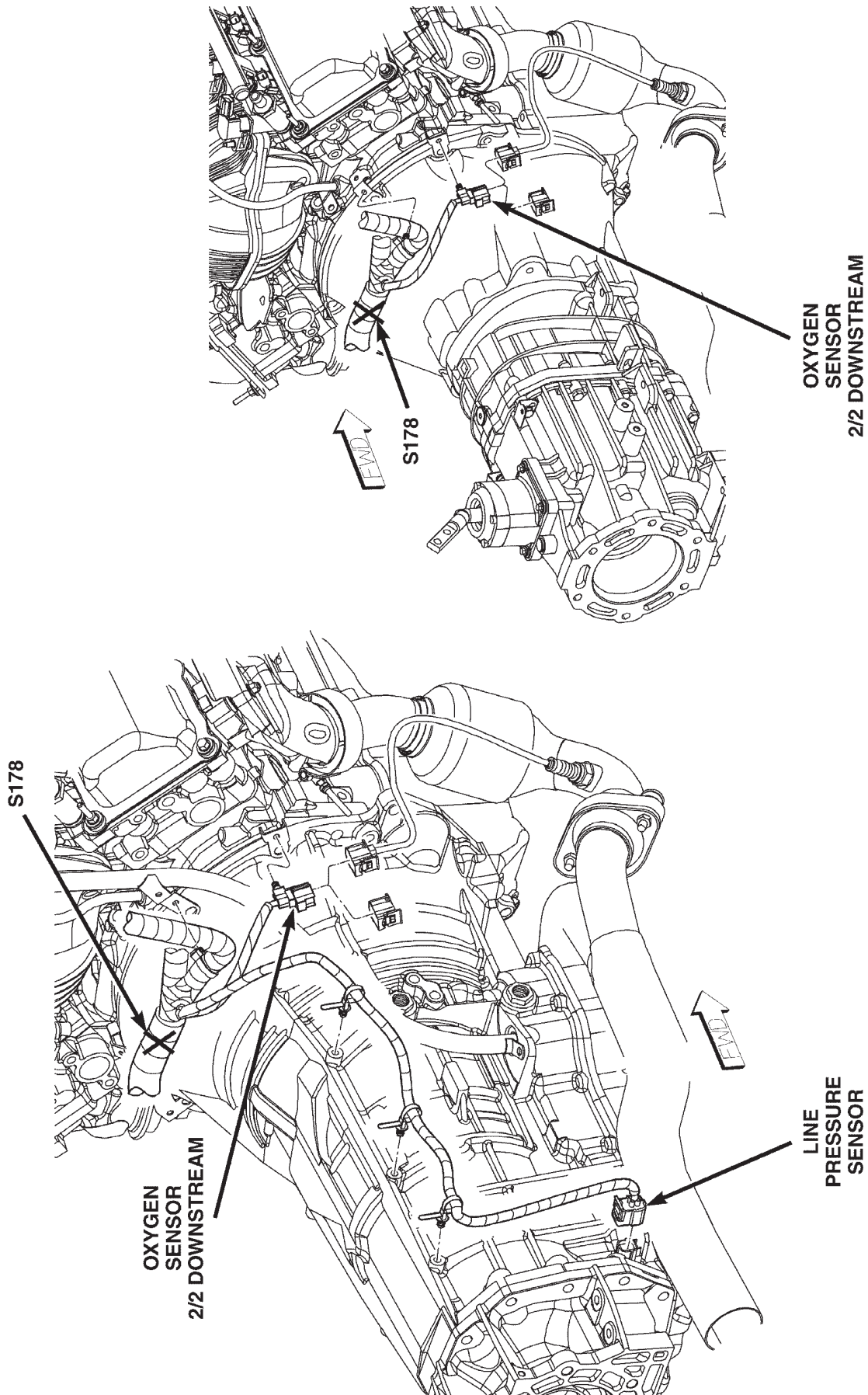


Fig. 5 LEFT SIDE TRANSMISSION, 3.7L

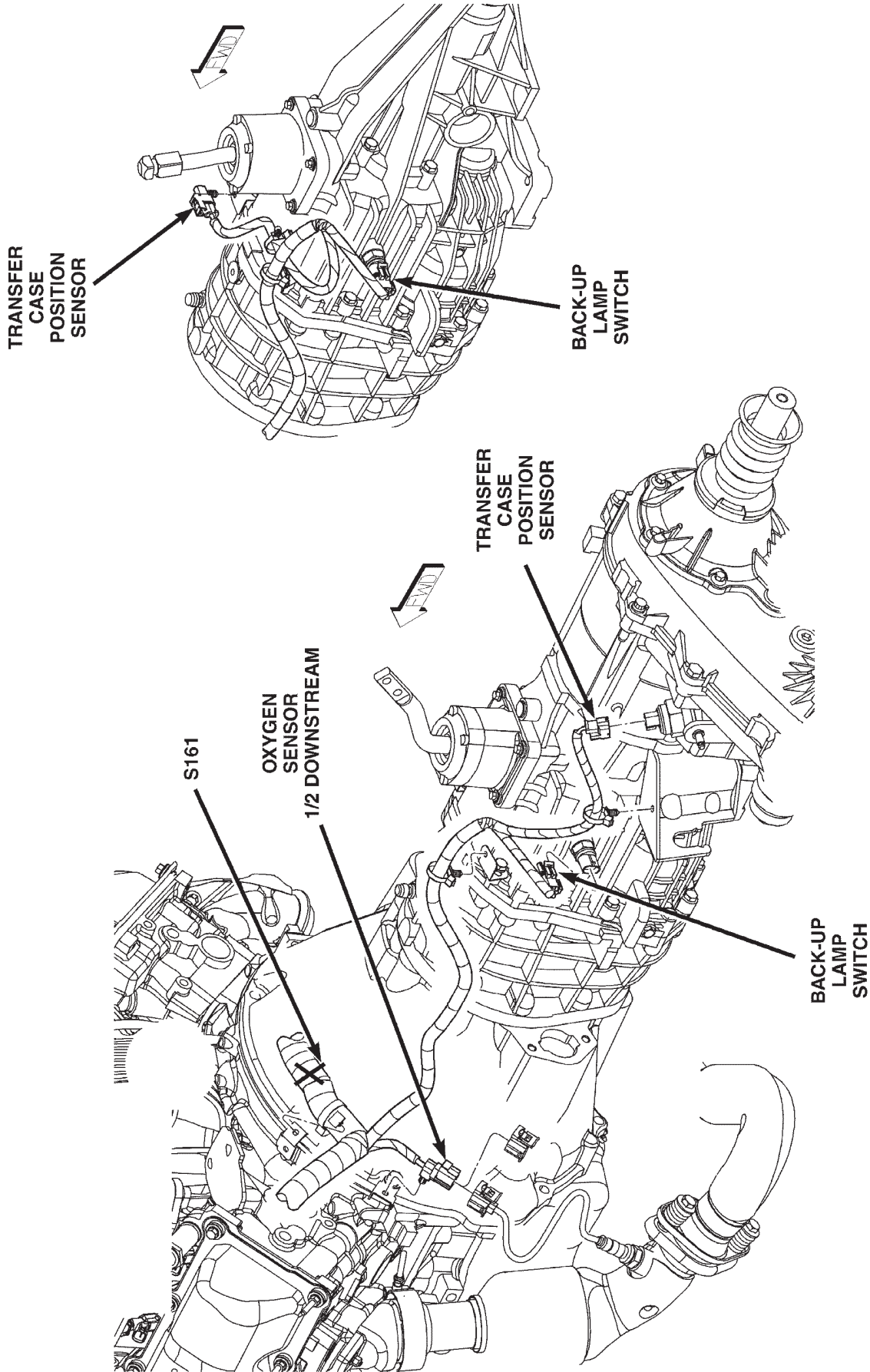
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4d9d

Fig. 6 RIGHT SIDE TRANSMISSION, 3.7L

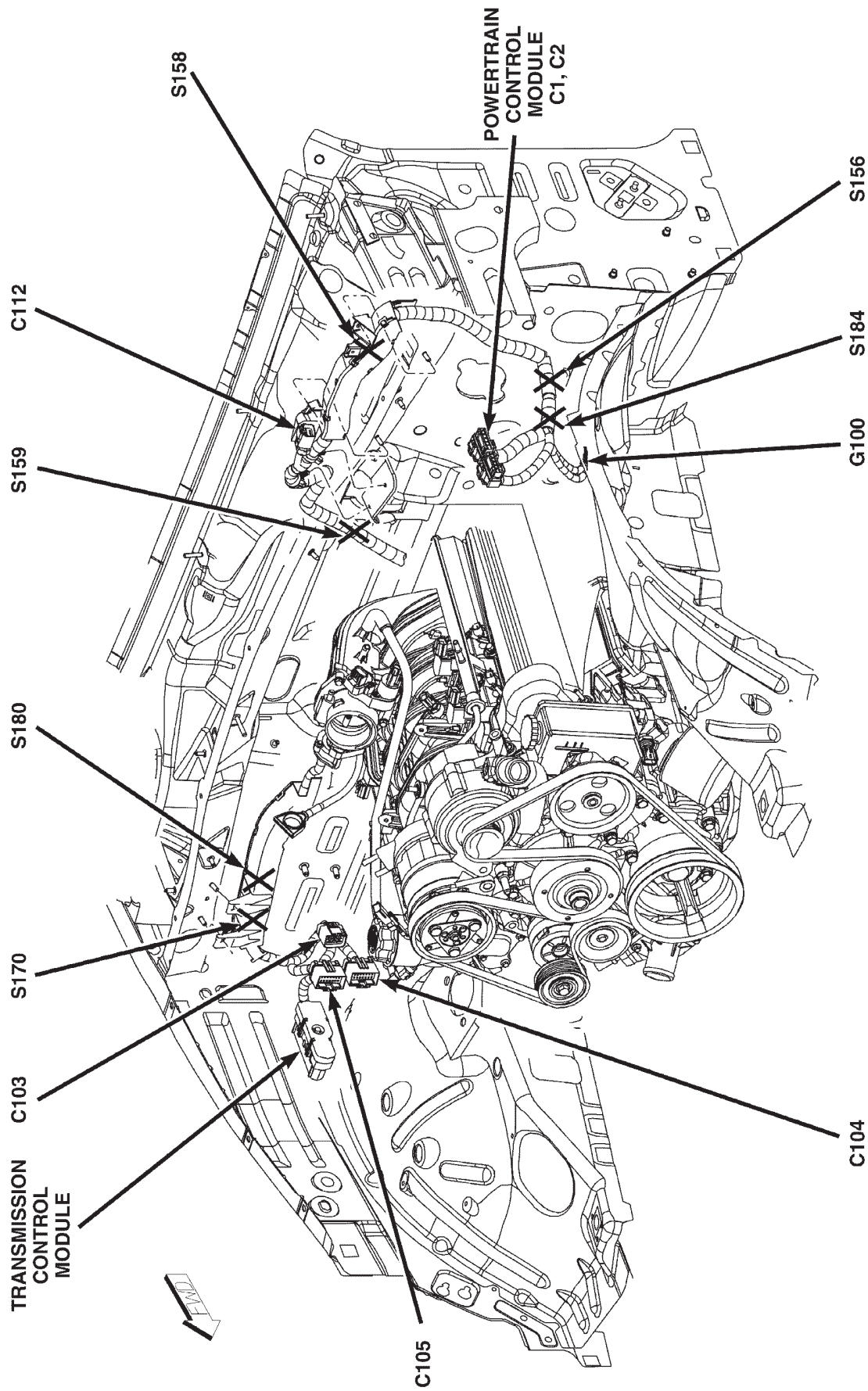
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4dc1

Fig. 7 MANUAL TRANSMISSION, 3.7L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

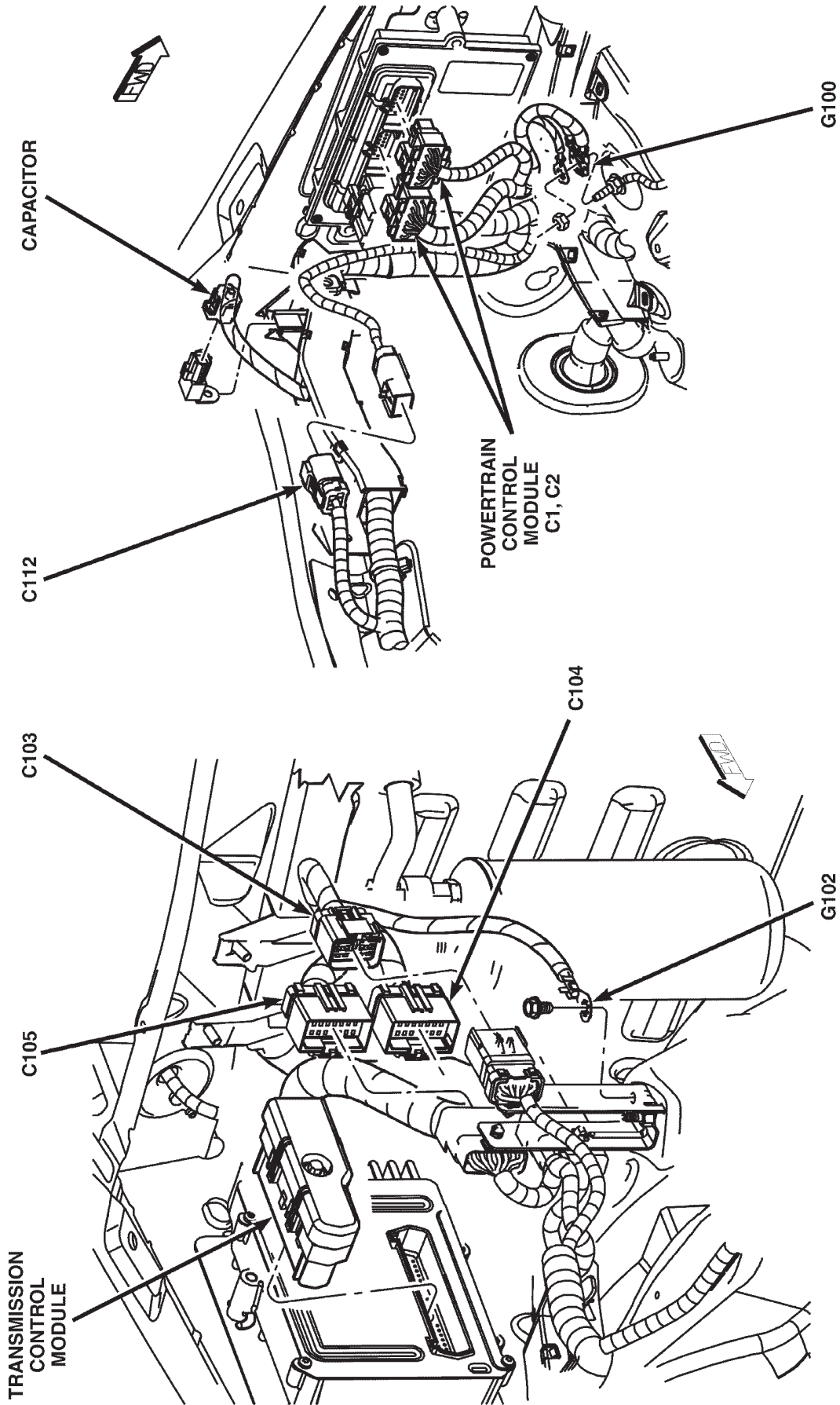


80ce4dc5

Fig. 8 RIGHT SIDE ENGINE COMPARTMENT, 3.7L



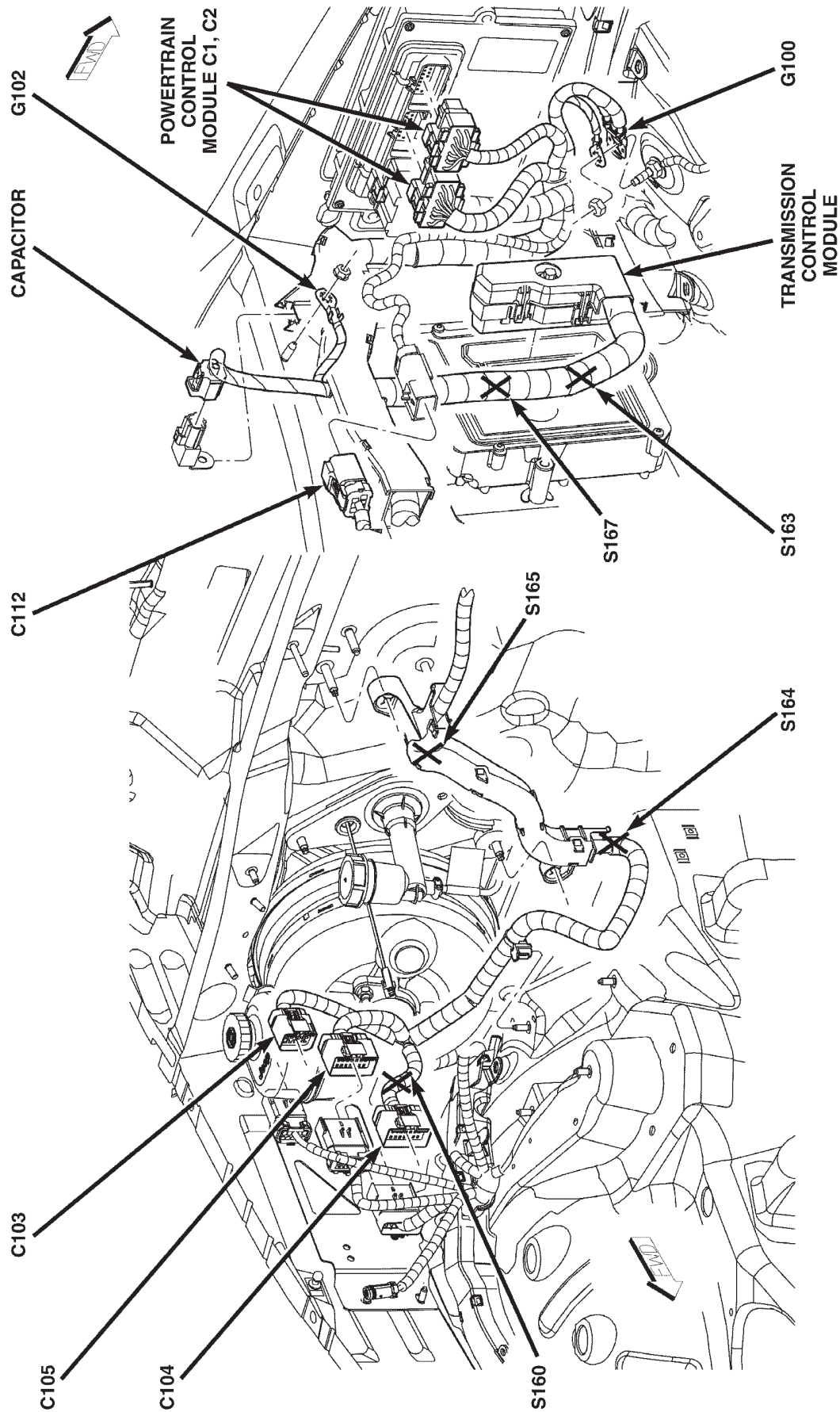
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4dcd

Fig. 9 LEFT SIDE ENGINE COMPARTMENT, 3.7L

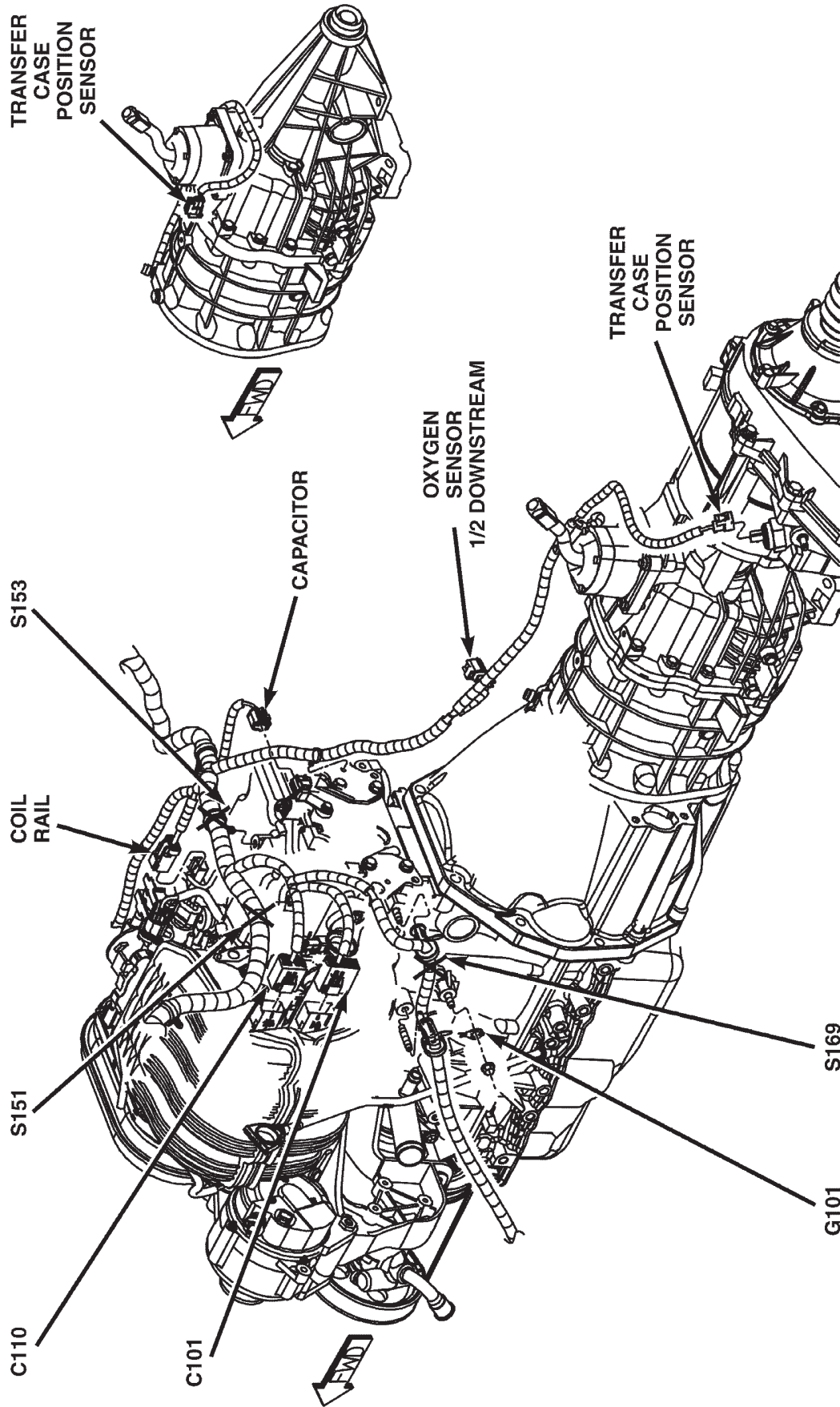
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4dc9

Fig. 10 RIGHT SIDE ENGINE COMPARTMENT, 3.7L, RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4dd7

Fig. 11 ENGINE/TRANSMISSION, 2.4L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ce4cbb

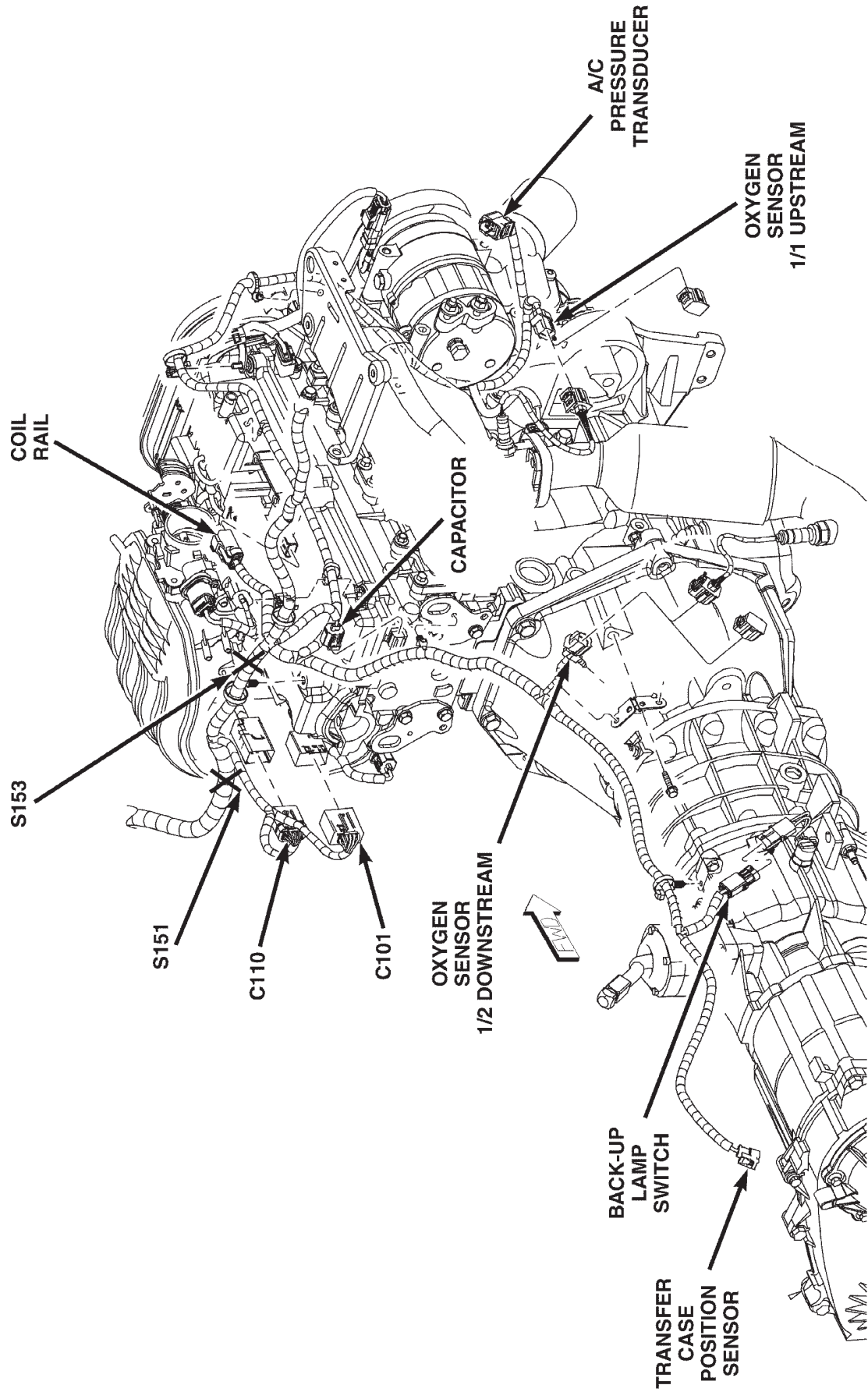


Fig. 12 ENGINE/TRANSMISSION, 2.4L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ce4de0

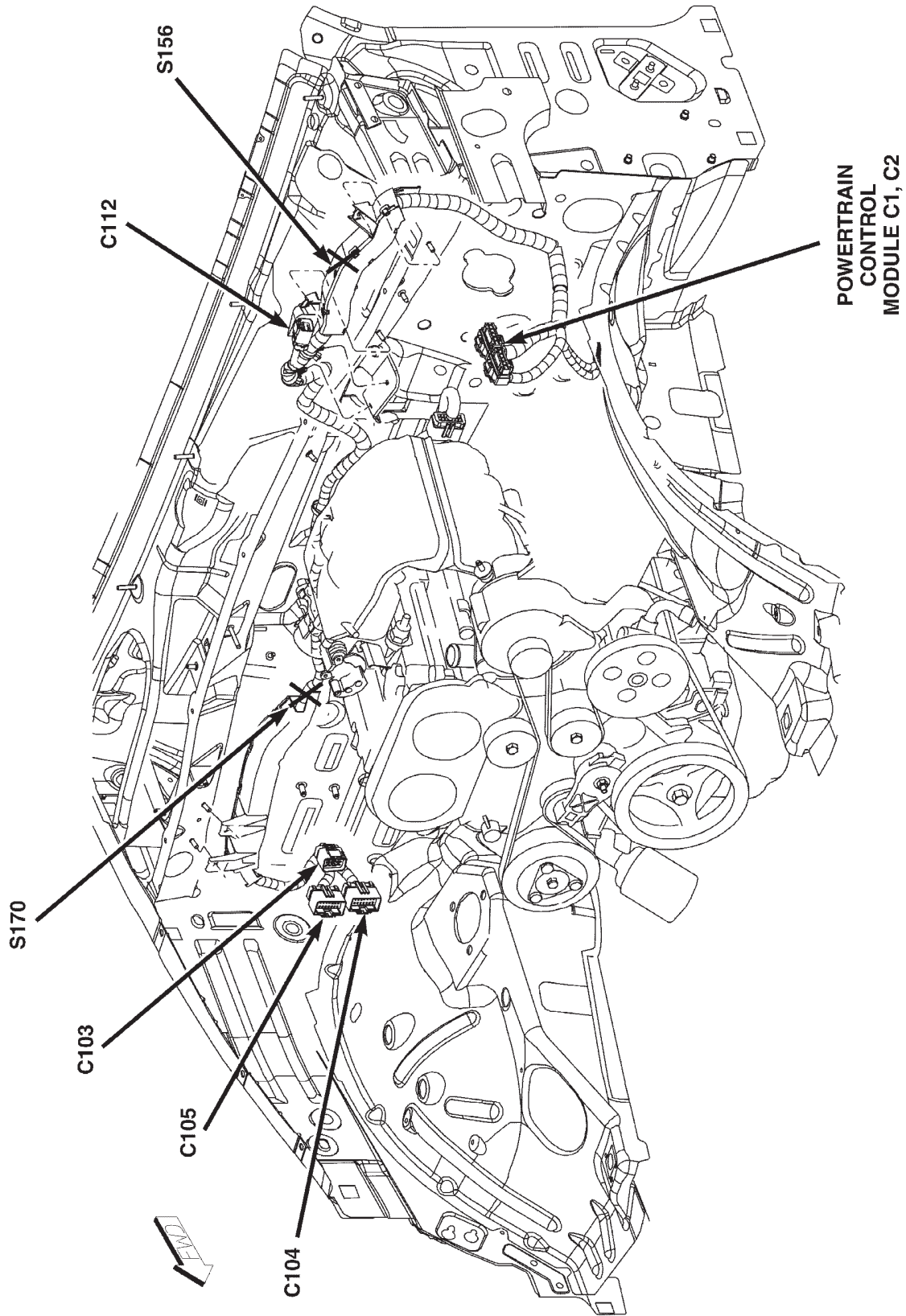
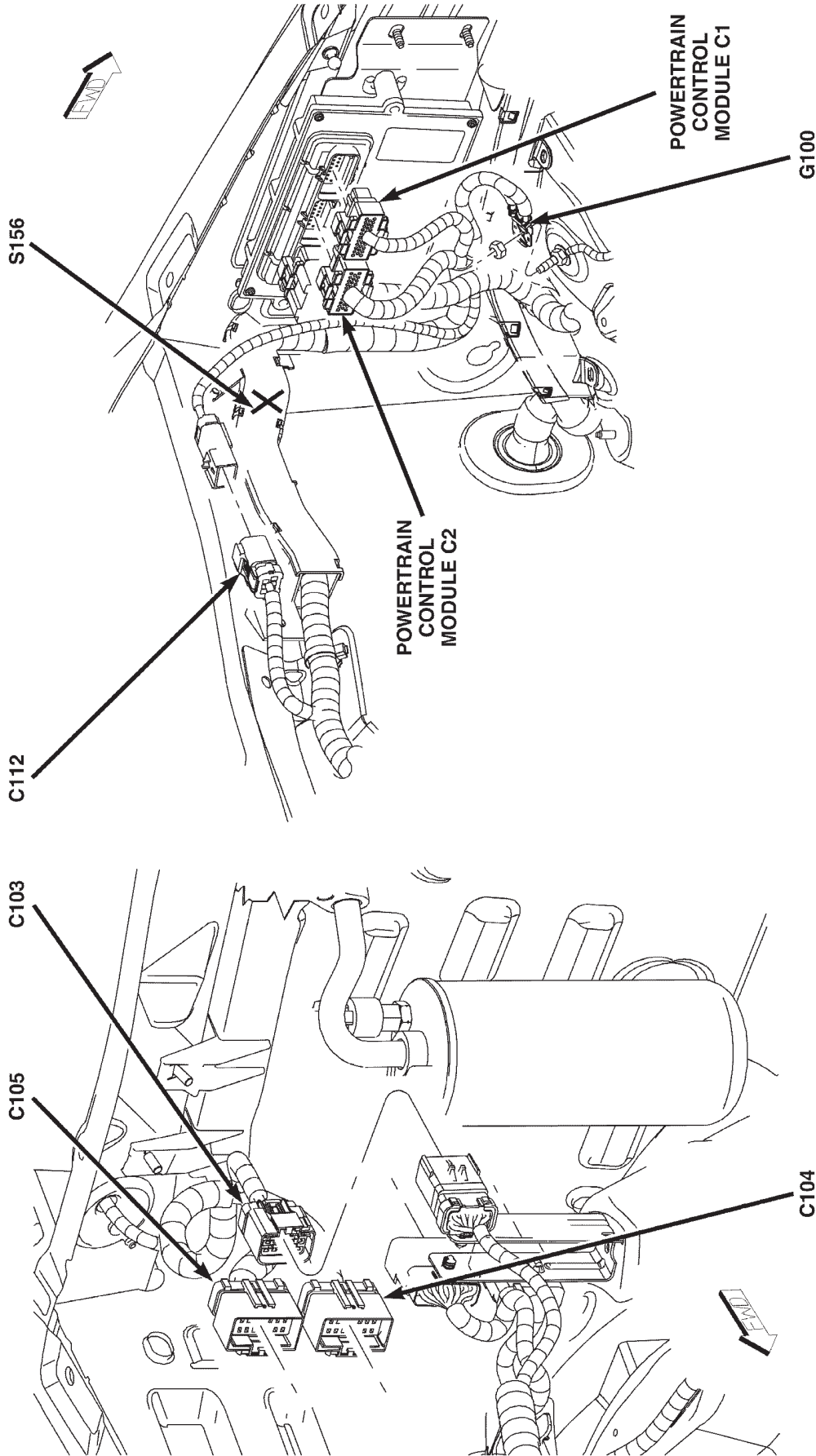


Fig. 13 ENGINE COMPARTMENT, 2.4L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80cc4de7

Fig. 14 RIGHT REAR ENGINE COMPARTMENT, 2.4L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

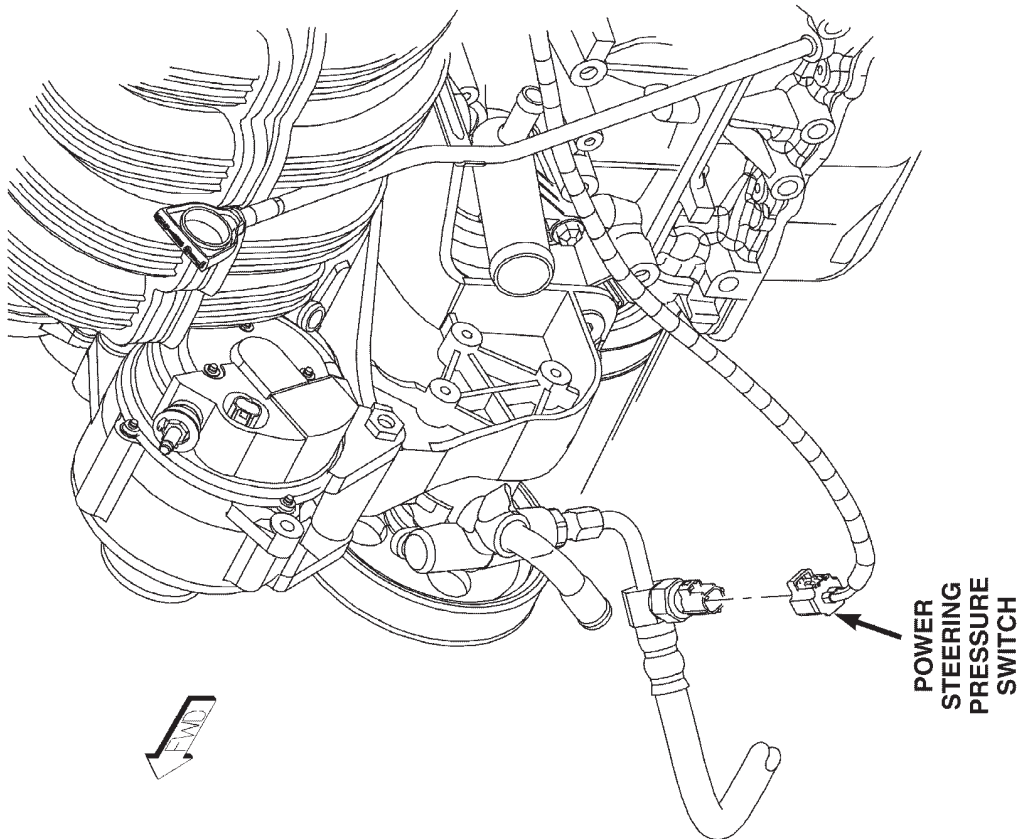
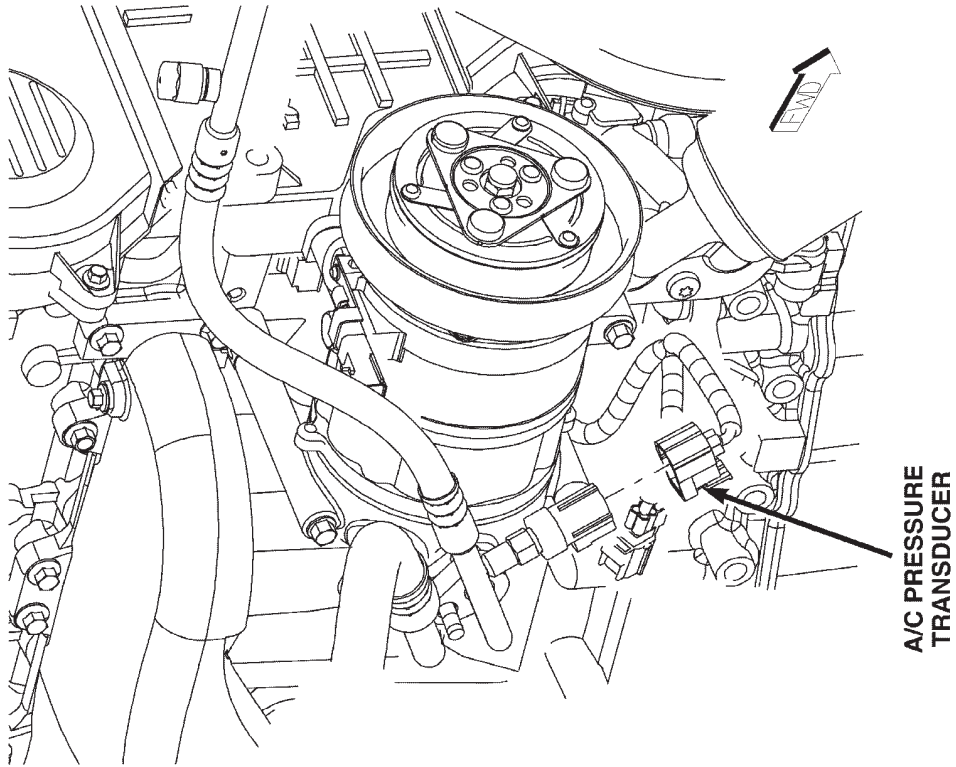
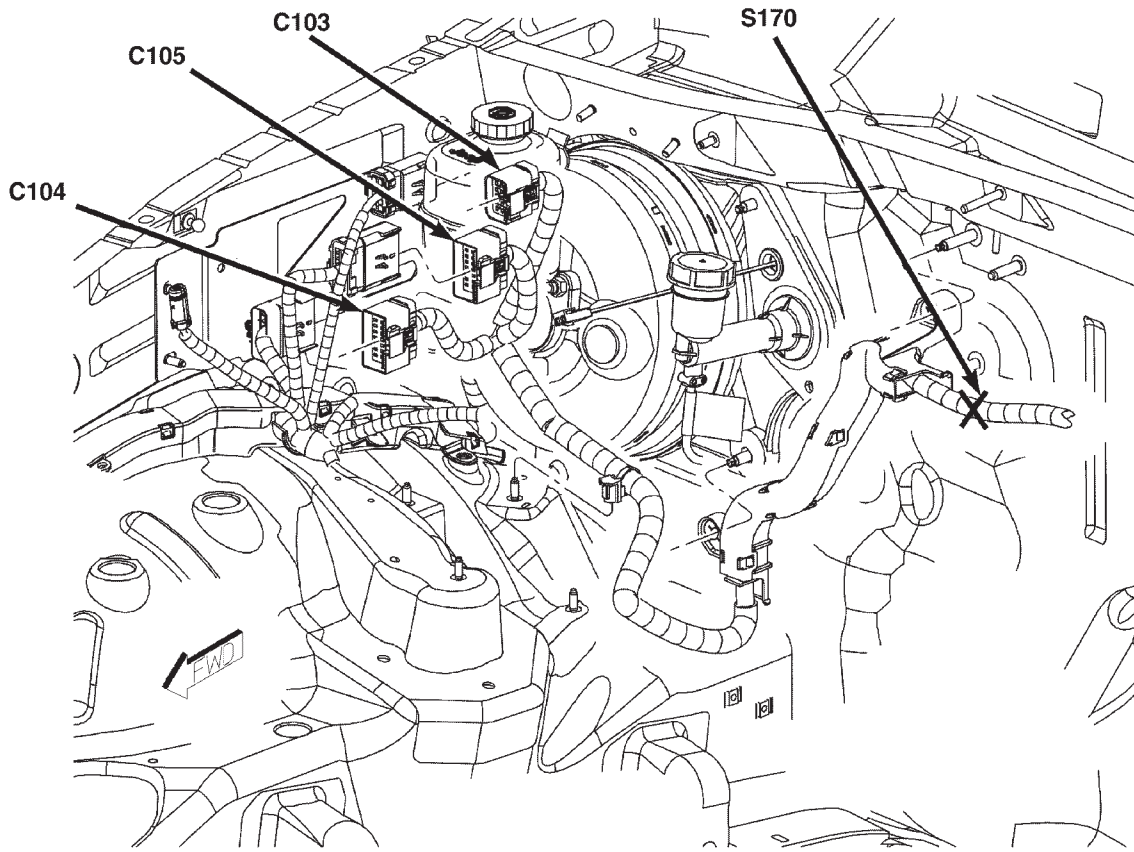


Fig. 15 ENGINE, 2.4L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

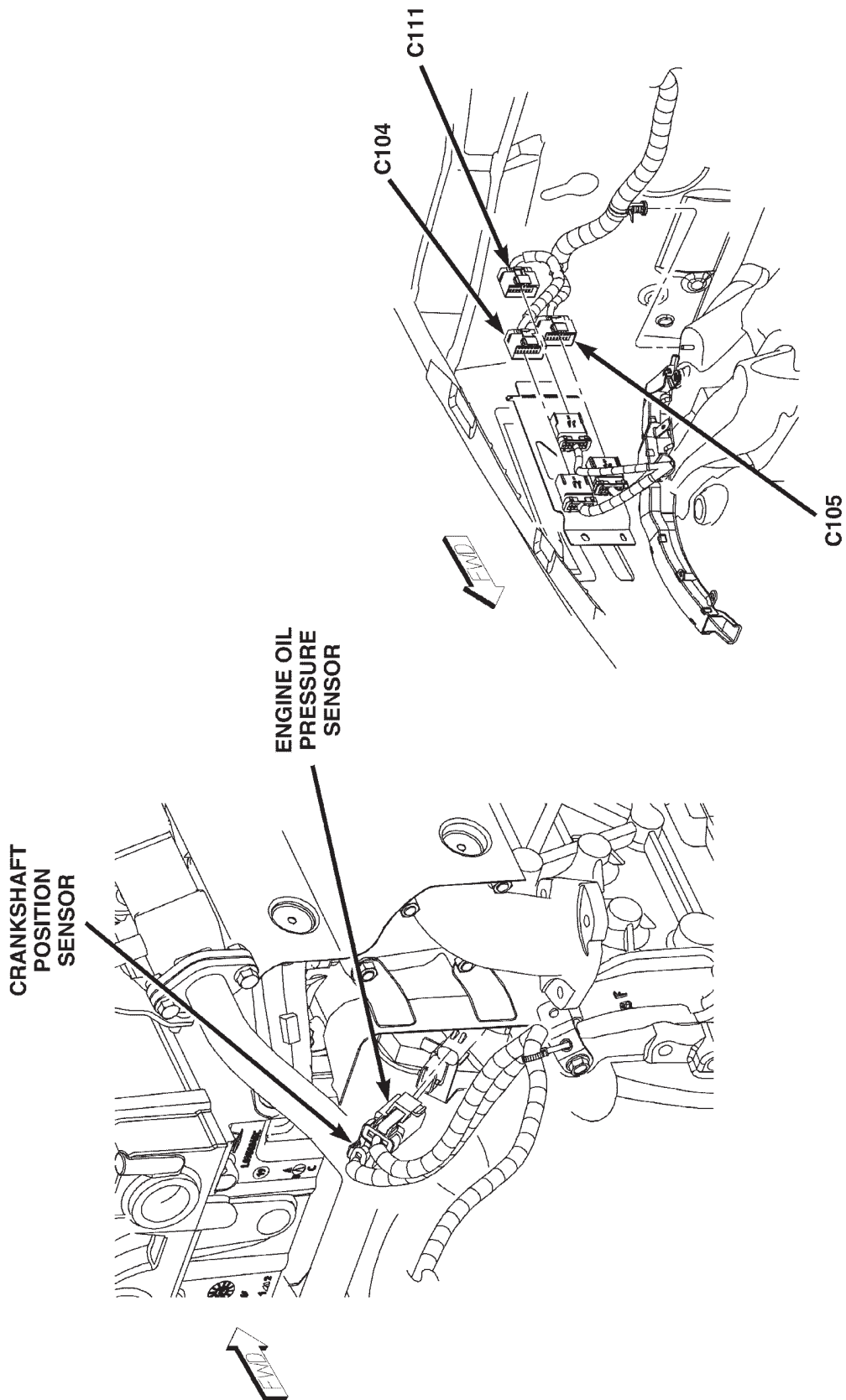


80ce4df6

**Fig. 16 RIGHT REAR ENGINE COMPARTMENT, 2.4L**



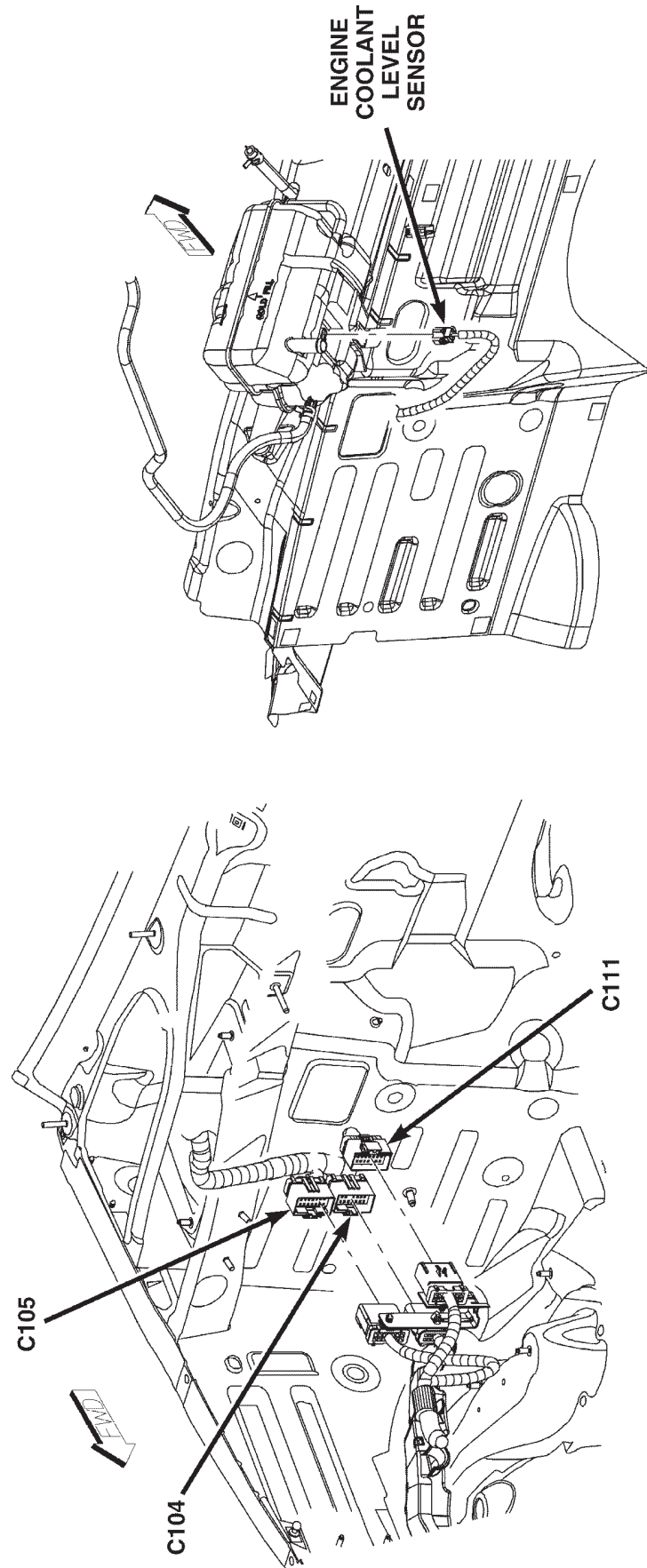
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4d1d

Fig. 17 DIESEL ENGINE

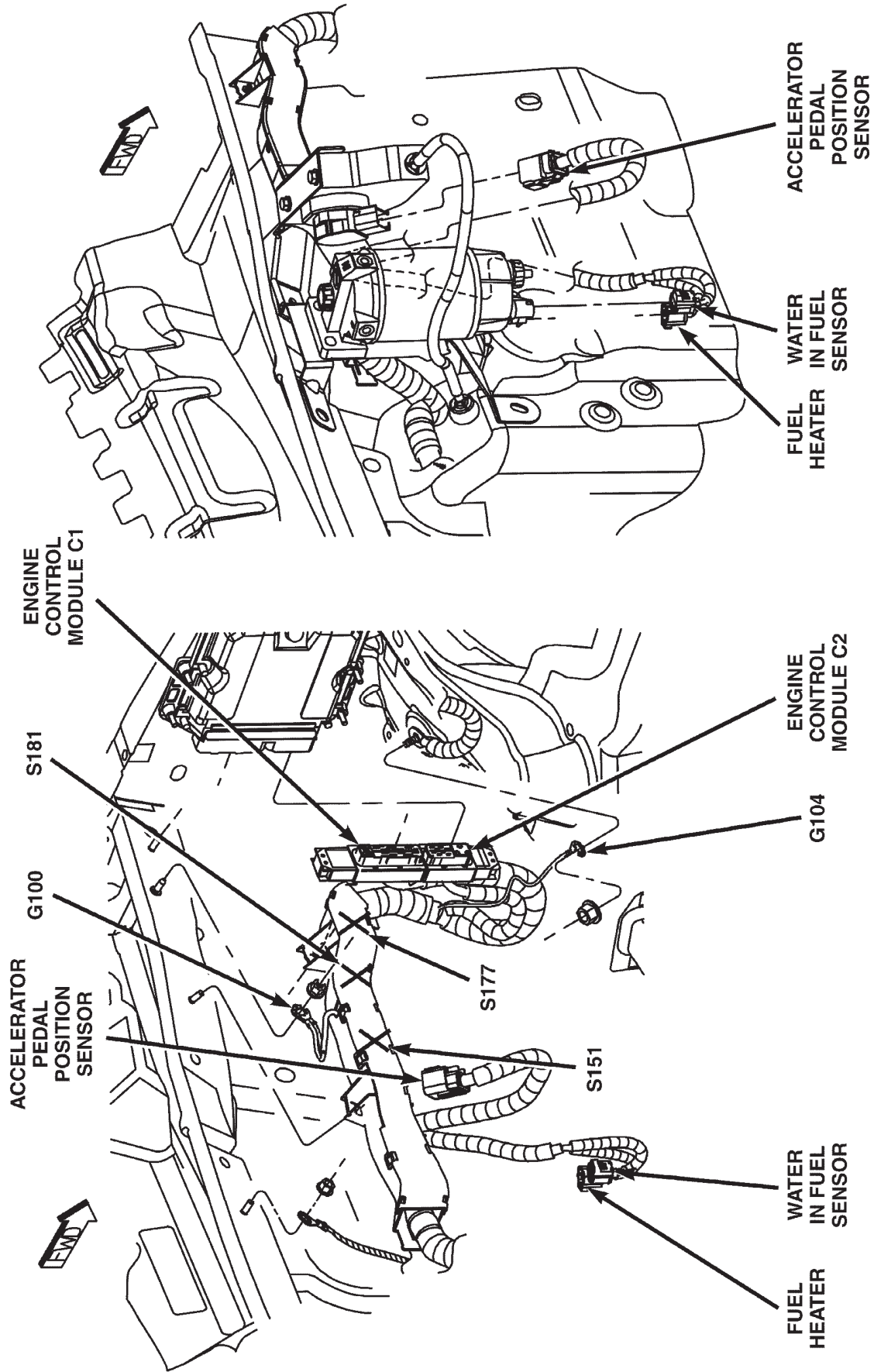
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e02

Fig. 18 DIESEL ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e09

Fig. 19 DIESEL ENGINE COMPARTMENT

80ce4e10

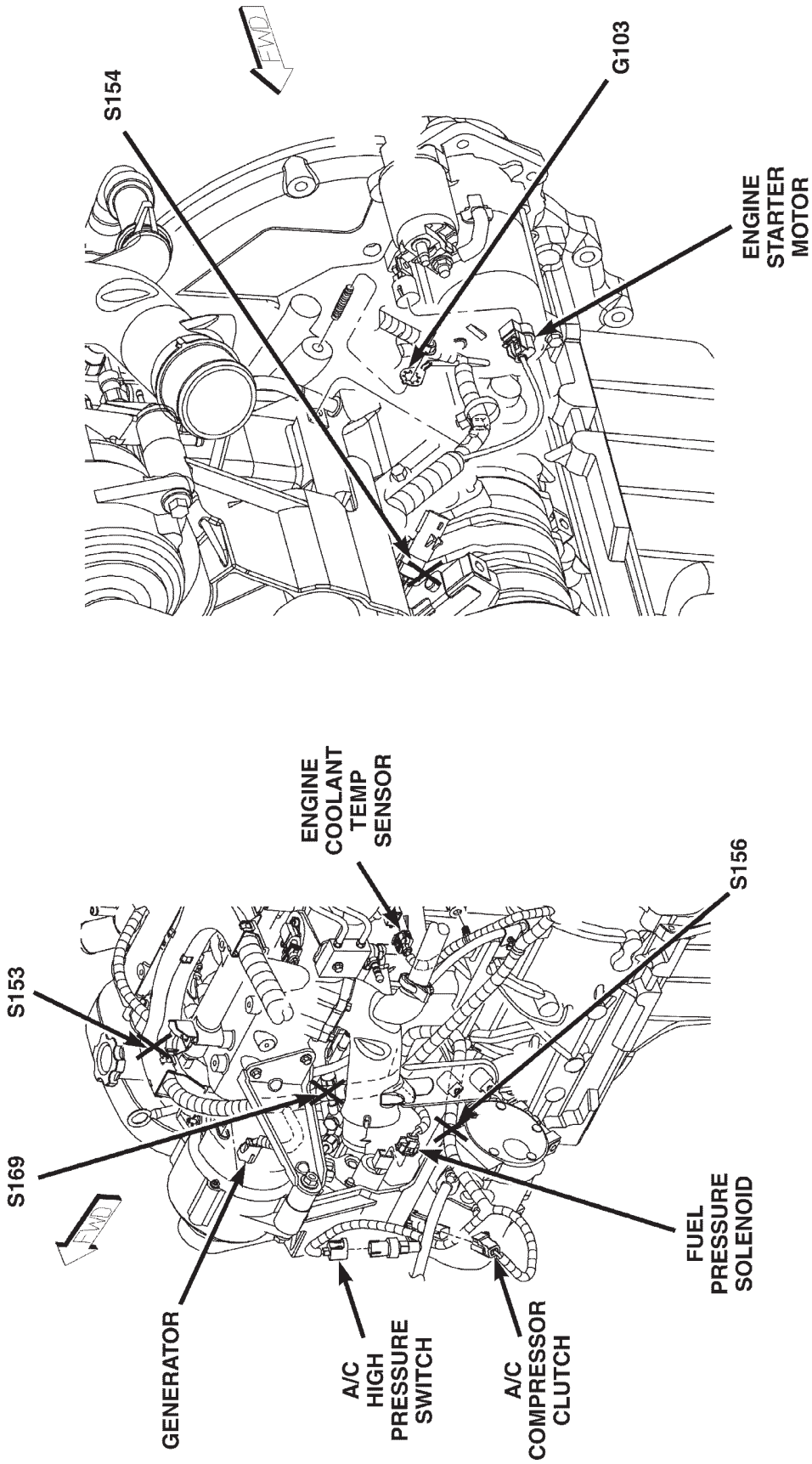
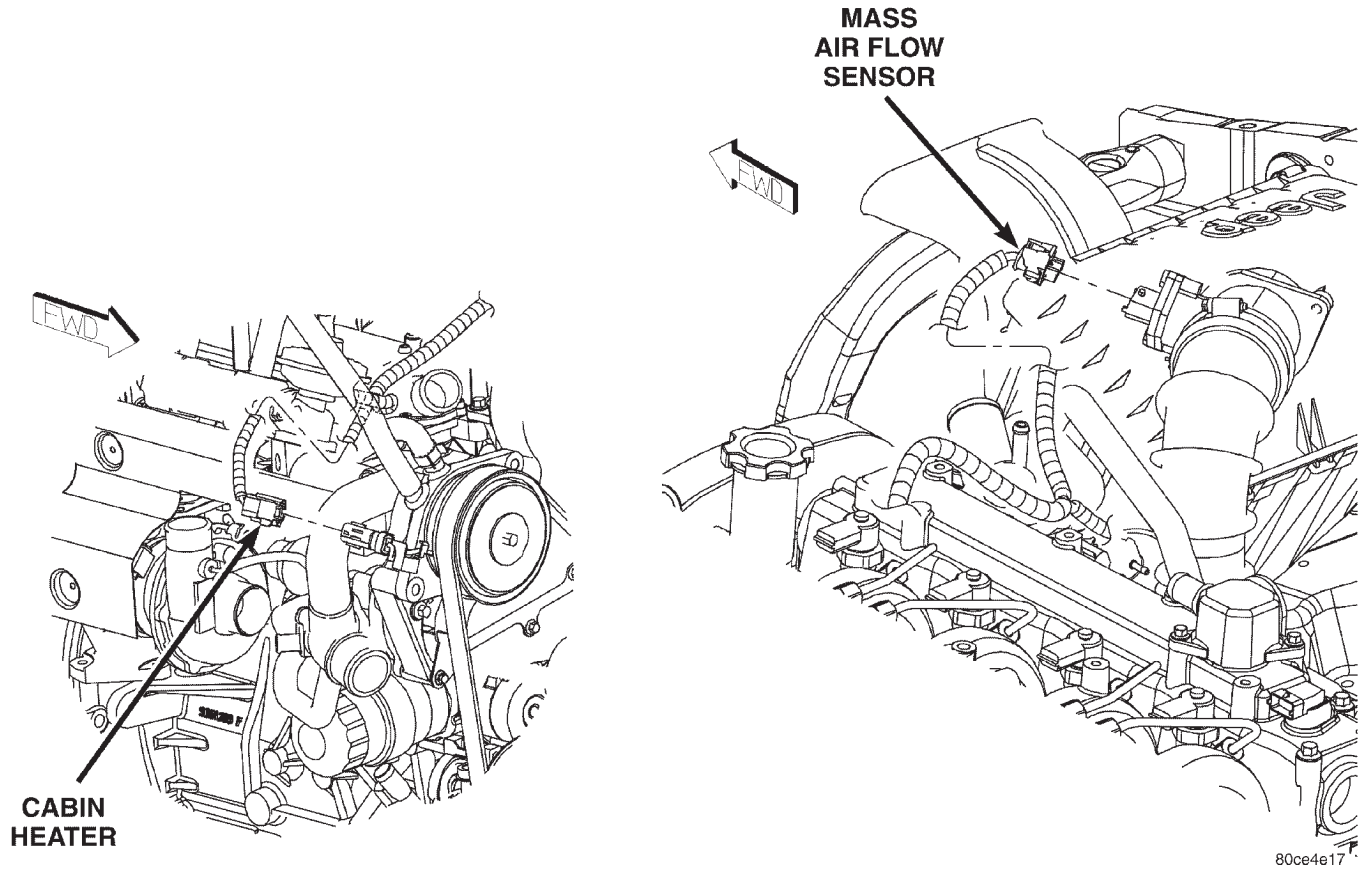


Fig. 20 LEFT SIDE DIESEL ENGINE

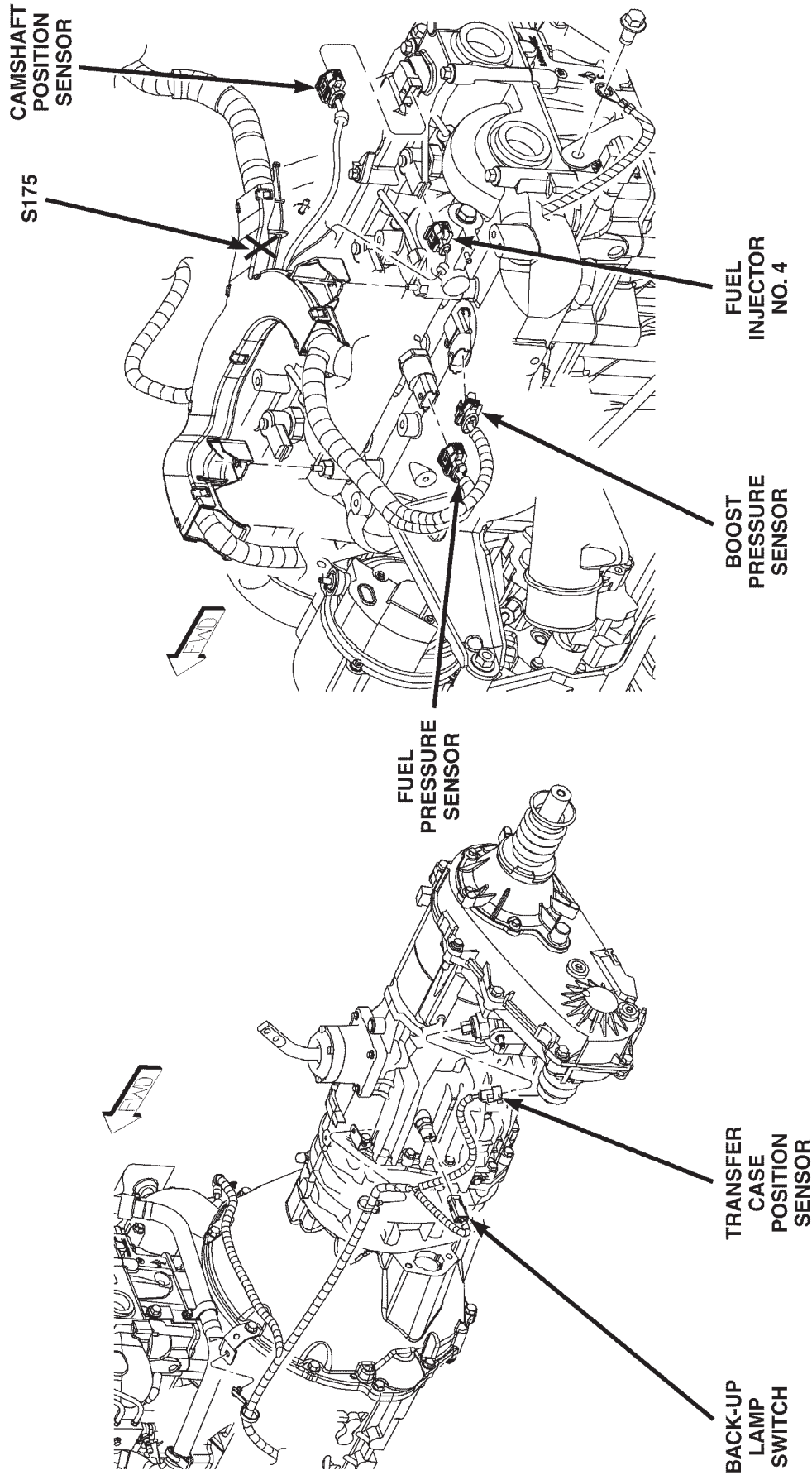
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e17

**Fig. 21 FRONT DIESEL ENGINE**

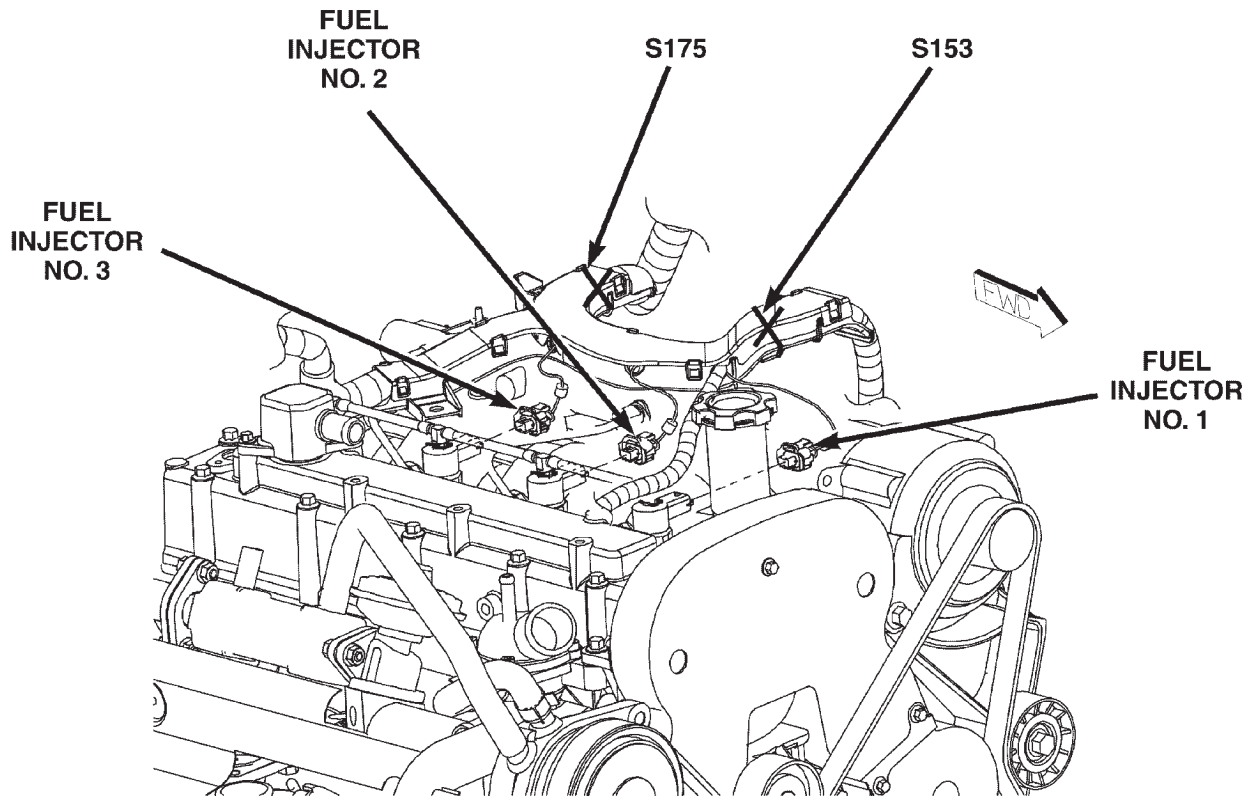
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e25

Fig. 22 REAR DIESEL ENGINE

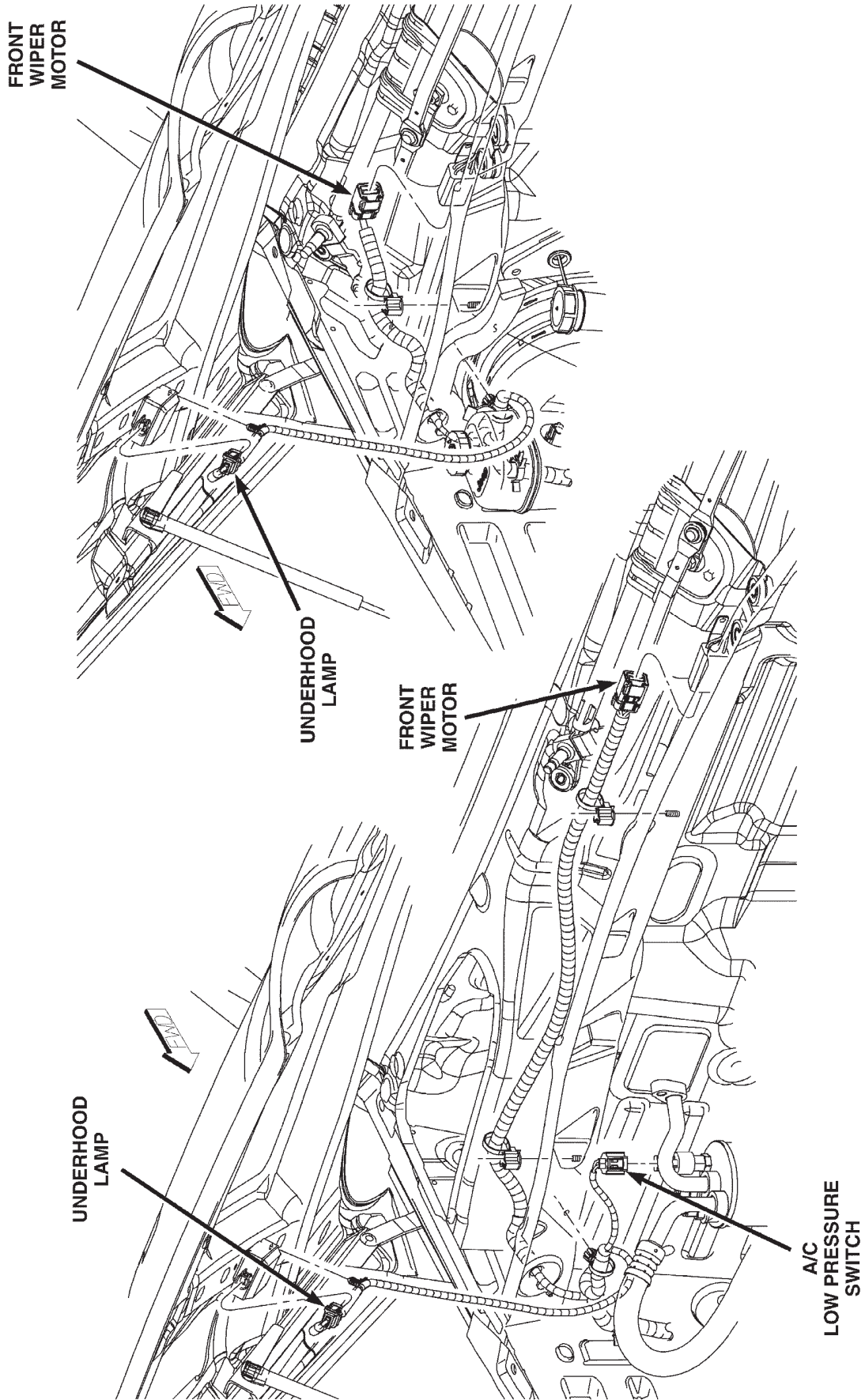
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e32

**Fig. 23 TOP DIESEL ENGINE**

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e43

Fig. 24 LEFT SIDE ENGINE COMPARTMENT



CONNECTOR/GROUND/SPLICE LOCATION (Continued)

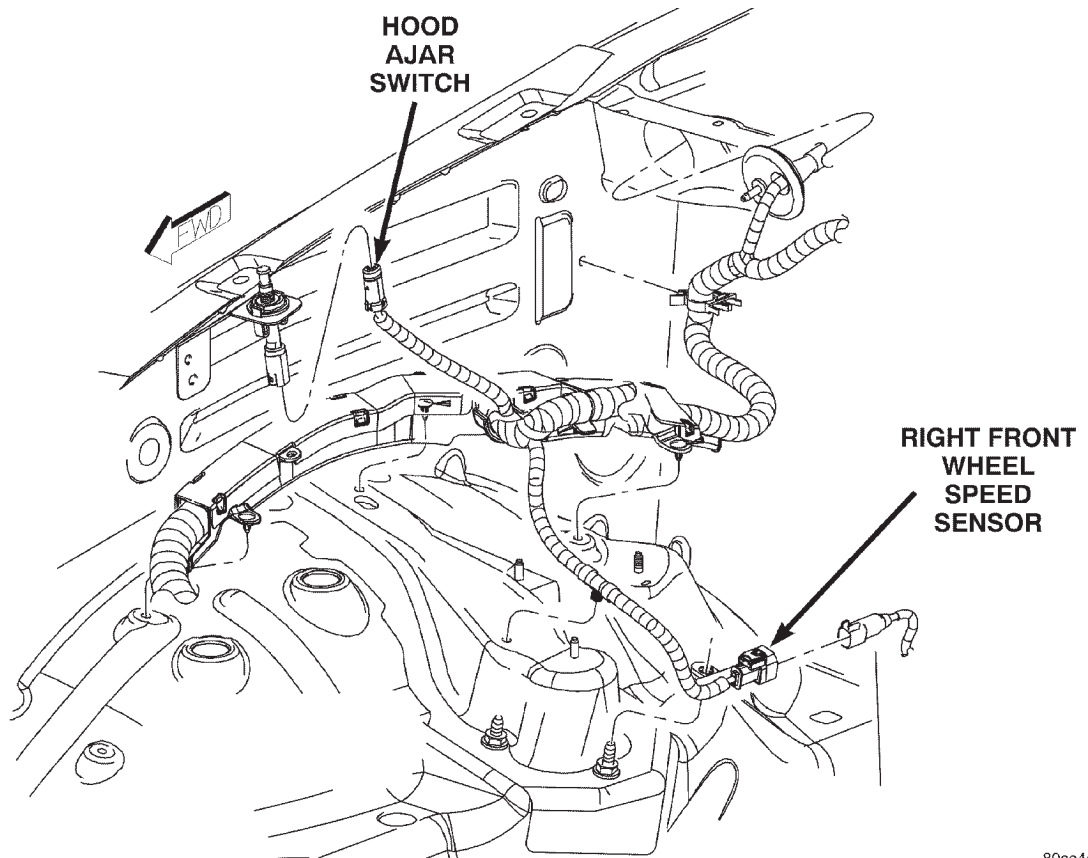


Fig. 25 RIGHT SIDE ENGINE COMPARTMENT

80ce4e53

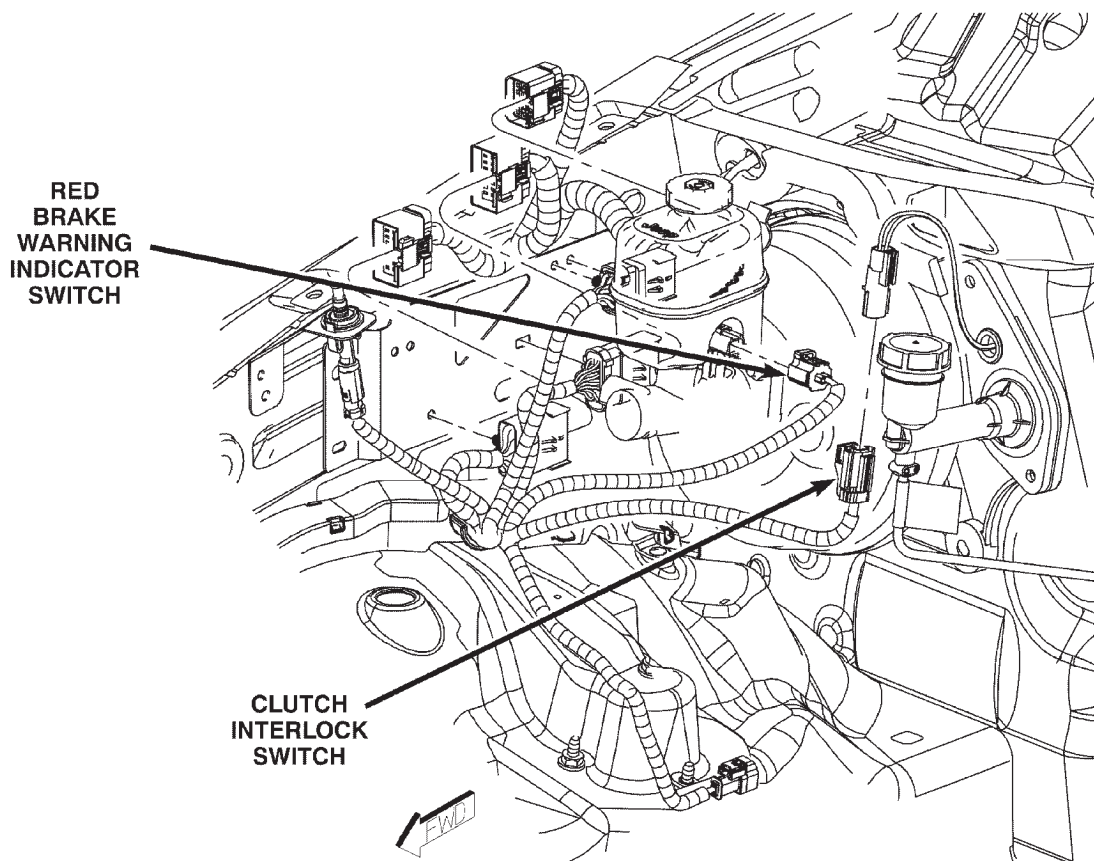
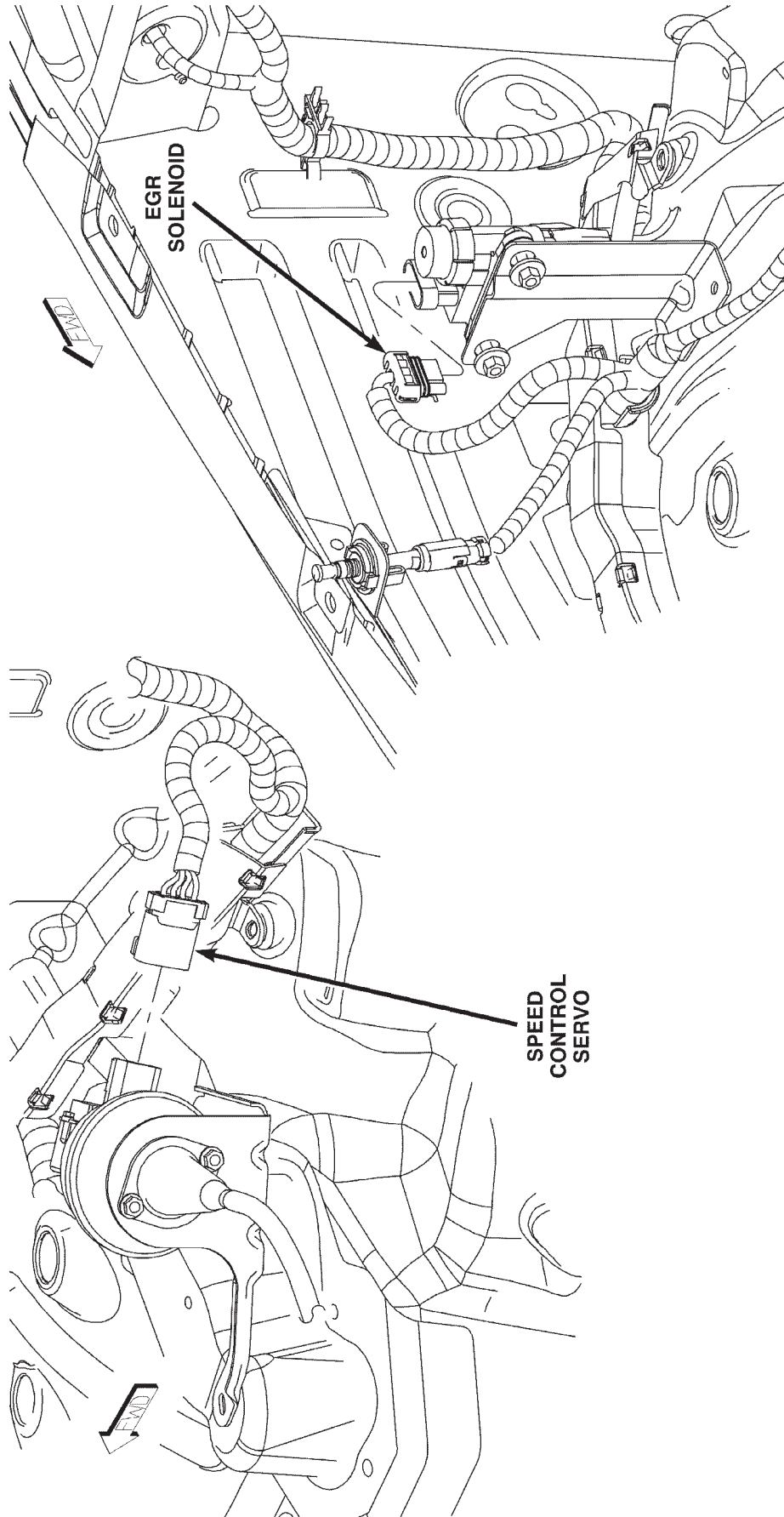


Fig. 26 RIGHT SIDE ENGINE COMPARTMENT, RHD

80ce4e5a

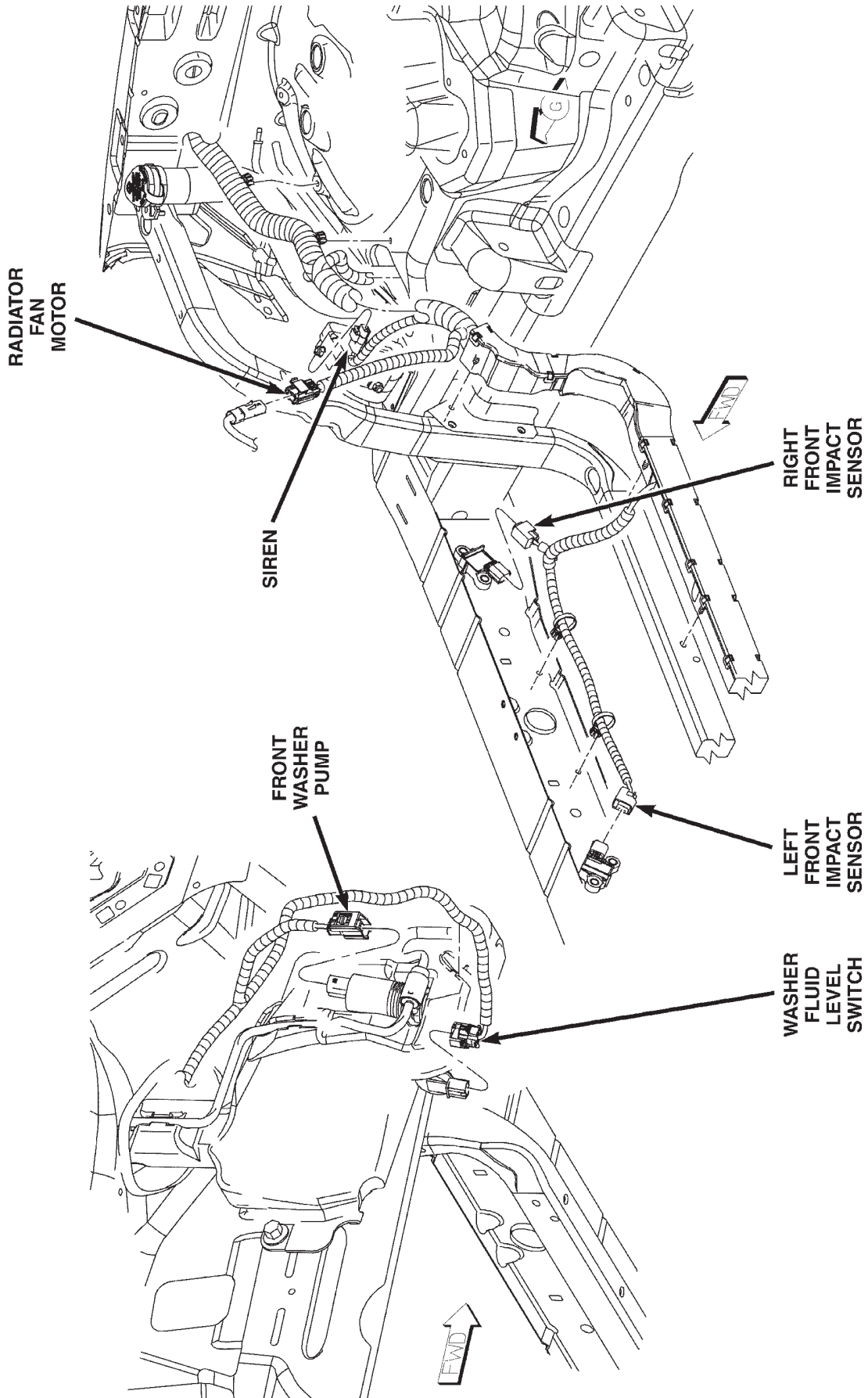
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e5e

Fig. 27 ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4e89

Fig. 28 ENGINE COMPARTMENT

80ce4e96

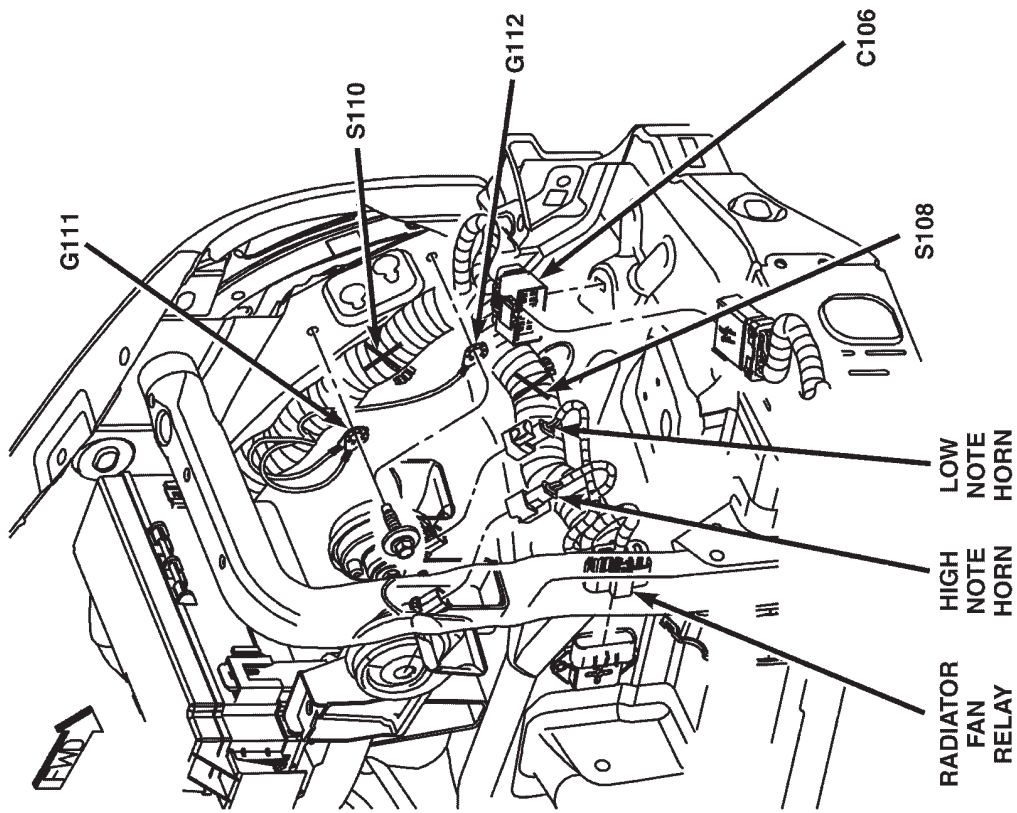
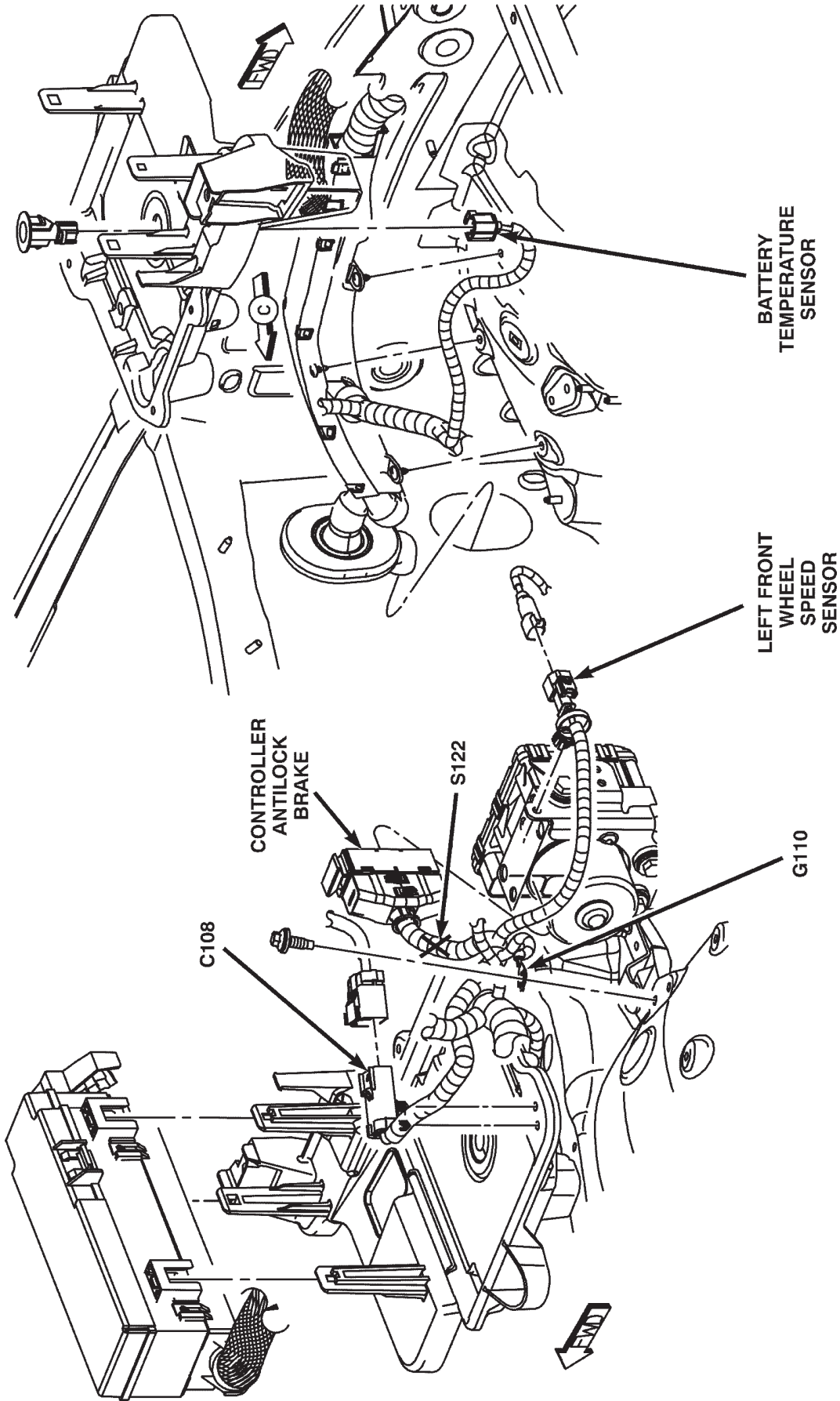


Fig. 29 FRONT ENGINE COMPARTMENT

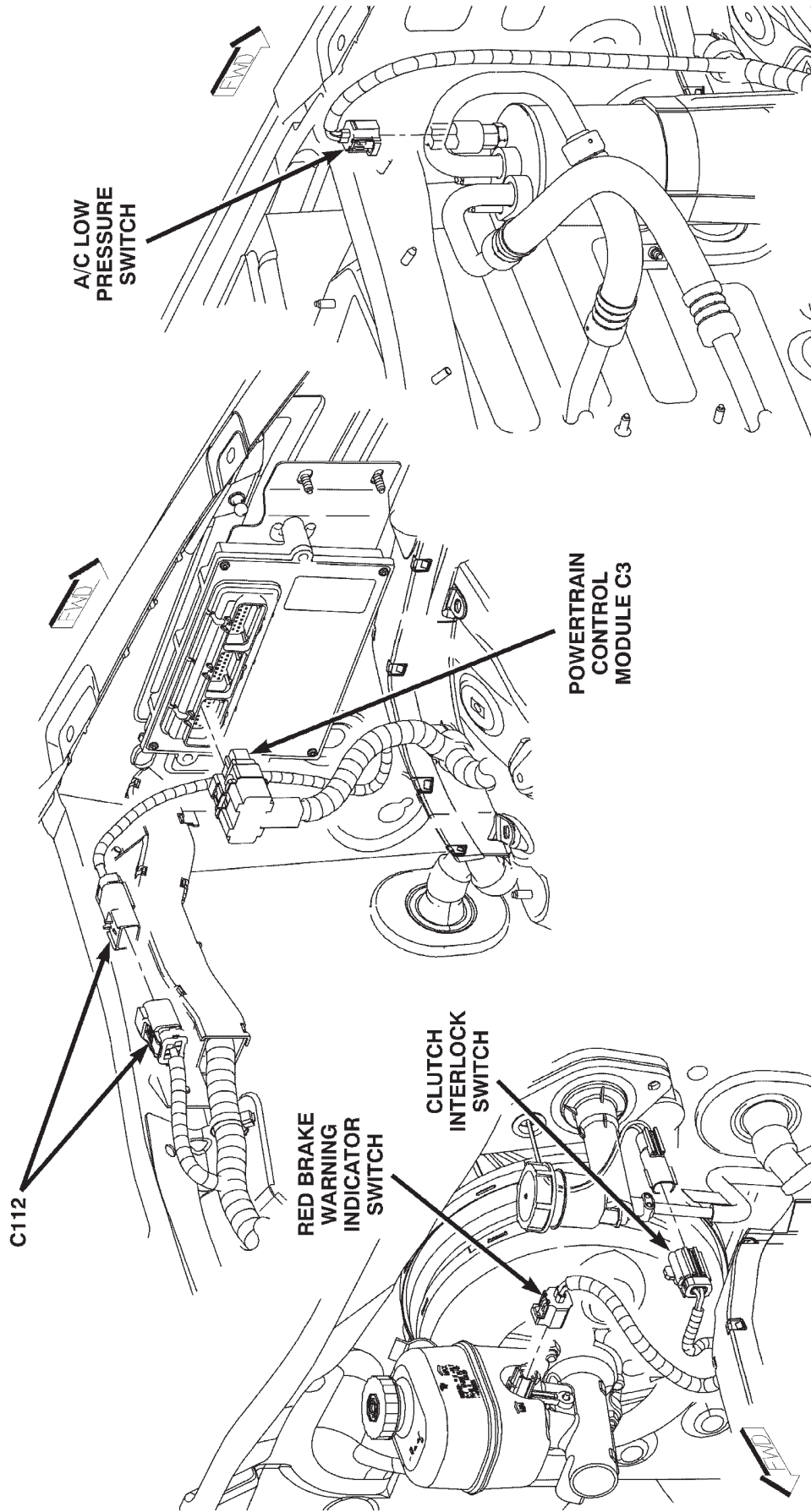
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4ea1

Fig. 30 LEFT SIDE ENGINE COMPARTMENT

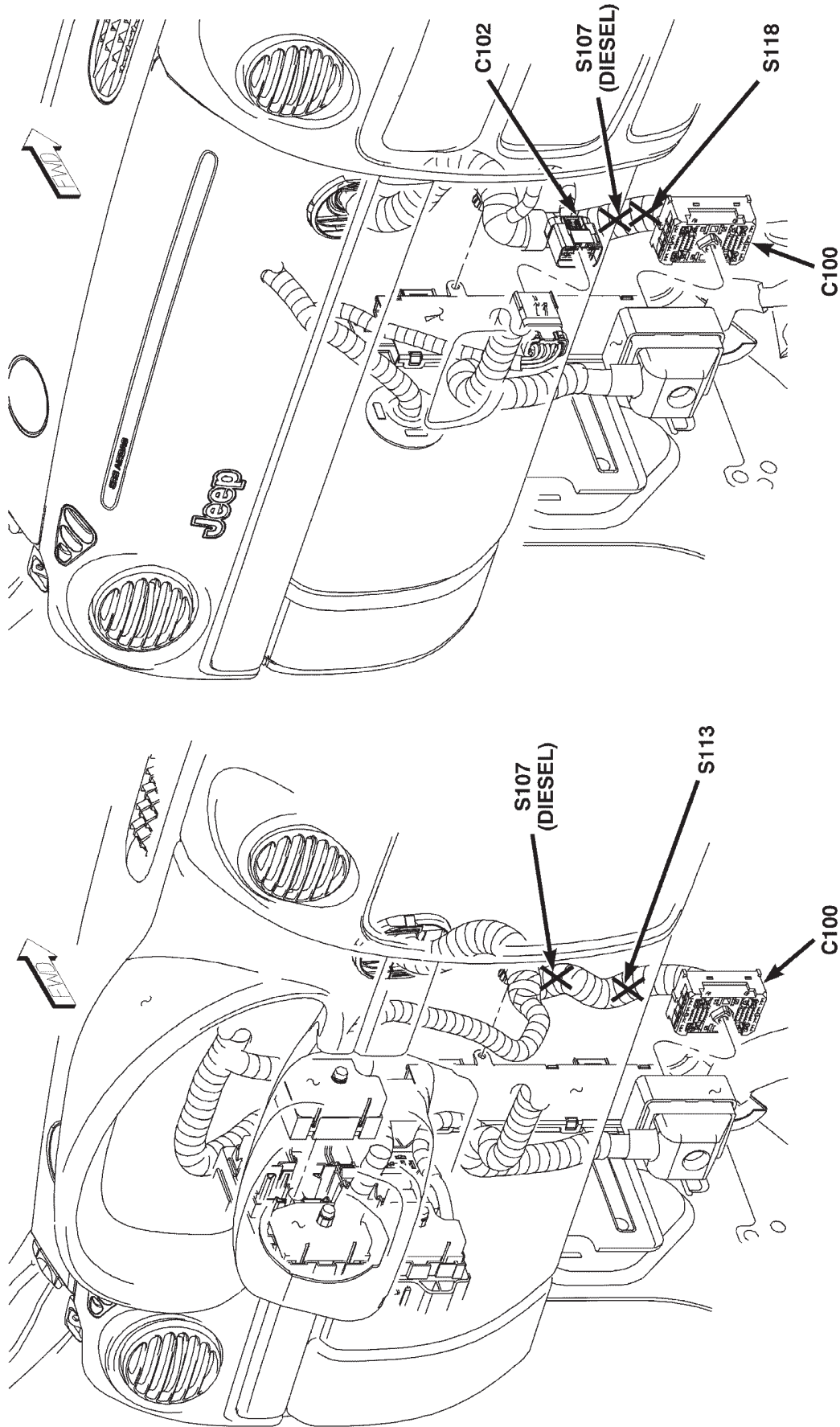
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80cc4ea5

Fig. 31 REAR ENGINE COMPARTMENT, RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4eb8

Fig. 32 ENGINE TO INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ce4ef9

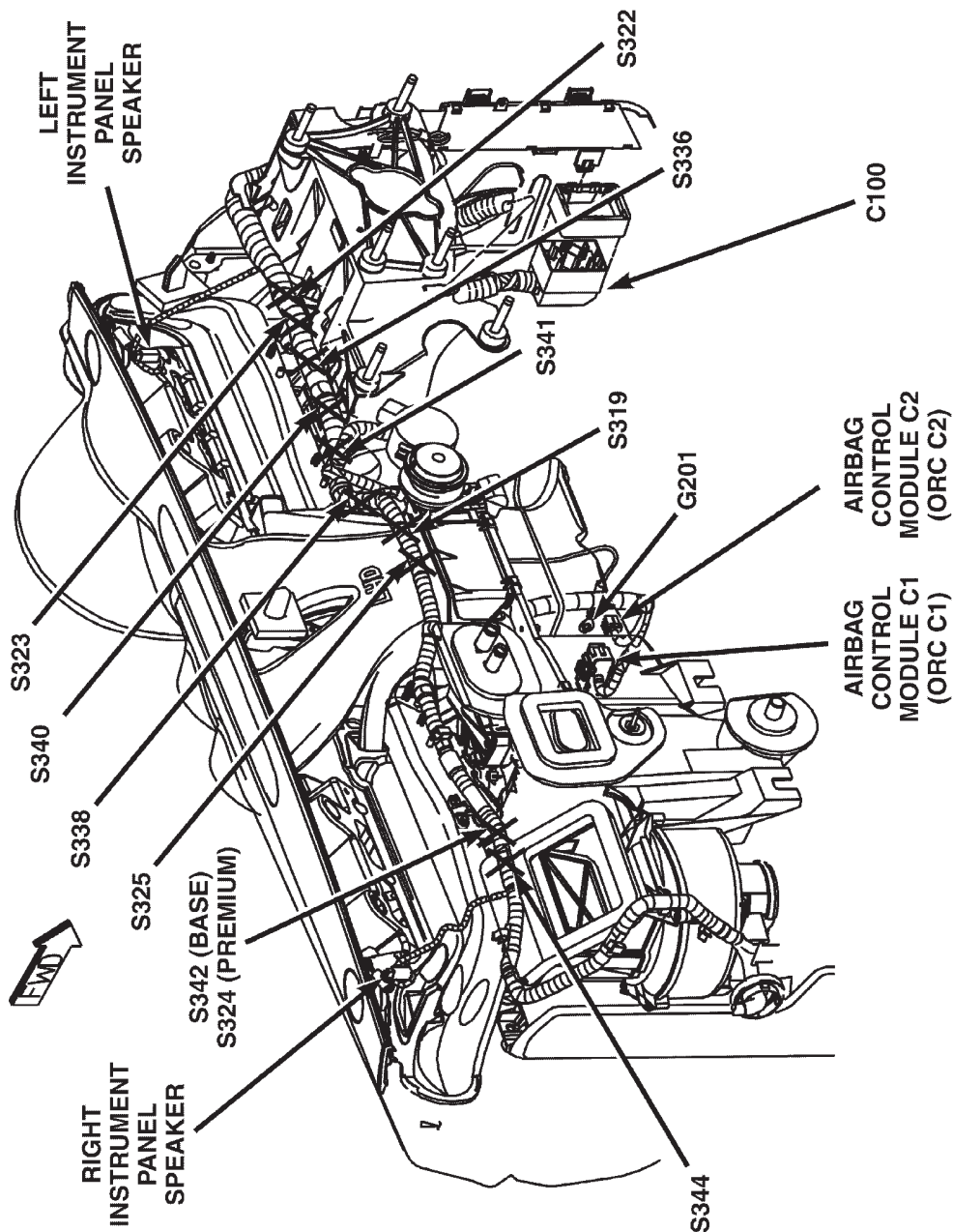
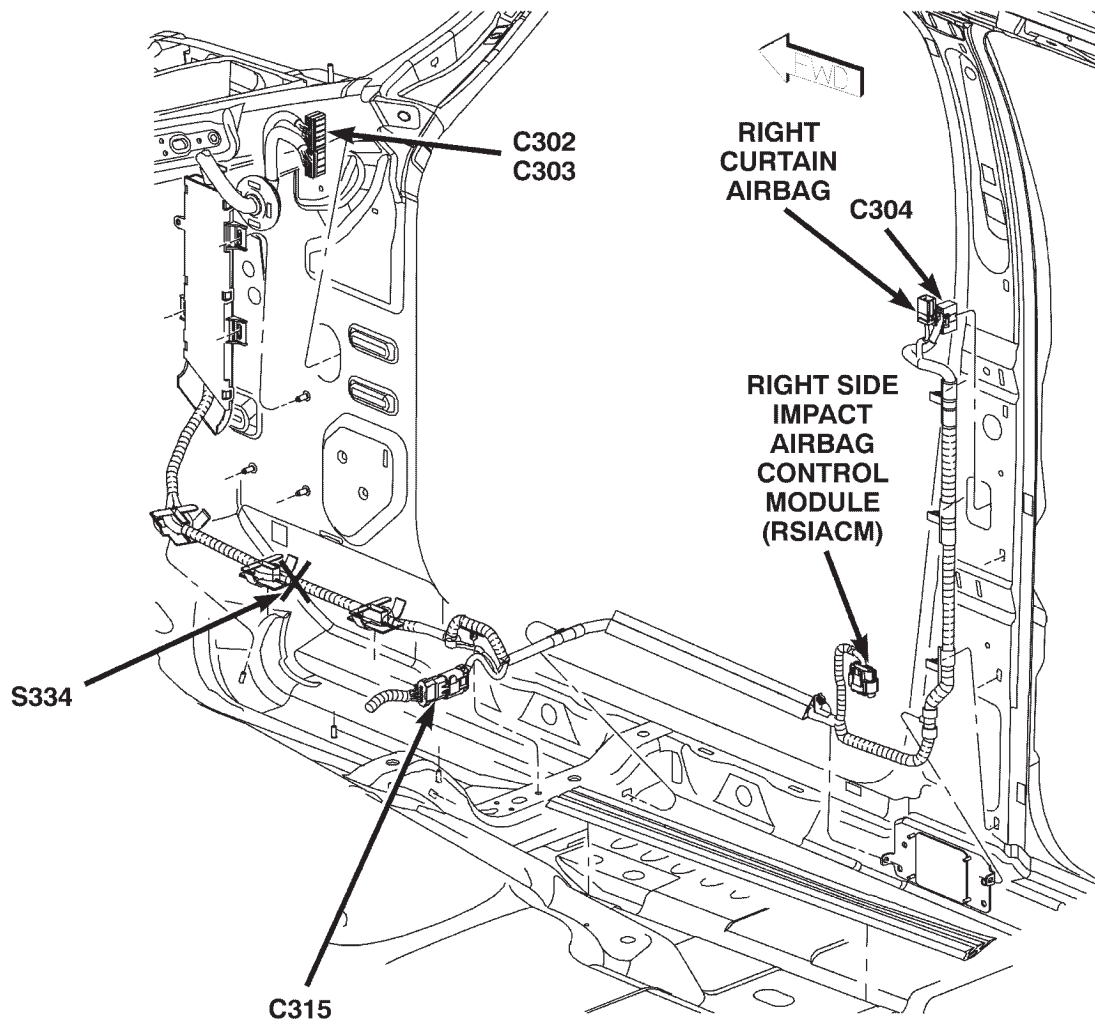


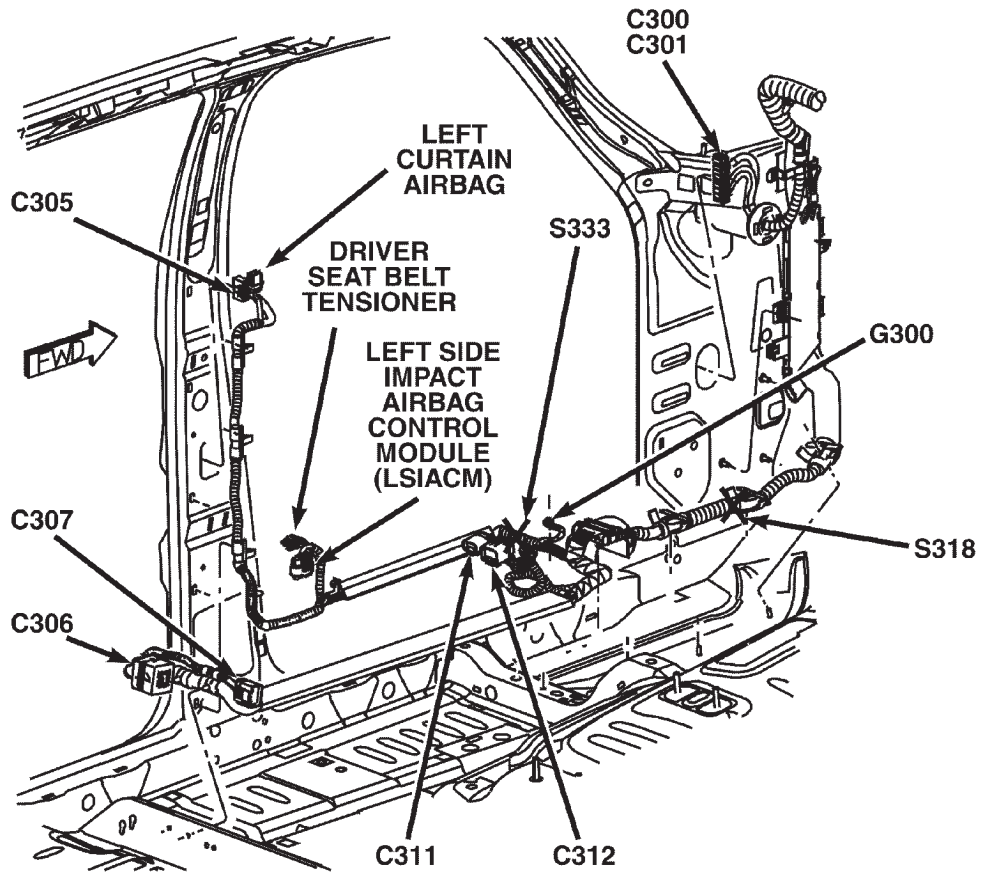
Fig. 33 INSTRUMENT PANEL, LHD





**Fig. 34 RIGHT FRONT BODY, LHD**

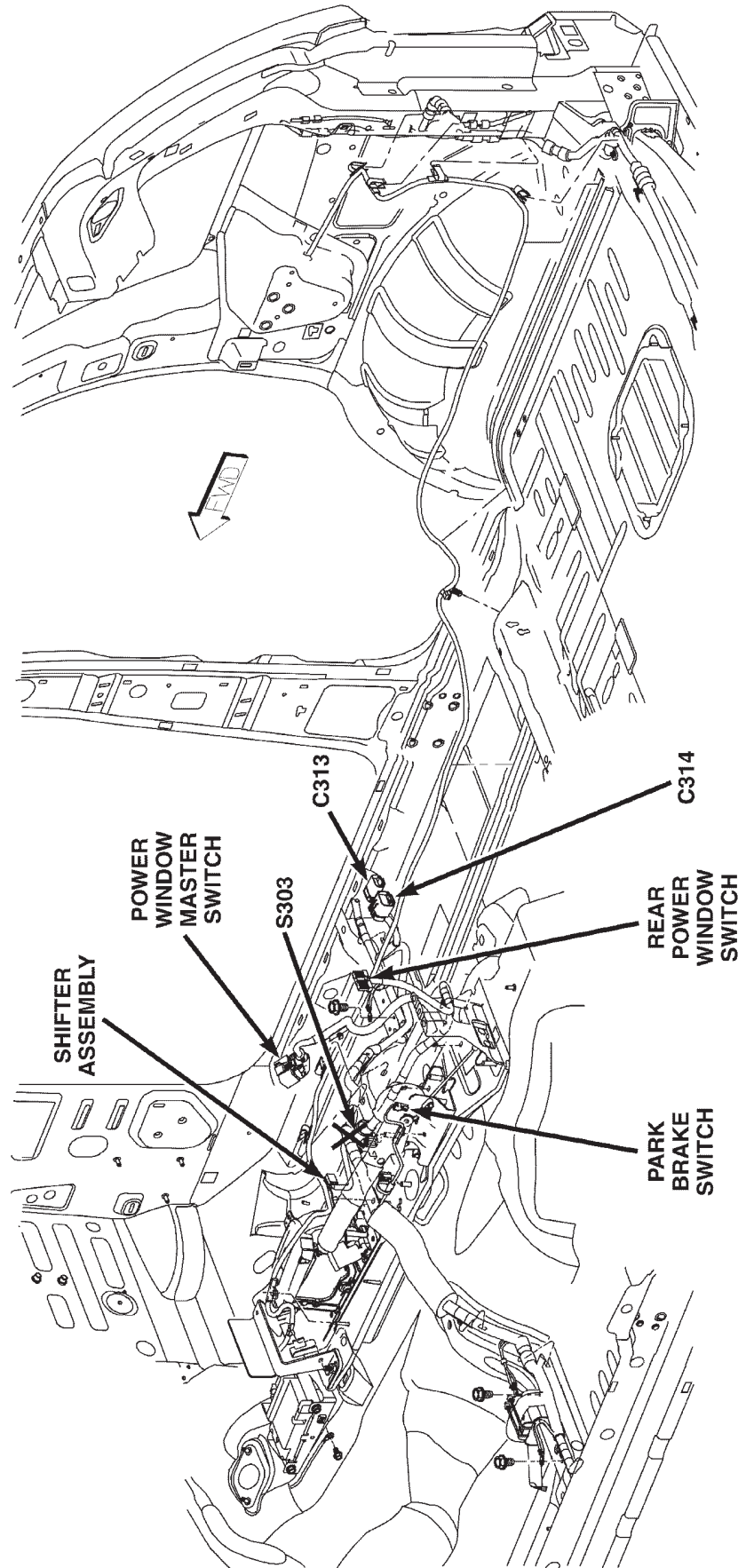
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4eca

**Fig. 35 LEFT FRONT BODY, LHD**

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4ed7

Fig. 36 RIGHT FRONT BODY, LHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ce4ee2

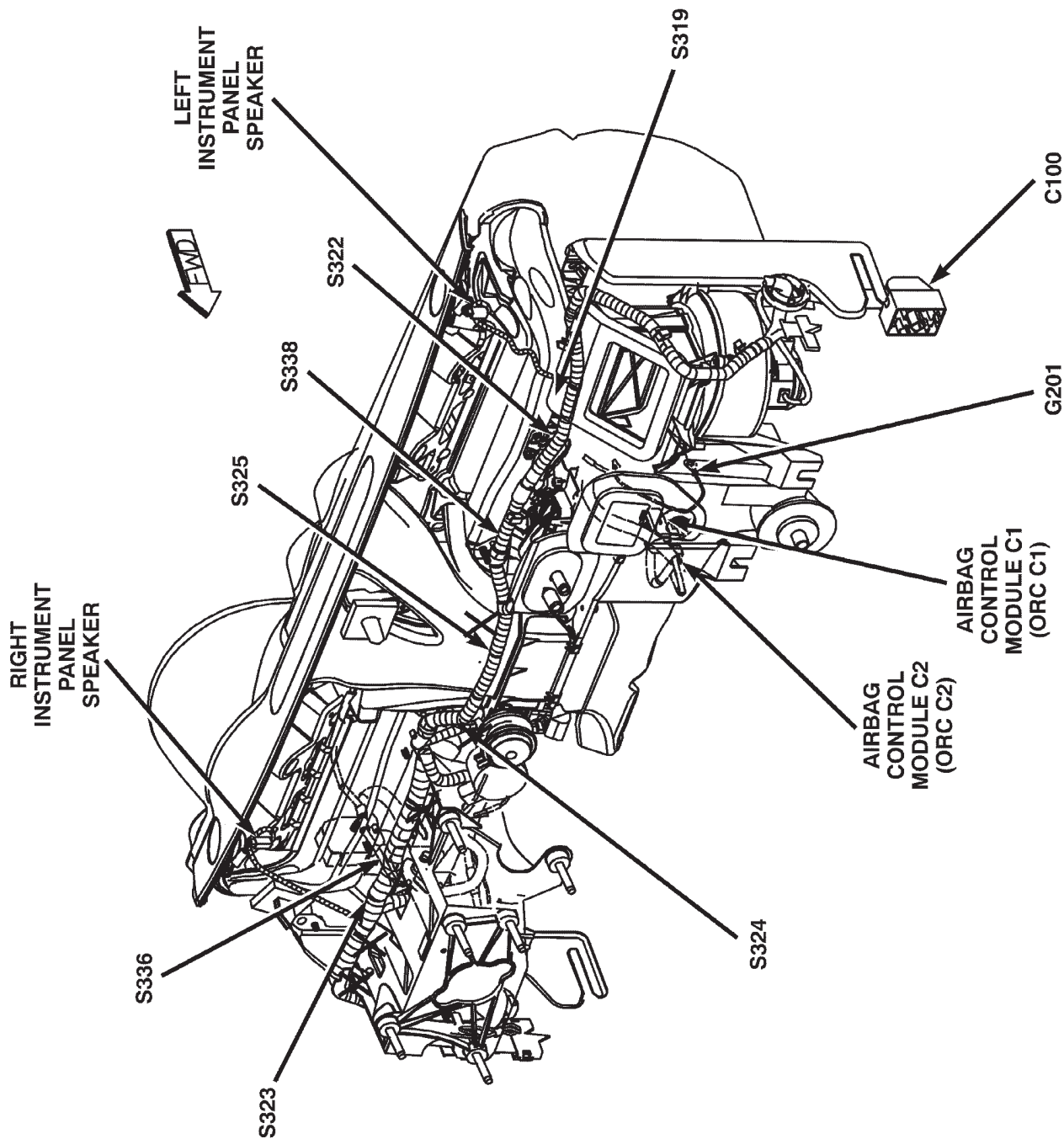


Fig. 37 INSTRUMENT PANEL, RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

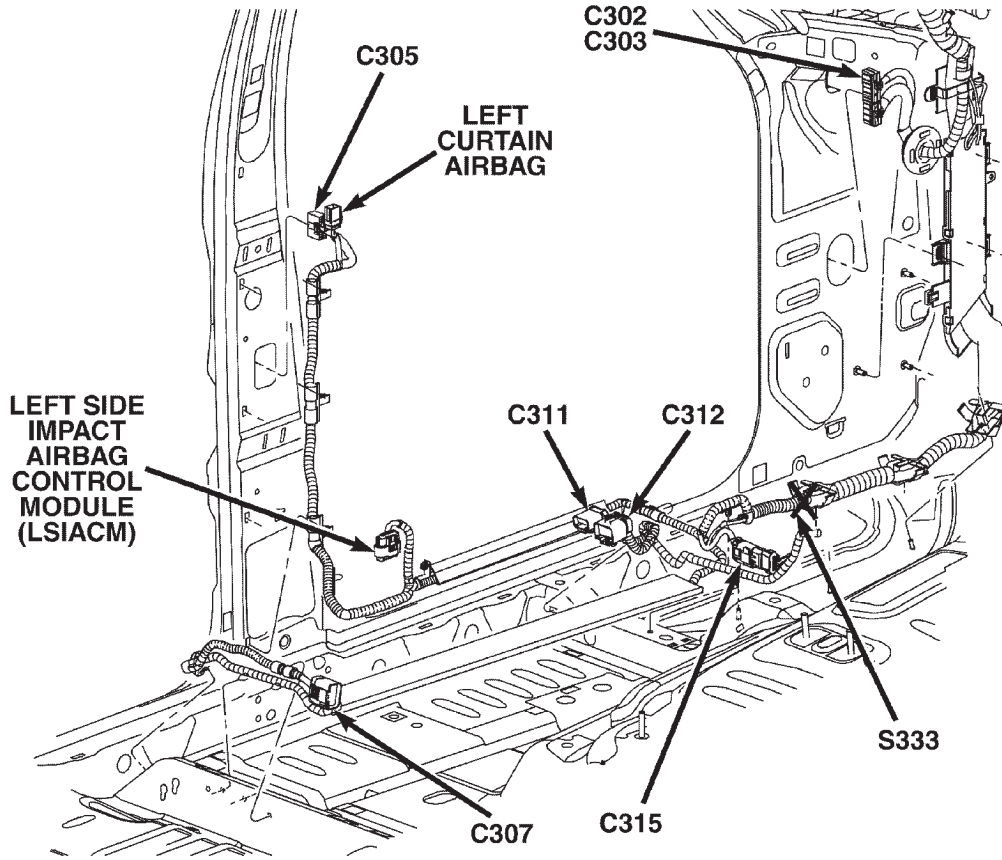


Fig. 38 LEFT FRONT BODY, RHD

80ce4eef

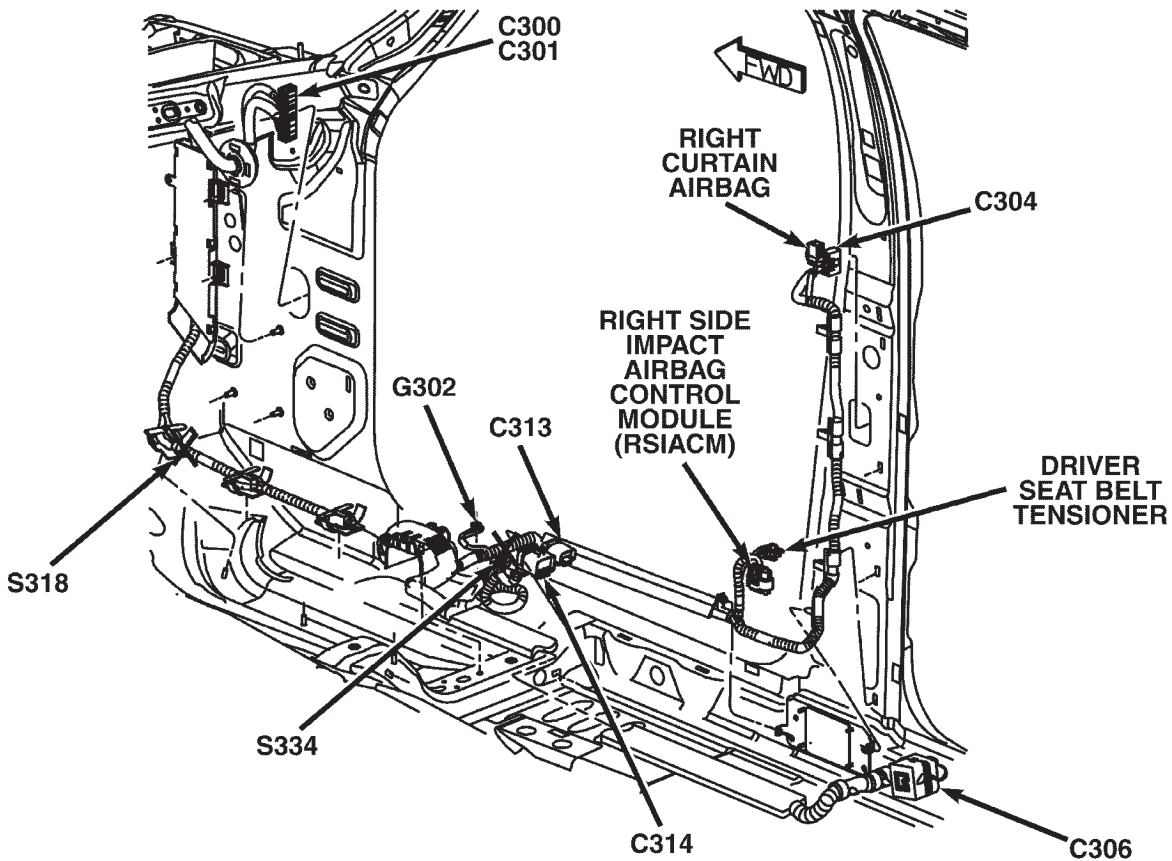
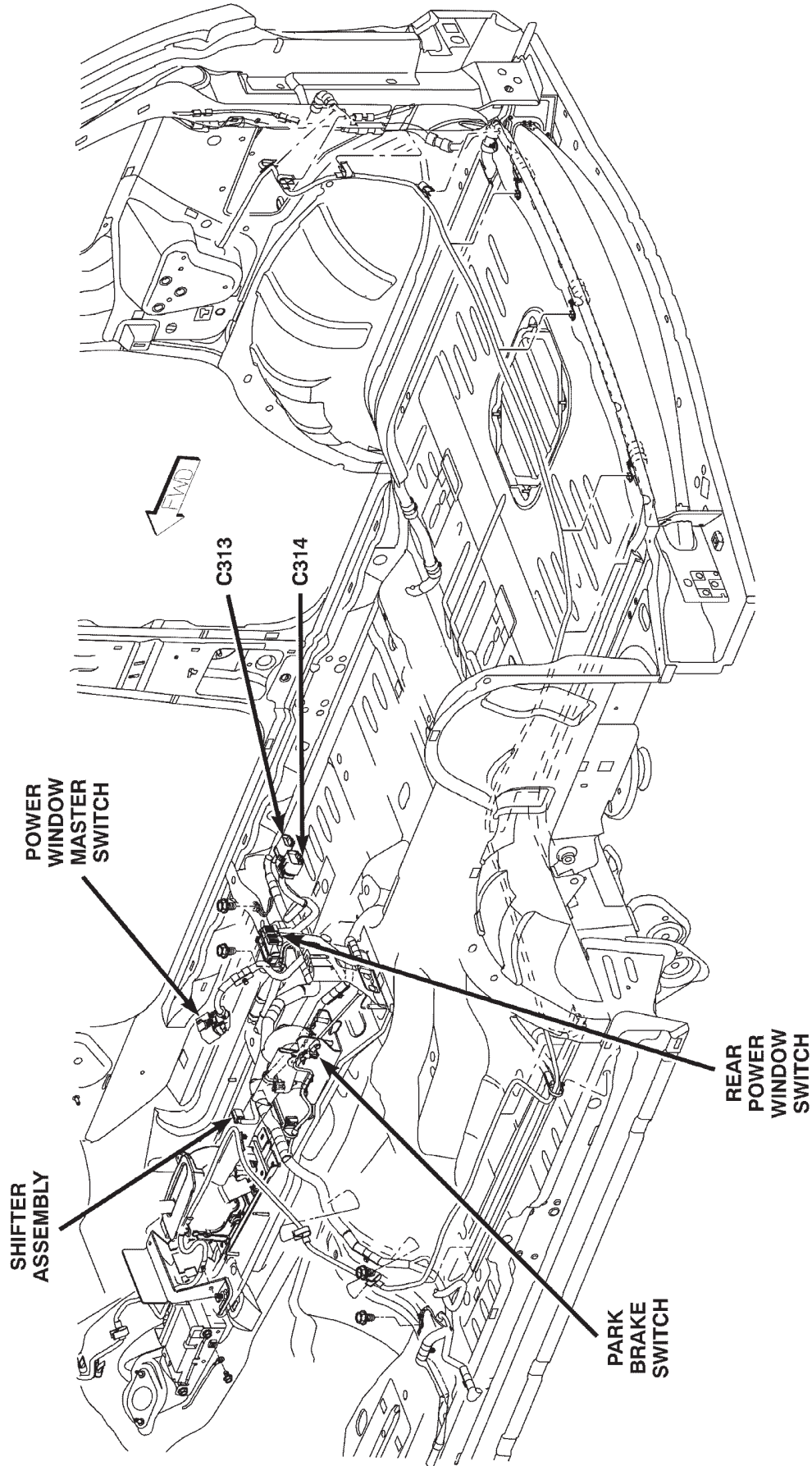


Fig. 39 RIGHT FRONT BODY, RHD

80ce4f0a

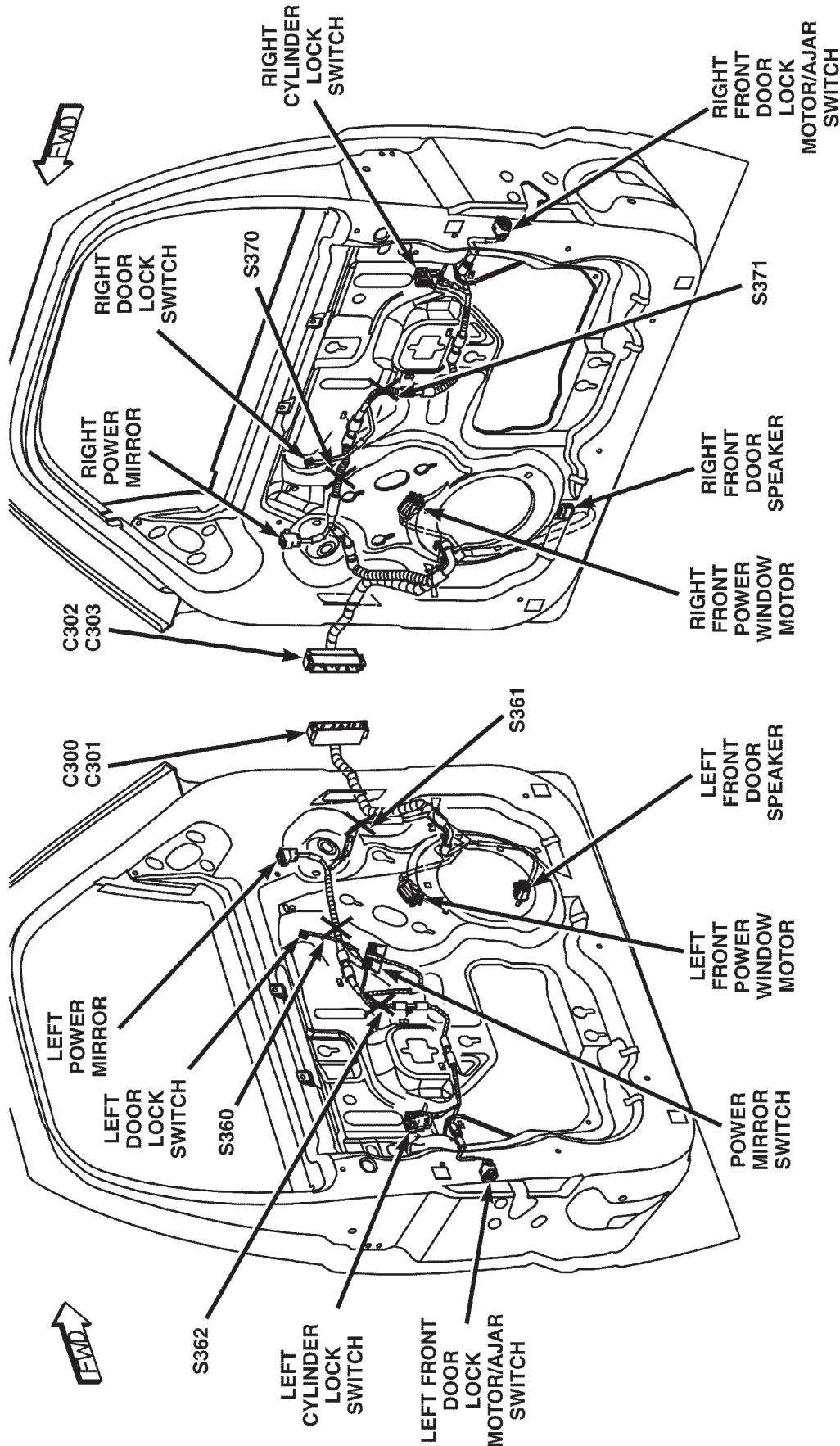
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4f23

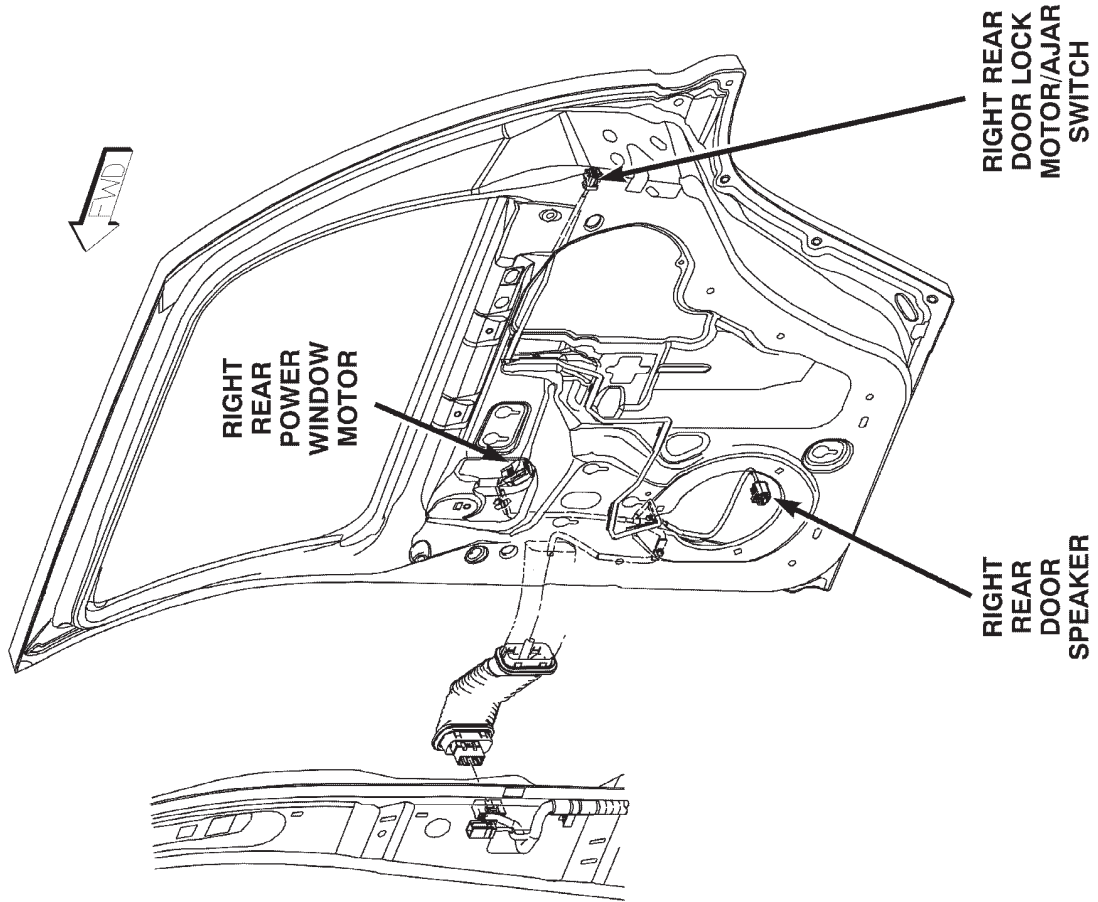
Fig. 40 RIGHT FRONT BODY, RHD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce4f59

Fig. 41 FRONT DOORS



80ce418c

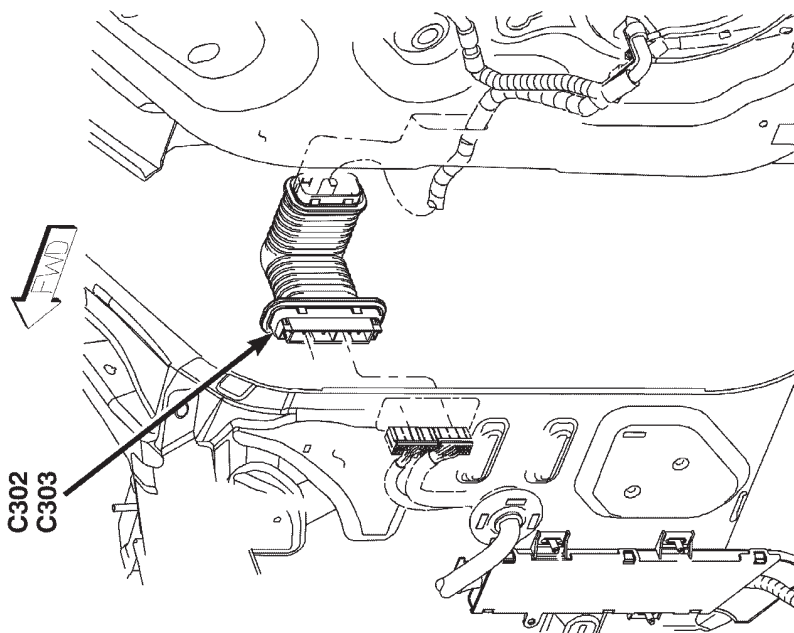
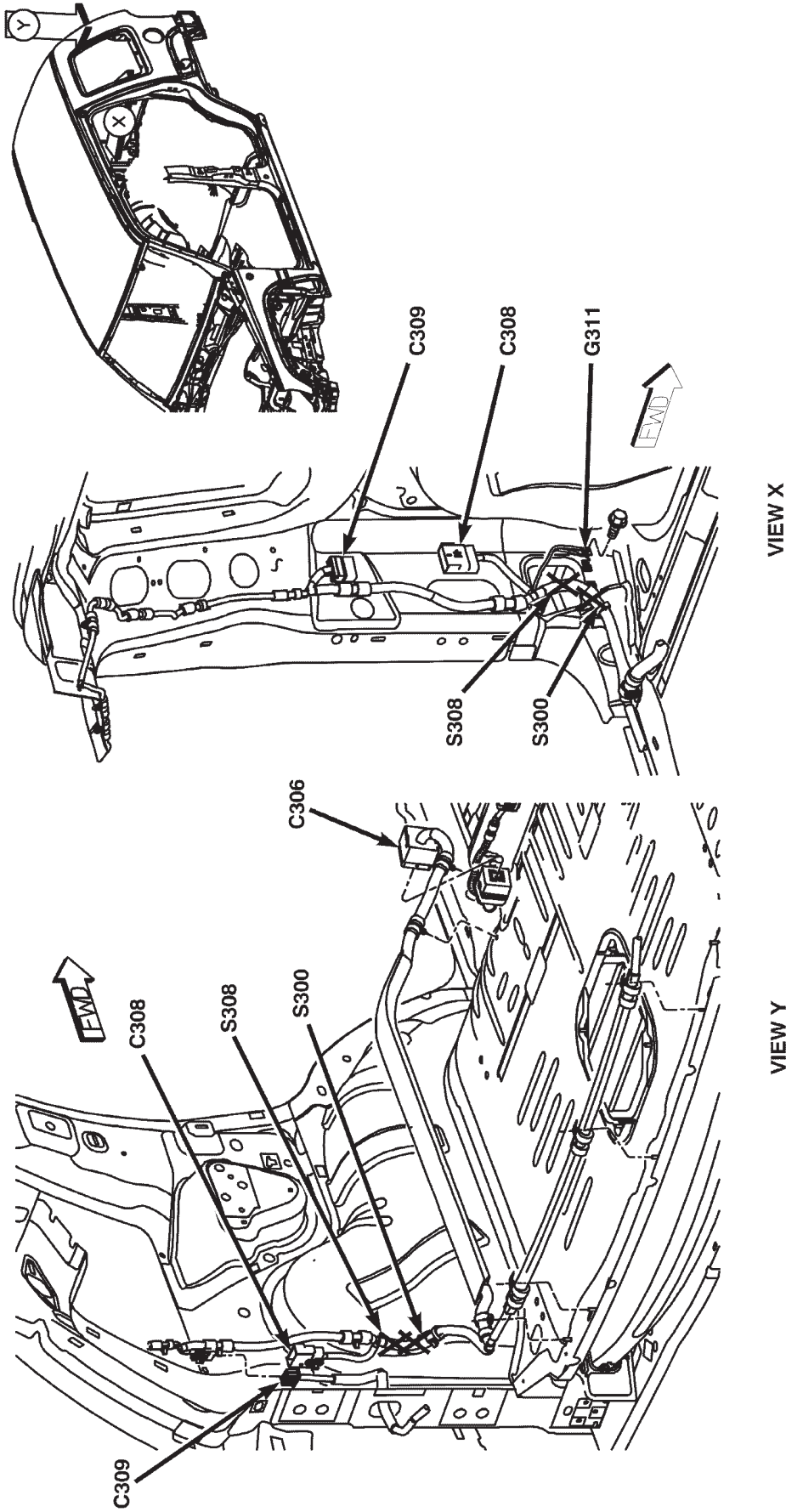


Fig. 42 REAR DOOR



CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce5192

Fig. 43 LEFT REAR BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ca51a7

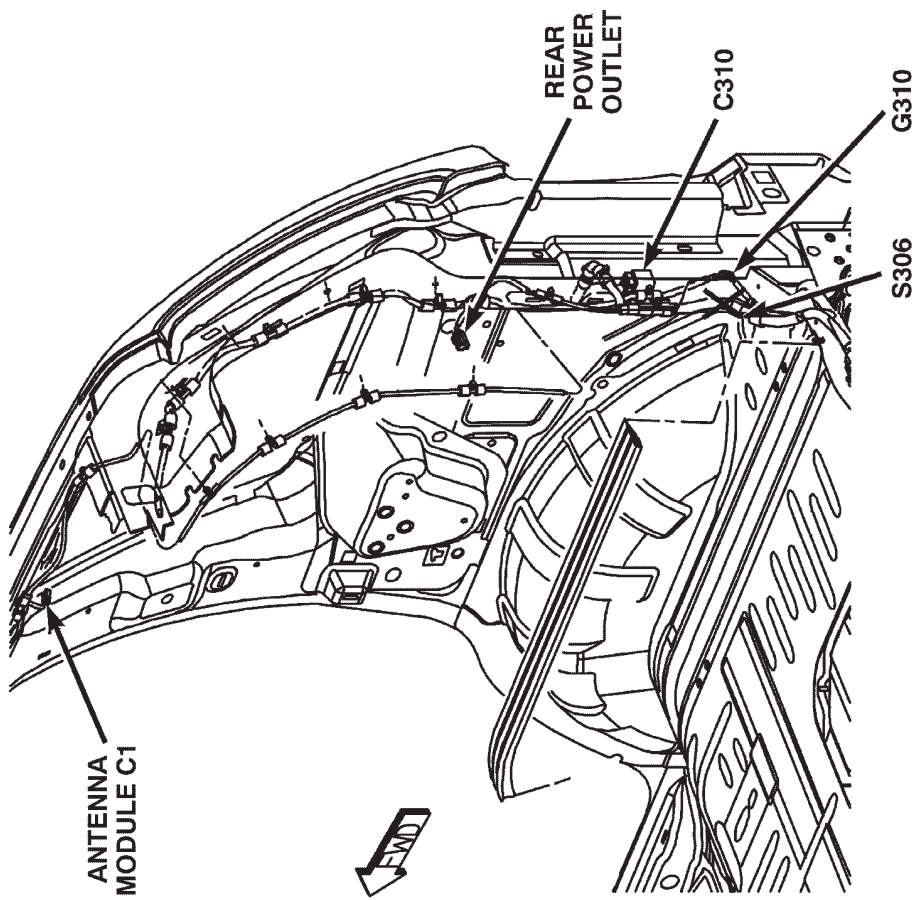
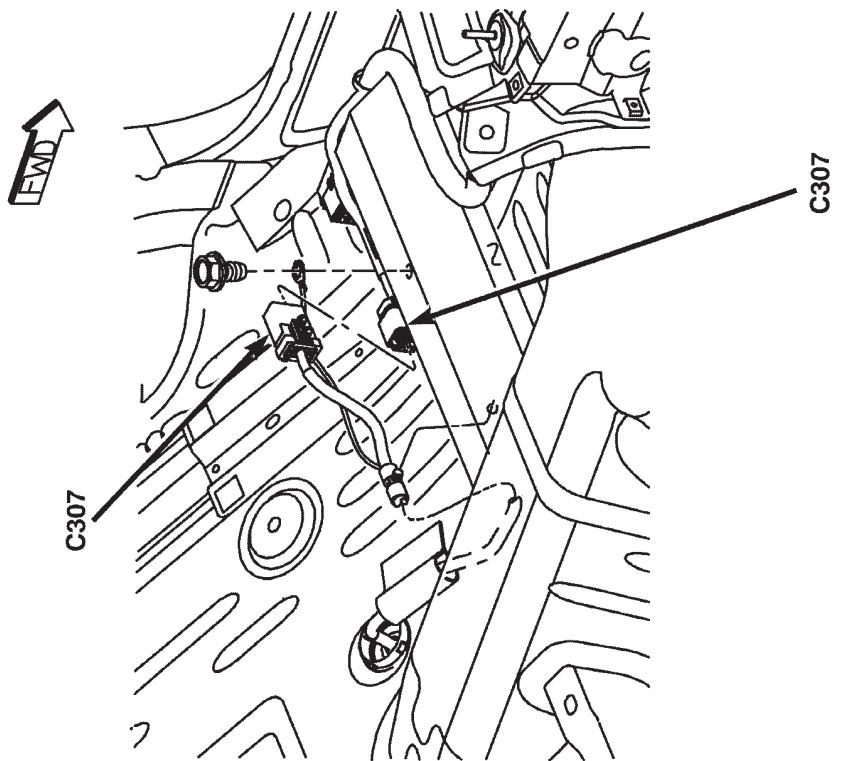
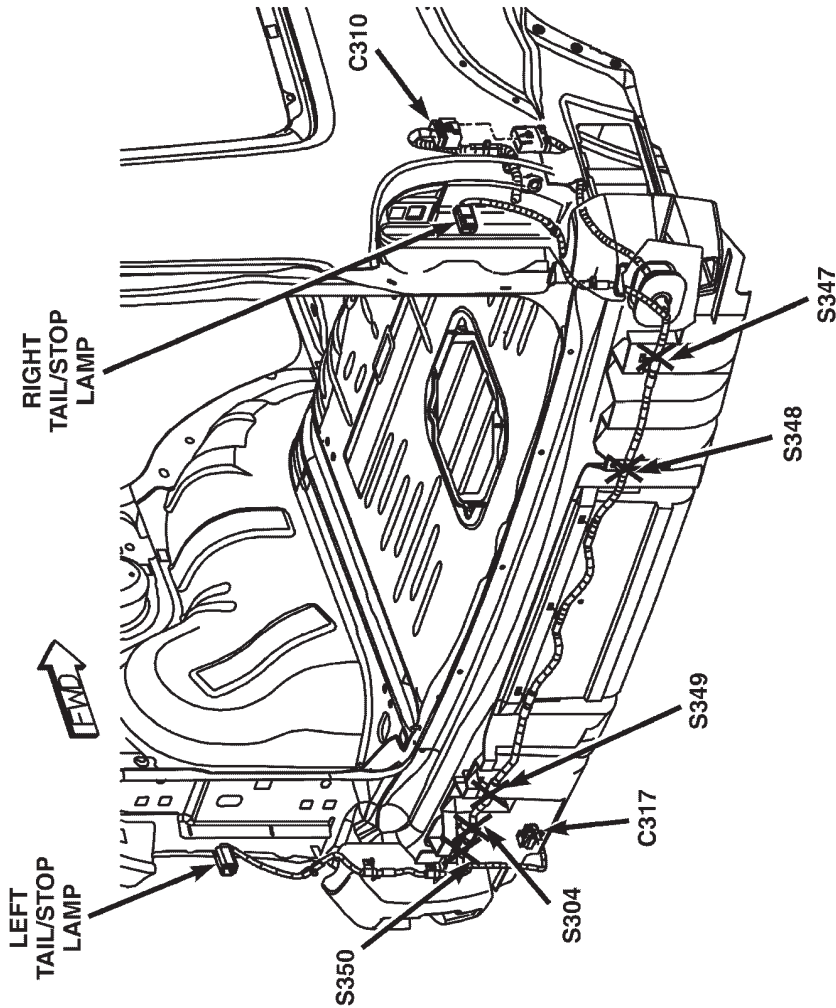
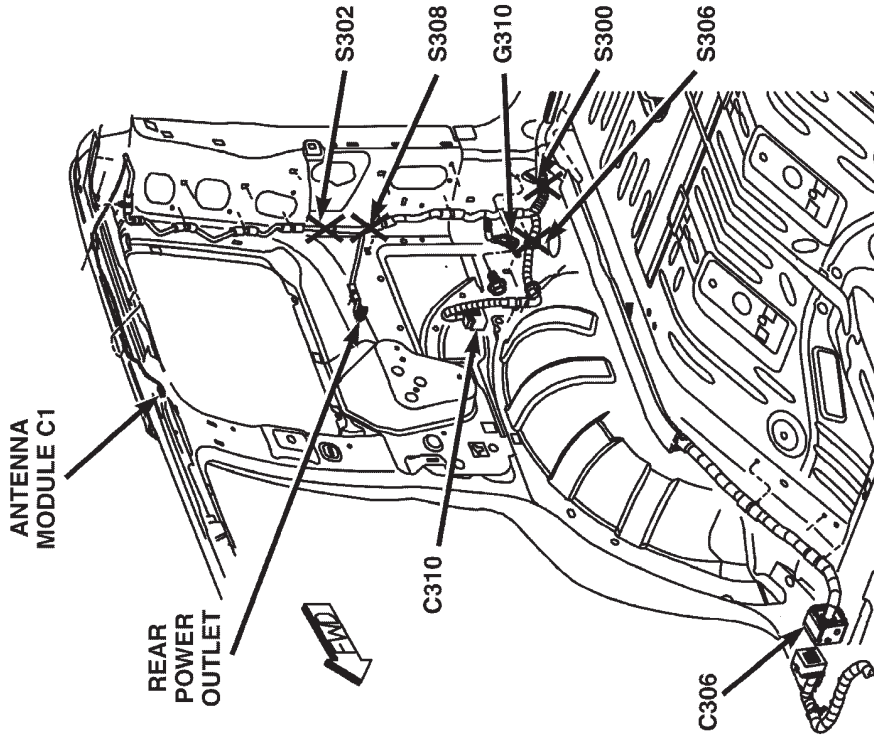


Fig. 44 RIGHT REAR BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce51b4

Fig. 45 REAR BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

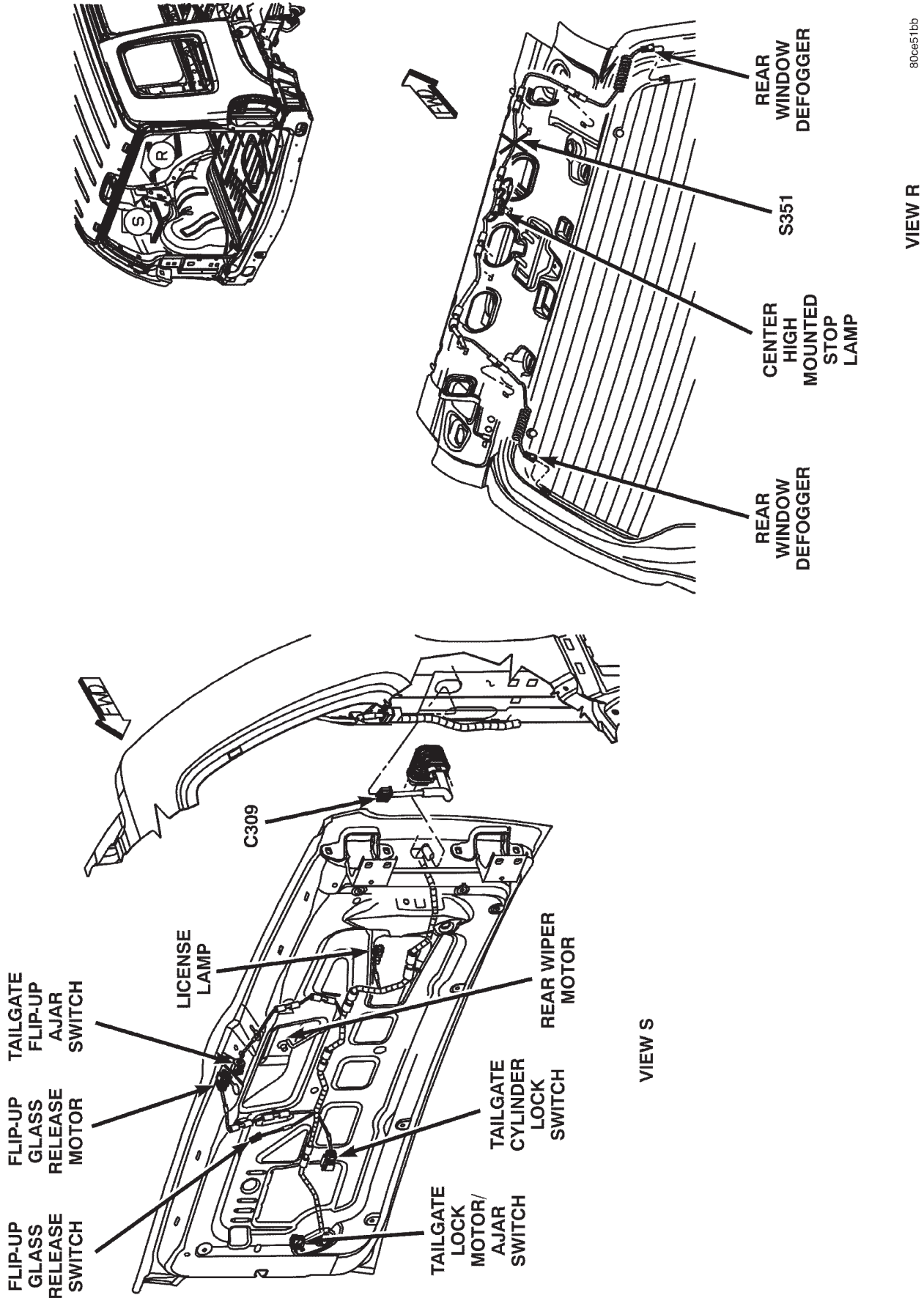
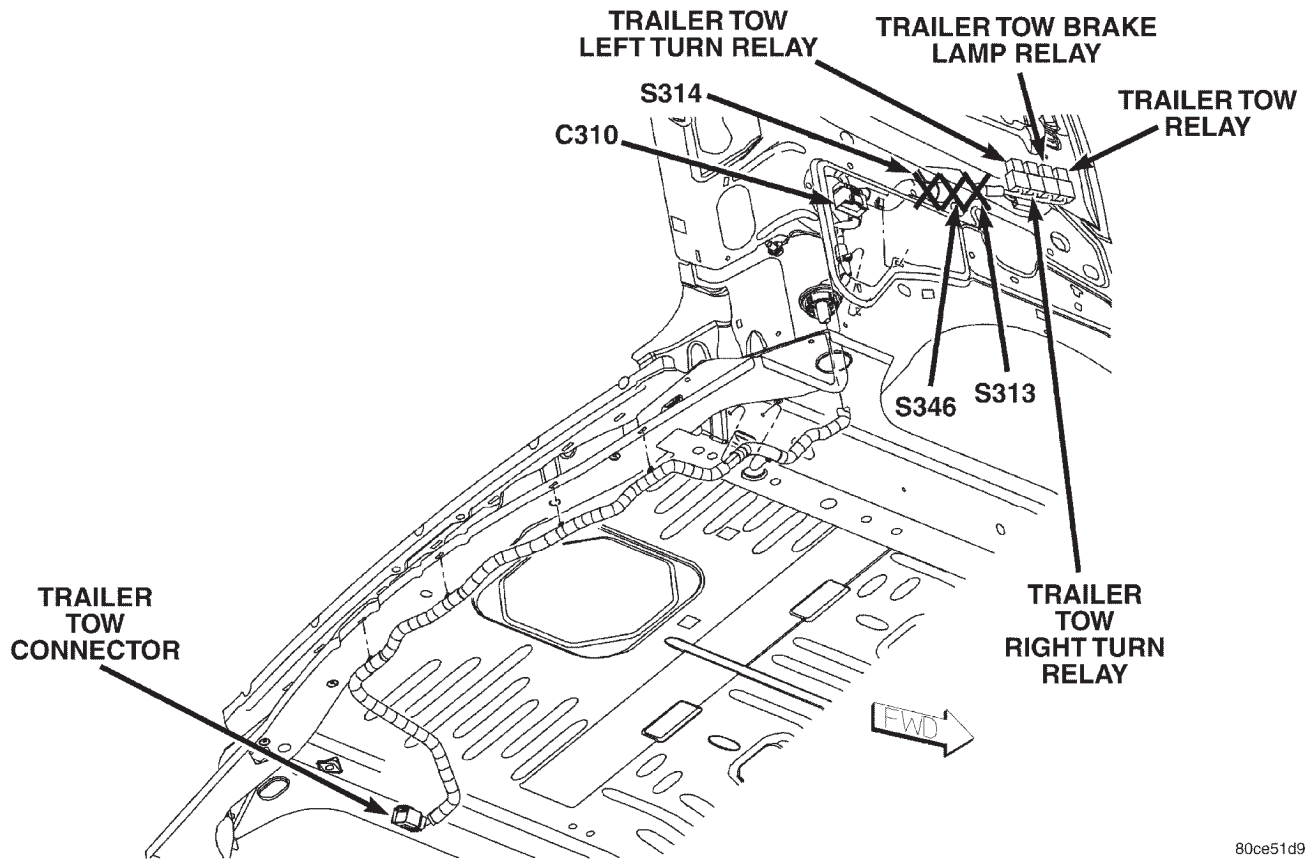


Fig. 46 TAILGATE

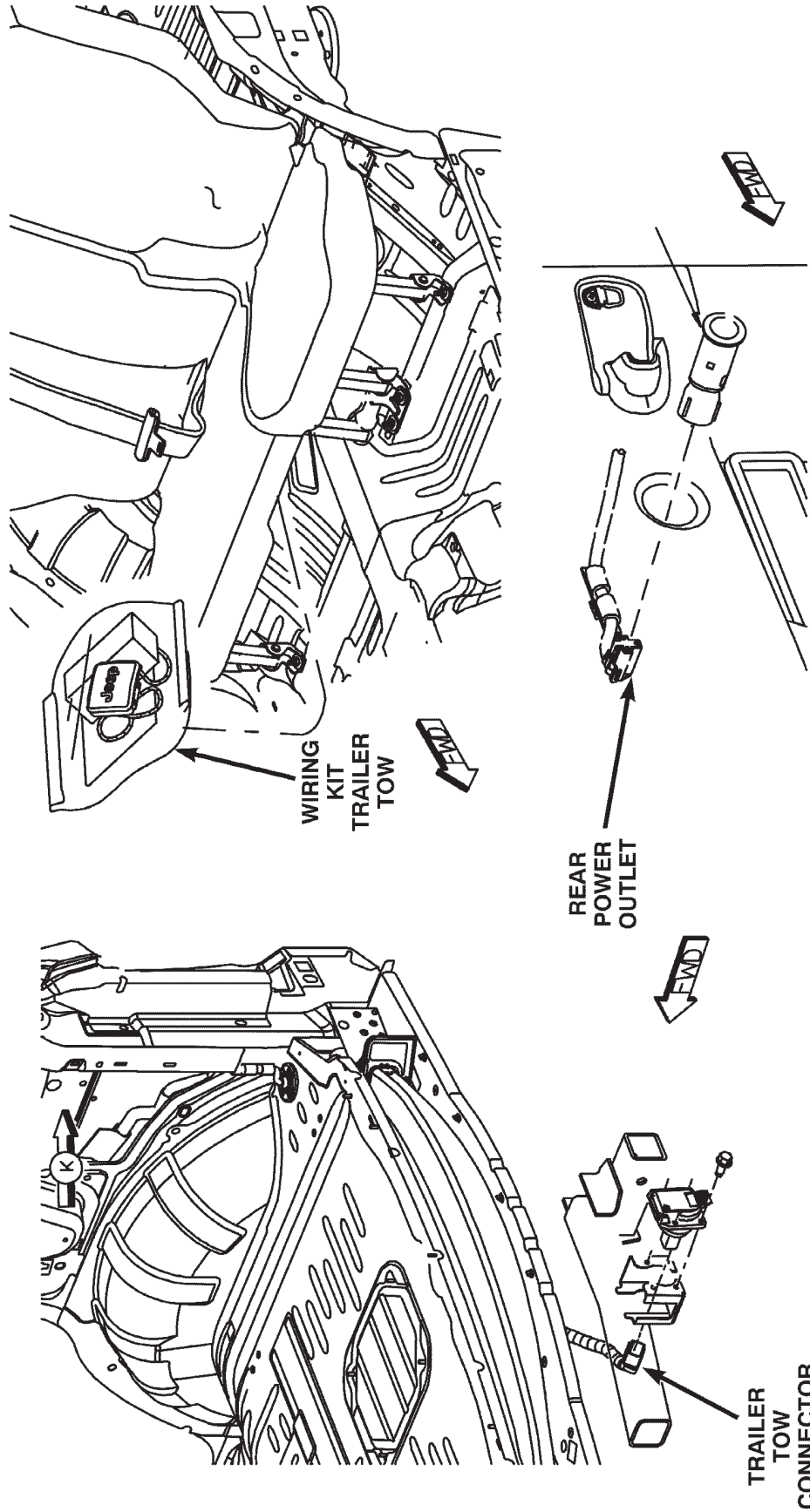
CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce51d9

**Fig. 47 TRAILER TOW CONNECTORS**

CONNECTOR/GROUND/SPLICE LOCATION (Continued)



80ce51f0

Fig. 48 REAR BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

80ce51fb

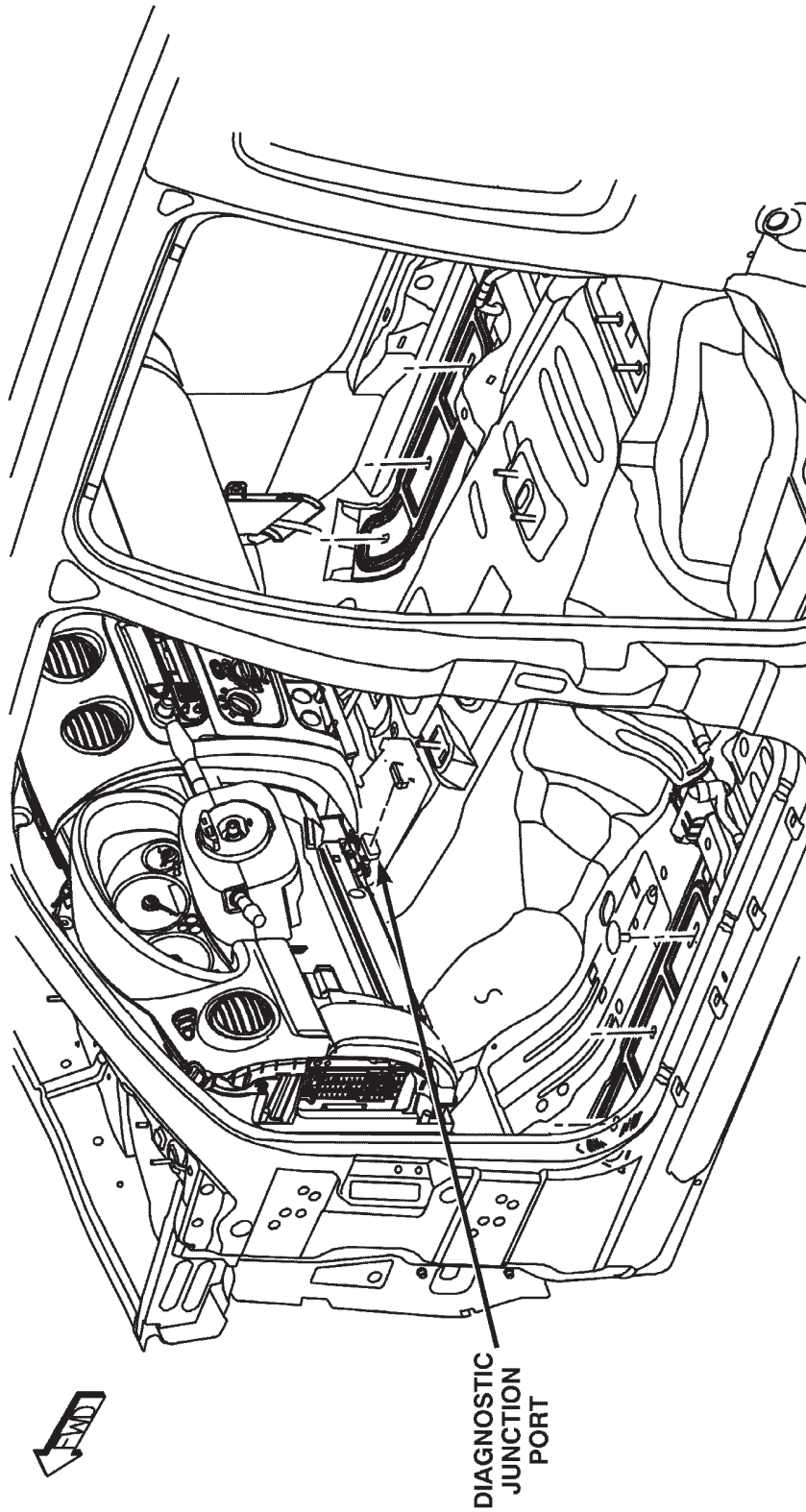


Fig. 49 DIAGNOSTIC JUNCTION PORT

# ENGINE - 3.7L

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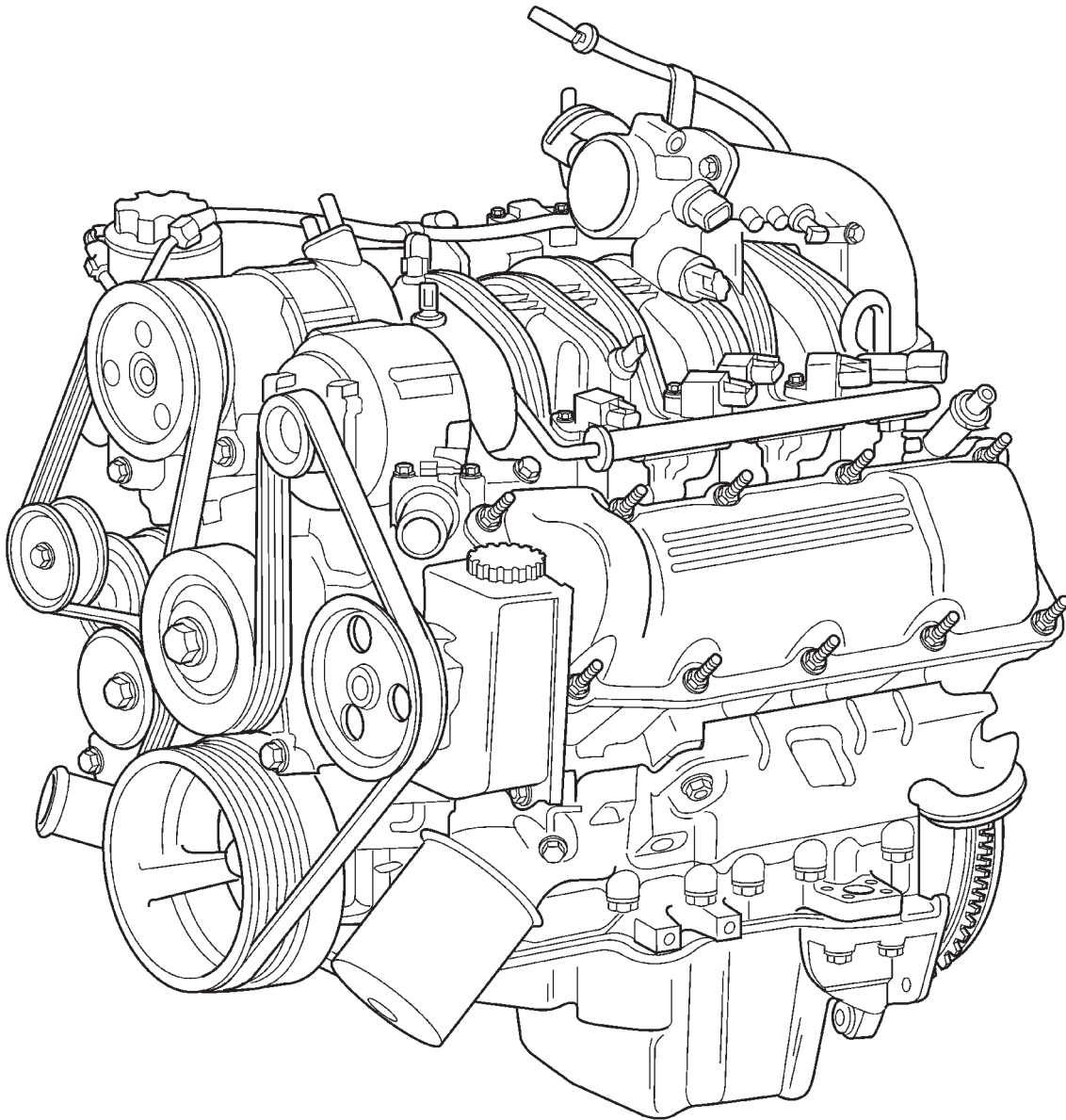
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## ENGINE - 3.7L

## DESCRIPTION



80ccc15e

**3.7 L ENGINE**

The 3.7 liter (226 CID) six-cylinder engine is an 90° single overhead camshaft engine. The cast iron cylinder block is made up of two different components; the first component is the cylinder bore and upper block, the second component is the bedplate that comprises the lower portion of the cylinder block and houses the lower half of the crankshaft main

bearings. The cylinders are numbered from front to rear with the left bank being numbered 1,3, and 5 and the right bank being numbered 2,4, and 6. The firing order is 1-6-5-4-3-2. The engine serial number is located at the right front side of the engine block

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE

DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—PERFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—MECHANICAL for possible causes and corrections of malfunctions. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING) and (Refer to 14 - FUEL SYSTEM/FUEL INJECTION - DIAGNOSIS AND TESTING) for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery 2. Corroded or loose battery connections. 3. Faulty starter. 4. Faulty coil or control unit. 5. Incorrect spark plug gap. 6. Incorrect right bank cam timing. 7. Dirt or water in fuel system. 8. Faulty fuel pump, relay or wiring. 9. Faulty cam or crank sensor	1. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals. 3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING). 4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL). 5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING). 6. Refer to engine timing in this section. 7. Clean system and replace fuel filter. 8. Repair or replace as necessary. 9. Refer to Ignition system.
ENGINE STALLS OR ROUGH IDLE	1. Vacuum leak. 2. Faulty crank position sensor 4. Faulty coil.	1. Inspect intake manifold and vacuum hoses, repair or replace as necessary. 2. Replace crank position sensor. 4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).

ENGINE - 3.7L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
	5. Incorrect cam timing.	5. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).
1. ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs. 2. Dirt or water in fuel system. 3. Faulty fuel pump. 4. Blown cylinder head gasket. 5. Low compression. 6. Burned, warped or pitted valves. 7. Plugged or restricted exhaust system. 8. Faulty coil. 9. Incorrect cam timing.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. Clean system and replace fuel filter. 3. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING). 4. Replace cylinder head gasket. 5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), repair as necessary. 6. Replace as necessary. 7. Inspect and replace as necessary. 8. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL). 9. Refer to Engine Timing in this section.
1. ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped. 2. Dirt in fuel system. 3. Burned, warped or pitted valves. 4. Faulty coil.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. Clean fuel system. 3. Replace as necessary. 4. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped. 2. Faulty coil. 3. Dirt or water in fuel system.	1. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING). 2. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL). 3. Clean system and replace fuel filter.

## ENGINE - 3.7L (Continued)

## DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	<ol style="list-style-type: none"> <li>1. High or low oil level in crankcase.</li> <li>2. Thin or diluted oil.</li> <li>3. Low oil pressure.</li> <li>4. Dirt in lash adjusters.</li> <li>5. Worn rocker arms.</li> <li>7. Worn valve guides.</li> <li>8. Excessive runout of valve seats on valve faces.</li> </ol>	<ol style="list-style-type: none"> <li>1. (Refer to LUBRICATION &amp; MAINTENANCE/FLUID TYPES - SPECIFICATIONS).</li> <li>2. Change oil and filter.</li> <li>3. Check oil pump, if Ok, check rod and main bearings for excessive wear.</li> <li>4. Clean or replace as necessary.</li> <li>5. Replace as necessary.</li> <li>7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES &amp; SEATS - STANDARD PROCEDURE).</li> <li>8. Service valves and valve seats. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES &amp; SEATS - STANDARD PROCEDURE).</li> </ol>
ENGINE VIBRATION	<ol style="list-style-type: none"> <li>1. Counter Balance Shaft not timed properly</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to Engine Timing in this section</li> </ol>
CONNECTING ROD NOISE	<ol style="list-style-type: none"> <li>1. Insufficient oil supply.</li> <li>2. Low oil pressure.</li> <li>3. Thin or diluted oil.</li> <li>4. Excessive bearing clearance.</li> <li>5. Connecting rod journal out-of-round.</li> <li>6. Misaligned connecting rods.</li> </ol>	<ol style="list-style-type: none"> <li>1. (Refer to LUBRICATION &amp; MAINTENANCE/FLUID TYPES - SPECIFICATIONS).</li> <li>2. Check oil pump, if Ok, check rod and main bearings for excessive wear.</li> <li>3. Change oil and filter.</li> <li>4. Replace as necessary.</li> <li>5. Service or replace crankshaft.</li> <li>6. Replace bent connecting rods.</li> </ol>
MAIN BEARING NOISE	<ol style="list-style-type: none"> <li>1. Insufficient oil supply.</li> <li>2. Low oil pressure.</li> <li>3. Thin or diluted oil.</li> <li>4. Excessive bearing clearance.</li> <li>5. Excessive end play.</li> <li>6. Crankshaft journal out-of round.</li> <li>7. Loose flywheel or torque converter.</li> </ol>	<ol style="list-style-type: none"> <li>1. (Refer to LUBRICATION &amp; MAINTENANCE/FLUID TYPES - SPECIFICATIONS).</li> <li>2. Check oil pump, if Ok, check rod and main bearings for excessive wear.</li> <li>3. Change oil and filter.</li> <li>4. Replace as necessary.</li> <li>5. Check thrust washers for wear.</li> <li>6. Service or replace crankshaft.</li> <li>7. Tighten to correct torque</li> </ol>

ENGINE - 3.7L (Continued)

**DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - LUBRICATION**

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	<ol style="list-style-type: none"> <li>1. Gaskets and O-Rings.                             <ol style="list-style-type: none"> <li>(a) Misaligned or damaged.</li> <li>(b) Loose fasteners, broken or porous metal parts.</li> </ol> </li> <li>2. Crankshaft rear seal</li> <li>3. Crankshaft seal flange. Scratched, nicked or grooved.</li> <li>4. Oil pan flange cracked.</li> <li>5. Timing chain cover seal damaged.</li> <li>6. Scratched or damaged vibration damper hub.</li> </ol>	<ol style="list-style-type: none"> <li>1.                             <ol style="list-style-type: none"> <li>(a) Replace as necessary.</li> <li>(b) Tighten fasteners, Repair or replace metal parts.</li> </ol> </li> <li>2. Replace as necessary (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - REAR - REMOVAL).</li> <li>3. Polish or replace crankshaft.</li> <li>4. Replace oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).</li> <li>5. Re-seal timing cover.</li> <li>6. Polish or replace damper.</li> </ol>
OIL PRESSURE DROP	<ol style="list-style-type: none"> <li>1. Low oil level.</li> <li>2. Faulty oil pressure sending unit.</li> <li>3. Low oil pressure.</li> <li>4. Clogged oil filter.</li> <li>5. Worn oil pump.</li> <li>6. Thin or diluted oil.</li> <li>7. Excessive bearing clearance.</li> <li>8. Oil pump relief valve stuck.</li> <li>9. Oil pump suction tube loose, damaged or clogged.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and correct oil level.</li> <li>2. Replace sending unit (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL).</li> <li>3. Check oil pump and bearing clearance.</li> <li>4. Replace oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).</li> <li>5. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).</li> <li>6. Change oil and filter.</li> <li>7. Replace as necessary.</li> <li>8. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).</li> <li>9. Replace as necessary.</li> </ol>

## ENGINE - 3.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	<ol style="list-style-type: none"> <li>1. Worn or damaged rings.</li> <li>2. Carbon in oil ring slots.</li> <li>3. Incorrect ring size installed.</li> <li>4. Worn valve guides.</li> <li>5. Leaking valve guide seals.</li> </ol>	<ol style="list-style-type: none"> <li>1. Hone cylinder bores and replace rings.</li> <li>2. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).</li> <li>3. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).</li> <li>4. Ream guides and replace valves (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES &amp; SEATS - STANDARD PROCEDURE).</li> <li>5. Replace valve guide seals.</li> </ol>

### DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE

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) Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).

(5) Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

(8) (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

### DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

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.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner.

(6) 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.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression. While testing, listen for pressurized air escaping through the throttle body, tailpipe and 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 CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART .

ENGINE - 3.7L (Continued)

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

**Never** use the following to clean gasket surfaces:

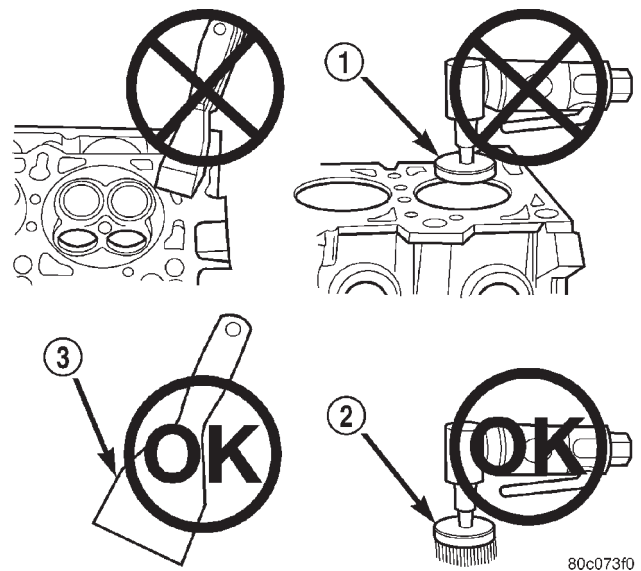
- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 1)

**NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.**

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 1)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 1)

**CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.**



**Fig. 1 Proper Tool Usage For Surface Preparation**

- 1 - ABRASIVE PAD
- 2 - 3M ROLOC™ BRISTLE DISC
- 3 - PLASTIC/WOOD SCRAPER

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

**CAUTION: Be sure that the tapped holes maintain the original center line.**

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.

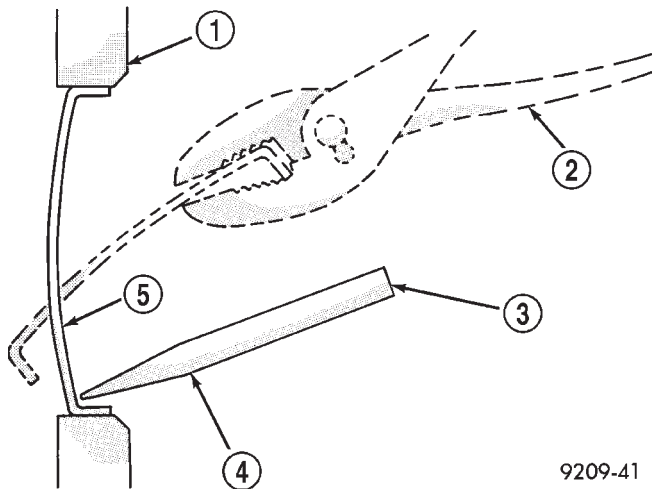


## ENGINE - 3.7L (Continued)

- 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.

**STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS**

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 2).



**Fig. 2 Core Hole Plug Removal**

- 1 - CYLINDER BLOCK  
 2 - REMOVE PLUG WITH PLIERS  
 3 - STRIKE HERE WITH HAMMER  
 4 - DRIFT PUNCH  
 5 - CUP PLUG

**CAUTION:** Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount. Make certain the new plug is cleaned of all oil or grease. Using proper drive plug, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 in.) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

**REMOVAL**

- (1) Disconnect the battery negative cable.
- (2) Remove hood. Mark hood hinge location for reinstallation.
- (3) Remove air cleaner assembly.

- (4) Remove radiator core support bracket.
- (5) Remove fan shroud with electric fan assembly.
- (6) Remove mechanical cooling fan.
- (7) Remove drive belt.

**NOTE:** It is **NOT** necessary to discharge the A/C system to remove the engine.

- (8) Remove A/C compressor and secure away from engine with lines attached.
- (9) Remove generator and secure away from engine.

**NOTE:** Do **NOT** remove the phenolic pulley from the P/S pump. It is not required for P/S pump removal.

- (10) Remove power steering pump with lines attached and secure away from engine.
- (11) Drain cooling system.
- (12) Remove coolant bottle.
- (13) Disconnect the heater hoses from the engine.
- (14) Disconnect heater hoses from heater core and remove hose assembly.
- (15) Disconnect throttle and speed control cables.
- (16) Remove upper radiator hose from engine.
- (17) Remove lower radiator hose from engine.
- (18) Disconnect the engine to body ground straps at the left side of cowl.
- (19) Disconnect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs
- Crankshaft Position Sensor

- (20) Remove coil over plugs.
- (21) Release fuel rail pressure.
- (22) Remove fuel rail and secure away from engine.

**NOTE:** It is not necessary to release the quick connect fitting from the fuel supply line for engine removal.

- (23) Remove the PCV hose.
- (24) Remove the breather hoses.
- (25) Remove the vacuum hose for the power brake booster.
- (26) Disconnect knock sensors.
- (27) Remove engine oil dipstick tube.
- (28) Remove intake manifold.
- (29) Install engine lift plate.

## ENGINE - 3.7L (Continued)

**NOTE: Recheck bolt torque for engine lift plate before removing engine.**

- (30) Secure the left and right engine wiring harnesses away from engine.
- (31) Raise vehicle.
- (32) Disconnect oxygen sensor wiring.
- (33) Disconnect crankshaft position sensor.
- (34) Disconnect the engine block heater power cable, if equipped.
- (35) Disconnect the front propshaft at the front differential and secure out of way.

**NOTE: It is necessary to disconnect the front propshaft for access to the starter and left side exhaust flange.**

- (36) Remove the starter.
- (37) Remove the ground straps from the left and right side of the block.
- (38) Disconnect the right and left exhaust pipes at the manifolds and from the crossover, and remove from the vehicle.

**NOTE: The exhaust clamps at the manifolds cannot be reused. New clamps must be used or leaks may occur.**

**NOTE: For manual transmission vehicles, the transmission must be removed from the vehicle, before the engine can be removed. The manual transmission will contact the floorpan before the engine clears the motor mounts, so it must be removed.**

- (39) Remove the structural cover.
- (40) Remove torque convertor bolts, and mark location for reassembly.
- (41) Remove transmission bellhousing to engine bolts.
- (42) Loosen left and right engine mount thru bolts.

**NOTE: It is not necessary to completely remove engine mount thru bolts, for engine removal.**

- (43) Lower the vehicle.
- (44) Support the transmission with a suitable jack.
- (45) Connect a suitable engine hoist to the engine lift plate.
- (46) Remove engine from vehicle.

## INSTALLATION

- (1) Position the engine in the vehicle.
- (2) Install both left and right side engine mounts onto engine.
- (3) Raise the vehicle.

(4) Install the transmission bellhousing to engine mounting bolts. Tighten the bolts to 41 N·m (30ft. lbs.).

- (5) Tighten the engine mount thru bolts.
- (6) Install the torque convertor bolts.
- (7) Connect the ground straps on the left and right side of the engine.
- (8) Install the starter.
- (9) Connect the crankshaft position sensor.
- (10) Install the engine block heater power cable, if equipped.

**CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.**

- (11) Install the structural cover.

**NOTE: New clamps must be used on exhaust manifold flanges. Failure to use new clamps may result in exhaust leaks.**

- (12) Install the left and right exhaust pipes.
- (13) Connect the left and right oxygen sensors.
- (14) Lower vehicle.
- (15) Remove the engine lift plate.
- (16) Connect the knock sensors.
- (17) Connect the engine to body ground straps at the left side of the cowl.
- (18) Install the intake manifold.
- (19) Install the engine oil dipstick tube.
- (20) Install the power brake booster vacuum hose.
- (21) Install the breather hoses.
- (22) Install the PCV hose.
- (23) Install the fuel rail.
- (24) Install the coil over plugs.
- (25) Connect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs
- Crankshaft Position Sensor

- (26) Connect lower radiator hose.
- (27) Connect upper radiator hose.
- (28) Connect throttle and speed control cables.
- (29) Install the heater hose assembly.
- (30) Install coolant recovery bottle.
- (31) Install the power steering pump.
- (32) Install the generator.
- (33) Install the A/C compressor.
- (34) Install the drive belt.

ENGINE - 3.7L (Continued)

- (35) Install the mechanical cooling fan.
- (36) Install the fan shroud with the electric fan assembly.
- (37) Install the radiator core support bracket.
- (38) Install the air cleaner assembly.
- (39) Refill the engine cooling system.
- (40) Install the hood.
- (41) Check and fill engine oil.
- (42) Connect the battery negative cable.
- (43) Start the engine and check for leaks.

SPECIFICATIONS

TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	54	40	—
Connecting Rod Cap—Bolts	27	20	—
	<b>PLUS 90° TURN</b>		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	Refer	To Procedure	
M8 Bolts	-	-	-
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		
Flexplate—Bolts	60	45	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	12	—	105
Water Pump—Bolts	54	40	—

3.7L ENGINE

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Engine Type	90° SOHC V-6 12-Valve
Displacement	3.7 Liters / 3700 cc ( Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	90.8 mm (3.40 in.)
Compression Ratio	9.1:1
Horsepower	210 BHP @ 5200 RPM
Torque	225 LB-FT @ 4200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-6-5-4-3-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.0 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)

ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
<b>PISTONS</b>	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
Weight	367.5 grams (12.96 oz)
<b>Ring Groove Diameter</b>	
No. 1	83.73 - 83.97 mm (3.296 - 3.269 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
<b>PISTON PINS</b>	
Type	Floating
Clearance In Piston	0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Diameter	24.013 - 24.016 mm (0.9454 - 0.9456 in.)
<b>PISTON RINGS</b>	
<b>Ring Gap</b>	
Top Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
<b>Side Clearance</b>	
Top Compression Ring	.051 - .094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 - .229 mm (.0007 - .0091 in.)
<b>Ring Width</b>	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)

DESCRIPTION	SPECIFICATION
<b>CONNECTING RODS</b>	
Bearing Clearance	0.010 - 0.048 mm (0.0004 - 0.0019 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Clearance	.015 - .028 mm (0.0006 - 0.0011 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	612 grams (21.588 ounces)
<b>CRANKSHAFT</b>	
<b>Main Bearing Journal</b>	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.002 - 0.034 mm
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.006 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in.)
<b>Connecting Rod Journal</b>	
Diameter	57.904 - 57.896 mm
Bearing Clearance	0.010 - 0.048 mm
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.006 mm (0.0002 in.)
<b>CAMSHAFT</b>	
Bore Diameter	26.02 - 26.04 mm (1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm (1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm (0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 - .200 mm (0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)

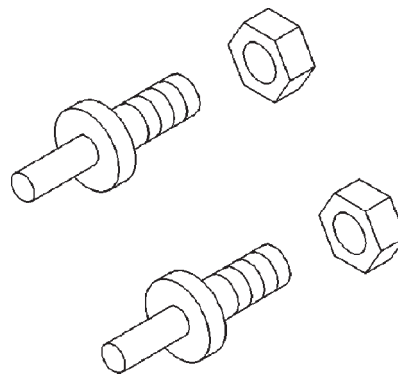
## ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
<b>VALVE TIMING</b>	
<b>Intake</b>	
Opens (ATDC)	3.6°
Closes (ATDC)	247.1°
Duration	243.5°
<b>Exhaust</b>	
Opens (BTDC)	232.5°
Closes (ATDC)	21.2°
Duration	253.70°
Valve Overlap	17.6°
<b>VALVES</b>	
Face Angle	45° - 45.5°
<b>Head Diameter</b>	
Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm 1.4516 - 1.4618 in.)
<b>Length (Overall)</b>	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
<b>Stem Diameter</b>	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
<b>Stem - to - Guide Clearance</b>	
Intake	0.018 - 0.069 mm (0.0008 - 0.0028 in.)
Exhaust	0.047 - 0.098 mm (0.0019 - 0.0039 in.)
<b>Max. Allowable Stem - to - Guide Clearance (Rocking Method)</b>	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)

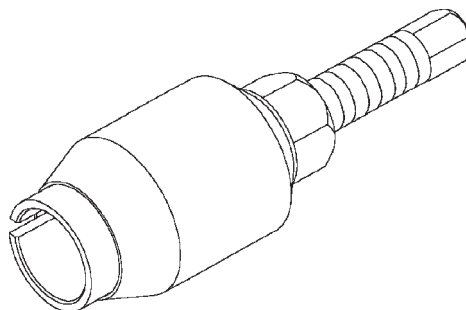
DESCRIPTION	SPECIFICATION
<b>Valve Lift (Zero Lash)</b>	
Intake	12.00 mm (0.472 in.)
Exhaust	10.90 mm (0.4292 in.)
<b>VALVE SPRING</b>	
<b>Free Length (Approx)</b>	
Intake and Exhaust	48.92 mm (1.9260 in.)
<b>Spring Force (Valve Closed)</b>	
Intake and Exhaust	361.0 - 399.0 N @ 40.12 mm (81.15 - 89.70 lbs. @ 1.5795 in.)
<b>Spring Force (Valve Open)</b>	
Intake and Exhaust	984.0 - 1076.0 N @ 28.12 mm 221.2 - 241.9 lbs. @ 1.107 in.)
<b>Number of Coils</b>	
Intake and Exhaust	7.30
<b>Wire Diameter</b>	
Intake and Exhaust	4.77 x 3.80mm (0.1878 - 0.1496 in.)
<b>Installed Height (Spring Seat to Bottom of Retainer)</b>	
<b>Nominal</b>	
Intake	41.11 mm (1.619 in.)
Exhaust	41.13 mm (1.619 in.)
<b>CYLINDER HEAD</b>	
Gasket Thickness (Compressed)	0.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
<b>Valve Seat Width</b>	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)

ENGINE - 3.7L (Continued)

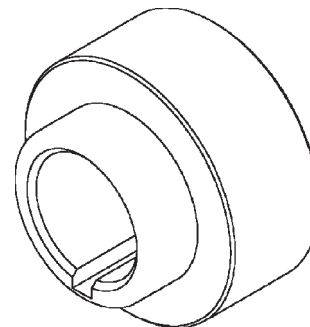
DESCRIPTION	SPECIFICATION
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
<b>OIL PUMP</b>	
Clearance Over Rotors/End Face(MAX)	0.035 - 0.095 mm (0.0014 - 0.0038 in.)
Cover Out - of -Flat (MAX)	0.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor Diameter (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	0.150 mm (0.006 in.)
<b>OIL PRESSURE</b>	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 758 kPa (25 - 110 psi)
* CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.	



**Adapter Pins 8346**



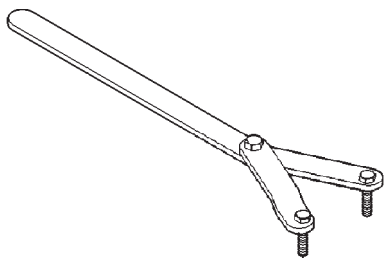
**Front Crankshaft Seal Remover 8511**



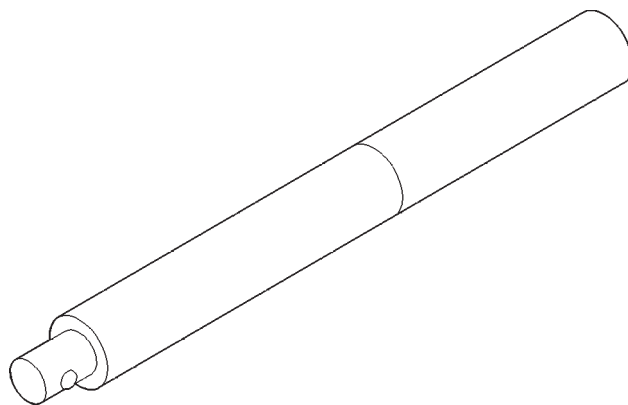
**Front Crankshaft Seal Installer 8348**

SPECIAL TOOLS

3.7L ENGINE

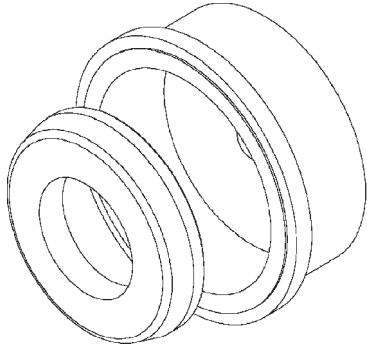


**Spanner Wrench 6958**

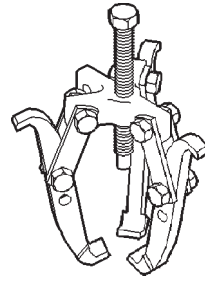


**Handle C-4171**

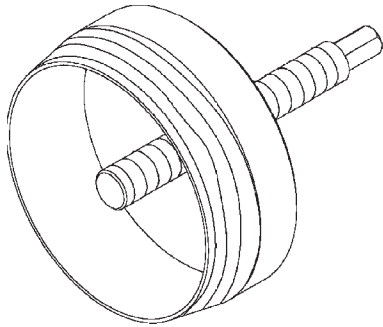
ENGINE - 3.7L (Continued)



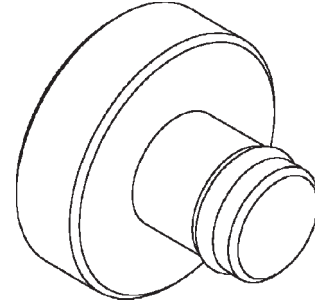
**Rear Crankshaft Seal Installer 8349**



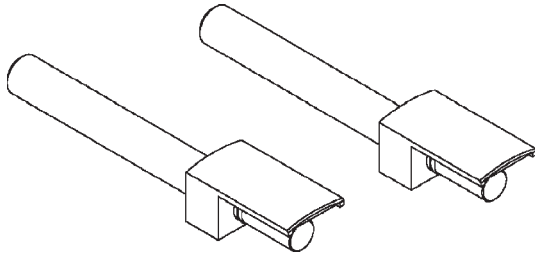
**Puller 1026**



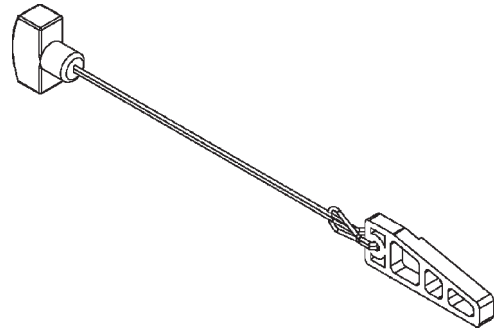
**Rear Crankshaft Seal Remover 8506**



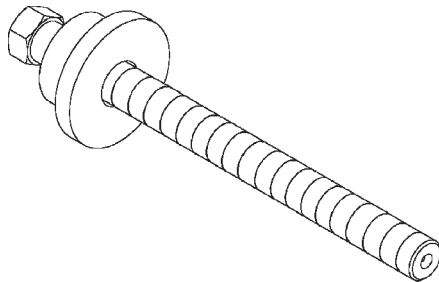
**Crankshaft Damper Removal Insert 8513**



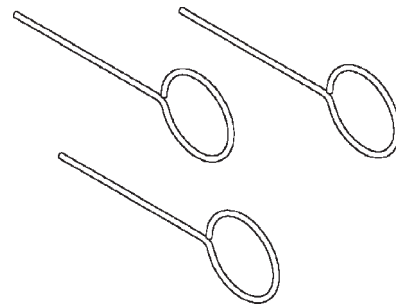
**Connecting Rod Guides 8507**



**Chain Tensioner Wedge 8379**

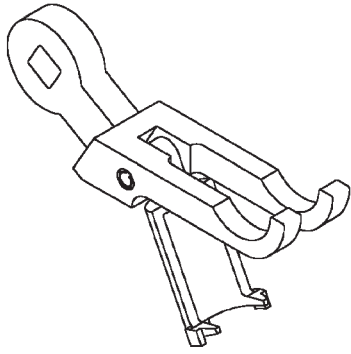


**Crankshaft Damper Installer 8512**

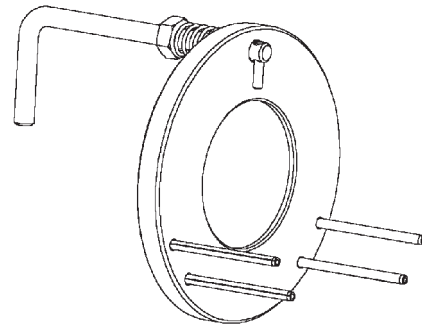


**Chain Tensioner Pins 8514**

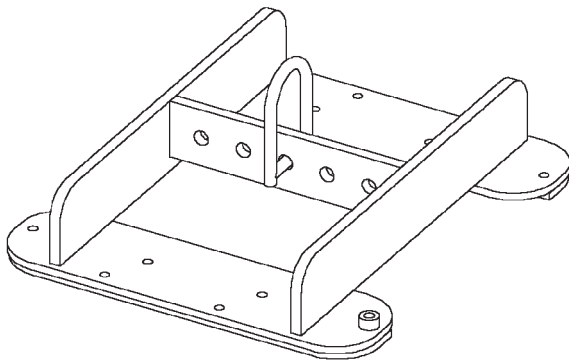
ENGINE - 3.7L (Continued)



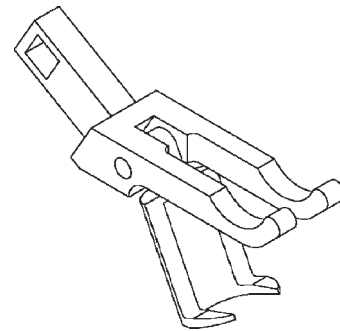
**VALVE SPRING COMPRESSOR 8426**



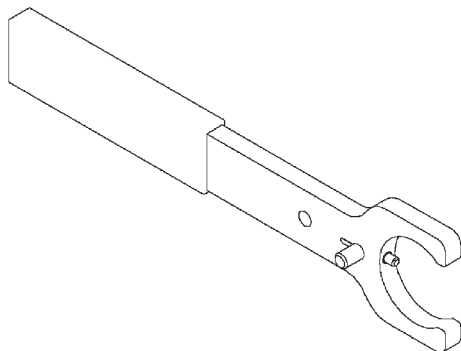
**HOLDER SECONDARY CAMSHAFT CHAIN 8429**



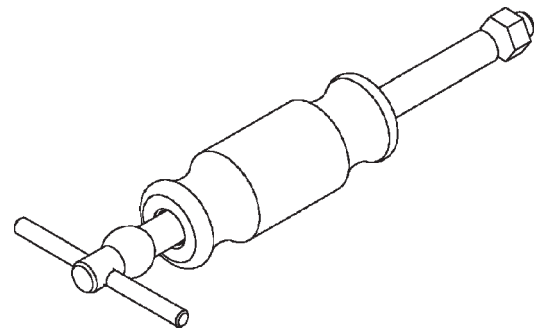
**ENGINE LIFTING FIXTURE 8427**



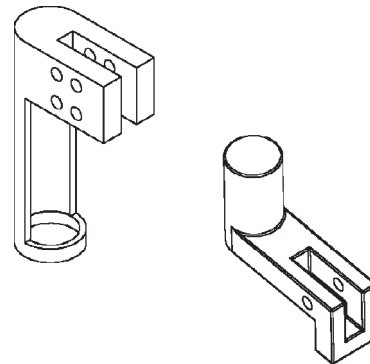
**Remover, Rocker Arm 8516**



**CAMSHAFT HOLDER 8428**



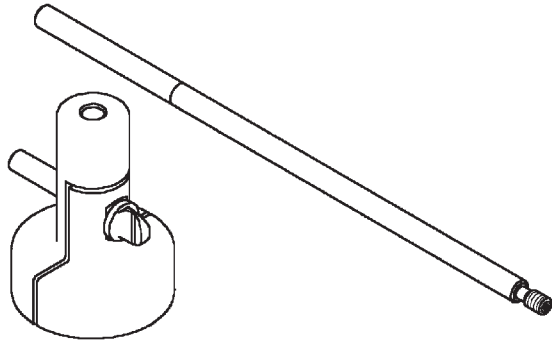
**Idler Shaft Remover 8517**



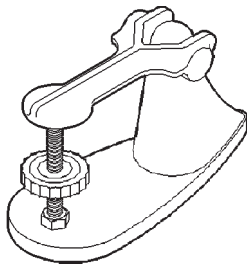
**Valve Spring Compressor Adapters 8519**



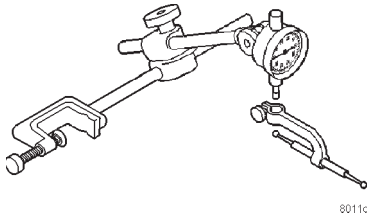
ENGINE - 3.7L (Continued)



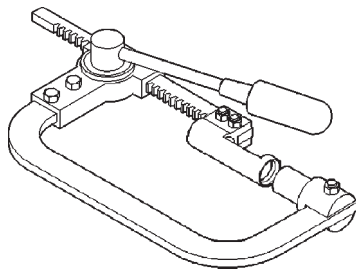
**INSTALLER - REMOVER - COUNTER BALANCE  
SHAFT 8641**



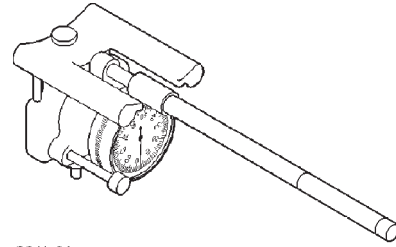
**Valve Spring Tester C-647**



**Dial Indicator C-3339**

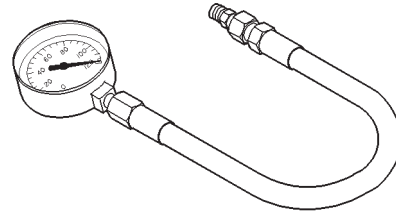


**Valve Spring Compressor C-3422-B**

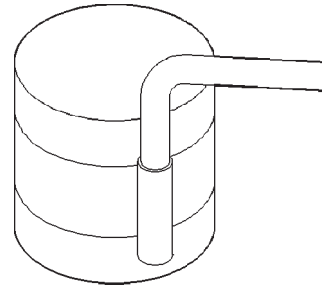


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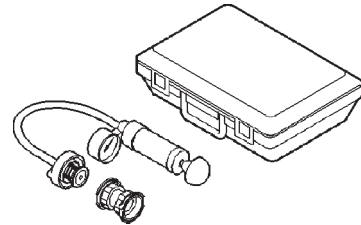
**Bore Size Indicator C-119**



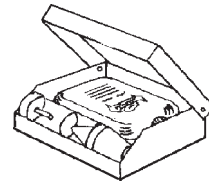
**Oil Pressure Gauge C-3292**



**Piston Ring Compressor C-385**



**Pressure Tester Kit 7700**



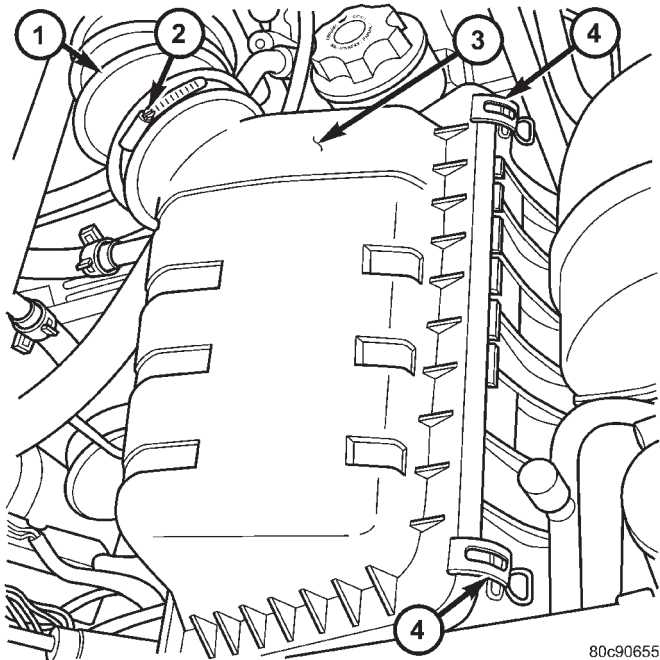
**Bloc-Chek-Kit C-3685-A**

## AIR CLEANER ELEMENT

### REMOVAL - 3.7L

Housing removal is not necessary for element (filter) replacement.

- (1) Pry up 2 spring clips (Fig. 3) from front of housing cover (spring clips retain cover to housing).
- (2) Release housing cover from 4 locating tabs located on rear of housing, and remove cover.
- (3) Remove air cleaner element (filter) from housing.
- (4) Clean inside of housing before replacing element.



**Fig. 3 AIR CLEANER ELEMENT - 3.7L**

- 1 - AIR INTAKE HOSE
- 2 - HOSE CLAMP
- 3 - COVER
- 4 - CLIPS (2)

### INSTALLATION - 3.7L

- (1) Install element into housing.
  - (2) Position housing cover into housing locating tabs.
  - (3) Pry up spring clips and lock cover to housing.
- If any air filter, air resonator, air intake tubes or air filter housing clamps had been loosened or removed, tighten them to 5 N·m (40 in. lbs.) torque.

## CYLINDER HEAD - LEFT

### DESCRIPTION - VALVE GUIDES

The valve guides are made of powdered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, and valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

## DIAGNOSIS AND TESTING

### DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

A tappet-like noise may be produced from several items. Check the following items.

- (1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.
- (2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.
- (3) Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
- (4) Low oil pressure.
- (5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.
- (6) Air ingested into oil due to broken or cracked oil pump pick up.
- (7) Worn valve guides.
- (8) Rocker arm ears contacting valve spring retainer.
- (9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.
- (10) Oil leak or excessive cam bore wear in cylinder head.
- (11) Faulty lash adjuster.

- Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

- Remove suspected lash adjusters, and replace.
- Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

### DIAGNOSIS AND TESTING - CYLINDER HEAD GASKET

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

## CYLINDER HEAD - LEFT (Continued)

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

## CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). 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 WITH COOLANT PRESSURE CAP REMOVED.**

## VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

## COOLING SYSTEM TESTER METHOD

**WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).**

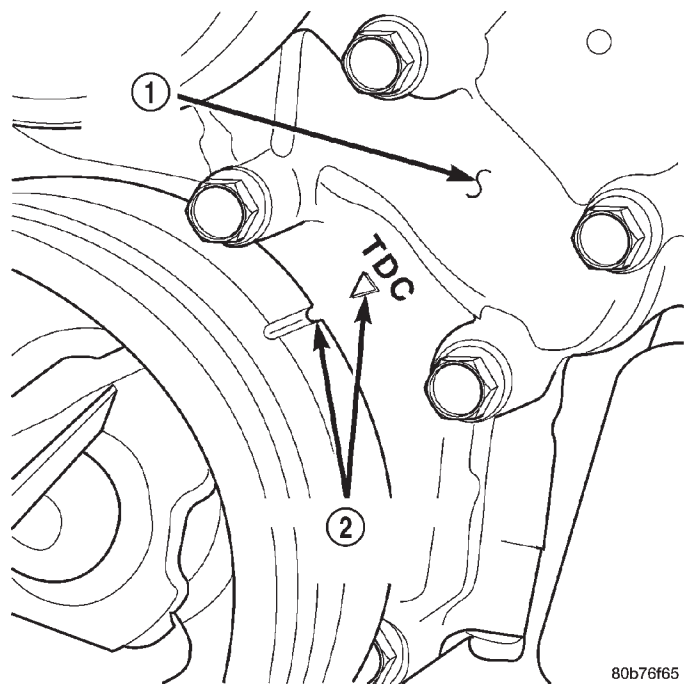
Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

## CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

## REMOVAL

- (1) Disconnect the negative cable from the battery.
- (2) Raise the vehicle on a hoist.
- (3) Disconnect the exhaust pipe at the left side exhaust manifold.
- (4) Drain the engine coolant. Refer to COOLING SYSTEM.
- (5) Lower the vehicle.
- (6) Remove the intake manifold. Refer to procedure in this section.
- (7) Remove the cylinder head cover. Refer to procedure in this section.
- (8) Remove the fan shroud and fan blade assembly. Refer to COOLING SYSTEM.
- (9) Remove accessory drive belt. Refer to COOLING SYSTEM.
- (10) Remove the power steering pump and set aside.
- (11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 4).



**Fig. 4 Engine Top Dead Center**

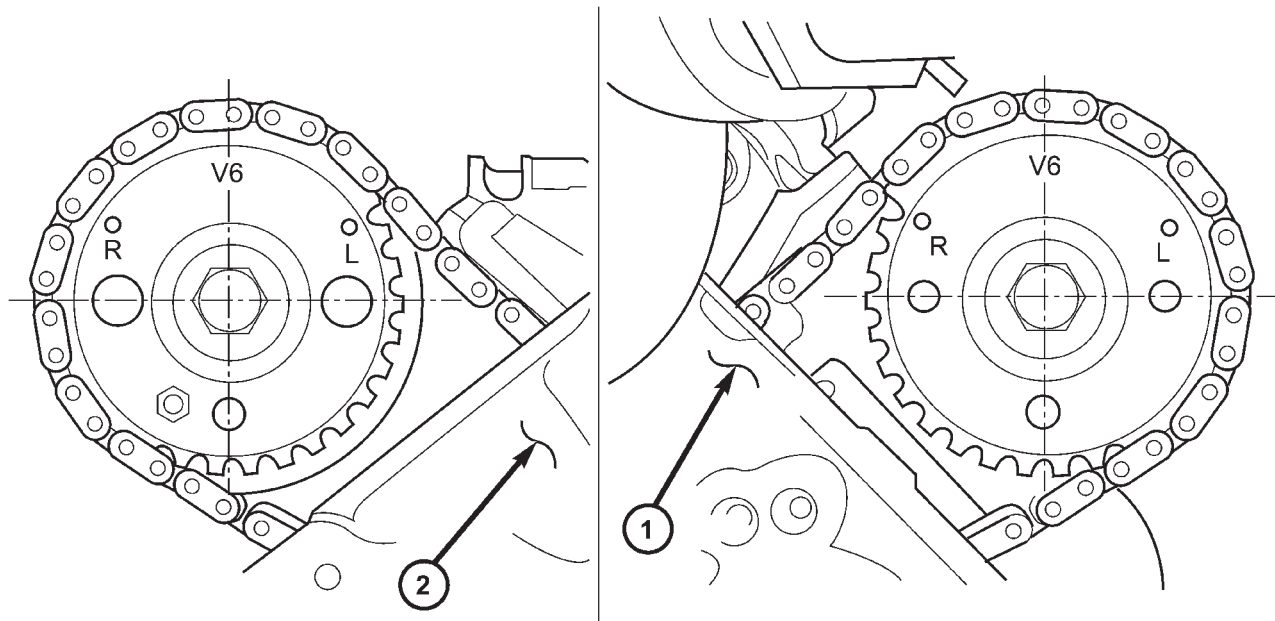
- 1 - TIMING CHAIN COVER
- 2 - CRANKSHAFT TIMING MARKS

(12) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 5). Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper. Refer to Procedure.

(14) Remove the timing chain cover. Refer to procedure.

CYLINDER HEAD - LEFT (Continued)



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**Fig. 5 Camshaft Sprocket V6 Marks**

- 1 - LEFT CYLINDER HEAD
- 2 - RIGHT CYLINDER HEAD

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture (Fig. 6).

**NOTE:** Mark the secondary timing chain prior to removal to aid in installation.

(16) Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.

(17) Remove the left side secondary chain tensioner. Refer to Timing Chain and Sprockets.

(18) Remove the cylinder head access plug (Fig. 7).

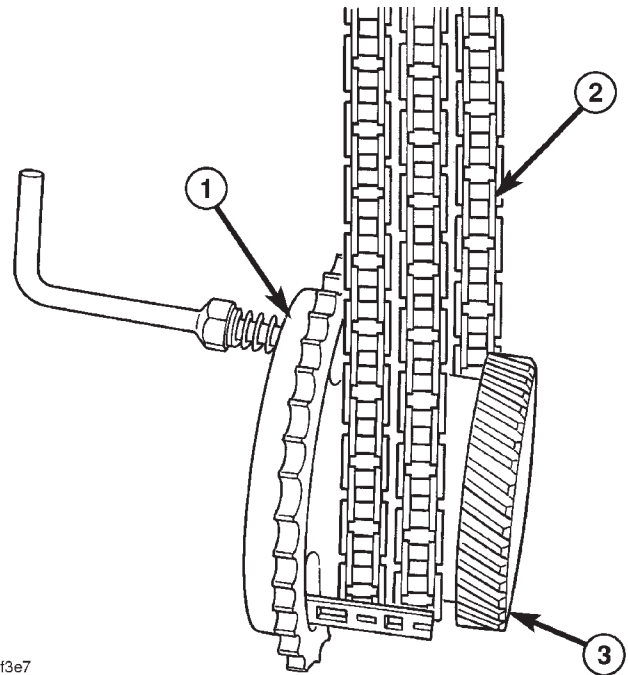
(19) Remove the left side secondary chain guide. Refer to Timing Chain and Sprockets.

(20) Remove the retaining bolt and the camshaft drive gear.

**CAUTION:** Do not allow the engine to rotate. Severe damage to the valve train can occur.

**CAUTION:** Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

**NOTE:** The cylinder head is attached to the cylinder block with twelve bolts.

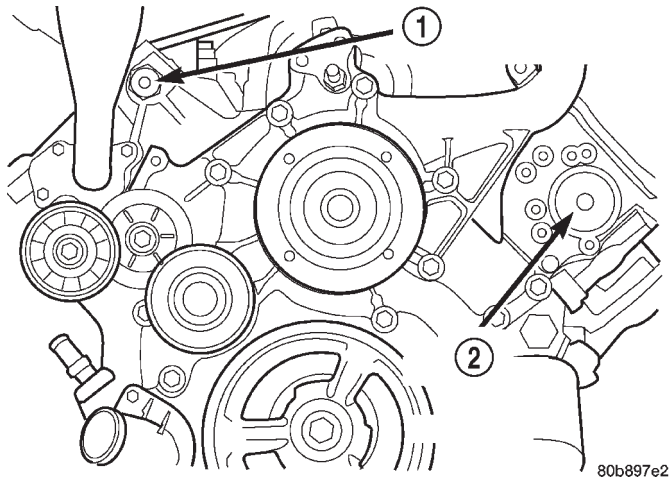


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**Fig. 6 Using Special Tool 8429**

- 1 - SPECIAL TOOL 8429
- 2 - CAMSHAFT CHAIN
- 3 - CRANKSHAFT TIMING GEAR

CYLINDER HEAD - LEFT (Continued)



**Fig. 7 Cylinder Head Access Plugs**

- 1 - RIGHT CYLINDER HEAD ACCESS PLUG
- 2 - LEFT CYLINDER HEAD ACCESS PLUG

- (21) Remove the cylinder head retaining bolts.
- (22) Remove the cylinder head and gasket. Discard the gasket.

**CAUTION:** Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head gasket sealing surface may prevent the gasket from properly sealing resulting in leaks.

**CLEANING**

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components (Fig. 8). (Refer to 9 - ENGINE - STANDARD PROCEDURE)

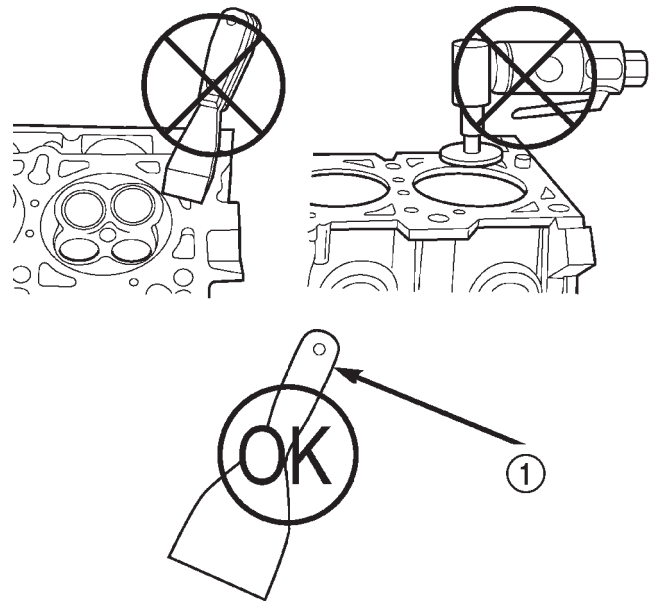
**INSTALLATION**

**NOTE:** The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced. The M8 head bolts, should not be reused. Use new M8 bolts.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 9).

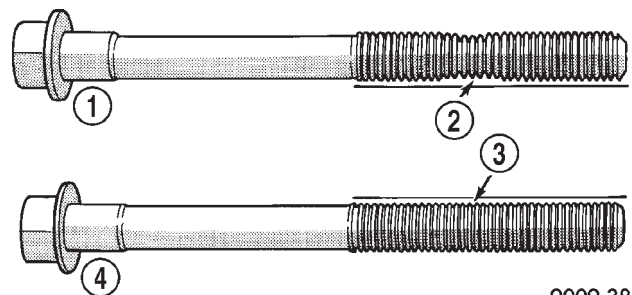
**CAUTION:** When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

- (1) Clean the cylinder head and cylinder block mating surfaces (Fig. 10).



**Fig. 8 Proper Tool Usage For Surface Preparation**

- 1 - PLASTIC/WOOD SCRAPER



**Fig. 9 Checking Cylinder Head Bolts for Stretching (Necking)**

- 1 - STRETCHED BOLT
- 2 - THREADS ARE NOT STRAIGHT ON LINE
- 3 - THREADS ARE STRAIGHT ON LINE
- 4 - UNSTRETCHED BOLT

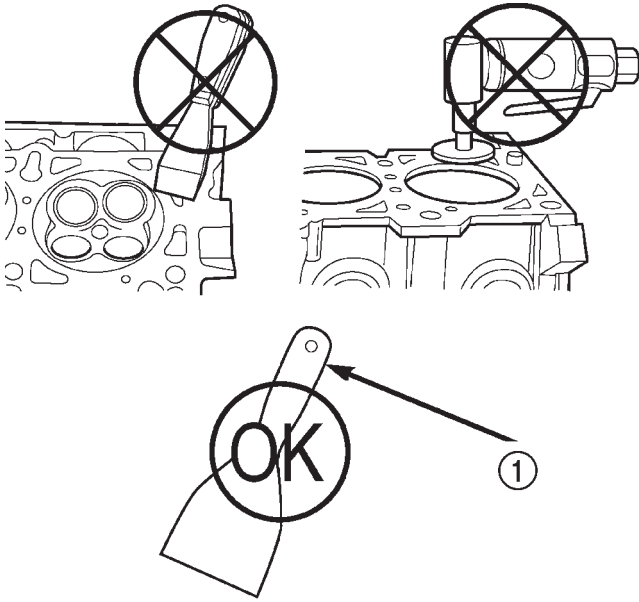
- (2) Position the new cylinder head gasket on the locating dowels.

**CAUTION:** When installing cylinder head, use care not damage the tensioner arm or the guide arm.

- (3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

**NOTE:** The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

CYLINDER HEAD - LEFT (Continued)



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**Fig. 10 Proper Tool Usage For Surface Preparation**

1 - PLASTIC/WOOD SCRAPER

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the eight M11 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

**NOTE:** The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yeild design.

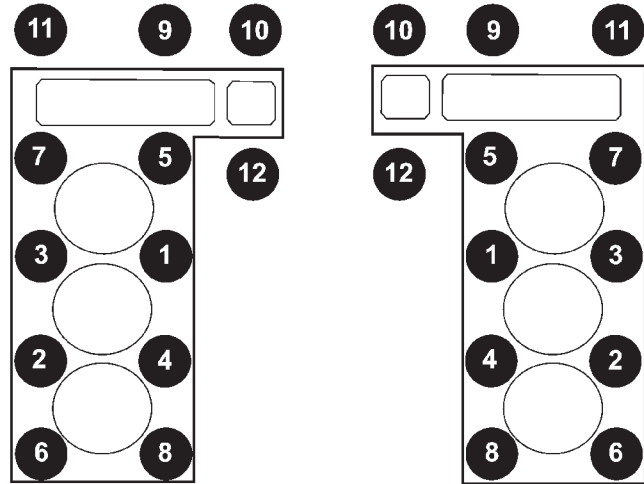
(6) Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 27 N·m (20 ft. lbs.).
- Step 2: Verify that bolts 1–10, all reached 27 N·m (20 ft. lbs.), by repeating step-1 without loosening the bolts. Tighten bolts 11 thru 14 to 14 N·m (10 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees (Fig. 11).
- Step 4: Tighten bolts 1–10, 90 degrees, again. Tighten bolts 11–14, 26 N·m (19 ft. lbs.)

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark on the gear then using Special Tool 8428 Camshaft Wrench, position the gear onto the camshaft.

**CAUTION:** Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.

- (8) Install the camshaft drive gear retaining bolt.
- (9) Install the left side secondary chain guide.



LEFT BANK

RIGHT BANK

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**Fig. 11 CYLINDER HEAD TIGHTENING SEQUENCE**

- (10) Install the cylinder head access plug.
- (11) Re-set and Install the left side secondary chain tensioner.
- (12) Remove Special Tool 8429.
- (13) Install the timing chain cover.
- (14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).
- (15) Install the power steering pump.
- (16) Install the fan blade assembly and fan shroud.
- (17) Install the cylinder head cover.
- (18) Install the intake manifold.
- (19) Refill the cooling system
- (20) Raise the vehicle.
- (21) Install the exhaust pipe onto the left exhaust manifold.
- (22) Lower the vehicle.
- (23) Connect the negative cable to the battery.
- (24) Start the engine and check for leaks.

## CAMSHAFT(S)

### DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. Four bearing journals are machined into the camshaft. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

## CAMSHAFT(S) (Continued)

## REMOVAL

**CAUTION:** When the timing chain is removed and the cylinder heads are still installed, **DO NOT** forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

**CAUTION:** When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8379 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

(1) Remove cylinder head cover. Refer to CYLINDER HEAD COVER in this section.

(2) Set engine to TDC cylinder #1, camshaft sprocket V6 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.

**CAUTION:** Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

**NOTE:** The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

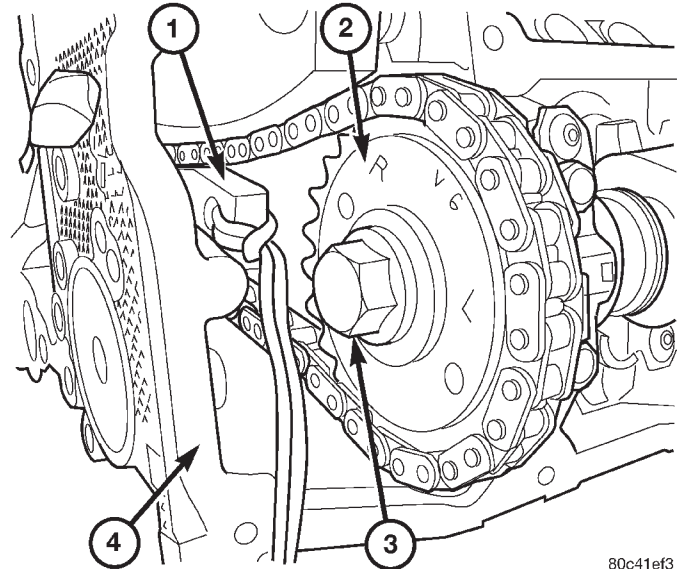
**CAUTION:** Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8379 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 12).

(6) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket (Fig. 13).

(7) Using Special Tool 8428 Camshaft Wrench, gently allow the camshaft to rotate 5° clockwise until the camshaft is in the neutral position (no valve load).

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.



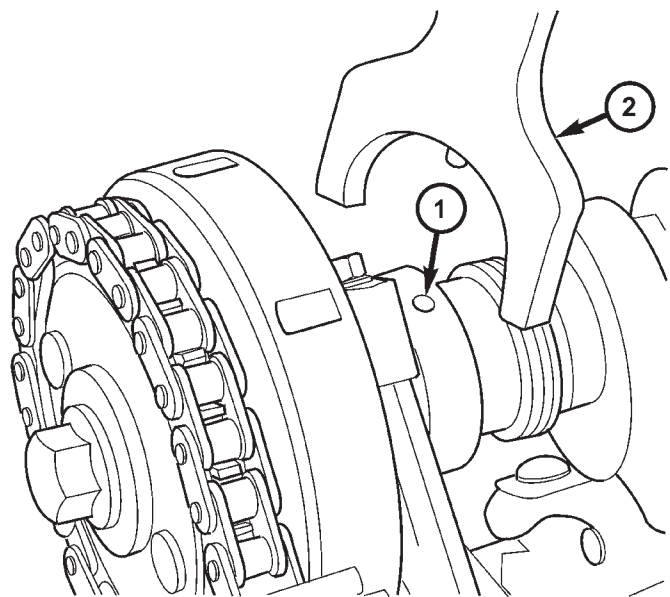
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**Fig. 12 SECURING TIMING CHAIN TENSIONERS USING TIMING CHAIN WEDGE — Typical**

1 - SPECIAL TOOL 8379

2 - CAMSHAFT SPROCKET

3 - CAMSHAFT SPROCKET BOLT



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**Fig. 13 Special Tool 8428**

1 - Camshaft hole

2 - Special Tool 8428

**CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.**

## CAMSHAFT(S) (Continued)

**NOTE:** When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

**INSTALLATION**

(1) Lubricate camshaft journals with clean engine oil.

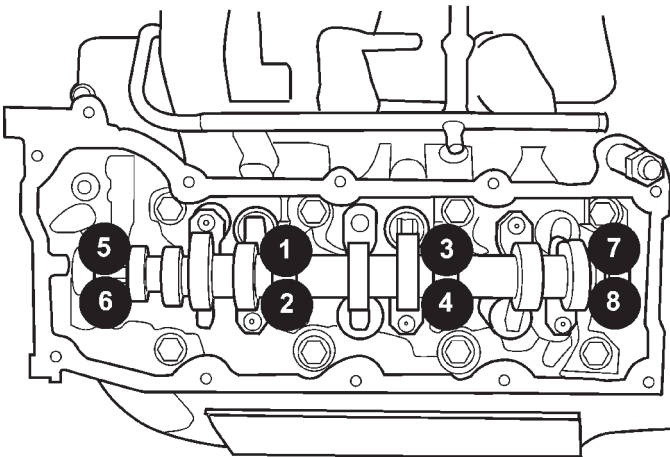
**NOTE:** Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

**NOTE:** Caps should be installed so that the stamped numbers on the caps are in numerical order, ( 1 thru 4 ) from the front to the rear of the engine. All caps should be installed so that the stamped arrows on the caps point toward the front of the engine.

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 14).



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**Fig. 14 Camshaft Bearing Caps Tightening Sequence**

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).

(7) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

**CAUTION:** Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

(8) Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8379 timing chain wedge.

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346, torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

**CYLINDER HEAD COVER(S)****DESCRIPTION**

The cylinder head covers are made of single layer stamped steel, and are not interchangeable from side-to-side (Fig. 15).

**REMOVAL**

(1) Disconnect negative cable from battery.

(2) Remove the resonator assemble and air inlet hose.

(3) Disconnect injector connectors and un-clip the injector harness.

(4) Route injector harness in front of cylinder head cover.

(5) Disconnect the left side breather tube and remove the breather tube.

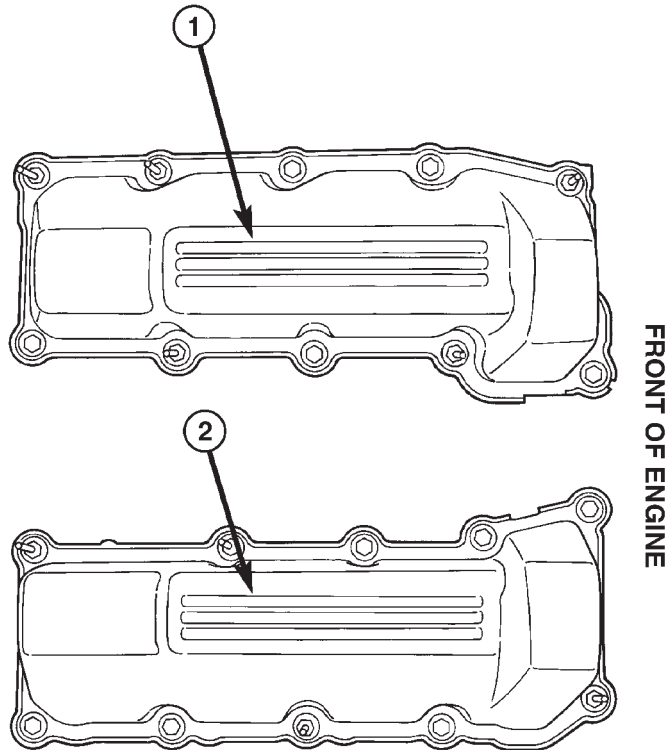
(6) Remove the cylinder head cover mounting bolts (Fig. 16).

(7) Remove cylinder head cover and gasket.

**NOTE:** The gasket may be used again, providing no cuts, tears, or deformation has occurred.



## CYLINDER HEAD COVER(S) (Continued)



FRONT OF ENGINE

**Fig. 15 CYLINDER HEAD COVERS**

- 1 - LEFT SIDE CYLINDER HEAD COVER  
2 - RIGHT SIDE CYLINDER HEAD COVER

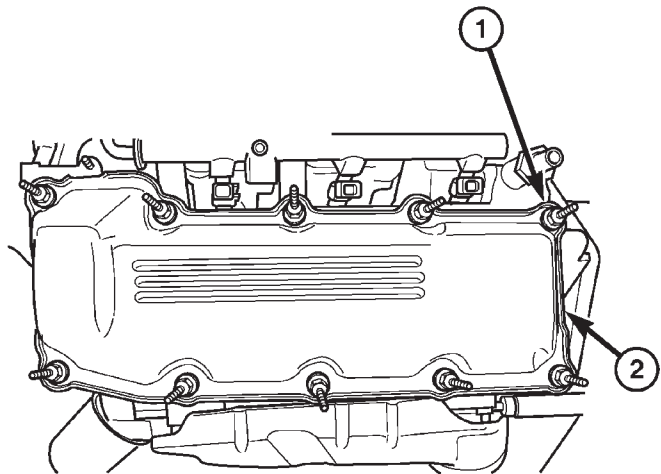
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**INSTALLATION**

**CAUTION:** Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

**NOTE:** The gasket may be used again, provided no cuts, tears, or deformation has occurred.

- (1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
- (2) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).
- (3) Install left side breather and connect breather tube.
- (4) Connect injector electrical connectors and injector harness retaining clips.
- (5) Install the resonator and air inlet hose.
- (6) Connect negative cable to battery.



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**Fig. 16 CYLINDER HEAD COVER - TYPICAL**

- 1 - SCREWS  
2 - CYLINDER HEAD COVER

**INTAKE/EXHAUST VALVES & SEATS****DESCRIPTION**

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

**STANDARD PROCEDURE - REFACING**

**NOTE:** Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

**NOTE:** When refacing valves and 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.

- (1) Using a suitable dial indicator measure the center of the valve seat. Total run out must not exceed 0.051 mm (0.002 in.).
- (2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the

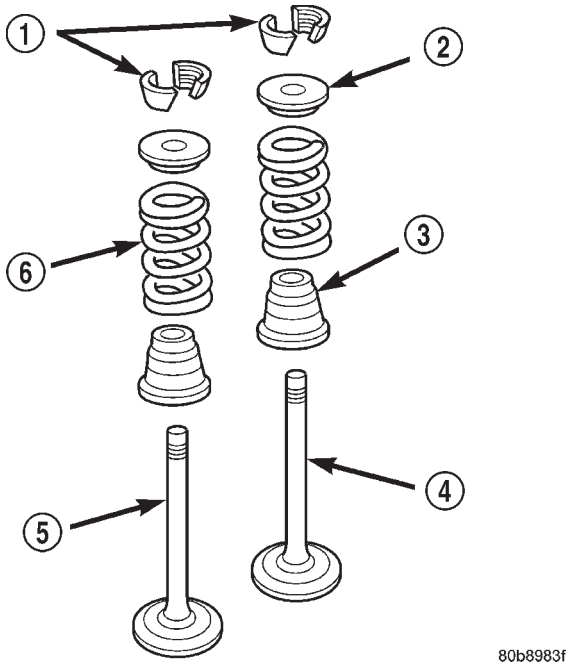
INTAKE/EXHAUST VALVES & SEATS (Continued)

valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 41.44 mm (1.6315 in.).

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle (Fig. 17).



**Fig. 17 Valve Assembly Configuration**

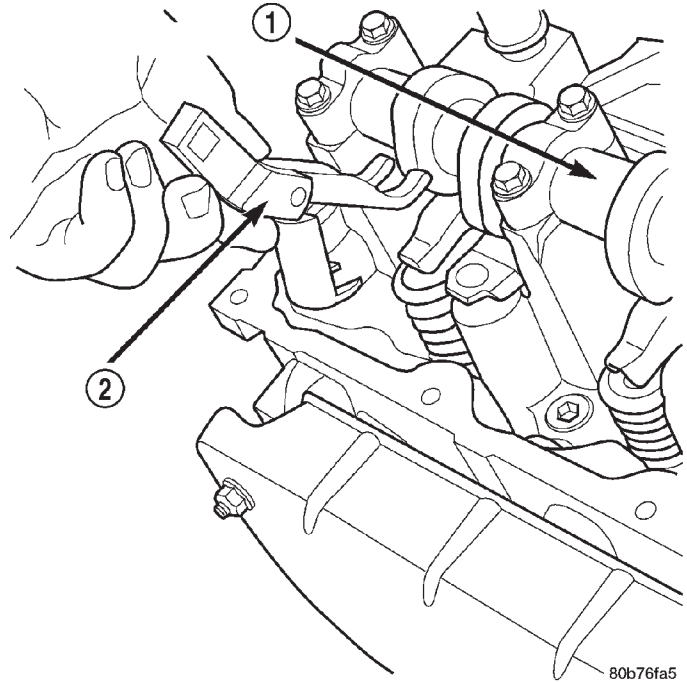
- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

**REMOVAL**

**NOTE:** The cylinder heads must be removed in order to perform this procedure.

(1) Remove rocker arms and lash adjusters. Refer to procedures in this section (Fig. 18).

(2) Remove the camshaft bearing caps and the camshaft.



**Fig. 18 Rocker Arm Removal**

- 1 - CAMSHAFT
- 2 - SPECIAL TOOL 8516

**NOTE:** All six valve springs and valves are removed in the same manner; this procedure only covers one valve and valve spring.

(3) Using Special Tool C-3422-B or C-3422-C Valve Spring Compressor and Special tool 8519 Adapter, compress the valve spring.

**NOTE:** It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(4) Remove the two spring retainer lock halves.

**NOTE:** the valve spring is under tension use care when releasing the valve spring compressor.

(5) Remove the valve spring compressor.

(6) Remove the spring retainer, and the spring.

**NOTE:** Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

(7) Remove the valve from the cylinder head.

**NOTE:** The valve stem seals are common between intake and exhaust.

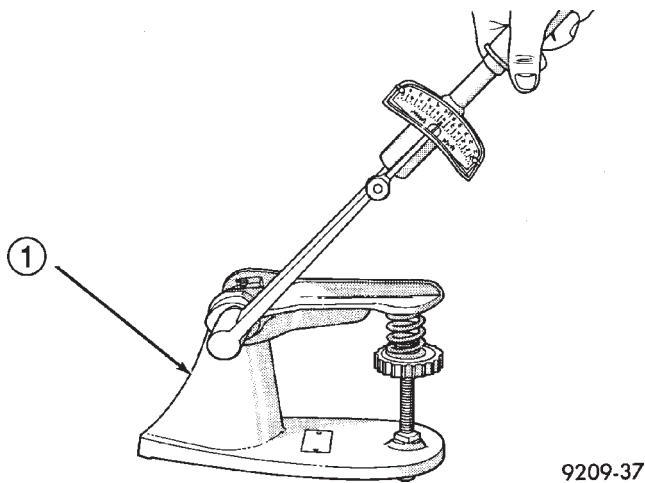
(8) Remove the valve stem seal. Mark the valve for proper installation.

## INTAKE/EXHAUST VALVES &amp; SEATS (Continued)

## TESTING VALVE SPRINGS

**NOTE:** Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.69 mm (1.602 in.) mark on the threaded stud and the zero mark on the front. Place spring over the 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 two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 19).



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**Fig. 19 Testing Valve Springs**

1 - SPECIAL TOOL C-647

## INSTALLATION

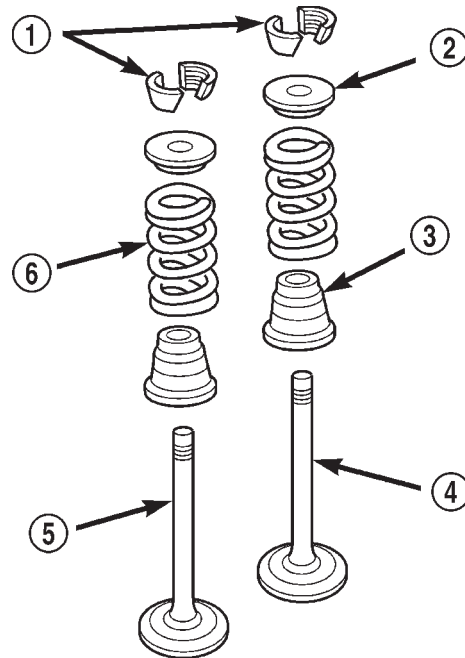
(1) coat the valve stem with clean engine oil and insert it into the cylinder head.

(2) Install the valve stem seal. make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(3) Install the spring and the spring retainer (Fig. 20).

(4) Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.

(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.



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**Fig. 20 Valve Assembly Configuration**

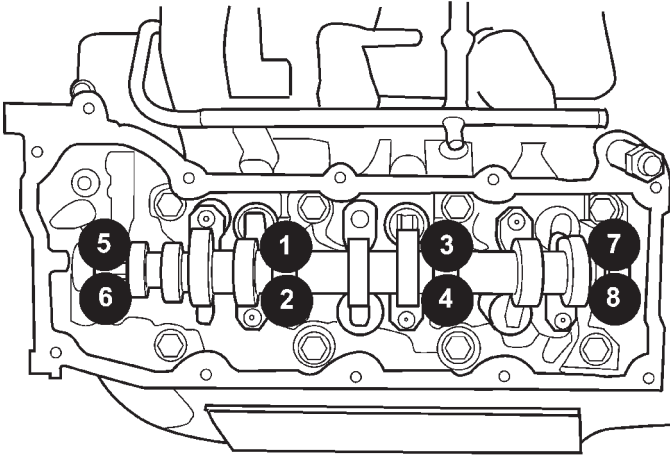
- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

(6) lubricate the camshaft journal with clean engine oil then Position the camshaft (with the sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock), then position the camshaft bearing caps.

(7) Install the camshaft bearing cap retaining bolts. Tighten the bolts 9-13 N·m (100 in. lbs.) in ½ turn increments in the sequence shown (Fig. 21).

(8) Position the hydraulic lash adjusters and rocker arms.

## INTAKE/EXHAUST VALVES &amp; SEATS (Continued)



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**Fig. 21 Camshaft Bearing Caps Tightening Sequence**

## ROCKER ARM

## DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

## VALVE GUIDE SEALS

## DESCRIPTION

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

## VALVE SPRINGS

## DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

## REMOVAL

(1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this Section.

(2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.

(3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.

(4) Apply shop air to the cylinder to hold the valves in place when the spring is removed.

**NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.**

(5) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

**NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.**

(6) Remove the two spring retainer lock halves.

**NOTE: the valve spring is under tension use care when releasing the valve spring compressor.**

(7) Remove the valve spring compressor.

(8) Remove the spring retainer, and the spring.

(9) Remove the valve stem seal.

**NOTE: The valve stem seals are common between intake and exhaust.**

## INSTALLATION

**NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.**

(1) Apply shop air to the cylinder to hold the valves in place while the spring is installed.

**NOTE: The valve stem seals are common between intake and exhaust.**

(2) Install the valve stem seal.

(3) Install the spring retainer, and the spring.

(4) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

(5) Install the two spring retainer lock halves.

**NOTE: the valve spring is under tension use care when releasing the valve spring compressor.**

(6) Remove the valve spring compressor.

(7) Disconnect the shop air to the cylinder.

(8) Install the spark plug for the cylinder the valve spring and seal was installed on.

## VALVE SPRINGS (Continued)

(9) Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.

(10) Install the cylinder head cover. Refer to Cylinder Head Cover in this Section.

## CYLINDER HEAD - RIGHT

## DESCRIPTION

## DESCRIPTION - CYLINDER HEAD

The cylinder heads are made of an aluminum alloy. The cylinder head features two valves per cylinder with pressed in powdered metal valve guides. The cylinder heads also provide enclosures for the timing chain drain, necessitating unique left and right cylinder heads.

## DESCRIPTION - VALVE GUIDES

The valve guides are made of powdered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, and valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

## DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

## DIAGNOSIS AND TESTING

## DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

A tappet-like noise may be produced from several items. Check the following items.

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Oil leak or excessive cam bore wear in cylinder head.

(11) Faulty lash adjuster.

- Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

- Remove suspected lash adjusters, and replace.

- Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

## DIAGNOSIS AND TESTING - CYLINDER HEAD GASKET

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

## CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). 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 WITH COOLANT PRESSURE CAP REMOVED.**

## CYLINDER HEAD - RIGHT (Continued)

## VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

## COOLING SYSTEM TESTER METHOD

**WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).**

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

## CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

## REMOVAL

- (1) Disconnect battery negative cable.
- (2) Raise the vehicle on a hoist.
- (3) Disconnect the exhaust pipe at the right side exhaust manifold.
- (4) Drain the engine coolant. Refer to COOLING SYSTEM.
- (5) Lower the vehicle.
- (6) Remove the intake manifold. Refer to procedure.
- (7) Remove the cylinder head cover. Refer to procedure.
- (8) Remove the fan shroud. Refer to COOLING SYSTEM.
- (9) Remove oil fill housing from cylinder head.
- (10) Remove accessory drive belt. Refer to COOLING SYSTEM.
- (11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark.
- (12) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position. Rotate the crankshaft one turn if necessary.
- (13) Remove the crankshaft damper. Refer to procedure.
- (14) Remove the timing chain cover. Refer to procedure.
- (15) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture.

**NOTE: Mark the secondary timing chain prior to removal to aid in installation.**

(16) Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.

(17) Remove the right side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.

(18) Remove the cylinder head access plug.

(19) Remove the right side secondary chain guide. Refer to Timing Chain and Sprockets in this section.

**CAUTION: The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 N·m (44 in. lbs.).**

(20) Remove the retaining bolt and the camshaft drive gear.

**CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.**

**CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.**

**CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.**

**NOTE: The cylinder head is attached to the cylinder block with twelve bolts.**

(21) Remove the cylinder head retaining bolts.

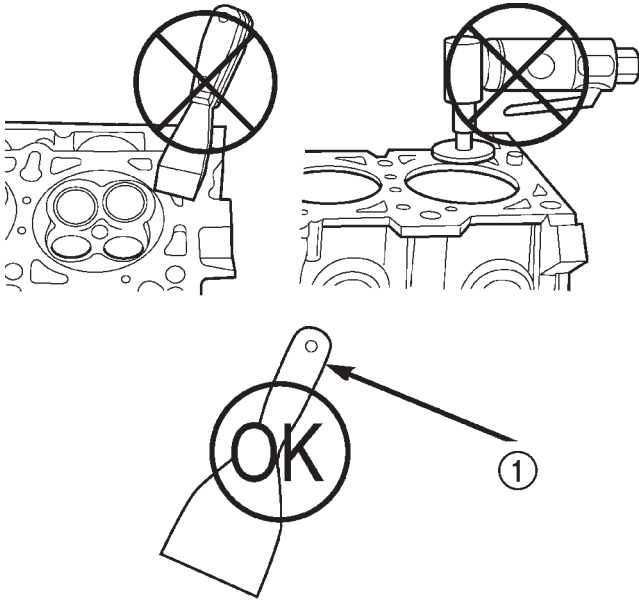
(22) Remove the cylinder head and gasket. Discard the gasket.

**CAUTION: Do not lay the cylinder head on its gasket sealing surface, do to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.**

## CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components (Fig. 22). (Refer to 9 - ENGINE - STANDARD PROCEDURE)

## CYLINDER HEAD - RIGHT (Continued)



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**Fig. 22 Proper Tool Usage For Surface Preparation**

1 - PLASTIC/WOOD SCRAPER

## INSPECTION

(1) Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If measurements exceed 0.0508 mm (0.002 in.) replace the cylinder head.

(2) Inspect the valve seats for damage. Service the valve seats as necessary.

(3) Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

## INSTALLATION

**NOTE:** The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined **BEFORE** reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced.

**CAUTION:** When cleaning cylinder head and cylinder block surfaces, **DO NOT** use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces.

(2) Position the new cylinder head gasket on the locating dowels.

**CAUTION:** When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

**NOTE:** The four M8 cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks. Do not reuse the old M8 bolts, use new M8 bolts.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the eight M10 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar Lock and Seal Adhesive** then install the bolts.

The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
  - Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.).
- Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

**CAUTION:** The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 N·m (44 in. lbs.).

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark on the gear then using Special Tool 8428 Camshaft Wrench, position the gear onto the camshaft.

**CAUTION:** Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

- (8) Install the camshaft drive gear retaining bolt.
- (9) Install the right side secondary chain guide.
- (10) Install the cylinder head access plug.
- (11) Re-set and install the right side secondary chain tensioner.
- (12) Remove Special Tool 8429.
- (13) Install the timing chain cover.
- (14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).
- (15) Install accessory drive belt.
- (16) Install the fan shroud.
- (17) Install the cylinder head cover.
- (18) Install the intake manifold.

## CYLINDER HEAD - RIGHT (Continued)

- (19) Install oil fill housing onto cylinder head.
- (20) Refill the cooling system.
- (21) Raise the vehicle.
- (22) Install the exhaust pipe onto the right exhaust manifold.
- (23) Lower the vehicle.
- (24) Reconnect battery negative cable.
- (25) Start the engine and check for leaks.

## CAMSHAFT(S)

## DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. Four bearing journals are machined into the camshaft. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

## REMOVAL

**CAUTION:** When the timing chain is removed and the cylinder heads are still installed, **DO NOT** forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

**CAUTION:** When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8379 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

- (1) Remove the cylinder head cover. Refer to CYLINDER HEAD COVER in this section.
- (2) Set engine to TDC cylinder #1, camshaft sprocket V6 marks at the 12 o'clock position.
- (3) Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.

**CAUTION:** Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

- (4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

**NOTE:** The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tension-

ers to extend, requiring timing chain cover removal in order to reset tensioners.

**CAUTION:** Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

- (5) Position Special Tool 8379 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide.

- (6) Remove the camshaft position sensor.

- (7) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket.

- (8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

**CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.**

**NOTE:** When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

- (9) Remove the camshaft bearing caps and the camshaft.

## INSTALLATION

- (1) Lubricate camshaft journals with clean engine oil.

**NOTE:** Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

- (2) Position the camshaft into the cylinder head.
- (3) Install the camshaft bearing caps, hand tighten the retaining bolts.

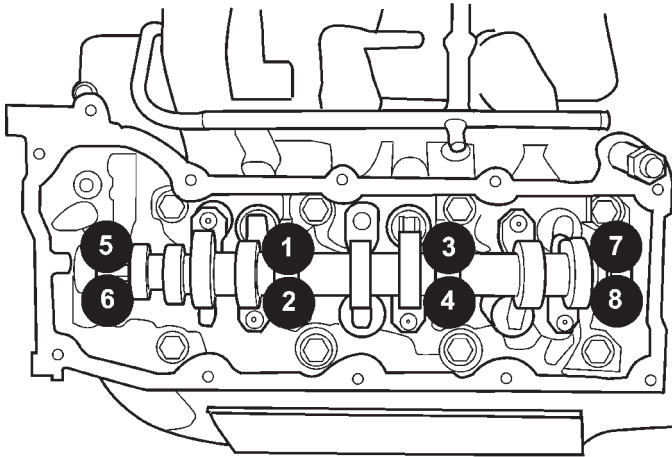
**NOTE:** Caps should be installed so that the stamped numbers on the caps are in numerical order, ( 1 thru 4 ) from the front to the rear of the engine. All caps should be installed so that the stamped arrows on the caps point toward the front of the engine.

- (4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 23).

- (5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).



## CAMSHAFT(S) (Continued)



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**Fig. 23 Camshaft Bearing Caps Tightening Sequence**

(6) Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).

(7) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

**CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.**

(8) Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove timing chain wedge special tool 8379.

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346, torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor.

(12) Install the cylinder head cover.

## CYLINDER HEAD COVER(S)

## REMOVAL

(1) Disconnect battery negative cable.

(2) Remove air cleaner assembly, resonator assembly and air inlet hose.

(3) Drain cooling system, below the level of the heater hoses. Refer to COOLING SYSTEM.

- (4) Remove accessory drive belt.
- (5) Remove air conditioning compressor retaining bolts and move compressor to the left.
- (6) Remove heater hoses.
- (7) Disconnect injector and ignition coil connectors.
- (8) Disconnect and remove positive crankcase ventilation (PCV) hose.
- (9) Remove oil fill tube.
- (10) Un-clip injector and ignition coil harness and move away from cylinder head cover.
- (11) Remove right rear breather tube and filter assembly.
- (12) Remove cylinder head cover retaining bolts.
- (13) Remove cylinder head cover.

## INSTALLATION

**CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.**

**NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.**

- (1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
- (2) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
- (3) Install right rear breather tube and filter assembly.
- (4) Connect injector, ignition coil electrical connectors and harness retaining clips.
- (5) Install the oil fill tube.
- (6) Install PCV hose.
- (7) Install heater hoses.
- (8) Install air conditioning compressor retaining bolts.
- (9) Install accessory drive belt
- (10) Fill Cooling system
- (11) Install air cleaner assembly, resonator assembly and air inlet hose.
- (12) Connect battery negative cable.

## INTAKE/EXHAUST VALVES &amp; SEATS

## STANDARD PROCEDURE - REFACING

**NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.**

INTAKE/EXHAUST VALVES & SEATS (Continued)

**NOTE:** When refacing valves and 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.

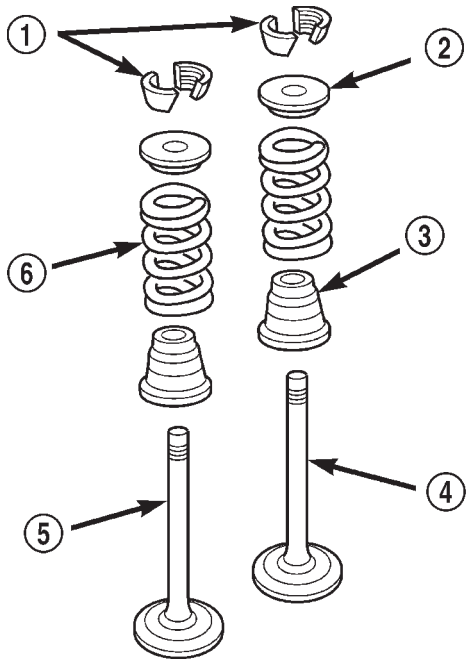
(1) Using a suitable dial indicator measure the center of the valve seat. Total run out must not exceed 0.051 mm (0.002 in).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 41.44 mm (1.6315 in.).

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle (Fig. 24).



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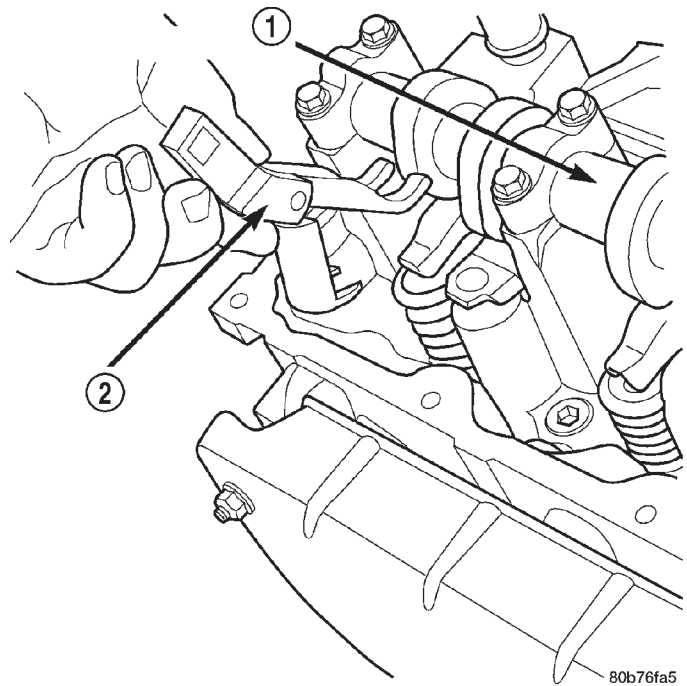
**Fig. 24 Valve Assembly Configuration**

- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

**REMOVAL**

**NOTE:** The cylinder heads must be removed in order to perform this procedure.

(1) Remove rocker arms and lash adjusters. Refer to procedures in this section (Fig. 25).



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**Fig. 25 Rocker Arm Removal**

- 1 - CAMSHAFT
- 2 - SPECIAL TOOL 8516

(2) Remove the camshaft bearing caps and the camshaft.

**NOTE:** All six valve springs and valves are removed in the same manner; this procedure only covers one valve and valve spring.

(3) Using Special Tool C-3422-B or C-3422-C Valve Spring Compressor and Special tool 8519 Adapter, compress the valve spring.

**NOTE:** It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(4) Remove the two spring retainer lock halves.

**NOTE:** the valve spring is under tension use care when releasing the valve spring compressor.

(5) Remove the valve spring compressor.

(6) Remove the spring retainer, and the spring.

## INTAKE/EXHAUST VALVES &amp; SEATS (Continued)

**NOTE:** Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

(7) Remove the valve from the cylinder head.

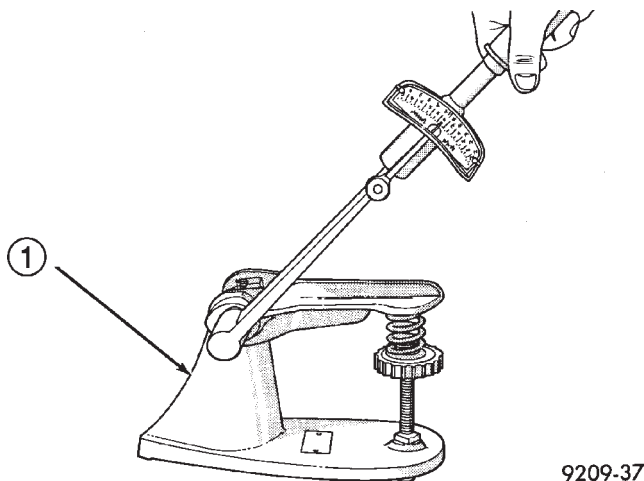
**NOTE:** The valve stem seals are common between intake and exhaust.

(8) Remove the valve stem seal. Mark the valve for proper installation.

## TESTING VALVE SPRINGS

**NOTE:** Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.69 mm (1.602 in.) mark on the threaded stud and the zero mark on the front. Place spring over the 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 two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 26).



**Fig. 26 Testing Valve Springs**

1 - SPECIAL TOOL C-647

## INSTALLATION

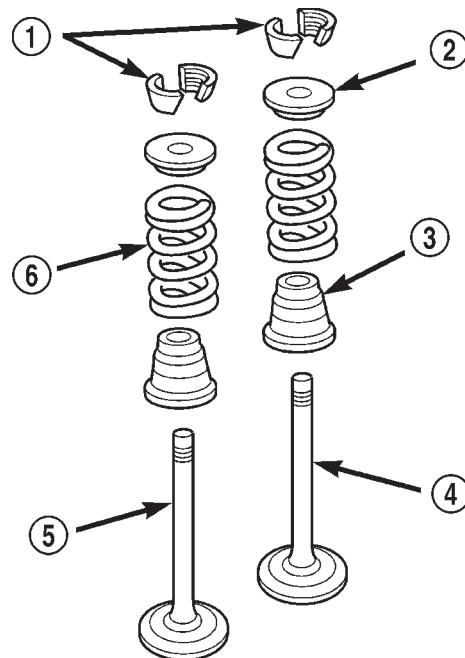
(1) coat the valve stem with clean engine oil and insert it into the cylinder head.

(2) Install the valve stem seal. make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(3) Install the spring and the spring retainer.

(4) Using the valve spring compressor, compress the spring and install the two valve spring retainer halves (Fig. 27).

(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.



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**Fig. 27 Valve Assembly Configuration**

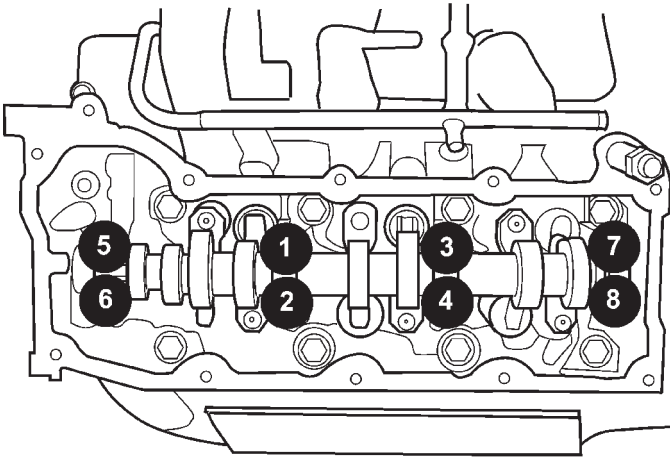
- 1 - VALVE LOCKS (3-BEAD)
- 2 - RETAINER
- 3 - VALVE STEM OIL SEAL
- 4 - INTAKE VALVE
- 5 - EXHAUST VALVE
- 6 - VALVE SPRING

(6) lubricate the camshaft journal with clean engine oil then Position the camshaft (with the sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock), then position the camshaft bearing caps.

(7) Install the camshaft bearing cap retaining bolts. Tighten the bolts 9-13 N·m (100 in. lbs.) in ½ turn increments in the sequence shown (Fig. 28).

(8) Position the hydraulic lash adjusters and rocker arms.

## INTAKE/EXHAUST VALVES &amp; SEATS (Continued)



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**Fig. 28 Camshaft Bearing Caps Tightening Sequence**

## ROCKER ARM

## DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

## REMOVAL

**NOTE:** Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

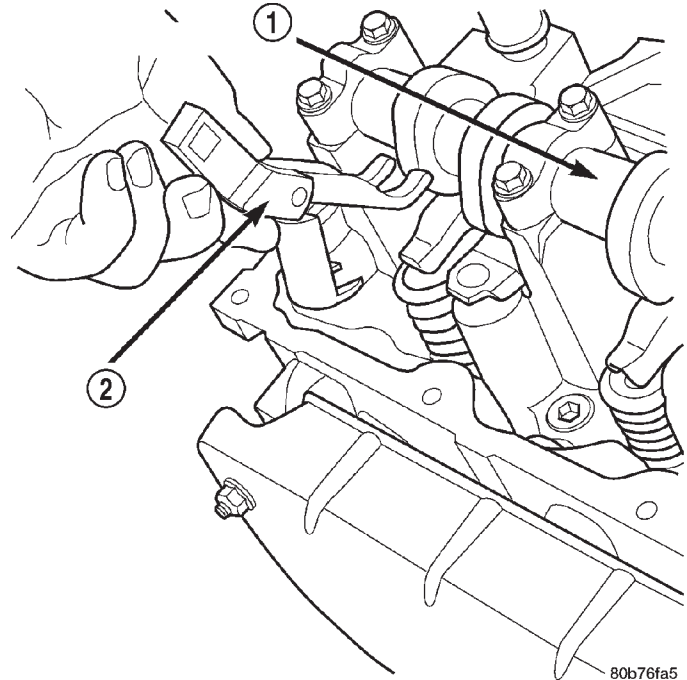
(2) For rocker arm removal on cylinder #4, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(3) For rocker arm removal on cylinder #1, Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(4) For rocker arm removal on cylinders #2 and #3, Rotate the crankshaft until cylinder #1 is at BDC compression stroke.

(5) For rocker arm removal on cylinders #5 and #6, Rotate the crankshaft until cylinder #1 is at BDC exhaust stroke.

(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 29).



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**Fig. 29 Rocker Arm - Removal**

1 - CAMSHAFT  
2 - SPECIAL TOOL 8516

## INSTALLATION

**CAUTION:** Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

**NOTE:** Coat the rocker arms with clean engine oil prior to installation.

(1) For rocker arm installation on cylinders #4, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinder #1, Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

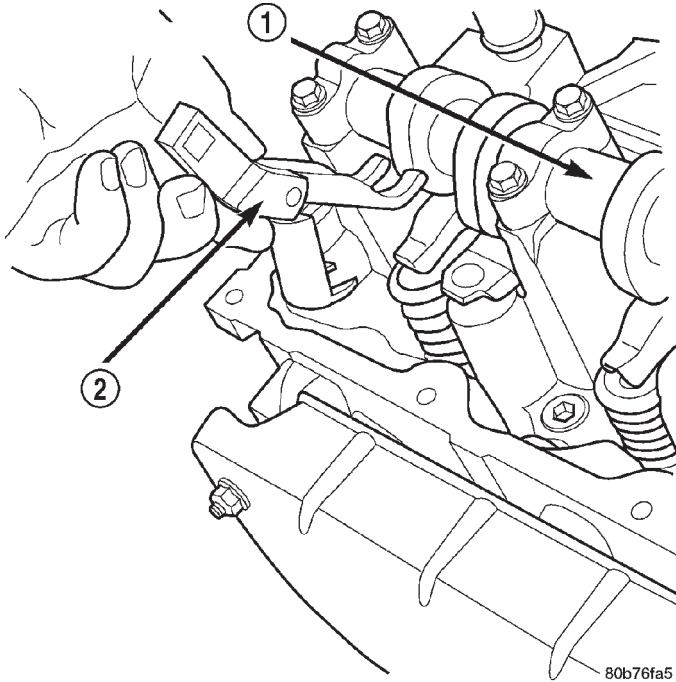
(3) For rocker arm installation on cylinders #2 and #3, Rotate the crankshaft until cylinder #1 is at BDC compression stroke.

(4) For rocker arm installation on cylinders #5 and #6, Rotate the crankshaft until cylinder #1 is at BDC exhaust stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 30).

(6) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

## ROCKER ARM (Continued)

**Fig. 30 Rocker Arm - Installation**

- 1 - CAMSHAFT  
2 - SPECIAL TOOL 8516

## VALVE GUIDE SEALS

## DESCRIPTION

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

## VALVE SPRINGS

## DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

## REMOVAL

- (1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this Section.
- (2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.
- (3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.
- (4) Apply shop air to the cylinder to hold the valves in place when the spring is removed.

**NOTE:** All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

- (5) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

**NOTE:** It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

- (6) Remove the two spring retainer lock halves.

**NOTE:** the valve spring is under tension use care when releasing the valve spring compressor.

- (7) Remove the valve spring compressor.
- (8) Remove the spring retainer, and the spring.
- (9) Remove the valve stem seal.

**NOTE:** The valve stem seals are common between intake and exhaust.

## INSTALLATION

**NOTE:** All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

- (1) Apply shop air to the cylinder to hold the valves in place while the spring is installed.

**NOTE:** The valve stem seals are common between intake and exhaust.

- (2) Install the valve stem seal.
- (3) Install the spring retainer, and the spring.
- (4) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.
- (5) Install the two spring retainer lock halves.

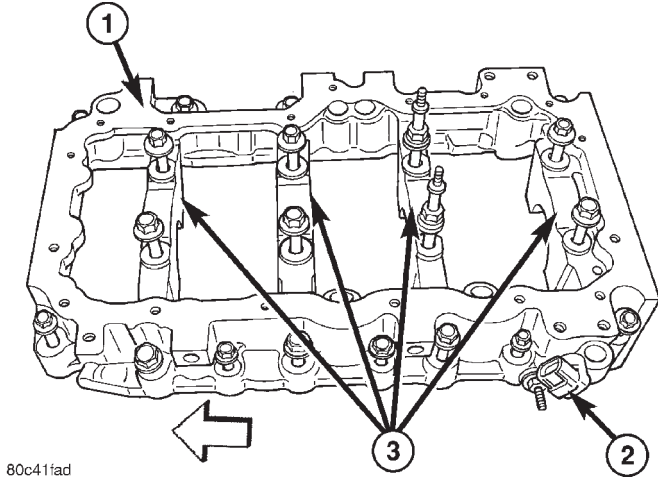
**NOTE:** the valve spring is under tension use care when releasing the valve spring compressor.

- (6) Remove the valve spring compressor.
- (7) Disconnect the shop air to the cylinder.
- (8) Install the spark plug for the cylinder the valve spring and seal was installed on.
- (9) Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.
- (10) Install the cylinder head cover. Refer to Cylinder Head Cover in this Section.

# ENGINE BLOCK

## DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate (Fig. 31) is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant bypass to a single poppet inlet thermostat is included in the cast aluminum front cover.



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**Fig. 31 CYLINDER BLOCK BEDPLATE**

- 1 - Cylinder Block Bedplate
- 2 - Crankshaft Position Sensor
- 3 - Crankshaft Main Bearing Caps

## STANDARD PROCEDURE - CYLINDER BORE HONING

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.

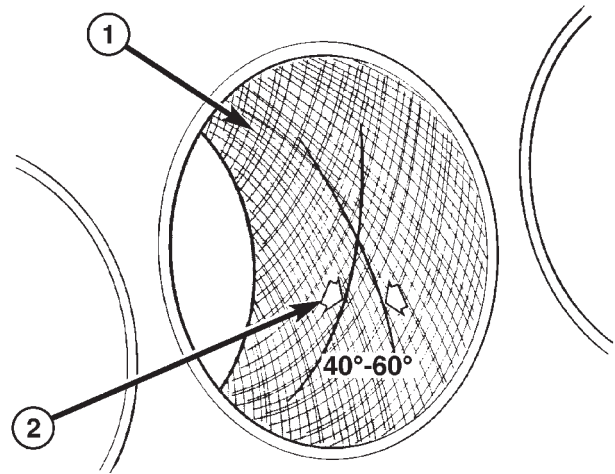
**CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.**

(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. 32).



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**Fig. 32 Cylinder Bore Crosshatch Pattern**

- 1 - CROSSHATCH PATTERN
- 2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper cross-hatch 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 cross-hatch 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.

## CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

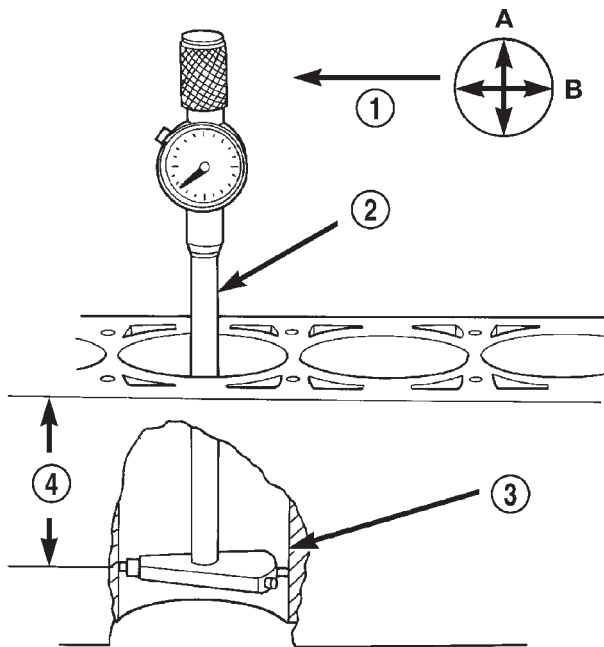
- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

## ENGINE BLOCK (Continued)

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the plugs to 34 N·m (25 ft. lbs.) torque.

## INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer (Fig. 33).



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**Fig. 33 Bore Gauge—Typical**

- 1 - FRONT
- 2 - BORE GAUGE
- 3 - CYLINDER BORE
- 4 - 38 MM (1.5 in)

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

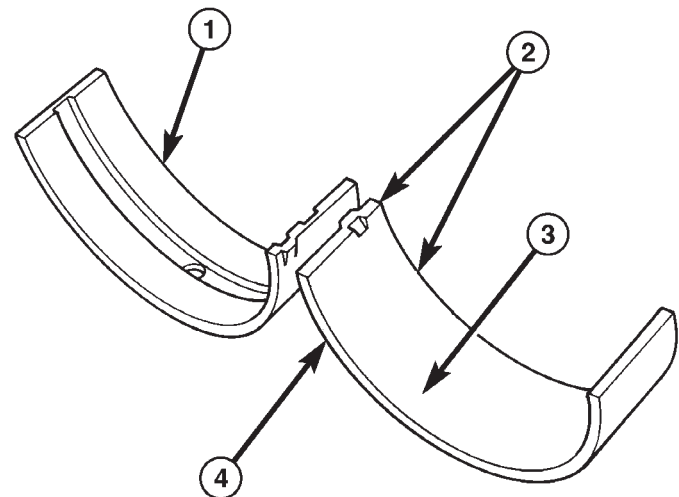
(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out-of-round condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

## CONNECTING ROD BEARINGS

## STANDARD PROCEDURE - CONNECTING ROD BEARING - FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 34) (Fig. 35). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 36). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.



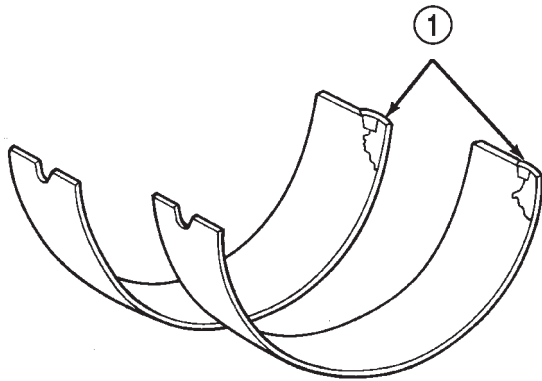
**HEAVIER WEAR  
PATTERN ON  
LOWER INSERT**

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**Fig. 34 Connecting Rod Bearing Inspection**

- 1 - UPPER BEARING HALF
- 2 - MATING EDGES
- 3 - GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
- 4 - WEAR PATTERN — ALWAYS GREATER ON UPPER BEARING
- 5 - LOWER BEARING HALF

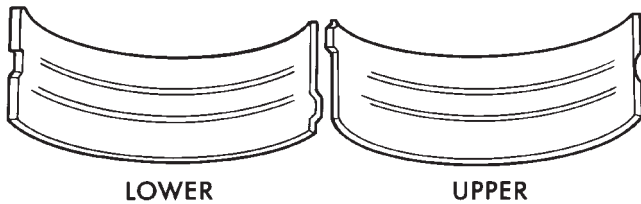
CONNECTING ROD BEARINGS (Continued)



J8909-128

**Fig. 35 Locking Tab Inspection**

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

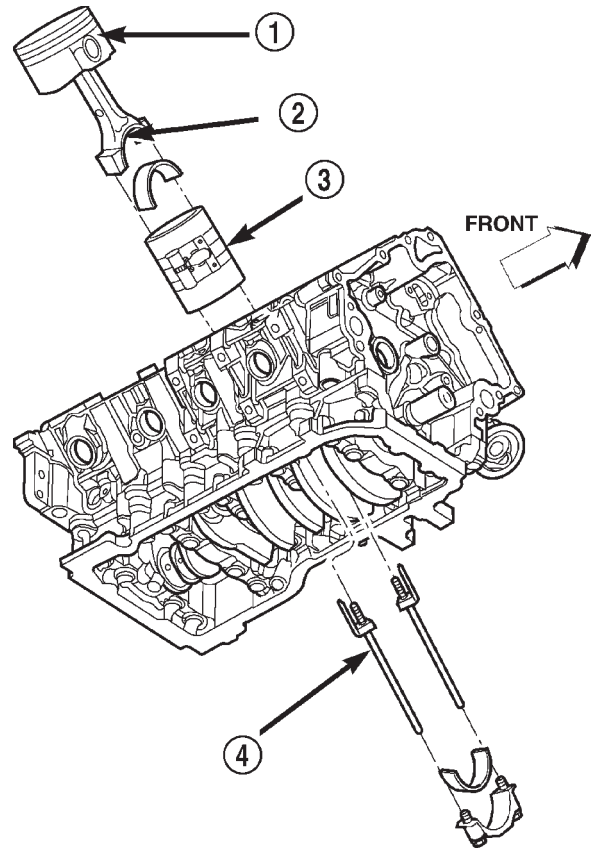


J8909-129

**Fig. 36 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal**

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

- (1) Wipe the oil from the connecting rod journal.
- (2) Lubricate the upper bearing insert and install in connecting rod.
- (3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 37) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The "F"'s near the piston wrist pin bore should point to the front of the engine.
- (4) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.
- (5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.



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**Fig. 37 Piston and Connecting Rod -Installation - Typical**

- 1 - "F" TOWARD FRONT OF ENGINE
- 2 - OIL SLINGER SLOT
- 3 - RING COMPRESSOR
- 4 - SPECIAL TOOL 8507

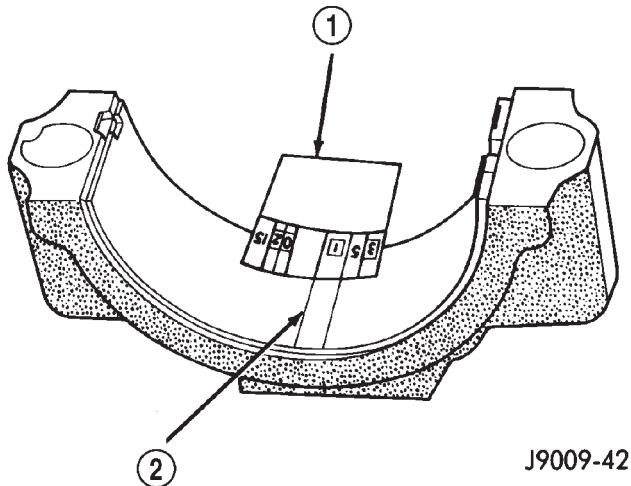
(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 38). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(7) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(8) If bearing-to-journal clearance exceeds the specification, determine which services bearing set to use the bearing sizes are as follows:



CONNECTING ROD BEARINGS (Continued)



J9009-42

**Fig. 38 Measuring Bearing Clearance with Plastigage**

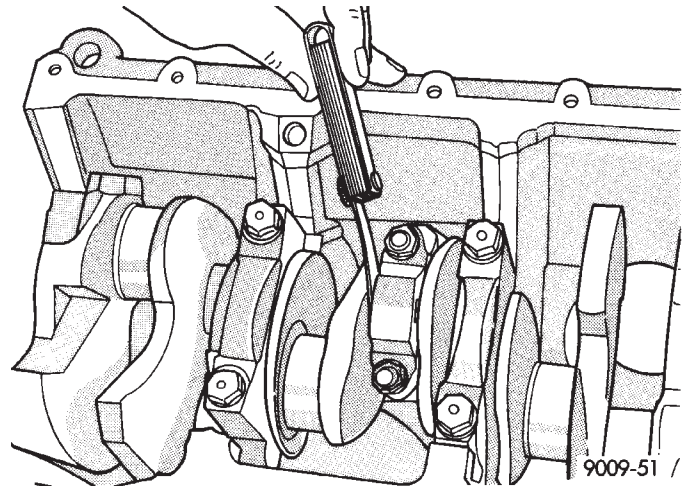
- 1 - PLASTIGAGE SCALE
- 2 - COMPRESSED PLASTIGAGE

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	50.983-50.967 mm (2.0073-2.0066 in.)
Std.	STANDARD	50.992-51.008 mm (2.0076-2.0082 in.)
.250 US	.250 mm (.010 in.)	50.758-50.742 mm (1.9984-1.9978 in.)

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

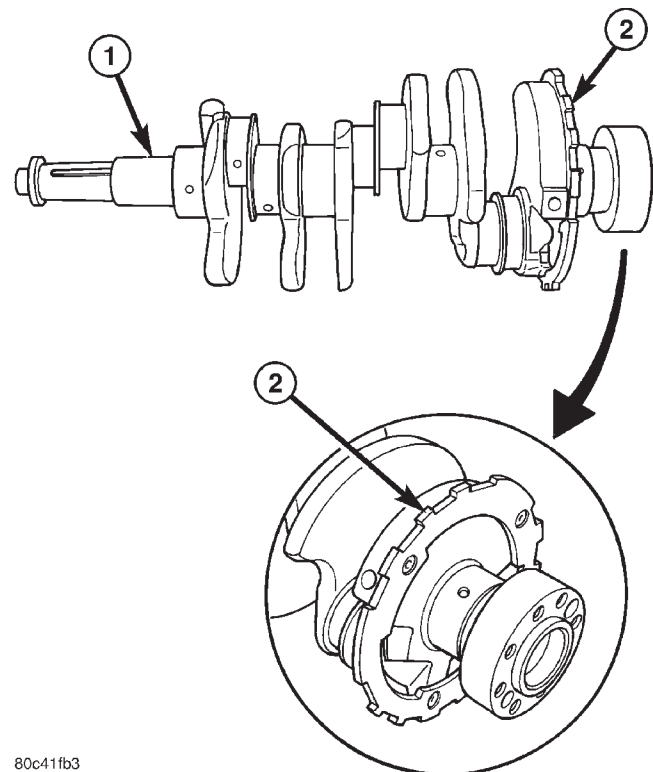
Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 39). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.



9009-51 /

**Fig. 39 Checking Connecting Rod Side Clearance - Typical**

lubrication. The number six counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.



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**Fig. 40 CRANKSHAFT AND TARGET RING**

- 1 - CRANKSHAFT
- 2 - CRANKSHAFT POSITION SENSOR TARGET RING

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 40) is constructed of nodular cast iron. The crankshaft is a three throw split pin design with six counterweights for balancing purposes. The crankshaft is supported by four select fit main bearings with the number two serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing

## CRANKSHAFT (Continued)

**REMOVAL**

**NOTE:** To remove the crankshaft from the engine, the engine must be removed from the vehicle.

- (1) Remove the engine. Refer to Engine Assembly in this section for procedure.
- (2) Remove the engine oil pump. Refer to Oil Pump in this section for procedure.

**CAUTION:** DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

- (3) Remove oil pan bolts and oil pan.
- (4) Remove the oil pump pickup tube and oil pan gasket /windage tray.
- (5) Remove the bedplate mounting bolts. Note the location of the two stud bolts for installation.
- (6) Remove the connecting rods from the crankshaft.

**CAUTION:** The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

**NOTE:** The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause sever damage to the crankshaft.

**NOTE:** The bedplate has pry points cast into it. Use these points only. The pry points are shown below.

- (7) Carefully pry on the pry points (Fig. 41) to loosen the bedplate then remove the bedplate.

**CAUTION:** When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

- (8) Remove the crankshaft.
- (9) Remove the crankshaft tone wheel.

**INSPECTION**

**NOTE:** Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder

block main bearing bores show damage the engine must be replaced.

- (1) If required, remove the main bearing halves from the cylinder block and bedplate.
- (2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.
- (3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.
- (4) Inspect the crankshaft thrust washer for scoring, scratches or blueing. If either condition exist replace the thrust washer.
- (5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

**INSTALLATION**

**CAUTION:** Main bearings are select fit. Refer to Crankshaft Main Bearings in this section for proper bearing selections.

**CAUTION:** When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

**NOTE:** Apply sealant to the tone wheel retaining screws prior to installation.

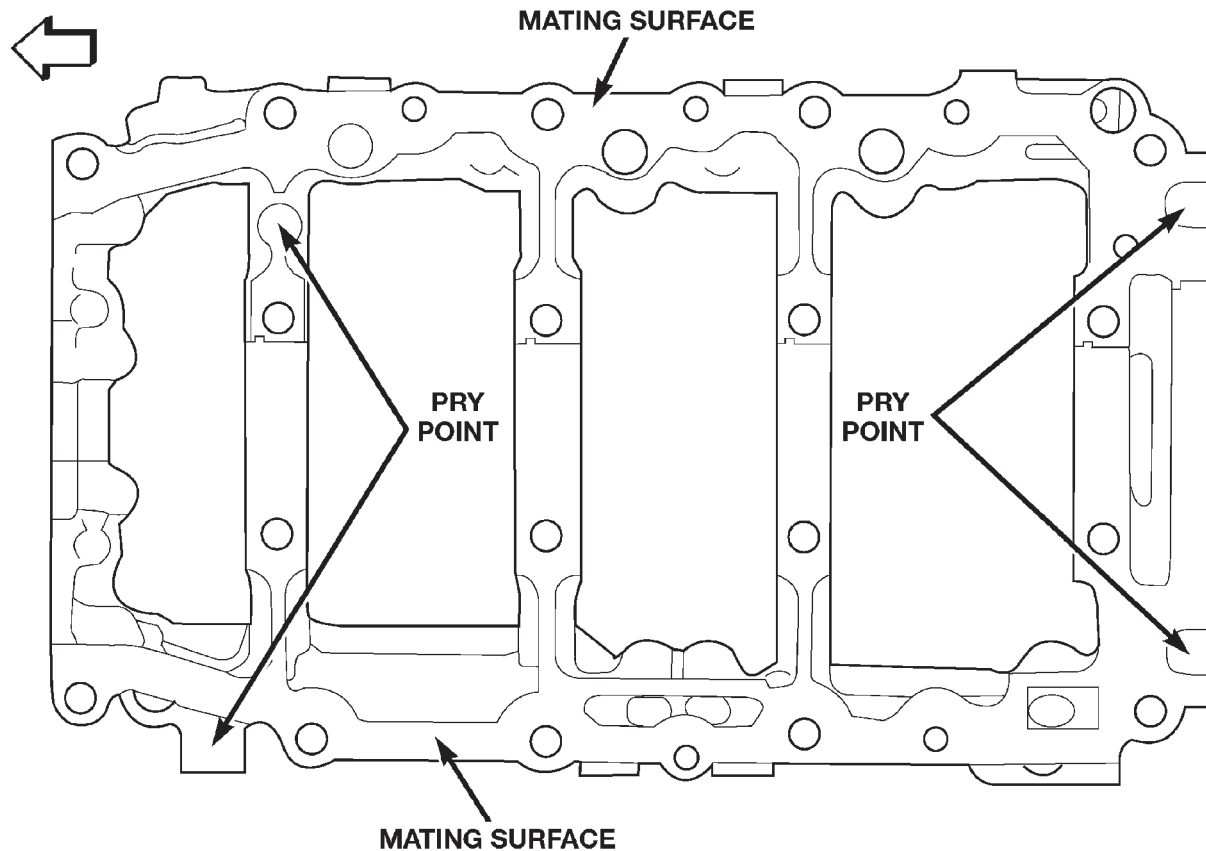
- (1) Lubricate upper main bearing halves with clean engine oil.
- (2) Install the crankshaft tone wheel. Torque the mounting screws to 22 N·m (21 ft. lbs.).
- (3) Position crankshaft in cylinder block.
- (4) Install the thrust washers (Fig. 42).

**CAUTION:** The bedplate to cylinder block mating surface must be coated with Mopar® Engine RTV sealant prior to installation. Failure to do so will cause severe oil leaks.

**NOTE:** Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

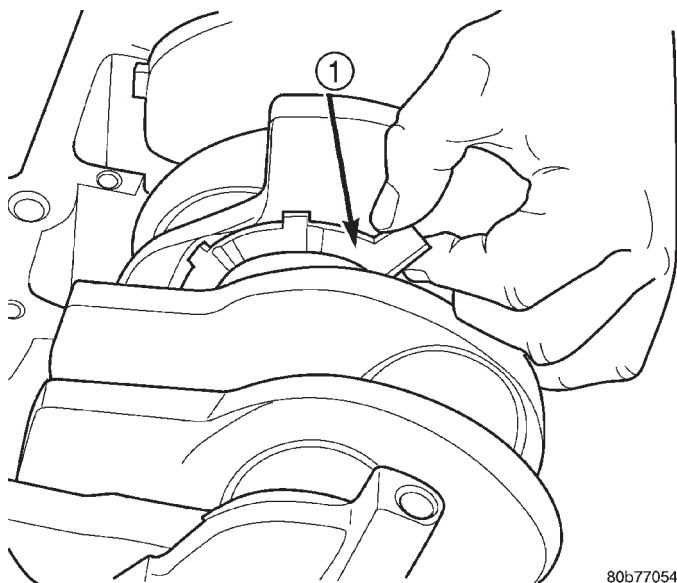
- (5) Apply a 2.5mm (0.100 inch) bead of Mopar® Engine RTV sealant to the cylinder block-to-bedplate mating surface as shown.
- (6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

## CRANKSHAFT (Continued)



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Fig. 41 BEDPLATE PRY POINT LOCATION



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Fig. 42 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

**NOTE:** Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 43).

- Hand tighten bolts **1D,1G and 1F** until the bedplate contacts the block.
- Tighten bolts **1-8** to 27 N·m (20 ft. lbs.)
- Tighten bolts **1A-1J** to 20 N·m (15 ft. lbs.)
- Tighten bolts **A-E** 8 N·m ( 6 ft. lbs.).
- Turn bolts **1-8** an additional 66°.
- Turn bolts **1D,1G, and 1F** an additional 42°.
- Turn bolts **1A,1B,1C,1E,1H,1I,and 1J** an additional 36°.
- Turn bolts **A-E** an additional 32°.

(8) Measure crankshaft end play. Refer to Crankshaft Main Bearings in this section for procedure.

(9) Install the connecting rods and measure side clearance. Refer to Connecting Rod Bearings in this section for procedure.

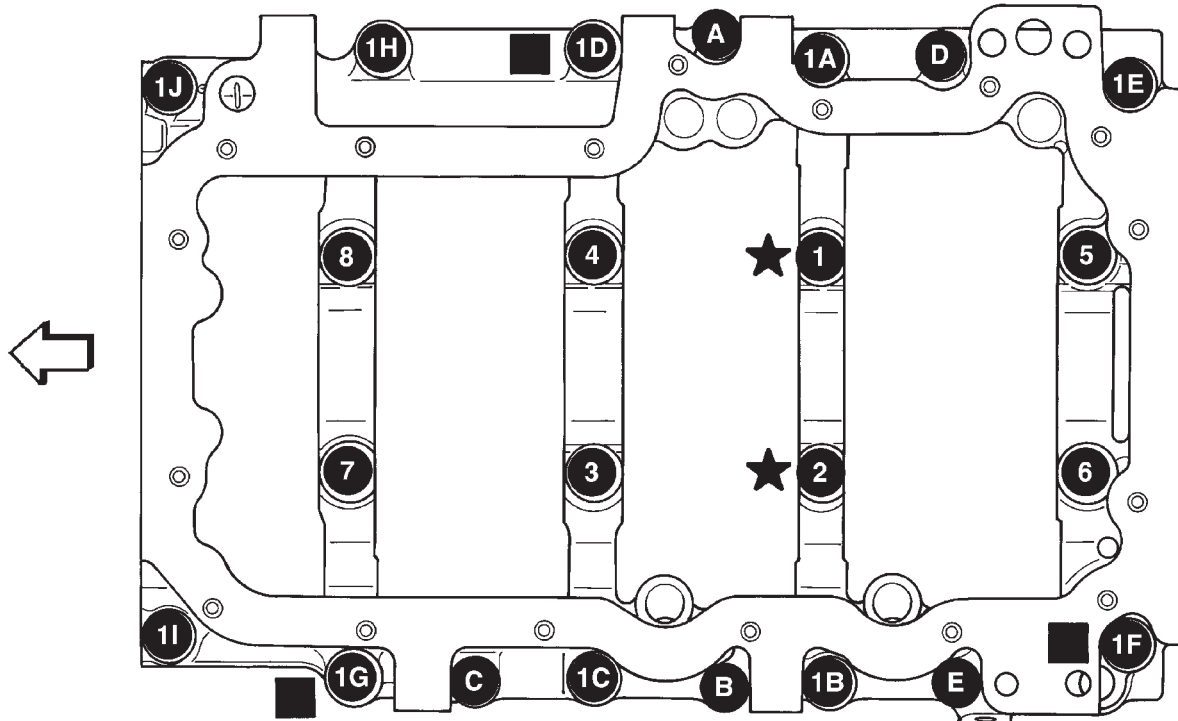
(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·n (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown.

(12) Install the engine.

CRANKSHAFT (Continued)

- ★ = STUDS
- = DOWEL LOCATIONS



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**Fig. 43 BEDPLATE TIGHTENING SEQUENCE**

**CRANKSHAFT MAIN BEARINGS**

**STANDARD PROCEDURE**

**MAIN BEARING - FITTING**

**SELECT FIT IDENTIFICATION**

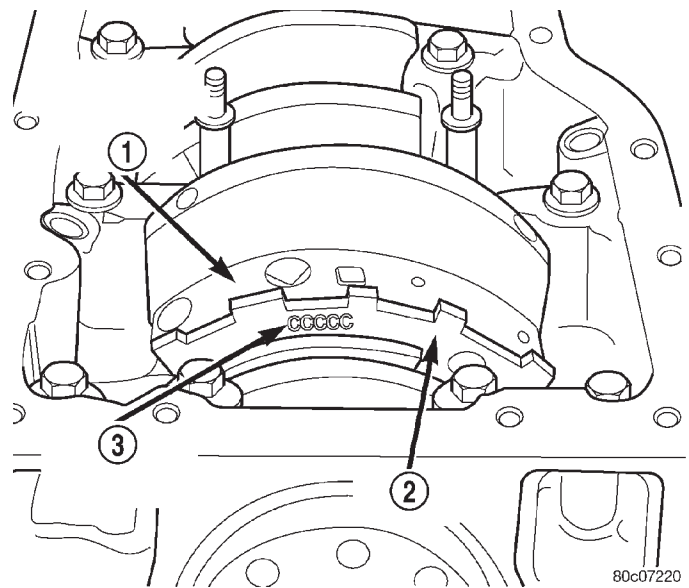
The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 44). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel is mounted to the number 8 counter weight on the crankshaft.

**INSPECTION**

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.



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**Fig. 44 Main Bearing Markings on Target Wheel -Typical**

- 1 - REARMOST CRANKSHAFT COUNTER WEIGHT
- 2 - TARGET WHEEL
- 3 - MAIN BEARING SELECT FIT MARKINGS

Replace all damaged or worn bearing inserts.

CRANKSHAFT MAIN BEARINGS (Continued)

**MAIN BEARING JOURNAL DIAMETER  
(CRANKSHAFT REMOVED)**

Remove the crankshaft from the cylinder block. Refer to CRANKSHAFT.

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block. Refer to CRANKSHAFT.

Check crankshaft end play. Refer to CHECKING CRANKSHAFT END PLAY.

**CRANKSHAFT MAIN BEARING SELECTION**

(1) Service main bearings are available in three grades. The chart below identifies the three service grades available.

<b>Crankshaft MARKING</b>	<b>JOURNAL SIZE SIZE mm (in.)</b>	
"R" Size	63.488 - 63.496 mm (2.4995 - 2.4998 in.)	
"S" Size	63.496 - 63.500 mm (2.4998 - 2.4999 in.)	
"T" Size	63.500 - 63.504 mm (2.4999 - 2.501 in.)	
Bearing size and application		
Bearing Code	Size	Application
Upper Bearing		
<b>A</b>	.2.443 - 2.447 mm (.0961 - .0963 in.)	Use with Cankshaft size "R"
<b>B</b>	2.439 - 2.443 mm (0.960 -.o961 in.)	Use with crankshaft "S, T"
<b>C</b>	2.435 - 2.439 mm (.0958 - .0960 in.)	Use with carnkshaft "U"
Lower Bearing Main "1" and "4"		
"1"	2.441 - 2.447 mm (.0961 -.0963 in.)	Use with carnkshaft "R, S"
"2"	2.435 - 2.441 mm (.0958 - .0962 in.)	Use with crankshaft "T, U"

<b>Crankshaft MARKING</b>	<b>JOURNAL SIZE SIZE mm (in.)</b>	
Lower Main Bearing "2" and "3"		
"3"	2.429 - 2.435 mm (.0956 - .0958 in.)	Use with crankshaft "R, S"
"4"	2.423 - 2.429 mm (.0953 - .0956 in.)	Use with crankshaft "T, U"
Bearing Clearances		
Main "1, 4"		
Crankshaft "R"	.004 - .034 mm ( .00015 - .0013 in.)	
Crankshaft "S"	.004 - .030 mm ( .00015 - .0011 in.)	
Crankshaft "T"	.006 - .032 mm (.0002 - .0012 in.)	
Crankshaft "U"	.002 - .032 mm (.00007 -. 0012 in.)	
Main "2, 3"		
Crankshaft "R"	.016 - .064 mm (.0 062 - .0025 in.)	
Crankshaft "S"	.016 - .042 mm (.00062 - .016 in.)	
Crankshaft "T"	.018 - .044 mm (.0007 - .0017 in.)	
Crankshaft "U"	.014 - .044 mm (.0005 - .0017 in.)	

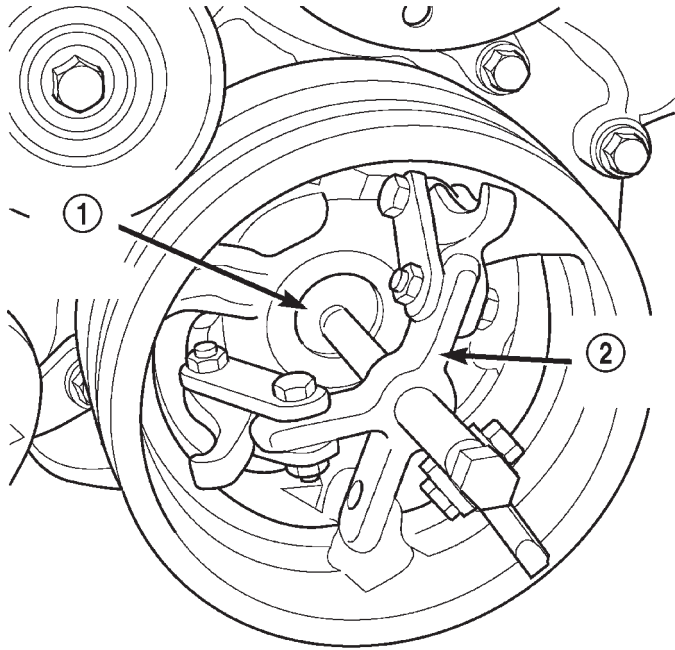
**CRANKSHAFT OIL SEAL - FRONT**

**REMOVAL**

- (1) Disconnect negative cable from battery.
- (2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
- (3) Remove A/C compressor mouning fasteners and set aside.
- (4) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
- (5) Remove upper radiator hose.
- (6) Disconnect electrical connector for fan mounted inside radiator shroud.
- (7) Remove radiator shroud attaching fasteners.
- (8) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
- (9) Remove crankshaft damper bolt.

CRANKSHAFT OIL SEAL - FRONT (Continued)

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 45).

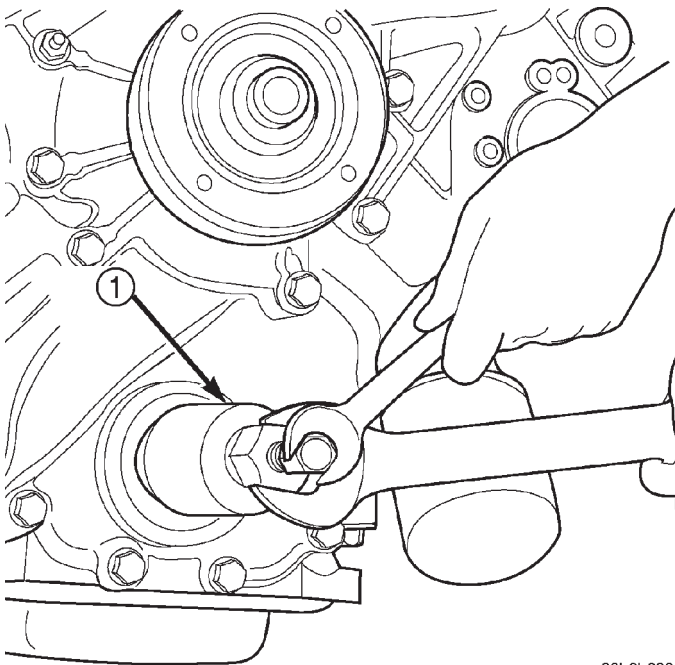


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**Fig. 45 Crankshaft Damper—Removal**

- 1 - SPECIAL TOOL 8513 INSERT
- 2 - SPECIAL TOOL 1026

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 46).



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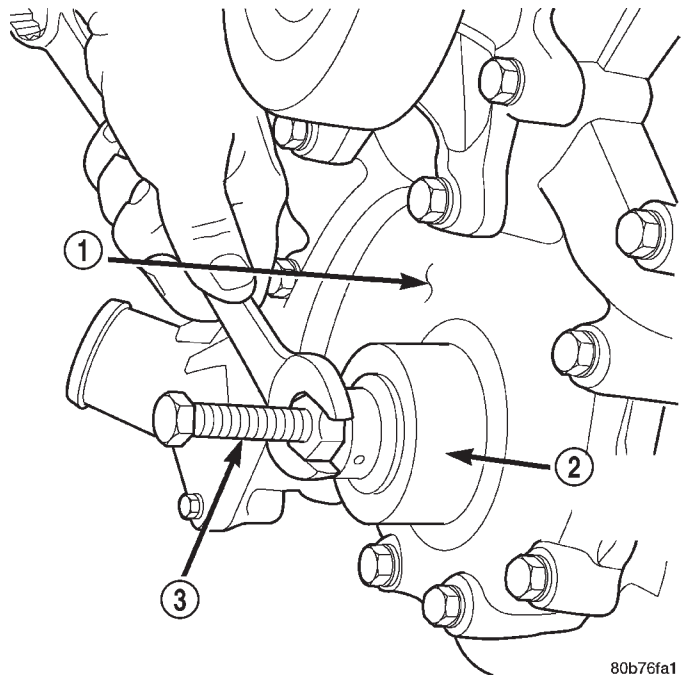
**Fig. 46 Crankshaft Front Seal—Removal**

- 1 - SPECIAL TOOL 8511

**INSTALLATION**

**CAUTION:** To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Using Special Tool 8348 and 8512, install crankshaft front seal (Fig. 47).



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**Fig. 47 Crankshaft Front Seal—Installation**

- 1 - TIMING CHAIN COVER
- 2 - SPECIAL TOOL 8348
- 3 - SPECIAL TOOL 8512

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(4) Install upper radiator hose.

(5) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(6) Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Connect negative cable to battery.

## CRANKSHAFT OIL SEAL - REAR

### REMOVAL

**NOTE:** This procedure can be performed in vehicle.

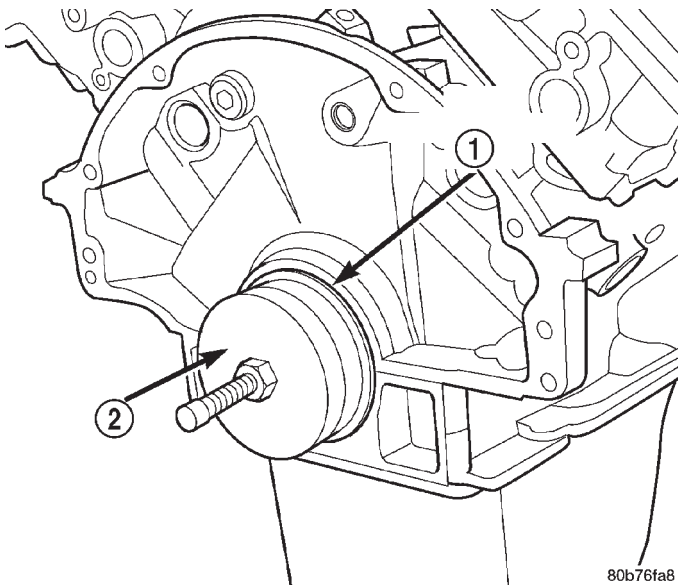
(1) If being performed in vehicle, remove the transmission.

(2) Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

**NOTE:** The crankshaft oil seal **CAN NOT** be reused after removal.

**NOTE:** The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

(3) Using Special Tool 8506 (Fig. 48), remove the crankshaft rear oil seal.

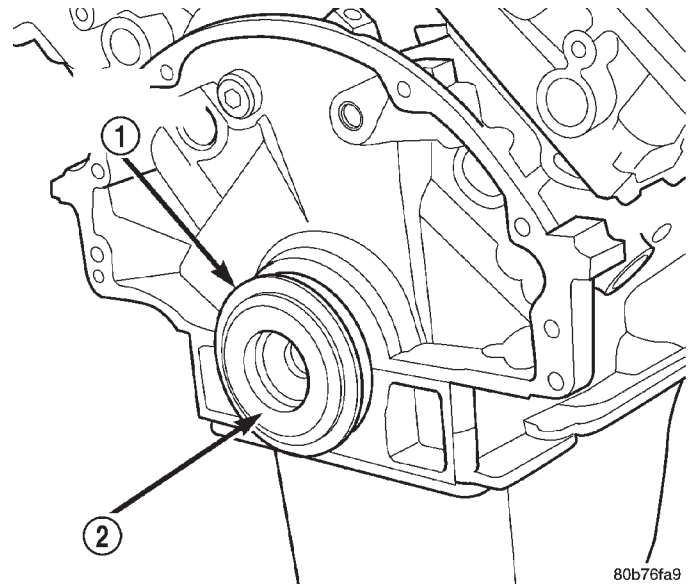


**Fig. 48 Crankshaft Rear Oil Seal Removal**

- 1 - REAR CRANKSHAFT SEAL
- 2 - SPECIAL TOOL 8506

### INSTALLATION

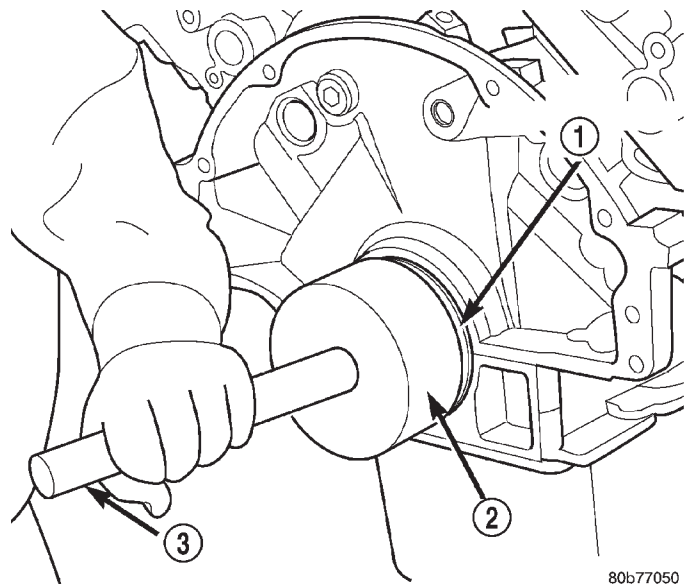
(1) Position the magnetic seal guide Special Tool 8349-2 (Fig. 49) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.



**Fig. 49 Crankshaft Rear Oil Seal Guide Special Tool 8349-2 and Oil**

- 1 - REAR CRANKSHAFT SEAL
- 2 - SPECIAL TOOL 8349-2 GUIDE

(2) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 50), with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.



**Fig. 50 Crankshaft Rear Oil Seal Installation**

- 1 - REAR CRANKSHAFT SEAL
- 2 - SPECIAL TOOL 8349-1 INSTALLER
- 3 - SPECIAL TOOL C-4171 HANDLE

- (3) Install the flexplate.
- (4) Install the transmission.

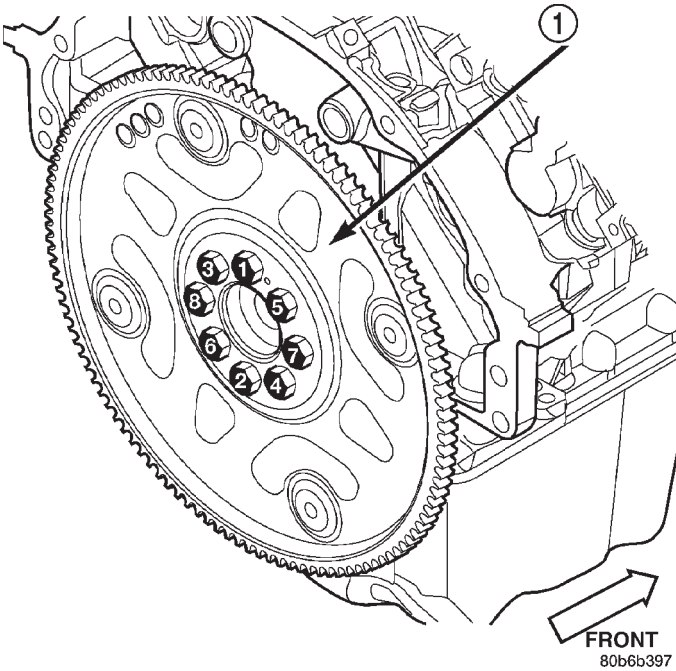
## FLEX PLATE

### REMOVAL

- (1) Remove the transmission.
- (2) Remove the bolts and flexplate.

### INSTALLATION

- (1) Position the flexplate onto the crankshaft and install the bolts hand tight.
- (2) Tighten the flexplate retaining bolts to 95 N·m (70 ft. lbs.) in the sequence shown (Fig. 51).
- (3) Install the transmission.



**Fig. 51 Flexplate Tightening Sequence**

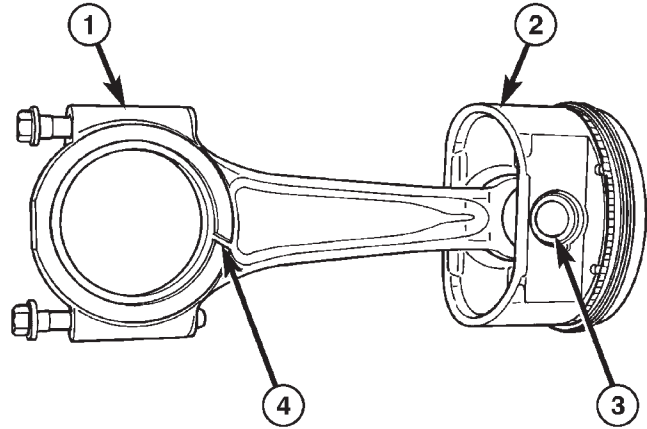
1 - FLEXPLATE

## PISTON & CONNECTING ROD

### DESCRIPTION

**CAUTION:** Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons are made of a high strength aluminum alloy. The top ring groove is coated with a anti-seize coating. The connecting rods are made of forged powdered metal, with a “fractured cap” design. A full floating piston pin is used to attach the piston to the connecting rod (Fig. 52).



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**Fig. 52 PISTON AND ROD ASSEMBLY**

1	Connecting Rod
2	Piston
3	Piston Pin
4	Oil Slinger Slot

### STANDARD PROCEDURE

#### CONNECTING ROD BEARING - FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs. Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting. Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

- (1) Wipe the oil from the connecting rod journal.
- (2) Lubricate the upper bearing insert and install in connecting rod.
- (3) Use piston ring compressor and Guide Pins Special Tool 8507 to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”'s near the piston wrist pin bore should point to the front of the engine.
- (4) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a



## PISTON &amp; CONNECTING ROD (Continued)

90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage. Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(7) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(8) If bearing-to-journal clearance exceeds the specification, determine which services bearing set to use the bearing sizes are as follows:

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	57.871-57.879 mm (2.2783-2.2786 in.)
Std.	STANDARD	57.896-57.904 mm (2.2793-2.2810 in.)
.250 US	.250 mm (.010 in.)	57.646-57.654 mm (2.2695-2.2698 in.)

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange. Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

## STANDARD PROCEDURE - PISTON FITTING

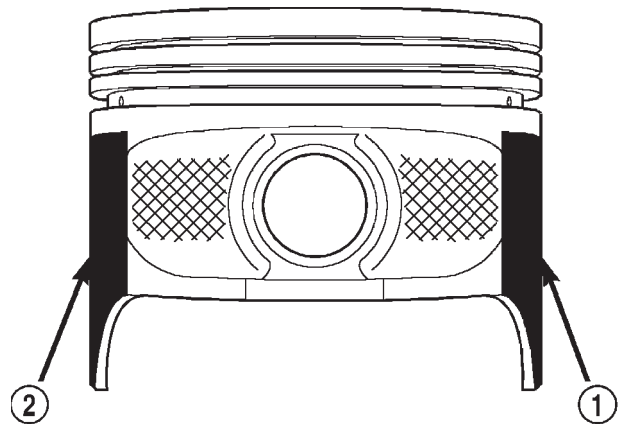
(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 54).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.

(4) 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 (Fig. 53). 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 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires 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.



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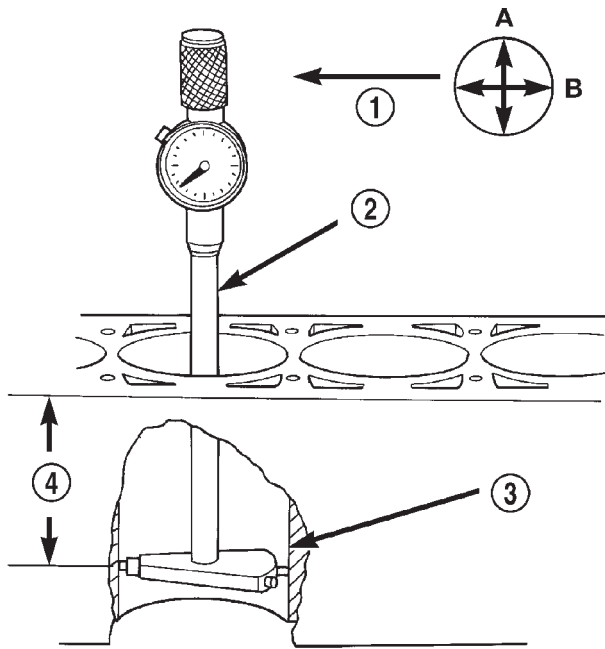
Fig. 53 Moly Coated Piston - Typical

- 1 - MOLY COATED  
2 - MOLY COATED

## REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove the following components:
  - Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
  - Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
  - Timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
  - Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
- (3) If necessary, 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.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod

## PISTON &amp; CONNECTING ROD (Continued)



**Fig. 54 Bore Gauge - Typical**

- 1 - FRONT
- 2 - BORE GAUGE
- 3 - CYLINDER BORE
- 4 - 38 MM (1.5 in)

assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

**CAUTION: DO NOT** use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

**NOTE:** Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool.

**CAUTION:** Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

**CAUTION:** Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

## CLEANING

**CAUTION: DO NOT** use a wire wheel or other abrasive cleaning device to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

**CAUTION: DO NOT** remove the piston pin from the piston and connecting rod assembly.

## INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

## INSTALLATION

(1) Before installing piston and connecting rod assemblies into the bore, install the piston rings.

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Ensure that tabs in bearing shell aligns with slots in connecting rod. Verify that parting line of bearing is aligned with parting line of connecting rod.

(4) Lubricate bearing surface with clean engine oil.

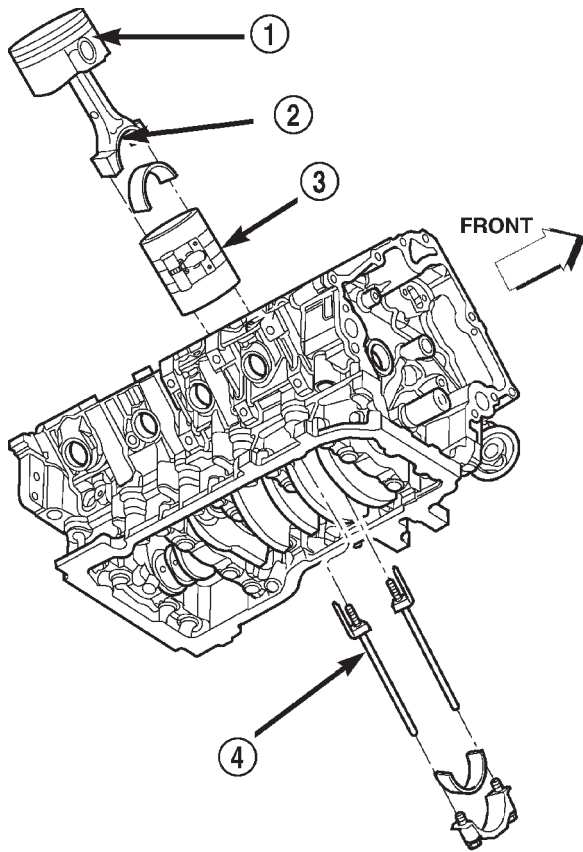
(5) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 55).

(6) The pistons are marked on the piston pin bore surface with an raised "F" indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine (Fig. 56).

(7) Wipe cylinder bore clean and lubricate with engine oil.

(8) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and pis-

## PISTON &amp; CONNECTING ROD (Continued)



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**Fig. 55 Piston and Connecting Rod - Installation - Typical**

- 1 - "F" TOWARD FRONT OF ENGINE
- 2 - OIL SLINGER SLOT
- 3 - RING COMPRESSOR
- 4 - SPECIAL TOOL 8507

ton into cylinder bore and carefully position connecting rod guides over crankshaft journal.

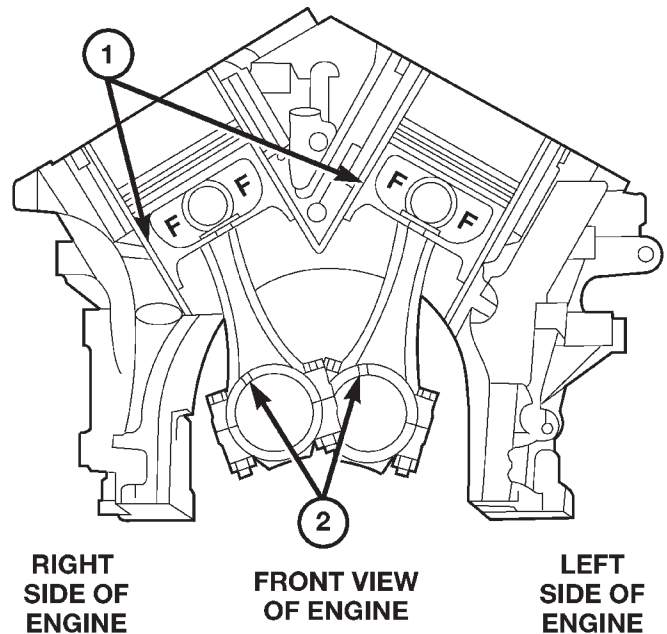
(9) Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

**CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.**

(10) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.

(11) Install the following components:

- Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).



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**Fig. 56 Piston and Connecting Rod Orientation**

- 1 - MAJOR THRUST SIDE OF PISTON
- 2 - OIL SLINGER SLOT

- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(12) Fill crankcase with proper engine oil to correct level.

(13) Connect negative cable to battery.

## PISTON RINGS

### STANDARD PROCEDURE - PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

- (1) Wipe the cylinder bore clean.
- (2) Insert the ring in the cylinder bore.

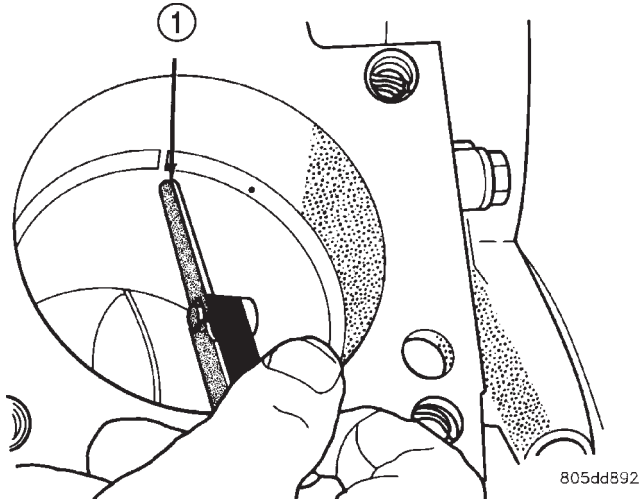
**NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.**

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 57). Replace any rings not within specification.

### PISTON RING SIDE CLEARANCE

PISTON RINGS (Continued)

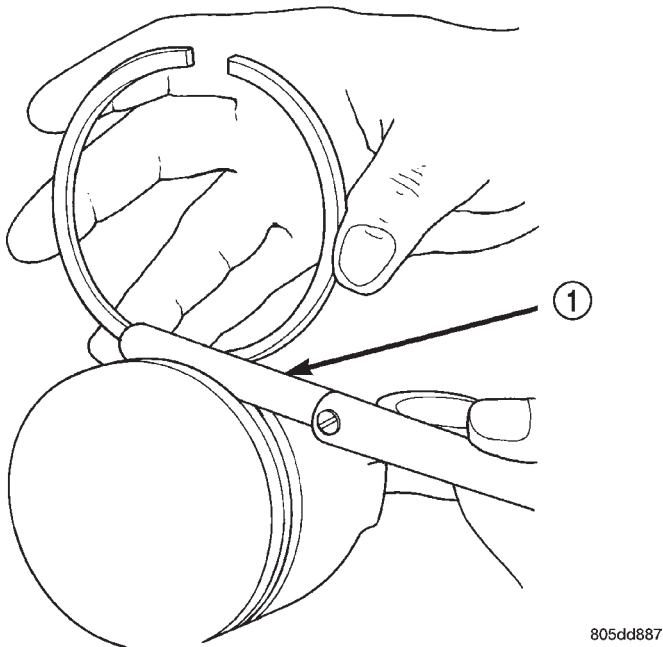


**Fig. 57 Ring End Gap Measurement - Typical**

1 - FEELER GAUGE

**NOTE:** Make sure the piston ring grooves are clean and free of nicks and burrs.

(5) Measure the ring side clearance as shown (Fig. 58) make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.



**Fig. 58 Measuring Piston Ring Side Clearance**

1 - FEELER GAUGE

(6) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094mm (0.0020- .0037 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	Ring Gap	Wear Limit
Upper Ring	0.23-0.39mm (0.009-0.015 in.)	0.43mm (0.017 in.)
Intermediate Ring	0.40-0.66mm (0.015-0.026 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.028-0.79mm (0.011- 0.031 in.)	1.55mm (0.061 in.)

(7) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

**NOTE:** Piston rings are installed in the following order:

- Oil ring expander.
- Upper oil ring side rail.
- Lower oil ring side rail.
- No. 2 Intermediate piston ring.
- No. 1 Upper piston ring.

(8) Install the oil ring expander.

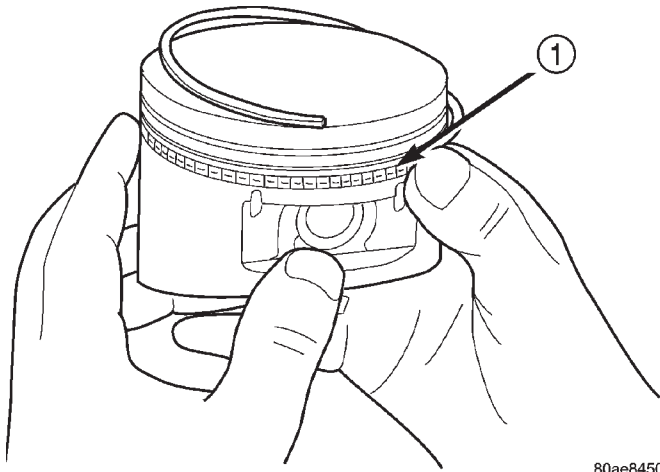
(9) Install upper side rail (Fig. 59) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 60).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 60).

(12) Position piston ring end gaps as shown in (Fig. 61). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

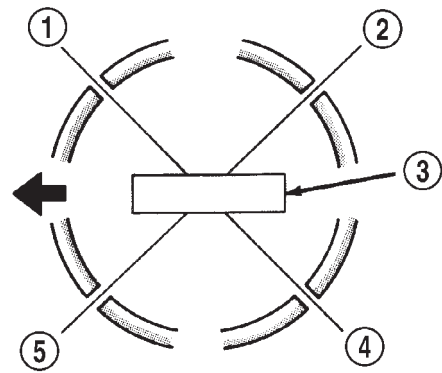
PISTON RINGS (Continued)



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**Fig. 59 Side Rail—Installation**

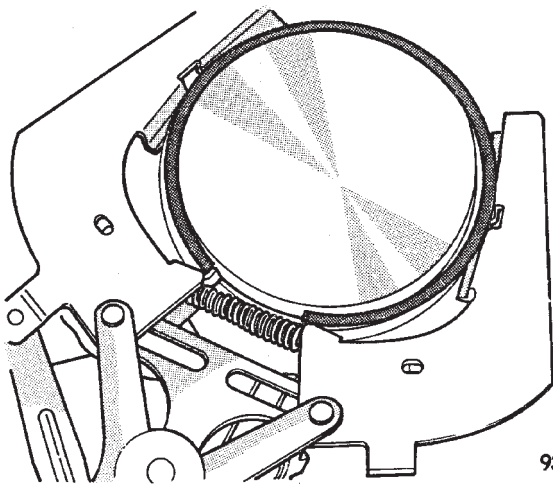
1 - SIDE RAIL END



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**Fig. 61 Piston Ring End Gap Position**

- 1 - SIDE RAIL UPPER
- 2 - NO. 1 RING GAP
- 3 - PISTON PIN
- 4 - SIDE RAIL LOWER
- 5 - NO. 2 RING GAP AND SPACER EXPANDER GAP



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**Fig. 60 Upper and Intermediate Rings—Installation**

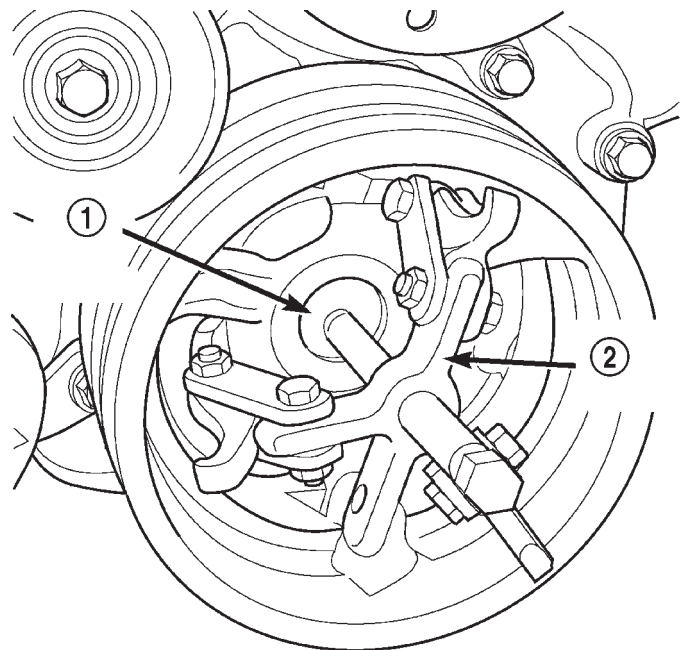
VIBRATION DAMPER

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

**NOTE:** Transmission cooler line snaps into shroud lower right hand corner.

- (3) Remove crankshaft damper bolt.
- (4) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 62).



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**Fig. 62 Crankshaft Damper—Removal**

- 1 - SPECIAL TOOL 8513 INSERT
- 2 - SPECIAL TOOL 1026

VIBRATION DAMPER (Continued)

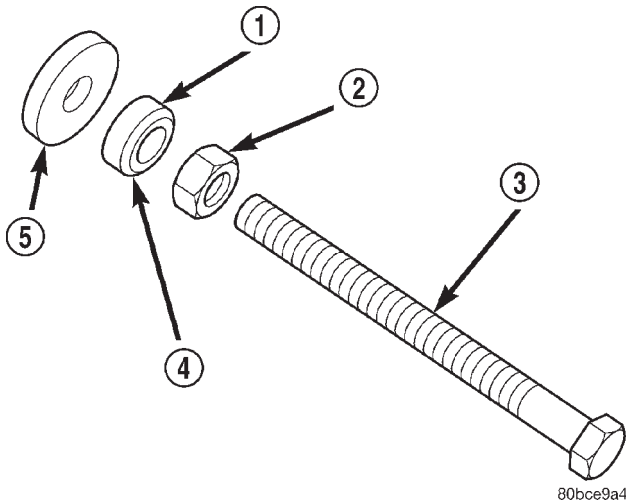
**INSTALLATION**

**CAUTION:** To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

**CAUTION:** Special Tool 8512A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

(2) Assemble Special Tool 8512-A as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST** face the nut). Then the hardened washer slides onto the threaded rod (Fig. 63). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).



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**Fig. 63 Proper Assembly Method for Special Tool 8512-A**

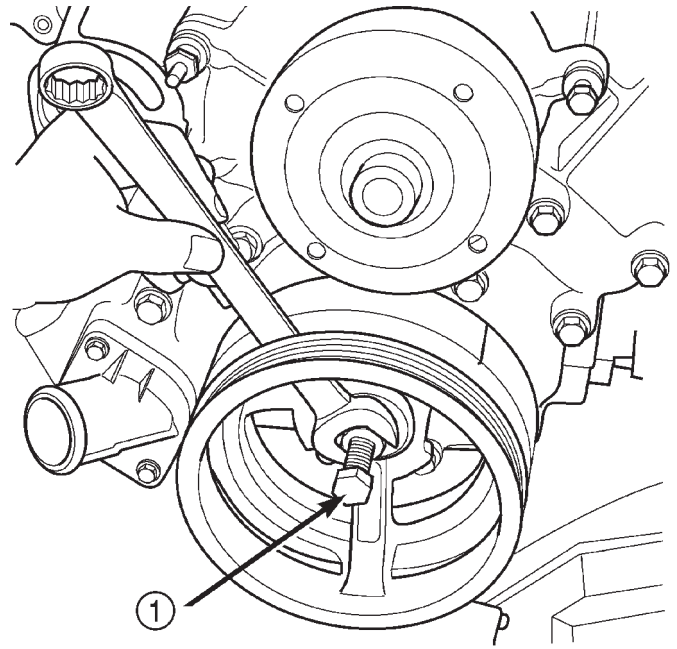
- 1 - BEARING
- 2 - NUT
- 3 - THREADED ROD
- 4 - BEARING HARDENED SURFACE (FACING NUT)
- 5 - HARDENED WASHER

(3) Using Special Tool 8512A, press damper onto crankshaft (Fig. 64).

(4) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(5) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Connect negative cable to battery.



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**Fig. 64 Crankshaft Damper Installation**

1 - SPECIAL TOOL 8512A

**STRUCTURAL COVER**

**DESCRIPTION**

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

**OPERATION**

The structural cover provides additional power-train stiffness and reduces noise and vibration.

**REMOVAL**

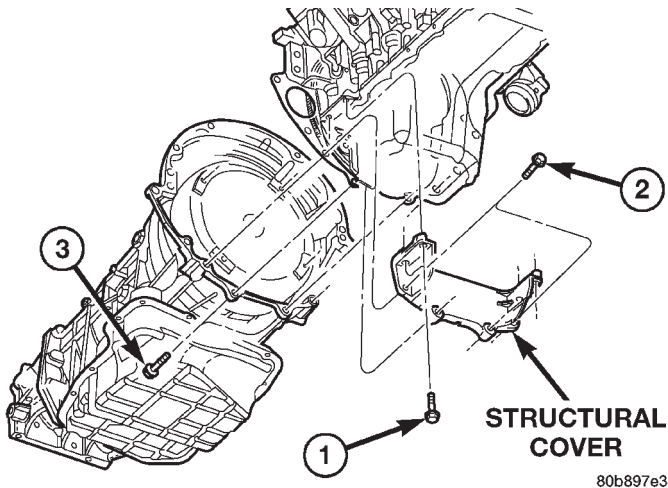
- (1) Raise vehicle on hoist.
- (2) Remove the bolts retaining structural cover (Fig. 65).
- (3) Remove the structural cover.

**INSTALLATION**

**CAUTION:** The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

- (1) Position the structural cover in the vehicle.
- (2) Install all bolts retaining the cover-to-engine. **DO NOT** tighten the bolts at this time.
- (3) Install the cover-to-transmission bolts. **DO NOT** tighten at this time.

STRUCTURAL COVER (Continued)



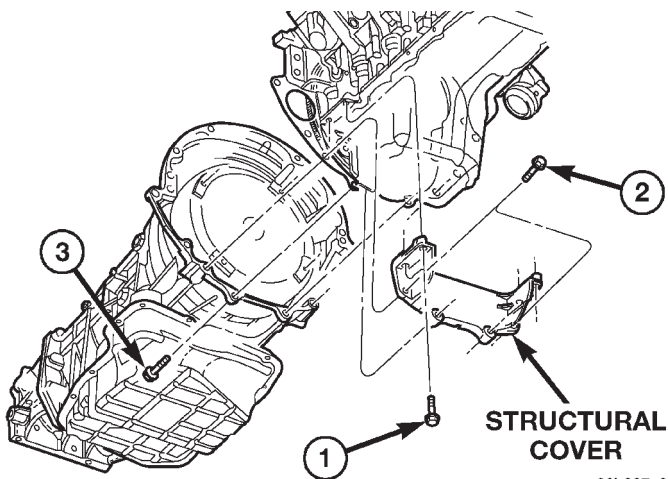
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**Fig. 65 Structural Cover**

- 1 - BOLT
- 2 - BOLT
- 3 - BOLT

**CAUTION:** The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 66) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 66) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.



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**Fig. 66 Structural Cover**

- 1 - BOLT
- 2 - BOLT
- 3 - BOLT

FRONT MOUNT

REMOVAL

(1) Disconnect the negative cable from the battery.

**CAUTION:** Remove the fan blade, fan clutch and fan shroud before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

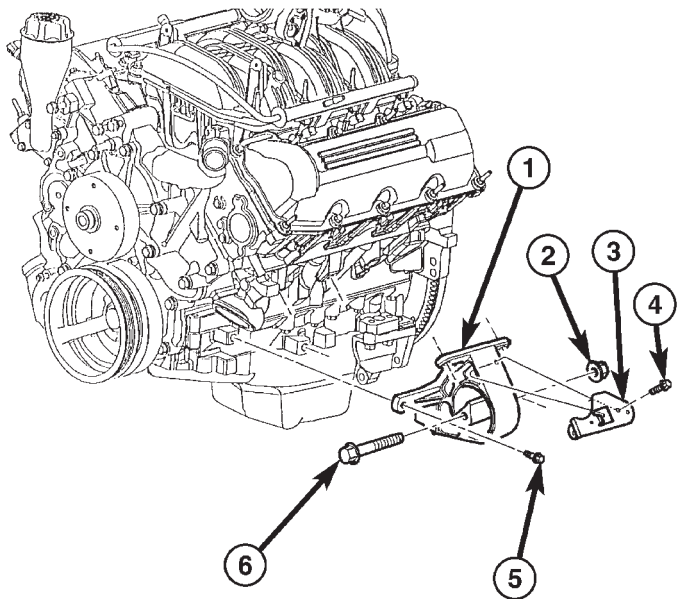
(2) Remove the fan blade, fan clutch and fan shroud. Refer to COOLING SYSTEM for procedure.

(3) Remove the engine oil filter.

(4) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(5) Remove the four (4) cylinder block-to-insulator mount bolts and the nut from the engine insulator mount through bolt.

(6) Using the jack, raise the engine high enough to remove the engine insulator mount through bolt and the insulator mount (Fig. 67) and (Fig. 68).

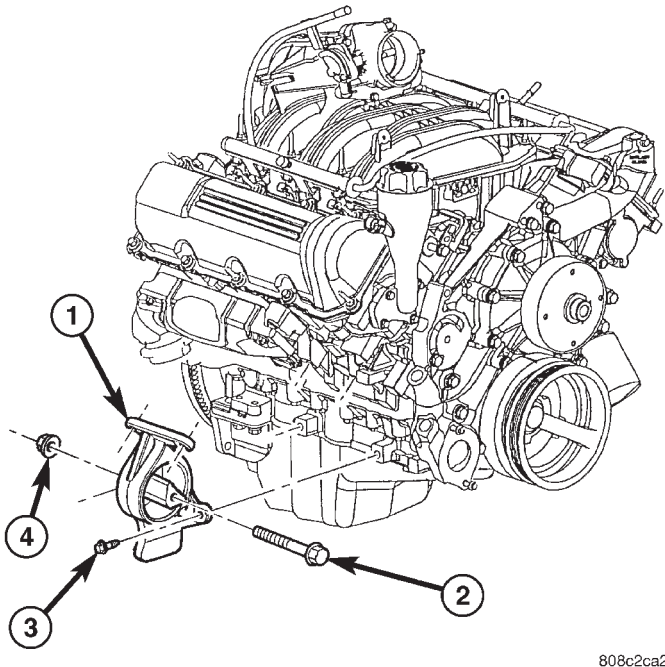


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**Fig. 67 Engine Insulator Mount 3.7 Left**

- 1 - MOUNT
- 2 - NUT
- 3 - WIRE RETAINER
- 4 - FASTENER
- 5 - BOLT
- 6 - THRU BOLT

## FRONT MOUNT (Continued)



**Fig. 68 Engine Insulator Mount 3.7 Right**

- 1 - MOUNT  
2 - THRU BOLT  
3 - BOLT  
4 - NUT

## INSTALLATION

- (1) Position the insulator mount and install the insulator mount through bolt.
- (2) Lower the engine until the cylinder block-to-insulator mount bolts can be installed.
- (3) Remove the jack and block of wood.
- (4) Torque the cylinder block-to-insulator mount bolts to 61 N·m (45 ft. lbs.).
- (5) Install and torque the through bolt retaining nut to 61 N·m (45 ft. lbs.).
- (6) Install the fan blade, fan clutch and fan shroud.

## REAR MOUNT

### REMOVAL

**NOTE:** A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

- (1) Disconnect negative cable from battery.
- (2) Raise the vehicle and support the transmission.
- (3) Remove the nuts holding the support cushion to the crossmember. Remove the crossmember.

### MANUAL TRANSMISSION

- Remove the support cushion nuts and remove the cushion.
- Remove the transmission support bracket bolts and remove the bracket from the transmission.

### AUTOMATIC TRANSMISSION

- Remove the support cushion bolts and remove the cushion and the support bracket from the transmission (4WD) or from the adaptor bracket (2WD).
- On 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission. Remove the adaptor bracket.

## INSTALLATION

### MANUAL TRANSMISSION:

- (1) Install the transmission support bracket to the transmission. Install the bolts and tighten to 46 N·m (34 ft. lbs.) torque.
- (2) Install the support cushion to the support bracket. Install the nuts and tighten to 75 N·m (55 ft. lbs.) torque.
- (3) Position the crossmember onto the support cushion studs. Install the stud nuts and tighten to 22 N·m (192 in. lbs) torque.
- (4) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.
- (5) Remove the transmission support.
- (6) Lower the vehicle.
- (7) Connect negative cable to battery.

### AUTOMATIC TRANSMISSION:

- (1) On 2WD vehicles, position the transmission support adaptor bracket to the transmission. Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.
- (2) Position the transmission support bracket and support cushion to the adaptor bracket (2WD) or the transmission (4WD). Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.
- (3) Position the crossmember onto the support cushion studs. Install the stud nuts and tighten to 22 N·m (192 in. lbs) torque.
- (4) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.
- (5) Remove the transmission support.
- (6) Lower the vehicle.
- (7) Connect negative cable to battery.

## LUBRICATION

### DESCRIPTION

The lubrication system is a full flow filtration pressure feed type.



## LUBRICATION (Continued)

**OPERATION**

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 69)

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orientation of the rocker arm, the camshaft intake

lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

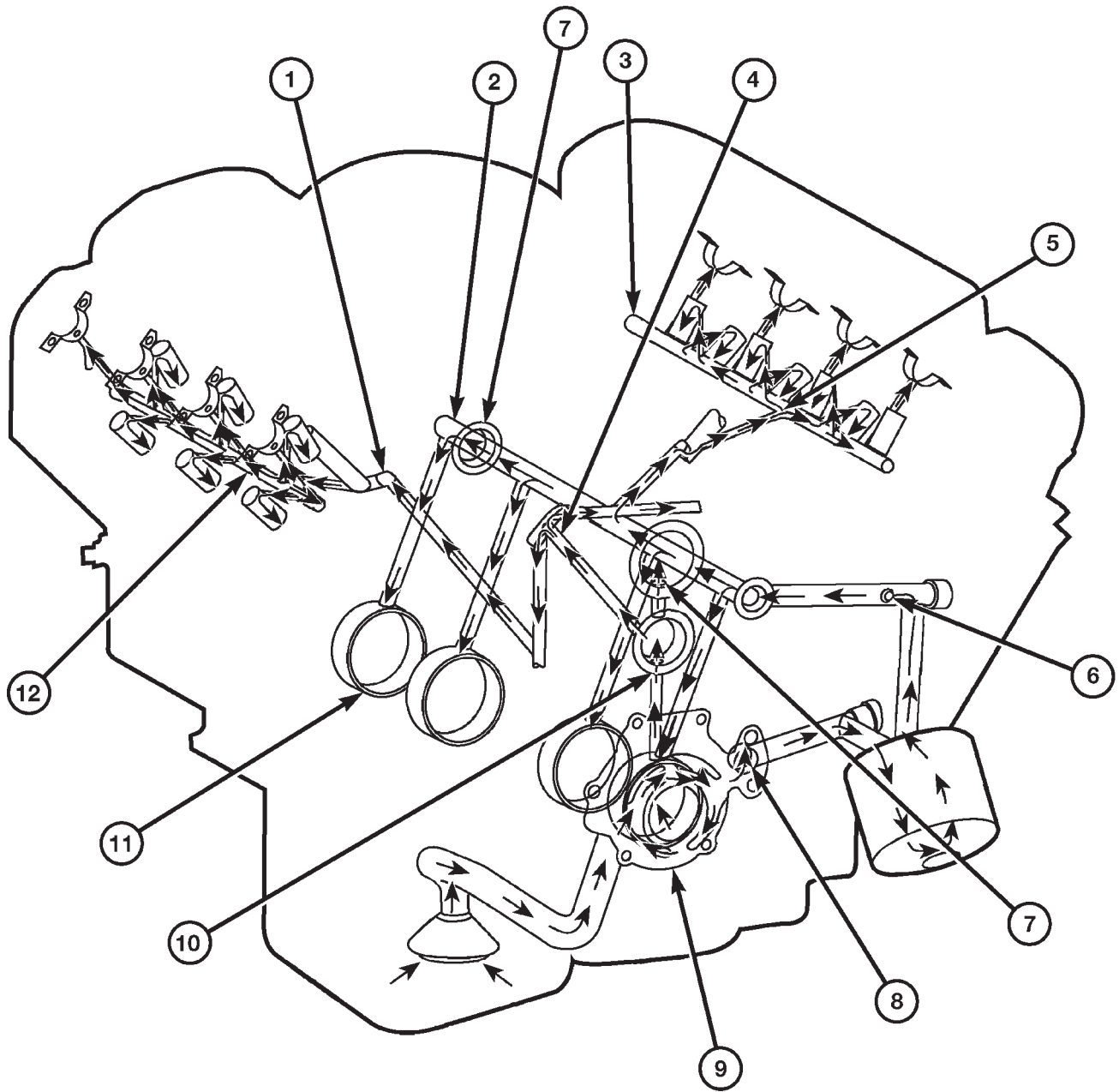
ENGINE LUBRICATION FLOW CHART - BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head* 4. Counterbalance Shaft Rear Journal
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1. Front Timing Chain Idler Shaft 2. Counterbalance Shaft - Front Journal 3. Both Secondary Chain Tensioners
Left Cylinder Head	Refer to Engine Lubrication Flow Chart - Cylinder Heads: Table 2
Right Cylinder Head	Refer to Engine Lubrication Flow Chart - Cylinder Heads: Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads	

ENGINE LUBRICATION FLOW CHART - CYLINDER HEADS: TABLE 2

FROM	TO
Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

LUBRICATION (Continued)



**Fig. 69 LUBRICATION OIL FLOW**

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- |   |   |
|---|---|
| 1 - OIL FLOW TO RIGHT CYLINDER HEAD       | 8 - OIL PUMP OUTLET TO CYLINDER BLOCK     |
| 2 - CYLINDER BLOCK MAIN OIL GALLERY       | 9 - OIL PUMP                              |
| 3 - LEFT CYLINDER HEAD OIL GALLERY        | 10 - OIL FLOW TO CRANKSHAFT MAIN JOURNALS |
| 4 - OIL FLOW TO BOTH SECONDARY TENSIONERS | 11 - CRANKSHAFT MAIN BEARING JOURNALS     |
| 5 - OIL FLOW TO LEFT CYLINDER HEAD        | 12 - RIGHT CYLINDER HEAD OIL GALLERY      |
| 6 - OIL PRESSURE SENSOR LOCATION          |   |
| 7 - OIL FLOW TO COUNTER BALANCE SHAFT     |   |

## LUBRICATION (Continued)

## DIAGNOSIS AND TESTING

## DIAGNOSIS AND TESTING - ENGINE OIL LEAK

Begin with a thorough 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 make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(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 inspection. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

## Air Leak Detection Test Method

(1) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(2) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) 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.**

(4) 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.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) 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.

(7) 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, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, 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 and scratches. The crankshaft seal flange is especially 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.

## DIAGNOSIS AND TESTING - ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 70) and install gauge assembly C-3292.

(2) Run engine until thermostat opens.

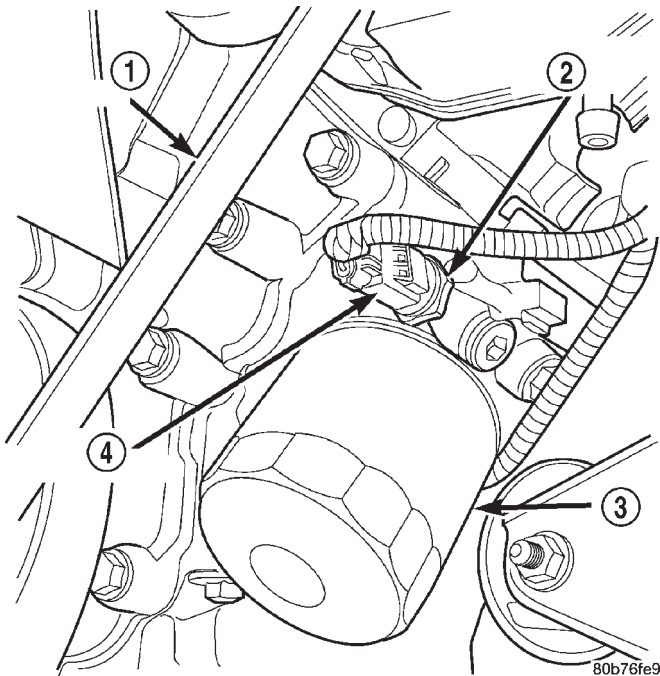
(3) Oil Pressure:

- Curb Idle—25 Kpa (4 psi) minimum

- 3000 rpm—170 - 550 KPa (25 - 80 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

## LUBRICATION (Continued)



**Fig. 70 Oil Pressure Sending Unit -Typical**

- 1 - BELT
- 2 - OIL PRESSURE SENSOR
- 3 - OIL FILTER
- 4 - ELEC. CONNECTOR

## DIAGNOSIS AND TESTING - 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, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, 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 9 - ENGINE - DIAGNOSIS AND TESTING), 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 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

## OIL

### STANDARD PROCEDURE - ENGINE OIL

**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

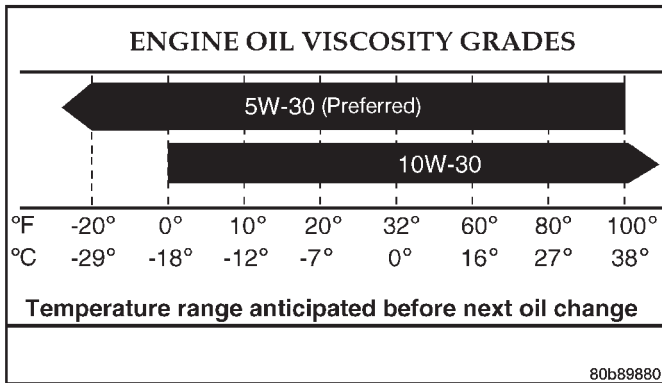
Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

### SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multi-

## OIL (Continued)

ple viscosities such as 5W-30 or 10W-30 in the 3.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 71).



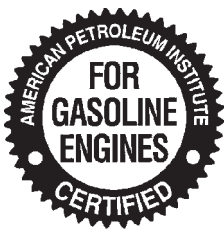
**Fig. 71 Temperature/Engine Oil Viscosity - 3.7L Engine**

## ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

## CONTAINER IDENTIFICATION

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 (Fig. 72).



9400-9

**Fig. 72 Engine Oil Container Standard Notations**

## OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located on the right side of the the 3.7L engine.

## CRANKCASE OIL LEVEL INSPECTION

**CAUTION:** Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil 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) Install 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 if level is below the SAFE ZONE on dipstick.

## ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

- (1) Position the vehicle on a level surface and turn engine off.
- (2) Remove oil fill cap.
- (3) Hoist and support vehicle on safety stands.
- (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 if damaged.
- (6) Install drain plug in crankcase.
- (7) Remove oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).
- (8) Install a new oil filter.
- (9) Lower vehicle and fill crankcase with 5 quarts of the specified type of engine oil described in this section.
- (10) Install oil fill cap.
- (11) Start engine and inspect for leaks.
- (12) Stop engine and inspect oil level.

## USED ENGINE OIL DISPOSAL

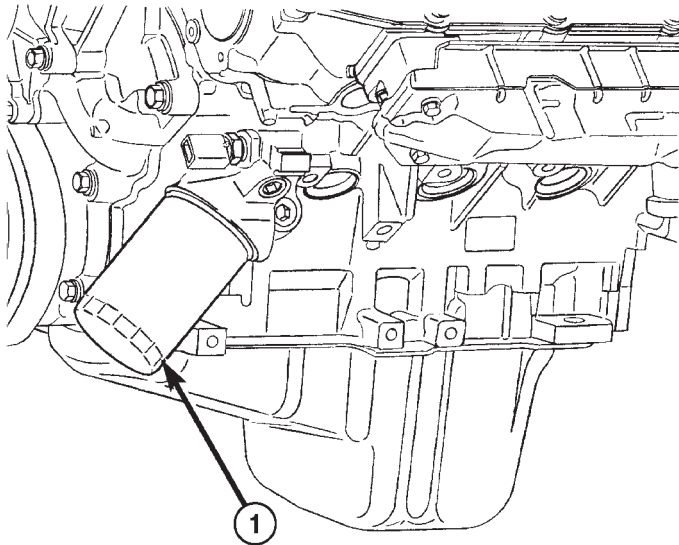
Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

## OIL FILTER

### REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

- (1) Position a drain pan under the oil filter.
- (2) Using a suitable oil filter wrench loosen filter.
- (3) Rotate the oil filter counterclockwise (Fig. 73) to remove it from the cylinder block oil filter boss.



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**Fig. 73 Oil Filter - 3.7L Engine**

1 - ENGINE OIL FILTER

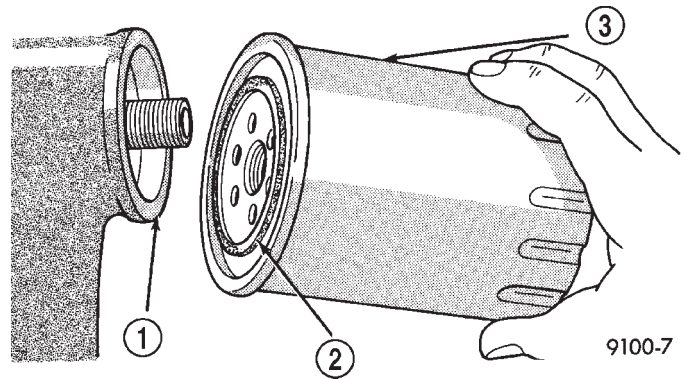
- (4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

**NOTE: Make sure filter gasket was removed with filter.**

- (5) With a wiping cloth, clean the gasket sealing surface of oil and grime.

### INSTALLATION

- (1) Lightly lubricate oil filter gasket with engine oil.
- (2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 74) hand tighten filter one full turn, do not over tighten.
- (3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.



9100-7

**Fig. 74 Oil Filter Sealing Surface—Typical**

1 - SEALING SURFACE  
2 - RUBBER GASKET  
3 - OIL FILTER

## OIL PAN

### DESCRIPTION

The engine oil pan is made of laminated steel and has a single plane sealing surface. The sandwich style oil pan gasket has an integrated windage tray and steel carrier (Fig. 75). The sealing area of the gasket is molded with rubber and is designed to be reused as long as the gasket is not cut, torn or ripped.

### REMOVAL

- (1) Remove the engine (Refer to 9 - ENGINE - REMOVAL).
- (2) Position the engine in a suitable engine stand.

**NOTE: Do not pry on oil pan or oil pan gasket. Gasket is integral to engine windage tray and does not come out with oil pan (Fig. 76).**

- (3) Remove the oil pan mounting bolts and oil pan.
- (4) Unbolt oil pump pickup tube and remove tube.
- (5) Remove the oil pan gasket/windage tray assembly from engine.

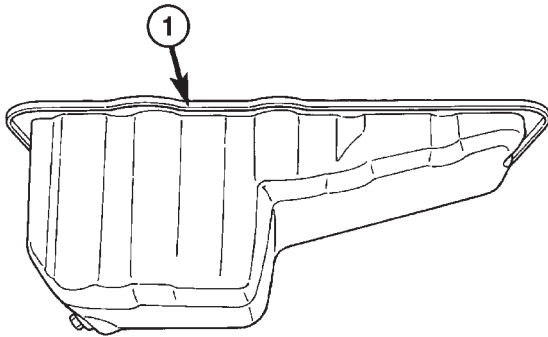
### CLEANING

- (1) Clean oil pan in solvent and wipe dry with a clean cloth.
- (2) Clean the oil pan gasket surface. **DO NOT** use a grinder wheel or other abrasive tool to clean sealing surface.
- (3) Clean oil screen and tube thoroughly in clean solvent.

### INSPECTION

- (1) Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

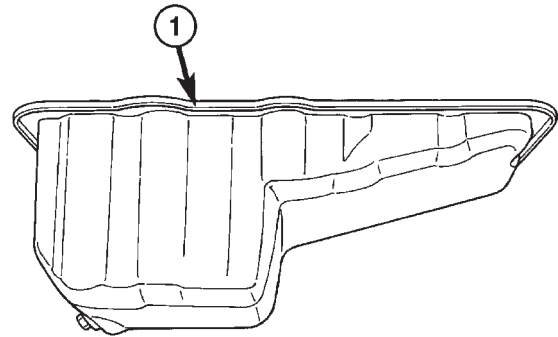
OIL PAN (Continued)



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**Fig. 75 OIL PAN AND GASKET**

- 1 - OIL PAN
- 2 - WINDAGE TRAY AND INTEGRATED OIL PAN GASKET



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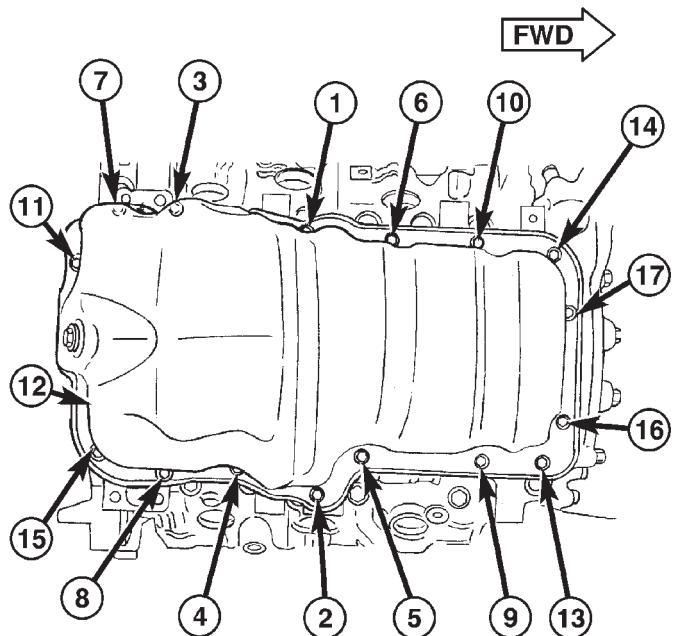
**Fig. 76 OIL PAN AND GASKET**

- 1 - OIL PAN
- 2 - WINDAGE TRAY AND INTEGRATED OIL PAN GASKET

(2) Inspect the oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

**INSTALLATION**

- (1) Clean the oil pan gasket mating surface of the bedplate and oil pan.
- (2) Inspect integrated oil pan gasket, and replace as necessary.
- (3) Position the integrated oil pan gasket/windage tray assembly.
- (4) Install the oil pickup tube
- (5) Install the mounting bolt and nuts. Tighten nuts to 28 N·m (20 ft. lbs.).
- (6) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 77).
- (7) Remove engine from engine stand.
- (8) Install engine (Refer to 9 - ENGINE - INSTALLATION).



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**Fig. 77 OIL PAN MOUNTING BOLT SEQUENCE**

## OIL PRESSURE SENSOR/ SWITCH

### DESCRIPTION

The 3-wire, solid-state engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

### OPERATION

The oil pressure sensor uses three circuits. They are:

- A 5-volt power supply from the Powertrain Control Module (PCM)
- A sensor ground through the PCM's sensor return
- A signal to the PCM relating to engine oil pressure

The oil pressure sensor has a 3-wire electrical function very much like the Manifold Absolute Pressure (MAP) sensor. Meaning different pressures relate to different output voltages.

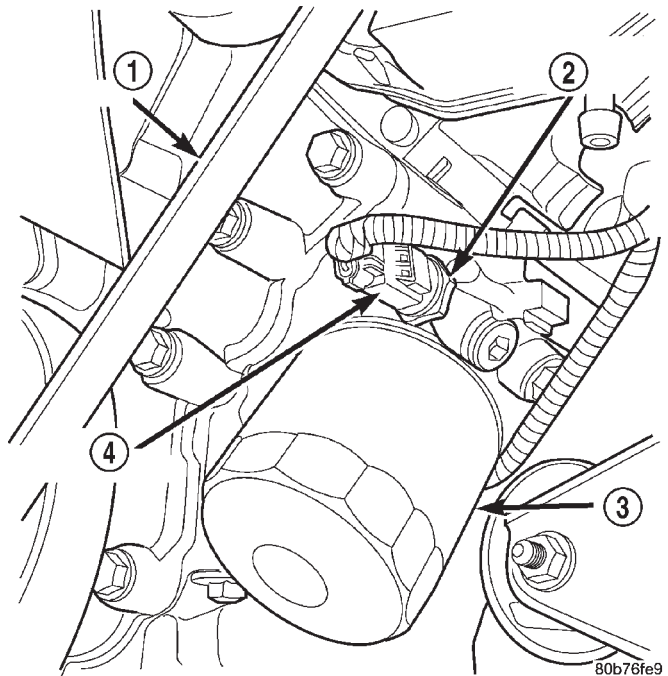
A 5-volt supply is sent to the sensor from the PCM to power up the sensor. The sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on either a CCD or PCI bus circuit (depending on vehicle line) to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

### REMOVAL

- (1) Disconnect the negative cable from the battery.
- (2) Raise vehicle on hoist.
- (3) Remove front splash shield.
- (4) Disconnect oil pressure sender wire (Fig. 78).
- (5) Remove the pressure sender (Fig. 78).

### INSTALLATION

- (1) Install oil pressure sender.
- (2) Connect oil pressure sender wire.
- (3) Install front splash shield.
- (4) Lower vehicle.
- (5) Connect the negative battery cable.



**Fig. 78 Oil Pressure Sending Unit**

- 1 - BELT
- 2 - OIL PRESSURE SENSOR
- 3 - OIL FILTER
- 4 - ELEC. CONNECTOR

## OIL PUMP

### REMOVAL

- (1) Remove the oil pan and pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
- (2) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
- (3) Remove the timing chains and tensioners (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
- (4) Remove the four bolts, primary timing chain tensioner and the oil pump.

### DISASSEMBLY

- (1) Remove oil pump cover screws and lift off cover plate.
- (2) Remove pump inner and outer rotors.

**NOTE:** Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

- (3) If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.



## OIL PUMP (Continued)

## INSPECTION

**CAUTION:** Oil pump pressure relief valve and spring should not be removed from the oil pump. If these components are disassembled and or removed from the pump the entire oil pump assembly must be replaced.

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(2) Lay a straight edge across the pump cover surface (Fig. 79). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.

(3) Measure the thickness of the outer rotor (Fig. 80). If the outer rotor thickness measures at 12.005 mm (0.4727 in.) or less the oil pump assembly must be replaced.

(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.382 in.) or less the oil pump assembly must be replaced.

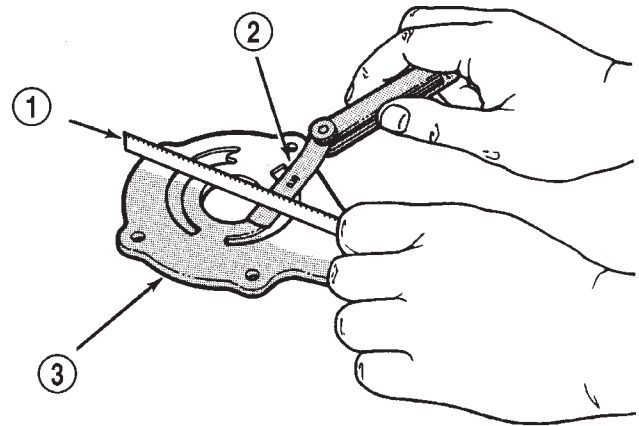
(5) Measure the thickness of the inner rotor (Fig. 81). If the inner rotor thickness measures at 12.005 mm (0.472 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 82). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 83). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 84).

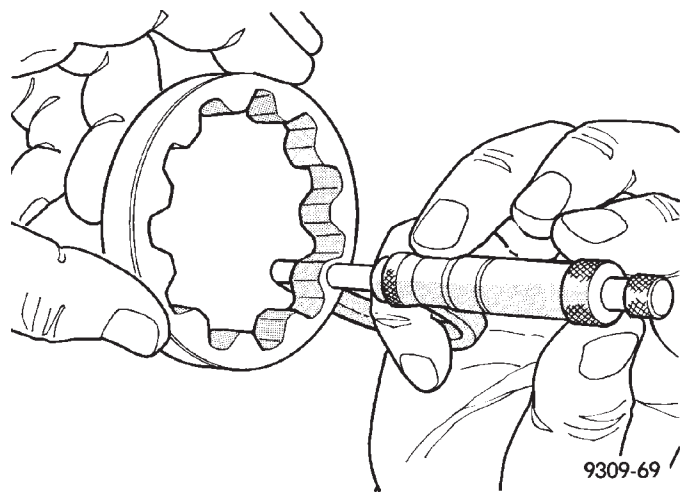
**NOTE:** The 3.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.



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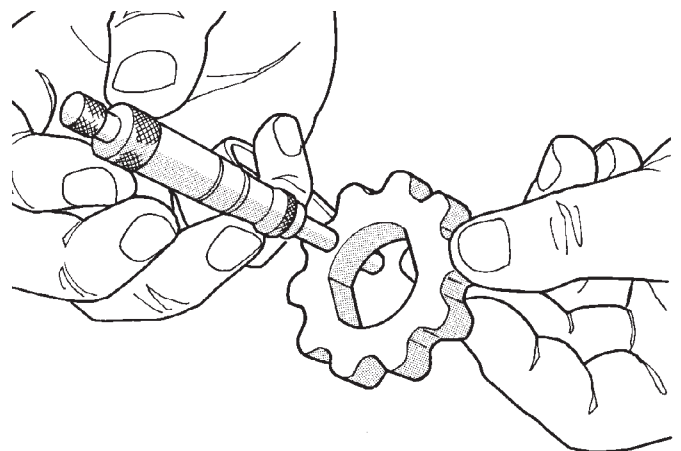
**Fig. 79 Checking Oil Pump Cover Flatness**

- 1 - STRAIGHT EDGE
- 2 - FEELER GAUGE
- 3 - OIL PUMP COVER



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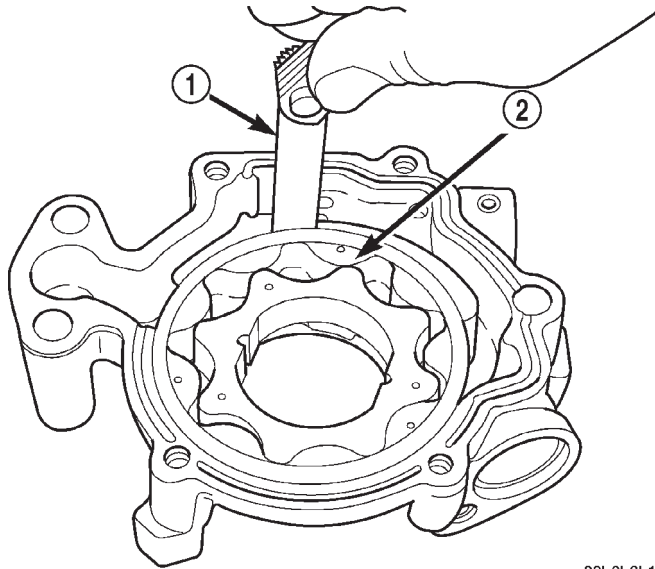
**Fig. 80 Measuring Outer Rotor Thickness**



9309-70

**Fig. 81 Measuring Inner Rotor Thickness**

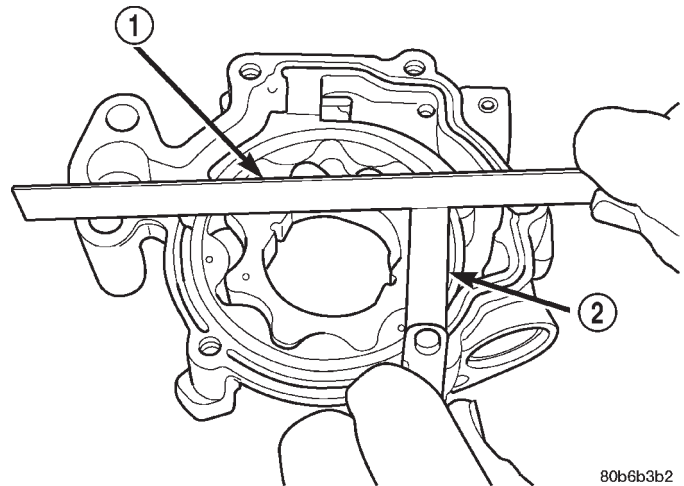
OIL PUMP (Continued)



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**Fig. 82 Measuring Outer Rotor Clearance in**

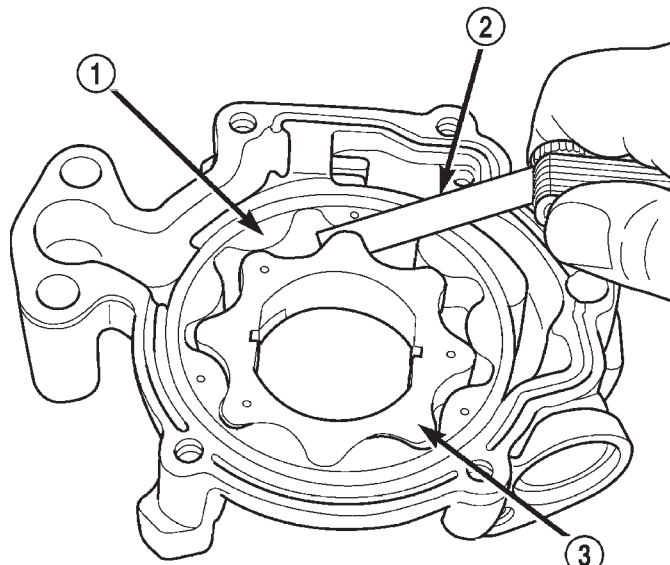
- 1 - FEELER GAUGE
- 2 - OUTER ROTOR



80b6b3b2

**Fig. 84 Measuring Clearance Over Rotors**

- 1 - STRAIGHT EDGE
- 2 - FEELER GAUGE



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**Fig. 83 Measuring Clearance Between Rotors**

- 1 - OUTER ROTOR
- 2 - FEELER GAUGE
- 3 - INNER ROTOR

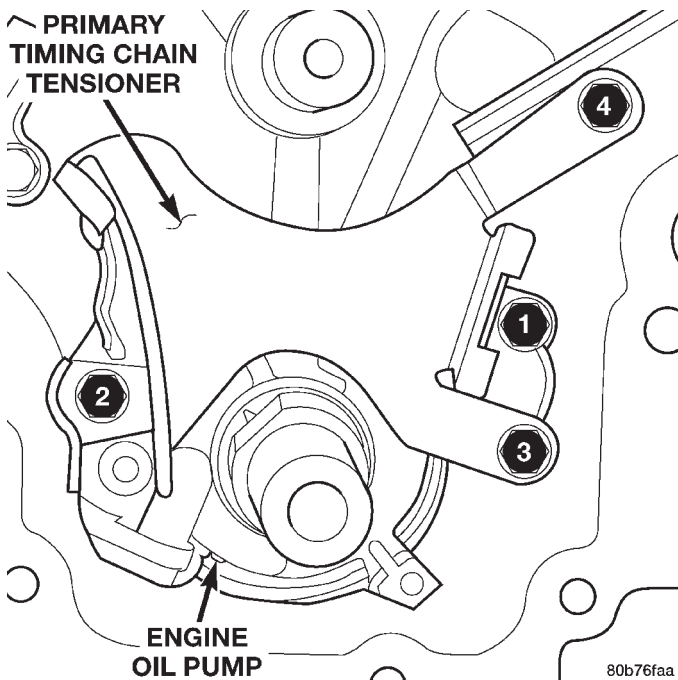
**ASSEMBLY**

- (1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.
- (2) Install inner and outer rotors
- (3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).
- (4) Prime oil pump before installation by filling rotor cavity with engine oil.
- (5) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

**INSTALLATION**

- (1) Position the oil pump onto the crankshaft and install two oil pump retaining bolts.
- (2) Position the primary timing chain tensioner and install the two retaining bolts.
- (3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 85).
- (4) Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
- (5) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
- (6) Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

## OIL PUMP (Continued)



**Fig. 85 Oil Pump and Primary Timing Chain Tensioner Tightening Sequence**

## INTAKE MANIFOLD

## DESCRIPTION

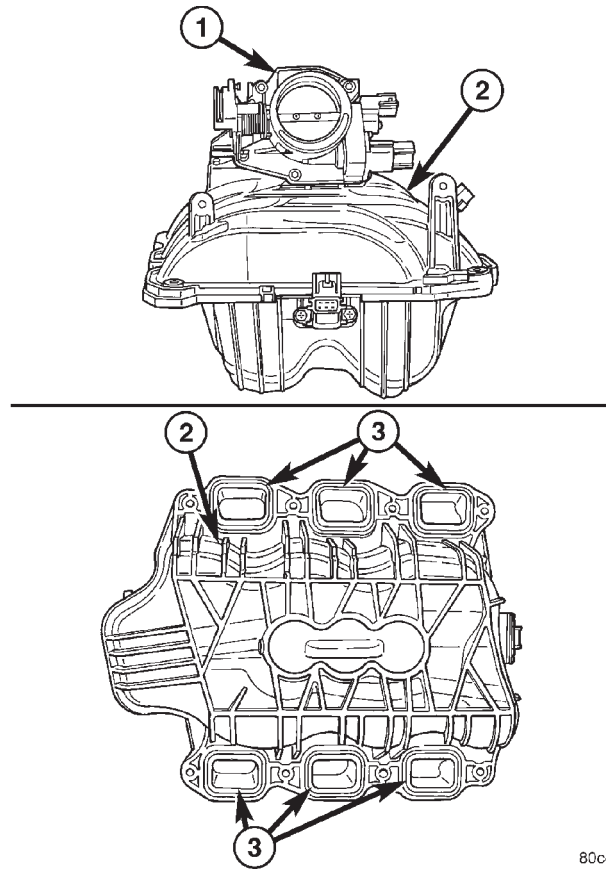
The intake manifold (Fig. 86) is made of a composite material and features 300 mm (11.811 in.) long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of six individual press in place port gaskets to prevent leaks. The throttle body attaches directly to the intake manifold. Eight studs and two bolts are used to fasten the intake to the head.

## DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKS

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 (Spray Bottle) at the suspected leak area.
- (3) If engine RPM'S change, the area of the suspected leak has been found.
- (4) Repair as required.



**Fig. 86 INTAKE MANIFOLD**

- 1 - THROTTLE BODY
- 2 - INTAKE MANIFOLD
- 3 - INTAKE PORT GASKETS

## REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove resonator assembly and air inlet hose.
- (3) Disconnect throttle and speed control cables.
- (4) Disconnect electrical connectors for the following components: Refer to FUEL SYSTEM for component locations.
  - Manifold Absolute Pressure (MAP) Sensor
  - Intake Air Temperature (IAT) Sensor
  - Throttle Position (TPS) Sensor
  - Coolant Temperature (CTS) Sensor
  - Idle Air Control (IAC) Motor
- (5) Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive crankcase ventilation (PCV) hose.
- (6) Disconnect generator electrical connections.
- (7) Disconnect air conditioning compressor electrical connections.
- (8) Disconnect left and right radio suppressor straps.
- (9) Disconnect and remove ignition coil towers.
- (10) Remove top oil dipstick tube retaining bolt and ground strap.

## INTAKE MANIFOLD (Continued)

- (11) Bleed fuel system. Refer to FUEL SYSTEM.
- (12) Remove fuel rail.
- (13) Remove throttle body assembly and mounting bracket.
- (14) Drain cooling system below coolant temperature level. Refer to COOLING SYSTEM.
- (15) Remove the heater hoses from the engine front cover and the heater core.
- (16) Unclip and remove heater hoses and tubes from intake manifold.
- (17) Remove coolant temperature sensor. Refer to FUEL SYSTEM.
- (18) Remove intake manifold retaining fasteners in reverse order of tightening sequence.
- (19) Remove intake manifold.

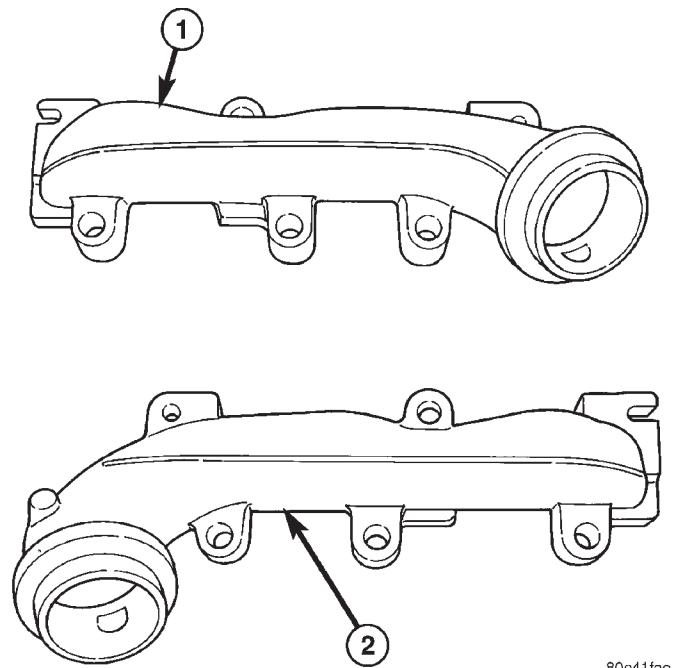
## INSTALLATION

- (1) Install intake manifold gaskets.
- (2) Install intake manifold.
- (3) Install intake manifold retaining bolts and tighten in sequence shown in to 12 N·m (105 in. lbs.).
- (4) Install left and right radio suppressor straps.
- (5) Install throttle body assembly.
- (6) Install throttle cable bracket.
- (7) Connect throttle cable and speed control cable to throttle body.
- (8) Install fuel rail.
- (9) Install ignition coil towers.
- (10) Position and install heater hoses and tubes onto intake manifold.
- (11) Install the heater hoses to the heater core and engine front cover.
- (12) Connect electrical connectors for the following components:
  - Manifold Absolute Pressure (MAP) Sensor
  - Intake Air Temperature (IAT) Sensor
  - Throttle Position (TPS) Sensor
  - Coolant Temperature (CTS) Sensor
  - Idle Air Control (IAC) Motor
  - Ignition coil towers
  - Fuel injectors
- (13) Install top oil dipstick tube retaining bolt and ground strap.
- (14) Connect generator electrical connections.
- (15) Connect Vapor purge hose, Brake booster hose, Speed control servo hose, Positive crankcase ventilation (PCV) hose.
- (16) Fill cooling system.
- (17) Install resonator assembly and air inlet hose.
- (18) Connect negative cable to battery.

## EXHAUST MANIFOLD

## DESCRIPTION

The exhaust manifolds (Fig. 87) are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields (Fig. 88) are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.



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Fig. 87 EXHAUST MANIFOLDS

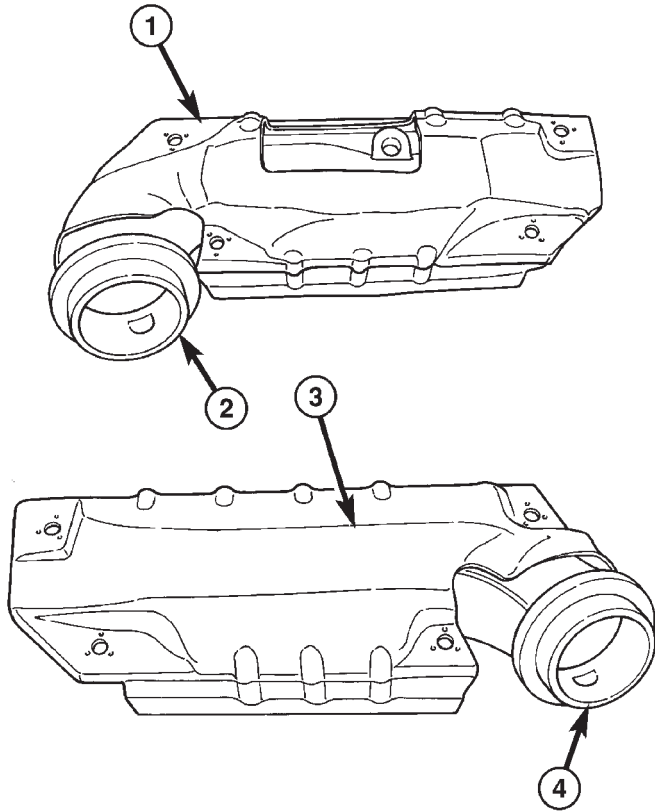
- 1 - LEFT SIDE EXHAUST MANIFOLD
- 2 - RIGHT SIDE EXHAUST MANIFOLD

## REMOVAL

## RIGHT EXHAUST MANIFOLD

- (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 shield (Fig. 89).
- (6) Remove bolts, nuts and washers attaching manifold to cylinder head.
- (7) Remove manifold and gasket from the cylinder head.

EXHAUST MANIFOLD (Continued)



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**Fig. 88 EXHAUST MANIFOLD HEAT SHIELDS**

- 1 - RIGHT SIDE EXHAUST MANIFOLD HEAT SHIELD
- 2 - RIGHT SIDE EXHAUST MANIFOLD FLANGE
- 3 - LEFT SIDE EXHAUST MANIFOLD HEAT SHIELD
- 4 - LEFT SIDE EXHAUST MANIFOLD FLANGE

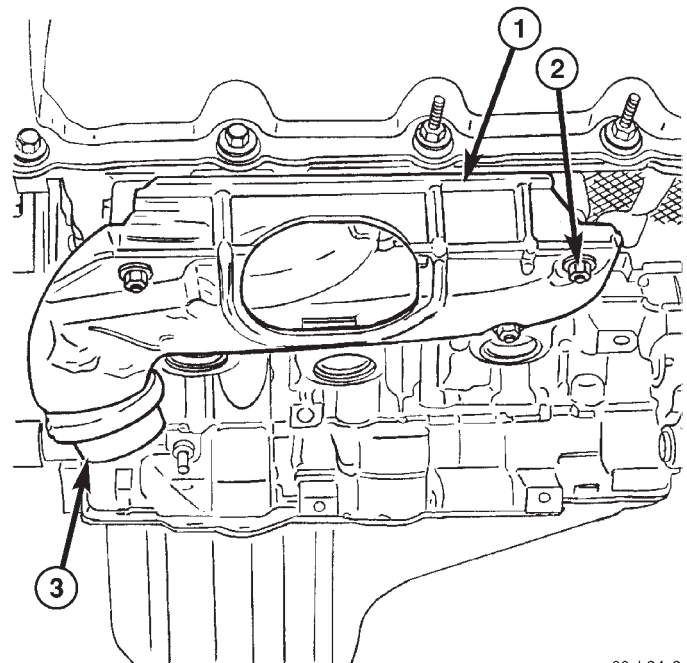
**LEFT EXHAUST MANIFOLD**

- (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. 90).
- (6) Remove bolts, nuts and washers attaching manifold to cylinder head.
- (7) Remove manifold and gasket from the cylinder head.

**INSTALLATION**

**RIGHT EXHAUST MANIFOLD**

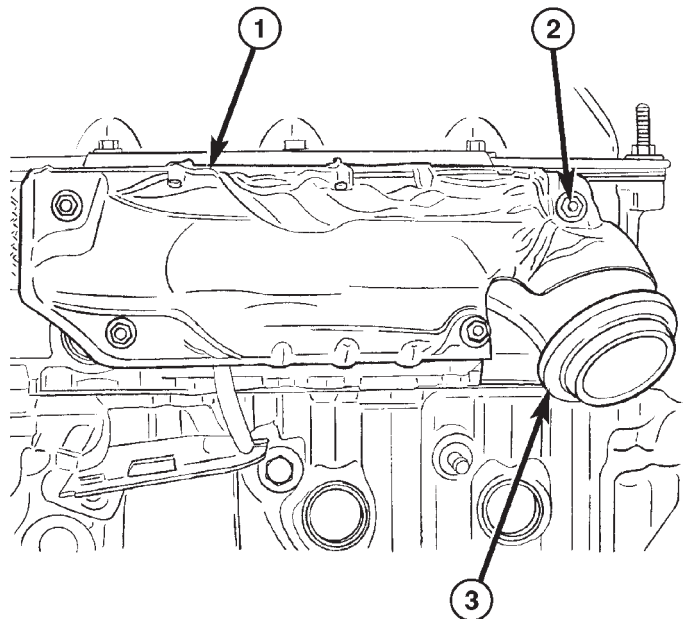
**CAUTION:** If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.



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**Fig. 89 EXHAUST MANIFOLD RIGHT**

- 1 - Heat Shield
- 2 - Nuts
- 3 - Manifold Flange



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**Fig. 90 EXHAUST MANIFOLD LEFT**

- 1 - Heat Shield
- 2 - Nuts
- 3 - Manifold Flange

## EXHAUST MANIFOLD (Continued)

(1) Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.

(2) Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

**CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.**

(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.

## LEFT EXHAUST MANIFOLD

**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 manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.

(2) Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

**CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.**

(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.

## VALVE TIMING

### DESCRIPTION

The timing drive system has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain, two secondary timing chain drives and a counterbalance shaft drive.

### OPERATION

The primary timing chain is a single inverted tooth chain type. The primary chain drives the large 40 tooth idler sprocket directly from a 20 tooth crank-

shaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and designed oil pump leakage. The idler sprocket assembly connects the primary chain drive, secondary chain drives, and the counterbalance shaft. The idler sprocket assembly consists of two integral 26 tooth sprockets a 40 tooth sprocket and a helical gear that is press-fit to the assembly. The spline joint for the 40 tooth sprocket is a non - serviceable press fit anti rattle type. A spiral ring is installed on the outboard side of the fifty tooth sprocket to prevent spline disengagement. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is a light press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are roller type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a 26 tooth cam sprocket directly from the 26 tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner incorporates a controlled leak path through a device known as a vent disc located in the nose of the piston to manage chain loads. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

## STANDARD PROCEDURE

### MEASURING TIMING CHAIN WEAR

**NOTE: This procedure must be performed with the timing chain cover removed.**

(1) Remove the timing chain cover. Refer to Timing Chain Cover in this section for procedure.

## VALVE TIMING (Continued)

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston. The measurement at point (A) must be less than 15mm (.5906 inches).

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. Refer to Timing Chain and Sprockets in this section for procedure.

## SERVICE PROCEDURES

## TIMING VERIFICATION

**CAUTION:** The 3.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

**NOTE:** Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

**NOTE:** The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

Engine base timing can be verified by the following procedure:

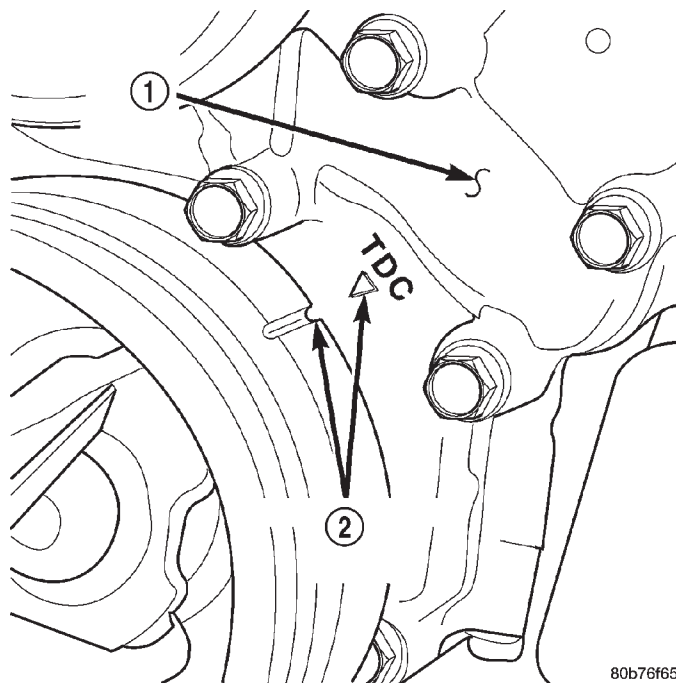
(1) Remove the cylinder head covers. Refer to the procedure in this section.

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 91). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

(3) Note the location of the V6 mark stamped into the camshaft drive gears. If the V6 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V6 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke. (Fig. 95)

(4) If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.

(5) If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.



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**Fig. 91 Engine Top Dead Center (TDC) Indicator Mark**

- 1 - TIMING CHAIN COVER  
2 - CRANKSHAFT TIMING MARKS

(6) If both camshaft drive gear V6 marks are at the twelve o'clock or the six o'clock position the engine base timing is correct. Reinstall the cylinder head covers.

## COUNTER BALANCE SHAFT TIMING

(1) Ensure that the engine is at TDC with both camshaft sprocket marks are in the 12 o'clock position. (Fig. 94)

(2) Look down the left cylinder gear chain cavity. The timing dot on the counter balance shaft drive gear should be in the 6 o'clock position (Fig. 92).

## TIMING - SINGLE CAMSHAFT

**NOTE:** to adjust the timing on one camshaft, perform the following procedure.

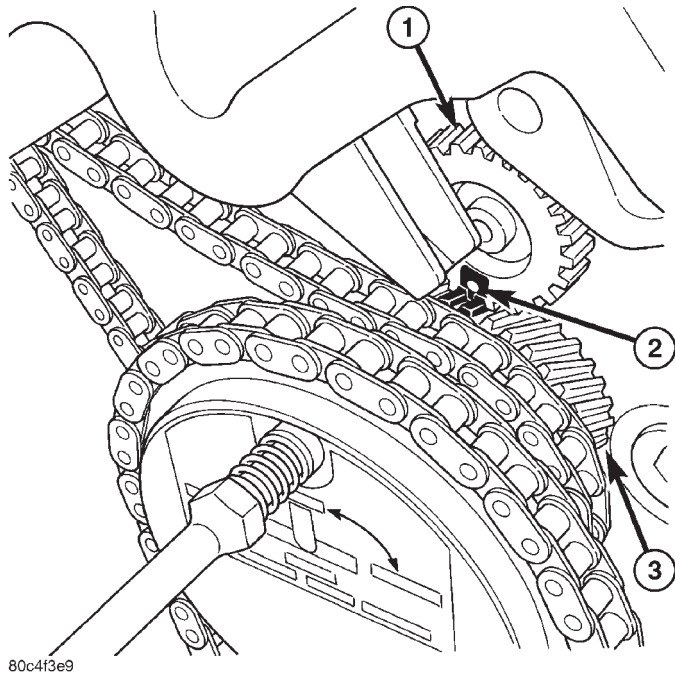
(1) Using Chain Tensioner Wedge, Special Tool 8379, stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position. (Fig. 93)

(2) Remove the camshaft drive gear retaining bolt.

(3) Carefully remove the camshaft drive gear from the camshaft.

(4) Re-index the camshaft drive gear in the chain until the V6 mark is at the same position as the V6 mark on the opposite camshaft drive gear.

VALVE TIMING (Continued)



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**Fig. 92 COUNTERBALANCE SHAFT ALIGNMENT MARKS**

- 1 - COUNTERBALANCE SHAFT
- 2 - TIMING MARKS
- 3 - IDLER SPROCKET

(5) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear.

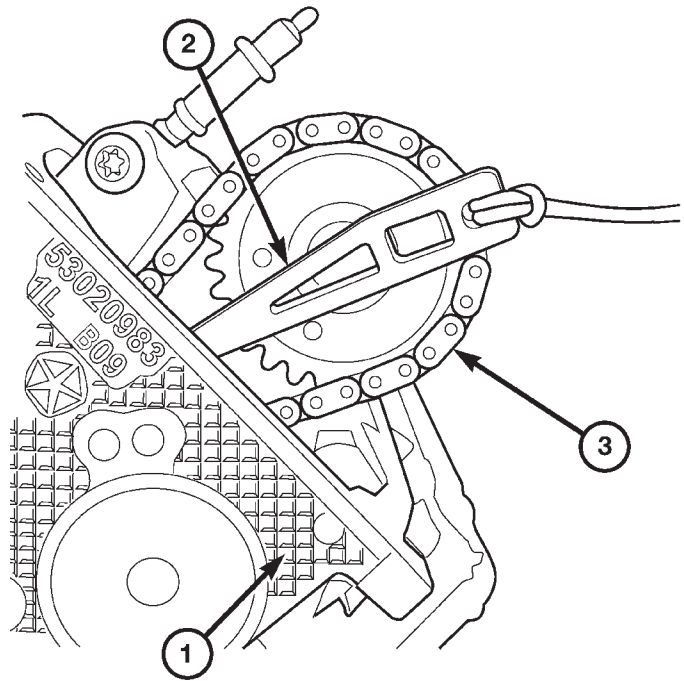
**CAUTION:** Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

(6) Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench, Tighten retaining bolt to 122N·m (90 ft. Lbs.).

(7) Remove Special Tool 8379.

(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V6 marks are in fact aligned.

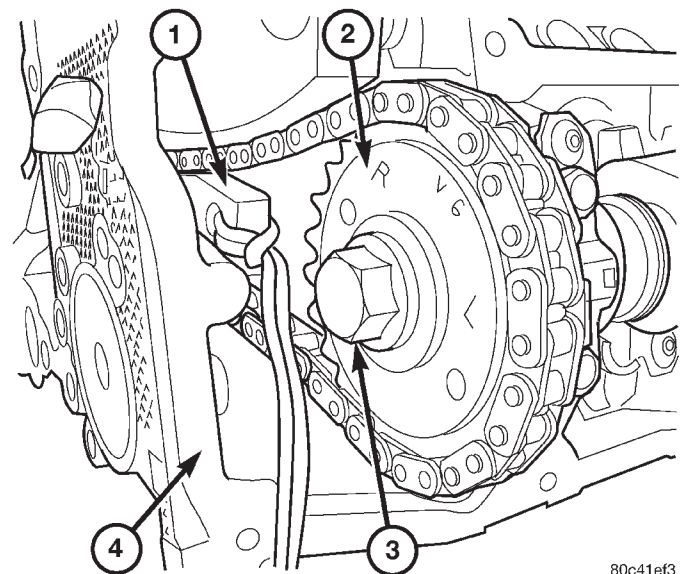
(9) Install the cylinder head covers. Refer to Cylinder Head Cover in this section.



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**Fig. 93 SECURING TIMING CHAIN TENSIONER USING TIMING CHAIN WEDGE**

- 1 - CYLINDER HEAD
- 2 -SPECIAL TOOL 8379
- 2 - TIMING CHAIN



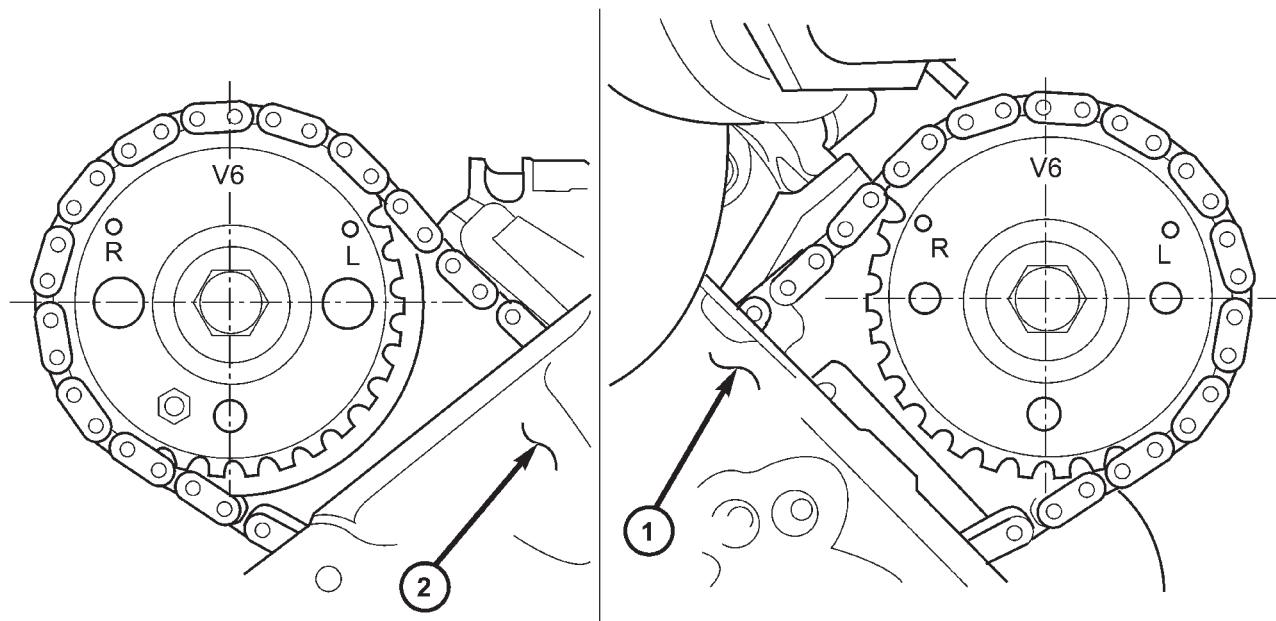
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**Fig. 94 CAMSHAFT DRIVE GEAR REMOVAL/INST**

- 1 - SPECIAL TOOL 8279 TIMING CHAIN WEDGE
- 2 - CAMSHAFT DRIVE GEAR
- 3 - RETAINING BOLT
- 4 - CYLINDER HEAD



## VALVE TIMING (Continued)



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**Fig. 95 Camshaft Sprocket V6 Marks**

- 1 - LEFT CYLINDER HEAD  
2 - RIGHT CYLINDER HEAD

## BALANCE SHAFT

### REMOVAL

(1) Remove the primary and secondary timing chains. Refer to TIMING CHAIN and SPROCKET.

**NOTE:** The balance shaft and gear are serviced as an assembly. Do not attempt to remove the gear from the balance shaft. Remove the retaining bolt from the counterbalance shaft thrust plate (Fig. 96).

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, remove the counterbalance shaft from the engine (Fig. 97).

### INSTALLATION

**NOTE:** The balance shaft and gear are serviced as an assembly. Do not attempt to remove the gear from the balance shaft.

(1) Coat counterbalance shaft bearing journals with clean engine oil.

**NOTE:** The balance shaft is heavy, and care should be used when installing shaft, so bearings are not damaged.

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, carefully install counterbalance shaft into engine.

(3) Install Counterbalance shaft thrust plate retaining bolt finger tight. Do not tighten bolt at this time.

(4) Position the right side of the thrust plate with the right chain guide bolt, install bolt finger tight.

(5) Torque the thrust plate retaining bolt to 28 N·m (250 in. lbs.).

(6) Remove the chain guide bolt so that guide can be installed.

## TIMING BELT / CHAIN COVER(S)

### REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

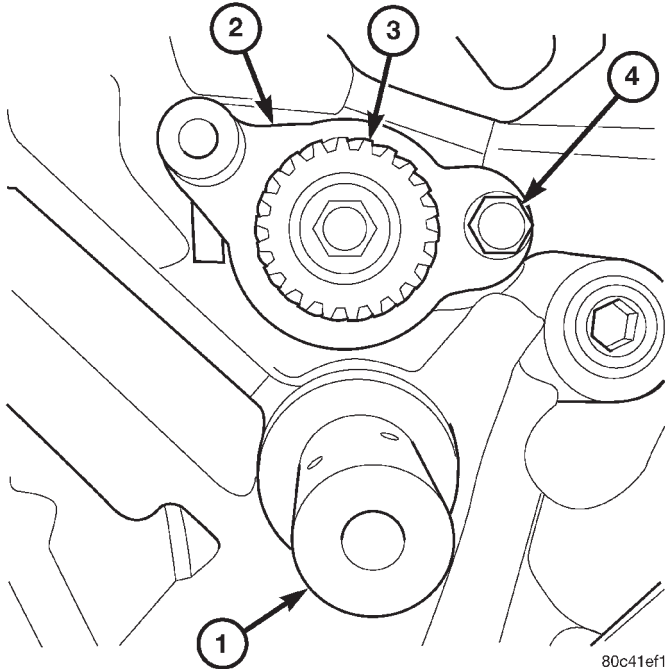
(3) Remove electric cooling fan and fan shroud assembly.

(4) Remove fan and fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(5) Disconnect both heater hoses at timing cover.

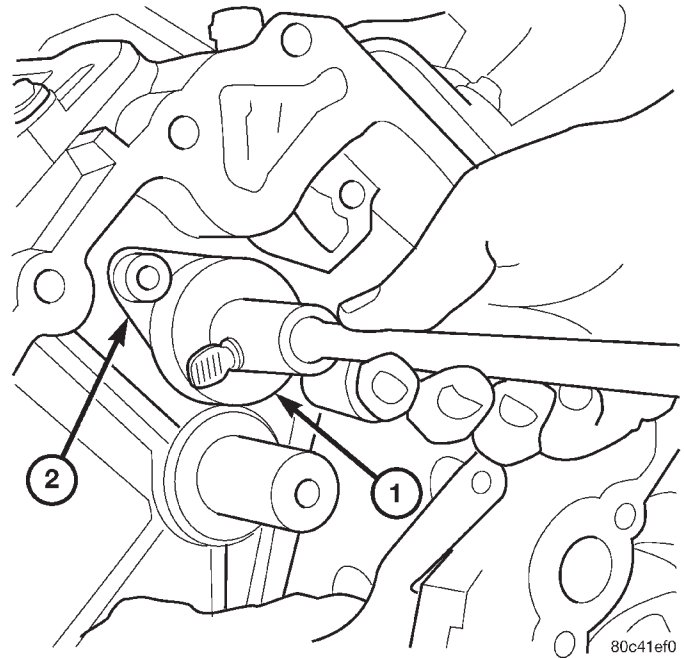
(6) Disconnect lower radiator hose at engine.

TIMING BELT / CHAIN COVER(S) (Continued)



**Fig. 96 COUNTERBALANCE SHAFT RETAINING PLATE**

- 1 - IDLER SHAFT
- 2 - COUNTERBALANCE SHAFT THRUST PLATE
- 3 - COUNTERBALANCE SHAFT DRIVE GEAR
- 4 - RETAINING BOLT



**Fig. 97 COUNTERBALANCE SHAFT REMOVAL/ INSTALLATION TOOL**

- 1 - COUNTERBALANCE SHAFT REMOVAL AND INSTALLATION TOOL
- 2 - COUNTERBALANCE SHAFT THRUST PLATE

(7) Remove accessory drive belt tensioner assembly (Fig. 98).

(8) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(9) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

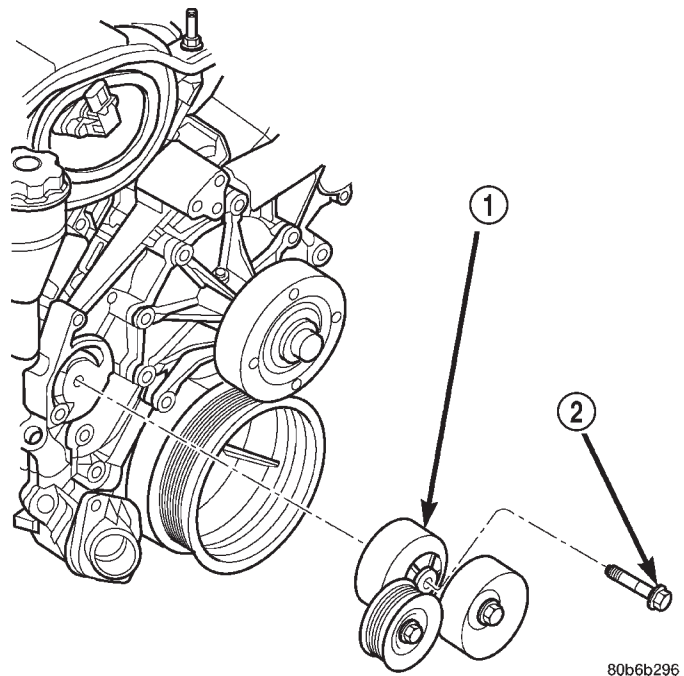
(10) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

**CAUTION:** The 3.7L engine uses an anerobic sealer instead of a gasket to seal the front cover to the engine block, from the factory. For service, Mopar® Engine RTV sealant must be substituted.

**NOTE:** It is not necessary to remove the water pump for timing cover removal.

(11) Remove the bolts holding the timing cover to engine block. (Fig. 99).

(12) Remove the timing cover.

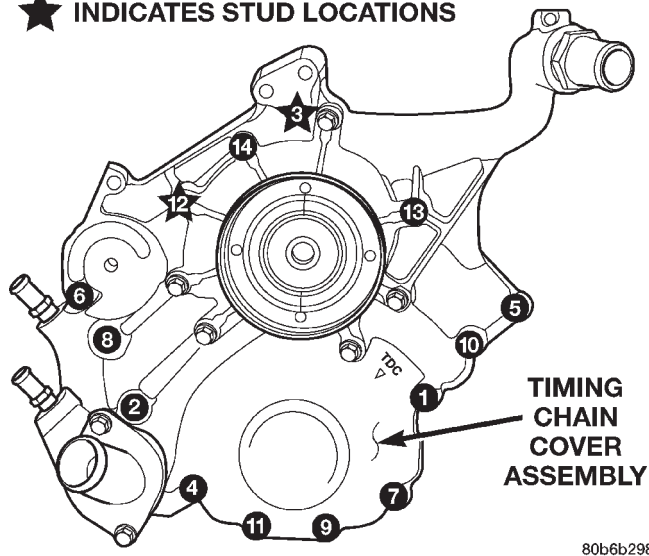


**Fig. 98 Accessory Drive Belt Tensioner**

- 1 - TENSIONER ASSEMBLY
- 2 - FASTENER TENSIONER TO FRONT COVER

## TIMING BELT / CHAIN COVER(S) (Continued)

★ INDICATES STUD LOCATIONS



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**Fig. 99 Timing Chain Cover Fasteners - Typical**  
**INSTALLATION**

**CAUTION:** Do not use oil based liquids to clean timing cover or block surfaces. Use only rubbing alcohol, along with plastic or wooden scrapers. Use no wire brushes or abrasive wheels or metal scrapers, or damage to surfaces could result.

(1) Clean timing chain cover and block surface using rubbing alcohol.

**CAUTION:** The 3.7L uses a special anaerobic sealer instead of a gasket to seal the timing cover to the engine block, from the factory. For service repairs, Mopar® Engine RTV must be used as a substitute.

(2) Inspect the water passage o-rings for any damage, and replace as necessary.

(3) Apply Mopar® Engine RTV sealer to front cover (Fig. 100).

(4) Install cover. Tighten fasteners in sequence as shown in (Fig. 101) to 54 N-m (40 ft. lbs.).

(5) Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

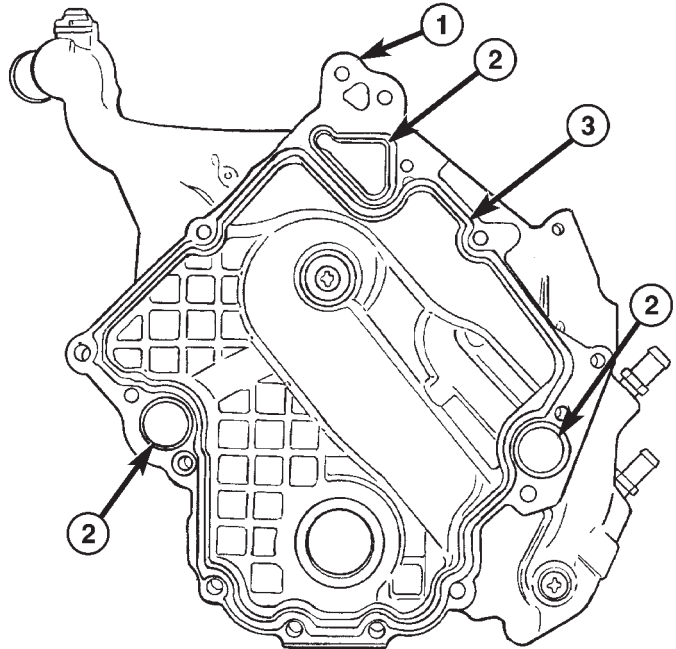
(6) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(7) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(8) Install accessory drive belt tensioner assembly (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION).

(9) Install radiator upper and lower hoses.

(10) Install both heater hoses.

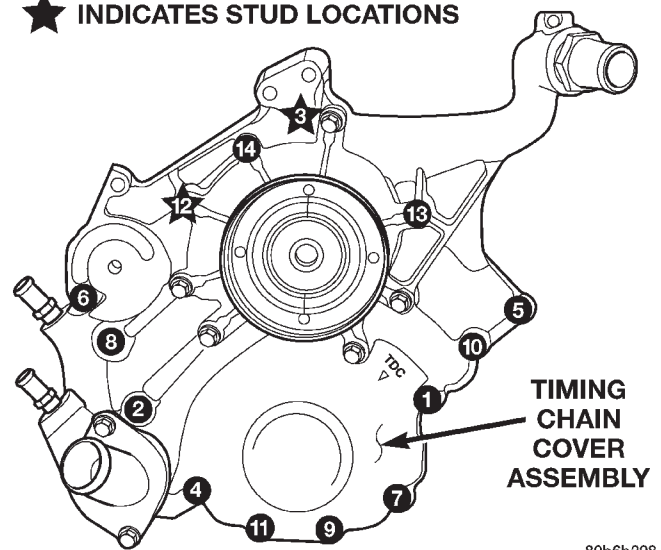


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**Fig. 100 TIMING COVER SEALANT**

- 1 - TIMING CHAIN COVER
- 2 - WATER PASSAGE ORING
- 3 - MOPAR® ENGINE RTV SEALER

★ INDICATES STUD LOCATIONS



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**Fig. 101 Timing Chain Cover Fasteners - Typical**

(11) Install electric fan shroud and viscous fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(12) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(13) Connect the battery negative cable.

## IDLER SHAFT

### REMOVAL

(1) Remove the primary and secondary timing chains and sprockets. Refer to procedure in this section.

**NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft, to install the removal tool.**

(2) Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore.

(3) Cover the radiator core with a suitable cover.

**CAUTION: Use care when removing the idler shaft, Do not strike the radiator cooling fins with the slide hammer.**

(4) Using Special Tool 8517 Slide Hammer, remove the idler shaft.

### INSTALLATION

(1) Thoroughly clean the idler shaft bore.

(2) Position the idler shaft in the bore.

**NOTE: The two lubrication holes in the idler shaft do not require any special alignment.**

**NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft, with clean engine oil.**

(3) Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.

(4) Coat the idler shaft with clean engine oil.

(5) Install the timing chains and sprockets. Refer to procedure in this section.

## TIMING BELT/CHAIN AND SPROCKET(S)

### REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system. Refer to COOLING SYSTEM for procedures.

(3) Remove right and left cylinder head covers. Refer to CYLINDER HEAD COVER.

(4) Remove radiator fan shroud. Refer to COOLING SYSTEM for procedure.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 103) (#1 cylinder exhaust stroke) and the camshaft sprocket "V6" marks are at the 12 o'clock position (Fig. 102).

**CAUTION: The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 N·m (44 in. lbs.).**

(6) Remove power steering pump. Refer to STEERING for procedure.

(7) Remove access plug from left and right cylinder heads for access to chain guide fasteners (Fig. 104).

(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.

(9) Remove crankshaft damper and timing chain cover. Refer to procedures.

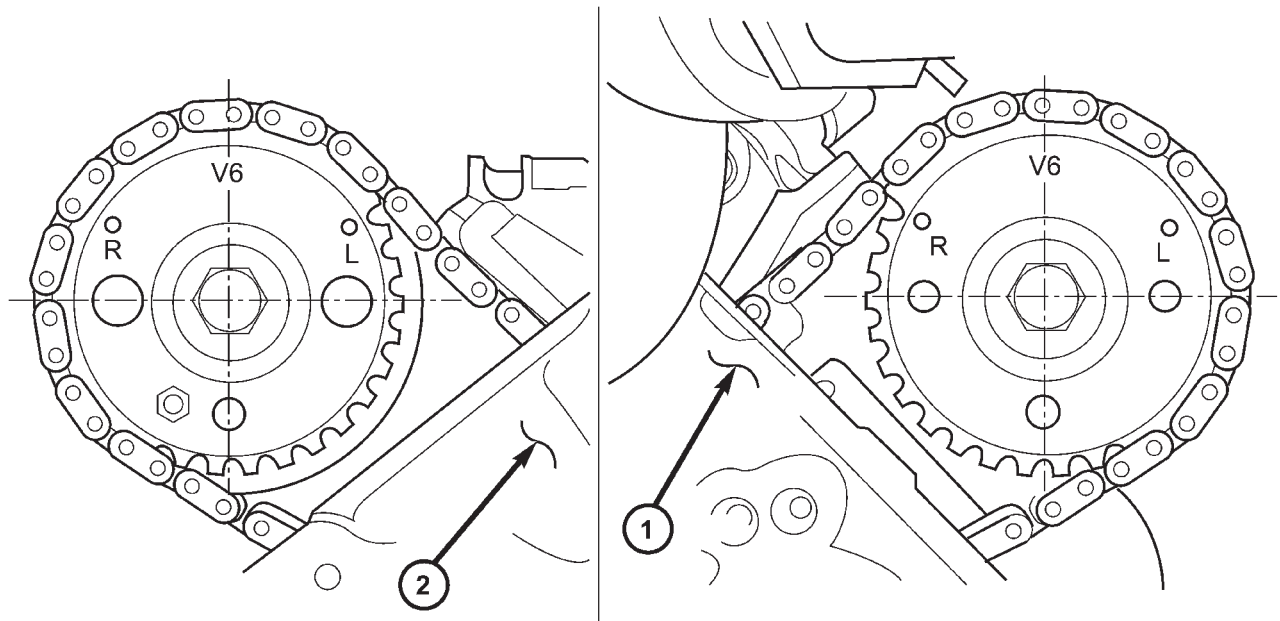
(10) Collapse and pin primary chain tensioner.

**CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.**

(11) Remove secondary chain tensioners.

(12) Remove camshaft position and crankshaft position sensors (Fig. 105) and (Fig. 106).

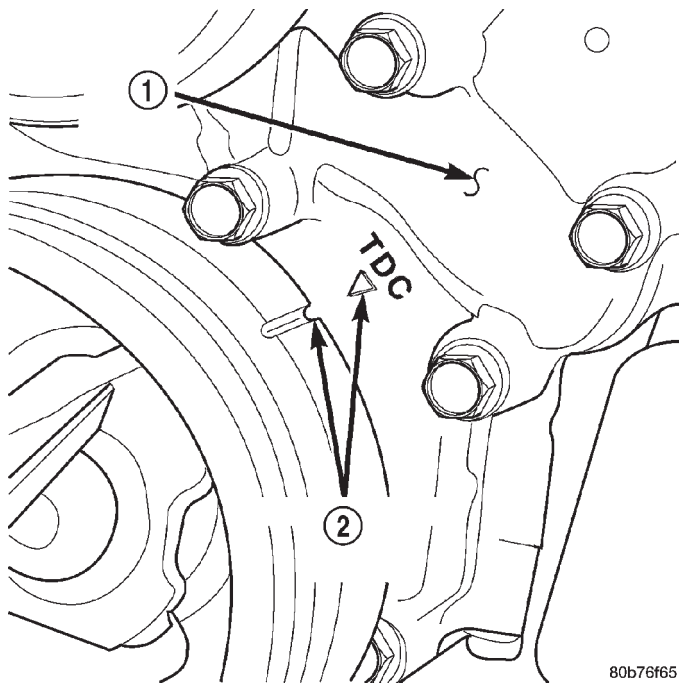
TIMING BELT/CHAIN AND SPROCKET(S) (Continued)



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**Fig. 102 Camshaft Sprocket V6 Marks**

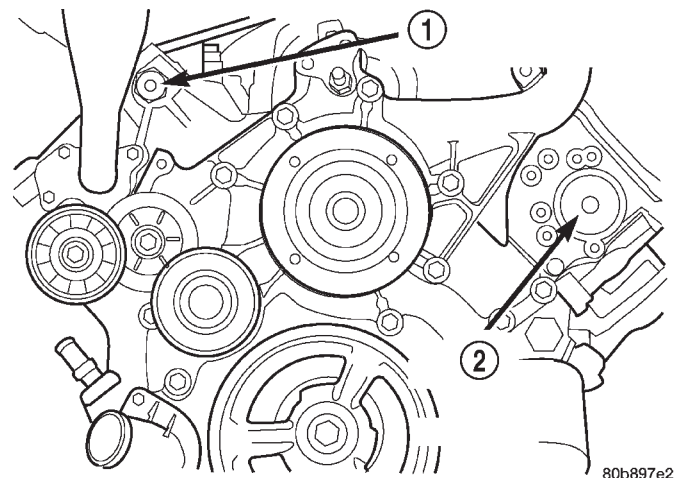
- 1 - LEFT CYLINDER HEAD
- 2 - RIGHT CYLINDER HEAD



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**Fig. 103 Engine Top Dead Center**

- 1 - TIMING CHAIN COVER
- 2 - CRANKSHAFT TIMING MARKS

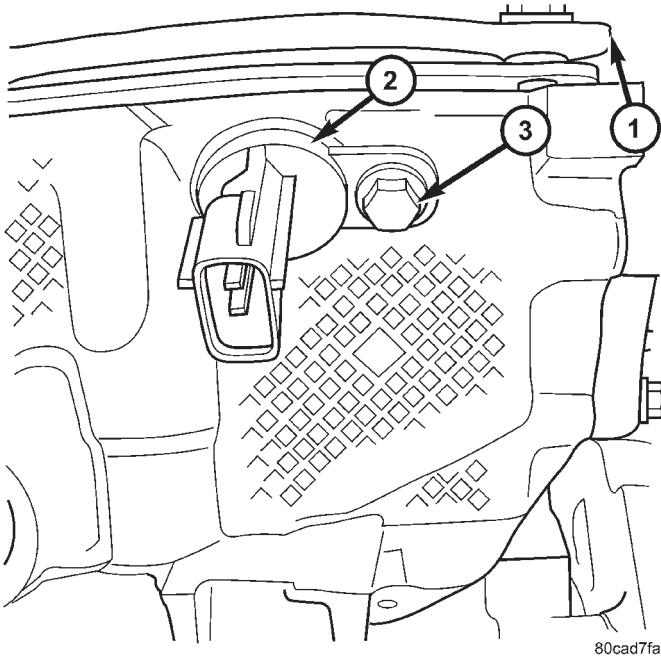


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**Fig. 104 Cylinder Head Access Plugs**

- 1 - RIGHT CYLINDER HEAD ACCESS PLUG
- 2 - LEFT CYLINDER HEAD ACCESS PLUG

TIMING BELT/CHAIN AND SPROCKET(S) (Continued)



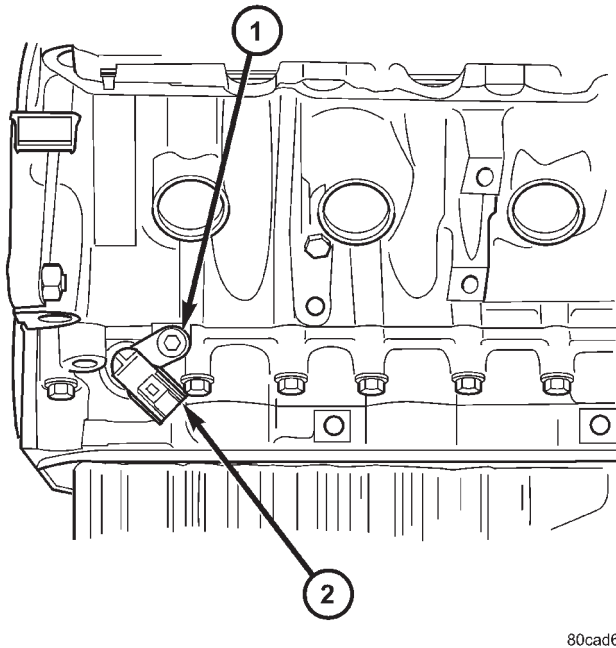
**Fig. 105 CAMSHAFT POSITION SENSOR**

- 1 - CYLINDER HEAD
- 2 - CAMSHAFT POSITION SENSOR
- 2 - SCREW

**CAUTION:** Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

**CAUTION:** Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

- (13) Remove left and right camshaft sprocket bolts.
- (14) While holding the left camshaft steel tube with Special Tool 8428 Camshaft Wrench, remove the left camshaft sprocket. Slowly rotate the camshaft approximately 5 degrees clockwise to a neutral position.
- (15) While holding the right camshaft steel tube with Special Tool 8428 Camshaft Wrench, remove the right camshaft sprocket.
- (16) Remove idler sprocket assembly bolt.
- (17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.
- (18) Remove both pivoting tensioner arms and chain guides.
- (19) Remove chain tensioner.



**Fig. 106 Crankshaft Position Sensor**

- 1 - CRANKSHAFT POSITION SENSOR
- 2 - CYLINDER HEAD COVER
- 3 - CAMSHAFT POSITION SENSOR
- 4 - RIGHT SIDE CYLINDER BLOCK

**INSPECTION**

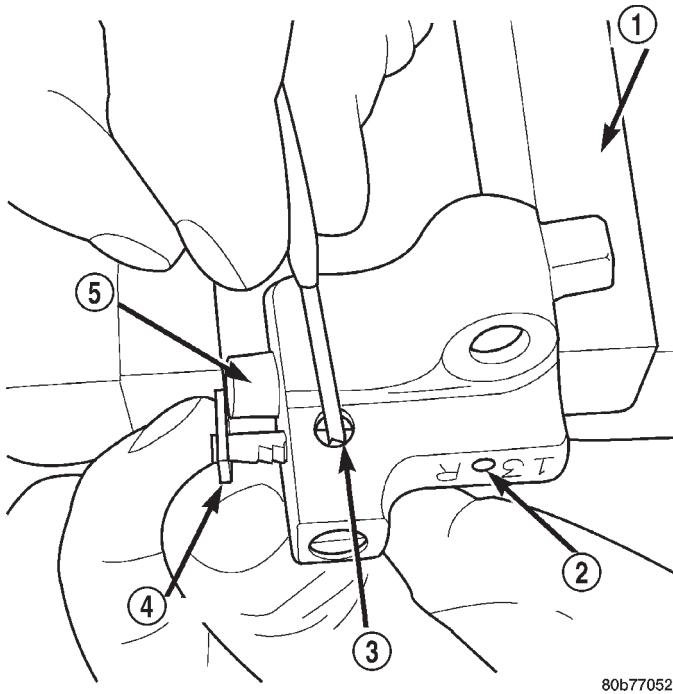
Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- Secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner tensioner arm and chain should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

## TIMING BELT/CHAIN AND SPROCKET(S) (Continued)

## INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner (Fig. 107). Slowly open vise to transfer piston spring force to lock pin.



**Fig. 107 Resetting Secondary Chain Tensioners**

- 1 - VISE
- 2 - INSERT LOCK PIN
- 3 - RATCHET PAWL
- 4 - RATCHET
- 5 - PISTON

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 28 N·m (250 in. lbs.).

**CAUTION:** The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(5) Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 28 N·m (250 in. lbs.).

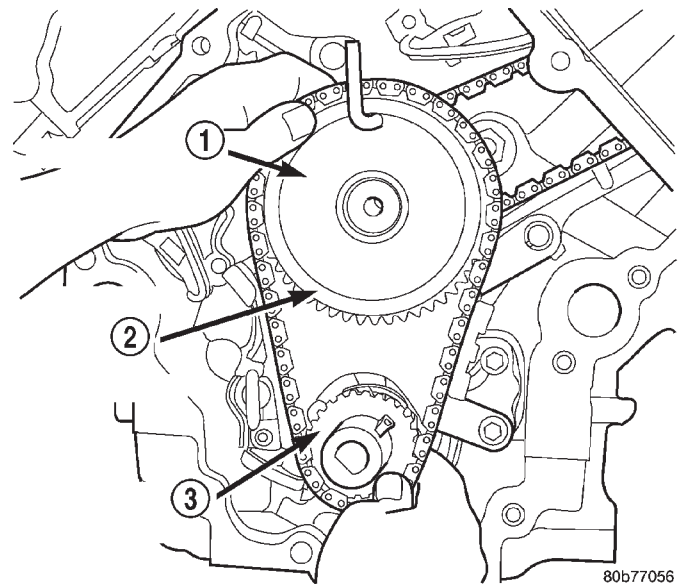
(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8429 to hold chains in place for installation.

(8) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket.

(9) Lubricate idler shaft and bushings with clean engine oil.

**NOTE:** The idler sprocket must be timed to the counterbalance shaft drive gear before the idler sprocket is fully seated.

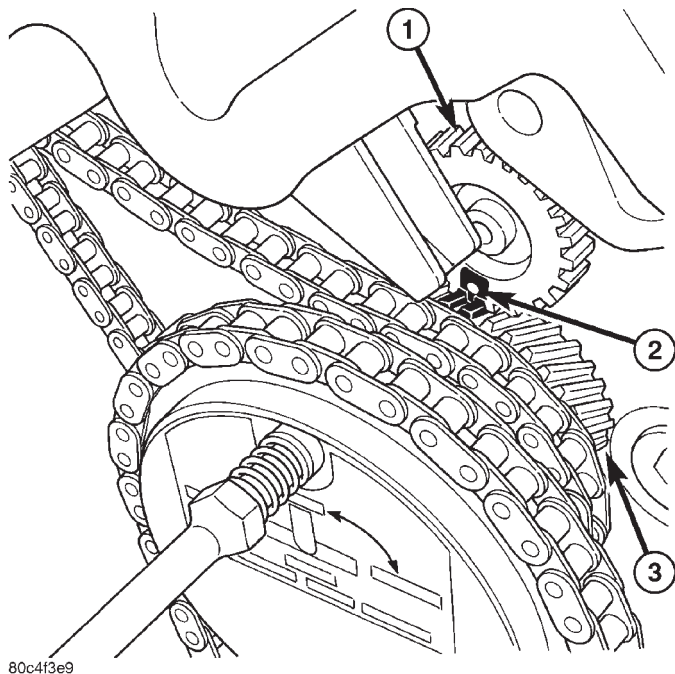


**Fig. 108 Installing Idler Gear, Primary and Secondary Timing Chains**

- 1 - SPECIAL TOOL 8429
- 2 - PRIMARY CHAIN IDLER SPROCKET
- 3 - CRANKSHAFT SPROCKET

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 108). After guiding both secondary chains through the block and cylinder head openings, affix chains with an elastic strap or the equivalent, This will maintain tension on chains to aid in installation. Align the timing mark on the idler sprocket to the timing mark on the counterbalance shaft drive gear, then seat idler sprocket fully (Fig. 109). Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

TIMING BELT/CHAIN AND SPROCKET(S) (Continued)



**Fig. 109 COUNTERBALANCE SHAFT ALIGNMENT MARKS**

- 1 - COUNTERBALANCE SHAFT
- 2 - TIMING MARKS
- 3 - IDLER SPROCKET

**NOTE:** It will be necessary to slightly rotate camshafts for sprocket installation.

(11) Align left camshaft sprocket “L” dot to plated link on chain.

(12) Align right camshaft sprocket “R” dot to plated link on chain.

**CAUTION:** Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in over-torque of bolt resulting in bolt failure.

(13) Remove Special Tool 8429, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the “V6” marks on camshaft sprockets are at the 12 o'clock position.

**CAUTION:** Ensure the plate between the left secondary chain tensioner and block is correctly installed.

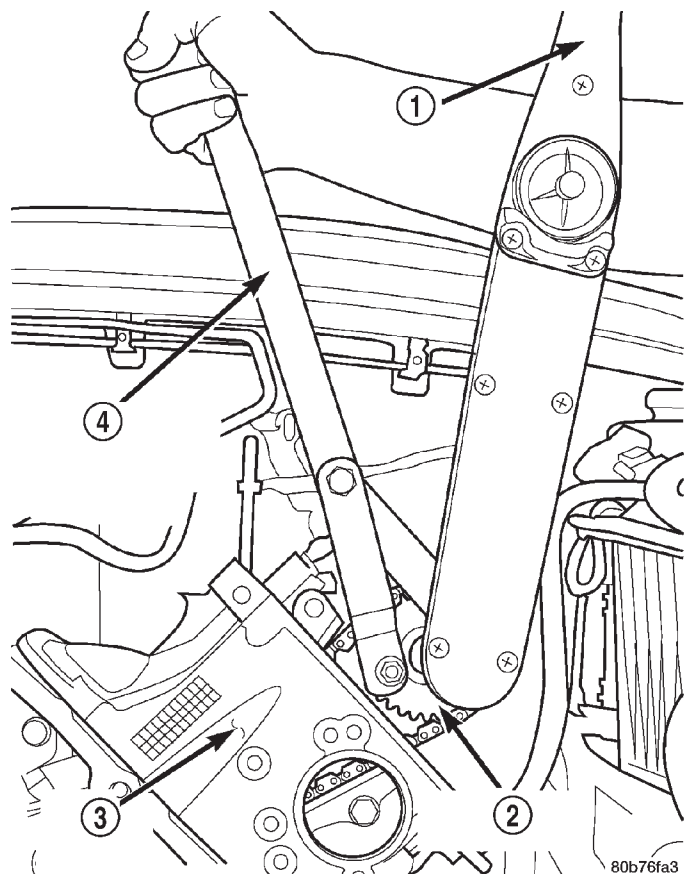
(15) Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

**NOTE:** Left and right secondary chain tensioners are not common.

(16) Remove all locking pins (3) from tensioners.

**CAUTION:** After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

(17) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 110) and right (Fig. 111). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).



**Fig. 110 Tightening Left Side Camshaft Sprocket Bolt**

- 1 - TORQUE WRENCH
- 2 - CAMSHAFT SPROCKET
- 3 - LEFT CYLINDER HEAD
- 4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

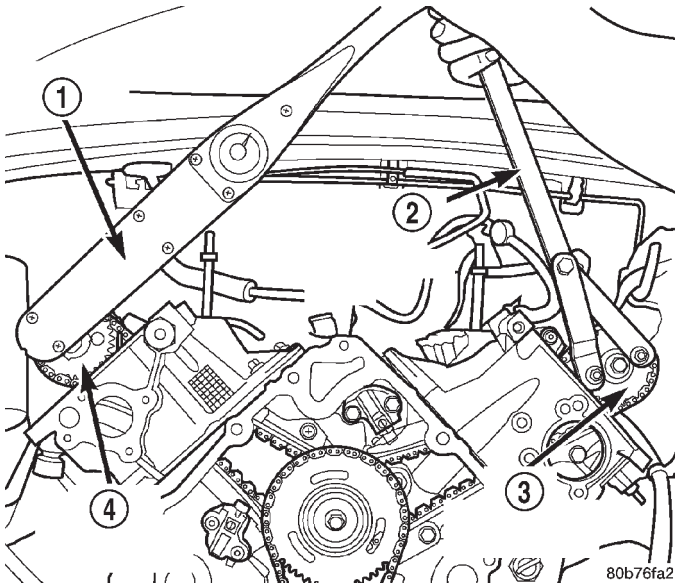
(18) Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock
- primary chain crankshaft sprocket dot is at 6 o'clock
- secondary chain camshaft sprockets “V6” marks are at 12 o'clock
- counterbalancer shaft drive gear dot is aligned to the idler sprocket gear dot

(19) Lubricate all three chains with engine oil.

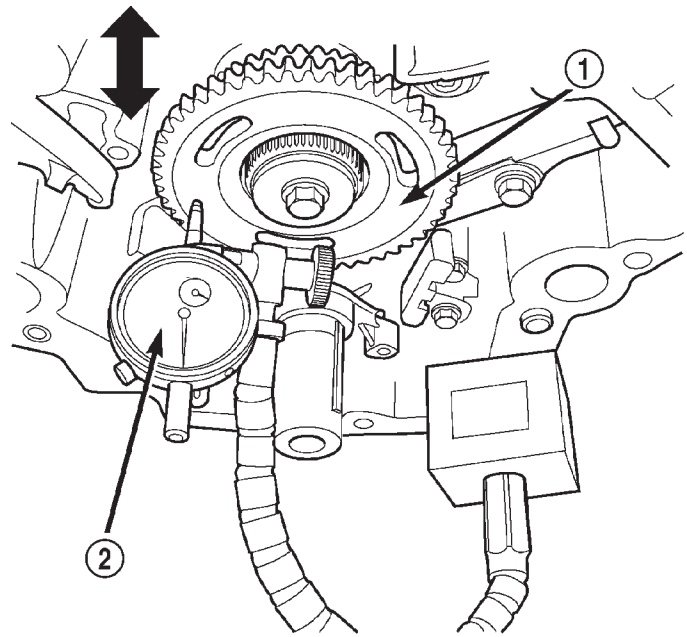


## TIMING BELT/CHAIN AND SPROCKET(S) (Continued)



**Fig. 111 Tightening Right Side Camshaft Sprocket Bolt**

- 1 - TORQUE WRENCH
- 2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
- 3 - LEFT CAMSHAFT SPROCKET
- 4 - RIGHT CAMSHAFT SPROCKET



**Fig. 112 Measuring Idler Gear End Play**

- 1 - IDLER SPROCKET ASSEMBLY
- 2 - DIAL INDICATOR

(20) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 112). The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.

(21) Install timing chain cover and crankshaft damper. Refer to procedures.

(22) Install cylinder head covers. Refer to procedures.

**NOTE:** Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

(23) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.).

(24) Install the oil fill housing.

(25) Install access plug in left cylinder head.

(26) Install power steering pump.

(27) Fill cooling system.

(28) Connect negative cable to battery.

# ENGINE

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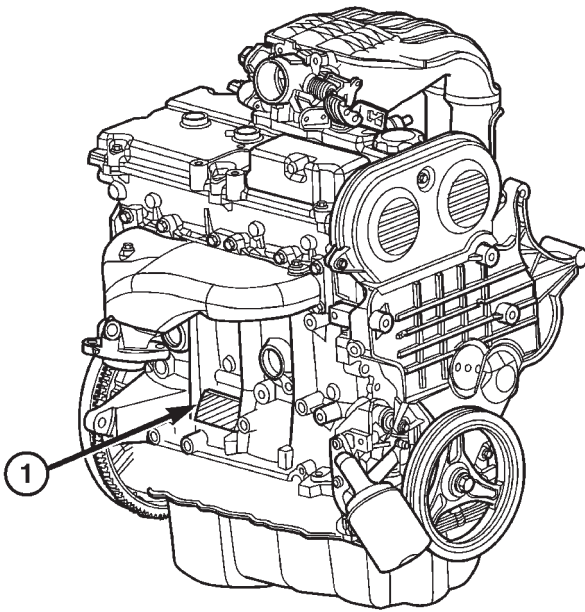
## ENGINE - 2.4L

### DESCRIPTION

The 2.4 Liter (148 cu. in.) in-line four cylinder engine is a double over head camshaft with hydraulic lifters and four valve per cylinder design. The engine is free-wheeling; meaning it has provisions for piston-to-valve clearance. However valve-to-valve interference can occur, if camshafts are rotated independently.

The cylinders are numbered from front of the engine to the rear. The firing order is 1-3-4-2.

The engine identification number is located on the rear of the cylinder block (Fig. 1).



80e20078

**Fig. 1 ENGINE IDENTIFICATION**

1 - ENGINE IDENTIFICATION

## DIAGNOSIS AND TESTING

### DIAGNOSIS AND TESTING - 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 PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

Check the coolant level and fill as required. DO NOT install the pressure cap.

Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

Clean spark plug recesses with compressed air.

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, with 552 kPa (80 psi) recommended.

Perform the test procedures on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the coolant.

All gauge pressure indications should be equal, with no more than 25% leakage per cylinder.

**FOR EXAMPLE:** At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

### DIAGNOSIS AND TESTING - 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) Check engine oil level and add oil if necessary.
- (2) Drive the vehicle until engine reaches normal operating temperature. Select a route free from traffic and other forms of congestion, observe all traffic laws, and accelerate through the gears several times briskly.
- (3) Remove all spark plugs from engine. As spark plugs are being removed, check electrodes for abnormal firing indicators fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.
- (4) Remove the Auto Shutdown (ASD) relay from the PDC.
- (5) Be sure throttle blade is fully open during the compression check.
- (6) Insert compression gage adaptor Special Tool 8116 or the equivalent, into the #1 spark plug hole in cylinder head. Connect the 0-500 psi (Blue) pressure transducer with cable adaptors to the DRBIII®.

## ENGINE - 2.4L (Continued)

(7) Crank engine until maximum pressure is reached on gage. Record this pressure as #1 cylinder pressure.

(8) Repeat the previous step for all remaining cylinders.

(9) Compression should not be less than 689 kPa (100 psi) and not vary more than 25 percent from cylinder to cylinder.

(10) If one or more cylinders have abnormally low compression pressures, repeat the compression test.

(11) If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question. **The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some malfunction is present.**

## DIAGNOSIS AND TESTING - ENGINE OIL LEAK INSPECTION

Begin with a thorough 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 make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(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 as necessary.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection.

(5) **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method as follows:

- Disconnect the fresh air hose (make-up air) at the cylinder head cover and plug or cap the nipple on the cover.

- Remove the PCV valve hose from the cylinder head cover. Cap or plug the PCV valve nipple on the cover.

- 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.**

- 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 provides the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

- If the leakage occurs at the crankshaft rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply. Remove the air hose, all plugs, and caps. Install the PCV valve and fresh air hose (make-up air). Proceed to next step.

(7) 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.

**NOTE: If oil leakage is observed at the dipstick tube to block location; remove the tube, clean and reseal using Mopar® Stud & Bearing Mount (press fit tube applications only), and for O-ring style tubes, remove tube and replace the O-ring seal.**

## 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. If a leak is present in this area, remove transmission for further inspection.

(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, oil gallery cup plug, bedplate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.

(4) If no leaks are detected, pressurize the crankcase as previously described.

**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

ENGINE - 2.4L (Continued)

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 and scratches. The crankshaft seal flange is especially 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.

(7) After the oil leak root cause and appropriate corrective action have been identified, replace component(s) as necessary.

**DIAGNOSIS AND TESTING - ENGINE**

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 Engine Mechanical and the Engine Performance diagnostic charts, for possible causes and corrections of malfunctions (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - MECHANICAL) (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - PERFORMANCE).

For fuel system diagnosis, (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING).

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
- Lash Adjuster (Tappet) Noise Diagnosis
- Engine Oil Leak Inspection

**DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE**

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery.  2. Corroded or loose battery connections.  3. Faulty starter.  4. Faulty coil(s) or control unit.  5. Incorrect spark plug gap.  6. Contamination in fuel system.  7. Faulty fuel pump.  8. Incorrect engine timing.	1. Test battery. Charge or replace as necessary. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - DIAGNOSIS AND TESTING)  2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals.  3. Test starting system. (Refer to 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)  4. Test and replace as needed. (Refer to Appropriate Diagnostic Information)  5. Set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - SPECIFICATIONS)  6. Clean system and replace fuel filter.  7. Test fuel pump and replace as needed. (Refer to Appropriate Diagnostic Information)  8. Check for a skipped timing belt/chain.

## ENGINE - 2.4L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE STALLS OR IDLES ROUGH	<ol style="list-style-type: none"> <li>1. Idle speed too low.</li> <li>2. Incorrect fuel mixture.</li> <li>3. Intake manifold leakage.</li> <li>4. Faulty ignition coil(s).</li> </ol>	<ol style="list-style-type: none"> <li>1. Test minimum air flow. (Refer to Appropriate Diagnostic Information)</li> <li>2. (Refer to Appropriate Diagnostic Information)</li> <li>3. Inspect intake manifold, manifold gasket, and vacuum hoses.</li> <li>4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)</li> </ol>
ENGINE LOSS OF POWER	<ol style="list-style-type: none"> <li>1. Dirty or incorrectly gapped plugs.</li> <li>2. Contamination in fuel system.</li> <li>3. Faulty fuel pump.</li> <li>4. Incorrect valve timing.</li> <li>5. Leaking cylinder head gasket.</li> <li>6. Low compression.</li> <li>7. Burned, warped, or pitted valves.</li> <li>8. Plugged or restricted exhaust system.</li> <li>9. Faulty ignition coil(s).</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean plugs and set gap.</li> <li>2. Clean system and replace fuel filter.</li> <li>3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)</li> <li>4. Correct valve timing.</li> <li>5. Replace cylinder head gasket.</li> <li>6. Test compression of each cylinder.</li> <li>7. Replace valves.</li> <li>8. Perform exhaust restriction test. (Refer to 11 - EXHAUST SYSTEM - DIAGNOSIS AND TESTING) Install new parts, as necessary.</li> <li>9. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)</li> </ol>
ENGINE MISSES ON ACCELERATION	<ol style="list-style-type: none"> <li>1. Dirty or incorrectly gapped spark plugs.</li> <li>2. Contamination in Fuel System.</li> <li>3. Burned, warped, or pitted valves.</li> <li>4. Faulty ignition coil(s).</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean spark plugs and set gap.</li> <li>2. Clean fuel system and replace fuel filter.</li> <li>3. Replace valves.</li> <li>4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)</li> </ol>
ENGINE MISSES AT HIGH SPEED	<ol style="list-style-type: none"> <li>1. Dirty or incorrect spark plug gap.</li> <li>2. Faulty ignition coil(s).</li> <li>3. Dirty fuel injector(s).</li> <li>4. Contamination in fuel system.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean spark plugs and set gap.</li> <li>2. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)</li> <li>Test and replace as necessary. (Refer to Appropriate Diagnostic Information)</li> <li>4. Clean system and replace fuel filter.</li> </ol>

ENGINE - 2.4L (Continued)

**DIAGNOSIS AND TESTING - ENGINE MECHANICAL**

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	<ol style="list-style-type: none"> <li>1. High or low oil level in crankcase.</li> <li>2. Thin or diluted oil.</li> <li>3. Thick oil</li>   <li>4. Low oil pressure.</li> <li>5. Dirt in tappets/lash adjusters.</li> <li>6. Worn rocker arms.</li> <li>7. Worn tappets/lash adjusters.</li> <li>8. Worn valve guides.</li> <li>9. Excessive runout of valve seats on valve faces.</li> <li>10. Missing adjuster pivot.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and correct engine oil level.</li> <li>2. Change oil to correct viscosity.</li> <li>3. (a) Change engine oil and filter. (b) Run engine to operating temperature. (c) Change engine oil and filter again.</li> <li>4. Check and correct engine oil level.</li> <li>5. Replace rocker arm/hydraulic lash adjuster assembly.</li> <li>6. Inspect oil supply to rocker arms.</li> <li>7. Install new rocker arm/hydraulic lash adjuster assembly.</li> <li>8. Replace cylinder head assembly.</li> <li>9. Grind valve seats and valves.</li> <li>10. Replace rocker arm/hydraulic lash adjuster assembly.</li> </ol>
CONNECTING ROD NOISE	<ol style="list-style-type: none"> <li>1. Insufficient oil supply.</li> <li>2. Low oil pressure.</li> <li>3. Thin or diluted oil.</li> <li>4. Thick oil</li>   <li>5. Excessive bearing clearance.</li> <li>6. Connecting rod journal out-of-round.</li> <li>7. Misaligned connecting rods.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check engine oil level.</li> <li>2. Check engine oil level. Inspect oil pump relief valve and spring.</li> <li>3. Change oil to correct viscosity.</li> <li>4. (a) Change engine oil and filter. (b) Run engine to operating temperature. (c) Change engine oil and filter again.</li> <li>5. Measure bearings for correct clearance. Repair as necessary.</li> <li>6. Replace crankshaft or grind surface.</li> <li>7. Replace bent connecting rods.</li> </ol>



## ENGINE - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
MAIN BEARING NOISE	<ol style="list-style-type: none"> <li>1. Insufficient oil supply.</li> <li>2. Low oil pressure.</li> <li>3. Thin or diluted oil.</li> <li>4. Thick oil</li> <li>5. Excessive bearing clearance.</li> <li>6. Excessive end play.</li> <li>7. Crankshaft journal out-of-round or worn.</li> <li>8. Loose flywheel or torque converter.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check engine oil level.</li> <li>2. Check engine oil level. Inspect oil pump relief valve and spring.</li> <li>3. Change oil to correct viscosity.</li> <li>4. (a) Change engine oil and filter. (b) Run engine to operating temperature. (c) Change engine oil and filter again.</li> <li>5. Measure bearings for correct clearance. Repair as necessary.</li> <li>6. Check thrust bearing for wear on flanges.</li> <li>7. Replace crankshaft or grind journals.</li> <li>8. Tighten to correct torque.</li> </ol>
OIL PRESSURE DROP	<ol style="list-style-type: none"> <li>1. Low oil level.</li> <li>2. Faulty oil pressure sending unit.</li> <li>3. Low oil pressure.</li> <li>4. Clogged oil filter.</li> <li>5. Worn parts in oil pump.</li> <li>6. Thin or diluted oil.</li> <li>7. Oil pump relief valve stuck.</li> <li>8. Oil pump suction tube loose.</li> <li>9. Oil pump cover warped or cracked.</li> <li>10. Excessive bearing clearance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check engine oil level.</li> <li>2. Install new sending unit.</li> <li>3. Check sending unit and main bearing oil clearance.</li> <li>4. Install new oil filter.</li> <li>5. Replace worn parts or pump.</li> <li>6. Change oil to correct viscosity.</li> <li>7. Replace oil pump.</li> <li>8. Remove oil pan and install new tube or clean, if necessary.</li> <li>9. Install new oil pump.</li> <li>10. Measure bearings for correct clearance.</li> </ol>
OIL LEAKS	<ol style="list-style-type: none"> <li>1. Misaligned or deteriorated gaskets.</li> <li>2. Loose fastener, broken or porous metal part.</li> <li>3. Misaligned or deteriorated cup or threaded plug.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace gasket(s).</li> <li>2. Tighten, repair or replace the part.</li> <li>3. Replace as necessary.</li> </ol>

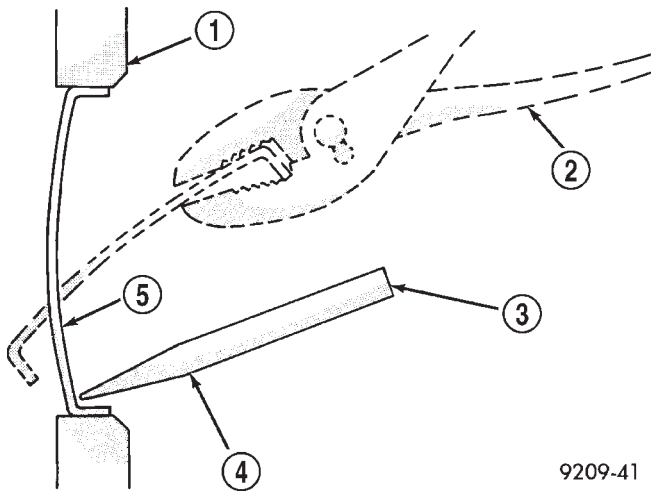
ENGINE - 2.4L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction.  2. Worn, scuffed or broken rings.  3. Carbon in oil ring slots. 4. Rings fitted too tightly in grooves.  5. Worn valve guide(s). 6. Valve stem seal(s) worn or damaged.	1. Check system and repair as necessary. (Refer to 25 - EMISSIONS CONTROL/ EVAPORATIVE EMISSIONS/PCV VALVE - DIAGNOSIS AND TESTING)  2. Hone cylinder bores. Install new rings.  3. Install new rings. 4. Remove rings and check grooves. If groove is not proper width, replace piston.  5. Replace cylinder head assembly. 6. Replace seal(s).

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 2).



9209-41

Fig. 2 Core Hole Plug Removal

- 1 - CYLINDER BLOCK
- 2 - REMOVE PLUG WITH PLIERS
- 3 - STRIKE HERE WITH HAMMER
- 4 - DRIFT PUNCH
- 5 - CUP PLUG

**CAUTION:** Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount. Make certain the new plug is cleaned of all oil or grease. Using proper drive plug, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 in.) inside the lead-in chamfer.

It is not necessary to wait for curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

STANDARD PROCEDURE - REPAIR OF DAMAGED OR WORN THREADS

Damaged or worn threads (excluding spark plug and camshaft bearing cap attaching 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) and installing an insert into the tapped hole. This brings 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.

STANDARD PROCEDURE - HYDROSTATIC LOCKED ENGINE

When an engine is suspected to be hydrostatically locked, regardless of what caused the problem, the following steps should be used.

**CAUTION:** DO NOT use starter motor to rotate the engine, severe damage may occur.

## ENGINE - 2.4L (Continued)

(1) Inspect air cleaner, induction system and intake manifold to insure system is dry and clear of foreign material.

(2) Remove negative battery cable.

(3) Place a shop towel around the spark plugs when removing them from the engine. This will catch any fluid that may possibly be in the cylinder under pressure.

(4) With all spark plugs removed, rotate engine crankshaft using a breaker bar and socket.

(5) Identify the fluid in the cylinder(s) (i.e., coolant, fuel, oil or other).

(6) Make sure all fluid has been removed from the cylinders. Inspect engine for damage (i.e., connecting rods, pistons, valves, etc.)

(7) Repair engine or components as necessary to prevent this problem from re-occurring.

**CAUTION: Squirt approximately one teaspoon of oil into the cylinders, rotate engine to lubricate the cylinder walls to prevent damage on restart.**

(8) Install new spark plugs.

(9) Drain engine oil and remove oil filter.

(10) Install a new oil filter.

(11) Fill engine with specified amount of approved oil.

(12) Connect negative battery cable.

(13) Start engine and check for any leaks.

## STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** 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 which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

**MOPAR® ENGINE RTV GEN II** is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always

inspect the package for the expiration date before use.

**MOPAR® ATF RTV** is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

**MOPAR® GASKET MAKER** is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

**MOPAR® BED PLATE SEALANT** is a unique (green-in-color) anaerobic type gasket material that is specially made to seal the area between the bed-plate and cylinder block without disturbing the bearing clearance or alignment of these components. The material cures slowly in the absence of air when torqued between two metallic surfaces, and will rapidly cure when heat is applied.

**MOPAR® GASKET SEALANT** is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

## SEALER APPLICATION

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) 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 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

ENGINE - 2.4L (Continued)

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

**STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION**

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

**Never** use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 3)

**NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.**

Only use the following for cleaning gasket surfaces:

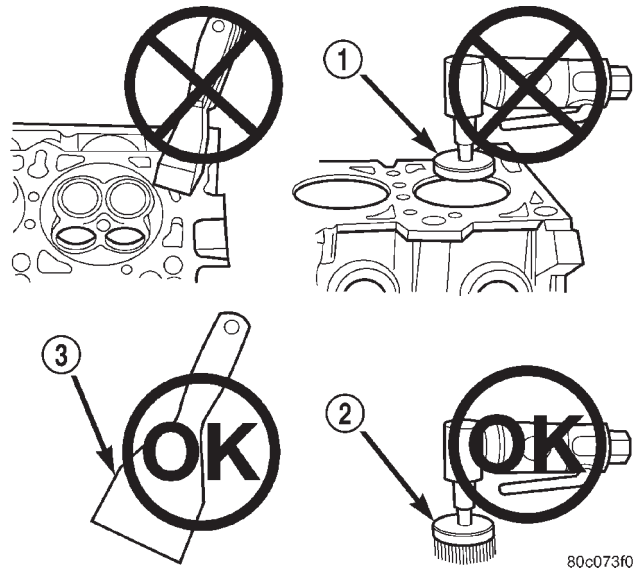
- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 3)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 3)

**CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.**

**STANDARD PROCEDURE - MEASURING BEARING CLEARANCE USING PLASTIGAGE**

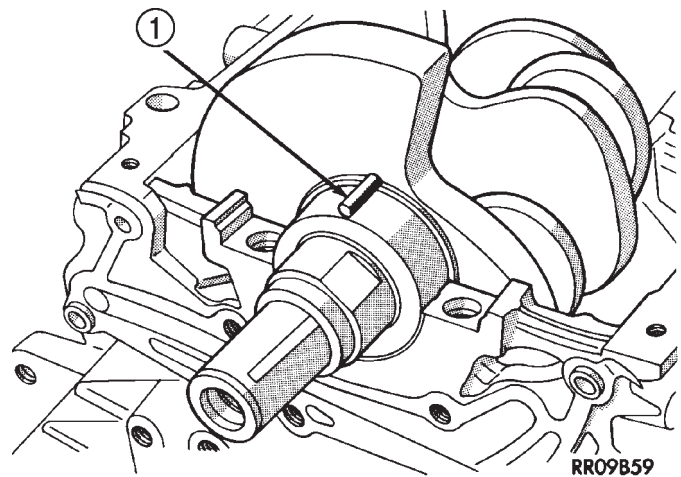
Engine crankshaft bearing clearances can be determined by use of Plastigage or equivalent. The following is the recommended procedure for the use of Plastigage:

- (1) Remove oil film from surface to be checked. Plastigage is soluble in oil.
- (2) Place a piece of Plastigage across the entire width of the bearing shell in the cap approximately 6.35 mm (1/4 in.) off center and away from the oil holes (Fig. 4). (In addition, suspected areas can be checked by placing the Plastigage in the suspected area). Torque the bearing cap bolts of the bearing being checked to the proper specifications.
- (3) Remove the bearing cap and compare the width of the flattened Plastigage with the metric



**Fig. 3 Proper Tool Usage For Surface Preparation**

- 1 - ABRASIVE PAD
- 2 - 3M ROLOCT™ BRISTLE DISC
- 3 - PLASTIC/WOOD SCRAPER



**Fig. 4 Plastigage Placed in Lower Shell—Typical**

- 1 - PLASTIGAGE

scale provided on the package. Locate the band closest to the same width. This band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Compare clearance measurements to specs found in engine specifications (Refer to 9 - ENGINE - SPECIFICATIONS). **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

## ENGINE - 2.4L (Continued)

**NOTE: Plastigage is available in a variety of clearance ranges. Use the most appropriate range for the specifications you are checking.**

(4) Install the proper crankshaft bearings to achieve the specified bearing clearances. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE) (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE)

**REMOVAL - ENGINE ASSEMBLY**

- (1) Disconnect the battery negative cable.
- (2) Remove hood. Mark hood hinge location for reinstallation.
- (3) Remove air cleaner assembly.
- (4) Remove radiator core support bracket.
- (5) Remove fan shroud with electric fan assembly.
- (6) Remove drive belt.

**NOTE: It is NOT necessary to discharge the A/C system to remove the engine.**

- (7) Remove A/C compressor and secure away from engine with lines attached.
- (8) Remove generator and secure away from engine.

**NOTE: Do NOT remove the phenolic pulley from the P/S pump. It is not required for P/S pump removal.**

- (9) Remove power steering pump with lines attached and secure away from engine.
- (10) Drain cooling system.
- (11) Remove coolant bottle.
- (12) Disconnect the heater hoses from the engine.
- (13) Disconnect heater hoses from heater core and remove hose assembly.
- (14) Disconnect throttle and speed control cables.
- (15) Remove upper radiator hose from engine.
- (16) Remove lower radiator hose from engine.
- (17) Disconnect the engine to body ground straps at the left side of cowl.
- (18) Disconnect the engine wiring harness at the following points:
  - Intake air temperature (IAT) sensor
  - Fuel Injectors
  - Throttle Position (TPS) Switch
  - Idle Air Control (IAC) Motor
  - Engine Oil Pressure Switch
  - Engine Coolant Temperature (ECT) Sensor
  - Manifold Absolute Pressure (MAP) Sensor
  - Camshaft Position (CMP) Sensor
  - Coil Over Plugs
  - Crankshaft Position Sensor
- (19) Remove coil over plugs.
- (20) Release fuel rail pressure.

- (21) Remove fuel rail and secure away from engine.
- (22) Remove the PCV hose.
- (23) Remove the breather hoses.
- (24) Remove the vacuum hose for the power brake booster.
- (25) Disconnect knock sensors.
- (26) Secure the left and right engine wiring harnesses away from engine.
- (27) Raise vehicle.
- (28) Disconnect oxygen sensor wiring.
- (29) Disconnect crankshaft position sensor.
- (30) Disconnect the engine block heater power cable, if equipped.
- (31) Disconnect the front propshaft at the front differential and secure out of way.
- (32) Remove the starter.
- (33) Remove the ground straps from the engine
- (34) Disconnect the exhaust pipes at the manifold.
- (35) Remove the structural cover, if equipped.
- (36) Remove torque convertor bolts, and mark location for reassembly.
- (37) Remove transmission bellhousing to engine bolts.
- (38) Loosen left and right engine mount thru bolts.

**NOTE: It is not necessary to completely remove engine mount thru bolts, for engine removal.**

- (39) Lower the vehicle.
- (40) Support the transmission with a suitable jack.
- (41) Connect a suitable engine hoist to the engine.

**CAUTION: The 2.4L engine with manual transmissions, can be removed without removing the manual transmission. Use caution when attempting this procedure as the clearance is tight.**

- (42) Remove engine from vehicle.

**INSTALLATION - ENGINE ASSEMBLY**

- (1) Position the engine in the vehicle.

**CAUTION: Use caution when installing 2.4L engine into vehicle equipped with manual transmission, as clearance is tight.**

- (2) Install both left and right side engine mounts into the frame mounts.
- (3) Raise the vehicle.
- (4) Install the transmission bellhousing to engine mounting bolts. Tighten the bolts to 41 N·m (30ft. lbs.).
- (5) Tighten the engine mount thru bolts.
- (6) Install the torque convertor bolts.
- (7) Connect the ground straps on the left and right side of the engine.

ENGINE - 2.4L (Continued)

- (8) Install the starter.
- (9) Connect the crankshaft position sensor.
- (10) Install the engine block heater power cable, if equipped.

**CAUTION:** The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

- (11) Install the structural cover.
- (12) Install the exhaust pipe.
- (13) Connect the oxygen sensors.
- (14) Lower vehicle.
- (15) Connect the knock sensors.
- (16) Connect the engine to body ground straps.
- (17) Install the power brake booster vacuum hose.
- (18) Install the breather hoses.
- (19) Install the PCV hose.
- (20) Install the fuel rail.
- (21) Install the coil over plugs.
- (22) Reconnect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs
- Crankshaft Position Sensor

- (23) Connect lower radiator hose.
- (24) Connect upper radiator hose.
- (25) Connect throttle and speed control cables.
- (26) Install the heater hose assembly.
- (27) Install coolant recovery bottle.
- (28) Install the power steering pump.
- (29) Install the generator.
- (30) Install the A/C compressor.
- (31) Install the drive belt.
- (32) Install the fan shroud with the electric fan assembly.
- (33) Install the radiator core support bracket.
- (34) Install the air cleaner assembly.
- (35) Refill the engine cooling system.
- (36) Install the hood.
- (37) Check and fill engine oil.
- (38) Connect the battery negative cable.
- (39) Start the engine and check for leaks.

SPECIFICATIONS

SPECIFICATIONS - 2.4L ENGINE

DESCRIPTION	SPECIFICATION
<b>General Specification</b>	
Type	In-Line OHV, DOHC
Number of Cylinders	4
Displacement	2.4 Liters (148 cu. in.)
Bore	87.5 mm (3.445 in.)
Stroke	101.0 mm (3.976 in.)
Compression Ratio	9.4:1
Firing Order	1-3-4-2
Compression Pressure	690 kPa (Minimum) (100 psi Minimum)
Max. Variation Between Cylinders	25%
<b>Cylinder Block</b>	
Cylinder Bore Diameter	87.4924–87.5076 mm (3.4446–3.4452 in.)
Out-of-Round (Max.)	0.051 mm (0.002 in.)
Taper (Max.)	0.051 mm (0.002 in.)
<b>Pistons</b>	
Piston Diameter	87.463–87.481 mm (3.4434–3.4441 in.)
Clearance @ 14 mm (9/16 in.) from bottom of skirt	0.024–0.057 mm (0.0009–0.0022 in.)
Weight	346–356 grams (12.20–12.56 oz.)
Land Clearance (Diametrical)	0.614–0.664 mm (0.024–0.026 in.)
Piston Length	66.25 mm (2.608 in.)
Piston Ring Groove Depth No. 1	4.640–4.784 mm (0.182–0.188 in.)
Piston Ring Groove Depth No. 2	4.575–4.719 mm (0.180–0.185 in.)

## ENGINE - 2.4L (Continued)

DESCRIPTION	SPECIFICATION
Piston Ring Groove Depth No. 3	4.097–4.236 mm (0.161–0.166 in.)
<b>Piston Pins</b>	
Clearance in Piston	0.005–0.018 mm (0.0002–0.0008 in.)
Clearance in Connecting Rod	Interference
Diameter	21.998–22.003 mm (0.8660–0.8662 in.)
End Play	None
Length	72.75–73.25 mm (2.864–2.883 in.)
<b>Piston Rings</b>	
Ring Gap—Top Compression Ring	0.25–0.51 mm (0.0098–0.020 in.)
Wear Limit	0.8 mm (0.031 in.)
Ring Gap—2nd Compression Ring	0.23–0.48 mm (0.009–0.018 in.)
Wear Limit	0.8 mm (0.031 in.)
Ring Gap—Oil Control Steel Rails	0.25–0.64 mm (0.0098–0.025 in.)
Wear Limit	1.00 mm (0.039 in.)
Ring Side Clearance—Compression Rings	0.030–0.080 mm (0.0011–0.0031 in.)
Wear Limit	0.10 mm (0.004 in.)
Ring Side Clearance—Oil Ring Pack	0.012–0.178 mm (0.0004–0.0070 in.)
Ring Width—Compression Rings	1.47–1.50 mm (0.057–0.059 in.)
Ring Width—Oil Ring Pack	2.72–2.88 mm (0.107–0.1133 in.)
<b>Connecting Rod</b>	
Bearing Clearance	0.025–0.071 mm (0.0009–0.0027 in.)
Wear Limit	0.075 mm (0.003 in.)
Bore Diameter—Piston Pin	20.96–20.98 mm (0.8252–0.8260 in.)

DESCRIPTION	SPECIFICATION
Bore Diameter—Crankshaft End	53.007–52.993 mm (2.0868–2.0863 in.)
Side Clearance	0.13–0.38 mm (0.005–0.015 in.)
Wear Limit	0.40 mm (0.016 in.)
Weight—Total (Less Bearing)	565.8 grams (19.96 oz.)
<b>Crankshaft</b>	
Connecting Rod Journal Diameter	49.984–50.000 mm (1.968–1.9685 in.)
Main Bearing Journal Diameter	59.992–60.008 mm (2.362–2.3625 in.)
Journal Out-of-Round (Max.)	0.0035 mm (0.0003 in.)
Journal Taper (Max.)	0.007 mm (0.0001 in.)
End Play	0.09–0.24 mm (0.0035–0.0094 in.)
Wear Limit	0.38 mm (0.015 in.)
Main Bearing Diametrical Clearance	0.018–0.062 mm (0.0007–0.0024 in.)
<b>Hydraulic Lash Adjuster</b>	
Body Diameter	15.901–15.913 mm (0.626–0.6264 in.)
Plunger Travel Minimum (Dry)	3.0 mm (0.118 in.)
<b>Cylinder Head Camshaft Bearing Bore Diameter</b>	
Journals No.1–6	26.020–26.041 mm (1.024–1.025 in.)
<b>Camshaft</b>	
Journal Diameter No. 1–6	25.951–25.970 mm (1.021–1.022 in.)
Bearing Clearance—Diametrical	0.069–0.071 mm (0.0027–0.003 in.)
End Play	0.05–0.17 mm (0.0019–0.0066 in.)
Lift (Zero Lash)	Intake 8.25 mm (0.324 in.)

ENGINE - 2.4L (Continued)

DESCRIPTION	SPECIFICATION
Exhaust	6.60 mm (0.259 in.)
Intake Valve Timing*	
Closes (ABDC)	51°
Opens (BTDC)	1°
Duration	232°
Exhaust Valve Timing*	
Closes (ATDC)	7°
Opens (BBDC)	47°
Duration	234°
Valve Overlap	8°
*All readings in crankshaft degrees. Timing points @ 4° from top of Ramps.	
<b>Cylinder Head</b>	
Material	Cast Aluminum
Gasket Thickness (Compressed)	0.71 mm (0.028 in.)
<b>Valve Seat</b>	
Angle	44.5–45°
Seat Diameter—Intake	34.37–34.63 mm (1.353–1.363 in.)
Seat Diameter—Exhaust	27.06–27.32 mm (1.065–1.075 in.)
Runout (Max.)	0.05 mm (0.002 in.)
Valve Seat Width—Intake and Exhaust	0.9–1.3 mm (0.035–0.051 in.)
Service Limit—Intake	2.0 mm (0.079 in.)
Service Limit—Exhaust	2.5 mm (0.098 in.)
<b>Valve Guide</b>	
Diameter I.D.	5.975–6.000 mm (0.235–0.236 in.)
Guide Bore Diameter	11.0–11.02 mm (0.4330–0.4338 in.)
Guide Height (spring seat to guide tip)	13.25–13.75 mm (0.521–0.541 in.)
<b>Valves</b>	
Face Angle—Intake and Exhaust	44.5–45°

DESCRIPTION	SPECIFICATION
Head Diameter—Intake	34.67–34.93 mm 1.364–1.375 in.)
Head Diameter—Exhaust	28.32–28.52 mm (1.114–1.122 in.)
Valve Length (Overall)	
—Intake	112.76–113.32 mm (4.439–4.461 in.)
—Exhaust	110.89–111.69 mm (4.365–4.397 in.)
Valve Stem Diameter	
—Intake	5.934–5.952 mm (0.2337–0.2344 in.)
—Exhaust	5.906–5.924 mm (0.2326–0.2333 in.)
<b>Valve Margin</b>	
Intake	1.2–1.7 mm (0.047–0.066 in.)
Service Limit	0.95 mm (1/32 in.)
Exhaust	0.985–1.315 mm (0.038–0.051 in.)
Service Limit	1.05 mm (3/64 in.)
<b>Valve Stem Tip</b>	
Intake	48.04 mm (1.891 in.)
Exhaust	47.99 mm (1.889 in.)
<b>Valve Stem to Guide Clearance</b>	
Intake	0.048–0.066 mm (0.0018–0.0025 in.)
Max. Allowable	0.076 mm (0.003 in.)
Service Limit	0.25 mm (0.010 in.)
Exhaust	0.0736–0.094 mm (0.0029–0.0037 in.)
Max. Allowable	0.101 mm (0.004 in.)
Service Limit	0.25 mm (0.010 in.)



## ENGINE - 2.4L (Continued)

DESCRIPTION	SPECIFICATION
<b>Valve Springs</b>	
Free Length (Approx.)	48.4 mm (1.905 in.)
Nominal Force (Valve Closed)	338 N @ 38.0 mm (75.98 lbs. @ 1.496 in.)
Nominal Force (Valve Open)	607 N @ 29.75 mm (136 lbs. @ 1.172 in.)
Installed Height	38.00 mm (1.496 in.)
Number of Coils	7.82
Wire Diameter	3.86 mm (1.496 in.)
<b>Oil Pump</b>	
Clearance Over Rotors (Max.)	0.10 mm (0.004 in.)
Cover Out-of-Flat (Max.)	0.025 mm (0.001 in.)
Inner Rotor Thickness (Min.)	9.40 mm (0.370 in.)
Outer Rotor Thickness (Min.)	9.40 mm (0.370 in.)
Outer Rotor Clearance (Max.)	0.039 mm (0.015 in.)
Outer Rotor Diameter (Min.)	79.95 mm (3.148 in.)
Tip Clearance Between Rotors (Max.)	0.20 mm (0.008 in.)
<b>Oil Pressure</b>	
At Curb Idle Speed*	25 kPa (4 psi)
At 3000 rpm	170–550 kPa (25–80 psi)
CAUTION: *If pressure is ZERO at curb idle, DO NOT run engine at 3000 rpm.	

## SPECIFICATIONS - TORQUE

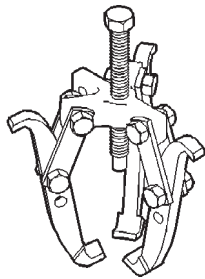
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Balance Shaft Carrier to Block—Bolts	54	40	—
Balance Shaft Gear Cover—Double Ended Fastener	12	—	105
Balance Shaft Sprocket—Bolt	28	—	250
Balance Shaft Chain Tensioner—Bolts	12	—	105
Balance Shaft Carrier Cover—Bolts	12	—	105
Camshaft Sprocket—Bolt	101	75	—
Connecting Rod Cap—Bolts	54 + $\frac{1}{4}$ turn	40 + $\frac{1}{4}$ turn	—
Crankshaft Main Bearing Cap/Bedplate			
—M8 Bolts	34		250
—M11 Bolts	41 + $\frac{1}{4}$ Turn	30 + $\frac{1}{4}$ Turn	—
Crankshaft Damper	136	100	—
Cylinder Head—Bolts	(Refer to 9 - ENGINE/ CYLINDER HEAD - INSTALLATION)		
Cylinder Head Cover—Bolts	12	—	105
Flex Plate to Crankshaft	95	70	—
Flywheel Mounting Bolts	81	60	—
Engine Mount Bracket Right—Bolts	61	45	—
Engine Mounting—Bolts	(Refer to 9 ENGINE/ ENGINE MOUNTING)		
Exhaust Manifold to Cylinder Head—Bolts	23	—	200
Exhaust Manifold Heat Shield—Bolts	12	—	105
Intake Manifold - Lower —Bolts	28	—	250
Oil Filter	20	15	—
Oil Pan—Bolts	12	—	105
Oil Pan Drain—Plug	27	20	—
Oil Pump to Block—Bolts	28	—	250

ENGINE - 2.4L (Continued)

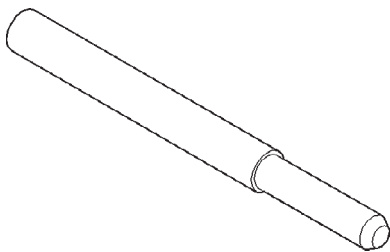
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Pump Cover Plate—Bolts	12	—	105
Oil Pump Pick-up Tube—Bolt	28	20	—
Oil Pump Relief Valve—Cap	41	30	
Spark Plugs	28	—	
Timing Belt Covers			
- Front Covers to Rear Cover—Bolts	12	—	105
- Rear Cover—Bolts	12	—	105
Timing Belt Tensioner Assembly—Bolts	61	45	—

SPECIAL TOOLS

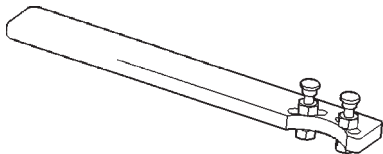
2.4L ENGINE



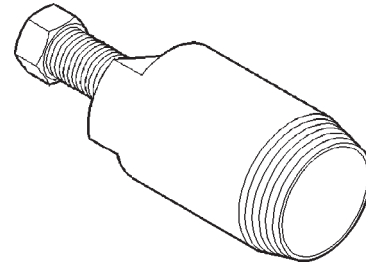
**Puller 1026**



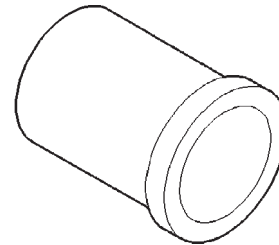
**Crankshaft Damper Removal Insert 6827-A**



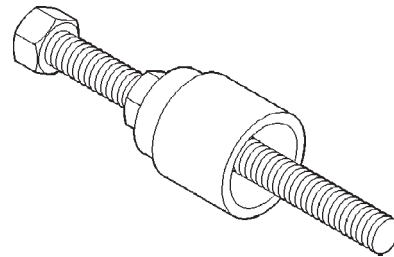
**Camshaft Sprocket Holder 6847**



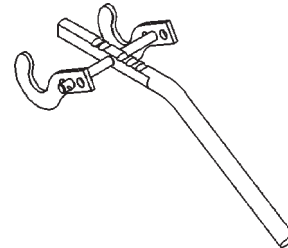
**Camshaft Seal Remover C-4679-A**



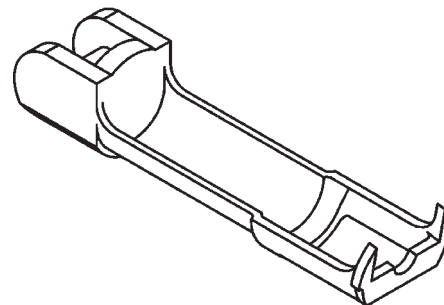
**Camshaft Seal Installer MD-998306**



**Crankshaft Damper Installer 6792**

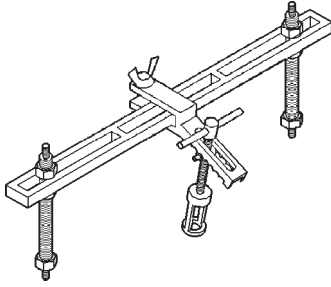


**Valve Spring Compressor 8215**

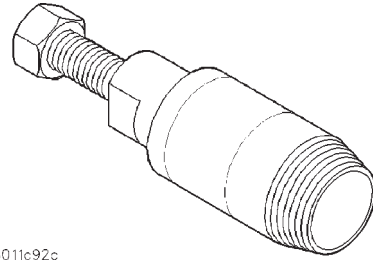


**Adaptor 8436**

ENGINE - 2.4L (Continued)

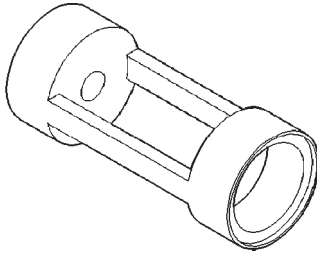


**Valve Spring Compressor MD-998772-A**

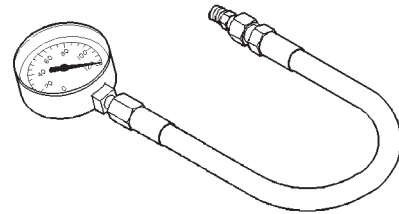


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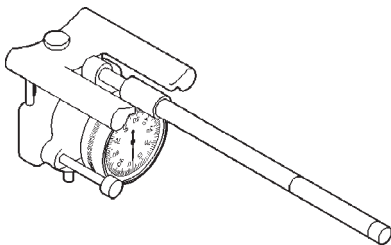
**Crankshaft Seal Remover 6771**



**Valve Spring Compressor Adapter 6779**

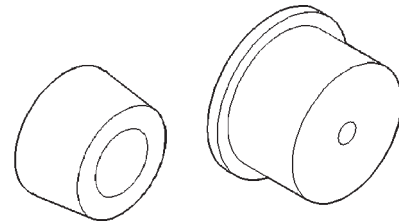


**Oil Pressure Gage C-3292**

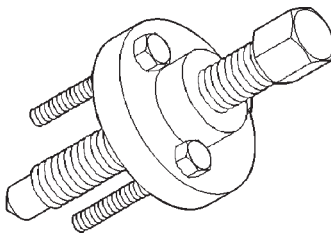


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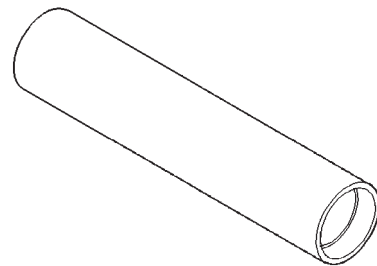
**Cylinder Bore Gage C-119**



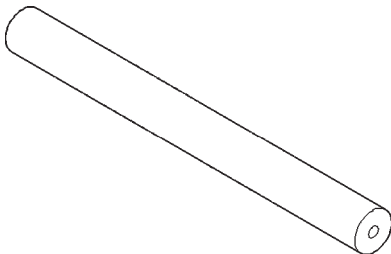
**Rear Crankshaft Seal Guide and Installer 6926-1 and 6926-2**



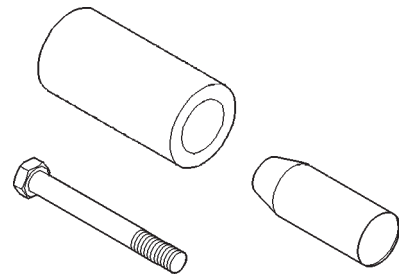
**Crankshaft Sprocket Remover 6793**



**Balance Shaft Sprocket Installer 6052**

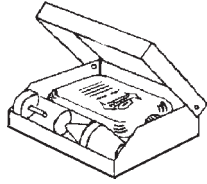


**Crankshaft Sprocket Remover Insert C-4685-C2**

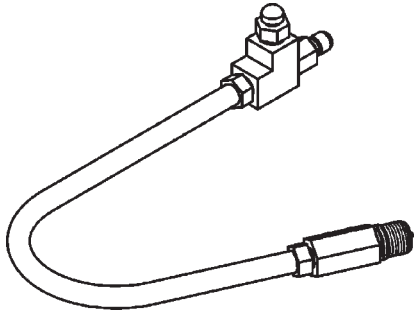


**Front Crankshaft Oil Seal Installer 6780**

ENGINE - 2.4L (Continued)



**Combustion Leak Tester C-3685-A**



**Cylinder Compression Pressure Adaptor 8116**

**AIR CLEANER ELEMENT**

**REMOVAL - 2.4L**

Housing removal is not necessary for element (filter) replacement.

- (1) Disconnect air intake duct at side of element cover.
- (2) Pry up 2 spring clips from front of housing cover (spring clips retain cover to housing).
- (3) Release housing cover from locating tabs located on rear of housing, and remove cover.
- (4) Remove air cleaner element (filter) from housing.
- (5) Clean inside of housing before replacing element.

**INSTALLATION - 2.4L**

- (1) Install element into housing.
  - (2) Position housing cover into housing locating tabs.
  - (3) Pry up spring clips and lock cover to housing.
  - (4) Connect air intake duct.
- If any air filter, air resonator, air intake tubes or air filter housing clamps had been loosened or removed, tighten them to 5 N·m (40 in. lbs.) torque.

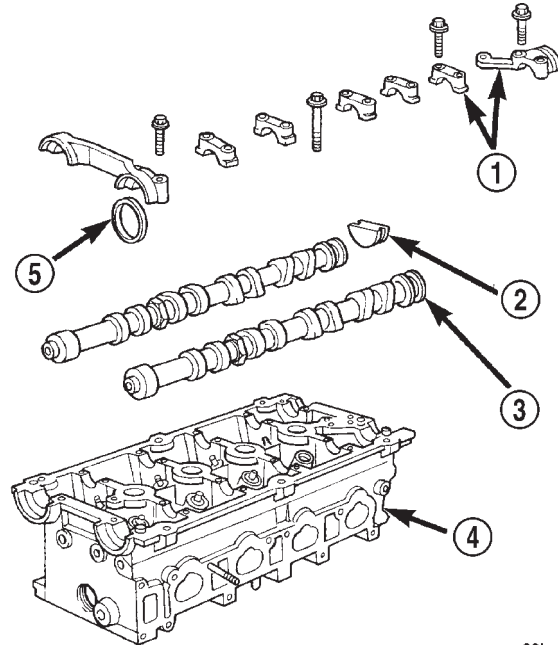
**CYLINDER HEAD**

**DESCRIPTION**

The cross flow designed, aluminum cylinder head contains dual over-head camshafts with four valves per cylinder (Fig. 5). The valves are arranged in two in-line banks. The intake valves face toward the left side of the vehicle. The exhaust valves face the right side. The cylinder head incorporates powdered metal

valve guides and seats. The cylinder head is sealed to the block using a multi-layer steel head gasket and retaining bolts.

Integral oil galleries providing lubrication passages to the hydraulic lash adjusters, camshafts, and valve mechanisms.



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**Fig. 5 Cylinder Head and Camshafts**

- CAM PLUG - NOT SHOWN
- 1 - CAMSHAFT BEARING CAPS
- 2 - PLUG
- 3 - CAMSHAFT
- 4 - CYLINDER HEAD
- 5 - CAMSHAFT OIL SEAL

**OPERATION**

The cylinder head closes the combustion chamber, allowing the pistons to compress the fuel/air mixture for ignition. The valves are actuated by the lobe profiles on the camshaft to open and close at specified duration to either allow clean air in the combustion chamber or the exhaust gases out; depending on the stroke of the engine.

**DIAGNOSIS AND TESTING - CYLINDER HEAD GASKET**

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

## CYLINDER HEAD (Continued)

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

## CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). 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 WITH COOLANT PRESSURE CAP REMOVED.**

## VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

## COOLING SYSTEM TESTER METHOD

**WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).**

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

## CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

## REMOVAL - CYLINDER HEAD

(1) Perform fuel system pressure release procedure **before attempting any repairs.** (Refer to 14 -

## FUEL SYSTEM/FUEL DELIVERY - SPECIFICATIONS)

- (2) Disconnect battery negative cable.
- (3) Drain cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)
- (4) Remove air filter housing and inlet tube.
- (5) Remove intake manifold.
- (6) Remove heater tube support bracket from cylinder head.
- (7) Disconnect radiator upper and heater supply hoses from water outlet connections.
- (8) Remove accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)
- (9) Raise vehicle and remove exhaust pipe from manifold.
- (10) Remove power steering pump and set aside. Do not disconnect lines.
- (11) Remove accessory drive bracket
- (12) Remove ignition coil and wires from engine.
- (13) Disconnect cam sensor and fuel injector wiring connectors.
- (14) Remove timing belt and camshaft sprockets. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)
- (15) Remove timing belt idler pulley and rear timing belt cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)
- (16) Remove cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)
- (17) Remove camshafts (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - REMOVAL).

**NOTE: Identify rocker arm position to ensure correct re-installation in original position, if reused.**

- (18) Remove rocker arms. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - REMOVAL).
- (19) Remove cylinder head bolts in REVERSE sequence of tightening.
- (20) Remove cylinder head from engine block.
- (21) Inspect and clean cylinder head. (Refer to 9 - ENGINE/CYLINDER HEAD - INSPECTION) (Refer to 9 - ENGINE/CYLINDER HEAD - CLEANING)

## CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

**NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.**

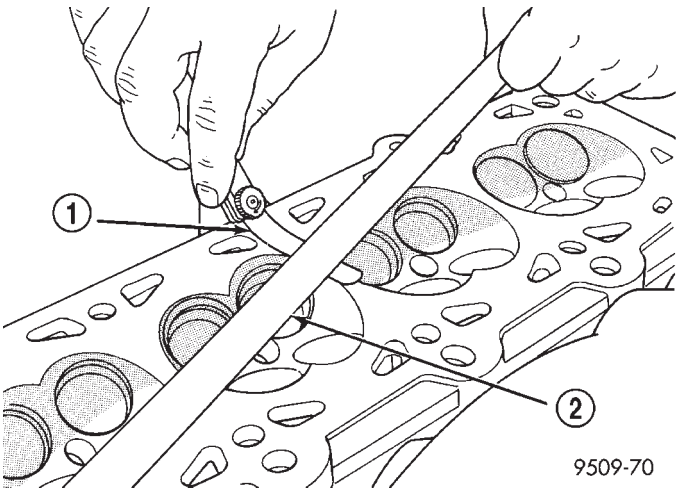
CYLINDER HEAD (Continued)

Remove all gasket material from cylinder head and block (Refer to 9 - ENGINE - STANDARD PROCEDURE). Be careful not to gouge or scratch the aluminum head sealing surface.

Clean all engine oil passages.

**INSPECTION**

- (1) Cylinder head must be flat within 0.1 mm (0.004 in.) (Fig. 6).
- (2) Inspect camshaft bearing journals for scoring.



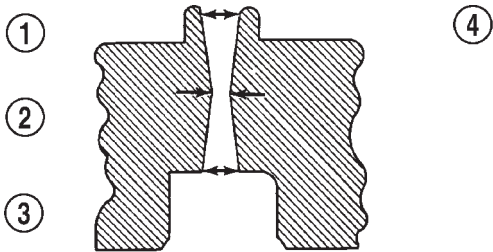
**Fig. 6 Checking Cylinder Head Flatness**

- 1 - FEELER GAUGE
- 2 - STRAIGHT EDGE

(3) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

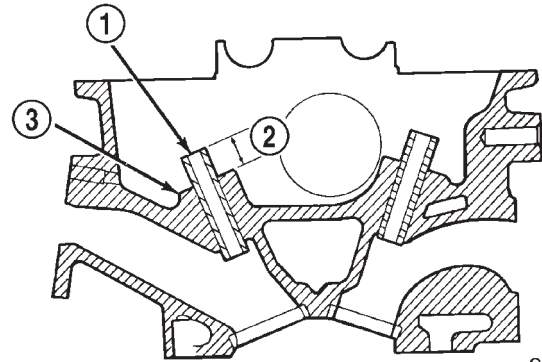
(4) Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bottom (Fig. 7). (Refer to 9 - ENGINE - SPECIFICATIONS) Replace guides if they are not within specification.

(5) Check valve guide height (Fig. 8).



**Fig. 7 Checking Wear on Valve Guide—Typical**

- 1 - TOP
- 2 - MIDDLE
- 3 - BOTTOM
- 4 - CUT AWAY VIEW OF VALVE GUIDE MEASUREMENT LOCATIONS



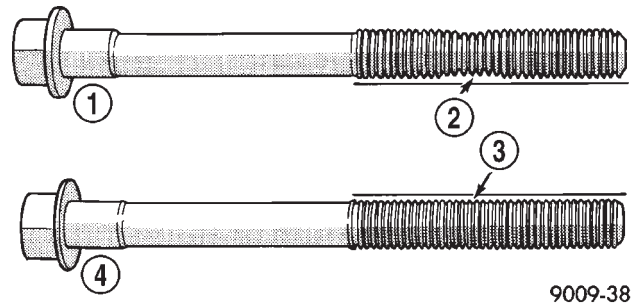
**Fig. 8 Valve Guide Height**

- 1 - VALVE GUIDE
- 2 - 13.25 - 13.75 MM (.521 - .541 IN.)
- 3 - SPRING SEAT

**INSTALLATION - CYLINDER HEAD**

**NOTE:** The Cylinder head bolts should be examined **BEFORE** reuse. If the threads are necked down, the bolts must be replaced (Fig. 9).

Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced.



**Fig. 9 Checking Bolts for Stretching (Necking)**

- 1 - STRETCHED BOLT
- 2 - THREADS ARE NOT STRAIGHT ON LINE
- 3 - THREADS ARE STRAIGHT ON LINE
- 4 - UNSTRETCHED BOLT

(1) Before installing the bolts, the threads should be coated with engine oil.

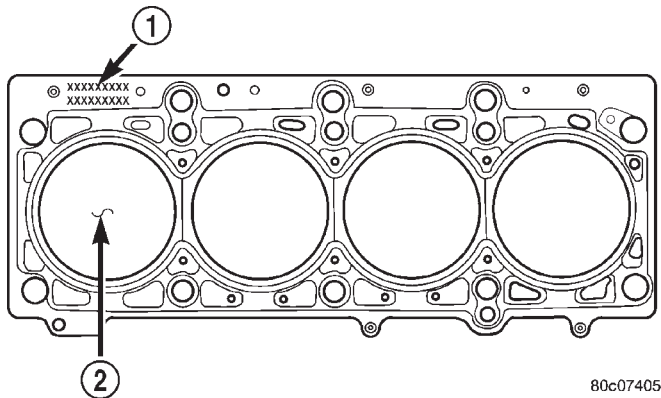
(2) Position cylinder head gasket on engine block (Fig. 10).

(3) Install cylinder head on engine block.

(4) Tighten the cylinder head bolts in the sequence shown in (Fig. 11). Using the 4 step torque turn method, tighten according to the following values:

- First All to 34 N·m (25 ft. lbs.)
- Second All to 68 N·m (50 ft. lbs.)

## CYLINDER HEAD (Continued)



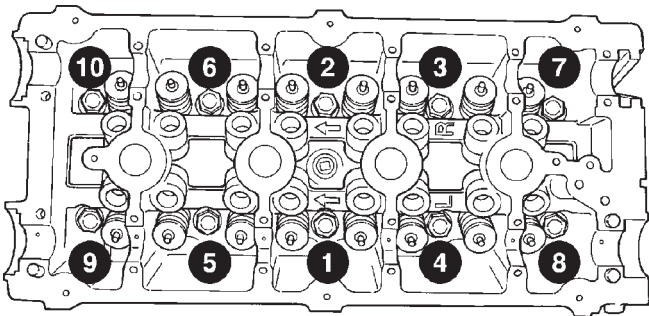
**Fig. 10 Cylinder Head Gasket Positioning**

- 1 - PART NUMBER FACES UP  
2 - NO. 1 CYLINDER

- Third All to 68 N·m (50 ft. lbs.)

**CAUTION:** Do not use a torque wrench for the following step.

- Fourth Turn an additional 1/4 Turn,



**Fig. 11 Cylinder Head Tightening Sequence**

(5) Install rocker arms. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - INSTALLATION)

(6) Install camshafts. (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - INSTALLATION).

(7) Install cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

(8) Install timing belt rear cover and timing belt idler pulley. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

(9) Install timing belt and camshaft sprockets. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

(10) Connect cam sensor and fuel injectors wiring connectors.

(11) Install ignition coil and wires. Connect ignition coil wiring connector.

(12) Install accessory drive bracket.

(13) Install power steering pump to cylinder head.

(14) Raise vehicle and install the exhaust pipe to the manifold.

(15) Install accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)

(16) Install heater tube support bracket to cylinder head.

(17) Install intake manifold.

(18) Connect all vacuum lines, electrical wiring, ground straps and fuel line.

(19) Fill cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

(20) Connect battery negative cable.

## CAMSHAFT OIL SEAL(S)

### REMOVAL

(1) Remove timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Hold each camshaft sprocket with Special Tool 6847 while removing center bolt (Fig. 12).

(3) Remove camshaft sprockets.

(4) Remove exhaust camshaft target ring.

(5) Remove exhaust camshaft sensor.

**CAUTION:** Inspect sensor and target ring for excessive wear. Clean sensor face and install new spacer pad.

(6) Remove rear timing belt cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(7) Remove camshaft seal using Special Tool C-4679-A (Fig. 13).

**CAUTION:** Do not nick shaft seal surface or seal bore.

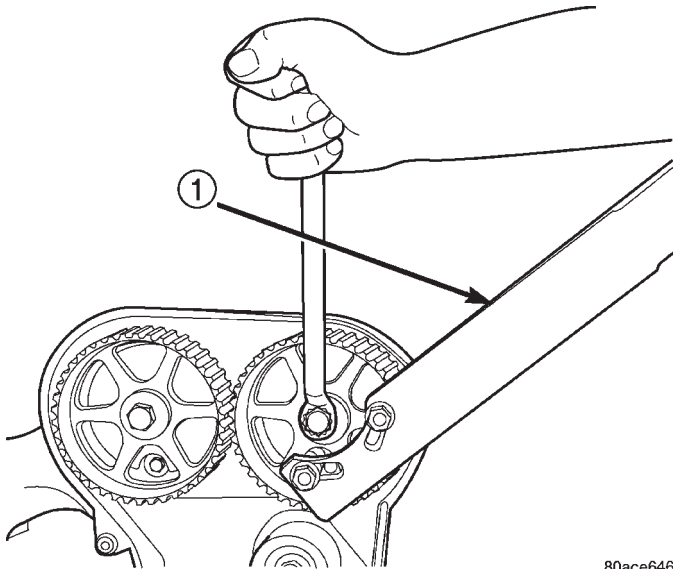
### INSTALLATION

**NOTE:** Clean and inspect sensor and target ring for excessive wear. Clean sensor face and always install a new spacer pad.

(1) Shaft seal surface must be free of varnish, dirt or nicks. Polish with 400 grit paper if necessary.

(2) Install camshaft seals into cylinder head using Special Tool MD-998306 until flush with head (Fig. 14).

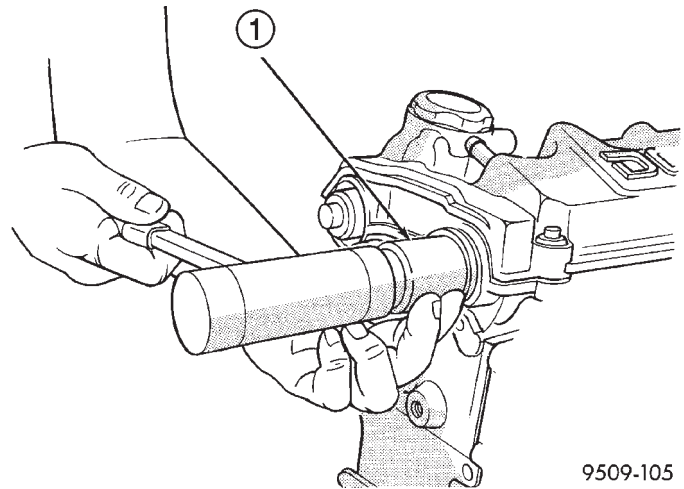
CAMSHAFT OIL SEAL(S) (Continued)



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**Fig. 12 Camshaft Sprocket - Removal/Installation**

1 - SPECIAL TOOL 6847

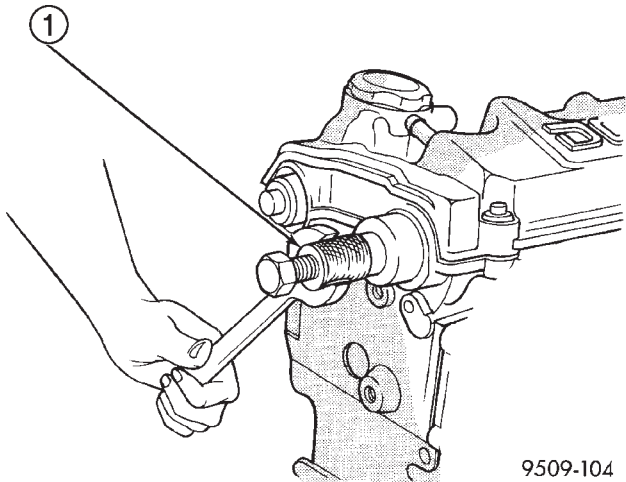


9509-105

**Fig. 14 Camshaft Seal - Installation**

1 - SPECIAL TOOL MD 998306

AND SPROCKETS - INSTALLATION) (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)



9509-104

**Fig. 13 Camshaft Oil Seal - Removal With C-4679-A**

1 - SPECIAL TOOL C-4679

(3) Install timing belt rear cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

**NOTE:** Target ring tab should provide positive snap-on fit on the camshaft.

(4) Install exhaust camshaft target ring with the word **FRONT** facing forward.

(5) Install exhaust camshaft sensor.

(6) Install camshaft sprockets. Hold each sprocket with Special Tool 6847 and tighten center bolt to 101 N·m (75 ft. lbs.).

(7) Install timing belt and front covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN

## CAMSHAFT(S)

### DESCRIPTION

Both nodular iron camshafts have six bearing journal surfaces and two cam lobes per cylinder (Fig. 15). Flanges at the rear journals control camshaft end play. Provision for a cam position sensor is located on the exhaust camshaft on the front of the cylinder head. A hydrodynamic oil seal is used for oil control at the front of the camshaft.

### OPERATION

The camshaft is driven by the crankshaft via drive sprockets and belt. The camshaft has precisely machined lobes to provide accurate valve timing and duration.

### STANDARD PROCEDURE - CAMSHAFT END-PLAY

(1) Oil camshaft journals and install camshaft **WITHOUT** cam follower assemblies. Install rear cam caps and tighten screws to specified torque.

(2) Using a suitable tool, move camshaft as far rearward as it will go.

(3) Zero dial indicator (Fig. 16).

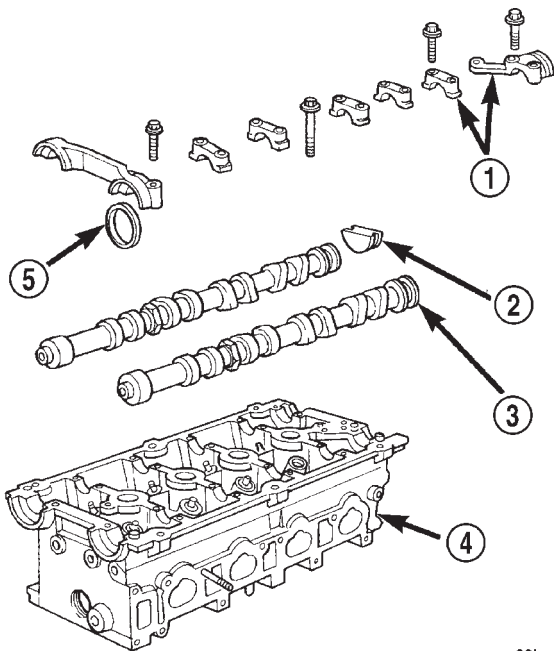
(4) Move camshaft as far forward as it will go.

(5) Record reading on dial indicator. For end play specification, (Refer to 9 - ENGINE - SPECIFICATIONS).

(6) If end play is excessive, check cylinder head and camshaft for wear; replace as necessary.



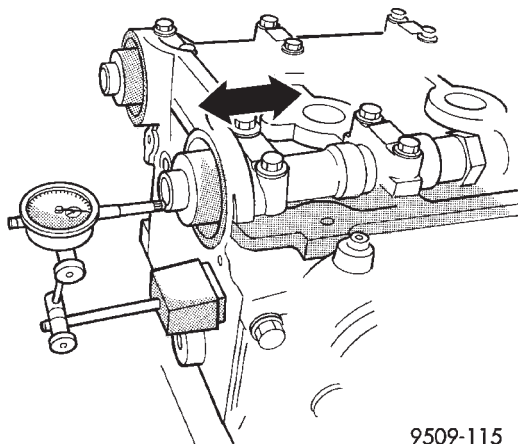
CAMSHAFT(S) (Continued)



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**Fig. 15 Camshafts**

- CAM PLUG - NOT SHOWN
- 1 - CAMSHAFT BEARING CAPS
- 2 - PLUG
- 3 - CAMSHAFT
- 4 - CYLINDER HEAD
- 5 - CAMSHAFT OIL SEAL



9509-115

**Fig. 16 Camshaft End Play - Typical**

**REMOVAL**

- (1) Remove cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)
- (2) Remove camshaft position sensor and camshaft target magnet. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/CAMSHAFT POSITION SENSOR - REMOVAL)
- (3) Remove timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(4) Remove camshaft sprockets and timing belt rear cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(5) Bearing caps are identified for location. Remove the outside bearing caps first (Fig. 17).

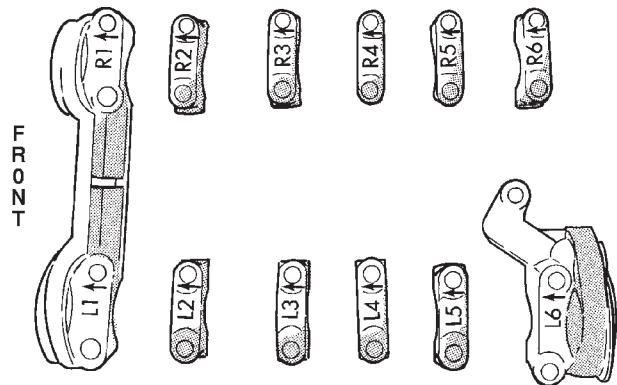
(6) Loosen the camshaft bearing cap attaching fasteners in sequence shown (Fig. 18) one camshaft at a time.

**CAUTION: Camshafts are not interchangeable. The intake cam number 6 thrust bearing face spacing is wider.**

(7) Identify the camshafts before removing from the head. The camshafts are not interchangeable.

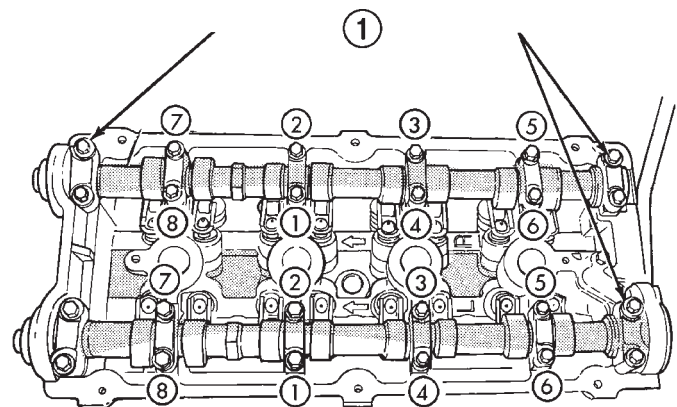
(8) Remove camshafts from cylinder head.

**NOTE: If removing rocker arms, identify for reinstallation in the original position.**



9509-112

**Fig. 17 Camshaft Bearing Cap Identification**



9509-113

**Fig. 18 Camshaft Bearing Cap - Removal**

- 1 - REMOVE OUTSIDE BEARING CAPS FIRST

**CLEANING**

Clean camshaft with a suitable solvent.

CAMSHAFT(S) (Continued)

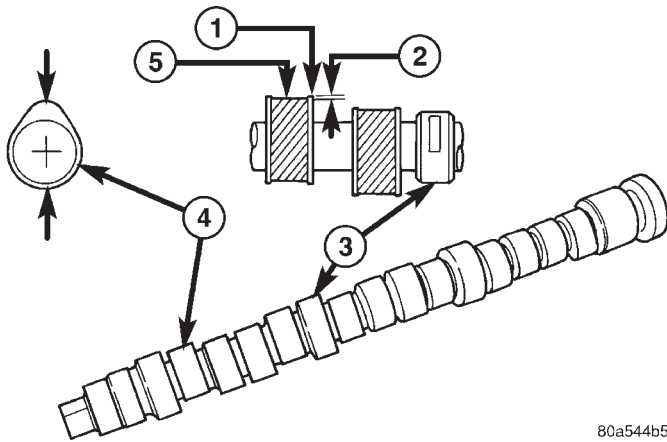
**INSPECTION**

(1) Inspect camshaft bearing journals for damage and binding (Fig. 19). If journals are binding, check the cylinder head for damage. Also check cylinder head oil holes for clogging.

(2) Check the cam lobe and bearing surfaces for abnormal wear and damage. Replace camshaft if defective.

**NOTE:** If camshaft is replaced due to lobe wear or damage, always replace the rocker arms.

(3) Measure the lobe actual wear (unworn area - wear zone = actual wear) (Fig. 19) and replace camshaft if out of limit. Standard value is 0.0254 mm (0.001 in.), wear **limit** is 0.254 mm (0.010 in.).



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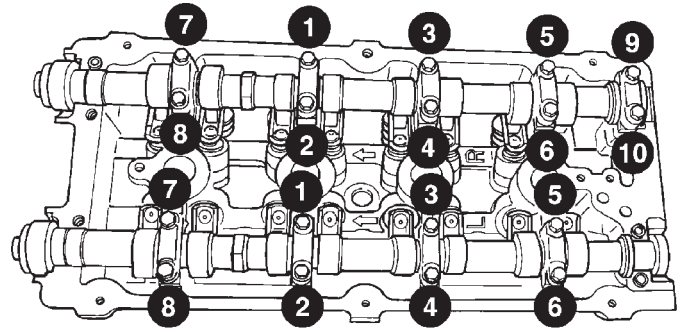
**Fig. 19 Checking Camshaft(s) for Wear**

- 1 - UNWORN AREA
- 2 - ACTUAL WEAR
- 3 - BEARING JOURNAL
- 4 - LOBE
- 5 - WEAR ZONE

**INSTALLATION**

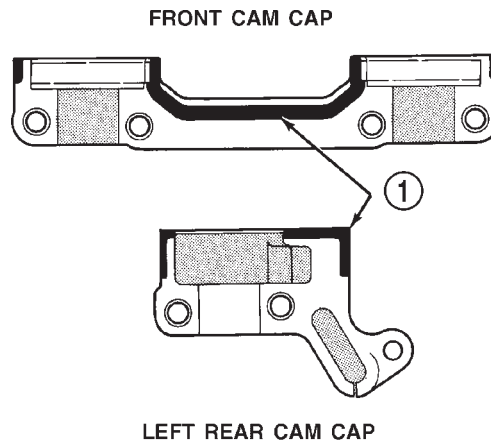
**CAUTION:** Ensure that **NONE** of the pistons are at top dead center when installing the camshafts.

- (1) Lubricate all camshaft bearing journals, rocker arms and camshaft lobes.
- (2) Install all rocker arms in original positions, if reused.
- (3) Position camshafts on cylinder head bearing journals. Install right and left camshaft bearing caps No. 2 – 5 and right No. 6. Tighten M6 fasteners to 12 N·m (105 in. lbs.) in sequence shown in (Fig. 20).
- (4) Apply Mopar® Gasket Maker to No. 1 and No. 6 bearing caps (Fig. 21). Install bearing caps and tighten M8 fasteners to 28 N·m (250 in. lbs.).



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**Fig. 20 Camshaft Bearing Cap Tightening Sequence**



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**Fig. 21 Camshaft Bearing Cap Sealing**

1 - 1.5 mm (.060 in.) DIAMETER BEAD OF MOPAR GASKET MAKER

**NOTE:** Bearing end caps must be installed before seals can be installed.

- (5) Install camshaft oil seals. (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT OIL SEAL(S) - INSTALLATION)
- (6) Install camshaft target magnet and camshaft position sensor.
- (7) Install cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)
- (8) Install timing belt rear cover and camshaft sprocket. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)
- (9) Install timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

## CYLINDER HEAD COVER

### REMOVAL

- (1) Remove intake manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL)
- (2) Remove ignition coil and spark plug wires.
- (3) Disconnect PCV and make-up air hoses from cylinder head cover.
- (4) Remove cylinder head cover bolts.
- (5) Remove cylinder head cover from cylinder head.

### CLEANING

Clean cylinder head and cover mating surfaces using a suitable solvent.

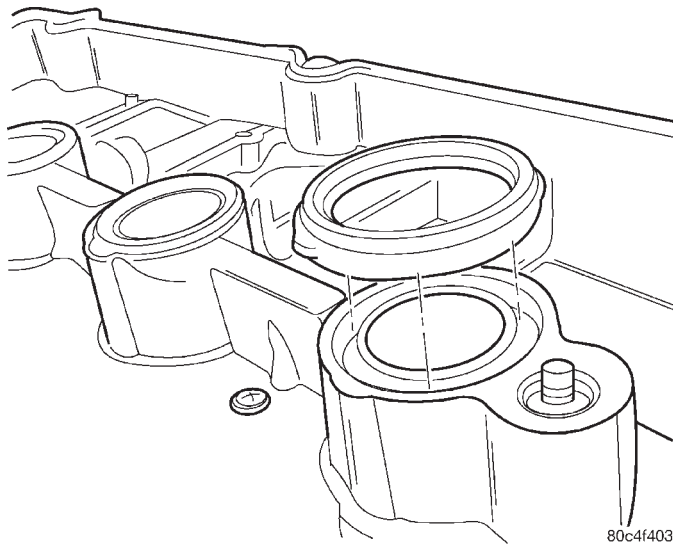
### INSPECTION

Inspect cover rails for flatness.

### INSTALLATION

**NOTE:** Replace spark plug well seals and bolt assemblies when installing a new cylinder head cover gasket.

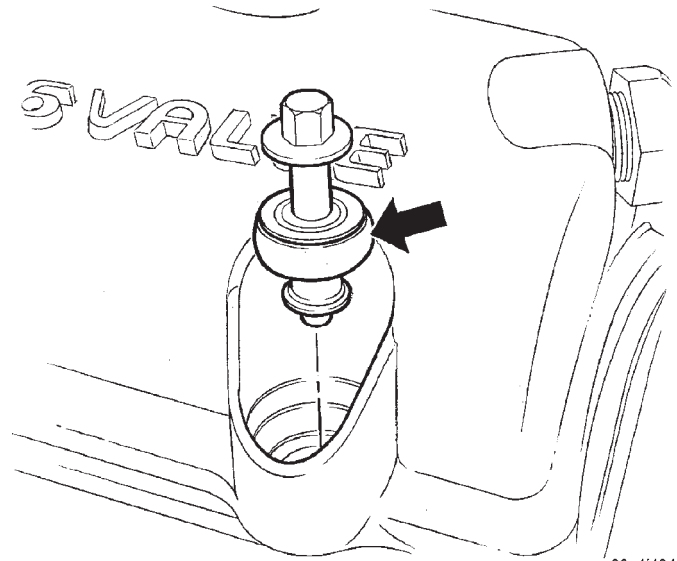
- (1) Install new cylinder head cover gaskets and spark plug well seals (Fig. 22).



**Fig. 22 Spark Plug Well Seals**

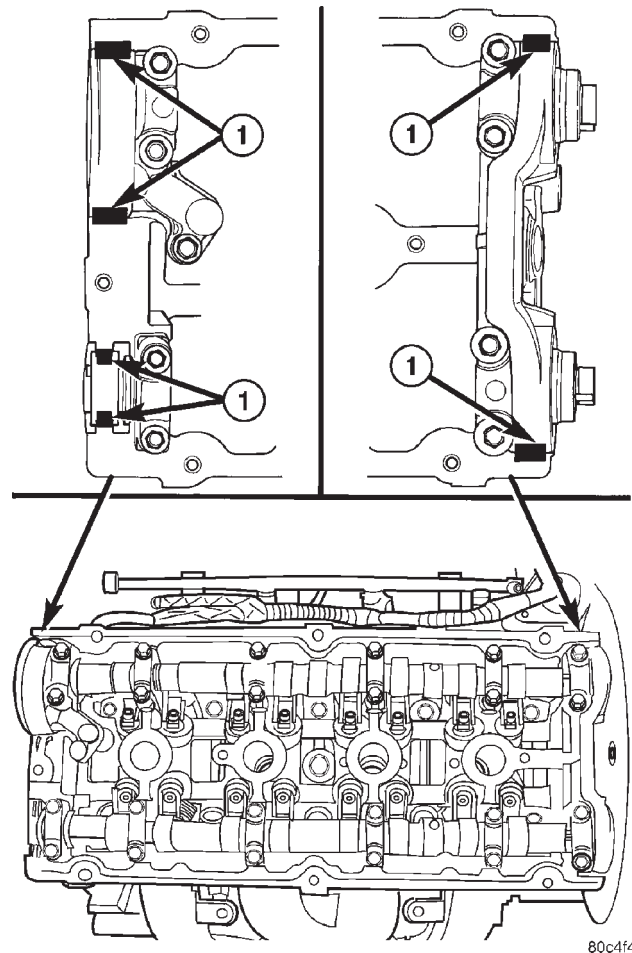
- (2) Replace cylinder head cover bolt assemblies (Fig. 23).

**CAUTION:** Do not allow oil or solvents to contact the timing belt as they can deteriorate the rubber and cause tooth skipping.



**Fig. 23 Cylinder Head Cover Bolt Assembly**

- (3) Apply Mopar® Engine RTV GEN II at the camshaft cap corners and at the top edges of the 1/2 round seal (Fig. 24).



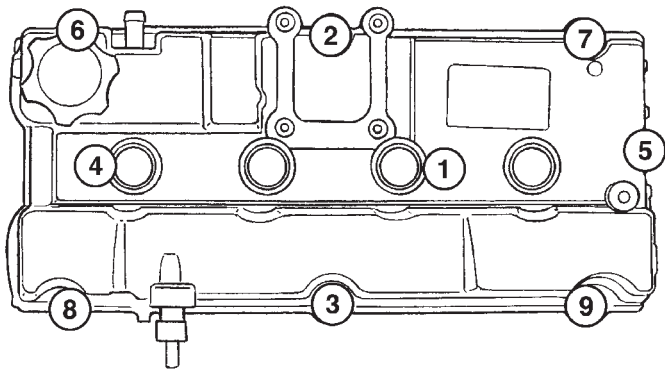
**Fig. 24 Sealer Locations - Typical**

1 - SEALER LOCATION

## CYLINDER HEAD COVER (Continued)

(4) Install cylinder head cover assembly to cylinder head. Install all bolts, ensuring the two (2) bolts containing the sealing washer are located in the center locations of cover. Tighten bolts in sequence shown in (Fig. 25). Using a 3 step torque method as follows:

- Tighten all bolts to 4.5 N·m (40 in. lbs.).
- Tighten all bolts to 9.0 N·m (80 in. lbs.).
- Tighten all bolts to 12 N·m (105 in. lbs.).



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**Fig. 25 CYLINDER HEAD TIGHTENING SEQUENCE**

- Install intake manifold.
- Install ignition coil and spark plug wires. Tighten fasteners to 12 N·m (105 in. lbs.).
- If the PCV valve was removed, apply Mopar® Thread Sealant with Teflon to threads and install valve to cylinder head cover. Tighten PCV valve to 8 N·m (70 in. lbs.).
- Connect PCV and make-up air hoses to cylinder head cover.

## INTAKE/EXHAUST VALVES & SEATS

### DESCRIPTION

The four valves per cylinder are opened by using roller rocker arms which pivot on hydraulic lash adjusters. The valves have chrome plated valve stems. Viton rubber valve stem seals are integral with the spring seats. They have chrome plated stems to prevent scuffing. Viton rubber valve stem seals are integral with the spring seats. The valves, spring retainers, and locks, are the 3 - bead lock design

## CLEANING

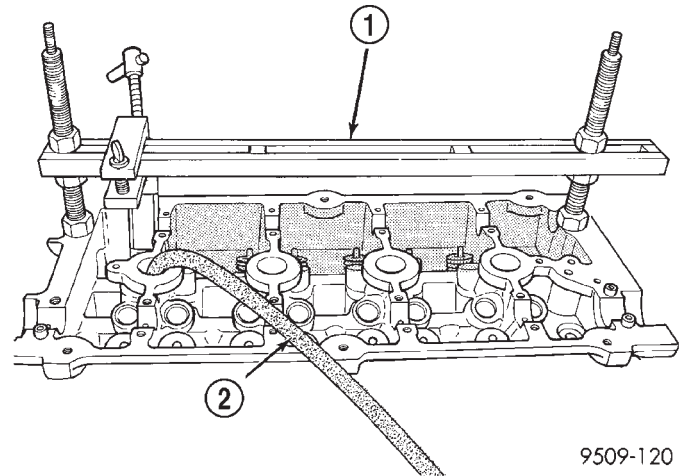
(1) Clean all valves thoroughly and discard burned, warped and cracked valves.

## VALVE SPRINGS

### REMOVAL

#### REMOVAL - CYLINDER HEAD ON

- Remove camshafts.
- Rotate crankshaft until piston is at TDC on compression.
- With air hose attached to adapter tool installed in spark plug hole, apply 90-120 psi air pressure.
- Using Special Tool MD-998772-A with adapter 6779 (Fig. 26), compress valve springs and remove valve locks.
- Remove valve spring(s).
- Remove valve stem seal(s) by using valve stem seal tool (Fig. 28).



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**Fig. 26 Valve Spring - Removal/Installation**

- VALVE SPRING COMPRESSOR MD 998772A
- AIR HOSE

### REMOVAL - CYLINDER HEAD OFF

- With cylinder head removed from cylinder block, compress valve springs using a universal valve spring compressor.
- Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.
- Before removing valves, **remove any burrs from valve stem lock grooves to prevent damage to the valve guides.** Identify valves, locks and retainers to insure installation in original location.
- Inspect the valves. (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE SPRINGS - INSPECTION)

## VALVE SPRINGS (Continued)

## INSPECTION

(1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested for correct tension. Discard the springs that do not meet specifications. The following specifications apply to both intake and exhaust valves springs:

- Valve Closed Nominal Tension—76 lbs. @ 38.0 mm (1.50 in.)
- Valve Open Nominal Tension—136 lbs. @ 29.75 mm (1.17 in.)

(2) Inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends. If the spring is more than 1.5 mm (1/16 inch) out of square, install a new spring.

## INSTALLATION

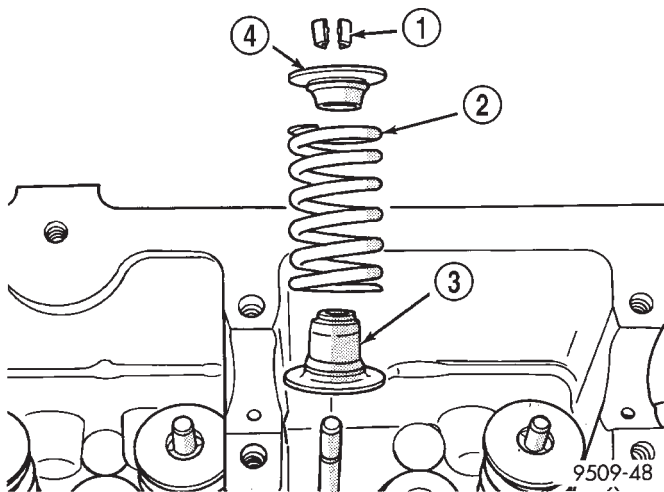
## INSTALLATION - CYLINDER HEAD ON

(1) Install valve seal/valve spring seat assembly (Fig. 27). Push the assembly down to seat it onto the valve guide.

(2) Install valve spring and retainer, use Special Tool MD-998772-A with adapter 6779 to compress valve springs only enough to install locks. Correct alignment of tool is necessary to avoid nicking valve stems.

(3) Remove air hose and install spark plugs.

(4) Install camshafts and cylinder head cover .



**Fig. 27 Valve Stem Seal/Valve Spring Seat - Typical**

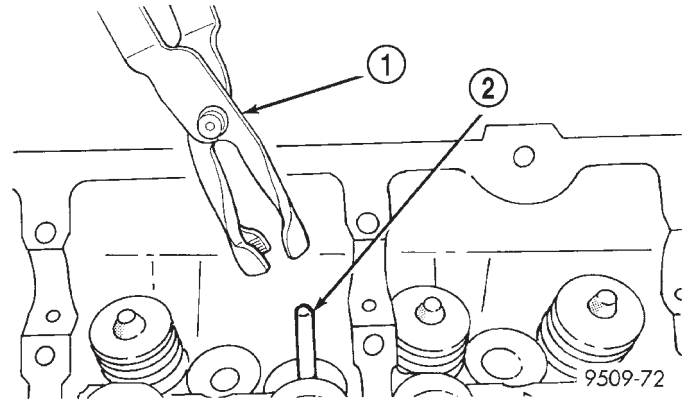
- 1 - 3-GROOVE -VALVE RETAINING LOCKS
- 2 - VALVE SPRING
- 3 - VALVE SEAL AND VALVE SPRING SEAT ASSEMBLY
- 4 - VALVE SPRING RETAINER

## INSTALLATION - CYLINDER HEAD OFF

(1) Coat valve stems with clean engine oil and insert in cylinder head.

(2) Install new valve stem seals on all valves using a valve stem seal tool (Fig. 28). The valve stem seals should be pushed firmly and squarely over valve guide.

**CAUTION:** When oversize valves are used, the corresponding oversize valve seal must also be used. Excessive guide wear may result if oversize seals are not used with oversize valves.



**Fig. 28 Valve Stem Oil Seal Tool**

- 1 - VALVE SEAL TOOL
- 2 - VALVE STEM

(3) Install valve springs and retainers. Compress valve springs only enough to install locks, taking care not to misalign the direction of compression. Nicked valve stems may result from misalignment of the valve spring compressor.

**CAUTION:** When depressing the valve spring retainers with valve spring compressor the locks can become dislocated. Ensure both locks are in the correct location after removing tool.

(4) Check the valve spring installed height B after refacing the valve and seat (Fig. 29). Make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 38.75 mm (1.525 in.), install a 0.762 mm (0.030 in.) spacer under the valve spring seat to bring spring height back within specification.

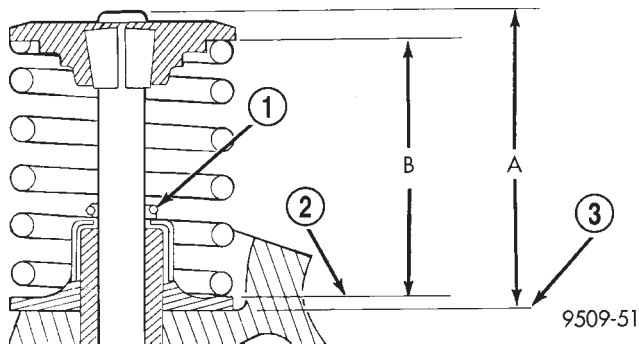
## HYDRAULIC LIFTERS

## DIAGNOSIS AND TESTING - LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS

A tappet-like noise may be produced from several items. Check the following items.

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

## HYDRAULIC LIFTERS (Continued)



**Fig. 29 Checking Spring Installed Height and Valve Tip Height Dimensions**

- 1 - GARTER SPRING
- 2 - VALVE SPRING SEAT
- 3 - CYLINDER HEAD SURFACE

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) During this time, turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor (integral to the head gasket) in the vertical oil passage to the cylinder head is plugged with debris.

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Faulty lash adjuster.

a. Check lash adjusters for sponginess while installed in cylinder head. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

b. Remove suspected lash adjusters, and replace as necessary.

## REMOVAL

**NOTE: This procedure is for in-vehicle service with camshafts installed.**

(1) Remove cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)

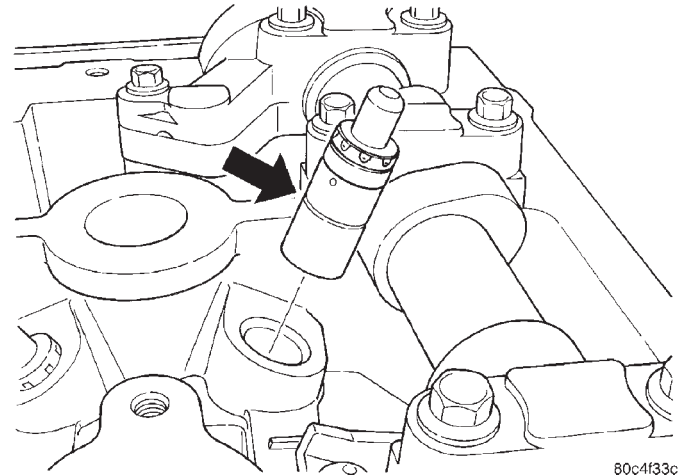
(2) Remove the camshafts (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - REMOVAL).

(3) Remove rocker arm. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - REMOVAL)

(4) Remove hydraulic lifter (Fig. 30).

(5) Repeat removal procedure for each hydraulic lifter.

(6) If reusing, mark each hydraulic lifter for reassembly in original position. Lifters are serviced as an assembly.



**Fig. 30 Hydraulic Lash Adjuster**

## INSTALLATION

(1) Install hydraulic lifter (Fig. 30). Ensure the lifters are at least partially full of engine oil. This is indicated by little or no plunger travel when the lifter is depressed.

(2) Install rocker arm. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - INSTALLATION)

(3) Repeat installation procedure for each hydraulic lifter.

(4) Install camshafts (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - INSTALLATION).

(5) Install cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

## ROCKER ARMS

### REMOVAL

**NOTE: This procedure is for in-vehicle service with camshafts installed.**

(1) Remove cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)

(2) Remove fuel rail. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - REMOVAL)

(3) Remove spark plugs.

(4) Rotate engine until the camshaft lobe, on the follower being removed, is position on its base circle (heel). Also, the piston should be a minimum of 6.3 mm (0.25 in) below TDC position.

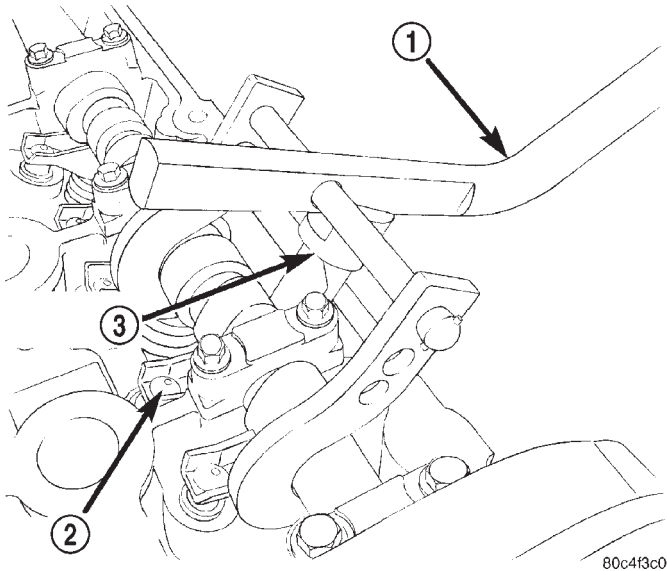
## ROCKER ARMS (Continued)

**CAUTION:** If cam follower assemblies are to be reused, always mark position for reassembly in their original positions.

(5) Using Special Tools 8215 and 8436 slowly depress valve assembly until rocker arm can be removed (Fig. 31).

**NOTE:** It may be necessary to remove additional brackets or components to allow clearance for tool handle movement.

(6) Repeat removal procedure for each rocker arm.



**Fig. 31 Rocker Arm - Removal/Installation**

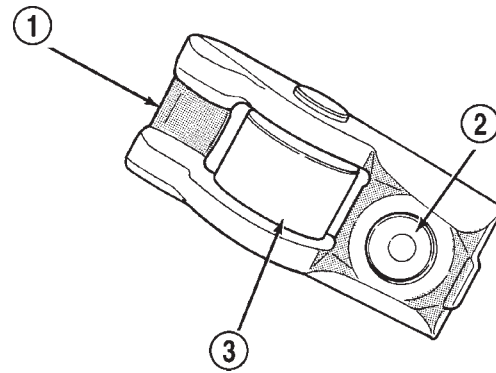
- 1 - SPECIAL TOOL 8215
- 2 - ROCKER ARM
- 3 - SPECIAL TOOL 8436

## INSPECTION

Inspect the rocker arm for wear or damage (Fig. 32). Replace as necessary.

## INSTALLATION

- (1) Lubricate rocker arm with clean engine oil.
- (2) Using Special Tools 8215 and 8436 slowly depress valve assembly until rocker arm can be installed on the hydraulic lifter and valve stem.
- (3) Repeat installation procedure for each rocker arm.
- (4) Install spark plugs.
- (5) Install fuel rail. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - INSTALLATION)
- (6) Install cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)



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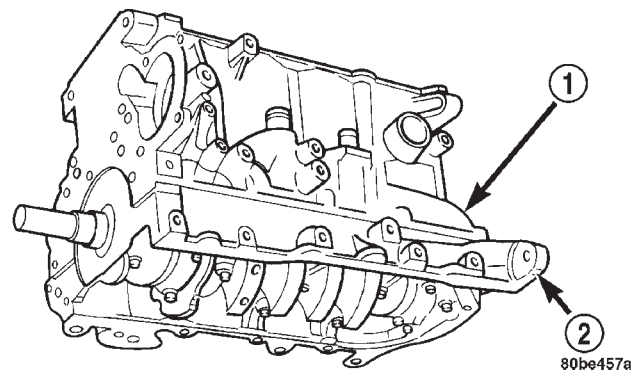
**Fig. 32 Rocker Arm - Typical**

- 1 - TIP
- 2 - LASH ADJUSTER POCKET
- 3 - ROLLER

## ENGINE BLOCK

## DESCRIPTION

The cast iron cylinder block is a two-piece assembly, consisting of the cylinder block and bedplate (Fig. 33). The bedplate incorporates the main bearing caps and bolts to the cylinder block. This design offers a much stronger lower end and increased cylinder block rigidity. The rear oil seal retainer is integral with the block. The bedplate and block are serviced as an assembly.



**Fig. 33 2.4L Cylinder Block and Bedplate - Typical**

- 1 - CYLINDER BLOCK
- 2 - BEDPLATE

## STANDARD PROCEDURE

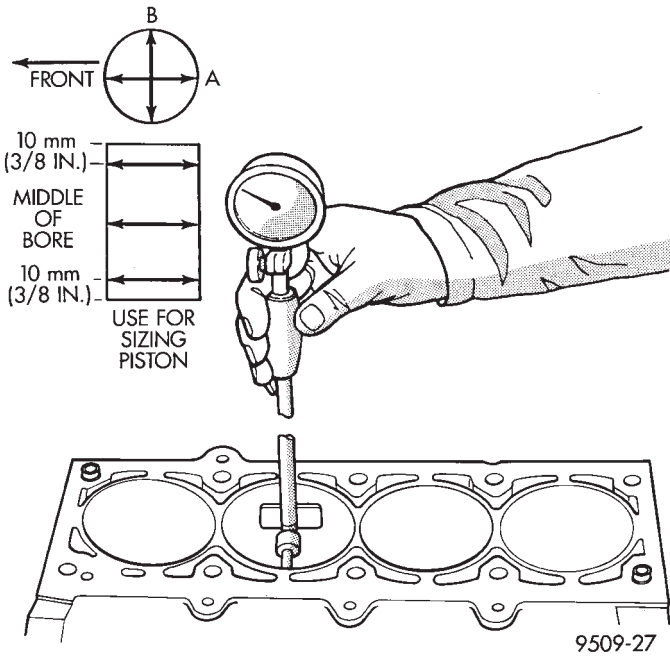
## STANDARD PROCEDURE - PISTON TO CYLINDER BORE FITTING

Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin about 14 mm (9/16 inch.) from the bottom of the skirt as shown in (Fig. 35). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line

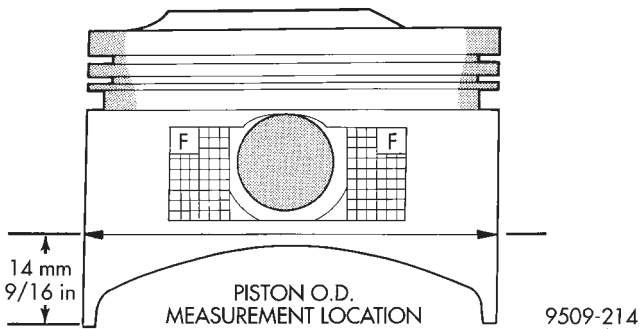
ENGINE BLOCK (Continued)

shown in (Fig. 34). Refer to for Engine Specifications (Refer to 9 - ENGINE - SPECIFICATIONS). Correct piston to bore clearance must be established in order to assure quiet and economical operation.

**NOTE:** Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).



**Fig. 34 Checking Cylinder Bore -Typical**



**Fig. 35 Piston Measurement - Typical**

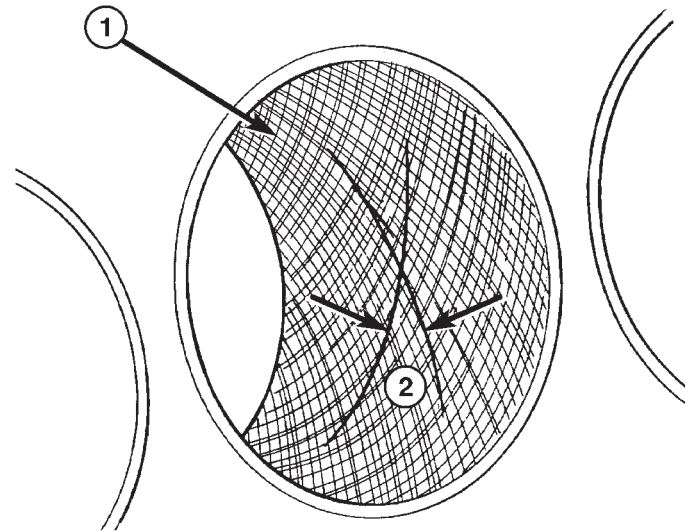
**STANDARD PROCEDURE - CYLINDER BORE HONING**

(1) Used carefully, the cylinder bore resizing hone, recommended tool C-823 or equivalent, equipped with 220 grit stones, is the best tool for this honing procedure. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

(2) Deglazing of the cylinder walls may be done using a cylinder surfacing hone, recommended tool

C-3501 or equivalent, equipped with 280 grit stones, if the cylinder bore is straight and round. 20–60 strokes depending on the bore condition, will be sufficient to provide a satisfactory surface. Use a light honing oil. **Do not use engine or transmission oil, mineral spirits or kerosene.** Inspect cylinder walls after each 20 strokes.

(3) Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks **intersect** at 40-60 degrees, the cross hatch angle is most satisfactory for proper seating of rings (Fig. 36).



**Fig. 36 Cylinder Bore Cross-Hatch Pattern**

- 1 - CROSS-HATCH PATTERN
- 2 - 40°-60°

(4) A controlled hone motor speed between 200–300 RPM is necessary to obtain the proper cross-hatch angle. The number of up and down strokes per minute can be regulated to get the desired 40–60 degree angle. Faster up and down strokes increase the cross-hatch angle.

(5) After honing, it is necessary that the block be cleaned again to remove all traces of abrasive.

**CAUTION:** Ensure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and hot water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil the bores after cleaning to prevent rusting.

**CLEANING**

Clean cylinder block thoroughly using a suitable cleaning solvent.



## ENGINE BLOCK (Continued)

## INSPECTION

## ENGINE BLOCK

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core plugs are to be installed, (Refer to 9 - ENGINE - STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS).

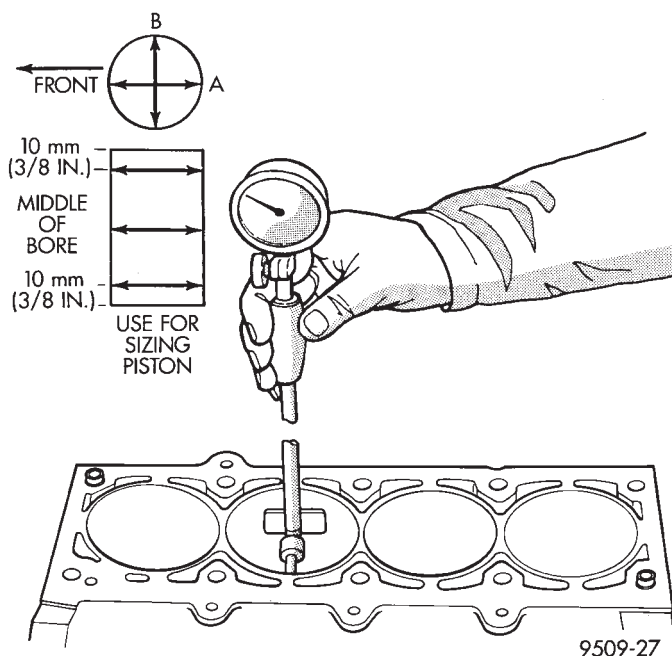
(3) Examine block and cylinder bores for cracks or fractures.

(4) Check block deck surfaces for flatness. Deck surface must be within service limit of 0.1 mm (0.004 in.).

## CYLINDER BORE

**NOTE:** The cylinder bores should be measured at normal room temperature, 21°C (70°F).

The cylinder walls should be checked for out-of-round and taper with Tool C119 or equivalent (Fig. 37) (Refer to 9 - ENGINE - SPECIFICATIONS). If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.



**Fig. 37 Checking Cylinder Bore Size**

Measure the cylinder bore at three levels in directions A and B (Fig. 37). Top measurement should be 10 mm (3/8 in.) down and bottom measurement should be 10 mm (3/8 in.) up from bottom of bore. (Refer to 9 - ENGINE - SPECIFICATIONS).

## CONNECTING ROD BEARINGS

## STANDARD PROCEDURE

## CONNECTING ROD - FITTING

(1) For measuring connecting rod bearing clearance procedure and use of Plastigage (Refer to 9 - ENGINE - STANDARD PROCEDURE). For bearing clearance refer to Engine Specifications. (Refer to 9 - ENGINE - SPECIFICATIONS)

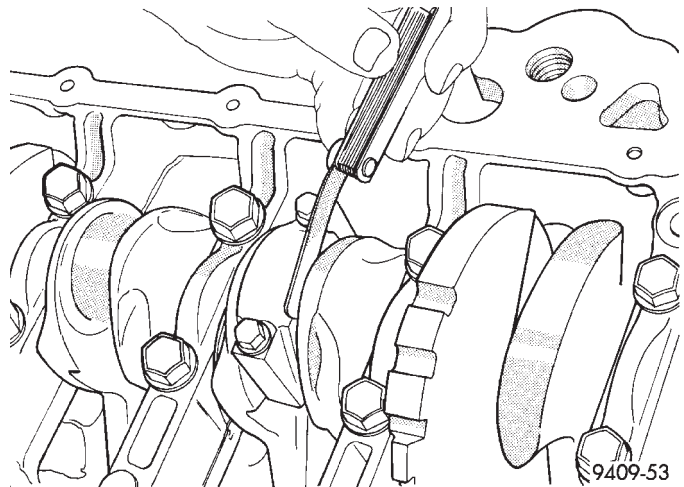
**NOTE:** The rod bearing bolts should not be reused.

(2) Before installing the **NEW** bolts the threads should be oiled with clean engine oil.

(3) Install each bolt finger tight then alternately torque each bolt to assemble the cap properly.

(4) Tighten the bolts to 27 N·m PLUS 1/4 turn (20 ft. lbs. PLUS 1/4 turn) **Do not use a torque wrench for last step.**

(5) Using a feeler gauge, check connecting rod side clearance (Fig. 38). Refer to clearance specifications (Refer to 9 - ENGINE - SPECIFICATIONS).



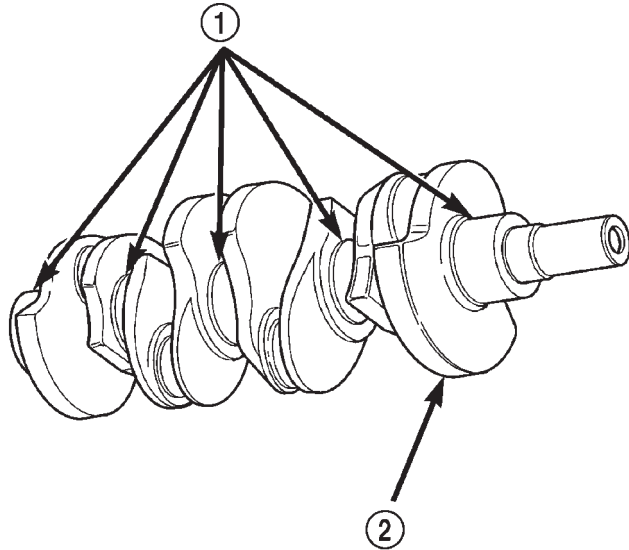
**Fig. 38 Connecting Rod Side Clearance**

## CRANKSHAFT

## DESCRIPTION

The crankshaft is made of nodular cast iron and includes five main bearing journals and four connecting rod journals (Fig. 39). The number three journal is the location for the thrust bearing. The mains and connecting rod journals have undercut fillet radiuses that are rolled for added strength. To optimize bearing loading, eight counterweights are used.

CRANKSHAFT (Continued)



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**Fig. 39 Crankshaft - Typical**

- 1 - MAIN BEARING JOURNALS
- 2 - COUNTER BALANCE WEIGHTS

**OPERATION**

The crankshaft transfers force generated by combustion within the cylinder to the flywheel or flex-plate.

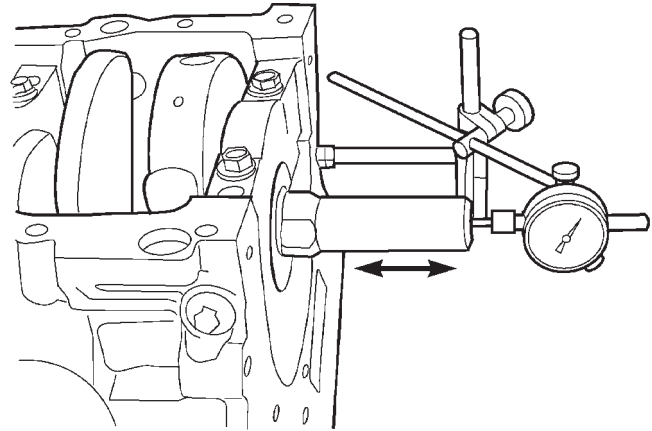
**STANDARD PROCEDURE - CRANKSHAFT END PLAY**

- (1) Using Dial Indicator C-3339 and Mounting Post L-4438, attach to front of engine, locating probe perpendicular on nose of crankshaft (Fig. 40).
- (2) Move crankshaft all the way to the rear of its travel.
- (3) Zero the dial indicator.
- (4) Move crankshaft all the way to the front and read the dial indicator. Refer to Engine Specifications.

**REMOVAL**

**NOTE:** Crankshaft can not be removed when engine is in vehicle.

- (1) Remove engine assembly from vehicle. (Refer to 9 - ENGINE - REMOVAL)
- (2) Remove flex plate and crankshaft rear oil seal.
- (3) Mount engine on a repair stand.
- (4) Drain engine oil and remove oil filter.
- (5) Remove the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)
- (6) Remove the timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)



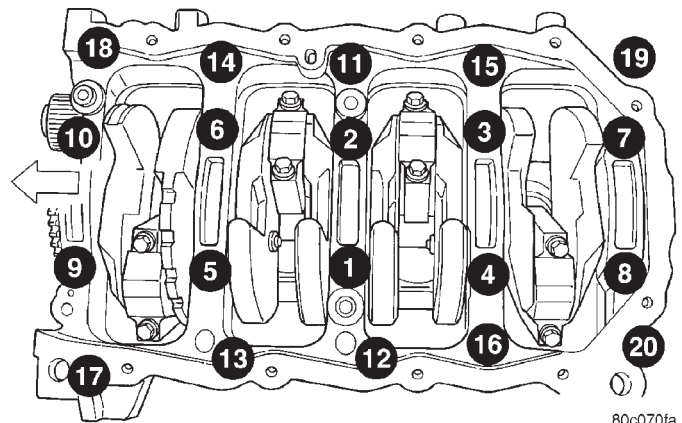
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**Fig. 40 CHECKING CRANKSHAFT END PLAY**

- (7) Remove the timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)
- (8) Remove the oil pump. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL)
- (9) Remove balance shafts and housing assembly. (Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - REMOVAL)
- (10) Remove all bedplate bolts from the engine block (Fig. 41).
- (11) Using a mallet gently tap the bedplate loose from the engine block dowel pins.

**CAUTION:** Do not pry up on one side of the bedplate. Damage may occur to cylinder block to bedplate alignment and thrust bearing.

- (12) Bedplate should be removed evenly from the cylinder block dowel pins to prevent damage to the dowel pins and thrust bearing.
- (13) Lift out crankshaft from cylinder block. Do not damage the main bearings or journals when removing the crankshaft.



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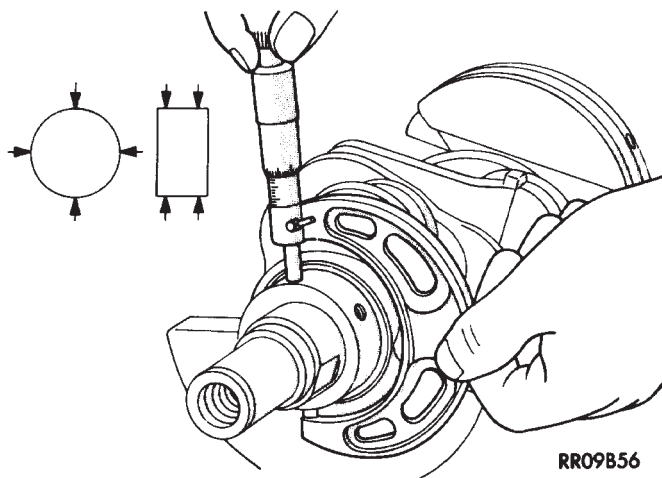
**Fig. 41 Bedplate Bolt Tightening Sequence**

CRANKSHAFT (Continued)

**INSPECTION**

The crankshaft journals should be checked for excessive wear, taper and scoring (Fig. 42). Limits of taper or out of round on any crankshaft journals should be within specifications. (Refer to 9 - ENGINE - SPECIFICATIONS) Journal grinding should not exceed 0.305 mm (0.012 in.) 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 passages.

**CAUTION:** With the nodular cast iron crankshafts, it is important that the final paper or cloth polish be in the same direction as normal rotation in the engine.



**Fig. 42 Crankshaft Journal Measurements**

**INSTALLATION**

(1) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 43).

(2) Make certain oil holes in block line up with oil hole in bearings and bearing tabs seat in the block tab slots.

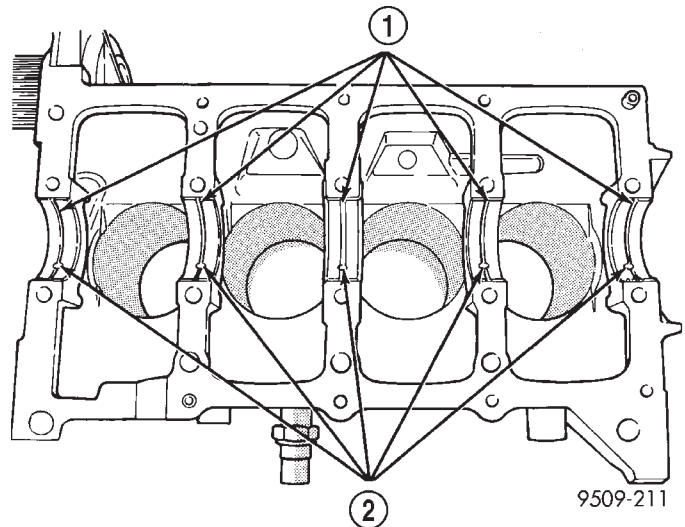
**CAUTION:** Do not get oil on the bedplate mating surface. It will affect the sealer ability to seal the bedplate to cylinder block.

(3) Oil the bearings and journals. Install crankshaft.

**CAUTION:** Use only the specified anaerobic sealer on the bedplate or damage may occur to the engine.

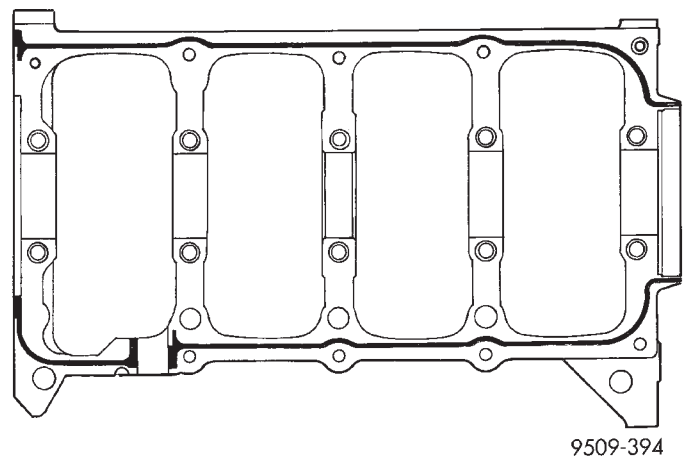
(4) Apply 1.5 to 2.0 mm (0.059 to 0.078 in.) bead of Mopar® Bed Plate Sealant to cylinder block as shown in (Fig. 44).

(5) Install lower main bearings into main bearing cap/bedplate. Make certain the bearing tabs are

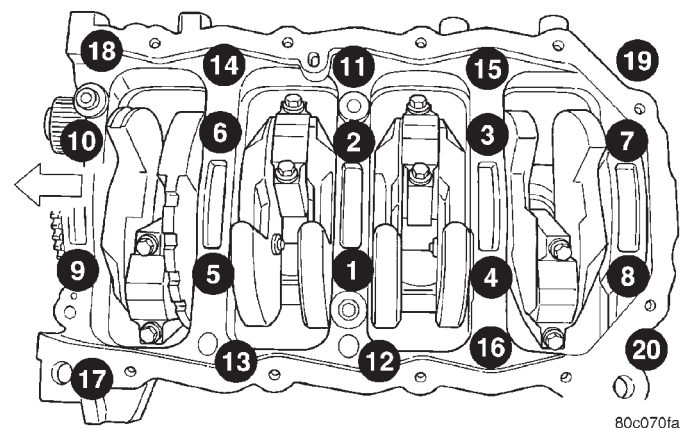


**Fig. 43 Installing Main Bearing Upper Shell**

- 1 - LUBRICATION GROOVES
- 2 - OIL HOLES



**Fig. 44 Bedplate Sealing**



**Fig. 45 Bedplate Bolt Torque Sequence**

seated into the bedplate slots. Install the main bearing/bedplate into engine block.

CRANKSHAFT (Continued)

(6) Before installing the bolts the threads should be oiled with clean engine oil, wipe off any excess oil.

(7) Install main bearing bedplate to engine block bolts 11, 17, and 20 finger tight. Tighten these bolts down together until the bedplate contacts the cylinder block.

(8) To ensure correct thrust bearing alignment, perform the following steps:

- Step 1: Rotate crankshaft until number 4 piston is at TDC.
- Step 2: Move crankshaft rearward to limits of travel.
- Step 3: Then, move crankshaft forward to limits of travel.
- Step 4: Wedge an appropriate tool between the rear of the cylinder block (**NOT BED PLATE**) and the rear crankshaft counterweight. This will hold the crankshaft in it's furthest forward position.
- Step 5: Install and tighten bolts (1-10) in sequence shown in (Fig. 45) to 41 N·m (30 ft. lbs.).
- Step 6: Remove wedge tool used to hold crankshaft.

(9) Tighten bolts (1-10) again to 41 N·m (30 ft. lbs.) +1/4 turn in sequence shown in (Fig. 45).

(10) Install main bearing bedplate to engine block bolts (11-20), and torque each bolt to 28 N·m (20 ft. lbs.) in sequence shown in (Fig. 45).

(11) After the main bearing bedplate is installed, check the crankshaft turning torque. The turning torque should not exceed 5.6 N·m (50 in. lbs.).

(12) Install balance shafts and housing assembly. (Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - INSTALLATION)

(13) Install the oil pump and pickup tube. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION)

(14) Install the timing belt rear cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

(15) Install the timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

(16) Install the timing belt front covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

(17) Install engine support bracket.

(18) Install the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION)

(19) Install the oil filter.

(20) Install crankshaft rear oil seal. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION)

(21) Install flex plate. Apply Mopar® Lock & Seal Adhesive to bolt threads and tighten to 95 N·m (70 ft. lbs.).

(22) Install the engine assembly. (Refer to 9 - ENGINE - INSTALLATION)

## CRANKSHAFT MAIN BEARINGS

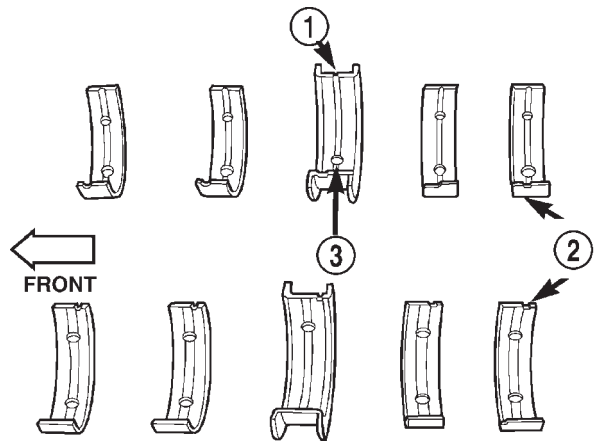
### STANDARD PROCEDURE - MAIN BEARING - FITTING

For crankshaft specifications (Refer to 9 - ENGINE - SPECIFICATIONS).

### CRANKSHAFT MAIN BEARINGS

The crankshaft is supported in five main bearings. All upper and lower bearing shells in the crankcase have oil grooves. Crankshaft end play is controlled by a flanged bearing on the number three main bearing journal (Fig. 46).

Upper and lower Number 3 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 46). All bearing cap bolts removed during service procedures are to be cleaned and oiled before installation. Bearing shells are available in standard and the following undersized: 0.025 mm (0.001 in.) and 0.250 mm (0.010 in.). Never install an undersize bearing that will reduce clearance below specifications. Replace or machine the crankshaft as necessary to obtain proper bearing clearances.



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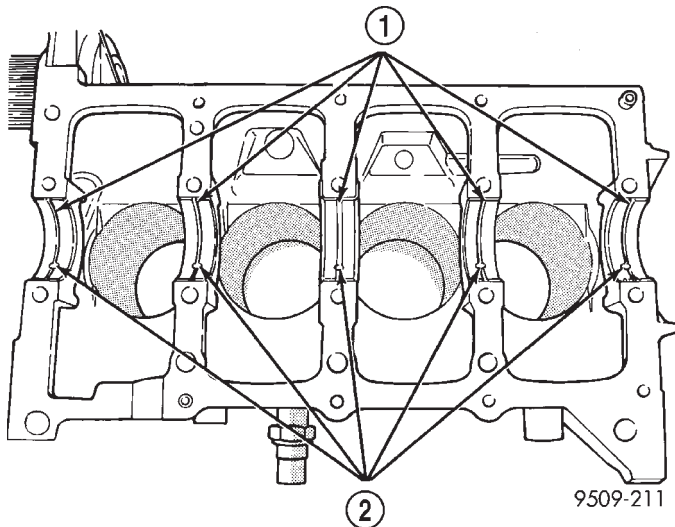
**Fig. 46 Main Bearing Identification**

- 1 - OIL GROOVE
- 2 - MAIN BEARINGS
- 3 - OIL HOLE

### MAIN BEARING INSTALLATION

(1) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 47).

## CRANKSHAFT MAIN BEARINGS (Continued)



**Fig. 47 Installing Main Bearing Upper Shell**

- 1 - LUBRICATION GROOVES  
2 - OIL HOLES

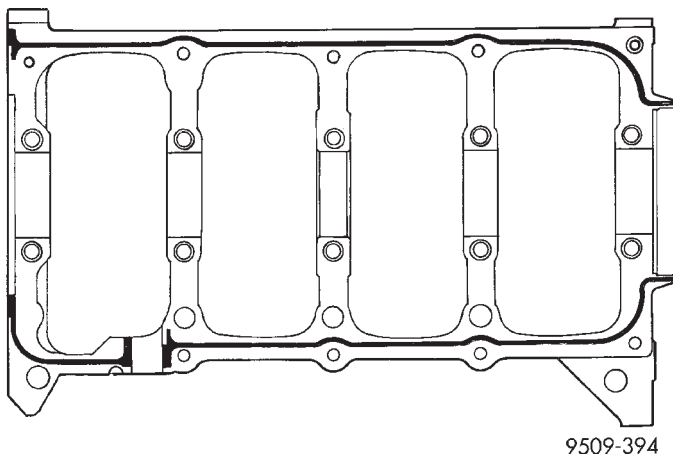
(2) Make certain oil holes in block line up with oil holes in bearings. Bearing tabs must seat in the block tab slots.

**CAUTION:** Do not get oil on the bedplate mating surface. It will may effect the sealer ability to seal the bedplate to cylinder block.

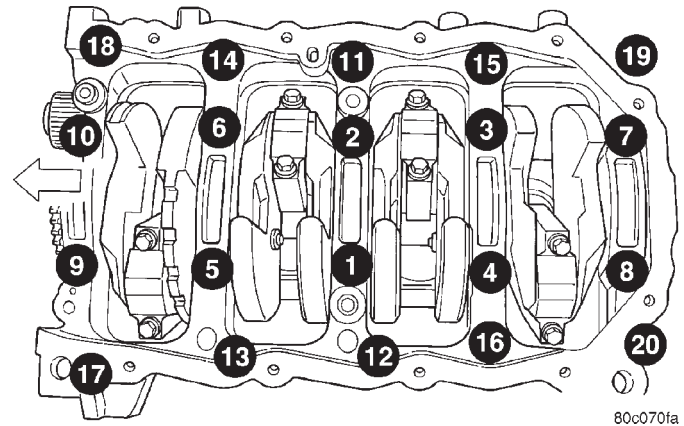
(3) Oil the bearings and journals and install crankshaft.

**CAUTION:** Use only the specified anaerobic sealer on the bedplate or damage may occur to the engine. Ensure that both cylinder block and bedplate surfaces are clean.

(4) Apply 1.5 to 2.0 mm (0.059 to 0.078 in.) bead of anaerobic sealer Mopar® Bed Plate Sealant to cylinder block as shown in (Fig. 48).



**Fig. 48 Main Bearing Caps/Bedplate Sealing**



**Fig. 49 Main Bearing Caps/Bedplate Tightening Sequence**

(5) Install lower main bearings into main bearing cap/bedplate. Make certain the bearing tabs are seated into the bedplate slots.

(6) Position the main bearing/bedplate onto the engine block.

(7) Before installing bolts, lubricate the threads with clean engine oil, wipe off any excess oil.

(8) Install main bearing bedplate to engine block bolts 11, 17 and 20 finger tight. Tighten these bolts down together until the bedplate contacts the cylinder block.

(9) To ensure correct thrust bearing alignment, perform the following steps:

- Step 1: Rotate crankshaft until number 4 piston is at TDC.

- Step 2: Move crankshaft rearward to limits of travel.

- Step 3: Then, move crankshaft forward to limits of travel.

- Step 4: Wedge an appropriate tool between the rear of the cylinder block (**NOT BED PLATE**) and the rear crankshaft counterweight. This will hold the crankshaft in it's furthest forward position.

- Step 5: Install and tighten bolts (1-10) in sequence shown in (Fig. 49) to 41 N·m (30 ft. lbs.).

- Step 6: Remove wedge tool used to hold crankshaft.

(10) Tighten bolts (1-10) again to 41 N·m (30 ft. lbs.) **PLUS** 1/4 turn in sequence shown in (Fig. 49).

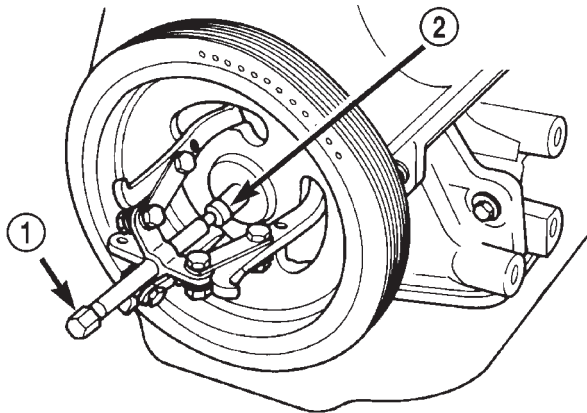
(11) Install main bearing bedplate to engine block bolts (11-20), and torque each bolt to 28 N·m (20 ft. lbs.) in sequence shown in (Fig. 49).

(12) After the main bearing bedplate is installed, check the crankshaft turning torque. The turning torque should not exceed 5.6 N·m (50 in. lbs.).

## CRANKSHAFT OIL SEAL - FRONT

### REMOVAL

(1) Remove the crankshaft vibration damper (Fig. 50). (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL)



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**Fig. 50 Crankshaft Vibration Damper - Removal - Typical**

- 1 - SPECIAL TOOL 1026 3-JAW PULLER
- 2 - SPECIAL TOOL 6827-A INSERT

(2) Remove timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(3) Remove crankshaft sprocket using Special Tool 6793 and insert C-4685-C2 (Fig. 51).

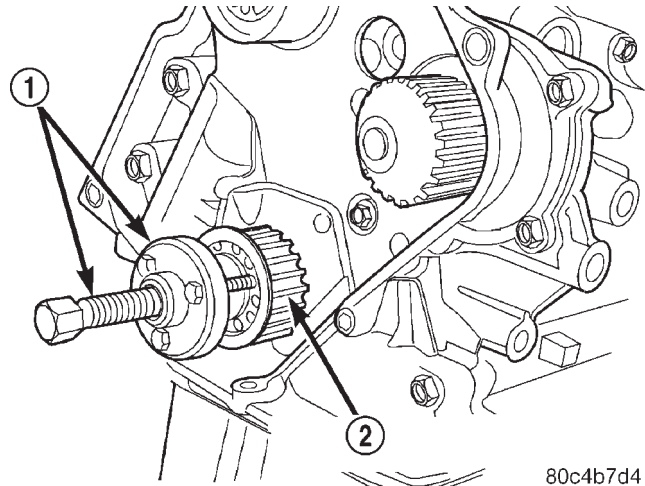
**CAUTION: Do not nick shaft seal surface or seal bore.**

(4) Using Tool 6771 to remove front crankshaft oil seal (Fig. 52). Be careful not to damage the seal surface of cover.

### INSTALLATION

(1) Install new seal by using Special Tool 6780 (Fig. 53).

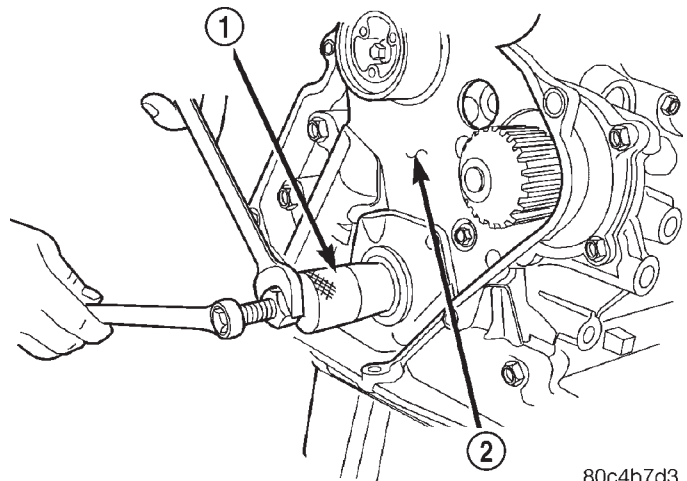
(2) Place seal into opening with seal spring towards the inside of engine. Install seal until flush with cover.



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**Fig. 51 Crankshaft Sprocket - Removal**

- 1 - SPECIAL TOOL 6793
- 2 - CRANKSHAFT SPROCKET

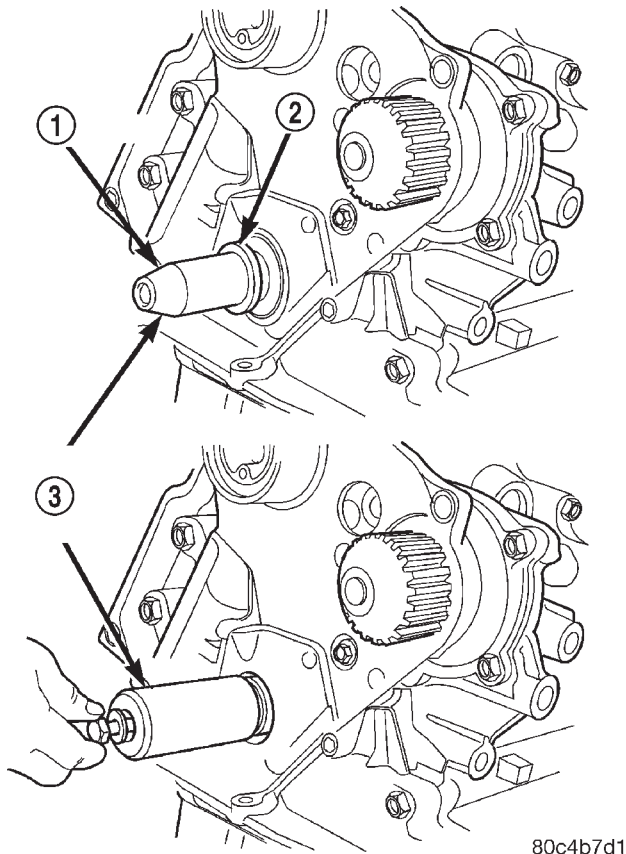


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**Fig. 52 Front Crankshaft Oil Seal - Removal**

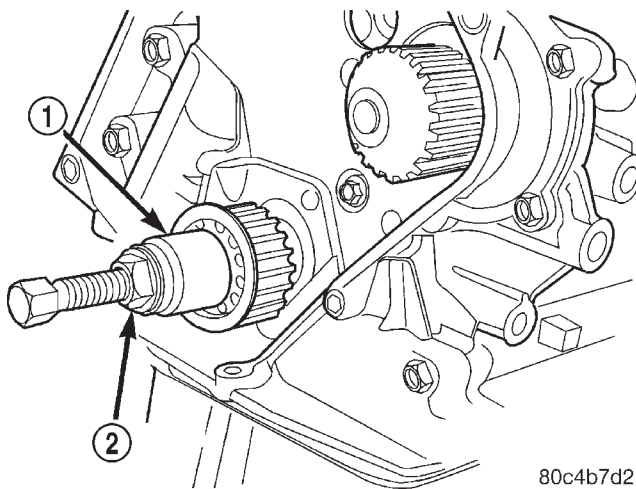
- 1 - SPECIAL TOOL 6771
- 2 - REAR TIMING BELT COVER

## CRANKSHAFT OIL SEAL - FRONT (Continued)

**Fig. 53 Crankshaft Front Oil Seal - Installation**

- 1 - PROTECTOR
- 2 - SEAL
- 3 - SPECIAL TOOL 6780

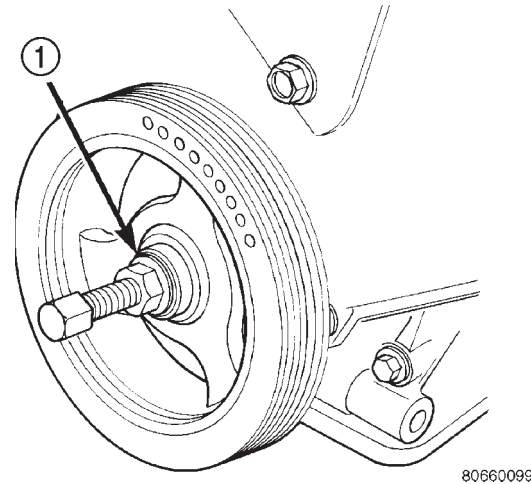
(3) Install crankshaft sprocket using Special Tool 6792 (Fig. 54).

**Fig. 54 Crankshaft Sprocket - Installation**

- 1 - SPECIAL TOOL 6792
- 2 - TIGHTEN NUT TO INSTALL

(4) Install timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

(5) Install crankshaft vibration damper (Fig. 55). (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION)

**Fig. 55 Crankshaft Vibration Damper - Installation - Typical**

- 1 - M12-1.75 x 150 MM BOLT, WASHER AND THRUST BEARING FROM SPECIAL TOOL 6792

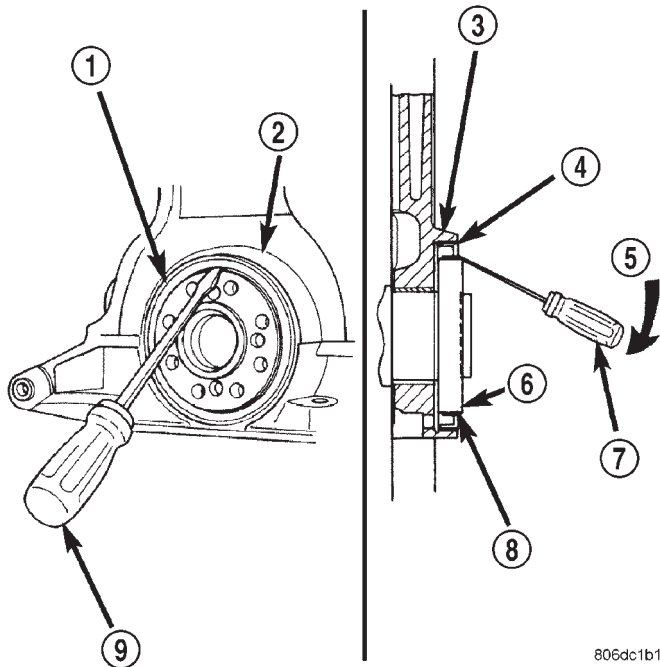
## CRANKSHAFT OIL SEAL - REAR

## REMOVAL

- (1) Remove transmission.
- (2) Remove flex plate.
- (3) Insert a 3/16 flat bladed screwdriver between the dust lip and the metal case of the crankshaft seal. Angle the screwdriver (Fig. 56) through the dust lip against metal case of the seal. Pry out seal.

**CAUTION:** Do not permit the screwdriver blade to contact crankshaft seal surface. Contact of the screwdriver blade against crankshaft edge (chamfer) is permitted.

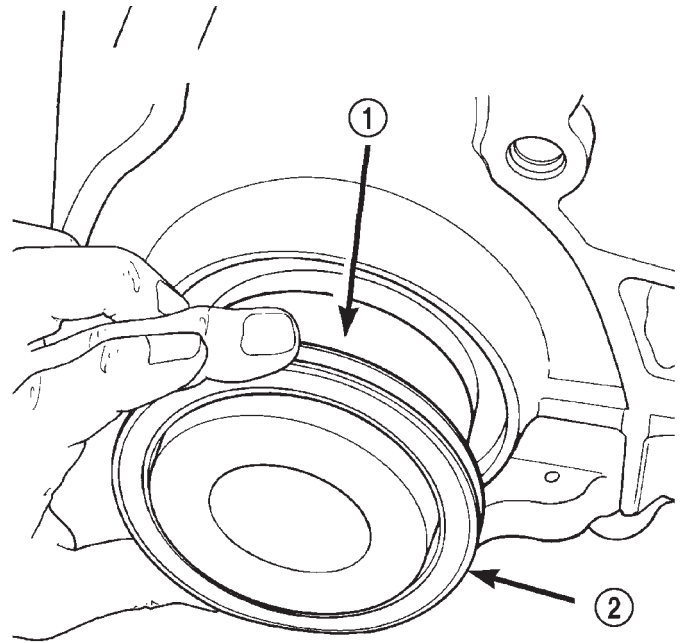
CRANKSHAFT OIL SEAL - REAR (Continued)



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**Fig. 56 Rear Crankshaft Oil Seal—Removal**

- 1 - REAR CRANKSHAFT SEAL
- 2 - ENGINE BLOCK
- 3 - ENGINE BLOCK
- 4 - REAR CRANKSHAFT SEAL METAL CASE
- 5 - PRY IN THIS DIRECTION
- 6 - CRANKSHAFT
- 7 - SCREWDRIVER
- 8 - REAR CRANKSHAFT SEAL DUST LIP
- 9 - SCREWDRIVER



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**Fig. 57 Rear Crankshaft Seal and Special Tool 6926-1**

- 1 - SPECIAL TOOL 6926-1 PILOT
- 2 - SEAL

**INSTALLATION**

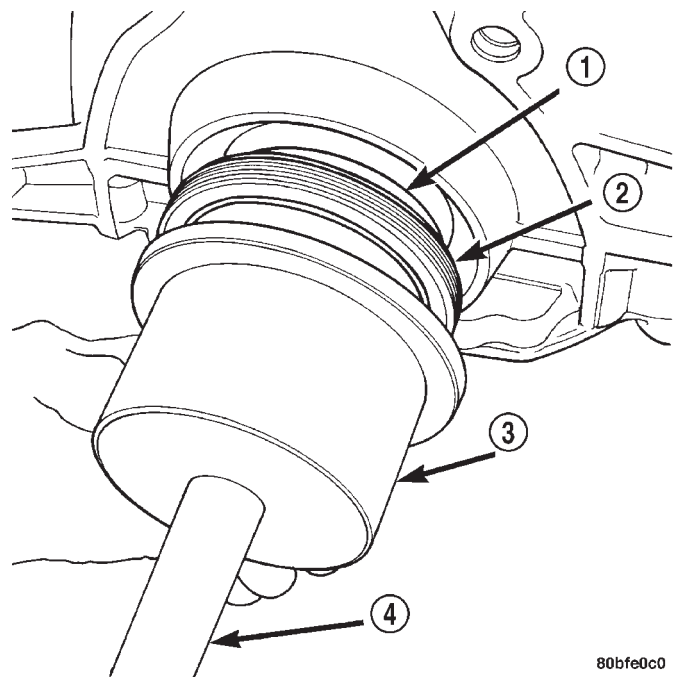
**CAUTION:** If burr or scratch is present on the crankshaft edge (chamfer), cleanup with 400 grit sand paper to prevent seal damage during installation of new seal.

**NOTE:** When installing seal, no lube on seal is needed.

- (1) Place Special Tool 6926-1 Seal Guide on crankshaft (Fig. 57).
- (2) Position seal over guide tool (Fig. 57). Guide tool should remain on crankshaft during installation of seal. Ensure that the lip of the seal is facing towards the crankcase during installation.

**CAUTION:** If the seal is driven into the block past flush, this may cause an oil leak.

- (3) Drive the seal into the block using Special Tool 6926-2 and handle C-4171 (Fig. 58) until the tool bottoms out against the block (Fig. 59).



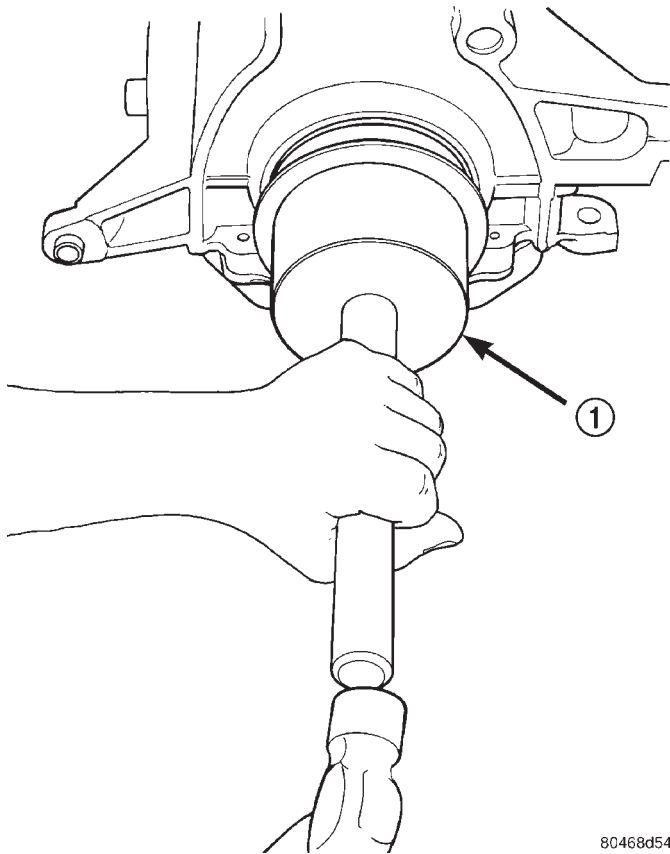
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**Fig. 58 Crankshaft Seal and Special Tools 6926-2 & C-4171**

- 1 - SPECIAL TOOL 6926-1 PILOT
- 2 - SEAL
- 3 - SPECIAL TOOL 6926-2 INSTALLER
- 4 - SPECIAL TOOL C-4171



## CRANKSHAFT OIL SEAL - REAR (Continued)



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**Fig. 59 Rear Crankshaft Seal—Installation**

1 - SPECIAL TOOL 6926-2 INSTALLER

(4) Install flex plate. Apply Mopar® Lock & Seal Adhesive to bolt threads and tighten bolts to 95 N·m (70 ft. lbs.).

(5) Install the transmission.

## PISTON &amp; CONNECTING ROD

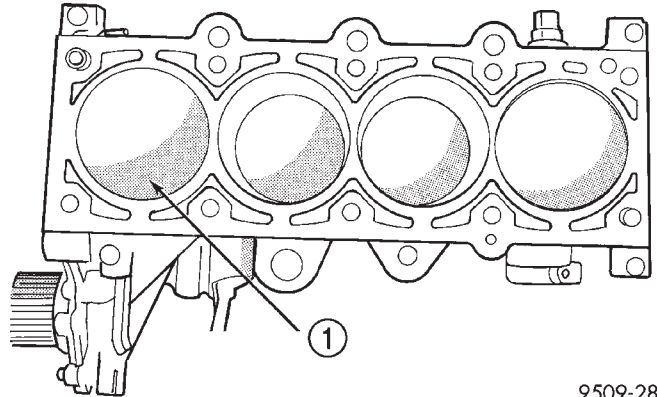
## DESCRIPTION

The pistons are made of a cast aluminum alloy. The pistons have pressed-in pins attached to forged powdered metal connecting rods. The pistons pin is offset 1 mm (0.0394 in.) towards the thrust side of the piston. The connecting rods are a cracked cap design and are not repairable. Hex head cap screws are used to provide alignment and durability in the assembly. The pistons and connecting rods are serviced as an assembly.

## OPERATION

The piston and connecting rod is the link between the combustion force to the crankshaft.

## REMOVAL



9509-286

**Fig. 60 Piston Markings**

1 - DIRECTIONAL ARROW WILL BE IMPRINTED IN THIS AREA

**NOTE: Cylinder Head must be removed before Pistons and Rods. Refer to Cylinder Head Removal in this section.**

(1) 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.** Mark piston with matching cylinder number (Fig. 60).

(2) Remove oil pan. Scribe the cylinder number on the side of the rod and cap (Fig. 61) for identification.

(3) Pistons have a directional stamping in the front half of the piston facing towards the **front** of engine.

(4) Pistons and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

(5) Remove Balance Shaft Assembly. Refer to Balance Shaft Removal in this section.

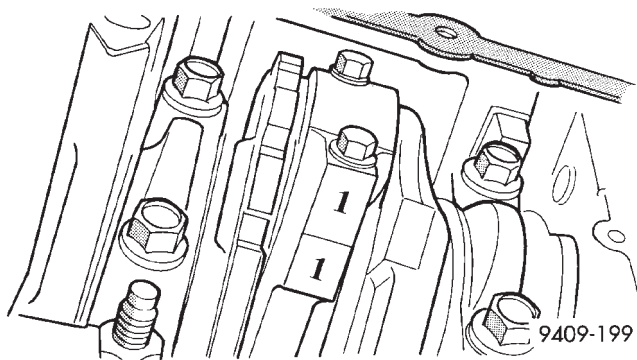
(6) Remove connecting rod cap bolts. Push each piston and rod assembly out of cylinder bore.

**NOTE: Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

(8) Piston and Rods are serviced as an assembly.

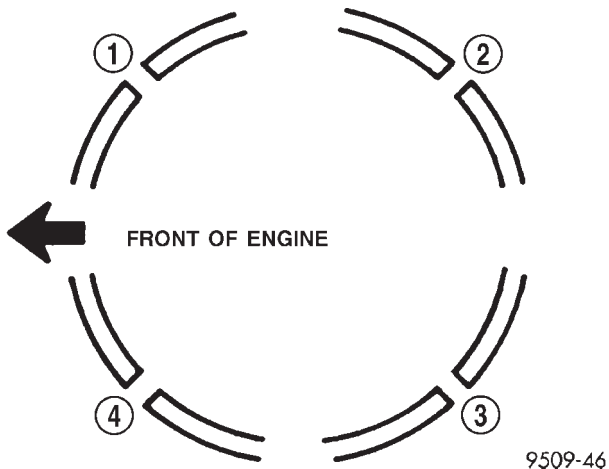
PISTON & CONNECTING ROD (Continued)



**Fig. 61 Identify Connecting Rod to Cylinder**

**INSTALLATION**

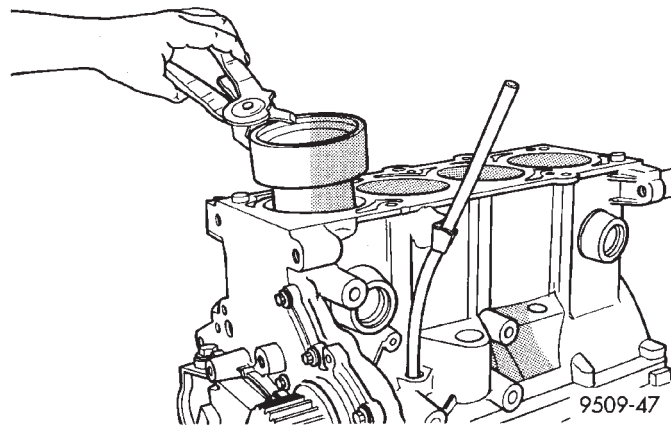
- (1) Before installing pistons and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.
- (2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 62). As viewed from top.



**Fig. 62 Piston Ring End Gap Position**

- 1 - GAP OF LOWER SIDE RAIL
- 2 - NO. 1 RING GAP
- 3 - GAP OF UPPER SIDE RAIL
- 4 - NO. 2 RING GAP AND SPACER EXPANDER GAP

- (3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston (Fig. 63). **Be sure position of rings does not change during this operation .**
- (4) The directional stamp on the piston should face toward the front of the engine.
- (5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston assembly into cylinder bore and guide rod over the crankshaft journal.



**Fig. 63 Piston—Installation**

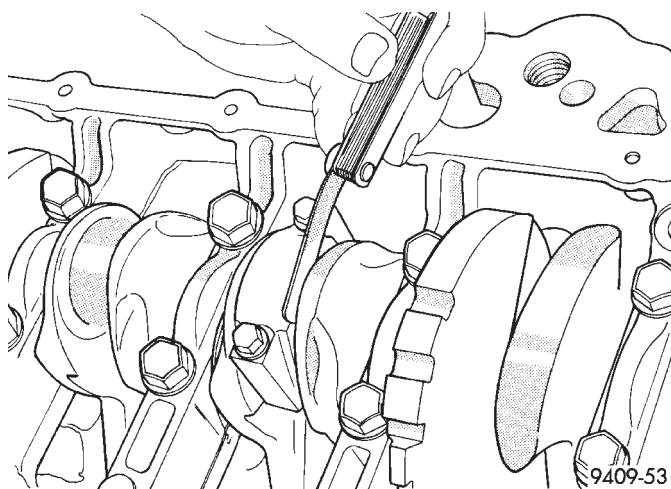
- (6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.

**NOTE: The connecting rod cap bolts should not be reused.**

- (7) Before installing the **NEW** bolts the threads should be coated with clean engine oil.
- (8) Install each bolt finger tight than alternately torque each bolt to assemble the cap properly.

**CAUTION: Do not use a torque wrench for second part of last step.**

- (9) Tighten the bolts to 54 N·m PLUS 1/4 turn (40 ft. lbs. PLUS 1/4 turn).
- (10) Using a feeler gauge, check connecting rod side clearance (Fig. 64).



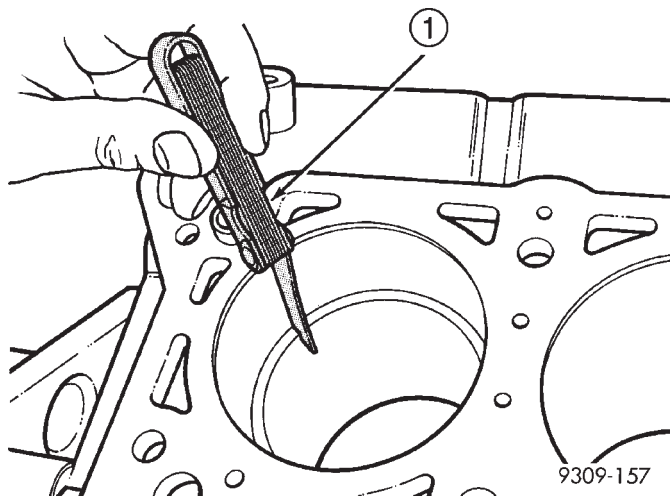
**Fig. 64 Checking Connecting Rod Side Clearance**

## PISTON RINGS

### STANDARD PROCEDURE

#### PISTON RING - FITTING

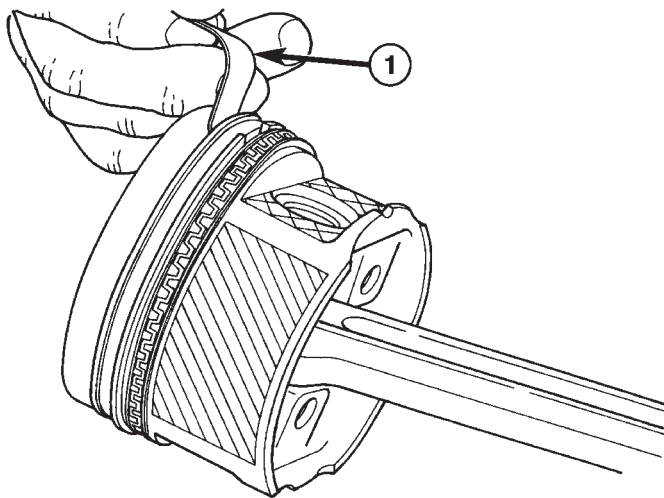
(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 65). Refer to Engine Specifications.



**Fig. 65 Piston Ring Gap**

1 - FEELER GAUGE

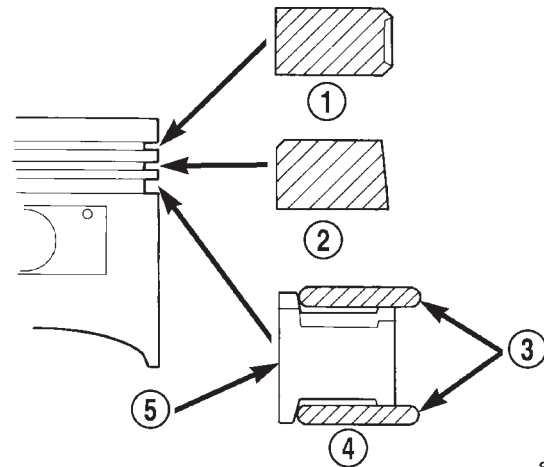
(2) Check piston ring to groove side clearance (Fig. 66). Refer to Engine Specifications.



**Fig. 66 Piston Ring Side Clearance**

1 - FEELER GAUGE

#### PISTON RINGS - INSTALLATION



**Fig. 67 Piston Ring Installation**

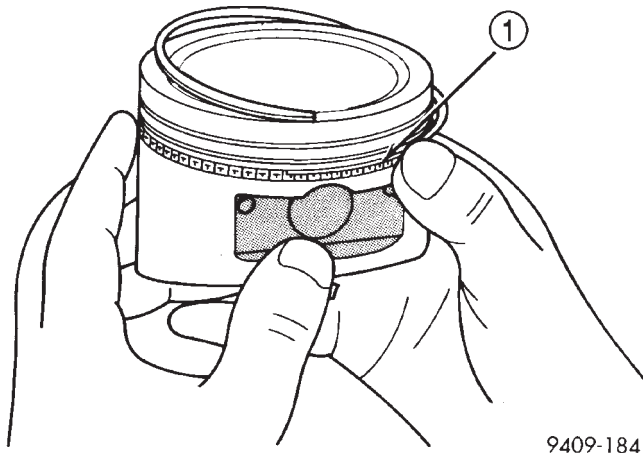
- 1 - NO. 1 PISTON RING
- 2 - NO. 2 PISTON RING
- 3 - SIDE RAIL
- 4 - OIL RING
- 5 - SPACER EXPANDER

(1) Install rings with manufacturers I.D. mark facing up, to the top of the piston (Fig. 67).

**CAUTION:** Install piston rings in the following order:

- a. Oil ring expander.
  - b. Upper oil ring side rail.
  - c. Lower oil ring side rail.
  - d. No. 2 Intermediate piston ring.
  - e. No. 1 Upper piston ring.
- (2) Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander** (Fig. 68).
- (3) Install upper side rail first and then the lower side rail.
- (4) Install No. 2 piston ring and then No. 1 piston ring.
- (5) Position piston ring end gaps as shown in (Fig. 69).
- (6) Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or on the thrust direction. Staggering ring gap is important for oil control.

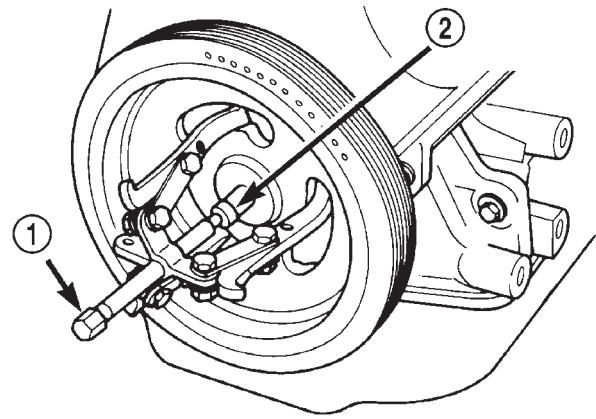
PISTON RINGS (Continued)



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**Fig. 68 Installing Side Rail - Typical**

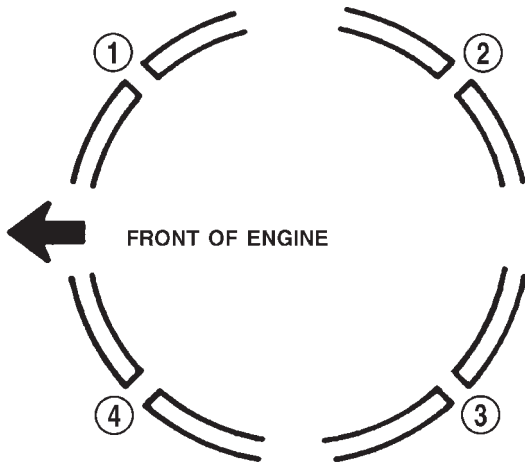
1 - SIDE RAIL END



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**Fig. 70 Crankshaft Vibration Damper - Removal - Typical**

1 - SPECIAL TOOL 1026 3-JAW PULLER  
2 - SPECIAL TOOL 6827-A INSERT



9509-46

**Fig. 69 Piston**

1 - GAP OF LOWER SIDE RAIL  
2 - NO. 1 RING GAP  
3 - GAP OF UPPER SIDE RAIL  
4 - NO. 2 RING GAP AND SPACER EXPANDER GAP

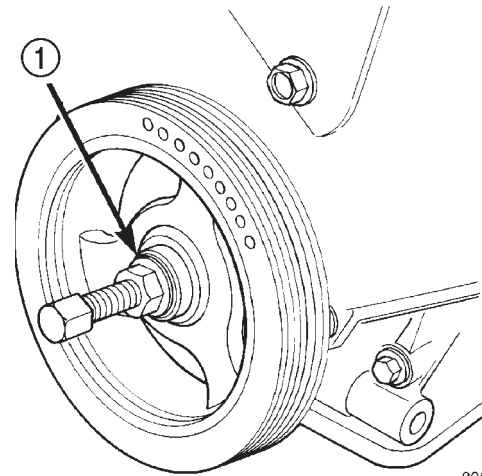
VIBRATION DAMPER

REMOVAL

- (1) Remove accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)
- (2) Remove crankshaft damper bolt.
- (3) Remove damper using Special Tool 3-Jaw Puller 1026 and Insert 6827-A (Fig. 70).

INSTALLATION

- (1) Install crankshaft vibration damper using M12 1.75 x 150 mm bolt, washer, thrust bearing and nut from Special Tool 6792 (Fig. 71).
- (2) Install crankshaft vibration damper bolt and tighten to 142 N-m (105 ft. lbs.).
- (3) Install accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)



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**Fig. 71 Crankshaft Vibration Damper - Installation - Typical**

1 - M12-1.75 x 150 MM BOLT, WASHER AND THRUST BEARING FROM SPECIAL TOOL 6792

## STRUCTURAL COLLAR

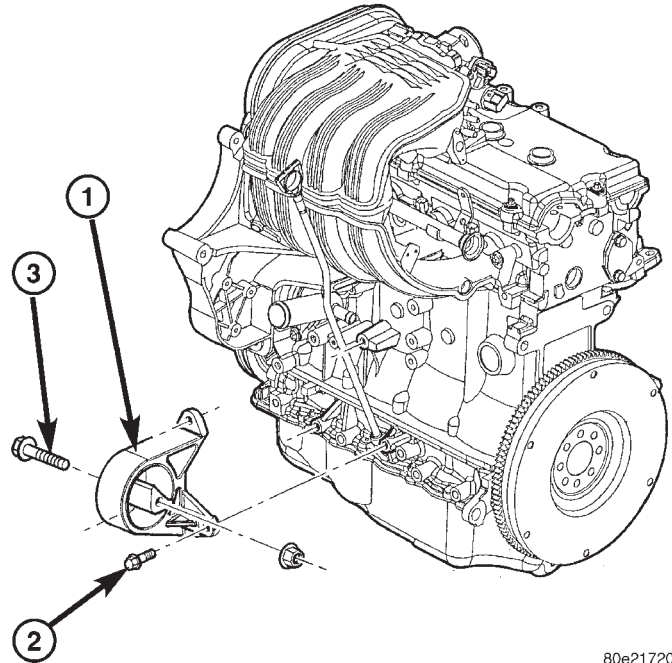
### REMOVAL

- (1) Raise vehicle on hoist.
- (2) Remove structural collar attaching bolts.
- (3) Remove collar.

### INSTALLATION

**CAUTION:** Torque procedure for the structural collar must be followed or damage could occur to oil pan and collar.

- (1) Perform the following steps for installing structural collar.
  - Step 1: Position collar between transmission and oil pan. Install collar to transmission bolts, **hand start only**.
  - Step 2: Install collar to oil pan bolts, **hand snug only**.
  - Step 3: Tighten collar to transmission bolts.
  - Step 4: Tighten collar to oil pan bolts.
- (2) Lower vehicle.



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**Fig. 72 LH ENGINE MOUNT**

- 1 - ENGINE MOUNT
- 2 - ENGINE MOUNT BOLT (3)
- 3 - ENGINE MOUNT THROUGH BOLT

## ENGINE MOUNTING

### DESCRIPTION

The engine mounting system consist of three mounts; right and a left side support the powertrain, and rear mount to control powertrain torque. The mounts are of molded rubber material.

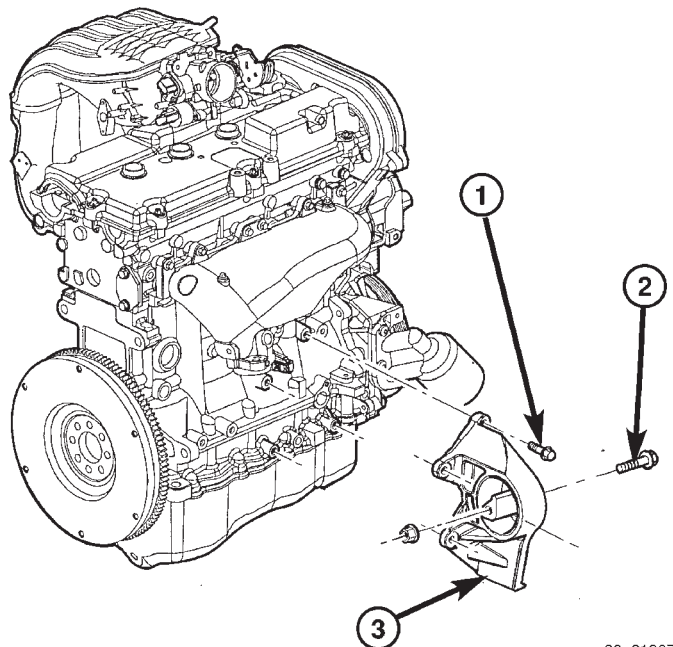
### FRONT MOUNT

#### REMOVAL

- (1) Raise vehicle on hoist.
- (2) Remove the front engine mount through bolt from the insulator.
- (3) Remove the engine front mount bolts and remove the insulator assembly.
- (4) Remove the front mounting bracket from engine, if necessary.

#### INSTALLATION

- (1) Install the insulator mount assembly (Fig. 72) and (Fig. 73).
- (2) Tighten the mount to engine bolts.
- (3) Loosely install the front engine mount through bolt to the insulator.
- (4) Lower the engine.
- (5) Tighten the through bolt.
- (6) Lower the vehicle.



80e21807

**Fig. 73 RH ENGINE MOUNT**

- 1 - ENGINE MOUNT BOLT (4)
- 2 - ENGINE MOUNT THROUGH BOLT
- 3 - ENGINE MOUNT

## REAR MOUNT

### REMOVAL

**NOTE:** A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

- (1) Disconnect negative cable from battery.
- (2) Raise the vehicle and support the transmission.
- (3) Remove the nuts holding the support cushion to the crossmember. Remove the crossmember.

### MANUAL TRANSMISSION

- a. Remove the support cushion nuts and remove the cushion.
- b. Remove the transmission support bracket bolts and remove the bracket from the transmission.

### AUTOMATIC TRANSMISSION

- c. Remove the support cushion bolts and remove the cushion and the support bracket from the transmission (4WD) or from the adaptor bracket (2WD).
- d. On 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission. Remove the adaptor bracket.

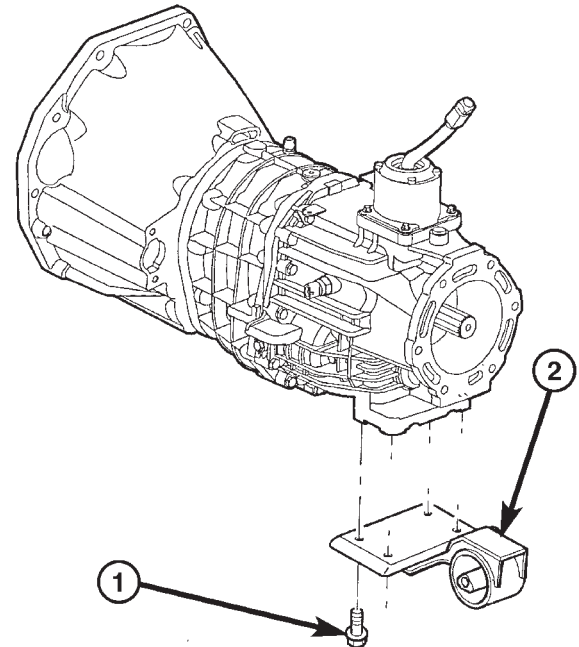
### INSTALLATION

#### MANUAL TRANSMISSION:

- (1) Install the support cushion to the transmission (Fig. 74) or (Fig. 75). Install the bolts and tighten.
- (2) Position the crossmember in the vehicle. Install the crossmember to mount through bolt and nut.
- (3) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.
- (4) Remove the transmission support.
- (5) Lower the vehicle.
- (6) Connect negative cable to battery.

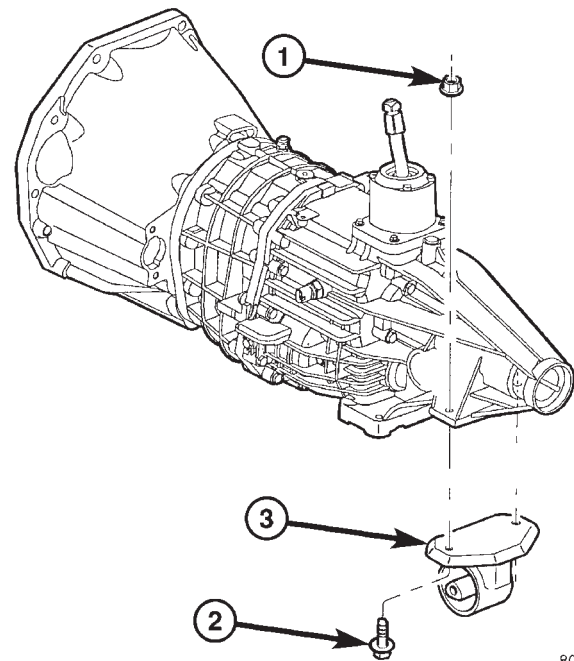
#### AUTOMATIC TRANSMISSION:

- (1) Install the transmission mount to transmission (Fig. 76) and (Fig. 77). Install the bolts.
- (2) Position the crossmember in the vehicle. Install the crossmember to mount through bolt and nut.
- (3) Remove the transmission support.
- (4) Lower the vehicle.
- (5) Connect negative cable to battery.



**Fig. 74 TRANSMISSION MOUNT-2.4L MANUAL TRANS**

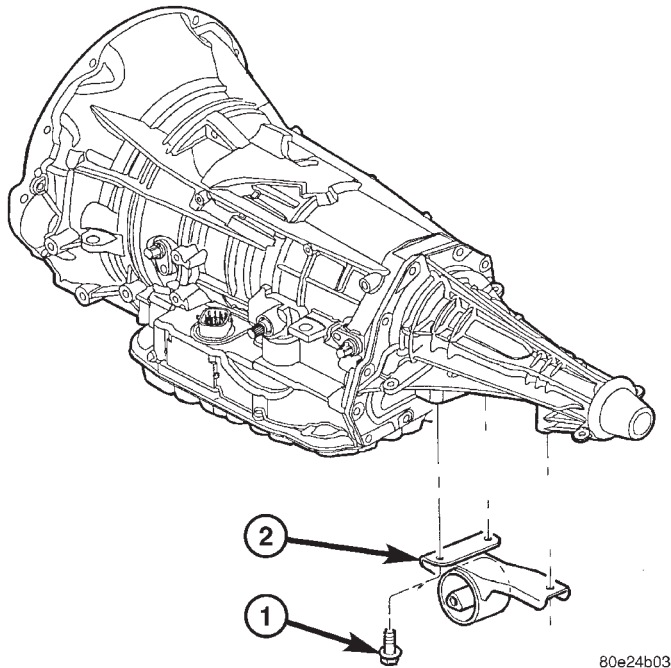
- 1 - TRANSMISSION MOUNT
- 2 - MOUNTING BOLT



**Fig. 75 TRANSMISSION MOUNT 3.7L MANUAL TRANS 2WD**

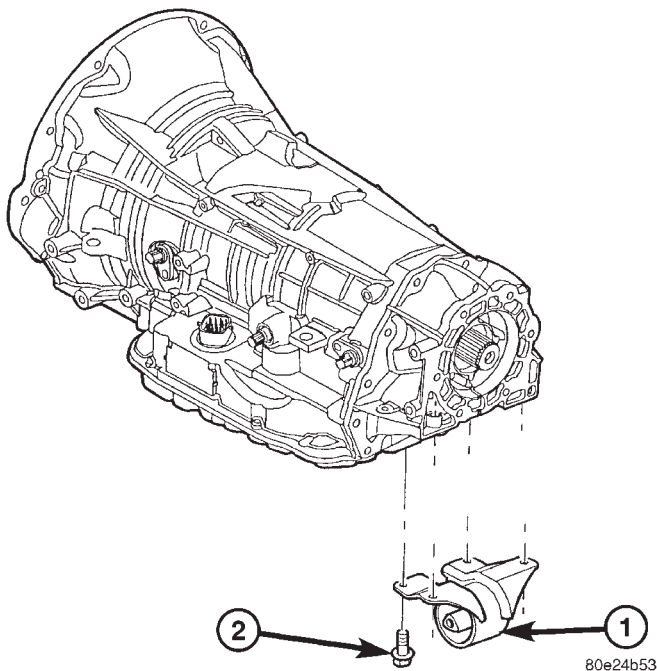
- 1 - NUT
- 2 - BOLT
- 3 - TRANS MOUNT

## LUBRICATION (Continued)



**Fig. 76 TRANSMISSION MOUNT 3.7L 2WD AUTO TRANS**

- 1 - BOLT  
2 - MOUNT



**Fig. 77 TRANSMISSION MOUNT 3.7L 4WD AUTO TRANS**

- 1 - MOUNT  
2 - BOLT

## LUBRICATION

## DESCRIPTION

The lubrication system is a full-flow filtration, pressure feed type. The oil pump is mounted in the front engine cover and driven by the crankshaft.

## OPERATION

Engine oil drawn up through the pickup tube and is pressurized by the oil pump and routed through the full-flow filter to the main oil gallery running the length of the cylinder block. A diagonal hole in each bulkhead feeds oil to each main bearing. Drilled passages within the crankshaft route oil from main bearing journals to connecting rod journals. Balance shaft lubrication is provided through an oil passage from the number one main bearing cap through the balance shaft carrier support leg. This passage directly supplies oil to the front bearings and internal machined passages in the shafts that routes oil from front to the rear shaft bearing journals. A vertical hole at the number five bulkhead routes pressurized oil through a restrictor (integral to the cylinder head gasket) up past a cylinder head bolt to an oil gallery running the length of the cylinder head. The camshaft journals are partially slotted to allow a predetermined amount of pressurized oil to pass into the bearing cap cavities. Lubrication of the camshaft lobes are provided by small holes in the camshaft bearing caps that are directed towards each lobe. Oil returning to the pan from pressurized components supplies lubrication to the valve stems. Cylinder bores and wrist pins are splash lubricated from directed slots on the connecting rod thrust collars.

## DIAGNOSIS AND TESTING - ENGINE OIL PRESSURE CHECKING

(1) Disconnect and remove oil pressure switch. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL)

(2) Install Special Tools C-3292 Gauge with 8406 Adaptor fitting.

(3) Start engine and record oil pressure. Refer to Specifications for correct oil pressure requirements. (Refer to 9 - ENGINE - SPECIFICATIONS)

**CAUTION:** If oil pressure is 0 at idle, do not perform the 3000 RPM test

(4) If oil pressure is 0 at idle. Shut off engine, check for pressure relief valve stuck open, a clogged oil pick-up screen or a damaged oil pick-up tube O-ring.

(5) After test is complete, remove test gauge and fitting.

## LUBRICATION (Continued)

(6) Install oil pressure switch and connector. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - INSTALLATION)

## OIL

## STANDARD PROCEDURE

## ENGINE OIL LEVEL CHECK

The best time to check engine oil level is after it has sat overnight, or if the engine has been running, allow the engine to be shut off for at least 5 minutes before checking oil level.

Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. Remove dipstick and observe oil level. Add oil only when the level is at or below the ADD mark (Fig. 78).

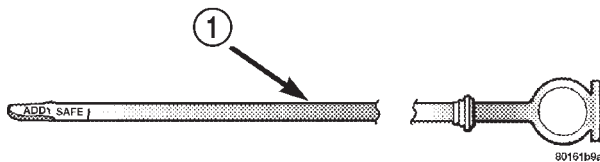


Fig. 78 Oil Level

1 - ENGINE OIL LEVEL DIPSTICK

## STANDARD PROCEDURE - ENGINE OIL AND FILTER CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION)

**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. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.**

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands. Refer to Hoisting and Jacking Recommendations. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(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) Remove oil filter. (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL)

(7) Install and tighten drain plug in crankcase.

(8) Install new oil filter. (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION)

(9) Lower vehicle and fill crankcase with specified type and amount of engine oil. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION)

(10) Install oil fill cap.

(11) Start engine and inspect for leaks.

(12) Stop engine and inspect oil level.

**NOTE: Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING listed above.**

## OIL FILTER

## DESCRIPTION

The engine oil filter is a high quality full-flow, disposable type. Replace the oil filter with a Mopar® or the equivalent.

## REMOVAL

(1) Raise vehicle on hoist.

(2) Position an oil collecting container under oil filter location.

**CAUTION: When servicing the oil filter avoid deforming the filter can by installing the remove/install tool band strap against the can to base lock seam. The lock seam joining the can to the base is reinforced by the base plate.**

(3) Using a suitable filter wrench, turn oil filter counterclockwise to remove (Fig. 79).

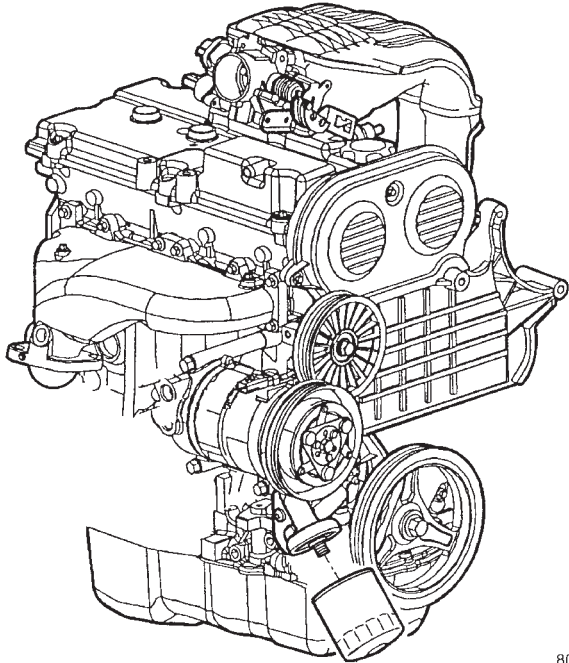
## INSTALLATION

(1) Clean and check filter mounting surface. The surface must be smooth, flat and free of debris or pieces of gasket.

(2) Lubricate new oil filter gasket with clean engine oil.



## OIL FILTER (Continued)



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**Fig. 79 2.4 OIL FILTER**

(3) Screw oil filter on until the gasket contacts base. Tighten to 21 N·m (15 ft. lbs.).

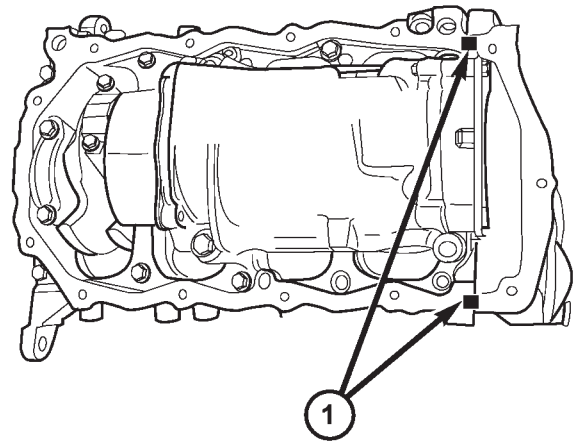
## OIL PAN

## REMOVAL

- (1) Remove air cleaner assembly.
- (2) Raise vehicle on hoist and drain engine oil.
- (3) Loosen the engine mount thru bolts.
- (4) Disconnect exhaust pipe at manifold.
- (5) Remove structural collar, if equipped.
- (6) Remove front axle mounting bolts, and lower axle as far possible, if equipped.
- (7) Using suitable jack, raise engine as needed.
- (8) Remove oil pan attaching bolts.
- (9) Remove oil pan.
- (10) Clean oil pan and all gasket surfaces.

## INSTALLATION

- (1) Install the oil pan gasket to the block.
- (2) Apply a 3MM (1/8 inch) bead of Mopar® Engine RTV at the oil pump to engine block parting line (Fig. 80).
- (3) Install pan and tighten the screws to 12 N·m (105 in. lbs.).
- (4) Lower engine, and remove jack.
- (5) Tighten engine mount thru bolts.
- (6) Raise the front axle into position, and reinstall front axle mounting bolts. If equipped.
- (7) Reconnect exhaust pipe to manifold.
- (8) Install structural collar, if equipped.
- (9) Lower vehicle.



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**Fig. 80 OIL PAN GASKET INSTALLATION**

1 - SEALER LOCATION

(10) Fill engine crankcase with proper oil to correct level.

(11) Reinstall air cleaner assembly.

OIL PRESSURE SENSOR/  
SWITCH

## DESCRIPTION

The 3-wire, electrical/mechanical engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

## OPERATION

The oil pressure sensor uses three circuits. They are:

- A 5-volt power supply from the Powertrain Control Module (PCM)
- A sensor ground through the PCM's sensor return
- A signal to the PCM relating to engine oil pressure

The oil pressure sensor has a 3-wire electrical function very much like the Manifold Absolute Pressure (MAP) sensor. Meaning different pressures relate to different output voltages.

A 5-volt supply is sent to the sensor from the PCM to power up the sensor. The sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the

OIL PRESSURE SENSOR/SWITCH (Continued)

instrument panel on either a CCD or PCI bus circuit (depending on vehicle line) to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

OIL PUMP

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)
- (3) Remove timing belt rear cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)
- (4) Remove oil pan. (Refer to 9 - ENGINE/LUBRI- CATION/OIL PAN - REMOVAL)
- (5) Remove crankshaft sprocket using Special Tools 6793 and C-4685-C2 (Fig. 81).
- (6) Remove crankshaft key (Fig. 82).

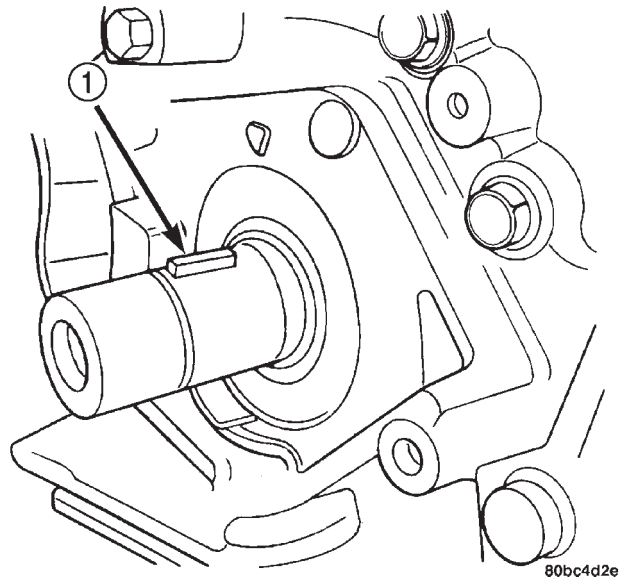


Fig. 82 Crankshaft Key

1 - CRANKSHAFT KEY

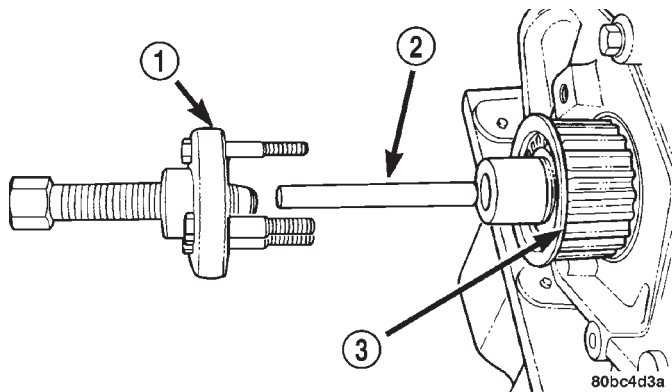


Fig. 81 Crankshaft Sprocket - Removal

1 - SPECIAL TOOL 6793  
 2 - SPECIAL TOOL C-4685-C2  
 3 - CRANKSHAFT SPROCKET

- (7) Remove oil pick-up tube.
- (8) Remove oil pump (Fig. 83) and front crankshaft seal.

DISASSEMBLY

- (1) To remove the relief valve, proceed as follows:
  - (a) Remove the threaded plug and gasket from the oil pump.
  - (b) Remove spring and relief valve.
- (2) Remove oil pump cover fasteners, and lift off cover.
- (3) Remove pump rotors.
- (4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

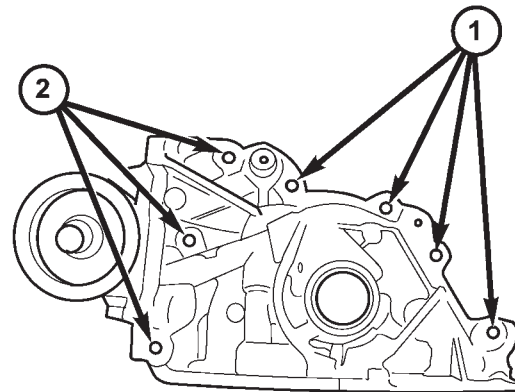


Fig. 83 2.4L OIL PUMP

1 - BOLTS  
 2 - BOLTS

CLEANING

- (1) Clean all parts thoroughly in a suitable sol- vent.

## OIL PUMP (Continued)

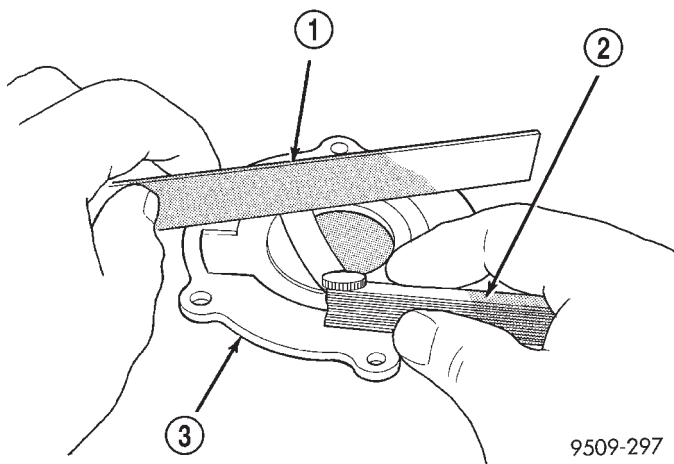
## INSPECTION

(1) Inspect the mating surface of the oil pump. Surface should be smooth. Replace pump cover if scratched or grooved.

(2) Lay a straightedge across the pump cover surface (Fig. 84). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

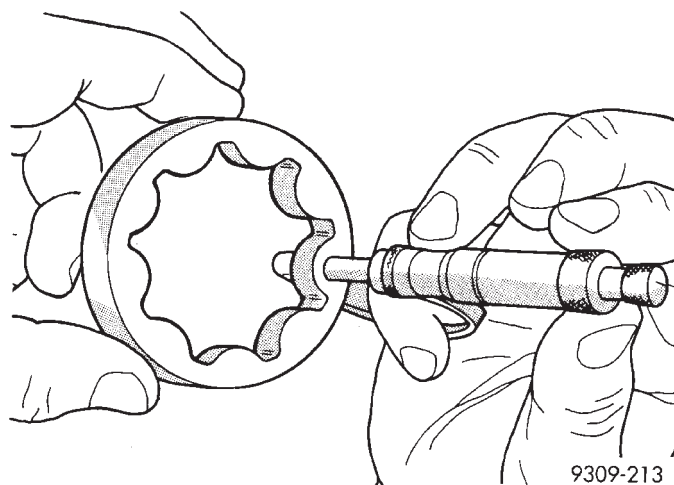
(3) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 9.40 mm (0.370 in.) or less (Fig. 85), or if the diameter is 79.95 mm (3.148 in.) or less, replace outer rotor.

(4) If inner rotor measures 9.40 mm (0.370 in.) or less replace inner rotor (Fig. 86).

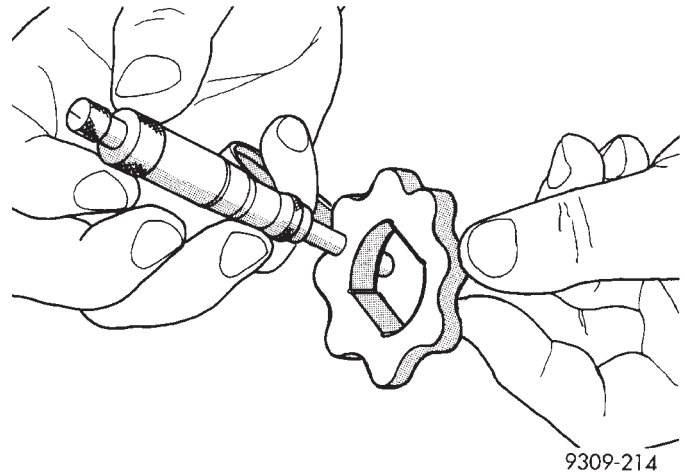


**Fig. 84 Checking Oil Pump Cover Flatness**

- 1 - STRAIGHT EDGE
- 2 - FEELER GAUGE
- 3 - OIL PUMP COVER



**Fig. 85 Measuring Outer Rotor Thickness**



**Fig. 86 Measuring Inner Rotor Thickness**

## ASSEMBLY

(1) Assemble pump, using new parts as required. **Install the inner rotor with chamfer facing the cast iron oil pump cover.**

(2) Prime oil pump before installation by filling rotor cavity with engine oil.

(3) Install cover and tighten fasteners to 12 N·m (105 in. lbs.).

**CAUTION: Oil pump pressure relief valve must be installed correctly or serious engine damage may occur.**

(4) Install relief valve, spring, gasket and cap. Tighten cap to 41 N·m (30 ft. lbs.).

## INSTALLATION

(1) Make sure all surfaces are clean and free of oil and dirt.

(2) Apply Mopar® Gasket Maker to oil pump as shown in (Fig. 87). Install O-ring into oil pump body discharge passage.

(3) Prime oil pump with engine oil before installation.

(4) Align oil pump rotor flats with flats on crankshaft. Install the oil pump to the block.

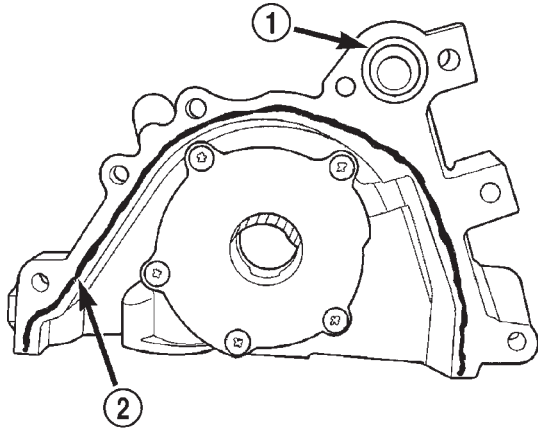
**CAUTION: To align, the front crankshaft seal MUST be out of pump, or damage may result.**

(5) Install new front crankshaft seal using Special Tool 6780 (Fig. 88).

(6) Install crankshaft key (Fig. 82).

**CAUTION: The crankshaft sprocket is set to a pre-determined depth from the factory for correct timing belt tracking. If removed, use of Special Tool 6792 is required to set the sprocket to original installation depth. An incorrectly installed sprocket will result in timing belt and engine damage.**

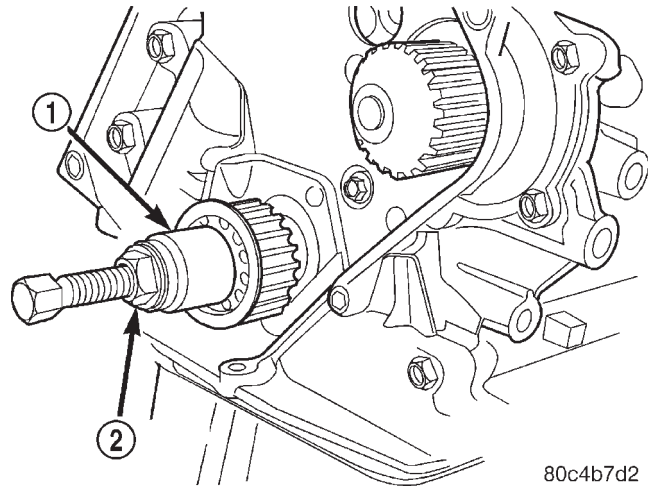
OIL PUMP (Continued)



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**Fig. 87 Oil Pump Sealing - Typical**

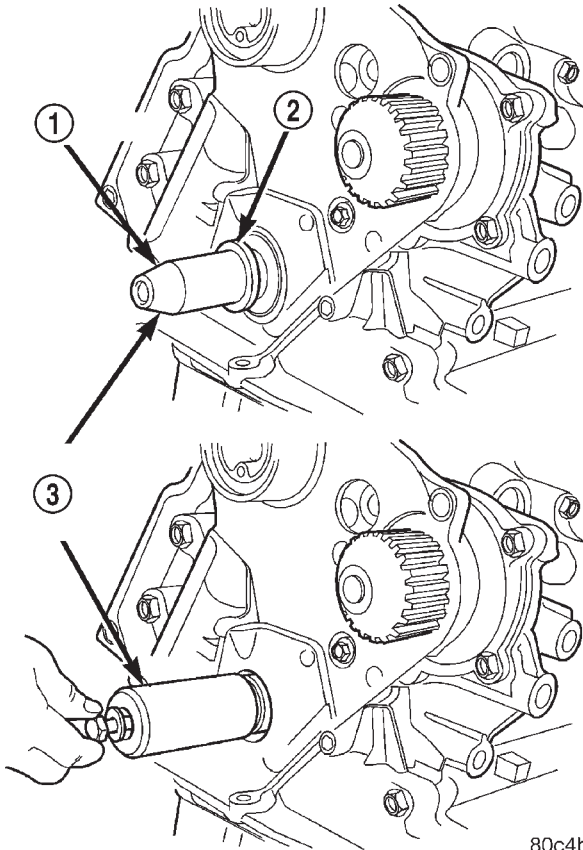
- 1 - O-RING
- 2 - SEALER LOCATION



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**Fig. 89 Crankshaft Sprocket - Installation**

- 1 - SPECIAL TOOL 6792
- 2 - TIGHTEN NUT TO INSTALL



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**Fig. 88 Front Crankshaft Seal - Installation**

- 1 - PROTECTOR
- 2 - SEAL
- 3 - SPECIAL TOOL 6780

- (7) Install crankshaft sprocket using Special Tool 6792 (Fig. 89).
- (8) Install oil pump pick-up tube.

(9) Install oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION)

(10) Install timing belt rear cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

(11) Install timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

## INTAKE MANIFOLD

### DESCRIPTION

The intake manifold is a one piece composite module that attaches to the cylinder head with fasteners. The manifold is a long branch design to enhance low and mid-range torque

### OPERATION

The intake manifold delivers air to the combustion chambers. This air allows the fuel delivered by the fuel injectors to ignite when the spark plug fire.

### DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKS

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.

## INTAKE MANIFOLD (Continued)

- (2) Spray a small stream of water (Spray Bottle) at the suspected leak area.
- (3) If engine RPM'S change, the area of the suspected leak has been found.
- (4) Repair as required.

## REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Disconnect connector from inlet air temperature sensor.
- (3) Disconnect air intake tube at throttle body and remove upper air cleaner housing.
- (4) Disconnect connector from throttle position sensor (TPS).
- (5) Disconnect connector from idle air control (IAC) motor.
- (6) Disconnect connector from MAP sensor.
- (7) Remove vacuum lines for purge solenoid and PCV valve at intake manifold.
- (8) Remove vacuum lines for power brake booster, LDP, EGR transducer, and speed control vacuum reservoir (if equipped) at intake manifold fittings.
- (9) Disconnect throttle, speed control (if equipped), and transaxle control (if equipped) and cables from throttle lever and bracket. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL)
- (10) Perform fuel system pressure release procedure **before attempting any repairs**. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE)
- (11) Disconnect fuel line. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE)
- (12) Disconnect coolant temperature sensor/fuel injector wire harness connector.
- (13) Disconnect fuel injector harness.
- (14) Remove intake manifold to cylinder head fasteners.
- (15) Remove the manifold from engine.

**CAUTION: Cover intake manifold openings to prevent foreign material from entering engine.**

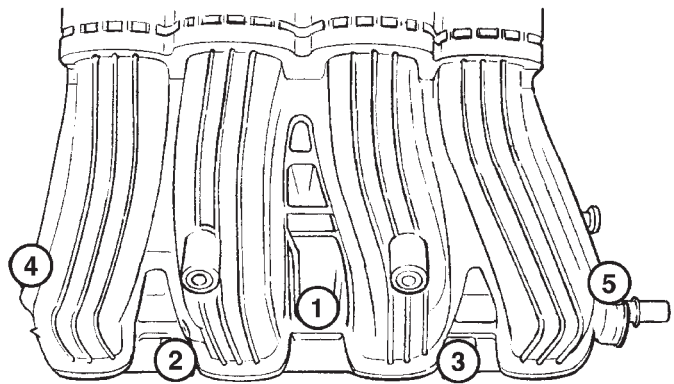
- (16) Inspect the manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSPECTION)

## INSPECTION

- (1) Check manifold surfaces for flatness with straight edge. Surface must be flat within 0.15 mm per 300 mm (0.006 in. per foot) of manifold length.
- (2) Inspect manifold for cracks or distortion. Replace manifold if necessary.

## INSTALLATION

- (1) Clean manifold sealing surfaces.
- (2) Install new manifold to cylinder head seals.
- (3) Install manifold to head.
- (4) Install and tighten intake manifold fasteners to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 90). Repeat procedure until all bolts are at specified torque.



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**Fig. 90 LOWER INTAKE MANIFOLD TIGHTENING SEQUENCE**

- (5) Install throttle cables in bracket.
- (6) Connect throttle, speed control, (if equipped), cables to throttle lever.
- (7) Connect vacuum lines for power brake booster, LDP, EGR transducer, and speed control vacuum reservoir (if equipped) at upper intake manifold fittings.
- (8) Connect vacuum lines for purge solenoid and PCV valve.
- (9) Connect electrical connectors for MAP sensor, throttle position sensor (TPS), and idle air control (IAC) motor.
- (10) Connect the fuel line. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE)
- (11) Connect coolant temperature sensor/fuel injector wiring harness electrical connector.
- (12) Install the air cleaner housing and air intake tube to throttle body.
- (13) Connect inlet air temperature sensor connector.
- (14) Connect negative cable to battery.

## EXHAUST MANIFOLD

### DESCRIPTION

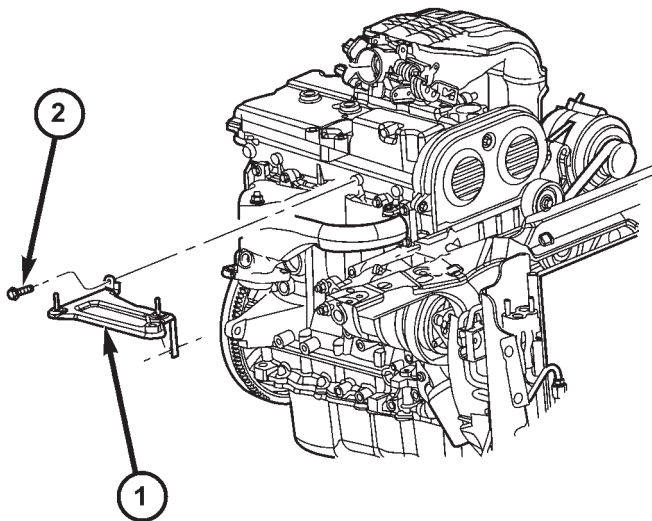
The exhaust manifold is made of Hi-Silicone Moly nodular cast iron for strength and high temperatures. The manifold attaches to the cylinder head.

### OPERATION

The exhaust manifold collects the exhaust gasses exiting the combustion chambers. Then it channels the exhaust gasses to the exhaust pipe attached to the manifold.

### REMOVAL

- (1) Raise vehicle and disconnect exhaust pipe from the exhaust manifold.
- (2) Lower the vehicle.
- (3) Disconnect upstream oxygen sensor connector at the rear of exhaust manifold.
- (4) Remove the air cleaner bracket (Fig. 91).



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**Fig. 91 AIR CLEANER BRACKET**

- 1 - AIR CLEANER BRACKET  
2 - BOLT (2)

- (5) Remove the heat shield.
- (6) Remove the bolts attaching the manifold to the cylinder head.
- (7) Remove exhaust manifold.
- (8) Inspect the manifold. (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSPECTION)

### CLEANING

- (1) Discard gasket (if equipped) and clean all surfaces of manifold and cylinder head.

### INSPECTION

- (1) Inspect manifold gasket surfaces for flatness with straight edge. Surface must be flat within 0.15 mm per 300 mm (0.006 in. per foot) of manifold length.
- (2) Inspect manifolds for cracks or distortion. Replace manifold as necessary.

### INSTALLATION

- (1) Clean the manifold mating surfaces.
- (2) Install exhaust manifold with a new gasket. Tighten attaching nuts to 20 N·m (175 in. lbs.).
- (3) Attach exhaust pipe to exhaust manifold and tighten fasteners to 37 N·m (27 ft. lbs.).
- (4) Install and connect the oxygen sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/O2 SENSOR - COMPONENT LOCATION)
- (5) Install the heat shield.
- (6) Install the air cleaner bracket.

## TIMING BELT COVER(S)

### REMOVAL

#### FRONT COVER

- (1) Remove crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL)
- (2) Remove generator drive belt tensioner assembly. (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - REMOVAL)
- (3) Remove timing belt front cover bolts, and remove covers.

#### REAR COVER

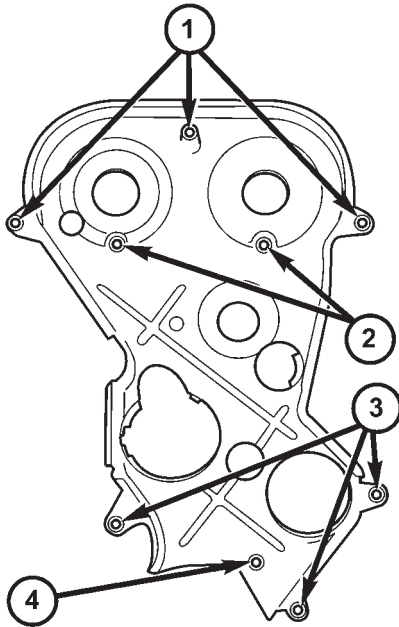
- (1) Remove front covers.
- (2) Remove timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)
- (3) Hold camshaft sprocket with Special Tool 6847 while removing center bolt.
- (4) Remove timing belt idler pulley.
- (5) Remove rear cover fasteners and remove cover from engine.

### INSTALLATION

#### REAR COVER

- (1) Install timing belt rear cover and bolts (Fig. 92). Torque bolts to 12 N·m (105 in. lbs).

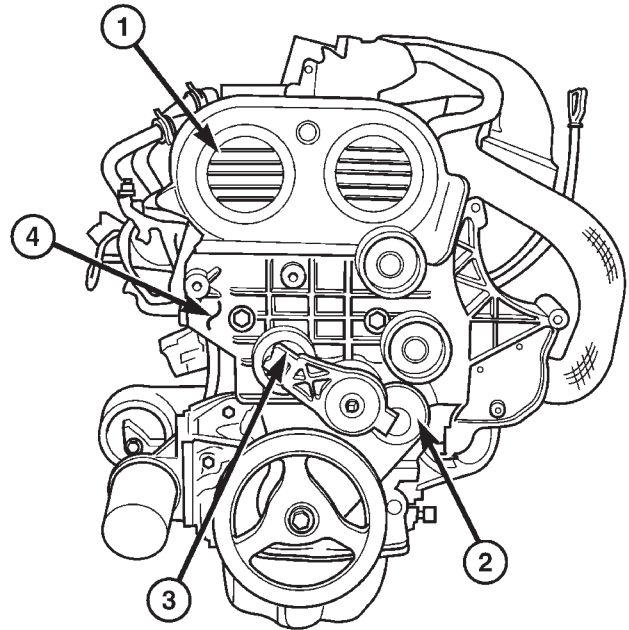
## TIMING BELT COVER(S) (Continued)



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**Fig. 92 TIMING BELT REAR COVER FASTENERS**

- 1 - OUTER COVER TO REAR COVER FASTENERS (3)
- 2 - REAR COVER TO CYLINDER HEAD FASTENERS
- 3 - OUTER COVER TO REAR COVER FASTENERS (3)
- 4 - INNER COVER TO BLOCK FASTENERS



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**Fig. 93 ACCESSORY DRIVE BRACKET**

- 1- UPPER TIMING BELT COVER
- 2- LOWER TIMING BELT COVER
- 3- BELT TENSIONER
- 4- ACCESSORY DRIVE BRACKET

**CAUTION:** Do not use an impact wrench for tightening camshaft sprocket bolt. Damage to the timing locating pin can occur. Hand tighten using a wrench **ONLY**.

(2) Install camshaft sprockets, and camshaft target ring. Hold sprockets with Special Tool 6848 and tighten center bolt to 101 N·m (75 ft. lbs.).

(3) Install timing belt idler pulley and tighten mounting bolt to 61 N·m (45 ft. lbs.).

(4) Install timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

(5) Install accessory drive bracket (Fig. 93).

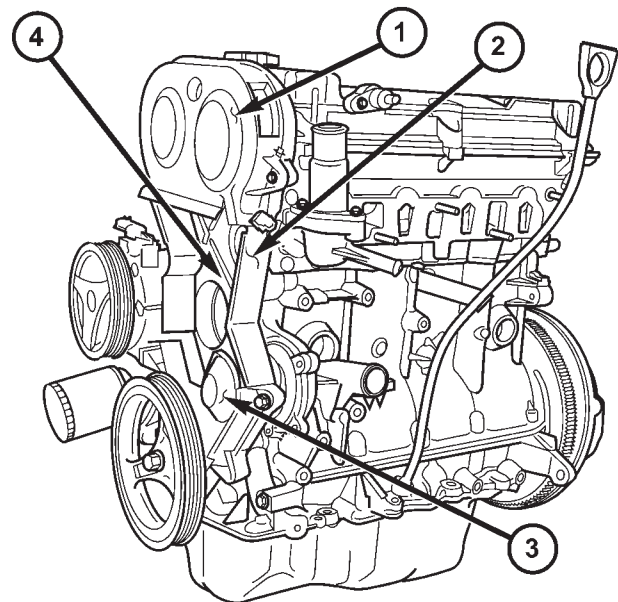
(6) Install front covers.

**FRONT COVER**

(1) Install timing belt front covers (Fig. 94). Tighten fasteners to 7 N·m (60 in. lbs.).

(2) Install generator drive belt tensioner. (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION)

(3) Install crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION)



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**Fig. 94 TIMING BELT COVERS**

- 1- UPPER TIMING BELT COVER
- 2- REAR TIMING BELT COVER
- 3- LOWER TIMING BELT COVER
- 4- ACCESSORY DRIVE BRACKET NOT SHOWN

## TIMING BELT AND SPROCKET(S)

### REMOVAL

#### REMOVAL - TIMING BELT

- (1) Remove air cleaner upper cover, housing, and clean air tube.
- (2) Raise vehicle on hoist.
- (3) Remove accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - REMOVAL)
- (4) Remove crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL)
- (5) Remove air conditioner/generator belt tensioner and pulley assembly. (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - REMOVAL)
- (6) Remove timing belt lower front cover bolts and remove cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)
- (7) Lower vehicle.
- (8) Remove bolts attaching timing belt upper front cover and remove cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

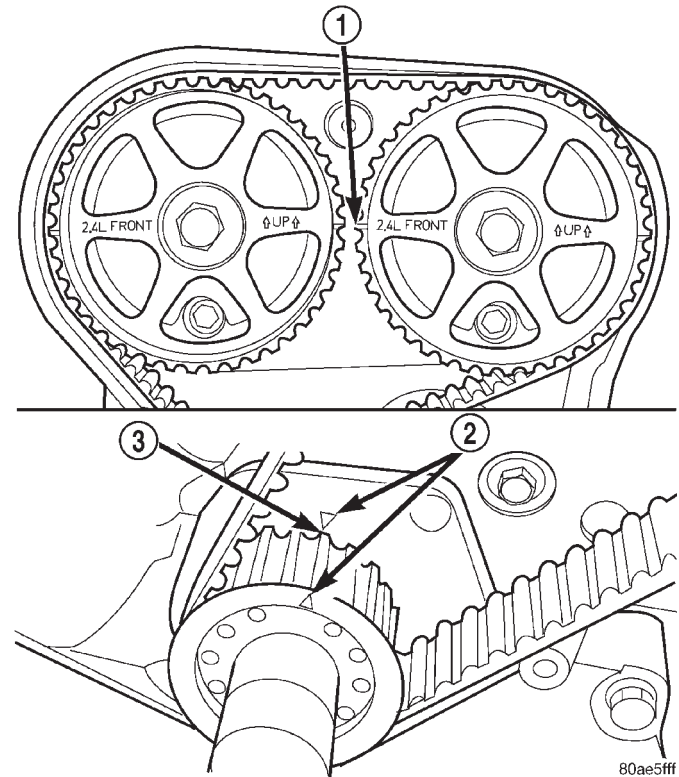
**CAUTION:** When aligning crankshaft and camshaft timing marks always rotate engine from crankshaft. Camshaft should not be rotated after timing belt is removed. Damage to valve components may occur. Always align timing marks before removing timing belt.

- (9) Before the removal of the timing belt, rotate crankshaft until the TDC mark on oil pump housing aligns with the TDC mark on crankshaft sprocket (trailing edge of sprocket tooth) (Fig. 95).

**NOTE:** The crankshaft sprocket TDC mark is located on the trailing edge of the sprocket tooth. Failure to align trailing edge of sprocket tooth to TDC mark on oil pump housing will cause the camshaft timing marks to be misaligned.

- (10) Install 6 mm Allen wrench into belt tensioner. Before rotating the tensioner, insert the long end of a 1/8" or 3 mm Allen wrench into the pin hole on the front of the tensioner (Fig. 96). While rotating the tensioner counterclockwise, push in lightly on the 1/8" or 3 mm Allen wrench, until it slides into the locking hole.

- (11) Remove timing belt.



**Fig. 95 Crankshaft and Camshaft Timing**

- 1 - CAMSHAFT TIMING MARKS
- 2 - CRANKSHAFT TDC MARKS
- 3 - TRAILING EDGE OF SPROCKET TOOTH

#### REMOVAL - CRANKSHAFT SPROCKET

- (1) Disconnect negative battery cable.
- (2) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
- (3) Remove crankshaft sprocket using Special Tools 6793 and insert C-4685-C2 (Fig. 97).

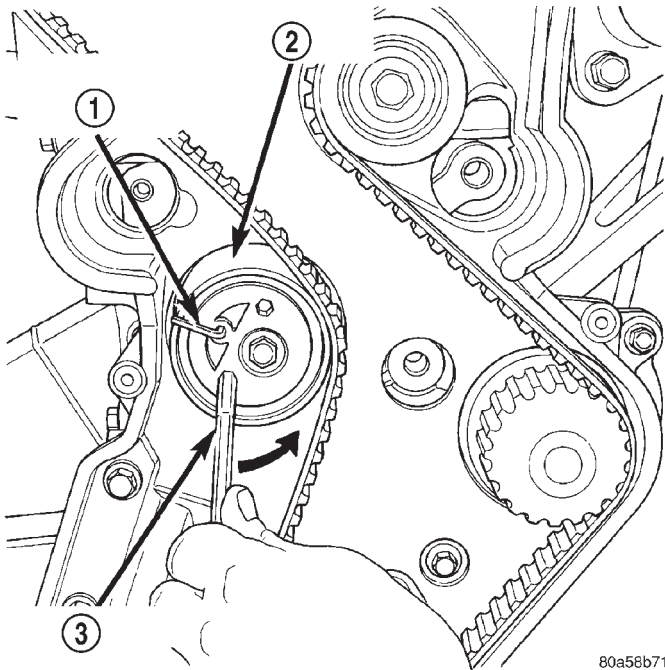
#### CLEANING

Do Not attempt to clean a timing belt. If contamination from oil, grease, or coolants have occurred, the timing belt should be replaced.

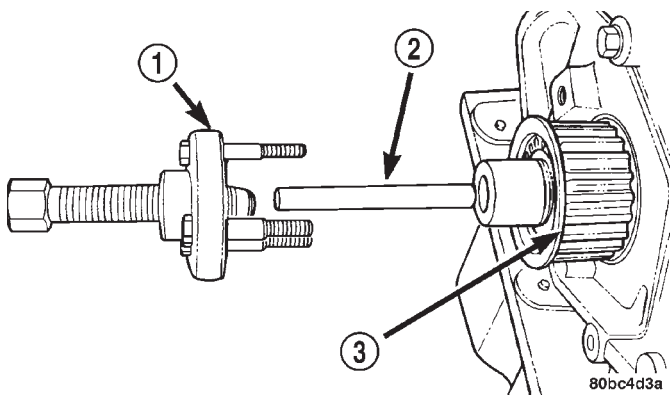
Clean all sprockets using a suitable solvent. Clean all sprocket grooves of any debris.



## TIMING BELT AND SPROCKET(S) (Continued)

**Fig. 96 Locking Timing Tensioner**

- 1 - 1/8 OR 3mm ALLEN WRENCH
- 2 - BELT TENSIONER
- 3 - 6mm ALLEN WRENCH

**Fig. 97 Crankshaft Sprocket - Removal**

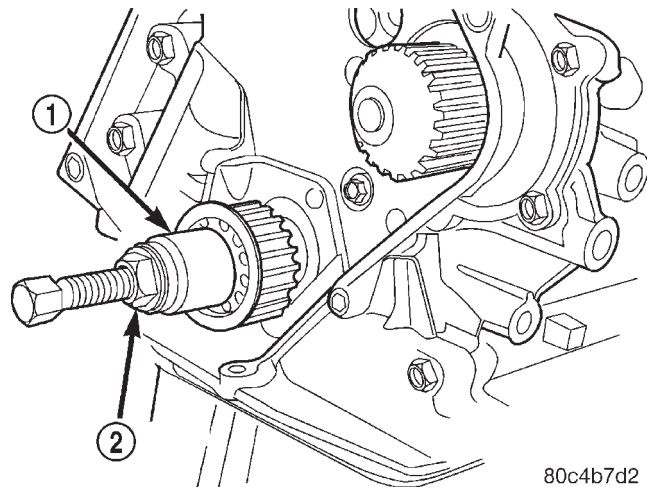
- 1 - SPECIAL TOOL 6793
- 2 - SPECIAL TOOL C-4685-C2
- 3 - CRANKSHAFT SPROCKET

## INSTALLATION

## INSTALLATION - CRANKSHAFT SPROCKET

**CAUTION:** The crankshaft sprocket is set to a pre-determined depth from the factory for correct timing belt tracking. If removed, use of Special Tool 6792 is required to set the sprocket to original installation depth. An incorrectly installed sprocket will result in timing belt and engine damage.

- (1) Install crankshaft sprocket using Special Tool 6792 (Fig. 98).

**Fig. 98 Crankshaft Sprocket - Installation**

- 1 - SPECIAL TOOL 6792
- 2 - TIGHTEN NUT TO INSTALL

- (2) Install timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

## INSTALLATION - TIMING BELT

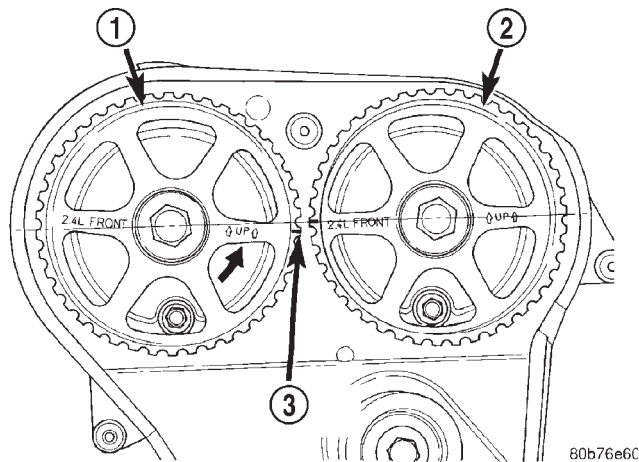
**CAUTION:** The crankshaft sprocket is set to a pre-determined depth from the factory for correct timing belt tracking. If removed, use of Special Tool 6792 is required to set the sprocket to original installation depth. An incorrectly installed sprocket will result in timing belt and engine damage.

## TIMING BELT AND SPROCKET(S) (Continued)

(1) Set crankshaft sprocket to TDC by aligning the sprocket with the arrow on the oil pump housing.

(2) Set camshafts timing marks so that the exhaust camshaft sprocket is a 1/2 notch below the intake camshaft sprocket (Fig. 99).

**CAUTION:** Ensure that the arrows on both camshaft sprockets are facing up.



**Fig. 99 Camshaft Sprocket Alignment**

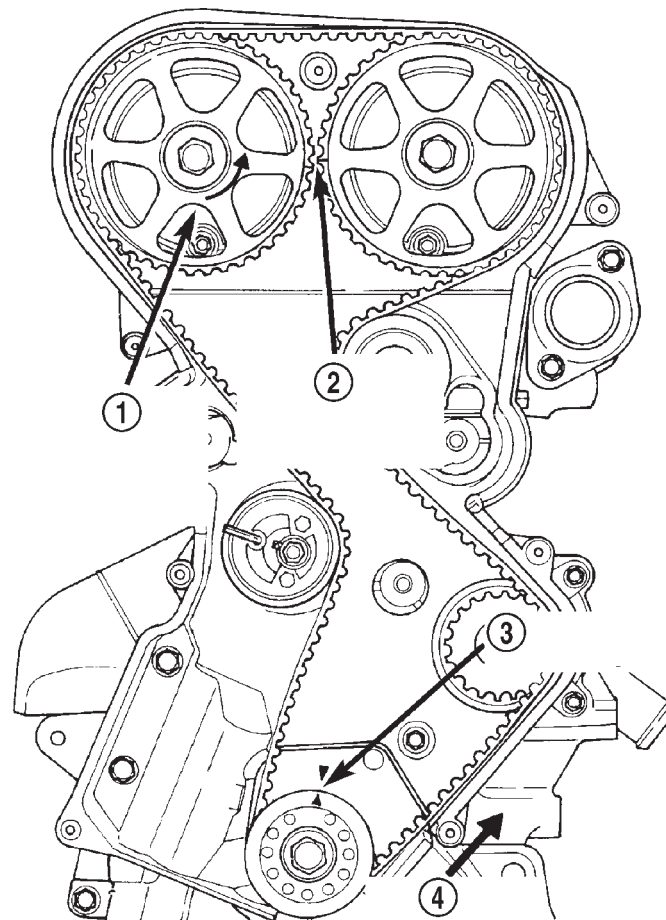
- 1 - CAMSHAFT SPROCKET-EXHAUST
- 2 - CAMSHAFT SPROCKET-INTAKE
- 3 - 1/2 NOTCH LOCATION

(3) Install timing belt. Starting at the crankshaft, go around the water pump sprocket, idler pulley, camshaft sprockets and then around the tensioner (Fig. 100).

(4) Move the exhaust camshaft sprocket counterclockwise (Fig. 100) to align marks and take up belt slack.

(5) Insert a 6 mm Allen wrench into the hexagon opening located on the top plate of the belt tensioner pulley. Rotate the top plate **COUNTERCLOCKWISE**. The tensioner pulley will move against the belt and the tensioner setting notch will eventually start to move clockwise. Watching the movement of the setting notch, continue rotating the top plate counterclockwise until the setting notch is aligned with the spring tang (Fig. 101). Using the allen wrench to prevent the top plate from moving, torque the tensioner lock nut to 30 N·m (22 ft. lbs.). Setting notch and spring tang should remain aligned after lock nut is torqued.

(6) Remove allen wrench and torque wrench.



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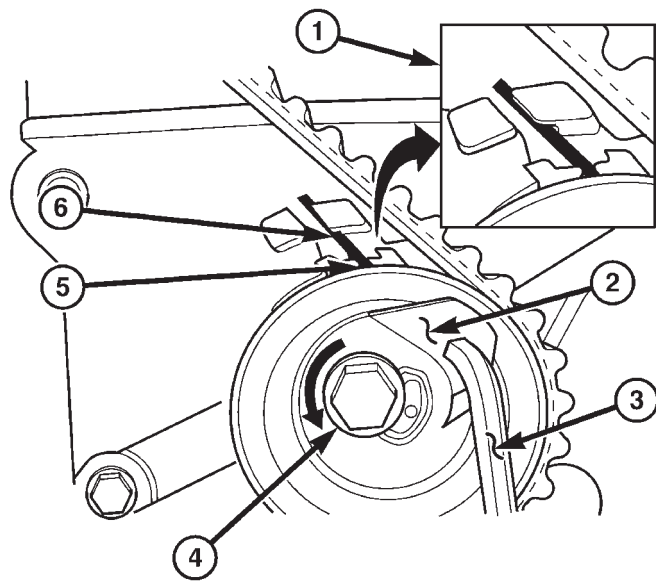
**Fig. 100 Timing Belt - Installation - Typical**

- 1 - ROTATE CAMSHAFT SPROCKET TO TAKE UP BELT SLACK
- 2 - CAMSHAFT TIMING MARKS 1/2 NOTCH LOCATION
- 3 - CRANKSHAFT AT TDC
- 4 - INSTALL BELT IN THIS DIRECTION

**NOTE:** Repositioning the crankshaft to the TDC position must be done only during the **CLOCKWISE** rotation movement. If TDC is missed, rotate a further two revolutions until TDC is achieved. **DO NOT** rotate crankshaft counterclockwise as this will make verification of proper tensioner setting impossible.

(7) Once the timing belt has been installed and tensioner adjusted, rotate the crankshaft **CLOCKWISE** two complete revolutions manually for seating of the belt, until the crankshaft is repositioned at the TDC position. Verify that the camshaft and crankshaft timing marks are in proper position (Fig. 102).

TIMING BELT AND SPROCKET(S) (Continued)



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**Fig. 101 Timing Belt Tension Adjustment**

- 1 - ALIGN SETTING NOTCH WITH SPRING TANG
- 2 - TOP PLATE
- 3 - 6mm ALLEN WRENCH
- 4 - LOCK NUT
- 5 - SETTING NOTCH
- 6 - SPRING TANG

(8) Check if the spring tang is within the tolerance window (Fig. 103). If the spring tang is within the tolerance window, the installation process is complete and nothing further is required. If the spring tang is not within the tolerance window, repeat Steps 5 through 7.

(9) Install timing belt front covers and bolts. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

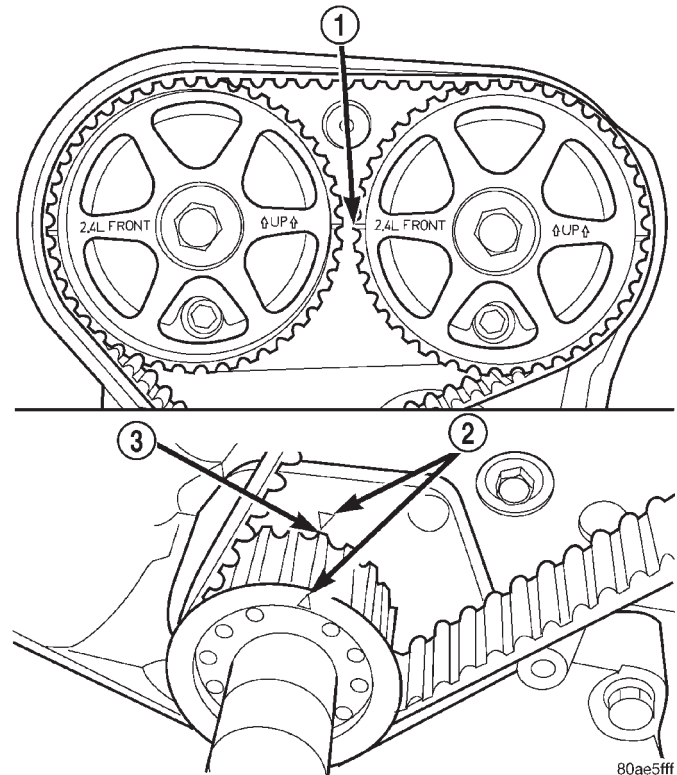
(10) Install air conditioning/generator belt tensioner and pulley. (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION)

(11) Install crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION)

(12) Install accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)

(13) Install drive belt splash shield.

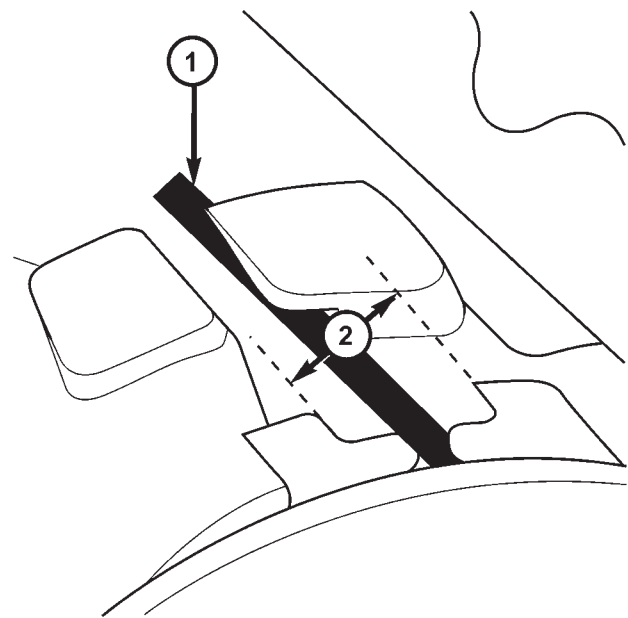
(14) Install air cleaner housing, upper cover, and clean air tube.



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**Fig. 102 Crankshaft and Camshaft Timing**

- 1 - CAMSHAFT TIMING MARKS
- 2 - CRANKSHAFT TDC MARKS
- 3 - TRAILING EDGE OF SPROCKET TOOTH



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**Fig. 103 Timing Belt Tension Verification**

- 1 - SPRING TANG
- 2 - TOLERANCE WINDOW

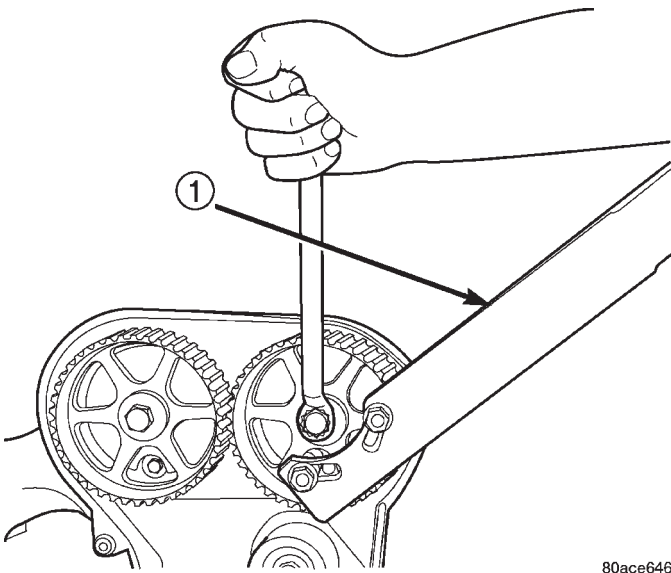
## TIMING BELT TENSIONER & PULLEY

### REMOVAL

(1) Remove the timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Remove timing belt idler pulley.

(3) Hold camshaft sprocket with Special Tool 6847 while removing bolt (Fig. 104). Remove both cam sprockets.



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**Fig. 104 Camshaft Sprocket - Removal/Installation**

1 - SPECIAL TOOL 6847

(4) Remove rear timing belt cover fasteners and remove cover from engine (Fig. 105).

(5) Remove lower bolt attaching timing belt tensioner assembly to engine and remove tensioner **as an assembly**.

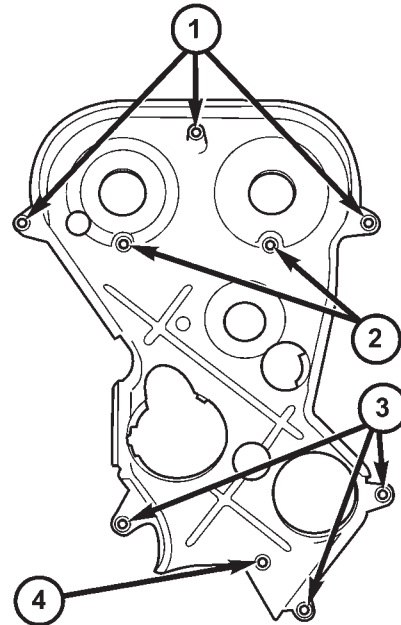
### INSTALLATION

(1) Align timing belt tensioner assembly to engine and install lower mounting bolt **but do not tighten**. To properly align tensioner assembly—install one of the engine bracket mounting bolts (M10) 5 to 7 turns into the tensioner's upper mounting location.

(2) Torque the tensioner's lower mounting bolt to 61 N·m (45 ft. lbs.). Remove the upper bolt used for tensioner alignment.

(3) Install rear timing belt cover and fasteners.

(4) Install timing belt idler pulley and torque mounting bolt to 61 N·m (45 ft. lbs.).



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**Fig. 105 TIMING BELT REAR COVER FASTENERS**

- 1 - OUTER COVER TO REAR COVER FASTENERS (3)
- 2 - REAR COVER TO CYLINDER HEAD FASTENERS
- 3 - OUTER COVER TO REAR COVER FASTENERS (3)
- 4 - INNER COVER TO BLOCK FASTENERS

(5) Install camshaft sprockets. Use Special Tool 6847 to hold sprockets, torque bolts to 101 N·m (75 ft. lbs.).

(6) Install the timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

## BALANCE SHAFT

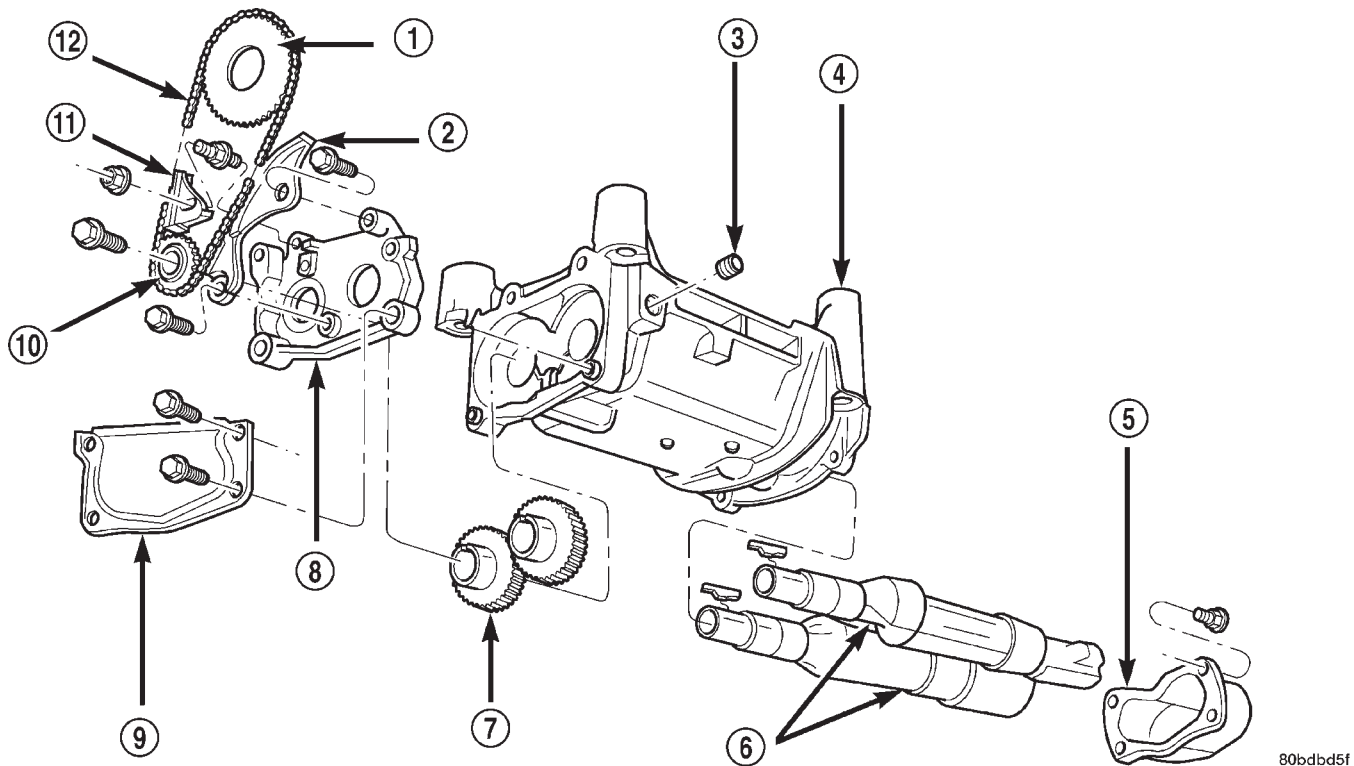
### DESCRIPTION

The 2.4L engine is equipped with two nodular cast iron balance shafts installed in a cast aluminum carrier attached to the lower cylinder block (Fig. 106).

### OPERATION

The balance shafts are driven by the crankshaft via a roller chain and sprockets. The balance shafts are connected by helical gears. The dual counter rotating shafts decrease second order vertical shaking forces caused by component movement.

## BALANCE SHAFT (Continued)



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**Fig. 106 Balance Shafts and Carrier Assembly**

- |                    |                 |
|--------------------|-----------------|
| 1 - SPROCKET       | 7 - GEARS       |
| 2 - TENSIONER      | 8 - GEAR COVER  |
| 3 - PLUG           | 9 - CHAIN COVER |
| 4 - CARRIER        | 10 - SPROCKET   |
| 5 - REAR COVER     | 11 - GUIDE      |
| 6 - BALANCE SHAFTS | 12 - CHAIN      |

## REMOVAL

### BALANCE SHAFTS

- (1) Drain engine oil.
- (2) Remove the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)
- (3) Remove chain cover, guide and tensioner (Fig. 107). Also see Carrier Assembly Removal for service procedures requiring only temporary relocation of assembly.
- (4) Remove gear cover retaining stud (double ended to also retain chain guide). Remove cover and balance shaft gears (Fig. 107).
- (5) Remove balance shaft gear, chain sprocket retaining screws, and crankshaft chain sprocket. Remove chain and sprocket assembly (Fig. 108). Using two wide pry bars, work the sprocket back and forth until it is off the shaft.

- (6) Remove carrier gear cover and balance shafts (Fig. 109).

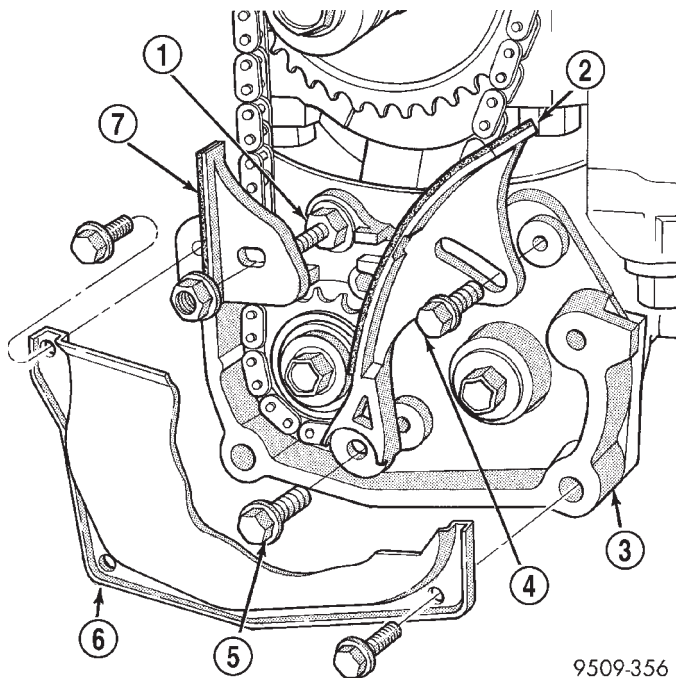
- (7) Remove four carrier to crankcase attaching bolts to separate carrier from engine bedplate.

### BALANCE SHAFT CARRIER

The following components will remain intact during carrier removal. Gear cover, gears, balance shafts and the rear cover (Fig. 110).

- (1) Remove chain cover and driven balance shaft chain sprocket screw.
- (2) Loosen tensioner pivot and adjusting screws, move driven balance shaft inboard through driven chain sprocket. Sprocket will hang in lower chain loop.
- (3) Remove carrier to crankcase attaching bolts to remove carrier.

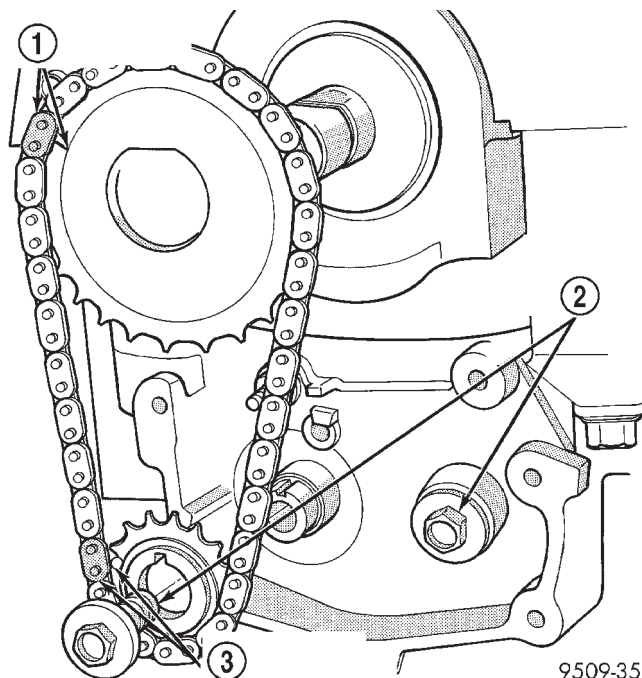
## BALANCE SHAFT (Continued)



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**Fig. 107 Chain Cover, Guide and Tensioner**

- 1 - STUD
- 2 - TENSIONER (ADJUSTER)
- 3 - GEAR COVER
- 4 - ADJUST SCREW
- 5 - PIVOT SCREW
- 6 - CHAIN COVER (CUTAWAY)
- 7 - GUIDE



9509-357

**Fig. 108 Drive Chain and Sprockets**

- 1 - NICKEL PLATED LINK AND MARK
- 2 - GEAR/SPROCKET SCREWS
- 3 - NICKEL PLATED LINK AND DOT

## INSTALLATION

## BALANCE SHAFT TIMING

## BALANCE SHAFT INSTALLATION

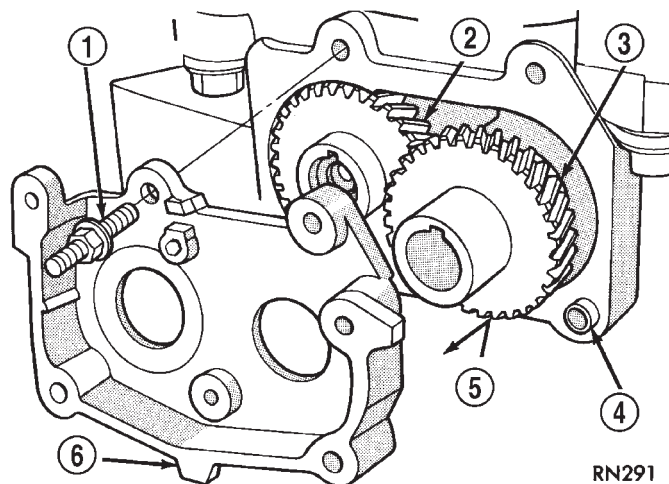
Balance shaft and carrier assembly installation is the reverse of the removal procedure. **During installation crankshaft-to-balance shaft timing must be established. Refer to Timing procedure in this section.**

(1) With balance shafts installed in carrier (Fig. 110) position carrier on crankcase and install four attaching bolts and tighten to 54 N·m (40 ft. lbs.).

(2) Turn balance shafts until both shaft key ways are up, parallel to vertical centerline of engine. Install short hub drive gear on sprocket driven shaft and long hub gear on gear driven shaft. After installation gear and balance shaft keyways must be up with gear timing marks meshed as shown in (Fig. 111).

(3) Install gear cover and tighten double ended stud/washer fastener to 12 N·m (105 in. lbs.).

(4) Align flat on balance shaft drive sprocket to the flat on crankshaft (Fig. 112).

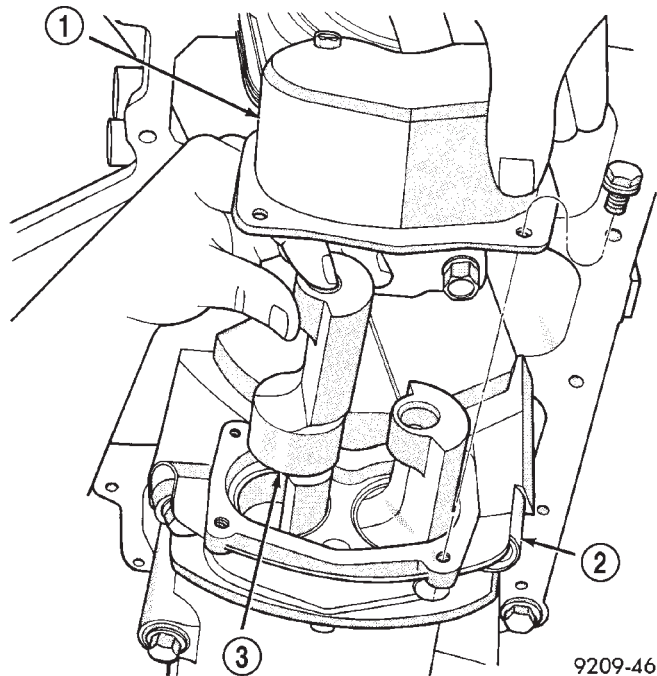


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**Fig. 109 Gear Cover and Gears**

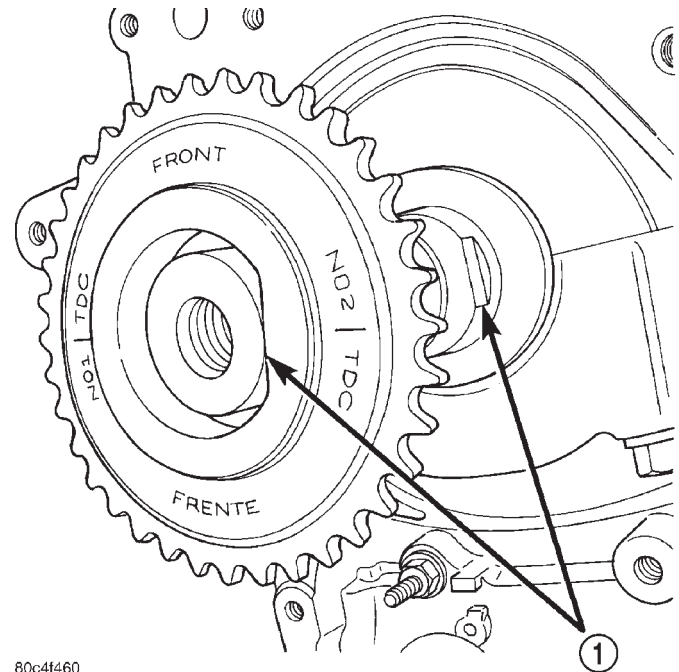
- 1 - STUD (DOUBLE ENDED)
- 2 - DRIVE GEAR
- 3 - DRIVEN GEAR
- 4 - CARRIER DOWEL
- 5 - GEAR(S)
- 6 - GEAR COVER

BALANCE SHAFT (Continued)



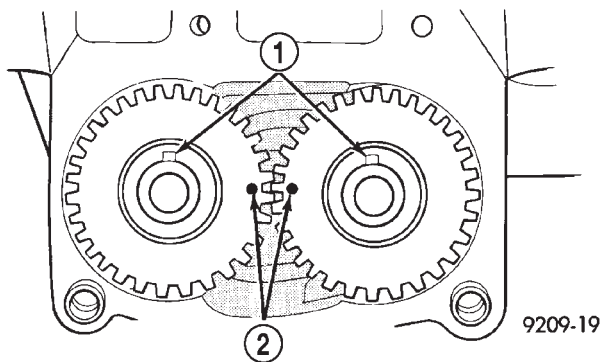
**Fig. 110 Balance Shaft - Removal/Installation**

- 1 - REAR COVER
- 2 - CARRIER
- 3 - BALANCE SHAFT



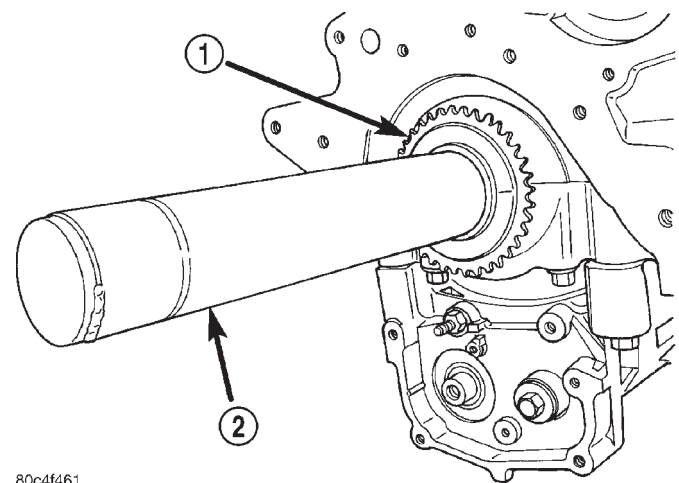
**Fig. 112 Balance Shaft Sprocket Alignment to Crankshaft**

- 1 - ALIGN FLATS



**Fig. 111 Gear Timing**

- 1 - KEYWAYS UP
- 2 - GEAR ALIGNMENT DOTS



**Fig. 113 Balance Shaft Drive**

- 1 - SPROCKET
- 2 - SPECIAL TOOL 6052

(5) Install balance shaft drive sprocket on crankshaft using Special Tool 6052 (Fig. 113).

(6) Turn crankshaft until number 1 cylinder is at top dead center (TDC). The timing marks on the chain sprocket should line up with the parting line on the left side of number one main bearing cap. (Fig. 114).

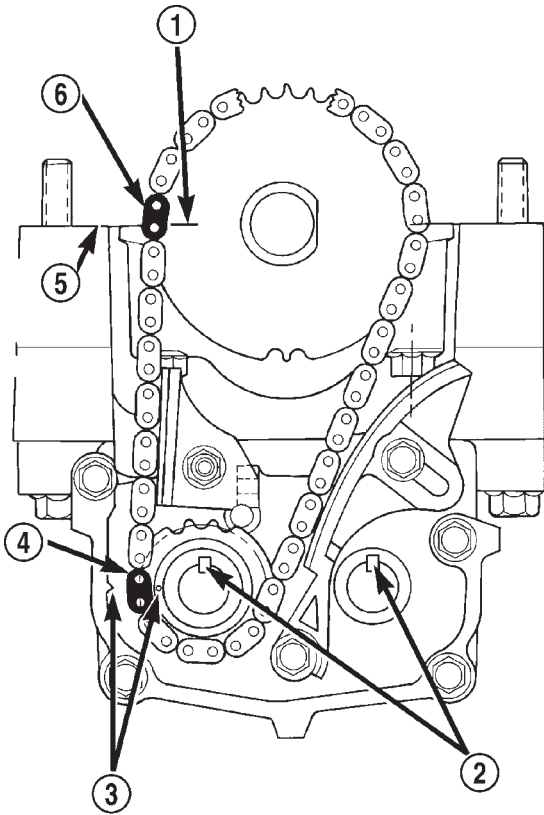
(7) Place chain over crankshaft sprocket so that the plated link of the chain is over the number 1 cylinder timing mark on the balance shaft crankshaft sprocket (Fig. 114).

(8) Place balance shaft sprocket into the timing chain (Fig. 114) and align the timing mark on the sprocket (dot) with the (lower) plated link on the chain.

**NOTE:** The lower plated link is 8 links from the upper link.

BALANCE SHAFT (Continued)

(9) With balance shaft keyways pointing up (12 o'clock) slide the balance shaft sprocket onto the nose of the balance shaft. The balance shaft may have to be pushed in slightly to allow for clearance.



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**Fig. 114 Balance Shaft Timing**

- 1 - MARK ON SPROCKET
- 2 - KEYWAYS UP
- 3 - ALIGN MARKS
- 4 - PLATED LINK
- 5 - PARTING LINE (BEDPLATE TO BLOCK)
- 6 - PLATED LINK

**NOTE: THE TIMING MARK ON THE SPROCKET, THE (LOWER) NICKEL PLATED LINK, AND THE ARROW ON THE SIDE OF THE GEAR COVER SHOULD LINE UP WHEN THE BALANCE SHAFTS ARE TIMED CORRECTLY.**

(10) If the sprockets are timed correctly, install the balance shaft bolts and tighten to 28 N·m (250 in. lbs.). A wood block placed between crankcase and crankshaft counterbalance will prevent crankshaft and gear rotation.

**(11) CHAIN TENSIONING:**

(a) Install chain tensioner loosely assembled.

(b) Position guide on double ended stud making sure tab on the guide fits into slot on the gear cover. Install and tighten nut/washer assembly to 12 N·m (105 in. lbs.).

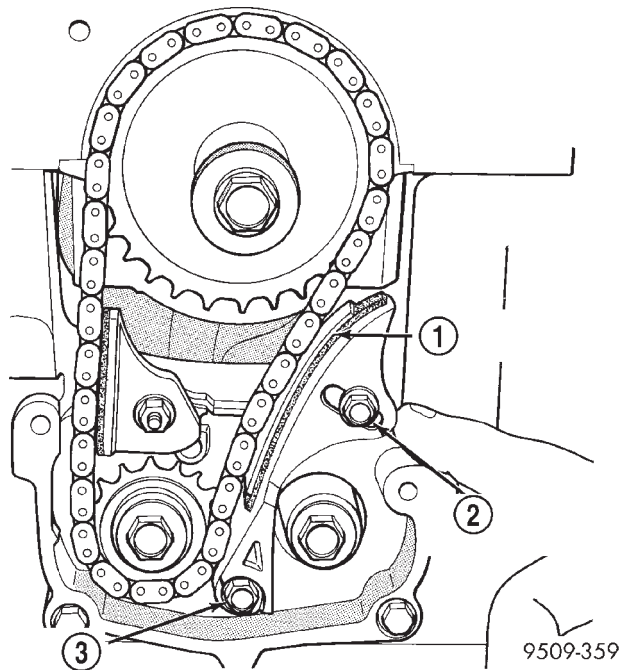
(c) Place a shim 1 mm (0.039 in.) thick x 70 mm (2.75 in.) long or between tensioner and chain. Push tensioner and shim up against the chain. **Apply firm pressure 2.5-3 Kg (5.5-6.6 lbs.) directly behind the adjustment slot to take up all slack.** Chain must have shoe radius contact as shown in (Fig. 115).

(d) With the load applied, tighten top tensioner bolt first, then bottom pivot bolt. Tighten bolts to 12 N·m (105 in. lbs.). Remove shim.

(e) Install carrier covers and tighten screws to 12 N·m (105 in. lbs.).

(12) Install pick-up tube and oil pan.

(13) Fill engine crankcase with proper oil to correct level.



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**Fig. 115 Chain Tension Adjustment**

- 1 - 1MM (0.039 IN.) SHIM
- 2 - TENSIONER (ADJUSTER) BOLT
- 3 - PIVOT BOLT



## BALANCE SHAFT CARRIER

### REMOVAL

(Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - REMOVAL)

### INSTALLATION

(Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - INSTALLATION)

## BALANCE SHAFT CHAIN

### REMOVAL

(Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - REMOVAL)

### INSTALLATION

(Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - INSTALLATION)

# EXHAUST SYSTEM

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## EXHAUST SYSTEM

### DESCRIPTION

The basic exhaust system consists of an engine exhaust manifold, exhaust down pipe, exhaust pipe, exhaust heat shield(s), muffler and exhaust tailpipe

The exhaust system uses a single muffler.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it will transfer objectionable noises originating from the engine to the 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 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.**



## EXHAUST SYSTEM (Continued)

## DIAGNOSIS AND TESTING - EXHAUST SYSTEM

## EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	<ol style="list-style-type: none"> <li>1. Leaks at pipe joints.</li> <li>2. Rusted or blown out muffler.</li> <li>3. Broken or rusted out exhaust pipe.</li> <li>4. Exhaust pipe leaking at manifold flange.</li> <li>5. Exhaust manifold cracked or broken.</li> <li>6. Leak between exhaust manifold and cylinder head.</li> <li>7. Catalytic converter rusted or blown out.</li> <li>8. Restriction in exhaust system.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten clamps/bolts to specified torque at leaking joints.</li> <li>2. Replace muffler. Inspect exhaust system.</li> <li>3. Replace exhaust pipe.</li> <li>4. Tighten/replace flange attaching nuts/bolts.</li> <li>5. Replace exhaust manifold.</li> <li>6. Tighten exhaust manifold to cylinder head bolts.</li> <li>7. Replace catalytic converter assy.</li> <li>8. Remove restriction, if possible. Replace restricted part if necessary.</li> </ol>

## 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.

## CATALYTIC CONVERTER

## DESCRIPTION - CATALYTIC CONVERTER

**WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.**

**CAUTION: 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.**

The stainless steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the 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 to avoid contaminating the catalyst core.**

50 State emission vehicles incorporate two mini catalytic converters located after the exhaust manifolds and before the inline catalytic converter.

## REMOVAL

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.**

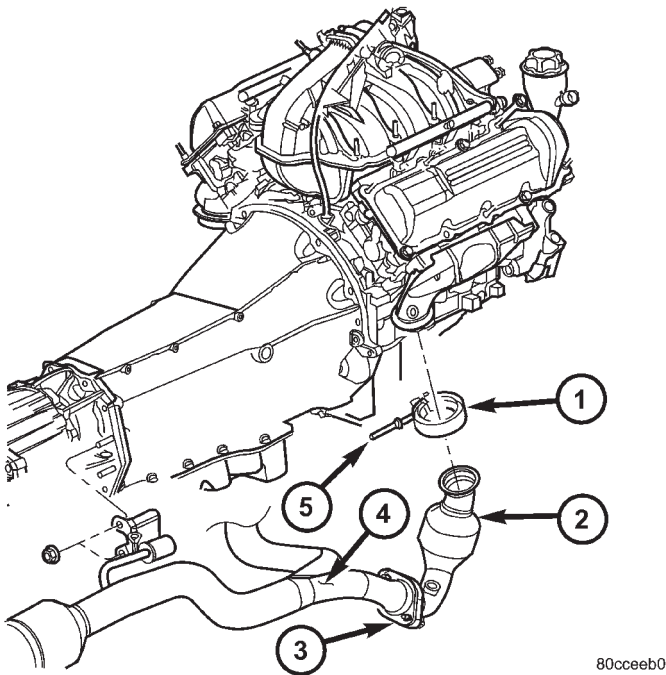
- (1) Raise and support the vehicle.
- (2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
- (3) Remove the bolts from the crossover pipe to the catalytic converter connection.
- (4) Disconnect oxygen sensor wiring.
- (5) Loosen the nuts from the clamp that hold the catalytic converter to the exhaust pipe flange connection.

## CATALYTIC CONVERTER (Continued)

**NOTE: Do not remove nut from T-Bolt. Only remove nut far enough, so that the T end can be removed from the clamp.**

- (6) Remove the T bolt end of the fastener, from the clamp.
- (7) Spread the clamp, and remove the catalytic converter from the vehicle.
- (8) Discard the clamp (Fig. 1).

**NOTE: The catalytic converter to exhaust manifold clamp is not reusable. Always use a new clamp when reinstalling the catalytic converter.**



**Fig. 1 Catalyst Removal**

- 1 - V-Clamp
- 2 - Catalytic Converter
- 3 - Flange
- 4 - Crossover Pipe
- 5 - T-Bolt

## 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.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

## INSTALLATION

(1) Position the catalytic converter onto the exhaust pipe flange connection. Tighten the nuts to 28 N·m (250 in. lbs.) torque.

(2) Install the muffler onto the catalytic converter until the alignment tab is inserted into the alignment slot.

(3) Install the exhaust clamp at the muffler and catalytic converter connection. Tighten the clamp nuts to 47 N·m (35 ft. lbs.) torque.

(4) Connect oxygen sensor wiring.

(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.

## CROSS-OVER PIPE

## REMOVAL

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.**

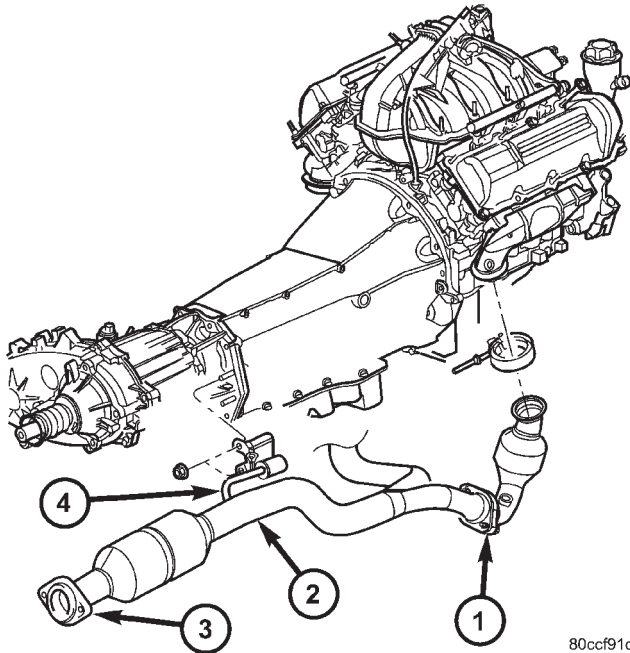
**WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.**

- (1) Raise and support the vehicle.
- (2) Saturate the bolts and nuts with lubricant. Allow 5 minutes for penetration.
- (3) Remove the retaining fasteners holding crossover pipe to exhaust pipe.
- (4) Remove the fasteners from the crossover pipe to the catalytic converter connection.
- (5) Remove the crossover pipe from the hanger insulator (Fig. 2).

## INSTALLATION

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.**

## CROSS-OVER PIPE (Continued)



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**Fig. 2 Crossover Pipe**

- 1 - Crossover-toCatalytic Converter flange
- 2 - Crossover Pipe
- 3 - Crossover Pipe to Tail Pipe Flange
- 4 - Hanger Bracket

**WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.**

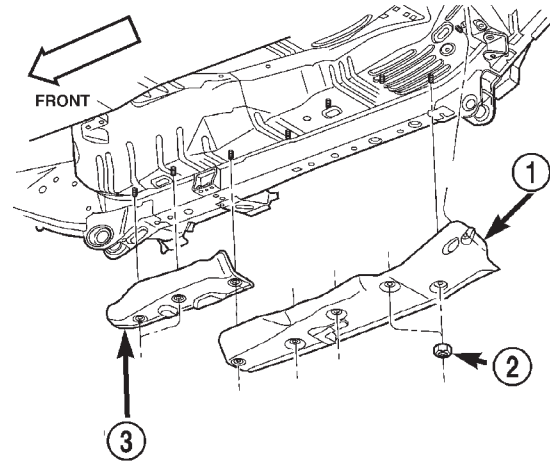
- (1) Install the crossove pipe into the hanger insulator.
- (2) Install and torque the fasteners in the crossover pipe to the left and right catalytic converter connection.
- (3) Install and torque the retaining fasteners holding the crossover pipe to exhaust pipe.
- (4) Lower vehicle..
- (5) Start engine and check for leaks.

## HEAT SHIELDS

## DESCRIPTION

Heat shields are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter. The catalytic converter releases additional heat into the exhaust

system. Under severe operating conditions, the temperature increases in the area of the converter. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency (Fig. 3).



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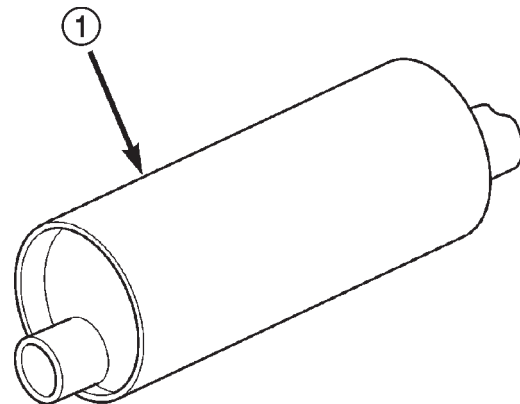
**Fig. 3 Front and Rear Floor Pan Heat Shields Typical**

- 1 - REAR FLOOR PAN HEAT SHIELD
- 2 - HEAT SHIELD RETAINING NUTS
- 3 - FRONT FLOOR PAN HEAT SHIELD

## MUFFLER

## DESCRIPTION

The 3.7L engine uses a galvanized steel muffler (Fig. 4) to control exhaust noise levels and exhaust back pressure.



80bcea59

**Fig. 4 Muffler - Typical**

- 1 - MUFFLER

## MUFFLER (Continued)

**REMOVAL**

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINE.**

**CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.**

- (1) Raise and support the vehicle.
- (2) Disconnect front tailpipe hanger from the insulator (Fig. 5).
- (3) Remove the mounting nuts from the muffler to catalytic converter flange (Fig. 5).
- (4) Remove the tailpipe from the rear tailpipe hanger (Fig. 5).
- (5) Remove the muffler and tailpipe assembly from the vehicle.

**INSTALLATION**

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muf-

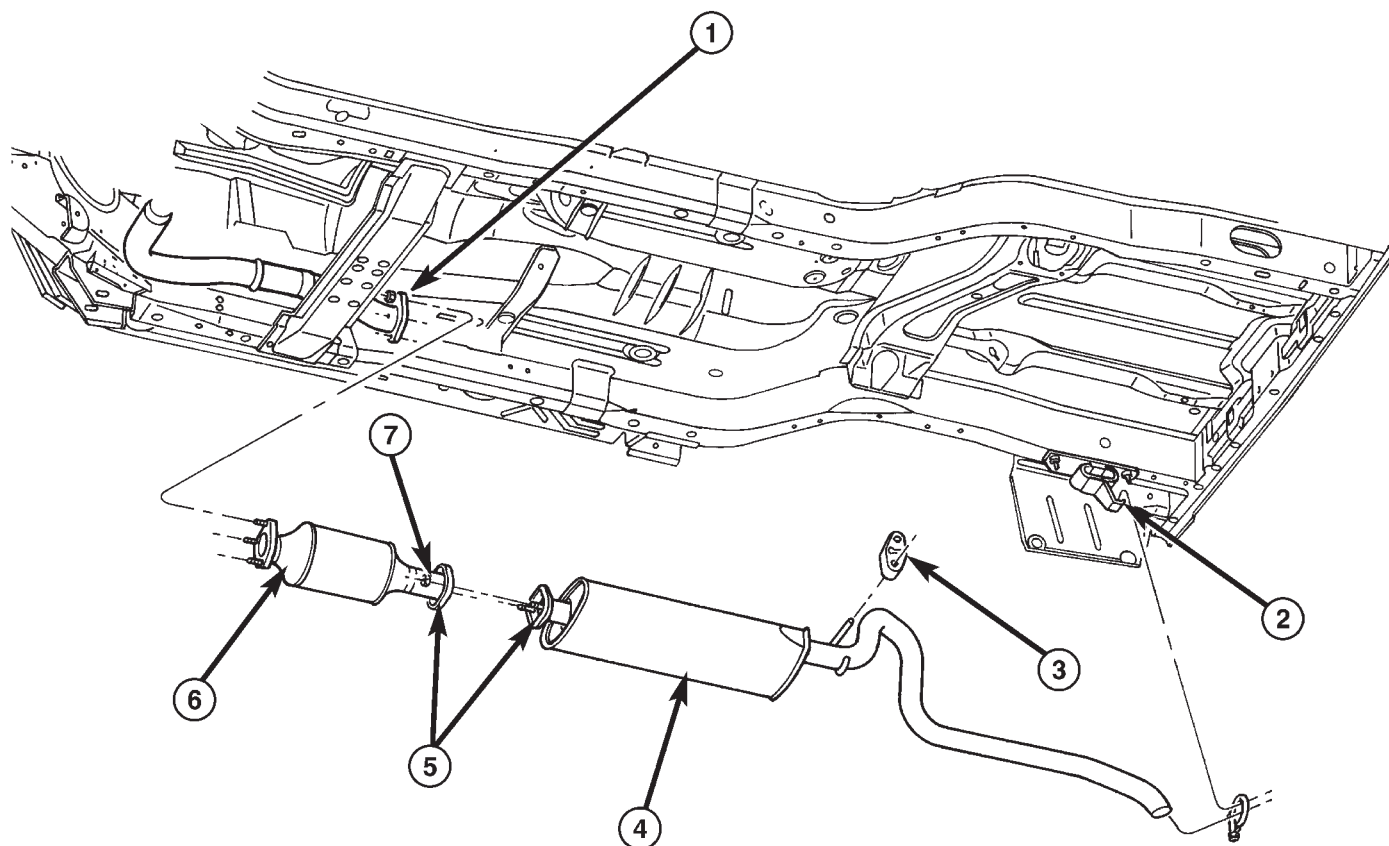
fler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINE.**

**CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.**

- (1) Position muffler and tailpipe assembly into vehicle.
- (2) Install clamp retaining tailpipe to the rear tailpipe hanger (Fig. 5). **DO NOT** tighten clamp at this time.
- (3) Install mounting nuts onto the muffler to catalytic converter flange studs (Fig. 5). **DO NOT** tighten nuts at this time.
- (4) Make sure the exhaust system is in proper alignment. There should be at least 25mm (1 inch) clearance between the exhaust components and any surrounding components.
- (5) Tighten muffler to catalytic converter flange mounting nuts to 28.5 N·m (21 ft. lbs.).
- (6) Tighten tailpipe clamp to 48 N·m (35 ft. lbs.).

## MUFFLER (Continued)



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**Fig. 5 Muffer/Tailpipe Removal and Installation**

1 - EXHAUST PIPE FLANGE JOINT  
2 - REAR TAILPIPE HANGER  
3 - FRONT TAILPIPE HANGER  
4 - MUFFLER

5 - FLANGE JOINT  
6 - CATALYTIC CONVERTER  
7 - NUT

# EXHAUST SYSTEM

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## EXHAUST SYSTEM

### DESCRIPTION

The basic exhaust system consists of an engine exhaust manifold, exhaust down pipe, exhaust pipe, exhaust heat shield(s), muffler and exhaust tailpipe

The exhaust system uses a single muffler.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it will transfer objectionable noises originating from the engine to the 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 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.**



## EXHAUST SYSTEM (Continued)

## DIAGNOSIS AND TESTING - EXHAUST SYSTEM

## EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	<ol style="list-style-type: none"> <li>1. Leaks at pipe joints.</li> <li>2. Rusted or blown out muffler.</li> <li>3. Broken or rusted out exhaust pipe.</li> <li>4. Exhaust pipe leaking at manifold flange.</li> <li>5. Exhaust manifold cracked or broken.</li> <li>6. Leak between exhaust manifold and cylinder head.</li> <li>7. Catalytic converter rusted or blown out.</li> <li>8. Restriction in exhaust system.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten clamps/bolts to specified torque at leaking joints.</li> <li>2. Replace muffler. Inspect exhaust system.</li> <li>3. Replace exhaust pipe.</li> <li>4. Tighten/replace flange attaching nuts/bolts.</li> <li>5. Replace exhaust manifold.</li> <li>6. Tighten exhaust manifold to cylinder head bolts.</li> <li>7. Replace catalytic converter assy.</li> <li>8. Remove restriction, if possible. Replace restricted part if necessary.</li> </ol>

## 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.

## CATALYTIC CONVERTER

## DESCRIPTION - CATALYTIC CONVERTER

**WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.**

**CAUTION: 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.**

The stainless steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the 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 to avoid contaminating the catalyst core.**

50 State emission vehicles incorporate two mini catalytic converters located after the exhaust manifolds and before the inline catalytic converter.

## REMOVAL

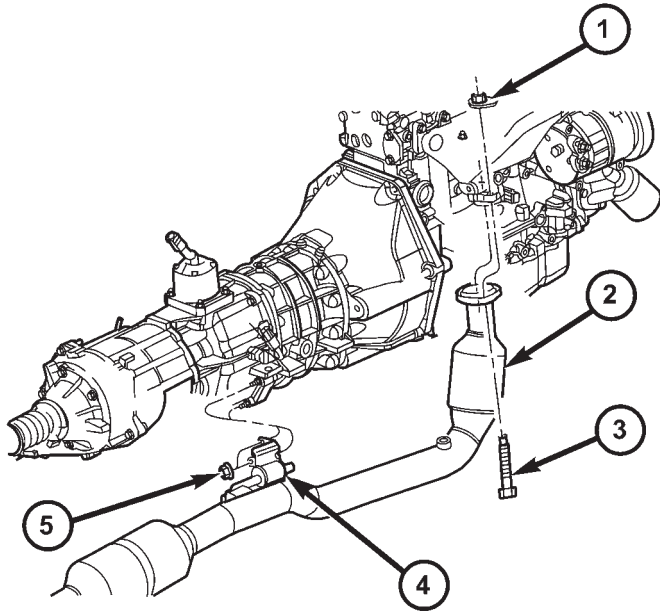
**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.**

- (1) Raise and support the vehicle.
- (2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
- (3) Remove the bolts from the crossover pipe to the catalytic converter connection.
- (4) Disconnect oxygen sensor wiring.
- (5) Loosen and remove the nuts from the clamp that hold the catalytic converter to the exhaust pipe flange connection.

CATALYTIC CONVERTER (Continued)

2.4L ENGINES

- (1) Disconnect the oxygen sensors.
- (2) Remove the two bolts and flanged nuts at the manifold (Fig. 1).
- (3) Lower the catalyst assembly and slide out of the mount at the transmission (if equipped).
- (4) Remove the catalyst assembly from the vehicle.



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**Fig. 1 2.4L CATALYST ASSEMBLY - 4x4**

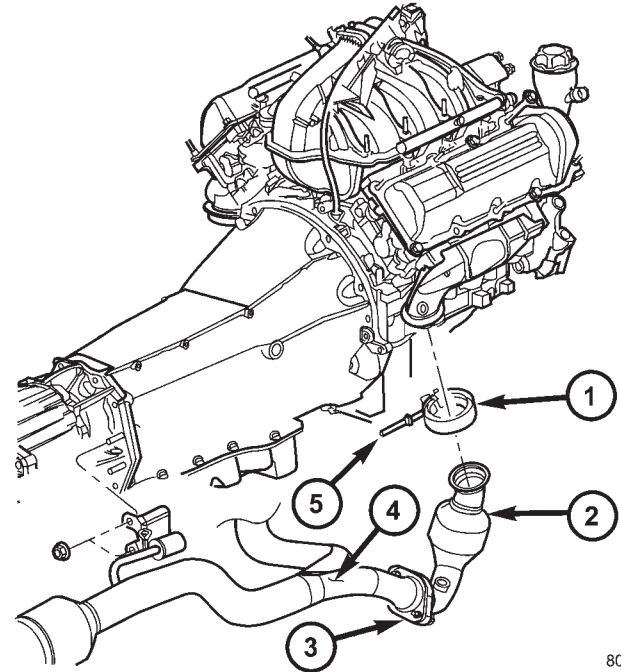
- 1- FLANGED NUT
- 2- CATALYST ASSEMBLY
- 3- BOLT
- 4- HANGER
- 5- NUT

3.7L ENGINES

**NOTE: Do not remove nut from T-Bolt. Only remove nut far enough, so that the T end can be removed from the clamp.**

- (1) Remove the T bolt end of the fastener, from the clamp.
- (2) Spread the clamp, and remove the catalytic converter from the vehicle.
- (3) Discard the clamp (Fig. 2).

**NOTE: The catalytic converter to exhaust manifold clamp is not reusable. Always use a new clamp when reinstalling the catalytic converter.**



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**Fig. 2 Catalytic Removal**

- 1 - V-Clamp
- 2 - Catalytic Converter
- 3 - Flange
- 4 - Crossover Pipe
- 5 - T-Bolt

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.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

INSTALLATION

- (1) Position the catalytic converter onto the exhaust pipe flange connection. Tighten the nuts to 28 N·m (250 in. lbs.) torque.
- (2) Install the muffler onto the catalytic converter until the alignment tab is inserted into the alignment slot.
- (3) Install the exhaust clamp at the muffler and catalytic converter connection. Tighten the clamp nuts to 47 N·m (35 ft. lbs.) torque.
- (4) Connect oxygen sensor wiring.
- (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.

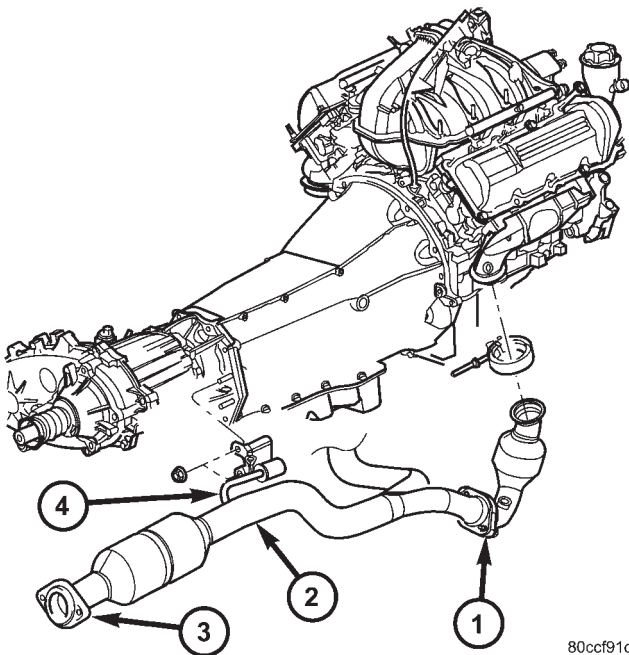
## CROSS-OVER PIPE

### REMOVAL

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.**

**WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.**

- (1) Raise and support the vehicle.
- (2) Saturate the bolts and nuts with lubricant. Allow 5 minutes for penetration.
- (3) Remove the retaining fasteners holding crossover pipe to exhaust pipe.
- (4) Remove the fasteners from the crossover pipe to the catalytic converter connection.
- (5) Remove the crossover pipe from the hanger insulator (Fig. 3).



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**Fig. 3 Crossover Pipe**

- 1 - Crossover-to-Catalytic Converter flange
- 2 - Crossover Pipe
- 3 - Crossover Pipe to Tail Pipe Flange
- 4 - Hanger Bracket

### INSTALLATION

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.**

**WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.**

- (1) Install the crossover pipe into the hanger insulator.
- (2) Install and torque the fasteners in the crossover pipe to the left and right catalytic converter connection.
- (3) Install and torque the retaining fasteners holding the crossover pipe to exhaust pipe.
- (4) Lower vehicle..
- (5) Start engine and check for leaks.

## HEAT SHIELDS

### DESCRIPTION

Heat shields (Fig. 4) are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter. The catalytic converter releases additional heat into the exhaust system. Under severe operating conditions, the temperature increases in the area of the converter. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency.

## MUFFLER

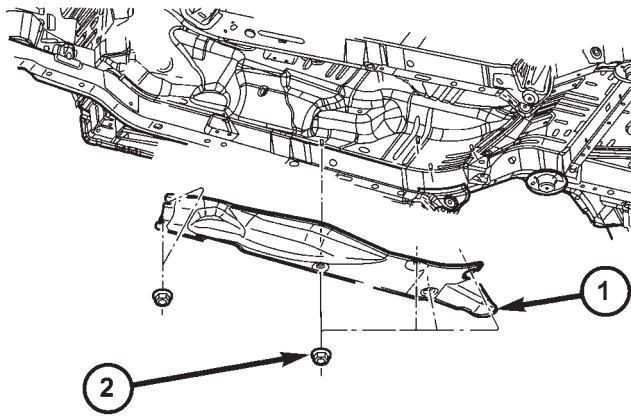
### DESCRIPTION

The 2.4L and 3.7L engine uses a galvanized steel muffler (Fig. 5) to control exhaust noise levels and exhaust back pressure.

### REMOVAL

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

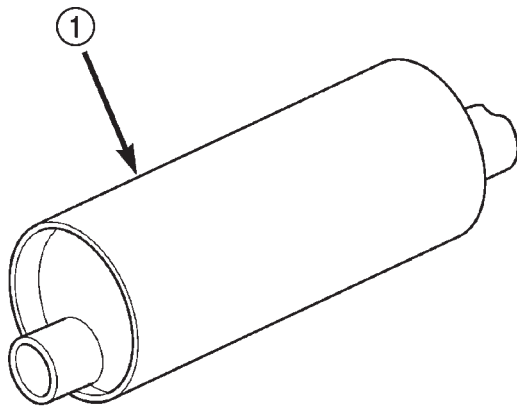
MUFFLER (Continued)



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**Fig. 4 KJ REAR HEAT SHIELD**

- 1 - HEAT SHIELD
- 2 - NUT



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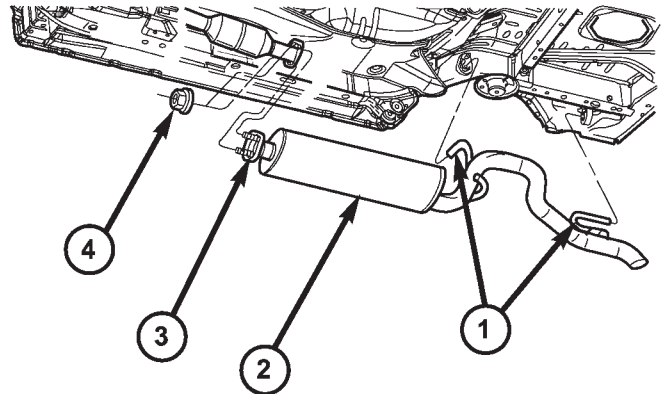
**Fig. 5 Muffler - Typical**

- 1 - MUFFLER

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINE.**

**CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.**

- (1) Raise and support the vehicle.
- (2) Disconnect front tailpipe hanger from the insulator (Fig. 6).
- (3) Remove the mounting nuts from the muffler to catalytic converter flange (Fig. 6).
- (4) Remove the tailpipe from the rear tailpipe hanger.
- (5) Remove the muffler and tailpipe assembly from the vehicle (Fig. 6).



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**Fig. 6 KJ MUFFLER AND TAILPIPE ASSEMBLY**

- 1- TAILPIPE HANGERS
- 2- MUFFLER
- 3- FLANGE
- 4- NUT

**INSTALLATION**

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are either clamped together or welded together.

**WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINE.**

**CAUTION: When servicing exhaust system components, disconnect the oxygen sensor connector. Allowing the exhaust system to hang by the oxygen sensor harness will damage the wiring and/or sensor.**

## MUFFLER (Continued)

(1) Position muffler and tailpipe assembly into vehicle.

(2) Install clamp retaining tailpipe to the rear tailpipe hanger. **DO NOT** tighten clamp at this time.

(3) Install mounting nuts onto the muffler to catalytic converter flange studs. **DO NOT** tighten nuts at this time.

(4) Make sure the exhaust system is in proper alignment. There should be at least 25mm (1 inch)

clearance between the exhaust components and any surrounding components.

(5) Tighten muffler to catalytic converter flange mounting nuts to 28.5 N·m (21 ft. lbs.).

(6) Tighten tailpipe clamp to 48 N·m (35 ft. lbs.).

# FRAMES & BUMPERS

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## FRONT FASCIA

### REMOVAL

(1) Remove the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL)

(2) Raise and support vehicle.

(3) Remove the front wheel opening flare moldings. (Refer to 23 - BODY/EXTERIOR/FRONT WHEEL OPENING FLARE MOLDINGS - REMOVAL)

(4) Remove the four screws through the lower air dam (Fig. 1).

(5) Disconnect the electrical connectors:

- Fascia to grille opening reinforcement. (Fig. 1)
- Side repeater lights, both sides, if equipped.

(Fig. 2)

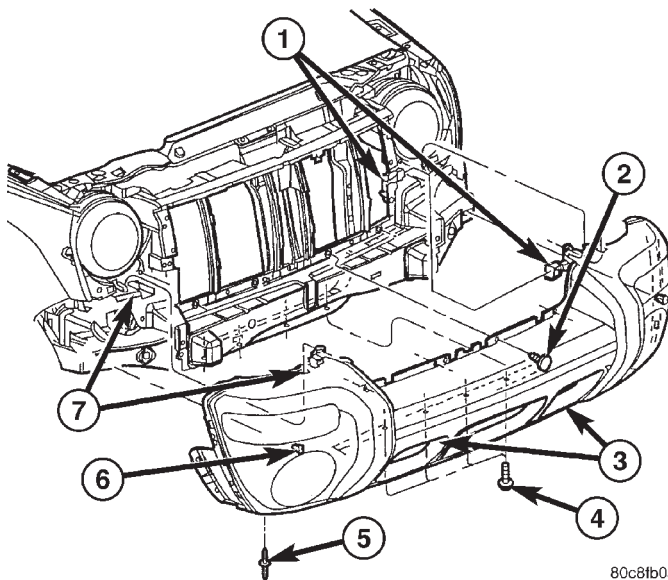
(6) Remove the six push pins from the grill support.

(7) Remove the rivets attaching the air dam to the wheelhouse splash shield.

(8) Release the support tabs beneath the headlamps.

(9) Release the inner support clips from within the fascia between the lights (Fig. 2).

(10) Remove the fascia.

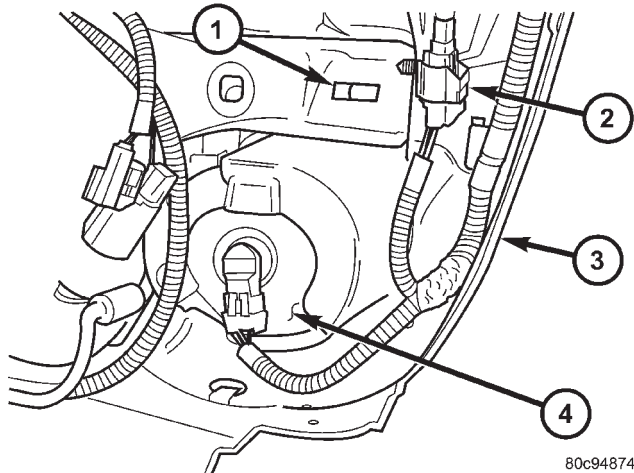


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**Fig. 1 FRONT FASCIA**

- 1 - ELECTRICAL CONNECTOR
- 2 - PUSH PINS
- 3 - FRONT FASCIA ASSEMBLY
- 4 - LOWER SCREWS
- 5 - PLASTIC RIVETS (2)
- 6 - INNER SUPPORT CLIPS
- 7 - SUPPORT TABS

## FRONT FASCIA (Continued)



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**Fig. 2 FASCIA INNER SUPPORT**

- 1 - INNER SUPPORT CLIP
- 2 - SIDE REPEATER CONNECTOR (IF EQUIPPED)
- 3 - FASCIA ASSEMBLY
- 4 - FOG LAMP

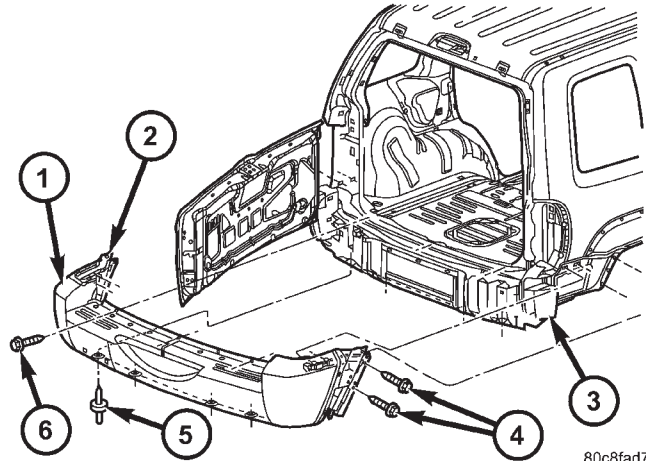
**INSTALLATION**

- (1) Install the fascia.
- (2) Connect the electrical connectors.
  - Side repeater lights, both sides, if equipped.
  - Fascia to grille opening reinforcement.
- (3) Install the six push pin fasteners into the grill support.
- (4) Install the four screws through the lower air damn.
- (5) Install new rivets attaching the air dam to the wheelhouse splash shield.
- (6) Install the front wheel opening flare moldings. (Refer to 23 - BODY/EXTERIOR/WHEEL OPENING FLARE MOLDING - INSTALLATION)
- (7) Install the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION)

**REAR FASCIA****REMOVAL**

- (1) Remove the wheel flares (rear). (Refer to 23 - BODY/EXTERIOR/REAR WHEEL OPENING FLARE MOLDINGS - REMOVAL)
- (2) Remove the rear lamp units. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR LAMP UNIT - REMOVAL)

- (3) Remove the four side bolts. (Fig. 3)
- (4) Remove the four bottom rivets.
- (5) Remove the 3 bolts along the upper edge.
- (6) Separate the side plastic retainers and remove the fascia from the vehicle.



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**Fig. 3 REAR FASCIA**

- 1 - REAR FASCIA ASSEMBLY
- 2 - PLASTIC RETAINERS
- 3 - FASCIA SUPPORT BRACKET
- 4 - SIDE BOLTS
- 5 - RIVETS
- 6 - UPPER BOLTS

**INSTALLATION**

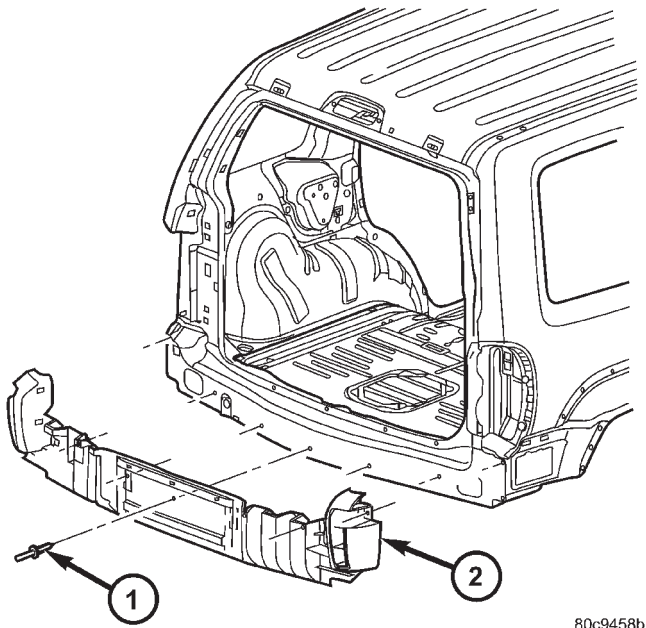
**NOTE:** Fascia must be pushed completely forward to allow the plastic retainers full engagement in their respective slots.

- (1) Install the fascia and insert the plastic retainers.
- (2) Install the three upper bolts.
- (3) Install the four side bolts.
- (4) Install four bottom rivets.
- (5) Install the rear lamp units. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/REAR LAMP UNIT - INSTALLATION)
- (6) Install the rear half wheel opening flares. (Refer to 23 - BODY/EXTERIOR/WHEEL OPENING FLARE MOLDING - INSTALLATION)

## REAR FASCIA SUPPORT

### REMOVAL

- (1) Remove the rear fascia assembly. (Refer to 13 - FRAME & BUMPERS/BUMPERS/REAR FASCIA - REMOVAL)
- (2) Remove the six rivets and remove the fascia support (Fig. 4).



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**Fig. 4 REAR FASCIA SUPPORT**

- 1 - RIVETS
- 2 - SUPPORT

### INSTALLATION

- (1) Install the fascia support onto the vehicle and install six new rivets.
- (2) Install the rear fascia assembly. (Refer to 13 - FRAME & BUMPERS/BUMPERS/REAR FASCIA - INSTALLATION)

## FRAME

### SPECIFICATIONS

#### SPECIFICATIONS - FRAME DIMENSIONS

Frame dimensions are listed in metric scale. All dimensions are from center to center of Principal Locating Point (PLP), or from center to center of PLP and fastener location.

#### VEHICLE PREPARATION

Position the vehicle on a level work surface. Using screw or bottle jacks, adjust the vehicle PLP heights to the specified dimension above a level work surface. Vertical dimensions can be taken from the work surface to the locations indicated were applicable.

**NOTE: All measurements are in MM.**

#### DIMENSION ILLUSTRATIONS

DESCRIPTION	FIGURE
TOP VIEW	( 5 )
SIDE VIEW	( 6 )



FRAME (Continued)

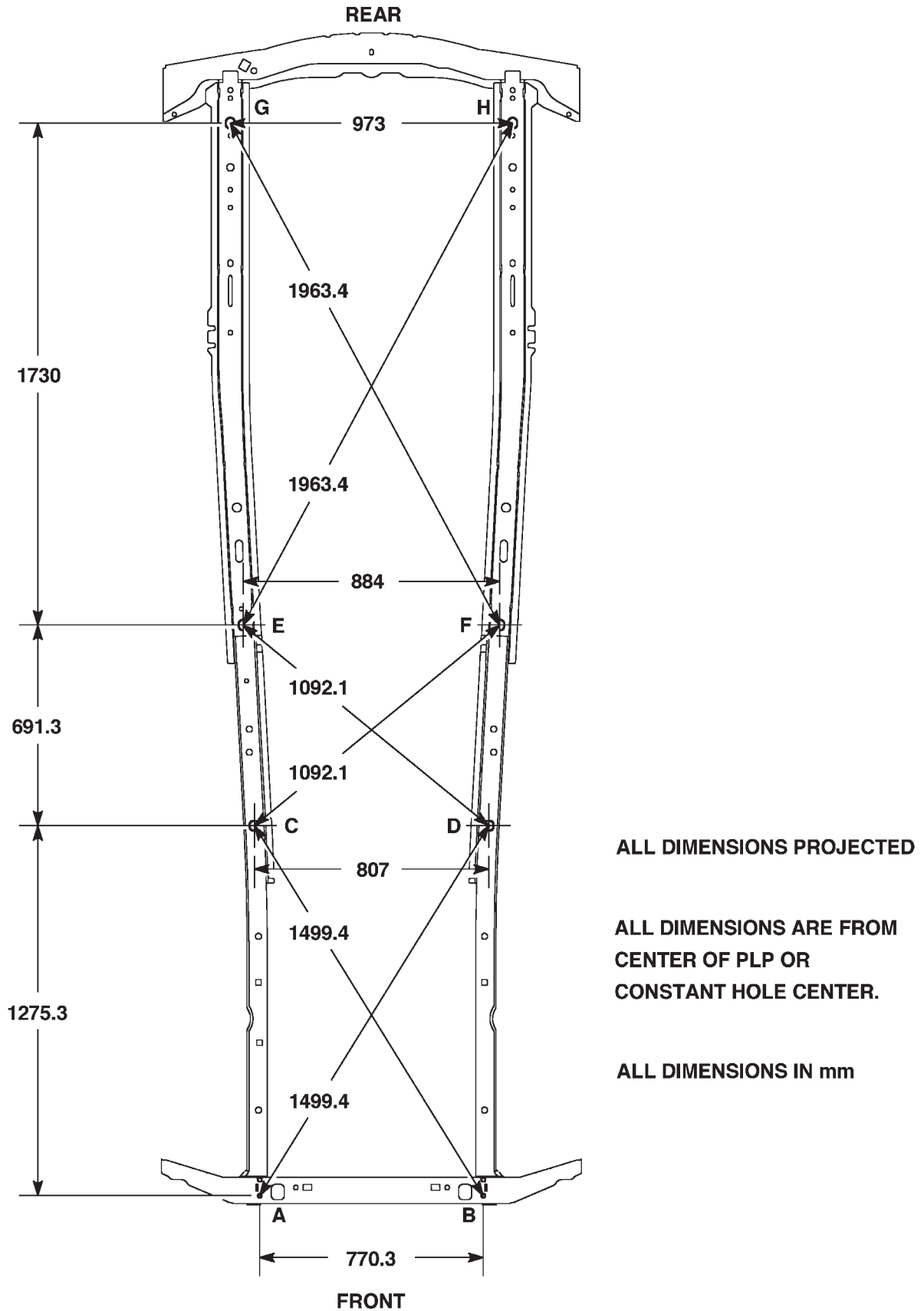


Fig. 5 TOP VIEW

FRAME (Continued)

ALL DIMENSIONS PROJECTED

ALL DIMENSIONS ARE FROM  
CENTER OF PLP OR  
CONSTANT HOLE CENTER.

ALL DIMENSIONS IN mm

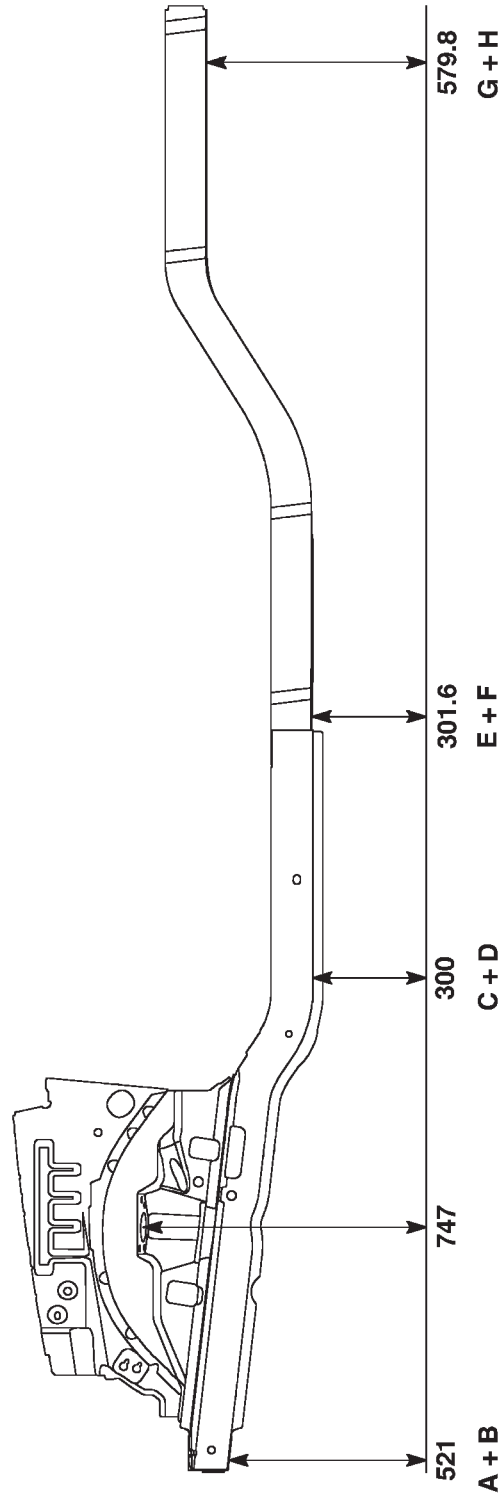


Fig. 6 SIDE VIEW

FRAME (Continued)

## SPECIFICATIONS - TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
ENGINE CRADLE CROSSMEMBER INNER RAIL BOLTS	47	35	—
ENGINE CRADLE CROSSMEMBER MOUNTING BOLTS	122	90	—
ENGINE MOUNT THROUGH BOLTS/NUTS	88	65	—
FRONT SKID PLATE BOLTS	61	45	—
FRONT TOW HOOK NUTS/BOLT	61	45	—
FUEL TANK SKID PLATE	88	65	—
REAR CROSSMEMBER BOLTS	47	35	—
REAR TOW HOOK BOLTS	88	65	—
TRAILER HITCH BOLTS	88	65	—
TRANSFER CASE SKID PLATE BOLTS	34	25	—
TRANSMISSION MOUNT THROUGH BOLT/NUT	88	65	—

## FRONT SKID PLATE

## REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the skid plate bolts and remove the skid plate. (Fig. 7)

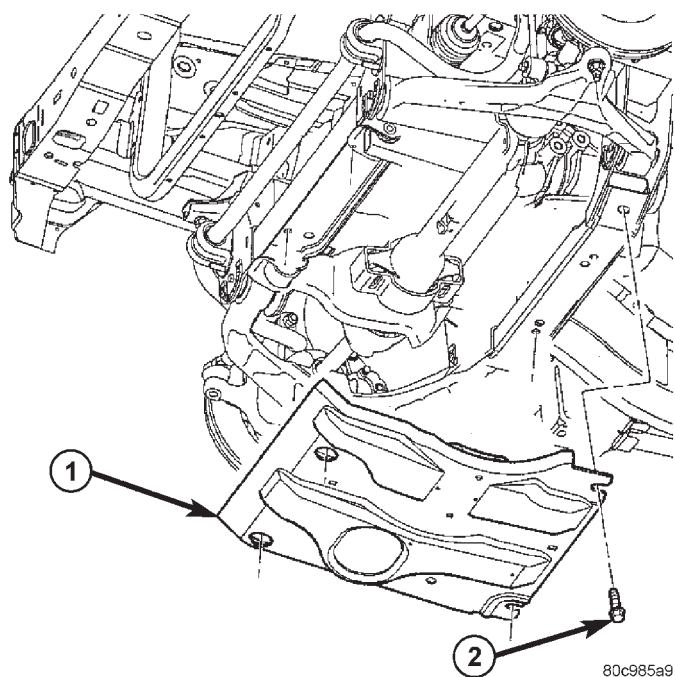


Fig. 7 SKID PLATE

- 1 - SKID PLATE
- 2 - BOLTS (4)

## INSTALLATION

- (1) Install the skid plate.
- (2) Install the bolts and tighten to 61 N·m (45 ft. lbs.).

## ENGINE CRADLE CROSSMEMBER

## REMOVAL

- (1) Install a suitable engine support tool.
- (2) Raise and support the vehicle.
- (3) Remove the lower control arms. (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL)
- (4) Remove the sway bar. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - REMOVAL)
- (5) Remove the front axle, if equipped. (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - REMOVAL)
- (6) Remove the power steering rack. (Refer to 19 - STEERING/GEAR - REMOVAL)
- (7) Loosen the engine mount through bolts.
- (8) Support the engine cradle with a suitable lifting device.
- (9) Using a grease pencil or equivalent, mark the location of the engine support cradle.
- (10) Remove the engine cradle bolts and remove the engine cradle.

## INSTALLATION

- (1) Raise and support the vehicle.
- (2) Using a suitable lifting device raise the engine cradle into the vehicle while lining up the engine mount through bolts.

ENGINE CRADLE CROSSMEMBER (Continued)

- (3) Align the engine cradle to the marks made during removal and install the mounting and inner rail bolts.
- (4) Tighten the mounting bolts to 122 N·m (90 ft. lbs.).
- (5) Tighten the inner rail bolts to 47 N·m (35 ft. lbs.).
- (6) Tighten the engine mount through bolts to 88 N·m (65 ft. lbs.).
- (7) Install the power steering rack. (Refer to 19 - STEERING/GEAR - INSTALLATION)
- (8) Install the front axle, if equipped. (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - INSTALLATION)
- (9) Install the stabilizer bar. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - INSTALLATION)
- (10) Install the lower control arms. (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION)
- (11) Lower the vehicle and remove the engine support tool.

TRANSFER CASE SKID PLATE

REMOVAL

- (1) Remove the bolts and remove the skid plate. (Fig. 8)

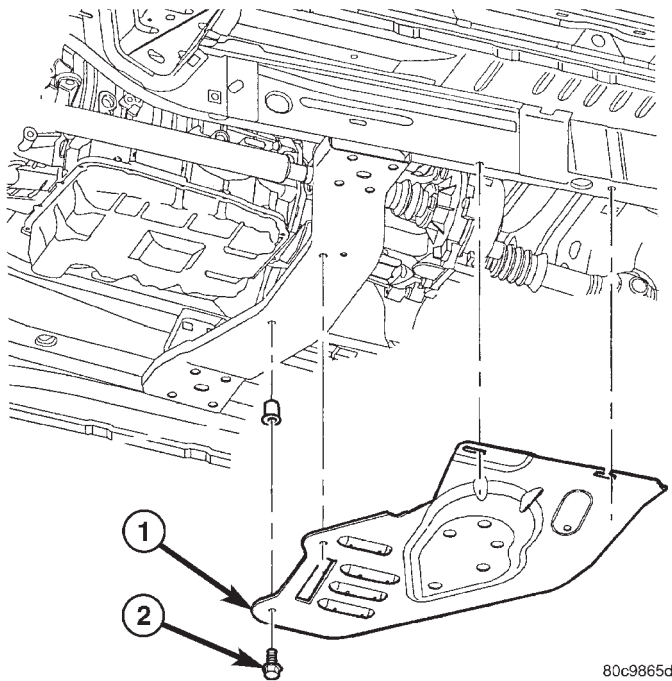


Fig. 8 SKID PLATE

- 1 - SKID PLATE
- 2 - BOLTS

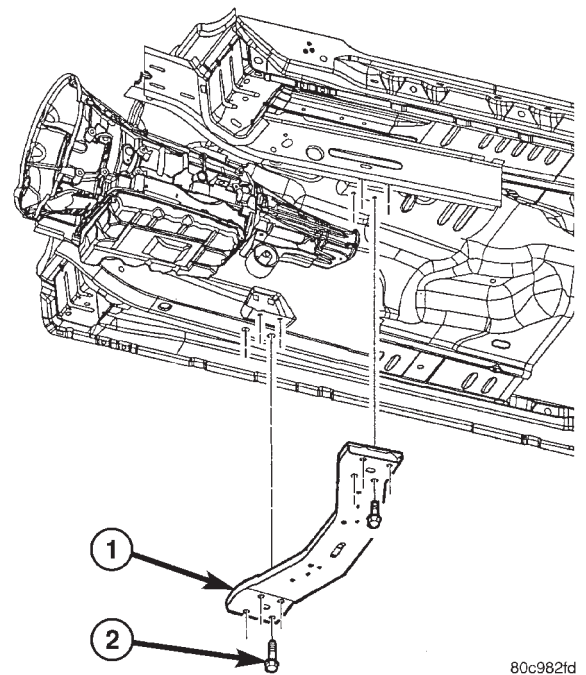
INSTALLATION

- (1) Install the skid plate.
- (2) Install the bolts and tighten to 34 N·m (25 ft. lbs.).

REAR CROSSMEMBER

REMOVAL

- (1) Raise and support the vehicle.
- (2) Support the transmission with a suitable lifting device.
- (3) Remove the transmission mount through bolt.
- (4) Remove the crossmember bolts and remove the crossmember. (Fig. 9)



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Fig. 9 CROSS MEMBER

- 1 - CROSSMEMBER
- 2 - BOLTS

INSTALLATION

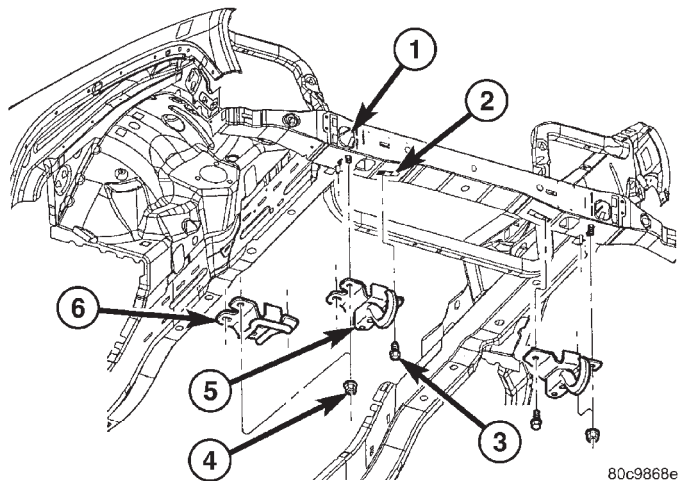
- (1) Install the crossmember and install the bolts.
- (2) Tighten the bolts to 47 N·m (35 ft. lbs.)
- (3) Install transmission mount through bolt and tighten to 88 N·m (65 ft. lbs.).

## FRONT TOW HOOK

### REMOVAL

**NOTE:** Front fascia must be removed to replace the stud plate. (Refer to 13 - FRAME & BUMPERS/ BUMPERS/FRONT FASCIA - REMOVAL)

(1) Remove the nuts and bolt and remove the tow eye/hook. (Fig. 10)



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**Fig. 10 TOW HOOKS/EYE**

- 1 - STUD PLATE
- 2 - U-NUT
- 3 - BOLTS
- 4 - NUTS
- 5 - TOW HOOK
- 6 - TOW EYE

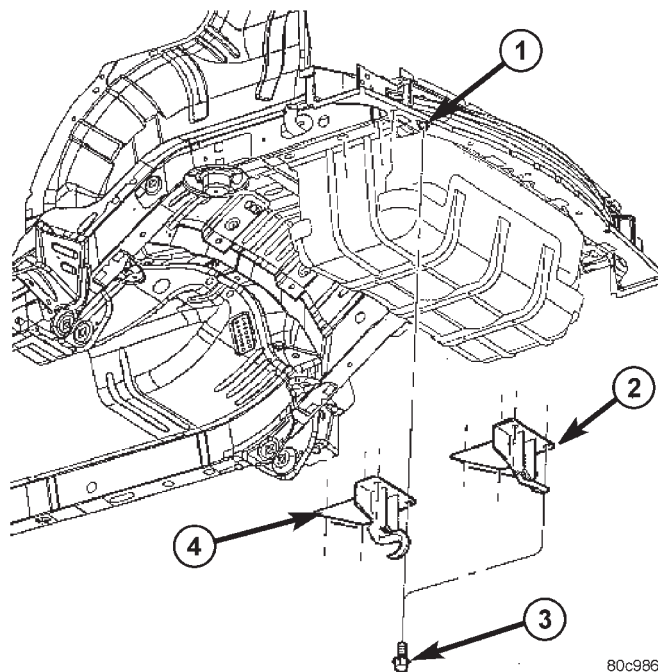
### INSTALLATION

- (1) Install the stud plate if previously removed.
- (2) Install the tow eye/hook.
- (3) Install the nuts and bolt and tighten to 61 N·m (45 ft. lbs.).
- (4) Install the front fascia if the stud plate was replaced. (Refer to 13 - FRAME & BUMPERS/ BUMPERS/FRONT FASCIA - INSTALLATION)

## REAR TOW HOOK

### REMOVAL

(1) Remove the bolts and remove the tow hook/eye. (Fig. 11)



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**Fig. 11 TOW HOOK/EYE**

- 1 - U-NUT
- 2 - TOW EYE
- 3 - BOLTS
- 4 - TOW HOOK

### INSTALLATION

- (1) Install the tow hook/eye.
- (2) Install the bolts and tighten to 88 N·m (65 ft. lbs.).

## TRAILER HITCH

### REMOVAL

- (1) Remove the tow hooks, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/REAR TOW HOOK - REMOVAL)
  - (2) Disconnect trailer electrical connector.
  - (3) Support the hitch with a suitable lifting device.
  - (4) Remove the bolts and remove the trailer hitch.
- (Fig. 12)

### INSTALLATION

- (1) Support the hitch with a suitable lifting device and install the hitch.
- (2) Install the bolts and tighten to 88 N·m (65 ft. lbs.)
- (3) Connect the electrical connector.

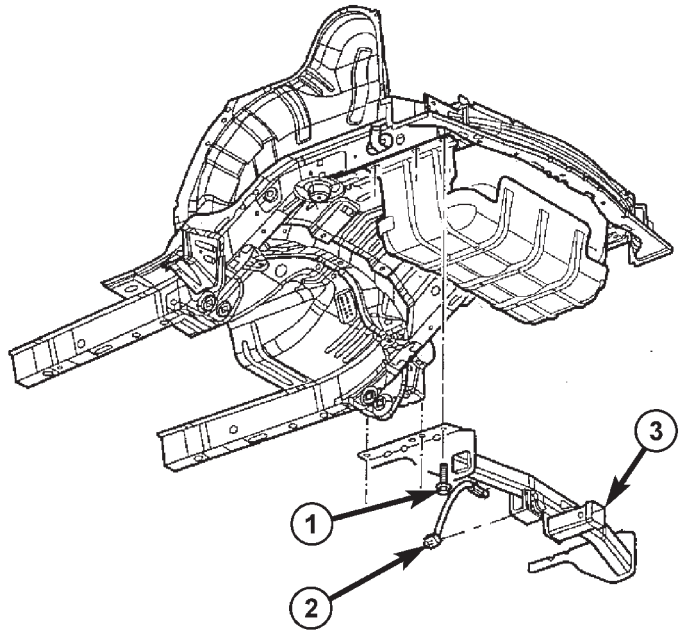
## FUEL TANK SKID PLATE

### REMOVAL

- (1) Raise and support the vehicle.
- (2) Support the skid plate with a suitable lifting device.
- (3) Remove the trailer hitch, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/TRAILER HITCH - REMOVAL)
- (4) Remove the tow hooks, if not previously removed. (Refer to 13 - FRAME & BUMPERS/FRAME/REAR TOW HOOK - REMOVAL)
- (5) Remove the bolts and remove the fuel tank skid plate.

### INSTALLATION

- (1) Install the skid plate and support with a suitable lifting device.



**Fig. 12 TRAILER HITCH**

- 1 - BOLTS
- 2 - TRAILER LIGHTS ELECTRICAL CONNECTOR
- 3 - TRAILER HITCH

- (2) Install the trailer hitch, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/TRAILER HITCH - INSTALLATION)
- (3) Install the tow hooks, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/REAR TOW HOOK - INSTALLATION)
- (4) Install the bolts and tighten to 88 N·m (65 ft. lbs.).



# FUEL SYSTEM

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# FUEL DELIVERY

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## FUEL DELIVERY

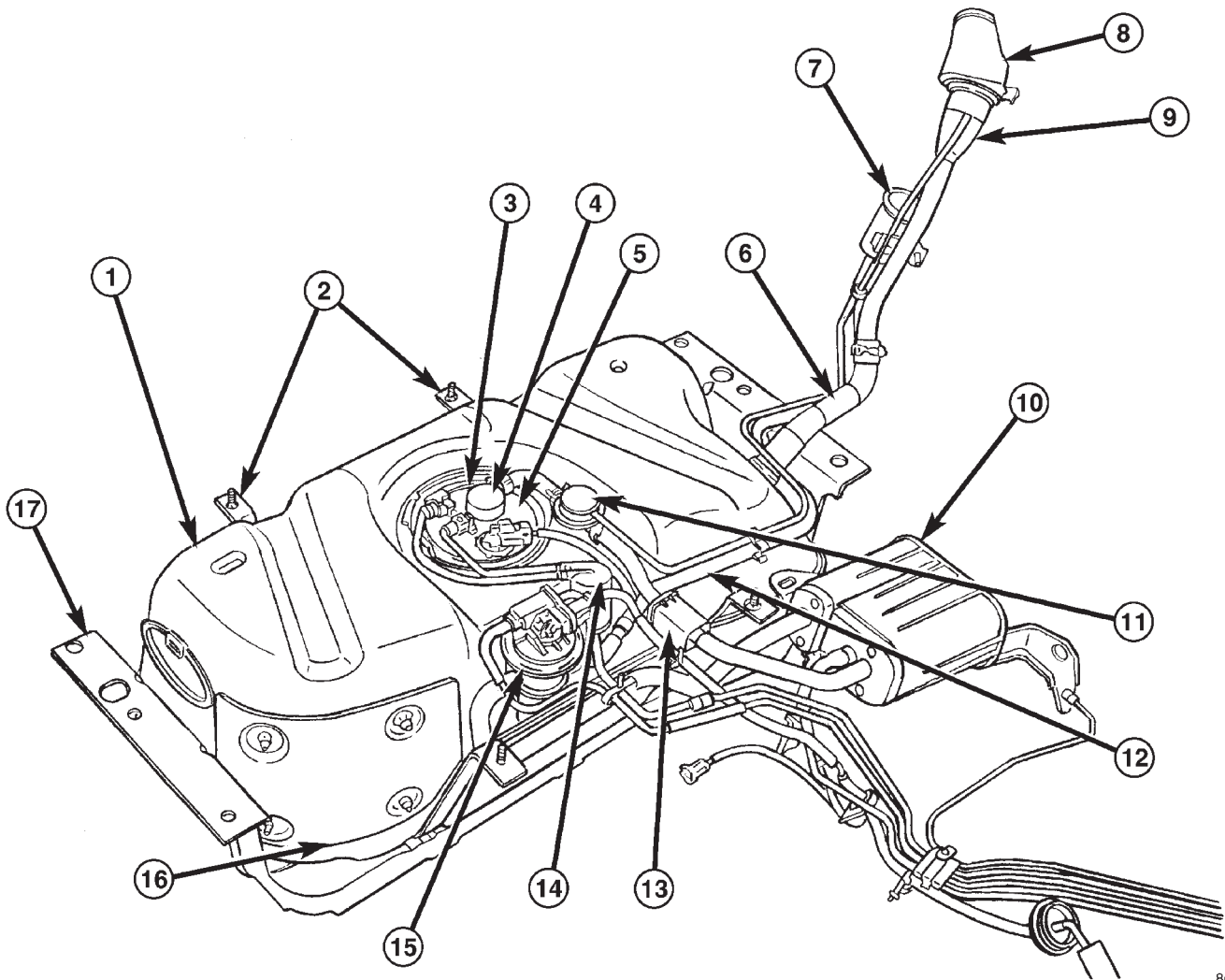
### DESCRIPTION

The fuel delivery system consists of:

- the 2-section fuel pump module containing the electric fuel pump, fuel pressure regulator, fuel gauge sending unit (fuel level sensor) and a fuel filter located inside the lower section of pump module
- fuel tubes/lines/hoses
- A separately mounted main fuel filter

- quick-connect fittings
- fuel injector rail
- fuel tank
- fuel tank filler/vent tube assembly
- fuel tank filler tube cap
- accelerator pedal
- throttle cable

Certain fuel delivery components can be found in (Fig. 1).



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**Fig. 1 FUEL DELIVERY COMPONENTS**

- |                                |                            |
|--------------------------------|----------------------------|
| 1 - FUEL TANK                  | 10 - EVAP CANISTER         |
| 2 - FUEL TANK STRAPS           | 11 - FLOW MANAGEMENT VALVE |
| 3 - FUEL PUMP MODULE LOCK RING | 12 - FRESH AIR TUBE        |
| 4 - CHECK (CONTROL) VALVE      | 13 - HOSE SLEEVE           |
| 5 - FUEL PUMP MODULE FLANGE    | 14 - FUEL FILTER           |
| 6 - FUEL FILL HOSE             | 15 - LEAK DETECTION PUMP   |
| 7 - FRESH AIR FILTER           | 16 - HEAT SHIELD           |
| 8 - FUEL FILL CAP/BEZEL        | 17 - SKID PLATE            |
| 9 - FUEL FILL TUBE             |                            |

FUEL DELIVERY (Continued)

**OPERATION**

Fuel is picked up in the fuel tank by the fuel pump module. This module is located on the bottom of the fuel tank.

A fuel return system is provided within the fuel pump module using check valves. A separate fuel return line from the engine to the tank is not used.

The fuel pressure regulator and the main fuel filter are not combined. They are separate items.

The fuel tank assembly consists of: the fuel tank, fuel pump module assembly, fuel pump module lock ring/gasket, ORVR components. Refer to 25, Emission Control System for ORVR information.

A fuel filler/vent tube assembly using a pressure/vacuum, 1/4 turn fuel filler cap is used. The fuel filler tube contains a flap door located below the fuel fill cap. A one-way check valve is installed into the tanks fuel fill fitting.

Also to be considered part of the fuel system is the evaporation control system and ORVR 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 25, Emission Control Systems.

Both fuel filters (mounted to front of fuel tank, and inside the bottom fuel pump module) are designed for extended service. They do not require normal scheduled maintenance. The bottom section of the fuel pump module (with included filter) should only be replaced if a diagnostic procedure indicates to do so. Also, the fuel filter mounted to the front of the fuel tank should only be replaced if a diagnostic procedure indicates to do so.

**DIAGNOSIS AND TESTING - 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:

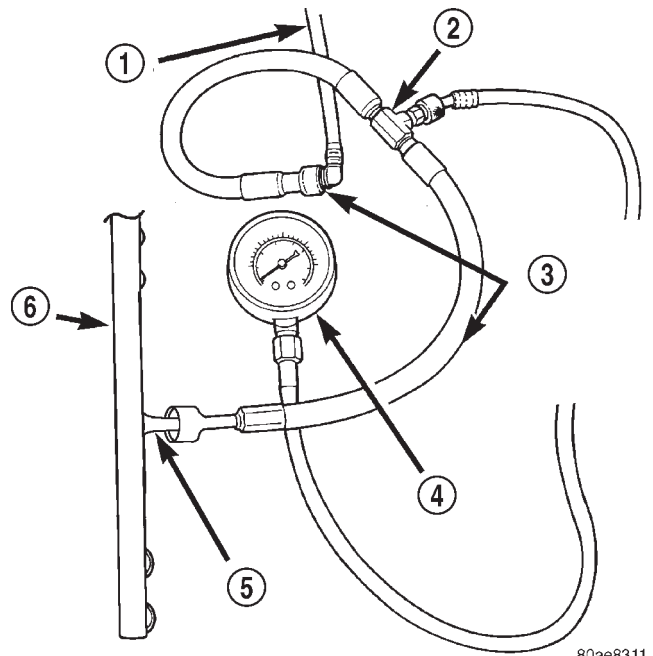
- Fuel pressure bleeding past a fuel injector(s).

- Fuel pressure bleeding past the check valve in the fuel pump module.

(1) Disconnect the fuel inlet line at fuel rail. Refer to Quick Connect Fittings for procedures. On some engines, air cleaner housing removal may be necessary before fuel line disconnection.

(2) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16" fuel lines and tool number 6631 is used for 3/8" fuel lines.

(3) Connect correct Fuel Line Pressure Test Adapter Tool Hose between disconnected fuel line and fuel rail (Fig. 2).



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**Fig. 2 CONNECTING ADAPTER TOOL—TYPICAL**

- 1 - VEHICLE FUEL LINE
- 2 - TEST PORT "T"
- 3 - SPECIAL TOOL 6923, 6631, 6541 OR 6539
- 4 - FUEL PRESSURE TEST GAUGE
- 5 - FUEL LINE CONNECTION AT RAIL
- 6 - FUEL RAIL

(4) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adapter Tool. **The DRB® III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**

The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.

(5) Start engine and bring to normal operating temperature.

(6) Observe test gauge. Normal operating pressure should be 339 kPa +/-34 kPa (49.2 psi +/-5 psi).

(7) Shut engine off.

## FUEL DELIVERY (Continued)

(8) Pressure should not fall below **30 psi for five minutes.**

(9) 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.

(10) Again, start engine and bring to normal operating temperature.

(11) Shut engine off.

(12) **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.

(13) **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, fuel filter or fuel pressure regulator may be leaking.

Note: A quick loss of pressure usually indicates a defective check valve in the pressure regulator. A slow loss of pressure usually indicates a defective check valve in the bottom of the fuel pump module. The check valves are not serviced separately. Also, the electric fuel pump is not serviced separately.

## STANDARD PROCEDURE - FUEL SYSTEM PRESSURE RELEASE

**Use following procedure if the fuel injector rail is, or is not equipped with a fuel pressure test port.**

(1) Remove fuel fill cap.

(2) Remove fuel pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(3) Start and run engine until it stalls.

(4) Attempt restarting engine until it will no longer run.

(5) 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.**

(6) Unplug connector from any fuel injector.

(7) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(8) Connect other end of jumper wire to positive side of battery.

(9) 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.**

(10) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.

(11) Place a rag or towel below fuel line quick-connect fitting at fuel rail.

(12) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings.

(13) Return fuel pump relay to PDC.

(14) 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.

## FUEL DELIVERY (Continued)

## SPECIFICATIONS

## FUEL SYSTEM PRESSURE

339 kPa +/- 34 kPa (49.2 psi +/- 2 psi).

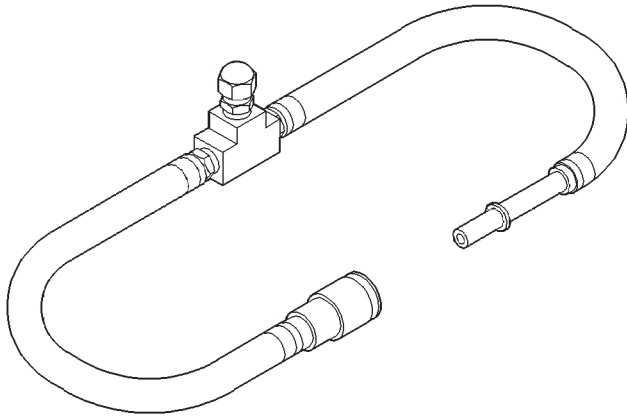
## TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting Nuts	12	-	105
Crankshaft Position Sensor - 2.4L	28	21	-
Crankshaft Position Sensor - 3.7L	28	21	-
Camshaft Position Sensor - 2.4L	12	-	106
Camshaft Position Sensor - 3.7L	12	-	106
Engine Coolant Temperature Sensor	11	-	96
EVAP Canister-to-Body Bolts	48	35	-
EVAP Canister-to-Canis. Bracket Bolt/Nut	11	-	100
Fuel Filler Hose Clamp at Tank	3	-	30
Fuel Filler Housing-to-Body Screws	2	-	17
Fuel Filter Mounting Nut at Tank	5.5	-	49
Fuel Pump Module Access Plate Nuts	3	-	26
Fuel Rail Mounting Bolts - 3.7L	11	-	100
Fuel Rail Mounting Bolts - 2.4L	28	-	250
Fuel Tank Heat Sheild Nuts	5.5	-	49
Fuel Tank Mounting Strap Bolts	61	45	-
Fuel Tank Skid Plate and Trailer Hitch	88	65	-
IAC Motor Mounting Screws	7	-	60
Leak Detection Pump Mounting Bracket-to-Fuel Tank Nuts	5.5	-	49
Leak Detection Pump-to-Bracket Nuts	1.2	-	11
Map Sensor Mounting Screws	3	-	25
PCM-to-Mounting Bracket Mounting Screws	4	-	35
Power Steering Pressure Switch	14-22	-	124-195
TPS Mounting Screws	7	-	60
Throttle Body Mounting Bolts	11	-	100
Oxygen Sensors	30	22	-

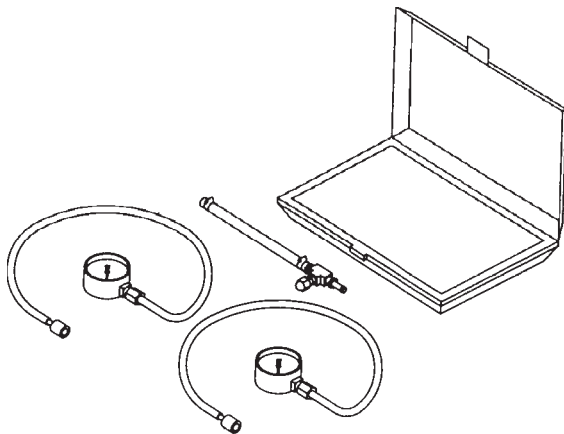
## FUEL DELIVERY (Continued)

## SPECIAL TOOLS

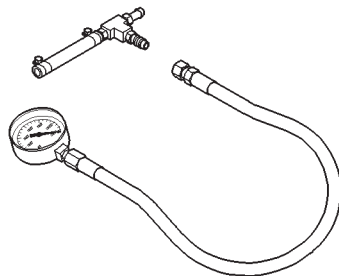
## FUEL SYSTEM



**ADAPTERS, FUEL PRESSURE TEST—6539 AND/OR  
6631**



**TEST KIT, FUEL PRESSURE—5069**



**TEST KIT, FUEL**

## FLOW MANAGEMENT VALVE

## DESCRIPTION

The flow management valve is a part of the ORVR system. This plastic valve is placed inline between the fuel tank vent fitting and the EVAP canister. It is located on top of the fuel tank (Fig. 1).

## OPERATION

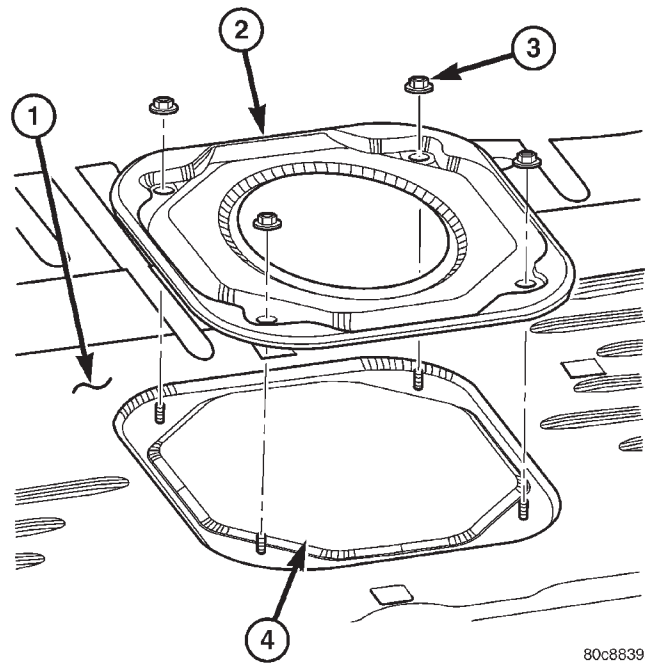
The flow management valve (Fig. 1) is one of the components used in the ORVR system. The valve meters the flow of fuel vapors to the EVAP canister during vehicle run and refueling. Pressure from the tank during refueling opens the main port valve and allows vapors to enter the EVAP canister. During vehicle run, the vapors are metered through an orifice to the EVAP canister. It is also used as a liquid separator to keep liquid fuel out of the EVAP canister.

## REMOVAL

The flow management valve is located on top of the fuel tank (Fig. 1).

(1) Four cargo holddown clamps are located inside the vehicle on the floor of the rear cargo area. Remove the 2 rearward mounted clamps by drilling out the clamp rivets.

(2) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 3).



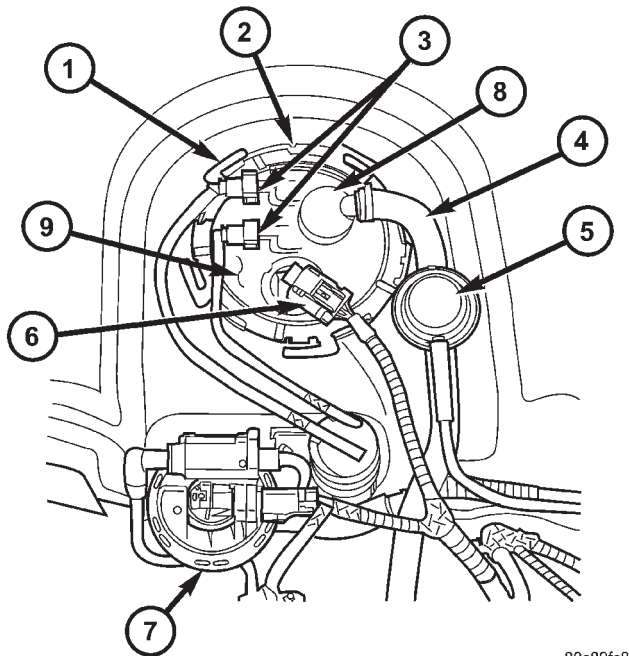
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**Fig. 3 ACCESS PLATE**

- 1 - FLOORPAN AT REAR
- 2 - FUEL PUMP MODULE ACCESS PLATE
- 3 - NUTS (4)
- 4 - OPENING TO PUMP MODULE

FLOW MANAGEMENT VALVE (Continued)

- (3) Remove 4 fuel pump module access plate nuts (Fig. 3).
- (4) While applying heat from a heat gun, carefully pry up fuel pump module access plate. Take care not to bend plate.
- (5) Disconnect flow management valve hose clamp and hose (Fig. 4) at pump module fitting. Also disconnect small recirculation line at top half of management valve.
- (6) Raise vehicle.
- (7) Disconnect opposite end of flow management valve hose at EVAP canister (Fig. 1).
- (8) Remove valve and 2 hoses as an assembly.



**Fig. 4 TOP OF FUEL PUMP MODULE**

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- 1 - LOCK RING
- 2 - ALIGNMENT NOTCH
- 3 - FUEL FILTER FITTINGS (2)
- 4 - ORVR SYSTEM HOSE AND CLAMP
- 5 - FLOW MANAGEMENT VALVE
- 6 - ELECTRICAL CONNECTOR
- 7 - LEAK DETECTION PUMP
- 8 - FUEL TANK CHECK (CONTROL) VALVE
- 9 - FUEL PUMP MODULE (UPPER SECTION)

**INSTALLATION**

- (1) Raise vehicle.
- (2) Attach 2 large hoses and 1 small line to flow management valve. Position this assembly to top of fuel tank.
- (3) Connect valve hose at EVAP canister.
- (4) Lower vehicle.
- (5) Attach valve hose and clamp to top of fuel pump module.
- (6) Apply silicone sealant to bottom of fuel pump module metal access plate.

- (7) Install fuel pump module metal access plate and 4 nuts. Tighten nuts to 3 N·m (26 in. lbs.) torque.
- (8) Position carpet and install 2 new cargo clamp rivets.

**FUEL FILTER**

**DESCRIPTION**

The fuel pressure regulator and fuel filter are not combined on this vehicle. The main fuel filter is attached to the front of the fuel tank (Fig. 1) and is a serviceable/replaceable item. Also refer to Inlet Filter and Fuel Pressure Regulator.

**REMOVAL**

The main fuel filter is attached to the front of fuel tank (Fig. 1). Three fuel lines are used at filter.  
**Fuel tank removal will not be necessary for fuel filter removal. Access is from rear cargo area.**

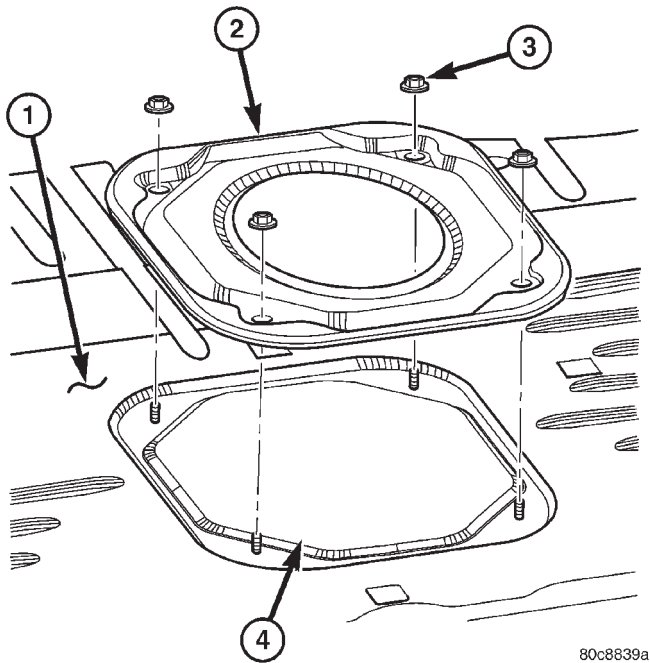
**WARNING: THE FUEL SYSTEM MAY BE UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING MOST FUEL SYSTEM COMPONENTS, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.**

- (1) Release fuel system pressure.
- (2) Four cargo holdown clamps are located inside vehicle on floor of rear cargo area. Two of these four clamps must be removed. Remove 2 rearward mounted clamps by drilling out clamp rivets.
- (3) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 5).
- (4) Remove 4 fuel pump module access plate nuts (Fig. 5).
- (5) While applying heat from a heat gun, carefully pry up metal fuel pump module access plate. Take care not to bend plate.
- (6) Clean top of fuel pump module area around fuel line connection points.
- (7) Disconnect 2 fuel lines at fuel pump module (Fig. 6) by pressing on tabs at side of fitting.
- (8) Raise vehicle.
- (9) Place drain pan under fuel filter.
- (10) A third fuel line is attached to bottom of filter (Fig. 7). The disconnection point for this 3rd line is approximately 1 foot towards front of vehicle. Clean fuel line connection point before disconnection. Disconnect by pressing on tabs at side of fitting.
- (11) Disconnect 3rd fuel line from body retention clip. Place a small screwdriver into side of clip and twist for removal.

## FUEL FILTER (Continued)

(12) Remove filter ground strap at fuel tank mounting strap.

(13) Remove 1 filter mounting nut (Fig. 7) and remove filter.



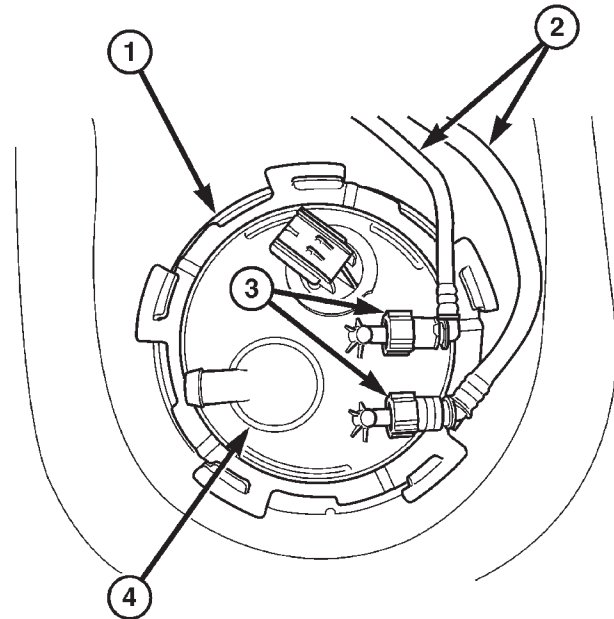
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**Fig. 5 ACCESS PLATE**

- 1 - FLOORPAN AT REAR
- 2 - FUEL PUMP MODULE ACCESS PLATE
- 3 - NUTS (4)
- 4 - OPENING TO PUMP MODULE

## INSTALLATION

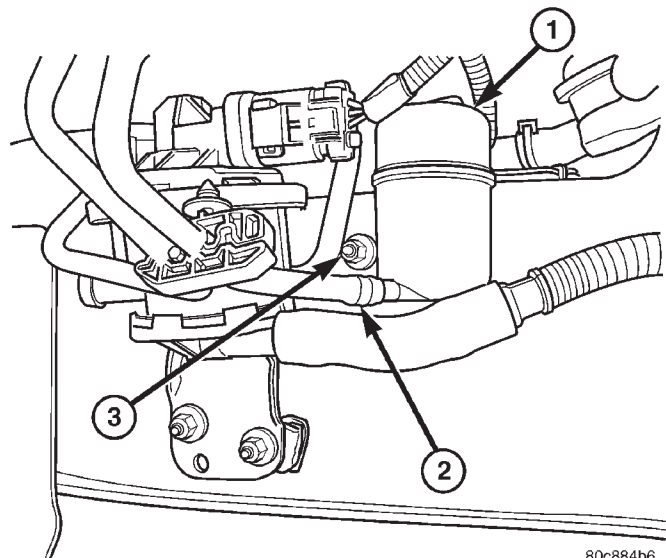
- (1) Raise vehicle.
- (2) Position fuel lines on filter towards top of fuel tank.
- (3) Position filter to mounting stud on front of fuel tank.
- (4) Install filter mounting nut and tighten. Refer to torque specifications.
- (5) A third fuel line is attached to bottom of filter. The connection point for this 3rd line is approximately 1 foot towards front of vehicle. Connect by snapping together.
- (6) Connect 3rd fuel line to body retention clip (snaps in).
- (7) Attach filter ground strap to tank mounting strap.
- (8) Lower vehicle.
- (9) Attach (snap on) 2 filter fuel lines at fuel pump module fittings.
- (10) Start engine and check fuel line fittings for leaks.
- (11) Apply silicone sealant to fuel pump module metal access plate.



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**Fig. 6 FUEL LINES AT PUMP MODULE**

- 1 - FUEL PUMP MODULE LOCKRING
- 2 - FUEL LINES TO FUEL FILTER (2)
- 3 - QUICK-CONNECT FITTINGS (2)
- 4 - ROLLOVER VALVE



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**Fig. 7 FUEL FILTER LOCATION**

- 1 - FUEL FILTER
- 2 - 3RD FUEL LINE TO ENGINE
- 3 - FILTER MOUNTING NUT

(12) Install fuel pump module metal access plate and 4 nuts. Tighten 4 nuts. Refer to torque specifications.

(13) Position carpet and install 2 new cargo clamp rivets in each cargo holdown clamp.

## FUEL LEVEL SENDING UNIT / SENSOR

### DESCRIPTION

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 (card).

### OPERATION

The fuel pump module has 4 different circuits (wires). Two of these circuits are used for the fuel gauge sending unit for fuel gauge operation, and for certain OBD II emission requirements. The other 2 wires are used for electric fuel pump operation.

**For Fuel Gauge Operation:** A constant current source of approximately 32 milliamps is supplied to the resistor track on the fuel gauge sending unit. This is fed directly from the Powertrain Control Module (PCM). **NOTE: For diagnostic purposes, this 12V power source can only be verified with the circuit opened (fuel pump module electrical connector unplugged). With the connectors plugged, output voltages will vary from about 0.6 volts at FULL, to about 8.6 volts at EMPTY (about 8.6 volts at EMPTY for Jeep models, and about 7.0 volts at EMPTY for Dodge Truck models).** The resistor track is used to vary the voltage (resistance) depending on fuel tank float level. As fuel level increases, the float and arm move up, which decreases voltage. As fuel level decreases, the float and arm move down, which increases voltage. The varied voltage signal is returned back to the PCM through the sensor return circuit.

Both of the electrical circuits between the fuel gauge sending unit and the PCM are hard-wired (not multi-plexed). After the voltage signal is sent from the resistor track, and back to the PCM, the PCM will interpret the resistance (voltage) data and send a message across the multi-plex bus circuits to the instrument panel cluster. Here it is translated into the appropriate fuel gauge level reading. Refer to Instrument Panel for additional information.

**For OBD II Emission Monitor Requirements:** The PCM will monitor the voltage output sent from the resistor track on the sending unit 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 diagnostic 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.

## DIAGNOSIS AND TESTING - FUEL LEVEL SENDING UNIT

The fuel level sending unit contains a variable resistor (track). As the float moves up or down, electrical resistance will change. Refer to Instrument Panel and Gauges for Fuel Gauge testing. To test the gauge sending unit only, it must be removed from vehicle. The unit is a separate part of the lower fuel pump module section. Refer to Fuel Pump Module Removal/Installation for procedures (remove only the upper section of the fuel pump module). Measure the resistance across the sending unit terminals. With float in up position, resistance should be 20 ohms (+/- 5%). With float in down position, resistance should be 270 ohms (+/- 5%).

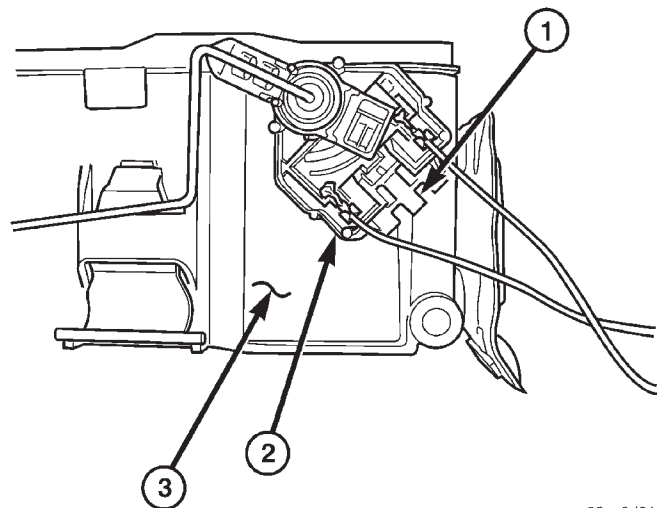
### REMOVAL

The fuel level sending unit (fuel level sensor) and float assembly is located on the side of the lower section of the fuel pump module. The lower section of the fuel pump module is located within the fuel tank.

(1) Remove lower section of fuel pump module from fuel tank. Refer to Fuel Pump Module Removal/Installation.

(2) To remove sending unit from pump module, lift on plastic locking tab (Fig. 8) while sliding sending unit upwards.

(3) Disconnect 4-wire electrical connector (Fig. 9) from bottom of upper section of fuel pump module. Separate necessary sending unit wiring.



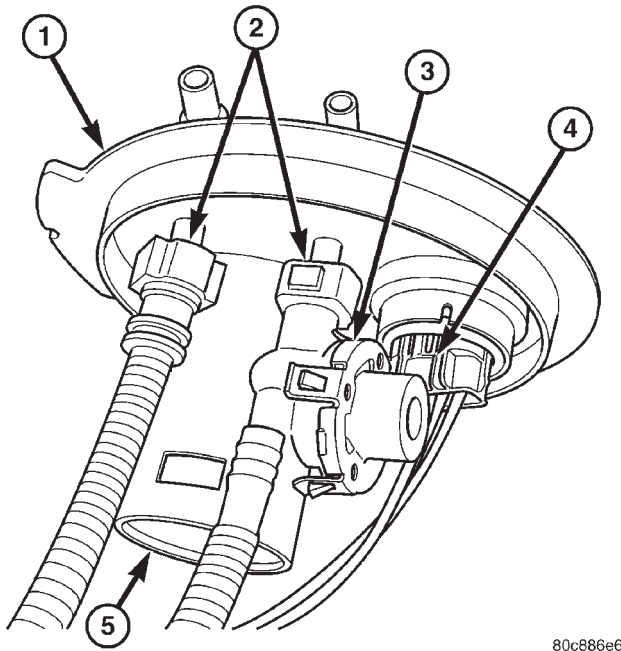
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**Fig. 8 FUEL LEVEL SENDING UNIT**

- 1 - LIFT TAB HERE FOR REMOVAL
- 2 - FUEL LEVEL SENDING UNIT
- 3 - LOWER SECTION OF PUMP MODULE



## FUEL LEVEL SENDING UNIT / SENSOR (Continued)



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**Fig. 9 FUEL PRESSURE REGULATOR/SENDING UNIT ELECTRICAL CONNECTOR**

- 1 - UPPER SECTION OF PUMP MODULE
- 2 - QUICK-CONNECT FITTINGS
- 3 - FUEL PRESSURE REGULATOR
- 4 - 4-WIRE ELECTRICAL CONNECTOR
- 5 - FUEL TANK CHECK (CONTROL) VALVE

## INSTALLATION

(1) Connect necessary wiring into electrical connectors. Connect 4-wire connector to upper section of pump module.

(2) Position sending unit to pump module. Slide and snap into place.

(3) Install lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

## FUEL LINES

### DESCRIPTION

Also refer to Quick-Connect Fittings.

**WARNING: THE FUEL SYSTEM MAY BE UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS, LINES, OR MOST COMPONENTS, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.**

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-

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.

## QUICK CONNECT FITTING

### DESCRIPTION

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Some may require the use of a special tool for disconnection and removal. Refer to Quick-Connect Fittings Removal/Installation for more information.

**CAUTION: The interior components (o-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.**

### STANDARD PROCEDURE - QUICK-CONNECT FITTINGS

Also refer to Fuel Tubes/Lines/Hoses and Clamps.

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Safety latch clips are used on certain components/lines. Certain fittings may require use of a special tool for disconnection.

### DISCONNECTING

**WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSE, FITTING OR LINE, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO FUEL SYSTEM PRESSURE RELEASE PROCEDURE.**

QUICK CONNECT FITTING (Continued)

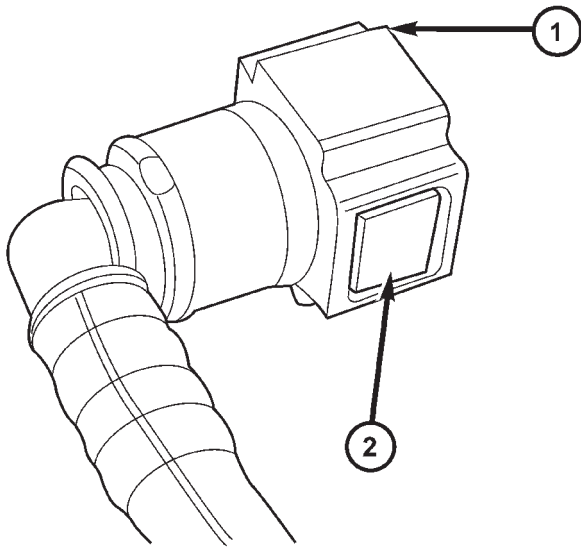
**CAUTION:** The interior components (o-rings, spacers) of some types of quick-connect fitting are not serviced separately. If service parts are not available, do not attempt to repair a damaged fitting or fuel line. If repair is necessary, replace complete fuel line assembly.

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure.

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) **2-Button Type Fitting:** This type of fitting is equipped with a push-button located on each side of quick-connect fitting (Fig. 10). Press on both buttons simultaneously for removal.

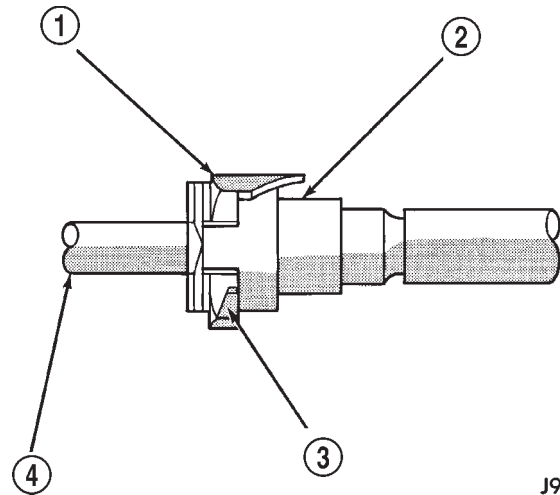


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**Fig. 10 2-BUTTON TYPE FITTING**

- 1 - QUICK-CONNECT FITTING
- 2 - PUSH-BUTTONS (2)

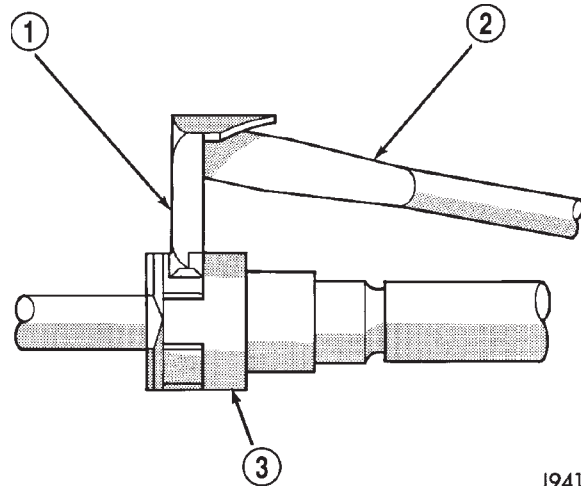
(5) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 11). The tab is removable. After tab is removed, quick-connect fitting can be separated from fuel system component.



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**Fig. 11 SINGLE-TAB TYPE FITTING**

- 1 - PULL TAB
- 2 - QUICK-CONNECT FITTING
- 3 - PRESS HERE TO REMOVE PULL TAB
- 4 - INSERTED TUBE END



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**Fig. 12 DISCONNECTING SINGLE-TAB TYPE FITTING**

- 1 - PULL TAB
- 2 - SCREWDRIVER
- 3 - QUICK-CONNECT FITTING

(a) Press release tab on side of fitting to release pull tab (Fig. 12). **If release tab is not pressed prior to releasing pull tab, pull tab will be damaged.**

(b) While pressing release tab on side of fitting, use screwdriver to pry up pull tab (Fig. 12).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 13).

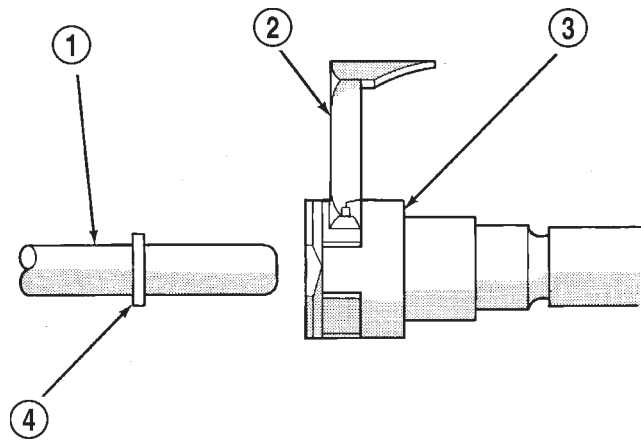
(6) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting (Fig. 14). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 14) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer.

(b) Pull fitting from fuel system component being serviced.

(c) 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.

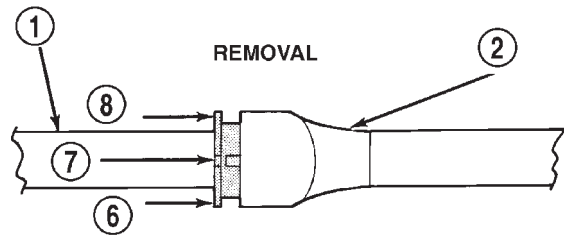
QUICK CONNECT FITTING (Continued)



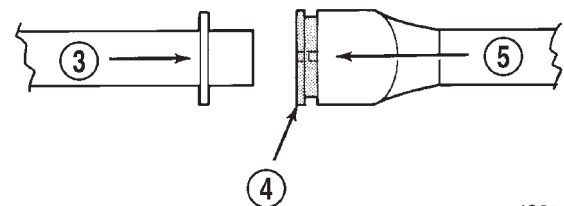
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**Fig. 13 REMOVING PULL TAB**

- 1 - FUEL TUBE OR FUEL SYSTEM COMPONENT
- 2 - PULL TAB
- 3 - QUICK-CONNECT FITTING
- 4 - FUEL TUBE STOP



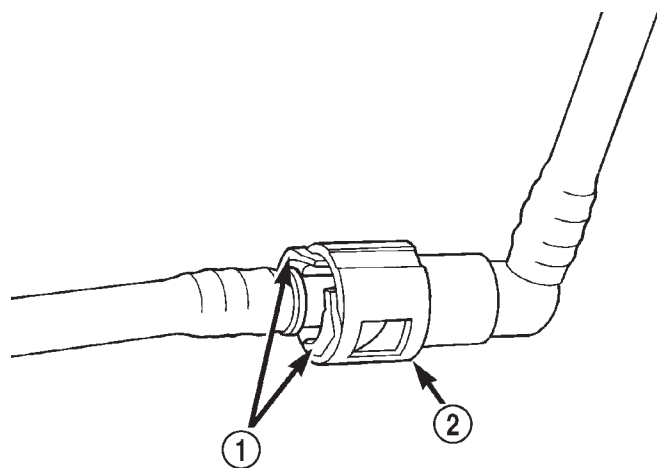
INSTALLATION



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**Fig. 15 PLASTIC RETAINER RING TYPE FITTING**

- 1 - FUEL TUBE
- 2 - QUICK CONNECT FITTING
- 3 - PUSH
- 4 - PLASTIC RETAINER
- 5 - PUSH
- 6 - PUSH
- 7 - PUSH
- 8 - PUSH



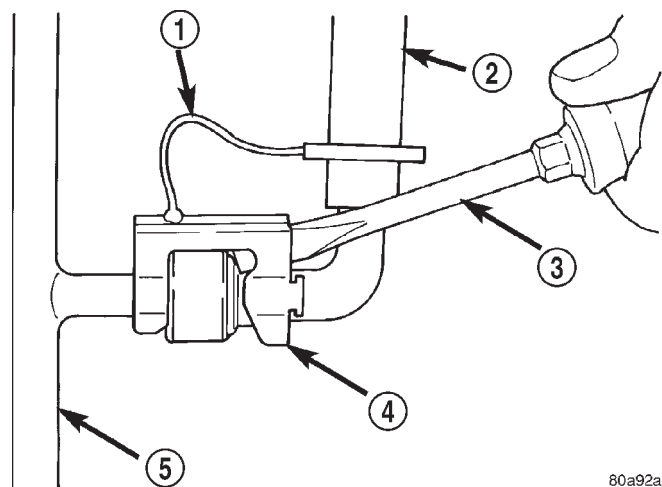
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**Fig. 14 TYPICAL 2-TAB TYPE FITTING**

- 1 - TAB(S)
- 2 - QUICK-CONNECT FITTING

(7) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 15) usually black in color.

(a) 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. 15). 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.**



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**Fig. 16 LATCH CLIP-TYPE 1**

- 1 - TETHER STRAP
- 2 - FUEL LINE
- 3 - SCREWDRIVER
- 4 - LATCH CLIP
- 5 - FUEL RAIL

QUICK CONNECT FITTING (Continued)

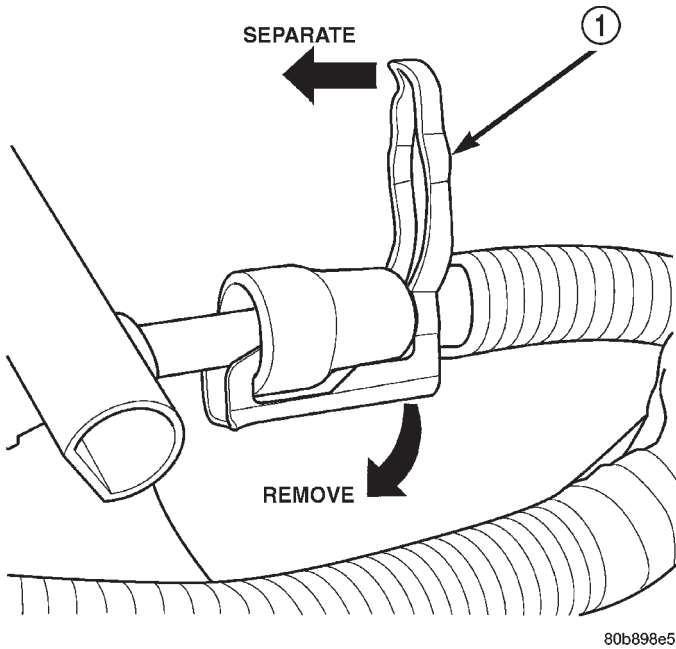


Fig. 17 LATCH CLIP-TYPE 2

1 - LATCH CLIP

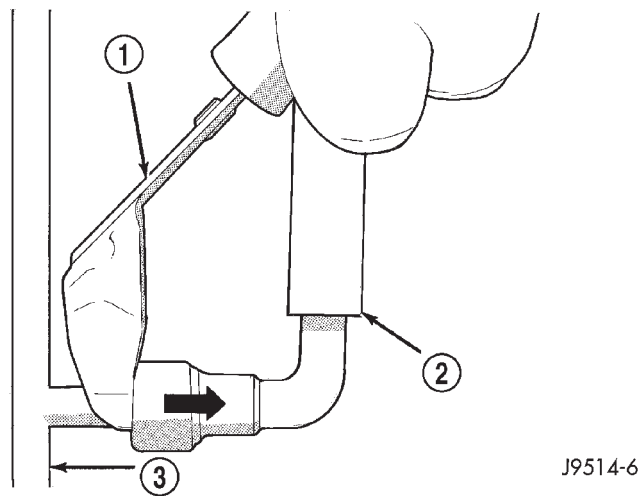


Fig. 18 FUEL LINE DISCONNECTION USING SPECIAL TOOL

1 - SPECIAL FUEL LINE TOOL  
 2 - FUEL LINE  
 3 - FUEL RAIL

(b) After disconnection, plastic retainer ring will remain with quick-connect fitting connector body.

(c) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(8) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used (Fig. 16) or (Fig. 17). Type-1 is tethered to fuel line and type-2 is not. A special tool will be necessary to

disconnect fuel line after latch clip is removed. The latch clip may be used on certain fuel line/fuel rail connection, or to join fuel lines together.

(a) Type 1: Pry up on latch clip with a screwdriver (Fig. 16).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 17) and swing away from fuel line.

(c) Slide latch clip toward fuel rail while lifting with screwdriver.

(d) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 18). Use tool to release locking fingers in end of line.

(e) With special tool still inserted, pull fuel line from fuel rail.

(f) After disconnection, locking fingers will remain within quick-connect fitting at end of fuel line.

(9) Disconnect quick-connect fitting from fuel system component being serviced.

CONNECTING

(1) Inspect quick-connect fitting body and fuel system component for damage. Replace as necessary.

(2) 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.

(3) 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.

(4) Continue pushing until a click is felt.

(5) Single-tab type fitting: Push new tab down until it locks into place in quick-connect fitting.

(6) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(7) Latch Clip Equipped: Install latch clip (snaps into position). **If latch clip will not fit, this indicates fuel line is not properly installed to fuel rail (or other fuel line). Recheck fuel line connection.**

(8) Connect negative cable to battery.

(9) Start engine and check for leaks.

FUEL PRESSURE REGULATOR

DESCRIPTION

The fuel pressure regulator is located on the bottom of the upper section of the fuel pump module. The fuel filter **is not combined** into the pressure regulator on this model.

## FUEL PRESSURE REGULATOR (Continued)

## OPERATION

The fuel 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 main fuel filter **is not combined** within the fuel pressure regulator as in other Jeep® models. Three different fuel filters are used: 1. a serviceable, separate, externally mounted, main fuel filter; 2. a non-serviceable primary filter located on the bottom of the electric fuel pump; 3. a non-serviceable secondary filter attached to the side of the fuel pump module.

**Fuel Flow:** Fuel migrates into the fuel pump module reservoir through a one-way check valve located on the bottom of the module. This check valve prevents the reservoir from running empty such as when going up or down hills with a low amount of fuel in the tank. A primary fuel filter (sock) is located at the bottom of the electric fuel pump. Fuel is drawn in through this filter, and up to the electric fuel pump. High pressure fuel (unregulated) is supplied from the electric fuel pump through a high-pressure line to one of 3 fittings on the main fuel filter. If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm within the regulator closes, and excess fuel is routed through a second fitting on the main fuel filter, and back into the fuel tank (the fuel pressure regulator is installed into the return side of the system). Pressure regulated fuel is then delivered from the third fitting on the fuel filter, up to and through the fuel rail, and on to the fuel injectors.

A secondary fuel filter is attached to the side of the fuel pump module. High-pressure from the electric fuel pump causes a siphoning action across a passage connected to this filter, and fuel is drawn into the fuel pump module reservoir. This is used to help keep the module reservoir full of fuel.

The fuel pressure regulator also 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 of the fuel pump module housing. **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.**

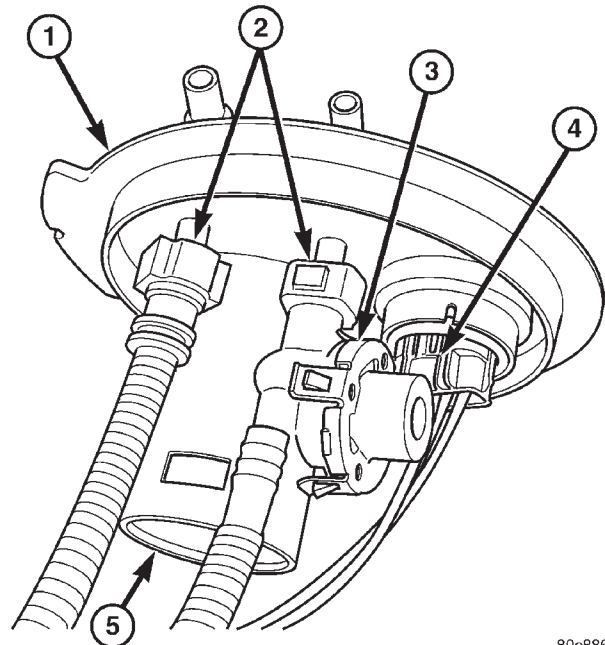
A separate fuel return line from the engine is not used with this system.

## REMOVAL

The fuel pressure regulator is located in the fuel tank. It is attached to the bottom of the upper section of the fuel pump module with a quick-connect fitting (Fig. 19). The fuel pump module is supplied in 2 sections (upper and lower). To replace the pressure regulator, the bottom section of the fuel pump module must be replaced.

(1) Remove upper and lower sections of fuel pump module from fuel tank. Refer to Fuel Pump Module Removal/Installation.

(2) Replace lower section of fuel pump module (includes fuel pressure regulator).



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**Fig. 19 FUEL PRESSURE REGULATOR/SENDING UNIT ELECTRICAL CONNECTOR**

- 1 - UPPER SECTION OF PUMP MODULE
- 2 - QUICK-CONNECT FITTINGS
- 3 - FUEL PRESSURE REGULATOR
- 4 - 4-WIRE ELECTRICAL CONNECTOR
- 5 - FUEL TANK CHECK (CONTROL) VALVE

## INSTALLATION

The fuel pressure regulator is located in the fuel tank. It is attached to the bottom of the upper section of the fuel pump module with a quick-connect fitting. The fuel pump module is supplied in 2 sections (upper and lower). To replace the pressure regulator, the bottom section of the fuel pump module must be replaced.

(1) Replace lower section of fuel pump module (includes fuel pressure regulator).

(2) Install upper and lower sections of fuel pump module to fuel tank. Refer to Fuel Pump Module Installation.

## FUEL PUMP

### DESCRIPTION

The electric fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump. The electric fuel pump is not a separate, serviceable component.

### OPERATION

Voltage to operate the electric pump is supplied through the fuel pump relay.

Fuel is drawn in through a filter at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

**Check Valve Operation:** The bottom section of the fuel pump module 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.** Refer to the Fuel Pressure Leak Down Test for more information.

The electric fuel pump is not a separate, serviceable component.

## DIAGNOSIS AND TESTING

### DIAGNOSIS AND TESTING - FUEL PUMP CAPACITY TEST

**Before performing this test, verify fuel pump pressure. Refer to Fuel Pump Pressure Test. Use this test in conjunction with the Fuel Pressure Leak Down Test.**

(1) Release fuel system pressure. Refer to Fuel Pressure Release Procedure.

(2) Disconnect fuel supply line at fuel rail. Refer to Quick-Connect Fittings. Some engines may require air cleaner housing removal before line disconnection.

(3) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16" fuel lines and tool number 6631 is used for 3/8" fuel lines.

(4) Connect correct Fuel Line Pressure Test Adapter Tool Hose into disconnected fuel supply line. Insert other end of Adaptor Tool Hose into a graduated container.

(5) Remove fuel fill cap.

(6) To activate fuel pump and pressurize system, obtain DRB® scan tool and actuate ASD Fuel System Test.

(7) A good fuel pump will deliver at least 1/10 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. Refer to Fuel Filter Removal/Installation for additional information.

(c) If both fuel pressure and capacity are low, replace bottom section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

### DIAGNOSIS AND TESTING - FUEL PUMP PRESSURE TEST

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.

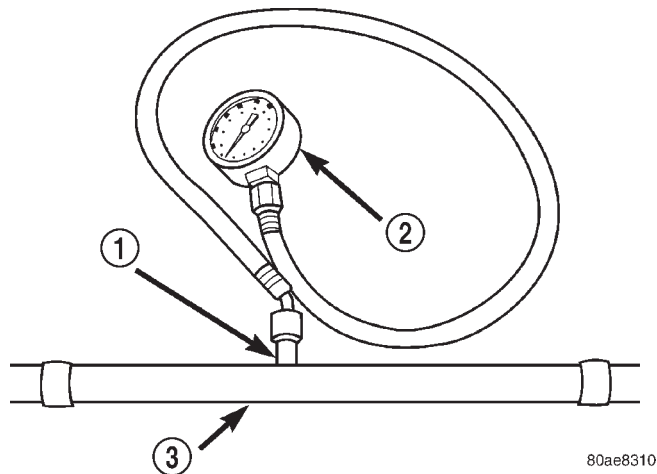
**Check Valve Operation:** The bottom section of the fuel pump module contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is 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.

The fuel system is equipped with a separate fuel pump module mounted, fuel pressure regulator. The fuel filter is remotely mounted. 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.**

## FUEL PUMP (Continued)

(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. 20). **The DRB® III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**



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**Fig. 20 FUEL PRESSURE TEST GAUGE (TYPICAL GAUGE INSTALLATION AT TEST PORT)**

- 1 - SERVICE (TEST) PORT
- 2 - FUEL PRESSURE TEST GAUGE
- 3 - FUEL RAIL

(2) Start and warm engine and note pressure gauge reading. Fuel pressure should be 339 kPa  $\pm$  34 kPa (49.2 psi  $\pm$  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 Leak Down Tests were not met, replace lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

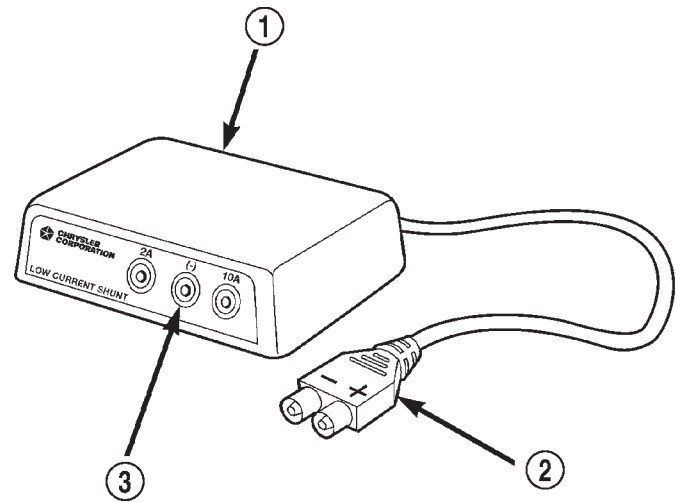
(4) If operating pressure is above 54.2 psi, electric fuel pump is OK, but fuel pressure regulator is defective. Replace lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(5) Install protective cap to fuel rail test port.

## DIAGNOSIS AND TESTING - 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. 21) and its test leads will be used to check fuel pump amperage specifications.



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**Fig. 21 LOW CURRENT SHUNT**

- 1 - LOW CURRENT SHUNT ADAPTER
- 2 - PLUG TO DRB
- 3 - TEST LEAD RECEPTACLES

(1) Be sure fuel tank contains fuel before starting test. If tank is empty or near empty, amperage readings will be incorrect.

(2) Obtain LCS adapter.

(3) Plug cable from LCS adapter into DRB scan tool at SET 1 receptacle.

(4) Plug DRB into vehicle 16-way connector (data link connector).

(5) Connect (-) and (+) test cable leads into LCS adapter receptacles. Use **10 amp (10A +)** receptacle and common (-) receptacles.

(6) Gain access to MAIN MENU on DRB screen.

(7) Press DVOM button on DRB.

(8) Using left/right arrow keys, highlight CHANNEL 1 function on DRB screen.

(9) Press ENTER three times.

(10) Using up/down arrow keys, highlight RANGE on DRB screen (screen will default to 2 amp scale).

(11) 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).**

(12) Remove cover from Power Distribution Center (PDC).

(13) Remove fuel pump relay from PDC. Refer to label on PDC cover for relay location.

FUEL PUMP (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.**

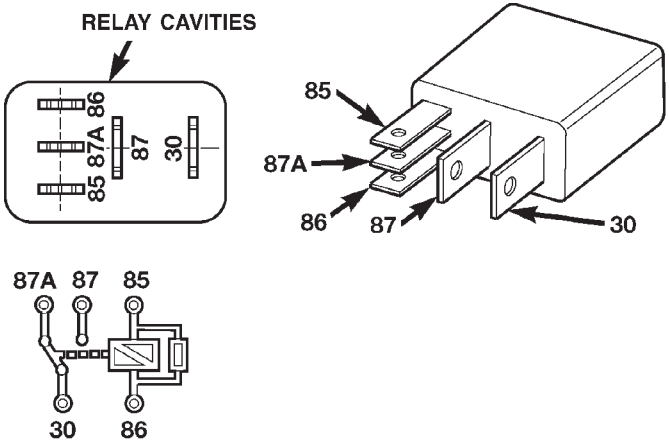
**CAUTION: To prevent possible damage to the vehicle electrical system and LCS adapter, the test leads must be connected into relay cavities exactly as shown in following steps.**

Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type-3.

(14) If equipped with **type-1 relay** (Fig. 22), 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. 22).

(15) If equipped with **type-2 relay** (Fig. 23), 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. 23).

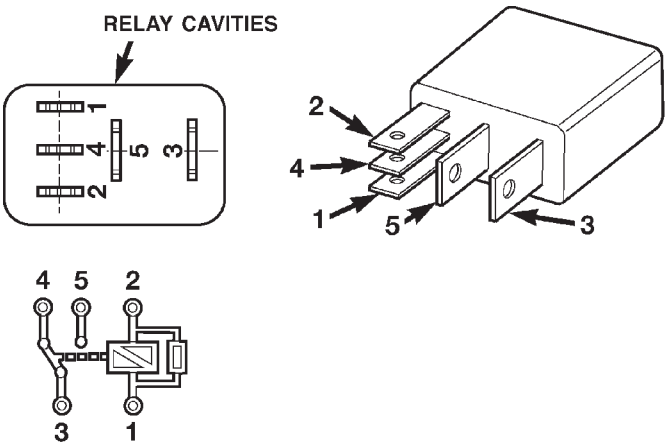
(16) If equipped with **type-3 relay** (Fig. 24), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 24).



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**Fig. 23 FUEL PUMP RELAY - TYPE 2**

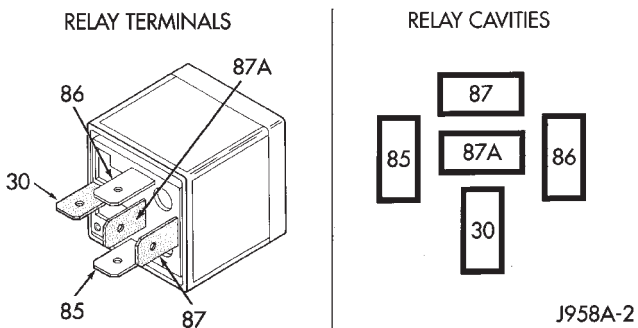
TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED



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**Fig. 24 FUEL PUMP RELAY - TYPE 3**

TERMINAL LEGEND	
NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN



**Fig. 22 FUEL PUMP RELAY - TYPE 1**



## FUEL PUMP (Continued)

(17) 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.

(18) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(19) Disconnect test leads from relay cavities immediately after testing.

## FUEL PUMP MODULE

## DESCRIPTION

The fuel pump module assembly is located in the fuel tank (Fig. 1). The assembly is divided into 2-sections, upper and lower. The lower section is locked to the bottom of the fuel tank. The complete assembly contains the following components:

- A fuel pressure regulator
- A separate fuel pick-up, or inlet filter
- An electric fuel pump
- A lockring to retain upper section of pump module to tank
- A rollover valve
- A vent fitting for ORVR system
- A soft gasket between tank flange and module
- A fuel gauge sending unit (fuel level sensor)
- Two fuel line connections (supply and return)

The fuel gauge sending unit may be serviced separately. If the electrical fuel pump, primary inlet filter or fuel pressure regulator require service, the lower section of the fuel pump module must be replaced.

## OPERATION

Refer to Fuel Pump, Inlet Filter, Fuel Pressure Regulator and Fuel Gauge Sending Unit.

## REMOVAL

The fuel pump module is divided into 2 sections, upper and lower. To service the check (control) valve, replace only the upper section. To service the fuel gauge sending unit, remove the upper section. To service the electric fuel pump, fuel pressure regulator or primary inlet filter, remove both sections and replace lower section.

**Fuel tank removal will not be necessary for fuel pump module removal. Access is from rear cargo area.**

(1) Four cargo holdown clamps are located inside the vehicle on the floor of the rear cargo area.

Remove the 2 rearward mounted clamps by drilling out the clamp rivets.

(2) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 25).

(3) Remove 4 fuel pump module access plate nuts (Fig. 25).

(4) While applying heat from a heat gun, carefully pry up fuel pump module access plate. Take care not to bend plate.

(5) Thoroughly clean area around top of pump module to prevent contaminants from entering fuel tank or fuel lines.

**WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING THE FUEL PUMP MODULE, FUEL SYSTEM PRESSURE MUST BE RELEASED.**

(6) Release fuel system pressure. Refer to Fuel System Pressure Release procedure.

(7) Disconnect 2 fuel lines at fuel pump module (Fig. 26) by pressing on 2 buttons at sides of fitting.

(8) Disconnect electrical connector (Fig. 26) at top of fuel pump module by sliding red colored tab first to unlock, and push grey colored tab down for removal.

(9) Disconnect ORVR hose clamp and hose (Fig. 26) at pump module fitting.

(10) Remove module lockring (Fig. 26) using a brass drift and hammer (counter-clockwise).

(11) Carefully lift upper section of pump module (Fig. 26) from fuel tank exposing connections (**lift upper section from tank very slowly until rubber gasket can be retained. If not, gasket will fall into fuel tank.**)

(a) Disconnect electrical connector (Fig. 27) at bottom of upper pump module section.

(b) Disconnect fuel pressure regulator (Fig. 27) at bottom of upper pump module section. Press on 2 locking tabs.

(c) Disconnect fuel return line (Fig. 27) at bottom of upper pump module section. Press on 2 locking tabs.

(d) Remove upper section of pump module (Fig. 28) from fuel tank.

(12) Using an approved gas holding tank, drain fuel tank through pump module opening. **If check (control) valve, or, only upper section of pump module is being serviced, tank draining is not necessary. If any other fuel pump module component is being serviced, the tank must be completely drained to the bottom.**

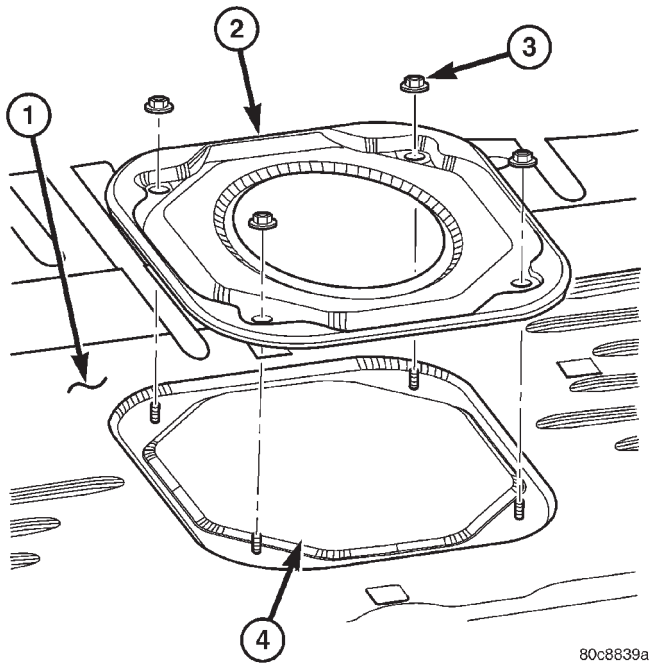
(13) To remove lower section of pump module from fuel tank:

(a) Using finger pressure, push on plastic release tab (Fig. 29) while sliding lock tab upward.

FUEL PUMP MODULE (Continued)

(b) The sides of pump module are equipped with tension springs (Fig. 29). These springs hold module to bottom of fuel tank into 2 formed guides (Fig. 30). Release module assembly from these 2 guides by sliding toward right side of fuel tank.

(c) Lift assembly from fuel tank.



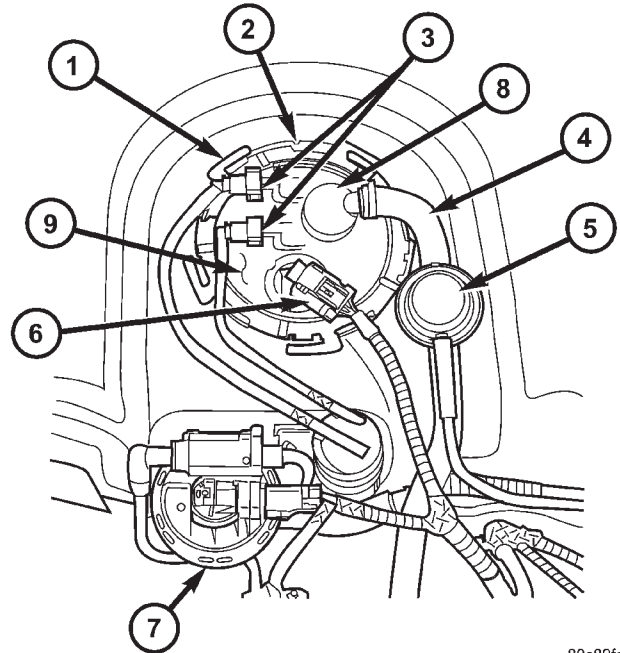
**Fig. 25 ACCESS PLATE**

- 1 - FLOORPAN AT REAR
- 2 - FUEL PUMP MODULE ACCESS PLATE
- 3 - NUTS (4)
- 4 - OPENING TO PUMP MODULE

**INSTALLATION**

**CAUTION:** Whenever fuel pump module is serviced, pump module gasket must be replaced.

- (1) Position lower section of fuel pump module assembly into fuel tank.
- (2) The bottom of fuel tank has 2 formed guides. Lock module assembly into these 2 guides by sliding toward left side of fuel tank.
- (3) Push down on plastic tab to lock module to fuel tank guides.
- (4) Connect fuel supply line to bottom of upper pump module section.
- (5) Connect fuel pressure regulator to bottom of upper pump module section.
- (6) Connect electrical connector to bottom of upper pump module section.
- (7) Position pump module into fuel tank. Notch on module must be facing rear of tank.



**Fig. 26 TOP OF FUEL PUMP MODULE**

- 1 - LOCK RING
- 2 - ALIGNMENT NOTCH
- 3 - FUEL FILTER FITTINGS (2)
- 4 - ORVR SYSTEM HOSE AND CLAMP
- 5 - FLOW MANAGEMENT VALVE
- 6 - ELECTRICAL CONNECTOR
- 7 - LEAK DETECTION PUMP
- 8 - FUEL TANK CHECK (CONTROL) VALVE
- 9 - FUEL PUMP MODULE (UPPER SECTION)

(8) Position lock ring to module. Tap locking using a brass drift and hammer (clockwise) until rotated up to built-on stops.

(9) Attach (snap on) 2 fuel filter fuel lines to top of fuel pump module.

(10) Connect hoses/lines to ORVR components.

(11) Fill fuel tank with fuel.

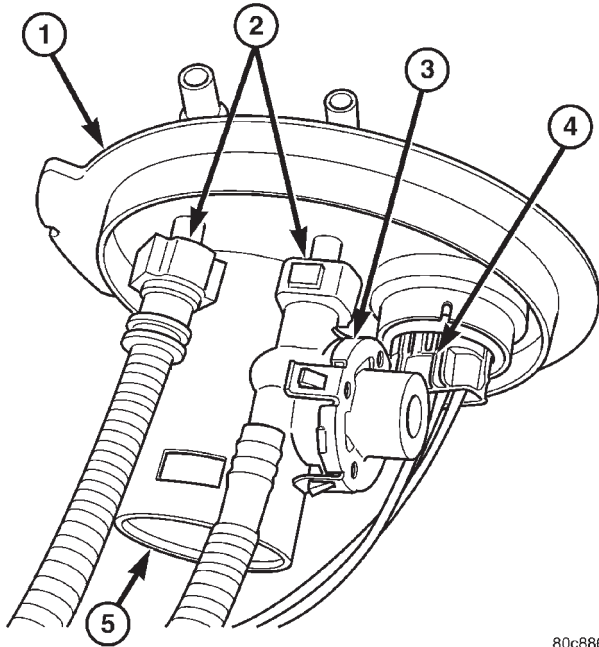
(12) Start engine and check for fuel leaks.

(13) Apply silicone sealant to bottom of fuel pump module metal access plate.

(14) Install fuel pump module metal access plate and 4 nuts. Tighten nuts to 3 N·m (26 in. lbs.) torque.

(15) Position carpet and install 2 new cargo clamp rivets into each cargo holdown clamp.

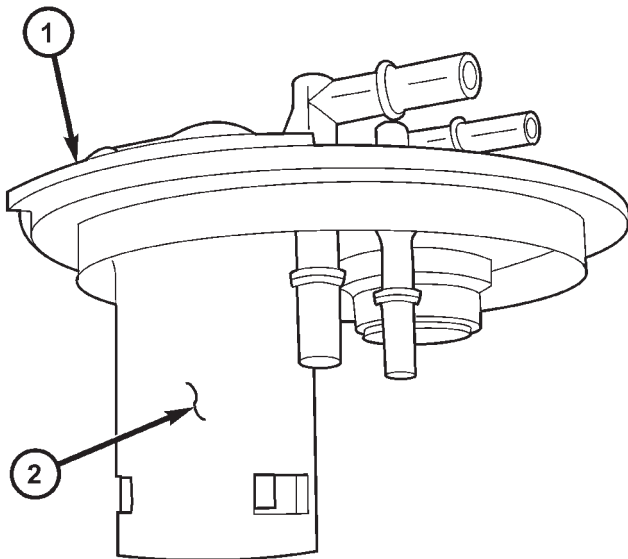
FUEL PUMP MODULE (Continued)



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**Fig. 27 FUEL PRESSURE REGULATOR/SENDING UNIT ELECTRICAL CONNECTOR**

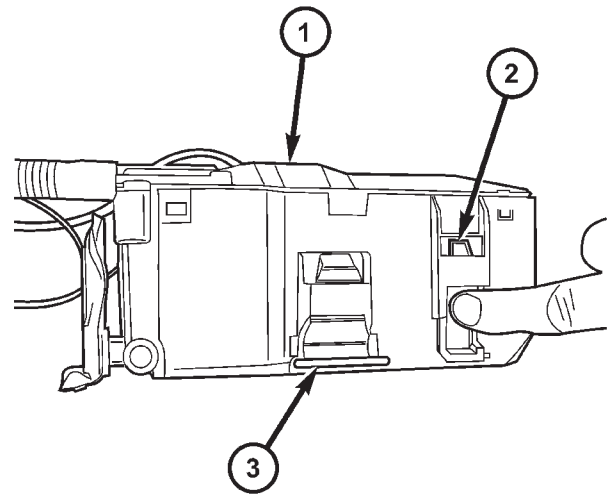
- 1 - UPPER SECTION OF PUMP MODULE
- 2 - QUICK-CONNECT FITTINGS
- 3 - FUEL PRESSURE REGULATOR
- 4 - 4-WIRE ELECTRICAL CONNECTOR
- 5 - FUEL TANK CHECK (CONTROL) VALVE



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**Fig. 28 UPPER SECTION - FUEL PUMP MODULE**

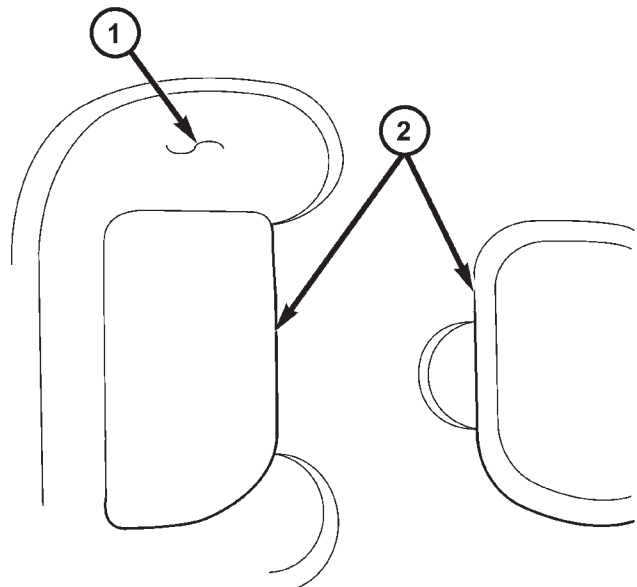
- 1 - UPPER SECTION - FUEL PUMP MODULE
- 2 - FUEL TANK CHECK (CONTROL) VALVE



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**Fig. 29 LOWER SECTION - FUEL PUMP MODULE**

- 1 - LOWER SECTION - FUEL PUMP MODULE
- 2 - RELEASE LOCK AND TAB
- 3 - TENSION SPRINGS



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**Fig. 30 FUEL PUMP MODULE GUIDES (IN FUEL TANK)**

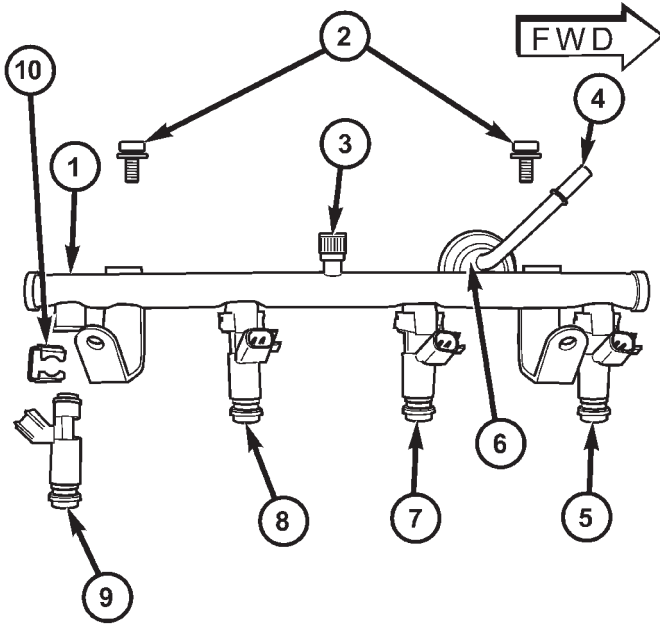
- 1 - FUEL TANK (INSIDE/LOWER)
- 2 - FUEL PUMP MODULE GUIDES

# FUEL RAIL

## DESCRIPTION

### 2.4L

The fuel injector rail is used to mount the fuel injectors to the engine (Fig. 31). On the 2.4L 4-cylinder engine, a **fuel damper** is located near the front of the fuel rail (Fig. 31).



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**Fig. 31 FUEL RAIL-2.4L**

- 1 - FUEL RAIL
- 2 - MOUNTING BOLTS
- 3 - TEST PORT
- 4 - QUICK-CONNECT FITTING
- 5 - INJ. #1
- 6 - DAMPER
- 7 - INJ #2
- 8 - INJ #3
- 9 - INJ #4
- 10- INJECTOR RETAINING CLIP

### 3.7L

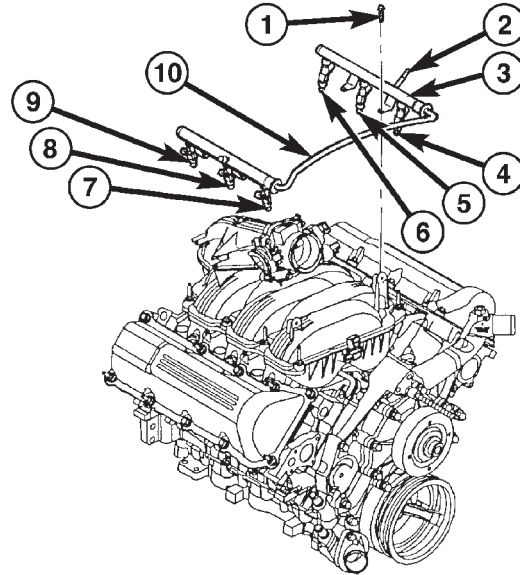
The fuel injector rail is mounted to the intake manifold (Fig. 32). It is used to mount the fuel injectors to the engine. The rail is equipped with a test port (Fig. 33) to check/test fuel system pressure.

A fuel rail mounted, fuel damper is not used with this engine.

## OPERATION

### 2.4L

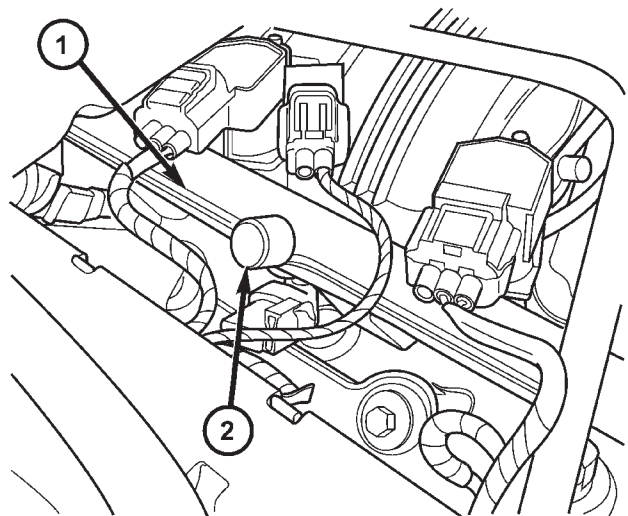
The fuel injector rail supplies the necessary fuel to each individual fuel injector.



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**Fig. 32 FUEL RAIL - 3.7L**

- 1 - MOUNTING BOLTS (4)
- 2 - QUICK-CONNECT FITTING
- 3 - FUEL RAIL
- 4 - INJ. #1
- 5 - INJ. #3
- 6 - INJ. #5
- 7 - INJ. #2
- 8 - INJ. #4
- 9 - INJ. #6
- 10 - CONNECTOR TUBE



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**Fig. 33 FUEL RAIL TEST PORT - 3.7L**

- 1 - FUEL RAIL
- 2 - TEST PORT

The fuel damper is used only to help control fuel pressure pulsations. These pulsations are the result

## FUEL RAIL (Continued)

of the firing of the fuel injectors. It is **not used** as a fuel pressure regulator. 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 Pressure Regulator for additional information.

The fuel rail is not repairable.

A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

## 3.7L

High pressure fuel from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

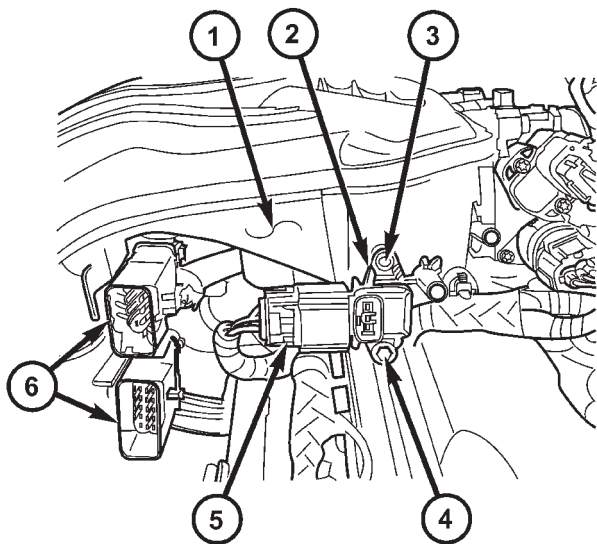
A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

## REMOVAL

## 2.4L

**WARNING: THE FUEL SYSTEM IS UNDER CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.**

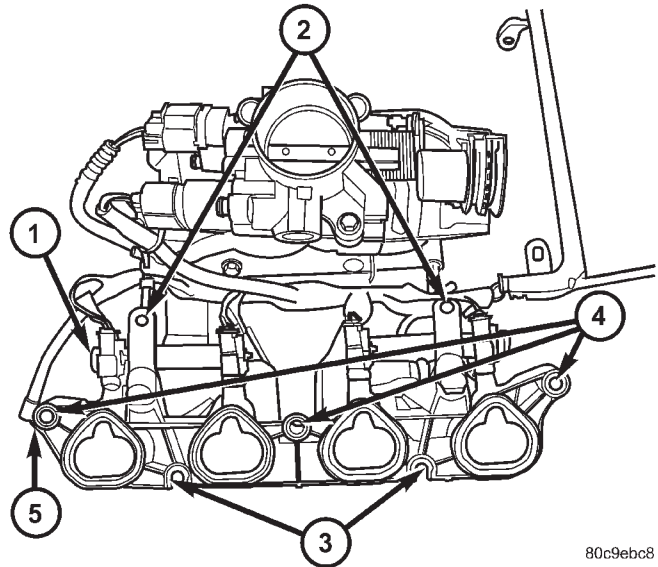


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**Fig. 34 MAP SENSOR LOCATION-2.4L**

- 1 - REAR OF INTAKE MANIFOLD
- 2 - MAP SENSOR
- 3 - ALIGNMENT PIN
- 4 - MOUNTING BOLT (TORX)
- 5 - ELECTRICAL CONNECTOR
- 6 - MAIN ENGINE HARNESS CONNECTORS

The fuel rail can be removed without removing the intake manifold if the following procedures are followed.



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**Fig. 35 FUEL RAIL MOUNTING-2.4L**

- 1 - FUEL RAIL
- 2 - INJECTION HARNESS CLIPS
- 3 - LOWER MOUNTING HOLES
- 4 - UPPER MOUNTING HOLES
- 5 - INTAKE MANIFOLD

- (1) Remove fuel tank filler tube cap.
- (2) Perform Fuel System Pressure Release Procedure.
- (3) Remove negative battery cable at battery.
- (4) Remove air duct at throttle body.
- (5) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.
- (6) Remove necessary vacuum lines at throttle body.
- (7) Drain engine coolant and remove thermostat and thermostat housing.
- (8) Remove PCV hose and valve at valve cover.
- (9) Remove 3 upper intake manifold mounting bolts (Fig. 35), but only loosen 2 lower bolts about 2 turns.
- (10) Disconnect 2 main engine harness connectors at rear of intake manifold (Fig. 34).
- (11) Disconnect 2 injection wiring harness clips at harness mounting bracket (Fig. 35).
- (12) Disconnect electrical connectors at all 4 fuel injectors. To remove connector refer to (Fig. 37). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.
- (13) Remove 2 injection rail mounting bolts (Fig. 31).

FUEL RAIL (Continued)

(14) Gently rock and pull fuel rail until fuel injectors just start to clear machined holes in intake manifold.

(15) Remove fuel rail (with injectors attached) from intake manifold.

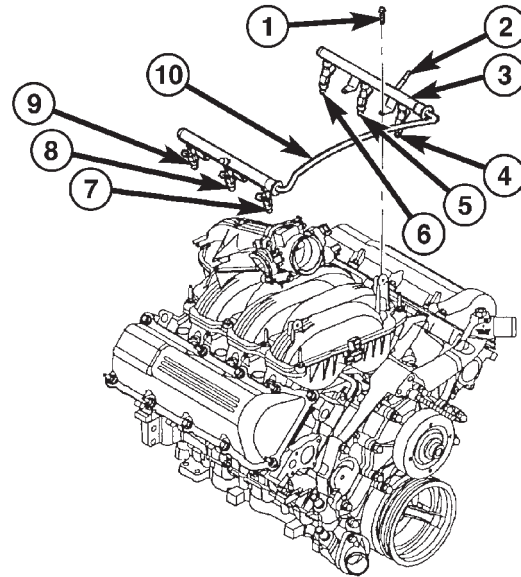
(16) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

3.7L

**WARNING: THE FUEL SYSTEM IS UNDER CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.**

**CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tube (Fig. 36). Due to design of tube, it does not use any clamps. Never attempt to install a clamping device of any kind to tube. When removing fuel rail assembly for any reason, be careful not to bend or kink tube.**

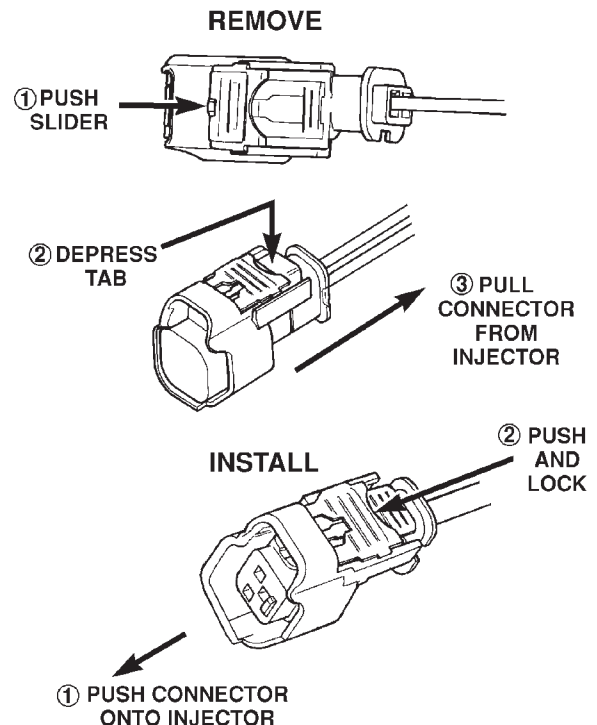
- (1) Remove fuel tank filler tube cap.
- (2) Perform Fuel System Pressure Release Procedure.
- (3) Remove negative battery cable at battery.
- (4) Remove air duct at throttle body air box.
- (5) Remove air box at throttle body.
- (6) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.
- (7) Remove necessary vacuum lines at throttle body.
- (8) Disconnect electrical connectors at all 6 fuel injectors. To remove connector refer to (Fig. 37). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.
- (9) Disconnect electrical connectors at throttle body sensors.
- (10) Remove 6 ignition coils. Refer to Ignition Coil Removal/Installation.
- (11) Remove 4 fuel rail mounting bolts (Fig. 36).
- (12) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in cylinder head. Gently rock and pull **right** side of rail until injectors just start to clear cylinder head holes. Repeat this procedure (left/right) until all injectors have cleared cylinder head holes.
- (13) Remove fuel rail (with injectors attached) from engine.



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**Fig. 36 FUEL RAIL REMOVE/INSTALL - 3.7L**

- 1 - MOUNTING BOLTS (4)
- 2 - QUICK-CONNECT FITTING
- 3 - FUEL RAIL
- 4 - INJ. #1
- 5 - INJ. #3
- 6 - INJ. #5
- 7 - INJ. #2
- 8 - INJ. #4
- 9 - INJ. #6
- 10 - CONNECTOR TUBE



80b61033

**Fig. 37 REMOVE/INSTALL INJECTOR CONNECTOR**

## FUEL RAIL (Continued)

(14) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

**INSTALLATION****2.4L Engine**

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in intake manifold.

(5) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(6) Push fuel rail down until fuel injectors have bottomed on shoulders.

(7) Install 2 fuel rail mounting bolts and tighten. Refer to torque specifications.

(8) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 37). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(9) Snap 2 injection wiring harness clips (Fig. 35) into brackets.

(10) Connect 2 main engine harness connectors at rear of intake manifold (Fig. 34).

(11) Tighten 5 intake manifold mounting bolts. Refer to Engine Torque Specifications.

(12) Install PCV valve and hose.

(13) Install thermostat and radiator hose. Fill with coolant. Refer to Cooling.

(14) Connect necessary vacuum lines to throttle body.

(15) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(16) Install air duct to throttle body.

(17) Connect battery cable to battery.

(18) Start engine and check for leaks.

**3.7L Engine**

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in cylinder head.

(5) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(6) Push **right** side of fuel rail down until fuel injectors have bottomed on cylinder head shoulder.

Push **left** fuel rail down until injectors have bottomed on cylinder head shoulder.

(7) Install 4 fuel rail mounting bolts and tighten. Refer to torque specifications.

(8) Install 6 ignition coils. Refer to Ignition Coil Removal/Installation.

(9) Connect electrical connectors to throttle body.

(10) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 37). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(11) Connect necessary vacuum lines to throttle body.

(12) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(13) Install air box to throttle body.

(14) Install air duct to air box.

(15) Connect battery cable to battery.

(16) Start engine and check for leaks.

**FUEL TANK****DESCRIPTION**

The fuel tank is constructed of a plastic material. Its main functions are for fuel storage and for placement of the fuel pump module, and certain ORVR components.

**OPERATION**

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.

A check (control) valve is mounted into the top section of the 2-piece fuel pump module. Refer to Fuel Tank Check Valve for additional information.

An evaporation control system is connected to the fuel tank 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) and/or an ORVR system. Refer to Emission Control System for additional information.

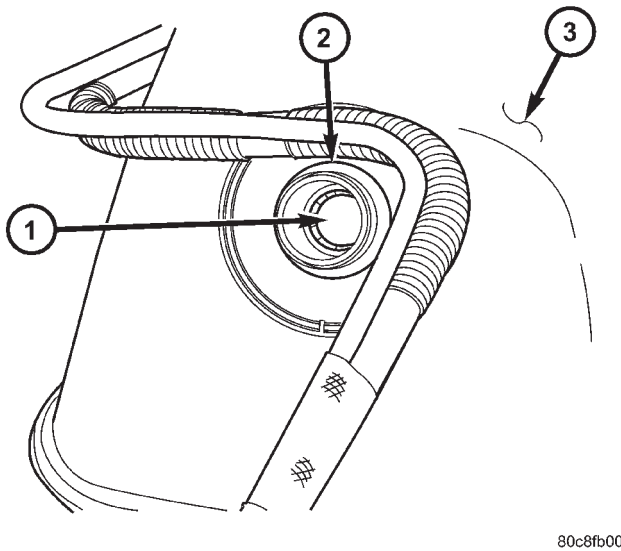
FUEL TANK (Continued)

**REMOVAL**

**Fuel Tank Draining**

**WARNING: THE FUEL SYSTEM MAY BE UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.**

Two different procedures may be used to drain fuel tank: removing fuel pump module access plate, or using DRB® scan tool. Due to a one-way check valve installed into the fuel fill opening fitting at the tank (Fig. 38), the tank cannot be drained conventionally at the fill cap.



**Fig. 38 FUEL FILL CHECK VALVE**

- 1 - ONE-WAY CHECK VALVE
- 2 - FUEL FILL FITTING
- 3 - SIDE OF FUEL TANK

The quickest draining procedure involves removing fuel pump module access plate.

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 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.

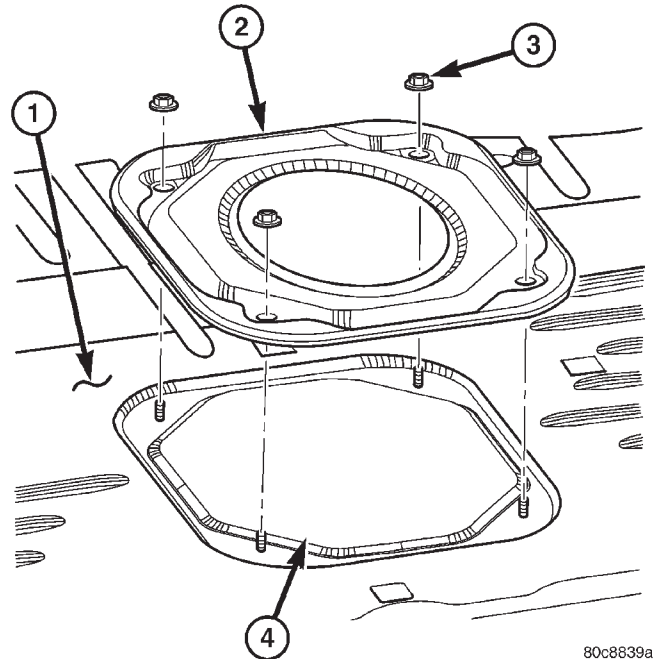
If electric fuel pump is not operating, fuel pump module access plate must be removed for fuel draining. Refer to following procedures.

**Fuel tank removal will not be necessary for fuel tank draining. Access for draining is from rear cargo area.**

(1) Open all windows in vehicle to allow for air ventilation.

(2) Four cargo holddown clamps are located inside the vehicle on the floor of the rear cargo area. Remove the 2 rearward mounted clamps by drilling out the clamp rivets.

(3) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 39).



**Fig. 39 ACCESS PLATE**

- 1 - FLOORPAN AT REAR
- 2 - FUEL PUMP MODULE ACCESS PLATE
- 3 - NUTS (4)
- 4 - OPENING TO PUMP MODULE

(4) Remove 4 fuel pump module access plate nuts (Fig. 39).

(5) While applying heat from a heat gun, carefully pry up fuel pump module access plate. Take care not to bend plate.

(6) Thoroughly clean area around top of pump module to prevent contaminants from entering fuel tank or fuel lines.

(7) Release fuel system pressure.

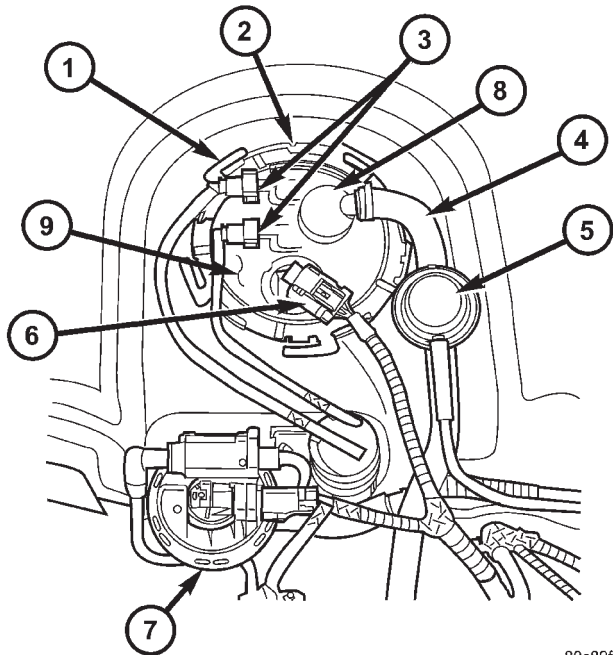
(8) Disconnect 2 fuel lines (Fig. 40) at fuel pump module by pressing on tabs at side of fitting.

(9) Disconnect electrical connector (Fig. 40). Slide red tab first to unlock, and push grey tab down for removal.

(10) Disconnect ORVR hose (Fig. 40) at pump module fitting.



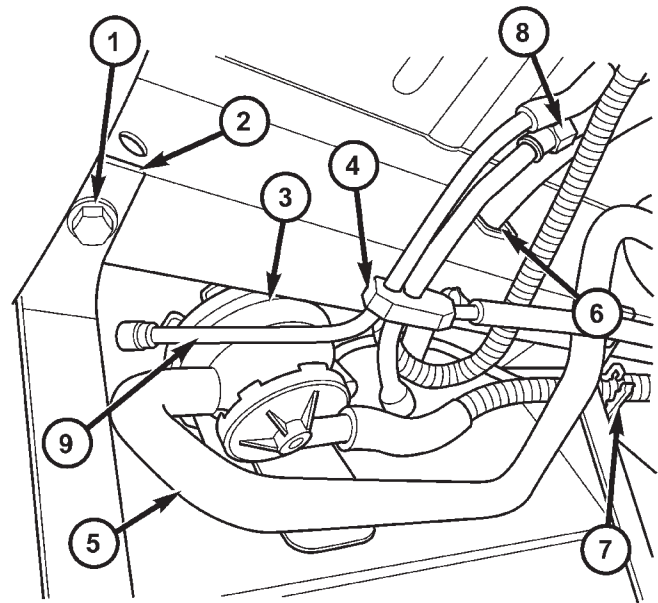
## FUEL TANK (Continued)



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Fig. 40 TOP OF FUEL PUMP MODULE

- 1 - LOCK RING
- 2 - ALIGNMENT NOTCH
- 3 - FUEL FILTER FITTINGS (2)
- 4 - ORVR SYSTEM HOSE AND CLAMP
- 5 - FLOW MANAGEMENT VALVE
- 6 - ELECTRICAL CONNECTOR
- 7 - LEAK DETECTION PUMP
- 8 - FUEL TANK CHECK (CONTROL) VALVE
- 9 - FUEL PUMP MODULE (UPPER SECTION)



80c8f0ce

Fig. 41 FRONT OF FUEL TANK

- 1 - TANK MOUNTING BOLTS (4)
- 2 - TANK MOUNTING STRAPS (2)
- 3 - LEAK DETECTION PUMP (LDP)
- 4 - BODY RETENTION CLIP (CENTER)
- 5 - LDP HOSES
- 6 - HOSE TO FUEL MANAGEMENT VALVE
- 7 - BODY RETENTION CLIP (LEFT/FRONT)
- 8 - QUICK-CONNECT FITTING
- 9 - LDP LINE

(11) Remove module lockring (Fig. 40) using a brass drift and hammer (counter-clockwise).

(12) Carefully lift upper section of pump module from fuel tank a few inches (**lift upper section from tank very slowly until rubber gasket can be retained. If not, gasket will fall into fuel tank.**)

(13) Using an approved gas holding tank, drain fuel tank through fuel pump module opening.

### Tank Removal

(1) After draining tank, temporarily place upper section of fuel pump module back into fuel tank.

(2) Raise vehicle.

(3) If equipped, remove fuel tank skid plate and tow hooks. Certain equipment packages will also require removal of the trailer hitch. Refer to Tow Hooks, Trailer Hitch or Skid Plate in 23, Body for removal/installation procedures.

(4) Disconnect fuel filter ground strap.

(5) Disconnect fuel filter outlet line from body retention clip located on frame near front/center of tank (Fig. 41). Place a small screwdriver into side of clip and twist for removal. Also disconnect Leak Detection Pump (LDP) line (Fig. 41) from this clip.

(6) Remove both 3/4" hoses at sides of Leak Detection Pump (LDP) (Fig. 41).

(7) Disconnect 3/4" flow management valve hose (Fig. 41) at EVAP canister.

(8) Remove fuel fill hose clamp (Fig. 42) at fuel tank, and disconnect hose from fuel tank.

(9) A third fuel line is attached to bottom of fuel filter. The disconnection point (quick-connect fitting) for this 3rd line is approximately 1 foot from front of tank towards front of vehicle (Fig. 41). Clean connection point before disconnection. Disconnect by pressing on tabs at side of quick-connect fitting. Also disconnect LDP vent line near this same point.

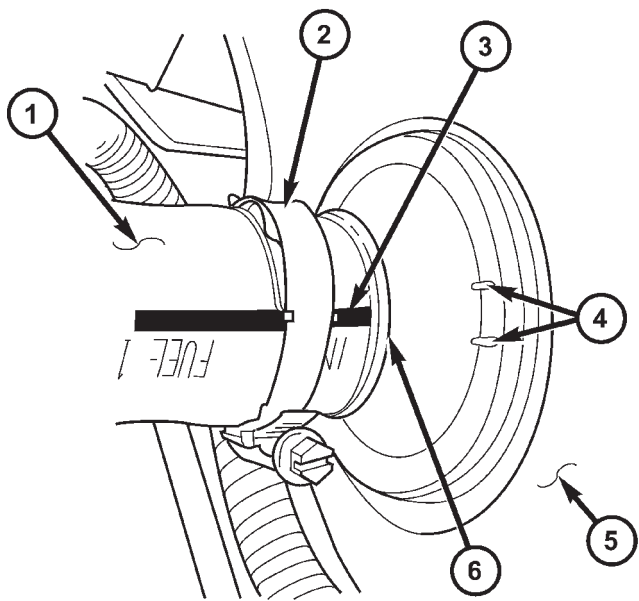
(10) Disconnect 2 vacuum/vent hoses from plastic retention clip at left/front of fuel tank line (Fig. 41).

(11) Support tank with a hydraulic jack.

(12) Remove 4 fuel tank strap bolts (Fig. 41) (2 at front of tank; 2 at rear of tank), and remove both tank support straps (Fig. 41).

(13) Carefully lower tank a few inches and disconnect electrical connector at top of LDP (Fig. 43). To disconnect electrical connector: Push upward on red colored tab to unlock. Push on black colored tab while removing connector.

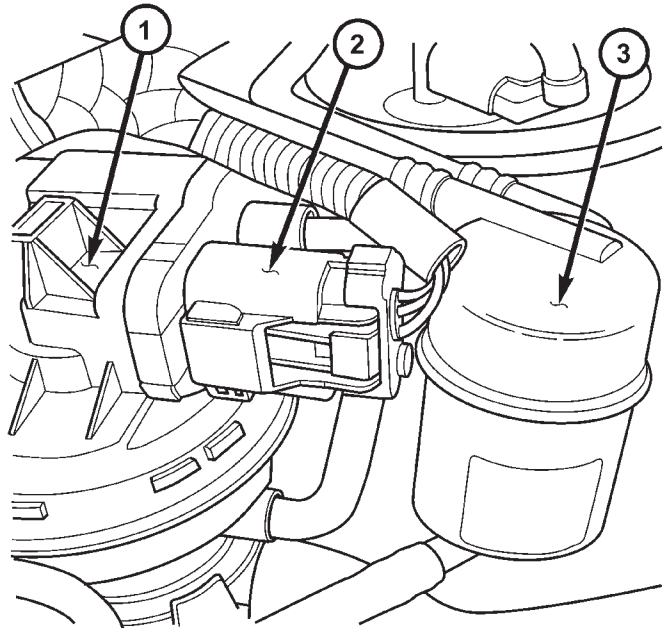
## FUEL TANK (Continued)



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**Fig. 42 FUEL FILL HOSE AT TANK**

- 1 - FUEL FILL HOSE AT TANK
- 2 - HOSE CLAMP
- 3 - WHITE PAINTED INDEX MARK
- 4 - ALIGNMENT NOTCHES
- 5 - LEFT SIDE OF FUEL TANK
- 6 - FUEL FILL FITTING



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**Fig. 43 LDP ELECTRICAL CONNECTOR**

- 1 - LEAK DETECTION PUMP (LDP)
- 2 - ELECTRICAL CONNECTOR
- 3 - FUEL FILTER

(14) Continue lowering tank while guiding remaining hoses and lines.

(15) If fuel tank is to be replaced, remove LDP, fuel filter and fuel pump module from tank. Refer to Leak Detection Pump, Fuel Filter and Fuel Pump Module Removal/Installation procedures.

**INSTALLATION**

(1) If fuel tank is to be replaced, install LDP, fuel filter and fuel pump module to tank. Refer to Leak Detection Pump, Fuel Filter and Fuel Pump Module Removal/Installation procedures.

(2) Position fuel tank to hydraulic jack.

(3) Raise tank while carefully guiding vent tubes/hoses through frame rail and crossmember. Before tank reaches body, connect electrical connector to Leak Detection Pump (LDP).

(4) Continue raising tank until positioned to body.

(5) Attach two fuel tank mounting straps and 4 mounting bolts. Tighten bolts to 61 N·m (45 ft. lbs.) torque.

(6) Connect 2 hoses to body retention clip at left/front of tank.

(7) Connect fuel filter fuel line to main fuel line (snaps together). After connecting, snap this line into body retention clip. Also connect LDP vacuum hose near this point.

(8) Install fuel fill hose and hose clamp to fuel tank fitting. Rotate hose until white painted index mark on hose (Fig. 42) is located between alignment notches on fuel tank fitting. Tighten clamp to 3.4 N·m (30 in. lbs.) torque.

(9) Connect fresh air and recirculation lines to fuel fill tube.

(10) Connect 3/4" lines to Leak Detection Pump (LDP).

(11) Connect 3/4" flow management valve hose to EVAP canister.

(12) Snap remaining lines into body retention clip at front/center of fuel tank.

(13) If equipped, install fuel tank skid plate, trailer hitch and tow hooks. Refer to Tow Hooks, Trailer Hitch or Skid Plate in 23, Body for removal/installation procedures.

(14) Lower vehicle.

(15) Attach (snap on) 2 fuel filter fuel lines to top of fuel pump module.

(16) Install electrical connector to top of fuel pump module.

(17) Connect negative battery cable to battery.

(18) Fill fuel tank with fuel.

(19) Start engine and check for fuel leaks near top of module.

(20) Apply silicone sealant to bottom of fuel pump module metal access plate.

## FUEL TANK (Continued)

(21) Install fuel pump module metal access plate and 4 nuts. Tighten nuts to 3 N·m (26 in. lbs.) torque.

(22) Position carpet and install 2 new cargo clamp rivets into each cargo holdown clamp.

## FUEL TANK CHECK VALVE

## DESCRIPTION

The fuel tank is equipped with a check valve. The valve (also referred to as a control valve) is located in the top section of the fuel pump module assembly (Fig. 1).

## OPERATION

The fuel tank check valve (also referred to as either a control valve, one-way check valve or float valve) will prevent fuel flow through the fuel tank vent in the event of an accidental vehicle rollover. It is also used as a part of the ORVR system. The EVAP canister and ORVR system draw fuel vapors from the fuel tank through this valve. Refer to ORVR in Emissions for additional information.

The valve may be serviced by replacing the upper section of the fuel pump module assembly.

## REMOVAL

The fuel tank check (control) valve is attached into the top section of the fuel pump module (Fig. 44). If replacement is necessary, the top section of the fuel pump module must be replaced. Refer to Fuel Pump Module Removal/Installation.

## INSTALLATION

The fuel tank check (control) valve is attached to the top section of the fuel pump module. If replacement is necessary, the top section of the fuel pump module must be replaced. Refer to Fuel Pump Module Removal/Installation.

## INLET FILTER

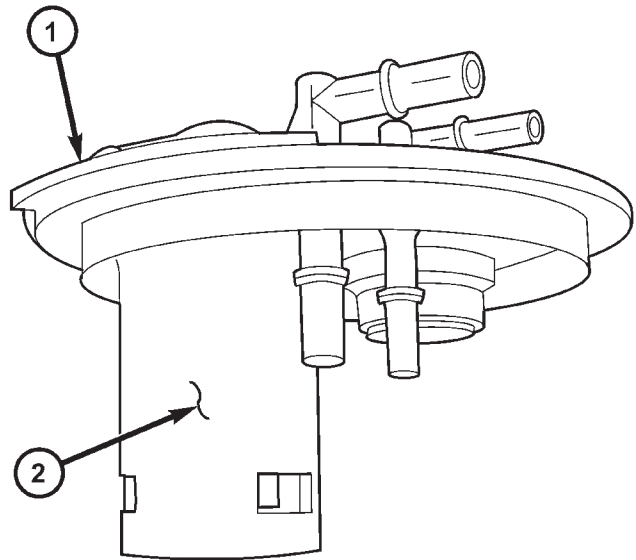
## REMOVAL

The fuel pump inlet filter is located on the bottom/side of the lower fuel pump module section (Fig. 45). The fuel pump module assembly is located in the fuel tank.

(1) Remove lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(2) Remove filter by prying from pump module with 2 small screwdrivers. Filter is snapped to module with 2 release tabs (Fig. 45).

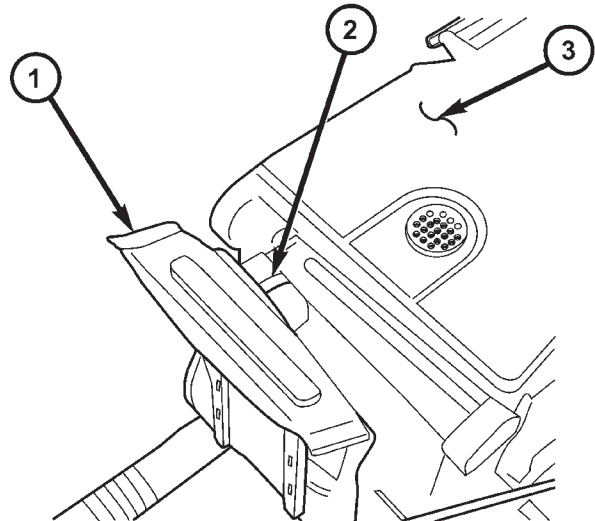
(3) Clean filter entrance into pump module opening.



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**Fig. 44 UPPER SECTION - FUEL PUMP MODULE**

- 1 - UPPER SECTION - FUEL PUMP MODULE  
2 - FUEL TANK CHECK (CONTROL) VALVE



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**Fig. 45 INLET FILTER**

- 1 - INLET FILTER  
2 - RELEASE TABS (2)  
3 - BOTTOM OF FUEL PUMP MODULE

## INSTALLATION

- (1) Snap new filter to bottom of fuel pump module.  
(2) Install lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

# FUEL INJECTION

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## FUEL INJECTION

### DESCRIPTION

The Powertrain Control Module (PCM) operates the fuel injection system. Refer to Powertrain Control Module in Electronic Control Modules for information.

## ACCELERATOR PEDAL

### REMOVAL

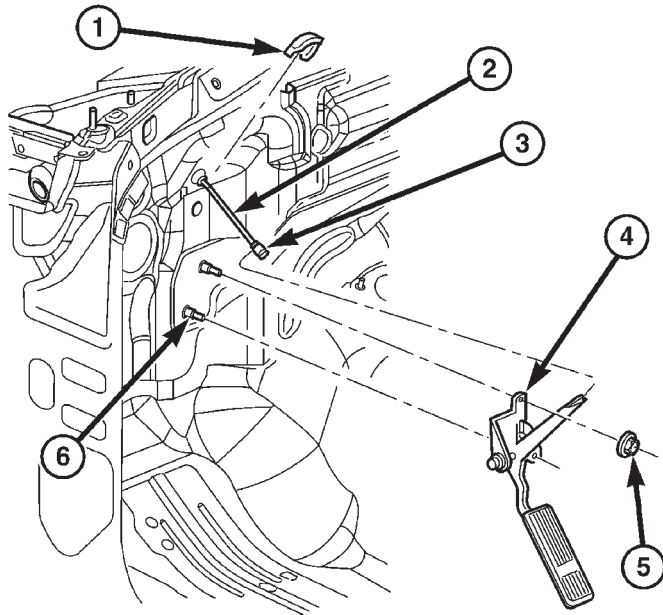
The accelerator pedal is serviced as a complete assembly including the bracket.

The accelerator pedal is connected to the upper part of the accelerator pedal arm by a plastic retainer (clip) (Fig. 1). This plastic retainer snaps into the top of the accelerator pedal arm.

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 1). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove 2 accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

## ACCELERATOR PEDAL (Continued)



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**Fig. 1 ACCELERATOR PEDAL/BRACKET ASSEMBLY**

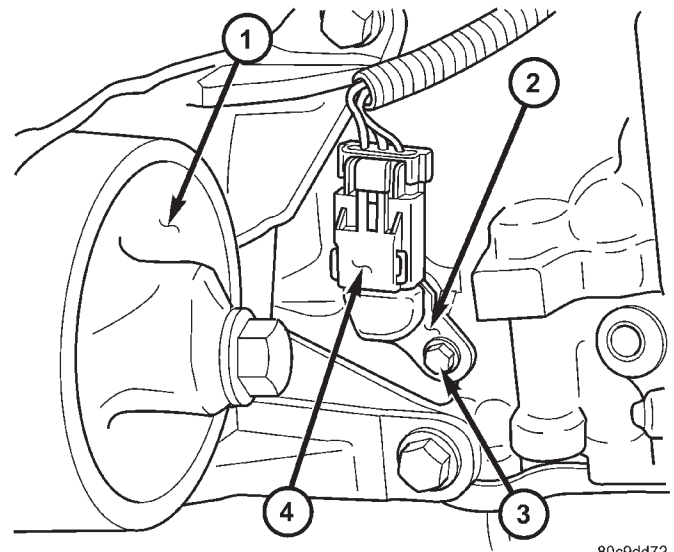
- 1 - METAL THROTTLE CABLE CLIP
- 2 - THROTTLE CABLE
- 3 - PLASTIC CABLE RETAINER
- 4 - PEDAL/BRACKET ASSEMBLY
- 5 - PEDAL MOUNTING NUTS (2)
- 6 - PEDAL MOUNTING STUDS (2)

**INSTALLATION**

- (1) Place accelerator pedal assembly over 2 studs (Fig. 1) protruding from floor pan.
- (2) Install 2 mounting nuts. Refer to torque specifications.
- (3) Slide throttle cable into opening slot in top of pedal arm.
- (4) Push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place.
- (5) Before starting engine, operate accelerator pedal to check for any binding.

**CRANKSHAFT POSITION SENSOR****DESCRIPTION****2.4L**

The Crankshaft Position (CKP) sensor is mounted into the right front side of the cylinder block (Fig. 2). It is positioned and bolted into a machined hole.



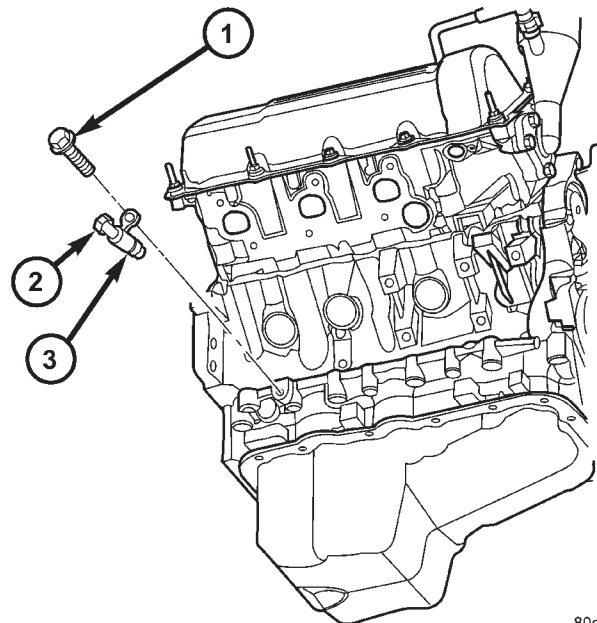
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**Fig. 2 CKP SENSOR LOCATION-2.4L**

- 1 - RIGHT FRONT ENGINE MOUNT
- 2 - CKP SENSOR
- 3 - MOUNTING BOLT
- 4 - ELECTRICAL CONNECTOR

**3.7L**

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block (Fig. 3). It is positioned and bolted into a machined hole.



80cea91d

**Fig. 3 CKP - 3.7L**

- 1 - MOUNTING BOLT
- 2 - CKP SENSOR
- 3 - O-RING

CRANKSHAFT POSITION SENSOR (Continued)

**OPERATION**

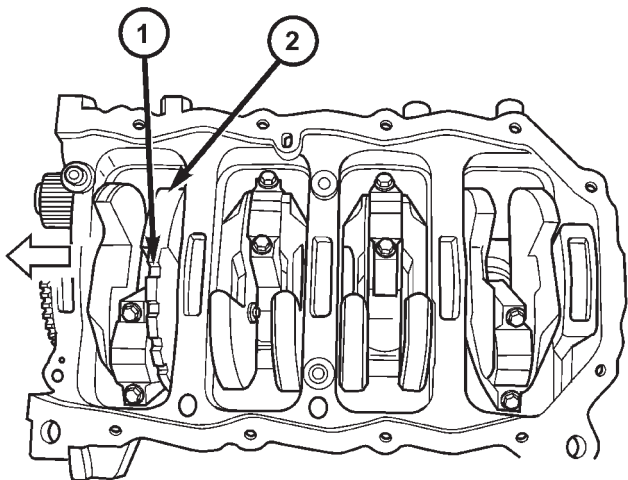
**2.4L**

Engine speed and crankshaft position are provided through the CKP (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.

A tonewheel (targetwheel) is a part of the engine crankshaft (Fig. 4). This tonewheel has sets of notches at its outer edge.

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.



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**Fig. 4 CKP OPERATION-2.4L**

- 1 - NOTCHES
- 2 - CRANKSHAFT

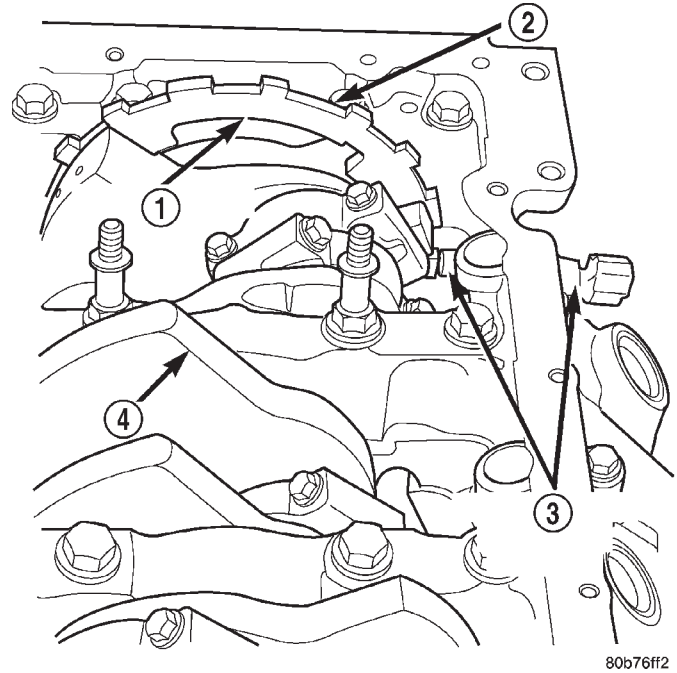
**3.7L**

Engine speed and crankshaft position are provided through the CKP (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.

A tonewheel (targetwheel) is bolted to the engine crankshaft (Fig. 5). This tonewheel has sets of notches 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.



80b76ff2

**Fig. 5 CKP OPERATION-3.7L**

- 1 - TONEWHEEL
- 2 - NOTCHES
- 3 - CRANKSHAFT POSITION SENSOR
- 4 - CRANKSHAFT

**REMOVAL**

**2.4L**

The Crankshaft Position (CKP) sensor is mounted into the right front side of the cylinder block (Fig. 6). It is positioned and bolted into a machined hole.

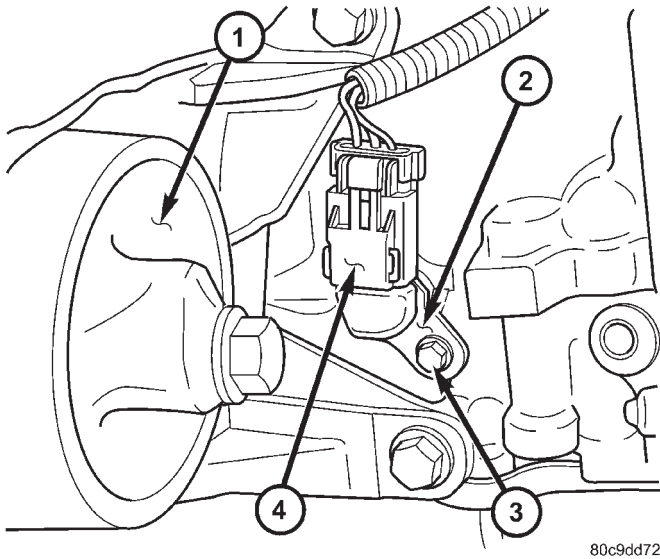
- (1) Disconnect sensor electrical connector.
- (2) Remove sensor bolt.
- (3) Carefully pry sensor from cylinder block in a rocking action.
- (4) Check condition of sensor o-ring (Fig. 7).

**3.7L**

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block (Fig. 8). It is positioned and bolted into a machined hole.

- (1) Raise vehicle.
- (2) Disconnect sensor electrical connector.
- (3) Remove sensor mounting bolt (Fig. 8).
- (4) Carefully remove sensor from cylinder block in a rocking and twisting action.
- (5) Check condition of sensor o-ring.

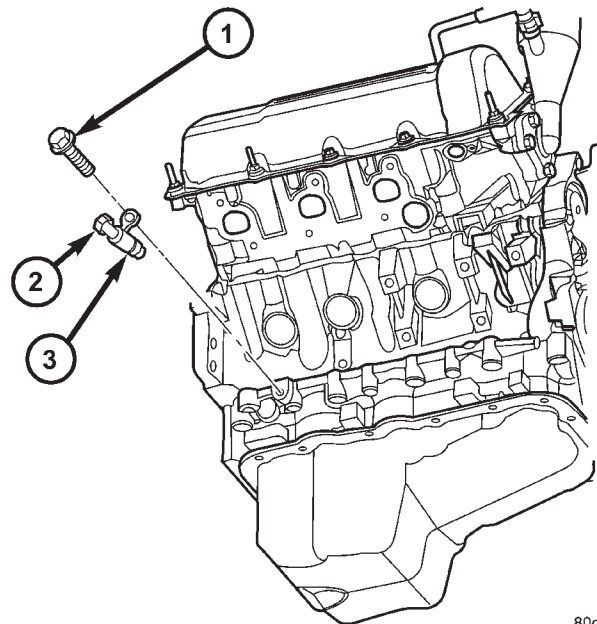
## CRANKSHAFT POSITION SENSOR (Continued)



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**Fig. 6 CKP SENSOR LOCATION-2.4L**

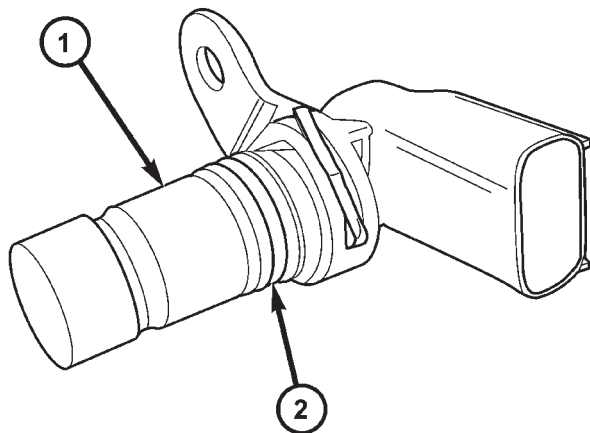
- 1 - RIGHT FRONT ENGINE MOUNT
- 2 - CKP SENSOR
- 3 - MOUNTING BOLT
- 4 - ELECTRICAL CONNECTOR



80cea91d

**Fig. 8 CKP - 3.7L**

- 1 - MOUNTING BOLT
- 2 - CKP SENSOR
- 3 - O-RING



80c9dde8

**Fig. 7 CKP AND O-RING-2.4L**

- 1 - CKP SENSOR
- 2 - O-RING

**INSTALLATION****2.4L**

- (1) Clean out machined hole in engine block.
- (2) Apply a small amount of engine oil to sensor o-ring.

- (3) Install sensor into engine 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. If sensor is not flush, damage to sensor mounting tang may result.

- (4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.

- (5) Connect electrical connector to sensor.

**3.7L**

- (1) Clean out machined hole in engine block.
- (2) Apply a small amount of engine oil to sensor o-ring.

- (3) Install sensor into engine block with a slight rocking and twisting action.

**CAUTION:** Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

- (4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.

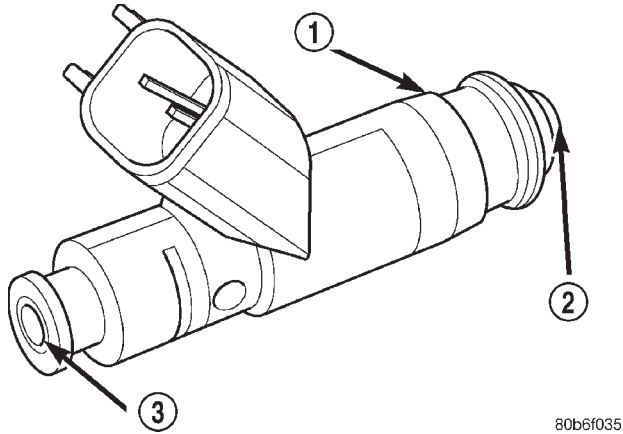
- (5) Connect electrical connector to sensor.

- (6) Lower vehicle.

## FUEL INJECTOR

### DESCRIPTION

An individual fuel injector (Fig. 9) is used for each individual cylinder.



**Fig. 9 FUEL INJECTOR — TYPICAL**

### OPERATION

#### OPERATION - FUEL INJECTOR

The top (fuel entry) end of the injector (Fig. 9) is attached into an opening on the fuel rail.

The fuel injectors 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.

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.

Battery voltage is supplied to the injectors through the ASD relay.

The PCM determines injector pulse width based on various inputs.

#### OPERATION - PCM OUTPUT

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.

Battery voltage (12 volts +) is supplied to the injectors through the ASD relay. The ASD relay will shut-down the 12 volt power source to the fuel injectors if the PCM senses the ignition is on, but the engine is not running. This occurs after the engine has not been running for approximately 1.8 seconds.

The PCM determines injector on-time (pulse width) based on various inputs.

#### DIAGNOSIS AND TESTING - FUEL INJECTOR

To perform a complete test of the fuel injectors and their circuitry, use the DRB scan tool and refer to the appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector. The injector is equipped with 2 electrical terminals (pins). Place an ohmmeter across the terminals. Resistance reading should be approximately 12 ohms  $\pm$ 1.2 ohms at 20°C (68°F).

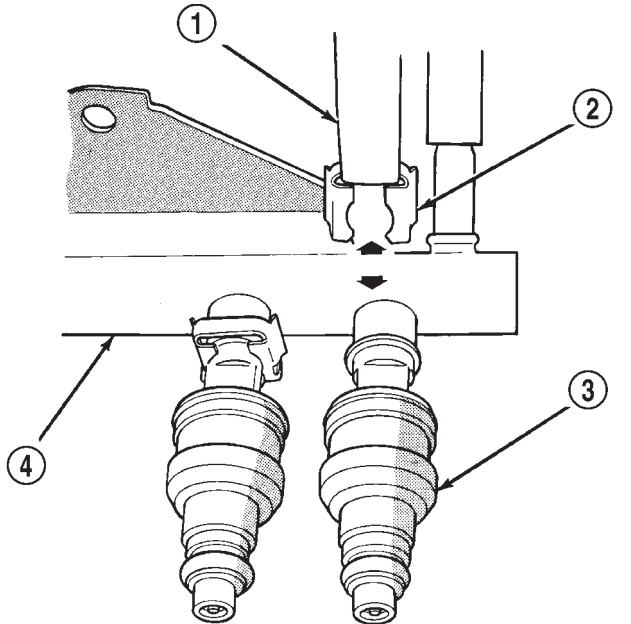


## FUEL INJECTOR (Continued)

**REMOVAL**

(1) Remove fuel rail. Refer to Fuel Injector Rail Removal.

(2) Disconnect clip(s) that retain fuel injector(s) to fuel rail (Fig. 10).



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**Fig. 10 INJECTOR RETAINING CLIP**

- 1 - PLIERS
- 2 - INJECTOR CLIP
- 3 - FUEL INJECTOR
- 4 - FUEL RAIL - TYPICAL

**INSTALLATION**

(1) Install fuel injector(s) into fuel rail assembly and install retaining clip(s).

(2) If same injector(s) is being reinstalled, install new o-ring(s).

(3) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(4) Install fuel rail. Refer to Fuel Rail Installation.

(5) Start engine and check for fuel leaks.

**FUEL PUMP RELAY****DESCRIPTION**

The 5-pin, 12-volt, fuel pump relay is located in the Power Distribution Center (PDC). Refer to the label on the PDC cover for relay location.

**OPERATION**

The Powertrain Control Module (PCM) energizes the electric fuel pump through the fuel pump relay. The fuel pump relay is energized by first applying battery voltage to it when the ignition key is turned

ON, and then applying a ground signal to the relay from the PCM.

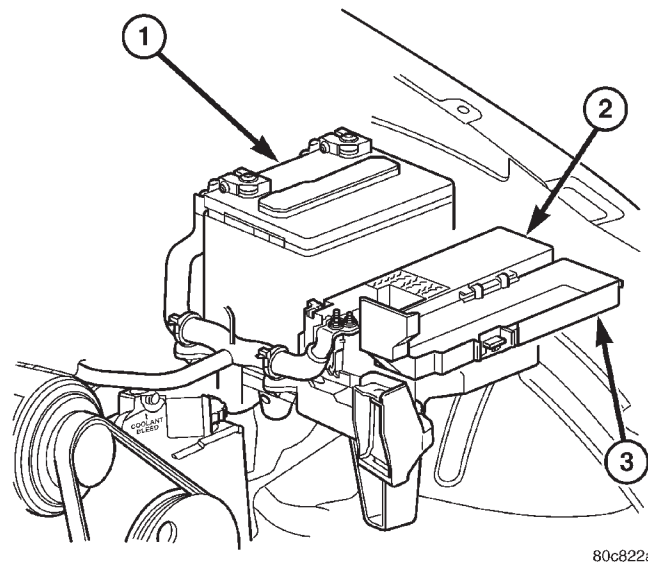
Whenever the ignition key is turned ON, the electric fuel pump will operate. But, the PCM will shut-down the ground circuit to the fuel pump relay in approximately 1–3 seconds unless the engine is operating or the starter motor is engaged.

**DIAGNOSIS AND TESTING - FUEL PUMP RELAY**

For procedures, refer to ASD Relay Diagnosis and Testing in the Ignition section.

**REMOVAL**

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 11). Refer to label on PDC cover for relay location.



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**Fig. 11 POWER DISTRIBUTION CENTER (PDC)**

- 1 - BATTERY
- 2 - PDC
- 3 - PDC COVER

- (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**

The fuel pump relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

- (1) Install relay to PDC.
- (2) Install cover to PDC.

## IDLE AIR CONTROL MOTOR

### DESCRIPTION

The IAC stepper motor is mounted to the throttle body, and regulates the amount of air bypassing the control of the throttle plate. As engine loads and ambient temperatures change, engine rpm changes. A pintle on the IAC stepper motor protrudes into a passage in the throttle body, controlling air flow through the passage. The IAC is controlled by the Powertrain Control Module (PCM) to maintain the target engine idle speed.

### OPERATION

At idle, engine speed can be increased by retracting the IAC motor pintle and allowing more air to pass through the port, or it can be decreased by restricting the passage with the pintle and diminishing the amount of air bypassing the throttle plate.

The IAC is called a stepper motor because it is moved (rotated) in steps, or increments. Opening the IAC opens an air passage around the throttle blade which increases RPM.

The PCM uses the IAC motor to control idle speed (along with timing) and to reach a desired MAP during decel (keep engine from stalling).

The IAC motor has 4 wires with 4 circuits. Two of the wires are for 12 volts and ground to supply electrical current to the motor windings to operate the stepper motor in one direction. The other 2 wires are also for 12 volts and ground to supply electrical current to operate the stepper motor in the opposite direction.

To make the IAC go in the opposite direction, the PCM just reverses polarity on both windings. If only 1 wire is open, the IAC can only be moved 1 step (increment) in either direction. To keep the IAC motor in position when no movement is needed, the PCM will energize both windings at the same time. This locks the IAC motor in place.

In the IAC motor system, the PCM will count every step that the motor is moved. This allows the PCM to determine the motor pintle position. If the memory is cleared, the PCM no longer knows the position of the pintle. So at the first key ON, the PCM drives the IAC motor closed, regardless of where it was before. This zeros the counter. From

this point the PCM will back out the IAC motor and keep track of its position again.

When engine rpm is above idle speed, the IAC is used for the following:

- Off-idle dashpot (throttle blade will close quickly but idle speed will not stop quickly)
- Deceleration air flow control
- A/C compressor load control (also opens the passage slightly before the compressor is engaged so that the engine rpm does not dip down when the compressor engages)
- Power steering load control

The PCM can control polarity of the circuit to control direction of the stepper motor.

**IAC Stepper Motor Program:** The PCM is also equipped with a memory program that records the number of steps the IAC stepper motor most recently advanced to during a certain set of parameters. For example: The PCM was attempting to maintain a 1000 rpm target during a cold start-up cycle. The last recorded number of steps for that may have been 125. That value would be recorded in the memory cell so that the next time the PCM recognizes the identical conditions, the PCM recalls that 125 steps were required to maintain the target. This program allows for greater customer satisfaction due to greater control of engine idle.

Another function of the memory program, which occurs when the power steering switch (if equipped), or the A/C request circuit, requires that the IAC stepper motor control engine rpm, is the recording of the last targeted steps into the memory cell. The PCM can anticipate A/C compressor loads. This is accomplished by delaying compressor operation for approximately 0.5 seconds until the PCM moves the IAC stepper motor to the recorded steps that were loaded into the memory cell. Using this program helps eliminate idle-quality changes as loads change. Finally, the PCM incorporates a "No-Load" engine speed limiter of approximately 1800 - 2000 rpm, when it recognizes that the TPS is indicating an idle signal and IAC motor cannot maintain engine idle.

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 IAC motor through the PCM.

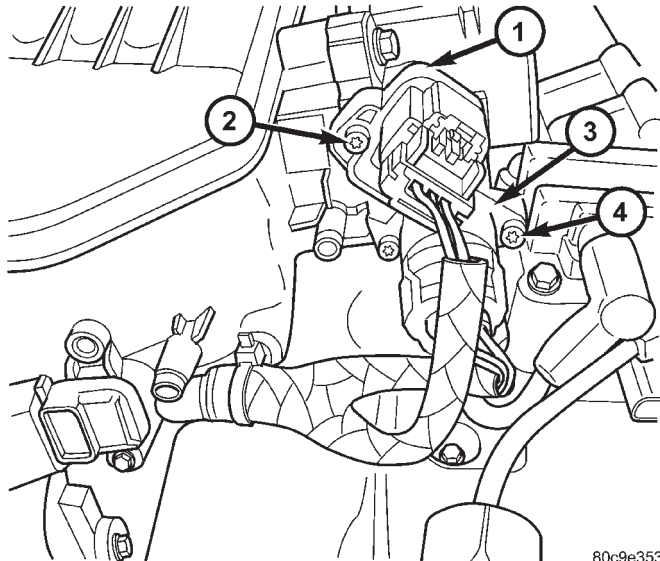
## IDLE AIR CONTROL MOTOR (Continued)

## REMOVAL

## 2.4L

The Idle Air Control (IAC) motor is located on the rear side of the throttle body (Fig. 12).

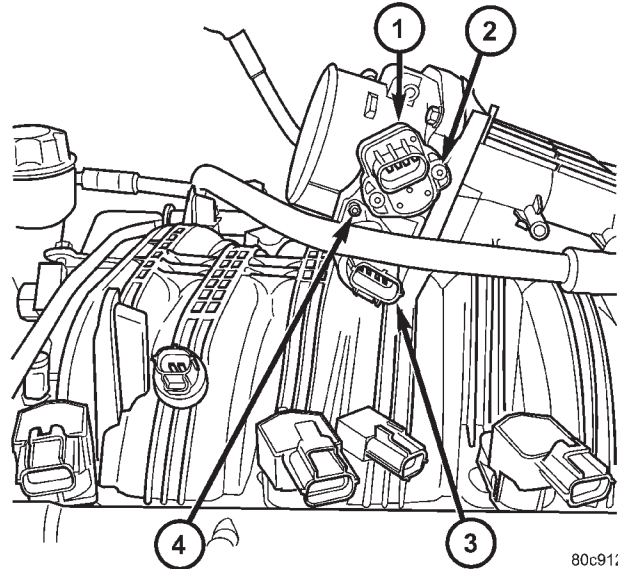
- (1) Disconnect electrical connector from IAC motor.
- (2) Remove two mounting bolts (screws).
- (3) Remove IAC motor from throttle body.



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**Fig. 12 TPS/IAC MOTOR - 2.4L**

- 1 - THROTTLE POSITION SENSOR (TPS)
- 2 - MOUNTING SCREWS
- 3 - IDLE AIR CONTROL MOTOR (IAC)
- 4 - MOUNTING SCREWS



80c9128d

**Fig. 13 TPS/IAC MOTOR - 3.7L**

- 1 - THROTTLE POSITION SENSOR (TPS)
- 2 - MOUNTING SCREWS
- 3 - IDLE AIR CONTROL MOTOR (IAC)
- 4 - MOUNTING SCREWS

- (2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
- (3) Install electrical connector.

## 3.7L

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 13).

- (1) Disconnect electrical connector from IAC motor.
- (2) Remove two mounting bolts (screws).
- (3) Remove IAC motor from throttle body.

## INSTALLATION

## 2.4L

The Idle Air Control (IAC) motor is located on the rear side of the throttle body.

- (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.

## 3.7L

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 13).

- (1) Install IAC motor to throttle body.

## INTAKE AIR TEMPERATURE SENSOR

### DESCRIPTION

The 2-wire Intake Manifold Air Temperature (IAT) sensor is installed in the intake manifold with the sensor element extending into the air stream.

The IAT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as intake manifold temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

### OPERATION

The IAT sensor provides an input voltage to the Powertrain Control Module (PCM) indicating the density of the air entering the intake manifold based upon intake manifold temperature. At key-on, a 5-volt power circuit is supplied to the sensor from the PCM. The sensor is grounded at the PCM through a low-noise, sensor-return circuit.

The PCM uses this input to calculate the following:

- Injector pulse-width
- Adjustment of spark timing (to help prevent spark knock with high intake manifold air-charge temperatures)

INTAKE AIR TEMPERATURE SENSOR (Continued)

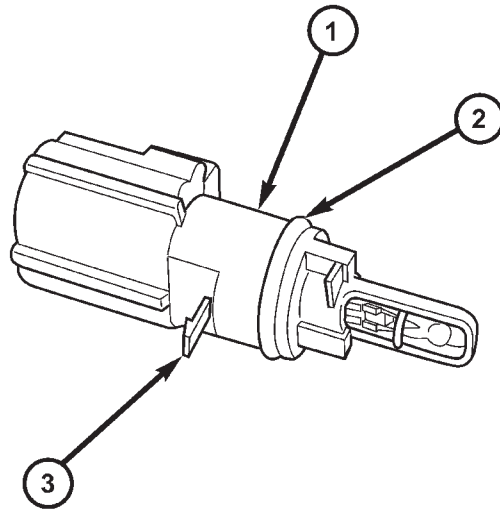
The resistance values of the IAT sensor is the same as for the Engine Coolant Temperature (ECT) sensor.

**REMOVAL**

**2.4L**

The intake manifold air temperature (IAT) sensor is installed into the intake manifold plenum at the rear end of the intake manifold (Fig. 14).

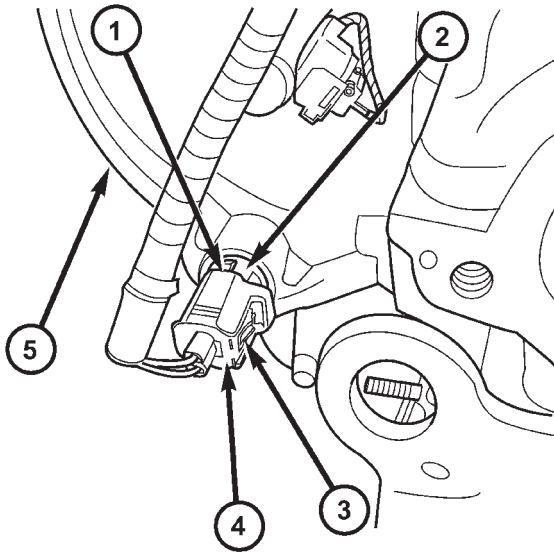
- (1) Disconnect electrical connector from IAT sensor.
- (2) Clean dirt from intake manifold at sensor base.
- (3) Gently lift on small plastic release tab (Fig. 14) or (Fig. 15) and rotate sensor about 1/4 turn counter-clockwise for removal.
- (4) Check condition of sensor o-ring (Fig. 15).



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**Fig. 15 IAT SENSOR TAB / O-RING**

- 1 - IAT SENSOR
- 2 - SENSOR O-RING
- 3 - RELEASE TAB



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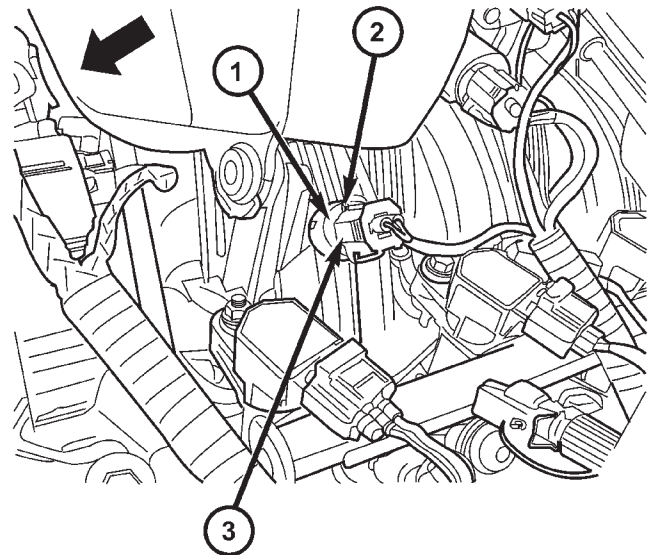
**Fig. 14 IAT SENSOR LOCATION-2.4L**

- 1 - RELEASE TAB
- 2 - IAT SENSOR
- 3 - PRESS HERE FOR REMOVAL
- 4 - ELECTRICAL CONNECTOR
- 5 - REAR END OF INTAKE MANIFOLD

**3.7L**

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 16).

- (1) Disconnect electrical connector from IAT sensor.
- (2) Clean dirt from intake manifold at sensor base.
- (3) Gently lift on small plastic release tab (Fig. 16) or (Fig. 15) and rotate sensor about 1/4 turn counter-clockwise for removal.
- (4) Check condition of sensor o-ring.



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**Fig. 16 IAT SENSOR LOCATION-3.7L**

- 1 - IAT SENSOR
- 2 - RELEASE TAB
- 3 - ELECTRICAL CONNECTOR

## INTAKE AIR TEMPERATURE SENSOR (Continued)

## INSTALLATION

## 2.4L

The intake manifold air temperature (IAT) sensor is installed into the intake manifold plenum at the rear end of the intake manifold.

- (1) Check condition of sensor o-ring.
- (2) Clean sensor mounting hole in intake manifold.
- (3) Position sensor into intake manifold and rotate clockwise until past release tab.
- (4) Install electrical connector.

## 3.7L

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 16).

- (1) Check condition of sensor o-ring.
- (2) Clean sensor mounting hole in intake manifold.
- (3) Position sensor into intake manifold and rotate clockwise until past release tab (Fig. 16).
- (4) Install electrical connector.

## MAP SENSOR

## DESCRIPTION

## 2.4L

The Manifold Absolute Pressure (MAP) sensor is mounted into the rear of the intake manifold with 1 screw.

## 3.7L

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold with 2 screws.

## OPERATION

The MAP sensor is used as an input to the Powertrain Control Module (PCM). It contains a silicon based sensing unit to provide data on the manifold vacuum that draws the air/fuel mixture into the combustion chamber. The PCM requires this information to determine injector pulse width and spark advance. When manifold absolute pressure (MAP) equals Barometric pressure, the pulse width will be at maximum.

A 5 volt reference is supplied from the PCM and returns a voltage signal to the PCM that reflects manifold pressure. The zero pressure reading is 0.5V and full scale is 4.5V. For a pressure swing of 0–15 psi, the voltage changes 4.0V. To operate the sensor, it is supplied a regulated 4.8 to 5.1 volts. Ground is provided through the low-noise, sensor return circuit at the PCM.

The MAP sensor input is the number one contributor to fuel injector pulse width. The most important function of the MAP sensor is to determine barometric pressure. The PCM needs to know if the vehicle is at sea level or at a higher altitude, because the air density changes with altitude. It will also help to correct for varying barometric pressure. Barometric pressure and altitude have a direct inverse correlation; as altitude goes up, barometric goes down. At key-on, the PCM powers up and looks at MAP voltage, and based upon the voltage it sees, it knows the current barometric pressure (relative to altitude). Once the engine starts, the PCM looks at the voltage again, continuously every 12 milliseconds, and compares the current voltage to what it was at key-on. The difference between current voltage and what it was at key-on, is manifold vacuum.

During key-on (engine not running) the sensor reads (updates) barometric pressure. A normal range can be obtained by monitoring a known good sensor.

As the altitude increases, the air becomes thinner (less oxygen). If a vehicle is started and driven to a very different altitude than where it was at key-on, the barometric pressure needs to be updated. Any time the PCM sees Wide Open Throttle (WOT), based upon Throttle Position Sensor (TPS) angle and RPM, it will update barometric pressure in the MAP memory cell. With periodic updates, the PCM can make its calculations more effectively.

The PCM uses the MAP sensor input to aid in calculating the following:

- Manifold pressure
- Barometric pressure
- Engine load
- Injector pulse-width
- Spark-advance programs
- Shift-point strategies (certain automatic transmissions only)
- Idle speed
- Decel fuel shutoff

The MAP sensor signal is provided from a single piezoresistive element located in the center of a diaphragm. The element and diaphragm are both made of silicone. As manifold pressure changes, the diaphragm moves causing the element to deflect, which stresses the silicone. When silicone is exposed to stress, its resistance changes. As manifold vacuum increases, the MAP sensor input voltage decreases proportionally. The sensor also contains electronics that condition the signal and provide temperature compensation.

The PCM recognizes a decrease in manifold pressure by monitoring a decrease in voltage from the reading stored in the barometric pressure memory cell. The MAP sensor is a linear sensor; meaning as pressure changes, voltage changes proportionately.

## MAP SENSOR (Continued)

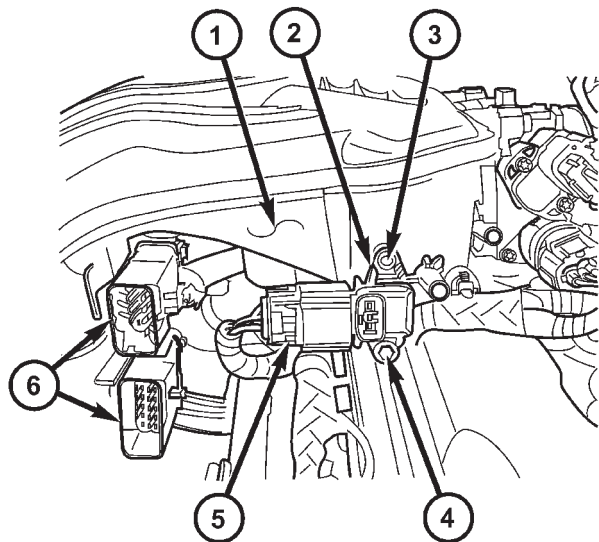
The range of voltage output from the sensor is usually between 4.6 volts at sea level to as low as 0.3 volts at 26 in. of Hg. Barometric pressure is the pressure exerted by the atmosphere upon an object. At sea level on a standard day, no storm, barometric pressure is approximately 29.92 in Hg. For every 100 feet of altitude, barometric pressure drops 0.10 in. Hg. If a storm goes through, it can change barometric pressure from what should be present for that altitude. You should know what the average pressure and corresponding barometric pressure is for your area.

## REMOVAL

## 2.4L

The Manifold Absolute Pressure (MAP) sensor is mounted into the rear of the intake manifold (Fig. 17). An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

- (1) Disconnect electrical connector at sensor.
- (2) Clean area around MAP sensor.
- (3) Remove sensor mounting screw (TORX head).
- (4) Remove MAP sensor from intake manifold.
- (5) Check condition of sensor o-ring (Fig. 19).



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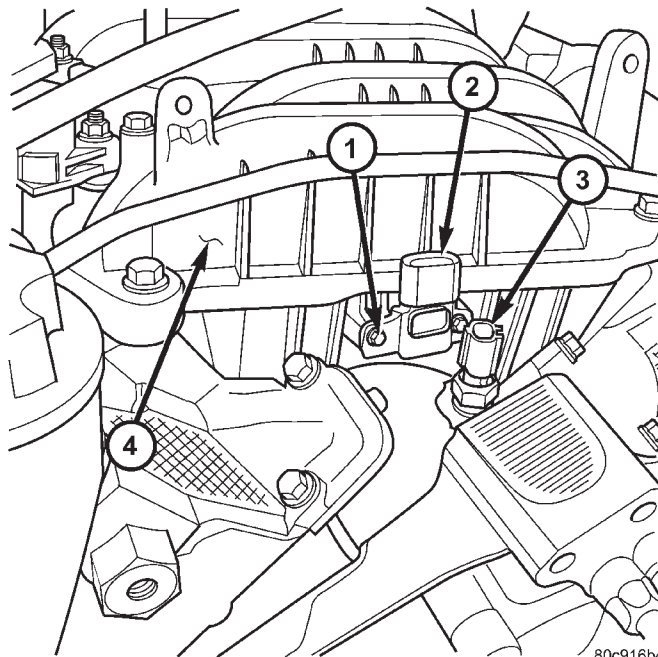
**Fig. 17 MAP SENSOR LOCATION-2.4L**

- 1 - REAR OF INTAKE MANIFOLD
- 2 - MAP SENSOR
- 3 - ALIGNMENT PIN
- 4 - MOUNTING BOLT (TORX)
- 5 - ELECTRICAL CONNECTOR
- 6 - MAIN ENGINE HARNESS CONNECTORS

## 3.7L

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold (Fig. 18). An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

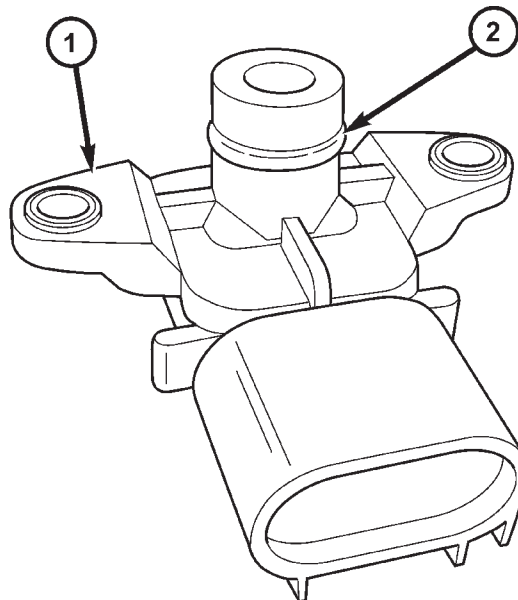
- (1) Disconnect electrical connector at sensor.
- (2) Clean area around MAP sensor.
- (3) Remove 2 sensor mounting screws.
- (4) Remove MAP sensor from intake manifold.
- (5) Check condition of sensor o-ring (Fig. 19).



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**Fig. 18 MAP SENSOR / ECT SENSOR - 3.7L**

- 1 - MOUNTING SCREWS
- 2 - MAP SENSOR
- 3 - ECT SENSOR



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**Fig. 19 MAP SENSOR O-RING**

- 1 - MAP SENSOR
- 2 - O-RING

## MAP SENSOR (Continued)

## INSTALLATION

## 2.4L

The Manifold Absolute Pressure (MAP) sensor is mounted into the rear of the intake manifold. An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

- (1) Clean MAP sensor mounting hole at intake manifold.
- (2) Check MAP sensor o-ring seal for cuts or tears.
- (3) Position sensor into manifold.
- (4) Install MAP sensor mounting screws. Tighten screw to 3 N·m (25 in. lbs.) torque.
- (5) Connect electrical connector.

## 3.7L

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold (Fig. 18). An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

- (1) Clean MAP sensor mounting hole at intake manifold.
- (2) Check MAP sensor o-ring seal for cuts or tears.
- (3) Position sensor into manifold.
- (4) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.
- (5) Connect electrical connector.

## OXYGEN SENSOR

## DESCRIPTION

The Oxygen Sensors (O<sub>2</sub>S) are attached to, and protrude into the vehicle exhaust system. Depending on the engine or emission package, the vehicle may use a total of either 2 or 4 sensors.

**2.4L Engine:** Two sensors are used: upstream (referred to as 1/1) and downstream (referred to as 1/2). With this emission package, the upstream sensor (1/1) is located just before the main catalytic converter. The downstream sensor (1/2) is located just after the main catalytic converter.

**3.7L V-6 Engine:** On this emissions package, 4 sensors are used: 2 upstream (referred to as 1/1 and 2/1) and 2 downstream (referred to as 1/2 and 2/2). With this emission package, the right upstream sensor (2/1) is located in the right exhaust downpipe just before the mini-catalytic converter. The left upstream sensor (1/1) is located in the left exhaust downpipe just before the mini-catalytic converter. The right downstream sensor (2/2) is located in the right exhaust downpipe just after the mini-catalytic converter, and before the main catalytic converter. The left downstream sensor (1/2) is located in the left exhaust downpipe just after the mini-catalytic converter, and before the main catalytic converter.

## OPERATION

An O<sub>2</sub> sensor is a galvanic battery that provides the PCM with a voltage signal (0-1 volt) inversely proportional to the amount of oxygen in the exhaust. In other words, if the oxygen content is low, the voltage output is high; if the oxygen content is high the output voltage is low. The PCM uses this information to adjust injector pulse-width to achieve the 14.7-to-1 air/fuel ratio necessary for proper engine operation and to control emissions.

The O<sub>2</sub> sensor must have a source of oxygen from outside of the exhaust stream for comparison. Current O<sub>2</sub> sensors receive their fresh oxygen (outside air) supply through the O<sub>2</sub> sensor case housing.

Four wires (circuits) are used on each O<sub>2</sub> sensor: a 12-volt feed circuit for the sensor heating element; a ground circuit for the heater element; a low-noise sensor return circuit to the PCM, and an input circuit from the sensor back to the PCM to detect sensor operation.

**Oxygen Sensor Heater Relay - 3.7L Engine:** On the 3.7L engine, 4 heated oxygen sensors are used. A separate oxygen sensor relay is used to supply voltage to the sensors heating elements for only the 1/2 and 2/2 downstream sensors. Voltage for the other 2 sensor heating elements is supplied directly from the Powertrain Control Module (PCM) through a Pulse Width Module (PWM) method.

**Pulse Width Module (PWM):** Voltage to the O<sub>2</sub> sensor heating elements is supplied directly from the Powertrain Control Module (PCM) through two separate Pulse Width Module (PWM) low side drivers. PWM is used on both the upstream and downstream O<sub>2</sub> sensors on the 2.4L engine, and only on the 2 upstream sensors (1/1 and 2/1) on the 3.7L engine. The main objective for a PWM driver is to avoid overheating of the O<sub>2</sub> sensor heater element. With exhaust temperatures increasing with time and engine speed, it's not required to have a full-voltage duty-cycle on the O<sub>2</sub> heater elements.

To avoid the large simultaneous current surge needed to operate all 4 sensors, power is delayed to the 2 downstream heater elements by the PCM for approximately 2 seconds.

**Oxygen Sensor Heater Elements:**

The O<sub>2</sub> sensor uses a Positive Thermal Co-efficient (PTC) heater element. As temperature increases, resistance increases. At ambient temperatures around 70°F, the resistance of the heating element is approximately 4.5 ohms. As the sensor's temperature increases, resistance in the heater element increases. This allows the heater to maintain the optimum operating temperature of approximately 930°-1100°F (500°-600° C). Although the sensors operate the same, there are physical differences, due to the envi-

## OXYGEN SENSOR (Continued)

ronment that they operate in, that keep them from being interchangeable.

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 certain O<sub>2</sub> sensor input(s) along with other inputs, and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O<sub>2</sub> sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

**Upstream Sensor - 2.4L Engine:** The upstream sensor (1/1) 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 catalytic convertor efficiency.

**Downstream Sensor - 2.4L Engine:** The downstream oxygen sensor (1/2) is also used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, 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 catalytic convertor efficiency.

**Upstream Sensors - 3.7L Engine:** Two upstream sensors are used (1/1 and 2/1). The 1/1 sensor is the first sensor to receive exhaust gases from the #1 cylinder. They provide 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 sensors. The PCM will change the air/fuel ratio until the upstream sensors input a voltage that the PCM has determined will make the downstream sensors output (oxygen content) correct.

The upstream oxygen sensors also provide an input to determine mini-catalyst efficiency. Main catalytic convertor efficiency is not calculated with this package.

**Downstream Sensors - 3.7L Engine:** Two downstream sensors are used (1/2 and 2/2). The downstream sensors are used to determine the correct air-

fuel ratio. As the oxygen content changes at the downstream sensor, 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).

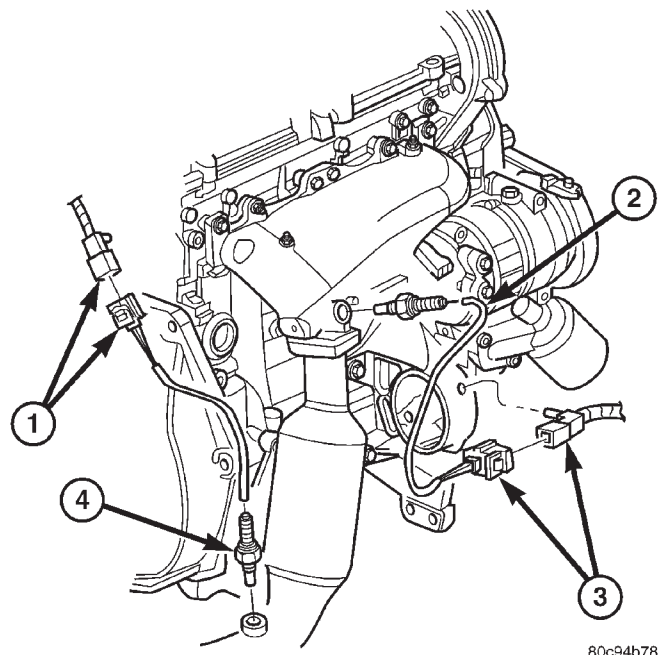
The downstream oxygen sensors also provide an input to determine mini-catalyst efficiency. Main catalytic convertor efficiency is not calculated with this package.

Engines equipped with either a downstream sensor(s), or a post-catalytic sensor, will monitor catalytic convertor efficiency. If efficiency is below emission standards, the Malfunction Indicator Lamp (MIL) will be illuminated and a Diagnostic Trouble Code (DTC) will be set. Refer to Monitored Systems in Emission Control Systems for additional information.

## REMOVAL

**CAUTION:** Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness.

Refer to (Fig. 20), (Fig. 21) or (Fig. 22) for O<sub>2</sub>S (oxygen sensor) location.



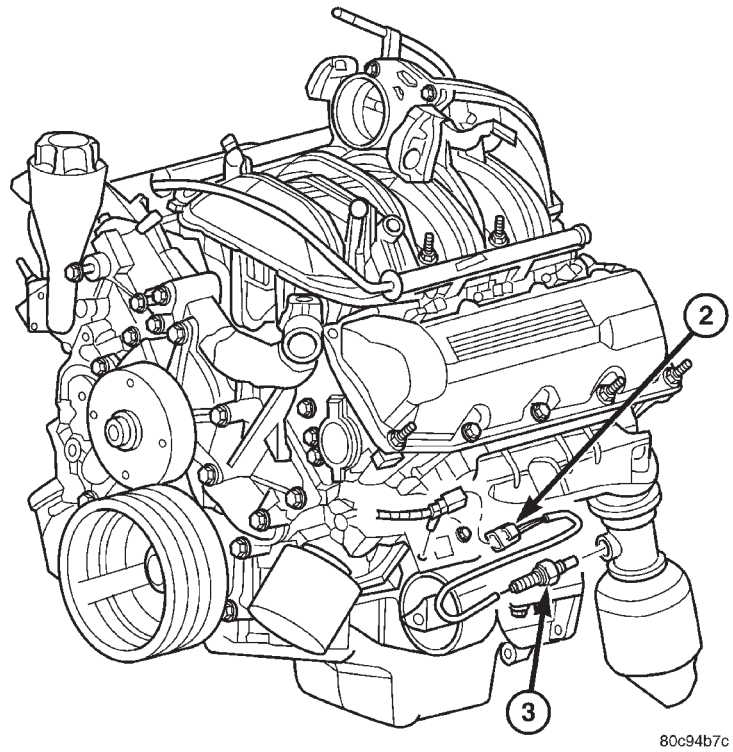
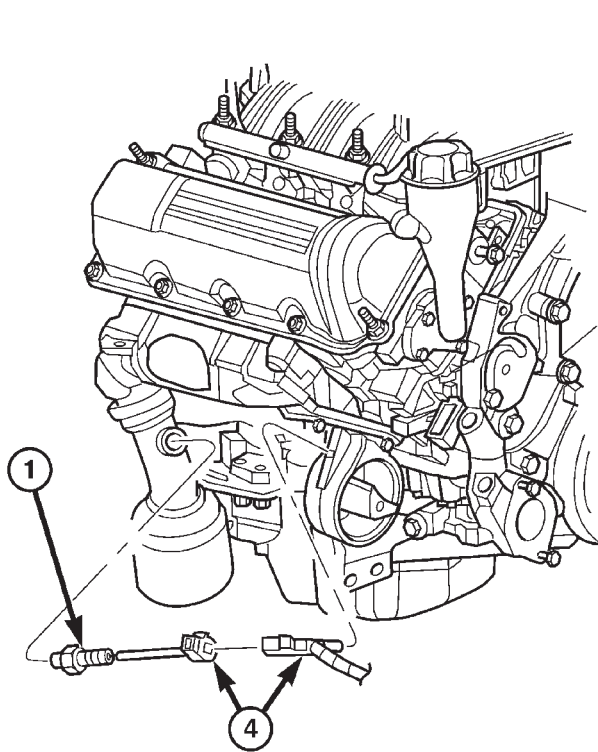
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**Fig. 20 OXYGEN SENSORS - 2.4L**

- 1 - ELECTRICAL CONNECTORS
- 2 - UPSTREAM SENSOR (1/1)
- 3 - ELECTRICAL CONNECTORS
- 4 - DOWNSTREAM SENSOR (1/2)



OXYGEN SENSOR (Continued)

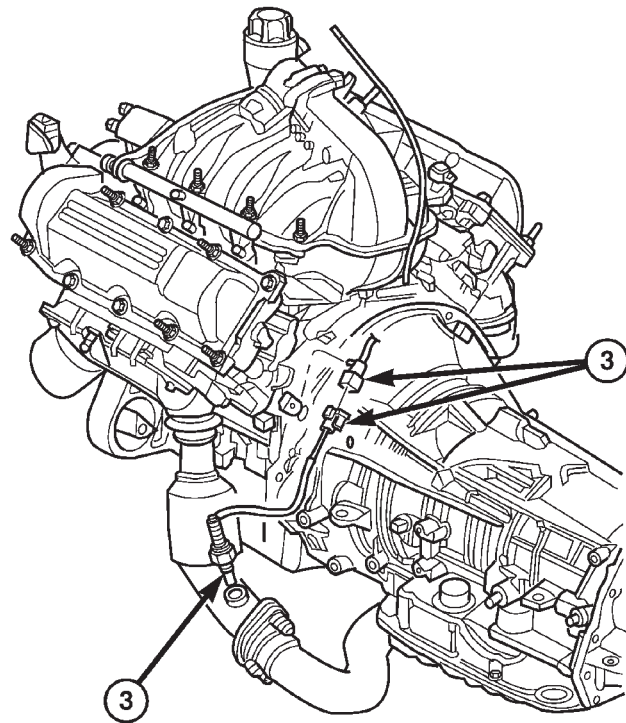
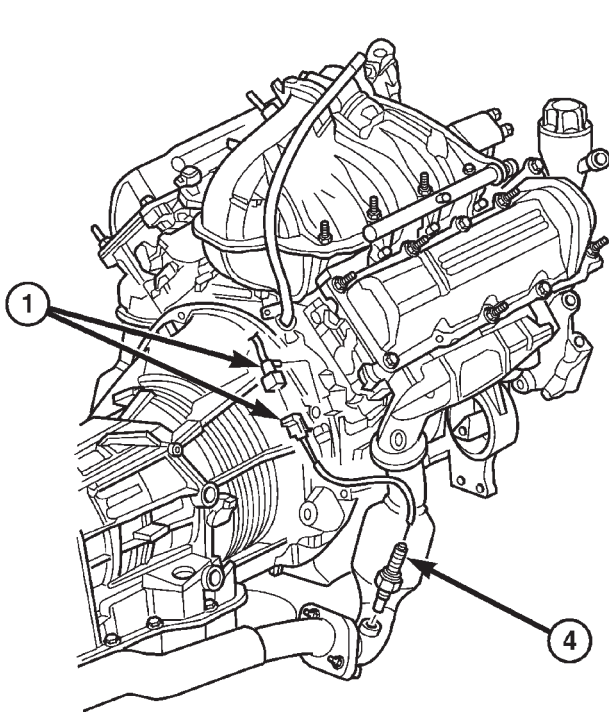


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**Fig. 21 OXYGEN SENSORS - UPSTREAM - 3.7L**

- 1 - RIGHT UPSTREAM SENSOR (2/1)
- 2 - ELECTRICAL CONNECTORS

- 3 - LEFT UPSTREAM SENSOR (1/1)
- 4 - ELECTRICAL CONNECTORS



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**Fig. 22 OXYGEN SENSORS - DOWNSTREAM - 3.7L**

- 1 - ELECTRICAL CONNECTORS
- 2 - ELECTRICAL CONNECTORS

- 3 - LEFT DOWNSTREAM SENSOR (1/2)
- 4 - RIGHT DOWNSTREAM SENSOR (2/2)

## OXYGEN SENSOR (Continued)

**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 vehicle.
- (2) Disconnect wire connector from O2S sensor.

**CAUTION: When disconnecting sensor electrical connector, do not pull directly on wire going into sensor.**

- (3) Remove O2S sensor with an oxygen sensor removal and installation tool.
- (4) Clean threads in exhaust pipe using appropriate tap.

## 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 threads of a new oxygen sensor.**

- (1) Install O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
- (2) Connect O2S sensor wire connector.
- (3) Lower vehicle.

## THROTTLE BODY

## DESCRIPTION

The throttle body is located on the intake manifold. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors.

## OPERATION

Filtered air from the air cleaner enters the intake manifold through the throttle body. The throttle body contains an air control passage 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.

Certain sensors are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle body linkage arm.

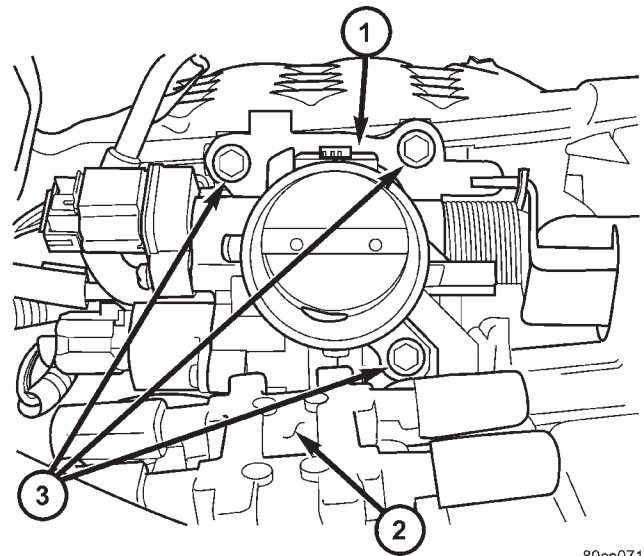
A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

## REMOVAL

## 2.4L

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).

- (1) Remove air cleaner tube at throttle body.
- (2) Disconnect throttle body electrical connectors at IAC motor and TPS.
- (3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section for removal/installation procedures.
- (4) Disconnect necessary vacuum lines at throttle body.
- (5) Remove 3 throttle body mounting bolts (Fig. 23).
- (6) Remove throttle body from intake manifold.
- (7) Check condition of old throttle body-to-intake manifold o-ring.



80ca0713

**Fig. 23 THROTTLE BODY MOUNTING BOLTS - 2.4L**

- 1 - THROTTLE BODY
- 2 - IGNITION COIL
- 3 - MOUNTING BOLTS (3)

## 3.7L

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).

- (1) Remove air cleaner tube at throttle body.
- (2) Disconnect throttle body electrical connectors at IAC motor and TPS.

## THROTTLE BODY (Continued)

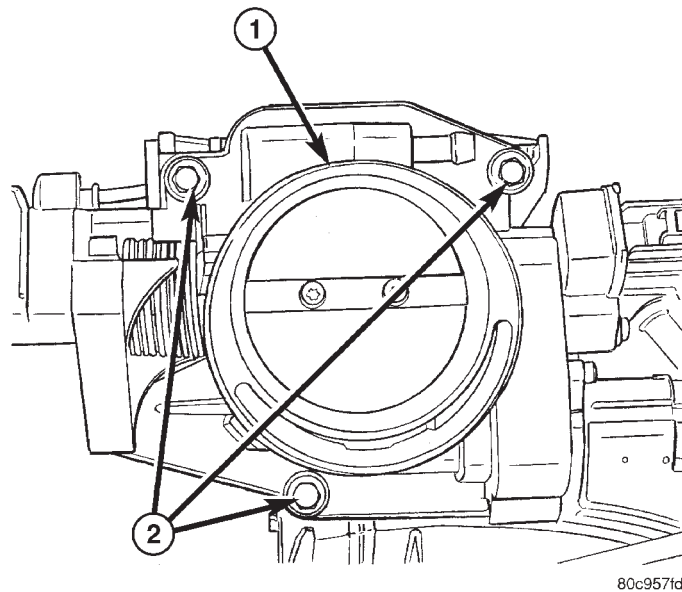
(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section for removal/installation procedures.

(4) Disconnect necessary vacuum lines at throttle body.

(5) Remove 3 throttle body mounting bolts (Fig. 24).

(6) Remove throttle body from intake manifold.

(7) Check condition of old throttle body-to-intake manifold o-ring (Fig. 25).



**Fig. 24 THROTTLE BODY MOUNTING BOLTS - 3.7L**

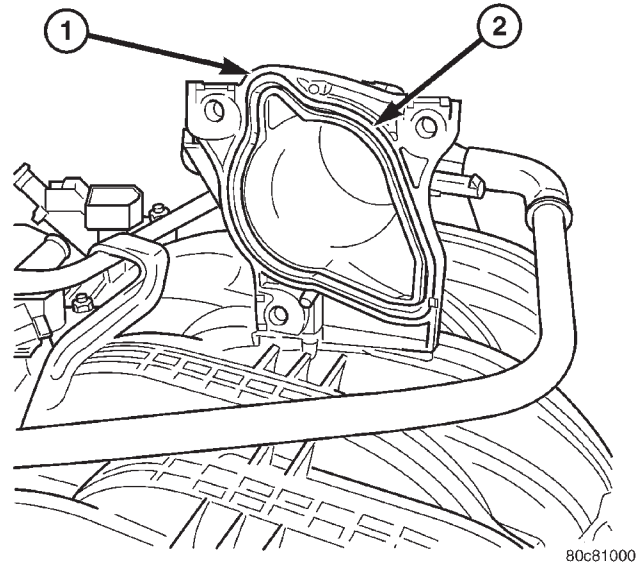
- 1 - THROTTLE BODY  
2 - MOUNTING BOLTS (3)

## INSTALLATION

## 2.4L

(1) Check condition of throttle body-to-intake manifold o-ring. Replace as necessary.

(2) Clean mating surfaces of throttle body and intake manifold.



**Fig. 25 THROTTLE BODY O-RING - 3.7L**

- 1 - INTAKE MANIFOLD  
2 - THROTTLE BODY O-RING

- (3) Install throttle body-to-intake manifold o-ring.  
(4) Install throttle body to intake manifold.  
(5) Install 3 mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.  
(6) Install control cables.  
(7) Install electrical connectors.  
(8) Install necessary vacuum lines.  
(9) Install air cleaner duct at throttle body.

## 3.7L

(1) Check condition of throttle body-to-intake manifold o-ring. Replace as necessary.

(2) Clean mating surfaces of throttle body and intake manifold.

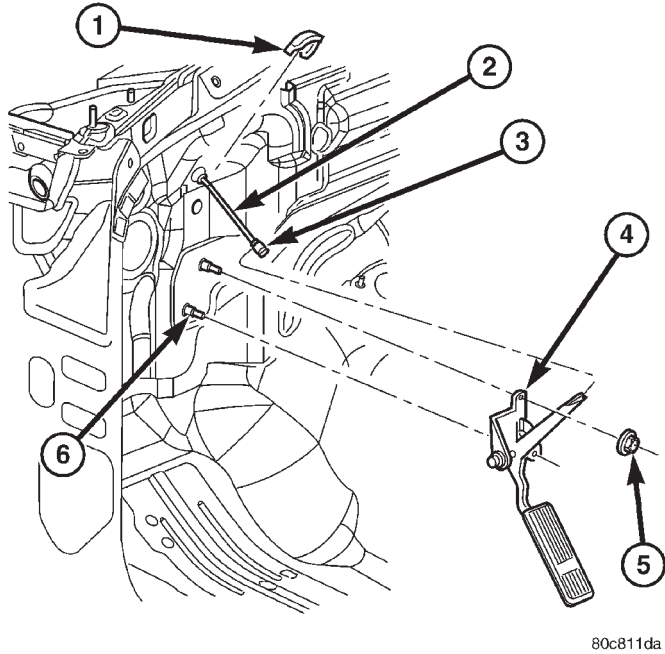
- (3) Install throttle body-to-intake manifold o-ring.  
(4) Install throttle body to intake manifold.  
(5) Install 3 mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.  
(6) Install control cables.  
(7) Install electrical connectors.  
(8) Install necessary vacuum lines.  
(9) Install air cleaner duct at throttle body.

# THROTTLE CONTROL CABLE

## REMOVAL

### 2.4L

**CAUTION:** Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or throttle cable.

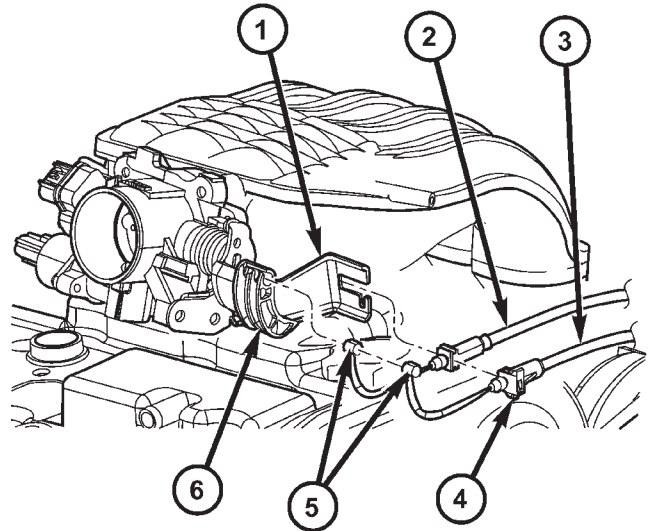


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**Fig. 26 ACCELERATOR PEDAL/BRACKET ASSEMBLY**

- 1 - METAL THROTTLE CABLE CLIP
- 2 - THROTTLE CABLE
- 3 - PLASTIC CABLE RETAINER
- 4 - PEDAL/BRACKET ASSEMBLY
- 5 - PEDAL MOUNTING NUTS (2)
- 6 - PEDAL MOUNTING STUDS (2)

- (1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 26). Plastic cable retainer snaps into top of pedal arm.
- (2) Remove cable core wire at pedal arm.
- (3) From inside vehicle, remove metal clip holding cable to dashpanel (Fig. 26).
- (4) Remove air box at throttle body.
- (5) Unsnap cable from dashpanel routing clip.
- (6) Remove cable housing from dash panel and pull into engine compartment.
- (7) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 27) from throttle body bellcrank.



80c9a750

**Fig. 27 THROTTLE CABLE, PIN, RELEASE TAB-2.4L**

- 1 - MOUNTING BRACKET
- 2 - SPEED CONTROL CABLE
- 3 - THROTTLE CABLE
- 4 - RELEASE TAB
- 5 - CABLE PINS
- 6 - BELLCRANK

(8) Using a pick or small screwdriver, press release tab (Fig. 27) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** To remove throttle cable from throttle body bracket, slide cable towards front of vehicle.

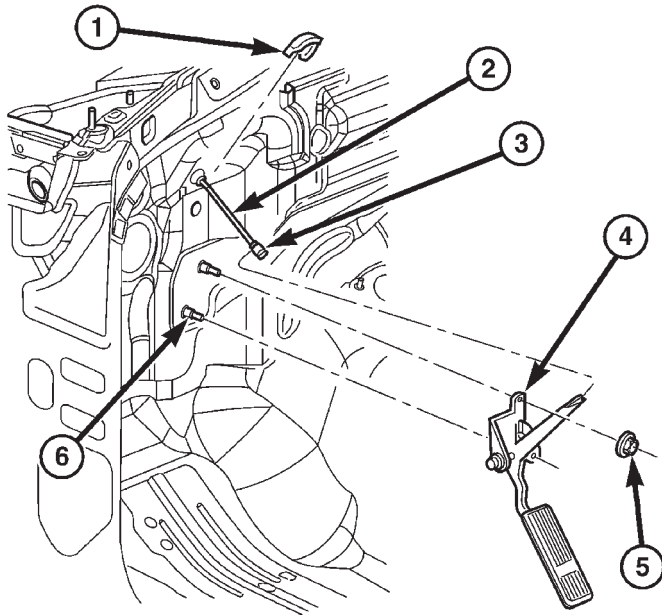
(9) Remove throttle cable from vehicle.

### 3.7L

**CAUTION:** Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or throttle cable.

- (1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 28). Plastic cable retainer snaps into top of pedal arm.
- (2) Remove cable core wire at pedal arm.
- (3) From inside vehicle, remove metal clip holding cable to dashpanel (Fig. 28).
- (4) Remove air box at throttle body.
- (5) Unsnap cable from dashpanel routing clip.
- (6) Remove cable housing from dash panel and pull into engine compartment.
- (7) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 29) from throttle body bellcrank.

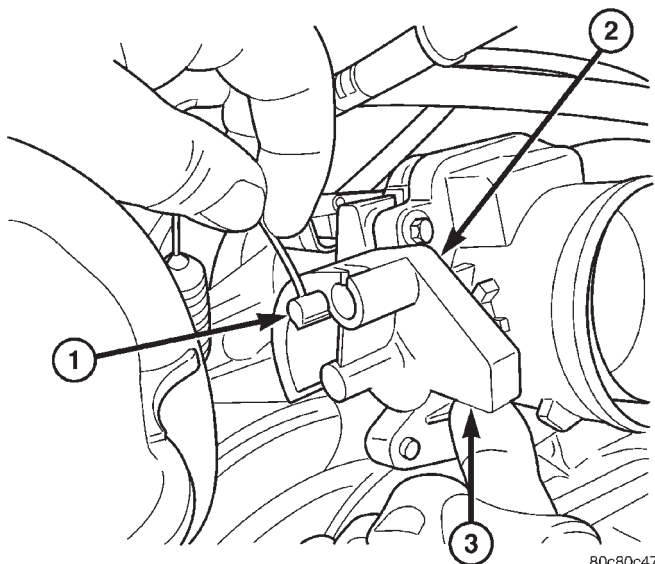
## THROTTLE CONTROL CABLE (Continued)



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**Fig. 28 ACCELERATOR PEDAL/BRACKET ASSEMBLY**

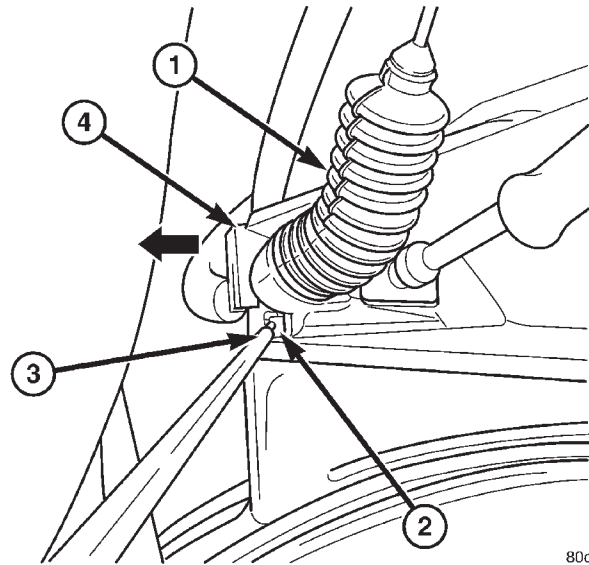
- 1 - METAL THROTTLE CABLE CLIP
- 2 - THROTTLE CABLE
- 3 - PLASTIC CABLE RETAINER
- 4 - PEDAL/BRACKET ASSEMBLY
- 5 - PEDAL MOUNTING NUTS (2)
- 6 - PEDAL MOUNTING STUDS (2)



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**Fig. 29 THROTTLE CABLE PIN-3.7L**

- 1 - THROTTLE CABLE PIN
- 2 - THROTTLE BODY BELLCRANK
- 3 - PUSH UP HERE



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**Fig. 30 THROTTLE CABLE RELEASE TAB-3.7L**

- 1 - THROTTLE CABLE
- 2 - RELEASE TAB
- 3 - PICK OR SCREWDRIVER
- 4 - PLASTIC CABLE MOUNT

(8) Using a pick or small screwdriver, press release tab (Fig. 30) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 30) towards right side of vehicle to remove throttle cable from throttle body bracket.

(9) Remove throttle cable from vehicle.

## INSTALLATION

(1) Slide accelerator cable plastic mount into throttle body mounting bracket. Continue sliding until release tab (Fig. 30) is aligned to hole in mounting bracket.

(2) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 29) into throttle body bellcrank.

(3) Push cable housing into rubber grommet and through opening in dash panel.

(4) From inside vehicle, install metal clip holding cable to dashpanel (Fig. 28).

(5) From inside vehicle, slide throttle cable core wire into opening (slot) in top of pedal arm.

(6) Push plastic cable retainer (clip) into pedal arm opening until it snaps in place.

(7) Install air box to throttle body.

(8) Before starting engine, operate accelerator pedal to check for any binding.

## THROTTLE POSITION SENSOR

### DESCRIPTION

The 3-wire Throttle Position Sensor (TPS) is mounted on the throttle body and is connected to the throttle blade shaft.

### OPERATION

The 3-wire TPS provides the Powertrain Control Module (PCM) with an input signal (voltage) that represents the throttle blade position of the throttle body. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the output voltage 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 .26 volts at minimum throttle opening (idle), to 4.49 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.

The PCM needs to identify the actions and position of the throttle blade at all times. This information is needed to assist in performing the following calculations:

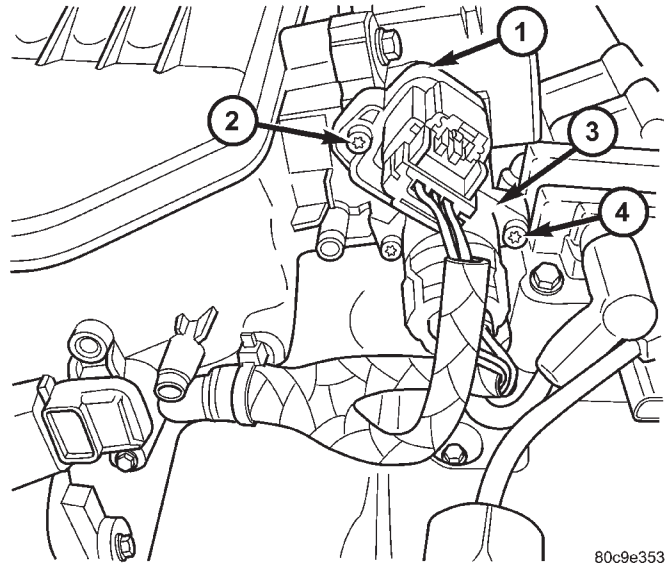
- Ignition timing advance
- Fuel injection pulse-width
- Idle (learned value or minimum TPS)
- Off-idle (0.06 volt)
- Wide Open Throttle (WOT) open loop (2.608 volts above learned idle voltage)
  - Deceleration fuel lean out
  - Fuel cutoff during cranking at WOT (2.608 volts above learned idle voltage)
  - A/C WOT cutoff (certain automatic transmissions only)

## REMOVAL

### 2.4L

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 31).

- (1) Disconnect TPS electrical connector.
- (2) Remove 2 TPS mounting screws.
- (3) Remove TPS.



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**Fig. 31 TPS/IAC MOTOR - 2.4L**

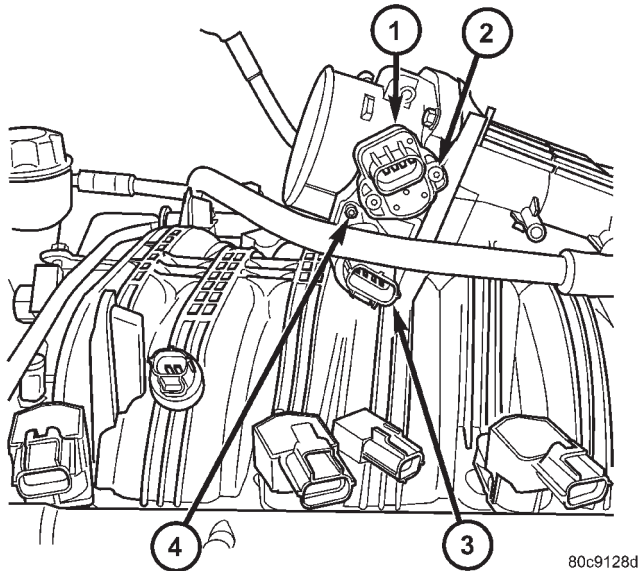
- 1 - THROTTLE POSITION SENSOR (TPS)
- 2 - MOUNTING SCREWS
- 3 - IDLE AIR CONTROL MOTOR (IAC)
- 4 - MOUNTING SCREWS

## THROTTLE POSITION SENSOR (Continued)

## 3.7L

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 32), or (Fig. 33).

- (1) Disconnect TPS electrical connector.
- (2) Remove 2 TPS mounting screws.
- (3) Remove TPS.



**Fig. 32 TPS/IAC MOTOR - 3.7L**

- 1 - THROTTLE POSITION SENSOR (TPS)
- 2 - MOUNTING SCREWS
- 3 - IDLE AIR CONTROL MOTOR (IAC)
- 4 - MOUNTING SCREWS

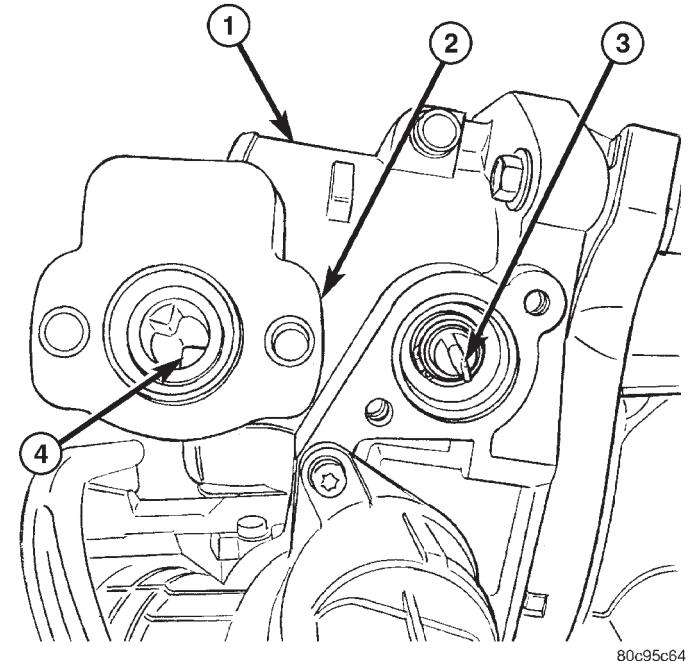
## INSTALLATION

## 2.4L

The Throttle Position Sensor (TPS) is mounted to the rear of the throttle body.

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 33). The TPS must be installed so that it can be rotated a few degrees. (If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs). The TPS will be under slight tension when rotated.

- (1) Install TPS and retaining screws.
- (2) Tighten screws to 7 N·m (60 in. lbs.) torque.
- (3) Connect TPS electrical connector to TPS.



**Fig. 33 TPS INSTALLATION - 3.7**

- 1 - THROTTLE BODY
- 2 - TPS
- 3 - THROTTLE BODY SHAFT
- 4 - SOCKET LOCATING TANGS

- (4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.
- (5) Install air cleaner tube to throttle body.

## 3.7L

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 32).

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 33). The TPS must be installed so that it can be rotated a few degrees. (If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs). The TPS will be under slight tension when rotated.

- (1) Install TPS and retaining screws.
- (2) Tighten screws to 7 N·m (60 in. lbs.) torque.
- (3) Connect TPS electrical connector to TPS.
- (4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.
- (5) Install air cleaner tube to throttle body.

# STEERING

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## STEERING

### DESCRIPTION

- Power steering systems consist of:
- Steering column & Intermediate Shaft
  - Rack and pinion steering gear
  - Belt driven hydraulic steering pump
  - Pump pressure, supply and return hoses
  - Oil Cooler

### OPERATION

The steering column intermediate shaft attaches the steering column to the gear pinion. The rotation of the pinion moves the gear rack from side-to-side. This lateral action of the rack pushes and pulls the tie rods to change the direction of the front wheels.

Power assist is provided by an engine mounted hydraulic pump. The pump supplies hydraulic fluid to the steering gear. All vehicles are equipped with an oil cooler.

## DIAGNOSIS AND TESTING

### 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 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.
	1. Gear mounting bolts loose. 2. Loose or damaged suspension components. 3. Internal gear noise. 4. Loose or damaged intermediate shaft or column.	1. Tighten bolts to specification. 2. Inspect and repair suspension. 3. Replace steering gear. 4. Inspect and repair or replace.
MOAN	Pressure hose in contact with other components.	Reposition hose.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.



## STEERING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
WHINE OR GROWL	<ol style="list-style-type: none"> <li>1. Low fluid level.</li> <li>2. Pressure hose in contact with other components.</li> <li>3. Internal pump noise.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill to proper level.</li> <li>2. Reposition hose.</li> <li>3. Replace pump.</li> </ol>
SUCKING AIR SOUND	<ol style="list-style-type: none"> <li>1. Loose return line clamp.</li> <li>2. O-ring missing or damaged on hose fitting.</li> <li>3. Low fluid level.</li> <li>4. Air leak between pump and reservoir.</li> <li>5. Reservoir cap not installed correctly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace clamp.</li> <li>2. Replace o-ring.</li> <li>3. Fill to proper level.</li> <li>4. Repair as necessary.</li> <li>5. Install reservoir cap correctly.</li> </ol>
SCRUBBING OR KNOCKING	<ol style="list-style-type: none"> <li>1. Wrong tire size.</li> <li>2. Wrong gear.</li> <li>3. Tire Pressure</li> </ol>	<ol style="list-style-type: none"> <li>1. Verify tire size.</li> <li>2. Verify gear.</li> <li>3. Adjust Tire Pressure</li> </ol>

*BINDING AND STICKING*

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	<ol style="list-style-type: none"> <li>1. Low fluid level.</li> <li>2. Tire pressure.</li> <li>3. Steering components (ball joints/tie rod ends).</li> <li>4. Loose belt.</li> <li>5. Low pump pressure.</li> <li>6. Column Intermediate shaft binding.</li> <li>7. Steering gear worn.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill to proper level.</li> <li>2. Adjust tire pressure.</li> <li>3. Inspect and repair as necessary.</li> <li>4. Adjust or replace.</li> <li>5. Pressure test and replace if necessary.</li> <li>6. Replace Intermediate Shaft.</li> <li>7. Replace gear.</li> </ol>

*INSUFFICIENT ASST. OR POOR RETURN TO CENTER*

CONDITION	POSSIBLE CAUSE	CORRECTION
HARD TURNING OR MOMENTARY INCREASE IN TURNING EFFORT	<ol style="list-style-type: none"> <li>1. Tire pressure.</li> <li>2. Low fluid level.</li> <li>3. Loose belt.</li> <li>4. Low pump pressure.</li> <li>5. Internal gear leak.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tire pressure.</li> <li>2. Fill to proper level.</li> <li>3. Adjust or replace.</li> <li>4. Pressure test and repair as necessary.</li> <li>5. Replace gear.</li> </ol>
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	<ol style="list-style-type: none"> <li>1. Tire pressure.</li> <li>2. Wheel alignment.</li> <li>3. Lack of lubrication.</li> <li>4. High friction in steering gear.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tire pressure.</li> <li>2. Align front end.</li> <li>3. Inspect and lubricate suspension components.</li> <li>4. Replace gear.</li> </ol>

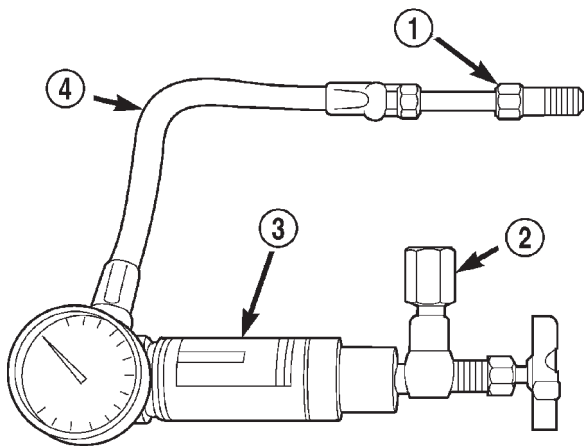
STEERING (Continued)

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 intermediate shaft.	1. Inspect and repair as necessary. 2. Inspect and replace bearings. 3. Tighten / replace gear mounting bolts/ isolators to specification. 4. Replace gear. 5. Inspect and replace as necessary.
VEHICLE PULLS, DRIFTS 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.

**DIAGNOSIS AND TESTING - POWER STEERING FLOW AND PRESSURE**

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the gallons per minute (GPM) or 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 and (Fig. 1) Adapter Kit 6893.



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**Fig. 1 Analyzer With Tube and Adapter**

- 1 - TUBE
- 2 - ADAPTER FITTINGS
- 3 - ANALYZER
- 4 - GAUGE HOSE

**FLOW AND PRESSURE TEST**

- (1) Check the power steering belt to ensure it is in good condition and adjusted properly.
- (2) Connect pressure gauge hose from the Power Steering Analyzer to Tube 6844.
- (3) Connect Adapter 6826 to Power Steering Analyzer test valve end.
- (4) Disconnect the high pressure hose from the power steering pump.
- (5) Connect the tube to the pump hose fitting.
- (6) Connect the power steering hose from the steering gear to the adapter.
- (7) Open the test valve completely.
- (8) 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.
- (9) Check fluid level, add fluid as necessary. Start engine again and let idle.
- (10) Check for air bubbles, Evacuate if necessary
- (11) Gauge should read below 862 kPa (125 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).
- (12) 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.

## STEERING (Continued)

(13) 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.

(14) 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 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 replaced.

**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 $\pm$ 50	FLOW RATE (GPM) AT 1500 RPM
3.7L, 2.4L & 2.5L	10342 kPa (1450 psi)	2.4 - 2.8

# COLUMN

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## COLUMN

### DESCRIPTION

The standard non-tilt and tilt steering column has been designed to be serviced as an assembly. The column is connected to the steering gear with a one piece shaft. The upper half has a support bearing mounted to a bracket. The bracket mounts to the frame rail with two nuts. The shaft is serviceable. The key cylinder, switches, clock spring, trim shrouds and steering wheel are serviced separately.

### OPERATION - SERVICE PRECAUTIONS

Safety goggles should be worn at all times when working on steering columns.

To service the steering wheel, switches or airbag, refer to Electrical - Restraints and follow all WARNINGS and CAUTIONS.

**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.**

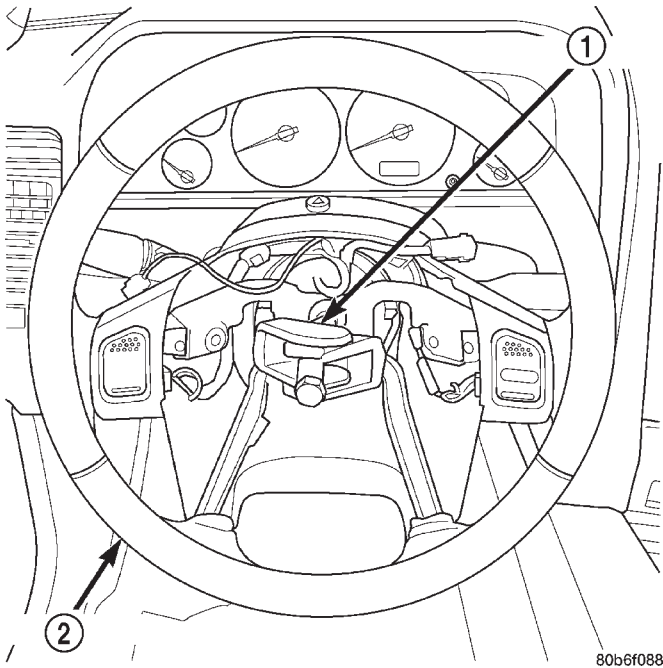
### REMOVAL

- (1) Position front wheels **straight ahead**.
- (2) Remove and isolate the negative ground cable from the battery.
- (3) Remove the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

**NOTE: If equipped with cruise control, disconnect clock spring harness from the cruise switch harness on the steering wheel.**

## COLUMN (Continued)

(4) Remove the steering wheel with an appropriate puller (Fig. 1) (Refer to 19 - STEERING/COLUMN/STEERING WHEEL - REMOVAL).

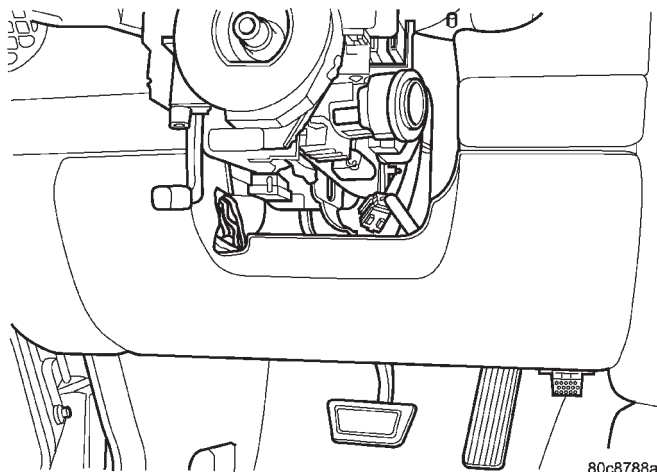


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**Fig. 1 Steering Wheel Puller**

- 1 - PULLER C-3894-A  
2 - STEERING WHEEL

(5) Remove knee blocker cover and knee blocker, (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL). (Fig. 2)

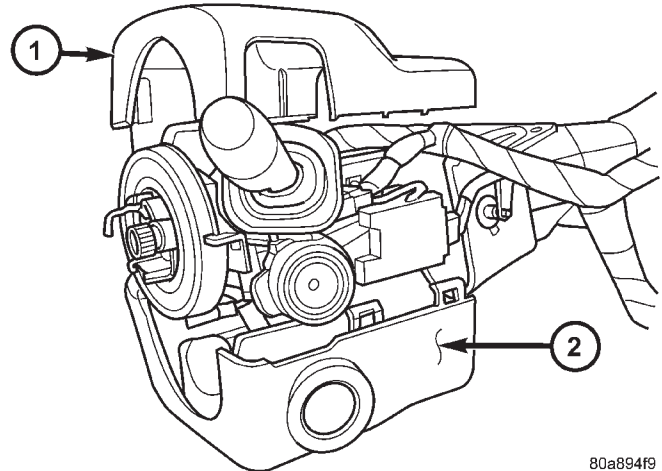


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**Fig. 2 KNEE BLOCKER**

(6) Remove screws from the lower column shroud (Fig. 3) and remove both the upper and lower shrouds.

(7) Turn ignition key to the on position.



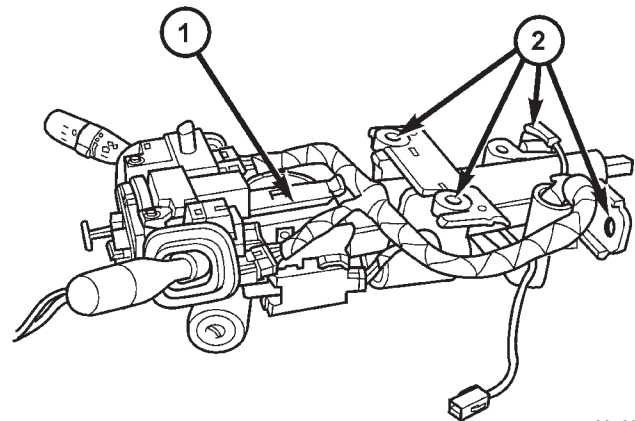
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**Fig. 3 SHROUD REMOVAL/INSTALL**

- 1 - Upper Shroud  
2 - Lower Shroud

(8) If vehicle is equipped with automatic transmission, disconnect shifter interlock cable from the column.

(9) Remove the steering coupler bolt and column mounting nuts and bolts (Fig. 4) then lower column off the mounting studs.



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**Fig. 4 STEERING COLUMN MOUNTING**

- 1 - Steering Column  
2 - Mounting Holes

(10) Disconnect and remove the wiring harness from the column (Fig. 5).

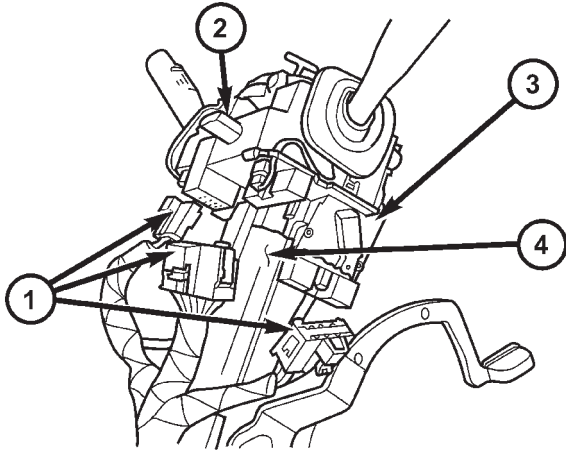
(11) Slide the shifter interlock cable from the tie straps.

(12) Remove column.

(13) Transfer the necessary parts if needed.

(14) Remove clock spring (Fig. 6), switches, (SKIM if equipped) (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

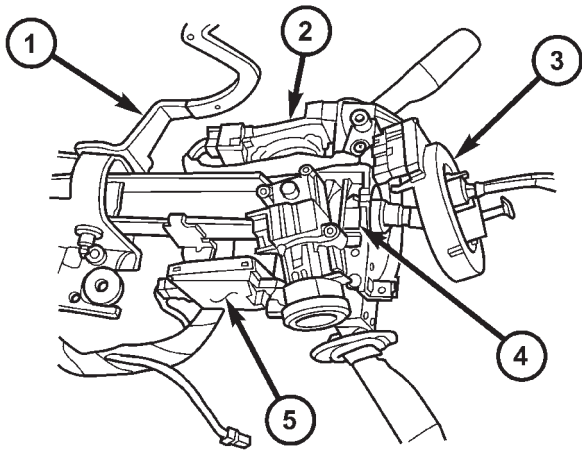
COLUMN (Continued)



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**Fig. 5 WIRING HARNESS COLUMN**

- 1 - Column Wiring Harness
- 2 - Multi-function Switch
- 3 - Ignition Switch
- 4 - Steering Column



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**Fig. 6 CLOCK SPRING**

- 1 - Tilt Lever
- 2 - Ignition Switch
- 3 - Clockspring
- 4 - Steering Column
- 5 - SKIM

**INSTALLATION**

(1) Align and install column into the steering coupler.

- (2) Install column harness and connect harness to switches.
- (3) Reroute the shifter interlock cable through the tie straps.
- (4) Install the column onto the mounting studs.
- (5) Install the two mounting nuts and the two mounting bolts all finger tight.

**CAUTION: Lower nuts must be installed and tightened first then the upper nuts in order to prevent damage to the capsules.**

- (6) Tighten the lower mounting nuts to 17 N·m (150 in. lbs.).
- (7) Tighten the upper mounting nuts to 17 N·m (150 in. lbs.).

(8) Install the steering column coupler bolt and tighten to 49 N·m (36 ft. lbs.).

- (9) Reconnect the shifter interlock cable.
- (10) Center the clock spring (if necessary) and install it on the column, (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

(11) Snap together the column shrouds and install the mounting screws.

(12) Install the knee blocker and the knee blocker cover, (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

(13)

**NOTE: Do not reuse the old steering wheel bolt (a new bolt must be used)**

**NOTE: Be certain that the steering wheel mounting bolt is tightened to the proper torque specification to ensure proper clockspring operation. Install the steering wheel and tighten bolt to 54 N·m (40 ft. lbs.) (Refer to 19 - STEERING/COLUMN/STEERING WHEEL - INSTALLATION).**

**NOTE: If equipped with cruise control, connect clock spring harness to cruise switch harness on the steering wheel.**

- (14) Install the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).
- (15) Install the negative battery terminal.

## COLUMN (Continued)

## SPECIFICATIONS

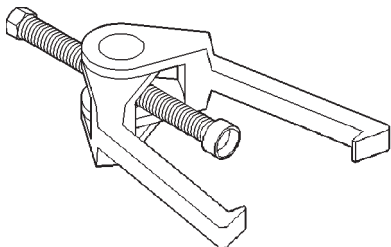
## TORQUE CHART

## TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Tilt Steering Column Steering Wheel Bolt	54	40	—
Tilt Steering Column Mounting Bolts	17	—	150
Tilt Steering Column Coupler Bolt	49	36	—
Non-Tilt Steering Column Steering Wheel Bolt	54	40	—
Non-Tilt Steering Column Mounting Bolts	17	—	150
Non-Tilt Steering Column Coupler Bolt	49	36	—
Ignition Switch Screws	2	—	17

## SPECIAL TOOLS

## STEERING COLUMN

*Puller C-3894-A*

## IGNITION SWITCH

## DESCRIPTION

The electrical ignition switch is located on the steering column. It is used as the main on/off switching device for most electrical components. The mechanical key lock cylinder is used to engage/disengage the electrical ignition switch.

## DIAGNOSIS AND TESTING - IGNITION SWITCH

## ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, Refer to the appropriate section for the component.

## MECHANICAL DIAGNOSIS (KEY DIFFICULT TO ROTATE)

**Vehicles equipped with an automatic transmission and a floor mounted shifter:** a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock system is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column components. The brake transmission shift interlock cable may be out of adjustment. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 30RH/GEAR SHIFT CABLE - ADJUSTMENTS). The interlock system within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 19 - STEERING/COLUMN - REMOVAL).

**Vehicles equipped with a manual transmission and a floor mounted shifter:** on certain models, a button is located on the steering column behind the ignition key lock cylinder. The button must be manually depressed to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. (Refer to 19 - STEERING/COLUMN - REMOVAL).

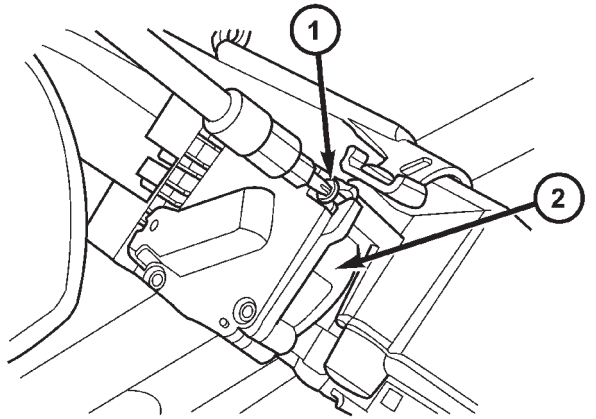
IGNITION SWITCH (Continued)

REMOVAL

**IGNITION SWITCH REMOVAL**

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

- (1) Remove lower steering column cover screws and remove cover.
- (2) Remove lock cylinder.(Refer to 19 - STEERING/COLUMN/KEY/LOCK CYLINDER - REMOVAL).
- (3) Remove the multi-function switch.
- (4) Disconnect the electrical connector at the rear of the ignition switch.
- (5) Remove the ignition switch mounting screw (Fig. 7). Use tamper proof torx bit to remove the screw.



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**Fig. 7 IGNITION SWITCH MOUNTING SCREW**

- 1 - Tamper Proof Torx Screw
- 2 - Ignition Switch

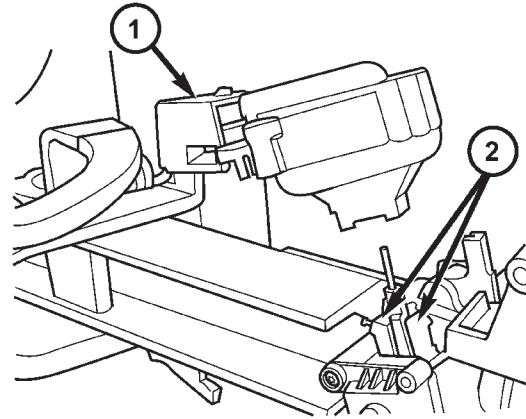
- (6) Pull the ignition switch straight out to remove from the locking tabs (Fig. 8)

INSTALLATION

**IGNITION SWITCH INSTALLATION**

The ignition key must be in the key cylinder for cylinder installation. The key cylinder must be aligned with the ignition switch for installation.

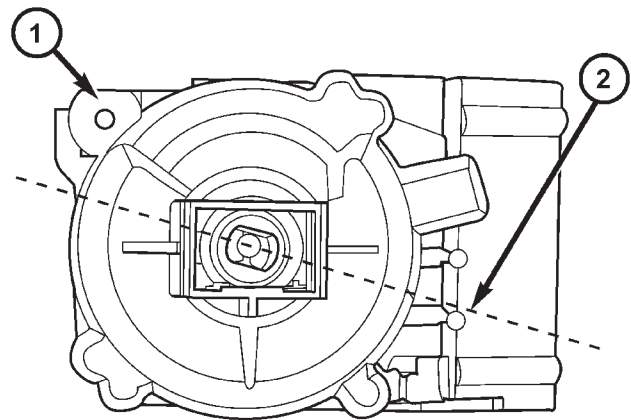
- (1) Before installing ignition switch, rotate the slot in the switch to the ON position (Fig. 9).
- (2) Connect the electrical connector to rear of ignition switch. Make sure that locking tab is fully seated into wiring connector.
- (3) Position the switch to the column and install tamper proof screw. Tighten screw to 2 N·m (17 in. lbs.).



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**Fig. 8 IGNITION SWITCH TABS**

- 1 - Ignition Switch
- 2 - Locking Tabs



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**Fig. 9 IGNITION SWITCH ON POSITION**

- 1 - Ignition Switch
- 2 - Rotate to On Position

- (4) Install the lock cylinder (Refer to 19 - STEERING/COLUMN/KEY/LOCK CYLINDER - INSTALLATION).

(5) Test the operation of the lock cylinder for smooth rotating.

- (6) Install the multi-function switch.
- (7) Install steering column lower cover.



## KEY-IN IGNITION SWITCH

### DESCRIPTION

The key-in ignition switch is integral to the ignition switch, which is mounted on the left side of the steering column, opposite the ignition lock cylinder. It closes a path to ground for the instrument cluster chime warning circuitry 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 key-in ignition switch cannot be repaired and, if faulty or damaged, the entire ignition switch must be replaced. (Refer to 19 - STEERING/COLUMN/IGNITION SWITCH - REMOVAL).

### DIAGNOSIS AND TESTING - KEY-IN IGNITION SWITCH

For circuit descriptions and diagrams, Refer to the appropriate sections on the individual components.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO ELECTRICAL - 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. Unplug the key-in ignition switch wire harness connector from the ignition switch.

(2) Check for continuity between the key-in switch sense circuit and the left front door jamb switch sense circuit 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.

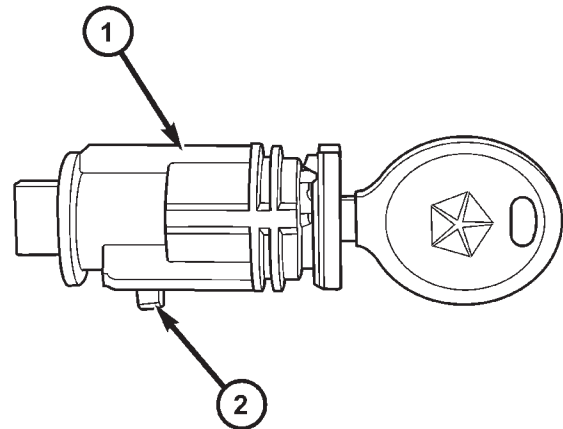
(3) Check for continuity between the left front door jamb switch sense circuit cavity of the key-in ignition switch wire harness connector and a good ground. There should be continuity with the driver door open, and no continuity with the driver door closed. If OK, see the diagnosis for Instrument Cluster in this group. If not OK, repair the circuit to the driver door jamb switch as required.

## LOCK CYLINDER

### REMOVAL

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

- (1) If equipped with an automatic transmission, place shifter in PARK position.
- (2) Remove the lower shroud cover.
- (3) Remove the remote keyless entry (R.K.E.) module.
- (4) Remove the halo ring around the lock cylinder.
- (5) Rotate key to ON position.
- (6) A release tang is located on bottom of key cylinder (Fig. 10).



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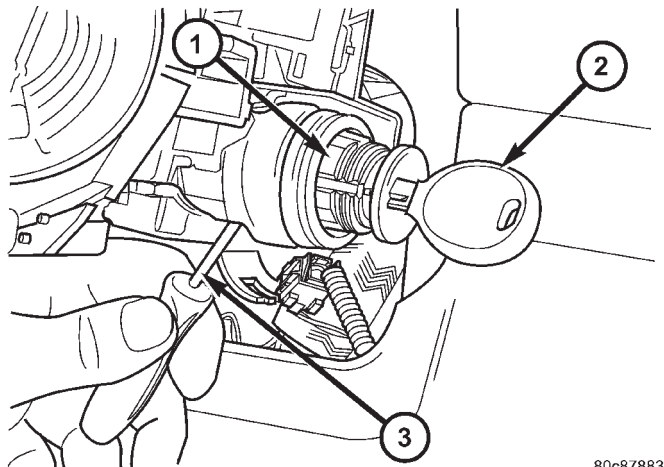
**Fig. 10 LOCK CYLINDER RELEASE TANG**

- 1 - Lock Cylinder  
2 - Release Tang

(7) Position a small screwdriver or pin punch into tang access hole on bottom of steering column (Fig. 11).

(8) Push the pin punch up while pulling key cylinder from steering column.

## LOCK CYLINDER (Continued)



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**Fig. 11 LOCK CYLINDER RELEASE**

- 1 - LOCK CYLINDER
- 2 - KEY
- 3 - PIN PUNCH

**INSTALLATION**

The ignition key must be in the key cylinder for cylinder installation.

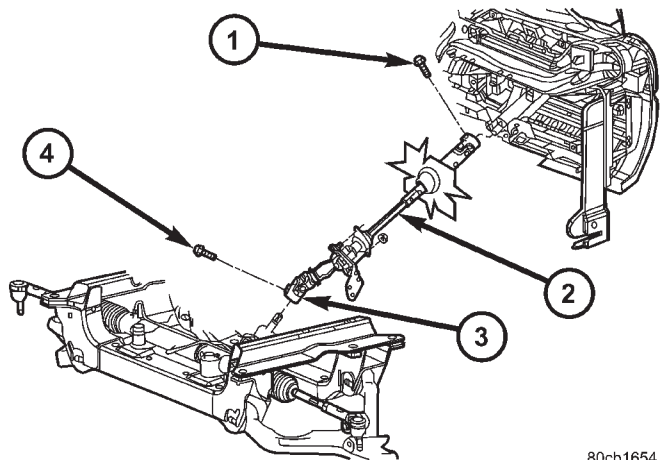
- (1) Install the lock cylinder into the housing using care to align the end of the lock cylinder with the ignition switch.
- (2) Push the lock cylinder in until it clicks.
- (3) Rotate the key to the lock position.
- (4) install the halo ring around the lock cylinder housing.
- (5) Install the R.K.E. module.
- (6) Install the lower shroud cover.

**INTERMEDIATE SHAFT****REMOVAL**

- (1) Disconnect the negative battery cable.
- (2) Remove knee blocker cover and knee blocker, (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).
- (3) Lock the steering wheel with the tires in the straight ahead position.
- (4) Remove the lower column pinch bolt (Fig. 12).
- (5) Lower the steering coupler shaft from the column.
- (6) Remove the intermediate shaft seal by pushing in the four tangs securing it to the panel (Fig. 12).
- (7) Remove the center support bearing bracket from the mount on the shock tower.
- (8) Remove the lower coupler pinch bolt at the steering gear (Fig. 12).
- (9) Remove the coupler at the steering gear (Fig. 12).

(10) Remove the intermediate shaft from the vehicle (Fig. 12).

(11) Remove the center support bracket from the steering shaft (if replacing the intermediate shaft).



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**Fig. 12 STEERING COUPLER**

- 1 - PINCH BOLT
- 2 - STEERING SHAFT
- 3 - STEERING COUPLER
- 4 - PINCH BOLT

**INSTALLATION**

- (1) Install the center support bracket to the steering shaft (if removed).
- (2) Install the intermediate shaft to the vehicle (Fig. 12).
- (3) Install the coupler at the steering gear (Fig. 12).
- (4) Install the lower coupler pinch bolt at the steering gear and tighten the bolt to 49 N·m (36 ft. lbs.) (Fig. 12).
- (5) Install the center support bearing bracket to the mounting holes on the shock tower.
- (6) Install the intermediate shaft seal by pushing it in securing the four tangs to the panel (Fig. 12).
- (7) Install the steering coupler shaft to the column.
- (8) Install the lower column pinch bolt and tighten the bolt to 49 N·m (36 ft. lbs.) (Fig. 12).
- (9) Unlock the steering wheel.
- (10) Install the knee blocker cover and knee blocker (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).
- (11) Reconnect the negative battery cable.

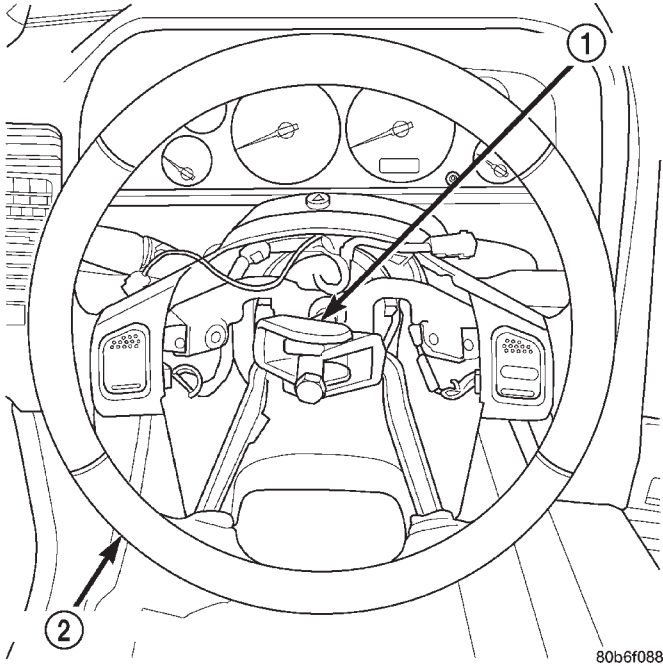
## STEERING WHEEL

### REMOVAL

(1) Disable and remove the drivers side airbag. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(2) Partially remove the steering wheel bolt and leave the bolt in the column.

(3) Install puller C-3894-A or equivalent using the top of the bolt to push on. (Fig. 13)



**Fig. 13 Steering Wheel Puller**

- 1 - PULLER C-3894-A  
2 - STEERING WHEEL

### INSTALLATION

**NOTE:** Do not reuse the old steering wheel bolt (a new bolt must be used)

(1) Install steering wheel to the column

**NOTE:** Be certain that the steering wheel mounting bolt is tightened to the proper torque specification to ensure proper clockspring operation.

(2) Install the new steering wheel bolt. Tighten the bolt to 54 N·m (40 ft. lbs.).

(3) Install the drivers side air bag. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

(4) Remove the steering wheel.

# GEAR

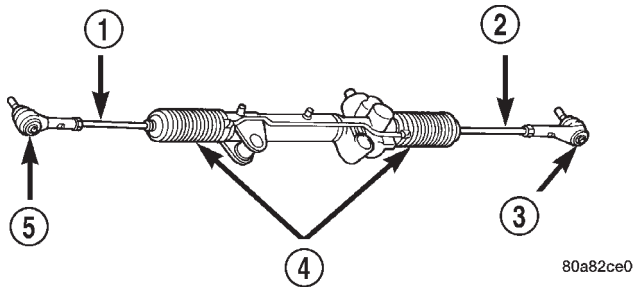
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## GEAR

### DESCRIPTION

A rack and pinion steering gear (Fig. 1) is made up of two main components, the pinion shaft and the rack. The gear cannot be adjusted or internally serviced. If a malfunction or a fluid leak occurs, the gear must be replaced as an assembly.



**Fig. 1 Rack & Pinion Steering Gear**

- 1 - TIE ROD - INNER
- 2 - TIE ROD - INNER
- 3 - TIE ROD END - OUTER LH
- 4 - BOOTS
- 5 - TIE ROD END - OUTER RH

### OPERATION

The steering column intermediate shaft is attached to the gear pinion. The rotation of the pinion moves the gear rack from side-to-side. This lateral action of the rack pushes and pulls the tie rods, which are connected to the steering knuckles to change the direction of the front wheels.

## REMOVAL

### REMOVAL - 4WD

- (1) Siphon the power steering fluid from the power steering reservoir.
- (2) Lock the steering wheel to prevent spinning of the clockspring.
- (3) Raise and support the vehicle.
- (4) Remove the skid plate from under the front end to gain access to the gear (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL).
- (5) Remove the front tire and wheel assemblies.

**NOTE: Mark the alignment adjusting cams for easier installation.**

- (6) Remove the lower control arms. (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL).
- (7) Remove the front axle. (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - REMOVAL).
- (8) Remove the tie rod end nuts.
- (9) Separate tie rod ends from the knuckles with Puller C-3894-A.
- (10) Remove the intermediate shaft lower coupler bolt and slide the coupler off the gear (Fig. 2).
- (11) Remove power steering pressure hose bracket (Fig. 3).
- (12) Remove the power steering lines from the gear (Fig. 2).
- (13) Remove the mounting bolts from the gear to the front cradle (Fig. 3).
- (14) Remove the steering gear from the vehicle.

## GEAR (Continued)

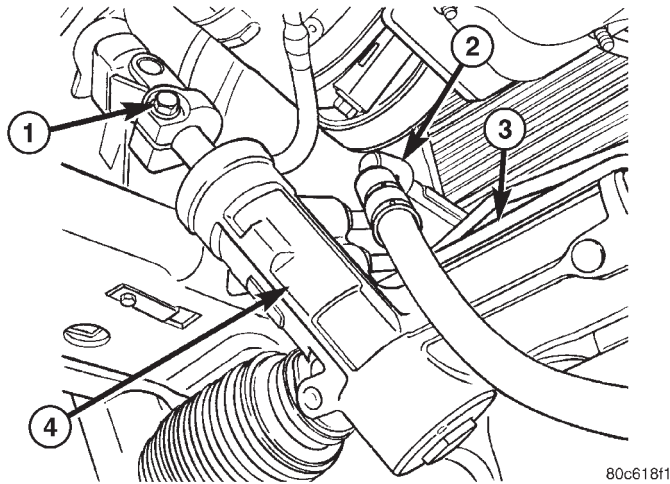


Fig. 2 COUPLER BOLT

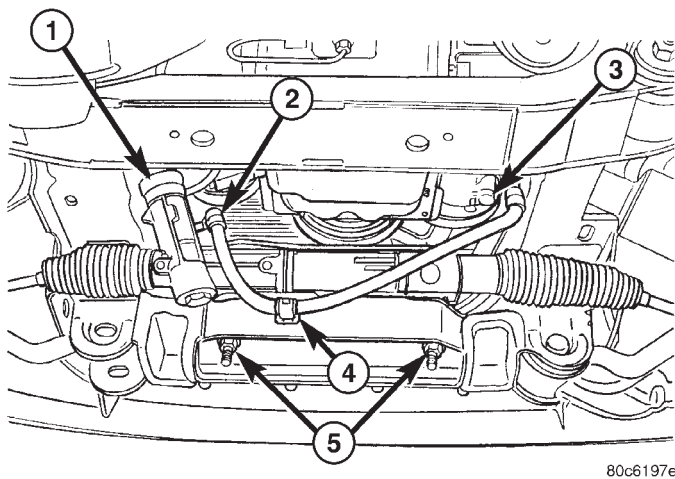


Fig. 3 RACK &amp; PINION

## REMOVAL - 2WD

- (1) Siphon the power steering fluid from the power steering reservoir.
- (2) Lock the steering wheel to prevent spinning of the clockspring.
- (3) Raise and support the vehicle.
- (4) Remove the skid plate from under the front end to gain access to the gear (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL).
- (5) Remove the tire and wheel assembly.

**NOTE:** Mark the alignment adjusting cams and tie rod end jam nuts on the steering gear for easier installation.

- (6) Remove the tie rod end nuts.
- (7) Separate tie rod ends from the knuckles with Puller C-3894-A.
- (8) Remove the lower intermediate shaft coupler bolt and slide the coupler off the gear (Fig. 2).

(9) Remove power steering pressure hose bracket (Fig. 3).

(10) Remove the power steering lines from the gear (Fig. 2).

(11) Remove the mounting bolts from the gear to the front cradle (Fig. 3).

(12) Remove the steering gear from the vehicle.

## INSTALLATION

## INSTALLATION - 4WD

(1) Transfer the tie rod ends to the new steering gear (if needed).

(2) Install the steering gear to the vehicle.

(3) Install the gear mounting bolts to the front cradle. (Fig. 3). Tighten the gear mounting bolts to 162 N·m (120 ft.lbs.)

(4) Install the power steering lines to the gear (Fig. 2).

(5) Install the power steering pressure hose bracket (Fig. 3).

(6) Install the lower coupler bolt and slide the coupler on to the gear (Fig. 2).

(7) Install the tie rod end to the knuckle and tighten the nuts.

(8) Install the front axle. (Refer to 3 - DIFFERENTIAL & DRIVELINE/FRONT AXLE - INSTALLATION).

(9) Install the lower control arms. (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION).

(10) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(11) Install the skid plate (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - INSTALLATION).

(12) Lower the vehicle.

(13) Unlock the steering wheel.

(14) Fill the power steering fluid (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(15) Reset the toe and center the steering wheel (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

## INSTALLATION - 2WD

(1) Transfer the outer tie rod ends to the new steering gear (if needed).

(2) Install the steering gear to the vehicle.

(3) Install the gear mounting bolts to the front cradle. (Fig. 3). Tighten the gear mounting bolts to 162 N·m (120 ft.lbs.)

(4) Install the power steering lines to the gear (Fig. 2).

GEAR (Continued)

(5) Install the power steering pressure hose bracket (Fig. 3).

(6) Install the lower coupler bolt and slide the coupler on to the gear (Fig. 2).

(7) Install the tie rod end to the knuckle and tighten the nuts.

(8) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Install the skid plate(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - INSTALLATION).

(10) Lower the vehicle.

(11) Unlock the steering wheel.

(12) Fill the power steering fluid (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(13) Reset the toe and center the steering wheel (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

SPECIFICATIONS

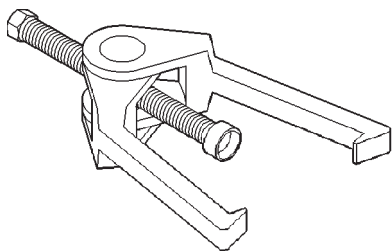
TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Rack and Pinion Steering Gear Gear to Frame Bolts	162	120	—
Rack and Pinion Steering Gear Intermediate Shaft Bolt	49	36	—
Tie Rod End Knuckle Nut	108	80	—
Tie Rod End Jam Nut	75	55	—
Power Steering Line Pressure Line	35	25	—
Power Steering Line Return Line	35	25	—

SPECIAL TOOLS

OUTER TIE ROD END REMOVAL TOOL



**Puller C-3894-A**

## LINKAGE

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## LINKAGE

## STANDARD PROCEDURE - STEERING LINKAGE

The tie rod end and ball stud seals should be inspected during all oil changes. If a seal is damaged, replace the tie rod.

**CAUTION:** If any steering components are replaced or serviced an alignment must be performed, to ensure the vehicle meets all alignment specifications.

## TIE ROD END

## REMOVAL

- (1) Raise and support the vehicle.
- (2) Remove the tire and wheel assembly.

**NOTE:** Mark the tie rod end jam nuts on the steering gear for easier installation.

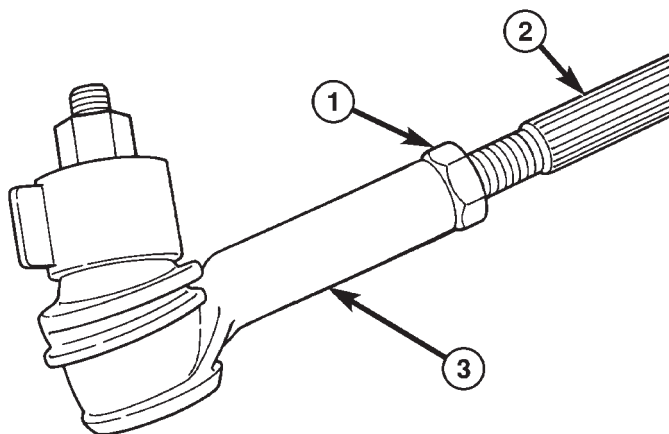
- (3) Loosen the tie rod end jam nut (Fig. 1).
- (4) Remove the tie rod end nut (Fig. 1).
- (5) Separate the tie rod end from the knuckle using tool C3894A.

**NOTE:** Count the number of turns when removing.

- (6) Remove the tie rod end from the rack (Fig. 1).

## INSTALLATION

- (1) Install the tie rod end to the rack to the exact number of turns that it was removed (Fig. 1).



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**Fig. 1 TIE ROD END**

- 1 - JAM NUT
- 2 - TIE ROD - INNER
- 3 - TIE ROD END - OUTER

- (2) Install the tie rod end to the knuckle. Tighten the nut to 108 N·m (80 ft.lbs).

- (3) Tighten the jam nut to 76 N·m (55 ft.lbs). (Fig. 1).

- (4) Install the tire and wheel assembly. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

- (5) Reset the toe and center the steering wheel (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

# PUMP

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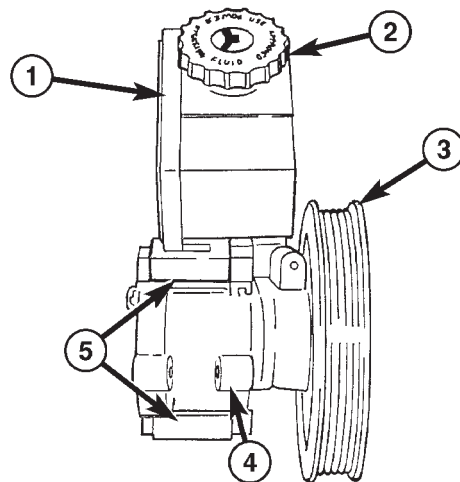
## PUMP

### DESCRIPTION

Hydraulic pressure for the power steering system is provided by a belt driven power steering pump (Fig. 1). The pump shaft has a pressed-on high strength plastic drive pulley that is belt driven by the crankshaft pulley. The integral reservoir used on the 3.7L only is attached to the pump body with spring clips (Fig. 1). The 2.4L uses a remote fluid reservoir (Fig. 2). The power steering pump is connected to the steering gear by the pressure and return hoses.

### OPERATION

The power steering pump is a constant flow rate and displacement, vane-type pump. The pump internal parts operate submerged in fluid. The flow control orifice is part of the high pressure line fitting. The pressure relief valve inside the flow control valve limits the pump pressure.



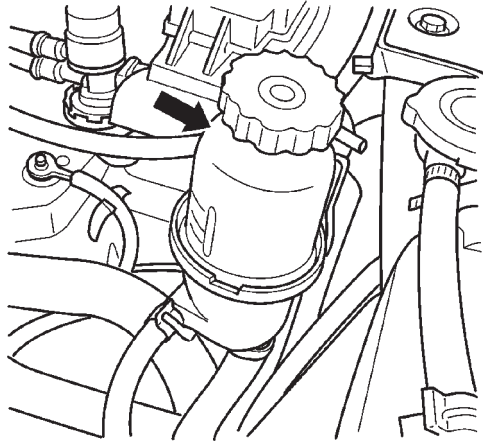
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**Fig. 1 POWER STEERING PUMP ASSEMBLY**

- 1 - RESERVOIR
- 2 - CAP
- 3 - PULLEY
- 4 - PUMP BODY
- 5 - RESERVOIR RETAINING CLIPS



## PUMP (Continued)



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Fig. 2 FLUID RESERVOIR - 2.4L

**NOTE:** Power steering pumps have different pressure rates and are not interchangeable with other pumps.

### STANDARD PROCEDURE - 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 ambient temperature.

- (1) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two minutes.
- (2) Raise the front wheels off the ground.
- (3) Slowly turn the steering wheel right and left, lightly contacting the wheel stops at least 20 times.
- (4) Check the fluid level add if necessary.
- (5) Lower the vehicle, start the engine and turn the steering wheel slowly from lock to lock.
- (6) Stop the engine and check the fluid level and refill as required.

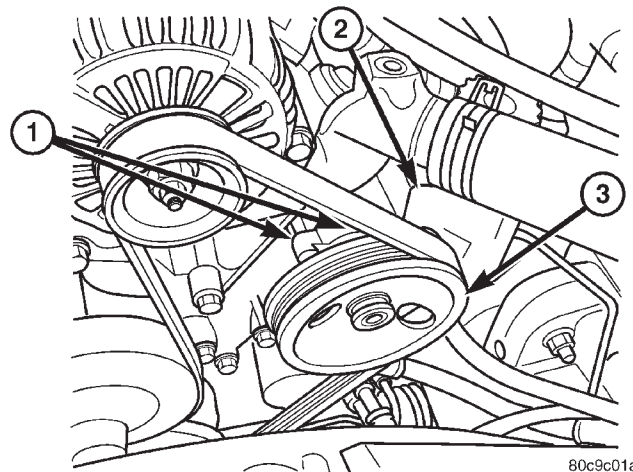
**CAUTION:** Do not run a vehicle with foamy fluid for an extended period. This may cause pump damage.

- (7) If the fluid is extremely foamy or milky looking, allow the vehicle to stand a few minutes and repeat the procedure.
- (8) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

## REMOVAL

### REMOVAL - 3.7L

- (1) Siphon out as much power steering fluid as possible.
- (2) Remove the radiator cross member (Refer to 23 - BODY/EXTERIOR/RADIATOR CROSSMEMBER - REMOVAL).
- (3) Remove the engine cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
- (4) Remove the fan shroud
- (5) Remove the serpentine drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
- (6) Remove the power steering high pressure hose at the pump.
- (7) Remove the return hose at the pump.
- (8) Remove the three bolts securing the pump to the bracket thru the holes in the pulley. (Fig. 3)
- (9) Remove the pump from the vehicle.



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Fig. 3 POWER STEERING PUMP - 3.7L

- 1 - MOUNTING BOLTS
- 2 - RESERVOIR
- 3 - STEEL PULLEY

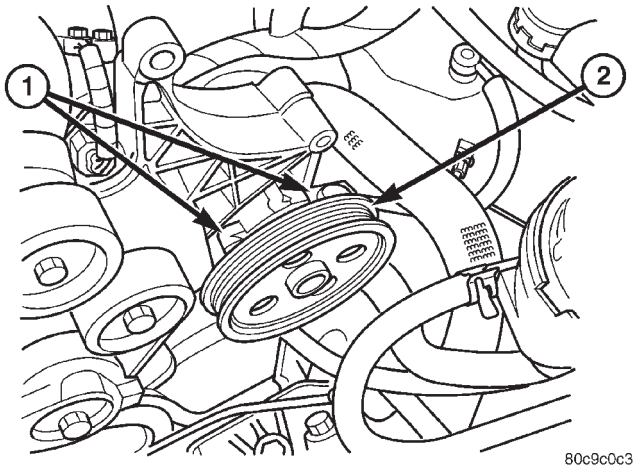
### REMOVAL - 2.4L

**CAUTION:** On vehicles equipped with the 2.4L, Do not reuse the old power steering pump pulley it is not intended for reuse. A new pulley must be installed if removed.

- (1) Siphon out as much power steering fluid as possible.
- (2) Remove the serpentine drive belt.
- (3) Remove the power steering high pressure hose at the pump using care not to remove the flow control valve.
- (4) Remove the return hose at the pump.

PUMP (Continued)

- (5) Remove the two nuts securing the wire loom behind the pump bracket.
- (6) Remove the three bolts securing the pump to the bracket thru the holes in the pulley. (Fig. 4)
- (7) Remove the pump from the vehicle.



**Fig. 4 POWER STEERING PUMP - 2.4L**

- 1 - MOUNTING BOLTS
- 2 - PULLEY

- (2) Install the three bolts securing the pump to the engine. (Fig. 3) Tighten the bolts to 47 N·m (35 ft.lbs.).
- (3) Install the power steering hoses.
- (4) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
- (5) Install the fan shroud
- (6) Install the engine cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
- (7) Install the radiator crossmember (Refer to 23 - BODY/EXTERIOR/RADIATOR CROSSMEMBER - INSTALLATION).
- (8) Refill the power steering fluid and check for leaks (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

**INSTALLATION - 2.4L**

- (1) Install the pump to the vehicle.
- (2) Install the three bolts securing the pump to the engine. (Fig. 4) Tighten the bolts to 47 N·m (35 ft.lbs.).
- (3) Install the two nuts securing the wire loom to the pump bracket.
- (4) Install the power steering pressure and supply hoses.
- (5) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
- (6) Refill the power steering fluid and check for leaks (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

**INSTALLATION**

**INSTALLATION - 3.7L**

- (1) Install the pump to the vehicle.

**SPECIFICATIONS**

**TORQUE CHART**

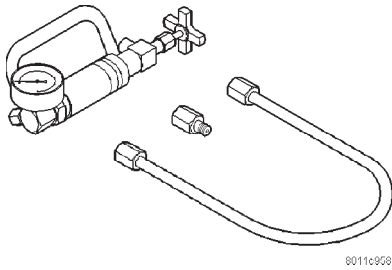
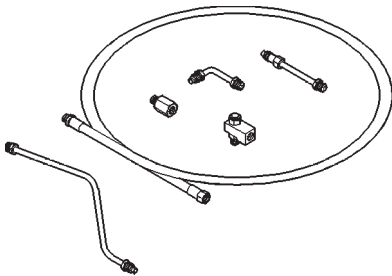
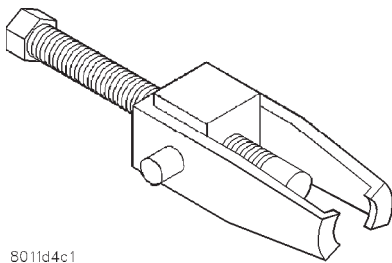
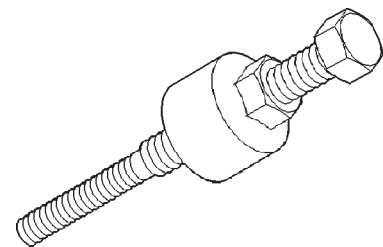
*TORQUE SPECIFICATIONS*

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Power Steering Pump Bracket to Pump	28	21	—
Power Steering Pump Bracket to Engine	47	35	—
Power Steering Pump Flow Control Valve	75	55	—
Power Steering Pump Pressure Line	28	21	—
Power Steering Pump Pressure Line Bracket	12	9	105

## PUMP (Continued)

## SPECIAL TOOLS

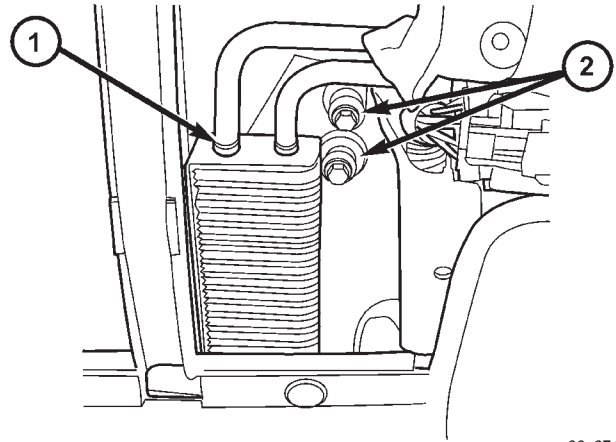
## POWER STEERING PUMP

**Analyzer Set, Power Steering Flow/Pressure 6815****Adapters, Power Steering Flow/Pressure Tester 6893****Puller C-4333****Installer, Power Steering Pulley C-4063B**

## FLUID COOLER

## DESCRIPTION

The power steering fluid cooler is located at the front of the vehicle. It is mounted to the radiator lower support just forward of the air-conditioning condenser and just rearward of the front fascia. The cooler is positioned so it is in the air flow through the front fascia of the vehicle (Fig. 5)

**Fig. 5 FLUID COOLER**

- 1 - FLUID COOLER  
2 - MOUNTING BOLTS

## OPERATION

The purpose of the power steering fluid cooler is to keep the temperature of the power steering system fluid from rising to a level that would affect the performance of the power steering system.

The cooler used on this vehicle is referred to as a fluid-to-air type cooler. This means that the air flow across the fin/tubes of the cooler is used to extract the heat from the cooler which it has absorbed from the power steering fluid flowing through it. The cooler is placed in series with the power steering fluid return line, between the steering gear and the power steering fluid reservoir. This lowers the temperature of the power steering fluid prior to it entering the power steering fluid reservoir where it is resupplied to the power steering pump.

## REMOVAL

- (1) Remove the return line at the gear.
- (2) Remove the return line at the reservoir.
- (3) Remove the grille (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL).
- (4) Remove the two cooler mounting bolts. (Fig. 5)
- (5) Remove the cooler from the vehicle.

## INSTALLATION

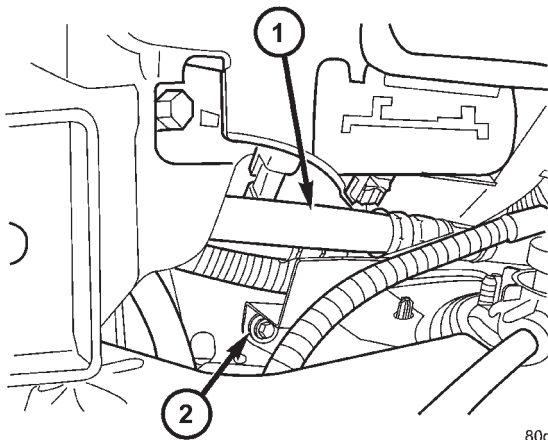
- (1) Install the cooler to the vehicle.
- (2) Install the two cooler mounting bolts. (Fig. 5).
- (3) Install the grille (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION).
- (4) Install the return line at the reservoir.
- (5) Install the return line at the gear.
- (6) Refill the power steering fluid and check for leaks (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

## HOSES

### REMOVAL

#### REMOVAL - PRESSURE HOSE

- (1) Siphon the power steering fluid from the reservoir.
- (2) Remove the radiator crossmember (Refer to 23 - BODY/EXTERIOR/RADIATOR CROSSMEMBER - REMOVAL).
- (3) Remove the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).
- (4) Remove the fan shroud.
- (5) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
- (6) Remove the pressure hose at the pump.
- (7) Disconnect the pressure switch electrical connector from the pressure hose.
- (8) Remove the pressure hose from the gear.
- (9) Remove the pressure hose mounting bracket bolts from behind the headlamp assembly. (Fig. 6)
- (10) Remove the pressure hose from the vehicle and transfer power steering pressure switch if necessary.



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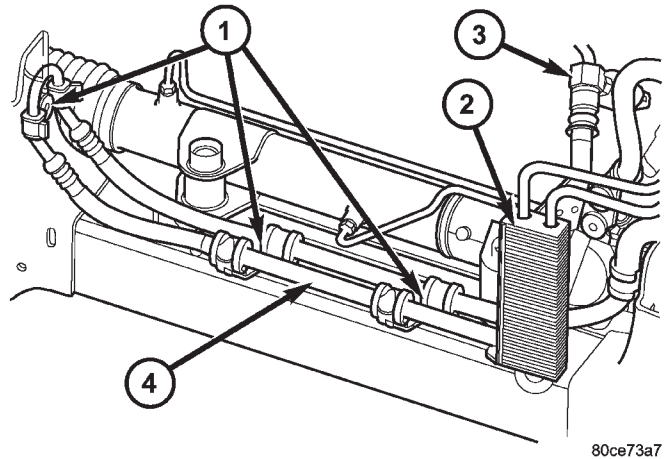
**Fig. 6 MOUNTING BRACKET**

- 1 - HIGH PRESSURE POWER STEERING HOSE
- 2 - MOUNTING BRACKET

#### REMOVAL - RETURN HOSE (GEAR TO THE COOLER)

- (1) Siphon the power steering fluid from the reservoir.
- (2) Remove the radiator crossmember (Refer to 23 - BODY/EXTERIOR/RADIATOR CROSSMEMBER - REMOVAL).
- (3) Remove the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

- (4) Remove the fan shroud.
- (5) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
- (6) Remove the return hose from the gear.
- (7) Remove the return hose at the cooler.
- (8) Remove the return hose mounting bracket bolts from the front cradle. (Fig. 7)
- (9) Remove the return hose from the vehicle.



**Fig. 7 RETURN HOSE TO COOLER**

- 1 - MOUNTING BRACKETS
- 2 - FLUID COOLER
- 3 - PRESSURE SWITCH
- 4 - RETURN HOSE

#### REMOVAL - RETURN HOSE (RESERVOIR TO THE COOLER)

- (1) Siphon the power steering fluid from the reservoir.
- (2) Remove the return hose from the pump reservoir.
- (3) Remove the return hose at the cooler.
- (4) Remove the return hose from the vehicle.

### INSTALLATION

#### INSTALLATION - PRESSURE HOSE

- (1) Install the pressure hose to the vehicle. (Fig. 8)
- (2) Install the pressure hose mounting bracket bolts behind the headlamp assembly. Tighten to to 12 N·m (9 ft.lbs.).
- (3) Install the pressure hose to the gear. Tighten the hose to 28 N·m (21 ft.lbs.).
- (4) Install the pressure switch electrical connector.
- (5) Install the pressure hose at the pump. Tighten the hose to 28 N·m (21 ft.lbs.).

## HOSES (Continued)

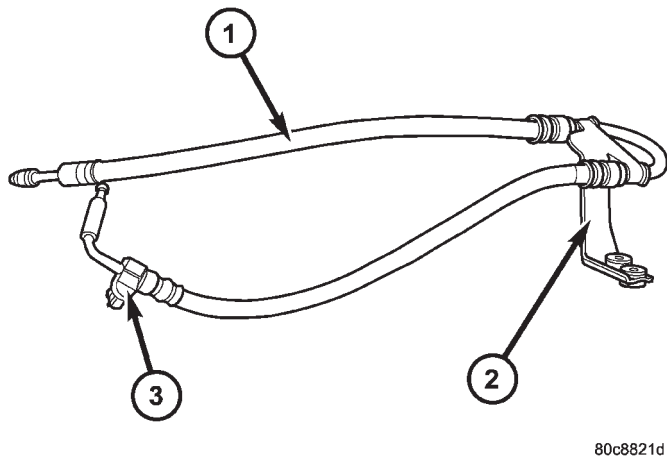
(6) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Install the fan shroud.

(8) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(9) Install the radiator crossmember (Refer to 23 - BODY/EXTERIOR/RADIATOR CROSSMEMBER - INSTALLATION).

(10) Refill the power steering fluid (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).



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**Fig. 8 HIGH PRESSURE HOSE ASSEMBLY**

- 1 - HIGH PRESSURE POWER STEERING HOSE  
2 - MOUNTING BRACKET  
3 - POWER STEERING PRESURE SWITCH

### INSTALLATION - RETURN HOSE (GEAR TO THE COOLER)

(1) Install the return hose to the vehicle. (Fig. 7)  
(2) Install the return hose mounting bracket bolts to the front cradle.

(3) Install the return hose at the cooler.

(4) Install the return hose at the gear 28 N·m (21 ft.lbs.).

(5) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Install the fan shroud.

(7) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(8) Install the radiator crossmember (Refer to 23 - BODY/EXTERIOR/RADIATOR CROSSMEMBER - INSTALLATION).

(9) Refill the power steering fluid (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

### INSTALLATION - RETURN HOSE (RESERVOIR TO THE COOLER)

(1) Install the return hose to the vehicle.

(2) Install the return hose to the pump reservoir.

(3) Install the return hose at the cooler.

(4) Refill the power steering fluid (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

### POWER STEERING PRESSURE SWITCH

#### DESCRIPTION

A pressure sensing switch is used in the power steering system. It is mounted on the high-pressure steering hose. This switch will be used with both 2.4L and 3.7L engines.

#### OPERATION

The switch is used on both the 2.4L 4-cylinder and 3.7L V-6 engines.

The power steering pressure switch provides an input to the Powertrain Control Module (PCM). This input is provided during periods of high steering pump load and low engine rpm; such as during parking maneuvers. The PCM increases the idle speed through the Idle Air Control (IAC) motor. This is done to prevent the engine from stalling under the increased load.

When steering pump pressure exceeds 3275 kPa  $\pm$  690 kPa (475 psi  $\pm$  100 psi), the Normally Closed (NC) switch will open and the PCM will increase the engine idle speed. This will prevent the engine from stalling.

When pump pressure drops to approximately 1379 kPa (200 psi), the switch circuit will re-close and engine idle speed will return to its previous setting.

#### REMOVAL

The power steering pressure switch is installed in the power steering high-pressure hose (Fig. 9).

(1) Remove the high pressure power steering hose (Refer to 19 - STEERING/PUMP/HOSES - REMOVAL).

(2) Disconnect electrical connector from power steering pressure switch.

(3) Place a small container or shop towel beneath switch to collect any excess fluid.

(4) Remove switch. Use back-up wrench on power steering line to prevent line bending.

#### INSTALLATION

(1) Install power steering switch into power steering line. (Fig. 9)

(2) Tighten to 9.6 N·m (85 in. lbs.) torque.

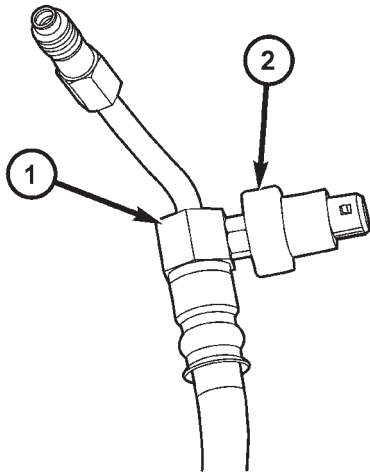
POWER STEERING PRESSURE SWITCH (Continued)

(3) Install the high pressure power steering hose (Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION).

(4) Connect electrical connector to switch.

(5) Check power steering fluid and add as necessary (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(6) Start engine and again check power steering fluid. Add fluid if necessary.



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**Fig. 9 POWER STEERING PRESSURE SWITCH**

- 1 - HIGH PRESSURE POWER STEERING HOSE
- 2 - O-RING
- 3 - POWER STEERING PRESSURE SWITCH

PULLEY

REMOVAL

**CAUTION:** On vehicles equipped with the 2.4L, Do not reuse the old power steering pump pulley it is not intended for reuse. A new pulley must be installed if removed.

(1) Remove pump assembly. (Refer to 19 - STEERING/PUMP - REMOVAL).

(2) Remove pulley from pump with Puller C-4333 or equivalent puller (Fig. 10).

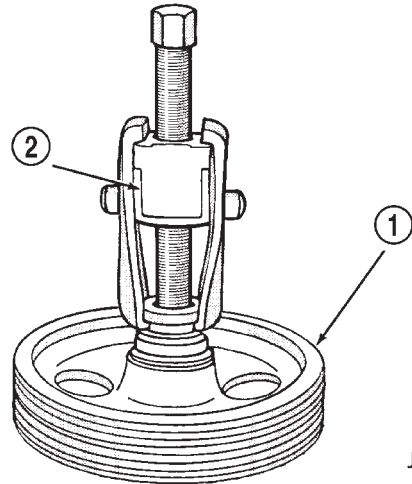
INSTALLATION

**NOTE:** The pulley is marked front for installation.

(1) Replace pulley if bent, cracked, or loose.

(2) Install pulley on pump with Installer C-4063-B or equivalent installer (Fig. 11). The pulley must be flush with the end of the shaft. Ensure the tool and pulley are aligned with the pump shaft.

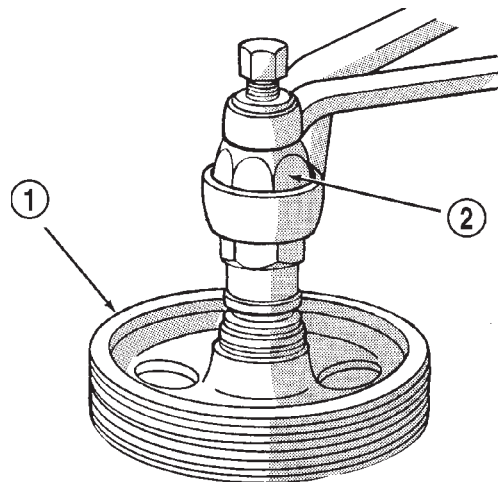
(3) Install pump assembly. (Refer to 19 - STEERING/PUMP - INSTALLATION)



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**Fig. 10 Pulley Removal**

- 1 - POWER STEERING PUMP DRIVE PULLEY
- 2 - SPECIAL TOOL C-4333



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**Fig. 11 Pulley Installation**

- 1 - POWER STEERING PUMP DRIVE PULLEY
- 2 - SPECIAL TOOL C-4063-B

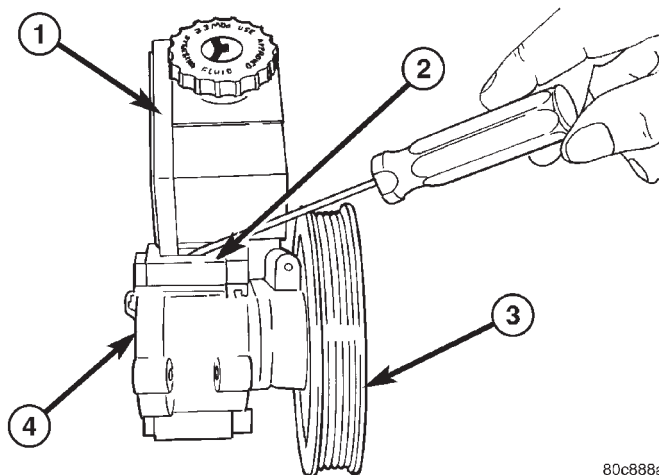
(4) With Serpentine Belt, run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

## RESERVOIR

### REMOVAL

#### REMOVAL - 3.7L

- (1) Remove the power steering pump. (Refer to 19 - STEERING/PUMP - REMOVAL).
- (2) Secure the pump in a holding fixture.
- (3) Remove the retaining clips by prying the lock tab upwards and tap the retaining clips off the pump body. (Fig. 12)
- (4) Remove the reservoir from the pump body.



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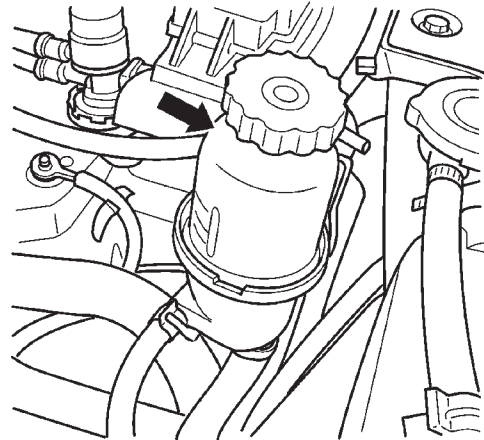
**Fig. 12 FLUID RESERVOIR**

- 1 - FLUID RESERVOIR
- 2 - RETAINING CLIP
- 3 - PULLEY
- 4 - PUMP BODY

#### REMOVAL - 2.4L

- (1) Siphon out as much power steering fluid as possible.
- (2) Remove the power steering hoses.

- (3) Remove the bolt securing the reservoir to the mounting bracket. (Fig. 13)
- (4) Remove the reservoir.



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**Fig. 13 FLUID RESERVOIR - 2.4L**

### INSTALLATION

#### INSTALLATION - 3.7L

- (1) Install the reservoir to the pump body.
- (2) Install the retaining clips to the pump and reservoir.
- (3) Install the pump to the engine. (Refer to 19 - STEERING/PUMP - INSTALLATION).
- (4) Refill the power steering fluid and check for leaks (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

#### INSTALLATION - 2.4L

- (1) Install the reservoir to the mounting bracket.
- (2) Install and tighten the bolt to
- (3) Install the hoses.
- (4) Refill the power steering fluid and check for leaks (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE). (Fig. 13)

# TRANSMISSION AND TRANSFER CASE

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## MANUAL - NV1500

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## MANUAL - NV1500

### DESCRIPTION

The NV1500 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. The Transmission is available in vehicles equipped with a 2.4L engine.

The transmission gear case consists of two aluminum gear housings and a detachable clutch housing.

The mainshaft is supported by two sealed ball bearings, and the countershaft is supported by two tapered roller bearings. The transmission gears all rotate on caged type needle bearings. A roller bearing is used between the input and output shaft.

The Transmission 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. Internal shift components consist of the forks, shaft, shift lever socket, and detent components.

The drain plug in on the bottom of the transmission and fill plug is on the side.

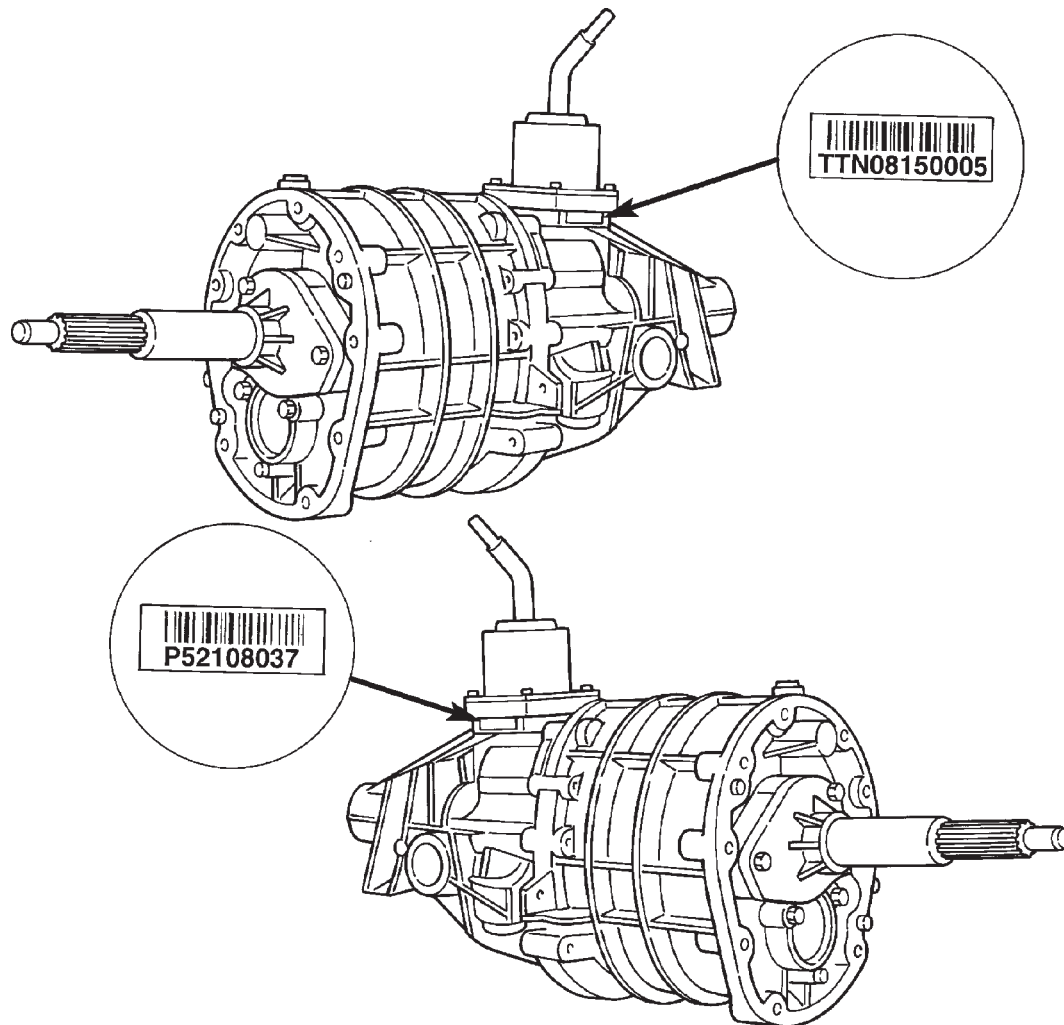
Identification bar code tags (Fig. 1) are located on each side of the transmission, below the shift tower. The tag located on the right side has the part num-

ber and the tag located on the left side has the build sequence and date information.

### OPERATION

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft, or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.





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**Fig. 1 NV1500 IDENTIFICATION**

## DIAGNOSIS AND TESTING - MANUAL TRANSMISSION

### 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 gear case, intermediate plate and adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. 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 the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is

severe, it may also contaminate the clutch disc causing the disc to slip, grab, and/or chatter.

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

### HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper, or contaminated lubricants. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind, and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

## MANUAL - NV1500 (Continued)

Component damage, incorrect clutch adjustment, or a damaged clutch pressure plate or disc are additional probable causes of increased shift effort. 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 hard or noisy shifts. In most cases, this condition will decline as the rings wear-in.

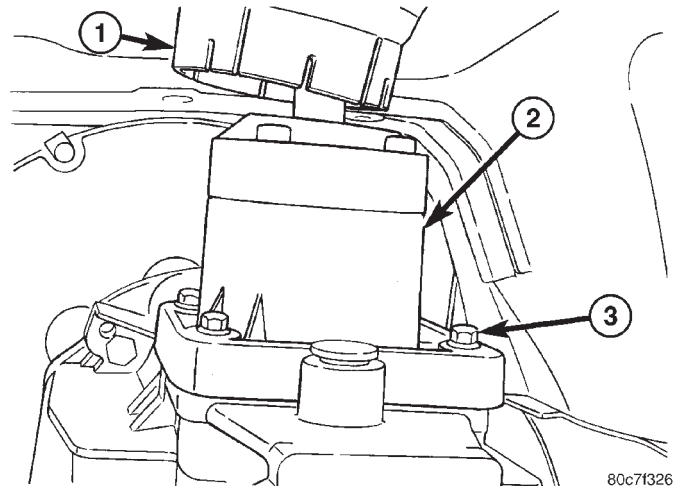
**TRANSMISSION NOISE**

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

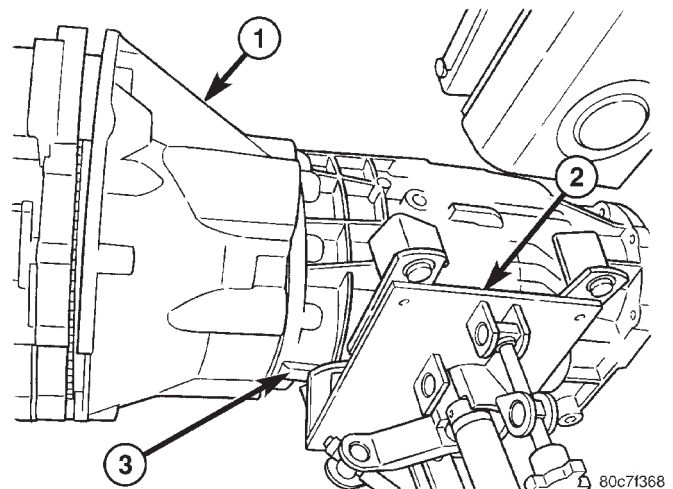
Severe, highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper, or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

**REMOVAL**

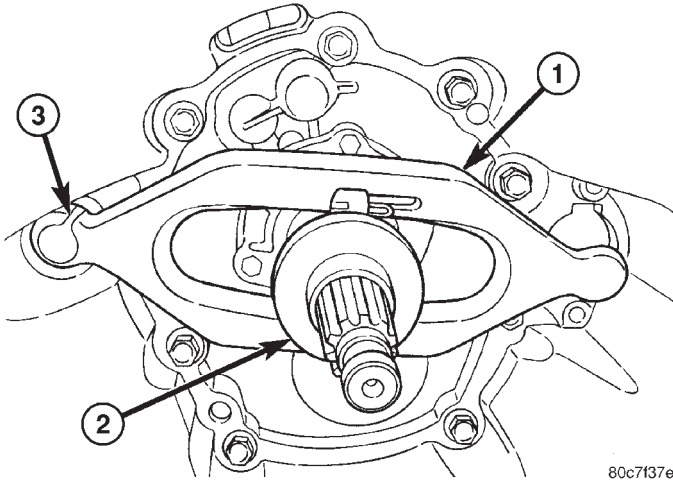
- (1) Shift transmission into neutral.
- (2) Raise and support the vehicle.
- (3) Remove skid plate if equipped.
- (4) Remove wiring connectors from the transmission.
- (5) Remove propeller shaft/shafts.
- (6) Remove transfer case shift cable, vent hose from and transfer case, if equipped.
- (7) Remove slave cylinder from clutch housing.
- (8) Remove starter.
- (9) Support engine with jack stand. Position wood block between jack and oil pan to avoid damaging pan.
- (10) Support transmission with a trans jack.
- (11) Remove exhaust hanger from the transmission crossmember.
- (12) Remove transmission dust shield.
- (13) Remove transmission mount and crossmember.
- (14) Lower trans jack enough to remove shift tower bolts (Fig. 2).
- (15) Lower transmission jack and remove transmission from under vehicle.
- (16) Pull transmission jack rearward (Fig. 3) until input shaft clears clutch.
- (17) Remove clutch release bearing, release fork and retainer clip (Fig. 4).
- (18) Remove clutch housing from transmission.

**Fig. 2 SHIFT TOWER**

- 1 - SHIFT TOWER BOOT
- 2 - SHIFT TOWER
- 3 - SHIFT TOWER BOLT (4)

**Fig. 3 TRANSMISSION ASSEMBLY**

- 1 - CLUTCH HOUSING
- 2 - TRANSMISSION JACK
- 3 - TRANSMISSION

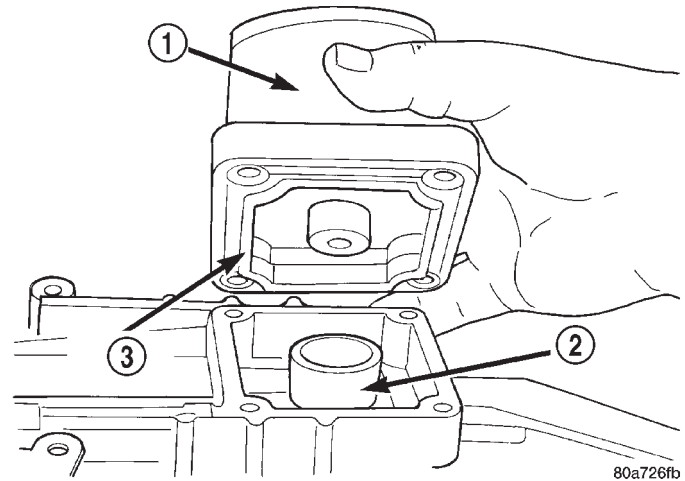


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**Fig. 4 CLUTCH RELEASE BEARING**

- 1 - FORK
- 2 - BEARING
- 3 - CLIP

(4) Remove shift tower bolts and remove tower and lever assembly (Fig. 6).



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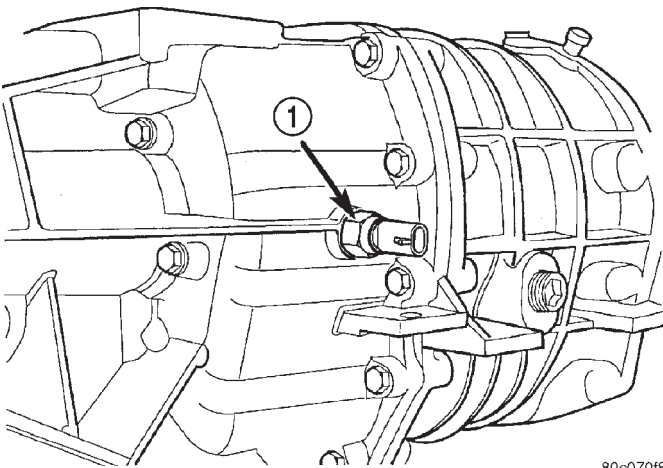
**Fig. 6 SHIFT TOWER**

- 1 - SHIFT TOWER AND LEVER ASSEMBLY
- 2 - SHIFT SOCKET
- 3 - SEAL

**DISASSEMBLY**

**FRONT HOUSING**

- (1) Shift transmission into Neutral.
- (2) Remove drain plug and drain lubricant into a container.
- (3) Remove backup light switch (Fig. 5).

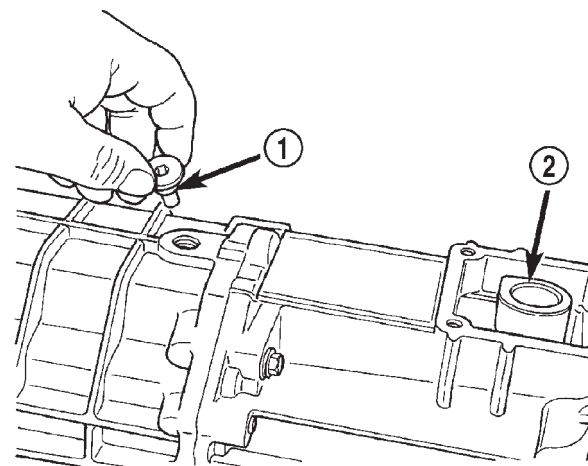


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**Fig. 5 BACKUP LIGHT SWITCH**

- 1 - BACKUP LAMP SWITCH

(5) Remove shift shaft lock bolt (Fig. 7). Bolt secures the shift shaft bushing and lever.



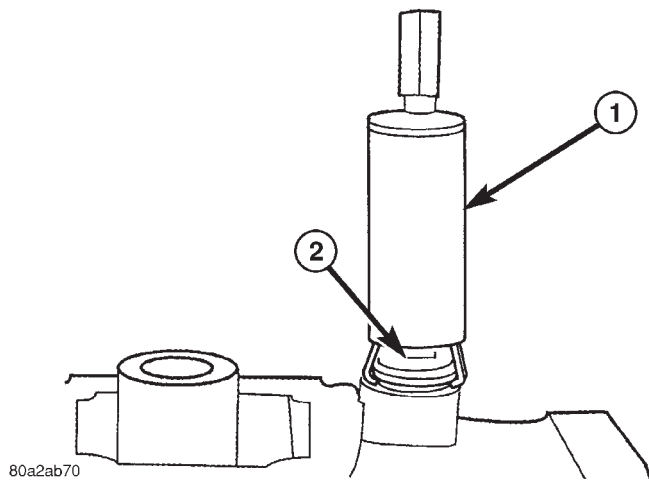
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**Fig. 7 SHIFT SHAFT BUSHING LOCK BOLT**

- 1 - SHIFT SHAFT LOCK BOLT
- 2 - SHAFT SOCKET

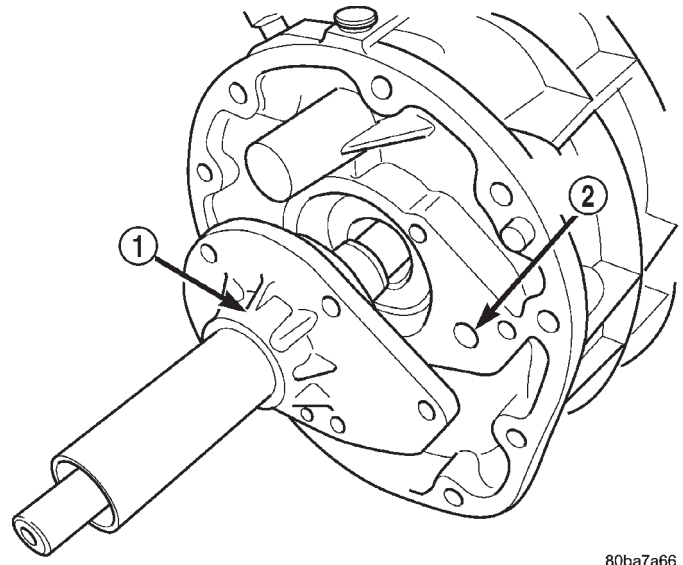
MANUAL - NV1500 (Continued)

(6) Remove shift shaft detent plug with Remover 8117A (Fig. 8).



**Fig. 8 DETENT PULLER**

- 1 - REMOVER
- 2 - DETENT PLUG

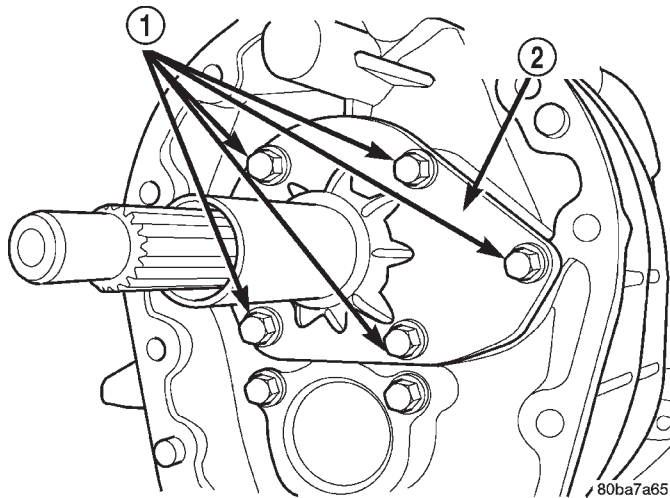


**Fig. 10 INPUT SHAFT BEARING RETAINER**

- 1 - BEARING RETAINER
- 2 - OIL FEED

(7) Remove shift shaft detent plunger and spring with a pencil magnet.

(8) Remove input shaft bearing retainer bolts (Fig. 9).



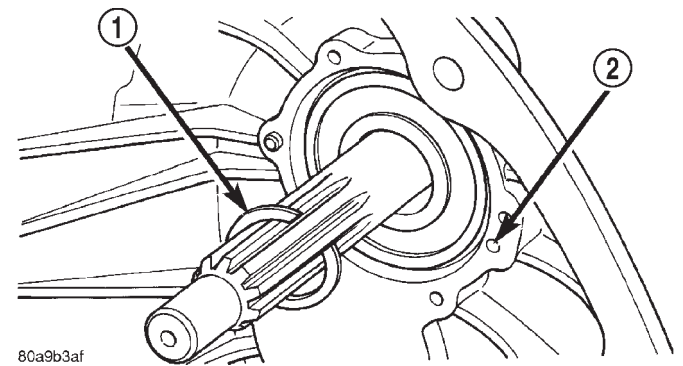
**Fig. 9 BEARING RETAINER BOLTS**

- 1 - BOLTS (5)
- 2 - BEARING RETAINER

(9) Remove bearing retainer from input shaft with a pry tool (Fig. 10).

(10) Remove snap ring securing input shaft in front bearing (Fig. 11).

(11) Remove front housing bolts (Fig. 12). Leave one bolt in place until geartrain is ready to be removed from case. Three bolts at the rear of housing are for the output shaft bearing retainer.



**Fig. 11 INPUT SHAFT SNAP RING**

- 1 - INPUT SHAFT SNAP RING
- 2 - OIL FEED

(12) Tap front housing off alignment dowels with a plastic mallet and separate the housing.

(13) Remove input shaft bearing (Fig. 13).

(14) Note position of input shaft, shift shaft, forks, and geartrain components in housing (Fig. 14).

**SHIFT SHAFT, SHIFT FORKS AND REVERSE IDLER**

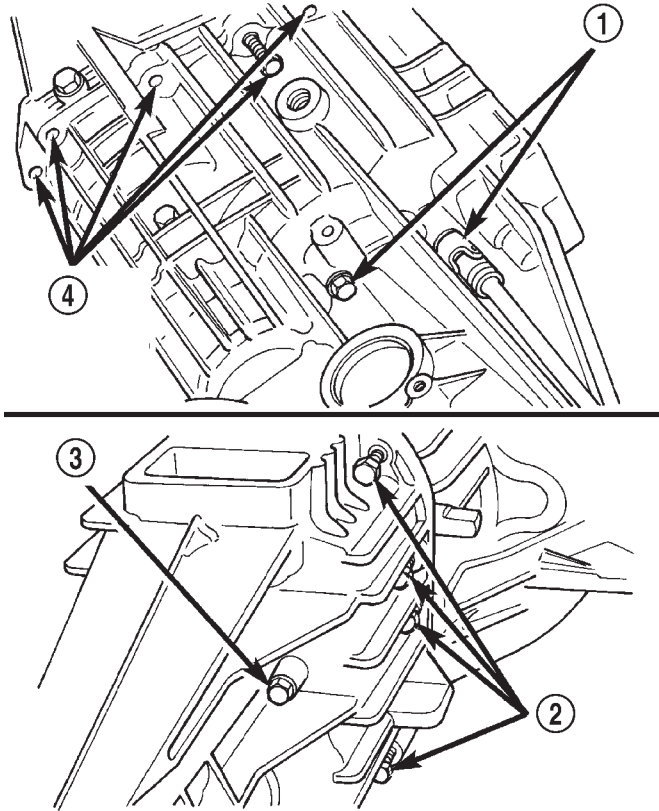
(1) Drive out roll pin that secures shift bushing and lever to shift shaft with a hammer and punch (Fig. 15).

(2) Position shift socket off to the side so roll pin removal does not interfere with gears.

(3) Drive out shift socket roll pin with a hammer and punch.

**NOTE: Use proper size punch to prevent damage to the shift shaft.**

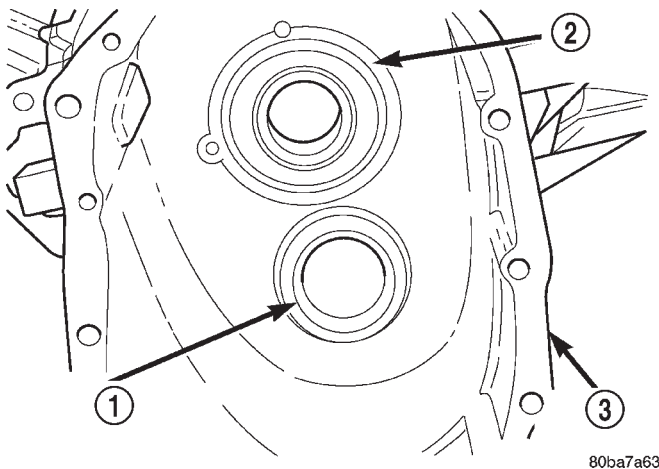
MANUAL - NV1500 (Continued)



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**Fig. 12 HOUSING AND BEARING RETAINER BOL**

- 1 - RETAINER BOLTS
- 2 - HOUSING BOLTS
- 3 - RETAINER BOLT
- 4 - HOUSING BOLT LOCATIONS

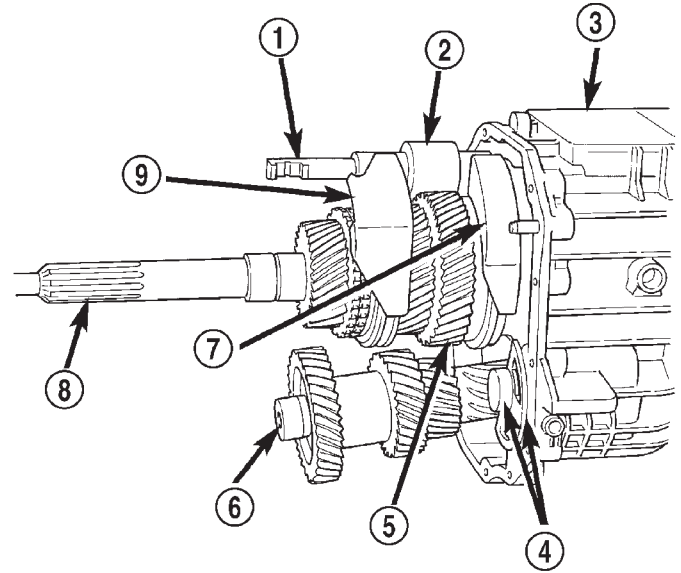


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**Fig. 13 INPUT SHAFT/COUNTERSHAFT BEARING**

- 1 - COUNTERSHAFT FRONT BEARING RACE
- 2 - INPUT SHAFT BEARING
- 3 - FRONT HOUSING

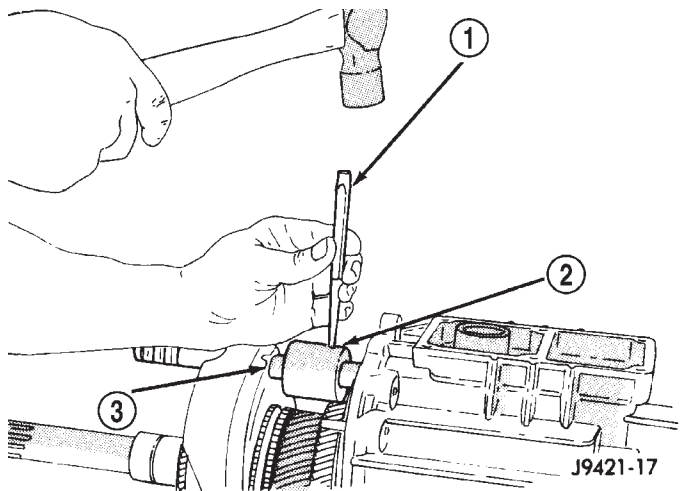
(4) Pull shift shaft straight out of rear housing and shift forks (Fig. 16).



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**Fig. 14 GEARTRAIN AND SHIFT COMPONENT**

- 1 - SHIFT SHAFT
- 2 - BUSHING
- 3 - REAR HOUSING
- 4 - REVERSE IDLER AND SUPPORT
- 5 - OUTPUT SHAFT AND GEARS
- 6 - COUNTERSHAFT
- 7 - 1-2 FORK
- 8 - INPUT SHAFT
- 9 - 3-4 FORK



J9421-17

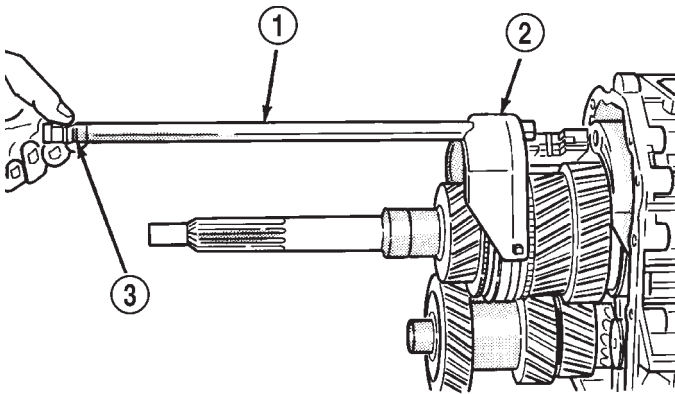
**Fig. 15 SHIFT SHAFT LEVER & BUSHING ROLL PIN**

- 1 - PIN PUNCH
- 2 - BUSHING AND LEVER
- 3 - SHIFT SHAFT

(5) Remove shift socket from rear housing (Fig. 17).

(6) Remove lever and bushing (Fig. 18).

MANUAL - NV1500 (Continued)

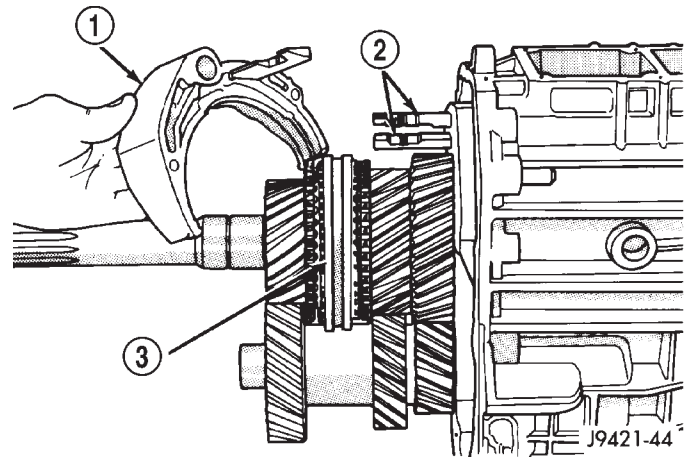


J9421-42

**Fig. 16 SHIFT SHAFT**

- 1 - SHIFT SHAFT
- 2 - 3-4 FORK
- 3 - SHAFT DETENT NOTCHES

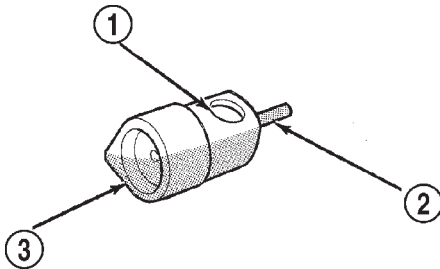
(7) Rotate 3-4 fork around synchro sleeve until fork clears shift arms on 1-2 and fifth-reverse forks, then remove 3-4 fork (Fig. 19).



J9421-44

**Fig. 19 3-4 SHIFT FORK**

- 1 - 3-4 FORK
- 2 - 1-2 AND 5TH-REVERSE FORK ARMS
- 3 - 3-4 SYNCHRO SLEEVE

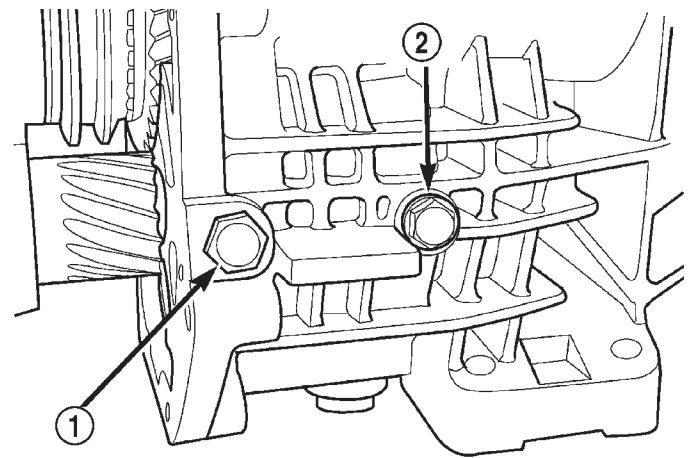


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**Fig. 17 SHIFT SOCKET AND ROLL PIN**

- 1 - SHAFT BORE
- 2 - ROLL PIN
- 3 - SHIFT SOCKET

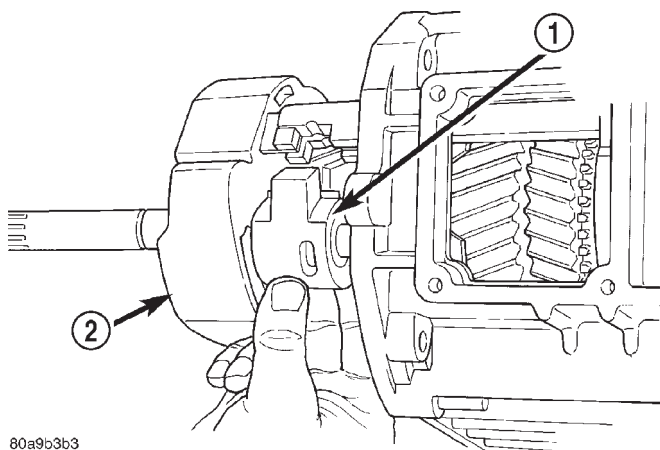
(8) Remove front reverse idler shaft support bolt and loosen rear bolt (Fig. 20).



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**Fig. 20 REVERSE IDLER SHAFT/SUPPORT BOLT**

- 1 - SUPPORT BOLT
- 2 - SHAFT BOLT



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**Fig. 18 SHIFT SHAFT LEVER AND BUSHING**

- 1 - SHAFT LEVER AND BUSHING
- 2 - 3-4 FORK

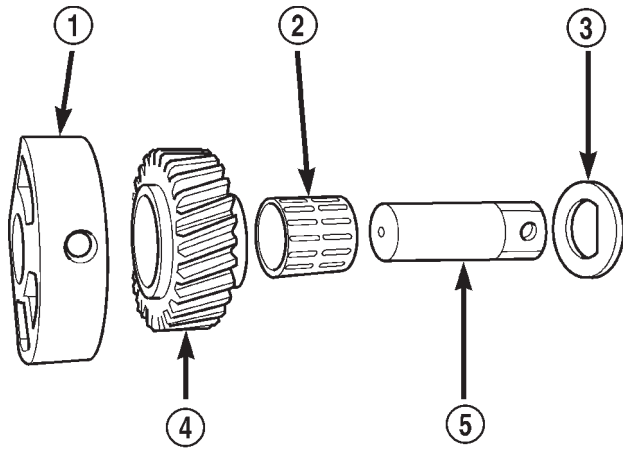
(9) Remove reverse idler shaft support by sliding it straight out of housing.

(10) Remove rear reverse idler shaft bolt.

(11) Remove reverse idler shaft, idler gear, bearing and thrust washer (Fig. 21).

**GEARTRAIN**

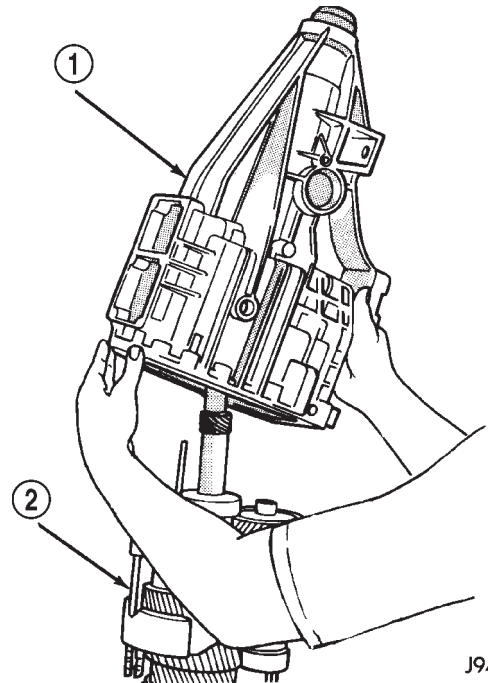
(1) Remove output shaft bearing retainer bolts (Fig. 22). Bolts are rear of shift tower opening.



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**Fig. 21 REVERSE IDLER ASSEMBLY**

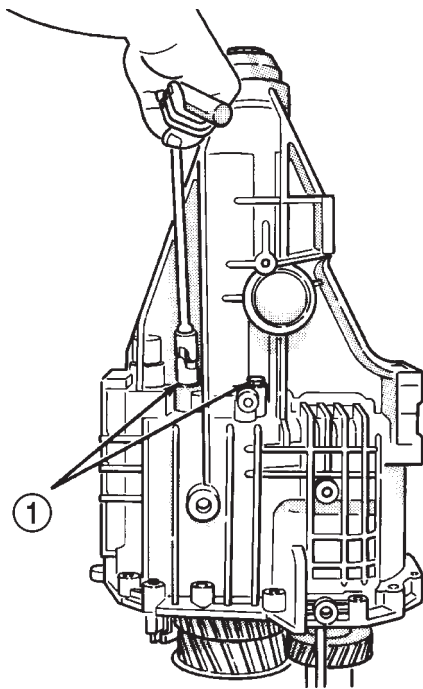
- 1 - SUPPORT
- 2 - BEARING
- 3 - WASHER
- 4 - GEAR
- 5 - SHAFT



J9421-51

**Fig. 23 REAR HOUSING**

- 1 - REAR HOUSING
- 2 - SHIFT FORKS AND GEARTRAIN



J9421-50

**Fig. 22 OUTPUT SHAFT BEARING RETAINER BOLTS**

- 1 - OUTPUT SHAFT BEARING RETAINER BOLTS (THIRD BOLT AT OPPOSITE SIDE OF CASE)

(2) Grab hold of mainshaft and countershaft and remove geartrain from rear housing (Fig. 23).

**GEARTRAIN**

- (1) Remove 1-2 and fifth-reverse forks from synchro sleeves.
- (2) Separate countershaft from mainshaft.
- (3) Separate input shaft from output shaft.

**COUNTERSHAFT**

- (1) Remove countershaft front and rear bearing with Puller 8356.
- (2) Remove rear bearing race (in rear housing) with Bearing Race Remover L-4454. Install new race with Driver C-4656 and Driver Handle C-4171.
- (3) Remove bearing shim cap from front housing (below input shaft bearing retainer). Remove shim. Drive race through and out of housing with Driver C-4656 and Driver Handle C-4171. Install new race into housing from outside. **Do not drive all the way into position. Tightening the shim cap will install the race to the proper position.** Install shim and shim cap and torque cap bolts to 28.5 N-m (21 ft. lbs.).

**OUTPUT SHAFT**

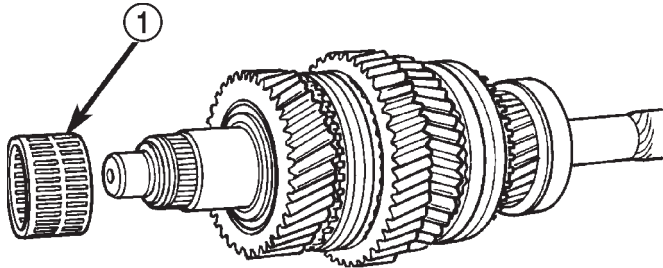
**NOTE:** Synchronizer hubs and sleeves are different. Remove synchronizer unit as an assembly to avoid intermixing parts. Mark each synchro hub and sleeve for assembly reference.

MANUAL - NV1500 (Continued)

(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 a shop press and Splitter 1130. Position splitter between second and third gears.

(3) Remove third gear needle bearing (Fig. 24).



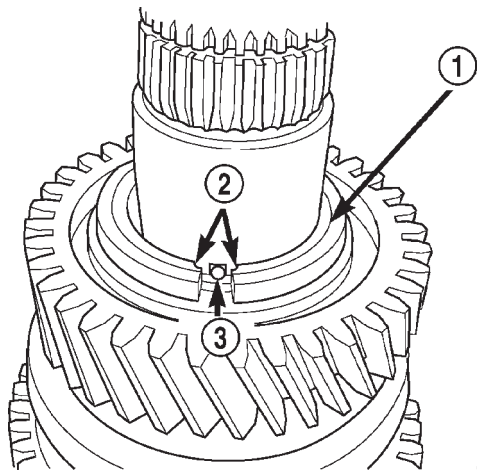
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**Fig. 24 THIRD GEAR NEEDLE BEARING**

- 1 - THIRD GEAR NEEDLE BEARING

(4) Remove retaining ring that secures two-piece thrust washer on shaft.

(5) Remove two-piece thrust washer (Fig. 25). Note position of washer locating lugs in shaft notches for installation reference.

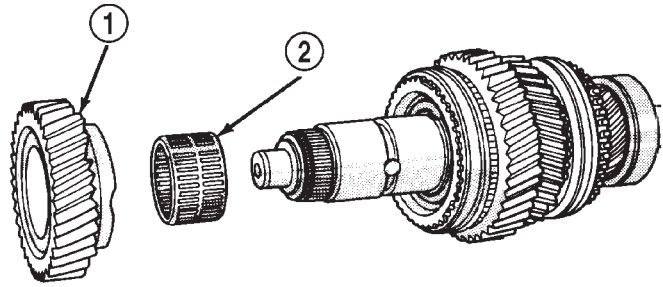


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**Fig. 25 TWO-PIECE THRUST WASH**

- 1 - WASHER (2 HALVES)
- 2 - PIN RELIEF
- 3 - PIN

(6) Remove second gear and needle bearing (Fig. 26).



J9421-25

**Fig. 26 SECOND GEAR AND NEEDLE BEARING**

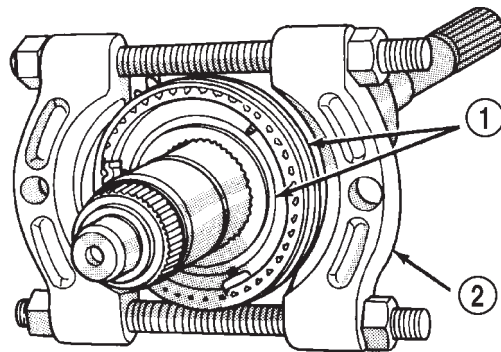
- 1 - SECOND GEAR
- 2 - SECOND GEAR NEEDLE BEARING

(7) Remove 2nd-3rd gear thrust washer locating pin.

(8) Remove second gear synchro ring and synchro cone.

(9) Remove 1-2 synchro hub snap ring.

(10) Remove 1-2 synchro hub and sleeve and first gear from output shaft with shop press and Splitter 1130 (Fig. 27). Position splitter between first and reverse gears.



J9421-27

**Fig. 27 1-2 SYNCHRO HUB AND SLEEVE**

- 1 - 1-2 SYNCHRO HUB AND SLEEVE
- 2 - BEARING SPLITTER

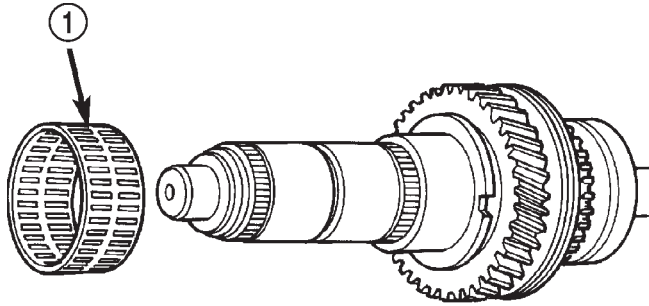
(11) Remove first gear needle bearing (Fig. 28).

(12) Remove output shaft bearing snap ring (Fig. 29).

(13) Remove output shaft bearing from shaft with shop press and Splitter 1130. Position splitter between bearing and fifth gear.

(14) Remove fifth gear (Fig. 30).

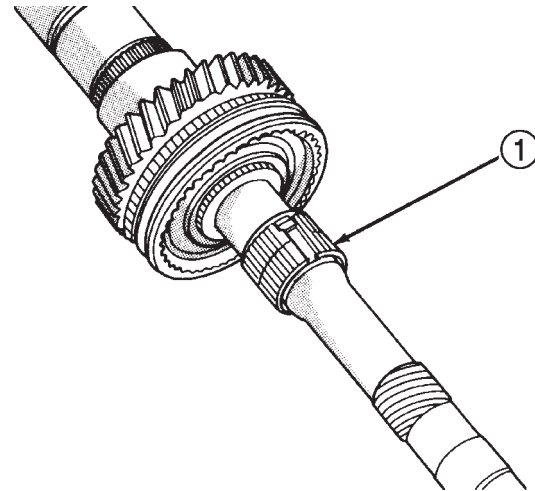




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**Fig. 28 FIRST GEAR NEEDLE BEARING**

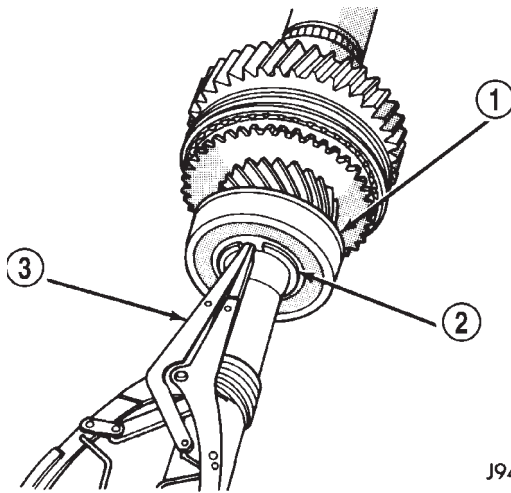
- 1 - FIRST GEAR NEEDLE BEARING



J9421-32

**Fig. 31 FIFTH GEAR NEEDLE BEARING**

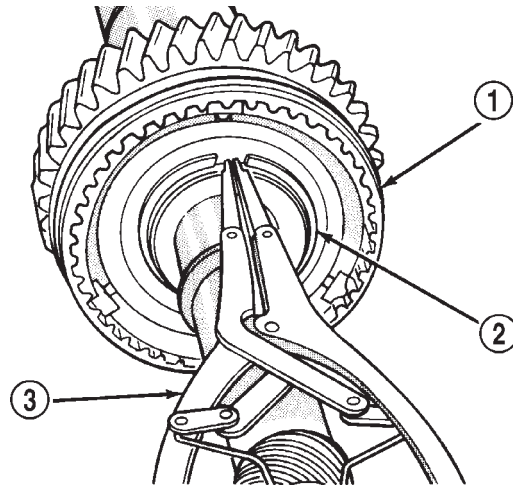
- 1 - FIFTH GEAR NEEDLE BEARING



J9421-29

**Fig. 29 OUTPUT SHAFT BEARING SNAP RING**

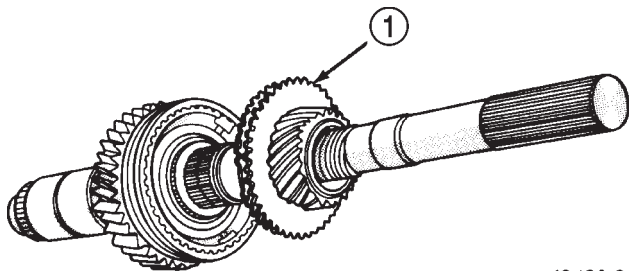
- 1 - OUTPUT SHAFT BEARING
- 2 - BEARING SNAP RING
- 3 - SNAP RING PLIERS



J9421-33

**Fig. 32 FIFTH REVERSE SYNCHRO HUB SNAP RING**

- 1 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
- 2 - SYNCHRO HUB SNAP RING
- 3 - SNAP RING PLIERS



J9421-31

**Fig. 30 FIFTH GEAR**

- 1 - FIFTH GEAR AND SYNCHRO RING

(15) Remove fifth gear needle bearing. Spread bearing apart just enough to clear shoulder on output shaft (Fig. 31).

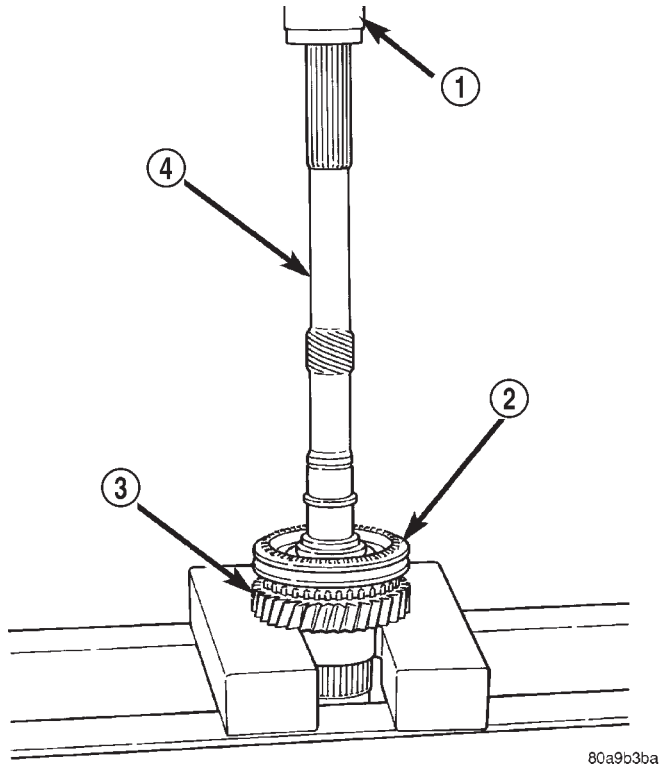
(16) Remove fifth-reverse synchro hub snap ring (Fig. 32).

(17) Remove fifth-reverse synchro hub and sleeve with shop press (Fig. 33).

(18) Remove reverse gear and needle bearing (Fig. 34).

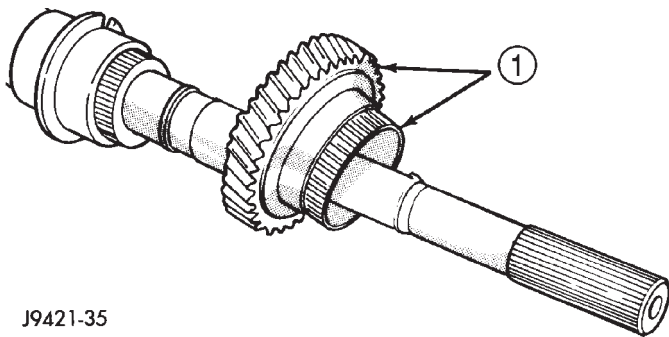
**CLEANING**

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.



**Fig. 33 FIFTH-REVERSE SYNCHRO HUB AND SLEEVE**

- 1 - PRESS
- 2 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
- 3 - REVERSE GEAR
- 4 - OUTPUT SHAFT



**Fig. 34 REVERSE GEAR AND NEEDLE BEARING**

- 1 - REVERSE GEAR AND NEEDLE BEARING

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.

## INSPECTION

**NOTE:** Minor nicks on the surface can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth.

## 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. 35). 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. 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. 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 roll pin that secures the lever to the shaft.

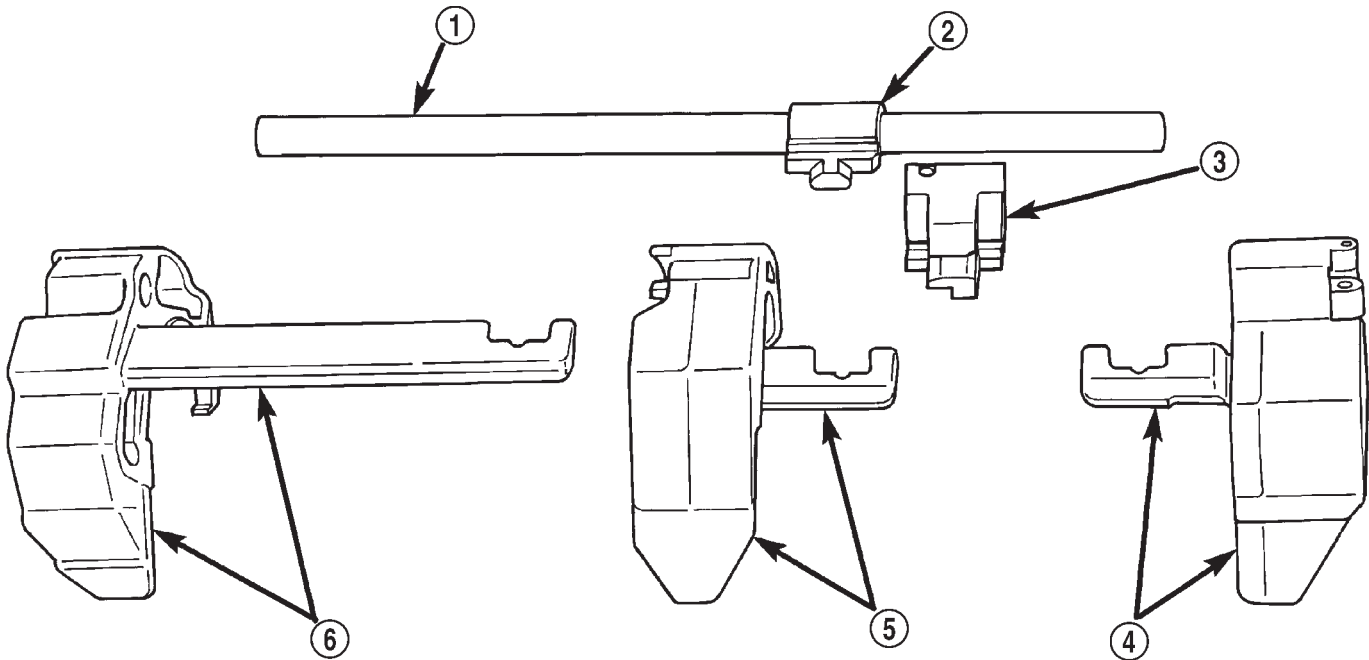
## FRONT/REAR HOUSINGS AND BEARING RETAINERS

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.

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.

Inspect the housings carefully for cracks, stripped threads, scored mating surfaces, damaged bearing bores or worn dowel pin holes.

**NOTE:** The front housing contains the countershaft front bearing race. The rear housing contains the countershaft rear bearing race. If a countershaft bearing failure results, the bearing races must be replaced also.



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**Fig. 35 SHIFT FORKS AND SHAFT**

- 1 - SHIFT SHAFT
- 2 - SHAFT LEVER
- 3 - SHAFT LEVER BUSHING

- 4 - 3-4 SHIFT FORK
- 5 - 1-2 SHIFT FORK
- 6 - FIFTH-REVERSE SHIFT FORK

Inspect input shaft bearing retainer. Be sure the release bearing slide surface of the retainer is in good condition. Replace the retainer seal if necessary.

Inspect 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.

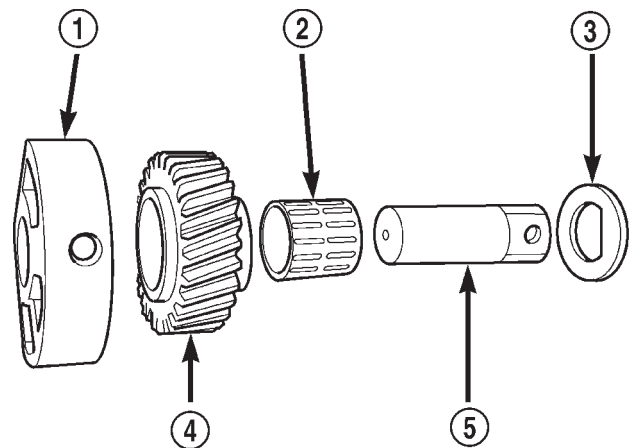
**COUNTERSHAFT BEARINGS AND RACES**

The countershaft bearings are standard tapered roller bearings with matching races. The races are pressed into the front and rear housings. Inspect countershaft bearings and races for abnormal wear or damage.

**REVERSE IDLER COMPONENTS**

Inspect idler gear, bearing, shaft, thrust washer and support for excessive wear or failure (Fig. 36). Replace 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 thrust washer, if cracked, chipped or worn. Replace idler gear if the teeth are chipped, cracked or worn thin. Replace shaft if worn, scored or the bolt threads are damaged beyond repair. Replace support segment if cracked or chipped and replace the idler attaching bolts if the threads are damaged.



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**Fig. 36 REVERSE IDLER ASSEMBLY**

- 1 - SUPPORT
- 2 - BEARING
- 3 - WASHER
- 4 - GEAR
- 5 - SHAFT

MANUAL - NV1500 (Continued)

**Shift Socket**

Inspect shift socket for wear or damage. Replace socket if the roll pin or shift shaft bores are damaged. Replace socket if the ball seat is worn, or cracked. Do not reuse the original shift socket roll pin. The socket roll pin is approximately 33 mm (1-1/4 in.) long.

**Output Shaft And Geartrain**

Inspect all gears for worn, cracked, chipped or broken teeth. 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.

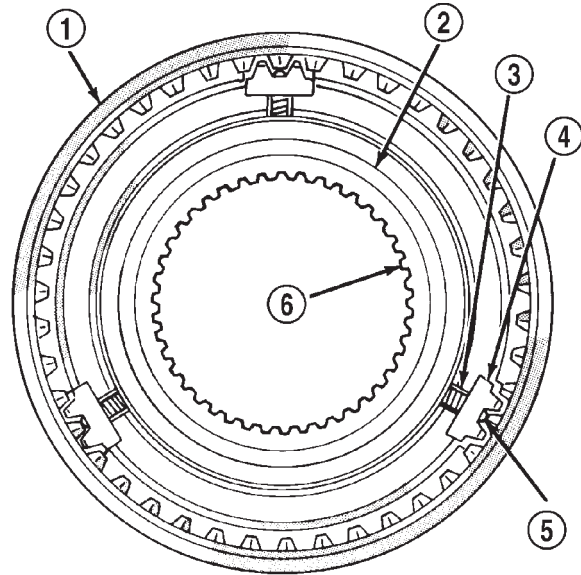
Inspect shaft splines and bearings surfaces. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn or brinnelled.

**ASSEMBLY**

**SYNCHRONIZER**

**NOTE: The easiest method of assembling each synchro is to install the springs, struts and detent balls one at a time.**

- (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 first spring in the hub and then install a strut over the spring. Verify 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 detent ball in the top of the strut. Then work the sleeve over the ball to hold it in place. Use a small flat blade screwdriver to press the ball into place while moving the sleeve over it.
- (5) Repeat procedure for the remaining springs, struts and balls. Tape or rubber band each strut and ball temporarily as they are installed.
- (6) Verify the three springs, struts and detent balls are all in place (Fig. 37).



J9421-57

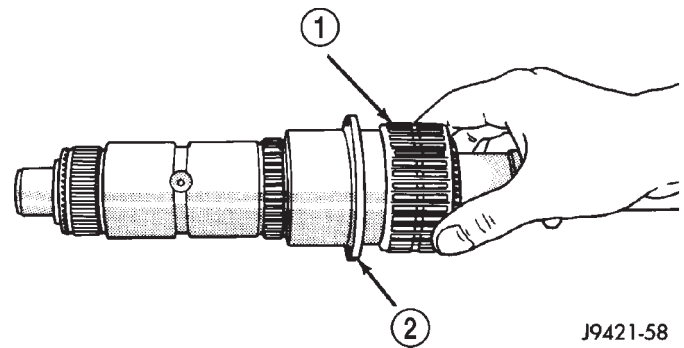
**Fig. 37 ASSEMBLED SYNCHRO COMPONENTS**

- 1 - SLEEVE
- 2 - HUB SHOULDER
- 3 - SPRING (3)
- 4 - STRUT (3)
- 5 - DETENT BALL (3)
- 6 - HUB

**OUTPUT SHAFT**

**NOTE: Lubricate shaft, gears and bearings with recommended lubricant and immerse each synchro ring in lubricant before installation. Petroleum jelly can be used to hold parts in place.**

- (1) Install reverse gear needle bearing on shaft (Fig. 38). Slide bearing up against shoulder on output shaft.



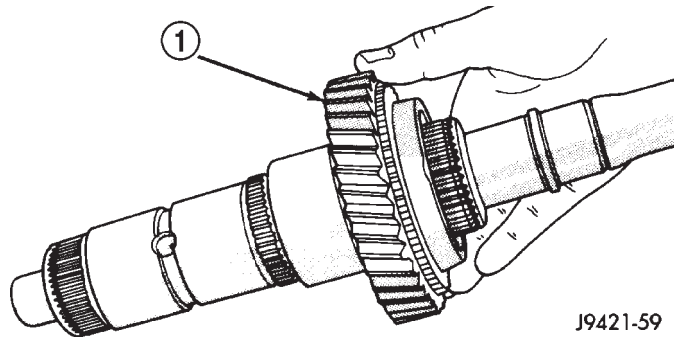
J9421-58

**Fig. 38 REVERSE GEAR BEARING**

- 1 - REVERSE GEAR BEARING
- 2 - SHOULDER

MANUAL - NV1500 (Continued)

(2) Install reverse gear over needle bearing (Fig. 39).



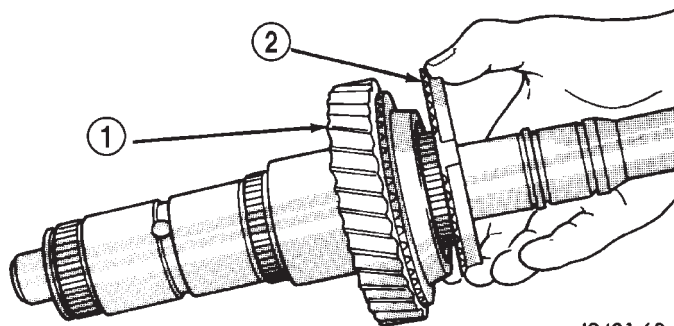
J9421-59

**Fig. 39 REVERSE GEAR**

- 1 - REVERSE GEAR

(3) Install solid brass synchro ring on reverse gear (Fig. 40).

**NOTE:** This synchro ring is different than all the rest. The angle on the friction face is 9° versus the 6.5° of all the other synchro rings.



J9421-60

**Fig. 40 REVERSE GEAR SYNCHRO RING**

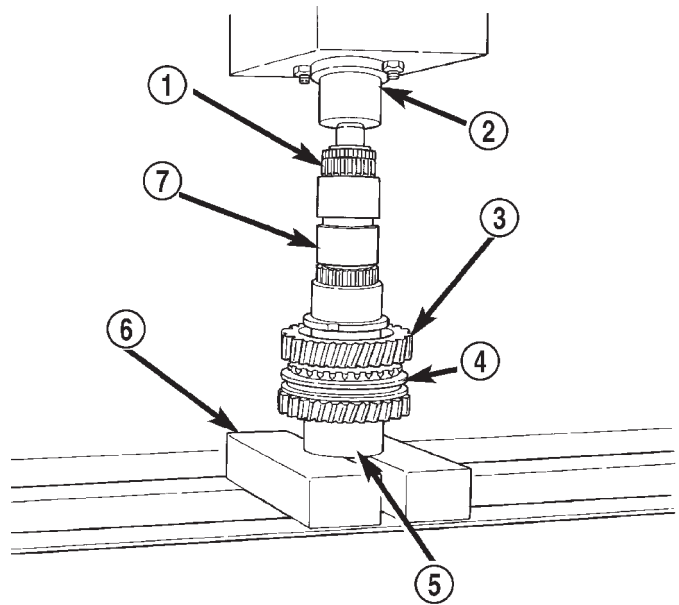
- 1 - REVERSE GEAR
- 2 - SYNCHRO RING (SOLID BRASS)

(4) Start fifth-reverse synchro assembly on output shaft splines by hand. Then seat synchro onto shaft with shop press and Cup 6310-1 (Fig. 41).

**CAUTION:** Fifth-reverse synchro hub and sleeve can be installed backwards. One side of the sleeve has double grooves and offset teeth. This side must be installed away from reverse gear (towards 5th).

**NOTE:** The synchro hub is a press fit design. There may be instances where the press is not necessary. As long as there is a snug fit between the hub and the shaft, the hub does not need to be replaced.

(5) Install **new** fifth-reverse hub snap ring (Fig. 42) and verify snap ring is seated in the shaft groove.

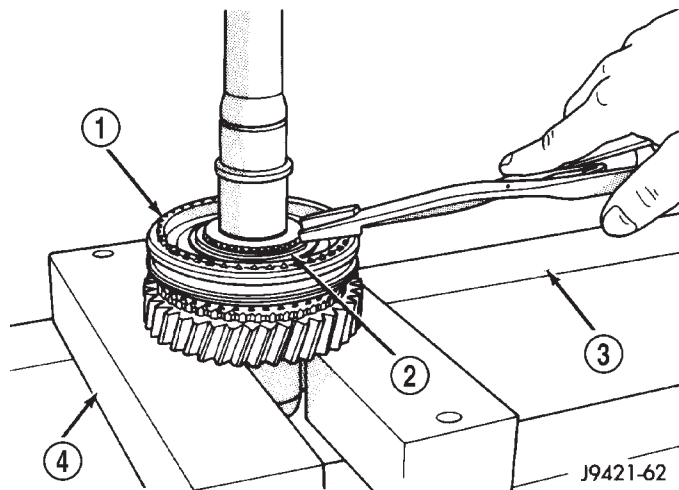


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**Fig. 41 FIFTH-REVERSE SYNCHRO ASSEMBLY**

- 1 - SPACER
- 2 - PRESS RAM
- 3 - REVERSE GEAR
- 4 - FIFTH-REVERSE SYNCHRO ASSEMBLY
- 5 - CUP
- 6 - PRESS BLOCKS
- 7 - OUTPUT SHAFT

**NOTE:** Install thickest snap ring that will fit in shaft groove.



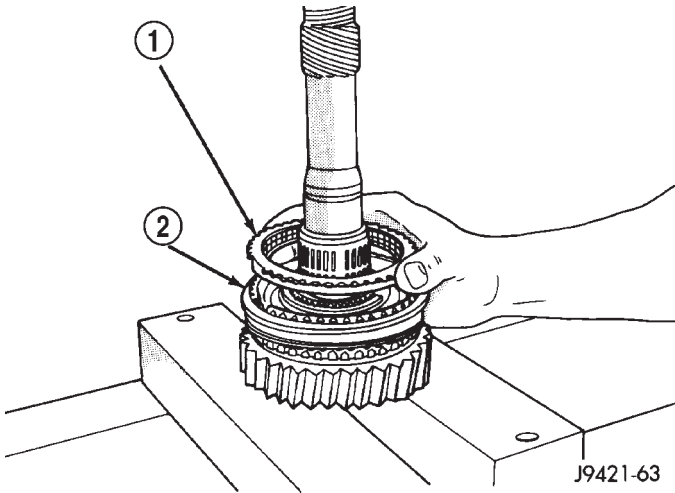
J9421-62

**Fig. 42 FIFTH-REVERSE SYNCHRO HUB SNAP RING**

- 1 - FIFTH-REVERSE SYNCHRO ASSEMBLY
- 2 - SNAP RING
- 3 - PRESS BED
- 4 - PRESS BLOCKS

MANUAL - NV1500 (Continued)

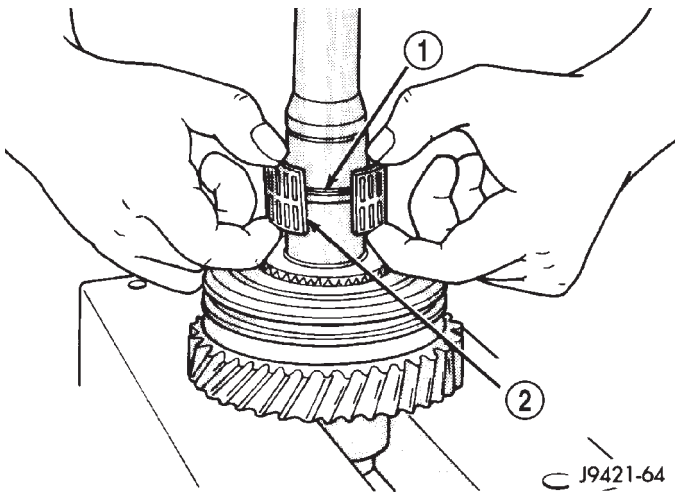
(6) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 43).



**Fig. 43 FIFTH GEAR SYNCHRO RING**

- 1 - FIFTH-SPEED SYNCHRO RING
- 2 - FIFTH-REVERSE SYNCHRO ASSEMBLY

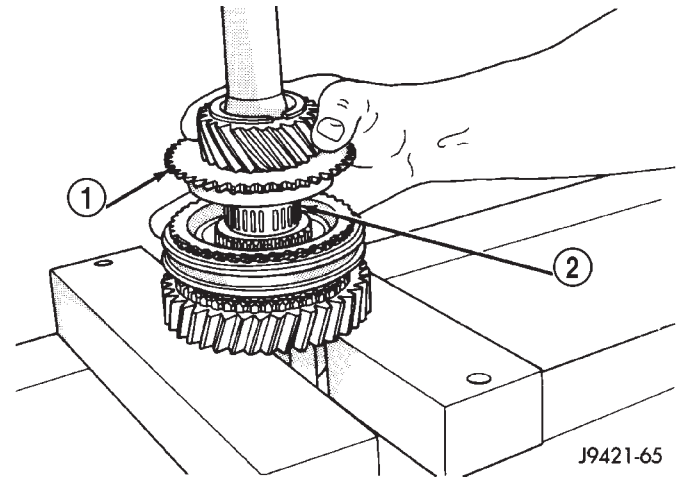
(7) Install fifth gear bearing, spreading bearing only enough to clear shoulder on output shaft (Fig. 44). Verify bearing is seated.



**Fig. 44 FIFTH GEAR BEARING**

- 1 - SHAFT SHOULDER
- 2 - FIFTH GEAR BEARING

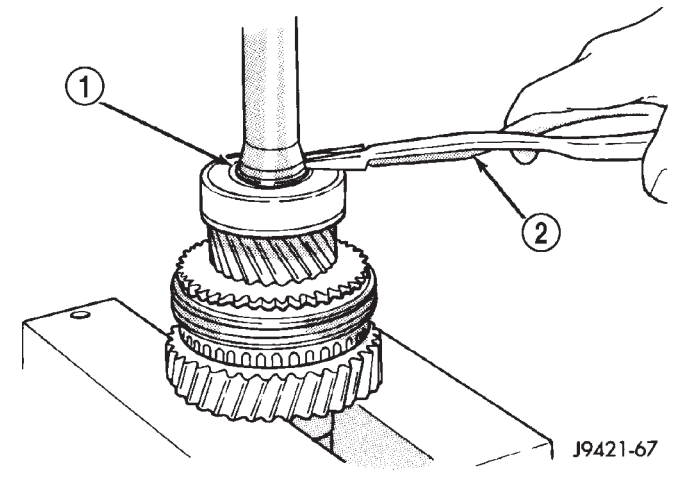
(8) Install fifth gear on shaft and onto bearing (Fig. 45).



**Fig. 45 FIFTH GEAR**

- 1 - FIFTH GEAR
- 2 - BEARING

(9) Install output shaft bearing.  
 (10) Install output shaft bearing snap ring, spread snap ring only enough to install it (Fig. 46). Verify snap ring is seated in shaft groove.



**Fig. 46 OUTPUT SHAFT BEARING**

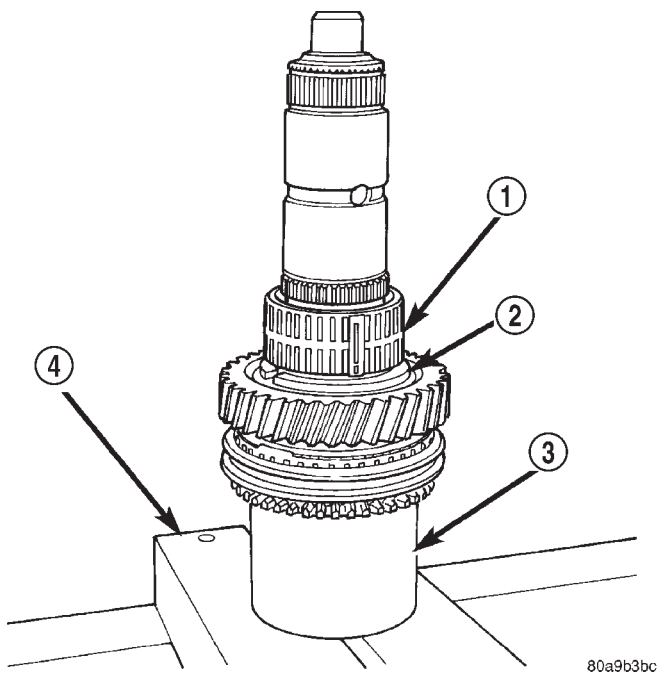
- 1 - BEARING SNAP RING
- 2 - HEAVY DUTY SNAP RING PLIERS

MANUAL - NV1500 (Continued)

(11) Invert output shaft and set the shaft in Cup 6310-1 so that fifth gear is seated on the tool (Fig. 47).

(12) Install first gear bearing on output shaft (Fig. 47). Verify bearing is seated on shaft shoulder and is properly joined.

(13) Install synchro cone onto first gear. Verify synchro cone locating tabs are properly located to the recesses in first gear.



**Fig. 47 FIRST GEAR BEARING**

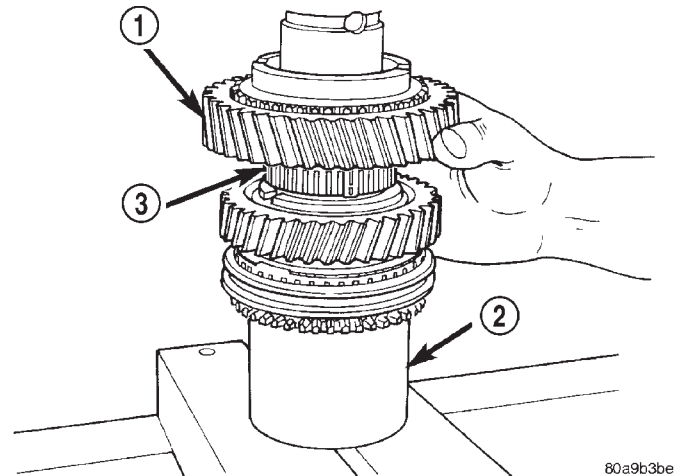
- 1 - FIRST GEAR BEARING
- 2 - SHAFT SHOULDER
- 3 - CUP
- 4 - PRESS BLOCKS

(14) Install first gear on shaft and over bearing with bearing synchro cone facing up (Fig. 48).

(15) Install first gear synchro ring (Fig. 49).

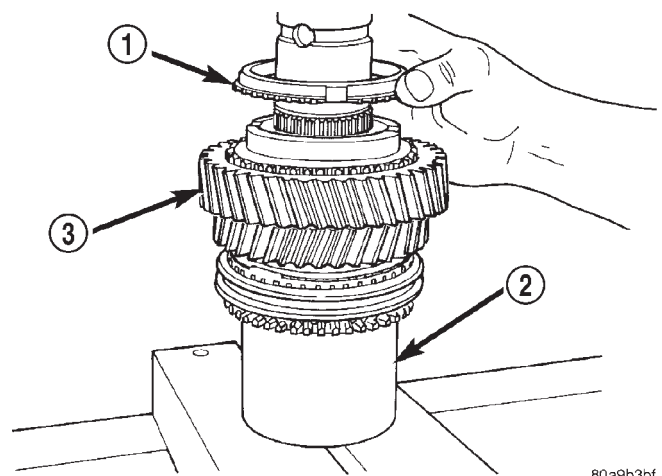
(16) Start 1-2 synchro assembly on shaft by hand (Fig. 50). Be sure synchro sleeve is properly positioned.

**CAUTION:** The 1-2 synchro hub and sleeve can be installed backwards. One side of the sleeve has a groove and offset teeth. This side must be installed towards 1st gear (away from 2nd gear).



**Fig. 48 FIRST GEAR**

- 1 - FIRST GEAR
- 2 - CUP
- 3 - BEARING



**Fig. 49 FIRST GEAR SYNCHRO RING**

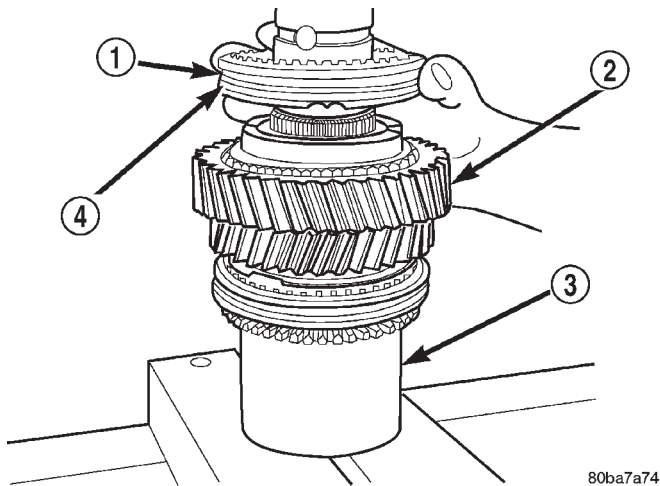
- 1 - FIRST GEAR SYNCHRO RING
- 2 - CUP
- 3 - FIRST GEAR

**NOTE:** The synchro hub is a press fit design. There may be instances where the press is not necessary. As long as there is a snug fit between the hub and the shaft, the hub does not need to be replaced.

(17) Press 1-2 synchro onto output shaft with suitable size pipe and shop press (Fig. 51).

**CAUTION:** Align synchro ring and sleeve as hub is being pressed onto the shaft. The synchro ring can be cracked if it becomes misaligned.

MANUAL - NV1500 (Continued)

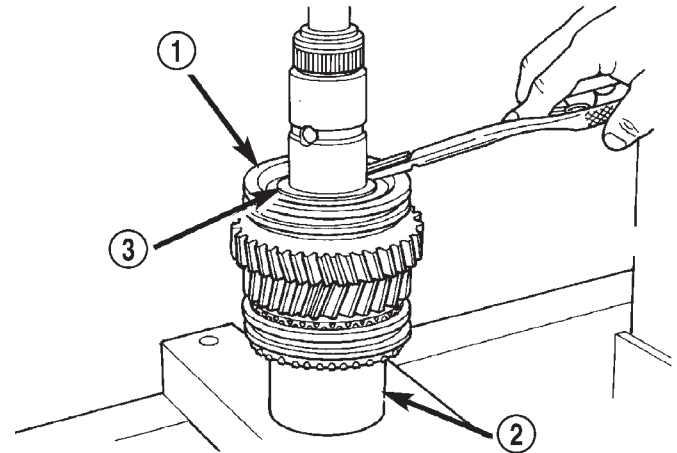


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**Fig. 50 START 1-2 SYNCHRO ON SHAFT**

- 1 - 1-2 SYNCHRO ASSEMBLY
- 2 - FIRST GEAR
- 3 - CUP
- 4 - SINGLE GROOVE SIDE OF SYNCHRO SLEEVE

(18) Install **new** 1-2 synchro hub snap ring (Fig. 52) with the thickest snap ring that will fit in shaft groove. Verify snap ring is seated in shaft groove.



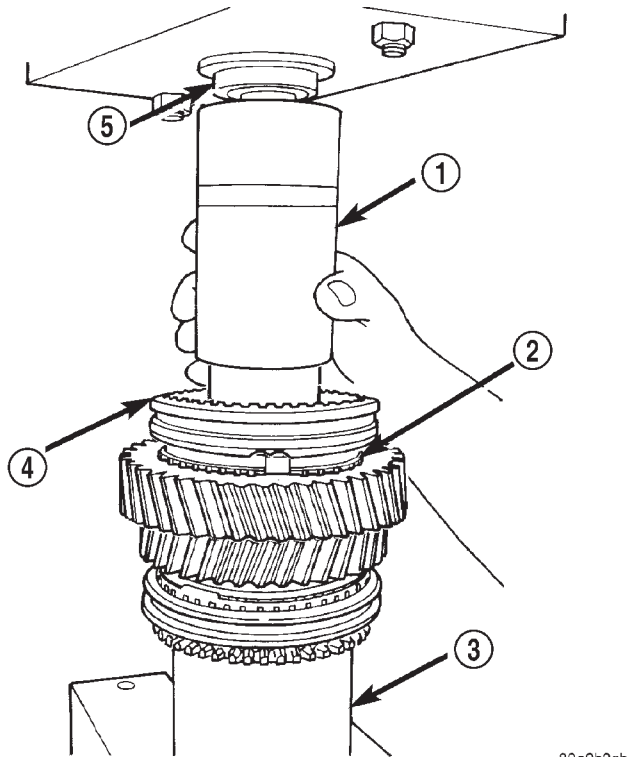
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**Fig. 52 1-2 SYNCHRO HUB SNAP RING**

- 1 - 1-2 SYNCHRO
- 2 - CUP
- 3 - SYNCHRO SNAP RING

(19) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 53). Verify synchro ring is seated in sleeve.

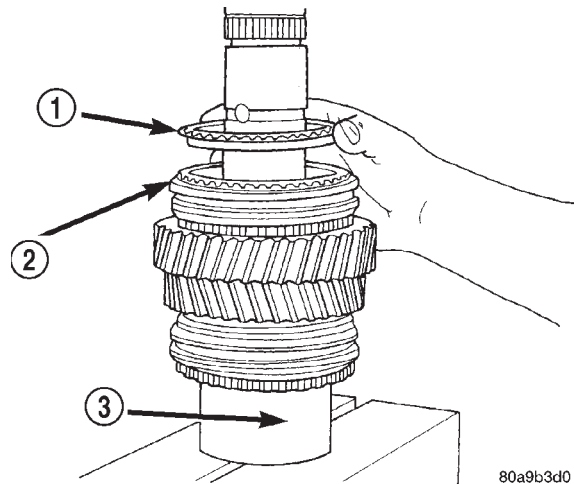
(20) Install synchro cone into synchro ring.



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**Fig. 51 PRESS 1-2 SYNCHRO ASSEMBLY**

- 1 - SUITABLE SIZE PIPE TOOL
- 2 - SYNCHRO RING
- 3 - CUP
- 4 - 1-2 SYNCHRO ASSEMBLY
- 5 - PRESS RAM



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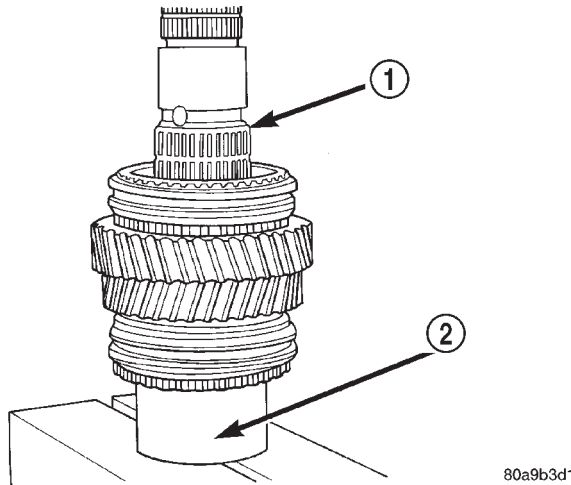
**Fig. 53 SECOND GEAR SYNCHRO RING**

- 1 - SECOND GEAR SYNCHRO RING
- 2 - 1-2 SYNCHRO
- 3 - CUP



MANUAL - NV1500 (Continued)

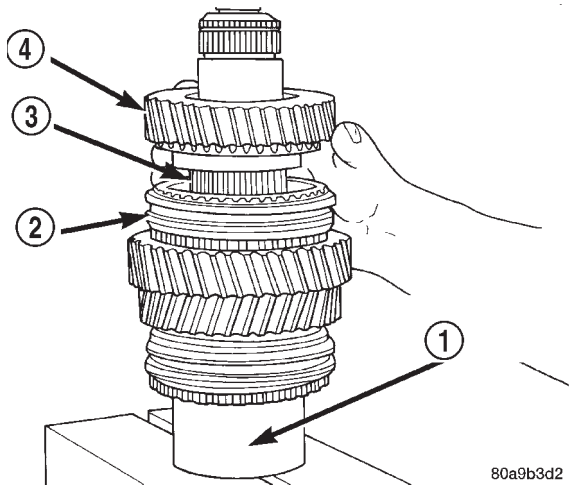
(21) Install second gear needle bearing on shaft (Fig. 54).



**Fig. 54 SECOND GEAR BEARING**

- 1 - SECOND GEAR BEARING
- 2 - CUP

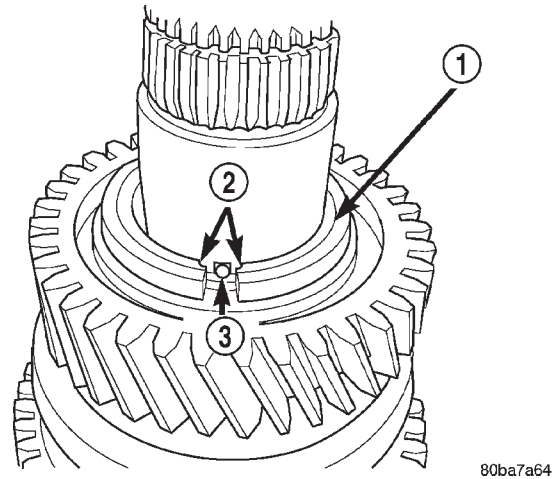
(22) Install second gear onto shaft and bearing (Fig. 55). Verify second gear is seated on synchro components.



**Fig. 55 SECOND GEAR**

- 1 - CUP
- 2 - 1-2 SYNCHRO ASSEMBLY
- 3 - BEARING
- 4 - SECOND GEAR

(23) Install thrust washer pin to shaft and install two-piece thrust washer (Fig. 56). Verify washer halves are seated in shaft groove and pin reliefs are positioned at washer locating pin.

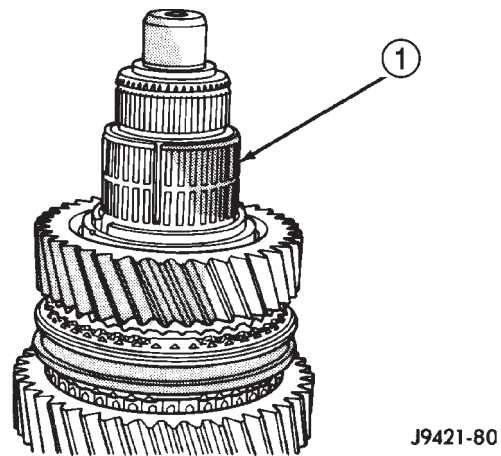


**Fig. 56 TWO-PIECE THRUST WASH**

- 1 - WASHER (2 HALVES)
- 2 - PIN RELIEF
- 3 - PIN

(24) Seat retaining ring around two-piece thrust washer.

(25) Install third gear needle bearing on shaft (Fig. 57).

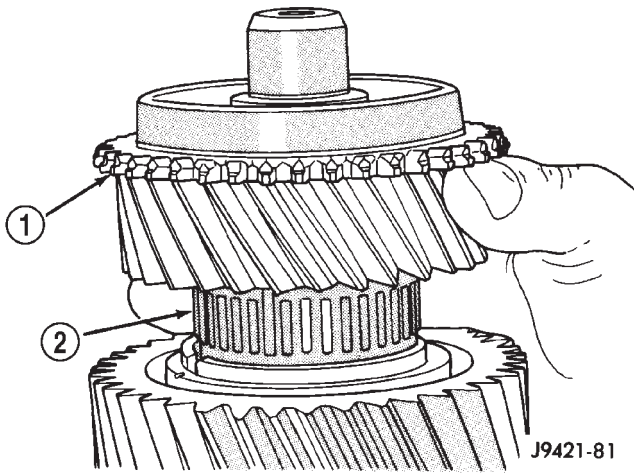


**Fig. 57 THIRD GEAR BEARING**

- 1 - THIRD GEAR BEARING

MANUAL - NV1500 (Continued)

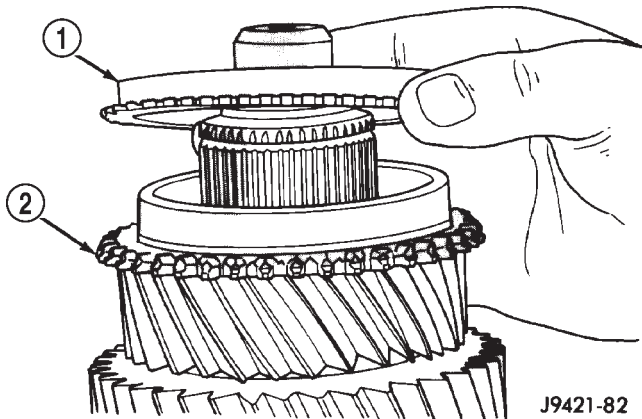
(26) Install third gear on shaft and bearing (Fig. 58).



**Fig. 58 THIRD GEAR**

- 1 - THIRD GEAR
- 2 - BEARING

(27) Install third speed synchro ring on third gear (Fig. 59).



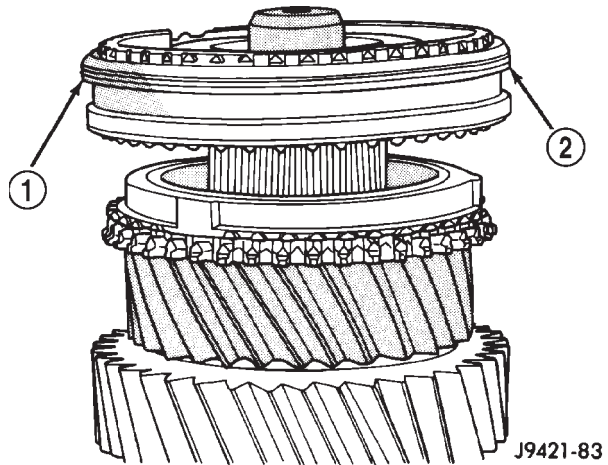
**Fig. 59 THIRD SPEED SYNCHRO RING**

- 1 - THIRD SPEED SYNCHRO RING
- 2 - THIRD GEAR

(28) Start 3-4 synchro hub on output shaft splines by hand (Fig. 60).

**CAUTION:** The 3-4 synchro hub and sleeve can be installed backwards. One side of the sleeve has two grooves and offset teeth. This side must be installed towards 3rd gear (away from 4th gear).

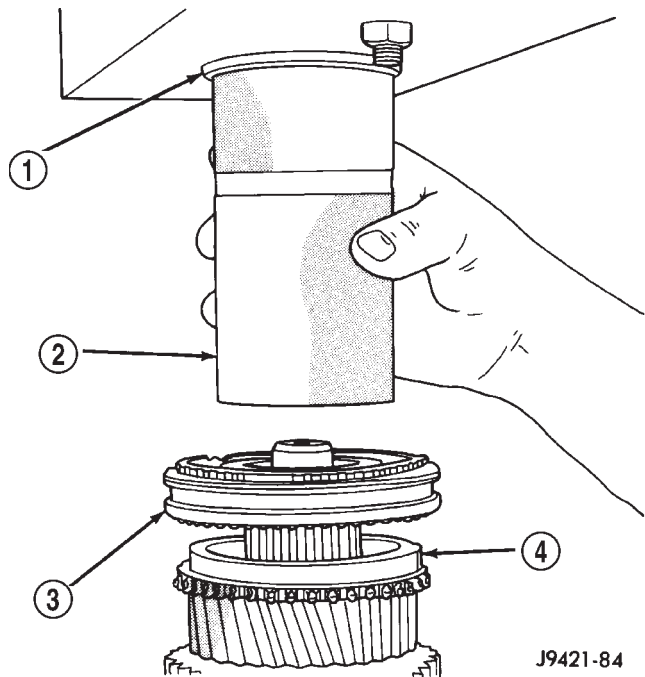
**NOTE:** The synchro hub is a press fit design. There may be instances where the press is not necessary. As long as there is a snug fit between the hub and the shaft, the hub does not need to be replaced.



**Fig. 60 START 3-4 SYNCHRO HUB ON OUTPUT SHAFT**

- 1 - GROOVED SIDE OF SLEEVE (TO FRONT)
- 2 - 3-4 SYNCHRO ASSEMBLY

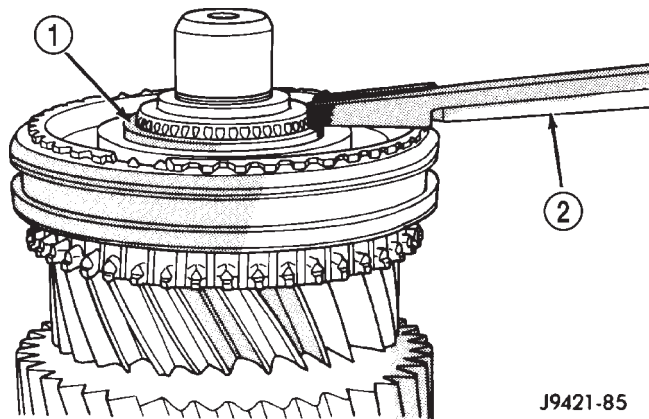
(29) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 61). Press tool must be as close to the hub center as possible but not contacting the shaft splines.



**Fig. 61 3-4 SYNCHRO ASSEMBLY ON SHAFT**

- 1 - PRESS RAM
- 2 - PIPE TOOL
- 3 - 3-4 SYNCHRO
- 4 - THIRD SPEED SYNCHRO RING

(30) Install 3-4 synchro hub new snap ring (Fig. 62) with thickest snap ring that will fit in shaft groove. Verify snap ring is seated in groove.

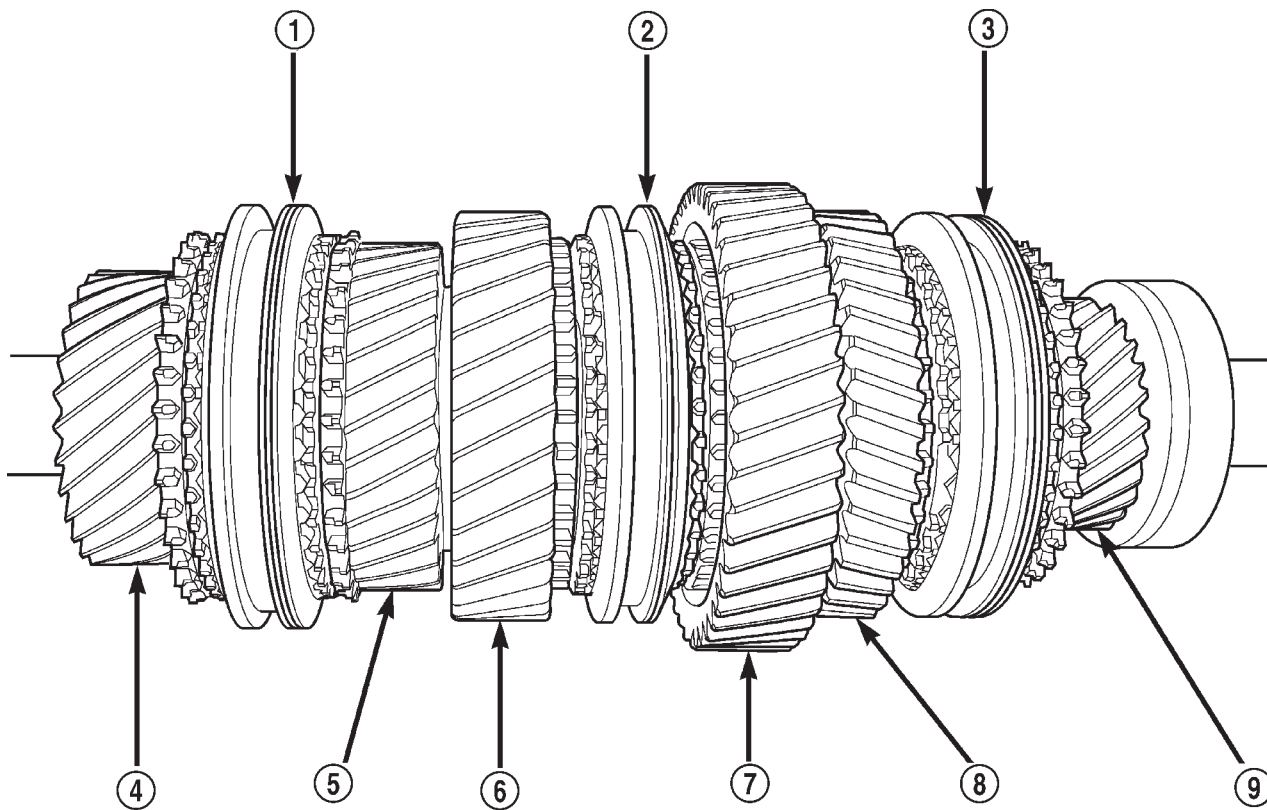


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**Fig. 62 3-4 SYNCHRO HUB SNAP RING**

- 1 - 3-4 SYNCHRO HUB SNAP RING
- 2 - HEAVY DUTY SNAP RING PLIERS

(31) Verify position of synchro sleeves before proceeding (Fig. 63).



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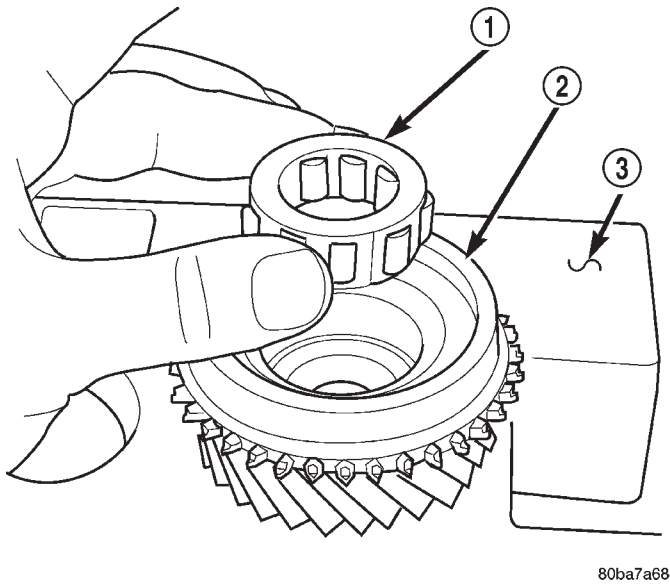
**Fig. 63 SYNCHRO SLEEVE POSITION**

- 1 - 2 GROOVES
- 2 - 1 GROOVE
- 3 - 2 GROOVES
- 4 - FOURTH GEAR
- 5 - THIRD GEAR
- 6 - SECOND GEAR
- 7 - FIRST GEAR
- 8 - REVERSE GEAR
- 9 - FIFTH GEAR

MANUAL - NV1500 (Continued)

**GEARTRAIN**

- (1) Install input shaft into Support Stand 8355 (Fig. 64).
- (2) Install pilot bearing in input shaft (Fig. 64).

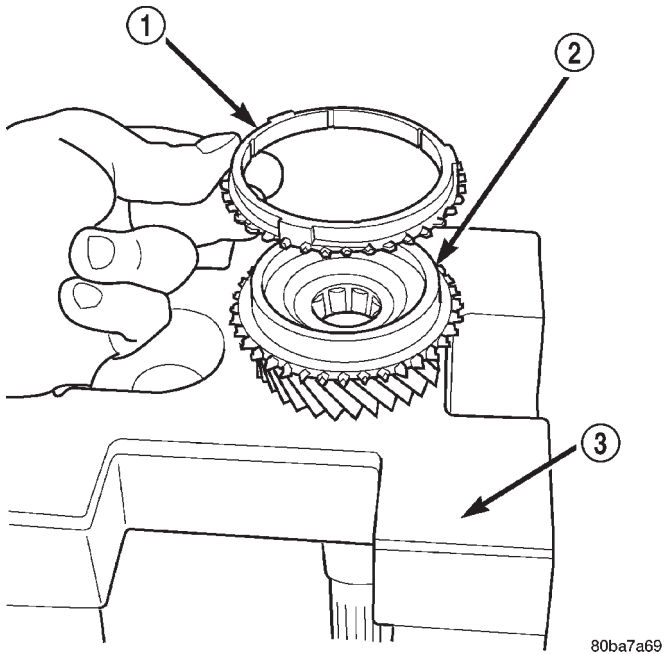


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**Fig. 64 INPUT SHAFT AND PILOT BEARING**

- 1 - PILOT BEARING
- 2 - INPUT SHAFT
- 3 - STAND

- (3) Install fourth gear synchro ring on input shaft (Fig. 65).

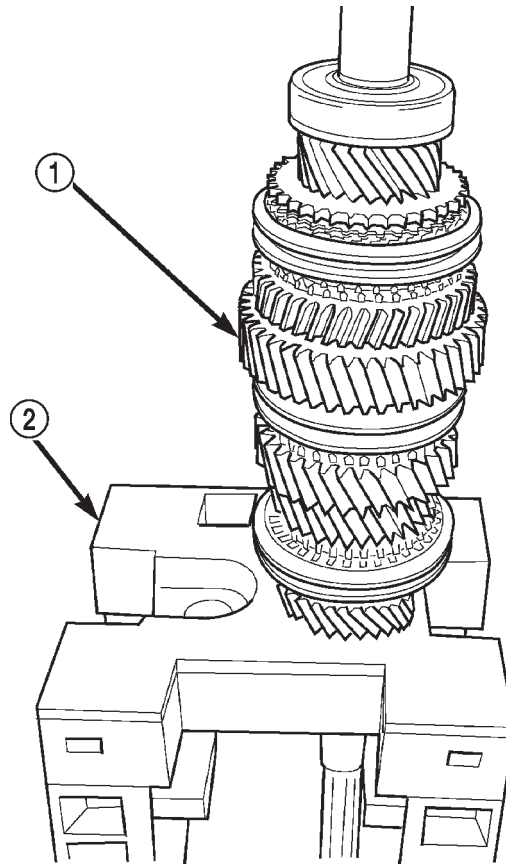


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**Fig. 65 FOURTH GEAR SYNCHRO RING ON INPUT SHAFT**

- 1 - FOURTH GEAR SYNCHRO RING
- 2 - INPUT SHAFT
- 3 - STAND

- (4) Install assembled output shaft and geartrain in input shaft (Fig. 66). Rotate output shaft until the 3-4 synchro ring seats in synchro hub and sleeve.



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**Fig. 66 MAINSHAFT ON SUPPORT STAND**

- 1 - MAIN SHAFT
- 2 - SUPPORT STAND

- (5) Slide countershaft into fixture slot. Verify countershaft and output shaft gears are fully meshed with the mainshaft gears (Fig. 67).

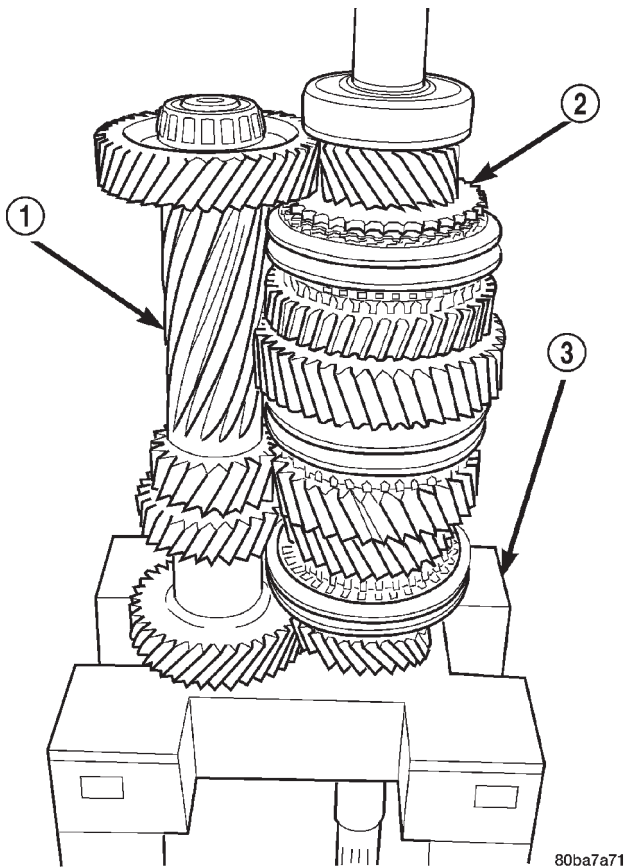
- (6) Thread one Pilot Stud 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear.

- (7) Assemble 1-2 and fifth reverse-shift forks (Fig. 68). Arm of fifth-reverse fork goes through slot in 1-2 fork.

- (8) Install assembled shift forks in synchro sleeves (Fig. 69). Verify forks are seated in sleeves.

**REAR HOUSING**

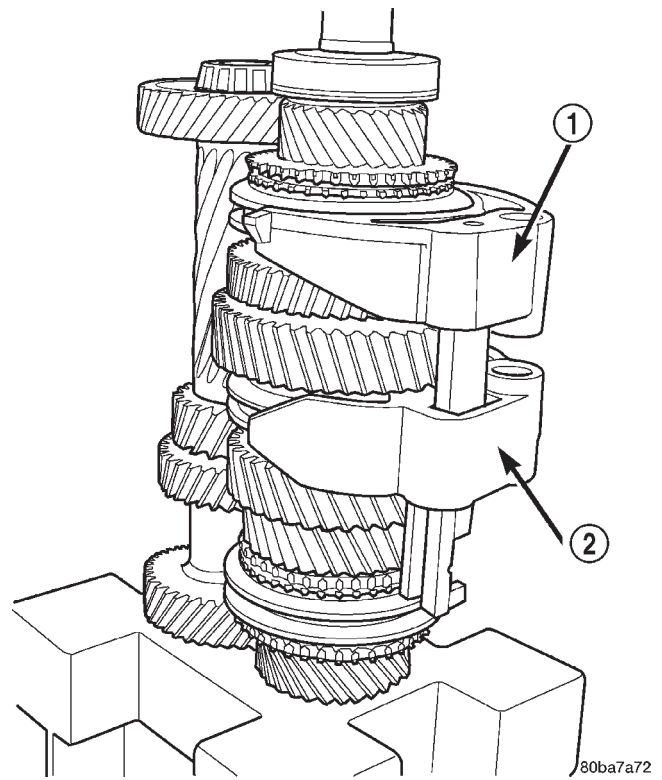
- (1) Lubricate countershaft rear bearing race.
- (2) Install rear housing onto geartrain (Fig. 70). Verify bearing retainer pilot stud is in correct bolt hole and countershaft and output shaft bearings are aligned in housing and on countershaft.
- (3) Seat rear housing on output shaft rear bearing and countershaft. Tap housing into place with plastic or rawhide hammer.



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**Fig. 67 COUNTERSHAFT ON SUPPORT STAND**

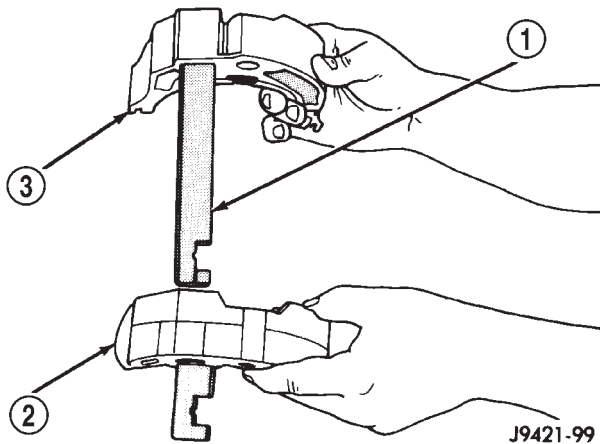
- 1 - COUNTER SHAFT
- 2 - MAIN SHAFT
- 3 - SUPPORT STAND



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**Fig. 69 SHIFT FORKS AND SYNCHROS**

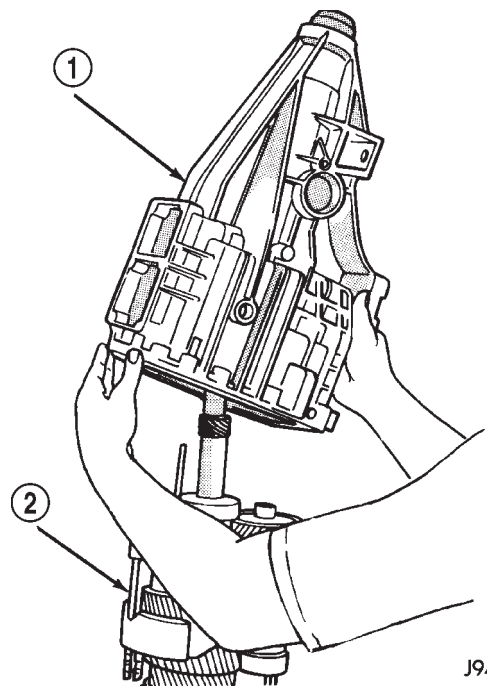
- 1 - FIFTH REVERSE SHIFT FORK
- 2 - 1-2 SHIFT FORK



J9421-99

**Fig. 68 1-2 AND FIFTH-REVERSE SHIFT FORKS**

- 1 - FIFTH-REVERSE FORK ARM
- 2 - 1-2 FORK
- 3 - FIFTH-REVERSE FORK



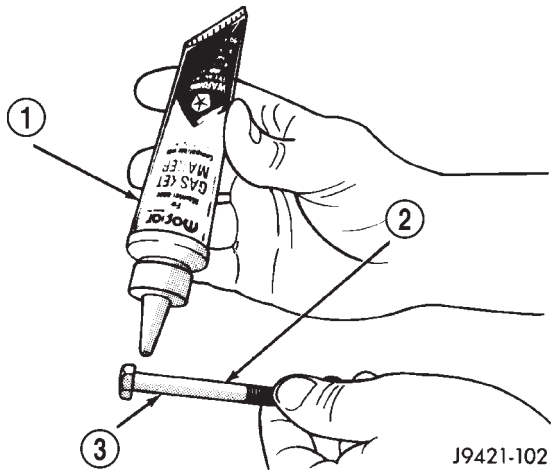
J9421-51

**Fig. 70 REAR HOUSING**

- 1 - REAR HOUSING
- 2 - SHIFT FORKS AND GEARTRAIN

MANUAL - NV1500 (Continued)

(4) Apply Mopar® Gasket Maker or equivalent to bolt threads, bolt shanks and under bolt heads (Fig. 71).



**Fig. 71 RETAINER AND HOUSING BOLTS**

- 1 - MOPAR GASKET MAKER
- 2 - RETAINER AND HOUSING BOLTS
- 3 - APPLY SEALER TO UNDERSIDE OF BOLT HEAD, SHANK AND THREADS

(5) Start first two bolts in retainer (Fig. 72). It may be necessary to move retainer rearward (with pilot stud) in order to start bolts.

(6) Remove Pilot Stud 8120 and install last retainer bolt (Fig. 72).

(7) Tighten all three retainer bolts to 22 N·m (16 ft. lbs.).

**NOTE: All bolts except the reverse idler shaft bolts have o-rings to seal the bolts to the transmission case. Inspect the o-rings to ensure that they are in good condition.**

**REVERSE IDLER**

(1) Remove geartrain and housing assembly from support stand with aid of helper.

(2) Assemble shaft, gear and washer (without bearing or support) and install into housing (Fig. 73).

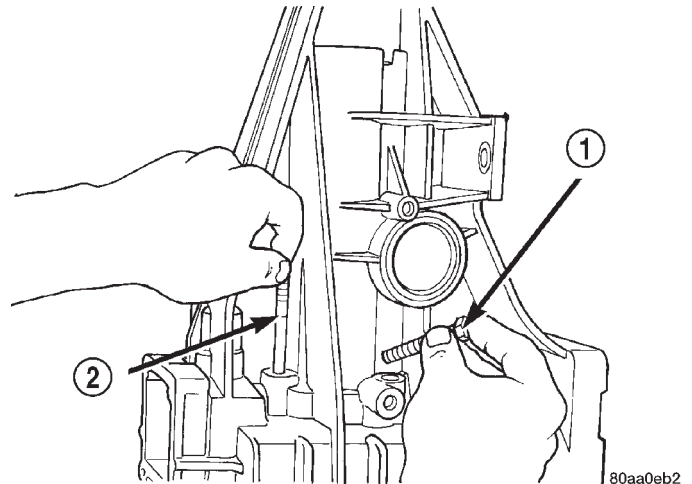
**NOTE: The small shoulder on the reverse idler gear goes toward the front of the transmission.**

(3) Apply Mopar® Gasket Maker or equivalent sealer to underside of idler shaft and support bolt heads, bolt shanks and bolt threads (Fig. 71).

(4) Align hole in housing with threaded hole in shaft and start shaft rear bolt a few threads.

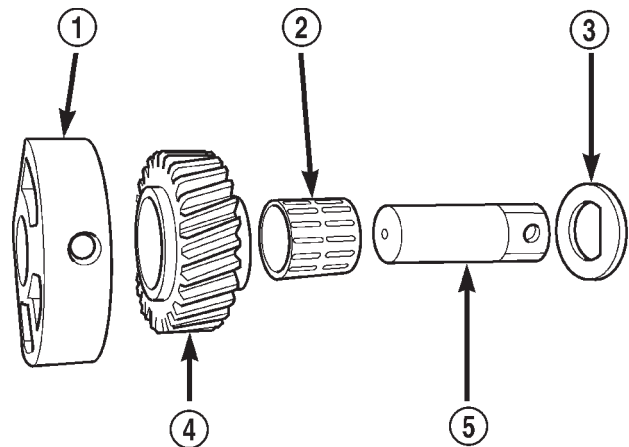
(5) Install bearing into position.

(6) Install segment (Fig. 73), align housing hole with segment threaded hole, and start support bolt a few threads.



**Fig. 72 PILOT STUD AND RETAINER BOLTS**

- 1 - BEARING RETAINER BOLT
- 2 - PILOT STUD



**Fig. 73 REVERSE IDLER ASSEMBLY**

- 1 - SUPPORT
- 2 - BEARING
- 3 - WASHER
- 4 - GEAR
- 5 - SHAFT

(7) Tighten large idler shaft bolt to 43 N·m (31.7 ft. lbs.). Tighten small idler shaft bolt to 22 N·m (16.2 ft. lbs.).

**CAUTION: Verify idler shaft and support segment are properly seated and 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.**

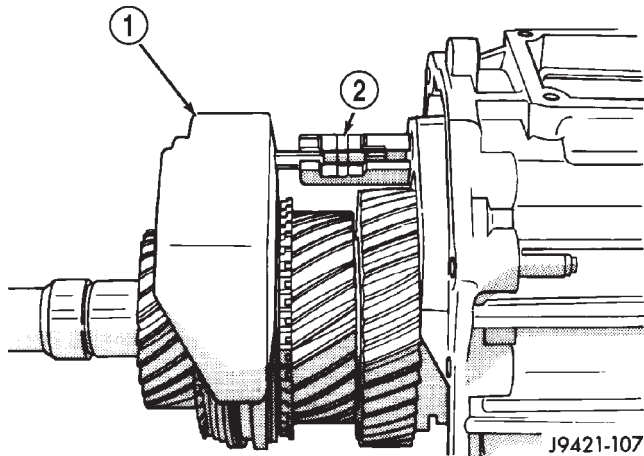
MANUAL - NV1500 (Continued)

**SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET**

(1) Verify all synchro sleeves are in Neutral position (centered on hub).

**CAUTION:** Synchros must all be in Neutral position to prevent damage to the housings, shift forks and gears during installation of the two housings.

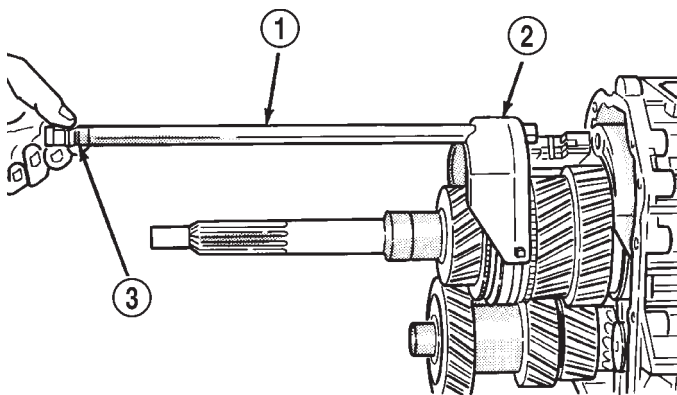
(2) Install 3-4 shift fork in synchro sleeve (Fig. 74). Verify groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms.



**Fig. 74 3-4 SHIFT FORK**

- 1 - 3-4 FORK
- 2 - ALIGN GROOVES IN FORK ARMS

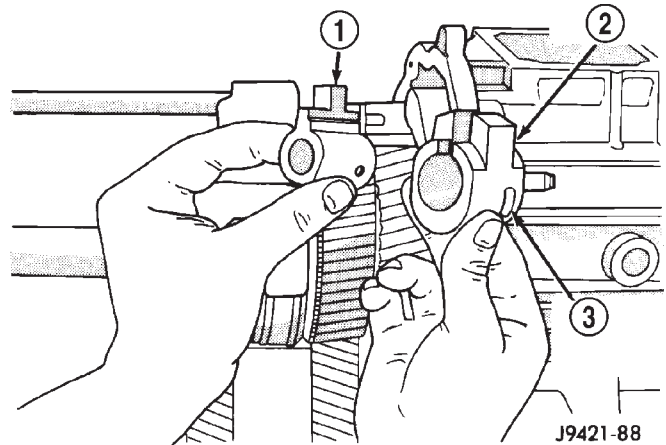
(3) Slide shift shaft through the shift forks (Fig. 75).



**Fig. 75 SHIFT SHAFT**

- 1 - SHIFT SHAFT
- 2 - 3-4 FORK
- 3 - SHAFT DETENT NOTCHES

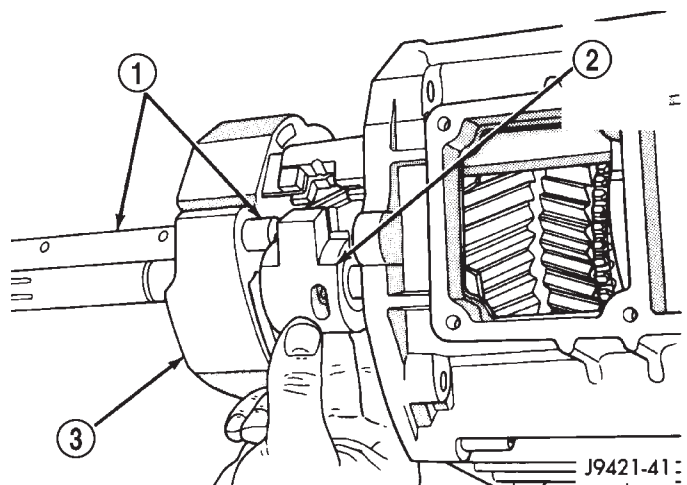
(4) Assemble shift shaft shift lever and bushing (Fig. 76). Slot in bushing must face up and roll pin hole for lever to align with hole in shaft.



**Fig. 76 SHIFT SHAFT LEVER AND BUSHING**

- 1 - SHAFT LEVER
- 2 - LEVER BUSHING
- 3 - BUSHING LOCK PIN SLOT

(5) Install assembled lever and bushing on shift shaft (Fig. 77).



**Fig. 77 SHIFT SHAFT LEVER AND BUSHING**

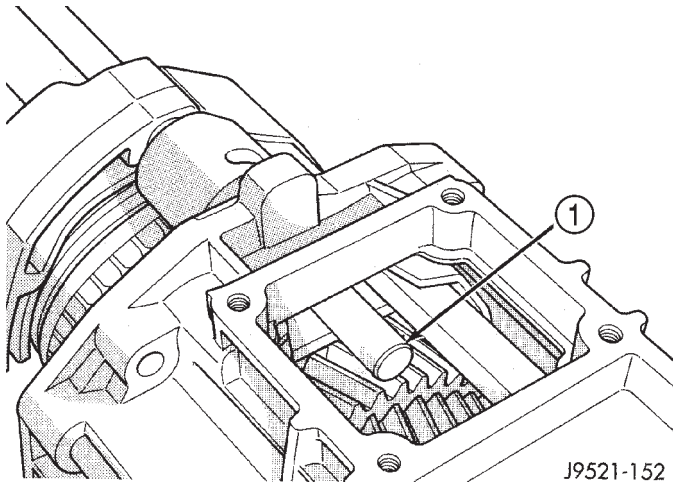
- 1 - SHIFT SHAFT
- 2 - SHAFT LEVER AND BUSHING
- 3 - 3-4 FORK

(6) Slide shift shaft through 1-2 and fifth-reverse fork and into shift lever opening in rear housing (Fig. 78).

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 79).

(8) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

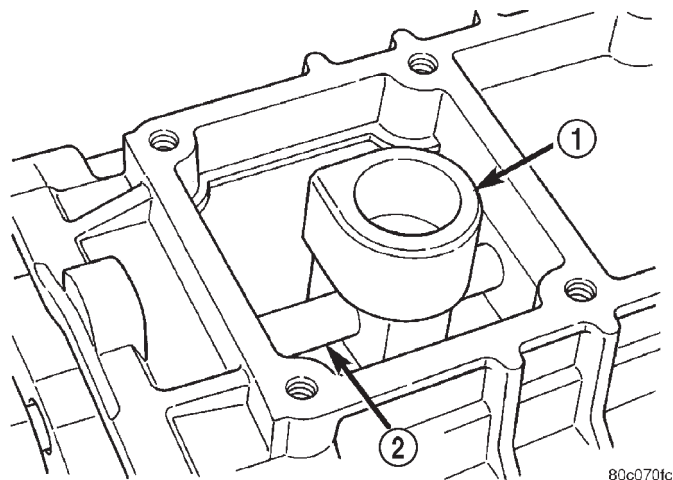
MANUAL - NV1500 (Continued)



J9521-152

**Fig. 78 LEVER OPENING IN HOUSING**

- 1 - SHIFT SHAFT



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**Fig. 79 SHIFT SOCKET AND SHAFT**

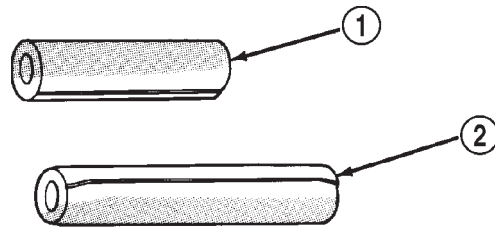
- 1 - SHIFT SOCKET
- 2 - SHIFT SHAFT

**CAUTION:** 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, transmission will have to be disassembled to correct shaft alignment.

(9) Select correct new roll pin for shift shaft lever (Fig. 80). 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.

(10) Align roll pin holes in shift shaft, lever and bushing, then start roll pin into shaft lever by hand (Fig. 81).

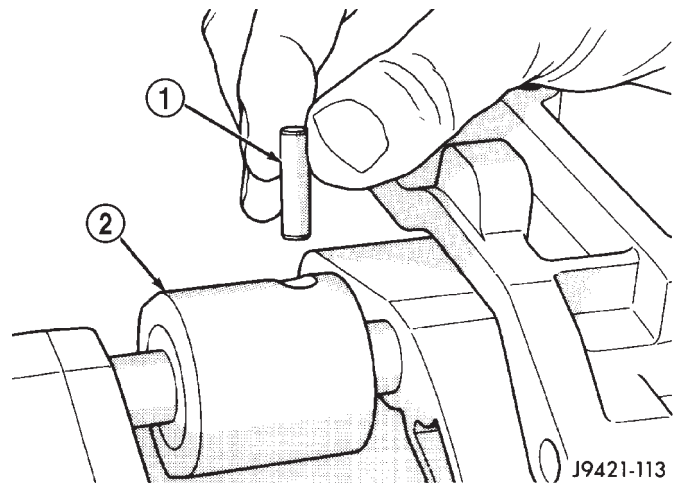
(11) Seat shaft lever roll pin with pin punch (Fig. 82).



J9421-86

**Fig. 80 SHAFT LEVER AND SOCKET ROLL PINS**

- 1 - SHAFT LEVER ROLL PIN
- 2 - SHIFT SOCKET ROLL PIN



J9421-113

**Fig. 81 STARTING ROLL PIN IN SHIFT SHAFT LEVER**

- 1 - SHAFT LEVER ROLL PIN
- 2 - LEVER AND BUSHING

**CAUTION:** 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) Verify lock pin slot in lever bushing is positioned as shown (Fig. 82).

(13) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 83).

(14) Seat roll pin in shift socket with pin punch. Roll pin must be installed flush with socket (Fig. 84).

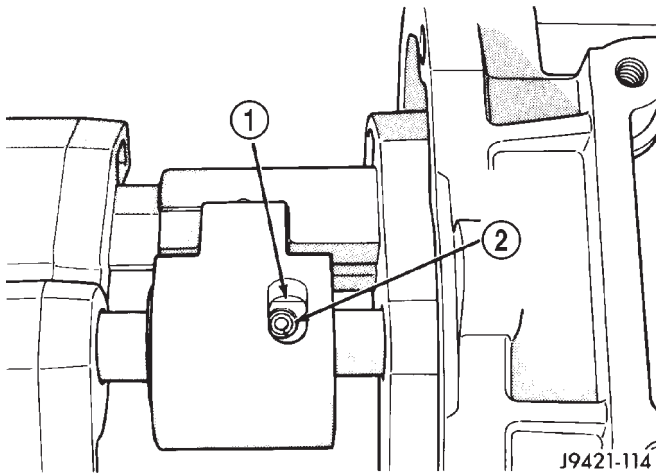
(15) Verify notches in shift fork arms are aligned.

**FRONT HOUSING AND INPUT SHAFT BEARING RETAINER**

(1) If previously removed, install input shaft bearing in front housing bore (Fig. 85). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

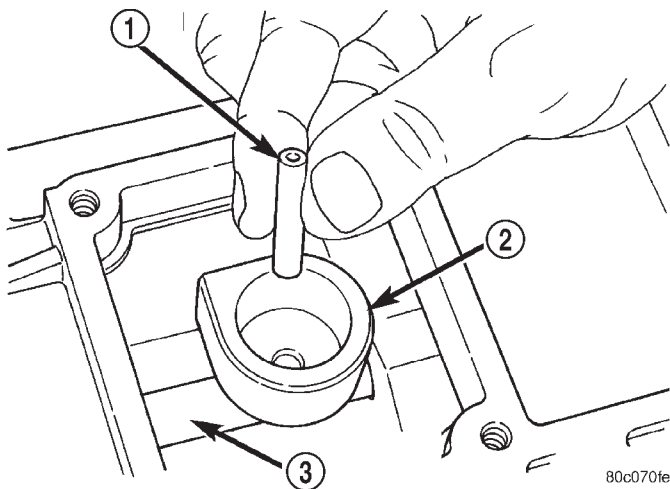
(2) Apply small amount of petroleum jelly to shift shaft bushing in front housing (Fig. 86).





**Fig. 82 SEATING SHIFT SHAFT LEVER ROLL PIN**

- 1 - BUSHING LOCK PIN SLOT
- 2 - SEAT ROLL PIN FLUSH WITH LEVER



**Fig. 83 STARTING ROLL PIN IN SHIFT SOCKET**

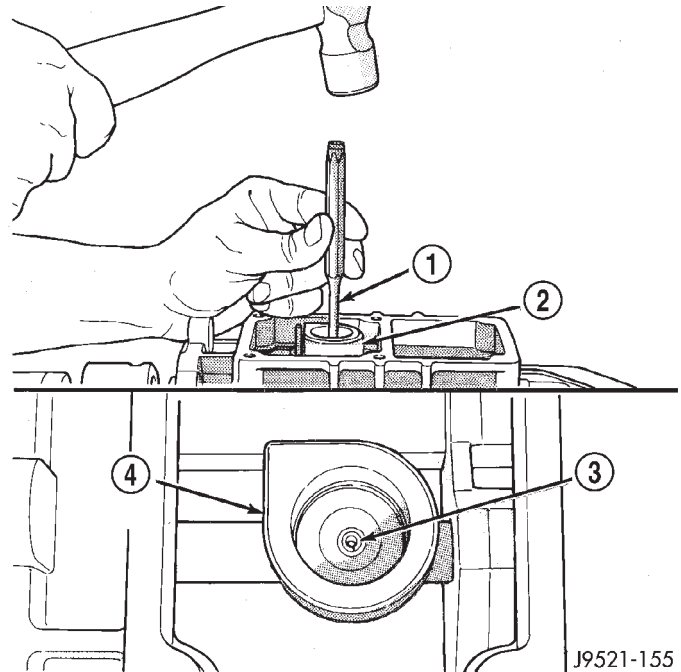
- 1 - ROLL PIN
- 2 - SHIFT SOCKET
- 3 - SHIFT SHAFT

(3) Apply 1/8 in. wide bead of Mopar® Gasket Maker or equivalent to mating surfaces of front and rear housings (Fig. 86).

(4) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain.

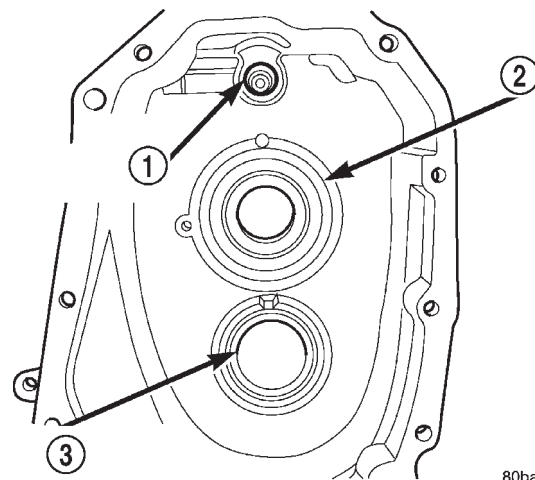
(5) Work front housing downward onto geartrain until seated on rear housing.

**CAUTION:** If the front housing will not seat on the rear housing, the shift components are not in Neutral, or one or more components are misaligned. Do not force the front housing into place.



**Fig. 84 SEATING SHIFT SOCKET ROLL PIN**

- 1 - PIN PUNCH
- 2 - SHIFT SOCKET
- 3 - SEAT ROLL PIN FLUSH
- 4 - SHIFT SOCKET

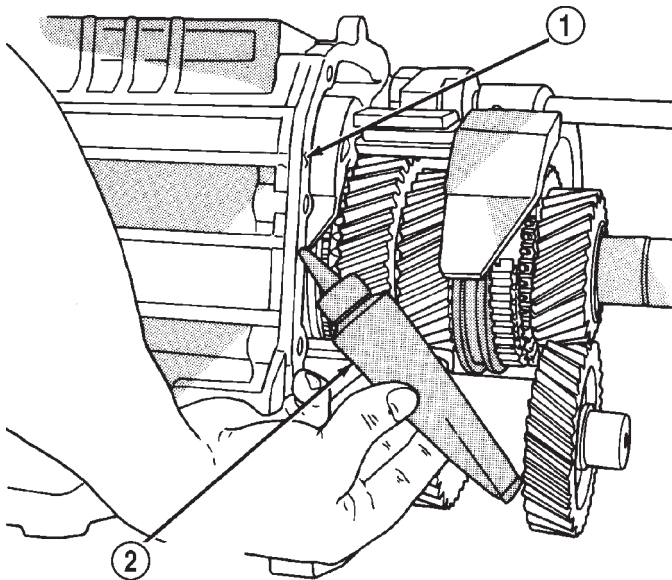


**Fig. 85 INPUT SHAFT AND COUNTERSHAFT BEARING**

- 1 - SHIFT SHAFT BUSHING
- 2 - INPUT SHAFT BEARING
- 3 - COUNTERSHAFT FRONT BEARING RACE

(6) Place transmission in horizontal position.

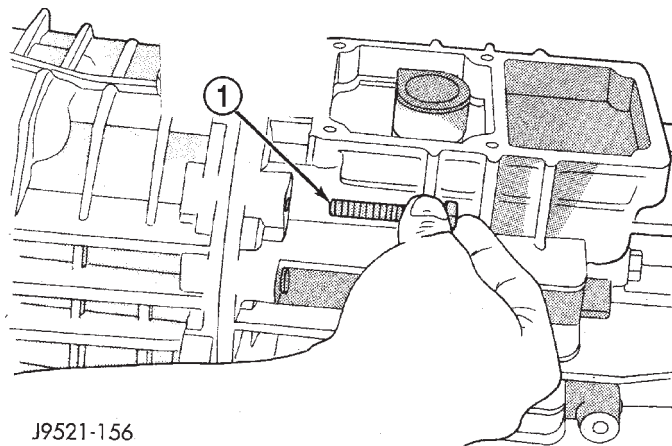
(7) Apply Mopar® Gasket Maker or equivalent to housing attaching bolts. Apply sealer material sealer to underside of bolt heads and to bolt shanks and threads (Fig. 87).



**Fig. 86 SEALER TO FRONT/REAR HOUSING**

- 1 - HOUSING FLANGE SURFACE
- 2 - MOPAR GASKET MAKER (OR LOCTITE 518)

(8) Install and start housing attaching bolts by hand (Fig. 87). Then tighten bolts to 34 N·m (25 ft. lbs.).



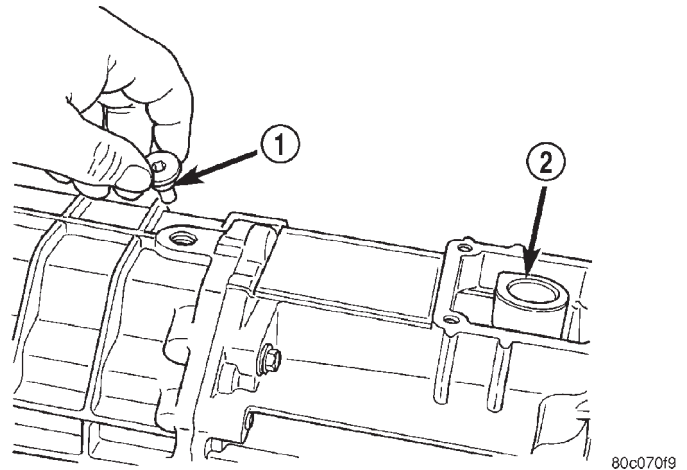
J9521-156

**Fig. 87 HOUSING ATTACHING BOLTS**

- 1 - HOUSING ATTACHING BOLTS (APPLY SEALER BEFOREHAND)

(9) Install shift shaft bushing lock bolt (Fig. 88). 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. 88 SHIFT SHAFT BUSHING LOCK BOLT**

- 1 - SHIFT SHAFT LOCK BOLT
- 2 - SHAFT SOCKET

(10) Remove countershaft bearing shim cap and shim. Attach a dial indicator and move countershaft front and back to measure shaft end play. The required countershaft pre-load 0.001-0.003 inches. Add this amount to the measured amount of countershaft end-play. This gives the amount of shims necessary to correctly pre-load the front and rear countershaft bearings.

(11) Install the selected shims and the shim cap. Tighten shim cap bolts to 29 N·m (21.4 ft. lbs.). Verify the shim selection by rotating the input shaft by hand with the transmission in neutral. The proper torque required to rotate the input shaft and the countershaft is approximately 5-7 in.lbs.. The input shaft should therefore be easily rotated by hand. If the input shaft cannot be rotated by hand or is not smooth through several rotations, re-check the countershaft pre-load.

(12) Lubricate then install shift shaft detent plunger in housing bore. **Verify plunger is fully seated in detent notch in shift shaft.**

**NOTE:** Lubricate plunger with Valvoline Dura blend® Semi-Synthetic or Synthetic grease or equivalent.

(13) Install detent plug in end of Installer 8123. Position plug on detent spring and compress spring until detent plug pilots in detent plunger bore. Drive detent plug into transmission case until plug seats.

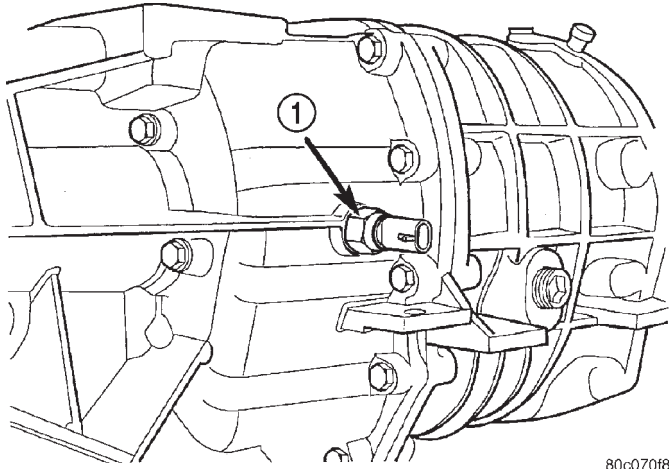
(14) Install backup light switch (Fig. 89).

(15) Install input shaft snap ring (Fig. 90).

(16) Install **new** oil seal in front bearing retainer with Installer 6448 (Fig. 91).

(17) Apply bead of Mopar® Silicone Sealer or equivalent to flange surface of front bearing retainer.

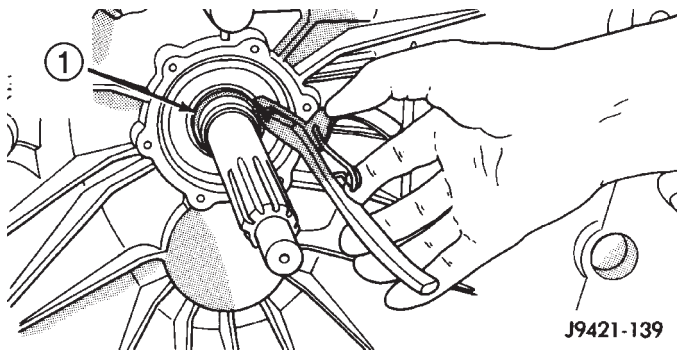
(18) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig.



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**Fig. 89 BACKUP LIGHT SWITCH**

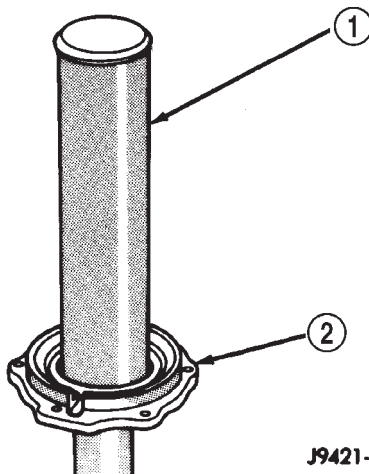
- 1 - BACKUP LAMP SWITCH



J9421-139

**Fig. 90 INPUT SHAFT SNAP RING**

- 1 - INPUT SHAFT SNAP RING



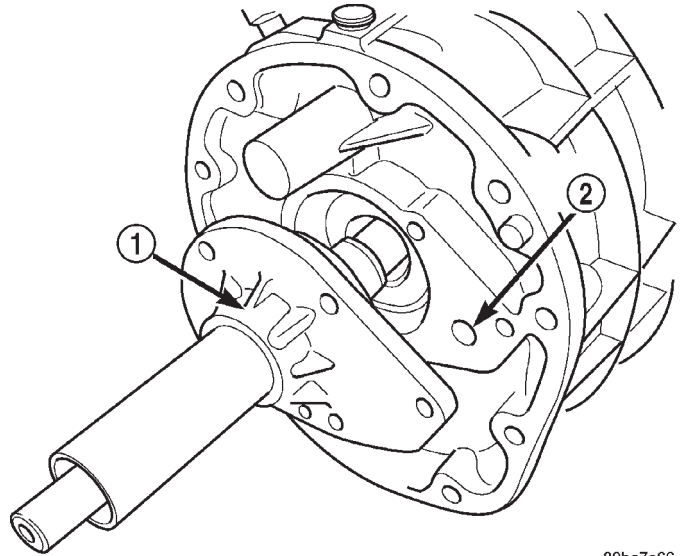
J9421-146

**Fig. 91 BEARING RETAINER OIL SEAL**

- 1 - INSTALLER  
2 - FRONT BEARING RETAINER

92). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer.

**NOTE:** Be sure that no sealer gets into the oil feed hole in the transmission case or bearing retainer.

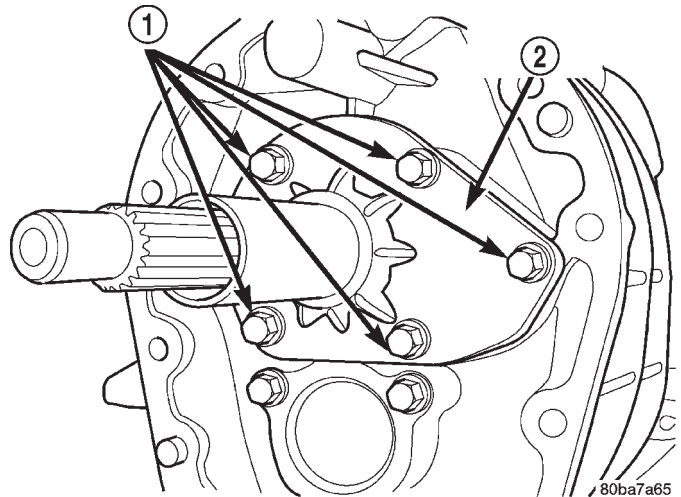


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**Fig. 92 INPUT SHAFT BEARING RETAINER**

- 1 - BEARING RETAINER  
2 - OIL FEED

(19) Install and tighten bearing retainer bolts to 29 N·m (21.4 ft. lbs.) (Fig. 93).



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**Fig. 93 INPUT SHAFT BEARING RETAINER BOLTS**

- 1 - BOLTS (5)  
2 - BEARING RETAINER

**SHIFT TOWER AND LEVER**

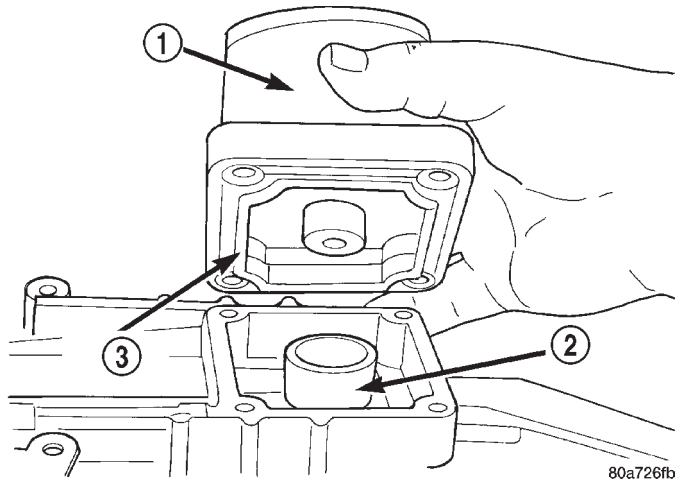
(1) Apply petroleum jelly to ball end of shift lever and interior of shift socket.

(2) Shift the transmission into third gear.

(3) Align and install shift tower and lever assembly (Fig. 94). Verify shift ball is seated in socket and offset in the tower is toward the passenger side of the vehicle before installing tower bolts.

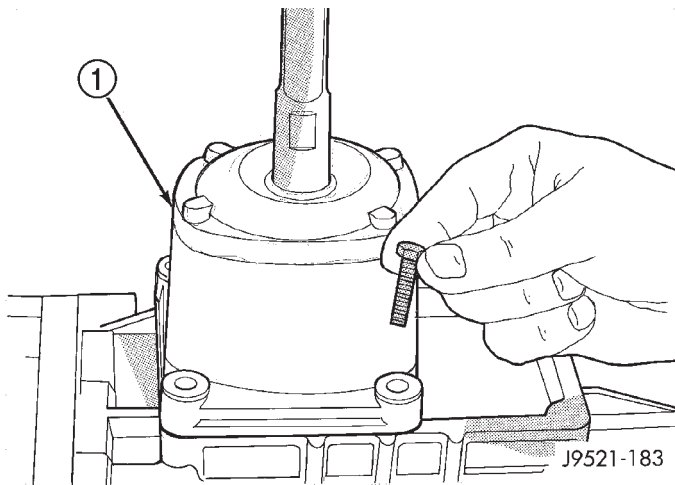
MANUAL - NV1500 (Continued)

(4) Install shift tower bolts (Fig. 95) and tighten bolts to 8.5 N·m (75.2 in. lbs.).



**Fig. 94 SHIFT TOWER**

- 1 - SHIFT TOWER AND LEVER ASSEMBLY
- 2 - SHIFT SOCKET
- 3 - SEAL



**Fig. 95 SHIFT TOWER BOLT**

- 1 - SHIFT TOWER AND LEVER ASSEMBLY

(5) Fill transmission to bottom edge of fill plug hole with Mopar® Transmission.

(6) Install and tighten fill plug to 34 N·m (25 ft. lbs.).

(7) Check transmission vent. Be sure vent is open and not restricted.

**INSTALLATION**

(1) Install clutch housing on transmission and tighten housing bolts to 46 N·m (34 ft. lbs.).

(2) Lubricate contact surfaces of release fork pivot ball stud and release fork with high temp grease.

(3) Install release bearing, fork and retainer clip.

(4) Position and secure transmission on transmission jack.

(5) Lightly lubricate pilot bearing and transmission input shaft splines with Mopar high temp grease.

(6) Raise transmission and align transmission input shaft and clutch disc splines. Then slide transmission into place.

(7) Install clutch housing-to-engine bolts and tighten to 58 N·m (43 ft.lbs.).

**NOTE:** Be sure the housing is properly seated on engine block before tightening bolts.

(8) Install shift tower and bolts. Tighten bolts to 7-10 N·m (5-7 ft.lbs.).

(9) Install rear crossmember and tighten crossmember bolts to 41 N·m (31 ft. lbs.).

(10) Install transmission mount bolts and to 54 N·m (40 ft. lbs.).

(11) Install exhaust bracket to crossmember.

(12) Remove support stands from engine and transmission.

(13) Install transfer case, shift cable and vent hose if equipped.

(14) Install wire connectors to transmission/transfer case.

(15) Install propeller shaft/shafts.

(16) Install slave cylinder in clutch housing.

(17) Install skid plate if equipped.

(18) Fill transmission and transfer case if equipped, with recommended lubricants.

MANUAL - NV1500 (Continued)

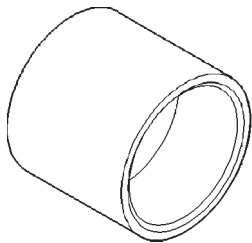
**SPECIFICATIONS - NV1500**

*TORQUE SPECIFICATIONS*

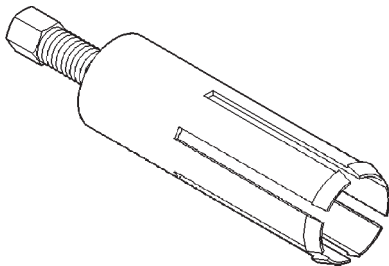
<b>DESCRIPTION</b>	<b>N-m</b>	<b>Ft. Lbs.</b>	<b>In. Lbs.</b>
Back up Lamp Switch	41	30	-
Coutershaft Bearing Shim Cap	41	30	-
Bearing Retainer - Front	41	30	-
Bearing Retainer - Rear	34	25	-
Drain/Fill Plug	34	25	-
Shift Shaft Lock Bolt	27	20	-
Idler Shaft Bolts - M8	27	20	-
Idler Shaft Bolts - M10	52	40	-
Shift Tower Bolts	14	10	120

**SPECIAL TOOLS**

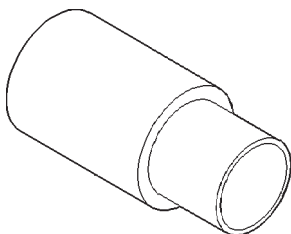
MANUAL - NV1500



**INSTALLER C-3995-A**



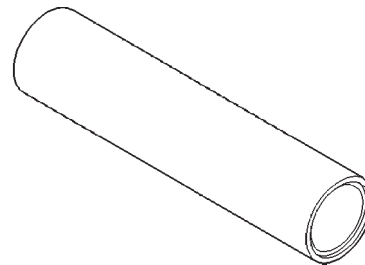
**REMOVER 6957**



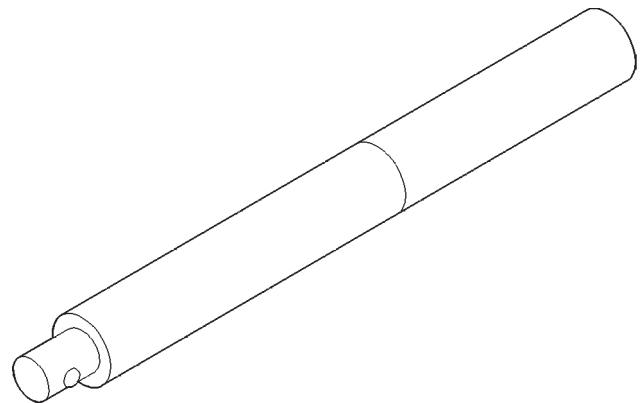
**INSTALLER 8160**



**INSTALLER C-4656**

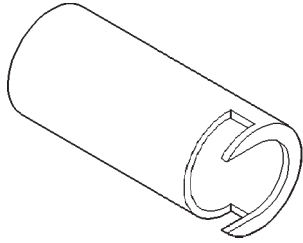


**INSTALLER 6448**

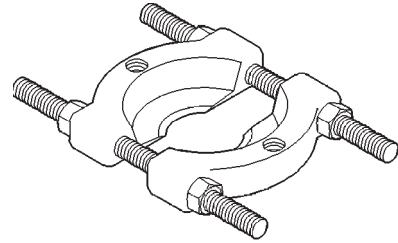


**HANDLE C-4171**

MANUAL - NV1500 (Continued)

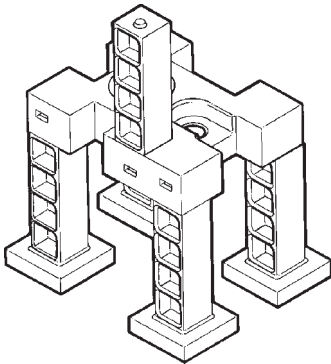


**REMOVER 8117**

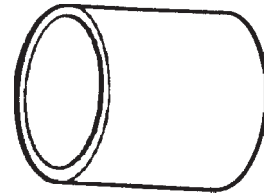


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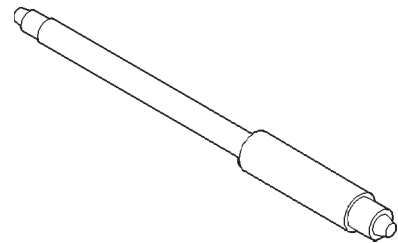
**SPLITTER BEARING 1130**



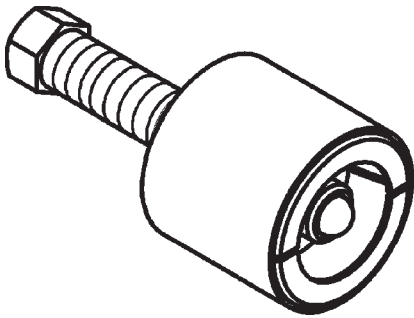
**SUPPORT STAND 8355**



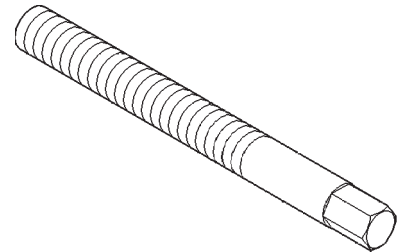
**CUP 6310-1**



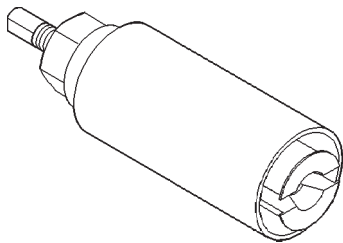
**REMOVER/INSTALLER 8119**



**REMOVER 8356**



**STUD ALIGNMENT 8120**

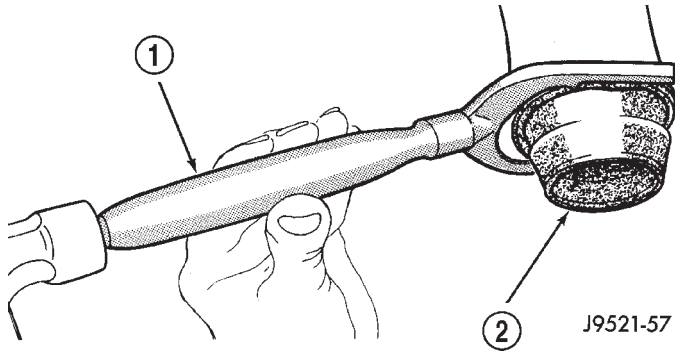


**REMOVER L-4454**

## EXTENSION HOUSING SEAL - NV1500

### REMOVAL

- (1) Raise and support vehicle.
- (2) Mark propeller shaft and axle yoke for alignment reference.
- (3) Disconnect and remove propeller shaft.
- (4) Remove old seal with Remover C-3985-B (Fig. 96) from transmission housing.

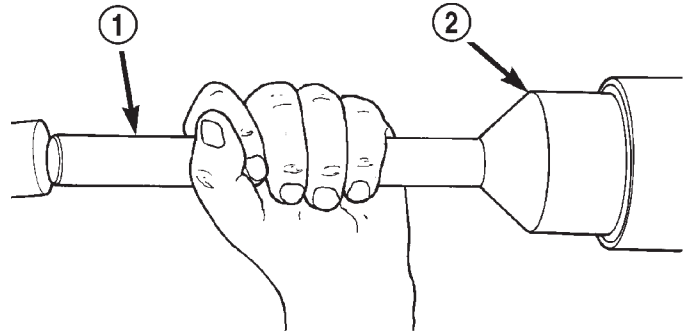


**Fig. 96 YOKE SEAL**

- 1 - REMOVER
- 2 - SEAL

### INSTALLATION

- (1) Place seal in position on transmission housing.
- (2) Drive new seal into transmission housing with Installer C-3972-A and Handle C-4171 (Fig. 97).
- (3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines.
- (4) Install propeller shaft with reference marks aligned.



**Fig. 97 Yoke Seal Installer**

- 1 - HANDLE
- 2 - INSTALLER

- (5) Remove support and lower vehicle.
- (6) Check transmission fluid level.

# MANUAL - NV3550

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## MANUAL - NV3550

### DESCRIPTION

The NV3550 is a medium-duty, 5-speed, constant mesh, fully synchronized manual transmission. The transmission is available in two and four-wheel drive configurations.

The gear case consists of two aluminum housings and a removable clutch housing. The clutch housing is not an integral part of the transmission.

Roller bearings and needle bearings are used in the transmission. The transmission gears all rotate on caged type needle bearings. Roller bearings are used to support the input, output and counter shafts.

The transmission 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.

The drain plug is located in the bottom of the transmission and fill plug is on the left side.

### OPERATION

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does

this by having the synchronizer hub splined to the mainshaft, or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.

### DIAGNOSIS AND TESTING - MANUAL TRANSMISSION

#### 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 gear case, intermediate plate and adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adaptor housing will be from the housing oil seals. 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 the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab, and/or chatter.



## MANUAL - NV3550 (Continued)

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

**HARD SHIFTING**

Hard shifting is usually caused by a low lubricant level, improper, or contaminated lubricants. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind, and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment, or a damaged clutch pressure plate or disc are additional probable causes of increased shift effort. 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 hard or noisy shifts. In most cases, this condition will decline as the rings wear in.

**TRANSMISSION NOISE**

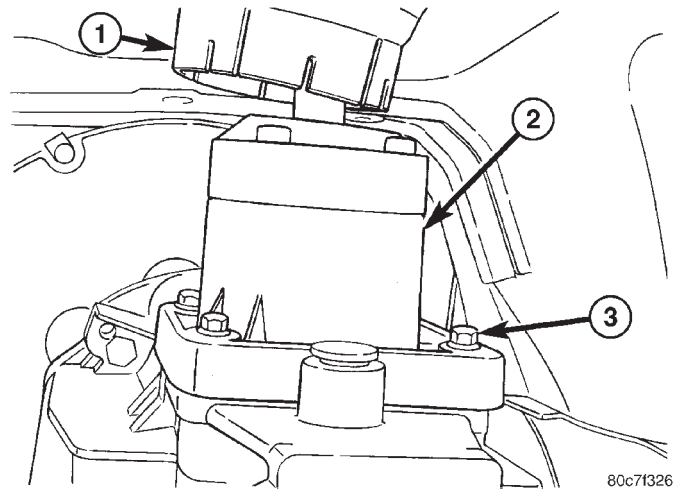
Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

Severe, highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper, or contaminated lubricant will 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**

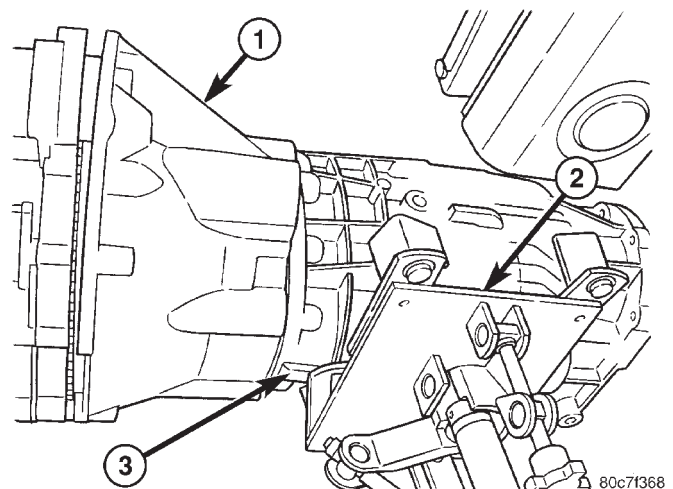
- (1) Shift transmission into neutral.
- (2) Raise and support the vehicle.
- (3) Remove skid plate if equipped.
- (4) Remove wiring connectors from the transmission.
- (5) Remove propeller shaft/shafts.
- (6) Remove transfer case shift cable, vent hose from and transfer case, if equipped.
- (7) Remove slave cylinder from clutch housing.
- (8) Support engine with jack stand. Position wood block between jack and oil pan to avoid damaging pan.

- (9) Support transmission with a trans jack.
- (10) Remove exhaust hanger from the transmission crossmember.
- (11) Remove transmission mount and crossmember.
- (12) Lower trans jack enough to remove shift tower bolts (Fig. 1).

**Fig. 1 SHIFT TOWER**

- 1 - SHIFT TOWER BOOT
- 2 - SHIFT TOWER
- 3 - SHIFT TOWER BOLT (4)

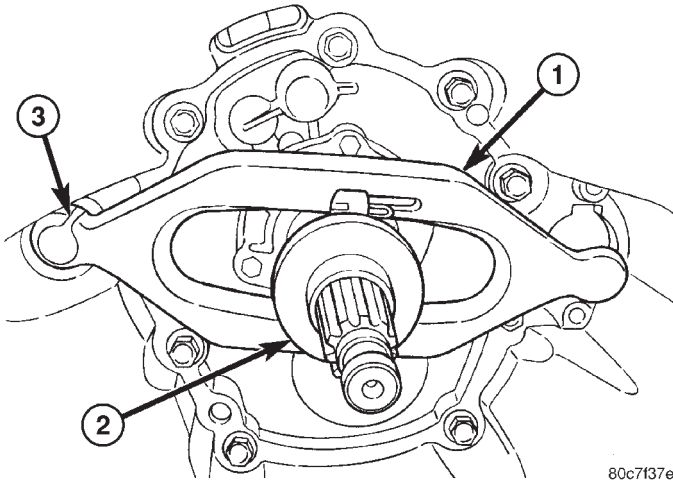
- (13) Remove clutch housing-to-engine bolts.
- (14) Pull transmission jack rearward (Fig. 2) until input shaft clears clutch.

**Fig. 2 TRANSMISSION ASSEMBLY**

- 1 - CLUTCH HOUSING
- 2 - TRANSMISSION JACK
- 3 - TRANSMISSION

MANUAL - NV3550 (Continued)

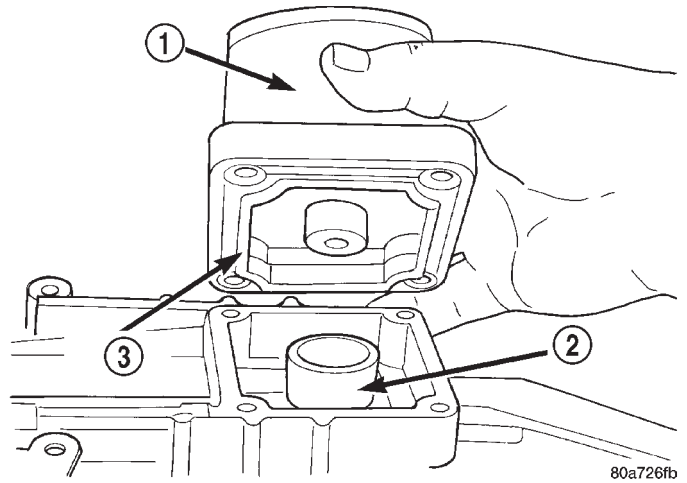
(15) Remove clutch release bearing, release fork and retainer clip (Fig. 3).



**Fig. 3 CLUTCH RELEASE BEARING**

- 1 - FORK
- 2 - BEARING
- 3 - CLIP

(5) Remove shift tower bolts and remove tower and lever assembly (Fig. 5).



**Fig. 5 SHIFT TOWER**

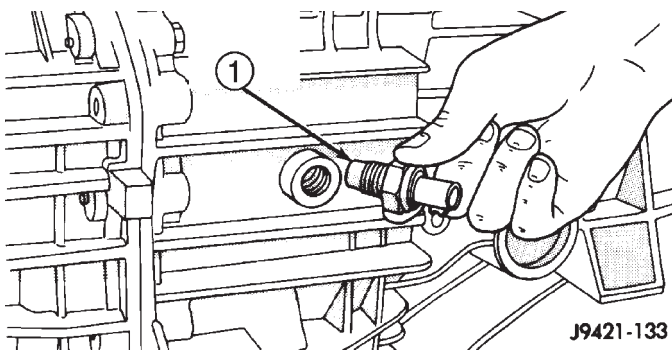
- 1 - SHIFT TOWER
- 2 - SHIFT SOCKET
- 3 - SEAL

(16) Remove clutch housing from transmission.

**DISASSEMBLY**

**FRONT HOUSING**

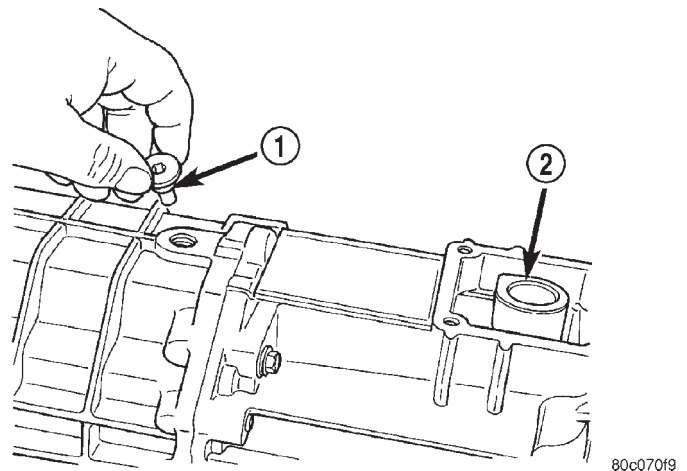
- (1) Shift transmission into Neutral.
- (2) Remove drain plug and drain lubricant.
- (3) Inspect drain plug magnet for debris.
- (4) Remove backup light switch located on passenger side of rear housing (Fig. 4).



**Fig. 4 BACKUP LIGHT SWITCH**

- 1 - BACKUP LIGHT SWITCH

(6) Remove shift shaft lock bolt (Fig. 6) located just forward of shift tower.



**Fig. 6 SHIFT SHAFT LOCK BOLT**

- 1 - SHIFT SHAFT LOCK BOLT
- 2 - SHAFT SOCKET

MANUAL - NV3550 (Continued)

(7) Remove shift shaft detent plug with Remover 8117A. Attach the fingers of the remover to the detent plug (Fig. 7). Then push the cup down till it contacts the trans. Tighten the nut (Fig. 8) till it pulls the plug from the trans case.

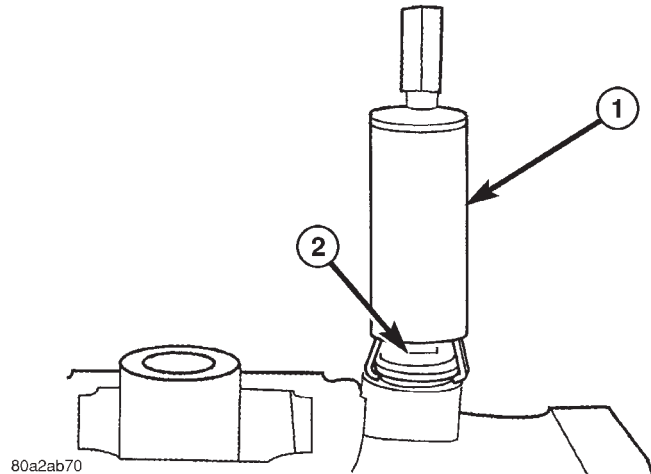


Fig. 7 DETENT PULLER

- 1 - REMOVER
- 2 - DETENT PLUG

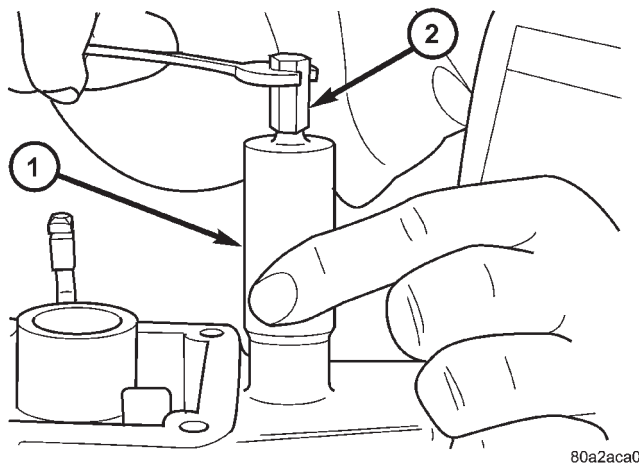


Fig. 8 PULL DETENT PLUG

- 1 - NUT
- 2 - REMOVER

(8) Remove shift shaft detent spring and plunger with a pencil magnet.

(9) Remove input shaft bearing retainer bolts.

(10) Loosen input shaft bearing retainer by **carefully** lifting the retainer with a pry tool to break sealer bead (Fig. 9).

(11) Remove bearing retainer from input shaft (Fig. 10).

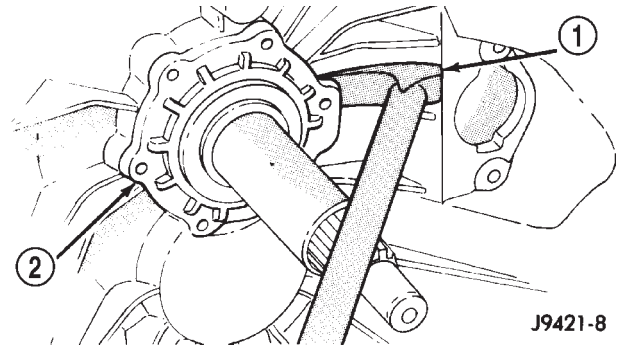


Fig. 9 BEARING RETAINER

- 1 - PRY TOOL
- 2 - INPUT SHAFT BEARING RETAINER

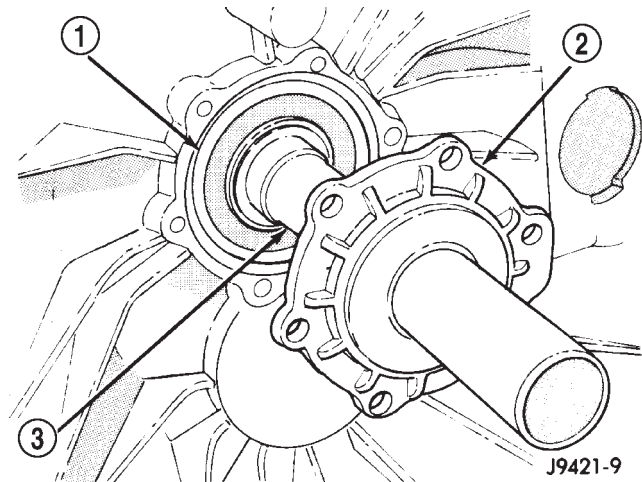


Fig. 10 INPUT SHAFT BEARING RETAINER

- 1 - SHAFT BEARING
- 2 - BEARING RETAINER
- 3 - INPUT SHAFT

(12) Remove snap ring that secures input shaft in front bearing (Fig. 11).

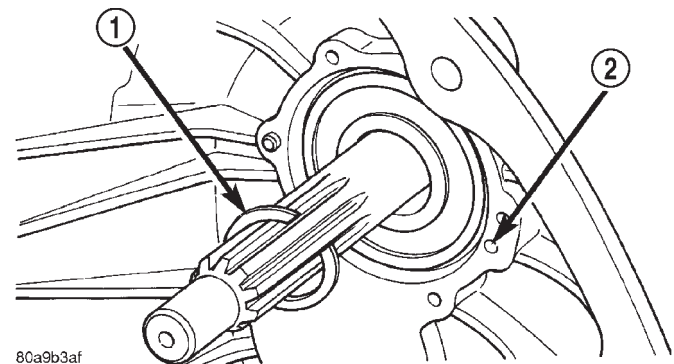
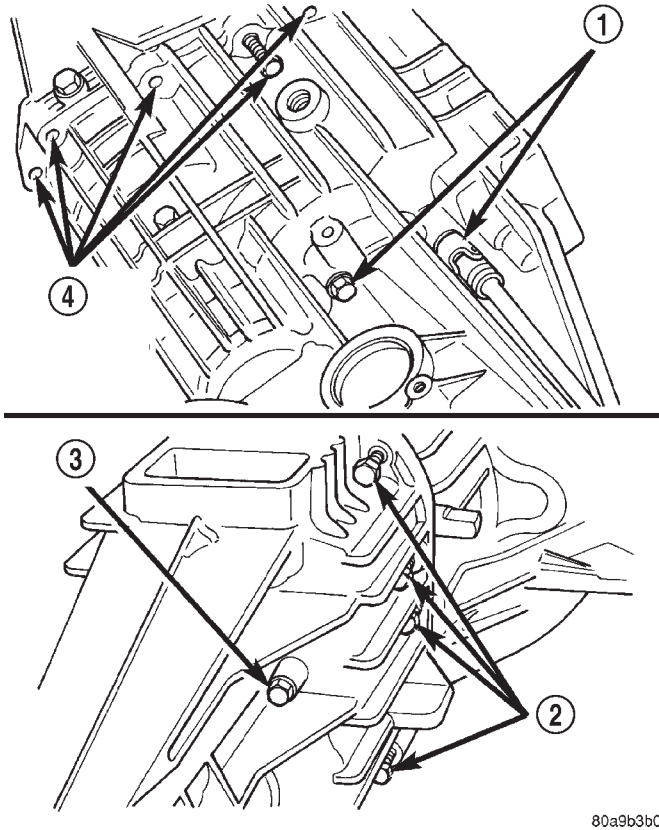


Fig. 11 INPUT SHAFT SNAP RING

- 1 - INPUT SHAFT SNAP RING
- 2 - OIL FEED

MANUAL - NV3550 (Continued)

(13) Remove front housing bolts that attach it to the rear housing (Fig. 12). Three bolts at rear of housing are for the output shaft bearing retainer. Leave one of these bolts in place until the geartrain is ready to be removed from case.



**Fig. 12 HOUSING AND BEARING RETAINER BOLTS**

- 1 - RETAINER BOLTS
- 2 - HOUSING BOLTS
- 3 - RETAINER BOLT
- 4 - HOUSING BOLT LOCATIONS

(14) Separate the housings (Fig. 13) by taping the front housing off the alignment dowels with a plastic mallet.

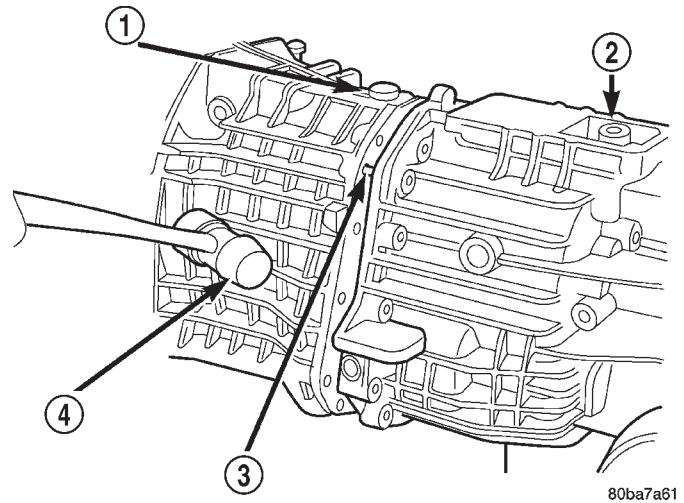
(15) Remove and inspect input shaft bearing and countershaft front bearing race (Fig. 14).

(16) Remove screw from reverse blocker and remove blocker (Fig. 15) from case.

(17) Note position of input shaft, shift shaft, forks and geartrain components in housing (Fig. 16).

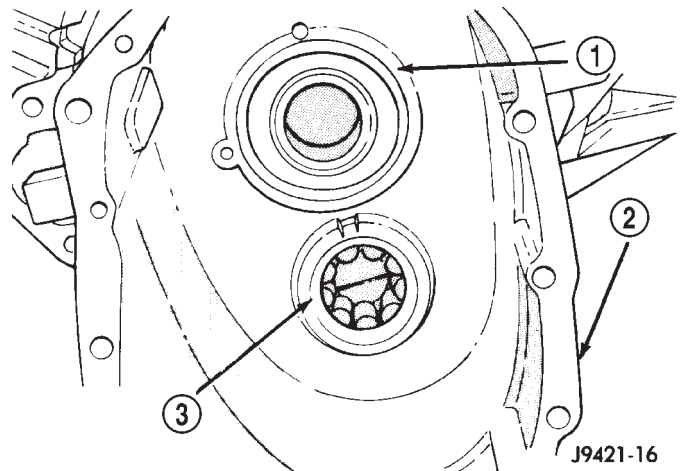
**SHIFT/FORK SHAFTS AND REVERSE IDLER SEGMENT**

(1) To remove the roll pin that secures the shift socket to the shift shaft, position Remover 6858 on the shift shaft. Center the tool over the roll pin and verify tool legs are firmly seated on the shift socket (Fig. 17).



**Fig. 13 FRONT HOUSING**

- 1 - FRONT HOUSING
- 2 - REAR HOUSING
- 3 - DOWELS (2)
- 4 - PLASTIC MALLET



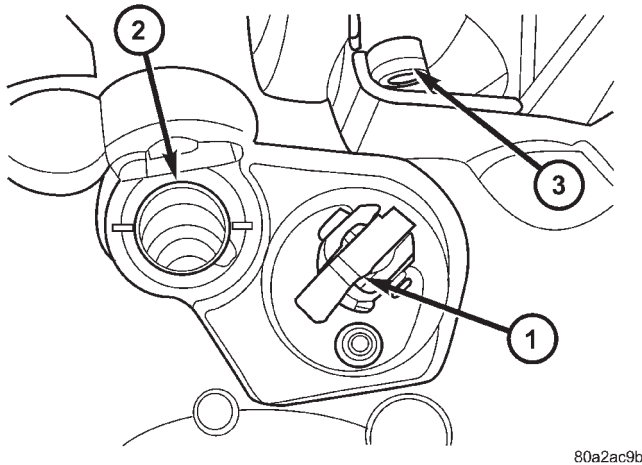
**Fig. 14 INPUT SHAFT AND COUNTERSHAFT BEARING RACE**

- 1 - INPUT SHAFT BEARING
- 2 - FRONT HOUSING
- 3 - COUNTERSHAFT FRONT BEARING

(2) Tilt the socket toward the side of the case, to position the roll pin at a slight angle. This will prevent the pin from being trapped between the gear teeth.

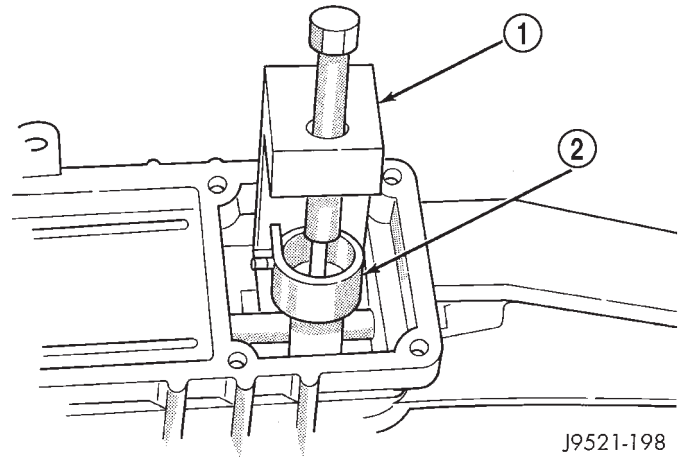
(3) Tighten the tool to press the roll pin downward and out of the shift socket (Fig. 17).

**NOTE:** Press roll pin just enough to clear the shift shaft. Be careful not to push the pin into the geartrain.



**Fig. 15 REVERSE BLOCKER**

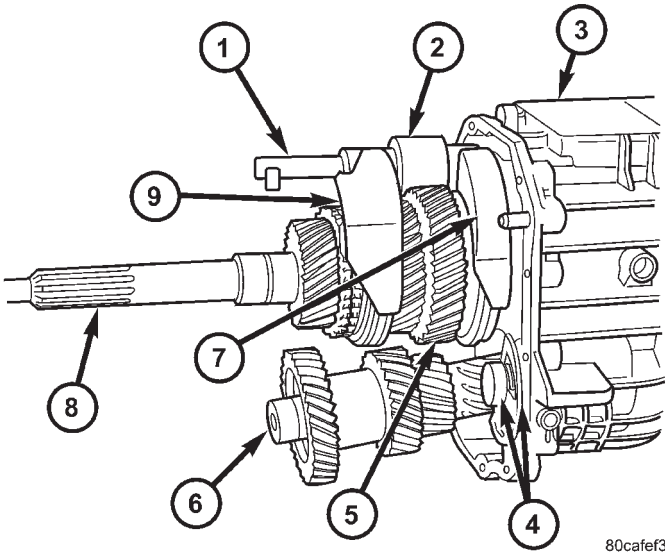
- 1 - REVERSE BLOCKER
- 2 - SHIFTER SHAFT BUSHING
- 3 - VENT



**Fig. 17 SHIFT SOCKET ROLL PIN**

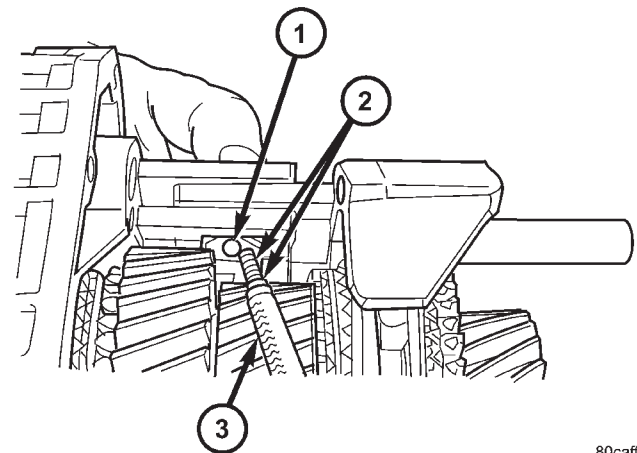
- 1 - REMOVER
- 2 - SHIFT SOCKET

**NOTE:** Place shop towel over shaft to contain detent ball and spring.



**Fig. 16 GEARTRAIN AND SHIFT COMPONENTS**

- 1 - SHIFT SHAFT
- 2 - BUSHING
- 3 - REAR HOUSING
- 4 - REVERSE IDLER AND SUPPORT
- 5 - OUTPUT SHAFT AND GEARS
- 6 - COUNTERSHAFT
- 7 - 1-2 FORK
- 8 - INPUT SHAFT
- 9 - 3-4 FORK



**Fig. 18 DETENT SPRING AND BALL**

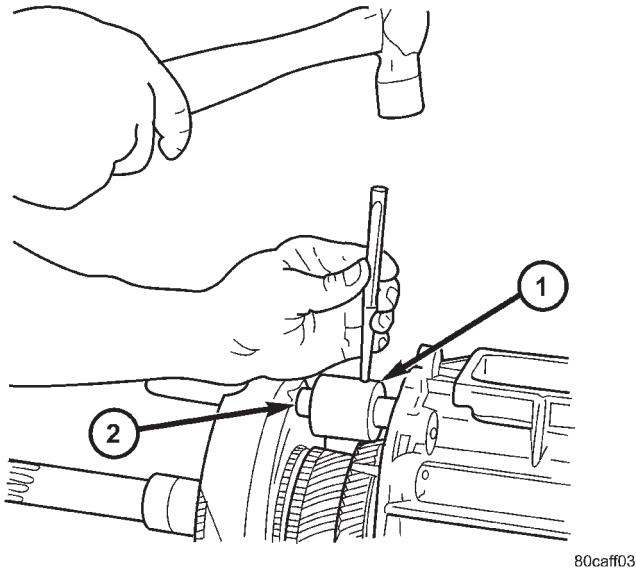
- 1 - SHAFT LEVER
- 2 - SPRING AND BALL
- 3 - MAGNET

(5) Drive out roll pin that secures shift bushing and lever to shift shaft (Fig. 19) with a hammer and punch.

**CAUTION:** Use proper size punch to avoid bending the shift shaft.

(4) Rotate lever and bushing upward and out of the shift forks and catch detent ball and spring (Fig. 18) as they exit the shaft lever.

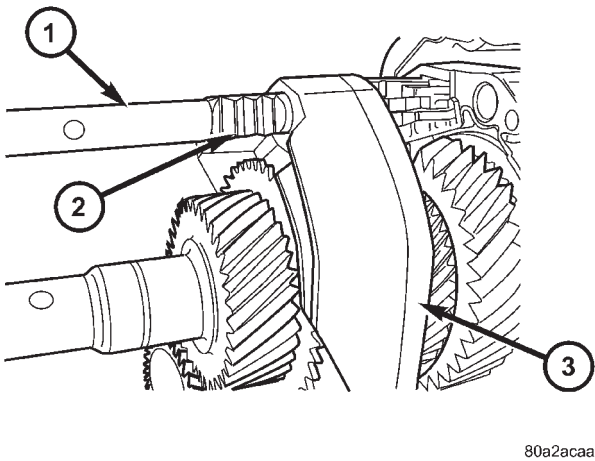
MANUAL - NV3550 (Continued)



**Fig. 19 SHIFT SHAFT LEVER AND BUSHING ROLL PIN**

- 1 - BUSHING AND LEVER
- 2 - SHIFT SHAFT

(6) Pull shift shaft straight (Fig. 20) out of rear housing.



**Fig. 20 SHIFT SHAFT**

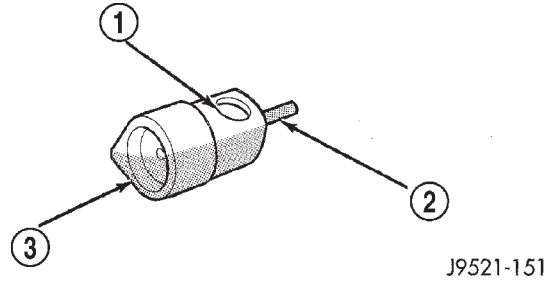
- 1 - SHIFTER SHAFT
- 2 - SHIFTER SHAFT DETENT
- 3 - 3-4 SHIFT FORK

(7) Remove shift socket from rear housing (Fig. 21).

(8) Remove lever and bushing (Fig. 22).

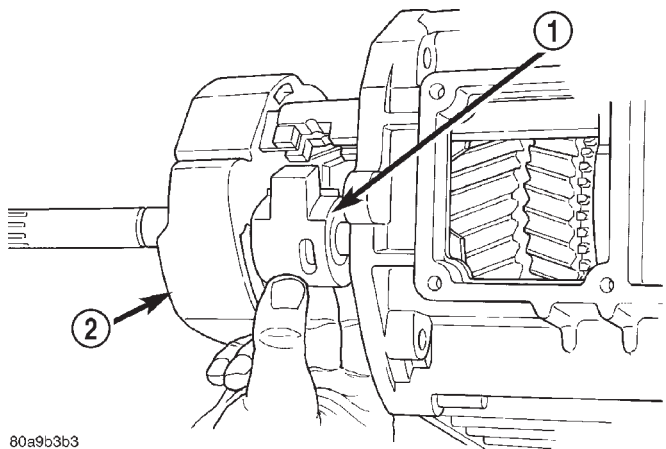
(9) Rotate 3-4 fork around synchro sleeve until fork clears shift arms on 1-2 and fifth-reverse forks, then remove 3-4 fork (Fig. 23).

(10) Remove the reverse idler shaft support bolt and loosen rear reverse idler shaft bolt (Fig. 24).



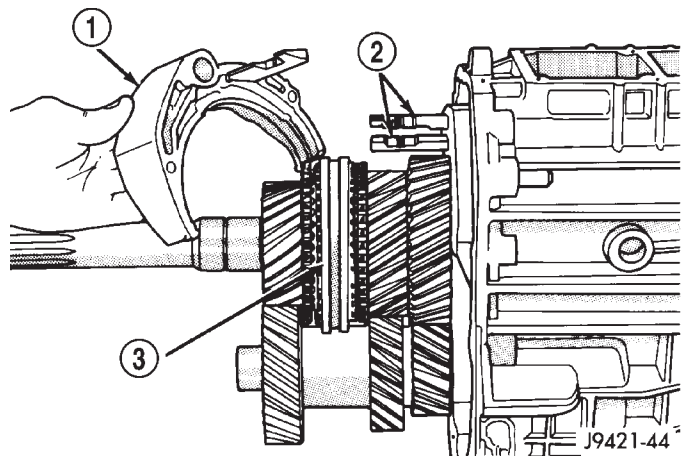
**Fig. 21 SHIFT SOCKET AND ROLL PIN**

- 1 - SHAFT BORE
- 2 - ROLL PIN
- 3 - SHIFT SOCKET



**Fig. 22 SHIFT SHAFT LEVER AND BUSHING**

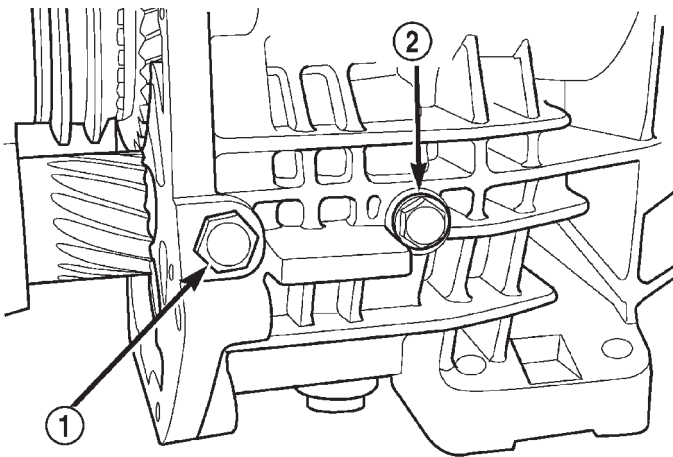
- 1 - SHAFT LEVER AND BUSHING
- 2 - 3-4 FORK



**Fig. 23 3-4 SHIFT FORK**

- 1 - 3-4 FORK
- 2 - 1-2 AND 5TH-REVERSE FORK ARMS
- 3 - 3-4 SYNCHRO SLEEVE

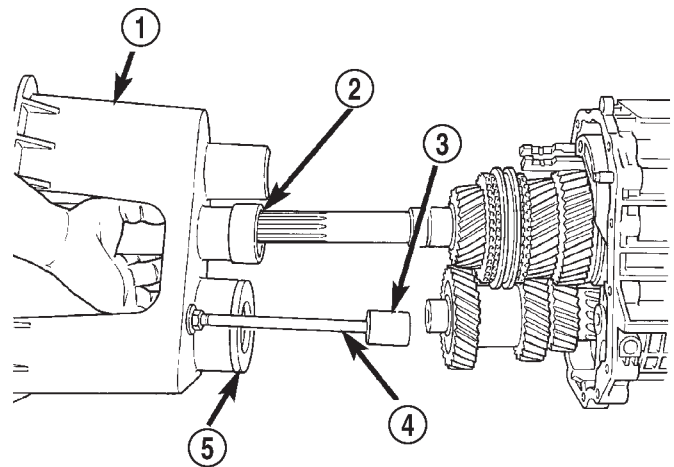
(11) Slide reverse idler shaft support (Fig. 25) straight out of housing.



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**Fig. 24 REVERSE IDLER SHAFT/SUPPORT BOLT**

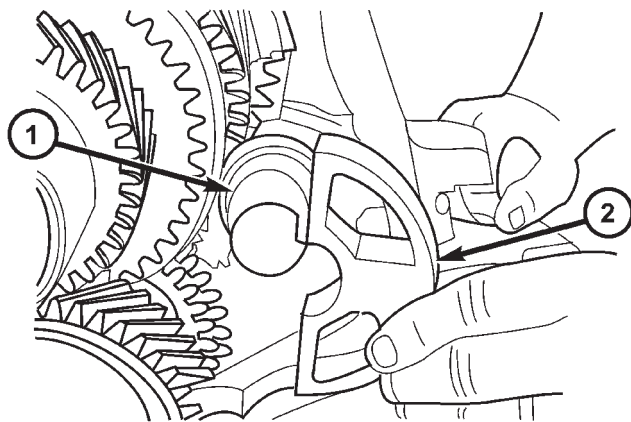
- 1 - SUPPORT BOLT
- 2 - SHAFT BOLT



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**Fig. 26 FIXTURE ASSEMBLY**

- 1 - FIXTURE
- 2 - ADAPTER
- 3 - CUP
- 4 - REVERSE IDLER PEDESTAL
- 5 - ADAPTER



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**Fig. 25 IDLER SHAFT SUPPORT**

- 1 - IDLER SHAFT
- 2 - IDLER SHAFT SUPPORT

(12) Support geartrain and rear housing on Fixture 6747 as follows:

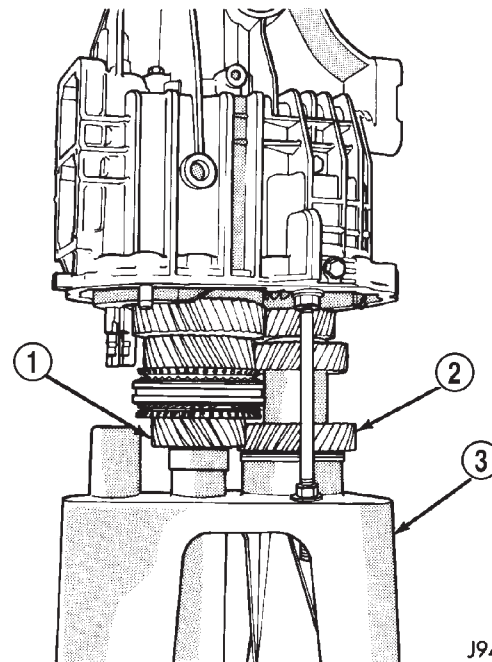
(a) Adjust height of reverse idler pedestal until the reverse idler shaft bottoms in Cup 8115.

(b) Position Adapters 6747-1A and 6747-2B on Fixture 6747.

(c) Slide fixture tool onto input shaft, countershaft and idler gear (Fig. 26).

(d) Stand geartrain and rear housing upright on fixture (Fig. 27). Have helper hold fixture tool in place while housing and geartrain is being rotated into upright position.

(13) Remove rear bolt holding reverse idler shaft in housing.



J9421-46

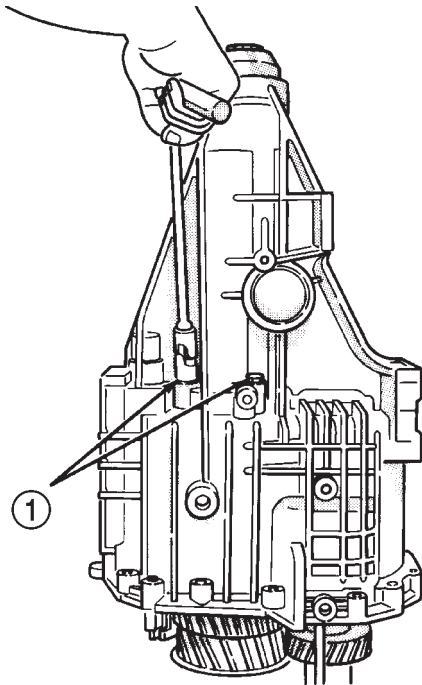
**Fig. 27 GEARTRAIN/HOUSING FIXTURE**

- 1 - INPUT SHAFT
- 2 - COUNTERSHAFT
- 3 - FIXTURE

**REAR HOUSING - 2WD**

(1) Remove three bolts rear of shift tower, that attach output shaft bearing retainer to rear case (Fig. 28).

(2) Tap rear housing upward and off output shaft bearing (Fig. 29).

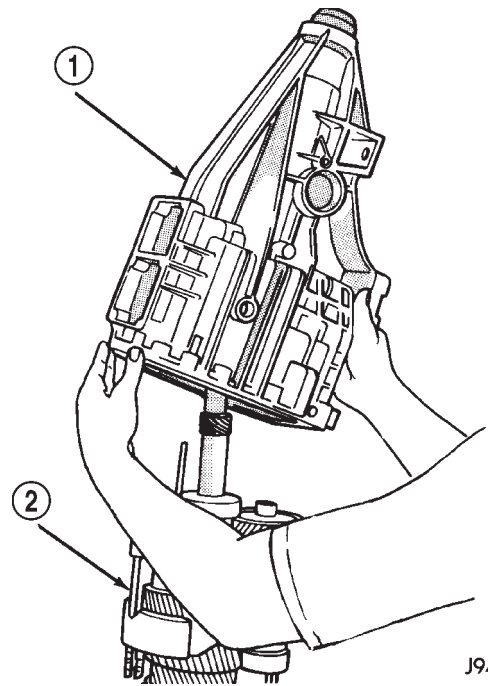


**Fig. 28 OUTPUT SHAFT**

1 - RETAINER BOLTS

J9421-50

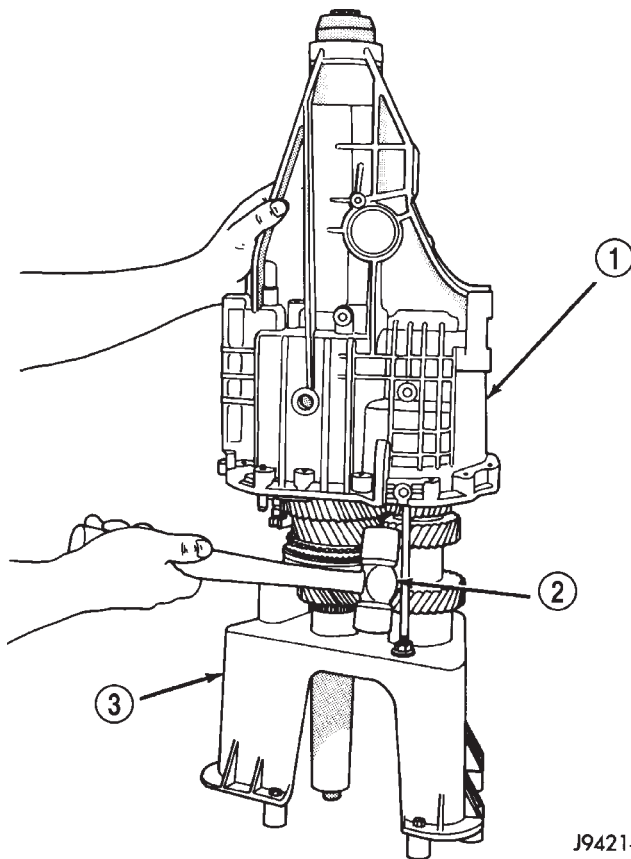
(3) Lift rear housing up and off geartrain (Fig. 30).



**Fig. 30 REAR HOUSING**

1 - REAR HOUSING  
2 - SHIFT FORKS AND GEARTRAIN

J9421-51



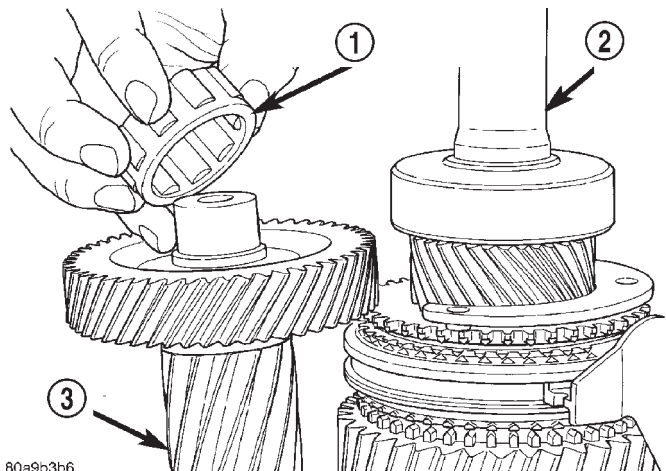
**Fig. 29 REAR HOUSING - 2WD**

1 - REAR HOUSING  
2 - PLASTIC/RAWHIDE MALLET  
3 - FIXTURE

J9421-49

(4) Remove countershaft rear bearing from countershaft (Fig. 31).

(5) Examine condition of bearing bore and idler shaft notch in rear housing. Replace housing if damaged.



**Fig. 31 COUNTERSHAFT REAR BEARING**

1 - COUNTERSHAFT REAR BEARING  
2 - OUTPUT SHAFT  
3 - COUNTER SHAFT

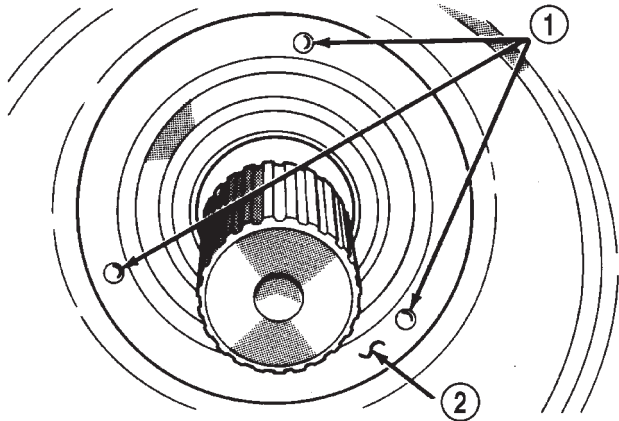
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## MANUAL - NV3550 (Continued)

**REAR ADAPTER HOUSING - 4WD**

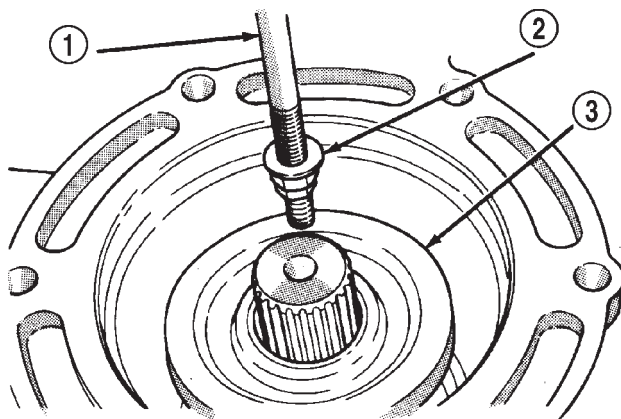
(1) Locate rear seal dimples (Fig. 32). Insert slide hammer mounted screw into one of the seal dimples and remove seal (Fig. 33).



J9421-197

**Fig. 32 SEAL DIMPLES - 4WD**

- 1 - DIMPLES
- 2 - SEAL FACE

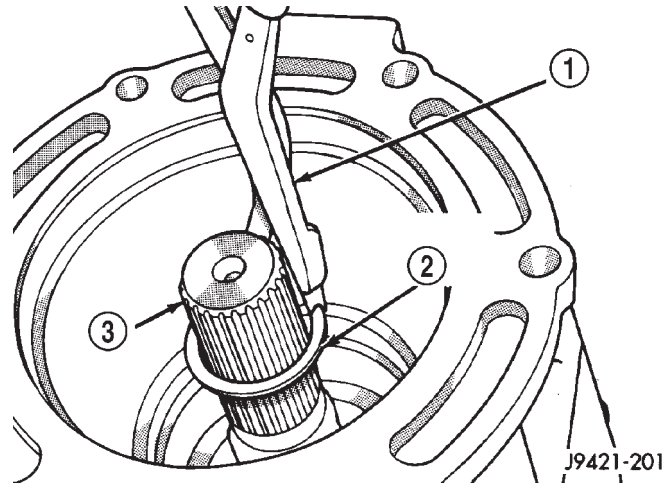


J9421-200

**Fig. 33 REAR SEAL - 4WD**

- 1 - SLIDE HAMMER
- 2 - SCREW
- 3 - REAR SEAL

(2) Remove rear bearing snap ring from output shaft with snap ring pliers (Fig. 34).

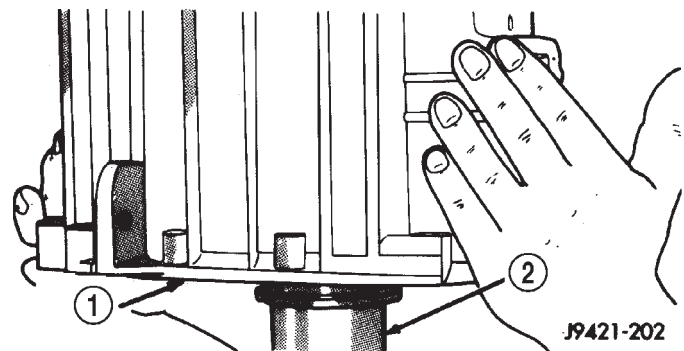


J9421-201

**Fig. 34 REAR BEARING SNAP RING - 4WD**

- 1 - HEAVY DUTY SNAP RING PLIERS
- 2 - REAR BEARING SNAP RING
- 3 - OUTPUT SHAFT

(3) Lift rear adapter housing upward and off geartrain (Fig. 35).



J9421-202

**Fig. 35 REAR ADAPTER HOUSING**

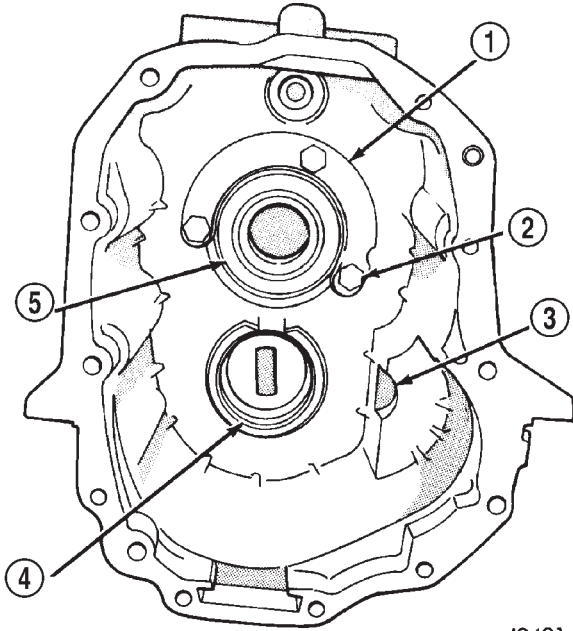
- 1 - REAR ADAPTER HOUSING
- 2 - OUTPUT SHAFT

(4) Remove bearing retainer bolts, rear bearing retainer and rear bearing (Fig. 36).

**NOTE:** If needed push or tap bearing out of the housing with a hammer.

(5) Inspect 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.

MANUAL - NV3550 (Continued)



J9421-203

**Fig. 36 REAR ADAPTER HOUSING COMPONENTS**

- 1 - BEARING RETAINER
- 2 - RETAINER BOLTS (3)
- 3 - IDLER SHAFT NOTCH
- 4 - COUNTERSHAFT REAR BEARING RACE
- 5 - REAR BEARING

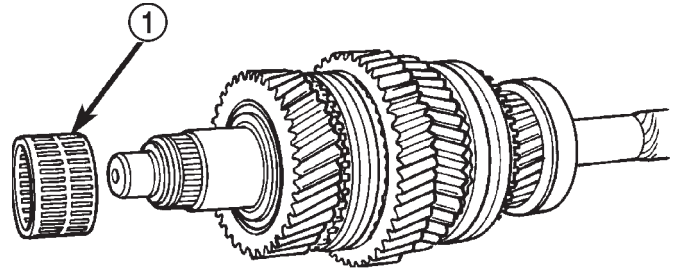
**GEARTRAIN FROM FIXTURE**

- (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.

**OUTPUT SHAFT**

**NOTE:** The synchronizer hubs and sleeves are different and must not be intermixed. Remove each synchronizer unit as an assembly to avoid intermixing parts. Reference mark or tag each synchro hub and sleeve for correct assembly.

- (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 Bearing Splitter 1130. Position splitter between second and third gears.
- (3) Remove third gear needle bearing (Fig. 37).

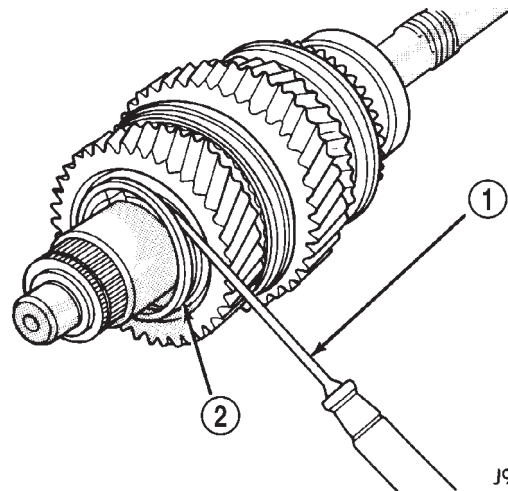


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**Fig. 37 THIRD GEAR NEEDLE BEARING**

- 1 - THIRD GEAR NEEDLE BEARING

- (4) Remove retaining ring that secures two-piece thrust washer on shaft (Fig. 38) with a small pry tool.



J9421-23

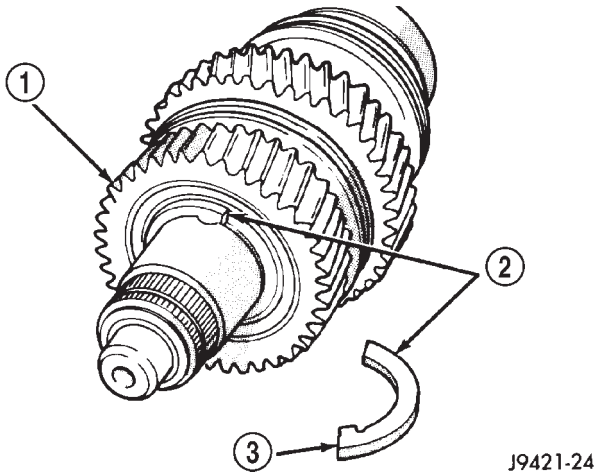
**Fig. 38 THRUST WASHER**

- 1 - PRY TOOL
- 2 - THRUST WASHER RETAINING RING

- (5) Remove two-piece thrust washer (Fig. 39).

MANUAL - NV3550 (Continued)

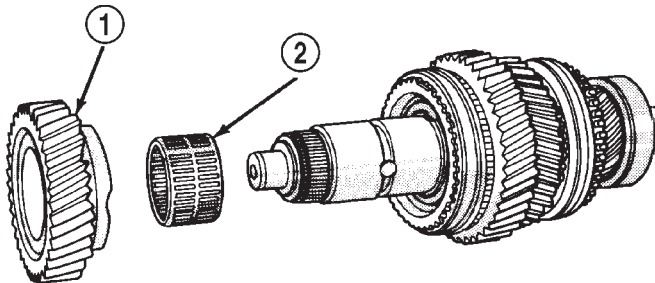
**NOTE:** Record location of washer locating lugs in shaft notches for installation reference.



**Fig. 39 TWO-PIECE THRUST WASHER**

- 1 - SECOND GEAR
- 2 - THRUST WASHER (2-PIECE)
- 3 - WASHER LOCATING LUG

(6) Remove second gear and needle bearing (Fig. 40).



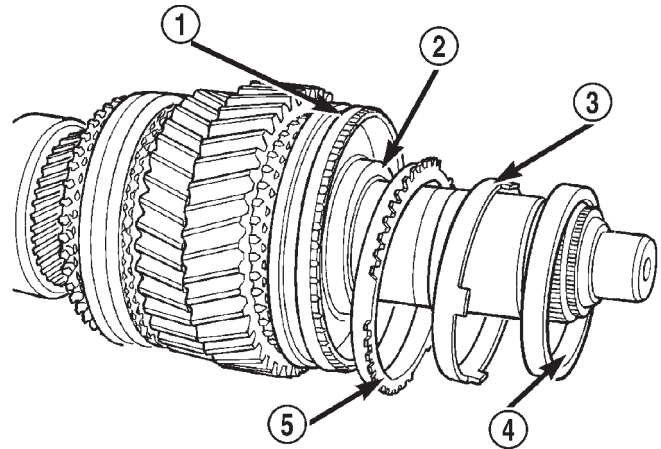
J9421-25

**Fig. 40 SECOND GEAR AND NEEDLE BEARING**

- 1 - SECOND GEAR
- 2 - SECOND GEAR NEEDLE BEARING

(7) Remove second gear synchro ring, synchro friction cone and synchro cone (Fig. 41).

(8) Remove interim ring and 1-2 synchro hub snap ring.

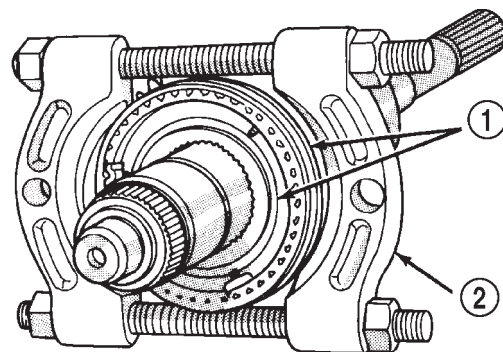


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**Fig. 41 SECOND GEAR SYNCHRO RING AND CONES**

- 1 - 1-2 SYNCHRO HUB AND SLEEVE
- 2 - INTERM RING
- 3 - SYNCHRO FRICTION CONE
- 4 - SYNCHRO CONE
- 5 - SYNCHRO RING

(9) Remove 1-2 synchro hub, sleeve and first gear from output shaft with a press and Bearing Splitter 1130 (Fig. 42). Position splitter between first and reverse gears.



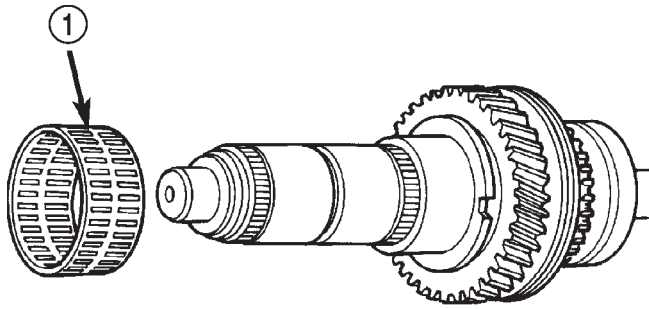
J9421-27

**Fig. 42 HUB SLEEVE AND 1-2 SYNCHRO**

- 1 - 1-2 SYNCHRO HUB AND SLEEVE
- 2 - BEARING SPITTER

MANUAL - NV3550 (Continued)

(10) Remove first gear needle bearing (Fig. 43).

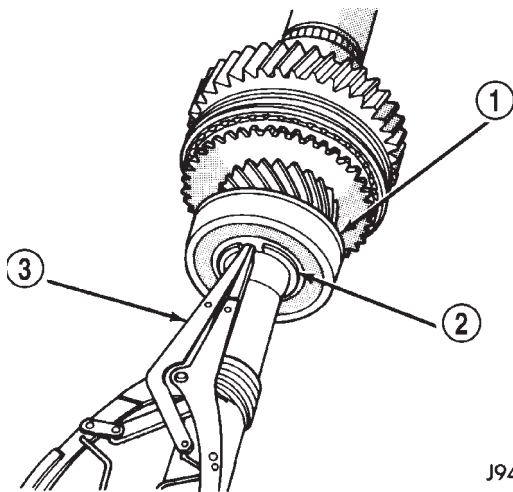


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**Fig. 43 FIRST GEAR NEEDLE BEARING**

1 - FIRST GEAR NEEDLE BEARING

(11) Remove output shaft bearing snap ring (Fig. 44).



J9421-29

**Fig. 44 OUTPUT SHAFT BEARING SNAP RING**

1 - OUTPUT SHAFT BEARING  
2 - BEARING SNAP RING  
3 - SNAP RING PLIERS

(12) Remove output shaft bearing on 2-wheel drive models.

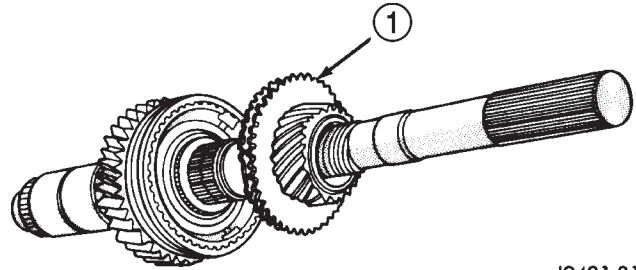
(13) Remove fifth gear (Fig. 45).

(14) Remove fifth gear needle bearing by spreading it apart just enough to clear shoulder on output shaft (Fig. 46).

(15) Remove fifth-reverse synchro hub snap ring (Fig. 47).

(16) Remove fifth-reverse synchro hub and sleeve with a press (Fig. 48).

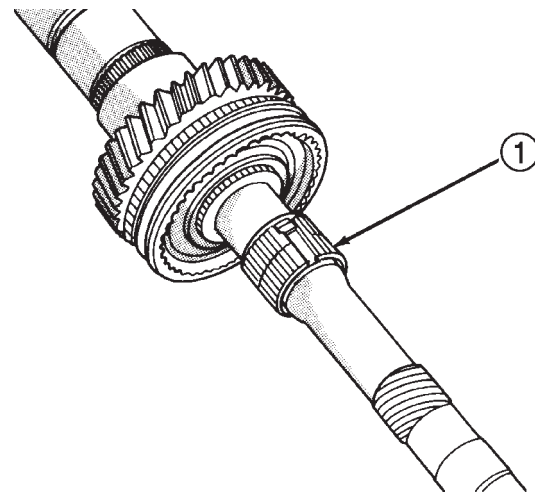
(17) Remove reverse gear and needle bearing (Fig. 49).



J9421-31

**Fig. 45 FIFTH GEAR**

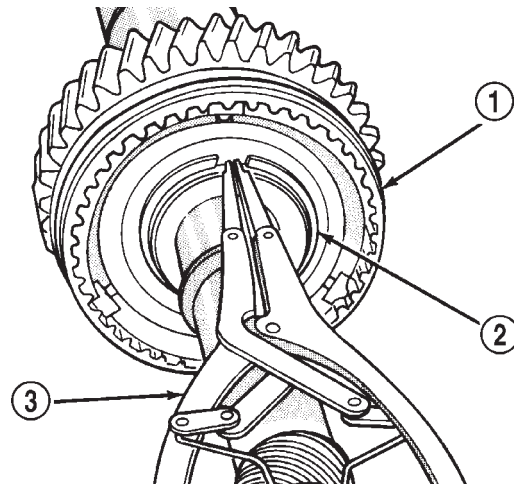
1 - FIFTH GEAR AND SYNCHRO RING



J9421-32

**Fig. 46 FIFTH GEAR NEEDLE BEARING**

1 - FIFTH GEAR NEEDLE BEARING

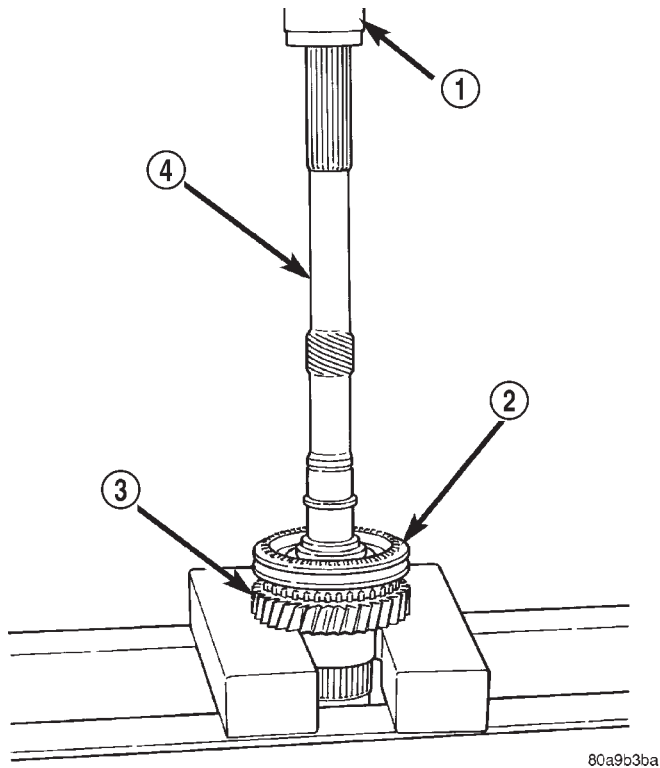


J9421-33

**Fig. 47 FIFTH-REVERSE SYNCHRO HUB SNAP RING**

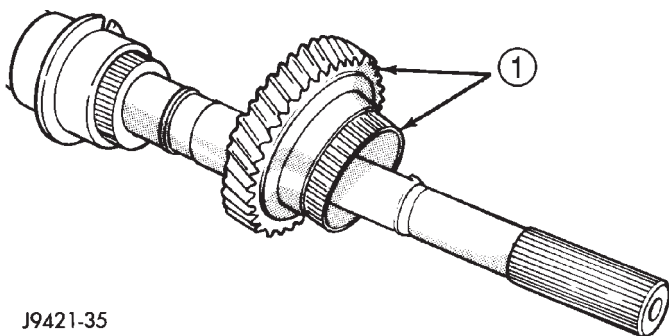
1 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE  
2 - SYNCHRO HUB SNAP RING  
3 - SNAP RING PLIERS

## MANUAL - NV3550 (Continued)



**Fig. 48 FIFTH-REVERSE SYNCHRO HUB AND SLEEVE**

- 1 - PRESS
- 2 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
- 3 - REVERSE GEAR
- 4 - OUTPUT SHAFT



**Fig. 49 REVERSE GEAR AND NEEDLE BEARING**

- 1 - REVERSE GEAR AND NEEDLE BEARING

### REVERSE IDLER

- (1) Remove idler gear snap rings (Fig. 50).
- (2) Remove thrust washer, wave washer, thrust plate and idler gear from shaft.
- (3) Remove idler gear needle bearing from shaft.

### CLEANING

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.

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.

### INSPECTION

**NOTE:** Minor nicks on surfaces can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth.

### 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. 51). 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. Replace the plunger and spring if in doubt about condition. Check condition of detent plunger bushings. Replace if damaged.

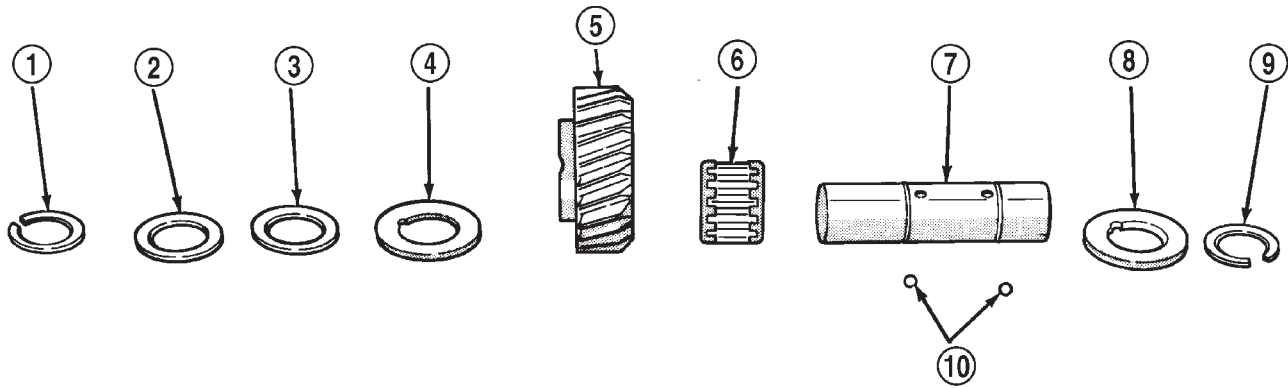
Inspect the shift shaft, shift shaft bushing and bearing, the shaft lever, and the lever bushing that fits over the lever. Replace the shaft if bent, cracked, or severely scored. Replace the shift shaft bushing or bearing if damaged.

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 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.

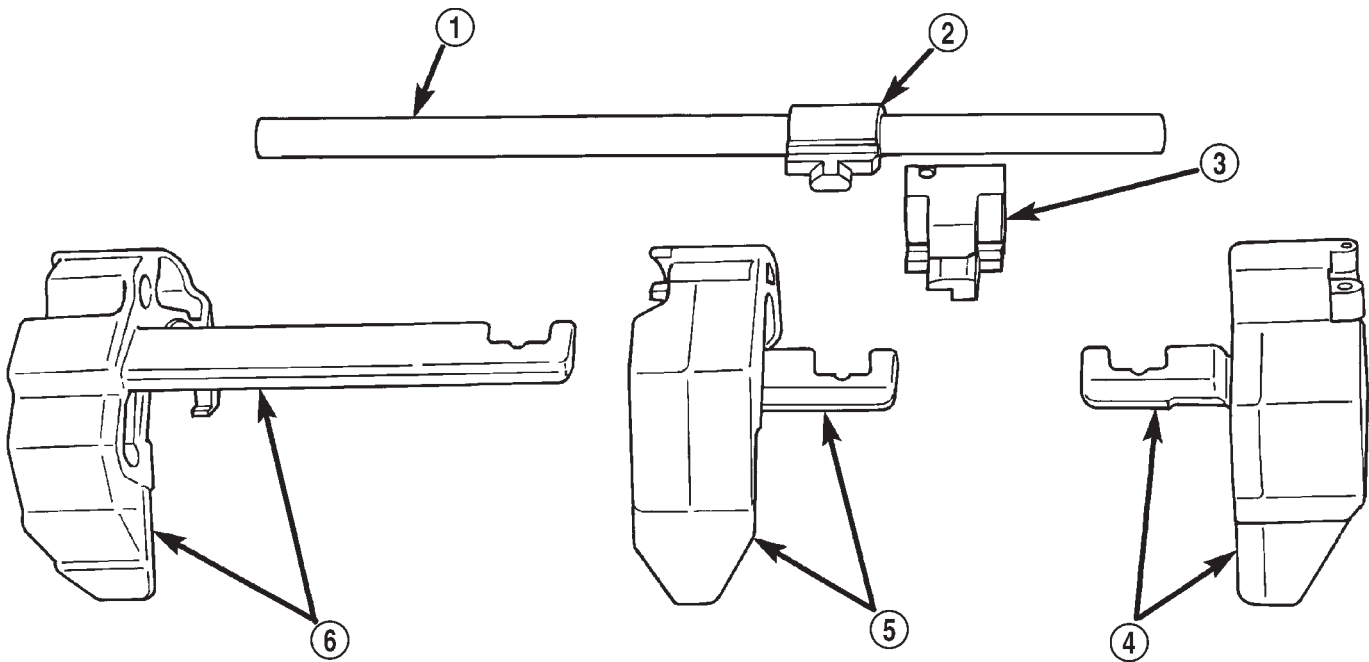
MANUAL - NV3550 (Continued)



J9421-53

**Fig. 50 REVERSE IDLER COMPONENTS**

- |                        |                              |
|------------------------|------------------------------|
| 1 - SNAP RING          | 6 - IDLER GEAR BEARING       |
| 2 - FLAT WASHER        | 7 - IDLER SHAFT              |
| 3 - WAVE WASHER        | 8 - THRUST WASHER            |
| 4 - THRUST WASHER      | 9 - SNAP RING                |
| 5 - REVERSE IDLER GEAR | 10 - THRUST WASHER LOCKBALLS |



80c070ff

**Fig. 51 Shift Forks And Shaft**

- |                         |                              |
|-------------------------|------------------------------|
| 1 - SHIFT SHAFT         | 4 - 3-4 SHIFT FORK           |
| 2 - SHAFT LEVER         | 5 - 1-2 SHIFT FORK           |
| 3 - SHAFT LEVER BUSHING | 6 - FIFTH-REVERSE SHIFT FORK |

MANUAL - NV3550 (Continued)

**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. Replace the retainer seal if necessary.

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. 52). The small diameter side goes in the bearing race.

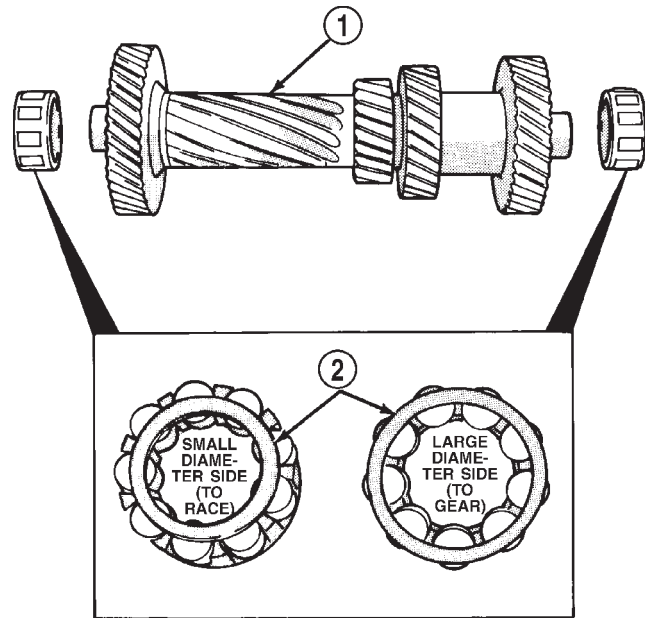
### REVERSE IDLER COMPONENTS

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



J9421-55

**Fig. 52 Countershaft Bearings**

- 1 - COUNTERSHAFT  
2 - BEARING CAGE

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 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 bearing surfaces. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn, or brinnelled.

### ASSEMBLY

**CAUTION:** Transmission shift components must be in the Neutral position during assembly, to prevent damage to synchros and shift components during housing installation.

**NOTE:** Use Mopar Gasket Maker or equivalent, for all case joints and Mopar silicone sealer or equivalent, for the input shaft bearing retainer.

MANUAL - NV3550 (Continued)

**SYNCHRONIZER**

**NOTE: Assemble synchro springs, struts and detent balls one at a time.**

(1) Slide the sleeve onto the hub, leaving enough room to install the spring in the hub and strut in the hub groove.

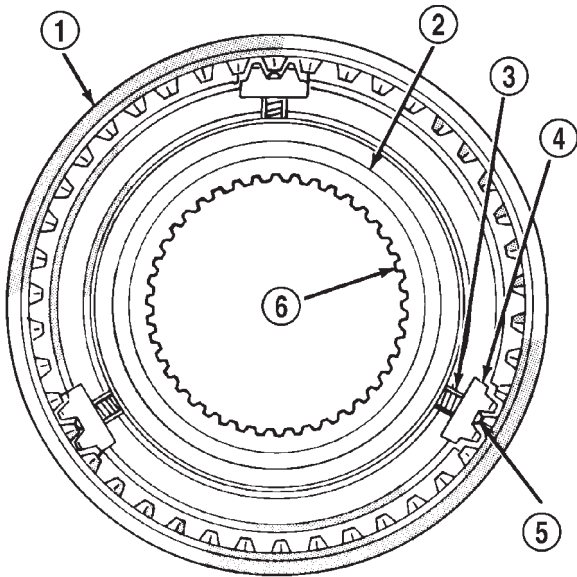
(2) Install the first spring in the hub. Then install a strut over the spring and verify the spring is seated in the spring bore in the strut.

(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. With a small flat blade screwdriver, press the ball into place while moving the sleeve over it.

(5) Repeat the procedure for the remaining springs, struts and balls. Tape or rubber band each strut and ball to temporarily secure as they are installed.

(6) Verify synchro springs, struts and detent balls are all in place (Fig. 53).



J9421-57

**Fig. 53 SYNCHRONIZER COMPONENTS**

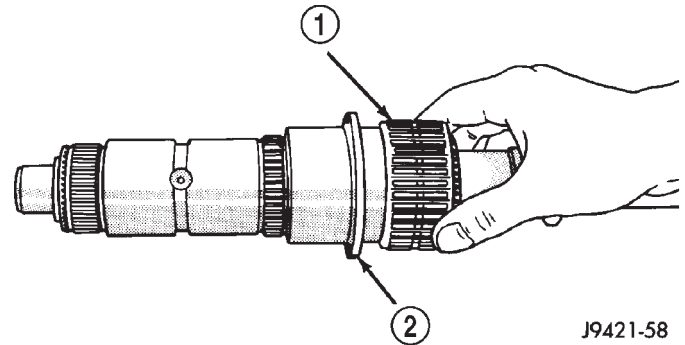
- 1 - SLEEVE
- 2 - HUB SHOULDER
- 3 - SPRING (3)
- 4 - STRUT (3)
- 5 - DETENT BALL (3)
- 6 - HUB

**OUTPUT SHAFT**

**NOTE: Lubricate shaft, gears, bearings and immerse each synchro ring with recommended**

lubricant during assembly. Petroleum jelly can be used to hold parts in place.

(1) Install reverse gear needle bearing, against the shoulder of the output shaft (Fig. 54).

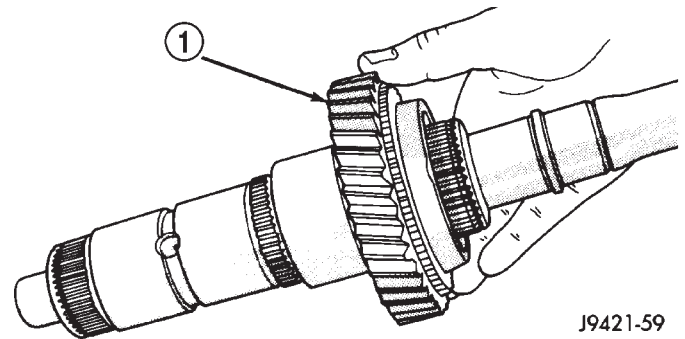


J9421-58

**Fig. 54 REVERSE GEAR BEARING**

- 1 - REVERSE GEAR BEARING
- 2 - SHOULDER

(2) Install reverse gear over needle bearing (Fig. 55).

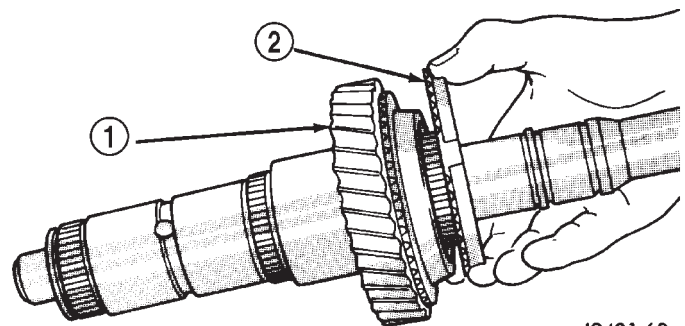


J9421-59

**Fig. 55 REVERSE GEAR**

- 1 - REVERSE GEAR

(3) Install brass synchro ring on reverse gear (Fig. 56).



J9421-60

**Fig. 56 REVERSE SYNCHRO**

- 1 - REVERSE GEAR
- 2 - SYNCHRO RING

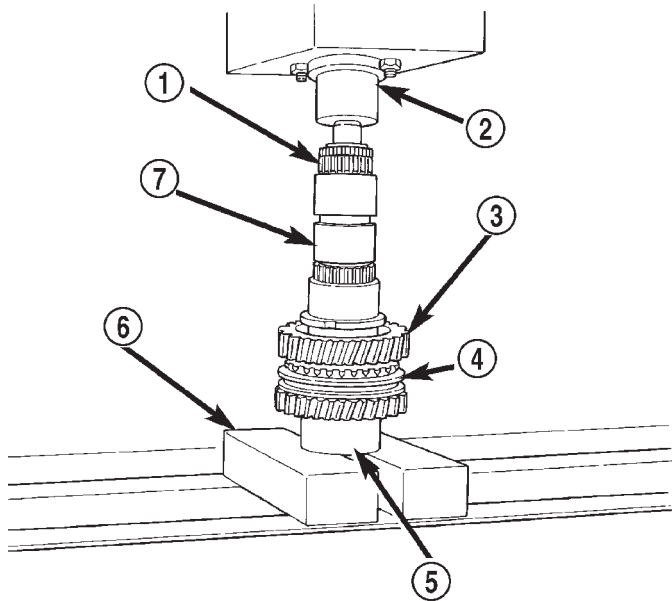


MANUAL - NV3550 (Continued)

(4) Assemble fifth-reverse synchro hub, sleeve, struts, springs and detent balls, if not previously done.

**NOTE:** The side of the hub with the shoulder around the hub bore and tapered side of the sleeve, faces the front of the shaft.

(5) Align fifth-reverse synchro assembly on output shaft splines. Seat synchro onto the shaft with Cup 6310-1 and a press (Fig. 57).



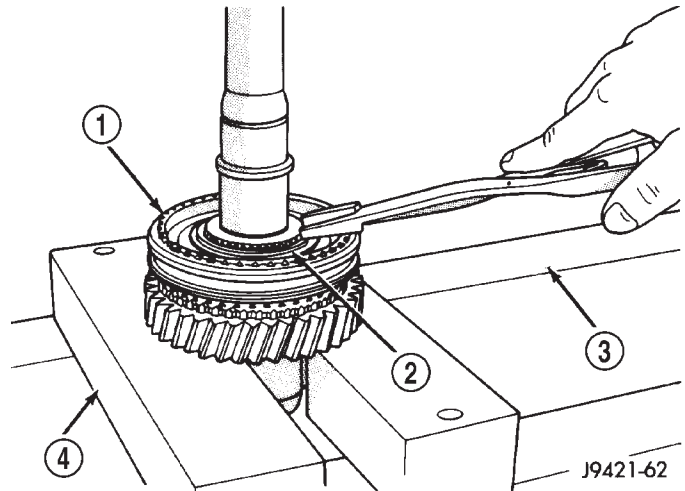
80a9b3bb

**Fig. 57 FIFTH-REVERSE SYNCHRO ASSEMBLY**

- 1 - SPACER
- 2 - PRESS RAM
- 3 - REVERSE GEAR
- 4 - FIFTH-REVERSE SYNCHRO ASSEMBLY
- 5 - CUP
- 6 - PRESS BLOCKS
- 7 - OUTPUT SHAFT

(6) Install **new** fifth-reverse hub snap ring (Fig. 58) and verify the snap ring is seated.

**NOTE:** Snap rings are available in thicknesses from 2.00 mm to 2.20 mm (0.078 to 0.086 in.). Install thickest snap ring that will fit in shaft groove.

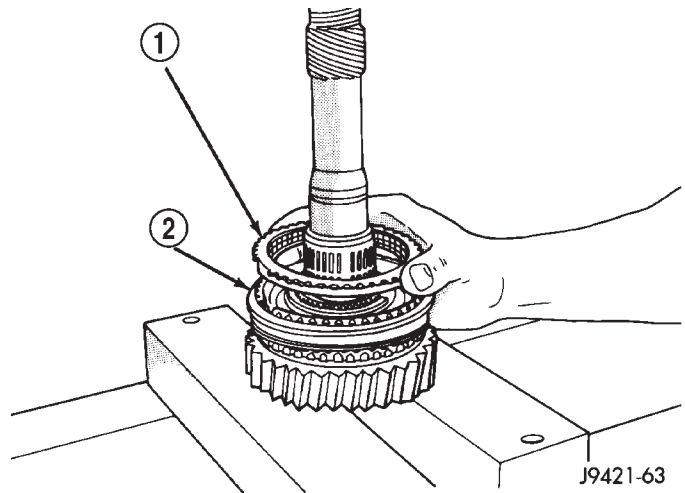


J9421-62

**Fig. 58 FIFTH/REVERSE SYNCHRO HUB SNAP RING**

- 1 - FIFTH-REVERSE SYNCHRO ASSEMBLY
- 2 - SNAP RING
- 3 - PRESS BED
- 4 - PRESS BLOCKS

(7) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 59).



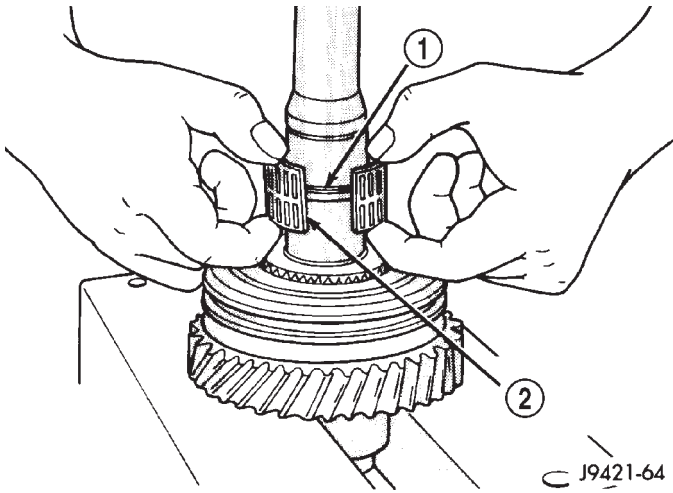
J9421-63

**Fig. 59 FIFTH GEAR SYNCHRO RING**

- 1 - FIFTH-SPEED SYNCHRO RING
- 2 - FIFTH-REVERSE SYNCHRO ASSEMBLY

MANUAL - NV3550 (Continued)

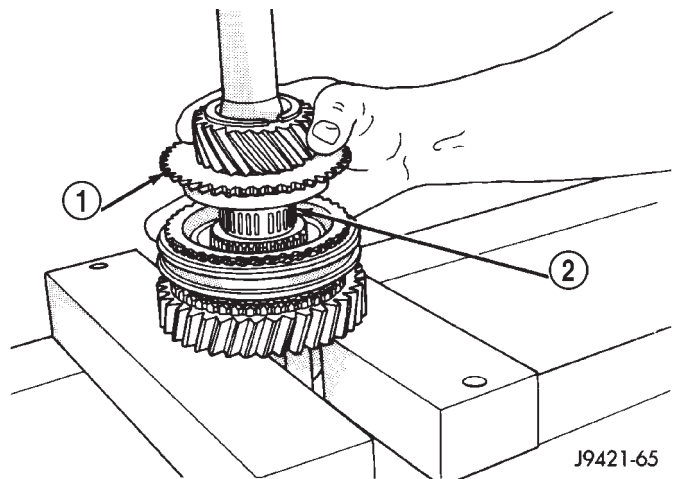
(8) Install fifth gear bearing by spreading bearing, just enough to clear shoulder on the output shaft (Fig. 60). Verify bearing is properly seated.



**Fig. 60 FIFTH GEAR BEARING**

- 1 - SHAFT SHOULDER
- 2 - FIFTH GEAR BEARING

(9) Install fifth gear on shaft and onto bearing (Fig. 61).

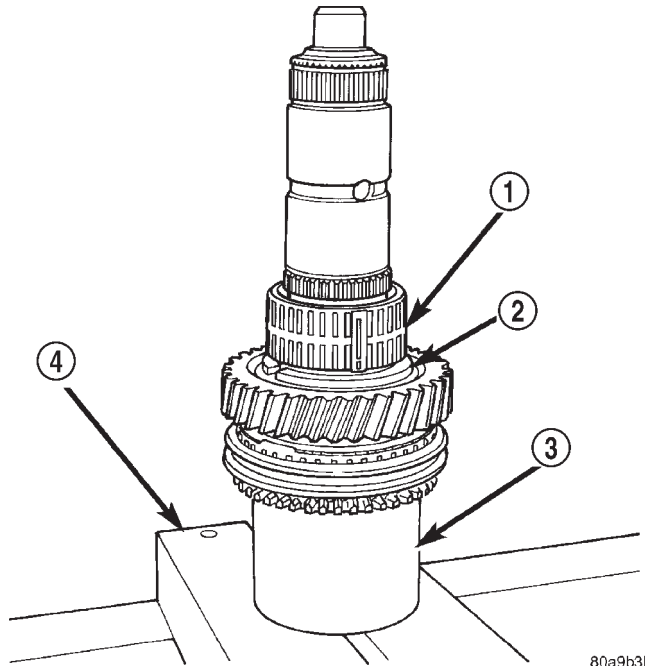


**Fig. 61 FIFTH GEAR**

- 1 - FIFTH GEAR
- 2 - BEARING

(10) Invert output shaft and set shaft in Cup 6310-1 so fifth gear is seated on the tool (Fig. 62).

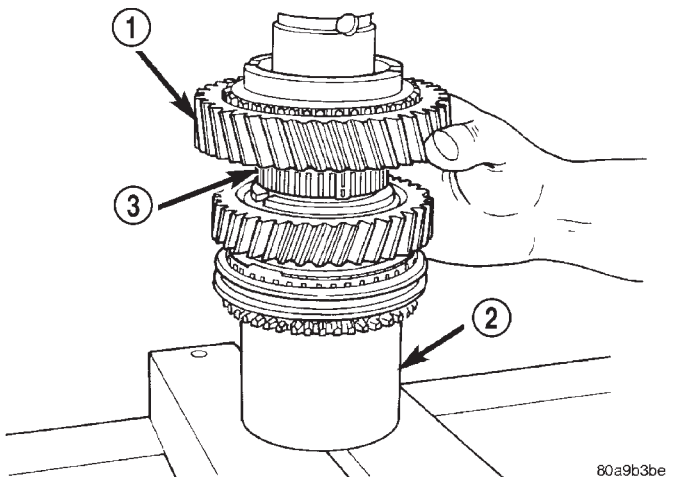
(11) Install first gear bearing on output shaft (Fig. 62). Verify bearing is seated on shaft shoulder and is properly joined.



**Fig. 62 FIRST GEAR BEARING**

- 1 - FIRST GEAR BEARING
- 2 - SHAFT SHOULDER
- 3 - CUP
- 4 - PRESS BLOCKS

(12) Install first gear on shaft and over bearing with bearing synchro cone facing up (Fig. 63).

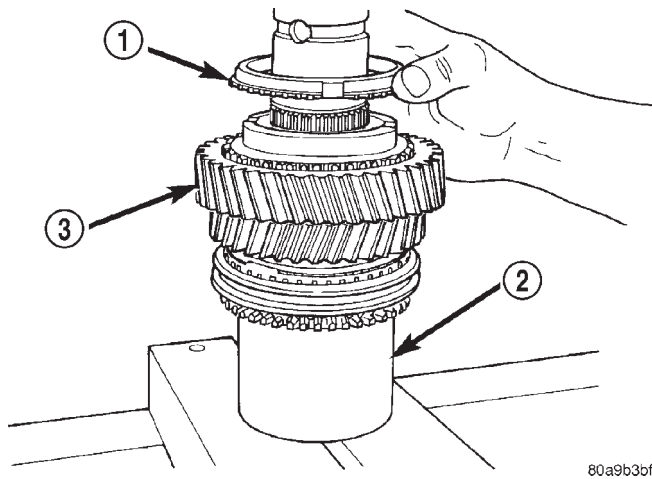


**Fig. 63 FIRST GEAR**

- 1 - FIRST GEAR
- 2 - CUP
- 3 - BEARING

MANUAL - NV3550 (Continued)

(13) Install first gear synchro ring (Fig. 64).



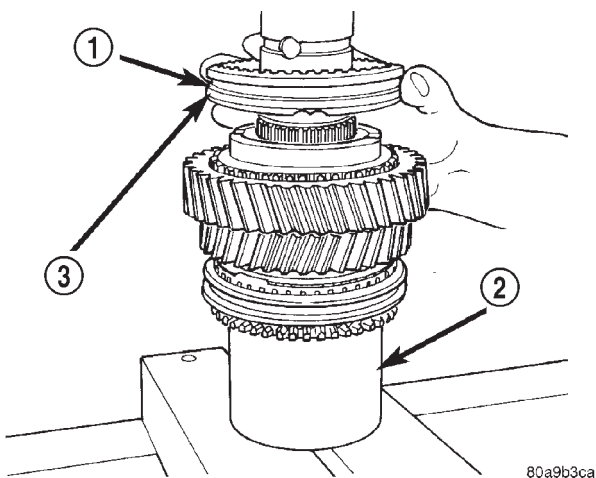
**Fig. 64 FIRST GEAR SYNCHRO RING**

- 1 - FIRST GEAR SYNCHRO RING
- 2 - CUP
- 3 - FIRST GEAR

(14) Assemble 1-2 synchro hub sleeve, springs, struts and detent balls.

**CAUTION:** One side of the synchro sleeve is marked First Gear Side. This side of the sleeve must face first gear.

(15) Align 1-2 synchro assembly on the shaft (Fig. 65).

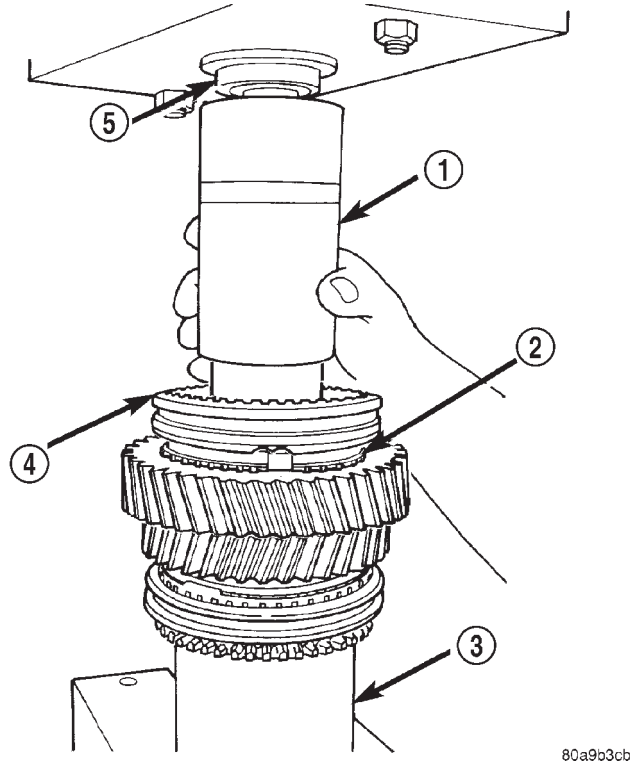


**Fig. 65 STARTING 1-2 SYNCHRO**

- 1 - 1-2 SYNCHRO ASSEMBLY
- 2 - CUP
- 3 - FIRST GEAR SIDE OF SYNCHRO SLEEVE

(16) Press 1-2 synchro onto output shaft using suitable size pipe tool and shop press (Fig. 66).

**CAUTION:** Ensure synchro ring and sleeve is aligned as hub is being pressed onto the shaft. The synchro ring can crack if not aligned.



**Fig. 66 PRESS 1-2 SYNCHRO**

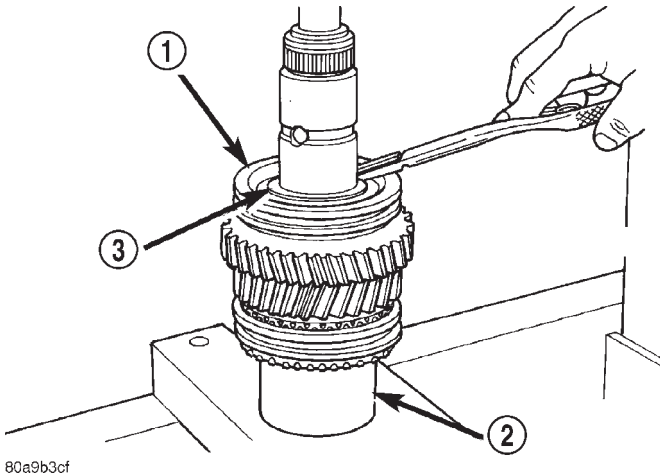
- 1 - SUITABLE SIZE PIPE
- 2 - SYNCHRO RING
- 3 - SPECIAL TOOL
- 4 - 1-2 SYNCHRO ASSEMBLY
- 5 - PRESS RAM

(17) Install interm ring.

(18) Install **new** 1-2 synchro hub snap ring (Fig. 67) and verify the snap ring is seated.

**NOTE:** Snap rings are available in thicknesses from 1.80 mm to 2.00 mm (0.070 to 0.078 in.). Install thickest snap ring that will fit in shaft groove.

MANUAL - NV3550 (Continued)



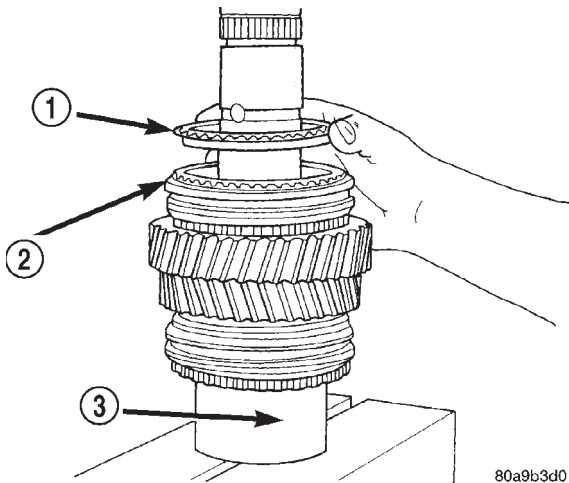
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**Fig. 67 1-2 SYNCHRO HUB SNAP RING**

- 1 - 1-2 SYNCHRO
- 2 - CUP
- 3 - SYNCHRO SNAP RING

(19) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 68). Verify synchro ring is properly seated.

(20) Install synchro friction cone and synchro cone in synchro ring.

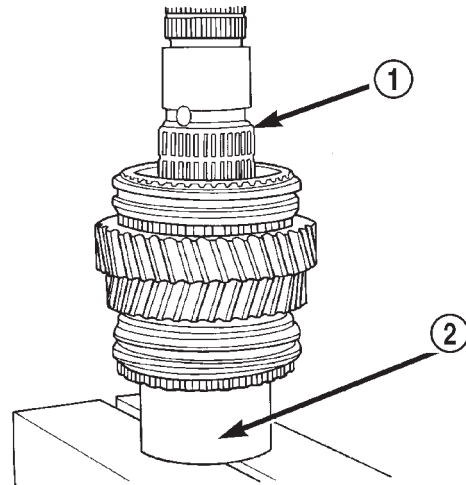


80a9b3d0

**Fig. 68 SECOND GEAR SYNCHRO RING**

- 1 - SECOND GEAR SYNCHRO RING
- 2 - 1-2 SYNCHRO
- 3 - CUP

(21) Install second gear needle bearing on shaft (Fig. 69).

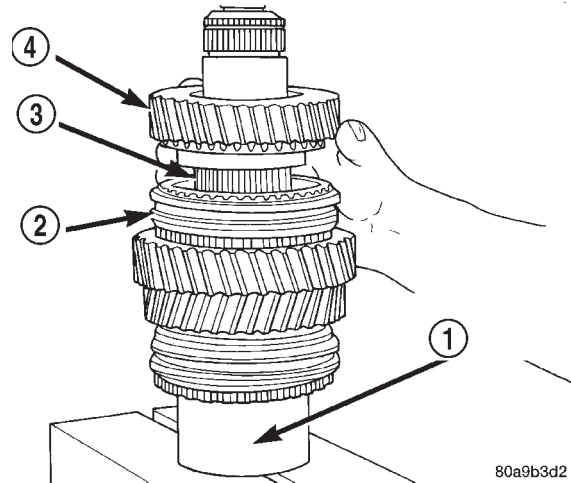


80a9b3d1

**Fig. 69 SECOND GEAR BEARING**

- 1 - SECOND GEAR BEARING
- 2 - CUP

(22) Install second gear onto shaft and bearing (Fig. 70). Verify second gear is fully seated on synchro components.



80a9b3d2

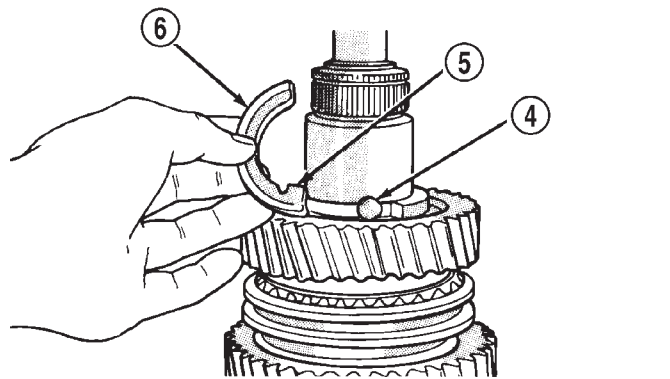
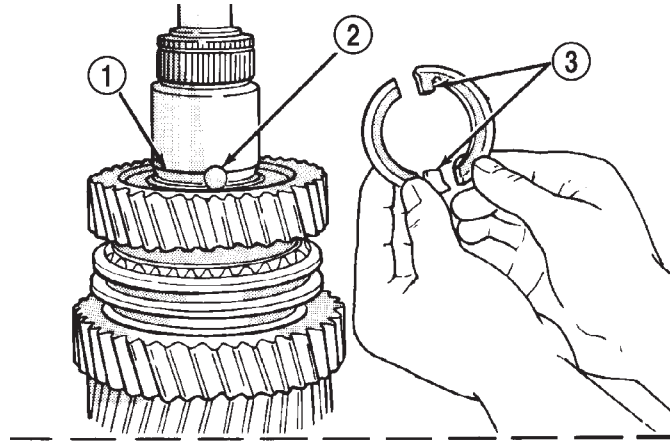
**Fig. 70 SECOND GEAR**

- 1 - CUP
- 2 - 1-2 SYNCHRO ASSEMBLY
- 3 - BEARING
- 4 - SECOND GEAR

MANUAL - NV3550 (Continued)

(23) Install two-piece thrust washer (Fig. 71). Ensure washer halves are seated in shaft groove and washer lugs are seated in shaft lug bores.

**NOTE:** Verify i.d. grooves and markings noted during removal are facing the correct direction.

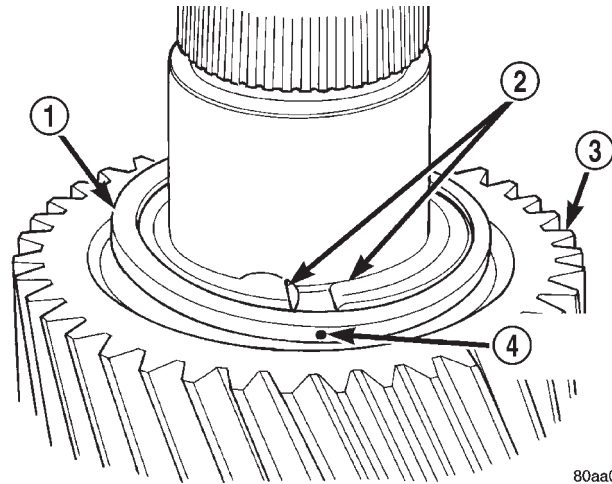


J9421-77

**Fig. 71 TWO-PIECE THRUST WASH**

- 1 - WASHER GROOVE IN SHAFT
- 2 - LUG BORE
- 3 - THRUST WASHER LUGS
- 4 - LUG BORE
- 5 - LUG
- 6 - WASHER HALF

(24) Start retaining ring around two-piece thrust washer (Fig. 72). Ensure locating dimple is between the thrust washer halves.

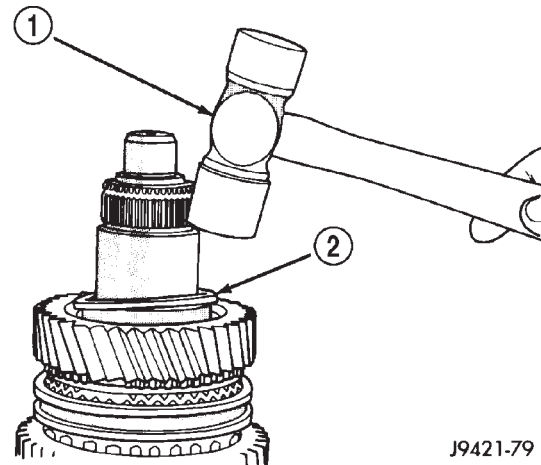


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**Fig. 72 RETAINING RING**

- 1 - THRUST WASHER RETAINING RING
- 2 - THRUST WASHER HALVES
- 3 - SECOND GEAR
- 4 - LOCATING DIMPLE

(25) Seat thrust washer retaining ring with plastic mallet (Fig. 73).



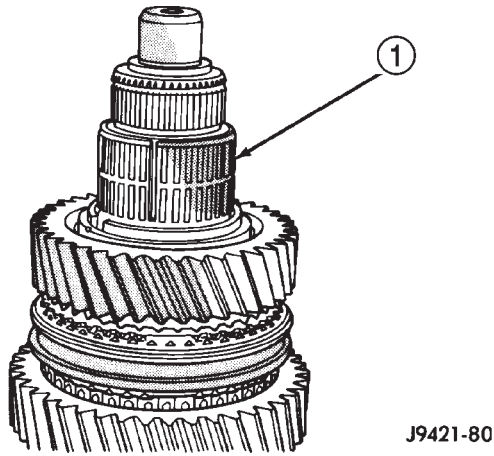
J9421-79

**Fig. 73 THRUST RETAINER**

- 1 - PLASTIC MALLET
- 2 - THRUST WASHER RETAINING RING

MANUAL - NV3550 (Continued)

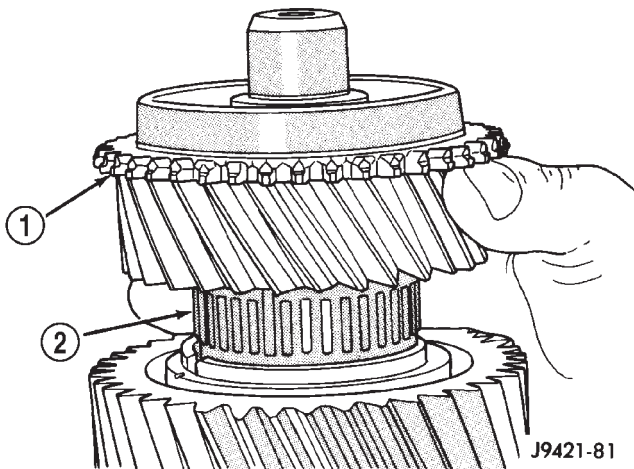
(26) Install third gear needle bearing on shaft (Fig. 74).



**Fig. 74 THIRD GEAR BEARING**

1 - THIRD GEAR BEARING

(27) Install third gear on shaft and bearing (Fig. 75).



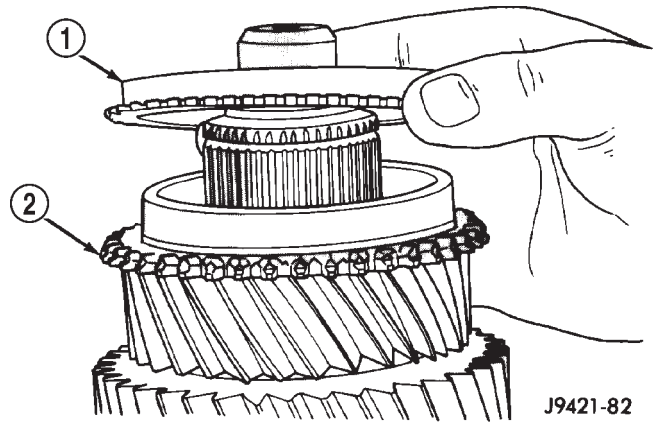
**Fig. 75 THIRD GEAR**

1 - THIRD GEAR  
2 - BEARING

(28) Install third speed synchro ring on third gear (Fig. 76).

(29) Assemble 3-4 synchro hub, sleeve, springs, struts and detent balls.

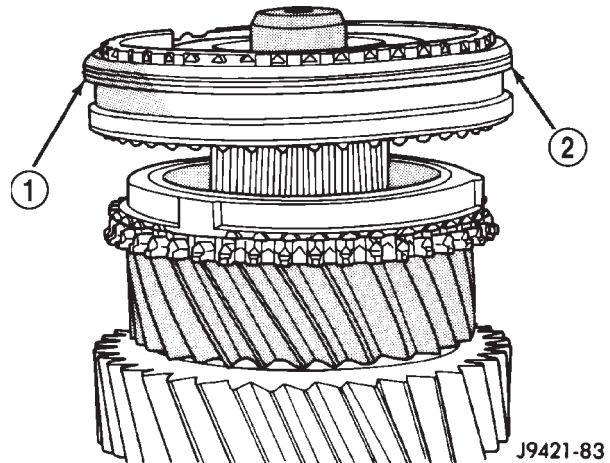
(30) Align 3-4 synchro hub on output shaft splines by hand (Fig. 77).



**Fig. 76 THIRD SPEED SYNCHRO RING**

1 - THIRD SPEED SYNCHRO RING  
2 - THIRD GEAR

**CAUTION:** One side of the sleeve has grooves in it. This side of sleeve must face the front of the shaft.



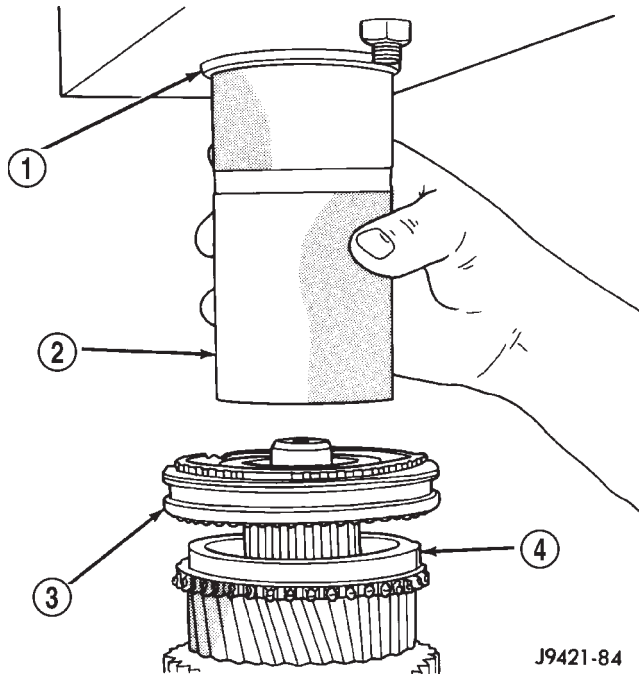
**Fig. 77 3-4 SYNCHRO HUB ON OUTPUT SHAFT**

1 - GROOVED SIDE OF SLEEVE  
2 - 3-4 SYNCHRO ASSEMBLY

(31) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe tool (Fig. 78).

MANUAL - NV3550 (Continued)

**NOTE:** Place the pipe on hub as close to output shaft as possible without contacting the shaft splines.

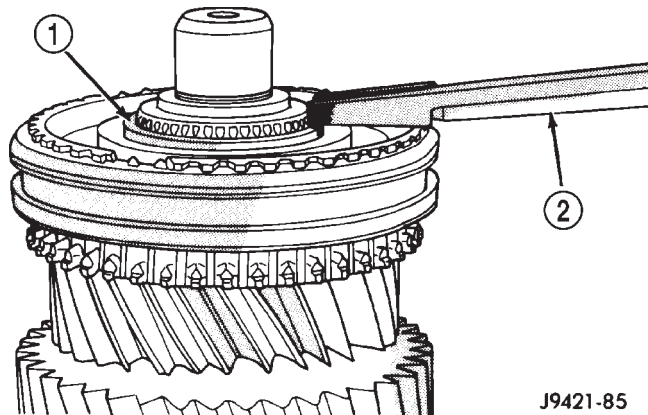


**Fig. 78 PRESS 3-4 SYNCHRO ON OUTPUT SHAF**

- 1 - PRESS RAM
- 2 - PIPE TOOL
- 3 - 3-4 SYNCHRO
- 4 - THIRD SPEED SYNCHRO RING

(32) Install **new** 3-4 synchro hub snap ring (Fig. 79) and verify snap ring is seated.

**NOTE:** Snap rings are available in thicknesses from 2.00 mm to 2.30 mm (0.078 to 0.090 in.). Install thickest snap ring that will fit in shaft groove.

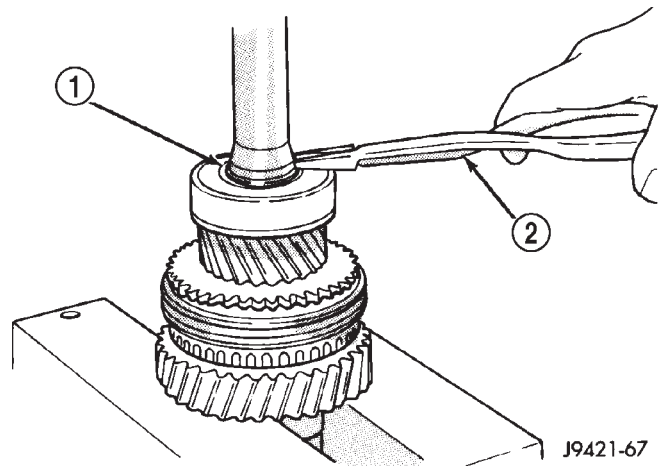


**Fig. 79 3-4 SYNCHRO HUB SNAP RING**

- 1 - 3-4 SYNCHRO HUB SNAP RING
- 2 - HEAVY DUTY SNAP RING PLIERS

(33) Install output shaft bearing.

(34) Install output shaft bearing snap ring, spreading it just enough to install it (Fig. 80). Verify snap ring is seated in shaft groove.



**Fig. 80 OUTPUT SHAFT BEARING**

- 1 - BEARING SNAP RING
- 2 - SNAP RING PLIERS

(35) Verify position of synchro sleeves before proceeding with assembly operations (Fig. 81). 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.

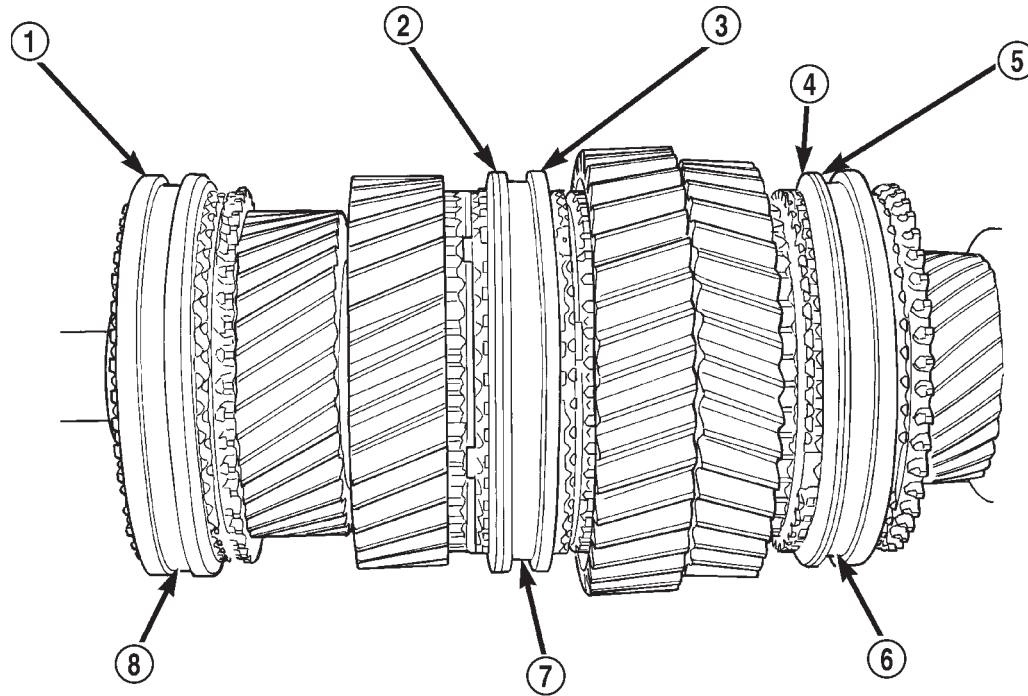
### REVERSE IDLER ASSEMBLY

- (1) Lubricate idler components with gear lube.
- (2) Slide idler gear bearing on shaft (Fig. 82). Bearing fits either way on shaft.
- (3) Slide gear onto shaft with recess to the rear (Fig. 82).
- (4) Place first lock ball in dimple at rear end of idler shaft (Fig. 82). Hold ball in place with petroleum jelly.
- (5) Slide thrust rear thrust washer onto shaft and over lock ball (Fig. 83).
- (6) Install snap ring in groove at rear of shaft (Fig. 83).
- (7) Install lock ball in dimple at front of shaft. Hold ball in place with petroleum jelly.
- (8) Install front thrust washer on shaft and slide washer up against gear and over lock ball (Fig. 84).
- (9) Install wave washer, flat washer and remaining snap ring on idler shaft (Fig. 84). Verify snap ring is seated.

### SHIFT SHAFT AND BUSHINGS/BEARINGS

- (1) Locate a bolt that will thread into the bushing without great effort.
- (2) Thread the bolt into the bushing, allowing the bolt to make its own threads in the bushing.

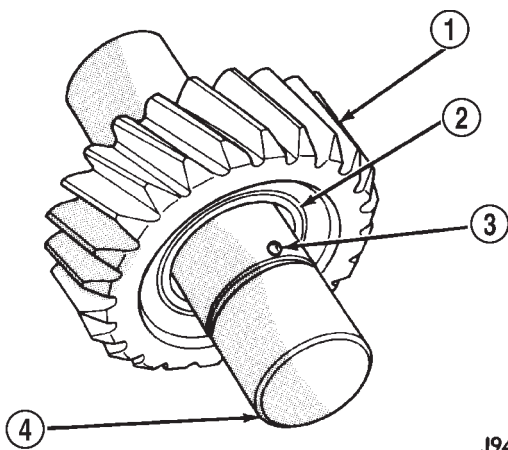
MANUAL - NV3550 (Continued)



80aa0ea9

**Fig. 81 SYNCHRO SLEEVE LOCATIONS**

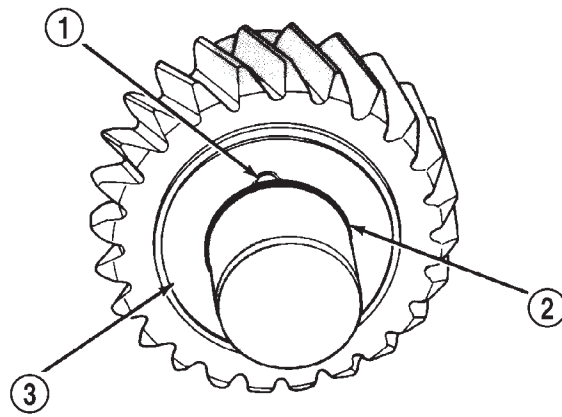
- |   |                            |
|---|----------------------------|
| 1 - DOUBLE GROOVE FORWARD                     | 5 - GROOVE FORWARD         |
| 2 - GROOVE FORWARD                            | 6 - 5TH-REV SYNCHRO SLEEVE |
| 3 - FIRST GEAR SIDE MARKING TOWARD FIRST GEAR | 7 - 1-2 SYNCHRO SLEEVE     |
| 4 - TAPER FORWARD                             | 8 - 3-4 SYNCHRO SLEEVE     |



J9421-87

**Fig. 82 IDLER GEAR AND BEARING**

- 1 - IDLER GEAR
- 2 - BEARING
- 3 - LOCK BALL
- 4 - REAR OF SHAFT



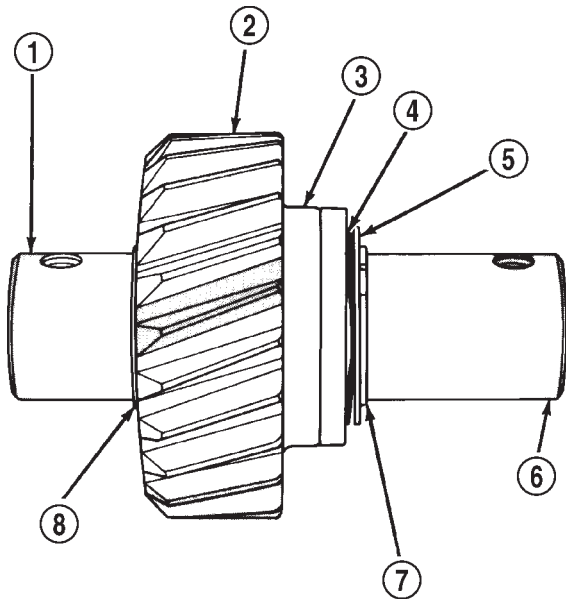
J9421-89

**Fig. 83 IDLER GEAR REAR THRUST WASHER**

- 1 - LOCK BALL
- 2 - SNAP RING GROOVE
- 3 - THRUST WASHER



MANUAL - NV3550 (Continued)



J9421-90

**Fig. 84 IDLER GEAR AND SHAFT ASSEMBLY**

- 1 - REAR OF SHAFT
- 2 - GEAR
- 3 - THRUST WASHER AND BALL
- 4 - WAVE WASHER
- 5 - FLAT WASHER
- 6 - FRONT OF SHAFT
- 7 - SNAP RING
- 8 - SNAP RING

(3) Attach a slide hammer or suitable puller to the bolt and remove bushing.

(4) Use the short end of Installer 8119 to install the new bushing.

(5) The bushing is correctly installed if the bushing is flush with the transmission case.

(6) To replace the bearing locate a bolt that will thread into the bearing without great effort.

(7) Thread the bolt into the bearing as much as possible.

(8) Attach a slide hammer or suitable puller to the bolt and remove the bearing.

(9) Use the short end of Installer 8119 to install the new bearing.

(10) The bearing is correctly installed if the bearing is flush with the transmission case.

## DETENT PLUNGER BUSHING

**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.

(1) Using the long end of Installer 8119, drive the detent bushings through the outer case and into the shift shaft bore.

(2) Remove the bushings from the shift shaft bore.

(3) Install a new detent plunger bushing on the long end of Installer 8118.

(4) Start the bushing in the detent plunger bore in the case.

(5) Drive the bushing into the bore until the tool contacts the transmission case.

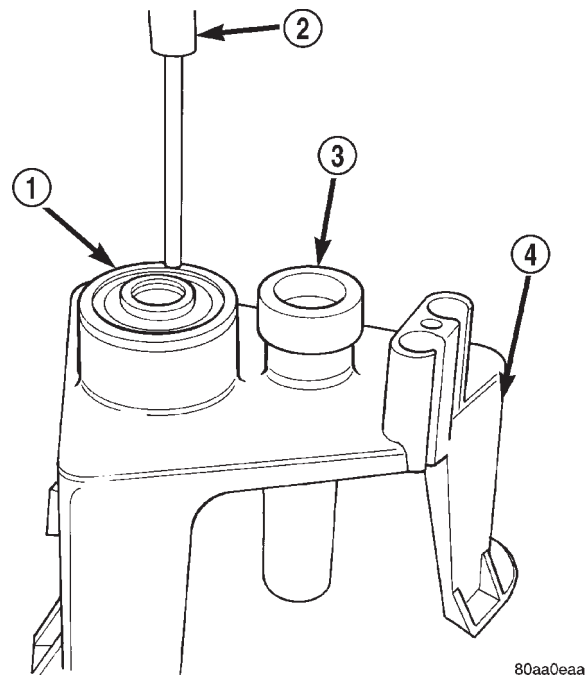
(6) Install a new detent plunger bushing on the short end of Installer 8118.

(7) Start the bushing in the detent plunger bore in the case.

(8) Drive the bushing into the bore until the tool contacts the transmission case.

## GEARTRAIN ASSEMBLY

(1) Install Adapter 6747-1A on input shaft hub of Fixture 6747 (Fig. 85).



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**Fig. 85 ASSEMBLY FIXTURE**

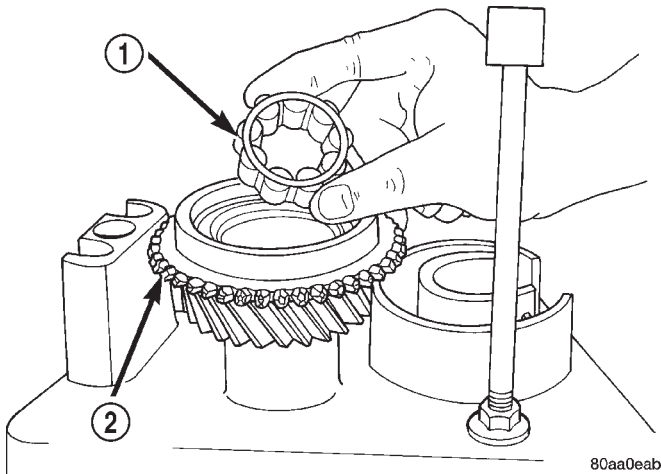
- 1 - ADAPTER 6747-2B
- 2 - CUP 8115
- 3 - ADAPTER 6747-1A
- 4 - FIXTURE

(2) Install input shaft in fixture and make sure Adapter 6747-1A is positioned under shaft as shown (Fig. 86).

(3) Install pilot bearing in input shaft (Fig. 86).

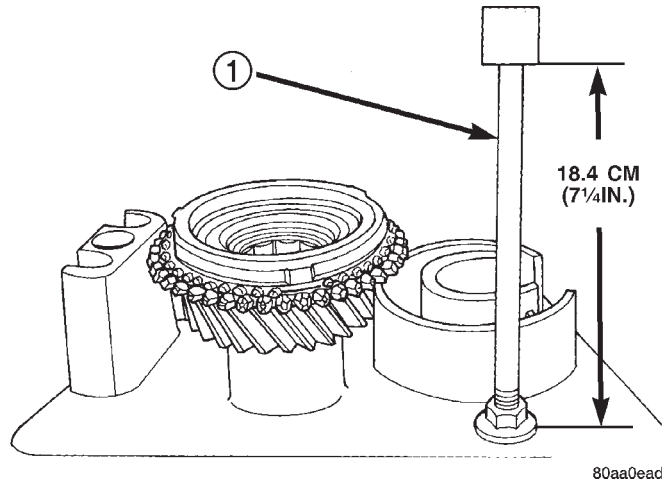
**NOTE:** The side of the pilot bearing with the small diameter goes toward the input shaft.

MANUAL - NV3550 (Continued)



**Fig. 86 PILOT BEARING AND INPUT SHAFT**

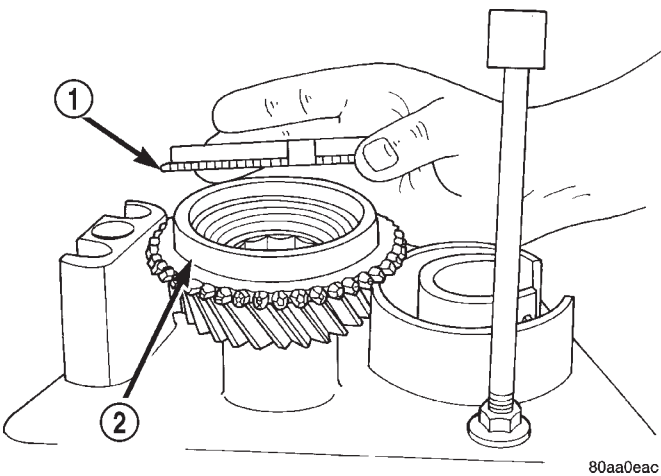
- 1 - PILOT BEARING
- 2 - INPUT SHAFT



**Fig. 88 IDLER PEDESTAL BASIC HEIGHT**

- 1 - REVERSE IDLER PEDESTAL

(4) Install fourth gear synchro ring on input shaft (Fig. 87).



**Fig. 87 FOURTH GEAR SYNCHRO**

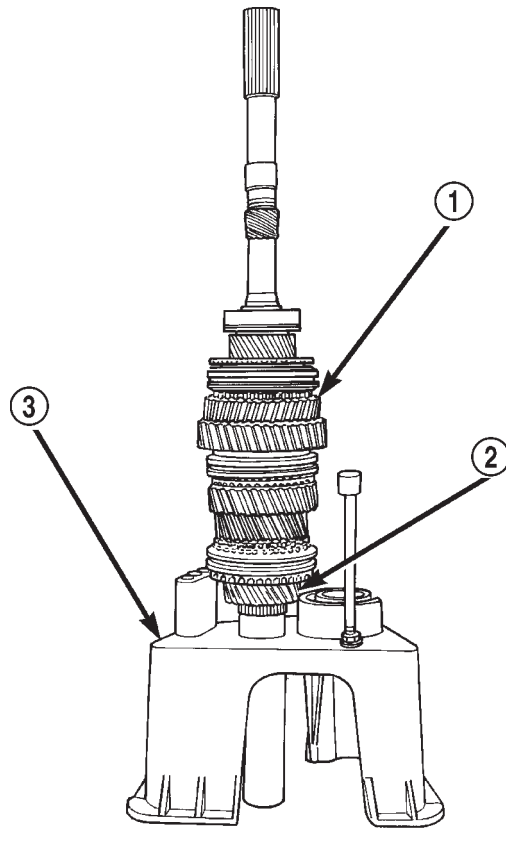
- 1 - FOURTH GEAR SYNCHRO RING
- 2 - INPUT SHAFT

(5) Adjust height of idler gear pedestal on assembly fixture (Fig. 88). Start with a basic height of 18.4 cm (7-1/4 in.). Final adjustment can be made after gear is positioned on pedestal.

(6) Install assembled output shaft and geartrain in input shaft (Fig. 89). Carefully rotate output shaft until the 3-4 synchro ring seats in synchro hub and sleeve.

(7) Install Adapter 6747-2B on front bearing hub of countershaft. The adapter has a shoulder on one side that goes towards the countershaft.

(8) Slide countershaft (and adapter) into fixture slot. Verify countershaft and output shaft gears are meshed with the mainshaft gears (Fig. 90).

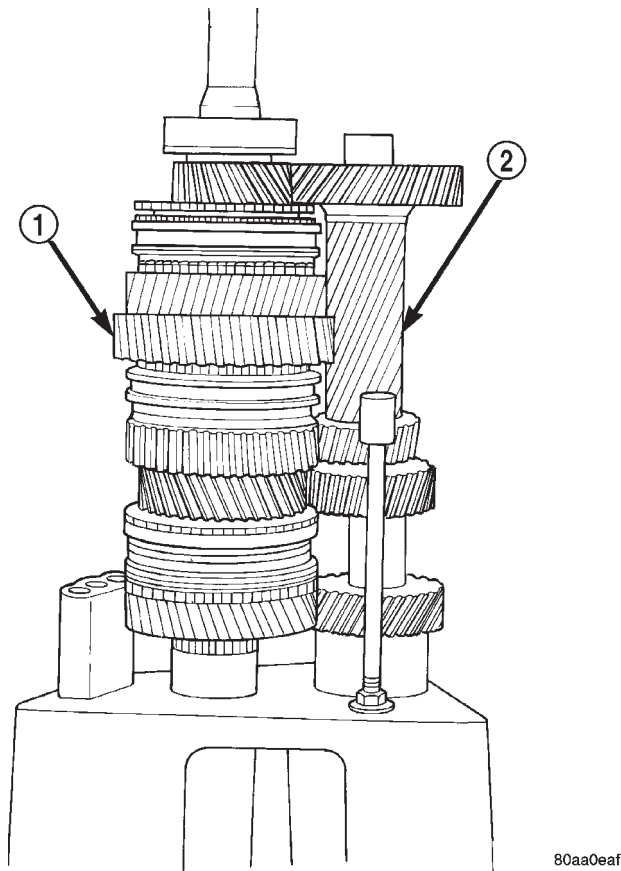


**Fig. 89 OUTPUT SHAFT AND GEARTRAIN**

- 1 - OUTPUT SHAFT AND GEARTRAIN
- 2 - INPUT SHAFT
- 3 - FIXTURE

(9) Check alignment of countershaft and output shaft gear teeth. Note 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.

MANUAL - NV3550 (Continued)

**Fig. 90 COUNTERSHAFT ON FIXTURE**

- 1 - OUTPUT SHAFT AND GEARTRAIN
- 2 - COUNTERSHAFT (SLIDE INTO PLACE ON FIXTURE TOOL)

(10) Position reverse idler in support cup of assembly fixture (Fig. 91). Ensure idler gear is properly meshed and aligned with shaft gear teeth and bolt holes are facing out and not toward geartrain. Adjust pedestal up or down if necessary and verify that short end of idler shaft is facing up as shown.

(11) On 2-wheel drive transmission, thread one Alignment Pin 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear as shown (Fig. 92).

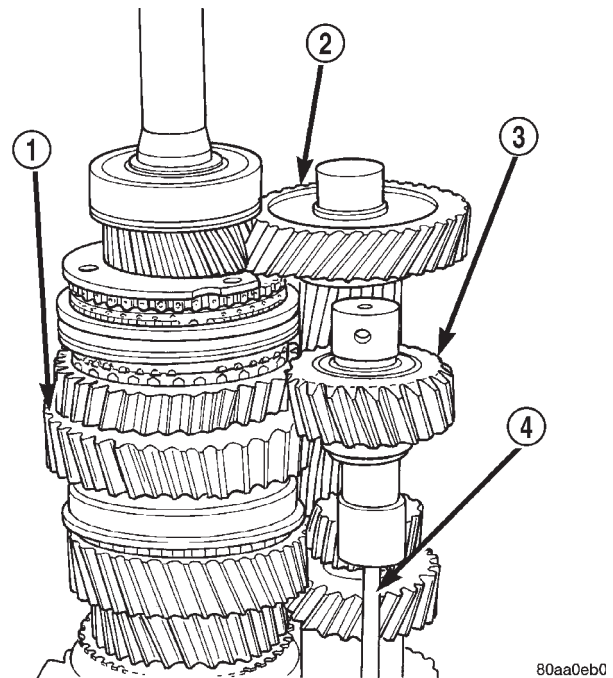
(12) Assemble 1-2 and fifth reverse-shift forks (Fig. 93). Arm of fifth-reverse fork goes through slot in 1-2 fork.

(13) Install assembled shift forks in synchro sleeves (Fig. 94). Verify forks are properly seated in sleeves.

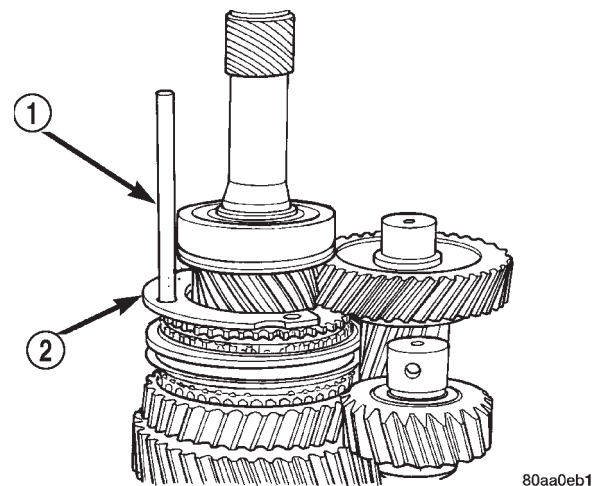
## REAR HOUSING - 2WD

(1) Drive adapter housing alignment dowels back into housing until dowels are flush with mounting surface (Fig. 95).

(2) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

**Fig. 91 REVERSE IDLER ASSEMBLY POSITION**

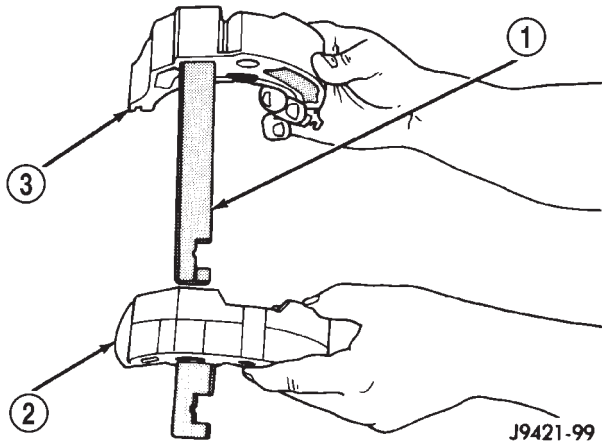
- 1 - OUTPUT SHAFT AND GEARTRAIN
- 2 - COUNTERSHAFT
- 3 - REVERSE IDLER ASSEMBLY
- 4 - TOOL PEDESTAL

**Fig. 92 POSITIONING OUTPUT SHAFT BEARING**

- 1 - ALIGNMENT PIN
- 2 - OUTPUT SHAFT BEARING RETAINER

(3) Install countershaft rear bearing in bearing race (Fig. 96).

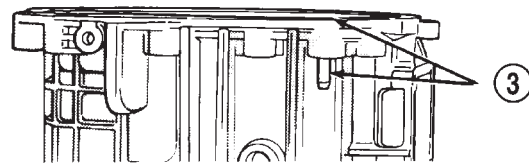
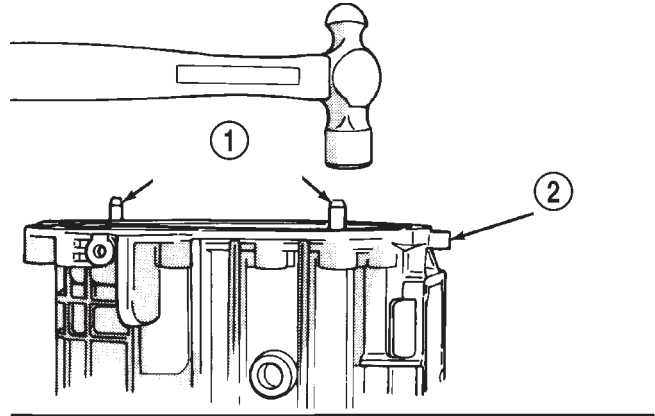
**CAUTION:** Large diameter side of the roller retainer must face the countershaft and small diameter side must face the race and housing (Fig. 97).



J9421-99

**Fig. 93 1-2 AND FIFTH-REVERSE**

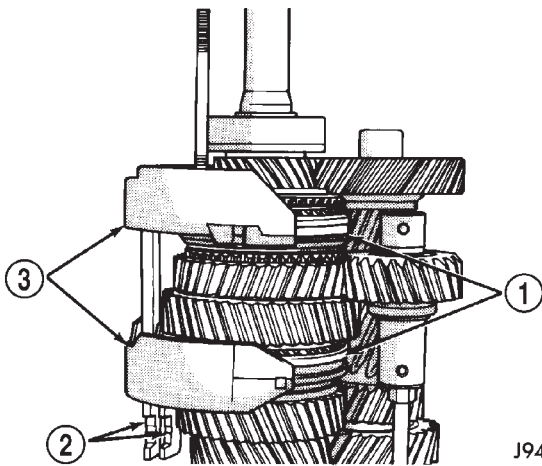
- 1 - INSERT ARM THROUGH 1-2 FORK
- 2 - 1-2 FORK
- 3 - FIFTH-REVERSE FORK



J9421-101

**Fig. 95 REAR HOUSING DOWELS**

- 1 - HOUSING ALIGNMENT DOWELS
- 2 - REAR HOUSING
- 3 - DOWEL FLUSH WITH SURFACE



J9421-100

**Fig. 94 SHIFT FORKS IN SYNCHRO**

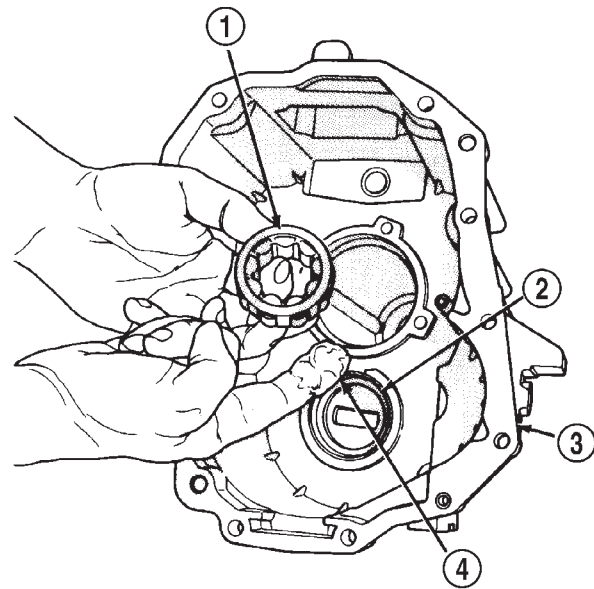
- 1 - SYNCHRO SLEEVES
- 2 - FORK ARMS
- 3 - SHIFT FORKS

(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. 97).

(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.

(7) Install rear housing onto geartrain (Fig. 98). Verify bearing retainer pilot stud is in correct bolt hole in the housing and countershaft and output shaft bearings are aligned in housing and on countershaft. If necessary lift upward on countershaft



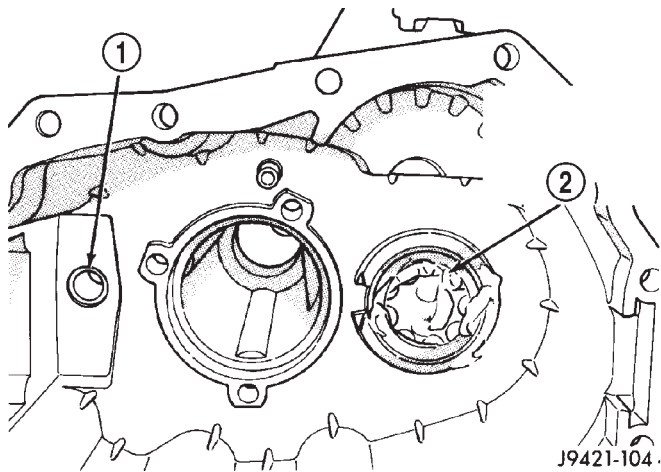
J9421-103

**Fig. 96 COUNTERSHAFT REAR BEARING**

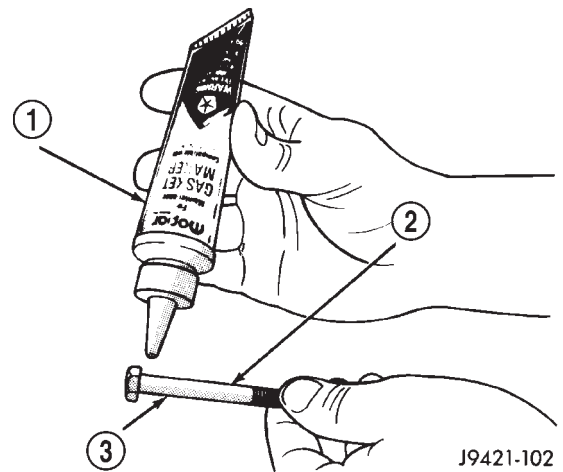
- 1 - COUNTERSHAFT REAR BEARING
- 2 - REAR BEARING RACE
- 3 - REAR HOUSING
- 4 - PETROLEUM JELLY

slightly to ensure that the countershaft rear bearing engages to the countershaft before the rear output shaft bearing engages the housing.

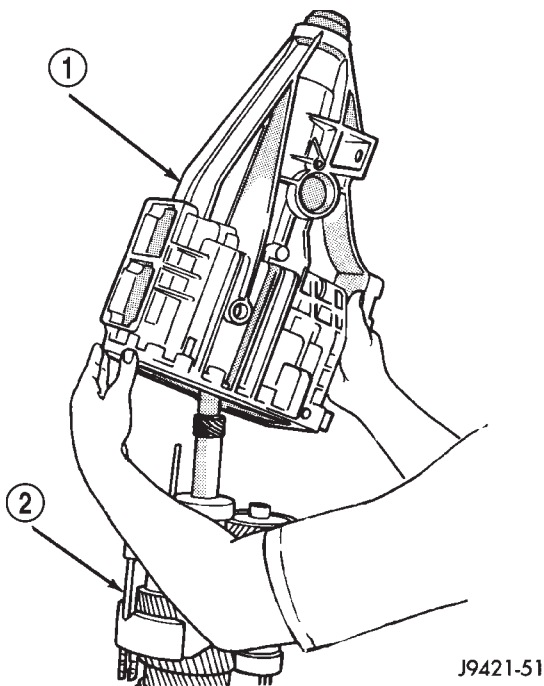
MANUAL - NV3550 (Continued)

**Fig. 97 COUNTERSHAFT REAR BEARING SEATED**

- 1 - SHIFT SHAFT BUSHING/BEARING
- 2 - COUNTERSHAFT REAR BEARING

**Fig. 99 SEAL RETAINING BOLTS**

- 1 - MOPAR GASKET MAKER (OR LOCTITE 518)
- 2 - RETAINER AND HOUSING BOLTS
- 3 - APPLY SEALER TO UNDERSIDE OF BOLT HEAD, SHANK AND THREADS

**Fig. 98 REAR HOUSING - 2WD**

- 1 - REAR HOUSING
- 2 - SHIFT FORKS AND GEARTRAIN

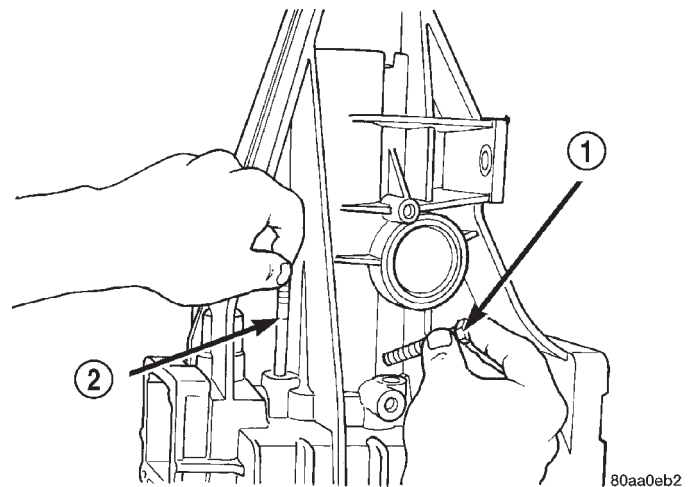
(8) Seat rear housing on output shaft rear bearing and countershaft by tapping the housing into place with a rawhide mallet.

(9) Apply Mopar Gasket Maker or equivalent to housing bolt threads, bolt shanks and under bolt heads (Fig. 99).

(10) Start first two bolts in retainer (Fig. 100). It may be necessary to move retainer rearward (with pilot stud) in order to start bolts in retainer.

(11) Remove Alignment Pin 8120 and install last retainer bolt (Fig. 100).

(12) Tighten all three retainer bolts to 30-35 N·m (22-26 ft. lbs.).

**Fig. 100 PILOT STUD AND RETAINER BOLTS - 2WD**

- 1 - BEARING RETAINER BOLT
- 2 - ALIGNMENT PIN

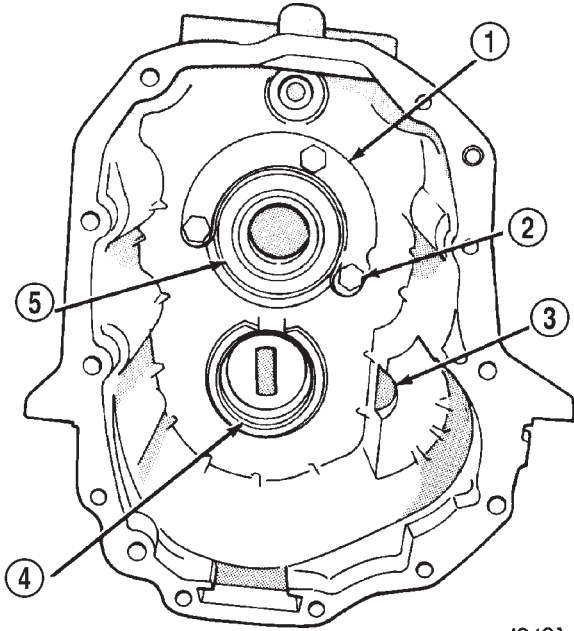
**ADAPTER HOUSING - 4WD**

(1) Install rear bearing in adapter housing, by tapping it into place with a wood hammer handle or wood dowel.

(2) Position rear bearing retainer in adapter housing (Fig. 101).

(3) Apply Mopar Gasket Maker or equivalent to threads, bolt shanks and under hex heads of bearing retainer bolts (Fig. 99).

MANUAL - NV3550 (Continued)



J9421-203

**Fig. 101 ADAPTER HOUSING - 4WD**

- 1 - BEARING RETAINER
- 2 - RETAINER BOLT
- 3 - IDLER SHAFT NOTCH
- 4 - COUNTERSHAFT BEARING RACE
- 5 - REAR BEARING

(4) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(5) Install countershaft rear bearing in bearing race (Fig. 97).

**CAUTION:** The large diameter side of the roller retainer must face the countershaft and the small diameter side must face the race and housing (Fig. 97).

(6) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

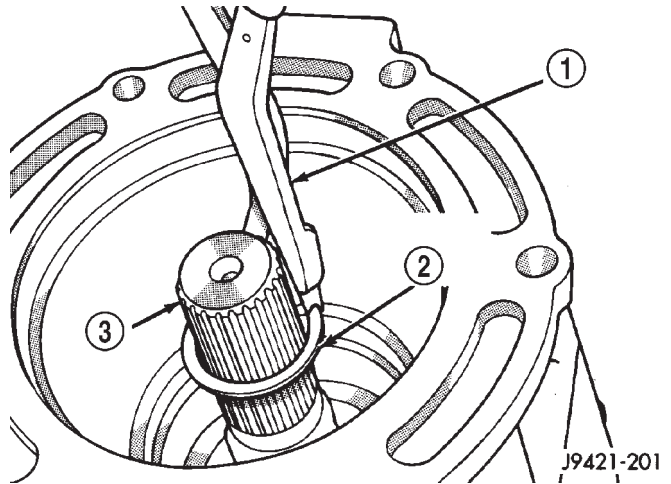
(7) Apply light coat of petroleum jelly to shift shaft bushing/bearing in adapter housing (Fig. 97).

(8) Install adapter housing on geartrain.

(9) Install rear bearing snap ring on output shaft (Fig. 102).

(10) Lubricate lip of new rear seal (Fig. 103) with Mopar Door Ease or transmission fluid.

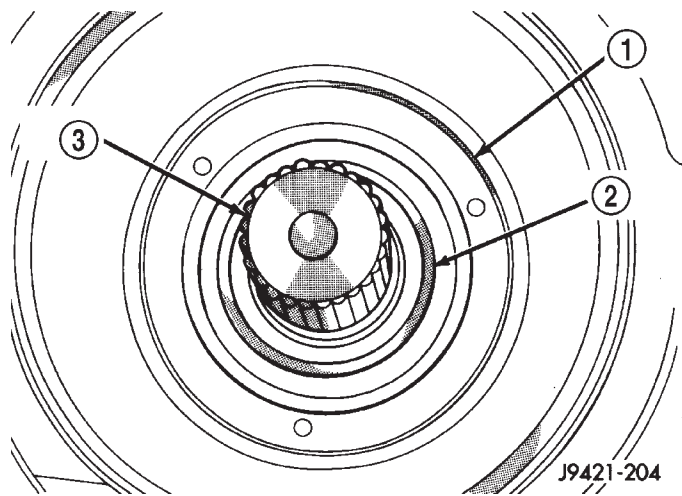
(11) Install **new** rear seal in adapter housing bore with Installer C-3860-A. Verify seal is seated in housing bore (Fig. 103).



J9421-201

**Fig. 102 REAR BEARING SNAP RING - 4WD**

- 1 - SNAP RING PLIERS
- 2 - SNAP RING
- 3 - OUTPUT SHAFT



J9421-204

**Fig. 103 REAR SEAL**

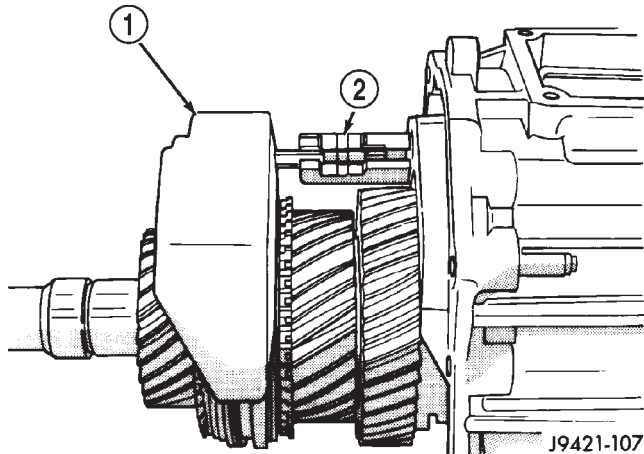
- 1 - REAR SEAL
- 2 - SEAL LIP
- 3 - OUTPUT SHAFT

MANUAL - NV3550 (Continued)

**SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET**

**CAUTION:** Transmission synchros must be in the Neutral position, to prevent damage to the housings, shift forks and gears during installation of the two housings.

(1) Install 3-4 shift fork in synchro sleeve (Fig. 104). Verify groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms as shown.

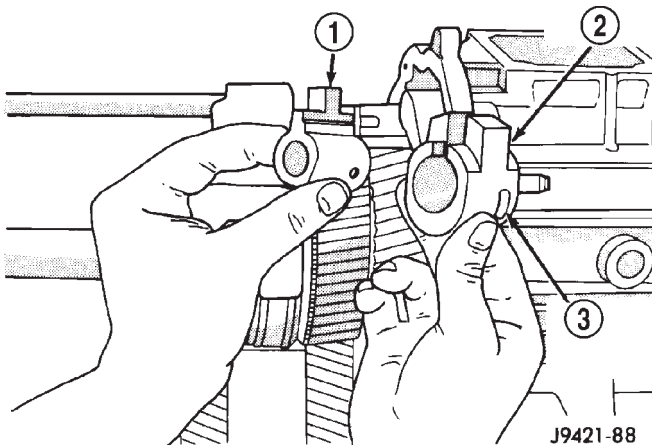


**Fig. 104 3-4 SHIFT FORK**

- 1 - 3-4 FORK
- 2 - ALIGN GROOVES IN FORK ARMS

(2) Slide the end of shift shaft with shaft detent notches through 3-4 shift fork.

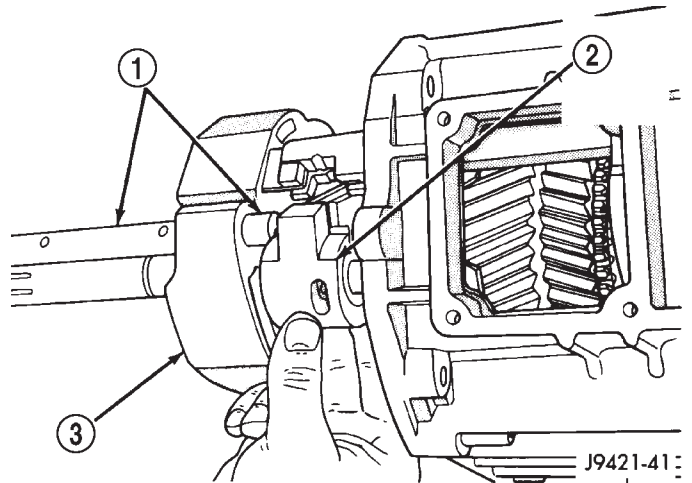
(3) Assemble shift shaft shift lever and bushing (Fig. 105). The slot in bushing must face up and roll pin hole for lever must be aligned with hole in shaft.



**Fig. 105 LEVER AND BUSHING**

- 1 - SHAFT LEVER
- 2 - LEVER BUSHING
- 3 - BUSHING LOCK PIN SLOT

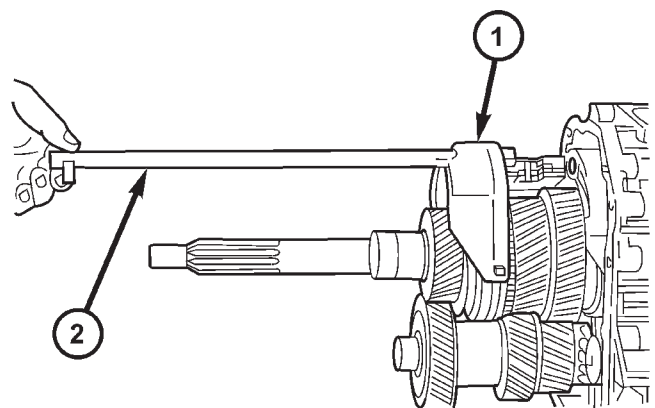
(4) Install assembled lever and bushing on shift shaft (Fig. 106).



**Fig. 106 LEVER AND BUSHING ASSEMBLY**

- 1 - SHIFT SHAFT
- 2 - SHAFT LEVER AND BUSHING
- 3 - 3-4 FORK

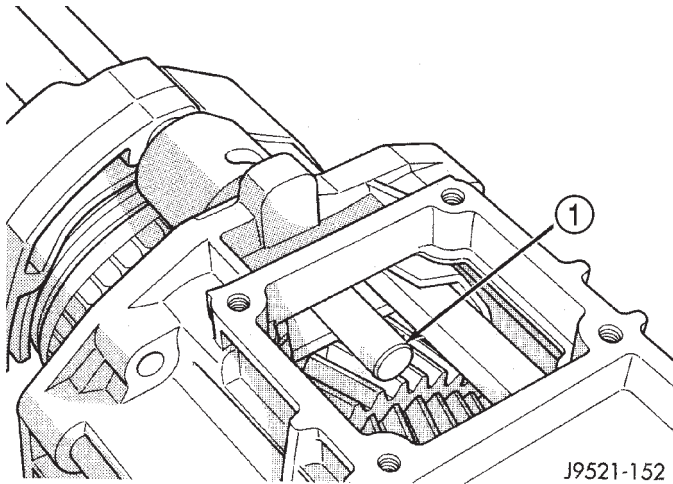
(5) Slide shift shaft through forks (Fig. 107) and into shift lever opening in rear housing (Fig. 108).



**Fig. 107 SHIFT SHAFT**

- 1 - SHIFT SHAFT
- 2 - 3-4 SHIFT FORK

MANUAL - NV3550 (Continued)

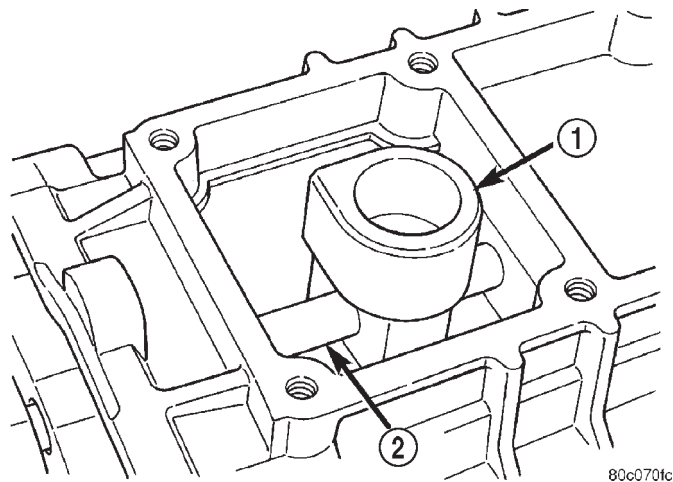


J9521-152

**Fig. 108 SHAFT IN LEVER OPENING**

- 1 - SHIFT SHAFT

(6) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 109).



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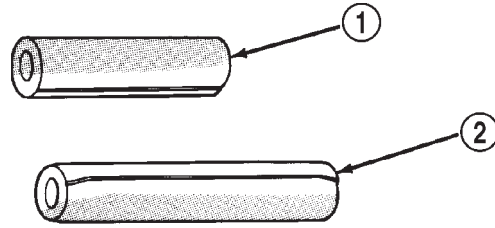
**Fig. 109 SHIFT SOCKET**

- 1 - SHIFT SOCKET
- 2 - SHIFT SHAFT

(7) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

**CAUTION:** 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.

(8) Select correct new roll pin for shift shaft lever (Fig. 110). 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.

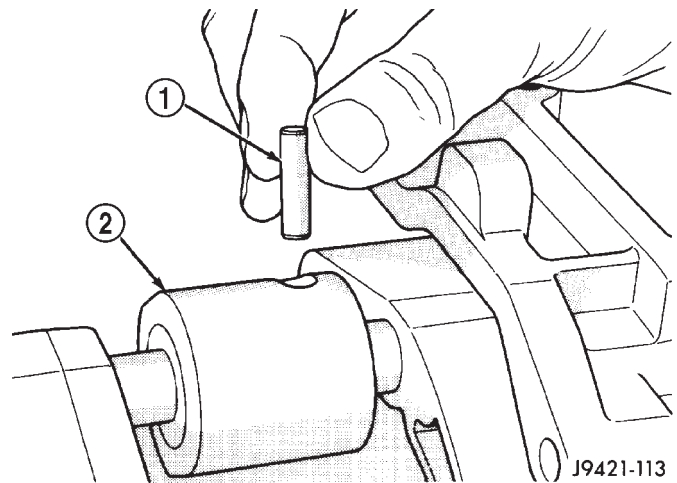


J9421-86

**Fig. 110 ROLL PIN IDENTIFICATION**

- 1 - SHAFT LEVER ROLL PIN
- 2 - SHIFT SOCKET ROLL PIN

(9) Align roll pin holes in shift shaft, lever and bushing. Then start roll pin into shaft lever by hand (Fig. 111).



J9421-113

**Fig. 111 ROLL PIN IN SHIFT SHAFT**

- 1 - SHAFT LEVER ROLL PIN (7/8 inch)
- 2 - LEVER AND BUSHING

(10) Seat shaft lever roll pin with pin punch (Fig. 112).

**CAUTION:** The shaft lever roll pin must be flush with the surface of the lever or lever bushing will bind on the roll pin.

(11) Verify lock pin slot in lever bushing is positioned as shown (Fig. 112).

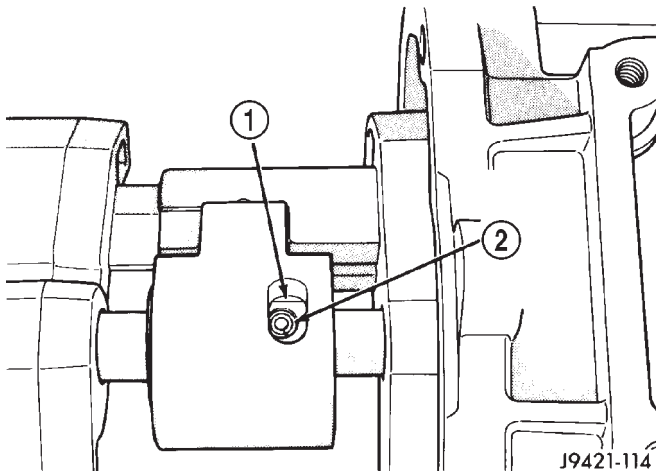
(12) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 113).

(13) Seat roll pin flush in shift socket with pin punch (Fig. 114).

(14) Verify notches in shift fork arms are aligned (Fig. 115). Realign arms if necessary.

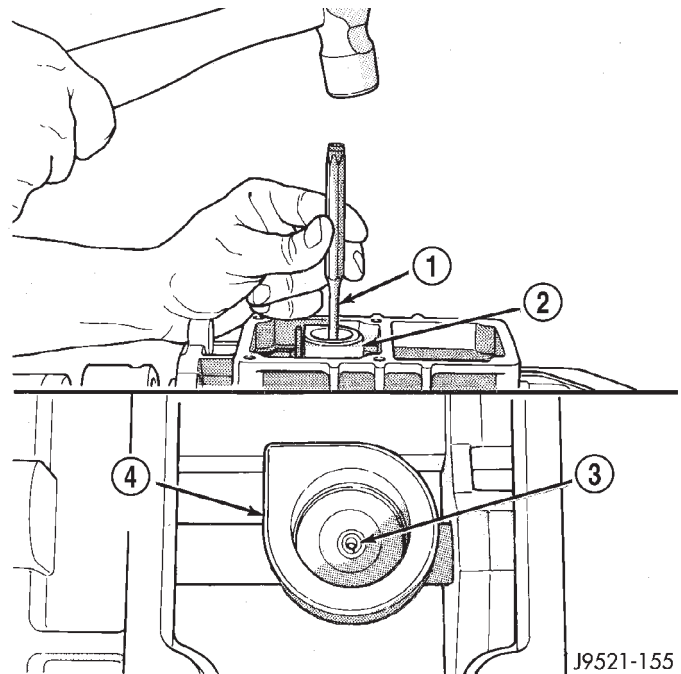
(15) Rotate shift lever and bushing downward to expose detent bore (Fig. 115) in the lever.





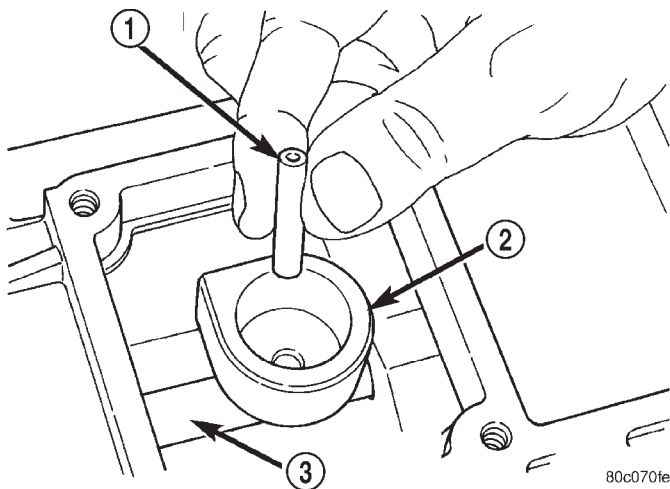
**Fig. 112 SHIFT SHAFT LEVER ROLL**

- 1 - BUSHING LOCK PIN SLOT
- 2 - SEAT ROLL PIN FLUSH WITH LEVER



**Fig. 114 SEATING SHIFT SOCKET ROLL PIN**

- 1 - PIN PUNCH
- 2 - SHIFT SOCKET
- 3 - SEAT ROLL PIN FLUSH
- 4 - SHIFT SOCKET



**Fig. 113 ROLL PIN IN SHIFT SOCKET**

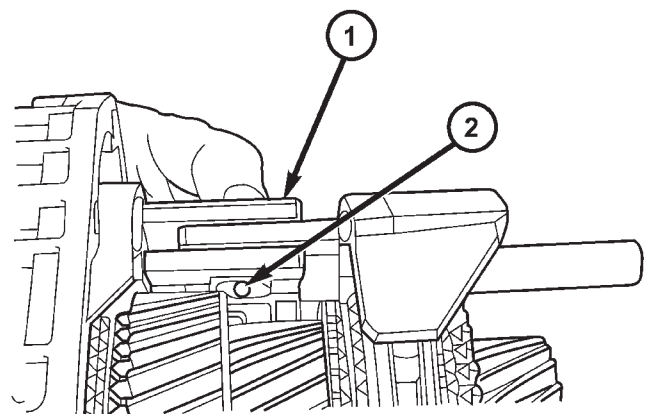
- 1 - ROLL PIN
- 2 - SHIFT SOCKET
- 3 - SHIFT SHAFT

(16) Install detent spring then the ball into the detent bore (Fig. 116) and hold the ball in the lever. Then rotate the lever upward into the fork arm notches.

**NOTE:** Verify detent ball is seated in the fork arms before proceeding.

**FRONT HOUSING AND INPUT SHAFT BEARING RETAINER**

(1) Install reverse blocker, retainer and retainer bolt in front housing.

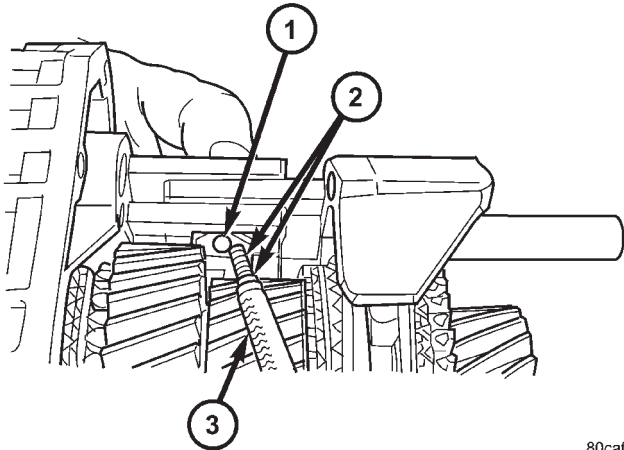


**Fig. 115 SHIFT LEVER POSITION**

- 1 - SHIFT FORK ARMS
- 2 - DETENT BORE

(2) Install input shaft bearing in front housing (Fig. 117). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

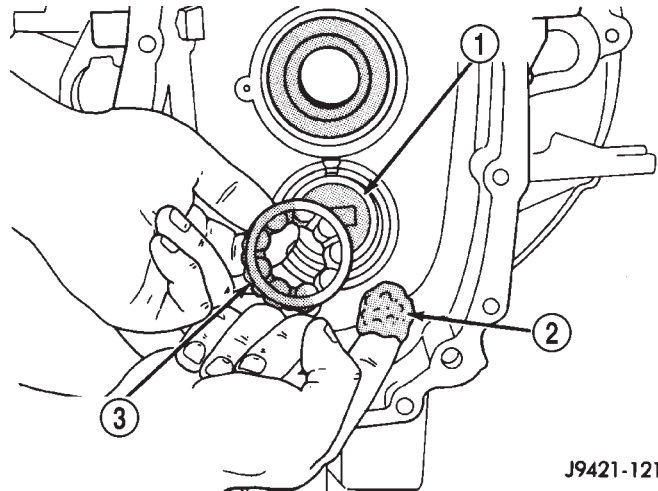
(3) Apply liberal quantity of petroleum jelly to countershaft front bearing. Then insert bearing in front housing race (Fig. 117). Large diameter side of bearing cage goes toward countershaft (Fig. 118).



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**Fig. 116 DETENT SPRING AND BALL**

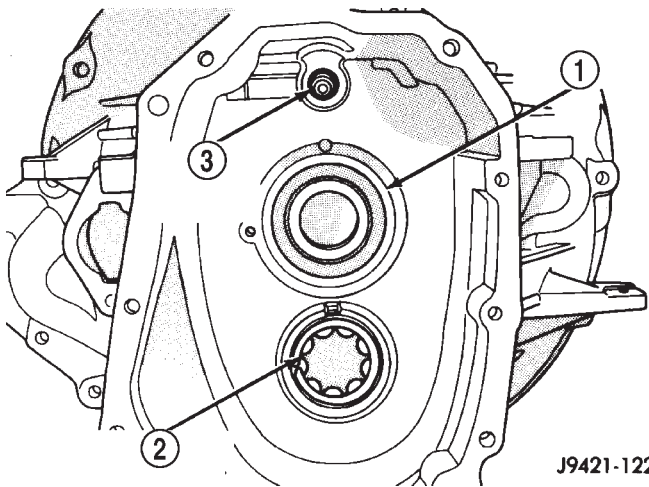
- 1 - SHAFT LEVER
- 2 - SPRING AND BALL
- 3 - MAGNET



J9421-121

**Fig. 118 COUNTERSHAFT FRONT BEARING**

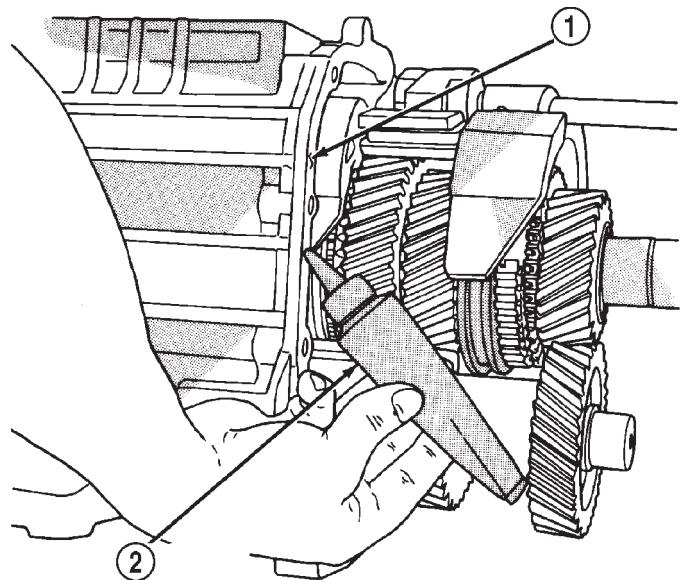
- 1 - BEARING RACE
- 2 - PETROLEUM JELLY
- 3 - COUNTERSHAFT FRONT BEARING



J9421-122

**Fig. 117 INPUT SHAFT AND COUNTERSHAFT FRONT BEARING**

- 1 - INPUT SHAFT BEARING
- 2 - COUNTERSHAFT FRONT BEARING
- 3 - SHIFT SHAFT BUSHING



J9421-123

**Fig. 119 SEAL FRONT/REAR HOUSINGS**

- 1 - HOUSING FLANGE SURFACE
- 2 - MOPAR GASKET MAKER (OR LOCTITE 518)

Small diameter side goes toward bearing race in housing.

(4) 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.

(5) Apply small amount of petroleum jelly to shift shaft bushing in front housing.

(6) Apply 1/8 in. wide bead of Mopar Gasket Maker or equivalent to mating surfaces of front and rear housings (Fig. 119).

(7) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain.

(8) Work front housing downward onto geartrain until seated on rear housing.

## MANUAL - NV3550 (Continued)

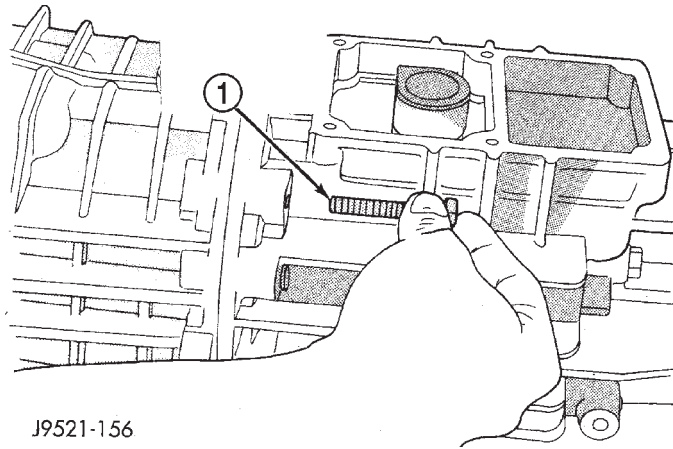
**CAUTION:** If the front housing will not seat on the rear housing, either the shift components are not in Neutral, or one or more components are misaligned. Do not force the front housing into place. This will result in damaged components.

(9) Tap rear housing alignment dowels back into place with hammer and pin punch. Both dowels should be flush fit in each housing. Have helper hold transmission upright while dowels are tapped back into place.

(10) Place transmission in horizontal position.

(11) 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. 120).

(12) Install and start housing attaching bolts by hand (Fig. 120). Then tighten bolts to 34 N·m (25 ft. lbs.).



J9521-156

**Fig. 120 HOUSING BOLTS**

1 - HOUSING ATTACHING BOLTS

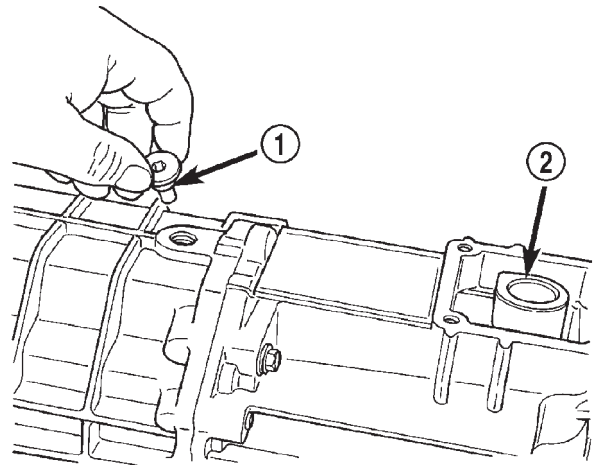
(13) Install shift shaft bushing lock bolt (Fig. 121). Apply Mopar Gasket Maker or equivalent to bolt threads, shank and underside of bolt head before installation.

**CAUTION:** If the lock bolt cannot be seated, do not try to force it into place. Either the shift shaft is not in Neutral or the shaft bushing (or lever) is misaligned.

(14) Lubricate then install shift shaft detent plunger in housing bore. Lubricate plunger with Valvoline Dura Blend® semi-synthetic/synthetic grease or equivalent.

**NOTE:** Verify plunger is fully seated in detent notch in shift shaft.

(15) Install detent spring inside plunger.

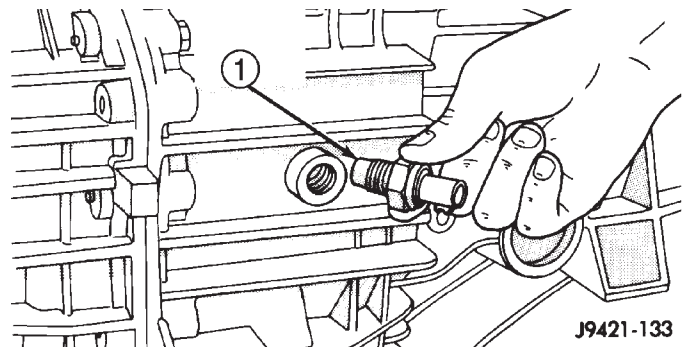


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**Fig. 121 SHIFT SHAFT BUSHING LOCK BOLT**1 - SHIFT SHAFT LOCK BOLT  
2 - SHAFT SOCKET

(16) Install plug on detent spring and compress spring. Then drive detent plug into transmission case until plug seats.

(17) Install backup light switch (Fig. 122).

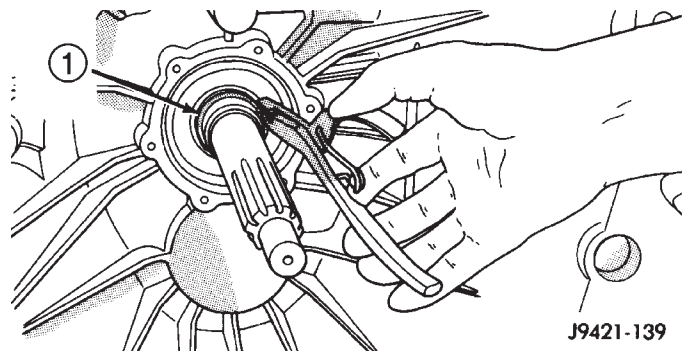


J9421-133

**Fig. 122 BACKUP LIGHT SWITCH**

1 - BACKUP LIGHT SWITCH

(18) Install input shaft snap ring (Fig. 123).



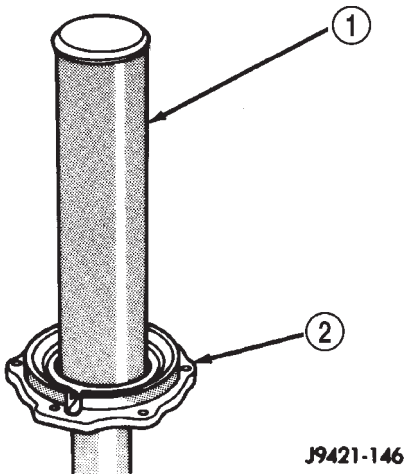
J9421-139

**Fig. 123 SHAFT SNAP RING - TYPICAL**

1 - INPUT SHAFT SNAP RING

MANUAL - NV3550 (Continued)

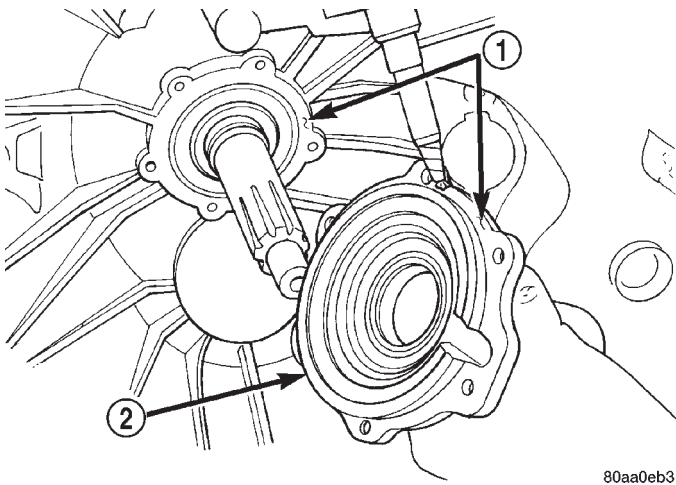
(19) Install **new** oil seal in front bearing retainer with Installer 6448 (Fig. 124).



**Fig. 124 OIL SEAL IN FRONT BEARING RETAINER**

- 1 - INSTALLER
- 2 - FRONT BEARING RETAINER

(20) Apply bead of Mopar silicone sealer or equivalent to flange surface of front bearing retainer (Fig. 125).

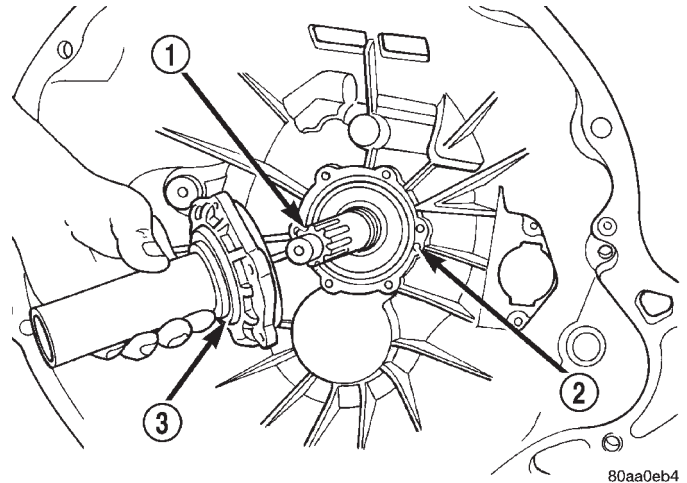


**Fig. 125 SEAL BEARING RETAINER AND HOUSING**

- 1 - APPLY SEALER BEAD
- 2 - INPUT SHAFT BEARING RETAINER

(21) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig. 126). Although retainer is one-way fit on housing, be sure bolt holes are aligned before seating retainer.

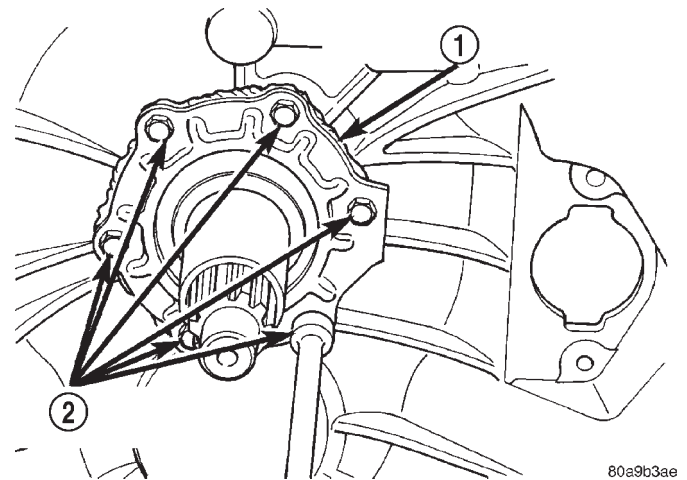
**CAUTION:** Do not allow sealer to get into the oil feed hole in the transmission case or bearing retainer.



**Fig. 126 INPUT SHAFT BEARING RETAINER**

- 1 - INPUT SHAFT
- 2 - OIL FEED
- 3 - BEARING RETAINER

(22) Install and tighten bearing retainer bolts to 7-10 N·m (5-7 ft. lbs.) (Fig. 127).



**Fig. 127 BEARING RETAINER BOLTS**

- 1 - RETAINER
- 2 - RETAINER BOLTS

## MANUAL - NV3550 (Continued)

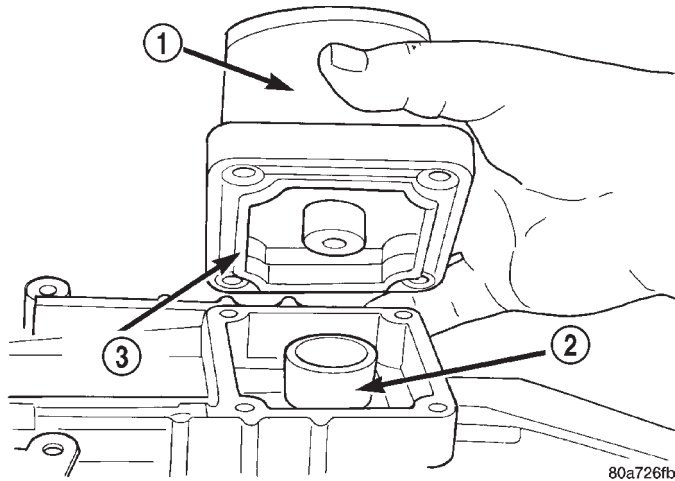
**SHIFT TOWER AND LEVER**

(1) Apply petroleum jelly to ball end of shift lever and interior of shift socket.

(2) Shift the transmission into third gear.

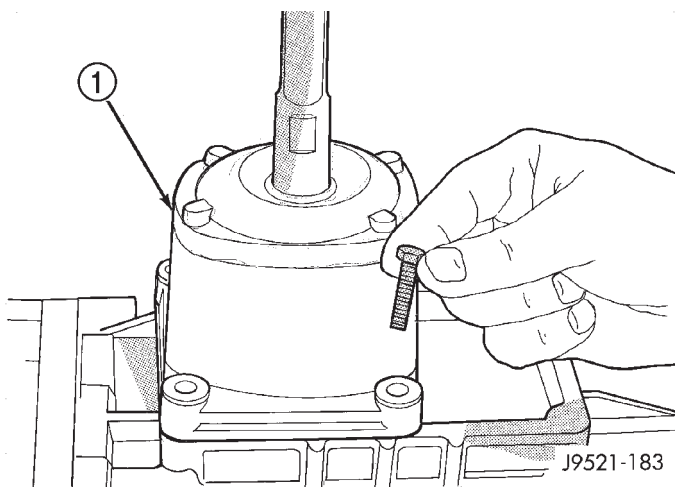
(3) Align and install shift tower and lever assembly (Fig. 128). Be sure shift ball is seated in socket and the offset in the tower is toward the passenger side of the vehicle before installing tower bolts.

(4) Install shift tower bolts (Fig. 129). Tighten bolts to 8.5 N·m (75.2 in. lbs.).



**Fig. 128 SHIFT TOWER**

- 1 - SHIFT TOWER  
2 - SHIFT SOCKET  
3 - SEAL



**Fig. 129 SHIFT TOWER BOLTS**

- 1 - SHIFT TOWER AND LEVER ASSEMBLY

(5) Fill transmission to bottom edge of fill plug hole with Mopar Transmission Lubricant.

(6) Install and tighten fill plug to 34 N·m (25 ft. lbs.).

(7) Check transmission vent. Be sure vent is open and not restricted.

**INSTALLATION**

(1) Install clutch housing on transmission and tighten housing bolts to 46 N·m (34 ft. lbs.).

(2) Lubricate contact surfaces of release fork pivot ball stud and release fork with high temp grease.

(3) Install release bearing, fork and retainer clip.

(4) Position and secure transmission on transmission jack.

(5) Lightly lubricate the transmission input shaft splines with Mopar high temp grease.

(6) Raise transmission and align transmission input shaft and clutch disc splines. Then slide transmission into place.

(7) Install clutch housing-to-engine bolts and tighten to 58 N·m (43 ft.lbs.).

**NOTE:** Be sure the housing is properly seated on engine block before tightening bolts.

(8) Install shift tower and bolts. Tighten bolts to 7-10 N·m (5-7 ft.lbs.).

(9) Install rear crossmember and tighten crossmember bolts to 41 N·m (31 ft. lbs.).

(10) Install transmission mount bolts and to 54 N·m (40 ft. lbs.).

(11) Install exhaust bracket to crossmember.

(12) Remove support stands from engine and transmission.

(13) Install transfer case, shift cable and vent hose if equipped.

(14) Install wire connectors to transmission/transfer case.

(15) Install propeller shaft/shafts.

(16) Install slave cylinder in clutch housing.

(17) Fill transmission and transfer case if equipped, with recommended lubricants.

(18) Install skid plate if equipped.

MANUAL - NV3550 (Continued)

SPECIFICATIONS

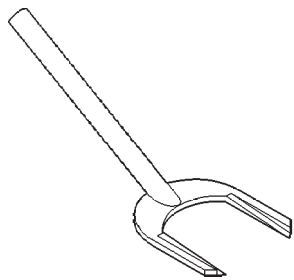
MANUAL - NV3550

TORQUE SPECIFICATIONS

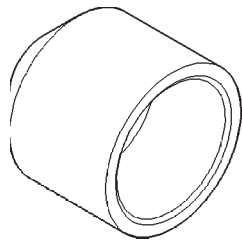
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Clutch Housing To Trans Bolts	46	34	-
Clutch Housing To Engine Bolts	68	50	-
Trans Mount Bolts	47	35	-
Crossmember Frame Bolts	61-75	44-55	-
Crossmember To Insulator Nuts	54-61	40-45	-
Drain/Fill Plug	9-27	14-20	-
Front To Rear Housing Bolts	30-35	22-26	-
Front Bearing Retainer Bolts	7-10	5-7	62-88
Idler Shaft Bolts	19-25	14-18	-
Rear Bearing Retainer Bolts	30-35	22-26	-
Shift Tower Bolts	7-10	5-7	62-88
Slave Cylinder Nuts	23	17	-

SPECIAL TOOLS

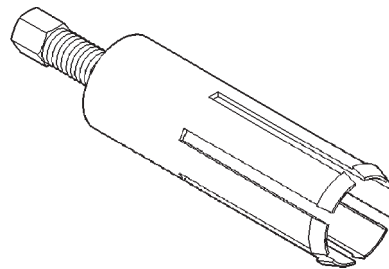
MANUAL - NV3550



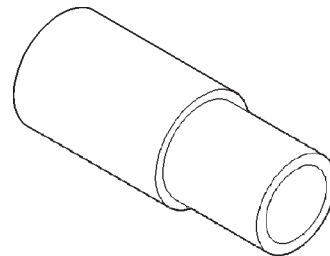
**Remover Seal C-3985-B**



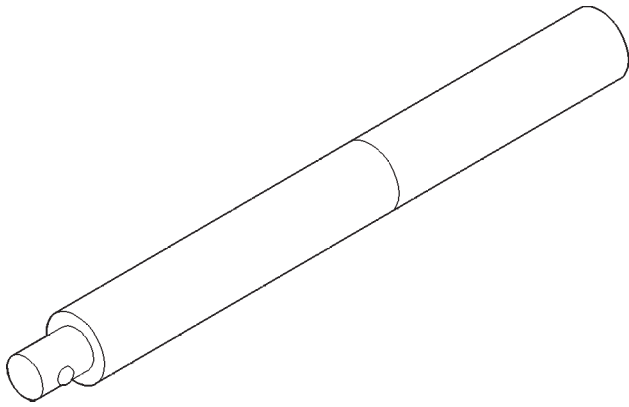
**Installer Seal C-3972-A**



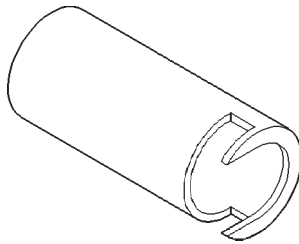
**Remover Bushing 6957**



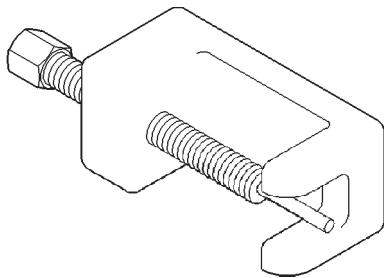
**Installer Bushing 6951**



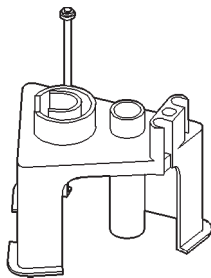
**Handle C-4171**



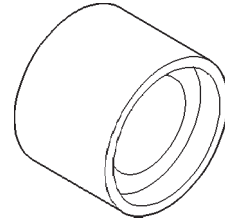
**Remover Plug 8117**



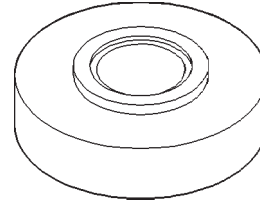
**Remover/Installer 6858**



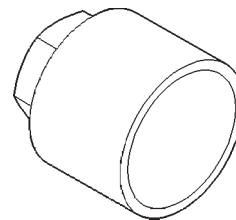
**Fixture 6747**



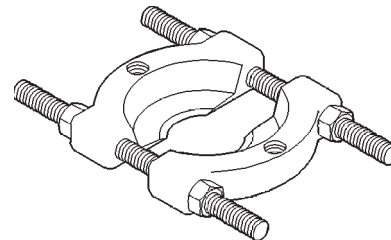
**Adapter 6747-1A**



**Adapter 6747-2B**

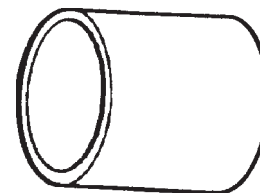


**Cup Adapter 8115**



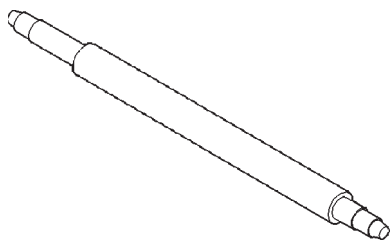
1130-90109ac3

**Splitter Bearing 1130**

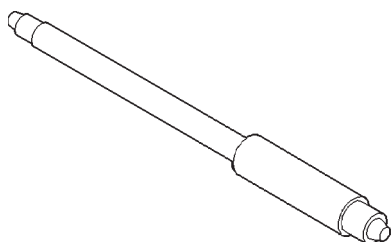


**Tube 6310-1**

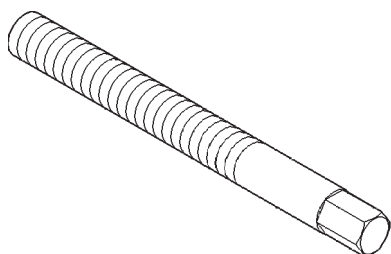
MANUAL - NV3550 (Continued)



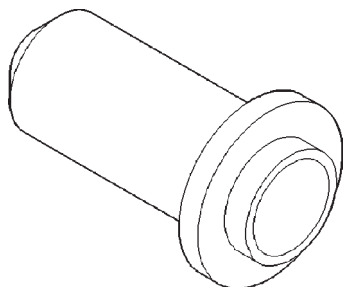
**Installer Bushing 8118**



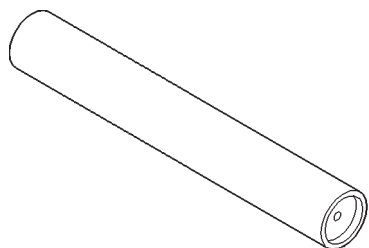
**Remover/Installer 8119**



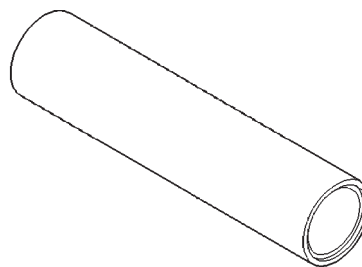
**Pin Alignment 8120**



**Installer Seal C-3860-A**



**Installer 8123**

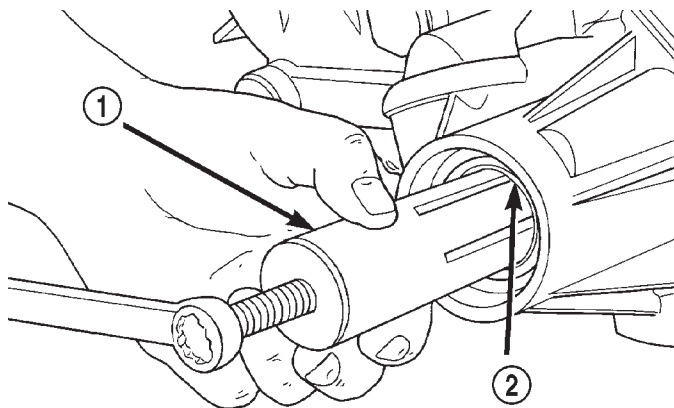


**Installer Cone 6448**

## EXTENSION HOUSING BUSHING - NV3550

### REMOVAL

- (1) Raise and support vehicle.
- (2) Mark reference lines on the propeller shaft and remove the shaft.
- (3) Remove housing yoke seal.
- (4) Insert Remover 6957 into rear housing and tighten tool to bushing and remove bushing (Fig. 130).



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**Fig. 130 Bushing Removal - Typical**

- 1 - REMOVER
- 2 - EXTENSION HOUSING BUSHING



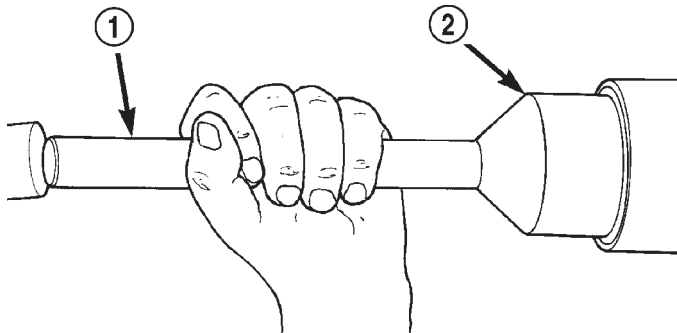
## EXTENSION HOUSING BUSHING - NV3550 (Continued)

**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 Installer C-3972-A (Fig. 131).



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**Fig. 131 Rear Housing Seal**

- 1 - HANDLE  
2 - INSTALLER

(4) Install propeller shaft with reference marks aligned.

(5) Remove support and lower vehicle.

(6) Check transmission fluid level.

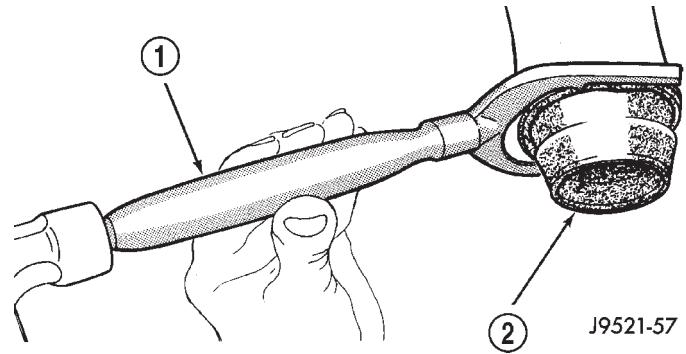
**EXTENSION HOUSING SEAL - NV3550****REMOVAL**

(1) Raise and support vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Remover C-3985-B (Fig. 132) from transmission housing.



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**Fig. 132 YOKE SEAL**

- 1 - REMOVER  
2 - SEAL

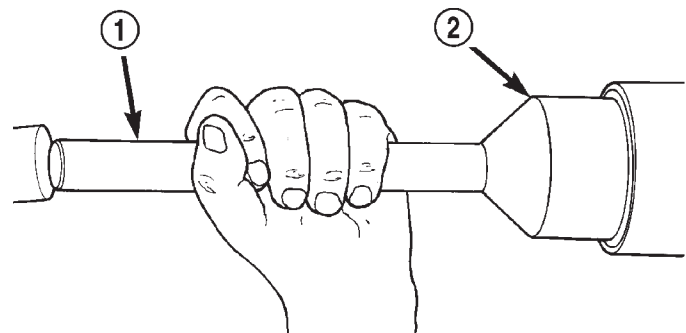
**INSTALLATION**

(1) Place seal in position on transmission housing.

(2) Drive new seal into transmission housing with Installer C-3972-A and Handle C-4171 (Fig. 133).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines.

(4) Install propeller shaft with reference marks aligned.



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**Fig. 133 Yoke Seal Installer**

- 1 - HANDLE  
2 - INSTALLER

(5) Remove support and lower vehicle.

(6) Check transmission fluid level.

## AUTOMATIC TRANSMISSION - 45RFE

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## AUTOMATIC TRANSMISSION - 45RFE

### DESCRIPTION

The 45RFE automatic transmission is a sophisticated, multi-range, electronically controlled transmission which combines optimized gear ratios for responsive performance, state of the art efficiency features and low NVH. Other features include driver adaptive shifting and three planetary gear sets to provide wide ratio capability with precise ratio steps for optimum driveability. The three planetary gear sets also make available a unique alternate second gear ratio. The primary 2nd gear ratio fits between 1st and 3rd gears for normal through-gear accelerations. The alternate second gear ratio (2prime) allows smoother 4-2 kickdowns at high speeds to provide 2nd gear passing performance over a wider highway cruising range.

The hydraulic portion of the transmission consists of the transmission fluid, fluid passages, hydraulic valves, and various line pressure control components.

The primary mechanical components of the transmission consist of the following:

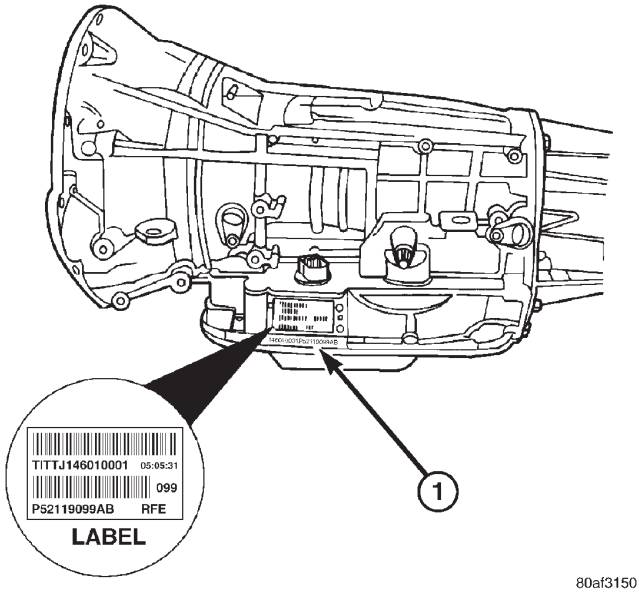
- Three multiple disc input clutches
- Three multiple disc holding clutches
- Five hydraulic accumulators
- Three planetary gear sets
- Dual Stage Hydraulic oil pump
- Valve body
- Solenoid pack

The TCM is the “heart” or “brain” of the electronic control system and relies on information from various direct and indirect inputs (sensors, switches, etc.) to determine driver demand and vehicle operating conditions. With this information, the TCM can calculate and perform timely and quality shifts through various output or control devices (solenoid pack, transmission control relay, etc.).

### TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan sealing surface (Fig. 1). Refer to this information when ordering replacement parts. A label is attached to the transmission case above the stamped numbers. The label gives additional information which may also be necessary for identification purposes.

AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 1 Transmission Part And Serial Number Location**

1 - IDENTIFICATION NUMBERS (STAMPED)

**GEAR RATIOS** The 45RFE gear ratios are:

1st .....	3.00:1
2nd .....	1.67:1
2nd Prime .....	1.50:1
3rd .....	1.00:1
4th .....	0.75:1
Reverse .....	3.00:1

**OPERATION**

The 45RFE offers full electronic control of all automatic up and downshifts, and features real-time adaptive closed-loop shift and pressure control. Electronic shift and torque converter clutch controls help protect the transmission from damage due to high temperatures, which can occur under severe operating conditions. By altering shift schedules, line pressure, and converter clutch control, these controls reduce heat generation and increase transmission cooling.

To help reduce efficiency-robbing parasitic losses, the transmission includes a dual-stage transmission fluid pump with electronic output pressure control. Under most driving conditions, pump output pressure greatly exceeds that which is needed to keep the clutches applied. The 45RFE pump-pressure control system monitors input torque and adjusts the pump pressure accordingly. The primary stage of the pump works continuously; the second stage is bypassed when demand is low. The control system also monitors input and output speed and, if incipient clutch slip is observed, the pressure control solenoid duty cycle is varied, increasing pressure in proportion to demand.

A high-travel torque converter damper assembly allows earlier torque converter clutch engagement to reduce slippage. Needle-type thrust bearings reduce internal friction. The 45RFE is packaged in a one-piece die-cast aluminum case. To reduce NVH, the case has high lateral, vertical and torsional stiffness. It is also designed to maximize the benefit of the structural dust cover that connects the bottom of the bell housing to the engine bedplate, enhancing overall power train stiffness. Dual filters protect the pump and other components. A pump return filter is added to the customary main sump filter. Independent lubrication and cooler circuits assure ample pressure for normal transmission operation even if the cooler is obstructed or the fluid cannot flow due to extremely low temperatures.

The hydraulic control system design (without electronic assist) provides the transmission with PARK, REVERSE, NEUTRAL, SECOND, and THIRD gears, based solely on driver shift lever selection. This design allows the vehicle to be driven (in “limp-in” mode) in the event of a electronic control system failure, or a situation that the Transmission Control Module (TCM) recognizes as potentially damaging to the transmission.

The TCM also performs certain self-diagnostic functions and provides comprehensive information (sensor data, DTC’s, etc.) which is helpful in proper diagnosis and repair. This information can be viewed with the DRB® scan tool.

**DIAGNOSIS AND TESTING**

**DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION**

**CAUTION:** Before attempting any repair on a 45RFE automatic transmission, check for Diagnostic Trouble Codes with the DRB® scan tool.

Transmission malfunctions may be caused by these general conditions:

- Poor engine performance
- Improper adjustments
- Hydraulic malfunctions
- Mechanical malfunctions
- Electronic malfunctions

Diagnosis of these problems should always begin by checking the easily accessible variables: fluid level and condition, gearshift cable adjustment. Then perform a road test to determine if the problem has been corrected or if more diagnosis is necessary. If the problem persists after the preliminary tests and corrections are completed, hydraulic pressure checks should be performed.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

**DIAGNOSIS AND TESTING - PRELIMINARY**

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 DRIVABLE**

- (1) Check for transmission fault codes using DRB® scan tool.
- (2) Check fluid level and condition.
- (3) Adjust gearshift cable 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 operation.

**VEHICLE IS DISABLED**

- (1) Check fluid level and condition.
- (2) Check for broken or disconnected gearshift cable.
- (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 check for debris. If pan is clear, remove transmission and check for damaged driveplate, 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.

**DIAGNOSIS AND TESTING - ROAD TESTING**

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that all 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, overrunning clutch, or line pressure problems.

A slipping clutch can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch Application chart provides a basis for analyzing road test results.

CLUTCH APPLICATION CHART

SLP	UD	OD	R	2C	4C	L/R	OVERRUNNING
P-PARK						ON	
R-REVERSE			ON			ON	
N-NEUTRAL						ON	
D-OVERDRIVE FIRST	ON					ON*	ON
SECOND	ON			ON			
SECOND PRIME	ON				ON		
THIRD	ON	ON					
FOURTH		ON			ON		
LIMP-IN	ON	ON					
2-FIRST	ON					ON*	ON
SECOND	ON			ON			
LIMP-IN	ON			ON			
1-LOW	ON					ON	ON

\*L/R clutch is on only with the output shaft speed below 150 rpm.

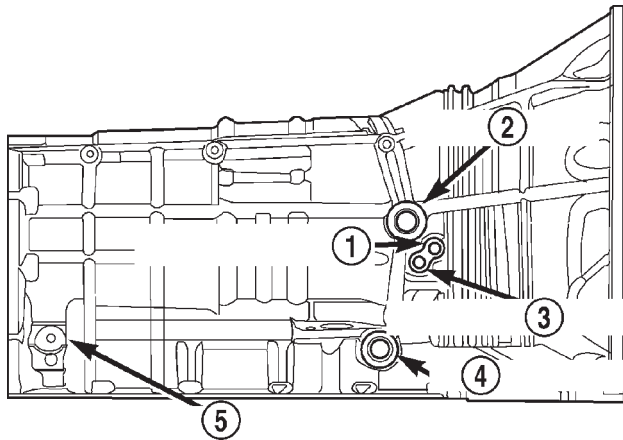
AUTOMATIC TRANSMISSION - 45RFE (Continued)

**DIAGNOSIS AND TESTING - HYDRAULIC PRESSURE TEST**

An accurate tachometer and pressure test gauges are required. Test Gauge C-3293-SP has a 300 psi range and is used at all locations where pressures exceed 100 psi.

**Pressure Test Port Locations**

Only two pressure ports are supplied on the transmission case. The torque converter clutch apply and release ports are located on the right side of the transmission case (Fig. 2).



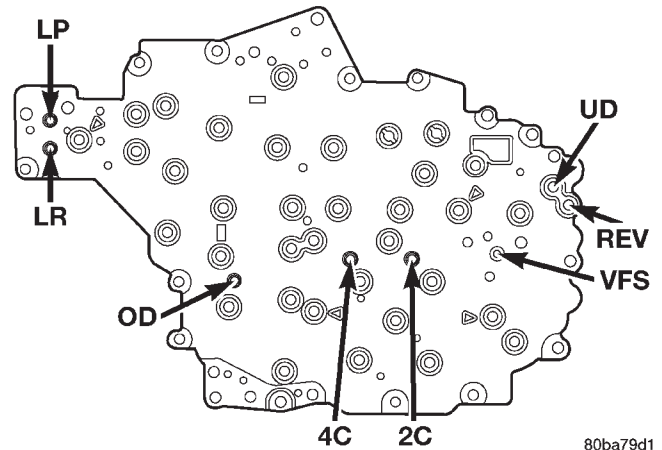
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**Fig. 2 Torque Converter Pressure Locations**

- 1 - TCC RELEASE
- 2 - TO COOLER
- 3 - TCC APPLY
- 4 - FROM COOLER
- 5 - LINE PRESSURE SENSOR

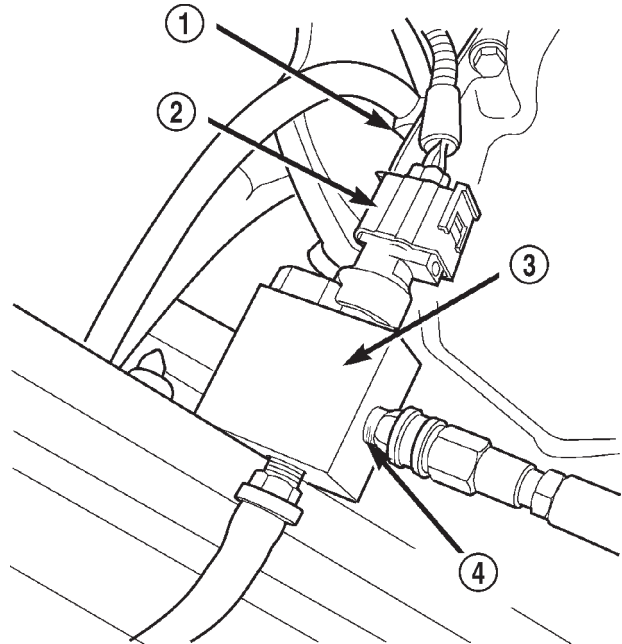
To determine the line pressure, there are two available methods. The DRB® scan tool can be used to read line pressure from the line pressure sensor. The second method is to install Line Pressure Adapter 8259 (Fig. 4) into the transmission case and then install the pressure gauge and the original sensor into the adapter. This will allow a comparison of the DRB® readings and the gauge reading to determine the accuracy of the line pressure sensor. The DRB® line pressure reading should match the gauge reading within ±10 psi.

In order to access any other pressure tap locations, the transmission oil pan must be removed, the pressure port plugs removed and Valve Body Pressure Tap Adapter 8258-A (Fig. 5) installed. The extensions supplied with Adapter 8258-A will allow the installation of pressure gauges to the valve body. Refer to (Fig. 3) for correct pressure tap location identification.



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**Fig. 3 Pressure Tap Locations**



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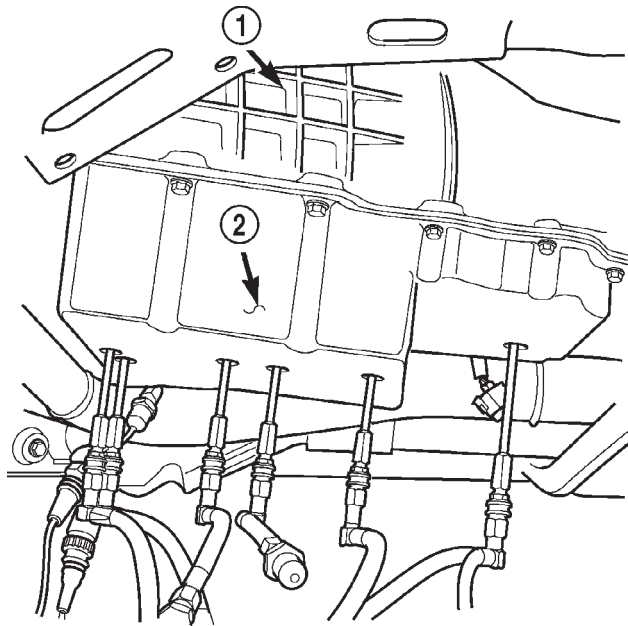
**Fig. 4 Line Pressure Adapter 8259**

- 1 - LINE PRESSURE SENSOR PORT
- 2 - LINE PRESSURE SENSOR
- 3 - TOOL 8259
- 4 - PRESSURE TAP

**TEST PROCEDURE**

All pressure readings should be taken with the transmission fluid level full, transmission oil at the normal operating temperature, and the engine at 1500 rpm. Check the transmission for proper operation in each gear position that is in question or if a specific element is in question, check the pressure readings in at least two gear positions that employ that element. Refer to the Hydraulic Schematics at the rear of this section to determine the correct pressures for each element in a given gear position.

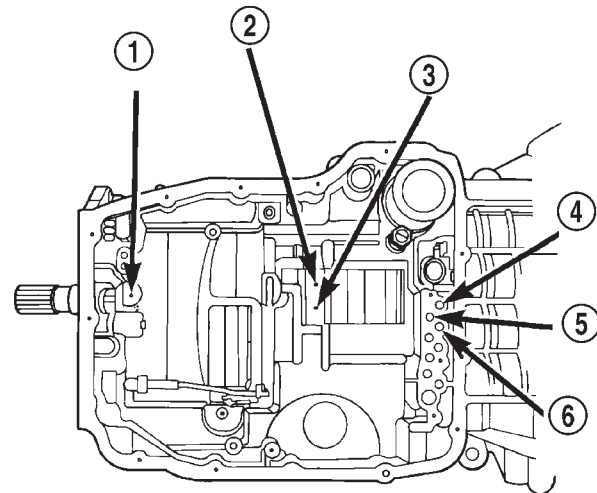
## AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 5 Valve Body Pressure Tap Adapter 8258-A**

- 1 - 45RFE TRANSMISSION
- 2 - TOOL 8258-A



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**Fig. 6 Air Pressure Test Passages**

- 1 - LOW REVERSE CLUTCH
- 2 - 4TH CLUTCH
- 3 - 2ND CLUTCH
- 4 - OVERDRIVE CLUTCH
- 5 - UNDERDRIVE CLUTCH
- 6 - REVERSE CLUTCH

**NOTE:** The 45RFE utilizes closed loop control of pump line pressure. The pressure readings may therefore vary greatly but should always follow line pressure.

Some common pressures that can be measured to evaluate pump and clutch performance are the upshift/downshift pressures and the garage shift pressures. The upshift/downshift pressure for all shifts is 120 psi. The garage shift pressure when performing a N-R shift is 220 psi. The garage shift pressure for the R-N and N-1 shifts is 120 psi.

## DIAGNOSIS AND TESTING - AIR CHECKING TRANSMISSION CLUTCH OPERATION

Air-pressure testing can be used to check transmission clutch operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The clutch apply passages are shown (Fig. 6).

**NOTE:** The air supply which is used must be free of moisture and dirt. Use a pressure of 30 psi to test clutch operation.

Apply air pressure at each port. If the clutch is functioning, a soft thump will be heard as the clutch is applied. The clutch application can also be felt by touching the appropriate element while applying air pressure. As the air pressure is released, the clutch should also release.

## DIAGNOSIS AND TESTING - CONVERTER HOUSING FLUID LEAK

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. Torque converter seal leaks tend to move along the drive hub and onto the rear of the converter. Pump cover seal tend to run down the cover and the inside surface of the bellhousing.

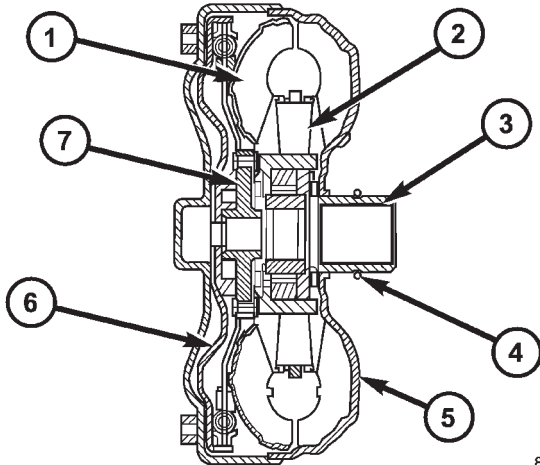
Some leaks, or suspected leaks, may be particularly difficult to locate. If necessary, a Mopar® approved dye may be used to locate a leak.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

**TORQUE CONVERTER LEAK POINTS**

Possible sources of converter leaks are:

- (1) Leaks at the weld joint around the outside diameter weld (Fig. 7).
- (2) Leaks at the converter hub weld (Fig. 7).



**Fig. 7 Torque Converter Assembly**

- 1 - TURBINE ASSEMBLY
- 2 - STATOR
- 3 - CONVERTER HUB
- 4 - O-RING
- 5 - IMPELLER ASSEMBLY
- 6 - CONVERTER CLUTCH PISTON
- 7 - TURBINE HUB

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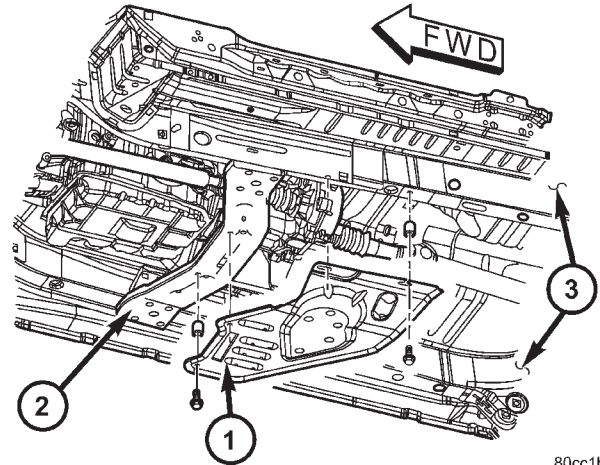
**STANDARD PROCEDURE - ALUMINUM THREAD REPAIR**

Damaged or worn threads in the aluminum transmission 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**

- (1) Disconnect the negative battery cable.
- (2) Raise and support the vehicle
- (3) Remove any necessary skid plates (Fig. 8). (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL)
- (4) Mark propeller shaft and axle companion flanges for assembly alignment.
- (5) Remove the rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)



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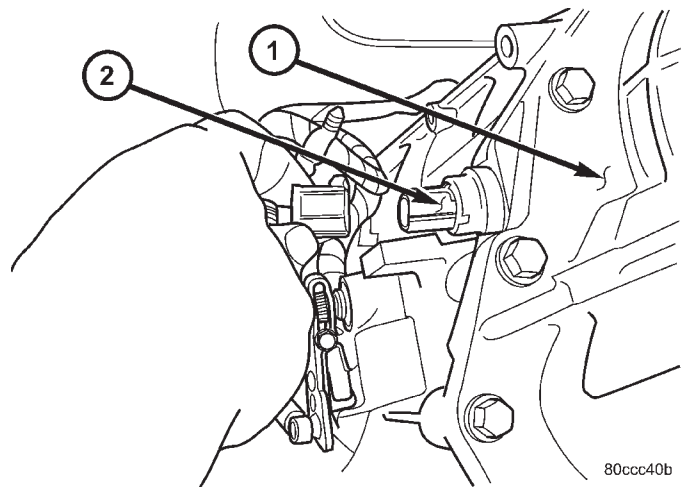
**Fig. 8 Remove Skid Plate**

- 1 - SKID PLATE
- 2 - TRANSMISSION CROSSMEMBER
- 3 - FRAME RAILS

(6) Remove the front propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(7) Disengage the output speed sensor connector from the output speed sensor (Fig. 9).

(8) Disengage the input speed sensor connector from the input speed sensor (Fig. 10).



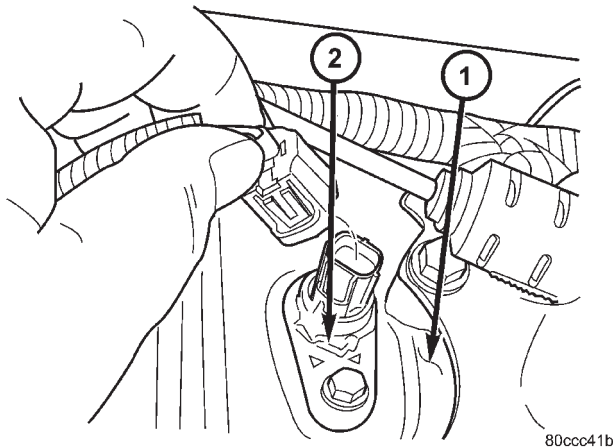
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**Fig. 9 Disconnect Output Speed Sensor**

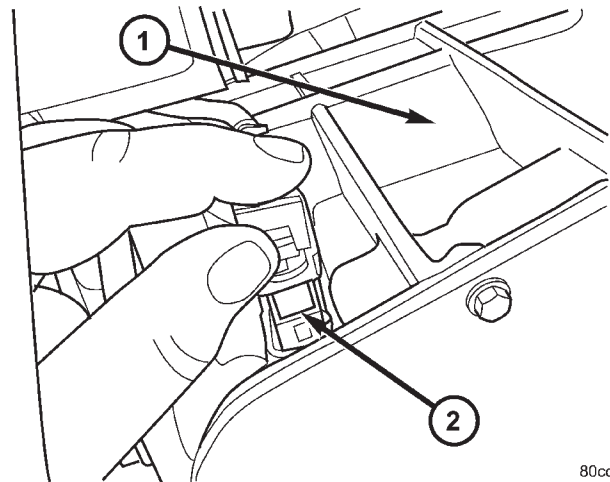
- 1 - TRANSMISSION
- 2 - OUTPUT SPEED SENSOR



## AUTOMATIC TRANSMISSION - 45RFE (Continued)

**Fig. 10 Disconnect Input Speed Sensor**

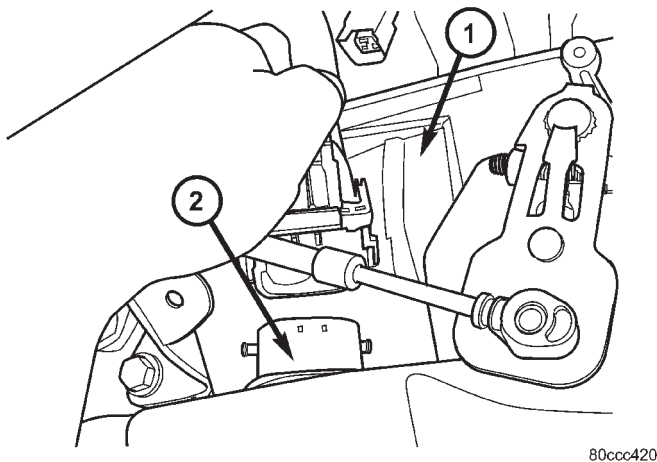
- 1 - TRANSMISSION  
2 - INPUT SPEED SENSOR

**Fig. 12 Disconnect Line Pressure Sensor**

- 1 - TRANSMISSION  
2 - LINE PRESSURE SENSOR

(9) Disengage the transmission solenoid/TRS assembly connector from the transmission solenoid/TRS assembly (Fig. 11).

(10) Disengage the line pressure sensor connector from the line pressure sensor (Fig. 12).

**Fig. 11 Disconnect Transmission Solenoid/TRS Assembly**

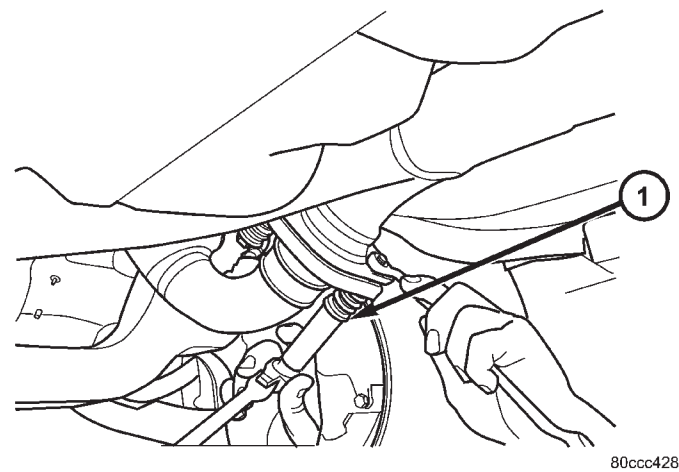
- 1 - TRANSMISSION  
2 - TRANSMISSION SOLENOID/TRS ASSEMBLY

(11) Remove the bolts holding the exhaust cross-over pipe to the pre-catalytic converter pipe flanges (Fig. 13).

(12) Remove the bolts holding the exhaust cross-over pipe to the catalytic converter flange.

(13) Disconnect gearshift cable from transmission manual valve lever (Fig. 14).

(14) Disengage the shift cable from the cable support bracket.

**Fig. 13 Remove Exhaust Flange Bolts**

- 1 - EXHAUST FLANGE BOLTS

(15) Remove the starter motor.

(16) Remove the engine to transmission collar (Fig. 15).

(17) 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.

(18) Disconnect transmission fluid cooler lines at transmission fittings and clips.

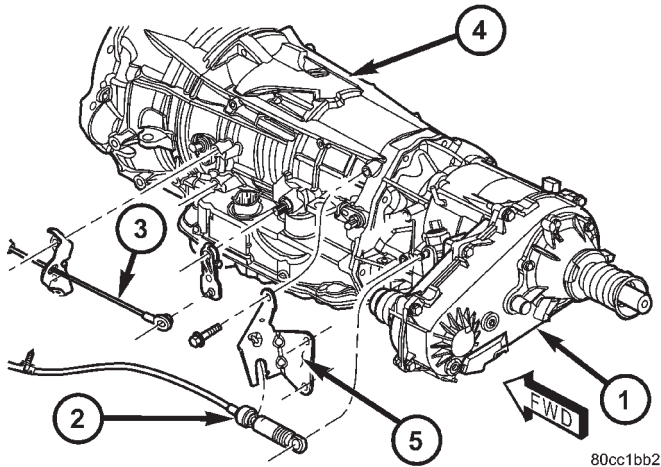
(19) Disconnect the transmission vent hose from the transmission.

(20) Remove transfer case.

(21) Support rear of engine with safety stand or jack.

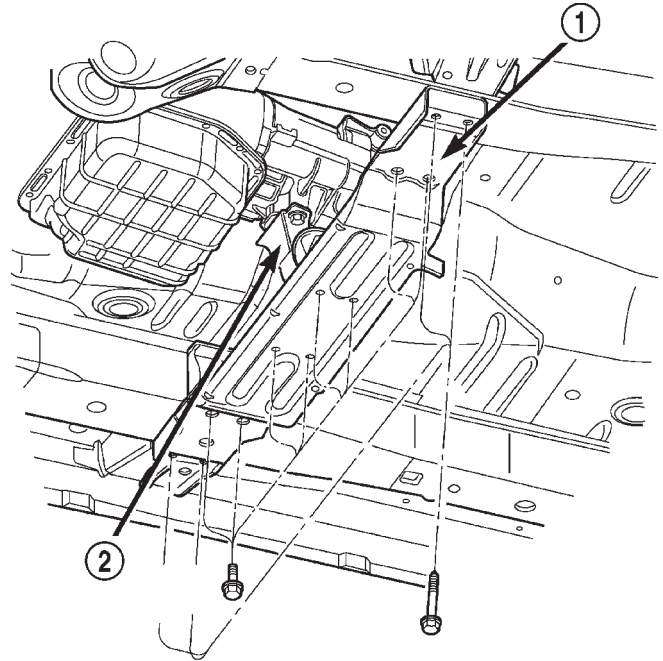
(22) Raise transmission slightly with service jack to relieve load on crossmember and supports.

AUTOMATIC TRANSMISSION - 45RFE (Continued)



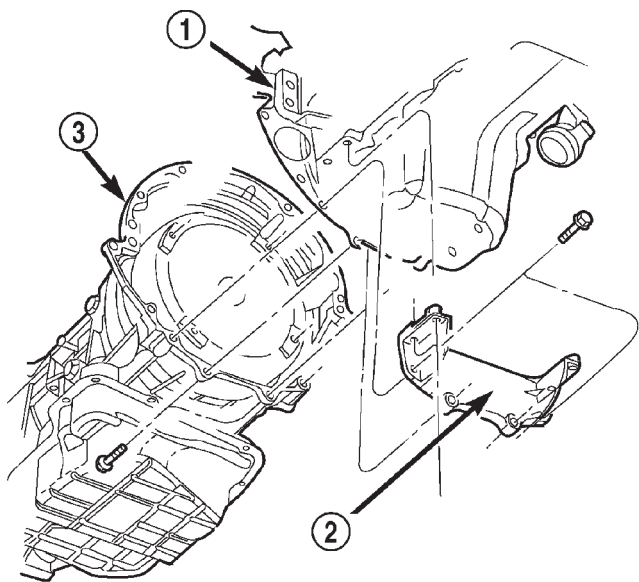
**Fig. 14 Remove Shift Cables**

- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET



**Fig. 16 Rear Transmission Crossmember**

- 1 - CROSSMEMBER
- 2 - REAR TRANSMISSION MOUNT



**Fig. 15 Transmission Collar**

- 1 - ENGINE
- 2 - ENGINE TO TRANSMISSION COLLAR
- 3 - TRANSMISSION

(23) Remove bolts securing rear support and cushion to transmission and crossmember (Fig. 16).

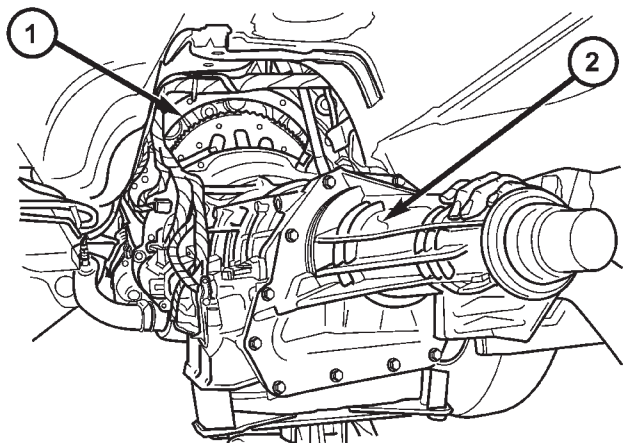
(24) Remove bolts attaching crossmember to frame and remove crossmember.

(25) Remove all remaining converter housing bolts.

(26) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(27) Hold torque converter in place during transmission removal.

(28) Lower transmission and remove assembly from under the vehicle (Fig. 17).



**Fig. 17 Remove Transmission**

- 1 - ENGINE
- 2 - TRANSMISSION

(29) To remove torque converter, carefully slide torque converter out of the transmission.

**DISASSEMBLY**

- (1) Drain fluid from transmission.

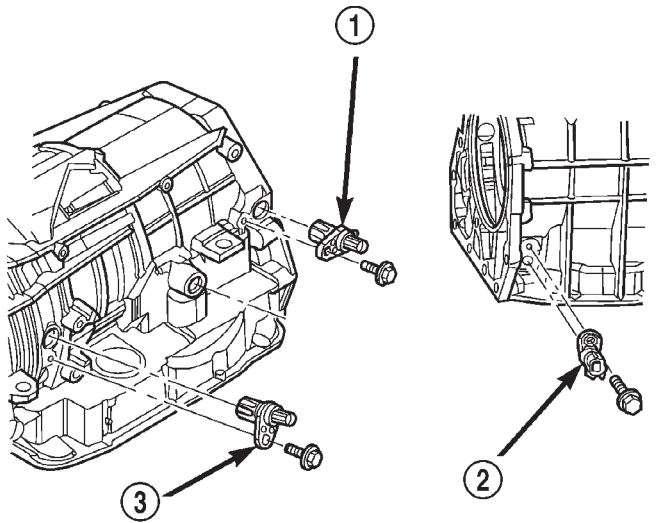
## AUTOMATIC TRANSMISSION - 45RFE (Continued)

(2) Clean exterior of transmission with suitable solvent or pressure washer.

(3) Remove the torque converter from the transmission.

(4) Remove the manual shift lever from the transmission.

(5) Remove the input, output, and line pressure sensors from the transmission case (Fig. 18).



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**Fig. 18 Remove Input, Output, and Line Pressure Sensors**

- 1 - OUTPUT SPEED SENSOR
- 2 - LINE PRESSURE SENSOR
- 3 - INPUT SPEED SENSOR

(6) Inspect the ends of the sensors for debris, which may indicate the nature of the transmission failure.

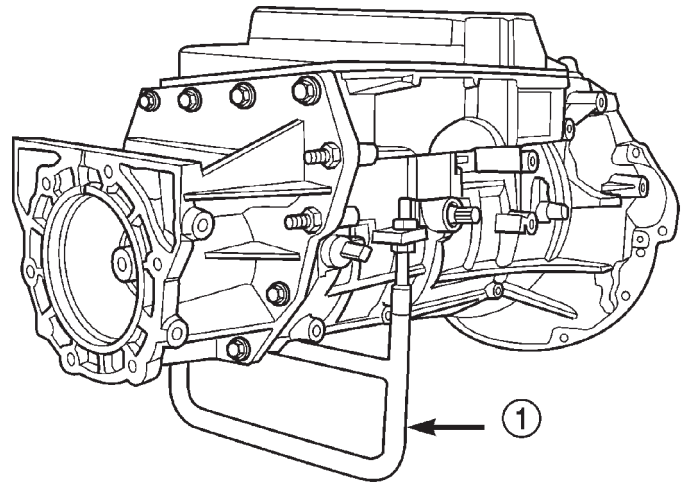
(7) Install Support Stand 8257 onto the transmission case (Fig. 19).

(8) Using Adapter 8266-1 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the input shaft end-play (Fig. 20).

**NOTE:** When measuring the input shaft end-play, two "stops" will be felt. When the input shaft is pushed inward and the dial indicator zeroed, the first "stop" felt when the input shaft is pulled outward is the movement of the input shaft in the input clutch housing hub. This value should not be included in the end-play measured value and therefore must be recorded and subtracted from the dial indicator reading.

(9) Remove the bolts holding the transmission extension/adaptor housing to the transmission case.

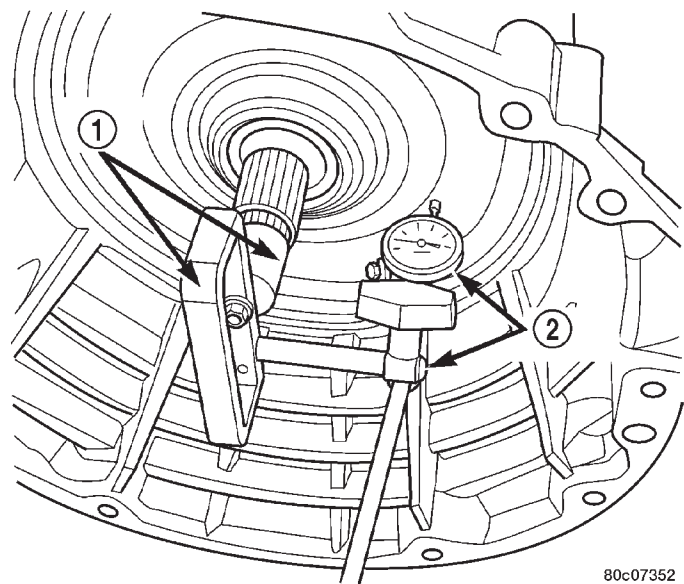
(10) Remove the extension/adaptor housing from the transmission case.



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**Fig. 19 Install Support Stand - Tool 8257**

- 1 - TOOL 8257



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**Fig. 20 Measure Input Shaft End Play**

- 1 - TOOL 8266
- 2 - TOOL C-3339

(11) Using Alignment Plate 8261, Adapter 8266-17 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the output shaft end-play (Fig. 21).

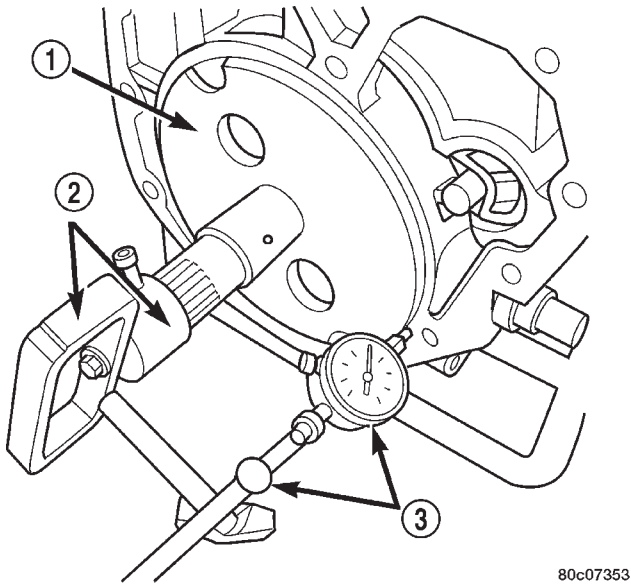
(12) Remove the bolts holding the transmission oil pan to the transmission case.

(13) Remove the transmission oil pan from the transmission case.

(14) Remove the primary oil filter and the oil cooler return filter (Fig. 22).

(15) Remove the cooler return filter bypass valve.

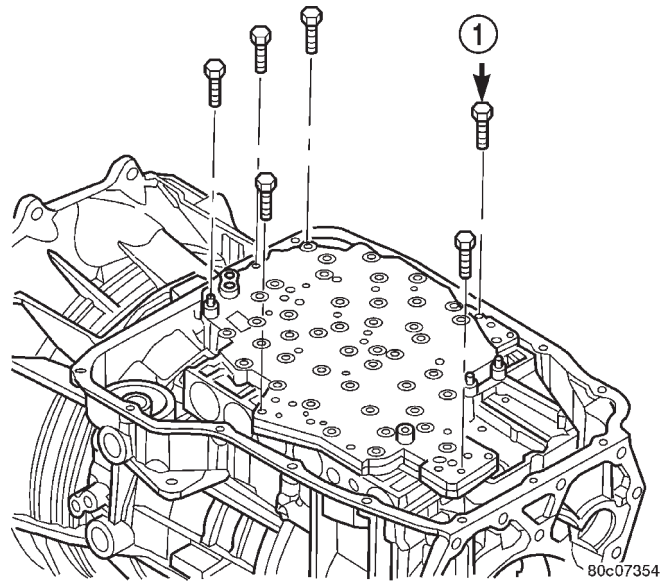
AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 21 Measure Output Shaft End Play**

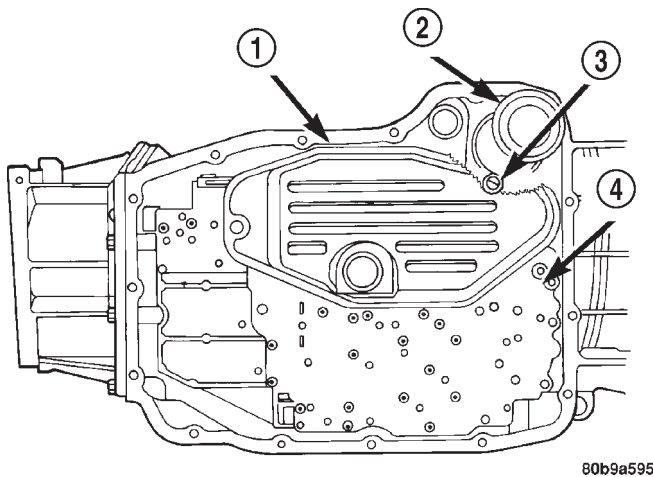
- 1 - TOOL 8261
- 2 - TOOL 8266
- 3 - TOOL C-3339



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**Fig. 23 Remove Valve Body Assembly**

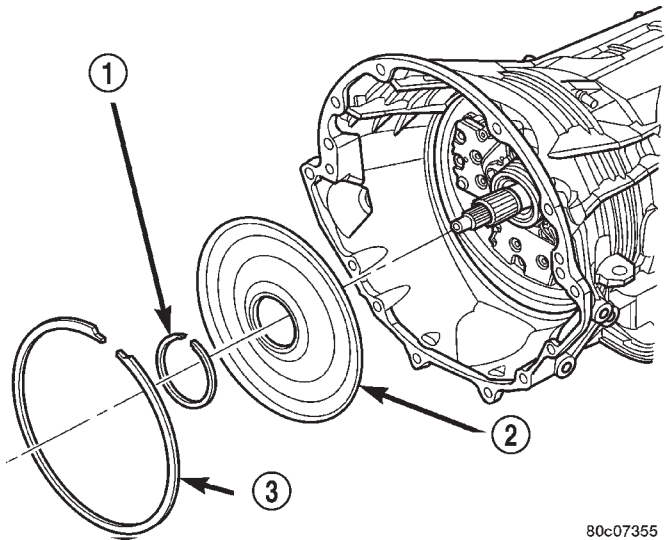
- 1 - VALVE BODY TO CASE BOLT (6)



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**Fig. 22 Remove Primary Oil and Cooler Filters**

- 1 - PRIMARY OIL FILTER
- 2 - COOLER RETURN FILTER
- 3 - COOLER RETURN FILTER BYPASS VALVE
- 4 - VALVE BODY



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**Fig. 24 Remove Transmission Front Cover**

- 1 - INNER SNAP-RING
- 2 - TRANSMISSION COVER
- 3 - OUTER SNAP-RING

(16) Remove the bolts holding the valve body to the transmission case (Fig. 23).

(17) Remove the valve body from the transmission case.

(18) Remove the outer snap-ring securing the transmission front cover into the transmission case (Fig. 24).

(19) Remove the inner snap-ring securing the transmission front cover to the oil pump (Fig. 24).

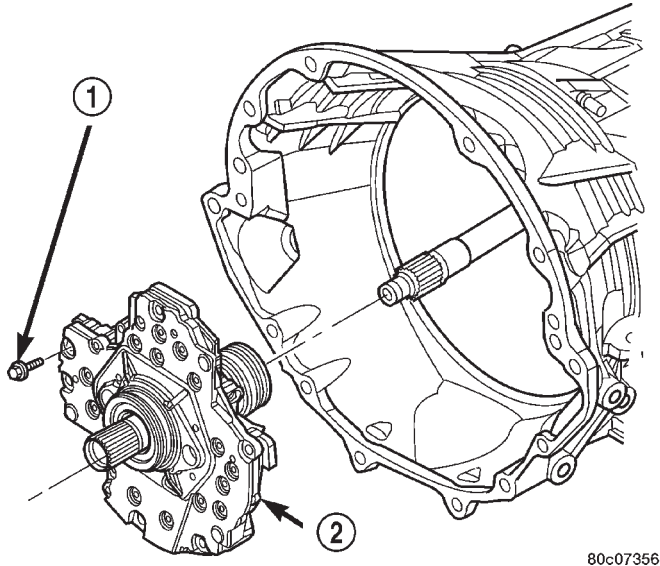
(20) Reaching through a case opening in the valve body area with a long blunted tool, remove the transmission front cover from the transmission case.

(21) Remove the bolts holding the oil pump into the transmission case (Fig. 25).

(22) Remove the oil pump. Hold inward on the input shaft to prevent pulling the input clutch assembly with the oil pump (Fig. 25).

(23) Remove the number 1 bearing from the input clutch assembly (Fig. 26).

AUTOMATIC TRANSMISSION - 45RFE (Continued)



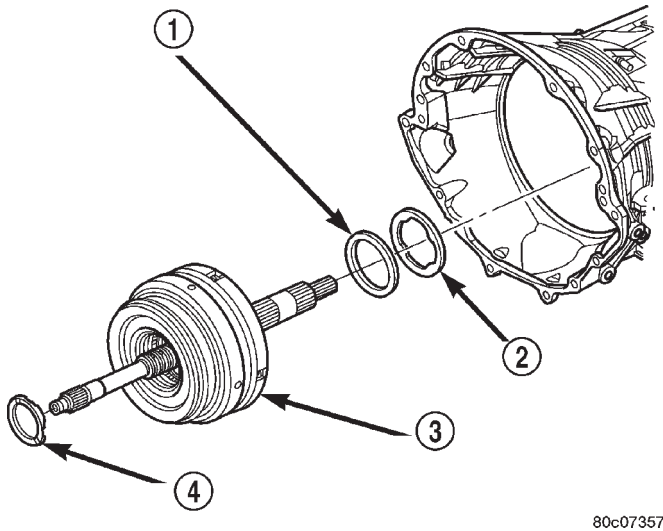
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**Fig. 25 Remove Oil Pump**

- 1 - OIL PUMP TO CASE BOLT (6)
- 2 - OIL PUMP

(24) Remove the input clutch assembly from the transmission case (Fig. 26).

(25) Remove the number 5 bearing and selective thrust plate from the input clutch assembly (Fig. 26), or the 4C clutch retainer/bulkhead.



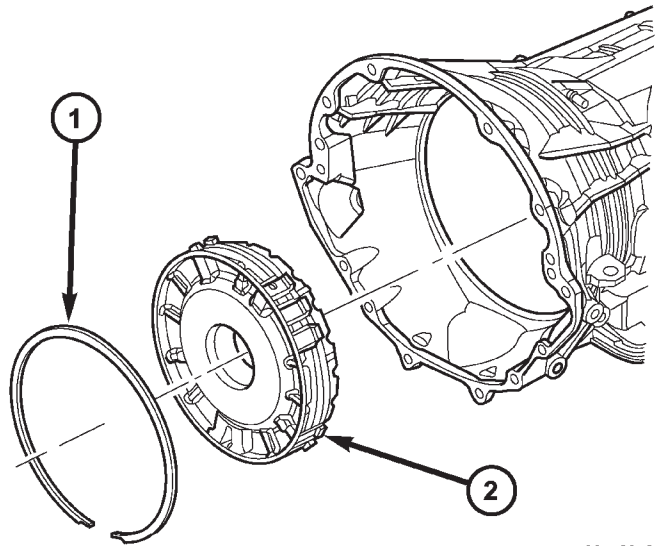
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**Fig. 26 Remove Input Clutch Assembly**

- 1 - BEARING NUMBER 5
- 2 - THRUST PLATE (SELECT)
- 3 - INPUT CLUTCH ASSEMBLY
- 4 - BEARING NUMBER 1

(26) Remove the 4C clutch retainer/bulkhead tapered snap-ring from the transmission case (Fig. 27).

(27) Remove the 4C clutch retainer/bulkhead from the transmission case (Fig. 27).



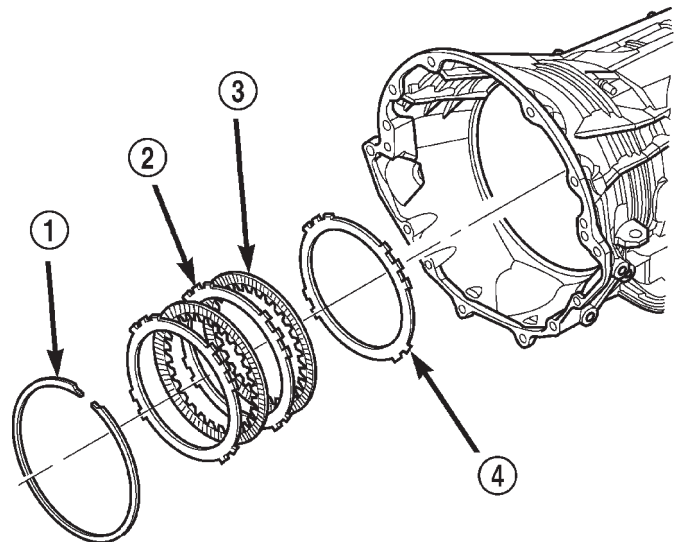
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**Fig. 27 Remove 4C Clutch Retainer/Bulkhead**

- 1 - SNAP-RING
- 2 - 4C CLUTCH RETAINER/BULKHEAD

(28) Remove the front 2C clutch pack snap-ring from the transmission case (Fig. 28).

(29) Remove the 2C clutch pack from the transmission case (Fig. 28).



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**Fig. 28 Remove 2C Clutch Pack**

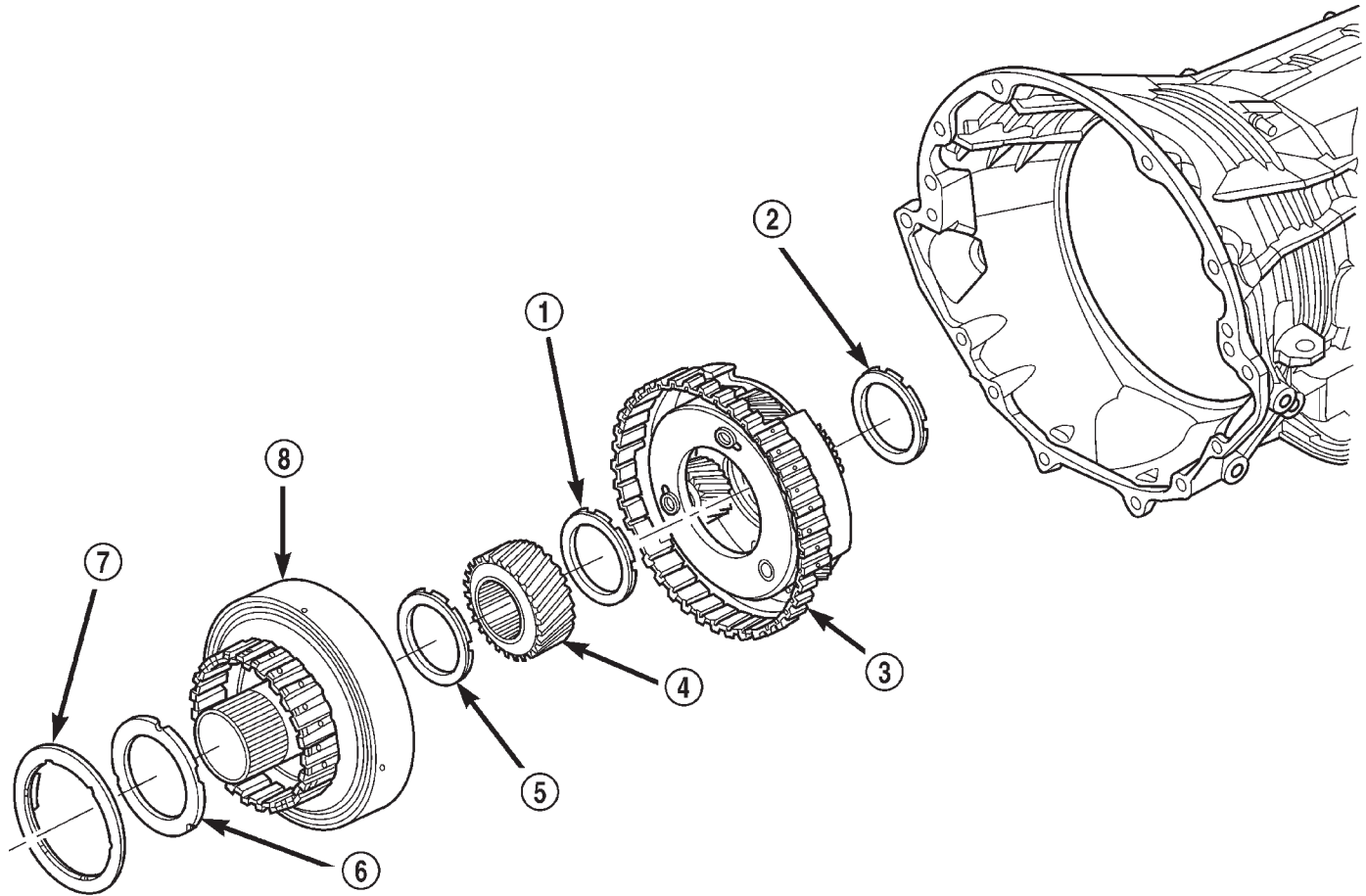
- 1 - SNAP-RING
- 2 - PLATE
- 3 - DISC
- 4 - REACTION PLATE

(30) Remove the rear selective plate and number 6 bearing from the reaction annulus (Fig. 29).

AUTOMATIC TRANSMISSION - 45RFE (Continued)

- (31) Remove the reaction annulus from the reaction planetary carrier (Fig. 29).
- (32) Remove the number 7 bearing (Fig. 29).
- (33) Remove the reaction sun gear (Fig. 29).
- (34) Remove the number 8 bearing from the reaction planetary carrier (Fig. 29).
- (35) Remove the reaction planetary carrier (Fig. 29). Note that this planetary gear set has three pinion gears.
- (36) Remove the number 9 bearing from the reverse planetary gear set (Fig. 29).

- (37) Remove the snap-ring holding the park sprag gear onto the output shaft (Fig. 30).
- (38) Remove the park sprag gear from the output shaft (Fig. 31).
- (39) Remove the input/reverse planetary assembly (Fig. 32).

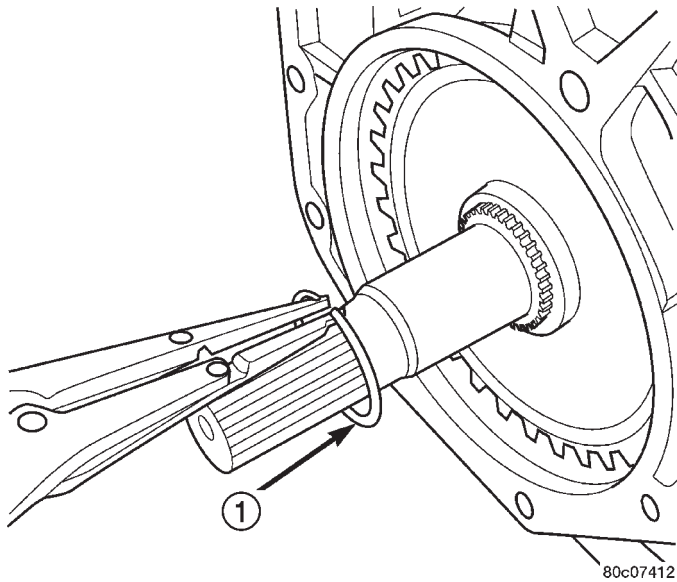


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**Fig. 29 Remove Reaction Annulus and Carrier**

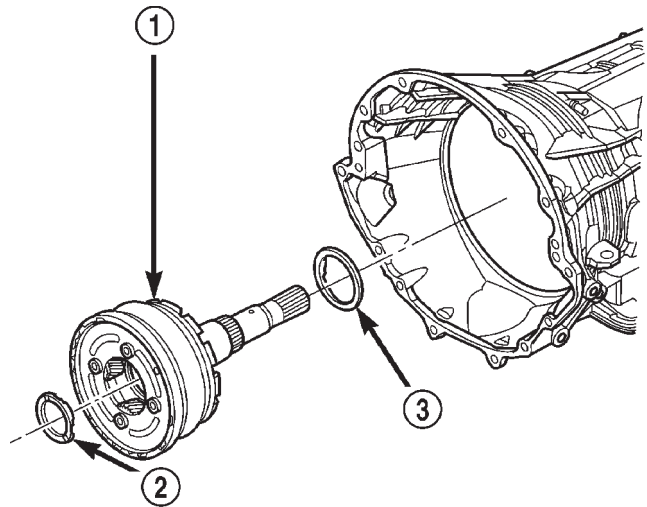
- |                                |                           |
|--------------------------------|---------------------------|
| 1 - BEARING NUMBER 8           | 5 - BEARING NUMBER 7      |
| 2 - BEARING NUMBER 9           | 6 - THRUST PLATE (SELECT) |
| 3 - REACTION PLANETARY CARRIER | 7 - BEARING NUMBER 6      |
| 4 - REACTION SUN GEAR          | 8 - REACTION ANNULUS      |

AUTOMATIC TRANSMISSION - 45RFE (Continued)



**Fig. 30 Remove Park Sprag Snap-Ring**

1 - SNAP-RING



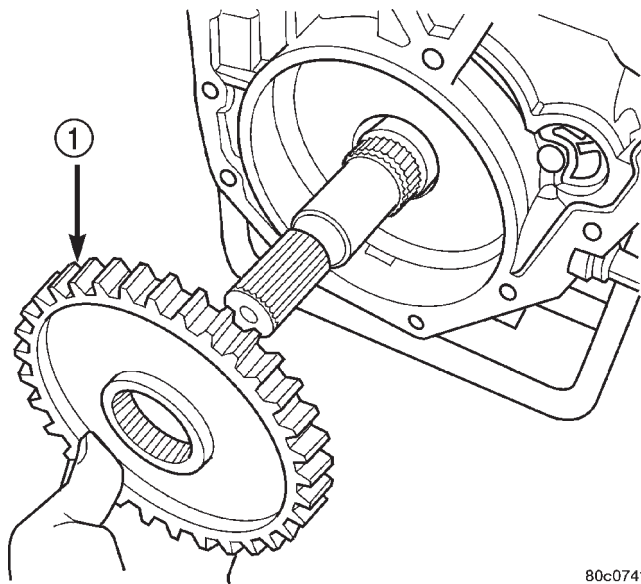
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**Fig. 32 Remove Input/Reverse Planetary Assembly**

1 - INPUT/REVERSE PLANETARY ASSEMBLY

2 - BEARING NUMBER 9

3 - BEARING NUMBER 12



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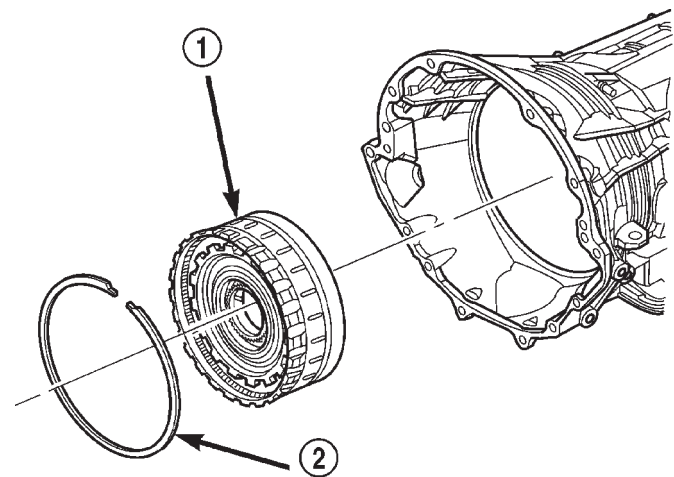
**Fig. 31 Remove Park Sprag Gear**

1 - PARK SPRAG GEAR

(40) Remove the number 12 bearing from the input/reverse planetary assembly (Fig. 32).

(41) Remove the snap-ring holding the low/reverse clutch retainer into the transmission case (Fig. 33).

(42) Remove the low/reverse clutch retainer from the transmission case (Fig. 33).



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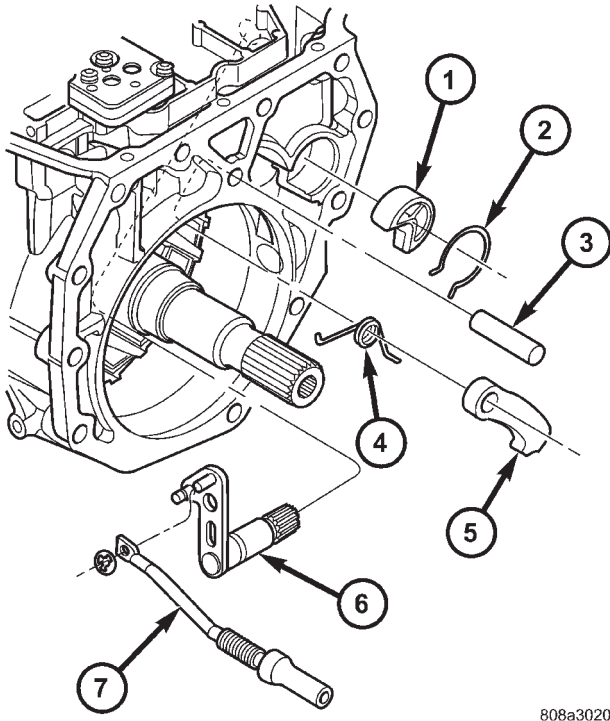
**Fig. 33 Remove Low/Reverse Clutch Retainer**

1 - LOW/REVERSE OVERRUNNING CLUTCH ASSEMBLY

2 - SNAP-RING

AUTOMATIC TRANSMISSION - 45RFE (Continued)

- (43) Remove the park pawl rod and e-clip (Fig. 34).
- (44) Remove the park pawl rod guide snap-ring (Fig. 34).
- (45) Remove the park pawl rod guide (Fig. 34).
- (46) Remove the park pawl pivot shaft, park pawl, and spring (Fig. 34).
- (47) Remove the manual selector shaft (Fig. 34).



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**Fig. 34 Manual Shaft/Park Lock Components**

- 1 - GUIDE
- 2 - SNAP-RING
- 3 - SHAFT
- 4 - SPRING
- 5 - PARK PAWL
- 6 - MANUAL SHAFT/LEVER
- 7 - PARK ROD

- (48) Remove the manual selector shaft seal.
- (49) Remove the dipstick tube seal.

**CLEANING**

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 +4, Type 9602, 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.

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.

**INSPECTION**

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.



## AUTOMATIC TRANSMISSION - 45RFE (Continued)

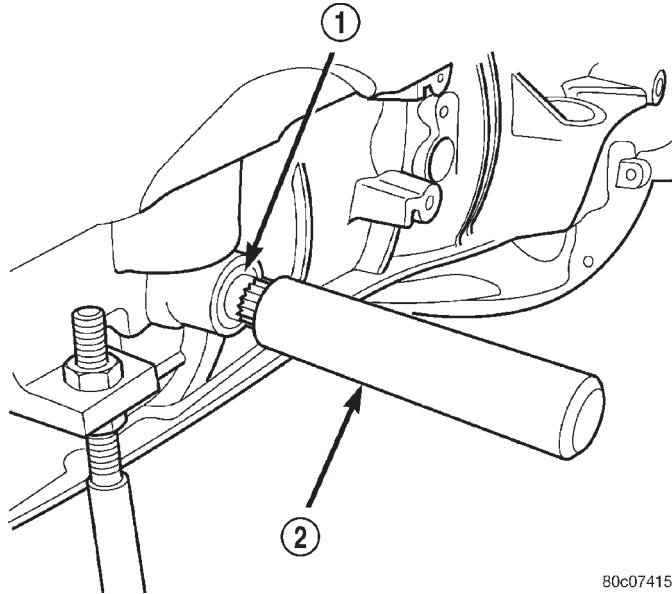
## ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install the cooler filter bypass valve.

(3) Torque the bypass valve to specification. The valve uses a tapered pipe thread and excessive torque can damage the transmission case. Tighten the cooler filter bypass valve to 4.5 N·m (40 in.lbs.).

(4) Install a new selector shaft seal using Seal Installer 8253 (Fig. 35).



**Fig. 35 Install Selector Shaft**

- 1 - SEAL
- 2 - TOOL 8253

(5) Install the manual selector shaft and retaining screw. Tighten the manual selector shaft retaining screw to 28 N·m (250 in.lbs.).

(6) Install the park pawl, spring, and shaft (Fig. 36).

(7) Install the park rod and e-clip (Fig. 36).

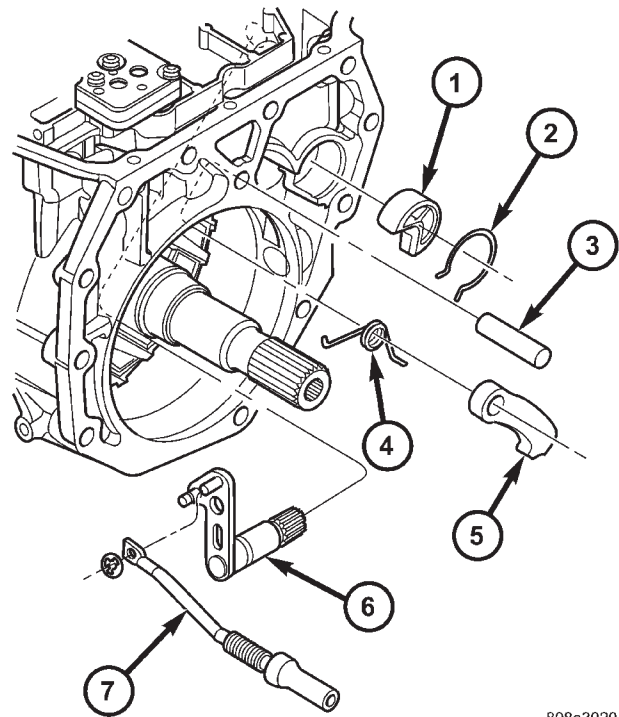
(8) Install the park rod guide and snap-ring (Fig. 36).

(9) Install a new dipstick tube seal using Seal Installer 8254 (Fig. 37).

**NOTE:** Before final assembly of transmission centerline, the 2C/4C clutch components should be installed into position and measured as follows:

(10) Install the 2C reaction plate into the transmission case (Fig. 38). The reaction plate is directional. The plate must be installed with the flat side toward the front of the transmission.

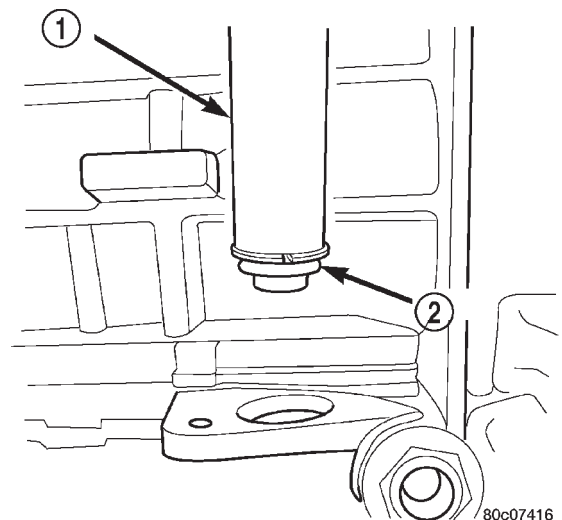
(11) Install the 2C clutch pack into the transmission case (Fig. 38).



808a3020

**Fig. 36 Manual Shaft/Park Lock Components**

- 1 - GUIDE
- 2 - SNAP-RING
- 3 - SHAFT
- 4 - SPRING
- 5 - PARK PAWL
- 6 - MANUAL SHAFT/LEVER
- 7 - PARK ROD



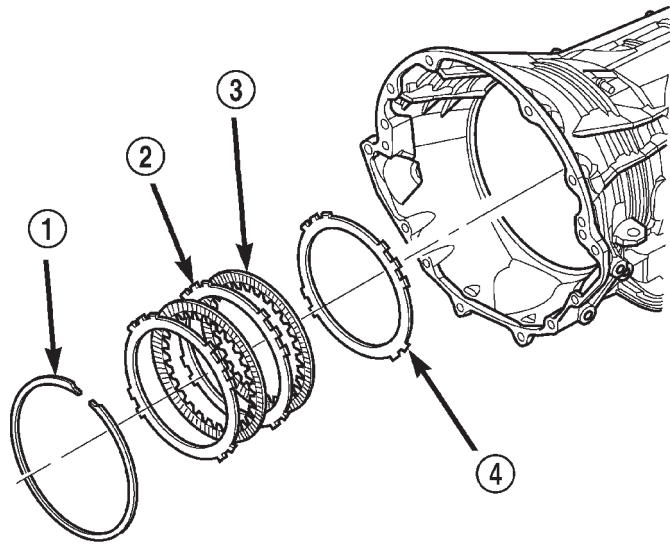
80c07416

**Fig. 37 Install Dipstick Tube Seal Using Tool 8254**

- 1 - TOOL 8254
- 2 - SEAL

AUTOMATIC TRANSMISSION - 45RFE (Continued)

(12) Install the flat 2C clutch snap-ring into the transmission case (Fig. 38).



**Fig. 38 Install 2C Clutch Pack**

- 1 - SNAP-RING
- 2 - PLATE
- 3 - DISC
- 4 - REACTION PLATE

(13) Install the 4C retainer/bulkhead into the transmission case. Make sure that the oil feed holes are pointing toward the valve body area.

(14) Install the 4C retainer/bulkhead tapered snap-ring into the transmission case. Make sure that the open ends of the snap-ring are located in the case opening toward the valve body area.

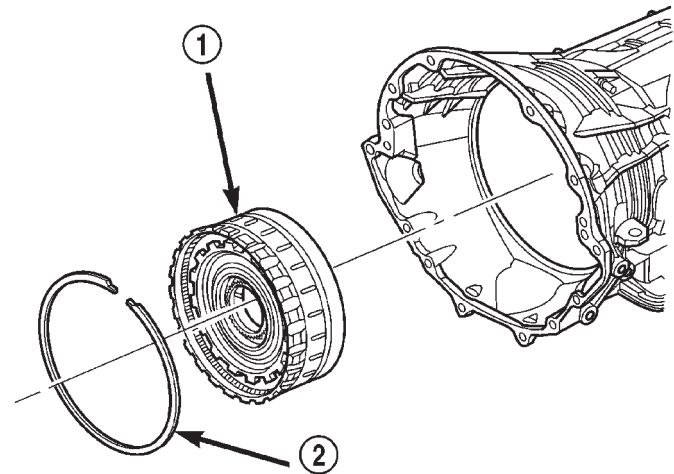
(15) Using a feeler gauge through the opening in the rear of the transmission case, measure the 2C clutch pack clearance between the 2C reaction plate and the transmission case at four different points. The average of these measurements is the 2C clutch pack clearance. The correct clutch clearance is 0.455-1.335 mm (0.018-0.053 in.). The reaction plate is not selective. If the clutch pack clearance is not within specification, the reaction plate, all the friction discs, and steels must be replaced.

(16) Remove the 4C retainer/bulkhead and all of the 2C clutch components from the transmission case.

(17) Install the low/reverse clutch assembly (Fig. 39). Make sure that the oil feed hole points toward the valve body area and that the bleed orifice is aligned with the notch in the rear of the transmission case.

(18) Install the snap-ring to hold the low/reverse clutch retainer into the transmission case (Fig. 39). The snap-ring is tapered and must be installed with

the tapered side forward. Once installed, verify that the snap-ring is fully seated in the snap-ring groove.



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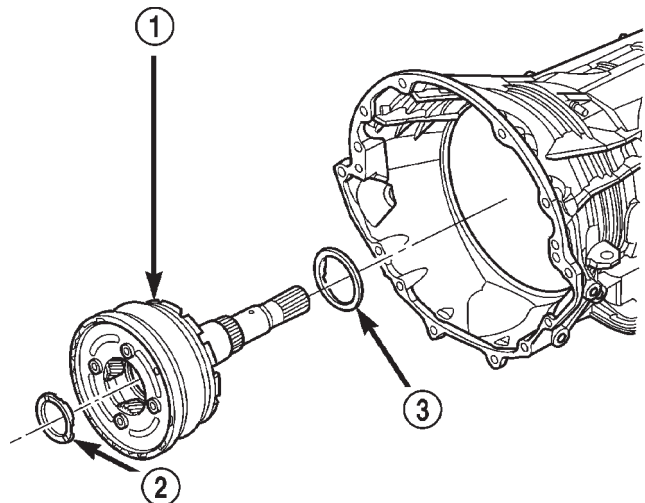
**Fig. 39 Install Low/Reverse Clutch Retainer**

- 1 - LOW/REVERSE OVERRUNNING CLUTCH ASSEMBLY
- 2 - SNAP-RING

(19) Air check the low/reverse clutch and verify correct overrunning clutch operation.

(20) Install the number 12 bearing over the output shaft and against the rear planetary gear set. The flat side of the bearing goes toward the planetary gearset and the raised tabs on the inner race should face the rear of the transmission.

(21) Install the reverse/input planetary assembly through the low/reverse clutch assembly (Fig. 40).



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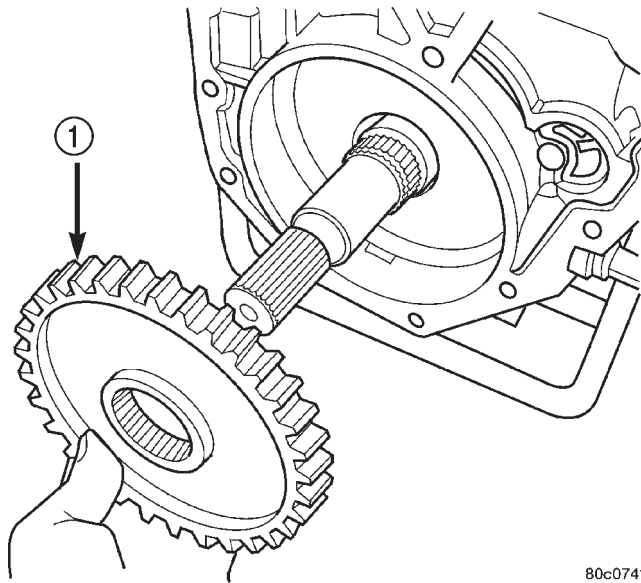
**Fig. 40 Install Input/Reverse Planetary Assembly**

- 1 - INPUT/REVERSE PLANETARY ASSEMBLY
- 2 - BEARING NUMBER 9
- 3 - BEARING NUMBER 12

## AUTOMATIC TRANSMISSION - 45RFE (Continued)

(22) Install the park sprag onto the output shaft (Fig. 41).

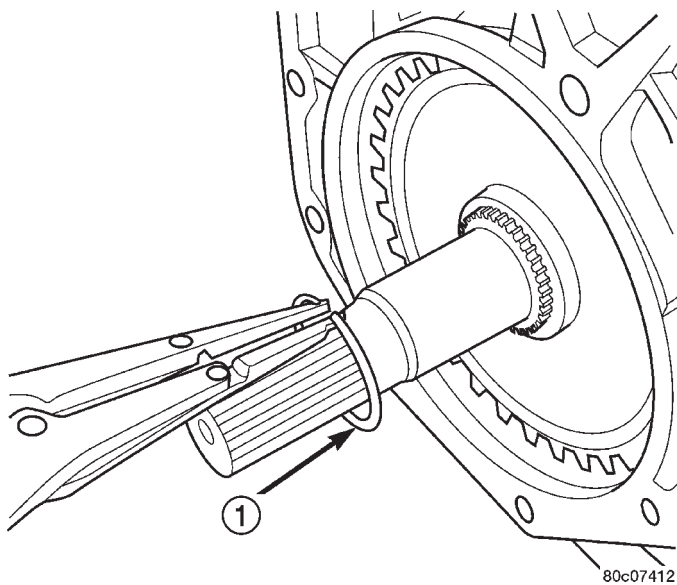
(23) Install the snap-ring to hold the park sprag onto the output shaft (Fig. 42).



80c07413

**Fig. 41 Install Park Sprag Gear**

1 - PARK SPRAG GEAR



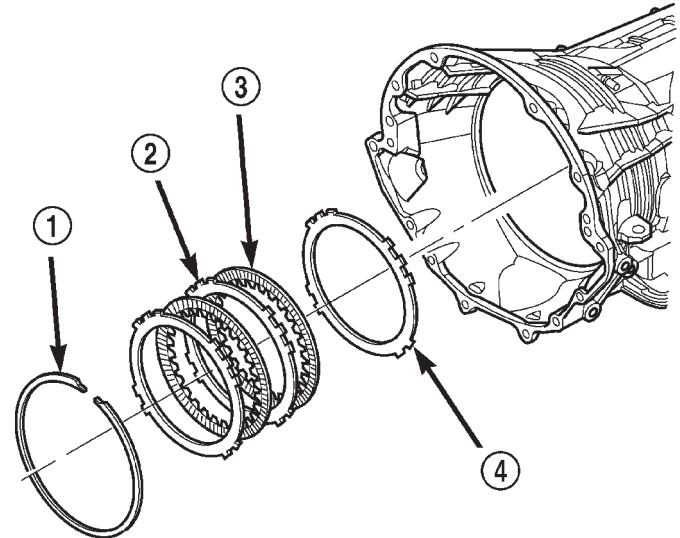
80c07412

**Fig. 42 Install Park Sprag Snap-Ring**

1 - SNAP-RING

(24) Install the 2C reaction plate into the transmission case (Fig. 43). The reaction plate is directional. The plate must be installed with the flat side toward the front of the transmission.

(25) Install the 2C clutch pack into the transmission case (Fig. 43).



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**Fig. 43 Install 2C Clutch Pack**

1 - SNAP-RING  
2 - PLATE  
3 - DISC  
4 - REACTION PLATE

(26) Install the number 8 bearing inside the reaction carrier with the outer race against the reaction planetary carrier.

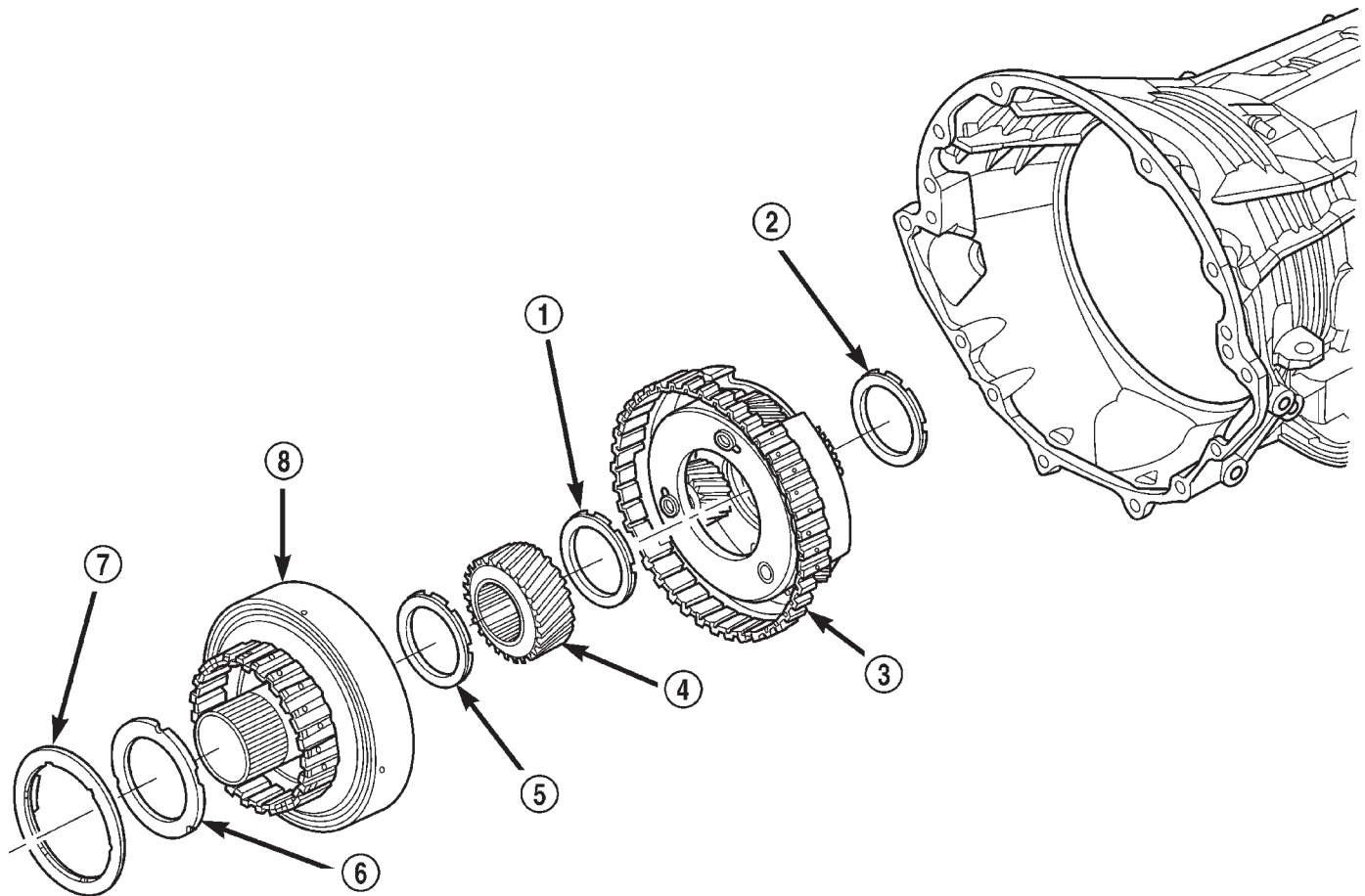
(27) Install the reaction planetary gear set and the number 9 bearing, with the inner race against the reaction planetary carrier, into the transmission case (Fig. 44).

(28) Install the flat 2C clutch snap-ring into the transmission case (Fig. 43).

(29) Install the reaction sun gear into the reaction planetary gear set. **Make sure** the small shoulder is facing the front of the transmission (Fig. 44).

(30) Install the number 7 bearing onto the reaction sun gear with the inner race against the sun gear (Fig. 44).

## AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 44 Install Reaction Annulus and Carrier**

- |                                |                           |
|--------------------------------|---------------------------|
| 1 - BEARING NUMBER 8           | 5 - BEARING NUMBER 7      |
| 2 - BEARING NUMBER 9           | 6 - THRUST PLATE (SELECT) |
| 3 - REACTION PLANETARY CARRIER | 7 - BEARING NUMBER 6      |
| 4 - REACTION SUN GEAR          | 8 - REACTION ANNULUS      |

(31) Install the output shaft selective thrust plate onto the reaction annulus with the oil grooves facing the annulus gear and the tabs and notches aligned as shown in (Fig. 45).

(32) Install the number 6 bearing against the output shaft selective thrust plate with the flat side against the thrust plate (Fig. 44) and the raised tabs on the inner race facing the front of the transmission.

(33) Install the reaction annulus into the reaction planetary gear set (Fig. 44).

(34) Install the 4C retainer/bulkhead into the transmission case. Make sure that the oil feed holes are pointing toward the valve body area. Rotate the reaction annulus during the installation of the 4C retainer/bulkhead to ease installation.

(35) Install the 4C retainer/bulkhead tapered snap-ring into the transmission case (Fig. 46) with the taper toward the front of the case. Make sure

that the open ends of the snap-ring are located in the case opening toward the valve body area.

(36) Air check the 2C and 4C clutch operation.

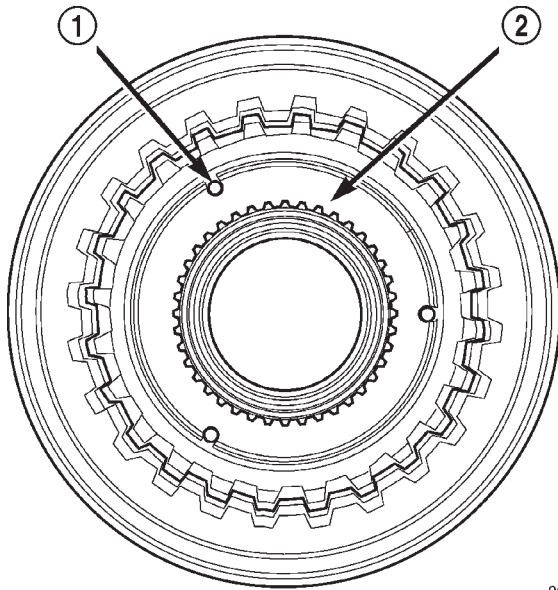
(37) Using Alignment Plate 8261, Adapter 8266-17 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the output shaft end-play (Fig. 47). The correct output shaft end-play is 0.22-0.55 mm (0.009-0.021 in.). Adjust as necessary. Install the chosen output shaft selective thrust plate and re-measure end-play to verify selection.

(38) Apply a bead of RTV silicone and install the extension/adaptor housing onto the transmission case.

(39) Install and torque the bolts to hold the extension/adaptor housing onto the transmission case. The correct torque is 54 N·m (40 ft.lbs.).

(40) Install the number 5 bearing and selective thrust plate onto the 4C retainer/bulkhead (Fig. 48). Be sure that the outer race of the bearing is against the thrust plate.

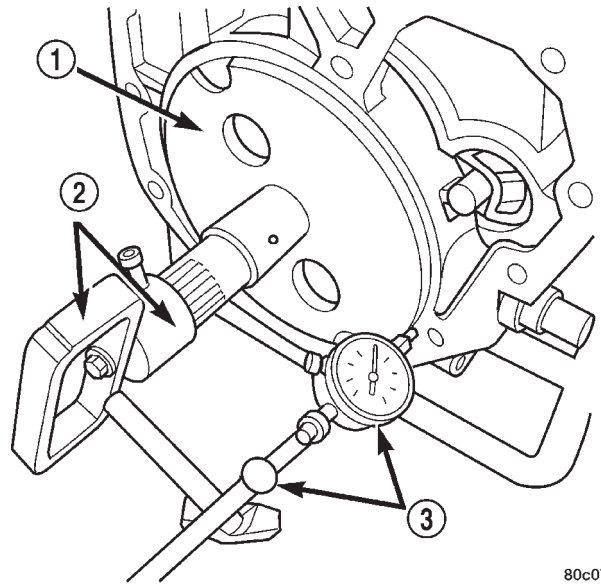
AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 45 Thrust Plate Alignment**

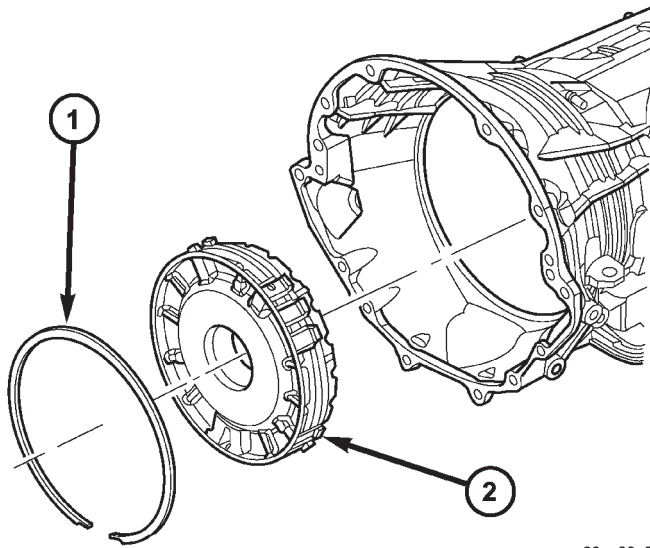
- 1 - LOCATING LUG (3)
- 2 - THRUST PLATE



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**Fig. 47 Measure Output Shaft End Play**

- 1 - TOOL 8261
- 2 - TOOL 8266
- 3 - TOOL C-3339

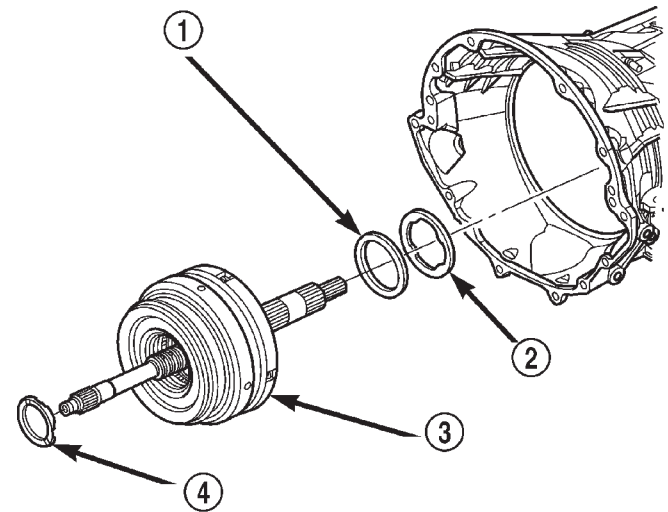


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**Fig. 46 Install 4C Clutch Retainer/Bulkhead**

- 1 - SNAP-RING
- 2 - 4C CLUTCH RETAINER/BULKHEAD

(41) Install the input clutch assembly into the transmission case (Fig. 48). Make sure that the input clutch assembly is fully installed by performing a visual inspection through the input speed sensor hole. If the tone wheel teeth on the input clutch assembly are centered in the hole, the assembly is fully installed.



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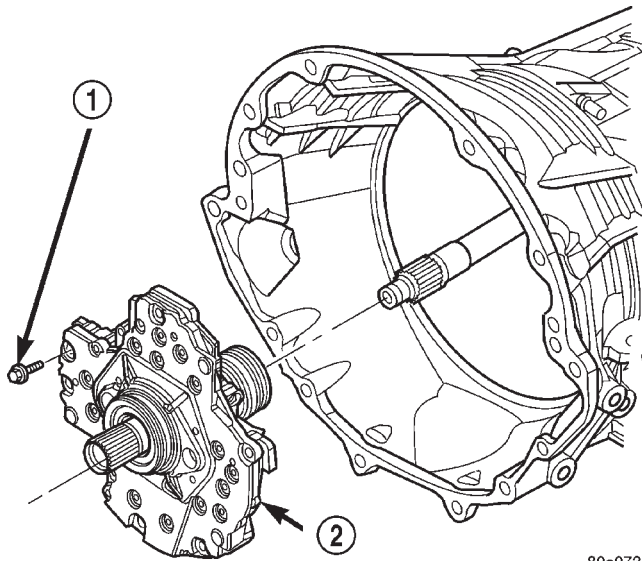
**Fig. 48 Install Input Clutch Assembly**

- 1 - BEARING NUMBER 5
- 2 - THRUST PLATE (SELECT)
- 3 - INPUT CLUTCH ASSEMBLY
- 4 - BEARING NUMBER 1

(43) Install the oil pump into the transmission case (Fig. 49).

(44) Install the bolts to hold the oil pump into the transmission case. Tighten the oil pump bolts to 28 N·m (250 in.lbs.).

AUTOMATIC TRANSMISSION - 45RFE (Continued)

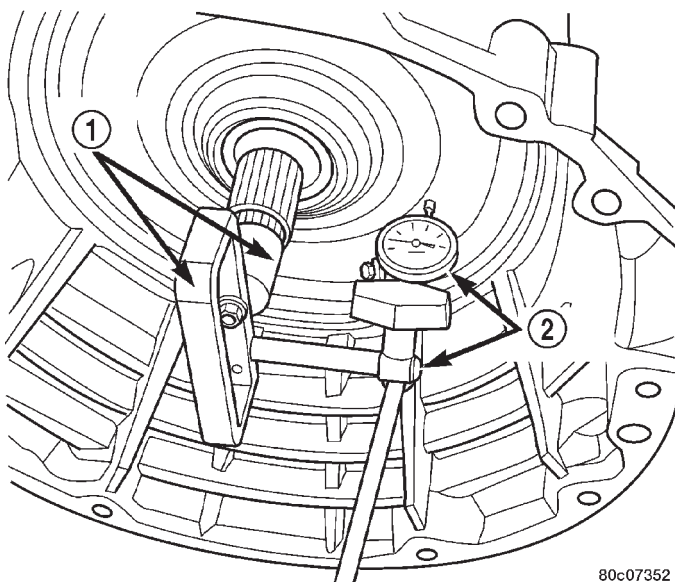


80c07356

**Fig. 49 Install Oil Pump**

- 1 - OIL PUMP TO CASE BOLT (6)
- 2 - OIL PUMP

(45) Using Adapter 8266-1 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the input shaft end-play (Fig. 50). The correct end-play is 0.46-0.89 mm (0.018-0.035 in.). Adjust as necessary. Install the chosen thrust plate on the number 5 bearing and re-measure end-play to verify selection.



80c07352

**Fig. 50 Measure Input Shaft End Play**

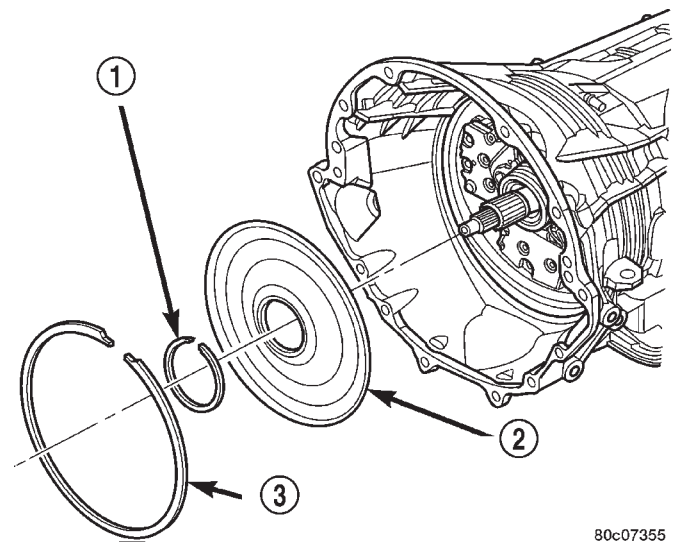
- 1 - TOOL 8266
- 2 - TOOL C-3339

**NOTE:** When measuring the input shaft end-play, two "stops" will be felt. When the input shaft is pushed inward and the dial indicator zeroed, the first "stop" felt when the input shaft is pulled outward is the movement of the input shaft in the input clutch housing hub. This value should not be included in the end-play measured value and therefore must be recorded and subtracted from the dial indicator reading.

(46) Install the transmission front cover into the transmission case (Fig. 51).

(47) Install the outer snap-ring to hold the transmission front cover into the transmission case (Fig. 51).

(48) Partially install the inner transmission front cover snap-ring onto the oil pump (Fig. 51).



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**Fig. 51 Install the Transmission Front Cover**

- 1 - INNER SNAP-RING
- 2 - TRANSMISSION COVER
- 3 - OUTER SNAP-RING

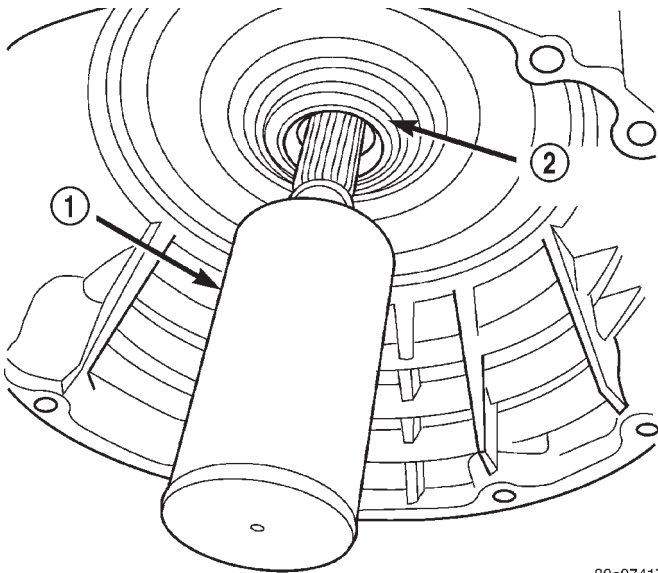
(49) Using Installer 8255, install the inner transmission front cover snap-ring the remainder of the way onto the oil pump (Fig. 52).

(50) Install the valve body (Fig. 53). Verify that the pin on the manual lever has properly engaged the TRS selector plate. Tighten the valve body to transmission case bolts to 12 N·m (105 in.lbs.).

(51) Install a new primary oil filter seal in the oil pump inlet bore. Seat the seal in the bore with the butt end of a hammer, or other suitable tool.

**CAUTION:** The primary oil filter seal **MUST** be fully installed flush against the oil pump body. **DO NOT** install the seal onto the filter neck and attempt to install the filter and seal as an assembly. Damage to the transmission will result.

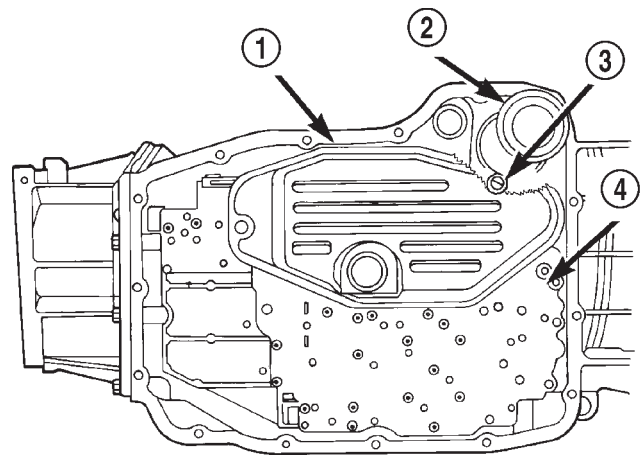
AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 52 Seat Snap-Ring Using Tool 8255**

- 1 - TOOL 8255
- 2 - SNAP-RING

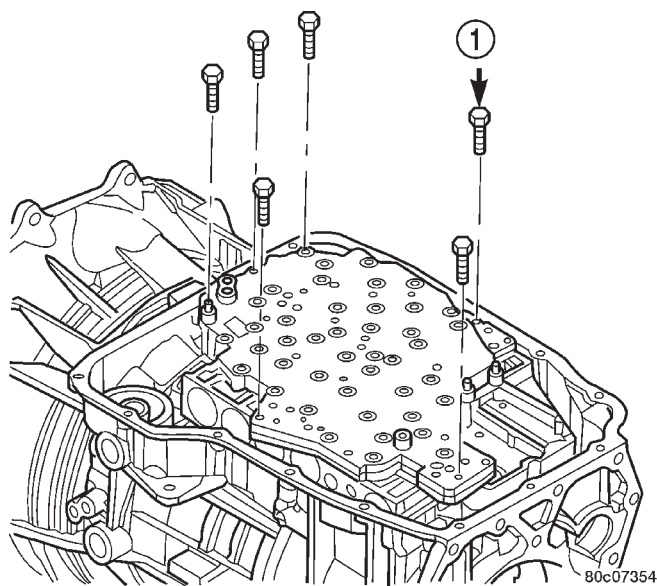


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**Fig. 54 Install Primary Oil and Cooler Filters**

- 1 - PRIMARY OIL FILTER
- 2 - COOLER RETURN FILTER
- 3 - COOLER RETURN FILTER BYPASS VALVE
- 4 - VALVE BODY

(54) Install the input, output, and line pressure sensors (Fig. 55). Tighten the bolts to 12 N·m (105 in.lbs.).



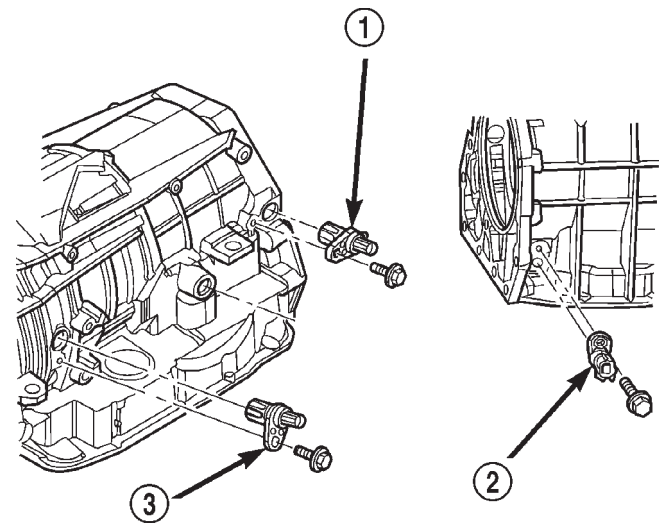
80c07354

**Fig. 53 Install Valve Body Assembly**

- 1 - VALVE BODY TO CASE BOLT (6)

(52) Install the primary oil filter and the oil cooler return filter (Fig. 54). Tighten the screw to hold the primary oil filter to the valve body to 4.5 N·m (40 in.lbs.). Using Oil Filter Wrench 8321, tighten the cooler return oil filter to the transmission case to 14 N·m (125 in.lbs.).

(53) Apply RTV silicone to the oil pan and install the transmission oil pan. Tighten the bolts to 12 N·m (105 in.lbs.).



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**Fig. 55 Install Input, Output, and Line Pressure Sensors**

- 1 - OUTPUT SPEED SENSOR
- 2 - LINE PRESSURE SENSOR
- 3 - INPUT SPEED SENSOR

(55) Install the manual shift lever from the transmission. Torque the retaining cross-bolt to 16 N·m (140 in.lbs.).

## AUTOMATIC TRANSMISSION - 45RFE (Continued)

**INSTALLATION**

(1) Check torque converter hub and hub drive flats for sharp edges burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper and crocus cloth if necessary. Verify that the converter hub o-ring is properly installed and is free of any debris. The hub must be smooth to avoid damaging pump seal at installation.

(2) If a replacement transmission is being installed, transfer any components necessary, such as the manual shift lever and shift cable bracket, from the original transmission onto the replacement transmission.

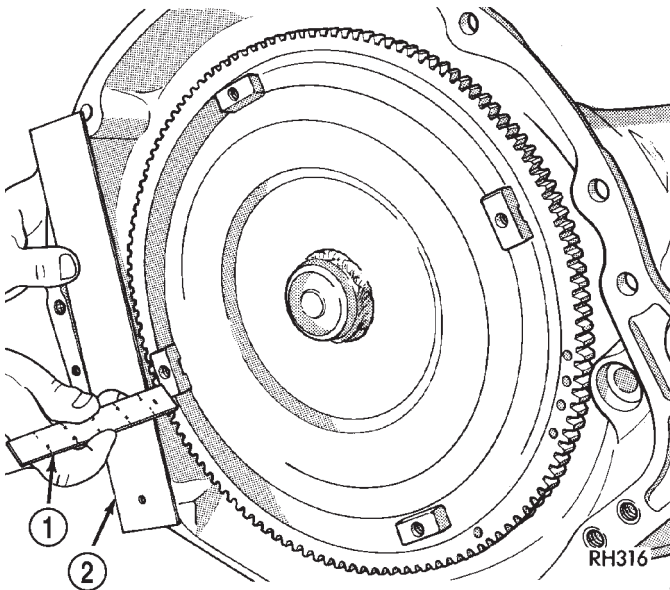
(3) Lubricate oil pump seal lip with transmission fluid.

(4) Align converter and 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. 56). Surface of converter lugs should be at least 13mm (1/2 in.) to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.



**Fig. 56 Checking Torque Converter Seating - Typical**

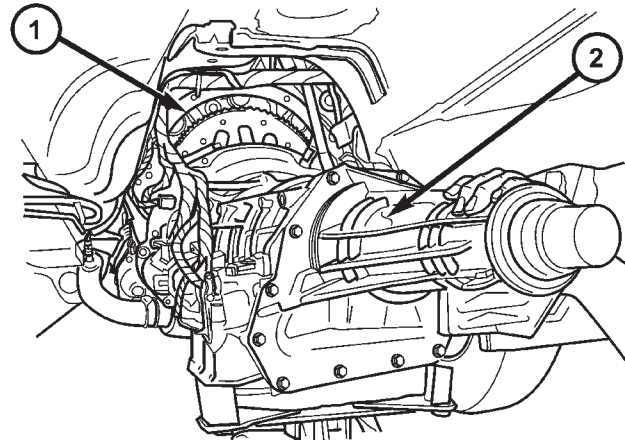
- 1 - SCALE  
2 - STRAIGHTEDGE

(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) Apply a light coating of Mopar® High Temp Grease to the torque converter hub pocket in the rear pocket of the engine's crankshaft.

(11) Raise transmission (Fig. 57) and align the torque converter with the drive plate and transmission converter housing with the engine block.



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**Fig. 57 Install Transmission**

- 1 - ENGINE  
2 - TRANSMISSION

(12) Move transmission forward. Then raise, lower or tilt transmission to align the converter housing with engine block dowels.

(13) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft. Verify that no wires, or the transmission vent hose, have become trapped between the engine block and the transmission.

(14) Install two bolts to attach the transmission to the engine.

(15) Install remaining torque converter housing to engine bolts. Tighten to 68 N·m (50 ft.lbs.).

(16) Install transfer case, if equipped. Tighten transfer case nuts to 35 N·m (26 ft.lbs.).

(17) Install rear transmission crossmember. Tighten crossmember to frame bolts to 68 N·m (50 ft.lbs.).

(18) Install rear support to transmission. Tighten bolts to 47 N·m (35 ft.lbs.).

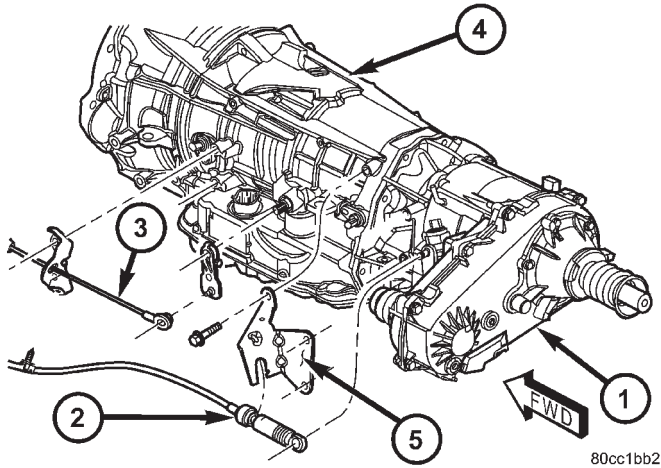
(19) Lower transmission onto crossmember and install bolts attaching transmission mount to crossmember. Tighten clevis bracket to crossmember bolts to 47 N·m (35 ft.lbs.). Tighten the clevis bracket to rear support bolt to 68 N·m (50 ft.lbs.).



AUTOMATIC TRANSMISSION - 45RFE (Continued)

(20) Remove engine support fixture.

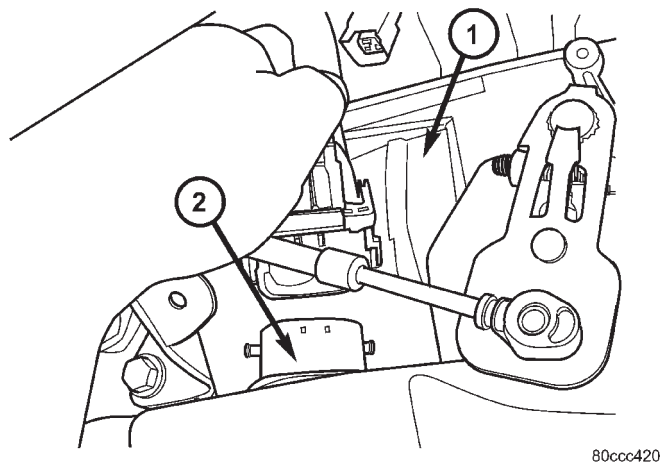
(21) Connect gearshift cable to support bracket and transmission manual lever (Fig. 58).



**Fig. 58 Install Shift Cables**

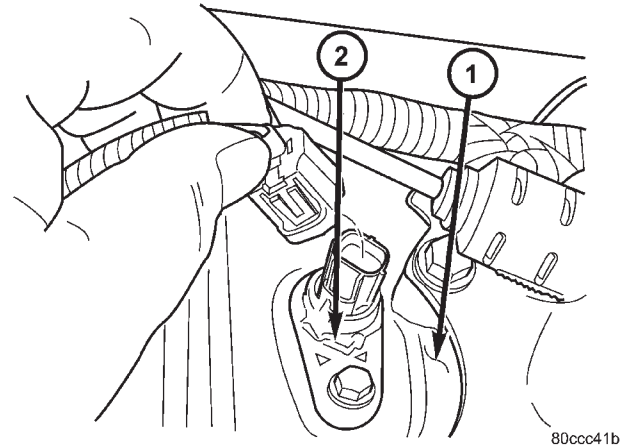
- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET

(22) Connect wires to solenoid and pressure switch assembly (Fig. 59) connector, input (Fig. 60) and output (Fig. 61) speed sensors, and line pressure sensor (Fig. 62). Be sure transmission harnesses are properly routed.



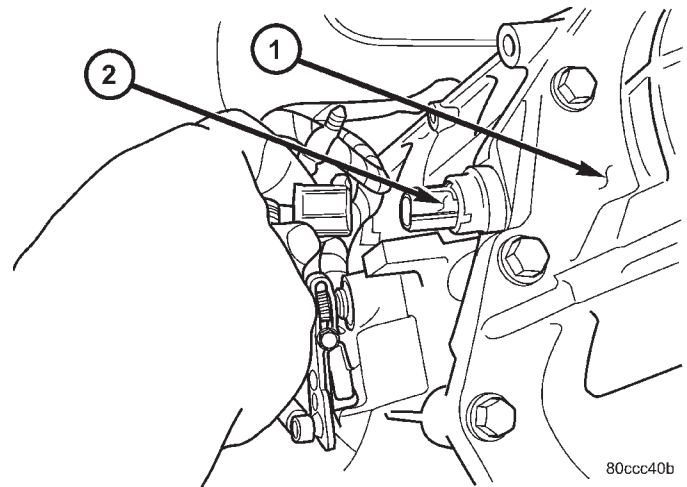
**Fig. 59 Connect Transmission Solenoid**

- 1 - TRANSMISSION
- 2 - TRANSMISSION SOLENOID/TRS ASSEMBLY



**Fig. 60 Connect Input Speed Sensor**

- 1 - TRANSMISSION
- 2 - INPUT SPEED SENSOR

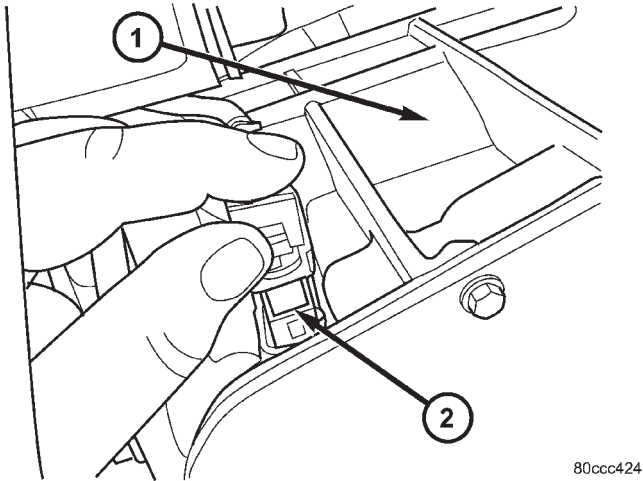


**Fig. 61 Connect Output Speed Sensor**

- 1 - TRANSMISSION
- 2 - OUTPUT SPEED SENSOR

**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.

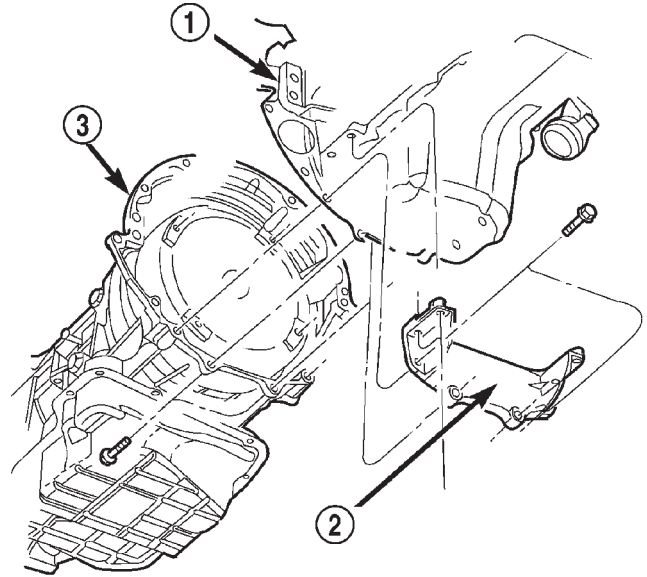
AUTOMATIC TRANSMISSION - 45RFE (Continued)



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**Fig. 62 Connect Line Pressure Sensor**

- 1 - TRANSMISSION
- 2 - LINE PRESSURE SENSOR



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**Fig. 64 Transmission Collar**

- 1 - ENGINE
- 2 - ENGINE TO TRANSMISSION COLLAR
- 3 - TRANSMISSION

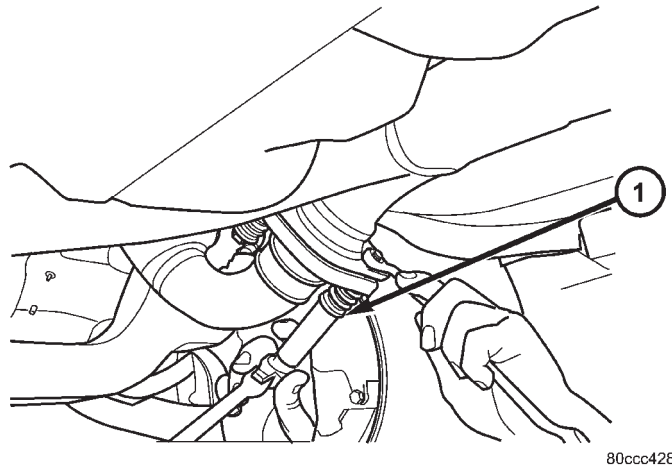
(23) Install torque converter-to-driveplate bolts. Tighten bolts to 31 N·m (270 in. lbs.).

(24) Install starter motor and cooler line bracket.

(25) Connect cooler lines to transmission.

(26) Install transmission fill tube.

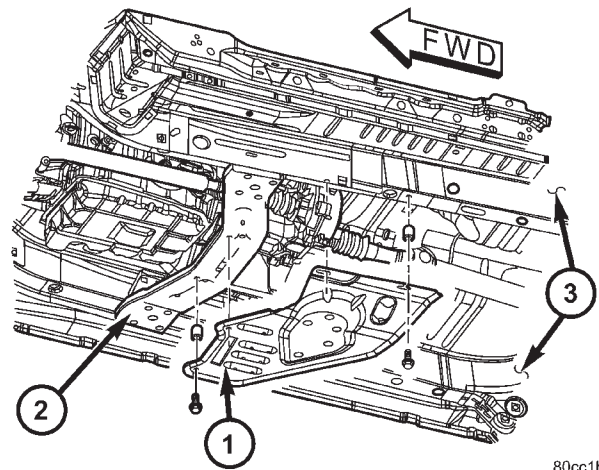
(27) Install exhaust components (Fig. 63).



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**Fig. 63 Install Exhaust Flange Bolts**

- 1 - EXHAUST FLANGE BOLTS



80cc1b7b

**Fig. 65 Install Skid Plate**

- 1 - SKID PLATE
- 2 - TRANSMISSION CROSSMEMBER
- 3 - FRAME RAILS

(28) Install the engine collar (Fig. 64) onto the transmission and the engine. Tighten the bolts to 54 N·m (40 ft.lbs.).

(29) Align and connect propeller shaft(s).

(30) Adjust gearshift cable if necessary.

(31) Install any skid plates removed previously (Fig. 65). (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION)

(32) Lower vehicle.

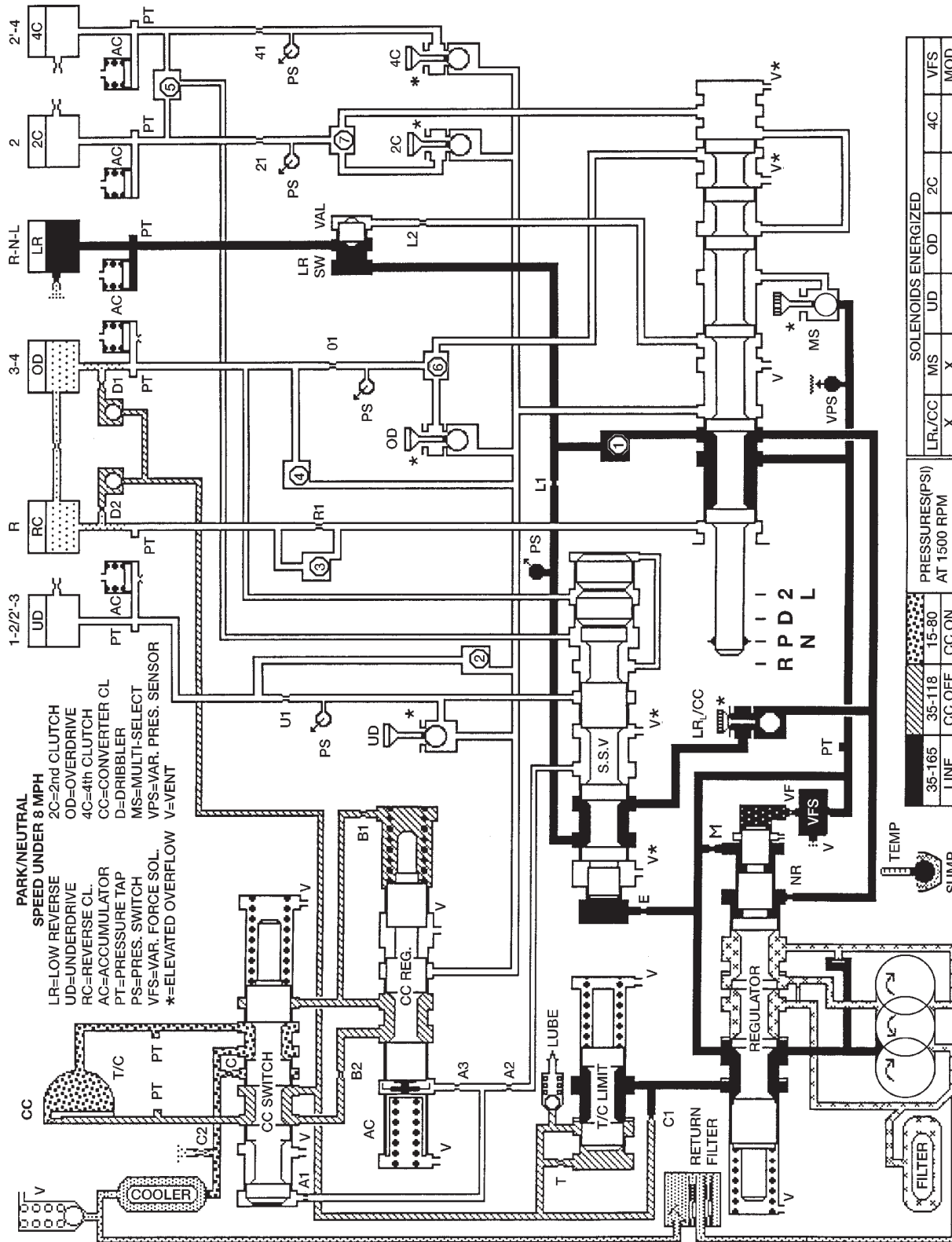
(33) Fill transmission with Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

AUTOMATIC TRANSMISSION - 45RFE (Continued)

SCHEMATICS AND DIAGRAMS

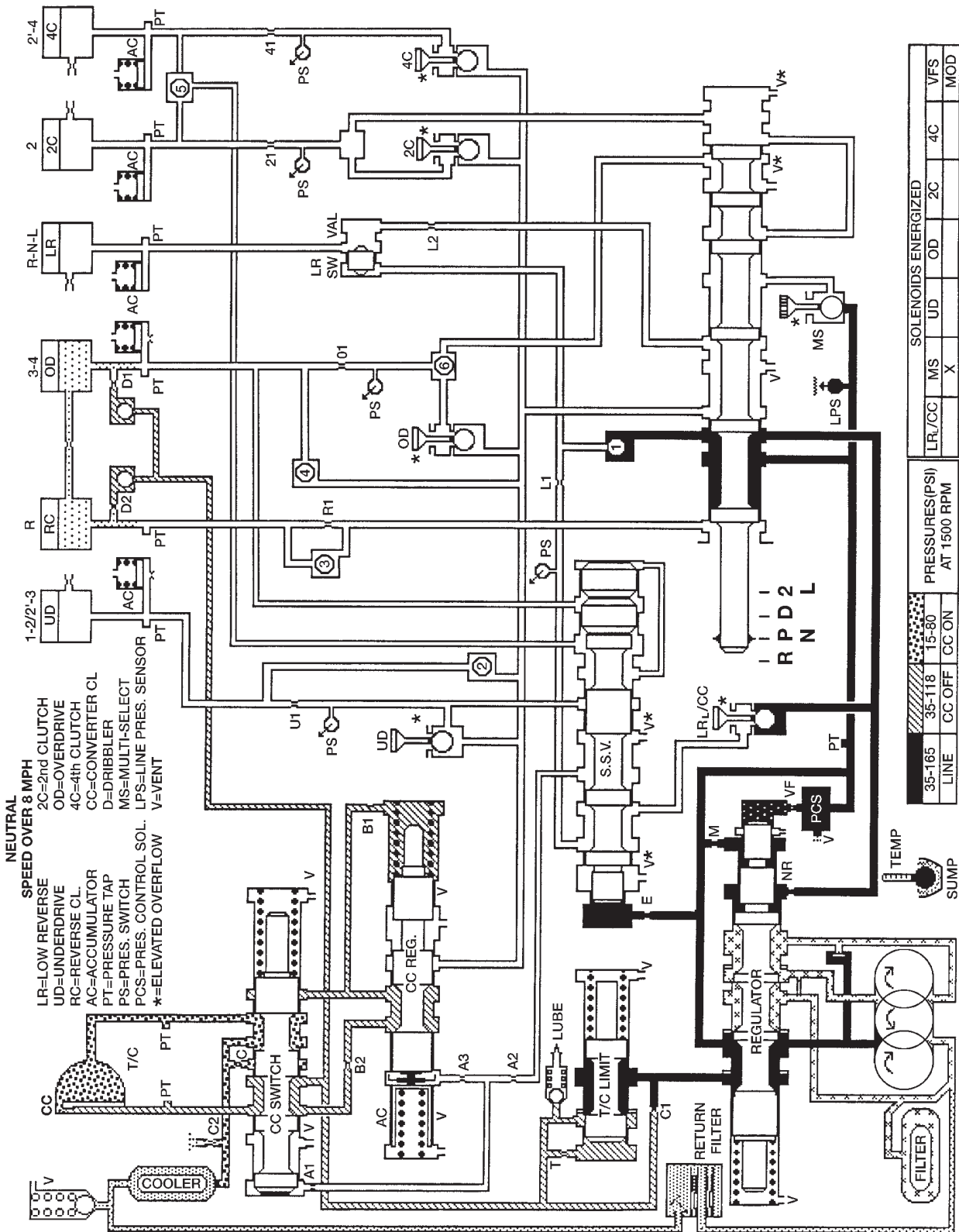
HYDRAULIC SCHEMATICS

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HYDRAULIC FLOW IN PARK/NEUTRAL

AUTOMATIC TRANSMISSION - 45RFE (Continued)

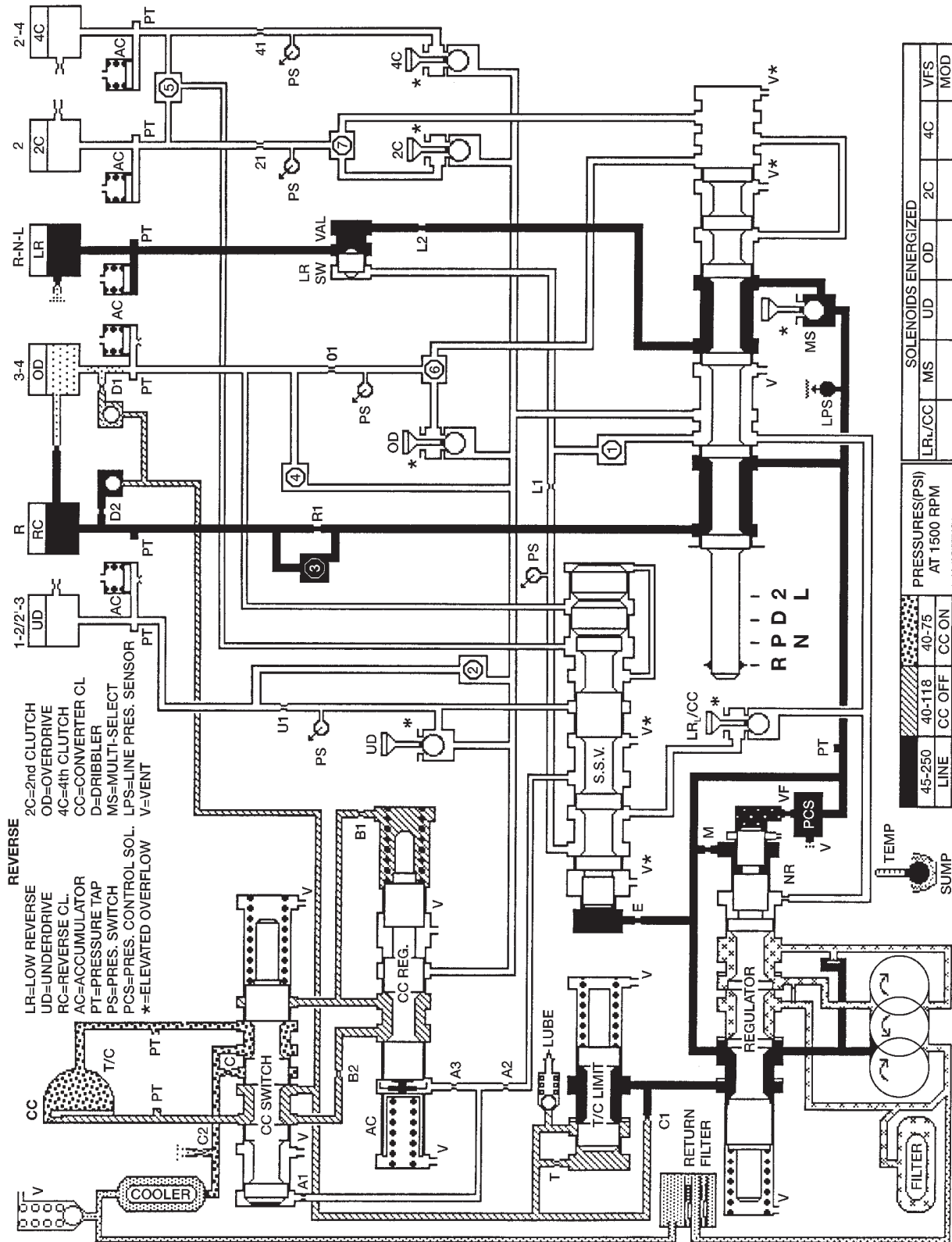


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HYDRAULIC FLOW IN NEUTRAL OVER 8MPH

AUTOMATIC TRANSMISSION - 45RFE (Continued)

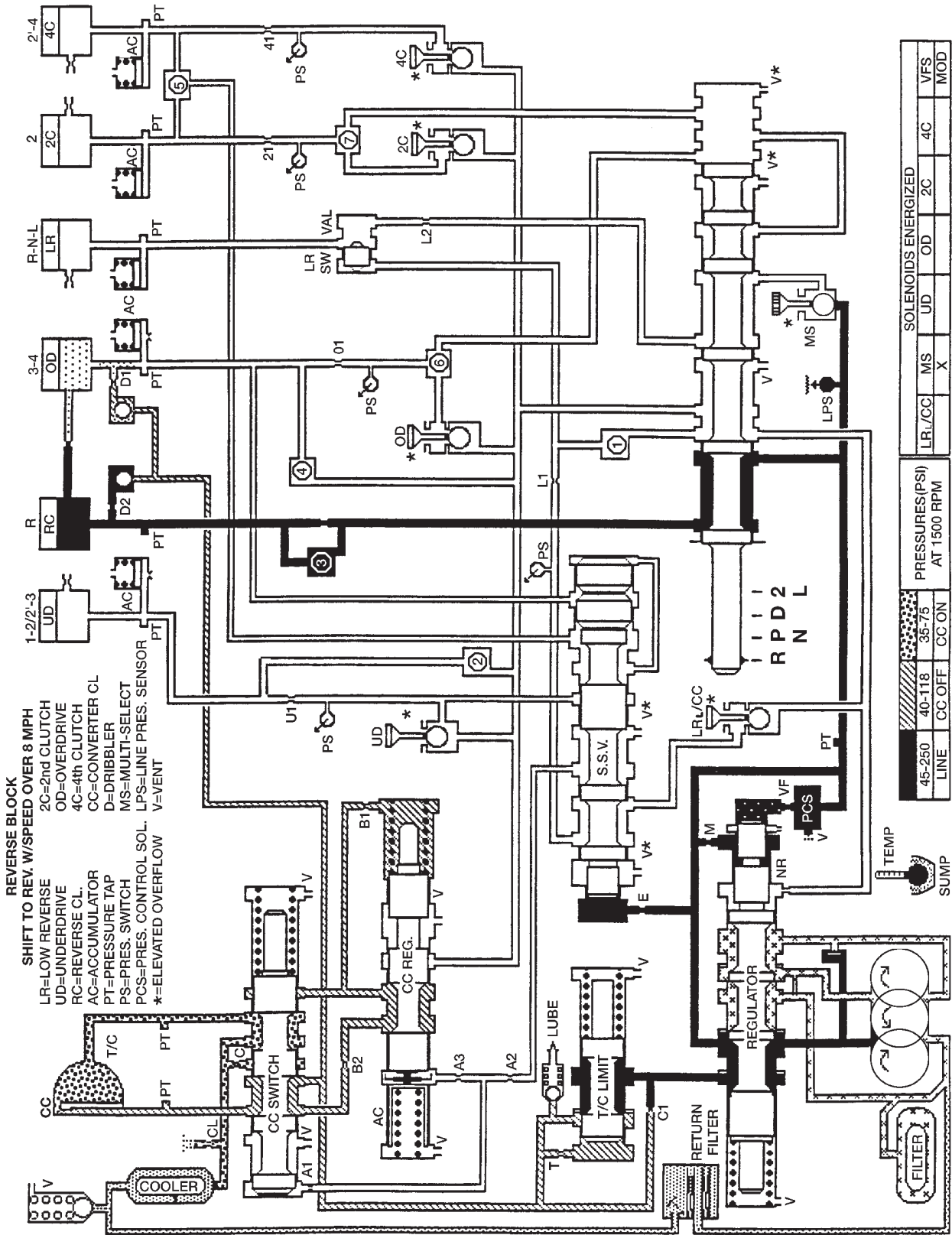
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HYDRAULIC FLOW IN REVERSE

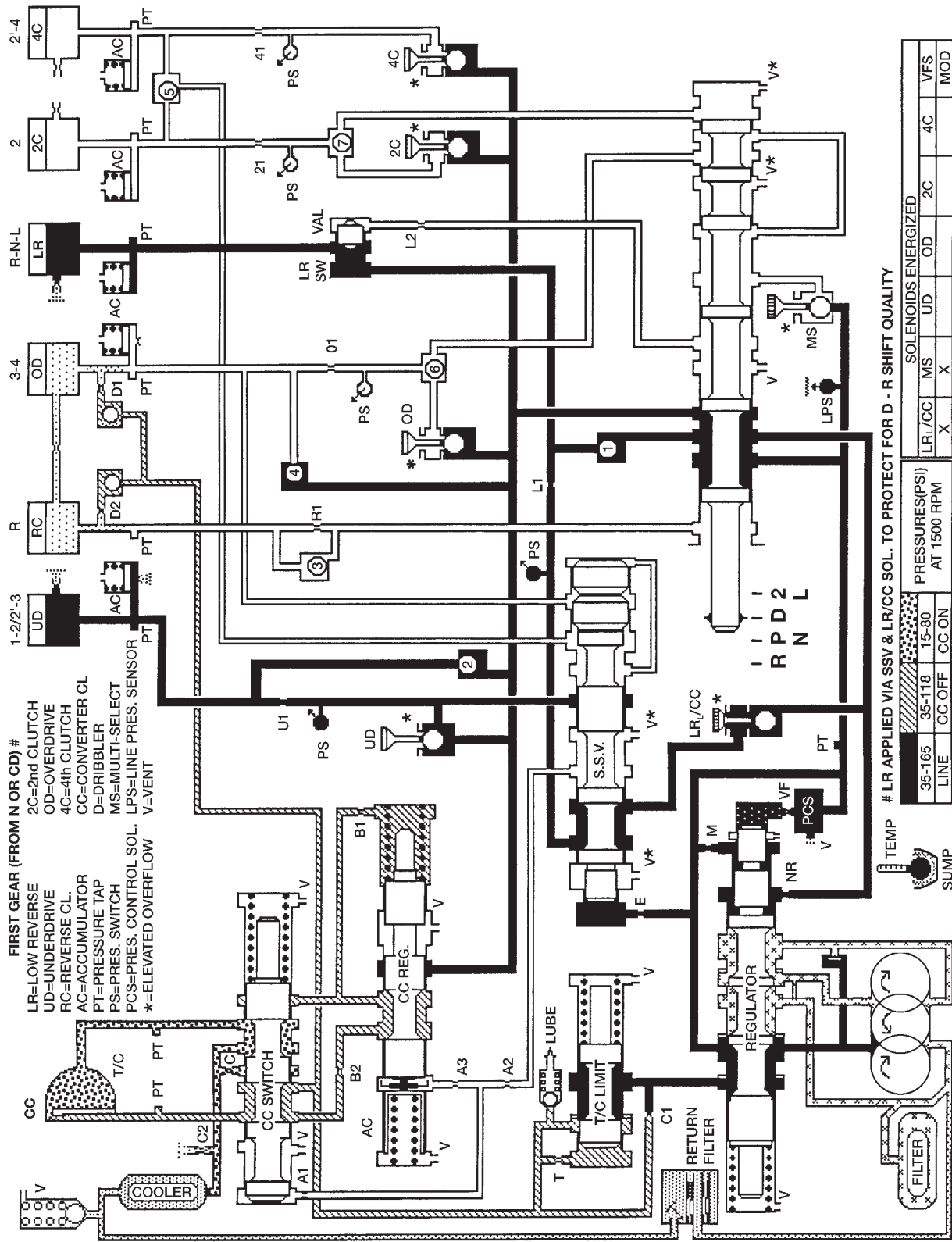
AUTOMATIC TRANSMISSION - 45RFE (Continued)

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HYDRAULIC FLOW IN REVERSE BLOCK

AUTOMATIC TRANSMISSION - 45RFE (Continued)

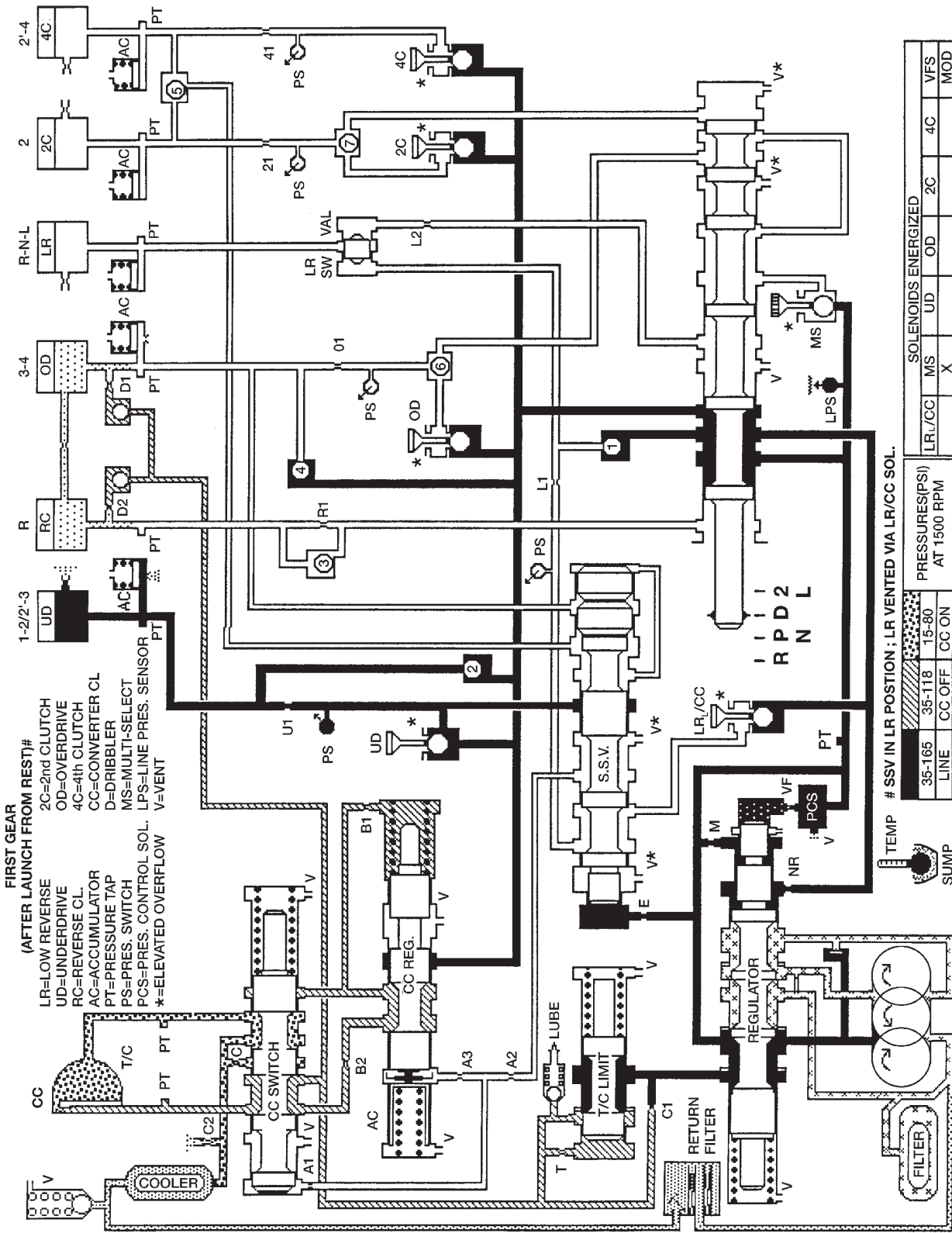


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HYDRAULIC FLOW IN FIRST GEAR (FROM N OR OD)

AUTOMATIC TRANSMISSION - 45RFE (Continued)

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**FIRST GEAR**  
 (AFTER LAUNCH FROM REST)#  
 LR=LOW REVERSE  
 UD=UNDERDRIVE  
 RC=REVERSE CL.  
 AC=ACCUMULATOR  
 PT=PRESSURE TAP  
 PS=PRES. SWITCH  
 PCS=PRES. CONTROL SOL.  
 \*=ELEVATED OVERFLOW

2C=2nd CLUTCH  
 OD=OVERDRIVE  
 4C=4th CLUTCH  
 CC=CONVERTER CL.  
 D=DRIBBLER  
 MS=MULTI-SELECT  
 LPS=LINE PRES. SENSOR  
 V=VENT

# SSV IN LR POSITION ; LR VENTED VIA LR/CC SOL.

LINE	35-165	35-118	15-80	CC OFF	CC ON	LR/CC	MS	UD	OD	2C	4C	VFS	MOD

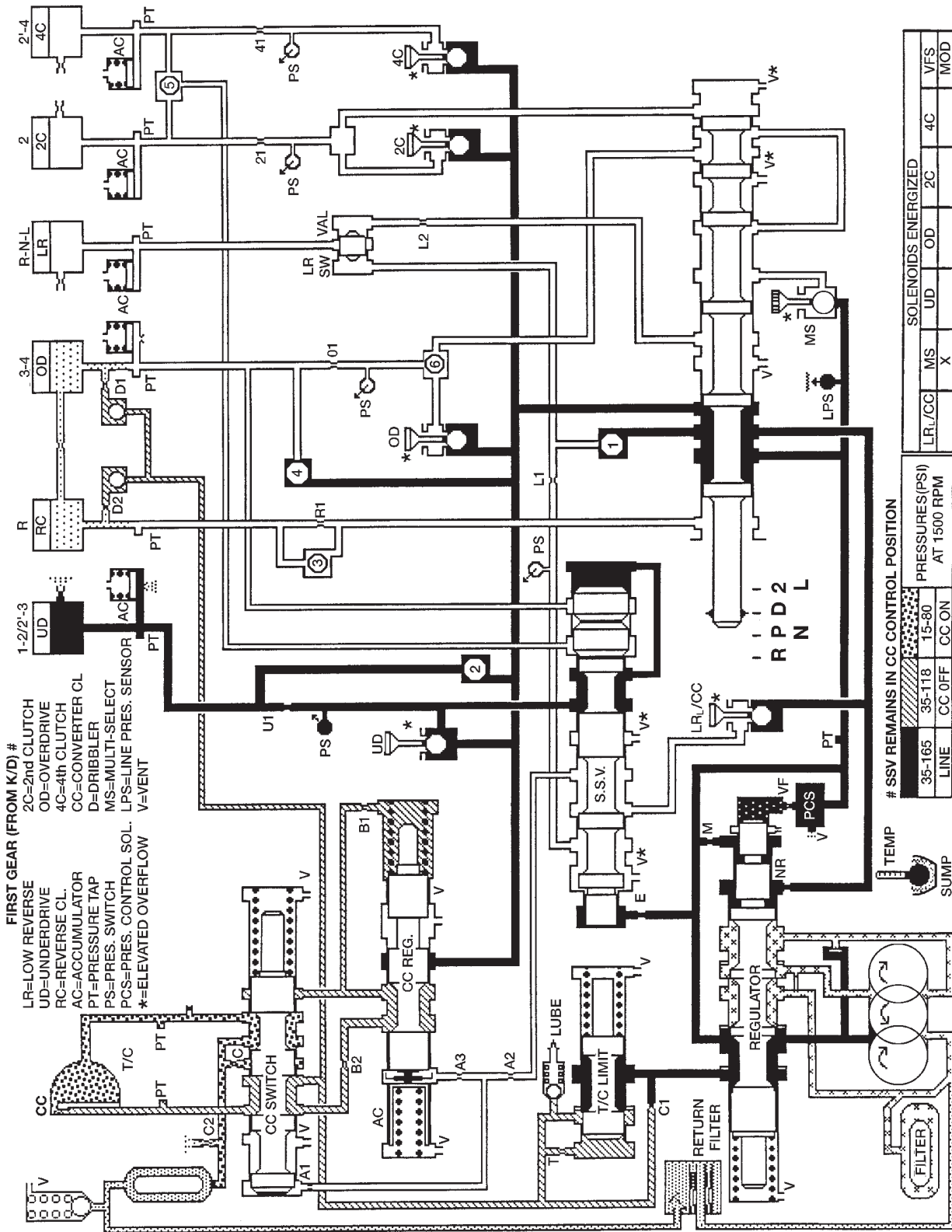
TEMP # SSV IN LR POSITION ; LR VENTED VIA LR/CC SOL.

HYDRAULIC FLOW IN FIRST GEAR (AFTER LAUNCH FROM REST)



AUTOMATIC TRANSMISSION - 45RFE (Continued)

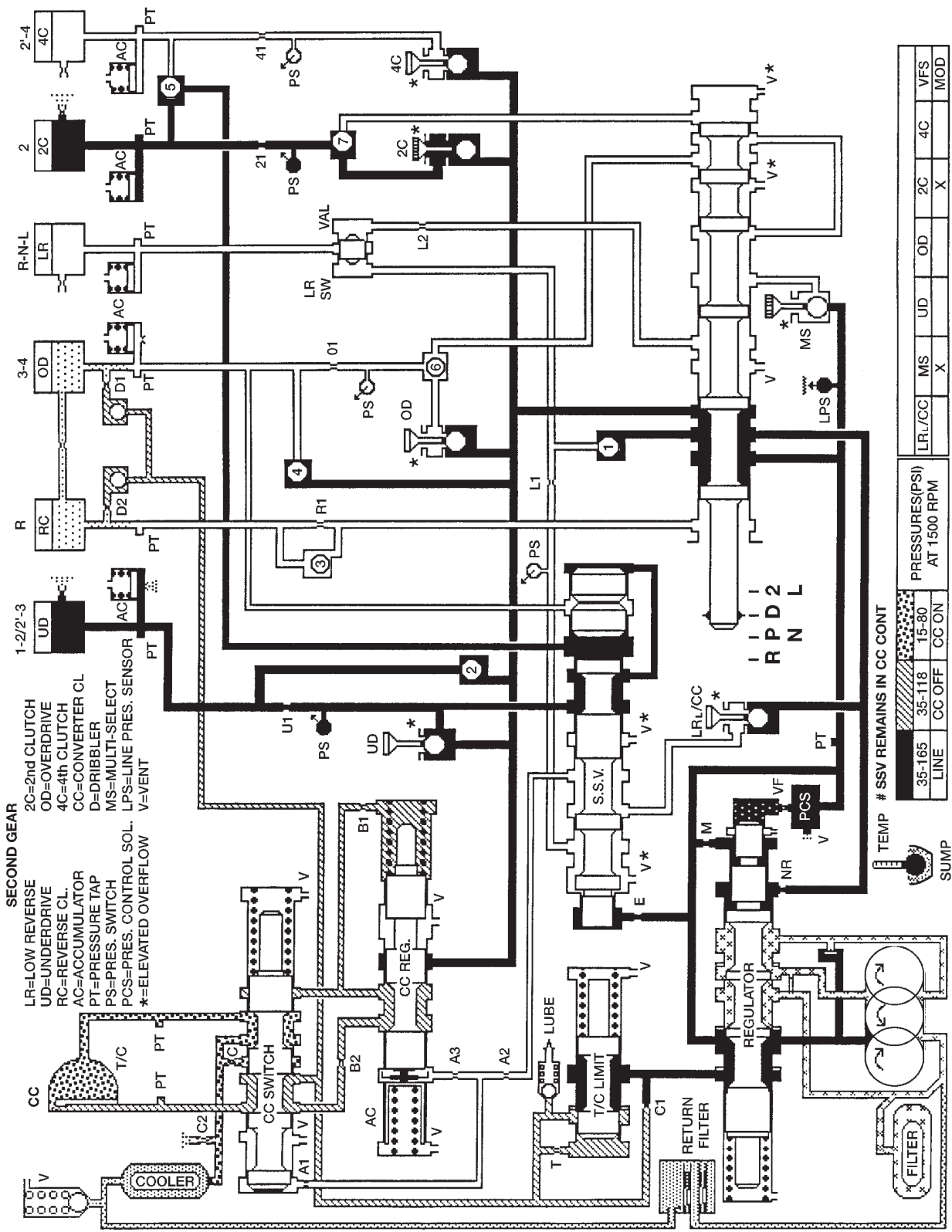
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HYDRAULIC FLOW IN FIRST GEAR (FROM K/D)

AUTOMATIC TRANSMISSION - 45RFE (Continued)

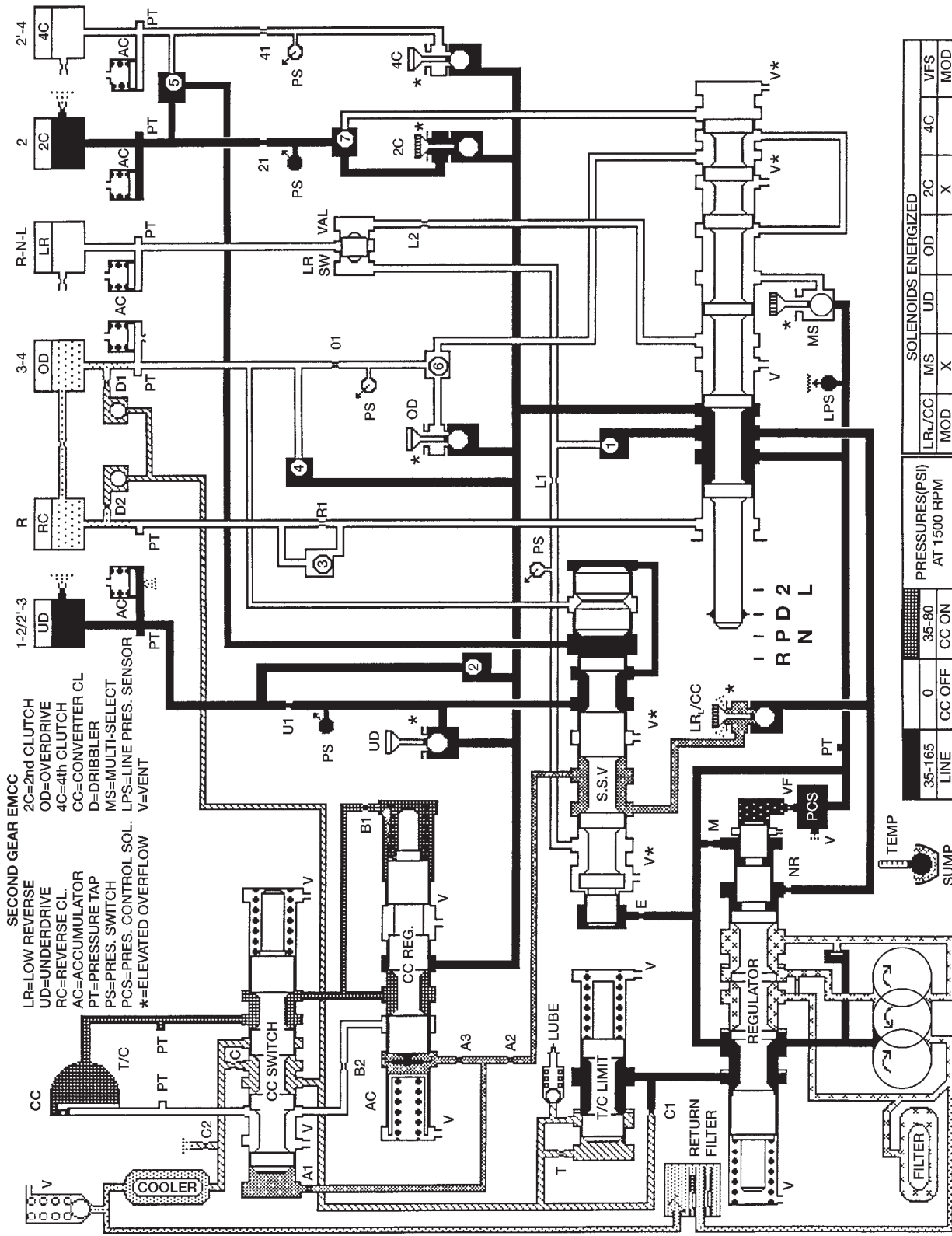
808a30b0



HYDRAULIC FLOW IN SECOND GEAR

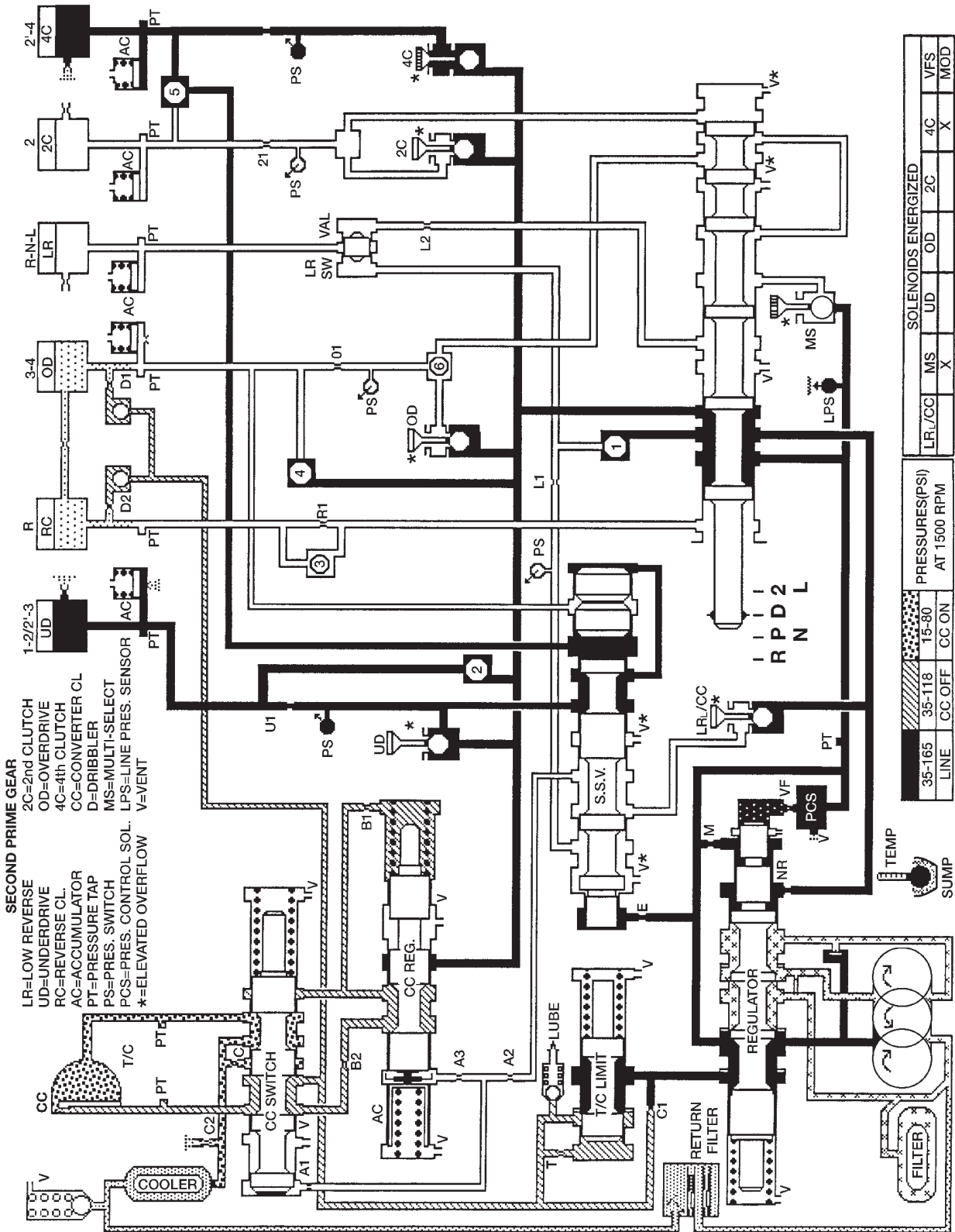
AUTOMATIC TRANSMISSION - 45RFE (Continued)

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HYDRAULIC FLOW IN SECOND GEAR EMCC

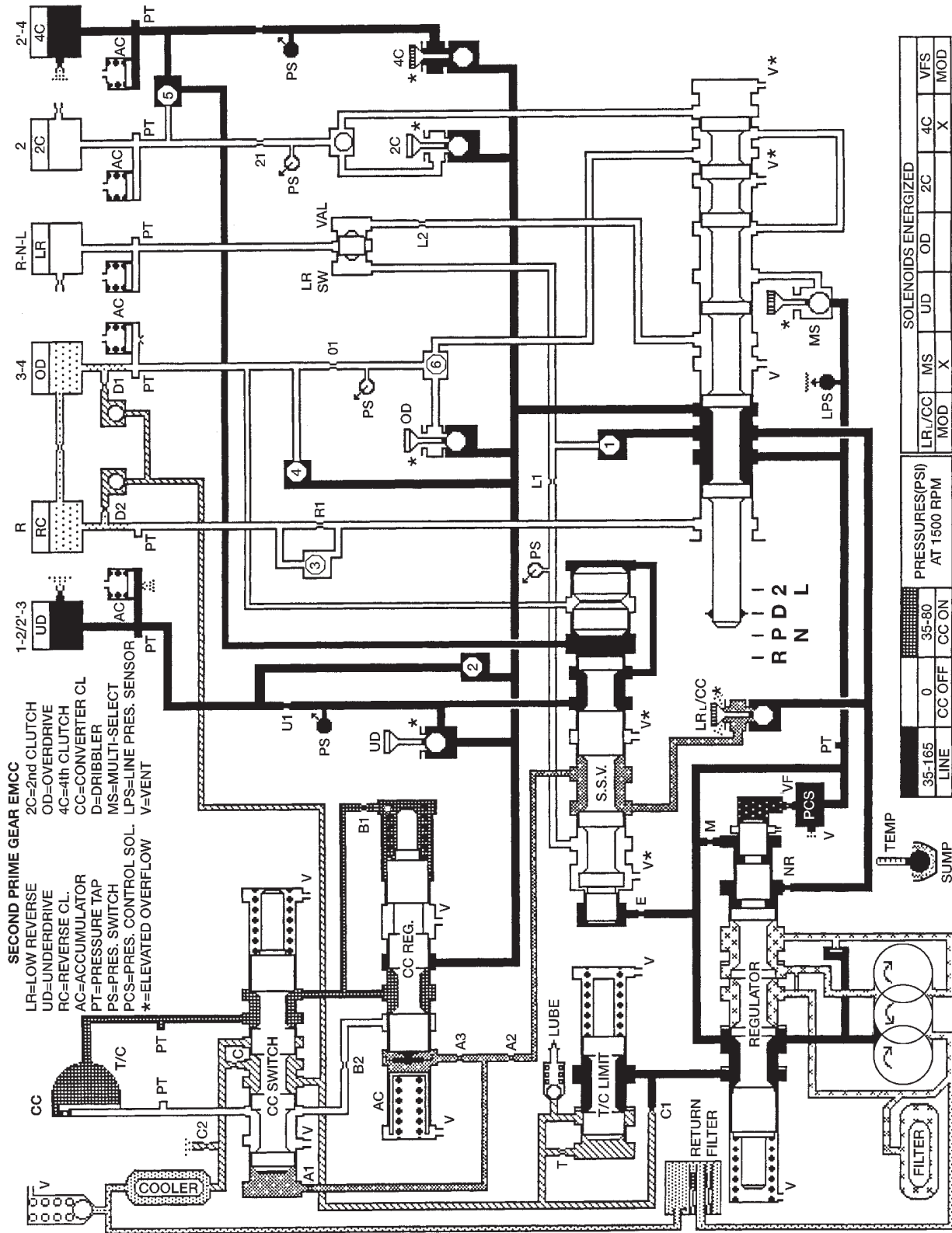
AUTOMATIC TRANSMISSION - 45RFE (Continued)



HYDRAULIC FLOW IN SECOND PRIME GEAR

808a30b2

AUTOMATIC TRANSMISSION - 45RFE (Continued)

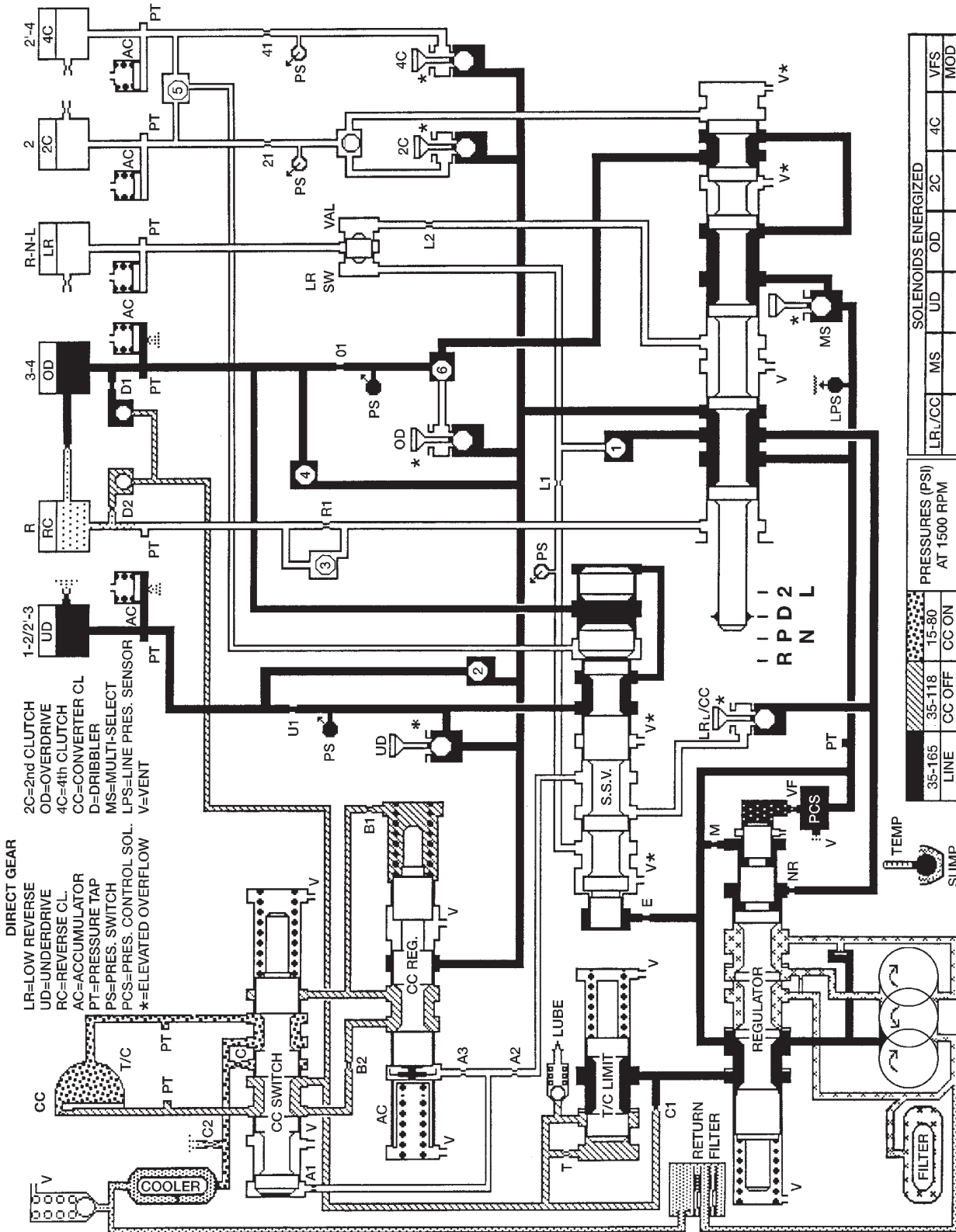


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HYDRAULIC FLOW IN SECOND PRIME GEAR EMCC

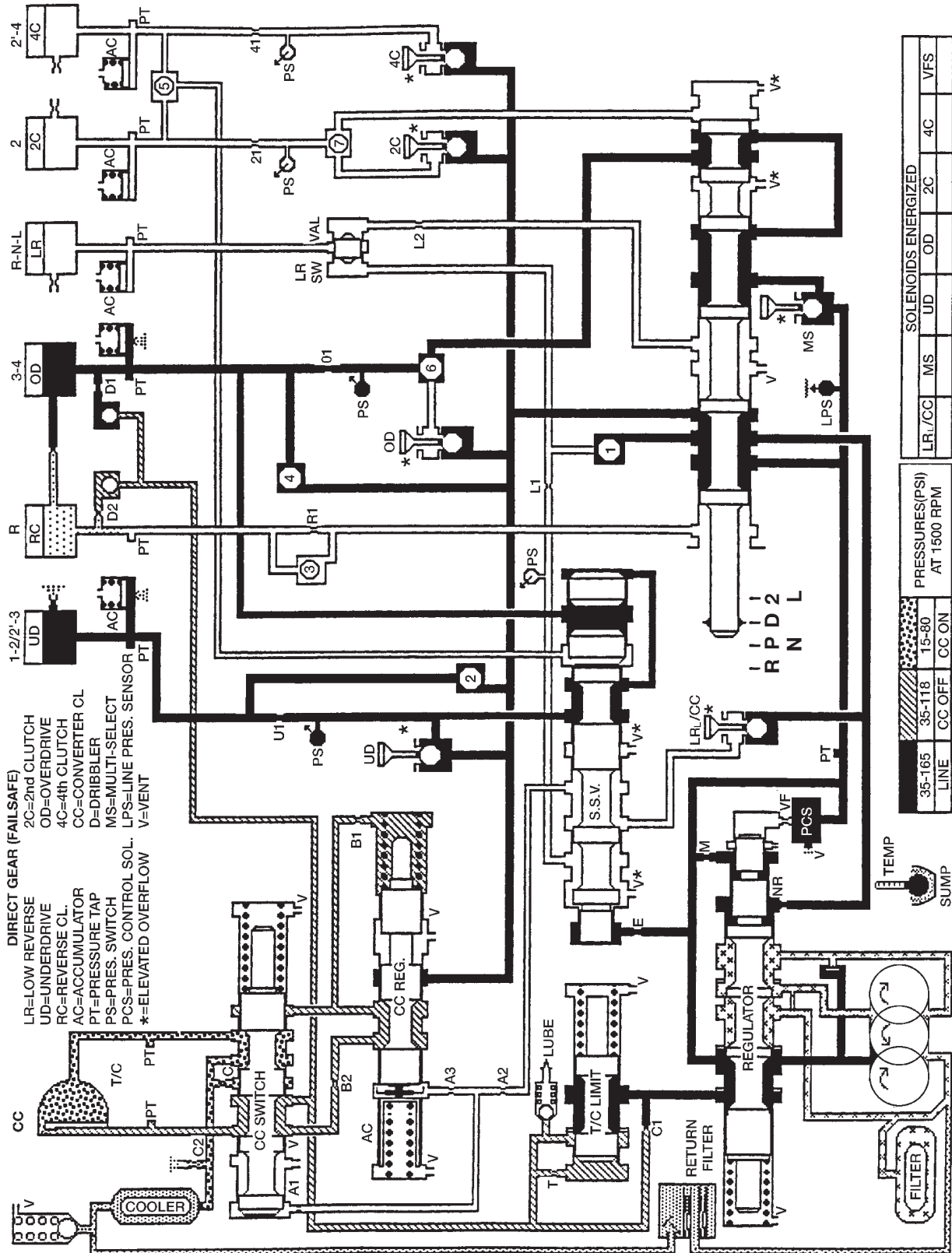
AUTOMATIC TRANSMISSION - 45RFE (Continued)

808a30b4



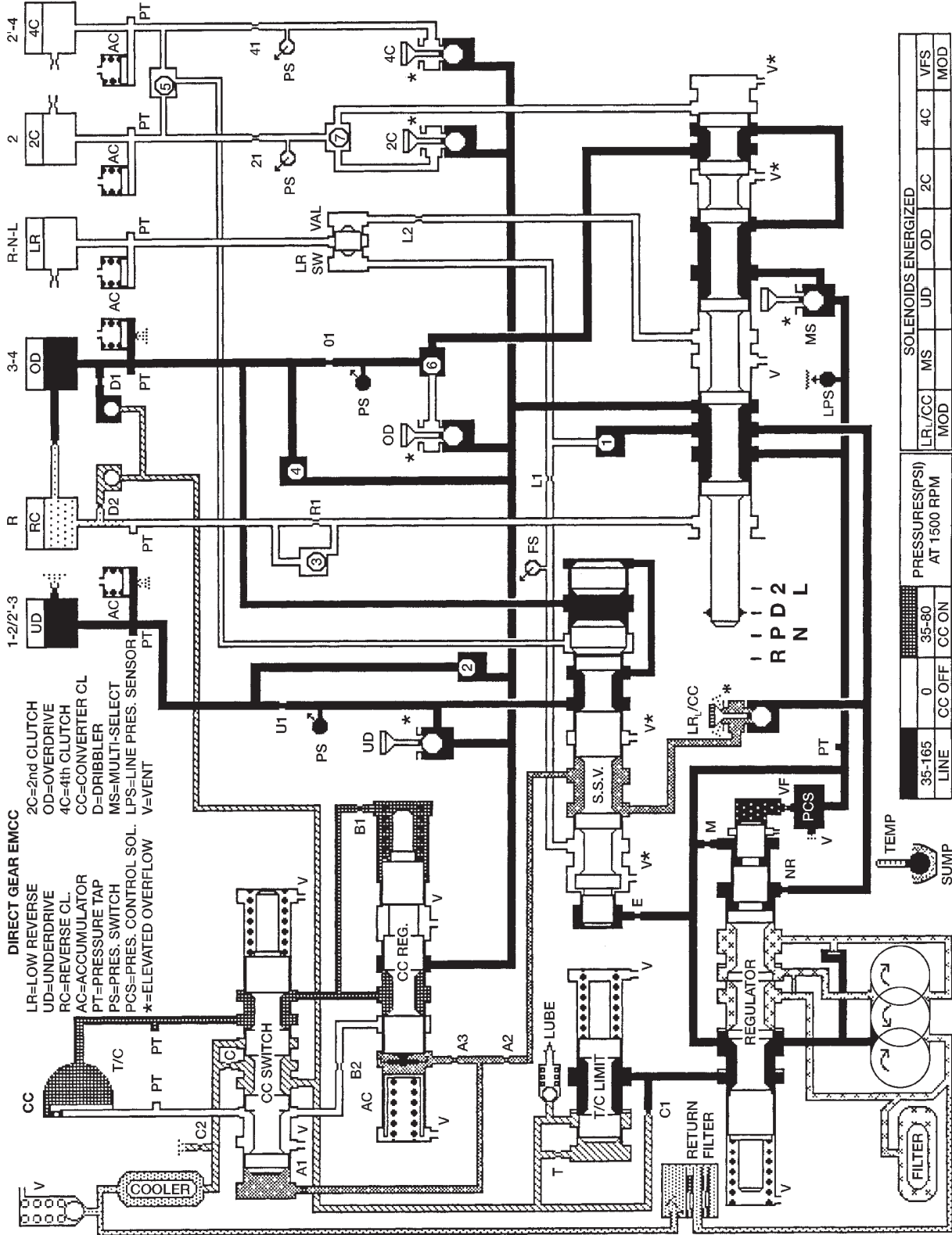
HYDRAULIC FLOW IN DIRECT GEAR

AUTOMATIC TRANSMISSION - 45RFE (Continued)



808a30b5

AUTOMATIC TRANSMISSION - 45RFE (Continued)

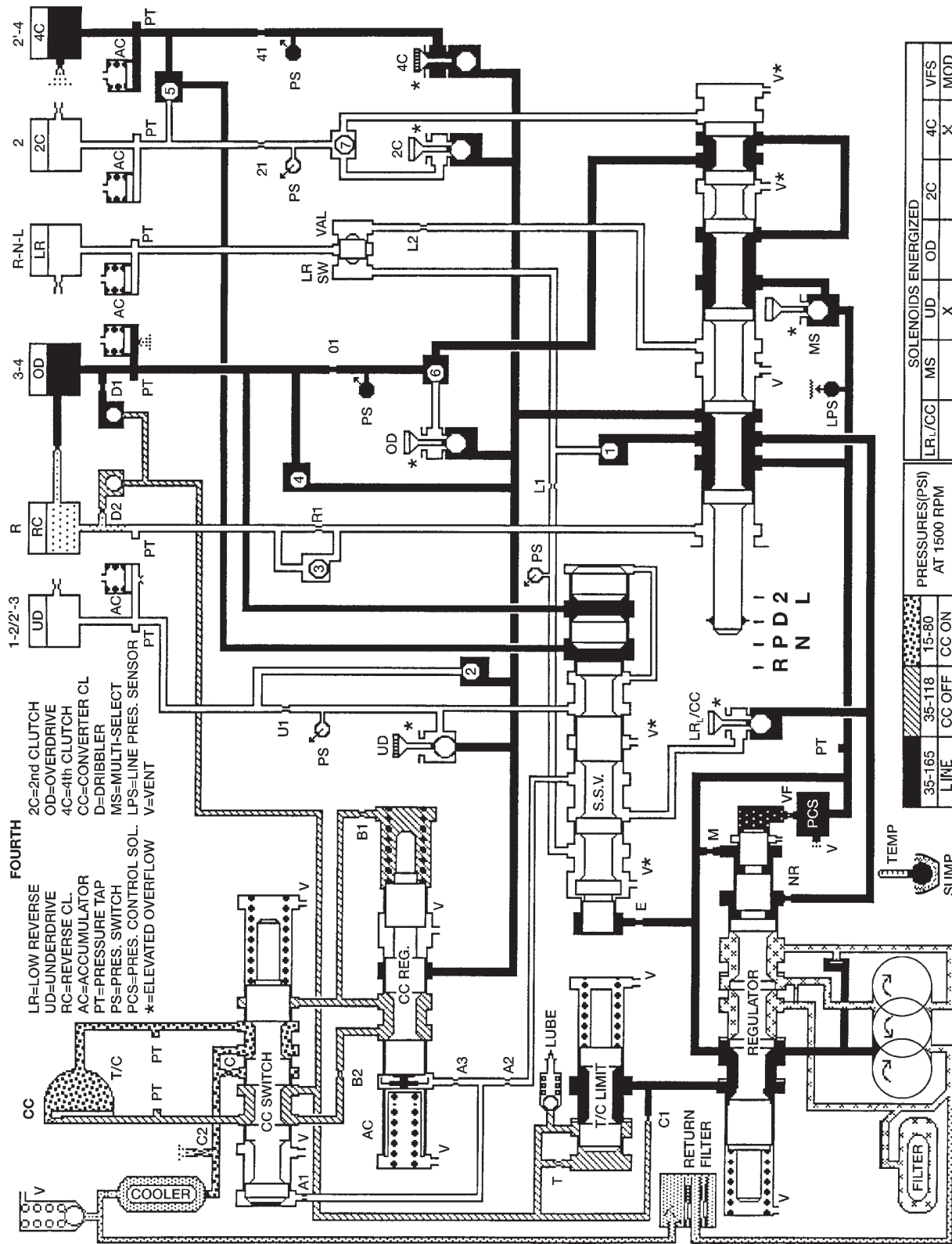


HYDRAULIC FLOW IN DIRECT GEAR EMCC

808a30b6



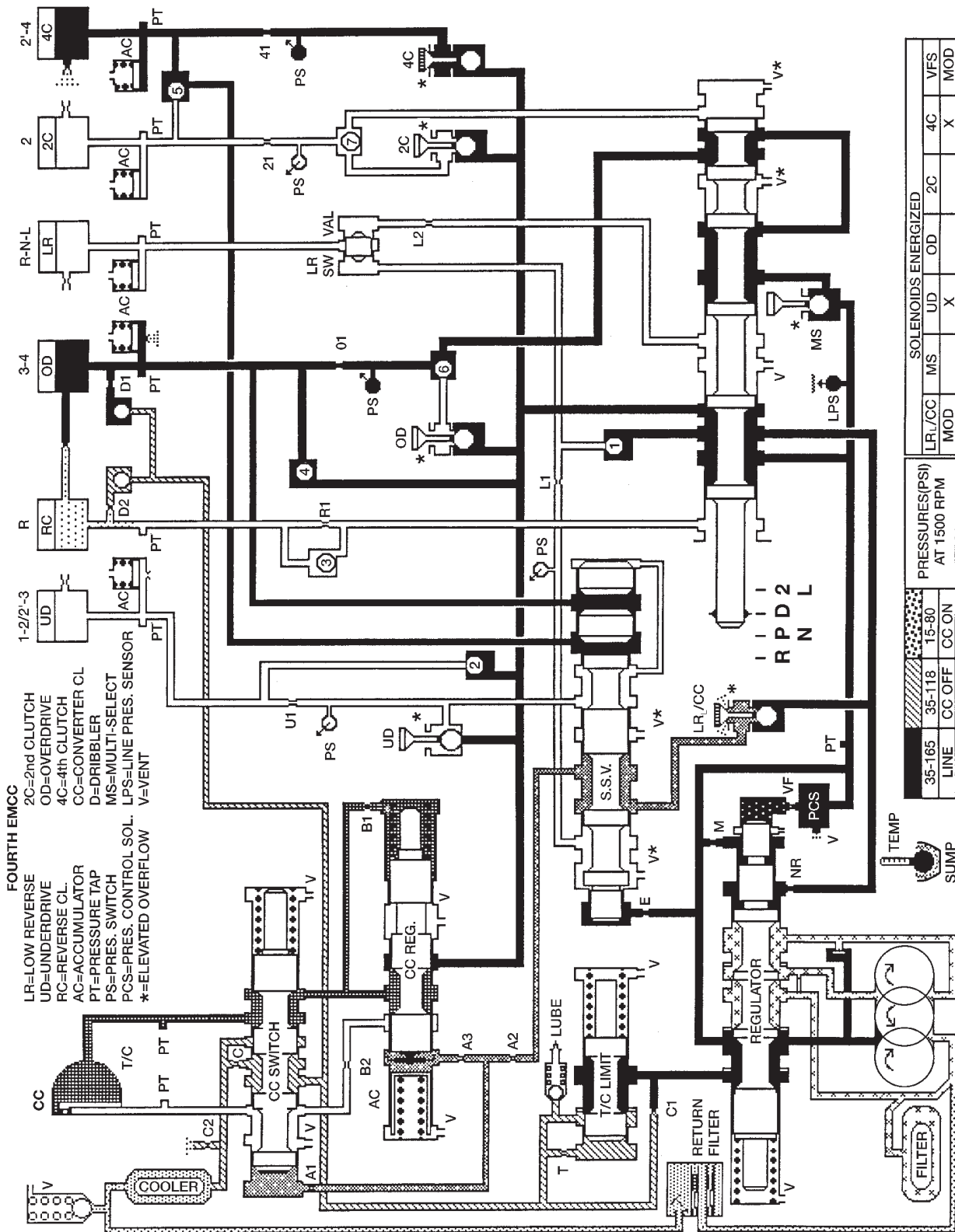
AUTOMATIC TRANSMISSION - 45RFE (Continued)



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HYDRAULIC FLOW IN FOURTH

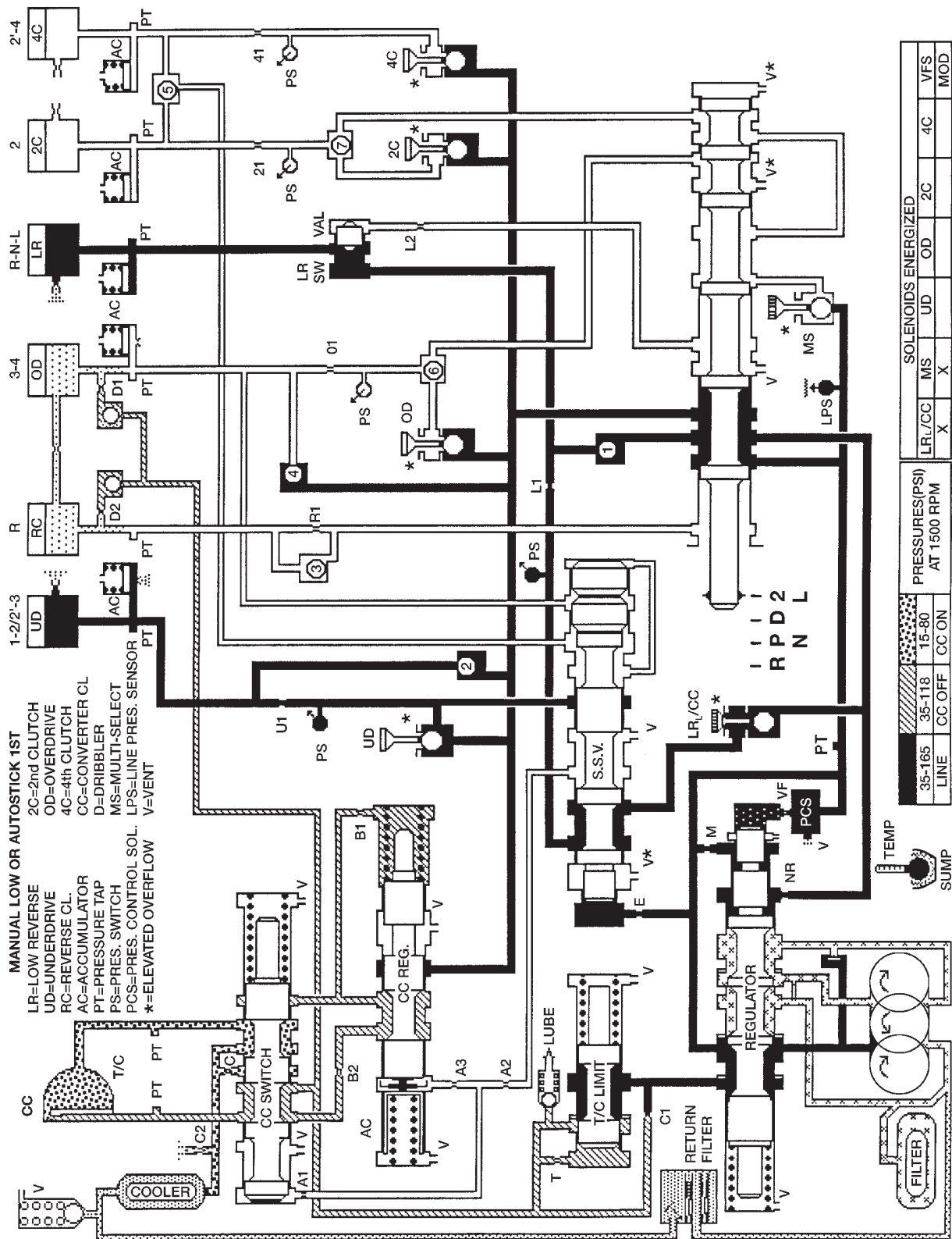
AUTOMATIC TRANSMISSION - 45RFE (Continued)



HYDRAULIC FLOW IN FOURTH EMCC

80883068

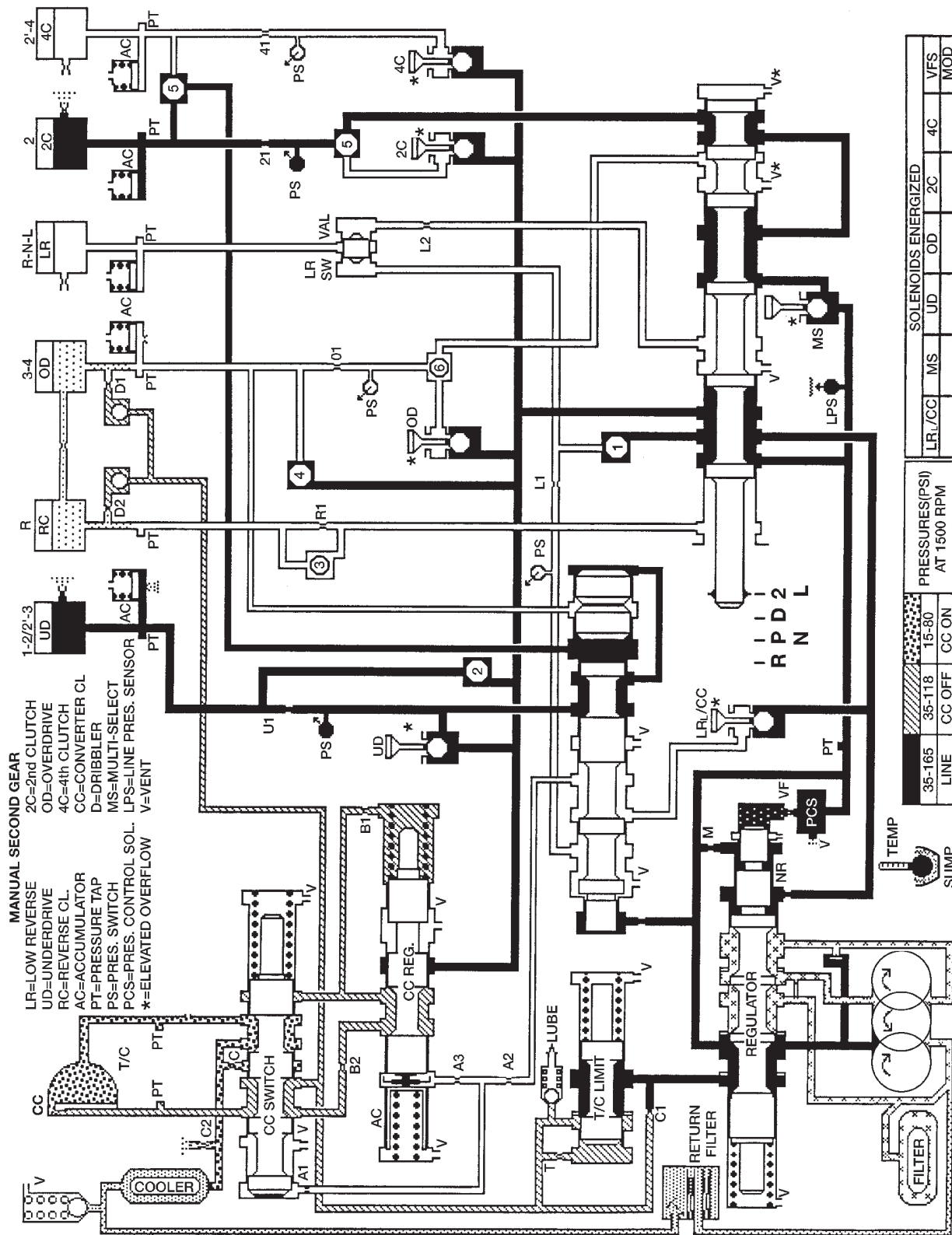
AUTOMATIC TRANSMISSION - 45RFE (Continued)



808a30b9

HYDRAULIC FLOW IN MANUAL LOW OR AUTOSTICK 1ST

AUTOMATIC TRANSMISSION - 45RFE (Continued)

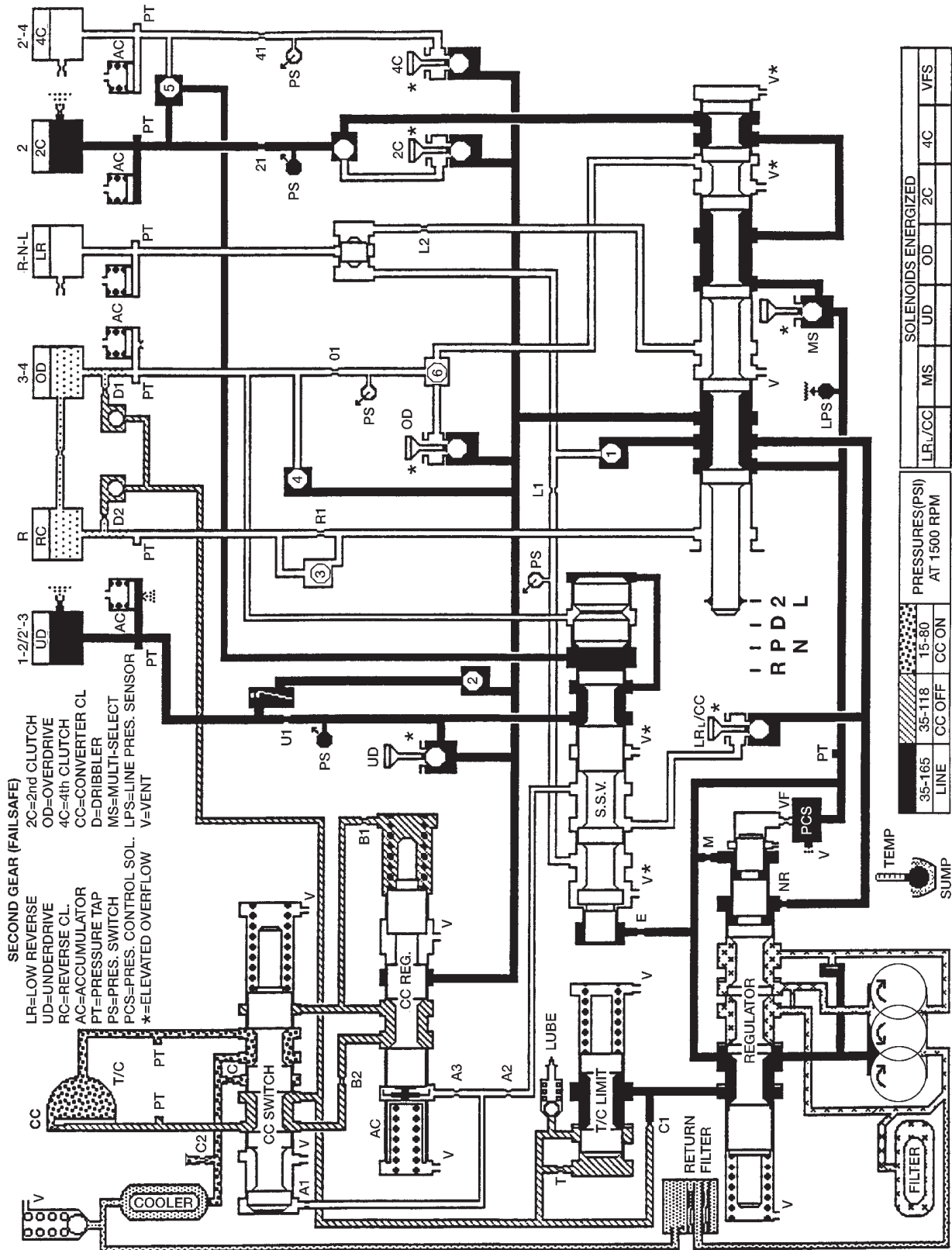


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HYDRAULIC FLOW IN MANUAL SECOND

AUTOMATIC TRANSMISSION - 45RFE (Continued)

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HYDRAULIC FLOW IN MANUAL SECOND (FAILSAFE)

## AUTOMATIC TRANSMISSION - 45RFE (Continued)

## SPECIFICATIONS

## TRANSMISSION

## GENERAL

Component	Metric	Inch
Output Shaft End Play	0.22-0.55 mm	0.009-0.021 in.
Input Shaft End Play	0.46-0.89 mm	0.018-0.035 in.
2C Clutch Pack Clearance	0.455-1.335 mm	0.018-0.053 in.
4C Clutch Pack Clearance	0.770-1.390 mm	0.030-0.055 in.
L/R Clutch Pack Clearance	1.00-1.74 mm	0.039-0.069 in.
OD Clutch Pack Clearance	1.103-1.856 mm	0.043-0.073 in.

Component	Metric	Inch
UD Clutch Pack Clearance	0.84-1.54 mm	0.033-0.061 in.
Reverse Clutch Pack Clearance	0.81-1.24 mm	0.032-0.049 in.
Recommended fluid	Mopar® ATF +4, type 9602	

## GEAR RATIOS

1ST	3.00:1
2ND	1.67:1
2ND Prime	1.50:1
3RD	1.0:1
4TH	0.75:1
REVERSE	3.00:1

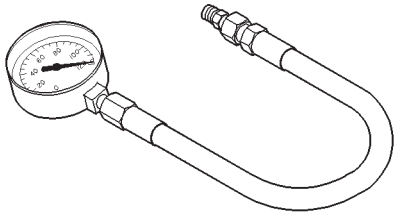
## TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	17.5	-	155
Bolt, torque convertor	31	23	-
Bolt/nut, crossmember	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Bolt, oil pan	11.8	-	105
Screw, primary fluid filter	4.5	-	40
Bolt, oil pump	28.2	-	250
Bolt, oil pump body to cover	4.5	-	40
Screw, plate to oil pump body	4.5	-	40
Bolt, valve body to case	11.8	-	105
Plug, pressure test port	5.1	-	45
Bolt, reaction shaft support	11.8	-	105
Screw, valve body to transfer plate	5.6	-	50
Screw, solenoid module to transfer plate	5.7	-	50
Screw, accumulator cover	4.5	-	40
Screw, detent spring	4.5	-	40
Bolt, input speed sensor	11.8	-	105
Bolt, output speed sensor	11.8	-	105
Bolt, line pressure sensor	11.8	-	105
Bolt, extension housing	54	40	-
Valve, cooler return filter bypass	4.5	-	40
Screw, manual valve cam retaining	4.5	-	40
Bolt, manual lever	28.2	-	250

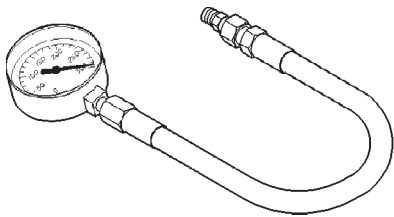
AUTOMATIC TRANSMISSION - 45RFE (Continued)

SPECIAL TOOLS

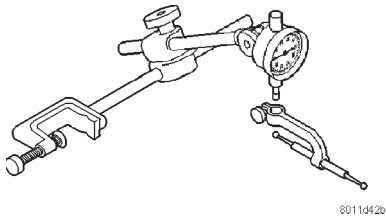
RFE TRANSMISSION



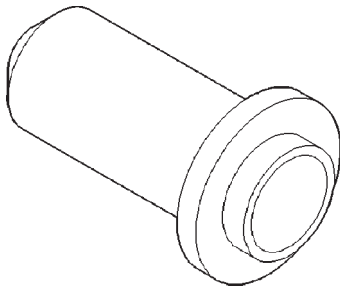
**Gauge, Oil Pressure - C-3292**



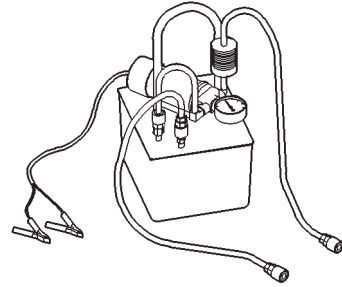
**Gauge, Oil Pressure - C-3293SP**



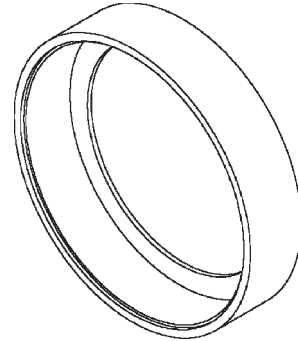
**Dial Indicator - C-3339**



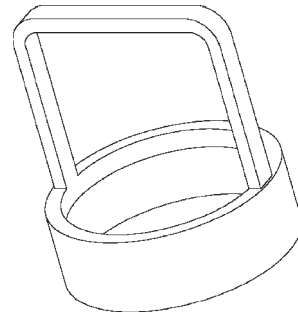
**Installer, Seal - C-3860-A**



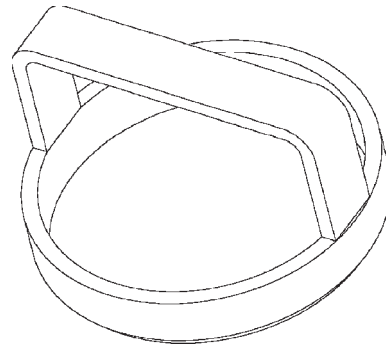
**Flusher, Oil Cooler - 6906-C**



**Compressor, Spring - 8249**

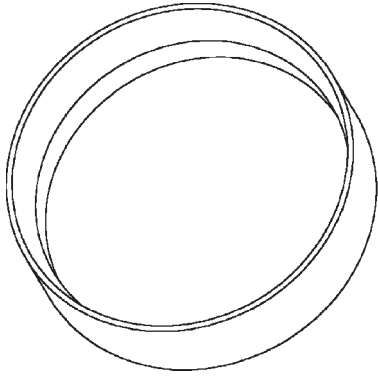


**Compressor, Spring - 8250**

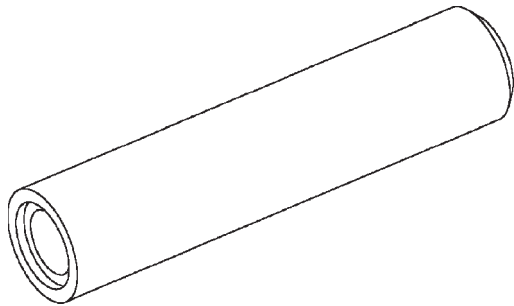


**Compressor, Spring - 8251**

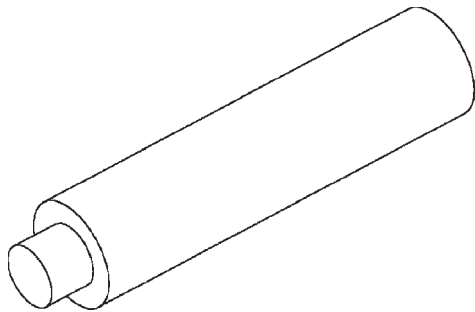
AUTOMATIC TRANSMISSION - 45RFE (Continued)



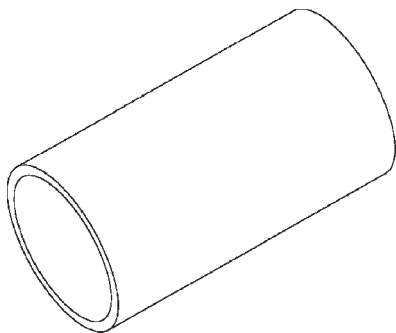
**Installer, Piston - 8252**



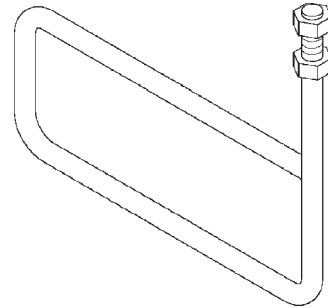
**Installer, Seal - 8253**



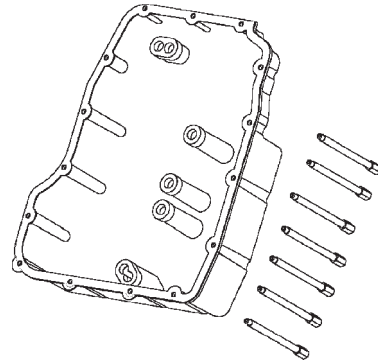
**Installer, Seal - 8254**



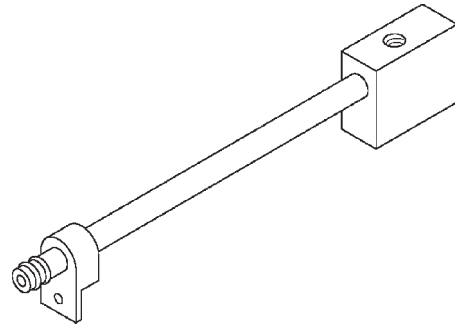
**Installer, Snap-ring - 8255**



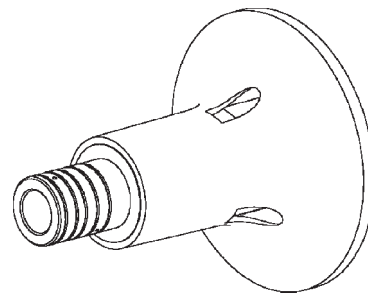
**Stand, Support - 8257**



**Adapter, Pressure Tap - 8258-A**



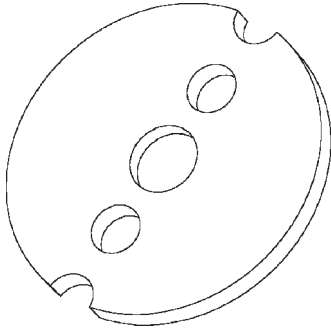
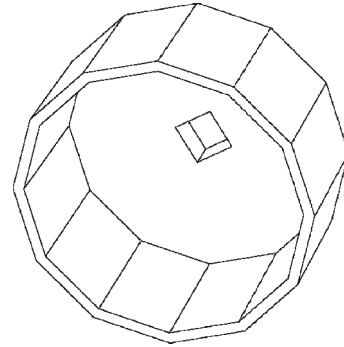
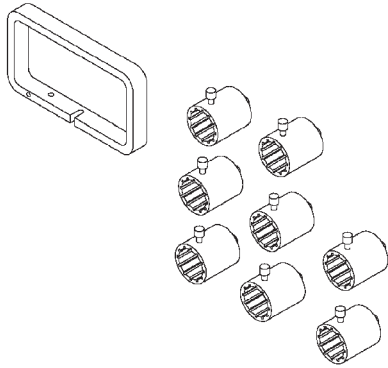
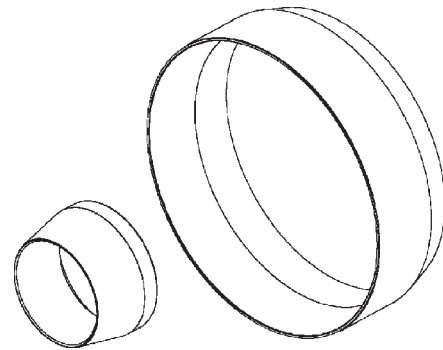
**Adapter, Line Pressure - 8259**



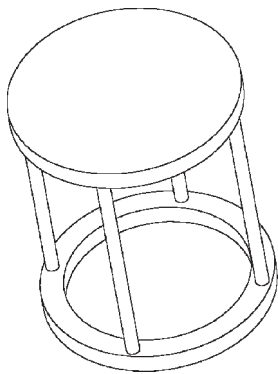
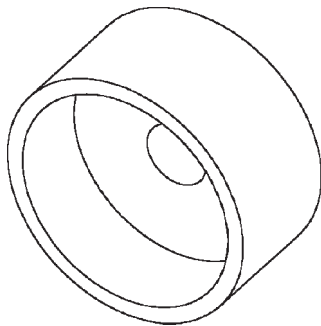
**Fixture, Input Clutch Pressure - 8260**



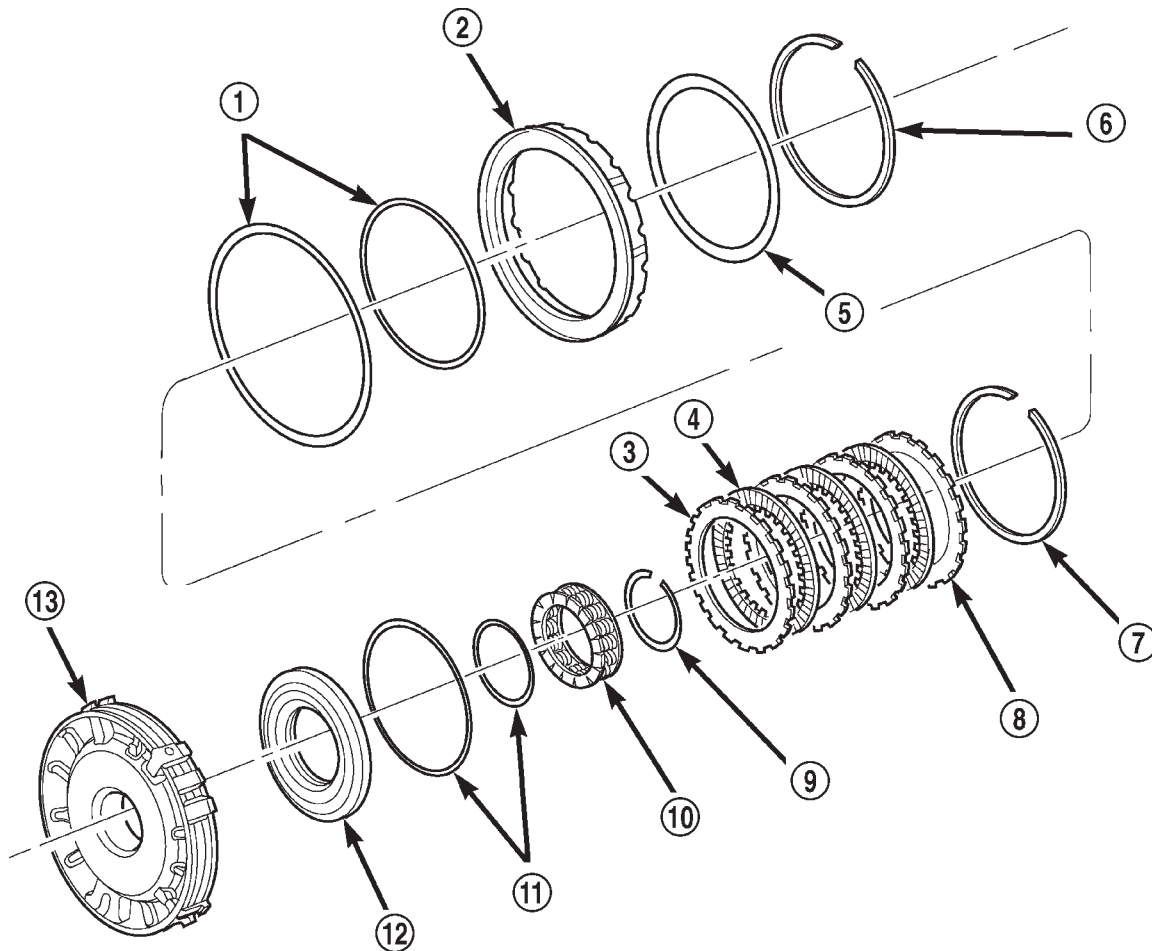
## 4C RETAINER/BULKHEAD (Continued)

**Plate, Alignment - 8261****Wrench, Filter - 8321****End Play Set - 8266****Installer, Piston - 8504****4C RETAINER/BULKHEAD****DISASSEMBLY**

- (1) Remove the 2C piston belleville spring snapping from the 4C retainer /bulkhead (Fig. 66).
- (2) Remove the 2C piston Belleville spring from the retainer/bulkhead (Fig. 66).
- (3) Remove the 2C piston from the retainer/bulkhead. Use 20 psi of air pressure to remove the piston if necessary.
- (4) Remove the 4C clutch snap-ring from the retainer/bulkhead (Fig. 66).
- (5) Remove the 4C clutch pack from the retainer/bulkhead (Fig. 66).
- (6) Using Spring Compressor 8250 and a suitable shop press, compress the 4C piston return spring and remove the snap-ring (Fig. 66).
- (7) Remove the 4C piston return spring and piston from the retainer/bulkhead (Fig. 66). Use 20 psi of air pressure to remove the piston if necessary.

**Compressor, Spring - 8285****Installer, Bearing - 8320**

## 4C RETAINER/BULKHEAD (Continued)



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**Fig. 66 4C Retainer/Bulkhead Components**

- |                          |                           |
|--------------------------|---------------------------|
| 1 - SEAL                 | 8 - REACTION PLATE        |
| 2 - 2C PISTON            | 9 - SNAP-RING             |
| 3 - PLATE                | 10 - RETURN SPRING        |
| 4 - DISC                 | 11 - SEAL                 |
| 5 - 2C BELLEVILLE SPRING | 12 - 4C PISTON            |
| 6 - SNAP-RING            | 13 - 4C RETAINER/BULKHEAD |
| 7 - SNAP-RING (SELECT)   |                           |

**ASSEMBLY**

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install new seals on the 2C and 4C pistons (Fig. 66).

(3) Lubricate all seals with Mopar® ATF +4, type 9602 prior to installation.

(4) Install the 4C piston into the 4C retainer/bulkhead (Fig. 66).

(5) Position the 4C piston return spring onto the 4C piston.

(6) Using Spring Compressor 8250 and a suitable shop press, compress the 4C piston return spring and install the snap-ring (Fig. 67).

(7) Assemble and install the 4C clutch pack into the retainer/bulkhead (Fig. 66) with the steel separator plate against the piston.

(8) Install the 4C reaction plate and snap-ring into the retainer/bulkhead (Fig. 66). The 4C reaction plate is non-directional.

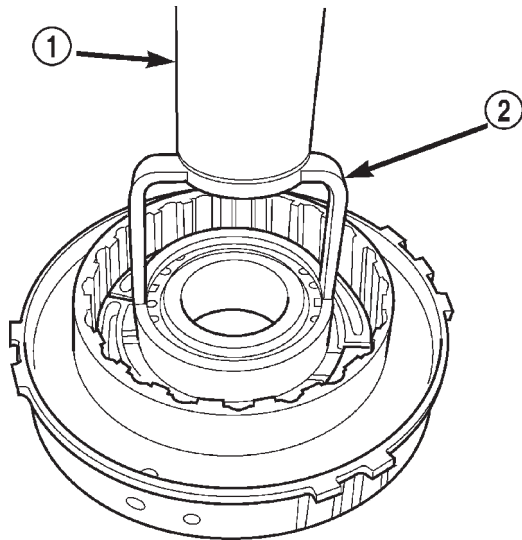
(9) Measure the 4C clutch clearance. The correct clutch clearance is 0.77-1.39 mm (0.030-0.055 in.). The snap-ring is selectable. Install the chosen snap-ring and re-measure to verify the selection.

(10) Install the 2C piston into the retainer/bulkhead (Fig. 66).

(11) Position the 2C Belleville spring onto the 2C piston.

(12) Position the 2C Belleville spring snap-ring onto the 2C Belleville spring (Fig. 66).

## 4C RETAINER/BULKHEAD (Continued)

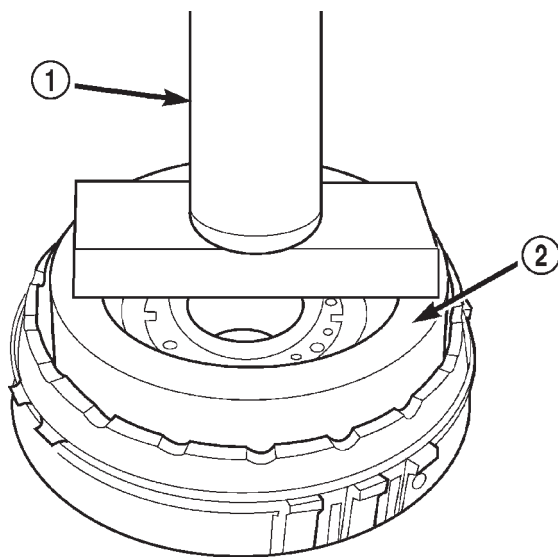


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**Fig. 67 Compress 4C Piston Return Spring Using Tool 8250**

- 1 - PRESS  
2 - TOOL 8250

(13) Using Spring Compressor 8249 and a suitable shop press (Fig. 68), compress the belleville spring until the snap-ring is engaged with the snap-ring groove in the retainer/bulkhead.



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**Fig. 68 Compress 2C Belleville Spring Using Tool 8249**

- 1 - PRESS  
2 - TOOL 8249

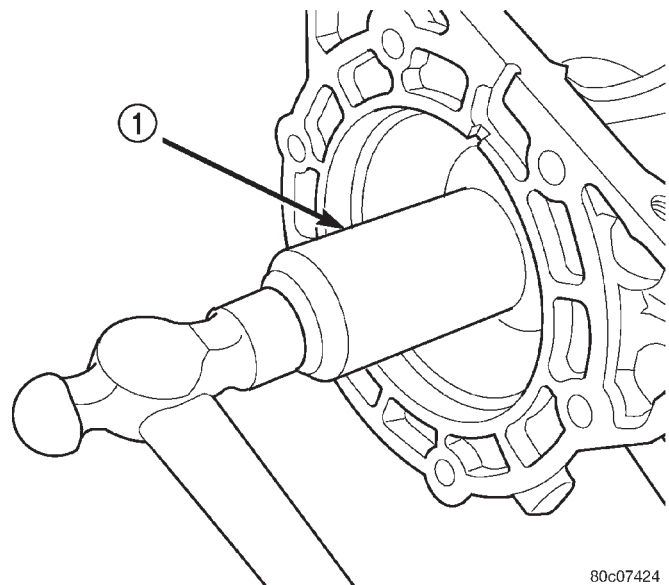
## ADAPTER HOUSING SEAL

## REMOVAL

- (1) Remove the transfer case from the transmission.
- (2) Using a screw mounted on a slide hammer, remove the adapter housing seal.

## INSTALLATION

- (1) Clean the adapter seal bore in the adapter housing of any residue or particles remaining from the original seal.
- (2) Install new oil seal in the adapter housing using Seal Installer C-3860-A (Fig. 69). A properly installed seal is flush to the face of the seal bore.



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**Fig. 69 Adapter Housing Seal Installation**

- 1 - TOOL C-3860-A

- (3) Install the transfer case onto the transmission.

## BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM

## DESCRIPTION

The Brake Transmission Shift Interlock System (BTSI), consists of a Park-Interlock cable and a solenoid mounted in the shift lever assembly. The Park-Interlock cable connects the automatic transmission floor mounted shifter to the steering column ignition switch.

## BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM (Continued)

**OPERATION**

The system locks the shifter into the PARK position. The interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed approximately one-half an inch. A magnetic holding device in the shift lever assembly is energized when the ignition is in the RUN position. When the key is in the RUN position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position, unless the shifter is fully locked into the PARK position.

**DIAGNOSIS AND TESTING - BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM**

(1) Verify that the key can only be removed in the PARK position

(2) When the shift lever is in PARK And the shift handle pushbutton is in the "OUT" position, the ignition key cylinder should rotate freely from OFF to LOCK. When the shifter is in any other gear or neutral position, the ignition key cylinder should not rotate to the LOCK position.

(3) Shifting out of PARK should not be possible when the ignition key cylinder is in the OFF position.

(4) Shifting out of PARK should not be possible while applying normal pushbutton force and ignition key cylinder is in the RUN or START positions unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the ACCESSORY or LOCK positions.

(6) Shifting between any gears, NEUTRAL or into PARK may be done without depressing foot brake pedal with ignition switch in RUN or START positions.

**FLUID AND FILTER****DIAGNOSIS AND TESTING****DIAGNOSIS AND TESTING - 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 and clutch 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.

**DIAGNOSIS AND TESTING - CAUSES OF BURNT FLUID**

Burnt, discolored fluid is a result of overheating which has three primary causes.

(1) Internal clutch slippage, usually caused by low line pressure, inadequate clutch apply pressure, or clutch seal failure.

(2) 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.

(3) 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.

**DIAGNOSIS AND TESTING - 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.

## FLUID AND FILTER (Continued)

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, an overhaul is necessary.

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.

## STANDARD PROCEDURE

## STANDARD PROCEDURE - FLUID LEVEL CHECK

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmission has too much fluid, the geartrain churns up foam and cause the same conditions which occur with a low fluid level.

In either case, air bubbles can cause overheating and/or fluid oxidation, and varnishing. This can interfere with normal valve, clutch, and accumulator operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

Along with fluid level, it is important to check the condition of the fluid. When the fluid smells burned, and is contaminated with metal or friction material particles, a complete transmission recondition is needed. Be sure to examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for a double check.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

The transmission has a dipstick to check oil level. It is located on the right side of the engine. Be sure to wipe all dirt from dipstick handle before removing.

The torque converter fills in both the P (PARK) and N (NEUTRAL) positions. Place the selector lever in P (PARK) to be sure that the fluid level check is accurate. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.** At normal operating temperature (approximately 82 C. or 180 F.), the fluid level is cor-

rect if it is in the HOT region (cross-hatched area) on the oil level indicator. The fluid level will be approximately at the upper COLD hole of the dipstick at 70° F fluid temperature.

**NOTE: Engine and Transmission should be at normal operating temperature before performing this procedure.**

- (1) Start engine and apply parking brake.
- (2) Shift the transmission into DRIVE for approximately 2 seconds.
- (3) Shift the transmission into REVERSE for approximately 2 seconds.
- (4) Shift the transmission into PARK.
- (5) Hook up DRB® scan tool and select transmission.
- (6) Select sensors.
- (7) Read the transmission temperature value.
- (8) Compare the fluid temperature value with the chart. (Fig. 70)
- (9) Adjust transmission fluid level shown on the dipstick according to the chart.

**NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.**

- (10) Check transmission for leaks.

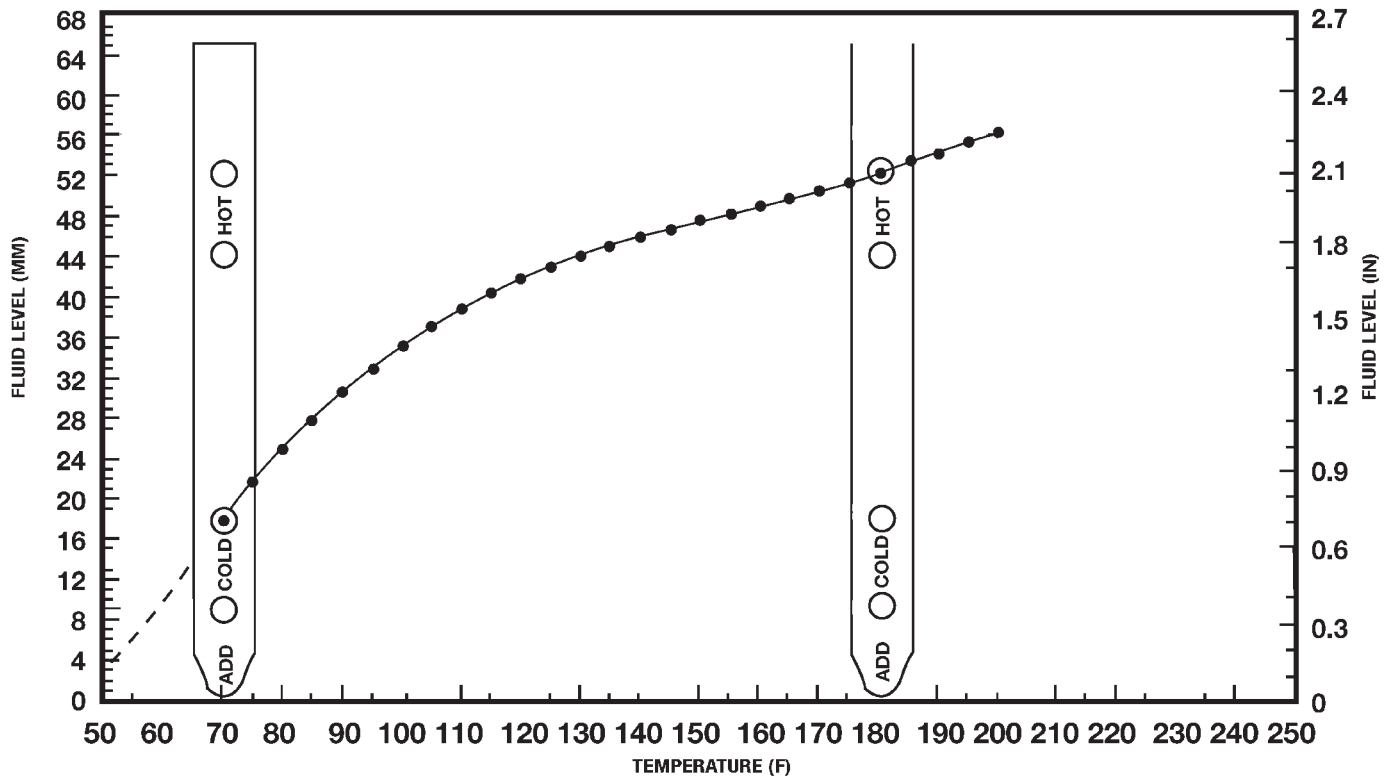
## STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION).

## 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.
- (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 bolts 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 screw holding filter to valve body (Fig. 71).
- (10) Separate filter from valve body and oil pump and pour fluid in filter into drain pan.

FLUID AND FILTER (Continued)



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**Fig. 70 Transmission Fluid Temperature Chart**

(11) Remove and discard the oil filter seal from the bottom of the oil pump.

(12) If replacing the cooler return filter, use Oil Filter Wrench 8321 to remove the filter from the transmission.

(13) Dispose of used trans fluid and filter(s) properly.

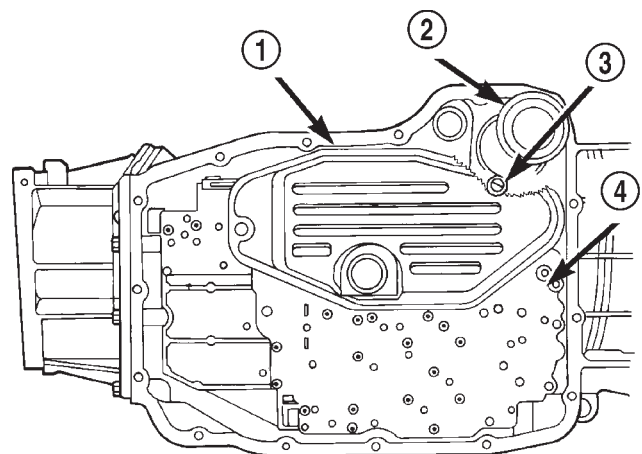
**INSPECTION**

Inspect bottom of pan and magnet for excessive amounts of metal. A light coating of clutch material on the bottom of the pan does not indicate a problem unless accompanied by a slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts of debris, refer to the diagnosis section of this group.

**CLEANING**

(1) Using a suitable solvent, clean pan and magnet.

(2) Using a suitable gasket scraper, clean original sealing material from surface of transmission case and the transmission pan.



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**Fig. 71 Transmission Filters - 4X4 Shown**

- 1 - PRIMARY OIL FILTER
- 2 - COOLER RETURN FILTER
- 3 - COOLER RETURN FILTER BYPASS VALVE
- 4 - VALVE BODY

**INSTALLATION**

(1) Install a new primary oil filter seal in the oil pump inlet bore. Seat the seal in the bore with the butt end of a hammer, or other suitable tool.

## FLUID AND FILTER (Continued)

**CAUTION:** The primary oil filter seal **MUST** be fully installed flush against the oil pump body. **DO NOT** install the seal onto the filter neck and attempt to install the filter and seal as an assembly. Damage to the transmission will result.

(2) Place replacement filter in position on valve body and into the oil pump.

(3) Install screw to hold filter to valve body (Fig. 71). Tighten screw to 4.5 N·m (40 in. lbs.) torque.

(4) Install new cooler return filter onto the transmission, if necessary. Torque the filter to 14.12 N·m (125 in.lbs.).

(5) Place bead of Mopar® RTV sealant onto the transmission case sealing surface.

(6) Place pan in position on transmission.

(7) Install bolts to hold pan to transmission. Tighten bolts to 11.8 N·m (105 in. lbs.) torque.

(8) Lower vehicle and fill transmission with Mopar® ATF +4, type 9602 fluid.

## STANDARD PROCEDURE - TRANSMISSION FILL

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 +4 to transmission:

(a) If only fluid and filter were changed, add **10 pints (5 quarts)** of ATF +4 to transmission.

(b) If transmission was completely overhauled, torque converter was replaced or drained, and cooler was flushed, add **24 pints (12 quarts)** of ATF +4 to transmission.

(3) Check the transmission fluid (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/FLUID - STANDARD PROCEDURE) and adjust as required.

## GEARSHIFT CABLE

### DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) The floor shifter lever and gate positions should be in alignment with all transmission PARK, NEUTRAL, and gear detent positions.

(2) Engine starts must be possible with floor shift lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gear position.

(3) With floor shift lever handle push-button not depressed and lever in:

(a) PARK position - Apply forward force on center of handle and remove pressure. Engine starts must be possible.

(b) PARK position - Apply rearward force on center of handle and remove pressure. Engine starts must be possible.

(c) NEUTRAL position - Normal position. Engine starts must be possible.

(d) NEUTRAL position - Engine running and brakes applied, apply forward force on center of shift handle. Transmission shall not be able to shift from NEUTRAL to REVERSE.

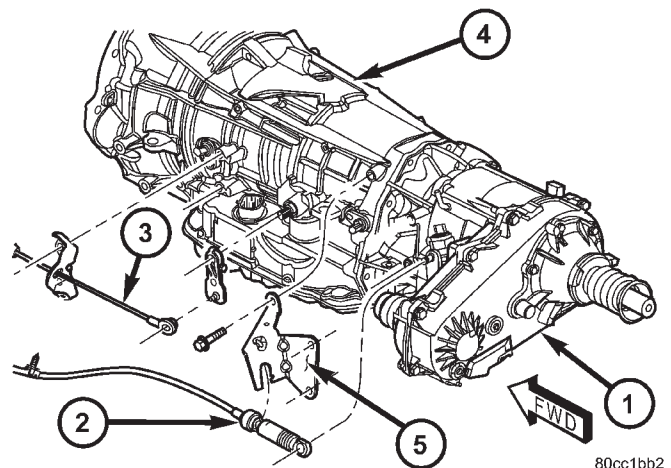
### REMOVAL

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Remove the shift cable eyelet from the transmission manual shift lever (Fig. 72).

(4) Remove shift cable from the cable support bracket.



**Fig. 72 Remove Shift Cables**

- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET

(5) Lower vehicle.

(6) Remove necessary console parts for access to shift lever assembly and shift cable. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

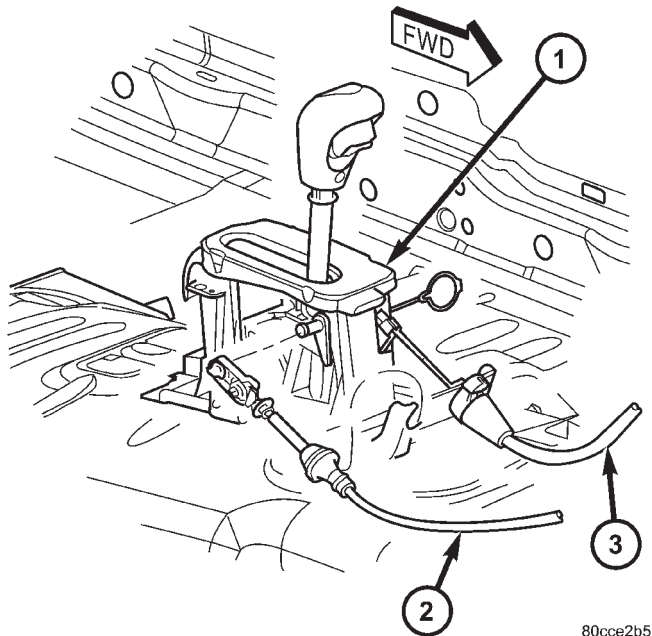
(7) Disconnect cable at shift lever and shifter assembly bracket (Fig. 73).

(8) Remove the nuts holding the shift cable seal plate to the floor pan (Fig. 74).

(9) Pull cable through floor panel opening.

(10) Remove shift cable from vehicle.

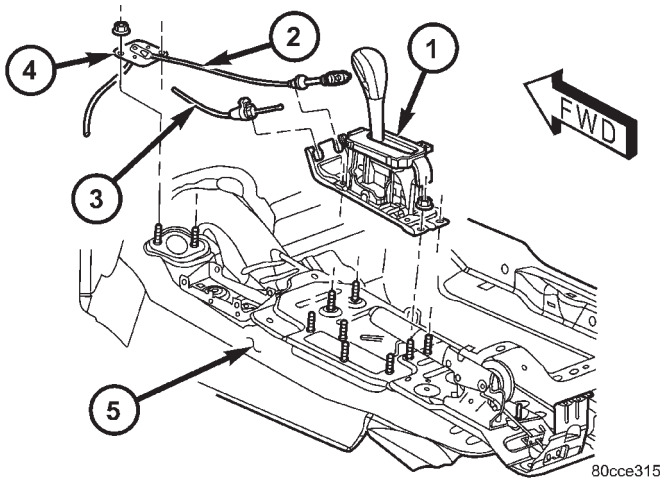
GEARSHIFT CABLE (Continued)



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**Fig. 73 Transmission Shift Cable At Shifter**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE



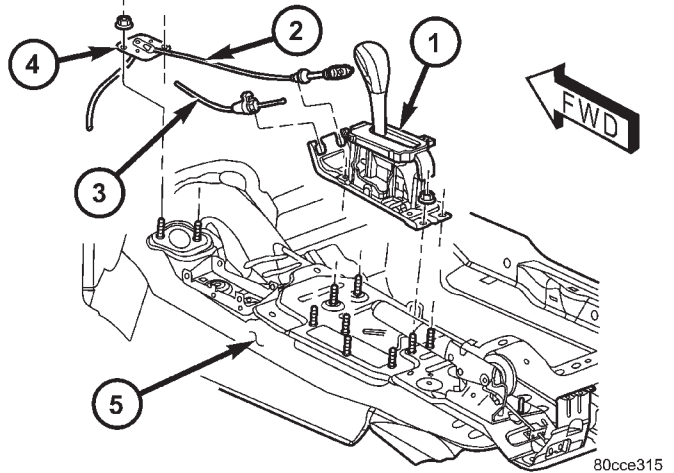
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**Fig. 74 Transmission Shifter Assembly**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - PARK-INTERLOCK CABLE
- 4 - SHIFT CABLE SEAL PLATE
- 5 - FLOOR PAN

**INSTALLATION**

- (1) Route cable through hole in floor pan.
- (2) Install seal plate to studs in floor pan (Fig. 75).
- (3) Install nuts to hold seal plate to floor pan. Tighten nuts to 7 N·m (65 in.lbs.).



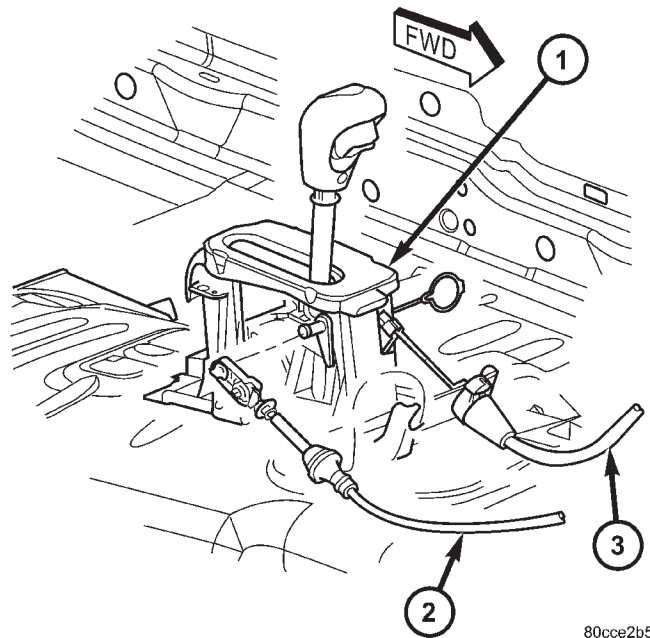
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**Fig. 75 Transmission Shifter Assembly**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - PARK-INTERLOCK CABLE
- 4 - SHIFT CABLE SEAL PLATE
- 5 - FLOOR PAN

(4) Install the shift cable to the shifter assembly bracket (Fig. 76). Push cable into the bracket until secure.

- (5) Place the floor shifter lever in PARK position.
- (6) Loosen the adjustment screw on the shift cable.
- (7) Snap the shift cable onto the shift lever pin.



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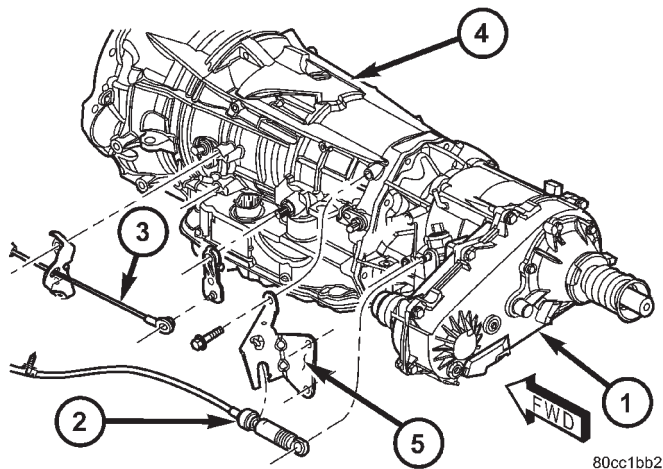
**Fig. 76 Transmission Shift Cable At Shifter**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE



## GEARSHIFT CABLE (Continued)

- (8) Raise the vehicle.
- (9) Install the shift cable to the shift cable support bracket (Fig. 77).
- (10) Shift the transmission into PARK. PARK is the rearmost detent position on the transmission manual shift lever.
- (11) Snap the shift cable onto the transmission manual shift lever.

**Fig. 77 Install Shift Cable**

- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET

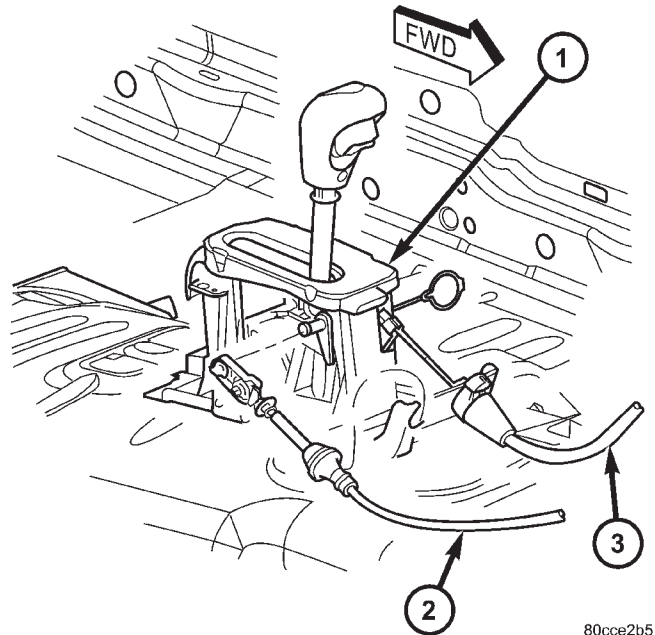
- (12) Lower vehicle.
- (13) Verify that the shift lever is in the PARK position.
- (14) Tighten the adjustment screw to 7 N·m (65 in.lbs.).
- (15) Verify correct shifter operation.
- (16) Install any console parts removed for access to shift lever assembly and shift cable. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

**ADJUSTMENTS - GEARSHIFT CABLE**

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT if the engine starts only in these positions. Adjustment is INCORRECT if the engine starts in one but not both positions. If the engine starts in any position other than PARK or NEUTRAL, or if the engine will not start at all, the TRS may be faulty.

**Gearshift Adjustment Procedure**

- (1) Shift transmission into PARK.
- (2) Remove floor console as necessary for access to the shift cable adjustment. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
- (3) Loosen the shift cable adjustment screw (Fig. 78).

**Fig. 78 Transmission Shift Cable At Shifter**

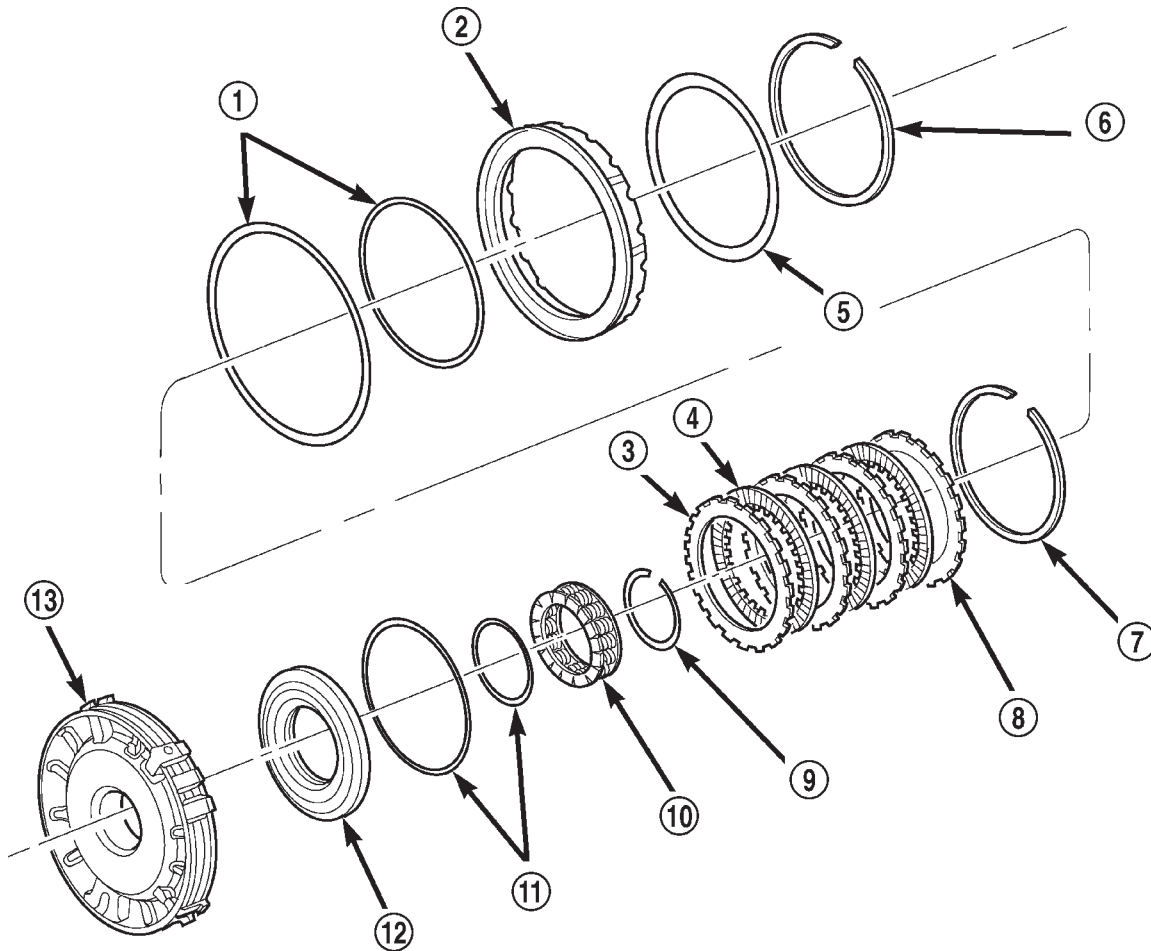
- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE

- (4) Raise vehicle.
- (5) Unsnap cable eyelet from transmission shift lever.
- (6) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.
- (7) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.
- (8) Snap cable eyelet onto transmission shift lever.
- (9) Lower vehicle
- (10) Tighten the shift cable adjustment screw to 7 N·m (65 in.lbs.).
- (11) Verify correct operation.
- (12) Install any floor console components removed for access. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

# HOLDING CLUTCHES

## DESCRIPTION

Three hydraulically applied multi-disc clutches are used to hold some planetary geartrain components stationary while the input clutches drive others. The 2C, 4C, and Low/Reverse clutches are considered holding clutches. The 2C and 4C clutches are located in the 4C retainer/bulkhead (Fig. 79), while the Low/Reverse clutch is located at the rear of the transmission case (Fig. 80).

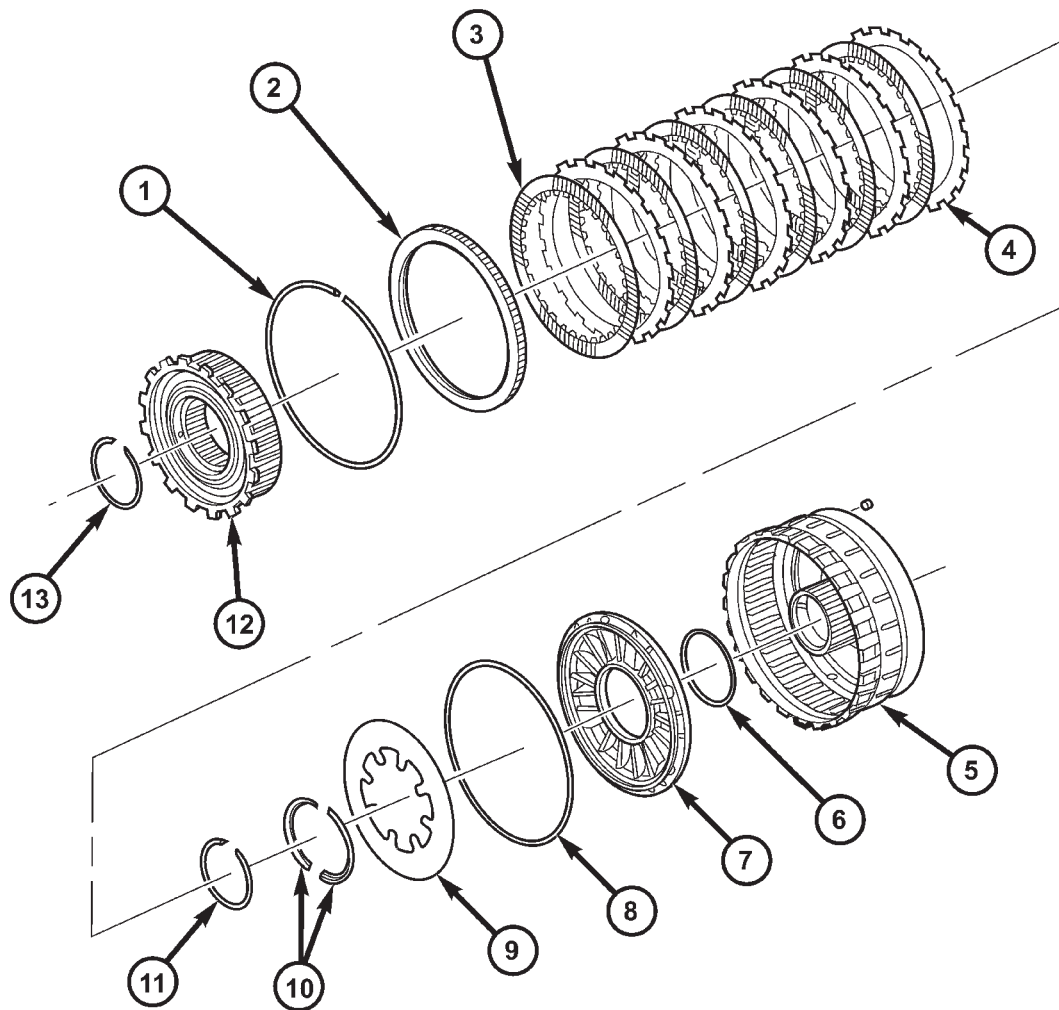


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**Fig. 79 2C and 4C Clutches**

- |                          |                           |
|--------------------------|---------------------------|
| 1 - SEAL                 | 8 - REACTION PLATE        |
| 2 - 2C PISTON            | 9 - SNAP-RING             |
| 3 - PLATE                | 10 - RETURN SPRING        |
| 4 - DISC                 | 11 - SEAL                 |
| 5 - 2C BELLEVILLE SPRING | 12 - 4C PISTON            |
| 6 - SNAP-RING            | 13 - 4C RETAINER/BULKHEAD |
| 7 - SNAP-RING (SELECT)   |                           |

## HOLDING CLUTCHES (Continued)



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**Fig. 80 Low/Reverse Clutch**

- |                         |                         |
|-------------------------|-------------------------|
| 1 - SNAP-RING (SELECT)  | 8 - SEAL                |
| 2 - REACTION PLATE      | 9 - BELLEVILLE SPRING   |
| 3 - DISC                | 10 - RETAINER           |
| 4 - PLATE               | 11 - SNAP-RING          |
| 5 - L/R CLUTCH RETAINER | 12 - OVERRUNNING CLUTCH |
| 6 - SEAL                | 13 - SNAP-RING          |
| 7 - PISTON              |                         |

**OPERATION****2C CLUTCH**

The 2C clutch is hydraulically applied in second gear by pressurized fluid against the 2C piston. When the 2C clutch is applied, the reverse sun gear assembly is held or grounded to the transmission case by holding the reaction planetary carrier.

**4C CLUTCH**

The 4C clutch is hydraulically applied in second prime and fourth gear by pressurized fluid against the 4C clutch piston. When the 4C clutch is applied,

the reaction annulus gear is held or grounded to the transmission case.

**LOW/REVERSE CLUTCH**

The Low/Reverse clutch is hydraulically applied in park, reverse, neutral, and first gear, only at low speeds, by pressurized fluid against the Low/Reverse clutch piston. When the Low/Reverse clutch is applied, the input annulus assembly is held or grounded to the transmission case.

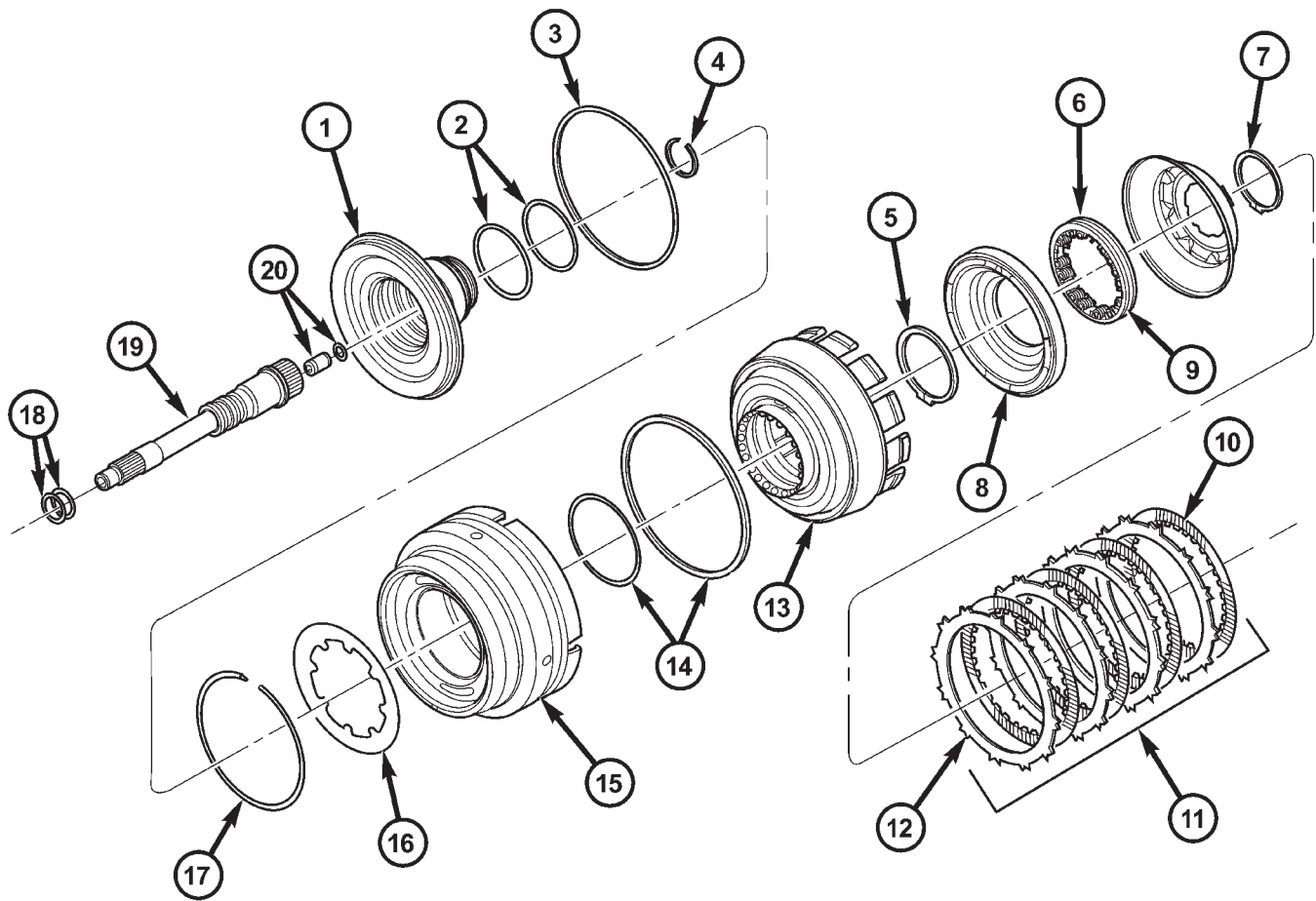
# INPUT CLUTCH ASSEMBLY

## DESCRIPTION

Three hydraulically applied input clutches are used to drive planetary components. The underdrive, overdrive, and reverse clutches are considered input clutches and are contained within the input clutch assembly (Fig. 81) and (Fig. 82). The input clutch assembly also contains:

- Input shaft
- Input hub
- Clutch retainer

- Underdrive piston
- Overdrive/reverse piston
- Overdrive hub
- Underdrive hub

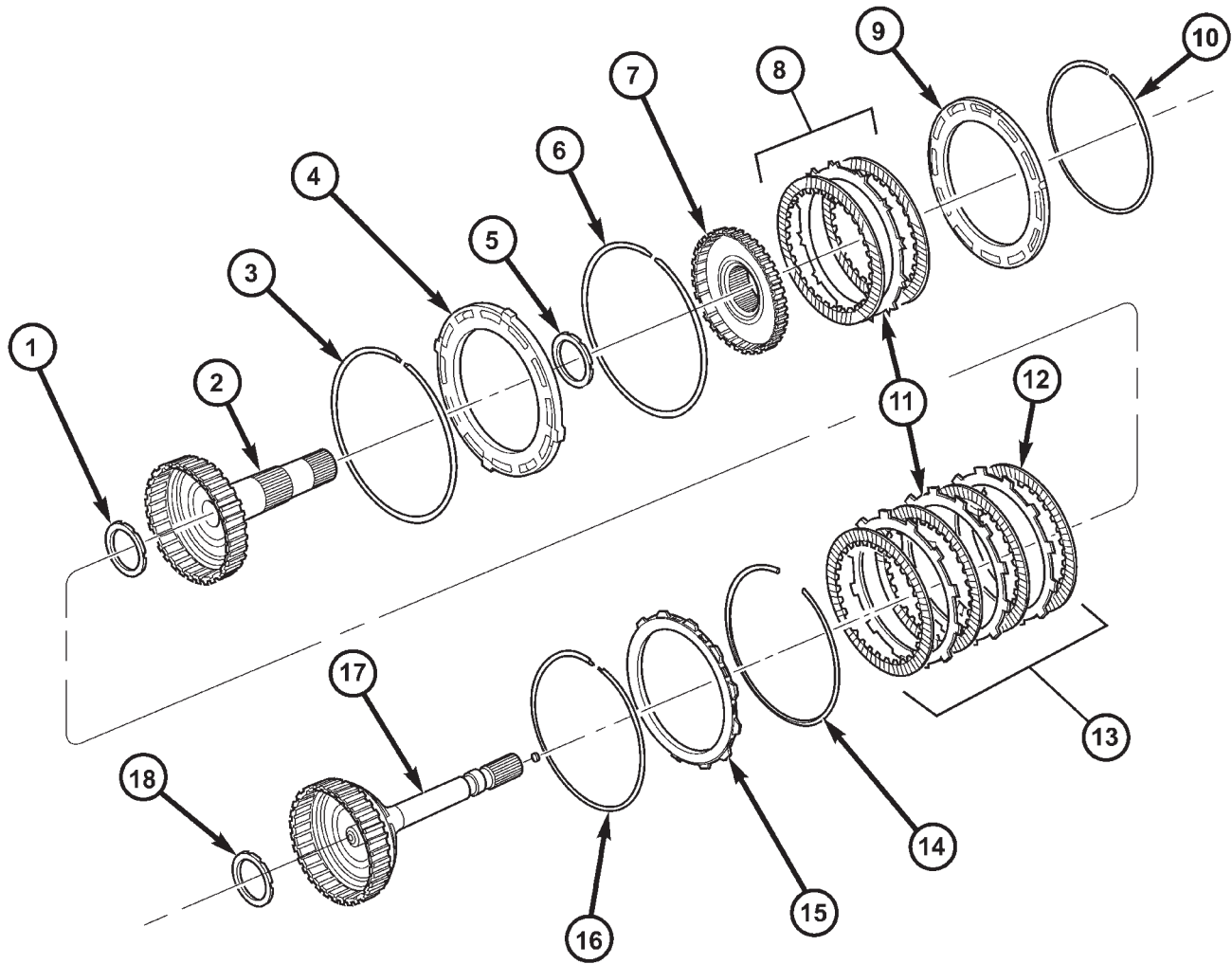


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**Fig. 81 Input Clutch Assembly - Part 1**

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>1 - INPUT CLUTCH HUB</li> <li>2 - O-RING SEALS</li> <li>3 - SEAL</li> <li>4 - SNAP-RING</li> <li>5 - SNAP-RING</li> <li>6 - UD BALANCE PISTON</li> <li>7 - SNAP-RING</li> <li>8 - UD PISTON</li> <li>9 - SPRING</li> <li>10 - DISC</li> </ul> | <ul style="list-style-type: none"> <li>11 - UD CLUTCH</li> <li>12 - PLATE</li> <li>13 - CLUTCH RETAINER</li> <li>14 - SEAL</li> <li>15 - OD/REV PISTON</li> <li>16 - BELLEVILLE SPRING</li> <li>17 - SNAP-RING</li> <li>18 - SEAL RINGS</li> <li>19 - INPUT SHAFT</li> <li>20 - LUBRICATION CHECK VALVE AND SNAP-RING</li> </ul> |
|--|--|

INPUT CLUTCH ASSEMBLY (Continued)



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**Fig. 82 Input Clutch Assembly - Part 2**

- |                            |                           |
|----------------------------|---------------------------|
| 1 - BEARING NUMBER 3       | 10 - SNAP-RING (SELECT)   |
| 2 - OD HUB/SHAFT           | 11 - PLATE                |
| 3 - SNAP-RING (WAVE)       | 12 - DISC                 |
| 4 - REV/OD REACTION PLATE  | 13 - OD CLUTCH            |
| 5 - BEARING NUMBER 4       | 14 - SNAP-RING (TAPERED)  |
| 6 - SNAP-RING (FLAT)       | 15 - UD/OD REACTION PLATE |
| 7 - REVERSE HUB/SHAFT      | 16 - SNAP-RING (FLAT)     |
| 8 - REVERSE CLUTCH         | 17 - UD HUB/SHAFT         |
| 9 - REVERSE REACTION PLATE | 18 - BEARING NUMBER 2     |

## INPUT CLUTCH ASSEMBLY (Continued)

**OPERATION**

The three input clutches are responsible for driving different components of the planetary geartrain.

**UNDERDRIVE CLUTCH**

The underdrive clutch is hydraulically applied in first, second, second prime, and third (direct) gears by pressurized fluid against the underdrive piston. When the underdrive clutch is applied, the underdrive hub drives the input sun gear.

**OVERDRIVE CLUTCH**

The overdrive clutch is hydraulically applied in third (direct) and fourth gears by pressurized fluid against the overdrive/reverse piston. When the overdrive clutch is applied, the overdrive hub drives the reverse carrier/input annulus assembly.

**REVERSE CLUTCH**

The reverse clutch is hydraulically applied in reverse gear by pressurized fluid against the overdrive/reverse piston. When the reverse clutch is applied, the reaction annulus gear is driven.

**DISASSEMBLY**

(1) Remove the reverse reaction plate selective snap-ring from the input clutch retainer (Fig. 83).

(2) Remove the reverse reaction plate from the input clutch retainer.

(3) Remove the reverse hub and reverse clutch pack from the input clutch retainer.

(4) Remove the number 4 bearing from the overdrive hub.

(5) Remove the overdrive hub from the input clutch retainer (Fig. 83).

(6) Remove the number 3 bearing from the underdrive hub.

(7) Remove the OD/reverse reaction plate snap-ring from the input clutch retainer.

(8) Remove the underdrive hub, overdrive clutch, and overdrive reaction plate from the input clutch retainer (Fig. 83).

**NOTE: The overdrive friction discs and steel discs are thicker than the matching components in the underdrive and reverse clutches.**

(9) Remove the number 2 bearing from the input clutch hub.

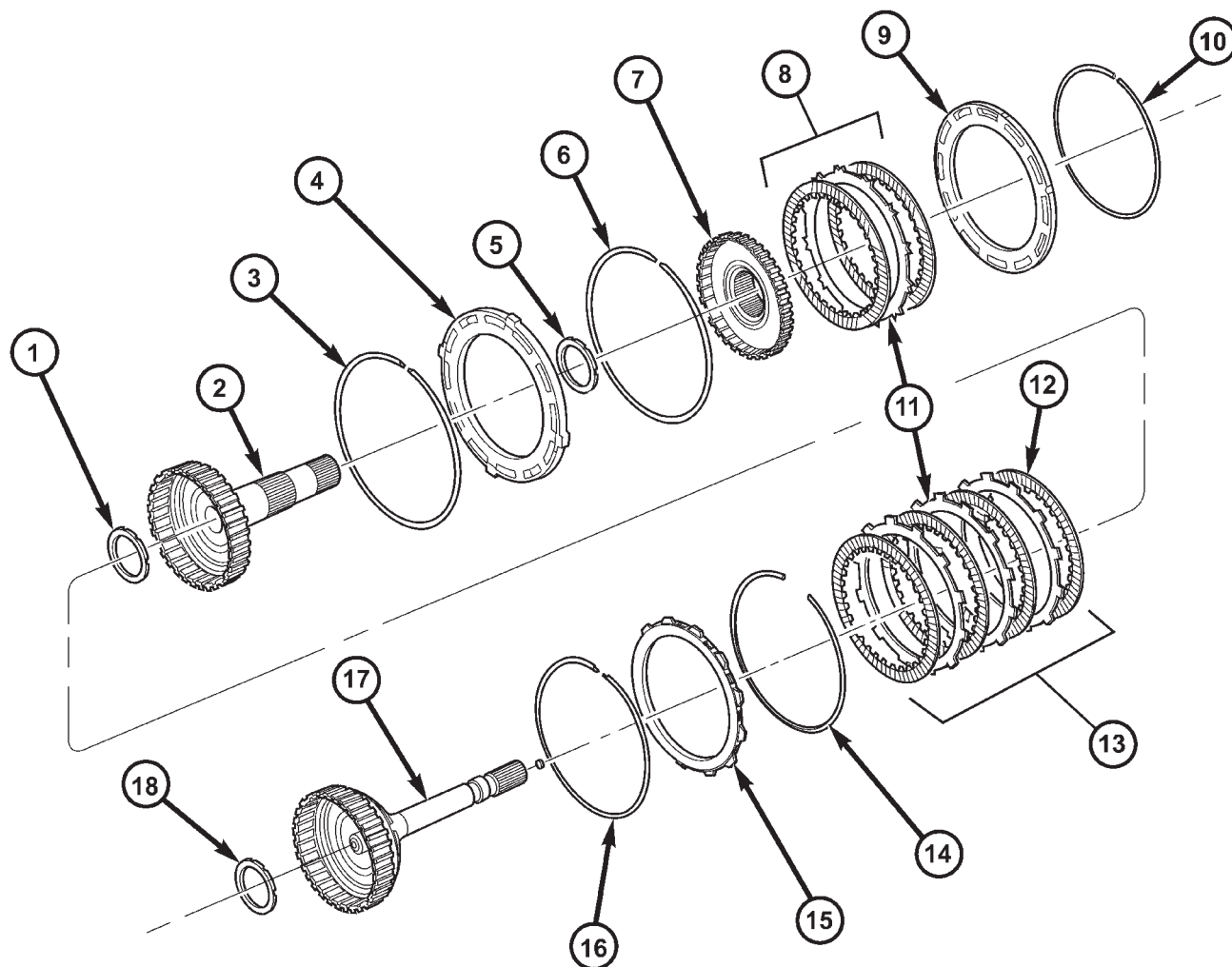
(10) Remove the overdrive clutch wave snap-ring from the input clutch retainer.

(11) Remove the UD/OD reaction plate tapered snap-ring from the input clutch retainer.

(12) Remove the UD/OD reaction plate from the input clutch retainer.

(13) Remove the UD/OD reaction plate flat snap-ring from the input clutch retainer (Fig. 83).

## INPUT CLUTCH ASSEMBLY (Continued)



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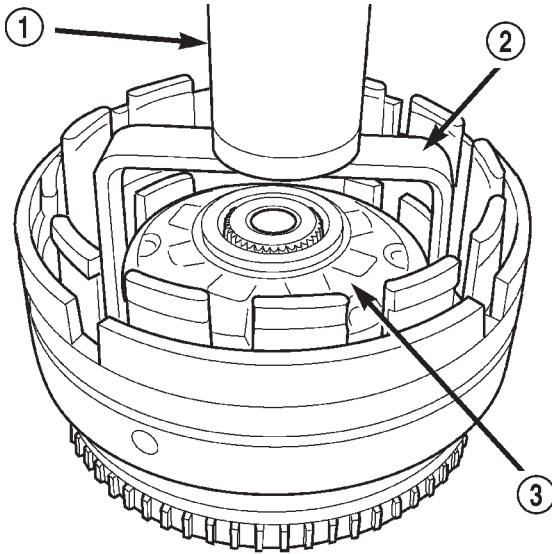
**Fig. 83 Input Clutch Assembly - Part 2**

- |                            |                           |
|----------------------------|---------------------------|
| 1 - BEARING NUMBER 3       | 10 - SNAP-RING (SELECT)   |
| 2 - OD HUB/SHAFT           | 11 - PLATE                |
| 3 - SNAP-RING (WAVE)       | 12 - DISC                 |
| 4 - REV/OD REACTION PLATE  | 13 - OD CLUTCH            |
| 5 - BEARING NUMBER 4       | 14 - SNAP-RING (TAPERED)  |
| 6 - SNAP-RING (FLAT)       | 15 - UD/OD REACTION PLATE |
| 7 - REVERSE HUB/SHAFT      | 16 - SNAP-RING (FLAT)     |
| 8 - REVERSE CLUTCH         | 17 - UD HUB/SHAFT         |
| 9 - REVERSE REACTION PLATE | 18 - BEARING NUMBER 2     |

## INPUT CLUTCH ASSEMBLY (Continued)

(14) Remove the underdrive clutch pack from the input clutch retainer (Fig. 85).

(15) Using Spring Compressor 8251, compress the UD/OD balance piston and remove the snap-ring from the input clutch hub (Fig. 84).



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**Fig. 84 Compressing UD/OD Balance Piston Using Tool 8251**

- 1 - PRESS  
2 - TOOL 8251  
3 - BALANCE PISTON

(16) Remove the UD/OD balance piston and piston return spring from the input clutch retainer (Fig. 85).

(17) Remove the underdrive piston from the input clutch retainer (Fig. 85).

**NOTE:** Both the UD/OD balance piston and the underdrive piston have seals molded onto them. If the seal is damaged, do not attempt to install a new seal onto the piston. The piston/seal must be replaced as an assembly.

(18) Remove the input clutch retainer tapered snap-ring.

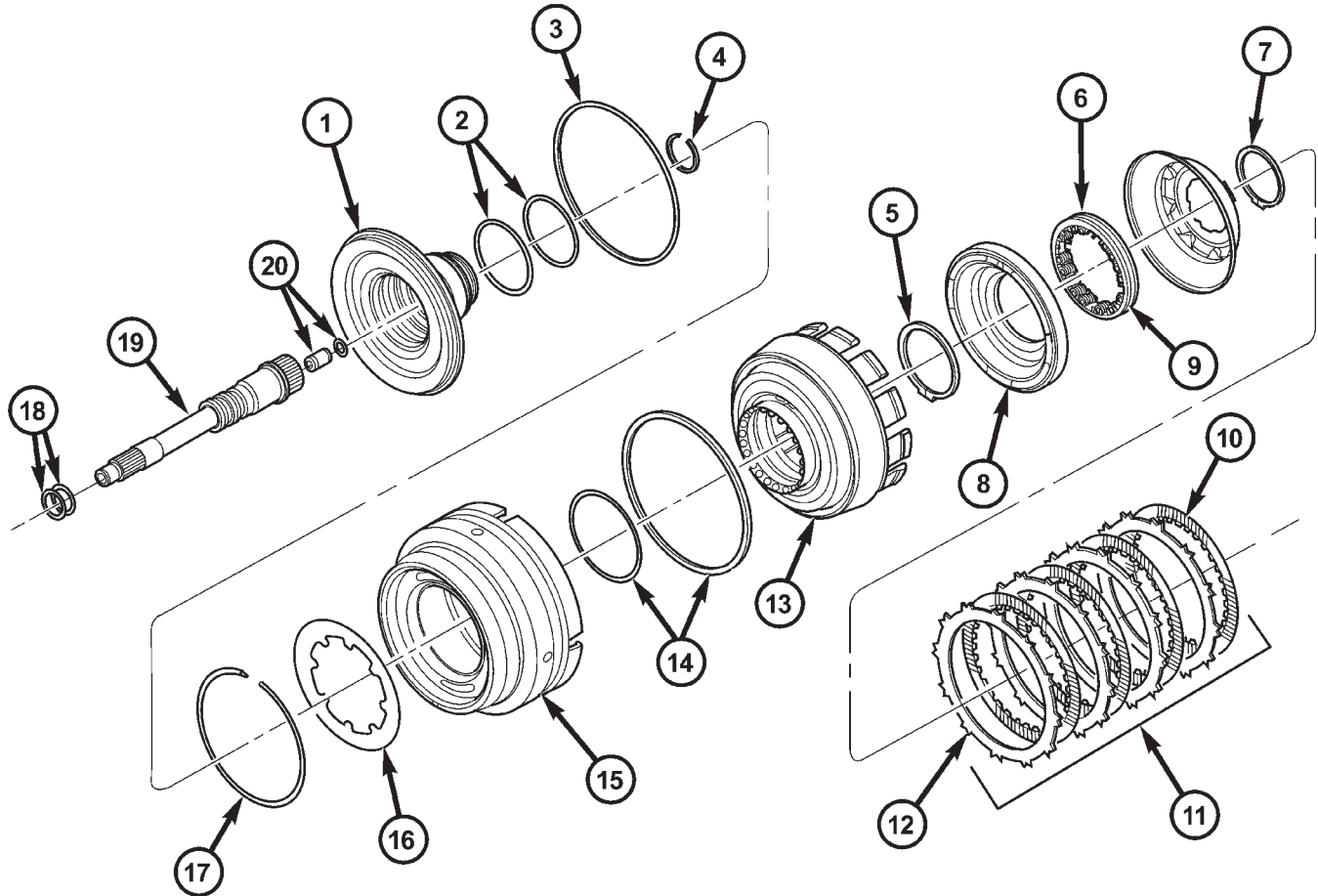
(19) Separate input clutch retainer from input clutch hub.

(20) Separate OD/reverse piston from input clutch hub retainer (Fig. 85).

(21) Remove all seals and o-rings from the input shaft and input hub. The o-rings on the input hub are color coded. Be sure to make note of which o-ring belongs in which location.



## INPUT CLUTCH ASSEMBLY (Continued)



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**Fig. 85 Input Clutch Assembly - Part 1**

- |                       |  |
|-----------------------|--|
| 1 - INPUT CLUTCH HUB  | 11 - UD CLUTCH                             |
| 2 - O-RING SEALS      | 12 - PLATE                                 |
| 3 - SEAL              | 13 - CLUTCH RETAINER                       |
| 4 - SNAP-RING         | 14 - SEAL                                  |
| 5 - SNAP-RING         | 15 - OD/REV PISTON                         |
| 6 - UD BALANCE PISTON | 16 - BELLEVILLE SPRING                     |
| 7 - SNAP-RING         | 17 - SNAP-RING                             |
| 8 - UD PISTON         | 18 - SEAL RINGS                            |
| 9 - SPRING            | 19 - INPUT SHAFT                           |
| 10 - DISC             | 20 - LUBRICATION CHECK VALVE AND SNAP-RING |

**ASSEMBLY**

(1) Install all new seals and o-rings onto the input shaft and input hub. The o-rings on the input hub are color coded. Be sure to install the correct o-ring in the correct location.

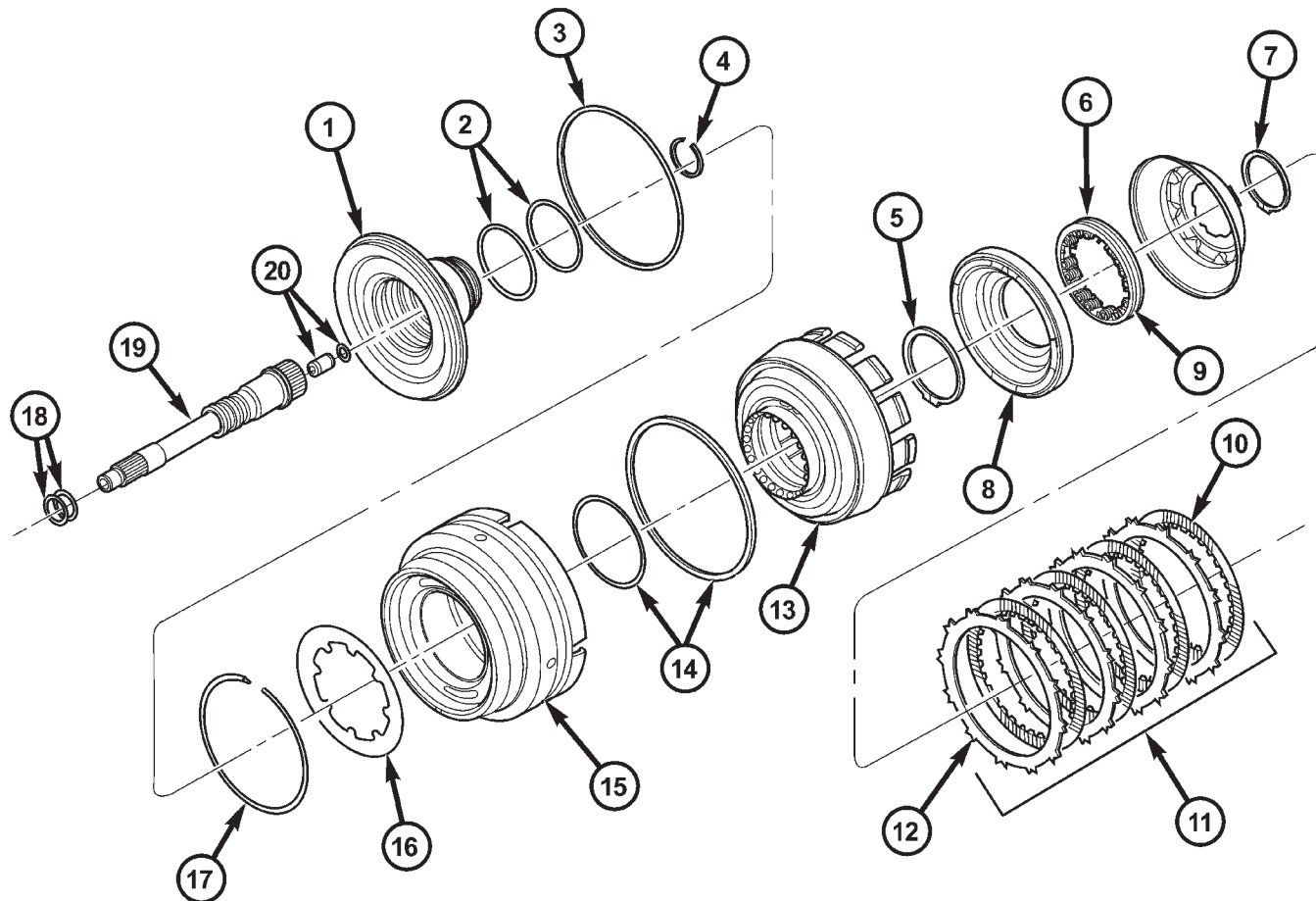
(2) Check the transmission lubrication check valve located in the input shaft using shop air. The valve should only allow air flow in one direction. If the valve allows no air flow, or air flow in both directions, the valve will need to be replaced.

(3) Lubricate all seals with Mopar® ATF +4, type 9602, prior to installation.

(4) Assemble the OD/reverse piston onto the input clutch hub (Fig. 86).

(5) Assemble the input clutch retainer onto the input clutch hub.

INPUT CLUTCH ASSEMBLY (Continued)



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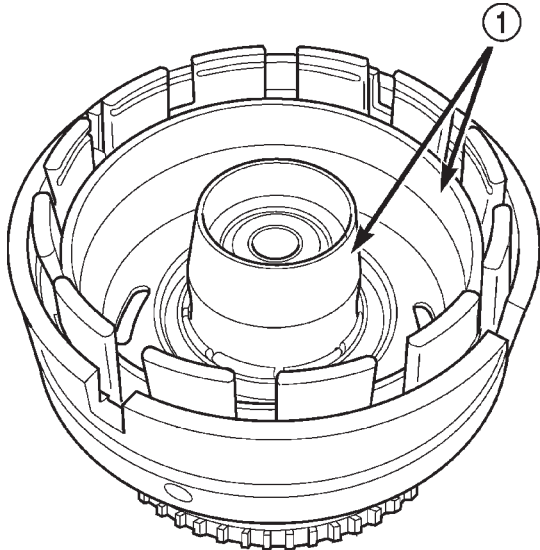
**Fig. 86 Input Clutch Assembly - Part I**

- |                       |  |
|-----------------------|--|
| 1 - INPUT CLUTCH HUB  | 11 - UD CLUTCH                             |
| 2 - O-RING SEALS      | 12 - PLATE                                 |
| 3 - SEAL              | 13 - CLUTCH RETAINER                       |
| 4 - SNAP-RING         | 14 - SEAL                                  |
| 5 - SNAP-RING         | 15 - OD/REV PISTON                         |
| 6 - UD BALANCE PISTON | 16 - BELLEVILLE SPRING                     |
| 7 - SNAP-RING         | 17 - SNAP-RING                             |
| 8 - UD PISTON         | 18 - SEAL RINGS                            |
| 9 - SPRING            | 19 - INPUT SHAFT                           |
| 10 - DISC             | 20 - LUBRICATION CHECK VALVE AND SNAP-RING |

## INPUT CLUTCH ASSEMBLY (Continued)

(6) Install the input clutch retainer tapered snap-ring with tapered side up onto the input clutch hub.

(7) Install Piston Guides 8504 into the input clutch retainer (Fig. 87) and onto the input clutch hub to guide the inner and outer underdrive piston seals into position.



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**Fig. 87 Install Underdrive Piston Using Tool 8504**

1 - TOOL 8504

(8) Install the underdrive piston into the input clutch retainer and over the input clutch hub (Fig. 86).

(9) Install the UD/OD balance piston return spring pack into the input clutch retainer.

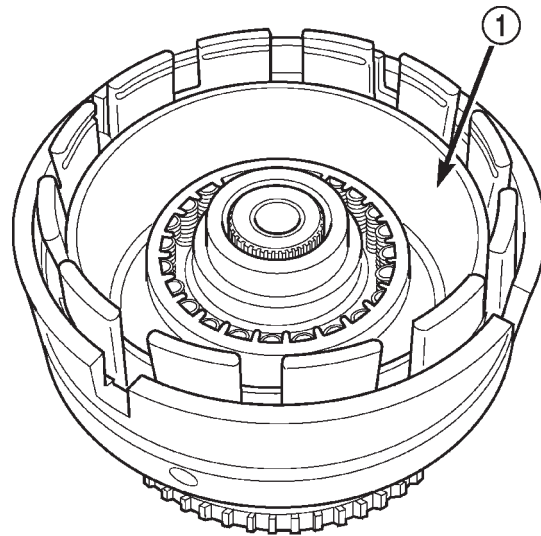
(10) Install Piston Guide 8252 into the input clutch retainer (Fig. 88) to guide the UD/OD balance piston seal into position inside the underdrive piston.

(11) Install the UD/OD balance piston into the input clutch retainer and the underdrive piston.

(12) Using Spring Compressor 8251, compress the UD/OD return spring pack and secure the piston in place with the snap-ring (Fig. 89).

(13) Install the underdrive clutch pack into the input clutch retainer (Fig. 86).

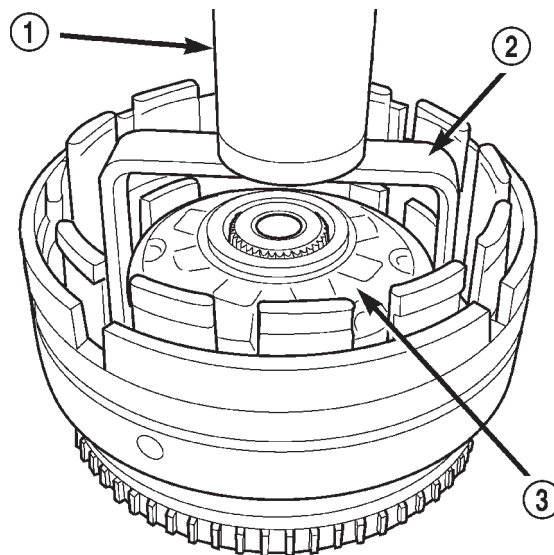
(14) Install the UD/OD reaction plate lower flat snap-ring (Fig. 90). The correct snap-ring can be identified by the two tabbed ears.



80c07428

**Fig. 88 Install Balance Piston Using Tool 8252**

1 - TOOL 8252

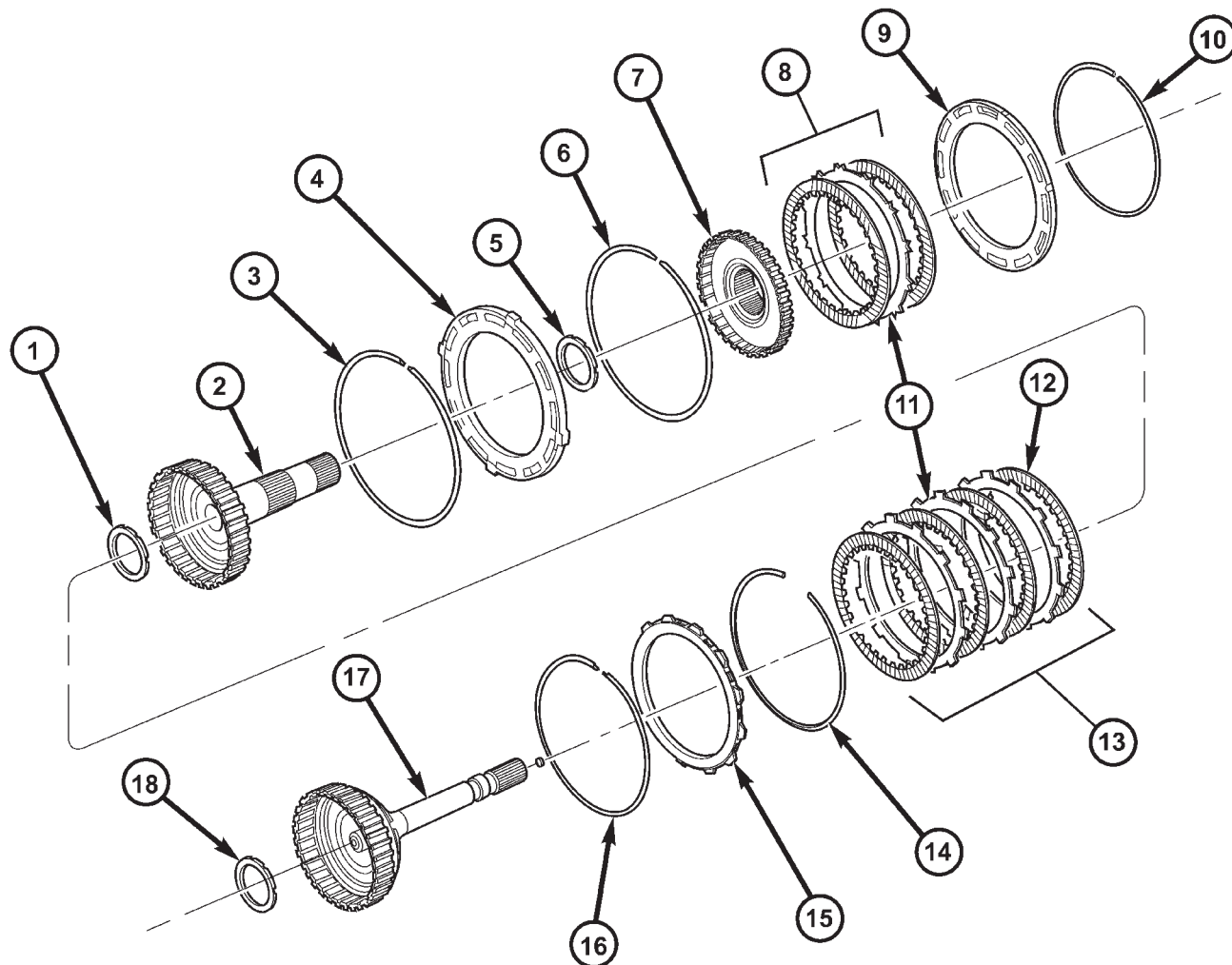


80c07426

**Fig. 89 Compressing UD/OD Balance Piston Using Tool 8251**

1 - PRESS  
2 - TOOL 8251  
3 - BALANCE PISTON

INPUT CLUTCH ASSEMBLY (Continued)



808a2e68

**Fig. 90 Input Clutch Assembly - Part II**

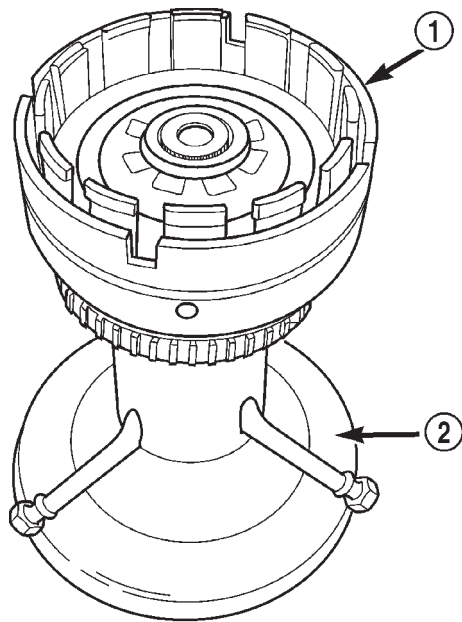
- |                            |                           |
|----------------------------|---------------------------|
| 1 - BEARING NUMBER 3       | 10 - SNAP-RING (SELECT)   |
| 2 - OD HUB/SHAFT           | 11 - PLATE                |
| 3 - SNAP-RING (WAVE)       | 12 - DISC                 |
| 4 - REV/OD REACTION PLATE  | 13 - OD CLUTCH            |
| 5 - BEARING NUMBER 4       | 14 - SNAP-RING (TAPERED)  |
| 6 - SNAP-RING (FLAT)       | 15 - UD/OD REACTION PLATE |
| 7 - REVERSE HUB/SHAFT      | 16 - SNAP-RING (FLAT)     |
| 8 - REVERSE CLUTCH         | 17 - UD HUB/SHAFT         |
| 9 - REVERSE REACTION PLATE | 18 - BEARING NUMBER 2     |

## INPUT CLUTCH ASSEMBLY (Continued)

(15) Install the UD/OD reaction plate into the input clutch retainer. The reaction plate is to be installed with the big step down.

(16) Install the UD/OD reaction plate upper tapered snap-ring with tapered side up.

(17) Install the input clutch assembly into Input Clutch Pressure Fixture 8260 (Fig. 91). Mount a dial indicator to the assembly, push down on the clutch discs and zero the indicator against the underdrive clutch discs (Fig. 92). Apply 20 psi of air pressure to the underdrive clutch and record the dial indicator reading. Measure and record UD clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with UD clutch pack clearance specification. The correct clutch clearance is 0.84-1.54 mm (0.033-0.061 in.). The reaction plate is not selective. If the clutch clearance is not within specification, replace the reaction plate along with all the friction and steel discs.



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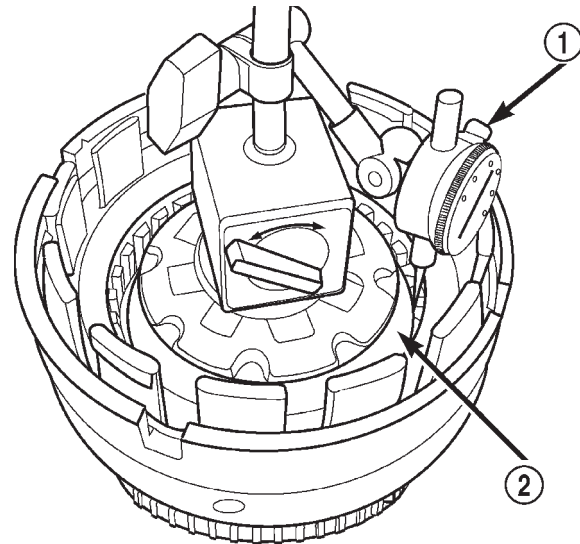
**Fig. 91 Input Clutch Assembly Mounted on Tool 8260**

- 1 - INPUT CLUTCH ASSEMBLY  
2 - TOOL 8260

(18) Install the overdrive clutch pack into the input clutch retainer (Fig. 90). The overdrive steel separator plates can be identified by the lack of the half-moon cuts in the locating tabs.

(19) Install the overdrive clutch wavy snap-ring with the two tabbed ears into the input clutch retainer.

(20) Install the OD/reverse reaction plate into the input clutch retainer. The reaction plate is non-directional (Fig. 90).



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**Fig. 92 Measuring UD Clutch Clearance**

- 1 - TOOL C-3339  
2 - UNDERDRIVE CLUTCH PACK

(21) Install the OD/reverse reaction plate flat snap-ring into the input clutch retainer.

(22) Mount a dial indicator to the assembly and zero the indicator against the OD/reverse reaction plate (Fig. 93). Apply 20 psi of air pressure to the overdrive clutch and record the dial indicator reading. Measure and record OD clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with OD clutch pack clearance specification. Verify that the clutch clearance is 1.103-1.856 mm (0.043-0.073 in.). The reaction plate is not selective. If the clutch clearance is not within specification, replace the reaction plate along with all the friction and steel discs.

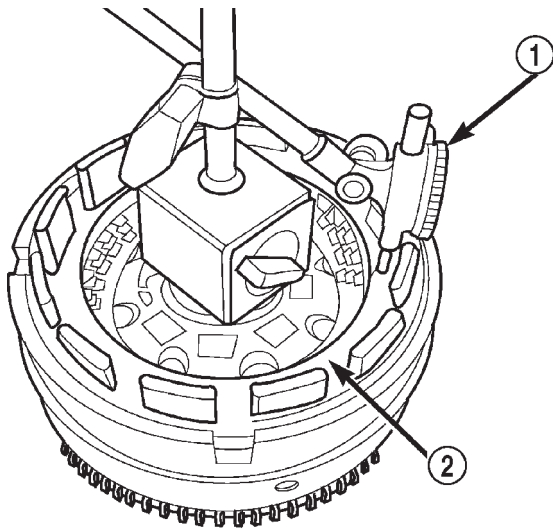
(23) Install the reverse clutch pack into the input clutch retainer (Fig. 90).

(24) Install the reverse reaction plate into the input clutch retainer.

(25) Install the reverse reaction plate selective snap-ring into the input clutch retainer.

(26) Mount a dial indicator to the assembly, push down on the clutch discs, pull up on the reaction plate to ensure the plate is properly seated and zero the indicator against the reverse clutch discs (Fig. 94). Apply 20 psi of air pressure to the reverse clutch and record the dial indicator reading. Measure and record Reverse clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with Reverse clutch pack clearance specification. The correct clutch clearance is 0.58-1.47 mm (0.023-0.058 in.). Adjust as necessary. Install the chosen snap-ring and re-measure to verify selection.

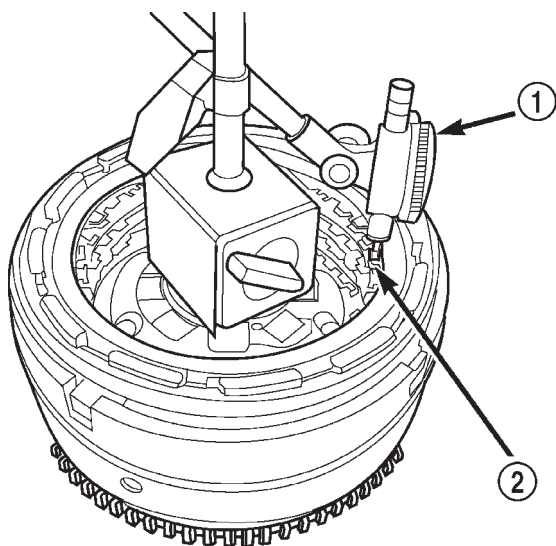
INPUT CLUTCH ASSEMBLY (Continued)



80c07447

**Fig. 93 Measuring OD Clutch Clearance**

- 1 - TOOL C-3339
- 2 - OD/REV REACTION PLATE



80c07446

**Fig. 94 Measuring Reverse Clutch Clearance**

- 1 - TOOL C-3339
- 2 - REVERSE CLUTCH PACK

(27) Remove the reverse clutch pack from the input clutch retainer.

(28) Install the number 2 bearing onto the underdrive hub with outer race against the hub with petroleum jelly.

(29) Install the underdrive hub into the input clutch retainer.

(30) Install the number 3 bearing into the overdrive hub with the outer race against the hub with petroleum jelly.

(31) Install the overdrive hub into the input clutch retainer.

(32) Install the number 4 bearing into the reverse hub with outer race against the hub with petroleum jelly.

(33) Install the reverse hub into the input clutch retainer.

(34) Install the complete reverse clutch pack.

(35) Install the reverse reaction plate and snap-ring.

(36) Push up on reaction plate to allow reverse clutch to move freely.

## INPUT SPEED SENSOR

### DESCRIPTION

The Input and Output Speed Sensors are two-wire magnetic pickup devices that generate AC signals as rotation occurs. They are mounted in the left side of the transmission case and are considered primary inputs to the Transmission Control Module (TCM).

### OPERATION

The Input Speed Sensor provides information on how fast the input shaft is rotating. As the teeth of the input clutch hub pass by the sensor coil, an AC voltage is generated and sent to the TCM. The TCM interprets this information as input shaft rpm.

The Output Speed Sensor generates an AC signal in a similar fashion, though its coil is excited by rotation of the rear planetary carrier lugs. The TCM interprets this information as output shaft rpm.

The TCM compares the input and output speed signals to determine the following:

- Transmission gear ratio
- Speed ratio error detection
- CVI calculation

The TCM also compares the input speed signal and the engine speed signal to determine the following:

- Torque converter clutch slippage
- Torque converter element speed ratio

### REMOVAL

(1) Raise vehicle.  
 (2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the input speed sensor (Fig. 95).

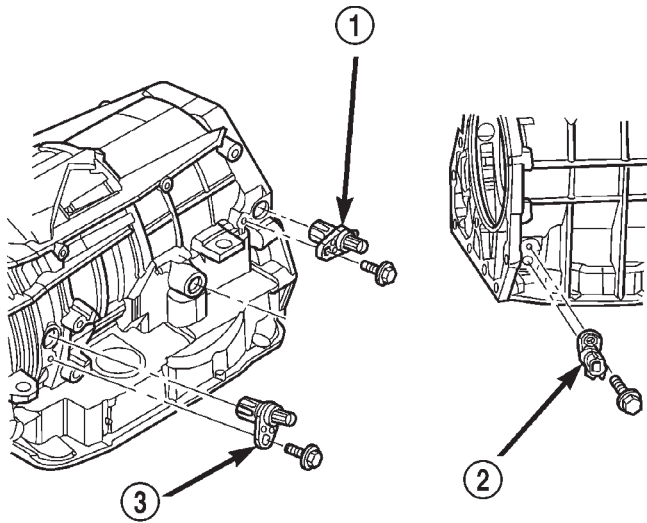
(4) Remove the bolt holding the input speed sensor to the transmission case.

(5) Remove the input speed sensor from the transmission case.

### INSTALLATION

(1) Install the input speed sensor into the transmission case.

## INPUT SPEED SENSOR (Continued)



80c07350

**Fig. 95 Input Speed Sensor**

- 1 - OUTPUT SPEED SENSOR  
2 - LINE PRESSURE SENSOR  
3 - INPUT SPEED SENSOR

(2) Install the bolt to hold the input speed sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

(3) Install the wiring connector onto the input speed sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

## LINE PRESSURE (LP) SENSOR

## DESCRIPTION

The TCM utilizes a closed-loop system to control transmission line pressure. The system contains a variable force style solenoid, the Pressure Control Solenoid, mounted on the side of the solenoid and pressure switch assembly. The solenoid is duty cycle controlled by the TCM to vent the unnecessary line pressure supplied by the oil pump back to the sump. The system also contains a variable pressure style sensor, the Line Pressure Sensor, which is a direct input to the TCM. The line pressure solenoid monitors the transmission line pressure and completes the feedback loop to the TCM. The TCM uses this information to adjust its control of the pressure control solenoid to achieve the desired line pressure.

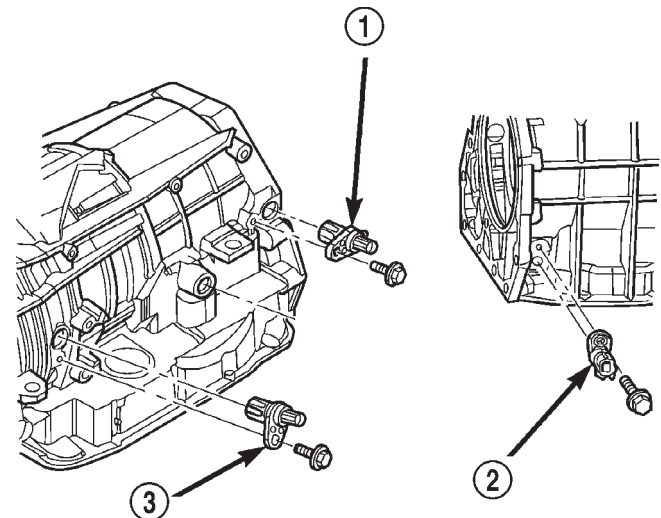
## OPERATION

The TCM calculates the desired line pressure based upon inputs from the transmission and engine. The TCM calculates the torque input to the transmission and uses that information as the primary

input to the calculation. The line pressure is set to a predetermined value during shifts and when the transmission is in the PARK and NEUTRAL positions. This is done to ensure consistent shift quality. During all other operation, the actual line pressure is compared to the desired line pressure and adjustments are made to the pressure control solenoid duty cycle.

## REMOVAL

- (1) Raise vehicle.
- (2) Place a suitable fluid catch pan under the transmission.
- (3) Remove the wiring connector from the line pressure sensor (Fig. 96).
- (4) Remove the bolt holding the line pressure sensor to the transmission case.
- (5) Remove the line pressure sensor from the transmission case.



80c07350

**Fig. 96 Line Pressure Sensor**

- 1 - OUTPUT SPEED SENSOR  
2 - LINE PRESSURE SENSOR  
3 - INPUT SPEED SENSOR

## INSTALLATION

(1) Install the line pressure sensor into the transmission case.

(2) Install the bolt to hold the line pressure sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

(3) Install the wiring connector onto the line pressure sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

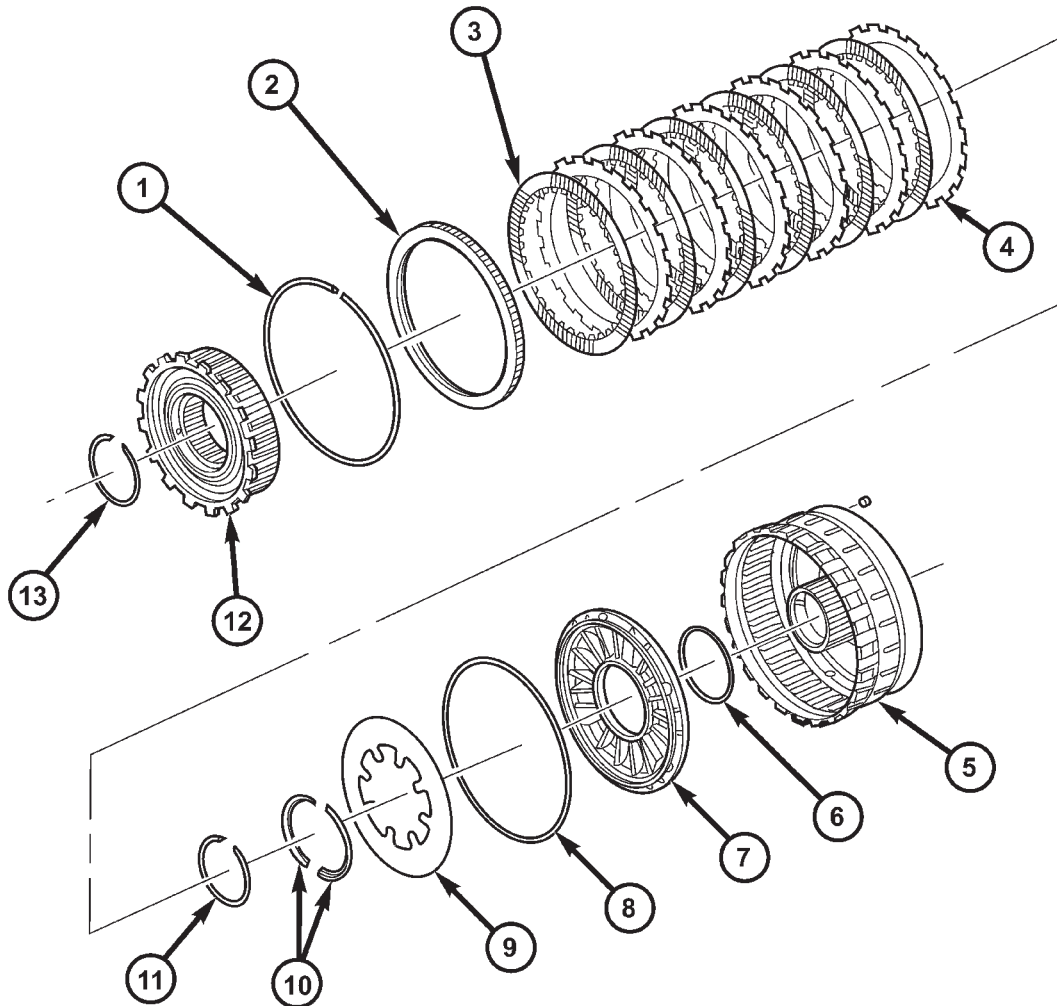
(5) Lower vehicle.

## LOW/REVERSE CLUTCH

### DISASSEMBLY

- (1) Remove the inner overrunning clutch snap-ring from the low/reverse clutch retainer (Fig. 97).
- (2) Remove the outer low/reverse reaction plate flat snap-ring (Fig. 97).
- (3) Remove the low/reverse clutch and the overrunning clutch from the low/reverse clutch retainer as an assembly (Fig. 97).
- (4) Separate the low/reverse clutch from the overrunning clutch.

- (5) Remove the overrunning clutch snap-ring (Fig. 98).
- (6) Remove the spacer from the overrunning clutch (Fig. 98).
- (7) Separate the inner and outer races of the overrunning clutch (Fig. 98).
- (8) Remove the overrunning clutch lower snap-ring (Fig. 98).
- (9) Using Spring Compressor 8285 and a suitable shop press (Fig. 99), compress the low/reverse piston Belleville spring and remove the split retaining ring

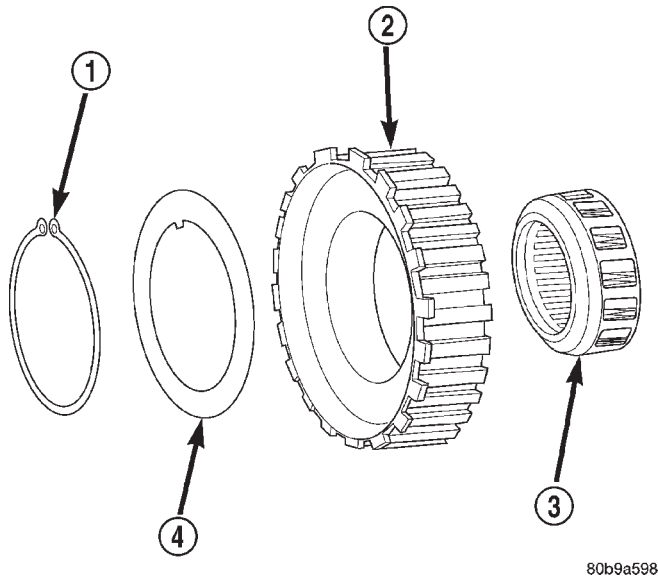


**Fig. 97 Low/Reverse Clutch Assembly**

- |                         |                         |
|-------------------------|-------------------------|
| 1 - SNAP-RING (SELECT)  | 8 - SEAL                |
| 2 - REACTION PLATE      | 9 - BELLEVILLE SPRING   |
| 3 - DISC                | 10 - RETAINER           |
| 4 - PLATE               | 11 - SNAP-RING          |
| 5 - L/R CLUTCH RETAINER | 12 - OVERRUNNING CLUTCH |
| 6 - SEAL                | 13 - SNAP-RING          |
| 7 - PISTON              |                         |



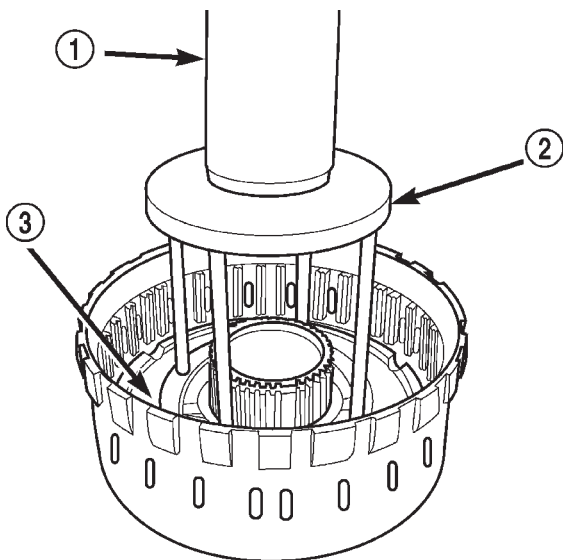
## LOW/REVERSE CLUTCH (Continued)



**Fig. 98 Overrunning Clutch**

- 1 - SNAP-RING
- 2 - OUTER RACE
- 3 - OVERRUNNING CLUTCH
- 4 - SPACER

holding the Belleville spring into the low/reverse clutch retainer.



**Fig. 99 Compress Low/Reverse Belleville Spring Using Tool 8285**

- 1 - PRESS
- 2 - TOOL 8285
- 3 - BELLEVILLE SPRING

(10) Remove the low/reverse clutch Belleville spring and piston from the low/reverse clutch retainer. Use 20 psi of air pressure to remove the piston if necessary.

## CLEANING

Clean the overrunning clutch assembly, clutch cam, and low-reverse clutch retainer. Dry them with compressed air after cleaning.

## INSPECTION

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 clutch retainer if the clutch race, roller surface or inside diameter is scored, worn or damaged.

## ASSEMBLY

(1) Check the bleed orifice to ensure that it is not plugged or restricted.

(2) Install a new seal on the low/reverse piston. Lubricate the seal with Mopar® ATF +4, type 9602, prior to installation.

(3) Install the low/reverse piston into the low/reverse clutch retainer.

(4) Position the low/reverse piston Belleville spring on the low/reverse piston.

(5) Using Spring Compressor 8285 and a suitable shop press (Fig. 99), compress the low/reverse piston Belleville spring and install the split retaining ring to hold the Belleville spring into the low/reverse clutch retainer.

(6) Install the lower overrunning clutch snap-ring (Fig. 98).

(7) Assemble the inner and outer races of the overrunning clutch (Fig. 98).

(8) Position the overrunning clutch spacer on the overrunning clutch.

(9) Install the upper overrunning clutch snap-ring (Fig. 98).

(10) Assemble and install the low/reverse clutch pack into the low/reverse clutch retainer (Fig. 97).

(11) Install the low/reverse reaction plate into the low/reverse clutch retainer (Fig. 97). The reaction plate is directional and must be installed with the flat side down.

(12) Install the low/reverse clutch pack snap-ring (Fig. 97). The snap-ring is selectable and should be chosen to give the correct clutch pack clearance.

(13) Measure the low/reverse clutch pack clearance and adjust as necessary. The correct clutch clearance is 1.00-1.74 mm (0.039-0.075 in.).

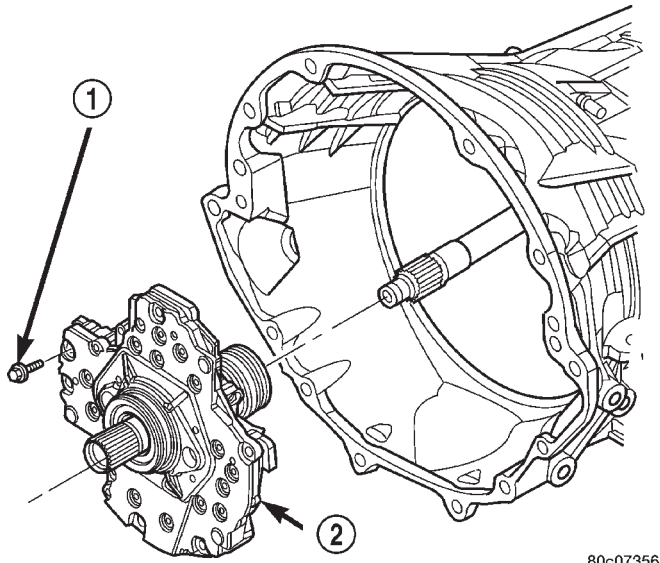
(14) Install the overrunning clutch into the low/reverse clutch retainer making sure that the index splines are aligned with the retainer.

(15) Install the overrunning clutch inner snap-ring.

## OIL PUMP

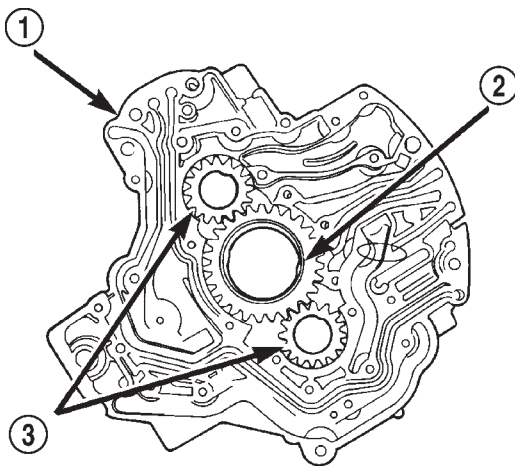
### DESCRIPTION

The oil pump (Fig. 100) is located at the front of the transmission inside the bell housing and behind the transmission front cover. The oil pump consists of two independent pumps (Fig. 101), a number of valves (Fig. 102), a front seal (Fig. 103), and a bolt on reaction shaft. The converter clutch switch and regulator valves, pressure regulator valve, and converter pressure limit valve are all located in the oil pump valve body.



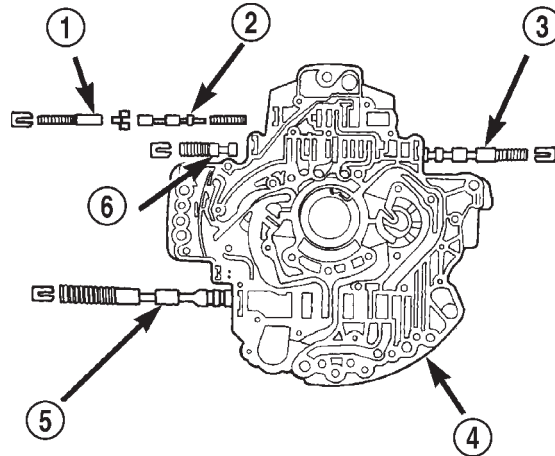
**Fig. 100 Oil Pump**

- 1 - OIL PUMP TO CASE BOLT (6)
- 2 - OIL PUMP



**Fig. 101 Oil Pump Gears**

- 1 - PUMP HOUSING
- 2 - DRIVE GEAR
- 3 - DRIVEN GEARS



80b9a593

**Fig. 102 Oil Pump Valves**

- 1 - TORQUE CONVERTER CLUTCH ACCUMULATOR VALVE
- 2 - TORQUE CONVERTER CLUTCH CONTROL VALVE
- 3 - TORQUE CONVERTER CLUTCH SWITCH VALVE
- 4 - PUMP VALVE BODY
- 5 - PRESSURE REGULATOR VALVE
- 6 - TORQUE CONVERTER CLUTCH LIMIT VALVE

### OPERATION

As the torque converter rotates, the converter hub rotates the oil pump drive gear. As the drive gear rotates both driven gears, a vacuum is created when the gear teeth come out of mesh. This suction draws fluid through the pump inlet from the oil pan. As the gear teeth come back into mesh, pressurized fluid is forced into the pump outlet and to the oil pump valves.

At low speeds, both sides of the pump supply fluid to the transmission. As the speed of the torque converter increases, the flow from both sides increases until the flow from the primary side alone is sufficient to meet system demands. At this point, the check valve located between the two pumps closes. The secondary side is shut down and the primary side supplies all the fluid to the transmission.

### CONVERTER CLUTCH SWITCH VALVE

The converter clutch switch valve is used to control the hydraulic pressure supplied to the front (OFF) side of the torque converter clutch.

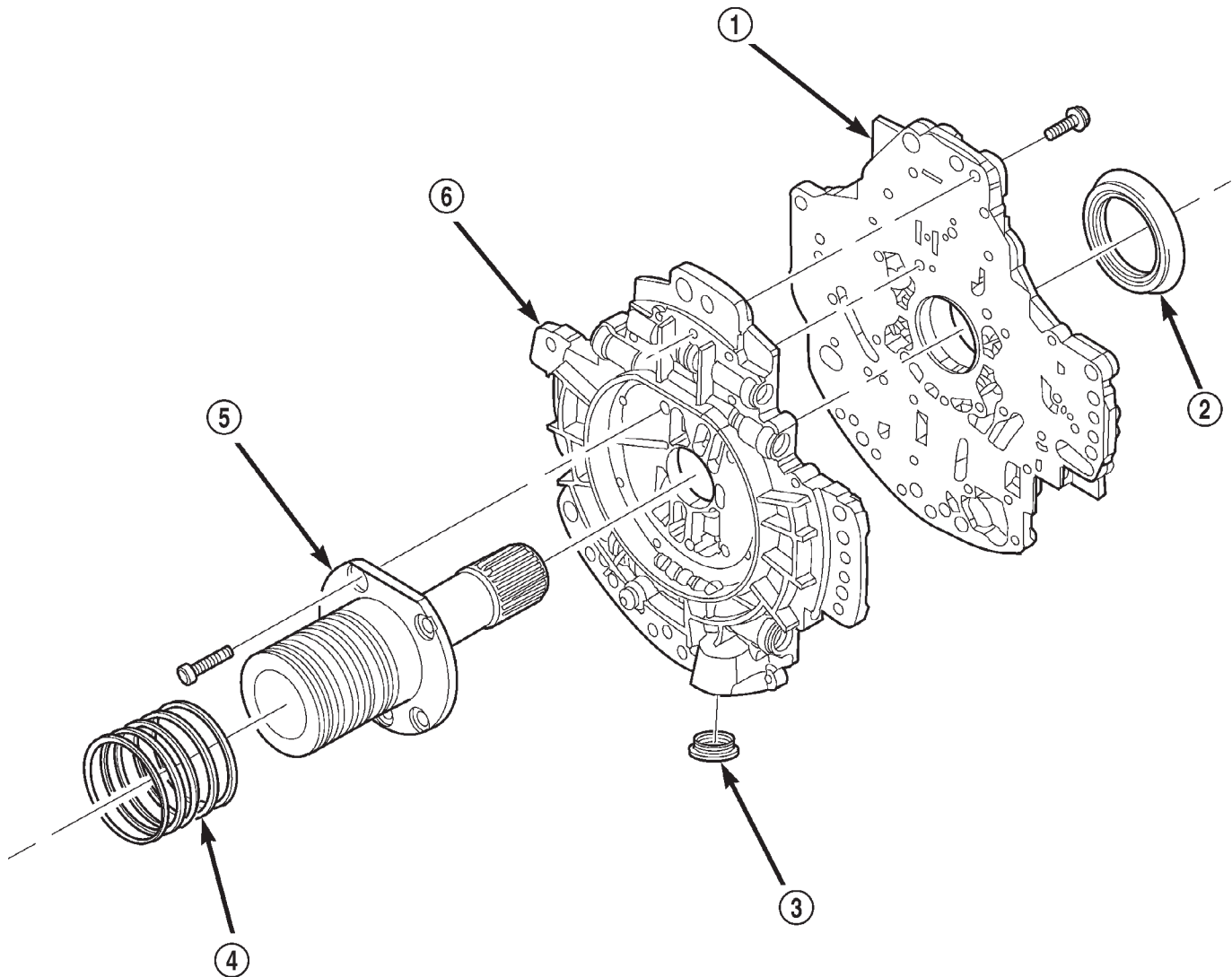
### CONVERTER CLUTCH REGULATOR VALVE

The converter clutch regulator valve is used to control the hydraulic pressure supplied to the back (ON) side of the torque converter clutch.

### TORQUE CONVERTER LIMIT VALVE

The torque converter limit valve serves to limit the available line pressure to the torque converter clutch to approximately 120 psi.

## OIL PUMP (Continued)



**Fig. 103 Oil Pump Reaction Shaft**

80c07011

1 - PUMP HOUSING  
2 - SEAL  
3 - OIL FILTER SEAL

4 - SEAL RING (5)  
5 - REACTION SHAFT SUPPORT  
6 - PUMP VALVE BODY

## STANDARD PROCEDURE - OIL PUMP VOLUME CHECK

Measuring the oil pump output volume will determine if sufficient oil flow to the transmission oil cooler exists, and whether or not an internal transmission failure is present.

Verify that the transmission fluid is at the proper level. Refer to the Fluid Level Check procedure in this section. If necessary, fill the transmission to the proper level with Mopar® ATF +4, type 9602, Automatic Transmission Fluid.

(1) Disconnect the **To cooler** line at the cooler inlet 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.

(2) Run the engine at **1800 rpm**, with the shift selector in neutral. Verify that the transmission fluid temperature is below 104.5° C (220° F) for this test.

(3) If one quart of transmission fluid is collected in the container in 30 seconds or less, oil pump flow volume is within acceptable limits. If fluid flow is intermittent, or it takes more than 30 seconds to collect one quart of fluid, refer to the Hydraulic Pressure tests in this section for further diagnosis.

(4) Re-connect the **To cooler** line to the transmission cooler inlet.

(5) Refill the transmission to proper level.

## OIL PUMP (Continued)

**DISASSEMBLY**

(1) Remove the bolts holding the reaction shaft support to the oil pump (Fig. 104).

(2) Remove the reaction shaft support from the oil pump (Fig. 104).

(3) Remove all bolts holding the oil pump halves together (Fig. 104).

(4) Using suitable prying tools, separate the oil pump sections by inserting the tools in the supplied areas and prying the halves apart.

**NOTE:** The oil pump halves are aligned to each other through the use of two dowels. Be sure to pry upward evenly to prevent damage to the oil pump components.

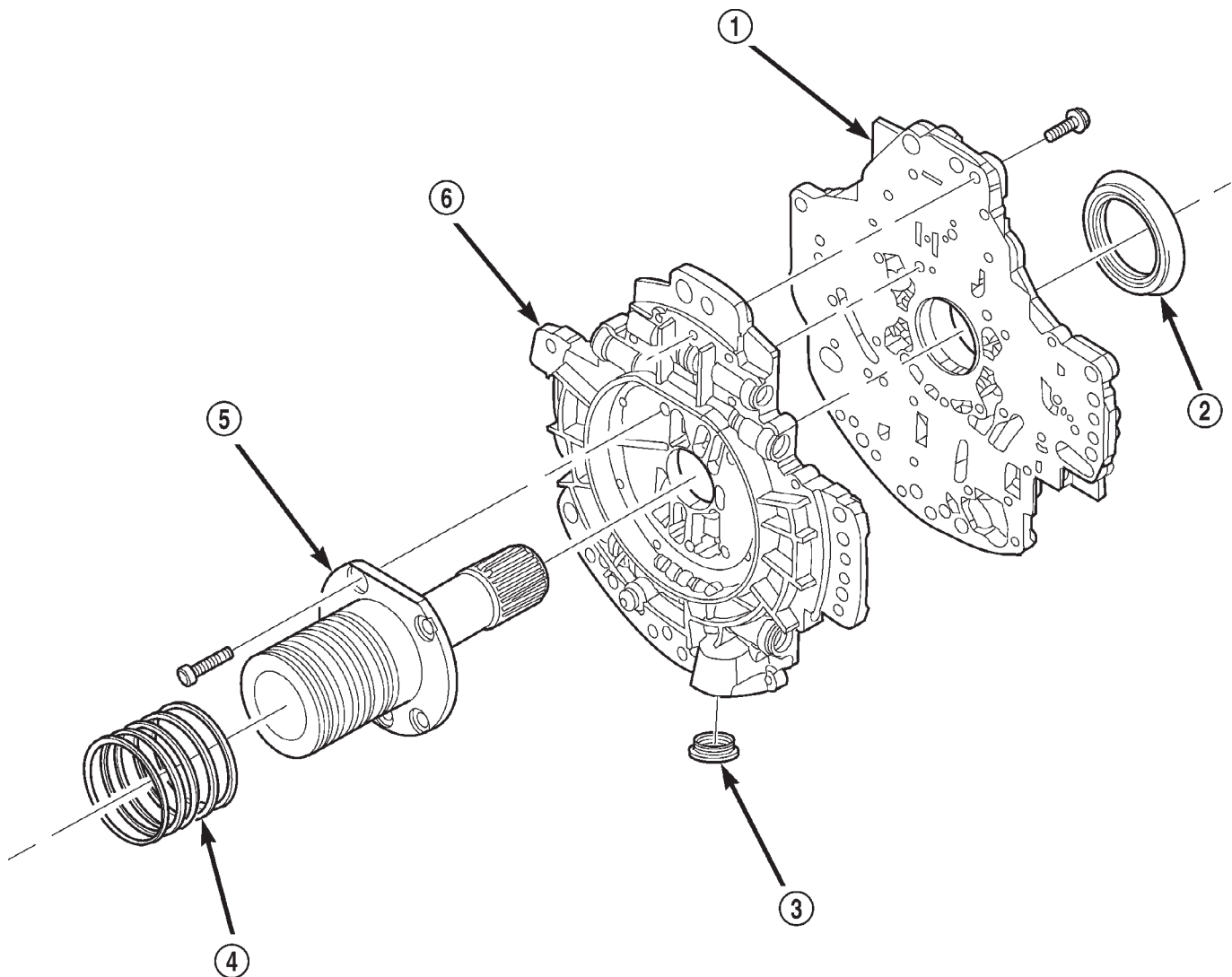
(5) Remove the screws holding the separator plate onto the oil pump body (Fig. 105).

(6) Remove the separator plate from the oil pump body (Fig. 105).

(7) Mark all gears for location. The gears are select fit and if the oil pump is to be reused, the gears must be returned to their original locations.

(8) Remove the oil pump gears from the oil pump case (Fig. 105).

(9) Remove the oil pump valve retainers and associated valve and spring one at a time (Fig. 106) (Fig. 107). Mark the combination of components as a group and tag them as to the location from which they were removed.



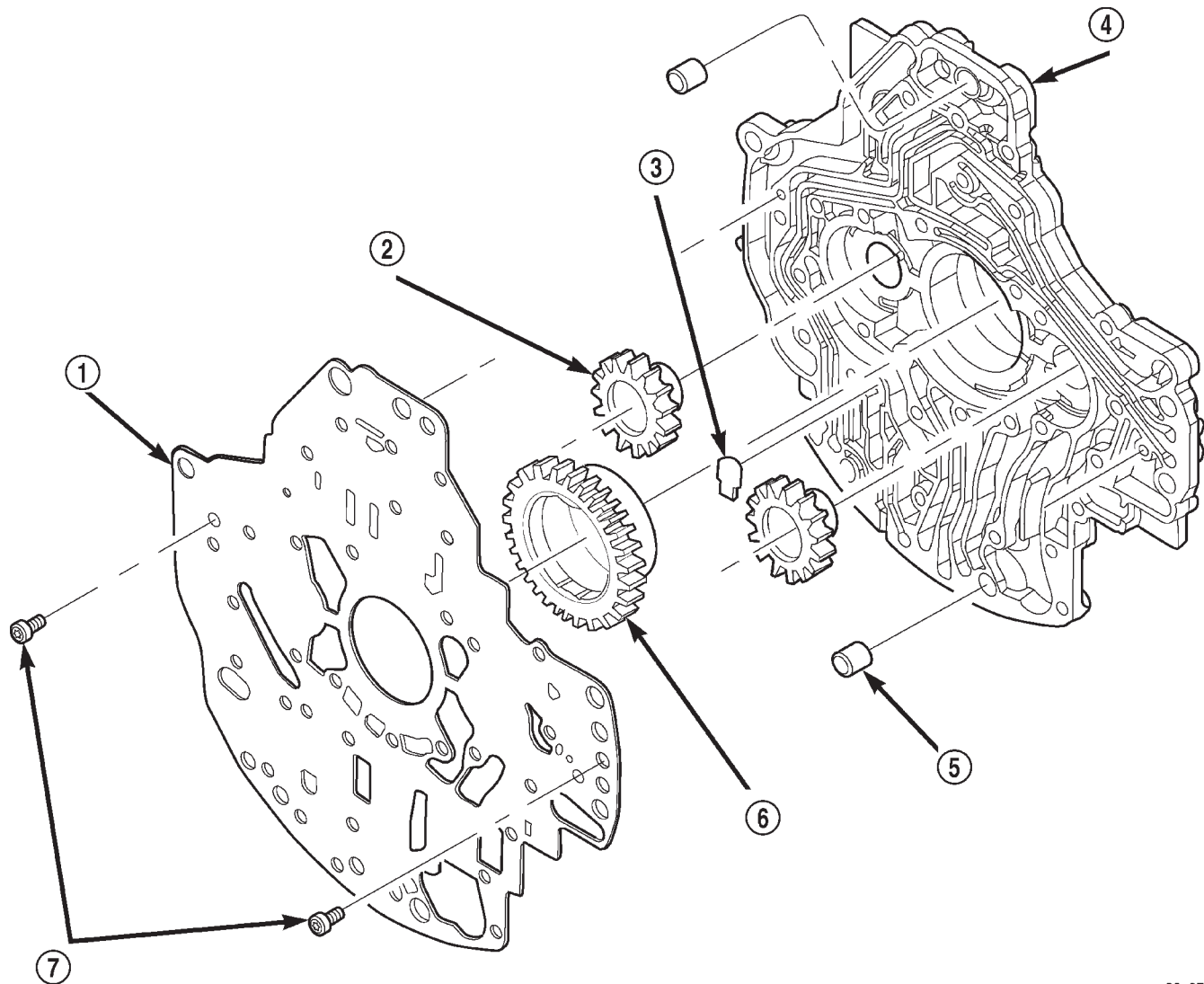
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**Fig. 104 Oil Pump Assembly**

1 - PUMP HOUSING  
2 - SEAL  
3 - OIL FILTER SEAL

4 - SEAL RING (5)  
5 - REACTION SHAFT SUPPORT  
6 - PUMP VALVE BODY

## OIL PUMP (Continued)



80c07012

**Fig. 105 Oil Pump Housing and Gears**

- 1 - SEPARATOR PLATE
- 2 - DRIVEN GEAR (2)
- 3 - CHECK VALVE
- 4 - PUMP HOUSING

- 5 - DOWEL (2)
- 6 - DRIVE GEAR
- 7 - SCREW

**CLEANING**

Clean pump and support components with solvent and dry them with compressed air.

**INSPECTION**

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.

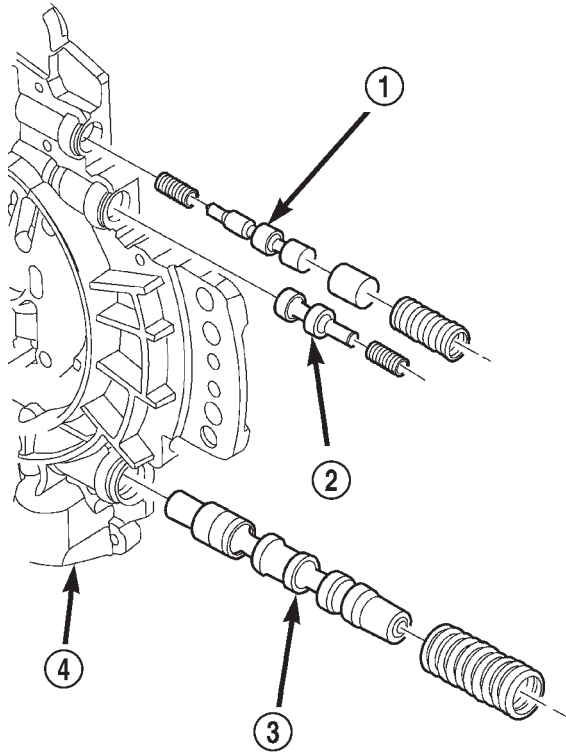
Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

Inspect the pump reaction shaft support bushings. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

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 oil pump cover. Use a penlight to view the bore interi-

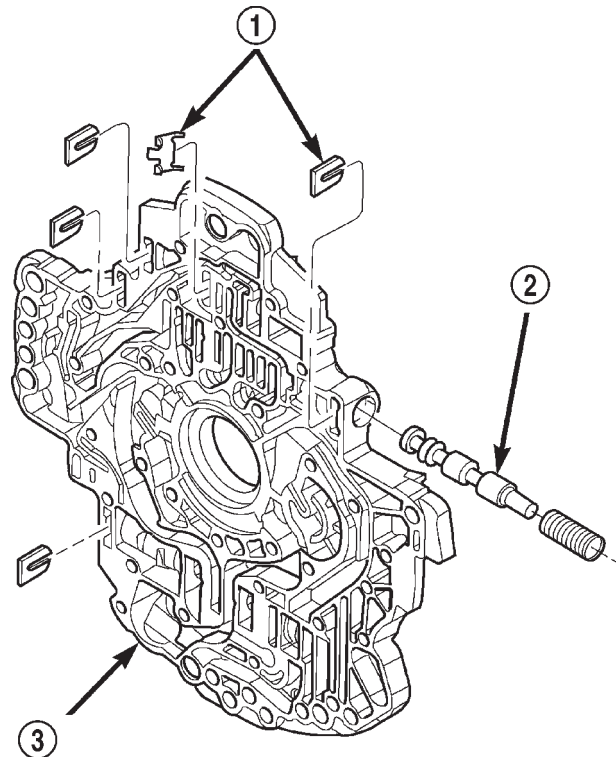
## OIL PUMP (Continued)



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**Fig. 106 Oil Pump Valve Body**

- 1 - T/C REGULATOR VALVE
- 2 - T/C LIMIT VALVE
- 3 - REGULATOR VALVE
- 4 - OIL PUMP VALVE BODY



80c07421

**Fig. 107 T/C Switch Valve**

- 1 - RETAINER
- 2 - T/C SWITCH VALVE
- 3 - OIL PUMP VALVE BODY

ors. Replace the oil pump if any bores are distorted or scored. Inspect all of the valve springs. The springs must be free of distortion, warpage or broken coils.

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.

**ASSEMBLY**

(1) Clean and inspect all components. Make sure that all passages are thoroughly cleaned and are free from dirt or debris. Make sure that all valves move freely in their proper bore. Make sure that all gear pockets and bushings are free from excessive wear and scoring. Replace the oil pump if any excessive wear or scoring is found.

(2) Coat the gears with Mopar® ATF +4, type 9602, and install into their original locations.

(3) Lubricate the oil pump valves with Mopar® ATF +4, type 9602, and install the valve, spring and retainer into the appropriate oil pump valve body bore (Fig. 106) (Fig. 107).

(4) Place the separator plate onto the oil pump body (Fig. 105).

(5) Install the screws to hold the separator plate onto the oil pump body (Fig. 105). Tighten the screws to 4.5 N·m (40 in.lbs.).

(6) Position the oil pump cover onto the locating dowels (Fig. 104).

(7) Seat the two oil pump halves together and install all bolts finger tight.

(8) Torque all bolts down slowly starting in the center and working outward. The correct torque is 4.5 N·m (40 in.lbs.).

(9) Verify that the oil pump gears rotate freely and smoothly.

(10) Position the reaction shaft support into the oil pump (Fig. 104).

(11) Install and torque the bolts to hold the reaction shaft support to the oil pump (Fig. 104). The correct torque is 12 N·m (105 in.lbs.).

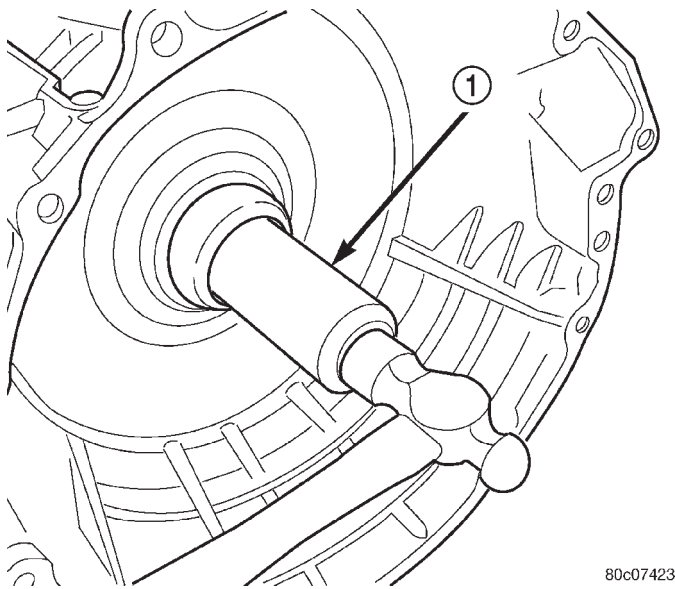
## OIL PUMP FRONT SEAL

### REMOVAL

- (1) Remove transmission from the vehicle.
- (2) Remove the torque converter from the transmission.
- (3) Using a screw mounted in a slide hammer, remove the oil pump front seal.

### INSTALLATION

- (1) Clean seal bore of the oil pump of any residue or particles from the original seal.
- (2) Install new oil seal in the oil pump housing using Seal Installer C-3860-A (Fig. 108).



**Fig. 108 Install Oil Pump Front Seal**

1 - TOOL C-3860-A

## OUTPUT SPEED SENSOR

### DESCRIPTION

The Input and Output Speed Sensors are two-wire magnetic pickup devices that generate AC signals as rotation occurs. They are mounted in the left side of the transmission case and are considered primary inputs to the Transmission Control Module (TCM).

### OPERATION

The Input Speed Sensor provides information on how fast the input shaft is rotating. As the teeth of the input clutch hub pass by the sensor coil, an AC voltage is generated and sent to the TCM. The TCM interprets this information as input shaft rpm.

The Output Speed Sensor generates an AC signal in a similar fashion, though its coil is excited by rotation of the rear planetary carrier lugs. The TCM interprets this information as output shaft rpm.

The TCM compares the input and output speed signals to determine the following:

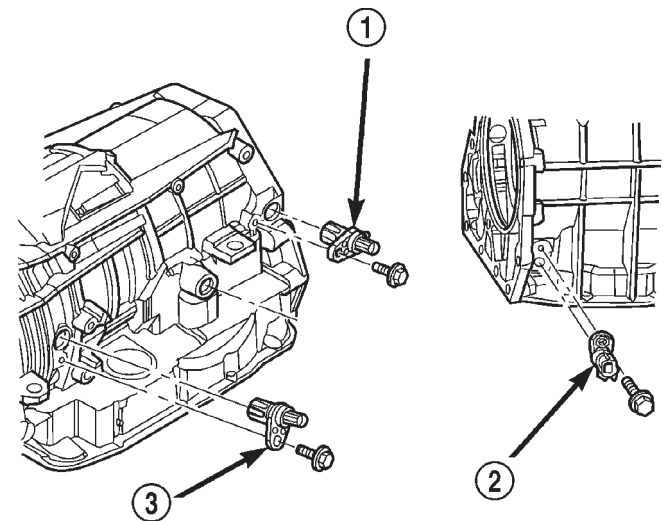
- Transmission gear ratio
- Speed ratio error detection
- CVI calculation

The TCM also compares the input speed signal and the engine speed signal to determine the following:

- Torque converter clutch slippage
- Torque converter element speed ratio

### REMOVAL

- (1) Raise vehicle.
- (2) Place a suitable fluid catch pan under the transmission.
- (3) Remove the wiring connector from the output speed sensor (Fig. 109).
- (4) Remove the bolt holding the output speed sensor to the transmission case.
- (5) Remove the output speed sensor from the transmission case.



**Fig. 109 Output Speed Sensor**

- 1 - OUTPUT SPEED SENSOR
- 2 - LINE PRESSURE SENSOR
- 3 - INPUT SPEED SENSOR

### INSTALLATION

- (1) Install the output speed sensor into the transmission case.
- (2) Install the bolt to hold the output speed sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).
- (3) Install the wiring connector onto the output speed sensor
- (4) Verify the transmission fluid level. Add fluid as necessary.
- (5) Lower vehicle.

## OVERDRIVE SWITCH

### DESCRIPTION

The overdrive OFF (control) switch is located in the shifter handle. The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

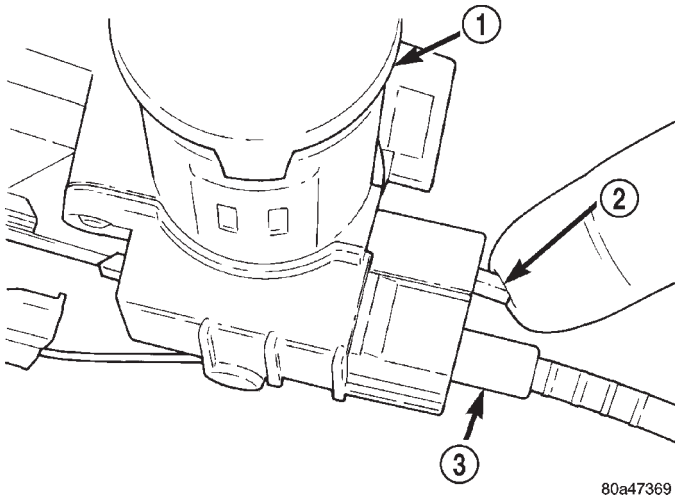
### OPERATION

At key-on, fourth gear 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 solenoids and allow upshifts to fourth gear. 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.

## PARK - INTERLOCK CABLE

### REMOVAL

- (1) Lower the steering column.
- (2) With the ignition switch in the "RUN" position depress the park-interlock cable locking tab, located on top of the cable connector (Fig. 110) at the steering column and pull the cable straight out.



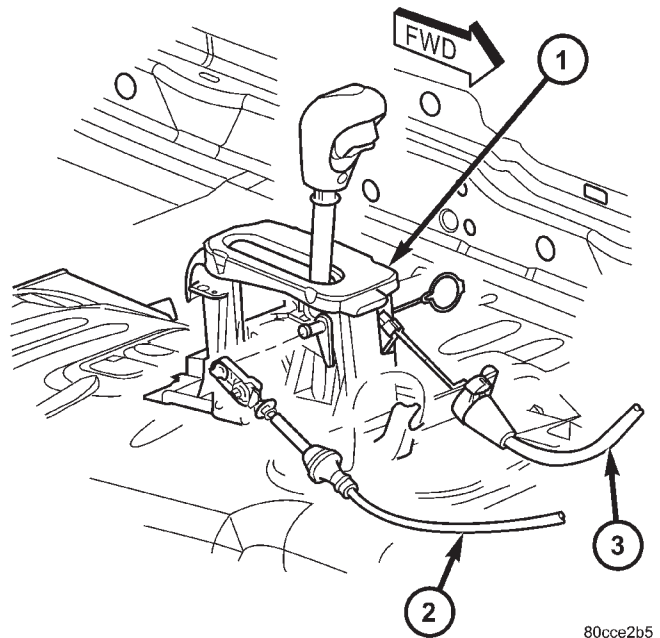
**Fig. 110 Park-Interlock Cable**

- 1 - IGNITION LOCK
- 2 - LOCK TAB
- 3 - CABLE END

(3) Remove the park-interlock cable from steering column.

(4) Remove the floor console and related trim. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(5) Disconnect the park-interlock cable from the shift lever assembly and remove the cable from the shifter assembly bracket (Fig. 111).



**Fig. 111 Shift Cables At Shifter**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE

(6) Release the park-interlock cable from any remaining clips.

(7) Remove park-interlock cable from the vehicle.

### INSTALLATION

**NOTE:** The gearshift cable must be secured into position and properly adjusted before the installation of the Park-Interlock Cable.

(1) Push the park-interlock cable straight into the square mounting hole in the steering column until cable snaps in place (Fig. 112).

(2) Snap park-interlock cable tie strap into hole in steering column tube.

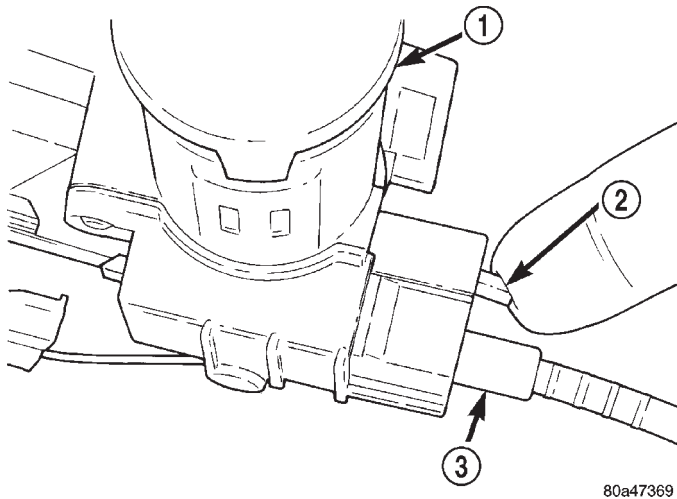
(3) Route cable to the shifter mechanism.

(4) Install the cable end fitting into shifter lever (Fig. 113).

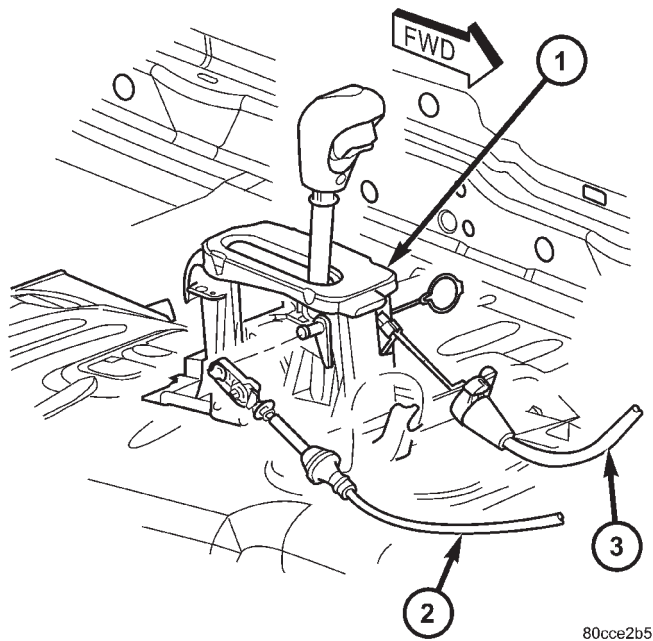
(5) Snap cable adjuster ears into floor shifter bracket.



## PARK - INTERLOCK CABLE (Continued)

**Fig. 112 Brake/Park Interlock Cable**

- 1 - IGNITION LOCK
- 2 - LOCK TAB
- 3 - CABLE END

**Fig. 113 Transmission Shift Cable At Shifter**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE

(6) Place the ignition key cylinder in the LOCK position.

(7) Push the cable adjuster lock clamp downward to lock it.

(8) Test the park-interlock cable operation.

(9) Install the floor console and related trim. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

**ADJUSTMENTS - PARK-INTERLOCK CABLE**

The park-interlock cable is part of the Brake Transmission Shift Interlock (BTSI) system. Correct cable adjustment is important to proper interlock operation. The gear shift and park lock cables must both be correctly adjusted in order to shift out of PARK.

(1) Remove floor console as necessary for access to the park-interlock cable. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(2) Shift the transmission into the PARK position.

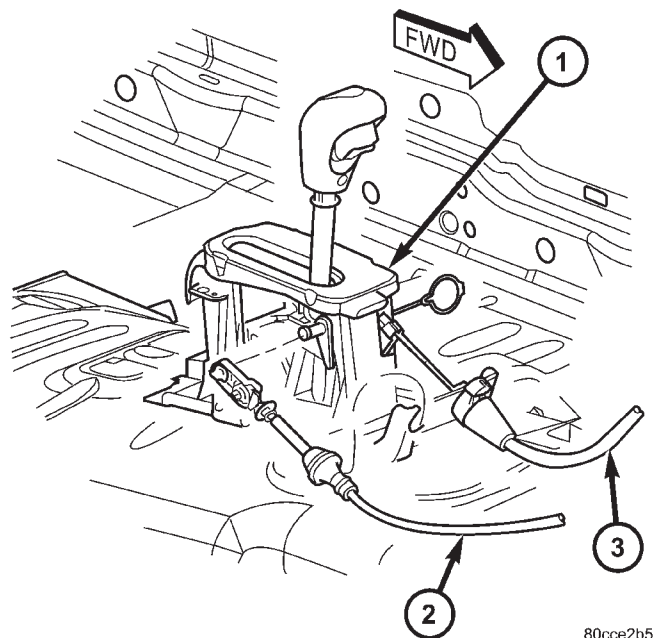
(3) Turn ignition switch to LOCK position. **Be sure ignition key cylinder is in the LOCK position. Cable will not adjust correctly in any other position.**

(4) Pull cable lock button up to release cable (Fig. 114).

(5) Ensure that the cable is free to self-adjust by pushing cable rearward and releasing.

(6) Push lock button down until it snaps in place.

(7) Verify proper operation. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/545RFE/SHIFT INTERLOCK SYSTEM - DIAGNOSIS AND TESTING)

**Fig. 114 Shift Cables At Shifter**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE

# PISTONS

## DESCRIPTION

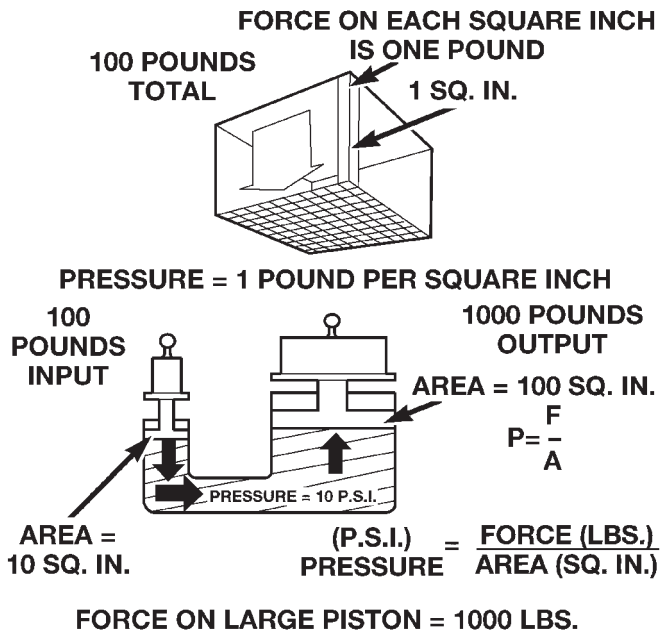
There are several sizes and types of pistons used in an automatic transmission. Some pistons are used to apply clutches. They all have in common the fact that they are round or circular in shape, located within a smooth walled cylinder, which is closed at one end and converts fluid pressure into mechanical movement. The fluid pressure exerted on the piston is contained within the system through the use of piston rings or seals.

## OPERATION

The principal which makes this operation possible is known as Pascal's Law. Pascal's Law can be stated as: "Pressure on a confined fluid is transmitted equally in all directions and acts with equal force on equal areas."

## PRESSURE

Pressure (Fig. 115) is nothing more than force (lbs.) divided by area (in or ft.), or force per unit area. Given a 100 lb. block and an area of 100 sq. in. on the floor, the pressure exerted by the block is: 100 lbs. 100 in or 1 pound per square inch, or PSI as it is commonly referred to.

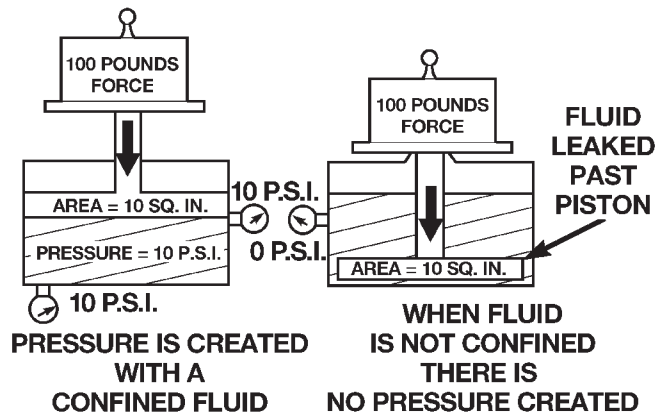


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Fig. 115 Force and Pressure Relationship

## PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 116) by applying a force to some given area in contact with the fluid. A good example of this is a cylinder filled with fluid and equipped with a piston that is closely fitted to the cylinder wall. If a force is applied to the piston, pressure will be developed in the fluid. Of course, no pressure will be created if the fluid is not confined. It will simply "leak" past the piston. There must be a resistance to flow in order to create pressure. Piston sealing is extremely important in hydraulic operation. Several kinds of seals are used to accomplish this within a transmission. These include but are not limited to O-rings, D-rings, lip seals, sealing rings, or extremely close tolerances between the piston and the cylinder wall. The force exerted is downward (gravity), however, the principle remains the same no matter which direction is taken. The pressure created in the fluid is equal to the force applied, divided by the piston area. If the force is 100 lbs., and the piston area is 10 sq. in., then the pressure created equals 10 PSI. Another interpretation of Pascal's Law is that regardless of container shape or size, the pressure will be maintained throughout, as long as the fluid is confined. In other words, the pressure in the fluid is the same everywhere within the container.



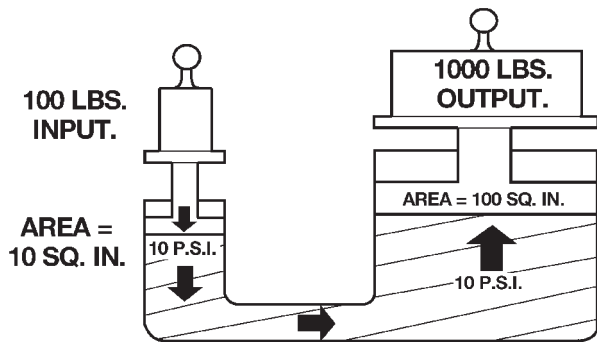
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Fig. 116 Pressure on a Confined Fluid

PISTONS (Continued)

**FORCE MULTIPLICATION**

Using the 10 PSI example used in the illustration (Fig. 117), a force of 1000 lbs. can be moved with a force of only 100 lbs. The secret of force multiplication in hydraulic systems is the total fluid contact area employed. The illustration, (Fig. 117), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept "pressure is the same everywhere" means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

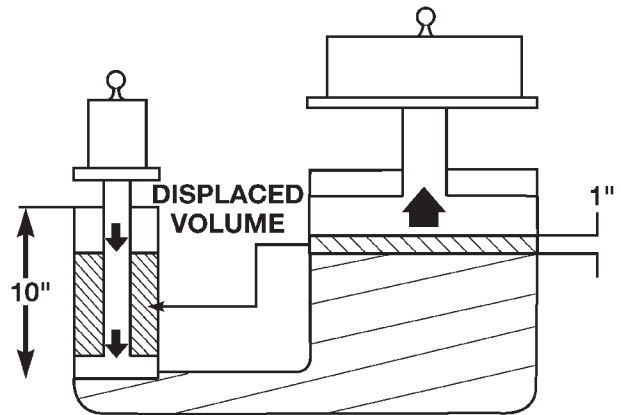


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**Fig. 117 Force Multiplication**

**PISTON TRAVEL**

The relationship between hydraulic lever and a mechanical lever is the same. With a mechanical lever it's a weight-to-distance output rather than a pressure-to-area output. Using the same forces and areas as in the previous example, the smaller piston (Fig. 118) has to move ten times the distance required to move the larger piston one inch. Therefore, for every inch the larger piston moves, the smaller piston moves ten inches. This principle is true in other instances also. A common garage floor jack is a good example. To raise a car weighing 2000 lbs., an effort of only 100 lbs. may be required. For every inch the car moves upward, the input piston at the jack handle must move 20 inches downward.



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**Fig. 118 Piston Travel**

## PLANETARY GEARTRAIN

### DESCRIPTION

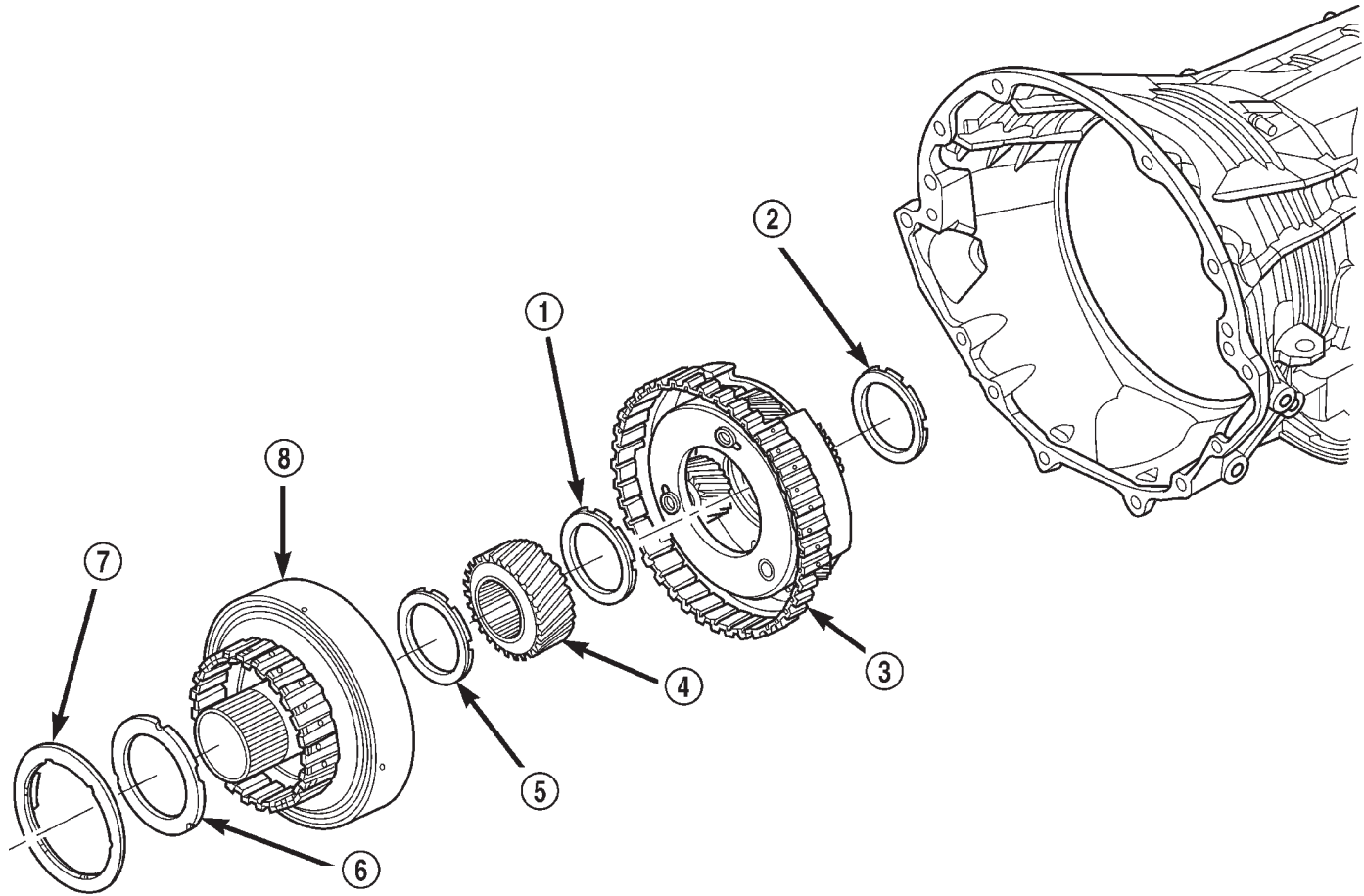
The planetary geartrain is located behind the 4C retainer/bulkhead, toward the rear of the transmission. The planetary geartrain consists of three primary assemblies:

- Reaction (Fig. 119).
- Reverse (Fig. 120).
- Input (Fig. 120).

## OPERATION

### REACTION PLANETARY GEARTRAIN

The reaction planetary carrier and reverse sun gear of the reaction planetary geartrain are a single component which is held by the 2C clutch when required. The reaction annulus gear is a stand alone component that can be driven by the reverse clutch or held by the 4C clutch. The reaction sun gear is driven by the overdrive clutch.



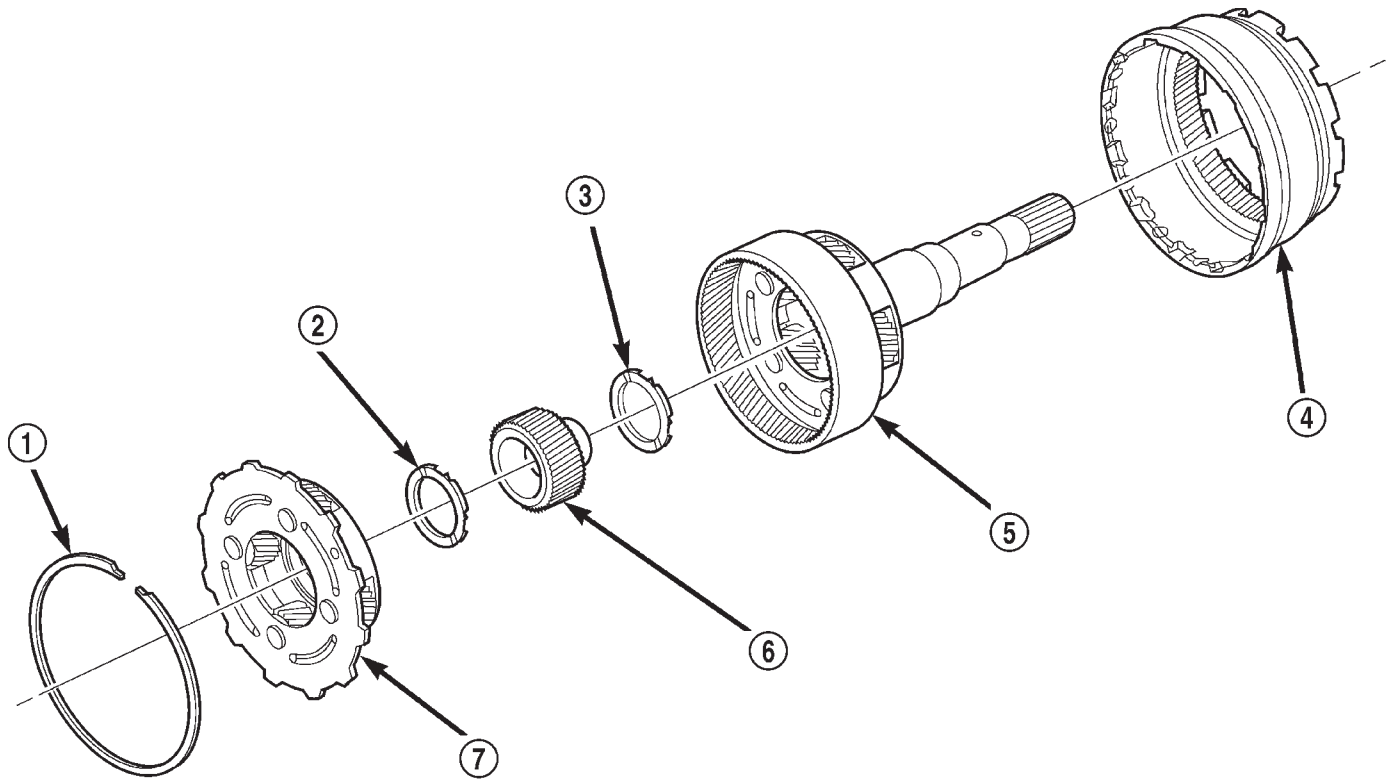
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**Fig. 119 Reaction Planetary Geartrain**

- 1 - BEARING NUMBER 8
- 2 - BEARING NUMBER 9
- 3 - REACTION PLANETARY CARRIER
- 4 - REACTION SUN GEAR

- 5 - BEARING NUMBER 7
- 6 - THRUST PLATE (SELECT)
- 7 - BEARING NUMBER 6
- 8 - REACTION ANNULUS

## PLANETARY GEARTRAIN (Continued)



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**Fig. 120 Reverse/Input Planetary Geartrain**

- 1 - SNAP-RING
- 2 - BEARING NUMBER 10
- 3 - BEARING NUMBER 11
- 4 - INPUT ANNULUS

- 5 - INPUT PLANETARY CARRIER
- 6 - INPUT SUN GEAR
- 7 - REVERSE PLANETARY CARRIER

### REVERSE PLANETARY GEARTRAIN

The reverse planetary geartrain is the middle of the three planetary sets. The reverse planetary carrier can be driven by the overdrive clutch as required. The reverse planetary carrier is also splined to the input annulus gear, which can be held by the low/reverse clutch. The reverse planetary annulus, input planetary carrier, and output shaft are all one piece.

PLANETARY GEARTRAIN (Continued)

**INPUT PLANETARY GEARTRAIN**

The input sun gear of the input planetary geartrain is driven by the underdrive clutch.

**DISASSEMBLY**

- (1) Remove the snap-ring holding the input annulus into the input carrier (Fig. 121).
- (2) Remove the input annulus from the input carrier (Fig. 121).
- (3) Remove the number 9 bearing from the reverse planetary carrier. Note that this planetary carrier has four pinion gears.
- (4) Remove the reverse planetary gear carrier (Fig. 121).
- (5) Remove the number 10 bearing from the input sun gear (Fig. 121).
- (6) Remove the input sun gear from the input carrier (Fig. 121).
- (7) Remove the number 11 bearing from the input carrier (Fig. 121).

**CLEANING**

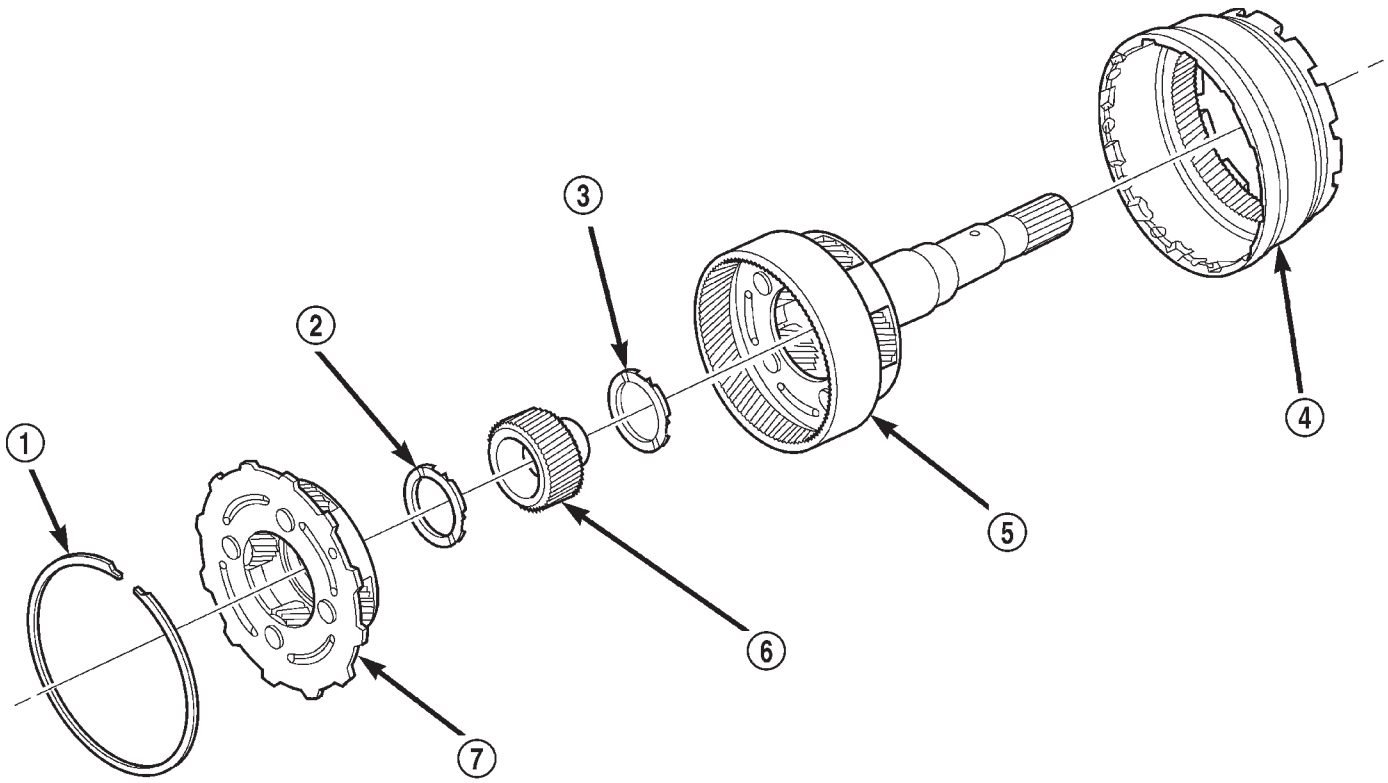
Clean the planetary components in solvent and dry them with compressed air.

**INSPECTION**

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.

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.



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**Fig. 121 Reverse/Input Planetary Carrier Assembly**

- |                       |                               |
|-----------------------|-------------------------------|
| 1 - SNAP-RING         | 5 - INPUT PLANETARY CARRIER   |
| 2 - BEARING NUMBER 10 | 6 - INPUT SUN GEAR            |
| 3 - BEARING NUMBER 11 | 7 - REVERSE PLANETARY CARRIER |
| 4 - INPUT ANNULUS     |                               |

## PLANETARY GEARTRAIN (Continued)

**ASSEMBLY**

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install the number 11 bearing into the input planetary carrier so that the inner race will be toward the front of the transmission (Fig. 121).

(3) Install the input sun gear into the input carrier (Fig. 121).

(4) Install the number 10 bearing onto the rear of the reverse planetary carrier with the inner race toward the carrier (Fig. 121).

(5) Install the number 9 bearing onto the front of the reverse planetary carrier with the outer race toward the carrier and the inner race facing upward (Fig. 121).

(6) Install the reverse planetary gear carrier into the input carrier (Fig. 121).

(7) Install the input annulus gear into the input carrier (Fig. 121).

(8) Install the snap-ring to hold the input annulus gear into the input carrier (Fig. 121).

**SHIFT MECHANISM****DESCRIPTION**

The gear shift mechanism provides six shift positions which are:

- Park (P)
- Reverse (R)
- Neutral (N)
- Drive (D)
- Manual second (2)
- Manual low (1)

**OPERATION**

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. No upshift to FOURTH gear will occur if any of the following are true:

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to THIRD is not yet complete.
- Vehicle speed is too low for the 3-4 shift to occur.

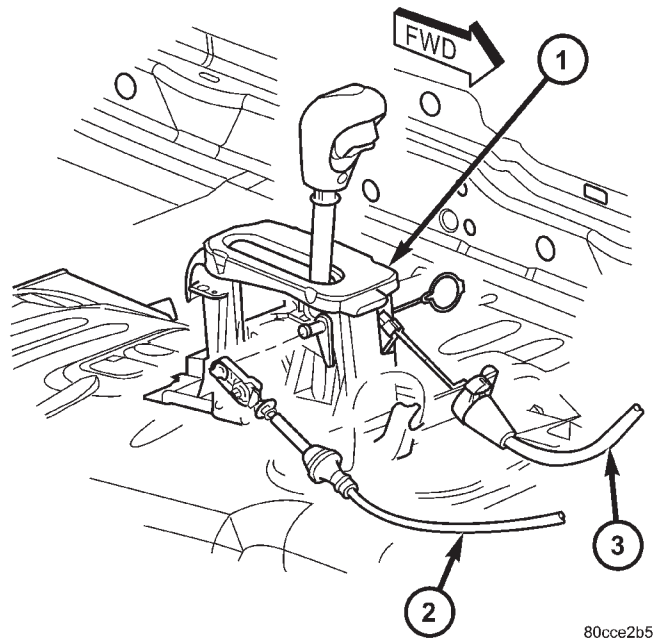
Upshifts into FOURTH will be delayed when the transmission fluid temperature is below 4.5° C (40° F) or above 115.5° C (240° F).

**REMOVAL**

(1) Remove any necessary console parts for access to shift lever assembly and shifter cables. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(2) Shift transmission into PARK.

(3) Disconnect the transmission shift cable at shift lever and shifter assembly bracket (Fig. 122).



**Fig. 122 Shift Cables At Shifter**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - BTSI CABLE

(4) Disconnect the park-interlock cable from the shifter lever and the shifter assembly bracket.

(5) Disengage all wiring connectors from the shifter assembly.

(6) Remove all nuts holding the shifter assembly to the floor pan (Fig. 123).

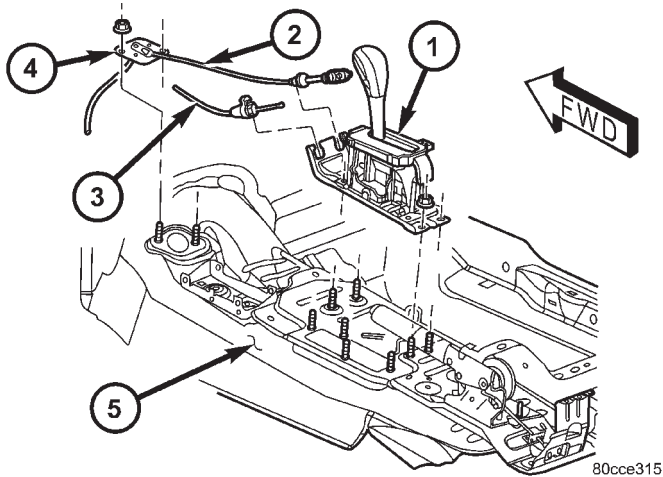
(7) Remove the shifter assembly from the vehicle.

**INSTALLATION**

(1) Install shifter assembly onto the shifter assembly studs on the floor pan.

(2) Install the nuts to hold the shifter assembly onto the floor pan. Tighten nuts to 28 N·m (250 in.lbs.).

## SHIFT MECHANISM (Continued)



**Fig. 123 Transmission Shifter Assembly**

- 1 - SHIFTER ASSEMBLY
- 2 - GEARSHIFT CABLE
- 3 - PARK-INTERLOCK CABLE
- 4 - SHIFT CABLE SEAL PLATE
- 5 - FLOOR PAN

(3) Install wiring harness to the shifter assembly bracket. Engage any wire connectors removed from the shifter assembly.

(4) Install the park-interlock cable into the shifter assembly bracket and into the shifter lever.

(5) Install the shift cable to the shifter assembly bracket. Push cable into the bracket until secure.

(6) Place the floor shifter lever in park position.

(7) Loosen the adjustment screw on the shift cable.

(8) Snap the shift cable onto the shift lever pin.

(9) Verify that the shift lever is in the PARK position.

(10) Tighten the adjustment screw to 7 N·m (65 in.lbs.).

(11) Verify correct shifter operation.

(12) Verify proper BTSI operation. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - DIAGNOSIS AND TESTING) Adjust the park-interlock cable as necessary. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/545RFE/SHIFT INTERLOCK CABLE - ADJUSTMENTS)

(13) Install any console parts removed for access to shift lever assembly and shift cables. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

## SOLENOID SWITCH VALVE

## DESCRIPTION

The Solenoid Switch Valve (SSV) is located in the valve body and controls the direction of the transmission fluid when the L/R-TCC solenoid is energized.

## OPERATION

The Solenoid Switch Valve controls line pressure from the LR-TCC solenoid. In 1st gear, the SSV will be in the downshifted position, thus directing fluid to the L/R clutch circuit. In 2nd, 3rd, and 4th, the solenoid switch valve will be in the upshifted position and directs the fluid into the torque converter clutch (TCC) circuit.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement. If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.

## SOLENOIDS

## DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizeable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.



## SOLENOIDS (Continued)

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

- Increase the amount of current applied to the coil or
- Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

## OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

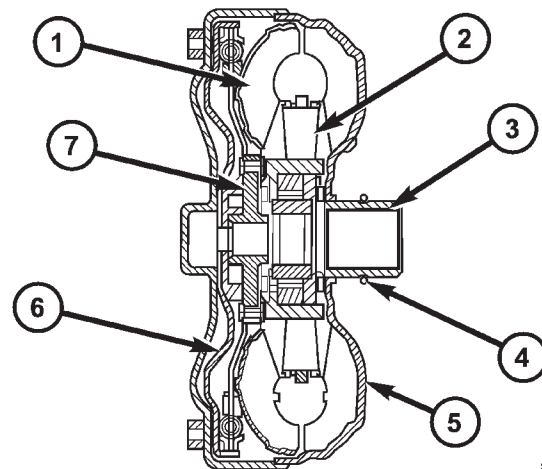
## TORQUE CONVERTER

## DESCRIPTION

The torque converter (Fig. 124) is a hydraulic device that couples the engine crankshaft to the transmission. 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. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The converter clutch engages in third gear. The torque converter hub drives the transmission oil (fluid) pump and contains an o-ring seal to better control oil flow.

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 resulted in large amounts of metal or fiber contamination in the fluid. If the fluid is contaminated, flush the fluid cooler and lines.



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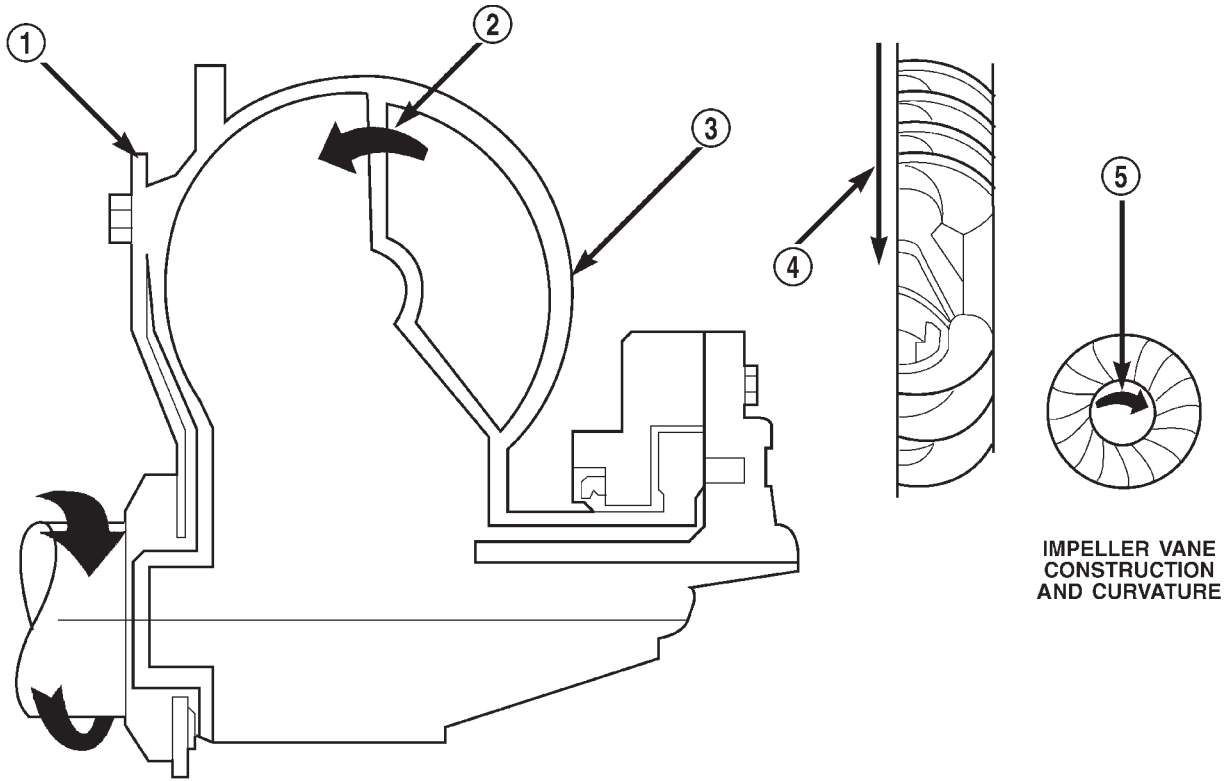
**Fig. 124 Torque Converter Assembly**

- 1 - TURBINE ASSEMBLY
- 2 - STATOR
- 3 - CONVERTER HUB
- 4 - O-RING
- 5 - IMPELLER ASSEMBLY
- 6 - CONVERTER CLUTCH PISTON
- 7 - TURBINE HUB

TORQUE CONVERTER (Continued)

**IMPELLER**

The impeller (Fig. 125) is an integral part of the converter housing. The impeller consists of curved blades placed radially along the inside of the housing on the transmission side of the converter. As the converter housing is rotated by the engine, so is the impeller, because they are one and the same and are the driving members of the system.



**IMPELLER VANE  
CONSTRUCTION  
AND CURVATURE**

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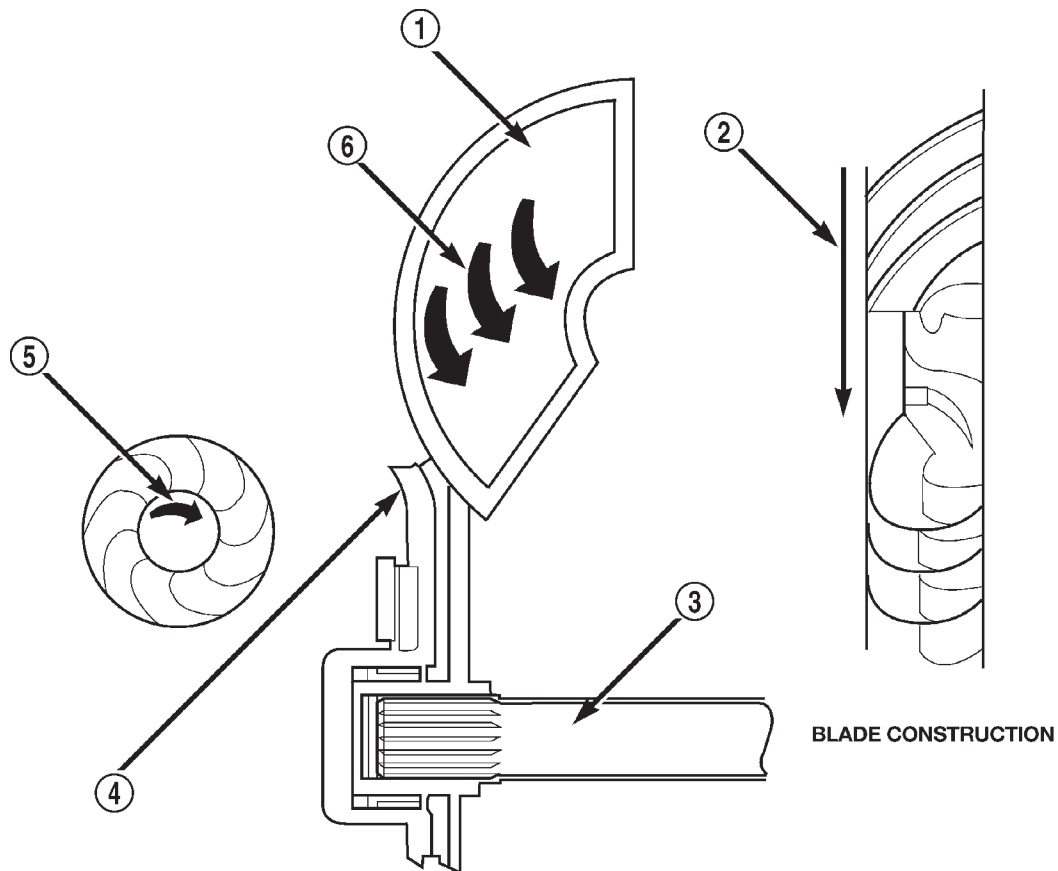
**Fig. 125 Impeller**

- 1 - ENGINE FLEXPLATE
- 2 - OIL FLOW FROM IMPELLER SECTION INTO TURBINE SECTION
- 3 - IMPELLER VANES AND COVER ARE INTEGRAL
- 4 - ENGINE ROTATION
- 5 - IMPELLER VANE CONSTRUCTION AND CURVATURE

## TORQUE CONVERTER (Continued)

**TURBINE**

The turbine (Fig. 126) is the output, or driven, member of the converter. The turbine is mounted within the housing opposite the impeller, but is not attached to the housing. The input shaft is inserted through the center of the impeller and splined into the turbine. The design of the turbine is similar to the impeller, except the blades of the turbine are curved in the opposite direction.



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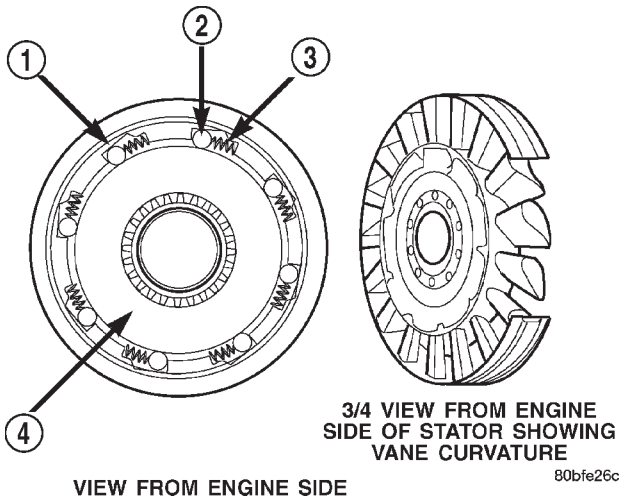
**Fig. 126 Turbine**

- |                     |                                       |
|---------------------|---------------------------------------|
| 1 - TURBINE VANE    | 4 - PORTION OF TORQUE CONVERTER COVER |
| 2 - ENGINE ROTATION | 5 - ENGINE ROTATION                   |
| 3 - INPUT SHAFT     | 6 - OIL FLOW WITHIN TURBINE SECTION   |

TORQUE CONVERTER (Continued)

**STATOR**

The stator assembly (Fig. 127) is mounted on a stationary shaft which is an integral part of the oil pump. The stator is located between the impeller and turbine within the torque converter case (Fig. 128). The stator contains an over-running clutch, which allows the stator to rotate only in a clockwise direction. When the stator is locked against the over-running clutch, the torque multiplication feature of the torque converter is operational.



**Fig. 127 Stator Components**

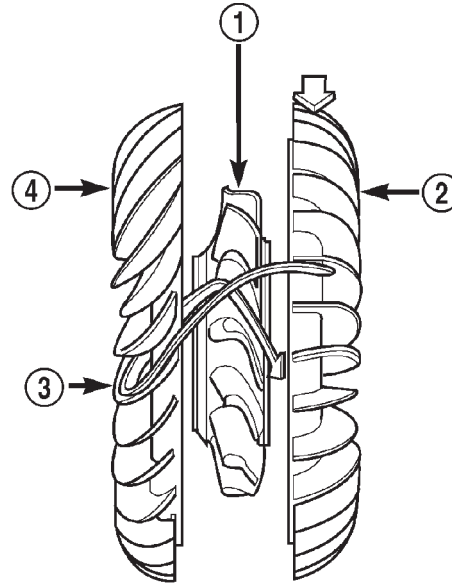
- 1 - CAM (OUTER RACE)
- 2 - ROLLER
- 3 - SPRING
- 4 - INNER RACE

**TORQUE CONVERTER CLUTCH (TCC)**

The TCC (Fig. 129) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock-free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston with friction material was added to the turbine assembly to provide this mechanical lock-up.

In order to reduce heat build-up in the transmission and buffer the powertrain against torsional vibrations, the TCM can duty cycle the L/R-CC Solenoid to achieve a smooth application of the torque converter clutch. This function, referred to as Electronically Modulated Converter Clutch (EMCC) can occur at various times depending on the following variables:

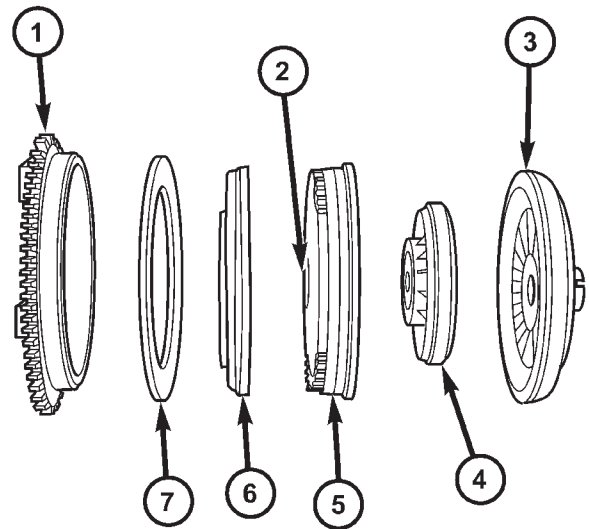
- Shift lever position
- Current gear range
- Transmission fluid temperature
- Engine coolant temperature
- Input speed



**Fig. 128 Stator Location**

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- 1 - STATOR
- 2 - IMPELLER
- 3 - FLUID FLOW
- 4 - TURBINE



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**Fig. 129 Torque Converter Clutch (TCC)**

- 1 - IMPELLER FRONT COVER
- 2 - THRUST WASHER ASSEMBLY
- 3 - IMPELLER
- 4 - STATOR
- 5 - TURBINE
- 6 - PISTON
- 7 - FRICTION DISC

- Throttle angle
- Engine speed

TORQUE CONVERTER (Continued)

**OPERATION**

The converter impeller (Fig. 130) (driving member), which is integral to the converter housing and bolted to the engine drive plate, rotates at engine speed. The converter turbine (driven member), which reacts from fluid pressure generated by the impeller, rotates and turns the transmission input shaft.

**TURBINE**

As the fluid that was put into motion by the impeller blades strikes the blades of the turbine, some of the energy and rotational force is transferred into the turbine and the input shaft. This causes both of them (turbine and input shaft) to rotate in a clockwise direction following the impeller. As the fluid is leaving the trailing edges of the turbine's blades it continues in a "hindering" direction back toward the impeller. If the fluid is not redirected before it strikes the impeller, it will strike the impeller in such a direction that it would tend to slow it down.

**STATOR**

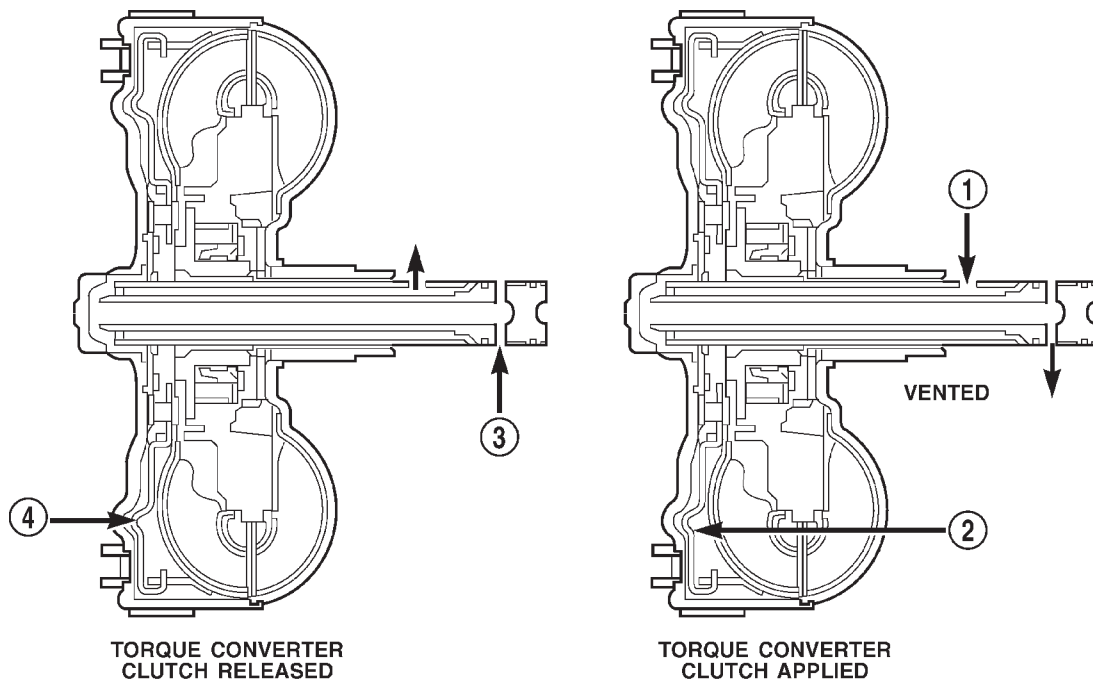
Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 131). Under stall conditions (the turbine is stationary), the oil leaving the turbine blades strikes the face of the stator blades and tries to rotate them in a counter-

clockwise direction. When this happens the over-running clutch of the stator locks and holds the stator from rotating. With the stator locked, the oil strikes the stator blades and is redirected into a "helping" direction before it enters the impeller. This circulation of oil from impeller to turbine, turbine to stator, and stator to impeller, can produce a maximum torque multiplication of about 2.4:1. As the turbine begins to match the speed of the impeller, the fluid that was hitting the stator in such a way as to cause it to lock-up is no longer doing so. In this condition of operation, the stator begins to free wheel and the converter acts as a fluid coupling.

**TORQUE CONVERTER CLUTCH (TCC)**

In a standard torque converter, the impeller and turbine are rotating at about the same speed and the stator is freewheeling, providing no torque multiplication. By applying the turbine's piston and friction material to the front cover, a total converter engagement can be obtained. The result of this engagement is a direct 1:1 mechanical link between the engine and the transmission.

The clutch can be engaged in second, 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. If the control switch is in the

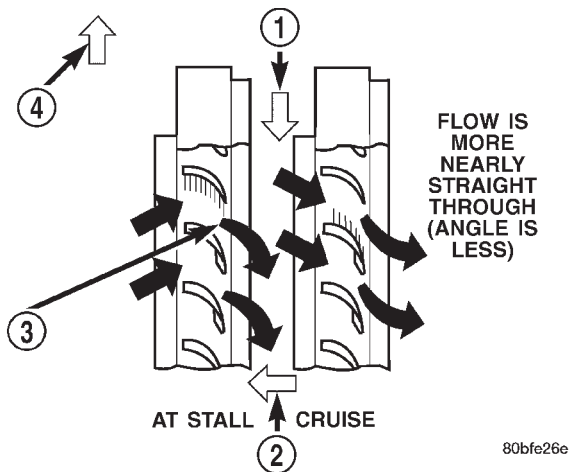


**Fig. 130 Torque Converter Fluid Operation - Typical**

- 1 - APPLY PRESSURE
- 2 - THE PISTON MOVES SLIGHTLY FORWARD

- 3 - RELEASE PRESSURE
- 4 - THE PISTON MOVES SLIGHTLY REARWARD

## TORQUE CONVERTER (Continued)



**Fig. 131 Stator Operation**

- 1 - DIRECTION STATOR WILL FREE WHEEL DUE TO OIL PUSHING ON BACKSIDE OF VANES
- 2 - FRONT OF ENGINE
- 3 - INCREASED ANGLE AS OIL STRIKES VANES
- 4 - DIRECTION STATOR IS LOCKED UP DUE TO OIL PUSHING AGAINST STATOR VANES

OFF position, the clutch will engage after the shift to third gear.

The TCM controls the torque converter by way of internal logic software. The programming of the software provides the TCM with control over the L/R-CC Solenoid. There are four output logic states that can be applied as follows:

- No EMCC
- Partial EMCC
- Full EMCC
- Gradual-to-no EMCC

#### NO EMCC

Under No EMCC conditions, the L/R Solenoid is OFF. There are several conditions that can result in NO EMCC operations. No EMCC can be initiated due to a fault in the transmission or because the TCM does not see the need for EMCC under current driving conditions.

#### PARTIAL EMCC

Partial EMCC operation modulates the L/R Solenoid (duty cycle) to obtain partial torque converter clutch application. Partial EMCC operation is maintained until Full EMCC is called for and actuated. During Partial EMCC some slip does occur. Partial EMCC will usually occur at low speeds, low load and light throttle situations.

#### FULL EMCC

During Full EMCC operation, the TCM increases the L/R Solenoid duty cycle to full ON after Partial EMCC control brings the engine speed within the

desired slip range of transmission input speed relative to engine rpm.

#### GRADUAL-TO-NO EMCC

This operation is to soften the change from Full or Partial EMCC to No EMCC. This is done at mid-throttle by decreasing the L/R Solenoid duty cycle.

#### 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 flats for sharp edges, burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper or crocus cloth if necessary. Verify that the converter hub o-ring is properly installed and is free from debris. The hub must be smooth to avoid damaging the pump seal at installation.

- (1) Lubricate oil pump seal lip with transmission fluid.
- (2) Place torque converter in position on transmission.

**CAUTION:** Do not damage oil pump seal or converter hub o-ring 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. 132). Surface of converter lugs should be at least 13 mm (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.

TORQUE CONVERTER (Continued)

(9) Fill the transmission with the recommended fluid.

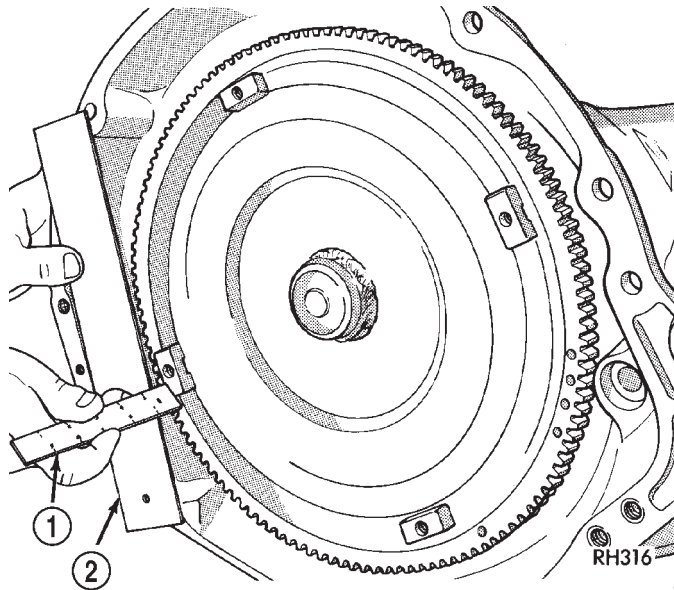


Fig. 132 Checking Torque Converter Seating-Typical

- 1 - SCALE
- 2 - STRAIGHTEDGE

## TRANSMISSION CONTROL RELAY

### DESCRIPTION

The relay is supplied fused B+ voltage, energized by the TCM, and is used to supply power to the solenoid pack when the transmission is in normal operating mode.

### OPERATION

When the relay is “off”, no power is supplied to the solenoid pack and the transmission is in “limp-in” mode. After a controller reset, the TCM energizes the relay. Prior to this, the TCM verifies that the contacts are open by checking for no voltage at the switched battery terminals. After this is verified, the voltage at the solenoid pack pressure switches is checked. After the relay is energized, the TCM monitors the terminals to verify that the voltage is greater than 3 volts.

## TRANSMISSION RANGE SENSOR

### DESCRIPTION

The Transmission Range Sensor (TRS) is part of the solenoid module, which is mounted to the top of the valve body inside the transmission.

The Transmission Range Sensor (TRS) has five switch contact pins that:

- Determine shift lever position
- Supply ground to the Starter Relay in Park and Neutral only.
- Supply +12 V to the backup lamps in Reverse only.

The TRS also has an integrated temperature sensor (thermistor) that communicates transmission temperature to the TCM and PCM.

### OPERATION

The Transmission Range Sensor (TRS) communicates shift lever position to the TCM as a combination of open and closed switches. Each shift lever position has an assigned combination of switch states (open/closed) that the TCM receives from four sense circuits. The TCM interprets this information and determines the appropriate transmission gear position and shift schedule.

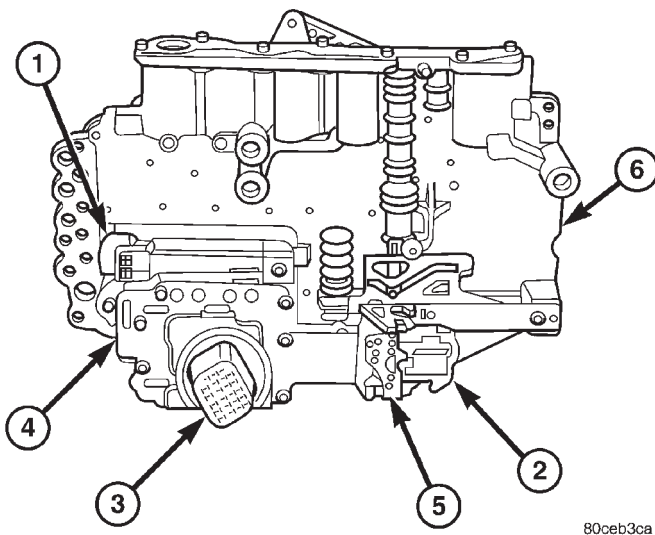
There are many possible combinations of open and closed switches (codes). Seven of these possible codes are related to gear position and five are recognized as “between gear” codes. This results in many codes which should **never occur**. These are called “invalid” codes. An invalid code will result in a DTC, and the TCM will then determine the shift lever position based on pressure switch data. This allows reasonably normal transmission operation with a TRS failure.

GEAR	C5	C4	C3	C2	C1
Park	CL	OP	OP	CL	CL
Temp 1	CL	OP	OP	CL	OP
Reverse	OP	OP	OP	CL	OP
Temp 2	OP	OP	CL	CL	OP
Neutral 1	OP	OP	CL	CL	CL
Neutral 2	OP	CL	CL	CL	CL
Temp 3	OP	CL	CL	CL	OP
Drive	OP	CL	CL	OP	OP
Temp 4	OP	CL	OP	OP	OP
Manual 2	CL	CL	OP	OP	OP
Temp 5	CL	OP	OP	OP	OP
Manual 1	CL	OP	CL	OP	OP

# TRANSMISSION SOLENOID/ TRS ASSEMBLY

## DESCRIPTION

The transmission solenoid/TRS assembly is internal to the transmission and mounted on the valve body assembly (Fig. 133). The assembly consists of six solenoids that control hydraulic pressure to the six friction elements (transmission clutches), and the torque converter clutch. The pressure control solenoid is located on the side of the solenoid/TRS assembly. The solenoid/TRS assembly also contains five pressure switches that feed information to the TCM.



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**Fig. 133 Transmission Solenoid/TRS Assembly**

- 1 - PRESSURE CONTROL SOLENOID
- 2 - TRANSMISSION RANGE SELECTOR PLATE
- 3 - 23-WAY CONNECTOR
- 4 - SOLENOID PACK
- 5 - TRANSMISSION RANGE SENSOR
- 6 - VALVE BODY

## OPERATION

### SOLENOIDS

Solenoids are used to control the L/R, 2C, 4C, OD, and UD friction elements. The reverse clutch is controlled by line pressure and the position of the manual valve in the valve body. All the solenoids are contained within the Solenoid and Pressure Switch Assembly. The solenoid and pressure switch assembly contains one additional solenoid, Multi-Select (MS), which serves primarily to provide 2nd and 3rd gear limp-in operation.

The solenoids receive electrical power from the Transmission Control Relay through a single wire. The TCM energizes or operates the solenoids individually by grounding the return wire of the solenoid as necessary. When a solenoid is energized, the solenoid valve shifts, and a fluid passage is opened or closed (vented or applied), depending on its default operating state. The result is an apply or release of a frictional element.

The MS and UD solenoids are normally applied to allow transmission limp-in in the event of an electrical failure.

The continuity of the solenoids and circuits are periodically tested. Each solenoid is turned on or off depending on its current state. An inductive spike should be detected by the TCM during this test. If no spike is detected, the circuit is tested again to verify the failure. In addition to the periodic testing, the solenoid circuits are tested if a speed ratio or pressure switch error occurs.

### PRESSURE SWITCHES

The TCM relies on five pressure switches to monitor fluid pressure in the L/R, 2C, 4C, UD, and OD hydraulic circuits. The primary purpose of these switches is to help the TCM detect when clutch circuit hydraulic failures occur. The switches close at 23 psi and open at 11 psi, and simply indicate whether or not pressure exists. The switches are continuously monitored by the TCM for the correct states (open or closed) in each gear as shown in the following chart:

GEAR	L/R	2C	4C	UD	OD
R	OP	OP	OP	OP	OP
P/N	CL	OP	OP	OP	OP
1ST	CL*	OP	OP	CL	OP
2ND	OP	CL	OP	CL	OP
2ND PRIME	OP	OP	CL	CL	OP
D	OP	OP	OP	CL	CL
FOURTH	OP	OP	CL	OP	CL

\*L/R is closed if output speed is below 100 rpm in Drive and Manual 2. L/R is open in Manual 1.

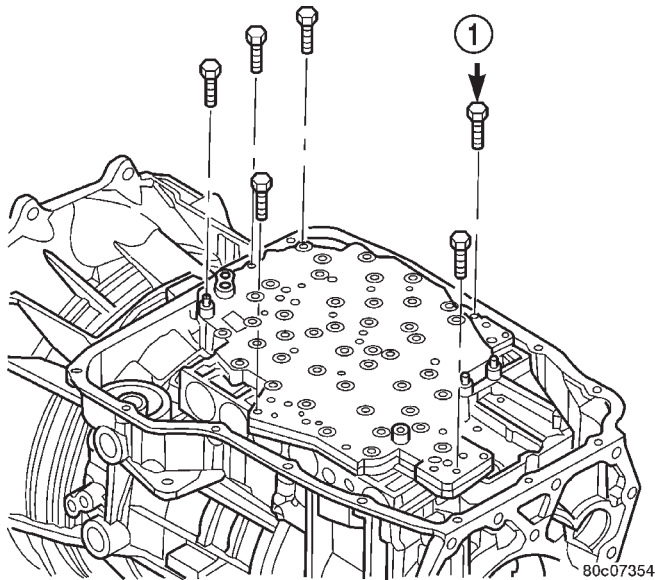
A Diagnostic Trouble Code (DTC) will set if the TCM senses any switch open or closed at the wrong time in a given gear.



## TRANSMISSION SOLENOID/TRS ASSEMBLY (Continued)

**REMOVAL**

(1) Remove the valve body from the transmission (Fig. 134).

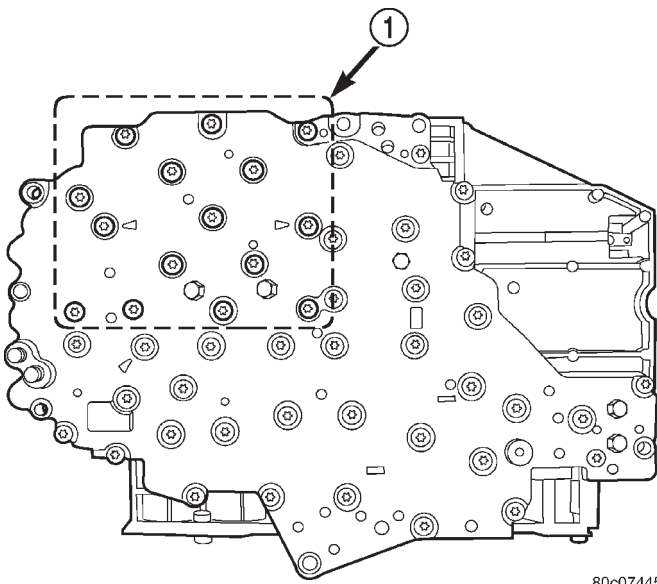


**Fig. 134 Valve Body Bolts**

1 - VALVE BODY TO CASE BOLT (6)

(2) Remove the screws holding the transmission solenoid/TRS assembly onto the valve body (Fig. 135).

(3) Separate the transmission solenoid/TRS assembly from the valve body.



**Fig. 135 Transmission Solenoid/TRS Assembly Screws**

1 - SOLENOID PACK BOLTS (15)

**INSTALLATION**

(1) Place TRS selector plate in the PARK position.  
 (2) Position the transmission solenoid/TRS assembly onto the valve body. Be sure that both alignment dowels are fully seated in the valve body and that the TRS switch contacts are properly positioned in the selector plate

(3) Install the screws to hold the transmission solenoid/TRS assembly onto the valve body.

(4) Tighten the solenoid assembly screws adjacent to the arrows cast into the bottom of the valve body first. Tighten the screws to 5.7 N·m (50 in.lbs.).

(5) Tighten the remainder of the solenoid assembly screws to 5.7 N·m (50 in.lbs.).

(6) Install the valve body into the transmission.

**TRANSMISSION TEMPERATURE SENSOR****DESCRIPTION**

The transmission temperature sensor is a thermistor that is integral to the Transmission Range Sensor (TRS).

**OPERATION**

The transmission temperature sensor is used by the TCM to sense the temperature of the fluid in the sump. Since fluid temperature can affect transmission shift quality and converter lock up, the TCM requires this information to determine which shift schedule to operate in.

**Calculated Temperature**

A failure in the temperature sensor or circuit will result in calculated temperature being substituted for actual temperature. Calculated temperature is a predicted fluid temperature which is calculated from a combination of inputs:

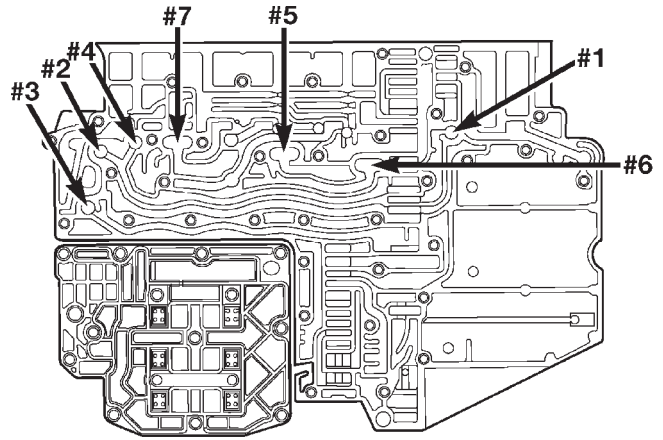
- Battery (ambient) temperature
- Engine coolant temperature
- In-gear run time since start-up

## VALVE BODY

### DESCRIPTION

The valve body consists of a cast aluminum valve body, a separator plate, and a transfer plate. The valve body contains valves and check balls that control fluid delivery to the torque converter clutch, bands, and frictional clutches. The valve body contains the following components (Fig. 136) and (Fig. 137):

- Solenoid switch valve
- Manual valve
- Low/reverse switch valve
- 5 Accumulators
- 7 check balls



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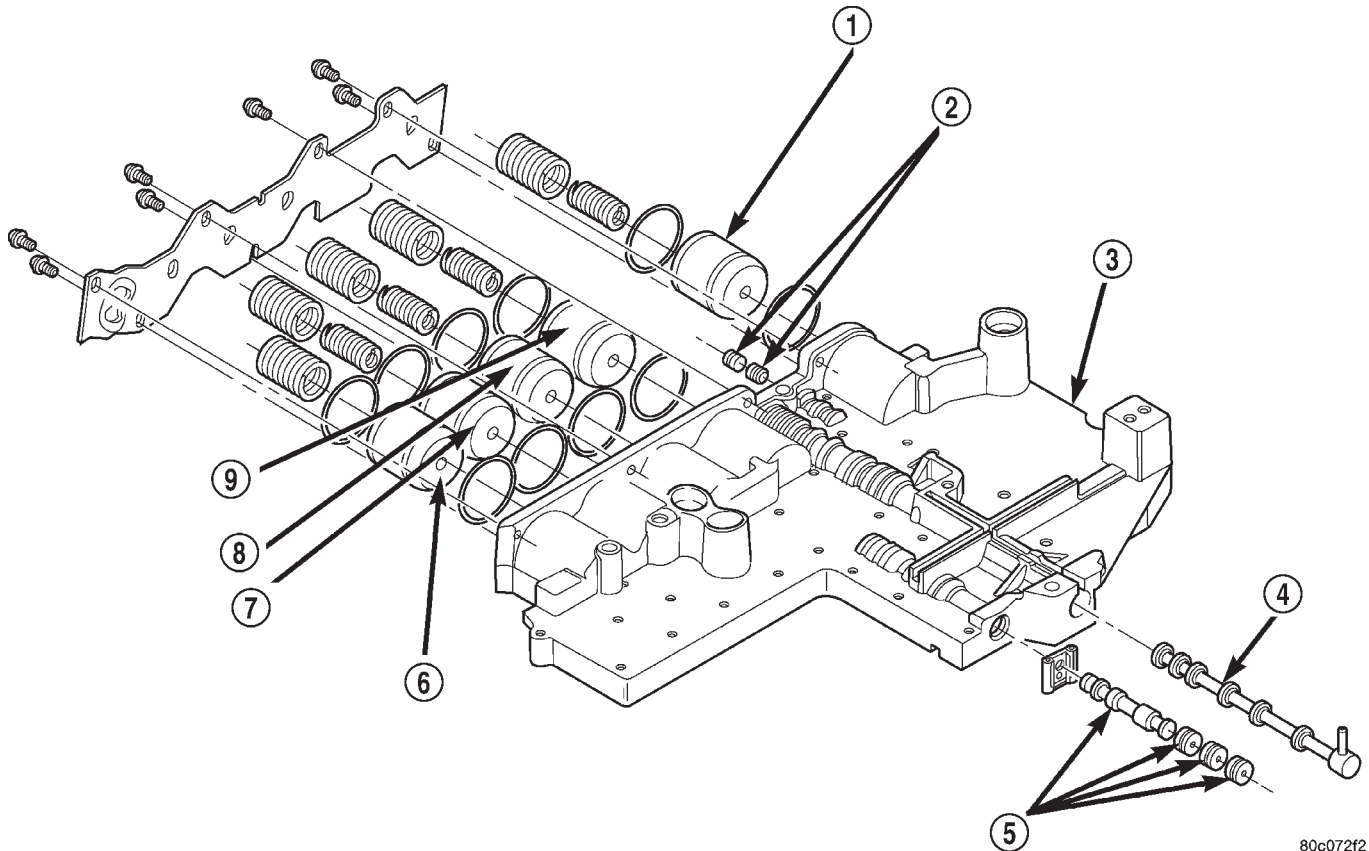
**Fig. 137 Check Ball Locations**

### OPERATION

**NOTE:** Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

### SOLENOID SWITCH VALVE

The Solenoid Switch Valve (SSV) controls the direction of the transmission fluid when the L/R-TCC solenoid is energized.



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**Fig. 136 Valve Body Components**

- 1 - LOW/REVERSE ACCUMULATOR
- 2 - LOW/REVERSE SWITCH VALVE
- 3 - UPPER VALVE BODY
- 4 - MANUAL VALVE
- 5 - SOLENOID SWITCH VALVE

- 6 - OVERDRIVE ACCUMULATOR
- 7 - UNDERDRIVE ACCUMULATOR
- 8 - 4C ACCUMULATOR
- 9 - 2C ACCUMULATOR

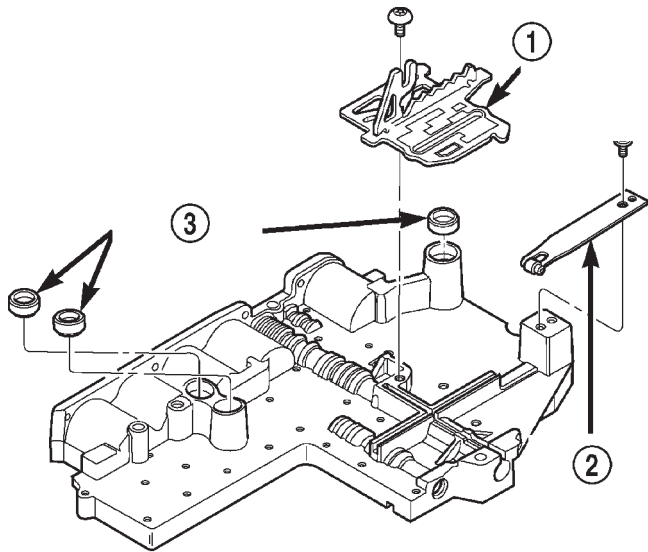
## VALVE BODY (Continued)

The Solenoid Switch Valve controls line pressure from the LR-TCC solenoid. In 1st gear, the SSV will be in the downshifted position, thus directing fluid to the L/R clutch circuit. In 2nd, 3rd, and 4th gears, the solenoid switch valve will be in the upshifted position and directs the fluid into the torque converter clutch (TCC) circuit.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement. If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.

## MANUAL VALVE

The manual valve is a relay valve. The purpose of the manual valve is to direct fluid to the correct circuit needed for a specific gear or driving range. The manual valve, as the name implies, is manually operated by the driver with a lever located on the top of the valve body. The valve is connected mechanically by a cable to the gearshift mechanism. The valve is held in each of its positions by a roller detent spring (Fig. 138) that engages the "roostercomb" of the TRS selector plate.



80c072f3

**Fig. 138 TRS Selector Plate and Detent Spring**

- 1 - TRS SELECTOR PLATE
- 2 - DETENT SPRING
- 3 - CLUTCH PASSAGE SEALS

## LOW/REVERSE SWITCH VALVE

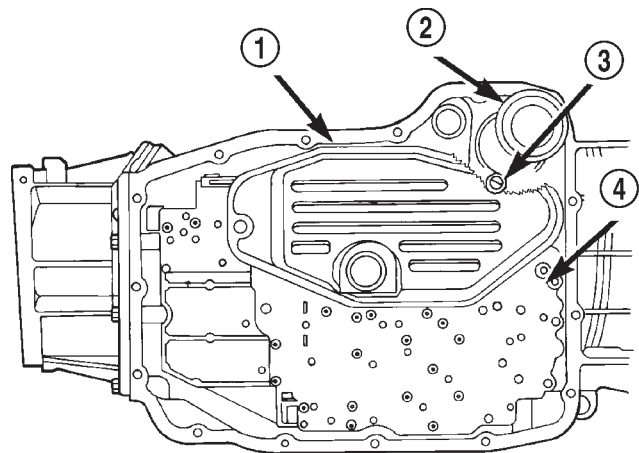
The low/reverse switch valve allows the low/reverse clutch to be operated by either the LR/CC solenoid or the MS solenoid.

## REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/VALVE BODY - DISASSEMBLY)

- (1) Shift transmission into PARK.
  - (2) Raise vehicle.
  - (3) Disconnect wires at the solenoid and pressure switch assembly connector.
  - (4) Position drain pan under transmission oil pan.
  - (5) Remove transmission oil pan.
  - (6) Remove the primary oil filter from valve body.
- (Fig. 139)



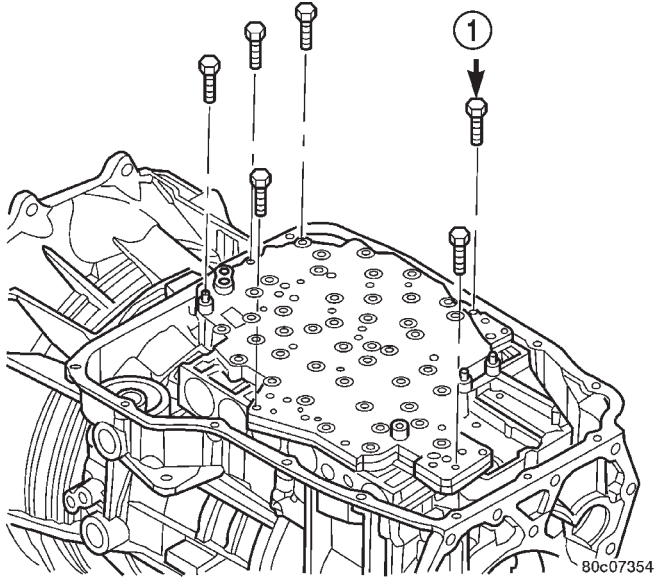
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**Fig. 139 Remove Primary Oil Filter**

- 1 - PRIMARY OIL FILTER
- 2 - COOLER RETURN FILTER
- 3 - COOLER RETURN FILTER BYPASS VALVE
- 4 - VALVE BODY

VALVE BODY (Continued)

- (7) Remove bolts attaching valve body to transmission case (Fig. 140).
- (8) Lower the valve body and work the electrical connector out of transmission case.
- (9) Separate the valve body from the transmission.

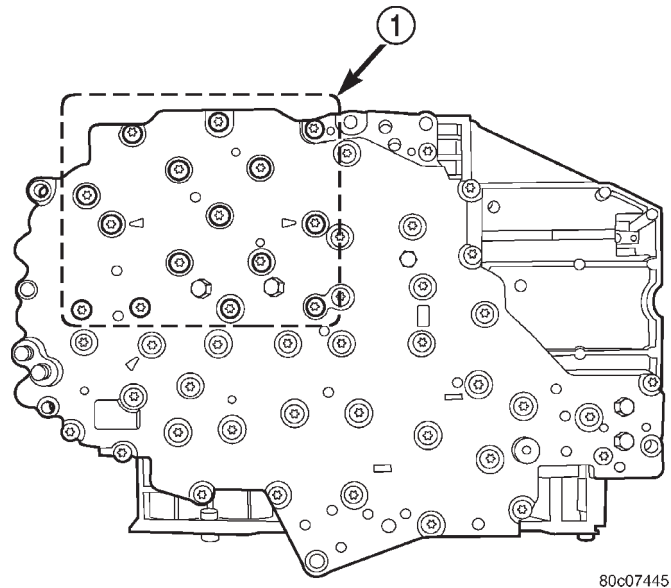


**Fig. 140 Valve Body Bolts**

1 - VALVE BODY TO CASE BOLT (6)

**DISASSEMBLY**

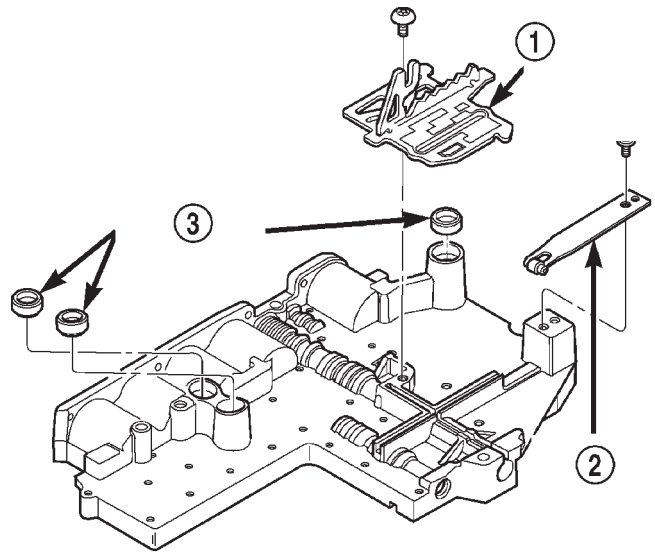
- (1) Remove the screws holding the solenoid and pressure switch assembly to the valve body (Fig. 141). Do not remove the screws on the top of the solenoid and pressure switch assembly.
- (2) Separate the solenoid and pressure switch assembly from the valve body.
- (3) Remove the screw holding the detent spring (Fig. 142) onto the valve body.
- (4) Remove the detent spring from the valve body.
- (5) Remove the TRS selector plate from the valve body and the manual valve.
- (6) Remove the clutch passage seals from the valve body, if necessary.
- (7) Remove the screws holding the accumulator cover onto the valve body (Fig. 143).
- (8) Remove the accumulator springs and pistons from the valve body. Note which accumulator piston and spring belong in each location.
- (9) Place the valve body on the bench with the transfer plate upward.



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**Fig. 141 Solenoid and Pressure Switch Assembly Screws**

1 - SOLENOID PACK BOLTS (15)



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**Fig. 142 Valve Body External Components**

1 - TRS SELECTOR PLATE  
 2 - DETENT SPRING  
 3 - CLUTCH PASSAGE SEALS

VALVE BODY (Continued)

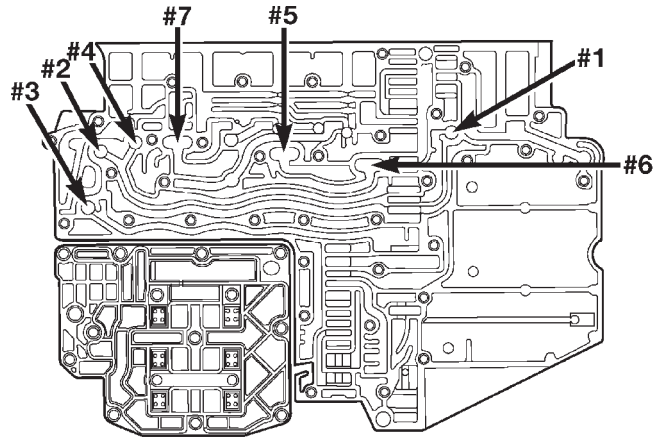
**NOTE:** The valve body contains seven check balls. The transfer plate must be placed upward to prevent losing the check balls when the transfer plate is removed from the valve body.

(10) Remove the screws holding the valve body to the valve body transfer plate.

(11) Remove the transfer plate from the valve body. Note the location of all check balls (Fig. 144).

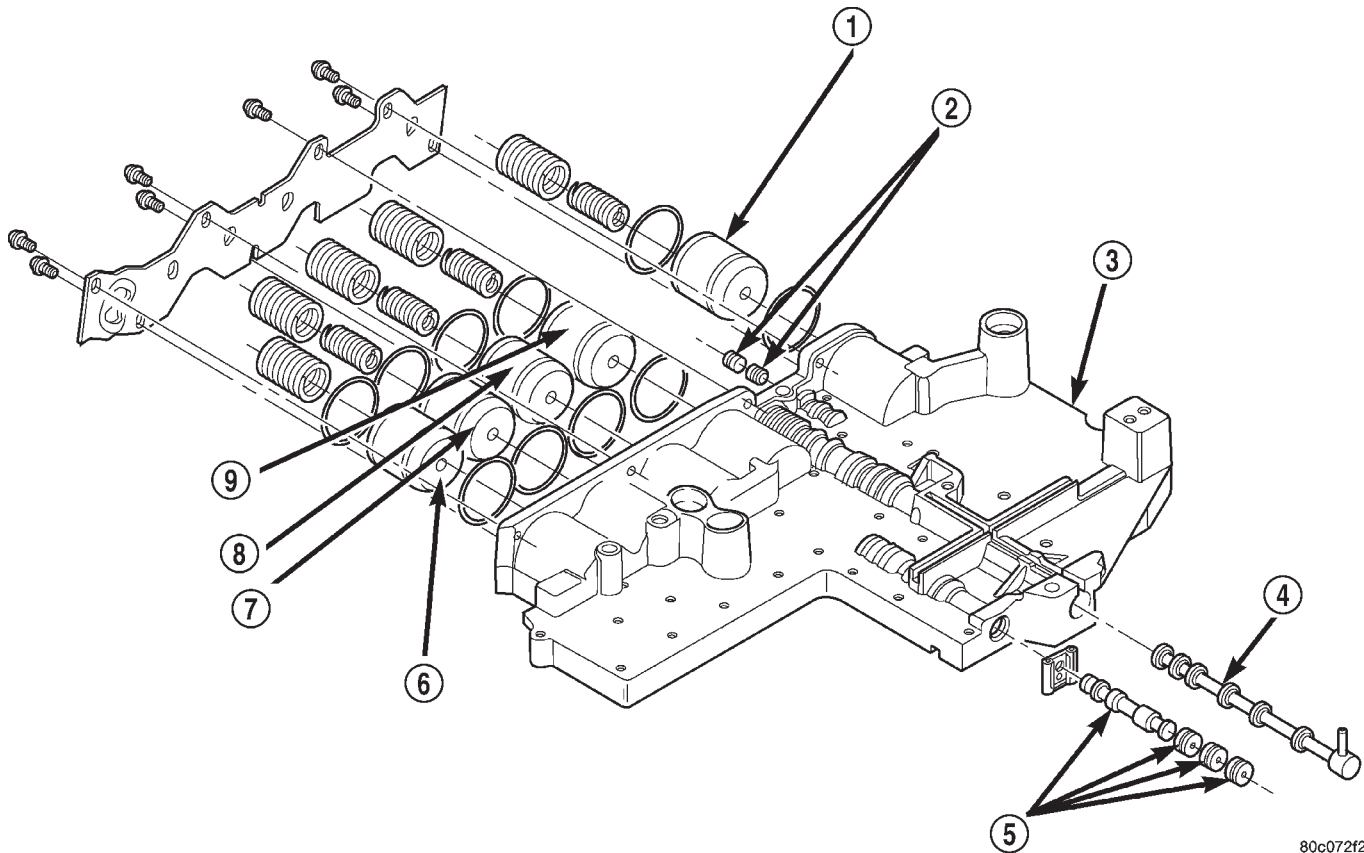
(12) Remove the check balls from the valve body.

(13) Remove the retainers securing the solenoid switch valve, manual valve, and the low/reverse switch valve into the valve body and remove the associated valve and spring. Tag each valve and spring combination with location information to aid in assembly. (Fig. 145)



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**Fig. 144 Check Ball Locations**



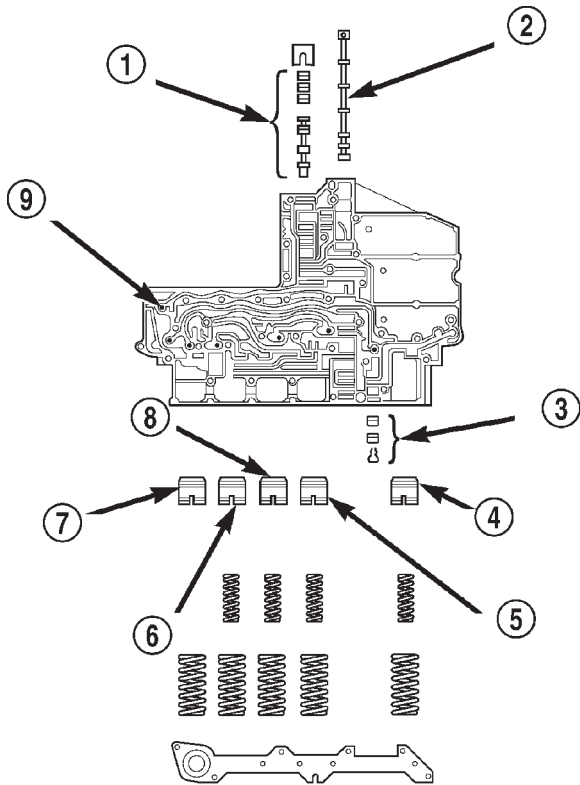
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**Fig. 143 Valve Body Components**

- 1 - LOW/REVERSE ACCUMULATOR
- 2 - LOW/REVERSE SWITCH VALVE
- 3 - UPPER VALVE BODY
- 4 - MANUAL VALVE
- 5 - SOLENOID SWITCH VALVE

- 6 - OVERDRIVE ACCUMULATOR
- 7 - UNDERDRIVE ACCUMULATOR
- 8 - 4C ACCUMULATOR
- 9 - 2C ACCUMULATOR

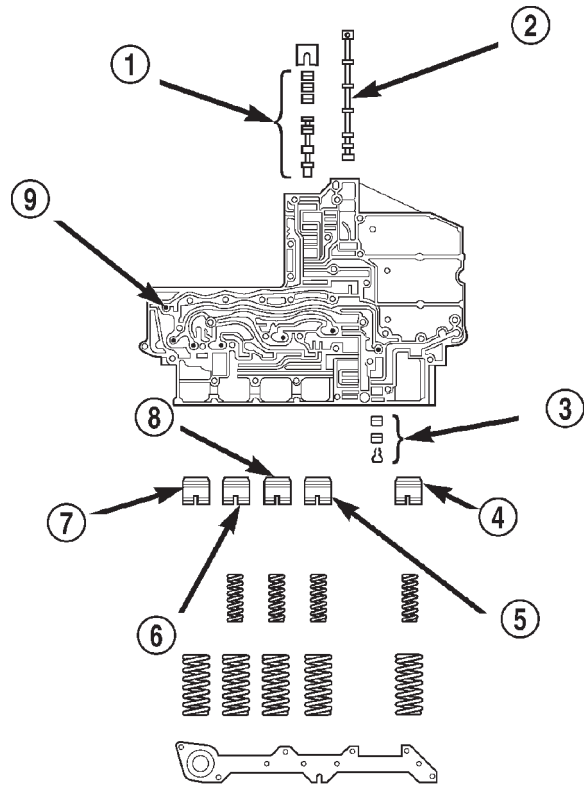
VALVE BODY (Continued)



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**Fig. 145 Valve Body Components**

- 1 - SOLENOID SWITCH VALVE
- 2 - MANUAL VALVE
- 3 - LOW REVERSE SWITCH VALVE
- 4 - LOW REVERSE ACCUMULATOR
- 5 - 2ND CLUTCH ACCUMULATOR
- 6 - UNDERDRIVE ACCUMULATOR
- 7 - OVERDRIVE ACCUMULATOR
- 8 - 4TH CLUTCH ACCUMULATOR
- 9 - CHECK BALLS (7)



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**Fig. 146 Valve Body Components**

- 1 - SOLENOID SWITCH VALVE
- 2 - MANUAL VALVE
- 3 - LOW REVERSE SWITCH VALVE
- 4 - LOW REVERSE ACCUMULATOR
- 5 - 2ND CLUTCH ACCUMULATOR
- 6 - UNDERDRIVE ACCUMULATOR
- 7 - OVERDRIVE ACCUMULATOR
- 8 - 4TH CLUTCH ACCUMULATOR
- 9 - CHECK BALLS (7)

**CLEANING**

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. (Fig. 146)

Do not immerse any of the electrical components in cleaning solution. Clean the electrical components 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.**

**INSPECTION**

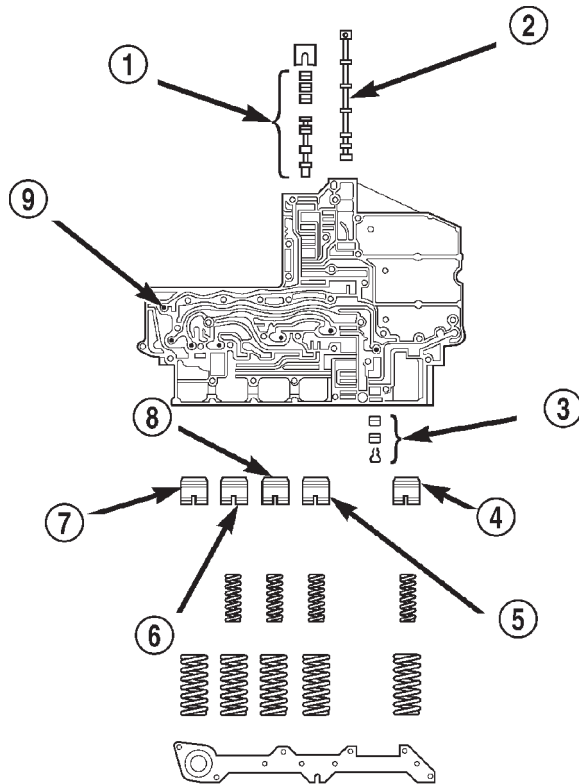
Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straight-edge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

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.

Inspect the valves and plugs (Fig. 147) 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

## VALVE BODY (Continued)

foreign matter from lodging between the valves and plugs and the bore.



80b9a599

**Fig. 147 Valve Body Components**

- 1 - SOLENOID SWITCH VALVE
- 2 - MANUAL VALVE
- 3 - LOW REVERSE SWITCH VALVE
- 4 - LOW REVERSE ACCUMULATOR
- 5 - 2ND CLUTCH ACCUMULATOR
- 6 - UNDERDRIVE ACCUMULATOR
- 7 - OVERDRIVE ACCUMULATOR
- 8 - 4TH CLUTCH ACCUMULATOR
- 9 - CHECK BALLS (7)

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.

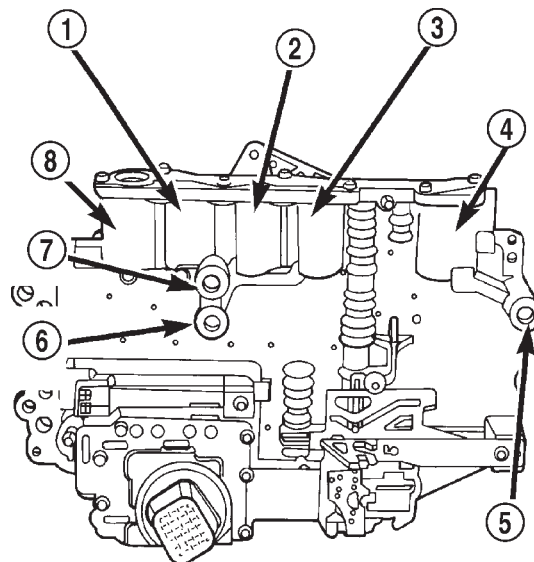
Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

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.

Inspect all the accumulator 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 accumulator springs. The springs must be free of distortion, warpage or broken coils.

Inspect all the fluid seals on the valve body (Fig. 148). Replace any seals that are cracked, distorted, or damaged in any way. These seals pass fluid pressure directly to the clutches. Any pressure leak at these points, may cause transmission performance problems.



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**Fig. 148 Valve Body Seals**

- 1 - UNDERDRIVE ACCUMULATOR (2 SPRINGS)
- 2 - 4TH CLUTCH ACCUMULATOR (2 SPRINGS)
- 3 - 2ND CLUTCH ACCUMULATOR (2 SPRINGS)
- 4 - LOW REVERSE ACCUMULATOR (2 SPRINGS)
- 5 - LOW/REVERSE PASSAGE SEAL
- 6 - 2ND CLUTCH PASSAGE SEAL
- 7 - 4TH CLUTCH PASSAGE SEAL
- 8 - OVERDRIVE ACCUMULATOR (1 SPRING)

## ASSEMBLY

(1) Lubricate valves, springs, and the housing valve bores with clean transmission fluid.

(2) Install solenoid switch valve, manual valve, and the low/reverse switch valve into the valve body.

(3) Install the retainers to hold each valve into the valve body.

(4) Install the valve body check balls into their proper locations.

(5) Position the transfer plate onto the valve body.

(6) Install the screws to hold the transfer plate to the valve body. Tighten the screws to 5.6 N·m (50 in. lbs.).

(7) Install the accumulator pistons and springs into the valve body in the location from which they were removed. Note that all accumulators except the

## VALVE BODY (Continued)

overdrive have two springs. The overdrive accumulator piston has only one spring.

(8) Position the accumulator cover onto the valve body.

(9) Install the screws to hold the accumulator cover onto the valve body. Tighten the screws to 4.5 N·m (40 in. lbs.).

(10) Install the TRS selector plate onto the valve body and the manual valve.

(11) Install the solenoid and pressure switch assembly onto the valve body.

(12) Install the screws to hold the solenoid and pressure switch assembly onto the valve body. Tighten the screws to 5.7 N·m (50 in. lbs.). Tighten the screws adjacent to the arrows cast into the bottom of the transfer plate first.

(13) Position the detent spring onto the valve body.

(14) Install the screw to hold the detent spring onto the valve body. Tighten the screw to 4.5 N·m (40 in. lbs.).

(15) Install new clutch passage seals onto the valve body, if necessary

**INSTALLATION**

(1) Check condition of seals on valve body and the solenoid and pressure switch assembly. Replace seals if cut or worn.

(2) Place TRS selector plate in the PARK position.

(3) Place the transmission in the PARK position.

(4) Lubricate seal on the solenoid and pressure switch assembly connector with petroleum jelly.

(5) Position valve body in transmission and align the manual lever on the valve body to the pin on the transmission manual shift lever.

(6) Seat valve body in case and install one or two bolts to hold valve body in place.

(7) Tighten valve body bolts alternately and evenly to 12 N·m (105 in. lbs.) torque.

(8) Install a new primary oil filter seal in the oil pump inlet bore. Seat the seal in the bore with the butt end of a hammer, or other suitable tool.

**CAUTION: The primary oil filter seal MUST be fully installed flush against the oil pump body. DO NOT install the seal onto the filter neck and attempt to install the filter and seal as an assembly. Damage to the transmission will result.**

(9) Place replacement filter in position on valve body and into the oil pump.

(10) Install screw to hold filter to valve body. Tighten screw to 4.5 N·m (40 in. lbs.) torque.

(11) Connect the solenoid and pressure switch assembly connector.

(12) Install oil pan. Tighten pan bolts to 12 N·m (105 in. lbs.) torque.

(13) Lower vehicle and fill transmission with Mopar® ATF +4, type 9602, fluid.

(14) Check and adjust gearshift cable, if necessary.



## TRANSFER CASE - NV231

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## TRANSFER CASE - NV231

**DESCRIPTION**

The NV231 is a part-time transfer case with a low range reduction gear system. The NV231 has three operating ranges plus a NEUTRAL position. A low range system provides a reduction ratio for increased low speed torque capability.

The geartrain is mounted in two aluminum case halves attached with bolts. The mainshaft front and rear bearings are mounted in aluminum retainer housings bolted to the case halves.

**OPERATING RANGES**

Transfer case operating ranges are:

- 2WD (2-wheel drive)
- 4Hi (4-wheel drive)
- 4 Lo (4-wheel drive low range)

The 2WD range is for use on any road surface at any time.

The 4Hi 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 wet or slippery or 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.

**SHIFT MECHANISM**

Operating ranges are selected with a floor mounted shift lever. The shift lever is connected to the transfer case range lever by a shift cable. A straight line shift pattern is used. Range positions are marked on the shifter knob bezel.

## TRANSFER CASE - NV231 (Continued)

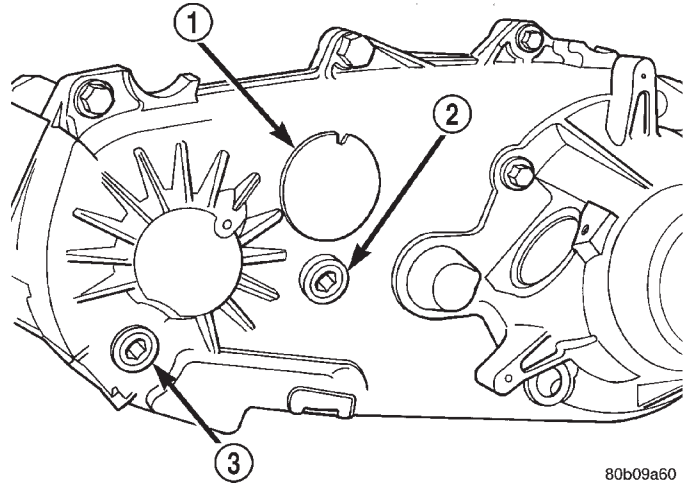
**IDENTIFICATION**

A circular ID tag is attached to the rear case of each transfer case (Fig. 1). The ID 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.

**OPERATION**

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range hub. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which operates the mode sleeve and hub. The sleeve and hub are not equipped with a synchronizer mechanism for shifting.



**Fig. 1 Fill/Drain Plug And I.D. Tag Locations - Typical**

- 1 - I.D. TAG
- 2 - FILL PLUG
- 3 - DRAIN PLUG

## TRANSFER CASE - NV231 (Continued)

## DIAGNOSIS AND TESTING - TRANSFER CASE - NV231

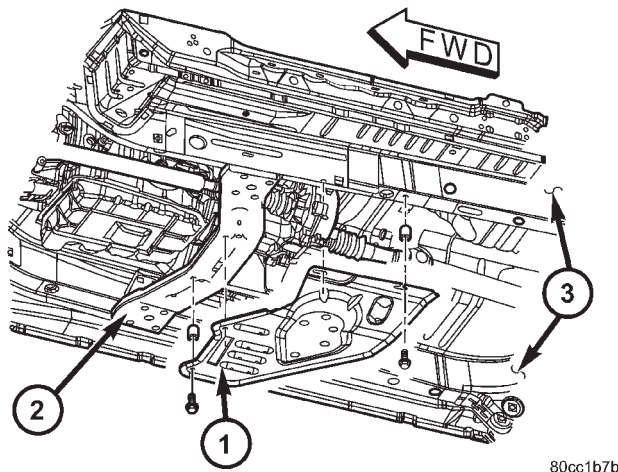
## DIAGNOSIS CHART

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 an extended period in 4H mode on dry surface, driveline torque load may cause difficulty. 3) Transfer case shift cable binding. 4) Insufficient or incorrect lubricant. 5) Internal transfer case components binding, worn, or damaged.	1) Slow vehicle and shift into desired range. 2) Stop vehicle and shift transfer case to Neutral position. Transfer case can then be shifted to the desired mode. 3) Repair or replace cable as necessary. 4) Drain and refill transfer case with the correct type and quantity of lubricant. 5) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct type and quantity of lubricant.
Transfer case noisy while in, or jumps out of, 4L mode.	1) Transfer case not completely engaged in 4L position. 2) Transfer case shifter binding. 3) Range fork damaged, inserts worn, or fork is binding on the shift rail. 4) Low range gear worn or damaged.	1) Slow vehicle, shift transfer case to the Neutral position, and then shift into the 4L mode. 2) Repair, replace, or tighten shifter as necessary. 3) Repair or replace components as necessary. 4) Repair or replace components as necessary.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled. 2) Transfer case vent closed or restricted. 3) Transfer case seals damaged or installed incorrectly.	1) Drain lubricant to the correct level. 2) Clean or replace vent as necessary. 3) Replace suspect seal.
Abnormal tire wear.	1) Extended operation in 4Hi mode on dry surfaces,	1) Operate vehicle in 2H mode on dry surfaces.

TRANSFER CASE - NV231 (Continued)

**REMOVAL**

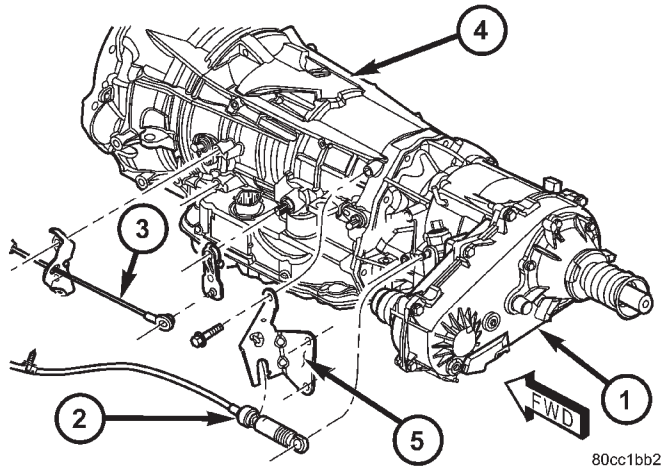
- (1) Shift transfer case into NEUTRAL.
- (2) Raise vehicle.
- (3) Remove skid plate (Fig. 2).
- (4) Drain transfer case lubricant.
- (5) Mark front and rear propeller shaft yokes for alignment reference.
- (6) Disconnect front/rear propeller shafts at transfer case.
- (7) Disconnect transfer case position sensor connector (Fig. 3).



**Fig. 2 Remove Skid Plate**

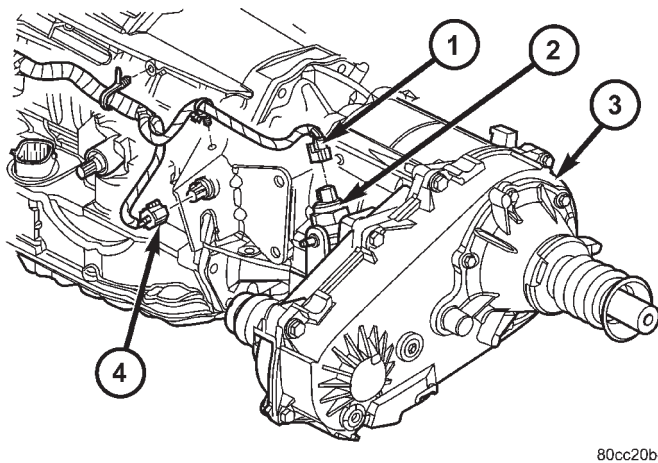
- 1 - SKID PLATE
- 2 - TRANSMISSION CROSSMEMBER
- 3 - FRAME RAILS

- (9) Disconnect the transfer case shift cable from the shift cable bracket.
- (10) Disconnect transfer case vent hose (Fig. 5).
- (11) Support transfer case with transmission jack.
- (12) Secure transfer case to jack with chains.
- (13) Remove nuts attaching transfer case to transmission.
- (14) Pull transfer case and jack rearward to disengage transfer case (Fig. 5).
- (15) Remove transfer case from under vehicle.



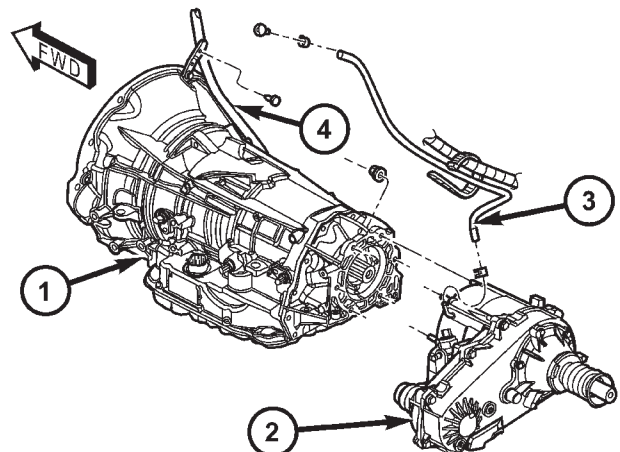
**Fig. 4 Remove Shift Cables**

- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET



**Fig. 3 Transfer Case Position Sensor and Connector**

- 1 - TRANSFER CASE POSITION SENSOR CONNECTOR
- 2 - TRANSFER CASE POSITION SENSOR
- 3 - TRANSFER CASE
- 4 - OUTPUT SPEED SENSOR CONNECTOR



**Fig. 5 Remove Vent Hose and Transfer Case**

- 1 - AUTOMATIC TRANSMISSION
- 2 - TRANSFER CASE
- 3 - VENT HOSE
- 4 - FILL TUBE

- (8) Disconnect transfer case shift cable at the range lever (Fig. 4).

## TRANSFER CASE - NV231 (Continued)

**DISASSEMBLY**

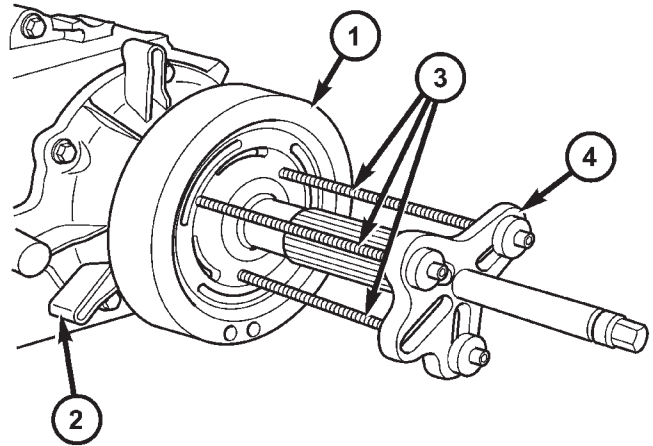
Position transfer case on shallow drain pan. Remove drain plug and drain lubricant remaining in case.

**REAR RETAINER AND OIL PUMP**

(1) Spread band clamp which holds output shaft boot to the output shaft slinger, or output shaft damper, with a suitable awl, or equivalent.

(2) Remove output shaft boot from slinger, or output shaft damper, and output shaft.

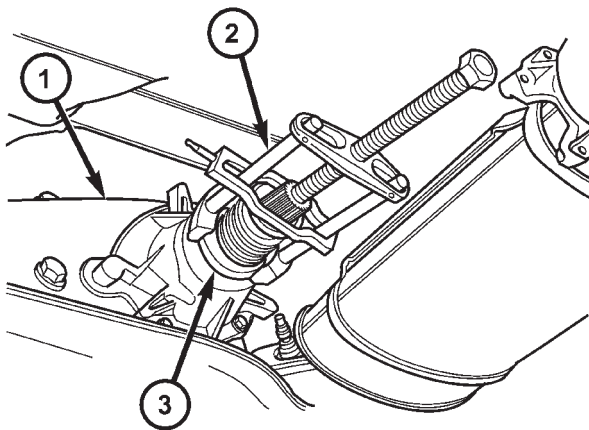
(3) If the vehicle is equipped with an automatic transmission, remove the output shaft rear slinger using Puller MD-998056-A (Fig. 6).



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**Fig. 7 Remove Damper**

- 1 - DAMPER
- 2 - TRANSFER CASE
- 3 - SCREWS - 8421
- 4 - YOKE PULLER



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**Fig. 6 Rear Slinger Removal**

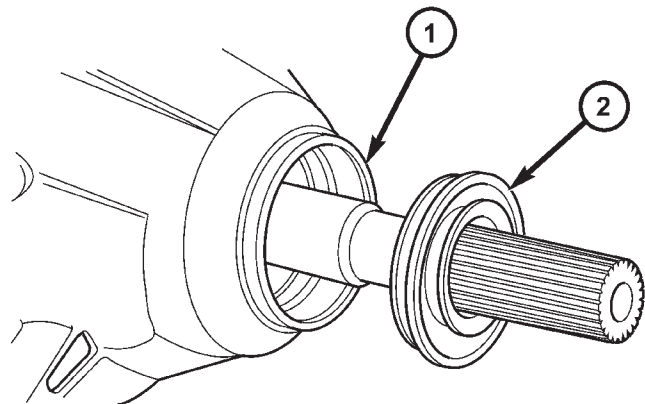
- 1 - TRANSFER CASE
- 2 - PULLER MD-998056-A
- 3 - REAR SLINGER

(4) If the vehicle is equipped with a manual transmission, use Screws 8421 (Fig. 7) and the puller yoke and forcing screw from a bolt-grip puller set, such as those used to remove steering wheels and harmonic balancers, to remove the transfer case output shaft damper.

(5) Use a suitable pry tool, or a slide hammer mounted screw, to remove the seal from the rear retainer (Fig. 8).

(6) Remove the rear output bearing I.D. retaining ring (Fig. 9).

(7) Remove the bolts holding the rear retainer to the rear case half.

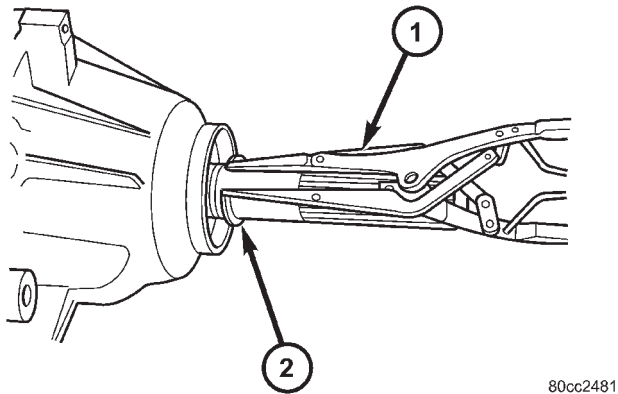


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**Fig. 8 Rear Retainer Seal**

- 1 - REAR RETAINER
- 2 - OUTPUT SHAFT SEAL

TRANSFER CASE - NV231 (Continued)



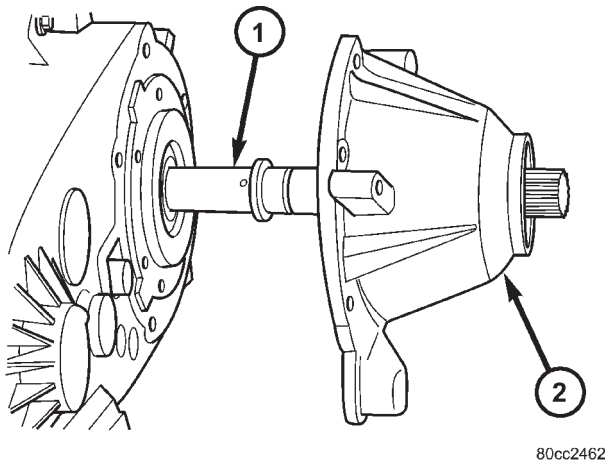
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**Fig. 9 Output Shaft Rear Bearing Retaining Ring**

- 1 - SNAP-RING PLIERS
- 2 - RETAINING RING

(8) Tap rear retainer with rawhide or rubber mallet to loosen sealer bead.

(9) Remove rear retainer from rear case half (Fig. 10).



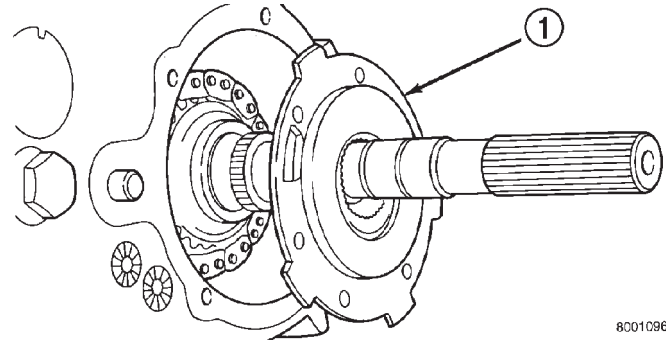
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**Fig. 10 Rear Retainer Removal**

- 1 - MAINSHAFT
- 2 - REAR RETAINER

(10) Remove the remaining output shaft bearing snap-ring.

(11) Disengage oil pickup tube from oil pump and remove oil pump assembly. Remove oil pump by tilting the edge of the oil pump from under the edge of the rear case half and sliding the pump off the output shaft (Fig. 11).

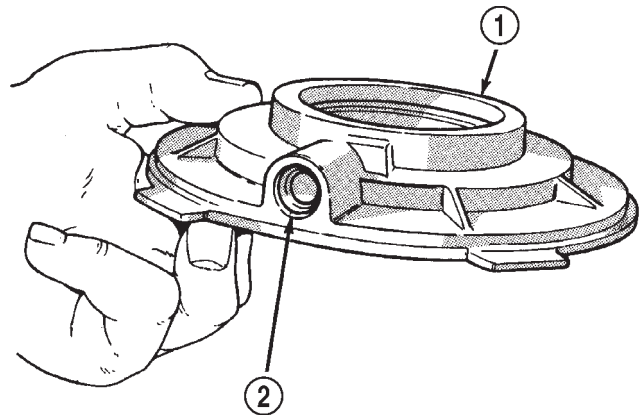


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**Fig. 11 Oil Pump Removal**

- 1 - OIL PUMP

(12) Remove pick-up tube o-ring from oil pump (Fig. 12), if necessary. Do not disassemble the oil pump, it is not serviceable.



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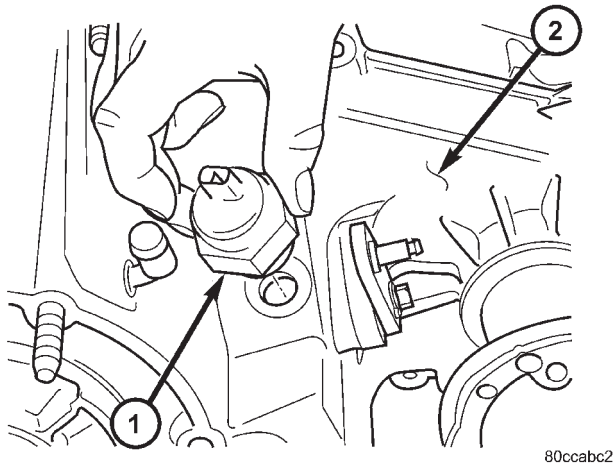
**Fig. 12 Pick-up Tube O-ring Location**

- 1 - OIL PUMP
- 2 - O-RING

TRANSFER CASE - NV231 (Continued)

COMPANION FLANGE AND RANGE LEVER

(1) Remove transfer case position sensor (Fig. 13).



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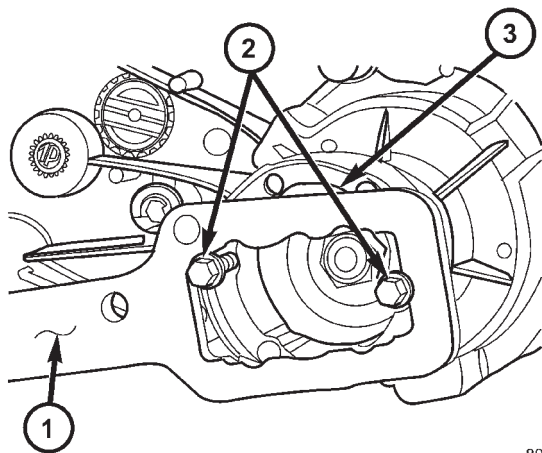
**Fig. 13 Remove Transfer Case Position Sensor**

- 1 - TRANSFER CASE POSITION SENSOR
- 2 - TRANSFER CASE

(2) Install two bolts (Fig. 14) partially into the propeller shaft companion flange, 180° from each other.

(3) Install the rectangular end of the Flange Holder C-3281 over the bolts to hold the companion flange stationary and remove the nut holding the companion flange to the output shaft.

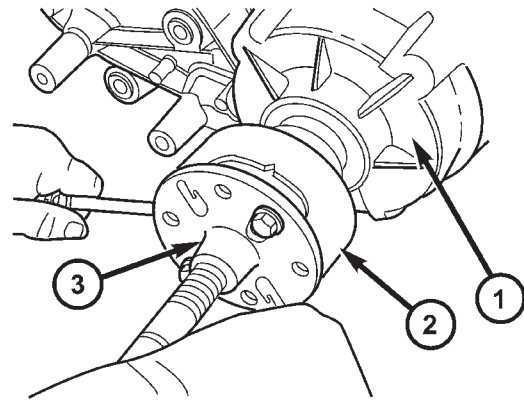
(4) Use Remover C-452 (Fig. 15) to remove the companion flange.



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**Fig. 14 Hold Companion Flange - Typical**

- 1 - HOLDER C-3281
- 2 - BOLTS
- 3 - COMPANION FLANGE



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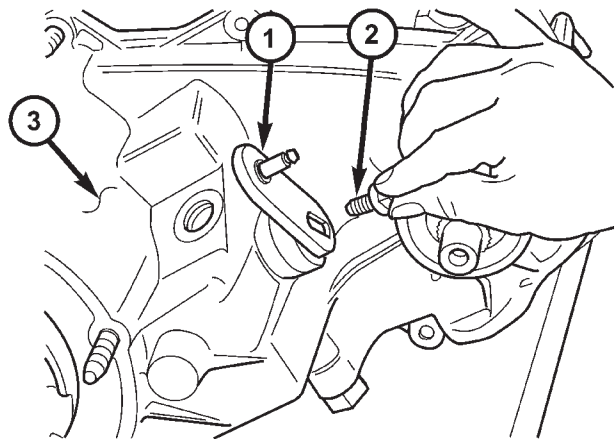
**Fig. 15 Remove Companion Flange - Typical**

- 1 - TRANSFER CASE
- 2 - COMPANION FLANGE
- 3 - REMOVER C-452

(5) Remove seal washer from front output shaft. Discard washer as it should not be reused.

(6) Remove the bolt (Fig. 16) that attaches the range lever to sector shaft. Then move sector to neutral position and remove range lever from shaft.

**NOTE:** Be sure to note the orientation of the range lever (lever up or down) so that it may be re-installed in the same direction.



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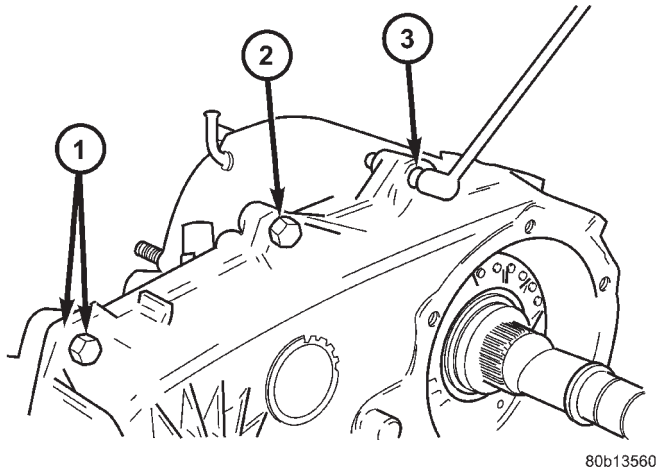
**Fig. 16 Remove Shift Lever Bolt**

- 1 - RANGE LEVER
- 2 - RANGE LEVER BOLT
- 3 - TRANSFER CASE

TRANSFER CASE - NV231 (Continued)

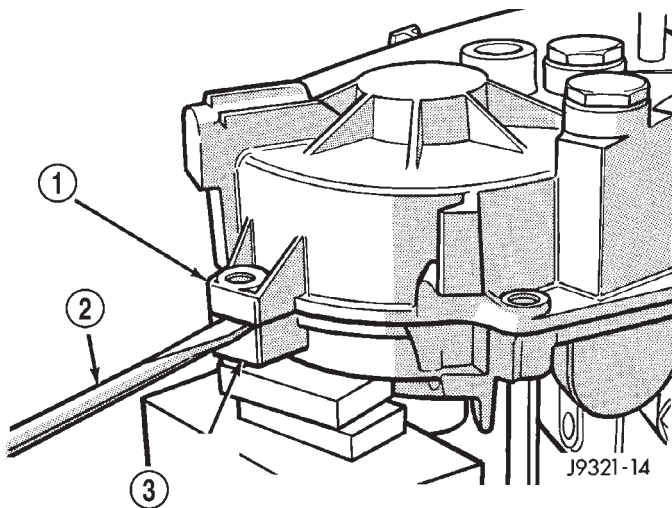
**FRONT OUTPUT SHAFT AND DRIVE CHAIN**

- (1) Support transfer case so rear case is facing upward.
- (2) Remove bolts holding front case to rear case. The case alignment bolts require flat washers (Fig. 17).
- (3) Loosen rear case with flat blade screwdriver to break sealer bead. Insert pry tool blade only into notches provided at each end of case (Fig. 18).
- (4) Remove rear case from front case.



**Fig. 17 Spline And Dowel Bolt Locations**

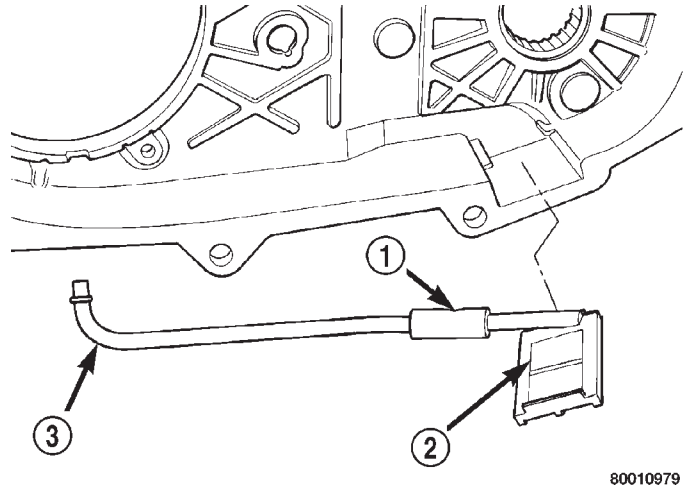
- 1 - DOWEL BOLT AND WASHER (2)
- 2 - CASE BOLTS
- 3 - SPLINE HEAD BOLT (1)



**Fig. 18 Loosening Rear Case - Typical**

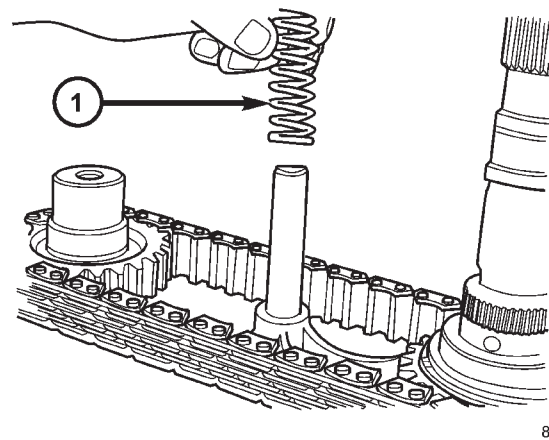
- 1 - REAR CASE
- 2 - PRY TOOL (IN CASE SLOT)
- 3 - FRONT CASE

- (5) Remove oil pickup tube from rear case (Fig. 19).
- (6) Remove mode fork spring (Fig. 20).
- (7) Pull front output shaft upward and out of front output shaft bearing (Fig. 21).
- (8) Remove front output shaft and chain.



**Fig. 19 Oil Pickup Tube Removal**

- 1 - CONNECTING HOSE
- 2 - PICKUP SCREEN
- 3 - PICKUP TUBE

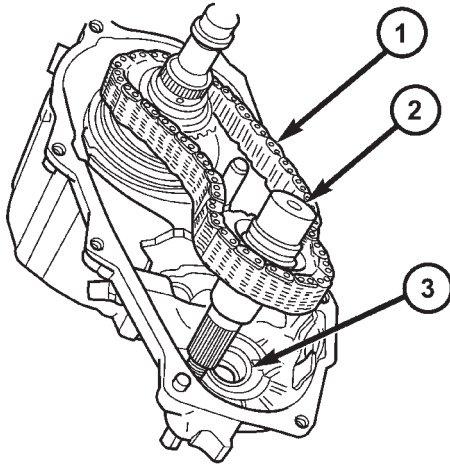


**Fig. 20 Mode Fork Spring Removal**

- 1 - MODE FORK SPRING



TRANSFER CASE - NV231 (Continued)



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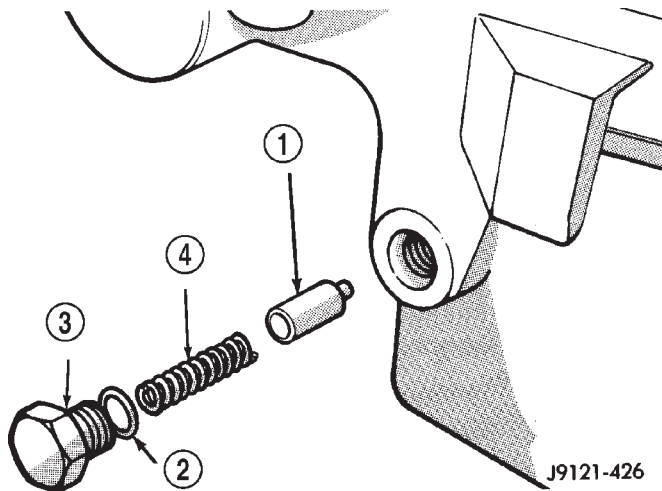
**Fig. 21 Remove Front Output Shaft And Drive Chain**

- 1 - DRIVE CHAIN
- 2 - FRONT OUTPUT SHAFT
- 3 - FRONT OUTPUT SHAFT BEARING

**SHIFT FORKS AND MAINSHAFT**

(1) Remove mainshaft from mode sleeve and input gear pilot bearing.

(2) Remove detent plug, O-ring, detent spring and detent plunger (Fig. 22).



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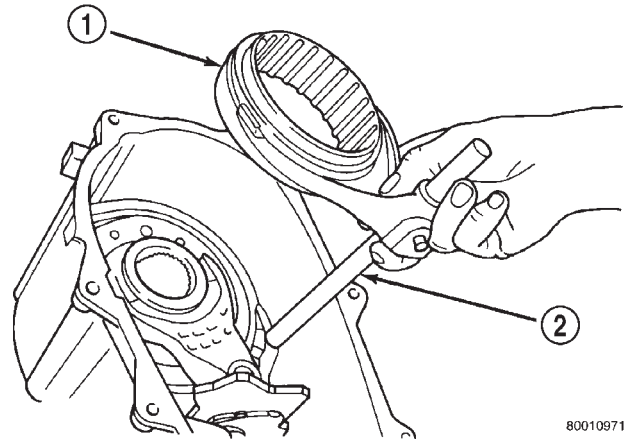
**Fig. 22 Detent Plug, Spring, And Plunger Removal**

- 1 - PLUNGER
- 2 - O-RING
- 3 - PLUG
- 4 - SPRING

(3) Remove mode fork and sleeve as an assembly (Fig. 23). Note position of sleeve for assembly reference. The short side of the sleeve faces upward.

(4) Remove range fork and sleeve as an assembly (Fig. 24). Note fork position for installation reference.

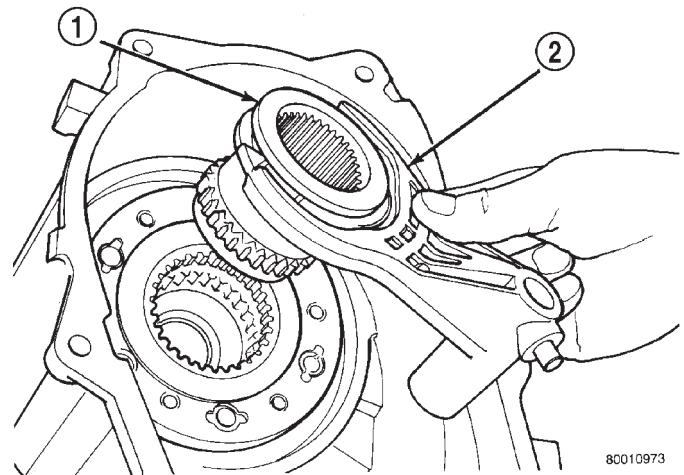
(5) Remove shift sector from front case (Fig. 25).



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**Fig. 23 Mode Fork And Sleeve Removal**

- 1 - MODE SLEEVE
- 2 - MODE FORK AND RAIL

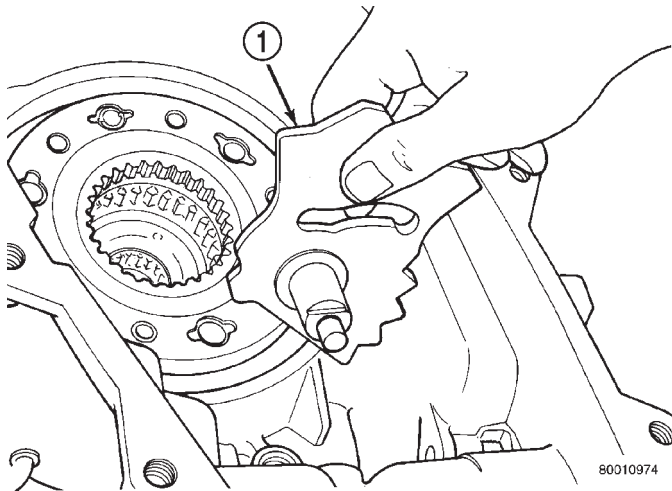


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**Fig. 24 Range Fork And Sleeve Removal**

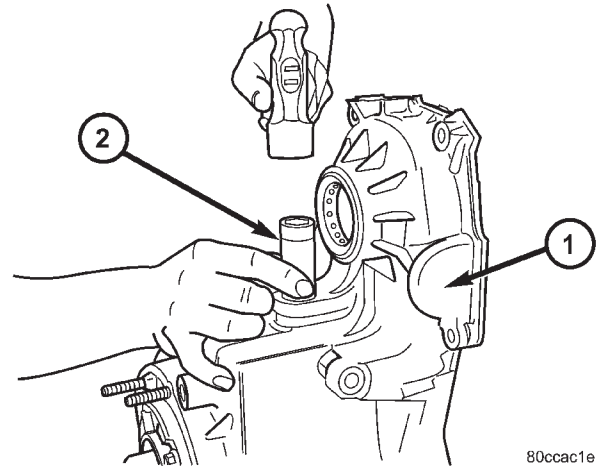
- 1 - RANGE HUB
- 2 - RANGE FORK

TRANSFER CASE - NV231 (Continued)



**Fig. 25 Shift Sector Removal**

- 1 - SHIFT SECTOR



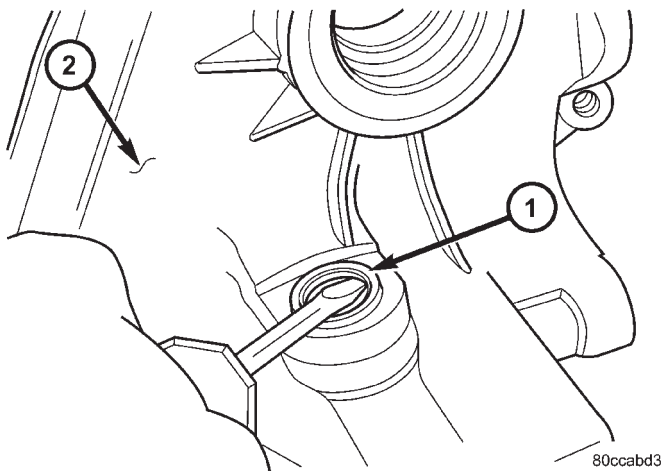
**Fig. 27 Remove Shift Sector Shaft Bearing**

- 1 - TRANSFER CASE  
2 - SOCKET

- (6) Remove the shift sector shaft seal (Fig. 26).  
(7) Remove the shift sector shaft bearing with an appropriate socket (Fig. 27).

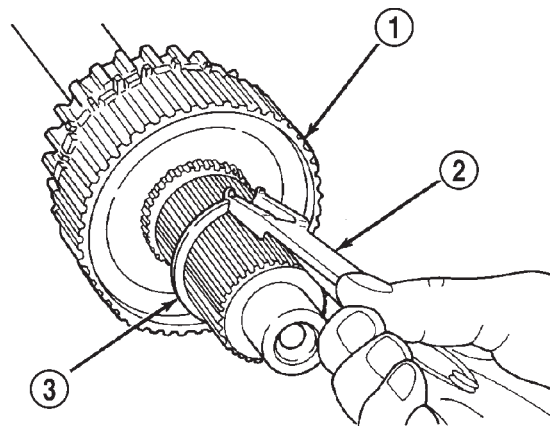
**MAINSHAFT**

- (1) Remove mode hub retaining ring with heavy duty snap-ring pliers (Fig. 28).  
(2) Slide mode hub off mainshaft (Fig. 29).  
(3) Slide drive sprocket off mainshaft (Fig. 30).



**Fig. 26 Remove Shift Shaft Seal**

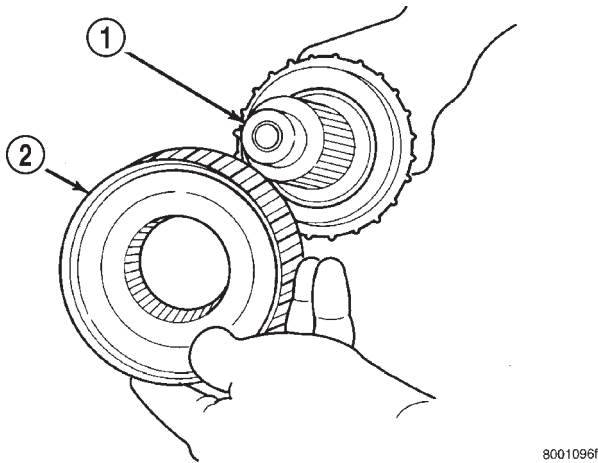
- 1 - SHIFT SHAFT SEAL  
2 - TRANSFER CASE



**Fig. 28 Mode Hub Retaining Ring Removal**

- 1 - MODE HUB  
2 - SNAP-RING PLIERS (HEAVY DUTY)  
3 - MODE HUB RETAINING RING

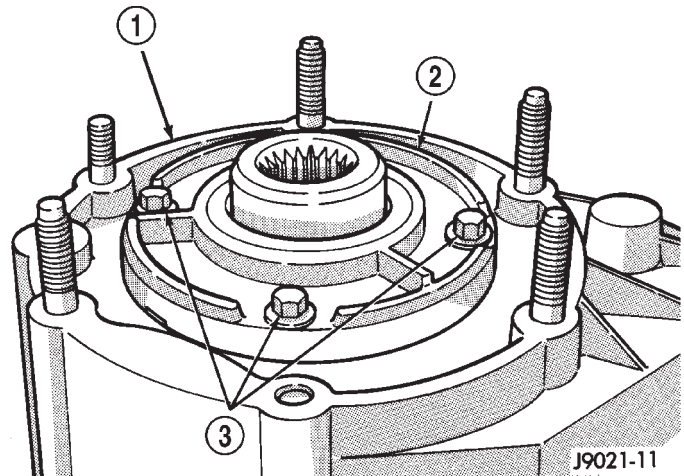
TRANSFER CASE - NV231 (Continued)



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**Fig. 29 Mode Hub Removal**

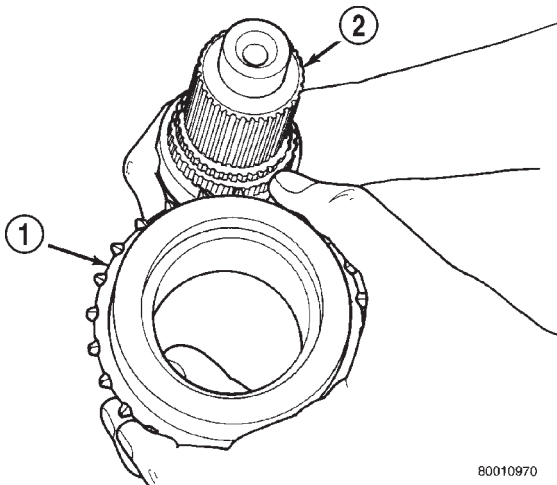
- 1 - MAINSHAFT
- 2 - MODE HUB



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**Fig. 31 Front Bearing Retainer Bolts**

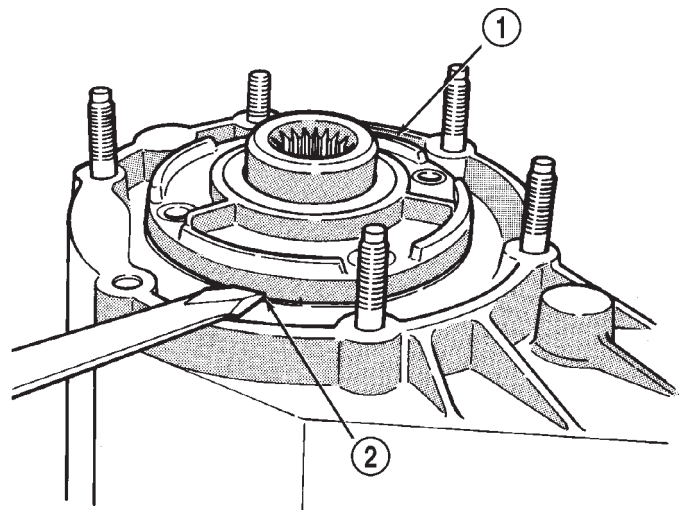
- 1 - FRONT CASE
- 2 - FRONT BEARING RETAINER
- 3 - RETAINER BOLTS



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**Fig. 30 Drive Sprocket Removal**

- 1 - DRIVE SPROCKET
- 2 - MAINSHAFT



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**Fig. 32 Front Bearing Retainer Removal**

- 1 - FRONT BEARING RETAINER
- 2 - RETAINER SLOT

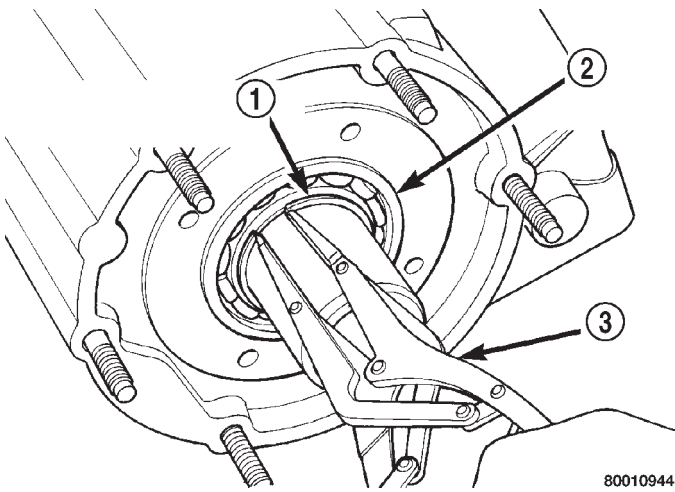
**INPUT GEAR AND LOW RANGE GEAR**

(1) Remove front bearing retainer attaching bolts (Fig. 31).

(2) Remove front bearing retainer. Pry retainer loose with pry tool positioned in slots at each end of retainer (Fig. 32).

TRANSFER CASE - NV231 (Continued)

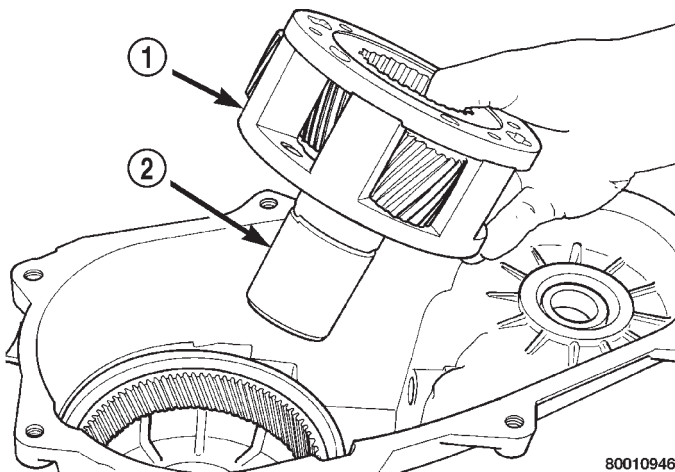
- (3) Remove front bearing retainer.
- (4) Remove input gear retaining ring with heavy duty snap-ring pliers (Fig. 33)



**Fig. 33 Removing Input Gear Retaining Ring**

- 1 - INPUT GEAR BEARING RETAINING RING
- 2 - INPUT GEAR BEARING
- 3 - SNAP-RING PLIERS

- (5) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 34). Tap gear out of bearing with plastic mallet if necessary.

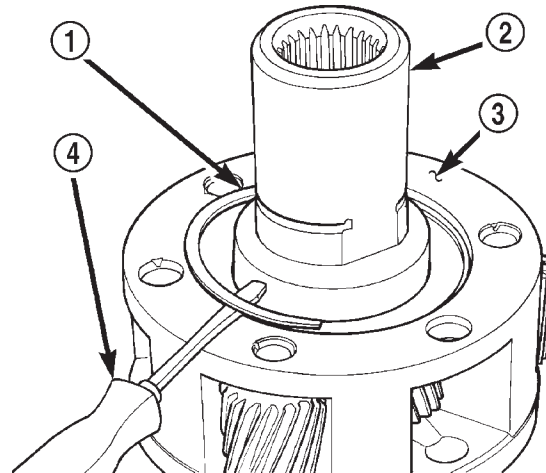


**Fig. 34 Input Gear And Planetary Carrier Removal**

- 1 - PLANETARY ASSEMBLY
- 2 - INPUT GEAR

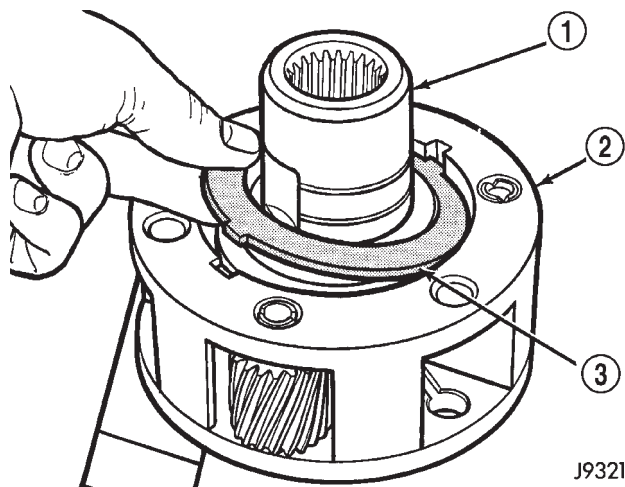
**INPUT AND LOW RANGE GEAR**

- (1) Remove snap-ring that retains input gear in low range gear (Fig. 35).
- (2) Remove retainer (Fig. 36).
- (3) Remove front tabbed thrust washer (Fig. 37).
- (4) Remove input gear (Fig. 38).
- (5) Remove rear tabbed thrust washer from low range gear (Fig. 39).



**Fig. 35 Input Gear Snap-Ring Removal**

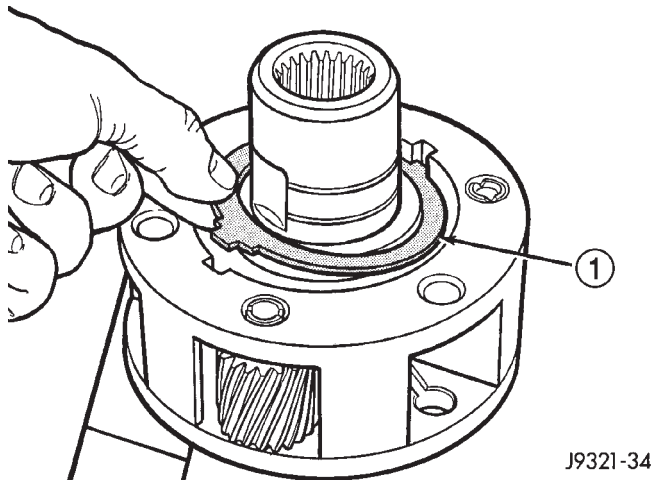
- 1 - CARRIER LOCK RETAINING RING
- 2 - INPUT GEAR
- 3 - PLANETARY CARRIER
- 4 - SCREWDRIVER



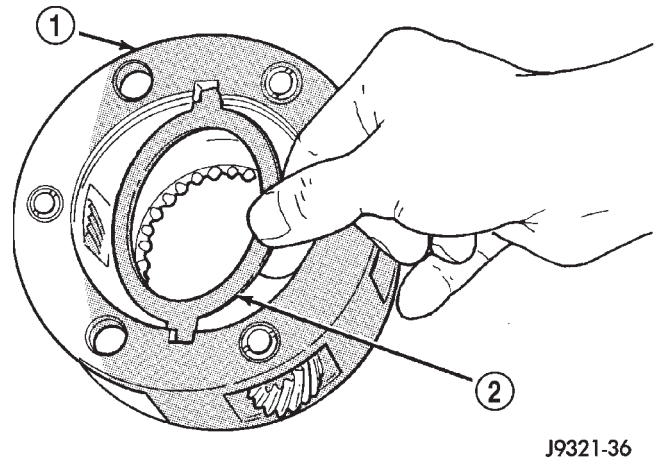
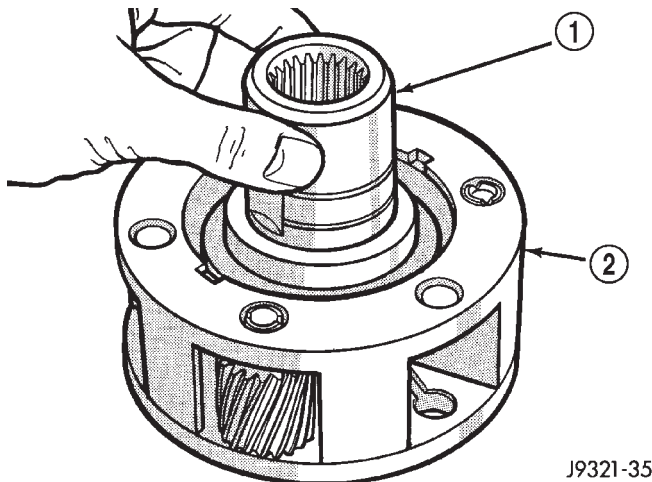
**Fig. 36 Input Gear Retainer Removal**

- 1 - INPUT GEAR
- 2 - LOW RANGE GEAR
- 3 - RETAINER

## TRANSFER CASE - NV231 (Continued)

**Fig. 37 Front Tabbed Thrust Washer Removal**

1 - FRONT TABBED THRUST WASHER

**Fig. 39 Rear Tabbed Thrust Washer Removal**1 - LOW RANGE GEAR  
2 - REAR TABBED THRUST WASHER**Fig. 38 Input Gear Removal**1 - INPUT GEAR  
2 - LOW RANGE GEAR**CLEANING**

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.

**INSPECTION****MAINSHAFT/SPROCKET/HUB**

Inspect the splines on the hub and shaft and the teeth on the sprocket (Fig. 40). Minor nicks and scratches can be smoothed with an oilstone. However, replace any part that 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.

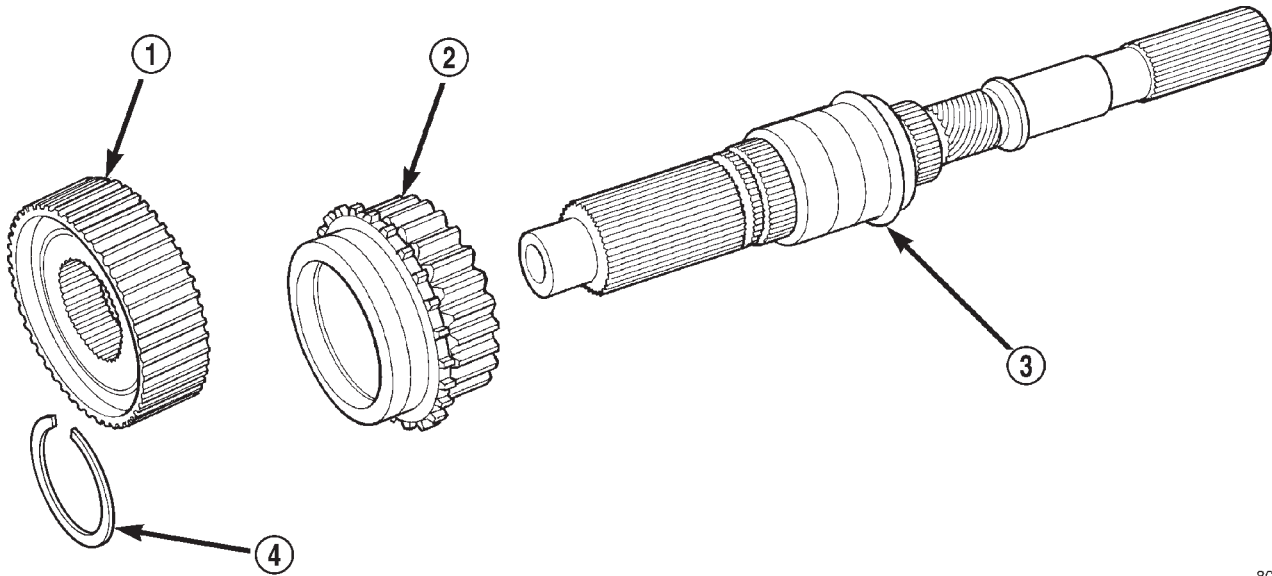
**INPUT GEAR AND PLANETARY CARRIER**

Check the teeth on the gear (Fig. 41). 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.

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.

TRANSFER CASE - NV231 (Continued)

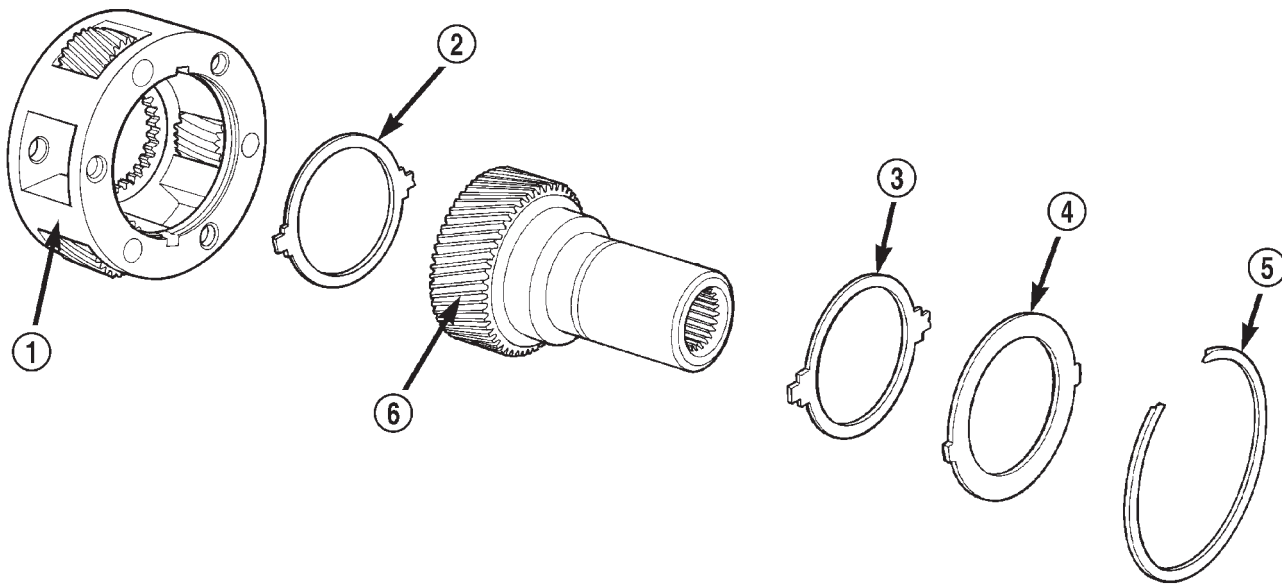


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**Fig. 40 Mainshaft, Mode Hub, And Drive Sprocket**

- 1 - MODE HUB
- 2 - DRIVE SPROCKET

- 3 - MAINSHAFT
- 4 - MODE HUB RETAINING RING



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**Fig. 41 Input Gear And Carrier Components**

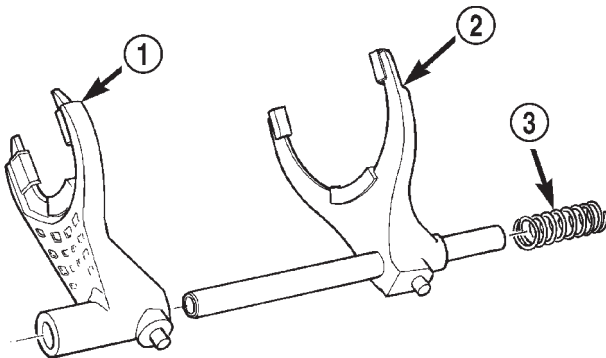
- 1 - PLANETARY CARRIER
- 2 - REAR THRUST WASHER
- 3 - FRONT THRUST WASHER

- 4 - CARRIER LOCK RING
- 5 - CARRIER LOCK RETAINING RING
- 6 - INPUT GEAR

## TRANSFER CASE - NV231 (Continued)

**SHIFT FORKS/HUBS/SLEEVES**

Check condition of the shift forks and mode fork shift rail (Fig. 42). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

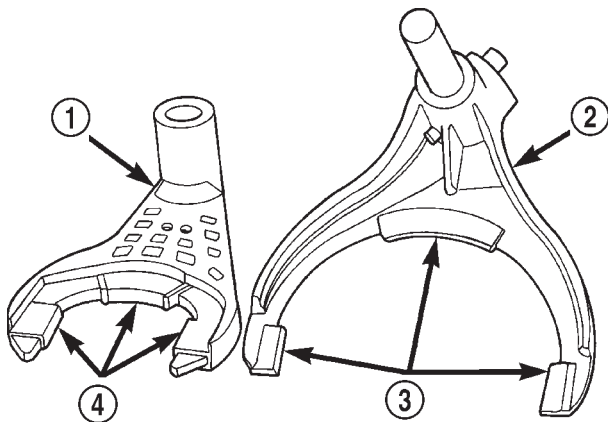


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**Fig. 42 Shift Forks**

- 1 - RANGE FORK
- 2 - MODE FORK AND RAIL
- 3 - MODE SPRING

Inspect the shift fork wear pads (Fig. 43). 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.



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**Fig. 43 Shift Fork And Wear Pad Locations**

- 1 - RANGE FORK
- 2 - MODE FORK
- 3 - WEAR PADS (SERVICEABLE)
- 4 - WEAR PADS (NON-SERVICEABLE)

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/BEARING/ SEAL/SLINGER/BOOT**

Inspect the retainer components (Fig. 44). 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.

An output shaft slinger is used on some vehicles, while an output shaft damper is used on other vehicles. The output shaft slinger and seal should be replaced outright; do not reuse either part.

Replace any part if distorted, bent, or broken. Also replace the boot if cut or torn. Replace the boot band clamps, do not reuse them.

**REAR OUTPUT SHAFT/YOKE/DRIVE CHAIN**

Check condition of the seal contact surfaces of the yoke slinger (Fig. 45). This surface must be clean and smooth to ensure proper seal life. Replace the yoke nut and seal washer as neither part should be reused.

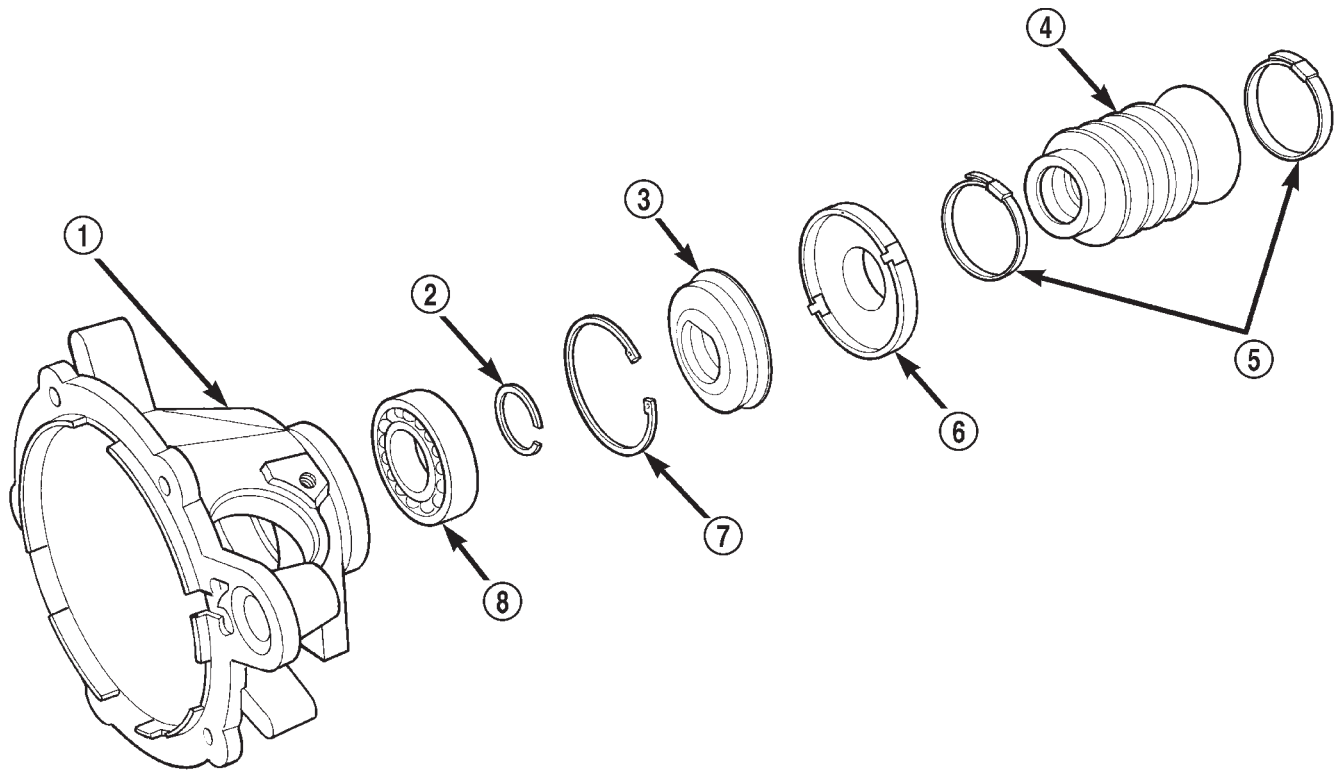
Inspect the shaft threads, sprocket teeth, and bearing surfaces. Minor nicks on the teeth can be smoothed with an oilstone. Use 320-400 grit emery to smooth minor scratches on the shaft bearing surfaces. Rough threads on the shaft can be chased if necessary. Replace the shaft if the threads are damaged, bearing surfaces are scored, or if any sprocket teeth are cracked or broken.

Examine the drive chain and shaft bearings. Replace the chain and both sprockets if the chain is 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. 46)

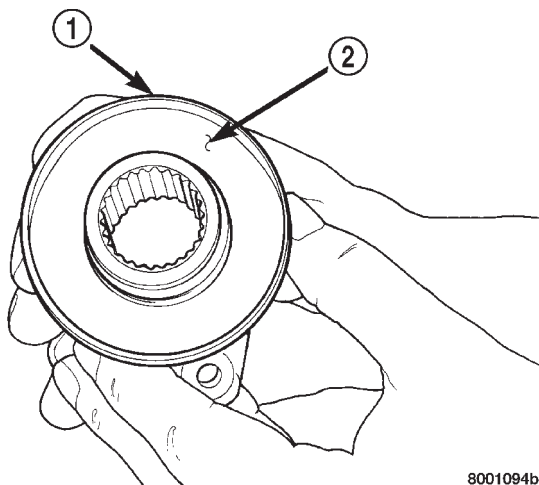
TRANSFER CASE - NV231 (Continued)



**Fig. 44 Rear Retainer Without Output Shaft Damper**

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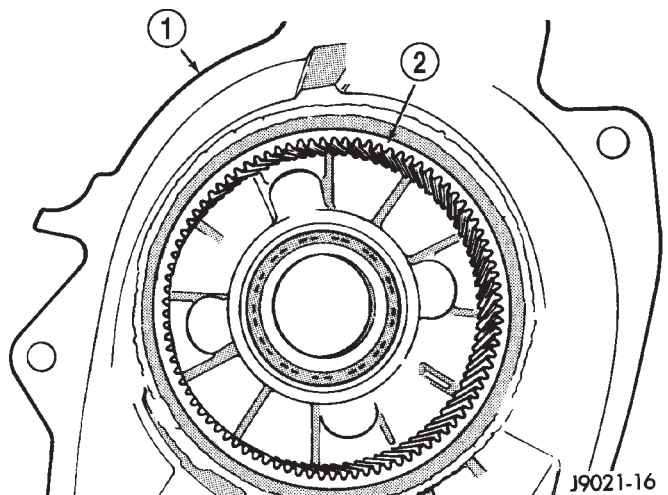
- |  |                                      |
|--|--------------------------------------|
| 1 - REAR RETAINER                              | 5 - BAND CLAMPS                      |
| 2 - REAR BEARING I.D. MAINSHAFT RETAINING RING | 6 - REAR SLINGER                     |
| 3 - REAR SEAL                                  | 7 - REAR BEARING O.D. RETAINING RING |
| 4 - BOOT                                       | 8 - REAR BEARING                     |



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**Fig. 45 Seal Contact Surface Of Yoke Slinger**

- 1 - FRONT SLINGER (PART OF YOKE)  
 2 - SEAL CONTACT SURFACE MUST BE CLEAN AND SMOOTH



J9021-16

**Fig. 46 Low Range Annulus Gear**

- 1 - FRONT CASE  
 2 - LOW RANGE ANNULUS GEAR



## TRANSFER CASE - NV231 (Continued)

**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. 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.

**ASSEMBLY**

Lubricate transfer case components with Mopar® ATF +4, type 9602, Automatic Transmission Fluid or petroleum jelly (where indicated) during assembly.

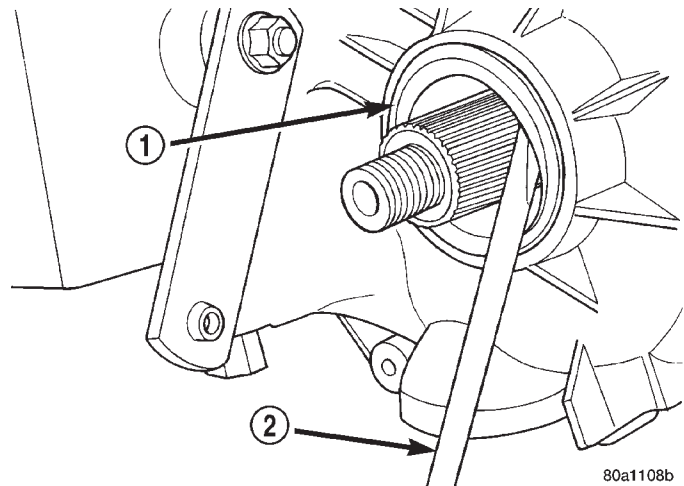
**BEARINGS AND SEALS**

**CAUTION:** The bearing bores in various transfer case components contain oil feed holes. Make sure replacement bearings do not block the holes.

(1) Remove the front output shaft seal from case with pry tool (Fig. 47).

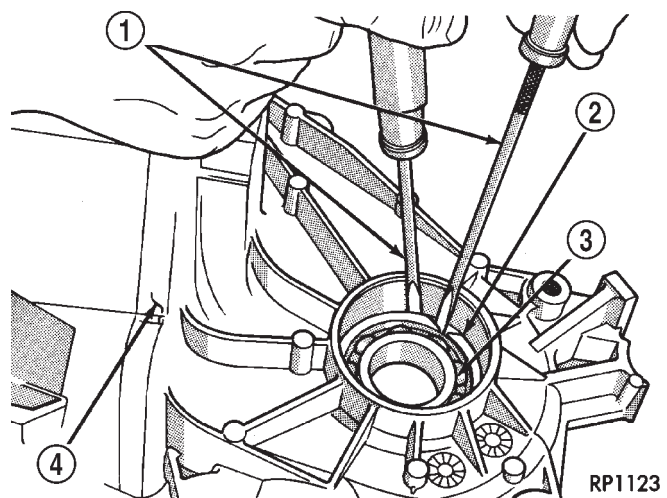
(2) Remove the front output shaft bearing retaining ring with screwdriver (Fig. 48).

(3) Remove bearing with Tool Handle C-4171 and Tool 5065 (Fig. 49).



**Fig. 47 Front Output Seal Removal - Typical**

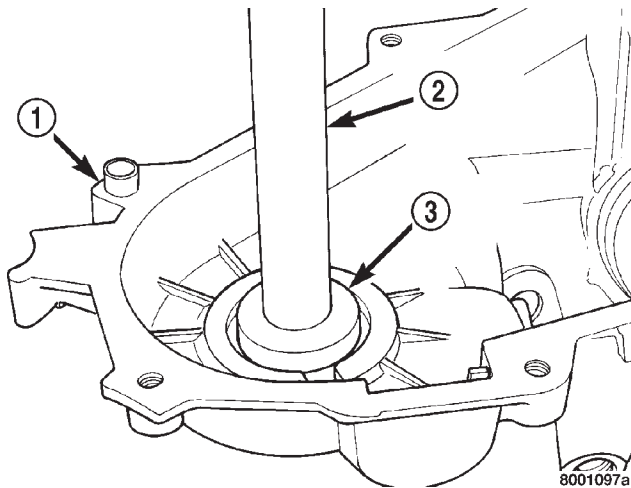
- 1 - OUTPUT SHAFT SEAL
- 2 - PRYBAR



**Fig. 48 Front Output Shaft Bearing Retaining Ring Removal**

- 1 - SCREWDRIVERS
- 2 - SNAP-RING
- 3 - FRONT OUTPUT SHAFT BEARING
- 4 - FRONT CASE

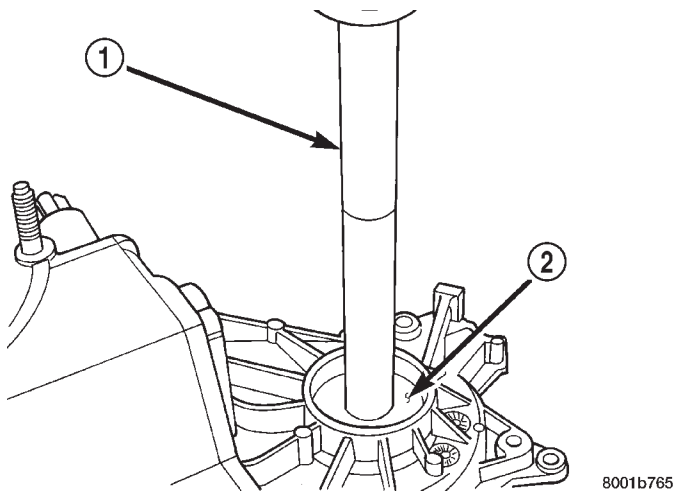
TRANSFER CASE - NV231 (Continued)



**Fig. 49 Front Output Shaft Bearing Removal**

- 1 - FRONT CASE
- 2 - SPECIAL TOOL C-4171
- 3 - SPECIAL TOOL 5065

(4) Install front output shaft front bearing in case with Tool Handle C-4171 and Installer 5064 (Fig. 50).



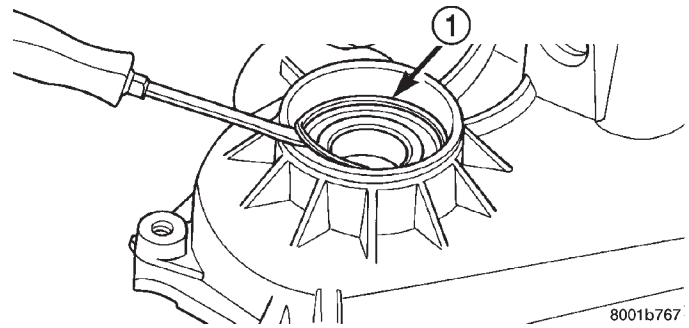
**Fig. 50 Front Output Shaft Bearing Installation**

- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL 5064

(5) Install output shaft front bearing retaining ring (Fig. 51). Start ring into place by hand. Then use small screwdriver to work ring into case groove. Be sure ring is fully seated before proceeding.

(6) Install new front output seal in front case with Installer Tool 8143-A as follows:

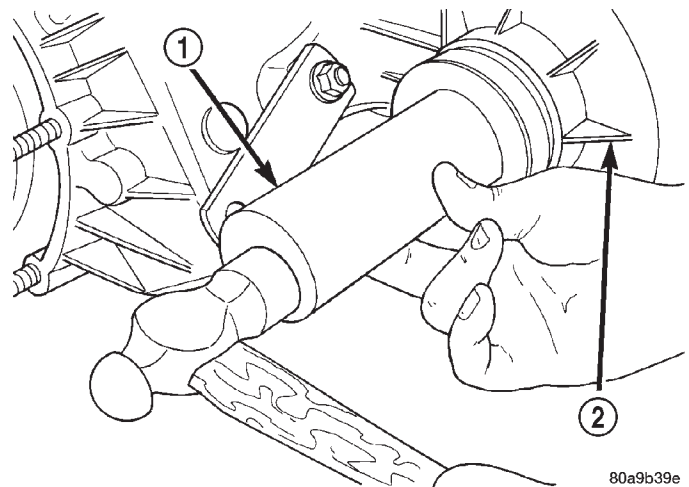
(a) Place new seal on tool. **Garter spring on seal goes toward interior of case.**



**Fig. 51 Installing Output Shaft Front Bearing Retaining Ring**

- 1 - WORK RETAINING RING INTO BORE GROOVE WITH SMALL SCREWDRIVER

(b) Start seal in bore with light taps from hammer (Fig. 52). Once seal is started, continue tapping seal into bore until installer tool bottoms against case.



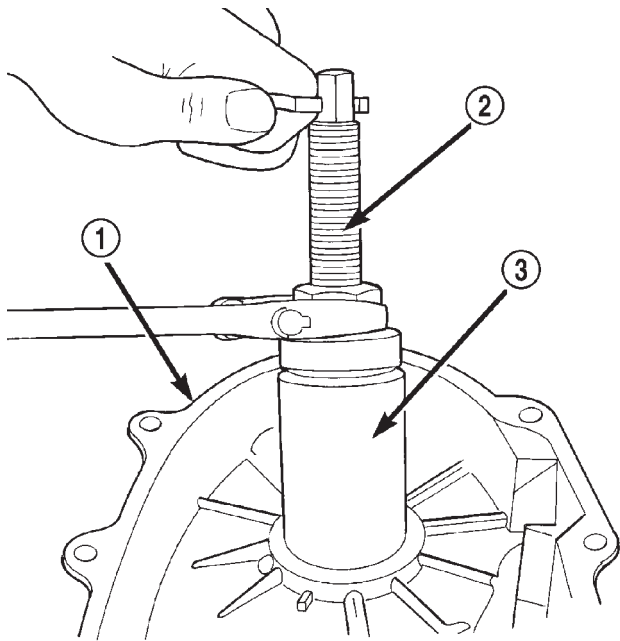
**Fig. 52 Front Output Seal Installation - Typical**

- 1 - INSTALLER 8143-A
- 2 - TRANSFER CASE

(7) Remove the output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 53).

(8) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 54). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 55).

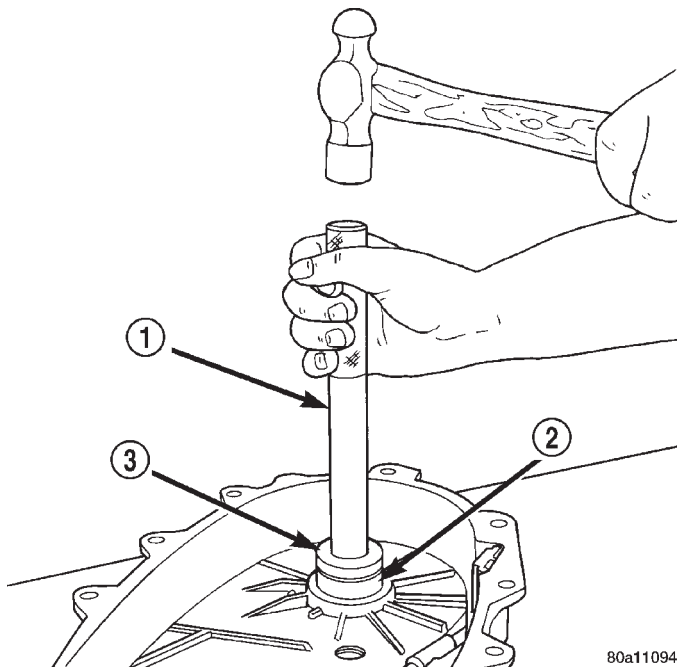
TRANSFER CASE - NV231 (Continued)



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**Fig. 53 Output Shaft Rear Bearing Removal**

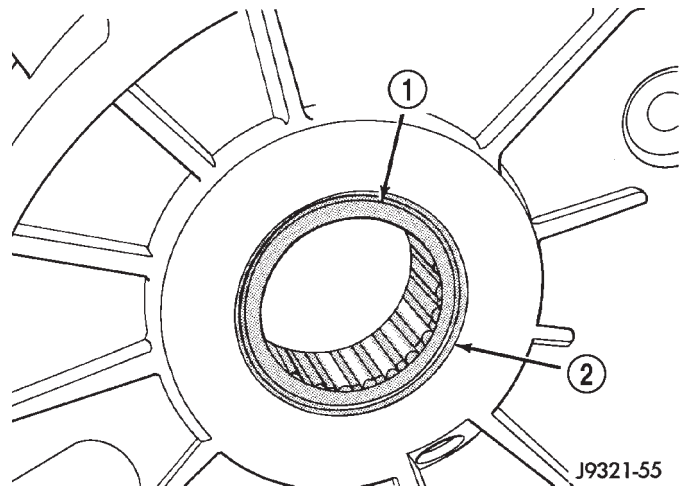
- 1 - REAR CASE
- 2 - SPECIAL TOOL L-4454-1 AND L-4454-3
- 3 - SPECIAL TOOL 8148



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**Fig. 54 Output Shaft Rear Bearing Installation**

- 1 - HANDLE C-4171
- 2 - OUTPUT SHAFT INNER BEARING
- 3 - INSTALLER 5066

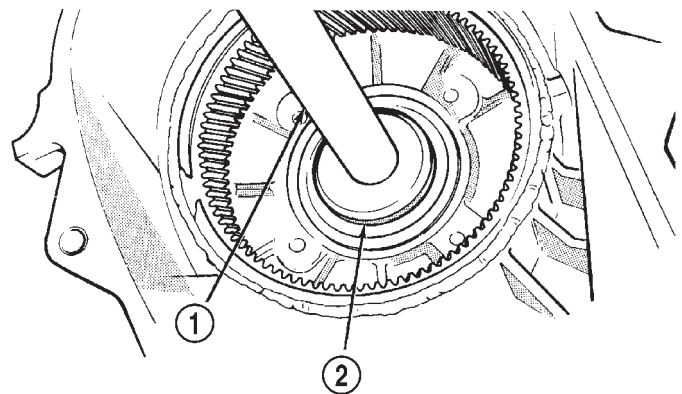


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**Fig. 55 Output Shaft Rear Bearing Installation Depth**

- 1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
- 2 - CHAMFER

(9) Using Remover C-4210 and Handle C-4171, drive input shaft bearing from inside the annulus gear bearing in the case (Fig. 56).



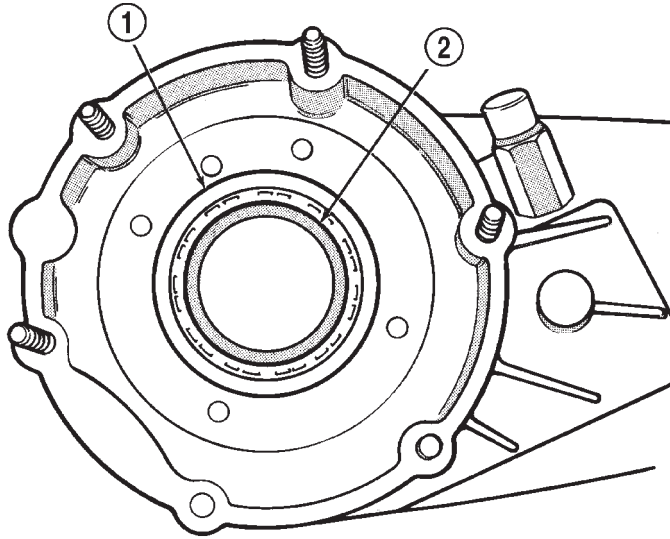
J9521-43

**Fig. 56 Input Shaft Bearing Removal**

- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL C-4210

(10) Install locating ring on new bearing.  
 (11) Position case so forward end is facing upward.  
 (12) Using Remover C-4210 and Handle C-4171, drive input shaft bearing into case. The bearing locating ring must be fully seated against case surface (Fig. 57).

TRANSFER CASE - NV231 (Continued)

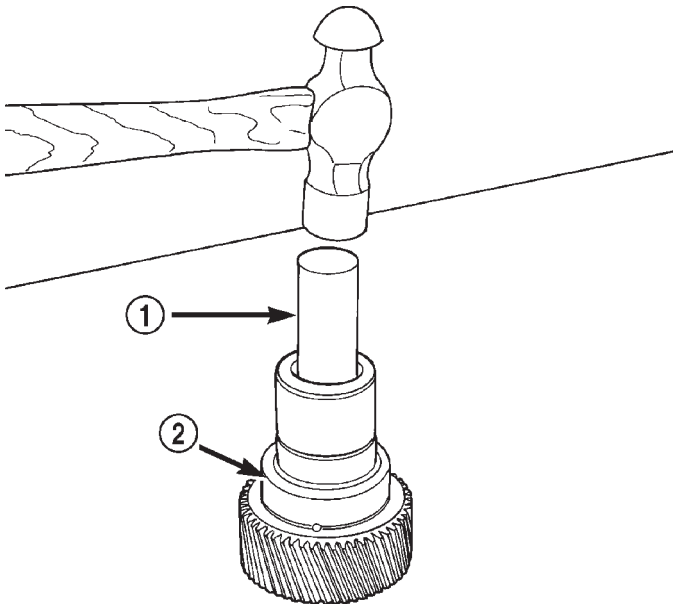


**Fig. 57 Seating Input Shaft Bearing** J8921-219

- 1 - SNAP-RING
- 2 - INPUT SHAFT BEARING

(13) 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. 58).

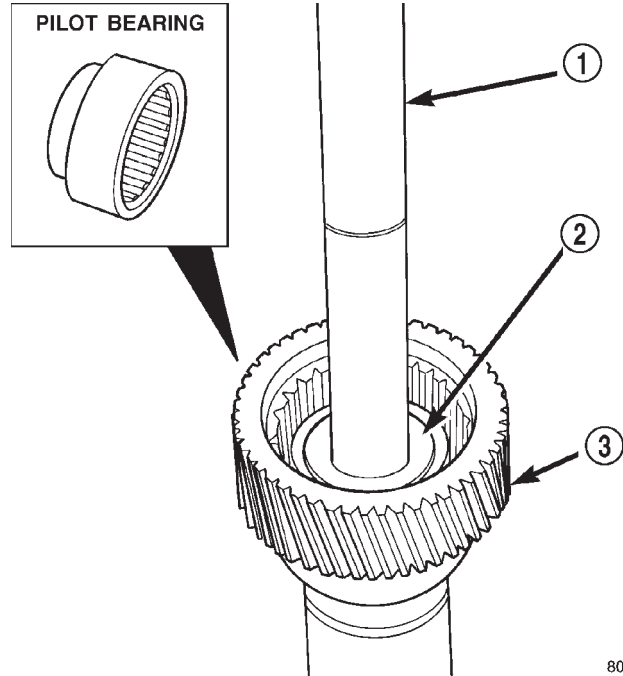
(14) Install new pilot bearing with Installer 5065 and Handle C-4171 (Fig. 59).



**Fig. 58 Remove Input Gear Pilot Bearing** 80a11090

- 1 - DRIFT
- 2 - INPUT GEAR

(15) Remove front bearing retainer seal with suitable pry tool.

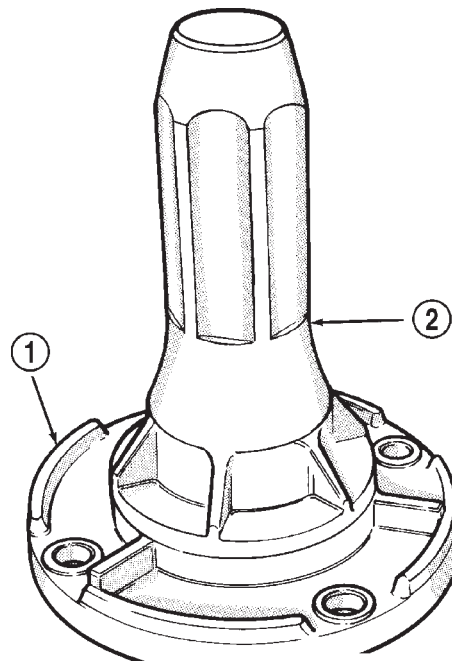


**Fig. 59 Install Input Gear Pilot Bearing**

- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL 5065
- 3 - INPUT GEAR

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(16) Install new front bearing retainer seal with Installer 7884 (Fig. 60).



**Fig. 60 Install Front Bearing Retainer Seal**

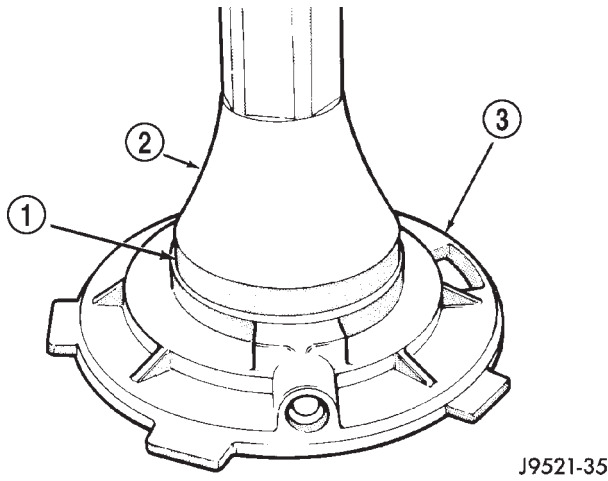
- 1 - FRONT BEARING RETAINER
- 2 - SPECIAL TOOL 7884

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TRANSFER CASE - NV231 (Continued)

(17) Remove seal from oil pump housing with a suitable pry tool

(18) Install new seal in oil pump housing with Installer 7888 (Fig. 61).

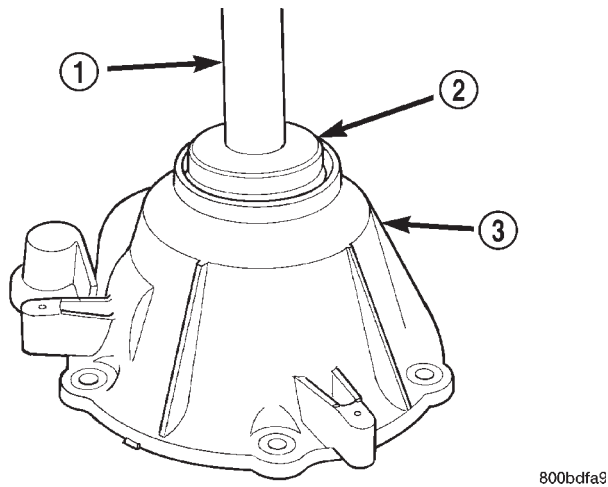


**Fig. 61 Oil Pump Seal Installation**

- 1 - HOUSING SEAL
- 2 - SPECIAL TOOL 7888
- 3 - OIL PUMP FEED HOUSING

(19) Remove rear retainer bearing with Installer 8128 and Handle C-4171.

(20) Install rear bearing in retainer with Handle C-4171 and Installer 5052 (Fig. 62).



**Fig. 62 Installing Rear Bearing In Retainer**

- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL 5052
- 3 - REAR RETAINER

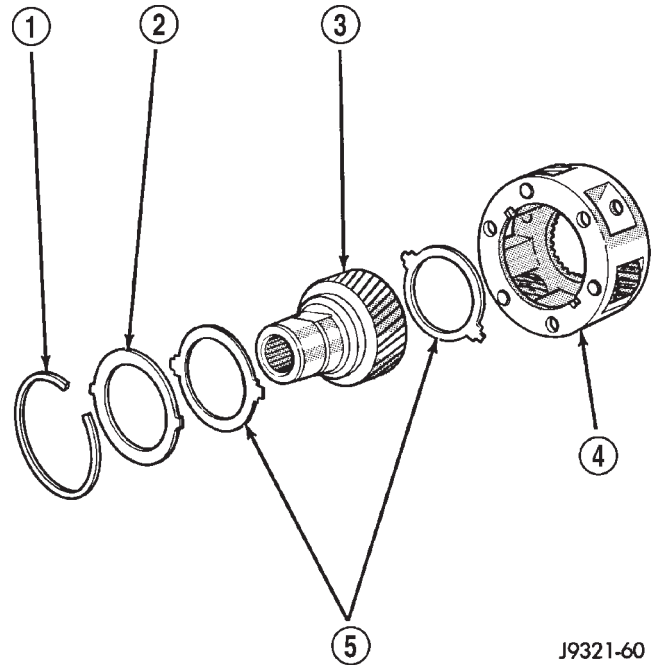
**INPUT AND LOW RANGE GEAR**

(1) Install first thrust washer in low range gear (Fig. 63). Be sure washer tabs are properly aligned in gear notches.

(2) Install input gear in low range gear. Be sure input gear is fully seated.

(3) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

(4) Install retainer on input gear and install snap-ring.



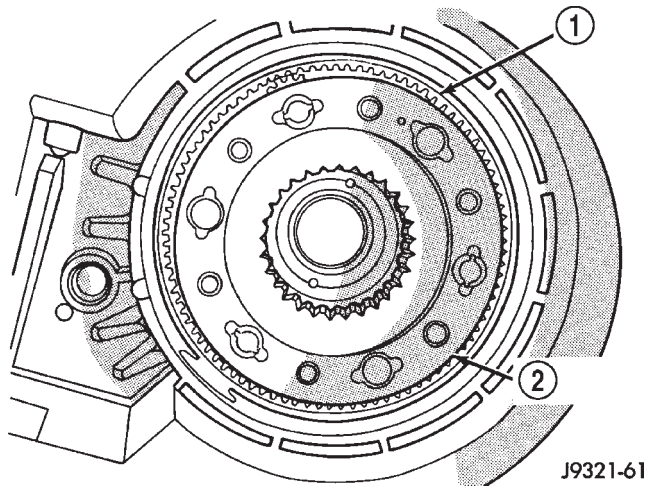
**Fig. 63 Input/Low Range Gear Components**

- 1 - SNAP-RING
- 2 - RETAINER PLATE
- 3 - INPUT GEAR
- 4 - LOW RANGE GEAR
- 5 - THRUST WASHERS

(5) 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.

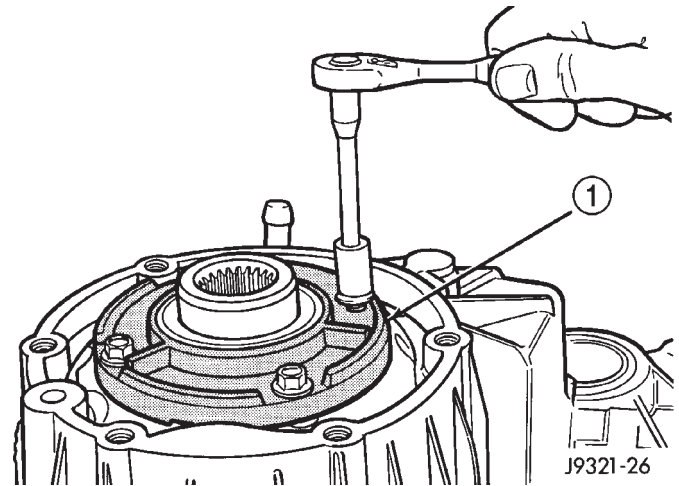
(6) Install snap-ring to hold input/low range gear into front bearing (Fig. 65).

TRANSFER CASE - NV231 (Continued)



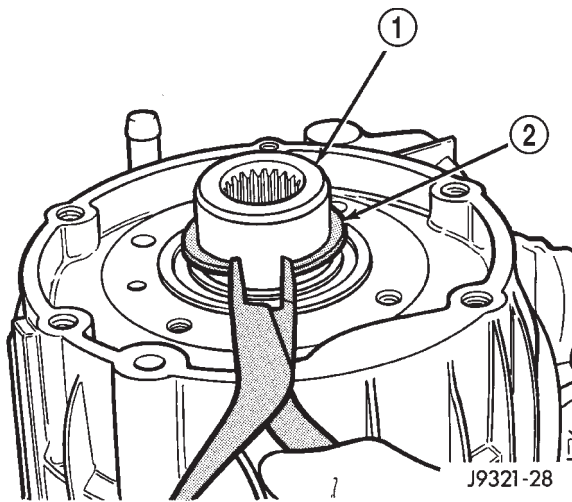
**Fig. 64 Input/Low Range Gear Installation**

- 1 - ANNULUS GEAR
- 2 - INPUT/LOW RANGE GEAR



**Fig. 66 Install Front Bearing Retainer**

- 1 - FRONT BEARING RETAINER



**Fig. 65 Install Snap-Ring**

- 1 - INPUT GEAR
- 2 - SNAP-RING

(7) Clean gasket sealer residue from retainer and inspect retainer for cracks or other damage.

(8) Apply a 3 mm (1/8 in.) bead of Mopar® gasket maker or silicone adhesive to sealing surface of retainer.

(9) 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.

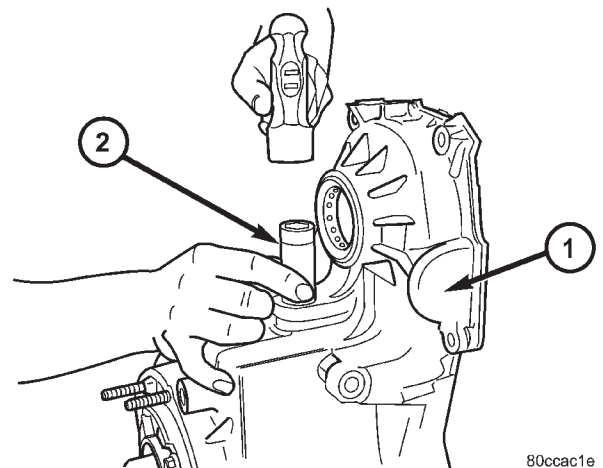
(10) Install bolts to hold retainer to transfer case (Fig. 66). Tighten to 21 N·m (16 ft. lbs.) of torque.

**MAINSHAFT**

- (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, SECTOR, AND MAINSHAFT**

- (1) Install the shift sector shaft bearing using a suitable socket until the bearing is flush to the bottom, inner edge of the bore (Fig. 67).



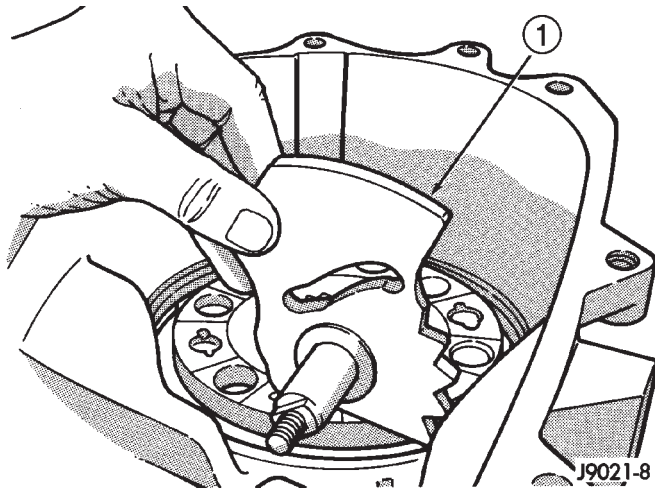
**Fig. 67 Install Shift Sector Shaft Bearing**

- 1 - TRANSFER CASE
- 2 - SOCKET

(2) Install a new shift sector shaft seal using a suitable socket until the seal is flush to the bottom of the bore lead-in chamfer.

TRANSFER CASE - NV231 (Continued)

(3) Install shift sector in case (Fig. 68). Lubricate sector shaft with transmission fluid before installation.

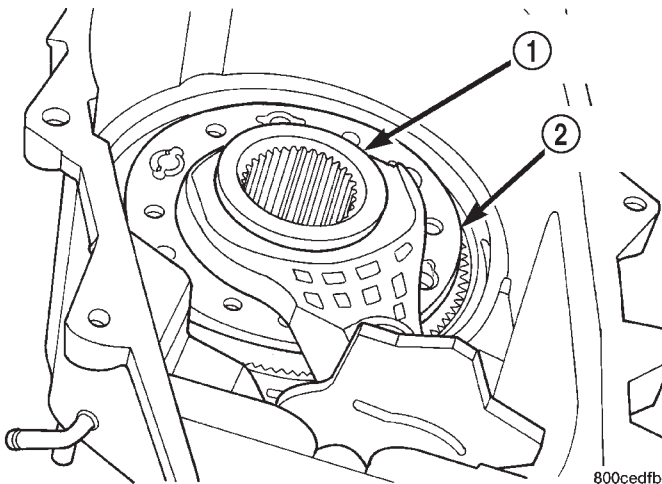


**Fig. 68 Shift Sector Installation**

- 1 - SHIFT SECTOR

(4) Assemble and install range fork and hub (Fig. 69). Be sure hub is properly seated in low range gear and engaged to the input gear.

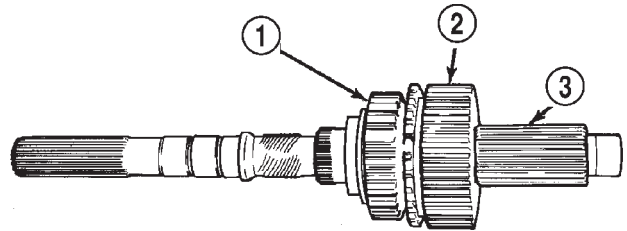
(5) Align and insert range fork pin in shift sector slot.



**Fig. 69 Install Range Fork And Sleeve Assembly**

- 1 - RANGE SLEEVE
- 2 - RANGE FORK

(6) Install assembled mainshaft (Fig. 70). Be sure shaft is seated in pilot bearing and input gear.



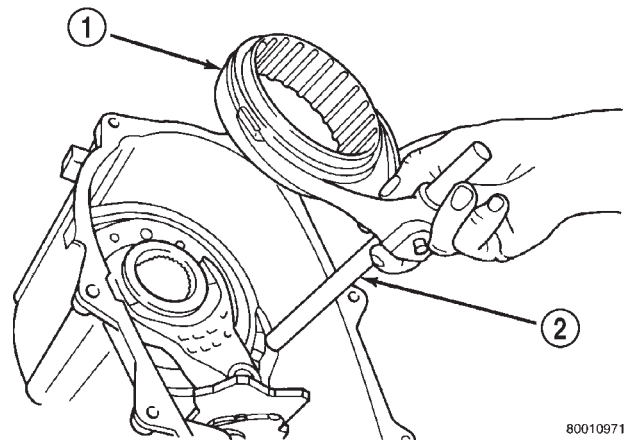
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**Fig. 70 Mainshaft Assembly Installation**

- 1 - DRIVE SPROCKET
- 2 - MODE HUB
- 3 - MAINSHAFT

(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. 71).



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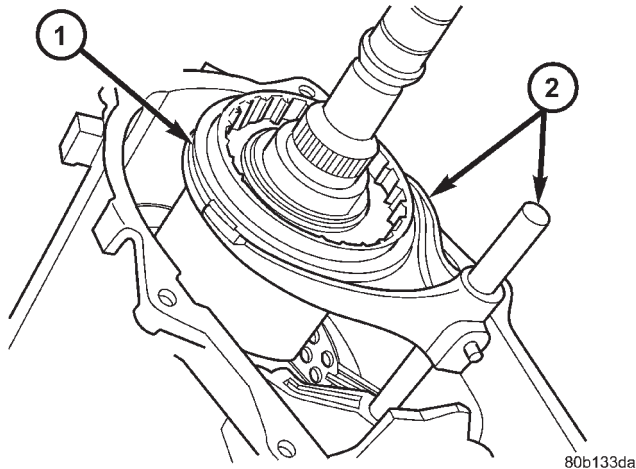
**Fig. 71 Assembling Mode Fork And Sleeve**

- 1 - MODE SLEEVE
- 2 - MODE FORK AND RAIL

(9) Install assembled mode fork and sleeve (Fig. 72). Be sure fork rail goes through range fork and into case bore. Also be sure sleeve is aligned and seated on mainshaft hub.

(10) Rotate sector to NEUTRAL position.

TRANSFER CASE - NV231 (Continued)

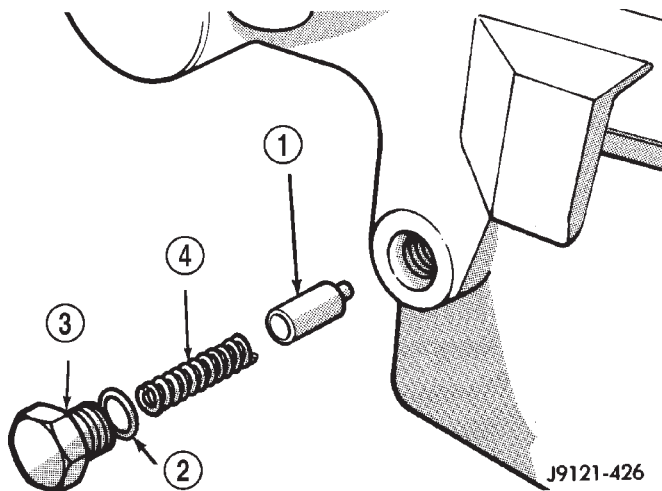


80b133da

**Fig. 72 Mode Fork And Sleeve Installation**

- 1 - MODE SLEEVE
- 2 - MODE FORK AND RAIL

- (11) Install new O-ring on detent plug (Fig. 73).
- (12) Lubricate detent plunger with transmission fluid or light coat of petroleum jelly.
- (13) Install detent plunger, spring and plug (Fig. 73).
- (14) Verify that plunger is properly engaged in sector.



J9121-426

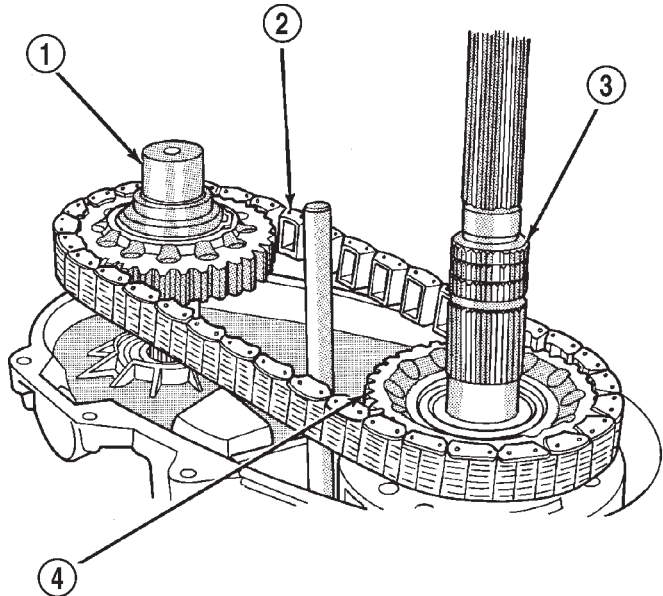
**Fig. 73 Detent Plug, Spring, And Plunger Installation**

- 1 - PLUNGER
- 2 - O-RING
- 3 - PLUG
- 4 - SPRING

**FRONT OUTPUT SHAFT AND DRIVE CHAIN**

- (1) Lubricate front output shaft-sprocket assembly, drive chain, and drive sprocket with transmission fluid.
- (2) Assemble drive chain and front output shaft (Fig. 74).

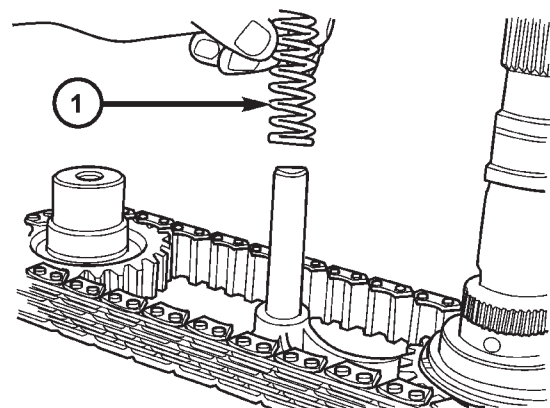
- (3) Start chain on mainshaft drive sprocket.
- (4) Guide front shaft into bearing and drive sprocket onto mainshaft drive gear (Fig. 74).
- (5) Install mode spring on upper end of mode fork shift rail (Fig. 75).



J9321-72

**Fig. 74 Installing Drive Chain And Front Output Shaft**

- 1 - FRONT OUTPUT SHAFT
- 2 - DRIVE CHAIN
- 3 - MAINSHAFT
- 4 - DRIVE SPROCKET



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**Fig. 75 Mode Fork Spring Removal**

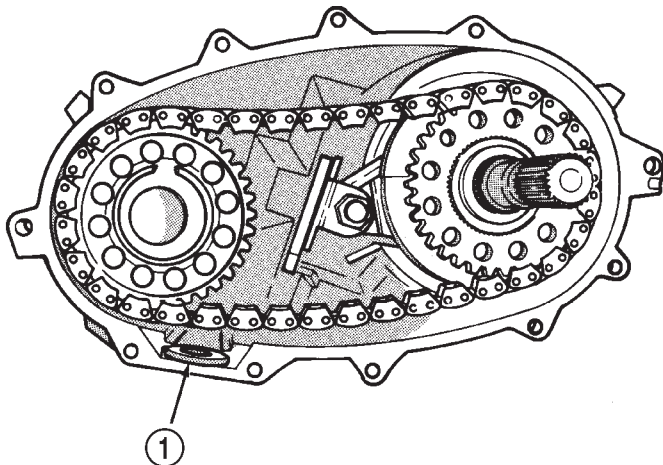
- 1 - MODE FORK SPRING



## TRANSFER CASE - NV231 (Continued)

## OIL PUMP AND REAR CASE

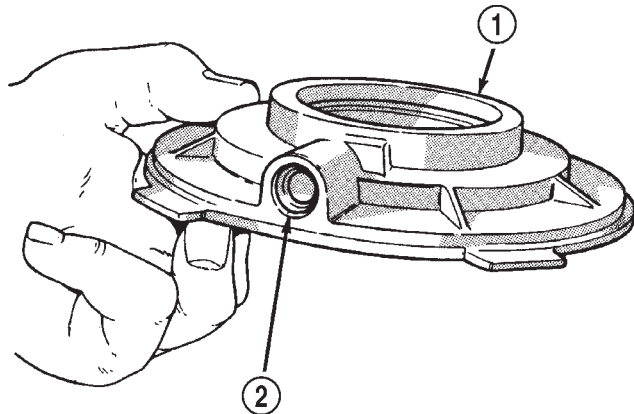
- (1) Install magnet in front case pocket (Fig. 76).
- (2) Assemble oil pickup screen, connecting hose, and tube.
- (3) Install new pickup tube O-ring in oil pump (Fig. 77).



J8921-288

**Fig. 76 Installing Case Magnet**

1 - MAGNET

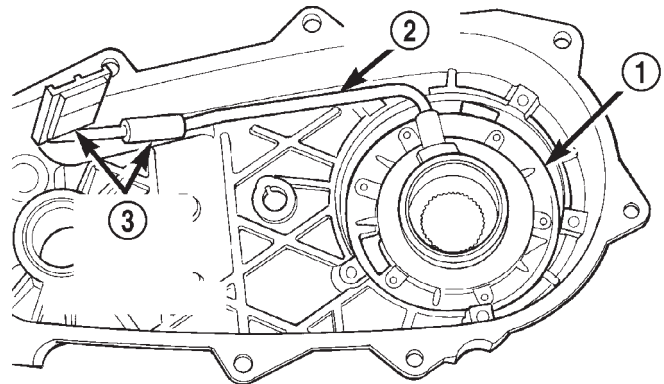


RR21F27

**Fig. 77 Pickup Tube O-Ring Position**1 - OIL PUMP  
2 - O-RING

- (4) Insert oil pickup tube in oil pump inlet.
- (5) Position assembled oil pump and pickup tube in rear case. Be sure pickup screen is securely seated in case slot. Also be sure oil pump locating tabs are outside rear case (Fig. 78).

(6) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to mounting flange of front case. Work sealer bead around bolt holes.



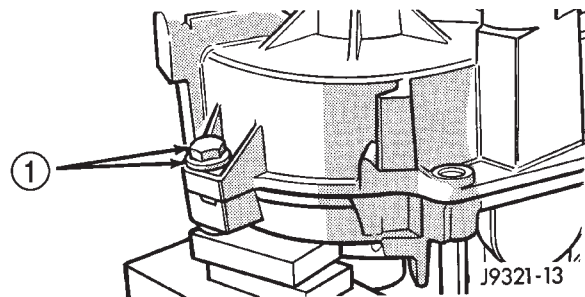
800bdf98

**Fig. 78 Oil Pump And Pickup Tube Installation**1 - OIL PUMP  
2 - PICKUP TUBE  
3 - PICKUP SCREEN AND CONNECTOR

- (7) Lift rear case and oil pump and carefully position assembly on front case. Be sure case dowels are aligned and that mode fork rail extends through rear case before seating rear case on front case.

(8) Install case attaching bolts. Alignment bolts at each end of case are only ones requiring washers (Fig. 79).

- (9) Tighten case bolts to 27-34 N·m (20-25 ft. lbs.) torque.



J9321-13

**Fig. 79 Alignment Bolt Location**

1 - ALIGNMENT BOLT AND WASHER (AT EACH END OF CASE)

## COMPANION FLANGE AND RANGE LEVER

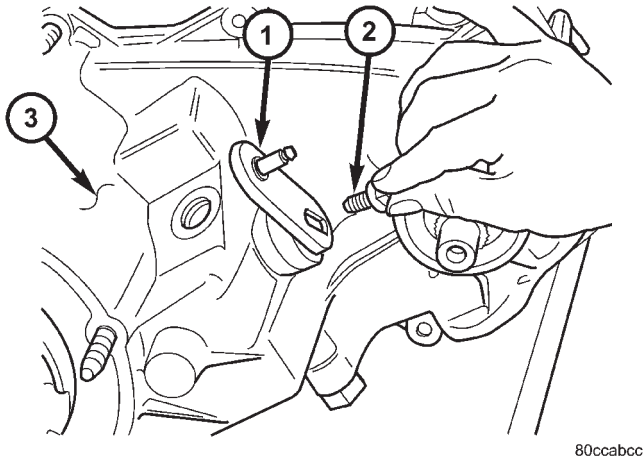
- (1) Install range lever and bolt on sector shaft (Fig. 80). Tighten bolt to 27-34 N·m (20-25 ft. lbs.) torque.

(2) Inspect the o-ring on the transfer case position sensor. Replace the o-ring if necessary.

(3) Install the transfer case position sensor in the front case (Fig. 81). Tighten sensor to 20-34 N·m (15-25 ft. lbs.) torque.

(4) Install new seal washer on front output shaft (Fig. 82).

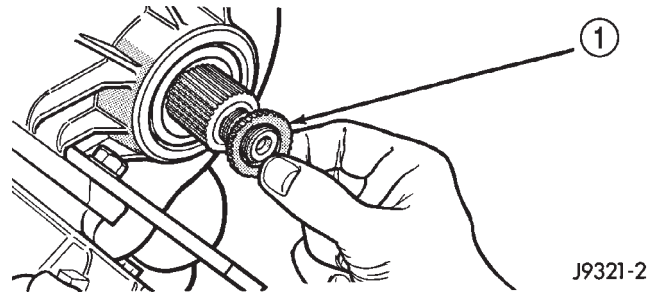
TRANSFER CASE - NV231 (Continued)



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**Fig. 80 Install Shift Lever Bolt**

- 1 - RANGE LEVER
- 2 - RANGE LEVER BOLT
- 3 - TRANSFER CASE



J9321-2

**Fig. 82 Seal Washer Installation**

- 1 - SEAL WASHER

**REAR RETAINER**

(1) Apply bead of Mopar® Sealer P/N 82300234, or Loctite™ Ultra Gray, to mating surface of rear retainer. Sealer bead should be a maximum of 3/16 inch.

(2) Install the forward rear output shaft bearing locating snap-ring.

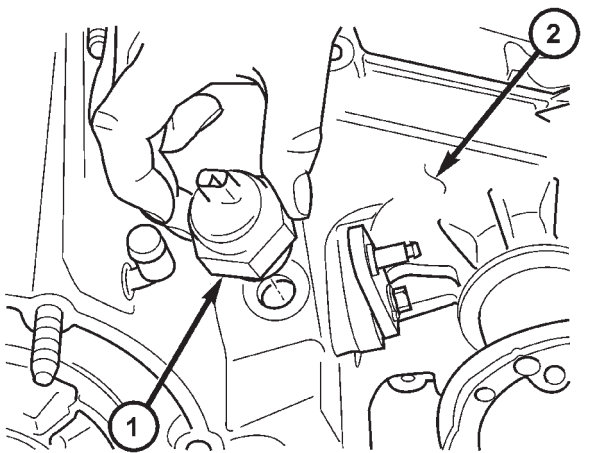
(3) Install rear retainer on rear case. Tighten retainer bolts to 20-27 N-m (15-20 ft. lbs.) torque.

(4) Install rear bearing I.D. retaining ring onto output shaft.

(5) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(6) Slide seal onto Seal Protector 8824 (Fig. 83). Slide seal protector and seal onto output shaft.

(7) Slide Installer 8691 onto seal and mainshaft. Drive seal into rear bearing retainer (Fig. 84).



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**Fig. 81 Install Transfer Case Position Sensor**

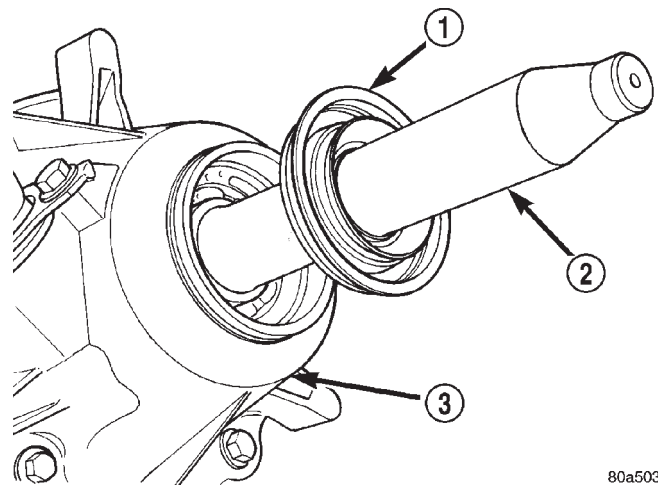
- 1 - TRANSFER CASE POSITION SENSOR
- 2 - TRANSFER CASE

(5) Lubricate companion flange hub with transmission fluid and install flange onto the front output shaft.

(6) Install new seal washer on front shaft.

(7) Install new flange nut onto front output shaft.

(8) Tighten flange nut to 122-176 N-m (90-130 ft. lbs.) torque.

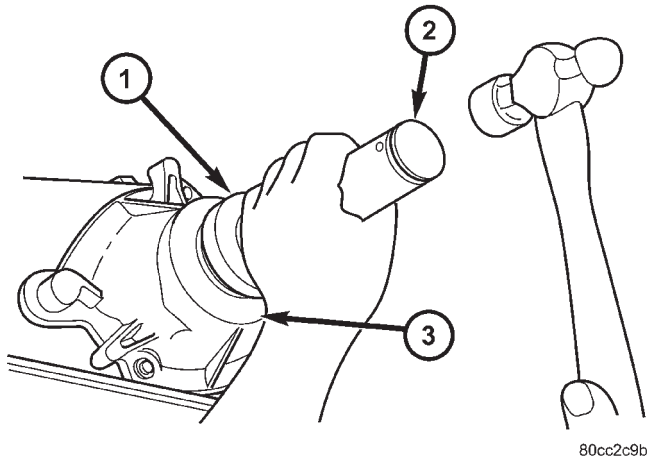


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**Fig. 83 Output Shaft Seal and Protector**

- 1 - OUTPUT SHAFT SEAL
- 2 - SPECIAL TOOL 8824
- 3 - TRANSFER CASE

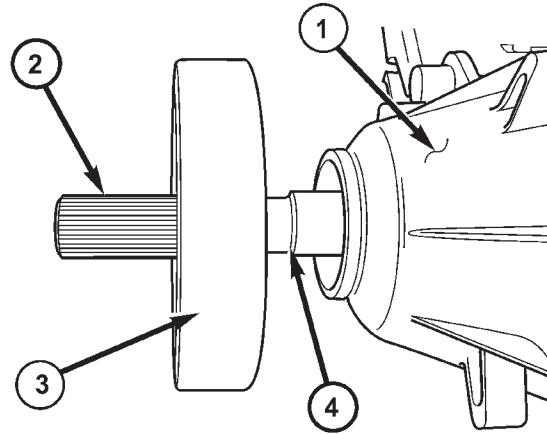
TRANSFER CASE - NV231 (Continued)



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**Fig. 84 Rear Seal Installation**

- 1 - SPECIAL TOOL 8691
- 2 - HANDLE
- 3 - TRANSFER CASE



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**Fig. 85 Position Damper on Output Shaft**

- 1 - TRANSFER CASE
- 2 - OUTPUT SHAFT
- 3 - DAMPER WEIGHT
- 4 - CHAMFER

(8) Install a new output shaft rear slinger with Installer 8408, if the vehicle is equipped with an automatic transmission.

(9) If the vehicle is equipped with a manual transmission, install the output shaft damper as follows:

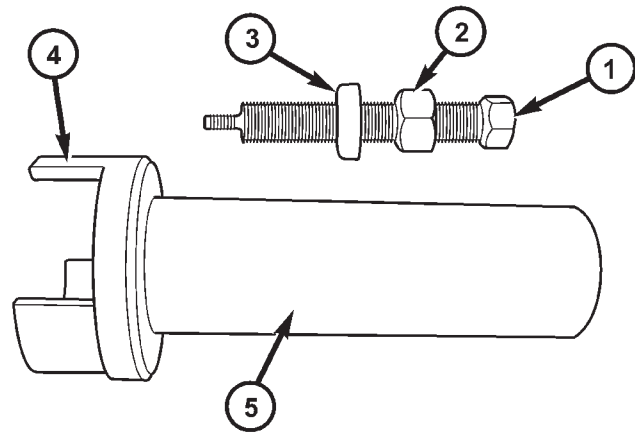
(a) Position the damper weight on the output shaft. Start the damper onto the output shaft chamfer, being careful to keep the weight square to the output shaft. (Fig. 85)

**NOTE:** Be sure that the damper is installed with the raised mounting flange for the propeller shaft boot is towards the rear of the mainshaft.

(b) Position Driver Installer 8680 (Fig. 86) onto the damper, making sure the legs of the installer are positioned through the slots of the damper.

(c) Thread the puller screw from Installer 8422 into the output shaft by hand only. Make sure the screw is fully threaded into the output shaft.

(d) Using a wrench to hold the pulling screw stationary (Fig. 87), turn the pulling screw nut until the driver legs contact the rear face of the transfer case rear retainer. When the legs contact the retainer, the damper is properly positioned on the output shaft.

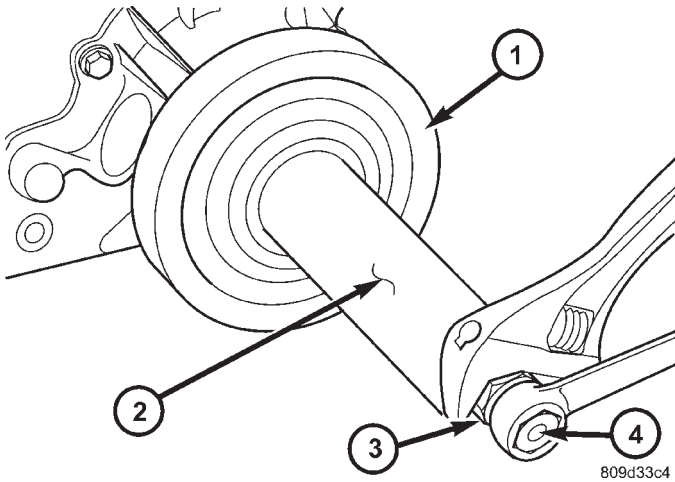


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**Fig. 86 Driver Installer 8680 and Puller Screw from 8422**

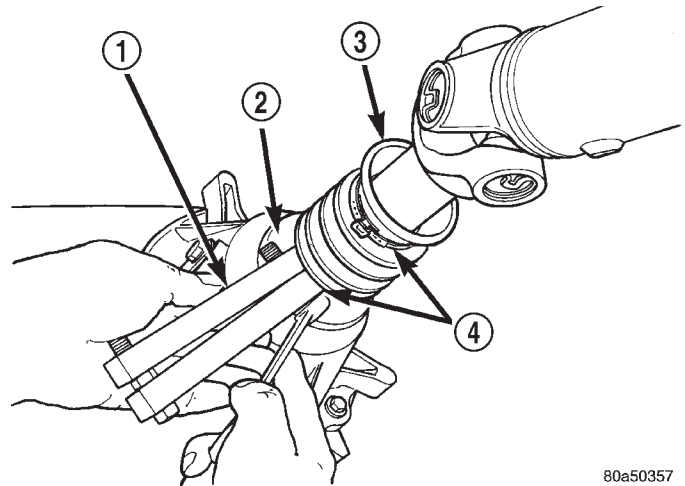
- 1 - PULLING SCREW
- 2 - PULLING SCREW NUT
- 3 - BEARING
- 4 - DRIVER LEGS
- 5 -INSTALLER DRIVER

TRANSFER CASE - NV231 (Continued)



**Fig. 87 Install Damper**

- 1 - DAMPER
- 2 - INSTALLER DRIVER
- 3 - PULLING SCREW NUT
- 4 - PULLING SCREW



**Fig. 88 Slinger Boot Installation - Typical**

- 1 - SPECIAL TOOL C-4975-A
- 2 - SLINGER
- 3 - BOOT
- 4 - CLAMP

(10) Install boot on output shaft slinger, or output shaft damper, and crimp retaining clamp with tool C-4975-A (Fig. 88).

**INSTALLATION**

- (1) Mount transfer case on a transmission jack.
- (2) Secure transfer case to jack with chains.
- (3) Position transfer case under vehicle.
- (4) Align transfer case and transmission shafts and install transfer case on transmission.
- (5) Install and tighten transfer case attaching nuts to 35 N·m (26 ft. lbs.) torque.
- (6) Connect vent hose.
- (7) Connect transfer case position sensor connector to sensor.

(8) Align and connect propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).

(9) Fill transfer case with correct fluid. Check transmission fluid level. Correct as necessary.

(10) Install skid plate. (Refer to 13 - FRAME & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION)

(11) Remove transmission jack and support stand.

(12) Connect shift cable to transfer case range lever.

(13) Lower vehicle and verify transfer case shift operation.

TRANSFER CASE - NV231 (Continued)

SPECIFICATIONS

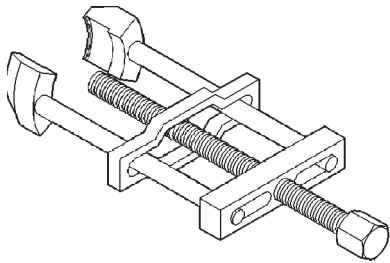
TRANSFER CASE - NV231

TORQUE

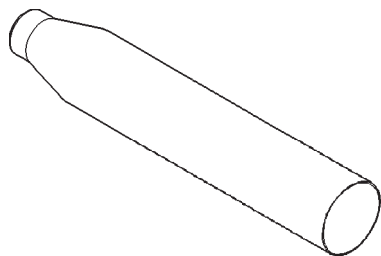
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Front Brg. Retainer	21	16	-
Bolt, Case Half	27-34	20-25	-
Nut, Front Companion Flange	122-176	90-130	-
Bolt, Range Lever	27-34	20-25	-
Bolt, Rear Retainer	35-46	26-34	-
Nuts, Mounting	35-47	26-35	-
Sensor, Transfer Case Position	20-34	15-25	-

SPECIAL TOOLS

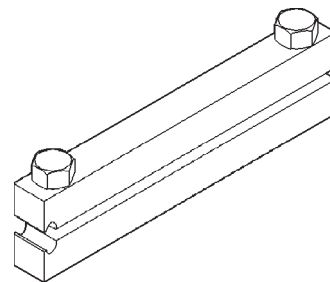
TRANSFER CASE - NV231



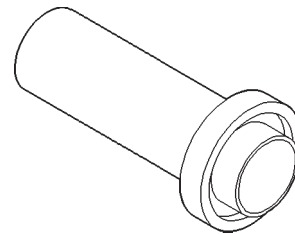
*Puller, Slinger - MD-998056-A*



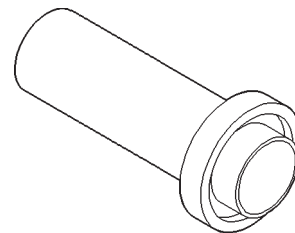
*Protector, Seal - 8824*



*Installer, Boot Clamp - C-4975-A*

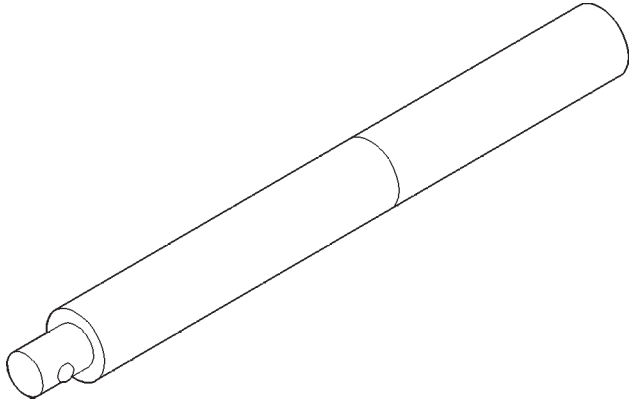


*Installer, Seal - 8143-A*

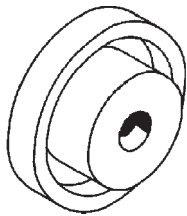


*Installer, Seal - 8691*

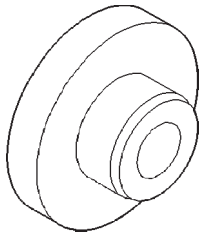
TRANSFER CASE - NV231 (Continued)



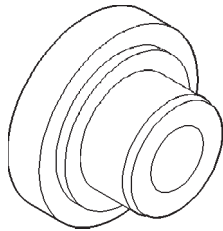
**Handle, Universal - C-4171**



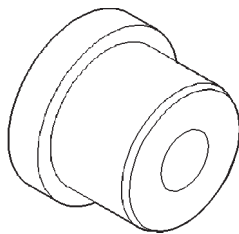
**Installer, Seal - C-4210**



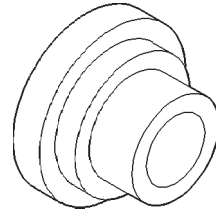
**Installer, Bearing - 5052**



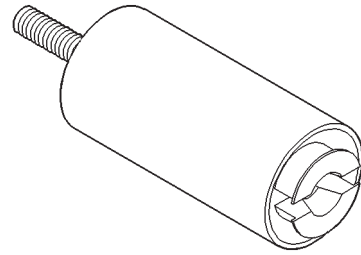
**Installer, Bearing - 5065**



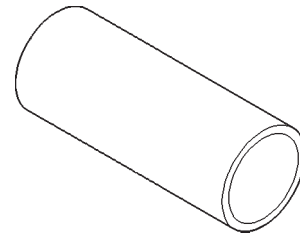
**Installer, Bushing - 5066**



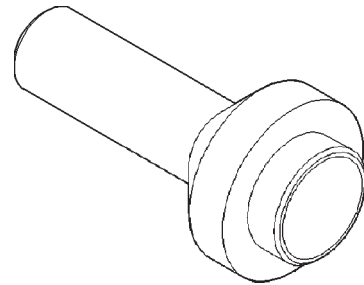
**Installer, Bearing - 8128**



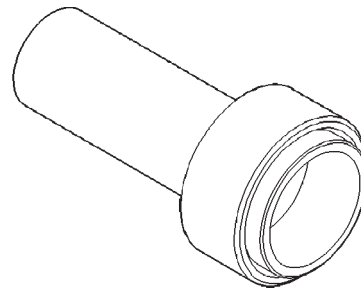
**Remover - L-4454**



**Cup - 8148**

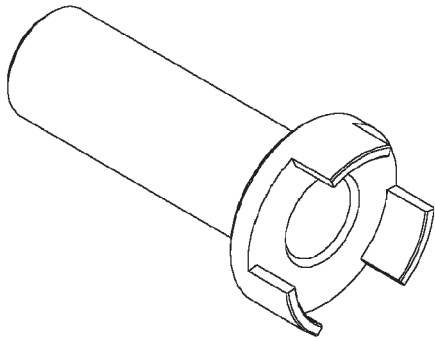
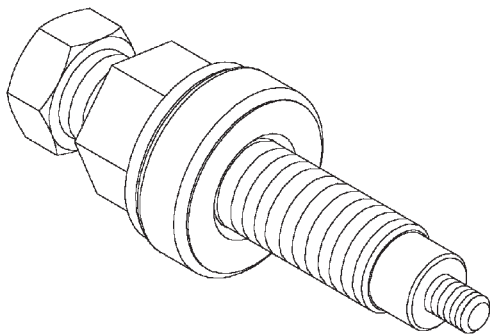
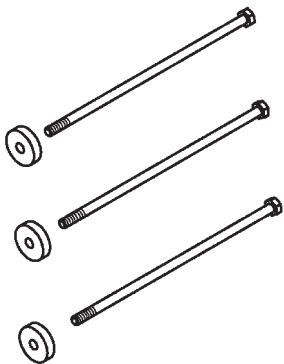
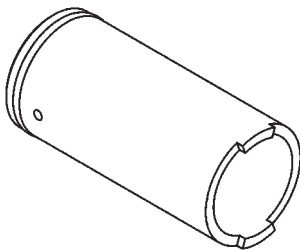


**Installer, Seal - 7884**

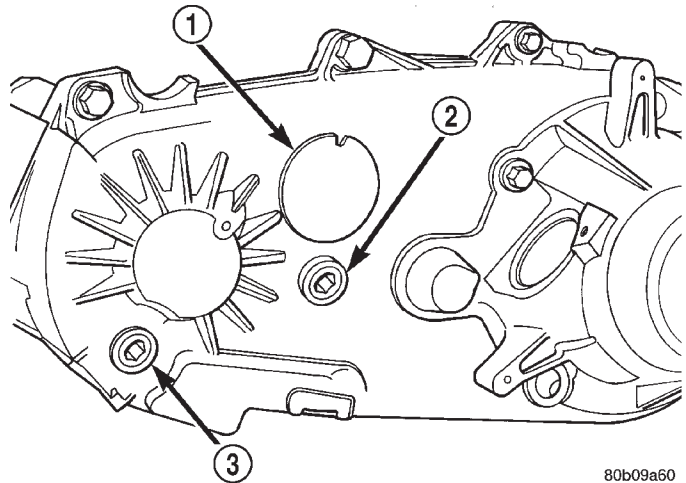


**Installer, Pump Housing Seal - 7888**

## TRANSFER CASE - NV231 (Continued)

**Driver, Installer - 8680****Screw, Remover - 8422-3****Screws, Remover - 8421****Installer, Output Shaft Slinger - 8408****FLUID****STANDARD PROCEDURE - FLUID DRAIN AND FILL**

The fill and drain plugs are both in the rear case (Fig. 89). Correct fill level is to the bottom edge of the fill plug hole. Be sure the vehicle is level to ensure an accurate fluid level check.



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**Fig. 89 Fill/Drain Plug and I.D. Tag Location - Typical**

- 1 - I.D. TAG
- 2 - FILL PLUG
- 3 - DRAIN PLUG

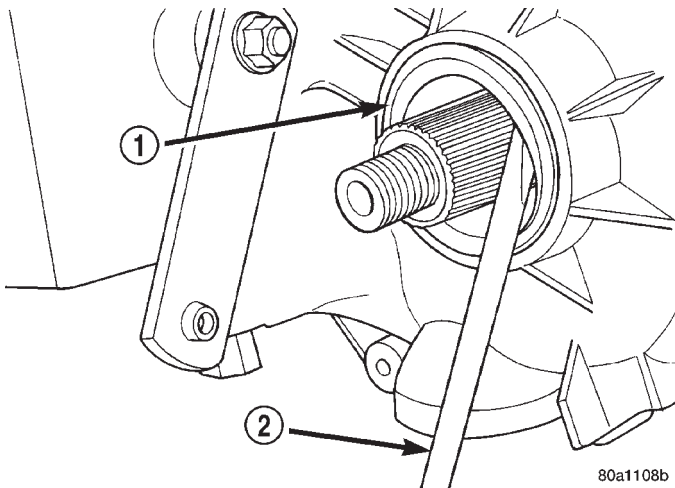
**FRONT OUTPUT SHAFT SEAL****REMOVAL**

- (1) Raise vehicle.
- (2) Remove front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)
- (3) Remove front output shaft companion flange.
- (4) Remove seal from front case with pry tool (Fig. 90).

**INSTALLATION**

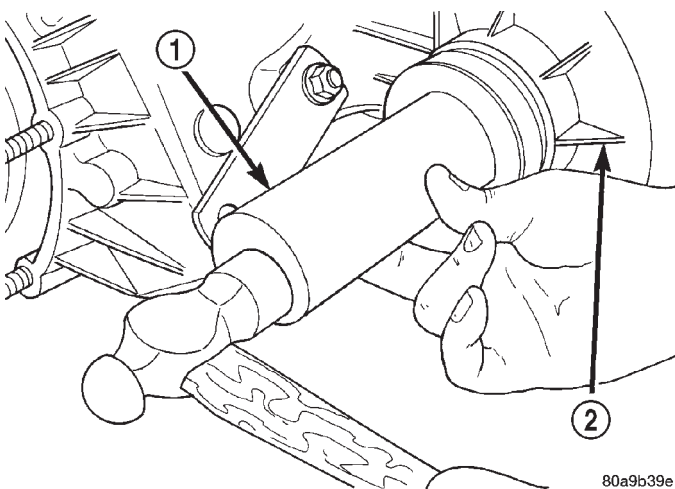
- (1) Install new front output seal in front case with Installer Tool 8143-A as follows:
  - (a) Place new seal on tool. Garter spring on seal goes toward interior of case.
  - (b) Start seal in bore with light taps from hammer (Fig. 91). Once seal is started, continue tapping seal into bore until installer tool seats against case.

FRONT OUTPUT SHAFT SEAL (Continued)



**Fig. 90 Remove Front Output Shaft Seal - Typical**

- 1 - OUTPUT SHAFT SEAL
- 2 - PRYBAR



**Fig. 91 Front Output Seal Installation - Typical**

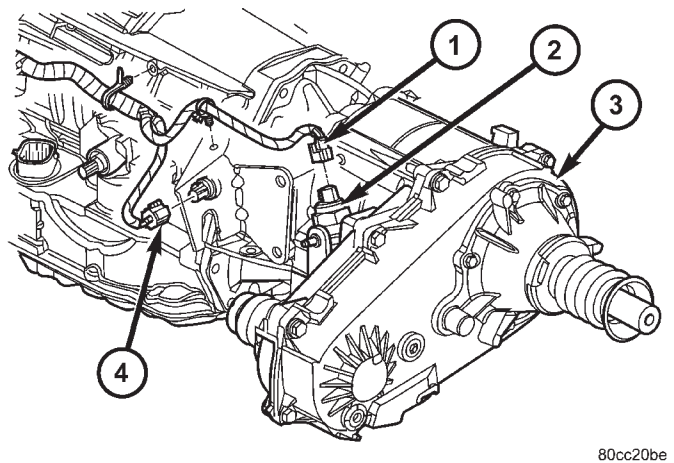
- 1 - INSTALLER 8143-A
- 2 - TRANSFER CASE

- (2) Install the front output shaft companion flange.
- (3) Install the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

POSITION SENSOR

DESCRIPTION

The transfer case position sensor (Fig. 92) is an electronic device whose output can be interpreted to indicate the transfer case's current operating mode. The sensor consists of a five position, resistive multiplexed circuit which returns a specific resistance value to the Powertrain Control Module (PCM) for each transfer case operating mode. The sensor is located on the top of the transfer case, just left of the transfer case centerline and rides against the sector plate roostercomb. The PCM supplies 5VDC (+/- 0.5V) to the sensor and monitors the return voltage to determine the sector plate, and therefore the transfer case, position.



**Fig. 92 Transfer Case Position Sensor and Connector**

- 1 - TRANSFER CASE POSITION SENSOR CONNECTOR
- 2 - TRANSFER CASE POSITION SENSOR
- 3 - TRANSFER CASE
- 4 - OUTPUT SPEED SENSOR CONNECTOR

OPERATION

During normal vehicle operation, the Powertrain Control Module (PCM) monitors the transfer case position sensor return voltage to determine the operating mode of the transfer case. Refer to the Operating Mode Versus Resistance table for the correct resistance for each position (Fig. 93). Note that the NEUTRAL position is allowed to float between sensor positions 3 and 4. If a resistance is measured anywhere in either range, the sensor is operating correctly.

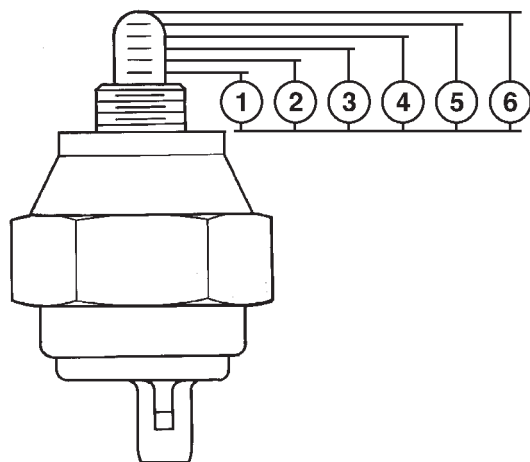


## POSITION SENSOR (Continued)

## OPERATING MODE VERSUS RESISTANCE

SENSOR POSITION	OPERATING MODE	SENSOR RESISTANCE (ohms)
1	2WD	1124-1243
2	4WD PART TIME	650-719
3	NEUTRAL	389-431
4	NEUTRAL	199-221
5	4WD LOW	57-64

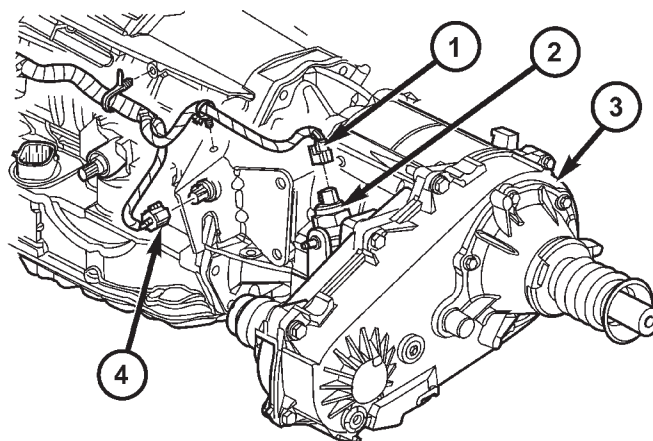
## REMOVAL



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**Fig. 93 Position Sensor Linear Movement**

- 1 - POSITION 1 - 10mm  $\pm$ 0.5mm
- 2 - POSITION 2 - 12mm  $\pm$ 0.5mm
- 3 - POSITION 3 - 14mm  $\pm$ 0.5mm
- 4 - POSITION 4 - 16mm  $\pm$ 0.5mm
- 5 - POSITION 5 - 18mm  $\pm$ 0.5mm
- 6 - POSITION 6 - 20mm  $\pm$ 0.5mm - FULL EXTENSION



80cc20be

**Fig. 94 Transfer Case Position Sensor and Connector**

- 1 - TRANSFER CASE POSITION SENSOR CONNECTOR
- 2 - TRANSFER CASE POSITION SENSOR
- 3 - TRANSFER CASE
- 4 - OUTPUT SPEED SENSOR CONNECTOR

## REAR OUTPUT SHAFT SEAL

## REMOVAL

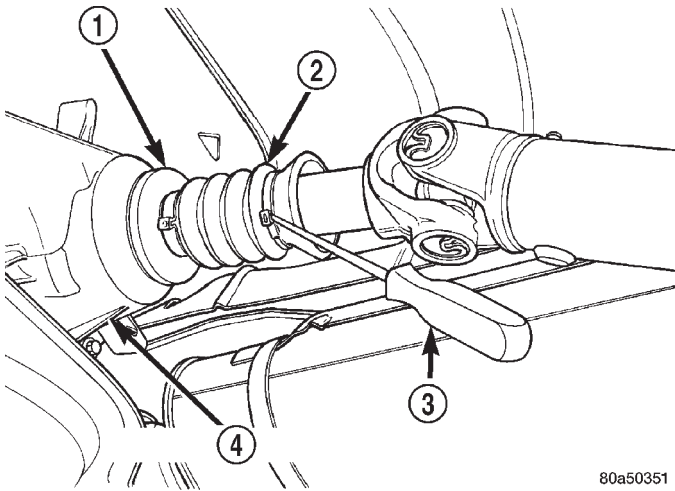
- (1) Raise and support the vehicle.
- (2) Disengage the transfer case position sensor connector from the position sensor (Fig. 94).
- (3) Remove the position sensor from the transfer case.

## INSTALLATION

- (1) Inspect the o-ring seal on the transfer case position sensor. Replace the o-ring if necessary.
- (2) Install the transfer case position sensor into the transfer case. Torque the sensor to 20-34 N·m (15-25 ft.lbs.).
- (3) Engage the transfer case position sensor connector to the position sensor.
- (4) Lower vehicle.
- (5) Verify proper sensor operation.

- (1) Shift the transmission and transfer case into NEUTRAL.
- (2) Raise and support vehicle.
- (3) Mark a line across the pinion shaft and at each end of the propeller shaft for installation reference.
- (4) Remove the U-joint strap bolts at the pinion shaft yoke.
- (5) Pry open clamp holding the dust boot to propeller shaft yoke (Fig. 95).
- (6) Slide the slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft.
- (7) Spread band clamp which holds output shaft boot to the output shaft slinger, or output shaft damper, with a suitable awl, or equivalent.

REAR OUTPUT SHAFT SEAL (Continued)



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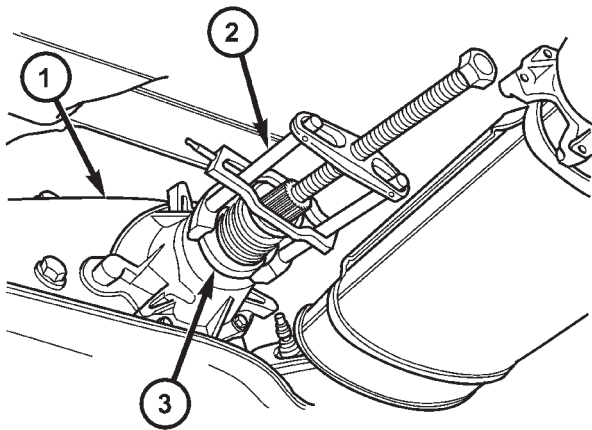
**Fig. 95 Dust Boot Clamp**

- 1 - SLINGER
- 2 - BOOT
- 3 - AWL
- 4 - TRANSFER CASE

**NOTE:** Vehicles built with a manual transmission use a damper weight on the transfer case output shaft. Be sure to identify the transfer case before proceeding.

(8) Remove output shaft boot from slinger, or output shaft damper, and output shaft.

(9) If the vehicle is not equipped with an output shaft damper, remove the output shaft rear slinger using Puller MD-998056-A (Fig. 96).

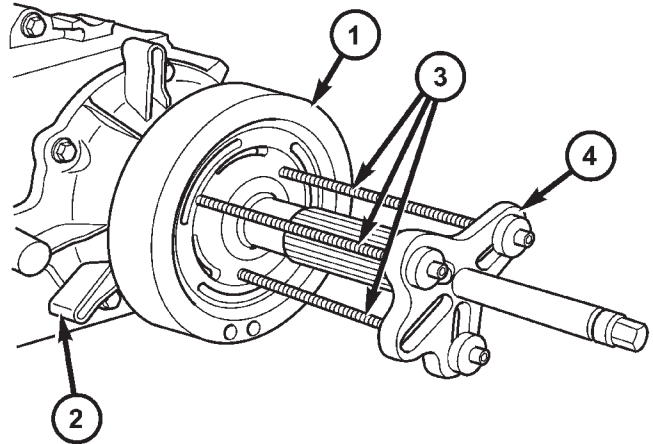


80cc2407

**Fig. 96 Rear Slinger Removal**

- 1 - TRANSFER CASE
- 2 - PULLER MD-998056-A
- 3 - REAR SLINGER

(10) If the vehicle is equipped with an output shaft damper, use Screws 8421 (Fig. 97) and the puller yoke and forcing screw from a bolt-grip puller set, such as those used to remove steering wheels and harmonic balancers, to remove the transfer case output shaft damper.

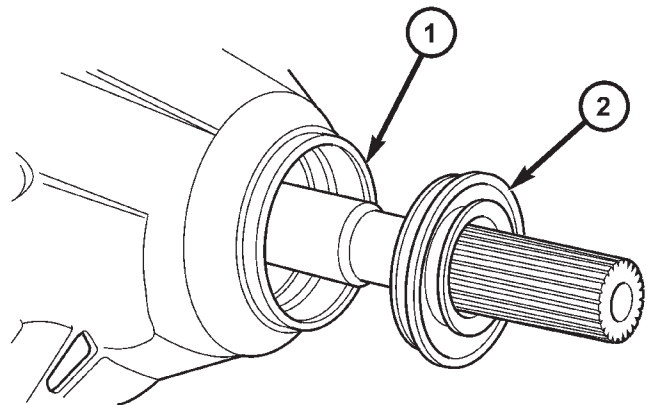


80ccbae

**Fig. 97 Remove Damper**

- 1 - DAMPER
- 2 - TRANSFER CASE
- 3 - SCREWS - 8421
- 4 - YOKE PULLER

(11) Use a suitable pry tool, or a slide hammer mounted screw, to remove the seal from the rear retainer (Fig. 98).



80cc23aa

**Fig. 98 Rear Retainer Seal**

- 1 - REAR RETAINER
- 2 - OUTPUT SHAFT SEAL

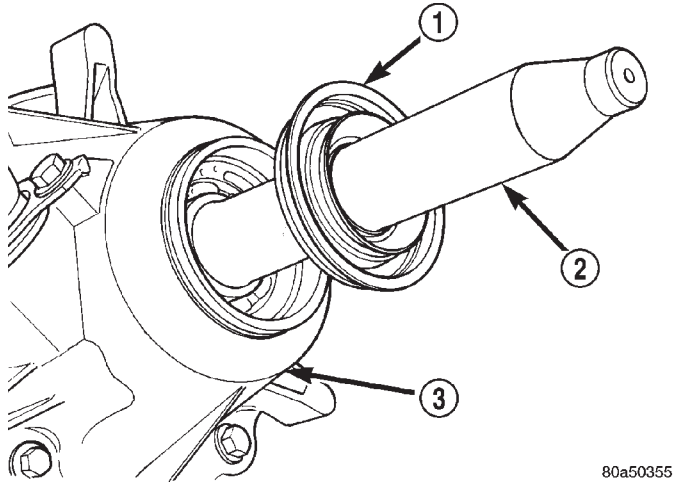
## REAR OUTPUT SHAFT SEAL (Continued)

**INSTALLATION**

(1) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(2) Slide seal onto Seal Protector 8824 (Fig. 99). Slide seal protector and seal onto output shaft.

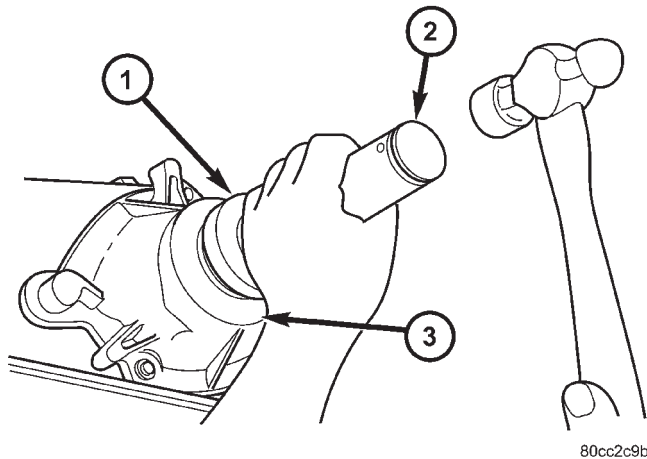
(3) Slide Installer 8691 onto seal and mainshaft. Drive seal into rear bearing retainer (Fig. 100).



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**Fig. 99 Output Shaft Seal and Protector**

- 1 - OUTPUT SHAFT SEAL
- 2 - SPECIAL TOOL 8824
- 3 - TRANSFER CASE



80cc2c9b

**Fig. 100 Rear Seal Installation**

- 1 - SPECIAL TOOL 8691
- 2 - HANDLE
- 3 - TRANSFER CASE

**NOTE:** Vehicles built with a manual transmission use a damper weight on the transfer case output shaft. Be sure to identify the transfer case before proceeding.

(4) Install a new output shaft rear slinger with Installer 8408, if the vehicle is not equipped with an output shaft damper.

(5) If the vehicle is equipped with an output shaft damper, install the output shaft damper as follows:

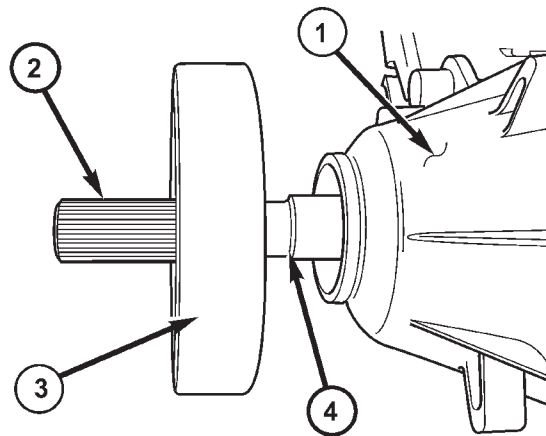
(a) Position the damper weight on the output shaft. Start the damper onto the output shaft chamfer, being careful to keep the weight square to the output shaft. (Fig. 101)

**NOTE:** Be sure that the damper is installed with the raised mounting flange for the propeller shaft boot towards the rear of the mainshaft.

(b) Position the Driver Installer 8680 (Fig. 102) onto the damper, making sure the legs of the installer are positioned through the slots of the damper.

(c) Thread the puller screw from Installer 8422 into the output shaft by hand only. Make sure the screw is fully threaded into the output shaft.

(d) Using a wrench to hold the pulling screw stationary (Fig. 103), turn the pulling screw nut until the driver legs contact the rear face of the transfer case rear retainer. When the legs contact the retainer, the damper is properly positioned on the output shaft.



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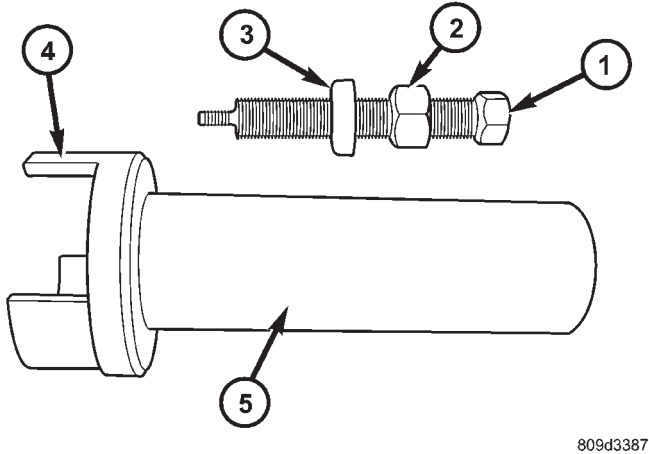
**Fig. 101 Position Damper on Output Shaft**

- 1 - TRANSFER CASE
- 2 - OUTPUT SHAFT
- 3 - DAMPER WEIGHT
- 4 - CHAMFER

(6) Install boot on output shaft slinger, or output shaft damper, and crimp retaining clamp with tool C-4975-A (Fig. 104).

(7) Slide the slip yoke on the transmission/transfer case output shaft. Align installation reference marks at the axle yoke and install the propeller shaft.

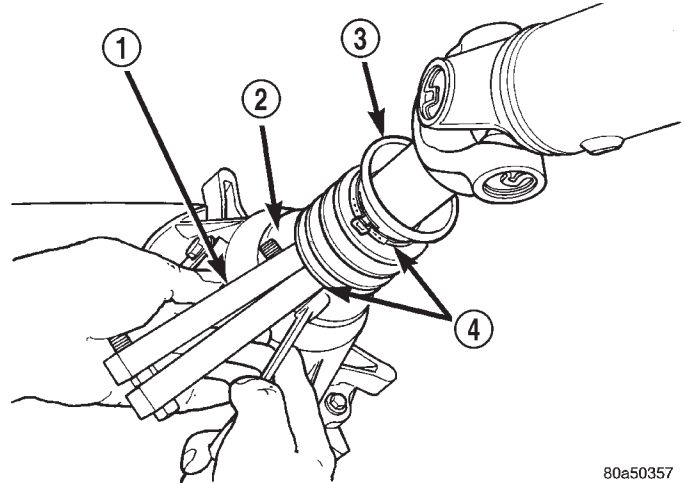
REAR OUTPUT SHAFT SEAL (Continued)



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**Fig. 102 Driver Installer 8680 and Screw Assembly from 8422**

- 1 - PULLING SCREW
- 2 - PULLING SCREW NUT
- 3 - BEARING
- 4 - DRIVER LEGS
- 5 - INSTALLER DRIVER



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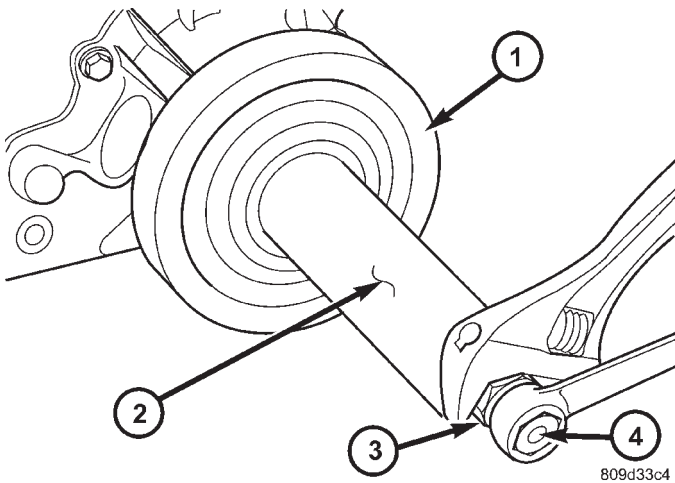
**Fig. 104 Slinger Boot Installation - Typical**

- 1 - SPECIAL TOOL C-4975-A
- 2 - SLINGER
- 3 - BOOT
- 4 - CLAMP

SHIFT LEVER

REMOVAL

- (1) Shift transfer case into 4L.
- (2) Raise vehicle.
- (3) Remove clip securing the transfer case shift cable to the shift cable support bracket (Fig. 105) and (Fig. 106).
- (4) Disengage any additional shift cable routing clips, if necessary.
- (5) Disengage the shift cable from the transfer case manual lever.
- (6) Lower vehicle.
- (7) Remove the floor console as necessary to access the shifter mechanism. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
- (8) Remove the nuts attaching lever assembly to floorpan and remove assembly and shift cable (Fig. 107).
- (9) Remove the shifter mechanism and cable assembly from the vehicle.



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**Fig. 103 Install Damper**

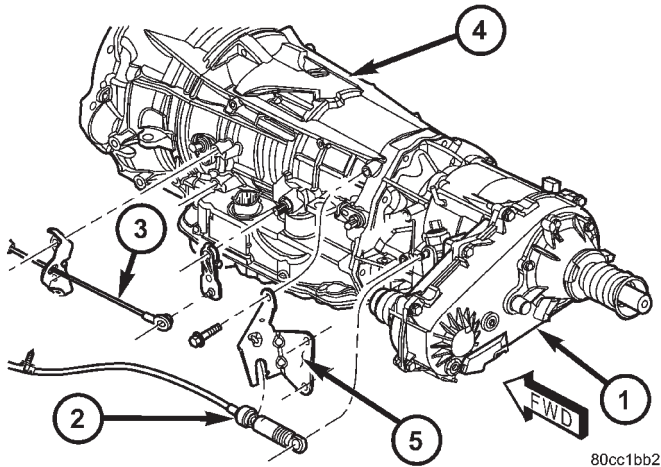
- 1 - DAMPER
- 2 - INSTALLER DRIVER
- 3 - PULLING SCREW NUT
- 4 - PULLING SCREW

(8) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N-m (14 ft. lbs.).

(9) Crimp clamp with Clamp Tool C-4975A to hold dust boot to propeller shaft yoke.

(10) Remove support and lower the vehicle.

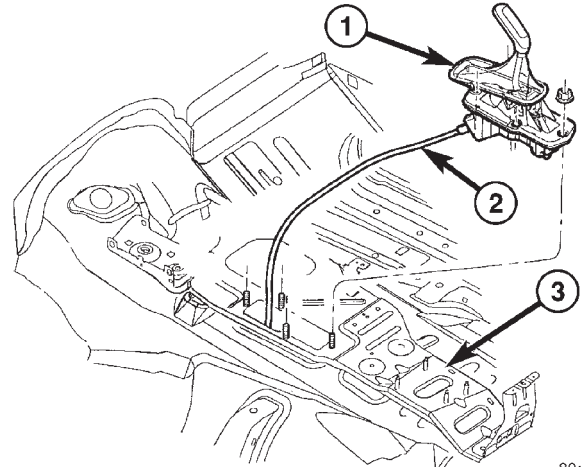
## SHIFT LEVER (Continued)



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**Fig. 105 Transfer Case Shift Cable - Automatic Transmission**

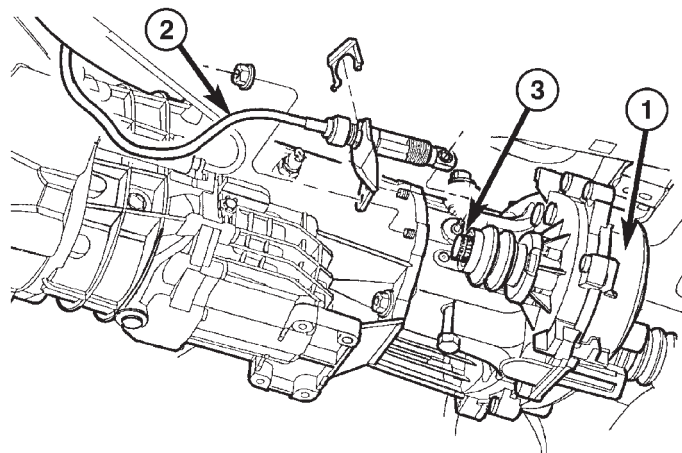
- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET



80cc5a32

**Fig. 107 Transfer Case Shifter Assembly**

- 1 - SHIFTER ASSEMBLY
- 2 - SHIFT CABLE
- 3 - FLOOR PAN



80cc5a3d

**Fig. 106 Transfer Case Shift Cable - Manual Transmission**

- 1 - TRANSFER CASE
- 2 - SHIFT CABLE
- 3 - MANUAL LEVER

## INSTALLATION

(1) Route the shift cable through the opening in the floor pan.

(2) Position the shift mechanism over the shifter retaining studs on the floor pan.

(3) Install the nuts to hold the shifter mechanism to the floor pan. Tighten the nuts to 11.86 N·m (105 in.lbs.).

(4) Install any floor console components previously removed. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(5) Verify that the floor shifter is in the 4L position.

(6) Raise vehicle.

(7) Route the shift cable through the opening in the shift cable support bracket.

(8) Install the cable and a new spring clip into the slot in the support bracket.

(9) Install any additional routing clips on the shift cable.

(10) Verify that the transfer case is in the 4L position. The 4L position for the transfer case is with the manual lever to the full rearward position.

(11) Attach the shift cable to the transfer case manual lever.

(12) Lower vehicle and check for proper transfer case shifter operation.

# TRANSFER CASE - NV242

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## TRANSFER CASE - NV242

### DESCRIPTION

The NV242 is a full-time transfer case. It provides full time 2-wheel, or 4-wheel drive operation.

A differential in the transfer case is used to control torque transfer to the front and rear axles. A low range gear provides increased low speed torque capability for off road operation. The low range provides a 2.72:1 reduction ratio.

The geartrain is mounted in two aluminum case halves attached with bolts. The mainshaft front and rear bearings are mounted in aluminum retainer housings bolted to the case halves.

### TRANSFER CASE IDENTIFICATION

A circular ID tag is attached to the rear case of each transfer case (Fig. 1). The ID tag provides the transfer case model number, assembly number, serial number, and low range ratio.

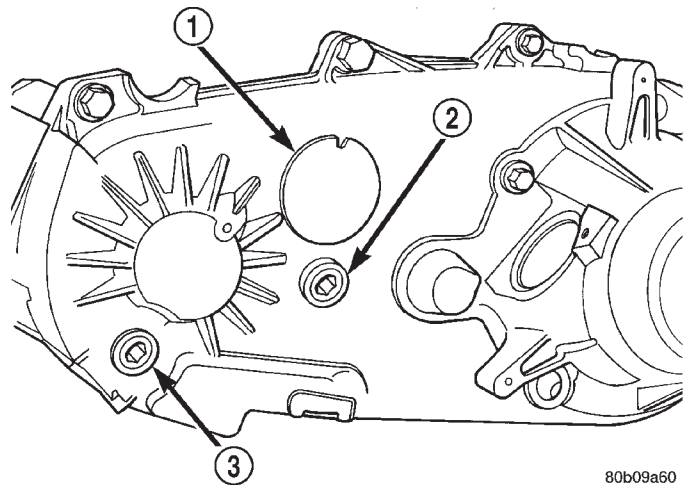
The transfer case serial number also represents the date of build.

### OPERATING RANGES

NV242 operating ranges are 2WD (2-wheel drive), 4x4 part-time, 4x4 full time, 4 Lo, and Neutral.

The 2WD and 4x4 full time ranges can be used at any time and on any road surface.

The 4x4 part-time and 4 Lo ranges are for off road use only. The only time these ranges can be used on hard surface roads, is when the surface is covered with snow and ice.



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**Fig. 1 Fill/Drain Plug And I.D. Tag Locations - Typical**

- 1 - I.D. TAG
- 2 - FILL PLUG
- 3 - DRAIN PLUG

### SHIFT MECHANISM

Operating ranges are selected with a floor mounted shift lever. The shift lever is connected to the transfer case range lever by a shift cable. A straight line shift pattern is used. Range positions are marked on the shifter bezel cover plate, or on the shift knob.

### OPERATION

The input gear is splined to the transmission output shaft. It drives the mainshaft through the plan-

## TRANSFER CASE - NV242 (Continued)

etary gear and range hub. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which oper-

ates the mode sleeve and hub. The sleeve and hub are not equipped with a synchro mechanism for shifting.

## DIAGNOSIS AND TESTING - TRANSFER CASE - NV242

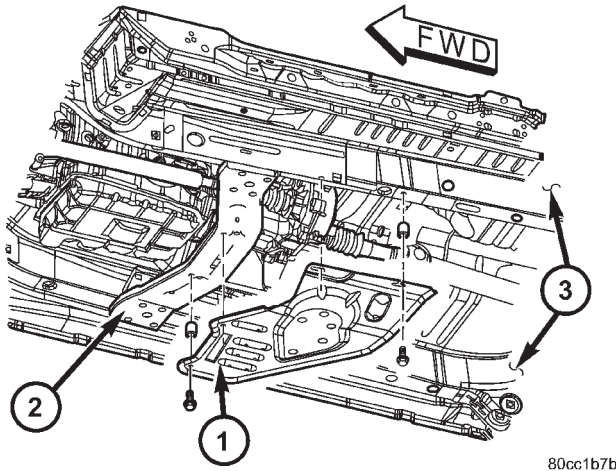
## DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Transfer case difficult to shift or will not shift into desired range.	1) Transfer case shift cable binding. 2) Insufficient or incorrect lubricant. 3) Internal transfer case components binding, worn, or damaged.	1) Repair or replace cable as necessary. 2) Drain and refill transfer case with the correct type and quantity of lubricant. 3) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct type and quantity of lubricant.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled. 2) Transfer case vent closed or restricted. 3) Transfer case seals damaged or installed incorrectly.	1) Drain lubricant to the correct level. 2) Clean or replace vent as necessary. 3) Replace suspect seal.
Transfer case will not shift through 4X4 part time range (light remains on)	1) Incomplete shift due to drivetrain torque load. 2) Incorrect tire pressure. 3) Excessive Tire wear. 4) Excessive vehicle loading.	1) Momentarily release the accelerator pedal to complete the shift. 2) Correct tire pressure as necessary. 3) Correct tire condition as necessary. 4) Correct as necessary.

TRANSFER CASE - NV242 (Continued)

**REMOVAL**

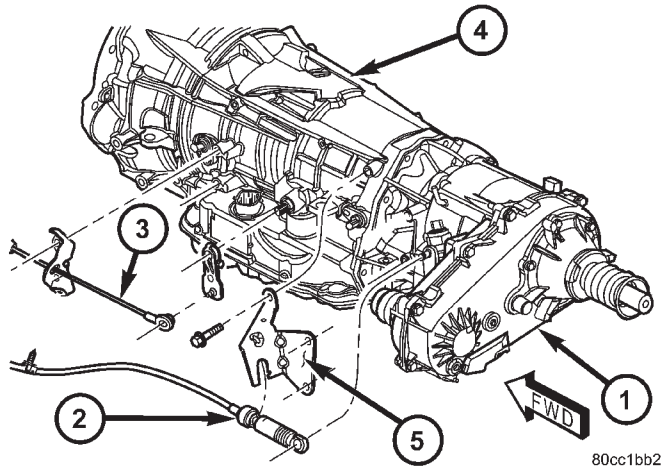
- (1) Shift transfer case into NEUTRAL.
- (2) Raise vehicle.
- (3) Remove skid plate (Fig. 2).
- (4) Drain transfer case lubricant.
- (5) Mark front and rear propeller shaft yokes for alignment reference.
- (6) Disconnect front/rear propeller shafts at transfer case.
- (7) Disconnect transfer case position sensor connector (Fig. 3).



**Fig. 2 Remove Skid Plate**

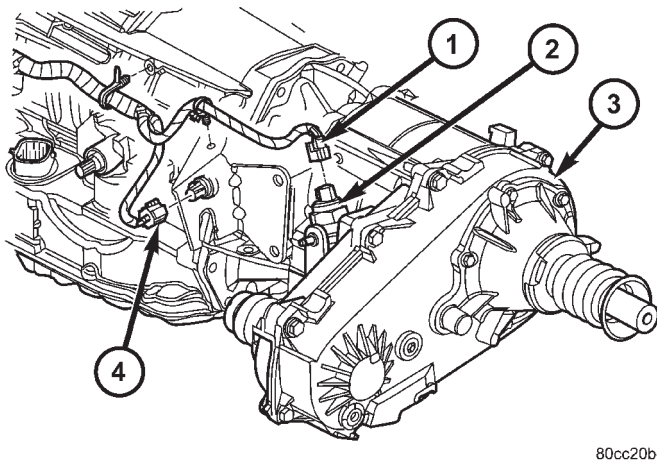
- 1 - SKID PLATE
- 2 - TRANSMISSION CROSSMEMBER
- 3 - FRAME RAILS

- (8) Disconnect transfer case shift cable at the range lever (Fig. 4).
- (9) Disconnect the transfer case shift cable from the shift cable bracket.
- (10) Disconnect transfer case vent hose (Fig. 5).
- (11) Support transfer case with transmission jack.
- (12) Secure transfer case to jack with chains.
- (13) Remove nuts attaching transfer case to transmission.
- (14) Pull transfer case and jack rearward to disengage transfer case (Fig. 5).
- (15) Remove transfer case from under vehicle.



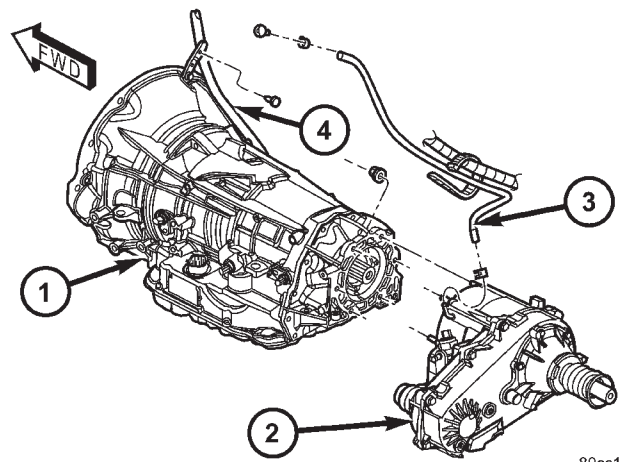
**Fig. 4 Remove Shift Cables**

- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET



**Fig. 3 Transfer Case Position Sensor and Connector**

- 1 - TRANSFER CASE POSITION SENSOR CONNECTOR
- 2 - TRANSFER CASE POSITION SENSOR
- 3 - TRANSFER CASE
- 4 - OUTPUT SPEED SENSOR CONNECTOR



**Fig. 5 Remove Vent Hose and Transfer Case**

- 1 - AUTOMATIC TRANSMISSION
- 2 - TRANSFER CASE
- 3 - VENT HOSE
- 4 - FILL TUBE

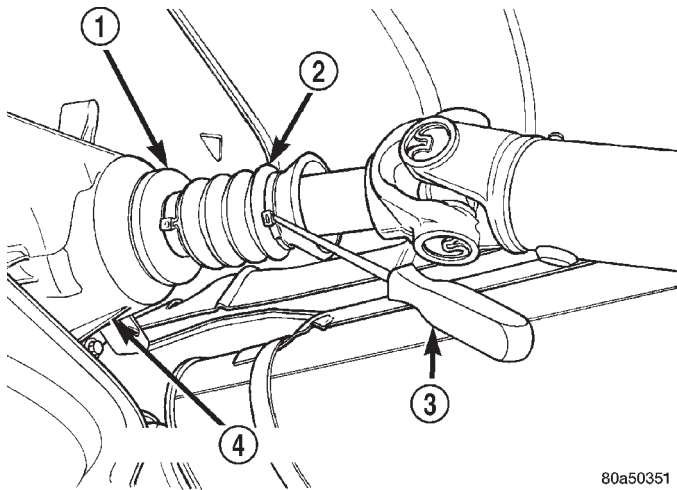


## TRANSFER CASE - NV242 (Continued)

## DISASSEMBLY

## REAR RETAINER

(1) Remove output shaft boot. Spread band clamp that secures boot on slinger with a suitable awl. Then slide boot off shaft (Fig. 6).

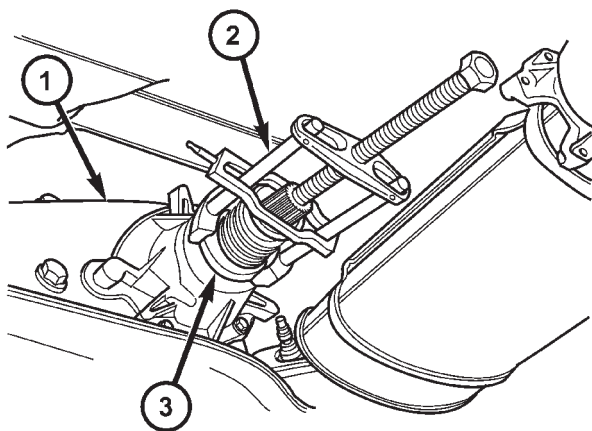


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**Fig. 6 Output Boot - Typical**

- 1 - SLINGER
- 2 - BOOT
- 3 - AWL
- 4 - TRANSFER CASE

(2) Using puller MD-998056-A, remove rear slinger (Fig. 7).



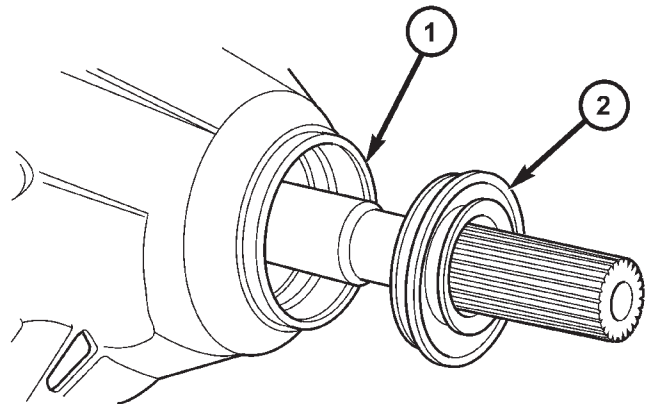
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**Fig. 7 Rear Slinger Removal**

- 1 - TRANSFER CASE
- 2 - PULLER MD-998056-A
- 3 - REAR SLINGER

(3) Remove rear seal from retainer (Fig. 8). Use pry tool, or collapse seal with punch to remove it.

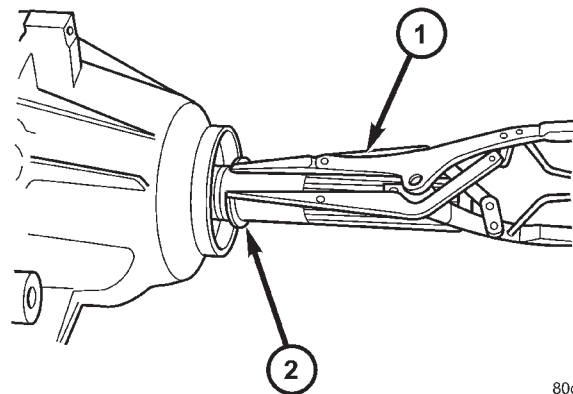
(4) Remove rear output bearing I.D. retaining ring (Fig. 9).



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**Fig. 8 Rear Retainer Seal**

- 1 - REAR RETAINER
- 2 - OUTPUT SHAFT SEAL



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**Fig. 9 Output Shaft Rear Bearing Retaining Ring**

- 1 - SNAP-RING PLIERS
- 2 - RETAINING RING

(5) Remove rear retainer bolts.

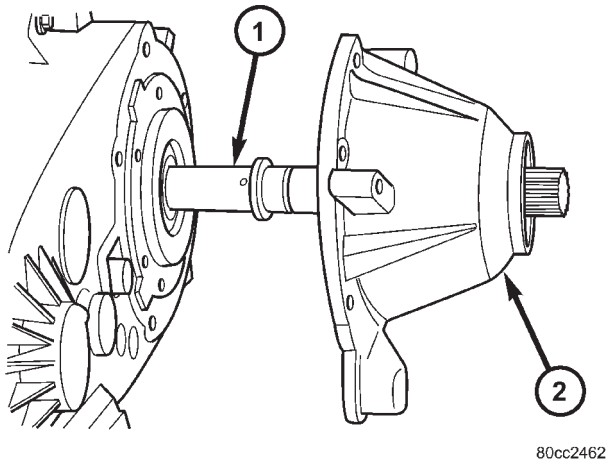
(6) Remove rear retainer. Tap retainer with mallet and pry upward to break sealer bead. Then slide retainer off case and output shaft (Fig. 10).

(7) Remove rear bearing O.D. retaining ring with snap-ring pliers. Then tilt pump and slide it off output shaft (Fig. 11)

(8) Remove pickup tube O-ring from pump (Fig. 12) but do not disassemble pump; it is not a serviceable part.

(9) Remove bolts attaching rear case to front case (Fig. 13). Note position of the two black finish bolts at each end of the case. These bolts go through the case dowels and require a washer under the bolt head.

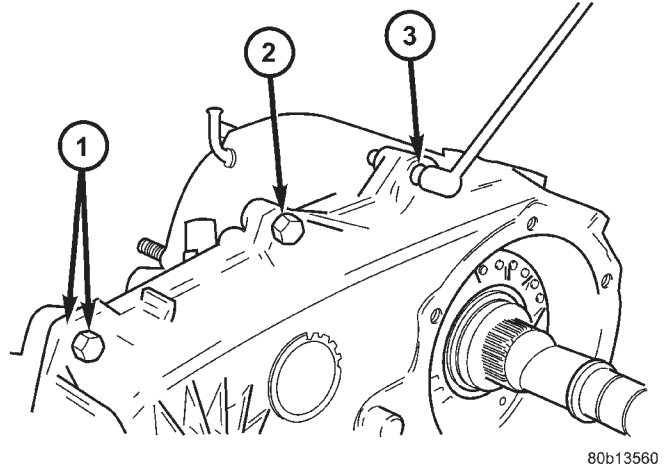
TRANSFER CASE - NV242 (Continued)



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**Fig. 10 Rear Retainer Removal**

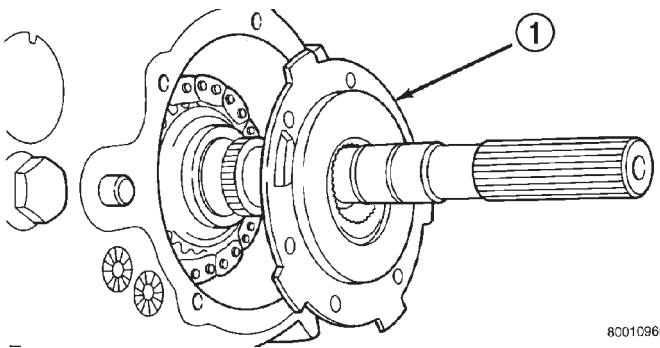
- 1 - MAINSHAFT
- 2 - REAR RETAINER



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**Fig. 13 Spline And Dowel Bolt Locations**

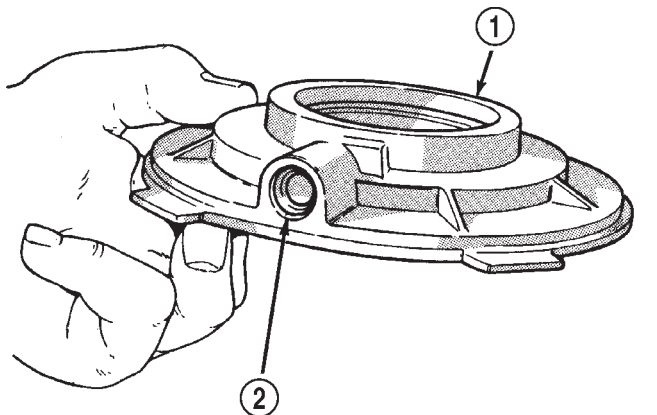
- 1 - DOWEL BOLT AND WASHER (2)
- 2 - CASE BOLTS
- 3 - SPLINE HEAD BOLT (1)



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**Fig. 11 Oil Pump Removal**

- 1 - OIL PUMP



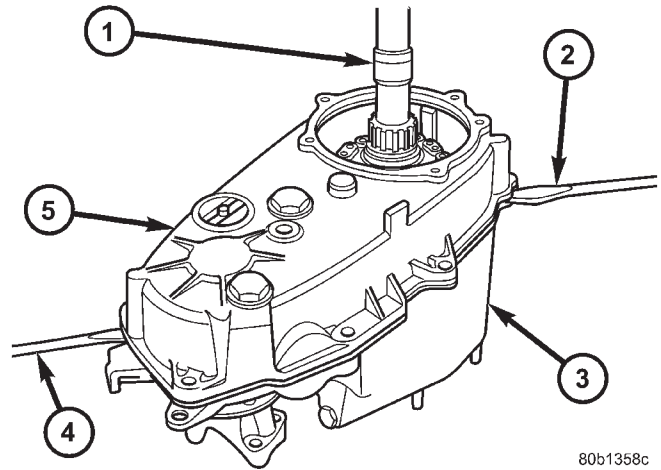
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**Fig. 12 Pickup Tube O-Ring Location**

- 1 - OIL PUMP
- 2 - O-RING

(10) Remove rear case from front case (Fig. 14). Insert screwdrivers into slots cast into each end of case. Then pry upward to break sealer bead and remove rear case.

**CAUTION:** Do not pry on the sealing surface of either case half as the surfaces will become damaged.



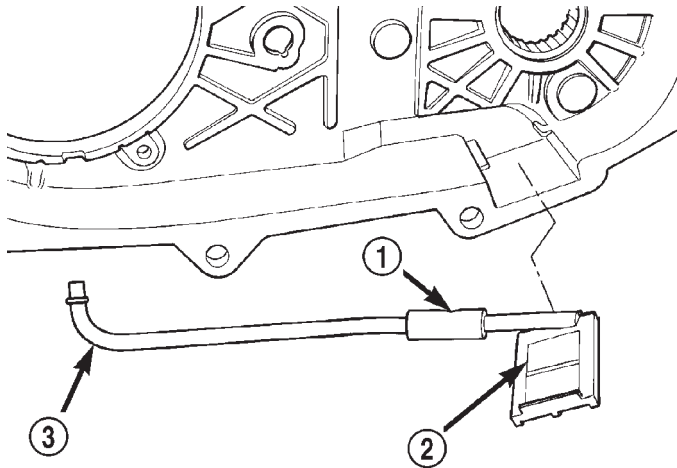
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**Fig. 14 Loosening/Removing Rear Case**

- 1 - MAINSHAFT
- 2 - SCREWDRIVER
- 3 - FRONT CASE
- 4 - SCREWDRIVER
- 5 - REAR CASE

TRANSFER CASE - NV242 (Continued)

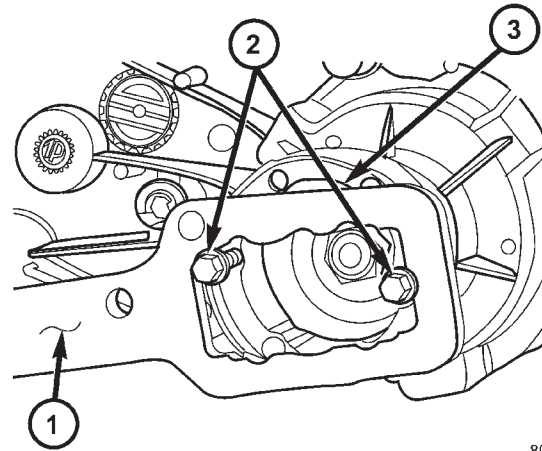
(11) Remove oil pickup tube and screen from rear case (Fig. 15).



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**Fig. 15 Oil Pickup Screen, Hose And Tube Removal**

- 1 - CONNECTING HOSE
- 2 - PICKUP SCREEN
- 3 - PICKUP TUBE



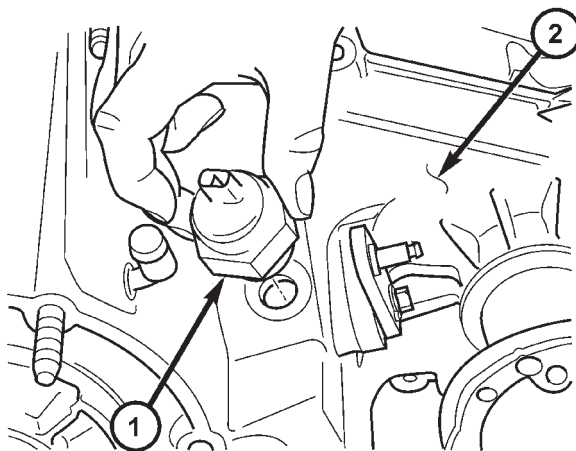
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**Fig. 17 Hold Companion Flange - Typical**

- 1 - HOLDER C-3281
- 2 - BOLTS
- 3 - COMPANION FLANGE

**COMPANION FLANGE AND RANGE LEVER**

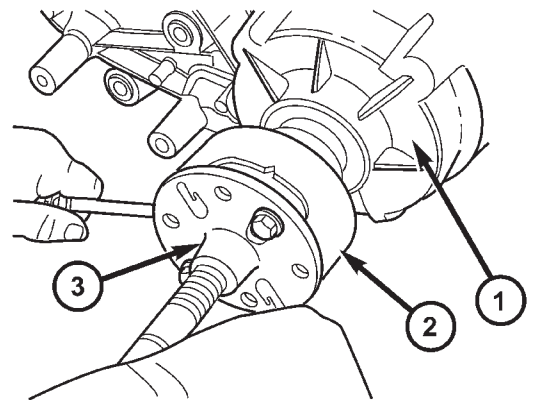
(1) Remove transfer case position sensor (Fig. 16).



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**Fig. 16 Remove Transfer Case Position Sensor**

- 1 - TRANSFER CASE POSITION SENSOR
- 2 - TRANSFER CASE



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**Fig. 18 Remove Companion Flange - Typical**

- 1 - TRANSFER CASE
- 2 - COMPANION FLANGE
- 3 - REMOVER C-452

(2) Install two bolts (Fig. 17) partially into the propeller shaft companion flange, 180° from each other.

(3) Install the rectangular end of the Flange Holder C-3281 over the bolts to hold the companion flange stationary and remove the nut holding the companion flange to the output shaft.

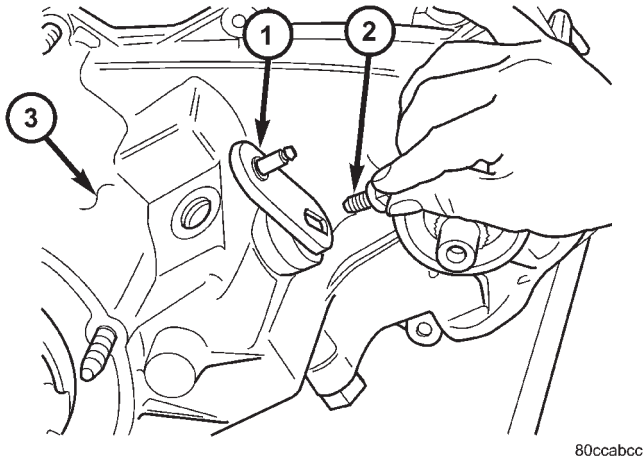
(4) Use Remover C-452 (Fig. 18) to remove the companion flange.

(5) Remove seal washer from front output shaft. Discard washer as it should not be reused.

(6) Remove the bolt (Fig. 19) that attaches the range lever to sector shaft. Then move sector to neutral position and remove range lever from shaft.

**NOTE:** Be sure to note the orientation of the range lever (lever up or down) so that it may be re-installed in the same direction.

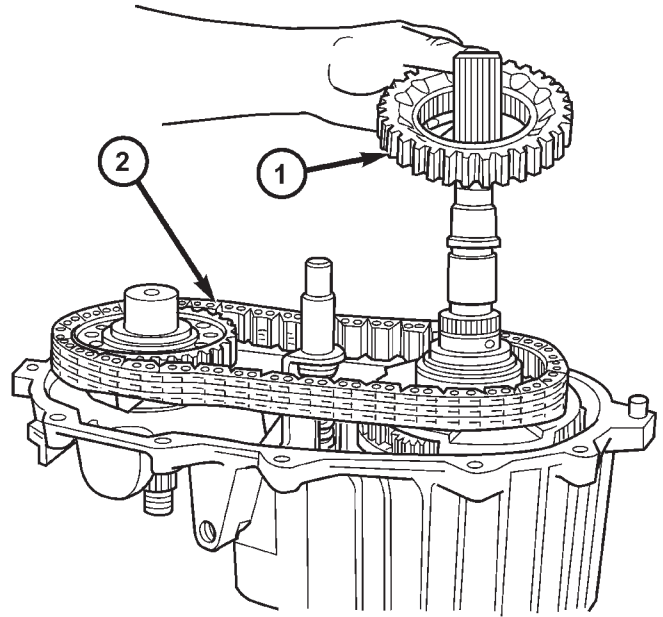
TRANSFER CASE - NV242 (Continued)



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**Fig. 19 Remove Shift Lever Bolt - Typical**

- 1 - RANGE LEVER
- 2 - RANGE LEVER BOLT
- 3 - TRANSFER CASE



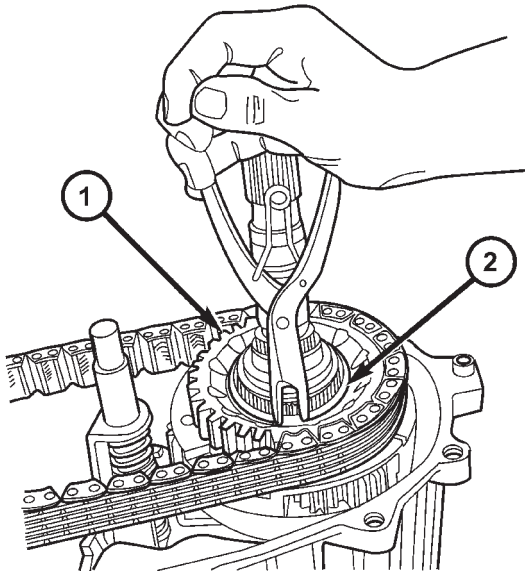
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**Fig. 21 Drive Sprocket And Chain Removal**

- 1 - DRIVE SPROCKET
- 2 - DRIVE CHAIN

**FRONT OUTPUT SHAFT AND DRIVE CHAIN**

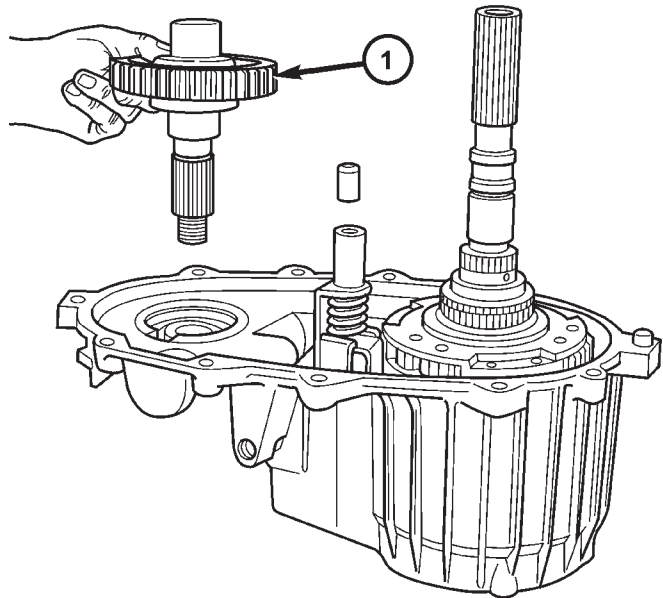
(1) Remove drive sprocket snap-ring (Fig. 20).



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**Fig. 20 Drive Sprocket Snap-Ring Removal**

- 1 - DRIVE SPROCKET
- 2 - DRIVE SPROCKET SNAP-RING



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**Fig. 22 Removing Front Output Shaft**

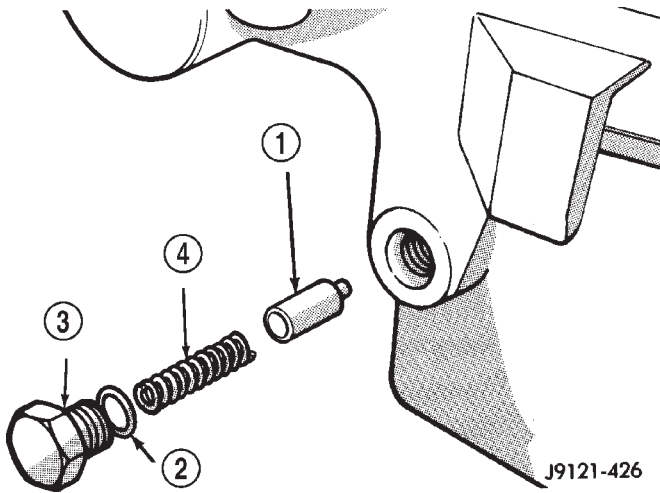
- 1 - FRONT OUTPUT SHAFT

(2) Remove drive sprocket and chain (Fig. 21).  
 (3) Remove front output shaft (Fig. 22).

TRANSFER CASE - NV242 (Continued)

SHIFT FORKS AND MAINSHAFT

(1) Remove shift detent plug, spring and pin (Fig. 23).



**Fig. 23 Detent Component Removal**

- 1 - PLUNGER
- 2 - O-RING
- 3 - PLUG
- 4 - SPRING

(2) Remove seal plug from low range fork lockpin access hole. Then move shift sector to align low range fork lockpin with access hole.

(3) Remove range fork lockpin with size number one easy-out tool as follows:

(a) Insert easy-out tool through access hole in side of transfer case and into lock-pin.

(b) Tap easy-out tool into lock-pin with hammer until tool is securely engaged into the lock-pin.

(c) Install a t-handle, such as from a tap and die set, onto the easy-out tool.

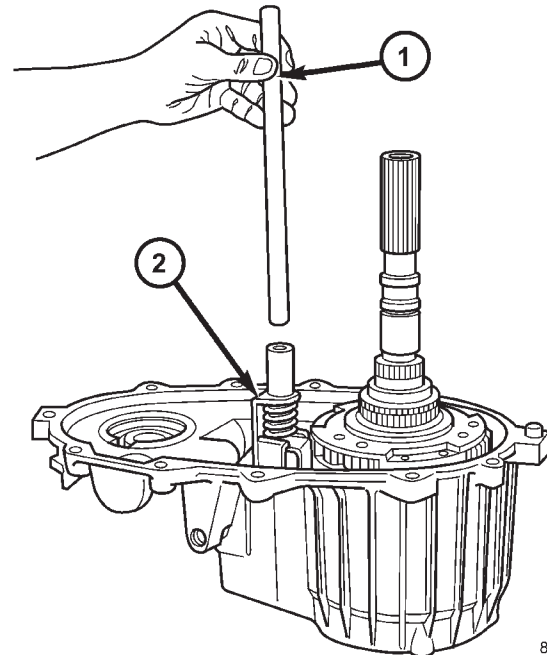
(d) Securely tighten the t-handle onto the tool.

(e) In one motion, pull upward and turn the t-handle counter-clockwise to remove the lock-pin.

(4) Remove shift rail by pulling it straight up and out of fork (Fig. 24).

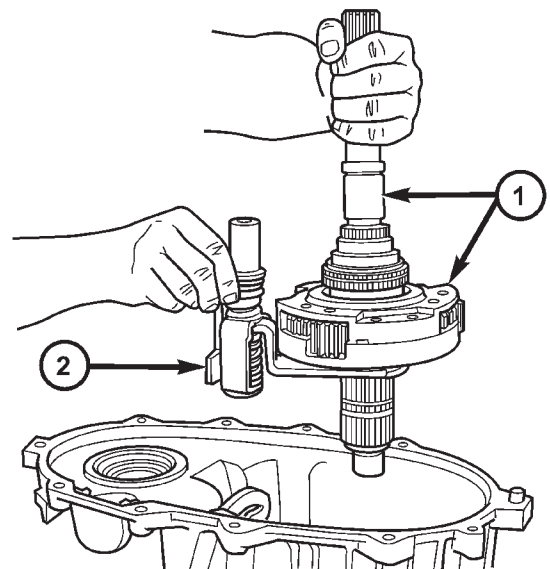
(5) Remove mode fork and mainshaft as assembly (Fig. 25).

(6) Remove mode shift sleeve and mode fork assembly from mainshaft (Fig. 26). Note position of mode sleeve in fork and remove sleeve.



**Fig. 24 Shift Rail Removal**

- 1 - SHIFT RAIL
- 2 - MODE FORK



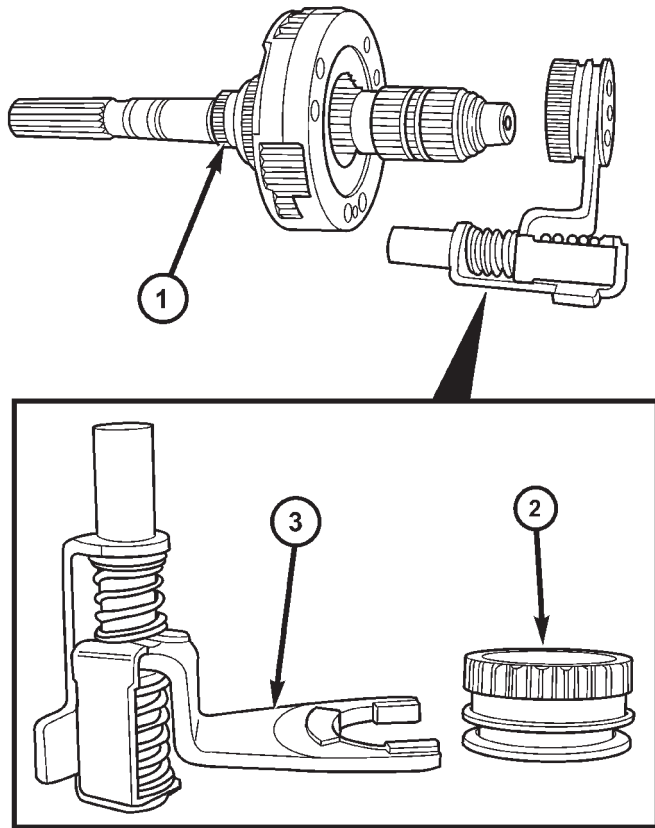
**Fig. 25 Mainshaft And Mode Fork Removal**

- 1 - MAINSHAFT ASSEMBLY
- 2 - MODE FORK

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80b135e0

TRANSFER CASE - NV242 (Continued)



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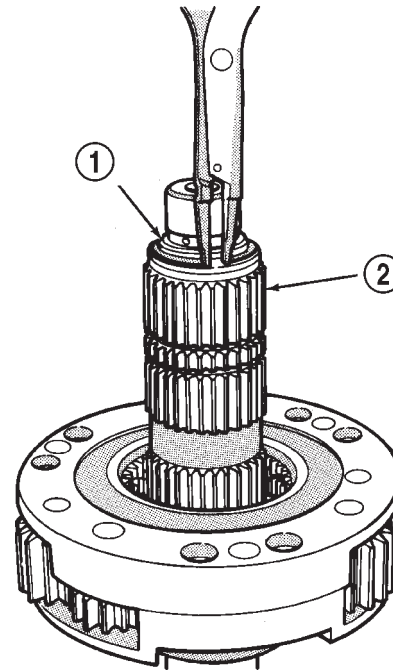
**Fig. 26 Separate Mode Fork And Sleeve**

- 1 - MAINSHAFT
- 2 - MODE SLEEVE
- 3 - MODE FORK ASSEMBLY

(7) Remove intermediate clutch shaft snap-ring (Fig. 27).

(8) Remove clutch shaft thrust ring (Fig. 28).

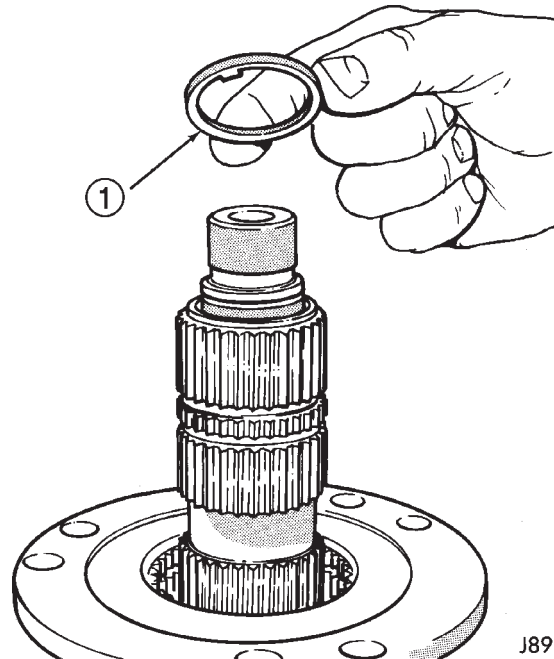
(9) Remove intermediate clutch shaft (Fig. 29).



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**Fig. 27 Intermediate Clutch Shaft Snap-Ring Removal**

- 1 - SNAP-RING
- 2 - INTERMEDIATE CLUTCH SHAFT

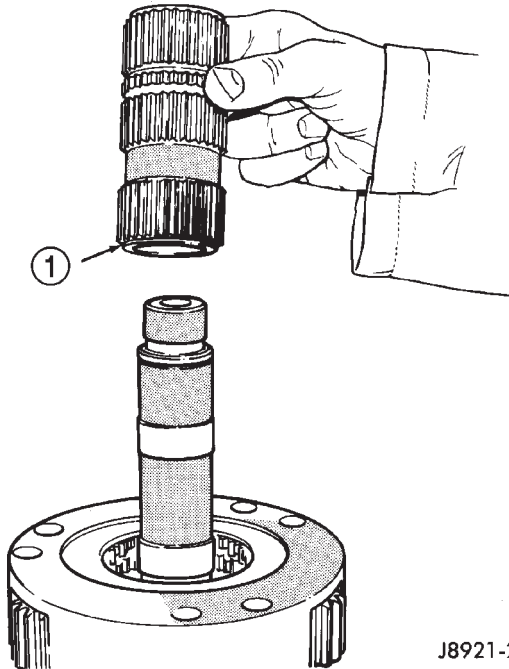


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**Fig. 28 Clutch Shaft Thrust Ring Removal**

- 1 - CLUTCH SHAFT THRUST RING

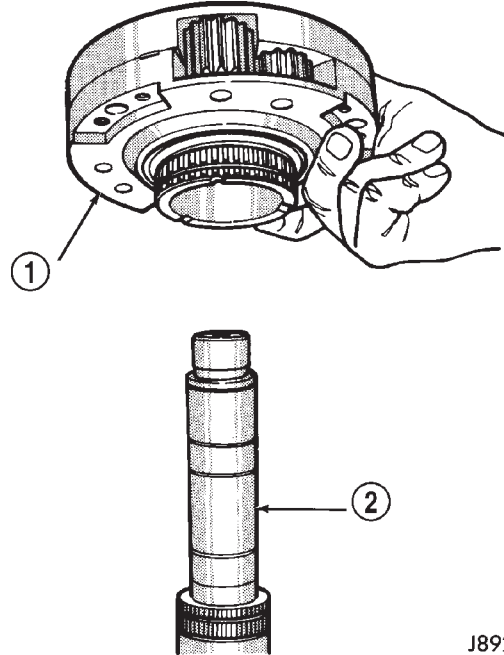
TRANSFER CASE - NV242 (Continued)



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**Fig. 29 Intermediate Clutch Shaft Removal**

- 1 - INTERMEDIATE CLUTCH SHAFT



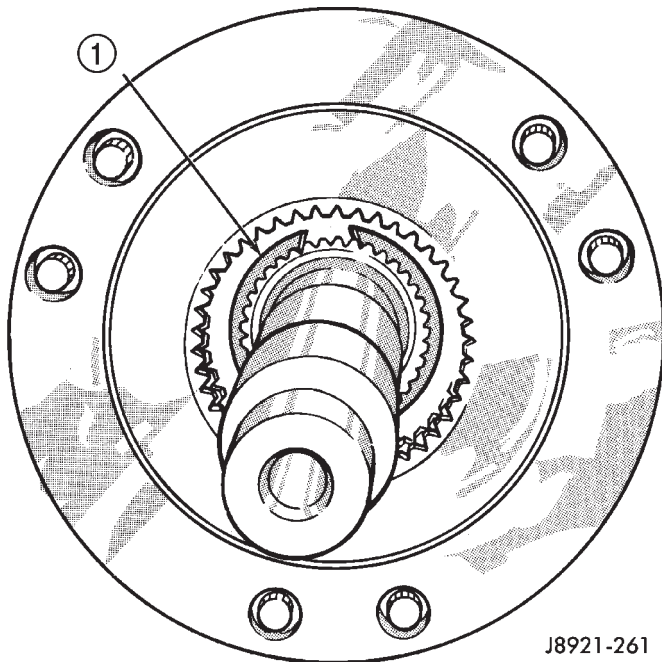
J8921-262

**Fig. 31 Differential Removal**

- 1 - DIFFERENTIAL
- 2 - MAINSHAFT

- (10) Remove differential snap-ring (Fig. 30).
- (11) Remove differential (Fig. 31).
- (12) Remove differential needle bearings and both needle bearing thrust washers from mainshaft.

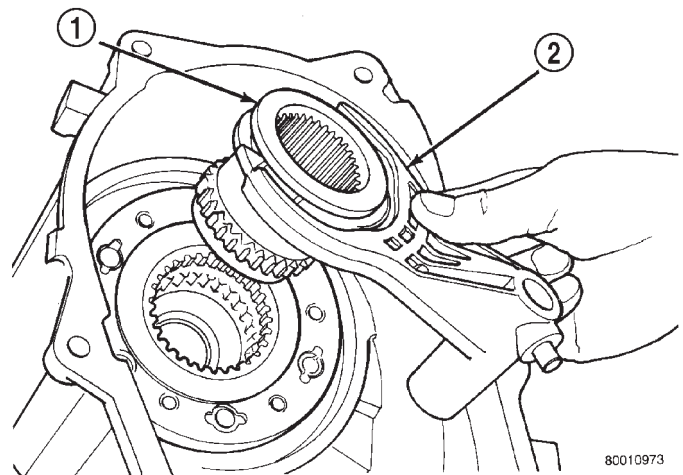
- (13) Slide low range fork pin out of shift sector slot.
- (14) Remove low range fork and sleeve (Fig. 32).
- (15) Remove shift sector.



J8921-261

**Fig. 30 Differential Snap-Ring Removal**

- 1 - DIFFERENTIAL SNAP-RING



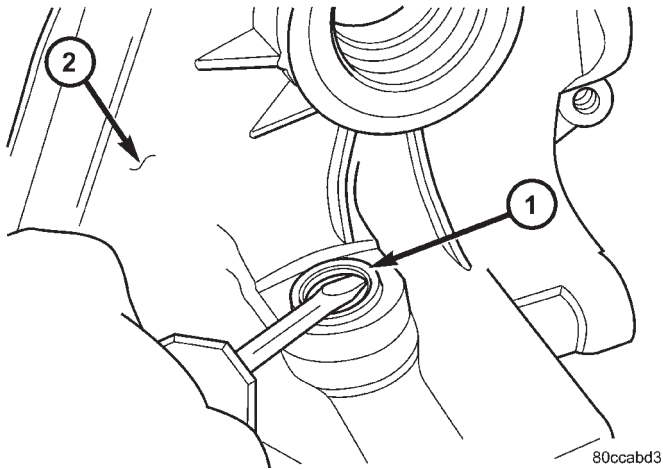
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**Fig. 32 Range Fork And Sleeve Removal**

- 1 - RANGE HUB
- 2 - RANGE FORK

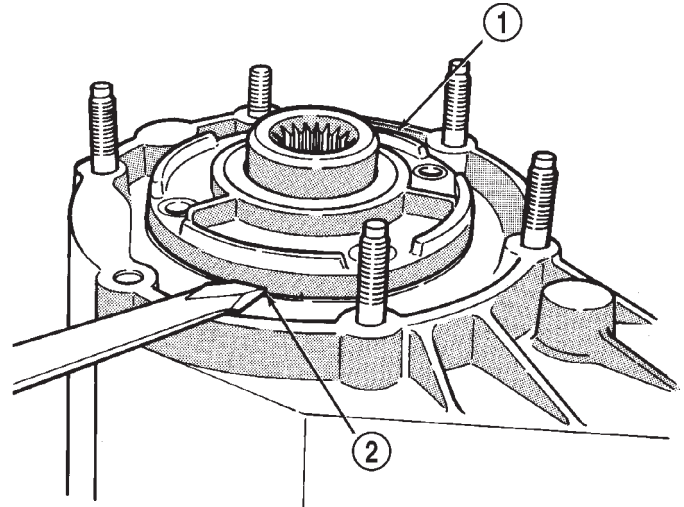
TRANSFER CASE - NV242 (Continued)

- (16) Remove the shift sector shaft seal (Fig. 33).
- (17) Remove the shift sector shaft bearing with an appropriate socket (Fig. 34).



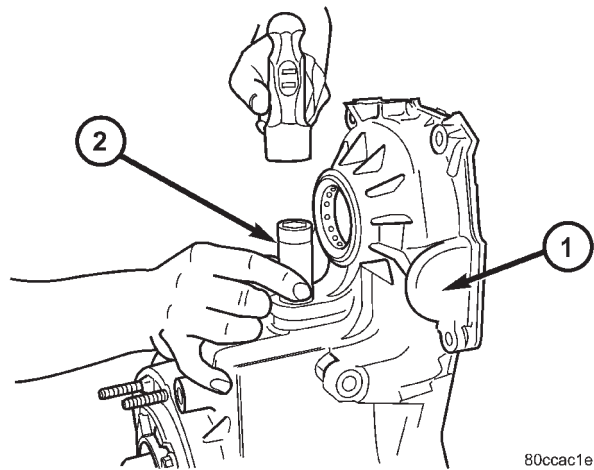
**Fig. 33 Remove Shift Shaft Seal**

- 1 - SHIFT SHAFT SEAL
- 2 - TRANSFER CASE



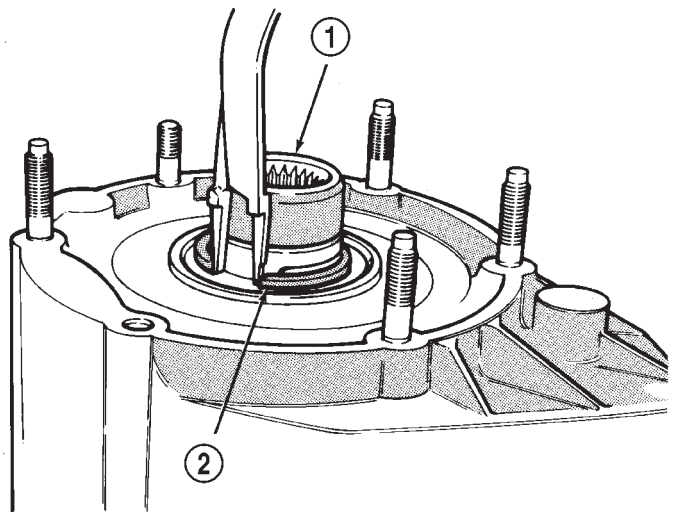
**Fig. 35 Front Bearing Retainer Removal**

- 1 - FRONT BEARING RETAINER
- 2 - RETAINER SLOT



**Fig. 34 Remove Shift Sector Shaft Bearing**

- 1 - TRANSFER CASE
- 2 - SOCKET



**Fig. 36 Input Gear Snap-Ring Removal**

- 1 - INPUT GEAR
- 2 - SNAP-RING

**INPUT GEAR/LOW RANGE ASSEMBLY**

- (1) Remove front bearing retainer bolts.
- (2) Remove front bearing retainer. Carefully pry retainer loose with screwdriver (Fig. 35). Position screwdriver in slots cast into retainer.
- (3) Remove input gear snap-ring (Fig. 36).

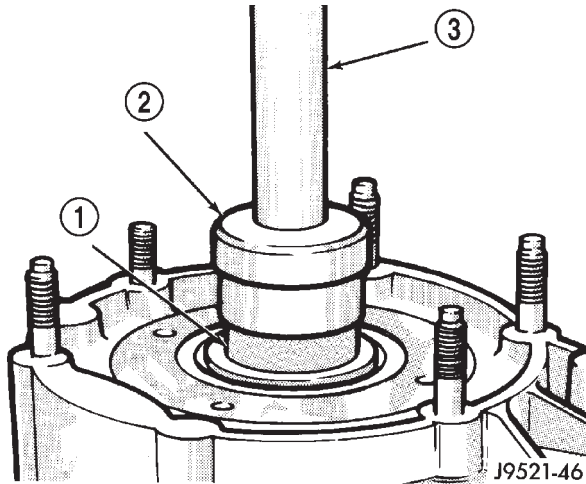


TRANSFER CASE - NV242 (Continued)

(4) Remove input/low range gear assembly from bearing with Tool Handle C-4171 and Tool 7829-A (Fig. 37).

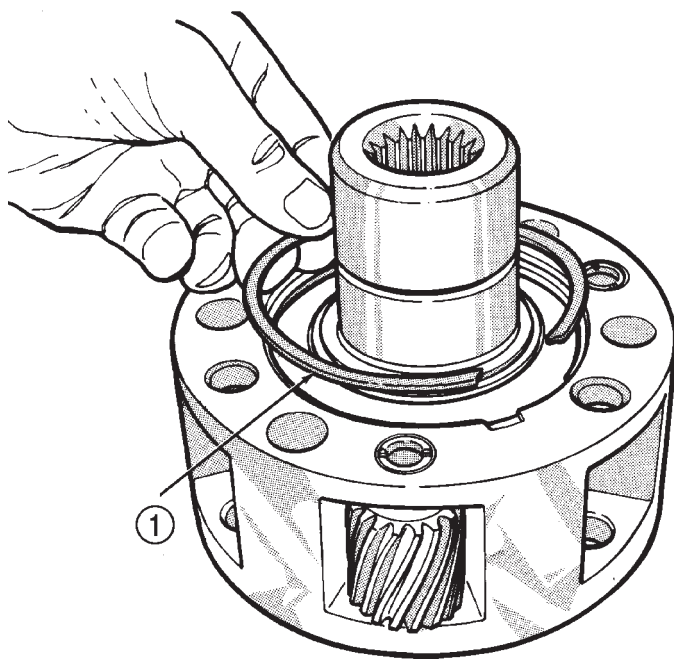
(5) Remove low range gear snap-ring (Fig. 38).

(6) Remove input gear retainer, thrust washers and input gear from low range gear (Fig. 39).



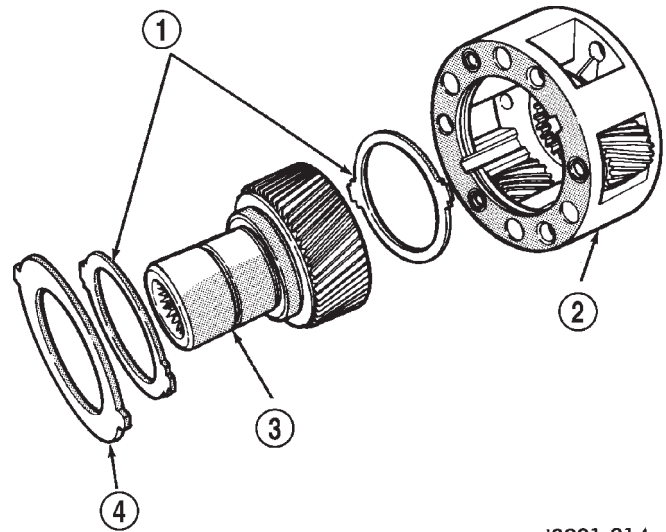
**Fig. 37 Input And Low Range Gear Assembly Removal**

- 1 - INPUT-LOW RANGE GEARS
- 2 - SPECIAL TOOL 7829-A
- 3 - SPECIAL TOOL C-4171



**Fig. 38 Low Range Gear Snap-Ring Removal/ Installation**

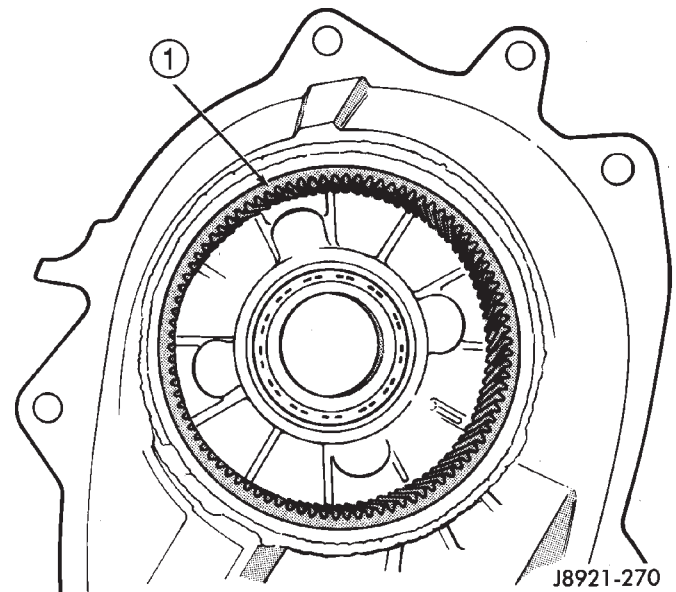
- 1 - LOW RANGE GEAR SNAP-RING



**Fig. 39 Low Range Gear Disassembly**

- 1 - THRUST WASHERS
- 2 - LOW RANGE GEAR
- 3 - INPUT GEAR
- 4 - RETAINER

(7) Inspect low range annulus gear (Fig. 40). The annulus gear is not a serviceable component. If damaged, replace gear and front case as assembly.



**Fig. 40 Inspecting Low Range Annulus Gear**

- 1 - LOW RANGE ANNULUS GEAR

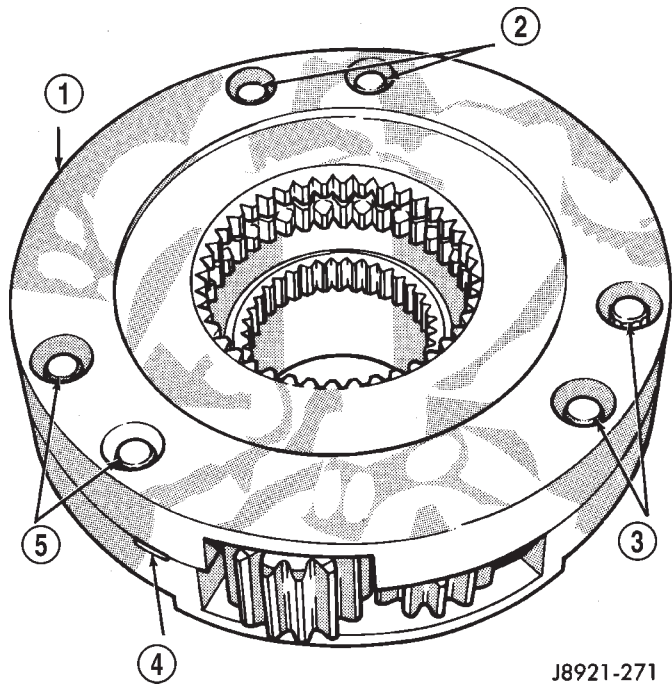
(8) Remove oil seals from following components:

- front bearing retainer.
- rear retainer.
- oil pump.
- case halves.

TRANSFER CASE - NV242 (Continued)

**DIFFERENTIAL**

- (1) Mark differential case halves for reference.
- (2) Remove differential case bolts.
- (3) Invert differential on workbench.
- (4) Separate top case from bottom case. Use slots in case halves to pry them apart (Fig. 41).
- (5) Remove thrust washers and planet gears from case pins (Fig. 42).
- (6) Remove mainshaft and sprocket gears from bottom case (Fig. 43). Note gear position for reference before separating them.



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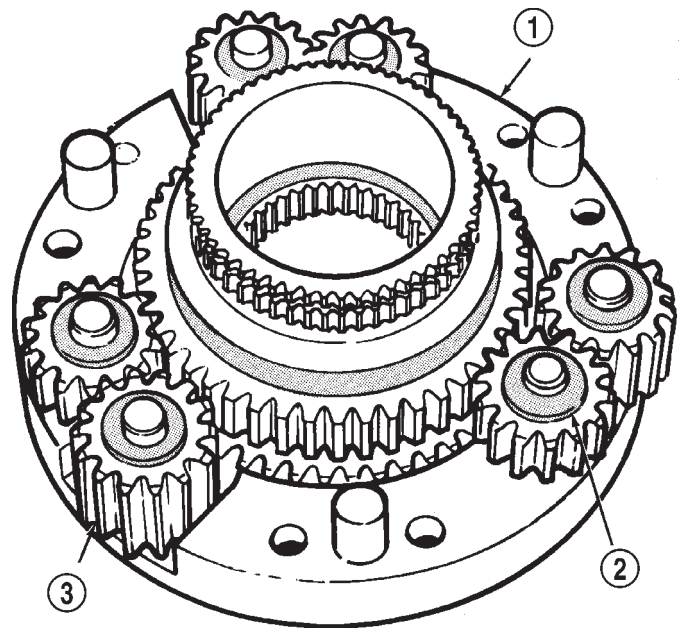
**Fig. 41 Separating Differential Case Halves**

- 1 - TOP CASE
- 2 - CASE BOLTS
- 3 - CASE BOLTS
- 4 - CASE SLOTS
- 5 - CASE BOLTS

**CLEANING**

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 all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

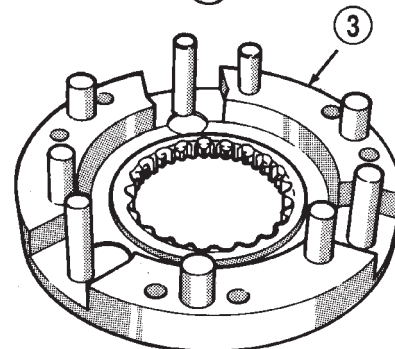
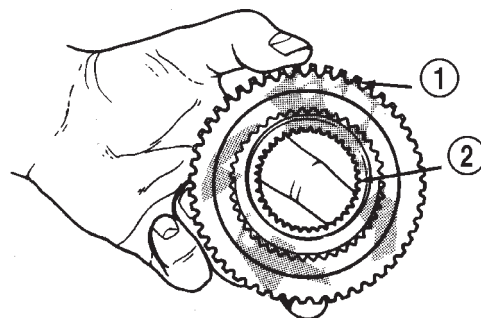
The oil pickup screen can be cleaned with solvent. Shake excess solvent from the screen after cleaning and allow it to air dry. Do not use compressed air.



J8921-272

**Fig. 42 Planet Gears And Thrust Washer Removal**

- 1 - BOTTOM CASE
- 2 - THRUST WASHERS (12)
- 3 - PLANET GEARS (6)



J8921-273

**Fig. 43 Mainshaft And Sprocket Gear Removal**

- 1 - MAINSHAFT GEAR
- 2 - SPROCKET GEAR
- 3 - BOTTOM CASE

TRANSFER CASE - NV242 (Continued)

**INSPECTION**

**MAINSHAFT/SPROCKET/HUB**

Inspect the splines on the hub and shaft and the teeth on the sprocket. Minor nicks and scratches can be smoothed with an oilstone. However, replace any part that 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**

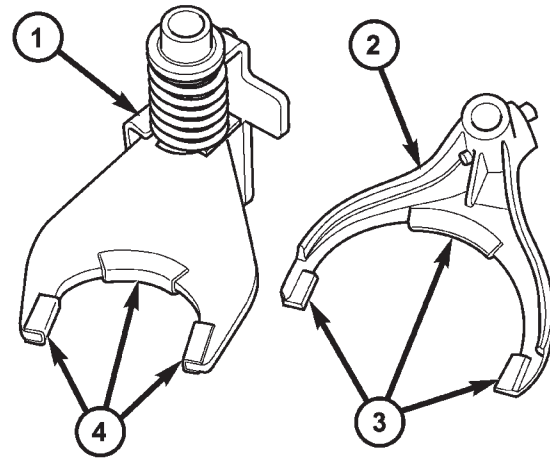
Check the teeth on the gear (Fig. 44). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300-400 grit emery cloth if necessary.

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.

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**

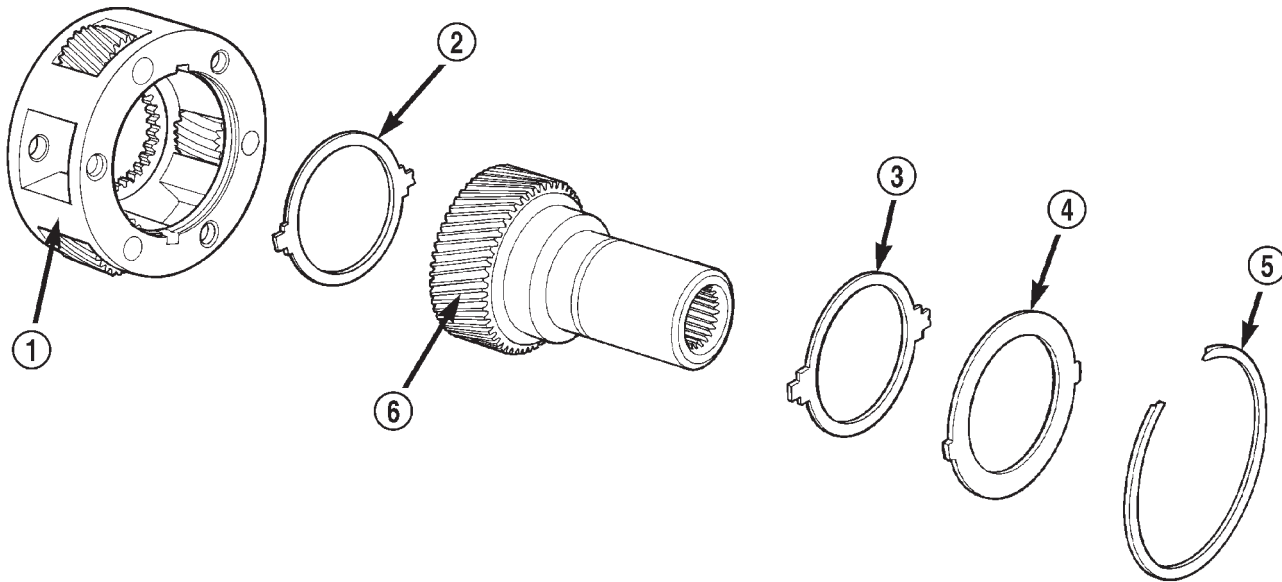
Check condition of the shift forks and mode fork shift rail (Fig. 45). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.



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**Fig. 45 Shift Fork And Wear Pad Locations**

- 1 - MODE FORK
- 2 - RANGE FORK
- 3 - WEAR PADS (SERVICEABLE)
- 4 - WEAR PADS (SERVICEABLE)



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**Fig. 44 Input Gear And Carrier Components**

- 1 - PLANETARY CARRIER
- 2 - REAR THRUST WASHER
- 3 - FRONT THRUST WASHER
- 4 - CARRIER LOCK RING
- 5 - CARRIER LOCK RETAINING RING
- 6 - INPUT GEAR

TRANSFER CASE - NV242 (Continued)

Inspect the shift fork wear pads. The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are also serviceable.

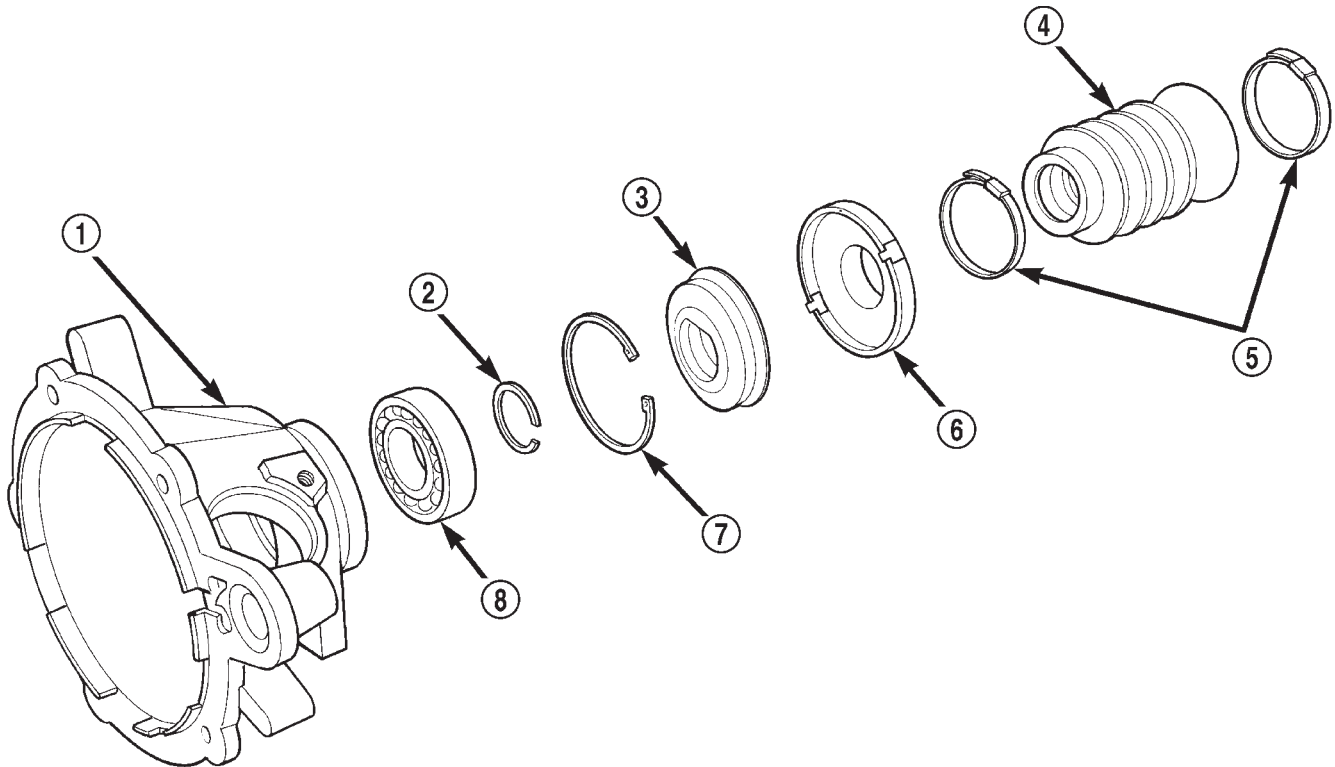
Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

**REAR RETAINER/BEARING/ SEAL/SLINGER/BOOT**

Inspect the retainer components (Fig. 46). 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.

Replace the slinger and seal outright; do not reuse either part.

Replace any part if distorted, bent, or broken. Also replace the boot if cut or torn. Replace the boot band clamps, do not reuse them.



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**Fig. 46 Rear Retainer - Typical**

- |  |                                      |
|--|--------------------------------------|
| 1 - REAR RETAINER                              | 5 - BAND CLAMPS                      |
| 2 - REAR BEARING I.D. MAINSHAFT RETAINING RING | 6 - REAR SLINGER                     |
| 3 - REAR SEAL                                  | 7 - REAR BEARING O.D. RETAINING RING |
| 4 - BOOT                                       | 8 - REAR BEARING                     |

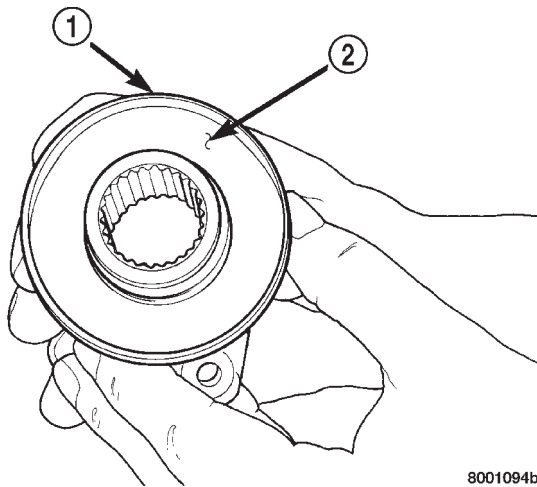
## TRANSFER CASE - NV242 (Continued)

**REAR OUTPUT SHAFT/YOKE/DRIVE CHAIN**

Check condition of the seal contact surfaces of the yoke slinger (Fig. 47). This surface must be clean and smooth to ensure proper seal life. Replace the yoke nut and seal washer as neither part should be reused.

Inspect the shaft threads, sprocket teeth, and bearing surfaces. Minor nicks on the teeth can be smoothed with an oilstone. Use 320-400 grit emery to smooth minor scratches on the shaft bearing surfaces. Rough threads on the shaft can be chased if necessary. Replace the shaft if the threads are damaged, bearing surfaces are scored, or if any sprocket teeth are cracked or broken.

Examine the drive chain and shaft bearings. Replace the chain and both sprockets if the chain is stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

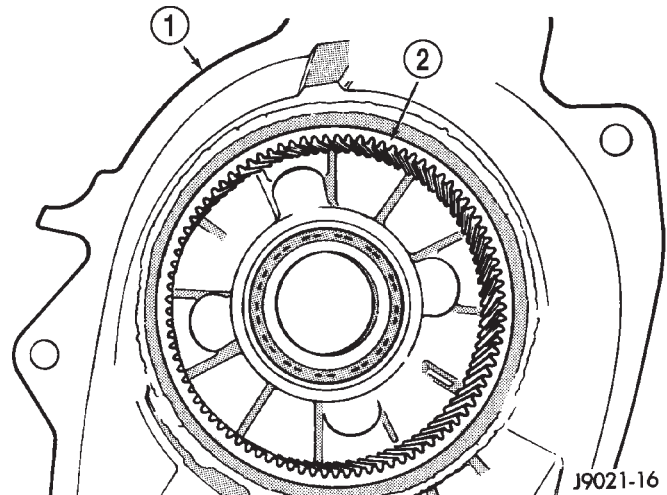


**Fig. 47 Seal Contact Surface Of Yoke Slinger**

- 1 - FRONT SLINGER (PART OF YOKE)  
2 - SEAL CONTACT SURFACE MUST BE CLEAN AND SMOOTH

**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. 48)



**Fig. 48 Low Range Annulus Gear**

- 1 - FRONT CASE  
2 - 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. 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.

**ASSEMBLY**

Lubricate transfer case components with automatic transmission fluid or petroleum jelly (where indicated) during assembly.

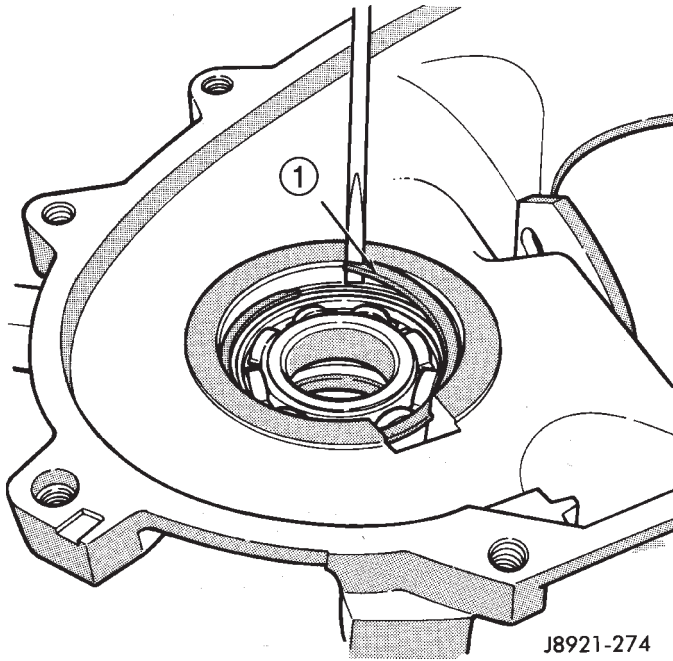
**CAUTION:** The bearing bores in various transfer case components contain oil feed holes. Make sure replacement bearings do not block the holes.

TRANSFER CASE - NV242 (Continued)

**BEARINGS AND SEALS**

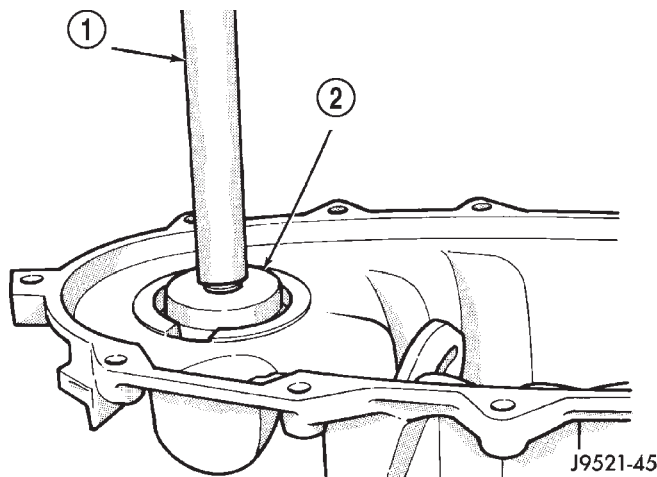
(1) Remove snap-ring that retains front output shaft front bearing in case (Fig. 49). Then remove bearing. Use hammer handle, or hammer and brass punch to tap bearing out of case.

(2) Install new front output shaft front bearing with Tool Handle C-4171 and Installer 8033-A with the tapered cone upward (Fig. 50).



**Fig. 49 Front Output Shaft Front Bearing Snap-Ring Removal**

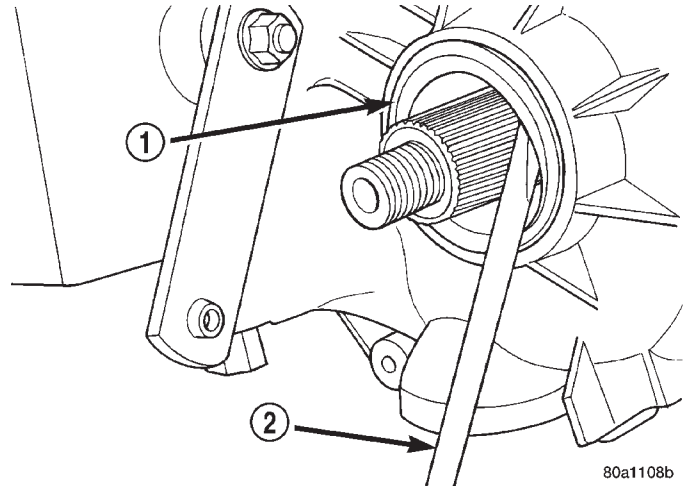
- 1 - FRONT BEARING SNAP RING



**Fig. 50 Front Output Shaft Front Bearing Installation**

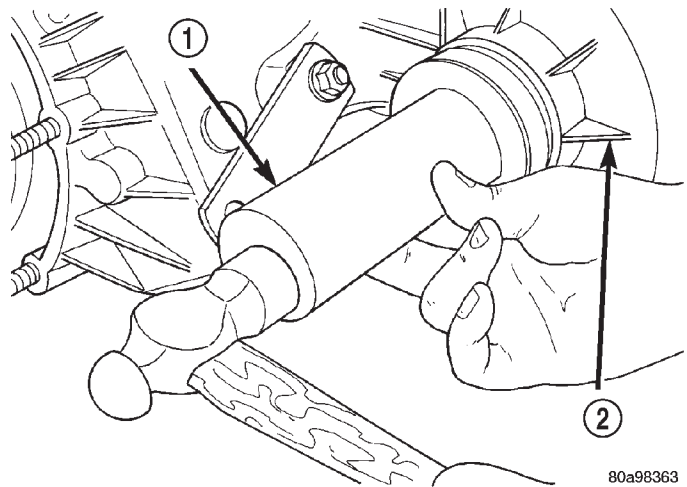
- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL 8033A

- (3) Install front bearing snap-ring (Fig. 49).
- (4) Remove front output shaft seal using an appropriate pry tool (Fig. 51) or slide-hammer mounted screw.
- (5) Install new front output shaft oil seal with Installer 6952-A (Fig. 52).



**Fig. 51 Remove Front Output Shaft Seal - Typical**

- 1 - OUTPUT SHAFT SEAL
- 2 - PRYBAR



**Fig. 52 Install Front Output Shaft Seal - Typical**

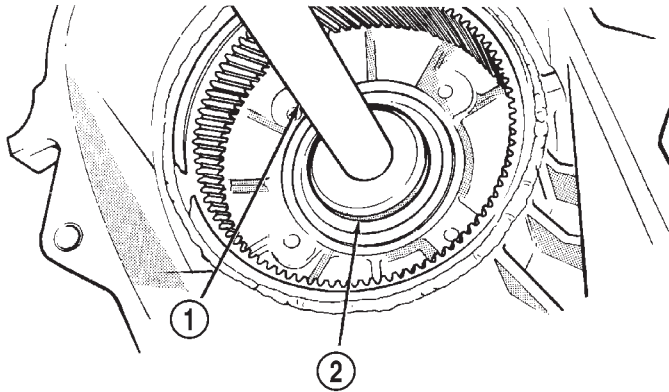
- 1 - INSTALLER 6952-A
- 2 - TRANSFER CASE

TRANSFER CASE - NV242 (Continued)

(6) Remove input gear bearing with Tool Handle C-4171 and Remover C-4210 (Fig. 53).

(7) Install snap-ring on new input gear bearing.

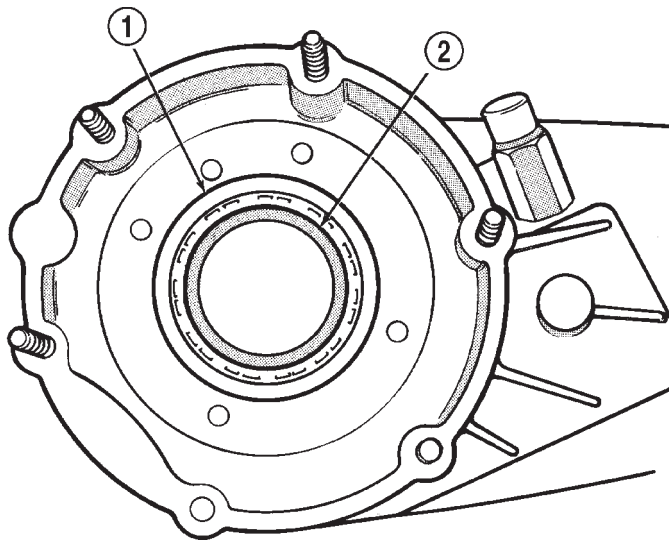
(8) Install new input gear bearing with Tool Handle C-4171 and Remover C-4210. Install bearing far enough to seat snap-ring against case (Fig. 54).



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**Fig. 53 Input Gear Bearing Removal**

- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL C-4210



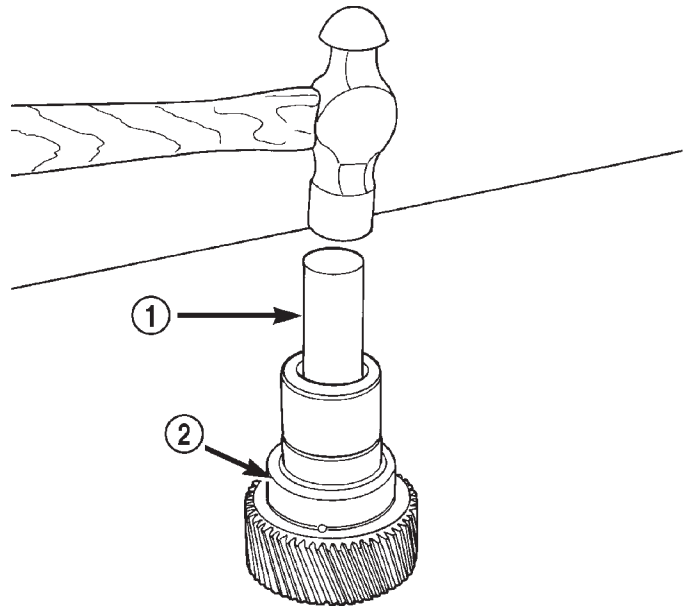
J8921-219

**Fig. 54 Seating Input Gear Bearing**

- 1 - SNAP-RING
- 2 - INPUT SHAFT BEARING

(9) Remove the 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. 55).

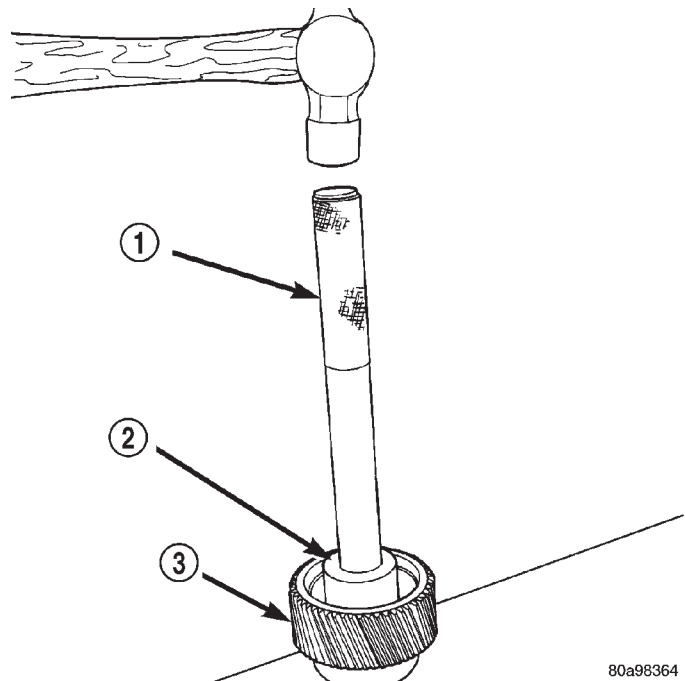
(10) Install new pilot bearing with Installer 8128 and Handle C-4171 (Fig. 56).



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**Fig. 55 Remove Input Gear Pilot Bearing**

- 1 - DRIFT
- 2 - INPUT GEAR



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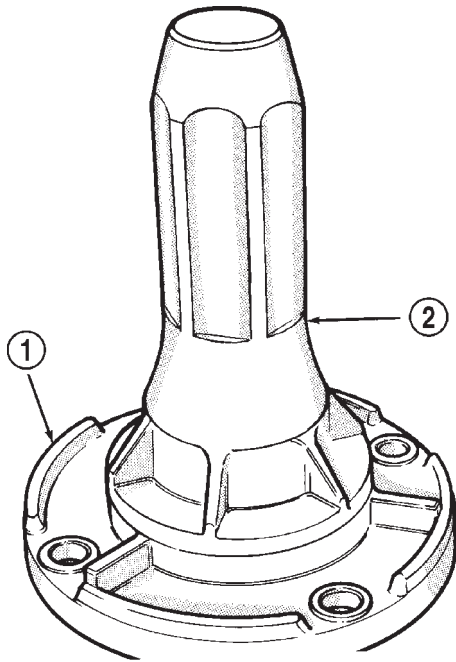
**Fig. 56 Install Input Gear Pilot Bearing**

- 1 - HANDLE C-4171
- 2 - INSTALLER 8128
- 3 - INPUT GEAR

(11) Install new seal in front bearing retainer with Installer 7884 (Fig. 57).

(12) Remove output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 58).

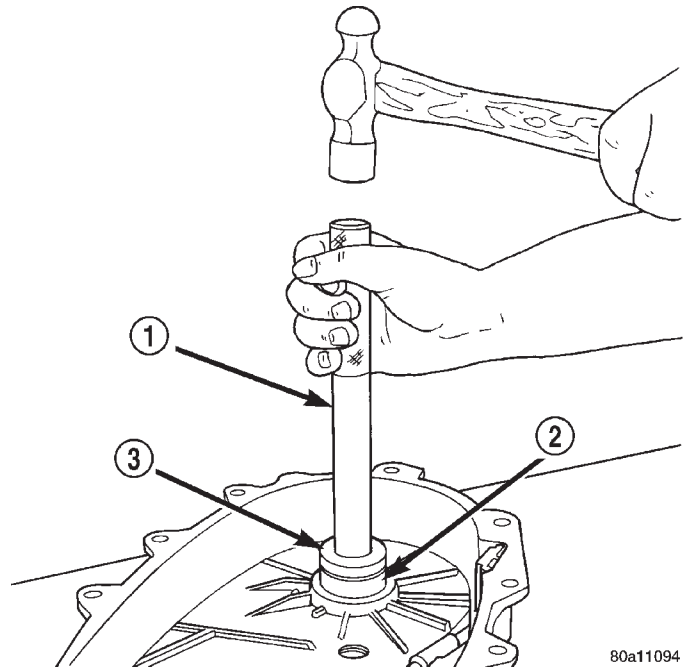
TRANSFER CASE - NV242 (Continued)



J9521-41

**Fig. 57 Front Bearing Retainer Seal Installation**

- 1 - FRONT BEARING RETAINER
- 2 - SPECIAL TOOL 7884



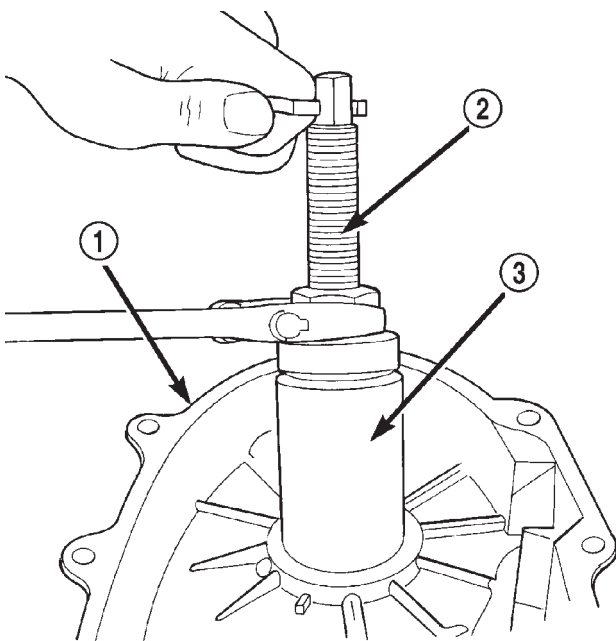
80a11094

**Fig. 59 Install Front Output Shaft Rear Bearing**

- 1 - HANDLE C-4171
- 2 - OUTPUT SHAFT INNER BEARING
- 3 - INSTALLER 5066

(13) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 59). Lubricate bearing after installation.

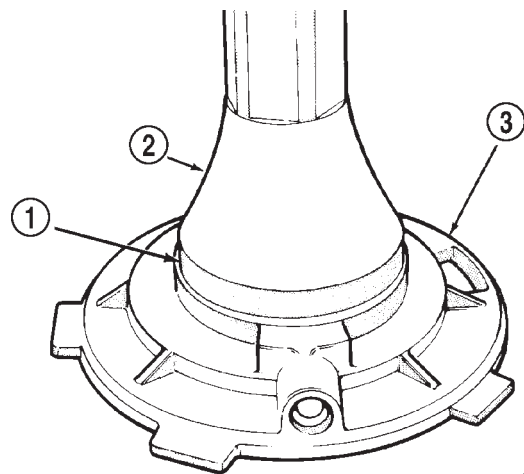
(14) Install new seal in oil pump feed housing with Special Tool 7888 (Fig. 60).



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**Fig. 58 Remove Front Output Shaft Rear Bearing**

- 1 - REAR CASE
- 2 - SPECIAL TOOL L-4454-1 AND L-4454-3
- 3 - SPECIAL TOOL 8148



J9521-35

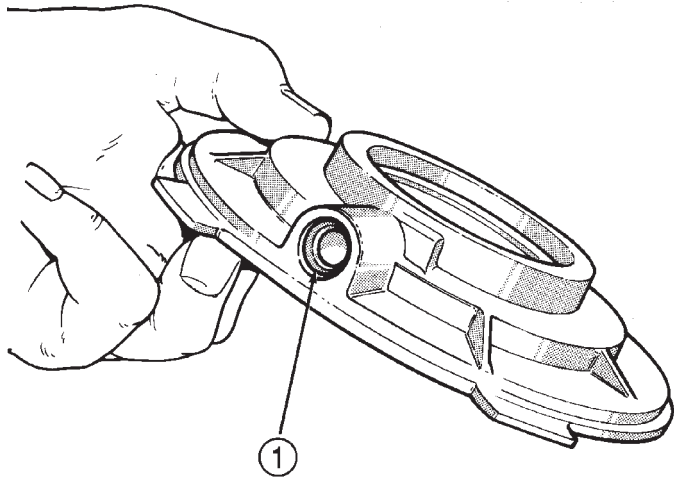
**Fig. 60 Oil Pump Seal Installation**

- 1 - HOUSING SEAL
- 2 - SPECIAL TOOL 7888
- 3 - OIL PUMP FEED HOUSING

(15) Install new pickup tube O-ring in oil pump (Fig. 61).



TRANSFER CASE - NV242 (Continued)



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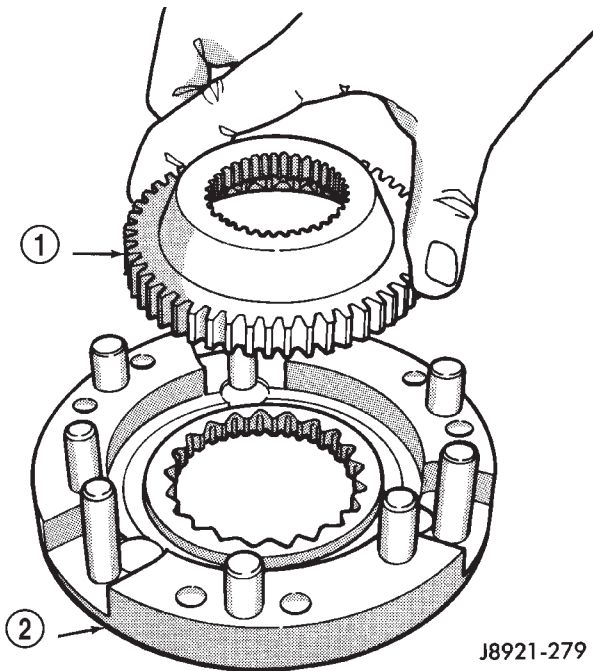
**Fig. 61 Pickup Tube O-Ring Installation**

1 - PICKUP TUBE O-RING

**DIFFERENTIAL**

(1) Lubricate differential components with automatic transmission fluid.

(2) Install sprocket gear in differential bottom case (Fig. 62).



J8921-279

**Fig. 62 Installing Differential Sprocket Gear**

1 - SPROCKET GEAR  
2 - BOTTOM CASE

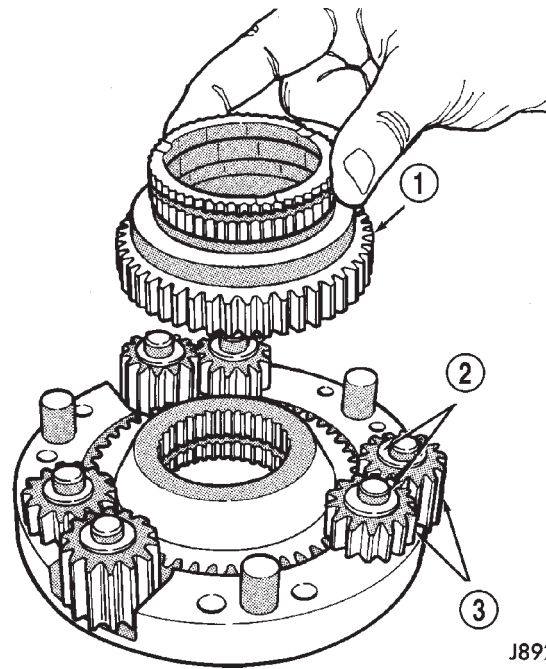
(3) Install differential planet gears and new thrust washers (Fig. 63). Be sure thrust washers are installed at top and bottom of each planet gear.

(4) Install differential mainshaft gear (Fig. 63).

(5) Align and position differential top case on bottom case (Fig. 64). Align using scribe marks made at disassembly.

(6) While holding differential case halves together, invert the differential and start the differential case bolts.

(7) Tighten differential case bolts to specified torque.

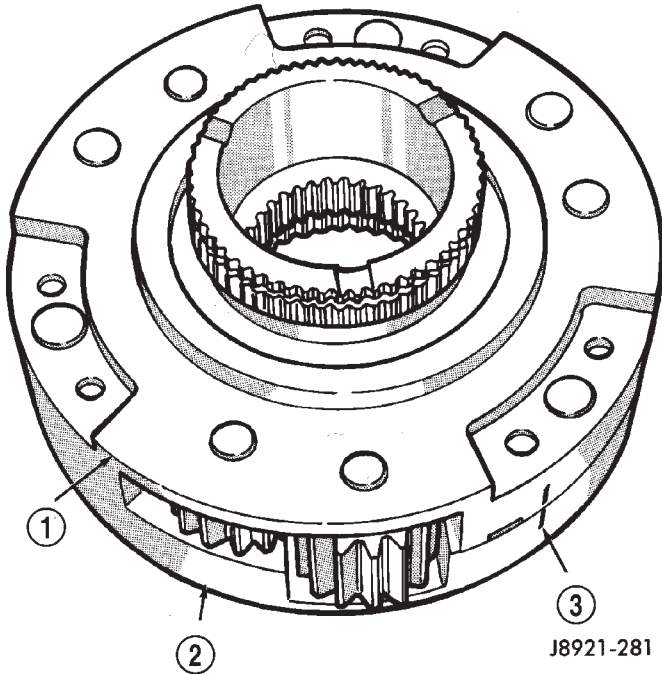


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**Fig. 63 Installing Mainshaft And Planet Gears**

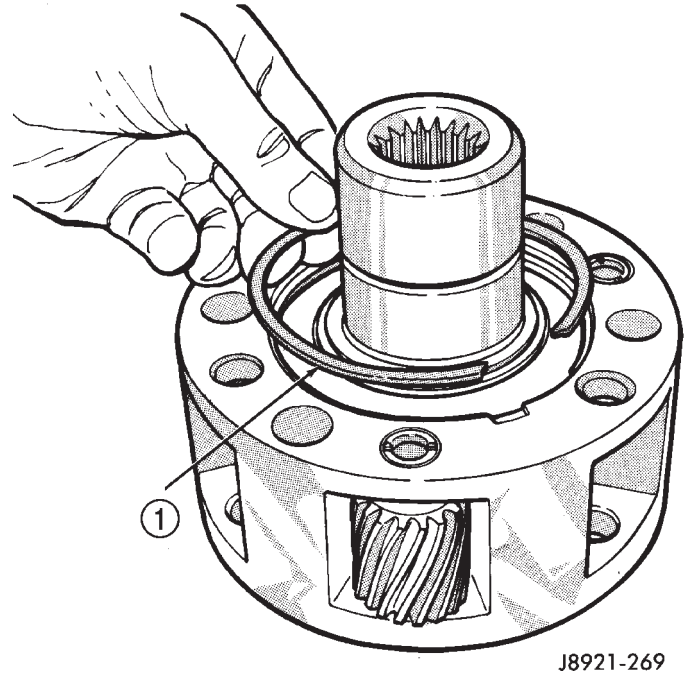
1 - MAINSHAFT GEAR  
2 - THRUST WASHERS (12)  
3 - PLANET GEARS (6)

TRANSFER CASE - NV242 (Continued)



**Fig. 64 Differential Case Assembly**

- 1 - TOP CASE
- 2 - BOTTOM CASE
- 3 - CASE ALIGNMENT MARKS

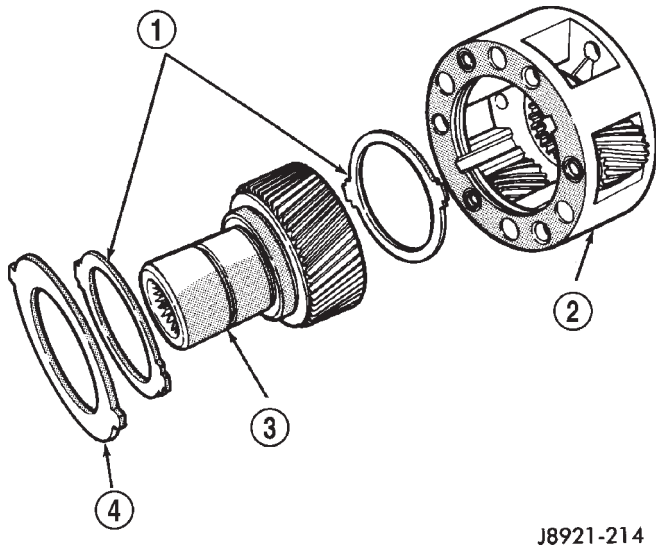


**Fig. 66 Install Low Range Gear Snap-Ring**

- 1 - LOW RANGE GEAR SNAP-RING

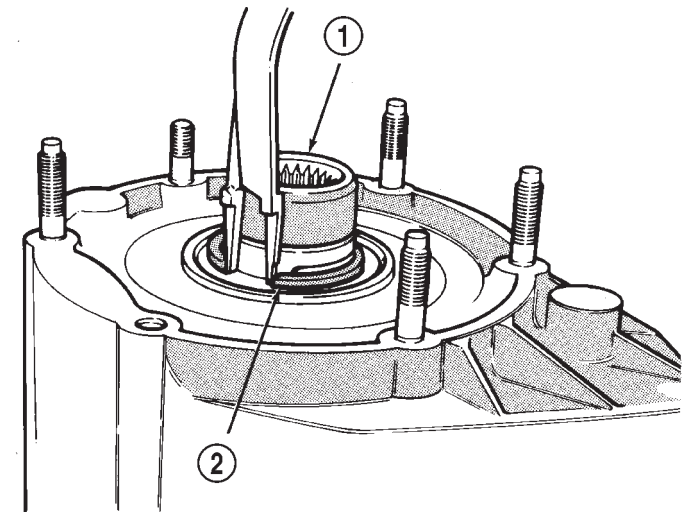
**INPUT GEAR/LOW RANGE ASSEMBLY**

- (1) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 65).
- (2) Install low range gear snap-ring (Fig. 66).



**Fig. 65 Low Range And Input Gear Assembly**

- 1 - THRUST WASHERS
- 2 - LOW RANGE GEAR
- 3 - INPUT GEAR
- 4 - RETAINER



**Fig. 67 Input Gear Snap-Ring Installation**

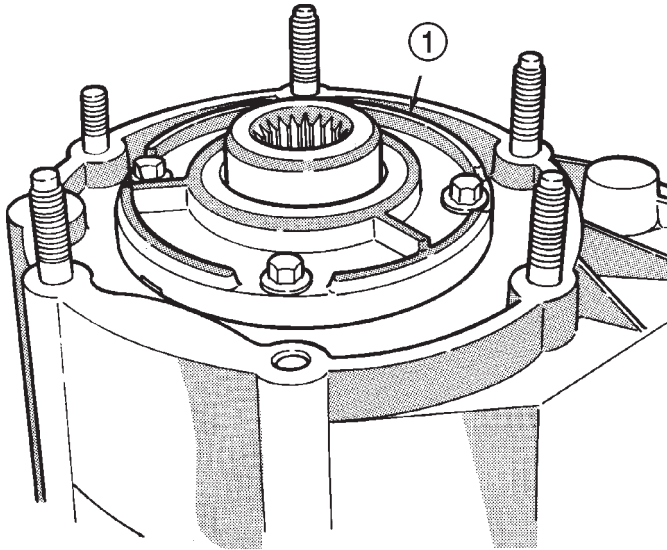
- 1 - INPUT GEAR
- 2 - SNAP-RING

- (3) Lubricate input gear and low range gears with automatic transmission fluid.
- (4) Start input gear shaft into front case bearing.
- (5) Press input gear shaft into front bearing.
- (6) Install new input gear snap ring (Fig. 67).

## TRANSFER CASE - NV242 (Continued)

(7) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to seal surface of front bearing retainer.

(8) Install front bearing retainer (Fig. 68). Tighten retainer bolts to 16 ft. lbs. (21 N-m) torque.



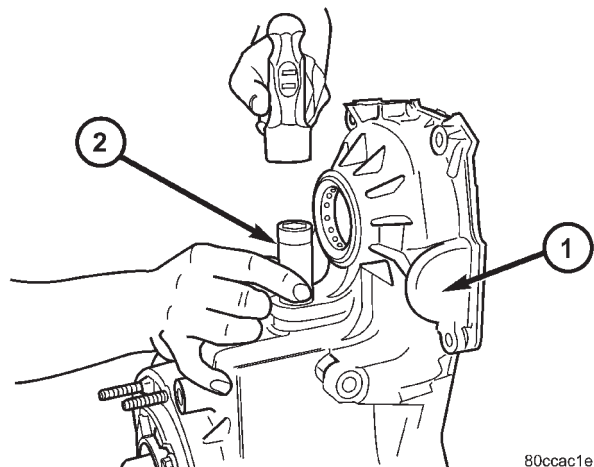
J8921-276

**Fig. 68 Installing Front Bearing Retainer**

1 - FRONT BEARING RETAINER

## SHIFT FORKS, SECTOR, AND MAINSHAFT

(1) Install the shift sector shaft bearing using a suitable socket until the bearing is flush to the bottom, inner edge of the bore (Fig. 69).



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**Fig. 69 Install Shift Sector Shaft Bearing**

1 - TRANSFER CASE

2 - SOCKET

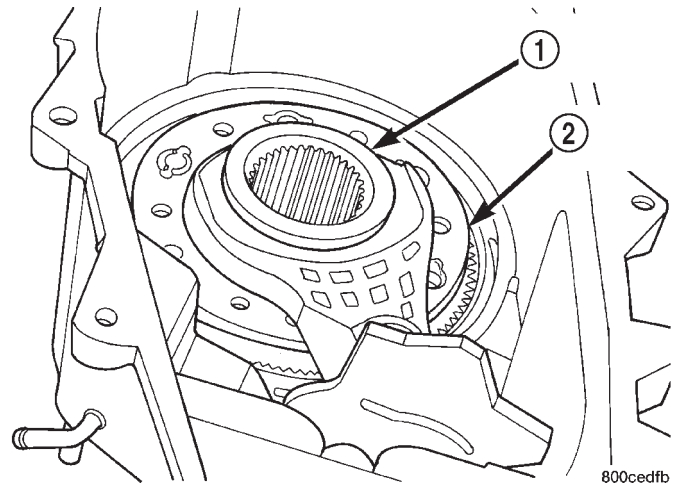
(2) Install a new shift sector shaft seal using a suitable socket until the seal is flush to the bottom of the bore lead-in chamfer.

(3) Install shift sector.

(4) Install new pads on low range fork, if necessary.

(5) Assemble low range fork and sleeve.

(6) Position low range fork and sleeve in case. Be sure low range fork pin is engaged in shift sector slot (Fig. 70).



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**Fig. 70 Install Range Fork And Sleeve Assembly**

1 - RANGE SLEEVE

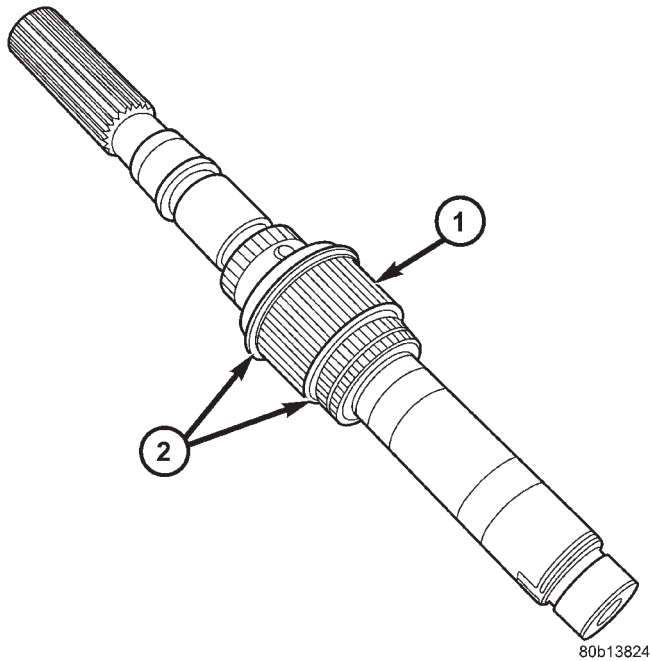
2 - RANGE FORK

(7) Install first mainshaft bearing spacer on mainshaft (Fig. 71).

(8) Install bearing rollers on mainshaft (Fig. 71). Coat bearing rollers with generous quantity of petroleum jelly to hold them in place.

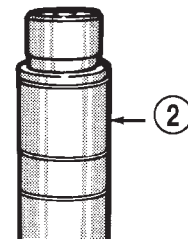
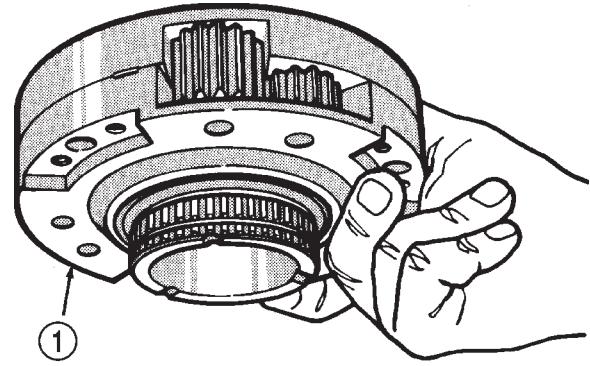
(9) Install remaining bearing spacer on mainshaft (Fig. 71). Do not displace any bearings while installing spacer.

TRANSFER CASE - NV242 (Continued)



**Fig. 71 Installing Mainshaft Bearing Rollers and Spacers**

- 1 - MAINSHAFT BEARING ROLLERS
- 2 - BEARING SPACERS



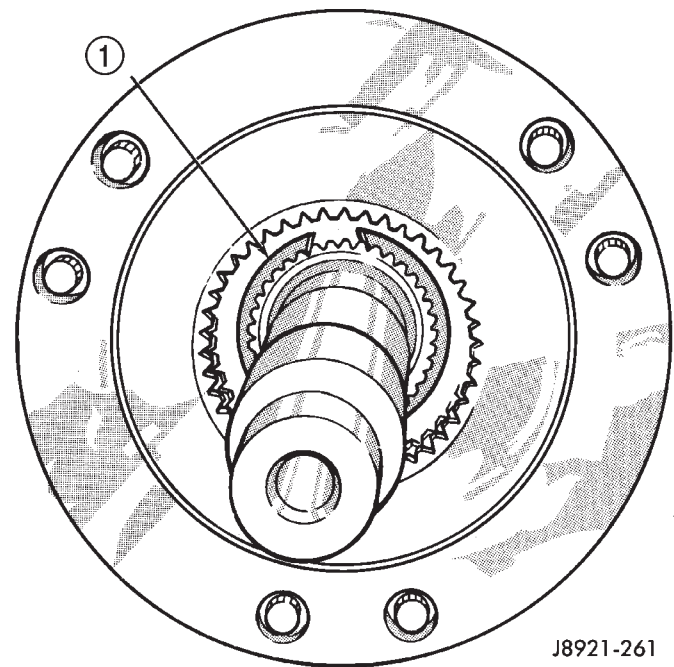
J8921-283

**Fig. 72 Differential Installation**

- 1 - DIFFERENTIAL
- 2 - MAINSHAFT

(10) Install differential (Fig. 72). Do not displace mainshaft bearings when installing differential.

- (11) Install differential snap-ring (Fig. 73).
- (12) Install intermediate clutch shaft (Fig. 74).
- (13) Install clutch shaft thrust washer (Fig. 75).
- (14) Install clutch shaft snap-ring (Fig. 76).

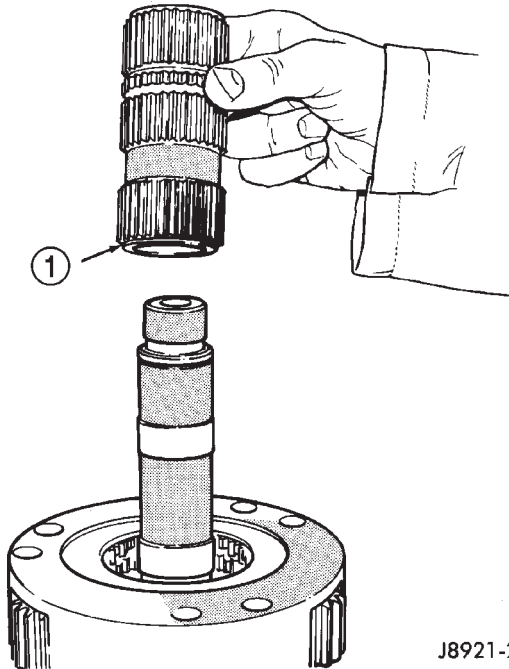


J8921-261

**Fig. 73 Installing Differential Snap-Ring**

- 1 - DIFFERENTIAL SNAP-RING

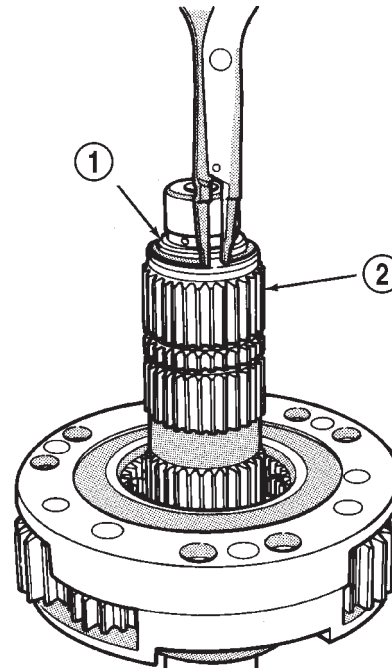
TRANSFER CASE - NV242 (Continued)



J8921-260

**Fig. 74 Installing Intermediate Clutch Shaft**

- 1 - INTERMEDIATE CLUTCH SHAFT



J8921-258

**Fig. 76 Installing Clutch Shaft Snap-Ring**

- 1 - SNAP-RING  
2 - INTERMEDIATE CLUTCH SHAFT

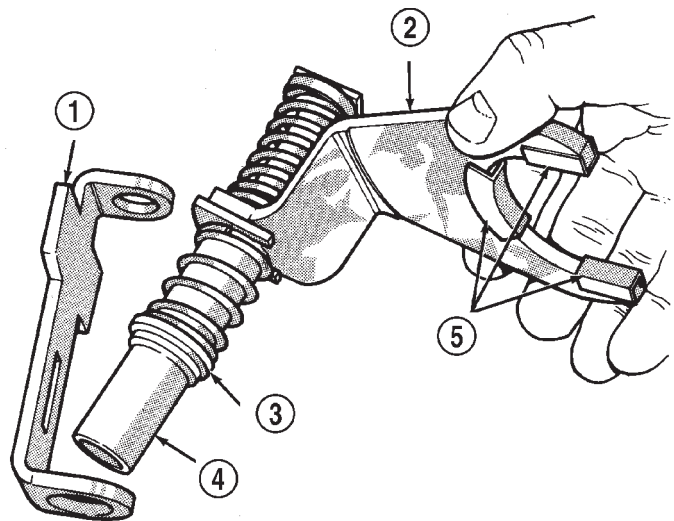
(15) Inspect mode fork assembly (Fig. 77). Replace pads and bushing if necessary. Replace fork tube if bushings inside tube are worn or damaged. Also check springs and slider bracket (Fig. 77). Replace worn, damaged components.



J8921-259

**Fig. 75 Installing Clutch Shaft Thrust Washer**

- 1 - CLUTCH SHAFT THRUST RING



J8921-284

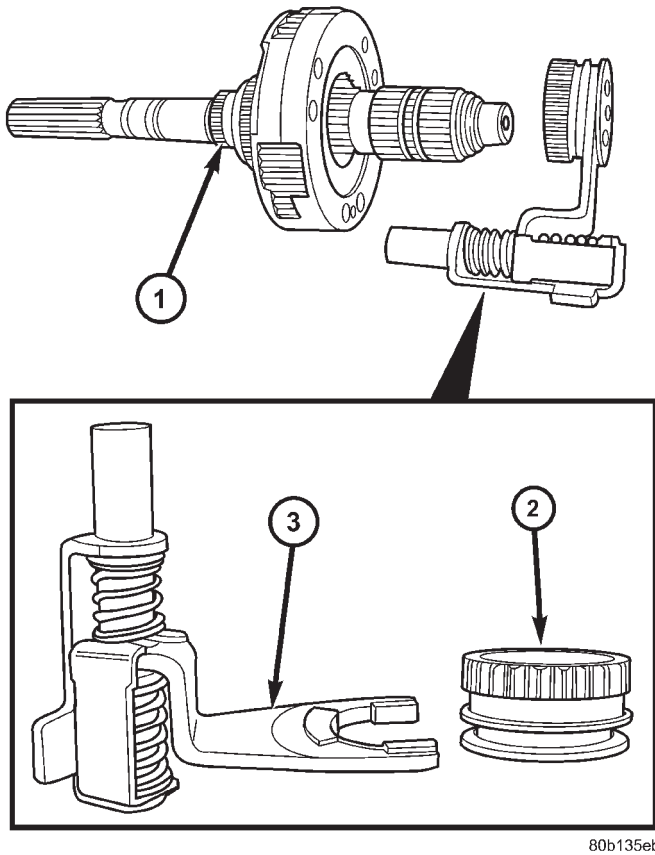
**Fig. 77 Mode Fork Assembly Inspection**

- 1 - SLIDER  
2 - MODE FORK  
3 - BUSHING/SPRING  
4 - TUBE  
5 - PADS

TRANSFER CASE - NV242 (Continued)

(16) Install mode sleeve in mode fork (Fig. 78). Then install assembled sleeve and fork on mainshaft. Be sure mode sleeve splines are engaged in differential splines.

(17) Install mode fork and mainshaft assembly in case (Fig. 79). Rotate mainshaft slightly to engage shaft with low range gears.



**Fig. 78 Installing Mode Fork And Sleeve**

- 1 - MAINSHAFT
- 2 - MODE SLEEVE
- 3 - MODE FORK ASSEMBLY

(18) Rotate mode fork pin into shift sector slot.  
 (19) Install shift rail (Fig. 80). Be sure rail is seated in both shift forks.

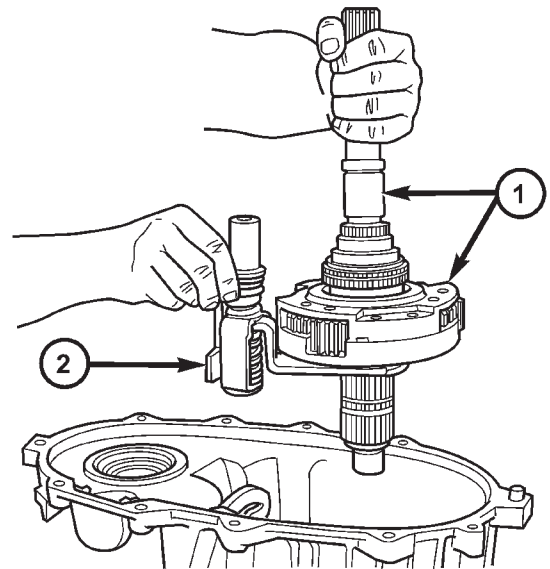
(20) Rotate shift sector to align lockpin hole in low range fork with access hole in case.

(21) Insert an easy-out in range fork lockpin to hold it securely for installation (Fig. 81). Lockpin is slightly tapered on one end. Insert tapered end into fork and rail.

(22) Insert lockpin through access hole and into shift fork (Fig. 81). Then remove easy-out and seat the pin with pin punch.

(23) Install plug in lockpin access hole.

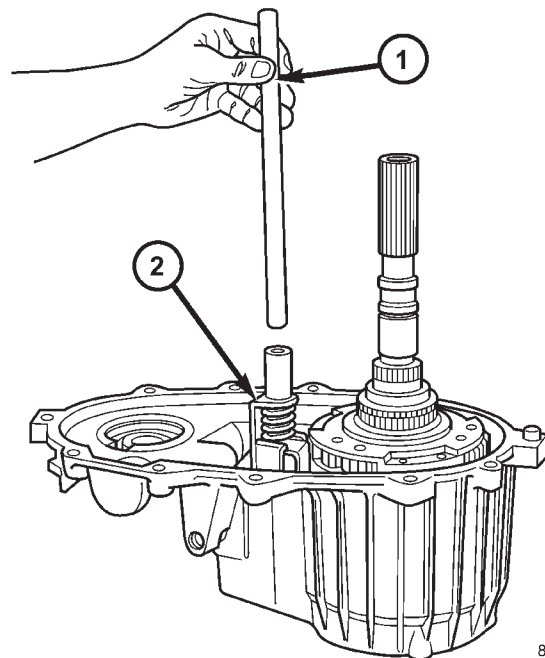
(24) Install detent plunger, detent spring and detent plug in case (Fig. 82).



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**Fig. 79 Assembled Mainshaft And Mode Fork Installation**

- 1 - MAINSHAFT ASSEMBLY
- 2 - MODE FORK

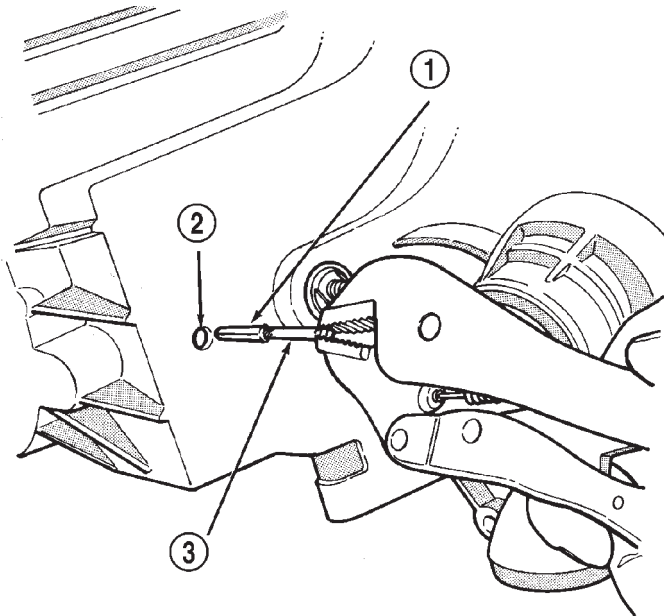


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**Fig. 80 Shift Rail Installation**

- 1 - SHIFT RAIL
- 2 - MODE FORK

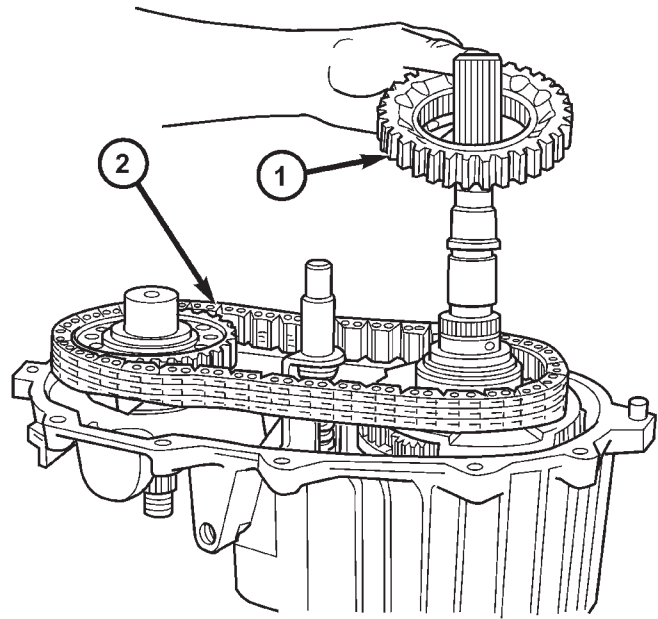
TRANSFER CASE - NV242 (Continued)



J8921-254

**Fig. 81 Installing Low Range Fork Lockpin**

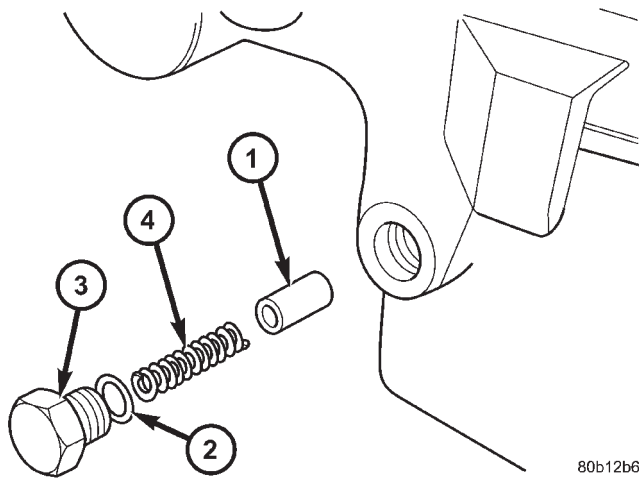
- 1 - LOW RANGE FORK LOCK PIN
- 2 - ACCESS HOLE
- 3 - EASY-OUT



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**Fig. 83 Drive Chain And Sprocket Installation**

- 1 - DRIVE SPROCKET
- 2 - DRIVE CHAIN



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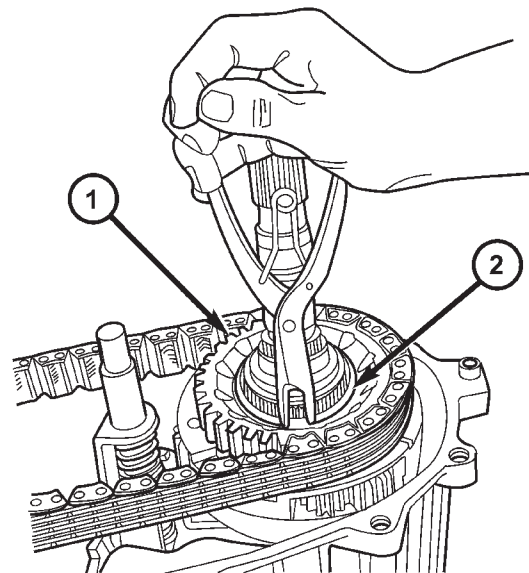
**Fig. 82 Detent Pin, Spring And Plug Installation**

- 1 - PLUNGER
- 2 - O-RING
- 3 - PLUG
- 4 - SPRING

**FRONT OUTPUT SHAFT AND DRIVE CHAIN**

- (1) Install front output shaft (Fig. 83).
- (2) Install drive chain (Fig. 83). Engage chain with front output shaft sprocket teeth.
- (3) Install drive sprocket (Fig. 83). Engage drive sprocket teeth with chain. Then engage sprocket splines with mainshaft splines.

(4) Install drive sprocket snap-ring (Fig. 84).



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**Fig. 84 Drive Sprocket Snap-Ring Installation**

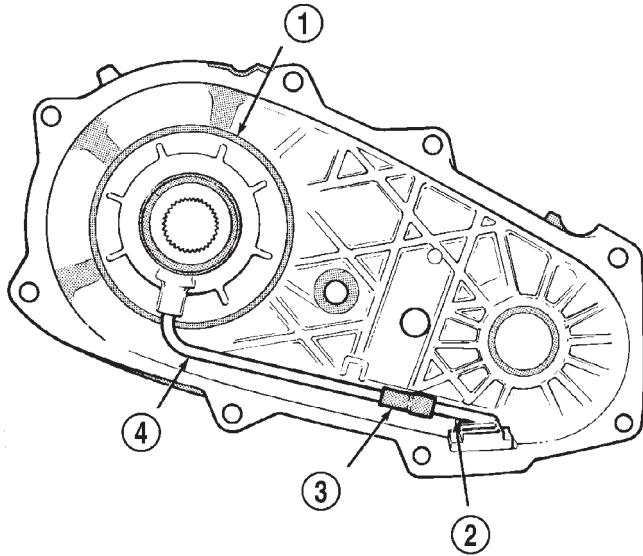
- 1 - DRIVE SPROCKET
- 2 - DRIVE SPROCKET SNAP-RING

TRANSFER CASE - NV242 (Continued)

**OIL PUMP AND REAR CASE**

(1) Insert oil pickup tube in oil pump and attach oil screen and connector hose to pickup tube. Then install assembled pump, tube and screen in rear case (Fig. 85). Be sure screen is seated in case slot as shown.

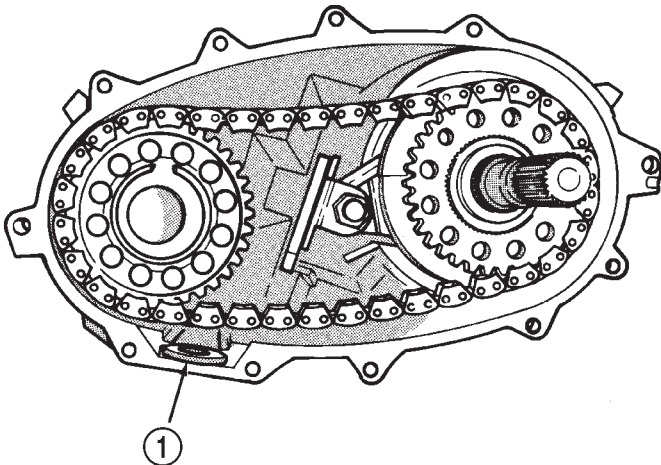
(2) Install magnet in front case pocket (Fig. 86).



J8921-287

**Fig. 85 Oil Screen And Pickup Tube Installation**

- 1 - OIL PUMP
- 2 - OIL SCREEN
- 3 - CONNECTOR
- 4 - PICKUP TUBE



J8921-288

**Fig. 86 Installing Case Magnet**

- 1 - MAGNET

(3) Apply 3 mm (1/8 in.) wide bead of Mopar® gasket maker or silicone adhesive sealer to seal surface of front case.

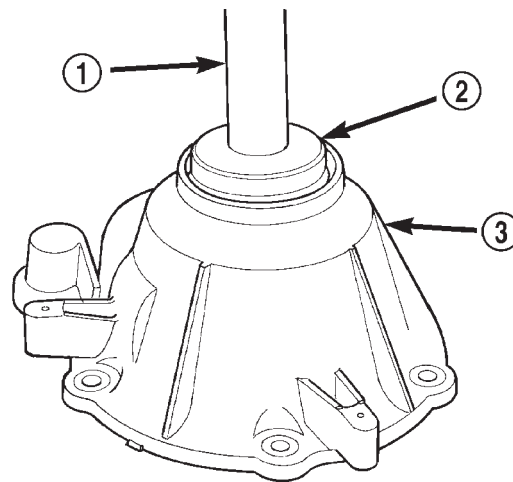
(4) Align and install rear case on front case. Be sure case locating dowels are in place and that mainshaft splines are engaged in oil pump inner gear.

(5) Install and tighten front case-to-rear case bolts to 41 N·m (30 ft. lbs.) torque. Be sure to install a washer under each bolt used at case dowel locations.

**REAR RETAINER**

(1) Remove rear bearing in retainer using Installer 8128 and Handle C-4171.

(2) Install rear bearing in retainer with Tools C-4171 and 5064 (Fig. 87).



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**Fig. 87 Installing Rear Bearing In Retainer**

- 1 - SPECIAL TOOL C-4171
- 2 - SPECIAL TOOL 5052
- 3 - REAR RETAINER

(3) Install rear bearing O.D. retaining ring with snap-ring pliers (Fig. 88). Be sure retaining ring is fully seated in retainer groove.

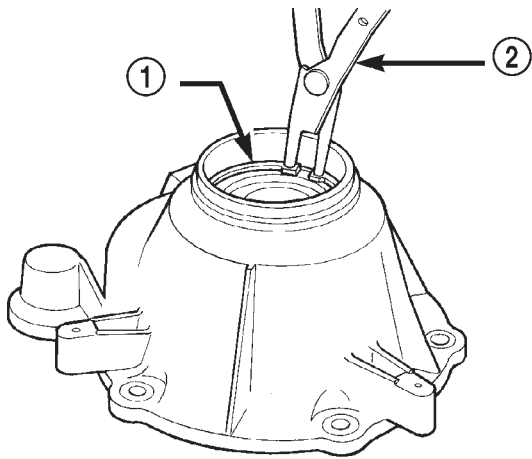
(4) Apply bead of Mopar® Sealer P/N 82300234, or Loctite™ Ultra Gray, to mating surface of rear retainer. Sealer bead should be a maximum of 3/16 in.

(5) Install rear retainer on rear case. Tighten retainer bolts to 20-27 N·m (15-20 ft. lbs.) torque.

(6) Install rear bearing I.D. retaining ring and spacer on output shaft.



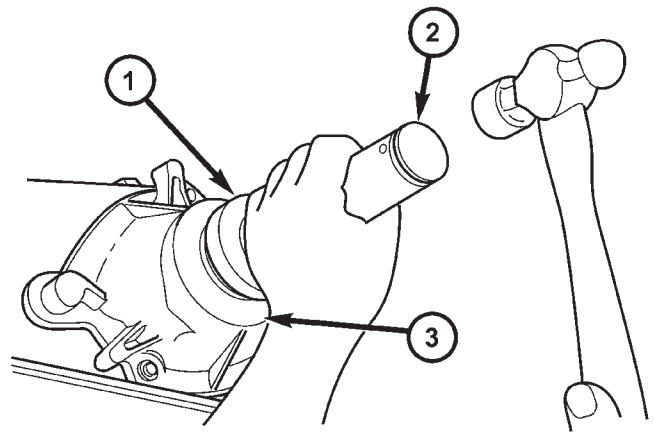
TRANSFER CASE - NV242 (Continued)



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**Fig. 88 Rear Bearing Retaining Ring Installation**

- 1 - REAR BEARING O.D. RETAINING RING
- 2 - SNAP-RING PLIERS



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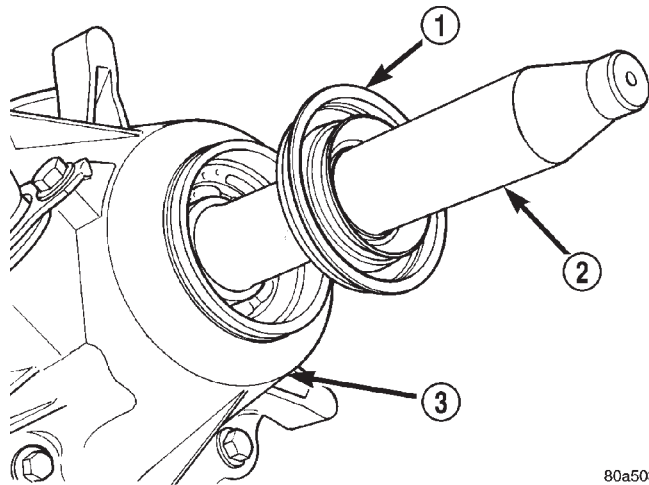
**Fig. 90 Rear Seal Installation**

- 1 - SPECIAL TOOL 8691
- 2 - HANDLE
- 3 - TRANSFER CASE

(7) Apply liberal quantity of petroleum jelly to new rear seal and to output shaft. Petroleum jelly is needed to protect seal lips during installation.

(8) Slide seal onto Seal Protector 6992 (Fig. 89). Slide seal protector and seal onto output shaft.

(9) Slide Installer C-4076-B onto seal protector with the recessed side of the tool toward the seal. Drive seal into rear bearing retainer with Installer C-4076-B and Handle MD-998323 (Fig. 90).

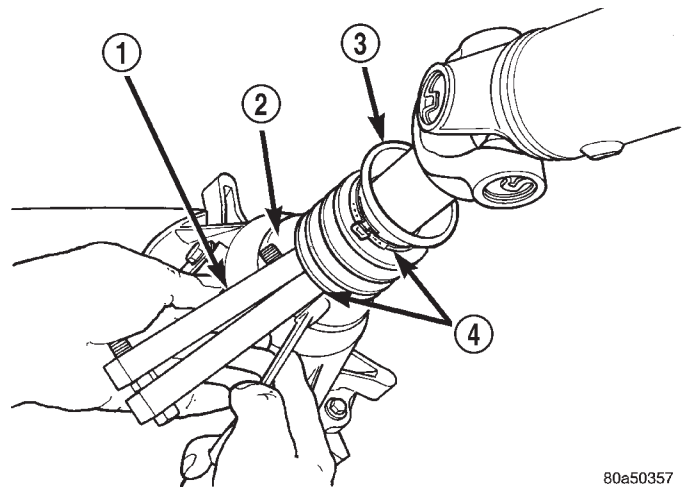


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**Fig. 89 Output Shaft**

- 1 - OUTPUT SHAFT SEAL
- 2 - SPECIAL TOOL 6992
- 3 - TRANSFER CASE

(10) Install rear slinger with Installer 8408.  
 (11) Install boot on output shaft slinger and crimp retaining clamp with tool C-4975-A (Fig. 91).



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**Fig. 91 Slinger Boot Installation**

- 1 - SPECIAL TOOL C-4975-A
- 2 - SLINGER
- 3 - BOOT
- 4 - CLAMP

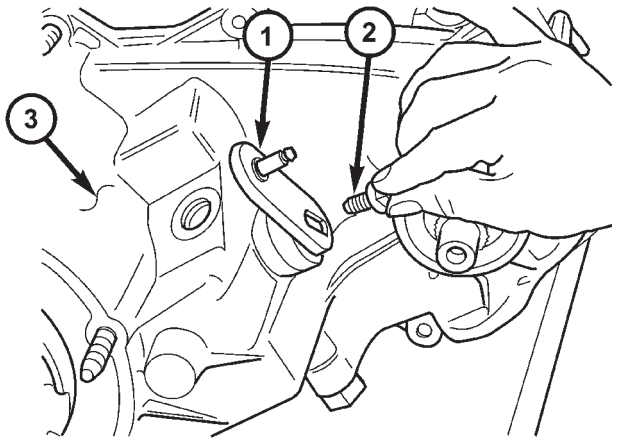
TRANSFER CASE - NV242 (Continued)

**COMPANION FLANGE AND RANGE LEVER**

(1) Install range lever and bolt on sector shaft (Fig. 92). Tighten bolt to 27-34 N·m (20-25 ft. lbs.) torque.

(2) Inspect the o-ring on the transfer case position sensor. Replace the o-ring if necessary.

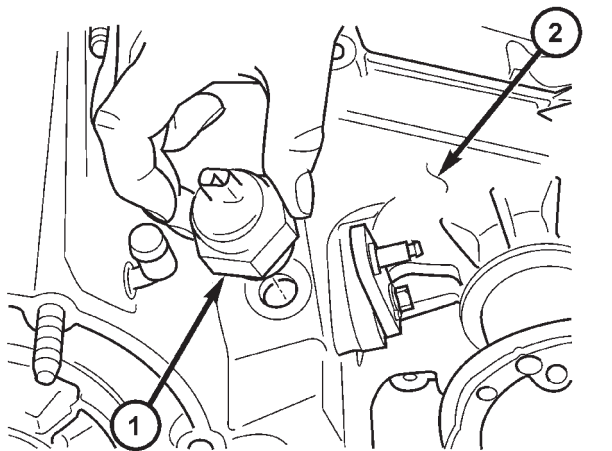
(3) Install the transfer case position sensor in the front case (Fig. 93). Tighten sensor to 20-34 N·m (15-25 ft. lbs.) torque.



80ccabc

**Fig. 92 Install Shift Lever Bolt**

- 1 - RANGE LEVER
- 2 - RANGE LEVER BOLT
- 3 - TRANSFER CASE



80ccabc2

**Fig. 93 Install Transfer Case Position Sensor**

- 1 - TRANSFER CASE POSITION SENSOR
- 2 - TRANSFER CASE

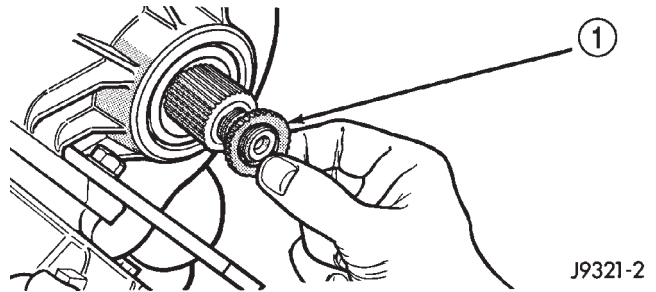
(4) Install new seal washer on front output shaft (Fig. 94).

(5) Lubricate companion flange hub with transmission fluid and install flange onto the front output shaft.

(6) Install new seal washer on front shaft.

(7) Install new flange nut onto front output shaft.

(8) Tighten flange nut to 122-176 N·m (90-130 ft. lbs.) torque.



J9321-2

**Fig. 94 Seal Washer Installation**

- 1 - SEAL WASHER

**INSTALLATION**

- (1) Mount transfer case on a transmission jack.
- (2) Secure transfer case to jack with chains.
- (3) Position transfer case under vehicle.
- (4) Align transfer case and transmission shafts and install transfer case on transmission.
- (5) Install and tighten transfer case attaching nuts to 35 N·m (26 ft. lbs.) torque.
- (6) Connect vent hose.
- (7) Connect transfer case position sensor connector to sensor.
- (8) Align and connect propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).
- (9) Fill transfer case with correct fluid. Check transmission fluid level. Correct as necessary.
- (10) Install skid plate. (Refer to 13 - FRAME & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION)
- (11) Remove transmission jack and support stand.
- (12) Connect shift cable to transfer case range lever.
- (13) Lower vehicle and verify transfer case shift operation.

## TRANSFER CASE - NV242 (Continued)

## SPECIFICATIONS

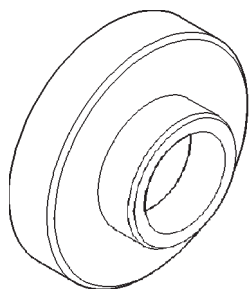
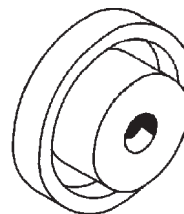
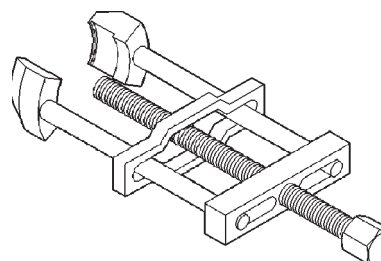
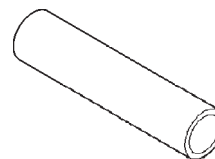
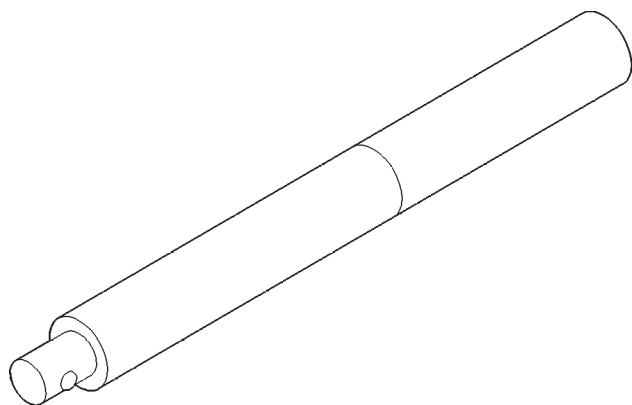
## NV242 TRANSFER CASE

## TORQUE SPECIFICATIONS

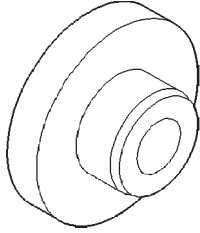
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Bolt, Differential Case	17-27	15-24	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Front Brg. Retainer	16-27	12-20	-
Bolt, Case Half	35-46	26-34	-
Nut, Front Companion Flange	122-176	90-130	-
Bolt, Range Lever	27-34	20-25	-
Bolt, Rear Retainer	35-46	26-34	-
Nuts, Mounting	35	26	-
Screw, Oil Pump	1.2-1.8	-	12-15
Sensor, Transfer Case Position	20-34	16-25	-

## SPECIAL TOOLS

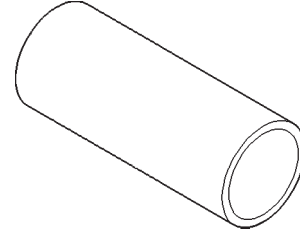
## TRANSFER CASE - NV242

**Installer - C-4076-B****Remover - C-4210****Puller, Slinger - MD-998056-A****Installer - MD-998323****Handle, Universal - C-4171**

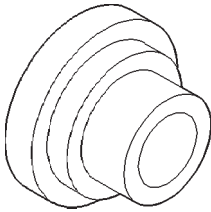
TRANSFER CASE - NV242 (Continued)



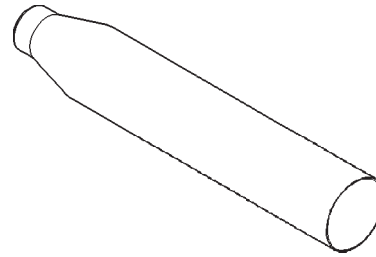
**Installer, Bearing - 5064**



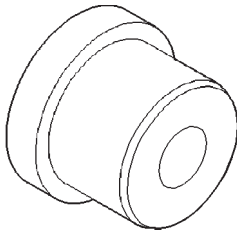
**Cup - 8148**



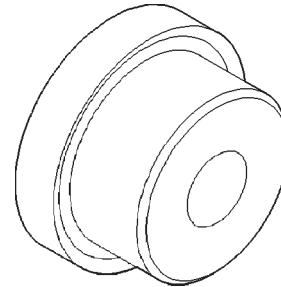
**Installer - 8128**



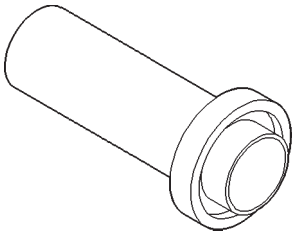
**Seal Protector - 6992**



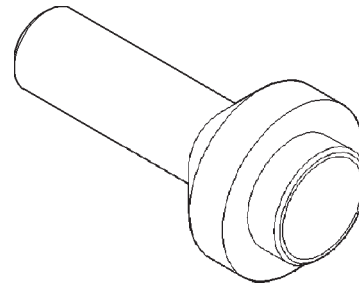
**Installer - 5066**



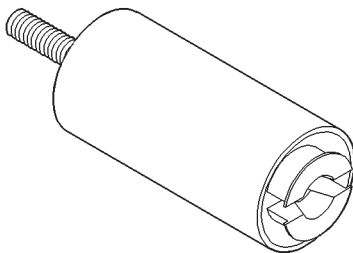
**Installer, Input Gear Bearing - 7829-A**



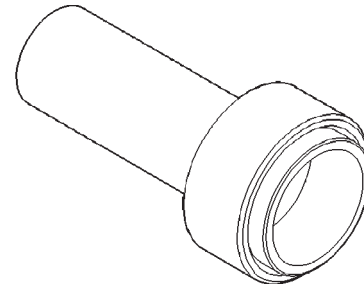
**Installer - 6952-A**



**Installer, Seal - 7884**

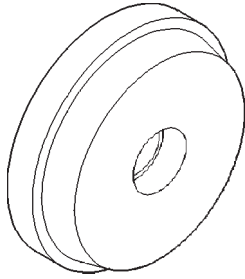


**Remover - L-4454**

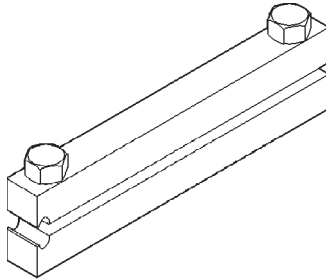


**Installer, Pump Housing Seal - 7888**

TRANSFER CASE - NV242 (Continued)



**Installer, Bearing - 8033-A**

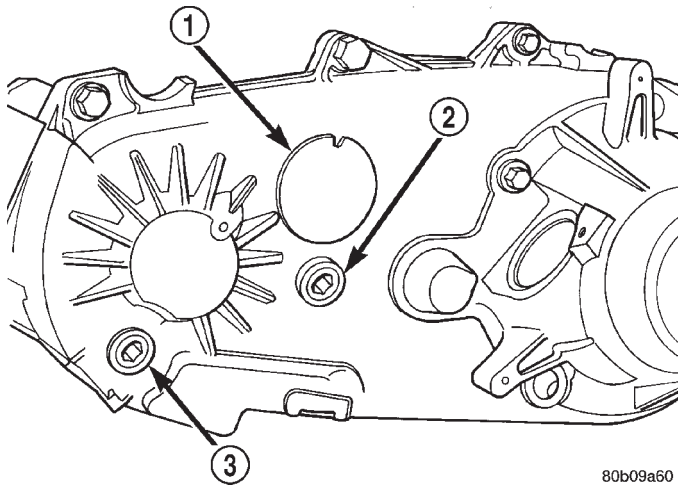


**Installer, Boot Clamp - C-4975-A**

**FLUID**

**STANDARD PROCEDURE - FLUID DRAIN AND FILL**

The fill and drain plugs are both in the rear case (Fig. 95). Correct fill level is to the bottom edge of the fill plug hole. Be sure the vehicle is level to ensure an accurate fluid level check.



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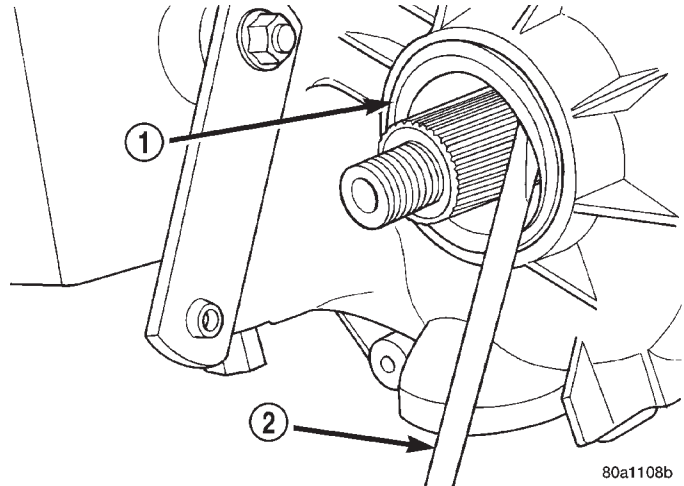
**Fig. 95 Fill/Drain Plug and I.D. Tag Location - Typical**

- 1 - I.D. TAG
- 2 - FILL PLUG
- 3 - DRAIN PLUG

**FRONT OUTPUT SHAFT SEAL**

**REMOVAL**

- (1) Raise vehicle.
- (2) Remove front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)
- (3) Remove front output shaft companion flange.
- (4) Remove seal from front case with pry tool (Fig. 96).



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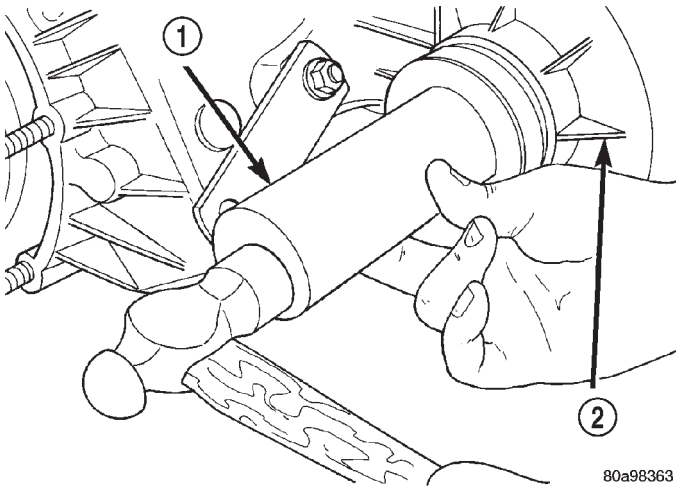
**Fig. 96 Remove Front Output Shaft Seal - Typical**

- 1 - OUTPUT SHAFT SEAL
- 2 - PRYBAR

**INSTALLATION**

- (1) Install new front output seal in front case with Installer Tool 6952-A 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. 97). Once seal is started, continue tapping seal into bore until installer tool seats against case.
- (2) Install the front output shaft companion flange.
- (3) Install the front propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

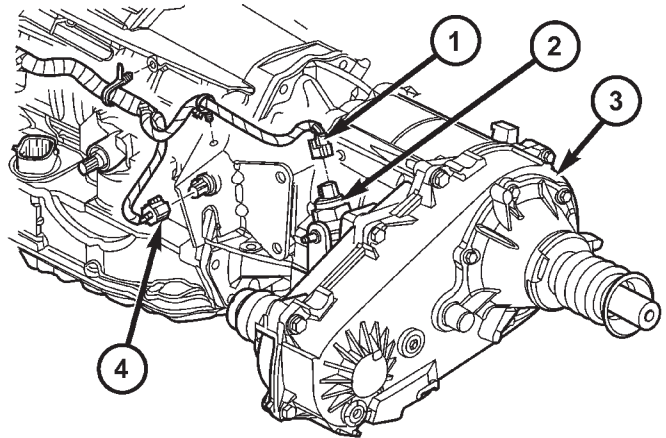
FRONT OUTPUT SHAFT SEAL (Continued)



**Fig. 97 Front Output Seal Installation - Typical**

- 1 - INSTALLER 6952-A
- 2 - TRANSFER CASE

0.5V) to the sensor and monitors the return voltage to determine the sector plate, and therefore the transfer case, position.



**Fig. 98 Transfer Case Position Sensor and Connector**

- 1 - TRANSFER CASE POSITION SENSOR CONNECTOR
- 2 - TRANSFER CASE POSITION SENSOR
- 3 - TRANSFER CASE
- 4 - OUTPUT SPEED SENSOR CONNECTOR

POSITION SENSOR

DESCRIPTION

The transfer case position sensor (Fig. 98) is an electronic device whose output can be interpreted to indicate the transfer case's current operating mode. The sensor consists of a five position, resistive multiplexed circuit which returns a specific resistance value to the Powertrain Control Module (PCM) for each transfer case operating mode. The sensor is located on the top of the transfer case, just left of the transfer case centerline and rides against the sector plate roostercomb. The PCM supplies 5VDC (+/-

OPERATION

During normal vehicle operation, the Powertrain Control Module (PCM) monitors the transfer case position sensor return voltage to determine the operating mode of the transfer case. Refer to the Operating Mode Versus Resistance table for the correct resistance for each position (Fig. 99).

OPERATING MODE VERSUS RESISTANCE

SENSOR POSITION	OPERATING MODE	SENSOR RESISTANCE (ohms)
1	2WD	1124-1243
2	4WD PART TIME	650-719
3	4WD FULL TIME	389-431
4	NEUTRAL	199-221
5	4WD LOW	57-64

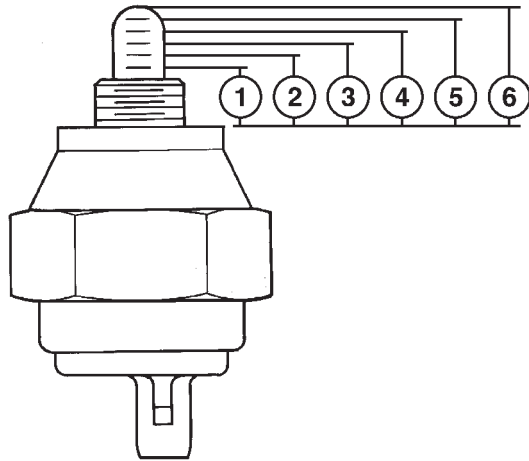
REMOVAL

- (1) Raise and support the vehicle.
- (2) Disengage the transfer case position sensor connector from the position sensor (Fig. 100).
- (3) Remove the position sensor from the transfer case.

INSTALLATION

- (1) Inspect the o-ring seal on the transfer case position sensor. Replace the o-ring if necessary.
- (2) Install the transfer case position sensor into the transfer case. Torque the sensor to 20-34 N·m (15-25 ft.lbs.).
- (3) Engage the transfer case position sensor connector to the position sensor.
- (4) Lower vehicle.

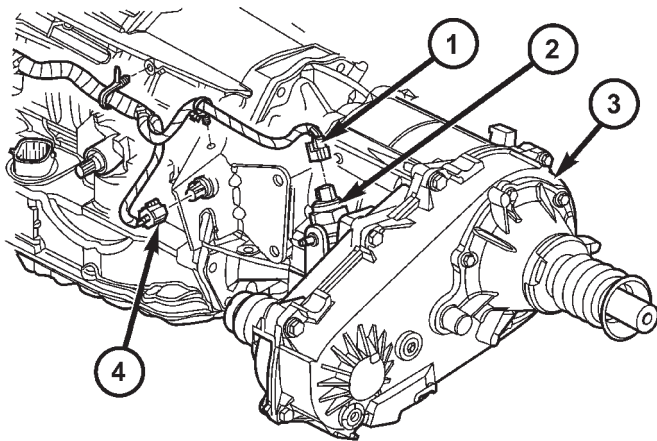
POSITION SENSOR (Continued)



80cc3d70

**Fig. 99 Position Sensor Linear Movement**

- 1 - POSITION 1 - 10mm ±0.5mm
- 2 - POSITION 2 - 12mm ±0.5mm
- 3 - POSITION 3 - 14mm ±0.5mm
- 4 - POSITION 4 - 16mm ±0.5mm
- 5 - POSITION 5 - 18mm ±0.5mm
- 6 - POSITION 6 - 20mm±0.5mm - FULL EXTENSION



80cc20be

**Fig. 100 Transfer Case Position Sensor and Connector**

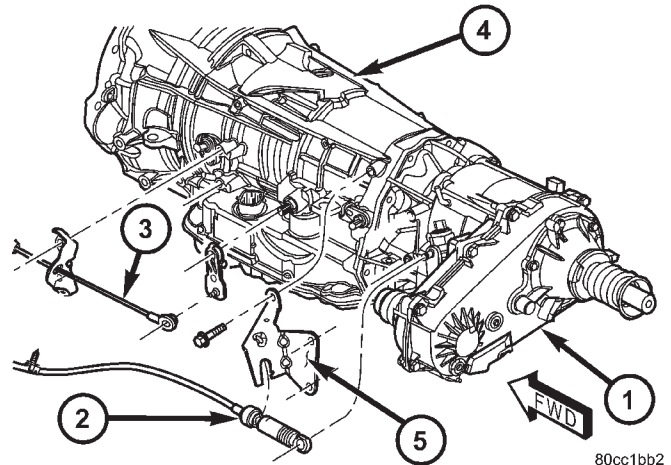
- 1 - TRANSFER CASE POSITION SENSOR CONNECTOR
- 2 - TRANSFER CASE POSITION SENSOR
- 3 - TRANSFER CASE
- 4 - OUTPUT SPEED SENSOR CONNECTOR

(5) Verify proper sensor operation.

SHIFT LEVER

REMOVAL

- (1) Shift transfer case into 4L.
- (2) Raise vehicle.
- (3) Remove clip securing the transfer case shift cable to the shift cable support bracket (Fig. 101) and (Fig. 102).
- (4) Disengage any additional shift cable routing clips, if necessary.



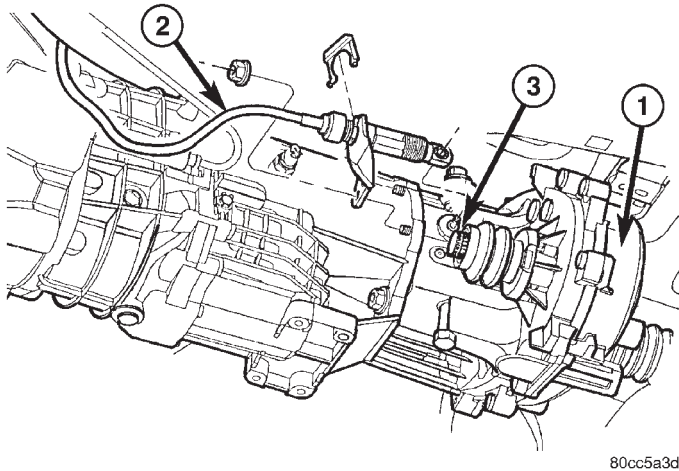
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**Fig. 101 Transfer Case Shift Cable - Automatic Transmission**

- 1 - TRANSFER CASE
- 2 - TRANSFER CASE SHIFT CABLE
- 3 - TRANSMISSION SHIFT CABLE
- 4 - AUTOMATIC TRANSMISSION
- 5 - TRANSFER CASE SHIFT CABLE BRACKET

- (5) Disengage the shift cable from the transfer case manual lever.
- (6) Lower vehicle.
- (7) Remove the floor console as necessary to access the shifter mechanism. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
- (8) Remove the nuts attaching lever assembly to floorpan and remove assembly and shift cable (Fig. 103).
- (9) Remove the shifter mechanism and cable assembly from the vehicle.

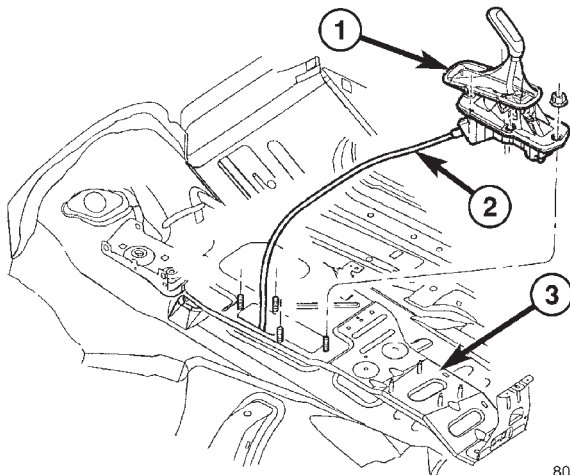
## SHIFT LEVER (Continued)



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**Fig. 102 Transfer Case Shift Cable - Manual Transmission**

- 1 - TRANSFER CASE
- 2 - SHIFT CABLE
- 3 - MANUAL LEVER



80cc5a32

**Fig. 103 Transfer Case Shifter Assembly**

- 1 - SHIFTER ASSEMBLY
- 2 - SHIFT CABLE
- 3 - FLOOR PAN

**INSTALLATION**

(1) Route the shift cable through the opening in the floor pan.

(2) Position the shift mechanism over the shifter retaining studs on the floor pan.

(3) Install the nuts to hold the shifter mechanism to the floor pan. Tighten the nuts to 11.86 N·m (105 in.lbs.).

(4) Install any floor console components previously removed. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(5) Verify that the floor shifter is in the 4L position.

(6) Raise vehicle.

(7) Route the shift cable through the opening in the shift cable support bracket.

(8) Install the cable and a new spring clip into the slot in the support bracket.

(9) Install any additional routing clips on the shift cable.

(10) Verify that the transfer case is in the 4L position. The 4L position for the transfer case is with the manual lever to the full rearward position.

(11) Attach the shift cable to the transfer case manual lever.

(12) Lower vehicle and check for proper transfer case shifter operation.





# TIRES/WHEELS

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## TIRES/WHEELS

### DIAGNOSIS AND TESTING - TIRES AND WHEEL RUNOUT

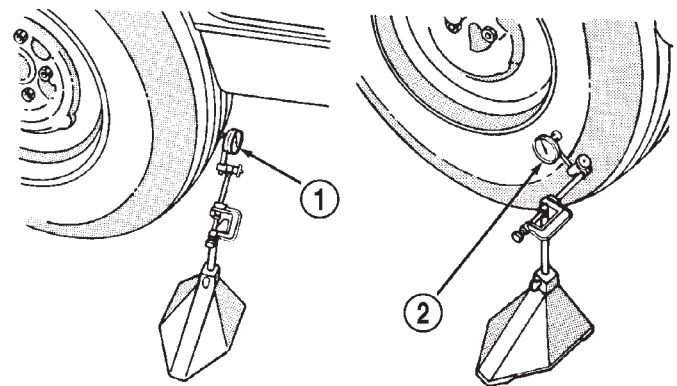
Radial runout is the difference between the high and low points on the tire or wheel (Fig. 1).

Lateral runout is the **wobble** of the tire or wheel.

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).



J9022-4

**Fig. 1 Checking Tire/Wheel/Hub Runout**

- 1 - RADIAL RUNOUT
- 2 - LATERAL RUNOUT

TIRES/WHEELS (Continued)

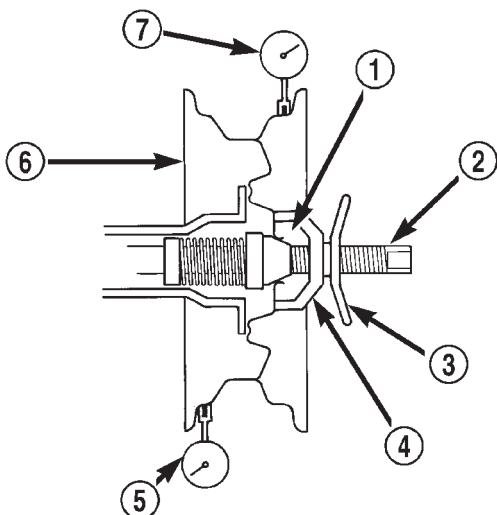
**METHOD 1 (RELOCATE WHEEL ON HUB)**

- (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.

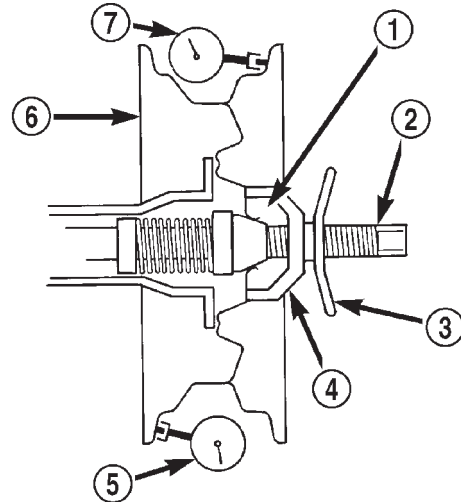
- (1) Remove tire from wheel and mount wheel on service dynamic balance machine.
- (2) Check wheel radial runout (Fig. 2) and lateral runout (Fig. 3).
  - **STEEL WHEELS:** Radial runout 0.024 in., Lateral runout 0.030 in. (average)
  - **ALUMINUM WHEELS:** Radial runout 0.014 in., Lateral runout 0.020 in. (average)
- (3) If point of greatest wheel lateral runout is near original chalk mark, remount tire 180 degrees. Recheck runout, (Refer to 22 - TIRES/WHEELS - STANDARD PROCEDURE).



**Fig. 2 Radial Runout**

- 1 - MOUNTING CONE
- 2 - SPINDLE SHAFT
- 3 - WING NUT
- 4 - PLASTIC CUP
- 5 - DIAL INDICATOR
- 6 - WHEEL
- 7 - DIAL INDICATOR

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80a611db

**Fig. 3 Lateral Runout**

- 1 - MOUNTING CONE
- 2 - SPINDLE SHAFT
- 3 - WING NUT
- 4 - PLASTIC CUP
- 5 - DIAL INDICATOR
- 6 - WHEEL
- 7 - DIAL INDICATOR

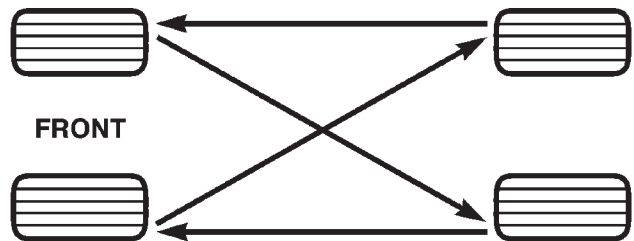
**STANDARD PROCEDURE**

**STANDARD PROCEDURE - TIRE ROTATION**

Tires on the front and rear operate at different loads and perform different steering, driving, and braking functions. For these reasons they wear at unequal rates and tend to develop irregular wear patterns. These effects can be reduced by rotating the tires at regular intervals. The benefits of tire rotation are:

- Increase tread life
- Maintain traction levels
- A smooth, quiet ride

The suggested method of tire rotation is (Fig. 4). Other rotation methods can be used, but they will not provide all the tire longevity benefits.



**Fig. 4 Tire Rotation Pattern**

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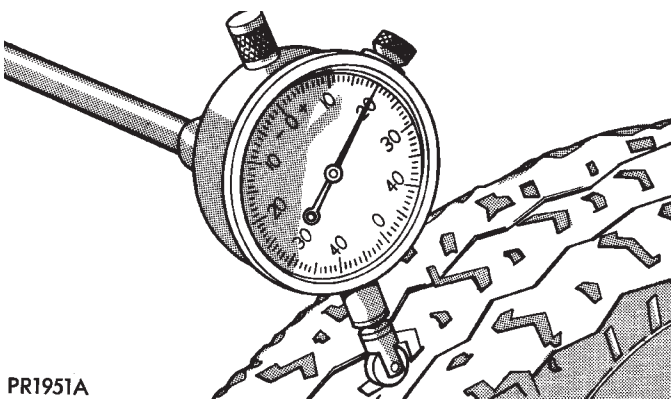
TIRES/WHEELS (Continued)

**STANDARD PROCEDURE - MATCH MOUNTING**

Tires and wheels are currently match mounted at the factory. Match mounting is a technique used to reduce runout in the wheel/tire assembly. This means that the high spot of the tire is aligned with the low spot on the wheel rim. The high spot on the tire is marked with a paint mark or a bright colored adhesive label on the outboard sidewall. The low spot on the rim is identified with a label on the outside of the rim and a dot on the inside of the rim. If the outside label has been removed the tire will have to be removed to locate the dot on the inside of the rim.

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) Use a dial indicator to locate the high spot of the tire on the center tread rib (Fig. 5). Record the indicator reading and mark the high spot on the tire. Place a mark on the tire at the valve stem location (Fig. 6).



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**Fig. 5 Dial Indicator**

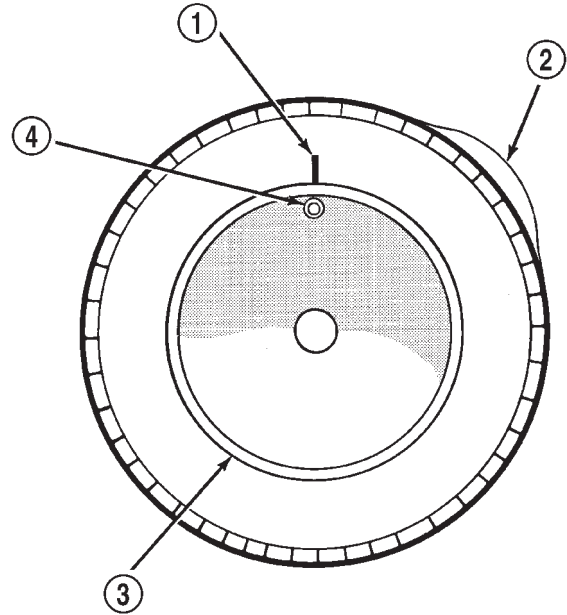
(2) Break down the tire and remount it 180 degrees on the rim (Fig. 7).

(3) Measure the total runout again and mark the tire to indicate the high spot.

(4) If runout is still excessive use the following procedures.

(a) If the high spot is within 101.6 mm (4.0 in.) of the first spot and is still excessive, replace the tire.

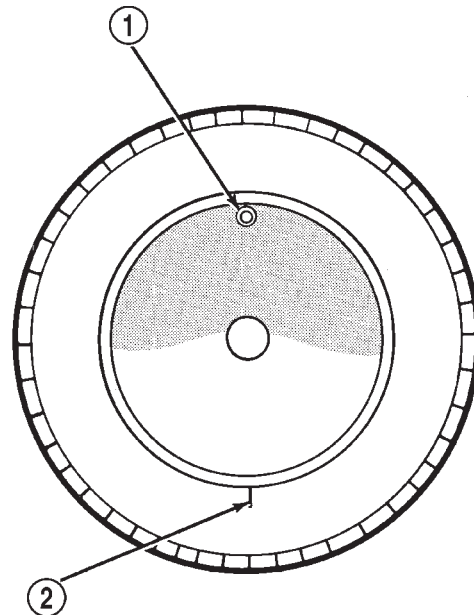
(b) If the high spot is within 101.6 mm (4.0 in.) of the first spot on the wheel, the wheel may be out of specifications, (Refer to 22 - TIRES/WHEELS - DIAGNOSIS AND TESTING).



J9322-3

**Fig. 6 First Measurement On Tire**

- 1 - REFERENCE MARK
- 2 - 1ST MEASUREMENT HIGH SPOT MARK TIRE AND RIM
- 3 - WHEEL
- 4 - VALVE STEM



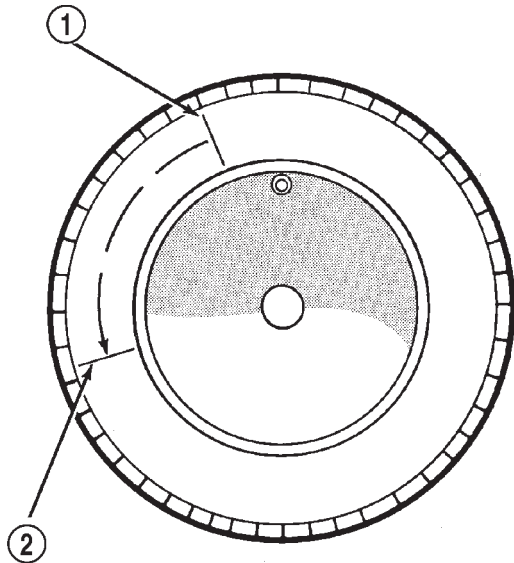
J9322-4

**Fig. 7 Remount Tire 180 Degrees**

- 1 - VALVE STEM
- 2 - REFERENCE MARK

## TIRES/WHEELS (Continued)

(c) 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. 8). This procedure will normally reduce the runout to an acceptable amount.



J9322-5

**Fig. 8 Remount Tire 90 Degrees In Direction of Arrow**

- 1 - 2ND HIGH SPOT ON TIRE  
2 - 1ST HIGH SPOT ON TIRE

**STANDARD PROCEDURE - WHEEL BALANCING**

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.

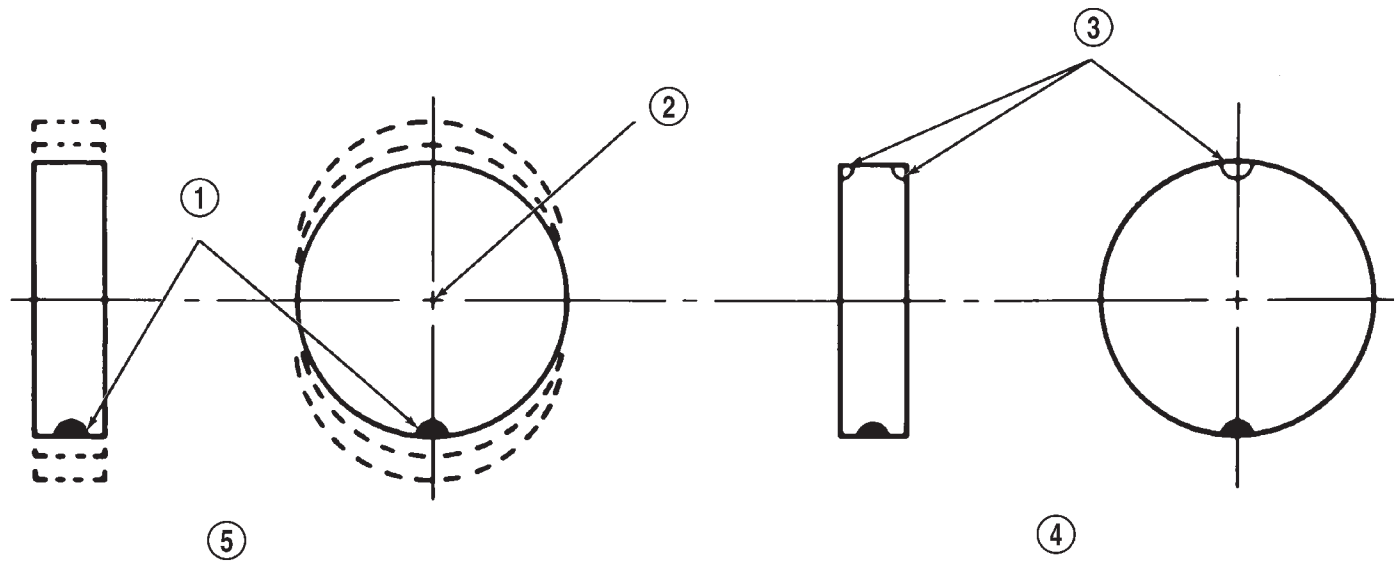
**NOTE:** Cast aluminum and forged aluminum wheels require coated balance weights and special alignment equipment.

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. 9).

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. 10).

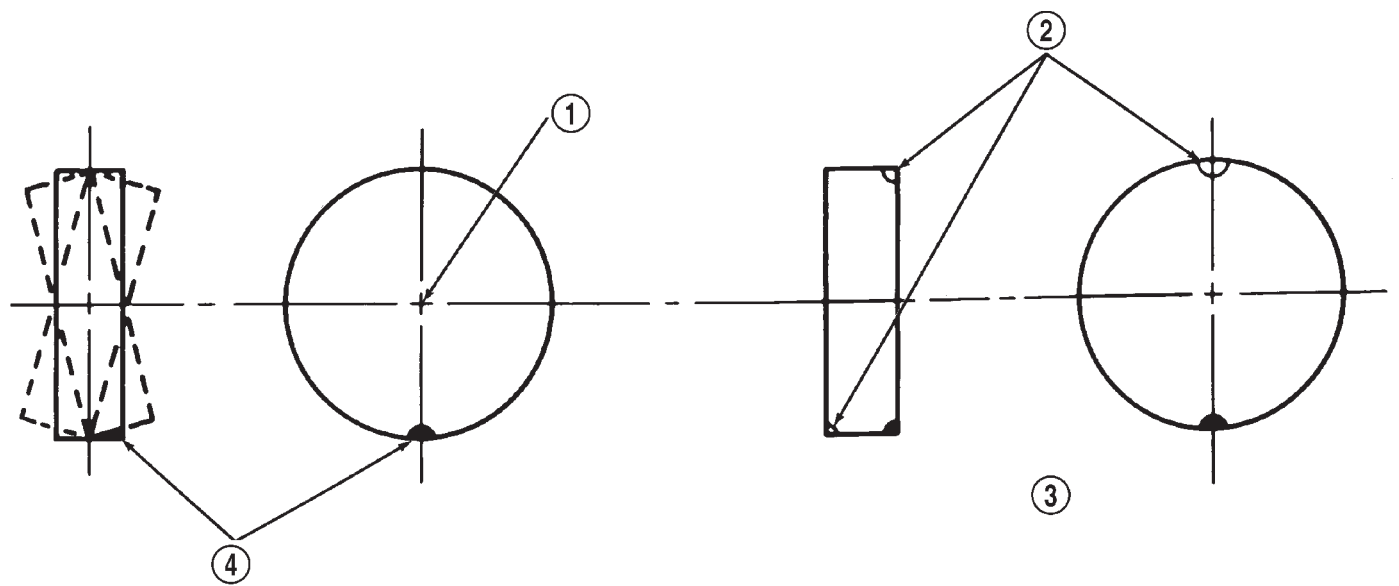
TIRES/WHEELS (Continued)



J8922-8

**Fig. 9 Static Unbalance & Balance**

- |                              |                                       |
|------------------------------|---------------------------------------|
| 1 - HEAVY SPOT               | 4 - CORRECTIVE WEIGHT LOCATION        |
| 2 - CENTER LINE OF SPINDLE   | 5 - TIRE OR WHEEL TRAMP, OR WHEEL HOP |
| 3 - ADD BALANCE WEIGHTS HERE |                                       |



J8922-9

**Fig. 10 Dynamic Unbalance & Balance**

- |                              |   |
|------------------------------|---|
| 1 - CENTER LINE OF SPINDLE   | 3 - CORRECTIVE WEIGHT LOCATION            |
| 2 - ADD BALANCE WEIGHTS HERE | 4 - HEAVY SPOT WHEEL SHIMMY AND VIBRATION |

# TIRES

## DESCRIPTION

### DESCRIPTION - 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, (Refer to 22 - TIRES/WHEELS - STANDARD PROCEDURE). 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. 11).

Performance tires have a speed rating letter after the aspect ratio number.

LETTER	SPEED RATING
S	180 km/h (112 mph)
T	190 km/h (118 mph)
U	200 km/h (124 mph)
H	210 km/h (130 mph)
V	240 km/h (149 mph)
W	270 km/h (168 mph)
Y	300 km/h (186 mph)

The speed rating is not always printed on the tire sidewall.

### TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

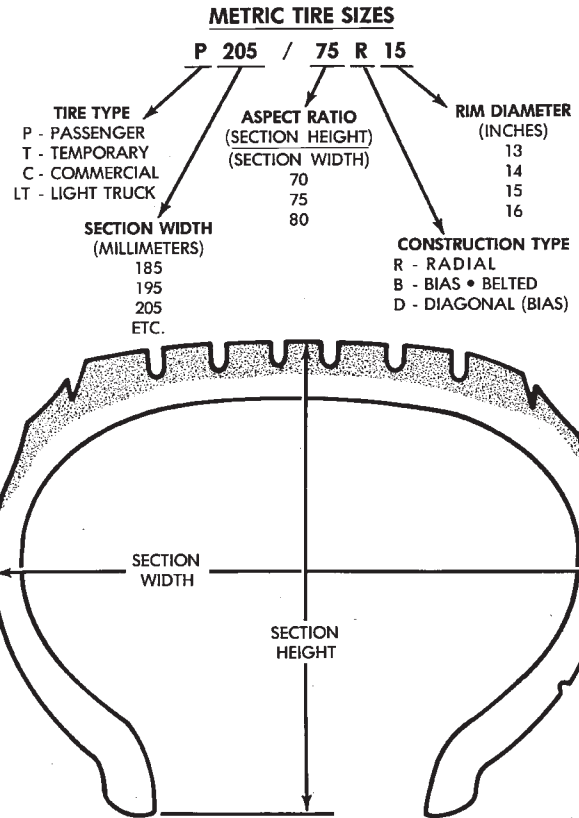


Fig. 11 Tire Identification

J9322-6

### DESCRIPTION - 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.

### DESCRIPTION - 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, then reinstalled. Do not exceed speeds of 50 M.P.H. when using the temporary spare tire. Refer to Owner's Manual for complete details.

TIRES (Continued)

**DESCRIPTION - 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 recommended 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.

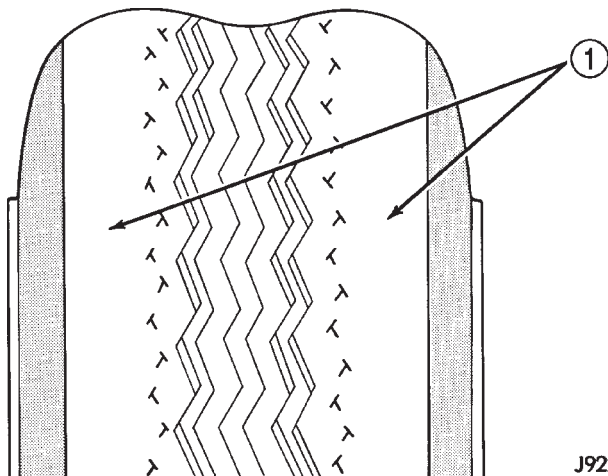
The use of oversize tires may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

**WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.**

**DIAGNOSIS AND TESTING**

**DIAGNOSIS AND TESTING - TIRE INFLATION**

Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure (Fig. 12).



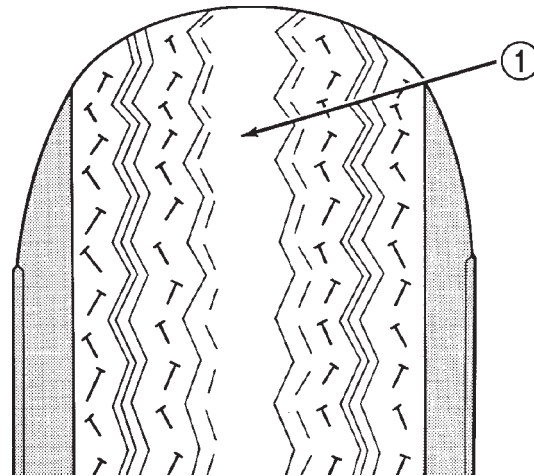
**Fig. 12 Under Inflation**

1 - THIN TIRE THREAD AREAS

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 13).

Improper inflation can cause:

- Uneven wear patterns



J9222-2

**Fig. 13 Over Inflation Wear**

1 - THIN TIRE THREAD AREA

- Reduced tread life
- Reduced fuel economy
- Unsatisfactory ride
- Vehicle drift

For proper tire pressure specification refer to the Tire Inflation Pressure Chart provided with the vehicle.

Tire pressures have been chosen to provide safe operation, vehicle stability, and a smooth ride. Tire pressure should be checked cold once a month. The spare tire pressure should be checked at least twice annually. Tire pressure decreases as the ambient temperature drops. Check tire pressure frequently when ambient temperature varies widely.

Inflation pressures specified on the placards are cold inflation pressure. The vehicle must sit for at least 3 hours to obtain the correct cold inflation pressure reading. Or driven less than one mile after sitting for 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation, due to increased tire temperature.

**WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND TREAD WEAR. THIS MAY CAUSE THE TIRE TO FAIL SUDDENLY, RESULTING IN LOSS OF VEHICLE CONTROL.**

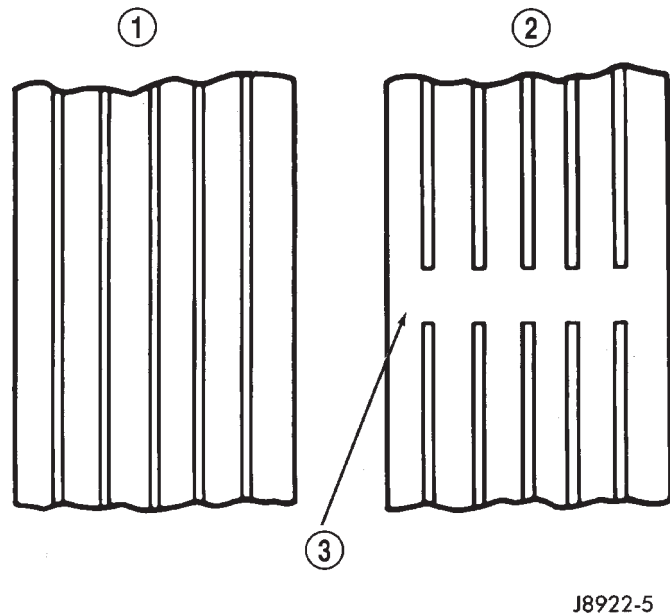


TIRES (Continued)

**DIAGNOSIS AND TESTING - 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. 14).

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.



**Fig. 14 Tread Wear Indicators**

- 1 - TREAD ACCEPTABLE
- 2 - TREAD UNACCEPTABLE
- 3 - WEAR INDICATOR

**DIAGNOSIS AND TESTING - TIRE WEAR PATTERNS**

Under inflation will cause wear on the shoulders of tire. Over inflation will cause wear at the center of tire.

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. 15).

Excessive toe-in or toe-out causes wear on the tread edges and a feathered effect across the tread (Fig. 15).

**DIAGNOSIS AND TESTING - 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, deceleration and slight left and right steering inputs.

**STANDARD PROCEDURE - 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. 16). 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.

**CLEANING**

Remove the protective coating on the tires before delivery of a vehicle. This coating may cause deterioration of the tires.

To remove the protective coating, apply warm water and let it soak for a few minutes. Afterwards, 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 a wire brush for cleaning.**

**SPECIFICATIONS**

*SPECIFICATIONS*

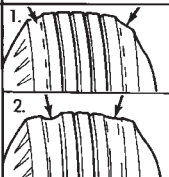
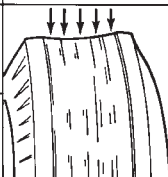
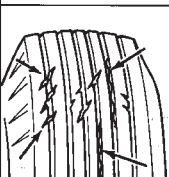
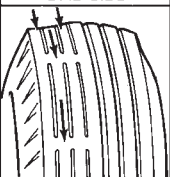
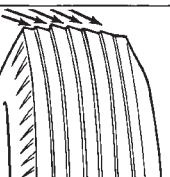
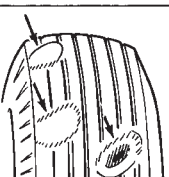
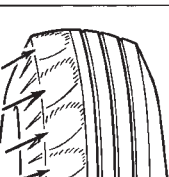
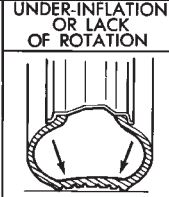
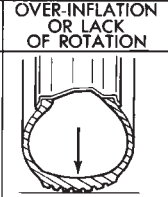
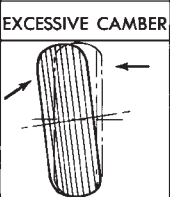
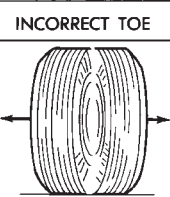
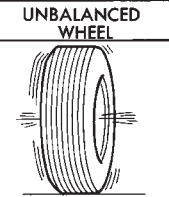
DESCRIPTION	SPECIFICATION
Tire	P215/75R16
Tire	P235/70R16
Spare Tire	P215/75D16 POLYSPARE ONLY ON 16"

**SPARE TIRE**

**REMOVAL**

- (1) Raise the license plate.
- (2) Remove the two bolts securing the wheel cover to the wheel.
- (3) Remove the two lug nuts and the one wheel lock (if equipped) securing the tire/wheel to the spare tire carrier.
- (4) Remove the spare tire.

SPARE TIRE (Continued)

CONDITION	RAPID WEAR AT SHOULDERS	RAPID WEAR AT CENTER	CRACKED TREADS	WEAR ON ONE SIDE	FEATHERED EDGE	BALD SPOTS	SCALLOPED WEAR
EFFECT							
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.

RN797

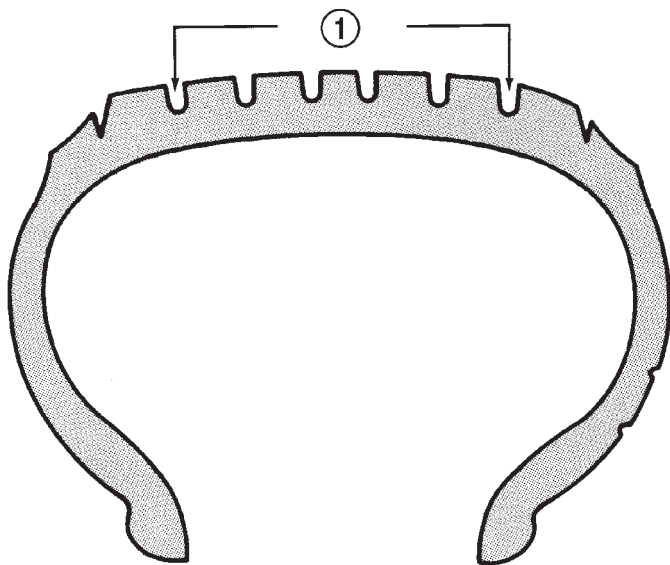
Fig. 15 Tire Wear Patterns

WHEELS

DESCRIPTION

The rim size is on the vehicle safety certification label located on the drivers door shut face. The size of the rim is determined by the drivetrain package. Original equipment wheels/rims are designed for operation up to the specified maximum vehicle capacity.

All models use stamped steel, cast aluminum or forged aluminum wheels. Every wheel has raised sections between the rim flanges and rim drop well called safety humps (Fig. 17).



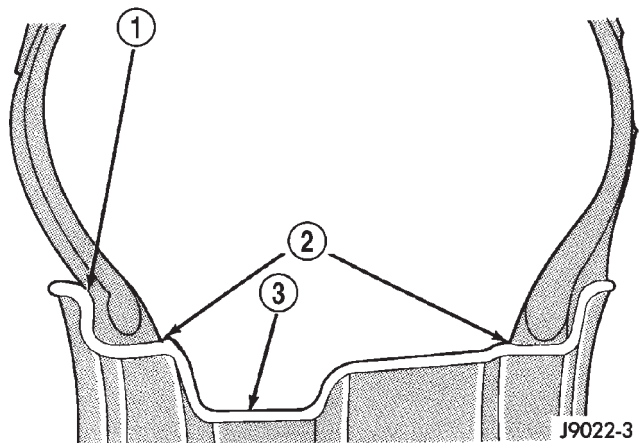
J8922-6

Fig. 16 Tire Repair Area

1 - REPAIRABLE AREA

INSTALLATION

- (1) Install the spare tire onto the studs on the carrier.
- (2) Install the two lug nuts and one wheel lock (if equipped). Tighten the nuts to 115 N·m (85 ft.lbs.)
- (3) Close the plastic wheel cover and install the two mounting bolts. Tighten the nuts to 115 N·m (85 ft.lbs.)
- (4) Close the license plate to cover the bolts and latch.



J9022-3

Fig. 17 Safety Rim

- 1 - FLANGE
- 2 - RIDGE
- 3 - WELL

## WHEELS (Continued)

Initial inflation of the tire forces the bead over these raised sections. In case of rapid loss of air pressure, the raised sections help hold the tire on the wheel.

The wheel studs and nuts are designed for specific applications. All aluminum and some steel wheels have wheel stud nuts with an enlarged nose. This enlarged nose is necessary to ensure proper retention of the wheels. Do not use replacement studs or nuts with a different design or lesser quality.

**DIAGNOSIS AND TESTING - WHEELS**

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.**

**STANDARD PROCEDURE****STANDARD PROCEDURE - WHEEL REPLACEMENT**

Wheels must be replaced if they have:

- Excessive runout
- Bent or dented
- Leak air through welds
- Have damaged bolt holes

Wheel repairs employing hammering, heating, or welding are not allowed.

Original equipment wheels are available through your dealer. Replacement wheels from any other source should be equivalent in:

- Load carrying capacity
- Diameter
- Width
- Offset

- Mounting configuration

Failure to use equivalent replacement wheels may affect the safety and handling of your vehicle. Replacement with **used** wheels is not recommended. Their service history may have included severe treatment.

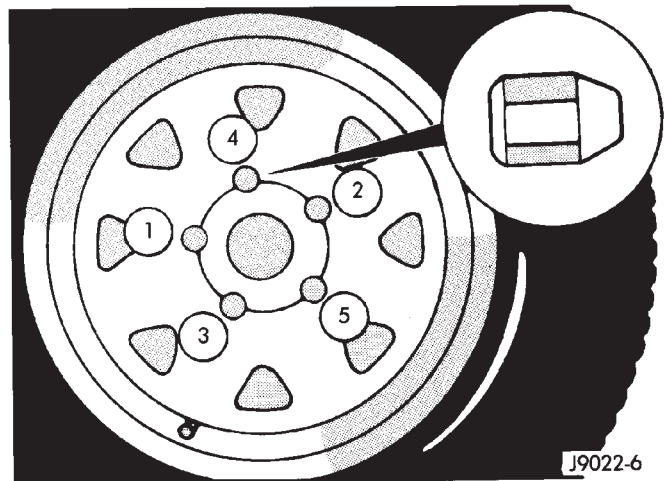
**STANDARD PROCEDURE - WHEEL MOUNTING**

The wheel studs and nuts are designed for specific applications. They must be replaced with equivalent parts. Do not use replacement parts of lesser quality or a substitute design. 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.

**NOTE: Do not use chrome plated lug nuts with chrome plated 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 wheel, first position it properly on the mounting surface. All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification (Fig. 18). **Never use oil or grease on studs or nuts.**



**Fig. 18 Lug Nut Tightening Pattern**

WHEELS (Continued)

SPECIFICATIONS

SPECIFICATION

TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Lug Nut 1/2 X 20 with 60° Cone	115-155	85-115	—

STUDS

REMOVAL

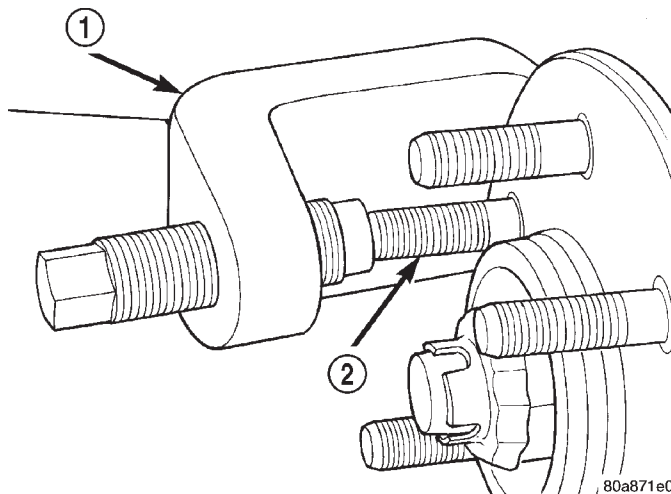
**CAUTION:** Do not use a hammer to remove wheel studs.

- (1) Raise and support vehicle.
- (2) Remove wheel and tire assembly.
- (3) Remove brake caliper, caliper adapter and rotor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).
- (4) Remove stud from hub with Remover C-4150A (Fig. 19).

INSTALLATION

**CAUTION:** Do not use a hammer to remove wheel studs.

- (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.
- (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, caliper adapter, and caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).



**Fig. 19 Wheel Stud Removal**

- 1 - REMOVER
- 2 - WHEEL STUD

- (6) Install wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE), use new lug nut on stud or studs that were replaced.
- (7) Remove support and lower vehicle.



# BODY

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## BODY

### WARNING

#### 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.**

DaimlerChrysler 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.

## BODY (Continued)

## DIAGNOSIS AND TESTING

## DIAGNOSIS AND TESTING - 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 vehi-

cle. 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 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.

## BODY (Continued)

**DIAGNOSIS AND TESTING - 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 cross winds. 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.

**STANDARD PROCEDURE****STANDARD PROCEDURE - BODY LUBRICATION**

All mechanisms and linkages should be lubricated when necessary. This will maintain ease of operation and provide protection against rust and excessive

wear. The weatherstrip seals should be lubricated to prolong their life as well as to improve door sealing.

All applicable exterior and interior vehicle operating mechanisms should be inspected and cleaned. Pivot/sliding contact areas on the mechanisms should then be lubricated.

(1) When necessary, lubricate the operating mechanisms with the specified lubricants.

(2) Apply silicone lubricant to a cloth and wipe it on door seals to avoid over-spray that can soil passenger's clothing.

(3) Before applying lubricant, the component should be wiped clean. After lubrication, any excess lubricant should be removed.

(4) The hood latch, latch release mechanism, latch striker, and safety latch should be lubricated periodically.

(5) The door lock cylinders should be lubricated twice each year (preferably autumn and spring).

- Spray a small amount of lock cylinder lubricant directly into the lock cylinder.

- Apply a small amount to the key and insert it into the lock cylinder.

- Rotate it to the locked position and then back to the unlocked position several times.

- Remove the key. Wipe the lubricant from it with a clean cloth to avoid soiling of clothing.

**STANDARD PROCEDURE - HEAT STAKING**

(1) Remove trim panel.

(2) Bend or move the trim panel components at the heat staked joints. Observe the heat staked locations and/or component seams for looseness.

(3) Heat stake the components.

(a) If the heat staked or component seam location is loose, hold the two components tightly together and using a soldering gun with a flat tip, melt the material securing the components together. Do not over heat the affected area, damage to the exterior of the trim panel may occur.

(b) If the heat staked material is broken or missing, use a hot glue gun to apply new material to the area to be repaired. The panels that are being heat staked must be held together while the applying the glue. Once the new material is in place, it may be necessary to use a soldering gun to melt the newly applied material. Do not over heat the affected area, damage to the exterior of the trim panel may occur.

(4) Allow the repaired area to cool and verify the repair.

(5) Install trim panel.



BODY (Continued)

## SPECIFICATIONS

## TORQUE SPECIFICATIONS

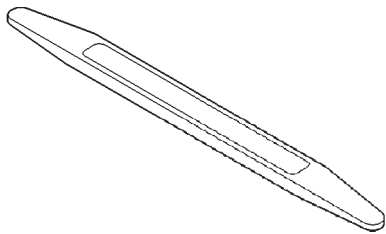
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FLIP-UP GLASS HINGE BOLTS	7	—	60
FRONT DOOR CHECK STRAP NUTS	12	9	—
FRONT DOOR CHECK STRAP TO A-PILLAR BOLTS	12	9	—
FRONT DOOR GLASS RUN CHANNEL BOLTS	9	—	80
FRONT DOOR HINGE TO A-PILLAR BOLTS	28	21	—
FRONT DOOR HINGE TO DOOR NUTS	23	17	—
FRONT DOOR LATCH SCREW	11	8	—
FRONT DOOR LATCH STRIKER SCREWS	28	21	—
FRONT DOOR OUTSIDE HANDLE NUTS	6	—	55
FRONT DOOR REGULATOR BOLTS	9	—	80
FRONT SEAT BACK RECLINER BOLTS	28	21	—
FRONT SEAT BOLTS/NUT	43	32	—
FRONT SEAT RISER BOLTS	28	21	—
FRONT SEAT TRACK BOLTS	28	21	—
HOOD HINGE TO BODY BOLTS	28	21	—
HOOD HINGE TO HOOD BOLTS	12	9	—
HOOD LATCH NUTS	12	9	—
HOOD LATCH SUPPORT BOLTS	10	—	85
INSTRUMENT PANEL CENTER SUPPORT BRACKET BOLTS	23	17	—
INSTRUMENT PANEL HVAC NUTS/BOLTS	6	—	55
INSTRUMENT PANEL ROLL DOWN BOLTS	54	40	—
INSTRUMENT PANEL TOP BOLTS	28	21	—
OUTSIDE MIRROR NUTS	7	—	65
RADIATOR CROSSMEMBER BOLTS	12	9	—
REAR DOOR CHECK STRAP NUTS	12	9	—
REAR DOOR CHECK STRAP TO A-PILLAR BOLTS	12	9	—
REAR DOOR GLASS RUN CHANNEL BOLTS	9	—	80
REAR DOOR HINGE TO B-PILLAR BOLTS	28	21	—
REAR DOOR HINGE TO DOOR NUTS	23	17	—
REAR DOOR LATCH SCREW	11	8	—
REAR DOOR LATCH STRIKER SCREWS	28	21	—
REAR DOOR OUTSIDE HANDLE NUTS	6	—	55
REAR SEAT BACK HINGE BOLTS	28	21	—
REAR SEAT LATCH/LOCK ASSEMBLY BOLTS	28	21	—
REAR SEAT OUTBOARD NUTS	43	32	—
REAR SEAT OUTER SEAT CUSHION LEG BOLTS	35	26	—
ROOF RACK BOLTS	8	—	75

BODY (Continued)

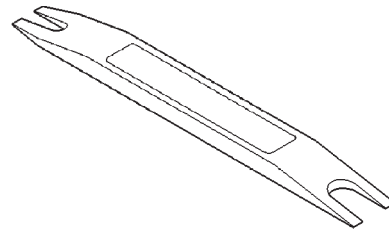
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
SIDE VIEW MIRROR NUTS	7	—	65
SWING GATE EXTERIOR HANDLE NUTS	6	—	55
SWING GATE HINGE BOLTS	31	23	—
SWING GATE HINGE TO D-PILLAR BOLTS	31	23	—
SWING GATE LATCH SCREWS	11	8	—
SWING GATE LATCH STRIKER SCREWS	11	8	—
WASHER BOTTLE BOLT	10	—	85

SPECIAL TOOLS

BODY



*Trim Stick C-4755*



*Molding Remover C-4829*



*Torx Bit Set C-4794-B*

# BODY STRUCTURE

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## ASSEMBLY

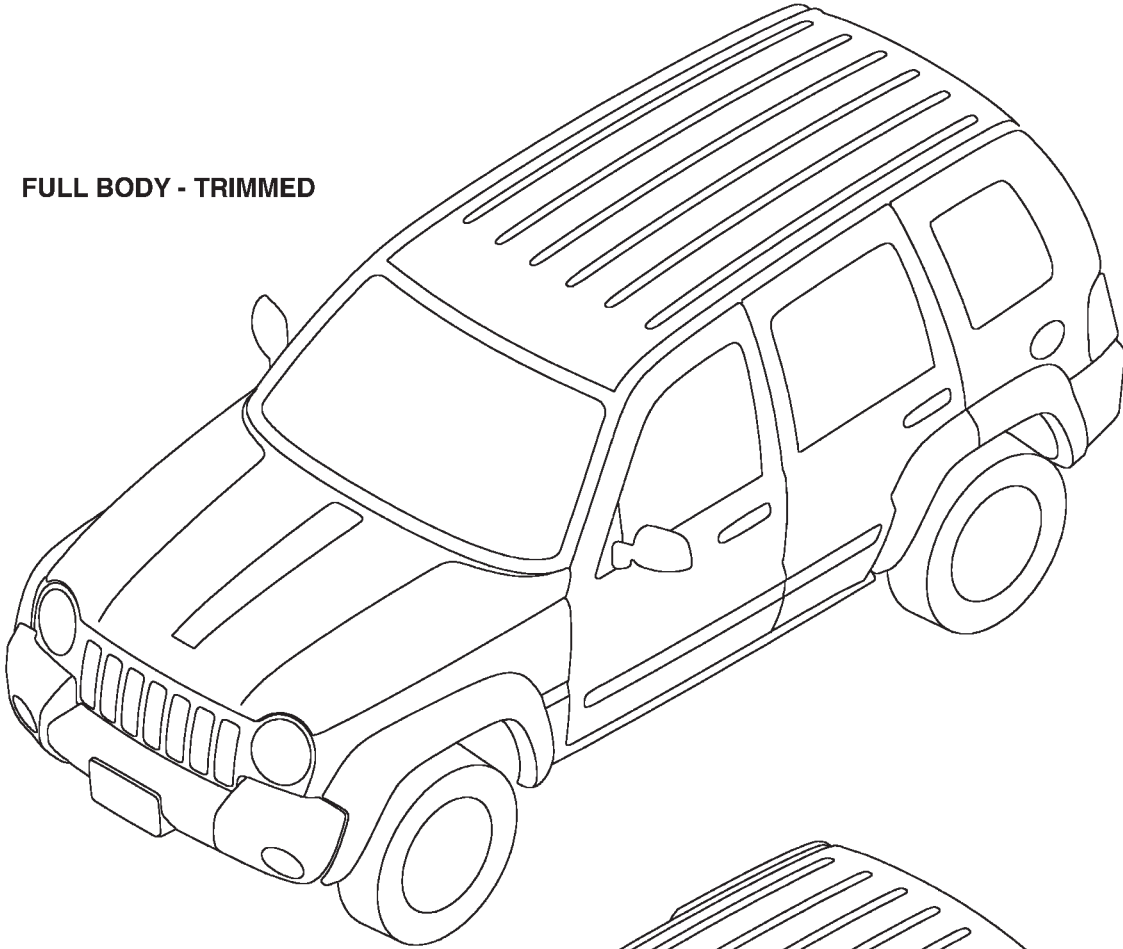
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## SPECIFICATION

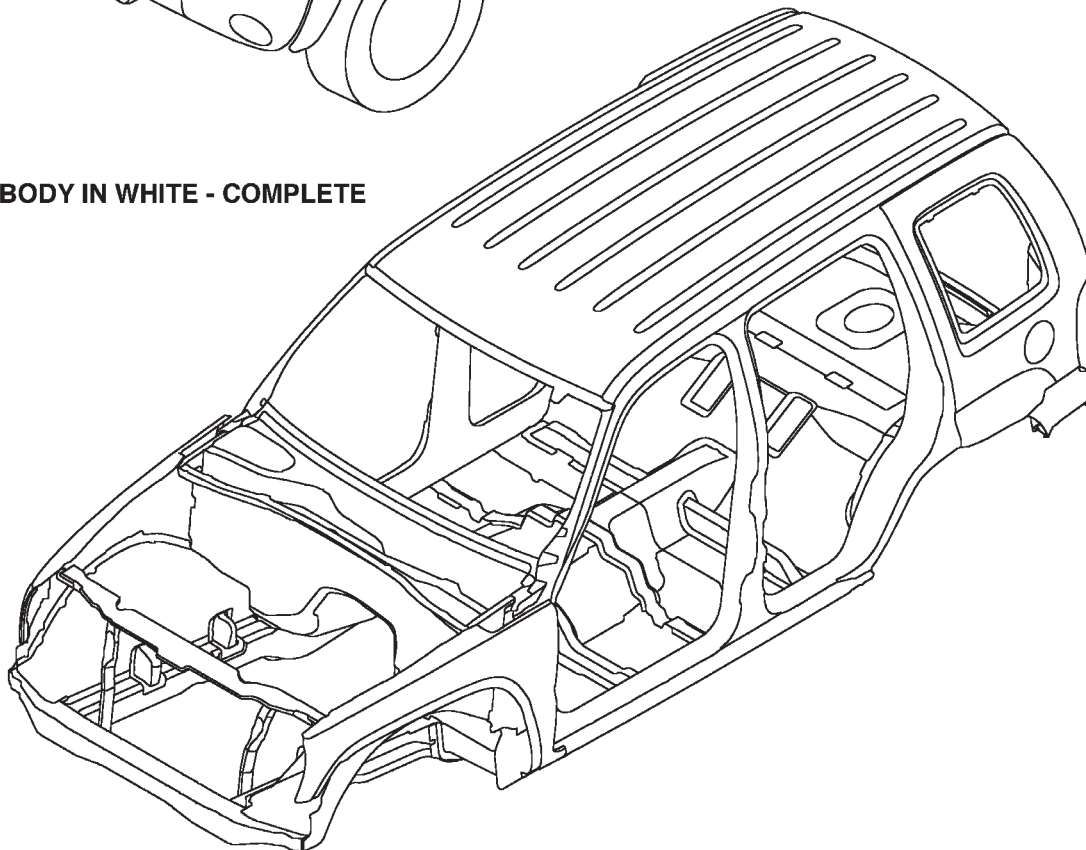
## INDEX

DESCRIPTION	FIGURE
COMPLETE BODY STRUCTURE VIEWS	( 1 )
BODY STRUCTURE - SECTIONS	( 2 )

**FULL BODY - TRIMMED**



**BODY IN WHITE - COMPLETE**



**Fig. 1 COMPLETE BODY STRUCTURE VIEWS**

ASSEMBLY (Continued)

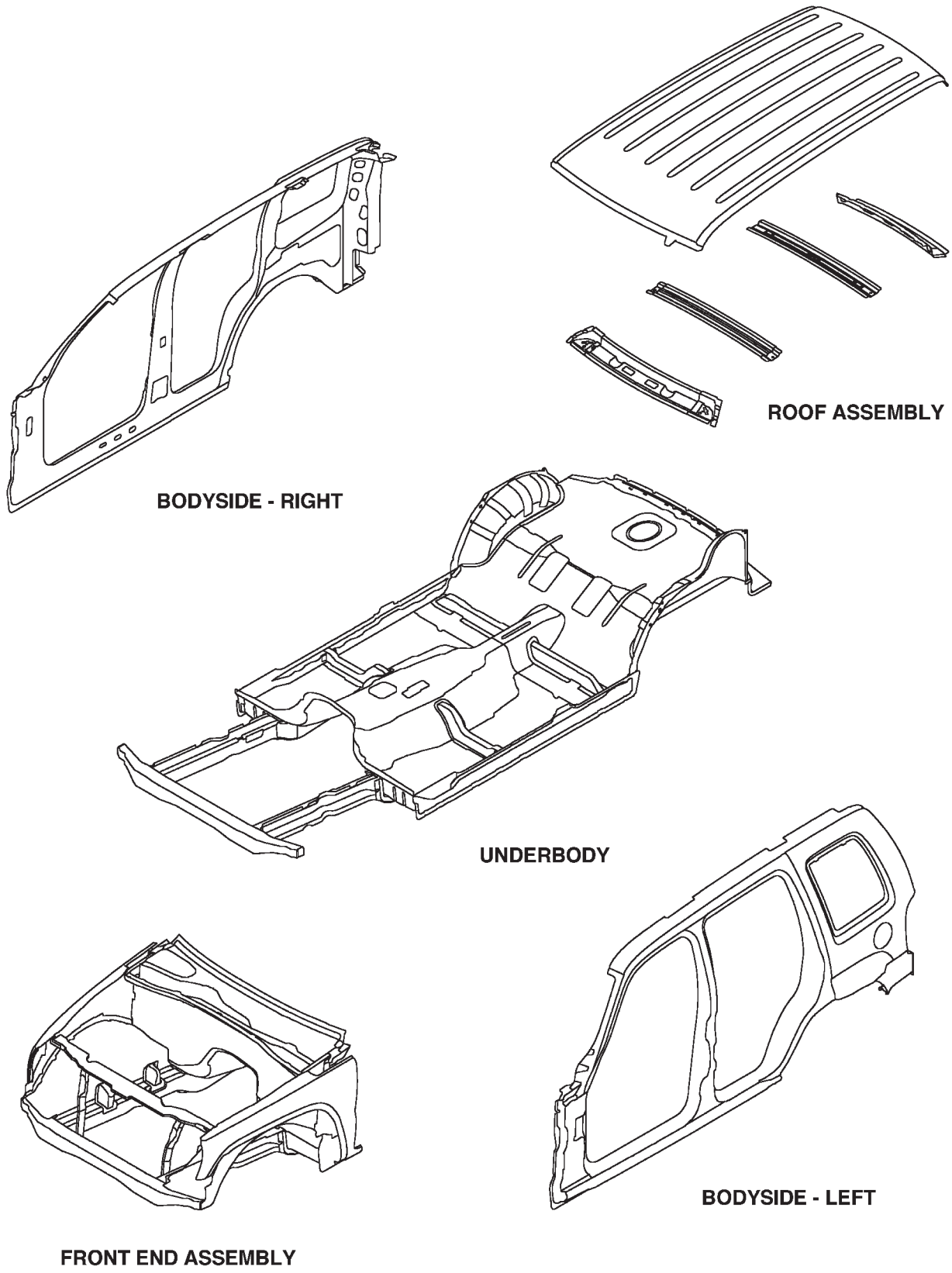


Fig. 2 BODY STRUCTURE - SECTIONS

# WELD AND STRUCTURAL ADHESIVE LOCATIONS

## SPECIFICATIONS

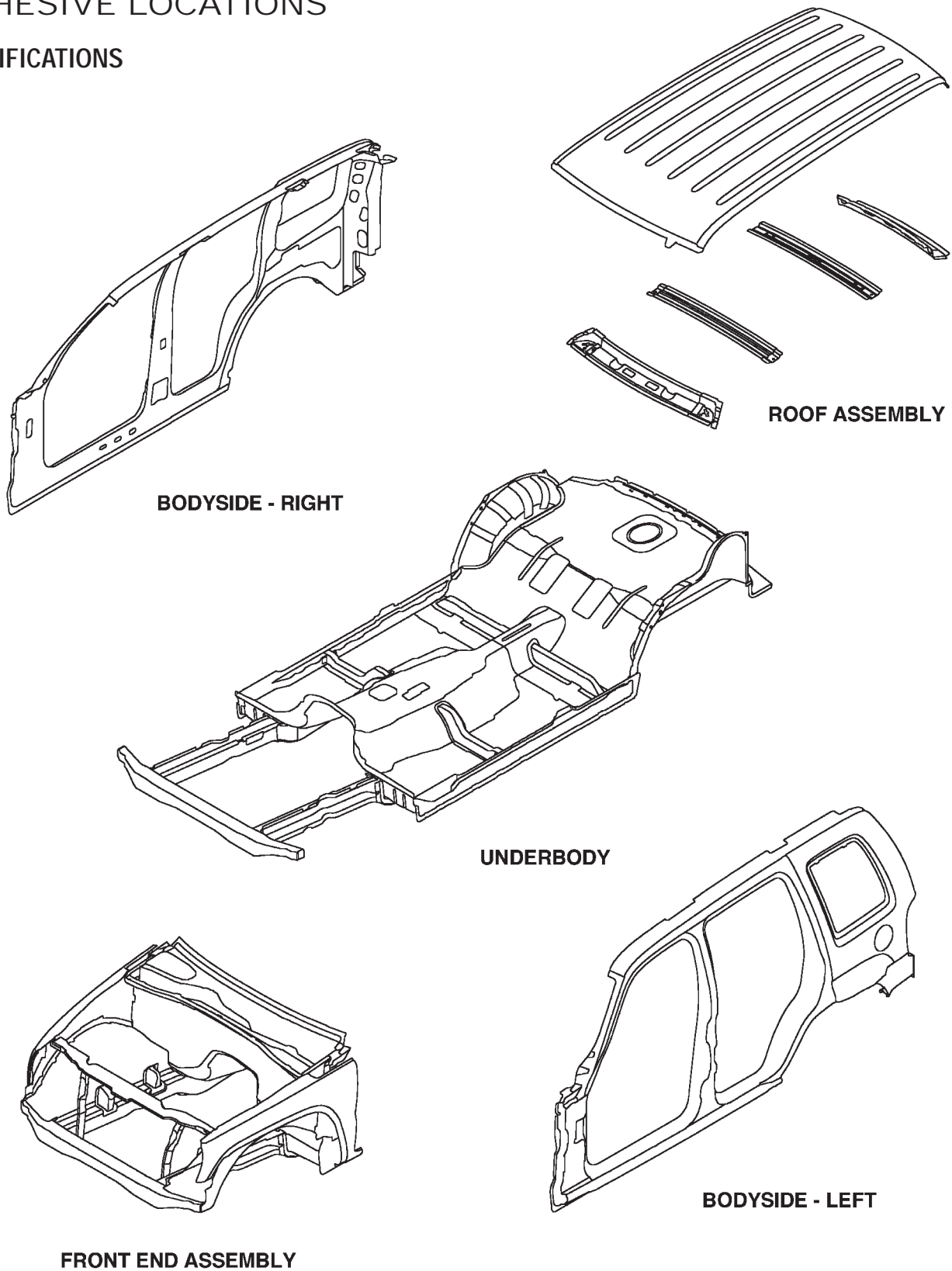


Fig. 3 BODY IN WHITE - SECTIONS

## WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

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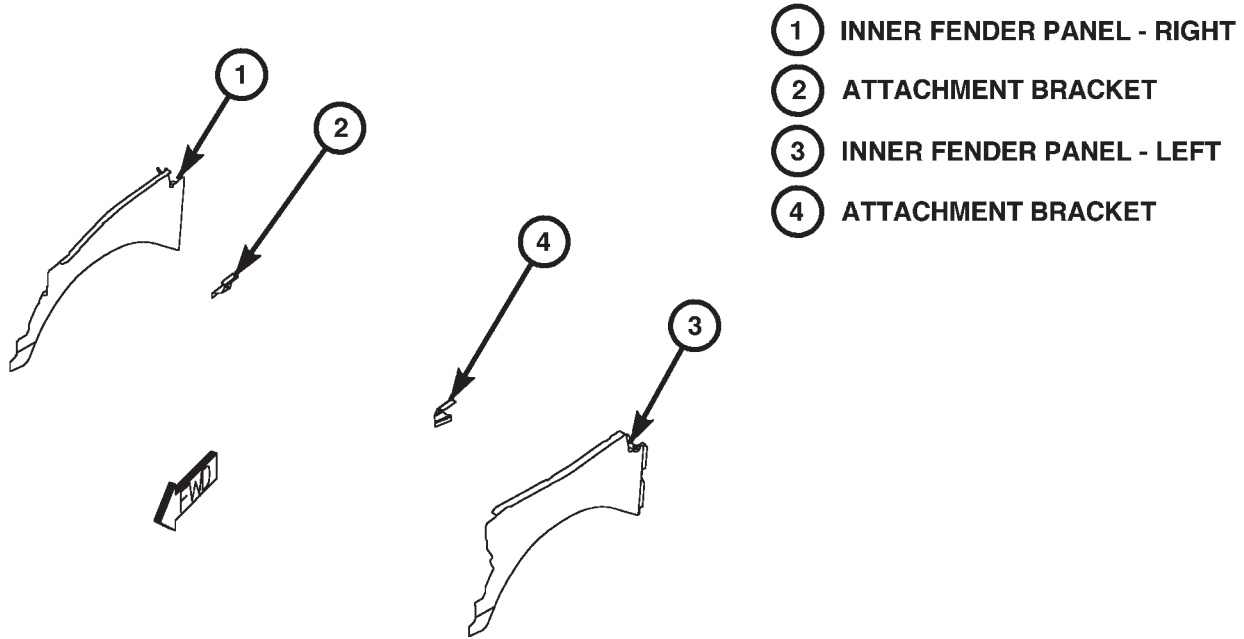


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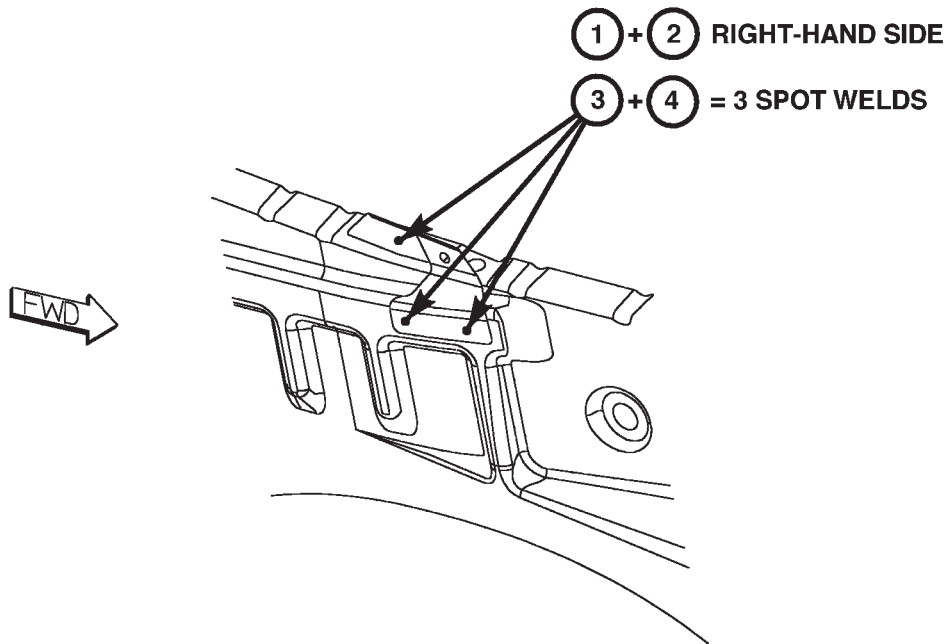
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WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

FRONT END ASSEMBLY



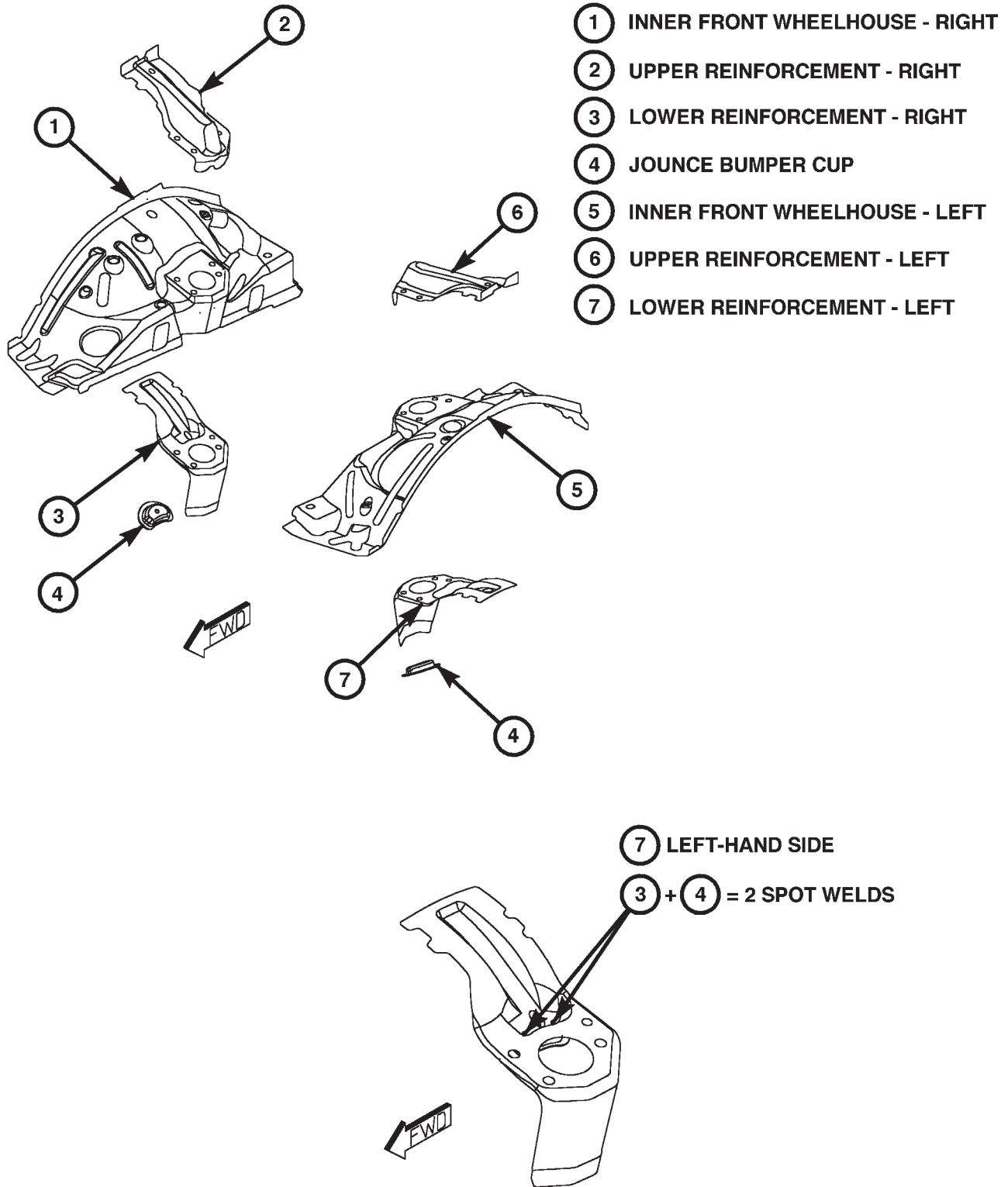
- ① INNER FENDER PANEL - RIGHT
- ② ATTACHMENT BRACKET
- ③ INNER FENDER PANEL - LEFT
- ④ ATTACHMENT BRACKET



LEFT-HAND SHOWN  
RIGHT-HAND OPPOSITE

Fig. 4 INNER FRONT PANELS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE

Fig. 5 INNER WHEEL HOUSES

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

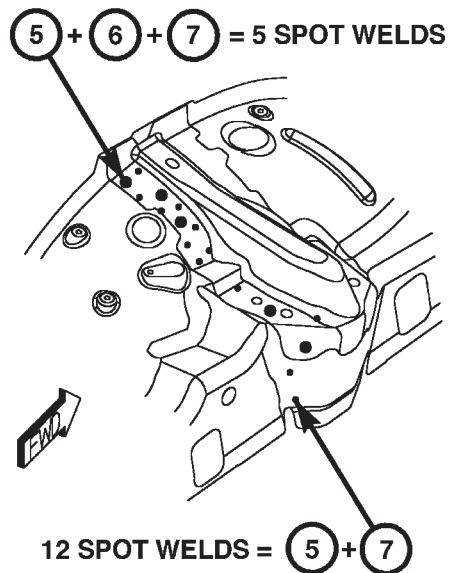
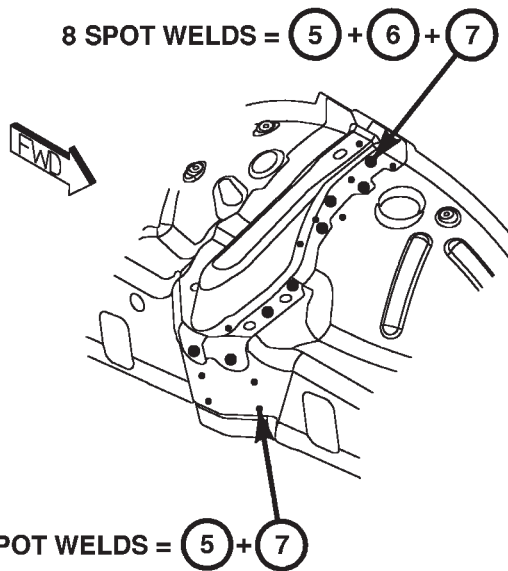
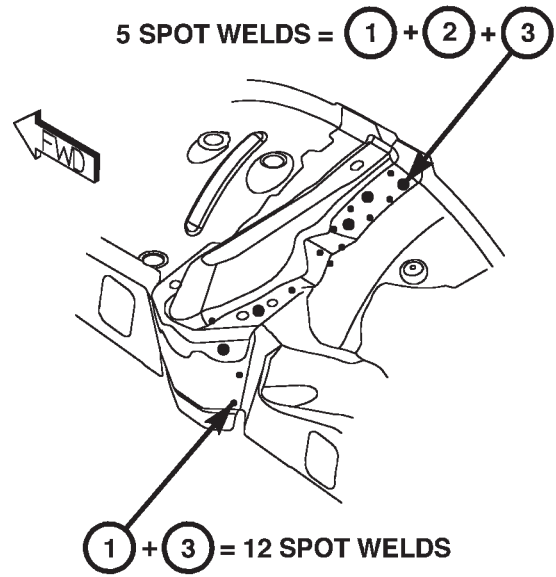
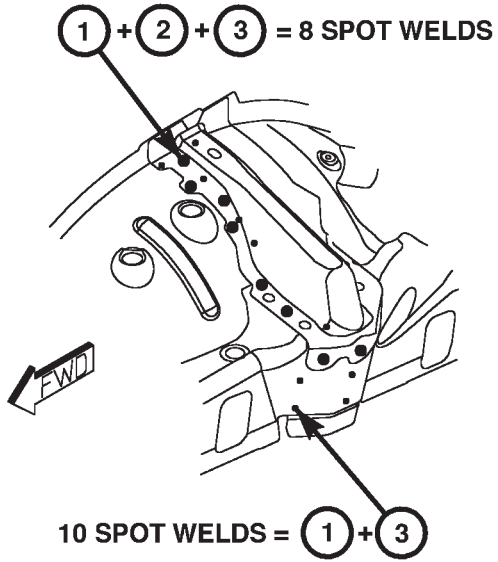


Fig. 6 INNER WHEEL HOUSES

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

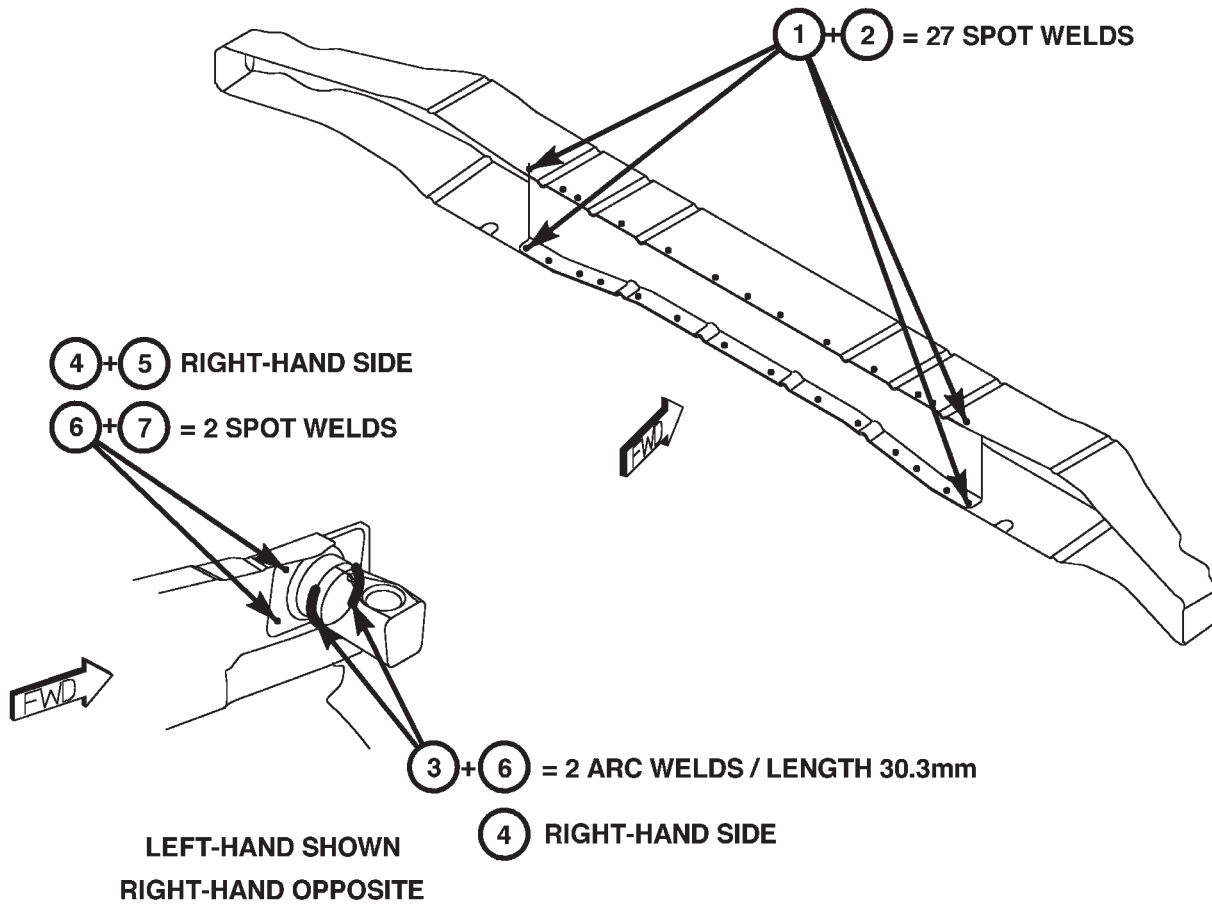
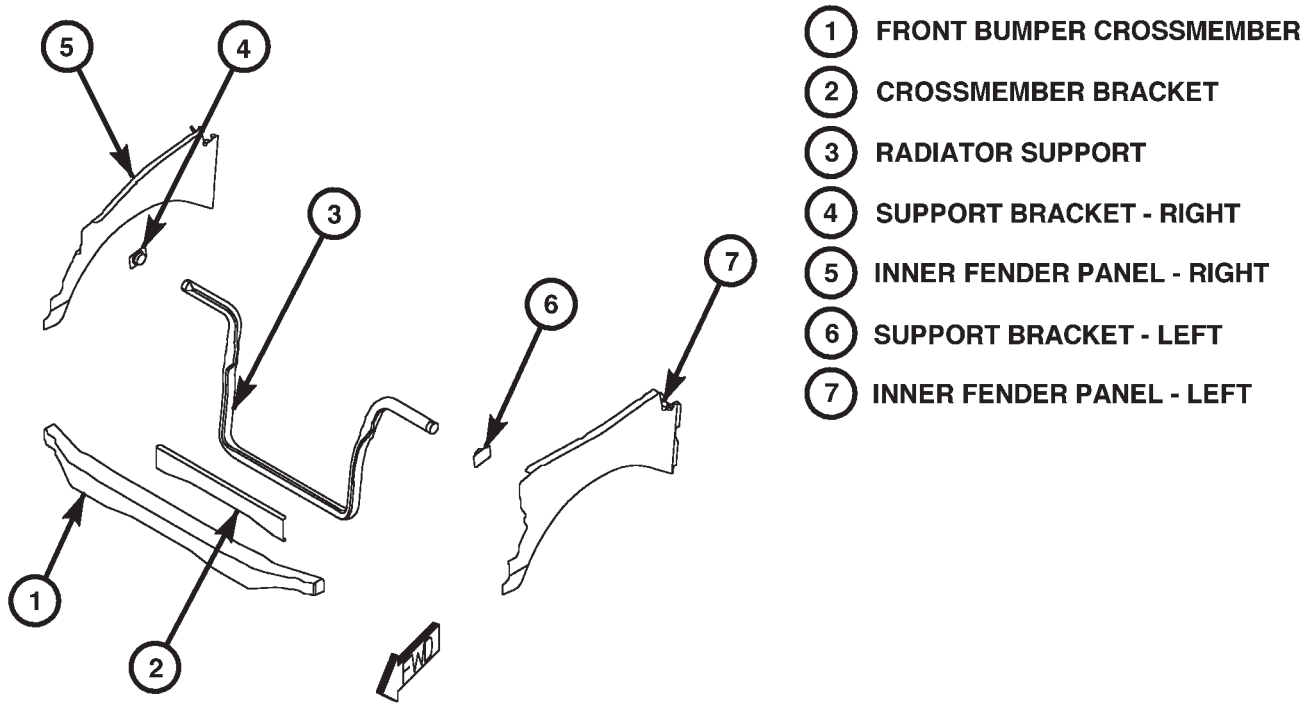
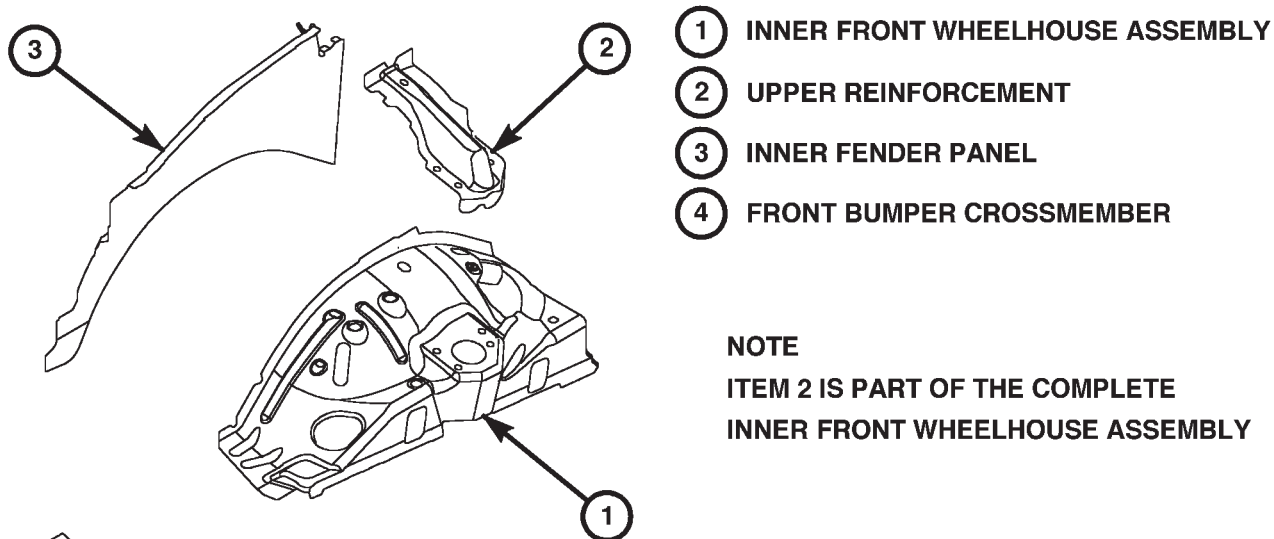
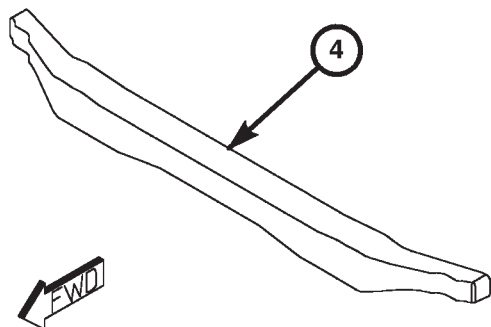


Fig. 7 FRONT BUMPER CROSSMEMBER

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



**NOTE**  
ITEM 2 IS PART OF THE COMPLETE  
INNER FRONT WHEELHOUSE ASSEMBLY



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE

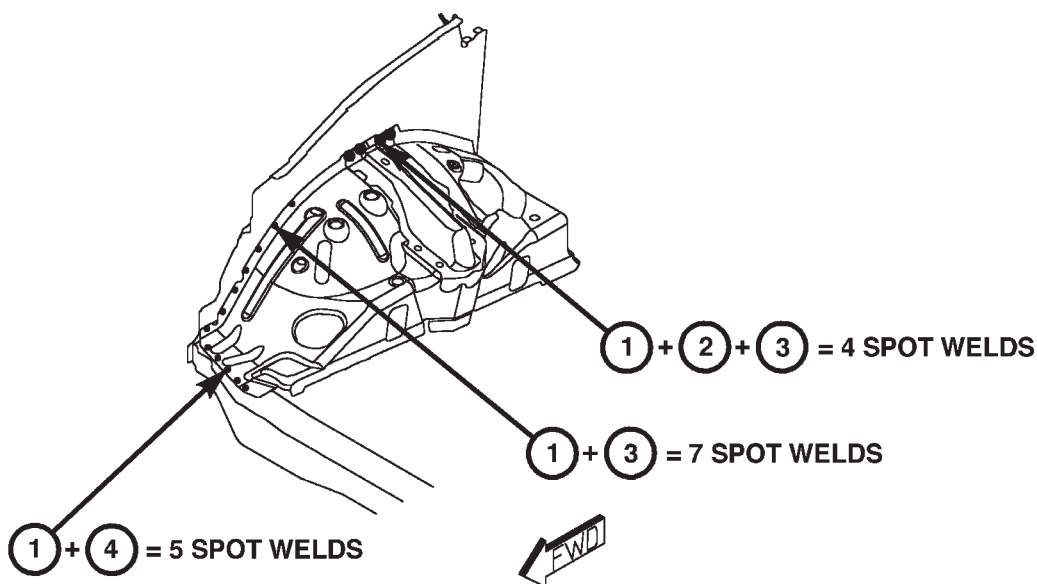
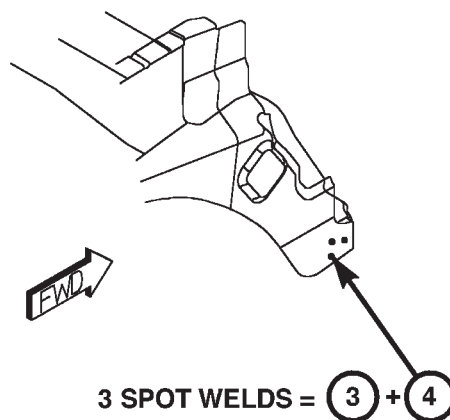
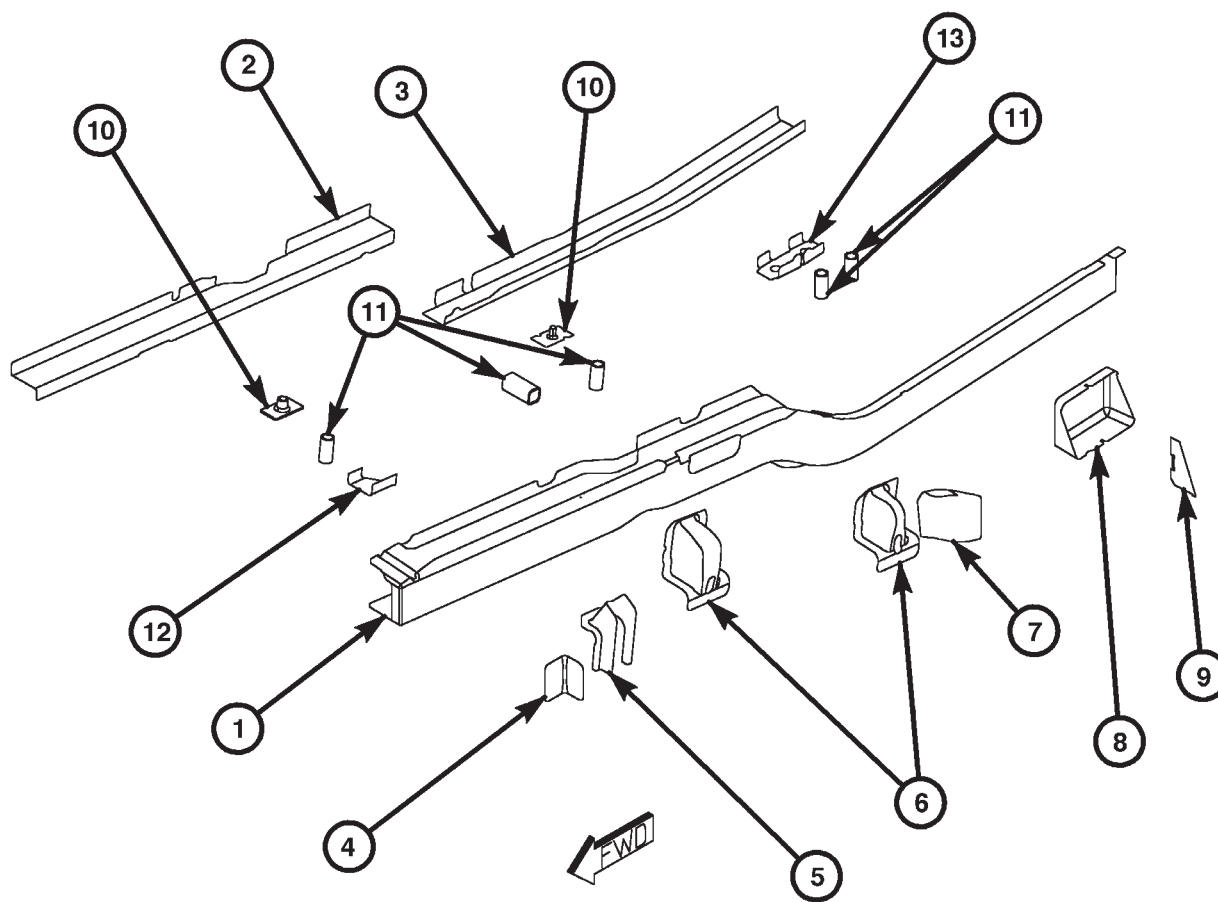


Fig. 8 INNER FRONT WHEELHOUSE

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

- |                                     |                             |
|-------------------------------------|-----------------------------|
| ① FRONT INNER RAIL                  | ⑧ ATTACHMENT BRACKET        |
| ② TIP REINFORCEMENT                 | ⑨ ATTACHMENT BRACKET GUSSET |
| ③ U-CHANNEL REINFORCEMENT           | ⑩ TAPPING PLATE             |
| ④ FRONT RAIL TO CROSSMEMBER BRACKET | ⑪ CRUSH TUBE SPACER         |
| ⑤ RAD SUPPORT AND RAIL BRACKET      | ⑫ CLOSEOUT SPACER BRACKET   |
| ⑥ MOUNTING BRACKET                  | ⑬ REAR SPACER BRACKET       |
| ⑦ REINFORCEMENT PLATE               |                             |



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE UNLESS SHOWN

Fig. 9 FRONT INNER RAILS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

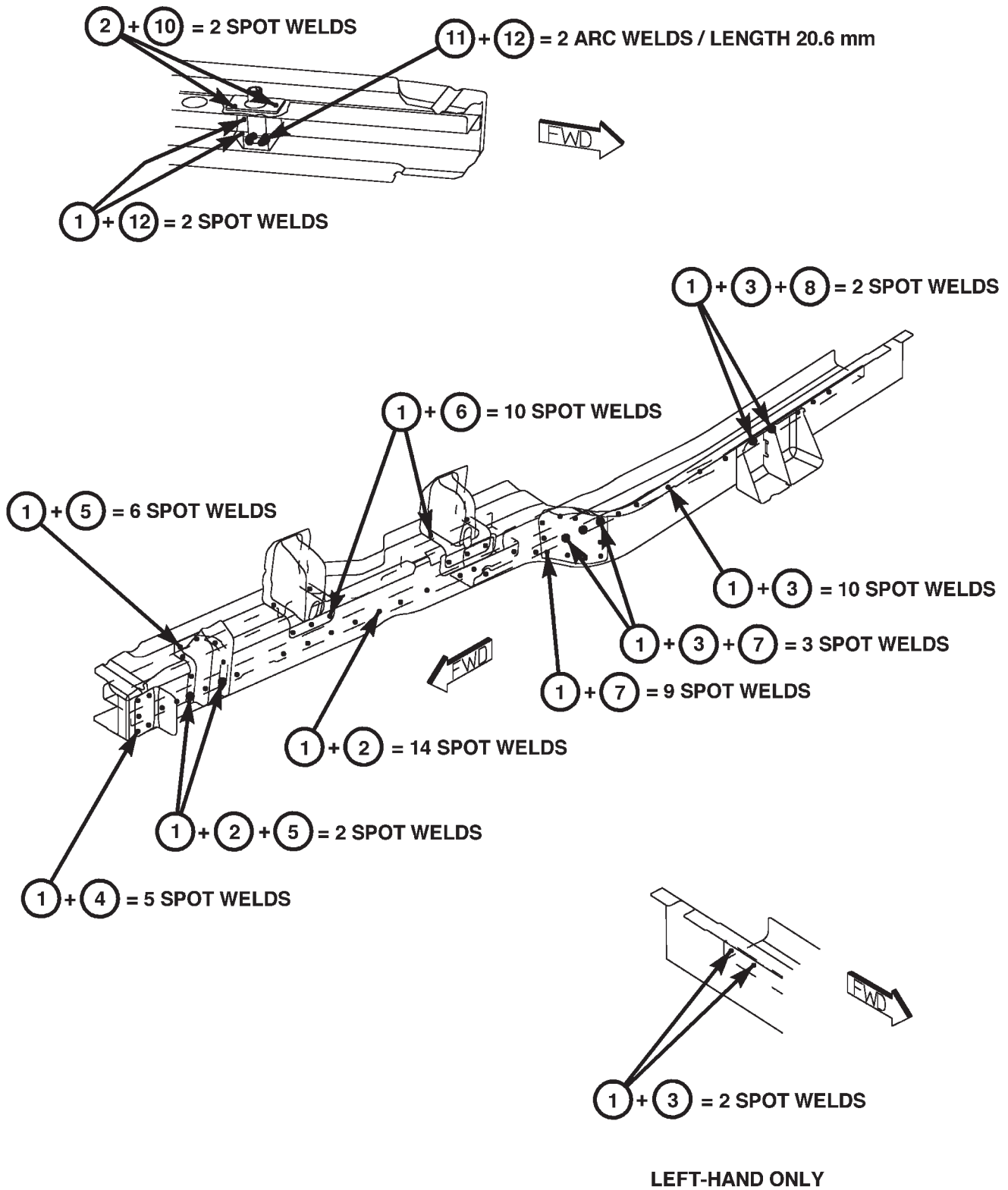


Fig. 10 FRONT INNER RAILS



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

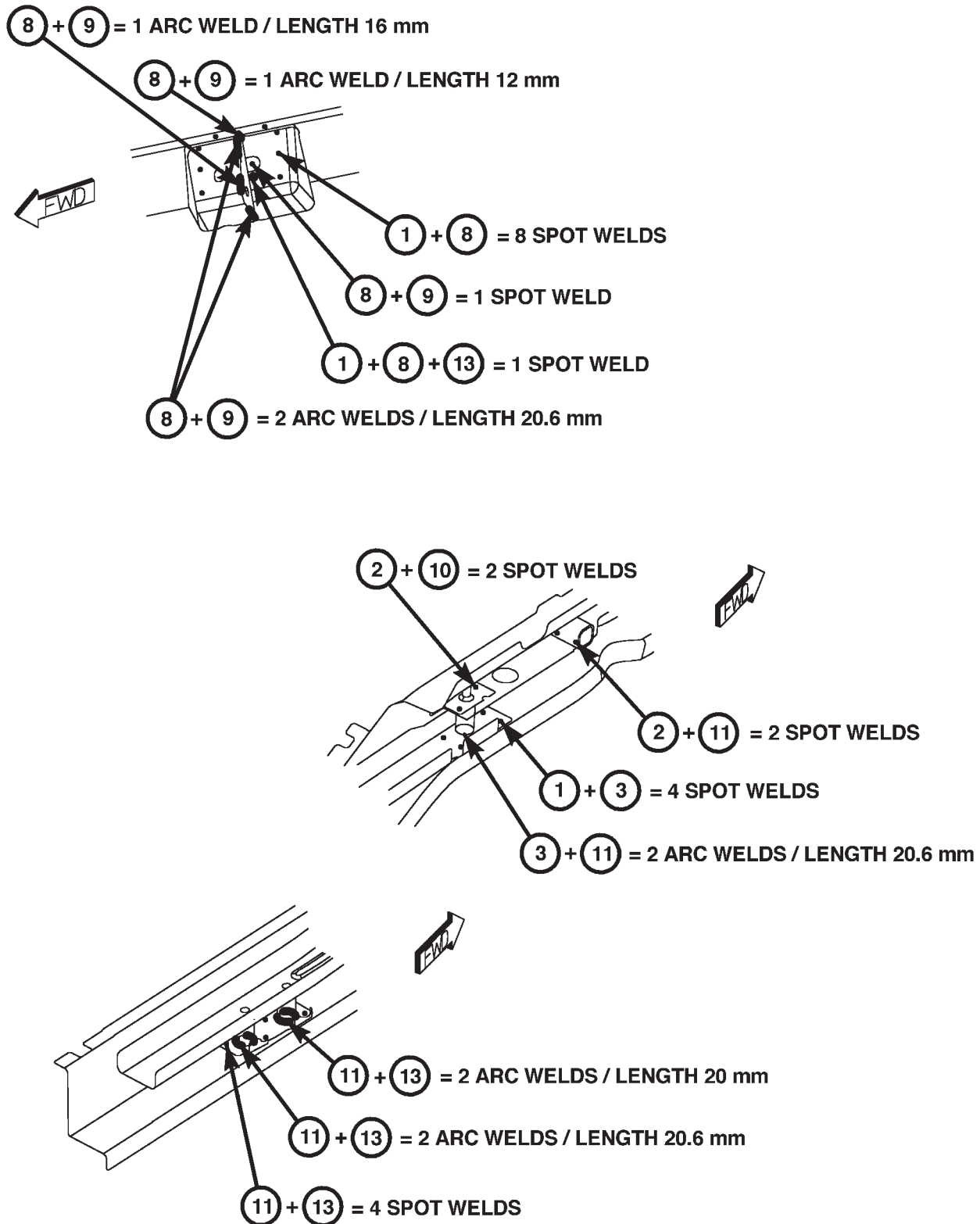


Fig. 11 FRONT INNER RAILS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

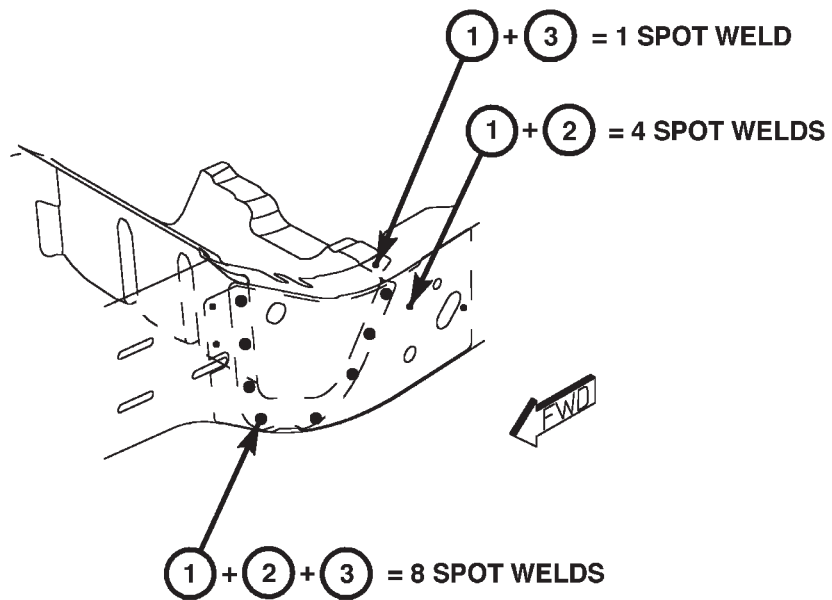
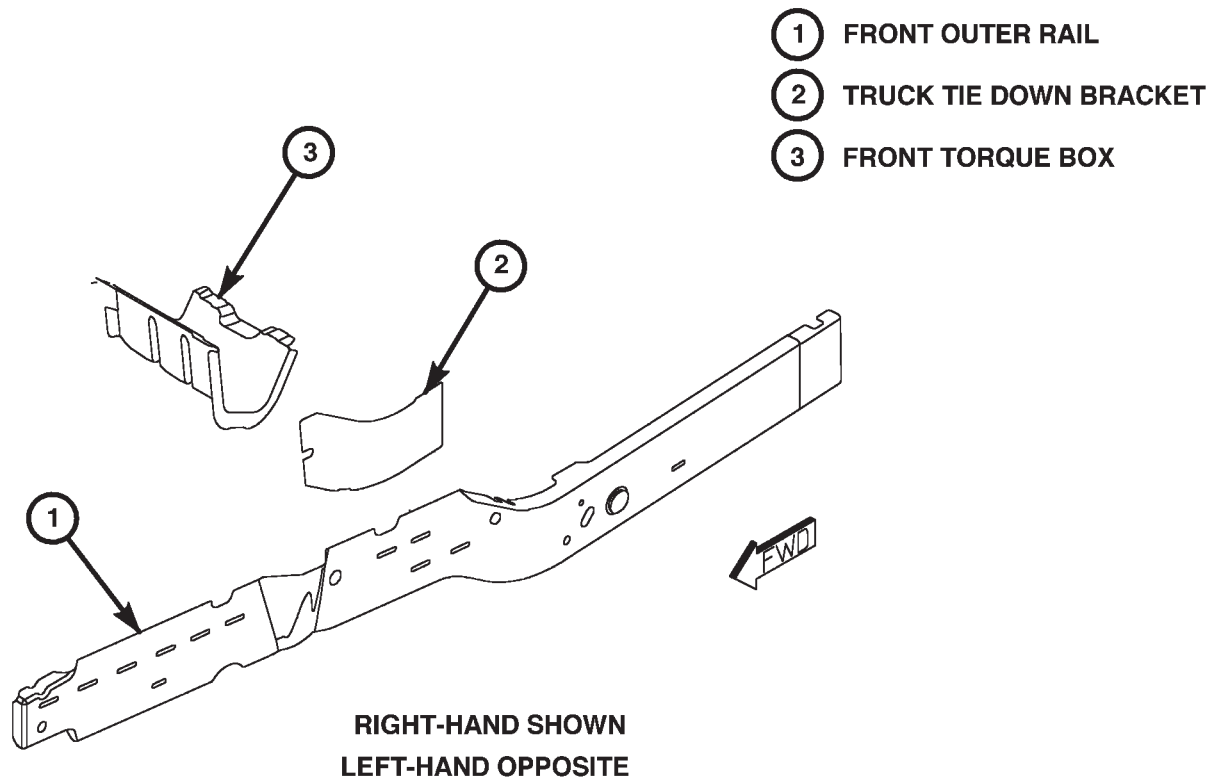


Fig. 12 FRONT OUTER RAIL

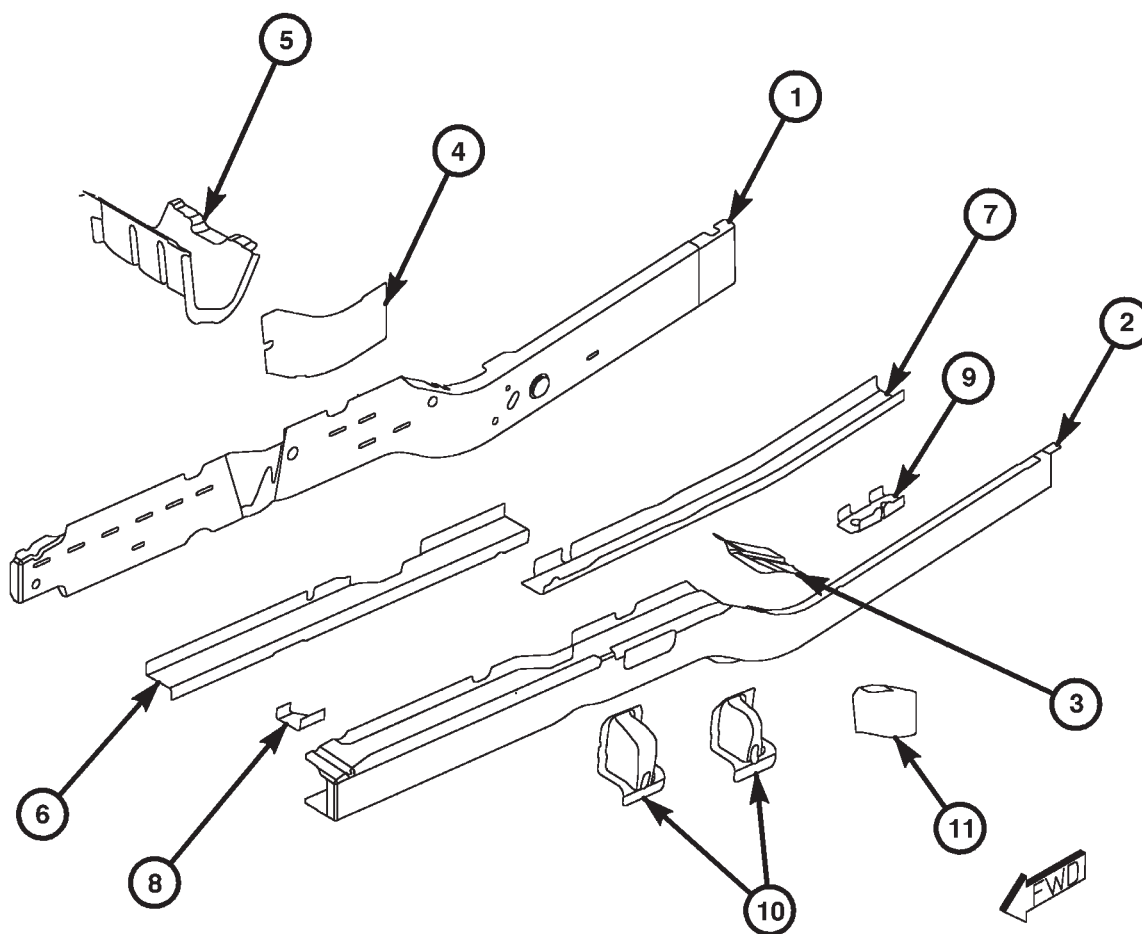
## WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

- |                                   |                           |
|-----------------------------------|---------------------------|
| ① FRONT OUTER RAIL ASSEMBLY       | ⑧ CLOSEOUT SPACER BRACKET |
| ② FRONT INNER RAIL ASSEMBLY       | ⑨ REAR SPACER BRACKET     |
| ③ FRONT FLOOR REINFORCEMENT PLATE | ⑩ MOUNTING BRACKET        |
| ④ TRUCK TIE DOWN BRACKET          | ⑪ REINFORCEMENT PLATE     |
| ⑤ FRONT TORQUE BOX                |                           |
| ⑥ TIP REINFORCEMENT               |                           |
| ⑦ U-CCHANNEL REINFORCEMENT        |                           |

## NOTE

ITEMS 4,5 ARE PARTS OF THE FRONT OUTER RAIL ASSEMBLY

ITEMS 6,7,8,9,10 AND 11 ARE PARTS OF THE FRONT INNER RAIL ASSEMBLY



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE UNLESS SHOWN

Fig. 13 FRONT OUTER RAILS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

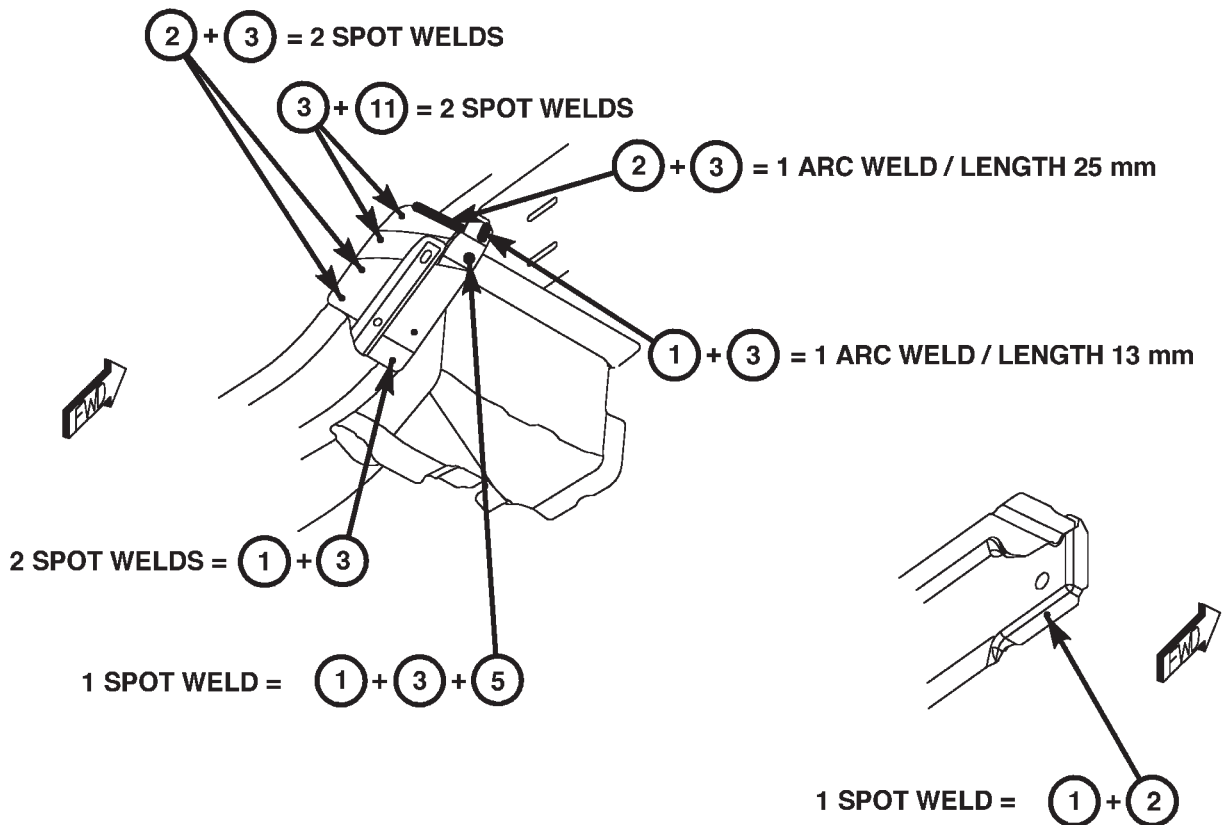
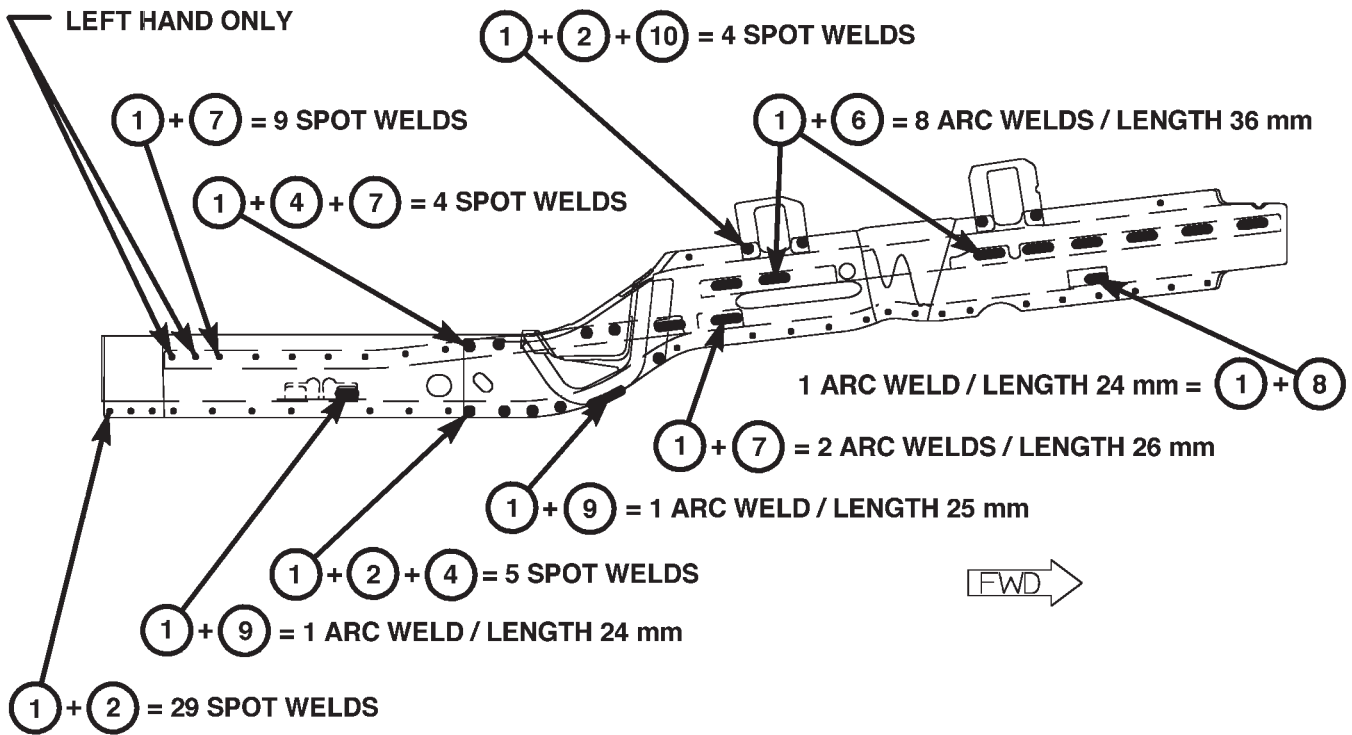


Fig. 14 FRONT OUTER RAILS

## WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

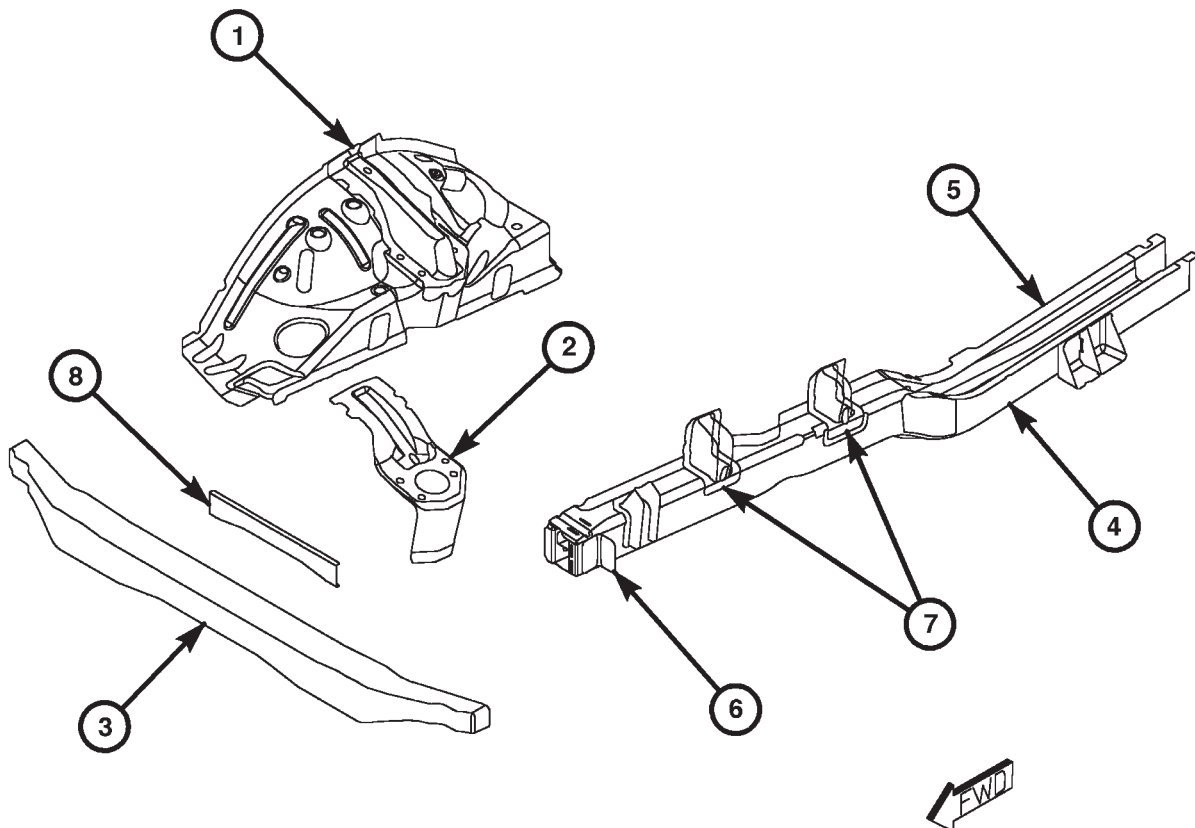
- |   |                           |   |                                   |
|---|---------------------------|---|-----------------------------------|
| ① | INNER FRONT WHEELHOUSE    | ⑤ | FRONT OUTER RAIL ASSEMBLY         |
| ② | LOWER REINFORCEMENT       | ⑥ | FRONT RAIL TO CROSSMEMBER BRACKET |
| ③ | FRONT BUMPER CROSSMEMBER  | ⑦ | MOUNTING BRACKET                  |
| ④ | FRONT INNER RAIL ASSEMBLY | ⑧ | CROSSMEMBER BRACKET               |

## NOTE

ITEMS 4,5,6 AND 7 ARE PARTS OF THE COMPLETE FRONT RAIL ASSEMBLY

ITEM 2 IS PART OF THE COMPLETE INNER FRONT WHEELHOUSE ASSEMBLY

ITEM 8 IS PART OF THE COMPLETE FRONT BUMPER CROSSMEMBER ASSEMBLY



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE

Fig. 15 INNER FRONT WHEELHOUSE/FRONT INNER RAIL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

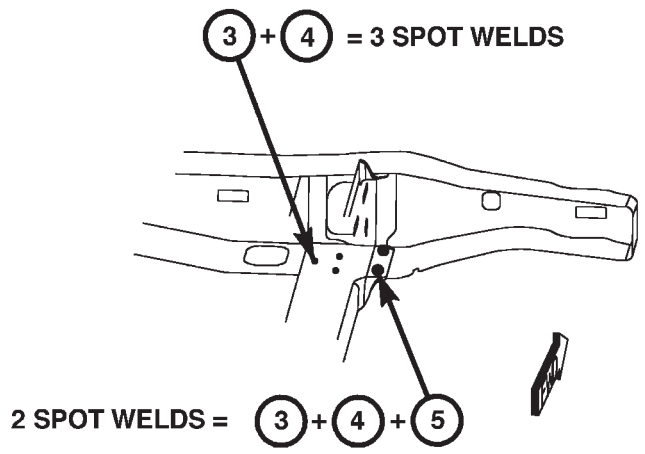
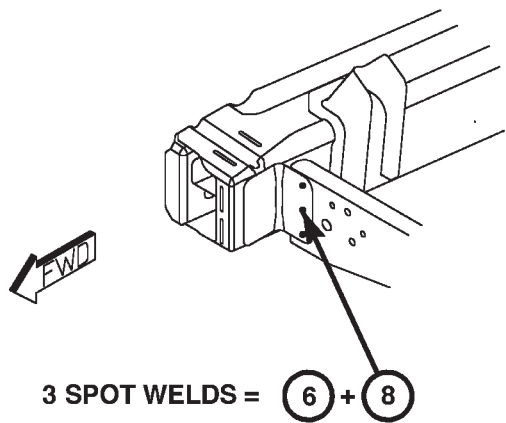
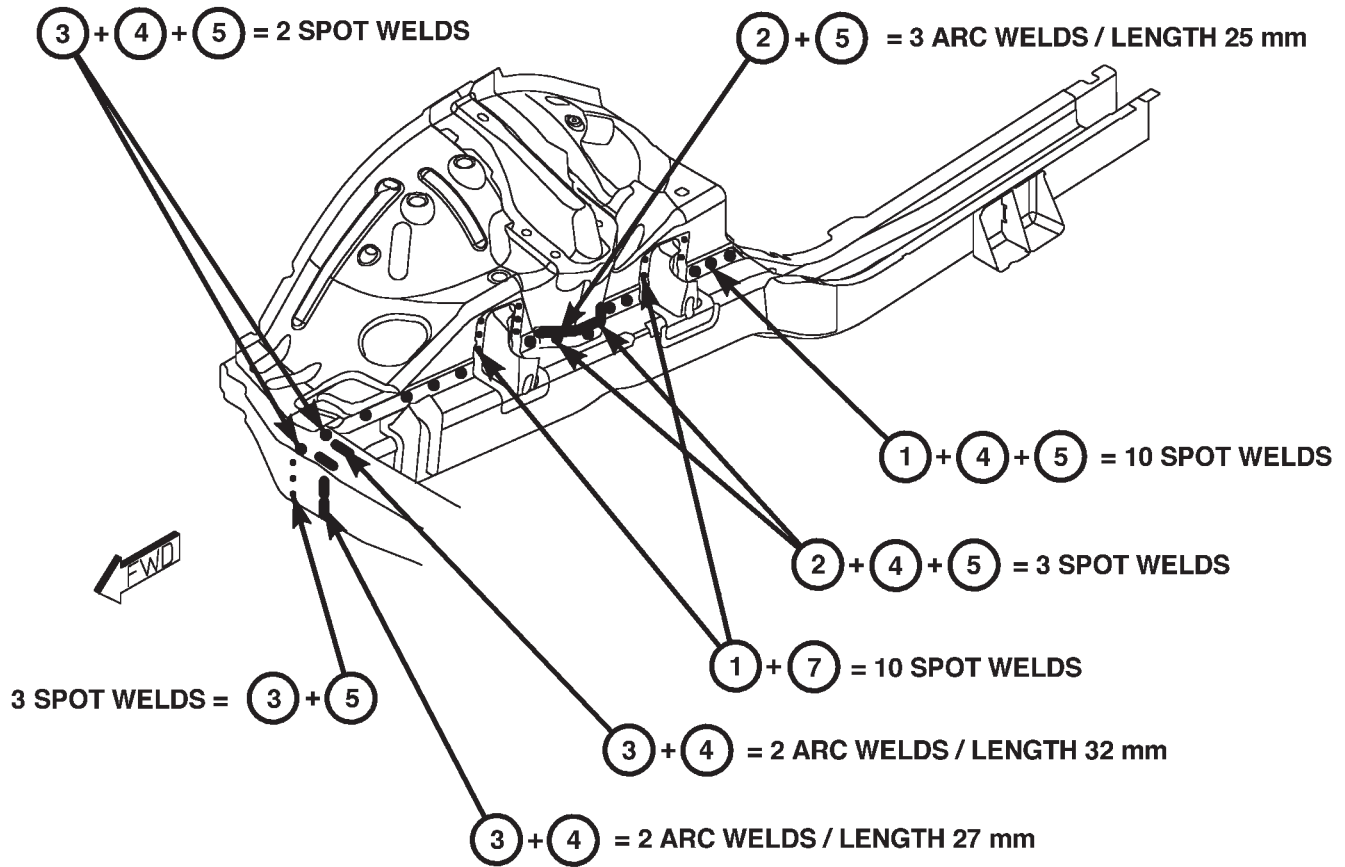
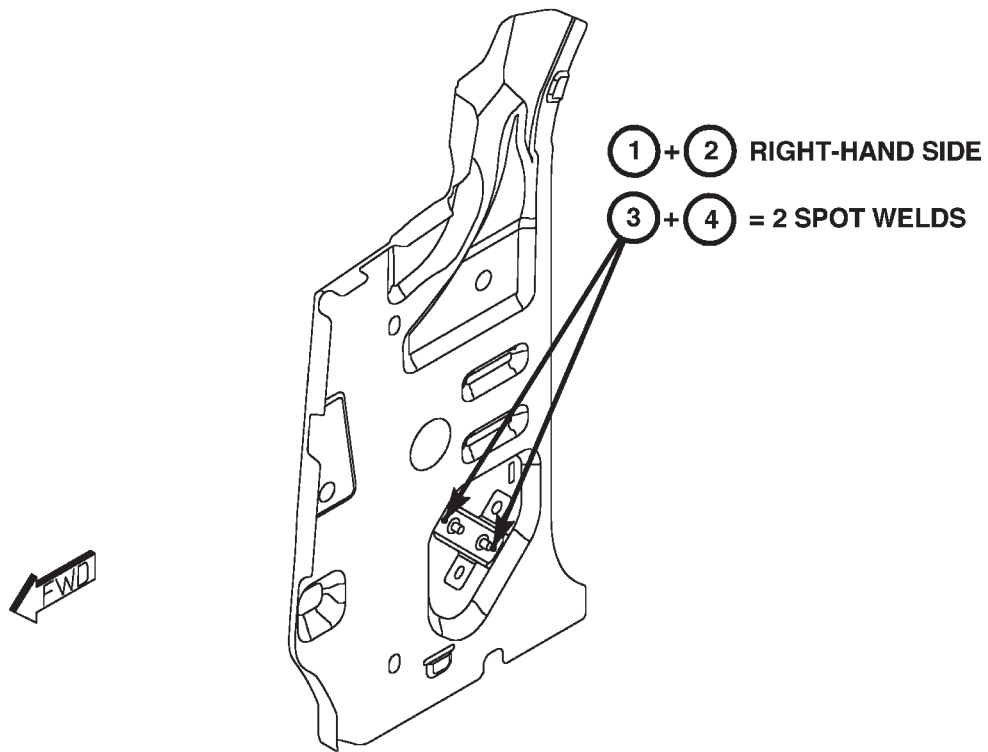
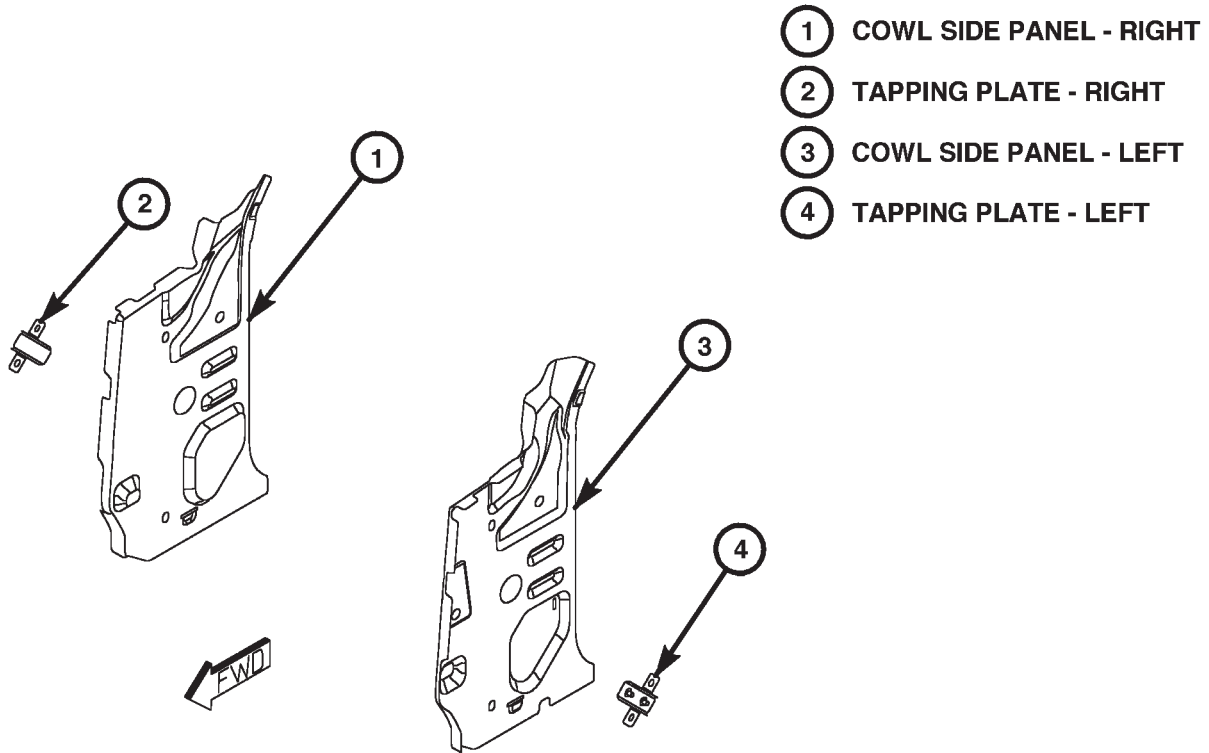


Fig. 16 INNER FRONT WHEELHOUSE/FRONT INNER RAIL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



LEFT-HAND SHOWN  
 RIGHT-HAND OPPOSITE

Fig. 17 COWL SIDE PANEL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

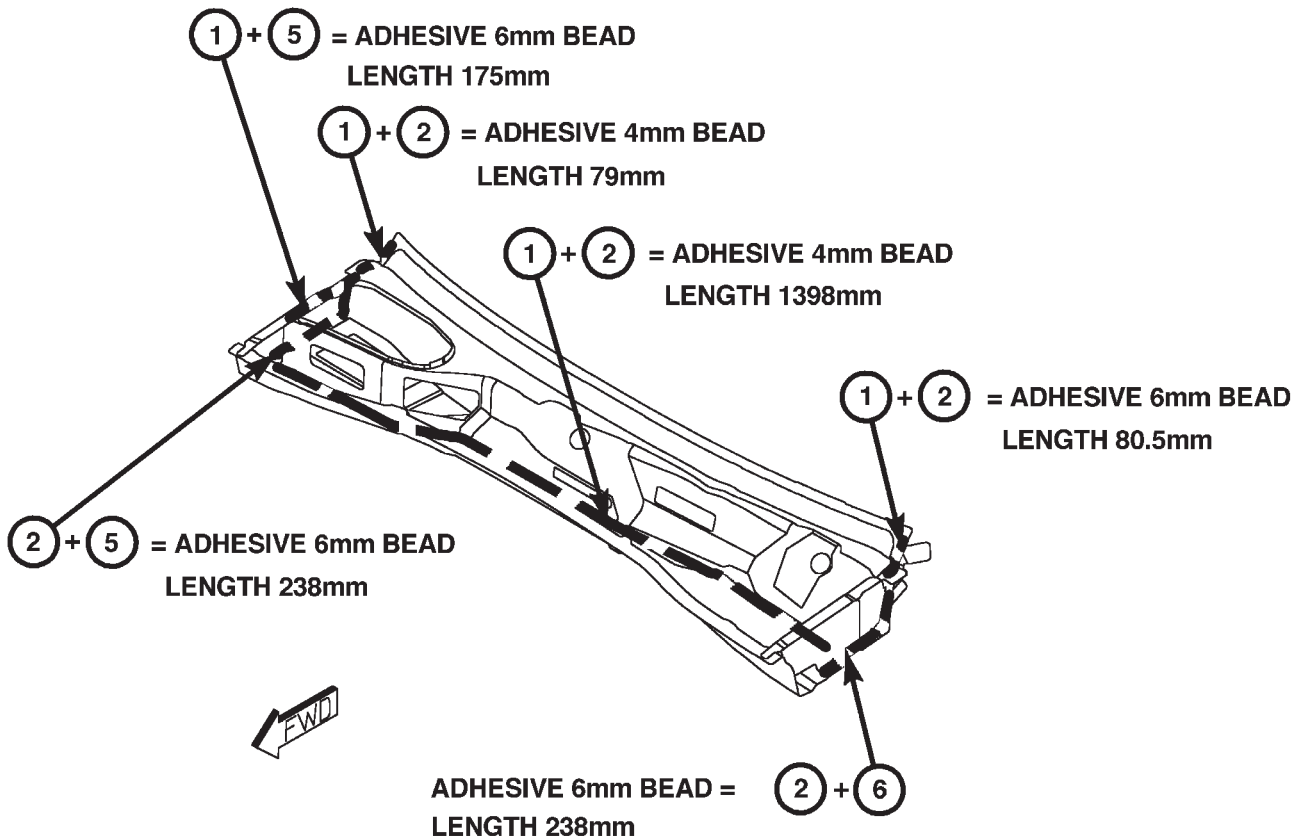
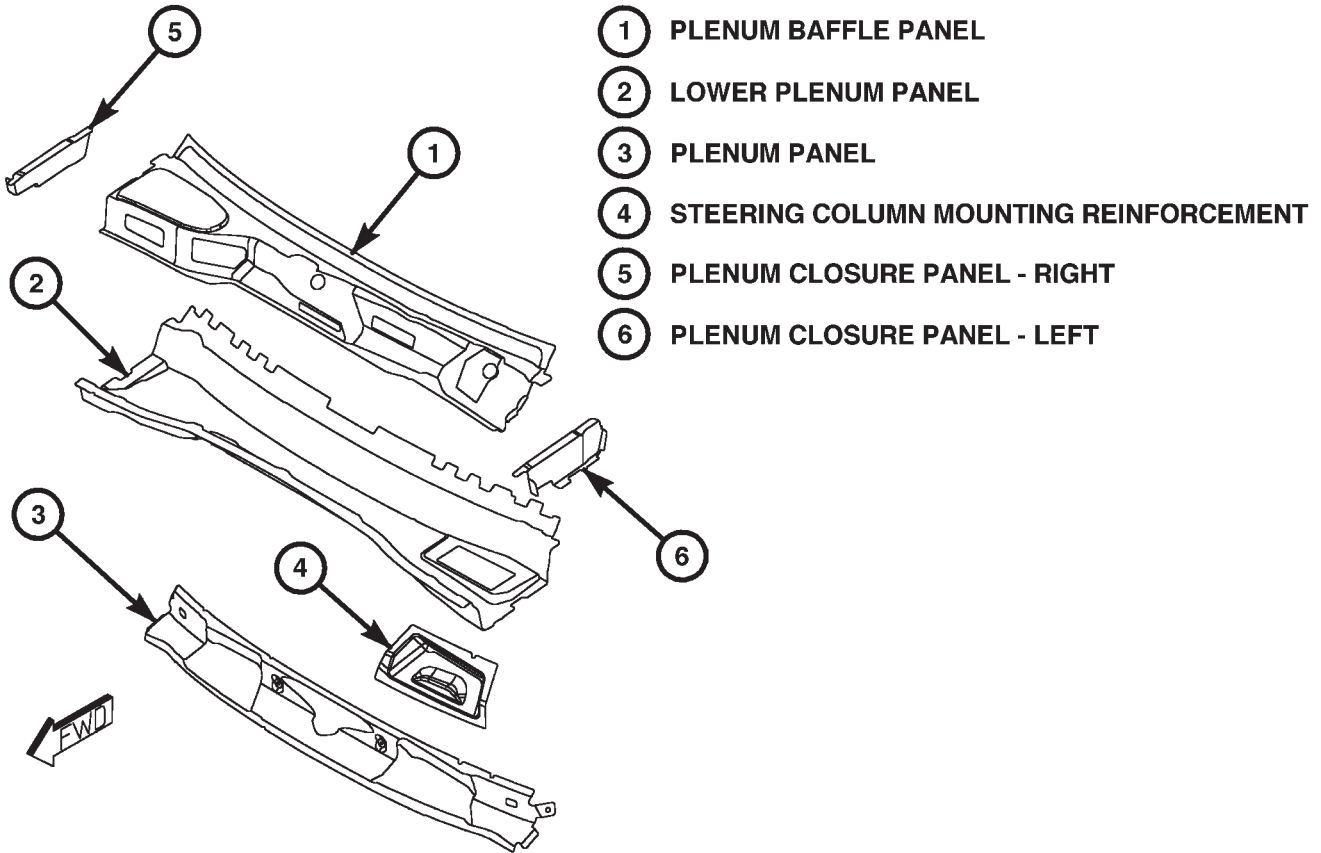


Fig. 18 PLENUM ASSEMBLY



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

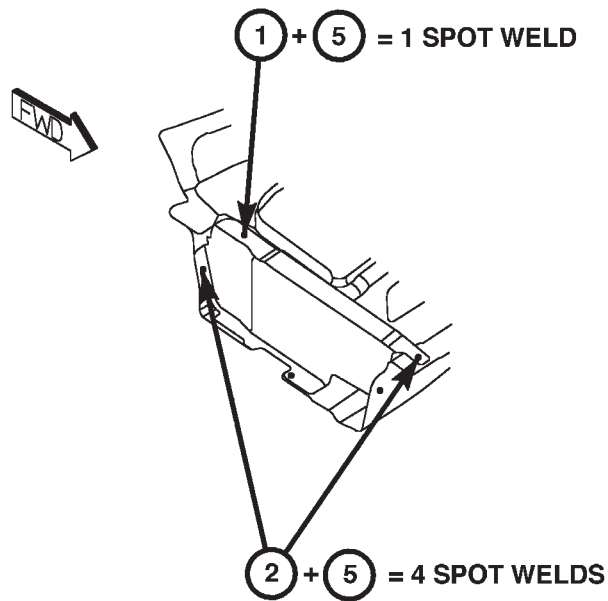
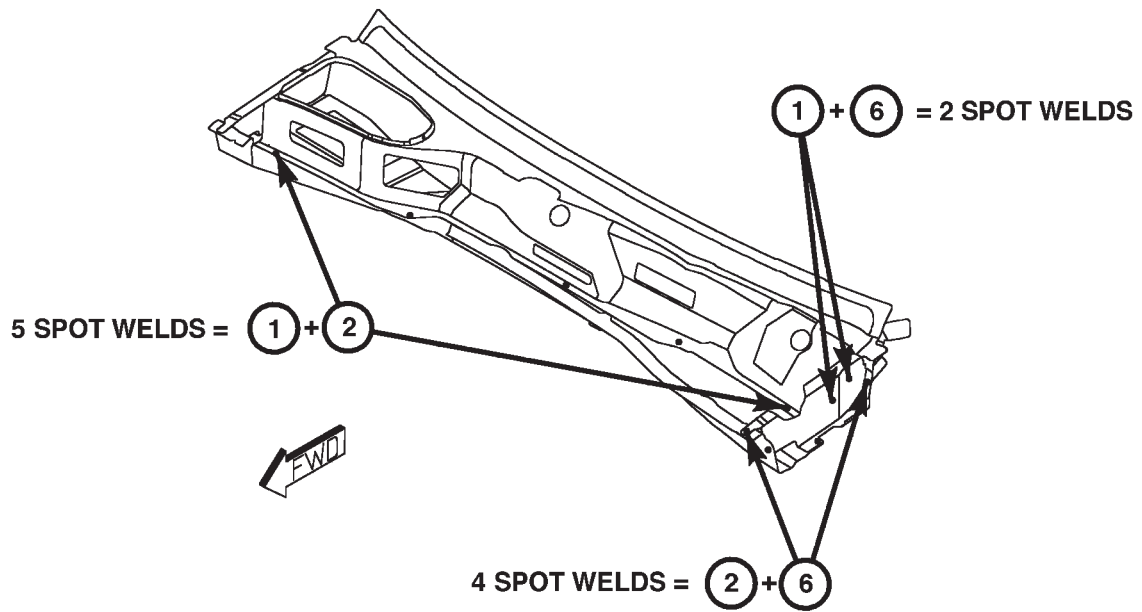


Fig. 19 PLENUM ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

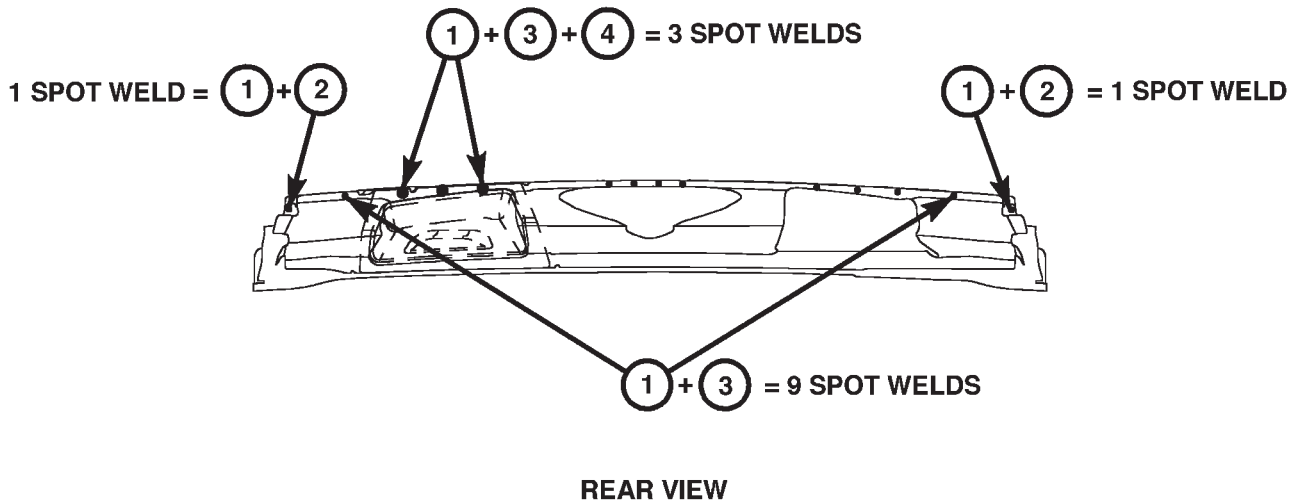
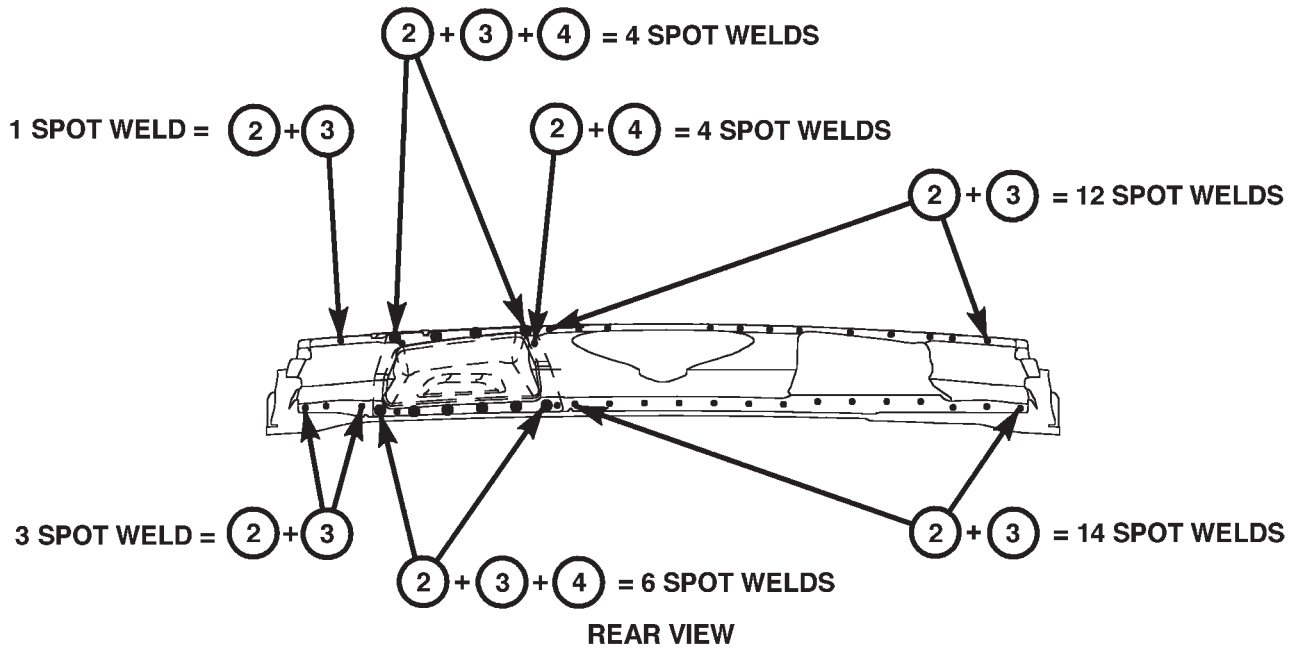
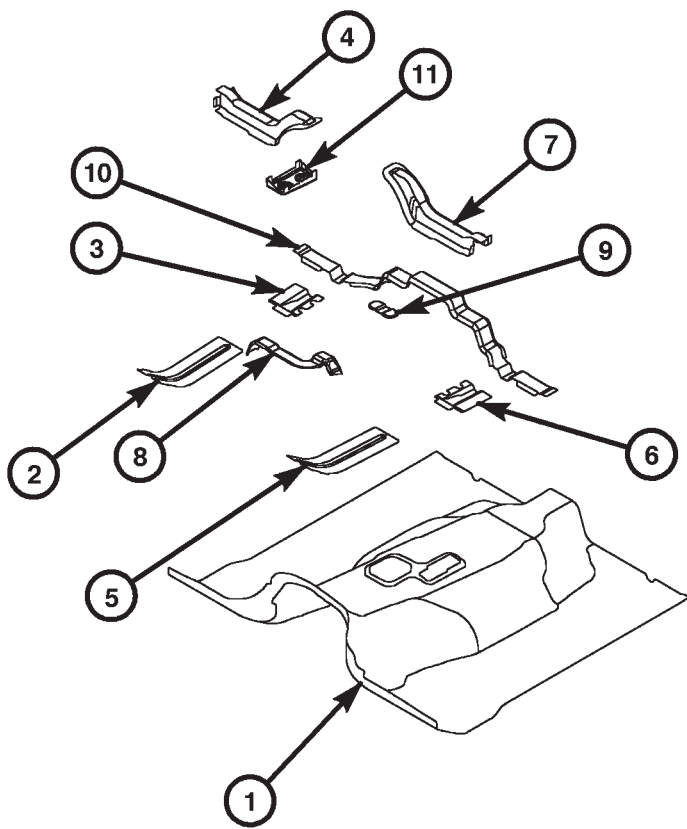


Fig. 20 PLENUM ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

FRONT END ASSEMBLY/UNDERBODY



- ① FRONT FLOOR PAN
- ② FRONT COMPRESSION PLATE - RIGHT
- ③ REAR COMPRESSION PLATE - RIGHT
- ④ FRONT SEAT CROSSMEMBER - RIGHT
- ⑤ FRONT COMPRESSION PLATE - LEFT
- ⑥ REAR COMPRESSION PLATE - LEFT
- ⑦ FRONT SEAT CROSSMEMBER - LEFT
- ⑧ TUNNEL FRONT REINFORCEMENT
- ⑨ TUNNEL CENTER REINFORCEMENT
- ⑩ FRONT SEAT CROSSMEMBER
- ⑪ ACM MOUNTING BRACKET

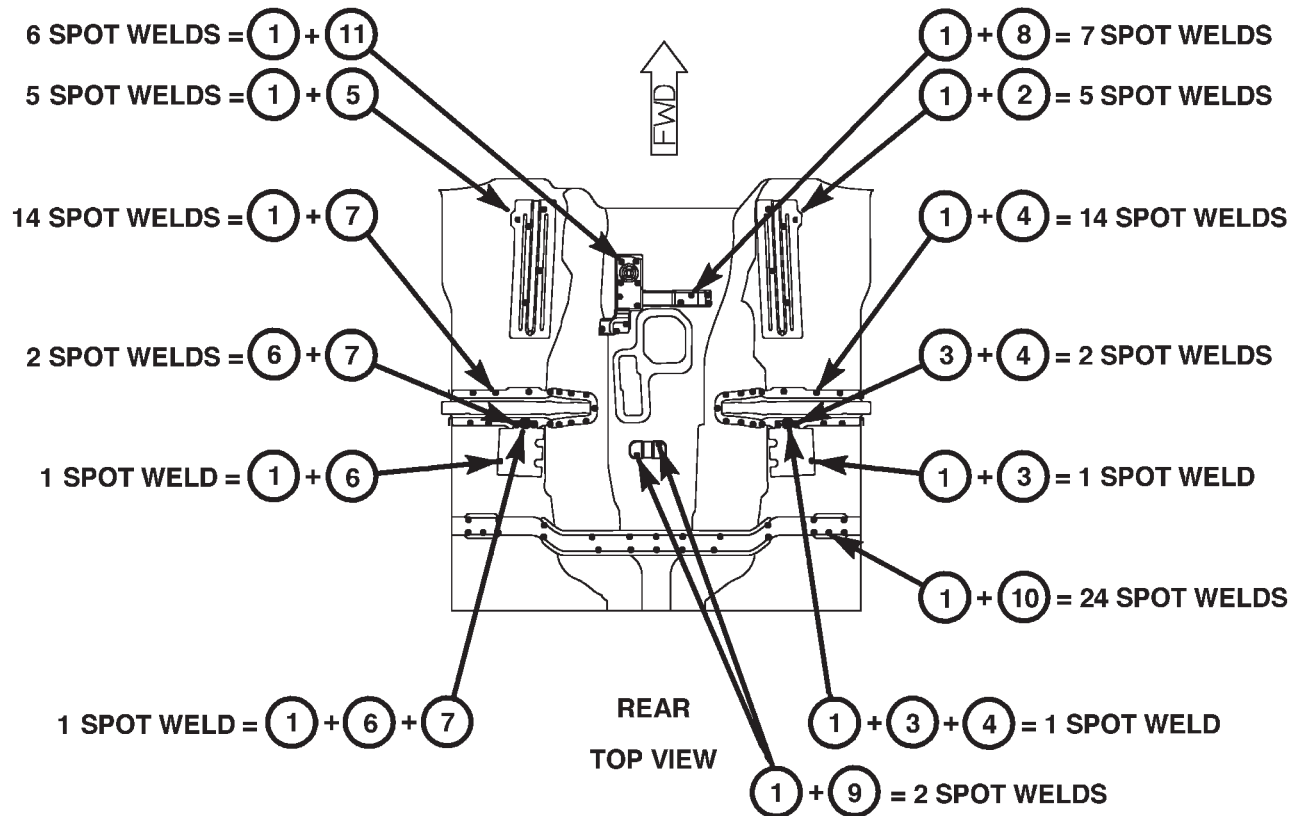


Fig. 21 FLOOR PAN ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

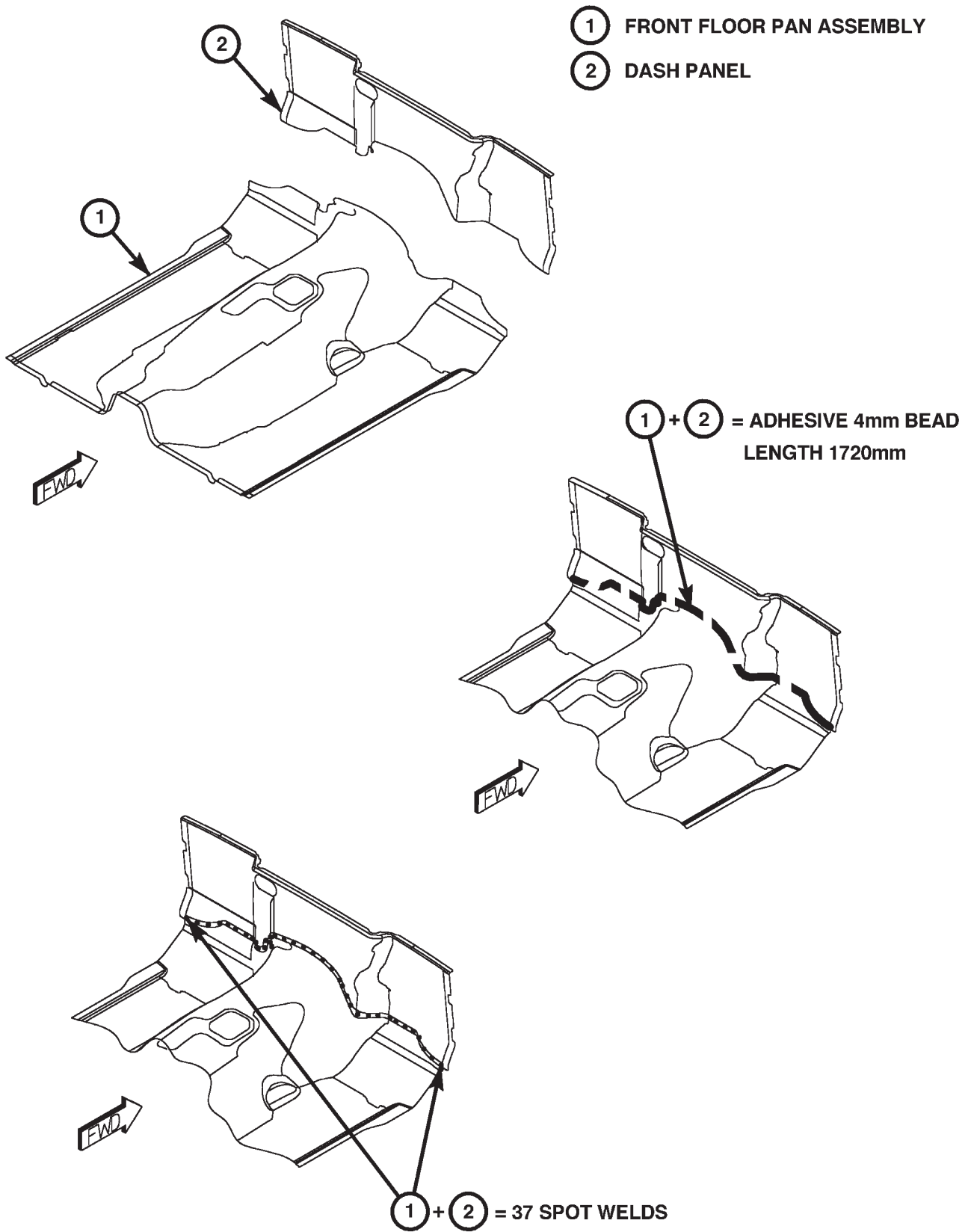
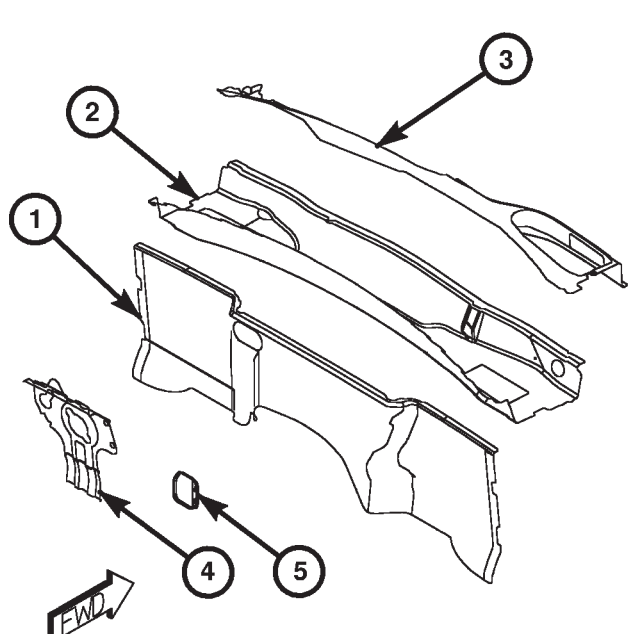


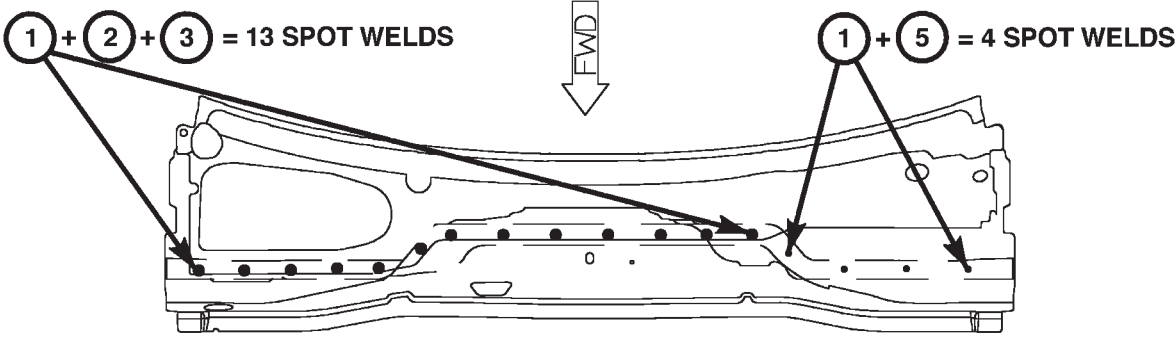
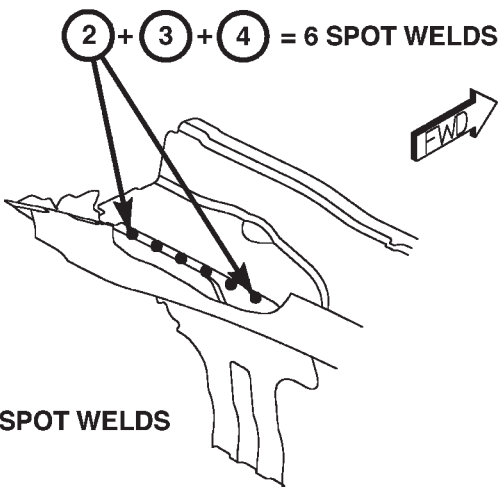
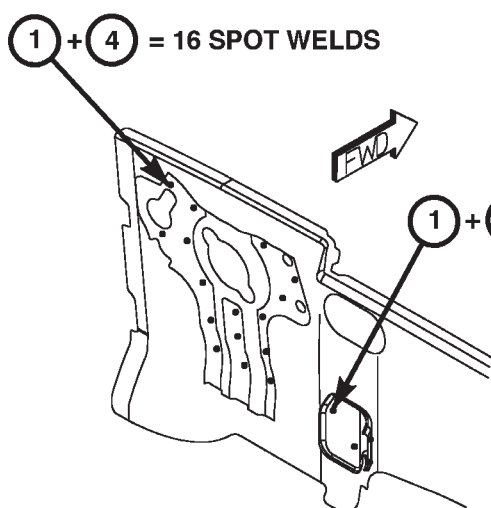
Fig. 22 FLOOR PAN ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



- ① DASH PANEL
- ② LOWER PLENUM PANEL
- ③ PLENUM BAFFLE PANEL
- ④ BRAKE MASTER CYLINDER REINFORCEMENT
- ⑤ ACCELERATOR PEDAL REINFORCEMENT

NOTE  
ITEMS 2 AND 3 ARE PARTS OF THE COMPLETE PLENUM ASSEMBLY



PLAN VIEW

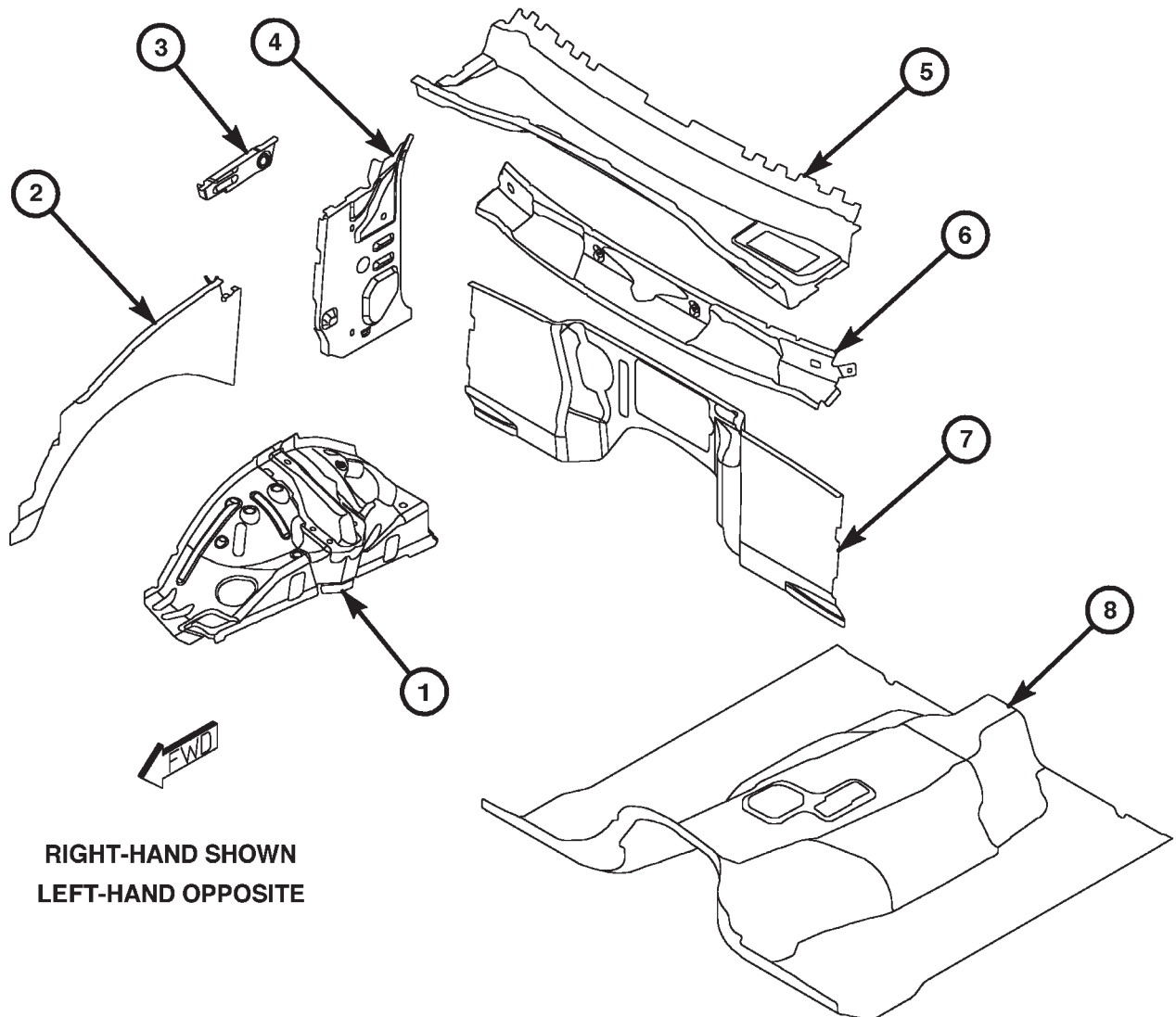
Fig. 23 DASH PANEL ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

- |                          |                            |
|--------------------------|----------------------------|
| ① INNER FRONT WHEELHOUSE | ⑤ LOWER PLENUM PANEL       |
| ② INNER FENDER PANEL     | ⑥ PLENUM PANEL             |
| ③ PLENUM CLOSURE PANEL   | ⑦ DASH PANEL               |
| ④ COWL SIDE PANEL        | ⑧ FRONT FLOOR PAN ASSEMBLY |

**NOTE**

ITEMS 3, 5 AND 6 ARE PARTS OF THE COMPLETE PLENUM ASSEMBLY



**Fig. 24 DASH PANEL/WHEELHOUSE ASSEMBLY**

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

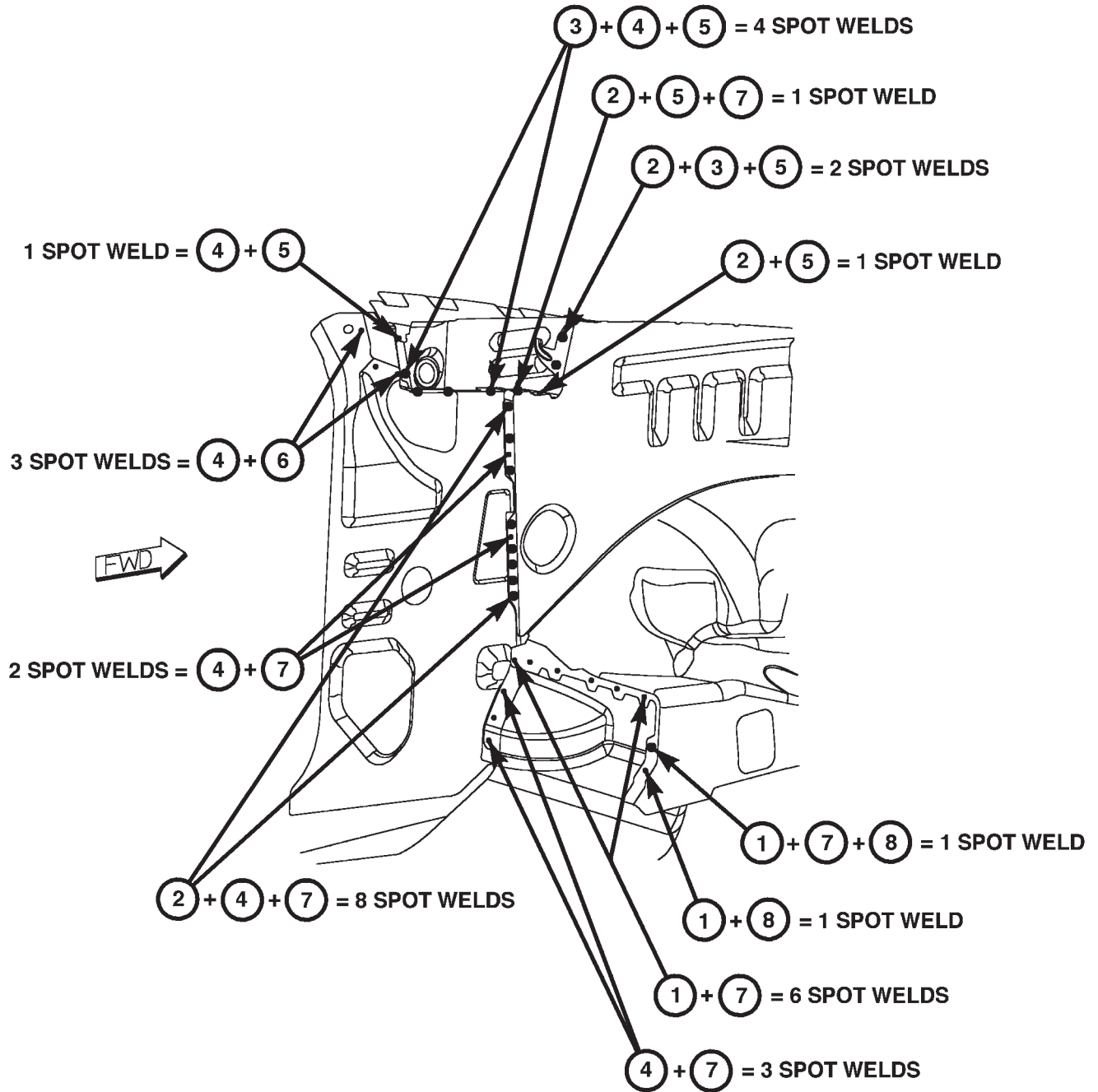


Fig. 25 COWL SIDE PANEL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

REAR FRAME RAILS

- |                                |                                     |
|--------------------------------|-------------------------------------|
| ① REAR RAIL                    | ⑨ CONTROL ARM MOUNTING BRACKET      |
| ② RAIL FRONT REINFORCEMENT     | ⑩ CONTROL ARM MOUNTING BRACKET      |
| ③ RAIL REAR REINFORCEMENT      | ⑪ REAR TORQUE BOX                   |
| ④ RAIL CENTER REINFORCEMENT    | ⑫ REAR SHOCK MOUNTING BRACKET       |
| ⑤ SHOCK MOUNTING SLEEVE        | ⑬ REAR SHOCK MOUNTING REINFORCEMENT |
| ⑥ EXHAUST HANGER BRACKET       | ⑭ SPRING MOUNTING REINFORCEMENT     |
| ⑦ ANCHOR PLATE                 | ⑮ REAR SPRING OUTER CROSSMEMBER     |
| ⑧ COIL SPRING MOUNTING BRACKET | ⑯ FUEL PASS THROUGH SLEEVE          |

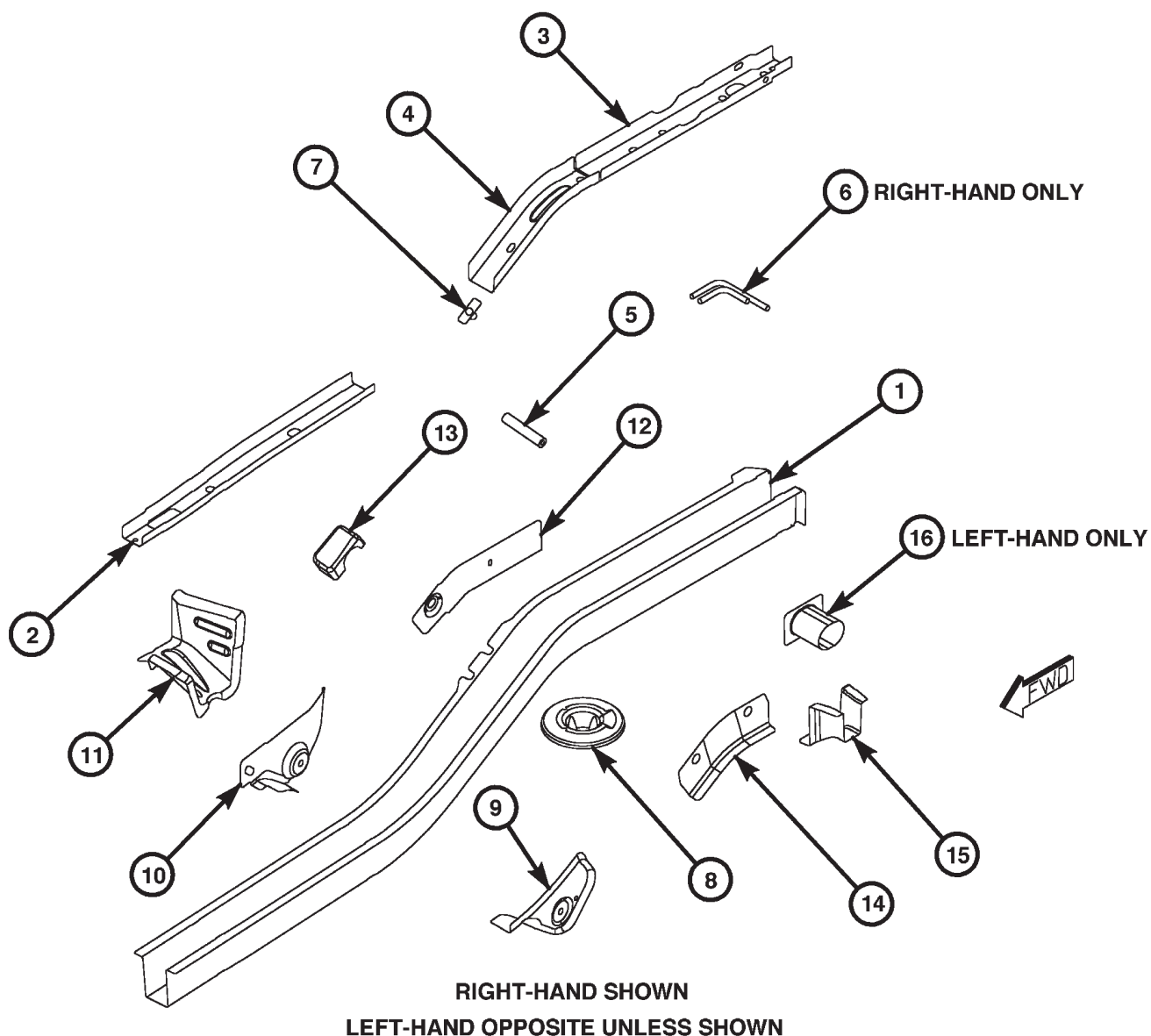


Fig. 26 REAR FRAME RAILS



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

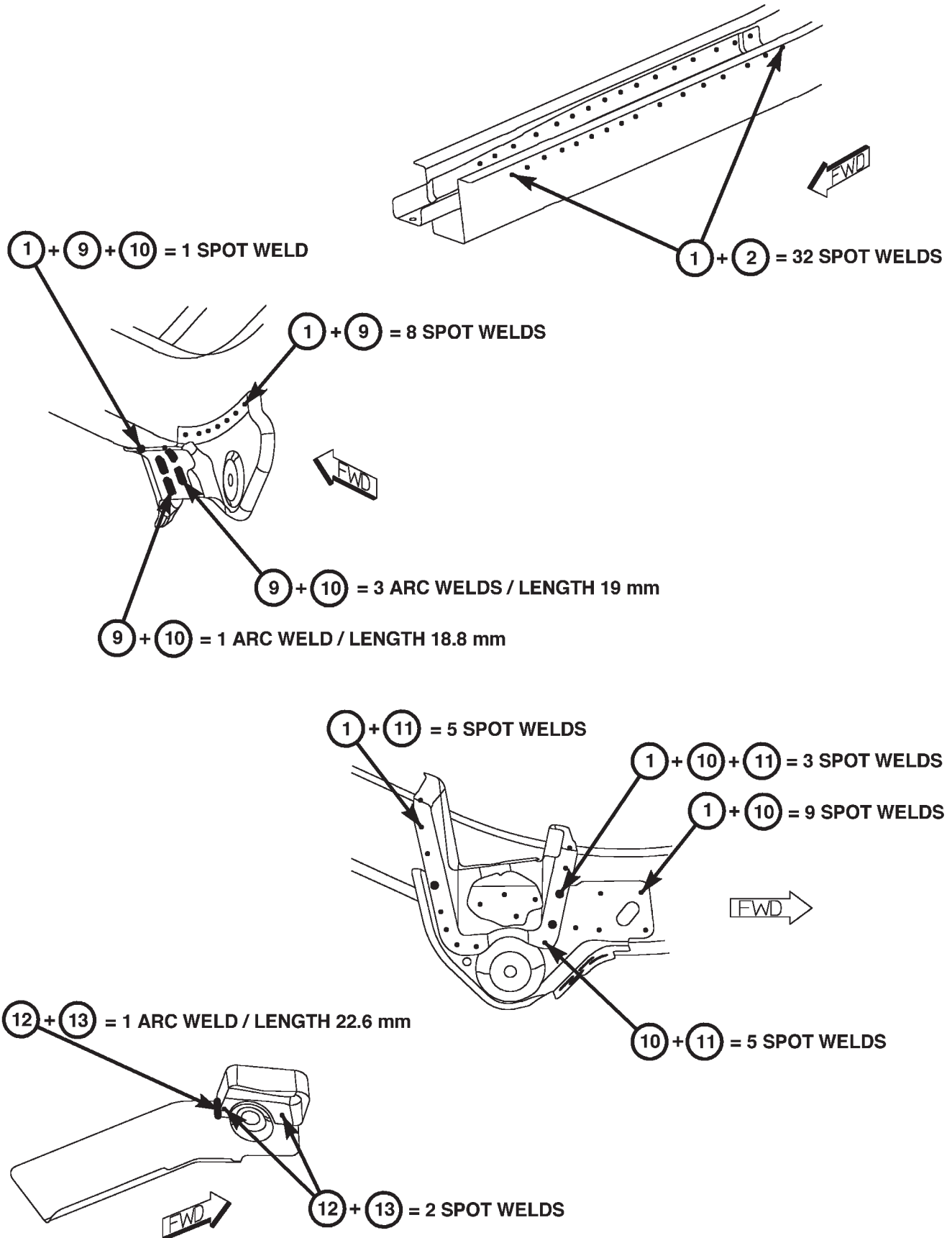


Fig. 27 REAR MOUNTING BRACKETS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

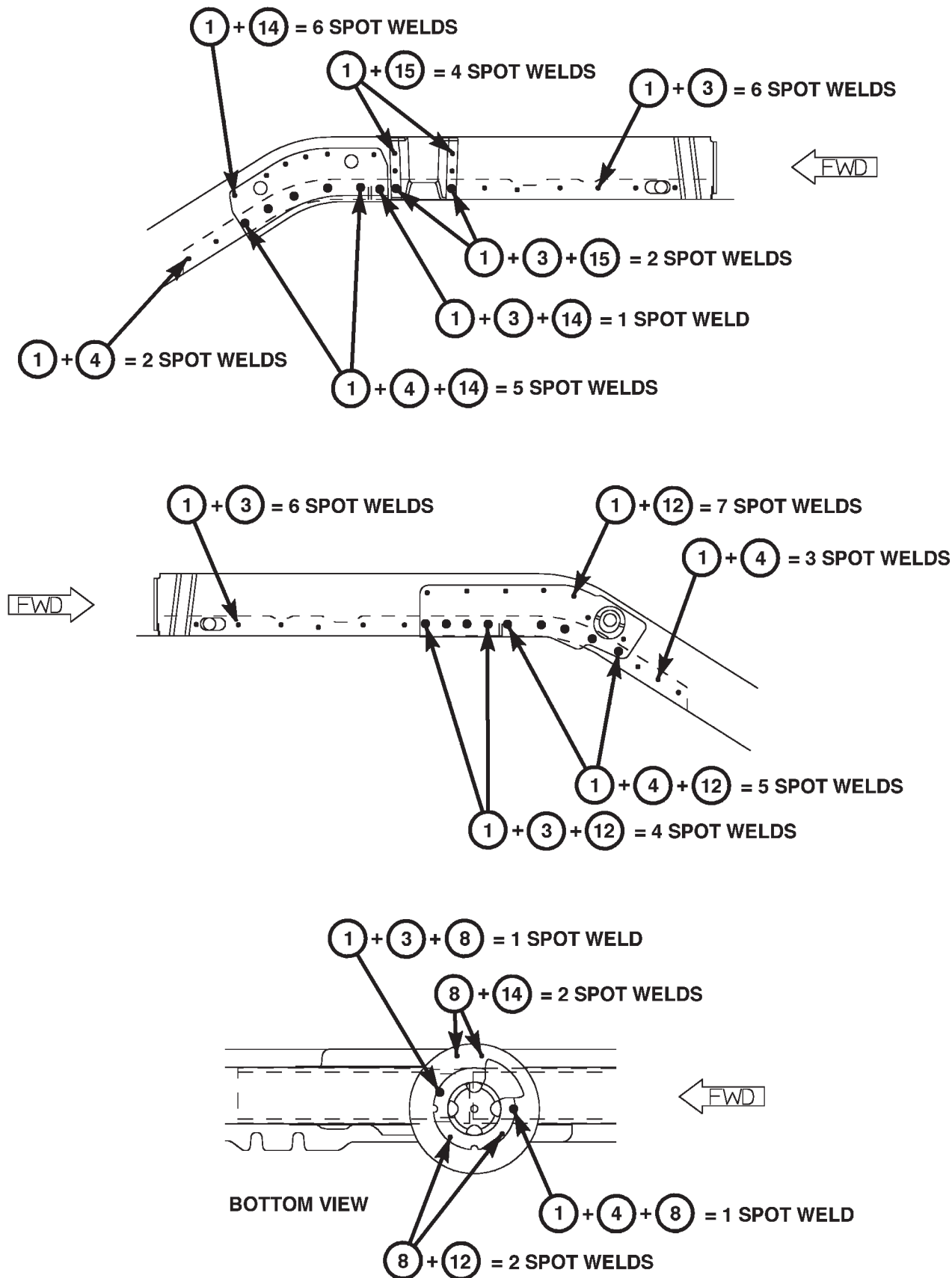


Fig. 28 REAR SPRING MOUNTINGS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

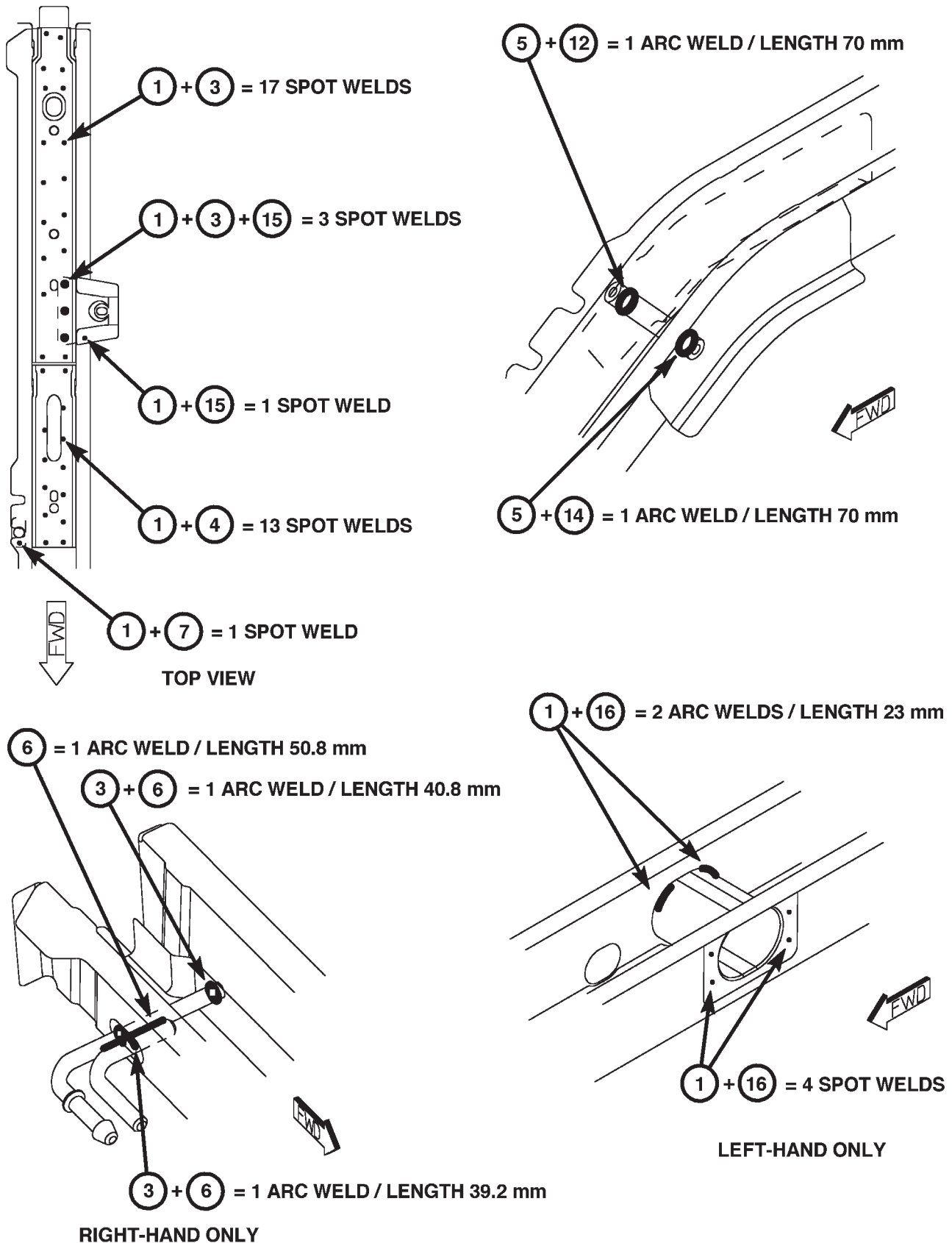


Fig. 29 REAR SPRING, SHOCK, FUEL PASS AND EXHAUST BRACKETS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

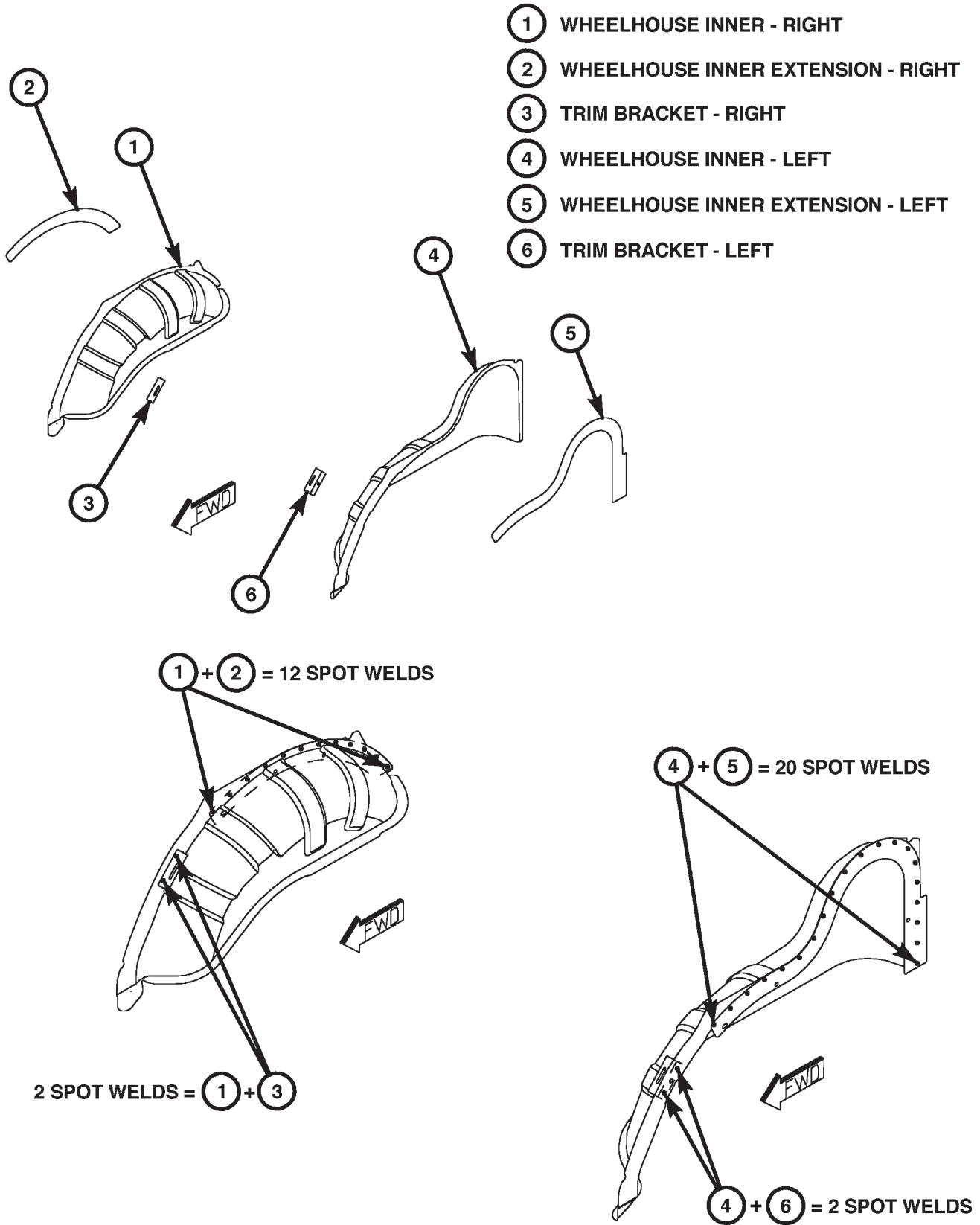
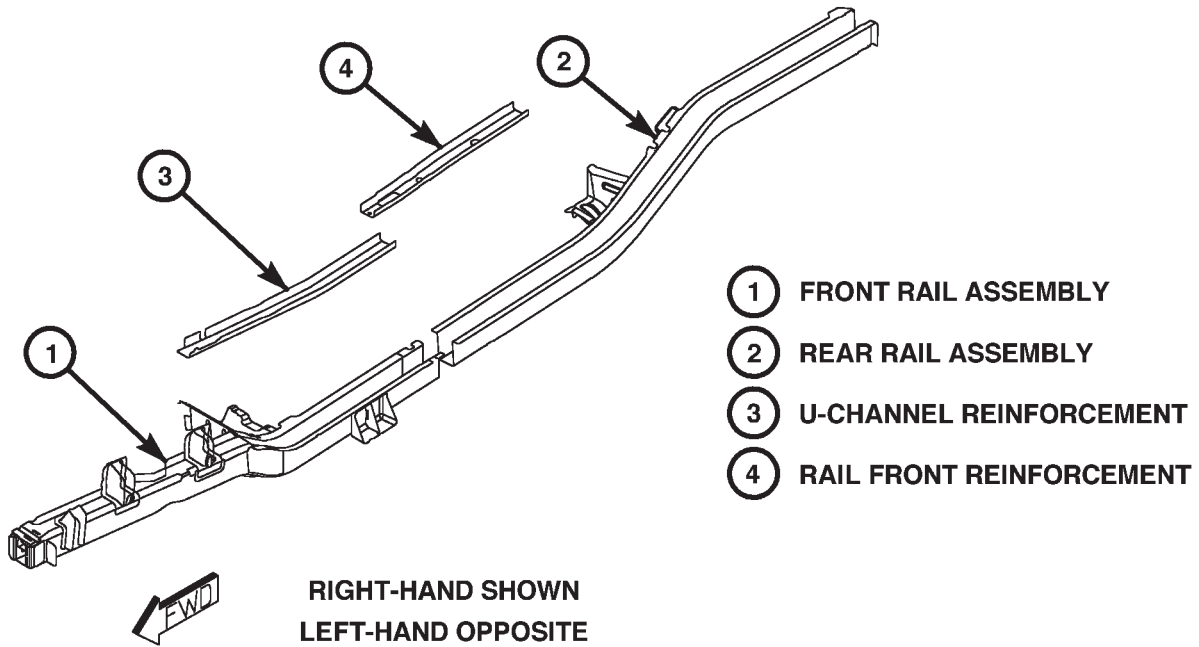


Fig. 30 REAR WHEELHOUSE ASSEMBLIES

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



**NOTE**

- ITEM 2 IS PART OF THE COMPLETE REAR FLOOR PAN ASSEMBLY
- ITEM 3 IS PART OF THE COMPLETE FRONT RAIL ASSEMBLY
- ITEM 4 IS PART OF THE COMPLETE REAR RAIL ASSEMBLY

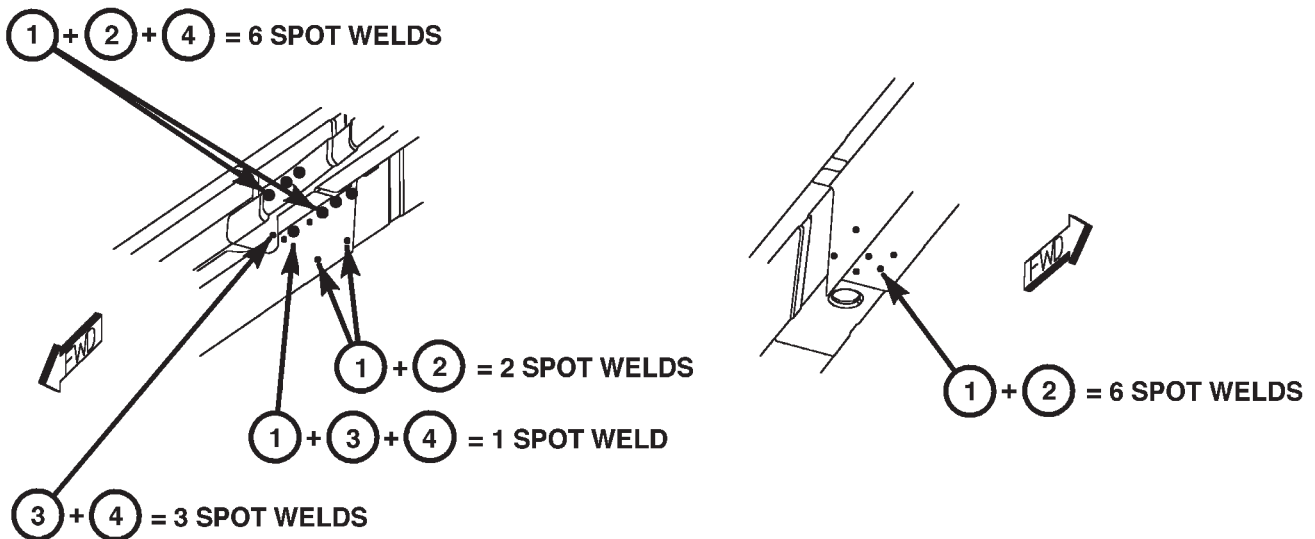
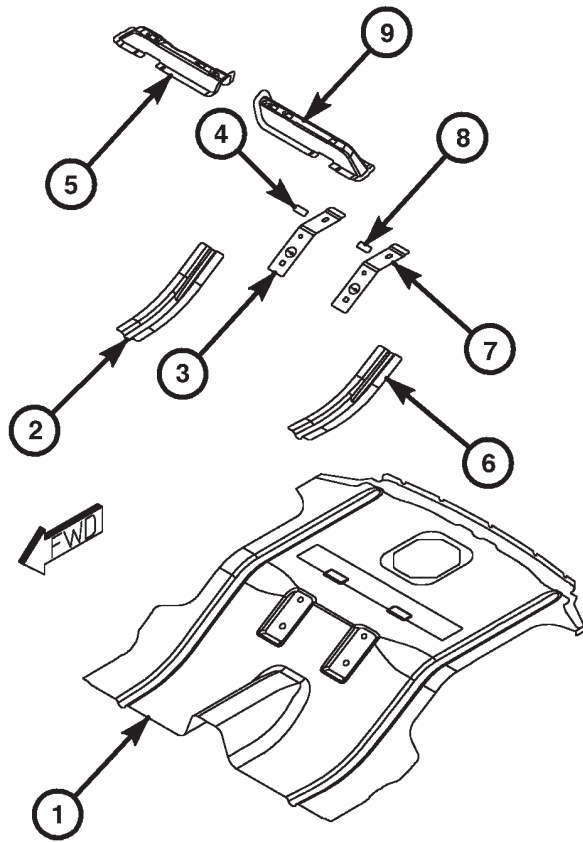


Fig. 31 RAIL ASSEMBLIES – FRONT/REAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

REAR FLOOR PAN ASSEMBLY



- ① REAR FLOOR PAN
- ② REAR COMPRESSION PLATE - RIGHT
- ③ SEAT BELT ANCHOR PLATE - RIGHT
- ④ ANCHOR PLATE - RIGHT
- ⑤ REAR SEAT FRONT CROSSMEMBER - RIGHT
- ⑥ REAR COMPRESSION PLATE - LEFT
- ⑦ SEAT BELT ANCHOR PLATE - LEFT
- ⑧ ANCHOR PLATE - LEFT
- ⑨ REAR SEAT FRONT CROSSMEMBER - LEFT

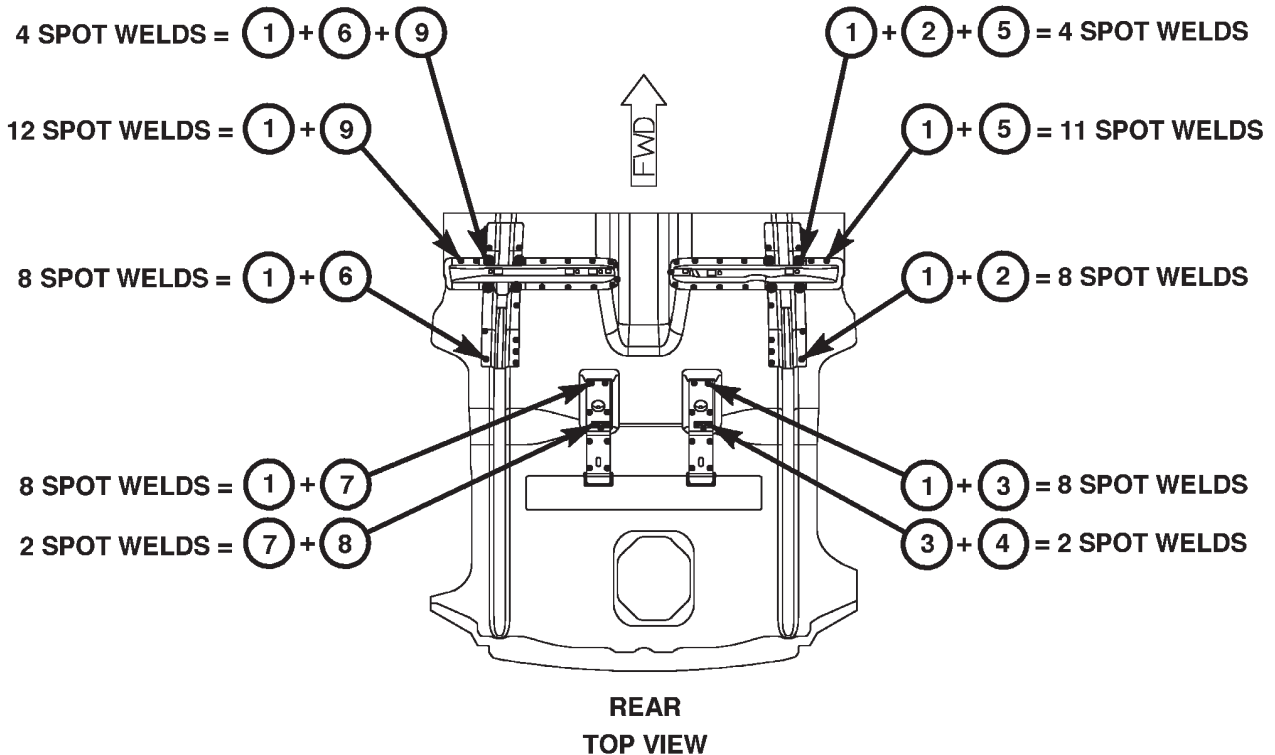


Fig. 32 REAR FLOOR PAN ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

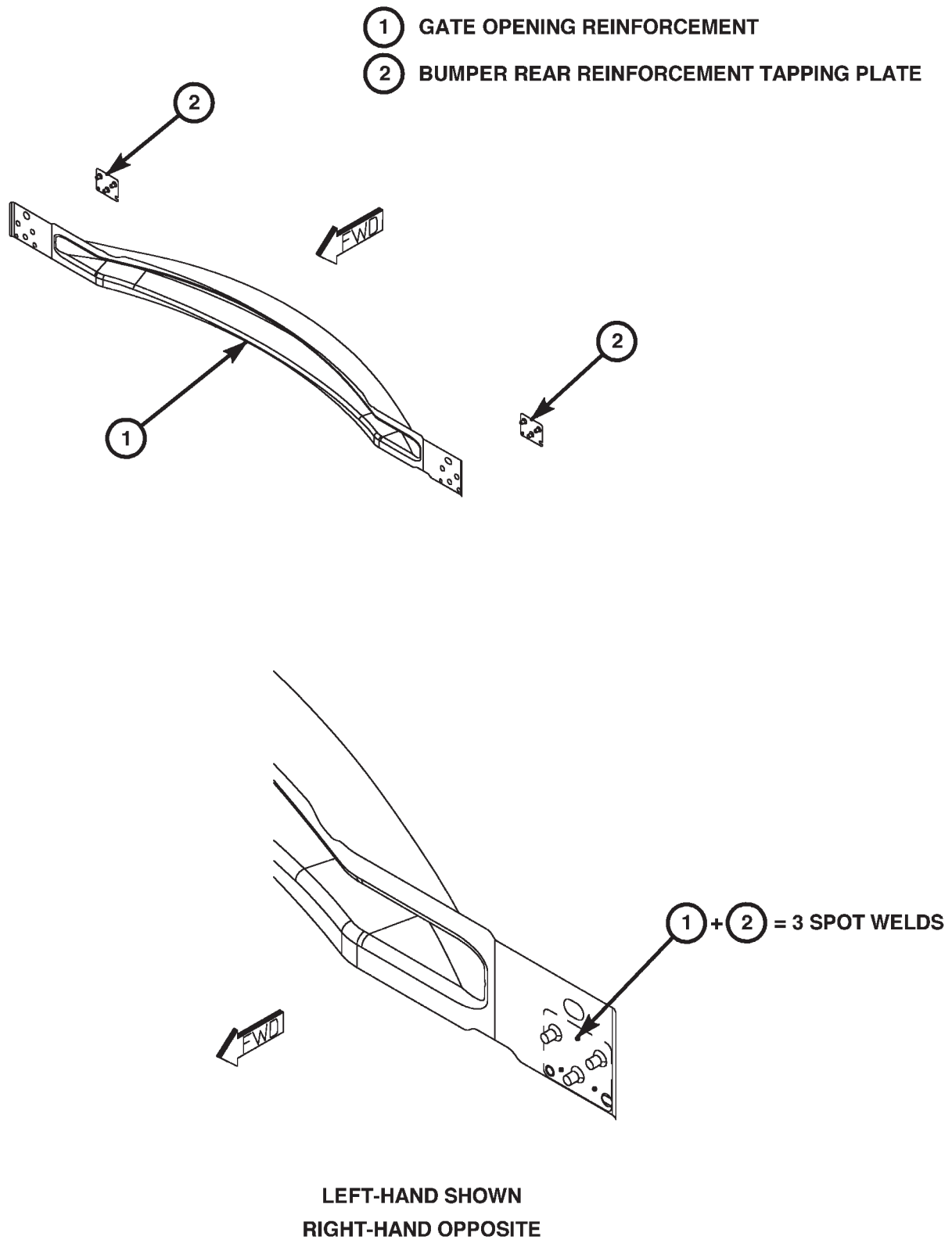


Fig. 33 BUMPER AND SWING GATE REINFORCEMENT

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| ① REAR FLOOR PAN ASSEMBLY           | ⑪ REAR SEAT CROSSMEMBER - RIGHT   |
| ② SEAT BELT ANCHOR PLATE            | ⑫ A-ARM LOWER BRACKET             |
| ③ REAR COMPRESSION PLATE            | ⑬ A-ARM UPPER BRACKET             |
| ④ REAR SEAT FRONT CROSSMEMBER       | ⑭ REAR SEAT CROSSMEMBER BULKHEAD  |
| ⑤ REAR RAIL ASSEMBLY - RIGHT        | ⑮ REAR SPRING CENTER CROSSMEMBER  |
| ⑥ REAR RAIL ASSEMBLY - LEFT         | ⑯ REAR SPRING OUTER CROSSMEMBER   |
| ⑦ REAR TORQUE BOX                   | ⑰ FUEL TANK SUPPORT               |
| ⑧ ANCHOR PLATE                      | ⑱ REAR CROSSMEMBER                |
| ⑨ REAR SHOCK MOUNTING REINFORCEMENT | ⑲ GATE OPENING REINFORCEMENT      |
| ⑩ FUEL PASS-THROUGH SLEEVE          | ⑳ REAR SEAT CROSSMEMBER - LEFT    |
|                                     | ㉑ FUEL TANK SUPPORT REINFORCEMENT |

NOTE

ITEMS 7,8,9 AND 10 ARE PARTS OF THE RIGHT AND LEFT REAR RAIL ASSEMBLIES

ITEMS 2,3 AND 4 ARE PARTS OF THE REAR FLOOR PAN ASSEMBLY

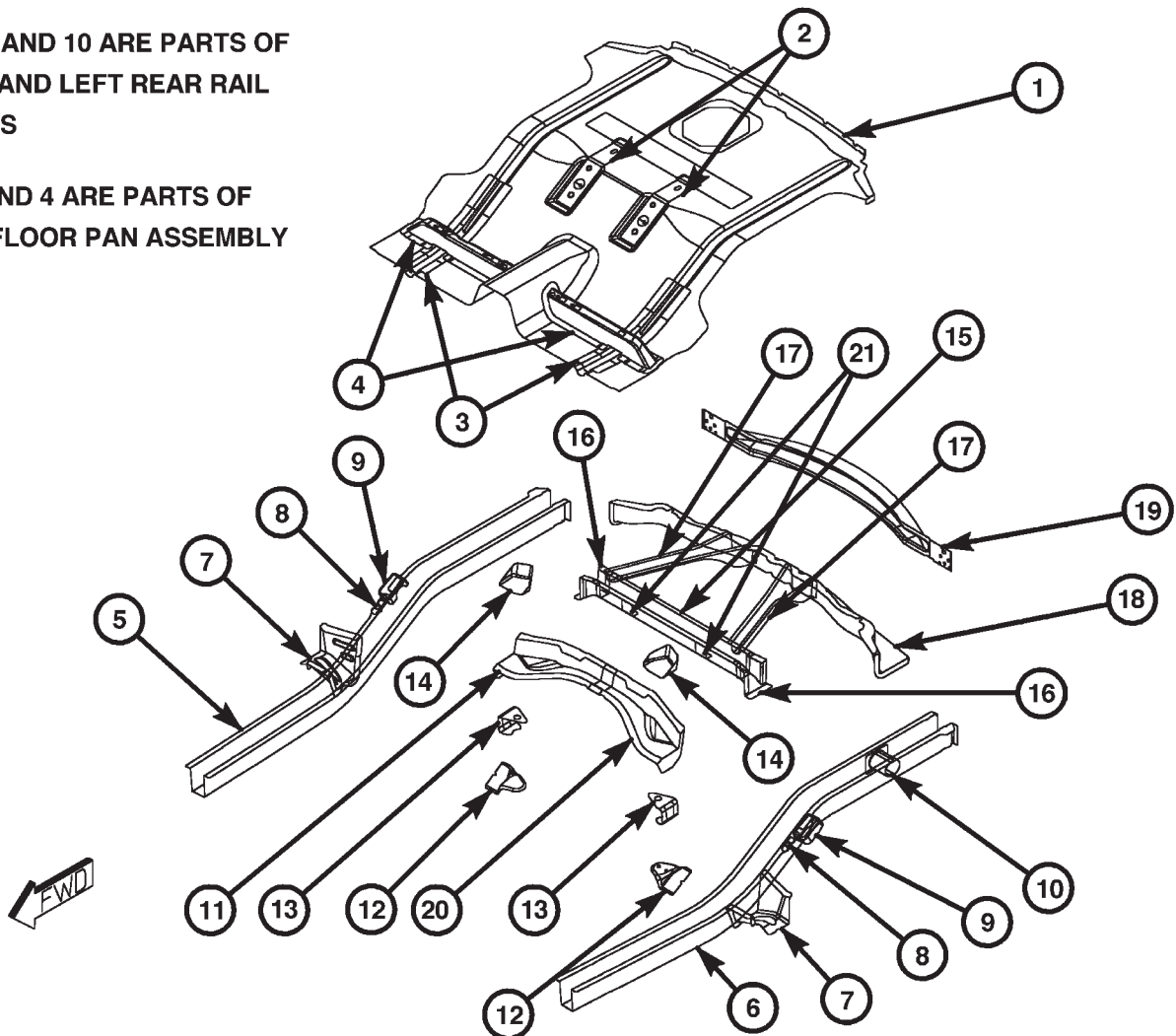


Fig. 34 REAR FLOOR PAN



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

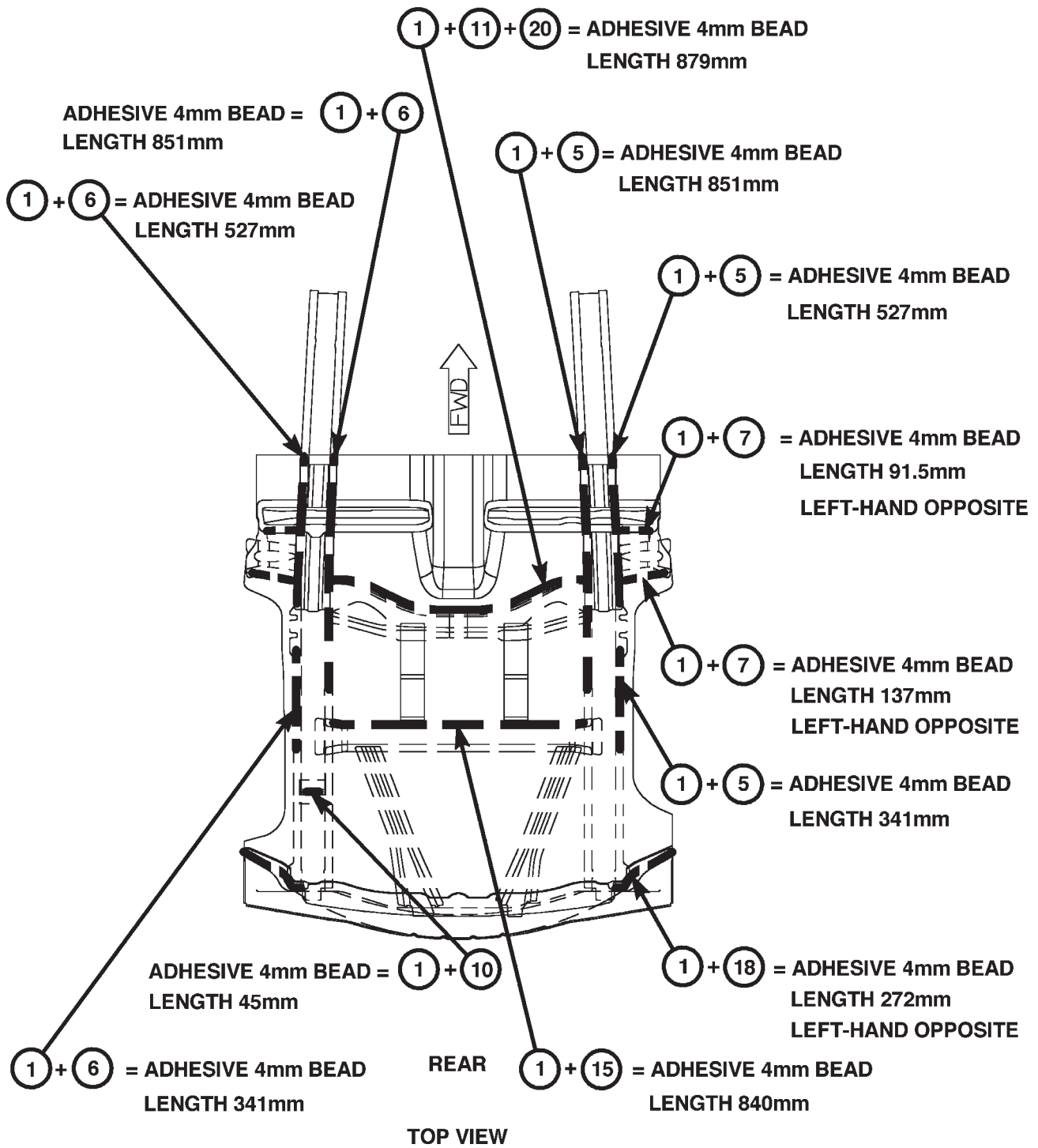


Fig. 35 REAR FLOOR PAN

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

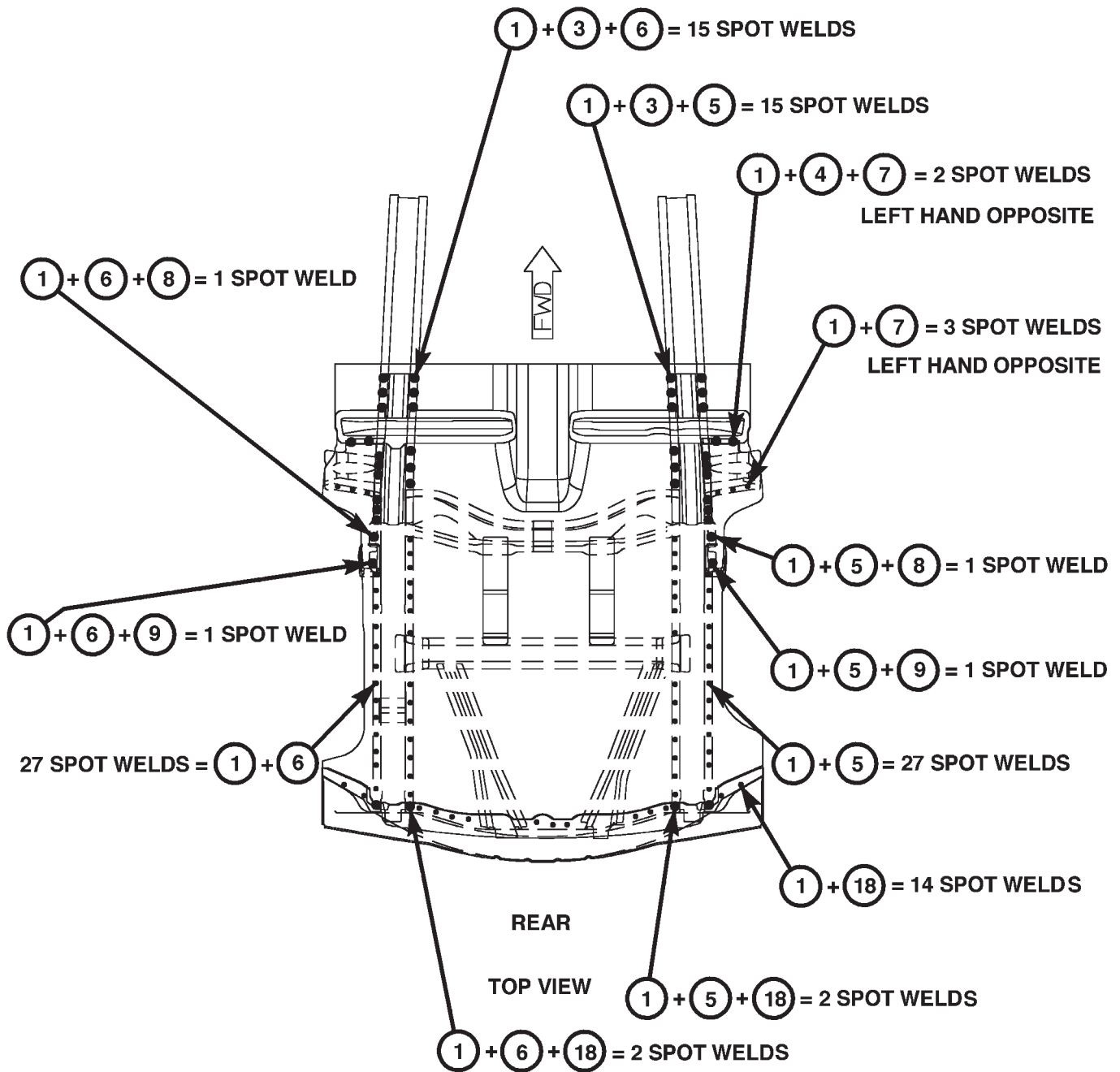


Fig. 36 REAR FLOOR PAN

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

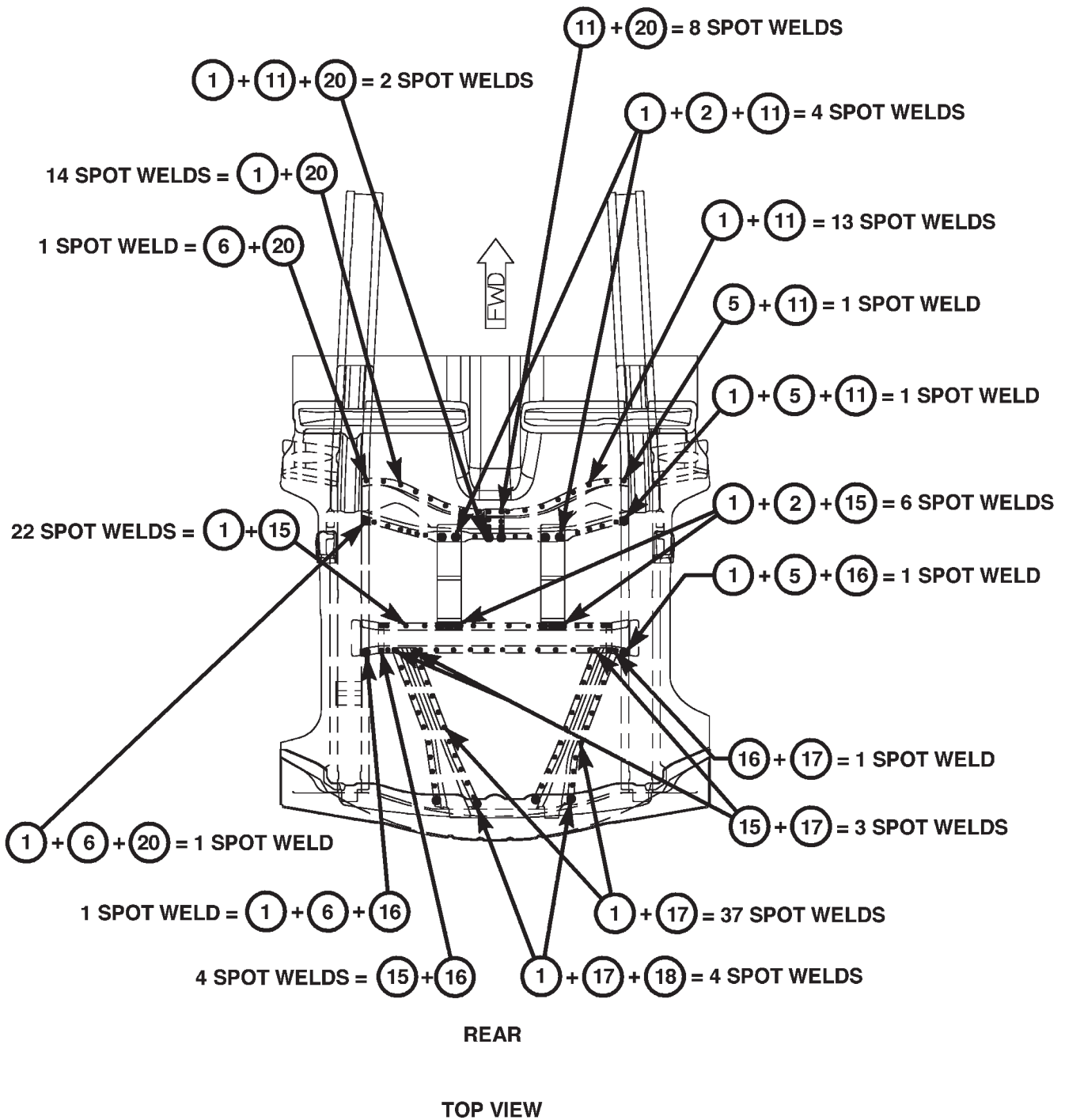


Fig. 37 REAR FLOOR PAN

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

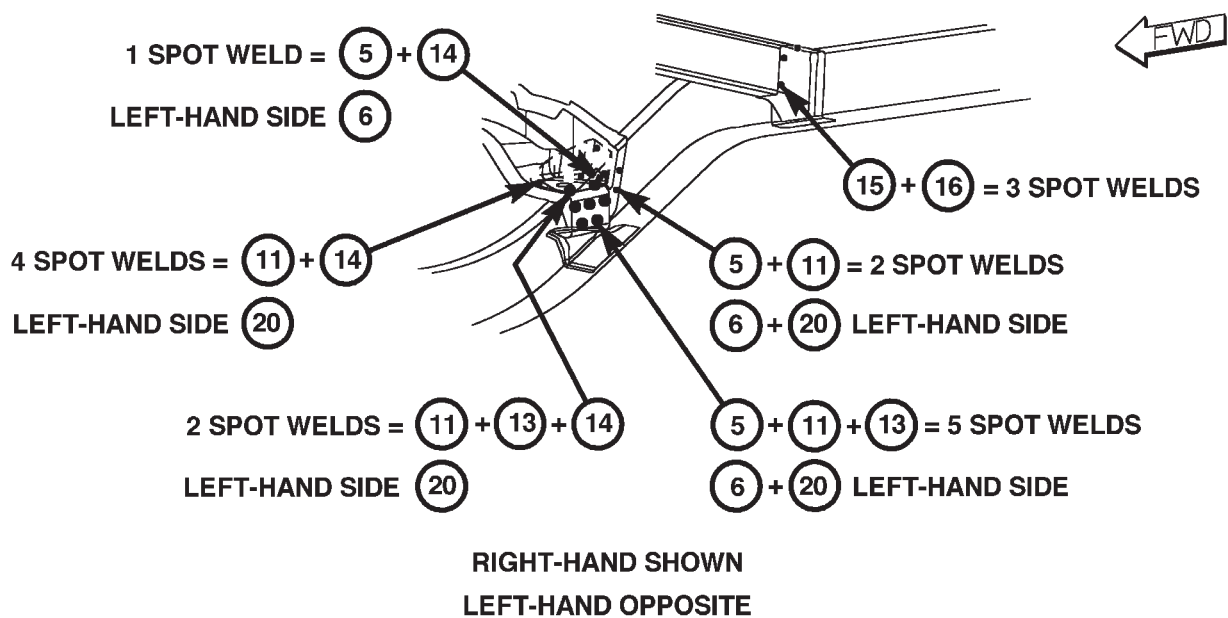
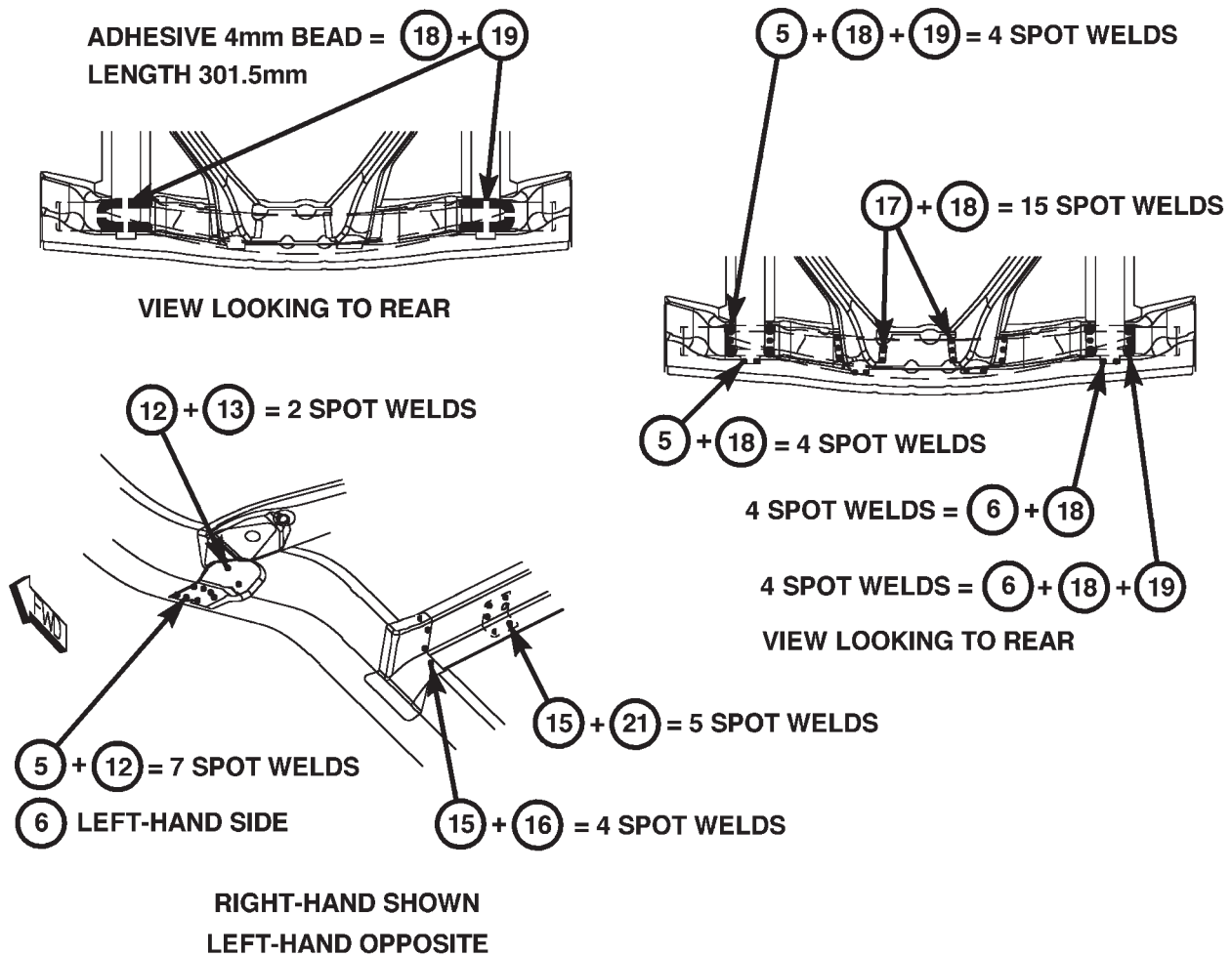


Fig. 38 REAR CROSSMEMBERS AND REINFORCEMENTS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

FULL FLOOR PAN ASSEMBLY

- |                                |                                     |
|--------------------------------|-------------------------------------|
| ① FRONT FLOOR PAN ASSEMBLY     | ⑪ COMPRESSION PLATE                 |
| ② REAR FLOOR PAN ASSEMBLY      | ⑫ REAR SEAT FRONT CROSSMEMBER       |
| ③ FRONT RAIL ASSEMBLY - RIGHT  | ⑬ BODY SIDE SILL                    |
| ④ FRONT RAIL ASSEMBLY - LEFT   | ⑭ COWL SIDE PANEL                   |
| ⑤ REAR RAIL ASSEMBLY - RIGHT   | ⑮ FRONT TORQUE BOX                  |
| ⑥ REAR RAIL ASSEMBLY - LEFT    | ⑯ REAR TORQUE BOX                   |
| ⑦ COMPRESSION PLATE            | ⑰ INNER WHEELHOUSE - RIGHT          |
| ⑧ REINFORCEMENT PLATE          | ⑱ INNER WHEELHOUSE - LEFT           |
| ⑨ FRONT SEAT FRONT CROSSMEMBER | ⑲ REAR SHOCK MOUNTING REINFORCEMENT |
| ⑩ FRONT SEAT REAR CROSSMEMBER  | ⑳ REAR CROSSMEMBER                  |
|                                | ㉑ D-PILLAR GUSSET - RIGHT           |
|                                | ㉒ D-PILLAR GUSSET - LEFT            |

NOTE

ITEMS 7,9,10 AND 11 ARE PARTS OF THE FRONT FLOOR PAN ASSEMBLY

ITEMS 12,16,19 AND 20 ARE PARTS OF THE COMPLETE REAR FLOOR PAN ASSEMBLY

ITEM 15 IS PART OF THE RIGHT AND LEFT FRONT RAIL ASSEMBLIES

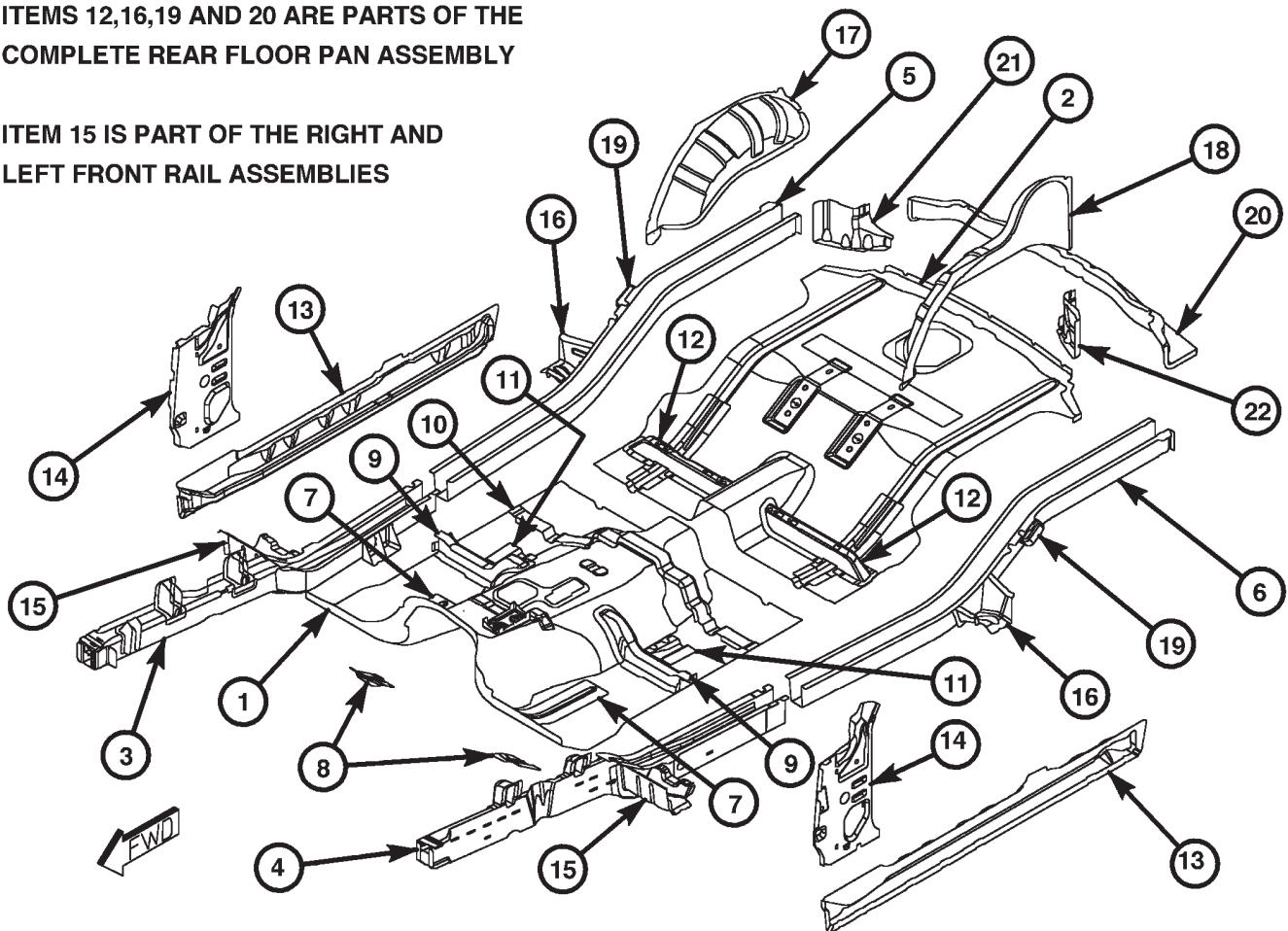


Fig. 39 FLOOR PAN ASSEMBLIES

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

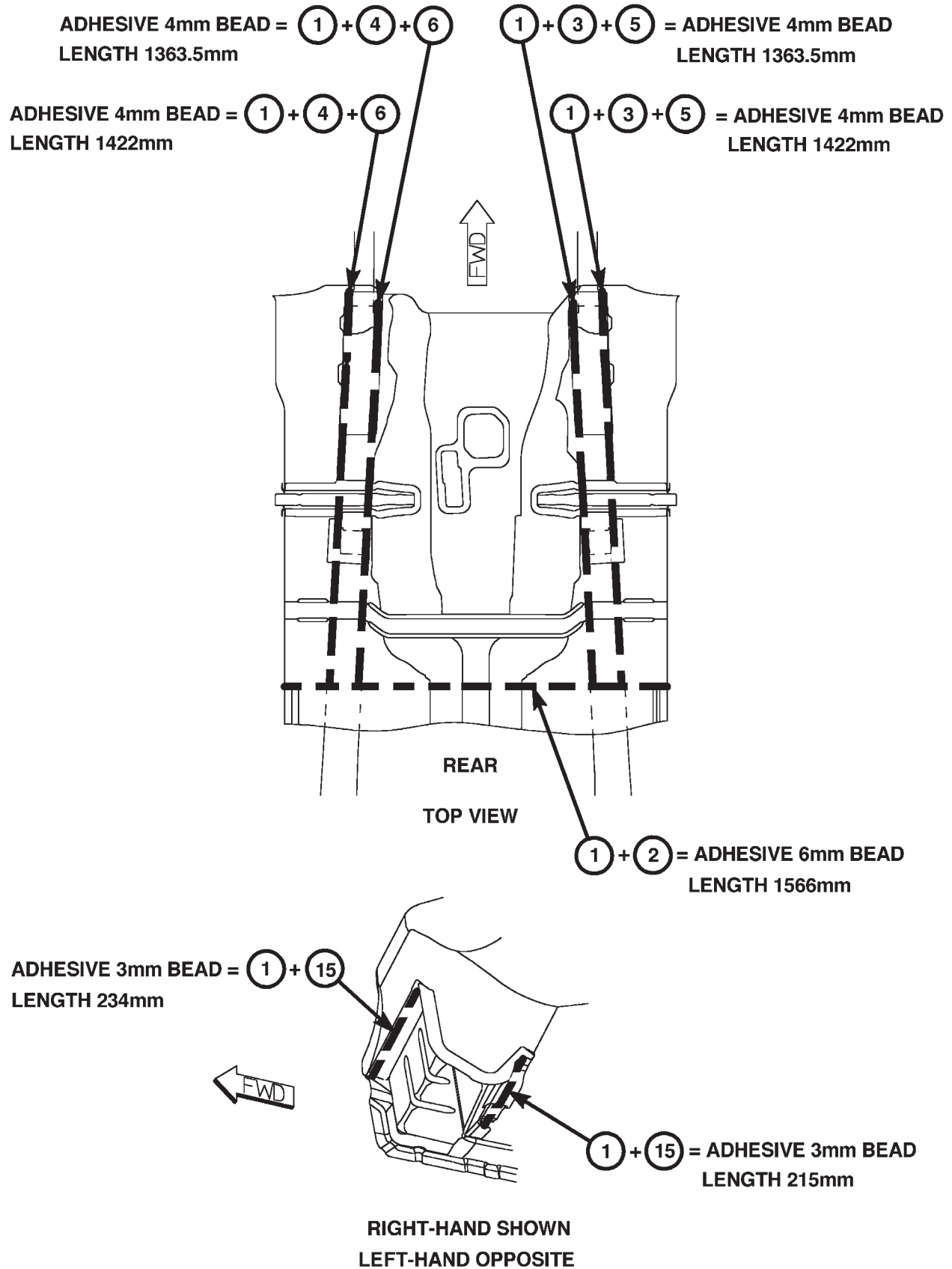


Fig. 40 FRONT RAILS – ADHESIVE LOCATIONS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

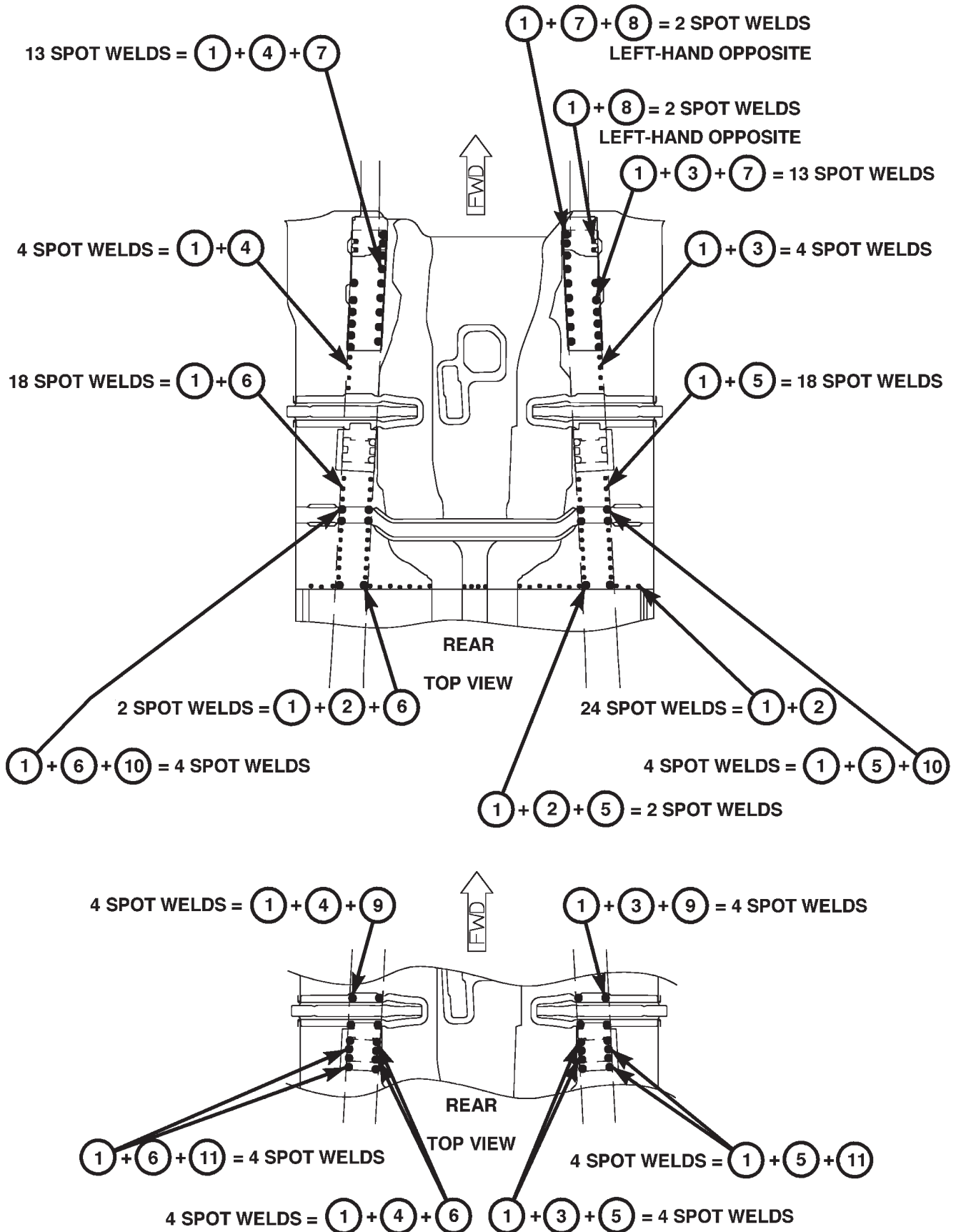


Fig. 41 FRONT RAILS - WELD LOCATIONS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

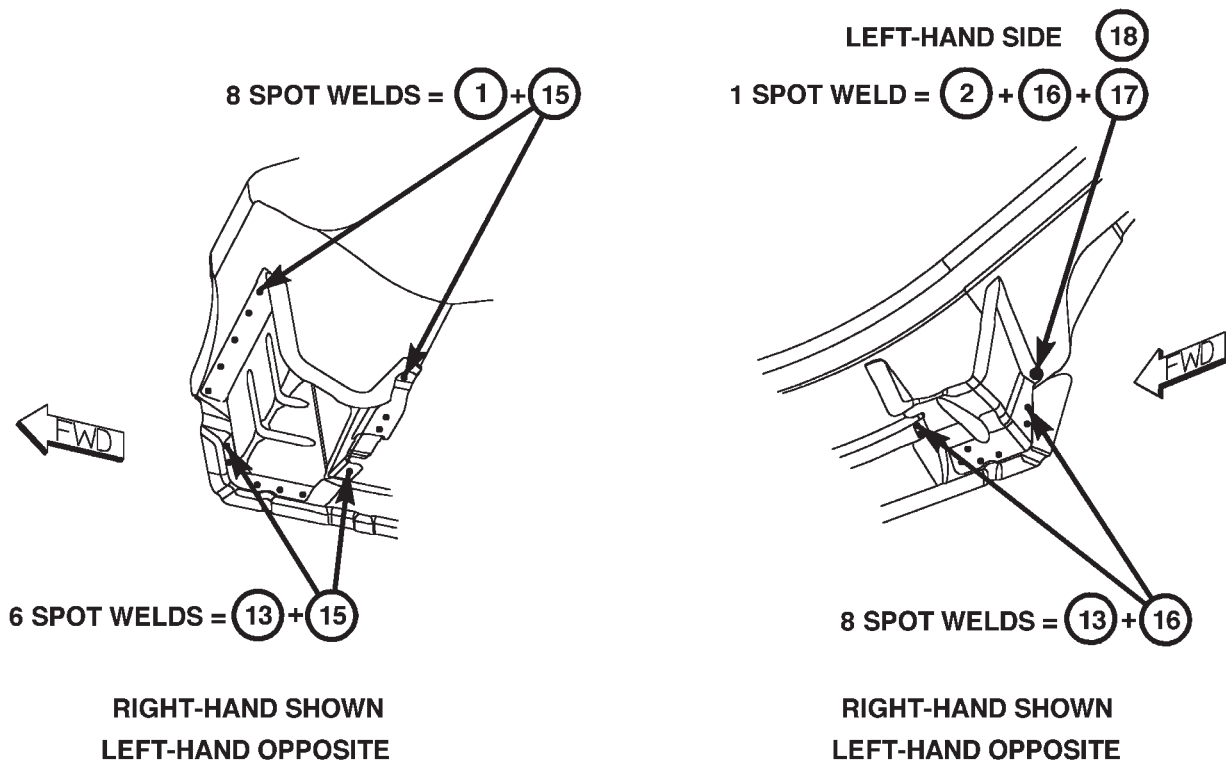
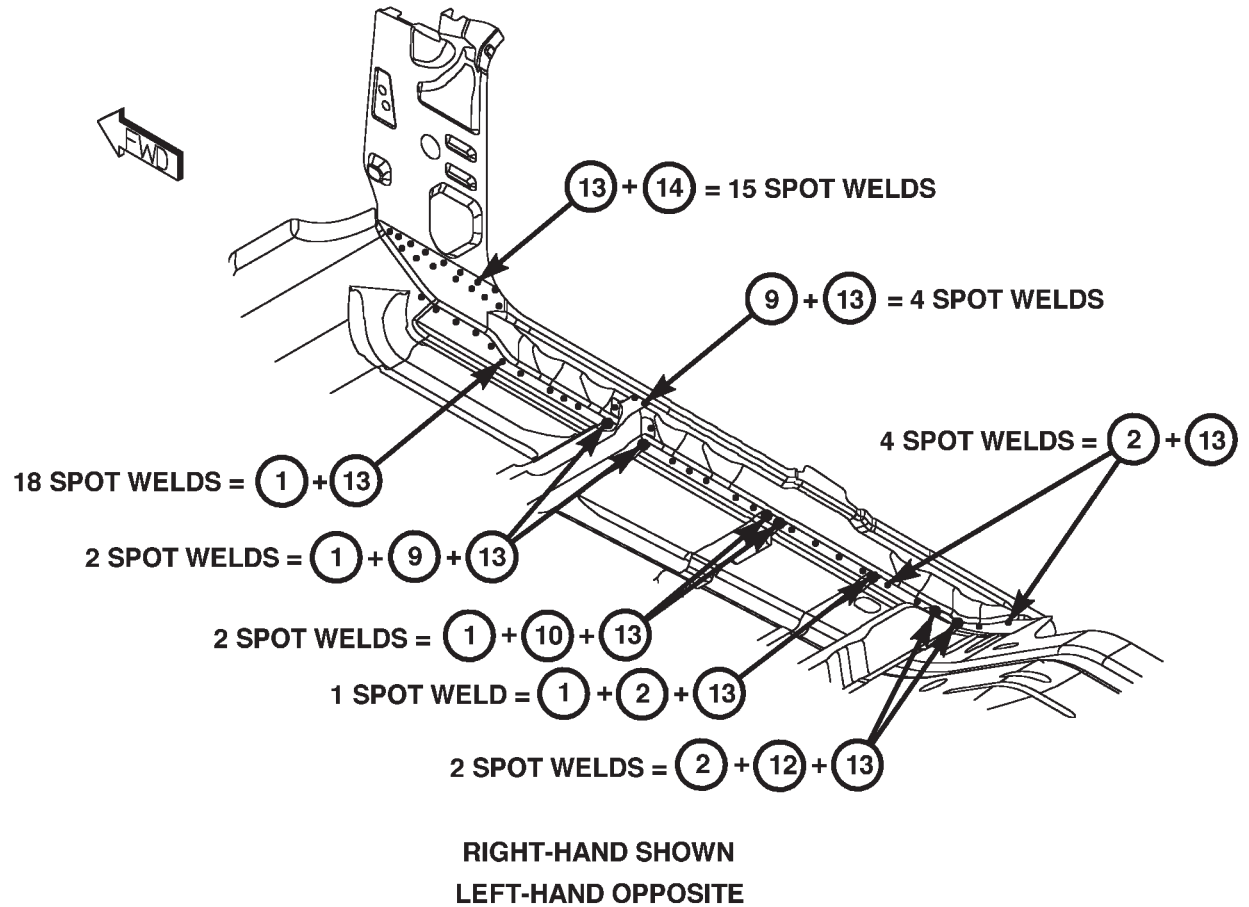


Fig. 42 SIDE SILLS



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

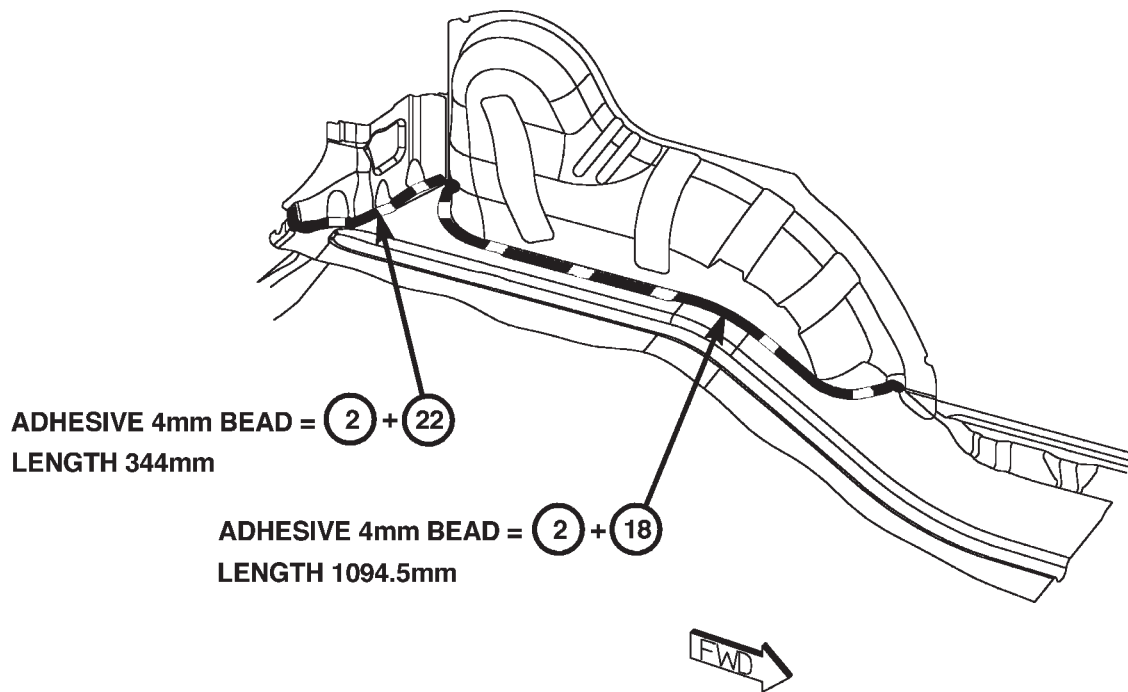
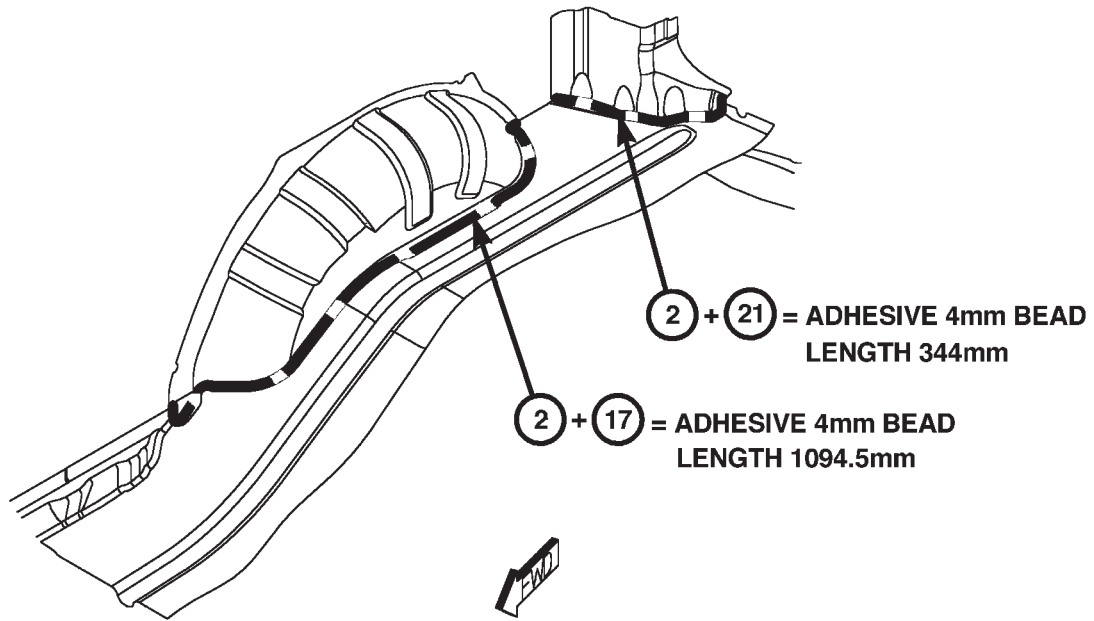


Fig. 43 WHEELHOUSES – ADHESIVE LOCATIONS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

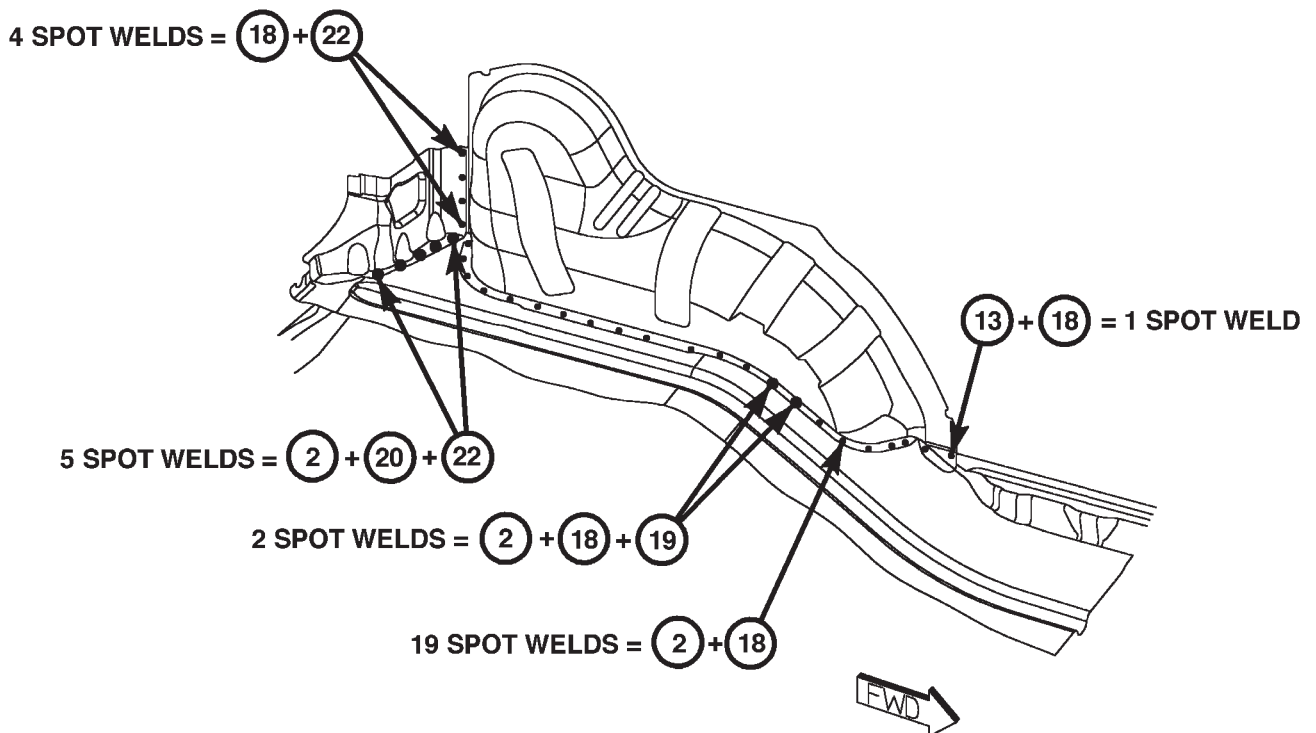
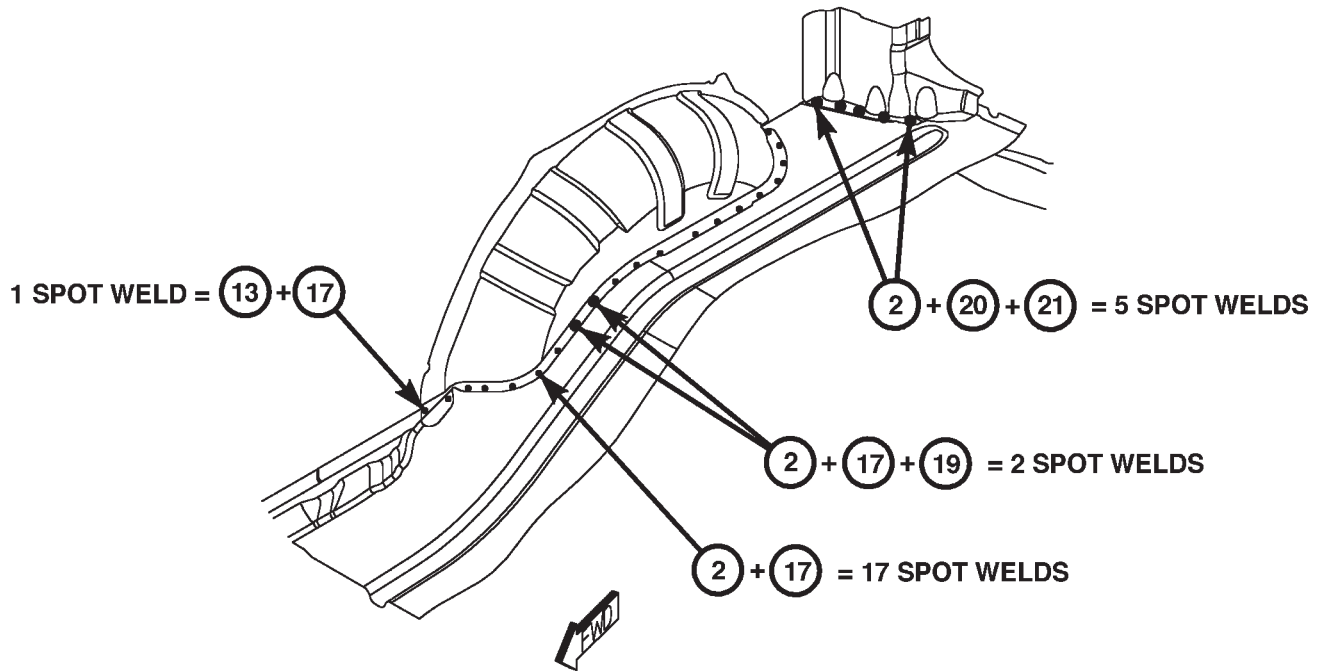
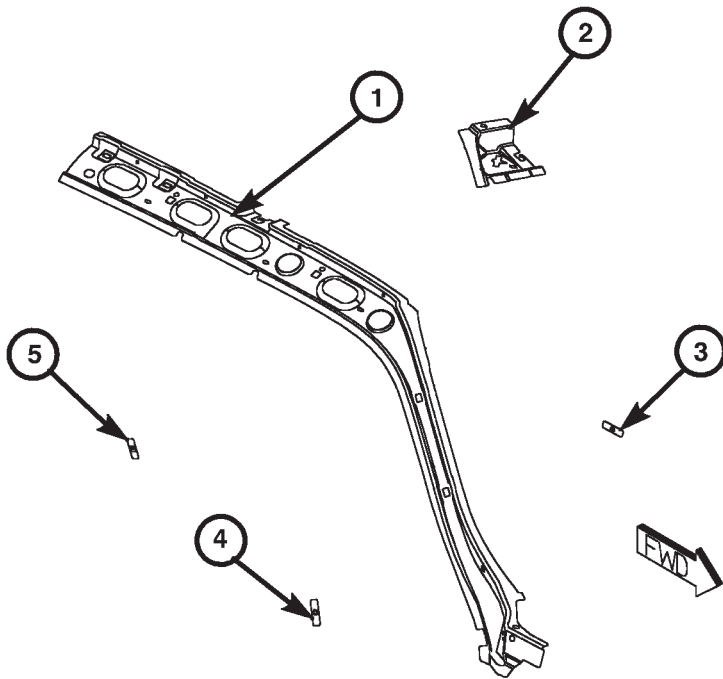


Fig. 44 WHEELHOUSES – WELD LOCATIONS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

BODY SIDE PANELS AND SUB ASSEMBLIES

- ① A-PILLAR REINFORCEMENT
- ② HEADER MOUNTING REINFORCEMENT
- ③ TAPPING PLATE
- ④ TAPPING PLATE
- ⑤ TAPPING PLATE



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE

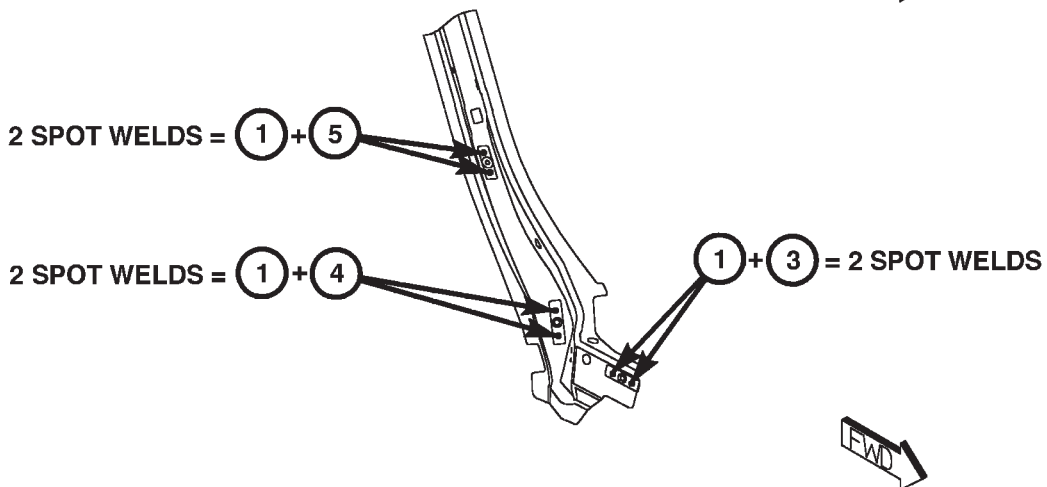
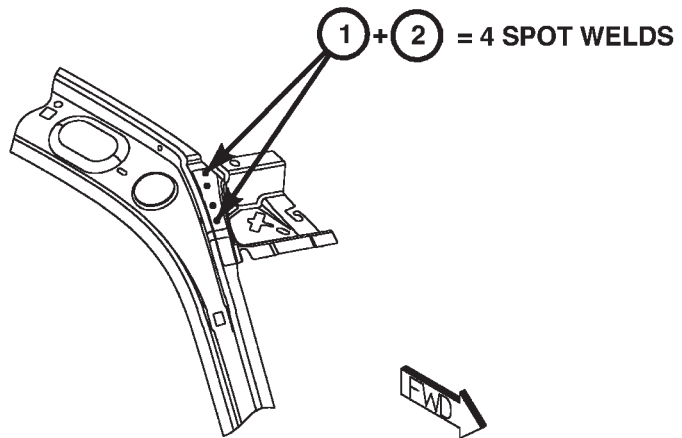


Fig. 45 A-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

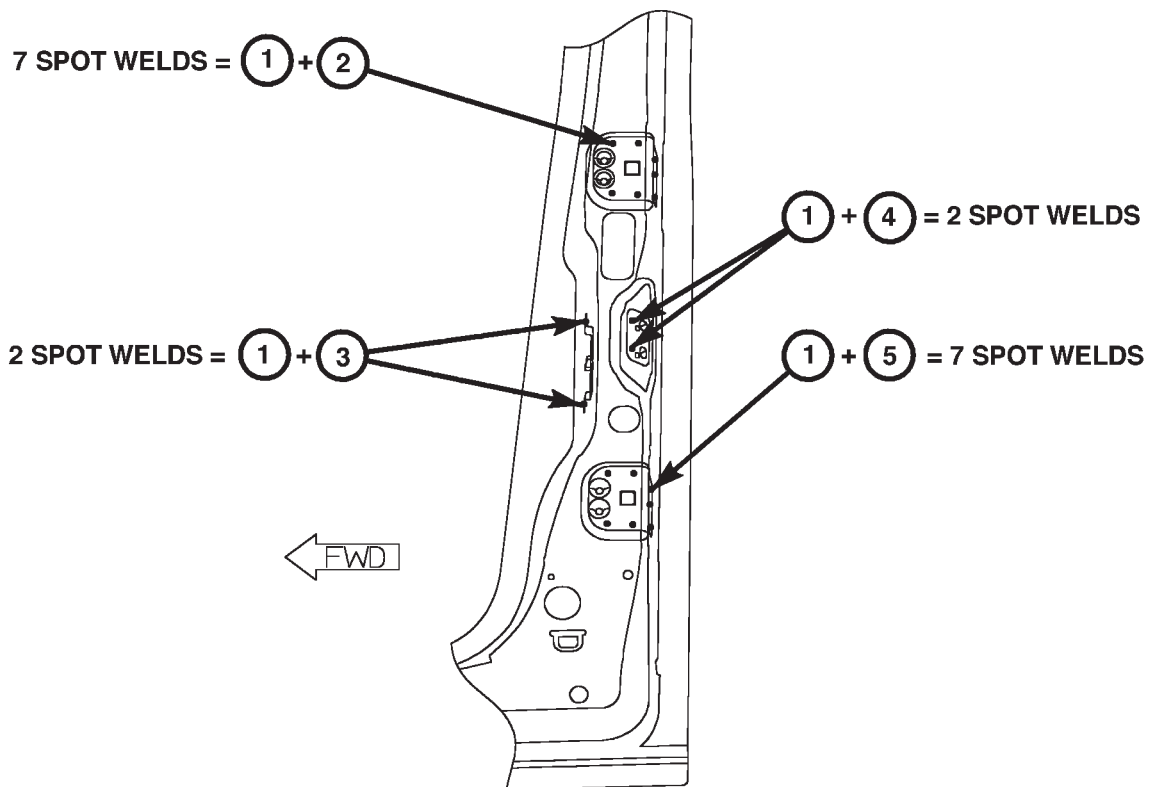
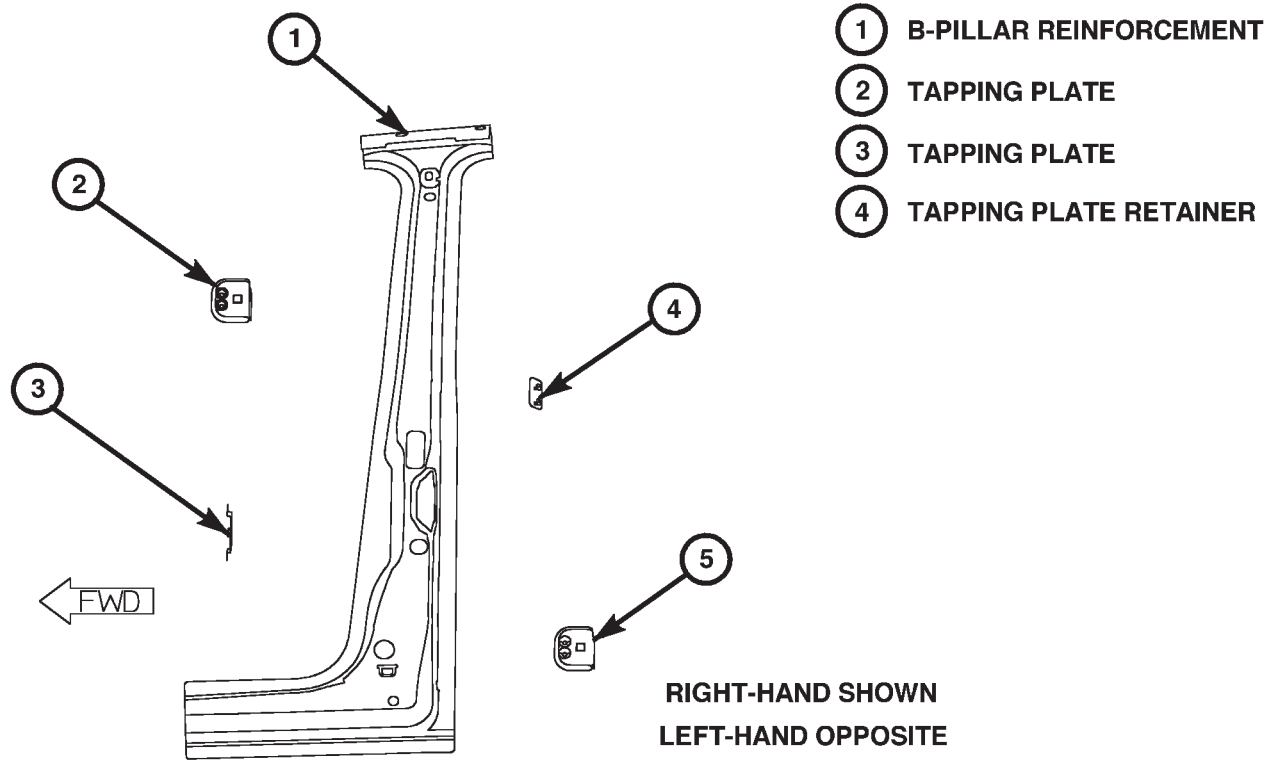
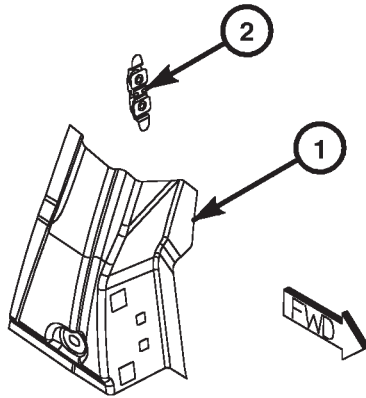


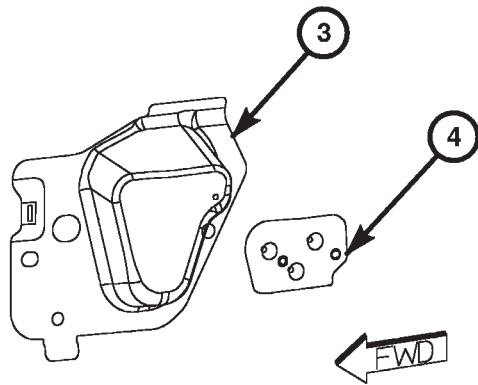
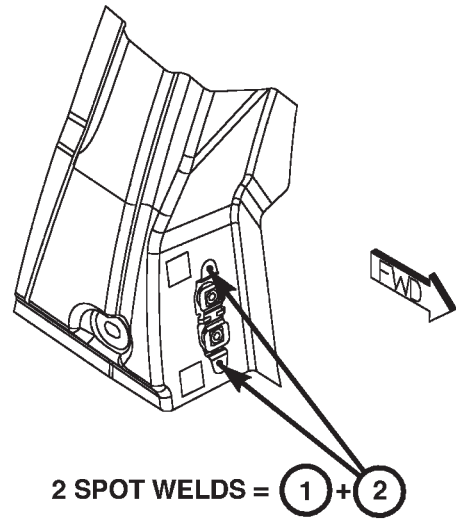
Fig. 46 B-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE

- ① C-PILLAR REINFORCEMENT
- ② TAPPING PLATE



RIGHT-HAND SHOWN  
LEFT-HAND OPPOSITE

- ③ SEAT BACK MOUNTING REINFORCEMENT
- ④ TAPPING PLATE

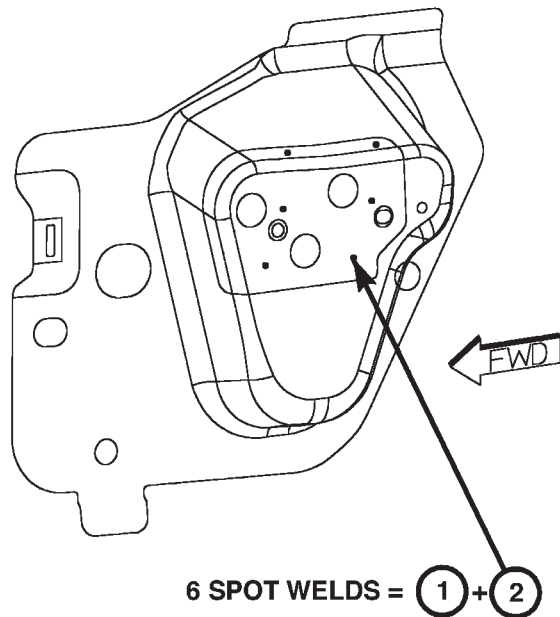


Fig. 47 C-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

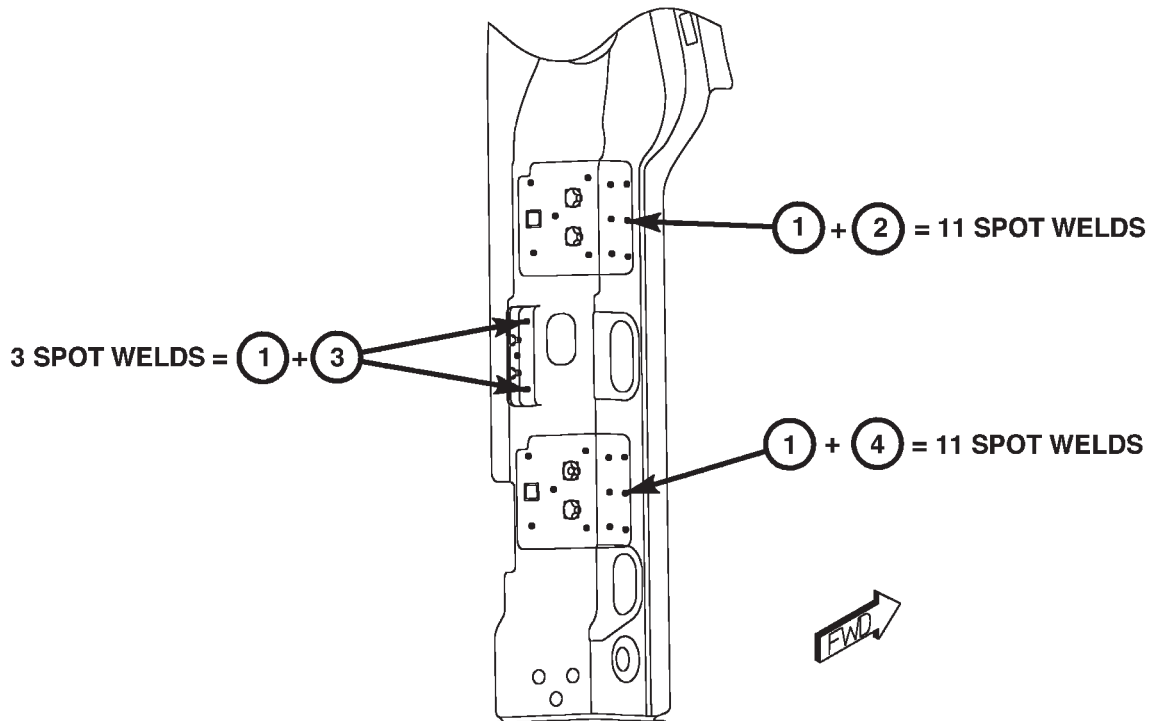
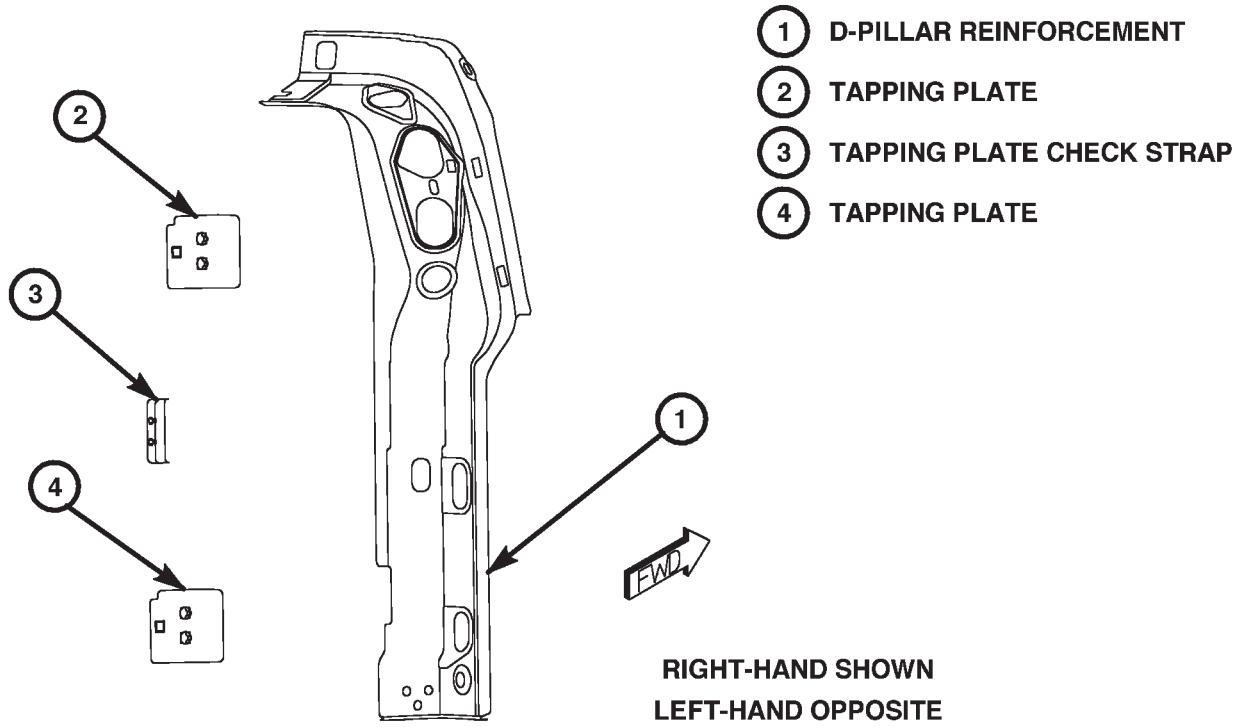


Fig. 48 D-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

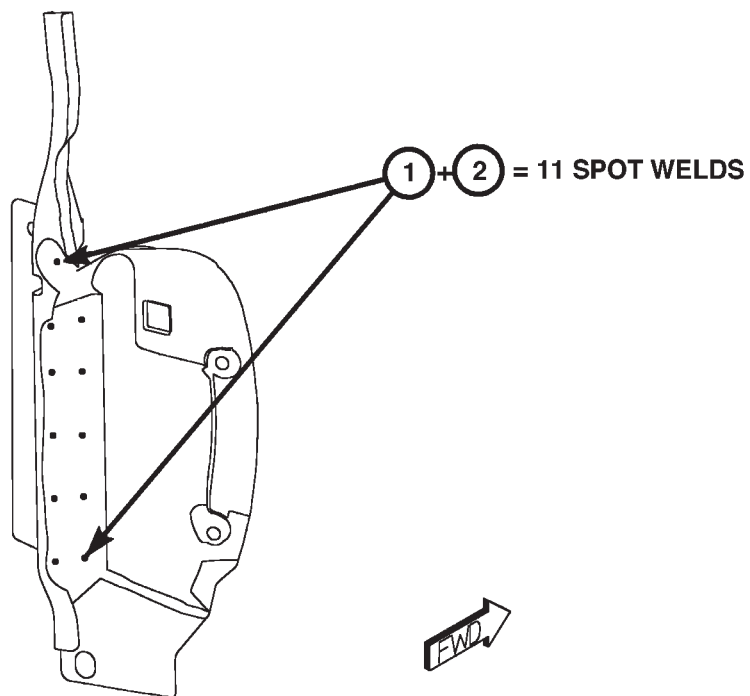
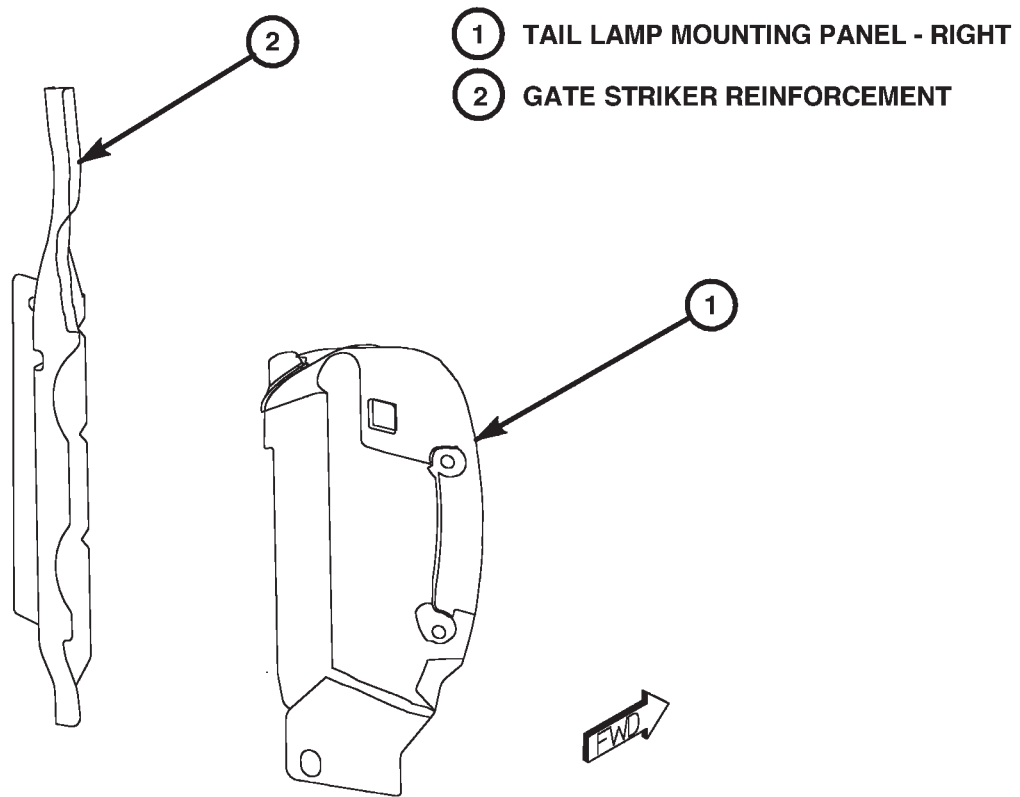


Fig. 49 TAIL LAMP MOUNTING PANEL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

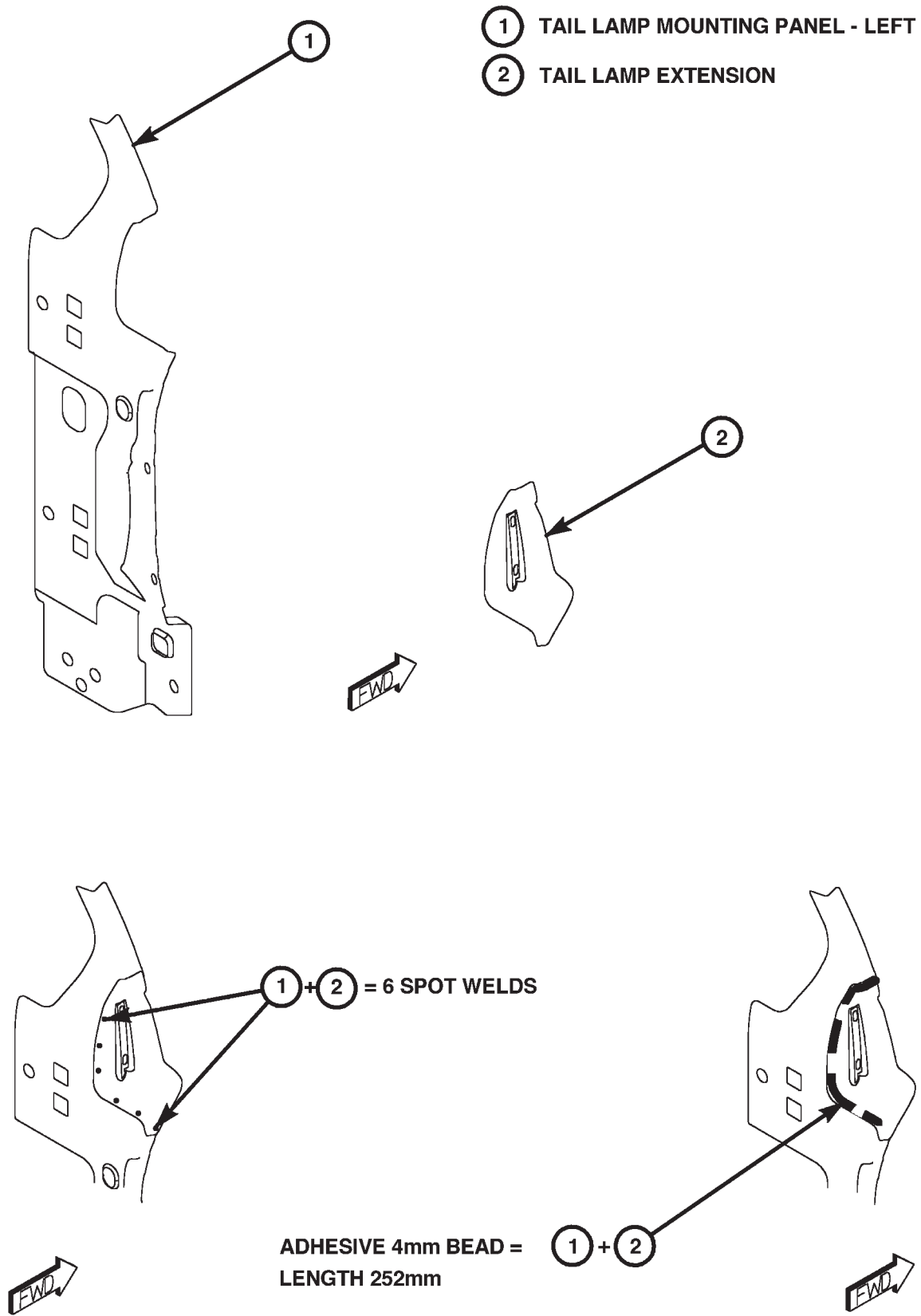


Fig. 50 TAIL LAMP MOUNTING PANEL



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

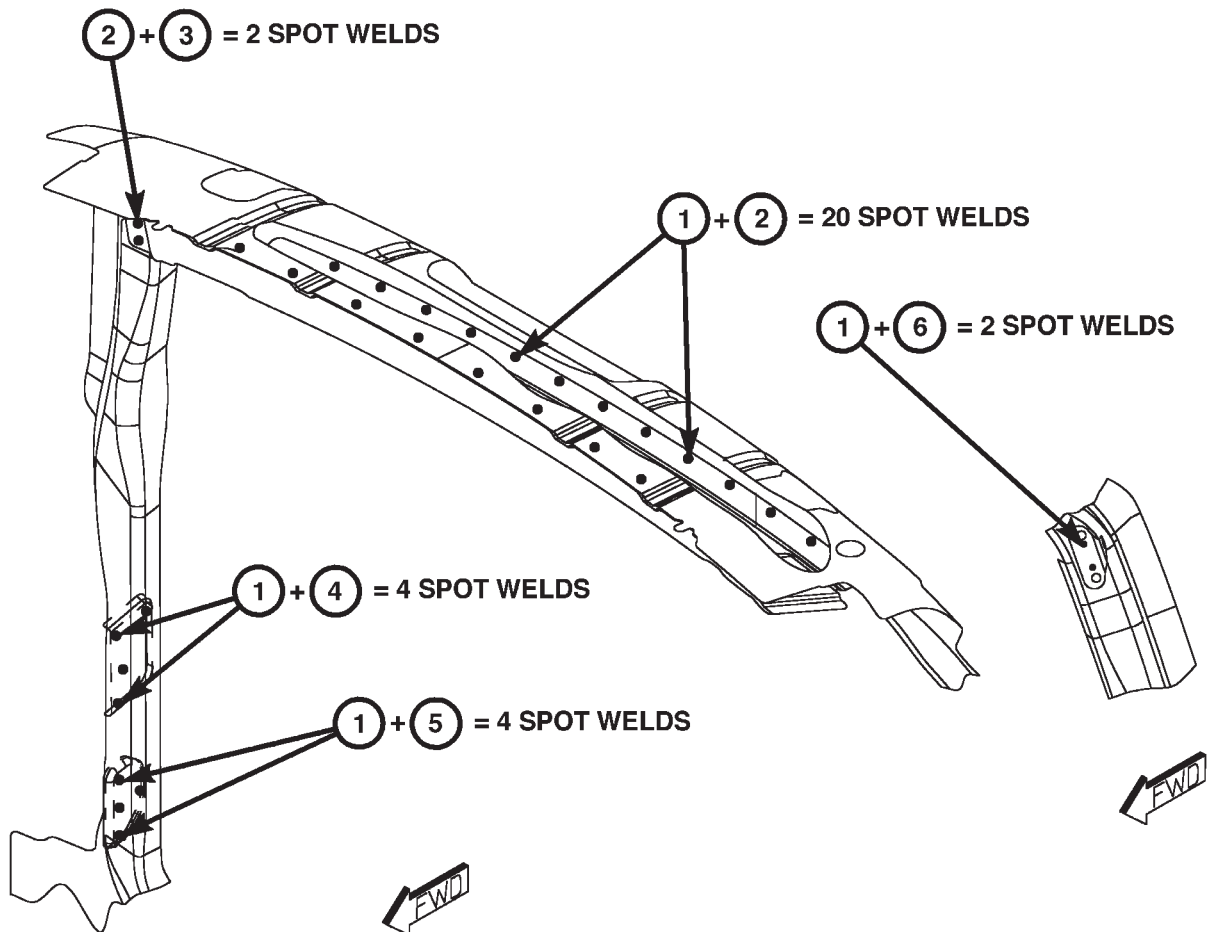
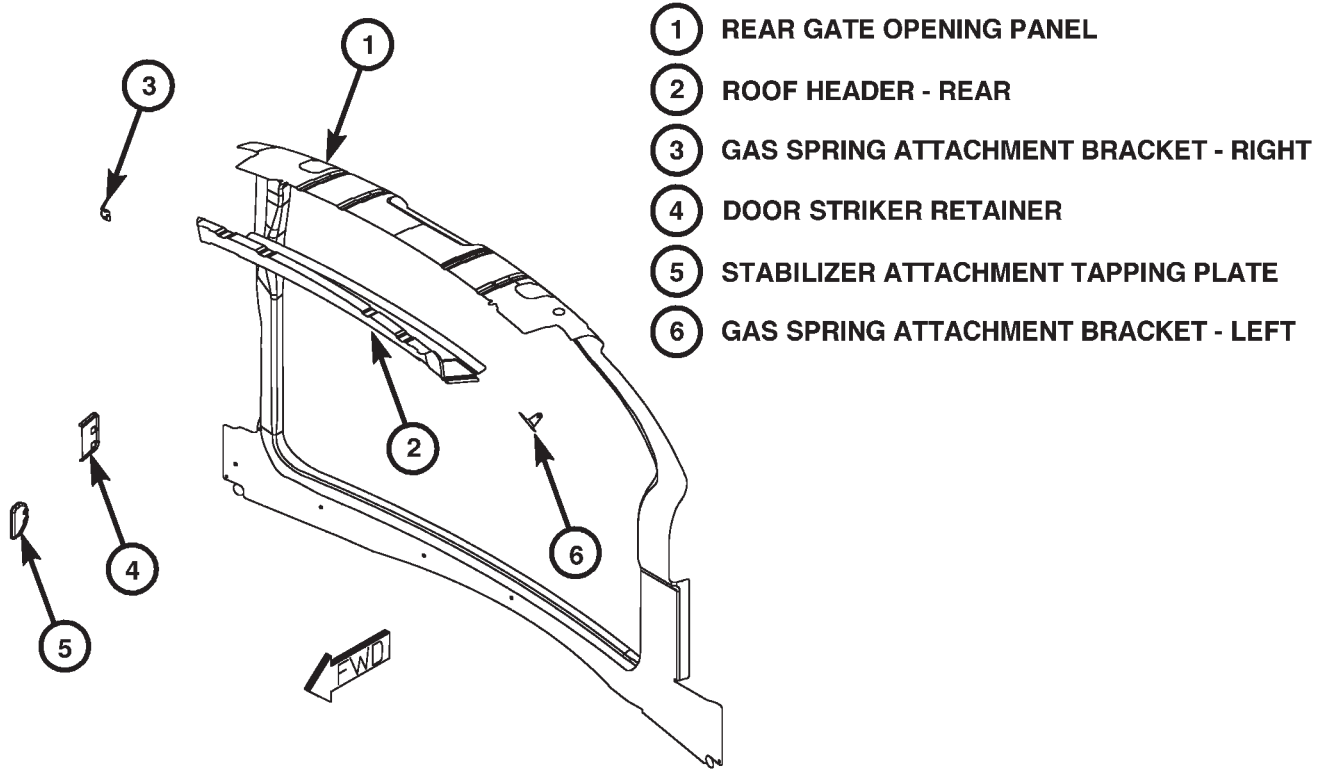
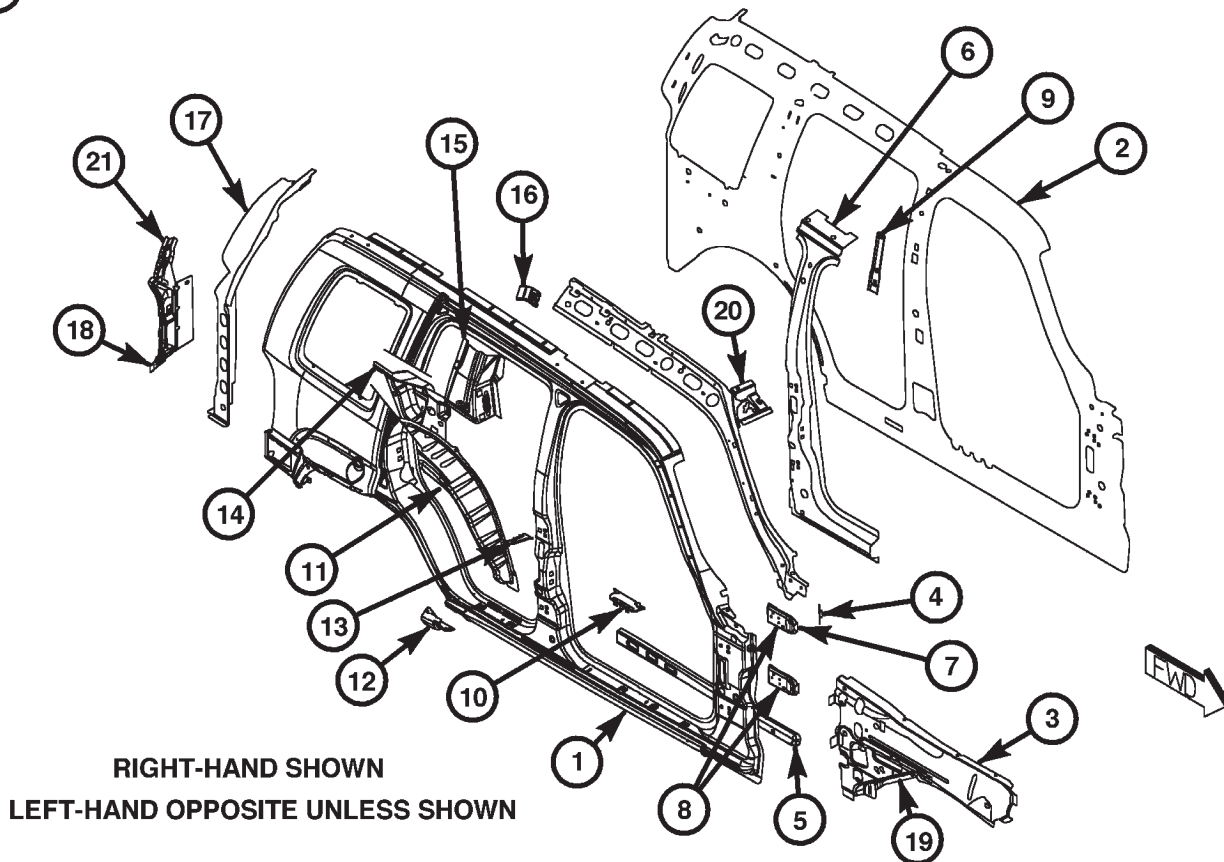


Fig. 51 SWING GATE OPENING

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

BODY SIDE PANELS

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| ① BODY SIDE OUTER PANEL               | ⑫ SILL MOLDING ATTACH BRACKET      |
| ② BODY SIDE INNER PANEL               | ⑬ C-PILLAR LOWER BAFFLE            |
| ③ INNER FENDER REINFORCEMENT ASSEMBLY | ⑭ SEAT BACK ATTACH REINFORCEMENT   |
| ④ A-PILLAR REINFORCEMENT              | ⑮ C-PILLAR REINFORCEMENT           |
| ⑤ BODY SIDE INNER LOWER REINFORCEMENT | ⑯ SEAT-SHOULDER BELT REINFORCEMENT |
| ⑥ B-PILLAR REINFORCEMENT              | ⑰ D-PILLAR REINFORCEMENT           |
| ⑦ CHECK STRAP ATTACHMENT TAPING PLATE | ⑱ TAIL LAMP PANEL ASSEMBLY         |
| ⑧ DOOR HINGE TAPPING PLATE            | ⑲ INNER FENDER REINFORCEMENT       |
| ⑨ B-PILLAR LOWER BAFFLE               | ⑳ HEADER MOUNTING REINFORCEMENT    |
| ⑩ SHOULDER BELT REINFORCEMENT         | ㉑ GATE STRIKER REINFORCEMENT       |
| ⑪ OUTER REAR WHEELHOUSE               |                                    |



NOTE

- ITEM 19 IS PART OF THE INNER FENDER REINFORCEMENT ASSEMBLY
- ITEM 20 IS PART OF THE A-PILLAR REINFORCEMENT ASSEMBLY
- ITEM 21 IS PART OF THE TAIL LAMP MOUNTING PANEL ASSEMBLY

Fig. 52 BODY SIDE PANEL ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

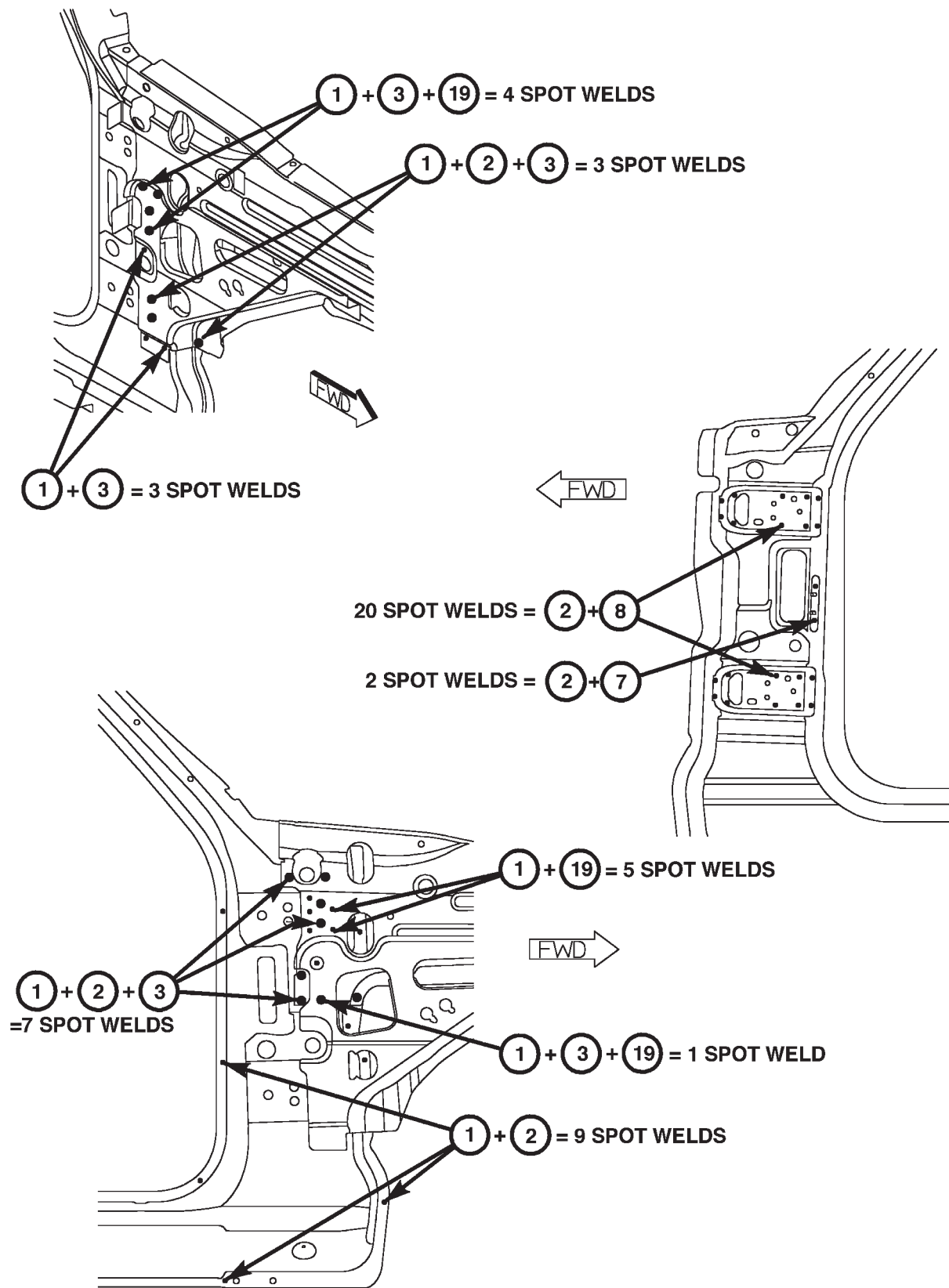


Fig. 53 FENDER REINFORCEMENT

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

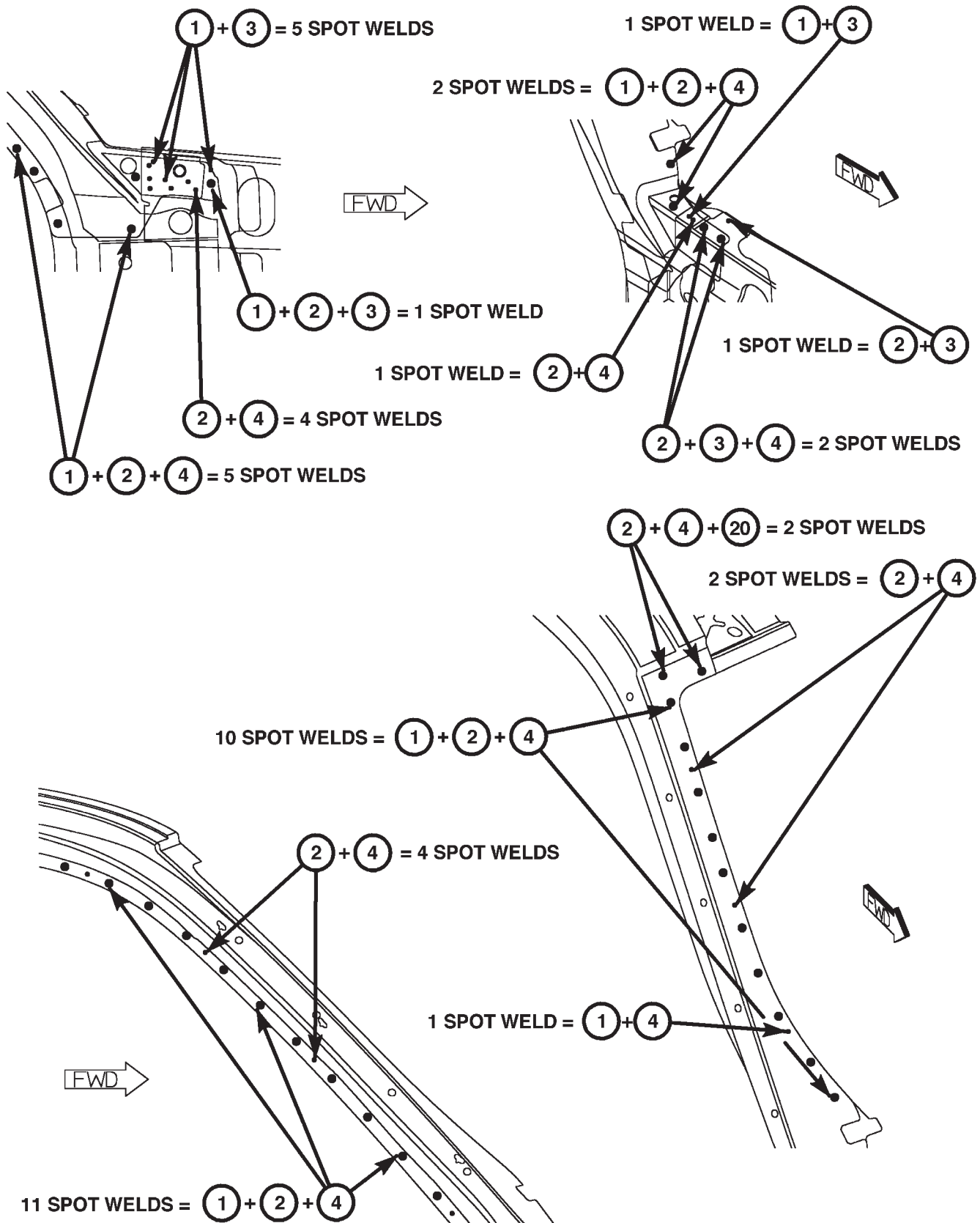


Fig. 54 A-PILLAR; FENDER REINFORCEMENT

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

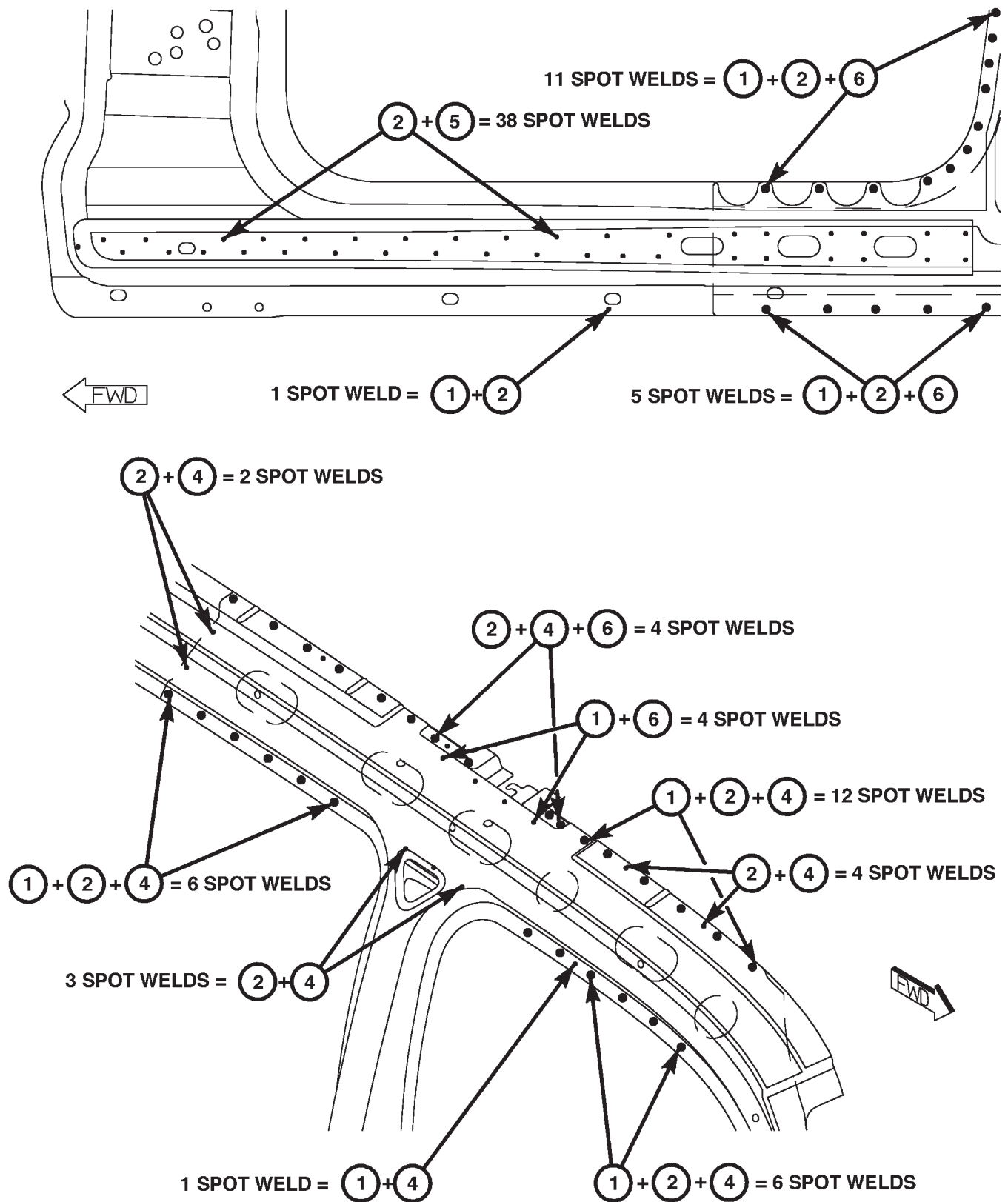


Fig. 55 UPPER AND LOWER BODY SIDE PANEL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

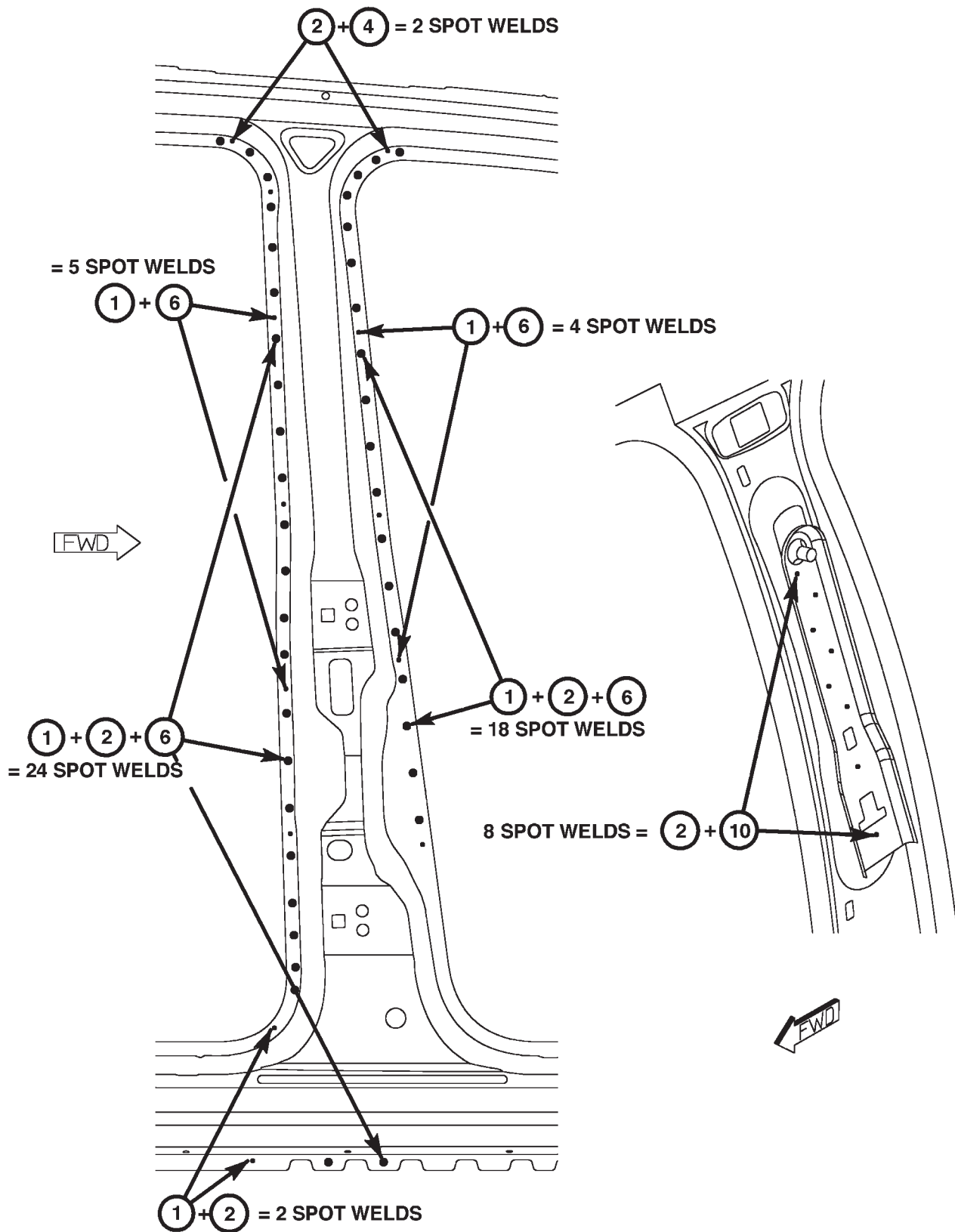


Fig. 56 B-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

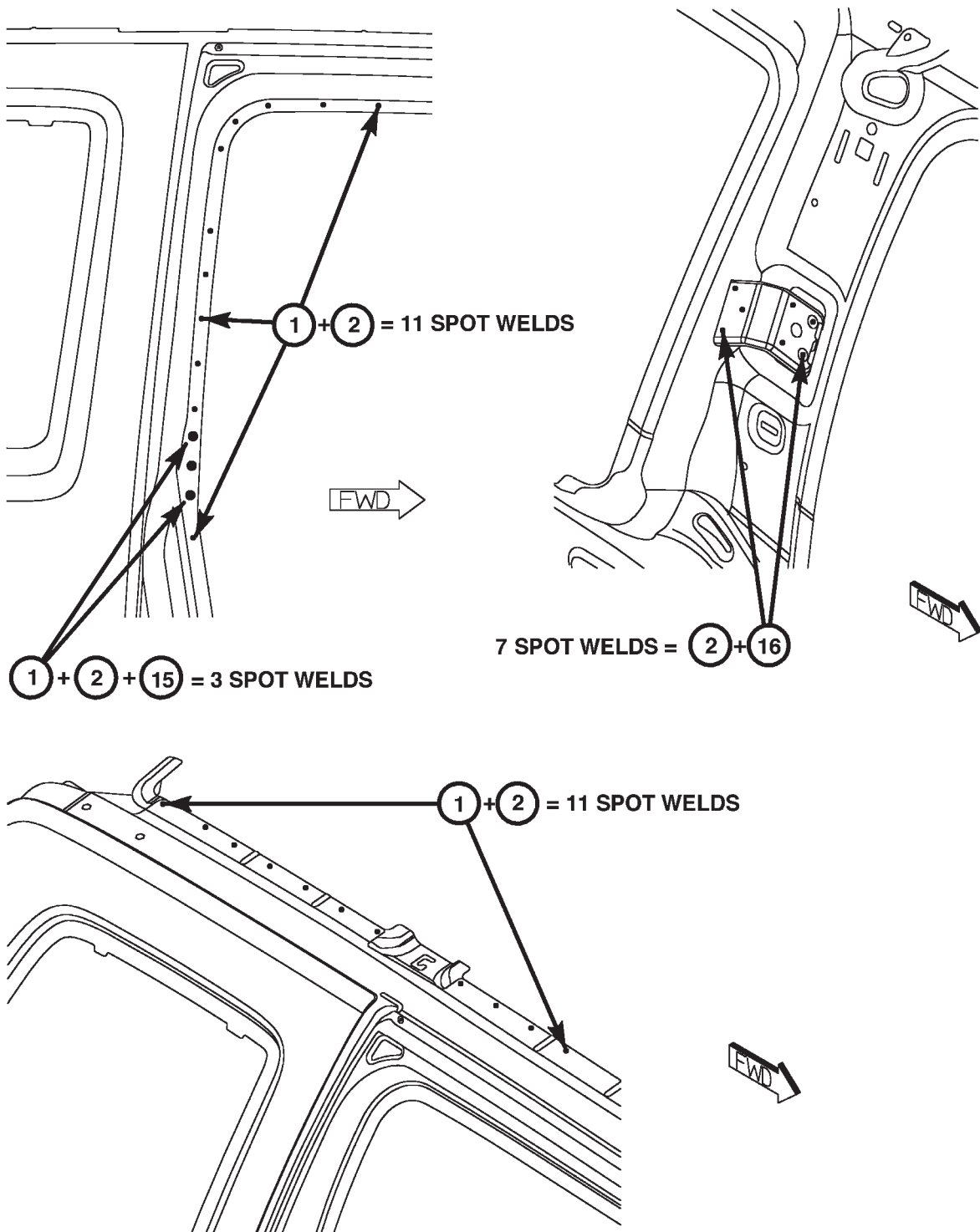


Fig. 57 C-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

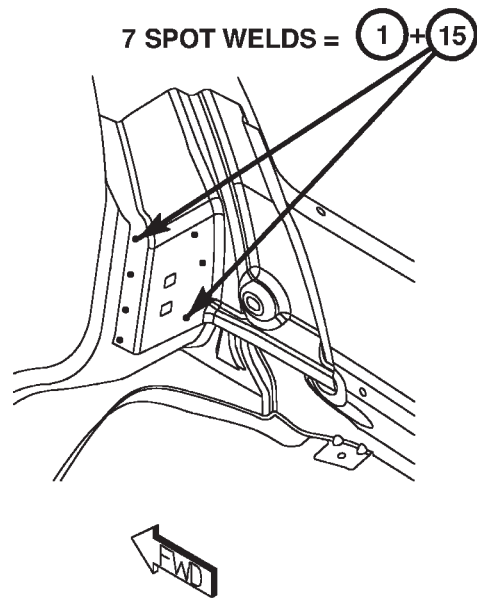
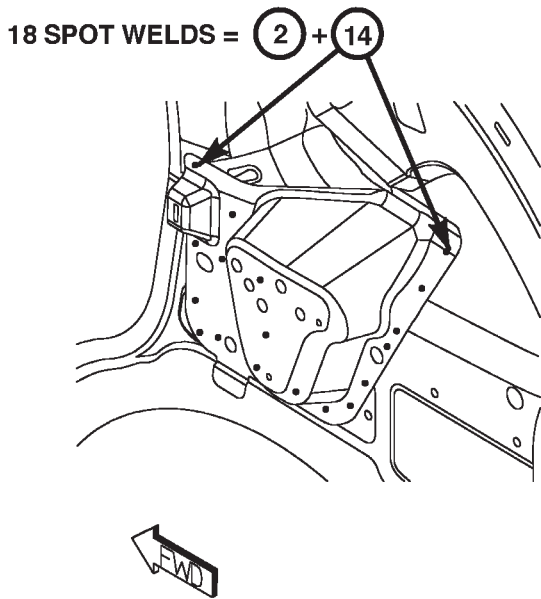
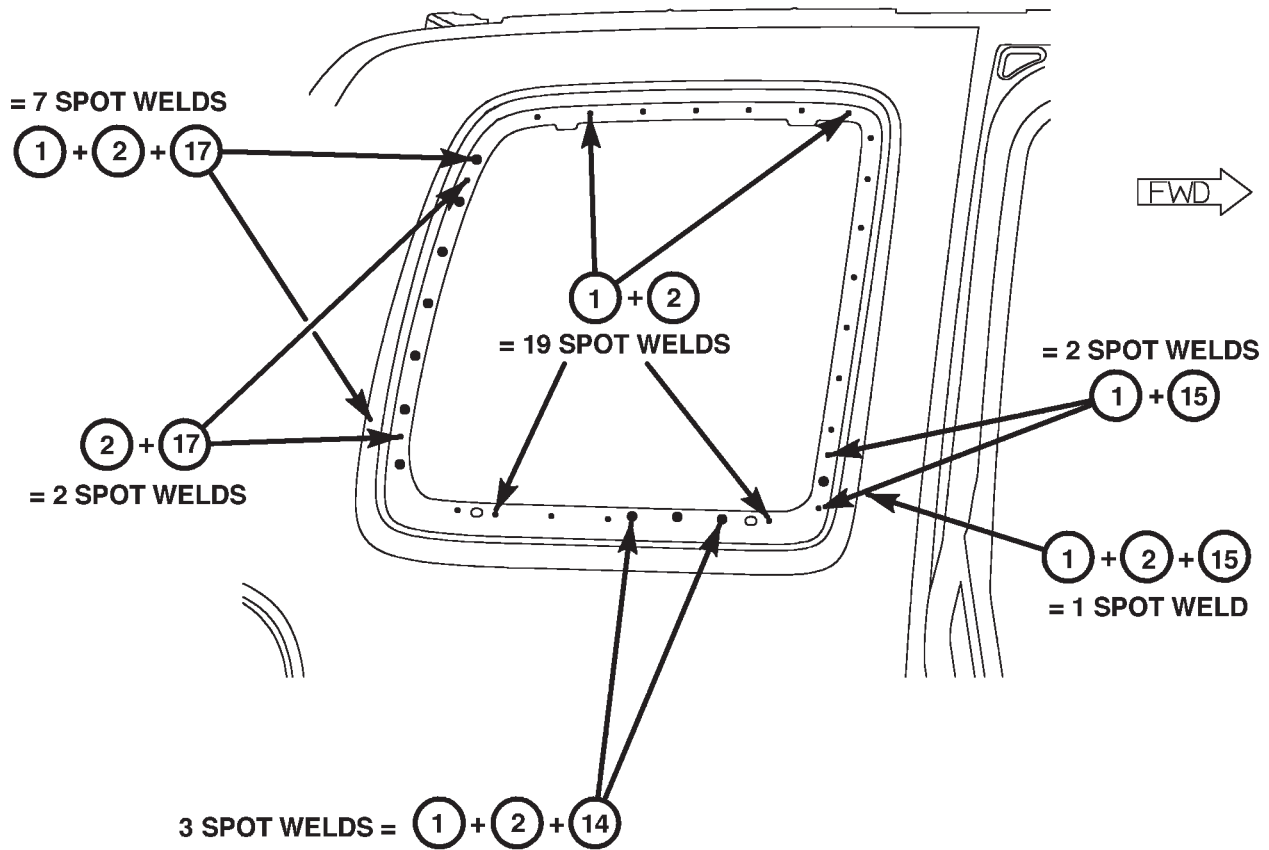


Fig. 58 QUARTER WINDOW OPENING



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

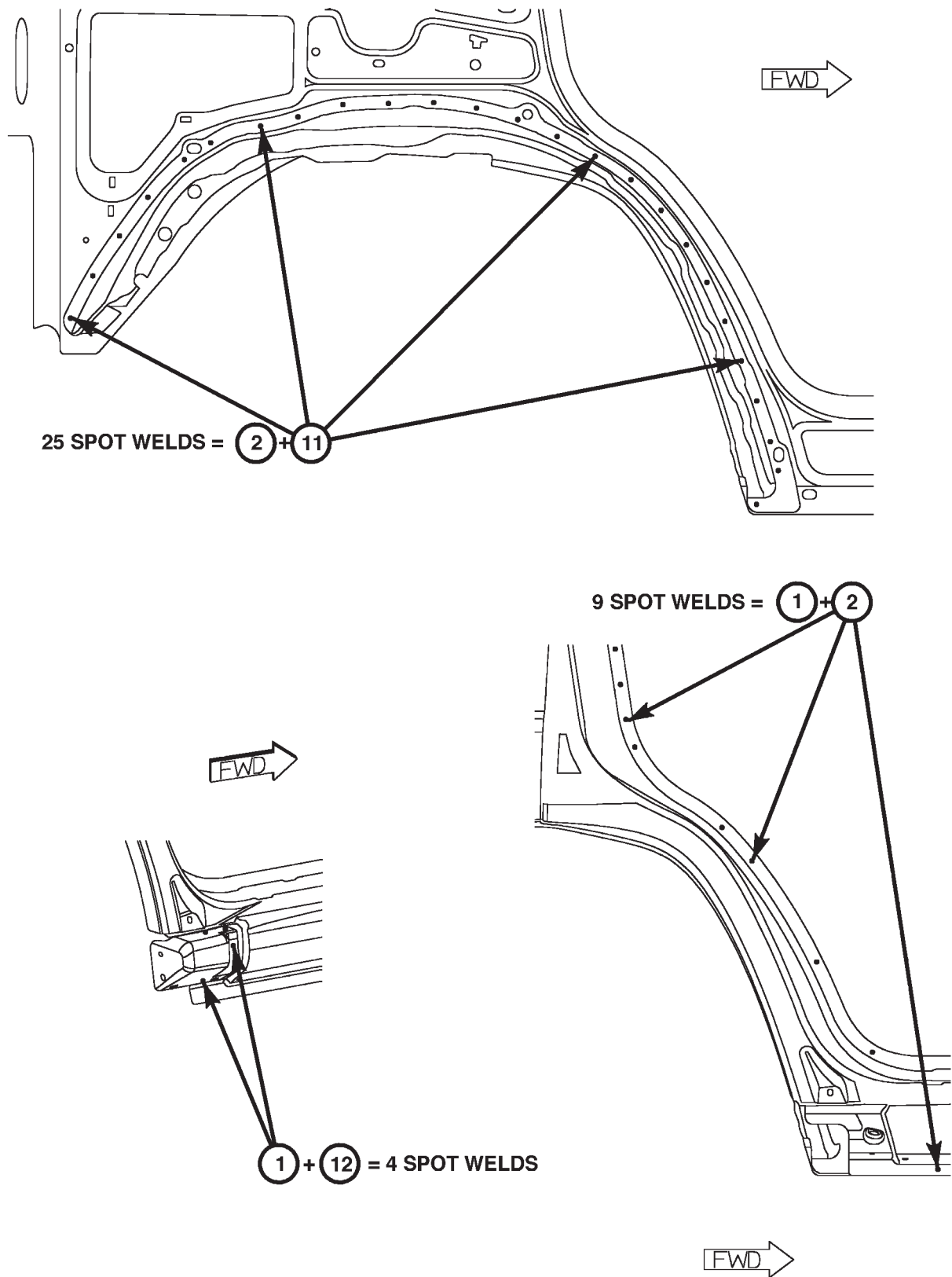


Fig. 59 OUTER REAR WHEELHOUSE

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

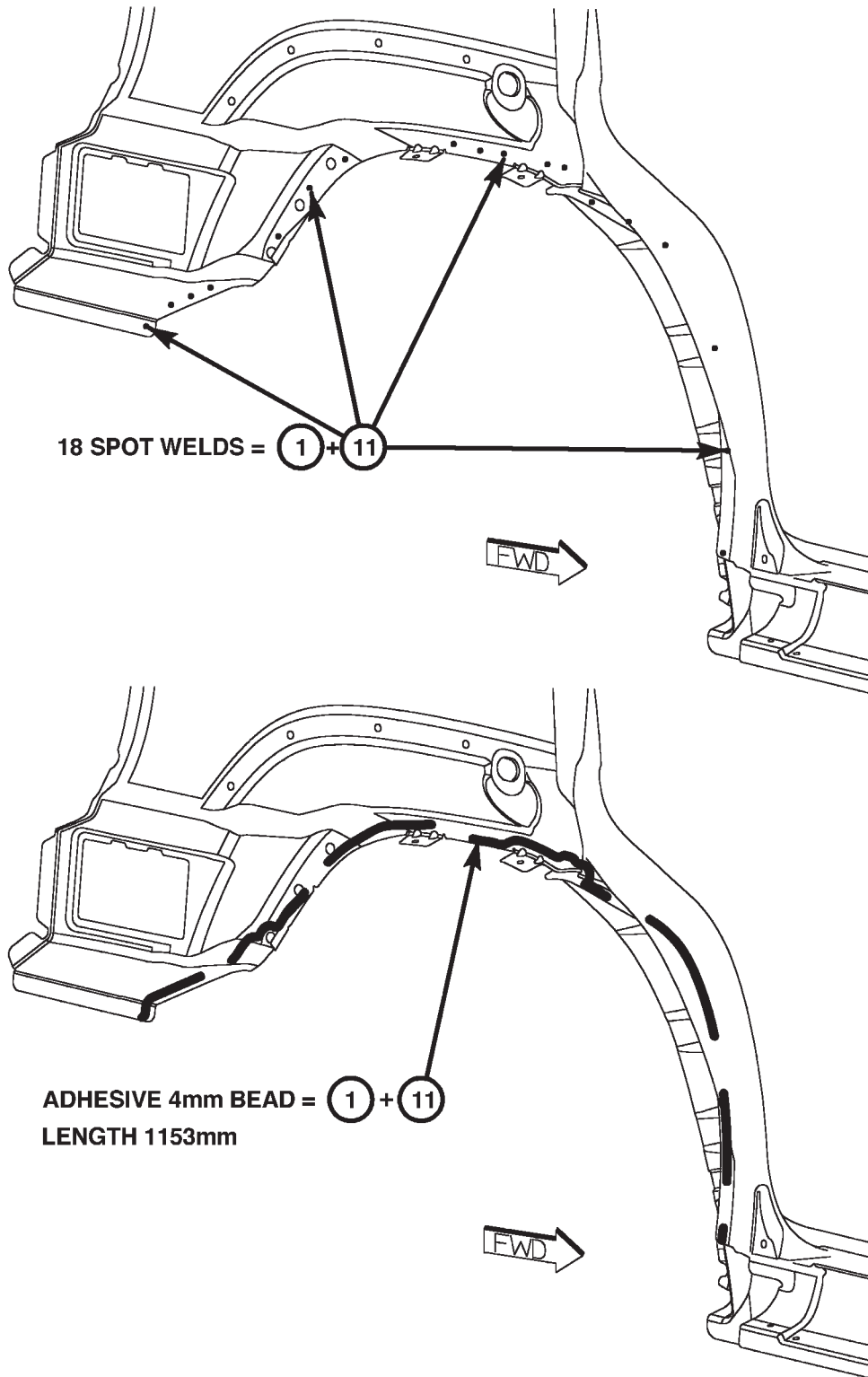


Fig. 60 OUTER REAR WHEELHOUSE

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

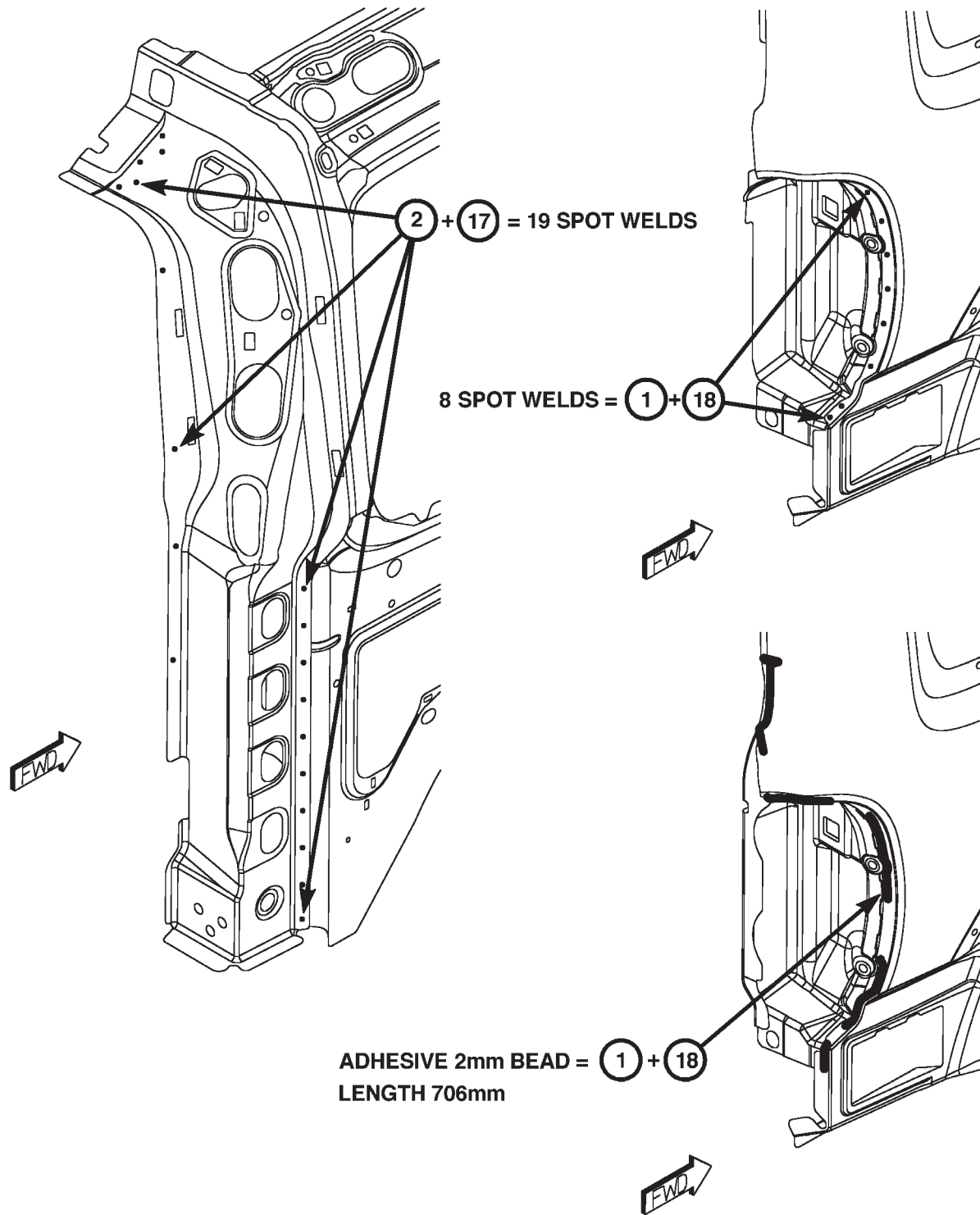


Fig. 61 D-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

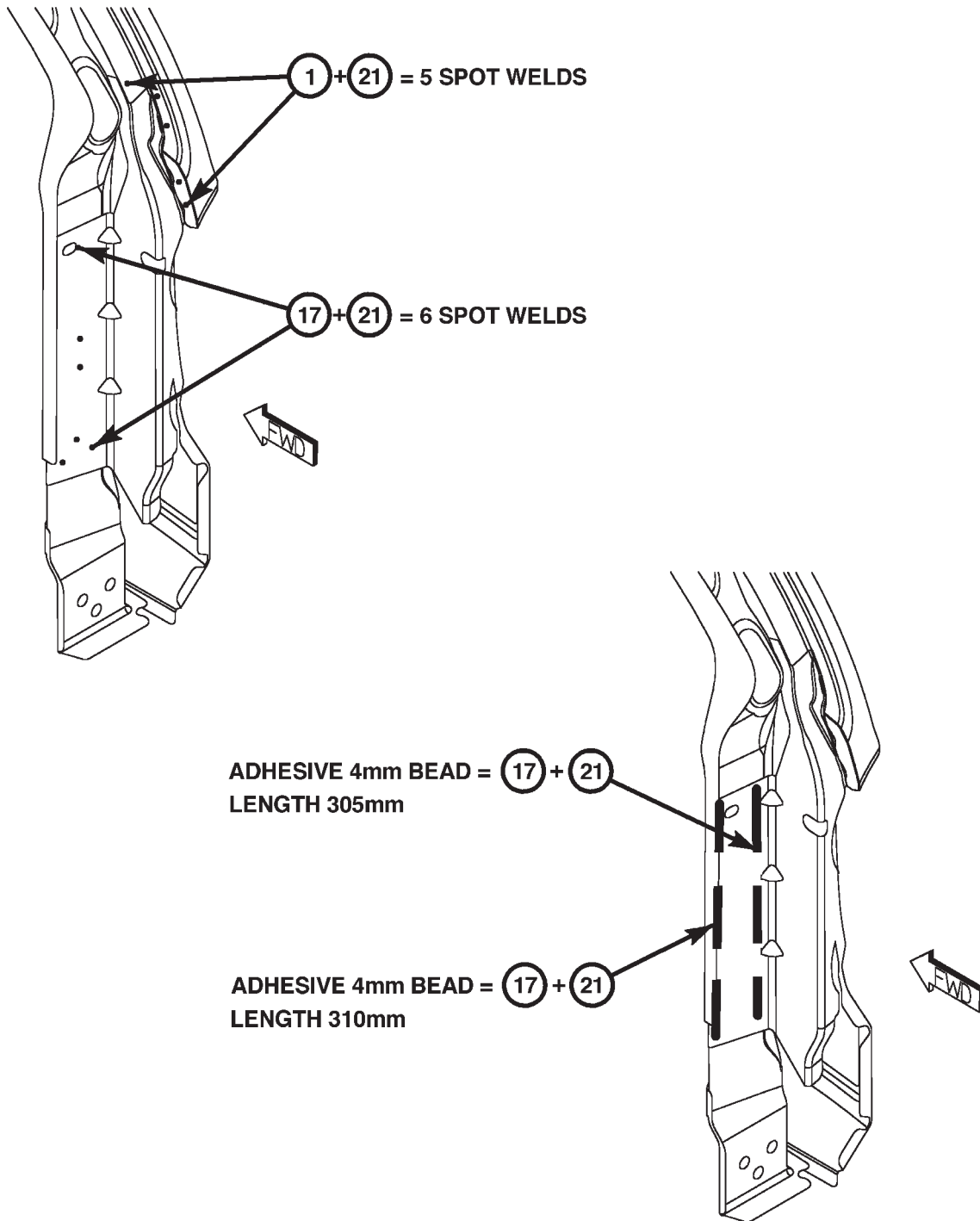
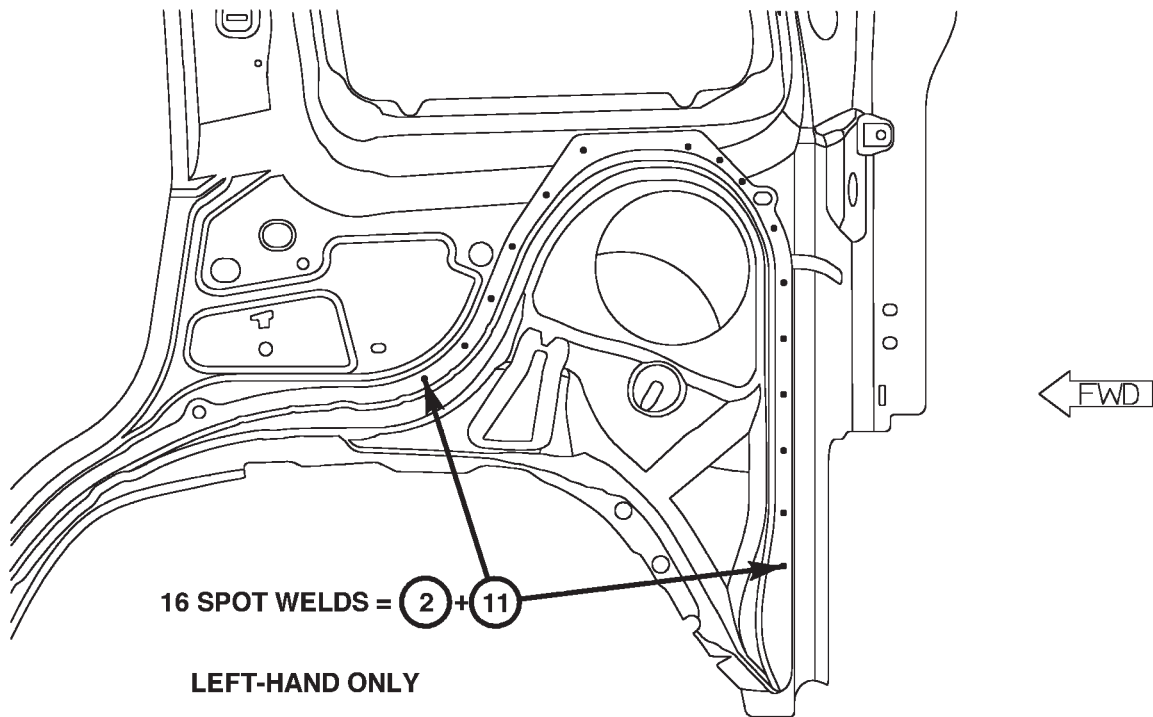


Fig. 62 SWING GATE STRIKER REINFORCEMENT

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



ADHESIVE 4mm BEAD = (17) + (18)      (1) + (18) = 2 SPOT WELDS  
 LENGTH 580mm

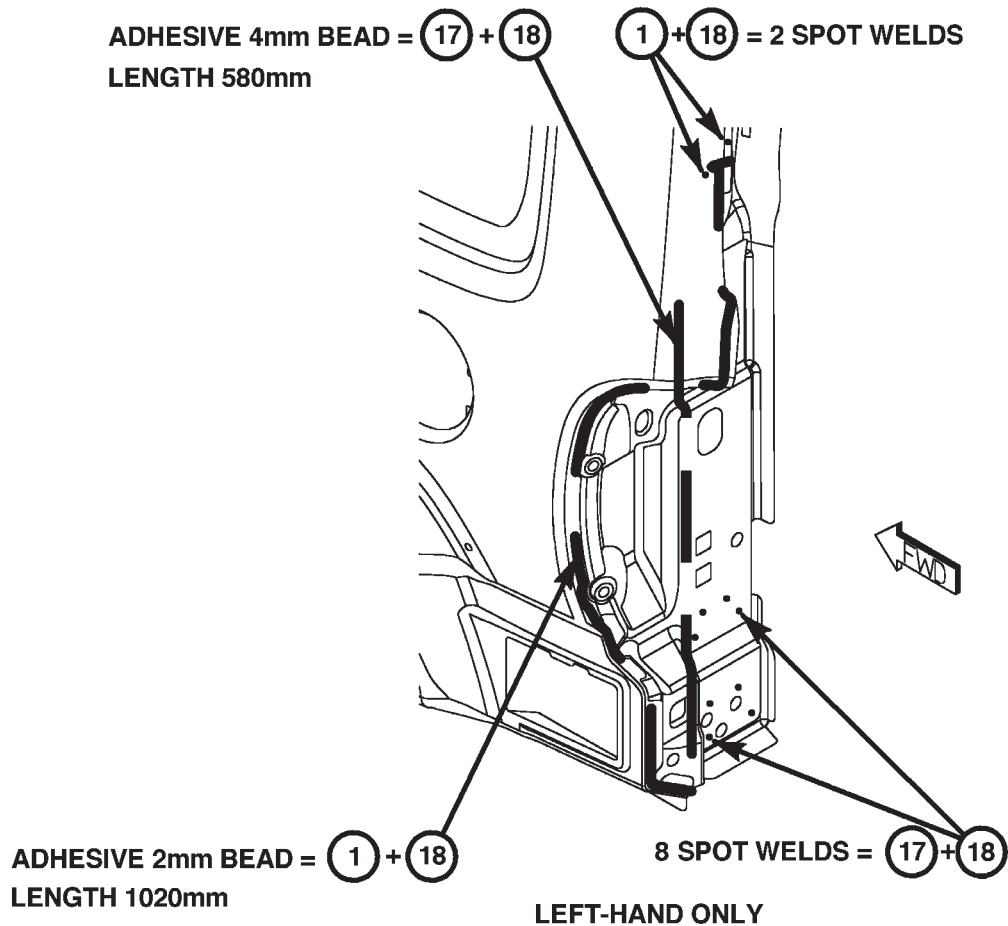


Fig. 63 REAR WHEELHOUSE AND TAIL LAMP

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

FENDER ASSEMBLIES

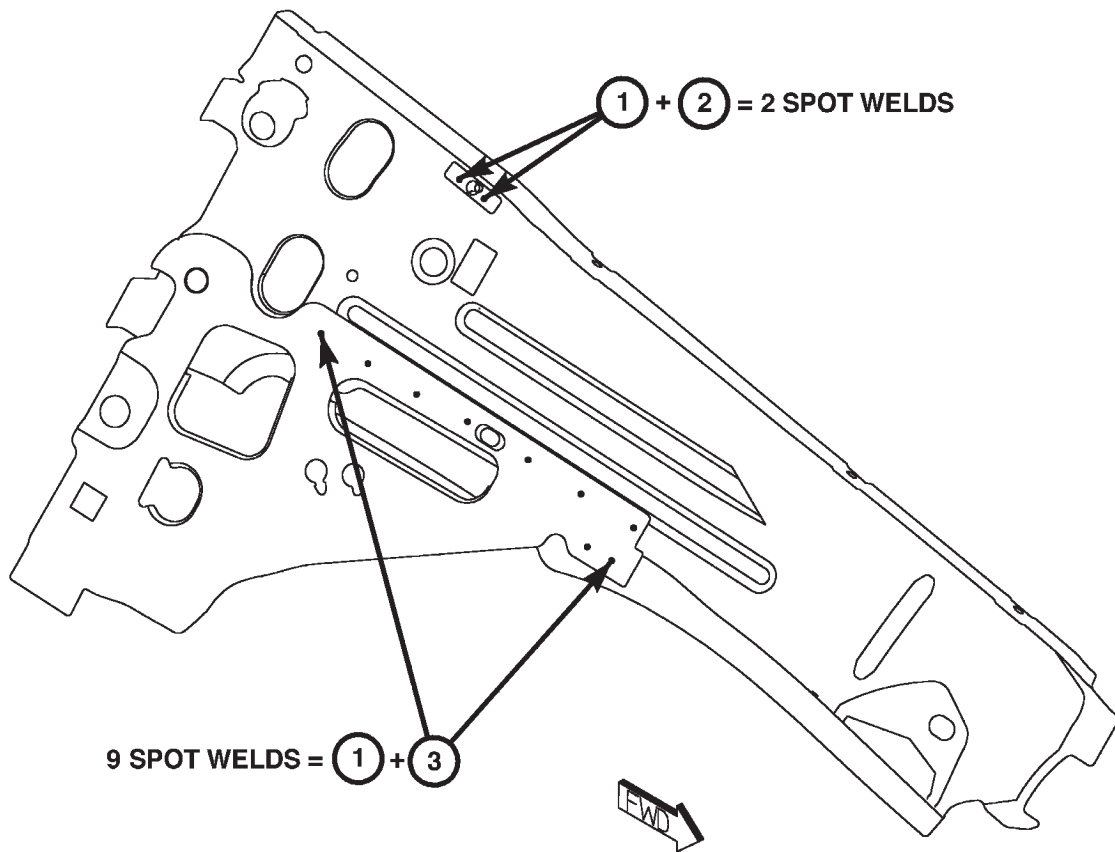
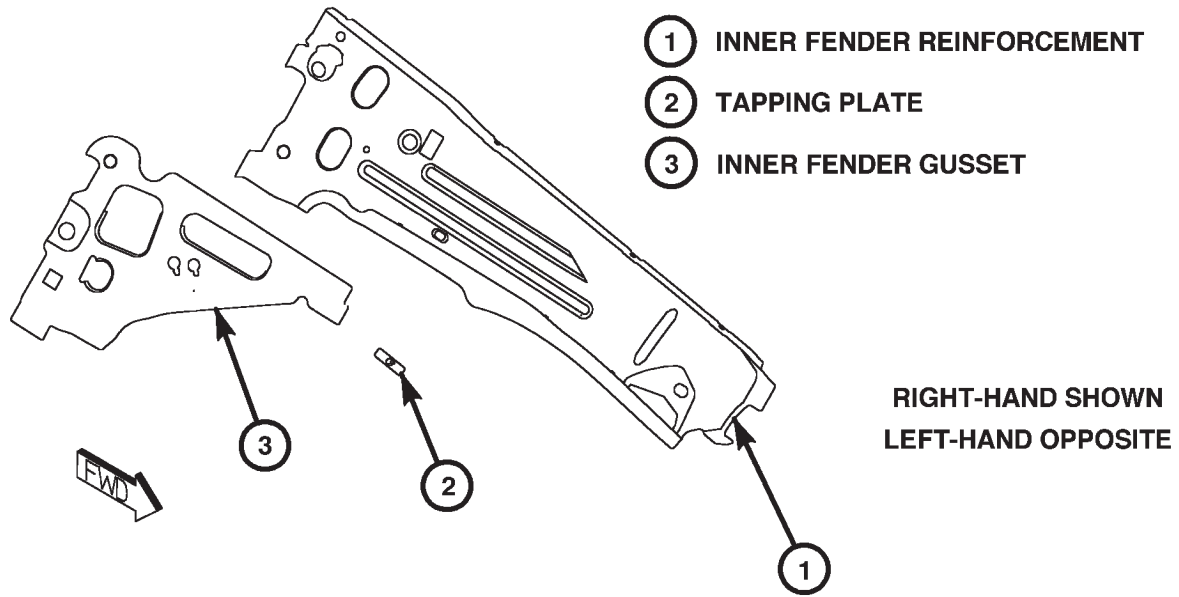


Fig. 64 FENDERS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

- |                              |                          |
|------------------------------|--------------------------|
| ① INNER FRONT WHEELHOUSE     | ⑦ PLENUM BAFFLE          |
| ② INNER FENDER REINFORCEMENT | ⑧ BODY SIDE INNER PANEL  |
| ③ INNER FENDER PANEL         | ⑨ A-PILLAR REINFORCEMENT |
| ④ RADIATOR SUPPORT BRACKET   | ⑩ PLENUM LOWER PANEL     |
| ⑤ INNER FRONT FENDER GUSSET  | ⑪ BODY SIDE OUTER PANEL  |
| ⑥ PLENUM CLOSURE             | ⑫ COWL SIDE PANEL        |

NOTE

ITEMS 3,5,8,9 AND 11 ARE PARTS OF THE BODY SIDE COMPLETE ASSEMBLY

ITEMS 1,2,4,6,7,10 AND 12 ARE PARTS OF THE UNDERBODY COMPLETE ASSEMBLY

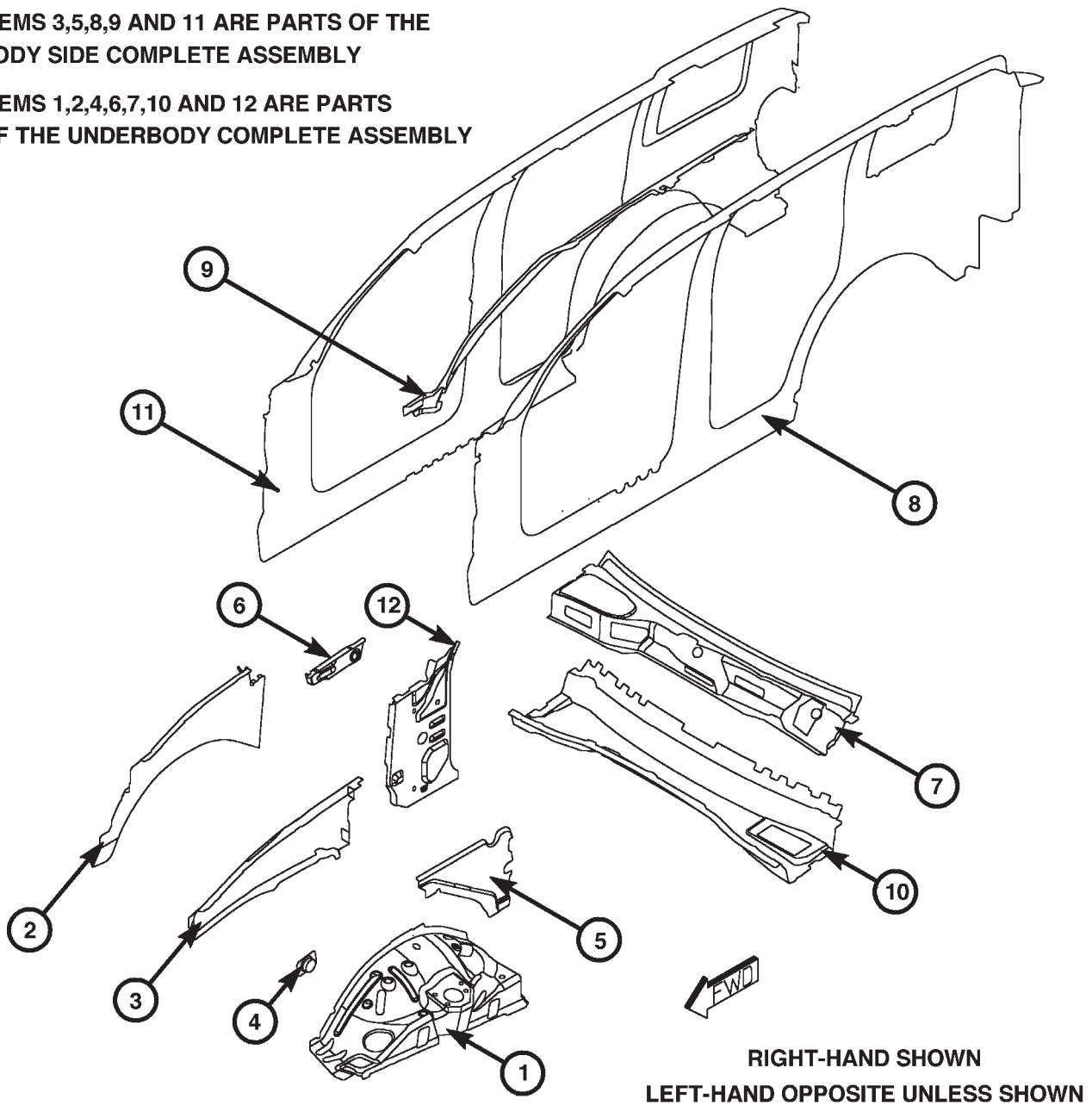


Fig. 65 FENDER ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

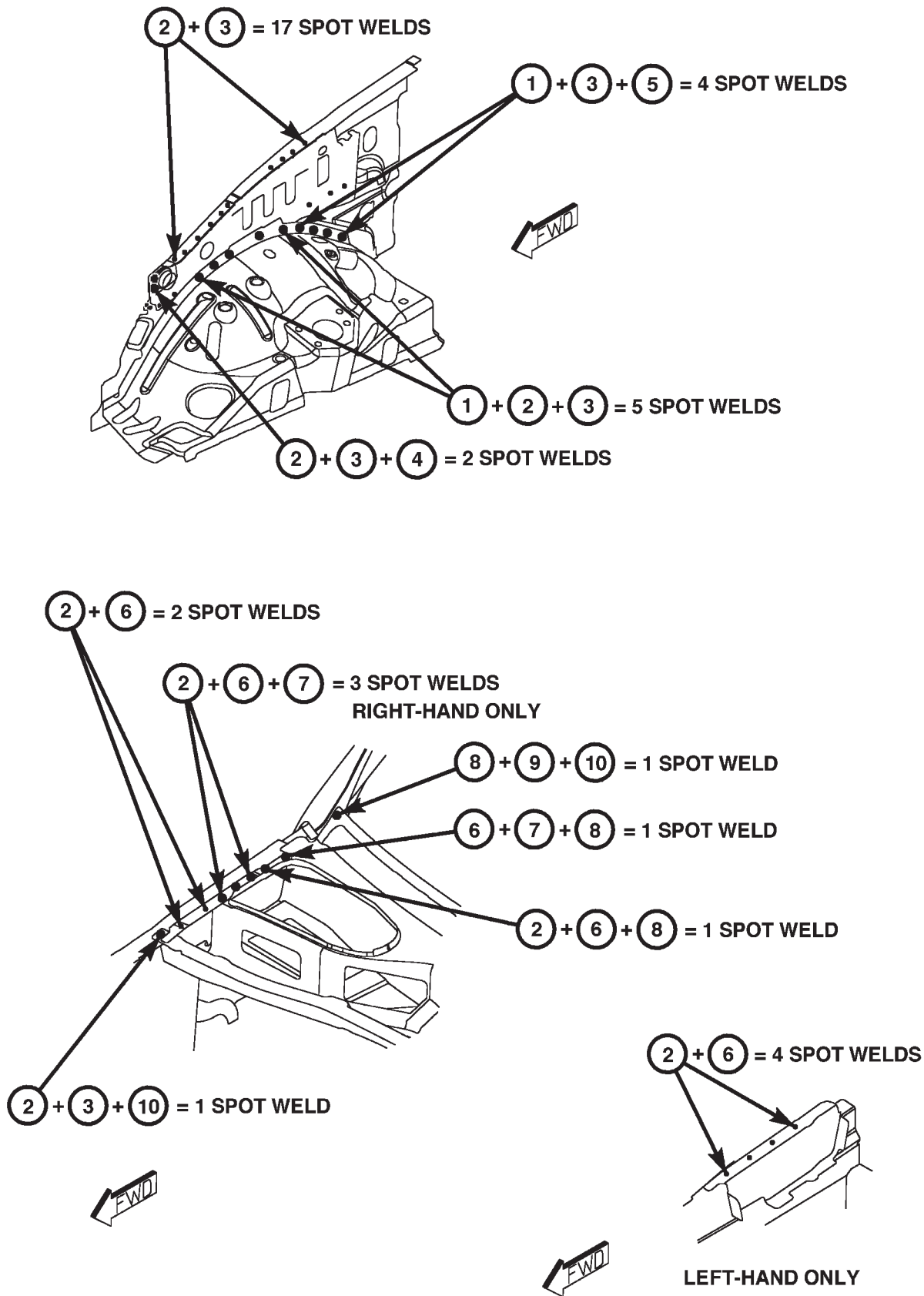


Fig. 66 INNER FENDER



WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

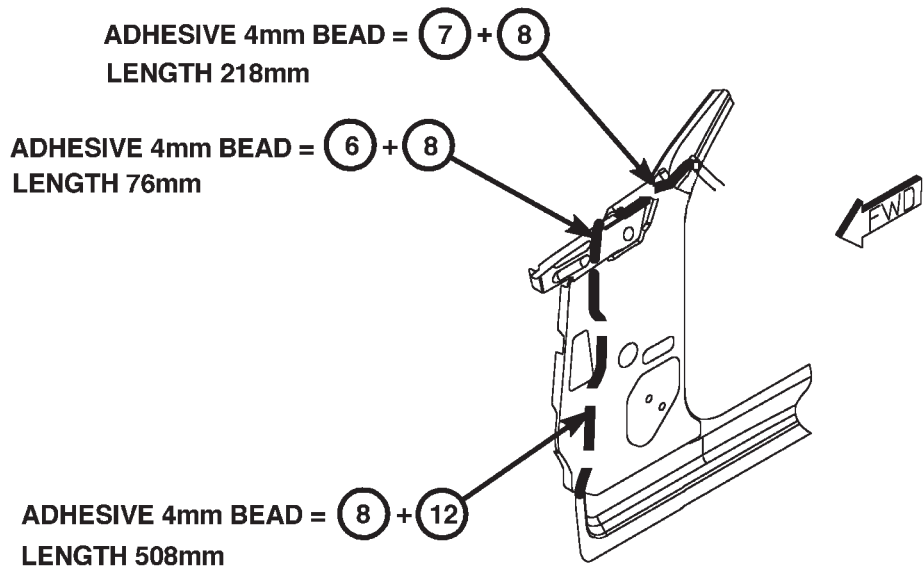
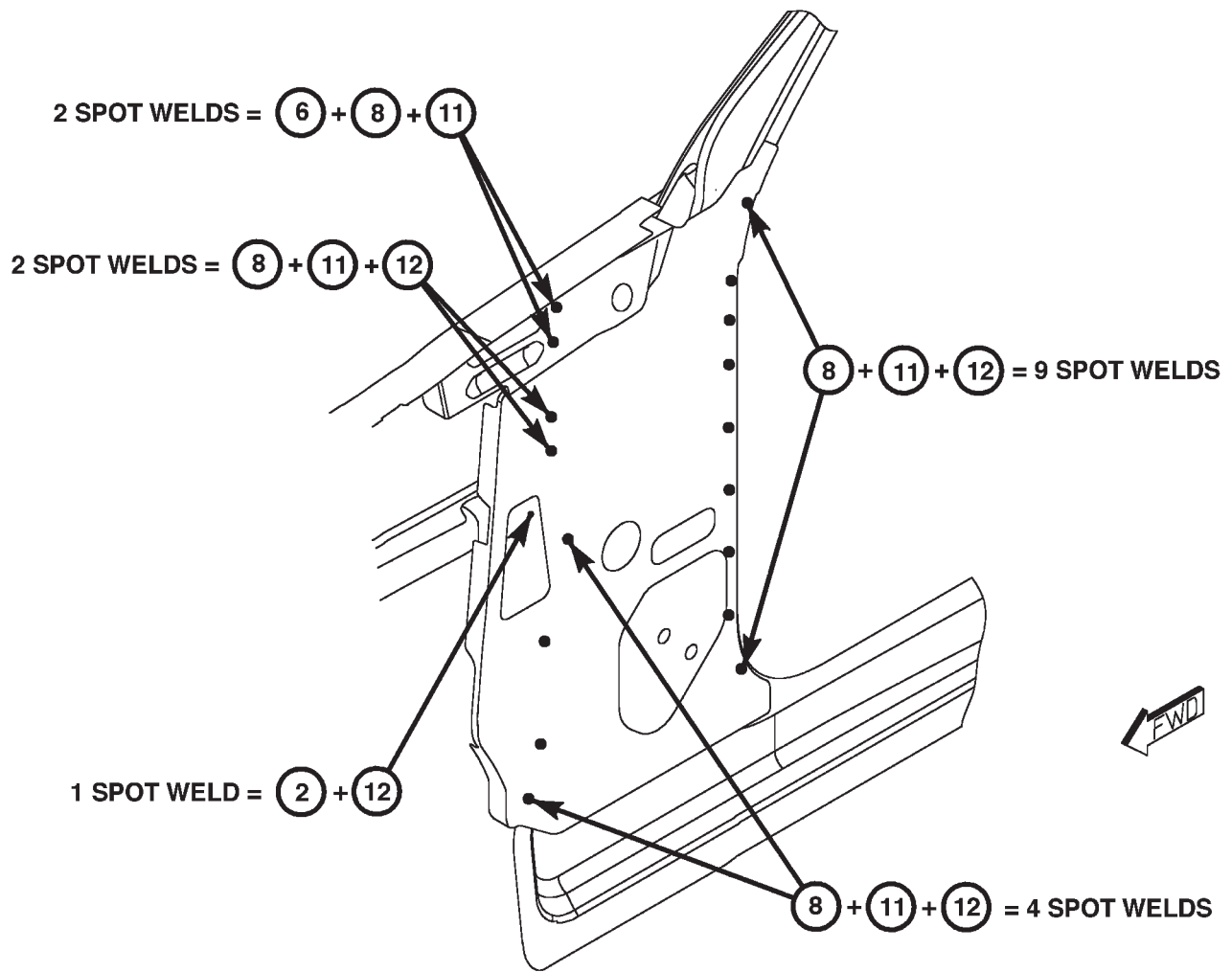


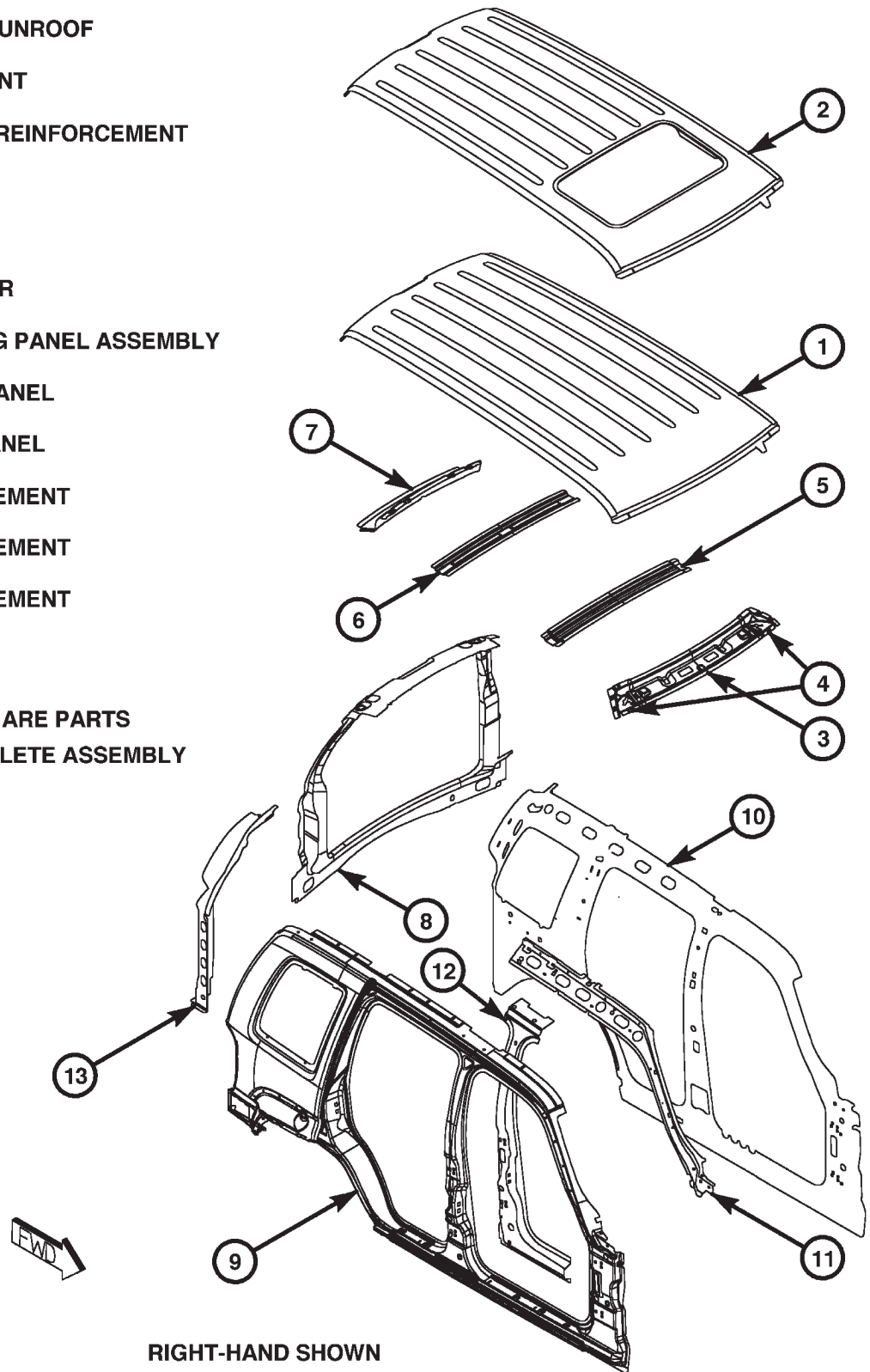
Fig. 67 FRONT INNER SIDE PANELS

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

ROOF PANEL ASSEMBLIES

- ① ROOF PANEL
- ② ROOF PANEL WITH SUNROOF
- ③ ROOF HEADER - FRONT
- ④ HEADER MOUNTING REINFORCEMENT
- ⑤ ROOF BOW - FRONT
- ⑥ ROOF BOW - REAR
- ⑦ ROOF HEADER - REAR
- ⑧ REAR GATE OPENING PANEL ASSEMBLY
- ⑨ BODY SIDE OUTER PANEL
- ⑩ BODY SIDE INNER PANEL
- ⑪ A-PILLAR REINFORCEMENT
- ⑫ B-PILLAR REINFORCEMENT
- ⑬ D-PILLAR REINFORCEMENT

NOTE  
 ITEMS 4,9,10,11,12 AND 13 ARE PARTS  
 OF THE BODY SIDE COMPLETE ASSEMBLY



RIGHT-HAND SHOWN  
 LEFT-HAND OPPOSITE

Fig. 68 ROOF PANEL ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

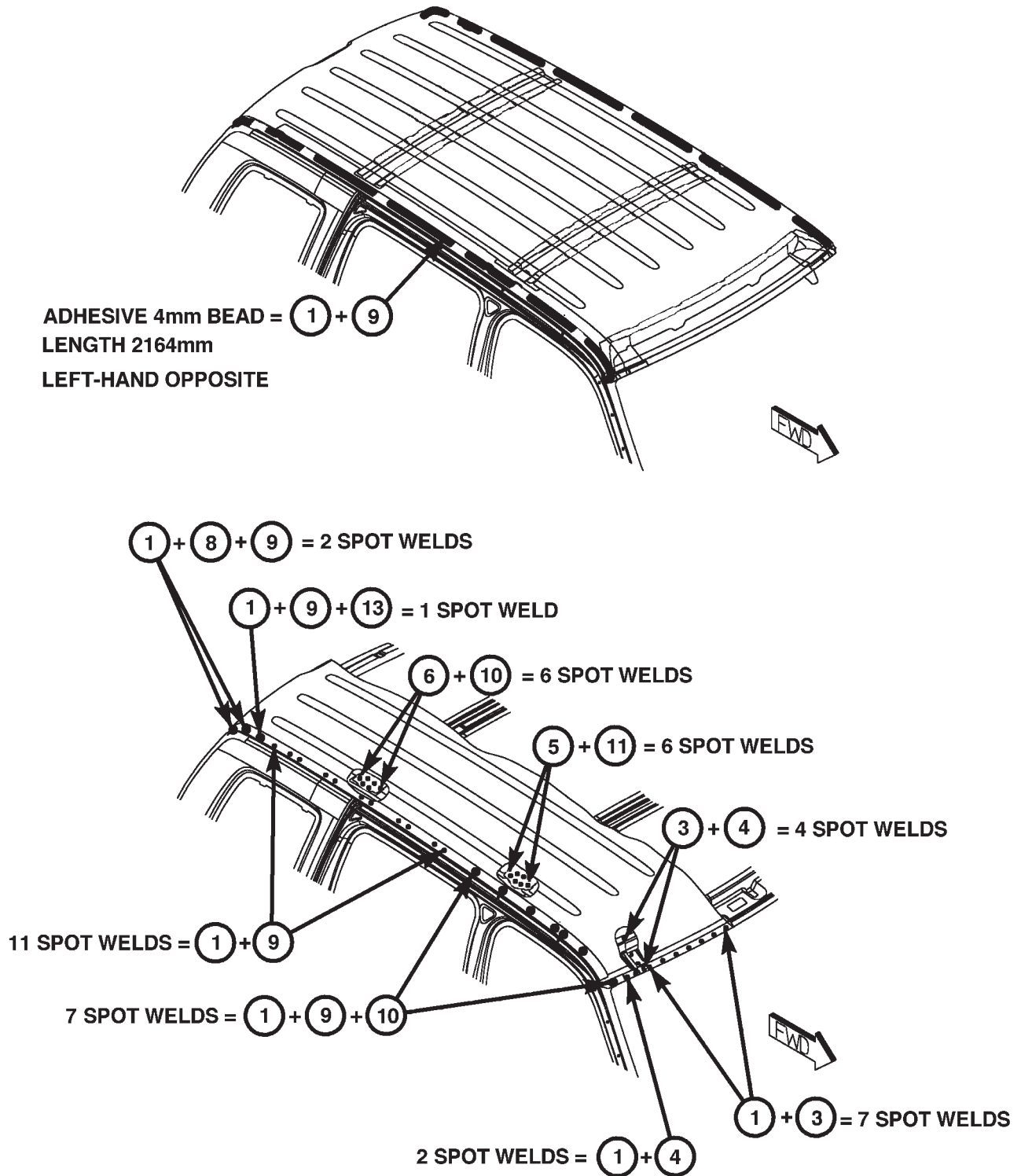


Fig. 69 ROOF PANEL ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

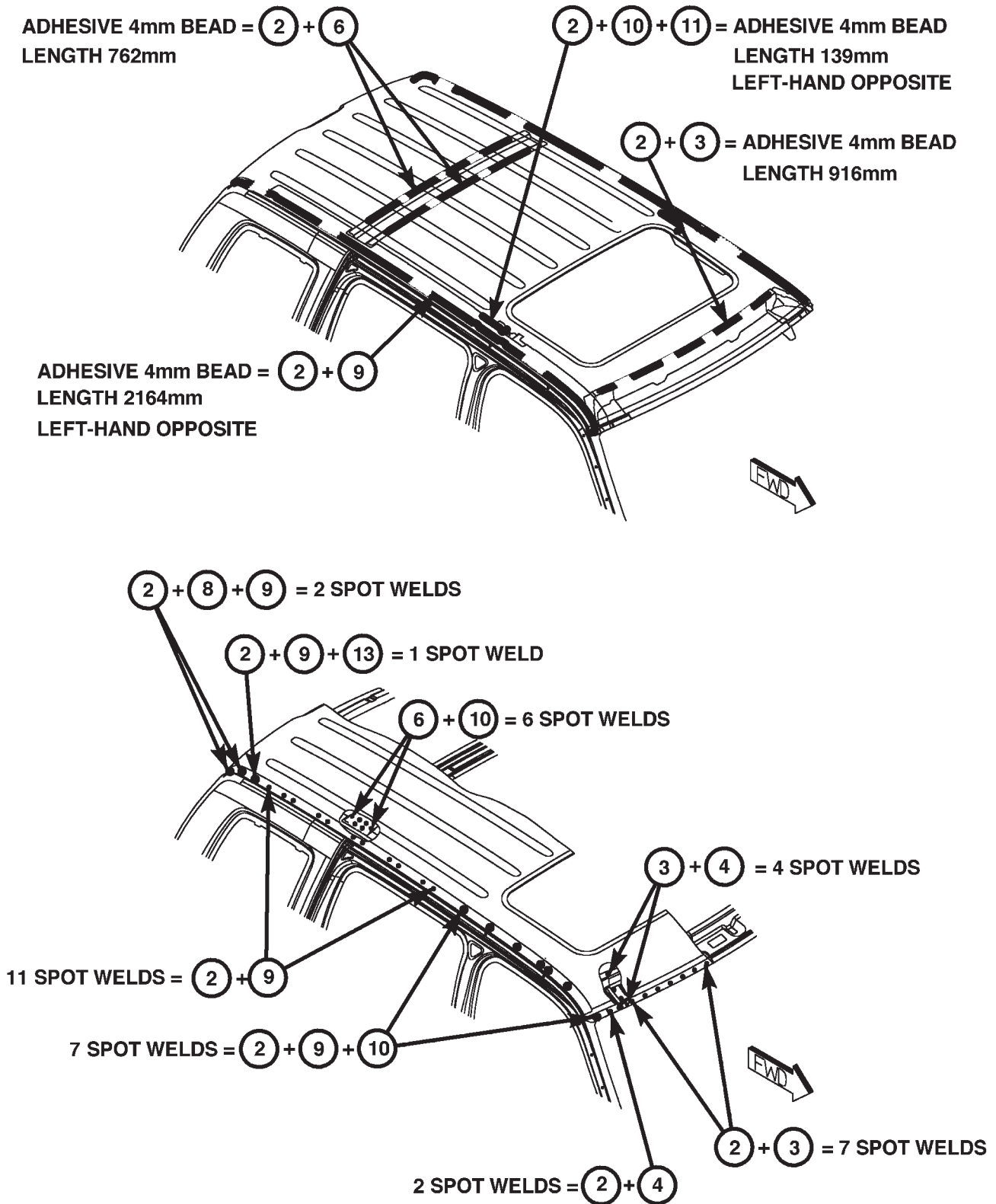
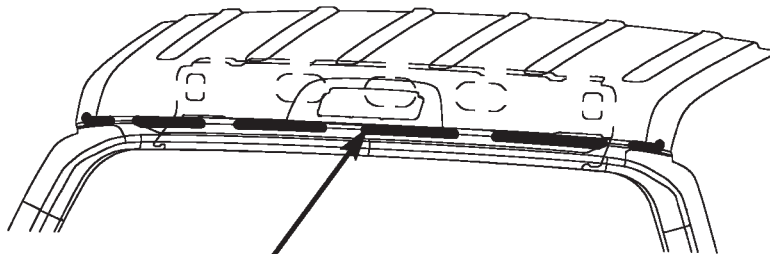


Fig. 70 ROOF PANEL

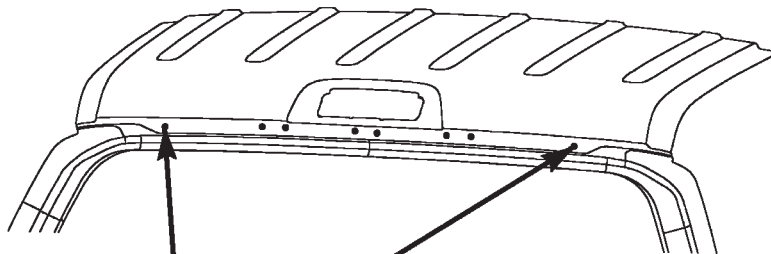
WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)



① + ⑧ = ADHESIVE 4mm BEAD  
LENGTH 1015mm



② ROOF PANEL WITH SUNROOF



① + ⑧ = 8 SPOT WELDS



② ROOF PANEL WITH SUNROOF

Fig. 71 ROOF PANEL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

BODY SIDE PANELS & FLOOR PAN ASSEMBLIES

- |  |                                    |
|--|------------------------------------|
| ① BODY SIDE OUTER PANEL                | ⑪ REAR GATE OPENING PANEL ASSEMBLY |
| ② BODY SIDE INNER PANEL                | ⑫ GATE STRIKER REINFORCEMENT       |
| ③ BODY SIDE SILL                       | ⑬ D-PILLAR LOWER TO FLOOR GUSSET   |
| ④ REAR WHEELHOUSE OUTER PANEL          | ⑭ GATE OPENING REINFORCEMENT       |
| ⑤ REAR WHEELHOUSE INNER PANEL ASSEMBLY | ⑮ TAIL LAMP MOUNTING PANEL         |
| ⑥ REAR WHEELHOUSE INNER EXTENSION      |                                    |
| ⑦ REAR CROSSMEMBER                     |                                    |
| ⑧ REAR FLOOR PAN                       |                                    |
| ⑨ D-PILLAR REINFORCEMENT               |                                    |
| ⑩ ROOF HEADER - REAR                   |                                    |

NOTE

ITEMS 1,2,9,12 AND 15 ARE PARTS OF THE BODY SIDE COMPLETE ASSEMBLY

ITEMS 3,4,5,6,7,8,13 AND 14 ARE PARTS OF THE UNDERBODY COMPLETE ASSEMBLY

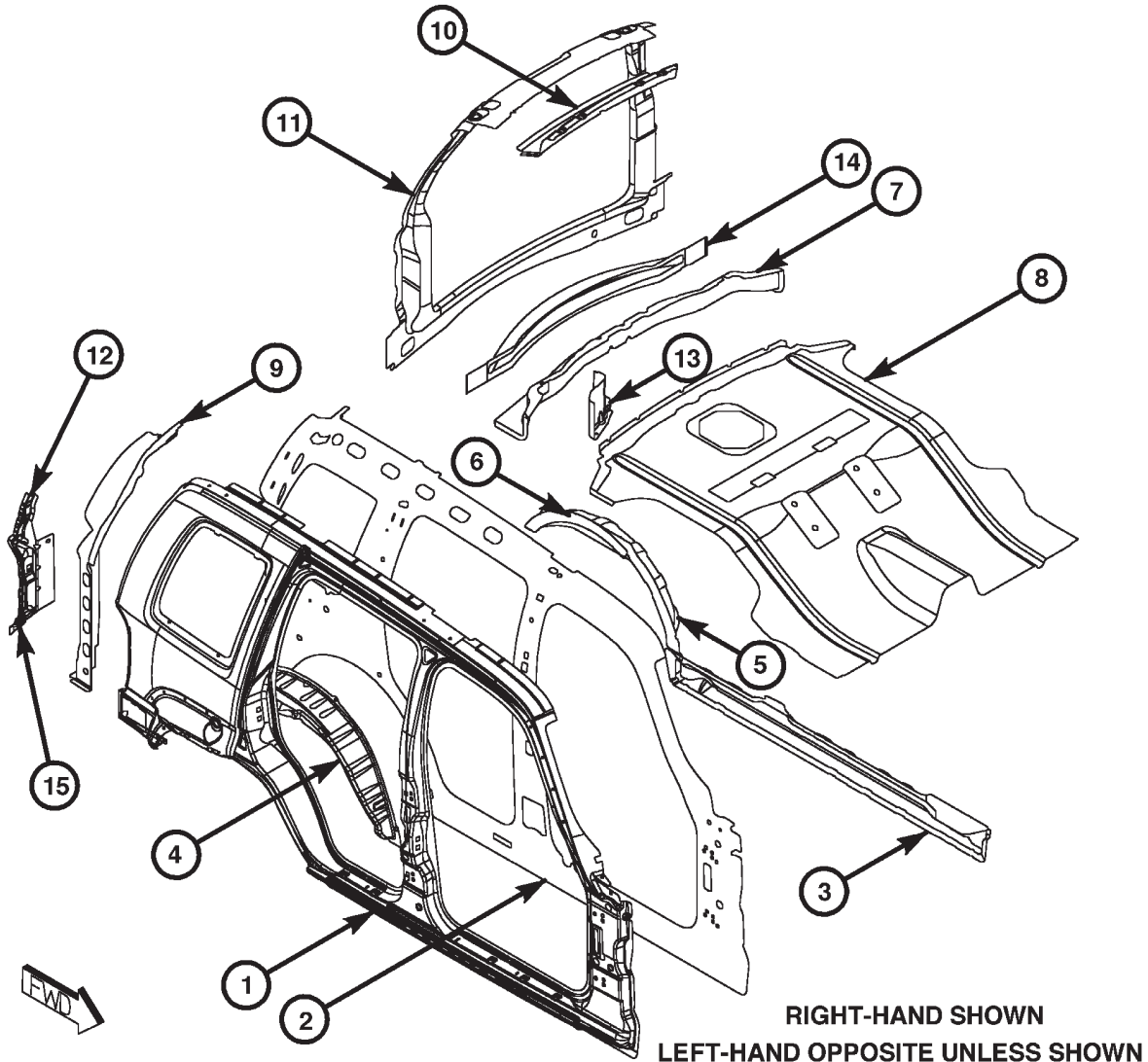


Fig. 72 BODY SIDE PANEL ASSEMBLY

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

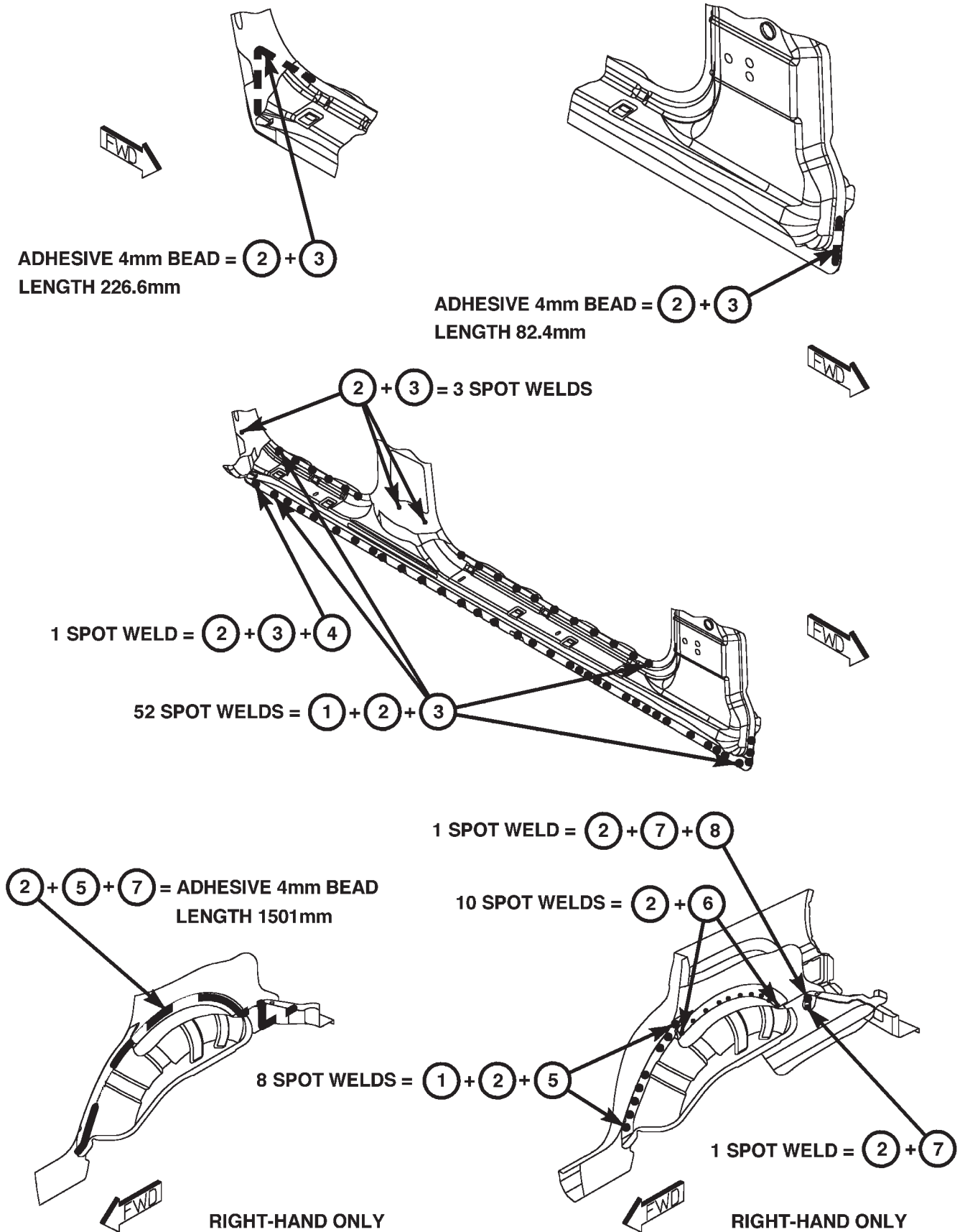


Fig. 73 BODY SIDE PANEL

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

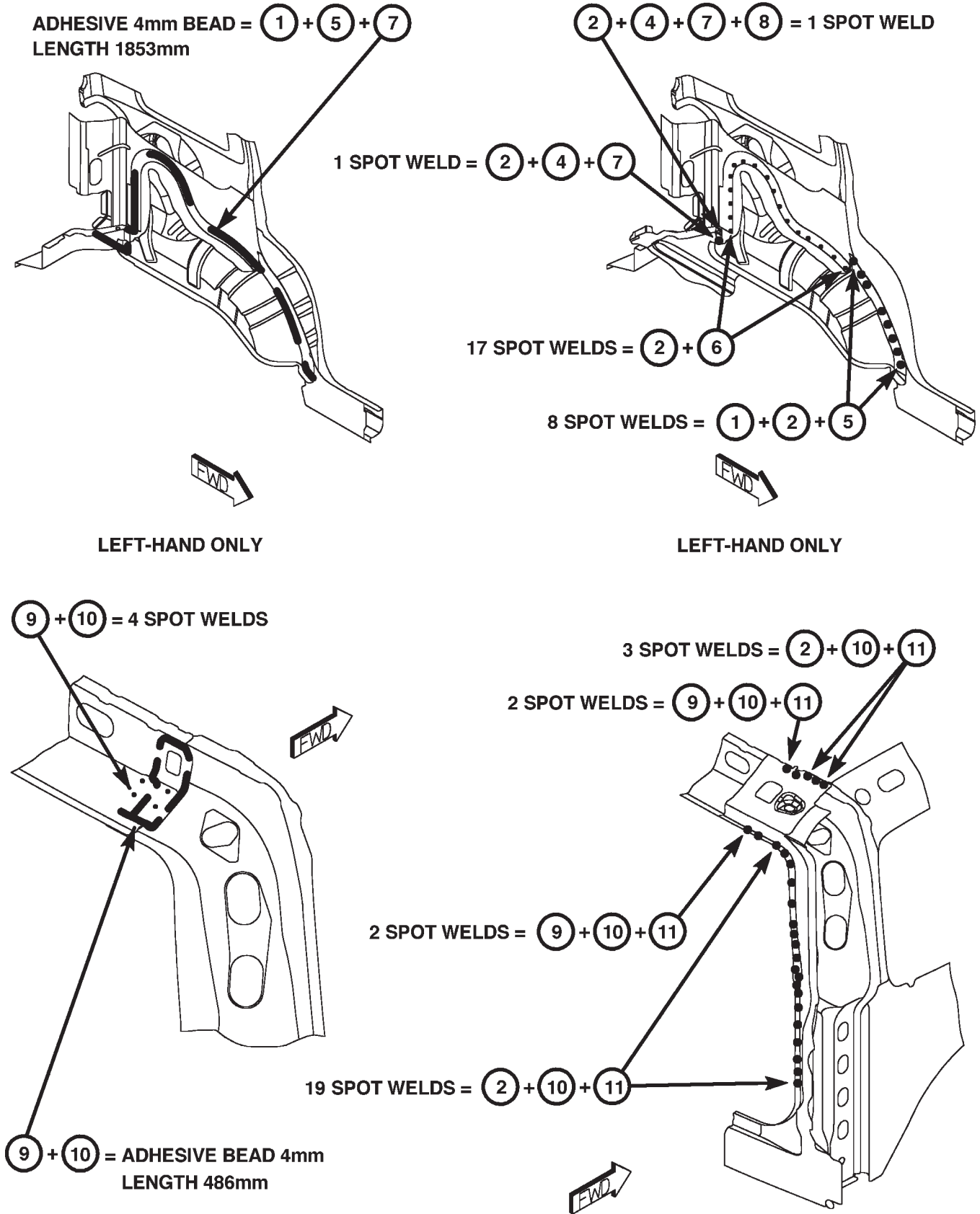
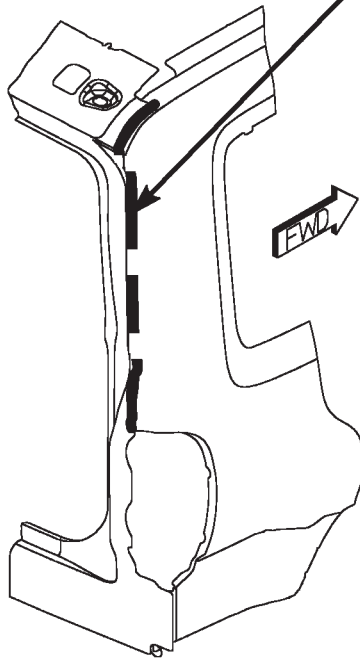


Fig. 74 BODY SIDE PANEL



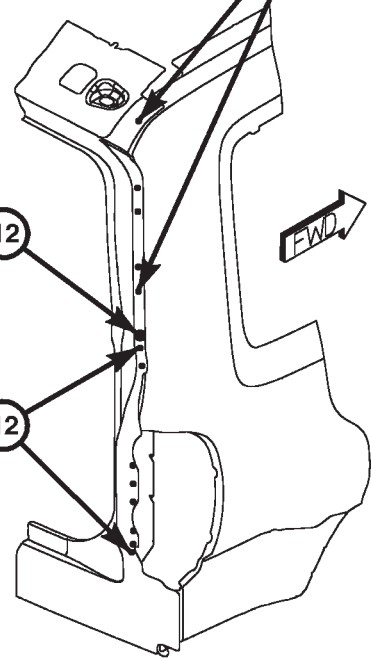
WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

ADHESIVE 4mm BEAD = (1) + (11)  
LENGTH 738mm



RIGHT-HAND ONLY

5 SPOT WELDS = (1) + (11)

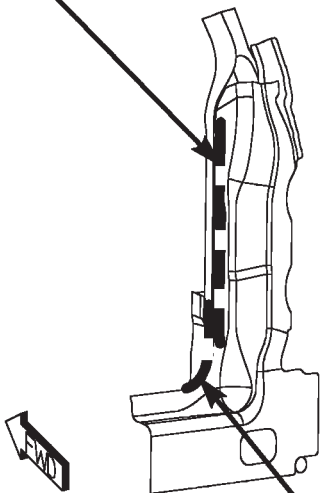


RIGHT-HAND ONLY

1 SPOT WELD = (1) + (11) + (12)

8 SPOT WELDS = (11) + (12)

(9) + (11) + (12) = ADHESIVE 4mm BEAD  
LENGTH 399mm  
RIGHT-HAND ONLY



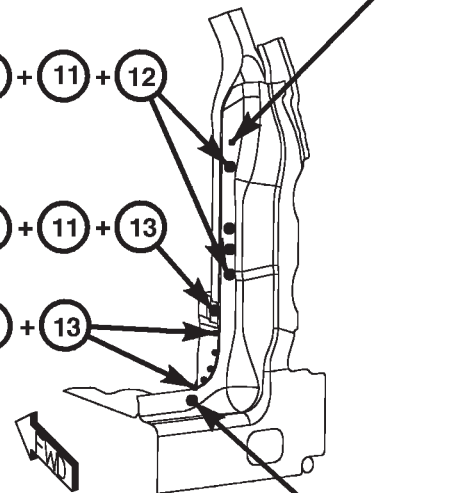
ADHESIVE 4mm BEAD = (11) + (13)  
LENGTH 188mm

1 SPOT WELD = (9) + (11)  
RIGHT-HAND ONLY

4 SPOT WELDS = (9) + (11) + (12)  
RIGHT-HAND ONLY

1 SPOT WELD = (9) + (11) + (13)

5 SPOT WELDS = (11) + (13)

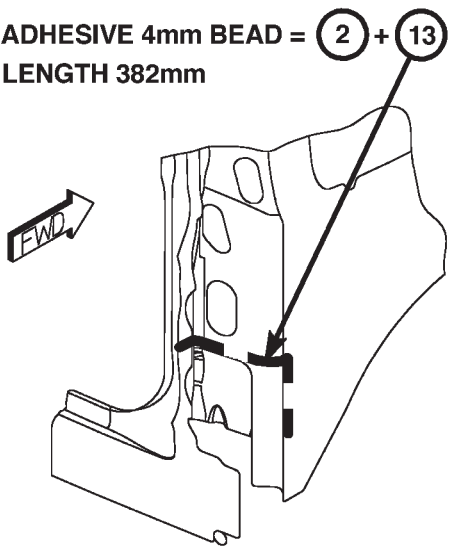


1 SPOT WELD = (8) + (11) + (13)

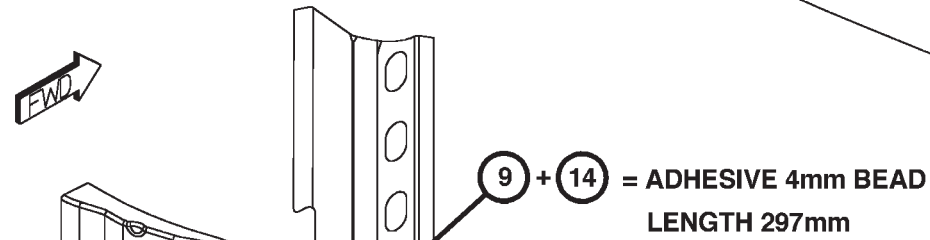
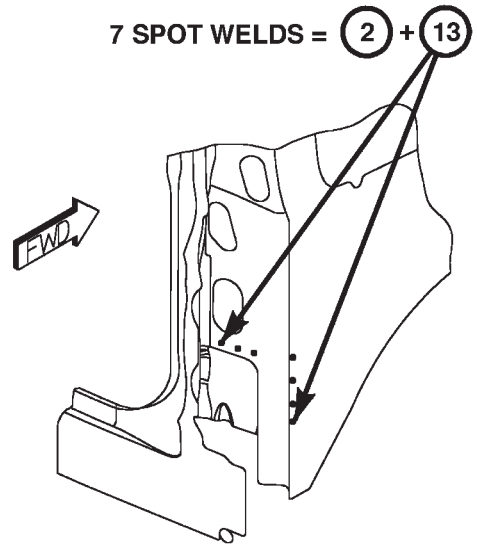
Fig. 75 D-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

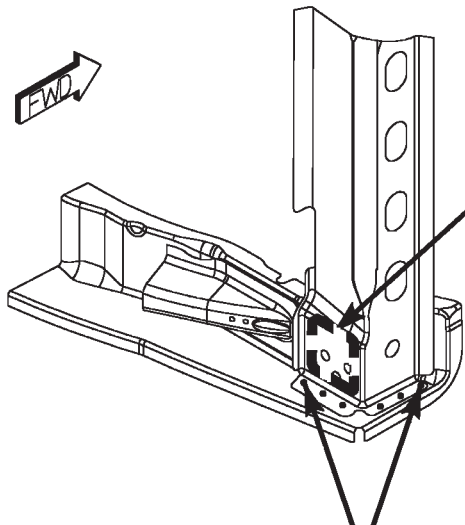
ADHESIVE 4mm BEAD = (2) + (13)  
 LENGTH 382mm



7 SPOT WELDS = (2) + (13)

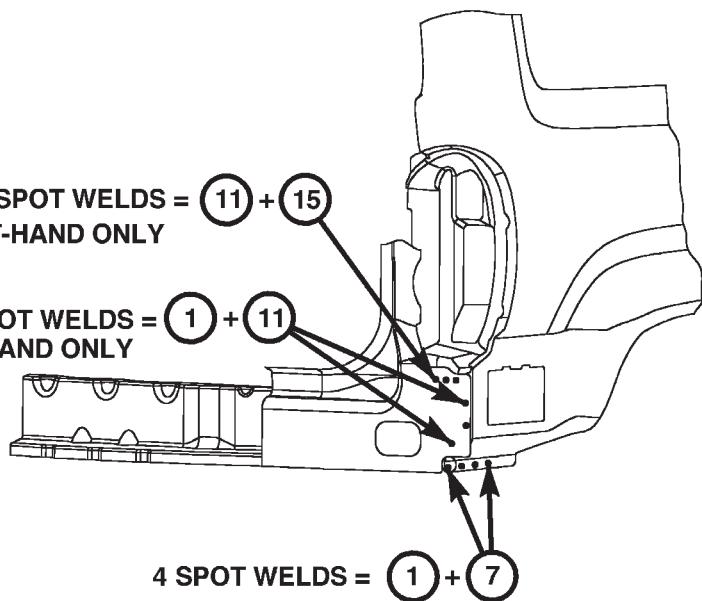


6 SPOT WELDS = (7) + (9)



3 SPOT WELDS = (11) + (15)  
 RIGHT-HAND ONLY

3 SPOT WELDS = (1) + (11)  
 RIGHT-HAND ONLY



4 SPOT WELDS = (1) + (7)

Fig. 76 D-PILLAR

WELD AND STRUCTURAL ADHESIVE LOCATIONS (Continued)

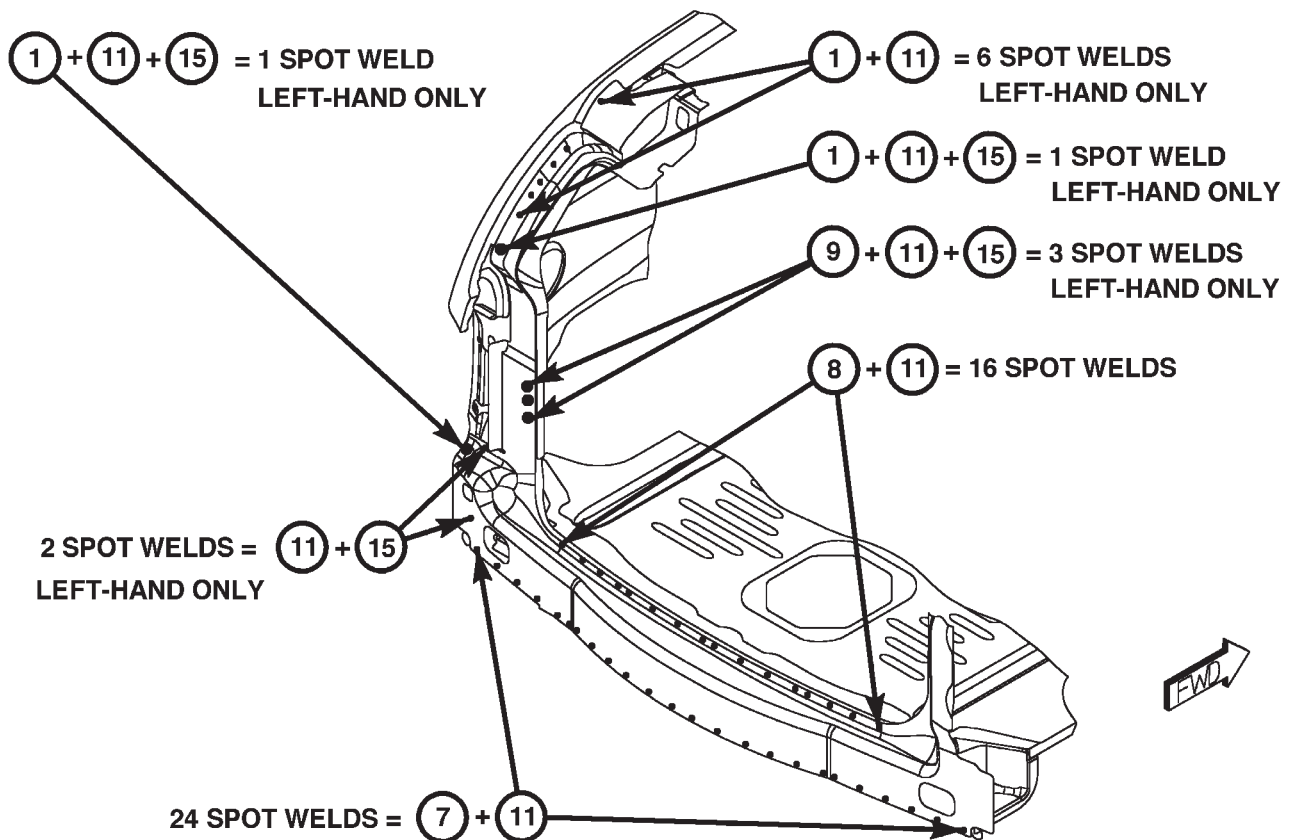
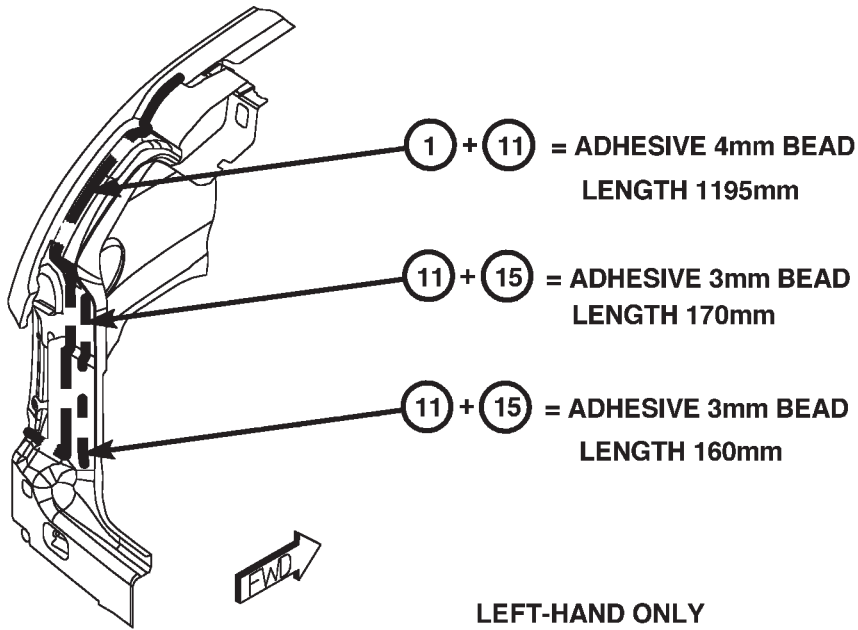


Fig. 77 SWING GATE OPENING

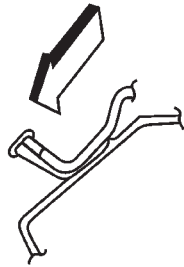
## SEALER LOCATIONS

## SPECIFICATIONS

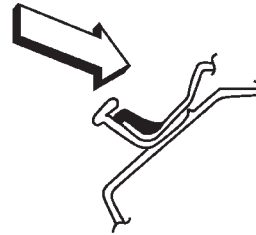
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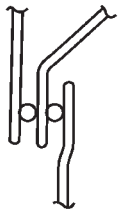
SEALER LOCATIONS (Continued)



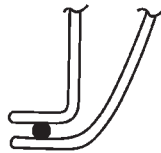
HOLD GUN NOZZLE IN DIRECTION OF ARROW IN ORDER TO EFFECTIVELY SEAL METAL JOINTS.



DO NOT HOLD GUN NOZZLE IN DIRECTION OF ARROW. SEALER APPLIED AS SHOWN IN INEFFECTIVE.



3 METAL THICKNESS



2 METAL THICKNESS



3 METAL THICKNESS



2 METAL THICKNESS

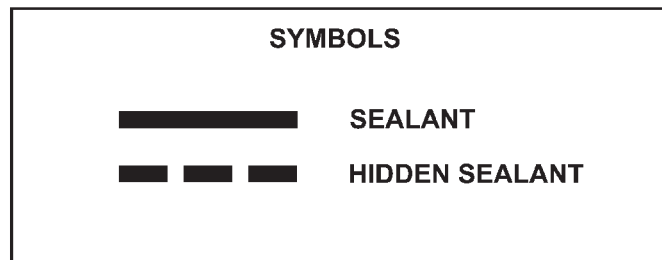
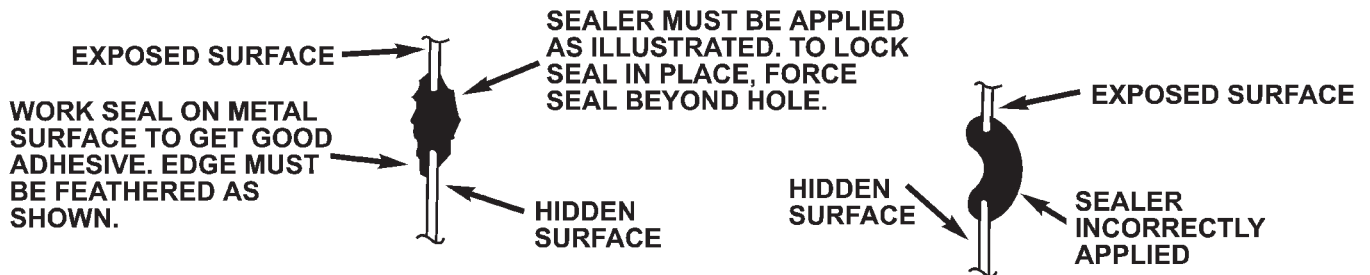


Fig. 78 APPLICATION METHODS

SEALER LOCATIONS (Continued)

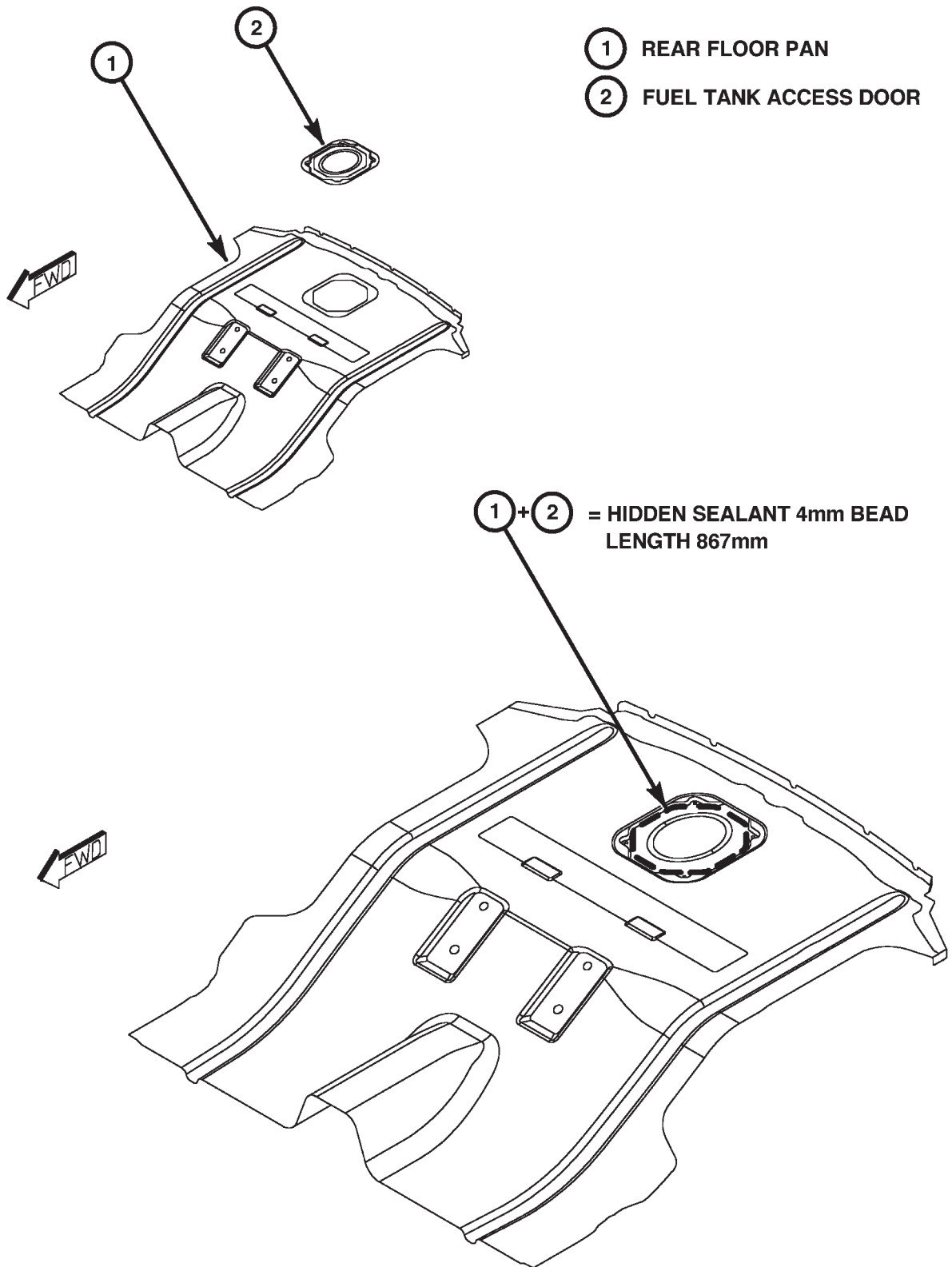


Fig. 79 REAR FLOOR PAN

SEALER LOCATIONS (Continued)

- ① FRONT FLOOR PAN ASSEMBLY
- ② REAR FLOOR PAN ASSEMBLY
- ③ BODY SIDE SILL
- ④ COWL SIDE PANEL

- ⑤ DASH PANEL
- ⑥ LOWER PLENUM PANEL
- ⑦ REAR SEAT FRONT CROSSMEMBER

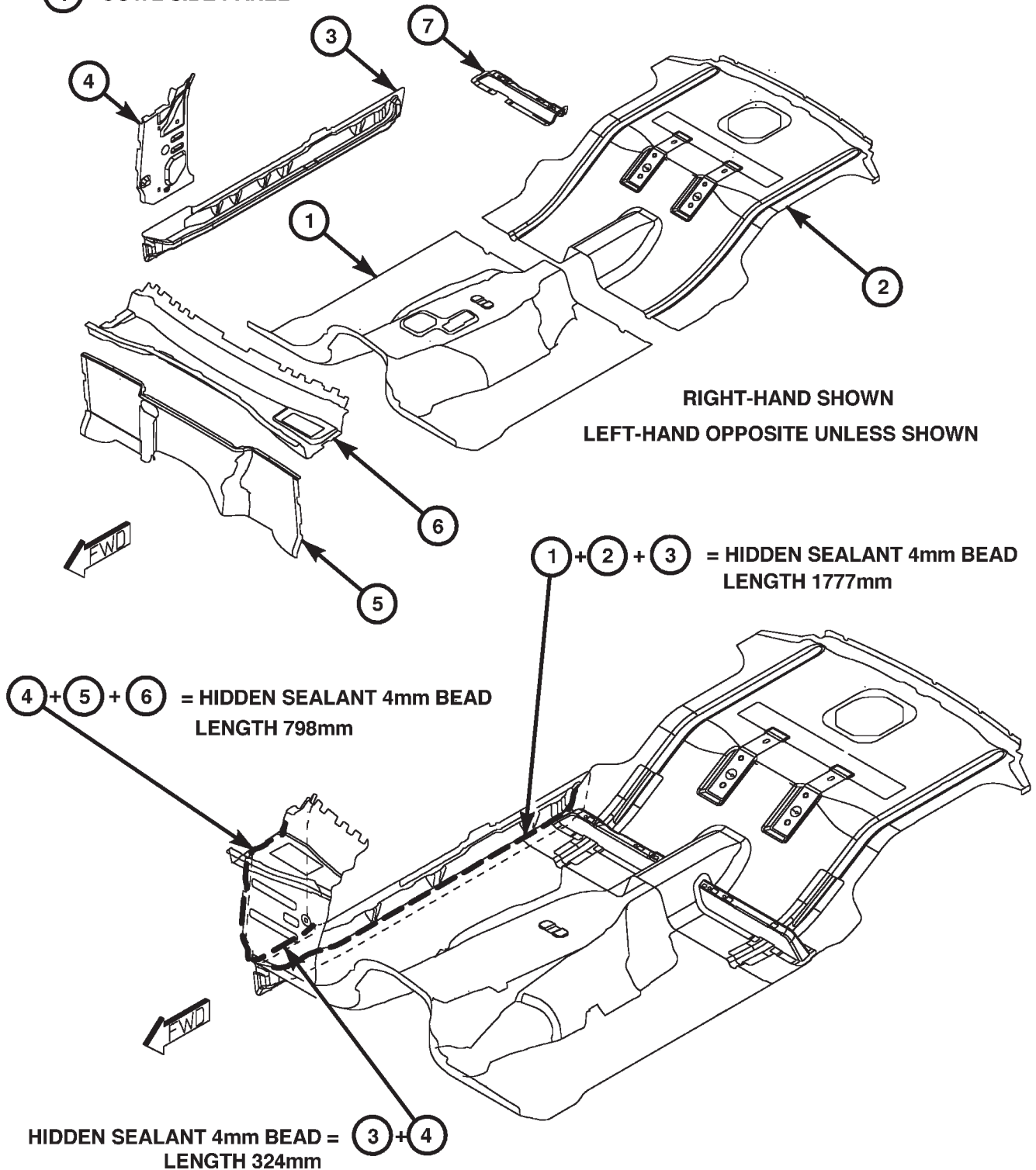


Fig. 80 FULL FLOOR PAN

SEALER LOCATIONS (Continued)

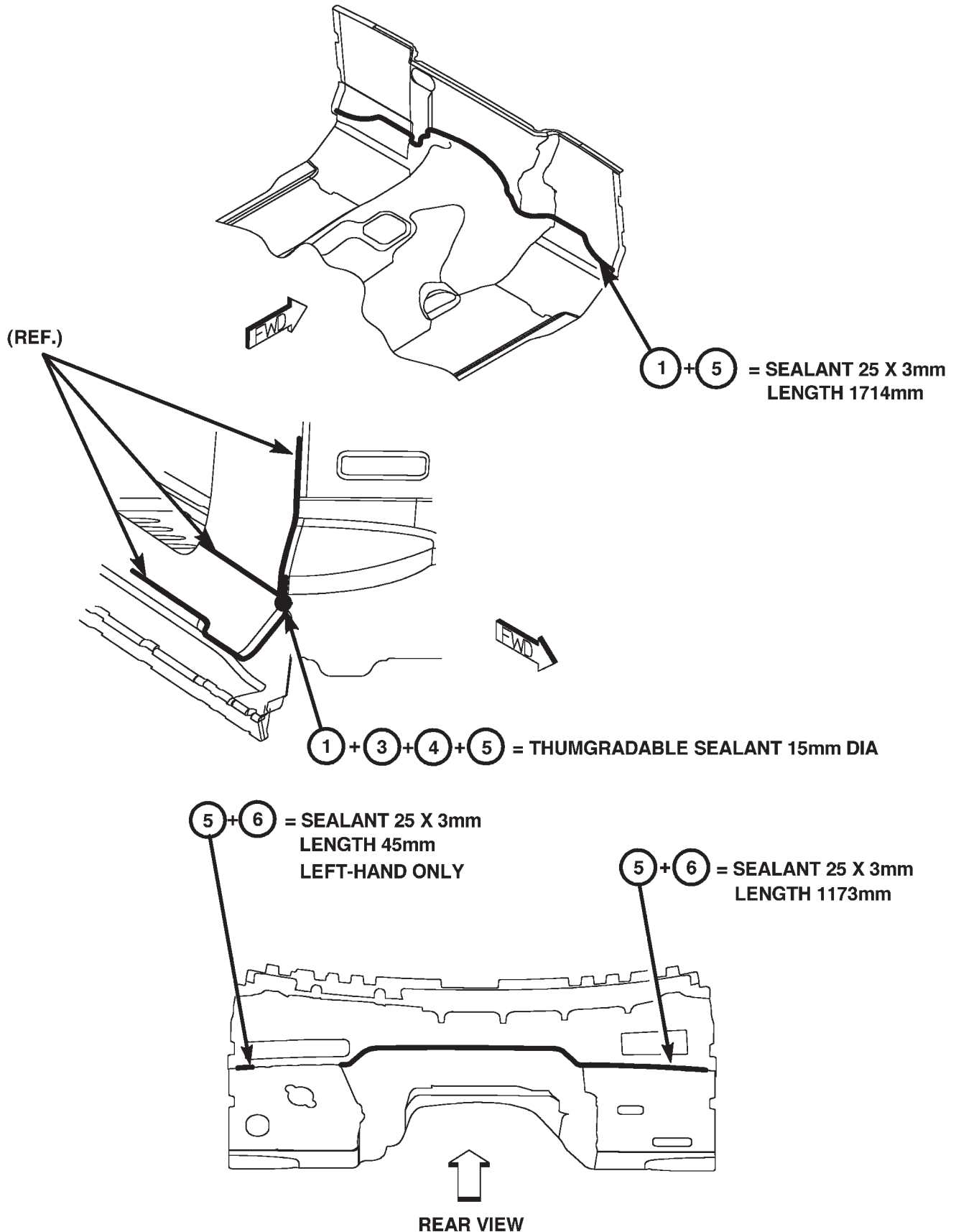


Fig. 81 FRONT FLOOR PAN & DASH PANEL



SEALER LOCATIONS (Continued)

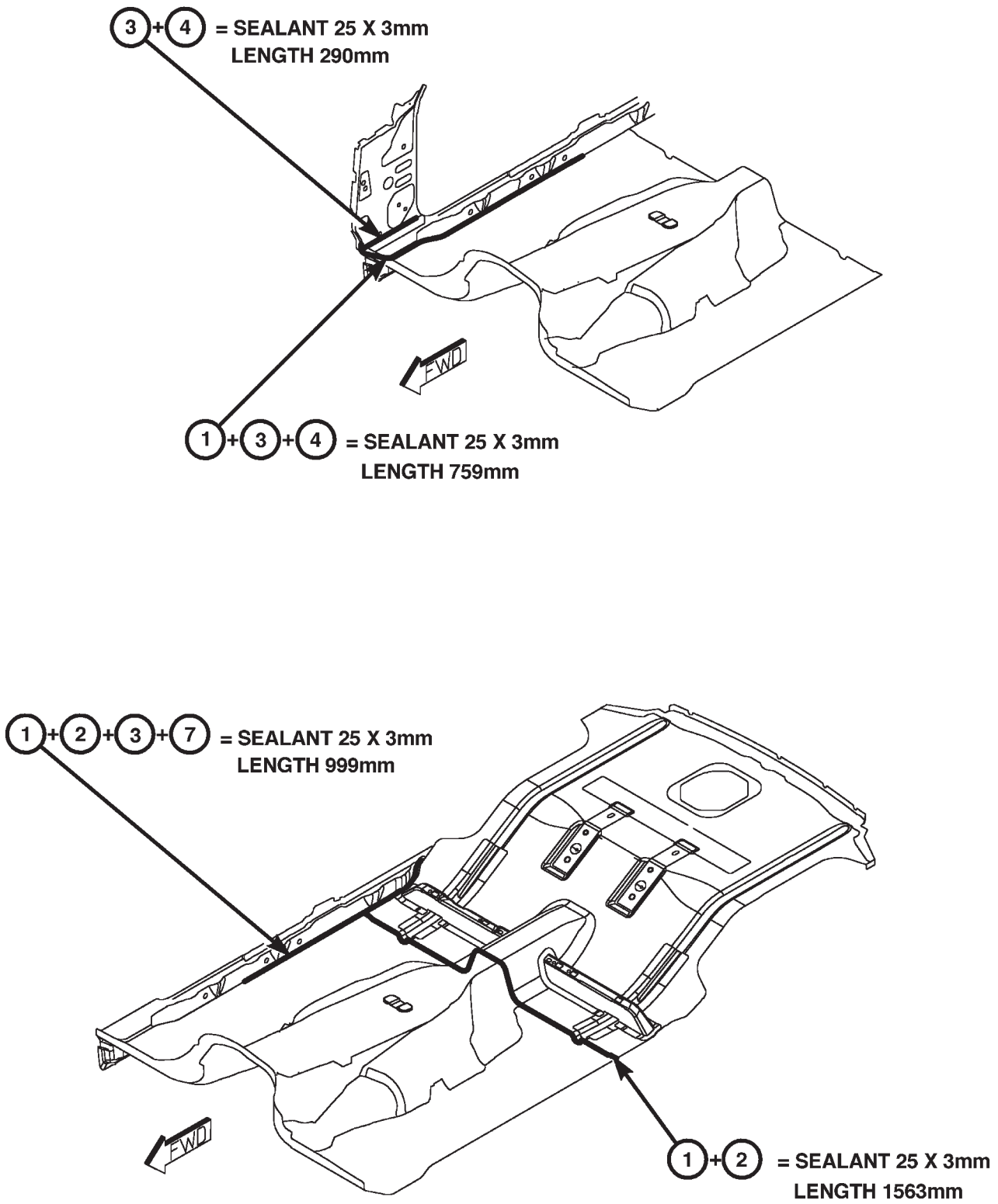


Fig. 82 FLOOR PAN

SEALER LOCATIONS (Continued)

- ① PLENUM BAFFLE PANEL
  - ② LOWER PLENUM PANEL
  - ③ PLENUM PANEL
  - ④ DASH PANEL
  - ⑤ BODY SIDE INNER PANEL
  - ⑥ A-PILLAR REINFORCEMENT
- ⑦ BODY SIDE OUTER PANEL
  - ⑧ COWL SIDE PANEL

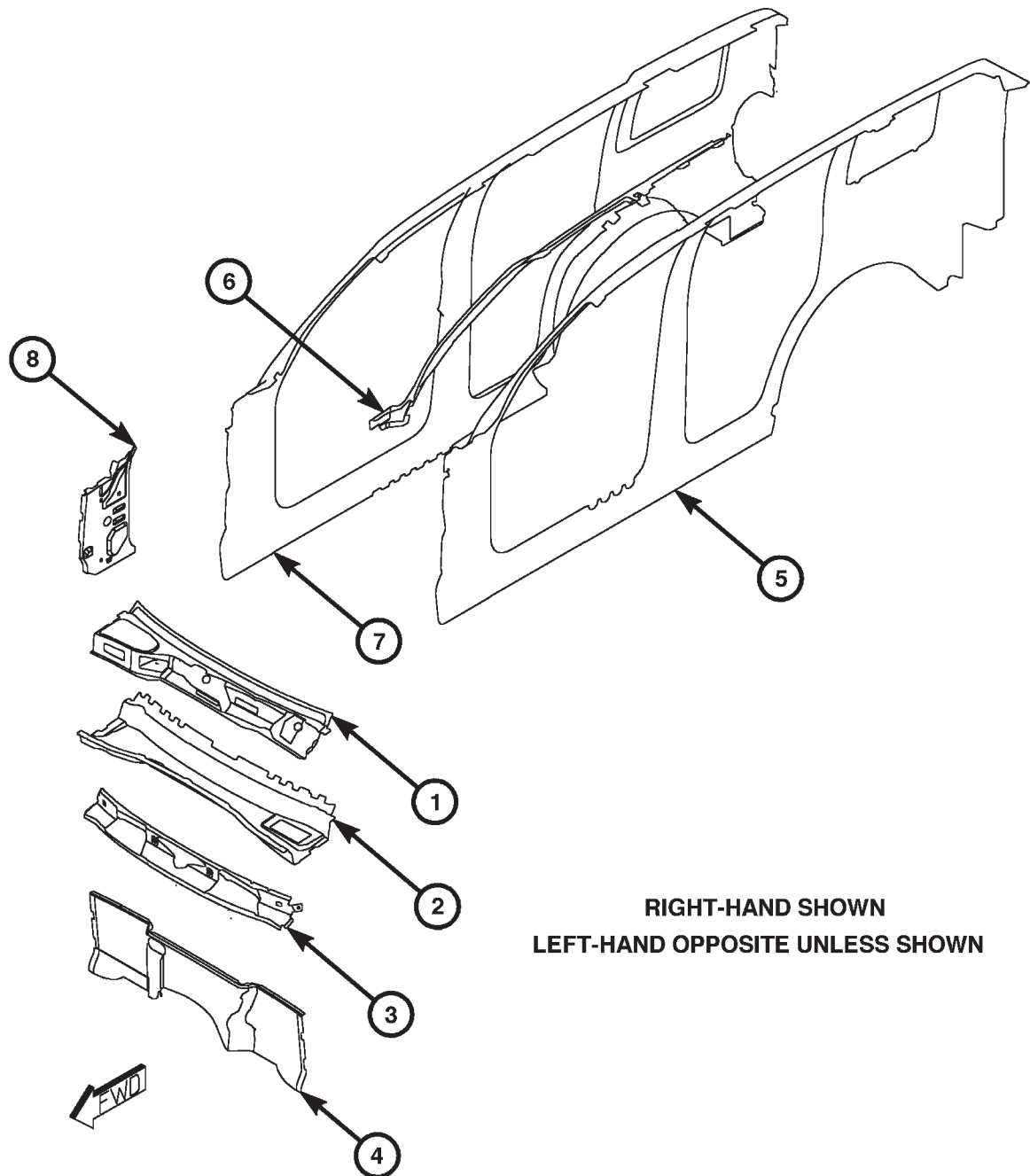
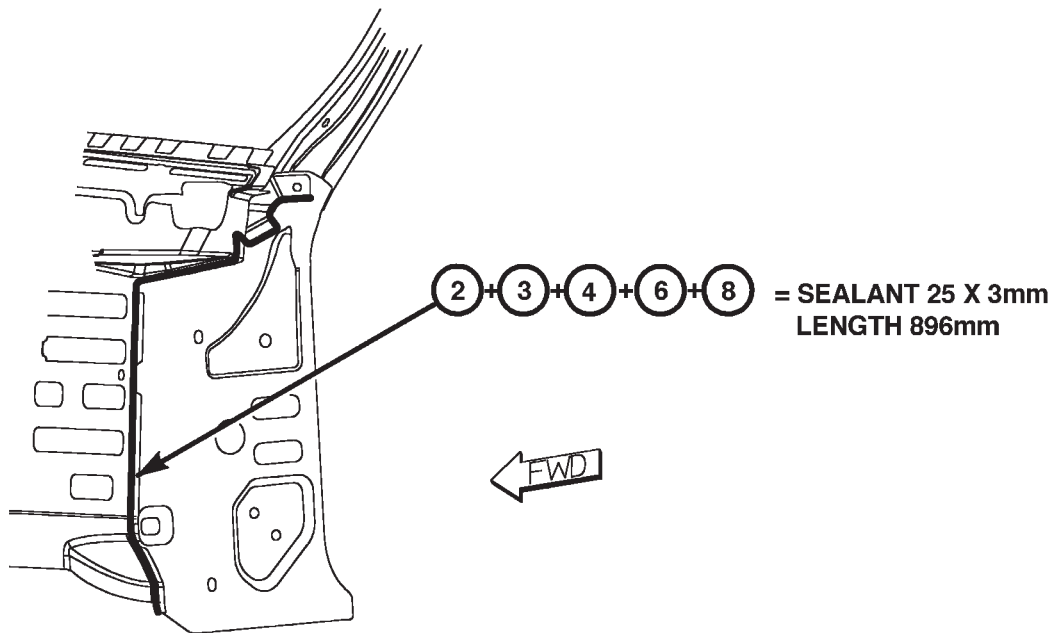
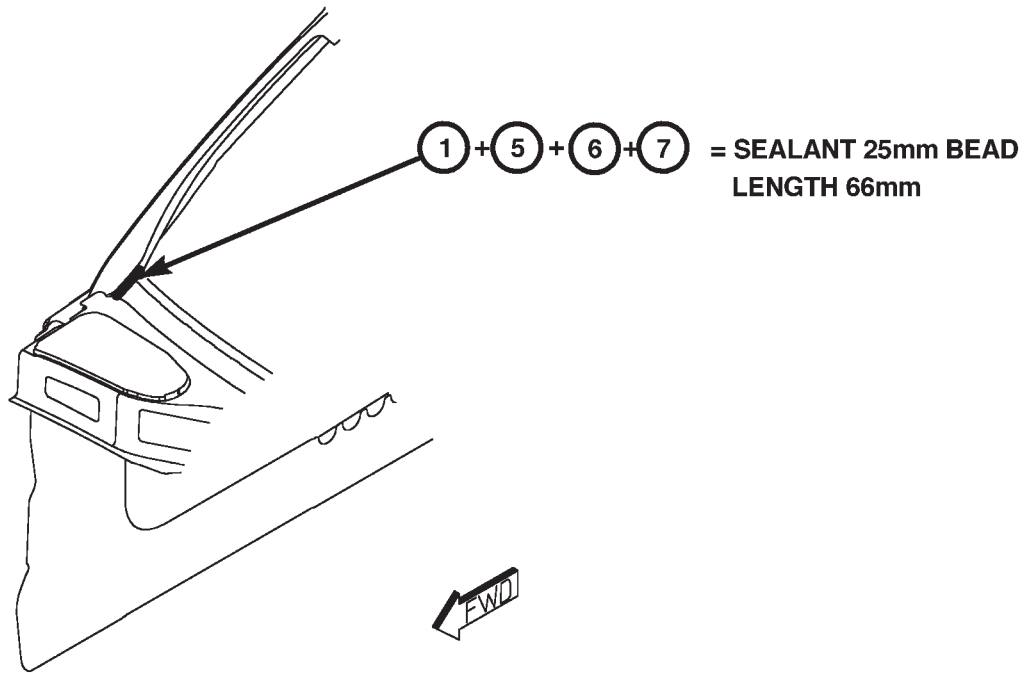


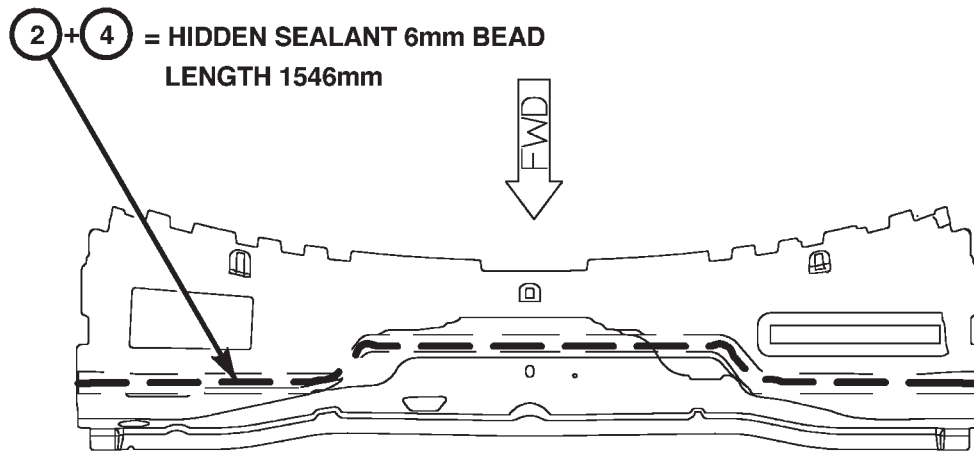
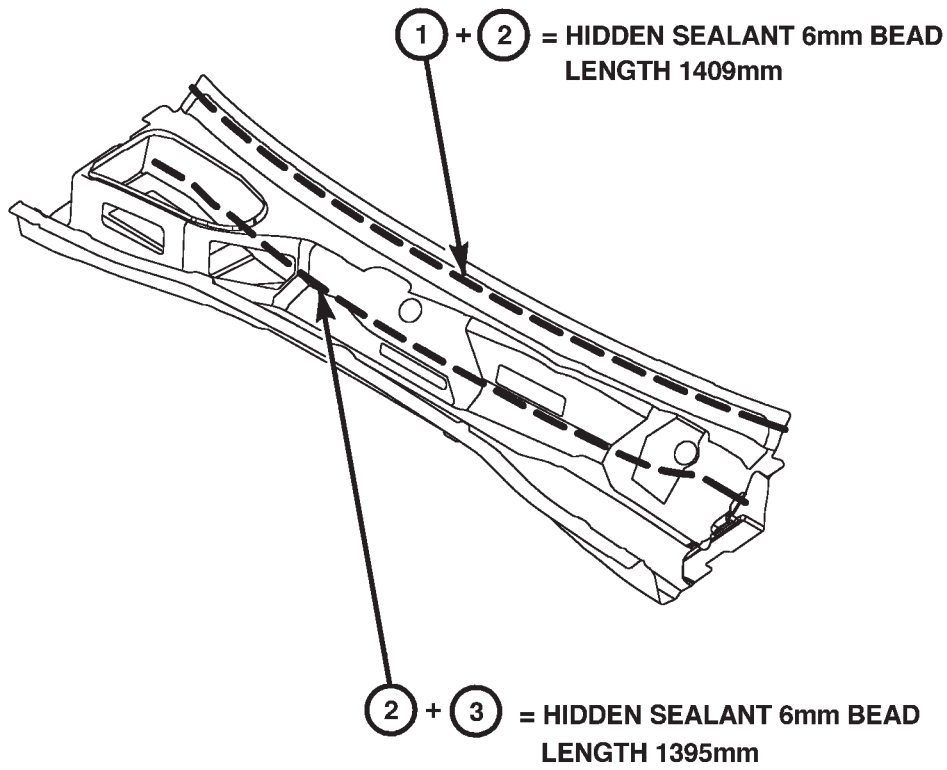
Fig. 83 BODY SIDE PANEL ASSEMBLY

SEALER LOCATIONS (Continued)



**Fig. 84 A-PILLAR & DASH PANEL**

SEALER LOCATIONS (Continued)



PLAN VIEW

Fig. 85 PLENUM AND DASH PANEL

SEALER LOCATIONS (Continued)

- ① BODY SIDE OUTER PANEL
- ② BODY SIDE INNER PANEL
- ③ A-PILLAR REINFORCEMENT
- ④ B-PILLAR REINFORCEMENT
- ⑤ OUTER WHEELHOUSE

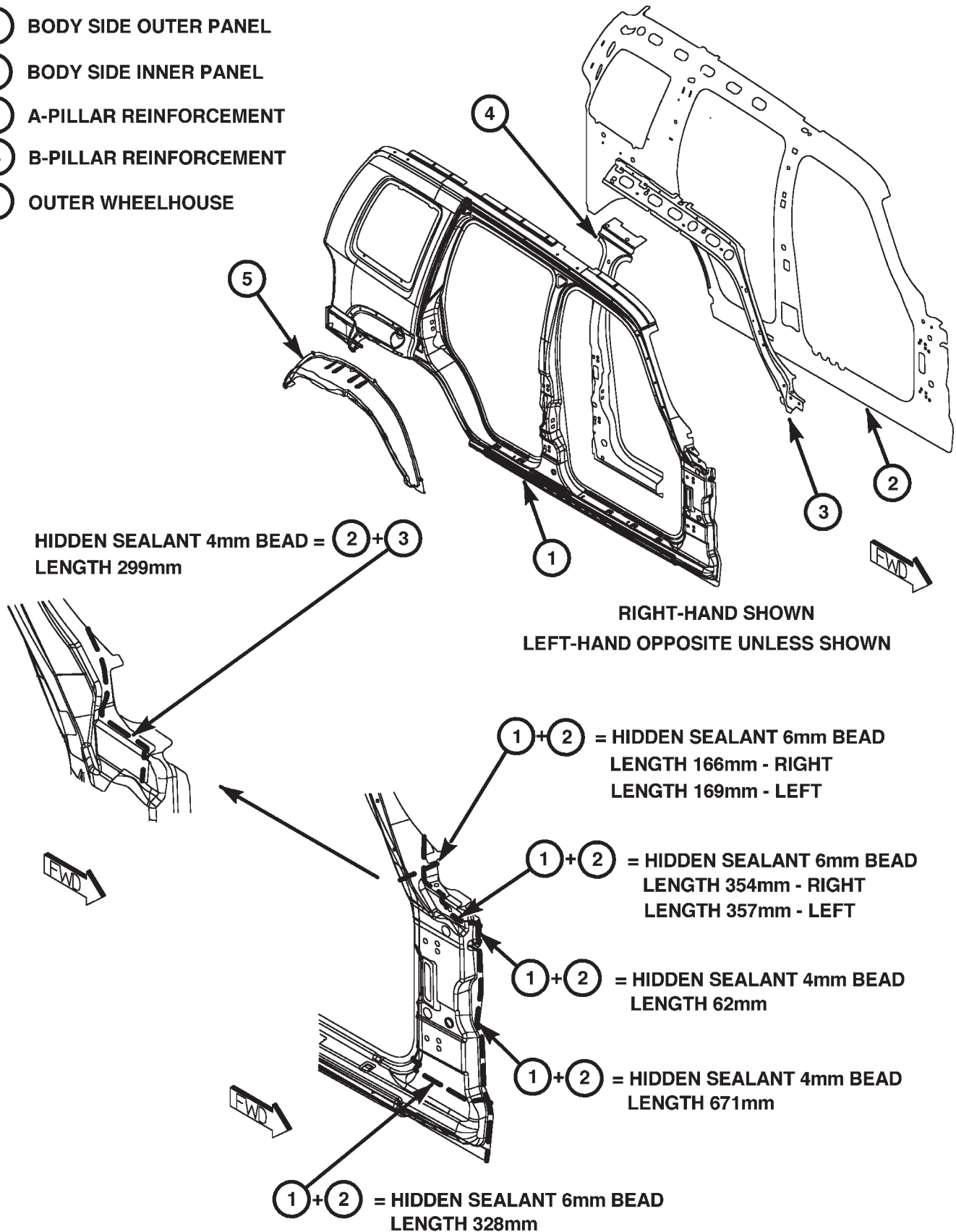


Fig. 86 BODY SIDE PANEL ASSEMBLIES

SEALER LOCATIONS (Continued)

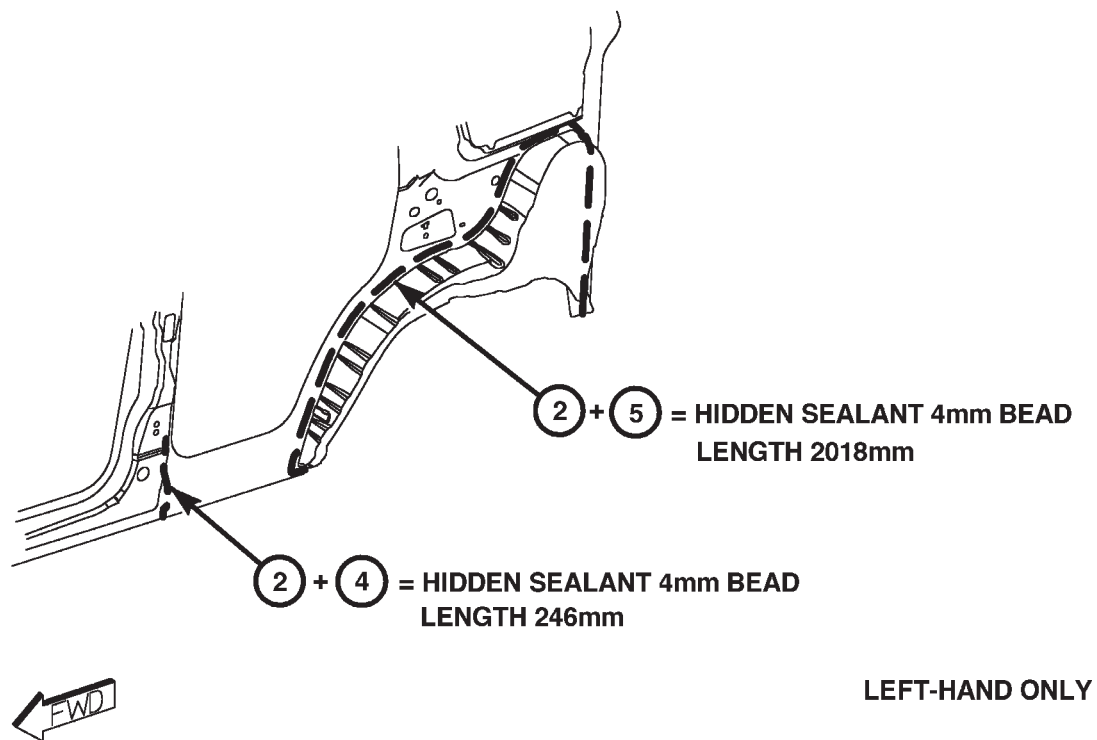
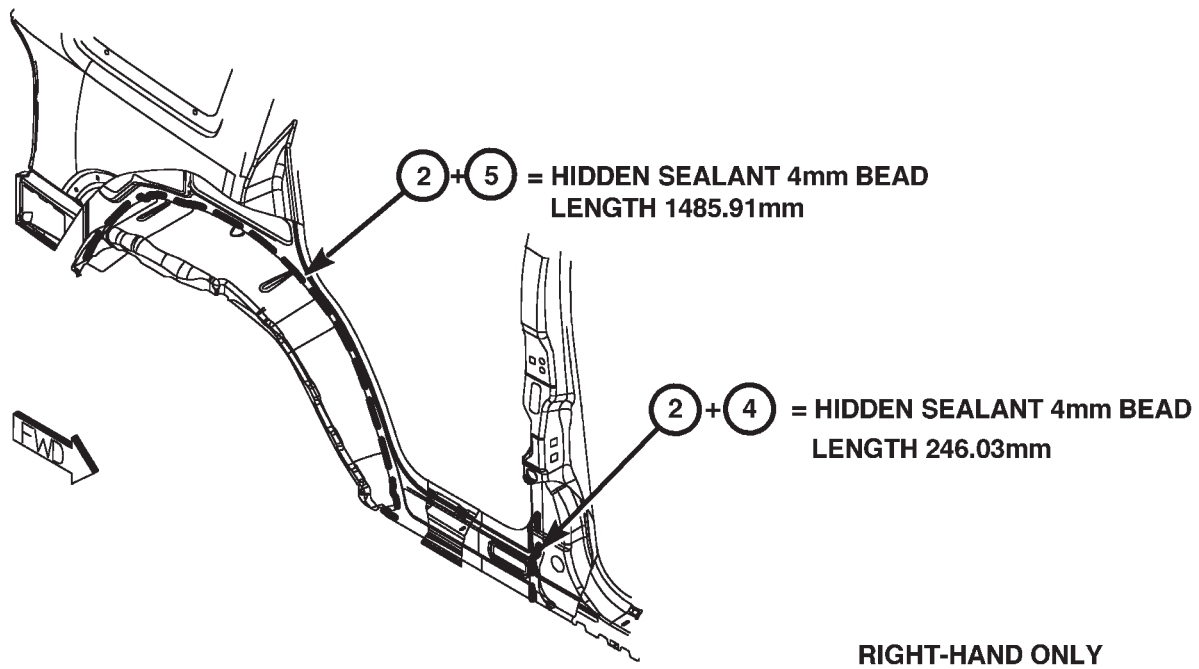
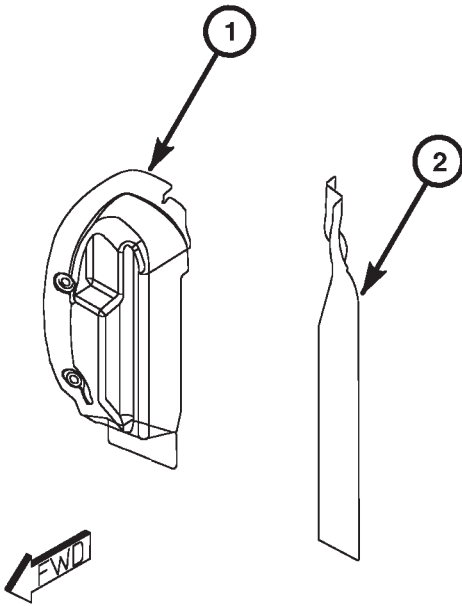


Fig. 87 WHEELHOUSES

SEALER LOCATIONS (Continued)

- ① TAIL LAMP MOUNTING GATE PANEL - RIGHT
- ② GATE STRIKER REINFORCEMENT



RIGHT-HAND ONLY

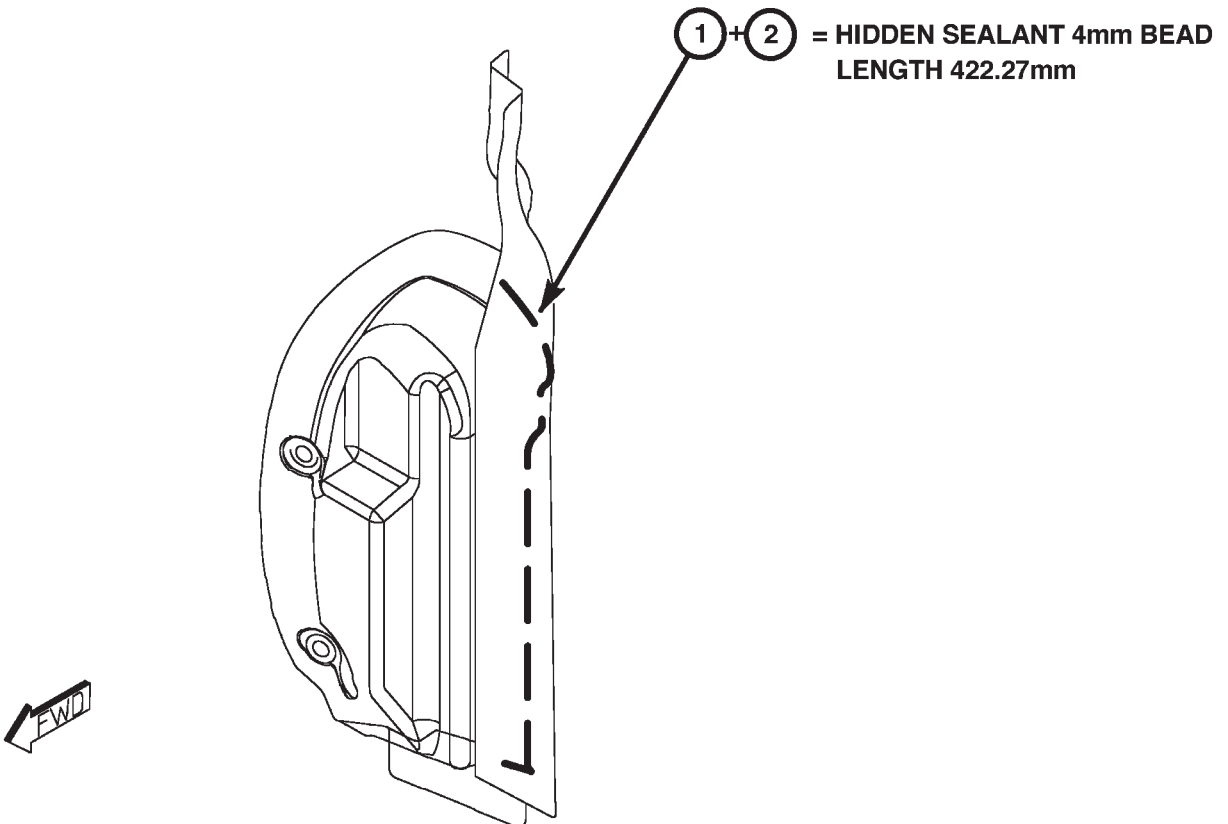


Fig. 88 TAIL LAMP MOUNTING

SEALER LOCATIONS (Continued)

- ① ROOF PANEL
- ② REAR GATE OPENING PANEL
- ③ BODY SIDE OUTER PANEL
- ④ TAIL LAMP MOUNTING PANEL
- ⑤ GATE STRIKER REINFORCEMENT
- ⑥ REAR CROSSMEMBER
- ⑦ TAIL LAMP EXTENSION

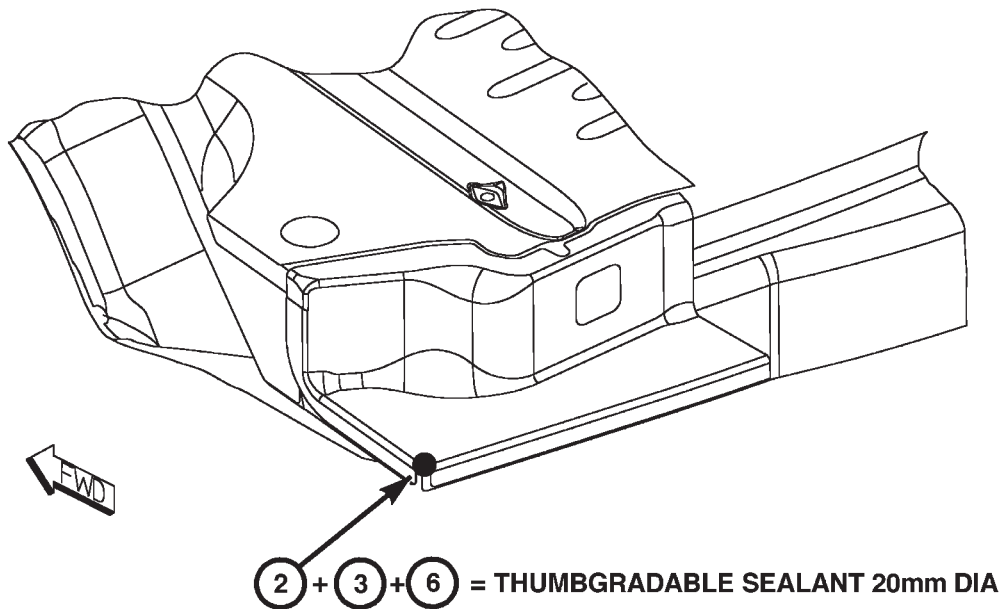
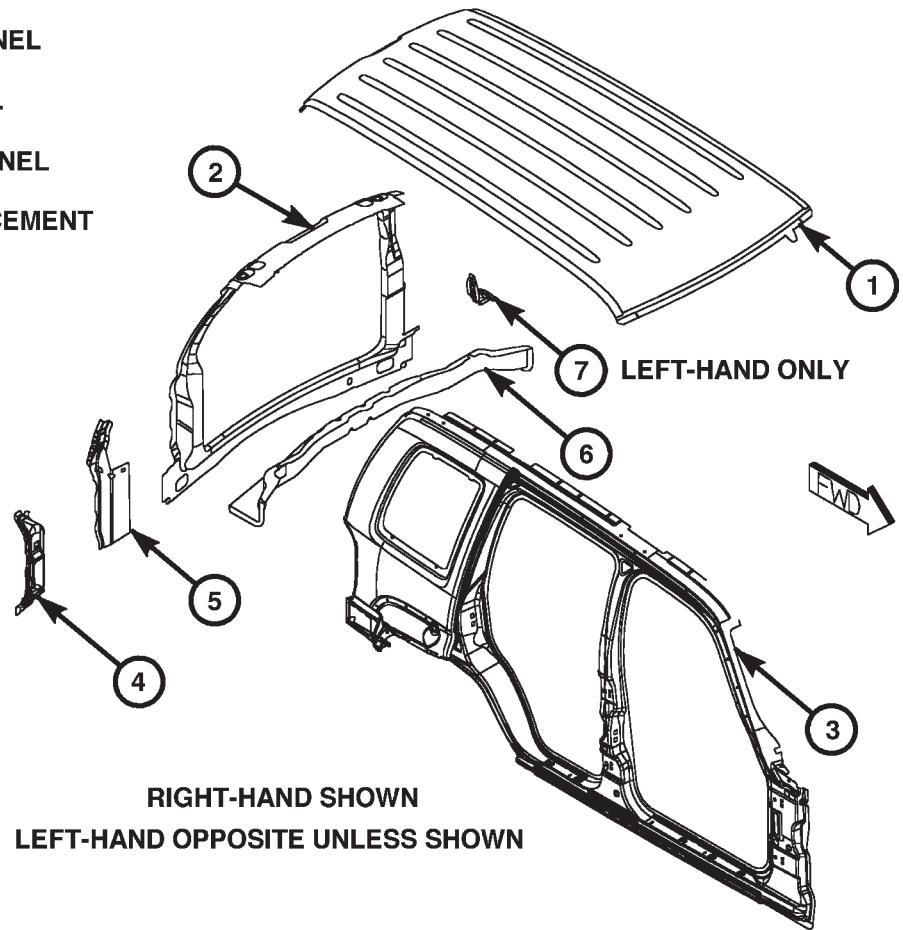


Fig. 89 ROOF PANEL & BODY SIDE SILL ASSEMBLY



SEALER LOCATIONS (Continued)

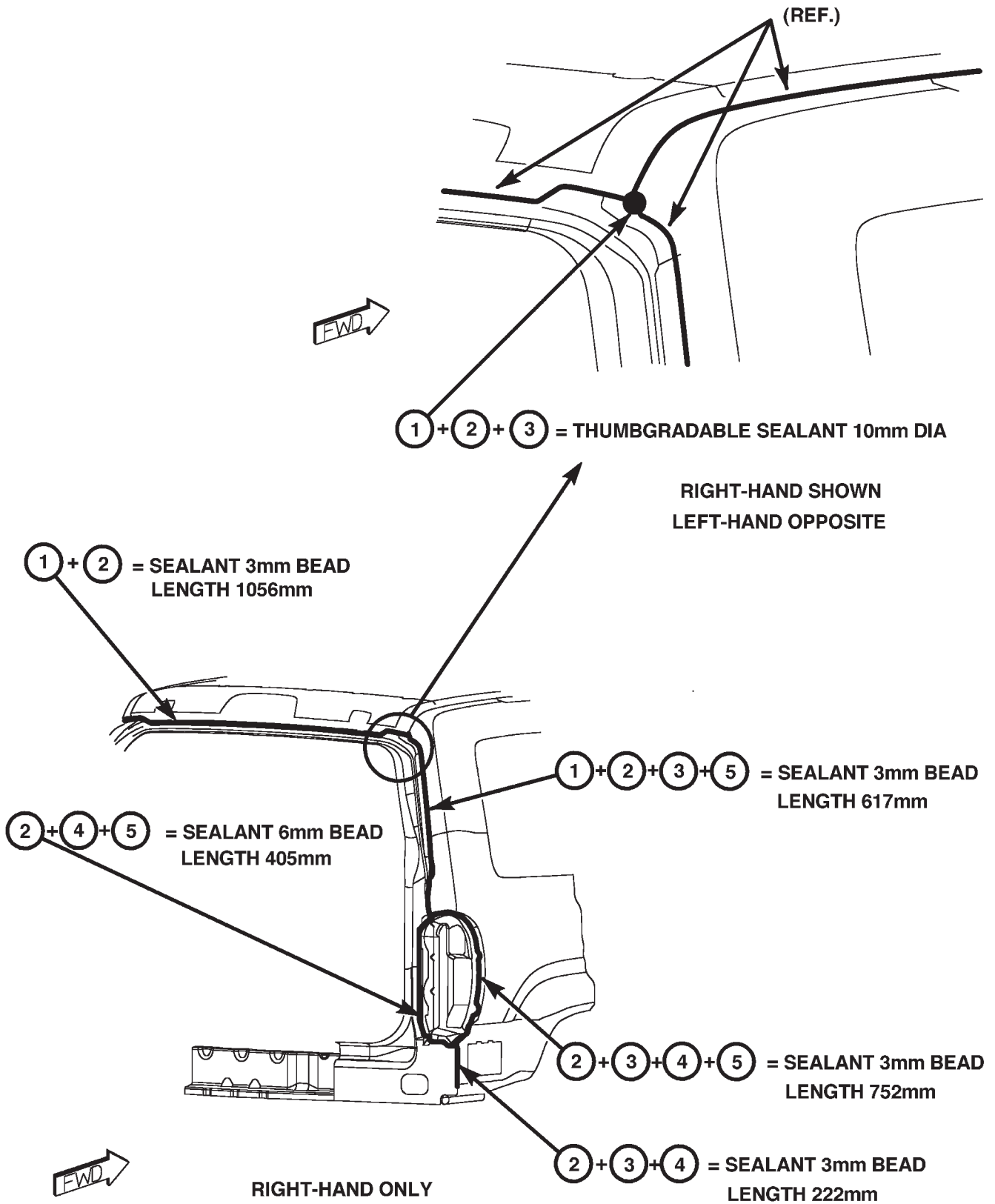


Fig. 90 SWING GATE OPENING

SEALER LOCATIONS (Continued)

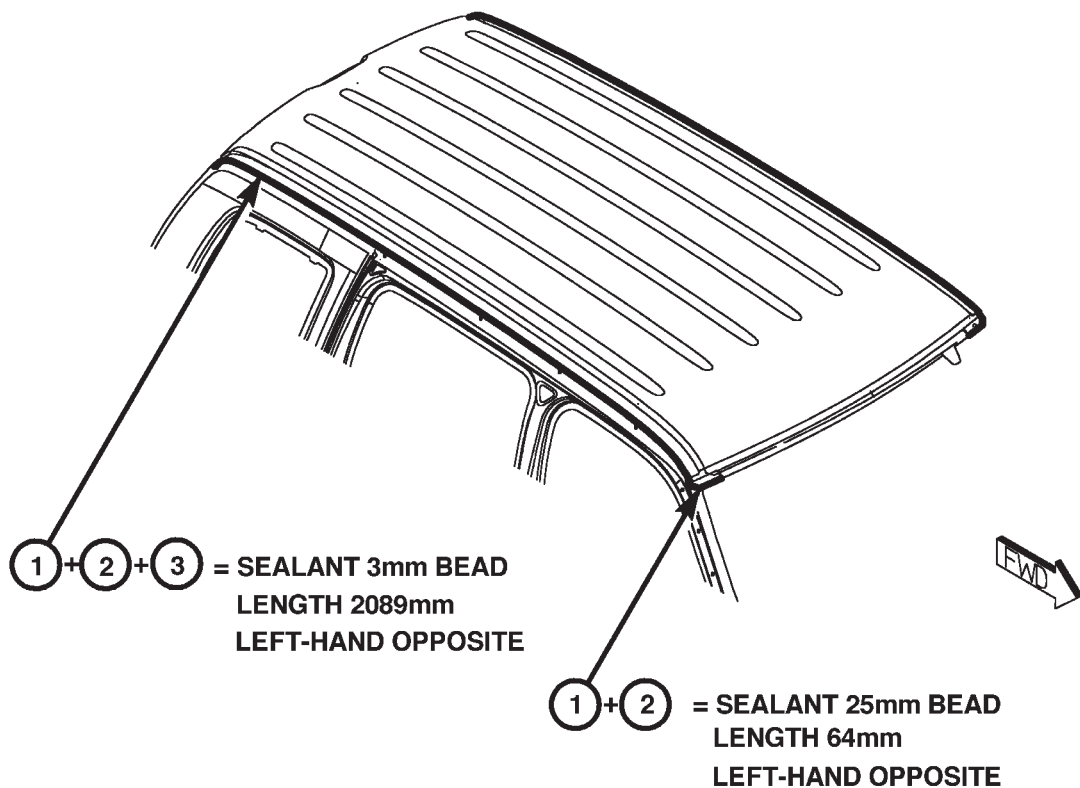
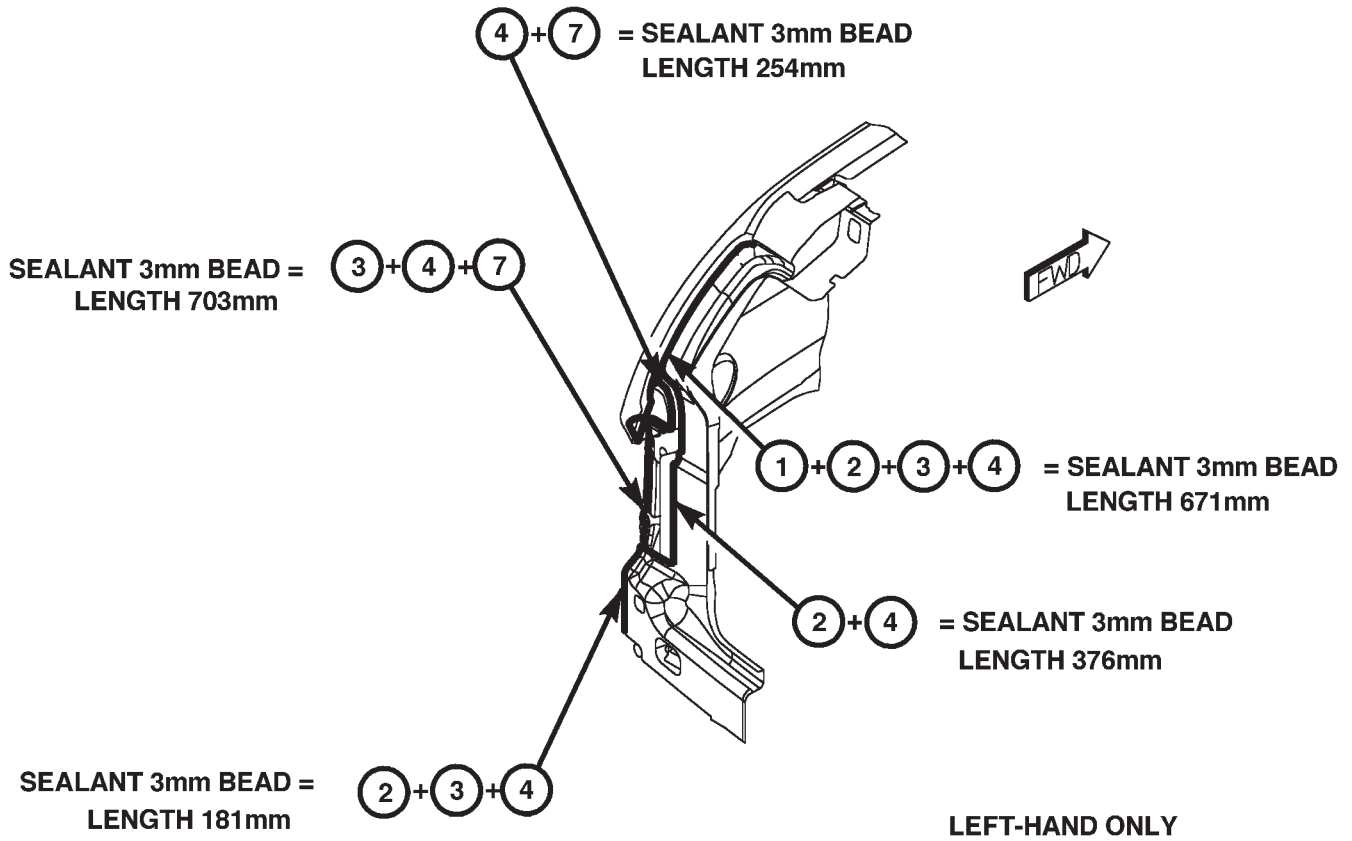


Fig. 91 ROOF PANEL; SWING GATE OPENING

SEALER LOCATIONS (Continued)

- |   |                          |
|---|--------------------------|
| ① TAIL LAMP MOUNTING GATE PANEL - RIGHT | ⑥ BODY SIDE INNER PANEL  |
| ② GATE STRIKER REINFORCEMENT            | ⑦ A-PILLAR REINFORCEMENT |
| ③ REAR GATE OPENING PANEL               | ⑧ BODY SIDE OUTER PANEL  |
| ④ REAR CROSSMEMBER                      | ⑨ BODY SIDE SILL         |
| ⑤ REAR FLOOR PAN                        | ⑩ COWL SIDE PANEL        |

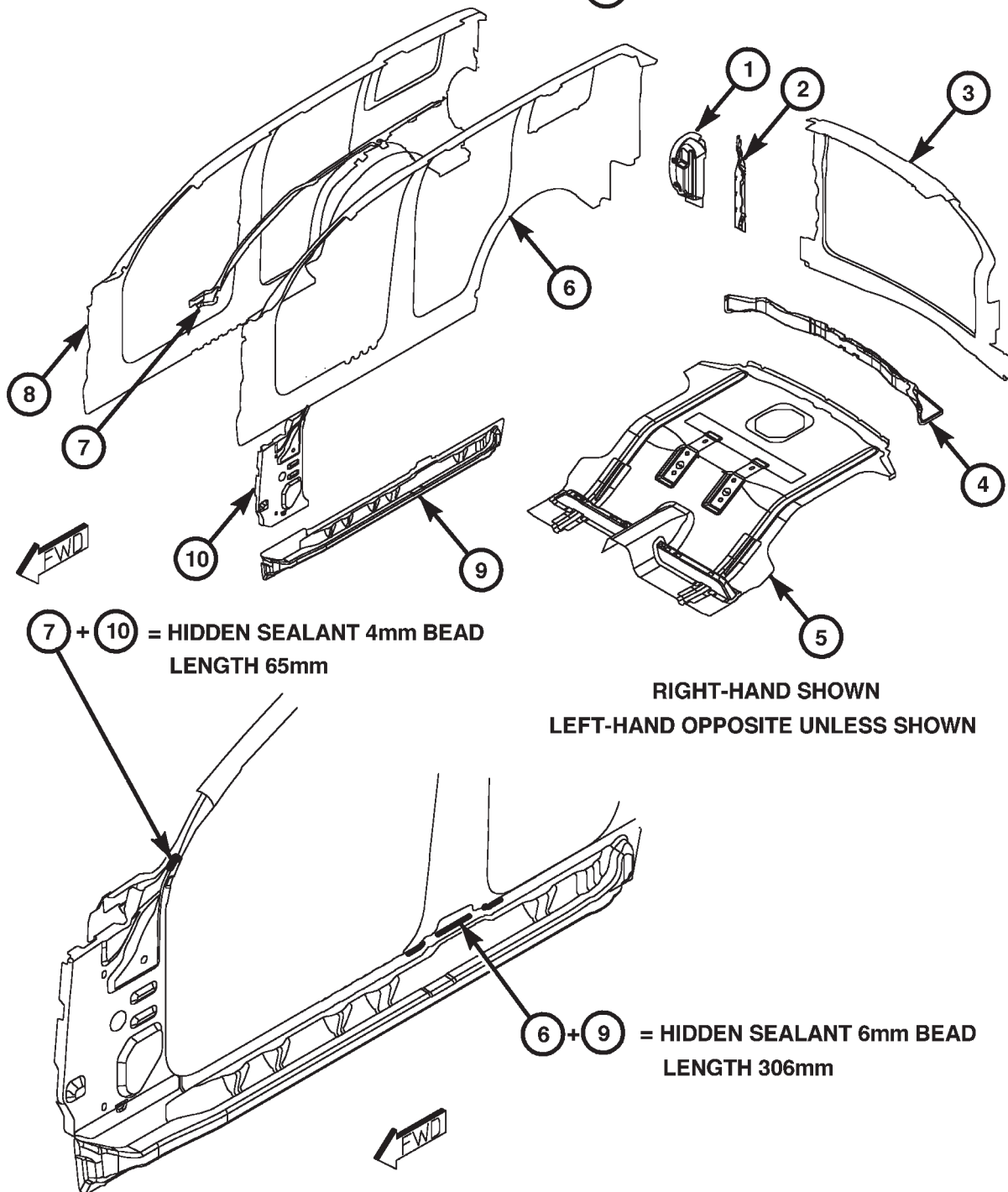


Fig. 92 BODY SIDE PANEL ASSEMBLY

SEALER LOCATIONS (Continued)

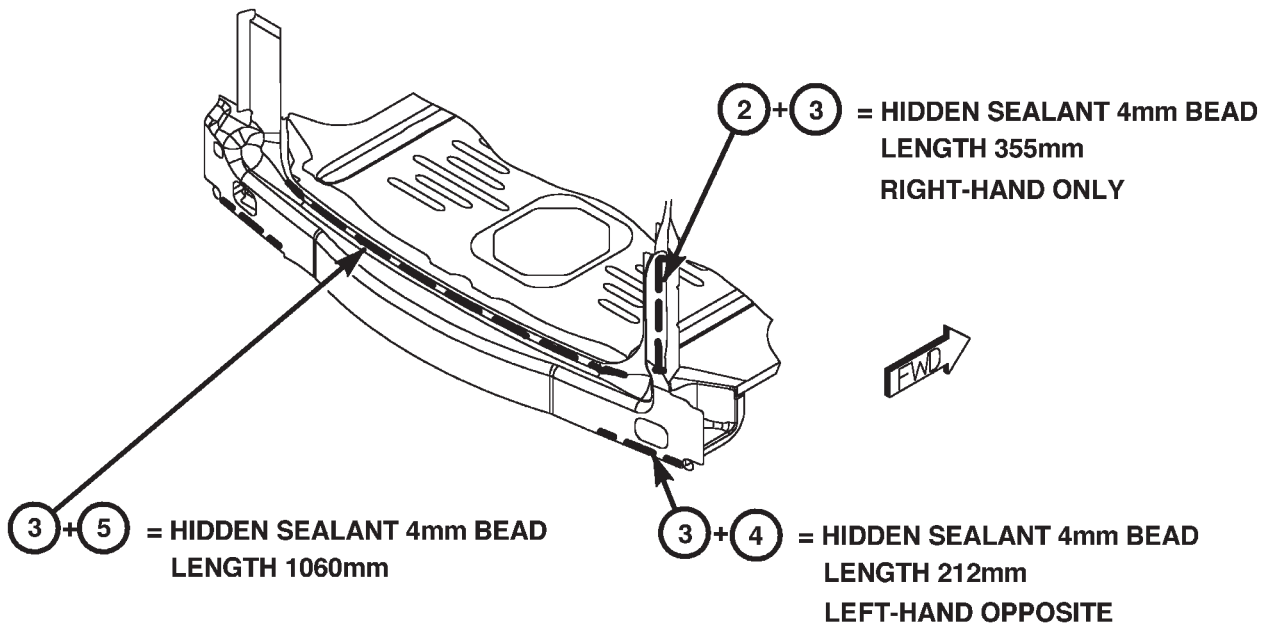
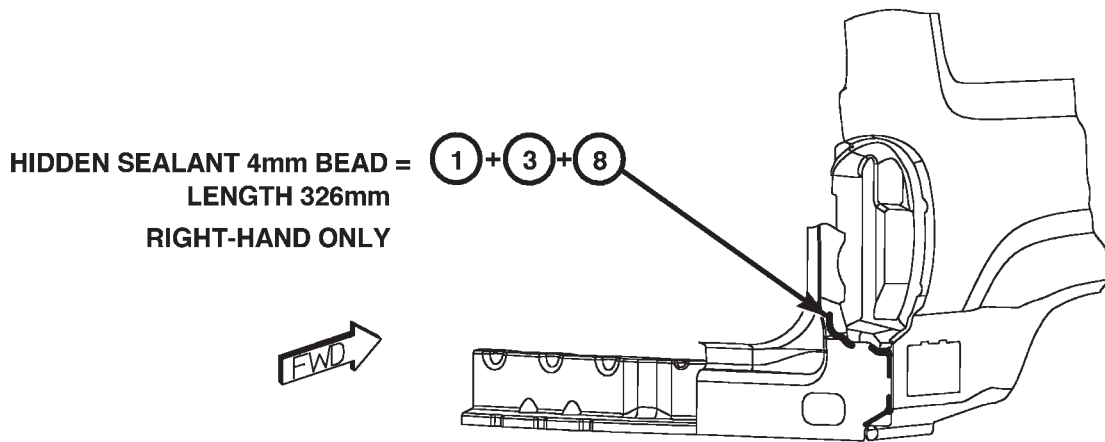
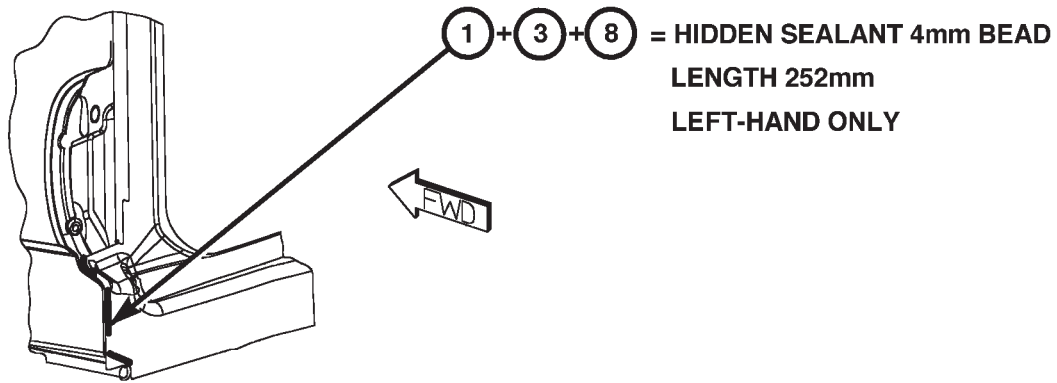


Fig. 93 SWING GATE OPENING

SEALER LOCATIONS (Continued)

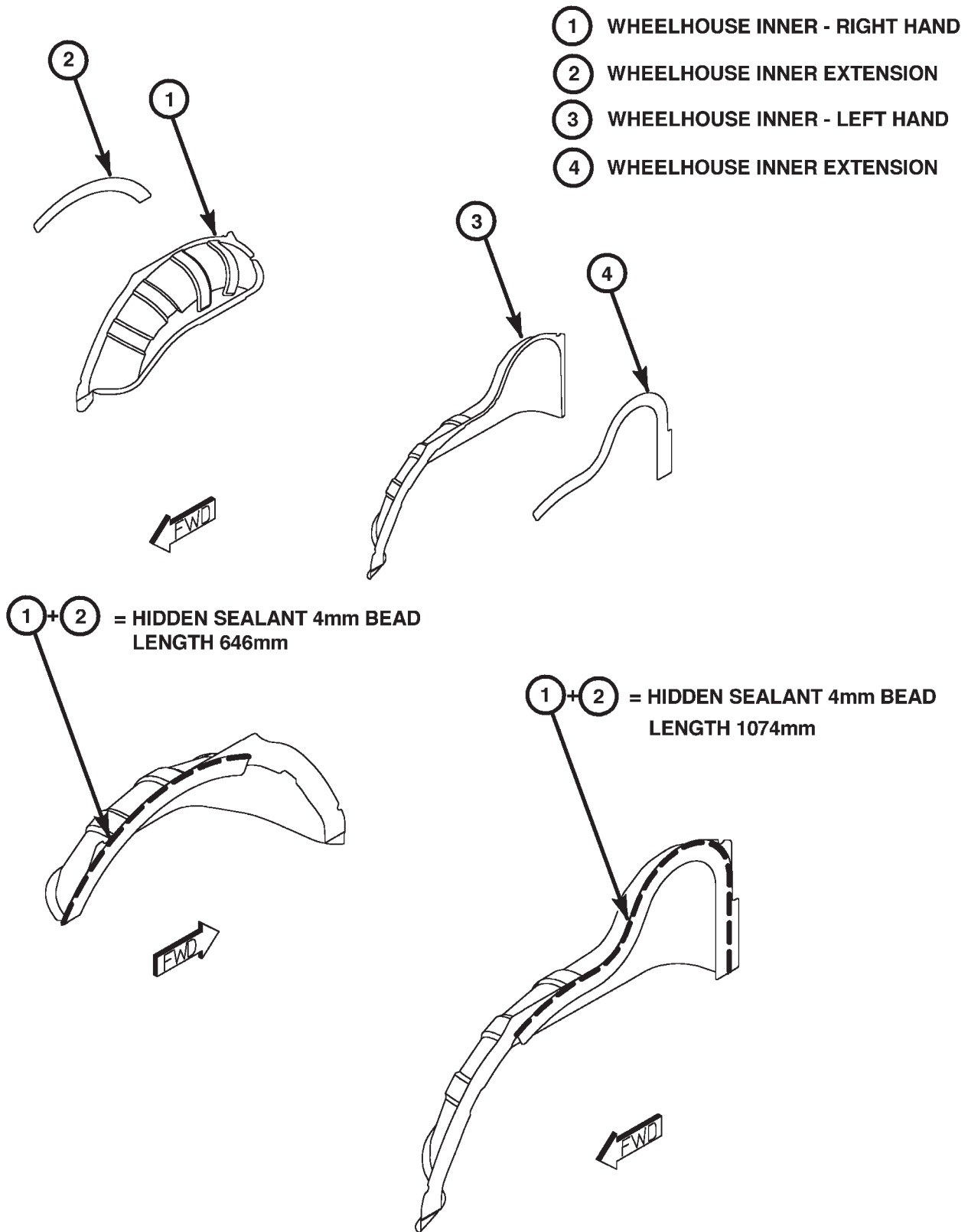


Fig. 94 WHEELHOUSES

SEALER LOCATIONS (Continued)

- ① BODY SIDE OUTER PANEL
- ② REAR OUTER WHEELHOUSE
- ③ WHEELHOUSE INNER EXTENSION
- ④ BODY SIDE INNER PANEL
- ⑤ REAR INNER WHEELHOUSE
- ⑥ BODY SIDE SILL
- ⑦ REAR FLOOR PAN
- ⑧ D-PILLAR LOWER TO FLOOR GUSSET
- ⑨ REAR CROSSMEMBER
- ⑩ REAR GATE OPENING PANEL

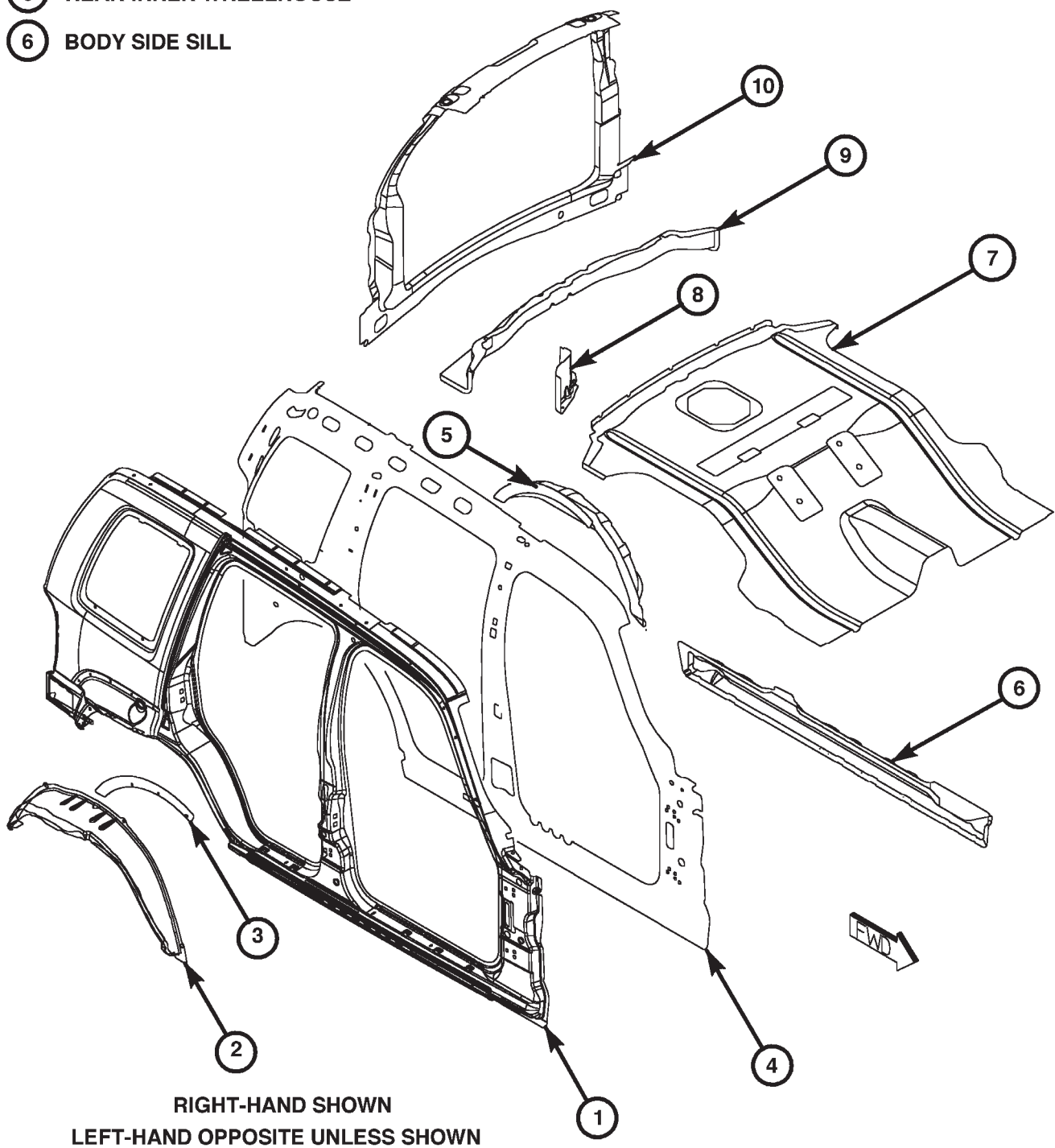


Fig. 95 BODY SIDE PANEL ASSEMBLY

SEALER LOCATIONS (Continued)

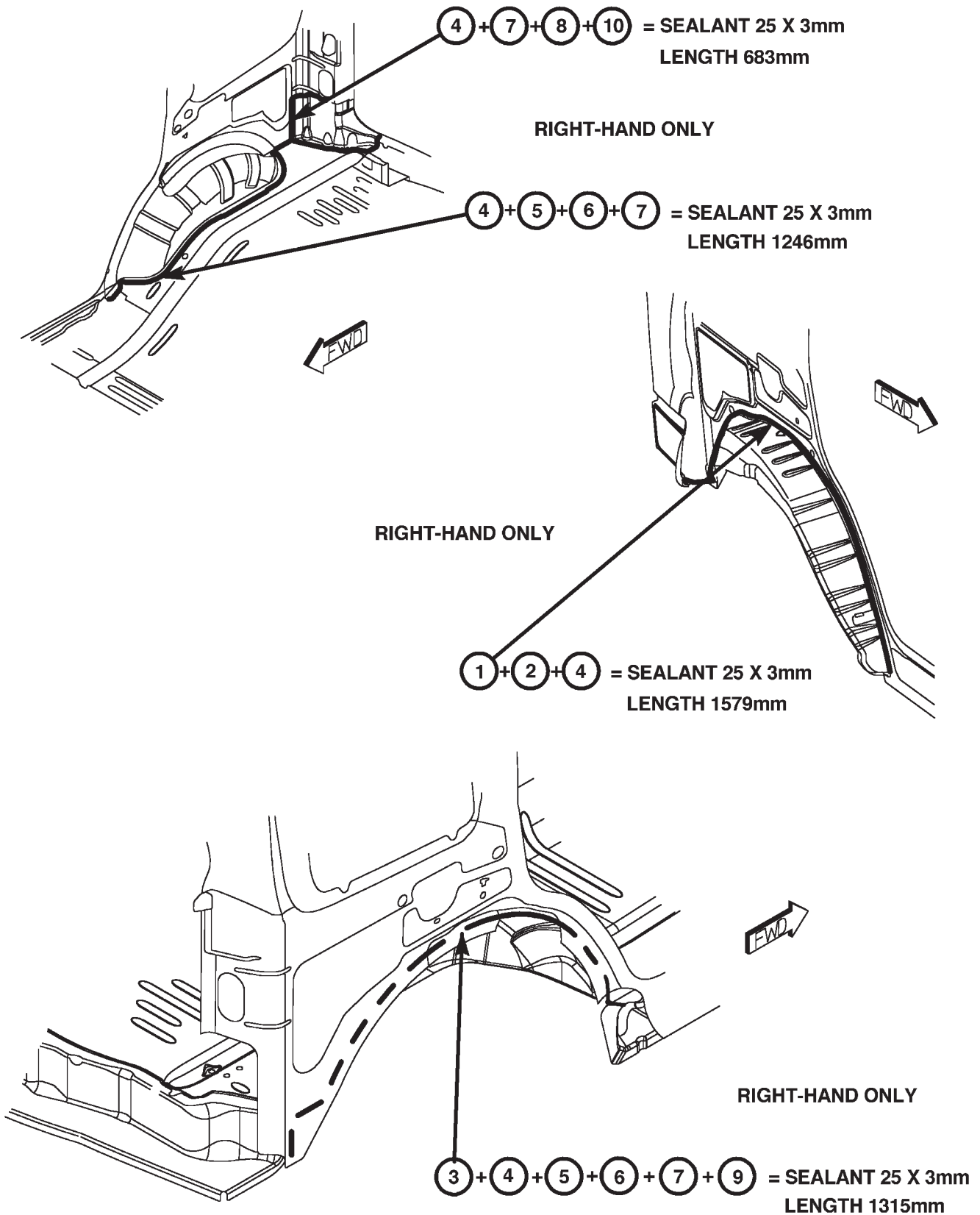


Fig. 96 WHEELHOUSES

SEALER LOCATIONS (Continued)

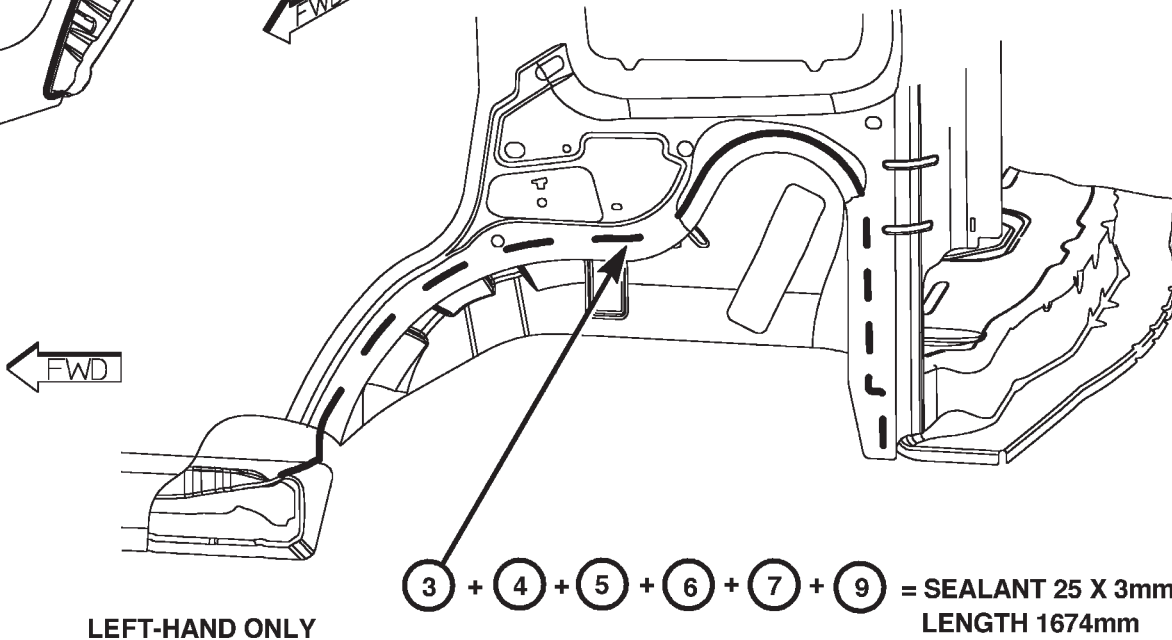
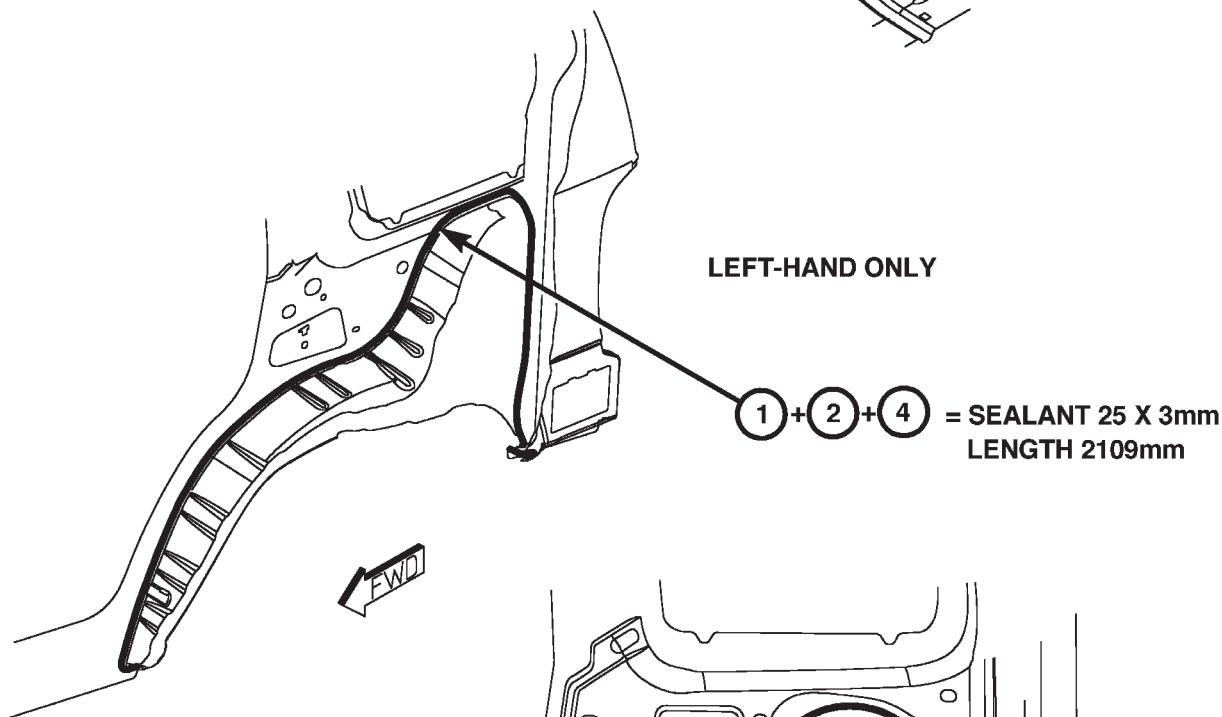
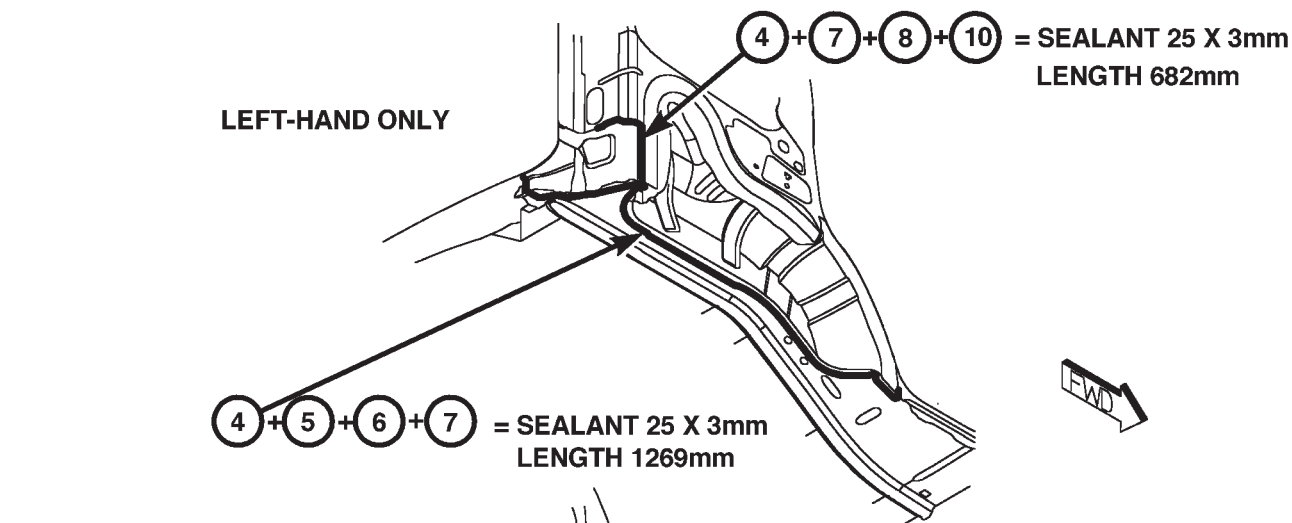
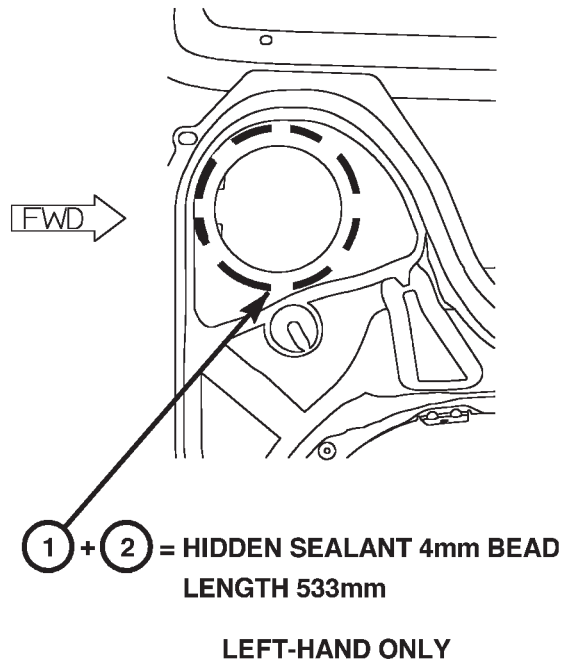


Fig. 97 WHEELHOUSES



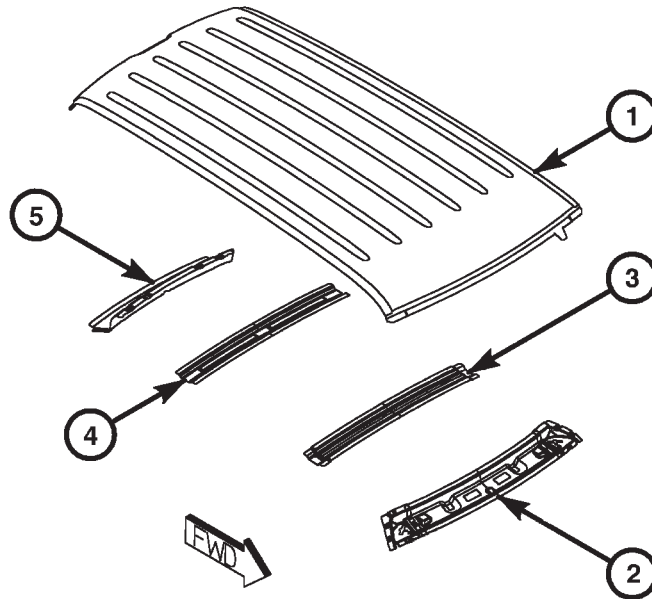
SEALER LOCATIONS (Continued)



*Fig. 98 WHEELHOUSE*

SEALER LOCATIONS (Continued)

- ① ROOF PANEL
- ② ROOF HEADER - FRONT
- ③ ROOF BOW - FRONT
- ④ ROOF BOW - REAR
- ⑤ ROOF HEADER - REAR



HIDDEN SEALANT = ① + ④  
4mm BEAD  
LENGTH 762mm

① + ③ = HIDDEN SEALANT 4mm BEAD  
LENGTH 672mm

① + ② = HIDDEN SEALANT 4mm BEAD  
LENGTH 916mm

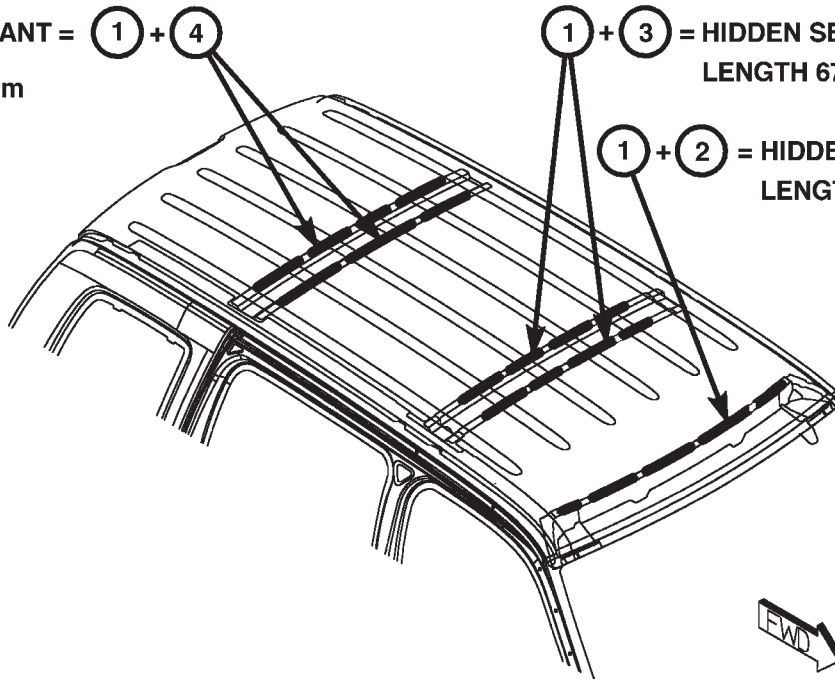
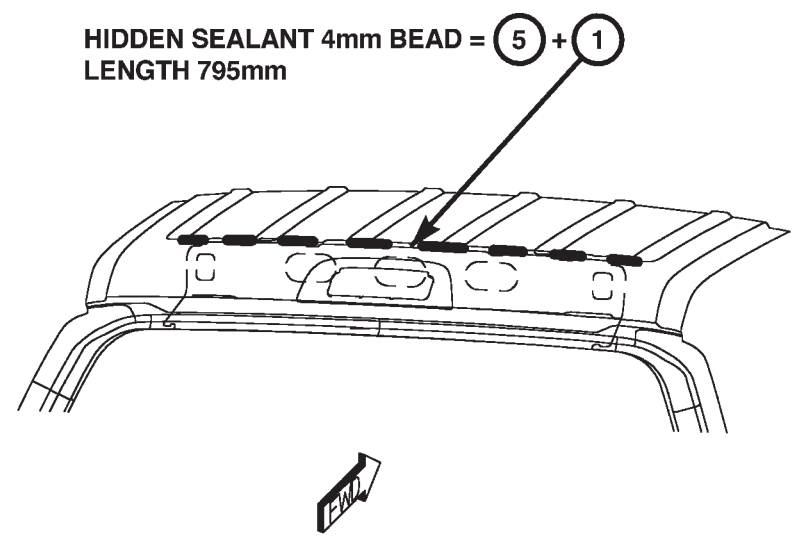


Fig. 99 ROOF PANEL ASSEMBLY

SEALER LOCATIONS (Continued)



*Fig. 100 ROOF PANEL/REAR ROOF HEADER*

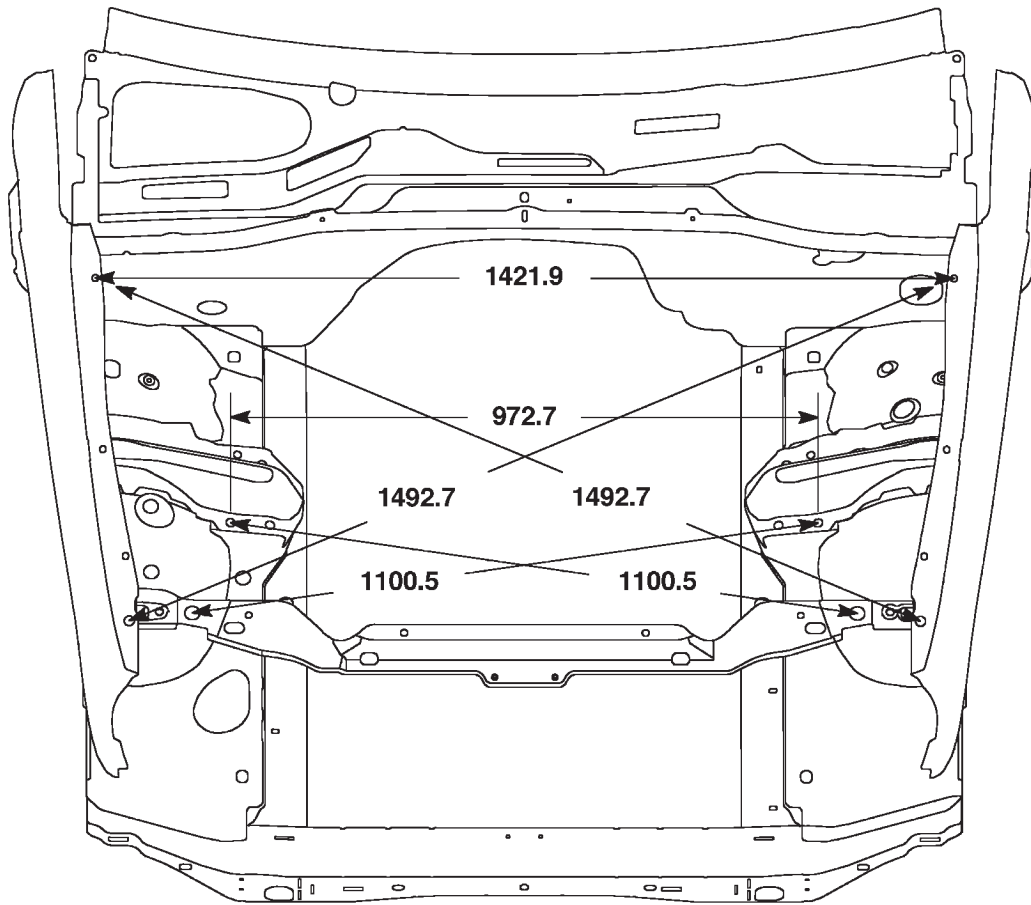
## OPENING DIMENSIONS

## SPECIFICATIONS

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WINDSHIELD OPENING	( 102 )
BODY SIDE OPENINGS	( 103 )
SWING GATE OPENING	( 104 )

OPENING DIMENSIONS (Continued)



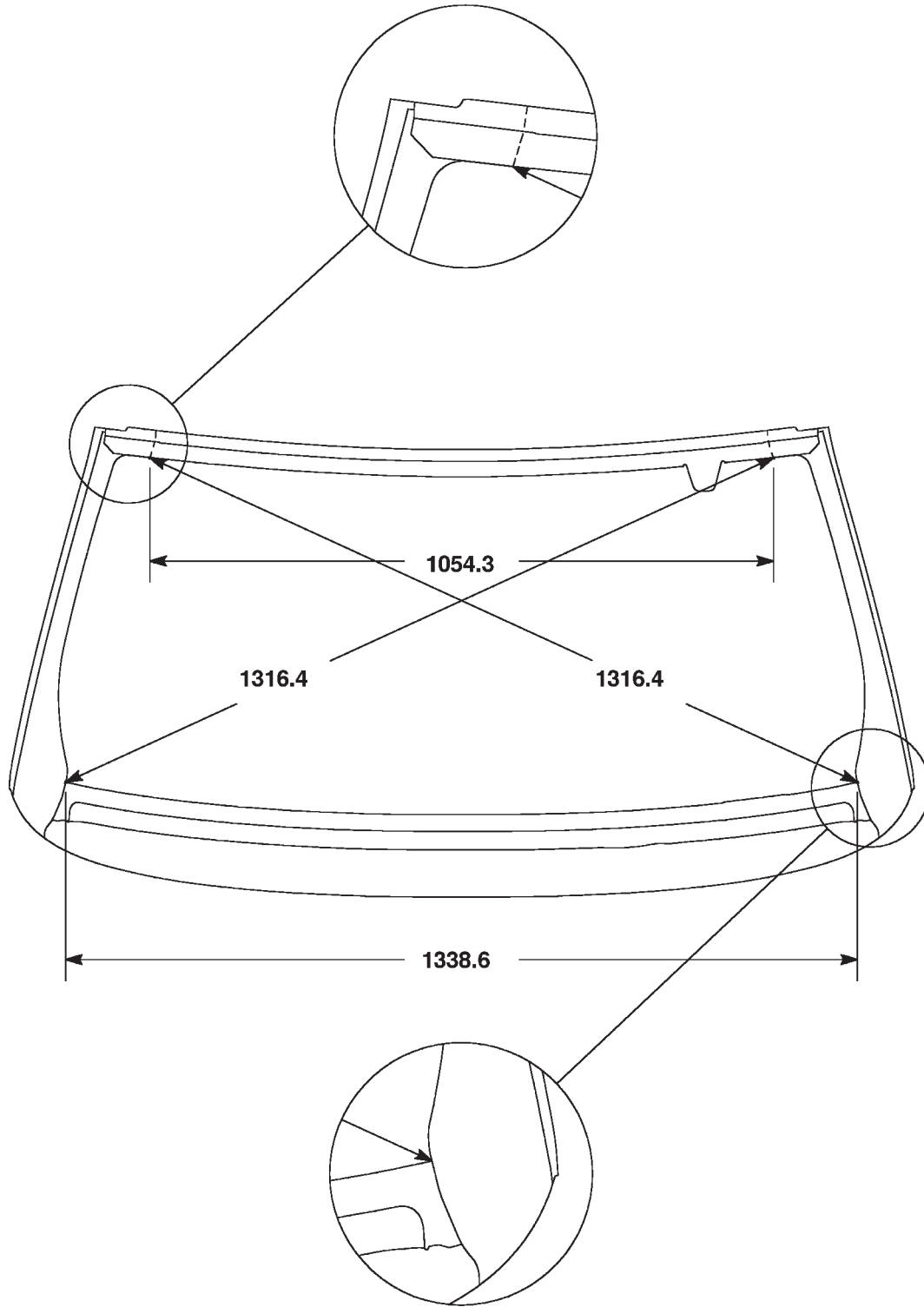
ALL DIMENSIONS ACTUAL

ALL DIMENSIONS IN mm

ALL DIMENSIONS ARE FROM  
CENTER OF PLP OR  
CONSTANT HOLE CENTER.

Fig. 101 ENGINE COMPARTMENT

OPENING DIMENSIONS (Continued)



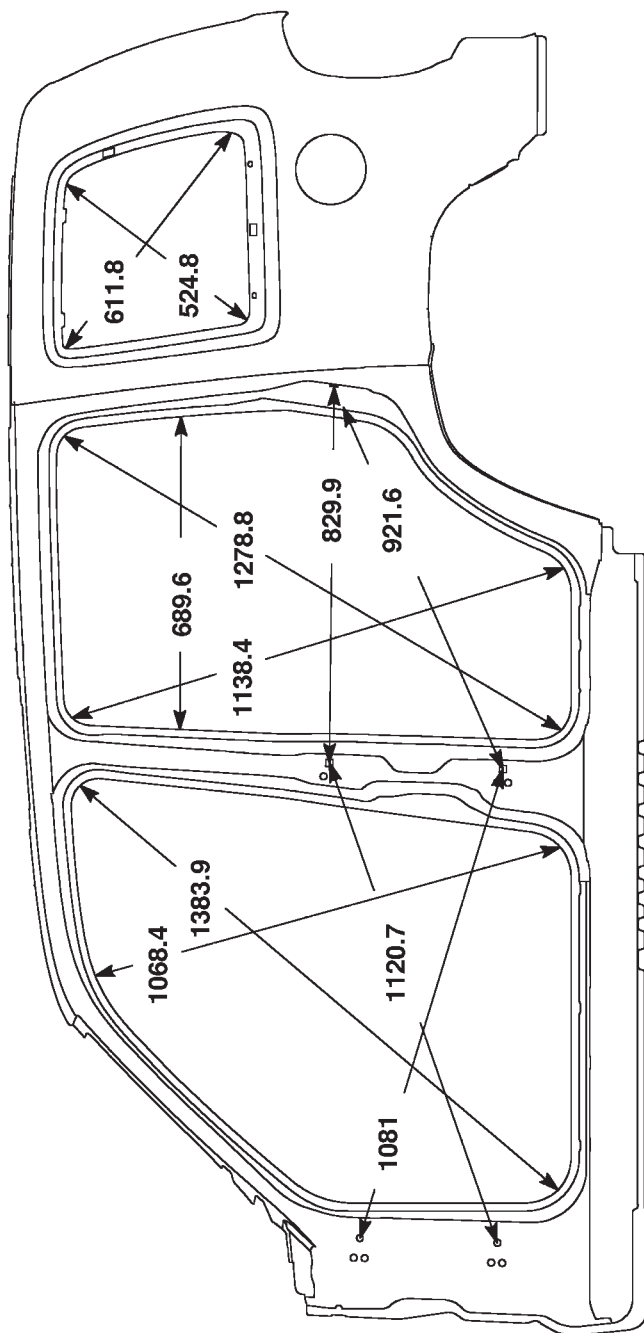
ALL DIMENSIONS ACTUAL

ALL DIMENSIONS IN mm

ALL DIMENSIONS ARE FROM  
PANEL CONNECTIONS.

Fig. 102 WINDSHIELD OPENING

OPENING DIMENSIONS (Continued)



ALL DIMENSIONS ARE FROM  
CENTER OF PLP OR  
CONSTANT HOLE CENTER  
AND CENTER OF RADIUS TO  
CENTER OF RADIUS.

ALL DIMENSIONS ACTUAL  
ALL DIMENSIONS IN mm

Fig. 103 BODY SIDE OPENINGS

OPENING DIMENSIONS (Continued)

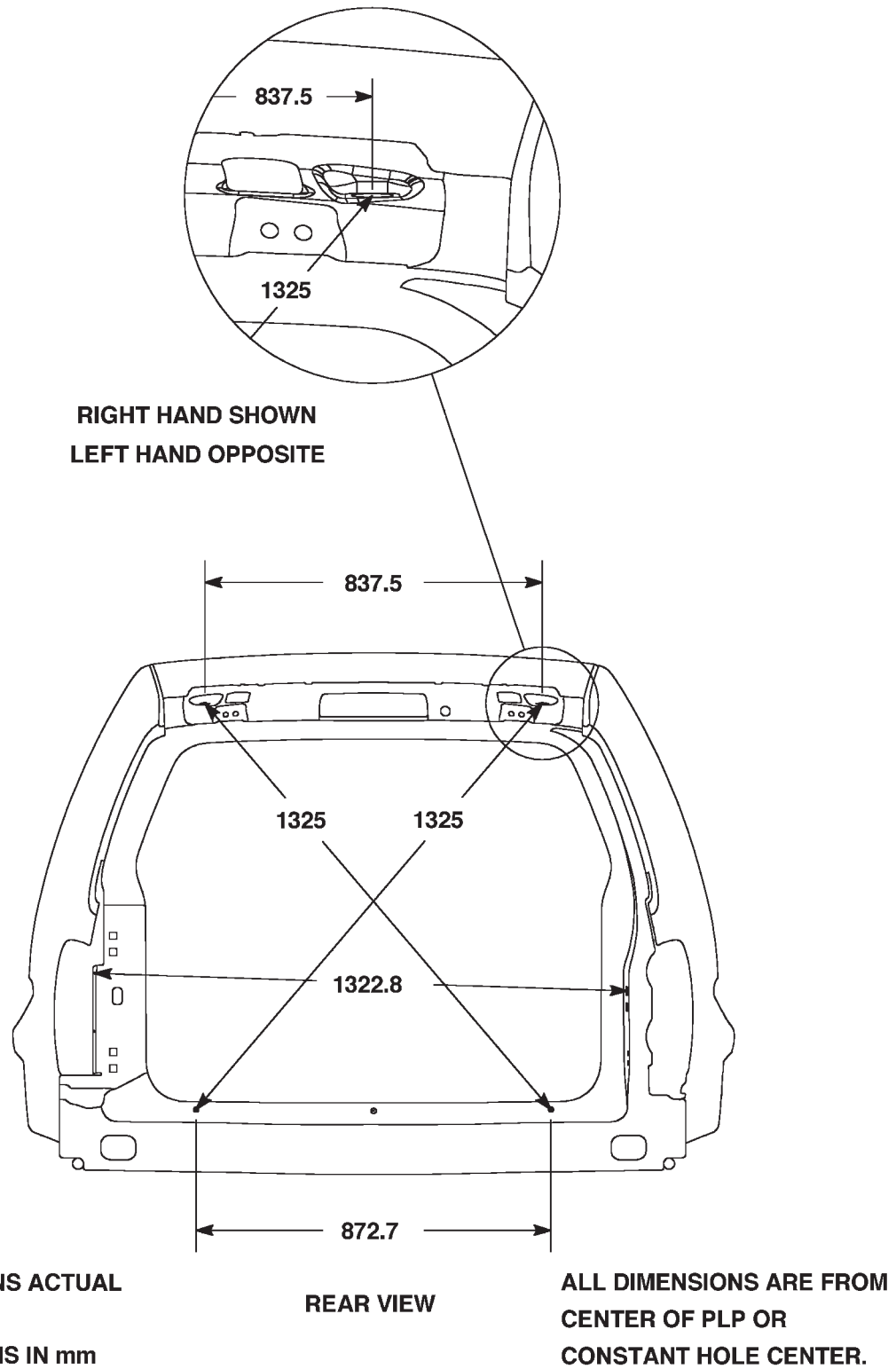


Fig. 104 SWING GATE OPENING



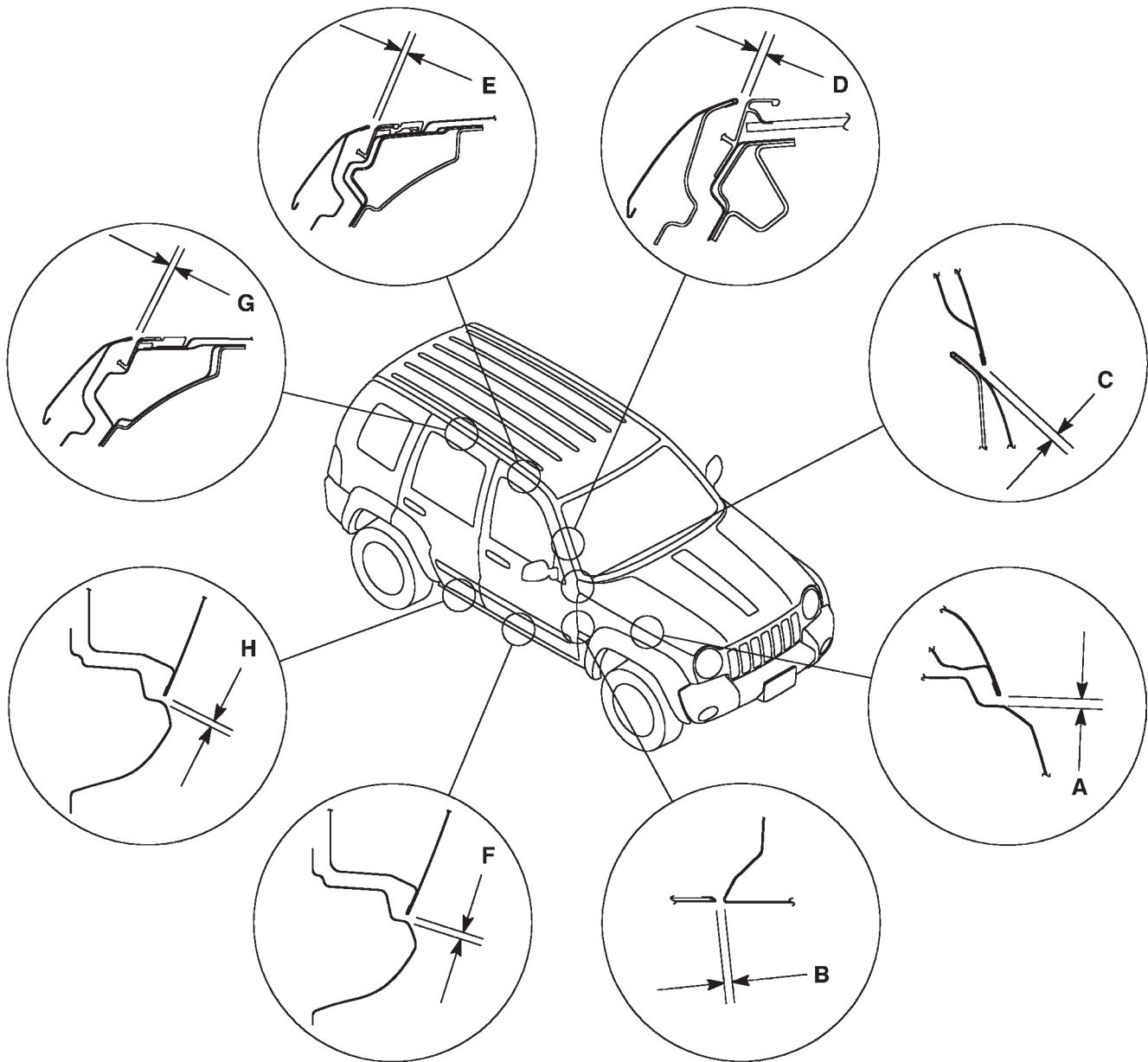
## GAP AND FLUSH

### SPECIFICATIONS

#### *GAP & FLUSH DIMENSIONS INDEX*

<b>DESCRIPTION</b>	<b>FIGURE</b>
FRONT QUADRANT	( 105 )
REAR QUADRANT	( 106 )

GAP AND FLUSH (Continued)



**Fig. 105 GAP & FLUSH/FRONT QUADRANT**

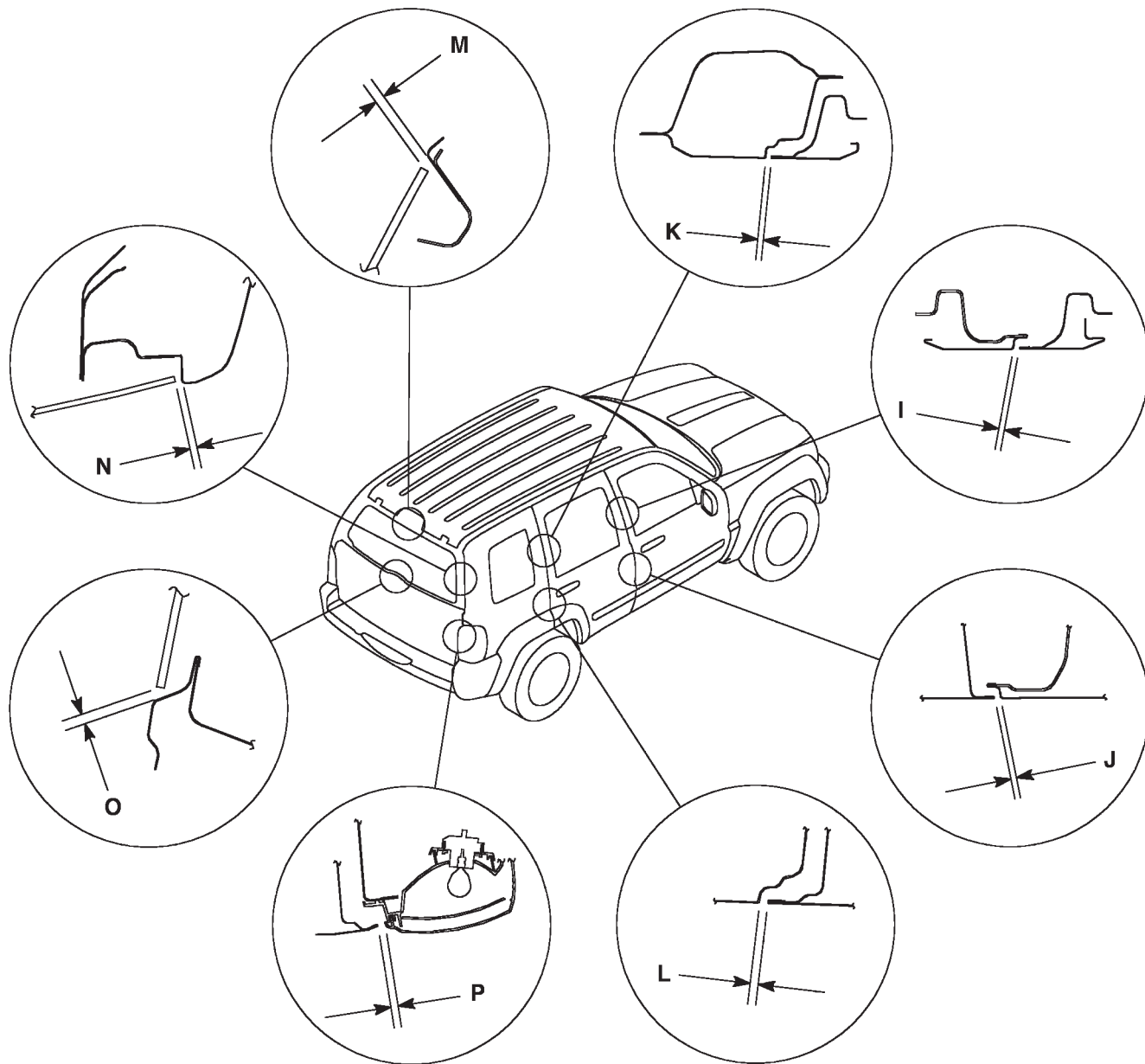
**NOTE:**

All measurements are in mm.

U/F = Under Flush

DIMENSION	GAP	FLUSH	DIMENSION	GAP	FLUSH
A	6.0 +/- 2.0	O/F 12.0 +/- 2.0	E	5.0 +/- 1.5	O/F 3.0 +/- 1.5
B	5.0 +/- 1.0	O/F 0.5 +/- 1.5	F	6.0 +/- 2.0	U/F 18.5 +/- 1.5
C	6.0 +/- 1.5	O/F 3.0 +/- 2.0	G	5.0 +/- 1.5	O/F 3.0 +/- 1.5
D	5.0 +/- 1.5	O/F 5.0 +/- 1.5	H	6.0 +/- 2.0	U/F 18.5 +/- 1.5

GAP AND FLUSH (Continued)



**Fig. 106 GAP & FLUSH/REAR QUADRANT**

**NOTE:**

All measurements are in mm.

U/F = Under Flush

DIMENSION	GAP	FLUSH	DIMENSION	GAP	FLUSH
I	5.0 +/- 1.0	0.0 +/- 1.5	M	6.0 +/- 1.5	U/F 4.7 +2.5/-1.0
J	5.0 +/- 1.0	0.0 +/- 1.5	N	6.0 +/- 1.5	U/F 4.0 +2.5/-1.0
K	5.0 +/- 1.0	0.0 +/- 1.5	O	6.0 +/- 1.5	—
L	5.0 +/- 1.0	0.0 +/- 1.5	P	5.0 +/- 1.0	U/F 0.5 +/- 1.0

# HOOD

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## HINGE

### REMOVAL

**NOTE:** It is not necessary to remove the hood to replace one or both hinges. The hinges can be replaced one at a time.

- (1) Raise and support hood.
- (2) Using a grease pencil or equivalent, mark position of hinge.
- (3) Remove hood support cylinder. (Refer to 23 - BODY/HOOD/SUPPORT CYLINDER - REMOVAL)
- (4) Remove nuts attaching hinge to hood.
- (5) Remove bolts attaching hinge to body.
- (6) Separate hinge from vehicle.

### INSTALLATION

- (1) Position hinge on vehicle and align reference marks.
- (2) Install bolts attaching hinge to body and tighten to 28 N·m (21 ft. lbs.).
- (3) Install nuts attaching hinge to hood 12 N·m (9 ft. lbs.).
- (4) Install hood hinge support cylinder. (Refer to 23 - BODY/HOOD/SUPPORT CYLINDER - INSTALLATION)

## HOOD

### REMOVAL

- (1) Raise hood.
- (2) Using a grease pencil or equivalent, mark location of hood hinges on hood for installation alignment.
- (3) Remove bolts attaching hinges to hood.
- (4) With the aid of a helper, remove hood from vehicle.

### INSTALLATION

- (1) Position hood on hinges.
- (2) Install bolts finger-tight.
- (3) Align hinges with installation reference marks and tighten bolts to 12 N·m (9 ft. lbs.).
- (4) Inspect hood for proper alignment and adjust as necessary.

## ADJUSTMENTS

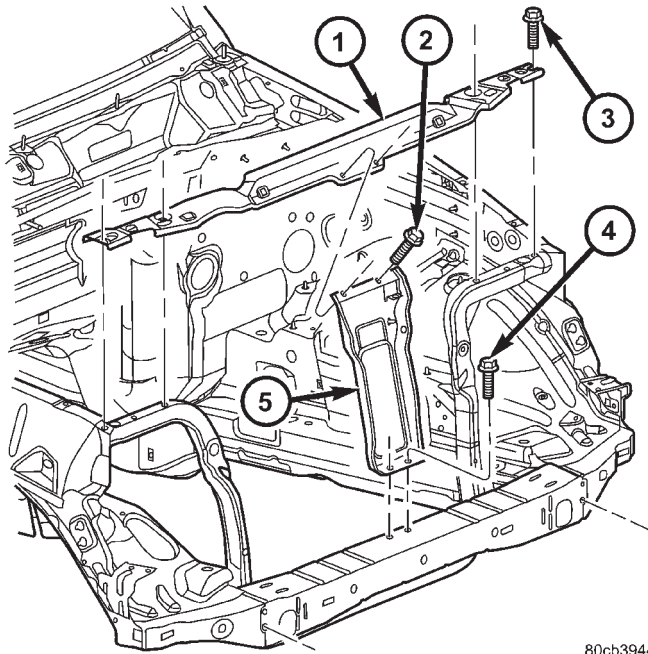
### ADJUSTMENT

- (1) If hood is low in relation to cowl panel, insert shims between hinge and hood.
- (2) Adjust hood bumper in or out to adjust hood-to-fender height alignment.
- (3) Adjust the hood latch as necessary. Tighten the nuts to 11 N·m (8 ft. lbs.).
- (4) Align the latch striker so that striker enters the latch squarely and without binding.

## LATCH

### REMOVAL

- (1) Remove the grill. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL)
- (2) Remove the latch support bracket bolts and position the latch assembly aside. (Fig. 1)
- (3) Remove the two latch nuts.
- (4) Disconnect the release cable.



**Fig. 1 RADIATOR CROSSMEMBER**

- 1 - CROSSMEMBER
- 2 - BOLTS (2)
- 3 - BOLTS (4)
- 4 - BOLTS (2)
- 5 - HOOD LATCH SUPPORT

### INSTALLATION

- (1) Connect the release cable and install the latch onto the support bracket.
- (2) Install the two nuts and tighten to 12 N·m (9 ft. lbs.).
- (3) Install the support bracket and the bolts.
- (4) Tighten the bolts to 12 N·m (9 ft. lbs.).
- (5) Install the grill. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION)

## LATCH RELEASE CABLE

### REMOVAL

- (1) Remove the battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL)
- (2) Remove the hood latch. (Refer to 23 - BODY/HOOD/LATCH - REMOVAL)

(3) Remove the powertrain control module. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/POWERTRAIN CONTROL MODULE - REMOVAL)

(4) Remove the hood release handle. (Refer to 23 - BODY/HOOD/LATCH RELEASE HANDLE - REMOVAL)

(5) Disconnect the attaching clips and remove the cable from the inside.

### INSTALLATION

(1) Install the cable from the inside and attach the retaining clips.

(2) Install the hood latch release handle. (Refer to 23 - BODY/HOOD/LATCH RELEASE HANDLE - INSTALLATION)

(3) Install the powertrain control module. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/POWERTRAIN CONTROL MODULE - INSTALLATION)

(4) Install the hood latch. (Refer to 23 - BODY/HOOD/LATCH - INSTALLATION)

(5) Install the battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION)

## SUPPORT CYLINDER

### REMOVAL

- (1) Open the hood and support.
- (2) Release the upper and lower clips.
- (3) Remove the support cylinder.

### INSTALLATION

(1) Install the support cylinder over the ball studs with the thin end down.

(2) Install the retaining clips and remove the support from the hood.

## LATCH RELEASE HANDLE

### REMOVAL

(1) Remove the cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL)

(2) Remove the three screws and remove the handle.

(3) Disconnect the hood release cable.

### INSTALLATION

(1) Connect the hood release cable to the handle.

(2) Install the handle and install the three screws.

(3) Install the cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION)

## DOOR - FRONT

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## CHECK STRAP

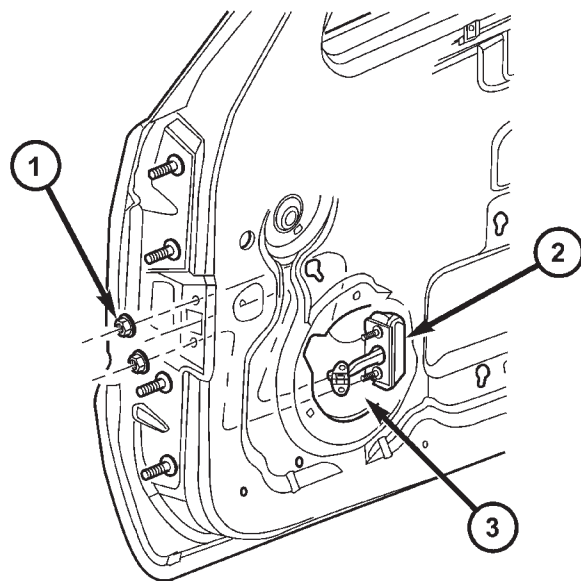
### REMOVAL

- (1) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)
- (2) Remove screws attaching door check to A-pillar.
- (3) Remove the two nuts and remove the door check strap. (Fig. 1)

### INSTALLATION

**NOTE:** Make sure the proper orientation of the check strap is maintained using the "R" and "L" on the top.

- (1) Install the check strap through the speaker hole.
- (2) Install the nuts and tighten to 12 N·m (9 ft. lbs.).
- (3) Connect the strap to the A-pillar and tighten the bolts to 12 N·m (9 ft. lbs.).
- (4) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - INSTALLATION)



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**Fig. 1 CHECK STRAP**

- 1 - NUTS
- 2 - CHECK STRAP
- 3 - SPEAKER OPENING

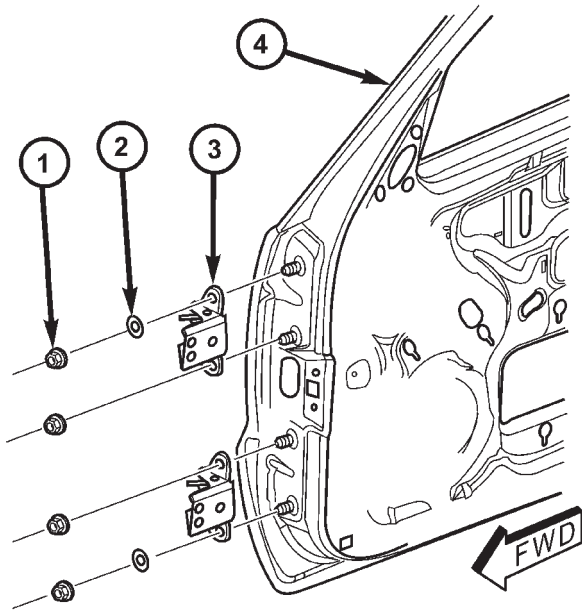
## DOOR

### REMOVAL

- (1) Disconnect the door wire harness electrical connector at the A-pillar.
- (2) Support the door with a suitable lifting device.
- (3) Remove the bolts attaching the check strap to the a-pillar.

**NOTE:** The epoxy washers should not be removed from the hinge. If the washers are removed the door may have to be re-adjusted.

- (4) Remove the nuts attaching the door hinges to the door. (Fig. 2)



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**Fig. 2 HINGES**

- 1 - NUTS (4)
- 2 - EPOXY WASHERS (2) (NOT REMOVABLE)
- 3 - HINGES
- 4 - DOOR

### INSTALLATION

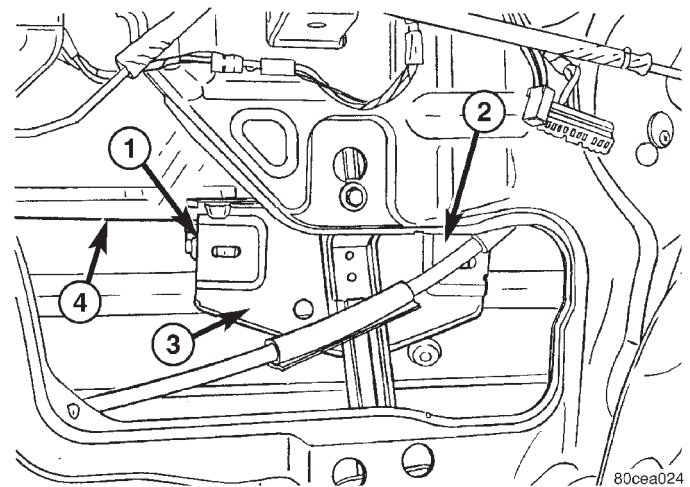
- (1) Support the door with a suitable lifting device and install the door onto the hinges.
- (2) Install the nuts and washers if they were removed previously and tighten to 23 N-m (17 ft. lbs.).
- (3) Connect the door wire harness electrical connector.
- (4) Connect the check strap to the a-pillar and install the bolts.
- (5) Tighten the check strap bolts to 12 N-m (9 ft. lbs.).

- (6) Adjust the door as necessary. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

## DOOR GLASS

### REMOVAL

- (1) Remove the outer belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR OUTER BELT MOLDING - REMOVAL)
- (2) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)
- (3) Raise the glass to the position shown and using a long flat blade or hook type tool, disengage clips attaching glass retainer to regulator lift plate. (Fig. 3)
- (4) Disconnect the glass from the regulator lift plate and re-install the clips.
- (5) Rotate the top of the glass toward the front and remove the glass from the window opening.



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**Fig. 3 DOOR GLASS/REGULATOR**

- 1 - DOOR GLASS ATTACHMENT CLIP (2)
- 2 - DOOR OPENING
- 3 - REGULATOR LIFT PLATE
- 4 - DOOR GLASS

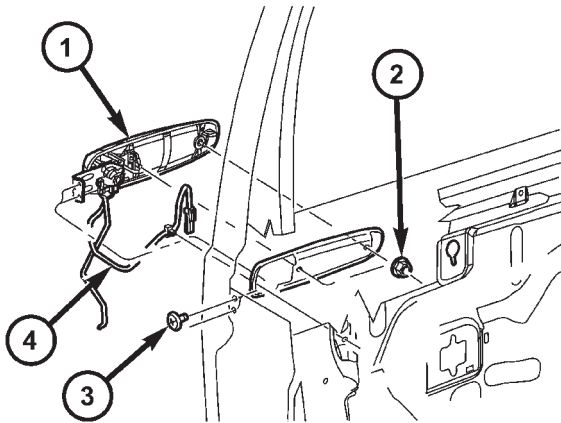
### INSTALLATION

- (1) Install the glass through the window opening and align the mounting plate to the lift plate.
- (2) Engage the glass to the regulator lift plate.
- (3) Install the outer belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR OUTER BELT MOLDING - INSTALLATION)
- (4) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - INSTALLATION)

## EXTERIOR HANDLE

### REMOVAL

- (1) Remove the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - REMOVAL)
- (2) Disconnect the lock switch electrical connector, if equipped. (Fig. 4)
- (3) Disconnect the handle rod at the handle and the key cylinder rod at the latch.
- (4) Remove the screws.
- (5) Remove the nuts and remove the handle.



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**Fig. 4 EXTERIOR HANDLE**

- 1 - EXTERIOR HANDLE
- 2 - NUTS
- 3 - SCREWS
- 4 - ELECTRICAL CONNECTOR

### INSTALLATION

- (1) Position the handle on the door and slide fully toward the rear of the door.
- (2) Install the nuts and tighten to 6 N·m (55 in. lbs.).
- (3) Install the screws and tighten to 6 N·m (55 in. lbs.).
- (4) Connect the handle rod at the handle and the key cylinder rod at the latch.
- (5) Connect the lock switch electrical connector, if equipped.
- (6) Install the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - INSTALLATION)

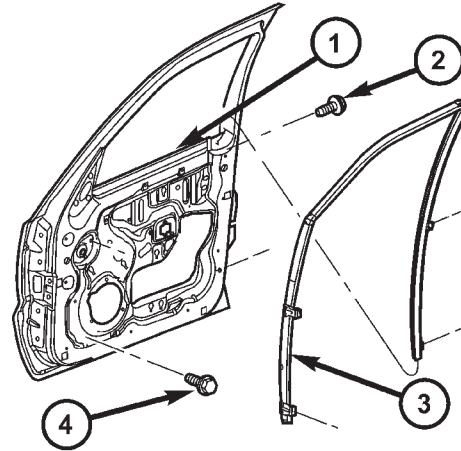
## GLASS RUN CHANNEL

### REMOVAL

- (1) Position the window into the down position.
- (2) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)

- (3) Remove the outer belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR OUTER BELT MOLDING - REMOVAL)

- (4) Remove the front and rear bolts. (Fig. 5)
- (5) Peel the weatherstrip out of the door frame and remove the run channel through the window opening.



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**Fig. 5 GLASS RUN CHANNEL**

- 1 - WINDOW OPENING
- 2 - REAR BOLTS (2)
- 3 - GLASS RUN CHANNEL
- 4 - FRONT BOLTS (2)

### INSTALLATION

- (1) Install the run channel through the window opening and into the door frame.
- (2) Install the front, rear bolts and tighten to 9 N·m (80 in. lbs.).
- (3) Install the outer belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR OUTER BELT MOLDING - INSTALLATION)
- (4) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - INSTALLATION)

## HINGE

### REMOVAL

- (1) Remove the door. (Refer to 23 - BODY/DOOR - FRONT/DOOR - REMOVAL)
- (2) Using a grease pencil or equivalent, mark the hinge location and remove the bolts.

### INSTALLATION

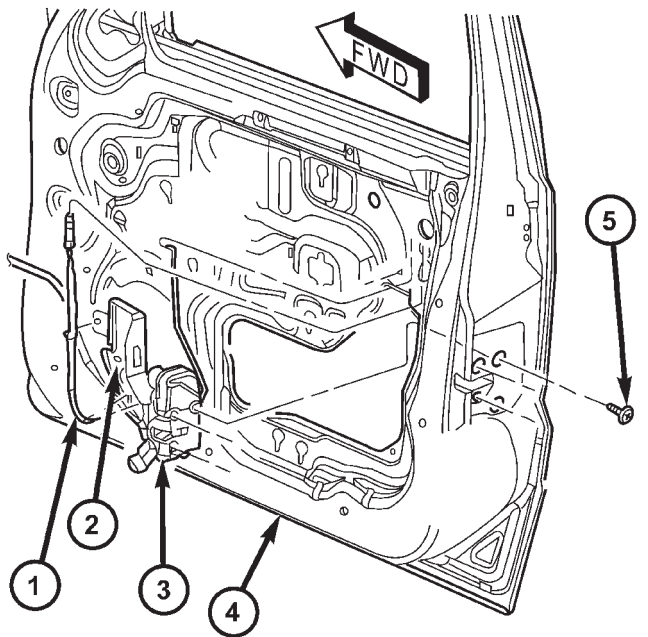
- (1) Install the hinges and bolts.
- (2) Tighten bolts to 28 N·m (21 ft. lbs.).
- (3) Install the door. (Refer to 23 - BODY/DOOR - FRONT/DOOR - INSTALLATION)



## LATCH

### REMOVAL

- (1) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)
- (2) Disconnect the exterior handle rod at the handle.
- (3) Disconnect the lock and lock cylinder rods at the latch.
- (4) Remove the screws and remove the latch assembly. (Fig. 6)
- (5) Disconnect the electrical connectors.



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**Fig. 6 LATCH**

- 1 - LOCK ACTUATOR ROD
- 2 - PLASTIC COVER
- 3 - LATCH ASSEMBLY
- 4 - DOOR
- 5 - SCREWS

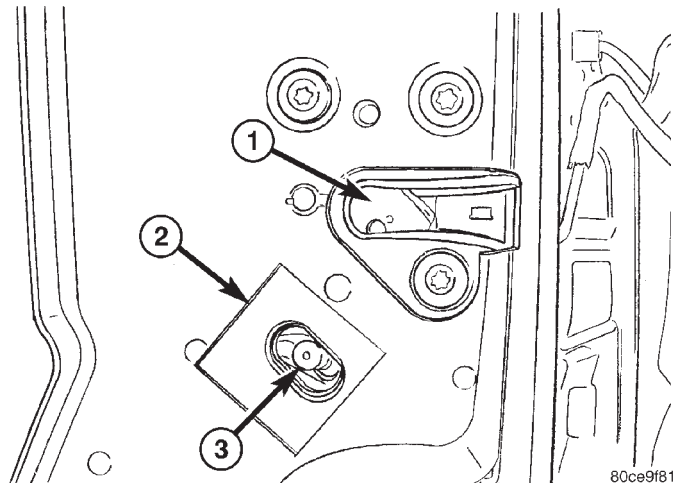
### INSTALLATION

- (1) Connect the latch electrical connectors.
- (2) Install the latch assembly into the door and install the screws.
- (3) Tighten the latch screws to 11 N·m (95 in. lbs.).
- (4) Connect the lock cylinder and lock actuator rods at the latch.
- (5) Connect the exterior handle actuator rod at the handle.
- (6) Adjust the latch as needed. (Refer to 23 - BODY/DOOR - FRONT/LATCH - ADJUSTMENTS)
- (7) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - INSTALLATION)

## ADJUSTMENTS

### ADJUSTMENT

- (1) Locate access hole and remove the mylar tape covering it. (Fig. 7)
- (2) Insert a 5/32-inch hex-wrench through hole and into adjustment screw. Loosen screw.
- (3) Operate outside handle several times to release any restriction because of mis-alignment.
- (4) Tighten adjustment screw to 3 N·m (30 in. lbs.).
- (5) Test handle and lock cylinder for proper operation.



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**Fig. 7 LATCH ADJUSTMENT SCREW**

- 1 - DOOR LATCH
- 2 - MYLAR TAPE
- 3 - ADJUSTMENT SCREW

## LATCH STRIKER

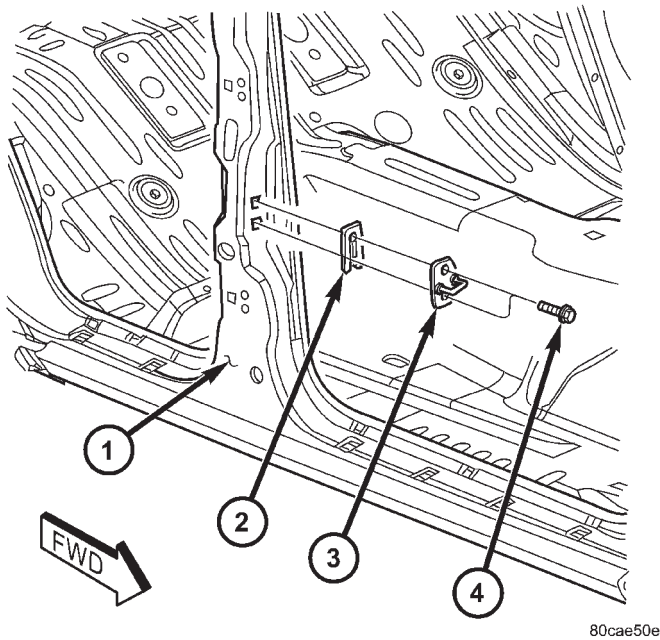
### REMOVAL

- (1) Remove the bolts. (Fig. 8)
- (2) Remove the latch striker and the spacer, if equipped.

### INSTALLATION

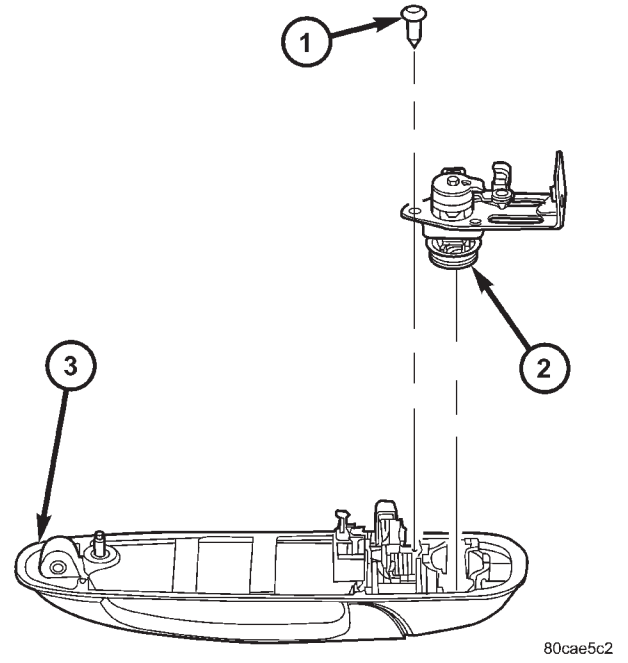
- (1) Install the striker and spacer, if equipped.
- (2) Install the bolts and tighten to 28 N·m (21 ft. lbs.).
- (3) Adjust the door as necessary. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

LATCH STRIKER (Continued)



**Fig. 8 LATCH STRIKER**

- 1 - B-PILLAR
- 2 - SPACER
- 3 - STRIKER
- 4 - BOLTS (2)



**Fig. 9 LOCK CYLINDER**

- 1 - SCREW
- 2 - LOCK CYLINDER ASSEMBLY
- 3 - EXTERIOR HANDLE

LOCK CYLINDER

REMOVAL

- (1) Remove the exterior handle. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - REMOVAL)
- (2) Remove the clip and remove the lock cylinder lever and switch, if equipped.
- (3) Remove the screw and remove the lock cylinder. (Fig. 9)

INSTALLATION

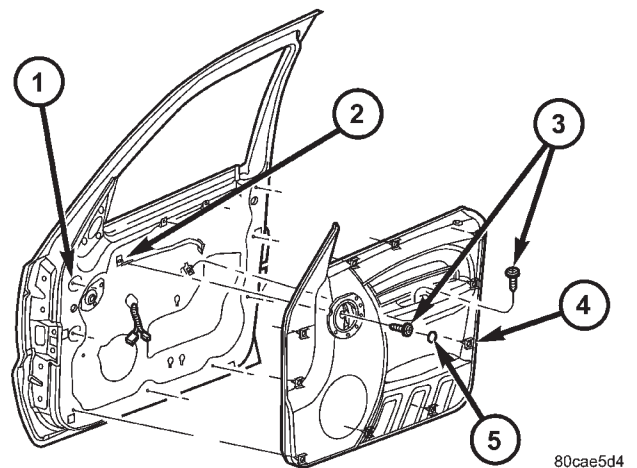
- (1) Install the lock cylinder and install the retaining screw.
- (2) Install the lock cylinder switch, if equipped, lever and retaining clip.
- (3) Install the exterior handle. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - INSTALLATION)

- (3) Using a trim stick C-4755 or equivalent, disengage the trim panel clips and remove the trim panel.
- (4) Disconnect the electrical connectors and the inside handle actuator rod. (Fig. 11)

TRIM PANEL

REMOVAL

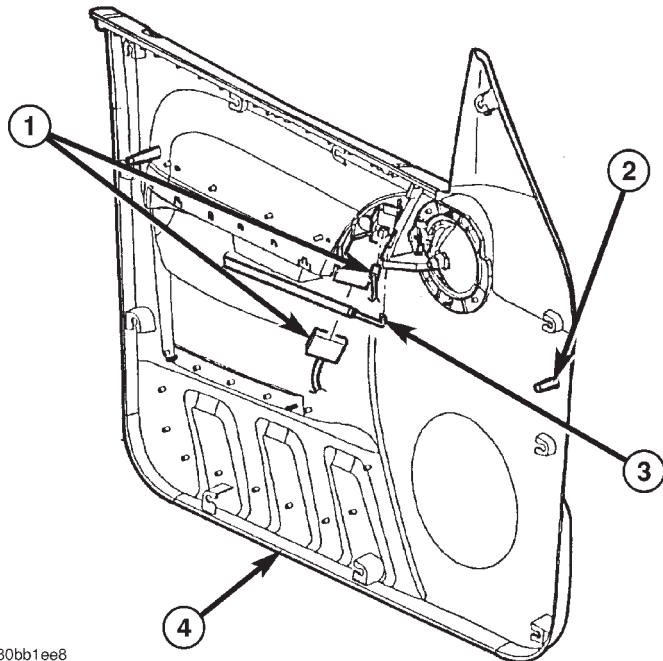
- (1) Remove the inside handle screw plug and remove the screw. (Fig. 10)
- (2) Remove the pull handle screw.



**Fig. 10 TRIM PANEL**

- 1 - ALIGNMENT PIN HOLES
- 2 - LATCH ACTUATOR ROD
- 3 - SCREWS (2)
- 4 - TRIM PANEL CLIPS
- 5 - INSIDE HANDLE SCREW PLUG

## TRIM PANEL (Continued)



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**Fig. 11 TRIM PANEL CONNECTIONS**

- 1 - ELECTRICAL CONNECTORS
- 2 - ALIGNMENT PINS
- 3 - LATCH ACTUATOR ROD
- 4 - TRIM PANEL

**INSTALLATION**

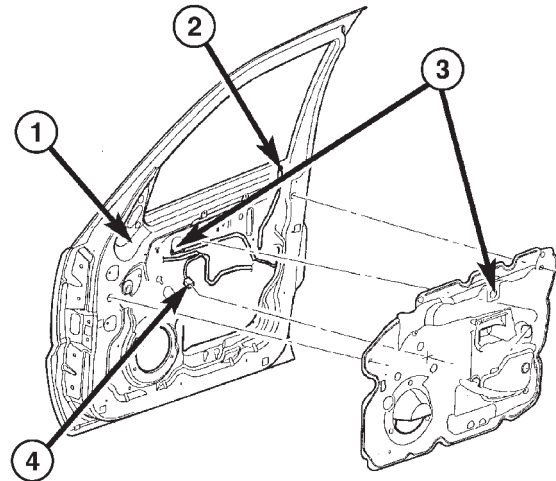
- (1) Connect the inside handle actuator rod and the electrical connectors.
- (2) Position the trim panel and seat the clips fully.
- (3) Install the screws and install the screw plug.

**WATERDAM****REMOVAL**

- (1) Remove the trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)
- (2) Remove the door speaker.
- (3) Peel waterdam away from inner door panel and off of the latch linkages (Fig. 12).

**INSTALLATION**

- (1) Position the wire harness and actuator rods through the holes in the waterdam.
- (2) Place waterdam onto the door.
- (3) Install the trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION)



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**Fig. 12 FRONT DOOR WATERDAM**

- 1 - DOOR
- 2 - LOCK ACTUATOR ROD
- 3 - INSIDE HANDLE ACTUATOR ROD AND HOLE
- 4 - ELECTRICAL CONNECTOR

**WINDOW REGULATOR - MANUAL****REMOVAL**

- (1) Remove the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - REMOVAL)
- (2) Loosen the bolts. (Fig. 13)
- (3) Disconnect the runout tube clip and remove the regulator.

**INSTALLATION**

- (1) Install the regulator assembly.
- (2) Tighten the bolts to 9 N·m (80 in. lbs.) using the sequence shown. (Fig. 14)
- (3) Install the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - INSTALLATION)

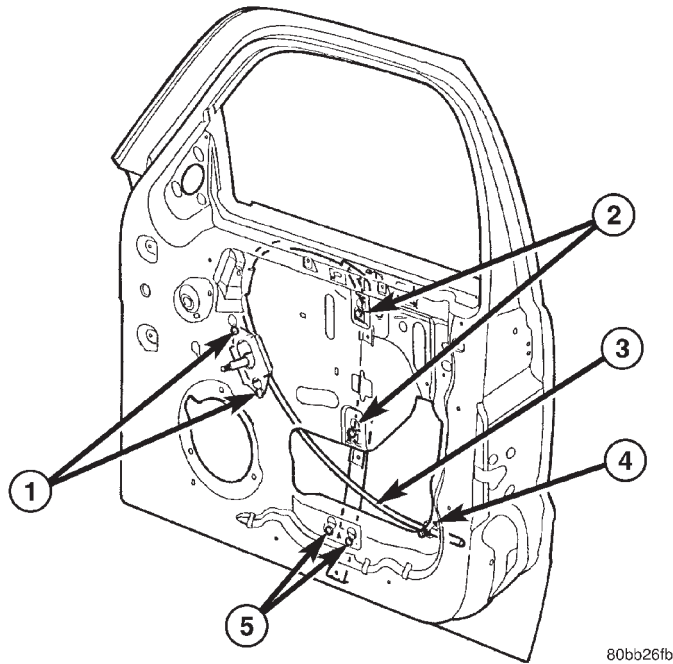
**WINDOW REGULATOR - ELECTRIC****REMOVAL**

- (1) Remove the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - REMOVAL)
- (2) Loosen the bolts. (Fig. 15)
- (3) Disconnect the runout tube clip.
- (4) Disconnect the electrical connector and remove the regulator.

**INSTALLATION**

- (1) Install the regulator assembly.
- (2) Connect the electrical connector.

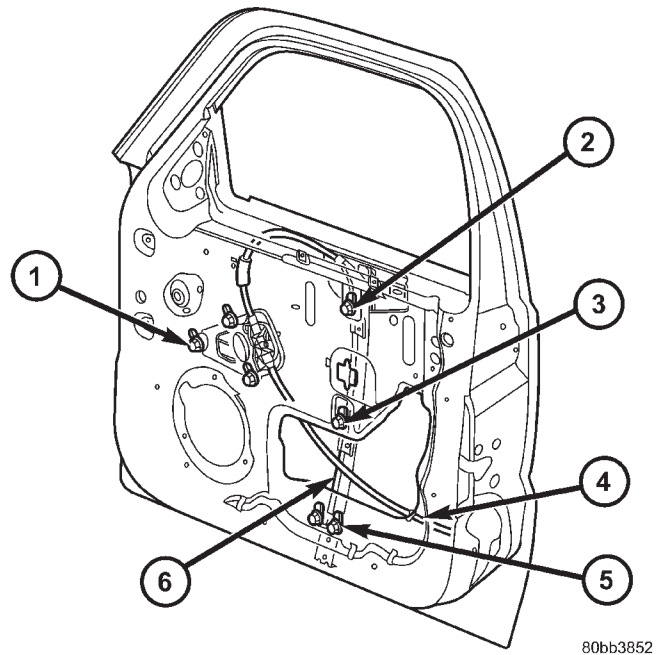
WINDOW REGULATOR - ELECTRIC (Continued)



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**Fig. 13 FRONT DOOR REGULATOR - MANUAL**

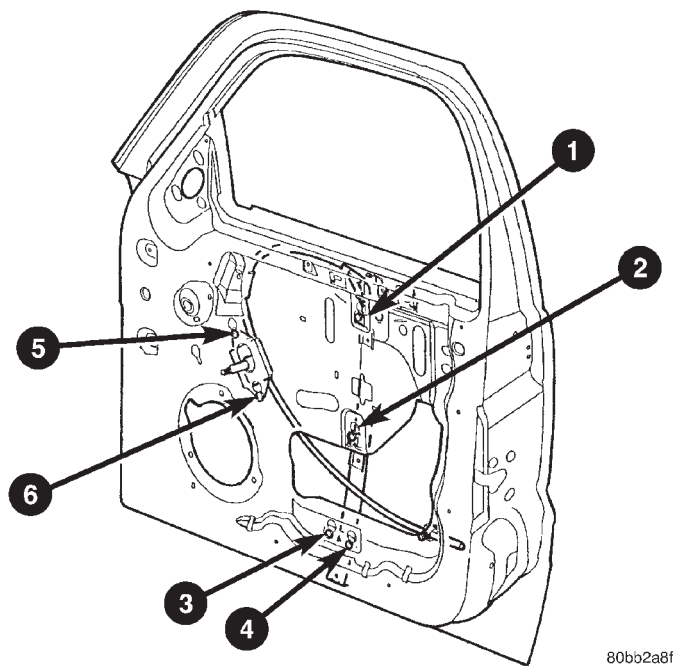
- 1 - BOLTS
- 2 - BOLTS
- 3 - RUNOUT TUBE
- 4 - RUNOUT TUBE CLIP
- 5 - BOLTS



80bb3852

**Fig. 15 WINDOW REGULATOR - ELECTRIC**

- 1 - BOLTS (3)
- 2 - BOLT
- 3 - BOLT
- 4 - RUNOUT TUBE CLIP
- 5 - BOLTS (2)
- 6 - REGULATOR ASSEMBLY

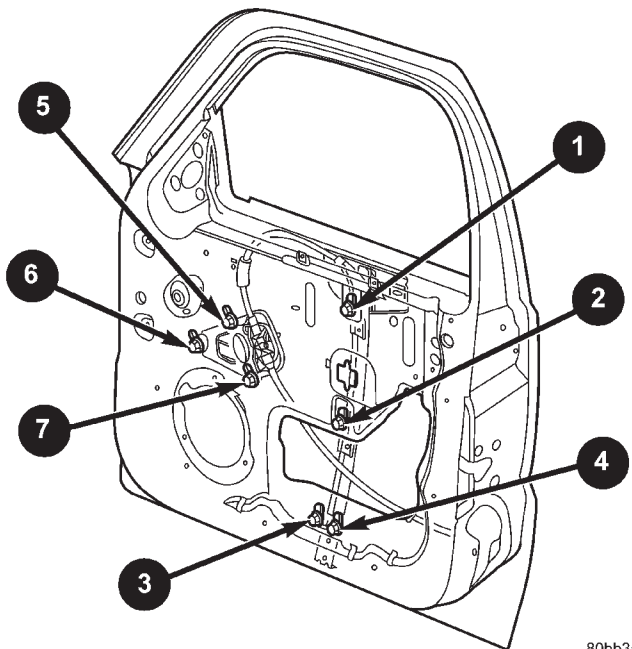


80bb2a8f

**Fig. 14 REGULATOR TIGHTENING SEQUENCE**

- (3) Tighten the bolts to 9 N·m (80 in. lbs.) using the sequence shown. (Fig. 16)
- (4) Connect the runout tube clip.

(5) Install the glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - INSTALLATION)



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**Fig. 16 REGULATOR TIGHTENING SEQUENCE**

## DOORS - REAR

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## CHECK STRAP

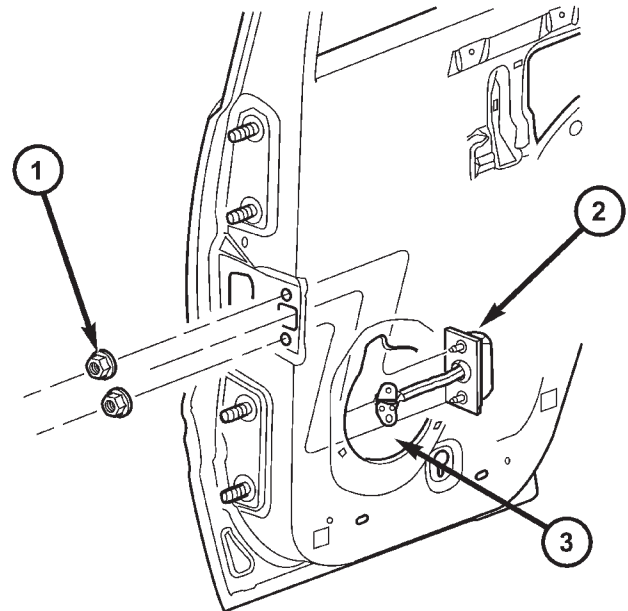
## REMOVAL

- (1) Remove the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - REMOVAL)
- (2) Remove screws attaching door check to b-pillar.
- (3) Remove the two nuts and remove the door check strap. (Fig. 1)

## INSTALLATION

**NOTE:** Make sure the proper orientation of the check strap is maintained using the "R" and "L" on the top.

- (1) Install the check strap through the speaker hole.
- (2) Install the nuts and tighten to 12 N·m (9 ft. lbs.).
- (3) Connect the strap to the b-pillar and tighten the bolts to 12 N·m (9 ft. lbs.).
- (4) Install the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - INSTALLATION)



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Fig. 1 CHECK STRAP

- 1 - NUTS
- 2 - CHECK STRAP
- 3 - SPEAKER OPENING

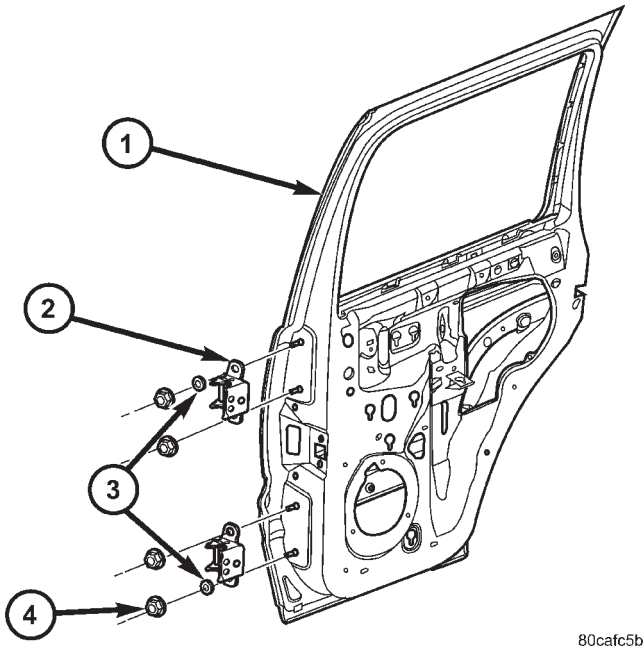
## DOOR

### REMOVAL

- (1) Disconnect the door wire harness electrical connector at the b-pillar.
- (2) Disconnect the check strap from the b-pillar. (Refer to 23 - BODY/DOORS - REAR/CHECK STRAP - REMOVAL)
- (3) Support the door with a suitable lifting device.

**NOTE:** The epoxy washers should not be removed from the hinge. If the washers are removed the door may have to be re-adjusted.

- (4) Remove the nuts attaching the door hinges to the door. (Fig. 2)



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**Fig. 2 HINGES**

- 1 - DOOR
- 2 - HINGES
- 3 - EPOXY WASHERS (2) (NOT REMOVABLE)
- 4 - NUTS

### INSTALLATION

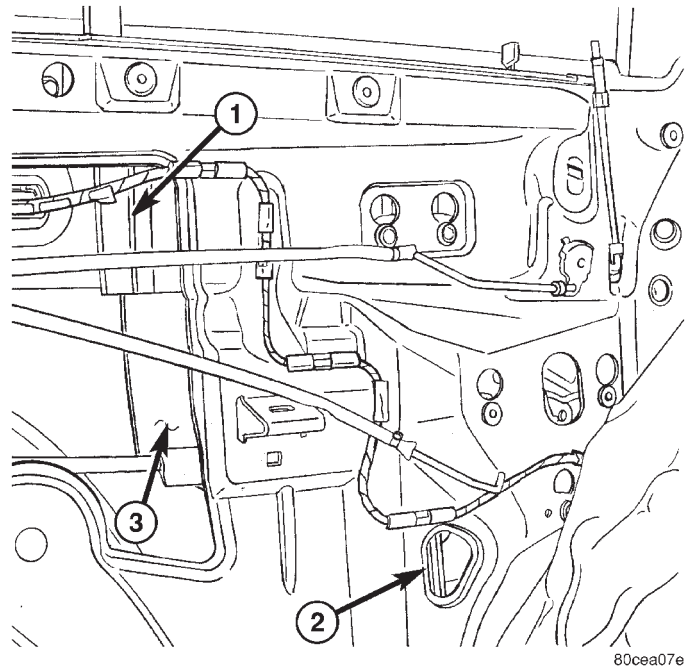
- (1) Support the door with a suitable lifting device and install the door onto the b-pillar.
- (2) Install the nuts, washers and tighten to 23 N-m (17 ft. lbs.).
- (3) Connect the door wire harness electrical connector.
- (4) Connect the check strap to the b-pillar. (Refer to 23 - BODY/DOORS - REAR/CHECK STRAP - INSTALLATION)

- (5) Adjust the door as necessary. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

## DOOR GLASS

### REMOVAL

- (1) Remove the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - REMOVAL)
- (2) Raise the glass and line up the lift plate clip with the hole in the door panel shown. (Fig. 3)
- (3) Using a long flat blade or hook type tool, disengage the clip attaching glass retainer to regulator lift plate.



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**Fig. 3 DOOR GLASS POSITION**

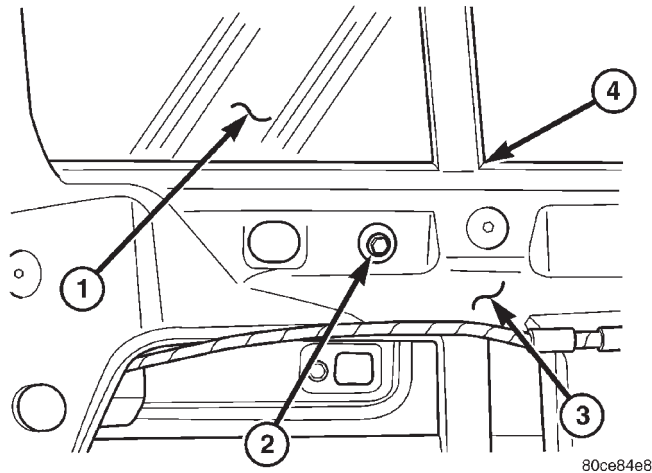
- 1 - GLASS DIVISION BAR
- 2 - DOOR PANEL SIGHT HOLE
- 3 - DOOR GLASS

- (4) Disconnect the glass from the regulator lift plate and re-install the clip.
- (5) Position the glass into the bottom of the door.
- (6) Remove the glass division bar bolt. (Fig. 4)
- (7) Twist the division bar towards the inside of the door and disengage the door glass.
- (8) Remove the glass from the window opening.

### INSTALLATION

- (1) Install the glass through the window opening.
- (2) Position the front of the glass into the glass run channel.

## DOOR GLASS (Continued)

**Fig. 4 GLASS DIVISION BAR**

- 1 - STATIONARY DOOR GLASS
- 2 - DIVISION BAR BOLT (1)
- 3 - DOOR
- 4 - GLASS DIVISION BAR

(3) Twist the glass division bar towards the inside of the door and position the door glass into the rear run channel.

(4) Lift glass up in the window and engage the pin into the regulator lift plate.

(5) Raise the glass into the closed position and install the division bar bolt.

(6) Tighten the bolt to 9 N·m (80 in. lbs.).

(7) Install the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - INSTALLATION)

**EXTERIOR HANDLE****REMOVAL**

(1) Remove the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - REMOVAL)

(2) Disconnect the actuator rod.

(3) Remove the nuts and remove the handle. (Fig. 5)

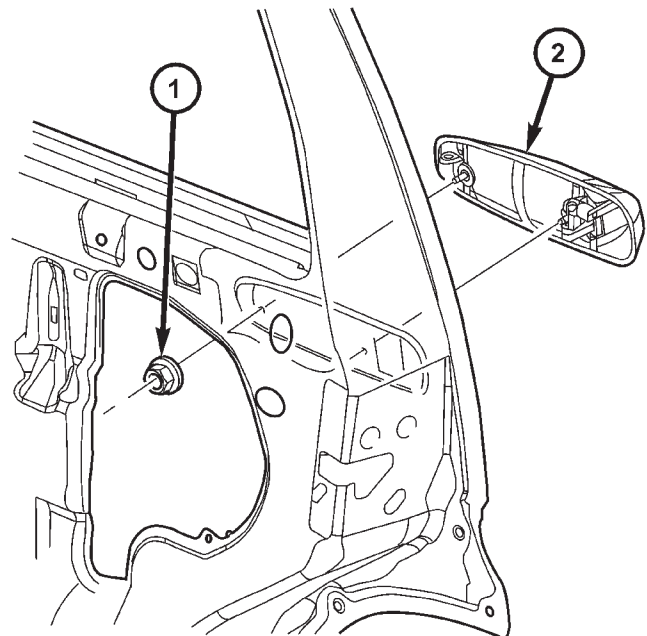
**INSTALLATION**

(1) Install the handle.

(2) Install the nuts and tighten to 6 N·m (55 in. lbs.).

(3) Connect the actuator rod.

(4) Install the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - INSTALLATION)

**Fig. 5 EXTERIOR HANDLE**

- 1 - NUTS (2)
- 2 - EXTERIOR HANDLE

**GLASS RUN CHANNEL****REMOVAL**

(1) Remove the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - REMOVAL)

(2) Remove the outer belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/REAR DOOR OUTER BELT MOLDING - REMOVAL)

(3) Remove the front and rear bolts. (Fig. 6)

(4) Peel the weatherstrip and quarter glass out of the door frame and remove the run channel through the window opening as an assembly.

**INSTALLATION**

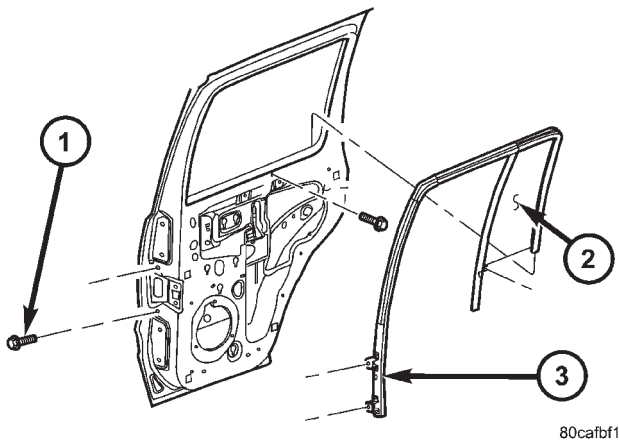
(1) Install the run channel and quarter glass assembly through the window opening and into the door frame.

(2) Install the front, rear bolts and tighten to 9 N·m (80 in. lbs.).

(3) Install the outer belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/REAR DOOR OUTER BELT MOLDING - INSTALLATION)

(4) Install the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - INSTALLATION)

GLASS RUN CHANNEL (Continued)



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**Fig. 6 GLASS RUN CHANNEL**

- 1 - BOLTS (3)
- 2 - QUARTER GLASS
- 3 - GLASS RUN CHANNEL ASSEMBLY

**HINGE**

**REMOVAL**

- (1) Remove the door. (Refer to 23 - BODY/DOORS - REAR/DOOR - REMOVAL)
- (2) Remove the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL)
- (3) Remove the two door hinge bolts from the inside of the b-pillar.
- (4) Remove the exterior bolts attaching the door hinges to the b-pillar.

**INSTALLATION**

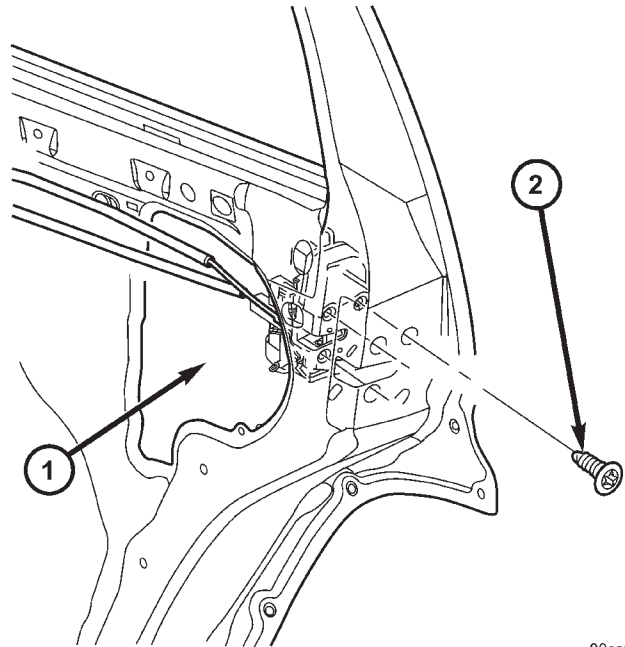
- (1) Install the hinges.
- (2) Install the exterior bolts and tighten to 28 N·m (21 ft. lbs.).
- (3) Install the two inner hinge bolts and tighten to 28 N·m (21 ft. lbs.).
- (4) Adjust the door as necessary. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
- (5) Install the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION)
- (6) Install the door. (Refer to 23 - BODY/DOORS - REAR/DOOR - INSTALLATION)

**LATCH**

**REMOVAL**

- (1) Remove the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - REMOVAL)

- (2) Disconnect the actuator rods.
- (3) Remove the screws and remove the latch assembly. (Fig. 7)
- (4) Disconnect the electrical connectors.



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**Fig. 7 LATCH**

- 1 - LATCH
- 2 - SCREWS (4)

**INSTALLATION**

- (1) Connect the latch electrical connectors.
- (2) Install the latch assembly into the door and install the screws.
- (3) Tighten the latch screws to 11 N·m (95 in. lbs.).
- (4) Connect the actuator rods.
- (5) Install the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - INSTALLATION)
- (6) Adjust the latch as needed. (Refer to 23 - BODY/DOORS - REAR/LATCH - ADJUSTMENTS)

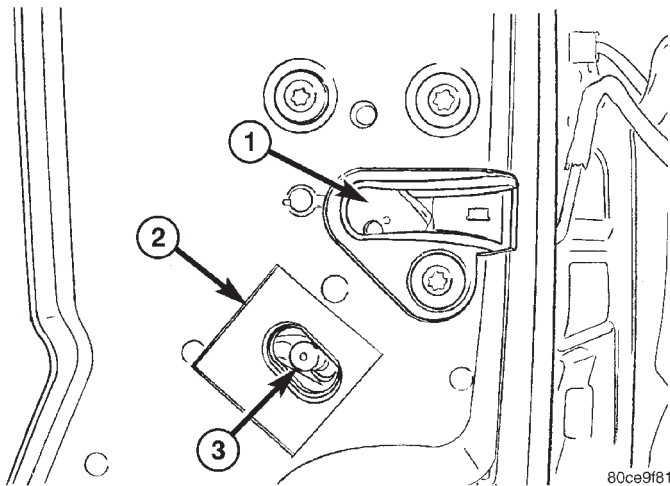
**ADJUSTMENTS**

**ADJUSTMENT**

- (1) Locate access hole and remove the mylar tape covering it. (Fig. 8)
- (2) Insert a 5/32-inch hex-wrench through hole and into adjustment screw. Loosen screw.
- (3) Operate outside handle several times to release any restriction because of mis-alignment.
- (4) Tighten adjustment screw to 3 N·m (30 in. lbs.).
- (5) Test handle and lock cylinder for proper operation.



## LATCH (Continued)

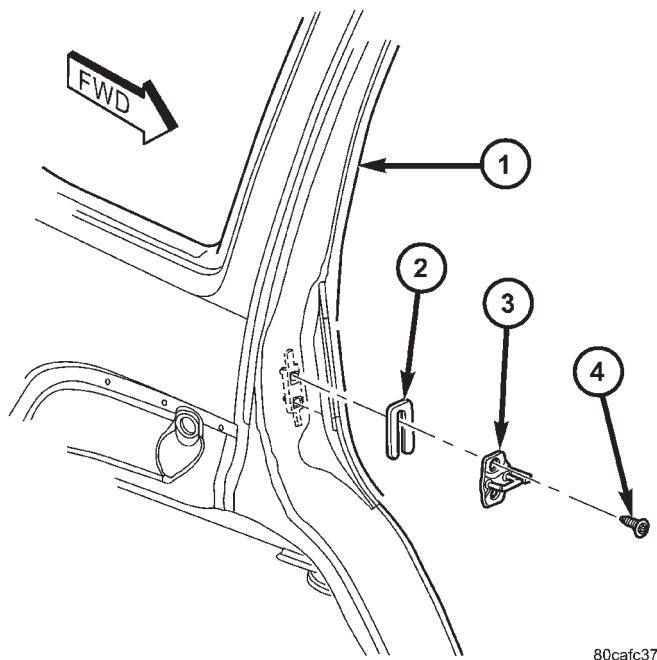
**Fig. 8 LATCH ADJUSTMENT SCREW**

- 1 - DOOR LATCH
- 2 - MYLAR TAPE
- 3 - ADJUSTMENT SCREW

## LATCH STRIKER

## REMOVAL

- (1) Remove the bolts. (Fig. 9)
- (2) Remove the latch striker and the spacer, if equipped.

**Fig. 9 LATCH STRIKER**

- 1 - C-PILLAR
- 2 - SPACER
- 3 - STRIKER
- 4 - SCREWS

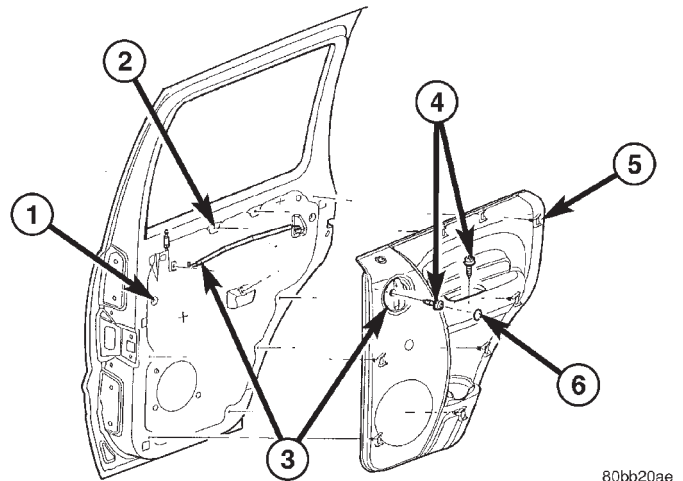
## INSTALLATION

- (1) Install the striker and spacer.
- (2) Install the bolts and tighten to 28 N·m (21 ft. lbs.).
- (3) Adjust the door as necessary. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

## TRIM PANEL

## REMOVAL

- (1) Remove the inside handle screw plug and remove the screw. (Fig. 10)
- (2) Remove the pull handle screw.
- (3) Using a trim stick C-4755 or equivalent, disengage the trim panel clips and remove the trim panel.
- (4) Disconnect the electrical connectors and the inside handle actuator rod. (Fig. 11)

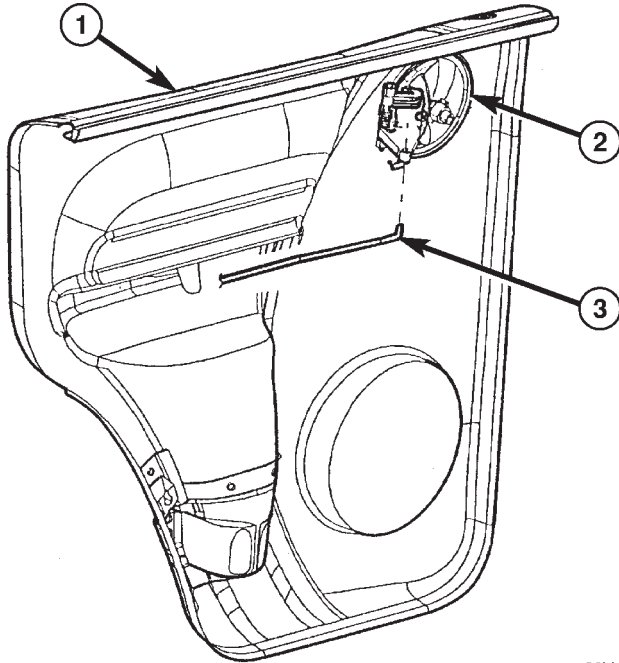
**Fig. 10 A REAR TRIM PANEL**

- 1 - WATERDAM
- 2 - TRIM PANEL CLIP HOLES
- 3 - INTERIOR HANDLE AND ACTUATOR ROD
- 4 - SCREWS (2)
- 5 - TRIM PANEL CLIPS
- 6 - INTERIOR HANDLE SCREW PLUG

## INSTALLATION

- (1) Connect the inside handle actuator rod and the electrical connectors.
- (2) Position the trim panel and seat the clips fully.
- (3) Install the screws and install the screw plug.

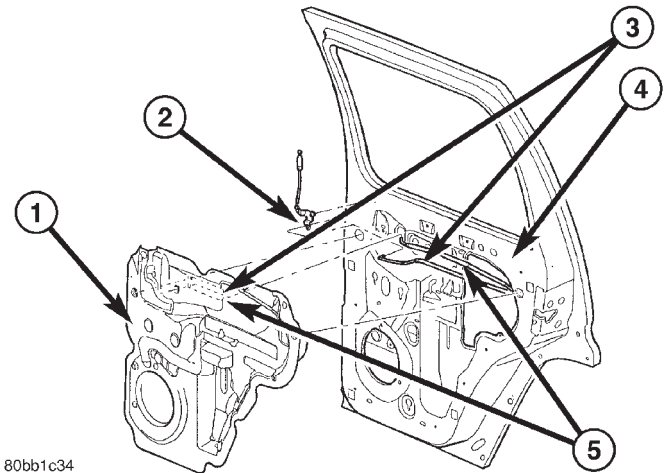
TRIM PANEL (Continued)



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**Fig. 11 A REAR DOOR TRIM PANEL CONNECTIONS**

- 1 - TRIM PANEL
- 2 - INTERIOR LATCH HANDLE
- 3 - LATCH ACTUATOR ROD



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**Fig. 12 REAR DOOR WATERDAM**

- 1 - WATERDAM
- 2 - LOCK ACTUATOR RODS
- 3 - LOCK ACTUATOR ROD AND HOLES
- 4 - DOOR
- 5 - INSIDE HANDLE ACTUATOR ROD AND HOLES

**WATERDAM**

**REMOVAL**

- (1) Remove the trim panel. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL)
- (2) Remove the door speaker.
- (3) Peel waterdam away from inner door panel and off of the latch linkages (Fig. 12).

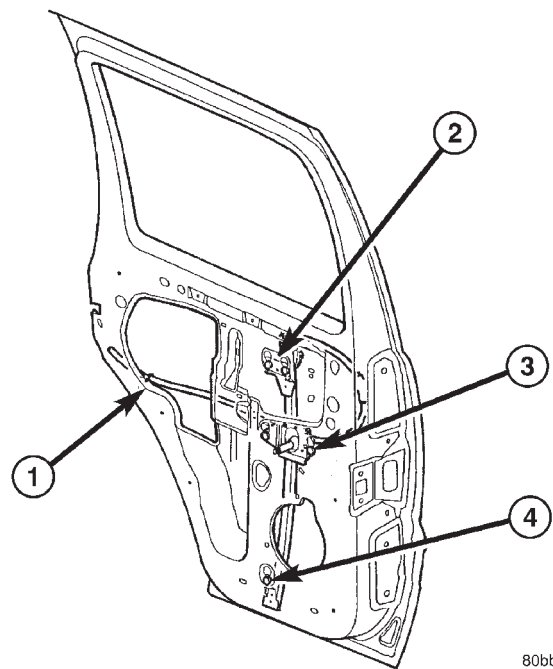
**INSTALLATION**

- (1) Position the wire harness and actuator rods through the holes in the waterdam.
- (2) Place waterdam onto the door.
- (3) Install the trim panel. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION)

**WINDOW REGULATOR - MANUAL**

**REMOVAL**

- (1) Remove the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - REMOVAL)
- (2) Remove the bolts. (Fig. 13)
- (3) Disconnect the runout tube clip and remove the regulator.



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**Fig. 13 WINDOW REGULATOR - MANUAL**

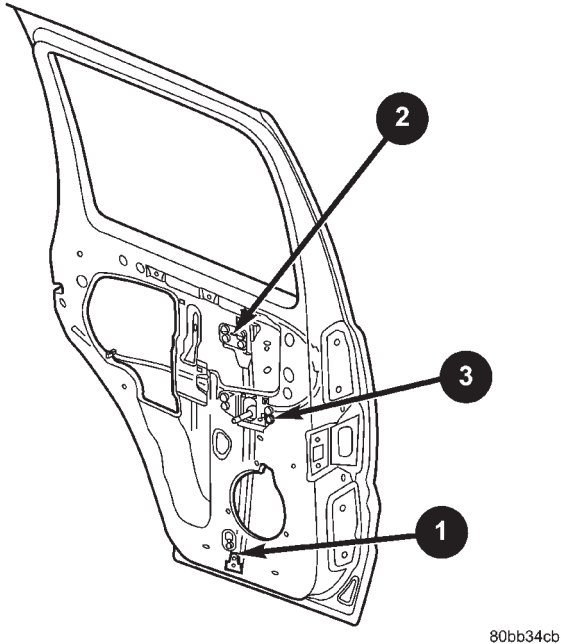
- 1 - RUNOUT TUBE CLIP
- 2 - BOLTS (2)
- 3 - BOLTS (2)
- 4 - BOLT (1)

**INSTALLATION**

- (1) Loosely install the bolts onto the regulator assembly.
- (2) Install the regulator assembly.

## WINDOW REGULATOR - MANUAL (Continued)

- (3) Install the runout tube clip.
- (4) Tighten the bolts to 9 N-m (80 in. lbs.) using the sequence shown. (Fig. 14)
- (5) Install the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - INSTALLATION)



**Fig. 14 REGULATOR TIGHTEN SEQUENCE**

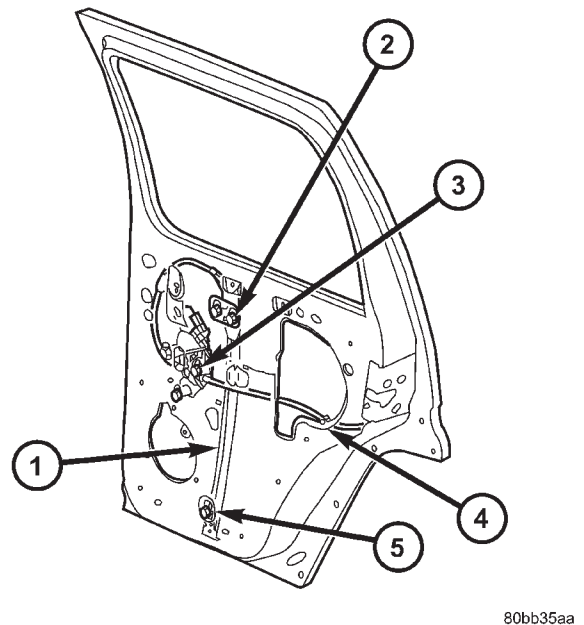
## WINDOW REGULATOR - ELECTRIC

## REMOVAL

- (1) Remove the door glass. (Refer to 23 - BODY/DOORS - REAR/DOOR GLASS - REMOVAL)
- (2) Remove the bolts. (Fig. 15)
- (3) Disconnect the runout tube clip and remove the regulator.
- (4) Disconnect the electrical connector.

## INSTALLATION

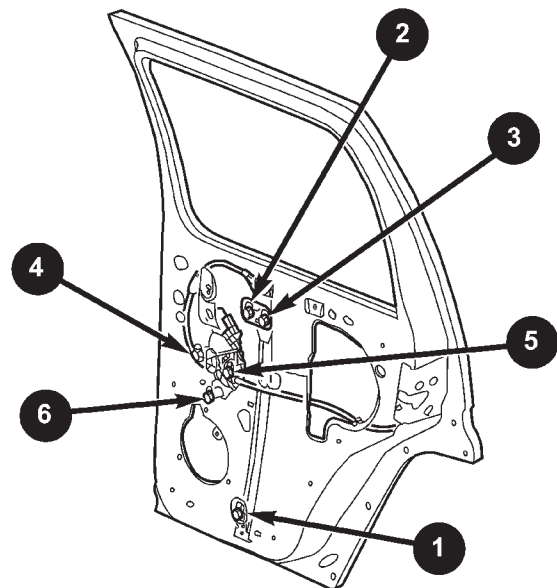
- (1) Connect the electrical connector.
- (2) Loosely install the bolts onto the regulator assembly.
- (3) Install the regulator assembly.
- (4) Tighten the bolts to 9 N-m (80 in. lbs.) using the sequence shown. (Fig. 16)
- (5) Install the glass. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - INSTALLATION)



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**Fig. 15 WINDOW REGULATOR - REAR**

- 1 - REGULATOR ASSEMBLY
- 2 - BOLTS (2)
- 3 - BOLTS (2)
- 4 - RUNOUT TUBE CLIP
- 5 - BOLT



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**Fig. 16 REGULATOR TIGHTENING SEQUENCE**

# SWING GATE

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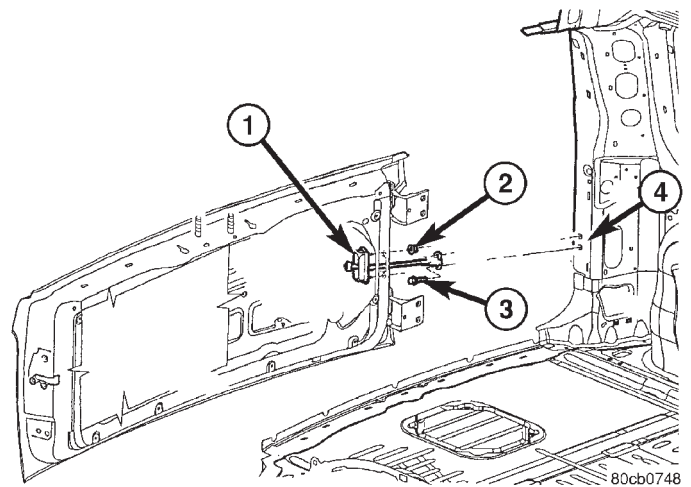
## CHECK STRAP

### REMOVAL

- (1) Remove the swing gate trim panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - REMOVAL)
- (2) Remove the quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL)
- (3) Remove the bolts attaching the check strap to the d-pillar. (Fig. 1)
- (4) Peel back the waterdam.
- (5) Remove the nuts and remove the check strap from the swing gate.

### INSTALLATION

- (1) Install the check strap.
- (2) Install the nuts and tighten to 10 N·m (89 in. lbs.).
- (3) Reposition the waterdam.
- (4) Install the trim panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - INSTALLATION)
- (5) Install the bolts attaching the check strap to the d-pillar and tighten to 11 N·m (8 ft. lbs.).
- (6) Install the quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION)



**Fig. 1 CHECK STRAP**

- 1 - CHECK STRAP
- 2 - NUTS (2)
- 3 - BOLTS (2)
- 4 - D-PILLAR

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## EXTERIOR HANDLE

### REMOVAL

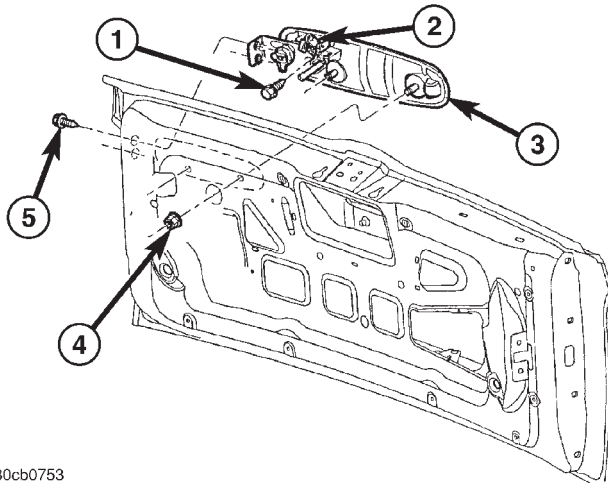
(1) Remove the trim panel and waterdam. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - REMOVAL)

(2) Disconnect the lock switch and flip-up glass release electrical connectors.

(3) Unclip the threaded clips and disconnect the actuator rods. (Fig. 2)

(4) Remove the screws.

(5) Remove the nuts and remove the handle.



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**Fig. 2 EXTERIOR HANDLE**

- 1 - LOCK CYLINDER SCREW
- 2 - LATCH ACTUATOR ROD CONNECTOR
- 3 - EXTERIOR HANDLE
- 4 - NUTS (2)
- 5 - SCREWS (2)

### INSTALLATION

(1) Install the handle and hold tightly against the gate and support bracket.

(2) Install the nuts and tighten to 6 N·m (55 in. lbs.).

(3) Install the screws.

(4) Connect the actuator rods and electrical connectors.

(5) Install the trim panel and waterdam. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - INSTALLATION)

## FLIP-UP GLASS

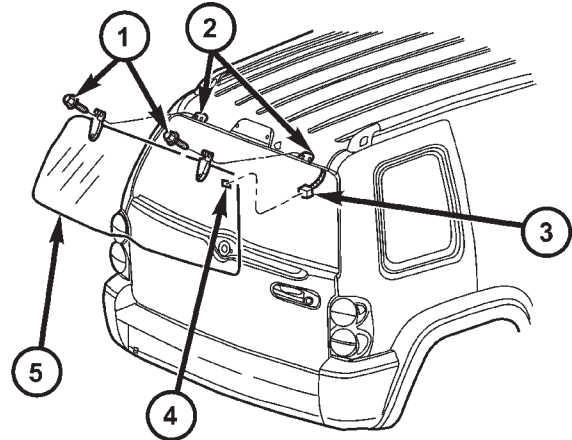
### REMOVAL

(1) Open the flip-up glass and disconnect the electrical connectors.

(2) Remove the support cylinders. (Refer to 23 - BODY/SWING GATE/FLIP-UP GLASS SUPPORT CYLINDER - REMOVAL)

(3) Open the glass to the full travel with the support cylinders off.

(4) Remove the bolts and remove the glass. (Fig. 3)



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**Fig. 3 FLIP-UP GLASS**

- 1 - BOLTS (4)
- 2 - HINGE MOUNTING HOLES
- 3 - DEFROSTER WIRE HARNESS
- 4 - DEFROSTER ELECTRICAL CONNECTOR
- 5 - FLIPPER GLASS

### INSTALLATION

(1) Install the flip-up glass and install the hinge bolts.

(2) Install the support cylinders. (Refer to 23 - BODY/SWING GATE/FLIP-UP GLASS SUPPORT CYLINDER - INSTALLATION)

(3) Connect the electrical connectors.

(4) Adjust flip-up glass fit if necessary and tighten the hinge bolts to 7 N·m (60 in. lbs.). (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

## FLIP-UP GLASS LATCH

### REMOVAL

(1) Remove the trim panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - REMOVAL)

(2) Disconnect the electrical connectors. (Fig. 4)

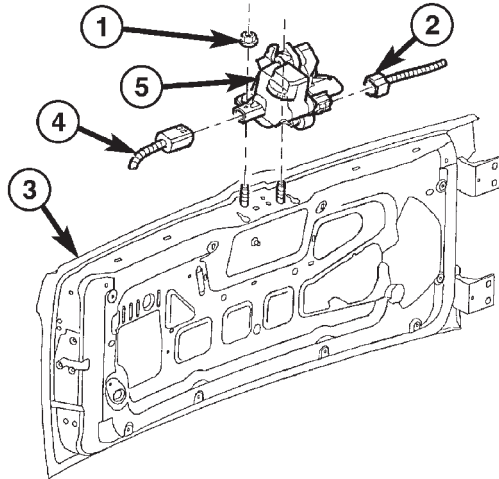
(3) Using a trim stick C-4755 or equivalent, mark the location of the latch assembly for installation.

(4) Remove the nuts and remove the latch assembly.

### INSTALLATION

(1) Install the latch assembly.

FLIP-UP GLASS LATCH (Continued)

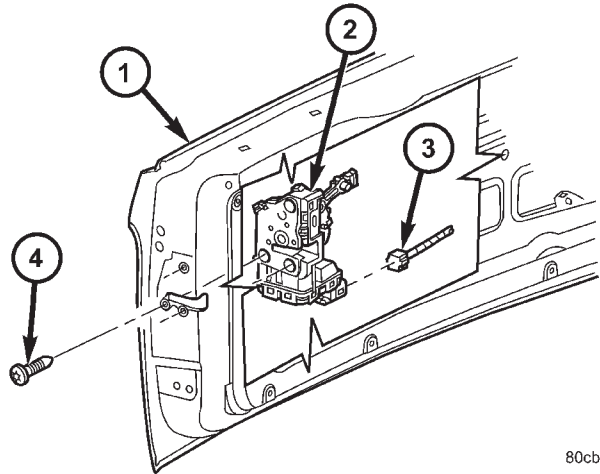


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**Fig. 4 FLIP-UP GLASS LATCH**

- 1 - NUTS (2)
- 2 - ELECTRICAL CONNECTOR
- 3 - SWING GATE
- 4 - ELECTRICAL CONNECTOR
- 5 - FLIP-UP GLASS LATCH

(3) Remove the screws and remove the latch.



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**Fig. 5 LATCH**

- 1 - SWING GATE
- 2 - LATCH ASSEMBLY
- 3 - ELECTRICAL CONNECTOR
- 4 - SCREWS

(2) Install the nuts and tighten to 12 N·m (9 ft. lbs.).

(3) Connect the electrical connectors.

(4) Install the trim panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - INSTALLATION)

(5) Adjust the latch to achieve the best glass fit. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

**HINGE**

**REMOVAL**

(1) Remove the swing gate. (Refer to 23 - BODY/SWING GATE/SWING GATE - REMOVAL)

(2) Remove the bolts and remove the hinges.

**INSTALLATION**

(1) Install the hinges.

(2) Install the bolts and tighten to 31 N·m (23 ft. lbs.).

(3) Install the swing gate. (Refer to 23 - BODY/SWING GATE/ SWING GATE - INSTALLATION)

**LATCH**

**REMOVAL**

(1) Remove the trim panel and waterdam. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - REMOVAL)

(2) Disconnect the electrical connector and actuator rod at the threaded clip. (Fig. 5)

**INSTALLATION**

(1) Connect the electrical connector and install the latch.

(2) Install the screws and tighten to 11 N·m (8 ft. lbs.).

(3) Connect the actuator rod.

(4) Install the trim panel and waterdam. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - INSTALLATION)

**LATCH STRIKER**

**REMOVAL**

(1) Open the gate and remove the screws attaching the striker to the d-pillar.

**INSTALLATION**

(1) Install the striker and install the nuts.

(2) Tighten the nuts to 28 N·m (21 ft. lbs.).

(3) Adjust the swing gate as necessary. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

**LOCK CYLINDER**

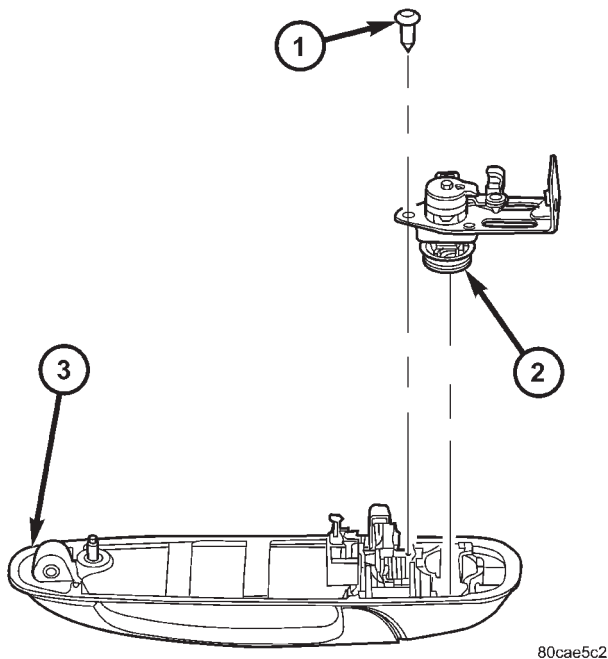
**REMOVAL**

(1) Remove the exterior handle. (Refer to 23 - BODY/SWING GATE/EXTERIOR HANDLE - REMOVAL)

## LOCK CYLINDER (Continued)

(2) Remove the clip and remove the lock cylinder switch.

(3) Remove the screw and remove the lock cylinder. (Fig. 6)



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**Fig. 6 LOCK CYLINDER**

- 1 - SCREW  
2 - LOCK CYLINDER  
3 - EXTERIOR HANDLE

## INSTALLATION

- (1) Install the lock cylinder.
- (2) Install the screw and tighten to 6 N-m (50 in. lbs.).
- (3) Install the lock cylinder switch and retaining clip.
- (4) Install the exterior handle. (Refer to 23 - BODY/SWING GATE/EXTERIOR HANDLE - INSTALLATION)

## SWING GATE

## REMOVAL

- (1) Remove the spare tire. (Refer to 22 - TIRES/WHEELS/TIRES/SPARE TIRE - REMOVAL)
- (2) Remove the quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL)
- (3) Support the swing gate with a suitable lifting device.
- (4) Disconnect the wire harness.

(5) Disconnect the check strap from the d-pillar. (Refer to 23 - BODY/SWING GATE/CHECK STRAP - REMOVAL)

(6) Remove the bolts and remove the swing gate.

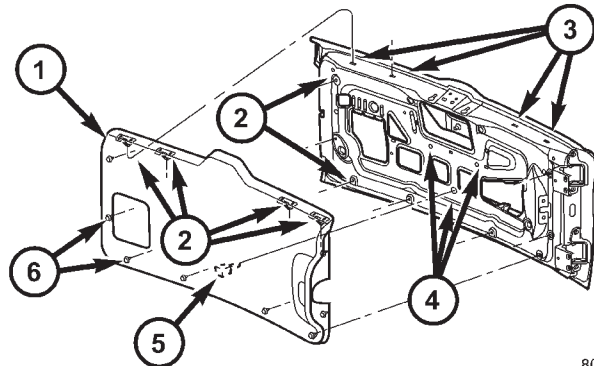
## INSTALLATION

- (1) Install the swing gate and install the bolts.
- (2) Tighten the bolts to 31 N-m (23 ft. lbs.).
- (3) Adjust the swing gate as needed adding 4 mm on the right side to compensate for sag after the spare tire is installed. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
- (4) Connect the wire harness electrical connector.
- (5) Connect the check strap. (Refer to 23 - BODY/SWING GATE/CHECK STRAP - INSTALLATION)
- (6) Install the quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION)
- (7) Install the spare tire. (Refer to 22 - TIRES/WHEELS/TIRES/SPARE TIRE - INSTALLATION)

## TRIM PANEL

## REMOVAL

- (1) Using a trim stick C-4755 or equivalent, release the push pin fasteners. (Fig. 7)
- (2) Lift trim panel up off of the upper trim panel clips



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**Fig. 7 SWING GATE TRIM PANEL**

- 1 - TRIM PANEL  
2 - UPPER TRIM PANEL CLIPS  
3 - UPPER TRIM CLIP HOLES  
4 - TRIM PANEL LOCATOR HOLES  
5 - SWING GATE LOCATOR PINS  
6 - PUSH IN FASTENERS

## INSTALLATION

- (1) Position the trim panel and seat the upper clips.
- (2) Fully seat the lower trim panel clips

## LATCH - ACCESS PANEL

### DESCRIPTION

This panel provides access to the gate latch if gate power fails. The gate can be unlocked by reaching in and pushing the lock lever down.

### REMOVAL

(1) Using a trim stick C-4755 or equivalent, remove the access panel.

### INSTALLATION

(1) Position and install the access panel.

## FLIP-UP GLASS SUPPORT CYLINDER

### REMOVAL

- (1) Open the flip-up glass and support.
- (2) Release the upper and lower clips.
- (3) Remove the support cylinder.

### INSTALLATION

- (1) Install the support cylinder over the ball studs with the thin end connected to the glass.
- (2) Install the retaining clips and remove the support from the flip-up glass.



# EXTERIOR

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## BODY SIDE MOLDINGS

### REMOVAL

(1) Using a trim stick C-4755 or equivalent, remove and discard the molding from the outside of the door.

### INSTALLATION

- (1) Thoroughly clean all residue from the body side molding attachment area of the door.
- (2) Wipe area clean with a 50% solution of water and alcohol and wipe dry.
- (3) Apply new body side molding using the locators in the door and apply pressure of approximately 40 p.s.i. over the entire surface of the molding.

## COWL GRILLE

### REMOVAL

- (1) Remove the hood seal.
- (2) Remove the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)
- (3) Remove the four plastic retainers and remove the cowl grill.

## INSTALLATION

- (1) Position the cowl grill and engage the nine clips to the bottom of the windshield.
- (2) Install the five plastic retainers.
- (3) Install the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)
- (4) Install the hood seal.

## EXTERIOR NAME PLATES

### REMOVAL

**NOTE:** Exterior nameplates are attached to body panels with adhesive tape.

- (1) Apply a length of masking tape on the body, parallel to the top edge of the nameplate to use as a guide, if necessary.
- (2) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun. Do not exceed 52°C (120°F) when heating emblem.
- (3) Using a trim stick C-4755 or equivalent, behind the emblem to separate the adhesive backing from the body.

EXTERIOR NAME PLATES (Continued)

(4) Clean adhesive residue from body with MOPAR Super Clean solvent or equivalent.

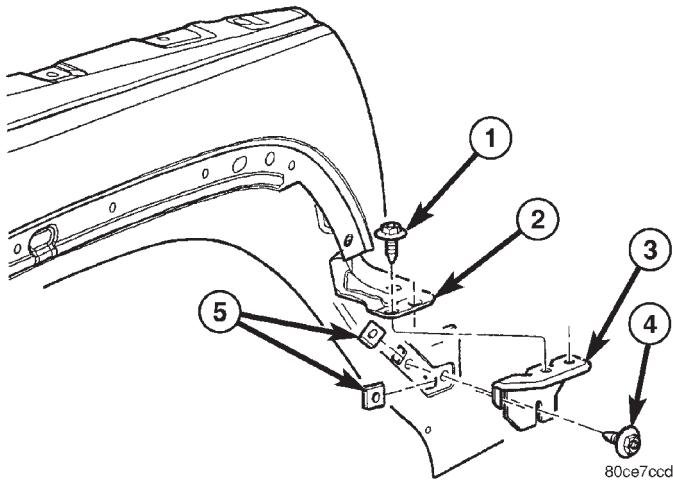
**INSTALLATION**

- (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.

**FRONT FENDER**

**REMOVAL**

- (1) Remove the wheel opening splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - REMOVAL)
- (2) Remove the fascia assembly. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT FASCIA - REMOVAL)
- (3) Remove the fender support bracket bolts. (Fig. 1)
- (4) Remove the bolts and remove the fender. (Fig. 2)

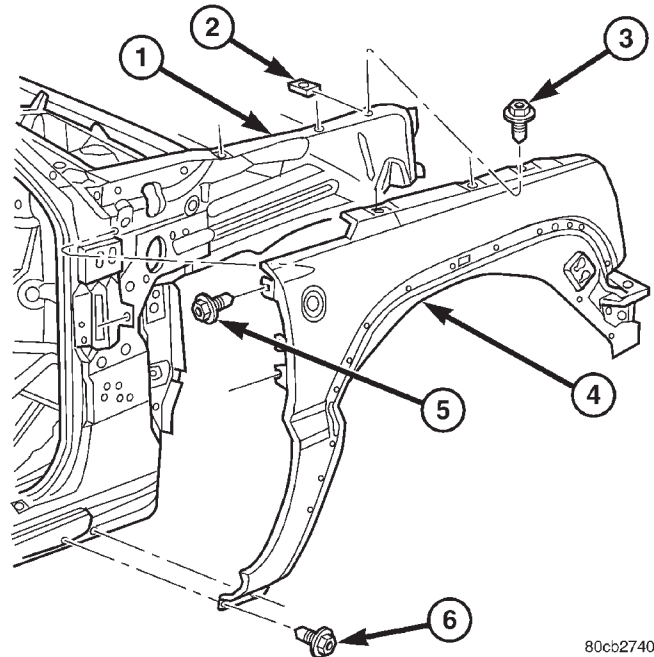


**Fig. 1 FENDER SUPPORT BRACKET**

- 1 - FENDER BOLTS (2)
- 2 - FENDER
- 3 - FENDER SUPPORT BRACKET
- 4 - SUPPORT BRACKET BOLTS (2)
- 5 - U-NUTS (2)

**INSTALLATION**

- (1) Install the fender assembly and install the bolts
- (2) Install the fender support bracket and install the bolts.



**Fig. 2 FRONT FENDER**

- 1 - HYDRAFORM
- 2 - U-NUTS
- 3 - BOLTS (3)
- 4 - FENDER
- 5 - BOLTS (2)
- 6 - BOLTS (2)

- (3) Align the fender with adjacent body parts and tighten the bolts to 12 N-m (9 ft. lbs.). (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
- (4) Install the fascia assembly. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT FASCIA - INSTALLATION)
- (5) Install the wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - INSTALLATION)

**FUEL FILL DOOR/HOUSING**

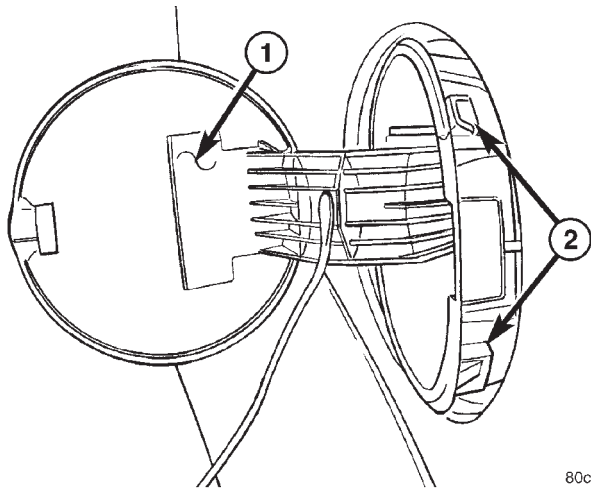
**REMOVAL**

- (1) Remove the fuel cap.
- (2) Remove the three screws connecting the fuel door/housing to the filler neck.
- (3) Reach in through the opening and depress the tabs at the upper and bottom right of the door/housing. (Fig. 3)
- (4) Remove the fuel door/housing from the vehicle.

**INSTALLATION**

- (1) Position the fuel filler door/housing into the vehicle and fully seat the tabs.

## FUEL FILL DOOR/HOUSING (Continued)



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**Fig. 3 FUEL FILL DOOR/HOUSING**

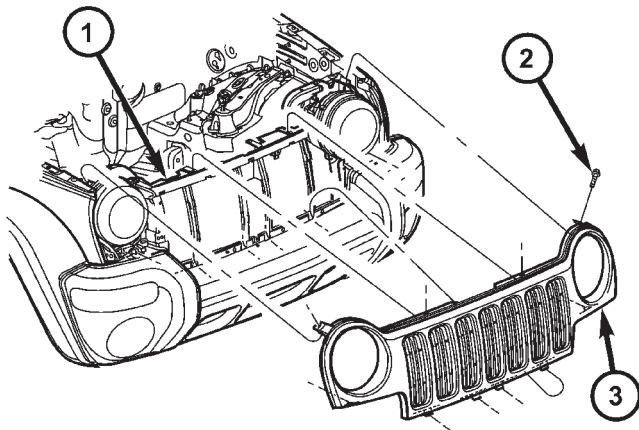
- 1 - FUEL FILL DOOR  
2 - HOUSING TABS

- (2) Install the three screws.  
(3) Install the fuel cap.

## GRILLE

## REMOVAL

- (1) Remove the upper screws. (Fig. 4)  
(2) Roll the grille forward and disengage the two grille hooks under the headlamp units.  
(3) Lift the grille forward and up off of the location tabs at the bottom and remove.



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**Fig. 4 GRILLE**

- 1 - GRILLE OPENING REINFORCEMENT  
2 - SCREWS (4)  
3 - GRILLE CLIPS

## INSTALLATION

- (1) Install the grille onto the locating tabs at the bottom.  
(2) Push the grille back and snap into the hooks in the grille opening reinforcement.  
(3) Check that the black welts at the outboard ends of the grille have a uniform appearance relative to the fender and install the screws.

## GRILLE OPENING REINFORCEMENT

## REMOVAL

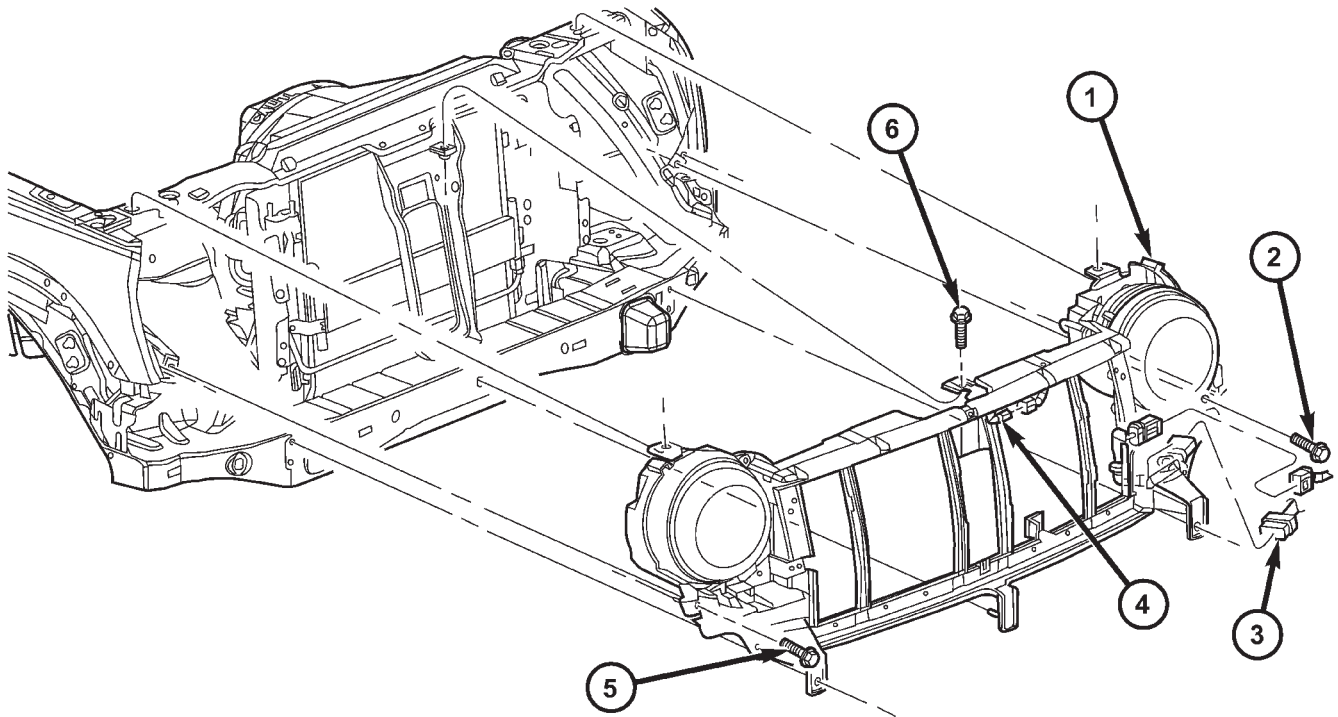
- (1) Remove the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL)  
(2) Remove the front fascia. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT FASCIA - REMOVAL)  
(3) Disconnect the electrical connectors. (Fig. 5)  
(4) Disconnect the rubber side flap push pin connectors.  
(5) Remove the seven bolts and remove the grille opening reinforcement.  
(6) Disconnect the headlamp units electrical connectors.

- (7) Remove the headlamp units. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL)

## INSTALLATION

- (1) Install the headlamp units. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION)  
(2) Connect the headlamp unit electrical connectors.  
(3) Install the grille opening reinforcement and install the seven bolts.  
(4) Connect the rubber side flap and install the push pin connectors.  
(5) Connect the electrical connectors. (Fig. 5)  
(6) Install the front fascia. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT FASCIA - INSTALLATION)  
(7) Install the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION)

GRILLE OPENING REINFORCEMENT (Continued)



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**Fig. 5 GRILLE OPENING REINFORCEMENT**

- |                                  |                          |
|----------------------------------|--------------------------|
| 1 - GRILLE OPENING REINFORCEMENT | 4 - ELECTRICAL CONNECTOR |
| 2 - BOLTS (3)                    | 5 - BOLTS (3)            |
| 3 - ELECTRICAL CONNECTORS        | 6 - BOLT (1)             |

FRONT WHEELHOUSE  
SPLASH SHIELD

REMOVAL

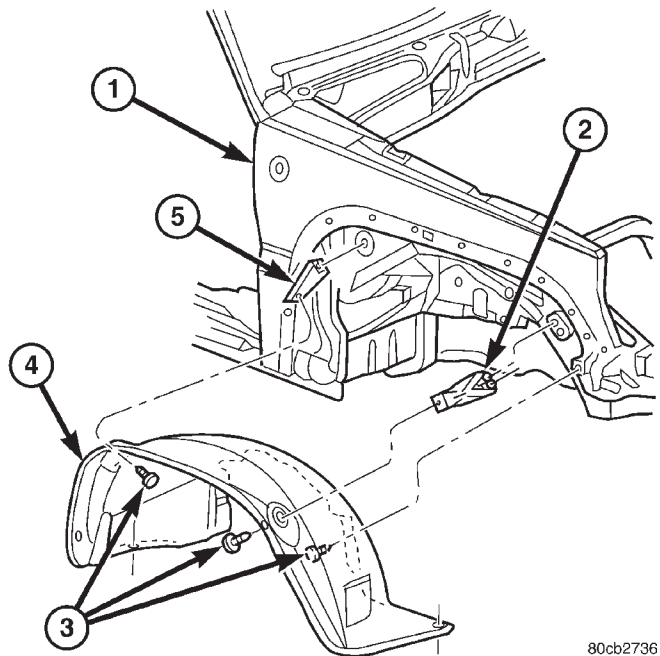
(1) Remove the wheel flare molding. (Refer to 23 - BODY/EXTERIOR/FRONT WHEEL OPENING FLARE MOLDING - REMOVAL)

(2) Remove the five push pin fasteners and remove the splash shield. (Fig. 6)

INSTALLATION

(1) Install the splash shield and install the five push pin fasteners.

(2) Install the wheel flare molding. (Refer to 23 - BODY/EXTERIOR/FRONT WHEEL OPENING FLARE MOLDING - INSTALLATION)



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**Fig. 6 FRONT WHEELHOUSE SPLASH SHIELD**

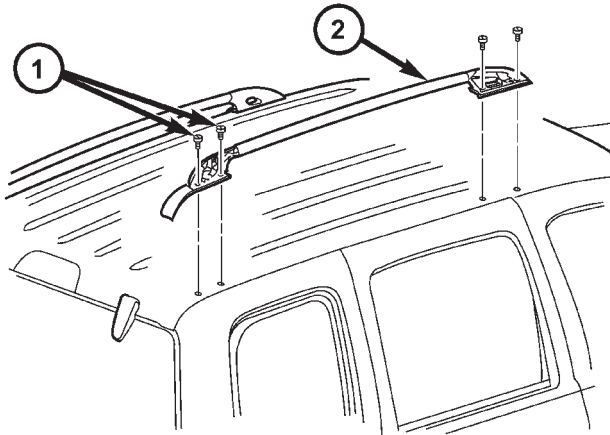
- |                            |
|----------------------------|
| 1 - FENDER                 |
| 2 - FLARE BRACKET          |
| 3 - PUSH PIN FASTENERS (5) |
| 4 - SPLASH SHIELD          |
| 5 - FLARE BRACKET          |

## LUGGAGE RACK

### REMOVAL

(1) Using a trim stick C-4755 or equivalent, remove the roof rack covers. (Fig. 8)

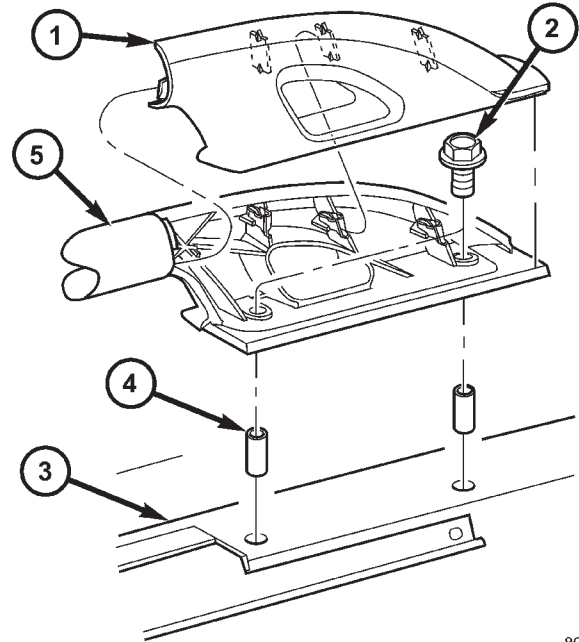
(2) Remove the bolts and remove the roof rack. (Fig. 7)



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**Fig. 7 LUGGAGE RACK**

- 1 - BOLTS (4)
- 2 - RACK RAIL



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**Fig. 8 RACK COVERS**

- 1 - COVER
- 2 - BOLTS
- 3 - ROOF PANEL
- 4 - KNURLED NUT
- 5 - ROOF RACK

### INSTALLATION

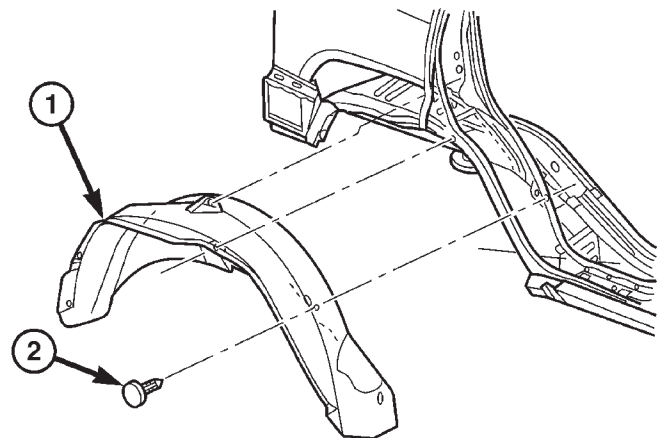
- (1) Install the roof rack and install the bolts.
- (2) Tighten the bolts to 8 N·m (75 in. lbs.).
- (3) Snap on the roof rack covers.

## REAR WHEELHOUSE SPLASH SHIELD

### REMOVAL

(1) Remove the wheel flare moldings. (Refer to 23 - BODY/EXTERIOR/REAR WHEEL OPENING FLARE MOLDING - REMOVAL)

(2) Remove the three push pin fasteners and remove the splash shield. (Fig. 9)



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**Fig. 9 WHEELHOUSE SPLASH SHIELD**

- 1 - SPLASH SHIELD
- 2 - PUSH PIN FASTENERS (3)

### INSTALLATION

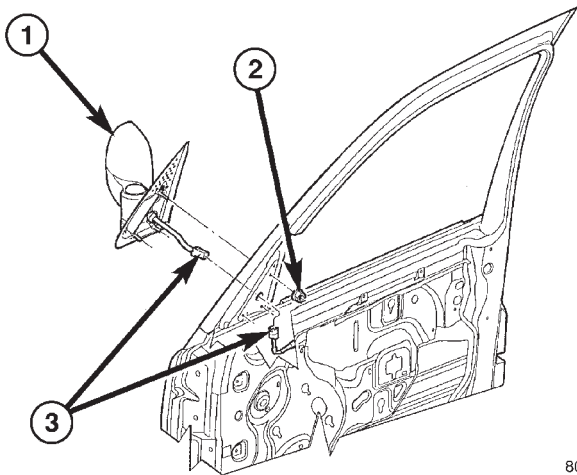
(1) Install the splash shield and install the three push pin fasteners.

(2) Install the wheel flare moldings. (Refer to 23 - BODY/EXTERIOR/REAR WHEEL OPENING FLARE MOLDING - INSTALLATION)

## SIDE VIEW MIRROR

### REMOVAL

- (1) Remove the trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)
- (2) Disconnect the electrical connector. (Fig. 10)
- (3) Remove the three nuts and remove the mirror assembly.



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**Fig. 10 SIDE VIEW MIRROR**

- 1 - MIRROR ASSEMBLY
- 2 - NUTS (3)
- 3 - ELECTRICAL CONNECTOR

### INSTALLATION

- (1) Install the mirror assembly.
- (2) Install the three nuts and tighten to 7 N·m (65 in. lbs.).
- (3) Connect the electrical connector.
- (4) Install the trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION)

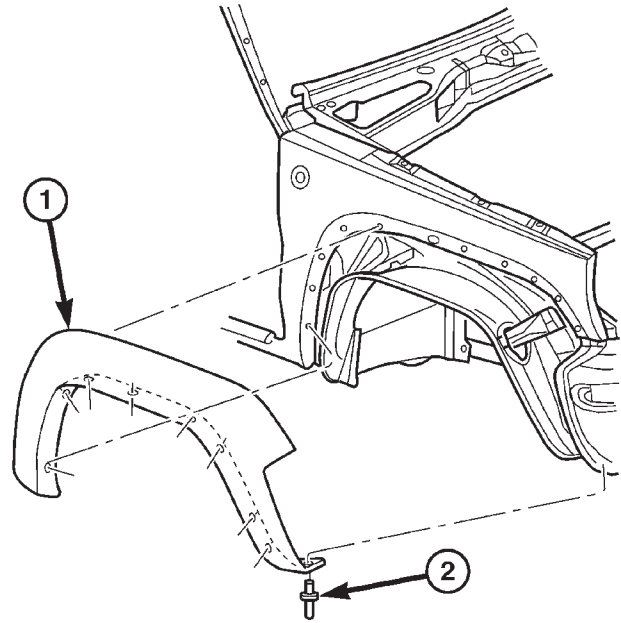
## FRONT WHEEL OPENING FLARE MOLDINGS

### REMOVAL

- (1) Remove the 10 rivets connecting the flare to the splash shield, flare brackets, fascia and air dam. (Fig. 11)
- (2) Using a trim stick C-4755 or equivalent, separate the clips attaching the molding to the fascia and fender.
- (3) Remove the flare molding.

### INSTALLATION

- (1) Position flare molding and seat clips into the fascia.
- (2) Seat the remaining clips into the fender.



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**Fig. 11 FRONT WHEEL OPENING FLARE MOLDING**

- 1 - FLARE MOLDING
- 2 - RIVETS (10)

- (3) Install ten new rivets securing the flare molding to the splash shield, flare brackets, fascia and air dam.

## REAR WHEEL OPENING FLARE MOLDINGS

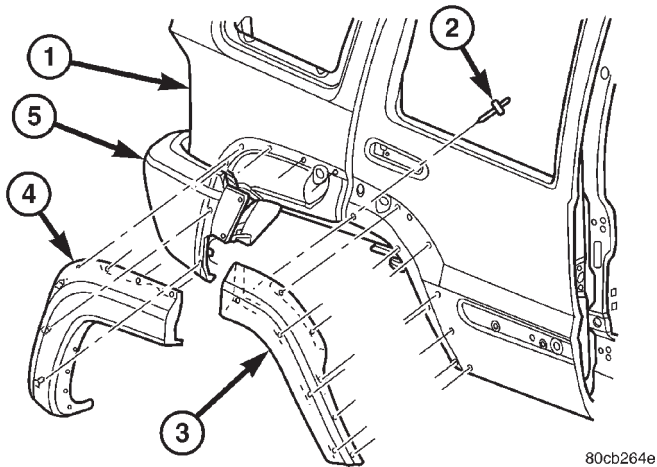
### REMOVAL

- (1) Open the rear door and remove the five rivets from the inside surface of the door. (Fig. 12)
- (2) Using a trim stick C-4755 or equivalent, separate the clips attaching the molding to the door and remove the molding.
- (3) Remove the 5 rivets from the rear flare and splash shield.
- (4) Using a trim stick C-4755 or equivalent, separate the clips attaching the molding to the body and the rear fascia and remove the molding.
- (5) Remove the two rivets and remove the flare extension. (Fig. 13)

### INSTALLATION

- (1) Install the flare extension and install two new rivets.
- (2) Position the rear flare molding and seat the clips attaching it to the body and the rear fascia.
- (3) Install five new rivets attaching the flare to the splash shield.

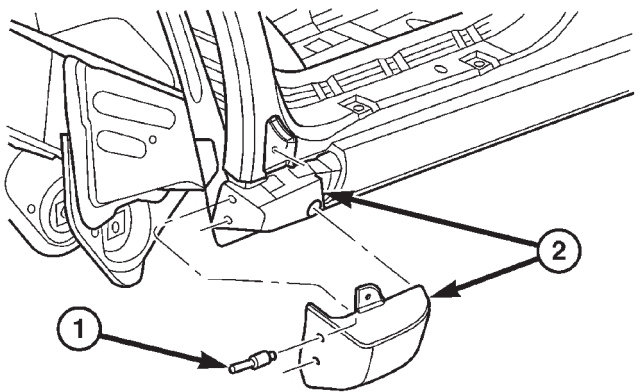
## REAR WHEEL OPENING FLARE MOLDINGS (Continued)



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**Fig. 12 REAR WHEEL OPENING FLARE MOLDINGS**

- 1 - D-PILLAR
- 2 - RIVETS (10)
- 3 - REAR DOOR FLARE MOLDING
- 4 - REAR FLARE MOLDING
- 5 - REAR FASCIA



80cb268c

**Fig. 13 FLARE EXTENSION**

- 1 - RIVETS (3)
- 2 - FLARE EXTENSION AND DOOR SILL

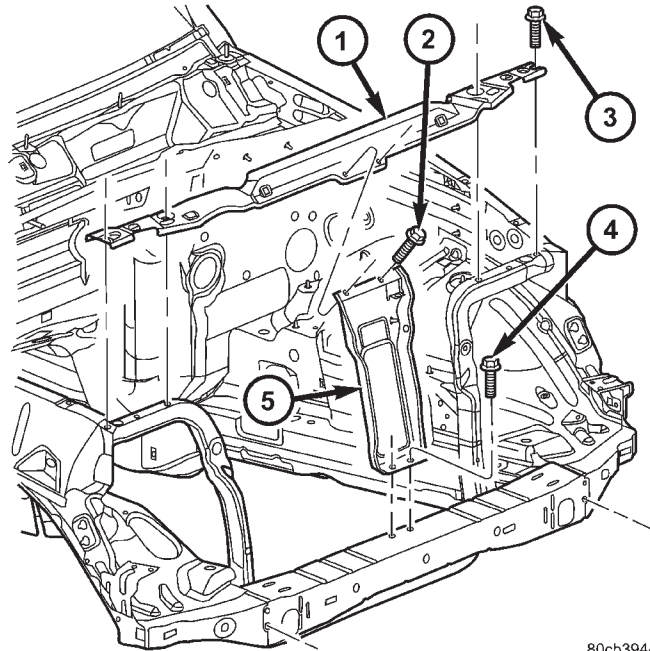
- (4) Position the door flare and seat the clips.
- (5) Install five new rivets through the inside surface of the door attaching the flare to the door.

## RADIATOR CROSSMEMBER

## REMOVAL

- (1) Remove the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL)
- (2) Remove the hood latch. (Refer to 23 - BODY/HOOD/LATCH - REMOVAL)

- (3) Remove the bolt securing the washer bottle to the crossmember.
- (4) Remove the bolts and remove the hood latch support. (Fig. 14)
- (5) Remove the bolts and remove the crossmember.



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**Fig. 14 RADIATOR CROSSMEMBER**

- 1 - CROSSMEMBER
- 2 - BOLTS (2)
- 3 - BOLTS (4)
- 4 - BOLTS (2)
- 5 - HOOD LATCH SUPPORT

## INSTALLATION

- (1) Install the crossmember and install the bolts.
- (2) Tighten the bolts to 10 N·m (85 in. lbs.).
- (3) Install the hood latch support and install the bolts.
- (4) Tighten the bolts to 10 N·m (85 in. lbs.).
- (5) Install the hood latch. (Refer to 23 - BODY/HOOD/LATCH - INSTALLATION)
- (6) Install the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION)
- (7) Install the bolt securing the washer bottle to the crossmember and tighten to 10 N·m (85 in. lbs.).

# INSTRUMENT PANEL

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## CLUSTER BEZEL

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Remove the drives side trim bezels. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVER SIDE BEZEL - REMOVAL)
- (2) Remove the instrument panel top cover. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL)
- (3) Remove the seven screws and remove the cluster bezel.

## INSTALLATION

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- (1) Install the cluster bezel and the seven screws.
- (2) Install the instrument panel top cover. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION)
- (3) Install the drives side trim bezels. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVER SIDE BEZEL - INSTALLATION)



## GLOVE BOX

### REMOVAL

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- (1) Open the glove box.
- (2) Squeeze the stop tabs located on the sides of the box and allow the box to open fully.
- (3) With box in the full down position slide the box to the right off of the hinges and remove.

### INSTALLATION

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- (1) Position the box on and slide the box to the left to engage the hinges.
- (2) Close the glove box.

## GLOVE BOX LATCH

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY**

**NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Remove the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL)
- (2) Remove the nine screws and remove the glove box skin.
- (3) Remove the latch from the locators.

### INSTALLATION

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- (1) Position the latch onto the locators.
- (2) Install the glove box skin onto the glove box and install the nine screws.
- (3) Install the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION)

## GLOVE BOX LATCH STRIKER

### REMOVAL

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GLOVE BOX LATCH STRIKER (Continued)

- (1) Open the glove box.
- (2) Remove the two striker screws and remove the latch striker.

**INSTALLATION**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Install the striker and install the two screws.
- (2) Loosen the screws to adjust if necessary.

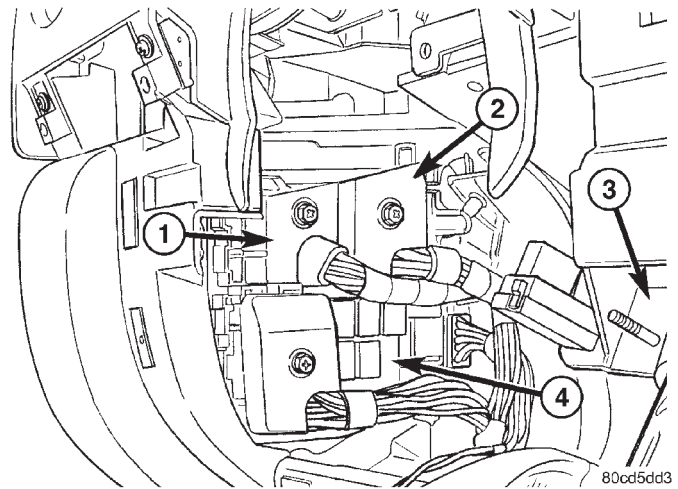
**INSTRUMENT PANEL ASSEMBLY**

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**NOTE:** Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the instrument panel top cover. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL)
- (3) Remove the speakers.
- (4) Remove the floor console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
- (5) Remove the radio. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL)
- (6) Remove the four nuts and remove the center support bracket. (Fig. 6)
- (7) Remove the steering column. (Refer to 19 - STEERING/COLUMN - REMOVAL)
- (8) Remove the drivers side cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL)
- (9) Disconnect the wire harness connector behind the drivers side cowl trim cover.
- (10) Disconnect the green and light blue wire harness bulk connectors at the junction block. (Fig. 1)

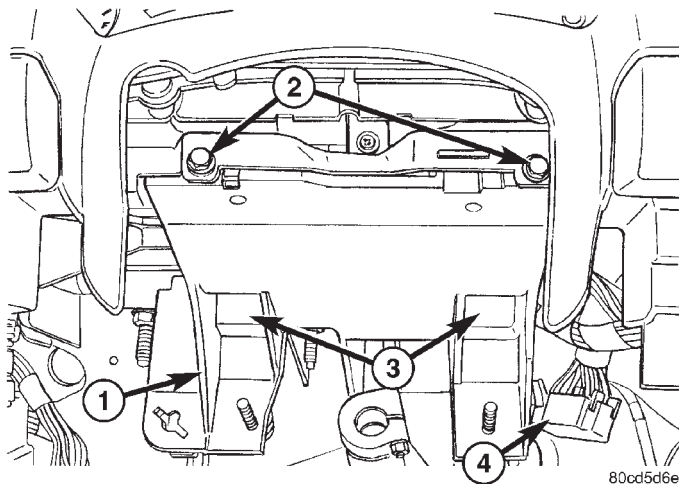


**Fig. 1 JUNCTION BLOCK CONNECTORS**

- 1 - ELECTRICAL CONNECTOR
- 2 - ELECTRICAL CONNECTOR
- 3 - PEDAL SUPPORT BRACKET
- 4 - JUNCTION BLOCK

- (11) Disconnect the electrical connector at the inner side of the pedal support bracket. (Fig. 2)
- (12) Remove the two bolts at the front of the pedal support bracket. (Fig. 2)
- (13) Remove the two bolts from the bottom side of the pedal support bracket. (Fig. 2)

## INSTRUMENT PANEL ASSEMBLY (Continued)

**Fig. 2 PEDAL SUPPORT BRACKET**

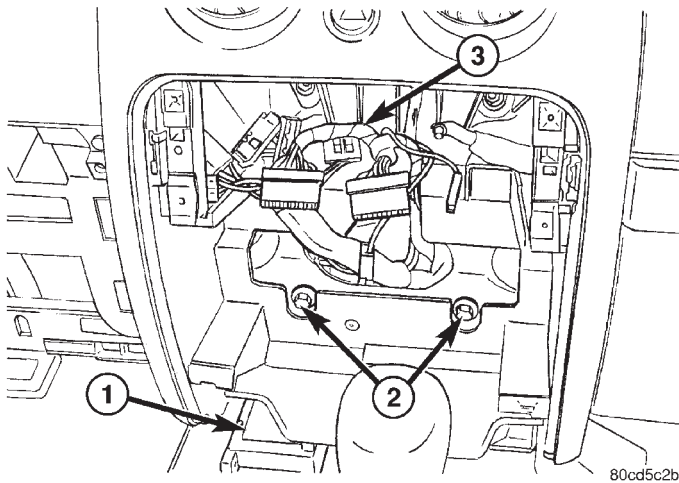
- 1 - PEDAL SUPPORT BRACKET
- 2 - BOLTS
- 3 - BOLTS
- 4 - ELECTRICAL CONNECTOR

(14) Remove the two roll down bracket bolts at the left cowl side panel. (Fig. 6)

(15) Remove the ground strap bolt and disconnect the restraint module electrical connector. (Fig. 3)

(16) Remove the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL)

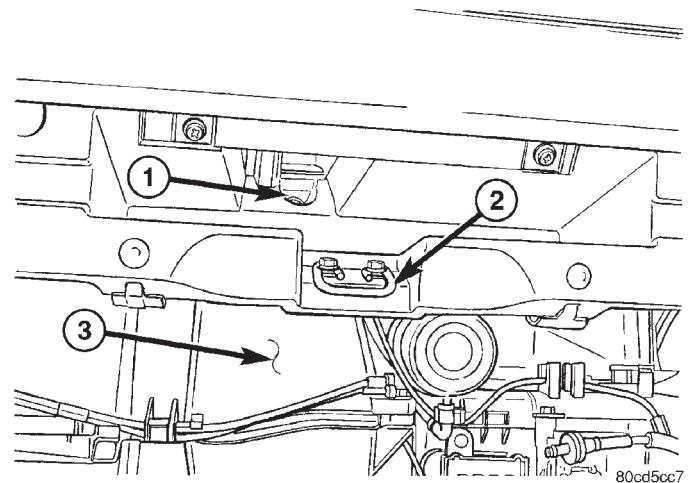
(17) Remove the two HVAC mounting bolts behind the center trim. (Fig. 3)

**Fig. 3 HVAC BOLTS**

- 1 - RESTRAINT MODULE
- 2 - HVAC BOLTS
- 3 - RADIO WIRE HARNESS

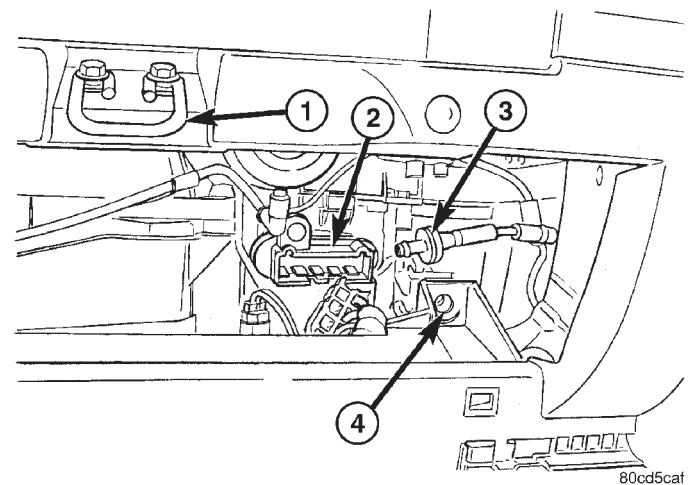
(18) Remove the passenger side trim bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/IP PASSENGER SIDE BEZEL - REMOVAL)

(19) Remove the HVAC mounting bolt above the glove box striker. (Fig. 4)

**Fig. 4 HVAC UPPER BOLT**

- 1 - BOLT
- 2 - GLOVE BOX STRIKER
- 3 - HVAC UNIT

(20) Remove the HVAC bolt at the lower outside corner of the glove box opening. (Fig. 5)

**Fig. 5 HVAC CONNECTIONS**

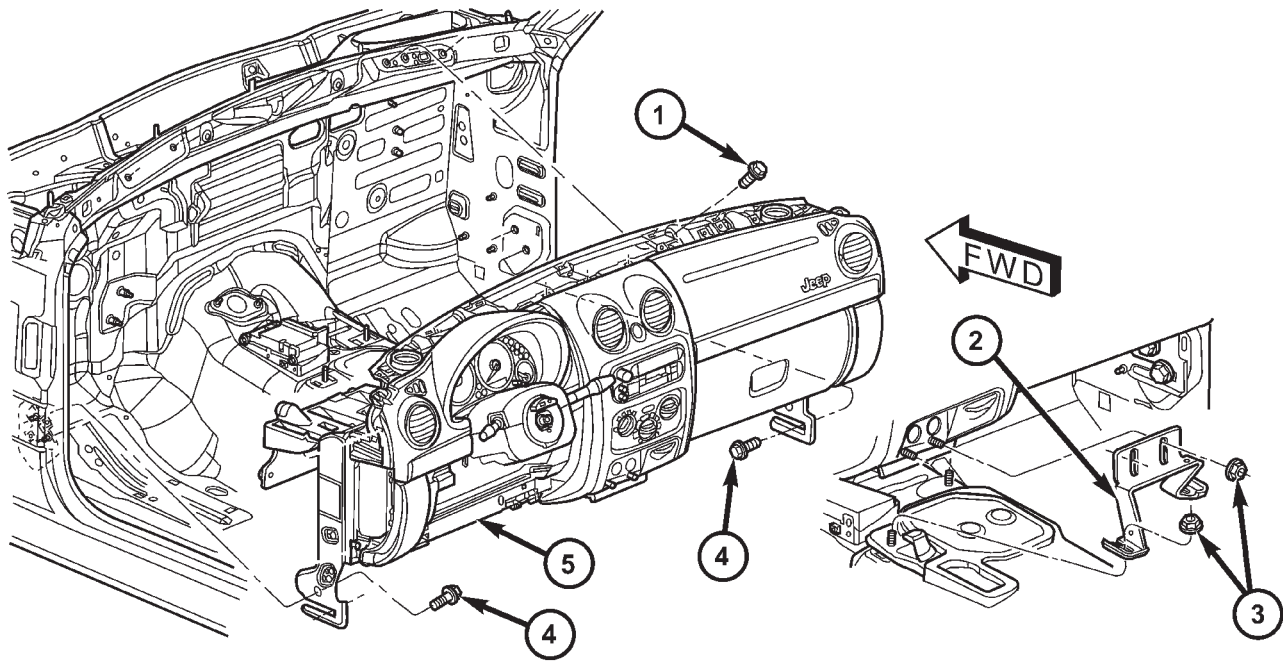
- 1 - GLOVE BOX STRIKER
- 2 - BLOWER RESISTOR
- 3 - VACUUM CHECK VALVE
- 4 - BOLT

(21) Remove the passenger side cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL)

(22) Disconnect the blower resistor electrical connector. (Fig. 5)

(23) Remove the two roll down bracket bolts at the right cowl side panel.

INSTRUMENT PANEL ASSEMBLY (Continued)



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**Fig. 6 INSTRUMENT PANEL ASSEMBLY**

- |                            |                               |
|----------------------------|-------------------------------|
| 1 - TOP BOLTS (4)          | 4 - ROLL DOWN BOLTS (4)       |
| 2 - CENTER SUPPORT BRACKET | 5 - INSTRUMENT PANEL ASSEMBLY |
| 3 - NUTS (4)               |                               |

(24) Disconnect the vacuum check valve and the vacuum reservoir. (Fig. 5)

(25) Disconnect the blower motor electrical connector.

(26) Remove the four bolts at the top of the instrument panel connecting to the cowl front panel.

(27) Roll the instrument panel rearward and remove the wire harness from routing channel in the rear.

(28) Disconnect the push pin fastener and position aside the radio wire harness. Note the location of the harness for installation.

(29) Remove the instrument panel.

**INSTALLATION**

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**IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Position the instrument panel into the vehicle.
- (2) Position the wire harness into the rear routing channel and roll the instrument panel back against the cowl.
- (3) Position the radio wire harness and seat the push pin fastener.

**NOTE: Position the speaker wires through the speaker openings.**

- (4) Install the four bolts at the top of the instrument panel connecting to the cowl front panel and tighten to 28 N·m (21 ft. lbs.).
- (5) Connect the blower motor electrical connector.
- (6) Connect the vacuum check valve and the vacuum reservoir.
- (7) Connect the blower resistor electrical connector.

**NOTE: Do not push or pull bracket. Tighten at the rest position.**

## INSTRUMENT PANEL ASSEMBLY (Continued)

(8) Install the two roll down bracket bolts at the right cowl side panel and tighten to 54 N·m (40 ft. lbs.).

(9) Install the HVAC mounting bolt at the lower outside corner of the glove box opening and tighten to 6 N·m (55 in. lbs.).

(10) Install the HVAC mounting bolt above the glove box striker.

(11) Install the passenger side trim bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL PASSENGER SIDE BEZEL - INSTALLATION)

(12) Install the passenger side cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION)

(13) Install the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION)

**NOTE: Do not push or pull bracket. Tighten at the rest position.**

(14) Install the two roll down bracket bolts at the drivers cowl side panel and tighten to 54 N·m (40 ft. lbs.).

(15) Install the two bolts at the bottom side of the pedal support bracket.

(16) Install the two bolts at the front of the pedal support bracket.

(17) Connect the electrical connector at the inner side of the pedal support bracket.

(18) Connect the wiring harness electrical connectors at the junction block.

(19) Connect the wire harness electrical connector behind the drivers side cowl trim cover.

(20) Install the left cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION)

(21) Install the steering column. (Refer to 19 - STEERING/COLUMN - INSTALLATION)

(22) Install the two HVAC mounting bolts behind the center trim.

(23) Install the ground strap and bolt and connect the restraint module electrical connector.

(24) Install the center support bracket and hold it tight against the instrument panel.

(25) Tighten the lower nuts to 23 N·m (17 ft. lbs.).

(26) Tighten the upper bracket nuts to 23 N·m (17 ft. lbs.).

(27) Install the radio. (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION)

(28) Install the floor console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(29) Install the speakers.

(30) Install the instrument panel top cover. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION)

(31) Reconnect the battery ground cable.

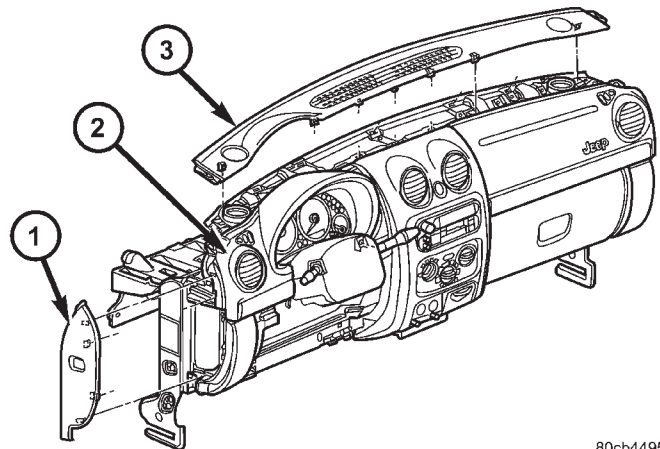
## INSTRUMENT PANEL TOP COVER

## REMOVAL

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(1) Remove the a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM AND GRAB HANDLE - REMOVAL)

(2) Using a trim stick C-4755 or equivalent, release the attachment clips and remove the top cover. (Fig. 7)



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**Fig. 7 INSTRUMENT PANEL COVERS**

- 1 - SIDE COVER
- 2 - INSTRUMENT PANEL ASSEMBLY
- 3 - TOP COVER

INSTRUMENT PANEL TOP COVER (Continued)

**INSTALLATION**

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- (1) Position the top cover and seat the clips fully.
- (2) Install the a-pillar trim panels. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM AND GRAB HANDLE - INSTALLATION)

**INSTRUMENT PANEL END CAP**

**REMOVAL**

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- (1) Open the door.
- (2) Using the finger indent, grasp and remove the side cover. (Fig. 7)

**INSTALLATION**

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**DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

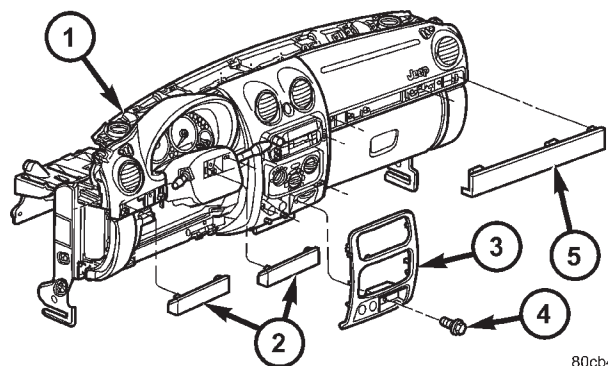
- (1) Position the side panels and seat the clips fully.

**INSTRUMENT PANEL DRIVER SIDE BEZELS**

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Using a trim stick C-4755 or equivalent, disengage the bezels on either side of the steering column. (Fig. 8)



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**Fig. 8 INSTRUMENT PANEL TRIM BEZELS**

- 1 - INSTRUMENT PANEL
- 2 - DRIVERS SIDE TRIM BEZELS
- 3 - CENTER TRIM BEZEL
- 4 - SCREW
- 5 - PASSENGER SIDE TRIM BEZEL

## INSTRUMENT PANEL DRIVER SIDE BEZELS (Continued)

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Position the appropriate driver side bezels on either side of the steering column and seat the attachment clips.

## INSTRUMENT PANEL CENTER BEZEL

## REMOVAL

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- (1) Remove the ashtray and remove the screw.
- (2) Using a trim stick C-4755 or equivalent, remove the center bezel from the instrument panel assembly. (Fig. 8)
- (3) Disconnect the electrical and vacuum connectors.

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SER-**

**VICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Connect the electrical and vacuum connectors.
- (2) Position the center bezel and seat the retaining clips starting with the lower clips first.
- (3) Install the screw and install the ash tray.

## INSTRUMENT PANEL PASSENGER SIDE BEZEL

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Remove the two screws.
- (2) Using a trim stick C-4755 or equivalent, release the retaining clips and remove the passenger side bezel. (Fig. 8)

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

## INSTRUMENT PANEL PASSENGER SIDE BEZEL (Continued)

- (1) Position the passenger side bezel and seat the retaining clips.
- (2) Install the two screws.

equivalent, approximately 25 mm (1 in.) up directly behind the lower edge of the knee blocker.

- (2) Release the lower clips and pull off the knee blocker.

## KNEE BLOCKER

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**CAUTION: Do not pry the knee blocker off at the cover. Failure to follow these instructions may result in damage to the knee blocker.**

- (1) At the label located on the lower instrument panel cross member, place a trim stick C-4755 or

## INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Position the knee blocker aligning attachment clips.

- (2) Pressing close to the attachment clips, fully seat the lower and then the upper clips.



# INTERIOR

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### 4WD FLOOR SHIFT BOOT

#### REMOVAL

(1) Remove the shift lever and remove the boot from the lever. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE/SHIFT LEVER - REMOVAL)

#### INSTALLATION

(1) Install the shift boot onto the shift lever and install the lever. (Refer to 21 - TRANSMISSION/TRANSAXLE/TRANSFER CASE/SHIFT LEVER - INSTALLATION)

### A-PILLAR TRIM AND GRAB HANDLE

#### REMOVAL

(1) Using a small pry tool or equivalent, remove the grab handle trim plugs.

(2) Remove the two grab handle screws.

(3) Remove the grab handle and a-pillar trim from the a-pillar.

#### INSTALLATION

(1) Snap a-pillar trim and grab handle into the a-pillar.

(2) Install the two screws and install the grab handle trim plugs.

## COWL TRIM COVER

### REMOVAL

(1) Remove the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(2) Remove the cowl trim cover by pulling it away from the a-pillar and releasing the clips.

### INSTALLATION

(1) Install the cowl trim cover and seat the retaining clips.

(2) Install the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

## DOOR SILL SCUFF PLATE

### REMOVAL

(1) Using a trim stick C-4755 or equivalent, pry up the scuff plate releasing the retaining clips.

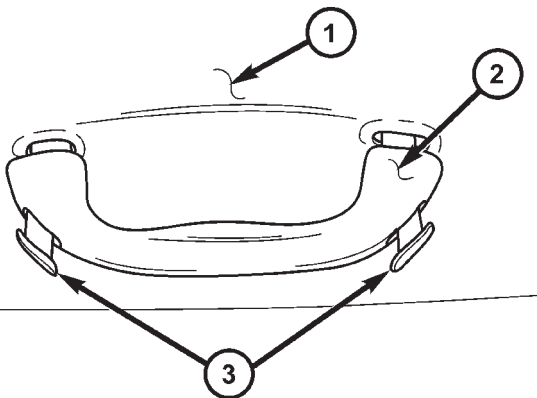
### INSTALLATION

(1) Position the scuff plate and seat the retaining clips.

## ASSIST HANDLE

### REMOVAL

(1) Using a small pry tool or equivalent, release the assist handle by prying out the clips at either end. (Fig. 1)



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**Fig. 1 ASSIST HANDLE**

- 1 - HEADLINER
- 2 - ASSIST HANDLE
- 3 - RETAINING CLIPS

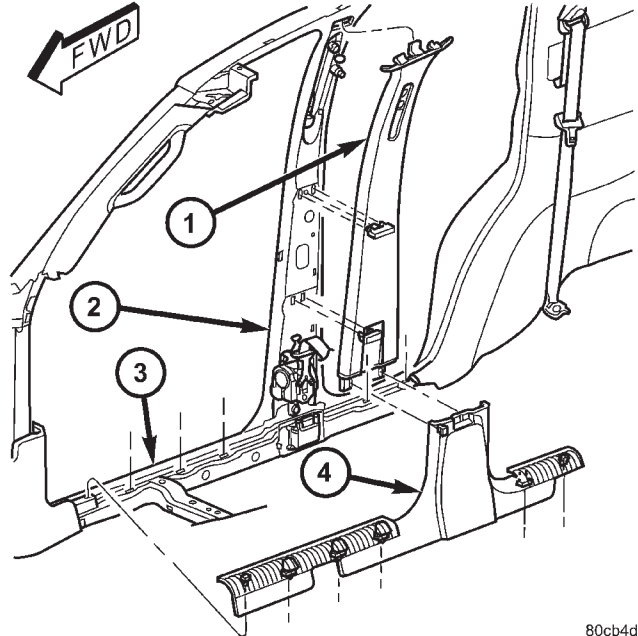
### INSTALLATION

(1) Position the assist handle and seat the retaining clips.

## B-PILLAR LOWER TRIM

### REMOVAL

(1) Using a trim stick C-4755 or equivalent, pry up the trim panel, releasing the retaining clips. (Fig. 2)



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**Fig. 2 B-PILLAR TRIM PANELS**

- 1 - UPPER B-PILLAR TRIM
- 2 - B-PILLAR
- 3 - DOOR SILL
- 4 - LOWER B-PILLAR

### INSTALLATION

(1) Position the trim panel and seat the retaining clips.

## B-PILLAR UPPER TRIM

### REMOVAL

(1) Remove the lower b-pillar trim panel. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(2) Remove the shoulder belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)

(3) Using a trim stick C-4755 or equivalent, release the trim retaining clips and remove. (Fig. 2)

## B-PILLAR UPPER TRIM (Continued)

**INSTALLATION**

- (1) Position the trim panel and seat the retaining clips.
- (2) Install the seat belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)
- (3) Install the b-pillar lower trim panel. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

**CARPETS AND FLOOR MATS****REMOVAL****Front Carpet**

- (1) Remove front seats. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)
- (2) Remove the floor console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
- (3) Remove the rear seats. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL)
- (4) Remove the cowl trim panels. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - REMOVAL)
- (5) Remove the b-pillar lower trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)
- (6) Remove the jack assembly.
- (7) Remove the carpet.

**Rear Cargo Carpet**

- (1) Remove the rivets attaching the cargo hooks to the floor.
- (2) Remove the carpet.

**INSTALLATION****Front Carpet**

- (1) Install the carpet.
- (2) Install the jack assembly.
- (3) Install the b-pillar lower trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)
- (4) Install the cowl trim panels. (Refer to 23 - BODY/INTERIOR/COWL TRIM COVER - INSTALLATION)
- (5) Install the rear seats. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION)
- (6) Install the floor console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)
- (7) Install the front seats. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

**Rear Cargo Carpet**

- (1) Install the carpet and slide under the trim panels.
- (2) Install new rivets securing the carpet and cargo hooks to the floor.

**SHIFT BEZEL****REMOVAL**

- (1) Using a trim stick C-4755 or equivalent, pry shift bezel out of the floor console.

**INSTALLATION**

- (1) Position the shift bezel and seat the retaining clips into the floor console.

**FLOOR CONSOLE****REMOVAL**

- (1) Remove the shift bezel, if equipped. (Refer to 23 - BODY/INTERIOR/SHIFT BEZEL - REMOVAL)
- (2) Set park brake lever in the up position.
- (3) Using a trim stick C-4755 or equivalent, disconnect the manual trans shifter boot, if equipped.
- (4) Using a trim stick C-4755 or equivalent, disconnect the transfer case shifter boot, if equipped.
- (5) Remove the four bolts. (Fig. 3)
- (6) Lift the console at the back and remove.

**INSTALLATION**

- (1) Position the front of the console and lower the rear over the shifter and brake levers.
- (2) Install the bolts.
- (3) Install the shift boots and seat the retainer clips.
- (4) Install the shift bezel. (Refer to 23 - BODY/INTERIOR/SHIFT BEZEL - INSTALLATION)

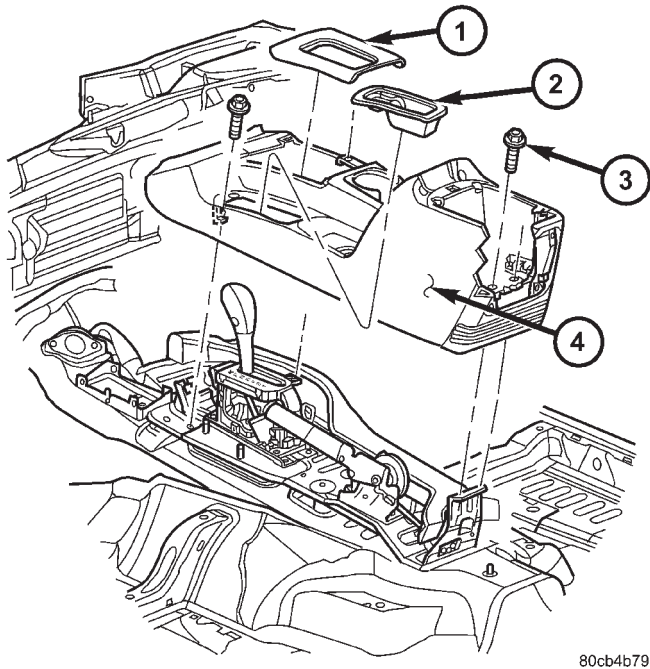
**FLOOR CONSOLE LID LATCH****REMOVAL**

- (1) Remove the screws and remove the lid.
- (2) Remove the screws attaching the lid cover and remove the latch.

**INSTALLATION**

- (1) Install the latch and the lid cover.
- (2) Install the screws attaching the lid cover.
- (3) Install the console lid onto the console and install the screws.

## FLOOR CONSOLE LID LATCH (Continued)



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**Fig. 3 FLOOR CONSOLE**

- 1 - SHIFT BEZEL
- 2 - ACCESSORY CUP
- 3 - BOLTS (4)
- 4 - FLOOR CONSOLE

**HEADLINER****REMOVAL**

- (1) Remove the a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM AND GRAB HANDLE - REMOVAL)
- (2) Remove the visors. (Refer to 23 - BODY/INTERIOR/SUN VISOR - REMOVAL)
- (3) Remove the sun visor support. (Refer to 23 - BODY/INTERIOR/SUN VISOR SUPPORT - REMOVAL)
- (4) Remove the overhead console. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL)
- (5) Cut rear washer hose at the mark about half-way up the a-pillar.
- (6) Remove the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL)
- (7) Remove the assist handles. (Refer to 23 - BODY/INTERIOR/ASSIST HANDLE - REMOVAL)
- (8) Remove the quarter trim. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL)
- (9) Disconnect the electrical connector along the left d-pillar and remove the ground wire.
- (10) Remove the dome light in the rear.
- (11) Remove the sunroof opening trim lace, if equipped. (Refer to 23 - BODY/SUNROOF/OPENING TRIM LACE - REMOVAL)

- (12) Remove the rear washer nozzle.
- (13) Remove the headliner.

**INSTALLATION**

- (1) Install the headliner.
- (2) Install the assist handles. (Refer to 23 - BODY/INTERIOR/ASSIST HANDLE - INSTALLATION)
- (3) Install the visors. (Refer to 23 - BODY/INTERIOR/SUN VISOR - INSTALLATION)
- (4) Install the visor supports. (Refer to 23 - BODY/INTERIOR/SUN VISOR SUPPORT - INSTALLATION)
- (5) Install the overhead console. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION)
- (6) Connect the rear washer hose, previously cut, with a hose junction.
- (7) Install the a-pillar trim and grab handles. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION)
- (8) Install the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION)
- (9) Install the rear washer nozzle.
- (10) Connect the electrical connector and ground wire at the left d-pillar.
- (11) Install the quarter trim panels. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION)
- (12) Install the rear dome light.
- (13) Install the sunroof opening trim lace, if equipped. (Refer to 23 - BODY/SUNROOF/OPENING TRIM LACE - INSTALLATION)

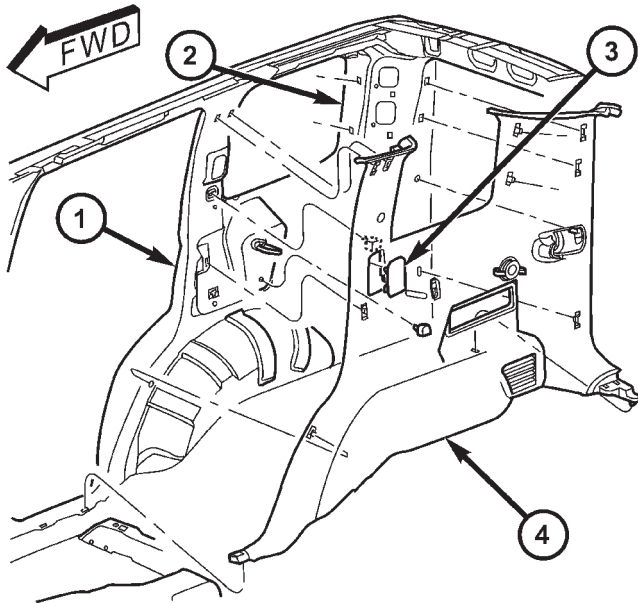
**QUARTER TRIM PANEL****REMOVAL**

- (1) Using a trim stick C-4755 or equivalent, remove the rear header trim.
- (2) Using a trim stick C-4755 or equivalent, remove the rear sill plate.
- (3) Remove the hook pin type connector.
- (4) Fold down the rear seat.
- (5) Remove the seat belt anchor and pivot. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)
- (6) Remove the belt access panel. (Fig. 4)
- (7) Remove the storage cover.
- (8) Disconnect the 12v power supply electrical connector, if equipped.

**INSTALLATION**

- (1) Position the 12v power supply electrical connector, if equipped.
- (2) Install the storage cover.

## QUARTER TRIM PANEL (Continued)



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**Fig. 4 QUARTER TRIM PANEL**

- 1 - C-PILLAR
- 2 - D-PILLAR
- 3 - BELT ACCESS PANEL
- 4 - QUARTER TRIM PANEL

- (3) Install the belt access panel.
- (4) Install the seat belt anchor and pivot. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)
- (5) Install the hook pin type connector.
- (6) Position the rear sill plate and seat the retaining clips.
- (7) Position the rear header trim and seat the retaining clips.

## REAR DOOR SCUFF PLATE

**REMOVAL**

- (1) Using a trim stick C-4755 or equivalent, release the retaining clips and remove the scuff plate.

**INSTALLATION**

- (1) Position the scuff plate and seat the retaining clips.

## SUN VISOR

**REMOVAL**

- (1) Remove the screws at the visor pivot.
- (2) Disconnect the electrical connector and remove the visor.

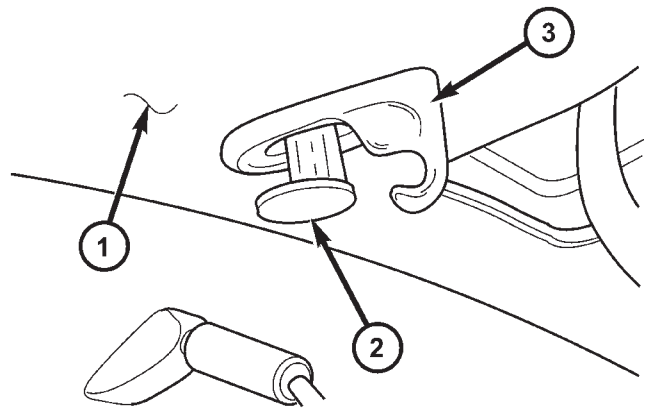
**INSTALLATION**

- (1) Connect the electrical connector and install the visor.
- (2) Install the screws at the visor pivots.

## SUN VISOR SUPPORT

**REMOVAL**

- (1) Using a small pry tool or equivalent, release the support retaining clip by prying out and remove the support. (Fig. 5)



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**Fig. 5 SUN VISOR SUPPORT**

- 1 - HEADLINER
- 2 - RETAINER CLIP
- 3 - SUN VISOR SUPPORT

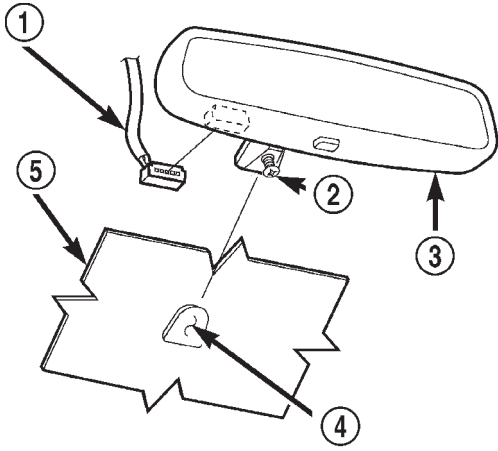
**INSTALLATION**

- (1) Position the visor support and seat the retaining clip.

## REAR VIEW MIRROR

### REMOVAL

- (1) If equipped, disconnect mirror harness connector.
- (2) Loosen the mirror base setscrew (Fig. 6).
- (3) Slide the mirror base upward and off the bracket.



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**Fig. 6 Rear View Mirror**

- 1 - CONNECTOR
- 2 - SCREW
- 3 - REAR VIEW MIRROR
- 4 - SUPPORT BUTTON
- 5 - WINDSHIELD

## INSTALLATION

### INSTALLATION

- (1) Position the mirror base at the bracket and slide it downward onto the support bracket (Fig. 6).
- (2) Tighten the setscrew 1 N·m (15 in. lbs.) torque.
- (3) If equipped, connect mirror harness connector.

## INSTALLATION - REARVIEW MIRROR SUPPORT BRACKET

- (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:

- (a) Crush the vial to saturate the felt applicator.
- (b) Remove the paper sleeve.
- (c) Apply accelerator to the contact surface on the bracket.
- (d) Allow the accelerator to dry for five minutes.
- (e) 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:

- (a) Apply one drop of adhesive at the center of the bracket contact-surface on the windshield glass.
- (b) Apply an even coat of adhesive to the contact surface on the bracket.
- (c) Align the bracket with the marked position on the windshield glass.
- (d) 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.

# PAINT

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## PAINT

### SPECIFICATIONS - PAINT CODES EXTERIOR COLORS

EXTERIOR COLOR	DAIMLERCHRYSLER CODE
Black Clear Coat	DX8
Bright Cactus Green Pearl Coat	AFM
Bright Silver Metallic Clear Coat	WS2
Dark Garnet Red Pearl Coat	XRV
Flame Red Clear Coat	PR4
Patriot Blue Pearl Coat	WB7
Salsa Red Pearl Coat	WE5
Shale Green Metallic Clear Coat	XGR
Steel Blue Pearl Coat	XBQ
Stone White Clear Coat	SW1
Woodland Brown Satin Glow	YU2

### INTERIOR COLORS

INTERIOR COLOR	DAIMLERCHRYSLER CODE
Taupe	L5
Dark Slate Gray	DV
Dark Slate Gray/Light Taupe	D2
Taupe/Light Taupe	L2

### ACCESSORY COLORS

PART	COLOR	DAIMLERCHRYSLER CODE
Renegade Roof Rack/Light Bar	Deep Gray	ZSP
Sport Fascia/Wheel Flare	Dark Neutral Gray	HS5

## PAINT CODE

### DESCRIPTION

The paint code is 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

### DESCRIPTION

The original equipment finish is a multi step process that involves cleaning, applying electro de-position (E-coat), anti-chip primer, base coat, and clear coat steps.

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.

## BASE COAT/CLEAR COAT FINISH (Continued)

**CAUTION: 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 surfaces. Damage to finish or color can result.**

## PAINT TOUCH-UP

## DESCRIPTION

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.

**WARNING: USE AN OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.**

## OPERATION

(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 finesse 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.

**WARNING: AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT. AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.**

## FINESSE SANDING/BUFFING &amp; POLISHING

## DESCRIPTION

Minor acid etching, orange peel, or smudging in clear coat or single-stage finishes can be reduced with light finesse sanding, hand buffing, and polishing. **If the finish has been finesse sanded in the past, it cannot be repeated. Finesse 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.**



## SEATS

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## HEADREST

## REMOVAL

(1) Depress head restraint release button and lift head restraint to full up position.

(2) Using a small flat blade, depress tab on right side head restraint release button and using your hand, simultaneously press tab on left side head restraint release button and pull head restraint up to separate from seat back.

## INSTALLATION

(1) Position head restraint in seat back, press tab on left side head restraint release button and push down head restraint to secure.

## HEADREST SLEEVE

## REMOVAL

(1) Remove the headrest. (Refer to 23 - BODY/ SEATS/HEADREST - REMOVAL)

(2) Remove the headrest sleeve cover.

(3) Rotate head restraint sleeve 1/4 turn counter-clockwise to release retaining tab.

(4) Pull sleeve from seat back frame.

## INSTALLATION

(1) Position sleeve in seat back frame.

(2) Rotate head restraint sleeve 1/4 turn clockwise to engage retaining tab.

(3) Install the headrest sleeve cover.

(4) Install the headrest. (Refer to 23 - BODY/ SEATS/HEADREST - INSTALLATION)

## SEAT - FRONT

### REMOVAL

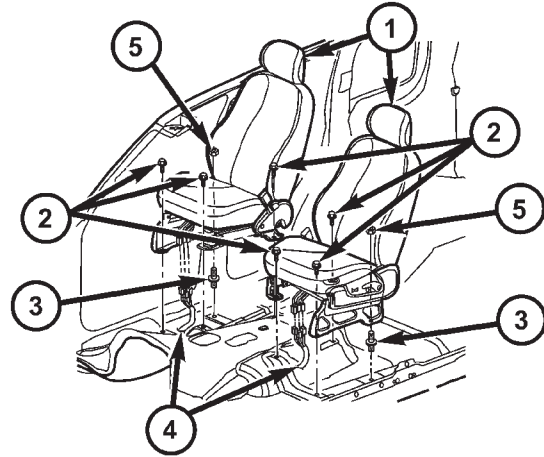
**WARNING:** DISABLE THE SUPPLEMENTAL RESTRAINTS SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINTS SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

**WARNING:** DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

- (1) Remove the seat belt anchor bolt. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)
- (2) Slide seat back and remove the front bolts. (Fig. 1)
- (3) Slide seat to forward position and remove the rear bolt/nut.
- (4) Disconnect the electrical connectors and remove the seat.

### INSTALLATION

**WARNING:** DISABLE THE SUPPLEMENTAL RESTRAINTS SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINTS SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.



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**Fig. 1 FRONT SEATS**

- 1 - FRONT SEATS
- 2 - BOLTS
- 3 - STUDS
- 4 - ELECTRICAL CONNECTORS
- 5 - NUTS

**WARNING:** DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

**WARNING:** DURING AND FOLLOWING ANY SEAT BELT SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, AND RETRACTORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. NEVER ATTEMPT TO REPAIR A SEAT BELT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE MOPAR PARTS CATALOG.

- (1) Install the seats and connect the electrical connectors.
- (2) Slide the seat to the rearward position and install the bolts.
- (3) Tighten the outboard bolt to 43 N·m (32 ft. lbs.) and then tighten the inboard bolt to 43 N·m (32 ft. lbs.).

## SEAT - FRONT (Continued)

(4) Slide the seat to the forward position and install the rear bolt and nut.

(5) Tighten the fasteners to 43 N·m (32 ft. lbs.).

(6) Install the seat belt anchor and bolt. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)

## SEAT BACK - FRONT

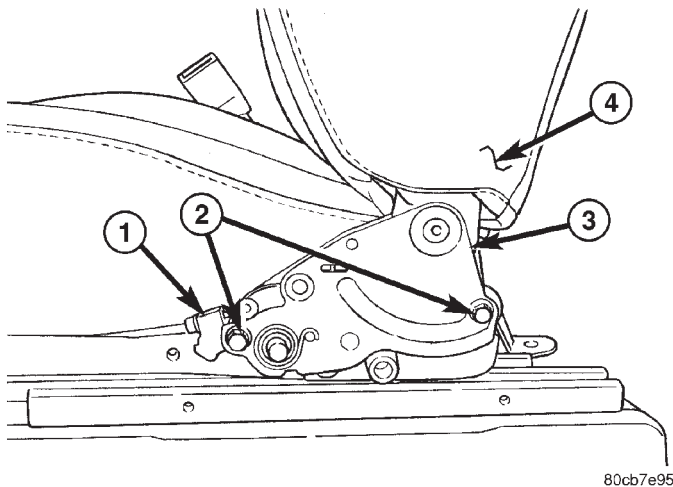
## REMOVAL

(1) Remove the seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)

(2) Remove the seat cushion side shields. (Refer to 23 - BODY/SEATS/SEAT CUSHION SIDE SHIELDS - REMOVAL)

(3) Disconnect the lock out cable from both recliners. (Fig. 2)

(4) Remove the bolts and remove the seat back.



**Fig. 2 SEAT BACK RECLINER**

- 1 - LOCK OUT CABLE
- 2 - BOLTS
- 3 - RECLINER
- 4 - SEAT BACK

## INSTALLATION

(1) Install the seat back and install the bolts.

(2) Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Connect the lock out cable to both recliners.

(4) Install the belt buckle. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT BUCKLE - INSTALLATION)

(5) Install the side shields. (Refer to 23 - BODY/SEATS/SEAT CUSHION SIDE SHIELDS - INSTALLATION)

(6) Install the seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

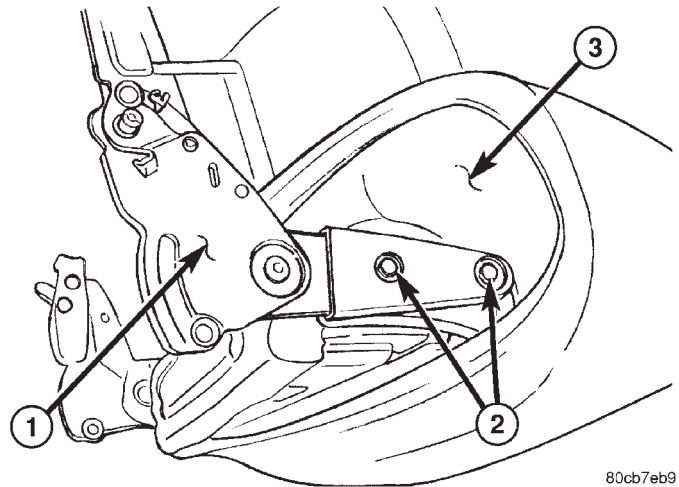
## SEAT BACK RECLINER - FRONT

## REMOVAL

(1) Remove the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - REMOVAL)

(2) Position the seat back cover out of the way and remove the bolts. (Fig. 3)

(3) Remove the recliners from the seat back frame.



**Fig. 3 SEAT BACK RECLINER**

- 1 - SEAT BACK RECLINER
- 2 - BOLTS
- 3 - SEAT BACK

## INSTALLATION

(1) Install the recliners onto the seat back.

(2) Position the seat back cover aside and install the recliner bolts.

(3) Tighten the bolts to 28 N·m (21 ft. lbs.).

(4) Install the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - INSTALLATION)

## SEAT BACK COVER - FRONT

## REMOVAL

(1) Remove the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - REMOVAL)

(2) Remove the head rest and remove the trim caps. (Refer to 23 - BODY/SEATS/HEADREST - REMOVAL)

(3) Disconnect the j-straps.

(4) Remove the two lower hog rings.

(5) Partially remove the seat back cover and remove the two upper hog rings.

(6) Remove the seat back cover.

SEAT BACK COVER - FRONT (Continued)

**INSTALLATION**

- (1) Partially install the seat back cover and replace the two top hog rings.
- (2) Pull cover down and replace the two lower hog rings.
- (3) Connect the j-straps.
- (4) Install trim caps and the head rest. (Refer to 23 - BODY/SEATS/HEADREST - INSTALLATION)
- (5) Install the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - INSTALLATION)

SEAT BACK CUSHION - FRONT

**REMOVAL**

- (1) Remove the seat back cover. (Refer to 23 - BODY/SEATS/SEAT BACK COVER - FRONT - REMOVAL)
- (2) Separate the cushion from the seat back frame.

**INSTALLATION**

- (1) Position the cushion onto the seat back frame.
- (2) Install the seat back cover. (Refer to 23 - BODY/SEATS/SEAT BACK COVER - FRONT - INSTALLATION)

SEAT CUSHION - FRONT

**REMOVAL**

- (1) Remove the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - REMOVAL)
- (2) Remove the two outer front track bolts and remove the track.

**INSTALLATION**

- (1) Install the seat cushion onto the seat track assembly and install the front two bolts.
- (2) Tighten the bolts to 28 N·m (21 ft. lbs.).
- (3) Install the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - INSTALLATION)

SEAT CUSHION COVER - FRONT

**REMOVAL**

- (1) Remove the seat cushion. (Refer to 23 - BODY/SEATS/SEAT CUSHION - FRONT - REMOVAL)
- (2) Disconnect the j-straps.
- (3) Remove the hog rings and remove the cushion cover.

**INSTALLATION**

- (1) Position the seat cushion cover and install new hog rings.
- (2) Connect the j-straps.
- (3) Install the seat cushion. (Refer to 23 - BODY/SEATS/SEAT CUSHION - FRONT - INSTALLATION)

SEAT CUSHION SIDE SHIELDS

**REMOVAL**

- (1) Remove the screw and remove the recliner handle.
- (2) Remove the screws and remove the seat side shields.

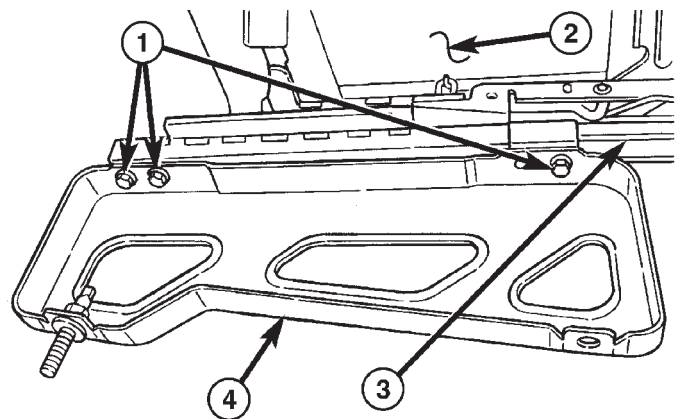
**INSTALLATION**

- (1) Install the shields and install the screws.
- (2) Install the recliner handle and install the screw.

MANUAL SEAT RISER

**REMOVAL**

- (1) Remove the seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)
- (2) Remove the bolts and remove the rivet from the release handle. (Fig. 4)
- (3) Remove the riser.



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**Fig. 4 FRONT SEAT RISER**

- 1 - BOLTS (3)
- 2 - SEAT CUSHION
- 3 - SEAT TRACK
- 4 - SEAT RISER

## MANUAL SEAT RISER (Continued)

**INSTALLATION**

- (1) Install the seat riser and install the bolts.
- (2) Tighten the bolts to 28 N·m (21 ft. lbs.).
- (3) Install a new release handle rivet.
- (4) Install the seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

**SEAT TRACK****REMOVAL**

- (1) Remove the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - REMOVAL)
- (2) Remove the outer riser. (Refer to 23 - BODY/SEATS/SEAT RISER - REMOVAL)
- (3) Remove the front outer bolts and remove the tracks.

**INSTALLATION**

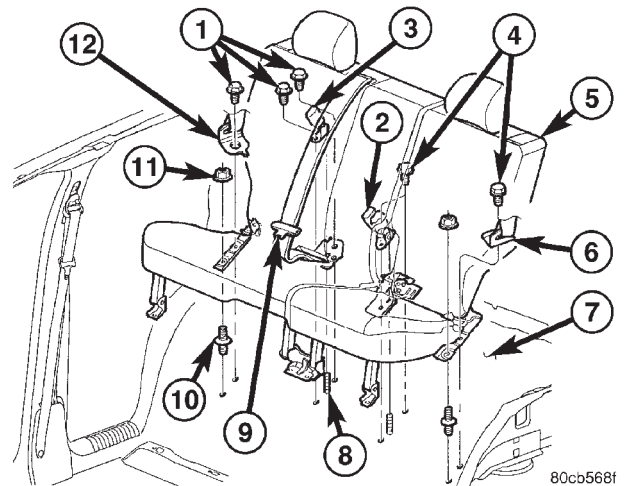
- (1) Install the seat track onto the seat cushion and install the front outer bolts.
- (2) Tighten the bolts to 28 N·m (21 ft. lbs.).
- (3) Install the seat riser. (Refer to 23 - BODY/SEATS/SEAT RISER - INSTALLATION)
- (4) Install the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - FRONT - INSTALLATION)

**SEAT - REAR****REMOVAL**

- (1) Remove the outer seat belt anchors. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)
- (2) Remove the inner seat belt buckles. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT BUCKLE - REMOVAL)
- (3) Remove the center seat belt anchor. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)
- (4) Remove the front bolts and nuts. (Fig. 5)
- (5) Fold down the seat backs and remove the seat assembly through the rear door.

**INSTALLATION**

- (1) Install the seat assembly and position over the studs.
- (2) Open the seat back and engage the latches onto the latch strikers.
- (3) Install the rear outboard nuts and tighten to 43 N·m (32 ft. lbs.).
- (4) Install the outer seat belt anchors. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)

**Fig. 5 REAR SEAT ASSEMBLY**

- 1 - SEAT BELT ANCHOR BOLTS
- 2 - BELT BUCKLES
- 3 - BELT BUCKLE
- 4 - SEAT BELT ANCHOR BOLTS
- 5 - REAR SEAT ASSEMBLY
- 6 - SEAT BELT ANCHOR
- 7 - FLOOR PAN
- 8 - STUDS
- 9 - CENTER SEAT BELT
- 10 - FRONT STUDS
- 11 - NUTS (2)
- 12 - SEAT BELT ANCHOR

(5) Install the inner seat belt buckles. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT BUCKLE - INSTALLATION)

(6) Install the center seat belt anchor. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)

(7) Install the front outer seat cushion leg bolts and tighten to 35 N·m (26 ft. lbs.)

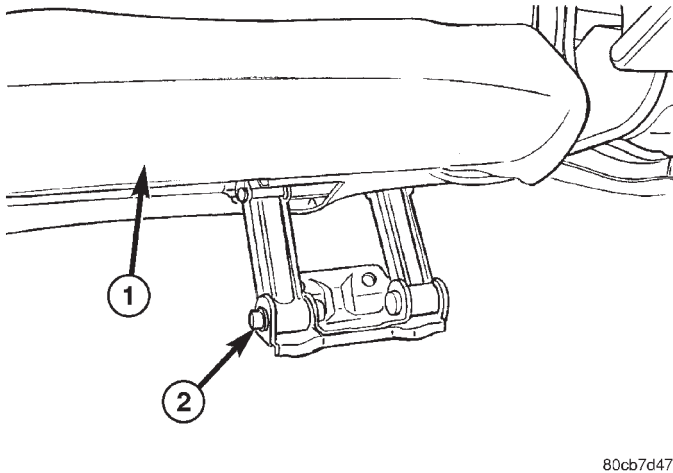
**SEAT BACK - REAR****REMOVAL**

- (1) Remove the seat assembly. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL)
- (2) Remove the front seat cushion hinge bolt. (Fig. 6)
- (3) Remove the center seat back hinge bolts and separate the rear seat assembly. (Fig. 7)
- (4) Release the clips and remove the seat back hinge covers.
- (5) Lift the seat cushion cover and remove the hinge bolts. (Fig. 8)
- (6) Remove the seat back.

**INSTALLATION**

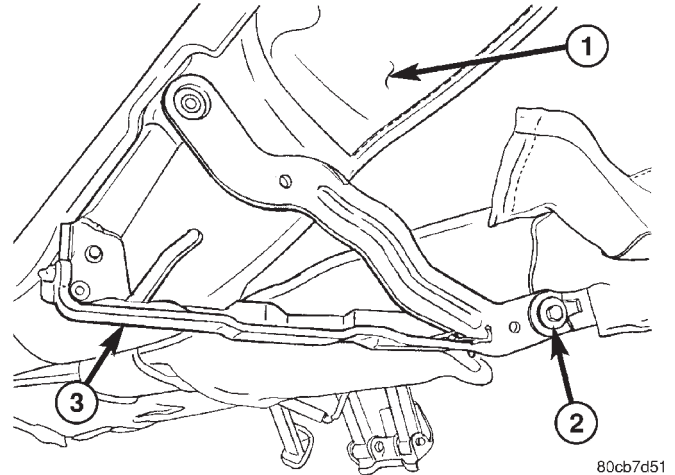
- (1) Install the seat back.

SEAT BACK - REAR (Continued)



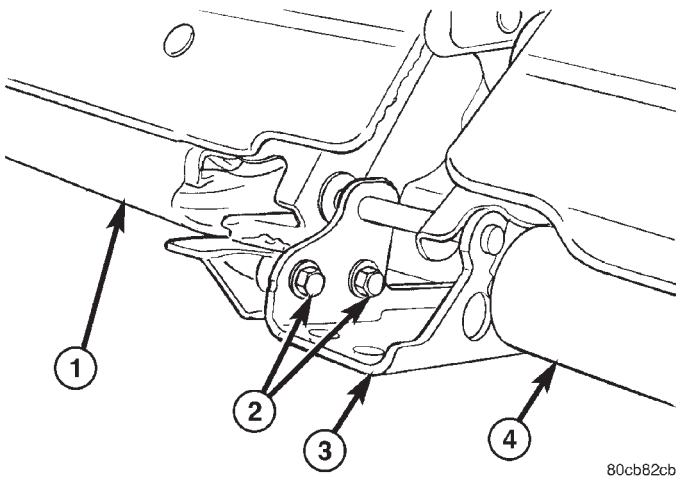
**Fig. 6 CENTER CUSHION HINGE**

- 1 - SEAT CUSHION
- 2 - BOLT



**Fig. 8 SEAT BACK HINGE**

- 1 - SEAT BACK
- 2 - BOLT
- 3 - SEAT BACK HINGE



**Fig. 7 CENTER SEAT BACK HINGE**

- 1 - SEAT CUSHION
- 2 - BOLTS
- 3 - SEAT BACK HINGE
- 4 - SEAT CUSHION

- (2) Install the seat back hinge bolt and tighten to 8 N·m (71 in. lbs.).
- (3) Position the seat back hinge covers and fully seat the clips.
- (4) Connect the seat halves and install the center seat back hinge bolts.
- (5) Tighten the bolts to 28 N·m (21 ft. lbs.).
- (6) Install the front seat cushion hinge bolt and tighten to 28 N·m (21 ft. lbs.).
- (7) Install the seat assembly. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION)

SEAT BACK COVER - REAR

REMOVAL

- (1) Remove the rear seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - REMOVAL)
- (2) Remove the screws and remove the center seat belt guide.
- (3) Remove the screws and push pin fasteners and remove the latch handle bezel.
- (4) Remove the head rest and remove the guide covers. (Refer to 23 - BODY/SEATS/HEADREST - REMOVAL)
- (5) Remove the screws and remove the grocery hooks.
- (6) Remove the push pin fasteners and remove the seat back panel.
- (7) Disconnect the j-straps.
- (8) Remove the seat back cover.

INSTALLATION

- (1) Install the seat back cover and connect the j-straps.
- (2) Install the seat back panel and install the push pin fasteners.
- (3) Install the grocery hooks and install the screws.
- (4) Install the head rest guide covers and install the head rest. (Refer to 23 - BODY/SEATS/HEADREST - INSTALLATION)
- (5) Install the latch handle bezel and install the screws and push pin fasteners.
- (6) Install the center seat belt guide and screws.
- (7) Install the rear seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - INSTALLATION)

## SEAT BACK CUSHION - REAR

### REMOVAL

(1) Remove the seat back cover. (Refer to 23 - BODY/SEATS/SEAT BACK COVER - REAR - REMOVAL)

(2) Separate the cushion from the seat back frame.

### INSTALLATION

(1) Position the seat back cushion onto the seat back frame.

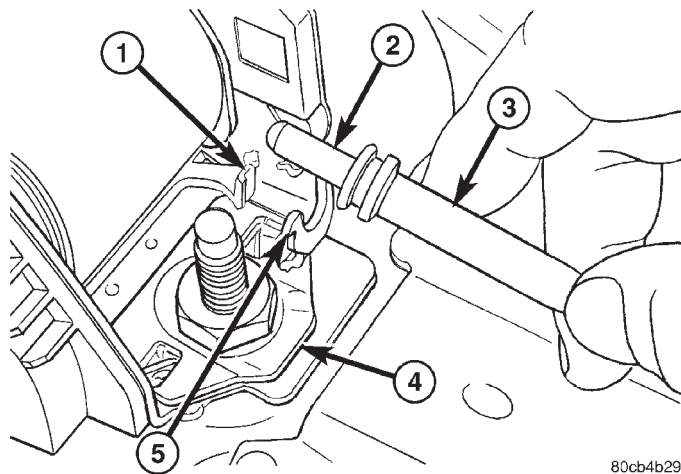
(2) Install the seat back cover. (Refer to 23 - BODY/SEATS/SEAT BACK COVER - REAR - INSTALLATION)

## FOLDING REAR SEAT BACK LATCH / LOCK

### REMOVAL

(1) Remove the rear seat back cushion. (Refer to 23 - BODY/SEATS/SEAT BACK CUSHION / COVER - REAR - REMOVAL)

(2) Disconnect the shoulder belt release cable. (Fig. 9)

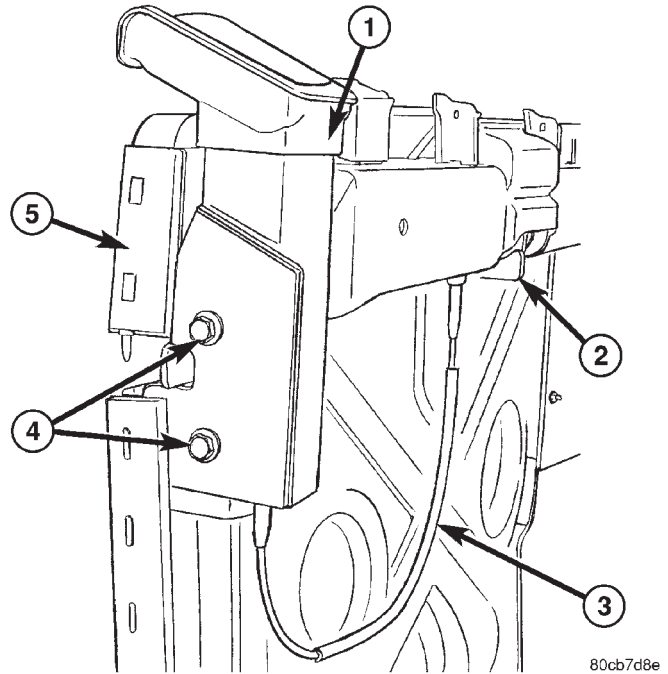


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**Fig. 9 Seat Back Latch Cable Disengage/Engage**

- 1 - LEVER
- 2 - PLUNGER
- 3 - LATCH CABLE FITTING
- 4 - REAR CENTER RETRACTOR
- 5 - SUPPORT

(3) Remove the bolts and remove the latch/lock assembly. (Fig. 10)



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**Fig. 10 LATCH/LOCK ASSEMBLY**

- 1 - LATCH/LOCK ASSEMBLY
- 2 - SEAT BELT RETRACTOR
- 3 - RETRACTOR RELEASE CABLE
- 4 - BOLTS
- 5 - REAR SEAT BACK FRAME

### INSTALLATION

(1) Install the latch/lock assembly and install the bolts.

(2) Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Connect the shoulder belt release cable.

(4) Install the rear seat back cushion. (Refer to 23 - BODY/SEATS/SEAT BACK CUSHION / COVER - REAR - INSTALLATION)

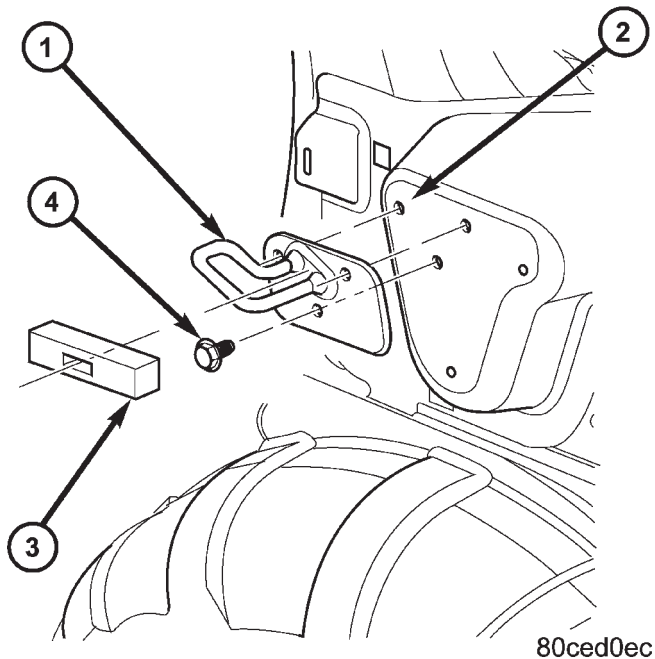
## REAR SEAT BACK LATCH STRIKER

### REMOVAL

(1) Remove the quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - REMOVAL)

(2) Remove the bolts and remove the striker. (Fig. 11)

## REAR SEAT BACK LATCH STRIKER (Continued)

**Fig. 11 REAR SEAT BACK LATCH STRIKER**

- 1 - LATCH STRIKER
- 2 - BODY SIDE PANEL
- 3 - STRIKER CLOSE-OUT
- 4 - BOLTS (3)

**INSTALLATION**

- (1) Position the striker and install the bolts.
- (2) Tighten the bolts to 35 N·m (26 ft. lbs.).
- (3) Install the quarter trim panel. (Refer to 23 - BODY/INTERIOR/QUARTER TRIM PANEL - INSTALLATION)

**SEAT BACK FRAME - REAR****REMOVAL**

- (1) Remove the center seat belt retractor, if equipped. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - REMOVAL)
- (2) Remove the seat back latch/lock assembly. (Refer to 23 - BODY/SEATS/FOLDING REAR SEAT BACK LATCH / LOCK - REMOVAL)

**INSTALLATION**

- (1) Install the seat back latch/lock assembly. (Refer to 23 - BODY/SEATS/FOLDING REAR SEAT BACK LATCH / LOCK - INSTALLATION)
- (2) Install the center seat belt retractor, if equipped. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT & RETRACTOR - INSTALLATION)

**SEAT CUSHION - REAR****REMOVAL**

- (1) Remove the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - REMOVAL)
- (2) Disconnect the j-straps and remove the seat cushion and cover.

**INSTALLATION**

- (1) Position the seat cushion and cushion cover onto the seat frame.
- (2) Connect the j-straps.
- (3) Install the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - INSTALLATION)



# STATIONARY GLASS

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## DOOR GLASS

### REMOVAL

(1) Remove the rear door glass run channel. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - REMOVAL)

### INSTALLATION

(1) Install the rear door glass run channel. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - INSTALLATION)

## QUARTER WINDOW

### REMOVAL

(1) Remove the headliner as necessary to gain access to the glass seal from the inside. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL)

(2) Cut urethane bonding from around quarter window glass using a suitable sharp cold knife. A pneumatic cutting device can be used if available.

(3) Separate glass from vehicle.

## INSTALLATION

**CAUTION: Open a window before installing glass. This will avoid pressurizing the passenger compartment. If a door or swing gate flip-up glass is slammed before urethane is cured, water leaks can result.**

The window opening fence should be cleaned of old urethane bonding material.

(1) Install the headliner as necessary. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION)

(2) Clean inside of glass with Mopar Glass Cleaner and lint-free cloth.

(3) Apply PVC (vinyl) primer 25 mm (1 in.) wide around edge of glass. Wipe with clean/dry lint-free cloth.

(4) Apply fence primer around edge of fence. Allow at least eighteen minutes drying time.

(5) Apply a 10 mm (0.4 in.) bead of urethane around window vinyl border location.

(6) Position glass into window opening and lock clips into place.

## WINDSHIELD

### WARNING

#### WINDSHIELD 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 PINCH WELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.

- DAIMLERCHRYSLER DOES NOT RECOMMEND GLASS ADHESIVE BY BRAND. TECHNICIANS SHOULD REVIEW PRODUCT LABELS AND TECHNICAL DATA SHEETS, AND USE ONLY ADHESIVES THAT THEIR MANUFACTURERS 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.**

### REMOVAL

(1) Remove inside rear view mirror. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - REMOVAL)

(2) Remove cowl cover. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL)

(3) Remove screws attaching windshield side molding to A-pillar.

(4) Remove upper windshield molding.

(5) Cut urethane bonding from around windshield using a suitable sharp cold knife. A pneumatic cutting device can be used if available.

(6) Separate windshield from vehicle.

### INSTALLATION

**WARNING: REVIEW ALL WARNINGS AND CAUTIONS IN THIS GROUP BEFORE PRECEDING WITH INSTALLATION.**

**CAUTION: Open a window before installing windshield. This will avoid pressurizing the passenger compartment. If a door or swing gate flip-up glass is slammed before urethane is cured, water leaks can result.**

The windshield fence should be cleaned of old urethane bonding material. 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. Position glass in the center of the opening against the support spacers. Mark the glass at the support spacers with a grease pencil or masking tape and ink pen to use as a reference for installation. Remove replacement windshield from windshield opening.

(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.

(3) Clean inside of windshield with Mopar Glass Cleaner and lint-free cloth.

(4) Apply clear glass primer 25 mm (1 in.) wide around edge of windshield. Wipe with clean/dry lint-free cloth.

(5) Apply black-out primer 15 mm (.75 in.) wide on top and sides of windshield and 25 mm (1 in.) on bottom of windshield. Allow at least three minutes drying time.

(6) Position windshield spacers on lower fence above support spacers at the edge of the windshield opening.

(7) Align the dot on the upper molding to the tick mark in the center of the glass and install upper molding onto windshield.

(8) Apply a 10 mm (0.4 in.) bead of urethane around perimeter of windshield along the inside of the moldings. Apply two beads along the bottom edge.

## WINDSHIELD (Continued)

(9) Apply fence primer around the perimeter of the windshield opening fence. Allow at least 18 minutes drying time.

(10) With aid of a helper, position windshield over windshield opening. Align reference marks at bottom of windshield to support spacers.

(11) Slowly lower windshield glass to windshield opening fence. Guide top molding into proper position if necessary. Push windshield inward to fence spacers at bottom and until top molding is flush to roof line.

(12) Clean excess urethane from exterior with Mopar Super Clean or equivalent.

(13) Install windshield side moldings. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/WINDSHIELD A-PILLAR WEATHERSTRIP - INSTALLATION)

(14) Install cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION)

(15) Install inside rear view mirror. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - INSTALLATION)

(16) After urethane has cured, water test windshield to verify repair.

# SUNROOF

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## SUNROOF

### DESCRIPTION

**WARNING: Keep fingers and other body parts out of sunroof opening at all times.**

The sunroof features a power sliding glass panel and a sunshade which can be manually positioned anywhere along its travel, rearward of glass panel front edge.

The sunroof is electrically operated from two switches located on the windshield header, rearward

of the map lamp. To operate the sunroof the ignition switch must be in either the Accessory or On/Run position. One switch (vent) is a push button type and opens the sunroof to the vent position only. The other switch (open/close) is a rocker type for opening and closing the sunroof. Pressing and releasing the open button once the sunroof will express open and the wind deflector will raise. If the button is pressed a second time the sunroof will stop in that position. Pressing and holding the close button will close the sunroof. If the close button is released the sunroof will stop in that position.

## SUNROOF (Continued)

## SUNROOF OPERATION INSTRUCTIONS

SWITCH INPUTS			
	OPEN	CLOSE	VENT
FULL VENT	Push and hold switch until glass stops in flush closed position glass will then express open	Push and hold switch until glass stops in flush closed position.	No action
VENT RANGE	Push and hold switch until glass passes through flush closed position. Glass will then open	Push and hold switch until glass stops in flush closed position.	Push and hold switch until glass stops in full vent position.
FLUSH	1. Press switch for less than 0.65 seconds for express to comfort stop.  2. Press switch for more than 0.65 seconds and glass will stop when switch is released	No action	Press and hold switch. Glass will travel through flush closed to full vent. Glass will stop when switch is released or when fully vented.
FULL OPEN	Press switch for less than 0.65 seconds for express to full open.	Press and hold switch until glass stops in flush closed position or anywhere in between.	Press and hold switch. Glass will travel through flush closed to full vent. Glass will stop when switch is released.

## DIAGNOSIS AND TESTING

## WATER DRAINAGE AND WIND NOISE

## DIAGNOSIS

The sliding glass panel is designed to seal water entry with a snug fit between the roof and the seal. The fit can be checked by inserting a piece of paper between the roof and the seal. The piece of paper should have some resistance when pulled out when the glass panel is in the closed position. The sunroof housing will drain off a minimum amount of water. Excessive wind noise could result if the gap clearances are exceeded. The sunroof glass panel may need to be adjusted. Refer to Sunroof Glass Panel Adjustment for proper procedures.

Adequate drainage is provided by a drain trough in the sunroof housing which encircles the sliding glass panel and leads to drain hoses. If a wet headliner or other water leak complaints are encountered, before performing any adjustments, first ensure that the drainage system is not plugged or disconnected. Use a pint container to pour water into the sunroof housing drain trough. If water flow is restricted, use compressed air to blow out any material plugging the drain system. Retest system again.

To further check for a disconnected drain hose:

(1) Remove A-pillar trim, sun visors, and map lamps/mini console.

(2) Remove sunroof opening trim lace. Refer to Sunroof Opening Trim Lace.

(3) Lower headliner as necessary to gain access to sunroof housing drain tubes. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL)

(4) Repair as necessary.

## DIAGNOSTIC PROCEDURES

Before beginning sunroof diagnostics verify that all other power accessories are in proper operating condition. Refer to Sunroof Diagnostic Chart for possible causes. If not, a common electrical problem may exist. Refer to Wiring Diagrams, in this publication for circuit, splice and component descriptions. Check the condition of the circuit protection (20 amp circuit breaker in cavity 19 of the Junction Block). Inspect all wiring connector pins for proper engagement and continuity. Check for battery voltage at the power sunroof controller, refer to Wiring Diagrams, for circuit information. If battery voltage of more than 10 volts is detected at the controller, proceed with the following tests (the controller will not operate at less than 10 volts).

SUNROOF (Continued)

Before beginning diagnosis for wind noise or water leaks, verify that the problem was not caused by releasing the control switch before the sunroof was fully closed. The sunroof module has a water-man-

agement system. If however, the sunroof glass is in a partial closed position, high pressure water may be forced beyond the water management system boundaries and onto the headlining.

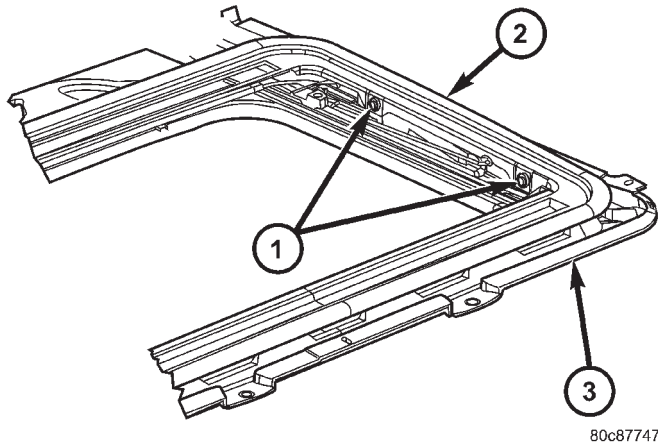
SUNROOF DIAGNOSIS CHART

SYMPTOM	POSSIBLE CAUSE
Sunroof motor inoperative.	Faulty control switch. Faulty circuit ground between sunroof electronics module, control switch, and body harness. Faulty power circuit between sunroof electronics module, control switch, and body harness. Faulty drive motor. Faulty electronics module. Faulty drive motor electrical connector.
Audible whine when switch is depressed, sunroof does not operate.	Faulty drive motor. Binding cable.
Audible clicking or ratcheting when switch is pressed, sunroof does not operate.	Broken or worn drive cable. Worn drive motor gear. Mechanisms not synchronized.
Sunroof vents and opens, but does not close.	Binding cable. Faulty circuit. Faulty control switch. Faulty electronic module. Faulty drive motor.
Sunroof vents, but does not open.	Binding cable or mechanism. Faulty circuit. Faulty switch. Faulty electronic module.
Sunroof does not vent	Binding cable or mechanism. Faulty circuit. Faulty control switch. Faulty sunroof electronic module.
Sunroof water leak.	Drain tubes clogged or kinked or disconnected from the sunroof. Glass panel improperly adjusted. Faulty glass panel seal.
Gurgling sound from sunroof	Low spot in drain hose routing, allowing water to stand.
Wind noise from sunroof.	Front of glass panel too high or rear too low. Wind deflector not deploying. Glass not centered in opening. Faulty glass panel seal.
Rattles from open sunroof while driving	Loose or broken attaching hardware. Worn or broken mechanism.

## GLASS PANEL

### REMOVAL

- (1) Slide sunshade rearward to the open position.
- (2) Move the glass panel to the closed position.
- (3) Remove the four glass panel screws (Fig. 1).
- (4) Lift off glass panel and remove from vehicle.



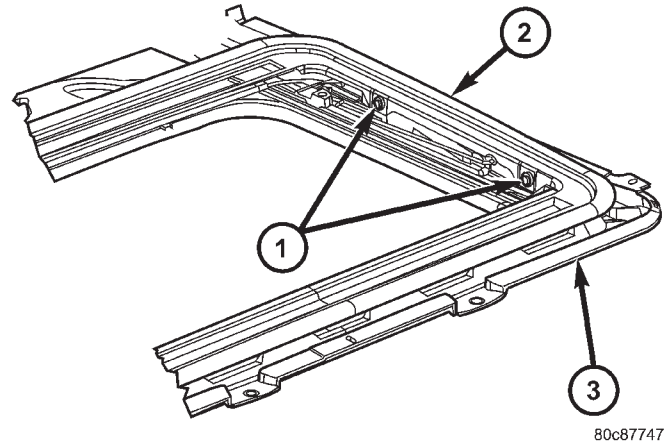
**Fig. 1 GLASS PANEL**

- 1 - SCREWS  
2 - GLASS PANEL  
3 - MODULE ASSEMBLY

of the glass panel is 1.75mm (0.07 in.) to .75 mm (0.03 in.) lower than the roof surface.

**NOTE:** Glass assembly seal is 2.5mm (0.1 in) higher than the glass panel. Measure at 300mm (11.8 in) outboard of the centerline of the vehicle.

(4) Verify sunroof operation and alignment. Check fit and re-adjust as necessary.



**Fig. 2 GLASS PANEL**

- 1 - SCREWS  
2 - GLASS PANEL  
3 - MODULE ASSEMBLY

### INSTALLATION

- (1) Position glass panel on to mechanism lift arm.
- (2) Start the four attaching screws.
- (3) Center glass in opening by running a business card around the glass.
- (4) Adjust glass panel. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - ADJUSTMENTS)

### ADJUSTMENTS

#### SUNROOF GLASS PANEL ADJUSTMENT

- (1) Move the sunshade rearward to the open position.
- (2) Move the sunroof glass panel to the fully closed position.
- (3) Adjust the glass one corner at a time.
  - (a) Loosen four glass screws (Fig. 2).
  - (b) Lift glass assembly and align the top of the glass panel to the top of the roof panel.
  - (c) Tighten screw to 3.5 N·m (31 in. lbs.).
  - (d) Repeat steps a. and b. for each corner of the glass panel.
  - (e) When properly adjusted, the front of the glass panel is 1.75 mm (0.07 in.) to 2.75 mm (0.11 in.) lower than the roof surface and the rear edge

## GLASS PANEL SEAL

### REMOVAL

- (1) Remove sunroof glass panel. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - REMOVAL)
- (2) Place glass panel on clean work area with the top side up. Support the glass assembly from underside to avoid bending or otherwise damaging the mounting tabs.
- (3) Grasp the seal and pull seal away from the glass panel. The seal is a one piece seal.

### INSTALLATION

**NOTE:** Always position seal seam on center of the passenger side of glass panel.

- (1) Place seal into position.
- (2) Install seal on glass. Using care working the seal around the glass, being careful not to over stretch the seal while installing.
- (3) Install the glass panel. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - INSTALLATION)

## SUNSHADE

### REMOVAL

- (1) Remove glass assembly from the sunroof assembly. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - REMOVAL)
- (2) Remove two screws from trough assembly (Fig. 3).
- (3) Remove trough assembly.
- (4) Slide the sunshade forward to disengage the guide feet from the tracks through the cutouts at the front of the tracks.

**CAUTION:** Use care not to crease the sunshade when removing or installing.

### INSTALLATION

- (1) Place sunshade into position, through the cutouts at the front of the tracks and slide the sunshade back.
- (2) Place trough assembly into position on sunroof module and install the screws.
- (3) Install the glass panel. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - INSTALLATION)

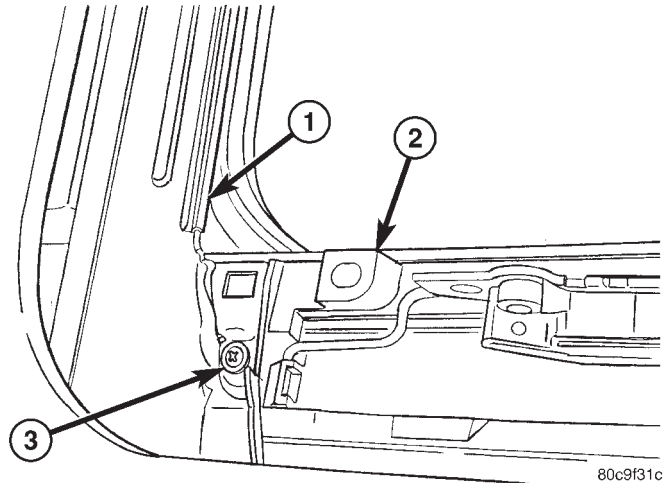
## GUIDE ASSEMBLY

### REMOVAL

- (1) Remove the glass panel. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - REMOVAL)
- (2) Place sunroof into the vent position.
- (3) Remove two screws from trough assembly (Fig. 3).
- (4) Remove trough assembly.
- (5) Disconnect the guide link (Fig. 4).
- (6) Slide trough guide forward and disengage the sliders through the notches in the guide channels (Fig. 5).

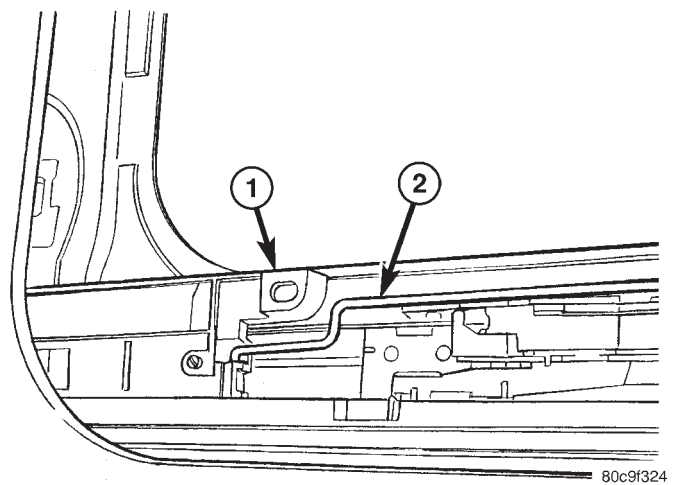
### INSTALLATION

- (1) Install the trough guide and engage the sliders into the guide channels through the notches.
- (2) Connect the guide link.
- (3) Install the trough and install the two screws.
- (4) Install the glass panel. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - INSTALLATION)



**Fig. 3 GUIDE ASSEMBLY TROUGH**

- 1 - TROUGH
- 2 - TROUGH GUIDE
- 3 - SCREW

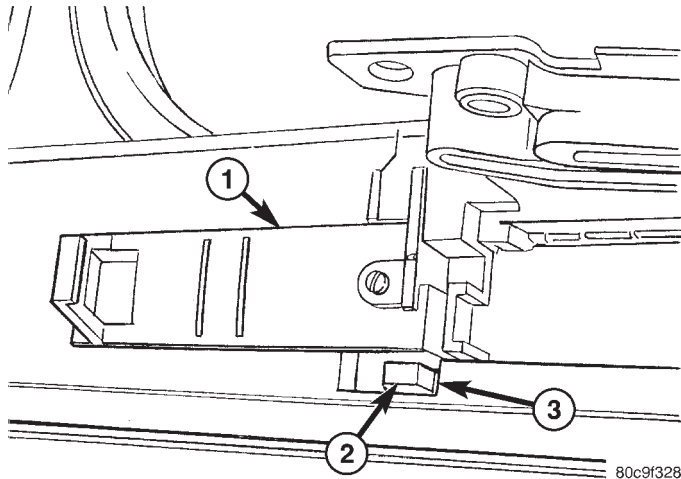


**Fig. 4 TROUGH GUIDES**

- 1 - TROUGH GUIDE
- 2 - GUIDE LINK



## GUIDE ASSEMBLY (Continued)

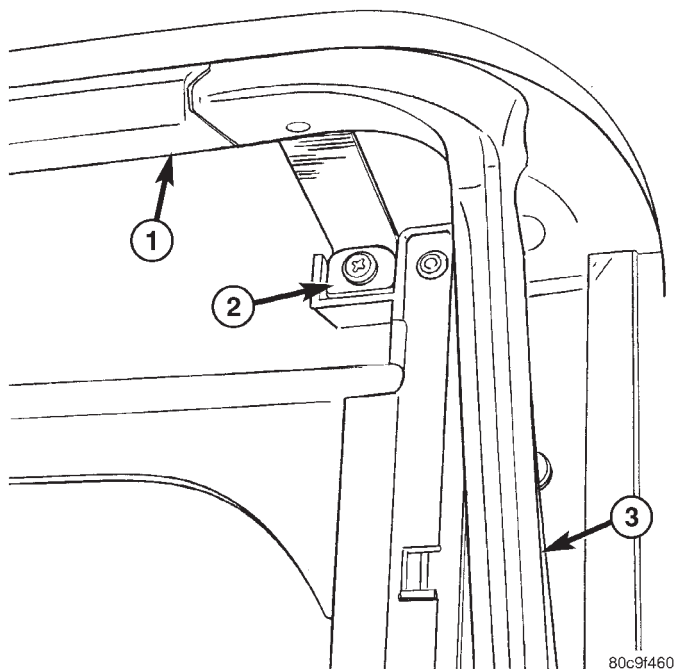
**Fig. 5 TROUGH GUIDE REMOVAL**

- 1 - TROUGH GUIDE
- 2 - NOTCH
- 3 - SLIDER

## WIND DEFLECTOR

## REMOVAL

- (1) Open sunroof glass panel to the full open position.
- (2) Remove screws attaching wind deflector straps to front crossmember (Fig. 6).

**Fig. 6 SUNSHADE**

- 1 - WIND DEFLECTOR
- 2 - SCREW
- 3 - SPRING

- (3) Rotate wind deflector back about 110° and slide backwards to disengage from the spring hook.

## INSTALLATION

- (1) Place wind deflector in position 110° to roof.
- (2) Push arms down and forward to engage spring hooks.
- (3) Rotate wind deflector forward into correct position. Depress wind deflector down onto front crossmember to check spring function.
- (4) Install fasteners attaching wind deflector straps to front crossmember.
- (5) Test sunroof operation.

## OPENING TRIM LACE

## REMOVAL

- (1) Remove lace by starting at the joint center of the opening on driver's side.
- (2) Pull one end of the lace away from the headliner until the entire lace is removed.

## INSTALLATION

- (1) Place end of trim lace into position starting at center of the opening on driver's side.
- (2) Push lace into position.
- (3) Ensure that the corner radii is fully engage.
- (4) Once trim lace is attached to sunroof module begin tucking the headliner under the lip on the trim lace working all the way around the opening.

## DRAIN TUBE

## REMOVAL

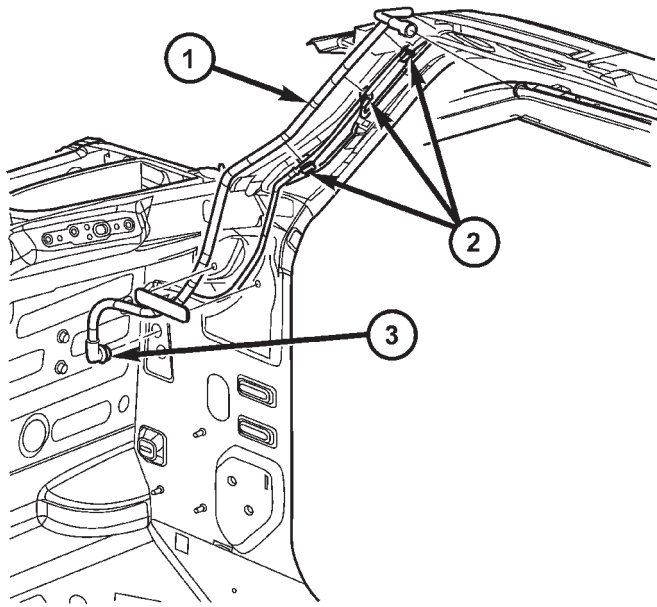
## FRONT DRAIN TUBES

- (1) Move glass panel to the fully closed position.
- (2) Remove sunroof opening trim lace.
- (3) Remove the headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL)
- (4) Disconnect the drain hose from the sunroof housing (Fig. 7).
- (5) Drain any liquid from hose connection, if necessary.
- (6) Remove the instrument panel top panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL)
- (7) Disconnect the grommet, attachment clips and remove the drain tube.

## REAR DRAIN TUBES

- (1) Move glass panel to the fully closed position.
- (2) Remove sunroof opening trim lace.
- (3) Remove headliner.

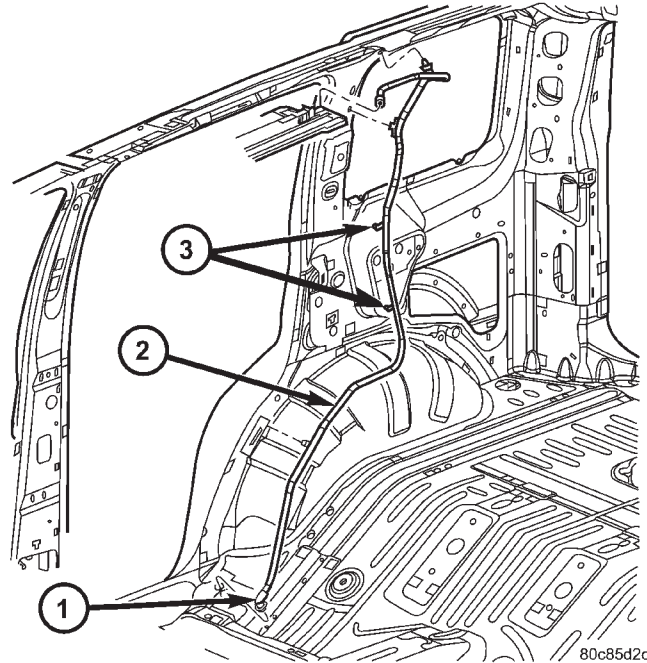
DRAIN TUBE (Continued)



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**Fig. 7 FRONT DRAIN TUBE**

- 1 - TUBE
- 2 - CLIPS
- 3 - GROMMET



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**Fig. 8 REAR DRAIN TUBE**

- 1 - GROMMET
- 2 - TUBE
- 3 - CLIPS

(4) Disconnect the drain hose from the sunroof housing (Fig. 8).

(5) Drain any liquid from hose connection, if necessary.

(6) Disconnect the grommet, attachment clips and remove the drain tube.

**INSTALLATION**

**FRONT DRAIN TUBES**

(1) Connect the drain hose to the sunroof housing and test drainage.

(2) Connect the body grommet and attachment clips.

(3) Install the instrument panel top panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION)

(4) Install the headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION)

(5) Install sunroof opening trim lace. (Refer to 23 - BODY/SUNROOF/OPENING TRIM LACE - INSTALLATION)

**REAR DRAIN TUBES**

(1) Connect the drain hose to the sunroof housing and test drainage.

(2) Connect the body grommet and attachment clips.

(3) Install the headliner.

(4) Install sunroof opening trim lace.

**MODULE ASSEMBLY**

**REMOVAL**

(1) Move glass panel to the fully closed position.  
 (2) Disconnect and isolate the negative battery cable.

(3) Remove sunroof opening trim lace.  
 (4) Remove headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL)

(5) Disconnect wire harness push in fasteners and electrical connector. (Fig. 9)

(6) Disconnect the drain tubes from sunroof housing.

(7) Loosen fasteners attaching sunroof module assembly.

(8) With the aid of a helper, remove fasteners attaching sunroof module assembly to roof panel (Fig. 10).

**INSTALLATION**

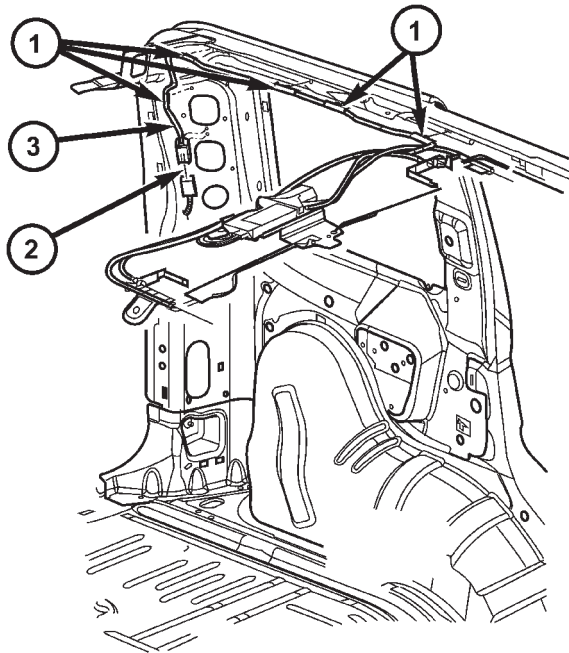
(1) With the Glass panel in the fully closed position.

(2) Raise rear end of sunroof module assembly and guide into position and start fasteners.

(3) Tighten the fasteners to 9 N·m (80 in. lbs.).

(4) Connect the drain tubes.

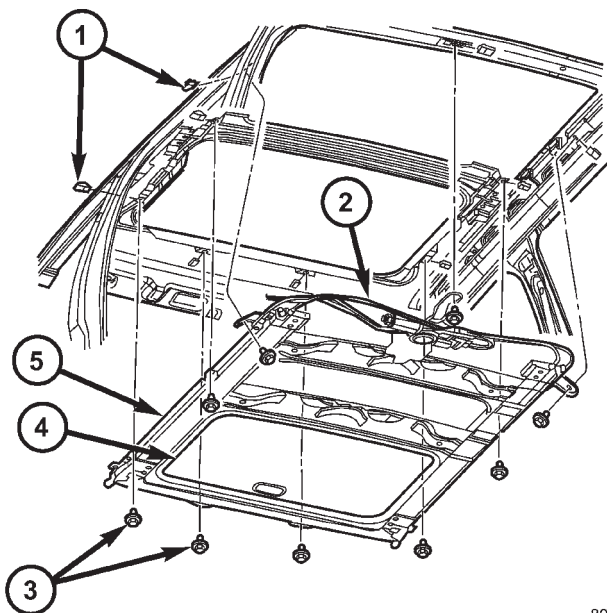
MODULE ASSEMBLY (Continued)



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**Fig. 9 WIRE HARNESS**

- 1 - CLIPS
- 2 - ELECTRICAL CONNECTOR
- 3 - WIRE HARNESS



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**Fig. 10 MODULE ASSEMBLY**

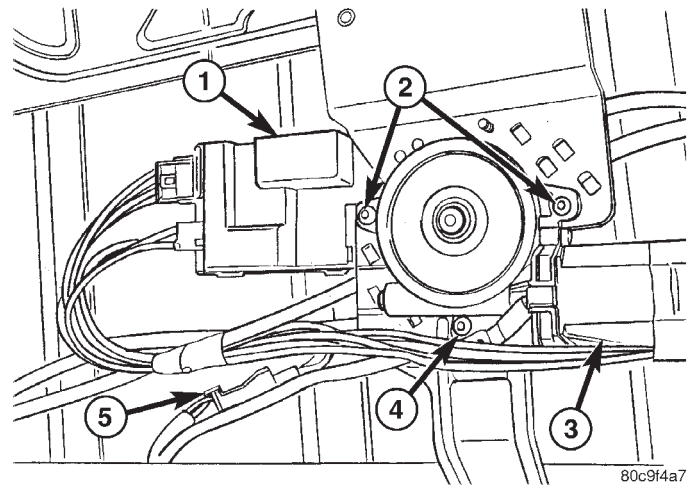
- 1 - U-NUTS
- 2 - DRIVE MOTOR
- 3 - BOLTS
- 4 - GLASS OPENING
- 5 - MODULE ASSEMBLY

- (5) Connect wire harness.
- (6) Install the headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION)
- (7) Install the opening trim lace. (Refer to 23 - BODY/SUNROOF/OPENING TRIM LACE - INSTALLATION)
- (8) Connect battery negative cable.
- (9) Test sunroof operation, adjust as necessary. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - ADJUSTMENTS)

**DRIVE MOTOR**

**REMOVAL**

- (1) Remove headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL)
- (2) Cut wire retaining tape being careful not to cut wires.
- (3) Disconnect the electrical connector (Fig. 11).
- (4) Remove three motor assembly attaching screws from bottom side of motor assembly and remove motor assembly from the motor bracket.



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**Fig. 11 DRIVE MOTOR ASSEMBLY**

- 1 - CONTROL MODULE
- 2 - SCREWS
- 3 - DRIVE MOTOR
- 4 - SCREW
- 5 - ELECTRICAL CONNECTOR

**INSTALLATION**

- (1) Place motor into position and install screws attaching motor to bracket.

**NOTE:** Hold electronics module to motor bracket when inserting motor shaft to avoid disengaging drive cables.

- (2) Connect electrical connector.
- (3) Tape wires to drive cables to prevent rattles.

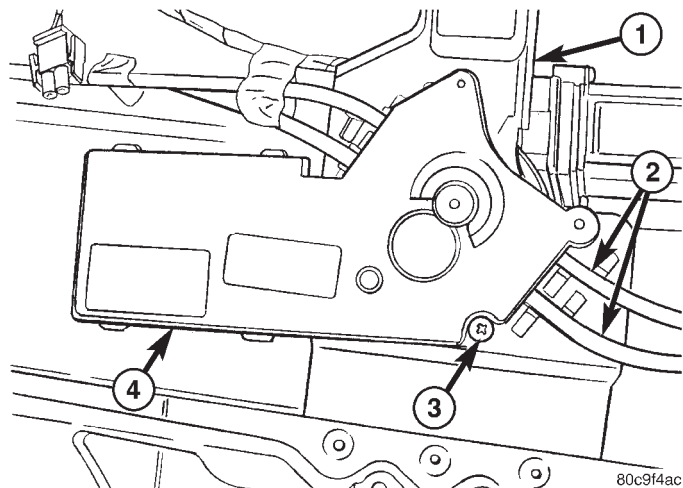
DRIVE MOTOR (Continued)

- (4) Test sunroof operation, adjust as necessary.
- (5) Install headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION)

CONTROL MODULE

REMOVAL

- (1) Remove the module assembly. (Refer to 23 - BODY/SUNROOF/MODULE ASSEMBLY - REMOVAL)
- (2) Remove three motor assembly retaining screws from bottom side of motor, and remove motor assembly (Fig. 11).
- (3) From top side of module assembly, remove one attaching screw from electronics module. (Fig. 12)



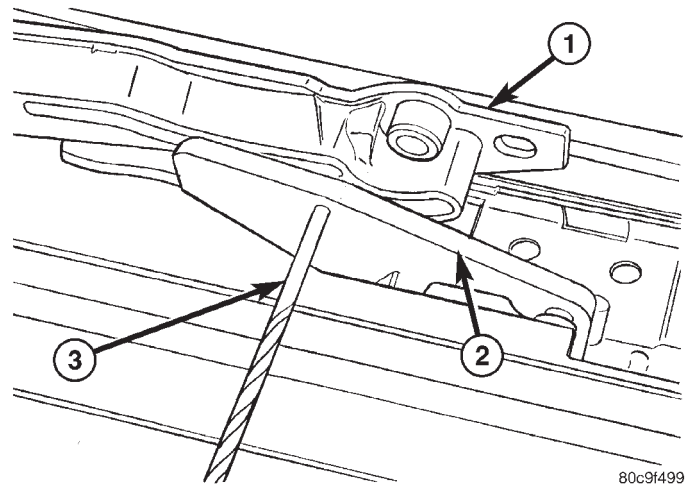
**Fig. 12 CONTROL MODULE**

- 1 - MOTOR BRACKET
- 2 - CABLES
- 3 - SCREW
- 4 - CONTROL MODULE

- (4) Remove old timing module.

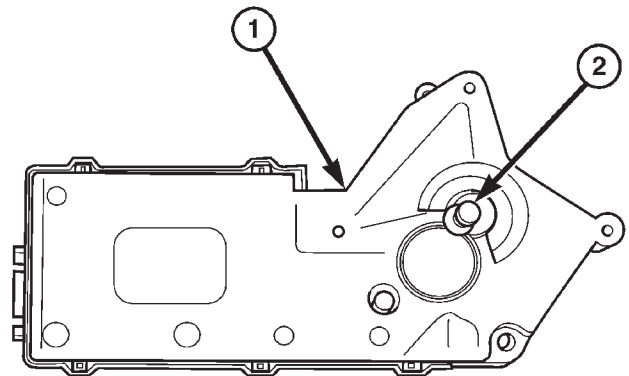
INSTALLATION

- (1) Check glass assembly position. Adjust to full closed position. Insert pin into holes in lift arm assembly to check position (Fig. 13).
- (2) Set new electronic module in position on top side of motor mounting bracket engaging drive cables with pinion gear in electronics module.
- (3) Install one screw to attach electronics module to motor bracket. Tighten screw to 3 N·m (27 in. lbs.) torque.
- (4) Install motor assembly to motor bracket and electronics module with three screws. Tighten screw to 1.75 N·m (15.5 in. lbs.) torque.
- (5) Remove the new module's timing pin and discard. (Fig. 14)



**Fig. 13 LIFT ARM POSITIONING**

- 1 - GLASS BRACKET
- 2 - LIFT ARM
- 3 - ALIGNMENT PIN



**Fig. 14 MODULE TIMING PIN**

- 1 - CONTROL MODULE
- 2 - TIMING PIN

- (6) Connect electrical connector to module assembly wire harness. Secure any loose wires.
- (7) Install module assembly. (Refer to 23 - BODY/SUNROOF/MODULE ASSEMBLY - INSTALLATION)
- (8) Test operation, adjust as necessary. (Refer to 23 - BODY/SUNROOF/GLASS PANEL - ADJUSTMENTS)
- (9) Install opening trim lace. (Refer to 23 - BODY/SUNROOF/OPENING TRIM LACE - INSTALLATION)

## CONTROL SWITCH

### DESCRIPTION

Vehicles equipped with a power sunroof utilize an sunroof control switch. On this model, the sunroof control switch is located in the overhead console, in between the two reading lamps. The switch is mounted in the overhead console with four plastic retaining tabs, molded into the switch housing.

This switch incorporates four selections of operation open, auto open, close and vent. The individual switches in the sunroof control switch unit cannot be repaired. If one switch is damaged or faulty, the entire sunroof control switch unit must be replaced.

### OPERATION

With the operation of the sunroof control switch, voltage is directed to the sunroof motor, through the switch contacts or control module. If the control switch is depressed and held depressed the voltage signal is controlled manually through the switch contacts, so when the switch is released the sunroof stops.

Refer to the owners manual for more information on the operation of the sunroof switch and system.

### DIAGNOSIS AND TESTING

The following test will determine if the sunroof control switch is operating properly.

(1) Remove the overhead console from the headliner (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(2) Remove the sunroof control switch from the overhead console (Refer to 23 - BODY/SUNROOF/CONTROL SWITCH - REMOVAL).

(3) Using an ohmmeter, test the switch terminals for proper continuity using the table below. If any of

the terminals do not show proper continuity, replace the sunroof control switch.

SWITCH POSITION (DEPRESSED)	CONTINUITY BETWEEN TERMINALS
VENT (V)	3, 4
OPEN (AUTO)	1, 4
CLOSE	2, 4

### REMOVAL

(1) Disconnect and isolate the negative battery cable.

(2) Remove the overhead console from the headliner (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(3) Disconnect the sunroof control switch electrical connector. Depress the connector retaining tab and pull the connector straight out.

(4) To remove the switch from the overhead console, push on the back of the switch until it comes free from the overhead console.

### INSTALLATION

(1) Install the switch in the overhead console assembly. Be certain the switch is securely snapped in place.

(2) Connect the sunroof control switch electrical connector. Be certain the switch connector is securely snapped in place.

(3) Install the overhead console (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION).

(4) Connect the negative battery cable.

# WEATHERSTRIP/SEALS

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## A-PILLAR SEAL

### REMOVAL

(1) Open the doors and peel the seal away from the a-pillar/windshield and the side rail weather strip flanges.

### INSTALLATION

(1) Position the a-pillar seal over the windshield/a-pillar and the side rail weatherstrip flanges and seat fully.

## COWL WEATHERSTRIP

### REMOVAL

(1) Open the hood and peel the cowl seal from the cowl panel and cowl flange.

### INSTALLATION

(1) Position the weatherstrip over the cowl flange and the cowl grille and seat fully.

## DOOR PRIMARY WEATHERSTRIP

### REMOVAL

(1) Remove the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(2) Peel seal off of the door opening flange.

### INSTALLATION

(1) Position the seal to the bottom of the door opening, with bulb facing outboard, starting the installation at the center of the lower flange. Press the seal onto the sill flange and work around the perimeter of the door opening until fully seated. Work in one direction, smoothing the seal to avoid puckers or wrinkles.

(2) Install the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

(3) When installing a new weatherstrip on the front door opening, remove the tear strip starting at the splice and moving around the front of the door to the back of the opening.

## DOOR PRIMARY WEATHERSTRIP (Continued)

(4) When installing a new weatherstrip on the rear door opening, remove the tear strip starting at the splice and moving around the back of the door to the front of the opening.

## DOOR LOWER WEATHERSTRIP

## REMOVAL

(1) Carefully disengage the push pin fasteners and remove the seal.

## INSTALLATION

(1) Position the seal and seat the push pin fasteners.

## FRONT DOOR OUTER BELT MOLDING

## REMOVAL

(1) Lower the window.  
(2) Pull the outer belt molding off of the door flange starting at the rear and moving forward.

## INSTALLATION

(1) Press the belt molding onto the outer door window flange starting at the rear and working forward.

## SWING GATE BELTLINE WEATHERSTRIP

## REMOVAL

(1) Remove the swing gate trim panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - REMOVAL)  
(2) Pull seal away from the corner tabs and remove from the swing gate flange.

## INSTALLATION

(1) Install the seal over the swing gate flange and seat the corner tabs.  
(2) Install the swing gate trim panel. (Refer to 23 - BODY/SWING GATE/TRIM PANEL - INSTALLATION)

## SWING GATE OPENING WEATHERSTRIP

## REMOVAL

(1) Open the swing gate and peel seal off of the gate opening flange.

## INSTALLATION

(1) Position the seal to the bottom of the gate opening starting the installation at the center of the flange. Press the seal onto the sill flange and work around the perimeter of the door opening until fully seated. Work in one direction, smoothing the seal to avoid puckers or wrinkles.

## REAR DOOR OUTER BELT MOLDING

## REMOVAL

(1) Lower the window.  
(2) Pull the outer belt molding off of the door flange starting at the rear and moving forward.

## INSTALLATION

(1) Press the belt molding onto the outer door window flange starting at the front and working back.

## SIDE RAIL WEATHERSTRIP/RETAINER

## REMOVAL

(1) Remove the windshield weatherstrip retainer. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/WINDSHIELD A-PILLAR WEATHERSTRIP/RETAINER - REMOVAL)  
(2) Remove the two screws.  
(3) Using a trim stick C-4755 or equivalent, release the push in fasteners and remove the weatherstrip.

## INSTALLATION

(1) Position the weatherstrip and seat the push in fasteners.  
(2) Install the two screws.  
(3) Install the windshield weatherstrip. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/WINDSHIELD A-PILLAR WEATHERSTRIP/RETAINER - INSTALLATION)

## WINDSHIELD A-PILLAR WEATHERSTRIP/RETAINER

## REMOVAL

(1) Open the doors and peel the a-pillar seal away from the a-pillar/windshield and the side rail weather strip flanges.  
(2) Remove the seven screws and remove the weatherstrip.

## WINDSHIELD A-PILLAR WEATHERSTRIP/RETAINER (Continued)

**INSTALLATION**

(1) Position the weatherstrip and install the seven screws.

(2) Position the a-pillar seal over the windshield/a-pillar and the side rail weatherstrip flanges and seat fully.

**COWL/PLENUM SEAL****REMOVAL**

(1) Remove the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL)

(2) Remove the seal from the plenum flange above the air inlet duct.

**INSTALLATION**

**NOTE: Seal should not be touching the plenum baffle flange seal.**

(1) Position the seal on the plenum flange and seat fully.

(2) Install the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION)

**COWL/PLENUM WINDOW  
BAFFLE SEAL****REMOVAL**

(1) Remove the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL)

(2) Remove the seal from the window below the cowl/plenum seal.

**INSTALLATION**

(1) Position the seal against the upper flange of the inner plenum window below the cowl/plenum seal and seat fully.

(2) Install the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION)





# HEATING & AIR CONDITIONING

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## HEATING & AIR CONDITIONING

### DESCRIPTION

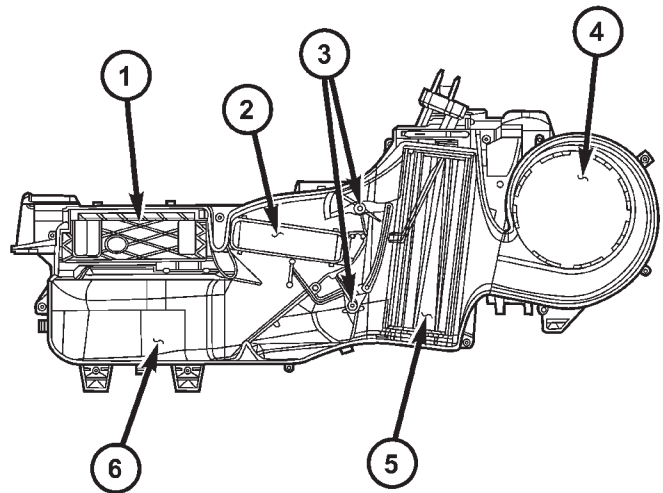
#### DESCRIPTION - HEATER AND AIR CONDITIONER

All vehicles are equipped with a common HVAC 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.

#### DESCRIPTION - COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the HVAC 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 Engine Cooling for more information before the opening of, or attempting any service to the engine cooling system.



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**Fig. 1 Blend Door**

- 1 - DEFROSTER DOOR
- 2- HEATER CORE
- 3- BLEND DOORS
- 4- BLOWER MOTOR HOUSING
- 5- EVAPORATOR (A/C ONLY)
- 6- LOWER HVAC CASE ASSEMBLY

## HEATING &amp; AIR CONDITIONING (Continued)

**DESCRIPTION - 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.

**OPERATION****OPERATION - HEATER AND AIR CONDITIONER**

The heater and optional air conditioner are blend-air type systems. In a blend-air system, a blend 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 A/C Heater control panel determines the discharge air temperature by controlling an electric actuator, which moves the blend door. This allows an almost immediate control of the output air temperature of the system.

The mode control knob on the heater-only or A/C Heater 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 actuators.

On all vehicles, the outside air intake can be shut off by selecting the Recirculation Mode with the mode control knob. This will operate a vacuum actuated recirculation 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 near the condenser outlet tube to meter refrigerant flow to the evaporator coil. To maintain minimum evaporator temperature and prevent evaporator freezing, the A/C low pressure switch on the accumulator cycles the compressor clutch.

**OPERATION - REFRIGERANT SYSTEM SERVICE PORT**

The high pressure service port is located on the refrigerant line, near the discharge port of the compressor. The low pressure service port is located on the liquid line at the side of the engine compartment, near the condenser.

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.

**DIAGNOSIS AND TESTING****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 HVAC 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 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. 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.

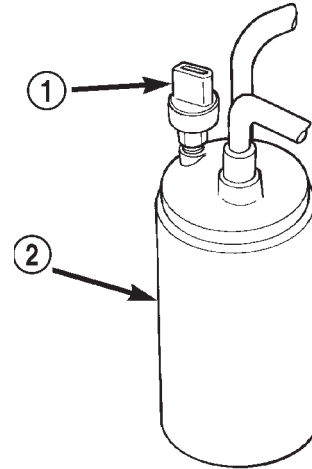
Humidity has an important bearing on the temperature of the air delivered to the interior of the vehicle. It is important to understand the effect that humidity has on the performance of the air conditioning system. When humidity is high, the evaporator has to perform a double duty. It must lower the 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. Removing 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 the 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.

Before proceeding, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION). The air temperature in the test room and in the vehicle must be a minimum of 21° C (70° F) for this test.

HEATING & AIR CONDITIONING (Continued)

- (1) Connect a tachometer a manifold gauge set or A/C recycling/charging station.
- (2) Set the A/C Heater mode control switch knob in the Recirculation Mode position, the temperature control knob in the full cool position, and the blower motor switch knob in the highest speed position.
- (3) Start the engine and hold the idle at 1,000 rpm with the compressor clutch engaged.
- (4) The engine should be at operating temperature. The doors and windows must be 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 a/c low pressure switch wire harness connector. (Fig. 2). Place a jumper wire across the terminals of the a/c low pressure switch wire harness connector.
- (7) With the compressor clutch engaged, record the discharge air temperature and the compressor discharge pressure.
- (8) Compare the discharge air temperature to the Performance Temperature and Pressure chart. If the discharge air temperature is high, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING -



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**Fig. 2 A/C LOW PRESSURE SWITCH - TYPICAL**

- 1 - A/C LOW PRESSURE SWITCH
- 2 - ACCUMULATOR

DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY).

Performance Temperature and Pressure					
Ambient Air Temperature	21° C (70° F)	27° C (80° F)	32° C (90° F)	38° C (100° F)	43° C (110° F)
Air Temperature at Center Panel Outlet	7° C (45° F)	7° C (45° F)	13° C (55° F)	13° C (55° F)	18° C (64° F)
Compressor Inlet Pressure at Service Port (low Side)	138 to 207 kPa (20 to 30 psi)	172 to 241 kPa (25 to 35 psi)	207 to 276 kPa (30 to 40 psi)	241 to 310 kPa (35 to 45 psi)	276 to 345 kPa (40 to 50 psi)
Condensor Out Pressure at Service Port (High Side)	1034 to 1724 kPa (150 to 250 psi)	1379 to 2068 kPa (200 to 300 psi)	1724 to 2413 kPa (250 to 350 psi)	1999 to 2689 kPa (290 to 390 psi)	2413 to 2965 kPa (350 to 430 psi)

- (9) Compare the compressor discharge pressure to the Performance Temperature and Pressure chart. If the compressor discharge pressure is high, see the Pressure Diagnosis chart.

## HEATING &amp; AIR CONDITIONING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
Rapid compressor clutch cycling (ten or more cycles per minute).	1. Low refrigerant system charge.	1. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
Equal pressures, but the compressor clutch does not engage.	1. No refrigerant in the refrigerant system. 2. Faulty fuse. 3. Faulty a/c compressor clutch coil. 4. Faulty a/c compressor clutch relay. 5. Improperly installed or faulty a/c low pressure switch. 6. Faulty a/c high pressure switch. 7. Faulty Powertrain Control Module (PCM).	1. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in 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 A/C Compressor/Diagnosis and Testing - Compressor Clutch Coil in this group. Test the compressor clutch coil and replace, if required. 4. See A/C Compressor Clutch Relay/Diagnosis and Testing - Compressor Clutch Relay in this group. Test the compressor clutch relay and relay circuits. Repair the circuits or replace the relay, if required. 5. See A/C Low Pressure Switch/Diagnosis and Testing in this group. Test the a/c low pressure switch and tighten or replace, if required. 6. See A/C High Pressure Switch/Diagnosis and Testing in this group. Test the a/c high pressure switch and replace, if required. 7. (Refer to Appropriate Diagnostic Information). Test the PCM and replace, if required.
Normal pressures, but A/C Performance Test air temperatures at center panel outlet are too high.	1. Excessive refrigerant oil in system. 2. Blend door inoperative or sealing improperly. 3. Blend door actuator faulty or inoperative.	1. See Refrigerant Oil/Standard Procedure - Refrigerant Oil Level in 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 Blend Door in this group. Inspect the blend door for proper operation and sealing and correct, if required. 3. Perform blend door actuator diagnosis, replace if faulty.
The low side pressure is normal or slightly low, and the 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.	1. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required. 2. See Accumulator in this group. Replace the restricted accumulator, if required. 3. See A/C Evaporator in this group. Replace the restricted evaporator coil, if required.

HEATING & AIR CONDITIONING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
	4. Faulty compressor.	4. See A/C Compressor in this group. Replace the compressor, if required.
The low side pressure is normal or slightly high, and the 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 Cooling for more information on air seals. Clean, repair, or replace components as required.  2. Refer to Cooling for more information. Test the cooling fan and replace, if required.  3. See Plumbing/Standard Procedure - Refrigerant System Charge in this group. Recover the refrigerant from the refrigerant system. Charge the refrigerant system to the proper level, if required.  4. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.  5. Refer to Cooling for more information. Test the cooling system and repair, if required.
The low side pressure is too high, and the high side pressure is too low.	1. Accessory drive belt slipping.  2. Fixed orifice tube not installed.  3. Faulty compressor.	1. Refer to Cooling for more information. Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required.  2. See A/C Orifice Tube in this group. Replace the liquid line, if required.  3. See A/C Compressor in this group. Replace the compressor, if required.
The low side pressure is too low, and the 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, Suction, and Discharge Line in 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 A/C Orifice Tube in this group. Replace the liquid line, if required.  3. See A/C Condenser in this group. Replace the restricted condenser, if required.

HEATING & AIR CONDITIONING (Continued)

**DIAGNOSIS AND TESTING - HEATER PERFORMANCE**

Before performing the following tests, refer to Cooling for the procedures to check the radiator coolant level, serpentine drive belt tension, radiator air flow and the radiator fan operation. Also be certain that the accessory vacuum supply line is connected at the engine intake manifold.

normal operating temperature, set the temperature control knob in the full hot position, the mode control switch knob in the floor heat 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 HVAC housing floor outlets. Compare the test thermometer reading to the Temperature Reference chart.

**MAXIMUM HEATER OUTPUT**

Engine coolant is delivered to the heater core through two heater hoses. With the engine idling at

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	52.2° C (126° F)	56.1° C (133° F)	59.4° C (139° F)	62.2° C (144° F)

If the floor outlet air temperature is too low, refer to Cooling 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 Cooling for the procedures.

**OBSTRUCTED COOLANT FLOW** Possible locations or causes of obstructed coolant flow:

- 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 blend door not functioning properly.

**TEMPERATURE CONTROL**

If the heater outlet air temperature cannot be adjusted with the temperature control knob on the

A/C Heater control panel, the following could require service:

- The A/C Heater control.
- The blend door actuator.
- The blend door.
- Improper engine coolant temperature.

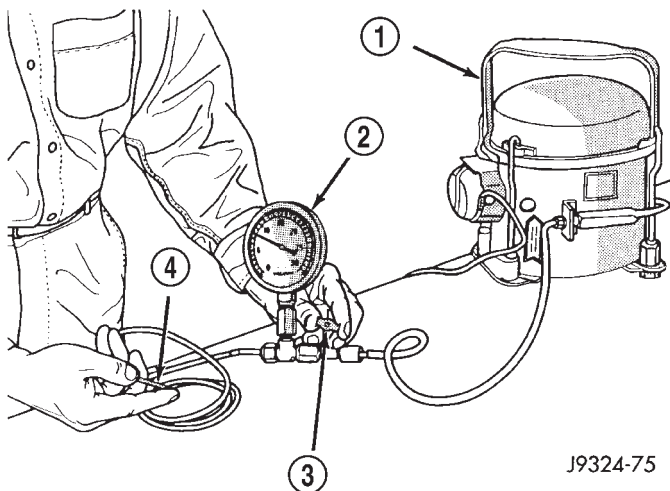
**DIAGNOSIS AND TESTING - VACUUM SYSTEM**

Vacuum control is used to operate the mode doors in the heater-only and a/c heater housings. Testing of the heater-only and A/C Heater 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 a faulty 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 intake manifold vacuum tap or at the vacuum reservoir.

## HEATING &amp; AIR CONDITIONING (Continued)

Use an adjustable vacuum test set (Special Tool C-3707-B) and a suitable vacuum pump to test the HVAC vacuum control system. With a finger placed over the end of the vacuum test hose probe (Fig. 3), 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. 3 ADJUST VACUUM TEST BLEED VALVE**

- 1 - VACUUM PUMP TOOL C-4289
- 2 - VACUUM TEST SET C-3707
- 3 - BLEED VALVE
- 4 - PROBE

### VACUUM CHECK VALVE

(1) Remove the vacuum check valve. The valve is located in the vacuum supply tube (black) at the HVAC system vacuum tee.

(2) Connect the test set vacuum supply hose to the A/C Heater 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 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.

### A/C HEATER CONTROLS

(1) Connect the test set vacuum probe to the HVAC vacuum supply (black) tube at the tee in the engine compartment. Position the test set gauge so that it can be viewed from the passenger compartment.

(2) Place the A/C Heater 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 the procedure in Locating Vacuum Leaks.

**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.

### LOCATING VACUUM LEAKS

**WARNING:** ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect the vacuum harness connector from the back of the HVAC control head (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - REMOVAL).

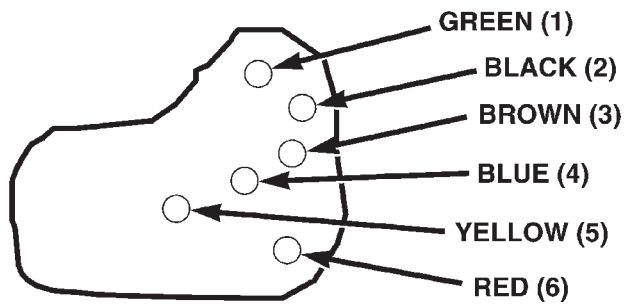
(2) Connect the test set vacuum hose probe to each port in the HVAC housing half of the vacuum harness connector, one port at a time, and pause after each connection. The test set gauge should return to the 27 kPa (8 in. Hg.) setting shortly after each connection is made. If OK, replace the faulty A/C Heater Control. If not OK, go to Step 3.

(3) Determine the vacuum line color of the vacuum circuit that is leaking. To determine the vacuum line colors, refer to the Vacuum Circuits chart (Fig. 4).

(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 appropriate service procedures.



HEATING & AIR CONDITIONING (Continued)



2002 KJ VACUUM LOGIC - HEATER ONLY CONTROL

PORT	1-GREEN	2-BLACK	3-BROWN	4-BLUE	5-YELLOW	6-RED
Actuation	Recirc Door	Source	Panel Door-Full	Floor/Def Floor	Floor/Def Mid-Pos	Panel Door-Mid
Off	Vacuum	Vacuum	Vent	Vent	Vent	Vent
Recirc	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Panel	Vent	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Bi-Level	Vent	Vacuum	Vent	Vacuum	Vacuum	Vacuum
Floor	Vent	Vacuum	Vent	Vacuum	Vacuum	Vent
Floor/Def	Vent	Vacuum	Vent	Vent	Vacuum	Vent
Defrost	Vent	Vacuum	Vent	Vent	Vent	Vent

2002 KJ VACUUM LOGIC - A/C CONTROL

PORT	1-GREEN	2-BLACK	3-BROWN	4-BLUE	5-YELLOW	6-RED
Actuation	Recirc Door	Source	Panel Door-Full	Floor/Def Floor	Floor/Def Mid-Pos	Panel Door-Mid
Off	Vacuum	Vacuum	Vent	Vent	Vent	Vent
Recirc a/c	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Panel a/c	Vent	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Bi-Level a/c	Vent	Vacuum	Vent	Vacuum	Vacuum	Vacuum
Bi-Level	Vent	Vacuum	Vent	Vacuum	Vacuum	Vacuum
Panel	Vent	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Floor	Vent	Vacuum	Vent	Vacuum	Vacuum	Vent
Floor/Def	Vent	Vacuum	Vent	Vent	Vacuum	Vent
Defrost	Vent	Vacuum	Vent	Vent	Vent	Vent

Fig. 4

HEATING & AIR CONDITIONING (Continued)

(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.

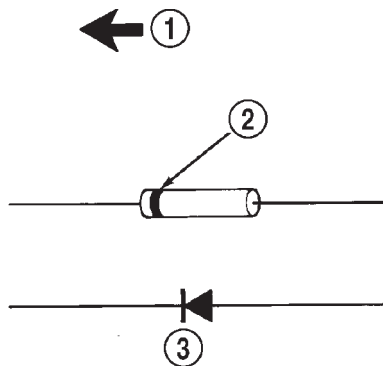
(6) To locate a leak in a vacuum line, leave one end of the line plugged and connect the test set hose or probe to the other end of the line. Run your fingers slowly along the line while watching the test set gauge. The vacuum reading will fluctuate when your fingers contact the source of the leak. To 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.

**STANDARD PROCEDURE - DIODE REPLACEMENT**

(1) Disconnect the battery negative cable and isolate it.

(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. 5).



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**Fig. 5 DIODE IDENTIFICATION**

- 1 - CURRENT FLOW
- 2 - BAND AROUND DIODE INDICATES CURRENT FLOW
- 3 - DIODE AS SHOWN IN THE DIAGRAMS

(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 negative cable, and test affected systems.

**SPECIFICATIONS**

**A/C APPLICATION TABLE**

Item	Description	Notes
Vehicle	KJ- Liberty	
System	R134a w/ fixed orifice tube	
Compressor	Sanden PXF-18	SP-10 PAG oil
Freeze-up Control	A/C low pressure switch	accumulator mounted
Low psi Control	opens < 25 psi - resets > 43 psi	
High psi Control	switch - opens > 450-490 psi - resets < 270-330 psi	discharge line
Control Head	manual type	
Mode Door	vacuum	
Blend Door	electric	
Recirculation Door	vacuum	
Blower Motor	hardwired to control head	resistor block
Cooling Fan	viscous for cooling, single speed electric for A/C	
Clutch	Electro-mechanical	
Control	relay	PCM
Draw	2 - 3.7 amps @ 12V	± 0.5V @ 70° F
Gap	0.016" - 0.031"	
DRB III®		
Reads	TPS, RPM, A/C switch test	
Actuators	clutch and fan relay	

## HEATING &amp; AIR CONDITIONING (Continued)

## SPECIFICATIONS

## TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
A/C COMPRESSOR CLUTCH PLATE NUT	14.4	10.5	127.4
A/C COMPRESOR LINE MANIFOLD FASTENER	28 (±6)	21 (±4)	250 (±50)
A/C COMPRESSOR TO MOUNTING BRACKET BOLTS - 3.7L and 2.4L	27	20	239
A/C COMPRESSOR TO MOUNTING BRACKET BOLTS - 2.5L DIESEL	33	25	292
ACCUMULATOR RETAINING BAND	5	3.7	44
BLEND DOOR ACTUATOR SCREWS	2.4 (±.34)	1.8 (±.25)	21 (±3)
HVAC HOUSING SCREWS	2.4 (±.34)	1.8 (±.25)	21 (±3)
HVAC HOUSING TO DASH PANEL NUTS	6.2	4.6	55
SUCTION LINE TO ACCUMULATOR FITTING	9	6.6	80

# CONTROLS

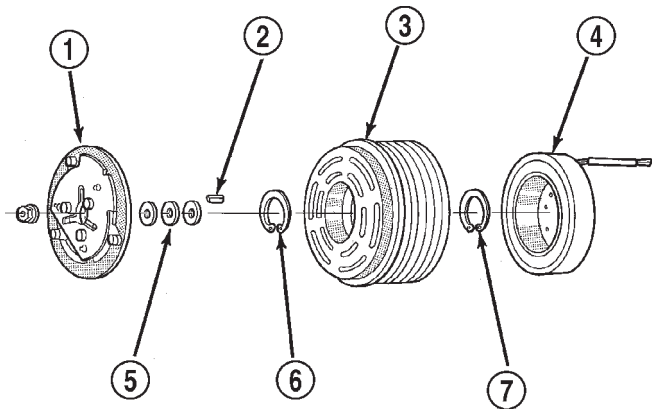
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## A/C COMPRESSOR CLUTCH

### DESCRIPTION - 3.7L and 2.4L

The compressor clutch assembly consists of a stationary electromagnetic coil, a rotor bearing and rotor assembly, and a clutch plate (Fig. 1). The electromagnetic coil unit and the rotor bearing and rotor assembly are each retained on the nose of the compressor front housing with snap rings. The clutch plate is keyed 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.



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**Fig. 1 COMPRESSOR CLUTCH - TYPICAL**

- 1 - CLUTCH PLATE
- 2 - NOT USED ON KJ
- 3 - ROTOR
- 4 - COIL
- 5 - CLUTCH SHIMS
- 6 - SNAP RING
- 7 - SNAP RING

### OPERATION - 3.7L and 2.4L

When the clutch coil is energized, it magnetically draws the clutch into contact with the rotor and drives the compressor shaft. When the coil is not energized, the rotor freewheels on the clutch rotor bearing, which is part of the rotor. The compressor clutch and coil are the only serviced parts on the compressor.

The compressor clutch engagement is controlled by several components: the A/C Heater mode control switch, the A/C low pressure switch, the A/C high pressure switch, the compressor clutch relay, and the Powertrain Control Module (PCM). The PCM may delay compressor clutch engagement for up to thirty seconds. Refer to Electronic Control Modules for more information on the PCM controls.

### DIAGNOSIS AND TESTING - A/C COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). The battery must be fully-charged before performing the following tests. Refer to 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 A/C Heater 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 0.2 volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within 0.2 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 III<sup>®</sup> scan tool and (Refer to Appropriate Diagnostic Information) for testing of the compressor clutch circuit and PCM control. 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)
- A/C heater mode control switch
- Compressor clutch relay
- A/C high pressure switch
- A/C low pressure 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.

### STANDARD PROCEDURE - A/C COMPRESSOR 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 A/C Heater control to the Recirculation Mode, the blower motor switch in the highest speed position, and the engine speed at 1500

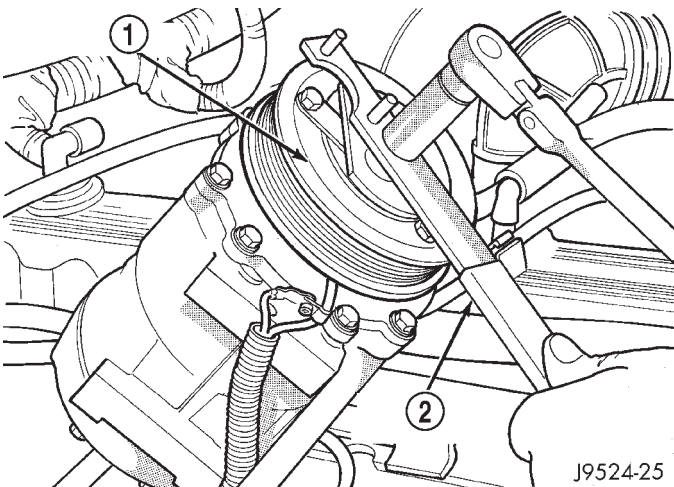
A/C COMPRESSOR CLUTCH (Continued)

to 2000 rpm. This procedure (burnishing) will seat the opposing friction surfaces and provide a higher compressor clutch torque capability.

**REMOVAL**

The refrigerant system can remain fully-charged during compressor clutch, rotor, or coil replacement. The compressor clutch can be serviced in the vehicle.

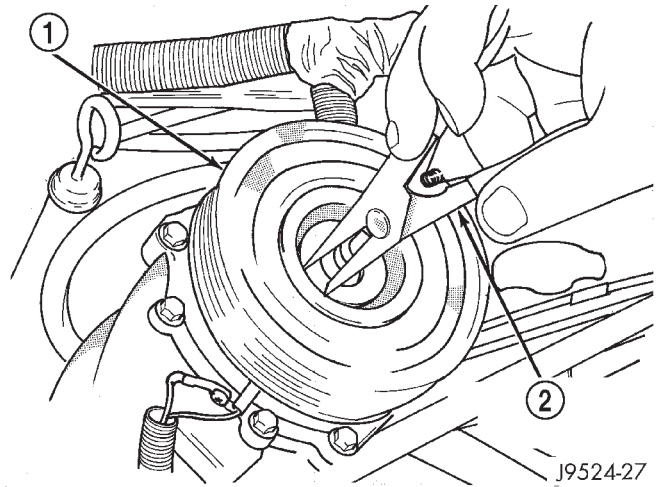
- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
- (3) Unplug the compressor clutch coil wire harness connector.
- (4) Remove the four bolts that secure the compressor to the mounting bracket.
- (5) Remove the compressor from the mounting bracket. Support the compressor in the engine compartment while servicing the clutch.
- (6) Insert the two pins of the spanner wrench (Special Tool C-4489 or equivalent) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 2).



**Fig. 2 CLUTCH NUT REMOVE**

- 1 - CLUTCH PLATE
- 2 - SPANNER

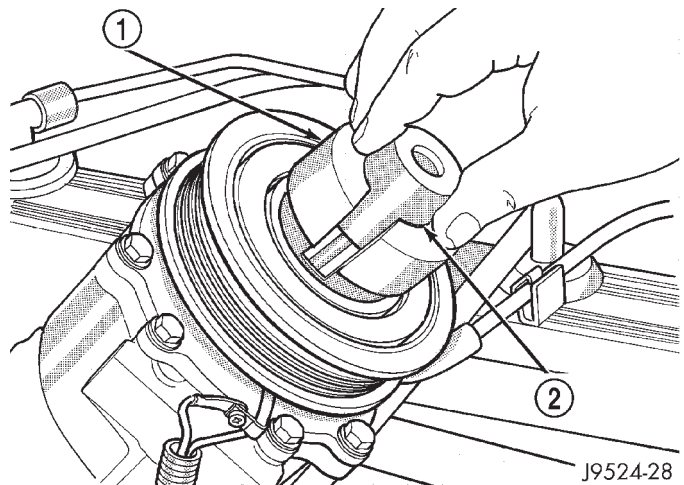
- (7) Remove the clutch plate.
- (8) Remove the compressor clutch shims.
- (9) Remove the external front housing snap ring with snap ring pliers (Fig. 3).



**Fig. 3 EXTERNAL SNAP RING REMOVE**

- 1 - PULLEY
- 2 - SNAP RING PLIERS

- (10) Install the lip of the rotor puller (Special Tool C-6141-1 or equivalent) into the snap ring groove exposed in the previous step, and install the shaft protector (Special Tool C-6141-2 or equivalent) (Fig. 4).



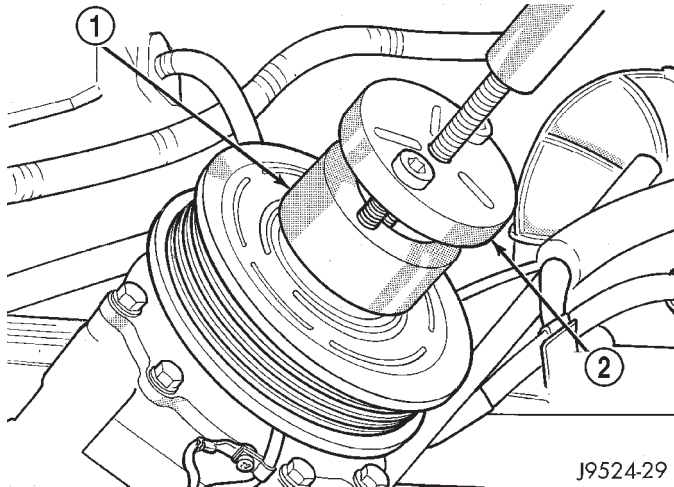
**Fig. 4 SHAFT PROTECTOR AND PULLER**

- 1 - PULLER JAW
- 2 - SHAFT PROTECTOR

## A/C COMPRESSOR CLUTCH (Continued)

(11) Install the puller through-bolts (Special Tool C-6461 or equivalent) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 5). Turn the puller center bolt clockwise until the rotor is free.

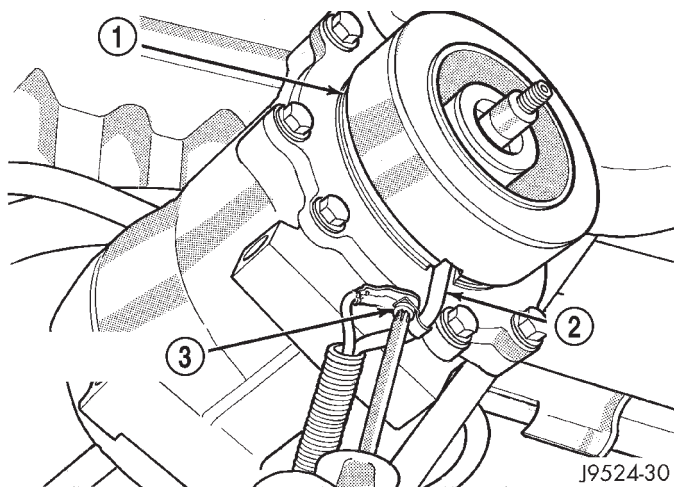
**CAUTION: DO NOT APPLY FORCE TO THE END OF THE COMPRESSOR SHAFT.**



**Fig. 5 INSTALL PULLER PLATE**

- 1 - PULLER JAW
- 2 - PULLER

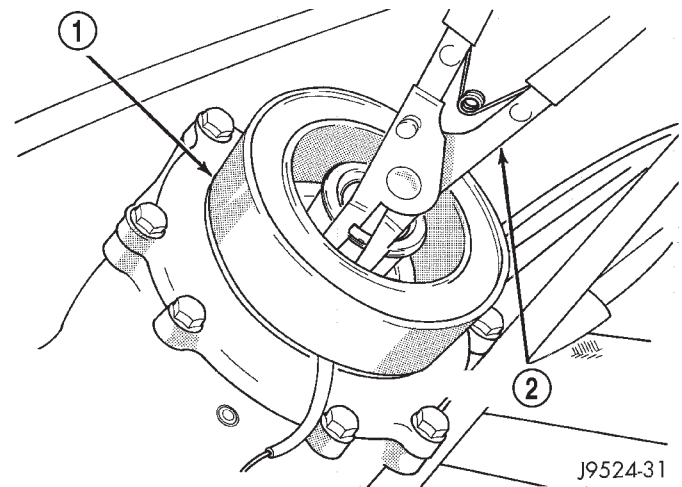
(12) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing (Fig. 6).



**Fig. 6 CLUTCH COIL LEAD WIRE HARNESS**

- 1 - COIL
- 2 - COIL WIRE
- 3 - RETAINER SCREW

(13) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 7). Slide the clutch field coil off of the compressor hub.



**Fig. 7 CLUTCH FIELD COIL SNAP RING REMOVE**

- 1 - COIL
- 2 - SNAP RING PLIERS

## INSPECTION

Examine the friction surfaces of the clutch rotor and the clutch plate for wear. The rotor and clutch plate should be replaced if there is excessive wear or scoring.

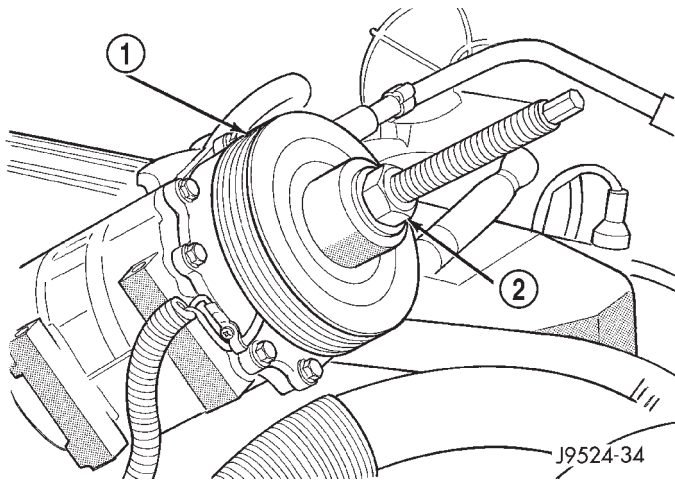
If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the rotor bearing for roughness or excessive leakage of grease. Replace the rotor and clutch plate, if required.

## INSTALLATION

- (1) Install the clutch field coil and snap ring.
- (2) Install the screw and retainer on the clutch coil lead wire harness on the compressor front housing. Tighten screw to 2.2 N-m (20 in. lbs.).
- (3) Align the rotor assembly squarely on the front compressor housing hub.
- (4) Install the rotor bearing assembly with the installer (Special Tool C-6871 or equivalent) (Fig. 8). Thread the installer on the shaft, then turn the nut until the rotor assembly is seated.
- (5) Install the external front housing 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.

A/C COMPRESSOR CLUTCH (Continued)



**Fig. 8 CLUTCH PULLEY INSTALL**

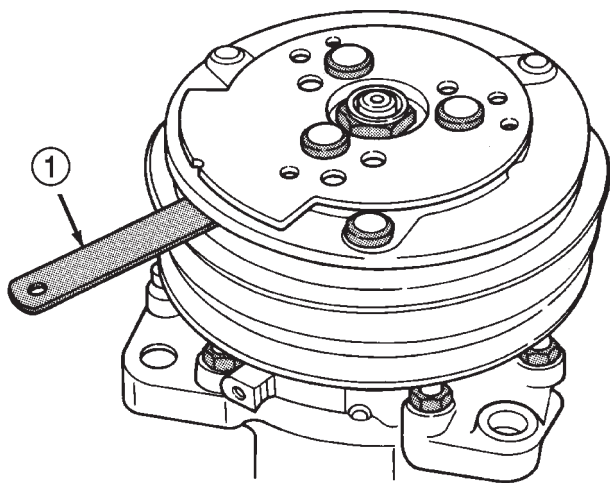
- 1 - ROTOR BEARING ASSEMBLY
- 2 - INSTALLER

**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.

(6) Install the original clutch shims on the compressor shaft.

(7) Install the clutch plate. Install the shaft hex nut and tighten to 15–20 N·m (11–15 ft. lbs.).

(8) Check the clutch air gap with a feeler gauge (Fig. 9). 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).



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**Fig. 9 CHECK CLUTCH AIR GAP**

- 1 - FEELER GAUGE

**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 a 1.0, 0.50, and 0.13 millimeter (0.040, 0.020, and 0.005 inch) shims from the new clutch hardware package that is provided with the new clutch.

(9) To complete the procedure, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

## A/C COMPRESSOR CLUTCH RELAY

### DESCRIPTION

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 located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

### OPERATION

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 A/C Heater mode control switch, the A/C low pressure switch, and the A/C high pressure switch. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C COMPRESSOR CLUTCH RELAY - DIAGNOSIS AND TESTING)

The compressor clutch relay cannot be repaired and, if faulty or damaged, it must be replaced.

### DIAGNOSIS AND TESTING - COMPRESSOR CLUTCH RELAY

#### RELAY TEST

The compressor clutch relay (Fig. 10) 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:

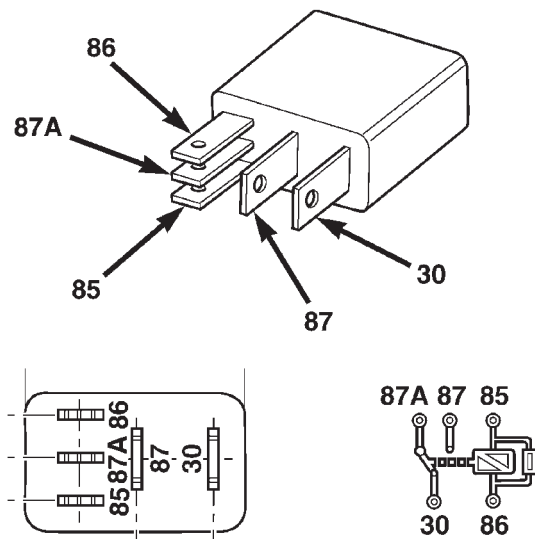
(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.



## A/C COMPRESSOR CLUTCH RELAY (Continued)

(2) Resistance between terminals 85 and 86 (electromagnet) should be 67.5 to 82.5 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. If not OK, replace the faulty relay.



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**Fig. 10 COMPRESSOR CLUTCH RELAY**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

### RELAY CIRCUIT TEST

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

(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 (gray) at all times. If not OK, repair the open circuit as required.

### REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC).

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC.

### INSTALLATION

(1) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(2) Install the PDC cover.

(3) Connect the battery negative cable.

(4) Test the relay operation.

## A/C HEATER CONTROL

### DESCRIPTION

Both the heater-only and A/C heater 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 information on the features, use, and suggested operation of these controls.

The heater-only or A/C heater 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. The control also has a push button to activate the rear window defogger.

The heater-only or A/C heater control panel cannot be repaired. If faulty or damaged, the entire unit must be replaced. The illumination lamps are available for service replacement.

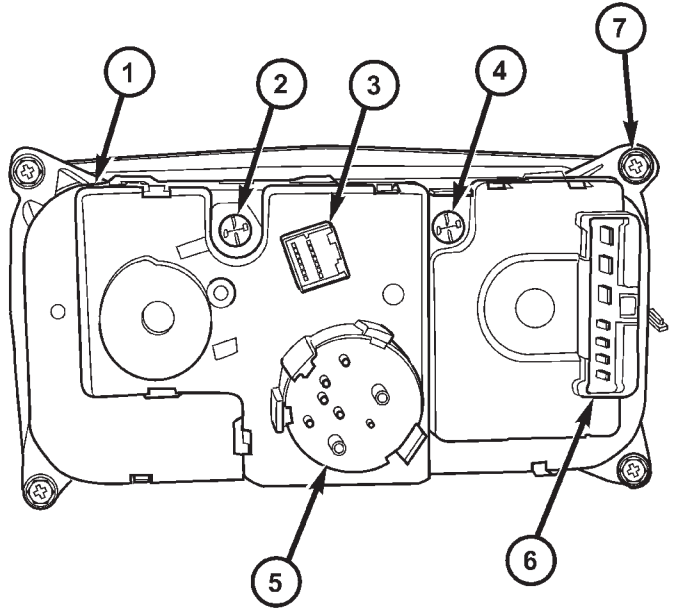
A/C HEATER CONTROL (Continued)

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the center bezel from the instrument panel(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).
- (3) Release the vacuum harness from the A/C Heater control.
- (4) Remove the four screws that secure the A/C Heater control to the instrument panel (Fig. 11).

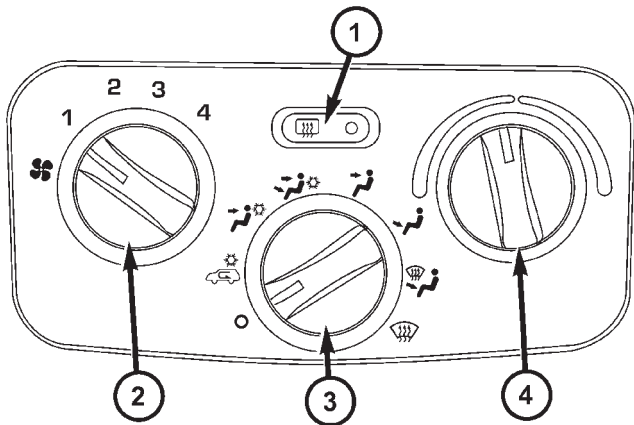
- (5) Pull the A/C Heater control assembly away from the instrument panel far enough to access the connections on the back of the control.
- (6) Unplug the wire harness connectors from the back of the A/C Heater control (Fig. 12).



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**Fig. 12 A/C HEATER CONTROL HEAD (Rear View)**

- 1 - A/C HEATER CONTROL HEAD
- 2 - A/C HEATER CONTROL HEAD LIGHT
- 3 - REAR WINDOW DEFOGGER SWITCH AND TEMPERATURE BLEND DOOR- CONNECTOR B (12 PIN)
- 4 - A/C HEATER CONTROL HEAD LIGHT
- 5 - MODE SELECT CONTROL
- 6 - BLOWER SPEED CONTROL- CONNECTOR A (7 PIN)
- 7 - MOUNTING SCREWS (4)



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**Fig. 11 A/C HEATER CONTROL**

- 1 - REAR WINDOW DEFOGGER SWITCH
- 2 - BLOWER SPEED CONTROL
- 3 - MODE SELECT CONTROL
- 4 - TEMPERATURE SELECT CONTROL

**INSTALLATION**

- (1) Plug the two wire harness connectors and one vacuum connector into the back of the A/C Heater control.
- (2) Position the A/C Heater control in the instrument panel bezel and secure it with four screws. Tighten the screws to 2.2 N·m (20 in. lbs.).
- (3) Reinstall the center bezel onto the instrument panel(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).
- (4) Connect the battery negative cable.

**A/C HIGH PRESSURE SWITCH**

**DESCRIPTION**

The A/C high pressure switch controls both A/C compressor clutch engagement/disengagement, and

## A/C HIGH PRESSURE SWITCH (Continued)

electric cooling fan operations. The 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.

### OPERATION

The A/C high pressure switch is connected in series electrically with the A/C low pressure 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, and also reduces electrical surging from compressor clutch engagement.

The A/C high pressure switch controls the electric cooling fan operation by monitoring refrigerant line pressures. When the discharge line pressure rises above 1900 to 2200 kPa (280 to 320 psi) the fan will turn on. The cooling fan will turn off when the discharge line pressure drops to 1600 kPa (235 psi).

The A/C high pressure switch controls the A/C clutch operation by disengaging the clutch when the discharge line pressure rises above 3100 to 3375 kPa (450 to 490 psi). The switch contacts will close and allow A/C clutch engagement when the discharge line pressure drops to 1860 to 2275 kPa (270 to 330 psi).

The A/C high pressure switch is a factory-calibrated unit. The switch cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

### DIAGNOSIS AND TESTING - A/C HIGH PRESSURE SWITCH

Before performing diagnosis of the A/C high pressure switch, verify that the refrigerant system has the correct refrigerant charge. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the A/C high pressure switch wire harness connector from the switch on the refrigerant system fitting.

(3) On the four terminal A/C high pressure switch, check for continuity between terminals C and D. On the two terminal A/C high pressure switch, check for continuity between both terminals of the 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.

### REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the A/C high pressure switch, which is mounted to a fitting on the non-flexible section of the discharge line nearest the compressor.

(3) Unscrew the A/C high pressure switch from the discharge line fitting.

(4) Remove the A/C high pressure 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 refrigerant oil of the type recommended for the compressor in the vehicle (Refer to 24 - HEATING & AIR CONDITIONING - SPECIFICATIONS). (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

(2) Install and tighten the a/c high pressure switch on the discharge line fitting. The switch should be hand-tightened onto the discharge line fitting.

(3) Plug the wire harness connector into the a/c high pressure switch.

(4) Connect the battery negative cable.

## A/C LOW PRESSURE SWITCH

### DESCRIPTION

The a/c low pressure 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.

### OPERATION

The a/c low pressure switch is connected in series electrically with the a/c high pressure switch, between ground and the Powertrain Control Module (PCM). The switch contacts open and close causing the PCM to turn the a/c compressor clutch on and off. This regulates the refrigerant system pressure and controls evaporator temperature. Controlling the evaporator temperature prevents condensate water

A/C LOW PRESSURE SWITCH (Continued)

on the evaporator fins from freezing and obstructing air conditioning system air flow.

The a/c low pressure switch contacts are open when the suction pressure is approximately 141 kPa (20.5 psi) or lower. The switch contacts will close when the suction pressure rises to approximately 234 to 262 kPa (34 to 38 psi) or above. Lower ambient temperatures, below approximately -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 a/c low pressure switch is a factory-calibrated unit. It cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

**DIAGNOSIS AND TESTING - A/C LOW PRESSURE SWITCH**

Before performing diagnosis of the a/c low pressure 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. 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.

Also verify that the refrigerant system has the correct refrigerant charge. (Refer to 24 - HEATING & AIR CONDITIONING - DIAGNOSIS AND TESTING - A/C PERFORMANCE) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS).

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the a/c low pressure switch wire harness connector from the switch on the accumulator fitting.

(3) Install a jumper wire between the two cavities of the a/c low pressure switch wire harness connector.

(4) Connect a manifold gauge set to the refrigerant system service ports. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM SERVICE EQUIPMENT) and (Refer to 24 - HEATING & AIR CONDITIONING - DESCRIPTION - REFRIGERANT SYSTEM SERVICE PORT)

(5) Connect the battery negative cable.

(6) Place the A/C Heater mode control switch knob in any A/C position and start the engine.

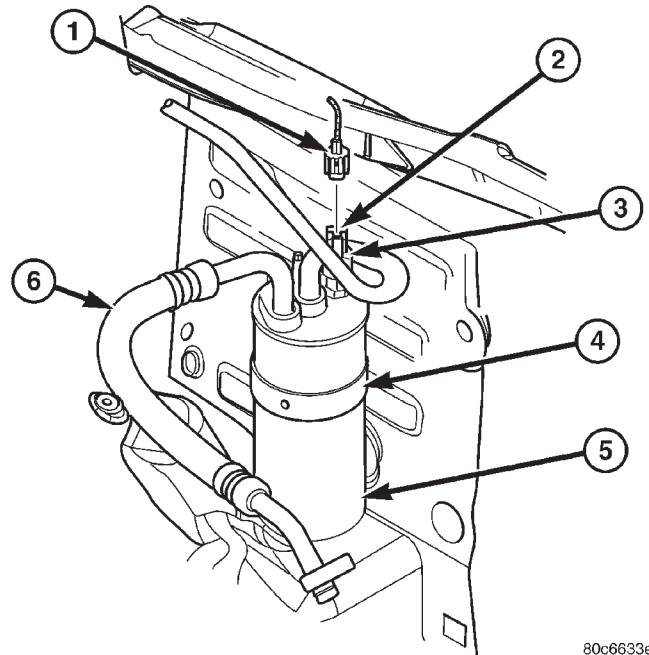
(7) Check for continuity between the two terminals of the a/c low pressure switch. There should be continuity with a suction pressure reading of 262 kPa

(38 psi) or above, and no continuity with a suction pressure reading of 141 kPa (20.5 psi) or below. If OK, test and repair the A/C switch sense circuit as required. If not OK, replace the faulty switch.

**REMOVAL**

(1) Disconnect and isolate the battery negative cable.

(2) Unplug the wire harness connector from the a/c low pressure switch on the top of the accumulator (Fig. 13).



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**Fig. 13 A/C LOW PRESSURE SWITCH**

- 1 - WIRING HARNESS CONNECTOR
- 2 - A/C LOW PRESSURE SWITCH
- 3 - A/C LINE TO EVAPORATOR
- 4 - ACCUMULATOR MOUNTING BRACKET
- 5 - ACCUMULATOR
- 6 - A/C LOW PRESSURE LINE

(3) Unscrew the a/c low pressure 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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

## A/C LOW PRESSURE SWITCH (Continued)

(2) Install and tighten the a/c low pressure switch on the accumulator fitting. The switch should be hand-tightened onto the accumulator fitting.

(3) Plug the wire harness connector into the a/c low pressure switch.

(4) Connect the battery negative cable.

## BLEND DOOR ACTUATOR

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

(2) Remove A/C housing from vehicle(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(3) Remove the screws that secure the blend door actuator to the top of the HVAC housing. (Fig. 14).

(4) Remove the blend door actuator.

## INSTALLATION

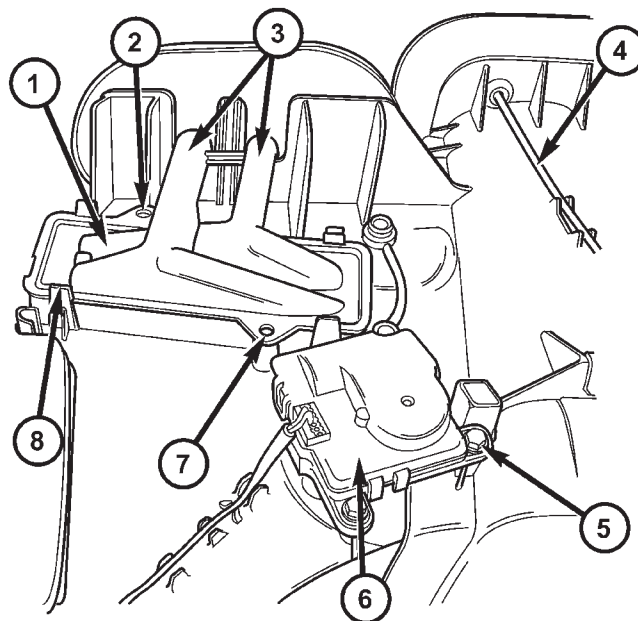
(1) Install the blend door actuator in place.

(2) Install and tighten the screws that secure the blend door actuator to the housing. Tighten the mounting screws to 2.4 ( $\pm$ .34) N·m (21 ( $\pm$ 3) in. lbs.).

(3) Install the HVAC housing into the vehicle(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION).

(4) Install the blend door actuator electrical connector from the wiring harness through the glove box.

(5) Connect the battery negative cable.



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**Fig. 14 HEATER CORE REMOVAL/INSTALLATION**

- 1 - HEATER CORE
- 2- MOUNTING SCREW HOLE
- 3- INLET AND OUTLET TUBES
- 4- VACUUM HARNESS
- 5- ACTUATOR SCREWS (3)
- 6- ELECTRIC BLEND DOOR ACTUATOR
- 7- MOUNTING SCREW HOLE
- 8- HEATER CORE RETAINER TABS (4)

## BLOWER MOTOR RELAY

## DESCRIPTION

The blower motor relay is a International Standards Organization (ISO)-type relay. The relay is an 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. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/BLOWER MOTOR RELAY - DIAGNOSIS AND TESTING)

## OPERATION

The blower motor relay is installed in a wire harness connector that is secured to the passenger side outboard end of the HVAC housing in the passenger compartment, next to the HVAC wire harness connector.

The blower motor relay cannot be repaired and, if faulty or damaged, it must be replaced.

BLOWER MOTOR RELAY (Continued)

**DIAGNOSIS AND TESTING - BLOWER MOTOR RELAY**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**RELAY TEST**

The blower motor relay (Fig. 15) is located in the PDC which is located under the hood.. 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 60.7 to 80.3 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 the Relay Circuit Test. If not OK, replace the faulty relay.

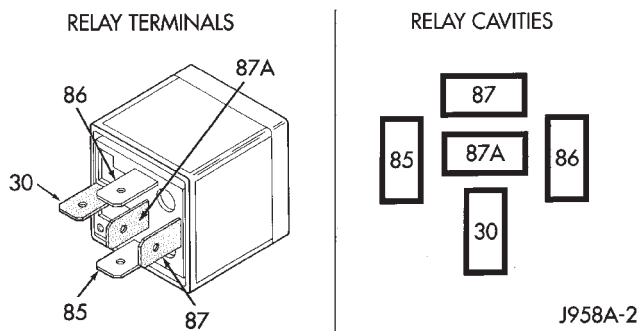
**RELAY CIRCUIT TEST**

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

- (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 connector 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 connector cavity for terminal 87 and the blower motor 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 connector 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 connector cavity for relay terminal 85 and a good ground at all times. If not OK, repair the open circuit as required.

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**



**Fig. 15 BLOWER MOTOR RELAY**

- 30 - COMMON FEED
- 85 - COIL GROUND
- 86 - COIL BATTERY
- 87 - NORMALLY OPEN
- 87A - NORMALLY CLOSED

## BLOWER MOTOR RELAY (Continued)

- (1) Disconnect and isolate the battery negative cable.
- (2) Unplug the blower motor relay from the PDC located under the hood.
- (3) Remove the blower motor relay.

### INSTALLATION

- (1) Install the blower motor relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.
- (2) Connect the battery negative cable.
- (3) Test the relay operation.

## BLOWER MOTOR RESISTOR

### DESCRIPTION

The blower motor resistor is mounted to the rear side of the HVAC housing on the passenger side of the vehicle.

### OPERATION

The resistor is a credit card resistor that utilizes resistor circuit tracers to reduce current flow to the blower. The blower motor switch directs the ground path through the correct resistor circuit to obtain the selected speed.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

### DIAGNOSIS AND TESTING - BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.

- (2) Open the glove box door and reach in and 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 relay as required. If not OK, replace the faulty blower motor resistor.

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.
- (2) Open the glove box door to gain access to the blower motor resistor.
- (3) Pull out the lock on the blower motor resistor wire harness connector to unlock the connector latch.
- (4) Depress the latch on the blower motor resistor wire harness connector and unplug the connector from the resistor.
- (5) Remove the two screws that secure the resistor to the HVAC housing.
- (6) Remove the resistor from the HVAC housing.

### INSTALLATION

- (1) Install the new resistor in the HVAC housing.
- (2) Install the two screws that secure the resistor to the HVAC housing and tighten to 2.2 N·m (20 in. lbs.).
- (3) Plug in the blower motor harness connector.
- (4) Push in the lock on the blower motor resistor harness connector.
- (5) Close the glove box door.
- (6) Connect the battery negative cable.

## BLOWER MOTOR SWITCH

### DESCRIPTION

The heater-only or A/C Heater blower motor is controlled by a four position rotary-type blower motor switch, mounted in the A/C Heater 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-only or A/C Heater mode control switch knob.

### OPERATION

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 A/C Heater control unit must be replaced.

### DIAGNOSIS AND TESTING - BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN 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 A/C Heater control from the instrument panel. Check for continuity between the ground circuit cavity of the A/C Heater 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 A/C Heater control wire harness connector unplugged, place the A/C Heater mode control switch knob in any position except the Off position. Check for continuity between the ground circuit ter-

minal and each of the blower motor driver circuit terminals of the A/C Heater 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 A/C Heater control connector and the blower motor resistor as required. If not OK, replace the faulty A/C Heater control unit.

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

The blower motor switch cannot be repaired and, if faulty or damaged, the entire heater-only or A/C Heater control unit must be replaced. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - REMOVAL)

### INSTALLATION

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) The blower motor switch cannot be repaired and, if faulty or damaged the entire heater-only or A/C heater control unit must be replaced(Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - INSTALLATION).



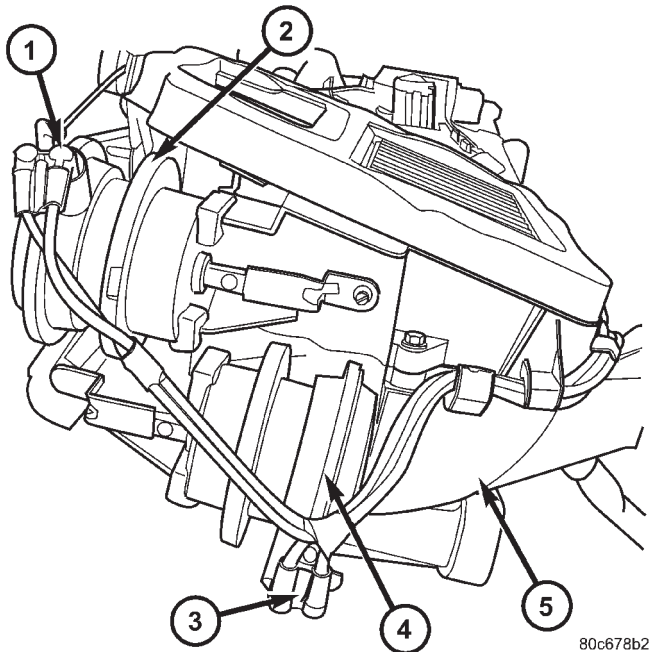
## MODE DOOR ACTUATOR

### REMOVAL

#### REMOVAL - PANEL DOOR ACTUATOR

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the instrument panel assembly from the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).
- (3) Unplug the vacuum harness connector from the defrost door actuator (Fig. 16).



**Fig. 16 HVAC DOOR VACUUM ACTUATORS**

- 1 - VACUUM LINE AND CONNECTOR
- 2 - PANEL DOOR ACTUATOR
- 3 - VACUUM LINE AND CONNECTOR
- 4 - FLOOR-DEFROST DOOR ACTUATOR
- 5 - HVAC ASSEMBLY

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the HVAC housing actuator mount. Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount.

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the defrost door lever.

(6) Remove the defrost door vacuum actuator from the vehicle.

#### REMOVAL - FLOOR - DEFROST DOOR ACTUATOR

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle (Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

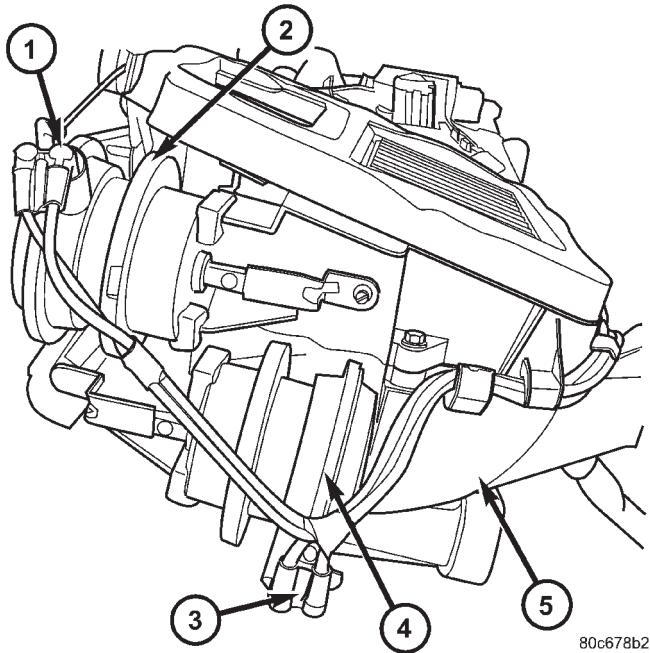
(3) Unplug the vacuum harness connector from the floor door actuator (Fig. 17).

(4) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the HVAC housing actuator mount. Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount. (Fig. 18)

(5) Rotate and tilt the vacuum actuator as required to disengage the hole on the end of the actuator link from the hooked pin on the end of the floor door lever.

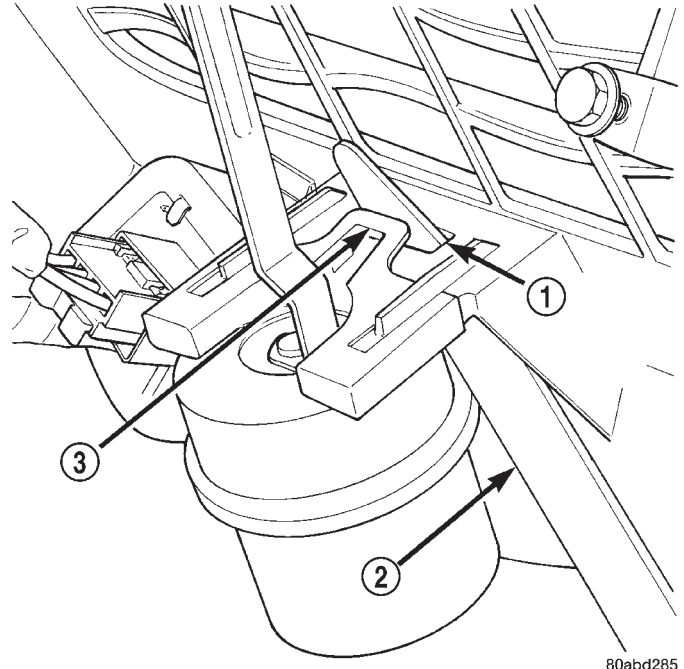
(6) Remove the floor door vacuum actuator from the vehicle.

MODE DOOR ACTUATOR (Continued)



**Fig. 17 HVAC DOOR VACUUM ACTUATORS**

- 1 - VACUUM LINE AND CONNECTOR
- 2 - PANEL DOOR ACTUATOR
- 3 - VACUUM LINE AND CONNECTOR
- 4 - FLOOR-DEFROST DOOR ACTUATOR
- 5 - HVAC ASSEMBLY



**Fig. 18 VACUUM ACTUATOR REMOVE/INSTALL - TYPICAL**

- 1 - ACTUATOR MOUNT LATCH HOLE
- 2 - TRIM STICK
- 3 - ACTUATOR LATCH

INSTALLATION

**INSTALLATION - PANEL DOOR ACTUATOR**

- (1) Install the defrost door vacuum actuator by snapping it into place, engage the hole on the end of the actuator link with the hooked pin on the end of the panel/demist door lever.
- (2) Plug in the vacuum harness connector to the defrost door actuator.
- (3) Install the instrument panel assembly in the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL ASSEMBLY - INSTALLATION).
- (4) Connect the battery negative cable.

**INSTALLATION - FLOOR - DEFROST DOOR ACTUATOR**

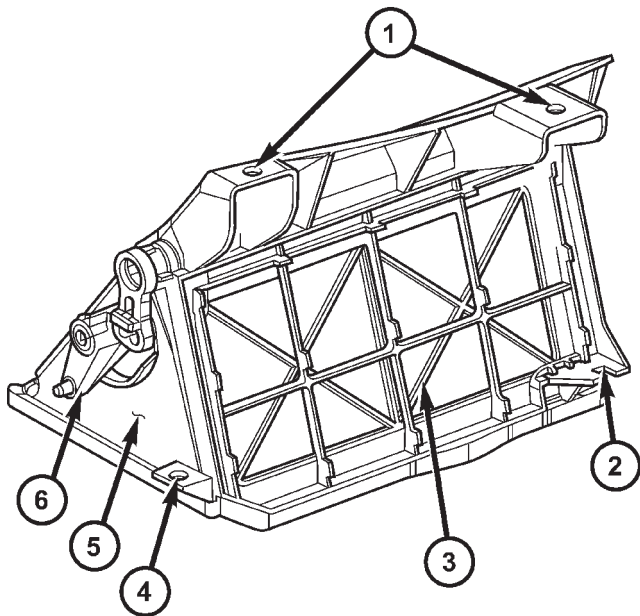
- (1) Engage the hole on the end of the actuator link to the hooked pin. Install the floor-defrost door vacuum actuator to the HVAC assembly. on the end of the floor door lever.
- (2) Install the floor door vacuum actuator to the HVAC assembly.
- (3) Install the instrument panel assembly into the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL ASSEMBLY - INSTALLATION).
- (4) Connect the battery negative cable.

## RECIRCULATION DOOR ACTUATOR

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

- (1) Disconnect and isolate the battery negative cable.
- (2) Unplug the vacuum harness connector from the recirculation door actuator (Fig. 19).



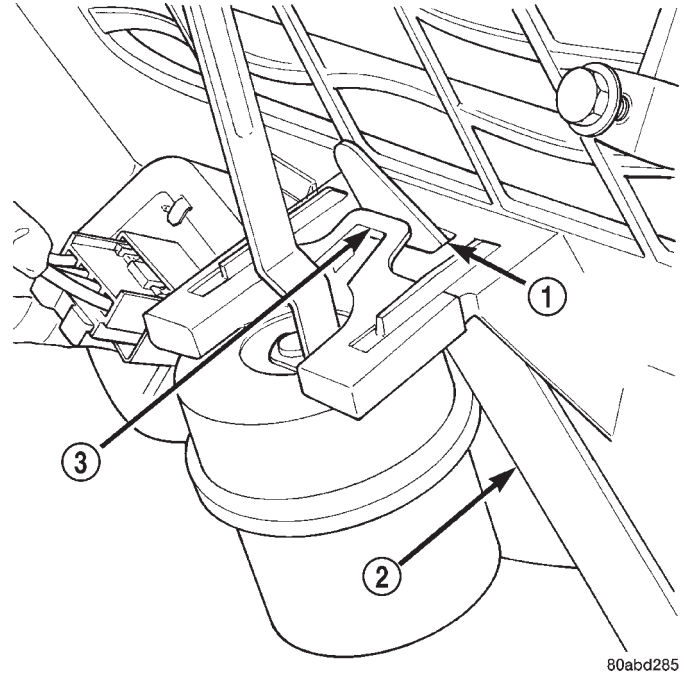
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**Fig. 19 RECIRCULATION DOOR ASSEMBLY**

- 1- INSTRUMENT PANEL ELECTRICAL HARNESS MOUNTING TABS
- 2- MOUNTING TAB
- 3- RECIRCULATION DOOR
- 4- MOUNTING TAB
- 5- RECIRCULATION DOOR ASSEMBLY
- 6- RECIRCULATION DOOR LEVER

(3) Insert a trim stick or another suitable wide flat-bladed tool into the latch hole on the HVAC housing actuator mount (Fig. 20).

(4) Gently pry the actuator latch while pulling firmly outwards on the actuator to remove the actuator from the mount (Fig. 21).



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**Fig. 20 VACUUM ACTUATOR REMOVE/INSTALL - TYPICAL**

- 1 - ACTUATOR MOUNT LATCH HOLE
- 2 - TRIM STICK
- 3 - ACTUATOR LATCH

(5) Disengage the hole on the end of the actuator link from the hooked pin on the end of the recirculation door lever.

(6) Remove the recirculation door vacuum actuator from the vehicle.

### INSTALLATION

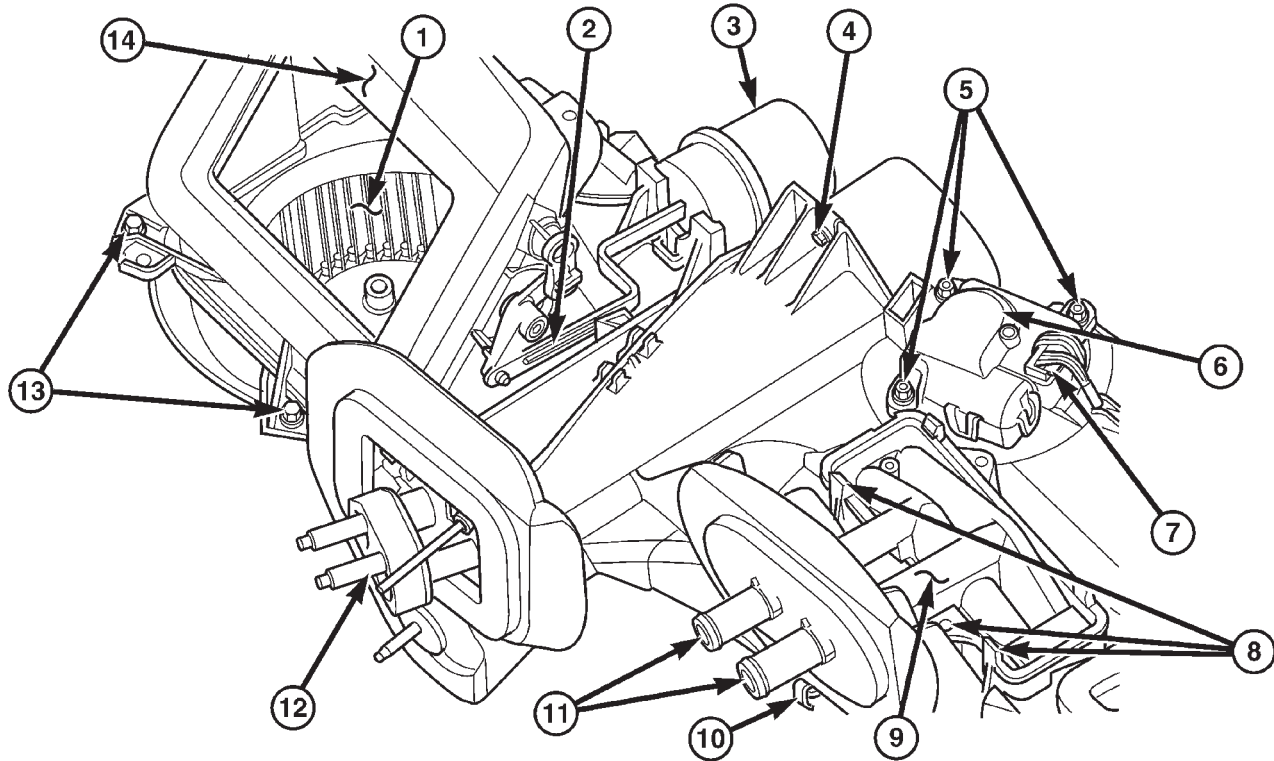
(1) Install the recirculation door vacuum actuator by slipping the arm on to the hole on the end of the actuator link with the hooked pin on the end of the panel/demist door lever.

(2) Snap the actuator back into its mount.

(3) Plug in the vacuum harness connector to the recirculation door actuator.

(4) Connect the battery negative cable.

RECIRCULATION DOOR ACTUATOR (Continued)



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**Fig. 21 HVAC CASE ASSEMBLY**

- |  |   |
|--|---|
| 1 - BLOWER MOTOR AND CAGE                        | 9 - HEATER CORE                               |
| 2 - RECIRCULATION DOOR ACTUATOR LINKAGE          | 10 - HVAC CASE RETAINER CLIP                  |
| 3 - RECIRCULATION DOOR VACUUM ACTUATOR           | 11 - HEATER CORE INPUT AND OUTPUT CONNECTIONS |
| 4 - CASE RETAINER SCREW                          | 12 - EVAPORATOR CONNECTION FLANGE             |
| 5 - BLEND DOOR ACTUATOR MOUNTING SCREWS          | 13 - HVAC CASE RETAINER SCREWS                |
| 6 - ELECTRIC BLEND DOOR ACTUATOR                 | 14 - HVAC HOUSING                             |
| 7 - ELECTRICAL CONNECTOR FOR BLEND DOOR ACTUATOR |   |
| 8 - HEATER CORE RETAINER TABS (4) AND SCREWS (2) |   |

## VACUUM CHECK VALVE

### DESCRIPTION

A vacuum check valve is installed in the accessory vacuum supply line in the engine compartment, near the vacuum tap on the engine intake manifold, and at the HVAC unit takeout. The vacuum check valve is designed to allow vacuum to flow in only one direction through the accessory vacuum supply circuits.

### OPERATION

The use of a vacuum check valve helps to maintain the system vacuum needed to retain the selected A/C Heater mode settings. The check valve will prevent the engine from bleeding down system vacuum through the intake manifold during extended heavy engine load (low engine vacuum) operation.

The vacuum check valve cannot be repaired and, if faulty or damaged, it must be replaced.

### REMOVAL

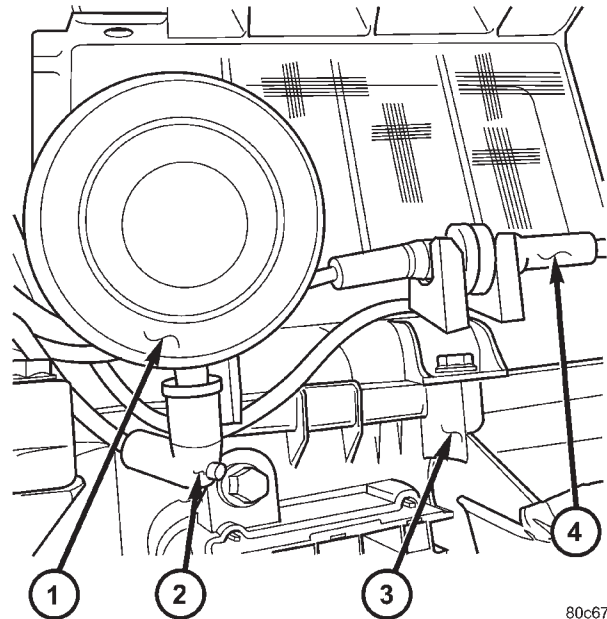
(1) Unplug the HVAC vacuum supply line connector at the vacuum check valve. The check valve is located behind the glove box on the passengers side of the vehicle (Fig. 22).

(2) Note the orientation of the check valve in the vacuum supply line for correct reinstallation.

(3) Unplug the vacuum check valve from the vacuum supply line fittings.

### INSTALLATION

(1) Plug in the vacuum check valve at the vacuum supply line fittings making sure of proper orientation.



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**Fig. 22 RECIRCULATION ACTUATOR AND CHECK VALVE**

- 1 - RECIRCULATION ACTUATOR
- 2 - VACUUM LINE TO RESEVOIR
- 3 - HVAC HOUSING
- 4 - VACUUM CHECK VALVE

(2) Plug in the vacuum check valve at the HVAC vacuum supply line connector.

# DISTRIBUTION

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## AIR OUTLETS

### DESCRIPTION - DEMISTER OUTLETS

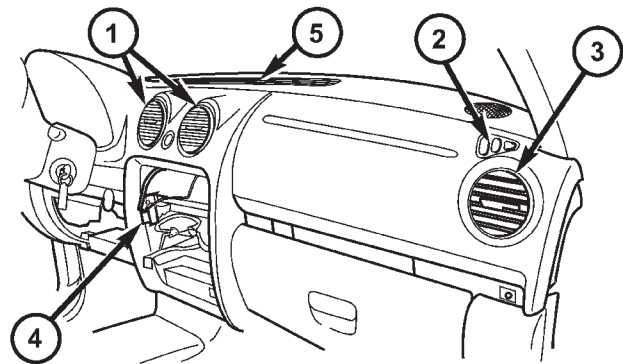
The side window demister outlets are integral to the instrument panel end caps(Refer to 23 - BODY/ INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL) and (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL END CAP - REMOVAL).

### REMOVAL - PANEL OUTLET BARRELS

(1) Use a trim stick or another suitable wide flat-bladed tool to gently pry the panel outlet barrels out of the panel outlet housing (Fig. 1). The barrel is retained by a light snap fit.

### INSTALLATION - PANEL OUTLET BARRELS

To install, position the barrel in the panel outlet housing and press firmly until the barrel snaps into place.



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**Fig. 1 DASH PANEL OUTLETS**

- 1 - CENTER OUTLETS
- 2 - SIDE WINDOW DEMISTER OUTLETS
- 3 - SIDE OUTLETS
- 4 - WIRING FOR HVAC CONTROL ASSEMBLY
- 5 - WINDSHIELD DEFROSTER OUTLET

## BLOWER MOTOR

### DESCRIPTION

The blower motor and blower wheel are located in the passenger side end of the HVAC housing, below the glove box. The blower motor controls the velocity of air flowing through the HVAC housing by spinning a squirrel cage-type blower wheel within the housing at the selected speed. The blower motor and wheel can be removed from the housing inside the vehicle without removing the dash or HVAC housing assembly.

### OPERATION

The blower motor will only operate when the ignition switch is in the On position, and the A/C Heater 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). Blower motor speed is controlled by regulating the ground path through the A/C Heater control blower motor switch and the blower motor resistor.

The blower motor and blower motor wheel cannot be repaired and, if faulty or damaged, they must be replaced. The blower motor and blower wheel are serviced only as a unit.

### DIAGNOSIS AND TESTING - BLOWER MOTOR

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). 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 A/C Heater mode control switch
- Faulty blower motor.

Possible causes of the blower motor not operating in all speeds include:

- Faulty blower motor switch
- Faulty blower motor resistor
- 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 bent
- Blower motor faulty.

### NOISE

To verify that the blower is the source of the noise, unplug the blower motor wire harness connector and operate the HVAC system. If the noise goes away, possible causes include:

- Foreign material in the HVAC housing
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower motor faulty.

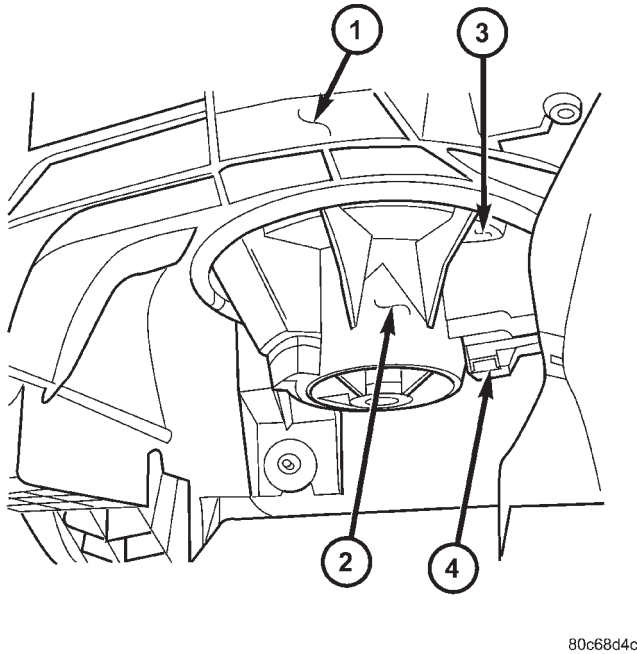
### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**BLOWER MOTOR (Continued)**

The blower motor is located on the passenger side of the vehicle under the dash

- (1) Disconnect and isolate the battery negative cable.
- (2) Unplug the blower motor wire harness connector (Fig. 2).



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**Fig. 2 HVAC BLOWER MOTOR**

- 1 - HVAC HOUSING
- 2 - BLOWER MOTOR
- 3 - RETAINER-LOCKING TAB
- 4 - BLOWER MOTOR ELECTRICAL CONNECTOR

- (3) Release the locking tab that secures the blower motor and wheel assembly to the HVAC housing.
- (4) Rotate and tilt the blower motor unit as needed for clearance to remove the blower motor and wheel from the HVAC housing.

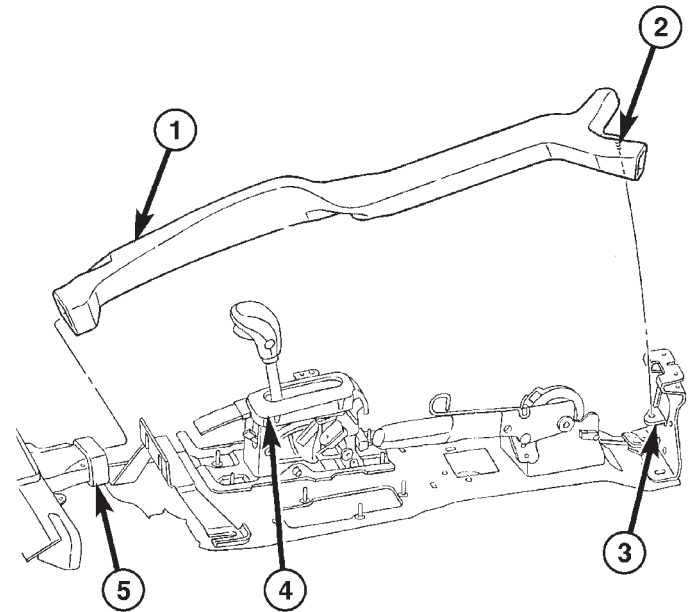
**INSTALLATION**

- (1) Align and install the blower motor and wheel assembly into the HVAC housing.
- (2) Rotate the blower assembly until the locking tab secures the blower motor and wheel assembly to the HVAC housing.
- (3) Plug in the blower motor wire harness connector.
- (4) Connect the battery negative cable.

**FLOOR CONSOLE DUCT**

**REMOVAL**

- (1) Disconnect and isolate the battery negative cable.
- (2) Remove the floor console from the sled (Fig. 3). Refer to Floor Console for the procedures(Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).



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**Fig. 3 CONSOLE DUCT REMOVE/INSTALL**

- 1 - REAR DUCT ASSEMBLY
- 2 - REAR DUCT RETAINER SCREW
- 3 - REAR DUCT MOUNTING FLANGE
- 4 - TRANSMISSION SHIFT LEVER ASSEMBLY
- 5 - FRONT TO REAR DUCT CONNECTING POINT

- (3) Lift the rear of the console duct out of the console rear mounting bracket on the sled and slide the duct rearward to disengage it from the floor duct and adapter.
- (4) Remove the console rear duct from the vehicle.

**INSTALLATION**

- (1) Push the console duct forward in place on the HVAC floor duct.
- (2) Align the rear tab of the console duct with the hole on the sled bracket.
- (3) Insert the push pin in the hole on the sled.
- (4) Install the floor console on the floor panel transmission tunnel(Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).
- (5) Connect the battery negative cable.



## FLOOR DUCT

### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the instrument panel from the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

(2) Remove the three screws that secure the floor duct to the HVAC housing.

(3) Remove the floor duct from the HVAC housing.

### INSTALLATION

(1) Install the floor duct on the HVAC housing.

(2) Install the three screws that secure the floor duct to the HVAC housing. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

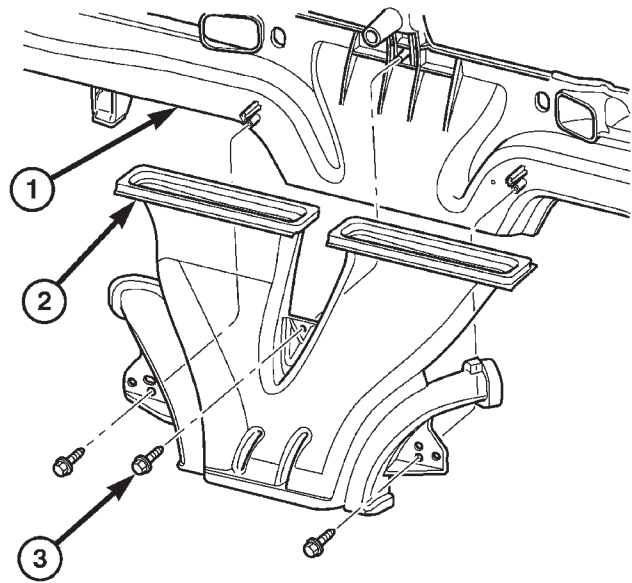
(3) Install the instrument panel in the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

## DEFROST - DEMISTER DUCT

### REMOVAL - DEFROST DUCT/DEMISTER ADAPTOR

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Remove the instrument panel assembly from the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).



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**Fig. 4 DEFROST/DEMISTER DUCT**

1 - INSTRUMENT PANEL

2 - DEFROST DUCT/ DEMISTER ADAPTOR

3 - SCREW

(2) Remove the three screws that secure the defrost duct/demister adaptor to the instrument panel (Fig. 4).

(3) Remove the defrost duct/demister duct from the instrument panel.

### INSTALLATION - DEFROST/DEMISTER DUCT

(1) Install the defrost/demister duct in the instrument panel.

(2) Install the three screws that secure the defrost/demister duct to the instrument panel.

(3) Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(4) Install the instrument panel assembly in the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

# HVAC HOUSING

## REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

(1) Disconnect and isolate the battery negative cable.

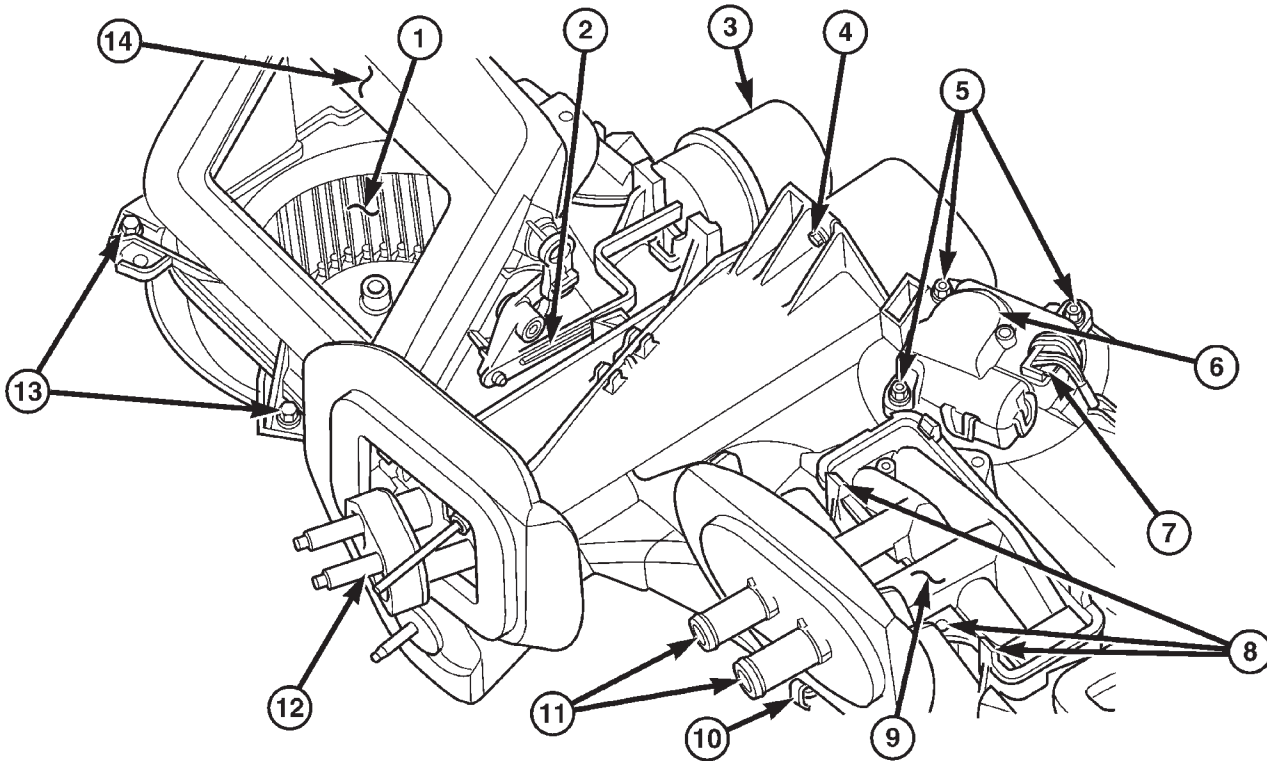
(2) Remove the instrument panel from the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

(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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube (Fig. 5). (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(5) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Drain the engine cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).



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**Fig. 5 HVAC CASE ASSEMBLY**

- |  |   |
|--|---|
| 1 - BLOWER MOTOR AND CAGE                        | 9 - HEATER CORE                               |
| 2 - RECIRCULATION DOOR ACTUATOR LINKAGE          | 10 - HVAC CASE RETAINER CLIP                  |
| 3 - RECIRCULATION DOOR VACUUM ACTUATOR           | 11 - HEATER CORE INPUT AND OUTPUT CONNECTIONS |
| 4 - CASE RETAINER SCREW                          | 12 - EVAPORATOR CONNECTION FLANGE             |
| 5 - BLEND DOOR ACTUATOR MOUNTING SCREWS          | 13 - HVAC CASE RETAINER SCREWS                |
| 6 - ELECTRIC BLEND DOOR ACTUATOR                 | 14 - HVAC HOUSING                             |
| 7 - ELECTRICAL CONNECTOR FOR BLEND DOOR ACTUATOR |   |
| 8 - HEATER CORE RETAINER TABS (4) AND SCREWS (2) |   |

## HVAC HOUSING (Continued)

(7) Disconnect the heater hoses from the heater core tubes. Install plugs in, or tape over the opened heater core tubes.

(8) Unplug the HVAC system vacuum supply line connector from the engine side harness.

(9) Remove the nuts from the HVAC housing mounting studs.

(10) Remove the HVAC housing from inside the vehicle taking care not to allow any remaining coolant to drain on the vehicles interior.

**DISASSEMBLY**

(1) Remove the HVAC housing from the vehicle and place it on the workbench. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL)

(2) Unplug the vacuum harness connectors from the mode and recirculation door actuators and the recirculation door actuator.

(3) Disengage the vacuum harness from any routing clips located on the lower half of the HVAC housing.

(4) Remove the blower motor and blower wheel unit from the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/BLOWER MOTOR - REMOVAL)

(5) Pop out the grommet on the vacuum supply line and slide hole in housing.

(6) Carefully remove the foam seals from the heater core and evaporator coil tube mounting flange of the HVAC housing. If the either seal is deformed or damaged it must be replaced.

(7) Use a screwdriver to pry off the four snap clips that help secure the upper and lower HVAC housing halves together.

(8) Remove the screws that secure the upper and lower HVAC housing halves together.

(9) Carefully separate the upper HVAC housing from the lower half.

**ASSEMBLY**

(1) Assemble the upper HVAC housing half to the lower half. During assembly, be certain of the following.

(a) That each of the mode door pivot shaft ends and the two temperature blend door shafts are properly engaged in there pivot holes.

(b) That the blower motor venturi ring is properly indexed and installed.

(c) If the unit is equipped with air conditioning, that the evaporator coil tube rubber seal is properly positioned in the grooves in both the upper and lower HVAC housing halves.

(2) Install the screws and four snap clips that secure the upper and lower HVAC housing halves to

each other. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the blower motor and wheel unit in the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/BLOWER MOTOR - INSTALLATION)

(4) Install the foam seals on the flanges around the heater core and evaporator coil tube mounting flange of the HVAC housing.

(5) Insert the vacuum supply line and connector through the foam seal on the heater core and evaporator coil tube mounting flange of the HVAC housing. Check that the vacuum grommet is securely seated into the housing hole flange.

(6) Engage the vacuum harness to the routing clips and plug in the vacuum harness connector at the floor door actuator and, if the unit is so equipped, at the recirculation air door actuator.

**INSTALLATION**

**WARNING: IF THE VEHICLE IS EQUIPPED WITH AIR CONDITIONING, REVIEW THE WARNINGS AND CAUTIONS IN PLUMBING BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

(1) Position the HVAC 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 and tighten the nuts onto the HVAC housing mounting studs. Tighten the nuts to 6.2 N·m (55 in.lbs.).

(3) Connect the HVAC system vacuum supply line connector.

(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 7 - COOLING/ENGINE - STANDARD PROCEDURE).

(5) If the vehicle is not equipped with air conditioning, go to Step 10.

(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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(7) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING -

HVAC HOUSING (Continued)

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(8) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

(9) Install the instrument panel in the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

(10) Connect the battery negative cable.

(11) Start the engine and check for proper operation of the heating and air conditioning systems.

BLEND DOOR

REMOVAL

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(1) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

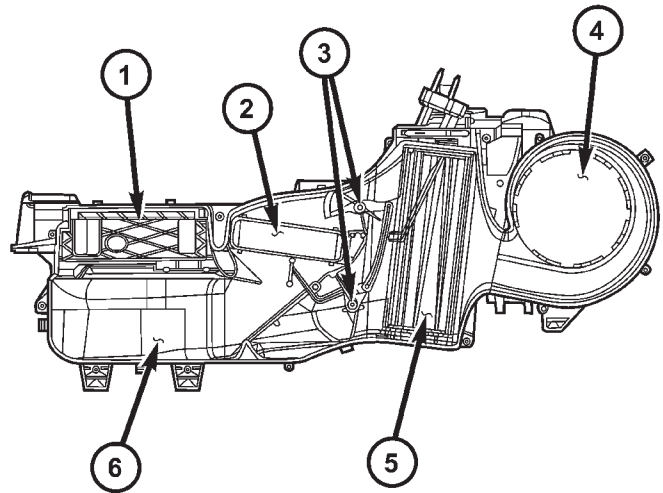
(2) Lift the blend door pivot shaft out of the pivot hole in the bottom of the lower half of the HVAC housing (Fig. 6).

INSTALLATION

(1) Place the blend door pivot shaft in of the pivot hole in the bottom of the lower half of the HVAC housing.

(2) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY)

(3) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)



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*Fig. 6 Blend Door*

- 1 - DEFROSTER DOOR
- 2- HEATER CORE
- 3- BLEND DOORS
- 4- BLOWER MOTOR HOUSING
- 5- EVAPORATOR (A/C ONLY)
- 6- LOWER HVAC CASE ASSEMBLY

MODE DOOR

REMOVAL

REMOVAL - DEFROST DOOR

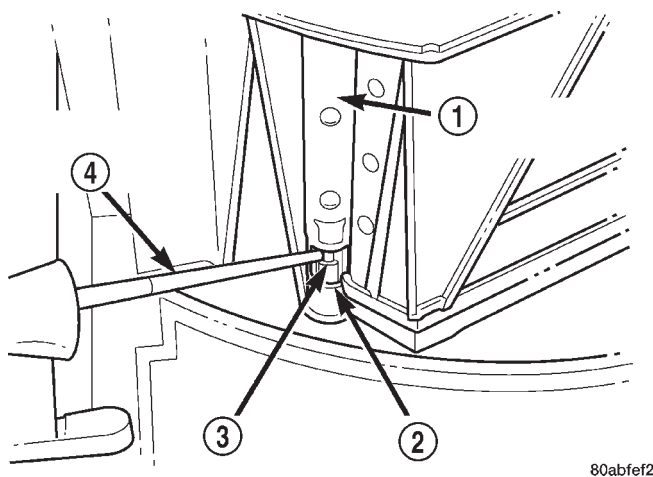
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## MODE DOOR (Continued)

**WARNING:** (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

(1) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(2) Insert a screwdriver into the latch hole (Fig. 7) of the panel door pivot shaft to release the latch of the panel door lever, and pull the lever out of the pivot shaft from the outside of the upper half of the HVAC housing.



**Fig. 7 PANEL DOOR REMOVE/INSTALL**

- 1 - DOOR PIVOT SHAFT
- 2 - LATCH HOLE
- 3 - CRANK ARM LATCH
- 4 - FLAT BLADE PRY TOOL

(3) Remove the defrost door from the HVAC housing.

## REMOVAL - FLOOR - DEFROST DOOR

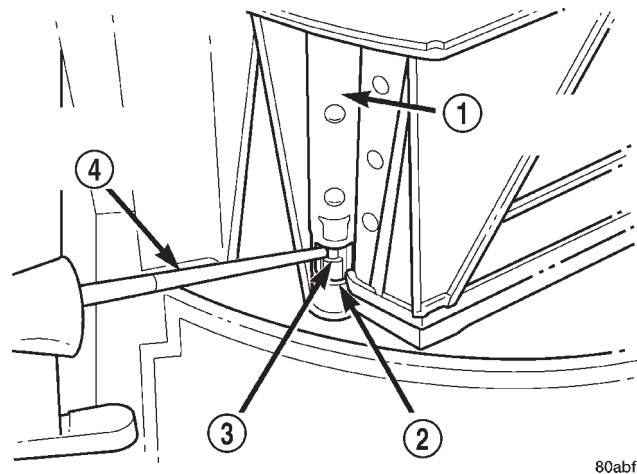
**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING:** (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

(1) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(2) Remove the floor door vacuum actuator from the lower HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/MODE DOOR ACTUATOR - REMOVAL - FLOOR DOOR ACTUATOR)

(3) Insert a screwdriver into the latch hole (Fig. 8) of the floor door pivot shaft to release the latch of the floor door lever, and pull the lever out of the pivot shaft from the outside of the lower half of the HVAC housing.



**Fig. 8 FLOOR DOOR REMOVE/INSTALL (typical)**

- 1 - DOOR PIVOT SHAFT
- 2 - LATCH HOLE
- 3 - CRANK ARM LATCH
- 4 - FLAT BLADE PRY TOOL

(4) Reach inside the lower half of the HVAC housing and carefully flex the floor door (Fig. 9) enough so that the door pivot clears the pivot hole in the housing.

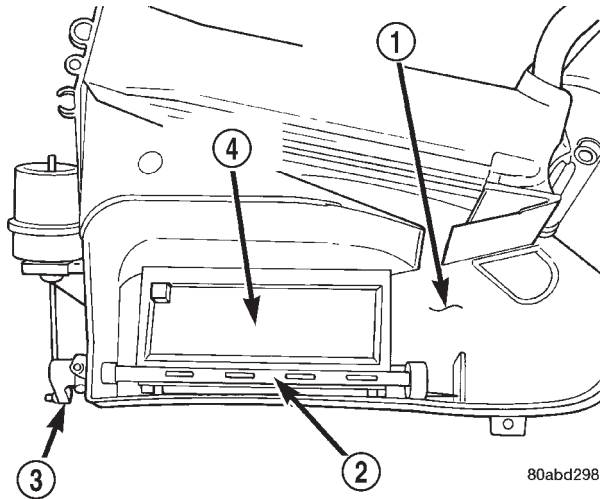
(5) Remove the floor door from the HVAC housing.

## INSTALLATION

### INSTALLATION - PANEL DOOR

- (1) Install the panel door in the HVAC housing.
- (2) Snap the panel door pivot shaft over the latch of the panel door lever.
- (3) Attach the demist door and lever to the upper HVAC housing. (Refer to 24 - HEATING & AIR CON-

MODE DOOR (Continued)



**Fig. 9 FLOOR DOOR (typical)**

- 1 - LOWER HVAC HOUSING
- 2 - PIVOT SHAFT
- 3 - CRANK ARM
- 4 - FLOOR DOOR

CONDITIONING/DISTRIBUTION/MODE DOOR - INSTALLATION - PANEL/DEMIST DOOR)

- (4) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY)
- (5) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

**INSTALLATION - FLOOR - DEFROST DOOR**

- (1) Install the floor-defrost door in the HVAC housing by placing the door in the lower housing.
- (2) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY)
- (3) Install the floor door vacuum actuator in the lower HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/MODE DOOR ACTUATOR - INSTALLATION - FLOOR DOOR ACTUATOR)
- (4) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

**RECIRC DOOR**

**REMOVAL**

A recirculation door and vacuum actuator are used only on models with the optional air conditioning system.

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE**

**ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: IF THE VEHICLE IS EQUIPPED WITH AIR CONDITIONING, REVIEW THE WARNINGS AND CAUTIONS IN PLUMBING BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

- (1) Remove the HVAC housing and disassemble. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)
- (2) Remove the four screws to remove the recirculation door assembly. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/RECIRCULATION DOOR ACTUATOR - REMOVAL)
- (3) Insert a screwdriver into the latch hole of the panel door pivot shaft to release the latch of the panel door lever and pull the lever out of the pivot shaft from the outside of the upper half of the HVAC housing.

**INSTALLATION**

- (1) Guide the recirculation door lever through the air intake grille of the HVAC housing while installing the door in the housing.
- (2) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY)
- (3) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)
- (4) Install the recirculation door vacuum actuator on the lower HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/RECIRCULATION DOOR ACTUATOR - INSTALLATION)

# PLUMBING

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## PLUMBING

### DESCRIPTION - 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, which is sandwiched between rubber layers, is used for the R-134a air conditioning system on this vehicle. This nylon tube 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 or steel, and commonly 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.

## PLUMBING (Continued)

In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from an exhaust manifold.

## WARNING

## SERVICE WARNINGS

**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

## SERVICE CAUTIONS

**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.**

**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.**



## PLUMBING (Continued)

**CAUTION - 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.

**STANDARD PROCEDURE****STANDARD PROCEDURE - REFRIGERANT  
SYSTEM SERVICE EQUIPMENT**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

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 proper care and use of this equipment.

A manifold gauge set may be needed with some recovery/recycling/charging equipment (Fig. 1). 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**

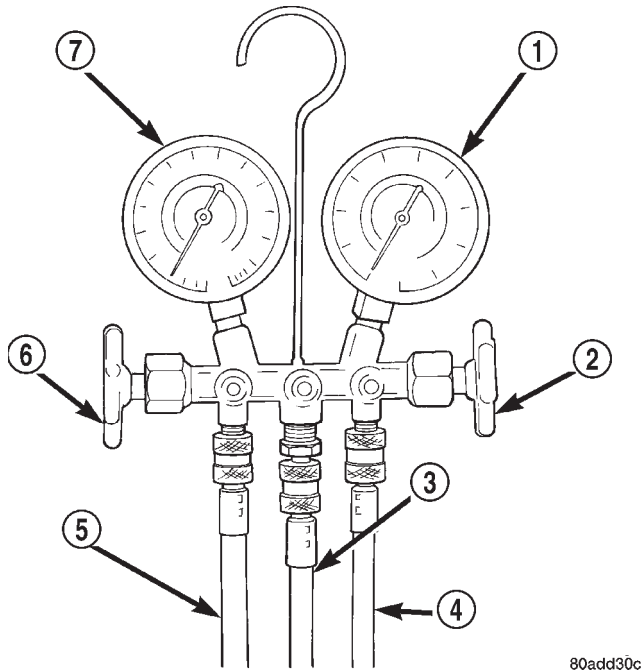
**CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.**

**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 between the accumulator outlet and the compressor.

**HIGH PRESSURE GAUGE HOSE** The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the discharge line between the compressor and the condenser inlet.

**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.

PLUMBING (Continued)



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**Fig. 1 MANIFOLD GAUGE SET - TYPICAL**

- 1 - HIGH PRESSURE GAUGE
- 2 - VALVE
- 3 - VACUUM/REFRIGERANT HOSE (YELLOW W/ BLACK STRIPE)
- 4 - HIGH PRESSURE HOSE (RED W/ BLACK STRIPE)
- 5 - LOW PRESSURE HOSE (BLUE W/ BLACK STRIPE)
- 6 - VALVE
- 7 - LOW PRESSURE GAUGE

**STANDARD PROCEDURE - REFRIGERANT RECOVERY**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

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.

**STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/**

**PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS)

(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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

**STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY)

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be

## PLUMBING (Continued)

used to charge the refrigerant system with R-134a refrigerant. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

### SPECIFICATIONS - CHARGE CAPACITY

The R-134a refrigerant system charge capacity for this vehicle is 0.737 kilograms (1.63 pounds).

## A/C COMPRESSOR

### DESCRIPTION

#### DESCRIPTION

The air conditioning system uses a Sanden PXF-18, reciprocating swash plate-type compressor on all models. This compressor has a fixed displacement of 180 cubic centimeters (10.984 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.

#### DESCRIPTION - HIGH PRESSURE RELIEF VALVE

A high pressure relief valve is located on the compressor cylinder head, which is on 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.

### OPERATION

#### OPERATION

The compressor is driven by the engine through an electric clutch, drive rotor 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.

### OPERATION - HIGH PRESSURE RELIEF VALVE

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 when 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 that 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.

### DIAGNOSIS AND TESTING - A/C COMPRESSOR NOISE

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 Cooling 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 rotor are properly aligned and have the correct air gap. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C COMPRESSOR CLUTCH - INSTALLATION)

A/C COMPRESSOR (Continued)

(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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(5) If the noise is from opening and closing of the high pressure relief valve, evacuate and recharge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE) 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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/ACCUMULATOR - REMOVAL) Check the refrigerant oil level and the refrigerant system charge. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - STANDARD PROCEDURE) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY) If the liquid slugging condition continues following accumulator replacement, replace the compressor. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL)

(7) If the noise continues, replace the compressor and repeat Step 1.

**REMOVAL**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

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.

(1) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

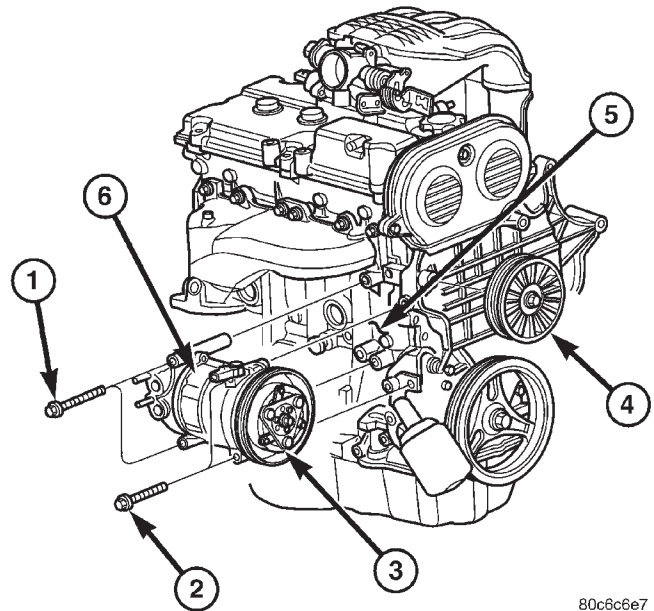
(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Unplug the compressor clutch coil wire harness connector.

(5) Remove the suction and discharge refrigerant line manifold from the compressor. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C DISCHARGE LINE - REMOVAL) Install plugs in, or tape over all of the opened refrigerant fittings.

(6) Remove the bolts that secure the compressor to the mounting bracket (Fig. 2) or (Fig. 3) or (Fig. 4).



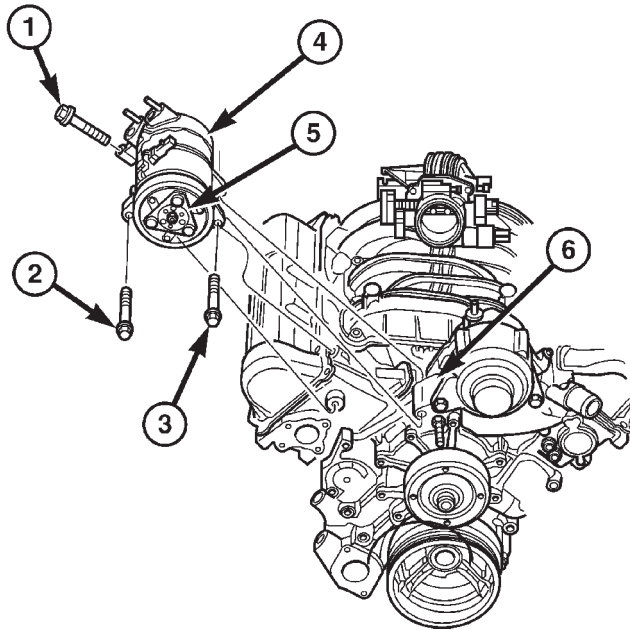
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**Fig. 2 A/C COMPRESSOR - 2.4L ENGINE**

- 1 - COMPRESSOR BOLT
- 2 - COMPRESSOR BOLT
- 3 - COMPRESSOR CLUTCH AND PULLEY
- 4 - IDLER PULLEY
- 5 - ENGINE BLOCK
- 6 - A/C COMPRESSOR

(7) Remove the compressor from the mounting bracket.

## A/C COMPRESSOR (Continued)



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**Fig. 3 A/C COMPRESSOR - 3.7L ENGINE**

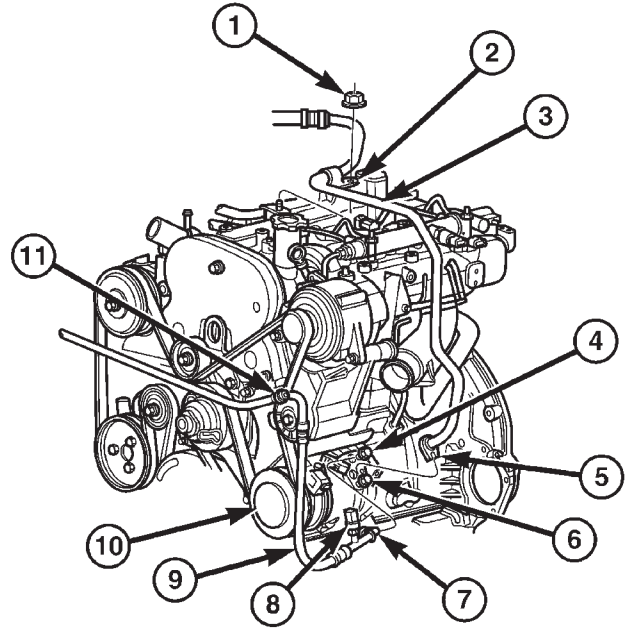
- 1 - COMPRESSOR BOLT #1
- 2 - COMPRESSOR BOLT #2
- 3 - COMPRESSOR BOLT #3
- 4 - A/C COMPRESSOR
- 5 - A/C COMPRESSOR CLUTCH AND PULLEY
- 6 - COMPRESSOR MOUNT

**INSTALLATION**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

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.

**NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - STANDARD PROCEDURE - REFRIGERANT OIL LEVEL) Use only refrigerant oil of the type recommended for the compressor in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)**



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**Fig. 4 A/C COMPRESSOR - 2.5L DIESEL ENGINE**

- 1 - SUCTION LINE MOUNTING NUT
- 2- SUCTION LINE MOUNTING CLIP
- 3- SUCTION LINE
- 4- MOUNTING SCREW FOR SUCTION LINE
- 5- SUCTION LINE MOUNTING FLANG
- 6- MOUNTING SCREW FOR DISCHARGE LINE
- 7- DISCHARGE LINE MOUNTING FLANG
- 8- A/C PRESSURE SENSOR
- 9- A/C DISCHARGE LINE
- 10- A/C COMPRESSOR ASSEMBLY
- 11- A/C DISCHARGE LINE SERVICE PORT

(1) Install the compressor to the mounting bracket. Tighten the three mounting bolts to 27 N·m (20 ft. lbs.), (2.4L gasoline and 2.5L diesel engines only).

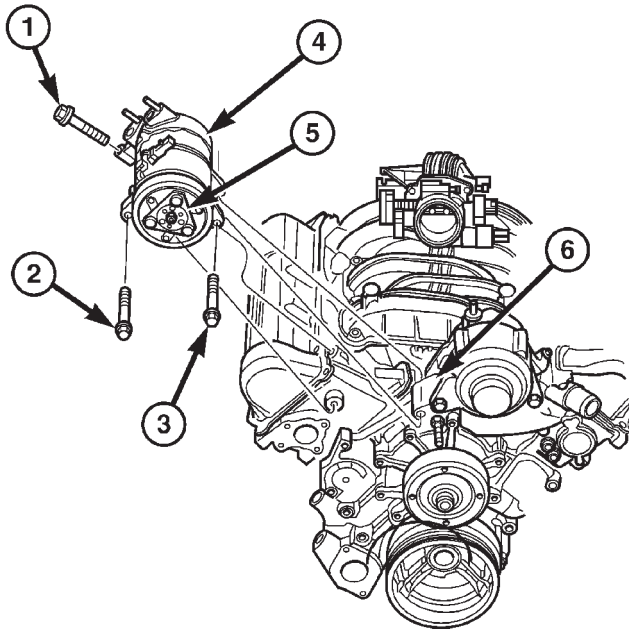
(2) On the 3.7L gasoline engine install and tighten the bolts in the following sequence (Fig. 5):

- The number one bolt (rear) is hand tightened first then tightened to 55 N·m (41 ft. lbs.)
- The number three bolt is then hand tightened and torqued to 40 N·m ( 30 ft. lbs.)
- The number two bolt is also hand tightened and torqued to 55 N·m ( 41 ft. lbs.)

(3) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor. Tighten the fastener to 28 N·m (250 in. lbs.).(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - INSTALLATION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C DISCHARGE LINE - INSTALLATION)

(4) Install the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

## A/C COMPRESSOR (Continued)



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**Fig. 5 A/C COMPRESSOR - 3.7L ENGINE**

- 1 - COMPRESSOR BOLT #1
- 2 - COMPRESSOR BOLT #2
- 3 - COMPRESSOR BOLT #3
- 4 - A/C COMPRESSOR
- 5 - A/C COMPRESSOR CLUTCH AND PULLEY
- 6 - COMPRESSOR MOUNT

(5) Plug in the compressor clutch coil wire harness connector.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(8) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

## A/C CONDENSER

### DESCRIPTION

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.

### OPERATION

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 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.

### REMOVAL

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Disconnect the discharge line refrigerant line fitting at the condenser inlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disconnect the liquid line (Left-Hand Drive) or liquid line jumper (Right-Hand Drive) refrigerant line fitting at the condenser outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

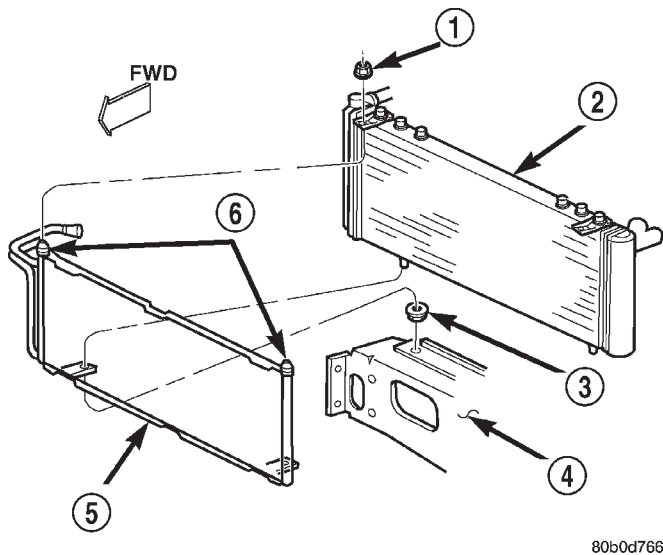
(5) Remove the radiator and the condenser from the vehicle as a unit. Refer to Cooling for the procedures.

(6) Remove the two nuts that secure the condenser studs to the upper brackets of the radiator (Fig. 6).

(7) Slide the condenser down from the radiator far enough for the condenser studs to clear the upper radiator bracket holes, and for the lower condenser bracket holes to clear the dowel pins on the bottom of the radiator.

(8) Remove the condenser from the radiator.

## A/C CONDENSER (Continued)



**Fig. 6 CONDENSER REMOVE/INSTALL**

- 1 - NUT
- 2 - RADIATOR
- 3 - GROMMET
- 4 - LOWER CROSSMEMBER
- 5 - CONDENSER
- 6 - STUDS

## INSTALLATION

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

- (1) Install the holes of the condenser lower brackets over the dowel pins on the bottom of the radiator.
- (2) Slide the condenser upwards until both of the condenser studs are installed through the holes in the radiator upper brackets. Tighten the mounting nuts to 5.3 N·m (47 in. lbs.).
- (3) Reinstall the radiator and condenser unit in the vehicle (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).
- (4) Remove the tape or plugs from the refrigerant line fittings on the condenser outlet and the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive). Install the liquid line or the liquid line jumper to the condenser outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)
- (5) Remove the tape or plugs from the refrigerant line fittings on the condenser inlet and the discharge

line. Connect the discharge line to the condenser inlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

- (6) Connect the battery negative cable.
- (7) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)
- (8) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

**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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)**

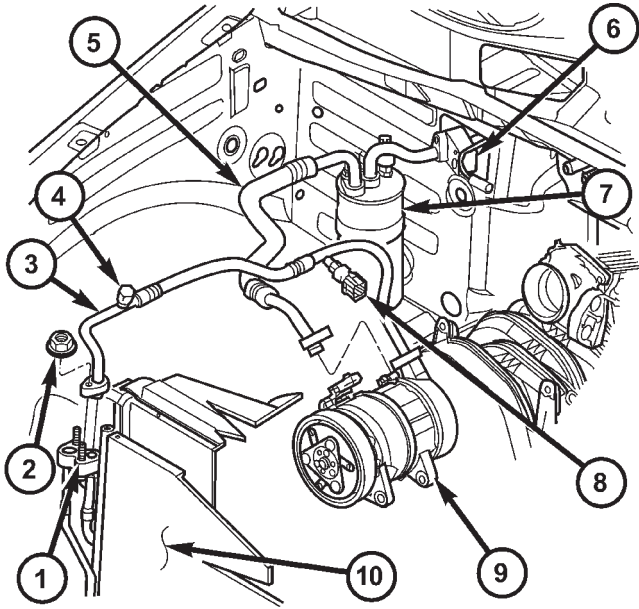
## A/C DISCHARGE LINE

### REMOVAL

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

- (1) Disconnect and isolate the battery negative cable.
- (2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)
- (3) Unplug the wire harness connector from the high pressure cut-off switch.
- (4) Disconnect the discharge line refrigerant line fitting from the condenser inlet tube (Fig. 7). (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.
- (5) Remove the nut that secures the suction line block fitting to the accumulator outlet. Install plugs in, or tape over all of the opened refrigerant line fittings.
- (6) Remove the screw that secures the suction and discharge line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

A/C DISCHARGE LINE (Continued)



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**Fig. 7 SUCTION AND DISCHARGE LINE REMOVAL**

- 1 - Condenser connection
- 2 - Discharge line to condenser mounting nut
- 3 - Discharge line
- 4 - Discharge line charging port
- 5 - Suction line
- 6 - Evaporator mounting ports
- 7 - Accumulator
- 8 - High pressure cut off switch
- 9 - AC compressor
- 10 - AC condenser

(7) Remove the suction and discharge line assembly from the vehicle.

**INSTALLATION**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

- (1) Remove the tape or plugs from the suction and discharge line manifold and the compressor. Install the suction and discharge line manifold to the compressor. Tighten the fastener to 28 N·m (250 in. lbs.).
- (2) Remove the tape or plugs from the suction line and the accumulator outlet block fittings. Install the suction line to the accumulator outlet and tighten the mounting nut to 9 N·m (80 in. lbs.).

(3) Remove the tape or plugs from the refrigerant line fittings on the discharge line and the condenser inlet tube. Connect the discharge line refrigerant line coupler to the condenser inlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(4) Plug in the wire harness connector to the high pressure cut-off switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

**A/C LIQUID LINE**

**REMOVAL**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Disconnect the liquid line refrigerant line couplers at the evaporator inlet and the condenser outlet (Fig. 8). (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Remove the liquid line from the vehicle.

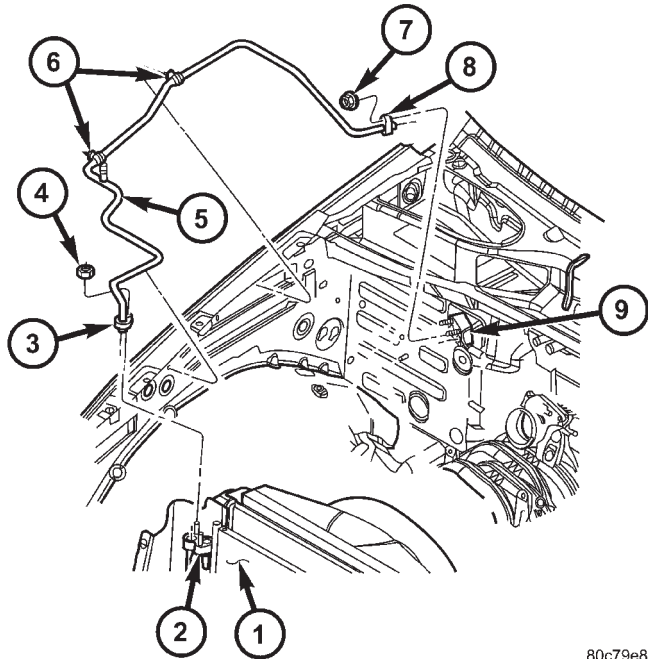
**INSTALLATION**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

(1) Remove the tape or plugs from the refrigerant line fittings on the liquid line, the evaporator inlet



## A/C LIQUID LINE (Continued)



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**Fig. 8 LIQUID LINE REMOVE/INSTALL**

- 1 - AC Condenser
- 2 - AC condenser connector ports
- 3 - Liquid line to condenser connector
- 4 - Mounting nut
- 5 - Liquid line
- 6 - Liquid line mounting clips (2)
- 7 - Mounting nut
- 8 - Liquid line to evaporator connection
- 9 - Evaporator connection

and the condenser outlet. Connect the liquid line to the evaporator inlet and condenser outlet refrigerant line couplers. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(2) Connect the battery negative cable.

(3) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(4) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

## A/C SUCTION LINE

## REMOVAL

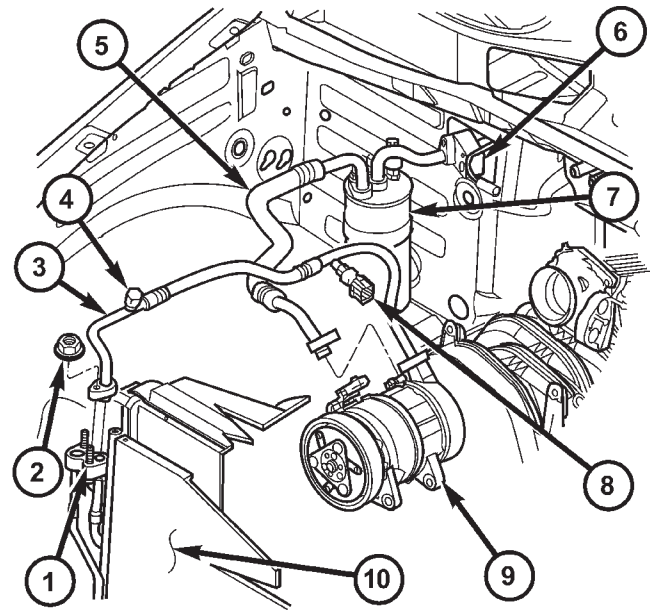
**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/**

**PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

(1) Disconnect and isolate the negative battery cable.

(2) Recover the refrigerant. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Unplug the wire harness connector from the a/c high pressure switch (Fig. 9).



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**Fig. 9 SUCTION AND DISCHARGE LINE REMOVAL**

- 1 - Condenser connection
- 2 - Discharge line to condenser mounting nut
- 3 - Discharge line
- 4 - Discharge line charging port
- 5 - Suction line
- 6 - Evaporator mounting ports
- 7 - Accumulator
- 8 - High pressure cut off switch
- 9 - AC compressor
- 10 - AC condenser

(4) Disconnect the discharge line refrigerant fitting from the condenser inlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the suction line block fitting to the accumulator outlet. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the fastener that secures the suction and discharge line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

## A/C SUCTION LINE (Continued)

(7) Remove the suction and discharge line assembly from the vehicle.

**INSTALLATION**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

(1) Remove the tape or plugs from the suction and discharge line manifold and the compressor. Install the suction and discharge line manifold to the compressor. Tighten the fastener to 28 N·m (250 in. lbs.).

(2) Remove the tape or plugs from the suction line and the accumulator outlet block fittings. Install the suction line to the accumulator outlet and tighten the mounting nut to 9 N·m (80 in. lbs.).

(3) Remove the tape or plugs from the refrigerant line fittings on the discharge line and the condenser inlet tube. Connect the discharge line refrigerant line coupler to the condenser inlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(4) Plug in the wire harness connector on the a/c high pressure switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

(8) Check the affected areas of the system for leaks.

**A/C EVAPORATOR****DESCRIPTION**

The evaporator coil is located in the HVAC housing, under the instrument panel. The evaporator coil is positioned in the HVAC 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.

**OPERATION**

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 when it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty or damaged, it must be replaced.

**REMOVAL**

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

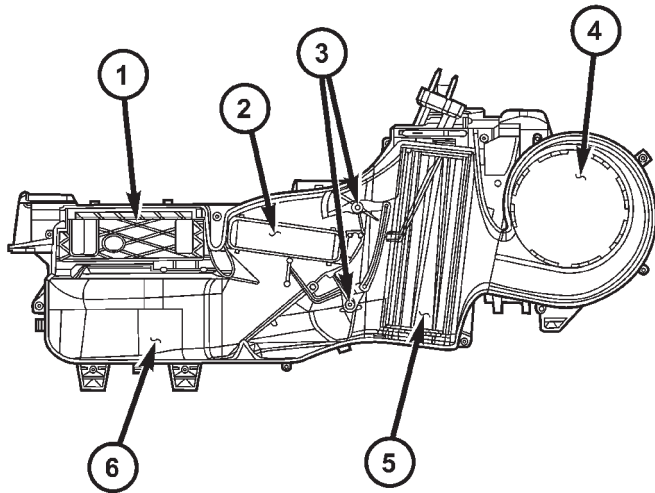
(1) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(2) Lift the evaporator coil unit out of the lower half of the HVAC housing. (Fig. 10).

**INSTALLATION**

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

## A/C EVAPORATOR (Continued)



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**Fig. 10 Blend Door**

- 1 - DEFROSTER DOOR
- 2 - HEATER CORE
- 3 - BLEND DOORS
- 4 - BLOWER MOTOR HOUSING
- 5 - EVAPORATOR (A/C ONLY)
- 6 - LOWER HVAC CASE ASSEMBLY

(1) Install the evaporator coil unit into of the lower half of the HVAC housing. Be certain that the evaporator foam insulator wrap and rubber tube seal are reinstalled.

(2) Reassemble and install the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

**NOTE:** If the evaporator was 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. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

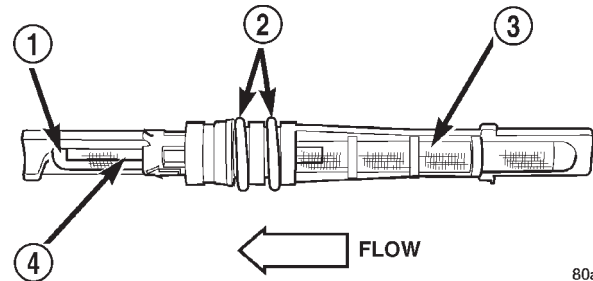
## A/C ORIFICE TUBE

### DESCRIPTION

The fixed orifice tube is installed in the liquid line (left-hand drive) or liquid line jumper (right-hand drive) between the outlet of the condenser and the inlet of the evaporator. The fixed orifice tube is

located in the end of the liquid line or liquid line jumper that is closest to the condenser outlet tube.

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. 11). 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.



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**Fig. 11 FIXED ORIFICE TUBE - TYPICAL**

- 1 - DIFFUSER SCREEN
- 2 - "O" RINGS
- 3 - INLET FILTER SCREENS
- 4 - ORIFICE

### OPERATION

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 and fixed orifice tube unit or liquid line jumper and fixed orifice tube unit must be replaced.

### REMOVAL

The fixed orifice tube is located in the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive) near the condenser. 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 unit or liquid line jumper unit must be replaced. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/LIQUID LINE - REMOVAL)

### INSTALLATION

The fixed orifice tube is located in the liquid line (Left-Hand Drive) or the liquid line jumper (Right-Hand Drive) near the condenser. 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 unit or liquid line jumper unit must be

A/C ORIFICE TUBE (Continued)

replaced. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/LIQUID LINE - REMOVAL)

ACCUMULATOR

DESCRIPTION

The accumulator is mounted in the engine compartment between the evaporator coil outlet tube and the compressor inlet.

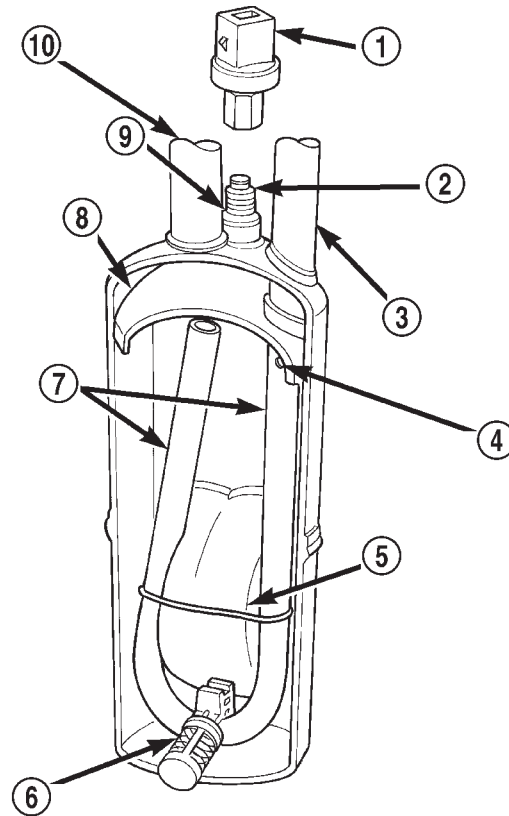
OPERATION

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 become trapped within the refrigerant system (Fig. 12).

REMOVAL

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

- (1) Disconnect and isolate the battery negative cable.
- (2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)
- (3) Unplug the wire harness connector from the low pressure cycling clutch switch.
- (4) Loosen the screw that secures the accumulator retaining band to the support bracket on the dash panel (Fig. 13).
- (5) Disconnect the suction line from the accumulator outlet tube refrigerant line fitting. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.
- (6) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) 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 vehicle.



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**Fig. 12 ACCUMULATOR - TYPICAL**

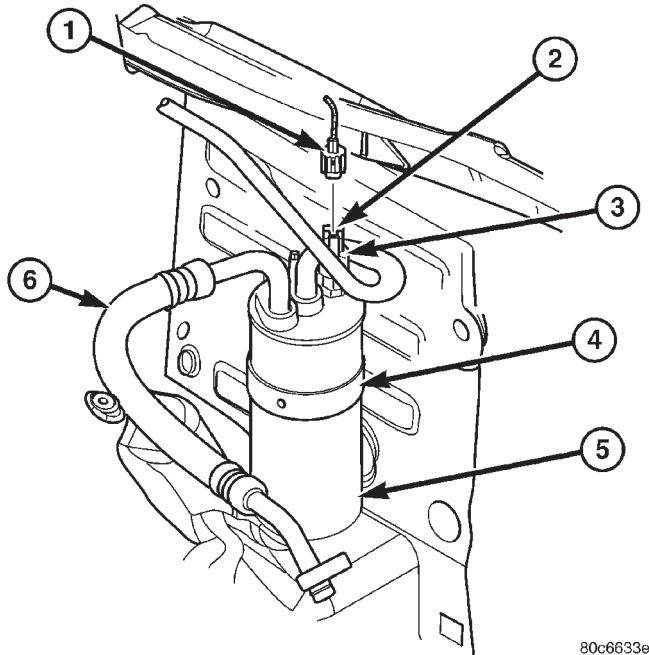
- 1 - A/C LOW PRESSURE SWITCH
- 2 - PRESSURE SWITCH FITTING
- 3 - OUTLET TO COMPRESSOR
- 4 - ANTI-SIPHON HOLE
- 5 - DESICCANT BAG
- 6 - OIL RETURN ORIFICE FILTER
- 7 - VAPOR RETURN TUBE
- 8 - ACCUMULATOR DOME
- 9 - O-RING SEAL
- 10 - INLET FROM EVAPORATOR

INSTALLATION

**WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

- (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 tube and the

## ACCUMULATOR (Continued)



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**Fig. 13 A/C LOW PRESSURE SWITCH**

- 1 - WIRING HARNESS CONNECTOR
- 2 - A/C LOW PRESSURE SWITCH
- 3 - A/C LINE TO EVAPORATOR
- 4 - ACCUMULATOR MOUNTING BRACKET
- 5 - ACCUMULATOR
- 6 - A/C LOW PRESSURE LINE

evaporator outlet tube. Connect the accumulator inlet tube refrigerant line coupler to the evaporator outlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(3) Tighten the accumulator retaining band screw to 5 N·m (45 in. lbs.).

(4) Remove the tape or plugs from the refrigerant line fittings on the suction line and the accumulator outlet tube. Connect the suction line to the accumulator outlet tube refrigerant line coupler. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(5) Plug the wire harness connector into the low pressure cycling clutch switch.

(6) Connect the battery negative cable.

(7) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(8) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

**NOTE:** If the accumulator is replaced, add 120 milliliters (4 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

## HEATER CORE

### DESCRIPTION

The heater core is located in the HVAC housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins and uses warm engine coolant as its heat source.

### OPERATION

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 temperature control door allows control of the heater output air temperature by controlling how much of the air flowing through the HVAC housing is directed through the heater core. The blower motor speed controls the volume of air flowing through the HVAC housing.

The heater core cannot be repaired and, if faulty or damaged, it must be replaced. Refer to Cooling for more information on the engine cooling system, the engine coolant and the heater hoses.

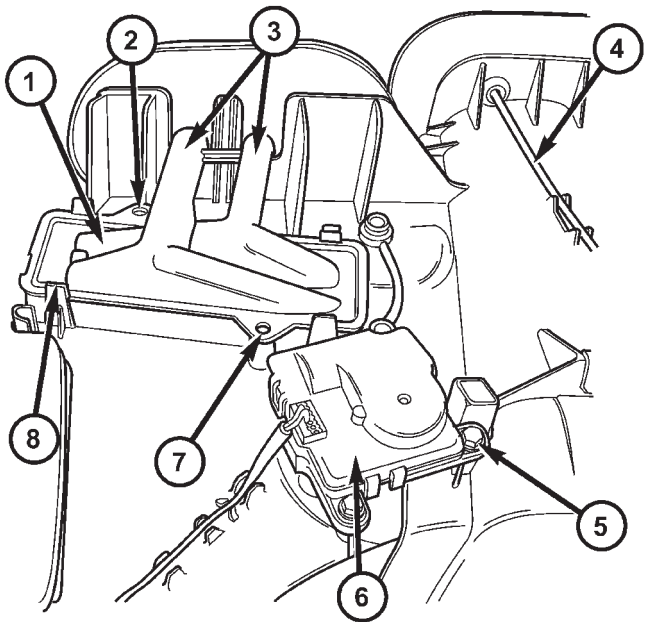
### REMOVAL

**WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.**

HEATER CORE (Continued)

**WARNING: IF THE VEHICLE IS EQUIPPED WITH AIR CONDITIONING, REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)**

- (1) Remove the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).
- (2) Remove the two heater core retaining screws (if equipped). (Fig. 14).



**Fig. 14 HEATER CORE REMOVAL/INSTALLATION**

- 1 - HEATER CORE
- 2- MOUNTING SCREW HOLE
- 3- INLET AND OUTLET TUBES
- 4- VACUUM HARNESS
- 5- ACTUATOR SCREWS (3)
- 6- ELECTRIC BLEND DOOR ACTUATOR
- 7- MOUNTING SCREW HOLE
- 8- HEATER CORE RETAINER TABS (4)

- (3) Gently push back on two of the heater core retaining tabs and pull up on heater core to remove.

**INSTALLATION**

**WARNING: IF THE VEHICLE IS EQUIPPED WITH AIR CONDITIONING, REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING &**

**AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)**

- (1) Install the heater core into the top of the HVAC housing.
- (2) Push on top of heater core until all four tabs are locked into place.
- (3) Install the two heater core retainer screws.
- (4) Install the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

**REFRIGERANT**

**DESCRIPTION**

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.

**OPERATION**

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 OIL**

**DESCRIPTION**

The refrigerant oil used in R-134a refrigerant systems is a synthetic-based, PolyAlkylene Glycol (PAG), wax-free lubricant. Mineral-based R-12 refrigerant

REFRIGERANT OIL (Continued)

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 PXF-18 compressor used in this vehicle is designed to use an SP-10 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

**OPERATION**

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.

**STANDARD PROCEDURE - 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 lubrica-

tion 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
Accumulator	90	3
Condenser	22	.75
Evaporator	45	1.5
Compressor	drain and measure the oil from the old compressor as noted	

# EMISSIONS CONTROL

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## EMISSIONS CONTROL

### DESCRIPTION

#### DESCRIPTION - EMISSION CONTROL SYSTEM

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 code applies to a non-emissions related component or system, and 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 Lamp (MIL). The MIL is displayed as an engine icon on the instrument panel. Refer to Malfunction Indicator Lamp (MIL) in this section.

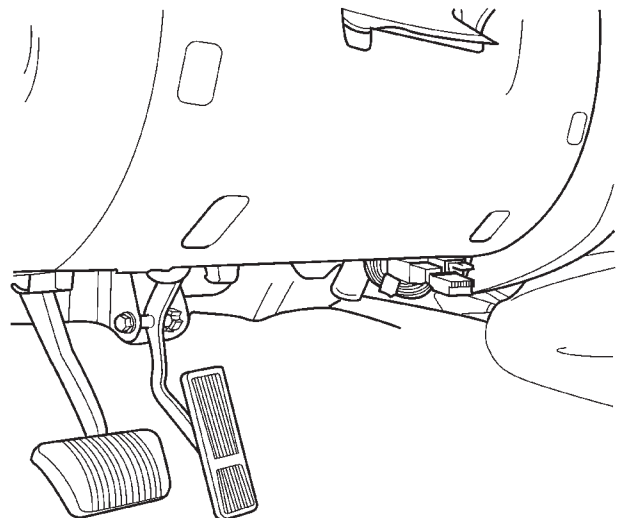
Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

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).

**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.



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**Fig. 1 DATA LINK CONNECTOR LOCATION**



EMISSIONS CONTROL (Continued)

**DESCRIPTION - 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.

**Remember that DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.**

**NOTE: For a list of DTC's, refer to the charts in this section.**

**BULB CHECK**

Each time the ignition key is turned to the ON position, the malfunction indicator (check engine) lamp on the instrument panel should illuminate for approximately 2 seconds then go out. This is done for a bulb check.

**DESCRIPTION - 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.

**OBTAINING DTC'S USING DRB SCAN TOOL**

(1) Connect the DRB scan tool to the data link (diagnostic) connector. This connector is located in the passenger compartment; at the lower edge of instrument panel; near the steering column.

(2) Turn the ignition switch on and access the "Read Fault" screen.

(3) Record all the DTC's and "freeze frame" information shown on the DRB scan tool.

(4) To erase DTC's, use the "Erase Trouble Code" data screen on the DRB scan tool. **Do not erase any DTC's until problems have been investigated and repairs have been performed.**

**DESCRIPTION - DIAGNOSTIC TROUBLE CODES**

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

<b>(M)</b> Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
<b>(G)</b> Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0030 (M)	1/1 O2 Sensor Heater Circuit Malfunction	Problem detected in oxygen sensor heater relay circuit.
P0031 (M)	1/1 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0032 (M)	1/1 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0036 (M)	1/2 O2 Sensor Heater Circuit Malfunction	Problem detected in oxygen sensor heater relay circuit.
P0037 (M)	1/2 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0038 (M)	1/2 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0043 (M)	1/3 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0044 (M)	1/3 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0051 (M)	2/1 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0052 (M)	2/1 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.

EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0057 (M)	2/2 O2 Sensor Heater Circuit Low	Problem detected in oxygen sensor heater relay circuit.
P0058 (M)	2/2 O2 Sensor Heater Circuit High	Problem detected in oxygen sensor heater relay circuit.
P0071 (M)	Amb/Bat Temp Sensor Performance	
P0106	Barometric Pressure Out of Range	MAP sensor input voltage out of an acceptable range detected during reading of barometric pressure at key-on.
P0107 (M)	Map Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
P0108 (M)	Map Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
PO111 (M)	Intake Air Temp Sensor Performance	
P0112 (M)	Intake Air Temp Sensor Voltage Low	Intake air (charge) temperature sensor input below the minimum acceptable voltage.
P0113 (M)	Intake Air Temp Sensor Voltage High	Intake air (charge) temperature sensor input above the maximum acceptable voltage.
P0116	Coolant Temp Sensor Performance	A rationality error has been detected in the coolant temp sensor.
P0117 (M)	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below the minimum acceptable voltage.
P0118 (M)	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above the maximum acceptable voltage.
P0121 (M)	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor signal.
P0121 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage.
P0122 (M)	Throttle Position Sensor Voltage Low	Throttle position sensor input below the acceptable voltage range.
P0122 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too Low	APPS voltage input below the minimum acceptable voltage.
P0123 (M)	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
P0123 (M)	Accelerator Position Sensor (APPS) Signal Voltage Too High	APPS voltage input above the maximum acceptable voltage.
P0125 (M)	Closed Loop Temp Not Reached	Time to enter Closed Loop Operation (Fuel Control) is excessive.
P0125 (M)	Engine is Cold Too Long	Engine does not reach operating temperature.
P0130 (M)	1/1 O2 Sensor Heater Circuit Malfunction	Oxygen sensor heater element malfunction.
P0131 (M)	1/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0132 (M)	1/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0133 (M)	1/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0134 (M)	1/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor input.

## EMISSIONS CONTROL (Continued)

<b>(M)</b> Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
<b>(G)</b> Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0135 (M)	1/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0136 (M)	1/2 O2 Sensor Heater Circuit Malfunction	Oxygen sensor heater element malfunction.
P0137 (M)	1/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0138 (M)	1/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0139 (M)	1/2 O2 Sensor Slow Response	Oxygen sensor response not as expected.
P0140 (M)	1/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0141 (M)	1/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0143 (M)	1/3 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0144 (M)	1/3 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0145 (M)	1/3 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0146 (M)	1/3 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0147 (M)	1/3 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0151 (M)	2/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0152 (M)	2/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage sustained above normal operating range.
P0153 (M)	2/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0154 (M)	2/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0155 (M)	2/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0157 (M)	2/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0158 (M)	2/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0159	2/2 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0160 (M)	2/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0161 (M)	2/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
PO165	Starter Relay Circuit	Problem detected in starter relay circuit.
P0168	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P0171 (M)	1/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.

EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0172 (M)	1/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0174 (M)	2/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
P0175 (M)	2/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0176	Loss of Flex Fuel Calibration Signal	No calibration voltage present from flex fuel sensor.
P0177	Water In Fuel	Excess water found in fuel by water-in-fuel sensor.
P0178	Flex Fuel Sensor Volts Too Low	Flex fuel sensor input below minimum acceptable voltage.
P0178	Water In Fuel Sensor Voltage Too Low	Loss of water-in-fuel circuit or sensor.
P0179	Flex Fuel Sensor Volts Too High	Flex fuel sensor input above maximum acceptable voltage.
P0181	Fuel Injection Pump Failure	Low power, engine derated, or engine stops.
P0182 (M)	CNG Temp Sensor Voltage Too Low	Compressed natural gas temperature sensor voltage below acceptable voltage.
P0183 (M)	CNG Temp Sensor Voltage Too High	Compressed natural gas temperature sensor voltage above acceptable voltage.
P0201 (M)	Injector #1 Control Circuit	An open or shorted condition detected in control circuit for injector #1 or the INJ 1 injector bank.
P0202 (M)	Injector #2 Control Circuit	An open or shorted condition detected in control circuit for injector #2 or the INJ 2 injector bank.
P0203 (M)	Injector #3 Control Circuit	An open or shorted condition detected in control circuit for injector #3 or the INJ 3 injector bank.
P0204 (M)	Injector #4 Control Circuit	Injector #4 or INJ 4 injector bank output driver stage does not respond properly to the control signal.
P0205 (M)	Injector #5 Control Circuit	Injector #5 output driver stage does not respond properly to the control signal.
P0206 (M)	Injector #6 Control Circuit	Injector #6 output driver stage does not respond properly to the control signal.
P0207 (M)	Injector #7 Control Circuit	Injector #7 output driver stage does not respond properly to the control signal.
P0208 (M)	Injector #8 Control Circuit	Injector #8 output driver stage does not respond properly to the control signal.
P0209 (M)	Injector #9 Control Circuit	Injector #9 output driver stage does not respond properly to the control signal.
P0210 (M)	Injector #10 Control Circuit	Injector #10 output driver stage does not respond properly to the control signal.
P0215	Fuel Injection Pump Control Circuit	Failure in fuel pump relay control circuit.
P0216 (M)	Fuel Injection Pump Timing Failure	High fuel supply restriction, low fuel pressure or possible wrong or incorrectly installed pump keyway.
P0217	Decreased Engine Performance Due To Engine Overheat Condition	Engine overheating. ECM will derate engine performance.

## EMISSIONS CONTROL (Continued)

<b>(M)</b> Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
<b>(G)</b> Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0219	Crankshaft Position Sensor Overspeed Signal	Engine has exceeded rpm limits.
P0222 (M)	Idle Validation Signals Both Low	Problem detected with idle validation circuits within APPS.
P0223 (M)	Idle Validation Signals Both High (Above 5 Volts)	Problem detected with idle validation circuits within APPS.
P0230	Transfer Pump (Lift Pump) Circuit Out of Range	Problem detected in fuel transfer pump circuits.
P0232	Fuel Shutoff Signal Voltage Too High	Fuel shut-off signal voltage too high from ECM to fuel injection pump.
P0234 (M)	Turbo Boost Limit Exceeded	Problem detected in turbocharger wastegate.
P0236 (M)	Map Sensor Too High Too Long	Problem detected in turbocharger wastegate.
P0237 (M)	Map Sensor Voltage Too Low	MAP sensor voltage input below the minimum acceptable voltage.
P0238 (M)	Map Sensor Voltage Too High	MAP sensor voltage input above the maximum acceptable voltage.
PO243	Wastegate Solenoid Circuit	
P0251 (M)	Fuel Inj. Pump Mech. Failure Fuel Valve Feedback Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0253 (M)	Fuel Injection Pump Fuel Valve Open Circuit	Problem sensed with fuel circuit internal to fuel injection pump.
P0254	Fuel Injection Pump Fuel Valve Current Too High	Problem caused by internal fuel injection pump failure.
P0300 (M)	Multiple Cylinder Mis-fire	Misfire detected in multiple cylinders.
P0301 (M)	CYLINDER #1 MISFIRE	Misfire detected in cylinder #1.
P0302 (M)	CYLINDER #2 MISFIRE	Misfire detected in cylinder #2.
P0303 (M)	CYLINDER #3 MISFIRE	Misfire detected in cylinder #3.
P0304 (M)	CYLINDER #4 MISFIRE	Misfire detected in cylinder #4.
P0305 (M)	CYLINDER #5 MISFIRE	Misfire detected in cylinder #5.
P0306 (M)	CYLINDER #6 MISFIRE	Misfire detected in cylinder #6.
P0307 (M)	CYLINDER #7 MISFIRE	Misfire detected in cylinder #7
P0308 (M)	CYLINDER #8 MISFIRE	Misfire detected in cylinder #8.
P0309 (M)	CYLINDER #9 MISFIRE	Misfire detected in cylinder #9.
P0310 (M)	CYLINDER #10 MISFIRE	Misfire detected in cylinder #10.
P0320 (M)	No Crank Reference Signal at PCM	No reference signal (crankshaft position sensor) detected during engine cranking.
P0320 (M)	No RPM Signal to PCM (Crankshaft Position Sensor Signal to JTEC)	A CKP signal has not been detected at the PCM.
P0325	Knock Sensor #1 Circuit	Knock sensor (#1) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0330	Knock Sensor #2 Circuit	Knock sensor (#2) signal above or below minimum acceptable threshold voltage at particular engine speeds.

EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0336 (M)	Crankshaft Position (CKP) Sensor Signal	Problem with voltage signal from CKP.
P0340 (M)	No Cam Signal At PCM	No fuel sync
P0341 (M)	Camshaft Position (CMP) Sensor Signal	Problem with voltage signal from CMP.
P0350	Ignition Coil Draws Too Much Current	A coil (1-5) is drawing too much current.
P0351 (M)	Ignition Coil # 1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0352 (M)	Ignition Coil # 2 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0353 (M)	Ignition Coil # 3 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0354 (M)	Ignition Coil # 4 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).
P0355 (M)	Ignition Coil # 5 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).
P0356 (M)	Ignition Coil # 6 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0357 (M)	Ignition Coil # 7 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0358 (M)	Ignition Coil # 8 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0370	Fuel Injection Pump Speed/Position Sensor Sig Lost	Problem caused by internal fuel injection pump failure.
P0380 (M)	Intake Air Heater Relay #1 Control Circuit	Problem detected in #1 air heater solenoid/relay circuit (not heater element)
P0381 (M)	Wait To Start Lamp Inoperative	Problem detected in wait-to-start bulb circuit.
P0382 (M)	Intake Air Heater Relay #2 Control Circuit	Problem detected in #2 air heater solenoid/relay circuit (not heater element)
P0387	Crankshaft Position Sensor Supply Voltage Too Low	CKP sensor voltage input below the minimum acceptable voltage.
P0388	Crankshaft Position Sensor Supply Voltage Too High	CKP sensor voltage input above the maximum acceptable voltage.
PO0400	Diesel EGR System Failure	
P0401	EGR System Failure	Required change in air/fuel ration not detected during diagnostic test.
P0403	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid control circuit.
P0404	EGR Position Sensor Rationality	EGR position sensor signal does not correlate to EGR duty cycle.
P0405	EGR Position Sensor Volts Too Low	EGR position sensor input below the acceptable voltage range.

## EMISSIONS CONTROL (Continued)

<b>(M)</b> Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
<b>(G)</b> Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0406	EGR Position Sensor Volts Too High	EGR position sensor input above the acceptable voltage range.
P0412	Secondary Air Solenoid Circuit	An open or shorted condition detected in the secondary air (air switching/aspirator) solenoid control circuit.
P0420 (M)	1/1 Catalytic Converter Efficiency	Catalyst 1/1 efficiency below required level.
P0432 (M)	1/2 Catalytic Converter Efficiency	Catalyst 2/1 efficiency below required level.
P0441 (M)	Evap Purge Flow Monitor	Insufficient or excessive vapor flow detected during evaporative emission system operation.
P0442 (M)	Evap Leak Monitor Medium Leak Detected	A small leak has been detected in the evaporative system.
P0443 (M)	Evap Purge Solenoid Circuit	An open or shorted condition detected in the EVAP purge solenoid control circuit.
P0455 (M)	Evap Leak Monitor Large Leak Detected	A large leak has been detected in the evaporative system.
P0456 (M)	Evap Leak Monitor Small Leak Detected	Leak has been detected in the evaporative system.
P0460	Fuel Level Unit No Change Over Miles	During low fuel
P0460	Fuel Level Unit No Change Over Miles	Fuel level sending unit voltage does not change for more than 40 miles.
PO061	Fuel Level Unit No Change Over Time	
P0462	Fuel Level Sending Unit Volts Too Low	Fuel level sensor input below acceptable voltage.
P0462 (M)	Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
P0463	Fuel Level Sending Unit Volts Too High	Fuel level sensor input above acceptable voltage.
P0463 (M)	Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.
P0500 (M)	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
P0500 (M)	No Vehicle Speed Sensor Signal	A vehicle speed signal was not detected.
P0505 (M)	Idle Air Control Motor Circuits	
P0508 (M)	IAC Motor Sense Circuit Low	
P0509 (M)	IAC Motor Sense Circuit High	
P0521	Oil Pressure Switch Rationality	
P0522	Oil Pressure Voltage Too Low	Oil pressure sending unit (sensor) voltage input below the minimum acceptable voltage.
P0523	Oil Pressure Voltage Too High	Oil pressure sending unit (sensor) voltage input above the maximum acceptable voltage.
P0524	Oil Pressure Too Low	Engine oil pressure is low. Engine power derated.

EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0545	A/C Clutch Relay Circuit	Problem detected in air conditioning clutch relay control circuit.
P0551	Power Steering Switch Failure	Incorrect input state detected for the power steering switch circuit. PL: High pressure seen at high speed.
P0562	Charging System Voltage Too Low	Supply voltage sensed at ECM too low.
P0563	Charging System Voltage Too High	Supply voltage sensed at ECM too high.
P0572	Brake Switch Input #1 Signal Missing	
P0573	Brake Switch Input #2 Signal Missing	
P0575	Cruise Control Switch Voltage Low	
P0576	Cruise Control Switch Voltage High	
P0577	Cruise Control Switch Voltage High	
P0600	PCM Failure SPI Communications	No communication detected between co-processors in the control module.
P0601 (M)	Internal Controller Failure	Internal control module fault condition (check sum) detected.
P0602 (M)	ECM Fueling Calibration Error	ECM Internal fault condition detected.
P0604	RAM Check Failure	Transmission control module RAM self test fault detected. -Aisin transmission
P0605	ROM Check Failure	Transmission control module ROM self test fault detected -Aisin transmission
P0606 (M)	ECM Failure	ECM Internal fault condition detected.
P0615	Starter Relay Control Circuit	An open or shorted condition detected in the starter relay control circuit.
P0622 (G)	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
P0645	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay control circuit.
P0700	EATX Controller DTC Present	This SBEC III or JTEC DTC indicates that the EATX or Aisin controller has an active fault and has illuminated the MIL via a CCD (EATX) or SCI (Aisin) message. The specific fault must be acquired from the EATX via CCD or from the Aisin via ISO-9141.
P0703	Brake Switch Stuck Pressed or Released	Incorrect input state detected in the brake switch circuit. (Changed from P1595)
P0703	Brake Switch Sense Circuit	
P0711 (M)	Trans Temp Sensor, No Temp Rise After Start	Relationship between the transmission temperature and overdrive operation and/or TCC operation indicates a failure of the Transmission Temperature Sensor. OBD II Rationality. Was MIL code 37.
P0712	Trans Temp Sensor Voltage Too Low	Transmission fluid temperature sensor input below acceptable voltage. Was MIL code 37.



## EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P0712 (M)	Trans Temp Sensor Voltage Too Low	Voltage less than 1.55 volts (4-speed auto. trans. only).
P0713	Trans Temp Sensor Voltage Too High	Transmission fluid temperature sensor input above acceptable voltage. Was MIL code 37.
P0713 (M)	Trans Temp Sensor Voltage Too High	Voltage greater than 3.76 volts (4-speed auto. trans. only).
P0720 (M)	Low Output SPD Sensor RPM, Above 15 MPH	The relationship between the Output Shaft Speed Sensor and vehicle speed is not within acceptable limits.
P0720 (M)	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).
P0740 (M)	Torq Con Clu, No RPM Drop at Lockup	Relationship between engine and vehicle speeds indicated failure of torque convertor clutch lock-up system (TCC/PTU solenoid)
P0743 (M)	Torque Converter Clutch Solenoid/Trans Relay Circuits	An open or shorted condition detected in the torque converter clutch (part throttle unlock) solenoid control circuit. Shift solenoid C electrical fault - Aisin transmission
P0743 (M)	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 (M)	Governor Pressur Sol Control/Trans Relay Circuits	An open or shorted condition detected in the Governor Pressure Solenoid circuit or Trans Relay Circuit in JTEC RE transmissions.
P0748 (M)	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).
P0751 (M)	O/D Switch Pressed (Lo) More Than 5 Minutes	Overdrive override switch input is in a prolonged depressed state.
P0751 (M)	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 (M)	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the overdrive solenoid control circuit or Trans Relay Circuit in JTEC RE transmissions. Was MIL code 45.
P0753 (M)	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).
P0756	AW4 Shift Sol B (2-3) Functional Failure	Shift solenoid B (2-3) functional fault - Aisin transmission
P0783 (M)	3-4 Shift Sol, No RPM Drop at Lockup	The overdrive solenoid is unable to engage the gear change from 3rd gear to the overdrive gear.
P0801	Reverse Gear Lockout Circuit Open or Short	An open or shorted condition detected in the transmission reverse gear lock-out solenoid control circuit.
P0830	Clutch Depressed Switch Circuit	Problem detected in clutch switch circuit.
P0833	Clutch Released Switch Circuit	Problem detected in clutch switch circuit.
P0836	4WD Mux Switch Circuit	
P0837	4WD Mux Switch Performance	

## EMISSIONS CONTROL (Continued)

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<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1110	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	Decreased Engine Performance Due To High Injection Pump Fuel Temp	Fuel temperature is above the engine protection limit. Engine power will be derated.
P1192	Intake Air Temp Sensor Voltage Low	
P1193	Intake Air Temp Sensor Voltage High	
P1194	O2 Heater Performance	
P1195 (M)	1/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/1 during catalyst monitor test. (Also see SCI DTC \$66) (was P0133)
P1196 (M)	2/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 2/1 during catalyst monitor test. (Also see SCI DTC \$7A) (was P0153)
P1197	1/2 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/2 during catalyst monitor test. (Also see SCI DTC \$68) (was P0139)
P1198	Radiator Temperature Sensor Volts Too High	Radiator coolant temperature sensor input above the maximum acceptable voltage.
P1199	Radiator Temperature Sensor Volts Too Low	Radiator coolant temperature sensor input below the minimum acceptable voltage.
P1280	Fuel System Relay Circuit	
P1281	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (Thermostat).
P1282	Fuel Pump/System Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
P1283	Idle Select Signal Invalid	ECM or fuel injection pump module internal fault condition detected.
P1284 (M)	Fuel Injection Pump Battery Voltage Out-Of-Range	Fuel injection pump module internal fault condition detected. Engine power will be derated.
P1285 (M)	Fuel Injection Pump Controller Always On	Fuel injection pump module relay circuit failure detected. Engine power will be derated.
P1286	Accelerator Position Sensor (APPS) Supply Voltage Too High	High voltage detected at APPS.
P1287	Fuel Injection Pump Controller Supply Voltage Low	ECM or fuel injection pump module internal fault condition detected. Engine power will be derated.
P1288	Intake Manifold Short Runner Solenoid Circuit	An open or shorted condition detected in the short runner tuning valve circuit.
P1289	Manifold Tune Valve Solenoid Circuit	An open or shorted condition detected in the manifold tuning valve solenoid control circuit.
P1290	High Pressure Solenoid Relay Ckt.	CNG Fuel System Pressure Too High—Compressed natural gas system pressure above normal operating range.
P1291	No Temp Rise Seen From Intake Heaters	Energizing Heated Air Intake does not change intake air temperature sensor an acceptable amount.

## EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1291 (M)	No Temperature Rise Seen From Intake Air Heaters	Problem detected in intake manifold air heating system.
P1292	CNG Pressure Sensor Voltage Too High	Compressed natural gas pressure sensor reading above acceptable voltage.
P1293	CNG Pressure Sensor Voltage Too Low	Compressed natural gas pressure sensor reading below acceptable voltage.
P1294 (M)	Target Idle Not Reached	Target RPM not achieved during drive idle condition. Possible vacuum leak or IAC (AIS) lost steps.
P1295 (M)	No 5 Volts to TP Sensor	Loss of a 5 volt feed to the Throttle Position Sensor has been detected.
P1295 (M)	Accelerator Position Sensor (APPS) Supply Voltage Too Low	APPS supply voltage input below the minimum acceptable voltage.
P1296	No 5 Volts to MAP Sensor	Loss of a 5 volt feed to the MAP Sensor has been detected.
P1297 (M)	No Change in MAP From Start To Run	No difference is recognized between the MAP reading at engine idle and the stored barometric pressure reading.
P1298	Lean Operation at Wide Open Throttle	A prolonged lean condition is detected during Wide Open Throttle
P1299	Vacuum Leak Found (IAC Fully Seated)	MAP Sensor signal does not correlate to Throttle Position Sensor signal. Possible vacuum leak.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the ASD or CNG shutoff relay control ckt.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
P1389	No ASD Relay Output Voltage At PCM	No Z1 or Z2 voltage sensed when the auto shutdown relay is energized.
P1389 (M)	No ASD Relay Output Voltage at PCM	An open condition detected In the ASD relay output circuit.
P1390	Timing Belt Skipped 1 Tooth or More	Relationship between Cam and Crank signals not correct
P1391 (M)	Intermittent Loss of CMP or CKP	Loss of the Cam Position Sensor or Crank Position sensor has occurred. For PL 2.0L
P1398 (M)	Mis-Fire Adaptive Numerator at Limit	PCM is unable to learn the Crank Sensor's signal in preparation for Misfire Diagnostics. Probable defective Crank Sensor
P1399	Wait To Start Lamp Cicuit	An open or shorted condition detected in the Wait to Start Lamp circuit.
P1403	No 5V to EGR Sensor	Loss of 5v feed to the EGR position sensor.
P01475	Aux 5 Volt Supply Voltage High	Sensor supply voltage for ECM sensors is too high.
P1476	Too Little Secondary Air	Insufficient flow of secondary air injection detected during aspirator test (was P0411)
P1477	Too Much Secondary Air	Excessive flow of secondary air injection detected during aspirator test (was P0411).

EMISSIONS CONTROL (Continued)

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<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1478	Battery Temp Sensor Volts Out of Limit	Internal temperature sensor input voltage out of an acceptable range.
P1479	Transmission Fan Relay Circuit	An open or shorted condition detected in the transmission fan relay circuit.
P1480	PCV Solenoid Circuit	An open or shorted condition detected in the PCV solenoid circuit.
P1481	EATX RPM Pulse Perf	EATX RPM pulse generator signal for misfire detection does not correlate with expected value.
P1482	Catalyst Temperature Sensor Circuit Shorted Low	Catalyst temperature sensor circuit shorted low.
P1483	Catalyst Temperature Sensor Circuit Shorted High.	Catalyst temperature sensor circuit shorted high.
P1484	Catalytic Converter Overheat Detected	A catalyst overheat condition has been detected by the catalyst temperature sensor.
P1485	Air Injection Solenoid Circuit	An open or shorted condition detected in the air assist solenoid circuit.
P1486	Evap Leak Monitor Pinched Hose Found	LDP has detected a pinched hose in the evaporative hose system.
P1487	Hi Speed Rad Fan CTRL Relay Circuit	An open or shorted condition detected in the control circuit of the #2 high speed radiator fan control relay.
P1488	Auxiliary 5 Volt Supply Output Too Low	Auxiliary 5 volt sensor feed is sensed to be below an acceptable limit.
P1488	5 Volt Supply Voltage Low	Sensor supply voltage for ECM sensors is too low.
P1489	High Speed Fan CTRL Relay Circuit	An open or shorted condition detected in the control circuit of the high speed radiator fan control relay.
P1490	Low Speed Fan CTRL Relay Circuit	An open or shorted condition detected in control circuit of the low speed radiator fan control relay.
P1491	Rad Fan Control Relay Circuit	An open or shorted condition detected in the radiator fan control relay control circuit. This includes PWM solid state relays.
P1492	Ambient/Batt Temp Sen Volts Too High	External temperature sensor input above acceptable voltage.
P1492 (M)	Ambient/Batt Temp Sensor Volts Too High	Battery temperature sensor input voltage above an acceptable range.
P1493 (M)	Ambient/Batt Temp Sen Volts Too Low	External temperature sensor input below acceptable voltage.
P1493 (M)	Ambient/Batt Temp Sen Volts Too Low	Battery temperature sensor input voltage below an acceptable range.
P1494 (M)	Leak Detection Pump Sw or Mechanical Fault	Incorrect input state detected for the Leak Detection Pump (LDP) pressure switch.
P1495	Leak Detection Pump Solenoid Circuit	An open or shorted condition detected in the Leak Detection Pump (LDP) solenoid circuit.
P1496	5 Volt Supply, Output Too Low	5 volt sensor feed is sensed to be below an acceptable limit. ( less than 4v for 4 sec )

## EMISSIONS CONTROL (Continued)

<b>(M)</b> Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
<b>(G)</b> Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1498	High Speed Rad Fan Ground CTRL Rly Circuit	An open or shorted condition detected in the control circuit of the #3 high speed radiator fan control relay.
P1499	Hydraulic cooling fan solenoid circuit	An open or shorted condition detected in the cooling fan control solenoid circuit.
P1594 (G)	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
P1594	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
P1595	Speed Control Solenoid Circuits	An open or shorted condition detected in either of the speed control vacuum or vent solenoid control circuits.
P1595	Speed Control Solenoid Circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.
P1596	Speed Control Switch Always High	Speed control switch input above maximum acceptable voltage.
P1597	Speed Control Switch Always Low	Speed control switch input below minimum acceptable voltage.
P1597	Speed Control Switch Always Low	Speed control switch input below the minimum acceptable voltage.
P1598	A/C Pressure Sensor Volts Too High	A/C pressure sensor input above maximum acceptable voltage.
P1598	A/C Sensor Input Hi	Problem detected in air conditioning electrical circuit.
P1599	A/C Pressure Sensor Volts Too Low	A/C pressure sensor input below minimum acceptable voltage.
P1599	A/C Sensor Input Lo	Problem detected in air conditioning electrical circuit.
P1602	PCM not programmed	
P1680	Clutch Released Switch Circuit	Problem detected in clutch switch electrical circuit.
P1681	No I/P Cluster CCD/J1850 Messages Received	No CCD/J1850 messages received from the cluster control module.
P1682 (G)	Charging System Voltage Too Low	Battery voltage sense input below target charging voltage during engine operation and no significant change in voltage detected during active test of generator output circuit.
P1682	Charging System Voltage Too Low	Charging system output voltage low.
P1683	SPD CTRL PWR Relay; or S/C 12v Driver CKT	An open or shorted condition detected in the speed control servo power control circuit.
P1683	Spd ctrl pwr rly, or s/c 12v driver circuit	An open or shorted condition detected in the speed control servo power control circuit.
P1684	Batt Loss (disconnected) in last 50 Starts	The battery has been disconnected within the last 50 starts
P1685	SKIM Invalid Key - (Wrong or Invalid Key MSG Received From SKIM)	The engine controller has received an invalid key from the SKIM.
P1686	No SKIM BUS Messages Received	No CCD/J1850 messages received from the Smart Key Immobilizer Module (SKIM).

EMISSIONS CONTROL (Continued)

<b>(M) Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.</b>		
<b>(G) Generator lamp illuminated</b>		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1687	No MIC BUS Message (No Cluster BUS Message)	No CCD/J1850 messages received from the Mechanical Instrument Cluster (MIC) module.
P1688 (M)	Internal Fuel Injection Pump Controller Failure	Internal problem within the fuel injection pump. Low power, engine derated, or engine stops.
P1689 (M)	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 (M)	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	Fuel Injection Pump Controller Calibration Error	Internal fuel injection pump failure. Low power, engine derated, or engine stops.
P1692	DTC Set In ECM	A "Companion DTC" was set in both the ECM and PCM.
P1693 (M)	DTC Detected in Companion Module	A fault has been generated in the companion engine control module.
P1693 (M)	DTC Detected in PCM/ECM or DTC Detected in ECM	A "Companion DTC" was set in both the ECM and PCM.
P1694	Fault In Companion Module	No CCD/J1850 messages received from the powertrain control module-Aisin transmission
P1694 (M)	No BUS (CCD) Messages received from ECM	Bus communication failure to PCM.
P1695	No CCD/J1850 Message From Body Control Module	No CCD/J1850 messages received from the body control module.
P1696	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the control module.
P1697	PCM Failure SRI Mile Not Stored	Unsuccessful attempt to update Service Reminder Indicator (SRI or EMR) mileage in the control module EEPROM.
P1698	No CCD/J1850 Message From TCM	No CCD/J1850 messages received from the electronic transmission control module (EATX) or the Aisin transmission controller.
P1698	No CCD Messages received from PCM	Bus communication failure to PCM. A "Companion DTC" was set in both the ECM and PCM.
P1699	No Climate Control Bus Messages	
P1719	Skip Shift Solenoid Circuit	An open or shorted condition detected in the transmission 2-3 gear lock-out solenoid control circuit.
P1740	TCC or OD Sol Perf	A rationality error has been detected in either the TCC solenoid or overdrive solenoid systems.
P1740 (M)	TCC OR O/D Solenoid Performance	Problem detected in transmission convertor clutch and/or overdrive circuits (diesel engine with 4-speed auto. trans. only).

## EMISSIONS CONTROL (Continued)

<b>(M)</b> Malfunction Indicator Lamp (MIL) illuminated during engine operation if this DTC was recorded (depending if required by CARB and/or EPA). MIL is displayed as an engine icon on instrument panel.		
<b>(G)</b> Generator lamp illuminated		
Generic Scan Tool P-Code	DRB Scan Tool Display	Brief Description of DTC
P1756 (M)	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear. (Mid Pressure Malfunction)
P1756 (M)	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	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear (Zero Pressure Malfunction)
P1757 (M)	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 (M)	Gov Press Sen Offset Volts Too Low or High	The Governor Pressure Sensor input is greater than a calibration limit or is less than a calibration limit for 3 consecutive park/neutral calibrations.
P1762 (M)	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	Governor Pressure Sensor Volts Too Hi	The Governor Pressure Sensor input is above an acceptable voltage level.
P1763 (M)	Governor Pressure Sensor Volts Too HI	Voltage greater than 4.89 volts (4-speed auto. trans. only).
P1764 (M)	Governor Pressure Sensor Volts Too Low	The Governor Pressure Sensor input is below an acceptable voltage level.
P1764 (M)	Governor Pressure Sensor Volts Too Low	Voltage less than .10 volts (4-speed auto. trans. only).
P1765 (M)	Trans 12 Volt Supply Relay CTRL Circuit	An open or shorted condition is detected in the Transmission Relay control circuit. This relay supplies power to the TCC
P1765 (M)	Trans 12 Volt Supply Relay Ctrl Circuit	Current state of solenoid output port is different than expected (4-speed auto. trans. only).
P1830	Clutch Override Relay Circuit	Problem detected in clutch pedal switch override relay circuit.
P1899 (M)	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch.
P1899 (M)	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).

## EMISSIONS CONTROL (Continued)

**DESCRIPTION - TASK MANAGER**

The PCM is responsible for efficiently coordinating the operation of all the emissions-related components. The PCM is also responsible for determining if the diagnostic systems are operating properly. The software designed to carry out these responsibilities is referred to as the 'Task Manager'.

**DESCRIPTION - 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 Lamp (MIL) will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the MIL 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 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 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.

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.



## EMISSIONS CONTROL (Continued)

**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" water. 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 O2 control system. If fuel vapor, indicated by a shift in the O2 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 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.

## EMISSIONS CONTROL (Continued)

Normal vehicle miles or engine misfire can cause a catalyst to decay. This can increase vehicle emissions and deteriorate engine performance, driveability and fuel economy.

The catalyst monitor uses dual oxygen sensors (O<sub>2</sub>S's) to monitor the efficiency of the converter. The dual O<sub>2</sub>S'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 O<sub>2</sub>S 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 O<sub>2</sub>S. A low voltage indicates high oxygen content (lean mixture). A high voltage indicates a low content of oxygen (rich mixture).

When the upstream O<sub>2</sub>S 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 O<sub>2</sub>S 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 O<sub>2</sub>S. 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 O<sub>2</sub>S copies the voltage of the upstream sensor. The only difference is a time lag (seen by the PCM) between the switching of the O<sub>2</sub>S's.

To monitor the system, the number of lean-to-rich switches of upstream and downstream O<sub>2</sub>S'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 will be illuminated.

### DESCRIPTION - 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-Continuous OBDII 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. These will include the following:

- Oxygen Sensor
- Catalyst Monitor
- Purge Flow Monitor
- Leak Detection Pump Monitor (if equipped)
- EGR Monitor (if equipped)
- Oxygen Sensor Heater Monitor

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 - COMPONENT MONITORS

There are several components that will affect vehicle emissions if they malfunction. If one of these components malfunctions the Malfunction Indicator Lamp (MIL) 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

## EMISSIONS CONTROL (Continued)

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.

**DESCRIPTION - 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 AIRFLOW**

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.

**DESCRIPTION - 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.

**DESCRIPTION - LOAD VALUE**

ENGINE	IDLE/NEUTRAL	2500 RPM/NEUTRAL
All Engines	2% to 8% of Maximum Load	9% to 17% of Maximum Load

## EMISSIONS CONTROL (Continued)

**OPERATION - TASK MANAGER**

The Task Manager determines which tests happen when and which functions occur when. Many of the diagnostic steps required by OBD II must be performed under specific operating conditions. The Task Manager software organizes and prioritizes the diagnostic procedures. The job of the Task Manager is to determine if conditions are appropriate for tests to be run, monitor the parameters for a trip for each test, and record the results of the test. Following are the responsibilities of the Task Manager software:

- Test Sequence
- MIL Illumination
- Diagnostic Trouble Codes (DTCs)
- Trip Indicator
- Freeze Frame Data Storage
- Similar Conditions Window

**Test Sequence**

In many instances, emissions systems must fail diagnostic tests more than once before the PCM illuminates the MIL. These tests are known as 'two trip monitors.' Other tests that turn the MIL lamp on after a single failure are known as 'one trip monitors.' A trip is defined as 'start the vehicle and operate it to meet the criteria necessary to run the given monitor.'

Many of the diagnostic tests must be performed under certain operating conditions. However, there are times when tests cannot be run because another test is in progress (conflict), another test has failed (pending) or the Task Manager has set a fault that may cause a failure of the test (suspend).

- Pending

Under some situations the Task Manager will not run a monitor if the MIL is illuminated and a fault is stored from another monitor. In these situations, the Task Manager postpones monitors **pending** resolution of the original fault. The Task Manager does not run the test until the problem is remedied.

For example, when the MIL is illuminated for an Oxygen Sensor fault, the Task Manager does not run the Catalyst Monitor until the Oxygen Sensor fault is remedied. Since the Catalyst Monitor is based on signals from the Oxygen Sensor, running the test would produce inaccurate results.

- Conflict

There are situations when the Task Manager does not run a test if another monitor is in progress. In these situations, the effects of another monitor running could result in an erroneous failure. If this **conflict** is present, the monitor is not run until the conflicting condition passes. Most likely the monitor will run later after the conflicting monitor has passed.

For example, if the Fuel System Monitor is in progress, the Task Manager does not run the EGR Monitor. Since both tests monitor changes in air/fuel ratio and adaptive fuel compensation, the monitors will conflict with each other.

- Suspend

Occasionally the Task Manager may not allow a two trip fault to mature. The Task Manager will **suspend** the maturing of a fault if a condition exists that may induce an erroneous failure. This prevents illuminating the MIL for the wrong fault and allows more precise diagnosis.

For example, if the PCM is storing a one trip fault for the Oxygen Sensor and the EGR monitor, the Task Manager may still run the EGR Monitor but will suspend the results until the Oxygen Sensor Monitor either passes or fails. At that point the Task Manager can determine if the EGR system is actually failing or if an Oxygen Sensor is failing.

**MIL Illumination**

The PCM Task Manager carries out the illumination of the MIL. The Task Manager triggers MIL illumination upon test failure, depending on monitor failure criteria.

The Task Manager Screen shows both a Requested MIL state and an Actual MIL state. When the MIL is illuminated upon completion of a test for a third trip, the Requested MIL state changes to OFF. However, the MIL remains illuminated until the next key cycle. (On some vehicles, the MIL will actually turn OFF during the third key cycle) During the key cycle for the third good trip, the Requested MIL state is OFF, while the Actual MIL state is ON. After the next key cycle, the MIL is not illuminated and both MIL states read OFF.

**Diagnostic Trouble Codes (DTCs)**

With OBD II, different DTC faults have different priorities according to regulations. As a result, the priorities determine MIL illumination and DTC erasure. DTCs are entered according to individual priority. DTCs with a higher priority overwrite lower priority DTCs.

**Priorities**

- Priority 0 — Non-emissions related trouble codes
- Priority 1 — One trip failure of a two trip fault for non-fuel system and non-misfire.
- Priority 2 — One trip failure of a two trip fault for fuel system (rich/lean) or misfire.
- Priority 3 — Two trip failure for a non-fuel system and non-misfire or matured one trip comprehensive component fault.

## EMISSIONS CONTROL (Continued)

- Priority 4 — Two trip failure or matured fault for fuel system (rich/lean) and misfire or one trip catalyst damaging misfire.

Non-emissions related failures have no priority. One trip failures of two trip faults have low priority. Two trip failures or matured faults have higher priority. One and two trip failures of fuel system and misfire monitor take precedence over non-fuel system and non-misfire failures.

**DTC Self Erasure**

With one trip components or systems, the MIL is illuminated upon test failure and DTCs are stored.

Two trip monitors are components requiring failure in two consecutive trips for MIL illumination. Upon failure of the first test, the Task Manager enters a maturing code. If the component fails the test for a second time the code matures and a DTC is set.

After three good trips the MIL is extinguished and the Task Manager automatically switches the trip counter to a warm-up cycle counter. DTCs are automatically erased following 40 warm-up cycles if the component does not fail again.

For misfire and fuel system monitors, the component must pass the test under a Similar Conditions Window in order to record a good trip. A Similar Conditions Window is when engine RPM is within  $\pm 375$  RPM and load is within  $\pm 10\%$  of when the fault occurred.

**NOTE: It is important to understand that a component does not have to fail under a similar window of operation to mature. It must pass the test under a Similar Conditions Window when it failed to record a Good Trip for DTC erasure for misfire and fuel system monitors.**

DTCs can be erased anytime with a DRB III. Erasing the DTC with the DRB III erases all OBD II information. The DRB III automatically displays a warning that erasing the DTC will also erase all OBD II monitor data. This includes all counter information for warm-up cycles, trips and Freeze Frame.

**Trip Indicator**

The **Trip** is essential for running monitors and extinguishing the MIL. In OBD II terms, a trip is a set of vehicle operating conditions that must be met for a specific monitor to run. All trips begin with a key cycle.

**Good Trip**

The Good Trip counters are as follows:

- Specific Good Trip
- Fuel System Good Trip
- Misfire Good Trip
- Alternate Good Trip (appears as a Global Good Trip on DRB III)

- Comprehensive Components
- Major Monitor
- Warm-Up Cycles

**Specific Good Trip**

The term Good Trip has different meanings depending on the circumstances:

- If the MIL is OFF, a trip is defined as when the Oxygen Sensor Monitor and the Catalyst Monitor have been completed in the same drive cycle.

- If the MIL is ON and a DTC was set by the Fuel Monitor or Misfire Monitor (both continuous monitors), the vehicle must be operated in the Similar Condition Window for a specified amount of time.

- If the MIL is ON and a DTC was set by a Task Manager commanded once-per-trip monitor (such as the Oxygen Sensor Monitor, Catalyst Monitor, Purge Flow Monitor, Leak Detection Pump Monitor, EGR Monitor or Oxygen Sensor Heater Monitor), a good trip is when the monitor is passed on the next start-up.

- If the MIL is ON and any other emissions DTC was set (not an OBD II monitor), a good trip occurs when the Oxygen Sensor Monitor and Catalyst Monitor have been completed, or two minutes of engine run time if the Oxygen Sensor Monitor and Catalyst Monitor have been stopped from running.

**Fuel System Good Trip**

To count a good trip (three required) and turn off the MIL, the following conditions must occur:

- Engine in closed loop
- Operating in Similar Conditions Window
- Short Term multiplied by Long Term less than threshold
- Less than threshold for a predetermined time

If all of the previous criteria are met, the PCM will count a good trip (three required) and turn off the MIL.

**Misfire Good Trip**

If the following conditions are met the PCM will count one good trip (three required) in order to turn off the MIL:

- Operating in Similar Condition Window
- 1000 engine revolutions with no misfire

**Warm-Up Cycles**

Once the MIL has been extinguished by the Good Trip Counter, the PCM automatically switches to a Warm-Up Cycle Counter that can be viewed on the DRB III. Warm-Up Cycles are used to erase DTCs and Freeze Frames. Forty Warm-Up cycles must occur in order for the PCM to self-erase a DTC and Freeze Frame. A Warm-Up Cycle is defined as follows:

- Engine coolant temperature must start below and rise above 160° F
- Engine coolant temperature must rise by 40° F
- No further faults occur

## EMISSIONS CONTROL (Continued)

**Freeze Frame Data Storage**

Once a failure occurs, the Task Manager records several engine operating conditions and stores it in a Freeze Frame. The Freeze Frame is considered one frame of information taken by an on-board data recorder. When a fault occurs, the PCM stores the input data from various sensors so that technicians can determine under what vehicle operating conditions the failure occurred.

The data stored in Freeze Frame is usually recorded when a system fails the first time for two trip faults. Freeze Frame data will only be overwritten by a different fault with a higher priority.

**CAUTION:** Erasing DTCs, either with the DRB III or by disconnecting the battery, also clears all Freeze Frame data.

**Similar Conditions Window**

The Similar Conditions Window displays information about engine operation during a monitor. Absolute MAP (engine load) and Engine RPM are stored in this window when a failure occurs. There are two different Similar conditions Windows: Fuel System and Misfire.

**FUEL SYSTEM**

• **Fuel System Similar Conditions Window** — An indicator that 'Absolute MAP When Fuel Sys Fail' and 'RPM When Fuel Sys Failed' are all in the same range when the failure occurred. Indicated by switching from 'NO' to 'YES'.

• **Absolute MAP When Fuel Sys Fail** — The stored MAP reading at the time of failure. Informs the user at what engine load the failure occurred.

• **Absolute MAP** — A live reading of engine load to aid the user in accessing the Similar Conditions Window.

• **RPM When Fuel Sys Fail** — The stored RPM reading at the time of failure. Informs the user at what engine RPM the failure occurred.

• **Engine RPM** — A live reading of engine RPM to aid the user in accessing the Similar Conditions Window.

• **Adaptive Memory Factor** — The PCM utilizes both Short Term Compensation and Long Term Adaptive to calculate the Adaptive Memory Factor for total fuel correction.

• **Upstream O<sub>2</sub>S Volts** — A live reading of the Oxygen Sensor to indicate its performance. For example, stuck lean, stuck rich, etc.

• **SCW Time in Window (Similar Conditions Window Time in Window)** — A timer used by the

PCM that indicates that, after all Similar Conditions have been met, if there has been enough good engine running time in the SCW without failure detected. This timer is used to increment a Good Trip.

• **Fuel System Good Trip Counter** — A Trip Counter used to turn OFF the MIL for Fuel System DTCs. To increment a Fuel System Good Trip, the engine must be in the Similar Conditions Window, Adaptive Memory Factor must be less than calibrated threshold and the Adaptive Memory Factor must stay below that threshold for a calibrated amount of time.

• **Test Done This Trip** — Indicates that the monitor has already been run and completed during the current trip.

**MISFIRE**

• **Same Misfire Warm-Up State** — Indicates if the misfire occurred when the engine was warmed up (above 160° F).

• **In Similar Misfire Window** — An indicator that 'Absolute MAP When Misfire Occurred' and 'RPM When Misfire Occurred' are all in the same range when the failure occurred. Indicated by switching from 'NO' to 'YES'.

• **Absolute MAP When Misfire Occurred** — The stored MAP reading at the time of failure. Informs the user at what engine load the failure occurred.

• **Absolute MAP** — A live reading of engine load to aid the user in accessing the Similar Conditions Window.

• **RPM When Misfire Occurred** — The stored RPM reading at the time of failure. Informs the user at what engine RPM the failure occurred.

• **Engine RPM** — A live reading of engine RPM to aid the user in accessing the Similar Conditions Window.

• **Adaptive Memory Factor** — The PCM utilizes both Short Term Compensation and Long Term Adaptive to calculate the Adaptive Memory Factor for total fuel correction.

• **200 Rev Counter** — Counts 0–100 720 degree cycles.

• **SCW Cat 200 Rev Counter** — Counts when in similar conditions.

• **SCW FTP 1000 Rev Counter** — Counts 0–4 when in similar conditions.

• **Misfire Good Trip Counter** — Counts up to three to turn OFF the MIL.

• **Misfire Data** — Data collected during test.

• **Test Done This Trip** — Indicates YES when the test is done.

# EVAPORATIVE EMISSIONS

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## EVAPORATIVE EMISSIONS

### DESCRIPTION - EVAPORATION 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 the control valve located in the top section of the fuel pump module, through the fuel management valve, and through vent hoses and tubes to a charcoal filled evaporative canister. The canister temporarily holds the vapors. The Powertrain Control Module (PCM) allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

Gas 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.

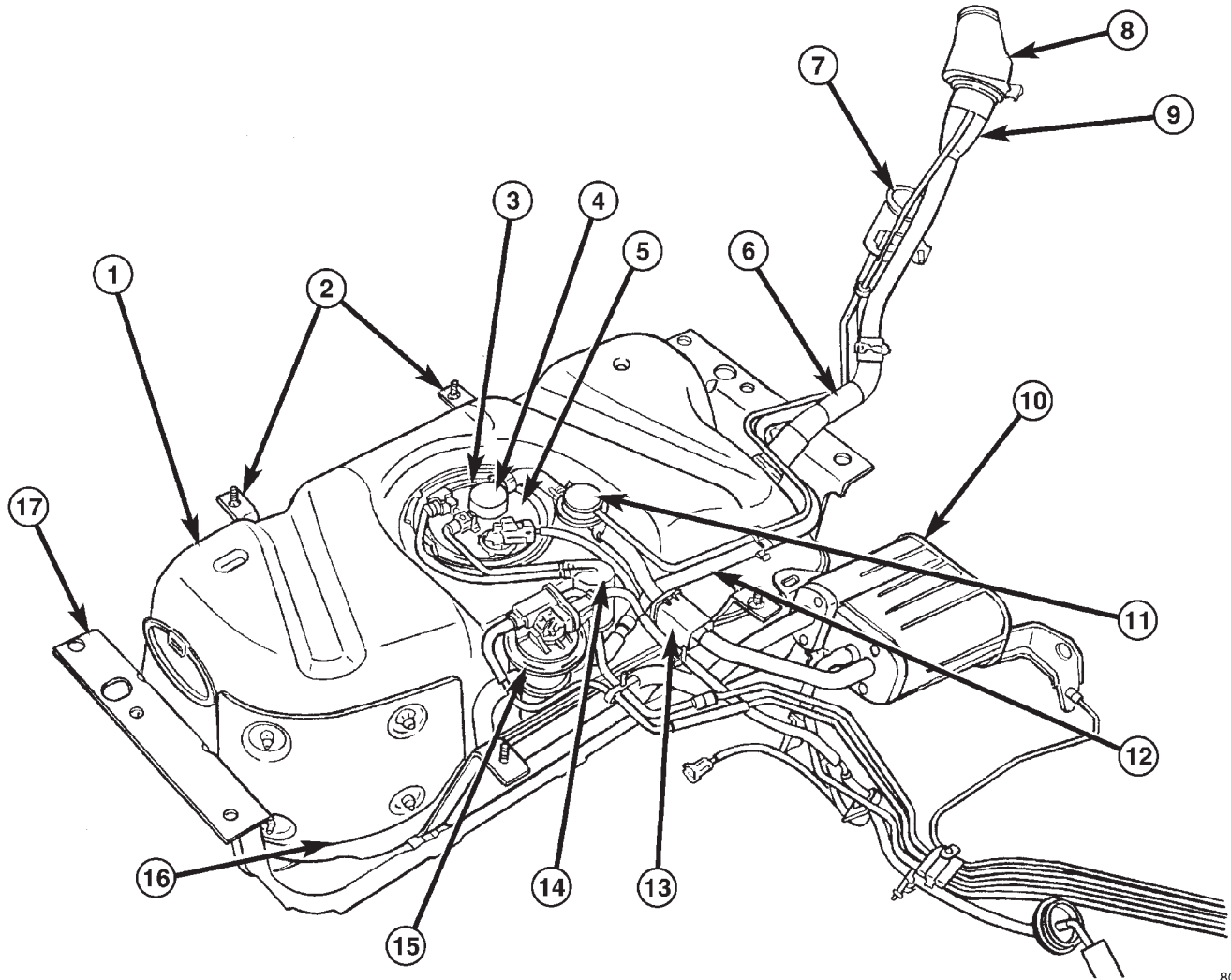
When equipped with certain emissions packages, a Leak Detection Pump (LDP) will be used as part of the evaporative system for OBD II requirements. Also refer to Leak Detection Pump.

Vehicles powered with gasoline engines are also equipped with ORVR (On-Board Refueling Vapor Recovery). Refer to ORVR for additional information.

**NOTE: The evaporative system uses specially manufactured lines/hoses. If replacement becomes necessary, only use fuel resistant, low permeation hose.**

Certain components can be found in (Fig. 1).

EVAPORATIVE EMISSIONS (Continued)



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**Fig. 1 FUEL DELIVERY COMPONENTS**

- |                                |                            |
|--------------------------------|----------------------------|
| 1 - FUEL TANK                  | 10 - EVAP CANISTER         |
| 2 - FUEL TANK STRAPS           | 11 - FLOW MANAGEMENT VALVE |
| 3 - FUEL PUMP MODULE LOCK RING | 12 - FRESH AIR TUBE        |
| 4 - CHECK (CONTROL) VALVE      | 13 - HOSE SLEEVE           |
| 5 - FUEL PUMP MODULE FLANGE    | 14 - FUEL FILTER           |
| 6 - FUEL FILL HOSE             | 15 - LEAK DETECTION PUMP   |
| 7 - FRESH AIR FILTER           | 16 - HEAT SHIELD           |
| 8 - FUEL FILL CAP/BEZEL        | 17 - SKID PLATE            |
| 9 - FUEL FILL TUBE             |                            |



## EVAPORATIVE EMISSIONS (Continued)

## SPECIFICATIONS

## TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting Nuts	12	-	105
Crankshaft Position Sensor - 2.4L	28	21	-
Crankshaft Position Sensor - 3.7L	28	21	-
Camshaft Position Sensor - 2.4L	12	-	106
Camshaft Position Sensor - 3.7L	12	-	106
Engine Coolant Temperature Sensor	11	-	96
EVAP Canister-to-Body Bolts	48	35	-
EVAP Canister-to-Canis. Bracket Bolt/Nut	11	-	100
Fuel Filler Hose Clamp at Tank	3	-	30
Fuel Filler Housing-to-Body Screws	2	-	17
Fuel Filter Mounting Nut at Tank	5.5	-	49
Fuel Pump Module Access Plate Nuts	3	-	26
Fuel Rail Mounting Bolts - 3.7L	11	-	100
Fuel Rail Mounting Bolts - 2.4L	28	-	250
Fuel Tank Heat Sheild Nuts	5.5	-	49
Fuel Tank Mounting Strap Bolts	61	45	-
Fuel Tank Skid Plate and Trailer Hitch	88	65	-
IAC Motor Mounting Screws	7	-	60
Leak Detection Pump Mounting Bracket-to-Fuel Tank Nuts	5.5	-	49
Leak Detection Pump-to-Bracket Nuts	1.2	-	11
Map Sensor Mounting Screws	3	-	25
PCM-to-Mounting Bracket Mounting Screws	4	-	35
Power Steering Pressure Switch	14-22	-	124-195
TPS Mounting Screws	7	-	60
Throttle Body Mounting Bolts	11	-	100
Oxygen Sensors	30	22	-

## EVAP/PURGE SOLENOID

### DESCRIPTION

The duty cycle EVAP canister purge solenoid (DCP) is located in the engine compartment. It is attached to a bracket located between the battery and the Power Distribution Center (PDC). The EVAP system test port is located near the solenoid.

### OPERATION

The duty cycle EVAP canister purge solenoid (DCP) regulates the rate of vapor flow from the EVAP canister to the intake manifold. The Powertrain Control Module (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 cycles (energizes and de-energizes) the solenoid 5 or 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time that the solenoid is energized. The PCM adjusts solenoid pulse width based on engine operating condition.

### REMOVAL

The duty cycle EVAP canister purge solenoid (DCP) is located in the engine compartment (Fig. 2). It is attached to a bracket located between the battery and the Power Distribution Center (PDC). The EVAP system test port is located near the solenoid (Fig. 2).

- (1) Disconnect electrical wiring connector at solenoid.
- (2) Disconnect vacuum harness at solenoid.
- (3) Remove solenoid and its support bracket (pull straight up).

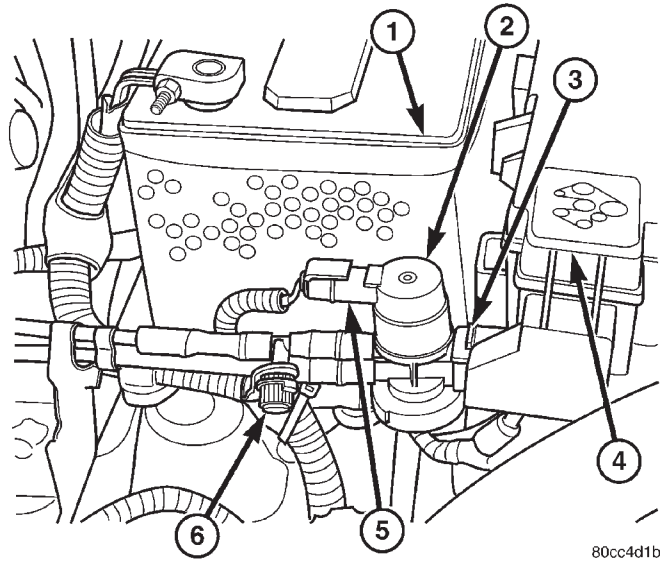
### INSTALLATION

- (1) Slip EVAP canister purge solenoid onto its mounting bracket.
- (2) Connect vacuum harness to solenoid.
- (3) Connect electrical connector to solenoid.

## FUEL FILLER CAP

### DESCRIPTION

The plastic fuel tank filler tube cap is threaded onto the end of the fuel fill tube. All models are equipped with a 1/4 turn cap.



**Fig. 2 EVAP / PURGE SOLENOID LOCATION**

- 1 - BATTERY
- 2 - EVAP/PURGE SOLENOID LOCATION
- 3 - MOUNTING BRACKET
- 4 - POWER DISTRIBUTION CENTER (PDC)
- 5 - SOLENOID ELECTRICAL CONNECTOR
- 6 - EVAP SYSTEM TEST PORT

### OPERATION

The loss of any fuel or vapor out of fuel filler tube is prevented by the use of a pressure-vacuum fuel fill 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.

**CAUTION:** Remove fill cap before servicing any fuel system component to relieve tank pressure. If equipped with an ORVR system and a Leak Detection Pump (LDP), the cap must be tightened securely. If cap is left loose, a Diagnostic Trouble Code (DTC) may be set.

## LEAK DETECTION PUMP

### DESCRIPTION

The Leak Detection Pump (LDP) is bolted to the front of the fuel tank (Fig. 1).

The Leak Detection Pump (LDP) is used only with certain emission packages.

The LDP is a device used to detect a leak in the evaporative system.

## LEAK DETECTION PUMP (Continued)

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.

## OPERATION

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 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.

## REMOVAL

The Leak Detection Pump (LDP) is attached (bolted) to the front of the fuel tank (Fig. 3). The LDP fresh air filter is located on the end of a hose. This hose is attached to the fuel fill tube assembly below and near the fuel fill opening (Fig. 1). The LDP and LDP filter are typically replaced (serviced) as one unit.

(1) Raise vehicle.

(2) Carefully remove two 3/4" vent hoses at sides of LDP.

(3) Carefully remove other vapor/vacuum hoses from LDP.

(4) Place a hydraulic jack under fuel tank.

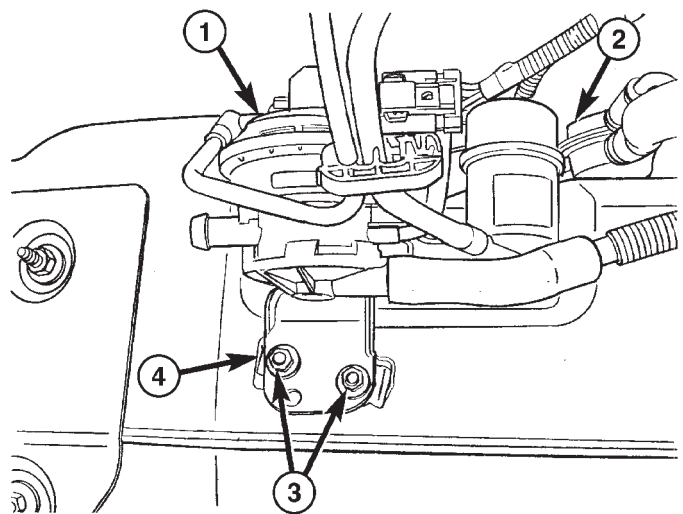
(5) Loosen 2 fuel tank strap mounting bolts at front of tank about 10 turns.

(6) Lower front of fuel tank about 1/2".

(7) Remove 2 LDP mounting nuts (Fig. 3) and lower LDP slightly to gain access to electrical connector (Fig. 4).

(8) Disconnect electrical connector at LDP. To disconnect: Slide red colored tab upward. Push on black colored tab while removing connector.

(9) Remove LDP from vehicle.



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**Fig. 3 LDP LOCATION / MOUNTING**

- 1 - LDP
- 2 - FLOW MANAGEMENT VALVE
- 3 - MOUNTING NUTS
- 4 - FRONT OF FUEL TANK

## INSTALLATION

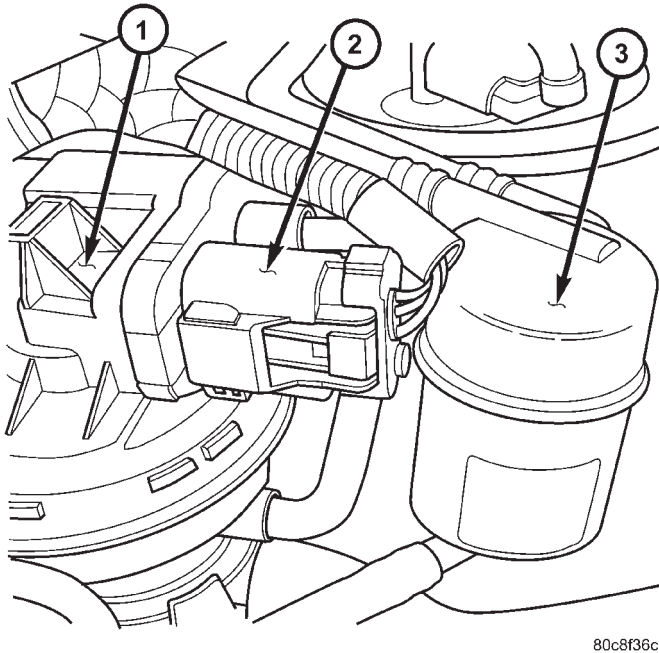
The Leak Detection Pump (LDP) is attached (bolted) to the front of the fuel tank. The LDP filter is located on the end of a hose. This hose is attached to the fuel fill tube assembly below and near the fuel fill opening. The LDP and LDP filter are replaced (serviced) as one unit.

(1) Install electrical connector to LDP. Push red colored tab downward to lock connector to LDP.

(2) Position LDP and LDP bracket to fuel tank mounting studs and install 2 nuts. Tighten nuts to 1 N·m (11 in. lbs.) torque.

(3) Raise fuel tank to body and tighten 2 strap bolts to 61 N·m (45 ft. lbs.) torque.

## LEAK DETECTION PUMP (Continued)



**Fig. 4 LDP ELECTRICAL CONNECTOR**

- 1 - LEAK DETECTION PUMP (LDP)  
 2 - ELECTRICAL CONNECTOR  
 3 - FUEL FILTER

(4) 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 duty cycle purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.**

## ORVR

### DESCRIPTION

The ORVR (On-Board Refueling Vapor Recovery) system consists of a unique fuel tank, flow management valve, fluid control valve, one-way check valve and vapor canister (Fig. 1).

### OPERATION

The ORVR (On-Board Refueling Vapor Recovery) system is used to remove excess fuel tank vapors. This is done while the vehicle is being refueled. Certain ORVR components can be found in (Fig. 1).

Fuel flowing into the fuel filler tube (approx. 1" I.D.) creates an aspiration effect drawing air into the fuel fill tube. During refueling, the fuel tank is vented to the EVAP canister to capture escaping vapors. With air flowing into the filler tube, there are no fuel vapors escaping to the atmosphere. Once the refueling vapors are captured by the EVAP canister,

the vehicle's computer controlled purge system draws vapor out of the canister for the engine to burn. The vapor flow is metered by the purge solenoid so that there is no, or minimal impact on driveability or tailpipe emissions.

As fuel starts to flow through the fuel fill tube, it opens the normally closed check valve and enters the fuel tank. Vapor or air is expelled from the tank through the control valve and on to the vapor canister. Vapor is absorbed in the EVAP canister until vapor flow in the lines stops. This stoppage occurs following fuel shut-off, or by having the fuel level in the tank rise high enough to close the control valve. This control valve contains a float that rises to seal the large diameter vent path to the EVAP canister. At this point in the refueling process, fuel tank pressure increases, the check valve closes (preventing liquid fuel from spitting back at the operator), and fuel then rises up the fuel filler tube to shut off the dispensing nozzle.

## PCV VALVE

### DESCRIPTION

#### 2.4L

The 2.4L 4-cylinder engine is equipped with a closed crankcase ventilation system and a Positive Crankcase Ventilation (PCV) valve.

This system consists of:

- a PCV valve attached to the left/front side of the valve cover (Fig. 5). It is secured with 1 bolt. An o-ring is used to seal valve to valve cover (Fig. 6).
- the air cleaner housing
- tubes and hoses to connect the system components.

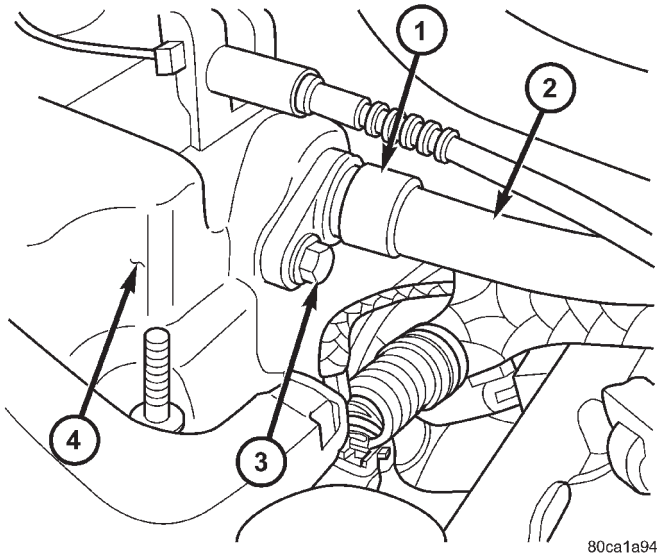
#### 3.7L

The 3.7L V-6 engine is equipped with a closed crankcase ventilation system and a Positive Crankcase Ventilation (PCV) valve.

This system consists of:

- a PCV valve mounted to the oil filler housing (Fig. 7). The PCV valve is sealed to the oil filler housing with an o-ring.
- the air cleaner housing
- two interconnected breathers threaded into the rear of each cylinder head (Fig. 8).
- tubes and hoses to connect the system components.

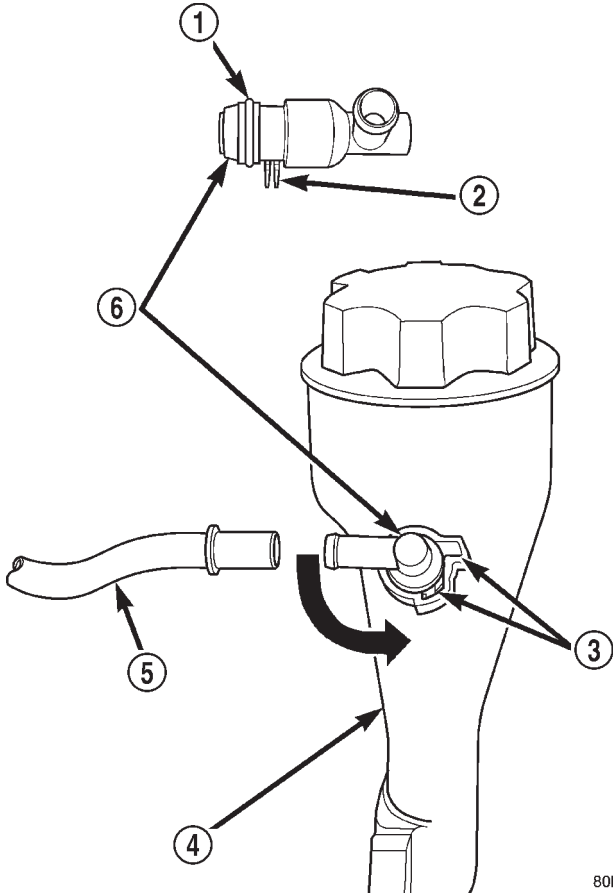
PCV VALVE (Continued)



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**Fig. 5 PCV VALVE LOCATION - 2.4L**

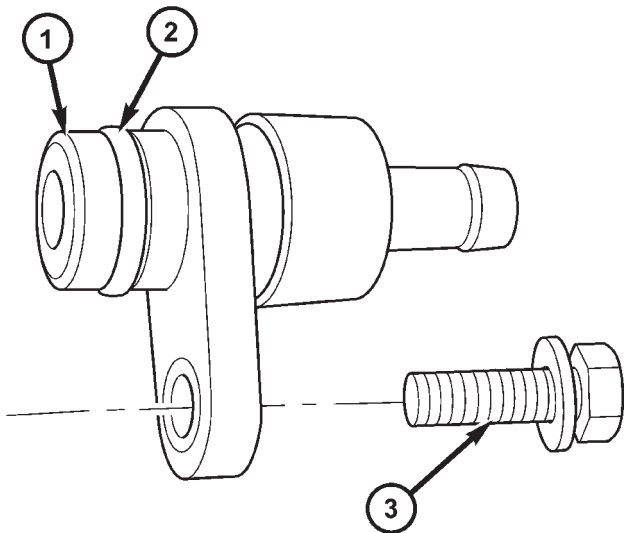
- 1 - PCV VALVE
- 2 - HOSE
- 3 - MOUNTING BOLT
- 4 - VALVE COVER (LEFT SIDE)



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**Fig. 7 PCV VALVE - 3.7L**

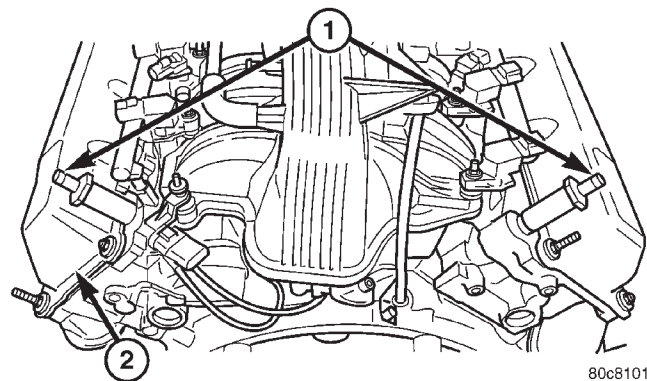
- 1 - O-RING
- 2 - LOCATING TABS
- 3 - CAM LOCK
- 4 - OIL FILLER TUBE
- 5 - PCV LINE/HOSE
- 6 - PCV VALVE



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**Fig. 6 PCV VALVE AND O-RING - 2.4L**

- 1 - PCV VALVE
- 2 - O-RING
- 3 - MOUNTING BOLT



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**Fig. 8 CRANKCASE BREATHERS (2) - 3.7L**

- 1 - CRANKCASE BREATHERS (2)
- 2 - REAR OF ENGINE

PCV VALVE (Continued)

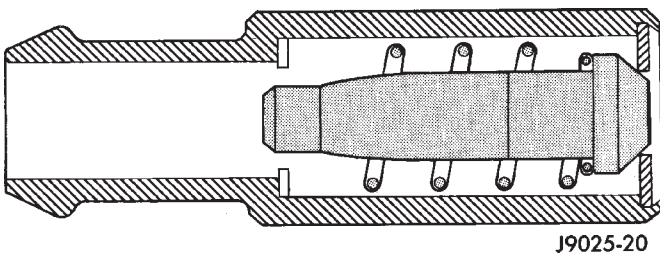
**OPERATION**

The PCV system operates by engine intake manifold vacuum. Filtered air is routed into the crankcase through the air cleaner hose and crankcase breather(s) (if used). 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.

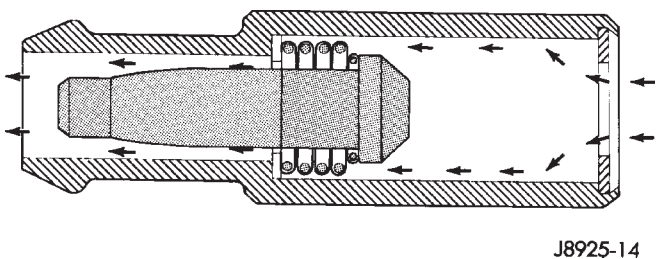
**TYPICAL** PCV valves are shown in (Fig. 9), (Fig. 10) and (Fig. 11).

When the engine is not operating, or during an engine pop-back, the spring forces the plunger back against the seat (Fig. 9). This will prevent vapors from flowing through the valve.



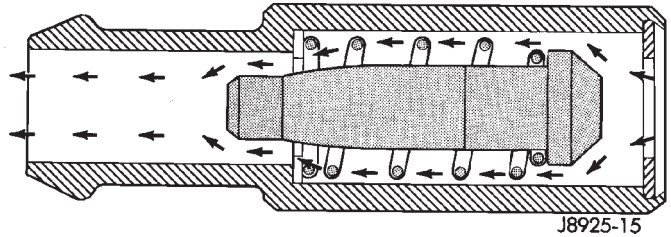
**Fig. 9 Engine Off or Engine Pop-Back—No Vapor Flow**

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. 10). In this position there is minimal vapor flow through the valve.



**Fig. 10 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. 11).



**Fig. 11 Moderate Intake Manifold Vacuum—Maximum Vapor Flow**

**DIAGNOSIS AND TESTING - PCV VALVE**

3.7L

(1) Disconnect PCV line/hose (Fig. 7) by disconnecting rubber connecting hose at PCV valve fitting.

(2) Remove PCV valve at oil filler tube by rotating PCV valve downward until locating tabs have been freed at cam lock (Fig. 7). After tabs have cleared, pull valve straight out from filler tube. **To prevent damage to PCV valve locating tabs, valve must be pointed downward for removal. Do not force valve from oil filler tube.**

(3) After valve is removed, check condition of valve o-ring (Fig. 7). Also, PCV valve should rattle when shaken.

(4) Reconnect PCV valve to its connecting line/hose.

(5) Start engine and bring to idle speed.

(6) If valve is not plugged, a hissing noise will be heard as air passes through valve. Also, a strong vacuum should be felt with a finger placed at valve inlet.

(7) If vacuum is not felt at valve inlet, check line/hose for kinks or for obstruction. If necessary, clean out intake manifold fitting at rear of manifold. Do this by turning 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.

(8) **Do not attempt to clean the old PCV valve.**

(9) Return PCV valve back to oil filler tube by placing valve locating tabs (Fig. 7) into cam lock. Press PCV valve in and rotate valve upward. A slight click will be felt when tabs have engaged cam lock. Valve should be pointed towards rear of vehicle.

(10) Connect PCV line/hose and connecting rubber hose to PCV valve.

(11) Disconnect rubber hose from fresh air fitting at air cleaner resonator box. Start engine and bring to idle speed. Hold a piece of stiff paper (such as a parts tag) loosely over the opening of the disconnected rubber hose.

(12) The paper should be drawn against the hose opening with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

## PCV VALVE (Continued)

(13) If vacuum is not present, disconnect each PCV system hose at top of each crankcase breather (Fig. 8). Check for obstructions or restrictions.

(14) If vacuum is still not present, remove each PCV system crankcase breather (Fig. 8) from each cylinder head. Check for obstructions or restrictions. If plugged, replace breather. Tighten breather to 12 N·m (106 in. lbs.) torque. Do not attempt to clean breather

(15) If vacuum is still not present, disconnect each PCV system hose at each fitting and check for obstructions or restrictions.

## REMOVAL

## 2.4L

The PCV valve is attached to the left/front side of the valve cover (Fig. 5). It is secured with 1 bolt. An o-ring is used to seal valve to valve cover (Fig. 6).

(1) Remove hose from valve (Fig. 5). Check condition of hose.

(2) Remove 1 bolt.

(3) Remove PCV valve from valve cover.

(4) Check condition of valve o-ring.

## 3.7L

The PCV valve is located on the oil filler tube (Fig. 12). Two locating tabs are located on the side of the valve (Fig. 12). These 2 tabs fit into a cam lock in the oil filler tube. An o-ring seals the valve to the filler tube.

(1) Disconnect PCV line/hose (Fig. 12) by disconnecting rubber hose at PCV valve fitting.

(2) Remove PCV valve at oil filler tube by rotating PCV valve downward (counter-clockwise) until locating tabs have been freed at cam lock (Fig. 12). After tabs have cleared, pull valve straight out from filler tube. **To prevent damage to PCV valve locating tabs, valve must be pointed downward for removal. Do not force valve from oil filler tube.**

(3) After valve is removed, check condition of valve o-ring (Fig. 12).

## INSTALLATION

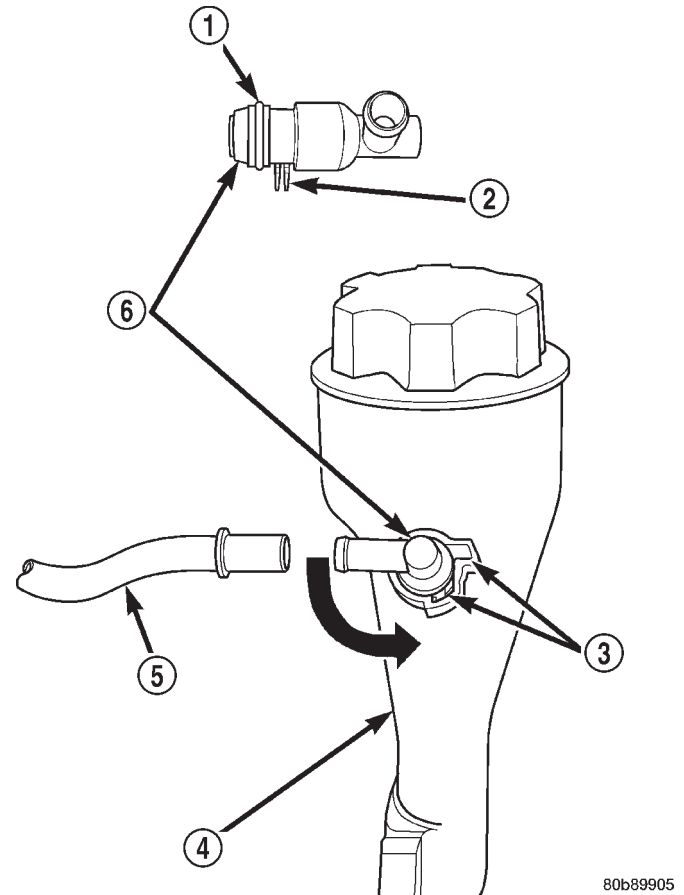
## 2.4L

(1) Check condition of PCV valve o-ring.

(2) Install PCV valve into valve cover.

(3) Install PCV valve mounting bolt.

(4) Install hose to valve.



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**Fig. 12 PCV Valve/Oil Filler Tube Location**

- 1 - O-RING
- 2 - LOCATING TABS
- 3 - CAM LOCK
- 4 - OIL FILLER TUBE
- 5 - PCV LINE/HOSE
- 6 - PCV VALVE

## 3.7L

The PCV valve is located on the oil filler tube. Two locating tabs are located on the side of the valve. These 2 tabs fit into a cam lock in the oil filler tube. An o-ring seals the valve to the filler tube.

(1) Return PCV valve back to oil filler tube by placing valve locating tabs into cam lock. Press PCV valve in and rotate valve upward. A slight click will be felt when tabs have engaged cam lock. Valve should be pointed towards rear of vehicle.

(2) Connect PCV line/hose and rubber hose to PCV valve.

## VACUUM LINES

### DESCRIPTION

A vacuum schematic for emission related items can be found on the VECI label. Refer to Vehicle Emission Control Information (VECI) Label for label location.

## VAPOR CANISTER

### DESCRIPTION

A maintenance free, EVAP canister is used on all gasoline powered models. The EVAP canister is located near the left/front corner of the fuel tank.

### OPERATION

The EVAP canister is filled with granules of an activated carbon mixture. Fuel vapors entering the EVAP canister are absorbed by the charcoal granules.

The canister serves two functions: as a temporary fuel vapor storage point while refueling the vehicle for the ORVR system, as a temporary vapor storage point while the engine is running.

Fuel tank pressure vents into the EVAP canister. Fuel vapors are temporarily held in the canister until they can be drawn into the intake manifold. The duty cycle EVAP canister purge solenoid allows the EVAP canister to be purged at predetermined times and at certain engine operating conditions.

Refer to ORVR for additional information.

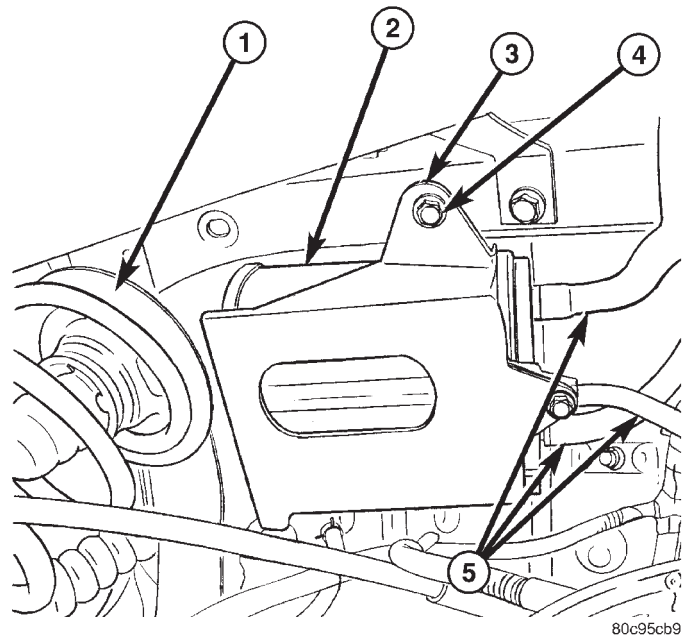
### REMOVAL

The EVAP canister is located near front of fuel tank and next to left/rear spring. (Fig. 13).

- (1) Raise vehicle.
- (2) Disconnect vacuum hoses/lines at EVAP canister. Note location of lines before removal.
- (3) Remove EVAP canister and mounting bracket assembly from body (2 bolts).
- (4) Remove canister-to-mounting bracket bolt.
- (5) Slide 2 canister mounting pins from mounting bracket (Fig. 14).

### INSTALLATION

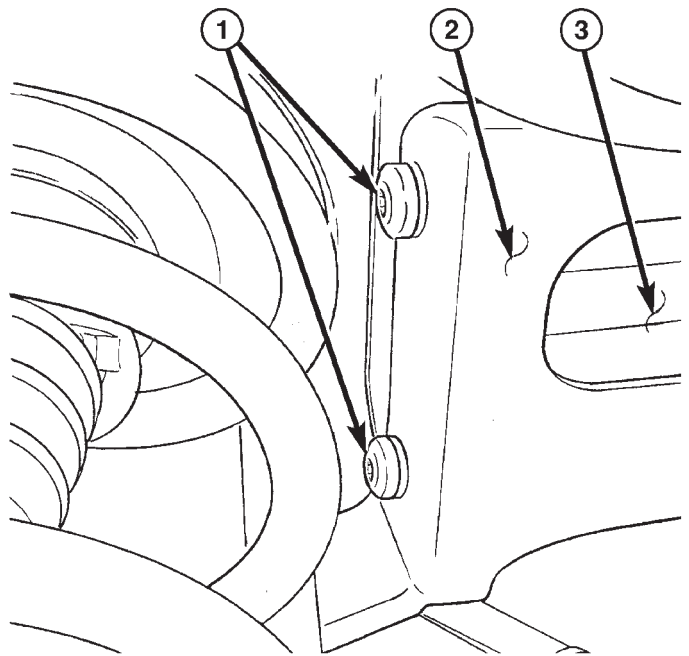
- (1) Slide 2 canister mounting pins into mounting bracket (Fig. 14).
- (2) Install canister-to-mounting bracket bolt.
- (3) Position canister and bracket assembly to body.
- (4) Install 2 mounting bracket bolts. Tighten to 47 N·m (35 ft. lbs.) torque.
- (5) Connect vacuum hoses/lines at EVAP canister.
- (6) Lower vehicle.



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**Fig. 13 EVAP CANISTER LOCATION**

- 1 - LEFT/REAR SPRING
- 2 - EVAP CANISTER
- 3 - MOUNTING BRACKET
- 4 - BRACKET BOLTS
- 5 - VACUUM LINES



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**Fig. 14 EVAP CANISTER MOUNTING PINS**

- 1 - MOUNTING PINS
- 2 - MOUNTING BRACKET
- 3 - EVAP CANISTER





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# SERVICE MANUAL COMMENTS

What errors(s) have you found?

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In order for us to assist you, please include as much details as possible when reporting an error

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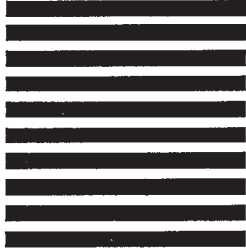


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