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1994 XJ and Supplements
Electronic Service Manual

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FOR INSTRUCTIONS

DaimlerChrysler Corporation

UNITED STATES

The special service tools referred to herein are required for certain service operations. These special service tools or their equivalent, if not obtainable through a local source, are available through the following outlet.

28635 Mound Road, Warren, Michigan 48092, U.S.A.

MILLER SPECIAL TOOLS
OTC Division, SPX Corporation

Telephone 1-800-801-5420 FAX 1-800-578-7375

CANADA

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C & D Riley Enterprises Ltd., P.O. Box 243, Amherstburg, Ontario N9V 2Z4
Telephone (519) 736-4600 FAX (519) 736-8433

INTERNATIONAL

The special service tools referred to herein are required for certain service operations. These special service tools or their equivalent, if not obtainable through a local source, are available through the following outlet.

28635 Mound Road, Warren, Michigan 48092, U.S.A.

MILLER SPECIAL TOOLS
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CAUTION

ALL SERVICE AND REBUILDING INSTRUCTIONS CONTAINED HEREIN ARE APPLICABLE TO, AND FOR THE CONVENIENCE OF, THE AUTOMOTIVE TRADE ONLY. All test and repair procedures on components or assemblies in non-automotive applications should be repaired in accordance with instructions supplied by the manufacturer of the total product.

Proper service and repair is important to the safe, reliable, operation of all motor vehicles. The service procedures recommended and described in this publication were developed for professional service personnel and are effective methods for performing vehicle repair. Following these procedures will help assure efficient economical vehicle performance and service reliability. Some of these service procedures require the use of special tools designed for specific procedures. These special tools should be used when recommended throughout this publication.

Special attention should be exercised when working with spring or tension loaded fasteners and devices such as E-Clips, Circlips, Snap rings, etc., as careless removal may cause personal injury. Always wear safety goggles whenever working on vehicles or vehicle components.

It is important to note that this publication contains various **Cautions** and **Warnings.** These should be carefully read in order to minimize the risk of personal injury, or the possibility that improper service methods may damage the vehicle or render it unsafe. It is important to note that these **Cautions** and **Warnings** cover only the situations and procedures DaimlerChrysler Corporation has encountered and recommended. DaimlerChrysler Corporation could not possibly know, evaluate, and advise the service trade of all conceivable ways that service may be performed, or of the possible hazards of each. Consequently, DaimlerChrysler Corporation has not undertaken any such broad service review. Accordingly, anyone who uses a service procedure, or tool, that is not recommended in this publication must assure oneself thoroughly that neither personal safety, nor vehicle safety, be jeopardized by the service methods they select.

NEXT PAGE ▶

CHRYSLER CORPORATION

SERVICE MANUAL and SUPPLEMENT

1994 JEEP®

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FOREWORD

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

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

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

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

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

NOTE: The acronyms, terminology and nomenclature used to identify emissions related components in this manual may have changed from prior publications. These new terms are in compliance with S.A.E. recommended practice J1930.

NEXT PAGE ▶

NOTE: Groups with the suffix "**-S**" are supplements to the original service manual publication.

GROUP TAB LOCATOR PAGE

CHRYSLER CORPORATION

SERVICE MANUAL

1994 JEEP®

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FOREWORD

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

This manual is designed as a supplement to be used along with the 1994 Jeep Cherokee/Wrangler Service Manual, 81-370-4146. It includes information related to 1994 vehicles built after December, 1993. It should be used in conjunction with the initial manual for complete vehicle coverage.

This contains general information, diagnosis, and testing procedures for the new R134a refrigerant system.

The Component and System Index of th is manual identifies the correct page for the component or system to be serviced. In addition, a Service Manual Comment form is included at the rear of this manual. Use the form to provide Chrysler Corporation with your comments and suggestions.

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

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INTRODUCTION

CONTENTS

DESIGNATIONS, LABELS/PLATES, CODES AND DIMENSIONS

INDEX

VEHICLE DESIGNATIONS

The Vehicle Designation Codes chart lists the vehicle description(s) and the corresponding vehicle designation code for each type of Jeep® vehicle (Figs. 1, 2, and 3). The vehicle designation codes are different from the Vehicle Identification Number (VIN) or body-type/style codes.

VEHICLE DESIGNATION CODES

VEHICLE DESCRIPTION	CODE
CHEROKEE - 2DR/4WD	XJ
CHEROKEE - 4DR/4WD	
CHEROKEE - 2DR/2WD	
CHEROKEE - 4DR/2WD	
WRANGLER - 4WD	YJ

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VEHICLE SAFETY CERTIFICATION LABEL

A vehicle safety certification label (Fig. 4) is attached to each Jeep® vehiclee. The label also lists the:

- gross vehicle weight rating (GVWR) and the gross front and rear axle weight ratings (GAWR's) based on a minimum tire rim size and a maximum cold tire inflation pressure;

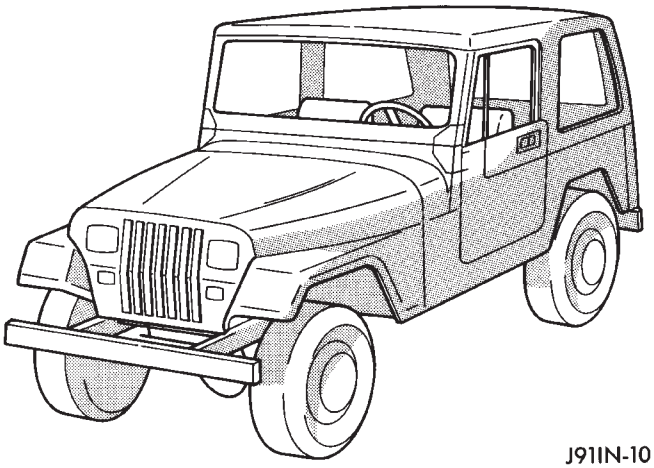

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Fig. 1 YJ—Wrangler Multi-Purpose Vehicle (With Hard Top)

- month and year of vehicle manufacture;
- vehicle identification number (VIN);
- type of vehicle and
- month, day and hour (MDH) of final assembly.

The label is located on the driver's side door edge.

VEHICLE IDENTIFICATION NUMBER (VIN) PLATE

The vehicle identification number (VIN) plate is attached to the top left side of the instrument panel at the base of the windshield. Each VIN contains 17 alpha-numerical characters. Refer to the decoding chart to determine the actual identification of a Jeep® vehicle.

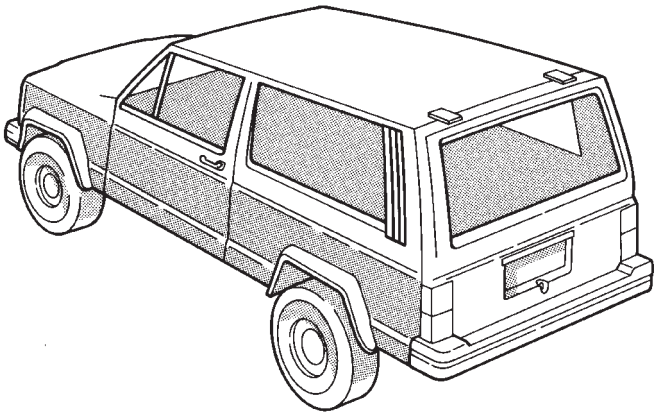

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Fig. 2 XJ—Cherokee 2-Door Multi-Purpose Vehicle

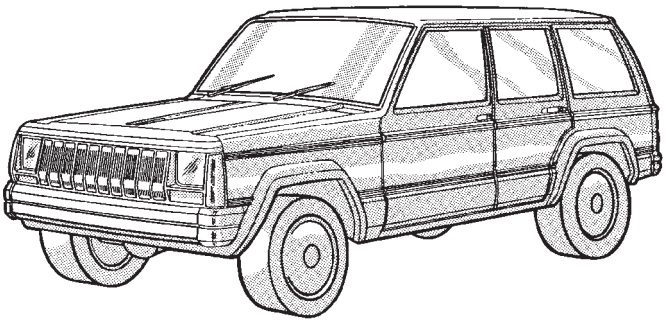

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Fig. 3 XJ—Cherokee 4-Door Multi-Purpose Vehicle

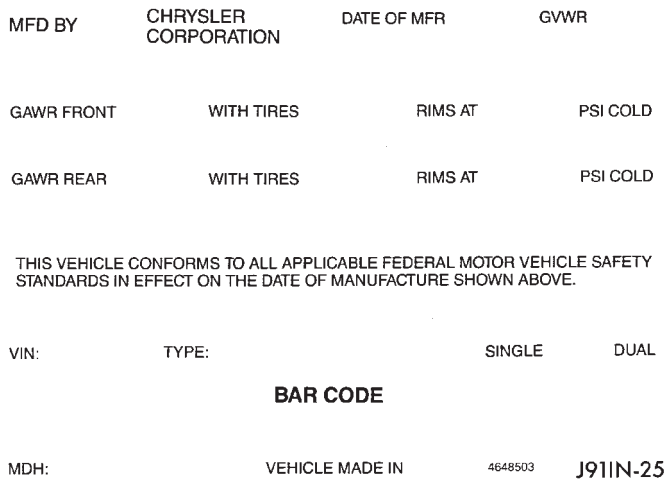


Fig. 4 Vehicle Safety Certification Label

VEHICLE CODE PLATE

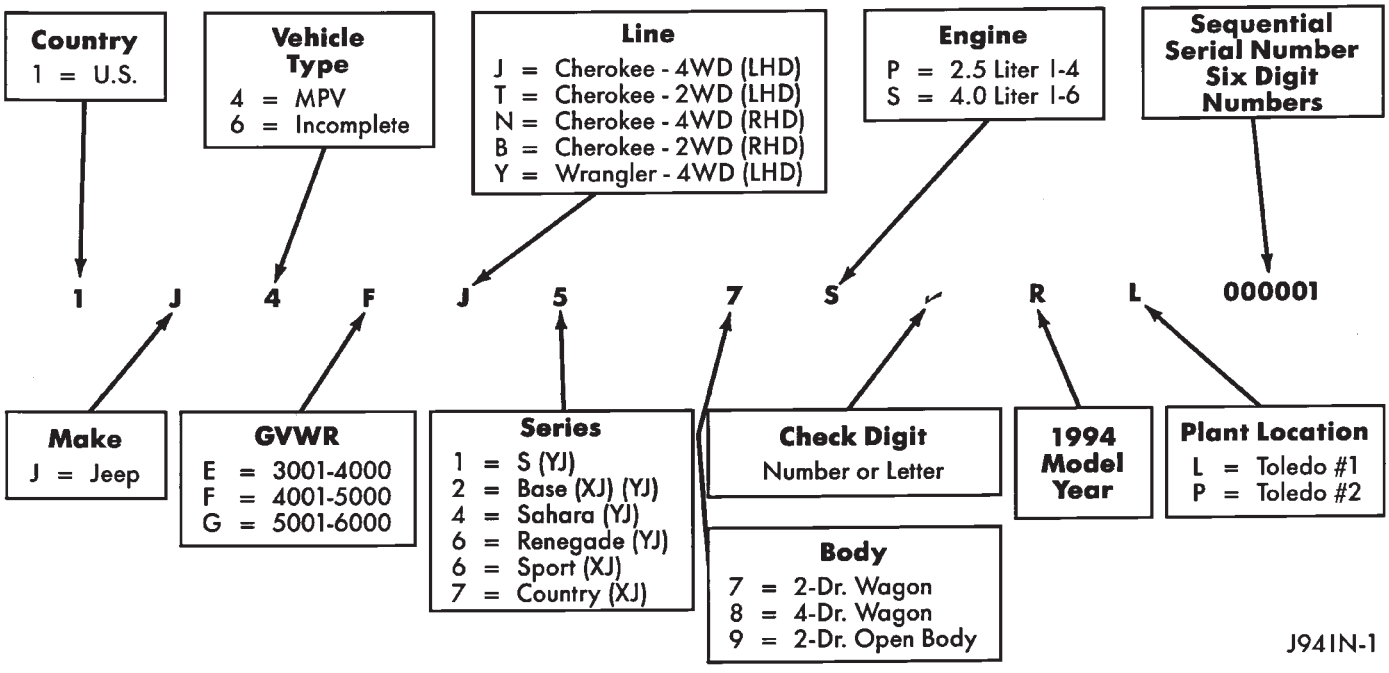
A metal vehicle code plate is attached to the left (driver) side of the dash panel in the engine compartment (Fig. 5). There can be a maximum of seven rows of vehicle information imprinted on the plate. The information should be read from left to right, starting with line 1 at the bottom of the plate up through line 7 (as applicable) at the top of the code plate.

Refer to the decoding chart to decode lines 1 up through 3.

Lines 4 through 7 (if used) on the vehicle code plate are imprinted on the plate (in sequence) according to the following:

- 3-character sales code,
- 3-digit numerical code, and
- 6-digit SEC code.

VEHICLE IDENTIFICATION NUMBER (VIN) DECODING



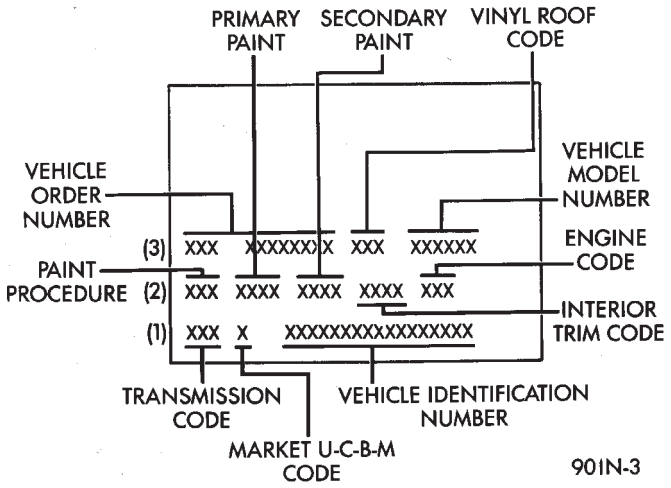


Fig. 5 Vehicle Code Plate

VEHICLE CODE DECODING

Line #1	Digit 1-3	Transmission Sales Code
	Digit 4	Open Space
	Digit 5	Market Code - U-C-B-M
	Digit 6	Open Space
	Digit 7-23	Vehicle Identification No.
Line #2	Digit 1-3	Paint Procedure
	Digit 4	Open Space
	Digit 5-8	Primary Paint
	Digit 9	Open Space
	Digit 10-13	Secondary Paint
	Digit 14	Open Space
	Digit 15-18	Trim Code
	Digit 19	Open Space
	Digit 20-22	Engine Sales Code
	Digit 23	Open Space
Line #3	Digit 1-12	Vehicle Order Number
	Digit 13	Open Space
	Digit 14-16	Vinyl Roof Code (Door Combo Code - Pillette)
	Digit 17	Open Space
	Digit 18-23	Model

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If there is not enough space left in the row for all of the 6-digit SEC code (if used):

- the unused space will remain blank, and
- the code will be listed in the next row.

The last nine positions of row 7 will contain a 2-digit code, when applicable, and a 6-digit gateline serial number (same as the last 6 numbers of the VIN).

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

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

ENGINE AND TRANSMISSION/TRANSFER CASE IDENTIFICATION

When required, refer to Group 9—Engines for all engine identification data. Refer to Group 21—Transmissions for all transmission/transfer case identification data.

MAJOR COMPONENT IDENTIFICATION

When required, refer to the applicable service information group for major component identification data.

TIRE INFLATION PRESSURE LABEL

The tire inflation pressures label is located on the glove box door inside panel (Fig. 6). The tires should also be inspected for visible wear. Also, inspect the tires for cracks, bulges and other road hazard damage. Refer to Group 22—Tires And Wheels.

VEHICLE DIMENSION DATA

The vehicle dimension data charts list the exterior and interior dimensions for each type of Jeep® vehicle.

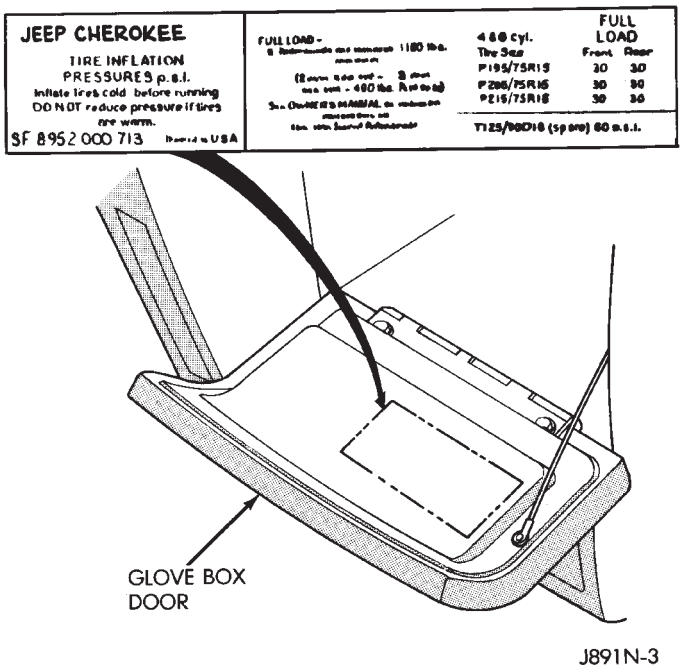

Fig. 6 Tire Inflation Pressures Label—Typical

VEHICLE LOAD DATA

The Vehicle Load Data chart lists the following information:

- the gross vehicle weight rating (GVWR),
- the gross axle weight ratings (GAWR),
- the cargo weight, and
- the passenger weight for each Jeep® type/body style.

INTERNATIONAL VEHICLE CONTROL AND DISPLAY SYMBOLS

Most of the graphic symbols illustrated in the following chart are used to identify various instrument controls and displays.

VEHICLE EXTERIOR DIMENSION DATA

MODEL NAME		MODEL	BASE cm/in	TRACK FRONT cm/in	TRACK REAR cm/in	LENGTH	OVERALL WIDTH cm/in	HEIGHT
Cherokee 2 DR-2WD	6-in Wheels	XJ	257.6	144.8	144.8	420.0	179.1	161.0
			101.4	58.0	58.0	165.3	70.5	63.4
	7-in Wheels		257.6	144.8	420.0	420.0	179.1	161.0
			101.4	58.0	58.0	165.3	70.5	63.4
Cherokee 4 DR-2WD	6-in Wheels	XJ	257.6	144.8	144.8	420.0	179.1	161.0
			101.4	57.0	57.0	165.3	70.5	63.4
	7-in Wheels		257.6	147.3	147.3	420.0	179.1	161.0
			101.4	58.0	58.0	165.3	70.5	63.4
Cherokee 2 DR-4WD	6-in Wheels	XJ	257.6	144.8	144.8	420.0	179.1	161.0
			101.4	57.0	57.0	165.3	70.5	63.4
	7-in Wheels		257.6	147.3	147.3	420.0	179.1	161.0
			101.4	58.0	58.0	165.3	70.5	63.4
Cherokee 4 DR-4WD	6-in Wheels	XJ	257.6	144.8	144.8	420.0	179.1	161.0
			101.4	57.0	57.0	165.3	70.5	63.4
	7-in Wheels		257.6	147.3	147.3	420.0	179.1	161.0
			101.4	58.0	58.0	165.3	70.5	63.4
Wrangler 2 DR-4WD		YJ	237.2	147.3	147.3	387.6	167.7	176.5
			93.4	58.0	58.0	152.6	66.0	69.5

VEHICLE INTERIOR DIMENSION DATA

VEHICLE	MODEL	HEAD FRONT cm/in	HEAD REAR cm/in	LEG FRONT cm/in	LEG REAR cm/in	SHOULDER FRONT cm/in	SHOULDER REAR cm/in	HIP FRONT cm/in	HIP REAR cm/in
Cherokee	XJ	97.3	96.5	105.7	89.7	139.7	140.2	140.5	113.0
		38.3	38.0	41.6	35.3	55.0	55.2	55.3	44.5
Wrangler (Hardtop)	YJ	102.1	102.9	100.1	88.9	134.8	143.0	134.8	91.4
		40.2	40.5	39.4	35.0	53.1	56.3	53.1	36.0

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XJ VEHICLE LOAD DATA

VEHICLE	BODY[1] STYLE	WHEEL/ TIRE	GVWR[2]	PASSENGER WEIGHT (MAX)	CARGO WEIGHT (MAX)	GAWR[3] FRONT	GAWR[3] REAR
XJ 2WD	72	15x7 P215/75R	4550	750	400	2500	2700
XJ 2WD	74	15x7 P215/75R	4600	750	400	2500	2700
XJ 4WD	72	15x7 P215/75R	4850	750	400	2500	2700
XJ 4WD	74	15x7 P215/75R	4900	750	400	2500	2700
XJ 2WD	72 W/TRAILER TOW PACKAGE	15x7 P215/75R	4550	750	400	2500	2700
XJ 2WD	74 W/TRAILER TOW PACKAGE	15x7 P215/75R	4600	750	400	2500	2700
XJ 4WD	72 W/TRAILER TOW PACKAGE	15x7 P215/75R	4850	750	400	2500	2700
XJ 4WD	74 W/TRAILER TOW PACKAGE	15x7 P215/75R	4900	750	400	2500	2700
XJ 4WD	COUNTRY[1]	15x7 P225/70R15	4900	750	400	2500	2700

All Weights Listed In Pounds.
[1] 72 = 2-Door Body
74 = 4-Door Body
[2] Gross Vehicle Weight Rating
[3] Gross Axle Weight Rating

YJ-VEHICLE LOAD DATA

VEHICLE	BODY[1] STYLE	WHEEL/ TIRE	GVWR[2]	PASSENGER WEIGHT (MAX)	CARGO WEIGHT (MAX)	GAWR[2] FRONT	GAWR[2] REAR
YJ	S	P205/75R15	4300	300	200	2500	2500
YJ	SAHARA (2TG)	P215/75R15	4300	300	200	2500	2500
YJ	SPORT (2TC)	P215/75R15	4300	300	200	2500	2500
YJ	SE	P215/75R15	4300	300	200	2500	2500

All Weights Listed In Pounds.
[1] Gross Vehicle Weight Rating
[2] Gross Axle Weight Rating

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VEHICLE CONTROL AND DISPLAY SYMBOLS

 HIGH BEAM	 FOG LIGHTS	 HEADLIGHTS, PARKING LIGHTS, PANEL LIGHTS	 TURN SIGNAL	 HAZARD WARNING	 WINDSHIELD WASHER
 WINDSHIELD WIPER	 WINDSHIELD WIPER AND WASHER	 WINDSHIELD DEMISTING AND DEFROSTING	 REAR WINDSHIELD WIPER/WASHER	 REAR WINDOW DEFOGGER	 REAR WINDOW WIPER
 REAR WINDOW WASHER	 FUEL	 ENGINE COOLANT TEMPERATURE	 BATTERY CHARGING CONDITION	 ENGINE OIL	 SEAT BELT
 BRAKE FAILURE	 PARKING BRAKE	 FRONT HOOD	 VENTILATING FAN	 HORN	 LIGHTER

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SPECIFICATIONS

SPECIFICATION NOTATIONS

All torque specifications listed in this service manual are in both metric system and SAE/English system.

WARNING: THE USE OF INCORRECT ATTACHING HARDWARE CAN RESULT IN COMPONENT DAMAGE AND/OR PERSONAL INJURY.

During all procedures, it is important to retain the original attaching hardware. If the hardware is not reusable, replace new hardware with equivalent specifications.

METRIC SYSTEM NOTATION

The following conversion chart will assist in converting SAE/English units to equivalent metric units.

TORQUE SPECIFICATIONS

TORQUE CHARTS

If applicable, torque chart(s) for screws, bolts and nuts is/are provided at the end of each service information group. Refer to the Standard Torque Specifications chart and the bolt grade/class identification illustrations (Figs. 7 and 8).

It is important to be aware that the torque values listed in the chart are based on clean and dry bolt threads. Reduce the applicable listed torque value by 10 percent when the bolt threads are lubricated with engine oil and by 20 percent if new, plated bolts are being tightened.

Various sizes of (Torx) head fasteners are used as attaching hardware for numerous components in Jeep® vehicles.

BOLT THREAD AND GRADE/CLASS IDENTIFICATION

THREAD IDENTIFICATION

SAE and metric bolt/nut threads are different. The difference is described in the Thread Notation chart.

GRADE/CLASS IDENTIFICATION

The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. The grade identification is determined by the line marks on the top of each bolt head (Fig. 7). The actual bolt strength grade corresponds to the number of line marks plus 2. For example:

- a grade 2 bolt has no line marks on top of the bolt head;
- a grade 5 bolt has 3 line marks on top of the bolt head;
- a grade 7 bolt has 5 line marks on top of the bolt head; and
- a grade 8 bolt has 6 line marks on top of the bolt head.

The most commonly used metric bolt strength classes are 9.8 and 12.9. The metric strength class identification number is imprinted on the head of the bolt (Fig. 8). The higher the class number, the greater the bolt strength. Some metric-dimension nuts are also imprinted with a single-digit strength class identification number on the nut face.

CONVERSION FORMULAS AND EQUIVALENT VALUES

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

COMMON METRIC EQUIVALENTS

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

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STANDARD TORQUE VALUES

BOLT TORQUE

BOLT SIZE	GRADE 5		GRADE 8	
	N·m	ft-lbs (in-lbs)	N·m	ft-lbs (in-lbs)
1/4-20	11	(95)	14	(125)
1/4-28	11	(95)	17	(150)
5/16-18	23	(200)	31	(270)
5/16-24	27	20	34	25
3/8-16	41	30	54	40
3/8-24	48	35	61	45
7/16-14	68	50	88	65
7/16-20	75	55	95	70
1/2-13	102	75	136	100
1/2-20	115	85	149	110
9/16-12	142	105	183	135
9/16-18	156	115	203	150
5/8-11	203	150	264	195
5/8-18	217	160	285	210
3/4-16	237	175	305	225

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THREAD NOTATION—SAE AND METRIC

INCH		METRIC	
5/16-18		M8 X 1.25	
THREAD MAJOR DIAMETER IN INCHES	NUMBER OF THREADS PER INCH	THREAD MAJOR DIAMETER IN MILLIMETERS	DISTANCE BETWEEN THREADS IN MILLIMETERS

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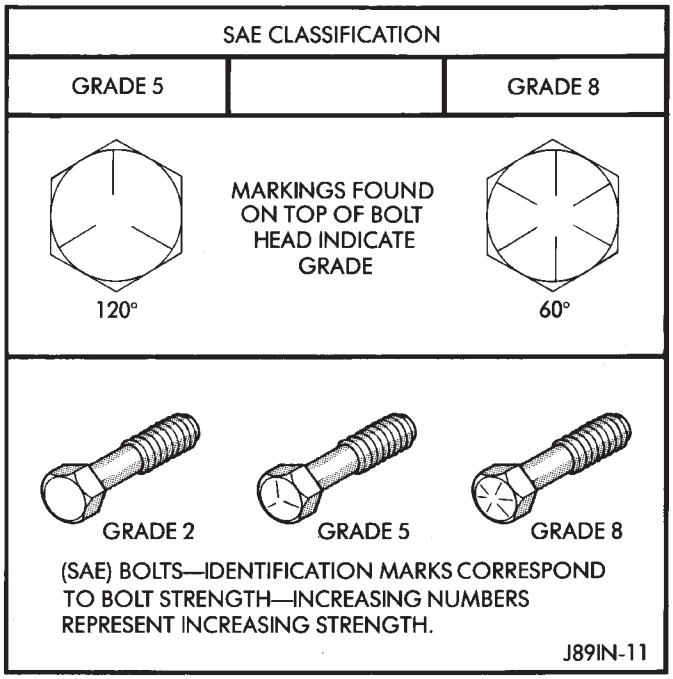


Fig. 7 SAE Bolt Grade Identification

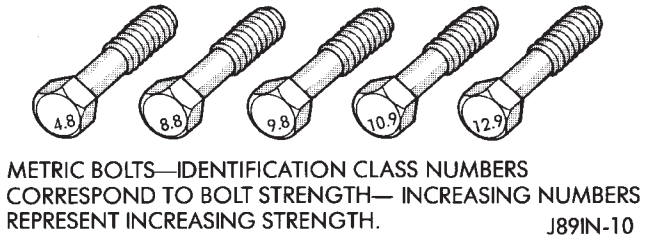


Fig. 8 Metric Bolt Class Identification

TORQUE CONVERSION

in-lbs to N•m

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

N•m to in-lbs

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

ft-lbs to N•m

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

N•m to ft-lbs

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

in. to mm

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

mm to in.

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

LUBRICATION AND MAINTENANCE

CONTENTS

GENERAL INFORMATION

INDEX

INTRODUCTION

Jeep® lubrication and maintenance is divided into required and recommended service tasks.

The recommendations and procedures listed in this group are intended for Jeep® Dealer Service Personnel.

Because conditions vary, it is necessary to schedule service tasks according to a time interval as well as a distance interval.

It is the owner's responsibility to have vehicle serviced. Owner is to pay for labor and necessary parts that are not covered by the warranty.

Additional lubrication and maintenance information is listed in the Owner's Manual, which is included with the vehicle.

SEVERE DRIVING CONDITIONS

When a vehicle is subjected to a severe driving condition, time between recommended maintenance should be decreased.

Refer to Engine Maintenance for the engine oil and filter maintenance interval when involved with a severe driving condition.

A severe driving condition is defined as either:

- frequent short trip driving less than 24 km (15 miles);
- frequent driving in a dusty environment;
- trailer towing;
- extensive engine idling;
- sustained high-speed operation;
- desert operation;
- frequent starting and stopping;
- cold-climate operation;
- off-road driving; or
- commercial service.

To service a Jeep® vehicle for a severe driving condition, change all the lubricating fluids and lubricate:

- the body components,
- all the driveline coupling joints, and
- the steering linkage

more often than for a normal driving condition to prevent excessive wear of the components.

DUSTY AREAS

Driving in an area with dust-filled air increases the risk of particles entering the engine and crankcase. With this type of severe driving condition, attention should be given to the engine and crankcase components.

OFF-ROAD (4WD) OPERATION

After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

HARSH SURFACE ENVIRONMENTS

After vehicle operation in a harsh surface environment, the following components should be inspected and cleaned as soon as possible:

- brake drums,
- brake linings,
- front wheel bearings (2WD vehicles only), and
- axle coupling joints.

This will prevent wear and/or unpredictable brake action.

ROUTINE SERVICE

The following routine vehicle service is highly recommended on a monthly basis.

TIRES—Inspect the tires for unusual wear/damage and determine if the inflation pressure is acceptable for the vehicle load.

BATTERY—Inspect and clean the terminals. Tighten the terminals, if necessary.

FLUIDS—Determine if the coolant, brake fluid, power steering, automatic transmission, and clutch fluid level are acceptable. Add fluid, if necessary.

LIGHTS/ELECTRICAL—Test all the electrically operated systems in the vehicle for proper operation.

It is also recommended that the engine oil level and the windshield washer fluid level be determined (and corrected) during each fuel fill-up.

FUEL REQUIREMENTS

All Jeep® engines require the use of unleaded gasoline. In addition, the fuel must have a minimum octane rating of 87.

CAUTION: UNLEADED FUEL ONLY must be used in vehicles equipped with a catalyst emission control system. All vehicles have reminders printed on the instrument panel (Fig. 1) and on the fuel filler door (Fig. 2). Vehicles also have fuel filler tubes that are designed to accept only the small-diameter unleaded gasoline nozzles. It is illegal to defeat the design of an unleaded fuel filler tube.

CLASSIFICATION OF LUBRICANTS

Lubricating fluids and chassis component lubricants are classified and graded according to standards recommended by the:

- Society of Automotive Engineers (SAE),

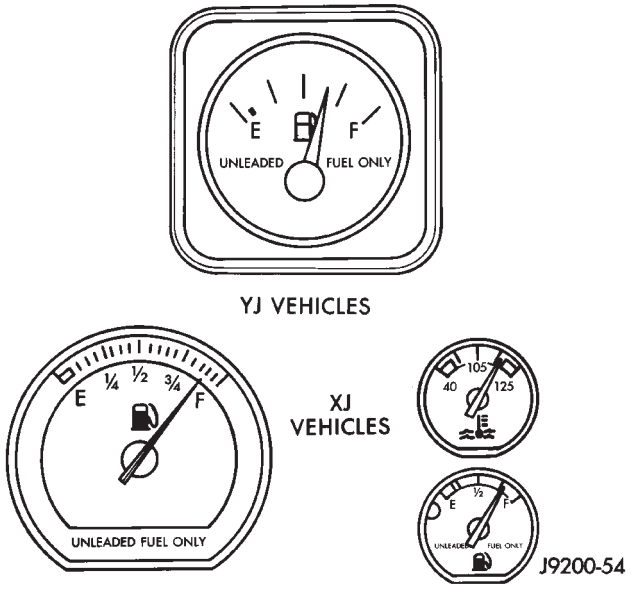


Fig. 1 Unleaded Fuel Only Reminders—Fuel Gauge

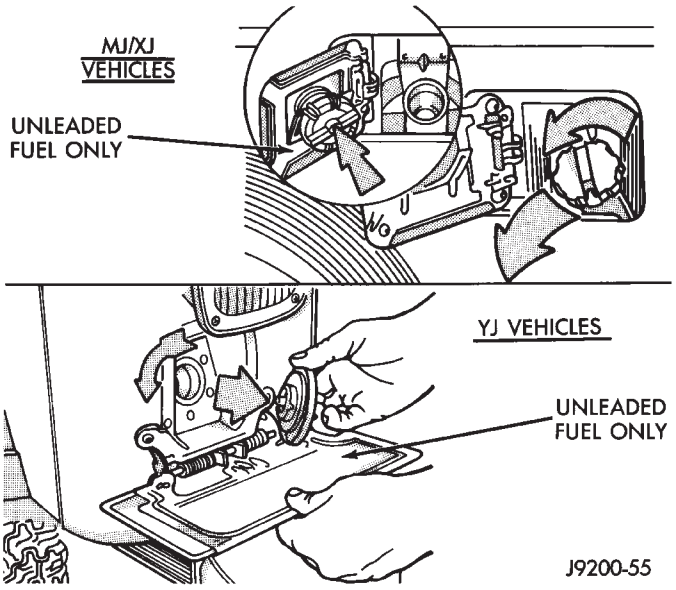


Fig. 2 Unleaded Fuel Only Reminder—Fuel Filler Door

- American Petroleum Institute (API), and
- National Lubricating Grease Institute (NLGI).

ENGINE OIL

SAE VISCOSITY GRADE

An SAE viscosity grade is used to specify viscosity of engine oil. SAE 30 specifies a single viscosity engine oil. Engine oils also have multiple viscosities (Fig. 3).

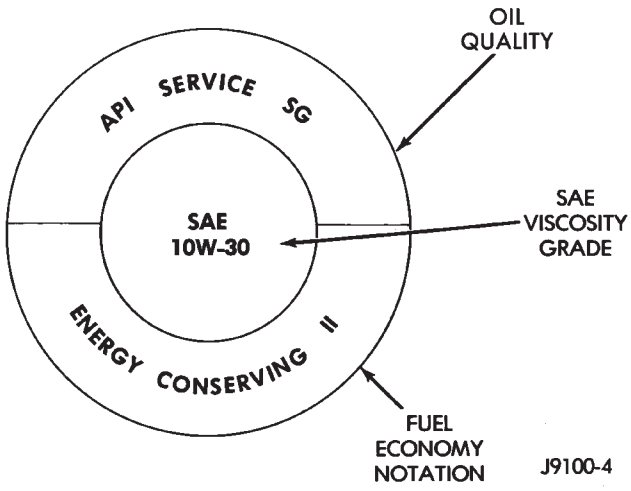


Fig. 3 SAE Oil Viscosity Grade & API Service Grade

The viscosity grade of an oil is an indicator of its thickness or flow capability. The lower the number, the better the flow. The second viscosity grade number (without a W suffix) is the warm/hot-temperature viscosity. The viscosity increases with engine temperature. With a single viscosity grade, the oil viscosity is valid only for one narrow temperature range.

Above that temperature range the viscosity will decrease, and below that range the viscosity will increase.

An engine oil with an SAE 5W-30 viscosity grade provides good flow capability for fast cold weather engine starts. The viscosity will then increase with engine temperature to provide good high-temperature engine lubrication.

API SERVICE GRADE

The API Service Grade specifies the type of engine/operating conditions for which the oil is intended. The API Service Grade specifications also apply to energy conserving engine oils (Fig. 3). The API certification mark is also used indicating that the oil is certified to meet the most critical requirements established by the manufacturer (Fig. 4).

9400-9

Fig. 4 The API Engine Oil Certification Mark

For maximum protection, use API Service Grade SG, SG/CD or SG/CE engine oil in Jeep® engines.

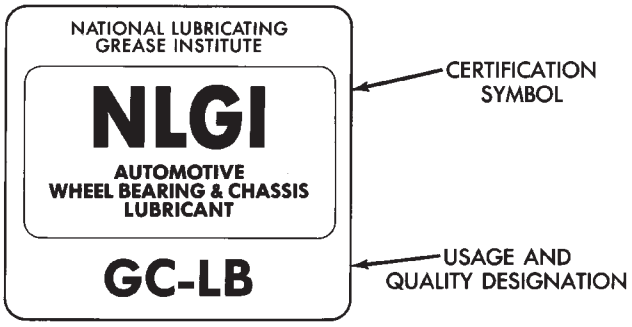
GEAR LUBRICANTS

A dual SAE viscosity grade is also used to specify the viscosity of multipurpose gear lubricants.

The API lubrication quality grade designation identifies gear lubricants in terms of recommended usage.

CHASSIS COMPONENT AND WHEEL BEARING LUBRICANTS

The chassis component and wheel bearing lubricants are identified by the NLGI Certification Symbol (Fig. 5).



J9200-57

Fig. 5 NLGI Lubricant Certification/Identification Symbol

The letter **G** indicates wheel bearing lubricant and the letter **L** indicates chassis lubricant. When the letters are combined the lubricant can be used for dual applications. The suffix letters **C** and **B** indicates quality level of the lubricant. Use only lubricants that display the NLGI Certification Symbol.

RECOMMENDED LUBRICANT AND REPLACEMENT PARTS

Jeep® vehicles are engineered to provide many years of dependable operation. When necessary, **MOPAR brand lubricants and genuine replacement parts** are highly recommended.

COMPONENTS REQUIRING NO LUBRICATION

There are many components that should not be lubricated. The components that should **not** be lubricated are:

- air pumps;
- generator bearings;
- drive belts;
- drive belt idler pulleys;
- rubber bushings;
- starter motor bearings;
- suspension strut bearings;
- throttle control cables;
- throttle linkage ball joints; and
- water pump bearings.

FLUID CAPACITIES

	CAPACITIES		
ENGINE OIL	QUARTS	LITERS	API SERVICE GRADES
2.5L Engine	4.0	3.8	SG, SG/CD or SG/CE
4.0L Engine	6.0	5.7	SG, SG/CD or SG/CE

COOLING SYSTEM	QUARTS	LITERS
2.5L Engine (XJ Vehicles)	10.0*	9.5*
2.5L Engine (YJ Vehicles)	9.0**	8.5**
4.0L Engine (XJ Vehicles)	12.0*	11.4*
4.0L Engine (YJ Vehicles)	10.5**	9.9**

*Includes 2.3 qt./2.2L for coolant reserve/recovery reservoir. **Includes 1 qt./0.9L for coolant recovery reserve reservoir.

TRANSMISSIONS (APPROX. CHANGE CAPACITIES)	PINTS	LITERS	TYPE
AX-5 (4 WD)	7.0	3.3	Man. 5 Speed
AX-15 (4 WD)	6.75	3.2	Man. 5 Speed
AX-5 (2 WD)	7.4	3.5	Man. 5 Speed
AX-15 (2 WD)	6.7	3.15	Man. 5 Speed
AW-4 (J Vehicles)	8.5*	4.0*	Automatic
998 (YJ Vehicles)	8.0*	3.8*	Automatic

Use API GL5/SAE 75W-90 grade lubrication for manual transmissions. Use MERCON® type ATF for AW-4 automatic transmission. Use DEXRON II® or ATF PLUS type 7176 for 998 automatic transmission. *Quantity will vary according to amount of ATF that remained in the converter.

FRONT/REAR AXLES	PINTS	LITERS	API QUALITY GRADE./SAE VISCOSITY
XJ Vehicles (1) (3)	2.5	1.2	API GL5/SAE 75W-90
YJ Vehicles (3) (2)	4.4	2.1	API GL5/SAE 75W-90
Heavy Duty Rear Axle (3) (2)	3.0	1.4	API GL5/SAE 75W-90

(1) With Trailer Two Class III Hitch (5000 lbs) use 75W-140 Synthetic Gear Lubricant in rear axle.
(2) With Trailer Two Package use API GL5 80W-140 Lubricant in rear axle.
(3) With Rear Axle Limited Slip Differential, Add 2 ounces of Friction Modifier Additive.

TRANSFER CASE	PINTS	LITERS	TYPE ATF
SELEC-TRAC 242 (XJ Vehicles)	3.0	1.4	ATF PLUS, MERCON® or DEXRON II®
COMMAND-TRAC 231 (XJ VEHICLES)	2.2	1.0	ATF PLUS, MERCON® or DEXRON II®
COMMAND-TRAC 231 (YJ VEHICLES)	3.25	1.5	ATF PLUS, MERCON® or DEXRON II®

FUEL TANK	GALLONS	LITERS
XJ Vehicles	20.2	76.4
YJ Vehicles (Standard)	15.0	56.8
YJ Vehicles (Optional)	20.0	75.7

MAINTENANCE SCHEDULES

INTRODUCTION

Chrysler Corporation has compiled recommended lubrication and maintenance schedules and procedures to help reduce premature wear or failure over a broad range of operating conditions.

SEVERE SERVICE MAINTENANCE

If the vehicle is involved with a severe driving condition, after each 4 800-km (3,000-miles)/3-month interval. A severe driving condition includes:

- frequent short trip driving less than 24 km (15 miles);
- frequent driving in a dusty environment;
- trailer towing;
- extensive engine idling;
- sustained high-speed operation;
- desert operation;
- frequent starting and stopping;
- cold-climate operation;
- off-road driving; or
- commercial service.

MAINTENANCE SCHEDULES

AT EACH STOP FOR FUEL

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

ONCE A MONTH

- Check tire pressure and look for unusual wear or damage.
- Inspect battery and clean and tighten terminals as required.
- Check electrolyte level and add water as needed.
- Check fluid levels of coolant reservoir, power steering and transmission and add as needed.
- Check all lights and all other electrical items for correct operation.
- Check rubber seals on each side of the radiator for proper fit.

7,500 MILES (12 000 KM) OR AT 6 MONTHS

- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

15,000 MILES (24 000 KM) OR AT 12 MONTHS

- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Check fluid level in battery.
- Rotate Tires.

22,500 MILES (36 000 KM) OR AT 18 MONTHS

- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

30,000 MILES (48 000 KM) OR AT 24 MONTHS

- Replace air cleaner filter.
- Replace spark plugs.
- Adjust drive belt.
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Check fluid level in battery.
- Drain and refill automatic transmission.
- Drain and refill transfer case.
- Rotate Tires.

37,500 MILES (60 000 KM) OR AT 30 MONTHS

- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Drain and refill manual transmission.
- Rotate Tires.

45,000 MILES (72 500 KM) OR AT 36 MONTHS

- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Check fluid level in battery.
- Rotate Tires.

52,500 MILES (84 500 KM) OR AT 42 MONTHS

- Flush and replace engine coolant.
- Check engine coolant system hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

60,000 MILES (96 500 KM) OR AT 48 MONTHS.
- Replace air cleaner filter.
- Replace distributor cap and rotor.
- Replace ignition wires.
- Replace spark plugs.
- Adjust or replace drive belt.
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Replace fuel filter (not required for Calif. vehicles).
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Check fluid level in battery.
- Drain and refill automatic transmission.
- Drain and refill transfer case.
- Rotate Tires.

67,500 MILES (108 500 KM) OR AT 54 MONTHS
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

75,000 MILES (120 500 KM) OR AT 60 MONTHS
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Drain and refill manual transmission.
- Rotate Tires.

82,500 MILES (133 000 KM) OR AT 66 MONTHS
- Flush and replace engine coolant.
- Check engine coolant system, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

90,000 MILES (145 000 KM) OR AT 72 MONTHS
- Replace air cleaner filter.
- Replace spark plugs.
- Adjust drive belt.
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Check fluid level in battery.
- Drain and refill automatic transmission.
- Drain and refill transfer case.
- Rotate Tires.

97,500 MILES (157 000 KM) OR AT 78 MONTHS
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

105,000 MILES (169 000 KM) OR AT 84 MONTHS
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

112,500 MILES (181 000 KM) OR AT 90 MONTHS
- Flush and replace engine coolant.
- Check engine coolant system hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Rotate Tires.

120,000 MILES (193 000 KM) OR AT 96 MONTHS
- Replace air cleaner filter.
- Replace distributor cap and rotor.
- Replace ignition wires.
- Replace spark plugs.
- Adjust or replace drive belt.
- Check engine coolant level, hoses and clamps.
- Change engine oil.
- Replace engine oil filter.
- Check exhaust system.
- Replace fuel filter (not required for Calif. vehicles).
- Lubricate steering linkage (4x4 models).
- Lubricate propeller shaft universal joints.
- Check fluid level in battery.
- Drain and refill automatic transmission.
- Drain and refill transfer case.
- Rotate Tires.

JUMP STARTING, HOISTING AND TOWING

JUMP STARTING

WARNING: DO NOT ATTEMPT TO PUSH OR TOW A VEHICLE TO START THE ENGINE. UNBURNED FUEL COULD ENTER THE EXHAUST CATALYTIC CONVERTER AND IGNITE AFTER THE ENGINE IS STARTED. THIS COULD CAUSE THE CONVERTER TO OVERHEAT AND RUPTURE.

BOOSTER BATTERY

WARNING: TO PREVENT PERSONAL INJURY OR CLOTHING DAMAGE, DO NOT ALLOW BATTERY (ACID) TO CONTACT EYES, SKIN OR CLOTHING. DO NOT LEAN OVER A BATTERY WHEN CONNECTING JUMPER CABLES. DO NOT ALLOW THE POSITIVE AND NEGATIVE CABLE CONNECTOR CLAMPS TO CONTACT EACH OTHER. KEEP OPEN FLAMES AND SPARKS AWAY FROM THE BATTERY VENT HOLES. ALWAYS WEAR EYE PROTECTION WHEN INVOLVED WITH BATTERIES.

If it is necessary to use a booster battery and jumper cables to start an engine use the following procedure.

(1) Engage the parking brake and shift the automatic transmission to PARK, manual transmission shift to NEUTRAL.

(2) Turn off all lights, the heater-A/C blower motor, and all other electrical loads.

WARNING: WHEN THE AIR TEMPERATURE IS BELOW THE FREEZING POINT (0°C OR 32°F), THE ACID IN A DISCHARGED VEHICLE BATTERY CAN FREEZE. DO NOT ATTEMPT TO JUMP START AN ENGINE BEFORE DETERMINING THE CONDITION OF THE BATTERY.

(3) Inspect the general condition of the battery.

CAUTION: Do not permit metal surfaces on vehicles to contact because this could establish ground continuity between vehicle bodies.

(4) Attach a red cable connector clamp to the positive (+) terminal on the booster battery. Connect the other red cable connector clamp to the positive (+) terminal on the discharged battery (Fig. 6).

CAUTION: Use care to avoid allowing the positive (+) and negative (-) cable clamps to contact each other. DO NOT lean over the battery when connecting the cable clamps.

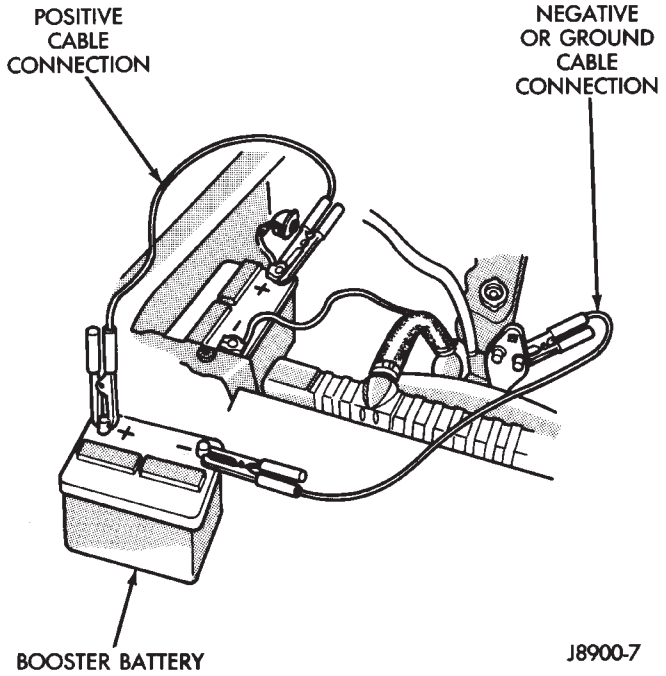


Fig. 6 Jumper Cable Connections

WARNING: DO NOT CONNECT A JUMPER CABLE CONNECTOR CLAMP TO THE NEGATIVE POST OF THE DISCHARGED BATTERY.

(5) Connect a black jumper cable connector clamp to the negative (-) terminal on the booster battery. Connect the other black jumper cable connector clamp to a good ground.

(6) Start the engine.

WARNING: THE USE OF ANY JUMPER CABLE DISCONNECTION PROCEDURE OTHER THAN THAT DESCRIBED BELOW COULD RESULT IN:

- **PERSONAL INJURY CAUSED BY BATTERY ELECTROLYTE SQUIRTING FROM THE BATTERY VENTS.**
- **PERSONAL INJURY AND/OR PROPERTY DAMAGE CAUSED BY BATTERY EXPLOSION.**
- **DAMAGE TO THE BOOSTER VEHICLE OR THE DISABLED VEHICLE CHARGING SYSTEM.**

(7) After the engine is started, or if the engine fails to start, the jumper cables must be disconnected in the following order:

- Black (negative) cable connector clamp from the engine ground contact.
- Black (negative) cable connector clamp from the negative terminal (-) on the booster battery.
- Red (positive) cable connector clamps from the positive (+) terminals on both batteries.

PORTABLE STARTING UNIT

There are many types of portable starting units available for starting engines. Follow the manufacturer's instructions when involved in any engine starting procedure.

HOISTING RECOMMENDATIONS

FLOOR JACK

When properly positioned, a floor jack can be used to lift a Jeep® vehicle. Support the vehicle in the raised position with jack stands at the front and rear ends as applicable (Fig. 7).

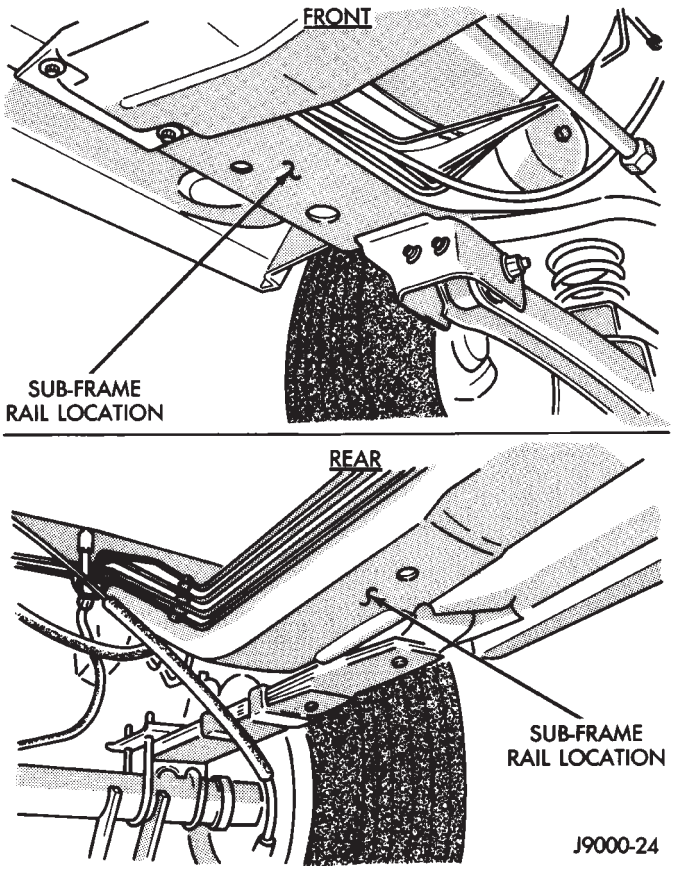


Fig. 7 Correct Vehicle Lifting Locations—Typical

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

- an axle tube,
- a body side sill,
- a steering linkage component,
- a drive shaft,
- the engine or transmission oil pan,
- the fuel tank, or
- a front suspension arm.

Use the correct sub-frame rail or frame rail lifting locations only (Fig. 7).

HOIST

A Jeep® vehicle can be lifted with a swiveling-arm type hoist; with a wheel-lift, twin-post hoist; or with a ramp-type, drive-on hoist.

When a swiveling-arm, frame-contact type hoist is used, ensure that the lifting pads are positioned at the correct sub frame rail (Fig. 7).

TOWING RECOMMENDATIONS

TOWING EQUIPMENT

A vehicle equipped with SAE approved sling-type towing equipment can be used to tow all Jeep® vehicles (Fig. 8). When it is necessary to rear-tow a vehicle, use the wheel-lift towing method with a tow dolly located under the front wheels. A vehicle with flat-bed towing equipment can also be used to transport a disabled vehicle.

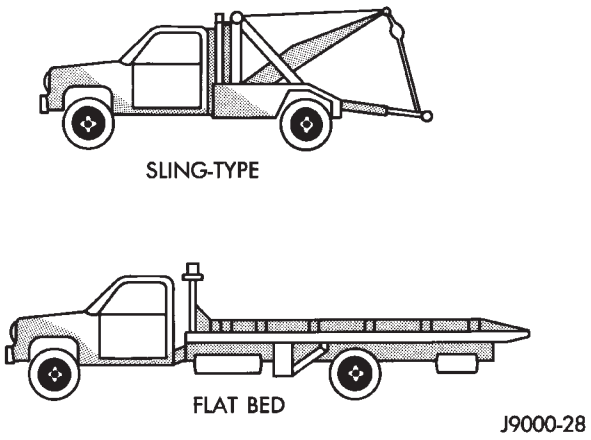


Fig. 8 Tow Vehicles With Approved Equipment

A wooden crossbeam with spacer blocks could possibly be required for proper connection when using the sling-type, front-end towing method (Fig. 9).

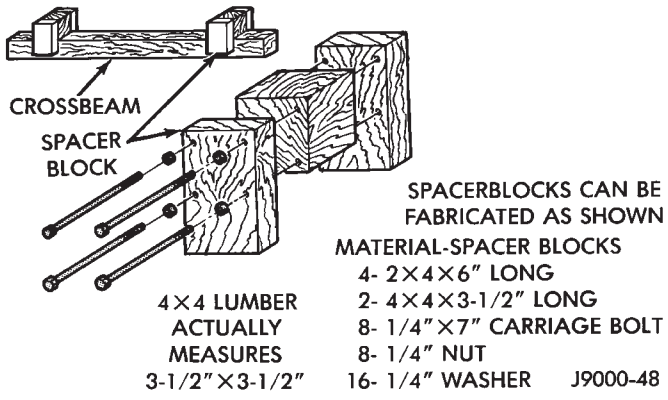


Fig. 9 Crossbeam & Spacer Block Construction

SAFETY PRECAUTIONS

The following safety precautions must be considered when preparing for and during a vehicle towing operation:

• if the vehicle is damaged, secure the loose and protruding parts;
• always use a safety chain system that is independent of the lifting and towing equipment;
• do not allow any of the towing equipment to contact the disabled vehicle's fuel tank;
• do not allow anyone to be under the disabled vehicle while it is lifted by the towing equipment;
• do not allow passengers to ride in a vehicle being towed;
• always observe all state and local laws involving warning signals, night illumination, speed, etc.
• do not attempt a towing operation that could jeopardize the safety of the operator, bystanders or other motorists;
• do not exceed a towing speed of 48 km/h (30 mph);
• avoid towing distances of more than 24 km (15 miles) whenever possible; and
• do not attach tow chains or a tow sling to a bumper, the steering linkage, the universal joints, the constant velocity (CV) joints, or a drive shaft.

CLEARANCES AND RAMP ANGLE

SURFACE CLEARANCE

The end of the disabled vehicle that is attached to the tow vehicle should be lifted a minimum of 10 cm or four inches off the surface. Inspect to ensure that the opposite end of the disabled vehicle has clearance from the surface.

RAMP ANGLE—FLAT-BED TOWING

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

SLING-TYPE, FRONT-END TOWING

XJ VEHICLES

Use the following guidelines when the tow vehicle is attached to the front end of a disabled vehicle.

(1) Always tow with the front wheels lifted off the surface and turned all the way to the right.

(2) Attach a J-hook to the disabled vehicle at the left side of the axle (Fig. 10).

(3) Position the sling crossbar close to the J-hook and below the front bumper (Fig. 11).

(4) Secure a chain to the right side of vehicle by placing it over the axle shaft tube and attaching it to a structural member.

(5) Attach the safety chains to the vehicle.

2WD With Manual Or Automatic Transmission

(6) Turn the ignition switch to the OFF position to unlock the steering wheel.

(7) Shift the transmission to NEUTRAL, mark the drive shaft and axle drive pinion gear shaft yoke for installation reference. Remove the drive shaft from the vehicle.

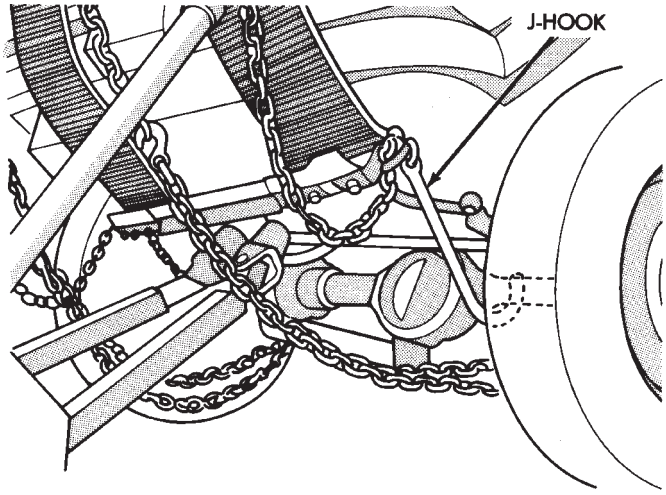


Fig. 10 Sling-Type, Front-End Towing (XJ Front View)

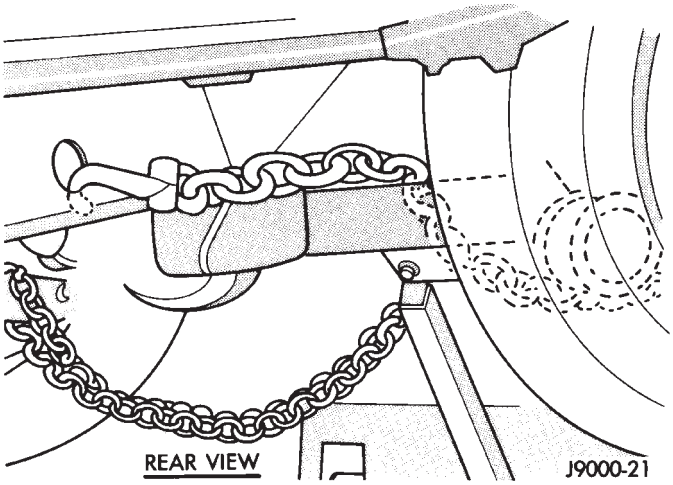


Fig. 11 Sling-Type, Front-End Towing (XJ Rear View)

(8) Cover the exposed end of the transmission extension housing and the universal joints. Store the drive shaft in a safe place.

4WD, Command-Trac (231 Part-Time 4WD Transfer Case) And Manual Transmission

(6) Turn the ignition switch to the OFF position to unlock the steering wheel.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(7) Shift the manual transmission into a forward gear and the transfer case to NEUTRAL.

4WD, Command-Trac (231 Part-Time 4WD Transfer Case) And Automatic Transmission

(6) Turn the ignition switch to the OFF position to unlock the steering wheel.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(7) Shift the automatic transmission to PARK and the transfer case to NEUTRAL.

4WD, Selec-Trac (242 Full-Time 4WD Transfer Case) And Automatic Transmission

(6) Turn the ignition switch to the OFF position to unlock the steering wheel.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(7) Shift the automatic transmission to PARK and the transfer case to NEUTRAL.

YJ VEHICLES

Use the following guidelines when the tow vehicle is attached to the front of a disabled vehicle.

(1) Always tow with the front wheels lifted off the surface and turned all the way to the right.

CAUTION: Use tow chains with T-hooks for connecting to the disabled vehicle's frame rails (Fig. 12). Never use J-hooks.

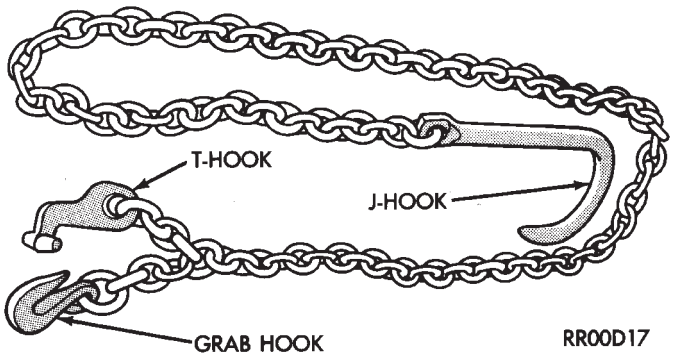


Fig. 12 Tow Chains & Hooks

(2) Attach the T-hooks to the slots in the front end of each frame rail (Fig. 13).

(3) Position each safety chain over the top of each front spring and inboard of each front spring shackle.

(4) Double wrap each chain.

(5) Position the sling crossbar under the front bumper.

Command-Trac (231 Part-Time 4WD Transfer Case) And Manual Transmission

(6) Turn the ignition switch to the OFF position to unlock the steering wheel.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(7) Shift the manual transmission to a forward gear and the transfer case to NEUTRAL.

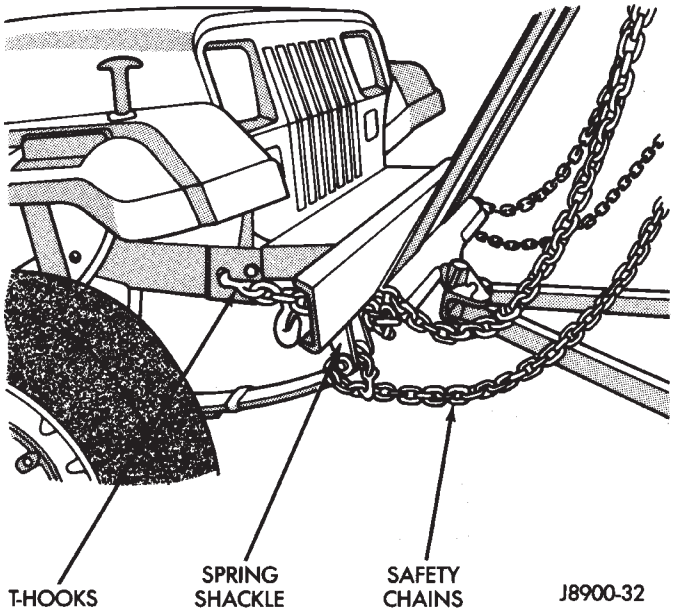


Fig. 13 Sling-Type, Front-End Towing (YJ Vehicles)

Command-Trac (231 Part-Time 4WD Transfer Case) And Automatic Transmission

(6) Turn the ignition switch to the OFF position to unlock the steering wheel.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(7) Shift the automatic transmission to PARK and the transfer case to NEUTRAL.

SLING-TYPE, REAR-END TOWING

YJ VEHICLES—Use wheel-lift equipment ONLY when towing from the rear end of the vehicle is necessary.

XJ VEHICLES—Use the following guidelines when the tow vehicle is attached to the rear of the disabled vehicle.

(1) Attach J-hooks around the axle shaft tubes outboard of the shock absorber.

(2) Place the sling crossbar under and forward of the bumper.

(3) Attach safety chains around the frame rails.

2WD With Manual Or Automatic Transmission

(1) Attach J-hooks around the axle shaft tubes outboard of the shock absorber.

(2) Place the sling crossbar under and forward of the bumper.

(3) Attach safety chains around the frame rails.

(4) Turn the ignition switch to the OFF position to unlock the steering wheel.

(5) Clamp the steering wheel with the front wheels in the straight ahead position. Do not use the steering column lock as a substitute for a clamping device.

(6) Shift the transmission to NEUTRAL.

4WD, Command-Trac (231 Part-Time 4WD Transfer Case) And Manual Transmission

(1) Attach J-hooks around the axle shaft tubes outboard of the shock absorber.

(2) Place the sling crossbar under and forward of the bumper.

(3) Attach safety chains around the frame rails.

(4) Turn the ignition switch to the OFF position to unlock the steering column.

(5) Clamp the steering wheel with the front wheels in the straight ahead position. Do not use the steering column lock as a substitute for a clamping device.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(6) Shift the transmission to a forward gear and the transfer case to NEUTRAL.

4WD, Command-Trac (231 Part-Time 4WD Transfer Case) And Automatic Transmission

(1) Attach J-hooks around the axle shaft tubes outboard of the shock absorber.

(2) Place the sling crossbar under and forward of the bumper.

(3) Attach safety chains around the frame rails.

(4) Turn the ignition switch to the OFF position to unlock the steering column.

(5) Clamp the steering wheel with the front wheels in the straight ahead position. Do not use the steering column lock as a substitute for a clamping device.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(6) Shift the transmission to PARK and the transfer case to NEUTRAL.

4WD, Selec-Trac (242 Full-Time 4WD Transfer Case) And Automatic Transmission

(1) Attach J-hooks around the axle shaft tubes outboard of the shock absorber.

(2) Place the sling crossbar under and forward of the bumper.

(3) Attach safety chains around the frame rails.

(4) Turn the ignition switch to the OFF position to unlock the steering column.

(5) Clamp the steering wheel with the front wheels in the straight ahead position. Do not use the steering column lock as a substitute for a clamping device.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(6) Shift the transmission to PARK and the transfer case to NEUTRAL.

TOWING WHEN IGNITION KEYS ARE NOT AVAILABLE

VEHICLE DOORS UNLOCKED

2WD Vehicles

Either one of two methods can be used:

- tow the vehicle with the drive shaft removed (refer to Sling-Type, Front-End Towing); or
- place a tow dolly under the rear wheels (Fig. 14) and tow with the front end raised (refer to Sling-Type, Front-End Towing).

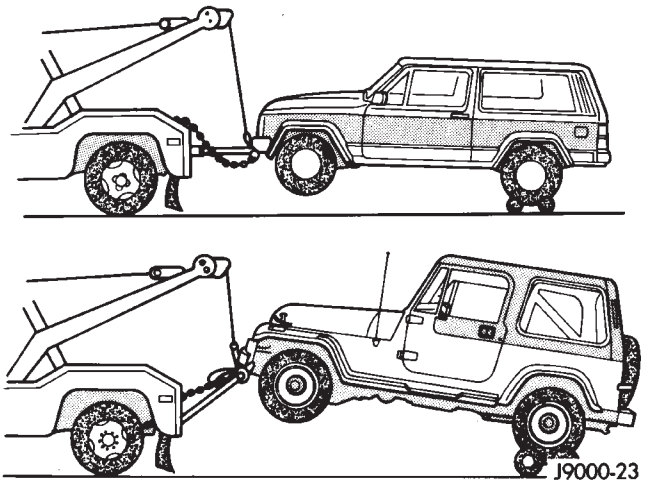


Fig. 14 Sling-Type, Front-End Towing With Rear Wheels On A Tow Dolly

4WD, Command-Trac (231 Part-Time 4WD Transfer Case) And Manual Transmission

(1) Shift the manual transmission to a forward gear.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(2) Shift the transfer case to NEUTRAL.

(3) The vehicle can now be towed with the front wheels raised (refer to Sling-Type, Front-End Towing).

4WD, Command-Trac (231 Part-Time 4WD Transfer Case) And Automatic Transmission

(1) Check and ensure that the automatic transmission is in PARK.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(2) Shift the transfer case to NEUTRAL.

(3) The vehicle can now be towed with the front wheels raised (refer to Sling-Type, Front-End Towing).

4WD, Selec-Trac (242 Full-Time 4WD Transfer Case) And Automatic Transmission

(1) Check and ensure that the automatic transmission is in PARK.

When the transfer case is in the NEUTRAL position, both axles are disengaged from the powertrain. This allows the vehicle to be towed without removing the drive shafts.

(2) Shift the transfer case to NEUTRAL.

(3) The vehicle can now be towed with the front wheels raised (refer to Sling-Type, Front-End Towing).

VEHICLE DOORS LOCKED

Place a tow dolly under the rear wheels (Fig. 14) and tow with the front end raised (refer to Sling-Type, Front-End Towing).

4WD EMERGENCY TOWING—TRANSFER CASE NOT SHIFTED TO NEUTRAL

When a situation arises and the transfer case cannot be shifted to NEUTRAL, any of the following methods can be used to tow a 4WD vehicle.

Drive shafts not removed, place the rear wheels on a tow dolly and tow with the front end raised.

Drive shafts not removed, place the front wheels on a tow dolly and tow with the rear end raised.

Rear drive shaft removed, tow with the front end raised.

Front drive shaft removed, tow with the rear end raised.

Both drive shafts removed, tow with all four wheels on the road surface.

(1) Turn ignition key switch to the unlocked (OFF) position.

(2) Shift the transmission to the NEUTRAL position.

(3) Determine the method by which the vehicle will be towed and prepare the vehicle for towing.

(4) Connect the vehicle to the tow vehicle. Refer to the applicable procedure.

FLAT TOWING (4 TIRES/WHEELS ON SURFACE)

Tow a vehicle in this manner only when all four wheels will freely rotate. Prepare the vehicle according to the following procedures.

2WD VEHICLES

(1) Mark the drive shaft and the axle drive pinion gear shaft yoke for installation alignment reference.

(2) Remove the drive shaft. Install a protective covering over the drive shaft U-joints to retain them assembled and protected.

(3) Cover the open end of the transmission extension housing.

4WD VEHICLES

(1) Mark the drive shafts and the axle drive pinion gear shaft yokes for installation alignment reference.

(2) Remove the drive shafts. Install a protective covering over the drive shaft U-joints/CV-joints to retain them assembled and protected.

(3) Cover the exposed ends of the transfer case.

CAUTION: Whenever a drive shaft has been removed and installed, check the transmission fluid level of the transmission and transfer case. Driving a vehicle with low tranfer case fluid can damage the transmission and transfer case.

EMERGENCY TOW HOOKS

WARNING: REMAIN AT A SAFE DISTANCE FROM A VEHICLE THAT IS BEING TOWED VIA ITS TOW HOOKS. THE TOW STRAPS/CHAINS COULD POSSIBLY BREAK AND CAUSE SERIOUS INJURY.

Some Jeep® vehicles are equipped with emergency tow hooks located at the front end (Fig. 15). Some Jeep® vehicles also have emergency tow hooks located at the rear ende. The tow hooks should be used for **EMERGENCY** purposes only.

CAUTION: DO NOT use emergency tow hooks for tow truck hook-up or highway towing.

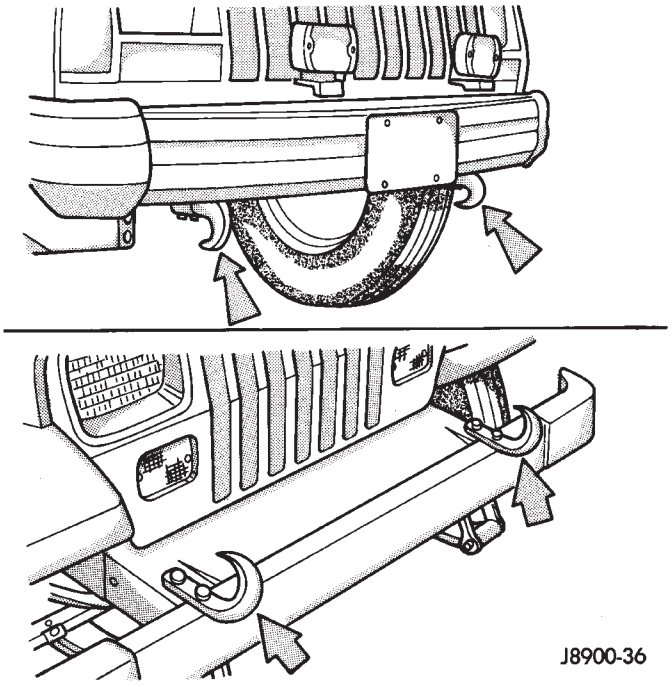


Fig. 15 Emergency Front Tow Hooks—XJ & YJ Vehicles

ENGINE MAINTENANCE

INDEX

ENGINE BREAK-IN

After first starting a new engine, allow it to idle and warm up for at least 15 seconds before shifting the transmission into a drive gear.

Drive the vehicle at:

- varying speeds less than 80 km/h (50 mph) for the first 160 km (100 miles), and
- speeds less than 88 km/h (55 mph) for the first 800 km (500 miles).

Avoid driving at full-throttle for extended periods of time. Also, avoid fast acceleration and sudden stops.

A special break-in engine oil is not required. The original oil installed in a vehicle is a quality lubricant. There is no requirement to have the oil changed or the oil filter replaced until the first scheduled maintenance interval.

The engine oil, coolant and all the other engine related fluid levels should be determined on a regular basis.

ENGINE OIL

SPECIFICATIONS

API SERVICE GRADE

For maximum engine protection during all driving conditions, install an engine oil that conforms to API Service Grade. MOPAR Engine Oil conforms to all of these API Service Grades.

SAE VISCOSITY

SAE designated multi-viscosity grade engine oil is to protect engines. This type of engine oil can usually be installed and remain in the engine until the next scheduled oil change. Select the engine oil viscosity according to the lowest ambient air temperature expected before the next scheduled oil change (Fig.1). Low viscosity engine oil allows easier engine starting during cold weather. SAE 5W-30 viscosity engine oil is recommended when the ambient air temperatures consistently decrease to below 10°F (-12°C).

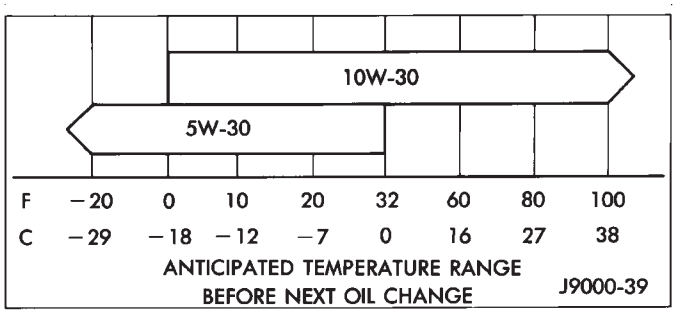


Fig. 1 Temperature/Engine Oil Viscosity

ENERGY CONSERVING OIL

In selecting the correct API grade and SAE grade, an **ENERGY CONSERVING** type engine oil is also recommended.

CONTAINER IDENTIFICATION

Standard engine oil notations have been adopted for selection of engine oil. The notations are located on side of plastic bottles and on the top of engine oil cans (Fig. 2).

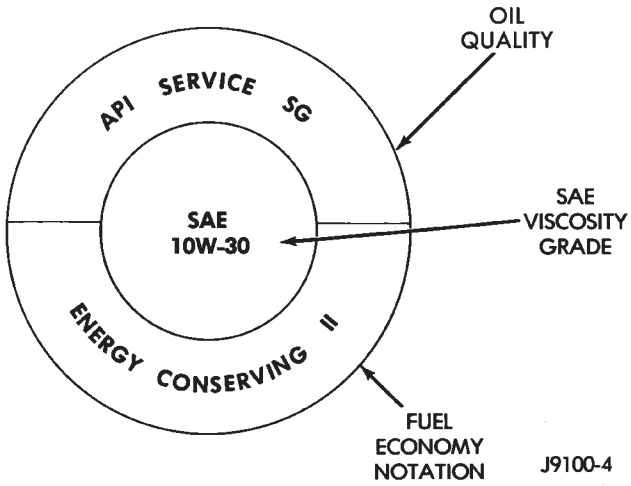


Fig. 2 Engine Oil Container Standard Notations

- The top, outer field contains the **API Service Grade** notation for the engine oil.

• The center field contains the **SAE viscosity grade** notation for the engine oil.
• The lower, outer field contains either the **ENERGY CONSERVING** or the **ENERGY CONSERVING II** notation for the engine oil.

CAUTION: Non-detergent engine oil or straight-mineral oil must never be used to lubricate a Jeep® engine. These type of oils will not provide proper engine lubrication and can result in engine damage.

LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of both 2.5L engines and 4.0L engines (Fig. 3).

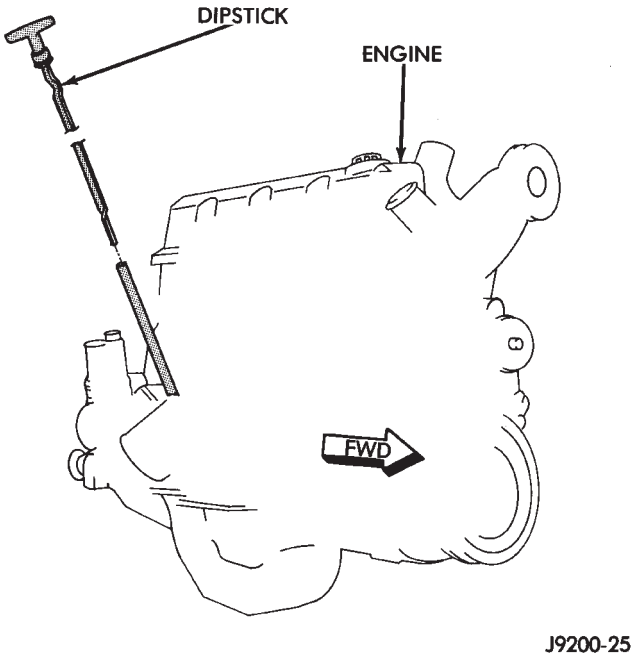


Fig. 3 Engine Oil Dipstick Location—Typical

ACCEPTABLE LEVEL

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 FULL marks on the engine oil dipstick (Figs. 4 and 5). The engine oil level should be determined at the end of each regular driving interval. The vehicle should be on a level surface. Wait for approximately five minutes after stopping the engine. Add engine oil only when the level indicated on the dipstick is at or below the ADD mark.

CAUTION: Do not overfill the engine crankcase with oil. This will cause oil aeration and result in a decrease in the engine oil pressure.

ADDITIVES

It is not necessary to add a special additive to engine oil for most types of vehicle operation. However, the addition of special additives containing anti-rust and anti-scuff compounds can be helpful in some instances. For example:

• with infrequent vehicle operation or short-trip only operation, or
• during engine break-in after a major engine overhaul and/or replacement piston installation.

MOPAR Engine Oil Supplement (or an equivalent product) is acceptable for the conditions listed above.

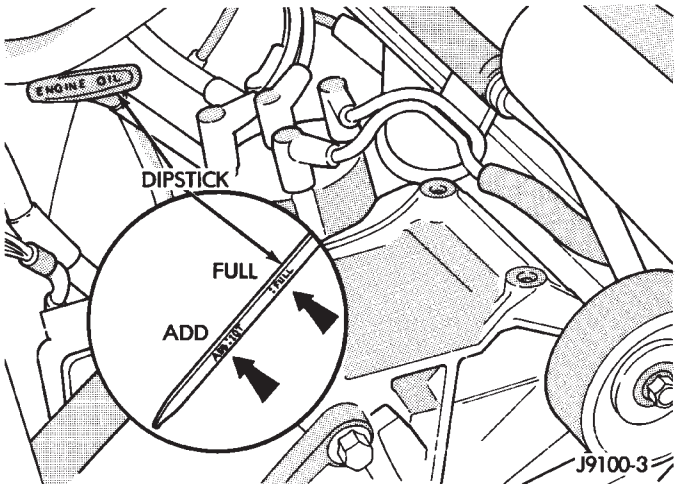


Fig. 4 Engine Oil Dipstick—2.5L Engine

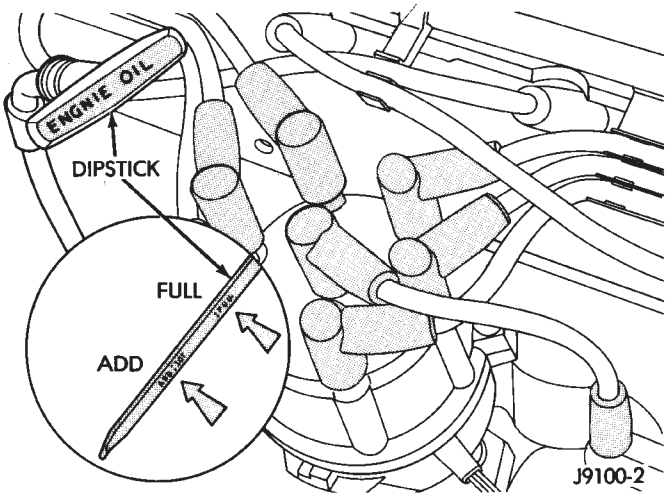


Fig. 5 Engine Oil Dipstick—4.0L Engine

ENGINE OIL FILTER

FILTER SPECIFICATION

All Jeep® engines are equipped with a high quality full-flow, throw-away type oil filter. The same type of replacement oil filter is recommended when a replacement is required.

ENGINE OIL CHANGE AND FILTER REPLACEMENT

WARNING: CARE SHOULD BE TAKEN WHEN CHANGING OIL. PROTECTIVE CLOTHING AND GLOVES SHOULD BE WORN. EXPOSED SKIN SHOULD BE WASHED WITH SOAP AND WATER TO REMOVE ANY ENGINE OIL. DO NOT USE GASOLINE, THINNER, OR SOLVENTS TO REMOVE ENGINE OIL FROM SKIN.

REQUIRED MAINTENANCE

With normal driving conditions, engine oil and filter must be changed after each 12 000-km (7,500-miles)/12-month interval. If the vehicle is involved with a severe driving condition, after each 4 800-km (3,000-miles)/3-month interval. A severe driving condition includes:

- frequent short trip driving less than 24 km (15 miles);
- frequent driving in a dusty environment;
- trailer towing;
- extensive engine idling;
- sustained high-speed operation;
- desert operation;
- frequent starting and stopping;
- cold-climate operation;
- off-road driving; or
- commercial service.

OIL CHANGE AND FILTER REPLACEMENT

(1) Drain the engine oil from the crankcase. Wait until after the engine has attained the normal operating temperature to ensure complete drainage of oil.

(2) Install the drain-hole plug with a replacement gasket.

The oil filter should be replaced during every engine oil change.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss (Figs. 6 and 7).

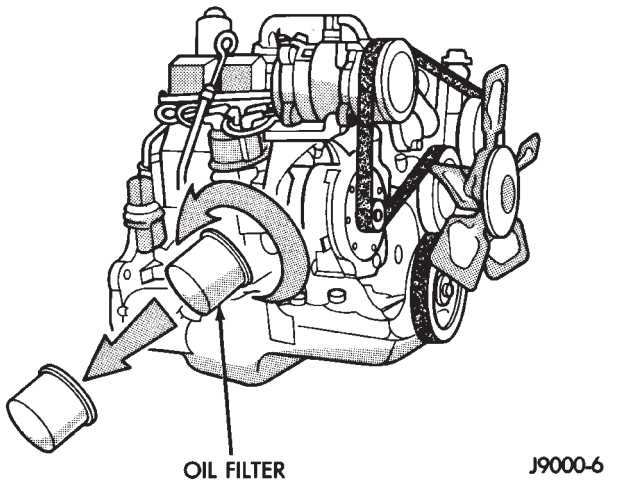


Fig. 6 Oil Filter Removal—2.5L Engine

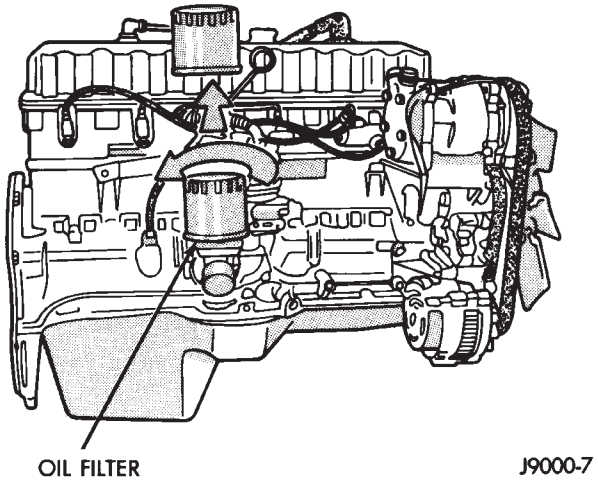


Fig. 7 Oil Filter—4.0L Engine

(4) Clean the cylinder block oil filter boss.

(5) Apply a light coat of engine oil to the rubber seal on the replacement oil filter.

CAUTION: Do not use oil filter with metric threads. The proper oil filter has SAE type 3/4 X 16 threads. The use of an oil filter with metric threads can result in engine oil leaks and engine failure.

(6) Install and **hand tighten** the oil filter 1/2 to 3/4 of-a-turn clockwise beyond the point where the seal first contacts the cylinder block.

(7) Add engine oil in fill hole located on top of engine cylinder head cover (Fig. 8).

(8) Observe the oil level on the dipstick. Add oil, if necessary, to increase the level to the FULL mark.

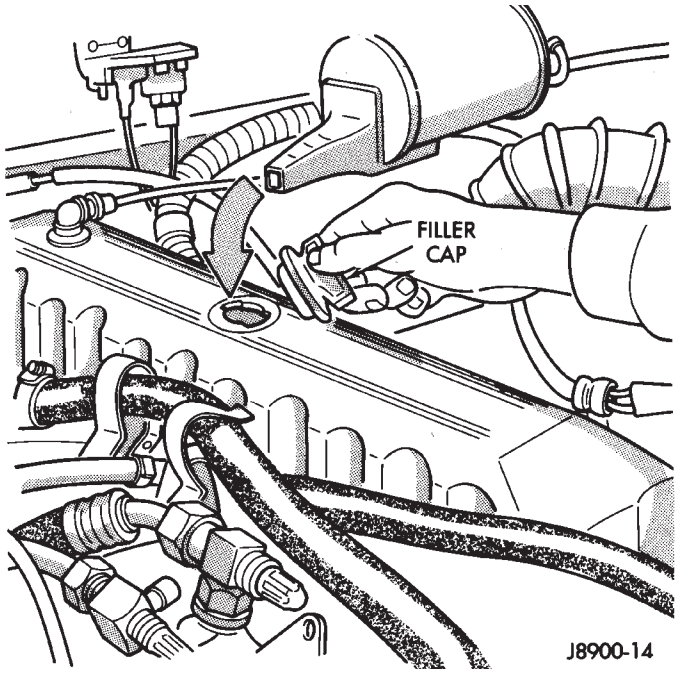


Fig. 8 Adding Engine Oil—Typical

CAUTION: Do not overfill the engine crankcase with oil. This will cause oil aeration and result in a decrease in the engine oil pressure.

(9) Start the engine and observe the oil pressure gauge or warning lamp. If the pressure does not increase or the warning lamp does not go out, stop the engine and determine the cause of the problem.

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 listed above.

COOLING SYSTEM

WARNING: USE EXTREME CAUTION WHEN REMOVING THE RADIATOR CAP IF THE ENGINE IS OPERATING. DO NOT PUT YOUR HANDS NEAR THE DRIVE BELT(S), PULLEYS OR FAN BLADE. DO NOT STAND IN A DIRECT LINE WITH THE FAN BLADE.

RECOMMENDED MAINTENANCE

The engine coolant level should be determined at least once a month and more often during periods of hot weather. Add coolant as necessary.

COOLANT LEVEL

With the engine at normal operating temperature, observe the coolant level in the **coolant recovery bottle**. The coolant level must be at least above the ADD mark and preferably at the FULL mark. Add coolant to the coolant recovery bottle **only**, if necessary.

REQUIRED MAINTENANCE

Check coolant level, and inspect condition of cooling system hoses and clamps after each 12 000-km (7,500-miles).

Initially, coolant must be drained and cooling system flushed and filled after the first 36 months of operation. Thereafter, after each 24-months interval of vehicle operation.

RECOMMENDED MAINTENANCE

The engine cooling system should be inspected for proper operation and for component failure at least every 12 months.

WARNING: IF THE ENGINE HAS BEEN RECENTLY OPERATED, USE EXTREME CARE WHEN REMOVING THE RADIATOR CAP TO AVOID SCALDING WITH HOT, PRESSURIZED COOLANT.

For additional information, refer to Section 7, Cooling System.

COOLANT FREEZE PROTECTION

Jeep® cooling systems contain a 50/50 mixture of anti-freeze and distilled water coolant. This is the recommended coolant mixture for most ambient temperatures. The factory-installed anti-freeze is formulated to prevent corrosion on all cooling system metal surfaces.

The degree of coolant freeze protection should be tested every 12 months. If the coolant is contaminated or **rusty** in appearance, cooling system should be drained and filled with a 50/50 mixture of fresh coolant. For additional information, refer to Group 7—Cooling System.

ENGINE AIR CLEANER FILTER ELEMENT

RECOMMENDED MAINTENANCE

Engine performance and fuel economy can be affected by a restricted air cleaner filter. The filter should be inspected on a regular basis for excessive air restriction.

If the filter element is saturated with oil, replace the filter element.

REQUIRED MAINTENANCE

Engine air cleaner filter must be replaced after each 48 000-km (30,000-miles).

If a vehicle is frequently operated in dusty areas, the air cleaner filter should be inspected often.

FILTER ELEMENT SERVICE/REPLACEMENT

(1) Remove the air cleaner cover from the body/housing (Fig. 9).

(2) Remove the air cleaner filter element from the body/housing.

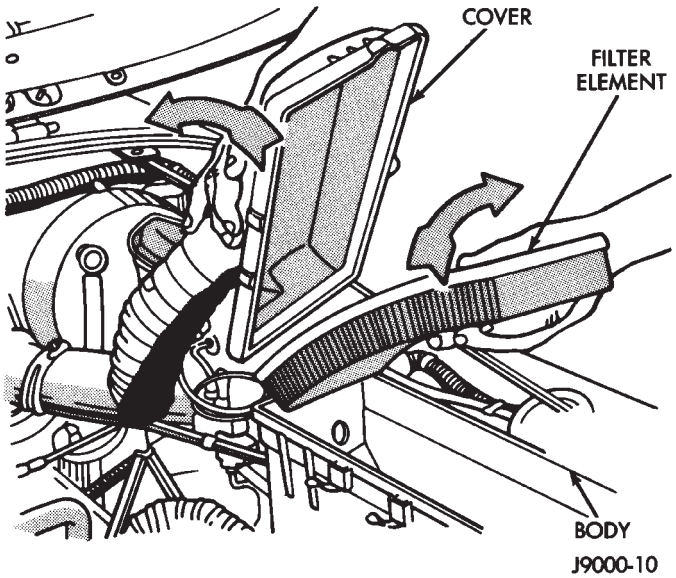


Fig. 9 Air Cleaner & Filter Element—2.5L and 4.0L Engines

CAUTION: Do not tap the filter element or immerse the filter in liquid to remove trapped particles.

(3) Clean filter element by gently blowing the trapped particles from the filter with compressed air. Direct air in the opposite direction of normal intake air flow. Keep air nozzle at least two inches away from the filter to avoid damage to filter.

(4) If the filter has become partially saturated with oil, replace the filter. Test the crankcase ventilating (CCV) system for proper operation.

(5) Wash the air cleaner cover and body/housing (Figs. 10) with cleaning solvent and wipe dry.

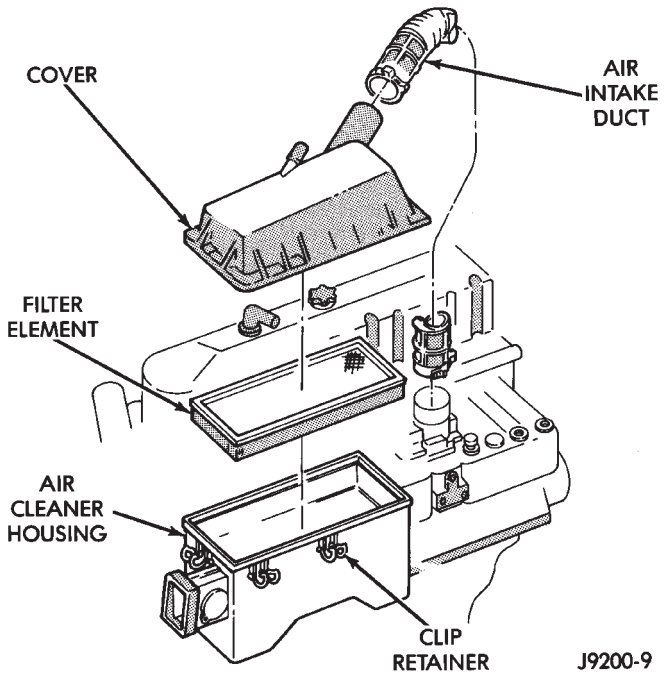


Fig. 10 Air Cleaner Body/Housing & Cover

(6) Install the air cleaner filter element and attach the cover to the body/housing.

CRANKCASE VENTILATION SYSTEM

All Jeep® 2.5L and 4.0L engines are equipped with a crankcase ventilation (CCV) system. Refer to Group 25—Emissions, for additional information.

FUEL USAGE STATEMENT—GAS ENGINES

Jeep® vehicles are designed to meet all emission regulations and provide excellent fuel economy using high quality unleaded gasoline. Only use unleaded gasolines having a minimum posted octane of 87.

If a Jeep® vehicle develops occasional light spark knock (ping) at low engine speeds, this is not harmful. However, **continued heavy knock at high speeds can cause damage and should be checked immediately.** Engine damage as a result of heavy knock operation may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, **those that contain detergents, corrosion and stability additives are recommended.** Using gasolines that have these additives will help improve fuel economy, reduce emissions and maintain vehicle performance. Generally, premium unleaded gasolines contain more additive than regular unleaded gasolines.

Poor quality gasoline can cause problems such as hard starting, stalling and stumble. If these problems occur, use another brand of gasoline before considering servicing the vehicle.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with materials that contain oxygen such as alcohol, MTBE and ETBE. The type and amount of oxygenate used in the blend is important. The following are generally used in gasoline blends:

ETHANOL

Ethanol (Ethyl or Grain Alcohol) properly blended, is used as a mixture of 10 percent ethanol and 90 percent gasoline. **Gasoline with ethanol may be used in your vehicle.**

METHANOL

CAUTION: Do not use gasolines containing methanol. Use of methanol/gasoline blends may result in starting and driveability problems. In addition, damage may be done to critical fuel system components.

Methanol (Methyl or Wood Alcohol) is used in a variety of concentrations blended with unleaded gasoline. You may encounter fuels containing 3 percent or more methanol along with other alcohols called cosolvents.

Problems that are the result of using methanol/gasoline blends are not the responsibility of Chrysler Corporation. They may not be covered by the vehicle warranty.

MTBE/ETBE

Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline and up to 15 percent MTBE. Gasoline and ETBE (Ethyl Tertiary Butyl Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used.

CLEAN AIR GASOLINE

Many gasolines are now being blended that contribute to cleaner air, especially in those areas of the country where air pollution levels are high. These new blends provide a cleaner burning fuel and some are referred to as **Reformulated Gasoline**.

In areas of the country where carbon monoxide levels are high, gasolines are being treated with oxygenated materials such as MTBE, ETBE and ethanol.

Chrysler Corporation supports these efforts toward cleaner air and recommends the use of these gasolines as they become available.

IGNITION CABLES, DISTRIBUTOR CAP AND ROTOR

REQUIRED IGNITION SYSTEM MAINTENANCE

The ignition cables, distributor cap and rotor must be replaced after each 96 000-km (60,000-miles). Refer to Group 8D—Ignition Systems for additional information.

IGNITION TIMING

The ignition timing for 2.5L and 4.0L engines is not adjustable. Refer to the specifications listed on the engine Emission Control Information Label. Refer to Group 25—Emission Control Systems for additional information.

SPARK PLUGS

REQUIRED MAINTENANCE

The spark plugs must be replaced after each 48 000-km (30,000-miles). Refer to the Spark Plugs chart below and to Group 8D—Ignition Systems for additional information.

SPARK PLUGS

ENGINE	PLUG	GAP	TORQUE
2.5L	RC-12LYC	0.88 mm 0.035 in	37 N•m 27 ft. lbs.
4.0L	RC-12LYC	0.88 mm 0.035 in	37 N•m 27 ft. lbs.

J9200-53

BATTERY

RECOMMENDED MAINTENANCE

The battery electrolyte level should be checked and the cable clamps should be inspected for corrosion. This should be done when the oil is changed and the oil filter is replaced.

The battery cables should be inspected for abnormal clamp and battery terminal post corrosion. Service the terminals and cable clamps as necessary.

In addition, the general condition of the battery should be determined before the start of cold and hot weather seasons. If the battery condition is marginal or worse, it should be replaced.

Care should be taken when disposing a battery after removal from a vehicle. Lead-acid batteries are highly poisonous and, when indiscriminately disposed, could create a problem for the environment. Contact the applicable local city or county government agency to determine where automobile (lead-acid) batteries can be properly disposed in the local area.

INSPECTION/SERVICE

WARNING: WEAR SAFETY GLASSES, RUBBER GLOVES AND PROTECTIVE CLOTHING WHEN HANDLING/SERVICING A BATTERY. THE BATTERY ELECTROLYTE CONTAINS SULFURIC ACID AND WILL CAUSE HARM IF IT CONTACTS SKIN, EYES OR CLOTHING. IT WILL ALSO DAMAGE PAINTED (AS WELL AS UN-PAINTED) SURFACES OF A VEHICLE. IF SULFURIC ACID CONTACTS ANY OF THESE, FLUSH IMMEDIATELY WITH LARGE AMOUNTS OF WATER. IF SULFURIC ACID CONTACTS SKIN OR EYES, GET IMMEDIATE MEDICAL ATTENTION. DO NOT SMOKE IN THE VICINITY OF A BATTERY. KEEP OPEN FLAMES AND SPARKS AWAY FROM BATTERY FILLER CAPS BECAUSE EXPLOSIVE GAS IS ALWAYS PRESENT.

(1) Disconnect the battery negative cable and then the positive cable.

(2) Clean the battery cable clamps and terminal posts with a wire brush and a battery terminal cleaner.

(3) Pry the battery cell filler caps upward to remove them and inspect each filler well (low-maintenance batteries only, not applicable to maintenance-free batteries). It could possibly be necessary to loosen the battery holddown clamp to remove the caps. Maintain the electrolyte level above the battery plates and at the bottom of the filler well ring. Add distilled water or low-mineral content drinking water, if necessary. In freezing weather (below 0°C/32°F), add the water just before driving to ensure that it mixes thoroughly with the electrolyte. This will prevent it from freezing.

(4) Remove the battery holddown strap and clean the battery case/battery tray.Clean with bicarbonate of soda (baking soda) and water. Rinse and dry the battery case/tray thoroughly after cleaning.

(5) Position the battery in the tray and install the holddown strap. **Do not over-tighten the nuts.**

(6) Connect the battery positive cable and then the negative cable to the battery.

(7) Apply a small amount of chassis lubricant (or an equivalent protective coating) to the cable terminals to minimize corrosion.

RUBBER AND PLASTIC DUCTS/HOSES/TUBING

RECOMMENDED MAINTENANCE

Rubber and plastic ducts/hoses/tubing should be inspected at the same time the engine oil is changed and the oil filter is replaced.

The conditions associated with vehicle operation determines the usable life of the rubber and plastic ducts/hoses/tubing. These conditions include:

- the extent and quality of vehicle maintenance,
- the geographic area of vehicle operation, and
- the length of exposure time to excess heat and chemical contaminants.

DUCT/HOSE/TUBING INSPECTION—EXCEPT EMISSION CONTROL HOSES/TUBING

Refer to Group 25—Emission Control Systems.

Engine performance could be affected by air leaks into various hoses.

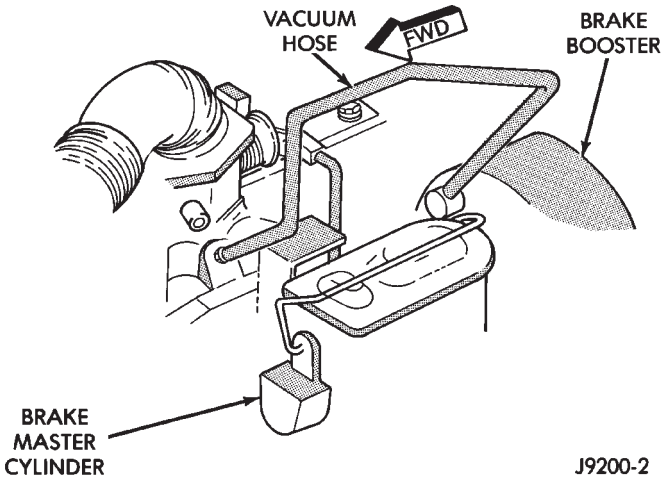


Fig. 11 Brake Booster Vacuum Hose (XJ)—Typical

Rubber/plastic ducts, hoses and tubing should be replaced immediately if there is any evidence of deterioration.

(1) Inspect all hose fittings for looseness and corrosion. Inspect rubber ducts (Fig. 12) and hoses for brittleness and cracks. Examine the hose ends (those that are slipped over nipple connectors) for splits.

(2) Inspect surface of hoses and tubing (Fig. 13) for heat and mechanical damage. **The hose and tubing that is located near an exhaust manifold should be given special attention.**

(3) Inspect the rubber hose routing to ensure that the hoses do not contact any heat source, moving component, etc., that could potentially cause heat or mechanical damage (Figs. 14, 15, and 16).

(4) Inspect all the hose connections to ensure that they are secure and that there is no fluid leakage. In many instances, liquid lubricants are used to aid in the connection of hoses to couplings.

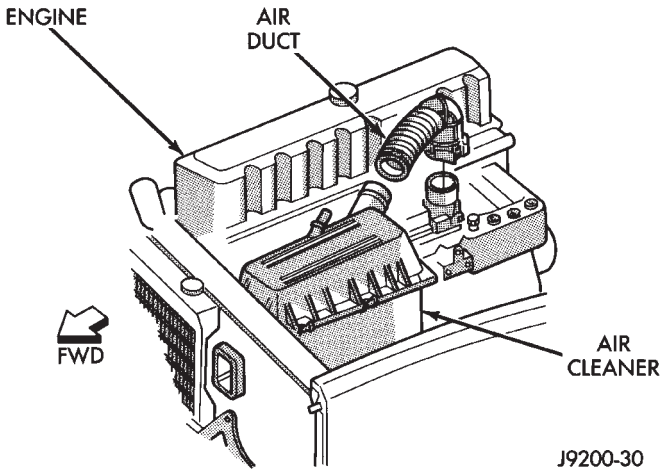


Fig. 12 Intake Air Duct (XJ)—Typical

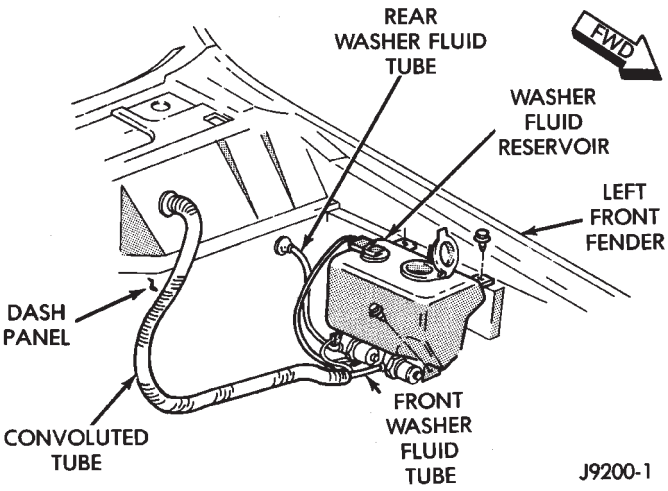


Fig. 13 Washer Fluid Tubing—Typical

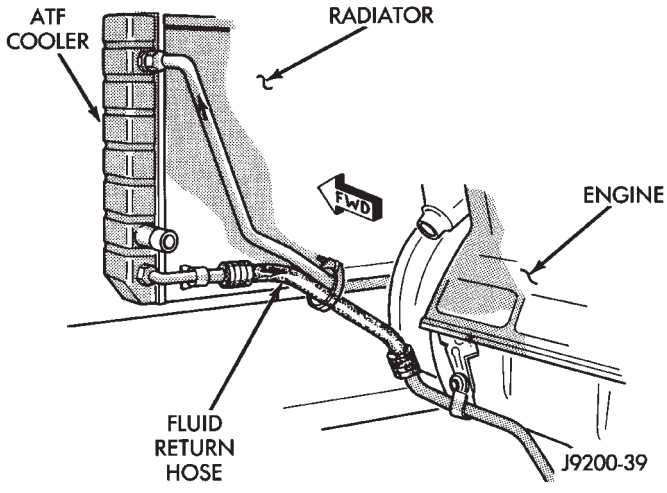


Fig. 14 ATF Cooler Hoses —XJ Vehicles

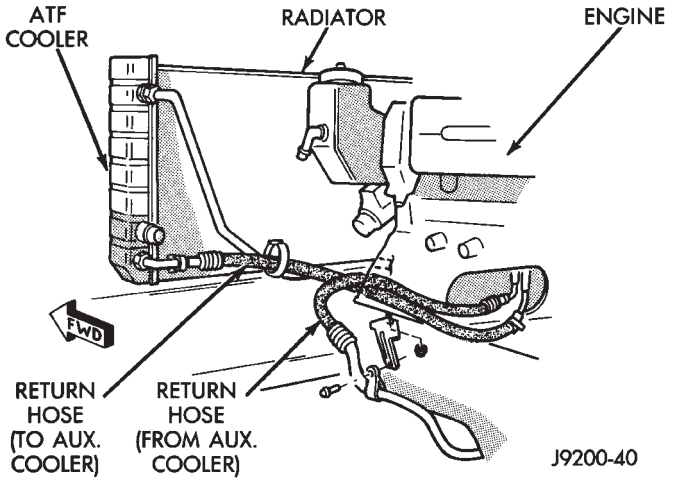


Fig. 15 ATF Cooler Hoses —XJ Vehicles

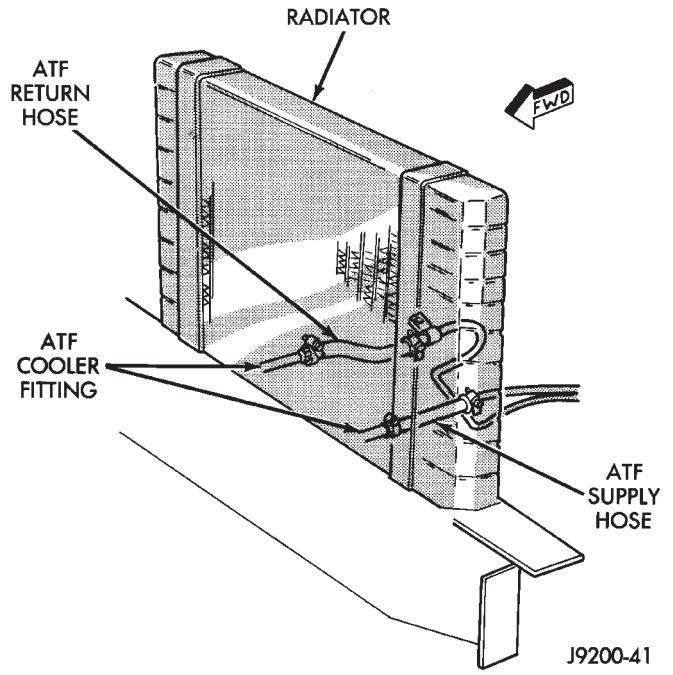


Fig. 16 ATF Cooler Hoses (4.0L)—YJ Vehicles

ENGINE SUPPORTS

RECOMMENDED MAINTENANCE

The general condition of the engine supports should be inspected at the same time as the engine oil is changed and the oil filter is replaced.

INSPECTION

(1) Test the hardware that attaches the engine cylinder block to the engine support brackets (Figs. 17 and 18) for the specified tightening torque.

(2) Inspect the rubber in the engine support cushions for softening and swelling. Slight surface deterioration and wear at the ends will not affect the functioning of an engine support.

ACCESSORY DRIVE BELT

RECOMMENDED MAINTENANCE

The accessory drive belt should be inspected for cracks, fraying, and excessive wear. If necessary, refer to Group 7—Cooling Systems for replacement procedures and adjustment specifications.

REQUIRED MAINTENANCE

The drive belt must be adjusted after each 48 000-km (30,000-miles) interval of vehicle operation has elapsed. The accessory drive belt must be replaced after each 96 000-km (60,000-miles). If necessary, refer to Group 7—Cooling Systems.

EXHAUST SYSTEM

REQUIRED MAINTENANCE

The general condition of the exhaust system must be inspected after each 12 000-km (7,500-miles).

An exhaust system must be properly aligned to prevent stress, leakage, and vehicle body contact.

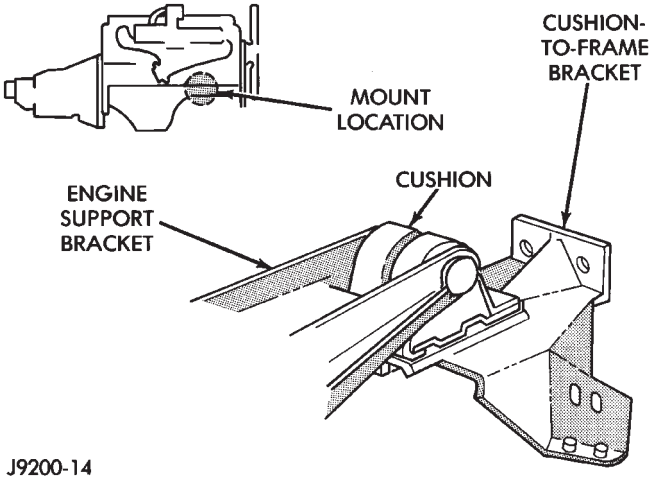


Fig. 17 Front Engine Support—Typical

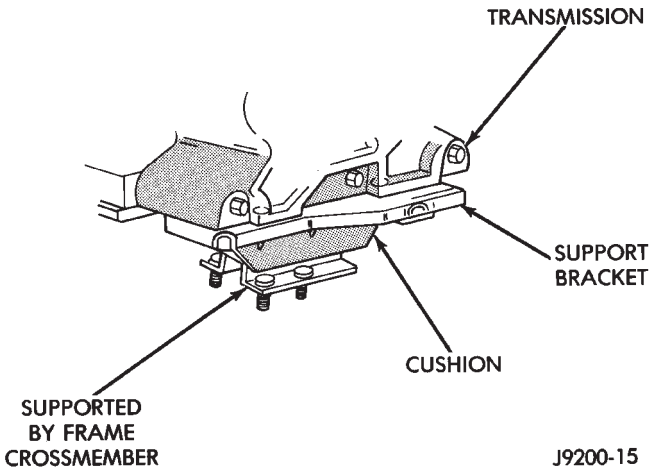


Fig. 18 Rear Engine Support—Typical

INSPECTION

When inspecting an exhaust system, inspect for cracked or loose joints, stripped screw/bolt threads, corrosion damage, and worn or broken hangers. Replace all components that are corroded or damaged. Do not attempt repair. Also, inspect for the following obvious conditions and correct as necessary:

- exhaust system leaks, damage, misalignment;
- contact with body panels metal or the frame; and
- catalytic converter bulging or excessive heat damage.

CAUTION: A catalytic converter will become contaminated if leaded gasoline is burned in the engine. If this occurs, the complete converter must be replaced.

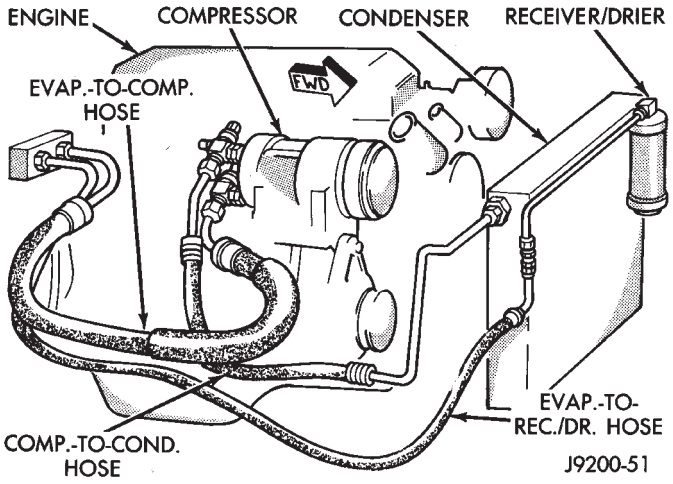


Fig. 19 A/C System (XJ)—2.5L Engine

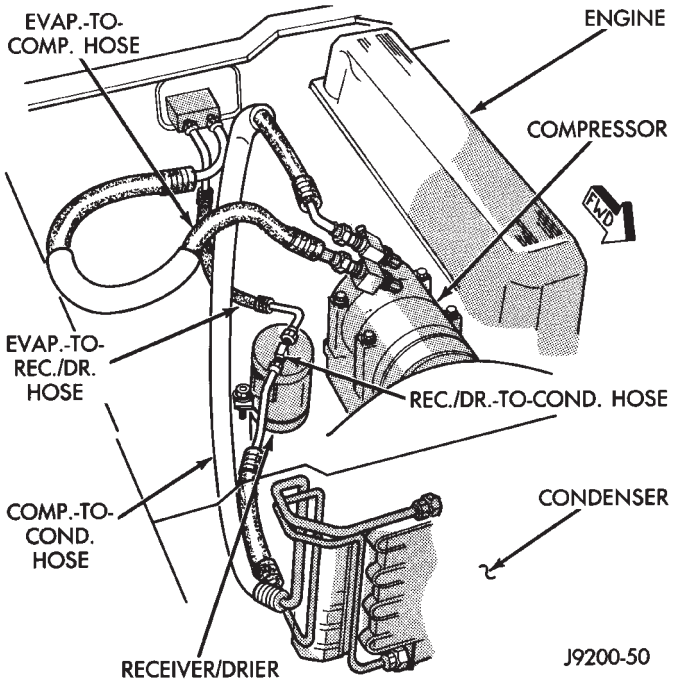


Fig. 20 A/C System (XJ)—4.0L Engine

AIR-CONDITIONER COMPRESSOR/HOSES/ FITTINGS

RECOMMENDED MAINTENANCE

The general condition of the A/C compressor, hoses and fittings should be inspected at the same time as the engine oil is changed (Figs. 19, 20 and 21).

LUBRICANT AND REFRIGERANT

In addition to inspection, the lubricant level in the compressor (Fig. 22) should be determined if there are indications that oil was lost.

Loss of lubricating oil usually accompanies a loss of refrigerant. The presence of bubbles/white foam within the receiver/drier sight glass indicates that some loss of refrigerant has occurred.

For additional information involving the A/C system, refer to Group 24—Heater And Air Conditioning.

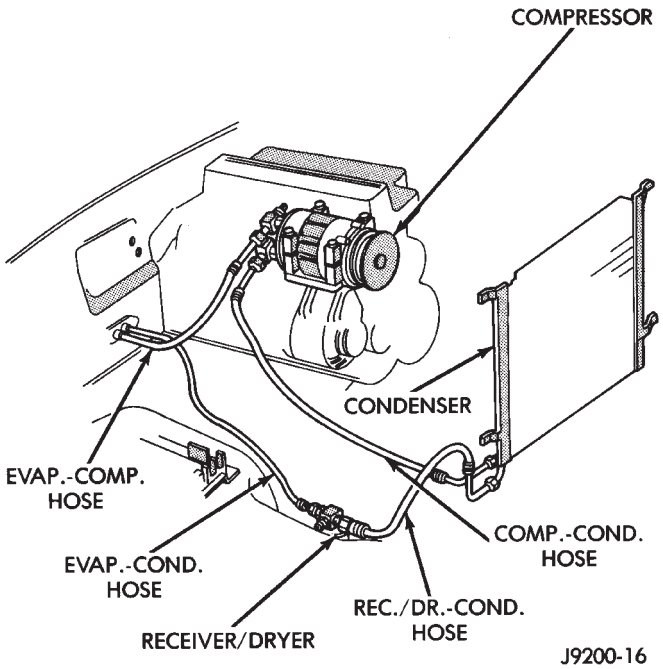


Fig. 21 A/C System (YJ)—4.0L Engine

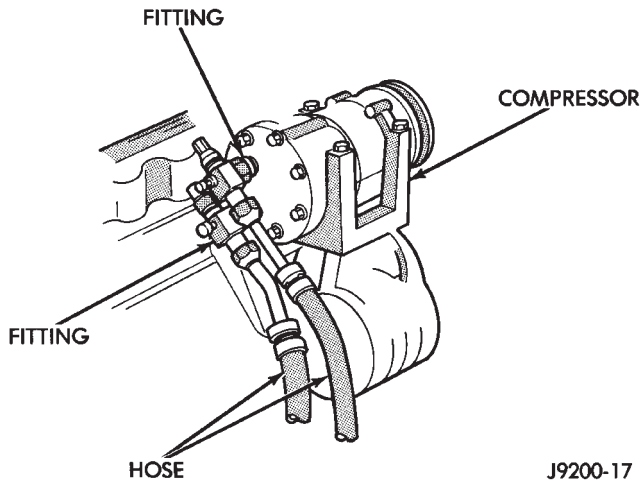


Fig. 22 A/C Compressor—Typical

DRIVETRAIN

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HYDRAULIC CLUTCH

RECOMMENDED MAINTENANCE

Check fluid level in the hydraulic clutch master cylinder reservoir (Fig. 1) at the same time engine oil is changed and oil filter is replaced. Add fluid as necessary.

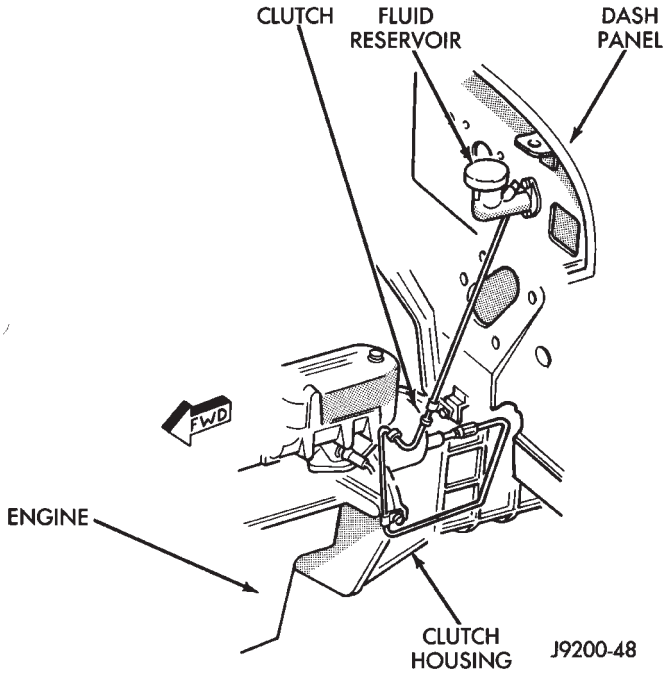


Fig. 1 Hydraulic Clutch (YJ)—Typical

FLUID SPECIFICATION

The only fluid recommended for use in a hydraulic clutch system is MOPAR Brake And Hydraulic Clutch Fluid., or an equivalent fluid.

CAUTION: Never use reclaimed brake fluid or fluid from an unsealed container. In addition, do not use fluid from a container that has been opened and allowed to stand for an extended length of time. Moisture in the air can be absorbed by the fluid, which causes dilution with loss of effectiveness.

FLUID LEVEL

Remove the master cylinder fluid reservoir cap (Fig. 2). The fluid level is determined by its height in relation to the level indicator ring (Fig. 3) located inside the reservoir. If necessary, add fluid until the height is level with the indicator ring.

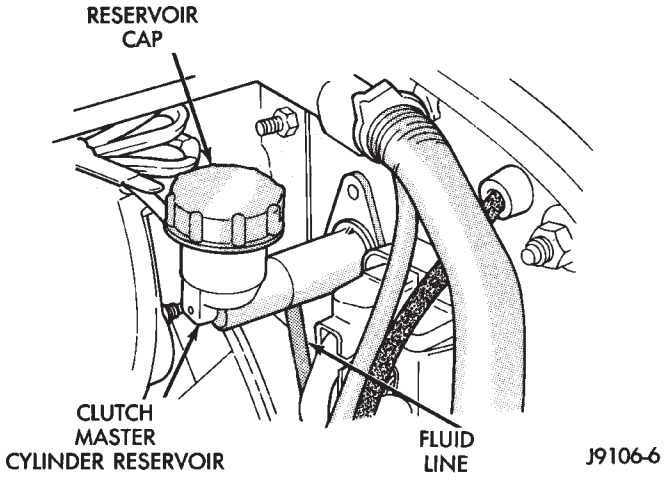


Fig. 2 Hydraulic Clutch Master Cylinder Fluid Reservoir

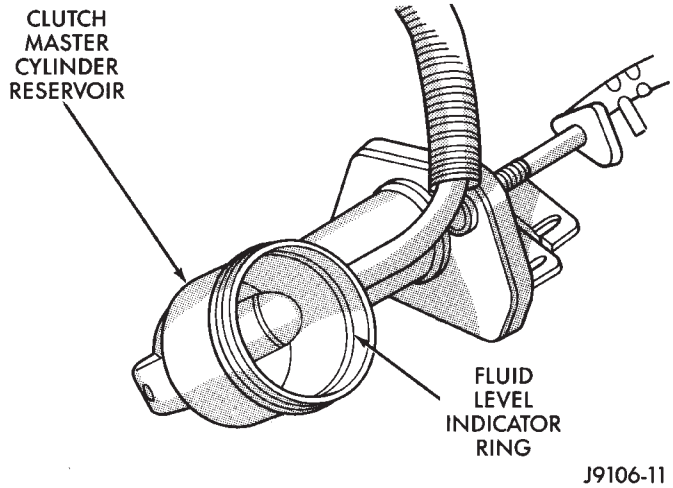


Fig. 3 Hydraulic Clutch Fluid Level

MANUAL TRANSMISSION

RECOMMENDED MAINTENANCE

The lube oil level in manual transmissions should be determined at the same time as the engine oil is changed and the oil filter is replaced. Add lube oil as necessary.

Under normal driving conditions, manual transmission lube oil should be changed after each 60 000-km (37,500 miles). With severe driving conditions, after each 29 000-km (18,000 miles).

LUBRICANT SPECIFICATION

When it becomes necessary to add to or change the lube oil in a Jeep® manual transmission, use SAE 75W-90, API Quality Grade GL-5 gear lubricant.

LUBRICANT LEVEL

The fill-hole plug for all manual transmissions is located on the right side of the case (Fig. 4). Determine the lubricant level according to the following procedure.

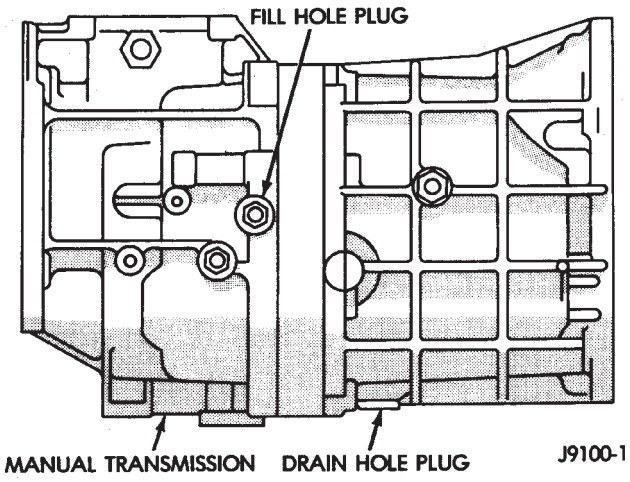


Fig. 4 Manual Transmission Fill- & Drain-Hole Plugs—Typical

(1) Remove the fill-hole plug (Fig. 4) from the transmission. The lube oil should be level with the bottom edge of the fill hole. The level can be slightly below the bottom edge of the fill hole if the lube oil is cold.

If the transmission is warm, lube oil could drip out of the fill hole. This is acceptable but the lube oil should not gush out of the fill hole.

(2) If not acceptable, raise the lube oil level to the bottom edge of the transmission fill hole. Use SAE 75W-90, API Quality Grade GL-5 gear lubricant.

Add lube oil in small amounts to raise the level.

(3) Install the fill-hole plug in the transmission. Tighten the plug with 37 N•m (27 ft. lbs.) torque.

LUBE OIL CHANGE

When it becomes necessary to change manual transmission lube oil, use the following procedure.

(1) Raise and support the vehicle.

(2) Remove the fill-hole plug from the transmission.

(3) Place a container to collect the lube oil under the transmission drain-hole plug.

(4) Remove the drain-hole plug and drain the lube oil from the transmission into the container.

Care should be exercised when disposing used lube oil after it has been drained from a transmission.

(5) Install the drain-hole plug in the transmission. Tighten the plug with 37 N•m (27 ft. lbs.) torque.

(6) Fill the transmission until the lube oil begins to drip out of the fill hole with SAE 75W-90, API Quality Grade GL-5 gear lubricant.

(7) Install the fill-hole plug in the transmission. Tighten the plug with 37 N•m (27 ft. lbs.) torque.

(8) Remove the support and lower the vehicle.

AUTOMATIC TRANSMISSION

RECOMMENDED MAINTENANCE

Check fluid level in automatic transmissions (Fig. 5) the same time the engine oil is changed and the oil filter is replaced. Add ATF as necessary.

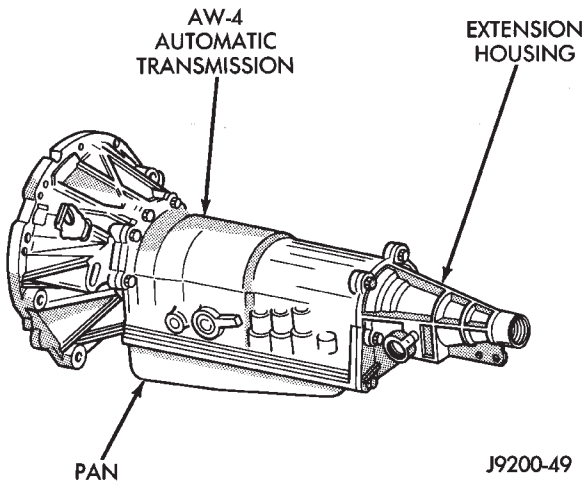


Fig. 5 AW-4 Automatic Transmission (XJ)

Under normal driving conditions, the ATF should be changed and the filter replaced after each 48 000-km (30,000-miles). With severe driving conditions, after each 29 000-km (12,000-miles).

ATF SPECIFICATIONS

When it becomes necessary to add fluid (ATF) to a Jeep® automatic transmission (or when the ATF is replaced), use:

- Mercon™ ATF **only** for AW-4 automatic transmissions (XJ vehicles), and
- MOPAR ATF PLUS type 7176 (or an equivalent Mercon™/Dexron II™ ATF) for 998 automatic transmissions (YJ vehicles).

SPECIAL ADDITIVES

The addition of any special-type fluid to a Jeep® automatic transmission is not recommended. The only exception is the addition of black-light detection

dye to aid in detecting the source of ATF leaks. The use of transmission sealing additives should also be avoided.

Black-light detection dye is factory-installed in automatic transmissions and, unless the ATF has been drained and re-placed, it is not necessary to add dye.

ATF LEVEL

Determine the ATF level according to the following procedure.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT PUT YOUR HANDS NEAR THE DRIVE BELT, PULLEYS OR FAN BLADE. DO NOT STAND IN A DIRECT LINE WITH THE FAN BLADE.

(1) Operate the engine and allow the automatic transmission sufficient time to warm to the normal operating temperature (77°C/170°F).

When at normal operating temperature, ATF will be uncomfortable to fingertips when the dipstick is touched. Normally, 25 km (15 miles) is a sufficient driving distance for a transmission to warm to normal operating temperature (77°C/170°F).

(2) Place the vehicle on a level surface.

(3) Operate the engine at idle speed.

(4) Engage the parking brake.

(5) Place a block in front of and at the rear of one wheel/tire to prevent vehicle movement.

(6) Depress the brake pedal and move the transmission selector lever through all the positions and then place the selector lever in NEUTRAL position.

(7) Remove the dipstick (Fig. 6) from the transmission filler tube and wipe it clean.

(8) Insert the dipstick into the transmission filler tube and seat the cap on top of the tube.

(9) Remove the dipstick and observe the ATF level on both sides of the dipstick. The ATF level is acceptable when it is between the ADD and FULL marks.

(10) While determining the ATF level in a transmission, also note the general condition of the fluid. Examine the fluid closely. If doubtful about its condition, drain a sample into a small container for evaluation.

(11) If the ATF level is either at or below the ADD mark, add sufficient ATF to raise the level to the FULL mark on the dipstick.

CAUTION: Do not over-fill an automatic transmission. Over-filling can cause the ATF to foam, which will result in over-heating, fluid oxidation and varnish formation.

(12) When it is necessary to add ATF, insert a long-necked funnel into the transmission filler tube.

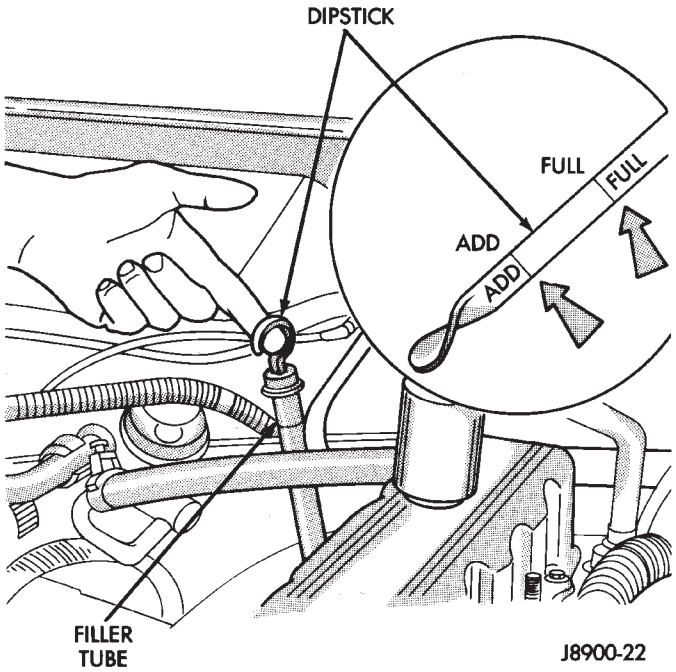
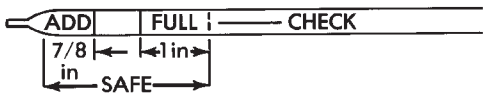


Fig. 6 Dipstick & ATF Level—Typical

DETERMINE THE ATF LEVEL WITH THE VEHICLE LEVEL, THE TRANSMISSION IN NEUTRAL AND THE FLUID TEMPERATURE ABOVE 22°C



THE VEHICLE SHOULD NOT BE DRIVEN IF THE ATF LEVEL IS LOWER THAN 7/8 INCH BELOW THE ADD MARK OR MORE THAN 1 INCH ABOVE THE FULL MARK. J9200-10

Fig. 7 Safe ATF Level Above 22°C/72°F

It requires only 0.5 liter (1.0 pint) of ATF to raise the level from the ADD mark to the FULL mark.

(13) Inspect for ATF leaks and correct as necessary.

(14) Remove the wheel/tire blocks.

ATF AND FILTER CHANGE

Automatic transmission fluid (ATF) does not deteriorate or wear out, but it does become contaminated. These contaminates will eventually restrict passages and orifices. The result is hard or rough shifting, or complete transmission failure. Also, the varnish eventually causes rubber seals to harden and become brittle.

When it is necessary to change the ATF and replace the filter in a Jeep® automatic transmission, use the following procedures.

DRAINING ATF/FILTER REMOVAL

Drain the automatic transmission fluid (ATF) immediately after stopping the engine (before the ATF cools).

(1) Raise and support the vehicle.

(2) Loosen the transmission pan bolts and drain the original ATF into an appropriate container. Remove the pan bolts, the pan and the gasket.

Care should be exercised when disposing used ATF after it has been drained from a vehicle transmission.

(3) Remove the screws and the ATF filter (Fig. 8). Discard the filter.

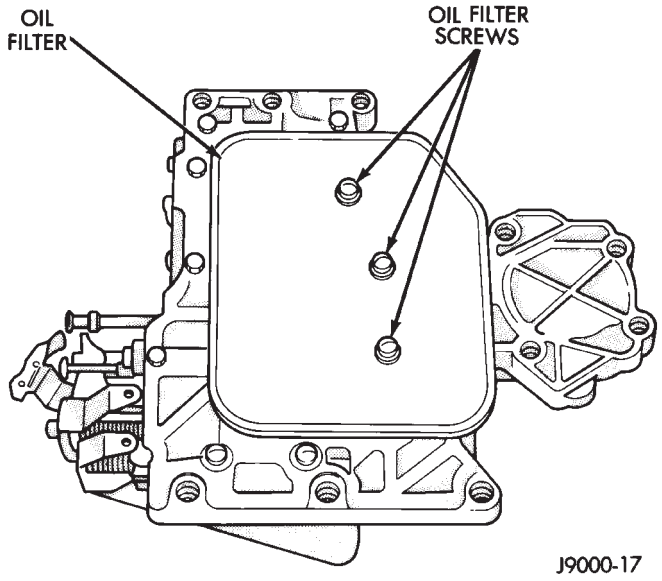


Fig. 8 ATF Filter—Typical

FILTER INSTALLATION/ATF RE-FILL

(1) Install a replacement ATF filter. Tighten the screws with 4 N●m (35 in. lbs.) torque.

(2) Clean the pan thoroughly. Install a replacement gasket on the pan. Install the pan with the attaching bolts:

- model AW-4 transmission — tighten the pan bolts with 7 N●m (60 in. lbs.) torque; and
- model 998 transmission — tighten the pan bolts with 17 N●m (150 in. lbs.) torque.

(3) Remove the support and lower the vehicle.

(4) Pour approximately 4.7 liters (5 quarts) of ATF into the filler tube. Use Mercon™ ATF for AW-4 automatic transmissions. Use MOPAR ATF PLUS type 7176 or equivalent, for 998 automatic transmissions.

(5) Place a block in front of and at the rear of one wheel/tire to prevent vehicle movement.

(6) Start the engine and allow it to idle a few minutes.

(7) Apply the brake pedal and engage the parking brake. Move the transmission selector lever through all positions, then place the selector lever in NEUTRAL position.

(8) With the transmission at normal operating temperature, observe the ATF level on the dipstick. Add ATF (if necessary) to raise the level to the FULL mark on the dipstick. **Only 0.5 liter (1.0 pint) will raise the level from the ADD mark to the FULL mark when the ATF is at normal operating temperature.**

(9) Inspect for fluid leaks and correct as necessary.

(10) Remove the wheel/tire blocks.

TRANSFER CASE

RECOMMENDED MAINTENANCE

The fluid (ATF) level in transfer cases should be determined at the same time as the engine oil is changed and the oil filter is replaced. Add ATF as necessary.

In addition, transfer case ATF should be changed after each 48 000-km (30,000-miles) interval of vehicle operation has elapsed.

FLUID SPECIFICATIONS

If it is necessary to add fluid to a transfer case (or when the fluid is changed), use MOPAR ATF PLUS type 7176 or an equivalent Mercon™/Dexron II™ ATF.

FLUID LEVEL

The transfer case fill-hole plug is located at the rear of the housing (Fig. 9).

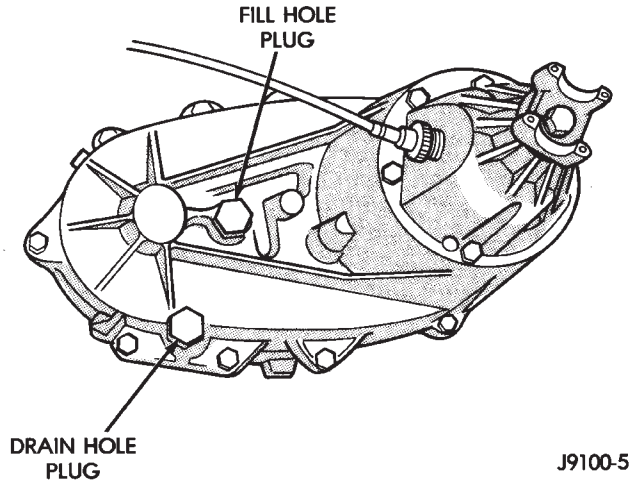


Fig. 9 Transfer Case—Typical

Determine the transfer case fluid (ATF) level according to the following procedure.

(1) Raise and support the vehicle.

(2) Remove the fill-hole plug from the transfer case. The ATF level should be at the bottom edge of the fill hole. The level can be slightly below the bottom edge of the fill hole if the fluid is cold.

If the transfer case ATF is warm, it is acceptable for the fluid to drip out of the fill hole. If the fluid gushes out of the fill hole, the level is too high.

(3) If the level is low, raise it to the bottom edge of the fill hole with MOPAR ATF PLUS type 7176 or an equivalent Mercon™/Dexron II™ ATF.

(4) Install the fill-hole plug. Tighten the plug with 47 N•m (35 ft. lbs.) torque.

(5) Remove the support and lower the vehicle.

FLUID CHANGE

When it becomes necessary to change the ATF in a Jeep® transfer case, use the following procedure.

(1) Raise and support the vehicle.

(2) Remove the fill-hole plug from the transfer case.

(3) Place an appropriate container under the transfer case drain-hole plug.

(4) Remove the drain-hole plug and drain the ATF from the transfer case into the container.

Care should be exercised when disposing used ATF after it has been drained from a transfer case.

CAUTION: Do not over-tighten the drain and fill-hole plugs. Over-tightening can strip the hole threads and/or crack the aluminum housing.

(5) Install the drain-hole plug in the transfer case. Tighten the plug with 47 N•m (35 ft. lbs.) torque.

(6) Fill the transfer case to the bottom edge of the fill hole with MOPAR ATF PLUS type 7176 (or an equivalent Mercon™/Dexron II™ ATF).

(7) Install the fill-hole plug in the transfer case. Tighten the plug with 47 N•m (35 ft. lbs.) torque.

(8) Remove the support and lower the vehicle.

FRONT AND REAR AXLES

RECOMMENDED MAINTENANCE

The lubricant level in axle differential housings should be determined at the same time as the engine oil is changed and the oil filter is replaced. Add lubricant as necessary.

In addition, with normal driving conditions, the axle lubricant should be changed after each 48 000-km (30,000-miles). With severe driving conditions, after each 29 000-km (12,000-miles).

LUBRICANT SPECIFICATIONS

For normal vehicle operation, use SAE 75W-90, API Quality Grade GL-5 gear lubricant in all Jeep® front (4WD only) and rear axles. Vehicles equipped with a Trac-Loc rear axle also require a friction modifier additive with the gear lubricant.

When involved in trailer towing applications use SAE 80W-140, API Quality Grade GL-5 gear lubricant in the rear axle. XJ Vehicles equipped with a class III trailer hitch require SAE 75W-140 synthetic gear lubricant in the rear axle.

LUBRICANT LEVEL

Determine the axle differential housing lubricant level according to the following procedure.

(1) Raise and support the vehicle.

(2) Remove the fill-hole plug (Figs. 10 and 11) from the axle differential housing cover. The gear lubricant should be 13 mm (1/2 inch) below the bottom edge of the fill hole.

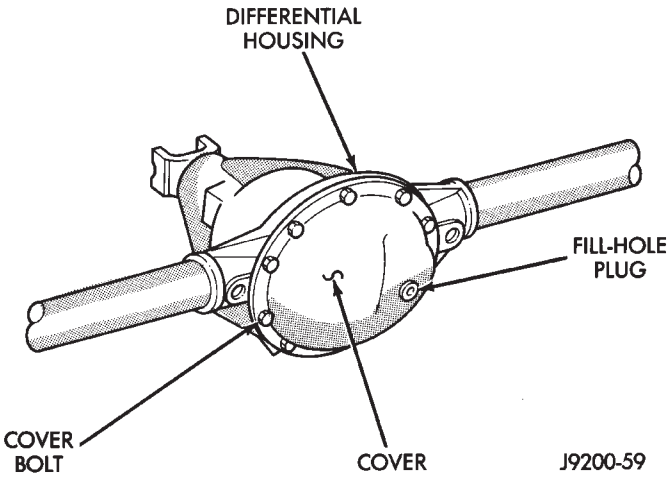


Fig. 10 Rear Axle—Typical

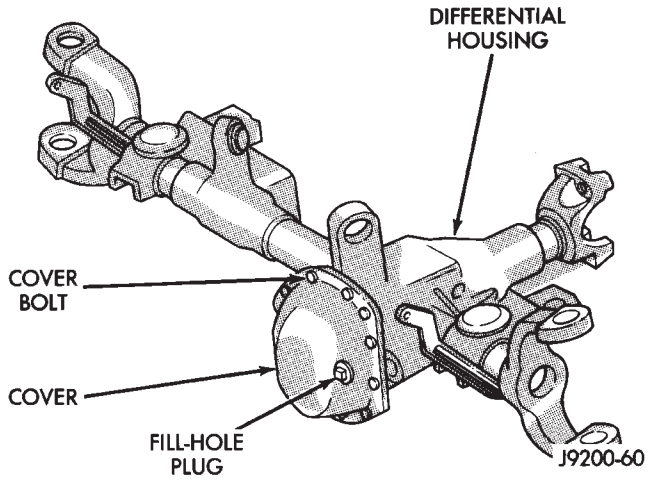


Fig. 11 Front Axle (4WD)—Typical

(3) If not acceptable, raise the lubricant level to 13 mm (1/2 inch) below the bottom edge of the fill hole.

Add lubricant in small amounts to raise the level.

(4) Install the fill-hole plug in the differential housing cover. Tighten the plug with 34 N°m (25 ft. lbs.) torque.

(5) Remove the support and lower the vehicle.

LUBRICANT CHANGE

When it becomes necessary to change the axle lubricant in a Jeep® front or rear axle, use the following procedure.

(1) Raise and support the vehicle.

(2) Place a container under the axle differential housing.

(3) Remove the axle differential housing cover bolts. Remove the housing cover.

(4) Allow the axle gear lubricant to completely drain into the container.

CAUTION: Do not flush a rear axle Trac-Loc differential. Trac-Loc differentials may be cleaned only by disassembling the unit and wiping the components with clean, lint-free cloth.

(5) Flush the inside of the differential housing with a flushing oil. **Do not use water, steam, kerosene or gasoline for flushing.**

(6) Remove any residual RTV sealant/gasket material from the differential housing and cover. Thoroughly clean the contact surfaces with mineral spirits and dry the surfaces completely.

(7) Apply a bead of MOPAR RTV Sealant, or an equivalent sealant, around the bolt circle on the housing and on the cover (Fig. 12).

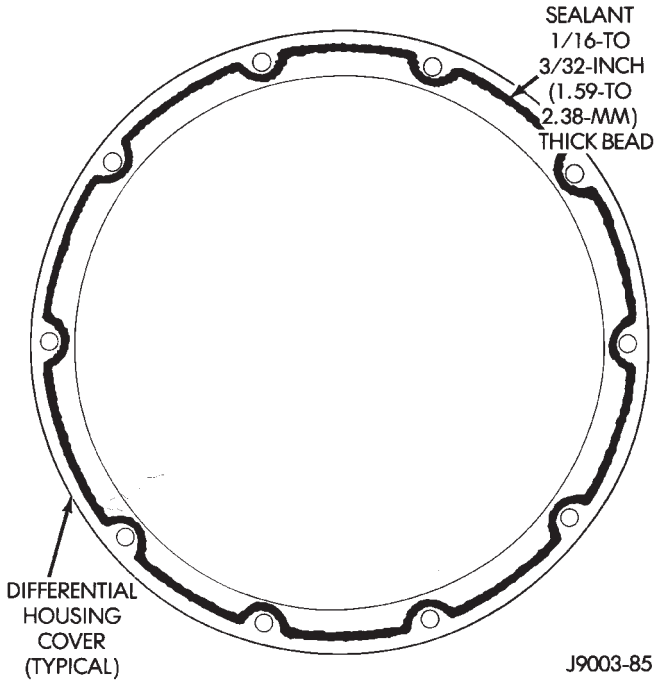


Fig. 12 RTV Sealant Application—Typical

If differential housing cover is not installed within 20 minutes after applying sealant, the sealant must be removed and another bead applied.

(8) Install the cover on the differential housing with the attaching bolts (Fig. 13). Tighten the cover bolts with 47 N●m (35 ft. lbs.) torque.

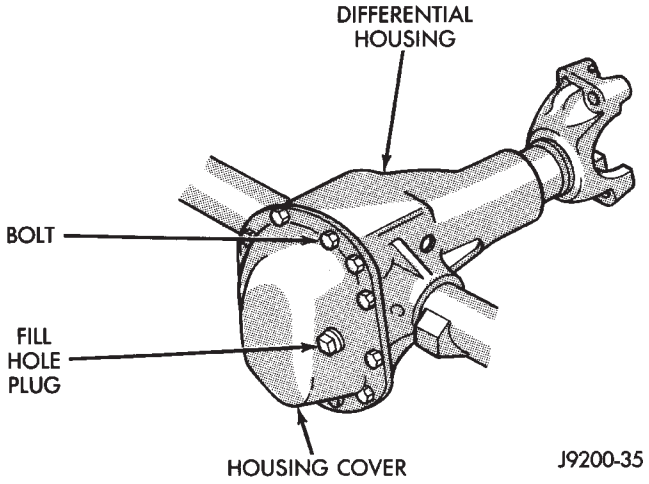


Fig. 13 Differential Housing Cover Installed

(9) Remove the fill-hole plug and add the replacement gear lubricant to the differential housing. Refer to Specifications above.

(10) Install the fill-hole plug. Tighten the plug with 34 N°m (25 ft. lbs.) torque.

(11) Remove the support and lower the vehicle.

DRIVE SHAFTS

RECOMMENDED LUBRICATION

With normal driving conditions, the drive shaft U-joint couplers and slip yoke splines (Figs. 14 and 15) should be lubricated after each 12 000-km (7,500-miles). With severe driving conditions, after each 4 800-km (3,000-miles).

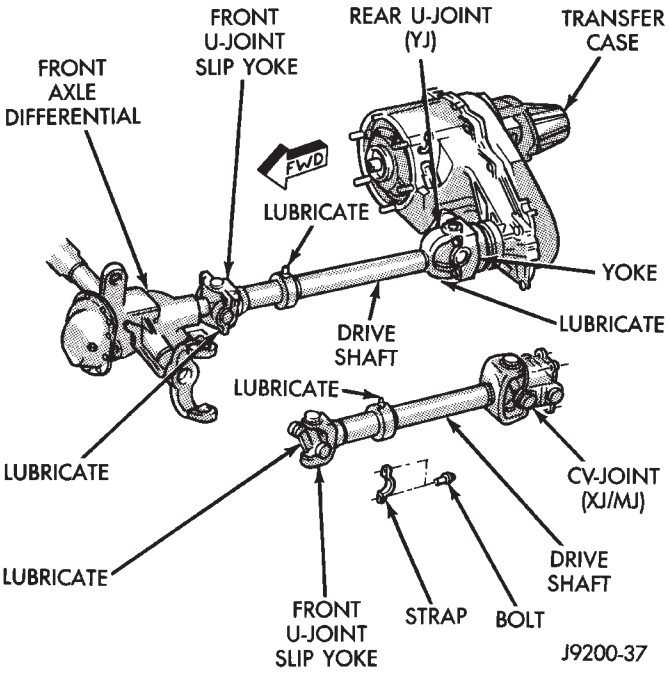


Fig. 14 Front Drive Shaft (4WD)—Typical

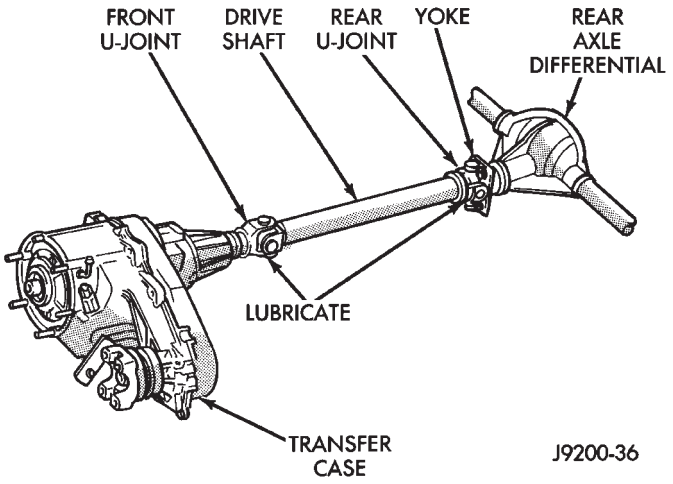


Fig. 15 Rear Drive Shaft (4WD)—Typical

CAUTION: It is very important that drive shafts be lubricated at periodic intervals and that the specified type of lubricant be used. Failure to properly lubricate could result in premature wear of drive shaft components.

LUBRICATION FITTINGS

The drive shaft universal-joint couplers (U-joints) and the front drive shaft slip yoke splines are equipped with Zerk fittings. The (CV-joints) are lubricated when assembled during manufacture and do not require additional lubrication.

LUBRICANT SPECIFICATION

Drive shaft U-joint couplers and slip yoke splines should be lubricated with a lubricant that is identified as NLGI GC-LB lubricant.

SLIP-YOKE SPLINE LUBRICATION

The method below will ensure complete lubrication of the front drive shaft slip-yoke splines (Fig. 14).

(1) Clean the tips of the Zerk type fittings.

(2) Use a gun or another appropriate lubricant dispenser to force pressurized lubricant into the slip yoke Zerk fittings.

(3) When the lubricant appears, cover the pressure relief hole with a finger. Force pressurized lubricant into fitting until it appears at slip-yoke seal.

RUBBER AND PLASTIC HOSES/TUBING

RECOMMENDED MAINTENANCE

The condition of underbody rubber hose and plastic tubing should be inspected for failure at the same time as oil is changed and oil filter is replaced.

HOSE/TUBING INSPECTION

Vehicle operating conditions determine the useable life of underbody hoses and tubing. These conditions include:

- the extent and quality of vehicle maintenance,
- the geographic area of vehicle operation, and
- the length of exposure time to excess heat and chemical contaminants.

(1) Inspect all hose and tubing fittings for looseness and corrosion. Inspect the rubber hoses for brittleness and cracks. Thoroughly inspect the hose ends (those that are slipped over nipple connectors) for splits (Figs. 16, 17, 18, 19, 20, 21 and 22).

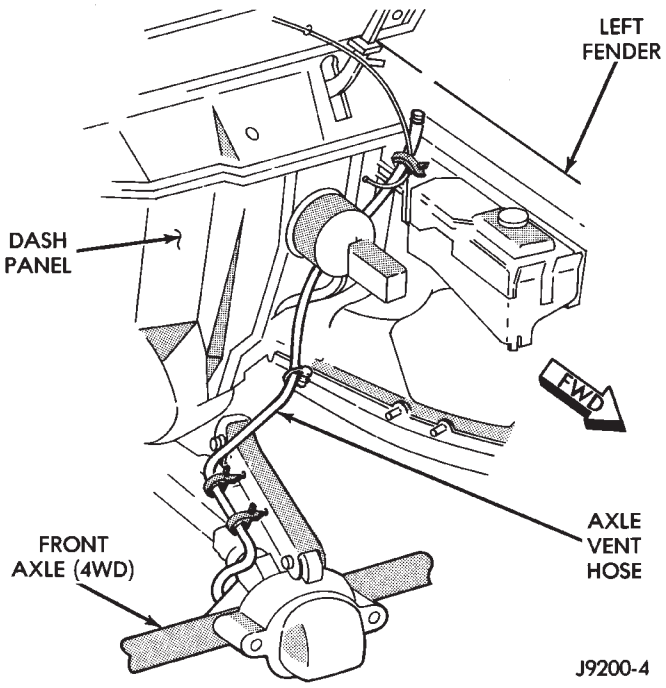


Fig. 16 Front Axle Vent Hose (4WD)—XJ Vehicles

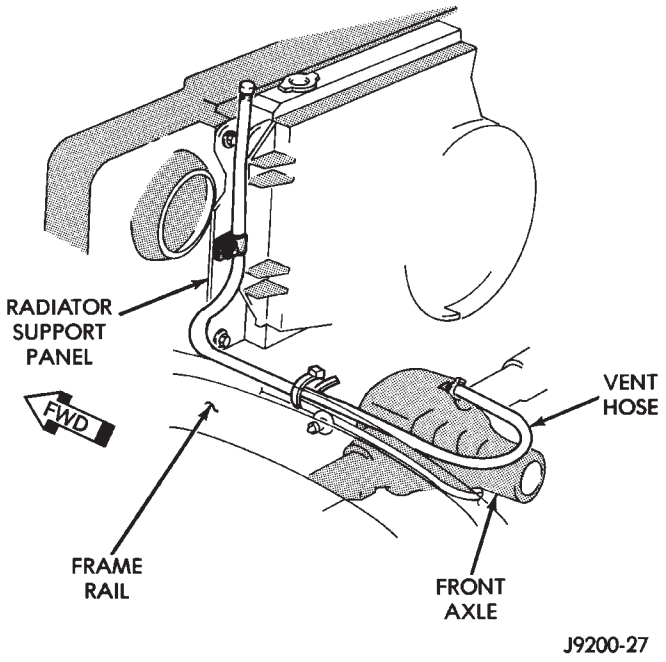


Fig. 17 Front Axle Vent Hose—YJ Vehicles

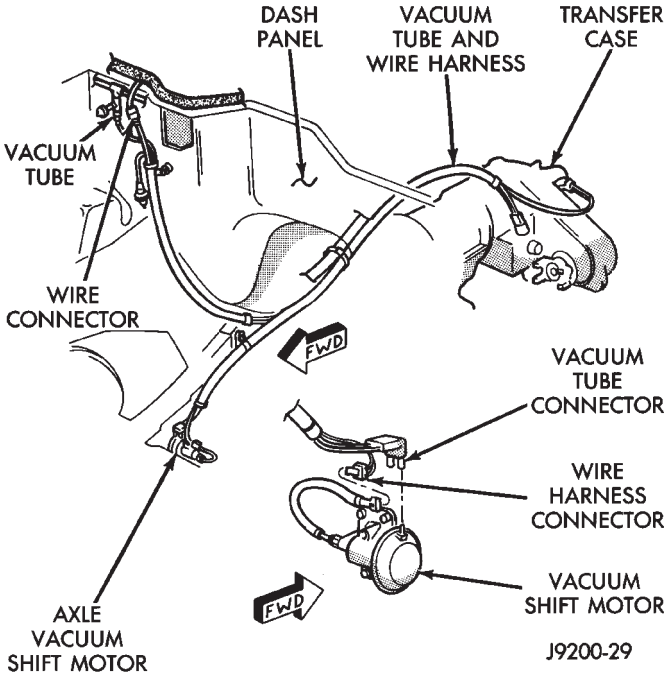


Fig. 18 Front Axle Vacuum Shift Tubing

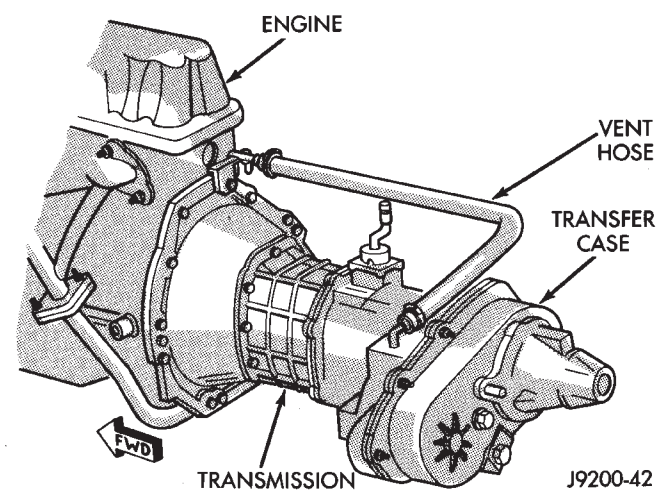


Fig. 19 Transfer Case Vent Hose (4WD)—Typical

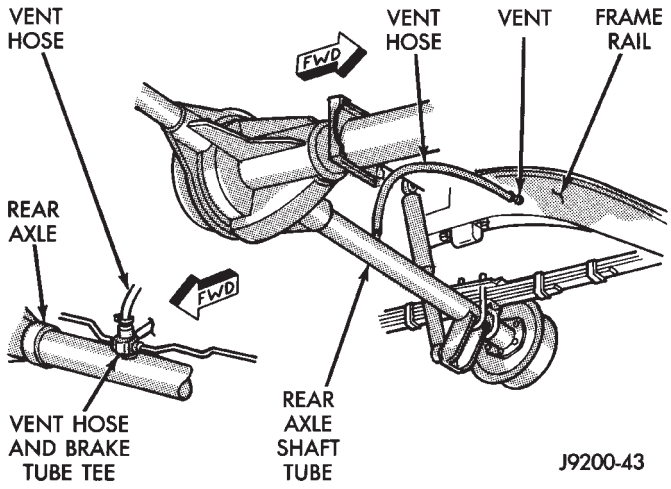


Fig. 20 Rear Axle Vent Hose—XJ Vehicles

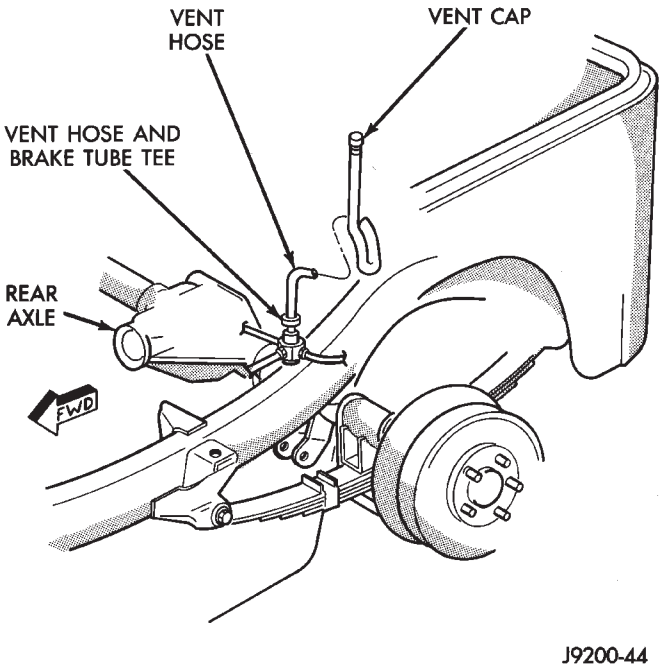


Fig. 21 Rear Axle Vent Hose—YJ Vehicles

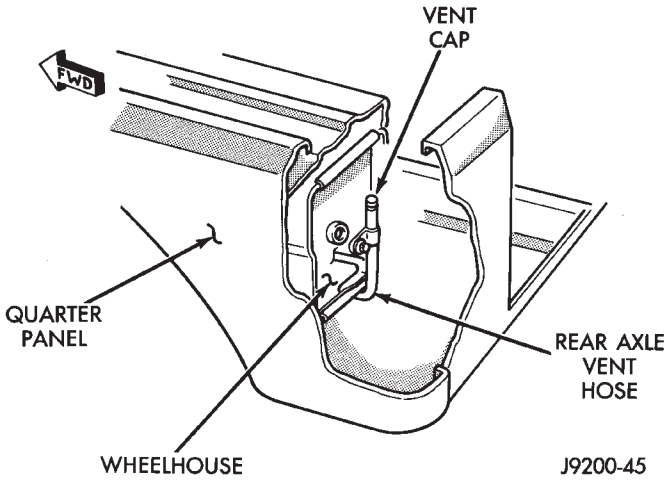


Fig. 22 Rear Axle Vent Hose At Wheelhouse—YJ Vehicles

(2) Inspect the surface of hoses and tubing for heat and mechanical damage. Hose and tubing located close to an exhaust pipe should be given special attention.

(3) Inspect the rubber hose routing to ensure that the hoses do not contact any heat source, moving component, etc., that would potentially cause heat or mechanical damage.

(4) Inspect all the hose connections to ensure that they are secure and there is no fluid leakage. Actual dripping of hot fluid should be noted and the clamps tightened in an attempt to stop the leakage before replacing the hose.

CHASSIS AND BODY COMPONENTS

INDEX

CHASSIS COMPONENT AND WHEEL BEARING LUBRICANTS

The chassis component and wheel bearing lubricants that are recommended for Jeep® vehicles are identified by the NLGI Certification Symbol (Fig. 1). The symbol contains a coded designation that identifies the usage and quality of the lubricant.

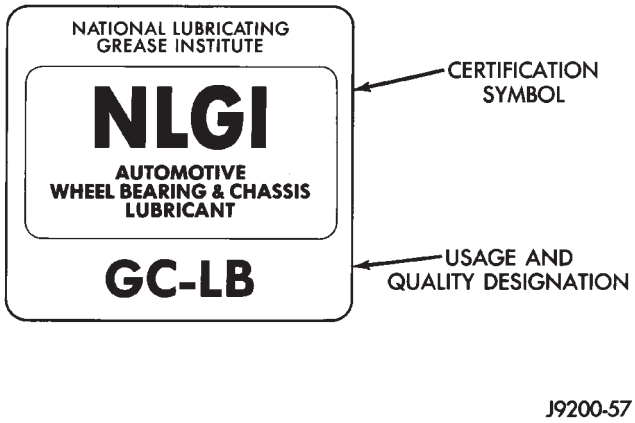


Fig. 1 NLGI Lubricant Container Certification/ Identification Symbol

The letter **G** designates wheel bearing lubricant. Letter **L** designates chassis lubricant. When the letters are combined the lubricant can be used for dual applications. The suffix letters **C** and **B** designate the level of the lubricant for the application. The letter **C** represents level available for wheel bearing lubricant (G) and the letter **B** represents level available for chassis lubricant (L).

STEERING LINKAGE AND BALL STUDS

RECOMMENDED MAINTENANCE

The general condition of the steering linkage (Fig. 2) should be inspected and the ball studs should be lubricated:

- 2WD vehicles — after each 24 000-km (15,000-miles) or six-months interval of vehicle operation has elapsed; or
- 4WD vehicles — after each 12 000-km (7,500-miles) or six-months interval of vehicle operation has elapsed.

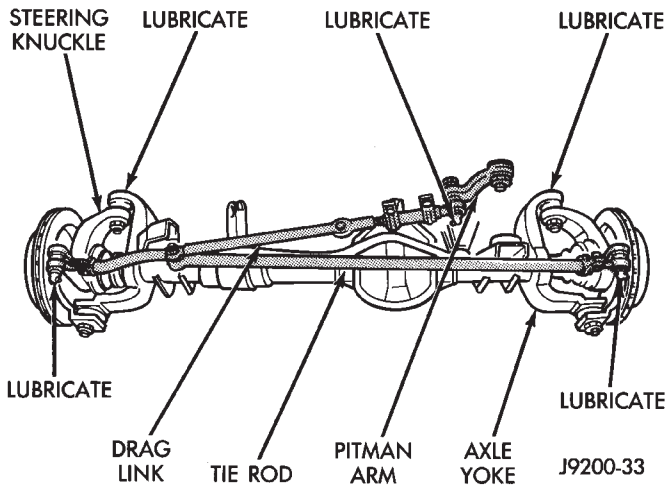


Fig. 2 Steering Components (XJ)—Typical

LUBRICANT SPECIFICATION

Steering linkage should be lubricated with a dual-purpose, lithium-base lubricant that is identified as NLGI GC-LB lubricant.

INSPECTION/LUBRICATION

(1) Inspect the steering linkage. Examine the tie rods and the drag link for bending, and the ball studs for looseness and excessive wear.

(2) Replace, as necessary, all torn/ruptured ball-stud seals and damaged/defective steering linkage components.

CAUTION: Use care to prevent lubricant from contacting the brake rotors.

(3) Lubricate the ball studs:

- clean the tips of the Zerk type lubrication fittings on the tie-rod and drag-link ball-stud ends to avoid lubricant contamination;
- lubricate the ball studs with high quality, dual-purpose, lithium base chassis/wheel bearing lubricant (NLGI GC-LB lubricant);
- cease the lubricant pressure when lubricant begins to freely exit the base of the seal, or if the seal begins to expand; and
- wipe the excess lubricant from the exterior surfaces of the ball joints and the adjacent surfaces.

FRONT WHEEL BEARINGS

Only 2WD XJ vehicles are equipped with front wheel bearings. XJ vehicles have semi-floating axle shafts and axle shaft bearings that are lubricated via differential lube oil.

RECOMMENDED MAINTENANCE—2WD XJ VEHICLES

The front wheel bearings should be lubricated (repacked) at the same time as front brake pad/caliper service is conducted.

LUBRICANT SPECIFICATION

Wheel bearings should be lubricated with a lubricant that is identified as NLGI GC-LB lubricant.

INSPECTION/LUBRICATION

(1) Remove the wheel/tire and the disc brake caliper. **Do not disconnect the caliper brake fluid hose unless the caliper must also be removed for maintenance. Support the caliper with a hanger to prevent brake fluid hose damage.**

(2) Remove the dust cap, the cotter pin, the nut retainer, the adjustment nut, and the thrust washer from the spindle (Fig. 3). Discard the cotter pin.

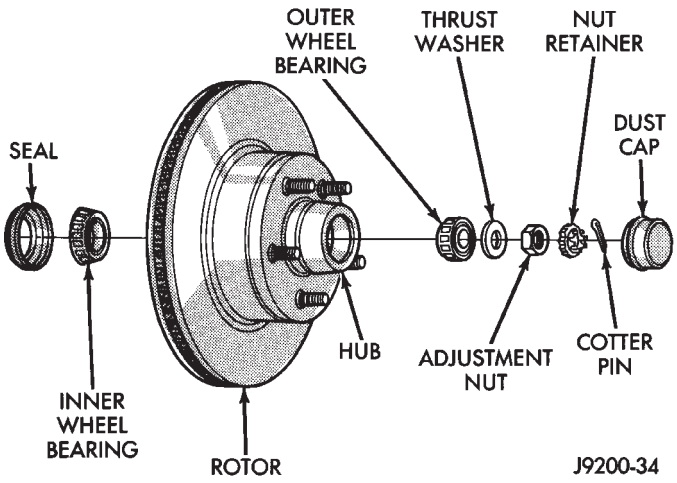


Fig. 3 2WD Front Wheel Bearings—XJ Vehicles

(3) Remove the wheel outer bearing from the hub.

(4) Remove the wheel hub/disc brake rotor from the spindle.

(5) Remove the seal and the inner wheel bearing from the hub cavity.

(6) After removal, inspect both front wheel bearing races for indications of pitting, brinelling and excessive heat.

(7) Wipe the spindle clean and apply a small amount of chassis/wheel bearing lubricant (NLGI GC-LB lubricant) to prevent rust. Wipe the wheel hub cavity clean.

CAUTION: Do not over-fill the wheel hub cavity with lubricant. Excessive lubricant can cause overheating and bearing damage. Also, excessive lubricant can be forced out of the wheel hub cavity and contaminate the brake rotor/pads.

(8) Partially fill the wheel hub cavity with chassis/wheel bearing lubricant (NLGI GC-LB lubricant).

(9) Pack the wheel bearings with chassis/wheel bearing lubricant (NLGI GC-LB lubricant). Ensure that sufficient lubricant is forced between the bearing rollers.

(10) Install the wheel inner bearing in the wheel hub and install a replacement seal.

(11) Clean the disc brake rotor contact surfaces, if necessary.

(12) Install the wheel hub/disc brake rotor on the spindle.

(13) Install the wheel outer bearing, the thrust washer, and the spindle nut.

(14) Tighten the spindle nut with 28 N•m (21 ft. lbs.) torque while rotating the disc brake rotor to seat the bearings.

(15) Loosen the spindle nut 1/2 turn. While rotating the disc brake rotor, tighten the spindle nut with 2 N•m (19 in. lbs.) torque.

(16) Install the nut retainer and a replacement cotter pin.

(17) Clean the dust cap and apply wheel bearing lubricant to the inside surface. **Do not fill the dust cap with lubricant.**

(18) Install the dust cap.

(19) Install the disc brake caliper.

POWER STEERING SYSTEM

RECOMMENDED MAINTENANCE

The condition of power steering system should be inspected and the fluid level checked. Add fluid as necessary.

FLUID SPECIFICATION

Jeep® power steering systems require MOPAR Power Steering Fluid, or an equivalent product.

The original power steering fluid installed in Jeep® vehicles includes black-light leak detection dye.

INSPECTION

Inspect the power steering system (Figs. 4 and 5) for the sources of fluid leaks, steering gear housing cracks and ensure that the steering gear is securely attached to the vehicle frame rail. Inspect the steering damper for leaks and loose connections.

FLUID LEVEL

The fluid level dipstick is attached to the reservoir cap (Fig. 6). The fluid level in the reservoir can be determined with the fluid either hot or cold.

(1) Remove the cap from the reservoir.

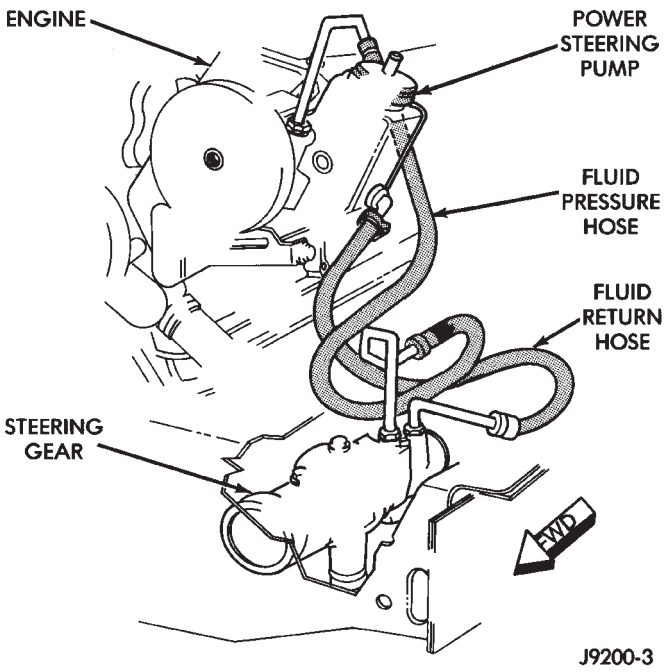


Fig. 4 Power Steering System—XJ Vehicles

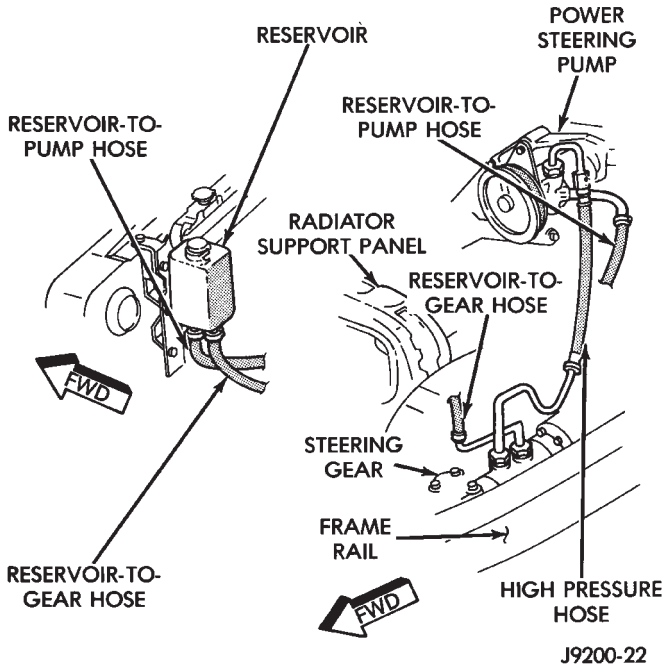


Fig. 5 Power Steering System—YJ Vehicles

(2) Depending on fluid temperature, if the level is below the FULL HOT mark or the FULL COLD mark on the dipstick, add power steering fluid.

(3) Install the cap on the reservoir.

MANUAL STEERING GEAR—YJ VEHICLES

RECOMMENDED MAINTENANCE

The manual steering gear should be inspected for damage at the same time as the engine oil is changed and the oil filter is replaced. Repair as necessary (refer to Group 19—Steering for additional information and service procedures).

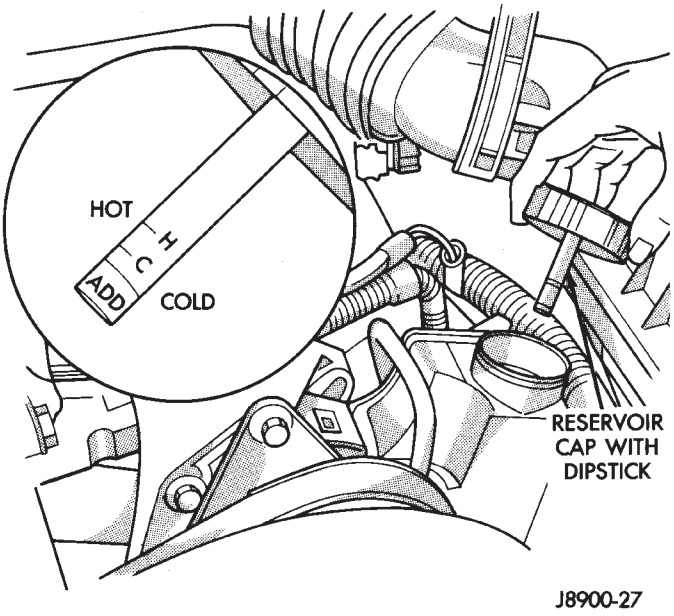


Fig. 6 Power Steering Fluid Reservoir Dipstick—Typical

POWER BRAKE SYSTEM

RECOMMENDED MAINTENANCE

The condition of the brake system should be inspected and the fluid level in the master cylinder should be checked each time the brake system is serviced. Add brake fluid and repair as necessary.

In addition, the brake system should be operationally tested periodically to ensure that it is functioning normally.

FLUID SPECIFICATION

Jeep® power brake systems require MOPAR Heavy-Duty Brake Fluid, or an equivalent product identified as conforming to FMVSS No. 116, DOT-3 and SAE J-1703 specifications.

Use **new brake fluid only** when adding fluid to the reservoir, to fill the brake system. Never use reclaimed fluid.

BRAKE FLUID LEVEL

STANDARD POWER BRAKE SYSTEM

(1) Clean the cover and the sides of the brake fluid reservoir.

(2) Detach the bail retainer from the reservoir cover and remove the cover from the reservoir.

(3) The brake fluid level should be 6 mm (1/4 in) below the rim of each reservoir well for XJ and YJ Vehicles (Fig. 7). If not, add brake fluid as necessary.

(4) Inspect the reservoir cover bail retainer for tension and the cover for proper fit. The cover should fit tight and have a good seal.

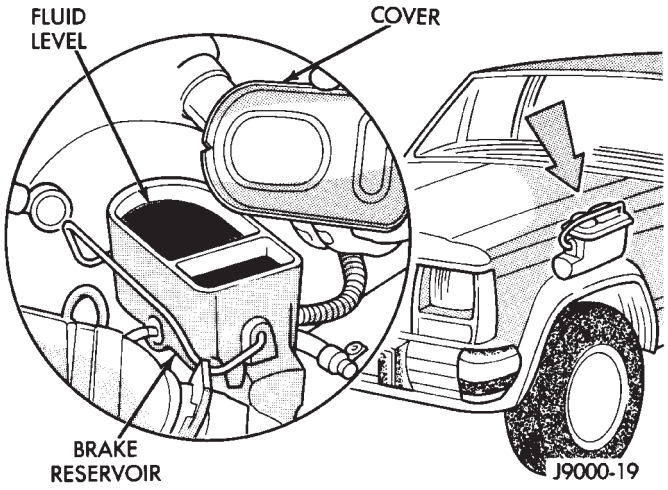


Fig. 7 Reservoir Fluid Level—Typical

(5) Inspect the reservoir rubber diaphragm seal for cracks, cuts and distortion.

(6) Inspect the brake fluid tubing fittings and the master cylinder housing for indications of fluid leakage. Repair as necessary.

(7) Install the brake fluid reservoir cover.

ANTI-LOCK BRAKE SYSTEM—XJ VEHICLES

The anti-lock brake system fluid reservoir for XJ Vehicles is located in the engine compartment at the left side of the dash panel.

(1) Turn the ignition switch ON and allow the pump motor to operate until it automatically de-energizes.

(2) Clean the cover before removing it.

CAUTION: Over-filling could cause fluid overflow and possible reservoir damage when the pump motor energizes.

(3) The brake fluid level should be no lower than the MIN arrow indicator on the side of the reservoir (Fig. 8). If not, add brake fluid as necessary. Raise the fluid level to the MAX arrow indicator only. Do not over-fill the reservoir.

(4) Turn the ignition switch OFF.

BRAKE SYSTEM INSPECTION

BRAKE FLUID HOSES/TUBING

(1) Inspect all brake fluid rubber hoses (Fig. 9) for cracks, swelling, kinks, a distorted condition and fluid leakage.

(2) Inspect the brake fluid hoses and tubing that are routed along the frame rail.

PADS/LININGS, ADJUSTER, WHEEL CYLINDERS AND CALIPER

The front disk brake pads can be visually inspected via the brake caliper inspection ports.

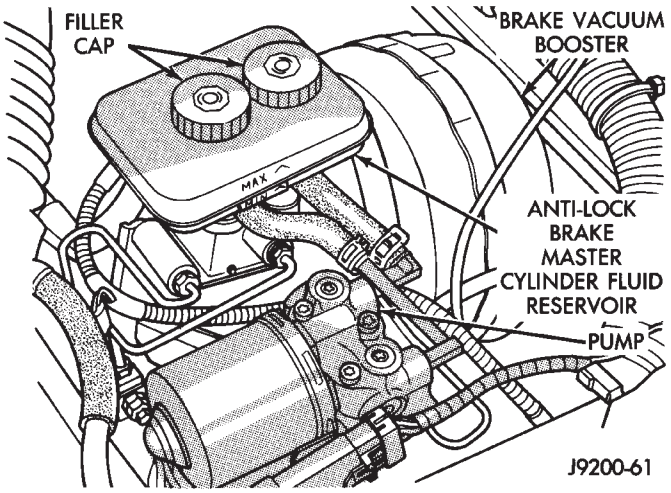


Fig. 8 Reservoir Fluid Level—Anti-Lock Brake System

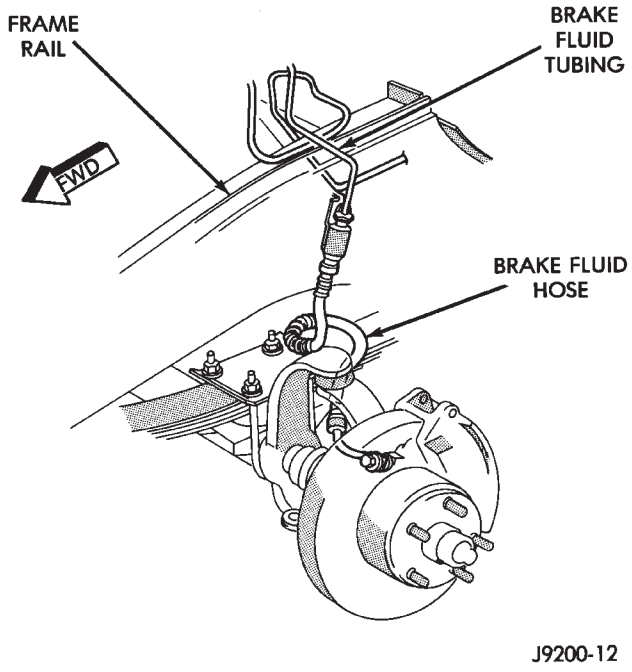


Fig. 9 Rubber Brake Fluid Hose—Typical

(1) Inspect the brake pads and linings for excessive wear, cracks, charred surfaces and broken rivets.

(2) Inspect the brake pads and linings for contamination with brake fluid, axle lubricant and/or another fluid.

(3) Replace the brake pads and/or linings if they are worn to within 0.78 mm (1/32 in) of the rivet head.

(4) Operate the rear brake self-adjuster lever and pivot. Test the operation of the self-adjuster screw for ease of movement.

(5) Inspect the self-adjuster components for bent areas, frayed cables, loose or overheated springs, and a binding condition.

(6) Inspect the disc brake caliper dust boot for correct installation, damage/tears and indications of brake fluid leakage. Inspect the bushings and pins for corrosion, tears and a binding condition.

(7) Pull the rear wheel cylinder dust boot back to expose the wheel cylinder housing and inspect for fluid leaks. Inspect the pistons and cylinder bores for proper appearance.

(8) Inspect the brake differential warning valve and housing for indications of leakage, kinked hoses and loose fittings.

PARK BRAKE

(1) As applicable, engage the park brake lever or pedal and then release it.

(2) If the park brake is functioning normally, test it for smooth operation and vehicle-holding capability.

(3) Inspect the park brake cables for kinks, fraying and a binding condition.

(4) With the park brake released, the rear wheels should rotate without restriction. Adjust the park brake cable tension at the equalizer (Fig. 10), if necessary.

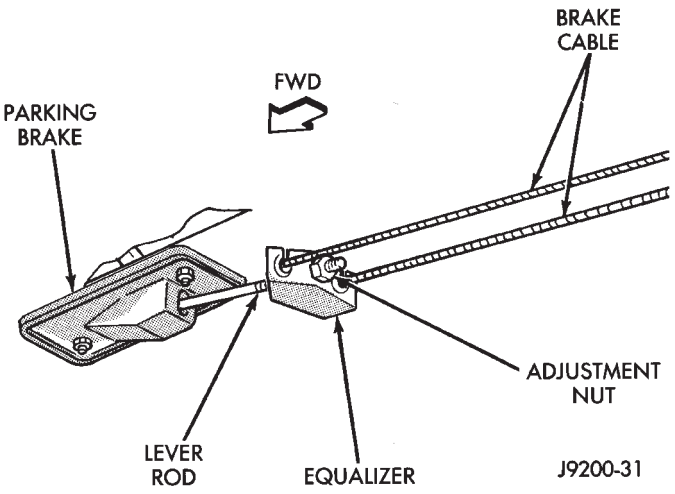


Fig. 10 Park Brake Equalizer (XJ)—Typical

(5) Repair any park brake malfunctions.

BRAKE OPERATIONAL TEST

(1) Drive the vehicle and test for proper brake action.

(2) Note any indication of drum/rotor overheating, wheel dragging or the vehicle pulling to one side when the brakes are applied.

(3) Evaluate any performance complaints received from the owner/operator.

(4) Repair the brake system as necessary (refer to Group 5—Brakes for additional information and service procedures).

TIRES

RECOMMENDED MAINTENANCE

The general condition of the tires and the inflation pressures should be inspected at the same time the engine oil is changed and the oil filter is replaced.

In addition, the tires/wheels should be rotated periodically to ensure even tread wear and maximum tread life. The tires/wheels should be rotated initially after the first 12 000-km (7,500-miles). Thereafter, after each 24 000-km (15,000-miles) interval of vehicle operation has elapsed.

INSPECTION

Inspect the tires for excessive wear, damage, etc. Test the tires for the recommended inflation pressure. Refer to the tire inflation pressure decal located on the inside of the glove box door, and also to Group 22—Tires And Wheels.

ROTATION

Refer to Group 22—Tires And Wheels for the recommended method of tire/wheel rotation for a Jeep® vehicle.

BODY COMPONENTS

RECOMMENDED MAINTENANCE

Body components should be lubricated (as required) after each 48 000-km (30,000-miles) interval of vehicle operation has elapsed.

LUBRICANT SPECIFICATIONS

All applicable exterior and interior body components should be:

- inspected for excessive wear,
- cleaned, and
- all pivot/sliding contact areas of the components should be lubricated with the specified lubricant.

Refer to the Body Lubricant Specifications chart below. When excessive wear is apparent, replace/repair as necessary.

LUBRICATION

All pivoting and sliding contact areas, including:

- seat tracks,
- door hinges/latches/strikers, and
- liftgate/tailgate/hood hinges (Fig. 11),

should be lubricated periodically to ensure quiet, easy operation and to protect against wear and corrosion.

(1) As required, lubricate the body components with the specified lubricants.

(2) When lubricating door weatherstrip seals, apply the lubricant to a cloth and wipe it on the seal.

(3) Prior to the application of lubricant, the component should be wiped clean to remove dust, grit and debris. After lubrication, any excess lubricant should be removed.

BODY LUBRICANT SPECIFICATIONS

COMPONENT	SERVICE INTERVAL	LUBRICANT
Door Latches	As Required	Multi-Purpose Grease NLGI GC-LB (Water Resistant) (1)
Hood Latch Release Mechanism & Safety Latch	As Required (When Performing Other Underhood Services)	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Hood Hinges	As Required	Engine Oil
Seat Regulator & Track Release Mechanism	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Tailgate Hinge	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Tailgate Support Arms	As Required	Engine Oil
Tailgate Latches	As Required	White Spray Lubricant (3)
Tailgate Release Handle (Pivot & Slide Contact Surfaces)	As Required	Multi-Purpose Grease NLGI GC-LB 2 EP (2)
Window System Components (Regulators, Tracks, Rods & Channel Areas — Except Glass Run Weatherstrips and Felt Lubricator, if Equipped)	As Required	White Spray Lubricant (3)
Lock Cylinders	Twice/Year	Lock Cylinder Lubricant (4)
Parking Brake Mechanism	As Required	Multi-Purpose Grease NLGI GC-LB (1)
1. Mopar Wheel Bearing Grease (High Temperature) 2. Mopar Multi-Mileage Lubricant 3. Mopar Spray White Lube 4. Mopar Lock Cylinder Lubricant		

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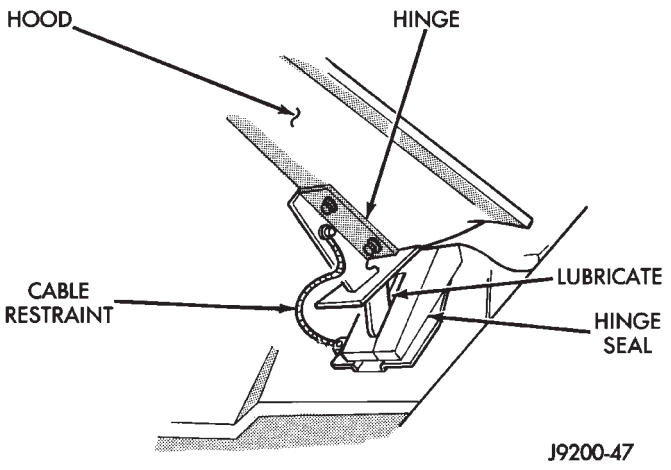


Fig. 11 Hood Hinge Lubrication—XJ Vehicles

(4) Extra close attention should be given to external key lock cylinders during the autumn and winter months to ensure protection from water and ice.

(5) Extra close attention should also be given to the hood latch components to ensure proper functioning.

HEADLAMPS

RECOMMENDED MAINTENANCE

Approximately every six months the headlamps should be displayed on a vertical test surface. This will ensure that the headlamps are positioned for safe night-time driving.

BEAM AIM ADJUSTMENT

(1) Changes in the vehicle front and rear suspension will alter the headlamp beam patterns and this can cause unsafe night-time driving conditions.

(2) If a vehicle is loaded the headlamp beam patterns should be displayed on an vertical test surface and the headlamps re-aimed.

(3) Observe the headlamp beam patterns on an appropriate vertical test surface and, if necessary, adjust the headlamp beam aim.

(4) If necessary, refer to Group 8L—Lamps for headlamp aim adjustment procedures.

FRONT SUSPENSION AND AXLE

CONTENTS

GENERAL INFORMATION

FRONT SUSPENSION

XJ VEHICLES

The Cherokee front suspension is a link/coil design comprised of (Fig. 1);

- Drive axle (4WD), tube axle (2WD)
- Track bar
- Stabilizer bar
- Upper and lower suspension arms
- Coil springs
- Dual-action shock absorbers
- Jounce bumpers (used to limit the travel of the suspension)

The link/coil suspension allows each wheel to adapt to different road surfaces without greatly affecting the opposite wheel. Wheels are attached to a hub/bearings which bolts to the knuckles. The hub/bearing is not serviceable and is replaced as a unit. Steering knuckles pivot on replaceable ball studs attached to the axle tube yokes.

The upper and lower suspension arms are different lengths, with bushings at both ends. They bolt the

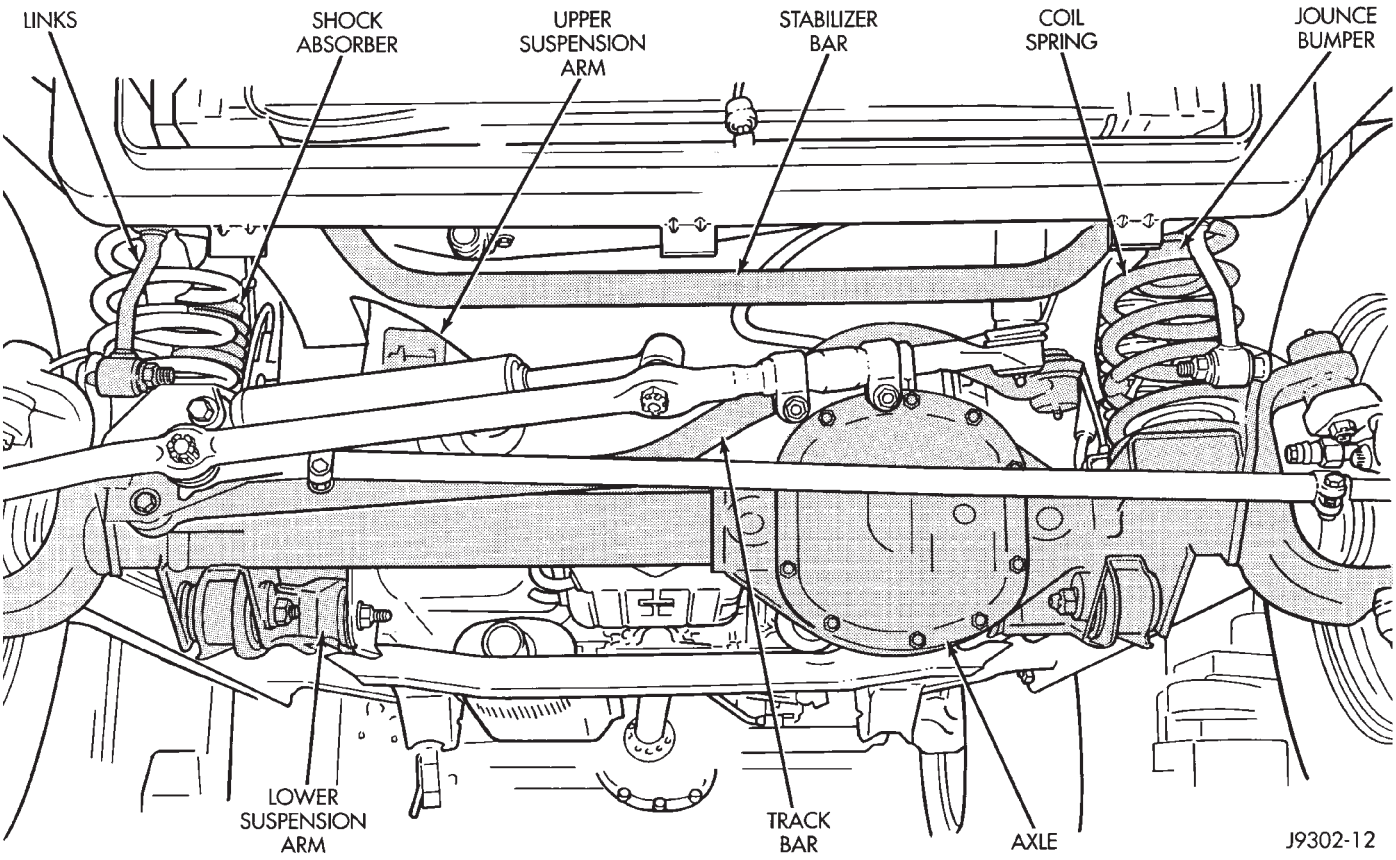


Fig. 1 XJ Front Suspension

axle assembly to the frame. The lower arms uses shims at the frame mount to allow for adjustment of caster and pinion angle. The suspension arm travel (jounce or rebound) is limited through the use of rubber bumpers.

Suspension components which use rubber bushings should be tightened at vehicle ride height. This will prevent premature failure of the bushing and maintain ride comfort. Bushings must never be lubricated.

The coil springs control ride quality and maintain proper ride height. The coil springs mount up in the fender shield which is part of the unitized body bracket. A rubber isolator is located between the top of the spring and the frame. The bottom of the spring seats on a axle pad and is retained with a clip.

The shock absorbers dampen jounce and rebound of the vehicle over various road conditions. The top of the shock absorbers are bolted to the frame. The bottom of the shocks are bolted to the axle spring bracket.

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

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

TUBE AXLE (2WD VEHICLES)

The front axle used on two-wheel drive vehicles is a one-piece, tubular axle (Fig. 2). The tubular axle mounts in the same bracketry as does the four-wheel drive front axle. The steering knuckles and hub bearing assemblies are the same as used on the Model 30 drive axle.

YJ VEHICLES

The Wrangler (YJ) front suspension is leaf spring design comprised of (Fig. 3);

- Drive axle
- Track bar
- Stabilizer bar
- Leaf springs
- Dual-action shock absorbers
- Jounce bumpers (used to limit the travel of the suspension)

The front suspension uses semi-elliptic multi-leaf springs mounted on the drive axle. The rearward end of the springs are mounted to the frame rail hangers through rubber bushings. The bushings isolate road noise as the springs move. The forward end of the springs are attached to the frame with shackles. The spring and shackles use rubber bushings to isolate road noise. The shackles allow the springs to change

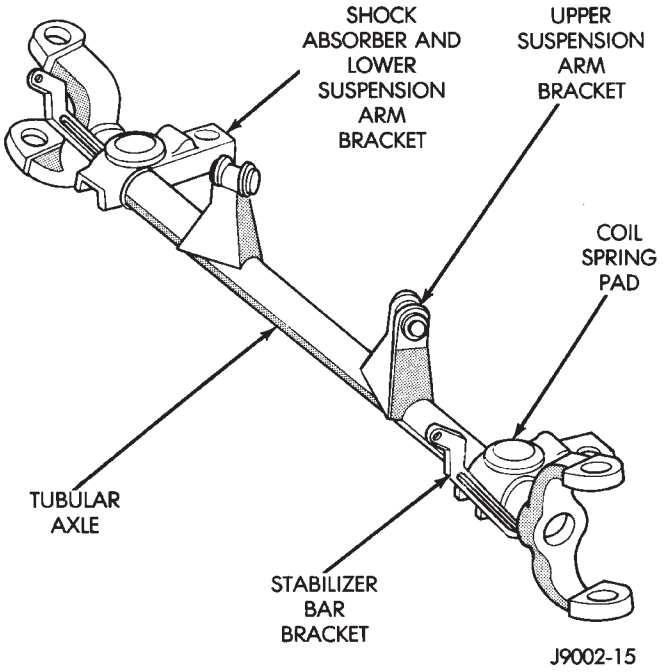


Fig. 2 Front Axle— 2WD Vehicles

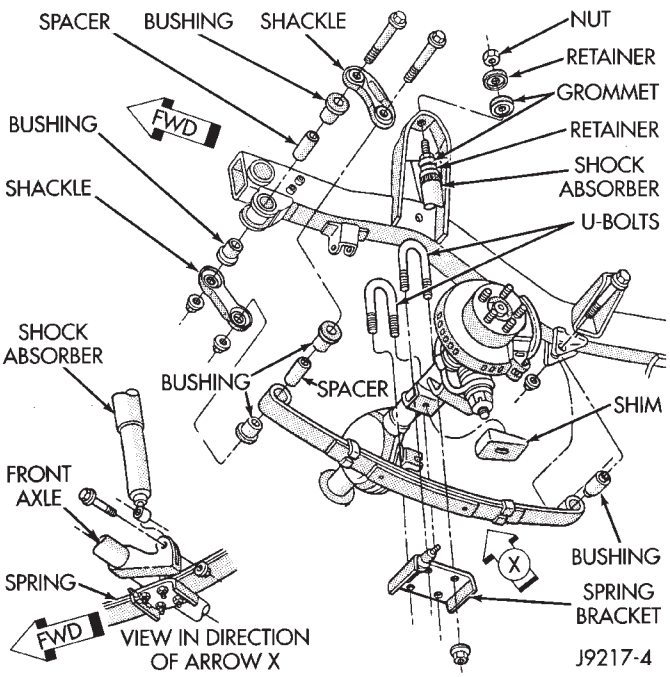


Fig. 3 YJ Front Suspension

their length as the vehicle moves over various road conditions. The spring and axle travel (jounce or rebound) is limited through use of rubber bumpers mounted on the frame.

Suspension components which use rubber bushings should be tightened at vehicle ride height. This will prevent premature failure of the bushing and maintain ride comfort. The bushings should never be lubricated.

The shocks absorbers dampen jounce and rebound of the vehicle over various road conditions. The top of the shock absorbers are bolted to the frame. The bottom of the shocks are bolted to the axle bracket.

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

The track bar is used to minimize front axle side-to-side movement. The track bar is attached to a frame rail bracket and the axle bracket.

The bar uses bushings at both ends.

FRONT DRIVE AXLE

It is not necessary to remove the complete axle from the vehicle for routine differential service. If the differential housing or axle shaft tubes are damaged, the complete axle assembly can be removed and serviced.

For complete drive axle assembly removal and installation refer to Drive Axle Assembly Replacement in this Group.

The removable cover provides for servicing without removing axle from vehicle.

The integral type housing, hypoid gear design has the centerline of the pinion set above the centerline of the ring gear.

The Model 30 axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the housing cover (Fig. 4). Build date identification codes are stamped on the axle shaft tube cover side.

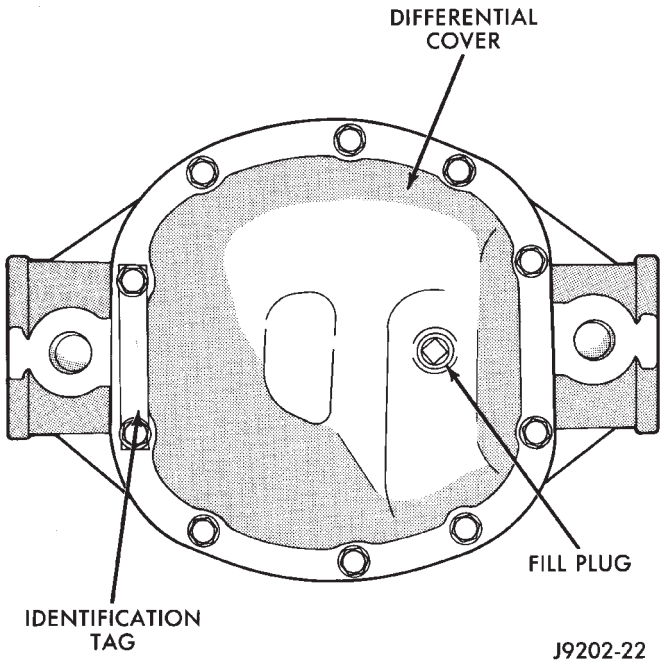


Fig. 4 Model 30 Differential Cover

XJ and YJ axles are equipped with an optional A.B.S. brake system. The A.B.S. tone rings are pressed onto the axle shaft near the hub and knuckle. For additional information on the A.B.S. system refer to Group 5, Brakes.

- XJ vehicles use a non-disconnect axle.
- YJ vehicles use a vacuum disconnect axle (Fig. 5).

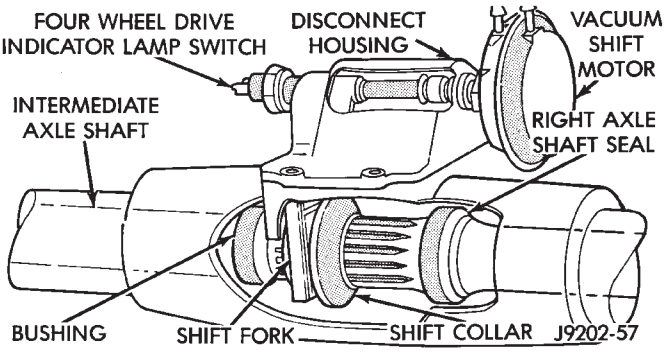


Fig. 5 Disconnect Feature

STANDARD DIFFERENTIAL OPERATION

The differential gear system divides the torque between the axle shafts. It allows the axle shafts to rotate at different speeds when turning corners.

Each differential side gear is splined to an axle shaft. The pinion gears are mounted on a pinion mate shaft and are free to rotate on the shaft. The pinion gear is fitted in a bore in the differential case and is positioned at a right angle to the axle shafts.

In operation, power flow occurs as follows:

- Pinion gear rotates the ring gear
- Ring gear (bolted to the differential case) rotates the case
- Differential pinion gears (mounted on the pinion mate shaft in the case) rotate the side gears
- Side gears (splined to the axle shafts) rotate the shafts

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to 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. 6).

When turning corners, the outside wheel must travel a greater distance than the inside wheel. This difference must be compensated for in order to prevent the wheels from scuffing and skidding through the turn. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 7). 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.

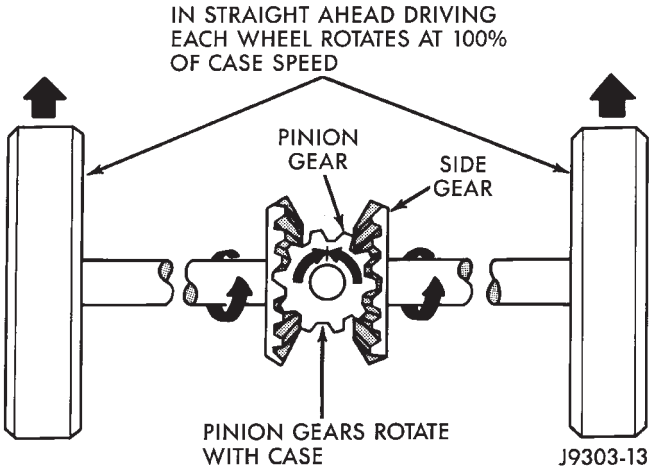


Fig. 6 Differential Operation—Straight-Ahead Driving

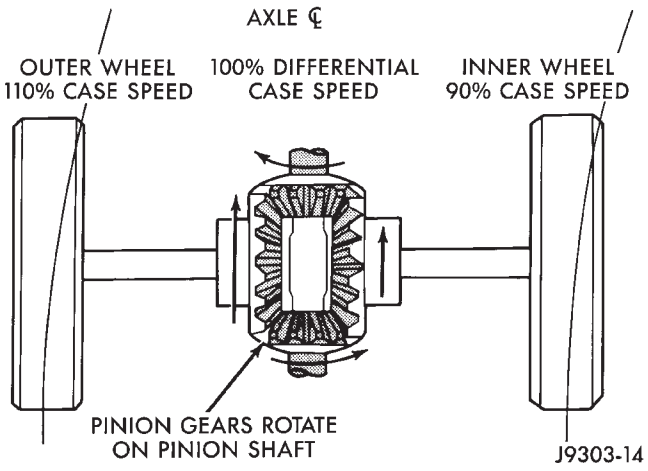


Fig. 7 Differential Operation—On Turns

FRONT WHEEL ALIGNMENT

INDEX

GENERAL INFORMATION

Front 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 maximize tire wear. The most important measurements of front end alignment are caster, camber and toe position.

Routine inspection of the front suspension and steering components is a good preventative maintenance practice. Inspection also helps to ensure safe operation of the vehicle.

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

• WHEEL TOE POSITION is the difference between the leading inside edges and trailing inside edges of the front tires (Fig. 1). Incorrect wheel toe position is the most common cause of unstable steering and uneven tire wear. The wheel toe position is the **final** front wheel alignment adjustment.

• STEERING AXIS INCLINATION ANGLE is measured in degrees and is the angle that the steering knuckles are tilted (Fig. 1). The inclination angle has a fixed relationship with the camber angle. It will

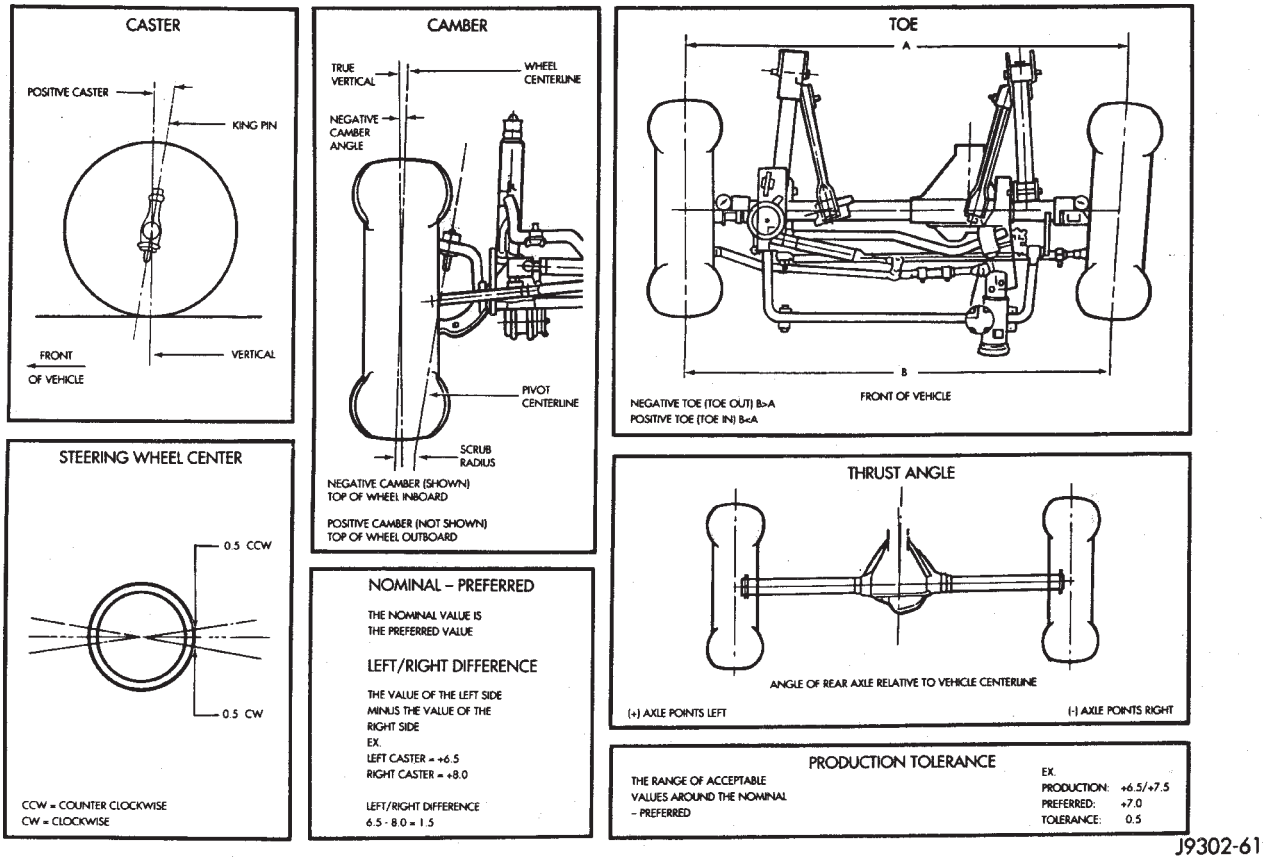


Fig. 1 Wheel Alignment Measurements

not change except when a spindle or ball stud is damaged or bent. The angle is not adjustable and the damaged component(s) must be replaced to correct mis-alignment.

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

PRE-ALIGNMENT INSPECTION

Before starting a front wheel alignment, the following inspection and necessary corrections must be completed.

(1) Tires with the same recommended air pressure, size, and thread wear. Refer to Group 22, Tires And Wheels for diagnosis information.

(2) Front wheel bearings for wear.

(3) Ball studs, steering linkage pivot points and steering gear for looseness, roughness, binding or wear. Refer to Group 19, Steering for additional information.

(4) Front wheels for excessive radial or lateral runout and unbalance. Refer to Group 22, Tires And Wheels for diagnosis information.

(5) Suspension components for wear and noise. Check components for correct torque. Refer to Groups 2 and 3, Suspension and Axle for additional information.

ALIGNMENT MEASUREMENTS AND ADJUSTMENTS

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

CAMBER

The wheel camber angle (Fig. 1) is preset at ZERO DEGREES (0°). The angle is not adjustable and cannot be altered.

CASTER

The caster angle (Fig. 1) is set at:

- XJ manual transmission, POSITIVE 6.5 DEGREES (+6.5°).
- XJ automatic transmission, POSITIVE 8.0 DEGREES (+8.0°).
- YJ all transmissions, POSITIVE 6.0 DEGREES (+6.0°).

Before checking the caster of the front axle for correct angle. Be sure the axle is not bent or twisted.

Road test the vehicle, and make left and right turns. If the steering wheel returns to the center position unassisted, the caster angle is correct. However, if steering wheel does not return toward the center position unassisted, an incorrect caster angle is probable.

Caster can be adjusted by installing the appropriate size shims (Fig. 2, 3). **Changing caster angle will also change the front propeller shaft angle. The propeller shaft angle has priority over caster. Refer to Group 16, Propeller Shafts for additional information.**

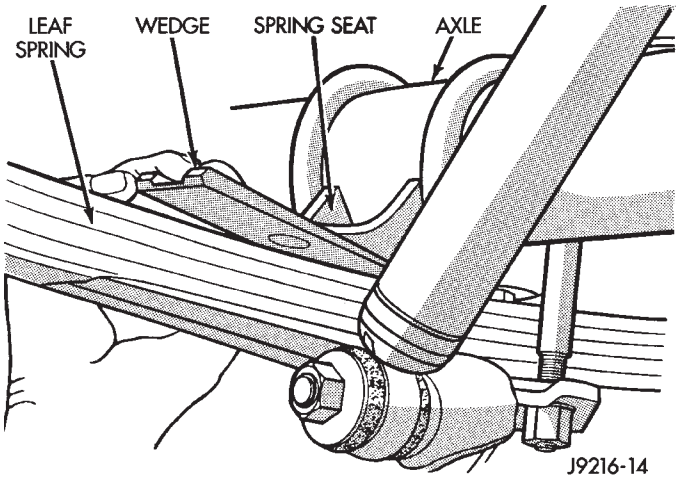


Fig. 2 Adjustment—YJ Vehicles

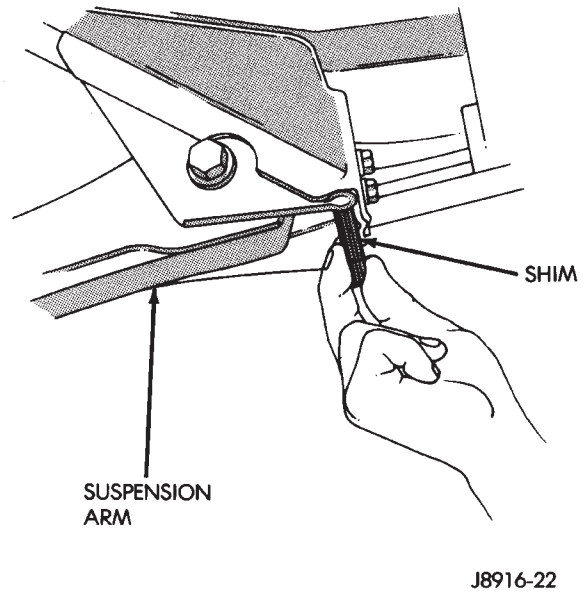
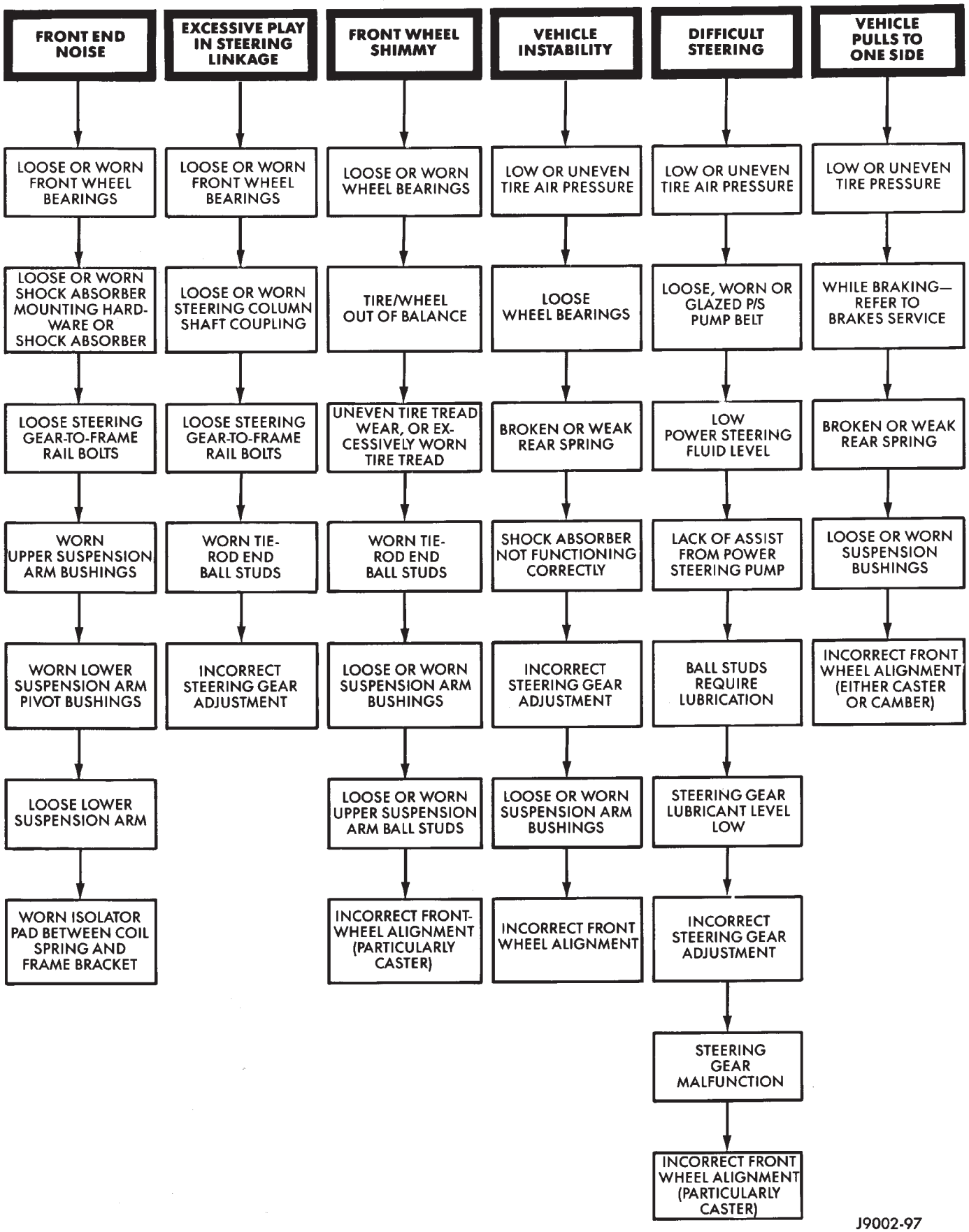


Fig. 3 Adjustment—XJ Vehicles

SUSPENSION AND STEERING SYSTEM DIAGNOSIS



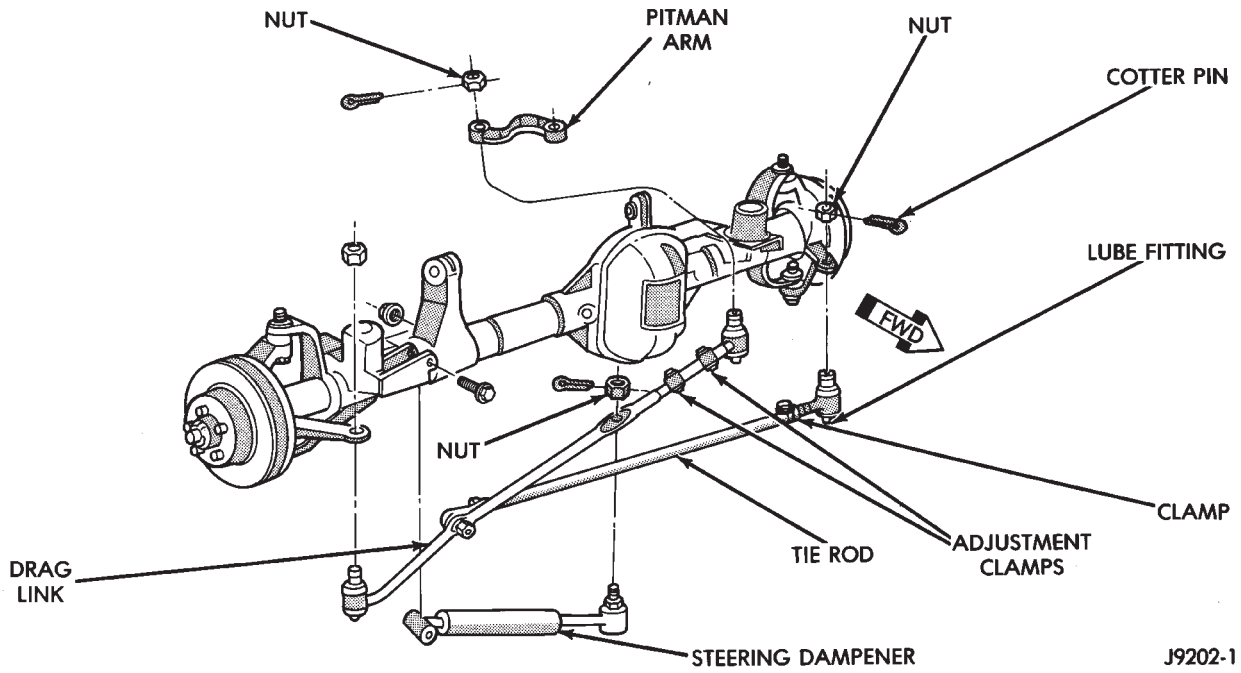


Fig. 4 Steering Linkage—XJ Vehicles

TOE POSITION—XJ VEHICLES

The wheel toe position adjustment should be 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 adjustment sleeve clamp bolts (Fig. 4).

(3) Adjust the right wheel toe position with the drag link. Turn the sleeve until the right wheel is at specifications. Position the clamp bolts as shown (Fig. 5) and tighten to 49 N·m (36 ft. lbs.) torque. **Make sure the toe setting does not change during clamp tightening.**

(4) Adjust the left wheel toe position with the tie rod. Turn the sleeve until the left wheel is at specifications. Position the clamp bolts as shown (Fig. 5) and tighten to 27 N·m (20 ft. lbs.) torque. **Make sure the toe setting does not change during clamp tightening.**

(5) Verify the right toe setting.

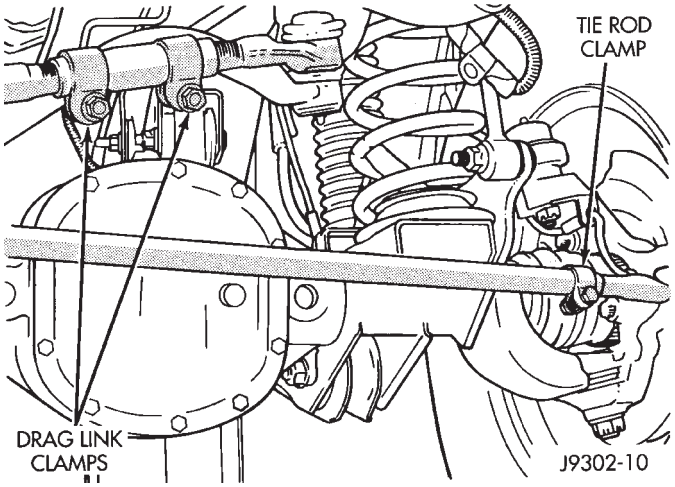


Fig. 5 Drag Link and Tie Rod Clamp Location

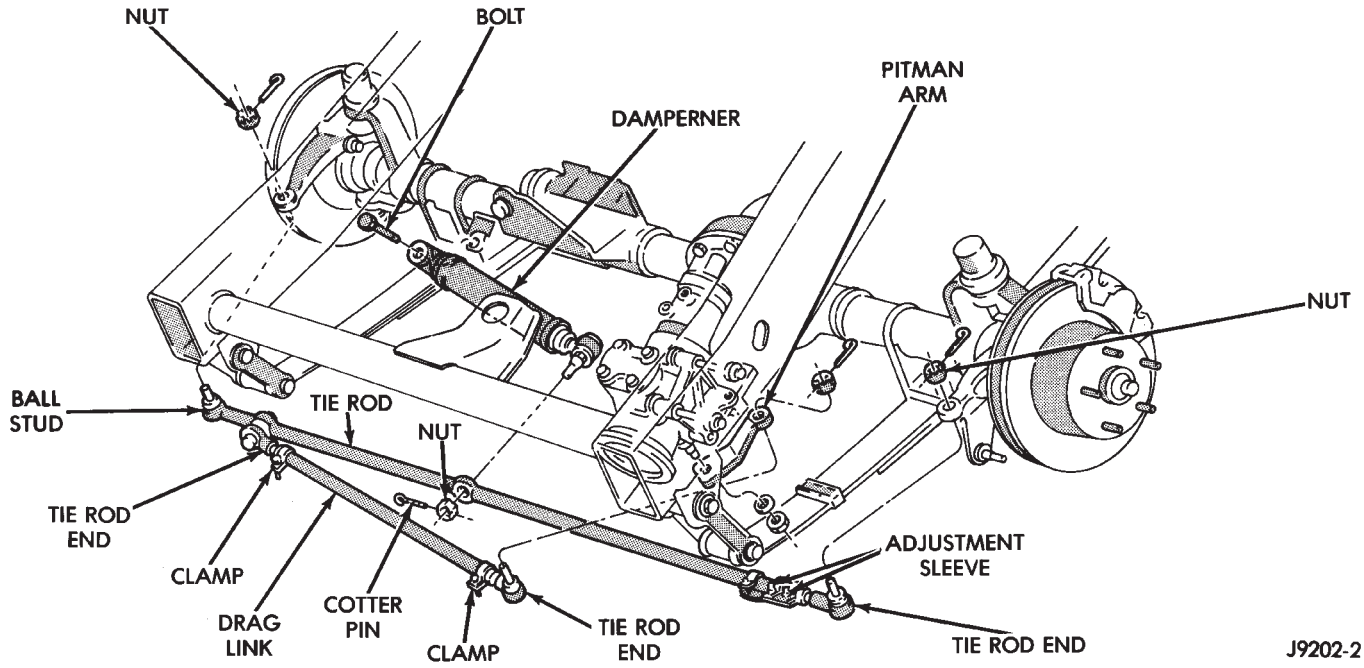


Fig. 6 Steering Linkage

TOE POSITION—YJ VEHICLES

The wheel toe position should be the final front wheel alignment adjustment. In all instances follow the equipment manufacturer's recommended procedure.

(1) Secure the steering wheel with the front wheels in the straight-ahead position. For vehicles equipped with power steering, start the engine before straightening the wheels.

ALIGNMENT SPECIFICATIONS—XJ VEHICLES

Adjustment	Set-To	OK Range
TOE:		
Right Wheel	0°	1/32 inch IN to 1/32 inch OUT
Left Wheel	0°	1/32 inch IN to 1/32 inch OUT
CAMBER	0°	+1/2° to −3/4°
CASTER	6°	5° to 9°
OUTSIDE WHEEL TURN ANGLE*	33° MAX.	33° to 32°

J9002-23

*STEERING STOPS ARE NOT ADJUSTABLE.

(2) Loosen the adjustment sleeve clamp bolts on the tie rod (Fig. 6).

YJ Vehicles

The tie rod and adjustment sleeve have both right and left hand threads to provide equal adjustment for each wheel.

(3) After the adjustment is completed, position the tie rod adjustment sleeve clamp bolts as shown.

(4) Tighten the adjustment sleeve clamp bolts to 27 N·m (20 ft. lbs.) torque.

(5) The steering wheel can be centered by the drag link. Complete the adjustment. Position the drag link clamp bolts as shown. Tighten the bolts to 49 N·m (36 ft. lbs.) torque.

ALIGNMENT SPECIFICATIONS—YJ VEHICLES

Adjustment	Set-To	OK Range
TOE:		
Right Wheel	0°	1/16 inch IN 1/16 inch OUT
Left Wheel	0°	1/16 inch IN 1/16 inch OUT
CAMBER	0°	−1/2° to +1/2°
CASTER:		
Manual Trans.	6.5°	5-1/4° to 7-1/4°
Auto. Trans.	8.0°	6-1/2° to 9°
OUTSIDE WHEEL TURN ANGLE*	33°	32° to 33°

* Steering stops are not adjustable. J9102-15

XJ FRONT SUSPENSION

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SERVICE INFORMATION

CAUTION: Suspension components that use rubber bushings should be tightened with the vehicle at the normal height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If the springs are not at their normal ride position, vehicle ride comfort could be affected along with premature bushing wear. Rubber bushings must never be lubricated.

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the cotter pin and nut from the ball stud end at the frame rail bracket (Fig. 1).

A puller tool may be necessary to separate the ball stud from the frame rail bracket.

(3) Remove the bolt and flag nut from the axle shaft tube bracket (Fig. 1). Remove the track bar.

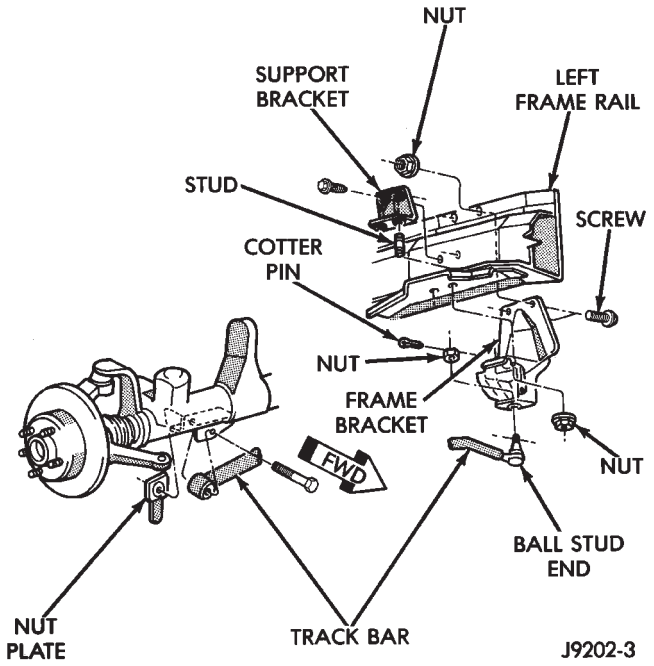

Fig. 1 Track Bar

INSTALLATION

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

(2) It may be necessary to pry the axle assembly over to install the track bar at the frame rail. Install track bar at the frame rail bracket. Install the retaining nut on the stud (Fig. 1).

(3) Remove the supports and lower the vehicle.

(4) Tighten the retaining bolt at the axle shaft tube bracket to 100 N·m (74 ft. lbs.) torque.

(5) Tighten the ball stud nut to 81 N·m (60 ft. lbs.) torque. Install a new cotter pin.

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Disconnect the stabilizer bar links from the axle brackets (Fig. 2).

(3) Disconnect the stabilizer bar from the links.

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

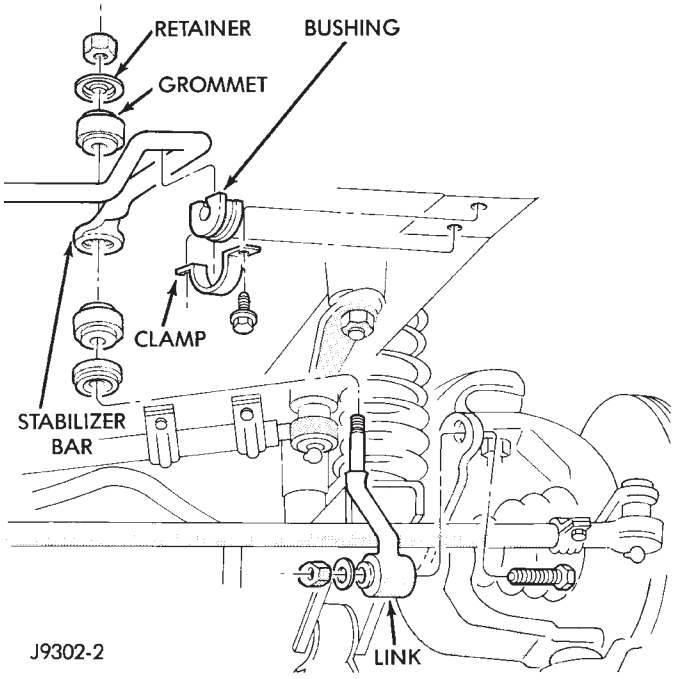

Fig. 2 Stabilizer Bar

INSTALLATION

(1) Inspect stabilizer bar bushings (Fig. 2). Replace bushings if cracked, cut, distorted, or worn.

(2) Position the stabilizer bar on the frame rail and install the bushings and clamps. Ensure the bar is centered with equal spacing on both sides. Tighten the bolts to 75 N·m (40 ft. lbs.).

(3) Install the links and grommets onto the stabilizer bar and axle brackets (Fig. 2). Tighten the nut at the connecting links at the axle bracket to 95 N·m (70 ft. lbs.) torque.

(4) Tighten the stabilizer bar to connecting link nut to 36 N·m (27 ft. lbs.) torque.

(5) Remove the supports and lower the vehicle.

UPPER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the upper suspension arm nut and bolt at the axle bracket (Fig. 3).

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

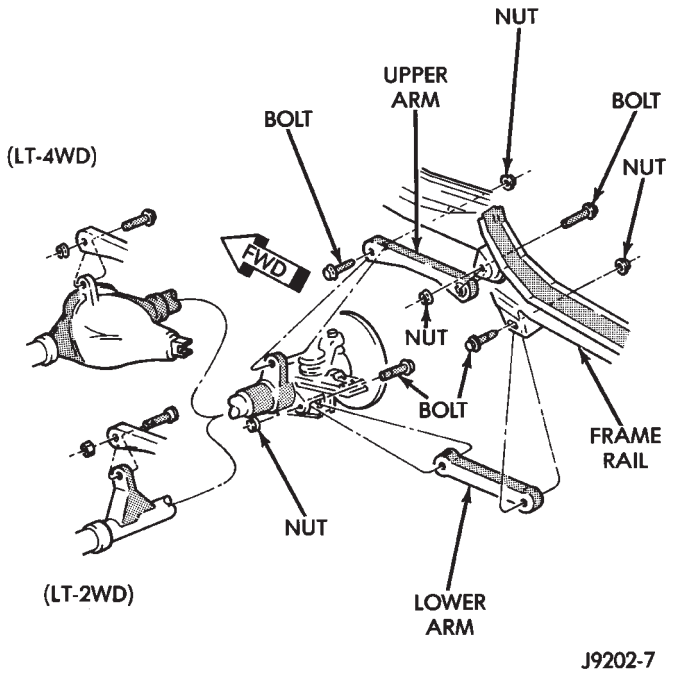

Fig. 3 Upper and Lower Suspension Arms

INSTALLATION

(1) Position the upper suspension arm at the axle and frame rail (Fig. 3).

(2) Install the bolts and finger tighten the nuts (Fig. 3).

(3) Remove the supports and lower the vehicle.

(4) Tighten the nut at the axle to 75 N·m (55 ft. lbs.) torque.

Tighten the nut at the frame bracket to 90 N·m (66 ft. lbs.) torque.

AXLE BUSHING REPLACEMENT

(1) Remove the upper suspension arm from axle. Refer to Upper Suspension Arm Removal in this Group.

(2) Insert Spacer 7932-3 (J-35581-3) around the bushing in the axle bracket ears (Fig. 4).

(3) Assemble and install Bushing Removal/Installer (Fig. 4).

(4) Remove the bushing by tightening the hex-head on Long Nut.

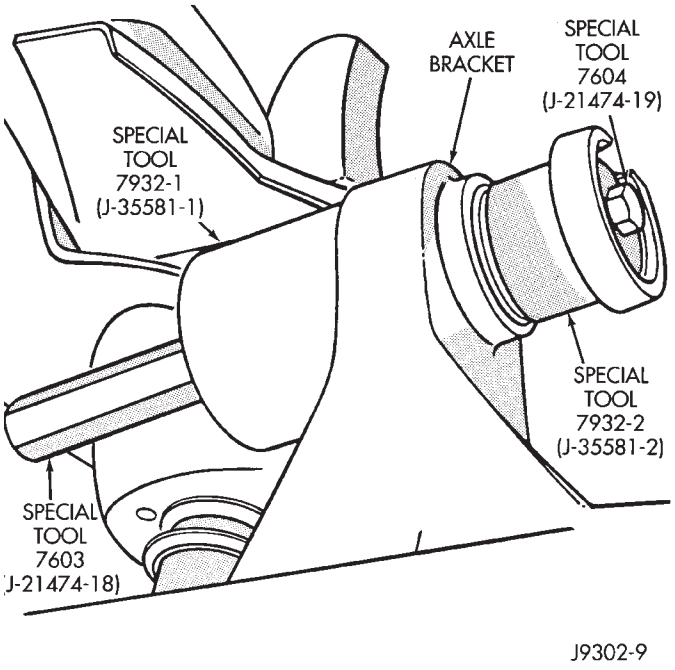

Fig. 4 Axle Bracket Bushing Removal

For two-wheel drive axles and right side on Model 30 axle, do not remove Spacer 7932-3 (J-35581-3) at this time.

(5) Position the new bushing on Installer.

(6) Install the bushing by tightening the hex-head on Long Nut (Fig. 5). Remove Spacer 7932-3 (J-35581-3).

(7) Install the upper suspension arm to axle. Refer to Upper Suspension Arm Installation in this Group.

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the lower suspension arm nut and bolt from the axle bracket (Fig. 3).

(3) Remove the nut and bolt (Fig. 3) from the rear bracket and remove the lower suspension arm.

INSTALLATION

(1) Position the lower suspension arm at the axle bracket and rear bracket (Fig. 3).

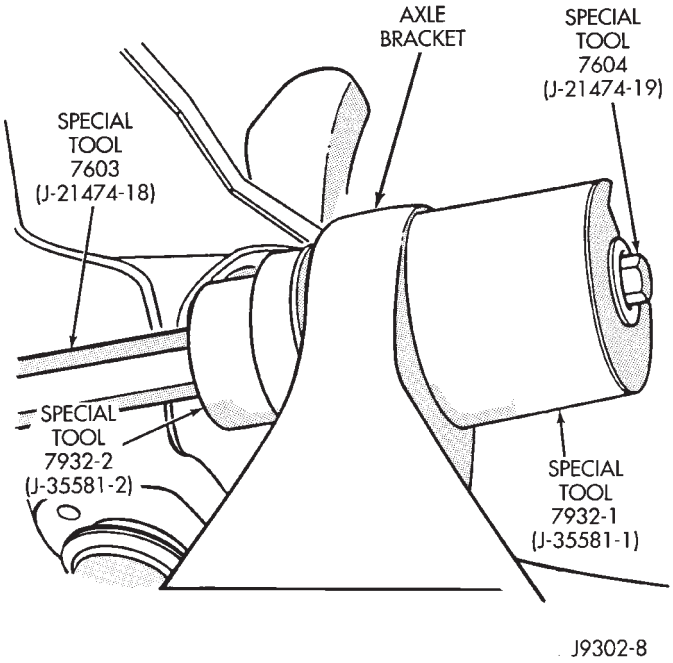

Fig. 5 Axle Bracket Bushing Installation

(2) Install the bolts and finger tighten the nuts (Fig. 3).

(3) Remove support and lower the vehicle.

(4) Tighten the front and rear nuts to 115 N·m (85 ft. lbs.) torque.

SPRING AND SHOCK DIAGNOSIS

A squeak noise from the shock absorber can be produced if movement between the rubber bushings and the metal occurs. This noise can usually be stopped by tightening the attaching nuts. If the squeak noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary.

The shock absorber bushings do not require any type of lubrication. Do not lubricate the bushings to reduce bushing noise. Grease or mineral oil-base lubricants will deteriorate the bushing rubber.

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

SHOCK ABSORBER

REMOVAL

(1) Remove the nut, retainer and grommet from the upper stud in the engine compartment (Fig. 6).

(2) Remove the lower nuts and bolts from the axle bracket (Fig. 6). Remove the shock absorber.

INSTALLATION

(1) Position the lower retainer and grommet on the upper stud. Insert the shock absorber through the shock tower hole.

(2) Install the lower bolts and nuts. Tighten nuts to 19 N·m (14 ft. lbs.) torque.

(3) Install the upper grommet and retainer on the stud in the engine compartment. Install the nut and tighten to 10 N·m (8 ft. lbs.) torque.

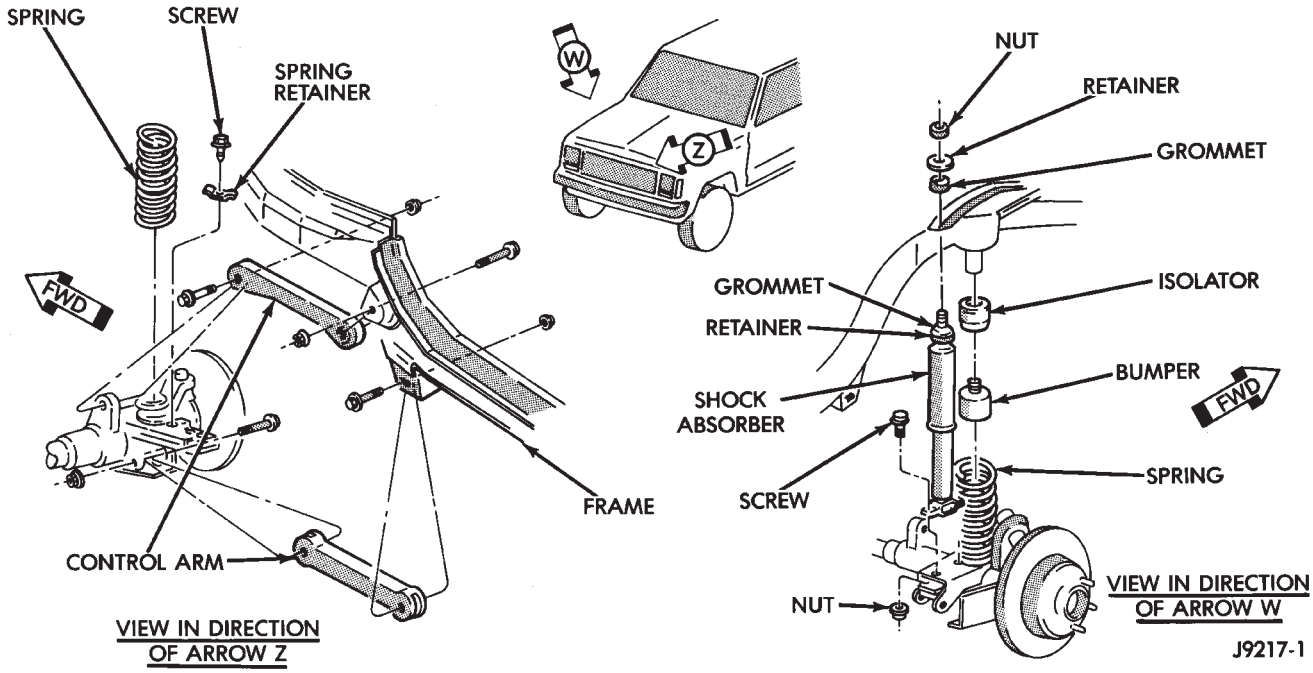

Fig. 6 Coil Spring & Shock Absorber

COIL SPRING

REMOVAL

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

(2) Remove the wheel if necessary.

(3) Mark and disconnect the front propeller shaft from the axle.

(4) Disconnect the lower suspension arms from the axle (Fig. 6).

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

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

(7) Disconnect the drag link from the pitman arm.

(8) Lower the axle until the spring is free from the upper mount. Remove the coil spring clip (Fig. 6) and remove the spring.

(9) Remove the jounce bumper if necessary from the upper spring mount (Fig. 6).

INSTALLATION

(1) Install the jounce bumper on the upper spring mount. Tighten the bolt to 42 N·m (31 ft. lbs.) torque (Fig. 6).

(2) Position the coil spring on the axle pad. Install the spring clip and bolt (Fig. 6). Tighten bolt to 21 N·m (16 ft. lbs.) torque.

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

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

(5) Install the lower suspension arms to the axle. DO NOT TIGHTEN AT THIS TIME.

(6) Install the front propeller shaft to the axle.

(7) Remove the supports and lower the vehicle.

(8) Tighten lower suspension arms nuts to 115 N·m (85 ft. lbs.) torque.

YJ FRONT SUSPENSION

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SERVICE INFORMATION

It is important to have the springs supporting the weight of the vehicle when the track bar fasteners are being torqued. If the springs are not at their normal ride position, vehicle ride comfort could be affected along with premature rubber bushing wear.

TRACK BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the retaining nuts and bolts (Fig. 1) from the axle bracket and frame bracket. Remove track bar.

INSTALLATION

(1) Position track bar at axle shaft tube bracket. Loosely install the retaining bolt and nut (Fig. 1).

(2) Loosely install the retaining bolt and nut at the frame bracket.

(3) Remove support and lower vehicle.

(4) Tighten the retaining nut at the axle shaft tube bracket to 100 N·m (74 ft. lbs.) torque.

(5) Tighten the retaining nut at the frame bracket to 142 N·m (105 ft. lbs.) torque.

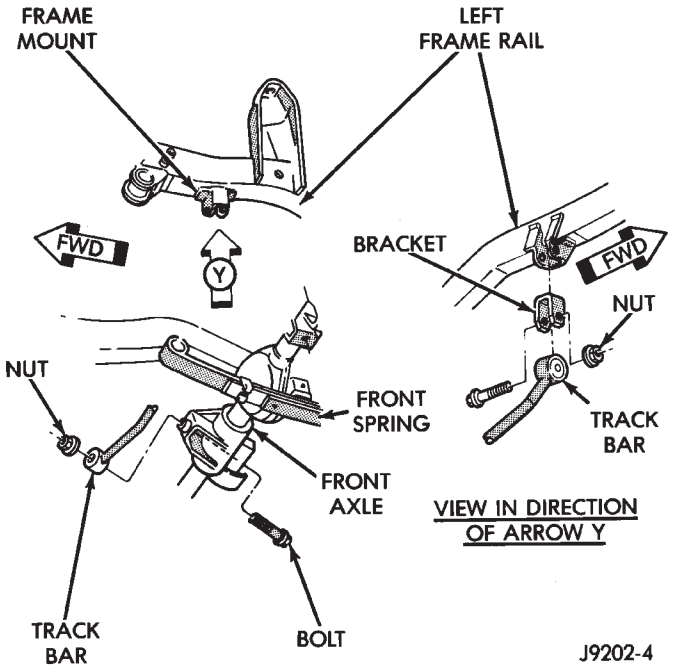

Fig. 1 Track Bar

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the retaining nut from the connecting link bolt (Fig. 2).

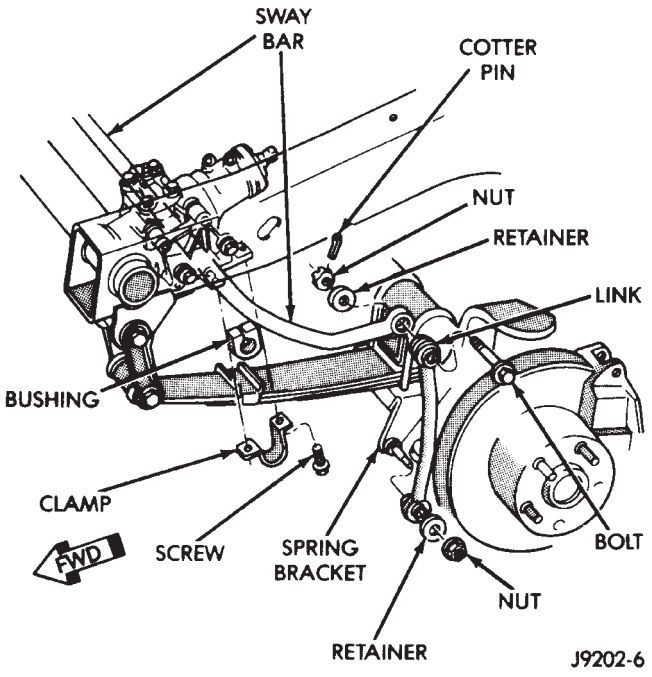

Fig. 2 Stabilizer Bar

(3) Remove the retaining clamps from frame rails

(4) Remove the stabilizer bar.

INSTALLATION

(1) Inspect the stabilizer bar bushings (Fig. 2). Replace the bushings if cracked, cut, distorted, or worn.

(2) Position the stabilizer bar on the frame. Install the retaining brackets and fasteners. Tighten bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the link upper bolts and nuts. Tighten the nuts to 61 N·m (45 ft. lbs.) torque.

(4) Tighten the link spring bracket nuts to 61 N·m (45 ft. lbs.) torque.

(5) Lower the vehicle.

SPRING AND SHOCK DIAGNOSIS

A squeak noise from the shock absorber or springs can be produced if movement between the rubber bushings and the metal occurs. This noise can usually be stopped by tightening the attaching nuts. If the squeak noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

The shock absorber bushings do not require any type of lubrication. Do not lubricate the bushings to reduce bushing noise. Grease or mineral oil-base lubricants will deteriorate the bushing rubber.

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

SHOCK ABSORBER

REMOVAL

(1) Remove the nut, retainer and grommet from the upper stud on the frame bracket (Fig. 3).

(2) Raise and support the vehicle.

(3) Remove the nut, washers and bolt from the shock absorber lower eye (Fig.3).

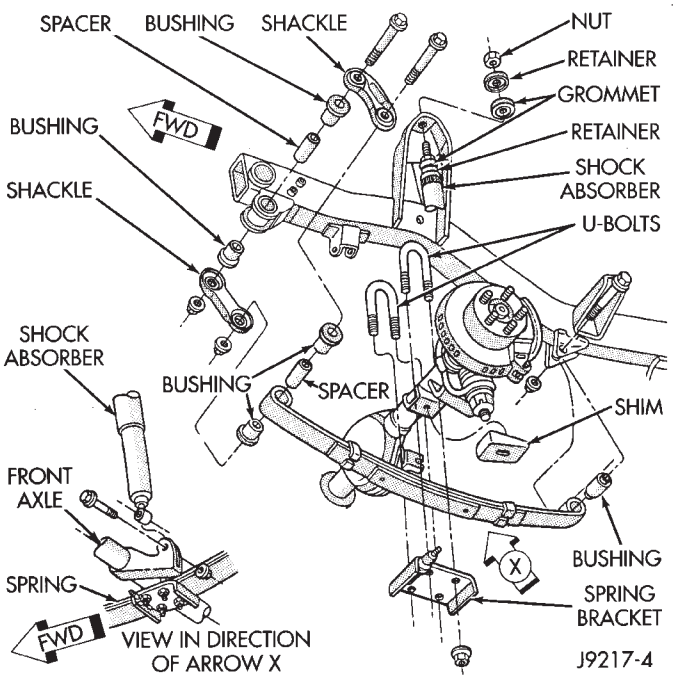

Fig. 3 Spring & Shock Absorber

(4) Remove the shock absorber.

(5) Remove the remaining grommet and retainer from the shock absorber stud.

INSTALLATION

(1) Position the lower retainer and grommet on the upper stud. Insert the shock absorber through the shock tower hole.

(2) Install the lower bolts and nuts. Tighten the nuts to 61 N·m (45 ft. lbs.) torque.

(3) Install the upper grommet and retainer on the stud on the frame bracket. Install the nut and tighten to 12 N·m (9 ft. lbs.) torque.

LEAF SPRING

REMOVAL

(1) Raise the vehicle.

(2) Support the vehicle with jack stands placed under the frame.

(3) Position a hydraulic jack under the axle. Raise the axle to relieve the axle weight from the springs.

(4) Remove the stabilizer bar links attaching nut.

(5) Remove the nuts, the U-bolts and spring bracket from the axle.

(6) Remove the nut and bolt that attaches the spring front eye to the shackle (Fig. 3).

(7) Remove the nut and bolt from the spring rear eye.

(8) Remove the spring from the vehicle.

The spring can be disassembled by removing the spring clips and the center bolt. If the spring bushings require replacement, refer to the bushing removal and installation procedures.

INSTALLATION

(1) Position the spring front eye in the shackle. Loosely install the attaching bolt and nut. Do not tighten at this time.

(2) Position the rear eye in the hanger bracket. Loosely install the attaching bolt and nut (Fig. 3). Do not tighten at this time.

(3) Position the axle. Install the spring bracket, U-bolts and nuts (Fig. 3). Tighten the U-bolt nuts to 122 N·m (90 ft. lbs.) torque.

(4) Attach the stabilizer bar links.

(5) Remove the hydraulic jack.

(6) Remove the support stands and lower the vehicle.

(7) Tighten the front shackle plate nut (Fig. 3) to 135 N·m (100 ft. lbs.) torque.

(8) Tighten the rear eye bracket nut to 142 N·m (105 ft. lbs.) torque.

LEAF SPRING EYE BUSHING REPLACEMENT

(1) Assemble tools shown (Fig. 4). Tighten the nut located at the socket wrench end of the threaded rod until the bushing is forced out.

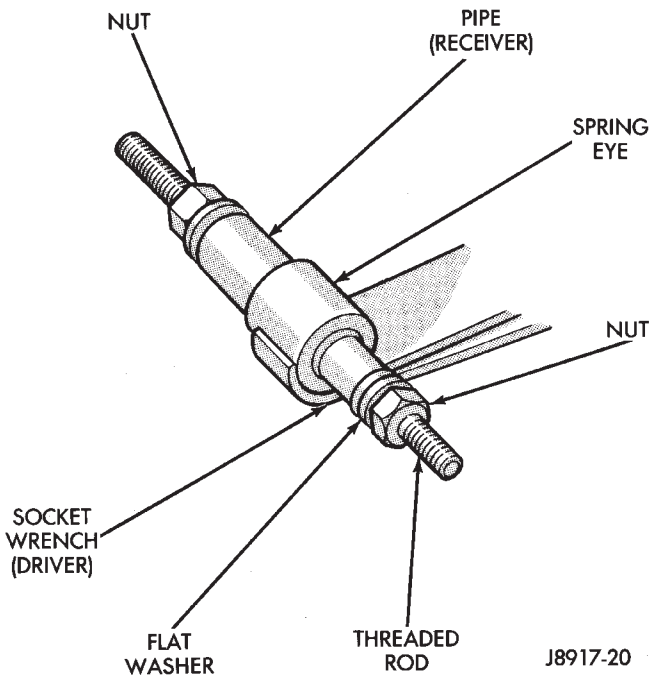

Fig. 4 Spring Eye Bushing Removal

(2) Assemble and align the bushing installation tools.

(3) Align the bushing with the spring eye and tighten the nut located at the socket wrench end of the threaded rod. Tighten until the bushing is forced into the spring eye.

The bushing must be centered in the spring eye. The ends of the bushing must be flush or slightly recessed within the end surfaces of the spring eye.

AXLE NOISE/VIBRATION DIAGNOSIS

INDEX

GENERAL INFORMATION

Axle bearing problem conditions are usually caused by:

- Insufficient or incorrect lubricant
- Foreign matter/water contamination
- Incorrect bearing preload torque adjustment
- Incorrect backlash (to tight)

When serviced, the bearings must be cleaned thoroughly. They should be dried with lint-free shop towels. **Never dry bearings with compressed air. This will overheat them and brinell the bearing surfaces. This will result in noisy operation after repair.**

Axle gear problem conditions are usually the result of:

- Insufficient lubrication
- Incorrect or contaminated lubricant
- Overloading (excessive engine torque) or exceeding vehicle weight capacity
- Incorrect clearance or backlash adjustment

Insufficient lubrication is usually the result of a housing cover leak. It can also be from worn axle shaft or pinion gear seals. Check for cracks or porous areas in the housing or tubes.

Using the wrong lubricant will cause overheating and gear failure. Gear tooth cracking and bearing spalling are indicators of this.

Axle component breakage is most often the result of:

- Severe overloading
- Insufficient lubricant
- Incorrect lubricant
- Improperly tightened components

Overloading occurs when towing heavier than recommended loads. Component breakage can occur when the wheels are spun excessively. Incorrect lubricant quantity contributes to breakage. Loose differential components can also cause breakage.

Incorrect bearing preload or gear backlash will not result in component breakage. Mis-adjustment will produce enough noise to cause service repair before a failure occurs. If a mis-adjustment condition is not corrected, component failure can result.

Excessive bearing preload may not be noisy. This condition will cause high temperature which can result in bearing failure.

GEAR AND BEARING NOISE

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant. Incorrect backlash, tooth contact, or worn/damaged gears can cause noise.

Gear noise usually happens at a specific speed range. The range is 30 to 40 mph, or above 50 mph. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak-noise range. If the noise stops or changes greatly, check for insufficient lubricant. Incorrect ring gear backlash, or gear damage can cause noise changes.

Differential side and pinion gears can be checked by turning the vehicle. They usually do not cause noise in straight-ahead driving. These gears are loaded during vehicle turns. If noise does occur during vehicle turns, the side or pinion gears could be worn or damaged. A worn pinion gear mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

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

Pinion gear bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs the pinion rear bearing is the source of the noise. If the bearing noise is heard during a coast, front bearing is the source.

Worn, damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise

level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U-joint or by worn side-gear thrust washers. A worn pinion gear shaft bore will also cause low speed knock.

VIBRATION

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

- Damaged drive shaft
- Missing drive shaft balance weight
- Worn, out-of-balance wheels
- Loose wheel lug nuts
- Worn U-joint
- Loose spring U-bolts
- Loose/broken springs
- Damaged axle shaft bearings
- Loose pinion gear nut
- Excessive pinion yoke run out
- Bent axle shaft

Check for loose or damaged front-end components or engine/transmission mounts. These components can contribute to what appears to be a rear-end vibration. Do not overlook engine accessories, brackets and drive belts.

All driveline components should be examined before starting any repair.

Refer to Group 22—Tires And Wheels for additional information involving vibration diagnosis.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed
- Loose engine/transmission/transfer case mounts
- Worn U-joints
- Loose spring mounts
- Loose pinion gear nut and yoke
- Excessive ring gear backlash
- Excessive differential 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.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
WHEEL NOISE	(a) Wheel loose.	(a) Tighten loose nuts.
	(b) Faulty, brinelled wheel bearing.	(b) Faulty or brinelled bearings must be replaced.
AXLE SHAFT NOISE	(a) Misaligned axle shaft tube.	(a) Inspect axle shaft tube alignment. Correct as necessary.
	(b) Bent or sprung axle shaft.	(b) Replace bent or sprung axle shaft.
	(c) End play in drive pinion bearings.	(c) Refer to Drive Pinion Bearing Pre-Load Adjustment.
	(d) Excessive gear backlash between ring gear and pinion gear.	(d) Check adjustment of ring gear backlash and pinion gear. Correct as necessary.
	(e) Improper adjustment of drive pinion gear shaft bearings.	(e) Adjust drive pinion shaft bearings.
	(f) Loose drive pinion gearshaft yoke nut.	(f) Tighten drive pinion gearshaft yoke nut with specified torque.
	(g) Improper wheel bearing adjustment.	(g) Readjust as necessary.
	(h) Scuffed gear tooth contact surfaces.	(h) If necessary, replace scuffed gears.
AXLE SHAFT BROKE	(a) Misaligned axle shaft tube.	(a) Replace broken axle shaft after correcting axle shaft tube alignment.
	(b) Vehicle overloaded.	(b) Replace broken axle shaft. Avoid excessive weight on vehicle.
	(c) Erratic clutch operation	(c) Replace broken axle shaft after inspecting for other possible causes. Avoid erratic use of clutch.
	(d) Grabbing clutch.	(d) Replace broken axle shaft. Inspect clutch and make necessary repairs or adjustments.
DIFFERENTIAL CASE CRACKED	(a) Improper adjustment of differential bearings.	(a) Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust differential bearings properly.
	(b) Excessive ring gear backlash.	(b) Replace cracked case; examine gears and bearings for possible damage. At reassembly, adjust ring gear backlash properly.
	(c) Vehicle overloaded.	(c) Replace cracked case; examine gears and bearings for possible damage. Avoid excessive weight on vehicle.
	(d) Erratic clutch operation.	(d) Replace cracked case. After inspecting for other possible causes, examine gears and bearings for possible damage. Avoid erratic use of clutch.
DIFFERENTIAL GEARS SCORED	(a) Insufficient lubrication.	(a) Replace scored gears. Scoring marks on the drive face of gear teeth or in the bore are caused by instantaneous fusing of the mating surfaces. Scored gears should be replaced. Fill rear differential housing to required capacity with proper lubricant. Refer to Specifications.
	(b) Improper grade of lubricant.	(b) Replace scored gears. Inspect all gears and bearings for possible damage. Clean and refill differential housing to required capacity with proper lubricant.
	(c) Excessive spinning of one wheel/tire.	(c) Replace scored gears. Inspect all gears, pinion bores and shaft for damage. Service as necessary.
LOSS OF LUBRICANT	(a) Lubricant level too high.	(a) Drain excess lubricant by removing fill plug and allow lubricant to level at lower edge of fill plug hole.

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SERVICE DIAGNOSIS (CONT'D)

Condition	Possible Cause	Correction
LOSS OF LUBRICANT (Cont'd)	(b) Worn axle shaft seals.	(b) Replace worn seals.
	(c) Cracked differential housing.	(c) Repair or replace housing as necessary.
	(d) Worn drive pinion gear shaft seal.	(d) Replace worn drive pinion gear shaft seal.
	(e) Scored and worn yoke.	(e) Replace worn or scored yoke and seal.
	(f) Axle cover not properly sealed.	(f) Remove cover and clean flange and reseal.
AXLE OVERHEATING	(a) Lubricant level too low.	(a) Refill differential housing.
	(b) Incorrect grade of lubricant.	(b) Drain, flush and refill with correct amount of the correct lubricant.
	(c) Bearings adjusted too tight.	(c) Readjust bearings.
	(d) Excessive gear wear.	(d) Inspect gears for excessive wear or scoring. Replace as necessary.
	(e) Insufficient ring gear backlash.	(e) Readjust ring gear backlash and inspect gears for possible scoring.
GEAR TEETH BROKE (RING GEAR AND PINION)	(a) Overloading.	(a) Replace gears. Examine other gears and bearings for possible damage. Replace parts as needed. Avoid overloading of vehicle.
	(b) Erratic clutch operation.	(b) Replace gears and examine the remaining parts for possible damage. Avoid erratic clutch operation.
	(c) Ice-spotted pavements.	(c) Replace gears. Examine the remaining parts for possible damage. Replace parts as required.
	(d) Improper adjustments.	(d) Replace gears. Examine other parts for possible damage. Ensure ring gear backlash is correct.
AXLE NOISE	(a) Insufficient lubricant.	(a) Refill axle with correct amount of the proper lubricant. Also inspect for leaks and correct as necessary.
	(b) Improper ring gear and drive pinion gear adjustment.	(b) Check ring gear and pinion gear teeth contact pattern.
	(c) Unmatched ring gear and drive pinion gear.	(c) Remove unmatched ring gear and drive pinion gear. Replace with matched gear and drive pinion gear set.
	(d) Worn teeth on ring gear or drive pinion gear.	(d) Check teeth on ring gear and drive pinion gear for correct contact. If necessary, replace with new matched set.
	(e) Loose drive pinion gear shaft bearings.	(e) Adjust drive pinion gearshaft bearing preload torque.
	(f) Loose differential bearings.	(f) Adjust differential bearing preload torque.
	(g) Misaligned or sprung ring gear.	(g) Measure ring gear runout.
	(h) Loose differential bearing cap bolts.	(h) Tighten with specified torque.

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MODEL 30 AXLE AND TUBE AXLE (2WD)

INDEX

INFORMATION

The housing for Model 30 front axles consists of 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 integral type housing, hypoid gear design has the centerline of the pinion set above the centerline of the ring gear.

The axle has a fitting for a vent hose used to relieve internal pressure caused by lubricant vaporization and internal expansion.

The axles are equipped with semi-floating axle shafts, meaning that loads are supported by the hub bearings. The axle shafts are retained by nuts at the hub bearings. The hub bearings are bolted to the steering knuckle at the outboard end of the axle tube yoke. The hub bearings are serviced as an assembly.

The axles are equipped with ABS brake sensors. The sensors are attached to the knuckle assemblies and tone rings are pressed on the axle shaft. **Use care when removing axle shafts as NOT to damage the tone wheel or the sensor.**

The stamped steel cover provides a means for inspection and servicing the differential.

The Model 30 axle has the assembly part number and gear ratio listed on a tag. The tag is attached to the housing cover. Build date identification codes are stamped on the axle shaft tube cover side.

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 cones and case. Pinion bearing preload is set and maintained by the use of collapsible spacer.

PINION GEAR DEPTH MEASUREMENT WITH PINION GAUGE SET 6774, Pinion Block 6733 and Dial Indicator C-3339 is performed when;

- Axle/differential housing is being replaced
- Original pinion depth shim pack is lost or misplaced
- Replacing the differential case
- Original differential bearing shim pack is lost or misplaced

COMMAND-TRAC—YJ VEHICLES

The Command-Trac system is a vacuum disconnect axle. The system has a two-piece axle shaft coupled together by a shift collar. For two-wheel drive operation, the vacuum motor and shift fork disengages the axle shaft splines. For four-wheel drive operation, the vacuum motor and shift fork engages the splines.

SELEC-TRAC—XJ VEHICLES

The Selec-Trac system is a non-disconnect axle. Shifting from two-wheel to four-wheel drive is at the transfer case.

For XJ vehicles equipped with **Selec-Trac** and ABS brake system, refer to Group 5—Brakes for additional service information.

LUBRICANT SPECIFICATIONS

Multi-purpose, hypoid gear lubricant should be used for Model 30 axles. The lubricant should have MIL-L-2105C and API GL 5 quality specifications. MOPAR® Hypoid Gear Lubricant conforms to both of these specifications.

- The factory fill for the Model 30 axle is SAE 75W gear lubricant. **Do not use heavier weight lubricant, this will cause axle engagement difficulties.**
- The factory installed lubricant quantity for the NON-DISCONNECT TYPE AXLE is 50±1 fluid oz..
- The factory installed lubricant quantity for the VACUUM-DISCONNECT TYPE AXLE is 56±1 fluid oz..

Refer to Group 0, Lubrication and Maintenance for additional information regarding temperature range, viscosity and fluid level.

CAUTION: If the axle is submerged in water, the lubricant must be replaced immediately to avoid the possibility of premature axle failure.

DRIVE AXLE ASSEMBLY REPLACEMENT—XJ VEHICLES

REMOVAL

(1) Raise the vehicle and position support stands under the frame rails slightly in behind the lower suspension arm frame brackets.
(2) Remove the front wheels.
(3) Remove the brake components and ABS brake sensor (if equipped). Refer to Group 5—Brakes.
(4) On 4WD vehicles, disconnect the axle vent hose.
(5) On 4WD vehicles, mark the drive shaft yoke and axle pinion yoke for alignment reference. Disconnect the drive shaft from the axle.
(6) Disconnect the stabilizer bar link at the axle bracket.
(7) Disconnect the shock absorbers from axle bracket.
(8) Disconnect the track bar from the axle bracket.
(9) Disconnect the tie rod and drag link from the steering knuckle. Disconnect the steering dampener from the axle bracket.
(10) Support the axle with a hydraulic jack under the differential.
(11) Disconnect the upper and lower suspension arms from the axle bracket.
(12) Lower the jack enough to remove the axle. The coil springs will drop with the axle.
(13) Remove the coil springs from the axle bracket.

INSTALLATION

CAUTION: All suspension components that use rubber bushings should be tightened with the vehicle at the ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If the springs are not at their normal ride position, vehicle ride comfort could be affected along with premature rubber bushing wear. Rubber bushings must never be lubricated.

(1) Install the springs and retainer clip. Tighten the retainer bolts to 21 N·m (16 ft. lbs.) torque.
(2) Support the axle on a hydraulic jack under the differential. Position the axle under the vehicle.
(3) Raise the axle with a floor jack and align it with the spring pads.
(4) Position the upper and lower suspension arm at the axle bracket. Install bolts and nuts finger tighten.
(5) Connect the track bar to the axle bracket and install the bolt. **Do not tighten at this time.**

It is important that the springs support the weight of the vehicle when the track bar is connected. If the springs are not at their usual position, the vehicle ride comfort could be affected.

(6) Install the shock absorber and tighten the bolt to 19 N·m (14 ft. lbs.) torque.
(7) Install the stabilizer bar link to the axle bracket. Tighten the nut to 95 N·m (70 ft. lbs.) torque.
(8) Install the drag link and tie rod to the steering knuckles and tighten the nuts to 47 N·m (35 ft. lbs.) torque. Install the steering dampener to the axle bracket and tighten the nut to 75 N·m (55 ft. lbs.) torque.
(9) Install the brake components and ABS brake sensor (if equipped). Refer to Group 5—Brakes.
(10) On 4WD vehicles, connect the vent hose to the tube fitting.
(11) On 4WD vehicles, align the reference marks and connect the drive shaft to the axle yoke. Tighten the U-joint clamp bolts to 19 N·m (14 ft. lbs.) torque.
(12) Check differential lubricant and add if necessary.
(13) Install the wheel and tire assemblies.
(14) Remove the supports and lower the vehicle.
(15) Tighten the upper suspension arm nuts to 75 N·m (55 ft. lbs.) torque. Tighten the lower suspension arm nuts to 115 N·m (85 ft. lbs.) torque.
(16) Tighten the track bar bolt at the axle bracket to 100 N·m (74 ft. lbs.) torque.
(17) Check the front wheel alignment.

DRIVE AXLE ASSEMBLY REPLACEMENT—YJ VEHICLES

REMOVAL

(1) Raise the vehicle and position support stands under the frame rails slightly behind the spring frame brackets.
(2) Remove the front wheels.
(3) Remove the brake components and ABS brake sensor (if equipped). Refer to Group 5—Brakes.
(4) Disconnect the axle vent hose and axle shift motor vacuum harness.
(5) Mark the drive shaft yoke and axle pinion yoke for alignment reference. Disconnect the drive shaft from the axle.
(6) Disconnect the stabilizer bar link at the axle bracket.
(7) Disconnect the shock absorbers from axle bracket.
(8) Disconnect the track bar from the axle bracket.

(9) Disconnect the tie rod from the steering knuckle. Disconnect the steering dampener from the axle bracket.

(10) Support the axle with a hydraulic jack under the differential. Raise the axle just enough to relieve the axle weight from the springs.

(11) Remove the spring U-bolts from the plate brackets.

(12) Loosen BUT DO NOT REMOVE the bolts that attach the spring rear pivot at the frame rail brackets. This will allow the springs to pivot without binding on the bushings.

(13) Disconnect shackle from the springs and lower the springs to the surface.

(14) Lower the jack enough to remove the axle.

INSTALLATION

CAUTION: All suspension components that use rubber bushings should be tightened with the vehicle at the normal height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If the springs are not at their normal ride position, vehicle ride comfort could be affected along with premature rubber bushing wear. Rubber bushings must never be lubricated.

(1) Support the axle on a hydraulic jack under the differential. Position the axle under the vehicle.

(2) Raise the springs and install the spring shackle bolts. **Do not tighten at this time.**

(3) Lower the axle and align the spring center bolts with the locating holes in the axle pads and plate brackets.

(4) Install the spring U-bolts through the plate brackets and tighten to 122 N·m (90 ft. lbs.) torque.

(5) Connect the track bar to the axle bracket and install the bolt. **Do not tighten at this time.**

It is important that the springs support the weight of the vehicle when the track bar is connected. If the springs are not at their usual position, the vehicle ride comfort could be affected.

(6) Install the shock absorber and tighten the nut to 61 N·m (45 ft. lbs.) torque.

(7) Install the stabilizer bar link to the axle bracket. Tighten the nut to 61 N·m (45 ft. lbs.) torque.

(8) Install the tie rod to the steering knuckles and tighten the nuts to 47 N·m (35 ft. lbs.) torque. Install the steering dampener to the axle bracket and tighten the bolt to 75 N·m (55 ft. lbs.) torque.

(9) Install the brake components and ABS brake sensor (if equipped). Refer to Group 5—Brakes.

(10) Connect the vent hose to the tube fitting and axle shift motor vacuum harness.

(11) Align the reference marks and connect the drive shaft to the axle yoke. Tighten the U-joint clamp bolts to 19 N·m (14 ft. lbs.) torque.

(12) Check differential lubricant and add if necessary.

(13) Install the wheel and tire assemblies.

(14) Remove the supports and lower the vehicle.

(15) Tighten the spring rear pivot bolt/nut to 142 N·m (105 ft. lbs.) torque. Tighten the spring shackle bolt/nut to 135 N·m (100 ft. lbs.) torque.

(16) Tighten the track bar nut at the axle bracket to 100 N·m (74 ft. lbs.) torque.

(17) Check the front wheel alignment.

LUBRICANT CHANGE

The gear lubricant will drain quicker if the vehicle has been recently driven.

(1) Raise and support the vehicle.

(2) Remove the lubricant fill hole plug from the differential housing cover.

(3) Remove the differential housing cover and drain the lubricant from the housing.

(4) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth. **Do not use water, steam, kerosene or gasoline for cleaning.**

(5) Remove the sealant from the housing and cover surfaces. Use solvent to clean the mating surfaces.

(6) Apply a bead of MOPAR® Silicone Rubber Sealant to the housing cover (Fig. 1). **Allow the sealant to cure for a few minutes.**

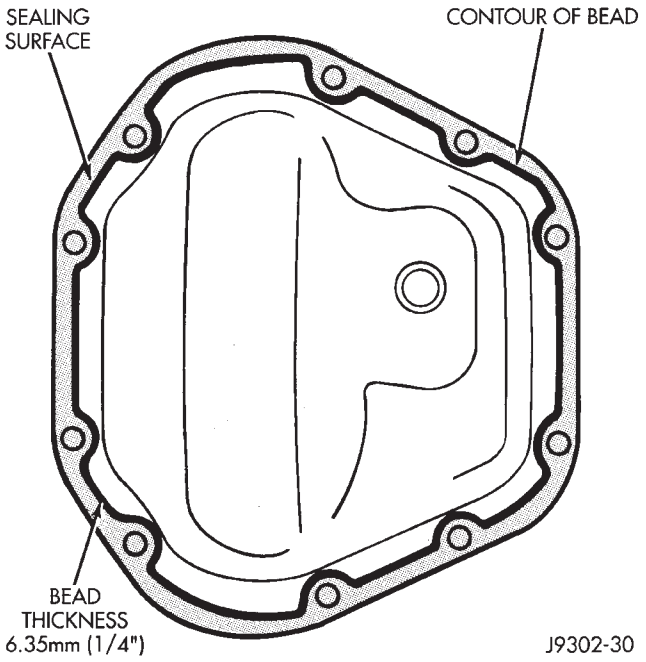


Fig. 1 Typical Housing Cover With Sealant

Install the housing cover within 5 minutes after applying the sealant. If not installed the sealant must be removed and another bead applied.

(7) Install the cover and any identification tag. Tighten the cover bolts in a criss-cross pattern to 41 N·m (30 ft. lbs.) torque.

(8) Refill the differential with MOPAR® Hypoid Gear Lubricant within 13 mm (1/2 in.) below the fill plug hole.

(9) Install the fill hole plug and lower the vehicle.

PINION SEAL REPLACEMENT

CAUTION: The following procedures must be used so the correct pinion bearing preload torque is retained. If this procedure is not followed, the result can be premature failure of the rear axle.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove wheel and tire assemblies.

(3) Mark the propeller shaft yoke and pinion yoke for installation alignment reference.

(4) Remove the propeller shaft from the yoke.

(5) Rotate the pinion gear three or four times. **Make sure brakes are not dragging during this procedure.**

(6) Measure the amount of torque (in Newton-meters or inch-pounds) necessary to rotate the pinion gear with a torque wrench. Note the torque for installation reference. **It must be known to properly adjust the pinion gear bearing preload torque after seal installation.**

(7) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 2).

(8) Mark the positions of the yoke and pinion gear for installation alignment reference.

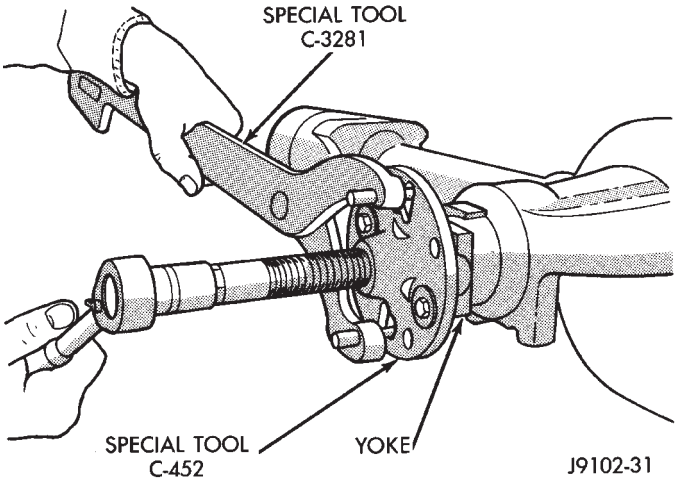


Fig. 2 Pinion Yoke Removal

(9) Use Remover W-251 to remove the pinion gear seal (Fig. 3).

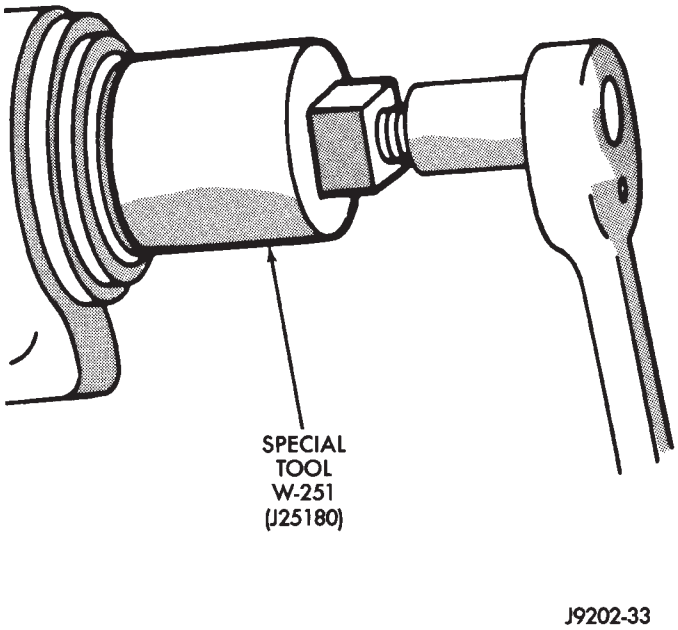


Fig. 3 Seal Removal

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer W-147-E and Handle C-4171 (Fig. 4).

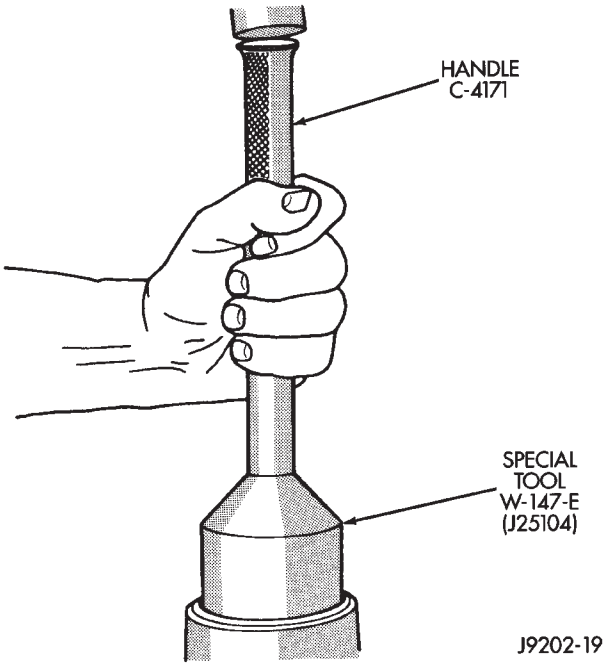


Fig. 4 Pinion Seal Installation

(2) Align the reference marks and install yoke on the pinion gear with Installer W-162-D.

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

CAUTION: Never loosen the pinion gear nut to decrease the pinion gear bearing preload torque. If the specified preload torque is exceeded, a new collapsible spacer must be installed. The torque sequence will have to be repeated.

(4) Install a socket and inch-pound torque wrench on the pinion nut.

(5) Rotate the shaft with the torque wrench and note the torque.

Required preload torque is the amount recorded during removal plus an additional 0.56 N·m (5 in. lbs.).

(6) Use Flange Wrench C-3281 to retain the yoke and shaft (Fig. 5). Tighten the shaft nut in very small increments.

(7) Continue tightening the shaft nut in small increments until the correct bearing preload torque is attained.

(8) Align the installation reference marks and attach the propeller shaft to the yoke.

(9) Add API grade GL 5 hypoid gear lubricant to the differential housing, if necessary.

(10) Install wheel and tire assemblies.

(11) Remove support and lower the vehicle.

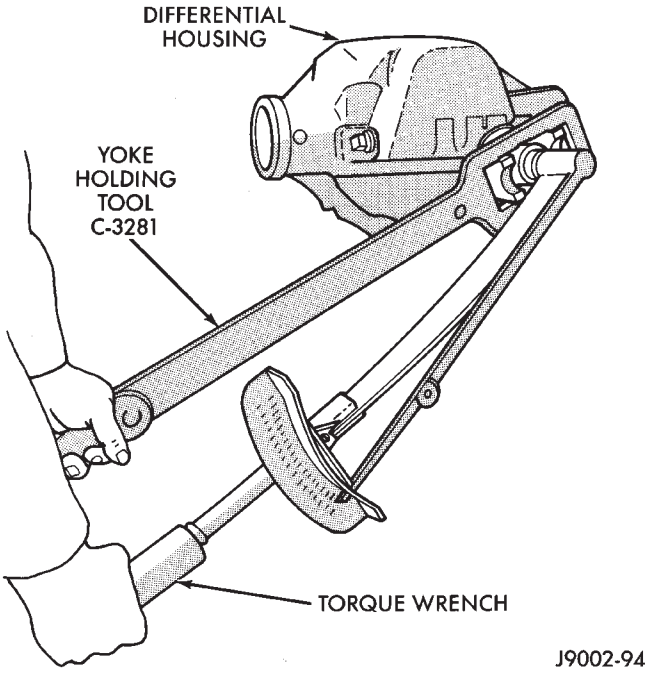


Fig. 5 Tightening Pinion Shaft Nut

HUB BEARING AND AXLE SHAFT

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake components from the axle, refer to Group 5, Brakes.

(4) Remove the cotter pin, nut retainer and axle hub nut (Fig. 6).

(5) Remove the hub to knuckle bolts (Fig. 6). Remove the hub from the steering knuckle and axle shaft.

(6) Remove the disc brake rotor shield from the bearing carrier (Fig. 6).

(7) On disconnect axles, remove vacuum shift motor housing. Refer to Vacuum Disconnect Axle in this section.

(8) Remove the axle shaft from the housing. **Avoid damaging the axle shaft oil seals in the differential.**

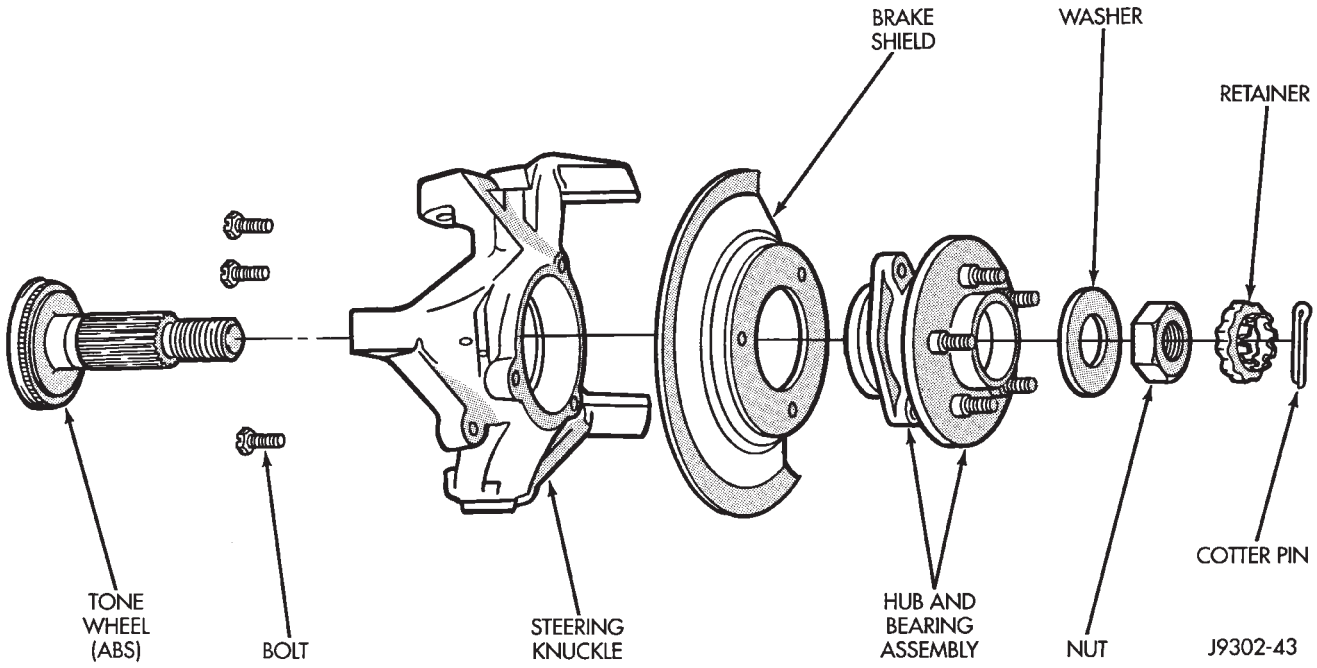


Fig. 6 Hub, Knuckle and Axle Shaft

INSTALLATION

(1) Thoroughly clean the axle shaft (Fig. 6) and apply a thin film of Mopar Wheel Bearing Grease to the shaft splines, seal contact surface, hub bore.

(2) Install the axle shaft into the housing and differential side gears. Avoid damaging the axle shaft oil seals in the differential.

(3) Install the hub bearing and brake dust shield to the knuckle.

(4) Install the hub to knuckle bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(5) Install the hub washer and nut. Tighten the hub nut to 237 N·m (175 ft. lbs.) torque. Install the nut retainer and a new cotter pin (Fig. 6).

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

(7) Install the wheel and tire assembly.

(8) Remove support and lower the vehicle.

AXLE SHAFT— CARDAN U-JOINT

DISASSEMBLY

Single cardan U-joints are not serviceable. If defective, they must be replaced as a unit. If the bearings, seals, spider or bearing caps are damaged or worn, replace the complete U-joint.

CAUTION: Clamp only the forged portion of the yoke in the vise. Also, to avoid distorting the yoke, do not over tighten the vise jaws.

(1) Remove the bearing cap retaining snap rings (Fig. 7).

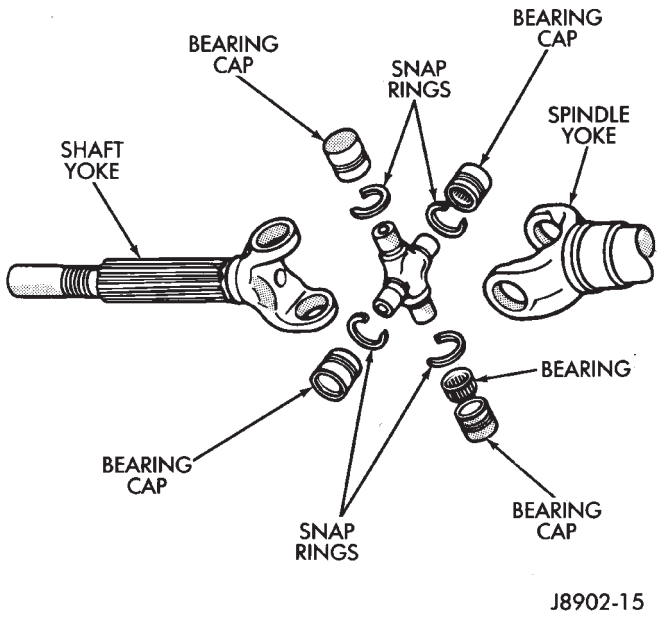


Fig. 7 Axle Shaft Outer U-Joint

It can be helpful to saturate the bearing caps with penetrating oil prior to removal.

(2) Locate a socket that is larger in diameter than the bearing cap. Place the socket (receiver) against the yoke and around the perimeter of the bearing cap to be removed. Locate a socket that is smaller in diameter than the bearing cap. Place the socket (driver) against the opposite bearing cap. Position the yoke with the sockets in a vise (Fig. 8).

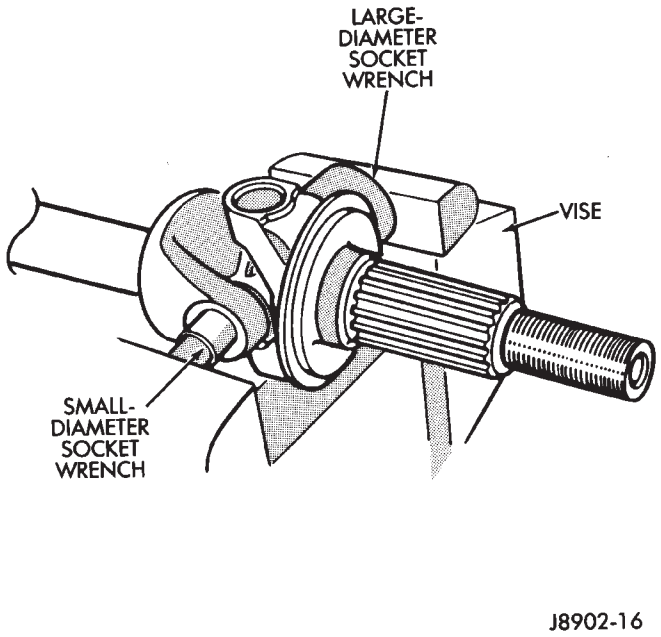


Fig. 8 Yoke Bearing Cap Removal

(3) Compress the vise jaws to force the bearing cap into the larger socket (receiver).

(4) Release the vise jaws. Remove the sockets and bearing cap that was partially forced out of the yoke.

(5) Repeat the above procedure for the remaining bearing cap.

(6) Remove the remaining bearing cap, bearings, seals and spider from the propeller shaft yoke.

CLEANING AND INSPECTION

(1) Clean all the U-joint yoke bores with cleaning solvent and a wire brush. Ensure that all the rust and foreign matter are removed from the bores.

(2) Inspect the yokes for distortion, cracks and worn bearing cap bores.

(3) Replace the complete U-joint if any of the components are defective.

ASSEMBLY

(1) Pack the bearing caps 1/3 full of wheel bearing lubricant. Apply extreme pressure (EP), lithium-base lubricant to aid in installation.

(2) Position the spider in the yoke. Insert the seals and bearings. Tap the bearing caps into the yoke bores far enough to hold the spider in position.

(3) Place the socket (driver) against one bearing cap. Position the yoke with the socket wrench in a vise.

(4) Compress the vise to force the bearing caps into the yoke. Force the caps enough to install the retaining clips.

(5) Install the bearing cap retaining clips.

(6) Install the axle shaft, refer to Hub Bearing and Axle Shaft installation.

VACUUM DISCONNECT AXLE — YJ VEHICLES

VACUUM CONTROL SYSTEM

The disconnect axle control system consists of;

- Vacuum control switch on the transfer case
- Air vent filter
- Shift motor
- Indicator switch
- Vacuum switch
- Check valve
- Vacuum harness (Fig. 9, 10)

Refer to Group 21—Transmissions for additional information involving the Command-Trac System Transfer Case.

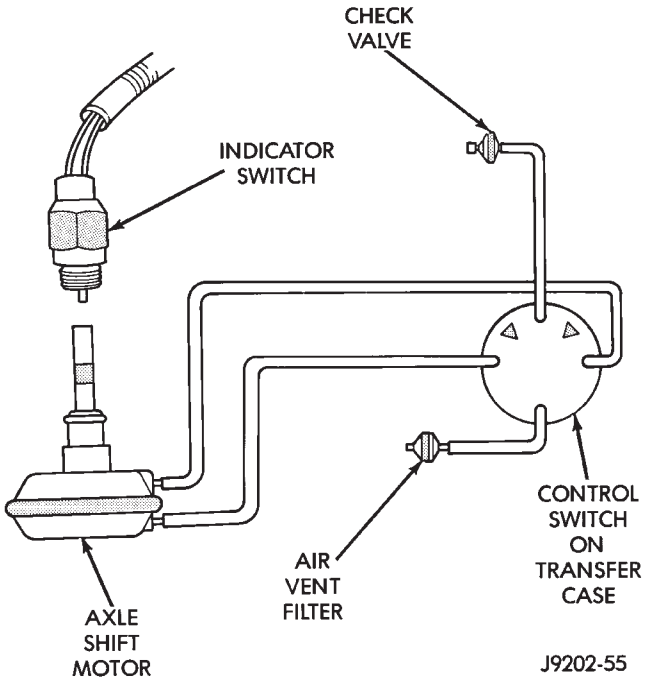


Fig. 9 Vacuum Control System

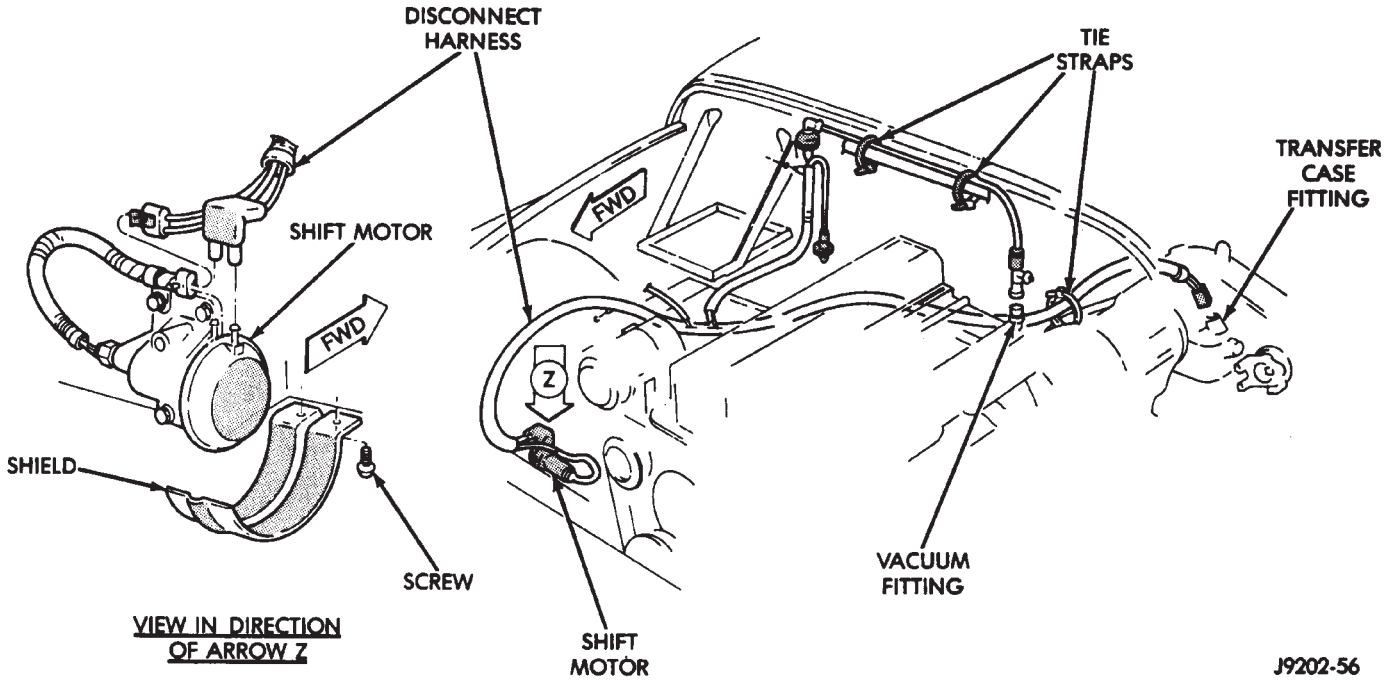
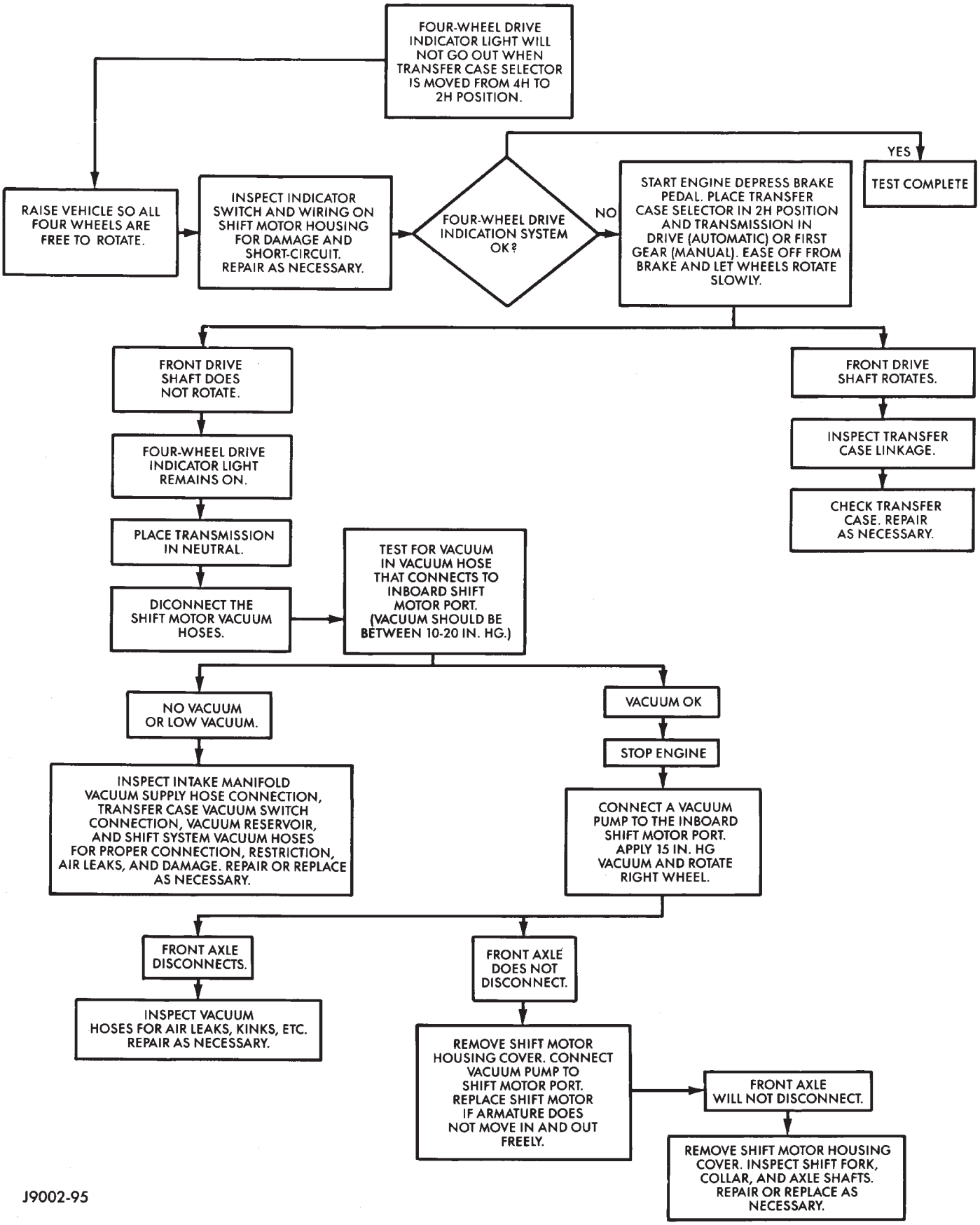


Fig. 10 Vacuum Hose Routing

DISCONNECT AXLE/SHIFT MOTOR DIAGNOSIS

TWO-WHEEL DRIVE OPERATION DIAGNOSIS



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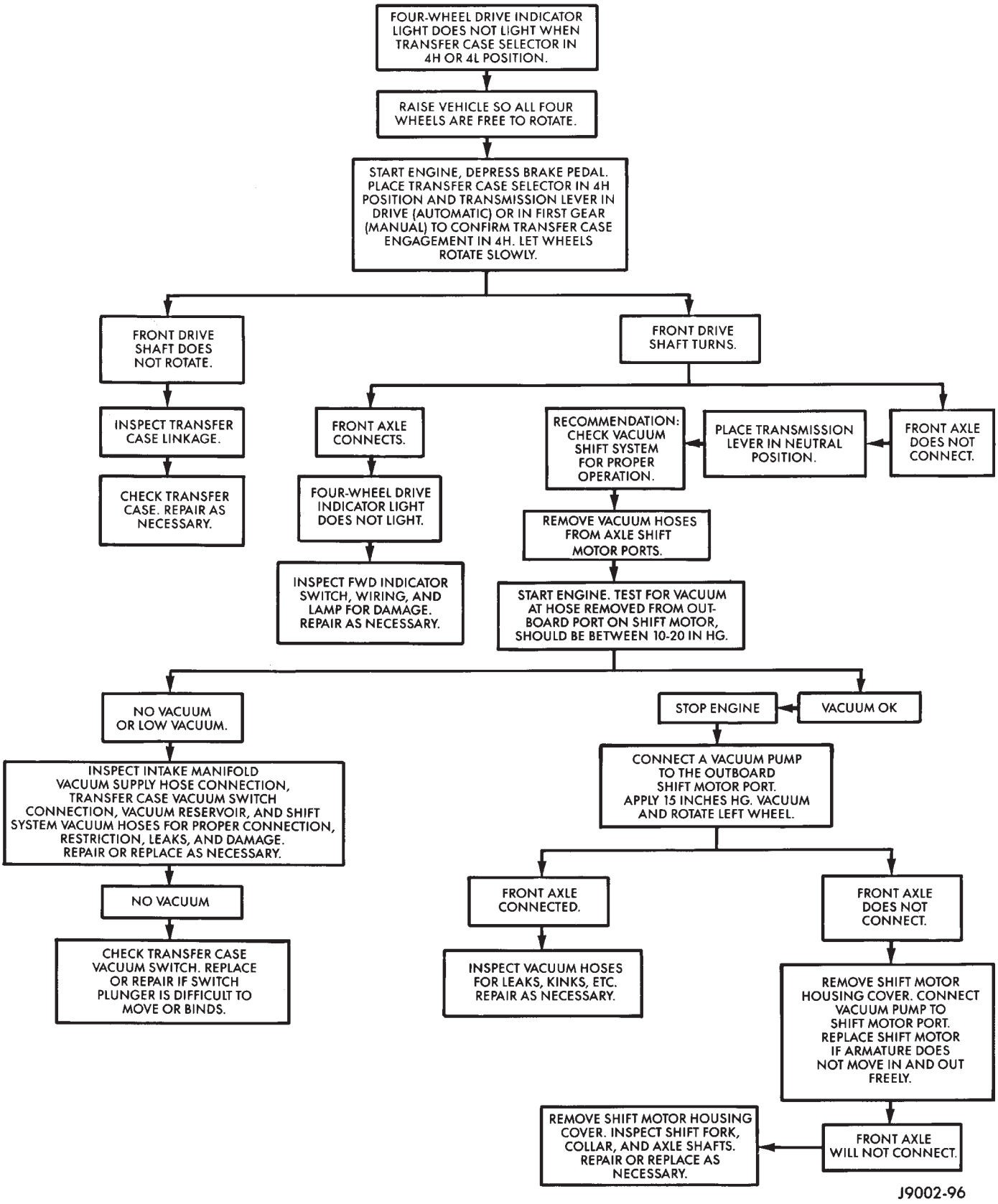
DISCONNECT AXLE/SHIFT MOTOR DIAGNOSIS (CONT'D)

FOUR-WHEEL DRIVE OPERATION DIAGNOSIS



SHIFT MOTOR — REMOVAL/DISASSEMBLY

(1) Disconnect the vacuum and wiring connector from the shift housing.

(2) Remove indicator switch.

(3) Remove the shift motor housing cover, gasket and shield from the housing (Fig. 11).

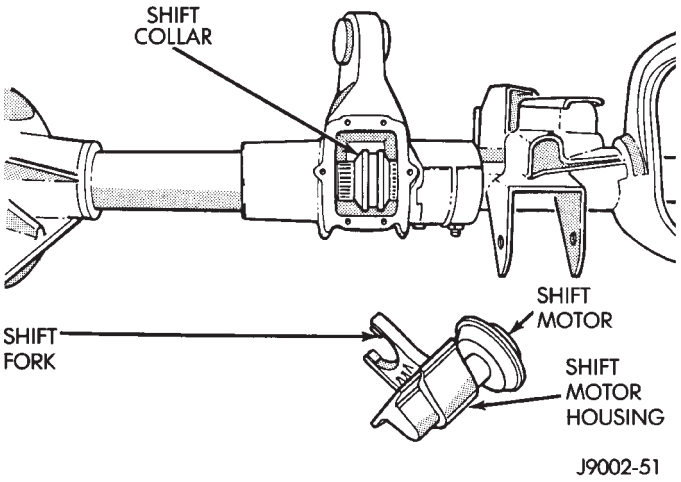


Fig. 11 Shift Motor Housing and Shift Collar

(4) Remove the E-clips from the shift motor housing and shaft. Remove shift motor and shift fork from the housing (Fig. 12).

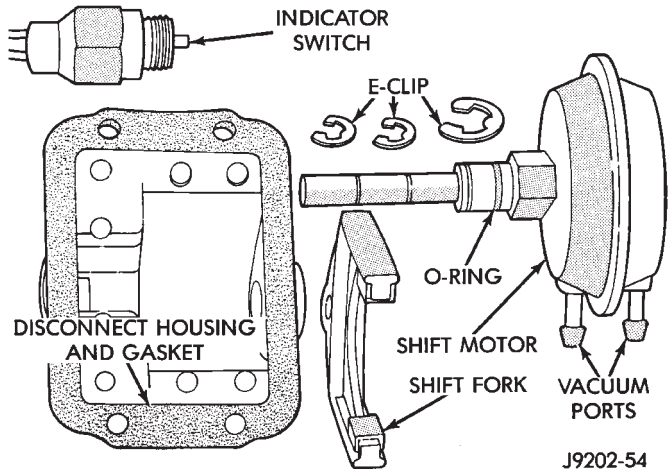


Fig. 12 Vacuum Shift Motor Components

(5) Remove the O-ring seal from the shift motor shaft.

(6) Clean and inspect all components. If any component is excessively worn or damaged, it should be replaced.

ASSEMBLY/INSTALLATION

(1) Install a new O-ring seal on the shift motor shaft.

(2) Insert the shift motor shaft through the hole in the housing and shift fork. The shift fork offset should be toward the differential.

(3) Install the E-clips on the shift motor shaft and housing.

(4) Install the shift motor housing gasket and cover. **Ensure the shift fork is correctly guided into the shift collar groove.**

(5) Install the shift motor housing shield and attaching bolts. Tighten the bolts to 11 N·m (101 in. lbs.) torque.

(6) Add 148 ml (5 ounces) of API grade GL 5 hypoid gear lubricant to the shift motor housing. Add lubricant through indicator switch mounting hole.

(7) Install indicator switch, electrical connector and vacuum harness.

INTERMEDIATE AXLE SHAFT—REMOVAL/ DISASSEMBLY

Service to the Disconnect axle seals and bearing require the use of Tool Set 6288 (J34659) and Seal Installer 6228.

(1) Remove the vacuum motor housing. Refer to Shift Motor Removal in this section.

(3) Remove the outer axle shaft. Refer to Hub Bearing and Axle Shaft in this section.

(4) Remove shift collar and intermediate axle shaft.

(5) Remove the inner axle shaft seal from the shift motor housing (Fig. 13).

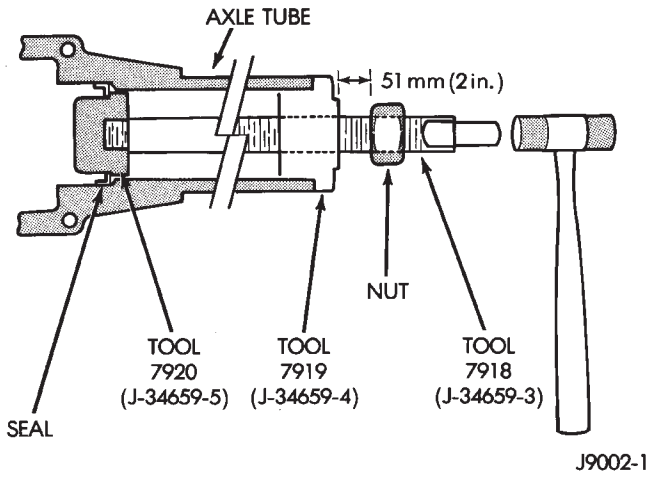


Fig. 13 Axle Shaft Inner Seal Removal

(6) Remove the intermediate axle shaft bearing (Fig. 14).

ASSEMBLY/INSTALLATION

(1) Position the bearing on installation tool. Seat the bearing in the housing bore (Fig. 15).

(2) Clean the inside perimeter of the axle shaft tube with fine crocus cloth.

(3) Apply a light film of oil to the inside lip of the new axle shaft seal.

(4) Install the inner axle seal (Fig. 16, 17).

The axle shaft seal primary installation tool 6228-1 will only force the seal partially into the

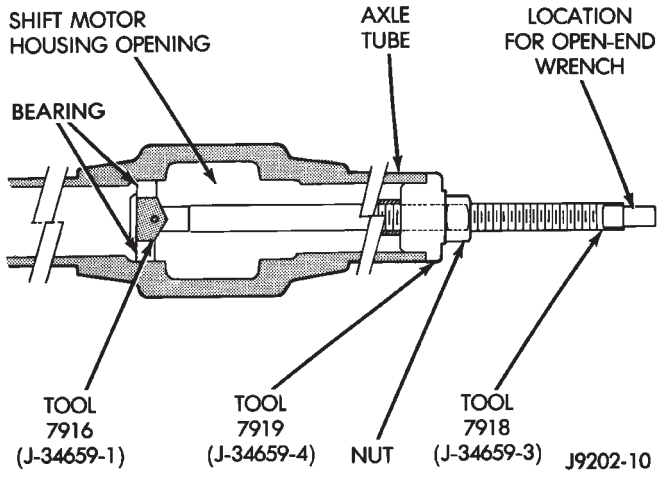


Fig. 14 Bearing Removal Tool Installed

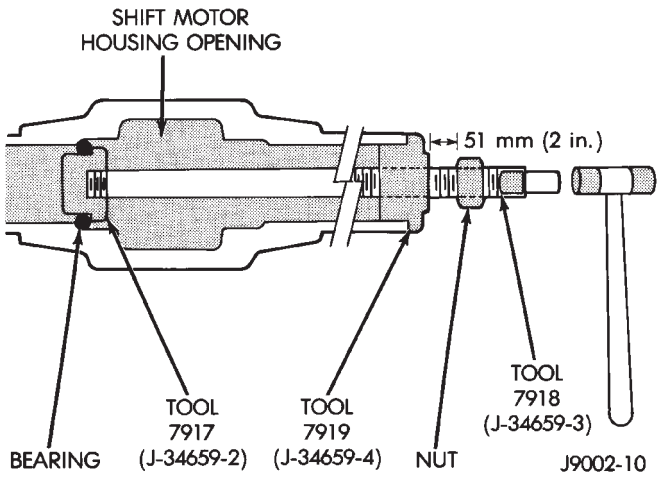


Fig. 15 Intermediate Shaft Bearing Installation

axle shaft tube bore. The axle shaft seal secondary installation tool 6228-3 must be used to completely seat the seal in the axle shaft tube bore. After seal installation, inspect that the seal is NOT distorted or cocked in the tube.

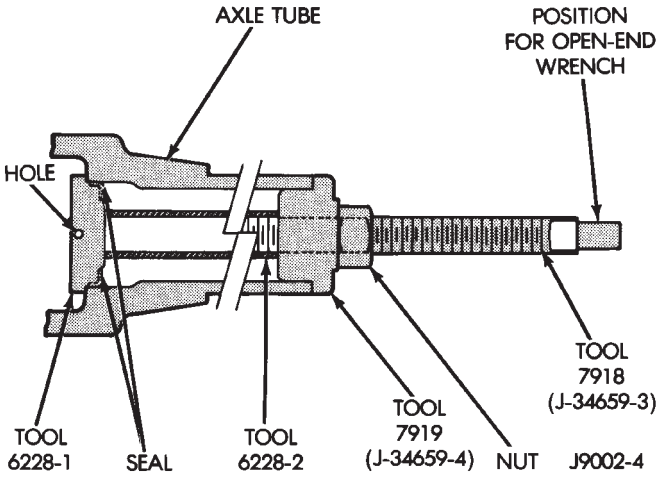


Fig. 16 Primary Installation of Seal (Step One)

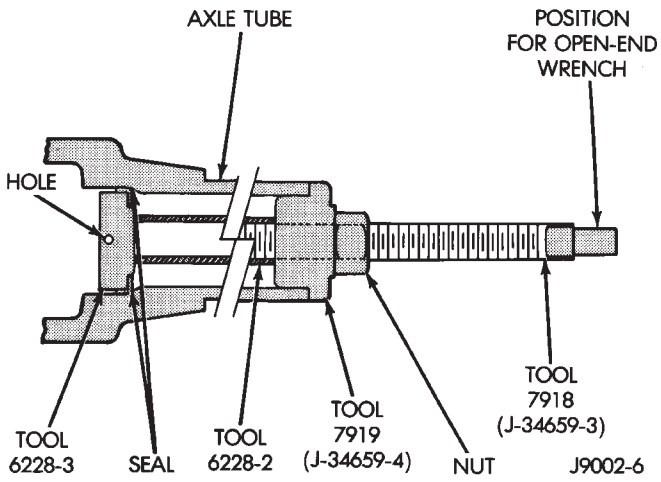


Fig. 17 Secondary Installation of Seal (Step Two)

(5) Insert the intermediate axle shaft into the differential side gear.

(6) Install the shift collar on the splined end of the intermediate axle shaft.

(7) Lubricate the splined end of the intermediate axle shaft with multi-purpose lubricant (Fig. 18).

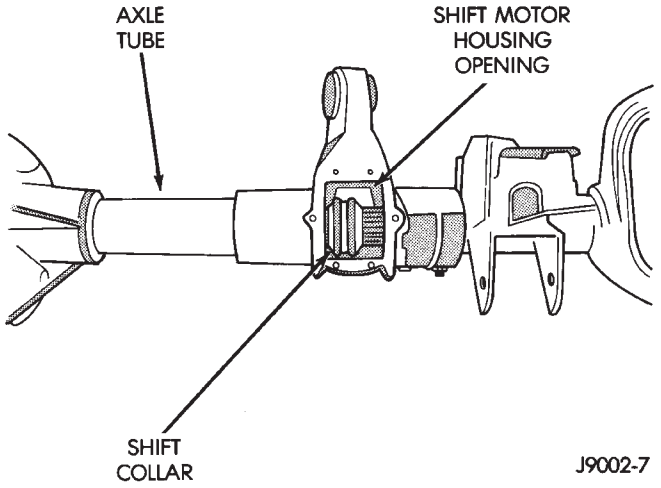


Fig. 18 Shift Collar Installation

CAUTION: Apply all-purpose lubricant to the axle shaft splines to prevent damage to the seal during axle shaft installation.

(8) Insert the axle shaft into the tube. Engage the splined-end of the shaft with the shift collar. Refer to Hub Bearing and Axle Shaft in this section.

(9) Install the vacuum motor housing. Refer to Shift Motor Installation in this section.

STEERING KNUCKLE AND BALL STUDS

Ball Stud service procedures below require removal of the hub bearing and axle shaft. Removal and installation of upper and lower ball stud requires use of Tool Kit 6289 (J34503-A).

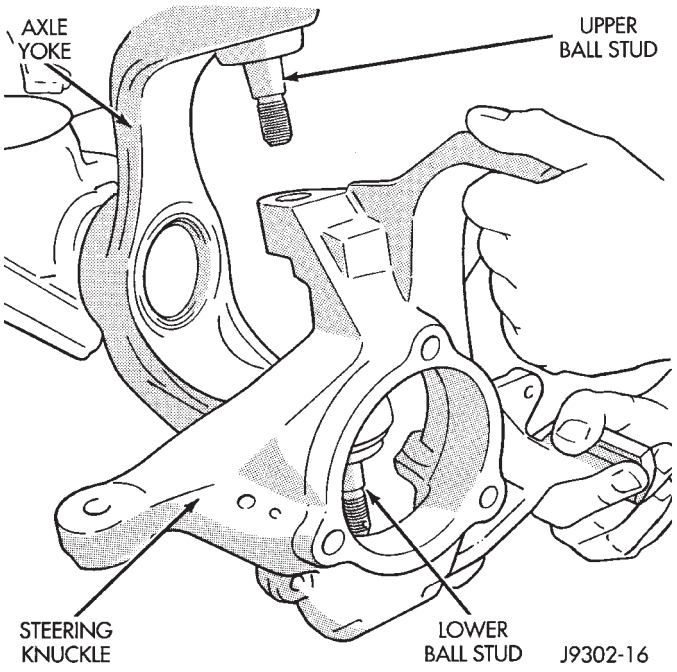


Fig. 19 Steering Knuckle Removal/Installation

The lower ball stud has two different designs. For this reason installer 6752 will also be needed. Check installers for proper fit.

KNUCKLE REMOVAL

(1) Remove hub bearing and axle shaft refer to the Removal procedure.

(2) Disconnect the tie-rod or drag link end from the steering knuckle arm. Remove the ABS sensor wire and bracket from knuckle.

(3) Remove the cotter pins from the upper and lower ball studs. Remove the upper and lower ball stud nuts.

(4) Strike the steering knuckle with a brass hammer to loosen. Remove knuckle from axle tube yokes (Fig. 19).

UPPER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig. 20).

LOWER BALL STUD REPLACEMENT

(1) Position tools as shown to remove and install ball stud (Fig.21). Because there are two different designs for the lower ball studs try both installers for proper fit.

KNUCKLE INSTALLATION

(1) Position the steering knuckle on the ball studs.

(2) Install and tighten the bottom retaining nut to 109 N·m (80 ft. lbs.) torque. Install new cotter pins.

(3) Install and tighten the top retaining nut to 101 N·m (75 ft. lbs.) torque. Install new cotter pin.

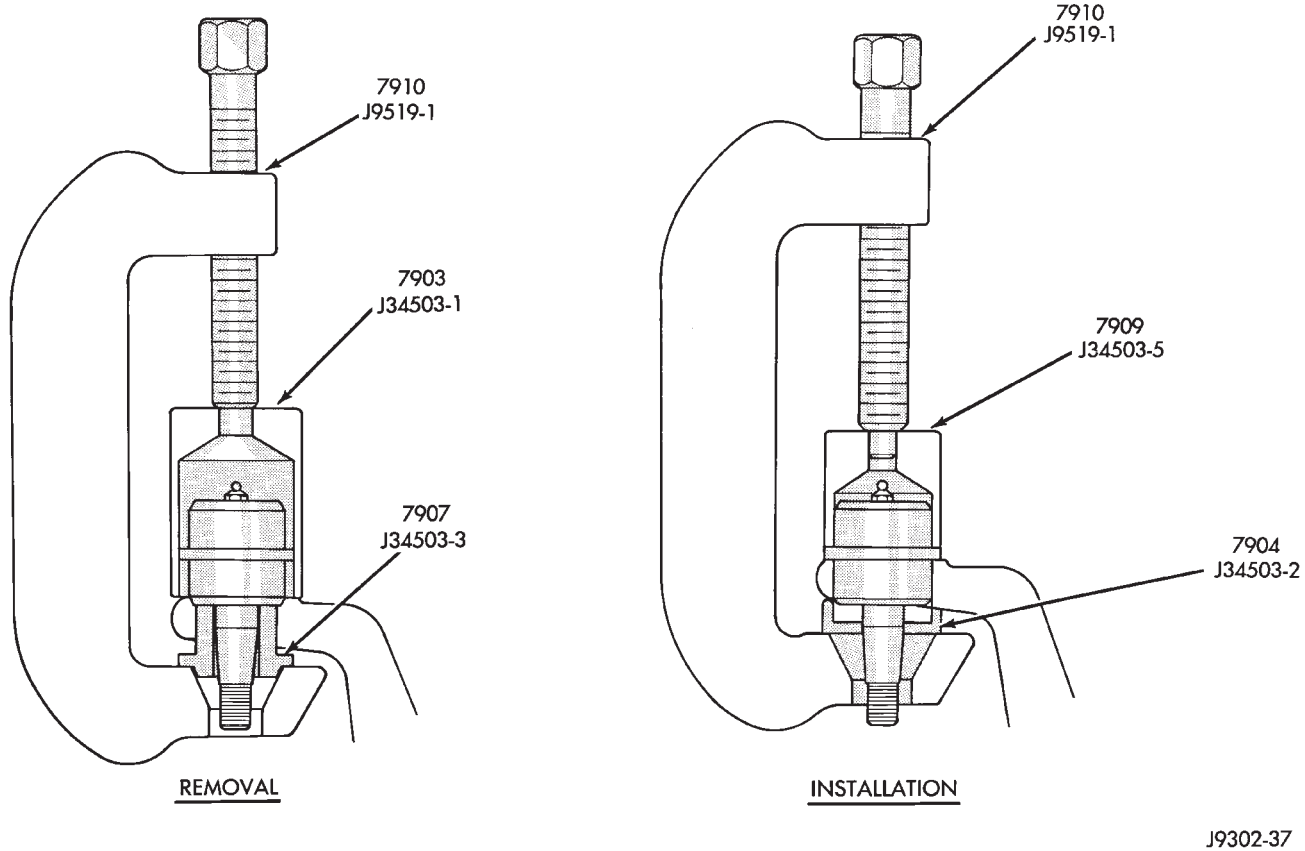


Fig. 20 Upper Ball Stud Remove/Install

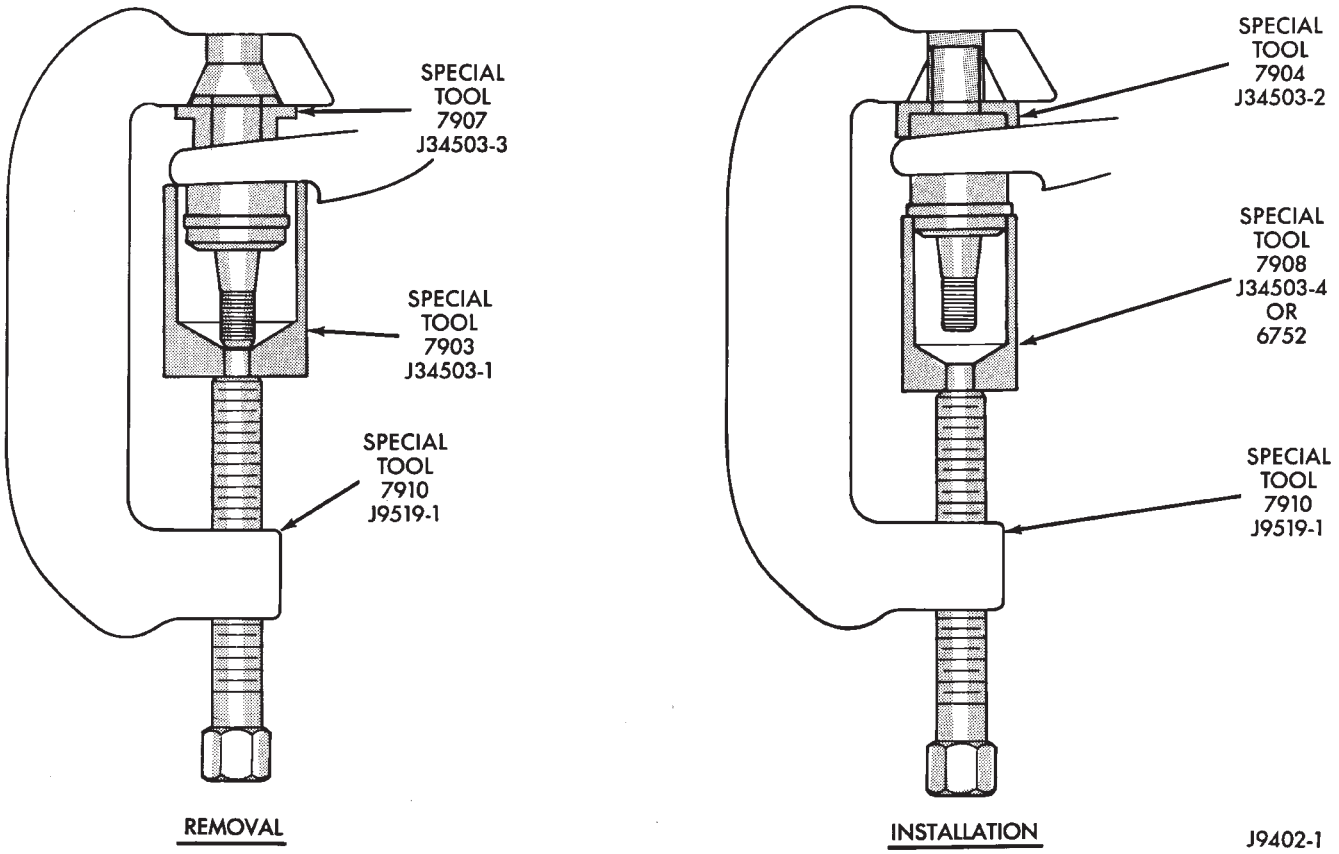


Fig. 21 Lower Ball Stud Remove/Install

(4) Install the Hub Bearing and Axle Shaft according to the installation procedure.

(5) Reconnect the tie-rod or drag link end onto the steering knuckle arm. Install the ABS sensor wire and bracket to the knuckle, refer to Group 5 — Brakes.

AXLE BUSHING REPLACEMENT

Refer to Axle Bushing Replacement in the Front Suspension section.

DIFFERENTIAL REMOVAL

To service the differential the axle assembly and axle shafts must be removed. Refer to the removal procedures in this Group.

(1) Note the installation reference letters stamped on the bearing caps and housing machined sealing surface (Fig. 22).

(2) Remove the differential bearing caps.

(3) Position Spreader W-129-B with the tool dowel pins seated in the locating holes (Fig. 23). Install the holddown clamps and tighten the tool turnbuckle finger-tight.

(4) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 26) and zero the indicator.

CAUTION:Do not spread over 0.38 mm (0.015 in). If the housing is over-separated, it could be distorted or damaged.

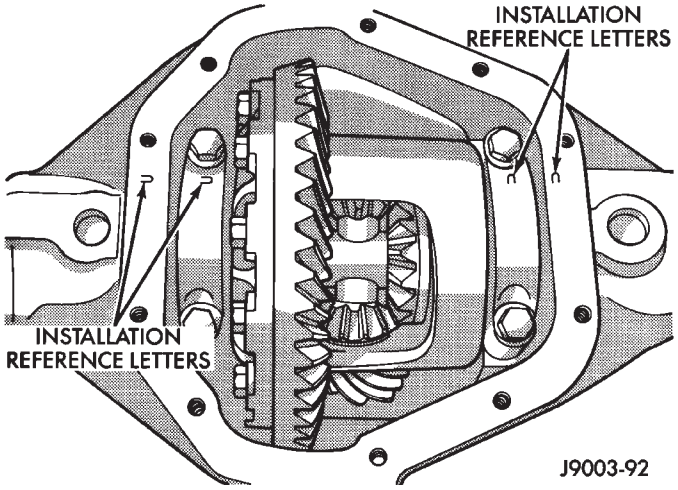


Fig. 22 Bearing Cap Identification

(5) Separate the housing enough to remove the case from the housing. Measure the distance with the dial indicator (Fig. 23).

(6) Remove the dial indicator.

(7) Pry the differential case loose from the housing. To prevent damage, pivot on housing with the end of the pry bar against spreader (Fig. 24).

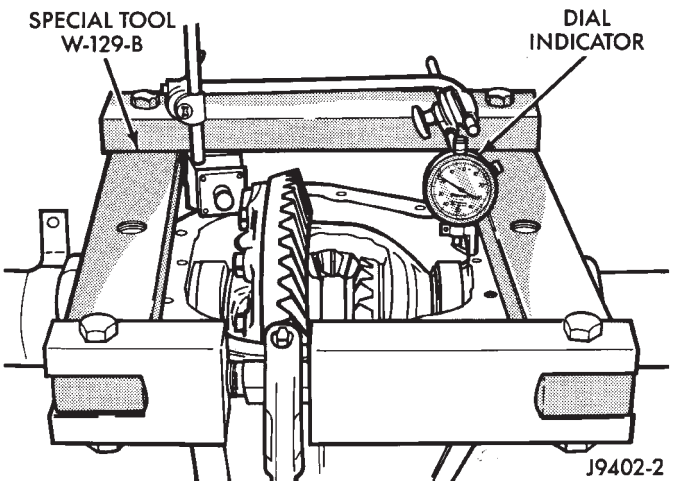


Fig. 23 Spread Differential Housing

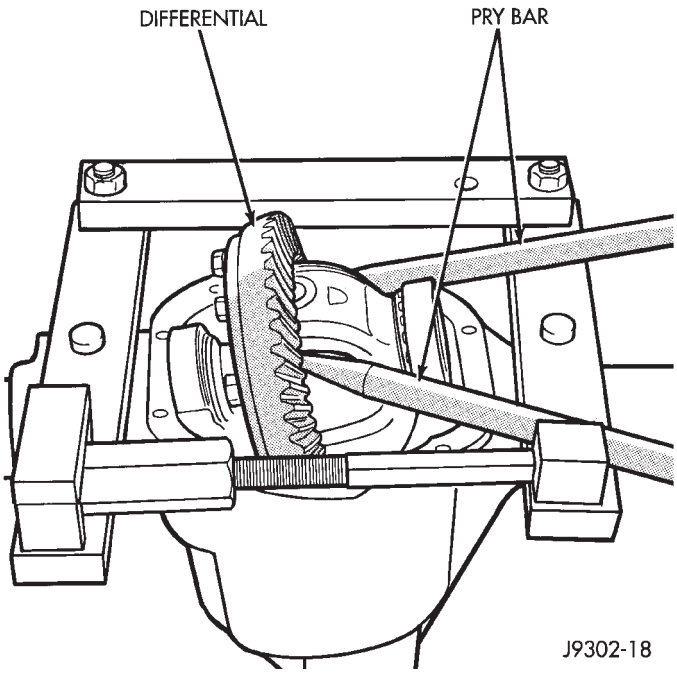


Fig. 24 Differential Removal

(8) Remove the case from housing. Mark or tag bearing cups indicating which side they were removed. Remove spreader from housing.

INNER AXLE SHAFT OIL SEAL REPLACEMENT

SELECT-TRAC

(1) Remove the inner axle shaft seals with a pry bay.

(2) Install oil seals with Discs 6764 and Turnbuckle D-112-A (Fig. 25). Tighten tool until disc bottoms in housing.

COMMAND-TRAC— LEFT-SIDE

(1) Remove the inner axle shaft seal with a pry bay.

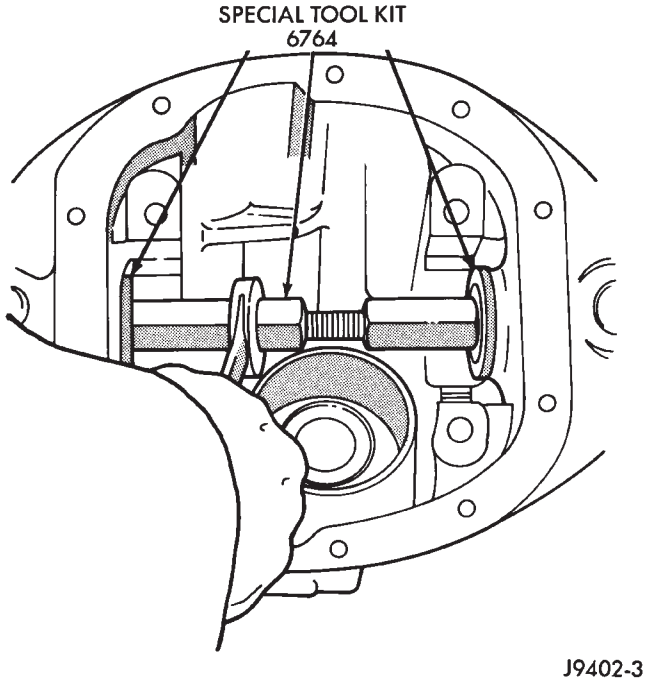


Fig. 25 Axle Seal Installation

(2) Install the inner axle seal on Tool 6228-1 (Fig. 26).

(3) Thread the **reverse** side of Installer 6228-1 tightly onto the threaded rod tool (Fig. 26).

(4) Press the seal into position.

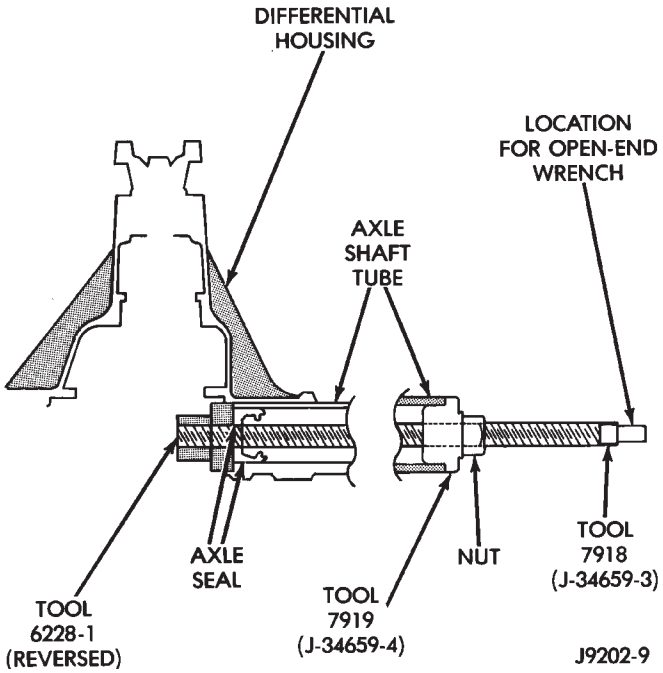


Fig. 26 Left Side Seal Installation

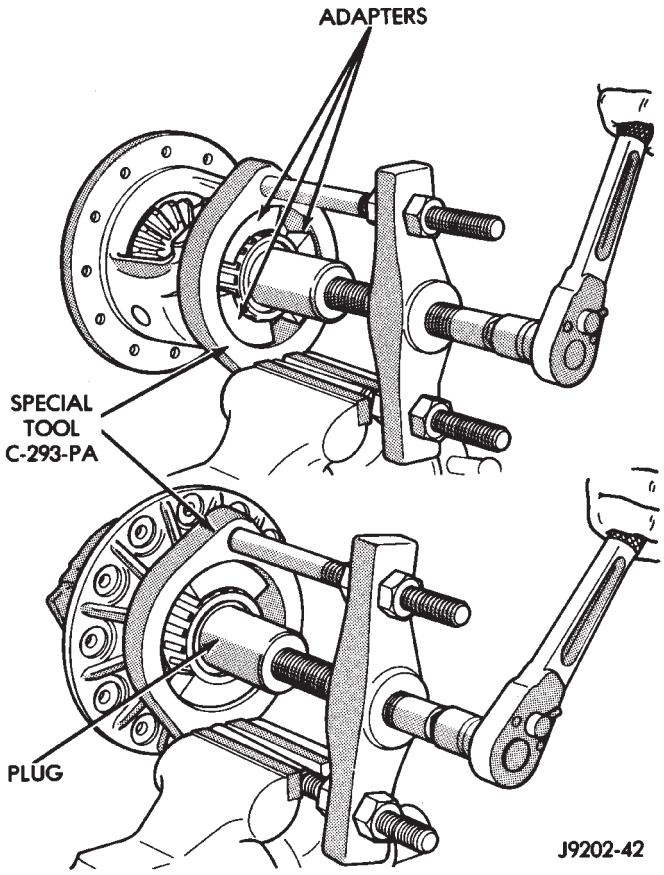


Fig. 27 Differential Bearing Removal

DIFFERENTIAL DISASSEMBLY

(1) Remove the bearings from the differential case with Press C-293-PA, Plug C-293-3, Adapter C-293-39 (Fig. 27).

Place adapter rings so they do not damage the bearing cage.

(2) Remove bearing shims from case hubs and mark them (with hub identity) for assembly reference. Record the thickness of the shims.

(3) Clamp the differential case in a vise equipped with soft jaws. Remove and **discard** the ring gear bolts. Tap the ring gear with a rawhide or plastic mallet and remove (Fig. 28).

(4) Use a drift to remove the pinion gear mate shaft lock pin (Fig. 29).

(5) Remove the mate shaft with a drift and hammer (Fig. 30).

(6) Rotate the differential side gears and remove the pinion mate gears and thrust washers (Fig. 31).

(7) Remove the differential side gears and thrust washers.

(8) Remove the case from the vise.

PINION REMOVAL/DISASSEMBLY

(1) Remove the pinion yoke nut and washer. Use Remover C-452 and Wrench C-3281 to remove the pinion yoke (Fig. 32).

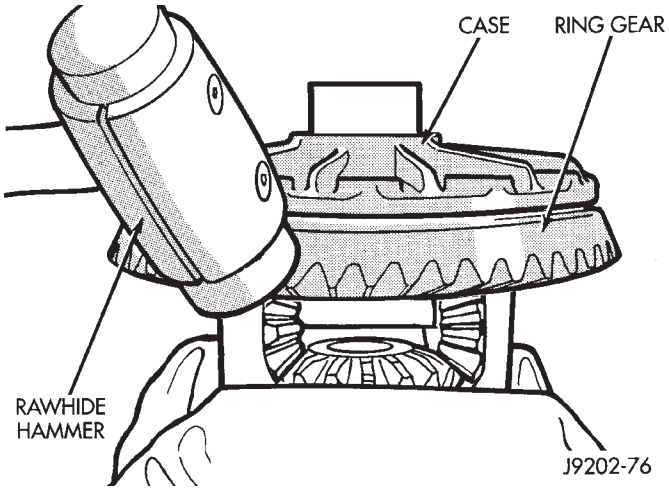


Fig. 28 Ring Gear Removal

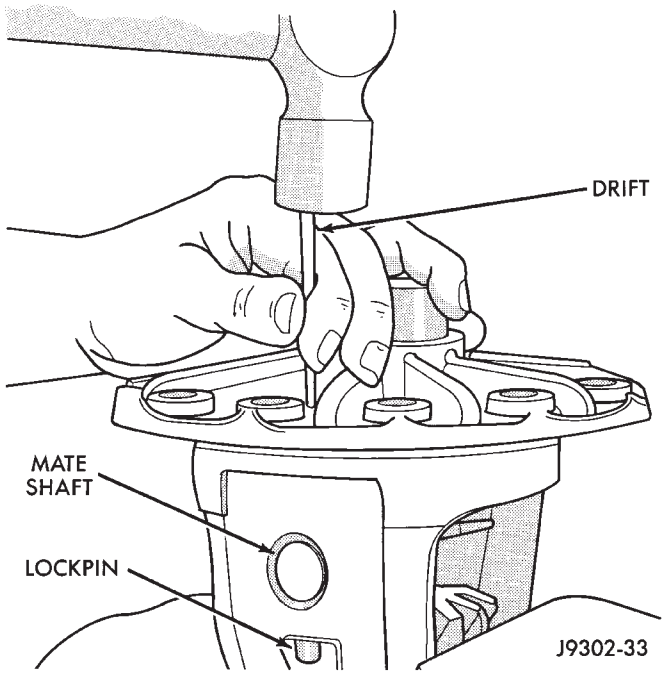


Fig. 29 Mate Shaft Lock Pin Removal

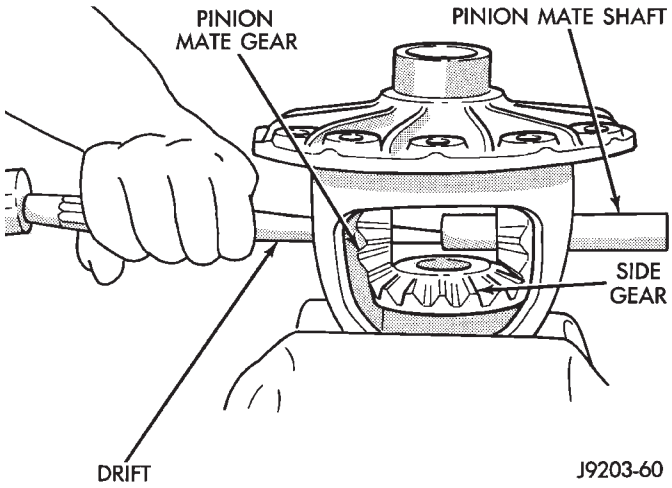


Fig. 30 Mate Shaft Removal

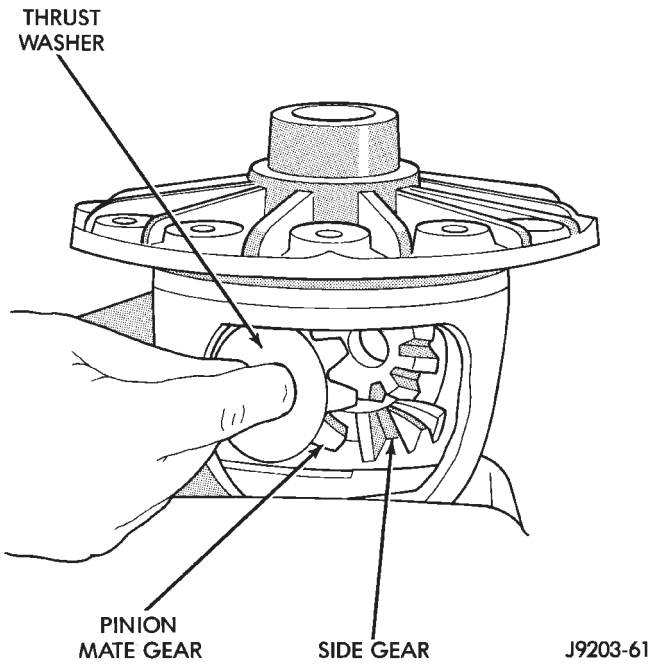


Fig. 31 Pinion Mate Gear Removal

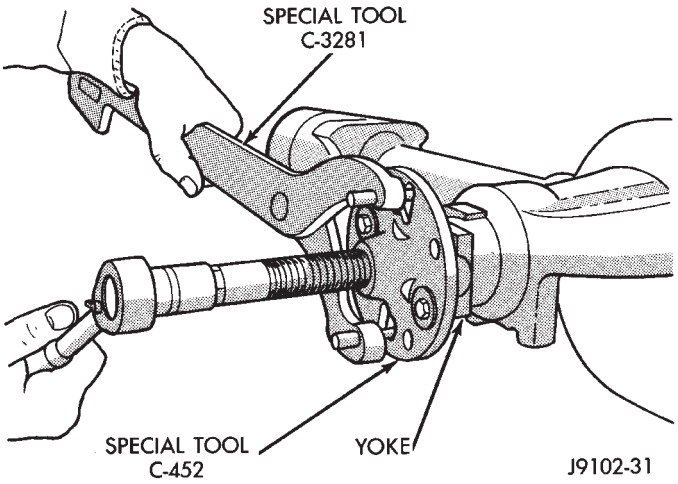


Fig. 32 Pinion Yoke Removal

(2) Remove the pinion gear seal with a slide hammer or pry out with bar.

(3) Drive out pinion gear from housing with rawhide or plastic hammer (Fig. 33). Catch the pinion with your hand to prevent it from falling and being damaged. **This will damage the front bearing rollers and bearing cup. The front bearing and cup must be replaced.** Remove and discard collapsible preload spacer (Fig. 34).

(4) Remove front bearing from housing.

(5) Remove the front pinion bearing cup with Remover D-147 and Handle C-4171 (Fig. 35).

(7) Remove the rear bearing cup from housing (Fig. 36). Use Remover D-149 and Handle C-4171.

(8) Remove the inner bearing from the pinion with Puller C-293-PA and Adapter C-293-39 (Fig. 37).

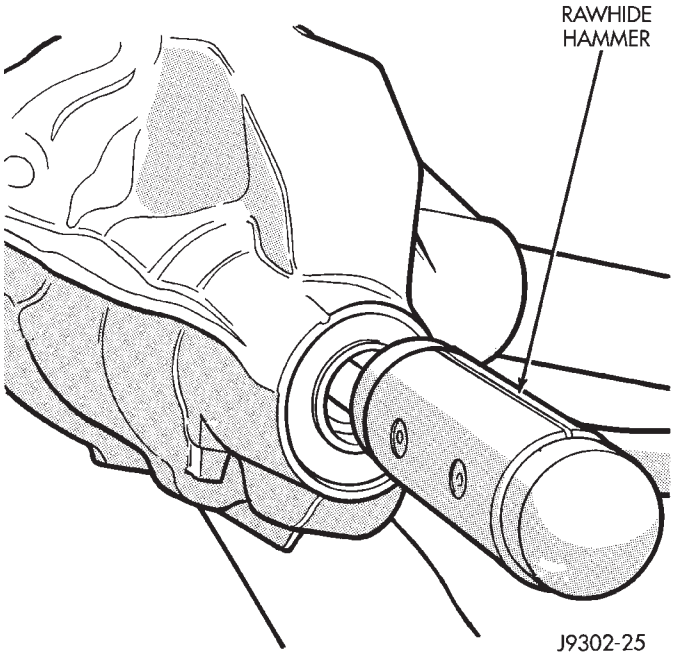


Fig. 33 Remove Pinion Gear

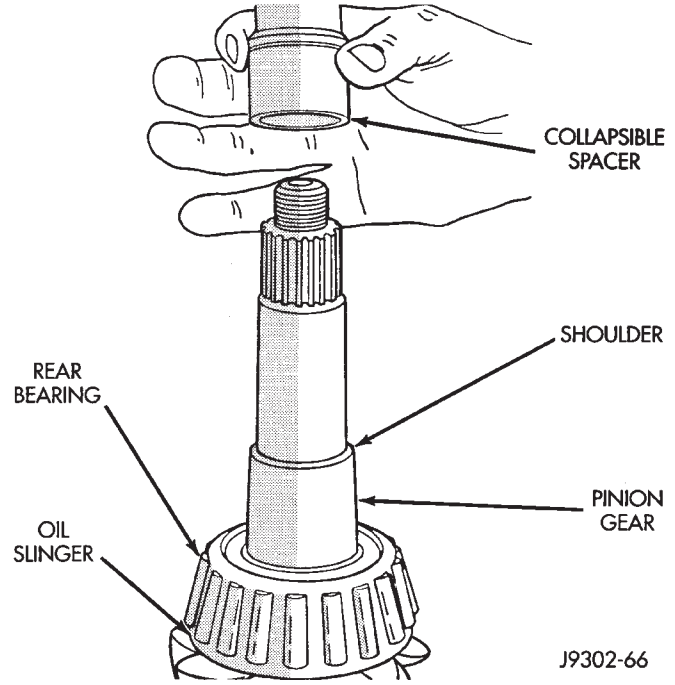


Fig. 34 Collapsible Preload Spacer

Place adapter rings so they do not damage the bearing cage.

(9) Remove the oil slinger from the pinion gear shaft. **Save the slinger it is used as select shim for pinion depth.**

CLEANING/INSPECTION

Wash differential components with cleaning solvent and dry with compressed air. **Do not steam clean the differential components.**

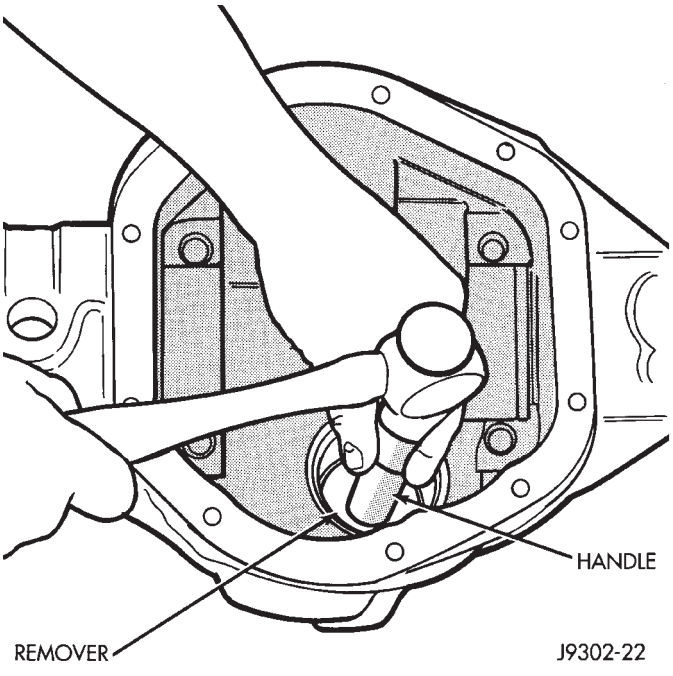


Fig. 35 Front Bearing Cup Removal

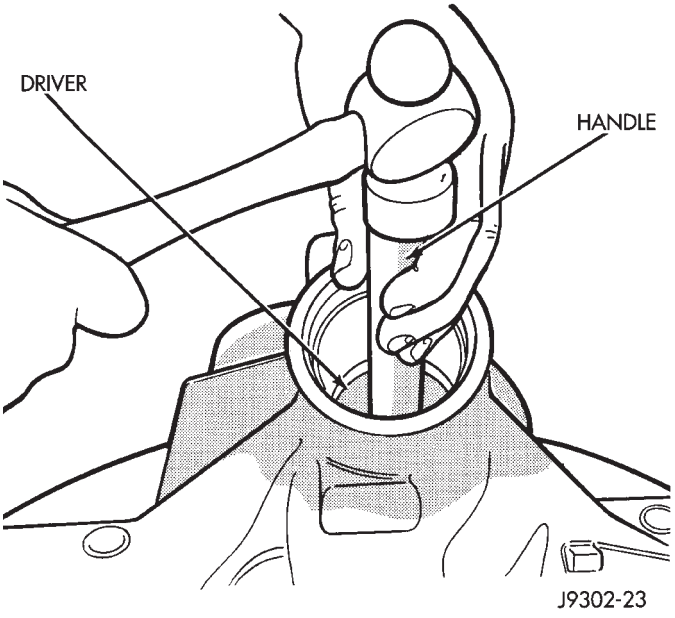


Fig. 36 Rear Bearing Cup Removal

Wash bearings with solvent and towel dry, do not dry with compressed air. **Cup and bearing must be replaced as a matched sets only.**

Clean the axle shaft tubes with a clean cloth.

Inspect for;

- Smooth appearance with no broken/dented surfaces on the bearing rollers or the roller contact surfaces.
- Bearing cups must not be distorted or cracked.
- Machined surfaces should be smooth and without any raised edges.
- Raised metal on shoulders of cup bores should be removed with a hand stone.

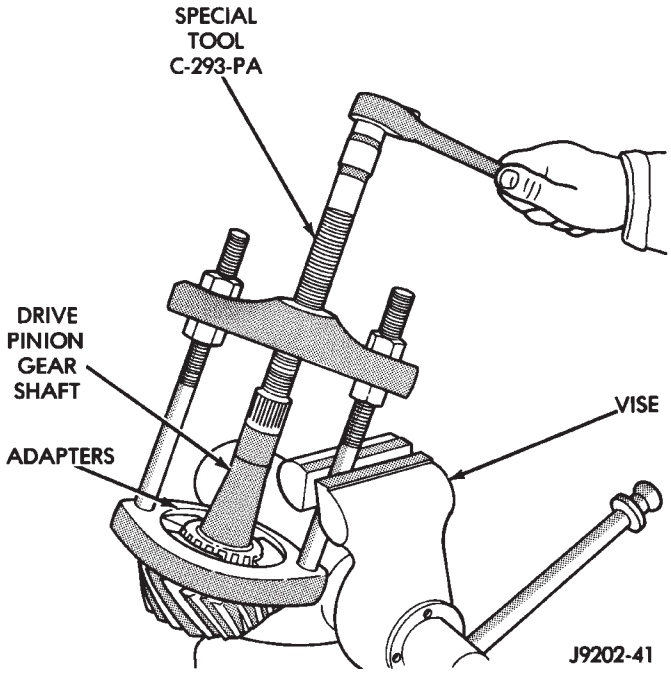


Fig. 37 Inner Bearing Removal

- Wear or damage to pinion gear mate shaft, pinion gears, side gears and thrust washers. Replace as a matched set only.
- Worn or chipped teeth to ring and pinion gears.
- Damaged bolt threads to ring gear. Replaced as a matched set only.
- Pinion yoke for cracks, worn splines, pitted areas, and a rough/corroded seal contact surface. Repair or replace the as necessary.

DIFFERENTIAL ASSEMBLY

ASSEMBLY

(1) Install the following components in the differential case (Fig. 38).

- Differential side gears and thrust washers
- Pinion gears and thrust washers
- Pinion gear mate shaft (align holes in shaft and case)

(2) Install and seat the locking roll pin in the differential case and mate shaft with a punch and hammer (Fig. 38). Peen metal part of case over pin in two places 180 degrees apart.

If replacement gears and thrust washers were installed, it is not necessary to measure the gear backlash. Correct fit is due to close machining tolerances during manufacture.

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

(4) Install new ring gear bolts and alternately tighten to 95-122 N·m (70-90 ft. lbs.) torque (Fig. 39).

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

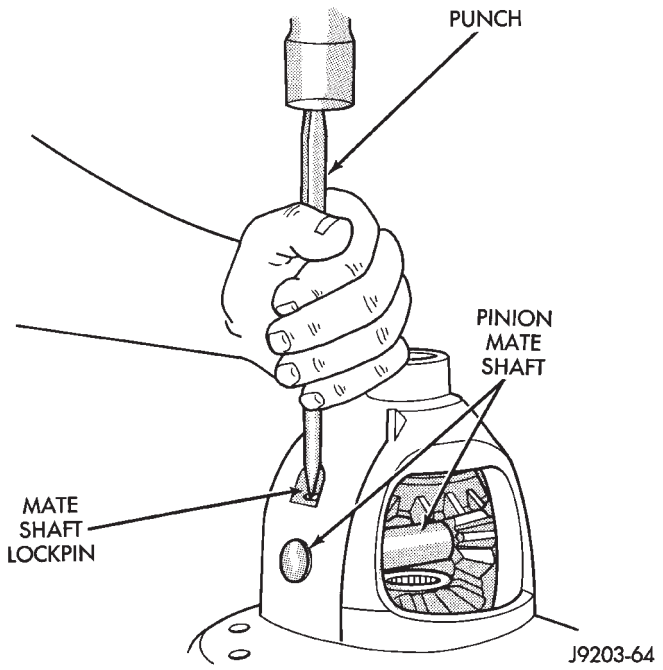


Fig. 38 Mate Shaft Pin Installation

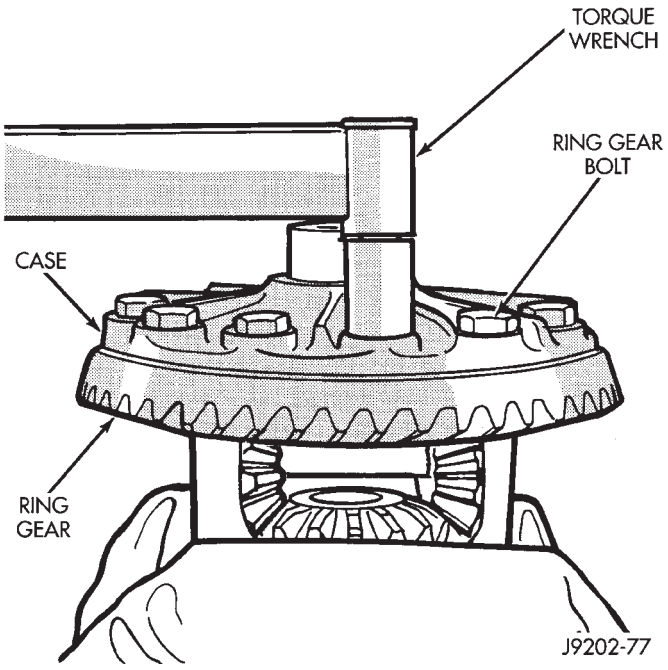


Fig. 39 Ring Gear Bolt Installation

PINION GEAR DEPTH INFORMATION

Ring and pinion gears are supplied as matched sets only. The identifying numbers for the ring and pinion gear are etched into the face of each gear (Fig. 40). 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 centerline of the ring gear to the back face of the pinion is 92.1 mm (3.625 inches) for Model 30 axles (Fig. 41). The standard depth provides the best teeth contact pattern.

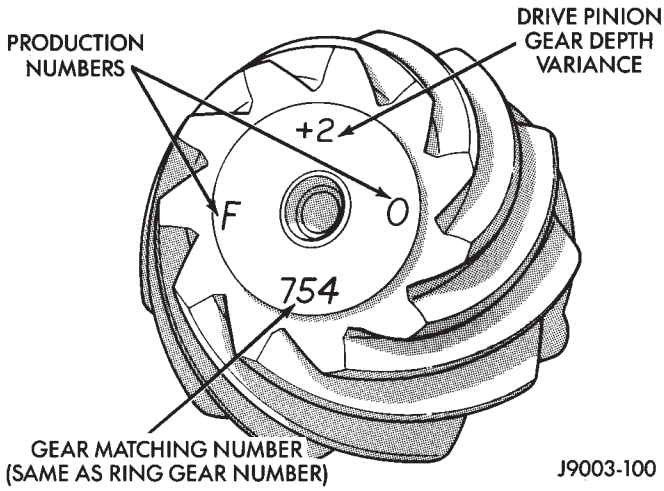


Fig. 40 Pinion Gear ID Numbers

THE BUTTON END ON THE PINION GEAR HEAD IS NO LONGER A MACHINED-TO-SPECIFICATIONS SURFACE. DO NOT USE THIS SURFACE FOR PINION DEPTH SET-UP OR CHECKING (Fig. 41).

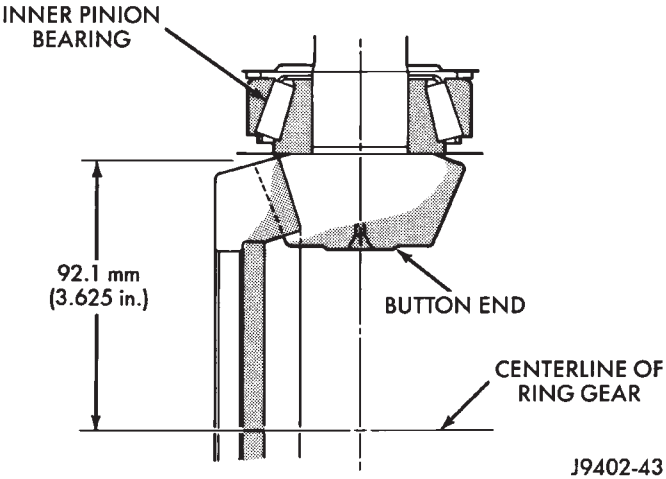


Fig. 41 Pinion Gear Head

Compensation for depth variance is achieved by a selected thickness oil slinger (production) or shims (service). The slinger is placed between the inner pinion bearing cone and gear head (Fig. 42). The shim pack is placed under the inner (rear) bearing cup for service. To change the pinion adjustment, shims are available in thicknesses of 0.003, 0.005, and 0.010 inch. **The oil slinger or baffle must be measured and the thickness included with the total shim pack.**

New gear set: note the depth variance etched into both the original and the replacement pinion gear. Add or subtract the thickness of the

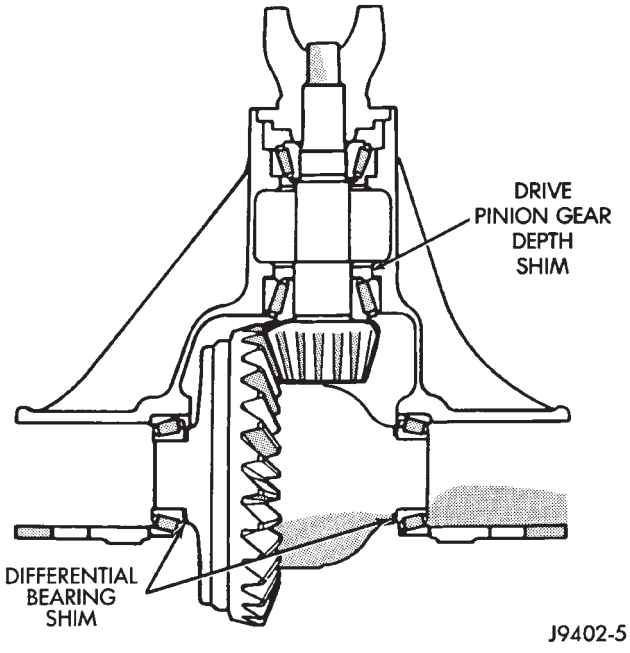


Fig. 42 Shim Locations

original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance charts.

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

For example, if old pinion is plus (+) 1 and the new pinion is minus (-) 3, intersecting figure is (+)0.004 inch (0.10mm). Add this amount to the original shim. Or if the old pinion is (-) 3 and the new pinion is (-) 2, intersecting figure is (-)0.001 inch (0.025mm). Subtract this amount from original shim. **Refer to the Pinion Gear Depth Variance Chart.**

DIFFERENTIAL AND PINION MEASUREMENT

DIFFERENTIAL ZERO END PLAY MEASUREMENT

(1) Place Master Differential Bearing D-134 (D-348) on the case hubs (Fig. 43) and install differential case into housing.

(2) Install a pilot stud at the right side of housing. Attach Dial Indicator to the pilot stud. Load indicator plunger against the back of the ring gear (Fig. 44).

(3) Insert a small pry bar between the bearing cap and left side of differential case. Pry the case as far as possible to right side (Fig. 44). Zero the dial indicator pointer.

(4) Pry the case to left side and **record** the travel distance.

The measurement above is the shim thickness necessary for case zero end-play. The total thickness will be determined during the ring gear backlash adjustment.

(5) Remove indicator, pilot stud and differential case from housing.

PINION GEAR DEPTH MEASUREMENT

Pinion gear depth measurement is necessary when axle housing is replaced or pinion select shim pack is unknown. It is also recommended when ring and pinion gears are replaced.

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	**−3**	**−2**	**−1**	**0**	**+1**	**+2**	**+3**	**+4**
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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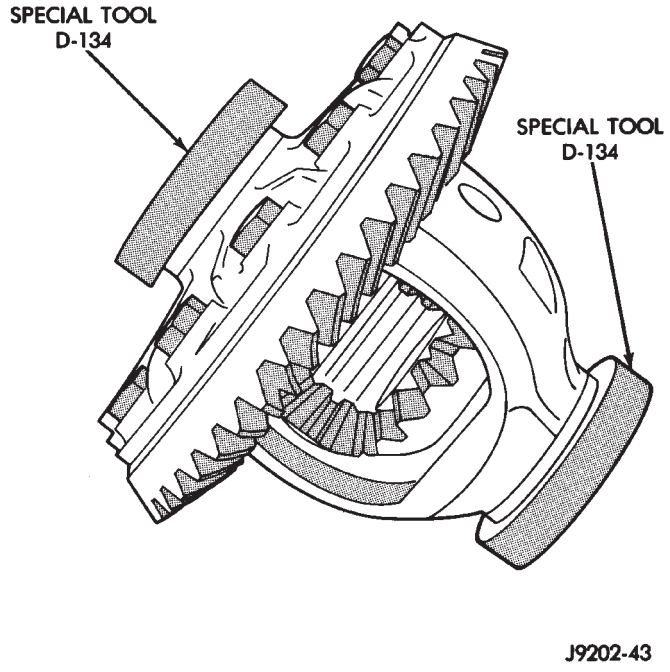

Fig. 43 Master Bearing Tools On Hubs

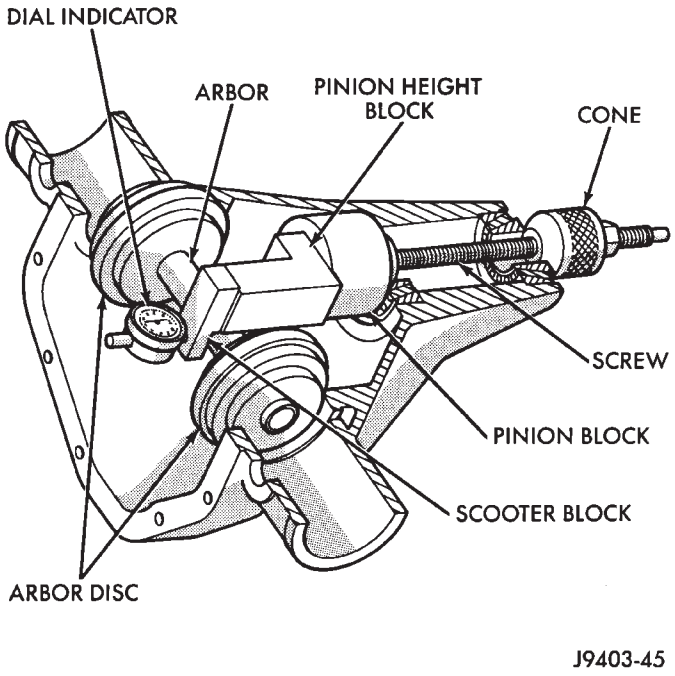

Fig. 45 Pinion Gear Depth Gauge Tools

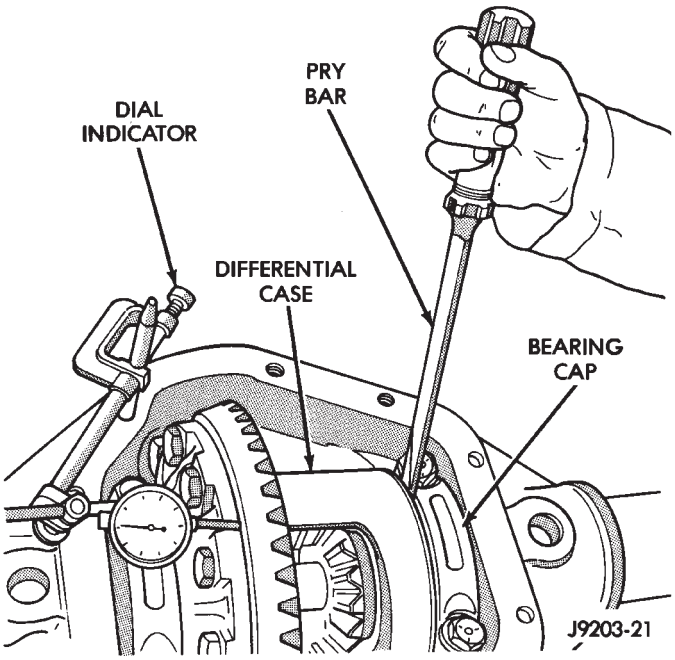

Fig. 44 Differential Case End Play Measurement

Measurements are done with pinion cups and pinion bearings installed in housing. Take measurements with Pinion Gauge Set 6774, Pinion Block 6733 and Dial Indicator C-3339 (Fig. 45).

(1) Assemble Pinion Gauge Set, Pinion Block and pinion bearings. Install assembly into differential pinion gear bore and hand tighten cone (Fig. 46).

(2) Place Arbor Disc 6732 on Arbor D-115-3 and position in the bearing cradles (Fig. 47). Install differential bearing caps on Arbor Discs and tighten caps snug only.

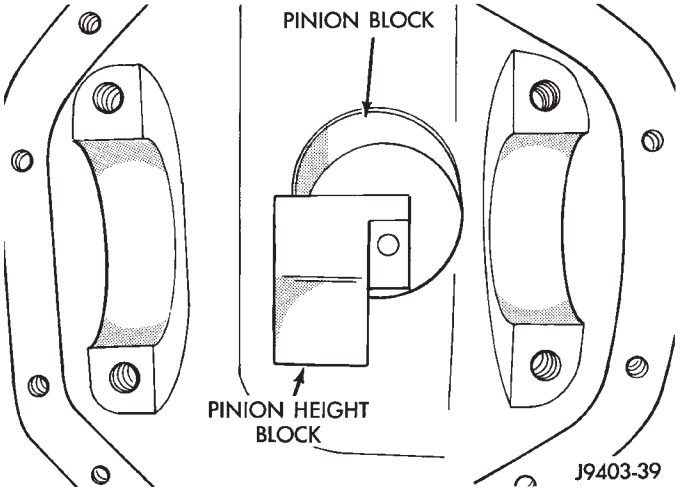

Fig. 46 Pinion Height Block

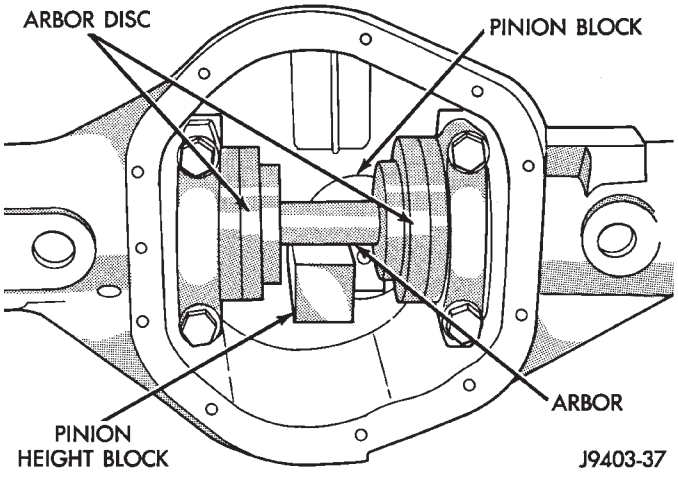

Fig. 47 Gauge Tools In Housing

Arbor Discs have different steps to fit other axle sizes. Pick correct size step for axle being serviced.

(3) Firmly place Scooter Block and Dial Indicator on pinion height block tool and zero the dial indicator pointer.

(4) Slide the Scooter Block across the arbor while observing indicator (Fig. 48). Record the longest travel distance, whether inward (-) or outward (+), indicated by the pointer.

The plunger travel distance indicated, plus or minus the variance etched in the gear is the required thickness for the depth shims.

(5) Measure the thickness of each depth shim with a micrometer and combine the shims necessary for total required shim pack thickness. **Include oil slinger or baffle thickness with the total shim pack thickness.**

(6) Remove the measurement tools from the differential housing.

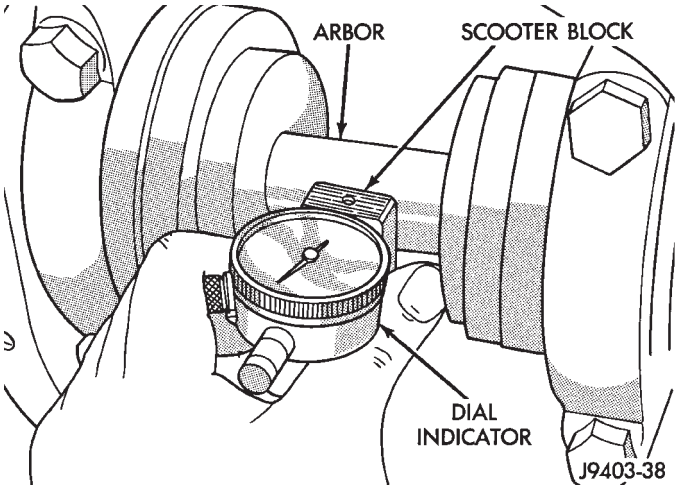

Fig. 48 Pinion Depth Measurement

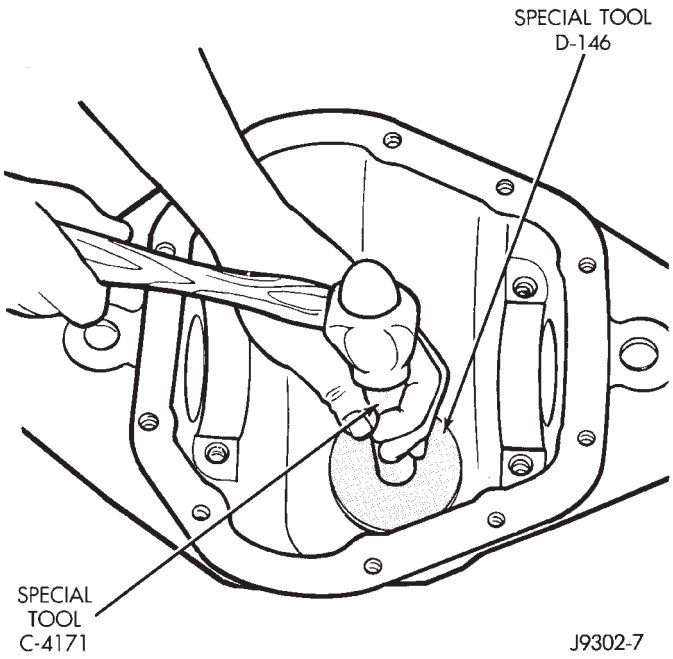

Fig. 49 Pinion Rear Bearing Cup Installation

PINION GEAR ASSEMBLY/INSTALLATION

(1) Place the shims (and baffle if equipped) in the pinion gear rear bearing bore. Install the bearing cup with Installer D-146 and Driver Handle C-4171 (Fig. 49). Ensure cup is correctly seated.

(2) Install the pinion front bearing cup with Installer D-144 and Handle C-4171 (Fig. 50).

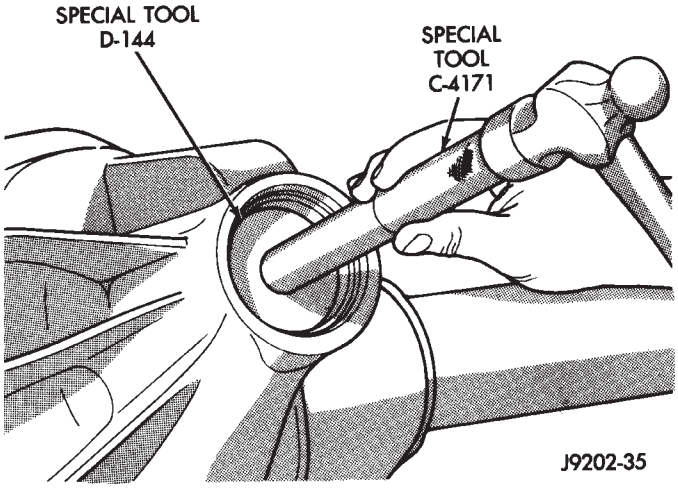

Fig. 50 Pinion Front Bearing Cup Installation

(3) Install the rear bearing and oil slinger on the pinion gear with Installer W-262 until completely seated (Fig. 51).

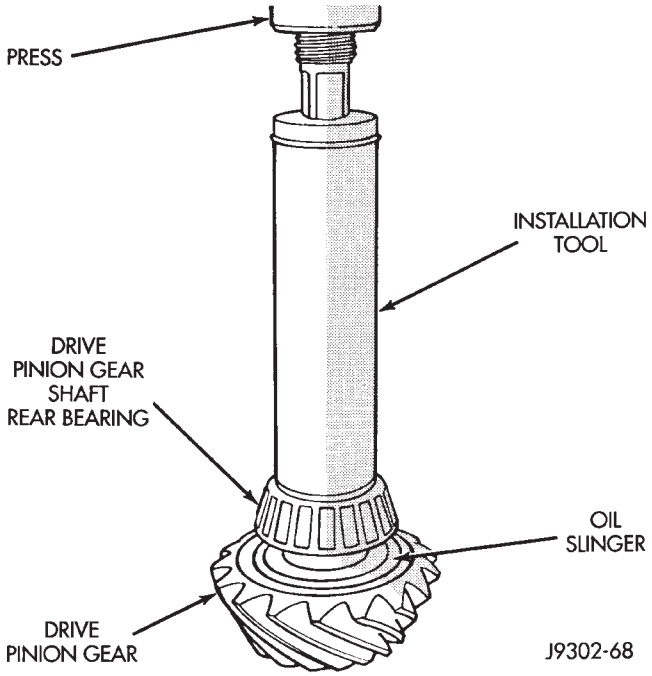

Fig. 51 Pinion Rear Bearing Installation

(4) Assemble collapsible spacer onto pinion shaft (Fig. 52).

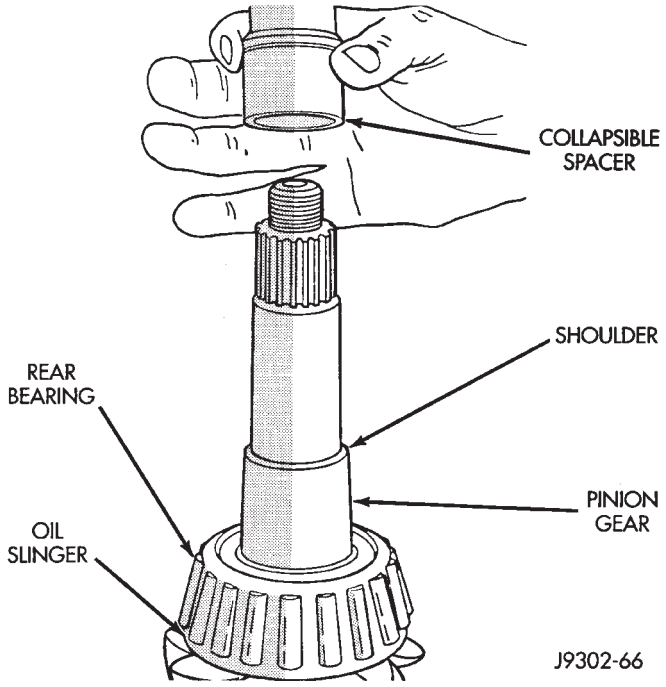

Fig. 52 Collapsible Preload Spacer

(5) Install pinion front bearing cone into cup and end yoke thrust washer.

(6) Apply a light coat of gear lubricant on lip of new pinion seal. Install seal with Installer W-147-E and Handle C-4171 (Fig. 53).

(7) Install pinion gear into differential housing.

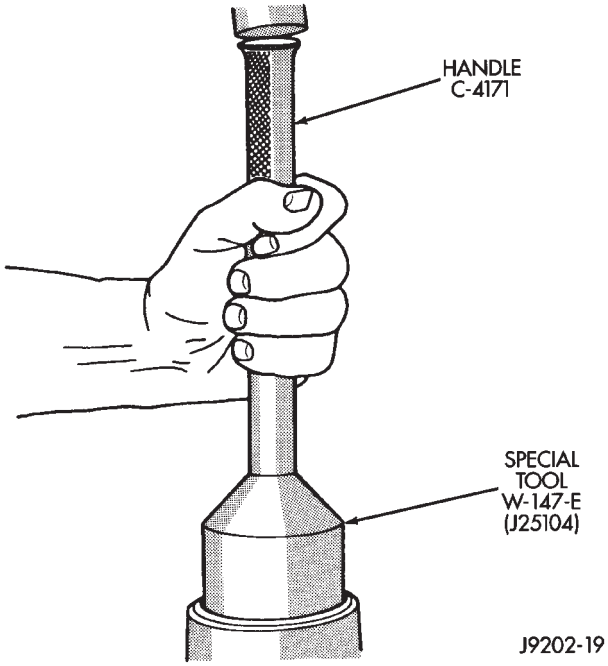

Fig. 53 Pinion Seal Installation

(8) Install yoke with Installer W-162-D and Wrench C-3281 (Fig. 54).

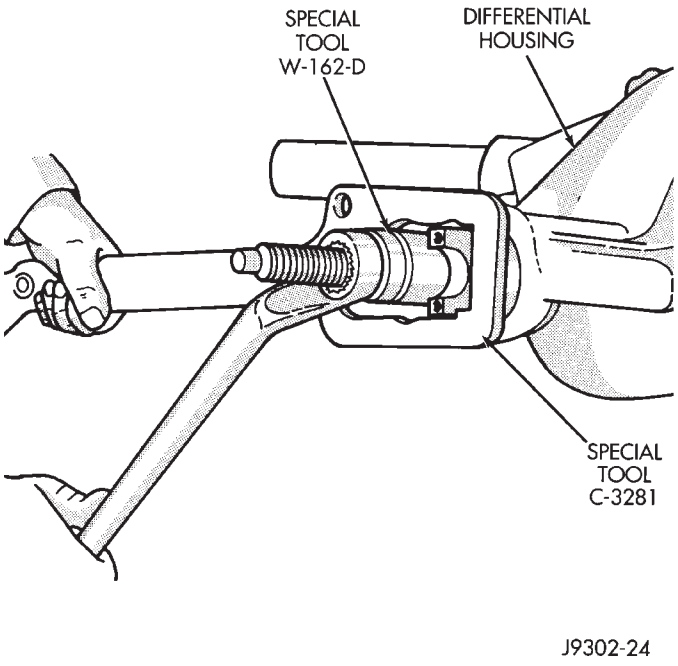

Fig. 54 Pinion Yoke Installation

(9) Install the yoke washer and a new nut on the pinion gear. Use Flange Wrench C-3281 to retain the yoke (Fig. 55). Tighten nut to 216 N·m (160 ft.lbs.) torque or enough to remove play. **Do not overtighten**.

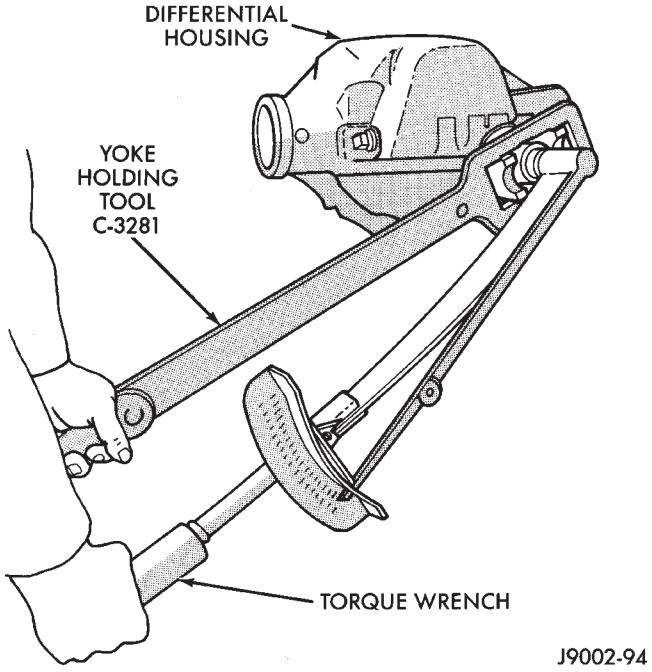

Fig. 55 Tightening Pinion Nut

CAUTION: Never loosen the pinion gear nut to decrease the pinion gear bearing preload torque. If the specified preload torque is exceeded, a new collapsible spacer must be installed. The torque sequence will have to be repeated.

(10) Use Flange Wrench C-3281 to retain the yoke (Fig. 55). Slowly tighten the nut in small increments until the rotating torque is achieved. Measure the rotating torque frequently to avoid over-tightening the nut.

(11) Check bearing rotating torque with an inch pound torque wrench (Fig. 56). The torque necessary to rotate the pinion gear should be;

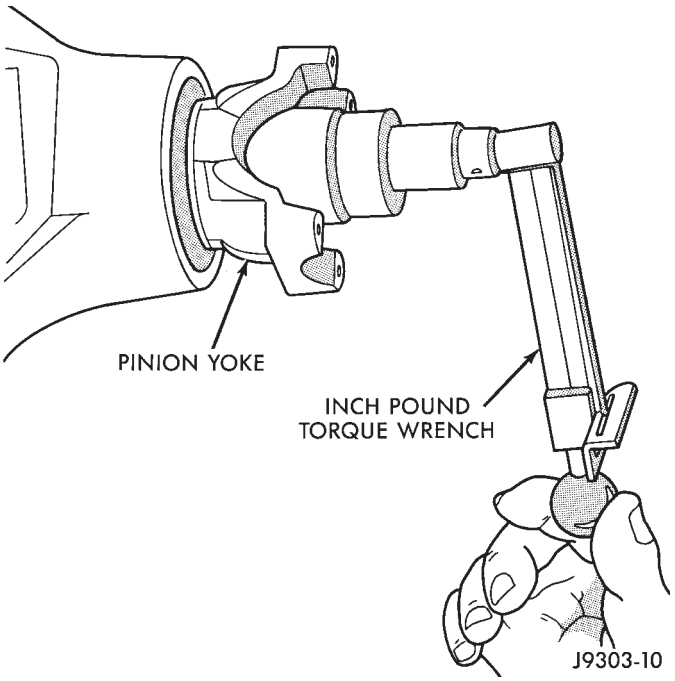

Fig. 56 Check Pinion Gear Torque

- Original Bearings — 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings — 2 to 5 N·m (15 to 35 in. lbs.).

DIFFERENTIAL SHIM PACK MEASUREMENT AND ADJUSTMENT

(1) Place Master Differential Bearing D-134 (D-348) on the case hubs.

(2) Install a pilot stud at the left side of housing. Attach Dial Indicator to housing. Load the indicator plunger against the back of the ring gear (Fig. 57). Ensure ring and pinion gear teeth are tightly meshed. Zero the indicator.

(3) Insert a small pry bar between the bearing cap and left side of differential case. Pry the case as far as possible to right side (Fig. 57). Zero the dial indicator pointer.

(4) Repeat the measurement several times to check consistency. Record the travel distance.

The measurement above shows shim thickness necessary to eliminate ring gear backlash. Subtract this thickness from case zero end-play shim thickness (Fig. 58). The shims must be placed at the ring gear side between the case and bearing.

(5) Remove indicator and pilot stud.

(6) Remove the differential case from housing.

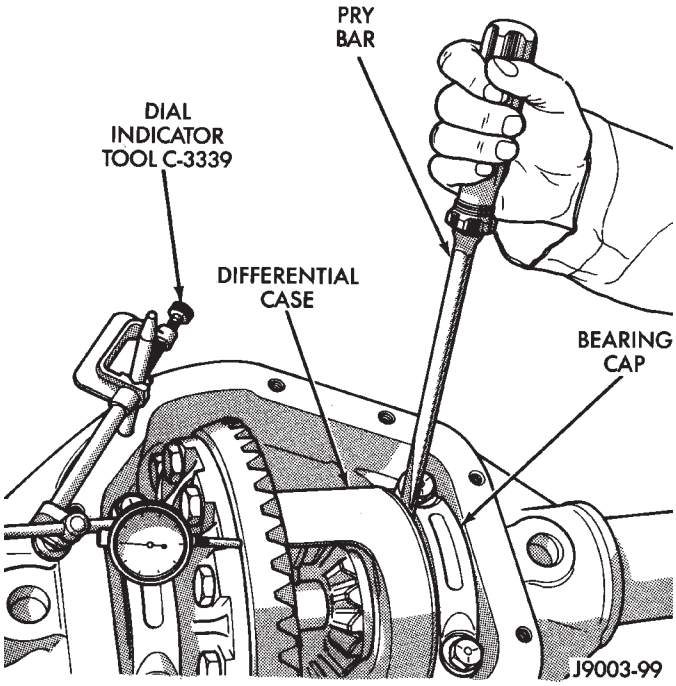

Fig. 57 Shim Pack Measurement

For Example:

Indicator Reading	LESS PINION	0.085 in.	total
Indicator Reading	WITH PINION	0.055 in.	total
BALANCE OF SHIM PACK		0.030 in.	total

Place BALANCE of shims at opposite side of ring gear

ADD an additional 0.015 in. shim to opposite side of ring gear for bearing preload

Ring Gear Side (Flange Side)	0.055 in.
Opposite Side	0.030 in.
Opposite Side Preload	0.015 in.
Total Opposite Side	0.045 in.

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Fig. 58 Shim Pack Calculations

(7) Remove the master bearing tools from the differential case hubs.

(8) Position the backlash shims (with determined thickness) on case hub (ring gear side). Install bearing on the hub with Bearing Installer C-3716-A and Driver Handle C-4171 (Fig. 59).

(9) Position the remaining zero end-play shims on hub at opposite side of case. Include an additional

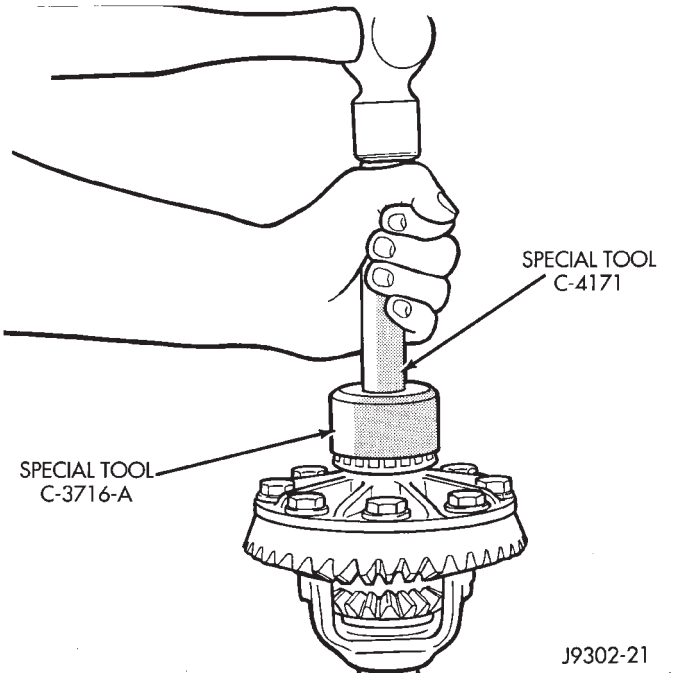


Fig. 59 Differential Bearing Installation

0.015 in. (0.38 mm) thick shim on this hub. This will provide the required differential bearing preload torque.

(10) Install bearings on hubs with Installer C-3716-A and Handle C-4171 (Fig. 59).

(11) Match each bearing cup with bearing (original). Install the cups on the bearings.

DIFFERENTIAL INSTALLATION

(1) Position Spreader W-129-B with the tool dowel pins seated in the locating holes (Fig. 60). Install the holddown clamps and tighten the tool turnbuckle finger-tight.

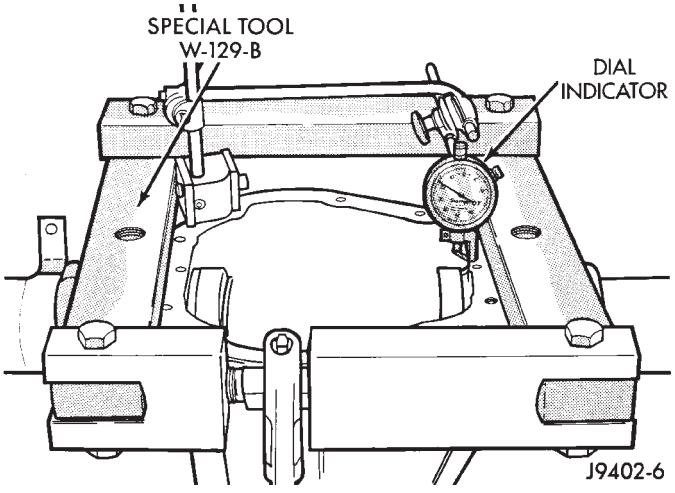


Fig. 60 Spread Differential Housing

(2) Install a pilot stud at the left side of the differential housing. Attach Dial Indicator to housing pilot stud. Load the indicator plunger against the opposite side of the housing (Fig. 60) and zero the indicator.

CAUTION: Do not spread over 0.38 mm (0.015 in). If the housing is over-separated, it could be distorted or damaged.

(3) Spread the housing enough to install the case in the housing. Measure the distance with the dial indicator (Fig. 60).

(4) Remove the dial indicator.

(5) Install case in the housing. Tap the differential case to ensure the bearings are fully seated (Fig. 61). Remove the spreader.

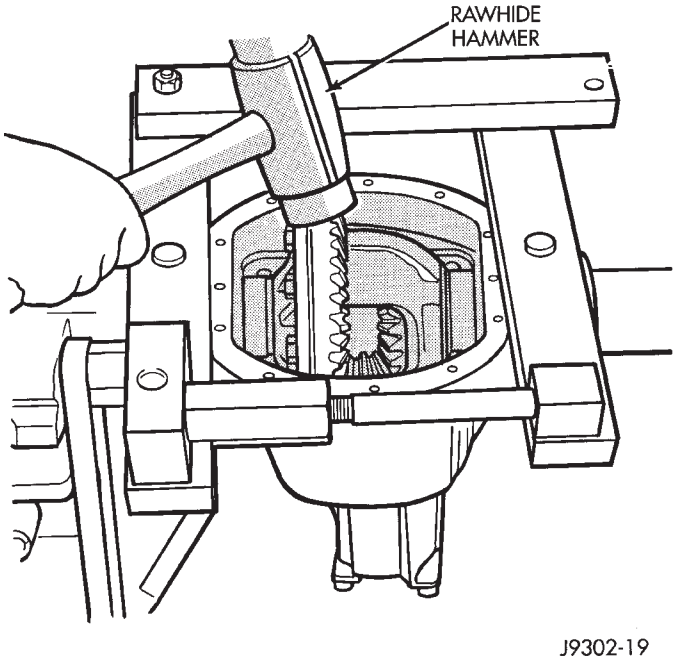


Fig. 61 Differential Installation

(6) Install the bearing caps at their original locations (Fig. 62). Tighten the bearing cap bolts to 61 N·m (45 ft. lbs.) torque.

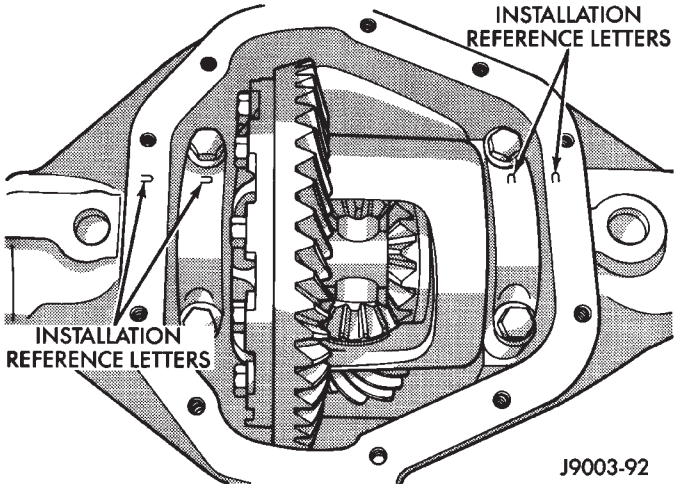


Fig. 62 Differential Bearing Cap Reference Letters

BACKLASH AND CONTACT PATTERN ANALYSIS

(1) Rotate assembly several revolutions to seat bearings. Measure backlash at three equally spaced locations around the perimeter of the ring gear with a dial indicator (Fig. 63).

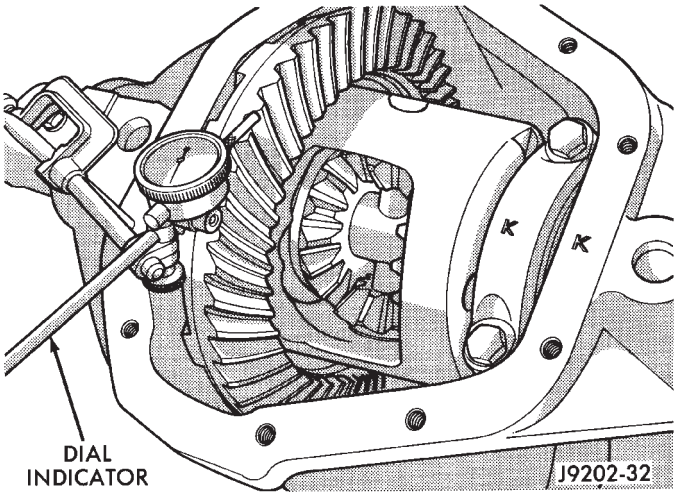


Fig. 63 Ring Gear Backlash Measurement

The ring gear backlash must be within 0.005 - 0.008 inch (0.12 - 0.20 mm). It cannot vary more than 0.002 inch (0.05 mm) between the points checked.

If backlash must be adjusted, transfer shims from one side of carrier to the other side. Adjust the backlash accordingly (Fig. 64). **DO NOT INCREASE THE TOTAL SHIM PACK THICKNESS, EXCESSIVE BEARING PRELOAD AND DAMAGE WILL OCCUR.**

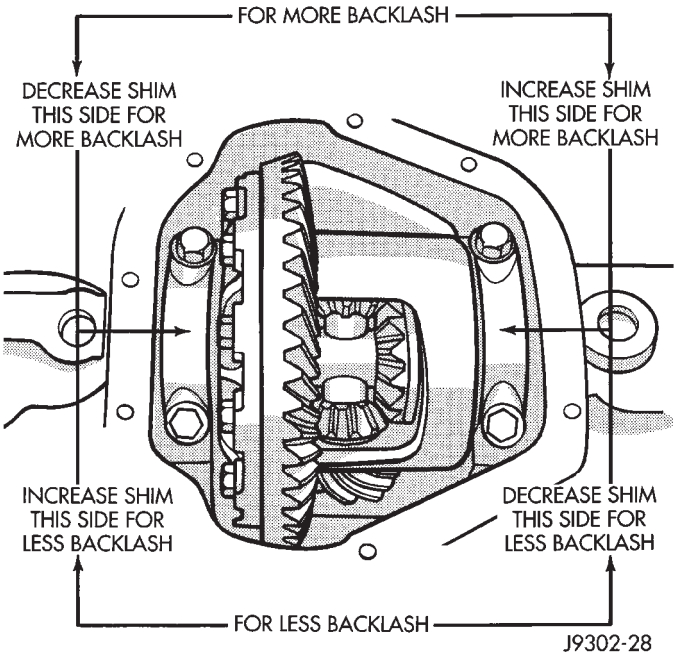


Fig. 64 Backlash Shim Adjustment

If the mesh and backlash steps have been followed in the procedures above, good gear teeth contact patterns should exist.

The ring gear teeth contact patterns will show if the pinion gear depth is correct. It will also show if the ring gear backlash has been adjusted correctly. The backlash must be maintained within the specified limits until the correct tooth contact patterns are obtained.

(2) Apply a thin coat of hydrated ferric oxide (yellow oxide of iron) to the drive and coast side of the ring gear teeth.

(3) Rotate the ring gear one complete revolution in both directions while a load is being applied. Insert a pry bar between the differential housing and the case flange. This action will produce distinct contact patterns on both the drive side and coast side of the ring gear teeth.

(4) Note patterns in compound. Refer to (Fig. 65) for interpretation of contact patterns and adjust accordingly.

FINAL ASSEMBLY

(1) Install the axle shafts. Refer to Axle Shaft Installation in this Group.

(2) Scrape the residual sealant from the housing and cover mating surfaces. Clean the mating surfaces with mineral spirits. Apply a bead of MOPAR® Silicone Rubber Sealant on the housing cover (Fig. 66). Allow the sealant to cure for a few minutes.

Install the housing cover within 5 minutes after applying the sealant. If not installed the sealant must be removed and another bead applied.

(3) Install the cover on the differential with the attaching bolts. Install the identification tag. Tighten the cover bolts with 41 N·m (30 ft. lbs.) torque.

CAUTION: Overfilling the differential can result in the lubricant foaming and overheating.

(4) Refill the differential housing with the specified quantity of MOPAR® Hypoid Gear Lubricant.

(5) Install the fill hole plug and tighten to 34 N·m (25 ft. lbs.) torque.

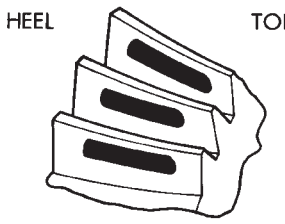
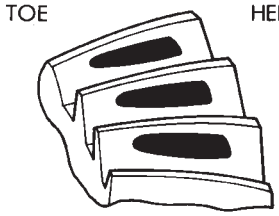
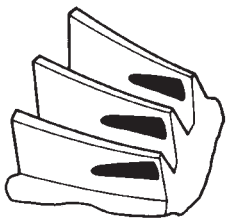
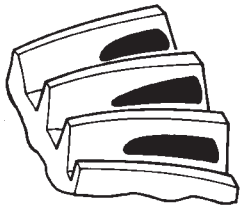
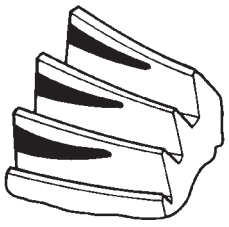
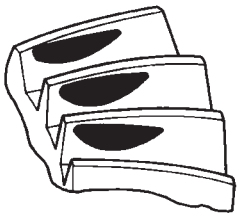
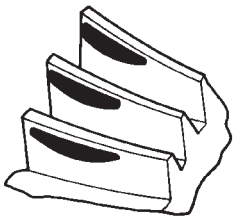
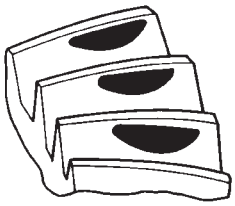
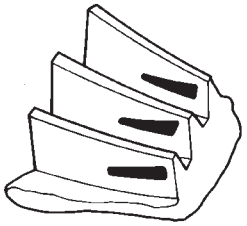
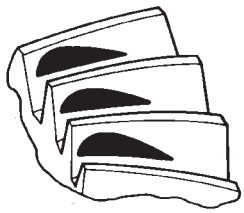
DRIVE SIDE OF RING GEAR TEETH	COAST SIDE OF RING GEAR TEETH	
		DESIRABLE CONTACT PATTERN. PATTERN SHOULD BE CENTERED ON THE DRIVE SIDE OF TOOTH. PATTERN SHOULD BE CENTERED ON THE COAST SIDE OF TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD ALWAYS BE SOME CLEARANCE BETWEEN CONTACT PATTERN AND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

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Fig. 65 Gear Tooth Contact Patterns

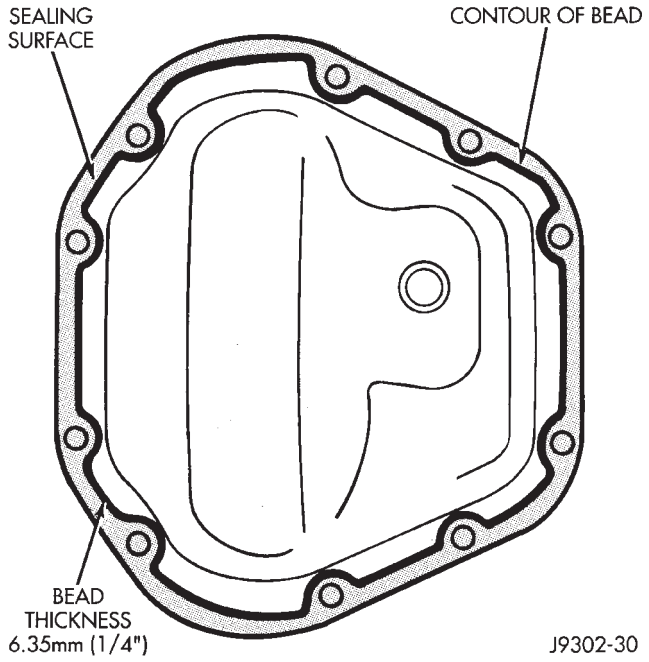

Fig. 66 Typical Housing Cover With Sealant

AXLE SPECIFICATIONS

MODEL 30 FRONT AXLE

Axle Type	Hypoid
Application	XJ/YJ
Ring Gear Diameter	7.125 in. (18.09 cm)
Lubricants	MOPAR Gear Lubrication or Equivalent SAE 75W-90, API Grade GL-5, MIL-L-2105C
Axle Shaft Joint	Cardan, C.V.
Lubricant Capacity*	YJ 56 oz. (1.65L). . XJ, 50 oz.(1.48L)
Axle Model	Dana 30-7AF
Axle Ratio	3.07, 3.55, 3.73, 4.11

***Command-Trac — add 5 ounces (148 ml) to front axle shift motor housing opening.**

Differential Bearing Preload Shim	0.015 in.	0.38 mm
Ring Gear Backlash	0.005-0.008 in.	0.12-0.20 mm
Drive Pinion Bearing Preload Torque	Collapsible Spacer	
Original Bearings	10-20 in. lbs.	1-2 N·m
New Bearings	15.35 in. lbs.	1.5-4 N·m
Drive Pinion Gear Depth	Select Shims	
Standard Setting	3.625 in.	92.1 mm

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TORQUE SPECIFICATIONS

XJ FRONT SUSPENSION COMPONENTS

DESCRIPTION	TORQUE
Coil Spring Retainer Screw	21 N·m
Lower Suspension Arm Nuts	115 N·m
Lower Suspension Arm Caster Adjuster Bracket Nuts	19 N·m
Shock Absorber Upper Nut	11 N·m
Shock Absorber Lower Bolt/Nut	19 N·m
Stabilizer Bar Link Nuts	36 N·m
Stabilizer Bar Link Axle Bracket Bolt	74 N·m
Stabilizer Bar Clamp Bolts	54 N·m
Track Bar Bracket to Reinforcement Plate Bolts	121 N·m
Track Bar Bracket to Stud Plate Nuts	100 N·m
Track Bar Bracket Reinforcement Plate Side Bolts	42 N·m
Track Bar Axle Bracket Bolt	100 N·m
Track Bar Ball Stud Retaining Nut	81 N·m
Upper Suspension Arm Rear Nut	89 N·m
Upper Suspension Arm Front Nut	74 N·m
Wheel Lug Nut ½ x 20 with 60° Cone	109 to 150 N·m

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YJ FRONT SUSPENSION COMPONENTS

DESCRIPTION	TORQUE
Jounce Bumper to Frame Screw	41 N·m
Stabilizer Bar Retainer Bolts	75 N·m
Stabilizer Bar Link Nut	61 N·m
Shock Absorber Lower Bolt	61 N·m
Shock Absorber Upper Nut	13 N·m
Spring U-bolt/Stud Nut	122 N·m
Spring Front Shackle Bolt	129 N·m
Spring Rear Pivot Bolt	142 N·m
Track Bar to Axle Nut	100 N·m
Track Bar to Frame Bolt	168 N·m
Wheel Lug Nut ½ x 20 with 60° Cone	109 to 150 N·m

J9302-72

MODEL 30 AXLE

DESCRIPTION	TORQUE
Bearing Cap Bolts	61 N·m (45 ft. lbs.)
Differential Cover Bolts	41 N·m (30 ft. lbs.)
Fill Hole Plug	34 N·m (25 ft. lbs.)
Hub Bearing to Knuckle Bolts	102 N·m (75 ft. lbs.)
Hub Bearing to Axle Shaft Nut	237 N·m (175 ft. lbs.)
Lower Ball Stud Nut	108 N·m (100 ft. lbs.)
Upper Ball Stud Nut	101 N·m (75 ft. lbs.)
Ring Gear Bolts	95 to 122 N·m (70 to 90 ft. lbs.)

J9402-28

FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

Throughout this group, references are made to particular vehicle models by alphabetical designation or by the particular vehicle nameplate. A chart showing a breakdown of the alphabetical designations is included in the Introduction section at the beginning of this manual.

The **Fuel System** consists of: the fuel tank, an electric (fuel tank mounted) fuel pump and a fuel filter. It also consists of fuel tubes/lines/hoses, vacuum hoses, throttle body and fuel injectors.

The **Fuel Delivery System** consists of: the electric fuel pump, fuel filter, fuel tubes/lines/hoses, fuel rail, fuel injectors and fuel pressure regulator.

A **Fuel Return System** is used on all vehicles. The system consists of: the fuel tubes/lines/hoses that route fuel back to the fuel tank.

The **Fuel Tank Assembly** consists of: the fuel tank, filler tube, fuel gauge sending unit/electric fuel pump module, a pressure relief/rollover valve and a pressure-vacuum filler cap.

Also to be considered part of the fuel system is the **Evaporation Control System.** This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Group 25, Emission Control Systems.

FUEL USAGE STATEMENT

Your vehicle was designed to meet all emission regulations and provide excellent fuel economy using high quality unleaded gasoline. Only use unleaded gasolines having a minimum posted octane of 87.

If your vehicle develops occasional light spark knock (ping) at low engine speeds, this is not harmful. However, **continued heavy knock at high speeds can cause damage and should be reported to your dealer immediately.** Engine damage as a result of heavy knock operation may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, **those that contain detergents, corrosion and stability additives are recommended.** Using gasolines that have these additives will help improve fuel economy, reduce emissions and maintain vehicle performance. Generally, premium unleaded gasolines contain more additive than regular unleaded gasolines.

Poor quality gasoline can cause problems such as hard starting, stalling and stumble. If you experience these problems, use another brand of gasoline before considering service for the vehicle.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with materials that contain oxygen such as alcohol, MTBE and ETBE. The type and amount of oxygenate used in the blend is important. The following are generally used in gasoline blends:

ETHANOL

Ethanol (Ethyl or Grain Alcohol) properly blended, is used as a mixture of 10 percent ethanol and 90 percent gasoline. **Gasoline with ethanol may be used in your vehicle.**

METHANOL

CAUTION: DO NOT USE GASOLINES CONTAINING METHANOL. Use of methanol/gasoline blends may result in starting and driveability problems. In addition, damage may be done to critical fuel system components.

Methanol (Methyl or Wood Alcohol) is used in a variety of concentrations blended with unleaded gaso-

line. You may encounter fuels containing 3 percent or more methanol along with other alcohols called co-solvents.

Problems that are the result of using methanol/gasoline blends are not the responsibility of Chrysler Corporation. They may not be covered by the vehicle warranty.

MTBE/ETBE

Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline and up to 15 percent MTBE. Gasoline and ETBE (Ethyl Tertiary Butyl Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used in your vehicle.

CLEAN AIR GASOLINE

Many gasolines are now being blended that contribute to cleaner air, especially in those areas of the country where air pollution levels are high. These new blends provide a cleaner burning fuel and some are referred to as **Reformulated Gasoline.**

In areas of the country where carbon monoxide levels are high, gasolines are being treated with oxygenated materials such as MTBE, ETBE and ethanol.

Chrysler Corporation supports these efforts toward cleaner air and recommends that you use these gasolines as they become available.

FUEL DELIVERY SYSTEM

INDEX

FUEL PUMP MODULE

The fuel pump module is installed in the top of the fuel tank. The fuel pump module contains the following components:

- Electric fuel pump
- Fuel pump reservoir
- In-tank fuel filter
- Fuel gauge sending unit
- Fuel supply and return tube connections

The fuel pump used on all vehicles is a gear/rotor type pump. It is driven by a permanent magnet 12 volt electric motor that is immersed in the fuel tank. The electrical pump is integral with the fuel sender unit. The pump/sender assembly is installed inside the fuel tank.

The fuel pump has a check valve at the outlet end that consists of a ball held against a seat by force applied from a spring. When the pump is operating, fuel pressure overcomes spring pressure and forces the ball off its seat, allowing fuel to flow. When the pump is not operating, spring pressure forces the ball back against the seat preventing fuel backflow through the pump.

Fuel system pressure is maintained at approximately 214 kPa (31 psi). This is when the pump is operating and vacuum is supplied to the fuel pressure regulator. If vacuum is not supplied to the pressure regulator, fuel pressure will be approximately 55-69 kPa (8-10 psi) higher. This may be due to a broken or clogged vacuum line. When the fuel pump is not operating, system fuel pressure of 131-269 kPa (19-39 psi) is maintained. This is done by the fuel pump outlet check valve and the vacuum assisted fuel pressure regulator.

REMOVAL—XJ MODELS

The fuel pump/gauge sender unit assembly can be removed from the fuel tank without removing the tank from the vehicle.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

WARNING: EXTINGUISH ALL TOBACCO SMOKING PRODUCTS BEFORE SERVICING THE FUEL SYSTEM. KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Remove fuel filler cap. Perform the Fuel Pressure Release Procedure as outlined in this group.

(2) Disconnect negative battery cable.

(3) Using an approved portable gasoline siphon/storage tank, drain fuel tank until fuel level is below one quarter (1/4) full.

(4) Raise and support vehicle.

WARNING: WRAP SHOP TOWELS AROUND FUEL HOSES TO ABSORB ANY FUEL SPILLAGE DURING FUEL TANK REMOVAL.

(5) Disconnect fuel vent supply and return tubes from fittings on fuel pump module.

(6) Disconnect fuel pump module electrical harness connector from main harness.

(7) Using a brass punch and hammer, remove fuel pump module lock ring by carefully tapping it counterclockwise (Fig. 1).

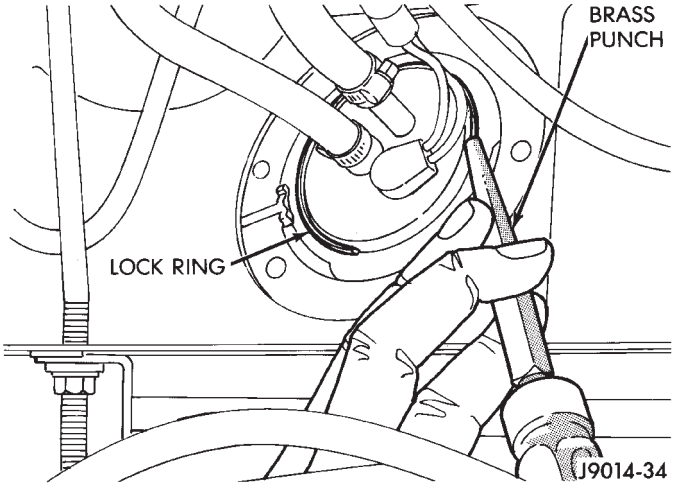

Fig. 1 Removing Lock Ring—XJ Models—Typical

(8) Remove fuel pump module and O-ring seal. Discard old O-ring and fuel pump module inlet filter.

DISASSEMBLY—XJ MODELS

(1) Remove and discard fuel pump inlet filter.

The wire terminals to the fuel pump motor are different in size and cannot be connected to the wrong terminal.

(2) Disconnect fuel pump terminal wires.

(3) Remove fuel pump outlet hose and clamp. Replace the hose if it shows any signs of fatigue or failure.

(4) Remove fuel pump top mounting bracket nut. Remove fuel pump (Fig. 2).

ASSEMBLY—XJ MODELS

Whenever the fuel pump is replaced, the fuel pump inlet filter (sock) must also be replaced.

(1) Place fuel pump top mounting bracket over top of pump.

(2) Position fuel pump into lower bracket. Slide stud of top bracket through hole in fuel pump side bracket. Tighten fuel pump top mounting nut.

(3) Install new fuel pump outlet hose. Secure with new clamps.

(4) Connect wire terminals to motor.

(5) Install new fuel pump inlet filter.

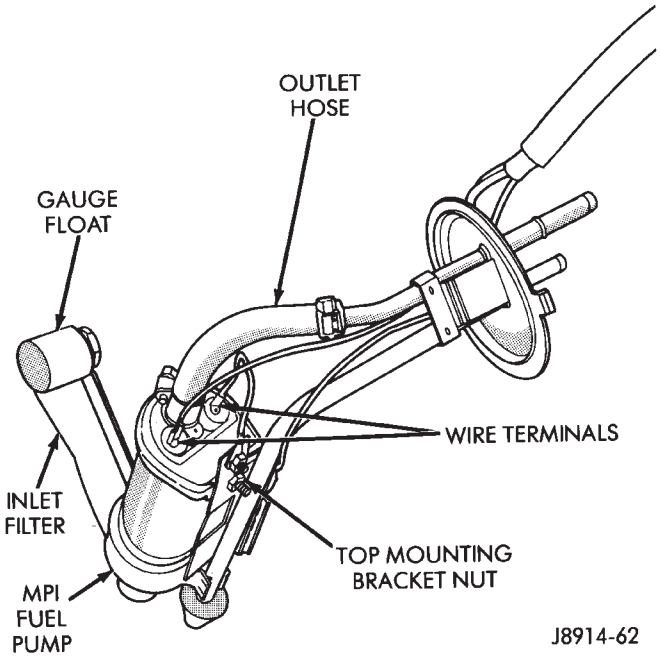

Fig. 2 Fuel Pump Module—XJ Models—Disassemble/Assemble

INSTALLATION—XJ MODELS

Whenever the fuel pump is replaced, the fuel pump inlet filter must also be replaced.

(1) Install new fuel pump inlet filter onto fuel pump.

(2) Install fuel pump module assembly and new O-ring seal. The rubber stopper on the end of the fuel return tube of the assembly must be inserted into the cup in the fuel tank reservoir (Fig. 3).

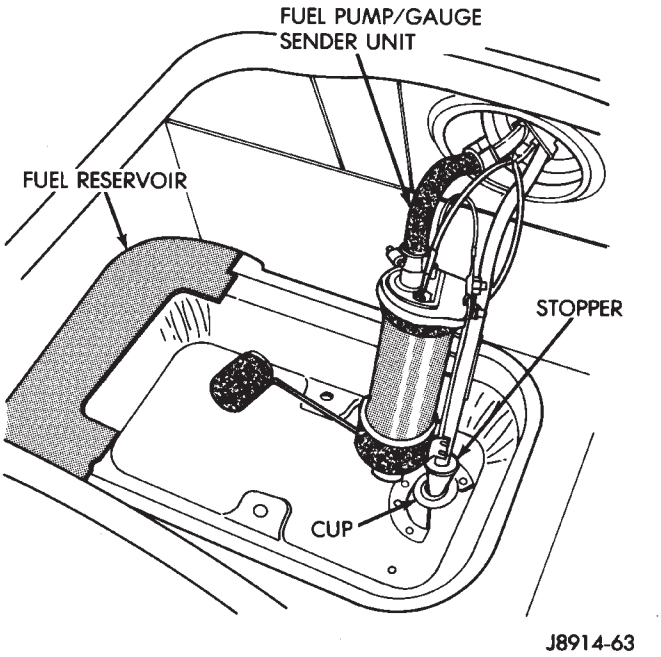

Fig. 3 Fuel Pump Module—XJ Models—Installation

(3) Using a brass punch and a hammer, install lock ring. Carefully tap lock ring clockwise until it seats against stop on fuel tank.

(4) Connect fuel supply and return hoses to fittings on fuel pump module. Tighten hose clamps.

(5) Connect fuel pump module electrical harness connector to main harness connector.

(6) Lower vehicle.

(7) Fill fuel tank. Install fuel tank cap.

(8) Connect negative battery cable.

(9) Start vehicle and inspect for leaks.

REMOVAL—YJ MODELS

The fuel tank must be removed to remove the fuel pump module.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

WARNING: EXTINGUISH ALL TOBACCO SMOKING PRODUCTS BEFORE SERVICING THE FUEL SYSTEM. KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Remove negative battery cable.

(2) Remove fuel filler cap. Perform the Fuel Pressure Release Procedure as outlined in this group.

(3) Remove fuel tank. Refer to Fuel Tank Removal—YJ Models.

(4) Remove fuel pump module assembly.

(5) Remove mounting screws. Lift assembly and gasket out of fuel tank. Discard old gasket (Fig. 4).

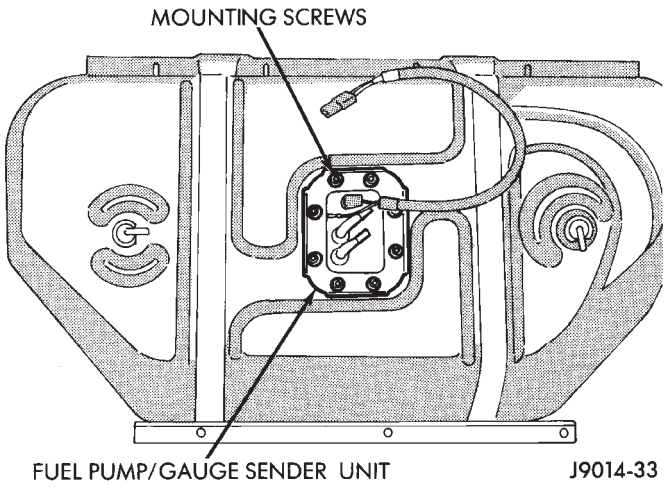

Fig. 4 Fuel Pump Module—Remove/Install—YJ Models

(6) Remove and discard fuel pump inlet filter.

DISASSEMBLY—YJ MODELS

(1) Remove and discard fuel pump inlet filter (Fig. 5).

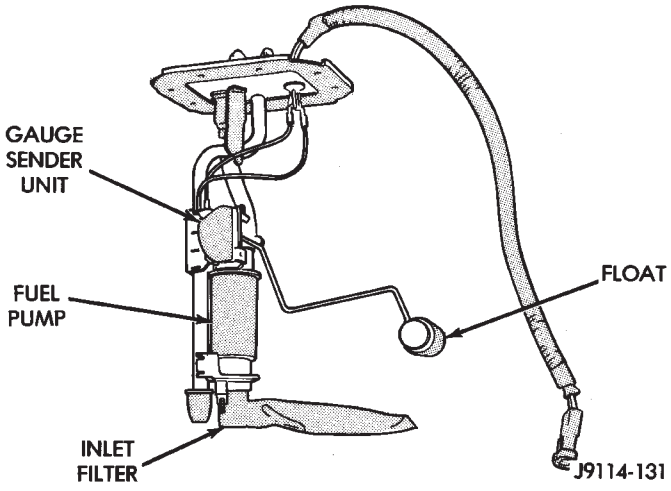

Fig. 5 Fuel Pump Module—YJ Models

The wire terminals to the fuel pump motor are different in size and cannot be connected to the wrong terminal.

(2) Disconnect fuel pump terminal wires from pump.

(3) Remove fuel pump outlet hose and clamp (Fig. 6). Replace the hose if it shows any signs of fatigue or failure.

(4) Remove fuel pump top mounting bracket nut (Fig. 6). Remove fuel pump.

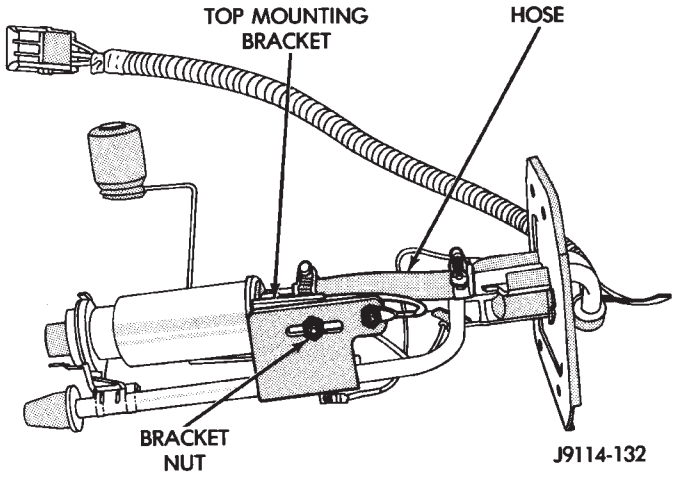

Fig. 6 Fuel Pump Removal/Installation—YJ Models

ASSEMBLY—YJ MODELS

Whenever the fuel pump is replaced, the fuel pump inlet filter (sock) must also be replaced.

(1) Place fuel pump top mounting bracket over top of pump.

(2) Position fuel pump into lower bracket. Slide stud of top bracket through hole in fuel pump side bracket. Tighten fuel pump top mounting nut.

(3) Install new fuel pump outlet hose. Secure with new clamps.
(4) Connect wire terminals to motor.
(5) Install new fuel pump inlet filter.

INSTALLATION—YJ MODELS

(1) Install a new fuel pump inlet filter.
(2) Install fuel pump module assembly with a new gasket between the assembly and tank. Tighten mounting screws to 2 N·m (18 in. lbs.) torque.
(3) Install fuel tank. Refer to Fuel Tank Installation—YJ Models.
(4) Fill fuel tank. Install fuel tank cap.
(5) Install negative battery cable.
(6) Start vehicle and check for leaks.

FUEL PUMP ELECTRICAL CONTROL

For an electrical operational description of the fuel pump, refer to the MFI System—Component Description/System Operation section of this group. See Automatic Shut Down (ASD) Relay—PCM Output.

For the 1994 model year, the ballast resistor and ballast resistor bypass relay are no longer used to control the fuel pump circuit.

FUEL PRESSURE RELEASE PROCEDURE

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING ANY FUEL SUPPLY OR FUEL RETURN SYSTEM COMPONENT.

(1) Disconnect negative battery cable.
(2) Remove fuel tank filler neck cap to release fuel tank pressure.

WARNING: DO NOT ALLOW FUEL TO SPILL ONTO THE ENGINE INTAKE OR EXHAUST MANIFOLDS. PLACE SHOP TOWELS UNDER AND AROUND THE PRESSURE PORT TO ABSORB FUEL WHEN THE PRESSURE IS RELEASED FROM THE FUEL RAIL.

WARNING: WEAR PROPER EYE PROTECTION WHEN RELEASING FUEL SYSTEM PRESSURE.

(3) Remove protective cap from pressure test port on the fuel rail (Fig. 7).
(4) Obtain the fuel pressure gauge/hose assembly from fuel pressure gauge tool set 5069. Remove the gauge from the hose.
(5) Place one end of hose (gauge end) into an approved gasoline container.
(6) Place a shop towel under the test port.
(7) To release fuel pressure, screw the other end of hose onto the fuel pressure test port.

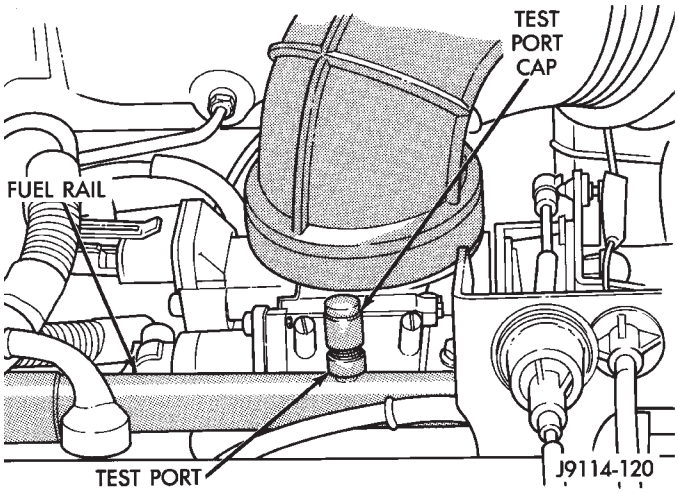

Fig. 7 Pressure Test Port—Typical

(8) After fuel pressure has been released, remove the hose from the test port.
(9) Install protective cap to fuel test port.

FUEL SYSTEM PRESSURE TEST

The fuel system is equipped with a vacuum assisted fuel pressure regulator (Fig. 8). With engine at idle speed, system fuel pressure should be approximately 214 kPa (31 psi) with the vacuum line connected to the regulator. With the vacuum line disconnected from the regulator, fuel pressure should be approximately 269 kPa (39 psi). This is 55-69 kPa (8-10 psi) higher.

(1) Remove the protective cap at the fuel rail (Fig. 7). Connect the 0-414 kPa (0-60 psi) fuel pressure gauge (from Gauge Set 5069) to test port pressure fitting on fuel rail (Fig. 9).

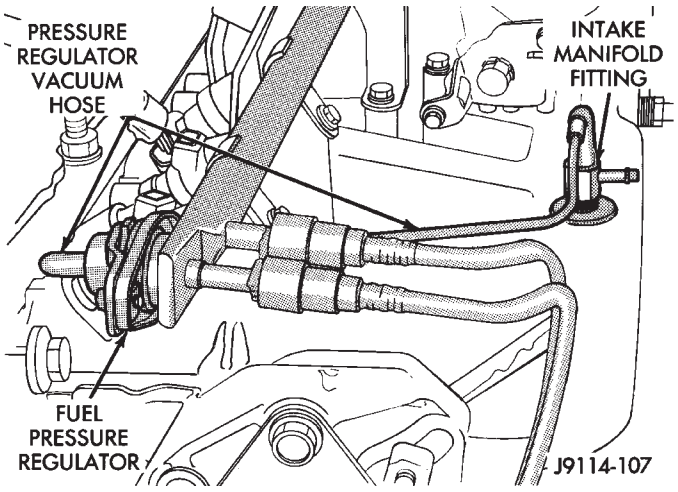

Fig. 8 Fuel Pressure Regulator—Typical

(2) Note pressure gauge reading. Fuel pressure should be approximately 214 kPa (31 psi) at idle.

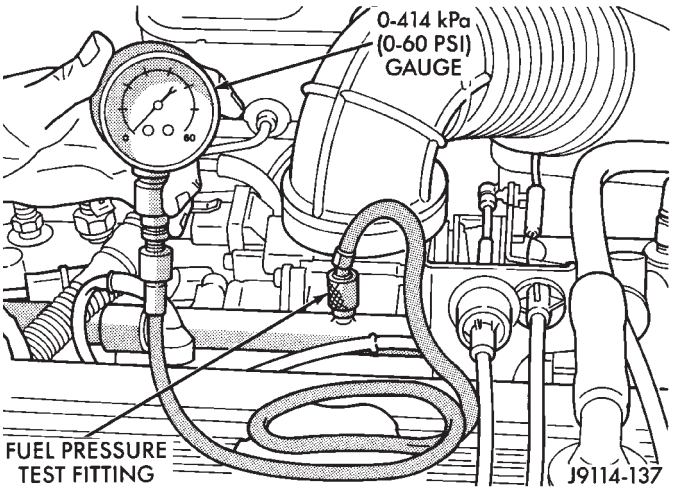

Fig. 9 Fuel Pressure Test Connection—Typical

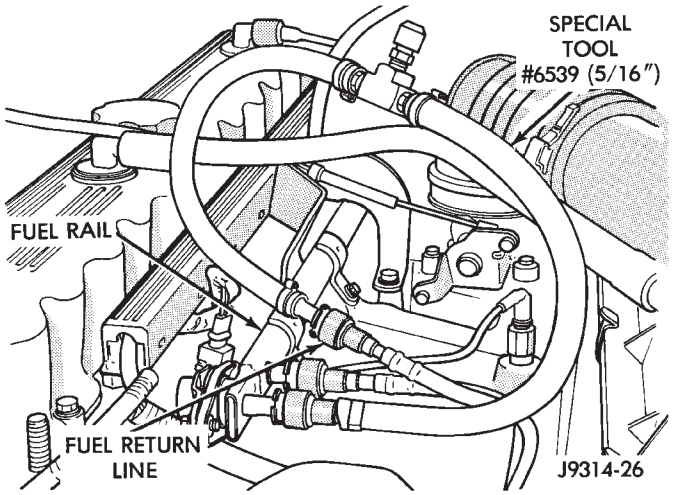

Fig. 10 Adapter Tool—Typical Connection

(3) Disconnect vacuum line (hose) at fuel pressure regulator (Fig. 8). Note gauge reading. With vacuum line disconnected, fuel pressure should rise to approximately 269 kPa (39 psi).

Fuel pressure should be approximately 55-69 kPa (8-10 psi) higher with vacuum line removed from regulator. If not, inspect pressure regulator vacuum line for leaks, kinks or blockage. If vacuum line checks OK and fuel pressure does not rise approximately 8-10 psi after disconnecting vacuum line, replace fuel pressure regulator.

The fuel pressure regulator is **not adjustable.**

(4) If fuel pressure exceeds 45 psi, check fuel return line/tube for kinks or obstructions.

If the previous tests checked good, fuel pump pressure is correct. If pump pressure was low, proceed as follows:

(5) Release fuel system pressure. Refer to the previous Fuel Pressure Release Procedure in this group.

(6) Disconnect the 5/16 inch fuel return line quick-connect fitting at fuel rail. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

Connect Fuel Line Pressure Test Adapter Tool number 6539 (5/16 in.) between the disconnected fuel return line and fuel rail (Fig. 10).

WARNING: THE FUEL SYSTEM PRESSURE IN THE FOLLOWING TEST MAY EXCEED 100 PSI. BEFORE STARTING TEST, VERIFY GOOD CONNECTIONS AT ENDS OF ADAPTER TOOL 6539. BE SURE TOOL IS LOCKED ONTO FUEL RAIL AND FUEL RETURN LINE. PULL FIRMLY ON ENDS OF TOOL TO VERIFY.

(7) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

(8) **MOMENTARILY** pinch the rubber hose portion of adapter tool 6539. Pressure should rise to approximately 75 psi within two (2) seconds. **DO NOT** pinch hose for longer than three seconds.

If fuel pump pressure rises to approximately 75 psi within two seconds, pressure is operating at its maximum and is correct.

If fuel pump pressure does not rise to approximately 75 psi within two seconds, proceed as follows:

(9) Release fuel system pressure. Refer to the previous Fuel Pressure Release Procedure in this group.

(10) Raise and support vehicle.

(11) Disconnect fuel supply line at inlet (fuel tank side) of fuel filter. Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) between fuel filter and fuel supply line.

WARNING: THE FUEL SYSTEM PRESSURE IN THE FOLLOWING TEST MAY EXCEED 100 PSI. BEFORE STARTING TEST, VERIFY GOOD CONNECTIONS AT ENDS OF ADAPTER TOOL 6631. BE SURE TOOL IS LOCKED ONTO FUEL FILTER AND FUEL SUPPLY LINE. PULL FIRMLY ON ENDS OF TOOL TO VERIFY.

(12) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

MOMENTARILY pinch the rubber hose portion of adapter tool 6631. Pressure should rise to approximately 75 psi within two (2) seconds. **DO NOT** pinch hose for longer than three seconds.

If fuel pump pressure now rises to approximately 75 psi within two seconds, but this pressure could not be met at the fuel rail, check for a plugged or restricted fuel filter. Also check the fuel supply line between fuel filter and fuel rail for kinks or obstructions. Proceed to the following Fuel Pump Capacity Test.

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure by performing the previous tests.

(1) Release the fuel system pressure from fuel system. Refer to the previous Fuel Pressure Release Procedure in this group.

(2) Disconnect the fuel supply line at fuel rail near pressure regulator. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(3) Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) into the disconnected fuel supply line. Insert the other end of tool 6631 into an approved gasoline container.

(4) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

A good fuel pump will deliver at least 1 liter of fuel per minute.

FUEL PRESSURE LEAK DOWN TEST

ENGINE OFF

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 the fuel pressure regulator.
- Fuel pressure bleeding past the check valve in the outlet end of the fuel tank mounted fuel pump.

(1) Remove protective cap at fuel rail test port (Fig. 11). With the engine off, connect an accurate 0-689 kPa (0-100 psi) fuel gauge to the pressure test port fitting on the fuel rail. The fitting on the pressure tester must be in good condition and free of any leaks before performing this test.

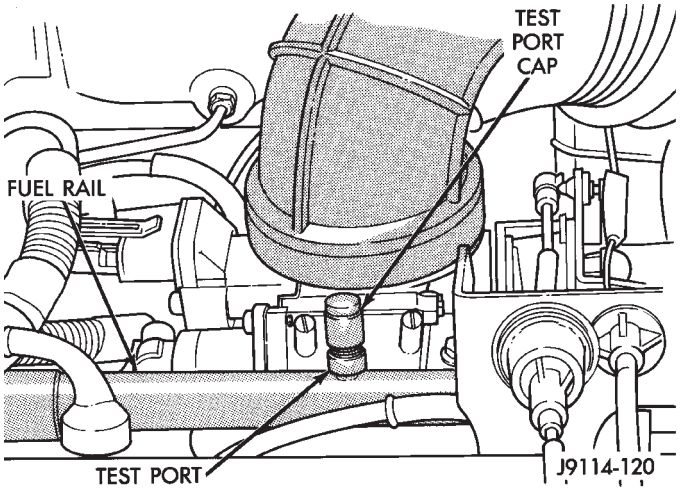

Fig. 11 Fuel Pressure Test Port—Typical

(2) Start the vehicle and let engine idle. Check fuel pressure reading on gauge. Fuel pressure should be within specifications. Refer to the previous Fuel System Pressure Tests.

(3) Shut engine off. Observe and record fuel pressure reading on gauge. Leave fuel pressure gauge connected. Allow engine to set for 30 minutes and then compare the fuel pressure reading on the gauge with the reading taken when engine was shut down. A pressure drop of up to 138 kPa (20 psi) within 30 minutes is within specifications.

(4) If the fuel pressure drop is within specifications, the fuel pump outlet check valve and fuel pressure regulator are both operating normally.

(5) If fuel pressure drop is greater than 138 kPa (20 psi), it must be determined if this drop is being caused by (in-tank mounted) fuel pump outlet check valve or fuel pressure regulator. Proceed to next step.

(6) Release the fuel system pressure from fuel system. Refer to the previous Fuel Pressure Release Procedure in this group.

(7) Disconnect both fuel lines at fuel rail near fuel pressure regulator. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(8) Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) between the disconnected fuel supply line and fuel rail (Fig. 12).

(9) Connect Fuel Line Pressure Test Adapter Tool number 6539 (5/16 in.) between the disconnected fuel return line and fuel rail (Fig. 12).

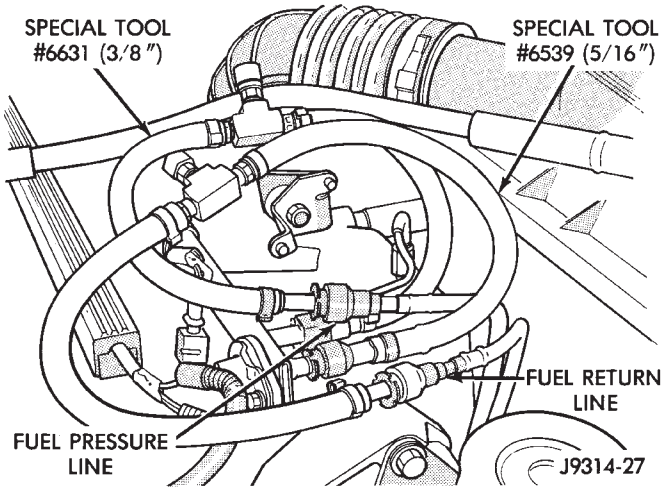

Fig. 12 Adapter Tools—Typical Connections

(10) Start engine. Observe and record fuel system pressure.

(11) Shut engine off.

(12) Clamp off the rubber hose portion of adapter tool number 6539 connected to the fuel return line. Allow engine to set for 30 minutes. If pressure has dropped more than 138 kPa (20 psi) in 30 minutes,

pressure is bleeding past the (in-tank mounted) fuel pump outlet check valve. Replace Fuel Pump Module assembly. Refer to Fuel Pump Module removal and installation in this group. If pressure drop is within specifications, proceed to next step.

(13) Clamp off the rubber hose portion of adapter tool number 6631 connected to the fuel supply line. Allow engine to set for 30 minutes. If pressure has dropped more than 138 kPa (20 psi) in 30 minutes, pressure is bleeding past the fuel pressure regulator. Replace fuel pressure regulator. Refer to Fuel Rail removal and installation in the Component Removal/ Installation section of this group.

MECHANICAL MALFUNCTIONS

Mechanical malfunctions are more difficult to diagnose with this system. The powertrain control module (PCM) has been programmed to compensate for some mechanical malfunctions such as incorrect cam timing, vacuum leaks, etc. If engine performance problems are encountered and diagnostic trouble codes are not displayed, the problem may be mechanical rather than electronic.

FUEL FILTER

The fuel filter protects the fuel injectors and fuel pressure regulator from dirt, water and other foreign matter. The filter is located under the vehicle along the frame rail (Figs. 13 or 14). Replace fuel filter at intervals specified in the Lubrication and Maintenance Schedule chart found in Group 0, Lubrication and Maintenance.

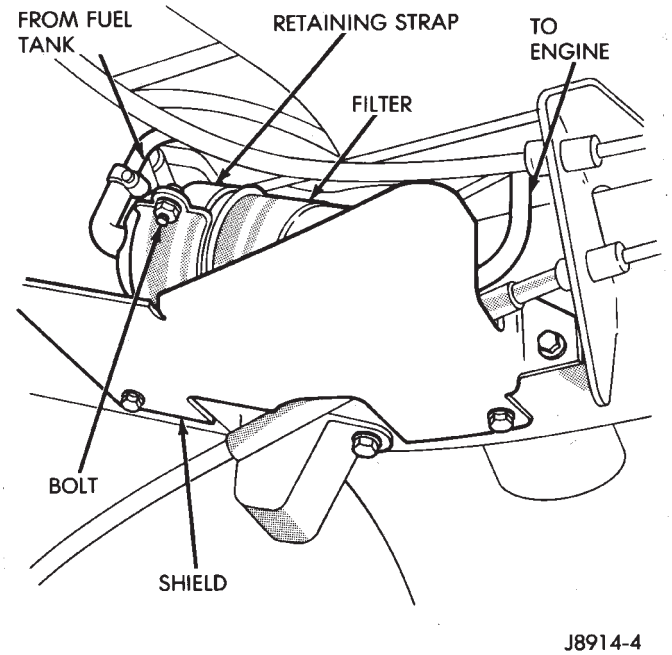

Fig. 13 Fuel Filter and Shield—YJ Models

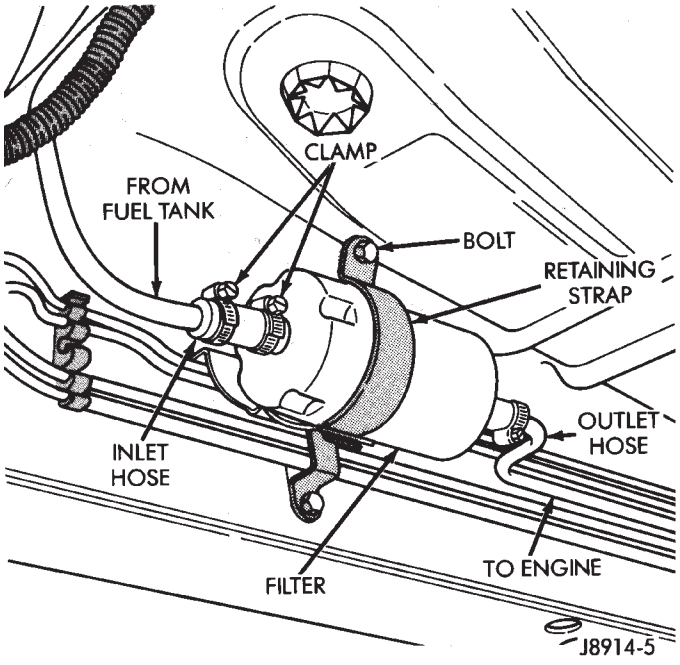

Fig. 14 Fuel Filter—XJ Models

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL FILTER.

(1) Disconnect negative battery cable. Remove fuel filler cap.

WARNING: FUEL PRESSURE MUST BE RELEASED BEFORE DISCONNECTING ANY FUEL SYSTEM COMPONENT.

(2) Release fuel system pressure. Refer to Fuel Pressure Release Procedure in this group.

(3) Raise and support vehicle.

(4) On YJ models remove the fuel filter shield (Fig. 13).

(5) Remove hoses and clamps from inlet and outlet sides of filter (Figs. 13 or 14). For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(6) Remove retaining strap bolt.

(7) Remove filter from vehicle.

INSTALLATION

CAUTION: The ends of the fuel filter are marked for correct installation. Install filter with the end marked IN towards fuel tank and the end marked OUT towards engine.

(1) Place fuel filter in retaining strap with the marked ends in the correct position.

(2) Install retaining strap bolt and tighten to 12 N·m (106 in. lbs.) torque.

(3) Install inlet and outlet hoses and hose clamps. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(4) On YJ models, install fuel filter shield (Fig. 13).

(5) Lower vehicle.

(6) Connect negative battery cable.

(7) Start engine and check for leaks.

FUEL TUBES/LINES/HOSES AND CLAMPS

Also refer to the proceeding section on Quick-Connect Fittings.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

Inspect all hose connections such as clamps, couplings and fittings to make sure they are secure and leaks are not present. The component should be replaced immediately if there is any evidence of degradation that could result in failure.

Never attempt to repair a plastic fuel line/tube. Replace as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel lines/tubes are properly routed to prevent pinching and to avoid heat sources.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high pressure fuel leaks.

Use new original equipment type hose clamps. Tighten hose clamps to 1 N·m (15 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to the previous Fuel Tubes/Lines/Hoses and Clamps section.

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type or a plastic retainer ring type.

SINGLE-TAB TYPE

This type of fitting is equipped with a single pull tab (Fig. 15). The tab is removable. After the tab is removed, the quick-connect fitting can be separated from the fuel system component.

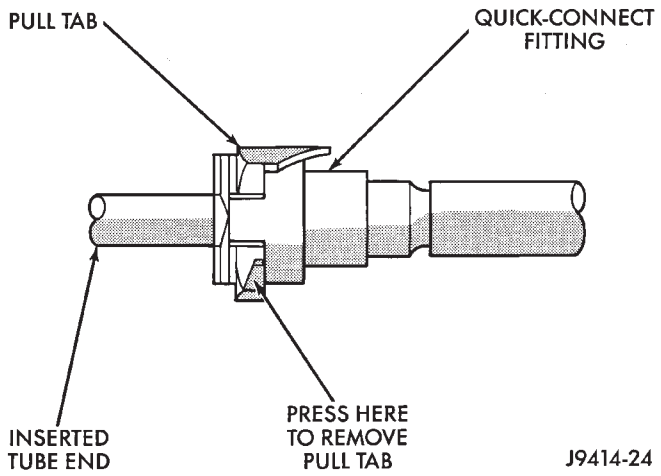

Fig. 15 Single-Tab Type Fitting

CAUTION: The interior components (O-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new pull tabs are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube/quick-connect fitting assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) Press the release tab on the side of fitting to release pull tab (Fig. 15).

CAUTION: If this release tab is not pressed prior to releasing the pull tab, the pull tab will be damaged.

(5) While pressing the release tab on the side of the fitting, use a screwdriver to pry up the pull tab (Fig. 16).

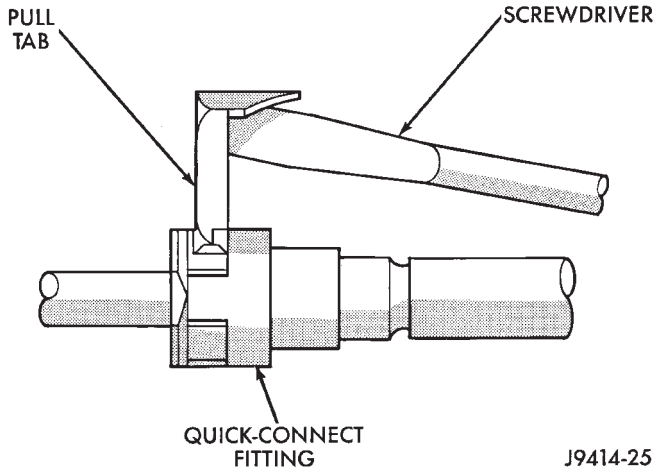

Fig. 16 Disconnecting Single-Tab Type Fitting

(6) Raise the pull tab until it separates from the quick-connect fitting (Fig. 17). Discard the old pull tab.

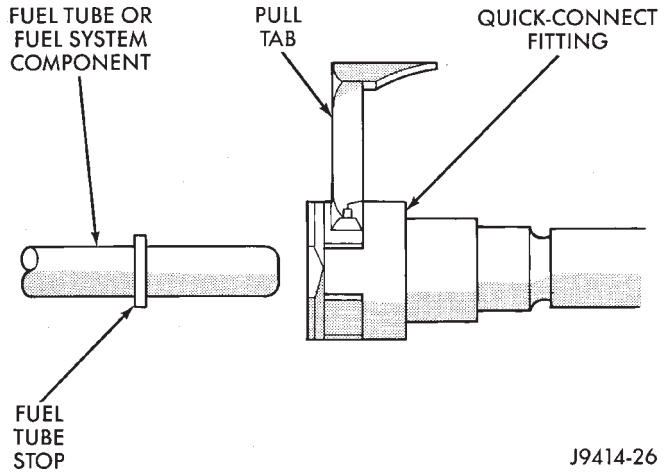

Fig. 17 Removing Pull Tab

(7) Disconnect the quick-connect fitting from the fuel system component being serviced.

(8) Inspect the quick-connect fitting body and fuel system component for damage. Replace as necessary.

(9) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(10) Insert the quick-connect fitting into the fuel tube or fuel system component until the built-on stop on the fuel tube or component rests against back of fitting.

(11) Obtain a new pull tab. Push the new tab down until it locks into place in the quick-connect fitting.

(12) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(13) Connect negative cable to battery.

(14) Start engine and check for leaks.

TWO-TAB TYPE FITTING

This type of fitting is equipped with tabs located on both sides of the fitting (Fig. 18). These tabs are supplied for disconnecting the quick-connect fitting from component being serviced.

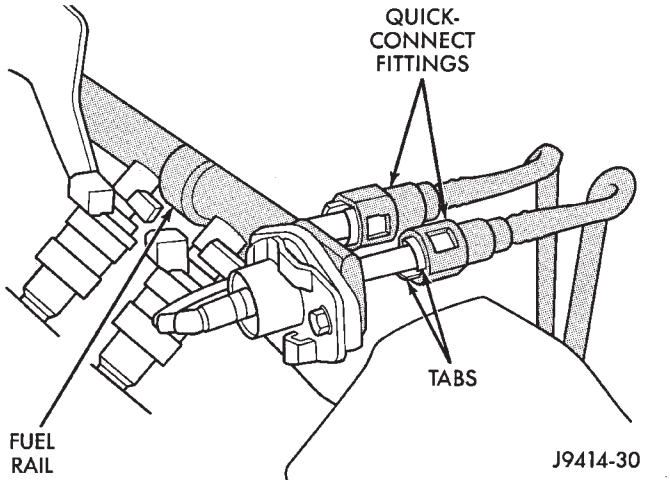

Fig. 18 Typical Two-Tab Type Quick-Connect Fitting

CAUTION: The interior components (O-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new plastic retainers are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube/quick-connect fitting assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To disconnect the quick-connect fitting, squeeze the plastic retainer tabs against the sides of the quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic re-

tainer. Pull the fitting from the fuel system component being serviced. The plastic retainer will remain on the component being serviced after fitting is disconnected. The O-rings and spacer will remain in the quick-connect fitting connector body.

(5) Inspect the quick-connect fitting body and component for damage. Replace as necessary.

CAUTION: When the quick-connect fitting was disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small screwdrivers. After removal, inspect the retainer for cracks or any damage.

(6) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(7) Insert the quick-connect fitting to the component being serviced and into the plastic retainer. When a connection is made, a click will be heard.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative cable to battery.

(10) Start engine and check for leaks.

PLASTIC RETAINER RING TYPE FITTING

This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 19) usually black in color.

CAUTION: The interior components (O-rings, spacers, retainers) of this type of quick-connect fitting are not serviced separately. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube/quick-connect fitting assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure.

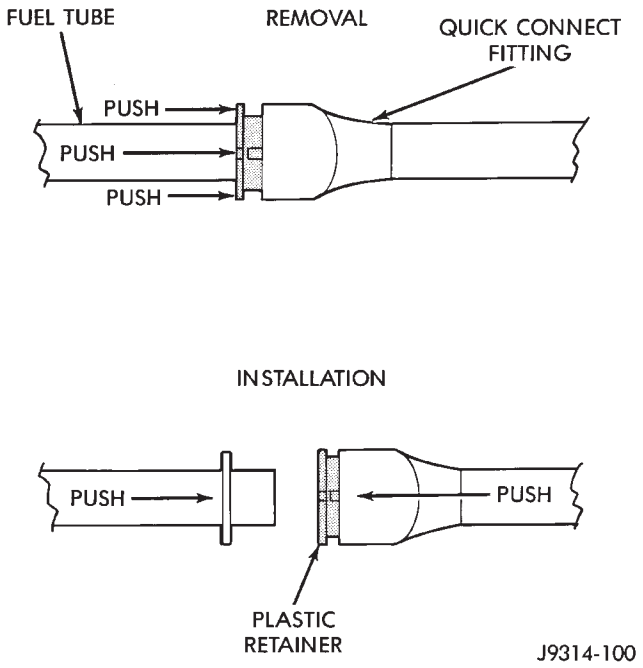

Fig. 19 Plastic Retainer Ring Type Fitting

Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To release the fuel system component from the quick-connect fitting, firmly push the fitting towards the component being serviced while firmly pushing the plastic retainer ring into the fitting (Fig. 19). With the plastic ring depressed, pull the fitting from the component. **The plastic retainer ring must be pressed squarely into the fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on the shoulder of the plastic retainer ring to aid in disconnection.**

After disconnection, the plastic retainer ring will remain with the quick-connect fitting connector body.

(5) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(6) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(7) Insert the quick-connect fitting into the component being serviced until a click is felt.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative battery cable to battery.

(10) Start engine and check for leaks.

FUEL TANKS

INDEX

GENERAL INFORMATION

All vehicles pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

All models are equipped with a pressure relief/rollover valve mounted in the top of the fuel pump module. The return line from the fuel pump to the fuel tank contains a one-way check valve.

An evaporative control system prevents raw fuel vapor from escaping into the atmosphere. Fuel vapors from the fuel tank are collected in the EVAP canister. When the engine is operating, the vapors are drawn into the intake manifold to be used in combustion. Refer to Group 25, Emission Control System for more information.

Inspect all hose/tube connections for completeness. Be sure that leaks are not present. Replace any hose that is cracked, scuffed, swelled, has rubbed against other vehicle components or shows any other sign of wear that could lead to failure. If it is necessary to replace a hose, only hose marked EFM/EFI may be used.

When installing hoses, be sure that they are routed away from contact with other vehicle components.

The hose clamps used on fuel injected vehicles are of a special rolled edge construction to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used on this system. Other types of clamps may cut into the hoses and cause high pressure fuel leaks.

FUEL TANK CAPACITIES

FUEL TANK	GALLONS*	LITERS*
XJ	20.02	76
YJ	20.0	76
YJ	15.0	57

*Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances, ambient temperature and refill procedure.

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NO-LEAD FUEL TANK FILLER TUBE

All vehicles are designed to operate using Unleaded fuels. The diameter of the opening in the fuel tank filler neck is sized to only accept unleaded fuel nozzles. Gasoline station pumps for unleaded and leaded fuels have different size nozzles. Leaded fuel nozzles are larger in diameter than unleaded nozzles. The fuel tank filler neck opening is also equipped with a deflector, which the smaller unleaded nozzle pushes back upon entering the filler neck. The deflector will prevent the larger diameter leaded fuel nozzles from entering the filler neck and will deflect fuel away from the filler neck. This happens if filling of the tank with leaded fuel is attempted.

A label is attached to the instrument panel under the fuel gauge that reads UNLEADED FUEL ONLY as a reminder to the driver. A similar label is located near the fuel tank filler.

FUEL TANK FILLER TUBE CAP

The loss of any fuel or vapor out of the filler neck is prevented by the use of a safety filler cap. This will release only under pressure of 10.9 to 13.45 kPa (1.58 to 1.95 psi). The vacuum release is between .97 and 2.0 kPa (.14 and .29 psi). This cap must be replaced by a similar unit if replacement is necessary.

CAUTION: Remove the fuel tank filler tube cap prior to removing or repairing fuel lines to relieve fuel tank pressure.

HEAT SHIELDS

The sheet metal heat shields may have to be removed when servicing the fuel tank, fuel lines or vapor vent line. The heat shields must be installed to protect the lines and tank from the heat of the exhaust system. Refer to Group 11, Exhaust System and Intake Manifold for proper installation.

FUEL TANK

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.

REMOVAL—XJ MODELS

Perform the preceding Fuel System Pressure Release Procedure.

(1) Disconnect negative battery cable.

(2) Remove the fuel filler cap. Using an approved portable gasoline siphon/storage tank, drain fuel tank.

(3) Raise and support vehicle.

(4) Disconnect fuel fill hose and fill vent hose from filler neck (Fig. 1).

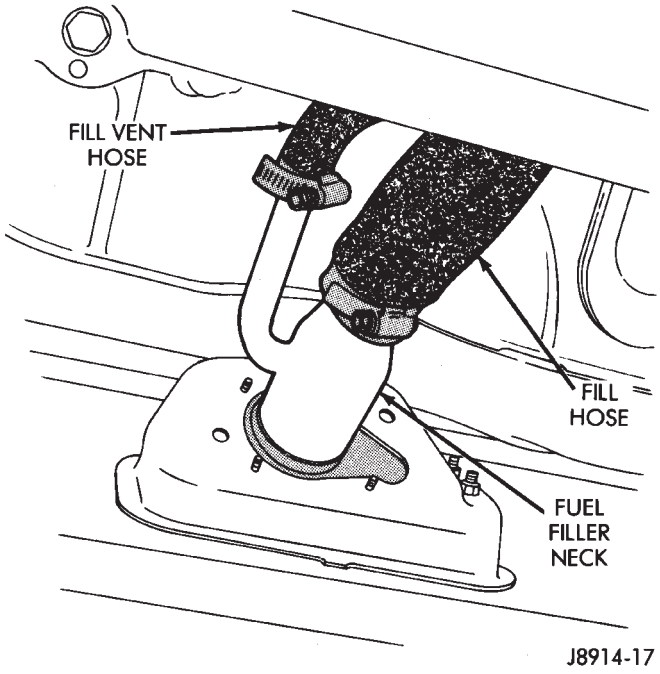

Fig. 1 Filler Neck Hoses—XJ Models

(5) Disconnect fuel pump module wire connector. Remove tie straps securing connector harness to fuel supply and return tubes.

WARNING: WRAP SHOP TOWELS AROUND FUEL HOSES TO ABSORB ANY FUEL SPILLAGE DURING FUEL TANK REMOVAL.

(6) Disconnect fuel tank vent hose from vent tube.

(7) Disconnect fuel supply and return hoses from tubes.

(8) If equipped, remove skid plate (Fig. 2).

(9) Remove fuel tank shield (Fig. 3).

(10) Center a transmission jack under the fuel tank.

(11) Remove support strap nuts. Move straps away from tank (Fig. 3).

(12) Lower fuel tank on transmission jack.

INSTALLATION—XJ MODELS

(1) Raise fuel tank into position. Connect fuel fill hose and vent hose to filler neck and tighten clamps.

(2) Wrap support straps around tank and over studs. Tighten strap nuts to 11.3 N·m (100 in. lbs.) torque.

(3) Remove transmission jack.

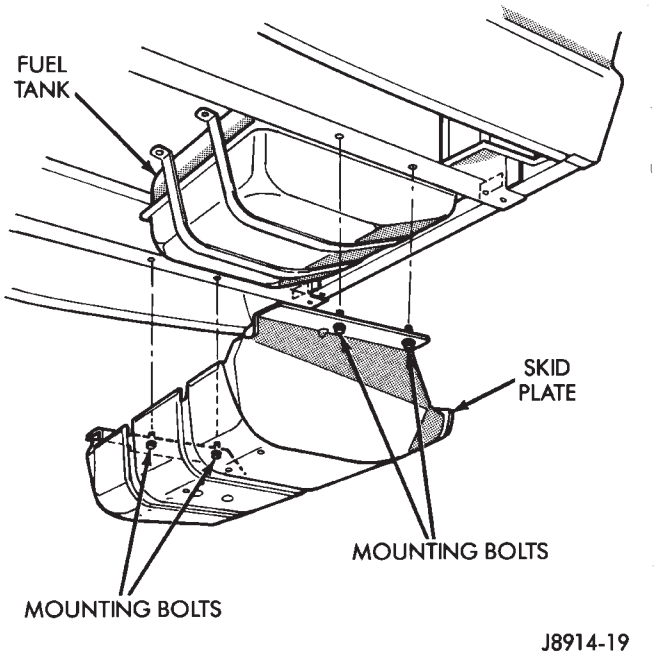

Fig. 2 Skid Plate—XJ Models

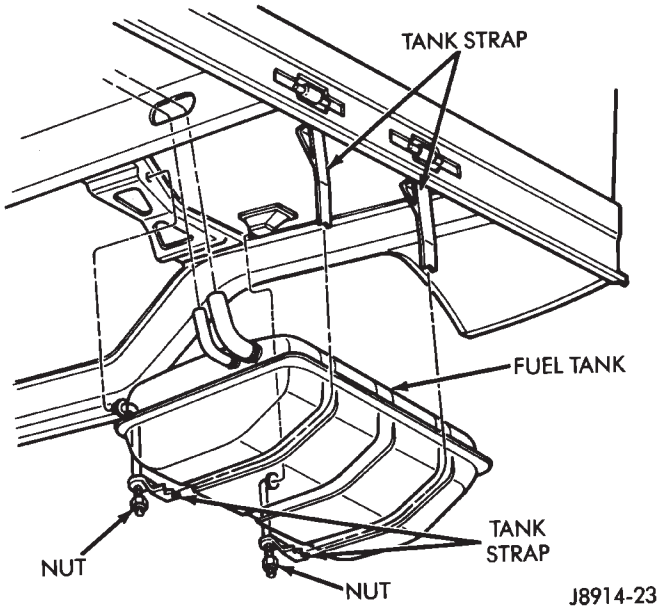

Fig. 3 Fuel Tank Remove/Install—XJ Models

(4) Install tank shield.

(5) If equipped, install tank skid plate.

(6) Connect vent hose to vent tube.

(7) Connect fuel supply hose to supply tube and fuel return hose to return tube. Tighten hose clamps.

(8) Connect fuel pump module wire connector to harness connector. Secure fuel pump module wire harness to fuel tubes with tie straps.

(9) Lower vehicle.

(10) Fill fuel tank. Install filler cap.

(11) Connect negative battery cable to battery.

(12) Start vehicle and inspect for leaks.

REMOVAL—YJ MODELS

WARNING: EXTINGUISH ALL TOBACCO SMOKING PRODUCTS BEFORE SERVICING THE FUEL SYSTEM. KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Disconnect negative battery cable.

(2) Remove the fuel filler cap. Using an approved portable gasoline siphon/storage tank, drain fuel tank.

(3) Raise and support vehicle.

(4) Using a small straight blade screwdriver, pull back the stems of the push clips that secure the fuel filler neck shroud (located at bottom of left rear wheel well) in place (Fig. 4). This unlocks the push clip allowing them to be removed by pulling assembly out of shroud. Remove shroud.

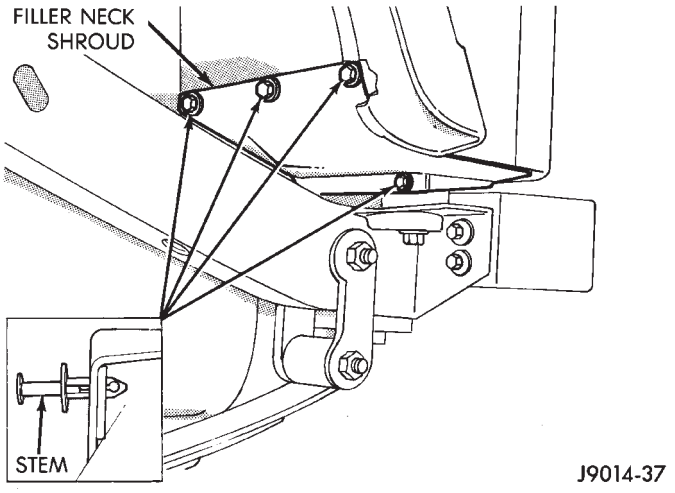

Fig. 4 Fuel Filler Neck Shroud—YJ Models

(5) Disconnect fuel fill hose and fill vent hose from filler neck (Fig. 5).

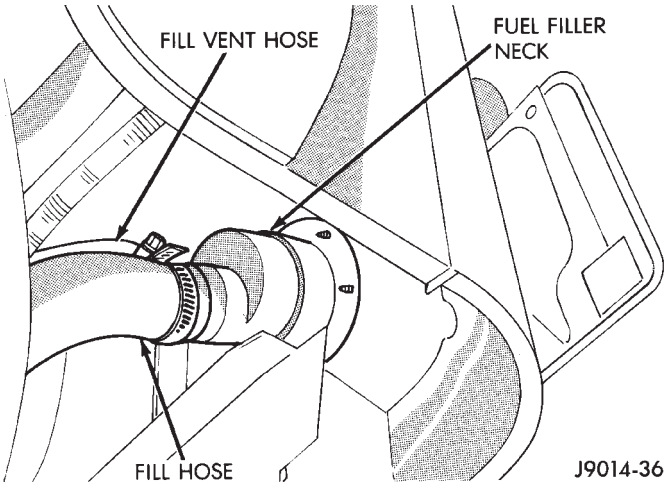

Fig. 5 Filler Neck Hoses—YJ Models

WARNING: WRAP SHOP TOWELS AROUND FUEL HOSES TO ABSORB ANY FUEL SPILLAGE DURING FUEL TANK REMOVAL.

(6) Disconnect fuel tank vent hose from vent tube. Disconnect fuel supply and return hoses from tubes (Fig. 6).

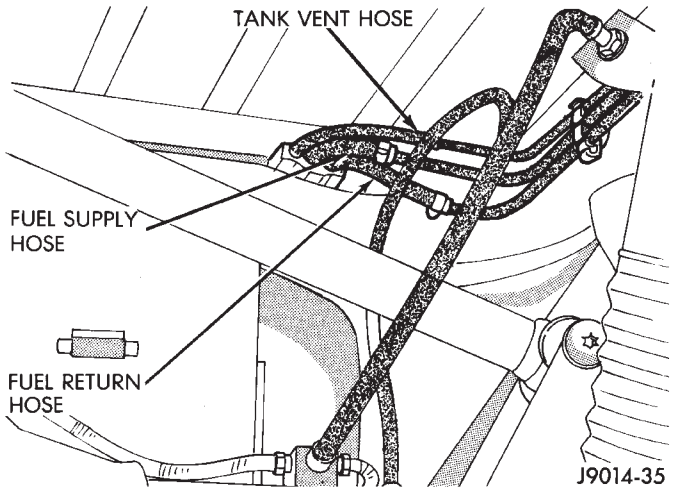

Fig. 6 Fuel Tank Hoses—YJ Models

The fuel tank and skid plate are removed as an assembly.

(7) Centrally position a transmission jack under skid plate/fuel tank assembly.

(8) Remove skid plate/fuel tank assembly mounting nuts (Fig. 7). **Do not loosen tank strap nuts.**

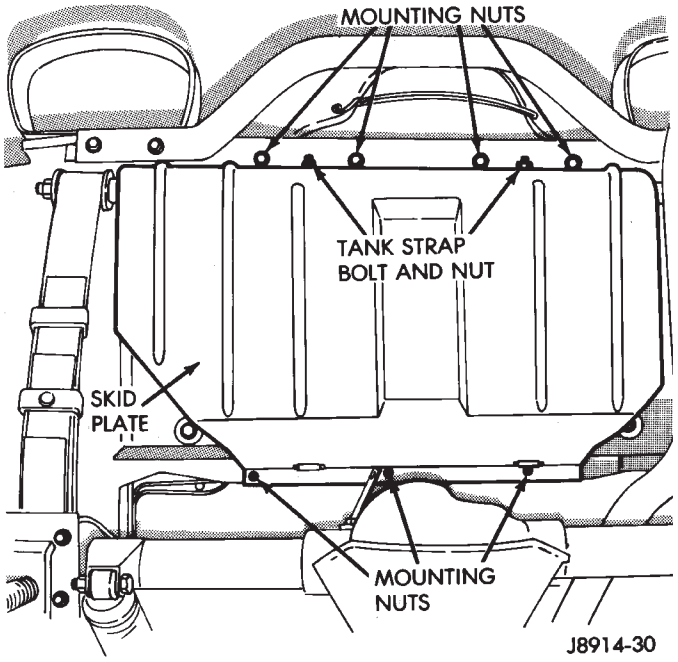

Fig. 7 Fuel Tank—Remove/Install—YJ Models

(9) Lower the skid plate/fuel tank assembly slightly and disconnect the gauge sender wire connector.

(10) Lower the fuel tank on transmission jack.

(11) Remove tank strap nuts to remove tank from skid plate.

INSTALLATION—YJ MODELS

(1) Place tank into skid plate. Wrap straps around tank with strap bolts inserted through holes in skid plate. Tighten strap nuts to 7.3 N·m (65 in. lbs.) torque.

(2) Raise skid plate/fuel tank until gauge sender wire connector can be connected to harness connector.

(3) Finish raising skid plate/fuel tank assembly into position. Tighten mounting nuts to 16 N·m (12 ft. lbs.) torque. Remove transmission jack.

(4) Connect fuel fill hose and fill vent hose to filler neck. Tighten hose clamps.

(5) Connect vent hose to vent tube.

(6) Connect fuel supply hose to the supply tube and fuel return hose to return tube. Tighten hose clamps.

(7) Install fuel filler neck shroud with push clips.

(8) Lower vehicle.

(9) Fill fuel tank. Install filler cap.

(10) Connect negative battery cable to battery.

(11) Start vehicle and inspect for leaks.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the fuel pump module. Refer to Fuel Pump Module in the Fuel Delivery System section of this group.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE

The fuel tank is equipped with a pressure relief/rollover valve (Fig. 8). The dual function valve will relieve fuel tank pressure and prevent fuel flow through the fuel tank vent tubes in the event of accidental vehicle rollover.

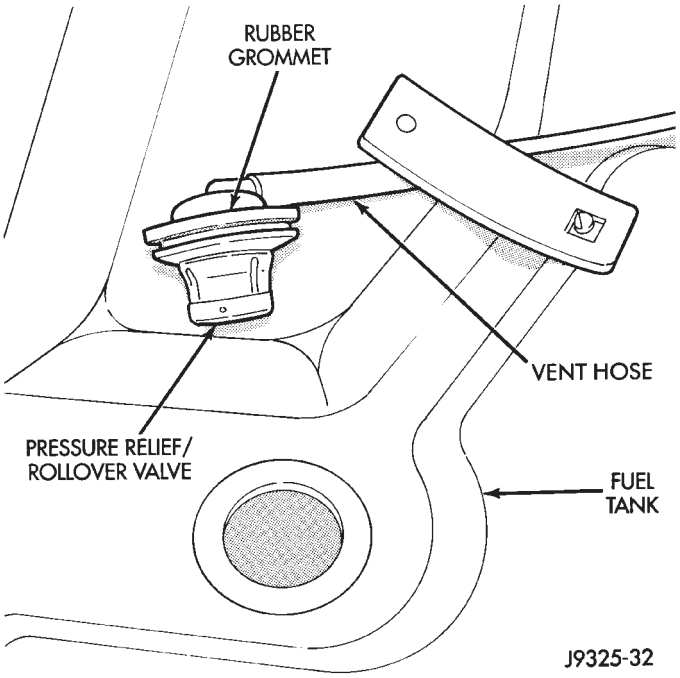

Fig. 8 Valve Location—Typical

The valve consists of a plunger, spring and orifice/guide plate (Fig. 9). The valve is normally open allowing fuel vapor to vent to the EVAP canister. Here it is stored until it can be consumed by the engine (under controlled conditions). The plunger seats in the guide plate at the orifice preventing liquid fuel from reaching the EVAP canister. This is done if bottom of plunger is contacted by fuel sloshing in tank when vehicle is cornering.

In the event of accidental vehicle rollover, the valve is inverted. In this position the plunger is forced against the guide plate and raw fuel is prevented from flowing through the valve orifice into the fuel tank vent tube.

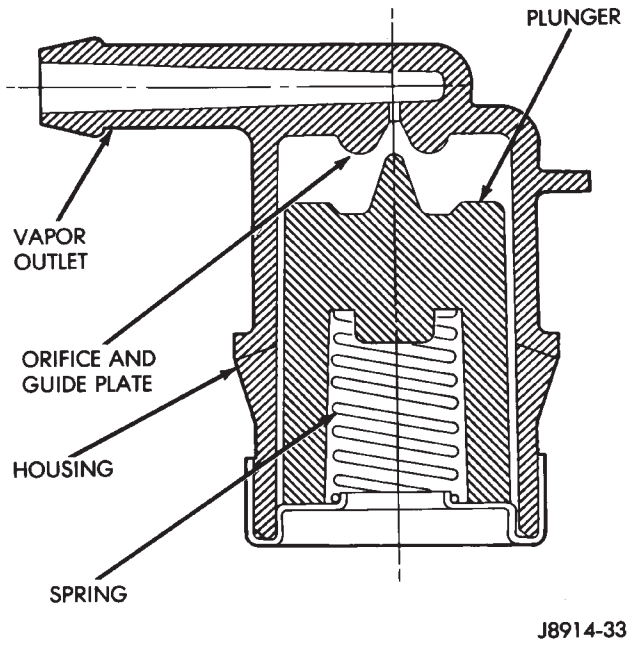

Fig. 9 Pressure Relief/Rollover Valve Operation

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE PRESSURE RELIEF/ROLLOVER VALVE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

(1) Disconnect negative battery cable.

(2) Remove the fuel filler cap and drain fuel tank. Refer to Fuel Tank Removal.

(3) Remove fuel tank. Refer to Fuel Tank Removal.

(4) The rollover valve is seated in a grommet. Remove by prying one side upward and then roll the grommet out of tank (Fig. 8).

INSTALLATION

(1) Start one side of grommet into opening in fuel tank. Using finger pressure only, press valve/grommet into place.

(2) Install fuel tank. Refer to Fuel Tank Installation.

(3) Fill fuel tank. Install fuel tank filler cap.

(4) Connect negative battery cable.

(5) Start vehicle and check for leaks.

ACCELERATOR PEDAL AND THROTTLE CABLE

GENERAL INFORMATION

The accelerator pedal is connected to the throttle body linkage by the throttle cable. The cable is protected by a plastic sheathing and is connected to the throttle body linkage by a ball socket. It is connected to the upper part of the accelerator pedal arm by a plastic retainer (clip) (Fig. 10). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 10) fasten the cable to the dash panel.

Dual throttle return springs (attached to the throttle shaft) are used to close the throttle.

CAUTION: Never attempt to remove or alter these springs.

ACCELERATOR PEDAL

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing the accelerator pedal or throttle cable.

REMOVAL

(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. 10). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over studs protruding from floor pan. Tighten mounting nuts to 5 N·m (36 in. lbs.) torque.

(2) Slide throttle cable into opening in top of pedal arm. Push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place.

(3) Before starting engine, operate accelerator pedal to check for any binding.

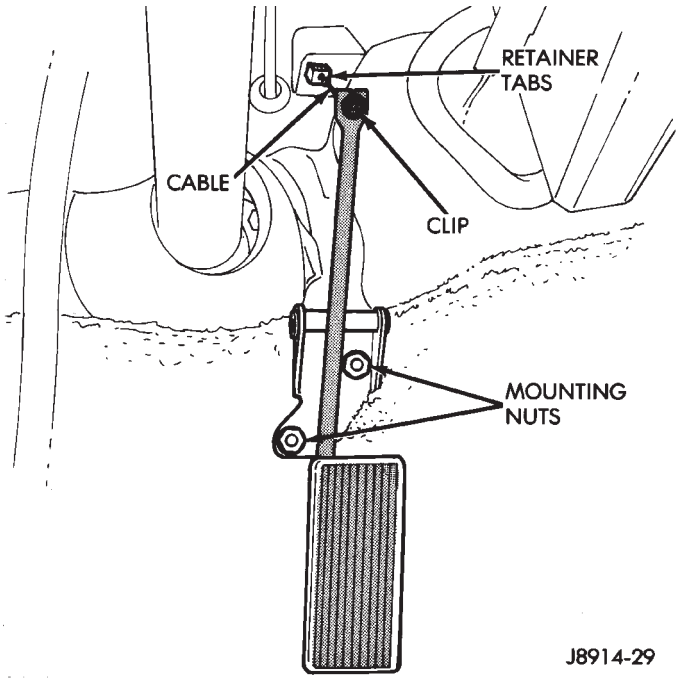

Fig. 10 Accelerator Pedal Mounting—Typical

THROTTLE CABLE

REMOVAL

(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. 10). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove the cable core wire at pedal arm.

(3) From inside the vehicle, pinch both sides of the cable housing retainer tabs (Fig. 10) at the dash panel. Remove cable housing from dash panel and pull into the engine compartment.

(4) Remove cable from clip on the engine cylinder head (valve) cover.

(5) Remove the throttle cable ball end socket at throttle body linkage (snaps off) (Fig. 11).

(6) Remove throttle cable from throttle body mounting bracket by compressing retainer tabs and pushing cable through hole in bracket. Remove throttle cable from vehicle.

INSTALLATION

(1) Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket. Connect cable ball end to throttle body linkage ball (snaps on).

(2) Snap cable into clip on the engine cylinder head (valve) cover.

(3) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(4) From inside drivers compartment, slide throttle cable core wire into opening in top of accelerator pedal arm. Push cable retainer (clip) into pedal arm opening until it snaps in place.

(5) Before starting engine, operate accelerator pedal to check for any binding.

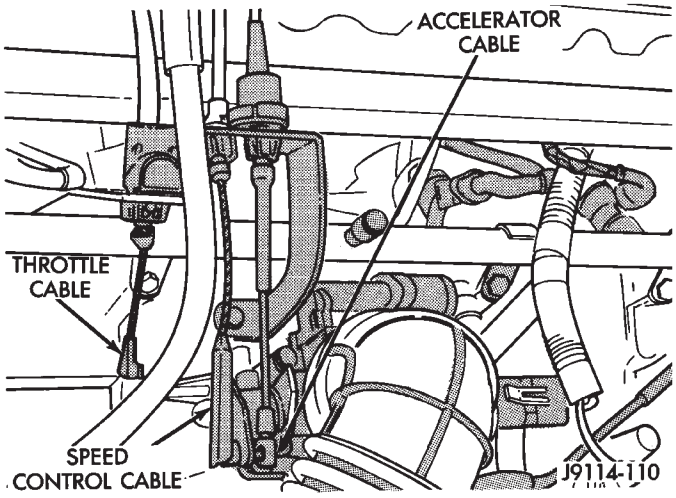

Fig. 11 Throttle (Accelerator) Cable—Typical

MULTI-PORT FUEL INJECTION (MFI)—COMPONENT DESCRIPTION/SYSTEM OPERATION

INDEX

GENERAL INFORMATION

All 2.5L 4 cylinder and 4.0L 6 cylinder engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

The Powertrain Control Module (PCM) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a preprogrammed, dual microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

Powertrain Control Module (PCM) Inputs represent the instantaneous engine operating conditions. Air-fuel mixture and ignition timing calibrations for various driving and atmospheric conditions are preprogrammed into the PCM. The PCM monitors and analyzes various inputs. It then computes engine fuel and ignition timing requirements based on these inputs. Fuel delivery control and ignition timing will then be adjusted accordingly.

Other inputs to the PCM are provided by the brake light switch, air conditioning select switch and the speed control switches. All inputs to the PCM are converted into signals.

Electrically operated fuel injectors spray fuel in precise metered amounts into the intake port directly above the intake valve. The injectors are fired in a specific sequence by the PCM. The PCM maintains an air/fuel ratio of 14.7 to 1 by constantly adjusting injector pulse width. Injector pulse width is the length of time that the injector opens and sprays fuel into the chamber. The PCM adjusts injector pulse width by opening and closing the ground path to the injector.

Manifold absolute pressure (air density) and engine rpm (speed) are the primary inputs that determine fuel injector pulse width. The PCM also monitors other inputs when adjusting air-fuel ratio.

Inputs That Effect Fuel Injector Pulse Width

- Exhaust gas oxygen content
- Engine coolant temperature
- Manifold absolute pressure (MAP)
- Engine speed
- Throttle position
- Battery voltage
- Air conditioning selection
- Transmission gear selection (automatic transmissions only)
- Speed control

The powertrain control module (PCM) adjusts ignition timing by controlling ignition coil operation. The ignition coil receives battery voltage when the ignition key is in the run or starter position. The PCM provides a ground for the ignition coil. The coil dis-

charges when the PCM supplies a ground. By switching the ground path on and off, the PCM regulates ignition timing.

The sensors and switches that provide inputs to the powertrain control module (PCM) comprise the Engine Control System. It is also comprised of the PCM Outputs (engine control devices that the are operated by the PCM).

SYSTEM DIAGNOSIS

The powertrain control module (PCM) tests many of its own input and output circuits. If a Diagnostic Trouble Code (DTC) is found in a major system, this information is stored in the PCM memory. Refer to On-Board Diagnostics in the MFI System—General Diagnosis section of this group for DTC information.

POWERTRAIN CONTROL MODULE (PCM)

The PCM operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a pre-programmed, dual microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

On XJ models, the PCM is located in the engine compartment next to the air cleaner (Fig. 1). On YJ models, the PCM is located in the engine compartment behind the windshield washer fluid reservoir (Fig. 2).

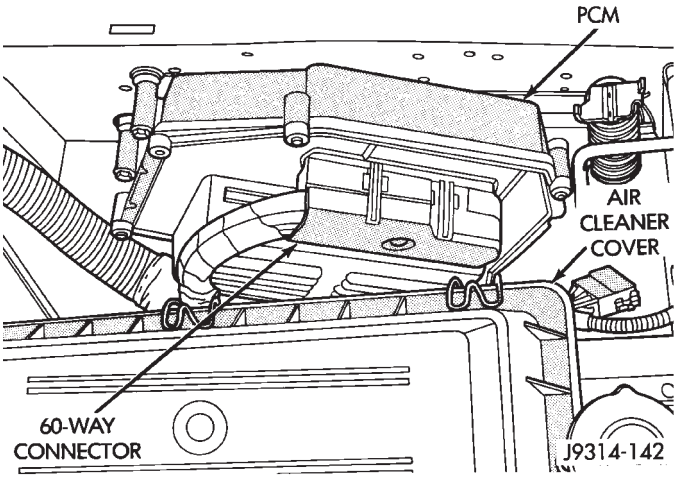

Fig. 1 PCM Location—XJ Models

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as PCM Outputs. The sensors and switches that provide inputs to the PCM are considered PCM Inputs.

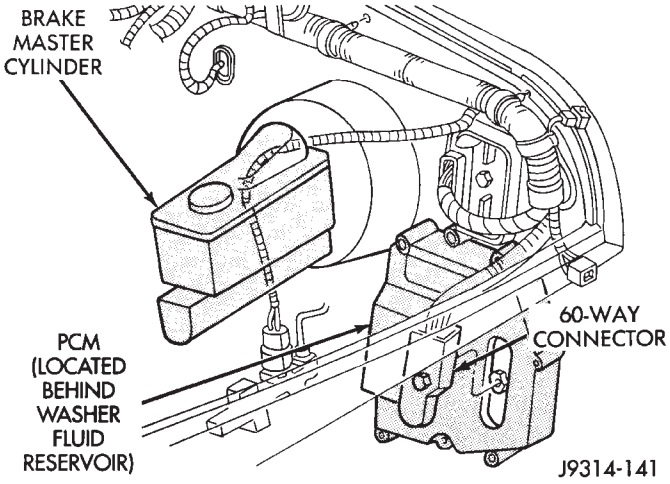

Fig. 2 PCM Location—YJ Models

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, 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.

Powertrain Control Module (PCM) Inputs:

- Generator output
- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shut down (ASD) sense
- Intake air temperature sensor
- Battery voltage
- Brake switch
- Engine coolant temperature sensor
- Crankshaft position sensor
- Ignition circuit sense (ignition switch in run position)
- Manifold absolute pressure sensor
- Overdrive/override switch
- Oxygen sensor
- Park/neutral switch (auto. trans. only)
- SCI receive (DRB scan tool connection)
- Speed control resume switch
- Speed control set switch
- Speed control on/off switch
- Camshaft position sensor signal
- Throttle position sensor
- Vehicle speed sensor
- Sensor return
- Power ground

- Signal ground

Powertrain Control Module (PCM) Outputs

- A/C clutch relay
- Idle air control (IAC) motor
- Auto shut down (ASD) relay
- Generator field
- Malfunction indicator lamp
- Fuel injectors
- Fuel pump relay
- Ignition coil
- SCI transmit (DRB scan tool connection)
- Shift indicator lamp (manual transmission only)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (on instrument panel, if equipped)
- Torque converter clutch relay (3-speed auto. trans. only)

The PCM contains a voltage convertor. This converts battery voltage to a regulated 8.0 volts. It is used to power the crankshaft position sensor and camshaft position sensor. The PCM also provides a five (5) volt supply for the Manifold Absolute Pressure (MAP) sensor and Throttle Position Sensor (TPS).

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units only.

A/C SELECT SIGNAL: When the A/C switch is in the ON position and the A/C low pressure switch is closed, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the PCM receives the A/C request signal from the evaporator switch. The input indicates that the evaporator temperature is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the IAC motor position.

If the A/C low pressure switch opens (indicating a low refrigerant level), the PCM will not receive an A/C select signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the evaporator switch opens, (indicating that evaporator is not in proper temperature range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUT DOWN (ASD) SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the power distribution center (PDC) in the engine compartment (Figs. 3 or 4). It is used to connect oxygen sensor heater element, ignition coil, generator field winding and fuel injectors to 12 volt + power supply. Also refer to Automatic Shut Down Relay—PCM Output.

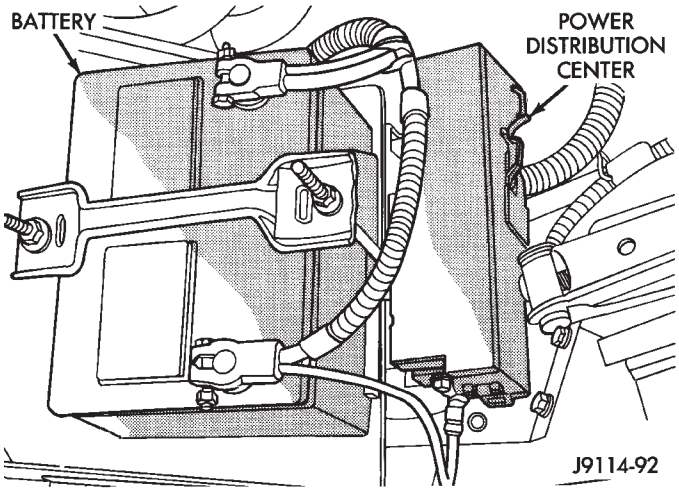

Fig. 3 Power Distribution Center—YJ Models

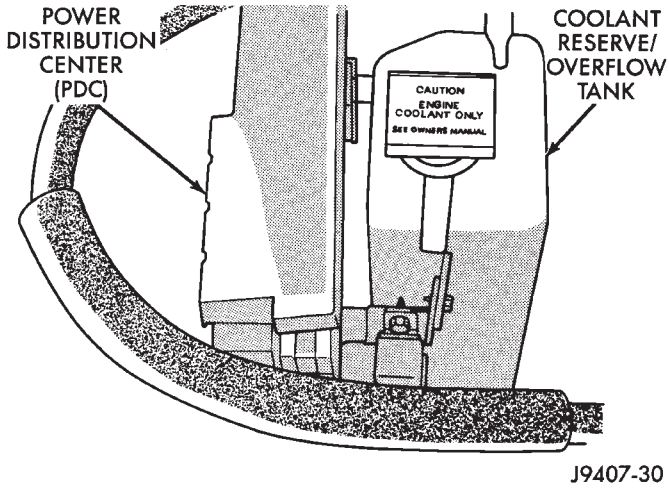

Fig. 4 Power Distribution Center—XJ Models

This input is used only to sense that the ASD relay is energized. If the PCM does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the powertrain control module (PCM). It also informs the PCM what voltage level is supplied to the ignition coil and fuel injectors.

If battery voltage is low, the PCM will increase injector pulse width (period of time that the injector is

energized). This is done to compensate for the reduced flow through injector caused by the lowered voltage.

BRAKE SWITCH—PCM INPUT

When the brake light switch is activated, the powertrain control module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM maintains idle speed to a scheduled rpm through control of the idle air control (IAC) motor. The brake switch input is also used to operate the speed control system.

CAMSHAFT POSITION SENSOR—PCM INPUT

A sync signal is provided by the camshaft position sensor located in the ignition distributor (Fig. 5). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

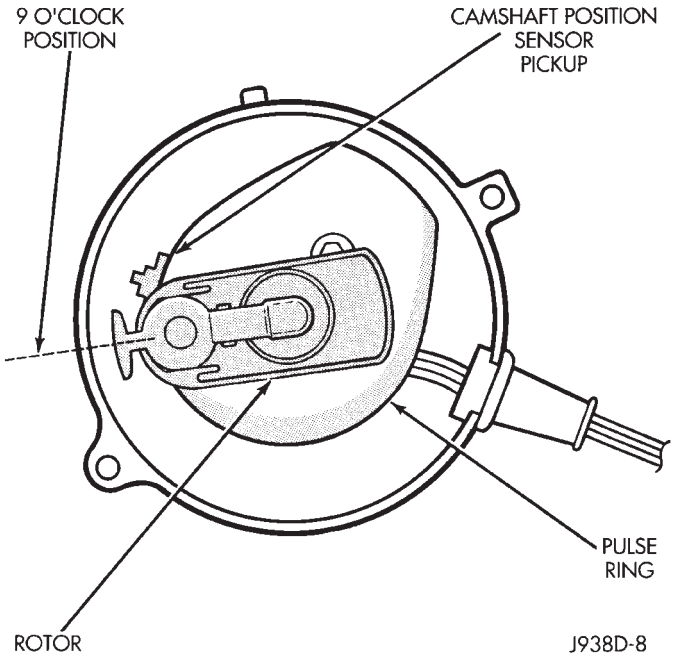

Fig. 5 Camshaft Position Sensor

DATA LINK CONNECTOR—PCM INPUT

The data link connector (diagnostic scan tool connector) links the DRB scan tool with the powertrain control module (PCM). The data link connector is located in the engine compartment (Figs. 6 or 7). For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

The data link connector uses two different pins on the PCM. One is for Data Link Transmit and the other is for Data Link Receive.

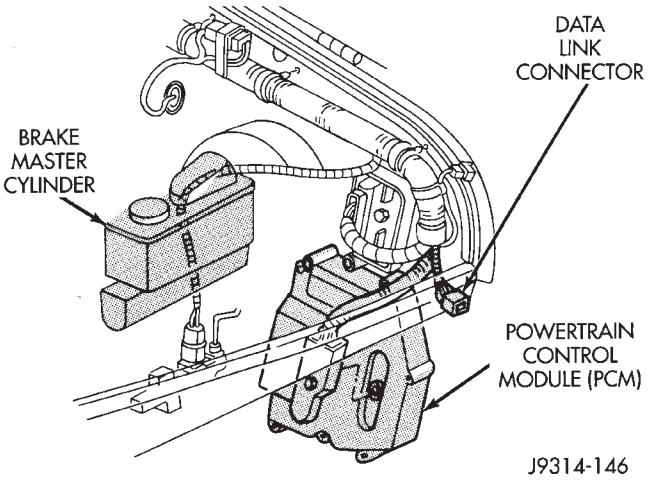

Fig. 6 Data Link Connector—YJ Models—Typical

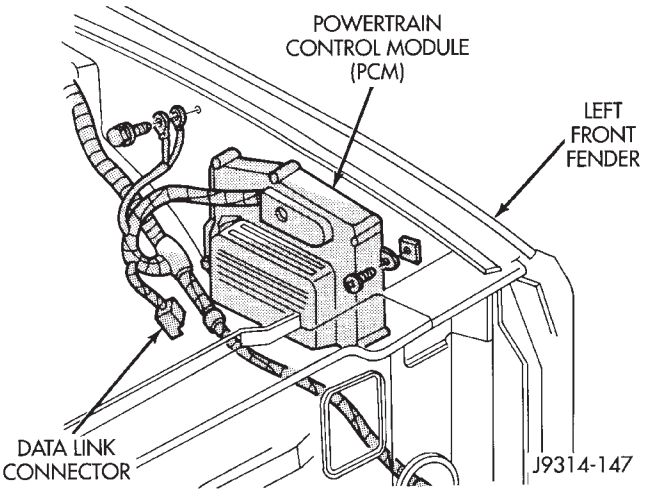

Fig. 7 Data Link Connector—XJ Models—Typical

INTAKE AIR TEMPERATURE SENSOR—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Figs. 8 or 9). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

CRANKSHAFT POSITION SENSOR—PCM INPUT

This sensor is a Hall Effect device that detects notches in the flywheel (manual transmission), or flexplate (automatic transmission).

This sensor is used to indicate to the powertrain control module (PCM) that a spark and or fuel injection event is to be required. The output from this sensor, in conjunction with the camshaft position sensor signal, is used to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

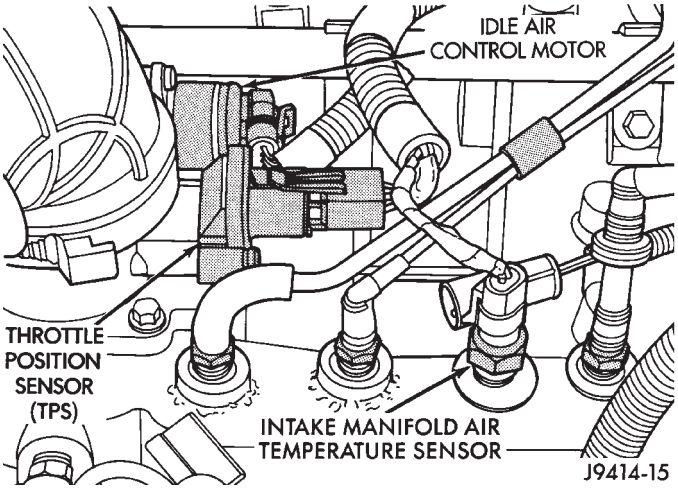

Fig. 8 Sensor Location—4.0L Engine

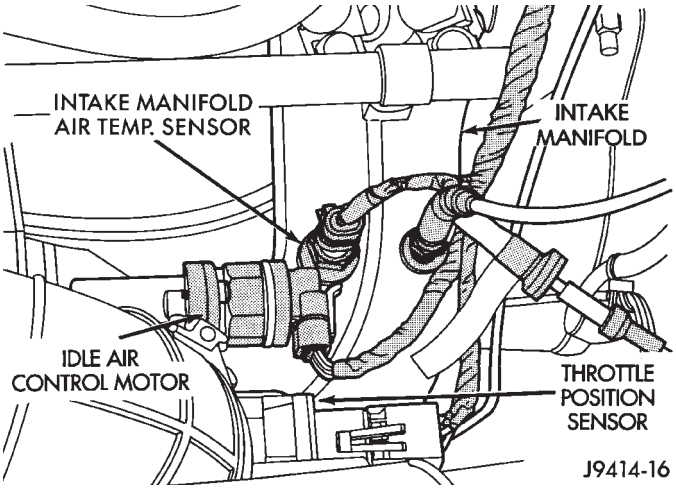

Fig. 9 Sensor Location—2.5L Engine

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor is installed in the thermostat housing (Fig. 10) and protrudes into the water jacket. The sensor provides an input voltage to the powertrain control module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor's resistance changes. The change in resistance results in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

Refer to Open Loop/Closed Loop Modes of Operation in this section of the group for more information.

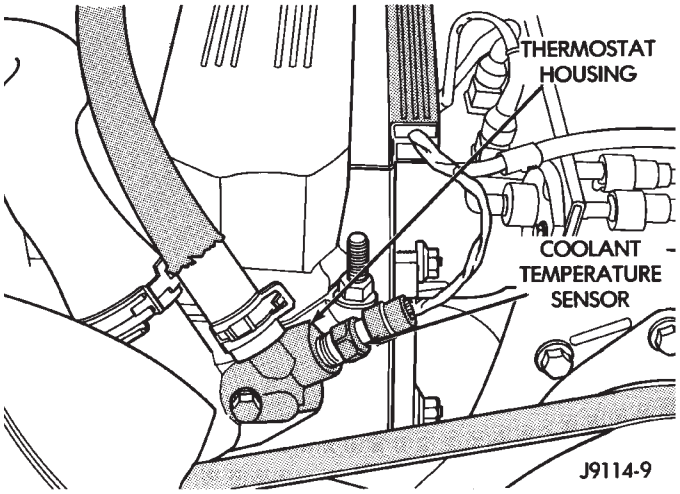

Fig. 10 Coolant Temperature Sensor—Typical

EXTENDED IDLE SWITCH—PCM INPUT

OPTIONAL POLICE PACKAGE ONLY

The extended idle switch is used to raise the engine idle speed to approximately 1000 rpm. This is when the shifter is in either the Park or Neutral position. A rocker-type 2-wire switch (extended idle switch) is mounted to the instrument panel. This switch will supply a ground circuit to the powertrain control module (PCM). **The switch is available only with 4.0L engine when supplied with the optional police package.**

For testing and diagnosis of this switch and its circuit, refer to the MFI System—General Diagnosis section of this group.

IGNITION CIRCUIT SENSE—PCM INPUT

The ignition circuit sense input tells the powertrain control module (PCM) the ignition switch has energized the ignition circuit. Refer to the wiring diagrams for circuit information.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the powertrain control module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine start-up (cranking) and engine load while the engine is running. The PCM uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted on the dash panel. The sensor is connected to the throttle body with a vacuum hose and to the PCM electrically.

OVERDRIVE/OVERRIDE SWITCH

On vehicles equipped with overdrive, the powertrain control module (PCM) regulates the 3-4 overdrive up-shift and down-shift through the overdrive solenoid.

Refer to Group 21 for more information.

OXYGEN (O2S) SENSOR—PCM INPUT

The O2S sensor is located in the exhaust down pipe (Fig. 11). It provides an input voltage to the powertrain control module (PCM) relating the oxygen content of the exhaust gas. The PCM uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

The O2S sensor produces voltages from 0 to 1 volt. This voltage will depend upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air-fuel mixture), the sensor produces a low voltage. When there is a lesser amount present (rich air-fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner.

In Closed Loop operation, the powertrain control module (PCM) monitors the O2S sensor input (along with other inputs). It then adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2S sensor input and adjusts injector pulse width to a preprogrammed value (based on other sensor inputs).

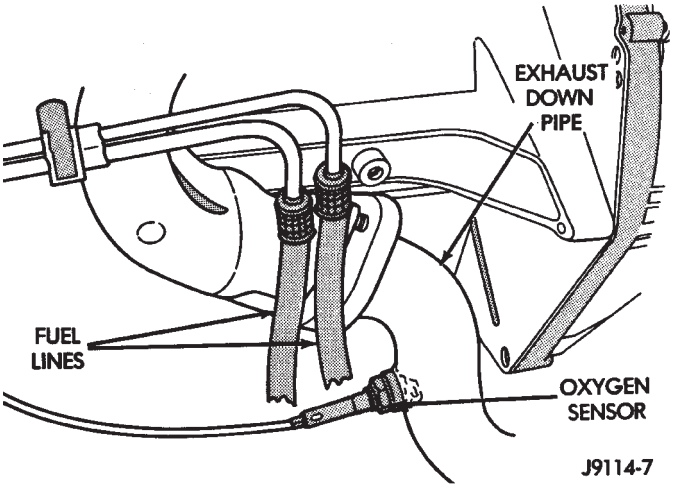

Fig. 11 Heated Oxygen Sensor Location—Typical

PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transmission housing and provides an input to the powertrain control module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width and ignition timing advance. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

POWER GROUND

The power ground is used to control ground circuits for the following powertrain control module (PCM) loads:

- Generator Field Winding
- 8 volt (PCM) power supply
- Fuel Injectors
- Ignition Coil

POWER STEERING PRESSURE SWITCH—PCM INPUT

A pressure sensing switch is included in the power steering system (mounted on the high-pressure line). This switch will be on vehicles equipped with a 2.5L engine and power steering. The switch (Fig. 12 YJ Models or Fig. 13 XJ Models) provides an input to the PCM. This input is provided during periods of high pump load and low engine rpm; such as during parking maneuvers. The PCM will then increase 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 1896 kPa ± 172 kPa (275 ± 25 psi) the PCM will increase the engine idle speed. This will prevent the engine from stalling.

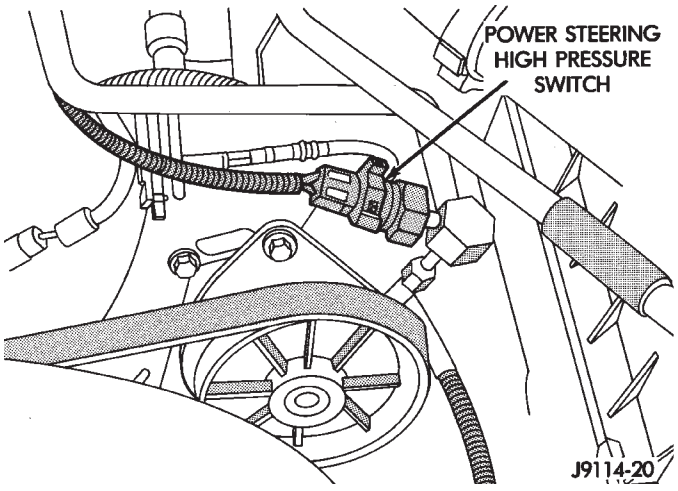

Fig. 12 Power Steering Pump Pressure Switch—YJ Models

SCI RECEIVE—PCM INPUT

SCI Receive is the serial data communication receive circuit for the DRB scan tool. The powertrain control module (PCM) receives data from the DRB through the SCI Receive circuit.

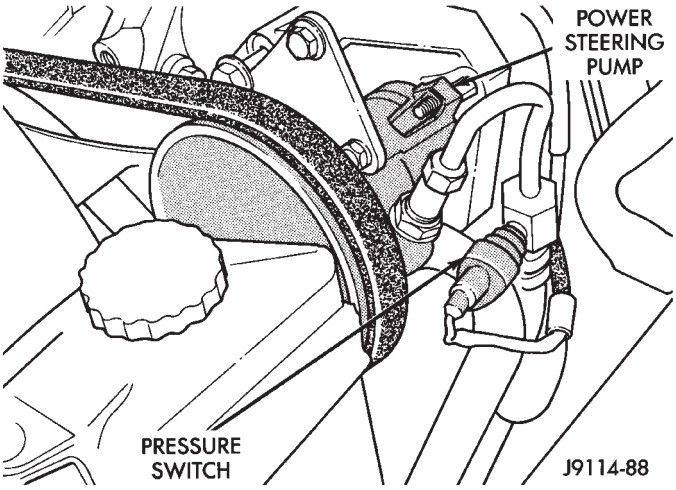

Fig. 13 Power Steering Pump Pressure Switch—XJ Models

SPEED CONTROL—PCM INPUT

The speed control system provides three separate inputs to the powertrain control module (PCM); On/Off, Set and Resume. The On/Off input informs the PCM that the speed control system has been activated. The Set input informs the PCM that a fixed vehicle speed has been selected. The Resume input indicates to the PCM that the previous fixed speed is requested.

The speed control operating range is from 50 km/h to 142 km/h (35 to 85 mph). Inputs that effect speed control operation are:

- Park/neutral switch
- Vehicle speed sensor
- Throttle position sensor

Refer to Group 8H for further speed control information.

SENSOR RETURN—PCM INPUT

Sensor Return provides a low noise ground reference for all system sensors.

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body (Figs. 14 or 15). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from 1 volt at minimum throttle opening (idle), to 4 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.

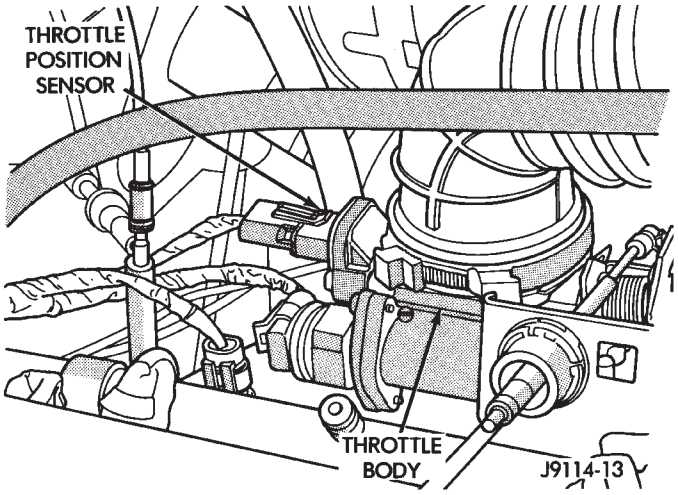

Fig. 14 Throttle Position Sensor—2.5L Engine

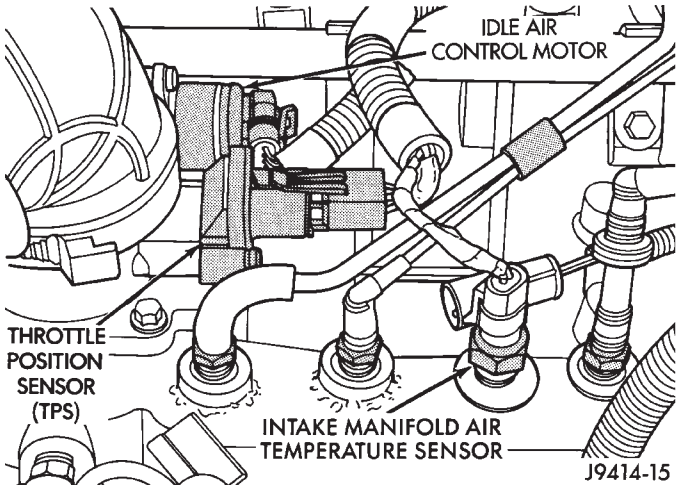

Fig. 15 Throttle Position Sensor—4.0L Engine

VEHICLE SPEED SENSOR—PCM INPUT

The vehicle speed sensor (Fig. 16) is located in the extension housing of the transmission (2 wheel drive) or on the transfer case extension housing (4 wheel drive). The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

The speed sensor generates 8 pulses per sensor revolution. These signals, in conjunction with a closed throttle signal from the throttle position sensor, indicate a closed throttle deceleration to the PCM. When the vehicle is stopped at idle, a closed throttle signal is received by the PCM (but a speed sensor signal is not received).

Under deceleration conditions, the PCM adjusts the idle air control (IAC) motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the IAC motor to maintain a desired engine speed.

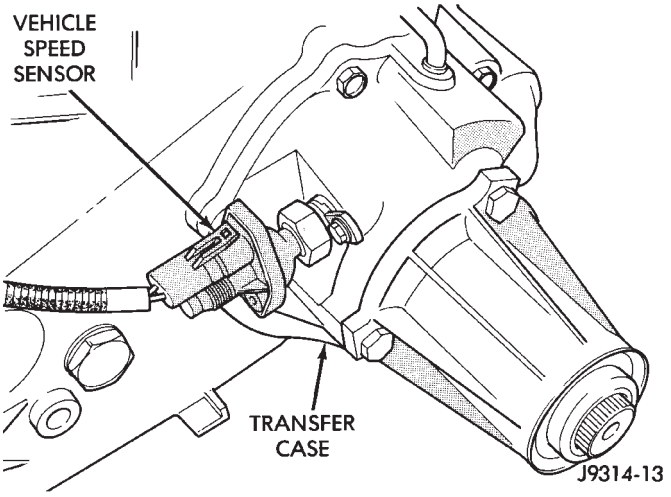

Fig. 16 Vehicle Speed Sensor—Typical

AIR CONDITIONING (A/C) CLUTCH RELAY—PCM OUTPUT

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off. The relay is located in the Power Distribution Center (PDC) (Figs. 17 or 18). For the location of the relay within the PDC, refer to label on PDC cover.

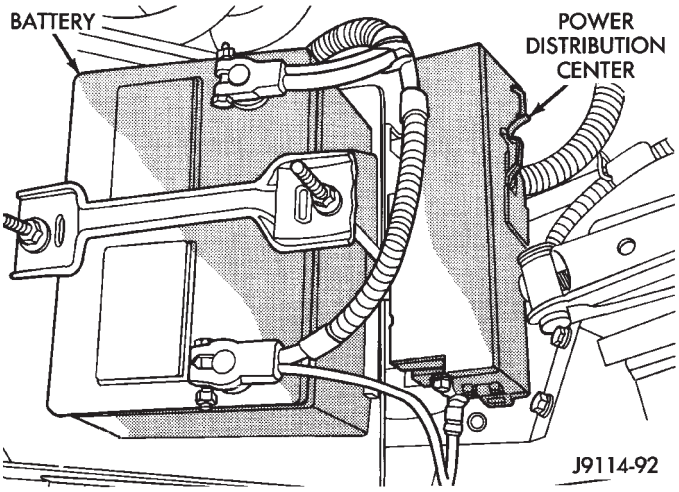

Fig. 17 PDC—YJ Models

When the PCM receives a request for A/C from A/C evaporator switch, it will adjust idle air control (IAC) motor position. This is done to increase idle speed. The PCM will then activate the A/C clutch through the A/C clutch relay. The PCM adjusts idle air control (IAC) stepper motor position to compensate for increased engine load from the A/C compressor.

By switching the ground path for the relay on and off, the PCM is able to cycle the A/C compressor clutch. This is based on changes in engine operating conditions. If, during A/C operation, the PCM senses low idle speeds or a wide open throttle condition, it will de-energize the relay. This prevents A/C clutch engagement. The relay will remain de-energized until the idle speed increases or the wide open throttle condition exceeds 15 seconds or no longer exists. The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

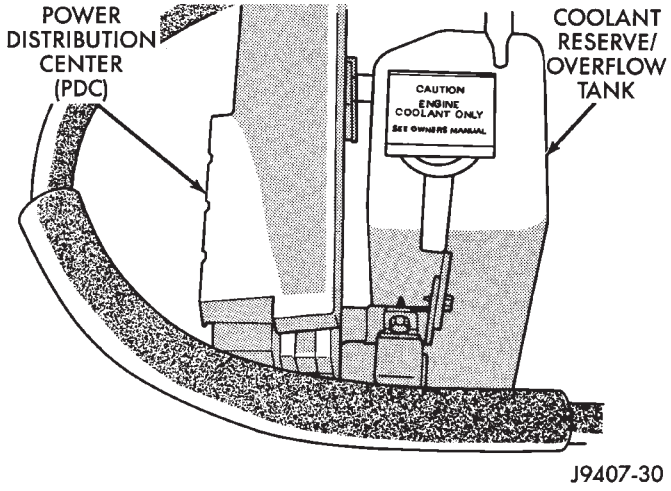

Fig. 18 PDC—XJ Models

AUTO SHUT DOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Figs. 17 or 18). For the location of this relay within the PDC, refer to label on PDC cover.

The ASD supplies battery voltage to the fuel pump, fuel injector, ignition coil, generator field winding and oxygen (O2S) sensor heating element. The ground circuit for the coil in the ASD relay is controlled by the powertrain control module (PCM). The PCM operates the relay by switching the ground circuit on and off.

The fuel pump relay is controlled by the PCM through same circuit that the ASD relay is controlled.

The powertrain control module (PCM) energizes the fuel pump through the fuel pump relay. (The PCM was formerly referred to as the SBEC or engine controller). Battery voltage is applied to the relay from the ignition switch. The relay is energized when a ground is provided by the PCM. The relay is located in the Power Distribution Center (PDC) (Figs. 17 or 18). For the location of fuel pump relay within PDC, refer to label on PDC cover.

For the 1994 model year, the ballast resistor and ballast resistor bypass relay are no longer used to control the fuel pump circuit.

DATA LINK CONNECTOR—PCM OUTPUT

Refer to the previous paragraphs on Data Link Connector—PCM Input for information.

EMR LAMP—PCM OUTPUT

The EMR lamp is not used for the 1994 model year.

FUEL PUMP RELAY—PCM OUTPUT

The PCM energizes the fuel pump through the fuel pump relay. Battery voltage is applied to the relay from the ignition switch. The relay is energized when a ground is provided by the PCM. Refer to Automatic Shut Down Relay for additional information.

FUEL INJECTORS—PCM OUTPUT

Six individual fuel injectors are used with the 4.0L 6 cylinder engine. Four individual fuel injectors are used with the 2.5L 4 cylinder engine. The injectors are attached to the fuel rail (Fig. 19).

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.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

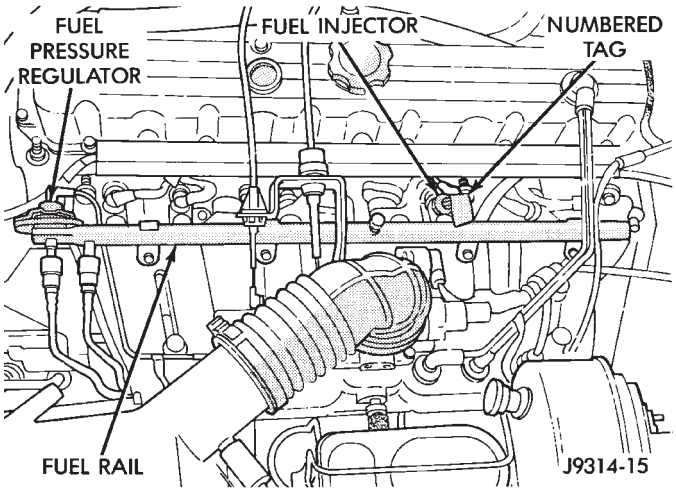

Fig. 19 Fuel Injectors—Typical

GENERATOR FIELD—PCM OUTPUT

The powertrain control module (PCM) regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for charging system information.

GENERATOR LAMP—PCM OUTPUT

IF EQUIPPED

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp on the instrument panel. For example, during low idle with all accessories turned on, the light may momentarily go on. Once the PCM corrects idle speed to a higher rpm, the light will go out. Refer to Group 8A, Battery/ Starting/Charging Systems for charging system information.

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

The IAC motor is mounted on the throttle body (Figs. 20 or 21) and is controlled by the powertrain control module (PCM).

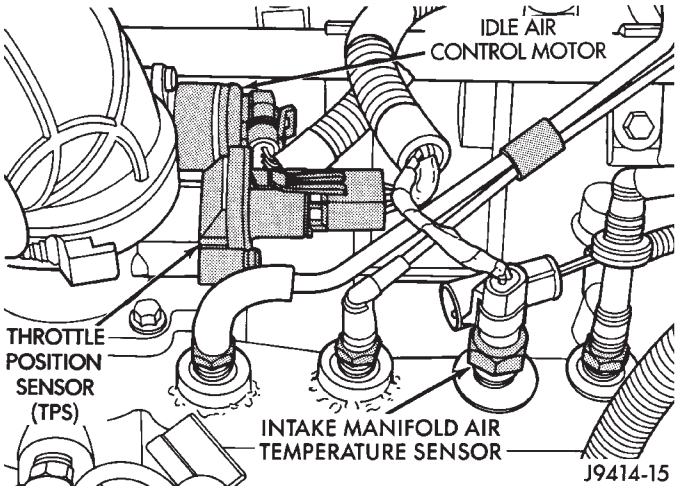

Fig. 20 IAC Motor—4.0L Engine

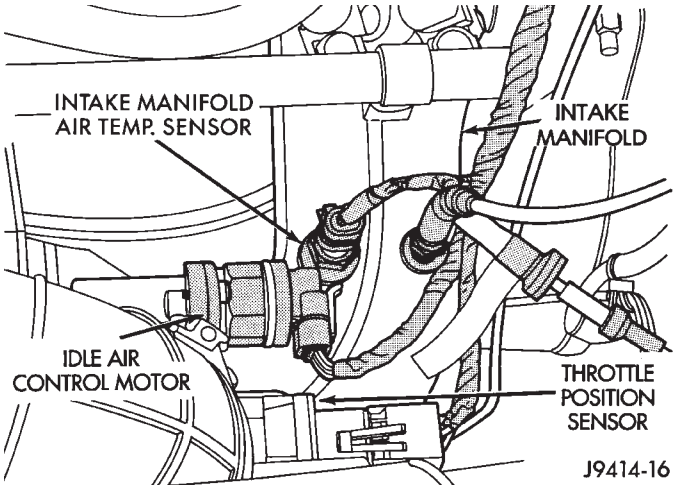

Fig. 21 IAC Motor—2.5L Engine

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle speed by mov-

ing the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

IGNITION COIL—PCM OUTPUT

System voltage is supplied to the ignition coil positive terminal. The powertrain control module (PCM) operates the ignition coil. **Base (initial) ignition timing is not adjustable.** The PCM adjusts ignition timing to meet changing engine operating conditions.

The ignition coil is located near the ignition distributor (Fig. 22).

Refer to Group 8D, Ignition System for additional information.

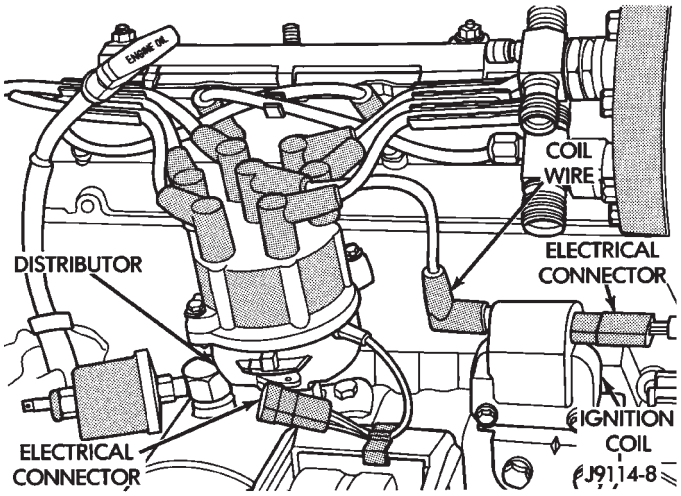

Fig. 22 Ignition Coil—Typical

MALFUNCTION INDICATOR LAMP—PCM OUTPUT

The Malfunction Indicator Lamp (formerly referred to as the Check Engine Lamp) illuminates on the instrument panel each time the ignition key is turned on. It will stay on for three seconds as a bulb test.

If the powertrain control module (PCM) receives an incorrect signal, or no signal from certain sensors or emission related systems, the lamp is turned on. This is a warning that the PCM has recorded a system or sensor malfunction. In some cases, when a problem is declared, the PCM will go into a limp-in mode. This is an attempt to keep the system operating. It signals an immediate need for service.

The lamp can also be used to display a Diagnostic Trouble Code (DTC). Cycle the ignition switch On-Off-On-Off-On within three seconds and any codes stored in the PCM memory will be displayed. This is done in a series of flashes representing digits. Refer to On-Board Diagnostics in the General Diagnosis section of this group for more information.

RADIATOR FAN RELAY—PCM OUTPUT

XJ MODELS ONLY

The electric radiator cooling fan used in XJ models (equipped with 4.0L engine, heavy duty cooling and/or air conditioning) is controlled by the powertrain control module (PCM) through radiator fan relay. The relay is energized when coolant temperature is above 103°C (217°F). It will then de-energize when coolant temperature drops to 98°C (208°F). Refer to Group 7, Cooling Systems for more information.

The relay is located in the power distribution center (PDC) (Fig. 23).

The electric radiator cooling fan is not used on YJ models.

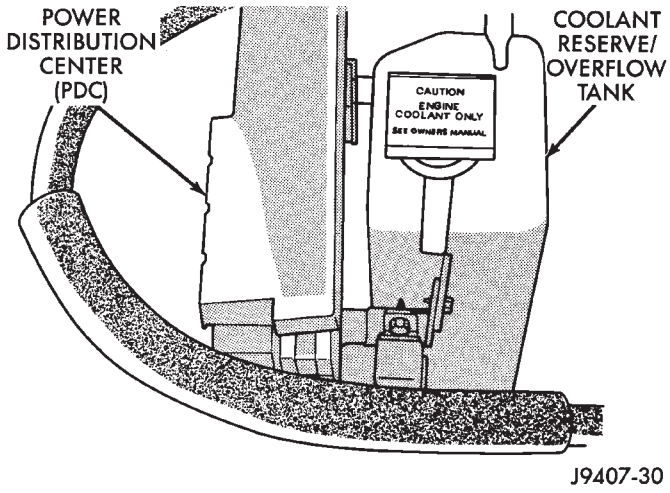

Fig. 23 PDC—XJ Models

SCI TRANSMIT—PCM OUTPUT

SCI Transmit is the serial data communication transmit circuit for the DRB scan tool. The powertrain control module (PCM) transmits data to the DRB through the SCI Transmit circuit.

SHIFT INDICATOR—PCM OUTPUT

Vehicles equipped with manual transmissions have an Up-Shift indicator lamp. The lamp is controlled by the powertrain control module (PCM). The lamp illuminates on the instrument panel to indicate when the driver should shift to the next highest gear for best fuel economy. The PCM will turn the lamp OFF after 3 to 5 seconds if the shift of gears is not performed. The up-shift light will remain off until vehicle stops accelerating and is brought back to range of up-shift light operation. This will also happen if vehicle is shifted into fifth gear.

The indicator lamp is normally illuminated when the ignition switch is turned on and it is turned off when the engine is started up. With the engine running, the lamp is turned on/off depending upon engine speed and load.

SPEED CONTROL—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed control vacuum and vent solenoids. Refer to Group 8H for speed control information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine rpm values to the instrument cluster tachometer (if equipped). Refer to Group 8E for tachometer information.

TORQUE CONVERTER CLUTCH RELAY—PCM OUTPUT

ALL 2.5L 4 CYL. WITH 3-SPEED AUTO. TRANS

4.0L 6 CYL. YJ MODELS WITH 3-SPEED AUTO. TRANS

The transmission mounted torque converter clutch (TCC) solenoid is used to control the torque converter. The solenoid is controlled through the powertrain control module (PCM) and by the TCC relay. This relay is used only on vehicles equipped with a 3-speed automatic transmission.

An electrical output signal is sent from the PCM to the TCC relay after the PCM receives information from the vehicle speed, MAP, throttle position and engine coolant temperature sensors. After the TCC relay receives this necessary information, it will send a signal to the torque converter clutch solenoid to control the torque converter.

On YJ models the TCC relay is located in the engine compartment, on the cowl panel and near the battery (Fig. 24). On XJ models the TCC relay is located in the power distribution center (PDC) (Fig. 23).

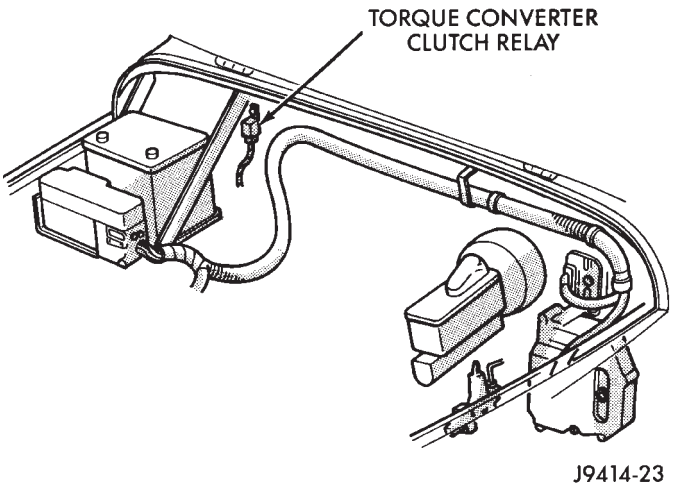

Fig. 24 TCC Relay Location—YJ Models

OPEN LOOP/CLOSED LOOP 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). There are several different modes of operation that determine how the PCM responds to the various input signals.

MODES

- Open Loop
- Closed Loop

During Open Loop modes, the powertrain control module (PCM) receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensor is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensor input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.

• Intake manifold air temperature sensor input is monitored
• Throttle position sensor (TPS) is monitored
• The auto shut down (ASD) relay is energized by the PCM for approximately three seconds.
• The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately one second unless the engine is operating or the starter motor is engaged
• The O2S sensor heater element is energized through the fuel pump relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.
• The up-shift indicator light is illuminated (manual transmission only).

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The powertrain control module (PCM) receives inputs from:
• Battery voltage
• Engine coolant temperature sensor
• Crankshaft position sensor
• Intake manifold air temperature sensor
• Manifold absolute pressure (MAP) sensor
• Throttle position sensor (TPS)
• Starter motor relay
• Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the 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 powertrain control module (PCM) receives inputs from:
• Battery voltage
• Crankshaft position sensor
• Engine coolant temperature sensor
• Intake manifold air temperature sensor
• Manifold absolute pressure (MAP) sensor
• Throttle position sensor (TPS)
• Camshaft position sensor signal (in the distributor)
• Park/Neutral Switch (Gear indicator signal—auto. trans. only)
• Air conditioning select signal (if equipped)
• Air conditioning request signal (if equipped)

Based on these inputs the following occurs:
• Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
• The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
• The PCM operates the A/C compressor clutch through the clutch relay. This is done if A/C has been selected by the vehicle operator and requested by the A/C thermostat.
• If the vehicle has a manual transmission, the up-shift light is operated by the PCM.
• When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the powertrain control module (PCM) receives inputs from:
• Air conditioning select signal (if equipped)
• Air conditioning request signal (if equipped)
• Battery voltage
• Crankshaft position sensor
• Engine coolant temperature sensor
• Intake manifold air temperature sensor
• Manifold absolute pressure (MAP) sensor
• Throttle position sensor (TPS)
• Camshaft position sensor signal (in the distributor)
• Battery voltage
• Park/Neutral Switch (gear indicator signal—auto. trans. only)
• Oxygen sensor

Based on these inputs, the following occurs:
• Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
• The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
• The PCM adjusts ignition timing by increasing and decreasing spark advance.
• The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

The optional Extended Idle Switch is used to raise the engine idle speed to approximately 1000 rpm. This is when the shifter is in either the Park or Neutral position. A rocker-type 2-wire switch (extended idle switch) is mounted to the instrument panel. This

switch will supply a ground circuit to the powertrain control module (PCM). **The switch is available only with 4.0L engine when supplied with the optional police package.**

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/Neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensor

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the powertrain control module (PCM) receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/Neutral switch (gear indicator signal—auto. trans. only)

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 battery voltage 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.

The PCM opens the ground circuit to the A/C clutch relay to disengage the A/C compressor clutch. This is done until the vehicle is no longer under deceleration (if the A/C system is operating).

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the powertrain control module (PCM) receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM opens the ground circuit to the A/C clutch relay to disengage the A/C compressor clutch. This will be done for approximately 15 seconds (if the air conditioning system is operating).

If the vehicle has a manual transmission, the upshift light is operated by the PCM.

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.

THROTTLE BODY

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 25). Fuel does not enter the intake manifold through the throt-

tle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 26) 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.

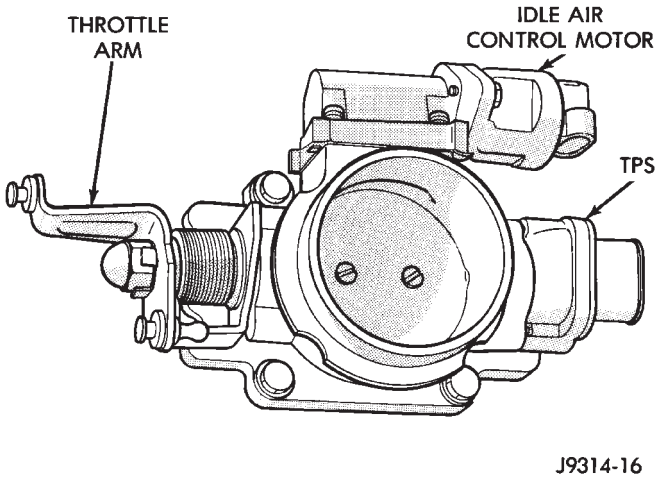

Fig. 25 Throttle Body—Typical

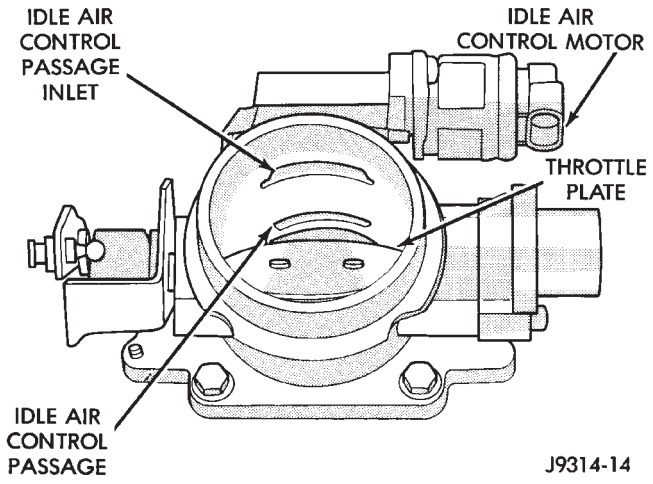

Fig. 26 Idle Air Control Passage

The throttle position sensor (TPS) and idle air control (IAC) motor are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

FUEL RAIL

The fuel rail supplies fuel to the injectors and is mounted to the intake manifold (Fig. 27). The fuel pressure regulator is attached to the rail and the fuel pressure test port is integral with the rail. The fuel rail is not repairable.

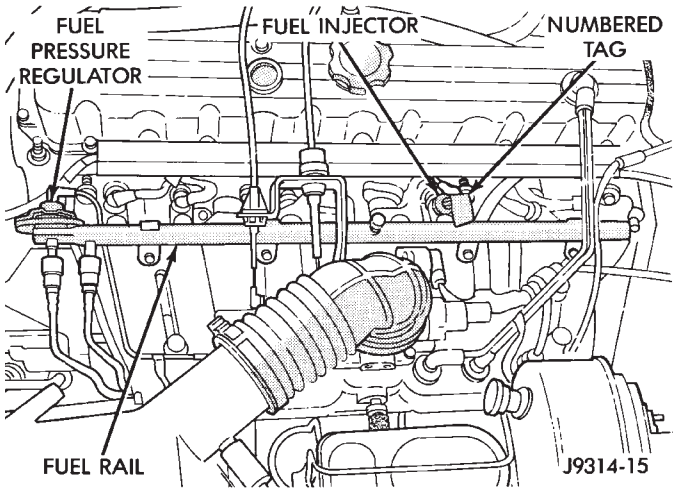

Fig. 27 Fuel Rail—Typical

FUEL PRESSURE REGULATOR

The fuel pressure regulator (Fig. 28) is a mechanical device that is not controlled by the powertrain control module (PCM).

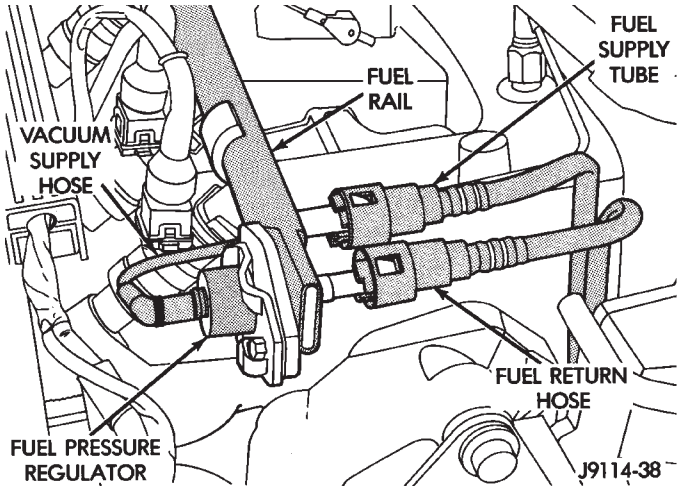

Fig. 28 Fuel Pressure Regulator—Typical

The fuel pressure regulator used is a vacuum balanced, nonadjustable type. The regulator is mounted on the output end of the fuel rail and is connected to intake manifold vacuum. The fuel return tube (to the fuel tank) is connected to the fuel pressure regulator.

The regulator is calibrated to maintain fuel system pressure at approximately 214 kPa (31 psi). This is with vacuum applied while the engine is at idle. Fuel pressure will be 55-69 kPa (8-10 psi) higher if vacuum is not applied to the regulator.

The pressure regulator contains a diaphragm, calibrated spring and a fuel return valve (Fig. 29). Fuel pressure operates on one side of the regulator, while spring pressure and intake manifold vacuum operate on the other side. Spring pressure on one side of the

diaphragm tries to force the return valve closed. Fuel pressure on other side of diaphragm, with assistance from manifold vacuum on spring side of diaphragm, act against spring pressure to open the return valve. System fuel pressure is the amount of fuel pressure required to force against spring pressure and unseat the return valve.

Without vacuum applied to the spring side of the regulator, the spring is calibrated to open the fuel return outlet. This happens when the pressure differential between the fuel injectors and the intake manifold reaches approximately 269 kPa (39 psi). Since manifold vacuum varies with engine operating conditions, the amount of vacuum applied to the spring side of the diaphragm varies. For this reason, fuel pressure varies, depending upon intake manifold vacuum. With low vacuum, such as during wide open throttle conditions, minimal vacuum assistance is available. Full spring pressure is exerted to seal the fuel outlet. This causes the system pressure to increase. With high vacuum, such as at engine idle or during vehicle deceleration, fuel pressure on one side of the diaphragm is balanced by intake manifold pressure. This is done on the spring side of the diaphragm and results in lower system fuel pressure.

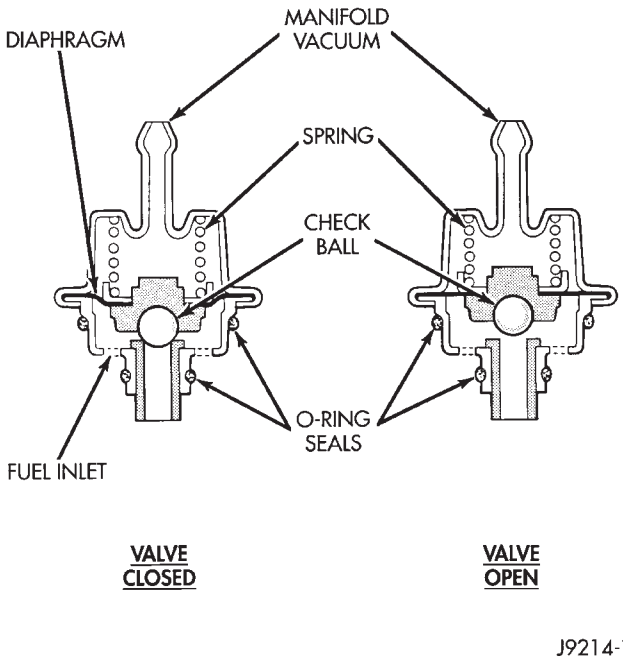

Fig. 29 Fuel Pressure Regulator Operation—Typical

MULTI-PORT FUEL INJECTION (MFI)—GENERAL DIAGNOSIS

INDEX

GENERAL INFORMATION

All 2.5L 4 cylinder and 4.0L 6 cylinder engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

VISUAL INSPECTION

A visual inspection for loose, disconnected, or incorrectly routed wires and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the 60-way connector is fully inserted into the connector of the Powertrain Control Module (PCM) (Figs. 1 or 2). Verify that the connector mounting bolt is tightened to 4 N·m (35 in. lbs.) torque.

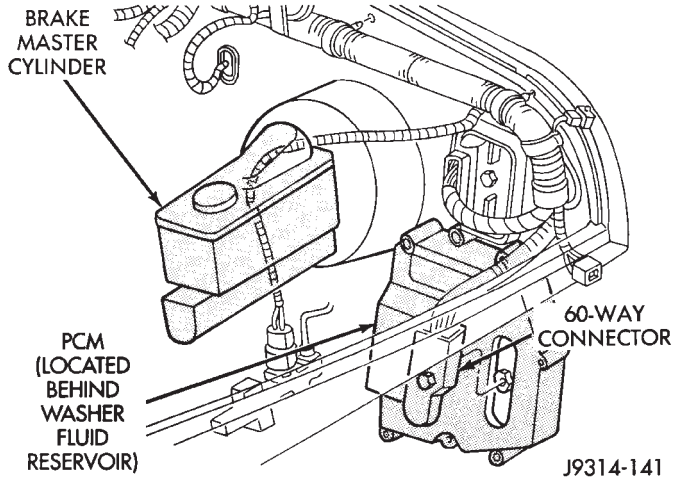

Fig. 1 PCM—YJ Models

(2) Inspect the battery cable connections. Be sure they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect ASD relay and radiator fan relay (if equipped) connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are installed in the Power Distribution Center (PDC) (Figs. 3 or 4).

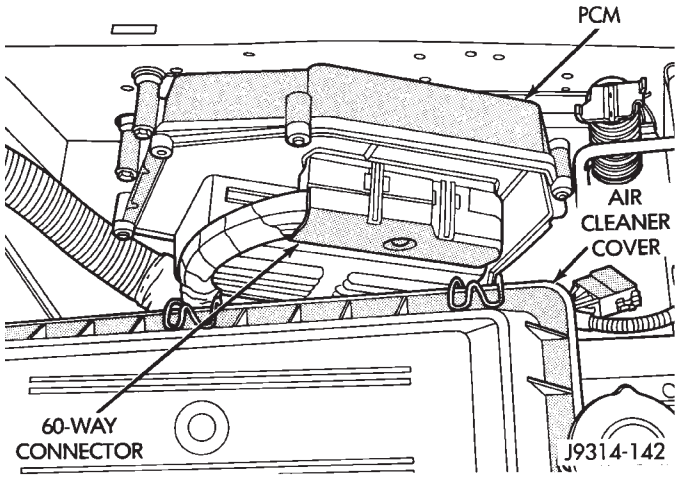

Fig. 2 PCM—XJ Models

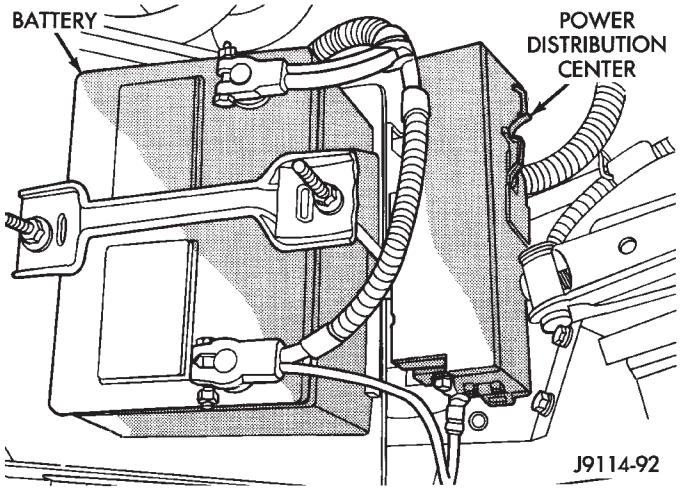

Fig. 3 PDC—YJ Models

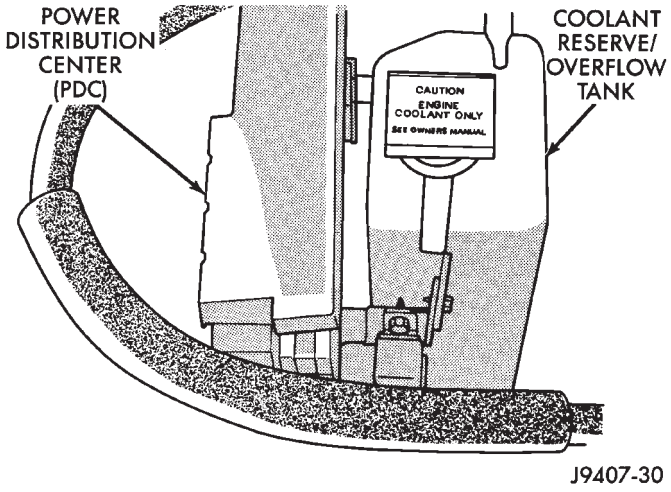

Fig. 4 PDC—XJ Models

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Figs. 5 or 6).

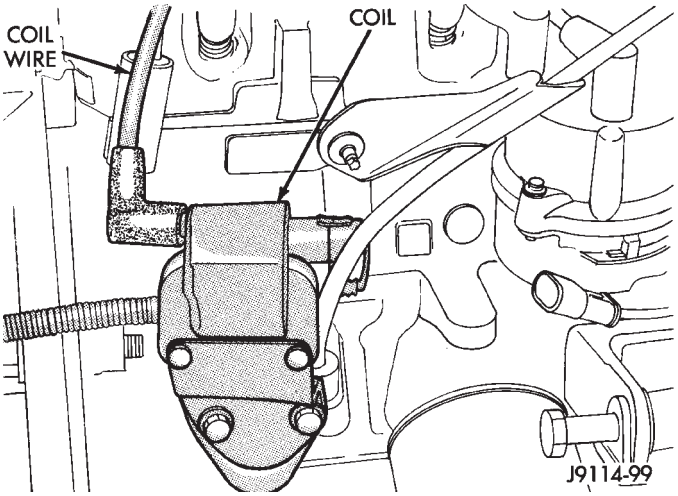

Fig. 5 Ignition Coil—2.5L Engine

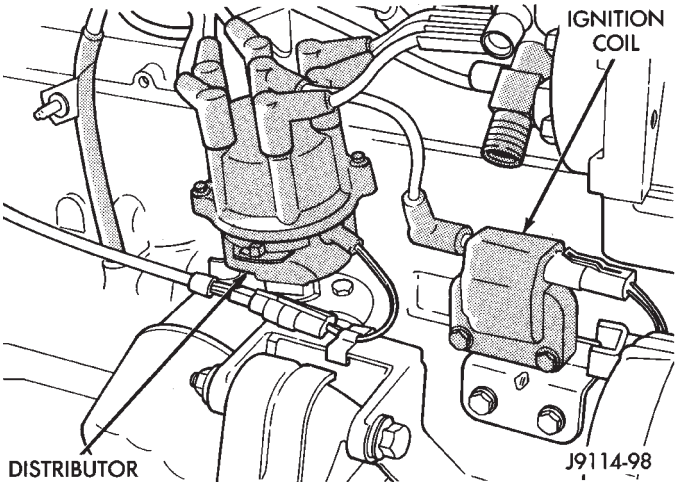

Fig. 6 Ignition Coil—4.0L Engine

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector is firmly connected to harness connector (Figs. 7 or 8). Inspect spark plug condition. Refer to Group 8D, Ignition System. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

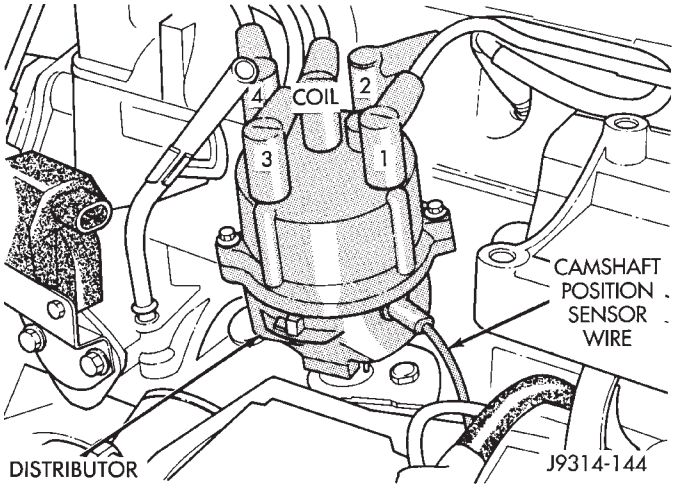

Fig. 7 Distributor and Wiring—2.5L Engine

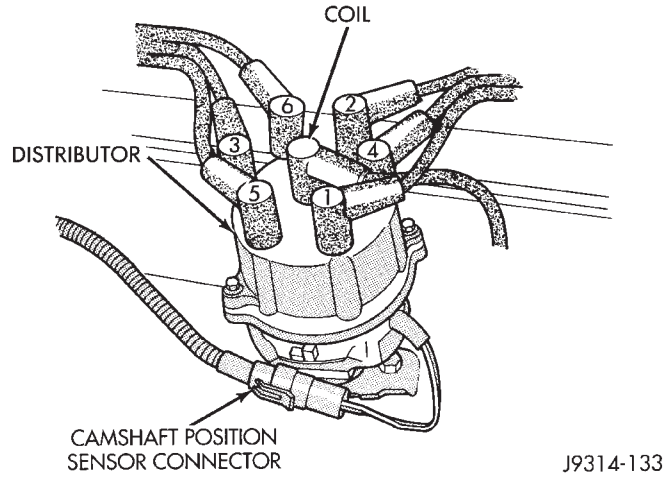

Fig. 8 Distributor and Wiring—4.0L Engine

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator (Fig. 9).

(7) Inspect the system ground connections at the cylinder block behind the engine oil dipstick tube (Fig. 10).

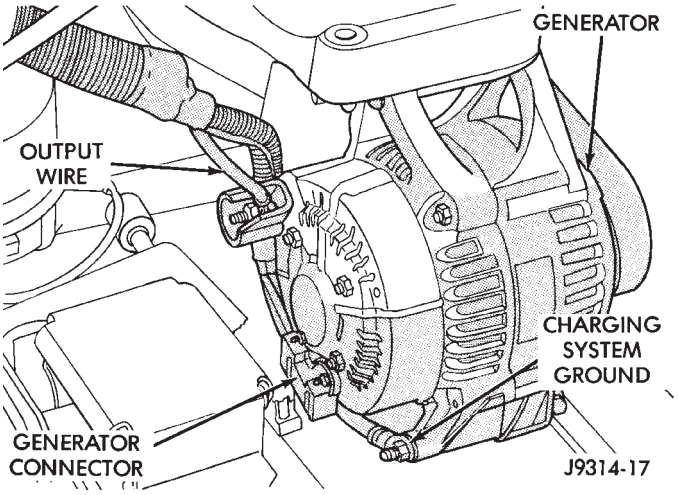

Fig. 9 Generator Connector and Output Wire Connections—Typical

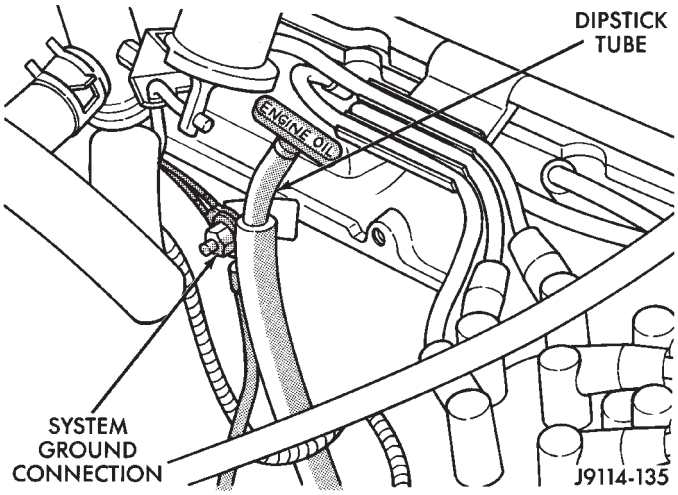

Fig. 10 System Ground Connections—Typical

(8) Verify that crankcase ventilation (CCV) fresh air hose is firmly connected to cylinder head and air cleaner covers (Figs. 11 or 12).

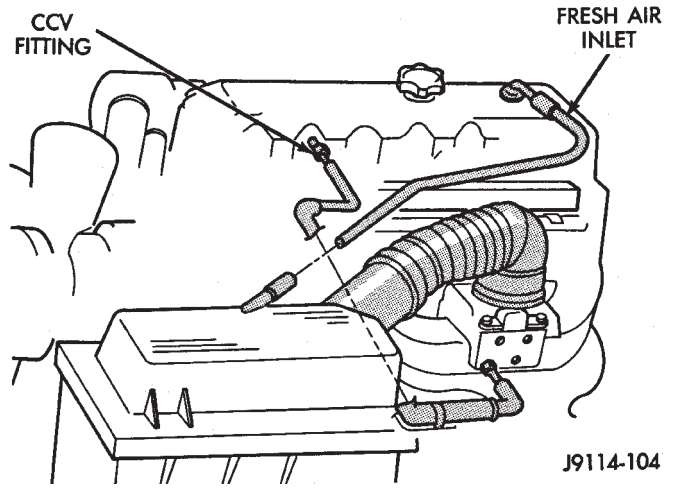

Fig. 11 CCV System—2.5L Engine

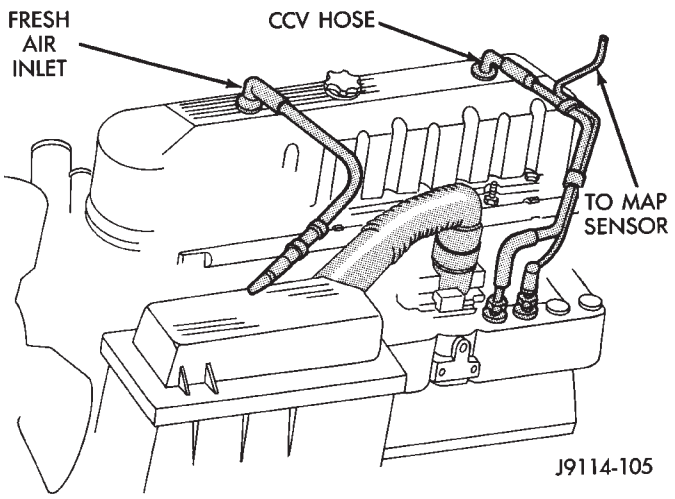

Fig. 12 CCV System—4.0L Engine

(9) Verify that vacuum hose is firmly connected to fuel pressure regulator and manifold fitting (Figs. 13 or 14).

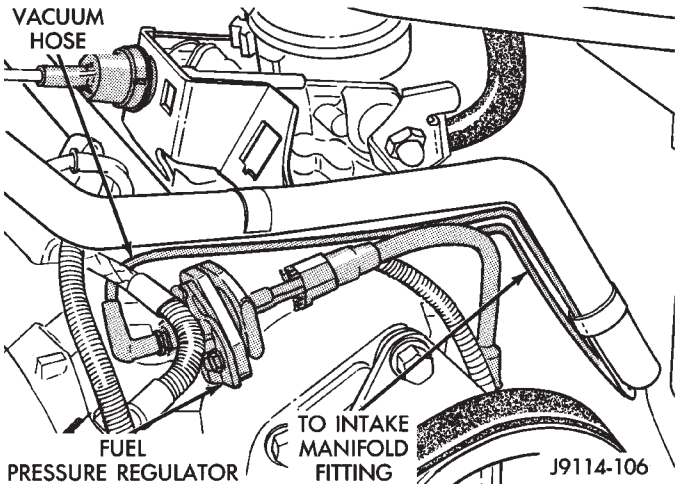

Fig. 13 Pressure Regulator Vacuum Hose—2.5L Engine

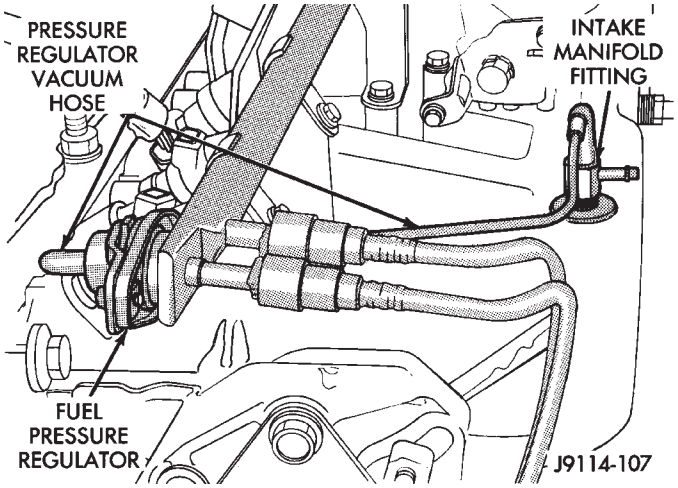

Fig. 14 Pressure Regulator Vacuum Hose—4.0L Engine

(10) Inspect fuel tube quick-connect fitting-to-fuel rail connections (Fig. 15).

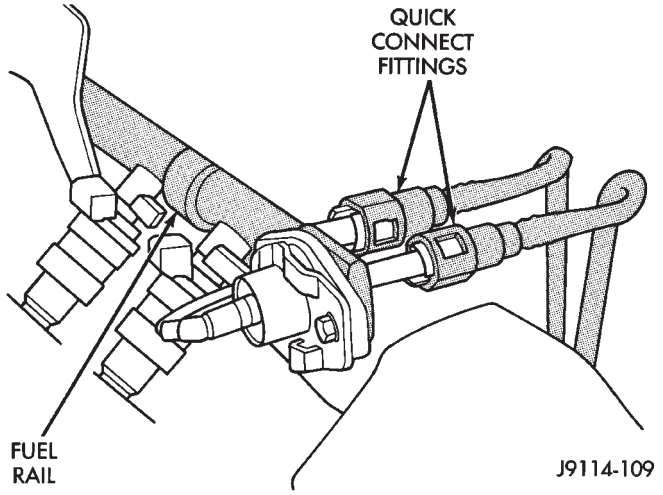

Fig. 15 Fuel Supply Tube—Typical

(11) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(12) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to the throttle arm of throttle body for any binding or restrictions (Fig. 16).

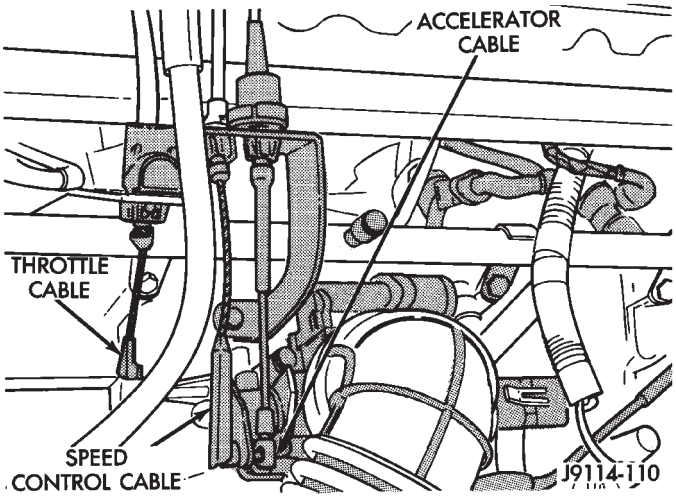

Fig. 16 Throttle Body Cables—Typical

(13) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster (Fig. 17).

(14) On XJ models equipped with 4.0L engine and A/C, verify that auxiliary cooling fan wire connector is firmly connected to harness (Fig. 18).

(15) Inspect the air cleaner inlet and air filter element for restrictions.

(16) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

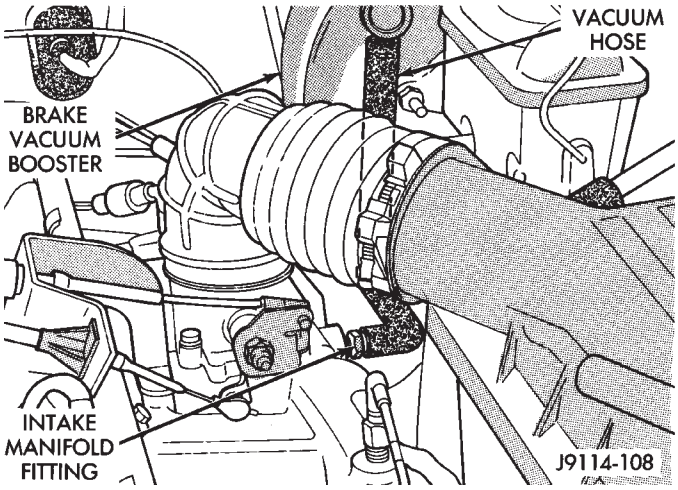

Fig. 17 Brake Vacuum Booster Hose—Typical

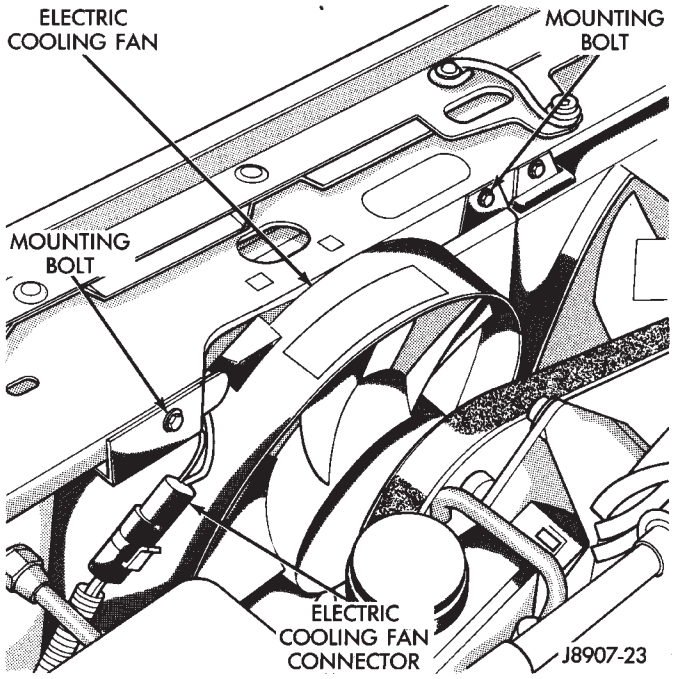

Fig. 18 Auxiliary Cooling Fan Connector—XJ with 4.0L Engine

(17) Verify that intake manifold air temperature sensor wire connector is firmly connected to harness connector (Figs. 19 or 20).

(18) Inspect engine ground strap connections at dash panel and rear cylinder head bolt (Fig. 21).

(19) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 22). Verify that vacuum hose is firmly connected to MAP sensor and to the intake manifold.

(20) Verify that fuel injector wire harness connectors are firmly connected to the fuel injectors in the correct order. Each harness connector is tagged with the number of its corresponding fuel injector (Fig. 23).

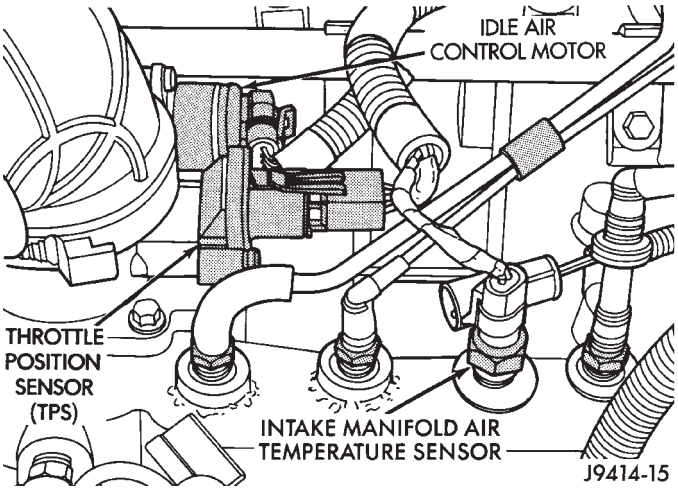

Fig. 19 Sensor Location—4.0L Engine

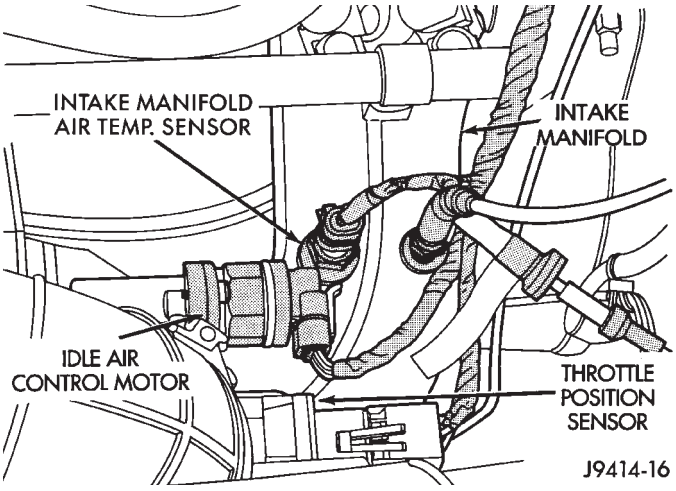

Fig. 20 Sensor Location—2.5L Engine

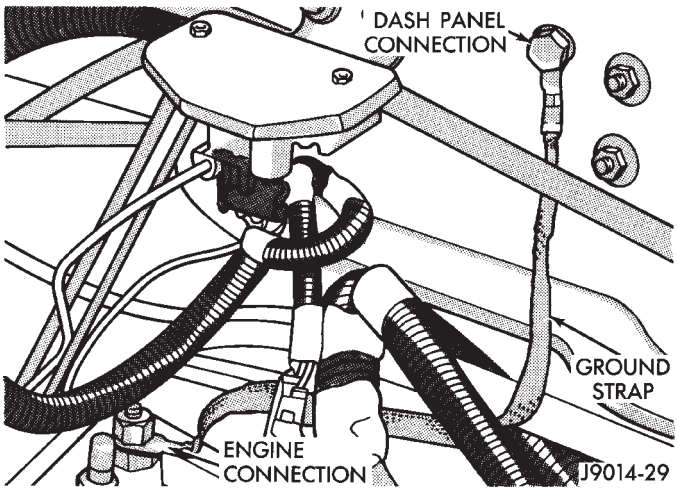

Fig. 21 Engine Ground Strap Connections—Typical

(21) Verify that harness connectors are firmly connected to idle air control (IAC) motor and throttle position sensor (TPS) (Figs. 19, 20 or 24).

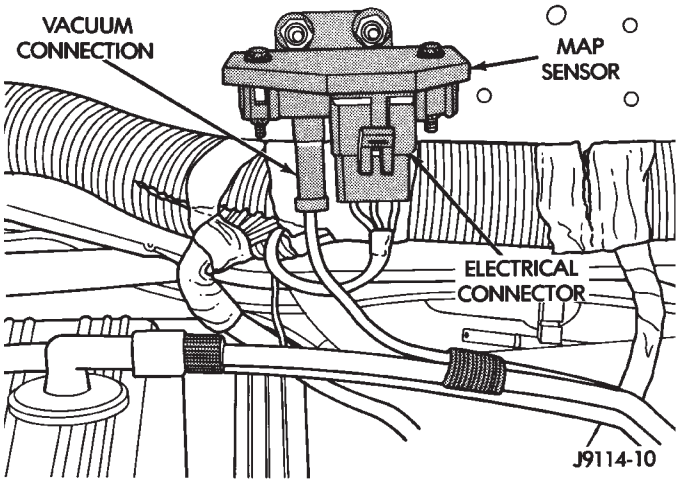

Fig. 22 MAP Sensor—Typical

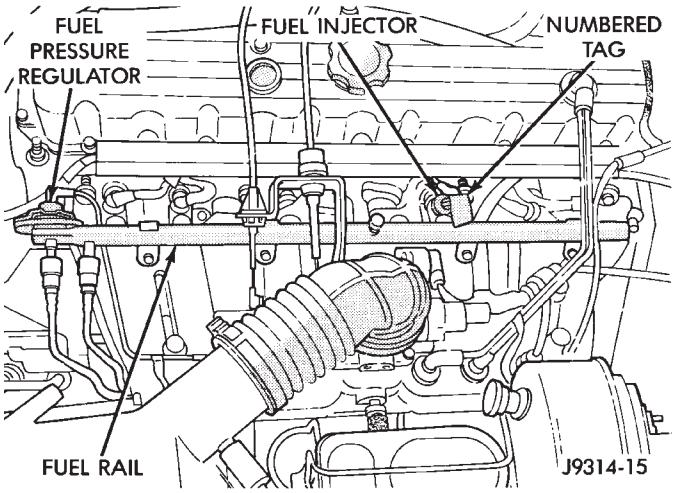

Fig. 23 Fuel Injector Wire Harness—Typical

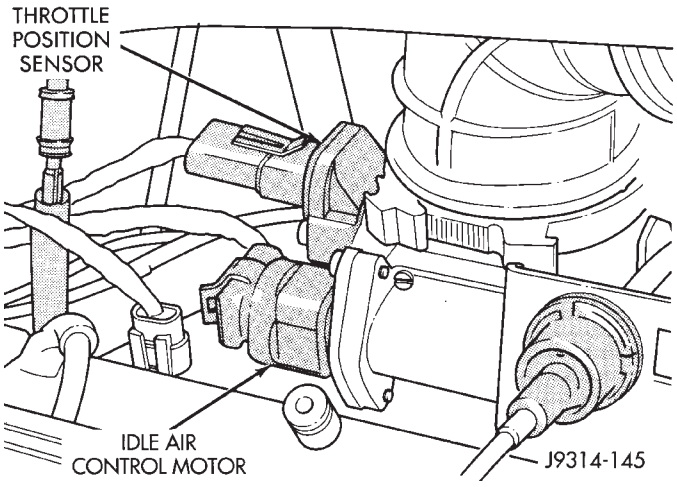

Fig. 24 IAC Motor and TPS—2.5L Engine

(22) Verify that wire harness connector is firmly connected to the coolant temperature sensor (Fig. 25).

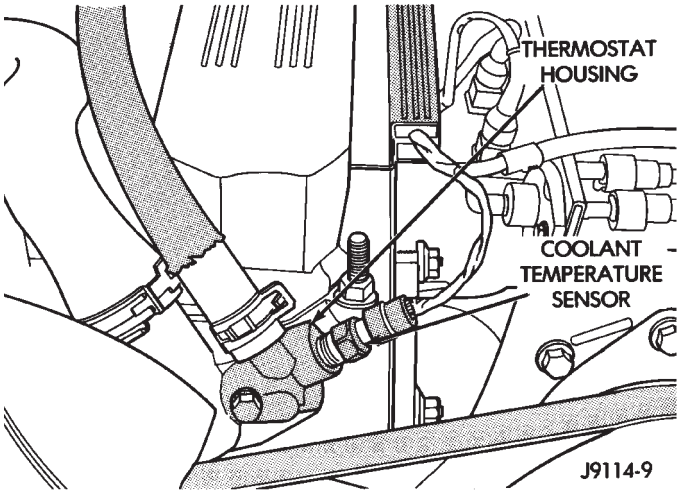

Fig. 25 Coolant Temperature Sensor—Typical

(23) Verify that oxygen sensor wire connector is firmly connected to the sensor. Inspect sensor and connector for damage (Fig. 26).

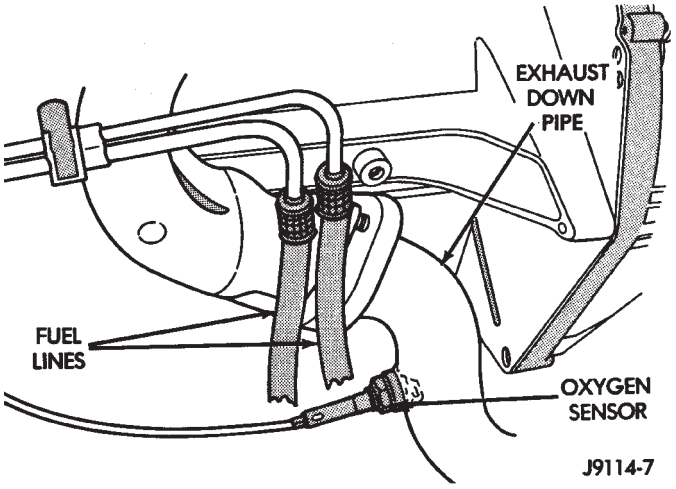

Fig. 26 Oxygen Sensor Location—Typical

(24) Raise and support the vehicle.

(25) Inspect for pinched or leaking fuel tubes. Inspect for pinched cracked or leaking fuel hoses.

(26) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(27) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral safety switch. Refer to Automatic Transmission section of Group 21.

(28) Verify that the harness connector is firmly connected to the vehicle speed sensor (Fig. 27).

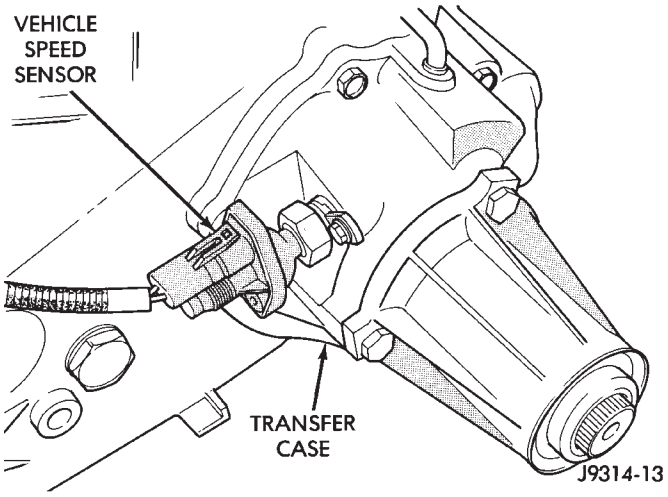

Fig. 27 Vehicle Speed Sensor—Typical

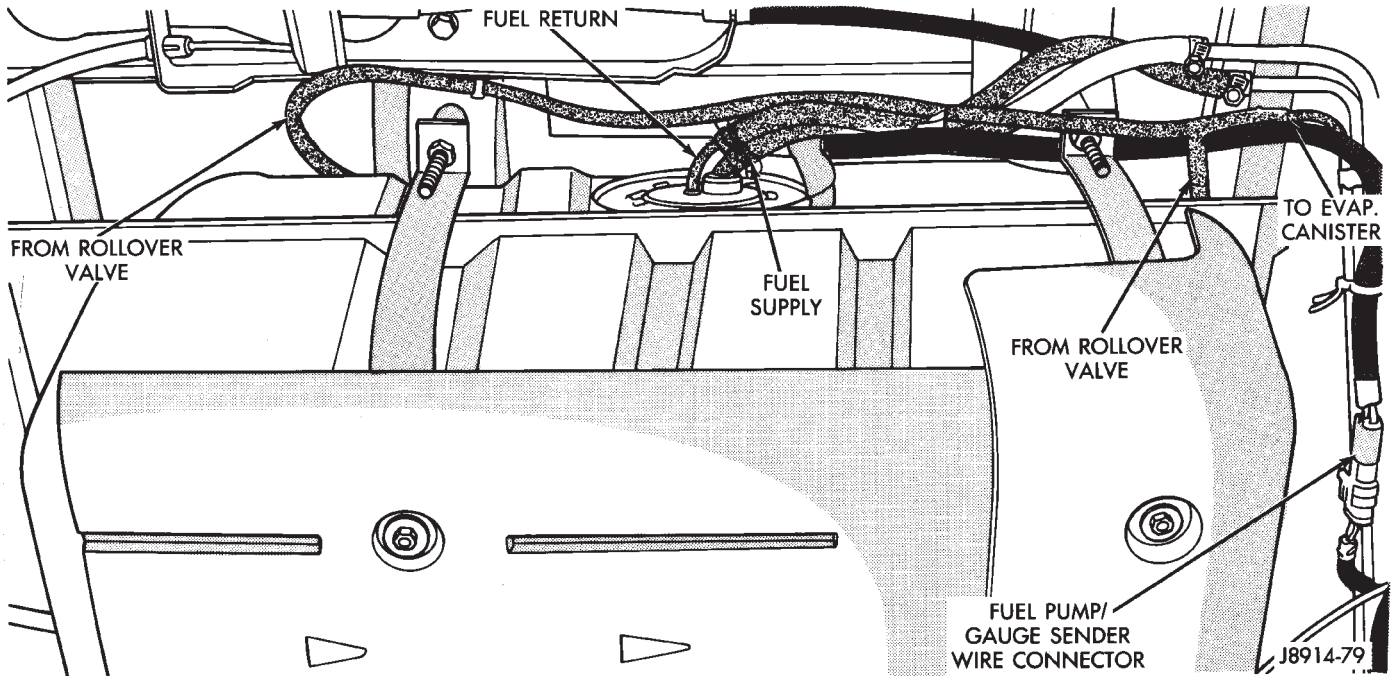

Fig. 28 Fuel Pump Module Connector and Fuel Hoses—Typical

(29) Verify that fuel pump module wire connector is firmly connected to harness connector.

(30) Inspect fuel hoses at fuel pump module for cracks or leaks (Fig. 28).

(31) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(32) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components (Fig. 29).

POWERTRAIN CONTROL MODULE (PCM) 60-WAY CONNECTOR

For PCM 60-way connector wiring schematics, refer to Group 8W, Wiring Diagrams.

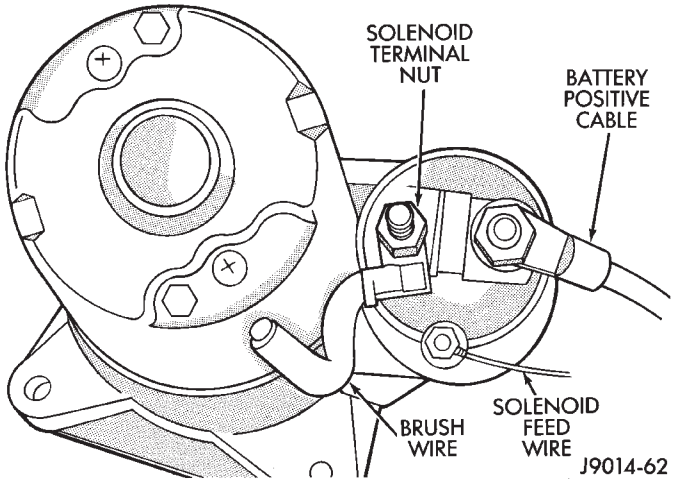

Fig. 29 Starter Solenoid Connections—Typical

SYSTEM SCHEMATICS

Fuel system schematics for the 2.5L 4 cylinder and 4.0L 6 cylinder engines are shown in figures 30, 31, 32 and 33.

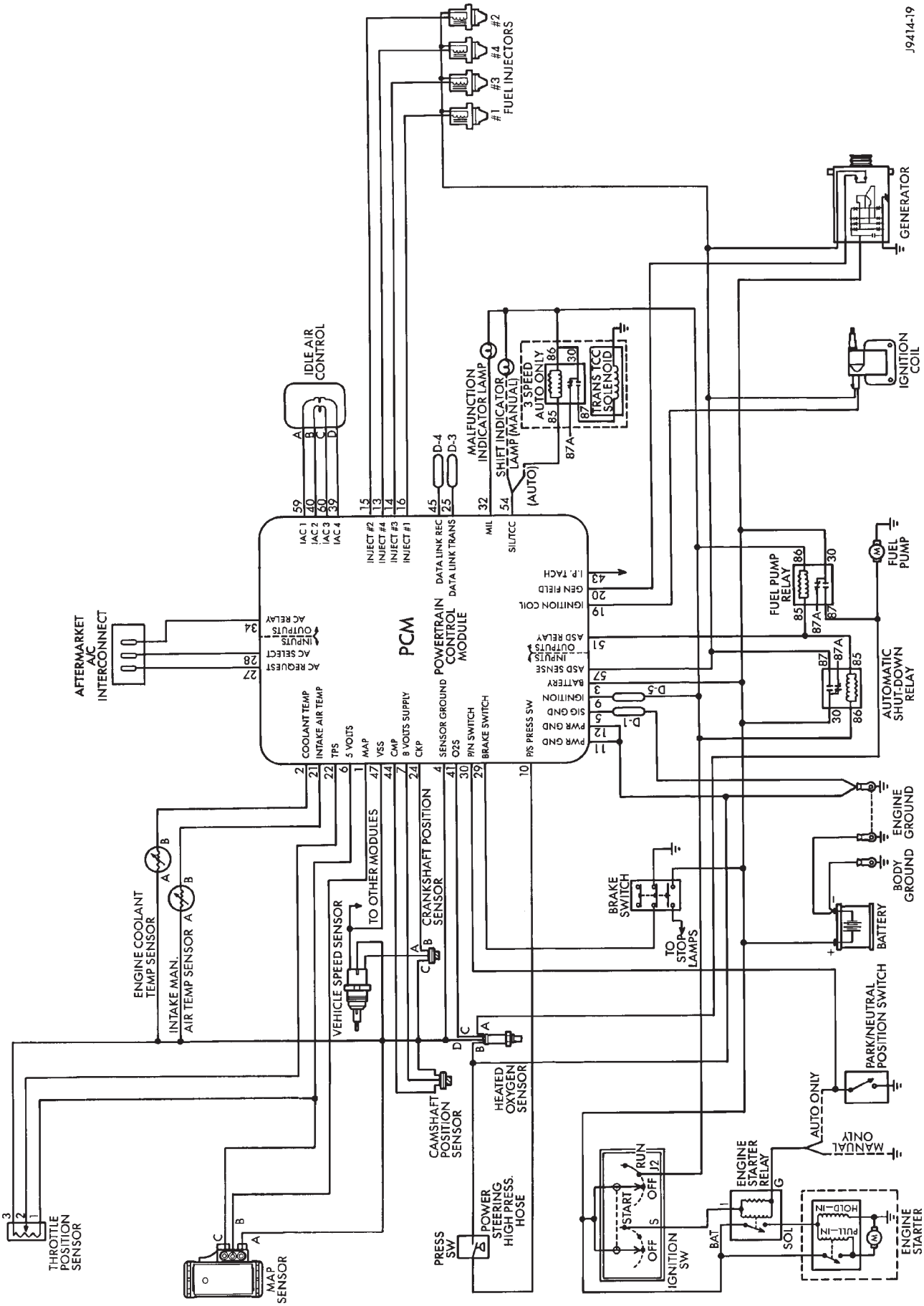

Fig. 30 System Schematic—YJ Models with 2.5L Engine

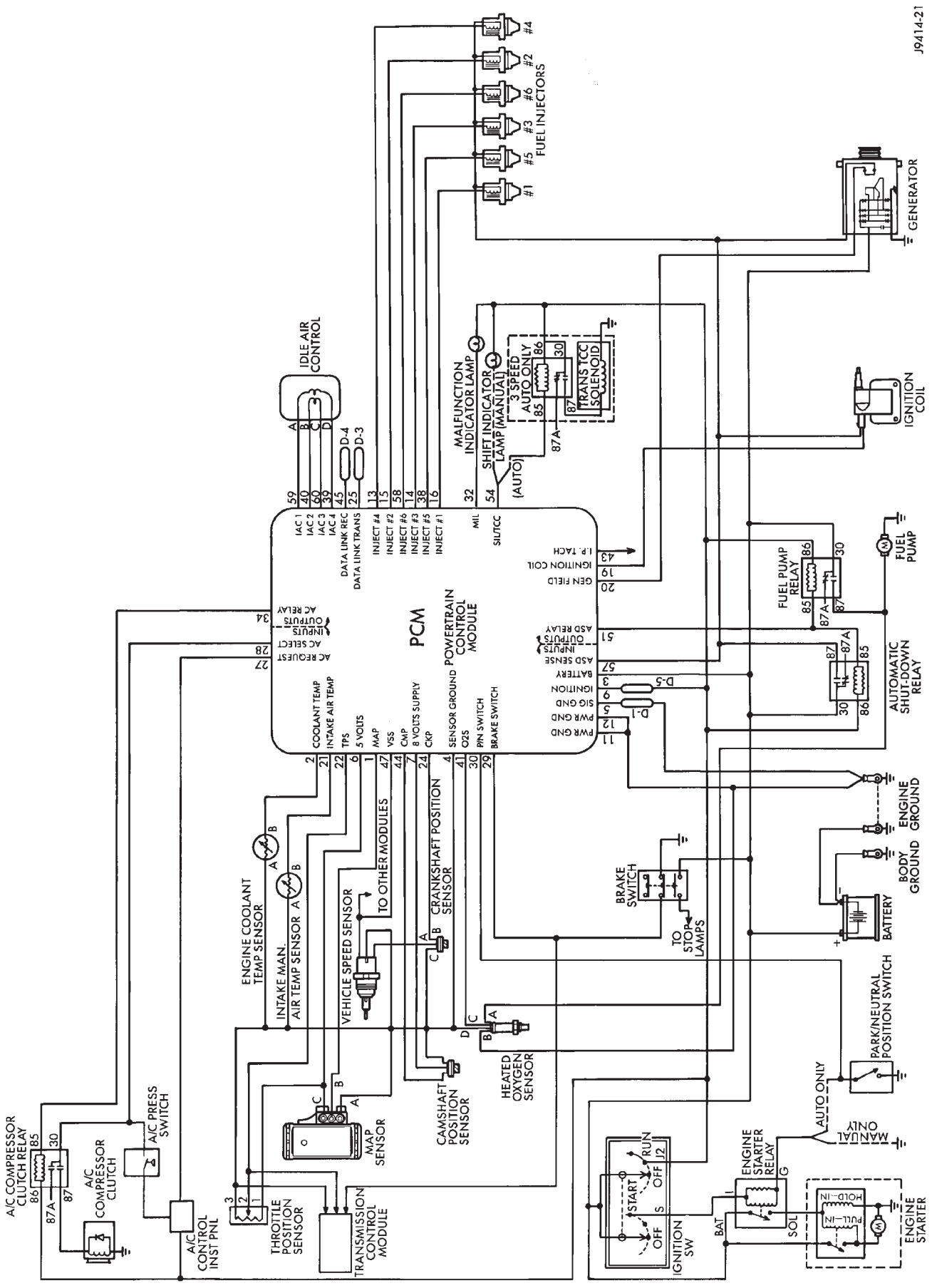

Fig. 31 System Schematic—YJ Models with 4.0L Engine

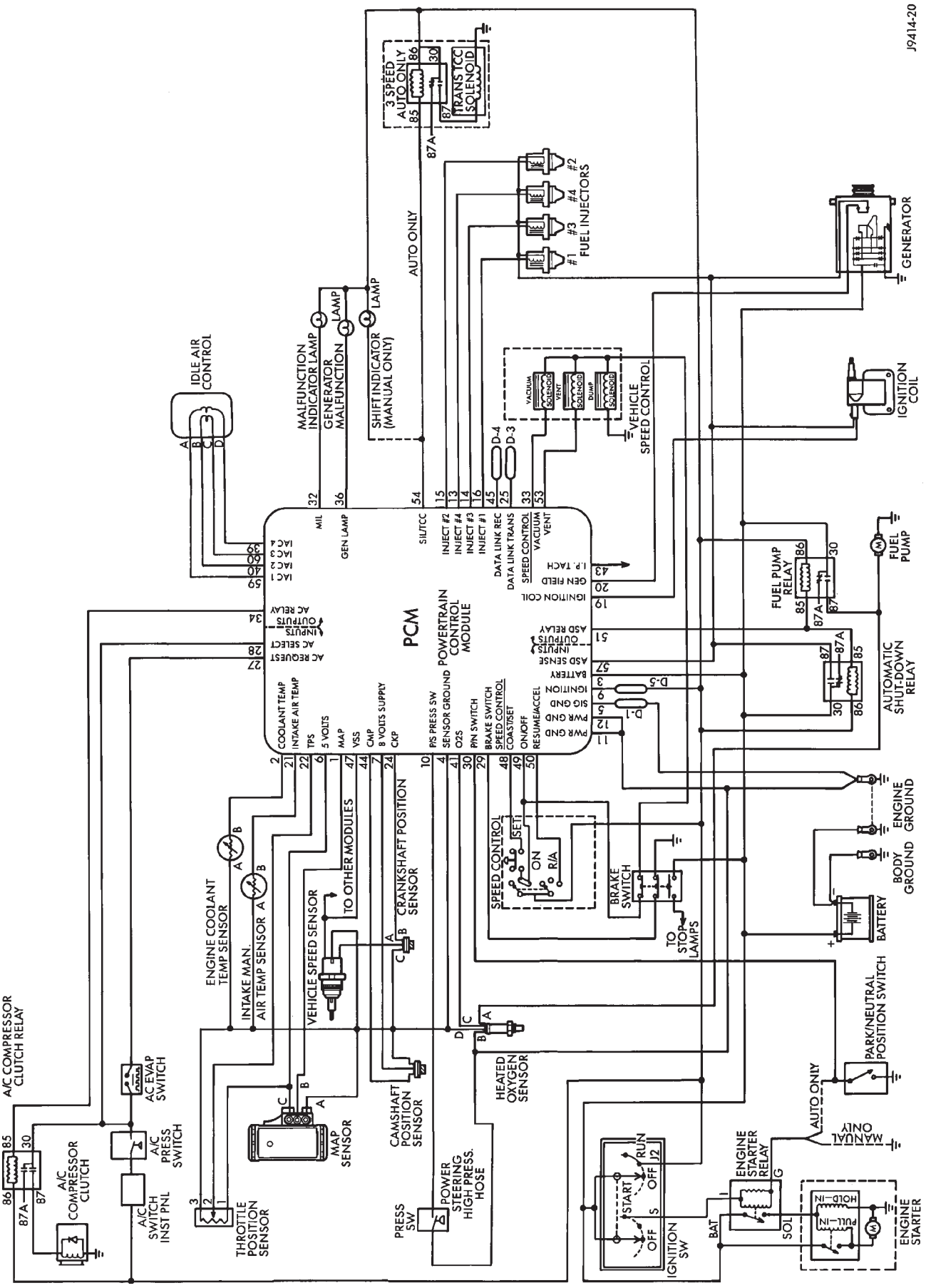

Fig. 32 System Schematic—XJ Models with 2.5L Engine

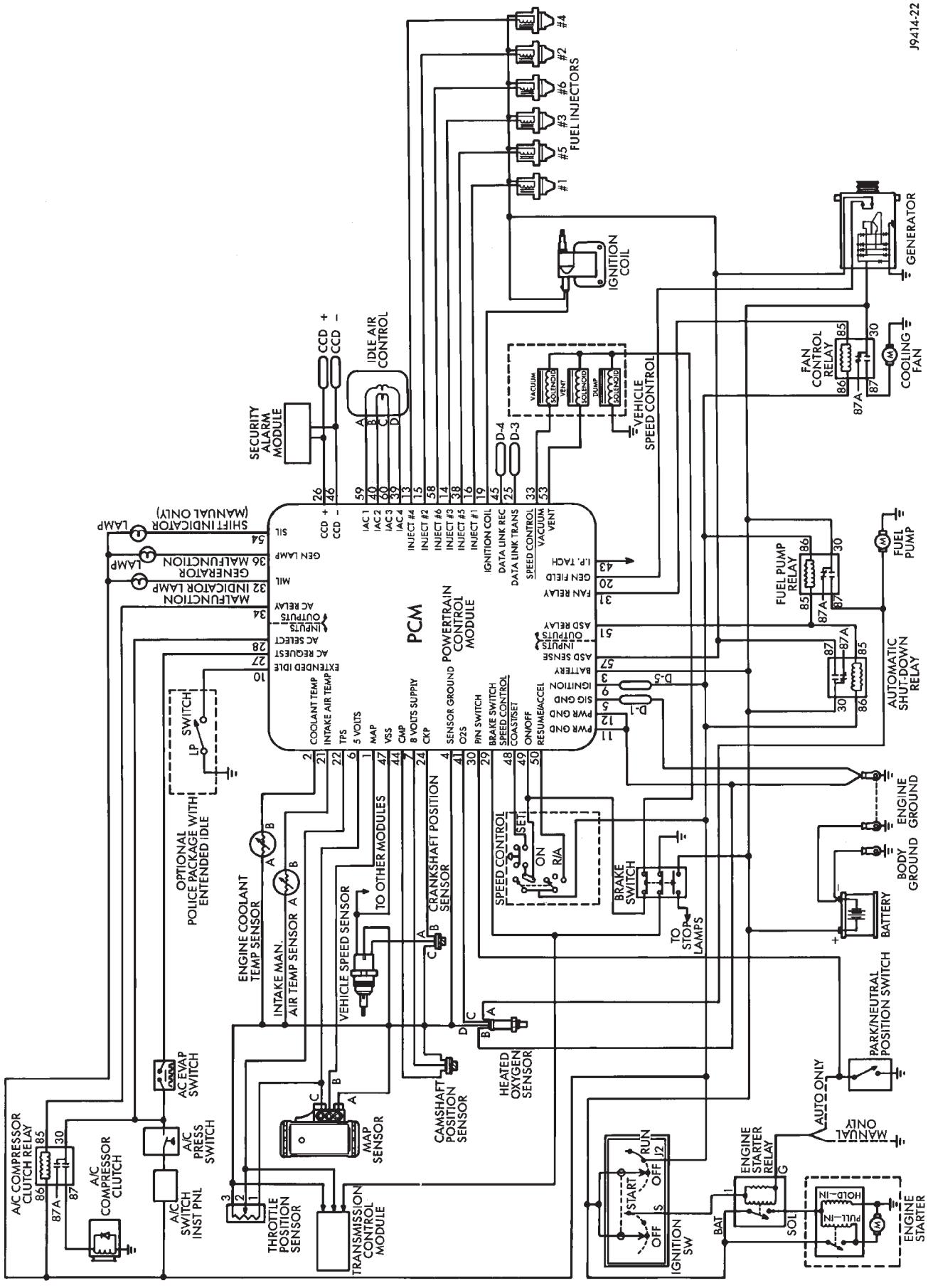

Fig. 33 System Schematic—XJ Models with 4.0L Engine

AUTOMATIC SHUT DOWN (ASD) RELAY TESTING

To perform a complete test of the ASD relay and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the relay only, refer to Relays—Operation/Testing in this section of the group.

CAMSHAFT POSITION SENSOR TEST

Refer to Group 8D, Ignition Systems, for Camshaft Position Sensor testing.

ENGINE COOLANT TEMPERATURE SENSOR TEST

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

Disconnect wire harness connector from engine coolant temperature sensor (Fig. 34).

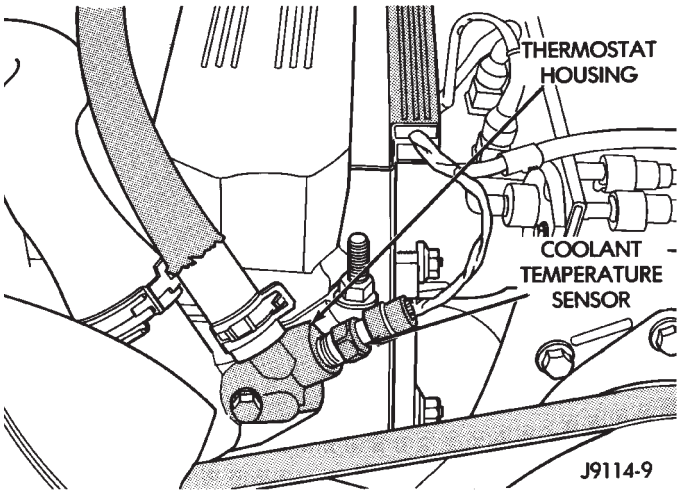

Fig. 34 Coolant Temperature Sensor—Typical

Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance should be less than 1000 ohms with the engine at its correct operating temperature. Refer to the Coolant Temperature Sensor/Manifold Air Temperature Sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test continuity of the wire harness. Do this between the Powertrain Control Module (PCM) wire harness connector terminal-2 and the sensor connector terminal. Also test continuity of wire harness terminal-4 to the sensor connector terminal. Repair the wire harness if an open circuit is indicated.

INTAKE AIR TEMPERATURE SENSOR TEST

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/MANIFOLD AIR TEMPERATURE

TEMPERATURE		RESISTANCE (OHMS)	
C	F	MIN	MAX
−40	−40	291,490	381,710
−20	−4	85,850	108,390
−10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

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Disconnect the wire harness connector from the intake manifold air temperature sensor (Figs. 35 or 36).

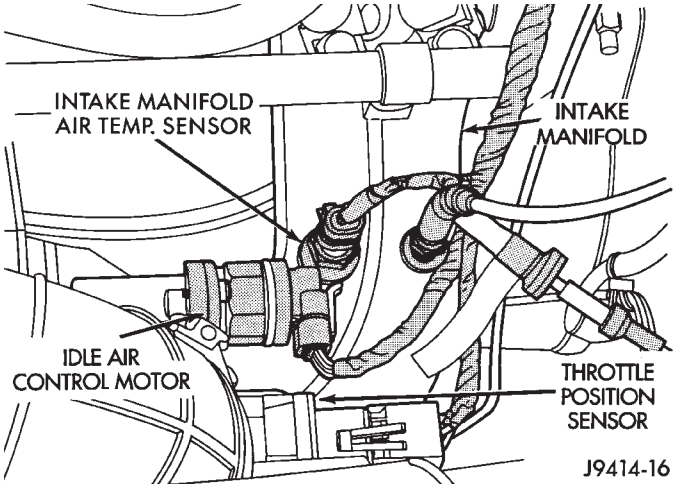


Fig. 35 Air Temperature Sensor—2.5L Engine

Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance should be less than 4000 ohms with the engine at operating temperature. The longer the engine idles, the warmer the intake manifold temperature will become. Refer to the Coolant Temperature Sensor/Manifold Air Temperature Sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test the resistance of the wire harness. Do this between the Powertrain Control Module (PCM) wire

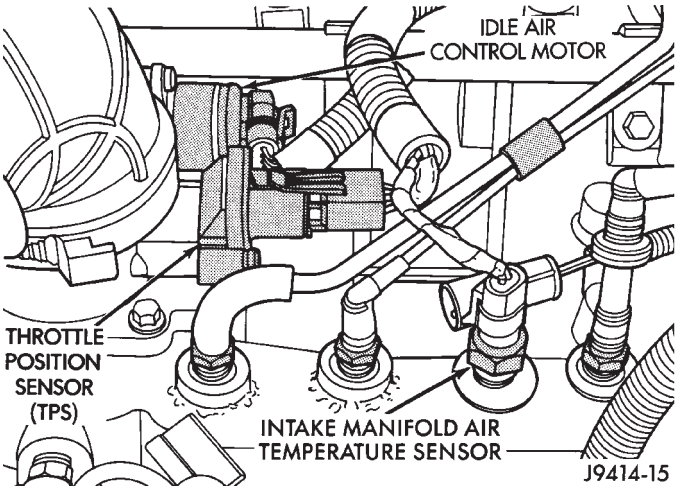


Fig. 36 Air Temperature Sensor—4.0L Engine

harness connector terminal-2 and the sensor connector terminal. Also test terminal-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

FUEL PUMP RELAY TESTING

For testing this relay, refer to Relays—Operation/ Testing in this section of the group.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of the MAP sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

Inspect the MAP sensor vacuum hose connections at the throttle body and sensor. Repair as necessary.

CAUTION: When testing, do not remove the electrical connector from MAP sensor (Fig. 37). Be sure that the MAP sensor harness wires are not damaged by the test meter probes.

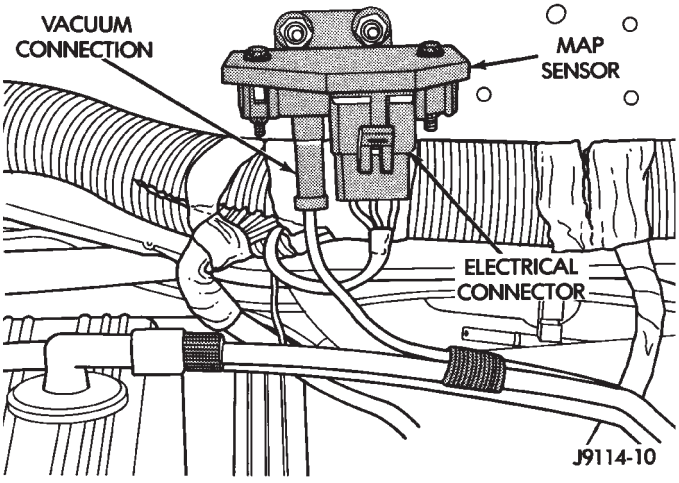


Fig. 37 MAP Sensor—Typical

Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (as marked on the sensor body) (Fig. 38). With the ignition switch ON and the engine OFF, output voltage should be 4-to-5 volts. The voltage should drop to 1.5-to-2.1 volts with a neutral-hot idle speed condition.

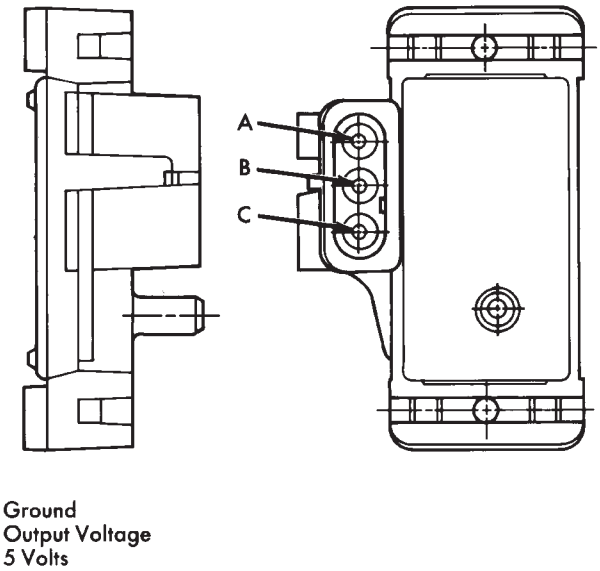


Fig. 38 MAP Sensor Connector Terminals—Typical

Test Powertrain Control Module (PCM) (terminal-5) for the same voltage described above to verify the wire harness condition. Repair as necessary.

Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 38) with the ignition ON and engine OFF. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at terminal-6 of the PCM wire harness connector. Repair or replace the wire harness as necessary.

Test the MAP sensor ground circuit at sensor connector terminal-A (Fig. 38) and PCM connector terminal-4. Repair the wire harness if necessary.

Test the MAP sensor ground circuit at the PCM connector between terminal-4 and terminal-11 with an ohmmeter. If the ohmmeter indicates an open circuit, inspect for a defective sensor ground connection. Refer to Group 8W, Wiring for location of engine grounds. If the ground connection is good, replace the PCM. If terminal-4 has a short circuit to 12 volts, correct this condition before replacing the PCM.

CRANKSHAFT POSITION SENSOR TEST

Refer to Group 8D, Ignition Systems for test procedures.

EXTENDED IDLE SWITCH TEST

OPTIONAL POLICE PACKAGE ONLY

OPERATION

The extended idle switch is used to raise the engine idle speed to approximately 1000 rpm when the shifter is in either the Park or Neutral position. A rocker-type 2-wire switch (extended idle switch) is mounted to the instrument panel. **This switch is available only with 4.0L engine when supplied with the optional police package.**

TESTING

The extended idle switch will control a ground circuit going to the powertrain control module (PCM). When a ground signal (through this switch) has been received at pin number 10 in the PCM, engine idle speed will increase.

Bring the engine to normal operating temperature and turn the extended idle switch to the ON position. Engine speed should now increase to approximately 1000 rpm when the shifter is in either the Park or Neutral position. If engine speed does not increase, apply a good ground to pin number 10 at the PCM using a small paper clip. Be careful not to damage the wiring with the paper clip. If the engine speed now increases, it can be assumed that the PCM is functioning correctly. Check the instrument panel mounted switch for a closed ground circuit when in the ON position. If the engine speed will not increase after applying a ground to pin number 10, replace the PCM. Refer to Group 8W, Wiring Diagrams for circuit and wiring information.

THROTTLE POSITION SENSOR (TPS) TEST

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The throttle position sensor (TPS) can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal (Figs. 39 or 40).

With the ignition key in the ON position, backprobe the TPS connector. Check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, TPS output voltage should must be greater than 200 millivolts. At wide open throttle, TPS output voltage must be less than 4.8 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

TORQUE CONVERTER CLUTCH RELAY TEST

To test the relay only, refer to Relays—Operation/Testing in this section of the group. To test the torque converter clutch circuit and related components, refer to the appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool.

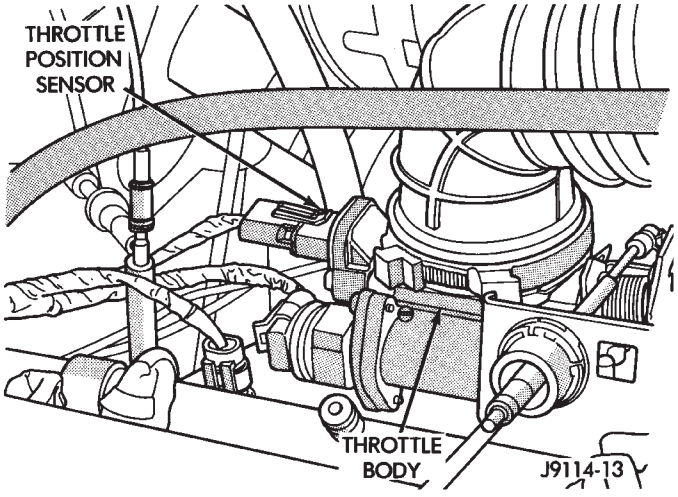


Fig. 39 TPS Testing—2.5L Engine

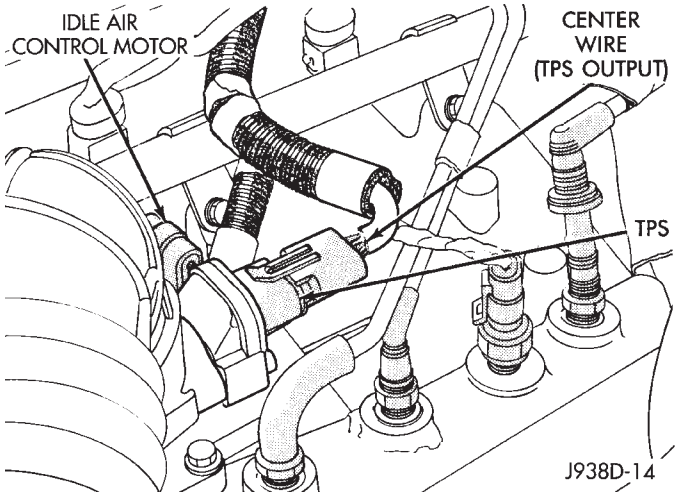


Fig. 40 TPS Testing—4.0L Engine

VEHICLE SPEED SENSOR TEST

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

OXYGEN SENSOR (O2S) HEATING ELEMENT TEST

To perform a complete test of the O2S sensor (Fig. 41) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The oxygen sensor heating element can be tested with an ohmmeter as follows:

With the sensor at room temperature 25 degrees C (77 degrees F), disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 5 and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

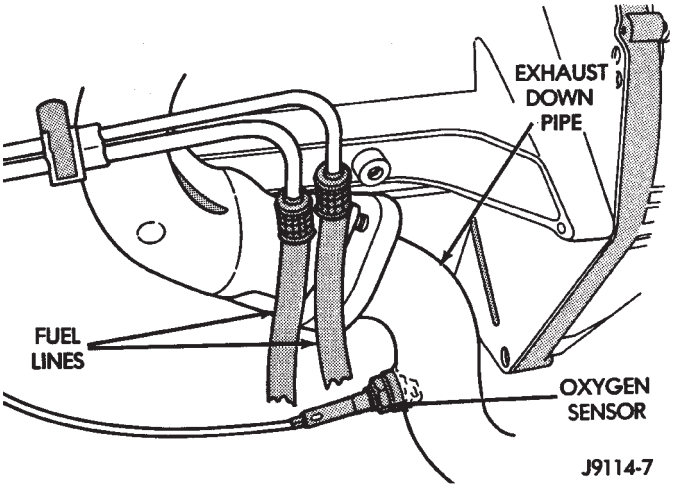


Fig. 41 Oxygen Sensor—Typical

IDLE AIR CONTROL MOTOR TEST

Idle Air Control (IAC) Motor operation can be tested using special exerciser tool number 7558 (Fig. 42).

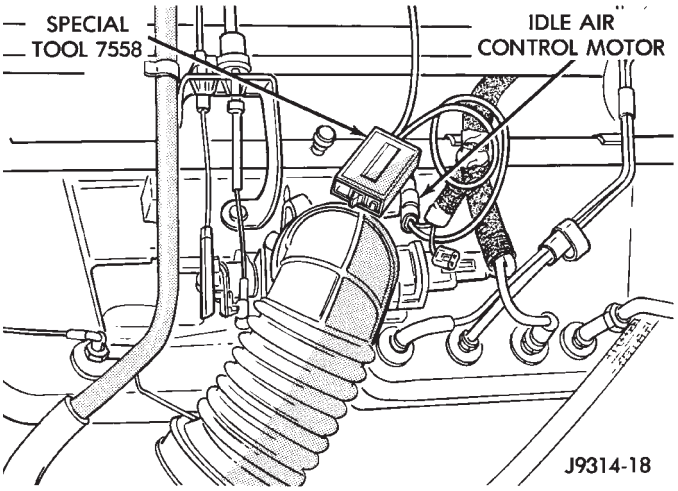


Fig. 42 IAC Motor Testing—Typical

CAUTION: Proper safety precautions must be taken when testing the idle air control motor:

- Set the parking brake and block the drive wheels
- Route all tester cables away from the cooling fans, drive belt, pulleys and exhaust components
- Provide proper ventilation while operating the engine
- Always return the engine idle speed to normal before disconnecting the exerciser tool

(1) With the ignition OFF, disconnect the IAC motor wire connector at throttle body (Fig. 42).

(2) Plug the exerciser tool number 7558 harness connector into the IAC motor.

(3) Connect the red clip of exerciser tool 7558 to battery positive terminal. Connect the black clip to negative battery terminal. The red light on the exerciser tool will flash when the tool is properly connected.

(4) Start engine.

When the switch on the tool is in the HIGH or LOW position, the light on the tool will flash. This indicates that voltage pulses are being sent to the IAC stepper motor.

(5) Move the switch to the HIGH position. The engine speed should increase. Move the switch to the LOW position. The engine speed should decrease.

(a) If the engine speed changes while using the exerciser tool, the IAC motor is functioning properly. Disconnect the exerciser tool and connect the IAC motor wire connector to the stepper motor.

(b) If the engine speed does not change, turn the ignition OFF and proceed to step (6). Do not disconnect exerciser tool from the IAC motor.

(6) Remove the IAC motor from the throttle body. Do not remove IAC motor housing from throttle body.

CAUTION: When checking IAC motor operation with the motor removed from the throttle body, do not extend the pintle (Fig. 43) more than 6.35 mm (.250 in). If the pintle is extended more than this amount, it may separate from the IAC motor. The IAC motor must be replaced if the pintle separates from the motor.

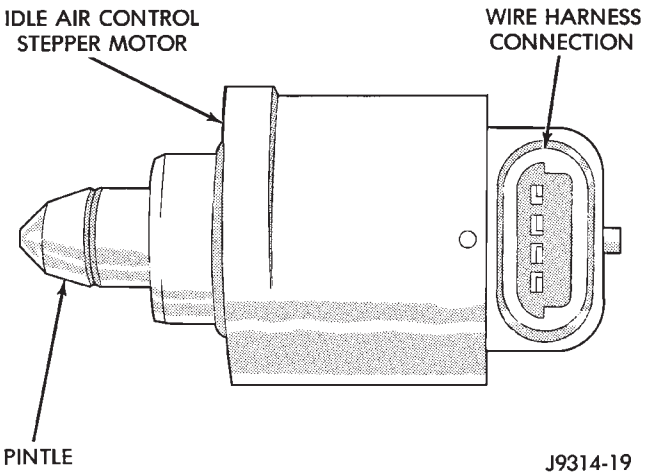


Fig. 43 Idle Air Control (IAC) Motor Pintle

(7) With the ignition OFF, cycle the exerciser tool switch between the HIGH and LOW positions. Observe the pintle. The pintle should move in-and-out of the motor.

(a) If the pintle does not move, replace the idle air control motor. Start the engine and test the replacement motor operation as described in step (5).

(b) If the pintle operates properly, check the idle air control motor bore in the throttle body bore for blockage and clean as necessary. Reinstall the idle air control motor and retest. If blockage is not

found, refer to the DRB scan tool and the appropriate Powertrain Diagnostics Procedures service manual.

RELAYS—OPERATION/TESTING

OPERATION

The following operations/tests apply to these relays only: automatic shut down (ASD), fuel pump and torque converter clutch. For operations/tests on all other relays, refer to the appropriate section of this service manual.

The relay terminal numbers from (Fig. 44) can be found on the bottom of the relay:

- Terminal number 30 is connected to battery voltage and can be switched or B+ (hot) at all times.
- Terminal number 87A is connected (a circuit is formed) to terminal 30 in the de-energized (normally OFF) position.
- Terminal number 87 is connected (a circuit is formed) to terminal 30 in the energized (ON) position. Terminal number 87 then supplies battery voltage to the component being operated.
- Terminal number 86 is connected to a switched (+) power source.
- Terminal number 85 is grounded by the powertrain control module (PCM).

TESTING

(1) Remove relay before testing.

(2) Using an ohmmeter, perform a resistance test between terminals 85 and 86. Resistance value (ohms) should be 75 ±5 ohms for resistor equipped relays.

(3) Connect the ohmmeter between terminals number 87A and 30. Continuity should be present at this time.

(4) Connect the ohmmeter between terminals number 87 and 30. Continuity should not be present at this time.

(5) Use a set of jumper wires (16 gauge or smaller). Connect one jumper wire between terminal number 85 (on the relay) to the ground side (-) of a 12 Volt power source.

(6) Attach the other jumper wire to the positive side (+) of a 12V power source. Do not connect the jumper wire to relay at this time.

CAUTION: DO NOT ALLOW THE OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THESE TESTS. DAMAGE TO OHMMETER MAY RESULT.

(7) Attach the other jumper wire (12V +) to terminal number 86. This will activate the relay. Continuity should now be present between terminals number

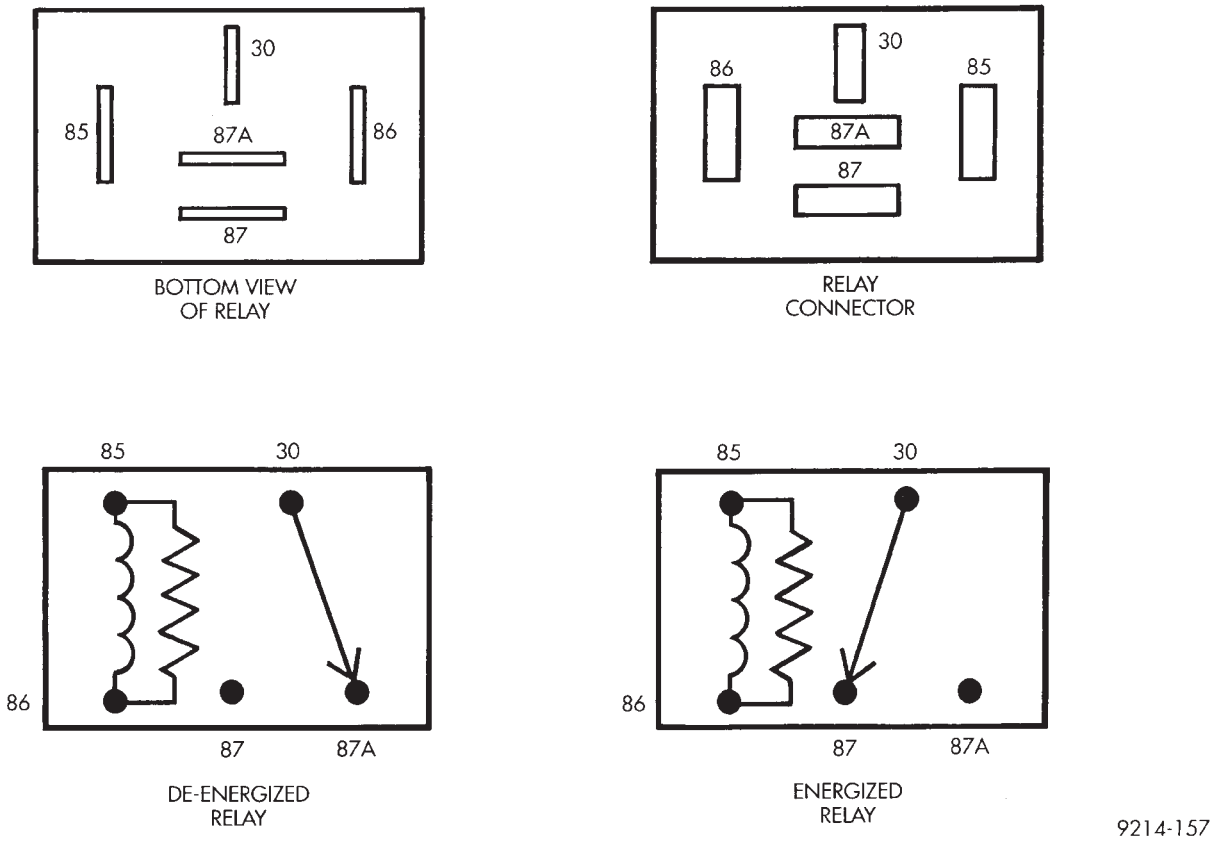


Fig. 44 Relay Terminals

87 and 30. Continuity should not be present between terminals number 87A and 30.

(8) Disconnect jumper wires from relay and 12 Volt power source.

If continuity or resistance tests did not pass, replace relay. If tests passed, refer to Group 8W, Wiring Diagrams for additional circuit information. Also refer to the appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool.

STARTER MOTOR RELAY TEST

Refer to Group 8A, Battery/Starting/Charging/System Diagnostics, for starter motor relay testing.

INJECTOR TEST

Disconnect the injector wire connector from the injector. Place an ohmmeter on the injector terminals. Resistance reading should be approximately 14.5 ohms ±1.2 ohms at 20°C (68°F). Proceed to following Injector Diagnosis chart.

FUEL SYSTEM PRESSURE TEST

Refer to the Fuel Delivery System section of this group. See Fuel System Pressure Test.

ON-BOARD DIAGNOSTICS (OBD)

The Powertrain Control Module (PCM) has been programmed to monitor many different circuits of the fuel injection system. If a problem is sensed in a monitored circuit often enough to indicate an actual problem, a Diagnostic Trouble Code (DTC) is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. If the problem is repaired or ceases to exist, the PCM cancels the DTC after 51 engine starts.

Certain criteria must be met for a diagnostic trouble code (DTC) to be entered into PCM memory. The criteria may be a specific range of engine rpm, engine temperature and/or input voltage to the PCM.

It is possible that a DTC for a monitored circuit may not be entered into memory even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. Example: assume that one of the criteria for the MAP sensor circuit is that the engine must be operating between 750 and 2000 rpm to be monitored for a DTC. If the MAP sensor output circuit shorts to ground when the engine rpm is above 2400 rpm, a 0 volt input will be seen by the PCM. A DTC will not be entered into memory because the condition does not occur within the specified rpm range.

A DTC indicates that the powertrain control module (PCM) has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

There are several operating conditions that the PCM does not monitor and set a DTC for. Refer to the following Monitored Circuits and Non-Monitored Circuits in this section.

MONITORED CIRCUITS

The powertrain control module (PCM) can detect certain problems in the fuel injection system.

Open or Shorted Circuit - The PCM can determine if sensor output (which is the input to PCM) is within proper range. It also determines if the circuit is open or shorted.

Output Device Current Flow - The PCM senses whether the output devices are hooked up.

If there is a problem with the circuit, the PCM senses whether the circuit is open, shorted to ground (-), or shorted to (+) voltage.

Oxygen Sensor - The PCM can determine if the oxygen sensor is switching between rich and lean. This is, once the system has entered Closed Loop. Refer to Open Loop/Closed Loop Modes Of Operation in the Component Description/System Operation section for an explanation of Closed (or Open) Loop operation.

NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems or conditions that could have malfunctions that result in driveability problems. A Diagnostic Trouble Code (DTC) may not be displayed for these conditions.

Fuel Pressure: Fuel pressure is controlled by the vacuum assisted fuel pressure regulator. 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 an oxygen sensor DTC to be stored in the PCM.

Secondary Ignition Circuit: The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open circuited spark plug cables.

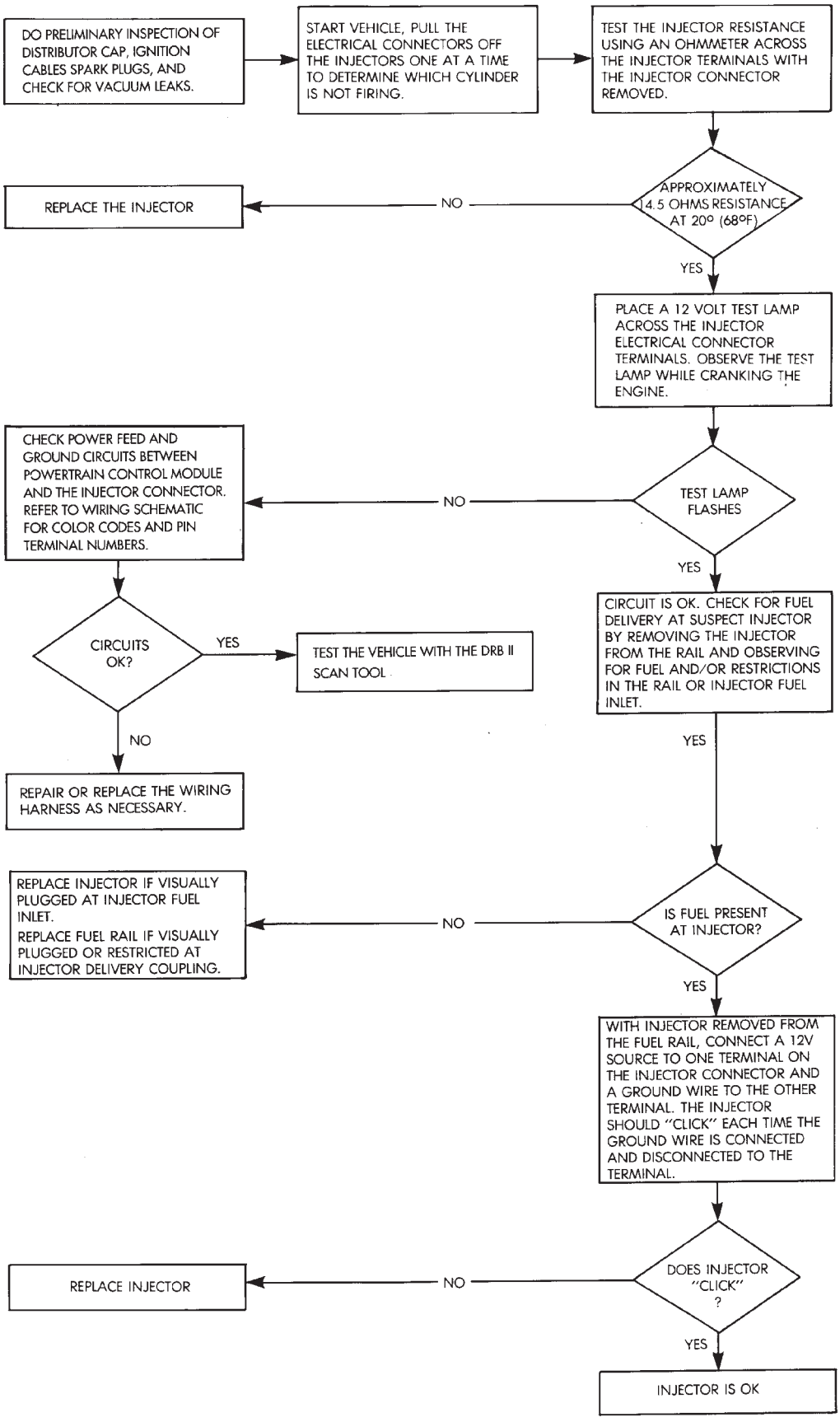
Engine Timing: The PCM cannot detect an incorrectly indexed timing chain, camshaft sprocket or crankshaft sprocket. The PCM also cannot detect an incorrectly indexed distributor. However, these could result in a rich or lean condition causing an oxygen sensor DTC to be stored in the PCM.

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.

Fuel Injector Malfunctions: The PCM cannot determine if the fuel injector is clogged, or the wrong injector is installed. However, these could result in a rich or lean condition causing an oxygen sensor DTC to be stored in the PCM.

INJECTOR DIAGNOSIS—VEHICLE RUNS ROUGH AND/OR HAS A MISS



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Excessive Oil Consumption: Although the PCM monitors exhaust stream oxygen content through oxygen sensor (closed loop), it cannot determine excessive oil consumption.

Throttle Body Air Flow: The PCM cannot detect a clogged or restricted air cleaner inlet or air filter element.

Evaporative System: The PCM will not detect a restricted, plugged or loaded EVAP canister.

Vacuum Assist: Leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices are not monitored by the PCM. However, a vacuum leak at the MAP sensor will be monitored and a diagnostic trouble code (DTC) will be generated by the PCM.

Powertrain Control Module (PCM) System Ground: The PCM cannot determine a poor system ground. However, a DTC may be generated as a result of this condition.

Powertrain Control Module (PCM) Connector Engagement: The PCM cannot determine spread or damaged connector pins. However, a DTC may be generated as a result of this condition.

HIGH AND LOW LIMITS

The powertrain control module (PCM) compares input signal voltages from each input device. It will establish high and low limits that are programmed into it for that device. If the input voltage is not within specifications and other Diagnostic Trouble Code (DTC) criteria are met, a DTC will be stored in memory. Other DTC criteria might include engine rpm limits or input voltages from other sensors or switches. The other inputs might have to be sensed by the PCM when it senses a high or low input voltage from the control system device in question.

ACCESSING DIAGNOSTIC TROUBLE CODES

A stored Diagnostic Trouble Code (DTC) can be displayed by cycling the ignition key On-Off-On-Off-On within three seconds and observing the Malfunction Indicator Lamp. This lamp was formerly referred to as the Check Engine Lamp. The lamp is located on the instrument panel.

They can also be displayed through the use of the Diagnostic Readout Box (DRB) scan tool. The DRB scan tool connects to the data link connector in the engine compartment (Figs. 45 or 46). For operation of the DRB, refer to the appropriate Powertrain Diagnostic Procedures service manual.

EXAMPLES:

- If the lamp flashes 4 times, pauses and flashes 1 more time, a flashing Diagnostic Trouble Code (DTC) number 41 is indicated.
- If the lamp flashes 4 times, pauses and flashes 6 more times, a flashing Diagnostic Trouble Code (DTC) number 46 is indicated.

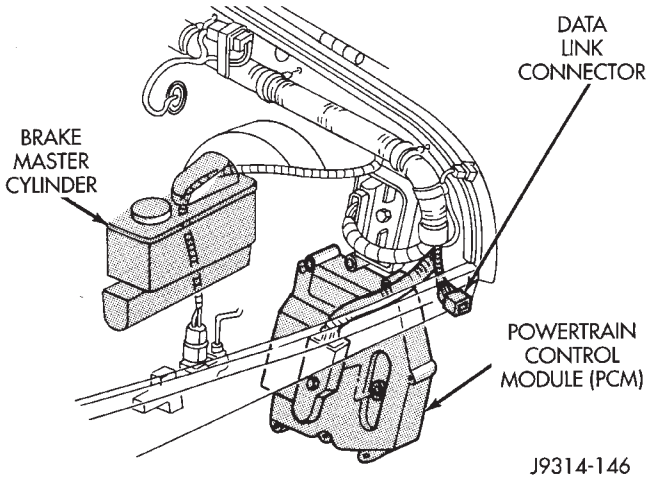

Fig. 45 Data Link Connector—YJ Models—Typical

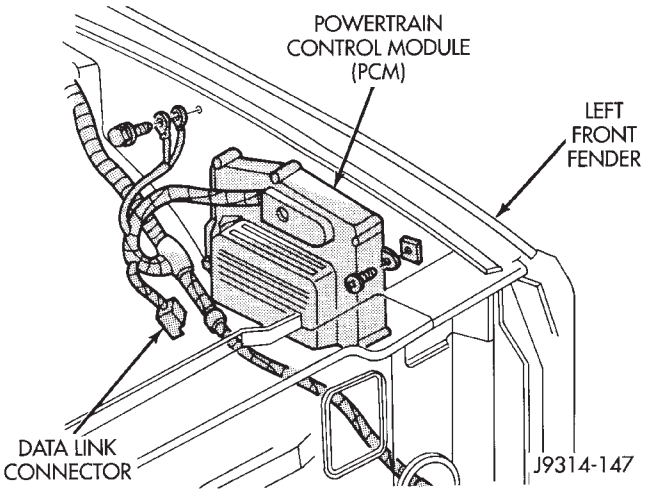

Fig. 46 Data Link Connector—XJ Models—Typical

After any stored DTC information has been observed, the display will end with a flashing DTC number 55. This will indicate the end of all stored information.

Refer to the Diagnostic Trouble Code (DTC) charts for DTC identification.

If the problem is repaired or ceases to exist, the Powertrain Control Module (PCM) cancels the DTC after 51 engine starts.

Diagnostic Trouble Codes indicate the results of a failure, but never identify the failed component directly.

The circuits of the data link connector are shown in (Fig. 47).

ERASING TROUBLE CODES

After the problem has been repaired, use the DRB scan tool to erase a Diagnostic Trouble Code (DTC). Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

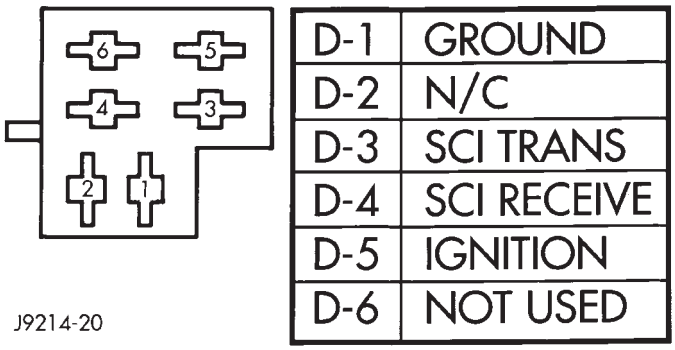

Fig. 47 Data Link Connector Schematic

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

DIAGNOSTIC TROUBLE CODE (DTC)

On the following pages, a list of diagnostic trouble codes is provided for the 2.5L 4 cylinder and 4.0L 6 cylinder engines. A DTC indicates that the powertrain control module (PCM) has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
11*	No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
12*	Battery Disconnect	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
13**	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading at start-up.
14**	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
	or	
	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
15**	No Vehicle Speed Sensor Signal	No vehicle distance (speed) sensor signal detected during road load conditions.
17*	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	O2S Stays at Center	Neither rich or lean condition detected from the oxygen sensor input.
	or	
	O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range.
22**	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
	or	
	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
23**	Intake Air Temp Sensor Voltage Low	Intake air temperature sensor input below the minimum acceptable voltage.
	or	
	Intake Air Temp Sensor Voltage High	Intake air temperature sensor input above the maximum acceptable voltage.
24**	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
	or	
	Throttle Position Sensor Voltage Low	Throttle position sensor input below the minimum acceptable voltage.
25**	Idle Air Control Motor Circuits	A shorted condition detected in one or more of the idle air control motor circuits.
27*	Injector #1 Control Circuit	Injector #1 output driver does not respond properly to the control signal.
	or	
	Injector #2 Control Circuit	Injector #2 output driver does not respond properly to the control signal.
	or	
	Injector #3 Control Circuit	Injector #3 output driver does not respond properly to the control signal.
	or	
	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
	or	
	Injector #5 Control Circuit	Injector #5 output driver does not respond properly to the control signal.
	or	
	Injector #6 Control Circuit	Injector #6 output driver does not respond properly to the control signal.
33*	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
34*	Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
	or	
	Speed Control Switch Always Low	Speed Control switch input below the minimum acceptable voltage.
	or	
	Speed Control Switch Always High	Speed Control switch input above the maximum acceptable voltage.
35* (XJ Only)	Rad Fan Control Relay Circuits	An open or shorted condition detected in the radiator fan relay circuit.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
41**	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
42*	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
44*	Battery Temp Sensor Volts out of Limit	An open or shorted condition exists in the engine coolant temperature sensor circuit or a problem exists in the PCM's battery temperature voltage circuit.
46**	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
47**	Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output.
51**	O2S Signal Stays Below Center (Lean)	Oxygen sensor signal input indicates lean air/fuel ratio condition during engine operation.
52**	O2S Signal Stays Above Center (Rich)	Oxygen sensor signal input indicates rich air/fuel ratio condition during engine operation.
53*	Internal PCM Failure	PCM Internal fault condition detected.
	or	
	PCM Failure SPI Communications	PCM Internal fault condition detected.
54*	No Cam Sync Signal at PCM	No fuel sync (camshaft signal) detected during engine cranking.
55*	N/A	Completion of diagnostic trouble code display on the Malfunction Indicator Lamp (Check Engine Lamp).
62*	PCM Failure SPI miles not stored	Unsuccessful attempt to update SPI miles in the PCM EEPROM.
63*	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

MULTI-PORT FUEL INJECTION (MFI)—COMPONENT REMOVAL/INSTALLATION

INDEX

ACCELERATOR PEDAL AND THROTTLE CABLE

Refer to the Accelerator Pedal and Throttle Cable section of this group for removal/installation procedures.

AIR CONDITIONING (A/C) CLUTCH RELAY

The A/C clutch relay is located in the Power Distribution Center (PDC) (Figs. 1 or 2). For location of this relay within the PDC, refer to label on PDC cover.

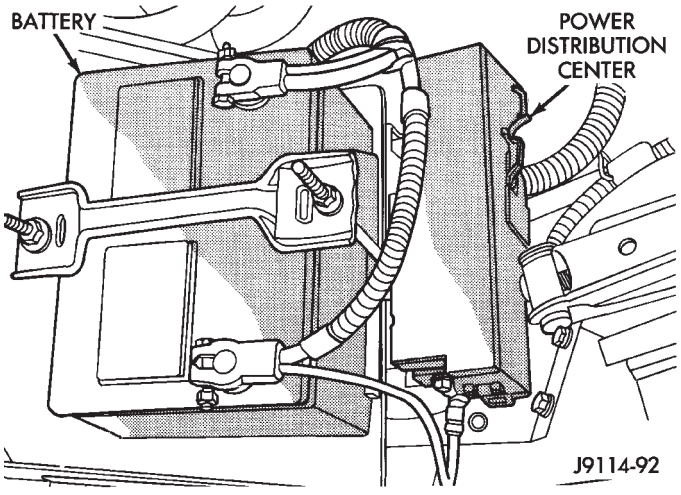

Fig. 1 PDC—YJ Models

AIR CLEANER HOUSING

Refer to Group 25, Emission Control System.

AIR FILTER

Refer to Group 25, Emission Control System.

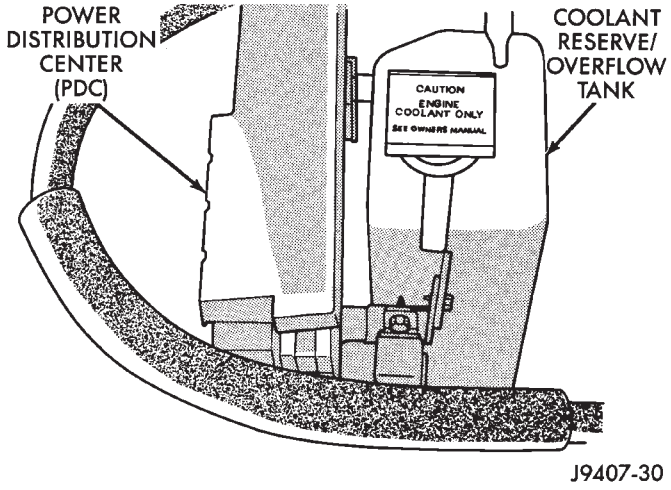

Fig. 2 PDC—XJ Models

AUTOMATIC SHUT DOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (Figs. 1 or 2) (PDC). For location of this relay within the PDC, refer to label on PDC cover.

BRAKE SWITCH

Refer to Group 5, Brakes for removal/installation procedures.

CAMSHAFT POSITION SENSOR

For removal/installation procedures, refer to Group 8D, Ignition System. See Camshaft Position Sensor.

INTAKE AIR TEMPERATURE SENSOR

The intake manifold air temperature sensor is installed into the intake manifold plenum (Figs. 3 or 4).

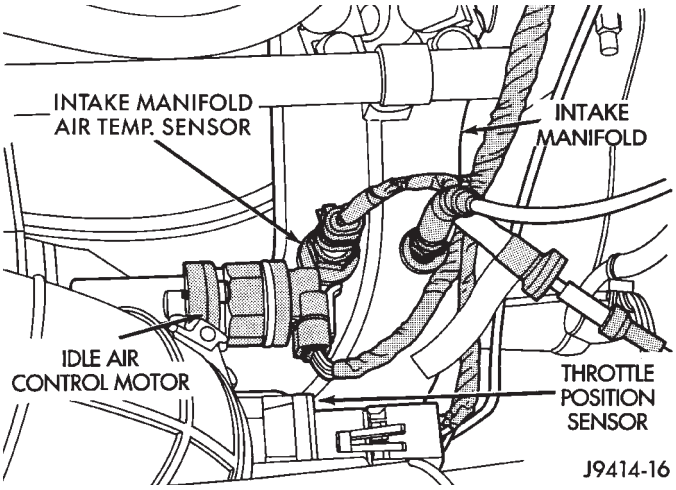

Fig. 3 Sensor Location—2.5L Engine

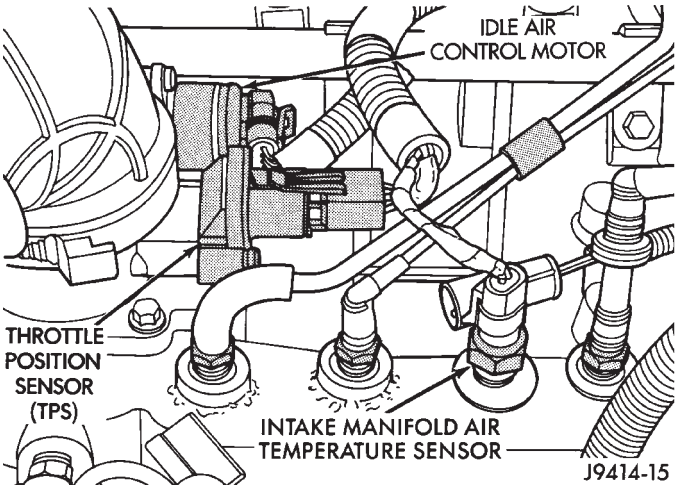

Fig. 4 Sensor Location—4.0L Engine

REMOVAL

(1) Disconnect the electrical connector from the sensor.

(2) Remove the sensor from the intake manifold.

INSTALLATION

(1) Install the sensor into the intake manifold. Tighten the sensor to 28 N·m (20 ft. lbs.) torque.

(2) Connect the electrical connector to the sensor.

CRANKSHAFT POSITION SENSOR

For description, operation and removal/installation procedures, refer to Group 8D, Ignition Systems in this manual.

ENGINE COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is installed in the thermostat housing (Fig. 5).

REMOVAL

(1) Drain cooling system until the coolant level is below the cylinder head. Observe the **WARNINGS** in Group 7, Cooling.

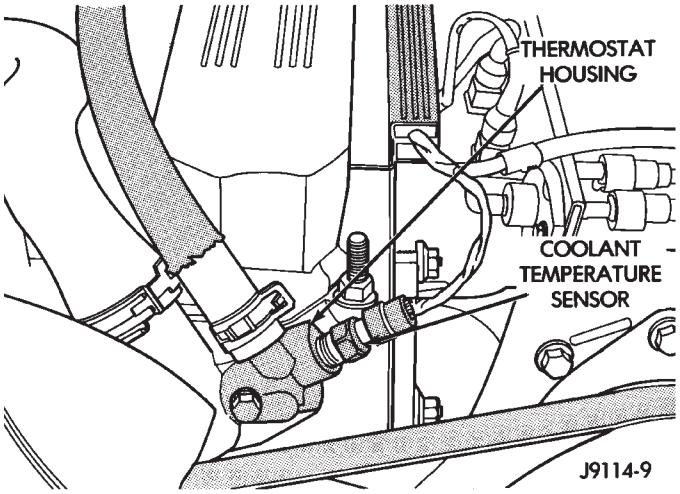

Fig. 5 Engine Coolant Temperature Sensor—Typical

(2) Disconnect the coolant temperature sensor wire connector.

(3) Remove the sensor from the thermostat housing (Fig. 5).

INSTALLATION

(1) Install coolant temperature sensor into the cylinder block. Tighten to 28 N·m (21 ft. lbs.) torque.

(2) Connect the wire connector.

(3) Fill the cooling system. Refer to Group 7, Cooling System.

FUEL FILTER

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

FUEL INJECTOR

REMOVAL

(1) Remove the fuel rail. Refer to Fuel Rail Removal in this section.

(2) Remove the clip(s) that retain the fuel injector(s) to the fuel rail (Fig. 6).

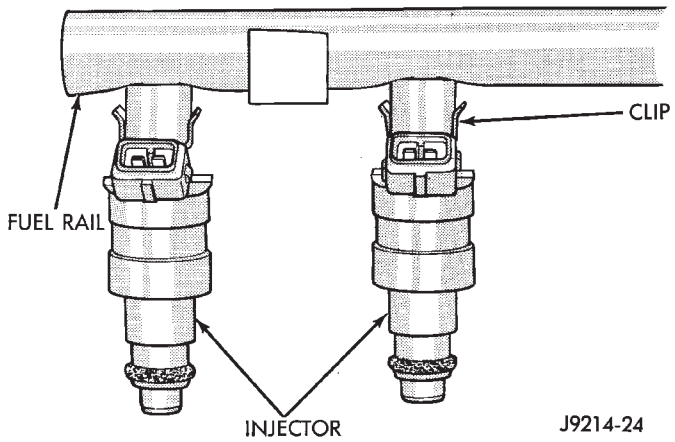

Fig. 6 Injector Retaining Clips

INSTALLATION

(1) Install the fuel injector(s) into the fuel rail assembly and install retaining clip(s).

(2) Install fuel rail. Refer to Fuel Rail Installation in this section.

(3) Start engine and check for fuel leaks.

FUEL PUMP MODULE

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

FUEL PUMP RELAY

The Fuel Pump relay is located in the Power Distribution Center (PDC) (Figs. 1 or 2). For location of this relay within the PDC, refer to label on PDC cover.

FUEL RAIL ASSEMBLY

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL RAIL.

(1) Remove fuel tank filler tube cap.

(2) Disconnect the negative battery cable from battery.

(3) Perform the Fuel System Pressure Release Procedure as described in the Fuel Delivery System section of this Group.

(4) Remove and numerically attach a tag (if fuel injector is not already tagged), the injector harness connectors. Do this at each injector (Fig. 7).

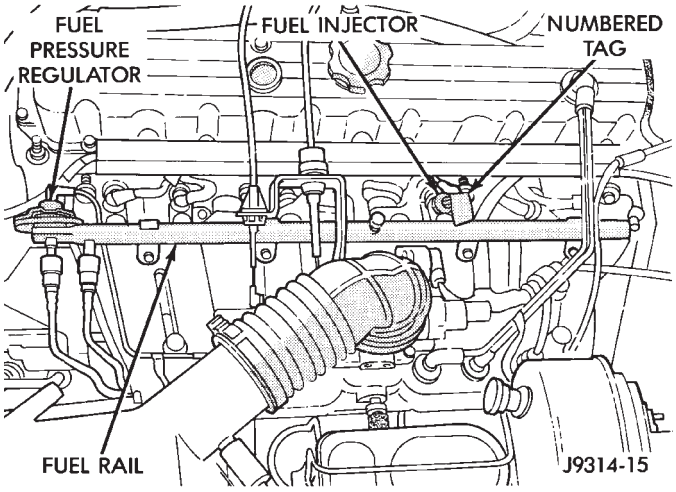

Fig. 7 Fuel Injector Harness—Typical

(5) Disconnect vacuum line from fuel pressure regulator (Fig. 7).

(6) Disconnect fuel supply line from fuel rail and the fuel return line from fuel pressure regulator (Fig. 7). Refer to Fuel Tubes/Lines/Hoses and Clamps, or Quick-Connect Fittings. These can both be found in the Fuel Delivery section of this group.

(7) Remove fuel rail mounting bolts.

On models with automatic transmissions, it may be necessary to remove automatic transmission throttle line pressure cable (and bracket). This will aid in fuel rail assembly removal.

(8) Remove fuel rail by gently rocking until all the fuel injectors are out of the intake manifold.

INSTALLATION

(1) Position tips of all fuel injectors into the corresponding injector bore in the intake manifold. Seat injectors into manifold.

(2) Tighten fuel rail mounting bolts to 27 N·m (20 ft. lbs.) torque.

(3) Connect injector harness connectors to appropriate (tagged) injector.

(4) Connect both fuel lines to fuel rail.

(5) Connect vacuum supply line to fuel pressure regulator.

(6) Install protective cap to pressure test port fitting.

(7) Install fuel tank cap.

(8) Connect negative battery cable to battery.

(9) Start engine and check for fuel leaks.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER OR FUEL INJECTOR, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

Refer to the Fuel Delivery System section of this group. See Fuel Pressure Release procedure.

FUEL TANKS

Refer to the Fuel Tank section of this group for removal/installation procedures.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE

Refer to the Fuel Tank section of this group for removal/installation procedures.

FUEL TUBES/LINES/HOSES AND CLAMPS

Refer to the Fuel Delivery System section of this group for removal/installation procedures. Also refer to Quick-Connect Fittings in the Fuel Delivery section of this group.

IDLE AIR CONTROL (IAC) MOTOR

The IAC motor is mounted to the throttle body adjacent to the throttle position sensor (Fig. 8).

REMOVAL

(1) Disconnect the electrical connector from the IAC motor.

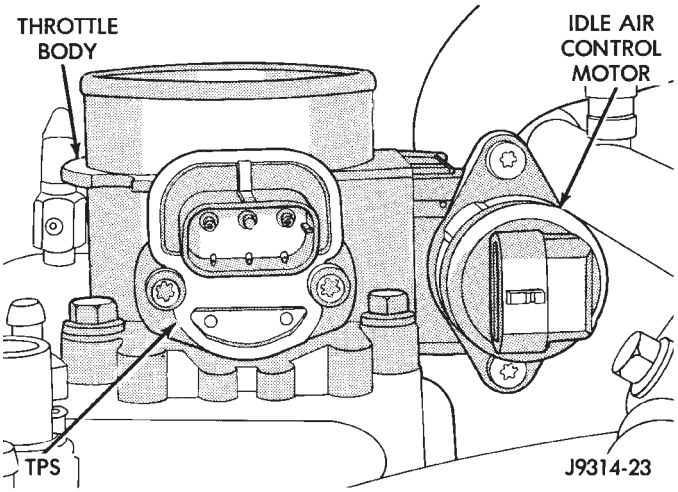

Fig. 8 Idle Air Control Motor—Removal/Installation—Typical

(2) Remove IAC motor torx head mounting bolts.
(3) Remove IAC motor.

INSTALLATION

(1) Install IAC motor into throttle body and tighten retaining bolts.
(2) Connect electrical connector to IAC motor.

IGNITION COIL

Refer to Group 8D, Ignition Systems for removal/installation procedures.

INTAKE MANIFOLD

Refer to Group 11, Exhaust System and Intake Manifold for removal/installation procedures.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor is located on the dash panel near the rear of the engine cylinder head (valve) cover (Fig. 9).

REMOVAL

(1) Disconnect the MAP sensor electrical connector (Fig. 9).
(2) Disconnect the MAP sensor vacuum supply hose (Fig. 9).
(3) Remove the MAP sensor mounting bolts and remove MAP sensor.

INSTALLATION

(1) Install MAP sensor to dash panel and secure with mounting bolts.
(2) Install the MAP sensor vacuum supply hose.
(3) Connect the MAP sensor electrical connector.

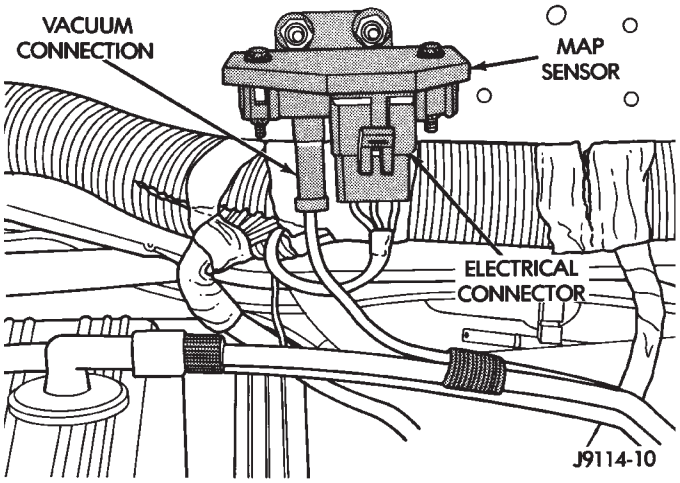

Fig. 9 MAP Sensor—Typical

OXYGEN (O2S) SENSOR

The O2S sensor is installed in the exhaust down pipe just below the exhaust manifold flange (Fig. 10).

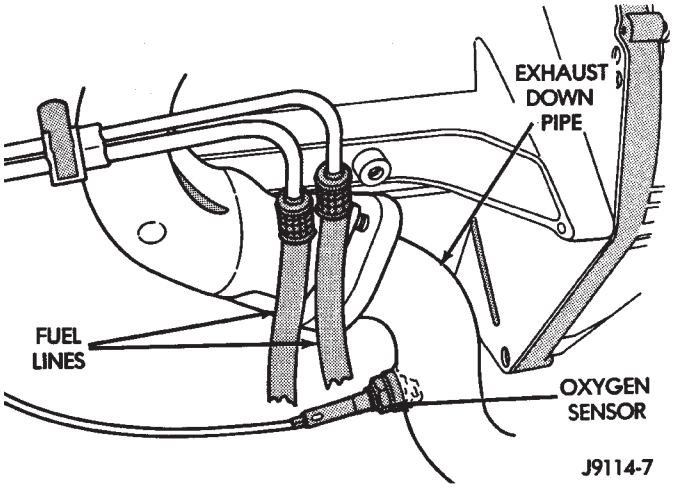

Fig. 10 Oxygen Sensor—Typical

REMOVAL

WARNING: THE EXHAUST MANIFOLD BECOMES VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support the vehicle.
(2) Separate the electrical connectors.
(3) Remove the O2S sensor from the exhaust manifold. Snap-On oxygen sensor wrench (number YA 8875) may be used for removal and installation.

INSTALLATION

Threads of new factory oxygen sensors are coated with anti-seize compound to aid in removal.

(1) Install the O2S sensor into the exhaust manifold and tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect the O2S sensor wire connector to the main harness.

(3) Lower the vehicle.

PARK NEUTRAL SWITCH

Refer to Group 21, Transmissions for park neutral switch service.

POWER STEERING PRESSURE SWITCH—2.5L ENGINE ONLY

The power steering pressure switch is installed in the power steering high pressure hose (Figs. 11 or 12).

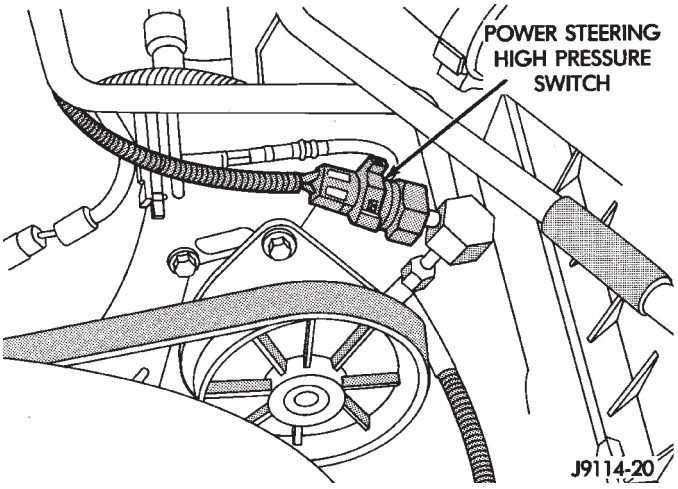

Fig. 11 Power Steering Pressure Switch—YJ Models

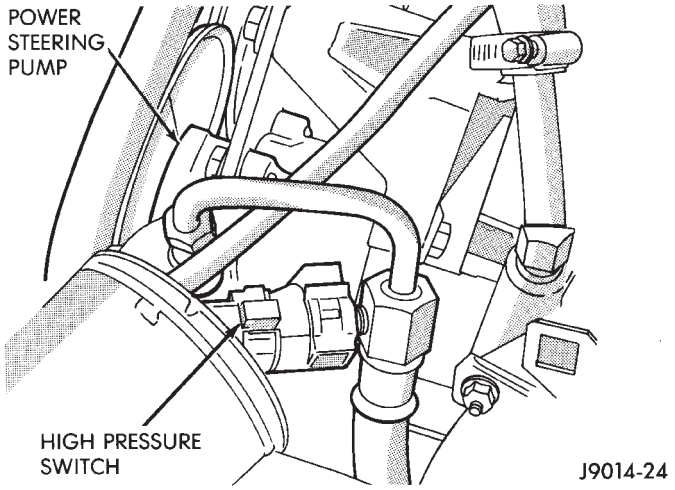

Fig. 12 Power Steering Pressure Switch—XJ Models

REMOVAL

(1) Disconnect the electrical connector from the power steering pressure switch.

(2) Place a small container or shop towel beneath the switch to collect any excess fluid.

(3) Remove the switch.

INSTALLATION

(1) Install the power steering switch.

(2) Connect the electrical connector to the switch.

(3) Check power steering fluid and add as necessary.

(4) Start the engine and again check power steering fluid. Add fluid if necessary.

POWERTRAIN CONTROL MODULE (PCM)

On XJ models, the PCM is located in the engine compartment next to the air cleaner (Fig. 13). On YJ models, the PCM is located in the engine compartment behind the windshield washer fluid reservoir (Fig. 14).

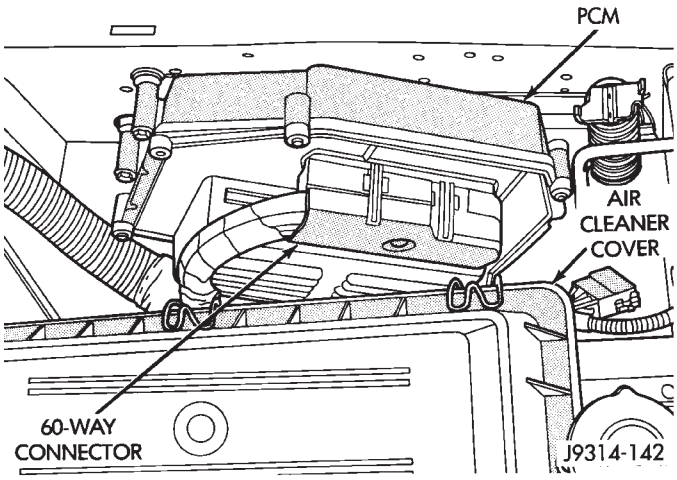

Fig. 13 PCM Location—XJ Models

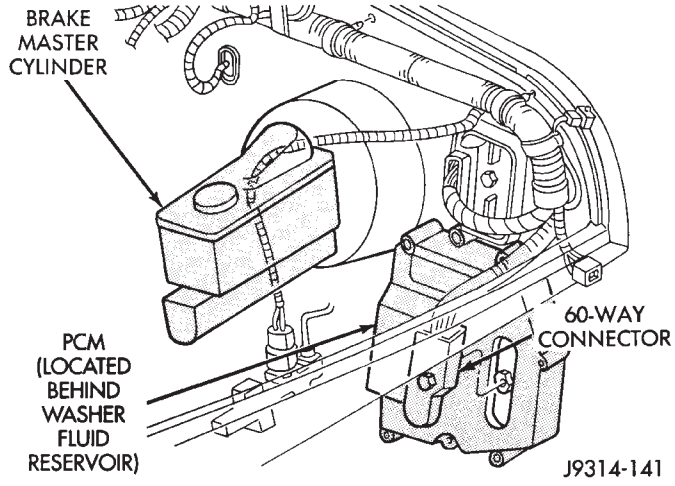

Fig. 14 PCM Location—YJ Models

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) YJ Models Only: Remove the windshield washer fluid tank.

(3) Loosen the 60-Way connector mounting bolt (Figs. 13 or 14).

(4) Remove the electrical connector by pulling straight back.

(5) Remove the three PCM mounting bolts.

(6) Remove PCM.

INSTALLATION

(1) After the PCM electrical connector has been separated from the PCM, inspect the pins for corrosion, being spread apart, bent or misaligned. Also inspect the pin heights in the connector. If the pin heights are different, this would indicate a pin has separated from the connector. Repair as necessary.

(2) Install PCM. Tighten three mounting bolts to 1 N·m (9 in. lbs.) torque.

(3) Engage 60-way connector into PCM. Tighten connector mounting bolt to 4 N·m (35 in. lbs.) torque.

(4) YJ Models: Install windshield washer fluid tank.

(5) Connect negative cable to battery.

QUICK-CONNECT FITTINGS

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

THROTTLE BODY

REMOVAL

(1) Disconnect the negative battery cable.

(2) Disconnect air cleaner hose from throttle body.

(3) Disconnect idle air control motor and throttle position sensor wire connectors.

(4) Disconnect accelerator cable, throttle cable (automatic transmission) and speed control cable (if equipped) from throttle arm (Fig. 15).

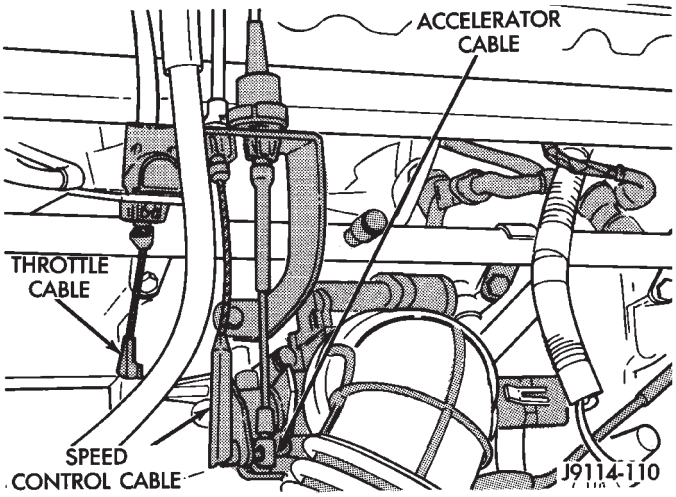

Fig. 15 Cables at Throttle Body

(5) Remove throttle body mounting bolts, throttle body and gasket. Discard old gasket (Fig. 16).

INSTALLATION

(1) Install throttle body and new gasket. Tighten throttle body mounting bolts to 12 N·m (9 ft. lbs.) torque.

(2) Connect idle air control motor and throttle position sensor wire connectors.

(3) Connect throttle linkage to throttle arm.

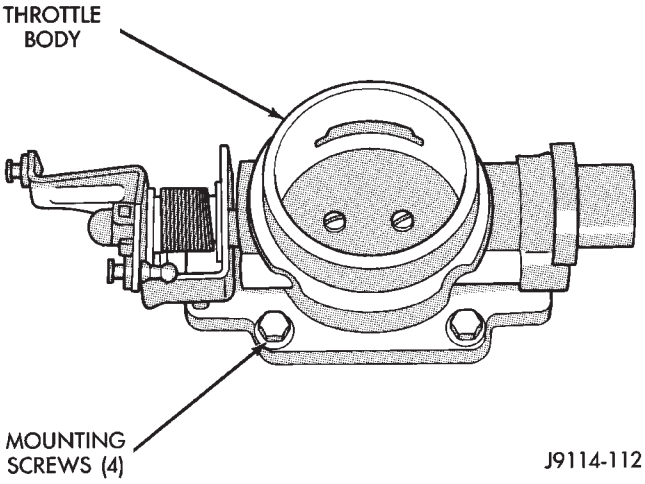

Fig. 16 Throttle Body—Removal/Installation—Typical

CAUTION: When the automatic transmission throttle cable is connected, it MUST be adjusted.

(4) If equipped with an automatic transmission, connect and adjust the transmission line pressure cable. Refer to Group 21, Transmissions for adjustment procedure.

(5) Install air cleaner hose to throttle body.

(6) Connect negative battery cable to battery.

THROTTLE POSITION SENSOR (TPS)

The TPS is mounted to the throttle body (Figs. 17 or 18).

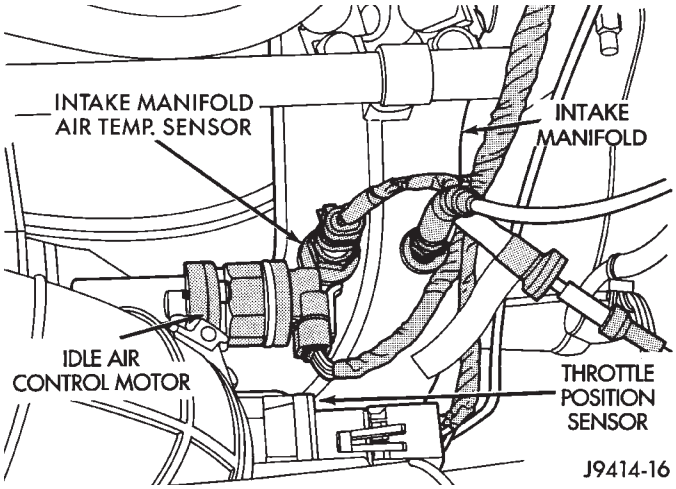

Fig. 17 TPS Location—2.5L Engine

REMOVAL

(1) Disconnect TPS electrical connector.

(2) Remove TPS mounting bolts.

(3) Remove TPS.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 19). The TPS must be installed so that it can be rotated a few degrees. (If

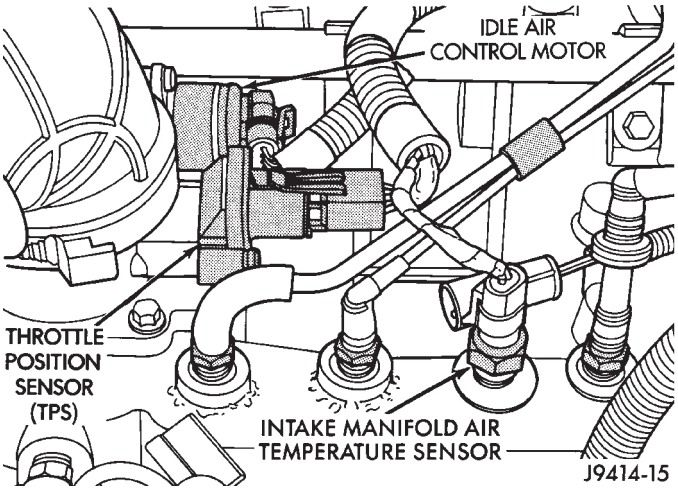

Fig. 18 TPS Location—4.0L Engine

the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

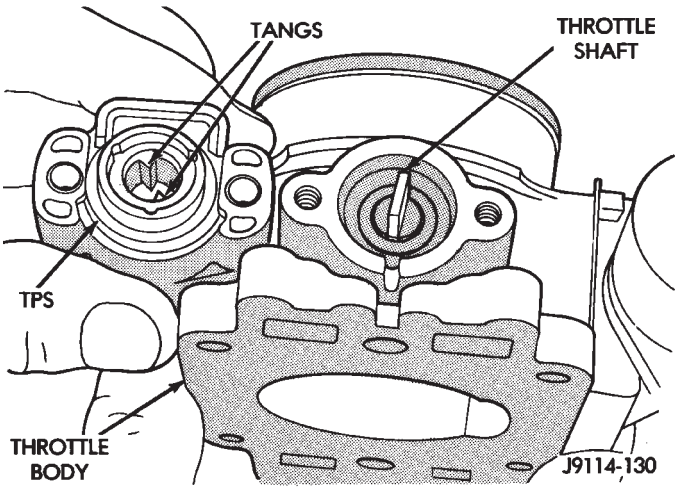

Fig. 19 Throttle Position Sensor—Installation

(1) Install the TPS and retaining bolts.

(2) Connect TPS electrical connector to TPS.

(3) Manually operate the throttle (by hand) to check for any TPS binding before starting the engine.

TORQUE CONVERTER CLUTCH RELAY

On YJ models, the TCC relay is located in the engine compartment. It is attached to the cowl panel with one bolt (Fig. 20). On XJ models, the TCC relay is located in the power distribution center (PDC) (Fig. 21). For location of this relay within the PDC, refer to label on PDC cover.

VEHICLE SPEED SENSOR

The vehicle speed sensor (Fig. 22) is located on the extension housing of the transmission on 2WD models. It is located on the transfer case on 4WD models.

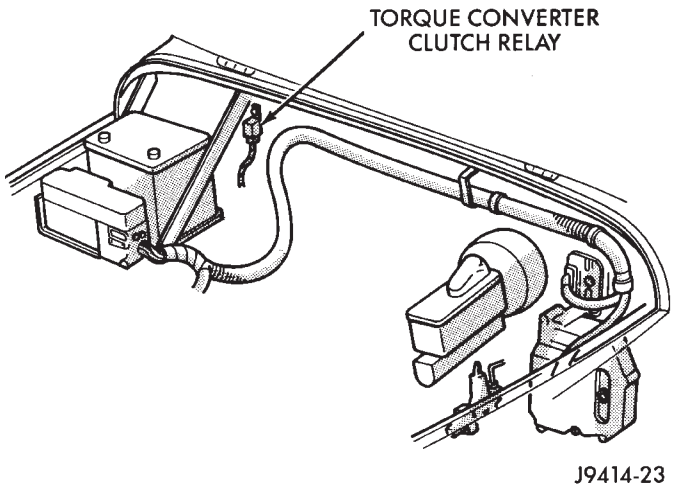

Fig. 20 TCC Relay Location—YJ Models

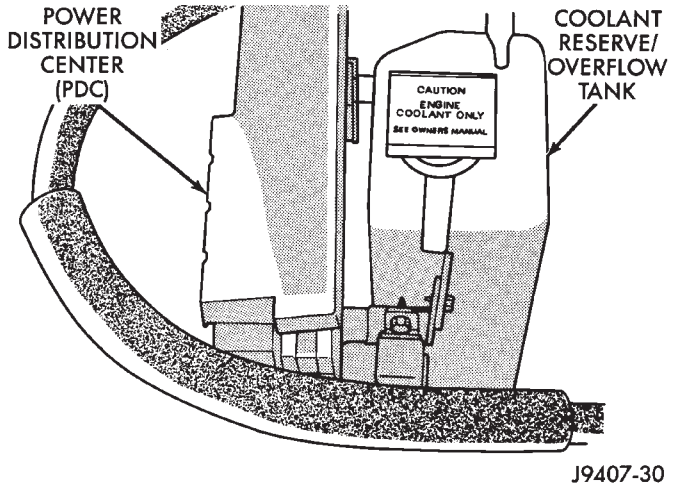

Fig. 21 Power Distribution Center—XJ Models

REMOVAL

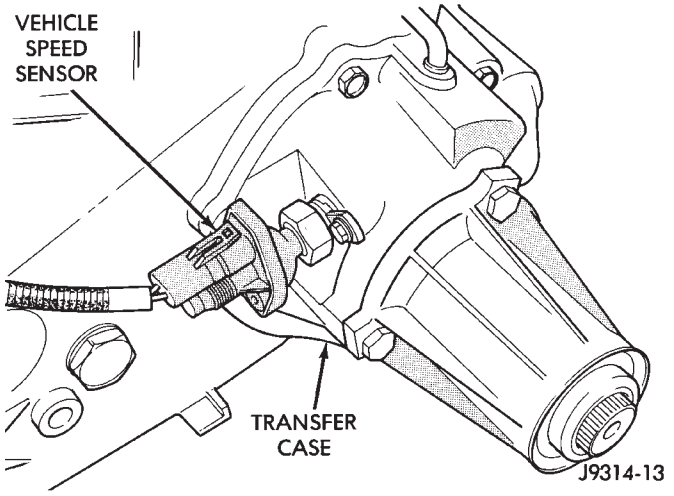

Fig. 22 Vehicle Speed Sensor Location—Typical

(1) Raise and support vehicle.

(2) Disconnect the electrical connector from the sensor.

(3) Remove the sensor mounting bolt (Fig. 23).

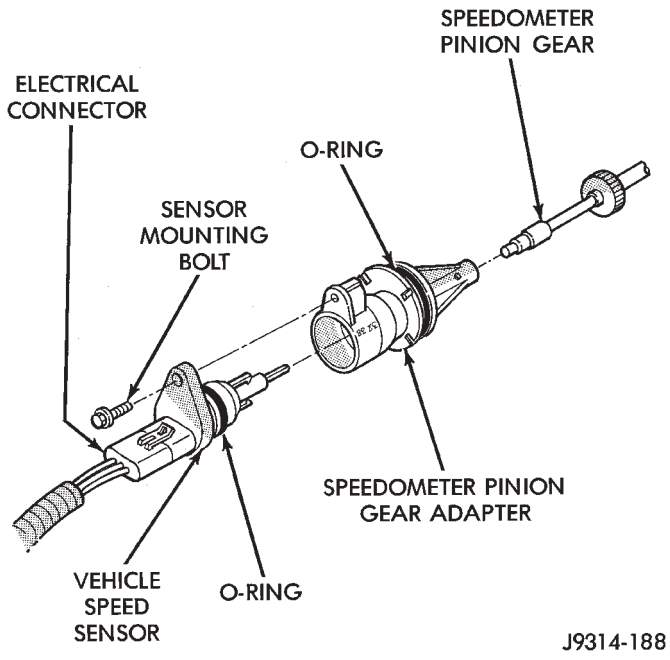

Fig. 23 Sensor Removal/Installation—Typical

(4) Remove the sensor (pull straight out) from the speedometer pinion gear adapter (Fig. 23). Do not remove the gear adapter from the transmission.

INSTALLATION

(1) Clean the inside of speedometer pinion gear adapter before installing speed sensor.

(2) Install sensor into speedometer gear adapter and install mounting bolt. **Before tightening bolt, verify speed sensor is fully seated (mounted flush) to speedometer pinion gear adapter.**

(3) Tighten sensor mounting bolt to 2.2 N·m (20 in. lbs.) torque.

(4) Connect electrical connector to sensor.

SPECIFICATIONS

GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. **If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label.** The VECI label is located in the engine compartment.

FUEL TANK CAPACITIES

FUEL TANK	GALLONS*	LITERS*
XJ	20.02	76
YJ	20.0	76
YJ	15.0	57

*Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances, ambient temperature and refill procedure.

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FUEL SYSTEM

COMPONENT	RATING
MFI Fuel System Pressure (with vacuum applied to regulator)	214 kPa (31 psi)
MFI Fuel System Pressure (without vacuum applied to pressure regulator)	269-276 kPa (39-41 psi)
MFI Fuel System Pressure Drop (fuel pump not engaged).....	Up to 138 kPa (20 psi)
Pressure-Vacuum Filler Cap Relief..	10 kPa (1.5 psi) pressure 6 kPa (1.8 in. Hg) vacuum

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TORQUE

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	4 N·m (36 in. lbs.)
Intake Manifold Air Temperature Sensor	28 N·m (20 ft. lbs.)
Engine Coolant Temperature Sensor	28 N·m (21 ft. lbs.)
PCM Mounting Screws	1 N·m (9 in. lbs.)
PCM 60-Way Connector Screw	4 N·m (35 in. lbs.)
Fuel Filter Retaining Strap	12 N·m (106 in. lbs.)
Fuel Pump/Gauge Send. Unit-to-Fuel Tank Screws (YJ)	2 N·m (18 in. lbs.)
Fuel Pump Line Nut	25 N·m (18 ft. lbs.)
Fuel Rail Mounting Bolts	27 N·m (20 ft. lbs.)
Fuel Tank Mounting Strap Nut (XJ)	11 N·m (100 in. lbs.)
Fuel Tank Skid Plate (YJ)	7 N·m (65 in. lbs.)
Fuel Tank Mounting Strap Nut (YJ)	18 N·m (13 ft. lbs.)
Oxygen Sensor	30 N·m (23 ft. lbs.)
Throttle Body Mtg. Bolts	12 N·m (9 ft. lbs.)

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BRAKES

CONTENTS

GENERAL INFORMATION

INDEX

WHEEL BRAKE COMPONENTS

Front disc and rear drum brakes are used on all models. The disc brake components consist of single piston calipers and ventilated rotors. The 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 actuating levers mounted on the rear drum brake secondary shoes. The parking brake mechanism is operated by a foot pedal on YJ models and a hand lever on XJ models.

POWER BRAKES

Power brakes are standard on all models. A vacuum operated power booster is used for standard and ABS brake applications.

HYDRAULIC COMPONENTS

A dual reservoir master cylinder is used for all standard brake applications. A combination proportioning valve/pressure differential switch is used. A center feed style master cylinder is used for ABS brake applications.

BRAKELINING MATERIAL

The factory installed brakelining on all models consists of an organic base material combined with metallic particles. The lining does not contain asbestos.

BRAKE WARNING LIGHTS

A red, brake warning light is used to alert the driver if a pressure differential exists between the front and rear hydraulic systems. The light also alerts the driver when the parking brakes are applied. The light illuminates for a few seconds at start up as part of a bulb check procedure.

An additional warning light is used on models with antilock brakes. This light is amber in color and is located in the same side of the instrument cluster as the red warning light. The amber light illuminates only when an ABS system fault occurs.

ANTILOCK BRAKE SYSTEM (ABS)

An antilock brake system (ABS) is available on XJ/YJ models. The system is an electronically operated, all-wheel brake control system. The ABS system is designed to retard wheel lockup during periods of high wheel slip braking. Refer to the antilock brake section for operation and service information.

BRAKE FLUID/LUBRICANTS/CLEANING SOLVENTS

Recommended fluid for all Jeep vehicles is Mopar DOT 3 brake fluid, or an equivalent meeting SAE J1703 and DOT 3 standards.

Use Mopar Multi Mileage grease to lubricate drum brake pivot pins and rear brakeshoe contact points on the support plates. Use GE 661, or Dow 111 silicone grease on caliper bushings and mounting bolts.

Use fresh brake fluid or Mopar brake cleaner to clean or flush brake system components. These are the only cleaning materials recommended.

CAUTION: Never use gasoline, kerosene, methyl or isopropyl alcohol, paint thinner, or any fluid containing mineral oil to clean the system components. These fluids damage rubber cups and seals. If system contamination is suspected, check the fluid for dirt, discoloration, or separation into distinct layers. Drain and flush the system with new brake fluid if contamination is suspected.

JEEP BODY CODE LETTERS

The body/model identification code letters for Jeep vehicles are as follows:

- Code letters XJ: Cherokee
- Code letters YJ: Wrangler/YJ

The code letters are used throughout this group to simplify model identification and component application.

BRAKE SAFETY PRECAUTIONS

WARNING: ALTHOUGH FACTORY INSTALLED BRAKELINING ON JEEP VEHICLES IS MADE FROM ASBESTOS FREE MATERIALS, SOME AFTER MARKET BRAKELINING MAY CONTAIN ASBESTOS. THIS SHOULD BE TAKEN INTO ACCOUNT WHEN REPAIRING A VEHICLE WITH PRIOR BRAKE SERVICE. WEAR A RESPIRATOR WHEN CLEANING BRAKE COMPONENTS AS ASBESTOS FIBERS CAN BE A HEALTH HAZARD. NEVER CLEAN WHEEL BRAKE COMPONENTS WITH COMPRESSED AIR. USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR REMOVING BRAKE DUST. IF A VACUUM CLEANER IS NOT AVAILABLE, CLEAN THE PARTS WITH WATER DAMPENED SHOP RAGS. DO NOT CREATE DUST BY SANDING BRAKELINING. DISPOSE OF ALL DUST AND DIRT SUSPECTED OF CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS. FOLLOW ALL RECOMMENDED SAFETY PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND THE ENVIRONMENTAL PROTECTION AGENCY (EPA), FOR HANDLING AND DISPOSAL OF PRODUCTS CONTAINING ASBESTOS.

ABS BRAKE DIAGNOSIS

INDEX

DIAGNOSIS PROCEDURES

ABS diagnosis involves three basic steps. First is observation of the warning light display. Second is a visual examination for low fluid level, leaks, parking brakes applied, or obvious damage to system components or wires. The third step involves using the DRB II scan tool to identify a faulty component.

The visual examination requires a check of reservoir fluid level and all system components. Things to look for are leaks, loose connections, or obvious component damage.

The final diagnosis step involves using the DRB II scan tool to determine the specific circuit or component at fault. The tester is connected to the ABS diagnostic connector in the passenger compartment. The connector is at the driver side of the center console under the instrument panel. Refer to the DRB II scan tool Manual for tester procedures. Also refer to the ABS Fault Diagnosis charts at the end of this section for additional diagnosis information.

Initial faults should be cleared and the vehicle road tested to reset any faults that remain in the system. Faults can be cleared with the DRB II scan tool.

REAR SPEED SENSOR AIR GAP

The front wheel sensors are fixed and cannot be adjusted. Only the rear sensor air gap is adjustable. Air gap must be set with a brass feeler gauge.

Correct air gap is important to proper signal generation. An air gap that is too large may cause complete loss of sensor input. Or, a gap that is too small could produce a false input signal, or damaging contact between the sensor and tone ring.

WHEEL/TIRE SIZE AND INPUT SIGNALS

Antilock system operation is dependant on accurate signals from the wheel speed sensors. Ideally, the vehicle wheels and tires should all be the same size and type. However, the Jeep ABS system is designed to function with a compact spare tire installed.

OPERATING SOUND LEVELS

The ABS pump and solenoid valves may produce some sound as they cycle on and off. This is a normal condition and should not be mistaken for faulty operation.

VEHICLE RESPONSE IN ANTILOCK MODE

During antilock braking, the HCU solenoid valves cycle rapidly in response to ECU inputs.

The driver will experience a pulsing sensation within the vehicle as the solenoids decrease, hold, or increase pressure as needed. A pulsing brake pedal will also be noted.

The pulsing sensation occurs as the solenoids cycle during antilock mode braking. A slight pulse in the brake pedal may also be noted during the dynamic self check part of system initialization.

STEERING RESPONSE

A modest amount of steering input is required during extremely high deceleration braking, or when braking on differing traction surfaces. An example of differing traction surfaces would be when the left side wheels are on ice and the right side wheels are on dry pavement.

LOSS OF SENSOR INPUT

Sensor malfunctions will most likely be due to loose connections, damaged sensor wires, incorrect rear sensor air gap, or a malfunctioning sensor. Additional causes of sensor faults would be sensor and tone ring misalignment or damage.

ABS WARNING LIGHT DISPLAY

ABS Light Illuminates At Startup

The amber ABS light illuminates at startup as part of the system self check feature. The light illuminates for 2-3 seconds then goes off as part of the normal self check routine.

ABS Light Remains On After Startup

An ABS system fault is indicated when the light remains on after startup. Diagnosis with the DRB II

scan tool will be necessary to determine which ABS component has malfunctioned.

ABS Light Illuminates During Brake Stop

A system fault such as loss of speed sensor signal or solenoid failure, will cause the amber warning light to illuminate. The most effective procedure here is to check for obvious damage first. Then check the electronic components with the DRB II scan tool.

BRAKE WARNING LIGHT DISPLAY

The red brake warning light and the ABS light operate independently. If the red light remains on after startup or illuminates during a brake stop, refer to the standard brake system diagnosis section. Either the parking brakes are applied, or a wheel brake malfunction has occurred.

ECU DIAGNOSIS

The ECU controls all phases of antilock system operation. It also differentiates between normal and antilock mode braking.

The ECU monitors and processes the signals generated from all of the system sensors at all times.

The ECU program includes a self check routine that tests each of the system components. The self check occurs during both phases of the initialization program. A failure of the self check program will cause the immediate illumination of the amber warning light. The light will also illuminate if a solenoid or other system component fails during the dynamic phase of initialization.

If a system malfunction should occur, do not immediately replace the ECU. A blown system fuse, bad chassis ground, or loss of feed voltage will each cause a system malfunction similar to an ECU failure. Never replace the ECU unless diagnosis with the DRB II scan tool indicates this is necessary.

HCU DIAGNOSIS

The HCU pump and motor and solenoid valve body are serviced only as an assembly. The HCU assembly should not be replaced unless a fault has actually been confirmed. Verify fault conditions with the DRB II scan tool before proceeding with repair.

ABS SYSTEM WIRING AND ELECTRICAL CIRCUITS

Location of the ABS fuse (in the fuse panel) is shown in Figure 1. The engine compartment harness routing for the ABS components is shown in Figure 2.

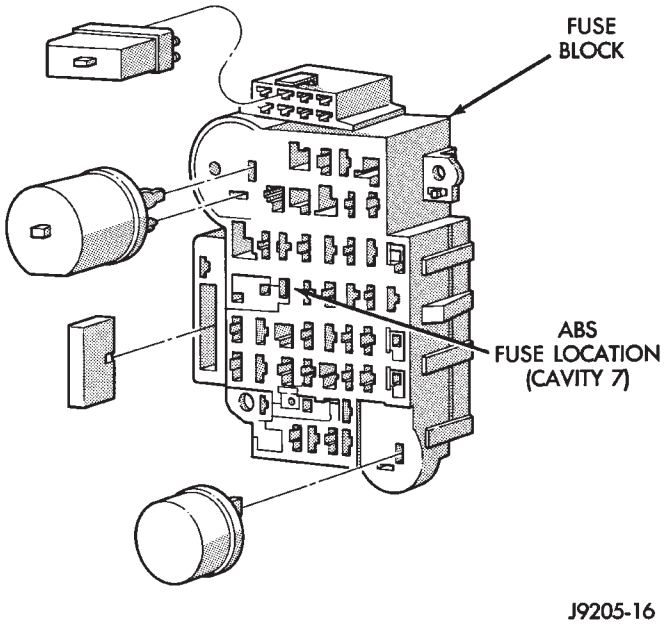

Fig. 1 ABS Fuse Location

ABS FAULT DIAGNOSIS

The fault diagnosis chart provides additional information on potential ABS system faults. Use the chart as a guide when diagnosing a system problem.

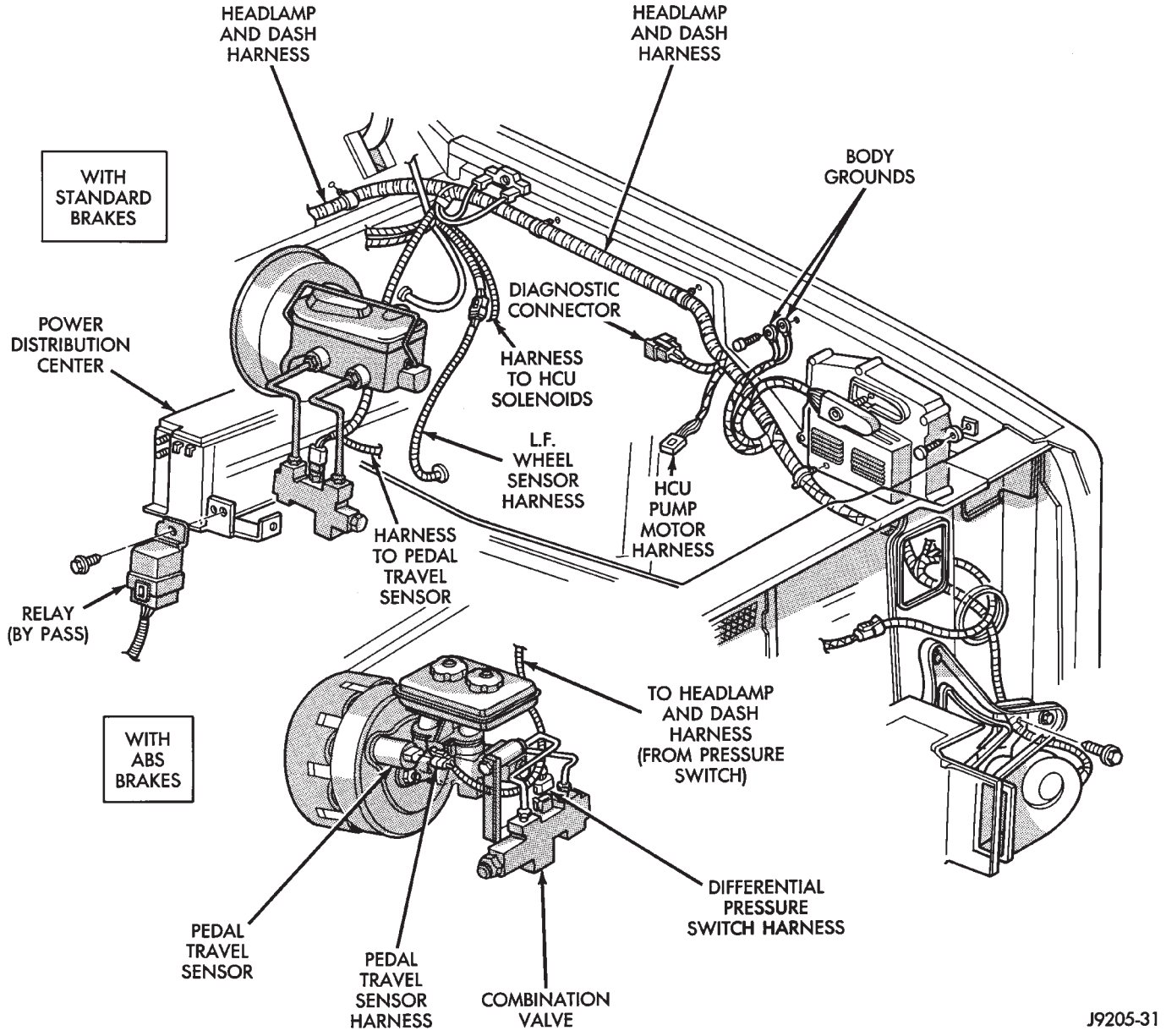

Fig. 2 ABS Engine Compartment Harness Routing (XJ)

ABS FAULT DIAGNOSIS

ABS CONDITION	PROBABLE CAUSE
WHEEL SENSOR FAULT	1. Sensor disconnected. 2. Incorrect sensor air gap (usually too large). 3. Damaged sensor wire. 4. Damaged sensor or tone ring. 5. Sensor and/or tone ring loose or misaligned.
HCU SOLENOID VALVE FAULT	1. Bad ECU. 2. HCU wire harness short, open loose connection, or wire damage. 3. System circuit breakers (in PDC) faulty. 4. Relay fault.
PUMP MOTOR FAULT	1. Fuse or wire harness problem. 2. Relay malfunction. 3. Pump motor sensor malfunction. 4. Pedal travel sensor fault (short, open, mismatched). 5. Pump motor malfunction.
MAIN RELAY FAULT	1. Short or open in relay. 2. Short or open in relay wiring. 3. Inadequate feed voltage (less than 9 volts).
ABS LIGHT ON BUT NO FAULT CODE SET	1. ABS fuse blown. 2. Inadequate feed voltage to ECU (less than 9 volts). 3. ECU ground wire damage or loose connection. 4. Main relay inoperative.
INADEQUATE FEED VOLTAGE (NOT ENOUGH VOLTAGE TO OPERATE SYSTEM)	1. Battery discharged or low on charge. 2. Battery cables loose or corroded (at terminals). 3. Loose, corroded system ground. 4. Loose harness connections or corroded connections.
DECREASING BRAKE PEDAL HEIGHT (MOVES CLOSER TO FLOOR)	Noticeable decrease during ABS stops is due to: (a) Fluid leak. (b) Air in system. (c) Pedal travel sensor cap and booster are mismatched. (d) Pedal travel sensor or pump malfunction.
INCREASING BRAKE PEDAL HEIGHT, PUMP RUNS CONTINUOUSLY DURING ABS STOP (PEDAL FARTHER FROM FLOOR)	1. Pump motor wire harness problem (short, open, ground, loose, damaged). 2. Pedal travel sensor fault.
ACCELERATION SWITCH FAULT	1. Switch wires loose, damaged. 2. Switch malfunction. 3. Switch mounted upside down.

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SERVICE BRAKE DIAGNOSIS

INDEX

GENERAL INFORMATION

The diagnosis information in this section covers service brake components which include:

- disc brake calipers
- disc brakeshoes
- drum brake wheel cylinders
- drum brakeshoes and brake drums
- drum brake support plates
- parking brake mechanism
- master cylinder/combination valve
- vacuum power brake booster
- brake pedal and brakelight switch
- brake warning light

DIAGNOSIS PROCEDURES

Service brake diagnosis involves determining if a problem is related to a mechanical, hydraulic or vacuum operated component. A preliminary brake check, followed by road testing and component inspection are needed to determine a problem cause.

Road testing will either verify proper brake operation or confirm the existence of a problem. Component inspection will, in most cases, identify the actual part responsible for a problem.

The first diagnosis step is the preliminary brake check. This involves inspecting fluid level, parking brake action, wheel and tire condition, checking for obvious leaks or component damage and testing brake pedal response. A road test will confirm or deny the existence of a problem. The final diagnosis procedure involves road test analysis and a visual inspection of brake components.

PRELIMINARY BRAKE CHECK

(1) If amber antilock light is illuminated, refer to Antilock Brake System Diagnosis. However, if red warning light is illuminated, or if neither warning light is illuminated, continue with diagnosis.

(2) Check condition of tires and wheels. Damaged wheels and worn, damaged, or underinflated tires can cause pull, shudder, tramp and a condition similar to grab.

(3) 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.

(4) Inspect brake fluid level:

(a) If vehicle has one-piece master cylinder, fluid level should be to 6 mm (1/4 in.) of reservoir rim. If vehicle two-piece, removable reservoir, correct level is to top of indicator rings in reservoir.

(b) On models with ABS brakes, preferred level is to MAX mark on reservoir. Acceptable level is between MAX and MIN marks.

(c) Remember that fluid level in the front and rear reservoir compartments will decrease in proportion to normal lining wear. However, if fluid level is abnormally low, look for leaks at calipers, wheel cylinders, brakelines and master cylinder.

(5) Inspect brake fluid condition:

(a) Fluid should be reasonably clear and free of foreign material. **Note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination. If fluid is clear of foreign material, it is OK.**

(b) If fluid is highly discolored, or appears to contain foreign material, drain out a sample with a clean suction gun. Pour sample in a glass container and note condition.

(c) If fluid separates into layers, obviously contains oil, or a substance other than brake fluid, system seals and cups will have to be replaced and hydraulic system flushed.

(6) Check parking brake operation. Verify free movement and full release of cables and foot pedal or hand lever. Also note if vehicle was being operated with parking brake partially applied.

(7) 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.

(8) If components inspected look OK, road test the vehicle.

ROAD TESTING

(1) If amber warning light is illuminated, problem is with antilock system component. Refer to Antilock Brake System Diagnosis.

(2) If red warning light is illuminated, or if neither warning light is illuminated, make several stops and note pedal action and brake response.

(3) Check brake pedal response with transmission in Neutral and engine running. Pedal should remain firm under steady foot pressure. If pedal falls away, problem is either in vacuum booster or master cylinder.

(4) During road test, make normal and firm brake stops in 25-40 mph range. Note faulty brake operation such as pull, grab, drag, noise, fade, pedal pulsation, etc.

(5) Inspect suspect brake components and refer to problem diagnosis information for causes of various brake conditions.

COMPONENT INSPECTION

Fluid leak points and dragging brake units can usually be located without removing any components. The area around a leak point will be wet with fluid. The components at a dragging brake unit (wheel, tire, rotor) will be quite warm or hot to the touch.

Other brake problem conditions will require component removal for proper inspection. Raise the vehicle and remove the necessary wheels for better visual access.

During component inspection, pay particular attention to heavily rusted/corroded brake components (e.g. rotors, caliper pistons, brake return/holddown springs, support plates, etc.).

Heavy accumulations of rust may be covering severe damage to a brake component. It is wise to remove surface rust in order to accurately determine the depth of rust penetration and damage. Light surface rust is fairly normal and not a major concern (as long as it is removed). However, heavy rust buildup, especially on high mileage vehicles may cover structural damage to such important components as brakelines, rotors, support plates, and brake boosters. Refer to the wheel brake service procedures in this group for more information.

DIAGNOSING SERVICE BRAKE PROBLEMS

BRAKE WARNING LIGHT OPERATION

The red brake warning light will illuminate under the following conditions:

- for 2-3 seconds at startup as part of normal bulb check
- parking brakes applied
- low pedal caused by malfunction in front/rear brake hydraulic circuit (differential switch valve actuated)

If the red light remains on after startup, first verify that the parking brakes are fully released. Then check pedal action and fluid level. A red light indicates that the valve in the differential pressure switch has been actuated. If a problem is confirmed, inspect the hydraulic system and wheel brake components.

On models with ABS brakes, the amber warning light only illuminates when an ABS component has malfunctioned. The ABS light operates independently of the red warning light. Refer to the antilock brake section for more detailed diagnosis information.

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 brakeline, fitting, hose, wheel cylinder, or caliper. Internal leakage in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

If leakage is severe, fluid will be evident at or around the leaking component. However internal leakage in the master cylinder will not be physically evident. Refer to the cylinder test procedure in this section.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up, worn lining and worn rotors or drums are the most likely causes. However, if the pedal remains low and/or the warning light illuminates, the problem is in the master cylinder, wheel cylinders, or calipers.

A decrease in master cylinder fluid level may only be the result of normal lining wear. Fluid level will decrease as lining wear occurs. It is a result of the outward movement of caliper and wheel cylinder pistons to compensate for normal wear.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. However, thin drums or substandard brake lines and hoses will also cause a condition similar to a spongy pedal. The proper course of action is to bleed the system, or replace thin drums and suspect quality brake lines and hoses.

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. Test the booster and valve as described in this section.

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. It is a product of incomplete brakeshoe release. Drag can be minor or severe enough to overheat the linings, rotors and drums.

Brake drag also has a direct effect on fuel economy. If undetected, minor brake drag can be misdiagnosed as an engine or transmission/torque converter problem.

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.

An additional cause of drag involves the use of incorrect length caliper mounting bolts. Bolts that are too long can cause a partial apply condition. The correct caliper bolts have a shank length of 67 mm (2.637 in.), plus or minus 0.6 mm (0.0236 in.). Refer to the Disc Brake service section for more detail on caliper bolt dimensions and identification.

Some common causes of brake drag are:

- loose or damaged wheel bearing
- seized or sticking caliper or wheel cylinder piston
- caliper binding on bushings or slide surfaces
- wrong length caliper mounting bolts (too long)
- loose caliper mounting bracket
- distorted brake drum or shoes
- rear brakeshoes binding on worn/damaged support plates
- severely rusted/corroded components
- misassembled components.

If brake drag occurs at all wheels, the problem may be related to a blocked master cylinder compensator port or faulty power booster (binds-does not release).

The brakelight switch can also be a cause of drag. An improperly mounted or adjusted brakelight switch can prevent full brake pedal return. The result will be the same as if the master cylinder compensator ports are blocked. The brakes would be partially applied causing drag.

BRAKE FADE

Brake fade is a product of overheating caused by brake drag. However, overheating and subsequent 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 roads. Refer to the Brake Drag information in this section for causes.

PEDAL PULSATION

Pedal pulsation is caused by components that are loose, or beyond tolerance limits.

Disc brake rotors with excessive lateral runout or thickness variation, or out of round brake drums are the primary causes of pulsation. Other causes are loose wheel bearings or calipers and worn, damaged tires.

PULL

A front pull condition could be the result of:

- contaminated lining in one caliper
- seized caliper piston
- binding caliper
- wrong caliper mounting bolts (too long)
- loose caliper
- loose or corroded mounting bolts
- improper brakeshoes
- damaged rotor
- incorrect wheel bearing adjustment (at one wheel)

A worn, damaged wheel bearing or suspension component are further causes of pull. A damaged front tire (bruised, ply separation) can also cause pull. Wrong caliper bolts (too long) will cause a partial apply condition and pull if only one caliper is involved.

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 the dragging brake unit.

As the dragging brake overheats, efficiency is so reduced that fade occurs. If the opposite brake unit is still functioning normally, its braking effect is magnified. This causes pull to switch direction in favor of the brake unit that is functioning normally.

When diagnosing a change in pull condition, 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

Rear grab (or pull) is usually caused by contaminated lining, bent or binding shoes and support plates, or improperly assembled components. This is particularly true when only one rear wheel is involved. However, when both rear wheels are affected, the master cylinder or proportioning valve could be at fault.

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

This condition is generally caused by water soaked lining. If the lining is only wet, it can be dried by driving with the brakes lightly applied for a mile or two. However, if the lining is both wet and dirty, disassembly and cleaning will be necessary.

BRAKE FLUID CONTAMINATION

There are two basic causes of brake fluid contamination. The first involves allowing dirt, debris, or other liquid materials to enter the cylinder reservoirs

when the cover is off. The second involves adding to, or filling the cylinder reservoirs with a non-recommended fluid.

Brake fluid contaminated with only dirt, or debris usually retains a normal appearance. In some cases, the foreign material will remain suspended in the fluid and be visible. The fluid and foreign material can be removed from the reservoir with a suction gun but only if the brakes have not been applied. If the brakes are applied after contamination, system flushing will be required. The master cylinder may also have to be disassembled, cleaned and the piston seals replaced. Foreign material lodged in the reservoir compensator/return ports can cause brake drag by restricting fluid return after brake application.

Brake fluid contaminated by a non-recommended fluid will usually be discolored, milky, oily looking, or foamy. In some cases, it may even appear as if the fluid contains sludge. **However, remember that brake fluid will darken in time and occasionally be cloudy in appearance. These are normal conditions and should not be mistaken for contamination.**

If some type of oil has been added to the system, the fluid will separate into distinct layers. To verify this, drain off a sample with a clean suction gun. Then pour the sample into a glass container and observe fluid action. If the fluid separates into distinct layers, it is definitely contaminated.

The only real correction for contamination by non-recommended fluid is to flush the entire hydraulic system and replace all the seals.

BRAKE NOISE

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 brakeshoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors can become so scored that replacement is necessary.

Thump/Clunk

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 brakeshoes can also produce a thump noise.

Chatter/Shudder

Brake chatter, or shudder 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.

BRAKELINING CONTAMINATION

Brakelining contamination is usually a product of leaking calipers or wheel cylinders, driving through deep water puddles, or lining that has become covered with grease and grit during repair.

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 condition similar to grab as the tire loses and recovers traction.

Flat-spotted tires can cause vibration and wheel tramp and generate shudder during brake operation.

A tire with internal damage such as a severe bruise or ply separation can cause pull and vibration.

DIAGNOSING PARKING BRAKE PROBLEMS

Adjustment Mechanism

Parking brake adjustment is controlled by a cable tensioner mechanism. This applies to 1991 through 1994 YJ models and 1992 and later XJ models. The cable tensioner, once adjusted at the factory, will not need further adjustment under normal circumstances. There are only two instances when adjustment is required. The first is when a new tensioner, or cables have been installed. And the second, is when the tensioner and cables are disconnected for access to other brake components.

Parking Brake problem Causes

In most cases, the actual cause of an improperly functioning parking brake (too loose/too tight/wont hold), can be traced to a drum brake component.

The leading cause of improper parking brake operation, is excessive clearance between the brakeshoes and the drum surface. Excessive clearance is a result of: lining and/or drum wear; oversize drums; or inoperative shoe adjuster components.

Excessive parking brake lever travel (sometimes described as a loose lever or too loose condition), is the result of worn brakeshoes/drums, improper brakeshoe adjustment, or mis-assembled brake parts.

A "too loose" condition can also be caused by inoperative brakeshoe adjusters. If the adjusters are mis-

assembled, they will not function. In addition, since the adjuster mechanism only works during reverse stops, it is important that complete stops be made. The adjuster mechanism does not operate when rolling stops are made in reverse. The vehicle must be brought to a complete halt before the adjuster lever will turn the adjuster screw.

A condition where the parking brakes do not hold, will most probably be due to a wheel brake component.

Items to look for when diagnosing a parking brake problem, are:

- rear brakeshoe wear
- rear brakedrum wear
- brakedrums machined beyond allowable diameter (oversize)
- parking brake front cable not secured to lever
- parking brake rear cable seized
- parking brake strut reversed
- parking brake strut not seated in both shoes
- parking brake lever not seated in secondary shoe
- parking brake lever or brakeshoe bind on support plate
- brakeshoes reversed
- adjuster screws seized
- adjuster screws reversed
- holddown or return springs misassembled or lack tension
- wheel cylinder pistons seized

Brake drums that are machined oversize are difficult to identify. If oversize drums are suspected, the diameter of the braking surface will have to be checked with an accurate drum gauge. Oversize drums will cause low brake pedal and lack of parking brake holding ability.

Improper parking brake strut and lever installation will result in unsatisfactory parking brake operation. Intermixing the adjuster screws will cause drag, bind and pull along with poor parking brake operation.

Parking brake adjustment and parts replacement procedures are described in the Parking Brake section.

MASTER CYLINDER/POWER BOOSTER TEST

(1) Start engine and check booster vacuum hose connections. 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.

(a) If pedal holds firm, proceed to step (5).

(b) If pedal does not hold firm and falls away, master cylinder is faulty (internal leakage). Overhaul or replace cylinder.

(5) Start engine and note pedal action.

(a) If pedal falls away slightly under light foot pressure then holds firm, proceed to step (6).

(b) If no pedal action is discernible, power booster or vacuum check valve is faulty. Install known good check valve and repeat steps (2) through (5).

(6) Rebuild booster vacuum reserve as follows: Release brake pedal. Increase engine speed to 1500 rpm, close throttle and immediately turn off ignition.

(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, perform booster and check valve vacuum tests.

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

(2) Remove check valve and valve seal from booster (Fig. 1).

(3) Hand operated vacuum pump can be used for test (Fig. 2).

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 1).

(5) Vacuum should hold steady. If gauge on pump indicates any vacuum loss, valve is faulty and must be replaced.

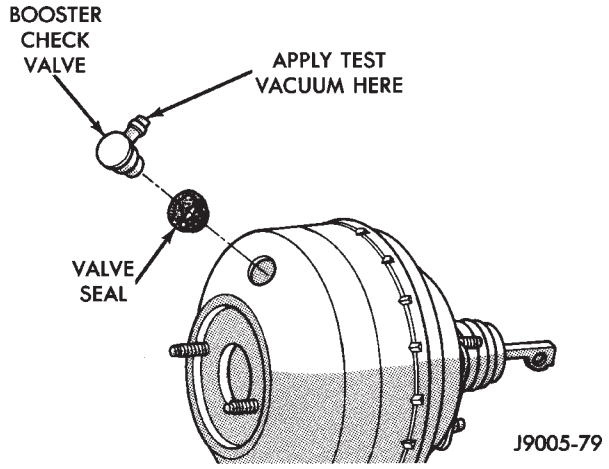

Fig. 1 Vacuum Check Valve And Seal (Typical)

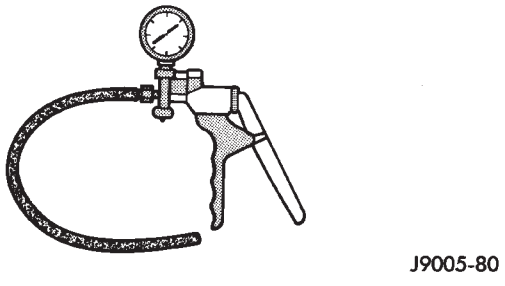

Fig. 2 Hand Operated Vacuum Pump (Typical)

POWER BOOSTER VACUUM TEST

(1) Connect a vacuum gauge to the booster check valve with a short length of hose and T-fitting (Fig. 3).

(2) Start and run engine at idle speed for one minute.

(3) Clamp hose shut between vacuum source and check valve (Fig. 3).

(4) Stop engine and observe vacuum gauge.

(5) If vacuum drops more than one inch HG (33 millibars) within 15 seconds, booster diaphragm or check valve is faulty.

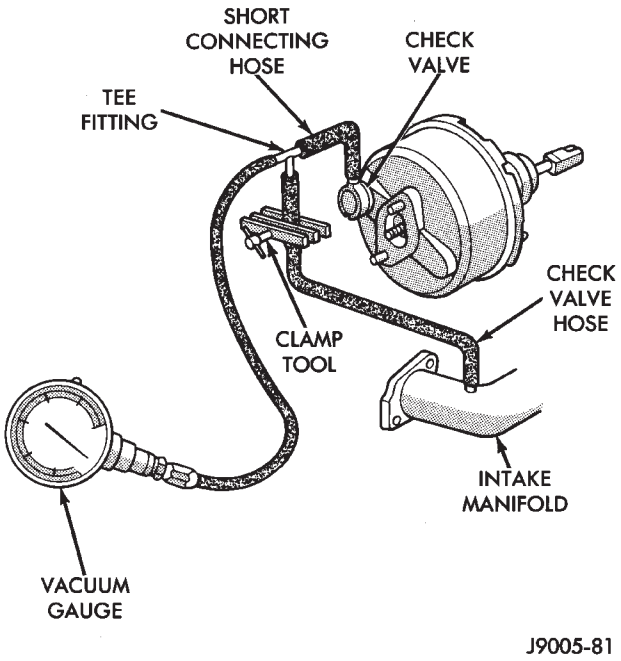

Fig. 3 Booster Vacuum Test Connections

BRAKE BLEEDING—BRAKE FLUID AND LEVEL—BRAKELINES AND HOSES

INDEX

RECOMMENDED BRAKE FLUID

The only brake fluid recommended for Jeep vehicles with standard or antilock brakes, is Mopar brake fluid, or an equivalent fluid meeting SAE J1703 and DOT 3 standards.

Use new brake fluid only to top off the master cylinder or refill the system. Never use reclaimed fluid, fluid not meeting the SAE/DOT standards or fluid from an unsealed container. Do not use fluid from any container that has been left open for any length of time. Fluid in open containers can absorb moisture.

BRAKE FLUID LEVEL

Always clean the master cylinder and cover before checking fluid level. If not cleaned, dirt from the cover could enter the fluid. Also check the cover seal and replace it if torn or distorted.

Correct fluid level is to within 6 mm (1/4 in.) of the reservoir rim, or to the fill mark on models with a plastic reservoir. Refer to the Antilock Brake section for fluid levels on models equipped with ABS brakes.

BRAKE FLUID CONTAMINATION

Oil in the fluid will cause brake system rubber seals to soften and swell. The seals may also become porous and begin to deteriorate.

If fluid contamination is suspected, drain off a sample from the master cylinder. A suction gun or similar device can be used for this purpose.

Empty the drained fluid into a glass container. Contaminants in the fluid will cause the fluid to separate into distinct layers. If contamination has occurred, the system rubber seals, hoses and cups must be replaced and the system thoroughly flushed with clean brake fluid.

BRAKE BLEEDING—XJ/YJ WITH STANDARD BRAKES

Use Mopar DOT 3 brake fluid, or an equivalent meeting SAE/DOT standards J1703-F and DOT 3, to fill and bleed the system.

On standard brake models, bleeding can be performed either manually or with pressure equipment. However, if pressure equipment is used, it will be necessary to hold the front brake metering valve open in order to bleed the front brakes. The valve can be held open with a tension clip tool or by hand. It will also be necessary that a suitable size pressure tank hose adapter be available for use on the master cylinder.

MANUAL BLEEDING PROCEDURE

(1) If master cylinder has been overhauled or a new cylinder will be installed, bleed cylinder on bench before installation. This shortens time needed to bleed system and ensures proper cylinder operation.

(2) Wipe master cylinder reservoir and cap clean with shop towels.

(3) Remove cover and fill master cylinder reservoir with Mopar, or equivalent DOT 3 brake fluid.

(4) Open all caliper and wheel cylinder bleed screws.

(5) Close bleed screws after fluid begins flowing from each bleed screw.

(6) Top off master cylinder reservoir again.

(7) Use following bleed sequence:

- master cylinder
- right rear
- left rear
- right front
- left front

(8) Observe following brake bleeding precautions:

- Do not pump brake pedal at any time while bleeding. Air in system will be compressed into small bubbles that are distributed throughout hydraulic system. This will make a second and third bleeding operation necessary.
- Bleed only one wheel brake unit at a time and use a bleed hose to bleed each wheel brake unit (Fig. 7).
- Attach one end of bleed hose to bleed screw and insert opposite end in glass container partially filled with brake fluid (Fig. 7). Glass container makes it easier to see air bubbles as they exit the bleed hose.
- Be sure end of bleed hose is immersed in fluid. Immersing hose end in fluid prevents air from being drawn back into cylinder and brakeline.

(9) Bleed master cylinder first. Have helper operate brake pedal while bleeding each master cylinder fluid outlet line.

CAUTION: Do not allow the master cylinder to run out of fluid when bleeding the brakes. An empty cylinder will allow additional air to be drawn into the system. Check the cylinder fluid level frequently and add fluid as needed.

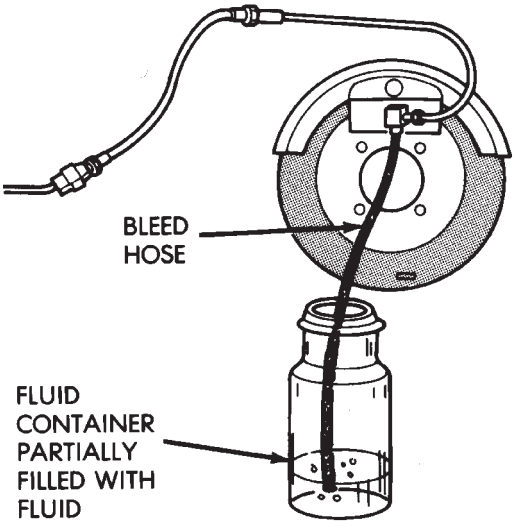

Fig. 7 Typical Bleed Hose And Fluid Container

(10) Bleed each wheel brake unit as follows:

(a) Open caliper or wheel cylinder bleed fitting 1/2 to 3/4 turn.

(b) Have helper press and hold brake pedal to floor. **Do not pump brake pedal while bleeding. Air in system will be compressed into small bubbles that are distributed throughout hydraulic system. This will make a second and third bleeding operation necessary.**

(c) Tighten bleed fitting and have helper release brake pedal. Continue bleeding operation until fluid entering bleed container is clear and free of bubbles.

(d) Repeat bleeding operation at remaining wheel brake units.

(e) Discard fluid bled into glass container. It should not be reused.

(11) Check and adjust master cylinder fluid level.

(12) Verify proper brake operation before moving vehicle.

PRESSURE BLEEDING

The front brake metering valve is located in the forward end of the combination valve. The valve stem is accessible from the same end of the valve. The stem must be either pressed inward, or held outward slightly in order to bleed the front brakes.

(1) Fill bleeder tank if necessary.

(2) Purge air from bleeder tank and lines before proceeding.

(3) Wipe master cylinder cover clean.

(4) Remove master cylinder cover and install pressure hose adapter in place of cover. A suitable adapter will usually be available from tank manufacturer.

(5) Connect bleeder tank pressure hose to adapter.

(6) Bleed master cylinder first. Then bleed rear brakes as described in manual bleeding procedure.

(7) Bleed front brakes as described in manual bleeding procedure. Have helper hold metering valve open by pressing valve stem inward slightly. Amount of valve stem movement needed to hold valve open is quite modest. Do not use excessive force.

(8) Remove pressure bleeding equipment and top off master cylinder reservoir.

BRAKE BLEEDING—XJ/YJ WITH ABS BRAKES

A different bleeding method is required for the ABS system. It is basically a three step process consisting of: A conventional manual brake bleed. A second bleed using the DRB II, followed by a repeat of the conventional manual bleed procedure. Recommended ABS bleeding procedure is as follows:

(1) Clean master cylinder reservoir caps and reservoir exterior. Dirt, foreign material on the caps and reservoir must not be allowed to enter reservoir.

(2) Fill reservoir with Mopar brake fluid, or equivalent quality fluid meeting SAE 1703 and DOT 3 standards.

(3) Recommended bleeding sequence is:

- master cylinder
- HCU valve body (at fluid lines)
- right rear wheel
- left rear wheel
- right front wheel
- left front wheel.

(4) Attach bleed hose to caliper or wheel cylinder bleed fitting. Immerse end of bleed hose in glass container partially filled with brake fluid. Be sure hose end is submerged in fluid (Fig. 7).

(5) Bleed each wheel brake unit as follows:

(a) Have helper apply and hold brake pedal.

(b) Open bleed screw 1/2 turn. Close bleed screw when brake pedal contacts floorpan. **Do not pump brake pedal at any time while bleeding. This compresses air into small bubbles which are distributed throughout system. Additional bleeding operations will then be necessary to remove all trapped air from the system.**

(c) Repeat bleeding operation 5-7 more times at each rear wheel brake unit.

(d) Continue bleeding until fluid entering glass container is free of air bubbles. Check reservoir fluid level frequently and add fluid if necessary.

(e) Repeat bleeding procedures at front wheels.

CAUTION: Do not allow the master cylinder reservoir to run dry while bleeding the brakes. Running dry will allow air to re-enter the system making a second bleeding operation necessary.

(6) Perform "Bleed Brake" procedure with DRB II scan tool. Procedure is described in DRB II software information and diagnostic manual.

(a) Connect DRB II scan tool to diagnostic connector.

(b) Run Bleed Brake procedure as described in tester manual.

(7) Repeat conventional bleeding procedure outlined in steps (1) through (8).

(8) Top off master cylinder fluid level if necessary.

(9) Verify proper brake operation.

BRAKELINES AND HOSES

Metal brakelines and rubber brake hoses should be inspected periodically and replaced if damaged.

Rubber brake hoses should be replaced if cut, cracked, swollen, or leaking. Rubber hoses must be replaced. They are not repairable parts.

When installing new, or original brakelines and hoses, lubricate the fitting threads with brake fluid before connection.

The steel brakelines should be checked every time the vehicle is in for normal maintainence. This is important on high mileage vehicles. It is even more important when a vehicle is operated in areas where salt is used regularly on the road surface during winter.

Heavily rusted/corroded brake rotors, drums, support plates, and brakelines should be cleaned and carefully inspected. Heavy rust buildup can hide severe damge to a component. Severely rusted parts should be replaced if you are unsure about their condition.

COMBINATION VALVE

The combination valve is not a serviceable part. The valve must be replaced if a malfunction occurs.

BRAKELINE CHARTS

Brakeline charts are provided in illustration Figures 1 through 8. The illustrations show typical brakeline routing, hose connections and component position.

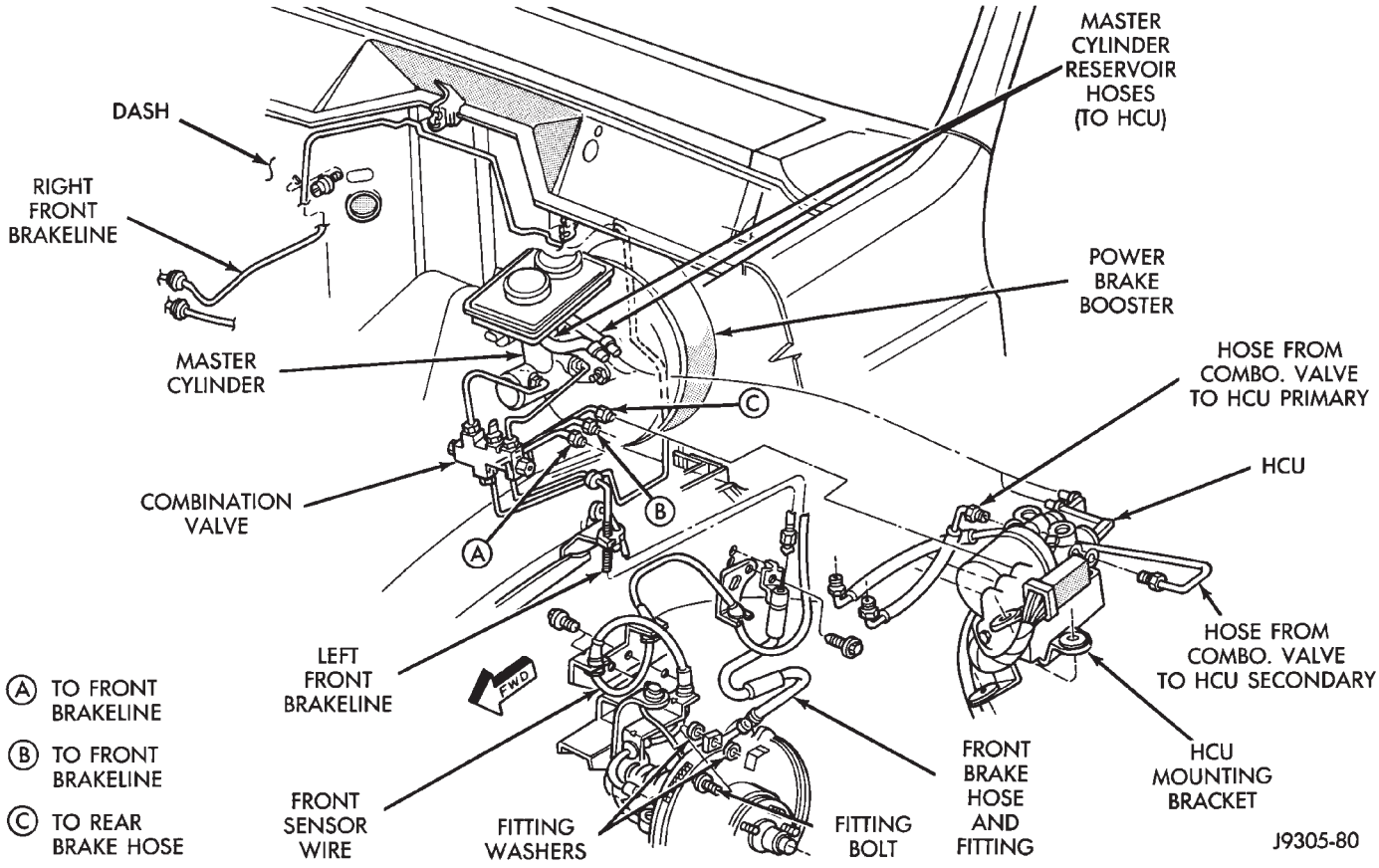

Fig. 1 Front Brakeline Routing (XJ With ABS Brakes)

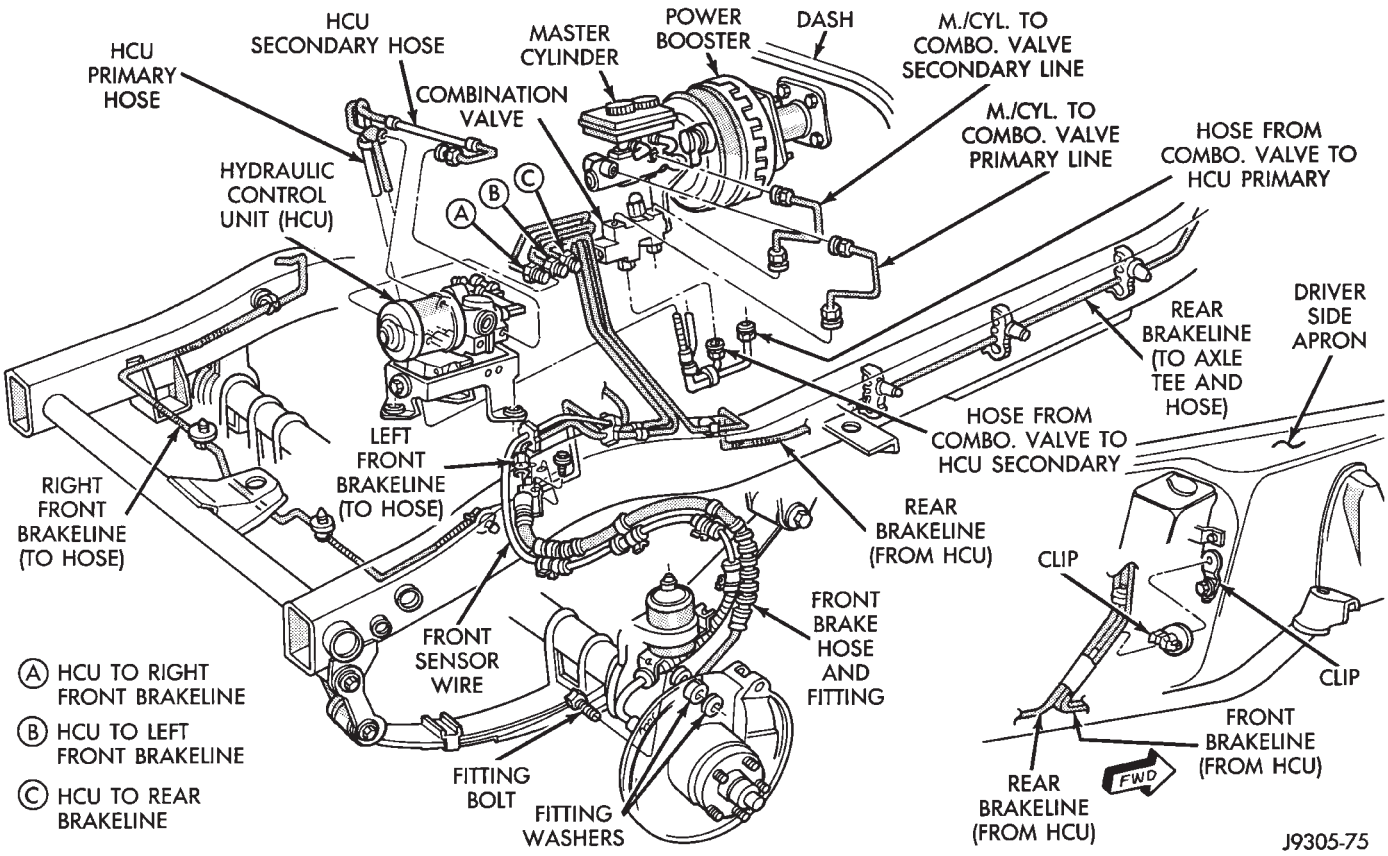

Fig. 2 Front Brakeline Routing (YJ With ABS Brakes)

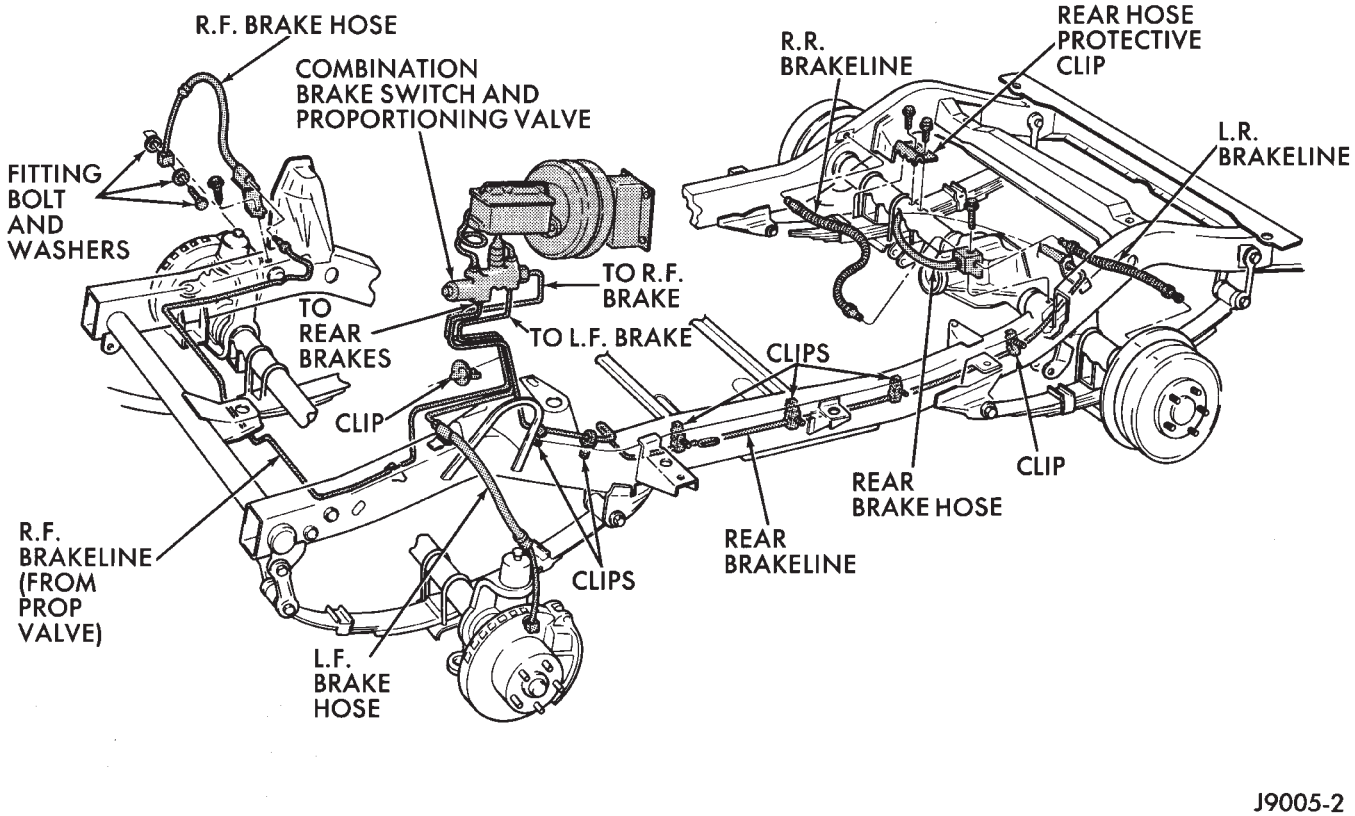

Fig. 3 Brakeline Routing (YJ With Standard Brakes)

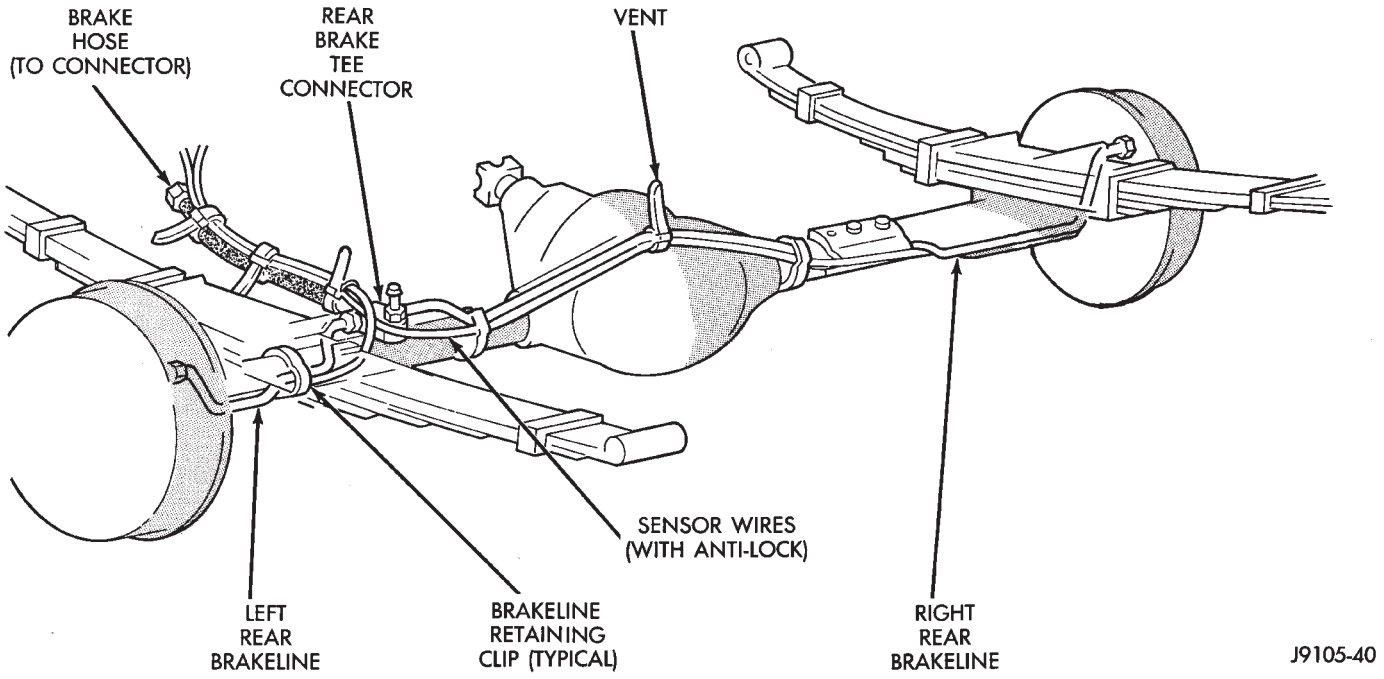

Fig. 4 Rear Brakeline Routing (XJ With Standard Brakes)

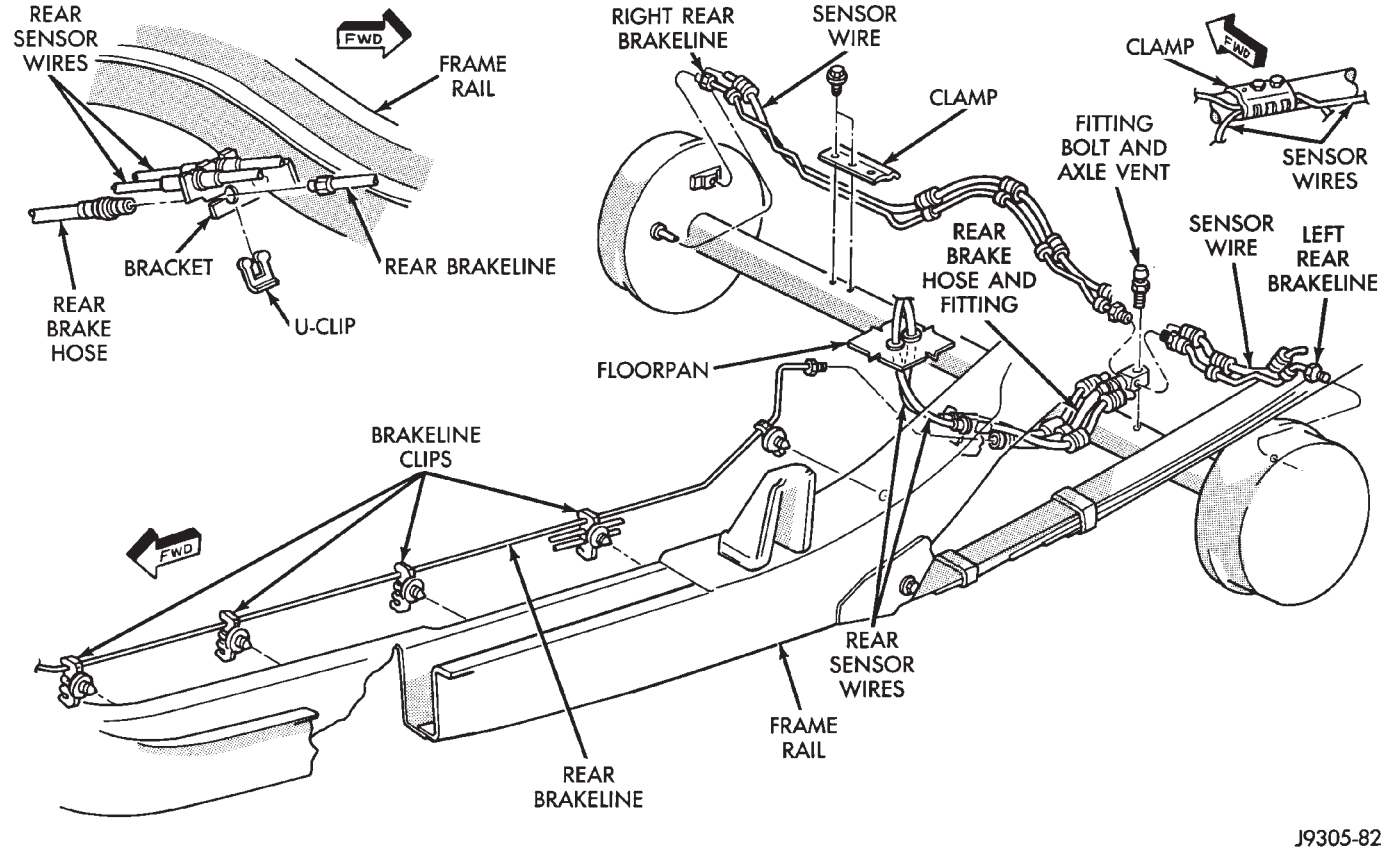

Fig. 5 Rear Brakeline Routing (XJ With ABS Brakes)

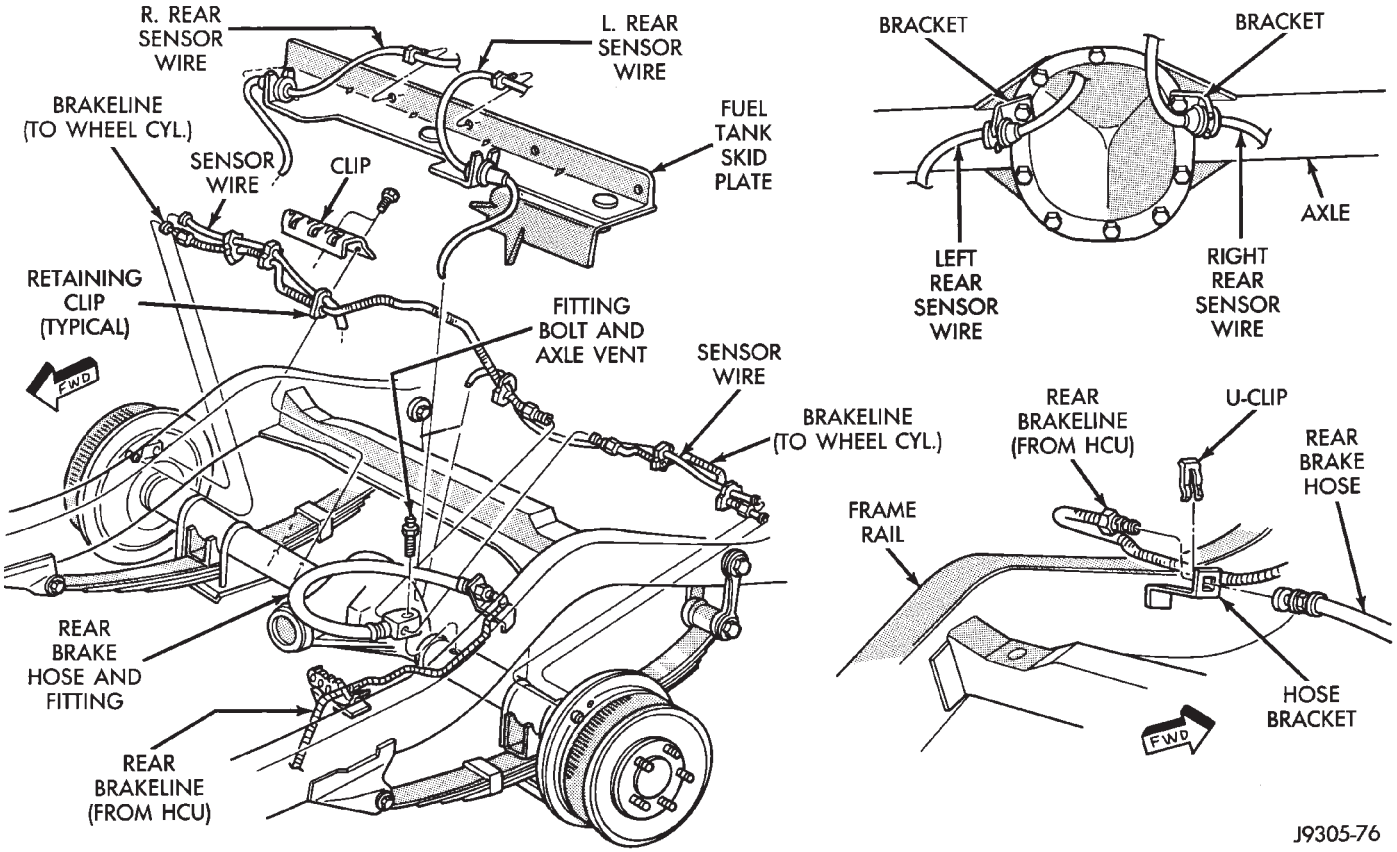

Fig. 6 Rear Brakeline Routing (YJ With ABS Brakes)

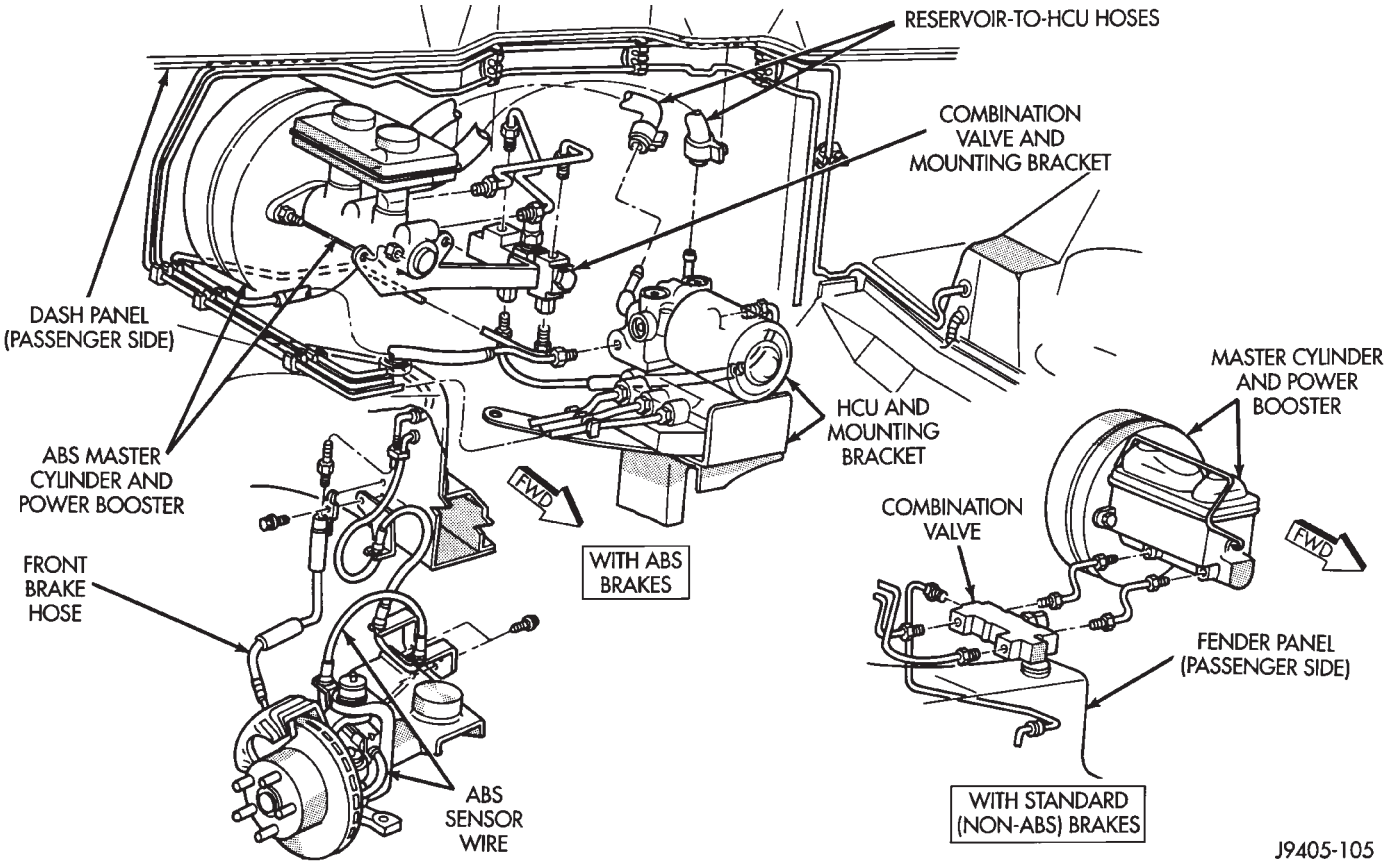

Fig. 7 Front Brakeline Routing (Right Hand Drive XJ With ABS Brakes)

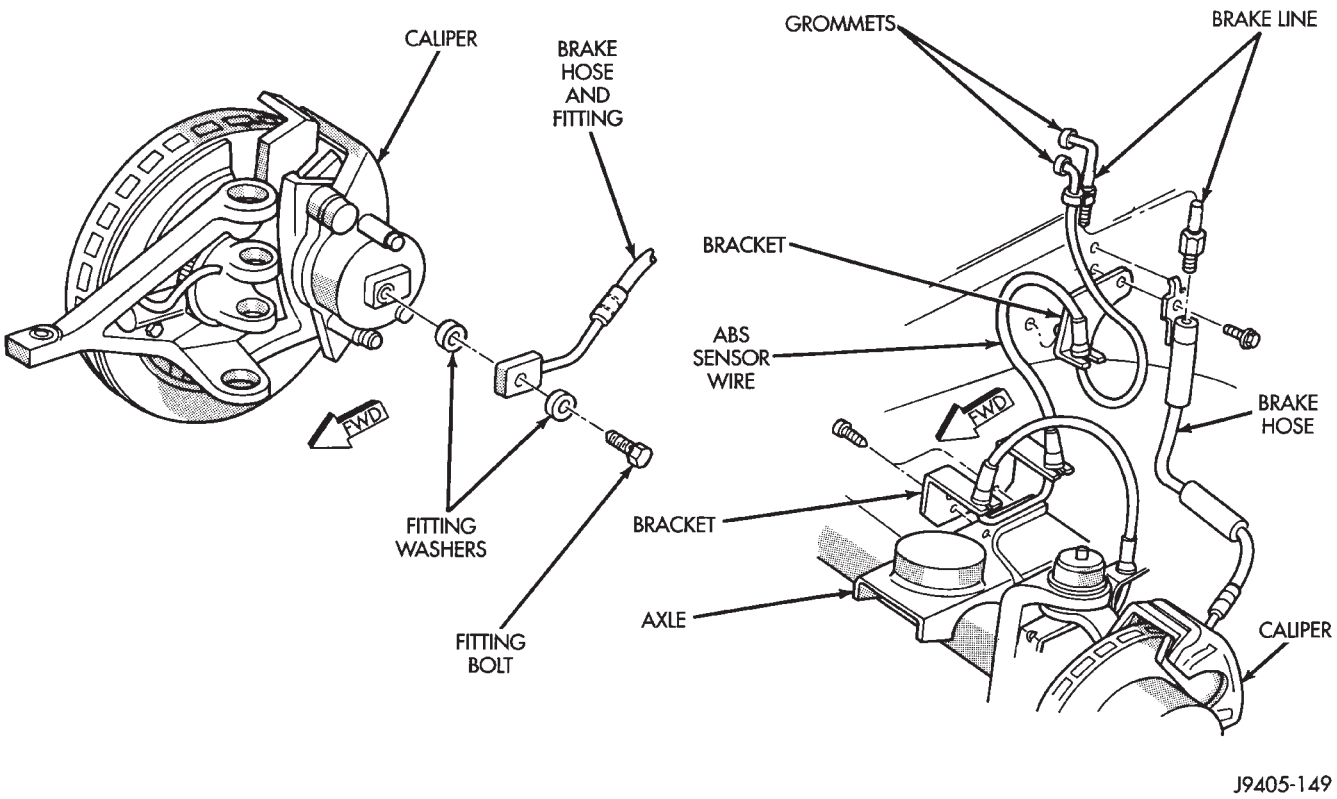

Fig. 8 Front Brake Hose Attachment (Right Hand Drive XJ With ABS Brakes)

STANDARD MASTER CYLINDER

INDEX

GENERAL SERVICE INFORMATION

The service information in this section covers the standard (non-ABS) master cylinder only. The center feed master cylinder used with the ABS system is covered in the antilock brake component service section.

MASTER CYLINDER REMOVAL

(1) Disconnect brake lines at master cylinder.

(2) Remove cylinder mounting nuts and remove master cylinder.

(3) Remove cylinder cover and drain fluid.

MASTER CYLINDER INSTALLATION

(1) Bleed master cylinder on bench before installation. Refer to overhaul assembly procedure in this section for bleeding method.

(2) Install cylinder on brake booster studs and install cylinder attaching nuts. Tighten nuts to 21 N•m (15 ft. lbs.).

(3) Connect brakelines to cylinder.

(4) Fill and bleed brake system.

MASTER CYLINDER OVERHAUL

CYLINDER DISASSEMBLY

(1) Remove cylinder cover and drain fluid.

(2) Examine cylinder cover seal. Discard seal if torn or distorted.

(3) Clamp cylinder in vise (Fig. 1).

(4) Press primary piston inward with wood dowel or phillips screwdriver and remove snap ring (Fig. 2).

(5) Remove and discard primary piston (Fig. 3). Piston is serviced only as an assembly.

(6) Remove secondary piston (Fig. 4). Apply air pressure through rear outlet port to ease piston out of bore. Cover small ports at bottom of rear reservoir with towel to prevent air leakage.

(7) Discard secondary piston. Do not disassemble piston as components are only serviced as assembly.

CLEANING AND INSPECTION

Clean the cylinder with Mopar brake cleaning solvent or clean brake fluid. Remove cleaning residue with compressed air.

Inspect the cylinder bore. A light discoloration of the bore surface is normal and acceptable but only if the surface is in good condition.

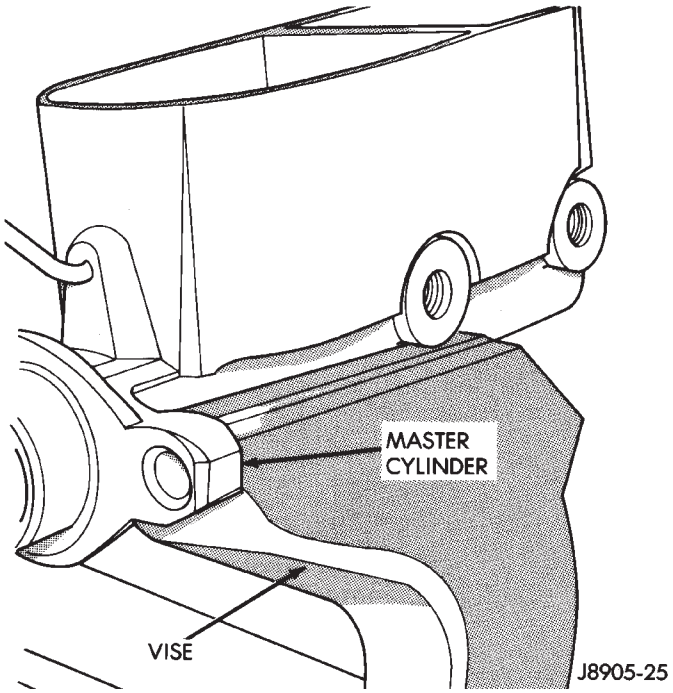

Fig. 1 Cylinder Mounted In Vise

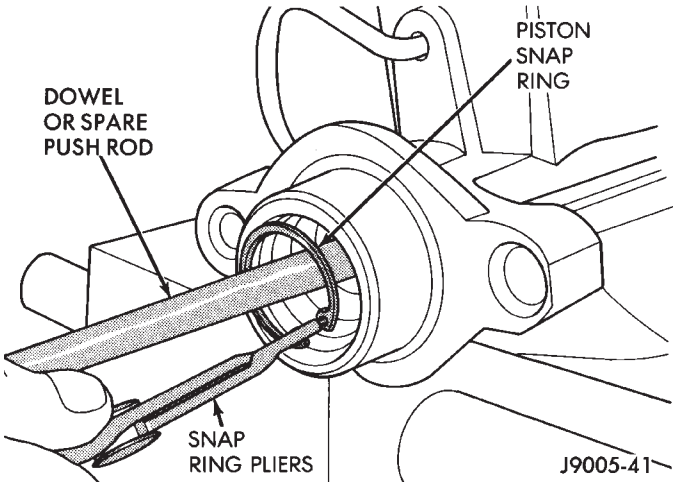

Fig. 2 Removing/Installing Piston Snap Ring

Replace the cylinder if the bore is scored, corroded, or pitted. **Do not hone the cylinder bore in an attempt to restore the surface. Replace the cylinder if the bore is corroded or if doubt exists about cylinder bore condition.**

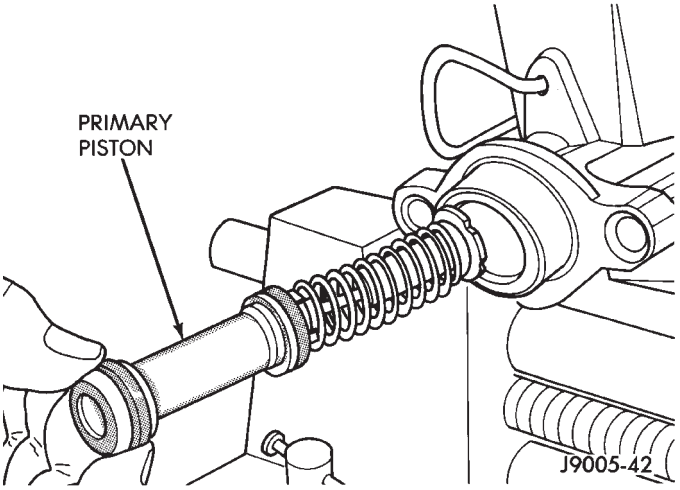

Fig. 3 Removing/Installing Primary Piston

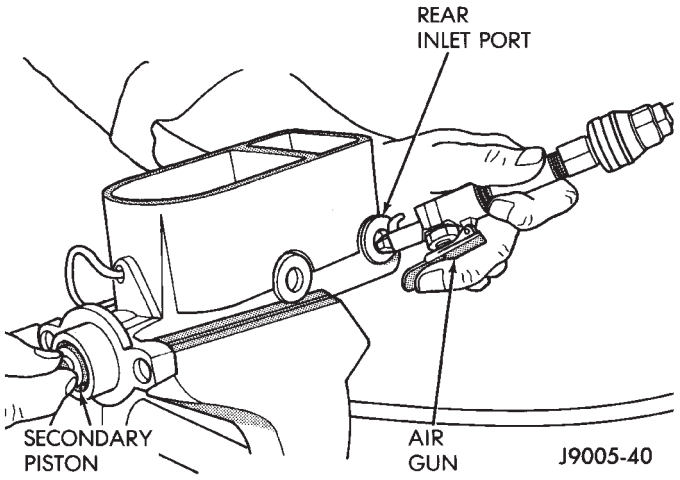

Fig. 4 Removing Secondary Piston Assembly

Check the outer and inner surfaces of the cylinder for cracks or porosity, especially if wet spots were noted on the cylinder outer surface during removal and disassembly.

Inspect the cylinder cover, seal and retainer spring. Replace the seal if torn or distorted and replace the cover and spring if either part is bent or damaged in any way.

MASTER CYLINDER ASSEMBLY

(1) Coat cylinder bore and new piston assemblies with brake fluid.

(2) Install secondary piston in bore with push and turn motion (Fig. 5). **Do not use any tools to start seals into bore. Tools can cut seal and scratch bore.**

(3) Insert primary piston in bore (Fig. 3).

(4) Push primary piston inward and install snap ring (Fig. 2).

(5) Fill master cylinder reservoirs with brake fluid.

(6) Fabricate and install bleed tubes in master cylinder (Fig. 6). Be sure tube ends are submerged in brake fluid. Tubes can be fabricated from copper tubing and spare brakeline fittings.

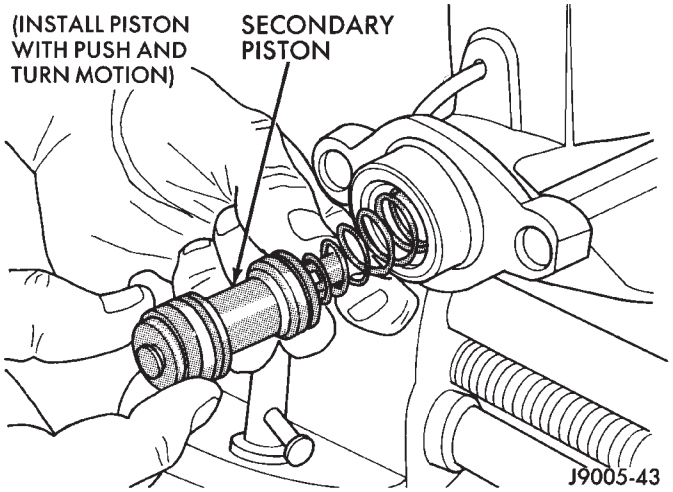

Fig. 5 Installing Secondary Piston

(7) Using push rod or wooden dowel (Fig. 6), press pistons fully into bore and allow pistons to return under spring pressure. Repeat this operation until air bubbles cease to appear in fluid.

(8) Remove bleed tubes. Cap outlet ports and install reservoir cover and seal.

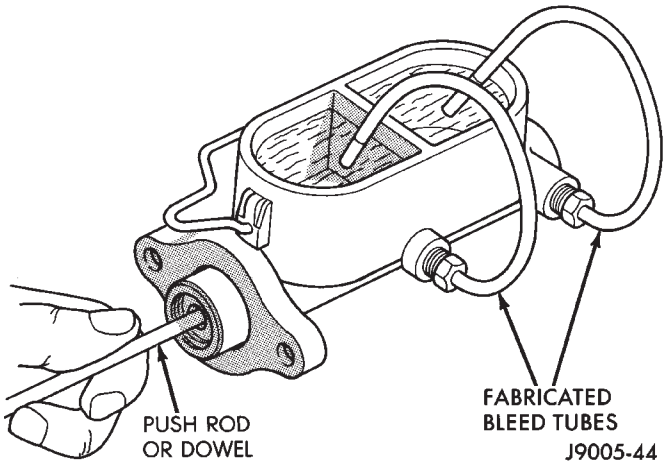

Fig. 6 Master Cylinder Bleeding

POWER BRAKE BOOSTER

INDEX

SERVICE INFORMATION

The power brake booster is not a serviceable component. If a booster malfunction occurs, the booster must be replaced as an assembly. The booster (Figs. 1 and 2), is attached to the dash panel and pedal support.

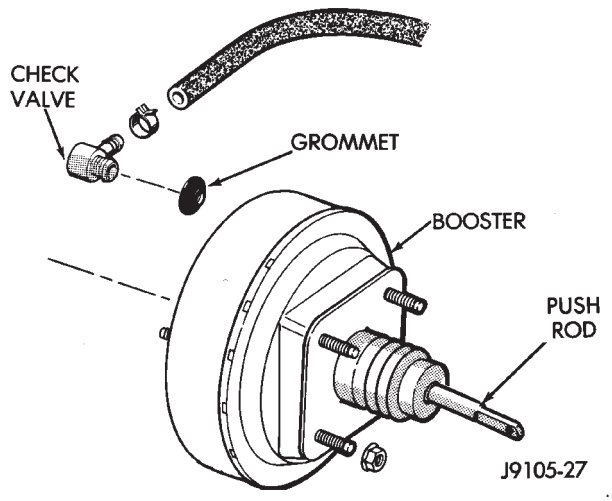

Fig. 1 Power Brake Booster (XJ)

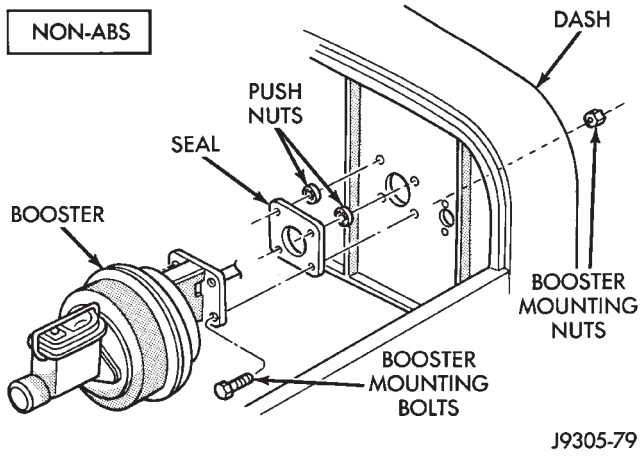

Fig. 2 Power Brake Booster (YJ)

POWER BRAKE BOOSTER OPERATION

Booster Components

The booster assembly consists of a housing divided into separate chambers by an internal diaphragm. The outer edge of the diaphragm is attached to the booster housing. The diaphragm is in turn, connected to the booster push rod.

Two push rods are used to operate the booster. One push rod connects the booster to the brake pedal. The second push rod (at the forward end of the housing), strokes the master cylinder pistons. The rear push rod is connected to the two diaphragms in the booster housing.

The atmospheric inlet valve is opened and closed by the push rod connected to the brake pedal. The booster vacuum supply is through a hose attached to a fitting on the intake manifold. The hose is connected to a vacuum check valve in the booster housing. The check valve is a one-way device that prevents vacuum leak back.

How Brake Boost Is Generated

Power assist is generated by utilizing the pressure differential between normal atmospheric pressure and a vacuum. The vacuum needed for booster operation is taken directly from the engine intake manifold. The entry point for atmospheric pressure is through an inlet valve at the rear of the housing.

The forward portion of the booster housing (area in front of the two diaphragms), is exposed to manifold vacuum. The rear portion (area behind the diaphragms), is exposed to normal atmospheric pressure of 101.3 kilopascals (14.7 pounds/square in.).

Pressing the brake pedal causes the rear push rod to open the inlet valve. This exposes the area behind the diaphragm to atmospheric pressure. The resulting force applied to the diaphragm is what provides the extra apply pressure for power assist.

POWER BRAKE BOOSTER REMOVAL

(1) Loosen but do not remove nuts attaching master cylinder to booster (Fig. 3).

(2) Remove instrument panel lower trim cover.

(3) Remove retaining clip attaching booster push rod to brake pedal (Fig. 4).

(4) Remove bolts/nuts attaching booster to dash panel.

(5) In engine compartment, loosen vacuum hose clamp and disconnect vacuum hose from booster check valve (Fig. 5).

(6) Remove master cylinder attaching nuts and remove cylinder from mounting studs on booster.

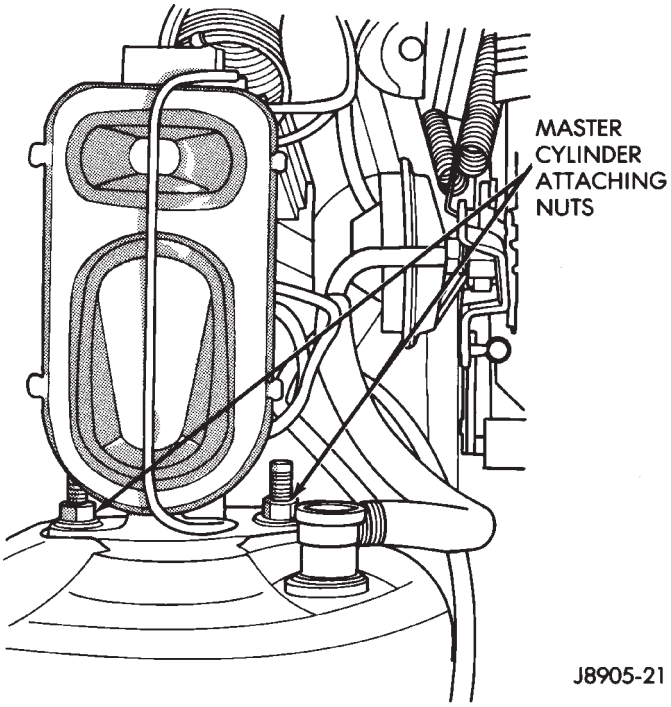

Fig. 3 Master Cylinder Attachment (Typical)

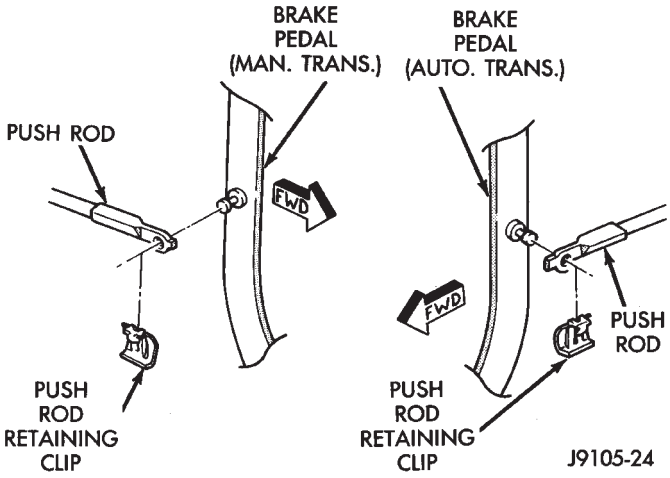

Fig. 4 Booster Push Rod Attachment

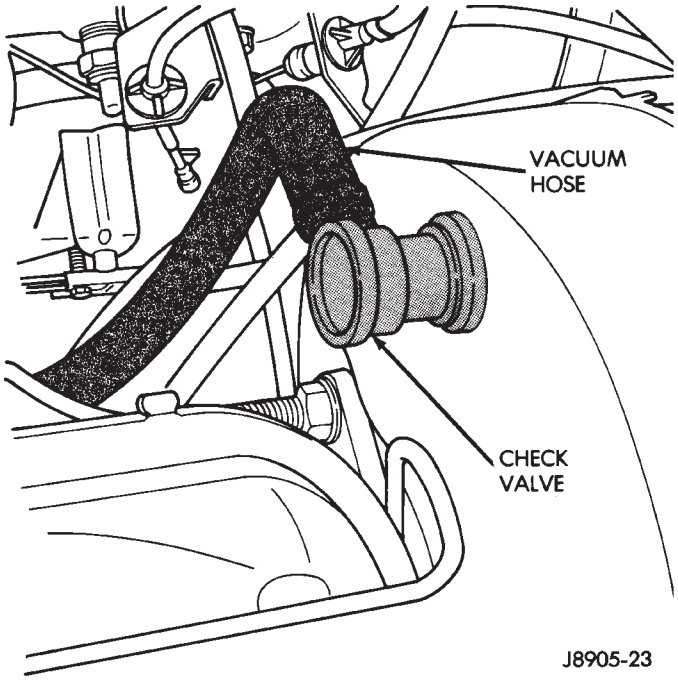

Fig. 5 Booster Check Valve And Hose

(7) Carefully move master cylinder aside and remove booster.

POWER BRAKE BOOSTER INSTALLATION

(1) Install check valve and grommet in booster. Also install spacer on booster, if equipped.

(2) Position booster on dash panel and install booster mounting bolts/nuts.

(3) Working inside vehicle, install nuts on booster mounting studs.

(4) Attach booster push rod to brake pedal. Secure push rod with new bolt and nuts.

(5) Tighten booster mounting bolts/stud nuts to 41 N·m (30 ft. lbs.) on XJ and 34 N·m (25 ft. lbs.) on YJ.

(6) Tighten pedal push rod bolt inner nut to 34 N·m (25 ft. lbs.) torque. Then tighten outer locknut to 8 N·m (75 in. lbs.) torque.

(7) Install master cylinder on booster studs. Tighten attaching nuts to 21 N·m (15 ft. lbs.).

(8) Connect vacuum hose to booster, top off master cylinder fluid level and check brake operation.

DISC BRAKES

INDEX

GENERAL INFORMATION

1994 Jeep XJ/YJ models are equipped with single piston, floating-type disc brake calipers. Ventilated, cast rotors are used for all applications.

The disc brake calipers are supported in mounting arms that are an integral part of the steering knuckle. The calipers slide on mounting bolts that also attach the calipers to the steering knuckle.

CALIPER OPERATION AND WEAR COMPENSATION

Caliper Operation

The significant feature of single piston caliper operation is that the calipers are free to slide laterally on the mounting bolts. It is the freedom of lateral movement that allows continous compensation for lining wear.

A simplified cross section of a single piston caliper is shown in Figure 1. The illustration graphically portrays the forces at work when the brakes are applied.

Upon brake application, fluid pressure exerted against the caliper piston increases greatly. Of equal importance, is the fact that this fluid pressure is exerted equally and in all directions. What this means, is that pressure in the caliper bore, will be exactly the same as pressure on the piston. In other words, pressure against piston and caliper bore will be equal.

Fluid pressure applied to the piston is transmitted directly to the inboard brakeshoe. This forces the shoe lining against the inner surface of the disc brake rotor (Fig. 1).

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 brakeshoe lining into contact with the outer surface of the disc brake rotor (Fig. 1).

In summary, fluid pressure acting simultaneously on both piston and caliper, produces a strong clamping action. When sufficient force is applied, friction will stop the rotors from turning and bring the vehicle to a stop.

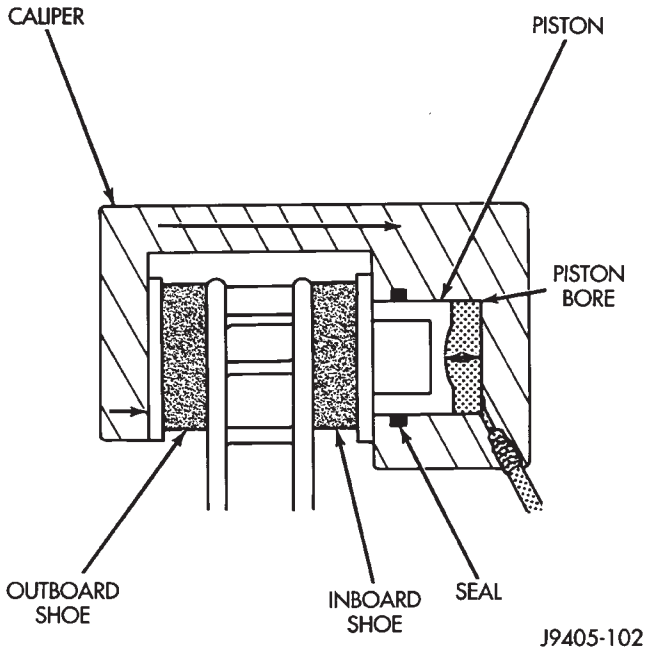

Fig. 1 Disc Brake Caliper Operation

Brakeshoe Wear Compensation

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 brakeshoes 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. 2). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

The amount of piston retraction is determined by brakelining wear. Generally, the amount is just

enough to maintain contact between the piston and inboard brakeshoe. Brakelining running clearance at the rotor, will be held between zero and a maximum of 0.12 mm (0.005 in.).

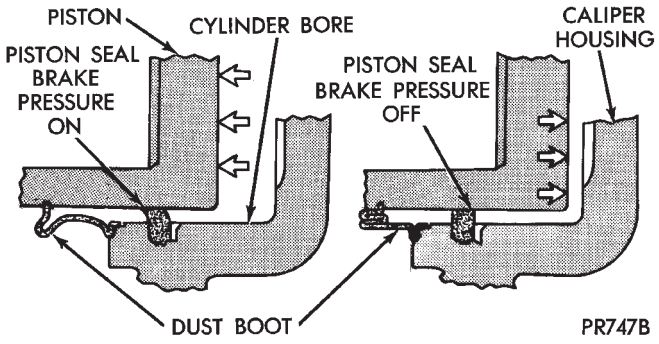

Fig. 2 Lining Wear Compensation By Piston Seal

DISC BRAKESHOE REMOVAL

(1) Raise vehicle and remove front wheels.

(2) Drain small amount of fluid from master cylinder front brake reservoir with suction gun.

(3) Bottom caliper piston in bore with C-clamp. Position clamp screw on outboard brakeshoe and clamp frame on rear of caliper. Typical C-clamp attachment is shown in Figure 3. **Do not allow clamp screw to bear directly on outboard shoe retainer spring. Use wood or metal spacer between shoe and clamp screw if necessary.**

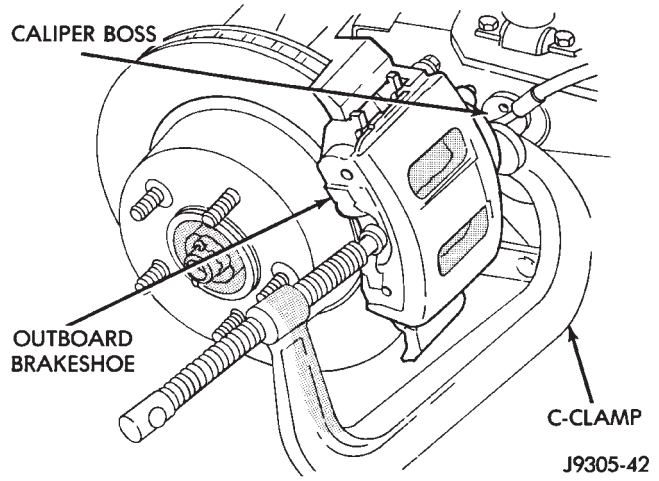

Fig. 3 Bottoming Caliper Piston With C-Clamp

(4) Remove caliper mounting bolts (Fig. 4). **If brakeshoes are being removed to correct a pull or drag condition, verify length of caliper bolts as they may be incorrect length. Refer to bolt information in brakeshoe installation procedure.**

(5) Tilt top of caliper outward. Use pry tool if necessary (Fig. 5).

(6) Lift caliper off steering knuckle (Fig. 6).

(7) **If original brakeshoes will be used, keep them in sets (left and right); they are not interchangeable.**

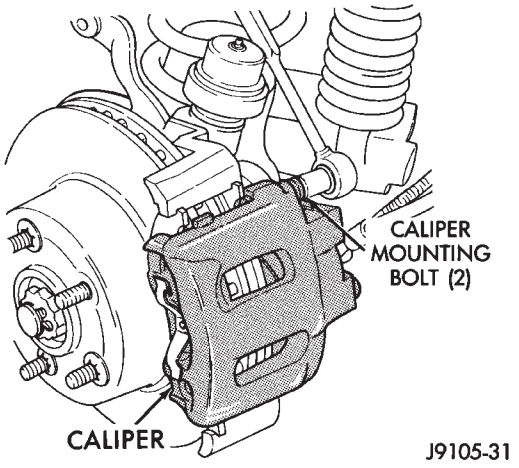

Fig. 4 Removing/Installing Caliper Mounting Bolts

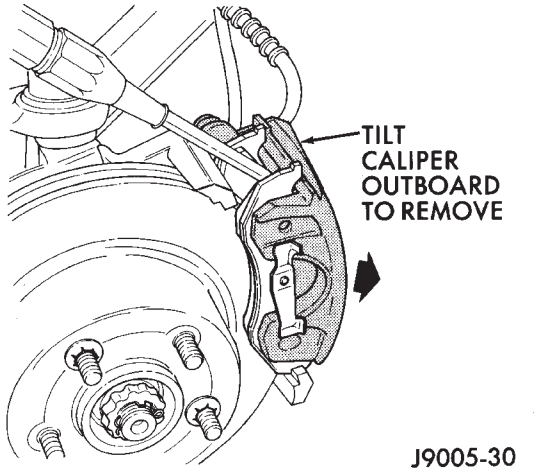

Fig. 5 Tilting Caliper Outward

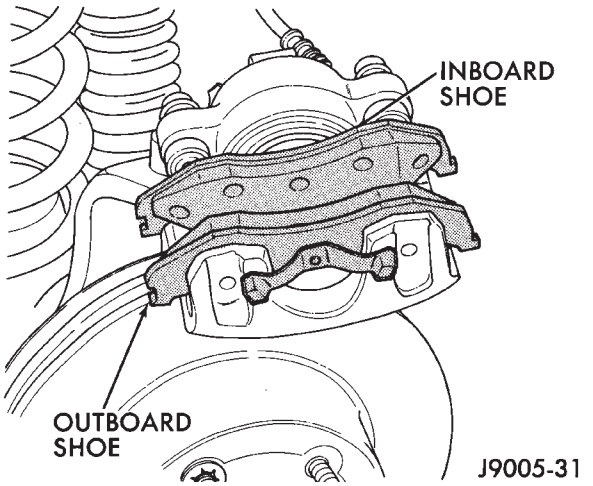

Fig. 6 Caliper Removal

(8) Remove outboard shoe. Press one end of shoe inward to disengage shoe lug. Then rotate shoe upward until retainer spring clears caliper. Press opposite end of shoe inward to disengage shoe lug and rotate shoe up and out of caliper (Fig. 7).

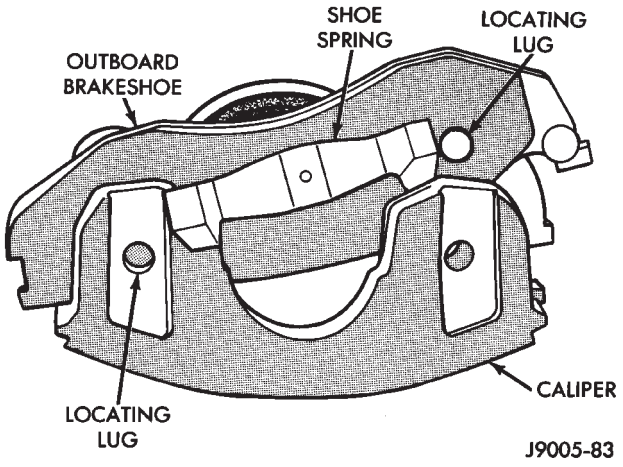

Fig. 7 Removing Outboard Brakeshoe

(9) Remove inboard shoe. Grasp ends of shoe and tilt shoe outward to release springs from caliper piston (Fig. 8). Then remove shoe from caliper.

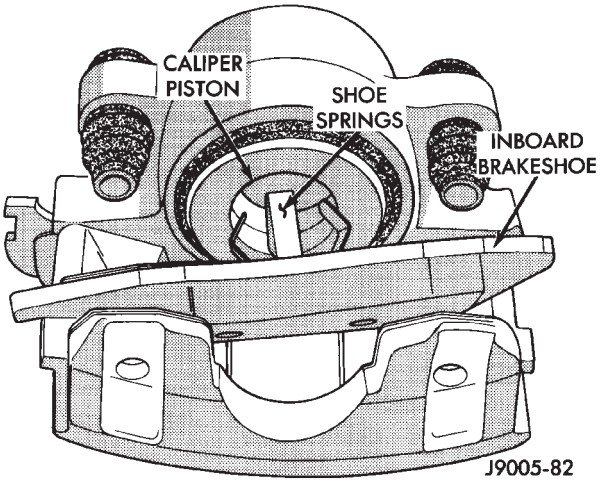

Fig. 8 Removing Inboard Brakeshoe

(10) Support caliper on box, mechanics stool, or secure it to nearby suspension part with wire. **Do not allow brake hose to support caliper weight.**

(11) Wipe caliper off with shop rags or towels. **Do not use compressed air. Compressed air can unseat dust boot and force dirt into piston bore.**

(12) Inspect condition of caliper piston dust boot (Fig. 9). Overhaul caliper if there is evidence of leakage past piston and dust boot. Then inspect caliper bushings and boots (Fig. 9). Replace boots if torn or cut. If bushings or boots are damaged, replace them.

DISC BRAKESHOE INSTALLATION

(1) Clean brakeshoe mounting ledge slide surfaces of steering knuckle with wire brush. Then apply light coat of Mopar multi-mileage grease to slide surfaces (Fig. 10).

(2) Lubricate caliper mounting bolts and bushings (Fig. 10). Use GE 661 or Dow 111 silicone grease.

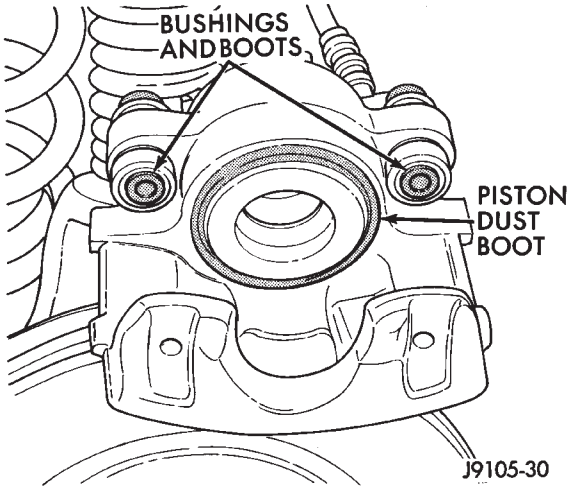

Fig. 9 Caliper Dust Boots And Bushing Locations

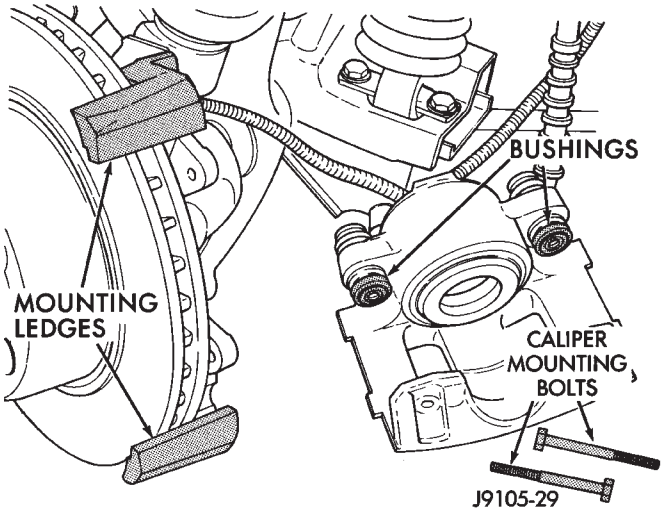

Fig. 10 Caliper Lubrication Points

(3) Keep new or original brakeshoes in sets. **Do not interchange them.**

(4) Install inboard shoe in caliper (Fig. 11). Be sure shoe retaining springs are fully seated in caliper piston.

(5) Install outboard shoe in caliper (Fig. 12). Start one end of shoe in caliper. Rotate shoe downward and into place until shoe locating lugs and shoe spring are seated.

(6) Verify that locating lugs on outboard shoe are seated in caliper (Fig. 6).

(7) Install caliper. Position notches at lower end of brakeshoes on bottom mounting ledge (Fig. 13). Then install caliper over rotor and seat upper ends of brakeshoes on top mounting ledge (Fig. 11).

CAUTION: Before securing the caliper, be sure the caliper brake hose is not twisted, kinked or touching any chassis components. Also be sure the hose is clear of all suspension and steering components. Loosen and reposition the hose if necessary.

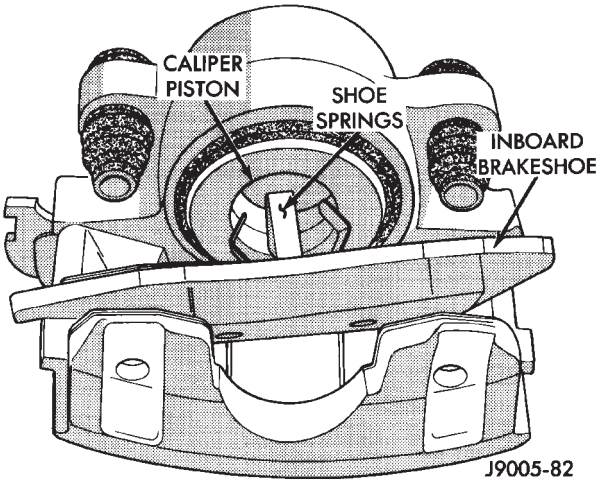

Fig. 11 Installing Inboard Brakeshoe

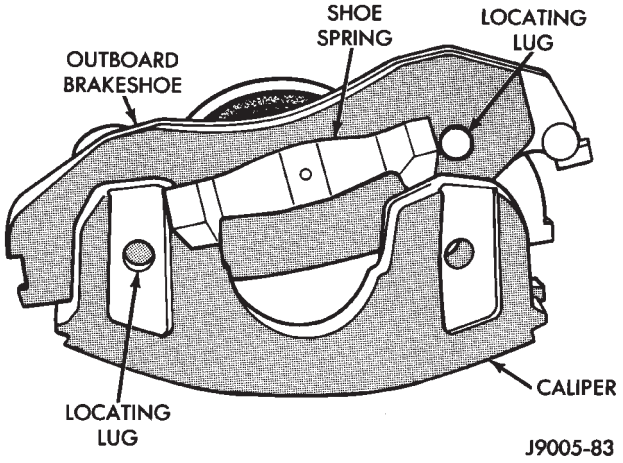

Fig. 12 Installing Outboard Brakeshoe

(8) Install and tighten caliper mounting bolts to 10-20 N·m (7-15 ft. lbs.) torque.

CAUTION: If new caliper bolts are being installed, or if the original reason for repair was a drag/pull condition, check caliper bolt length before proceeding. If the bolts have a shank length greater than 67.6 mm (2.66 in.), they will contact the inboard brakeshoe causing a partial apply condition. Refer to Figure 14 for required caliper bolt length.

(9) Install wheels. Tighten lug nuts to 102 N·m (75 ft. lbs.) torque.

(10) Pump brake pedal until caliper pistons and brakeshoes are seated.

(11) Top off brake fluid level if necessary. Use Mopar brake fluid or equivalent meeting SAE J1703 and DOT 3 standards only.

CALIPER REMOVAL

(1) Raise vehicle and remove front wheels.

(2) Remove caliper mounting bolts (Fig. 4).

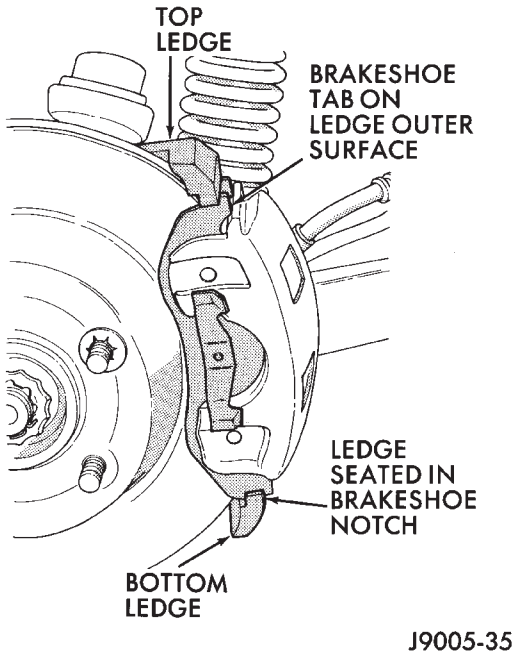

Fig. 13 Caliper Installation

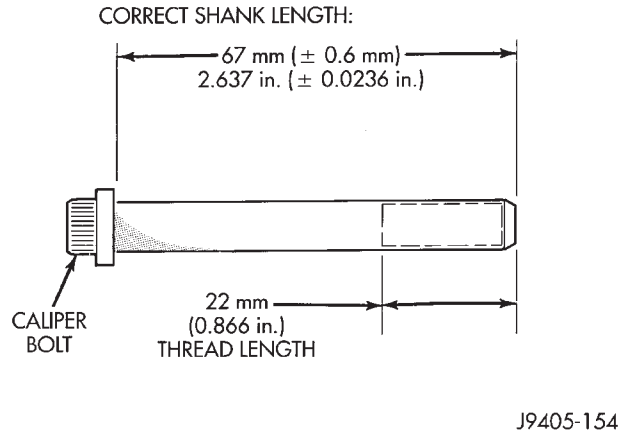

Fig. 14 Caliper Mounting Bolt Dimensions

(3) Rotate caliper rearward by hand or with pry tool (Fig. 5). Then rotate caliper and brakeshoes off mounting ledges.

(4) Remove caliper hose fitting bolt and disconnect front brake hose at caliper. Discard fitting bolt washers. They are not reusable and should be replaced.

(5) Remove caliper from vehicle.

CALIPER DISASSEMBLY

(1) Remove brakeshoes from caliper.

(2) Pad interior of caliper with minimum, 2.54 cm (1 in.) thickness of shop towels or rags (Fig. 15). Towels are needed to protect caliper piston during removal.

(3) Remove caliper piston with **short bursts** of low pressure compressed air. Direct air through fluid inlet port and ease piston out of bore (Fig. 16).

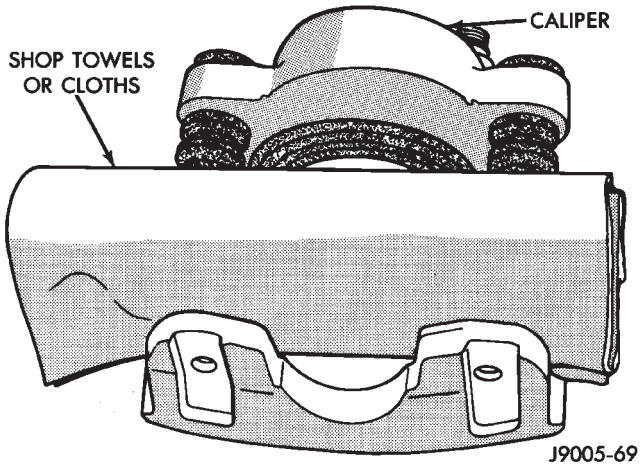

Fig. 15 Padding Caliper Interior To Protect Piston During Removal

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. In addition, NEVER attempt to catch the piston as it leaves the bore. This will result in personal injury.

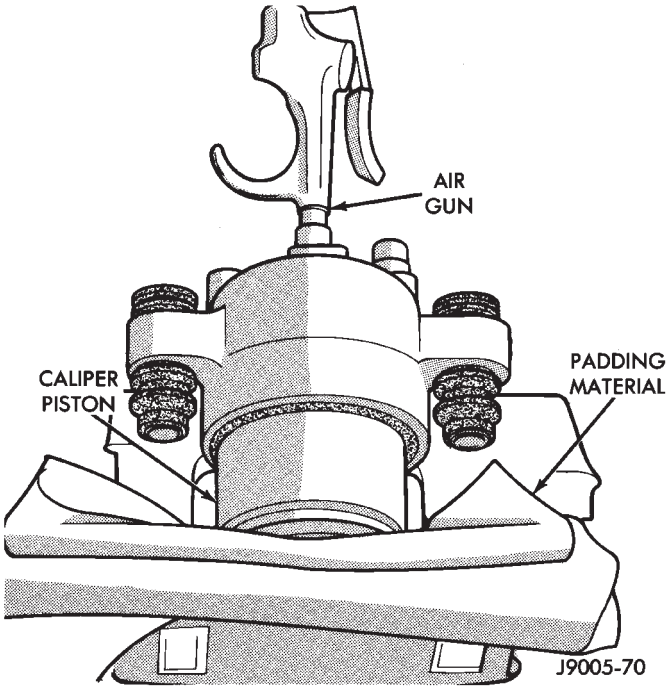

Fig. 16 Removing Caliper Piston

(4) Remove caliper piston dust boot (Fig. 17). Collapse boot with suitable tool and remove and discard boot.

(5) Remove and discard caliper piston seal with wood or plastic tool (Fig. 18). Do not use metal tools as they will scratch piston bore.

(6) Remove caliper mounting bolt bushings and boots (Fig. 19).

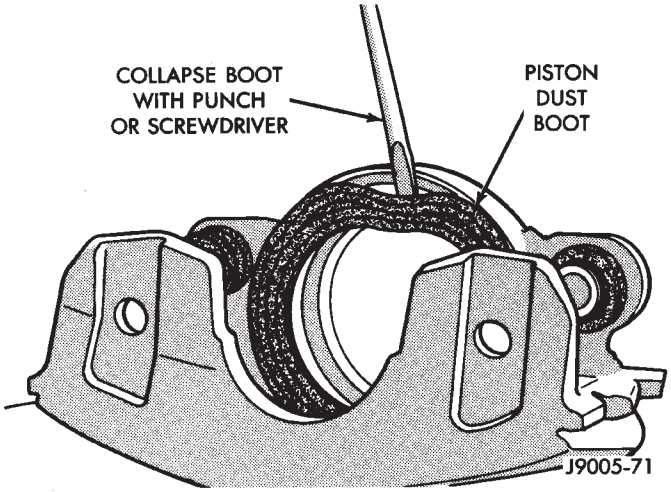

Fig. 17 Removing Caliper Piston Dust Boot

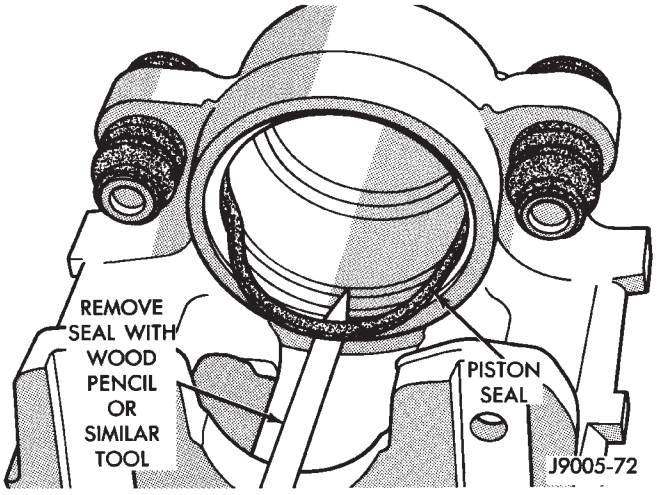

Fig. 18 Removing Caliper Piston Seal

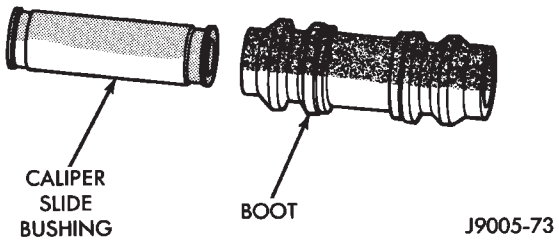

Fig. 19 Caliper Slide Bushing And Boot

CALIPER CLEANING AND INSPECTION

Clean the caliper and piston with Mopar brake cleaner, clean brake fluid, or denatured alcohol only. Do not use gasoline, kerosene, thinner, or similar solvents. These products leave a residue that will damage pistons and seals.

Wipe the caliper and piston dry with lint free towels or use low pressure compressed air.

Inspect the piston and piston bore. Replace the caliper if the bore is corroded, rusted, pitted, or scored.

Do not hone the caliper piston bore. Replace the caliper if the bore exhibits any of the aforementioned conditions.

Inspect the caliper piston. The piston is made from a phenolic resin (plastic material) and should be smooth and clean. Replace the piston if cracked, chipped, or scored. Do not attempt to restore a scored, or corroded piston surface by sanding or polishing. The piston must be replaced if damaged.

CAUTION: Never interchange phenolic resin and steel caliper pistons. The seals, seal grooves, caliper bores and piston tolerances are different for resin and steel pistons. Do not intermix these components.

Inspect the caliper mounting bolt bushings and boots. Replace the boots if cut or torn. Clean and lubricate the bushings with GE 661 or Dow 111 silicone grease if necessary.

Inspect condition of the caliper mounting bolts. Replace the bolts if corroded, rusted, or worn. Do not reuse the bolts if unsure of their condition.

Length of the caliper mounting bolts is also extremely important.

Use the replacement bolts specified in the parts catalog at all times. Do not use substitute bolts. Bolts that are too long will partially apply the inboard brakeshoe causing drag and pull. Refer to the caliper and brakeshoe installation procedures for service details and bolt dimensions.

CALIPER ASSEMBLY

(1) Coat caliper piston bore, new piston seal and piston with clean, fresh brake fluid.

(2) Lubricate caliper bushings and interior of bushing boots with GE 661, Dow 111, or Permatex Dielectric silicone grease.

(3) Install bushing boots in caliper first. Then insert bushing into boot and push bushing into place (Fig. 20).

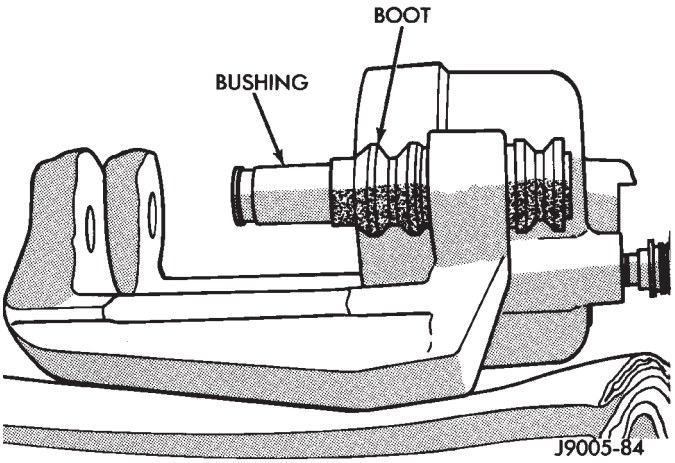

Fig. 20 Installing Bushings And Boots

(4) Install new piston seal in caliper bore. Press seal into seal groove with finger (Fig. 21).

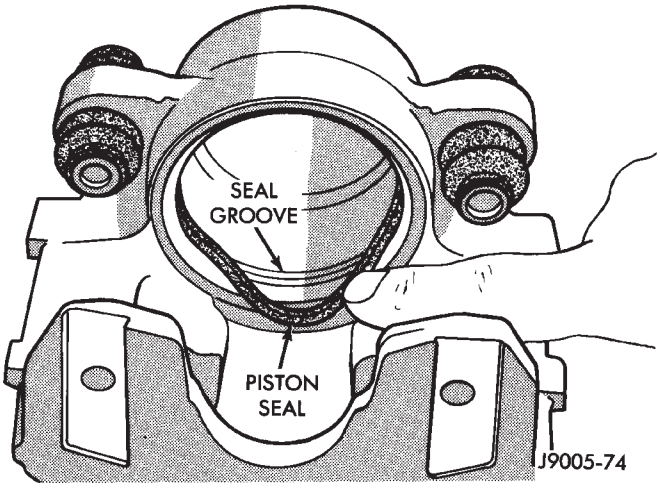

Fig. 21 Installing Piston Seal

(5) Install dust boot on caliper piston (Fig. 22). Slide boot over piston and seat boot in piston groove.

(6) Start caliper piston in bore by hand (Fig. 23). Use a turn and push motion to work piston into seal. Once piston is started in seal, press piston **only part way** into bore.

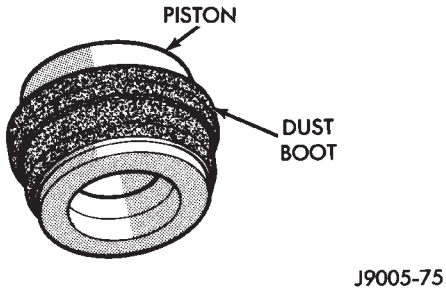

Fig. 22 Installing Dust Boot On Piston

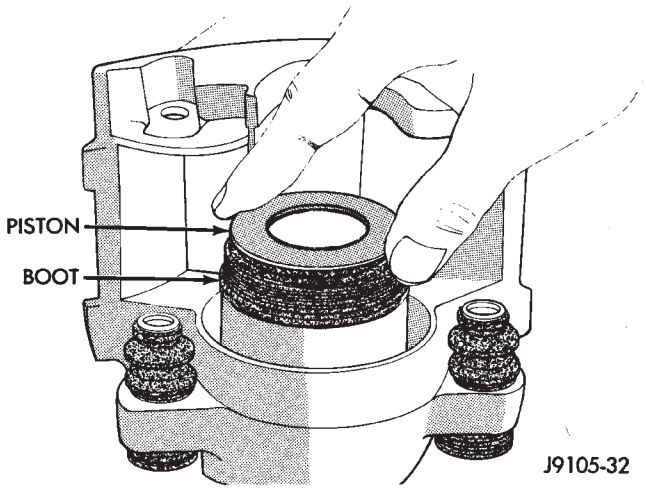

Fig. 23 Installing Caliper Piston

(7) Apply light coat of GE 661, Dow 111, or Permatex silicone grease to indicated areas (circumfer-

ence) of piston and caliper boot groove (Fig. 24). Grease serves as corrosion protection for these areas.

(8) Press caliper piston to bottom of bore.

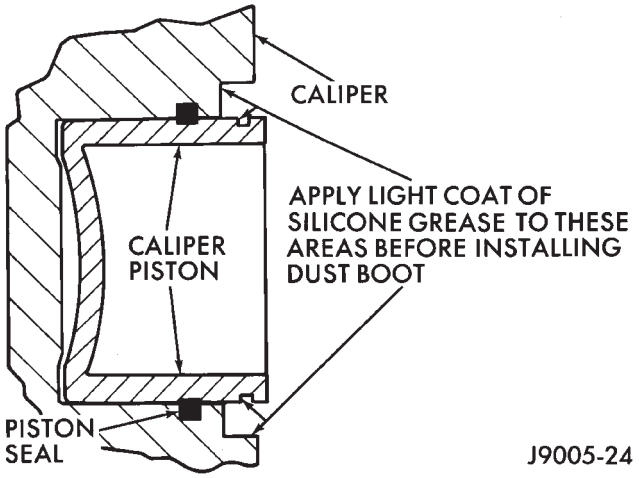

Fig. 24 Typical Caliper/Piston Areas To Be Lightly Coated With Silicone Grease

(9) Seat dust boot in caliper with Installer Tool C-4842 and Tool Handle C-4171 (Fig. 25).

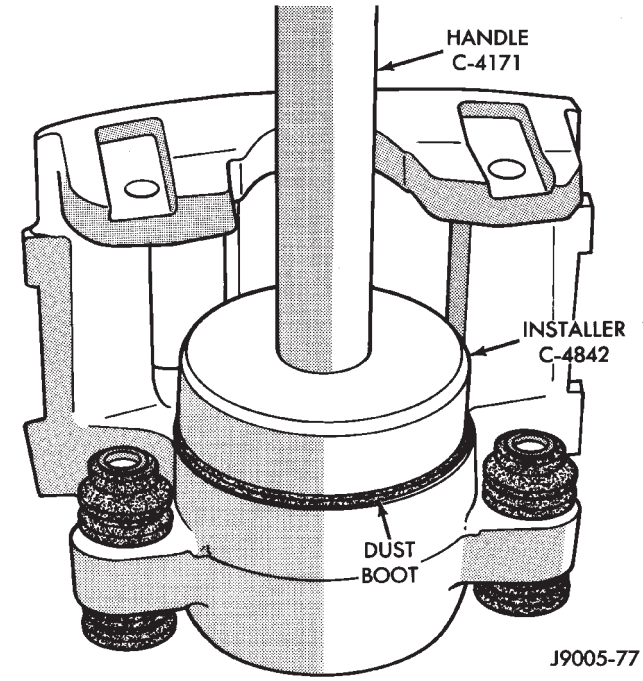

Fig. 25 Seating Caliper Piston Piston Dust Boot

(10) Install caliper bleed screw if removed.

CALIPER INSTALLATION

(1) Install brakeshoes in caliper (Figs. 11, 12).

(2) Connect brake hose fitting to caliper but do not tighten fitting bolt completely at this time. **Be sure to use new washers on fitting bolt to avoid leaks (Fig. 26).**

(3) Install caliper. Position mounting notches at lower end of brakeshoes on bottom mounting ledge

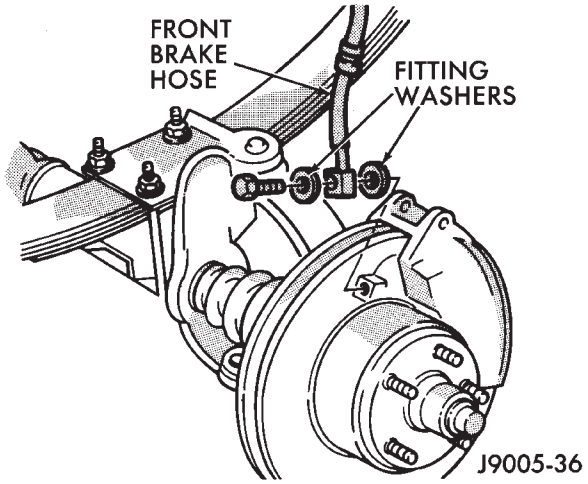

Fig. 26 Front Brake Hose And Fitting Components

(Fig. 13). Then rotate caliper over rotor and seat notches at upper end of shoes on mounting ledge (Fig. 13).

(4) Coat caliper mounting bolts with GE 661 or Dow 111 silicone grease. Then install and tighten bolts to 10-20 N·m (7-15 ft. lbs.) torque.

CAUTION: If new caliper bolts are being installed, or if the original reason for repair was a drag/pull condition, check caliper bolt length before proceeding. If the bolts have a shank length greater than 67.6 mm (2.66 in.), they may contact the inboard brakeshoe causing a partial apply condition. Refer to Figure 14 for the required caliper bolt length.

(5) Position front brake hose clear of all chassis components and tighten caliper fitting bolt to 31 N·m (23 ft. lbs.) torque.

CAUTION: Be sure the brake hose is not twisted or kinked at any point. Also be sure the hose is clear of all steering and suspension components. Loosen and reposition the hose if necessary.

(6) Install wheels. Tighten wheel lug nuts to 109-150 N·m (80-110 ft. lbs.) torque.

(7) Fill and bleed brake system. Refer to procedures in Service Adjustments section.

ROTOR REMOVAL

(1) Raise vehicle and remove wheel.

(2) Remove caliper.

(3) Remove retainers securing rotor to hub studs (Fig. 27).

(4) Remove rotor from hub (Fig. 27).

(5) If rotor shield requires service, remove front hub and bearing assembly.

ROTOR INSTALLATION

(1) Install rotor on hub.

(2) Install caliper.

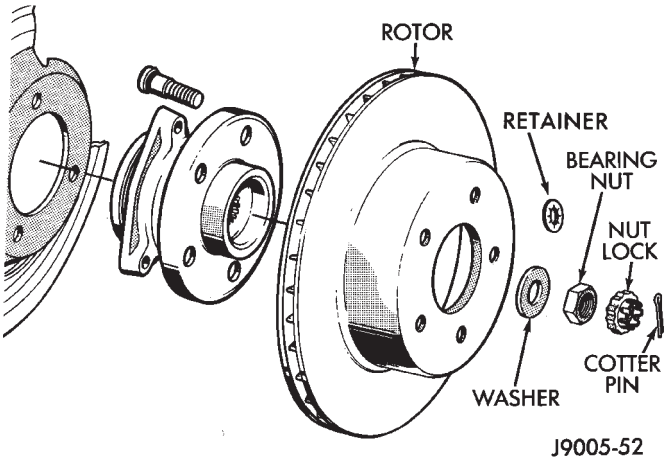

Fig. 27 Rotor And Hub

(3) Install new spring nuts on wheel studs.
(4) Install wheel and lower vehicle.

DISC BRAKE ROTOR THICKNESS

Rotor minimum usable thickness is 22.7 mm (0.89 in.). This dimension is either cast, or stamped on the rotor hub, or outer edge.

Measure rotor thickness at the center of the brakeshoe contact surface.

Replace the rotor if worn below minimum thickness. Also replace the rotor if refinishing would reduce thickness below the allowable minimum.

DISC BRAKE ROTOR RUNOUT

Check rotor lateral runout whenever pedal pulsation, or rapid, uneven brakelining wear has occurred.

On 4-wheel drive models, the rotor must be securely clamped to the hub to ensure an accurate runout measurement. Secure the rotor with the wheel nuts and 4 or 5 large diameter flat washers on each stud as shown (Fig. 28).

Use a dial indicator to check lateral runout (Fig. 28).

Maximum allowable rotor lateral runout is 0.13 mm (0.005 in.).

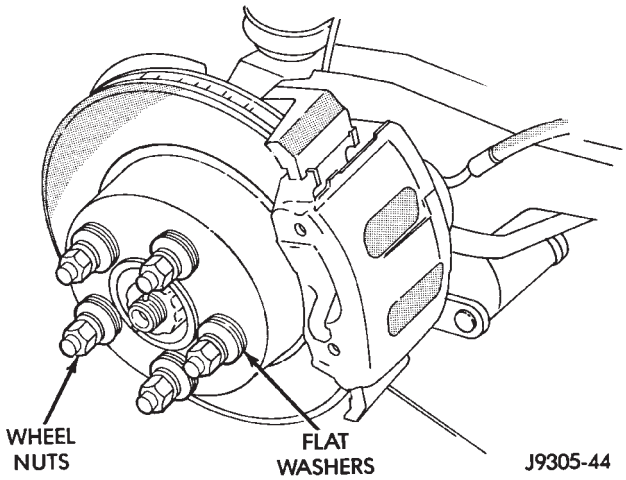

Fig. 28 Securing 4 x 4 Rotor For Lateral Runout Check

Check lateral runout with a dial indicator (Fig. 29). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brakeshoes.

Maximum allowable rotor runout for all models is 0.12 mm (0.005 in.).

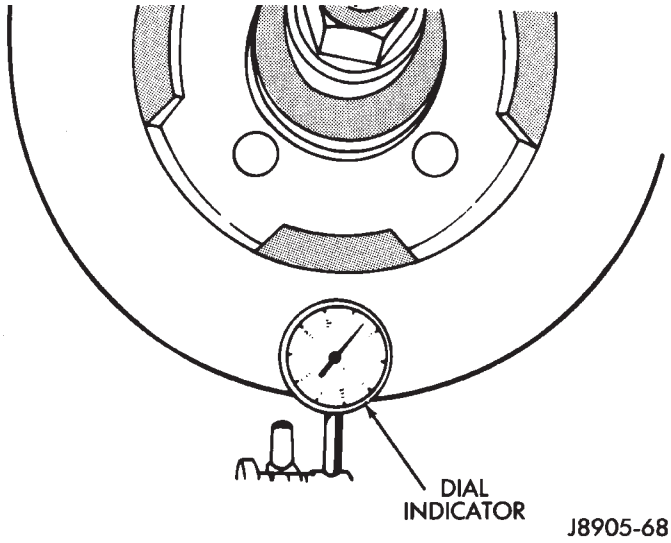

Fig. 29 Typical Method Of Checking Rotor Lateral Runout

DISC BRAKE ROTOR THICKNESS VARIATION

Variations in rotor thickness will cause pedal pulsation, noise and shudder.

Measure rotor thickness at four to six points around the rotor face. Position the micrometer approximately 2 cm (3/4 in.) from the rotor outer circumference for each measurement (Fig. 30).

Thickness should not **vary** by more than 0.013 mm (0.0005 in.) from point-to-point on the rotor. Refinish or replace the rotor if necessary.

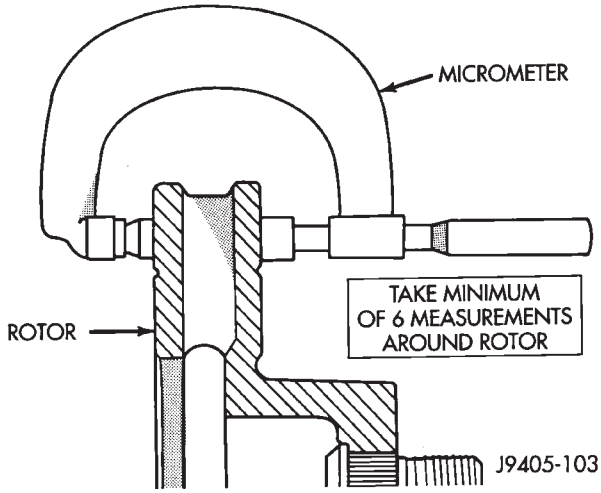

Fig. 30 Measuring Rotor Thickness Variation

DISC BRAKE ROTOR REFINISHING

When To Refinish

Rotor braking surfaces can be refinished by sanding and/or machining in a disc brake lathe. However, the rotor should be cleaned and inspected beforehand. Careful inspection will avoid refinishing rotors with very little service life left in them.

Pay particular attention to rotors that are heavily rusted, or corroded. Accumulated rust/corrosion on braking surfaces and ventilating ribs may extend to a depth beyond acceptable limits. This can be especially true on: (a) high mileage vehicles; (b) vehicles regularly exposed to road salt during winter months; (c) vehicles operated in coastal regions where salt air/road splash is a factor; (d) and vehicles used for extensive off-road operation.

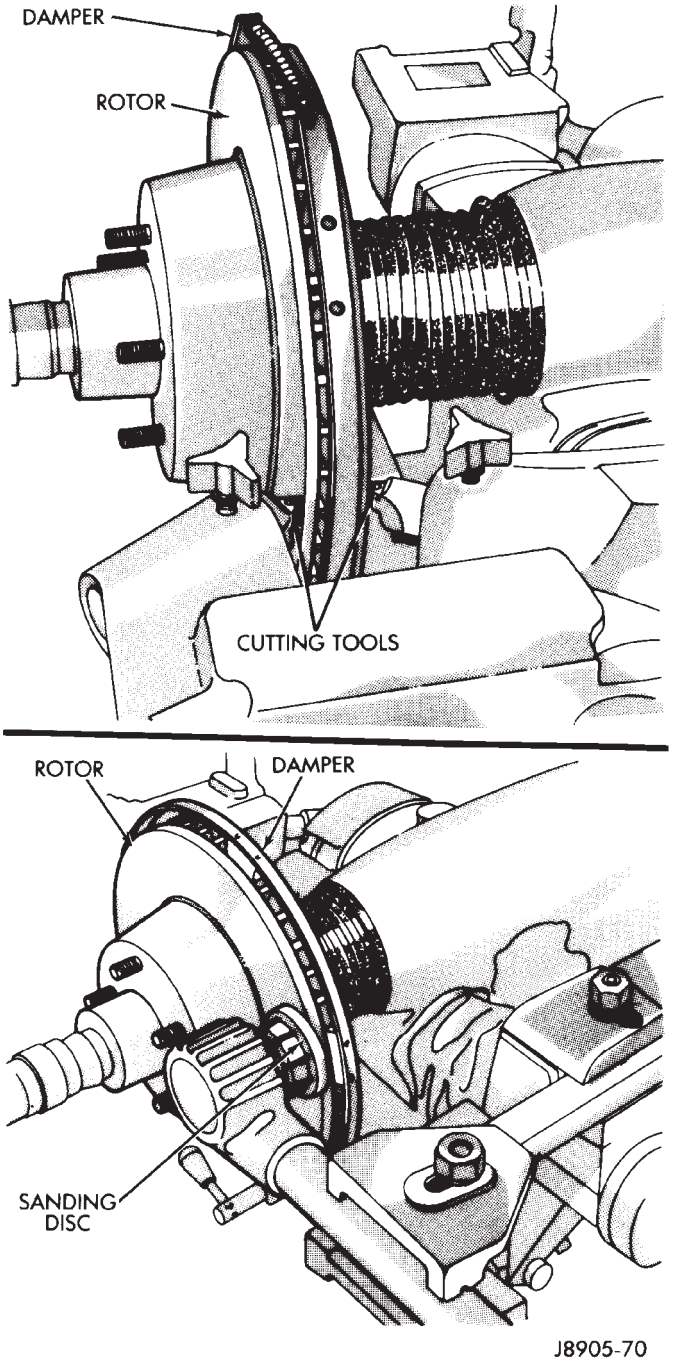

Fig. 31 Rotor Refinishing Equipment

Recommended Refinishing Equipment

The brake lathe must be capable of machining both rotor surfaces simultaneously with dual cutter heads (Fig. 31). **Equipment capable of machining only one side at a time will produce a tapered rotor.** The lathe should also be equipped with a grinder attachment, or dual sanding discs for final cleanup or light refinishing.

Refinishing Techniques

If the rotor surfaces only need minor cleanup of rust, scale, or scoring, use abrasive sanding discs to clean up the rotor surfaces. However, when a rotor is scored or worn, machining with cutting tools will be required.

Light cuts are recommended when machining the rotor surfaces. Heavy feed rates are not recommended and may result in chatter marks, or taper.

CAUTION: Never refinish a rotor if machining would cause the rotor to fall below minimum allowable thickness.

The final finish on the rotor should be a non-directional, cross hatch pattern (Fig. 32). Use sanding discs to produce this finish.

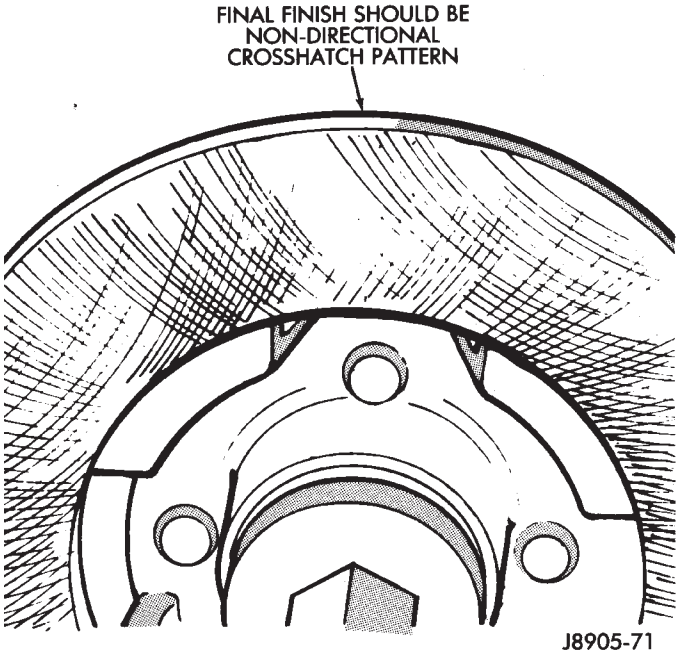

Fig. 32 Preferred Rotor Surface Finish

WHEEL NUT TIGHTENING

The wheel attaching nuts must be tightened properly to ensure efficient brake operation. Overtightening the nuts or tightening them in the wrong sequence can

cause distortion of the brake rotors and drums.

Impact wrenches are not recommended for tightening wheel nuts. A torque wrench should be used for this purpose.

A light coat of LPS Anti-Corrosion spray lube around the hub face and on the studs will cut down on rust/corrosion formation.

The correct tightening sequence is important in avoiding rotor and drum distortion. The correct sequence is in a diagonal crossing pattern (Fig. 33).

Recommended torque range for XJ/YJ wheel lug nuts is 108-149 N·m (80-110 ft. lbs.). Preferred set-to torque is 129 N·m (95 ft. lbs.) torque.

Seat the wheel and install the wheel nuts finger tight. Tighten the nuts in the sequence to 1/2 the required torque. Then repeat the tightening sequence to final specified torque.

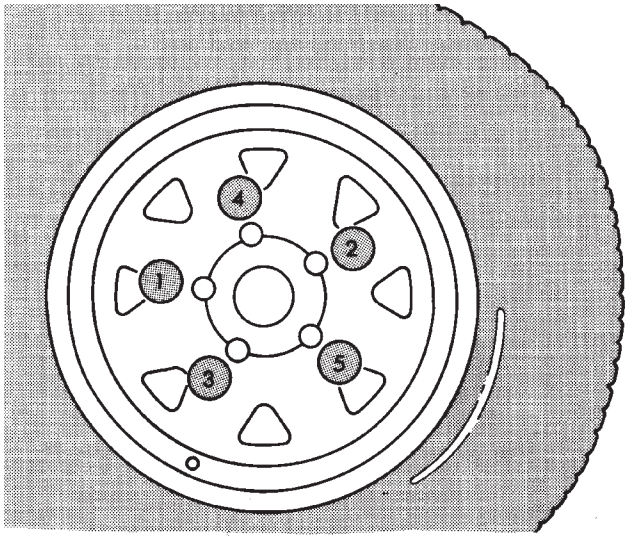

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Fig. 33 Wheel Nut Tightening Sequence

DRUM BRAKES

INDEX

DRUM BRAKESHOE REMOVAL (Figs. 1 and 2)

(1) Raise vehicle and remove rear wheels.

(2) Remove and discard spring nuts securing drums to wheel studs.

(3) Remove brake drums. If drums prove difficult to remove, retract brakeshoes. Remove access plug at the rear of backing plate and back off adjuster screw with brake tool and screwdriver.

(4) Remove U-clip and washer securing adjuster cable to parking brake lever.

(5) Remove primary and secondary return springs from anchor pin with Brake Spring Plier Tool 8078.

(6) Remove holddown springs, retainers and pins with Retaining Spring Tool C-4070.

(7) Install Spring Clamps C-416 on wheel cylinders to hold pistons in place.

(8) Remove adjuster lever, adjuster screw and spring.

(9) Remove adjuster cable and cable guide.

(10) Remove brakeshoes and parking brake strut.

(11) Disconnect cable from parking brake lever and remove lever.

DRUM BRAKESHOE INSTALLATION

(1) Clean support plate with Mopar brake cleaner. Replace support plate if worn, or rusted through at any point. Do not attempt to salvage, or reuse a damaged support plate.

(2) Clean and lubricate anchor pin with light coat of Mopar multi-mileage grease.

(3) Apply Mopar multi-mileage grease to brakeshoe contact surfaces of support plate (Figs. 3 and 4).

(4) Lubricate adjuster screw threads and pivot with Mopar spray lube.

(5) Attach parking brake lever to secondary brakeshoe. Use new washer and U-clip to secure lever.

(6) Remove wheel cylinder clamps.

(7) Attach parking brake cable to lever.

(8) Install brakeshoes on support plate. Secure shoes with new holddown springs, pins and retainers.

(9) Install parking brake strut and spring.

(10) Install guide plate and adjuster cable on anchor pin.

(11) Install primary and secondary return springs.

(12) Install adjuster cable guide on secondary shoe.

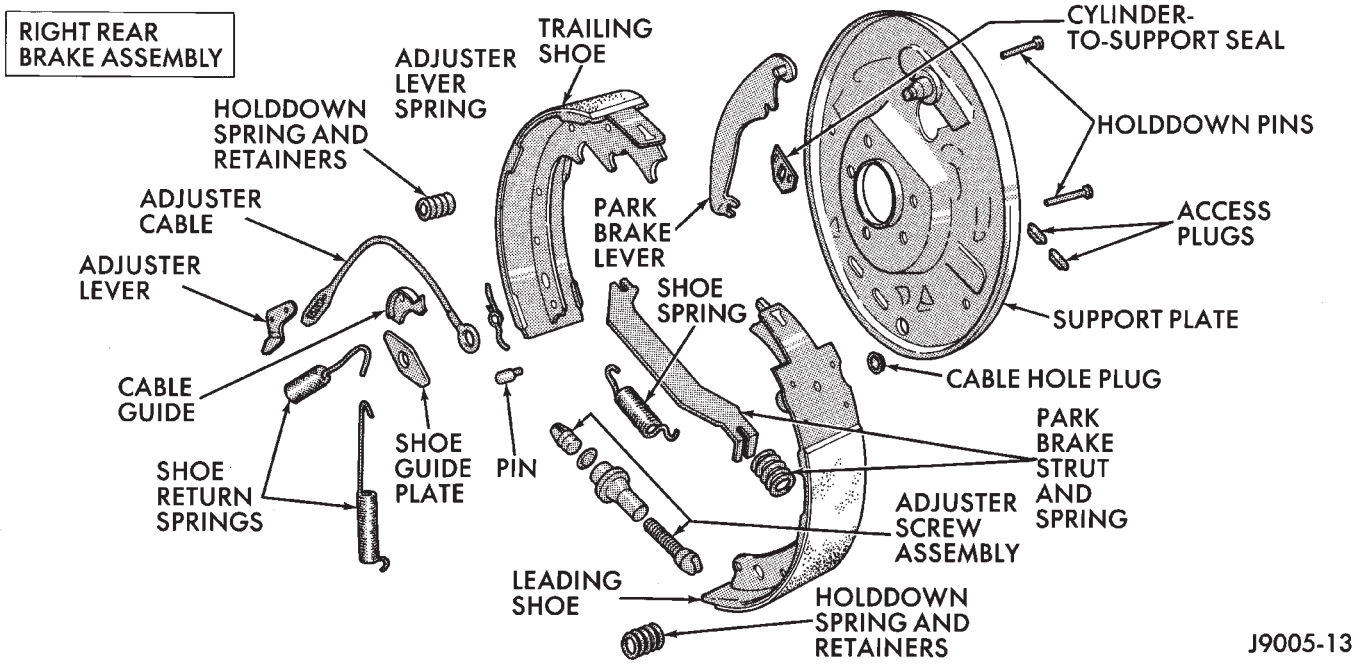

Fig. 1 Nine Inch Drum Brake Components

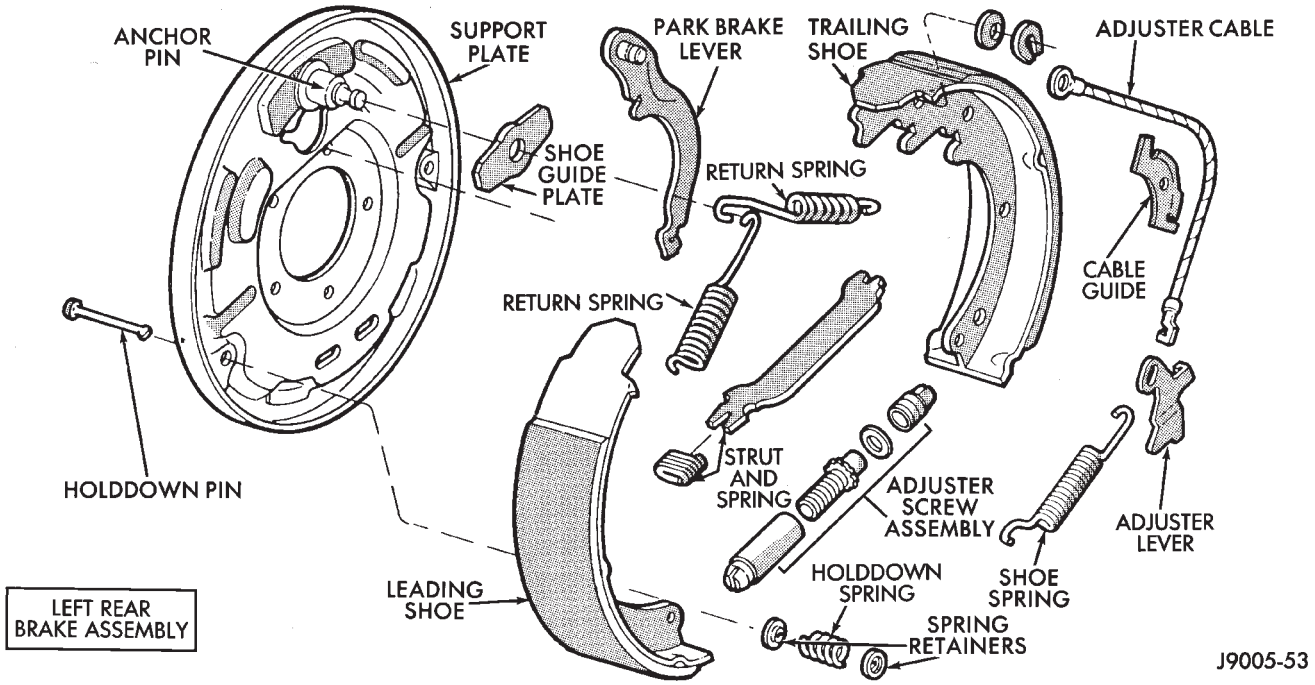

Fig. 2 Ten Inch Drum Brake Components

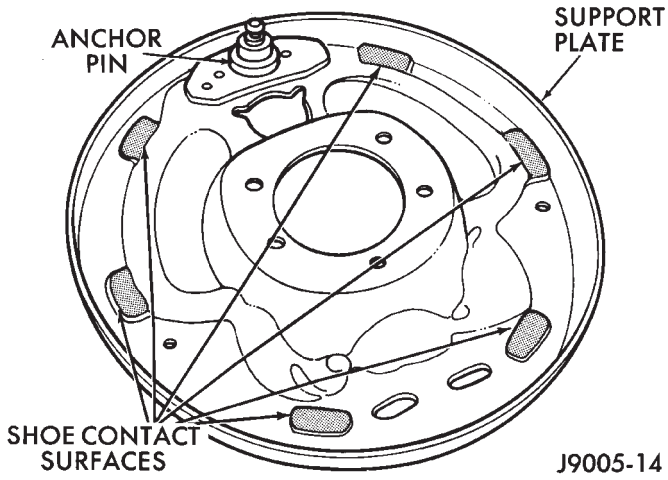

Fig. 3 Shoe Contact Surfaces (9-Inch Support Plate)

(13) Lubricate and assemble adjuster screw (Fig. 5).

(14) Install adjuster screw, spring and lever and connect to adjuster cable.

(15) Adjust shoes to drum as described in following procedure.

(16) Install wheel/tire assemblies and lower vehicle.

(17) Verify firm brake pedal before moving vehicle.

DRUM BRAKE ADJUSTMENT

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.

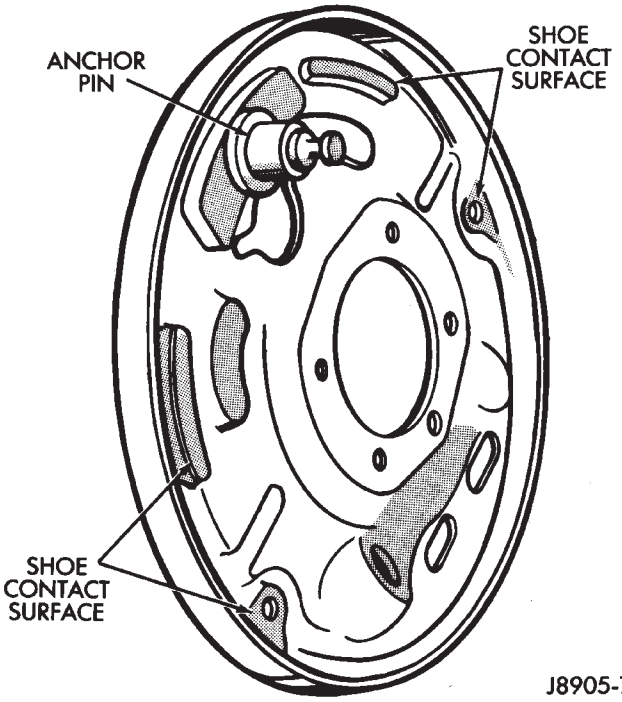

Fig. 4 Shoe Contact Surfaces (10-Inch Support Plate)

The only tool needed for adjustment is a standard brake gauge.

Adjustment is performed with the brakeshoes installed on the support plate. Procedure is as follows:

ADJUSTMENT PROCEDURE

(1) Raise and support vehicle rear end and remove wheels and brake drums.

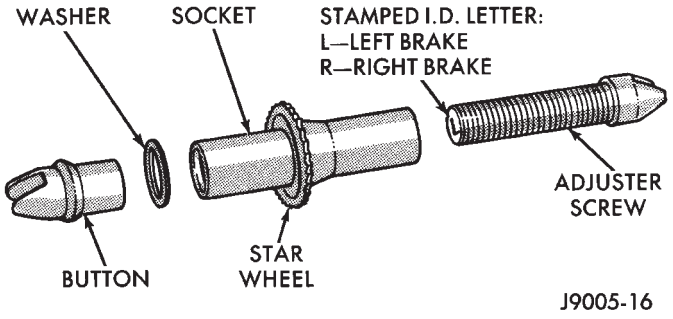

Fig. 5 Adjuster Screw Components (9-Inch Brake)

(2) Verify that left/right automatic adjuster lever and cable are properly connected.

(3) Insert brake gauge in drum. Expand gauge until gauge inner legs contact drum braking surface. Then lock gauge in position (Fig. 6).

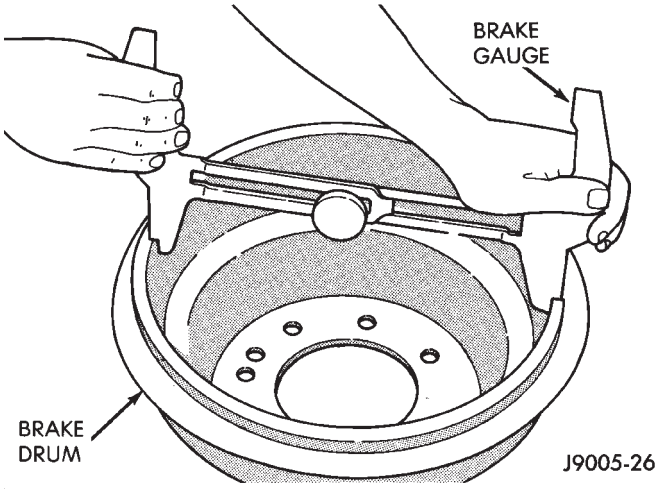

Fig. 6 Adjusting Gauge To Brake Drum

(4) Reverse gauge and install it on brakeshoes (Fig. 6). Position gauge legs at shoe centers as shown. If gauge does not fit (too loose or tight), adjust shoes.

(5) Pull shoe adjuster star wheel away from adjuster lever.

(6) Turn adjuster star wheel (by hand) to expand or retract brakeshoes. Continue adjustment until gauge outside legs are light drag-fit on shoes (Fig. 7).

(7) Repeat adjustment at opposite brakeshoe assembly.

(8) Install brake drums and wheels and lower vehicle.

(9) Make final adjustment as follows:

(a) Drive vehicle and make one forward stop followed by one reverse stop.

(b) Repeat procedure 8-10 times to actuate self adjuster components and equalize adjustment.

(c) **Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will NOT activate adjuster mechanism.**

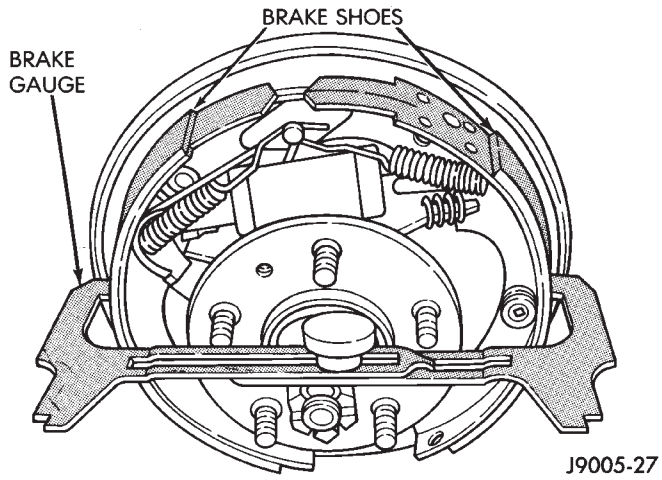

Fig. 7 Adjusting Brakeshoes To Gauge

WHEEL CYLINDER REMOVAL

(1) Raise vehicle and remove wheel.

(2) Disconnect brakeline at wheel cylinder. **If cylinder brakeline fitting is hard to break loose, spray generous amount of Mopar Rust Penetrant between fitting and line and around fitting threads in wheel cylinder. Note that it may require a few minutes for penetrant to work.**

(3) Remove brakeshoes.

(4) Remove bolts attaching wheel cylinder to support plate and remove cylinder.

WHEEL CYLINDER OVERHAUL (Figs. 8 and 9)

(1) Remove links.

(2) Remove dust boots.

(3) Remove cups and pistons. Discard cups.

(4) Remove and discard spring and expander.

(5) Remove bleed screw.

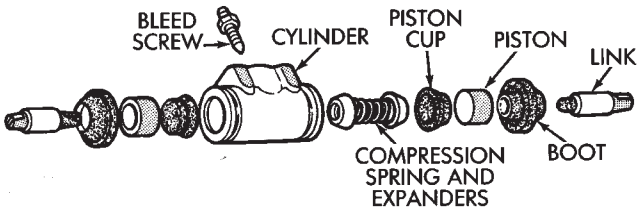

Fig. 8 Wheel Cylinder (9-Inch Brake)

(6) Clean cylinder, pistons and links with Mopar brake cleaner.

(7) Inspect cylinder bore and pistons. Light discoloration of bore is acceptable. However, replace cylinder if bore and pistons are scored, pitted, or corroded. **Do not hone cylinder bores or polish pistons. Replace cylinder as an assembly if bore is damaged.**

(8) Install bleed screw.

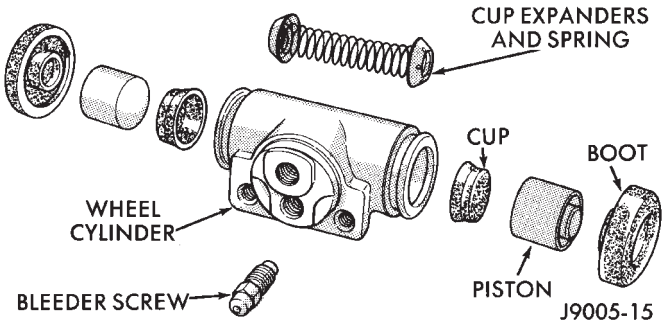

Fig. 9 Wheel Cylinder (10-Inch Brake)

(9) Coat cylinder bore, pistons, cups and expander with brake fluid and reassemble cylinder components. Be sure piston cup lips face expander.

WHEEL CYLINDER INSTALLATION

(1) Apply small bead of silicone sealer around cylinder mounting surface of support plate.

(2) Start brakeline in wheel cylinder fitting by hand.

(3) Align and seat wheel cylinder on support plate (Fig. 10).

(4) Install cylinder mounting bolts (Fig. 10). Tighten bolts to 10 N·m (90 in. lbs.) torque.

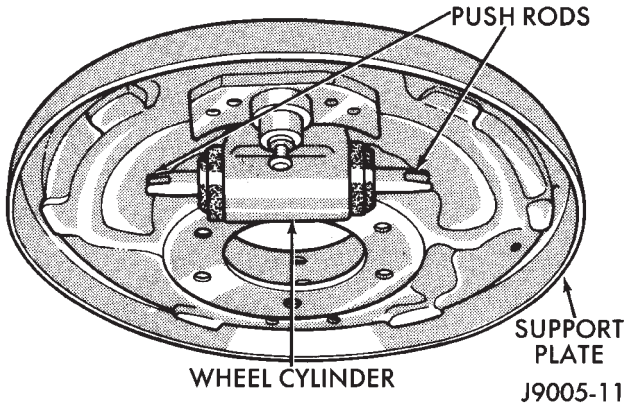

Fig. 10 Wheel Cylinder Mounting

(5) Tighten brakeline fitting to 15 N·m (132 in. lbs.) torque.

(6) Install brakeshoes. Adjust shoes to drum with brake gauge.

(7) Install brake drums and lower vehicle.

(8) Fill master cylinder and bleed brakes.

SUPPORT PLATE REPLACEMENT

The support plate should cleaned and inspected whenever the drum brake components are being serviced.

Check the support plate for wear, or rust through at the contact pads and replace the plate if necessary. Be sure to lubricate the contact pads with Mopar multi-mileage grease before shoe installation. Lubrication will avoid noisy operation and shoe bind.

(1) Raise vehicle and remove wheel/tire assembly.

(2) Remove brake drum, brakeshoes, and wheel cylinder.

(3) Remove axle shaft as described in Group 3.

(4) Remove support plate attaching nuts and remove support plate.

(5) Clean axle tube flange. If gasket is not used on flange, apply thin bead of silicone adhesive/sealer to flange.

(6) Position new support plate on axle tube flange.

(7) Apply Mopar Lock N″ Seal, or Loctite 242 to support plate attaching nuts. Then install and tighten nuts.

(8) Apply light coat of Mopar multi-mileage grease to contact pads of new support plate.

(9) Install wheel cylinder and brakeshoes.

(10) Adjust brakeshoes to drums. Refer to procedure in this section.

(11) Bleed brakes.

(12) Install wheel and tire assembly.

(13) Adjust parking brake cable tensioner. Refer to procedure in Parking Brake section.

(14) Lower vehicle and verify proper service brake and parking brake operation.

BRAKE DRUM REFINISHING

Brake drums can be machined to restore the braking surface. Use a brake lathe to clean up light scoring and wear.

CAUTION: Never refinish a brake drum if machining will cause the drum to exceed maximum allowable brake surface diameter.

Brake drums that are warped, distorted, or severely tapered should be replaced. Do not refinish drums exhibiting these conditions. Brake drums that are heat checked or have hard spots should also be replaced.

If the brake drums are heavily coated with rust, clean and inspect them carefully. Rust damage on high mileage drums can be severe enough to require replacement.

The maximum allowable diameter for the drum braking surface is usually indicated on the drum outer face (Fig. 11).

WHEEL NUT TIGHTENING

The wheel attaching lug nuts must be tightened properly to ensure efficient brake operation. Overtightening the nuts or tightening them in the wrong sequence can cause distortion of the brake rotors and drums.

Impact wrenches are not recommended for tightening wheel nuts. A torque wrench should be used for this purpose.

A light coat of LPS Anti-Corrosion spray lube around the hub face and on the studs will cut down on rust/corrosion formation.

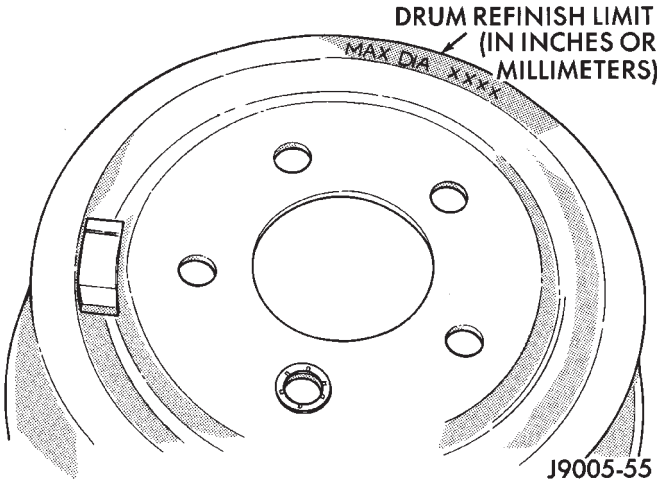

Fig. 11 Typical Location Of Brake Drum Refinish Limit

The correct tightening sequence is important in avoiding rotor and drum distortion. The correct sequence is in a diagonal crossing pattern (Fig. 12).

Recommended torque range for XJ/YJ wheel lug nuts is 109-150 N·m (80-110 ft. lbs.).

Seat the wheel and install the wheel nuts finger tight. Tighten the nuts in the sequence to half the required torque. Then repeat the tightening sequence to final specified torque.

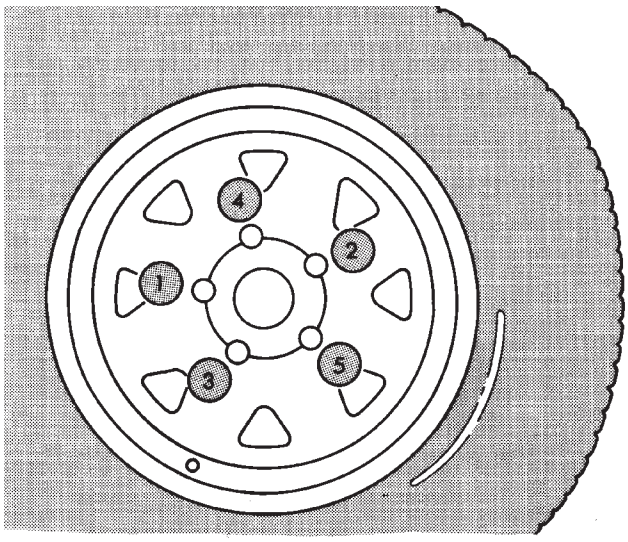

Fig. 12 Wheel Nut Tightening Sequence

ABS SYSTEM OPERATION

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GENERAL INFORMATION

The Jeep antilock brake system (ABS) is an electronically operated, all-wheel brake control system. Major components include the master cylinder, vacuum power brake booster, ECU, hydraulic control unit (HCU) and various control sensors (Fig. 1). The ABS brake system is available on XJ and YJ models.

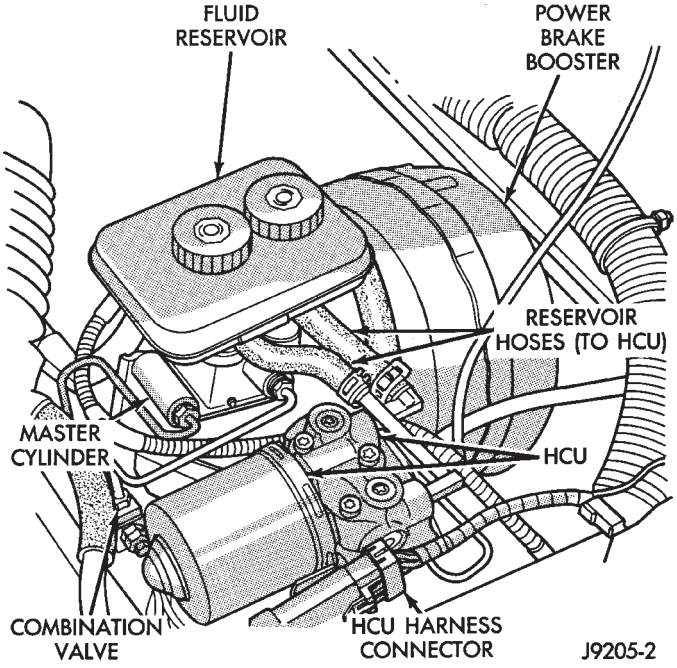

Fig. 1 Antilock Components (XJ Shown)

The antilock hydraulic system is a three channel design. The front wheel brakes are controlled individually and the rear wheel brakes in tandem (Fig. 2).

The antilock system is designed to retard wheel lockup during periods of high wheel slip when braking. Retarding wheel lockup is accomplished by modulating fluid pressure to the wheel brake units.

The ABS electronic control system is separate from other electrical circuits in the vehicle. A specially programmed electronic control unit (ECU) is used to operate the system components.

System components include:

- electronic control unit (ECU)
- wheel speed sensors and axle shaft tone rings
- hydraulic control unit (HCU)
- tandem master cylinder with central valves
- vacuum power brake booster
- pedal travel sensor
- acceleration switch
- main relay and pump motor relay
- ABS warning light
- pump motor sensor

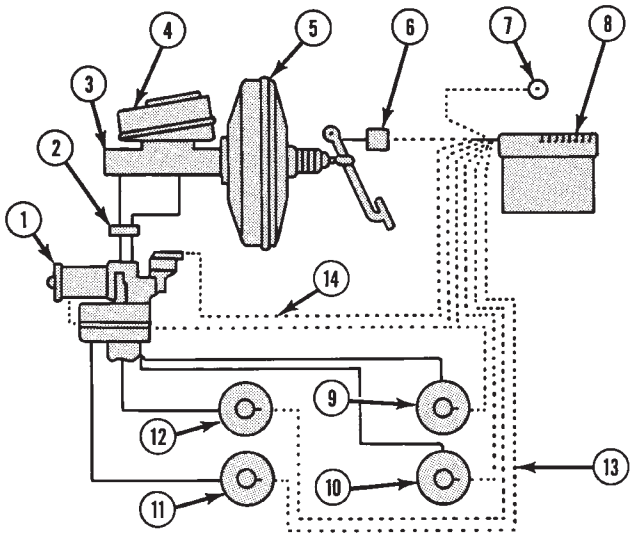

Fig. 2 AntiLock System Basic Layout

HYDRAULIC CONTROL UNIT (HCU)

The hydraulic control unit (HCU) consists of a valve body and pump/motor assembly (Fig. 3).

The valve body contains the electrically operated solenoid valves. It is the solenoid valves that modulate brake fluid apply pressure during antilock braking. The valves are operated by the antilock electronic control unit (ECU).

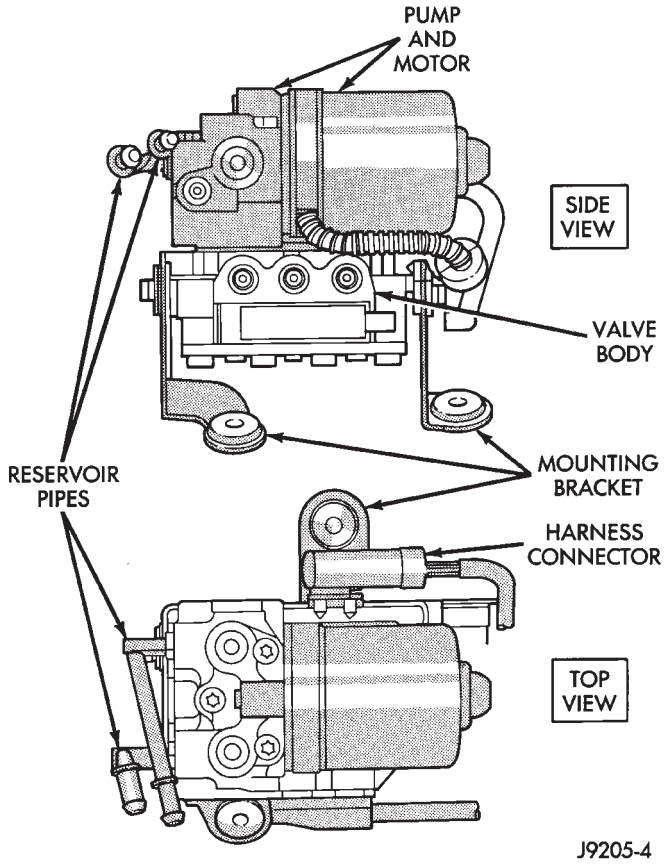

Fig. 3 AntiLock Hydraulic Control Unit (HCU)

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.

The pump/motor assembly provides the extra volume of fluid needed during antilock braking. The pump is connected to the master cylinder reservoir by supply and return hoses.

The pump is operated by an integral electric motor. The DC type motor is controlled by the ECU.

The pump mechanism consists of two opposing pistons operated by an eccentric cam. One piston supplies the primary hydraulic circuit. The opposite piston supplies the secondary hydraulic circuit. In operation, one piston draws fluid from the master cylinder reservoir. The opposing piston then pumps fluid to the valve body solenoids. The pump cam is operated by the electric motor.

MASTER CYLINDER

A new style tandem master cylinder is used with the ABS system (Fig. 4). It is a center feed design. The primary and secondary pistons each contain a central valve which is a unique feature. The valves are used in place of the conventional piston and seal assemblies. The valves close and open the cylinder pressure chambers during brake application and release.

The only repairable components on the ABS master cylinder are the reservoir, reservoir grommets and the connecting hoses. The cylinder itself cannot be disassembled and is serviced only as an assembly.

POWER BRAKE BOOSTER

A dual diaphragm, vacuum operated power brake booster is used with the ABS master cylinder (Fig.

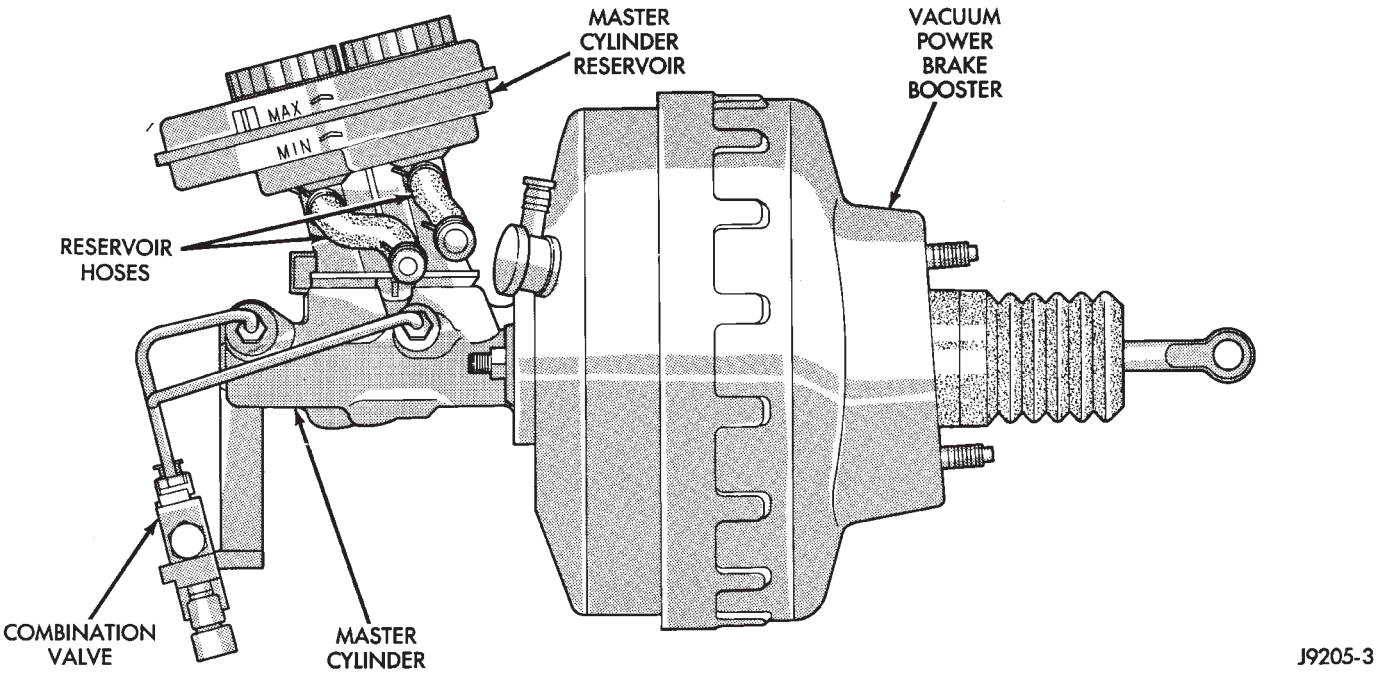

Fig. 4 ABS Power Brake Booster/Master Cylinder Assembly

4). The engine intake manifold serves as the vacuum source for booster operation.

The booster is mounted on the engine compartment side of the dash panel. The master cylinder is mounted on attaching studs at the front of the booster. The master cylinder central valves are directly actuated by the booster push rod.

The pedal travel sensor is mounted in the forward face of the booster shell. The sensor plunger is actuated by the booster diaphragm plate.

PEDAL TRAVEL SENSOR

The pedal travel sensor signals brake pedal position to the antilock ECU. The sensor signal is based on changes in electrical resistance. The resistance changes occur in steps that are generated by changes in brake pedal position. A resistance signal generated by changing brake pedal position, will cause the ECU to run the antilock pump when necessary.

The sensor is a plunger-type, electrical switch mounted in the forward housing of the power brake booster (Fig. 5). The sensor plunger is actuated by movement of the booster diaphragm plate.

The tip on the sensor plunger is color coded. The tip must be matched to the color dot on the face of the brake booster front shell (Fig. 5).

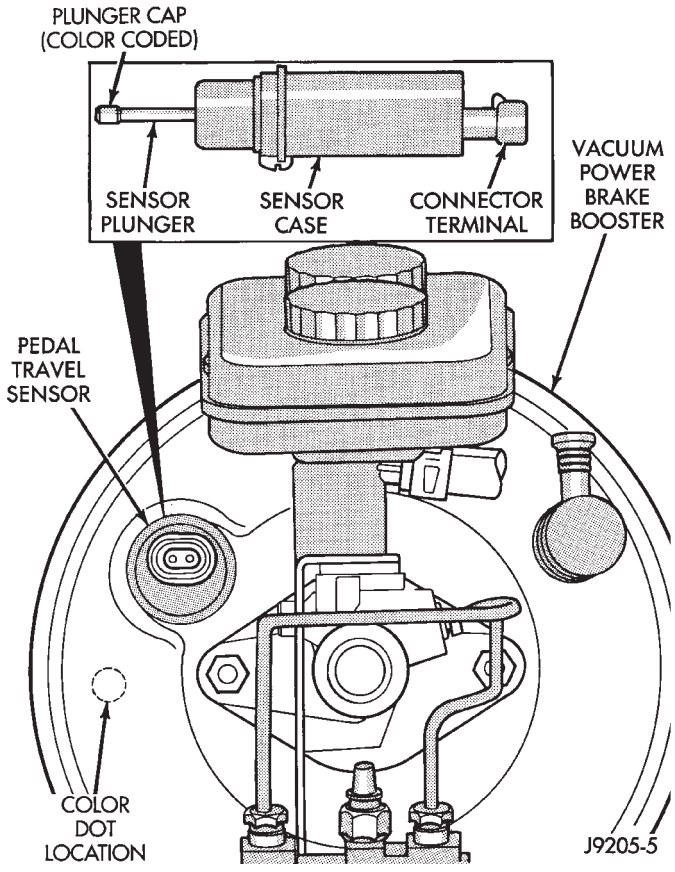

Fig. 5 Pedal Travel Sensor Location

WHEEL SPEED SENSORS

A sensor is used at each wheel. The sensors convert wheel speed into an electrical signal. This signal is transmitted to the antilock electronic control unit (ECU).

A gear-type tone ring serves as the trigger mechanism for each sensor. The tone rings are mounted at the outboard ends of the front and rear axle shafts.

Different sensors are used at the front and rear wheels (Fig. 6). The front/rear sensors have the same electrical values but are not interchangeable.

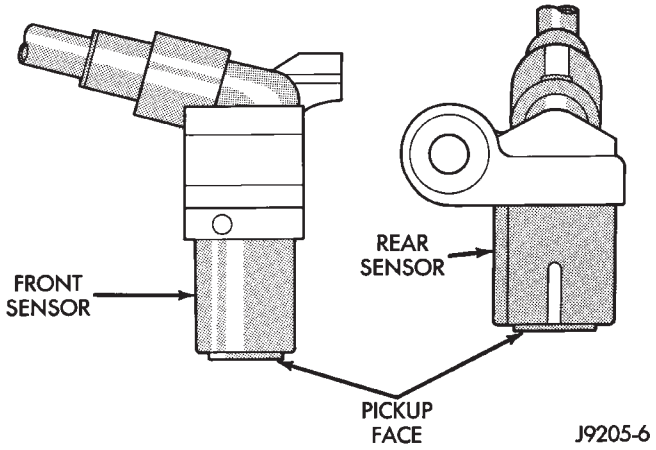

Fig. 6 Wheel Speed Sensors

ELECTRONIC CONTROL UNIT (ECU)

A separate electronic control unit (ECU) monitors, operates and controls the antilock system (Fig. 7). The ECU contains dual microprocessors. The logic block in each microprocessor receives identical sensor signals. These signals are processed and compared simultaneously (Fig. 8).

The ECU is located under the instrument panel. It is located at the right side of the steering column.

The power up voltage source for the ECU is through the ignition switch in the On and Run positions.

The antilock ECU is separate from the other vehicle electronic control units. It contains a self check program that illuminates the amber warning light when a system fault is detected. Faults are stored in a diagnostic program memory and are accessible with the DRB II scan tool.

ABS faults remain in memory until cleared, or until after the vehicle is started approximately 50 times. Stored faults are **not** erased if the battery is disconnected.

ACCELERATION SWITCH

An acceleration switch (Fig. 9), provides an additional vehicle deceleration reference during 4-wheel drive operation. The switch is monitored by the antilock ECU at all times.

The switch reference signal is utilized by the ECU when all wheels are decelerating at the same speed. Equal wheel speeds occur during braking in undifferentiated 4-wheel ranges.

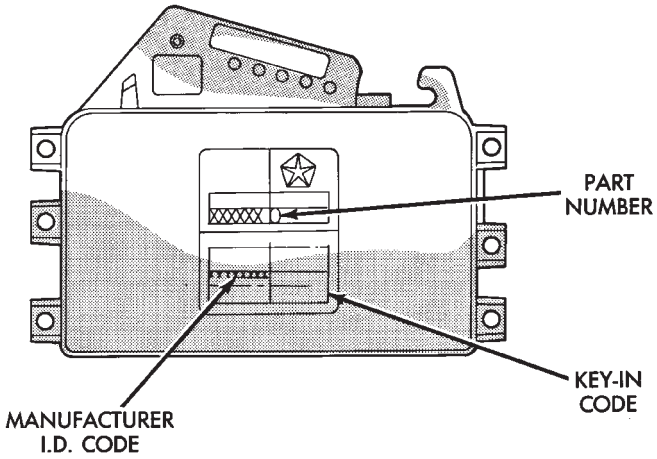

Fig. 7 Anti-Lock ECU

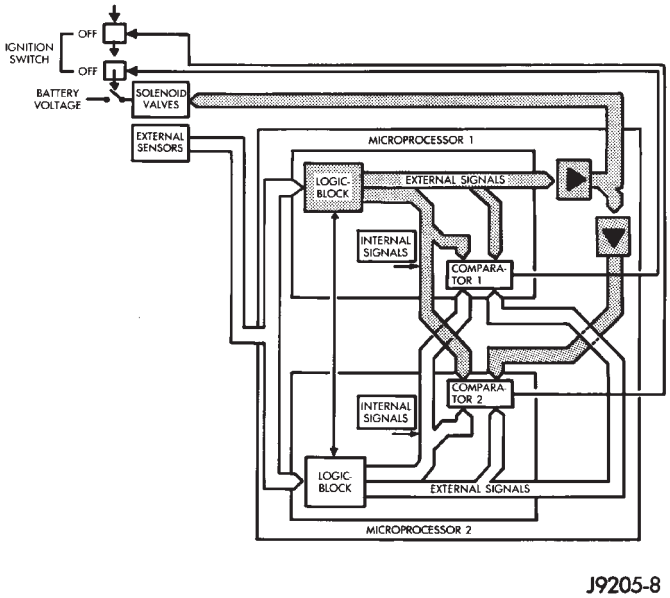

Fig. 8 ECU Dual Microprocessor Schematic

SYSTEM RELAYS

The ABS system has two relays, which are the main and motor pump relays. The motor pump relay is used for the motor pump only. The main relay is used for the solenoid valves and remaining system components. The main relay is connected to the ECU at the power control relay terminal.

The pump motor relay starts/stops the pump motor when signaled by the ECU. The start/stop signal to the ECU is generated by the pedal travel sensor. Refer to the ABS schematic at the end of this section for circuit details.

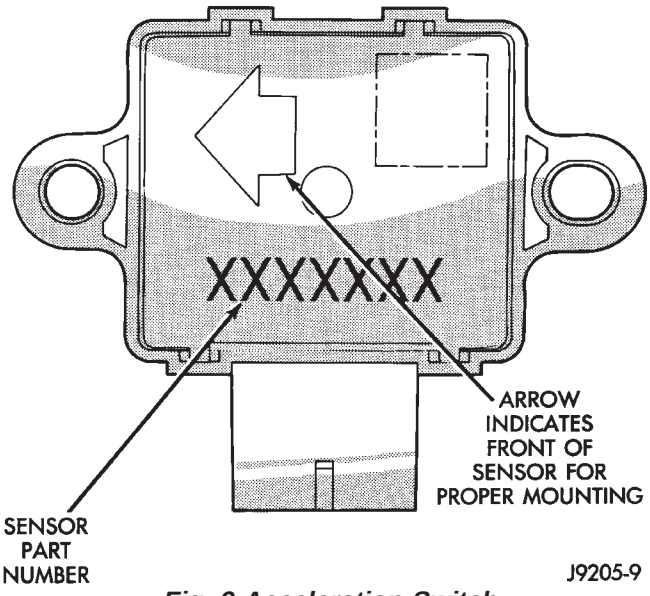

Fig. 9 Acceleration Switch

IGNITION SWITCH

The antilock ECU and warning light are in standby mode with the ignition switch in Off or Accessory position. No operating voltage is supplied to the system components.

A 12 volt power feed is supplied to the ECU, relays, solenoid valves, and warning light when the ignition switch is in the ON, Start and Run positions. Refer to the ABS system schematic at the end of this section for details.

SYSTEM WARNING LIGHTS

Two warning lights are used. The standard brake system light is red. The antilock system light is amber. Both lights are in the instrument cluster. The amber ABS light is in circuit with the ECU and operates independently of the red brake light.

The amber light indicates antilock system condition. It is in circuit with the valve body solenoids and main relay. The light illuminates (flashes) at start-up for the self check. The light then goes out when the self check program determines system operation is normal.

If an ABS fault occurs either during the start-up self check, or during normal operation, the amber light remains on until the fault is corrected.

COMBINATION VALVE

A combination valve is used with the ABS system (Fig. 2). The valve contains a front/rear brake pressure switch and proportioning valve. The valve is connected between the master cylinder and hydraulic control unit (HCU).

ANTILOCK BRAKE SYSTEM OPERATION

INDEX

SYSTEM POWER-UP AND INITIALIZATION

The antilock system is in standby mode with the ignition switch in Off or Accessory position. The antilock electrical components are not operational.

Turning the ignition switch to On or Run position allows battery voltage to flow through the switch to the ECU ignition terminal.

The ABS system is activated when battery voltage is supplied to the ECU. The ECU 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 immediately after the ignition switch is turned to the On position. The dynamic check occurs when vehicle road speed reaches approximately 10 kph (6 mph). During the dynamic check, the ECU briefly cycles the pump to verify operation. The HCU solenoids are checked continuously.

If an ABS component exhibits a fault during initialization, the ECU illuminates the amber warning light and registers a fault code in the microprocessor memory.

ABS OPERATION IN NORMAL BRAKING MODE

The ECU monitors wheel speed sensor inputs continuously while the vehicle is in motion. However, the ECU will not activate any ABS components as long as sensor inputs and the acceleration switch indicate normal braking.

During normal braking, the master cylinder, power booster and wheel brake units all function as they would in a vehicle without ABS. The HCU components are not activated.

ABS OPERATION IN ANTILOCK BRAKING MODE

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 ECU 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 zero (or lockup) during braking. Periods of high wheel slip occur when brake stops involve high pedal pressure and rate of vehicle deceleration.

The antilock system retards lockup during high slip conditions by modulating fluid apply pressure to the wheel brake units.

Brake fluid apply pressure is modulated according to wheel speed, degree of slip and rate of deceleration. A sensor at each wheel converts wheel speed into electrical signals. These signals are transmitted to the ECU for processing and determination of wheel slip and deceleration rate.

The Jeep ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem (Fig. 10). A speed sensor input signal indicating high slip conditions activates the ECU antilock program.

Two solenoid valves are used in each antilock control channel (Fig. 11). 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.

HCU SOLENOID VALVE OPERATION

Normal Braking

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.

Antilock Pressure Modulation

Solenoid valve pressure modulation occurs in three stages which are: 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 (Fig. 11).

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the ECU opens the outlet valve. Opening the outlet valve also opens the hydraulic return circuit to the master cylinder reser-

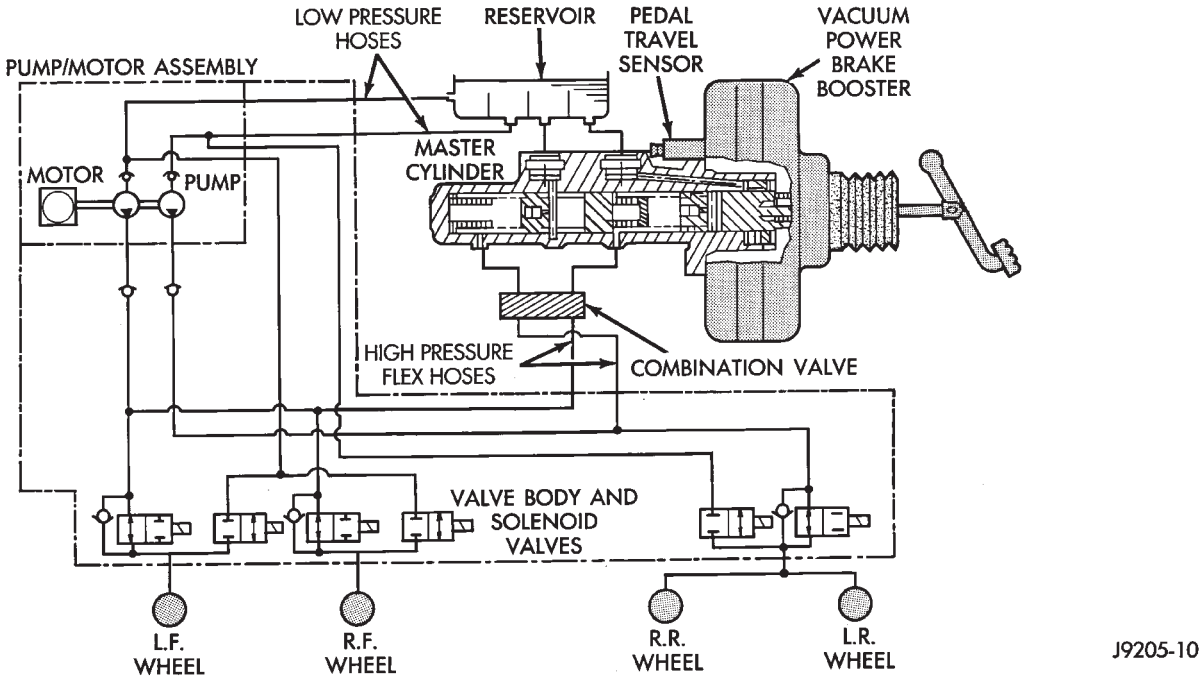

Fig. 10 Three-Channel ABS Hydraulic Control Circuit

voir. Fluid pressure is allowed to bleed off (decrease) as needed to prevent wheel lock.

Once the period of high wheel slip has ended, the ECU 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 (Fig. 12). Fluid apply pressure in the control channel is maintained at a constant rate. The ECU 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 (Fig. 13). The pressure increase cycle is used to counteract unequal wheel speeds. This cycle controls reapplication of fluid apply pressure after a pressure decrease cycle.

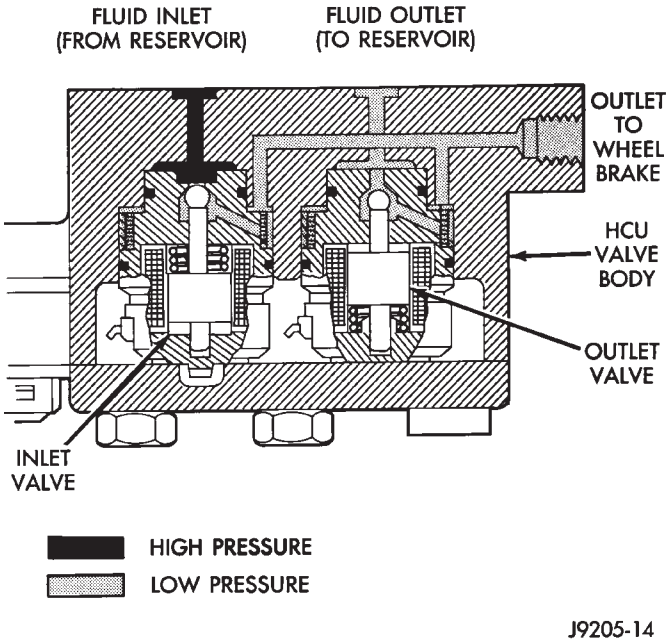

Fig. 11 Solenoid Valves In Pressure Decrease Cycle

HCU PUMP AND PEDAL TRAVEL SENSOR OPERATION

The HCU pump has two functions during antilock braking. First, the pump supplies the extra volume of fluid needed. And second, the pump maintains brake pedal height. The fluid source for the pump is the master cylinder reservoir. The reservoir and HCU are interconnected by hoses.

The pump motor is activated by the ECU. However, the signal to run the pump actually comes from the pedal travel sensor.

The pedal travel sensor is mounted in the forward face of the brake booster (Fig. 14). The sensor plunger is actuated by movement of the booster diaphragm plate. The sensor has a total of seven pedal positions, six of which are monitored. The six pedal positions monitored range from full release to full apply. Each pedal position (toward full apply), generates an increasing degree of electrical resistance in the sensor.

The ECU continuously monitors electrical resistance at the pedal travel sensor. The ECU activates the pump whenever sensor electrical resistance increases during ABS mode braking.

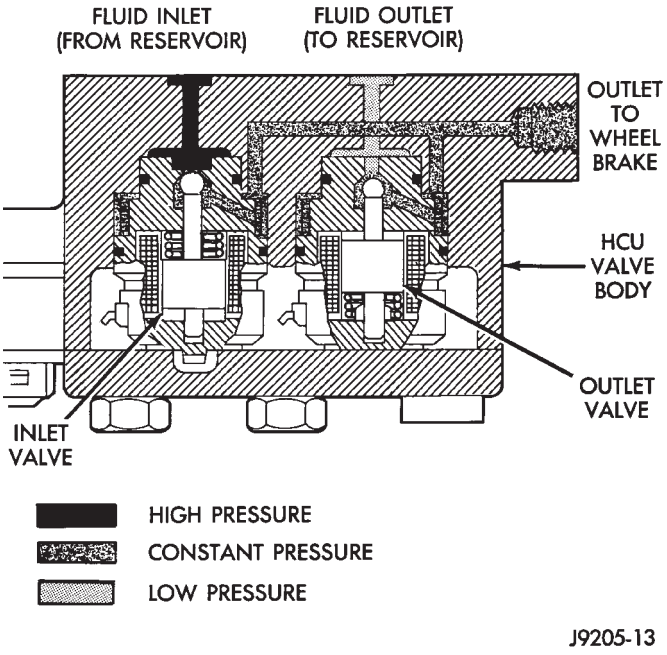

Fig. 12 Solenoid Valves In Pressure Hold Cycle

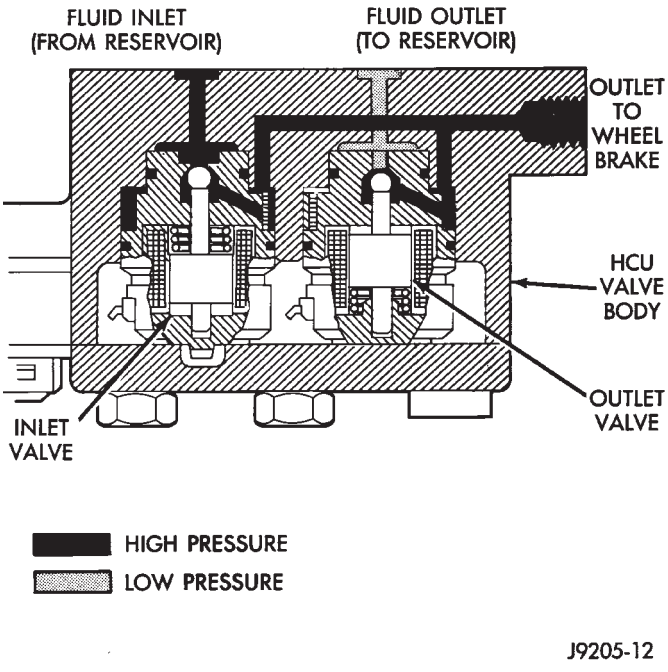

Fig. 13 Solenoid Valves In Pressure Increase Cycle

At the start of antilock braking, pedal height will decrease as the volume of fluid in the master cylinder is used up. When pedal height drops a predetermined amount, the pedal travel sensor will signal the ECU to run the pump. At this point, the pump is activated to supply the extra fluid volume and restore pedal height at the same time.

The pump does not run continuously. It cycles on/off according to signals from the travel sensor and ECU. The pump is connected directly to the master cylinder reservoir by hoses. During antilock braking, the additional volume of fluid needed is drawn by the pump from the reservoir.

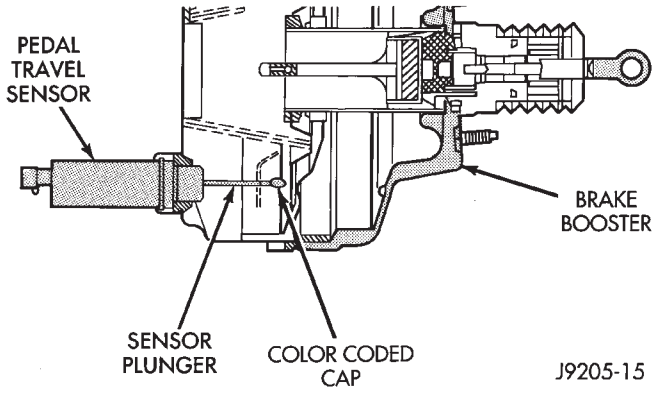

Fig. 14 Pedal Travel Sensor Actuation

WHEEL SPEED SENSOR OPERATION

Wheel speed input signals are generated by a sensor and tone ring at each wheel. The sensors, which are connected directly to the ECU, are mounted on brackets attached to the front steering knuckles and rear brake support plates.

The sensor triggering devices are the tone rings which are similar in appearance to gears. The tone rings are located on the outboard end of each front/rear axle shaft. The speed sensors generate a signal whenever a tone ring tooth rotates past the sensor pickup face.

The wheel speed sensors provide the input signal to the ECU. If input signals indicate ABS mode braking, the ECU causes the HCU solenoids to decrease, hold, or increase fluid apply pressure as needed.

The HCU solenoid valves are activated only when wheel speed input signals indicate that a wheel is approaching a high slip, or lockup condition. At this point, the ECU will cycle the appropriate wheel control channel solenoid valves to prevent slip or lockup.

The wheel sensors provide speed signals whenever the vehicle wheels are rotating. The ECU examines these signals for degree of deceleration and wheel slip. If signals indicate normal braking, the solenoid valves are not activated. However, when incoming signals indicate the approach of wheel slip, or lockup, the ECU cycles the solenoid valves as needed.

ACCELERATION SWITCH OPERATION

The ECU monitors the acceleration switch at all times. The switch assembly contains three mercury switches that monitor vehicle ride height and deceleration rates (G-force). Sudden, rapid changes in vehicle and wheel deceleration rate, triggers the switch sending a signal to the ECU. The switch assembly provides three deceleration rates; two for forward braking and one for rearward braking.

ECU OPERATION

The antilock ECU controls all phases of antilock operation. It monitors and processes input signals from all of the system sensors.

It is the ECU that activates the solenoid valves to modulate apply pressure during antilock braking. The ECU program is able to determine which wheel control channel requires modulation and which fluid pressure modulation cycle to use.

The ECU cycles the solenoid valves through the pressure decrease, hold and increase phases to retard and prevent wheel lock during periods of high wheel slip.

Solenoid valve operation is selective. The solenoid valves may not be cycled simultaneously, nor are they all cycled in the same pressure modulation phase at the same time. The ECU cycles the valves in each control channel as needed. For example, sensor inputs may indicate that only the left front wheel requires modulation during a period of high slip.

ABS COMPONENT SERVICE

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COMPONENT SERVICEABILITY

The ABS components are serviced as assemblies (Figs. 1 and 2); they are not repairable. The following ABS components can be replaced separately:

- center feed master cylinder
- master cylinder-to-booster seal
- power brake booster (includes matched pedal travel sensor)
- booster check valve and grommet
- pedal travel sensor and select fit caps
- combination valve
- HCU and pump motor assembly
- ECU
- acceleration sensor
- wheel sensors
- system wire harnesses

The axle shaft tone wheels are not serviceable. If a tone wheel becomes damaged, it will be necessary to replace the axle shaft, or disc brake rotor and hub assembly on 2-wheel drive models.

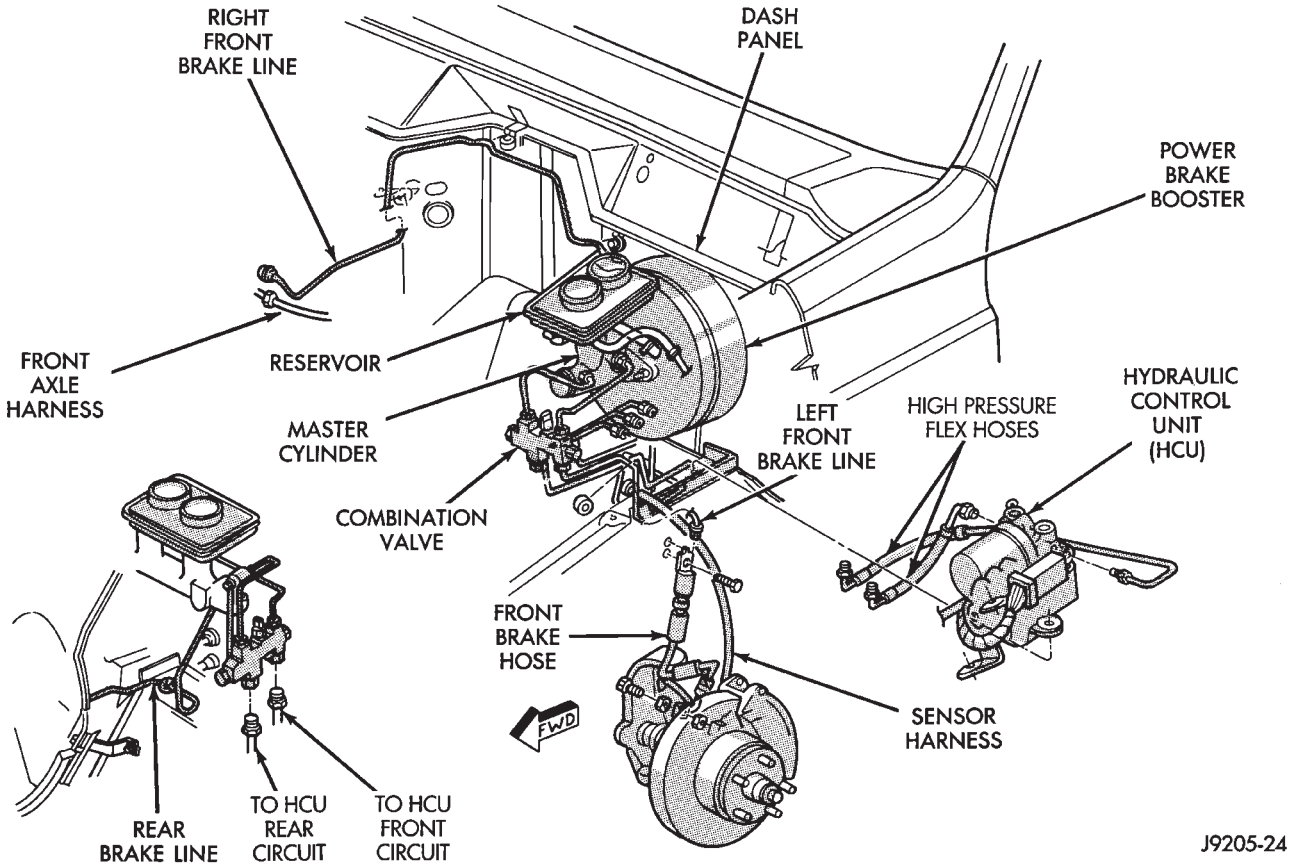


Fig. 1 ABS Hydraulic Component Locations (XJ)

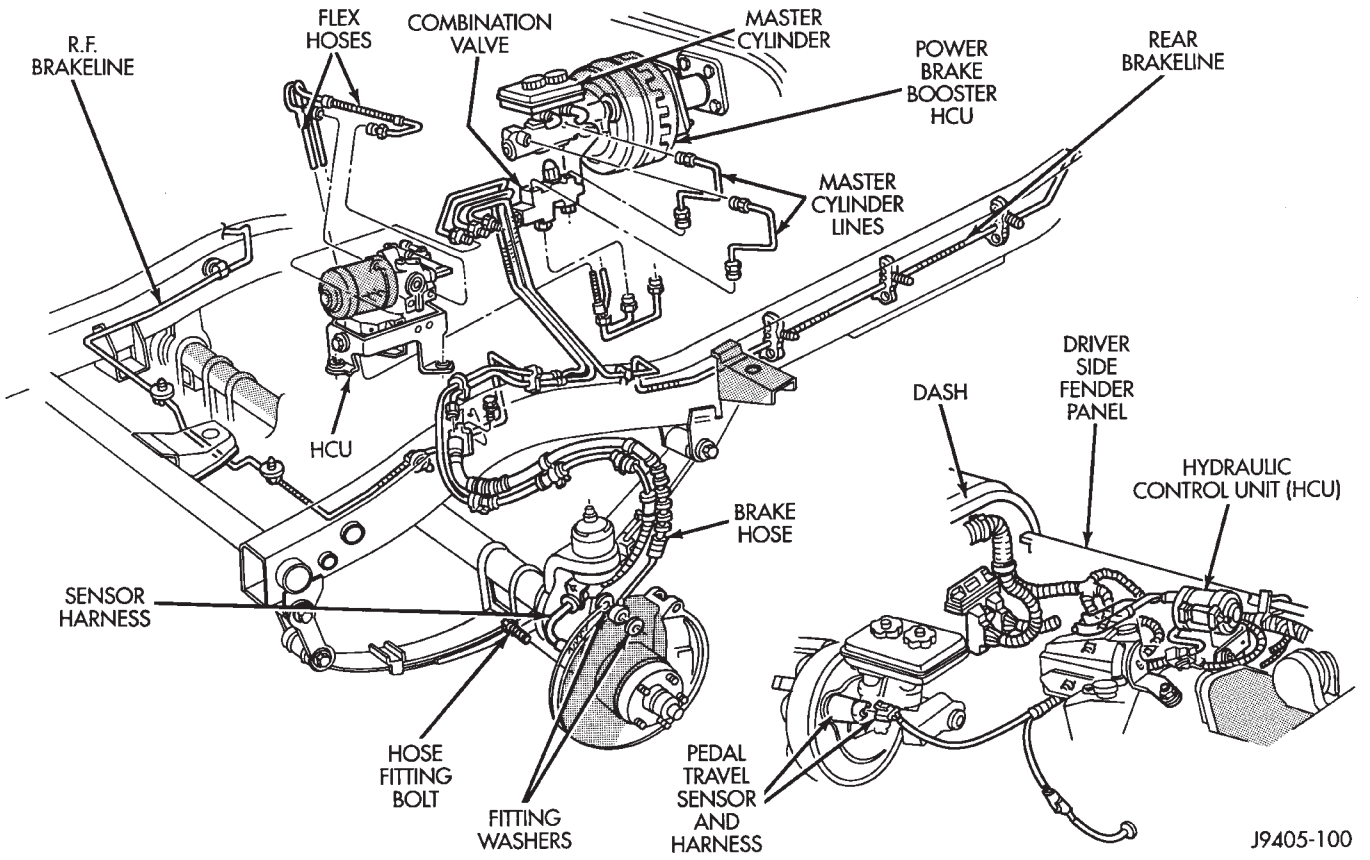


Fig. 2 ABS Hydraulic Component Locations (YJ)

The wheel brake components such as the calipers, brakeshoes, wheel cylinders, rotors and drums are all serviced the same as standard brake system components.

RECOMMENDED BRAKE FLUID

Recommended brake fluid for the Jeep ABS system is Mopar DOT 3 brake fluid. If Mopar fluid is not readily available, a top quality fluid meeting SAE J1703 and DOT 3 standards can be used.

Brake fluid used in the ABS system must meet the SAE and DOT quality standards and be exceptionally clean. **Never use substandard fluid, fluid not meeting the SAE and DOT standards, reclaimed fluid, or fluid from open containers.**

CORRECT FLUID LEVEL

Correct brake fluid level is marked on the driver side of the master cylinder reservoir (Fig. 3).

Preferred fluid level is to the MAX indicator mark. Acceptable fluid level is between the MAX and MIN marks.

If fluid level is at or below the MIN mark, the brake hydraulic system should be checked for leaks.

CAUTION: Clean the reservoir caps and exterior thoroughly before checking fluid level. Do not allow any dirt or foreign material to enter the reservoir while checking fluid level. Such materials can interfere with solenoid valve operation causing an ABS malfunction.

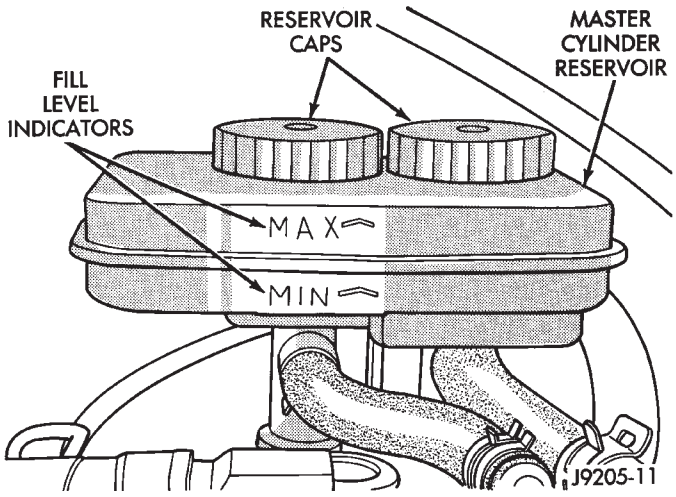


Fig. 3 Reservoir Fluid Level Indicators

IMPORTANCE OF CLEAN BRAKE FLUID

The antilock system brake fluid must be kept clean and uncontaminated. Foreign material in the fluid, or non-recommended fluids will cause system malfunctions.

Clean the reservoir and caps thoroughly before checking level or adding fluid. Cap open lines and hoses during service to prevent dirt entry.

Dirt or foreign material entering the ABS hydraulic system through the reservoir opening will circulate within the system. The result will be poor brake performance and possible component failure. Use clean, fresh fluid only to top off, or refill the system.

WHEEL SENSOR AIR GAP ADJUSTMENT

Only rear sensor air gap is adjustable. The front sensors are fixed and cannot be adjusted.

A rear sensor air gap adjustment is only needed when reinstalling an original sensor. Replacement sensors have an air gap spacer attached to the sensor pickup face. The spacer establishes correct air gap when pressed against the tone ring during installation. As the tone ring rotates, it peels the spacer off the sensor to create the required air gap.

Preferred rear sensor air gap is 1.1 mm (0.043 in.). Acceptable air gap range is 0.92 to 1.275 mm (0.036 to 0.050 in.).

Front sensor air gap is not adjustable. The front sensors are fixed in position and cannot be adjusted. Front sensor air gap can only be checked. Air gap should be 0.040 to 1.3 mm (0.0157 to 0.051 in.). If front sensor air gap is incorrect, the sensor is either loose, or damaged.

FRONT WHEEL SENSOR REMOVAL

(1) Raise vehicle and turn wheel outward for easier access to sensor.

(2) Remove sensor wire from mounting brackets.

(3) Clean sensor and surrounding area before removal.

(4) Remove bolt attaching sensor to steering knuckle and remove sensor.

(5) Unseat grommet retaining sensor wire in wheel house panel.

(6) In engine compartment, disconnect sensor wire connector at harness plug. Then remove sensor and wire.

FRONT WHEEL SENSOR INSTALLATION

(1) Apply Mopar Lock N' Seal or Loctite 242 to bolt that attaches sensor to steering knuckle. Use new sensor bolt if original bolt is worn or damaged.

(2) Position sensor on steering knuckle. Seat sensor locating tab in hole in knuckle and install sensor attaching bolt finger tight.

(3) Tighten sensor bolt to 14 N•m (11 ft. lbs.) torque.

(4) Attach sensor wire to steering knuckle bracket with grommets on sensor wire.

(5) Route sensor wire forward and behind shock absorber. Then attach sensor wire to spring seat bracket with grommets on sensor wire.

(6) Route sensor wire to outer sill bracket. Remove all twists or kinks from wire.

(7) Attach sensor wire to sill bracket with grommet. Be sure wire is free of twists and kinks.

(8) Verify sensor wire routing. Wire should loop forward and above sill bracket. Loose end of wire should be below sill bracket and towards brake hose.

(9) Seat sensor wire grommet in body panel and clip wire to brake line at grommet location.

(10) Connect sensor wire to harness in engine compartment.

REAR WHEEL SENSOR REMOVAL

(1) On XJ models, if separate connectors are not used to attach sensor harness to each sensor wire, proceed as follows:

(a) Raise and fold rear seat forward for access to rear sensor connectors (Figs. 4 and 5).

(b) Disconnect sensors at rear harness connectors.

(c) Push sensor grommets and sensor wires through floorpan.

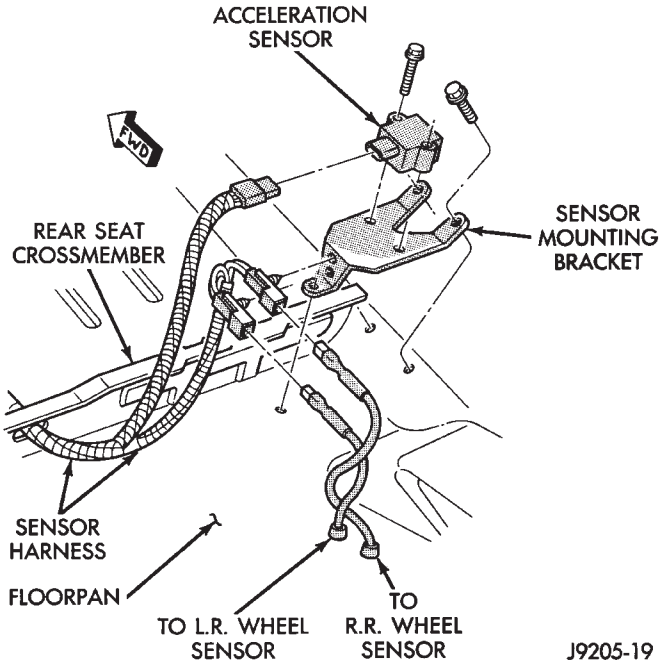


Fig. 4 Acceleration Switch And Rear Sensor Connections (XJ)

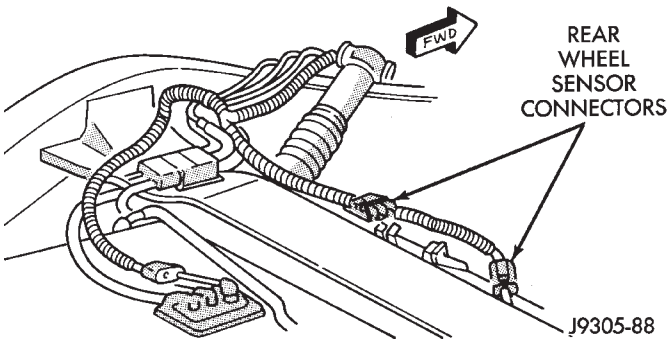


Fig. 5 Rear Sensor Connections (XJ)

(2) Raise vehicle.
(3) Disconnect sensor wires at rear axle connectors.
(4) Remove wheel and tire assembly.
(5) Remove brake drum.
(6) Remove clips securing sensor wires to brake lines or rear axle and rear brake hose.
(7) Unseat sensor support plate grommet.
(8) Remove bolt attaching sensor to bracket and remove sensor.

REAR WHEEL SENSOR INSTALLATION

(1) Insert sensor wire through support plate hole and seat sensor grommet in support plate.
(2) Apply Mopar Lock N' Seal or Loctite 242 to original sensor bolt. Use new bolt if original is worn or damaged.
(3) Install sensor bolt finger tight only at this time.
(4) Set sensor air gap as follows:
(a) If **original sensor** is being installed, remove any remaining pieces of cardboard spacer from sensor pickup face. Then adjust air gap to preferred setting of 1.1 mm (0.043 in.) with brass feeler gauge (Fig. 6). Tighten sensor bolt to 11 N·m (11 ft. lbs.) torque.
(b) If **new sensor** is being installed, push cardboard spacer on sensor face (Fig. 7) against tone ring. Then tighten sensor bolt to 8 N·m (6 ft. lbs.) torque. Correct air gap will be established as tone ring rotates and peels spacer off sensor face.
(c) Verify sensor air gap adjustment. If adjustment changed after tightening bolt, readjust sensor air gap as needed.

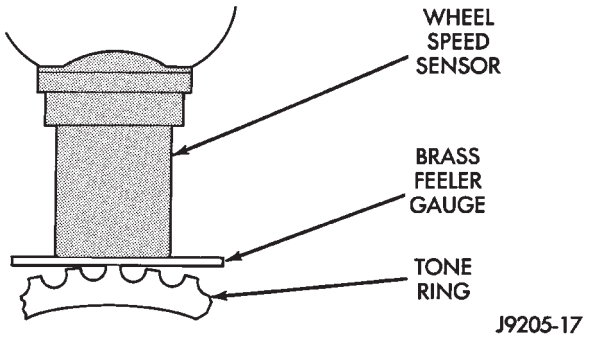


Fig. 6 Setting Air Gap On Original Rear Sensor

(5) On YJ, connect rear sensor wires to connectors at axle. On XJ, route sensor wires to rear seat area.
(6) Feed sensor wires through floorpan access hole and seat sensor grommets in floorpan.
(7) Verify that rear sensor wire are secured to rear brake hose and axle with clips. Verify that wire is clear of rotating components.
(8) Install brake drum and wheel.
(9) Lower vehicle.
(10) On XJ, connect sensor wire to harness connector. Then reposition carpet and fold rear seat down.

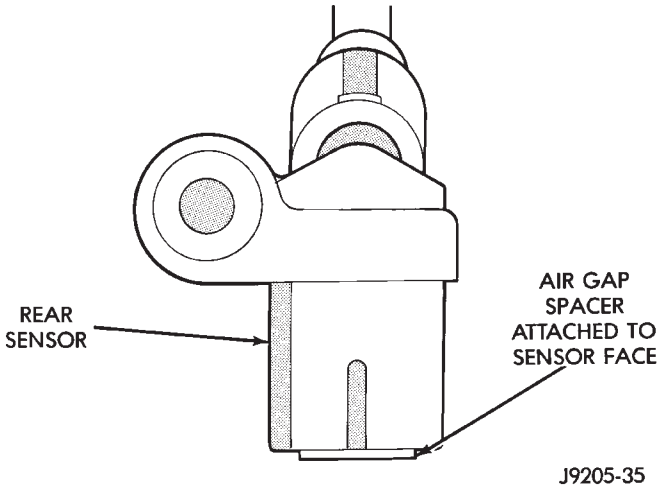


Fig. 7 New Rear Sensor With Air Gap Spacer

MASTER CYLINDER REMOVAL

(1) Disconnect pedal travel sensor wires.
(2) Remove air cleaner and hoses on XJ models.
(3) Remove clamps that secure reservoir hoses to HCU pipes.
(4) Position small drain container under master cylinder reservoir. Remove reservoir hoses from HCU pipes and allow fluid to drain into container before removing reservoir. Discard fluid drained from reservoir.
(5) Pump brake pedal to exhaust all vacuum from power brake booster.
(6) Disconnect necessary brakelines at master cylinder and combination valve. Also remove combination valve bracket bolt.
(7) Remove nuts attaching master cylinder to booster mounting studs.
(8) Remove master cylinder. Pull cylinder forward and off studs. Then work cylinder past combination valve, brakelines, pedal travel sensor and out of engine compartment.

MASTER CYLINDER INSTALLATION

(1) If new master cylinder is being installed, bleed cylinder on bench before installing it in vehicle.
(2) Work master cylinder into position and install it in booster. Be sure cylinder is properly seated on booster studs. Also be sure booster-to-cylinder seal is not displaced during installation.
(3) Connect reservoir hoses to HCU pipes.
(4) Verify that master cylinder and booster are properly connected.
(5) Install and tighten master cylinder attaching nuts to 34 N·m (25 ft. lbs.) torque.
(6) Connect brakelines to master cylinder.
(7) Install combination valve, if removed and install bolt that secures valve bracket to master cylinder.
(8) Connect sensor wires.

(9) Fill reservoir and bleed brakes. Refer to procedure in this section.

(10) Install air cleaner and hoses.

PEDAL TRAVEL SENSOR SERVICE

CAUTION: The pedal travel sensor and booster must form a matched set. The cap on the sensor plunger and booster shell are color coded for identification, and to ensure they are used as matched sets. Be sure the color of the sensor cap and the color dot on the booster shell are the same before installation. Refer to the Sensor Replacement information before installing a new or original sensor.

PEDAL TRAVEL SENSOR REMOVAL

(1) Disconnect wires at sensor.

(2) Pump brake pedal to exhaust all vacuum from booster.

(3) Unseat sensor retaining ring.

(4) Remove sensor from booster (Fig. 8).

PEDAL TRAVEL SENSOR REPLACEMENT

A new pedal travel sensor is supplied with four different color caps. The caps are color coded to ease matching them with the color code dot on the booster shell.

Compare the color of the new sensor cap and the color dot on the booster shell. If the colors match, proceed with sensor installation. However, if the colors **do not match**, select and install the correct color cap on the sensor plunger before proceeding.

PEDAL TRAVEL SENSOR INSTALLATION

(1) Check color dot on face of brake booster. Then check color of cap on sensor plunger. If colors match, proceed with installation. If colors do not match, install correct color cap on end of plunger.

(2) Install O-ring on sensor.

(3) Install sensor retaining ring on booster flange.

(4) Insert sensor in retaining ring and booster.

(5) Verify that retaining ring is properly engaged in sensor and that sensor is seated in booster.

(6) Connect wires to sensor.

(7) Check sensor operation with DRB II scan tool.

POWER BRAKE BOOSTER REMOVAL

(1) Pump brake pedal until all vacuum is exhausted from power brake booster.

(2) Disconnect pedal travel sensor.

(3) Remove air cleaner and hoses.

(4) Remove clamps that secure reservoir hoses to HCU pipes. Then remove hoses from pipes.

(5) Disconnect brakelines at master cylinder.

(6) Remove combination valve bracket bolt if necessary.

(7) Remove nuts attaching master cylinder to booster mounting studs.

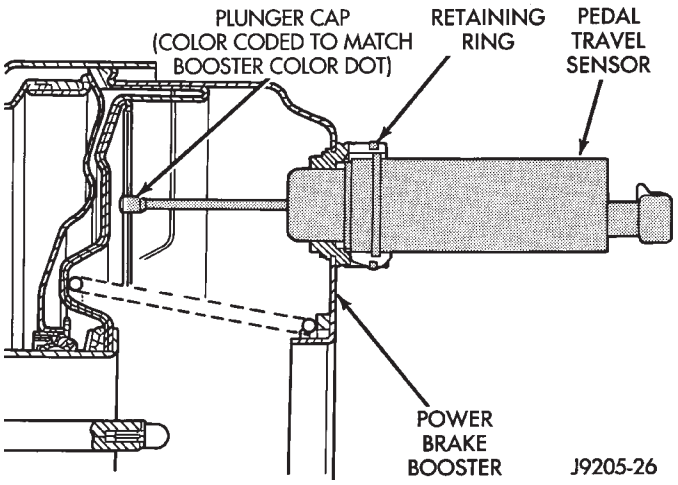


Fig. 8 Pedal Travel Sensor Mounting

(8) Remove master cylinder. Pull cylinder forward and off studs. Then work cylinder past combination valve, brakelines, pedal travel sensor and out of engine compartment.

(9) Disconnect vacuum hose at booster check valve.

(10) Disconnect booster push rod from brake pedal.

(11) Remove nuts attaching booster to passenger compartment side of dash panel.

(12) Slide booster forward and work it out of engine compartment.

POWER BRAKE BOOSTER INSTALLATION

(1) Position booster on dash panel. Align booster mounting studs with holes in panel and seat booster (Fig. 9).

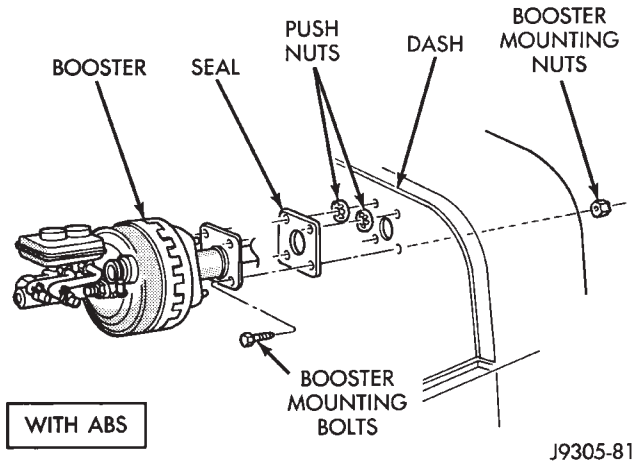


Fig. 9 Booster Attachment At Dash Panel—YJ Shown

(2) In passenger compartment, install booster attaching nuts on mounting studs. Tighten attaching nuts to 41 N·m (30 ft. lbs.) torque.

(3) Install seal on master cylinder. Seal is slight interference fit to help hold it in place.

CAUTION: The pedal travel sensor and booster must form a matched set. The cap on the sensor plunger and the color dot on the booster shell are color coded for identification, and to ensure they are used as matched sets. Be sure the color on the sensor cap and booster shell are the same before installation. Refer to the Sensor Replacement information before installing a new or original sensor.

(4) If new pedal travel sensor is being installed in original booster, compare color dot on booster shell with color of cap on sensor (Fig. 10). If both are same color, proceed with installation. However, if colors **do not match**, select correct color cap from kit supplied with new sensor and install it on end of sensor plunger.

(5) Install O-ring on pedal travel sensor.

(6) Install sensor retaining ring on booster flange. Be sure retaining ring is firmly seated.

(7) Insert sensor into booster. Be sure sensor is fully seated and engaged in retaining ring.

(8) Connect booster push rod to brake pedal.

(9) Attach vacuum hose to booster check valve.

(10) Install master cylinder on booster. Tighten cylinder attaching nuts to 25-30 N·m (220-267 in. lbs.) torque.

(11) Connect brakelines to master cylinder.

(12) Install combination valve bracket bolt if removed.

(13) Connect reservoir hoses to HCU pipes.

(14) Connect sensor wires.

(15) Bleed brakes. Refer to procedure in this section.

(16) Install air cleaner and hoses.

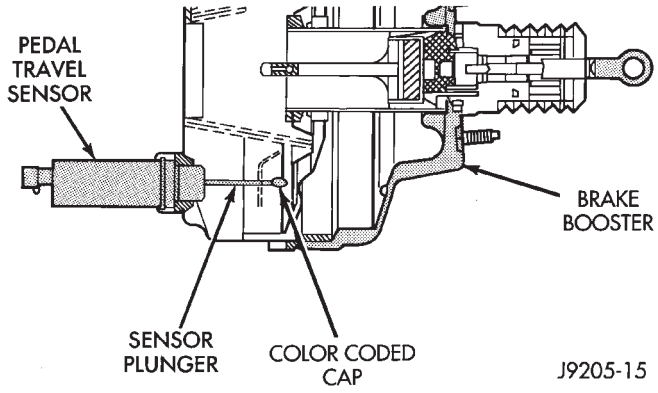


Fig. 10 Booster Push Rod And Pedal Travel Sensor

ACCELERATION SENSOR REMOVAL

(1) On XJ models, tilt rear seat assembly forward for access to sensor (Fig. 11).

(2) On YJ models, move driver seat forward or rearward for access to sensor and mounting bracket (Fig. 11).

(3) Disconnect sensor harness (Fig. 10).

(4) On XJ models, remove screws attaching sensor to bracket. Then remove sensor.

(5) On YJ models, remove screws attaching sensor bracket to floorpan. Then remove sensor from bracket.

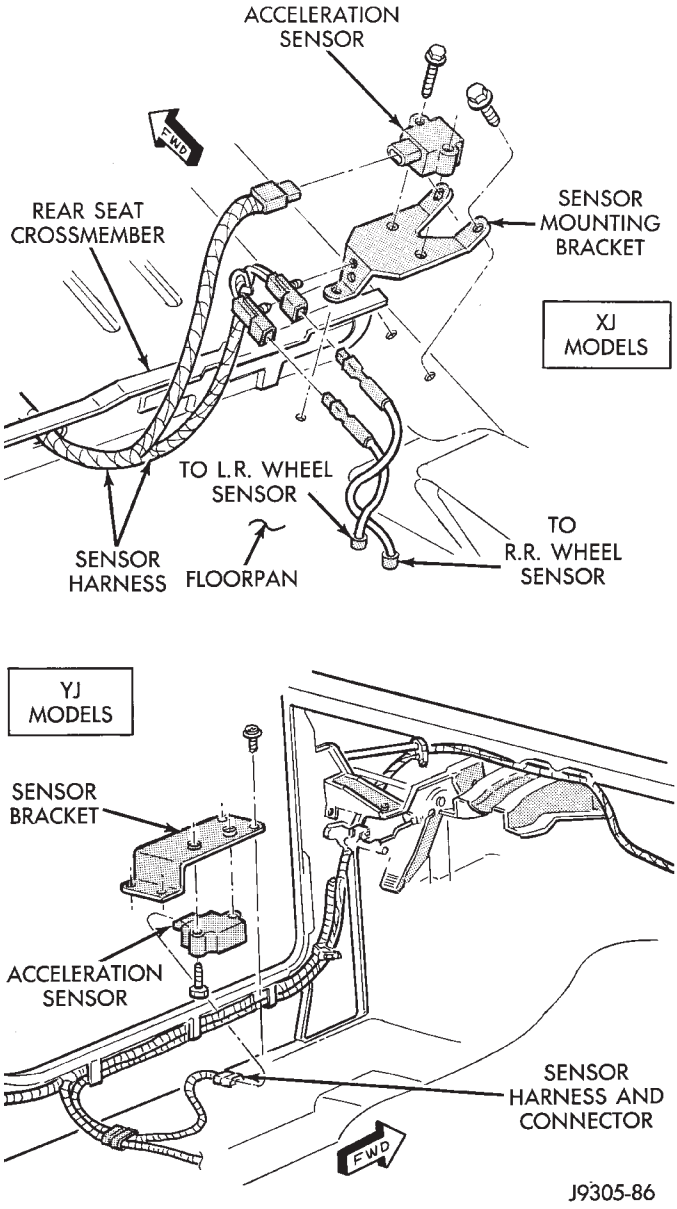


Fig. 11 Acceleration Sensor Mounting

ACCELERATION SENSOR INSTALLATION

(1) Note position of locating arrow on sensor. Sensor must be positioned so arrow faces forward.

CAUTION: The sensor mercury switch will not function properly if the sensor is mispositioned. Verify that the sensor locating arrow is pointing to the front of the vehicle.

(2) Position sensor in mounting bracket (Fig. 10).

(3) Install and tighten sensor attaching screws to 2-4 N·m (17-32 in. lbs.) torque.

(4) Connect harness to sensor. Be sure harness connecter is firmly seated.

(5) Move seat back to normal position.

ECU REPLACEMENT—XJ

ECU Removal

(1) Turn ignition key to Off position.

(2) Remove screws attaching ECU to mounting bracket (Fig. 12).

(3) Disconnect ECU wiring harness.

(4) Remove ECU.

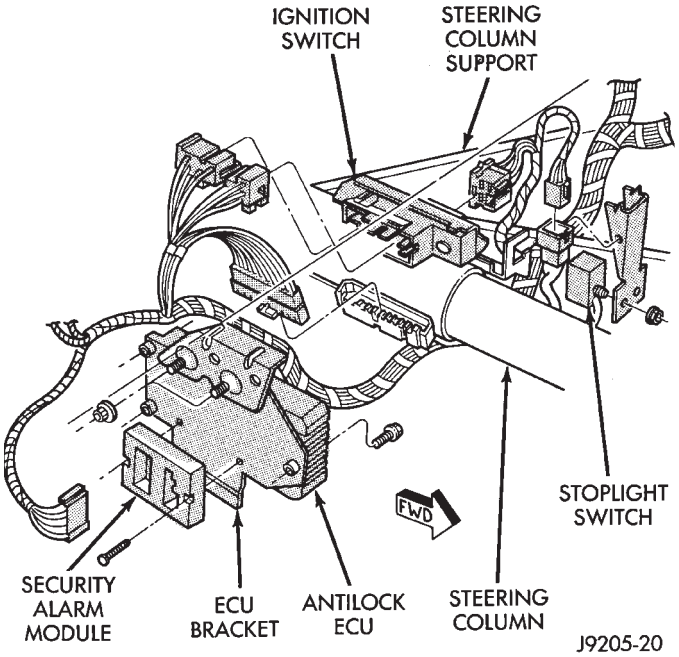


Fig. 12 Antilock ECU Mounting (XJ)

ECU Installation

(1) If new ECU is being installed, transfer mounting bracket to new ECU.

(2) Tighten ECU-to-mounting bracket screws to 8-13 N·m (75-115 in. lbs.) torque.

(3) Connect wire harness to ECU.

(4) Position and install ECU.

(5) Tighten ECU attaching nuts to 10-14 N·m (85-125 in. lbs.) torque.

ECU REPLACEMENT—YJ

The antilock electronic control unit (ECU) is attached to the dash panel inside the passenger compartment. It is positioned just above the heater/air conditioning plenum housing, in line with the glove box (Fig. 13).

The ECU is attached to the dash panel by bolts and nuts that are accessible from the engine compartment. The fasteners are located just to the right of the battery.

On models with air conditioning, it will be necessary to remove the air conditioning fascia panel and ducts for access to the ECU and harness connecter.

HCU REMOVAL—XJ

(1) Remove air cleaner.

(2) Remove clamp that secures air cleaner hose and pipe to fender apron (Fig. 14).

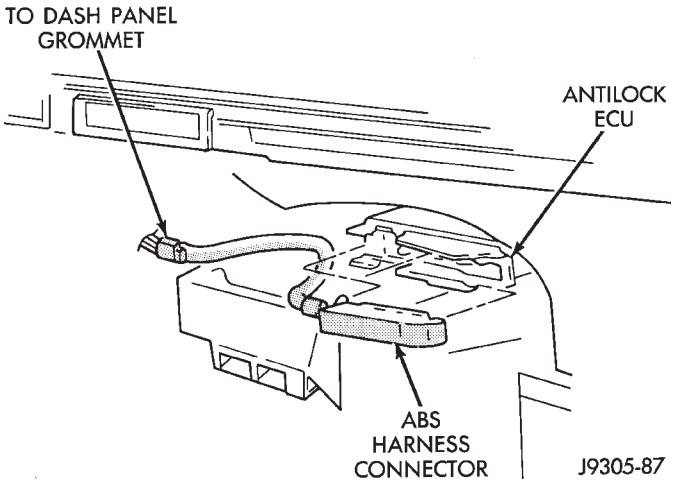


Fig. 13 ECU Location (YJ)

(3) Position suitable size fluid drain container under master cylinder reservoir hoses. Disconnect reservoir hoses from HCU and drain fluid into container. Discard old fluid and remove reservoir.

(4) Disconnect pump motor and solenoid harness wires at HCU (Fig. 15).

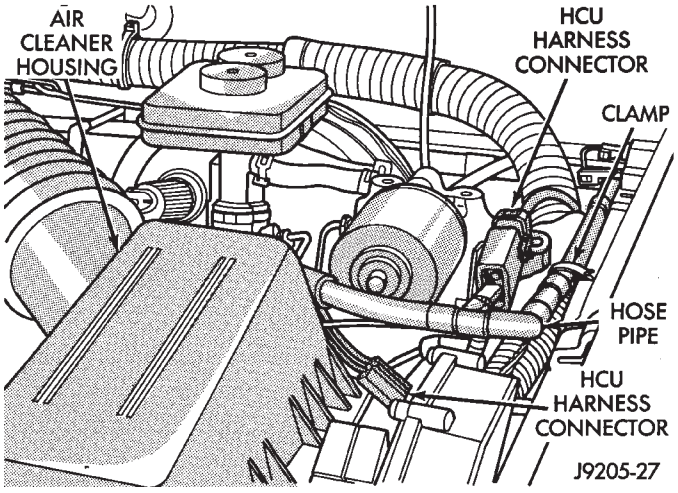


Fig. 14 Air Cleaner And Harness Connector Location (XJ)

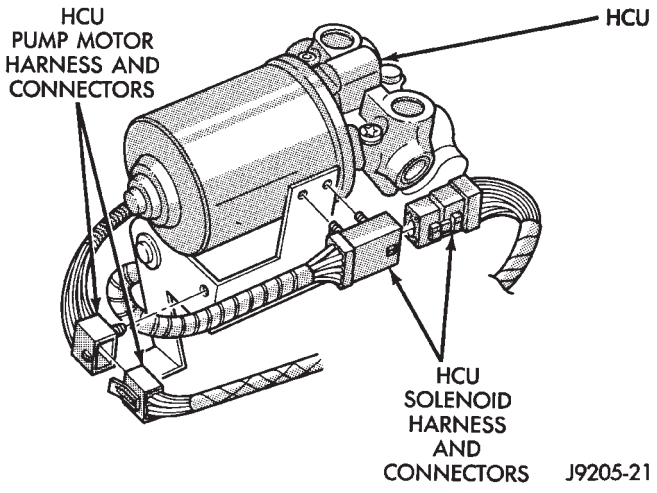


Fig. 15 HCU Wire Harness Connections

(5) Mark or tag HCU hydraulic lines for assembly reference.

(6) Disconnect hydraulic lines at HCU.

(7) Move HCU harness and air cleaner hose pipe aside for access to HCU bracket nuts.

(8) Remove single bolt and two nuts attaching HCU to mounting bracket on inner fender panel (Figs. 16 and 17).

(9) Remove HCU. Lift HCU up and off mounting bracket studs. Then work HCU past brakelines and master cylinder to remove it.

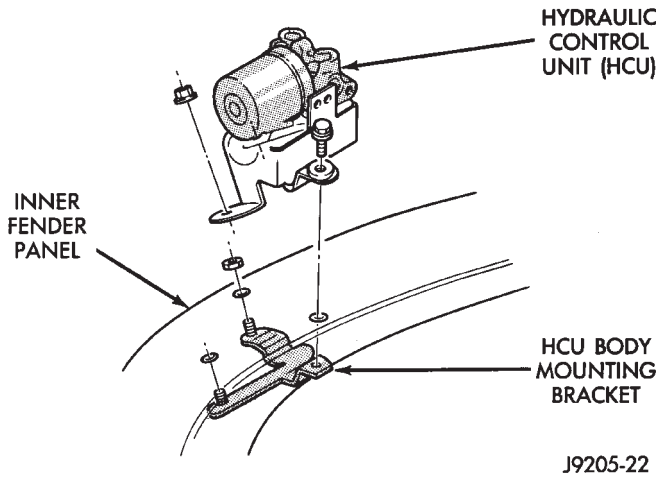


Fig. 16 HCU Mounting (Left Hand Drive XJ)

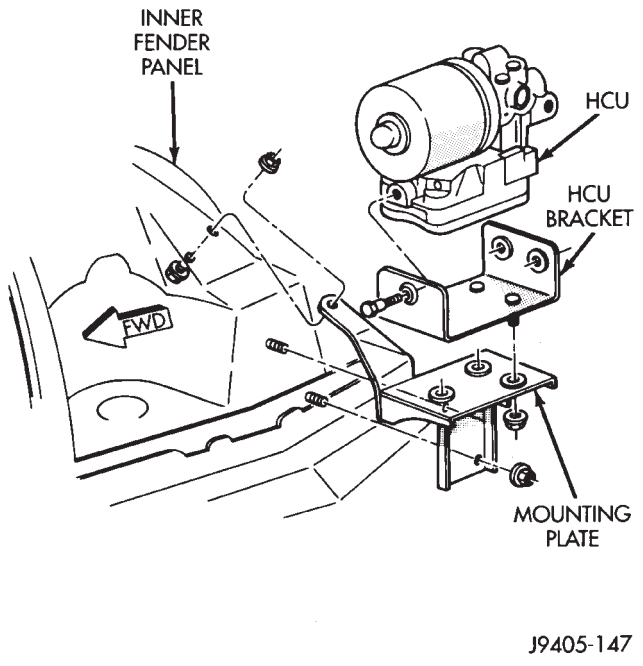


Fig. 17 HCU Mounting (Right Hand Drive XJ)

HCU INSTALLATION—XJ

(1) Connect master cylinder reservoir hoses to HCU pipes.

(2) Position HCU assembly on mounting bracket and install attaching nuts.

(3) Connect hydraulic lines to HCU (Fig. 18). Line fitting nuts and bosses on valve body ports are color coded. Be sure lines are properly connected.

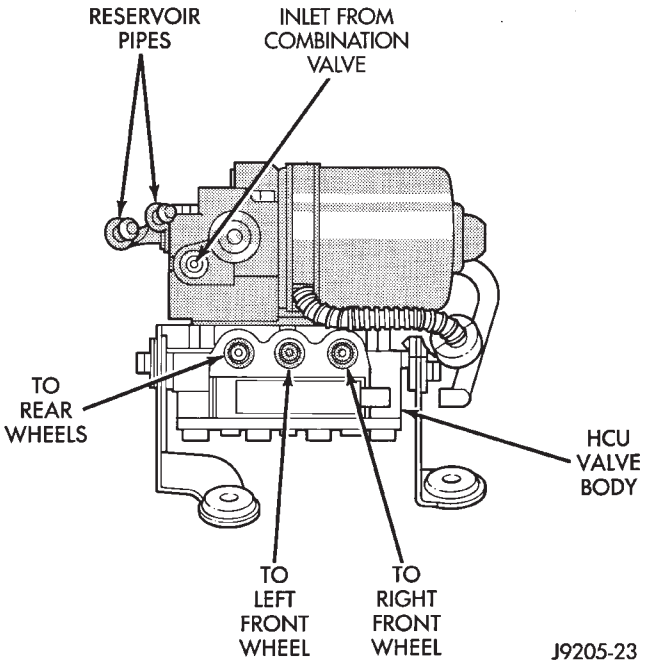


Fig. 18 HCU Hydraulic Line Connections

(4) Connect HCU harness wires to HCU.

(5) Check routing of HCU lines/hoses. Be sure lines are not kinked and are clear of engine components.

(6) Fill master cylinder reservoir with Mopar DOT 3 brake fluid or equivalent.

(7) Bleed brake system.

(8) Install air cleaner and hoses. Secure air cleaner hose pipe to fender apron with clamp.

(9) Check brake pedal action. Bleed brakes again if pedal is not firm (feels soft/spongy).

HCU REMOVAL—YJ

(1) Place shop towels or small container under master cylinder reservoir hoses.

(2) Disconnect master cylinder reservoir hoses at HCU.

(3) Disconnect all sensor and harness wires at HCU.

(4) Disconnect brakelines at HCU (Fig. 19). Mark or tag lines for installation reference.

(5) Remove bolt and nuts attaching HCU mounting bracket to fender apron and remove HCU.

HCU INSTALLATION—YJ

(1) Position HCU on fender apron (Figs. 2 and 19) and install attaching bolts/nuts.

(2) Connect brakelines to HCU.

(3) Connect harness and sensor wires to HCU.

(4) Connect master cylinder reservoir hoses to HCU.

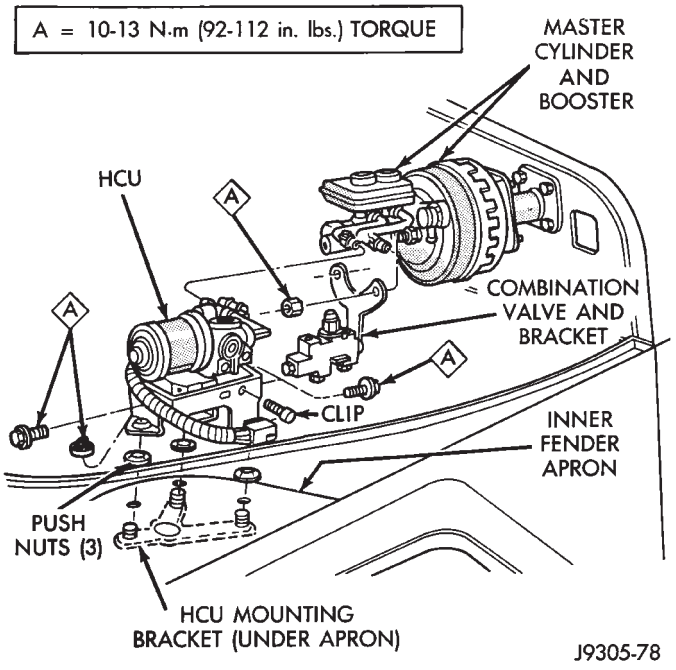


Fig. 19 HCU Mounting (YJ)

(5) Fill and bleed brake system.

COMBINATION VALVE REPLACEMENT—XJ

The combination valve is not a repairable component. The valve is serviced as an assembly whenever diagnosis indicates replacement is necessary.

(1) Remove air cleaner housing for access to valve, if necessary.

(2) Remove bolt attached valve to master cylinder (Fig. 20).

(3) Disconnect pedal travel sensor harness connector and move harness wires aside for working access if necessary.

(4) Disconnect pressure differential switch wires at valve.

(5) Disconnect hydraulic lines at valve and remove valve from vehicle.

(6) Connect hydraulic lines to valve.

(7) Position valve bracket on master cylinder and install bracket attaching bolt.

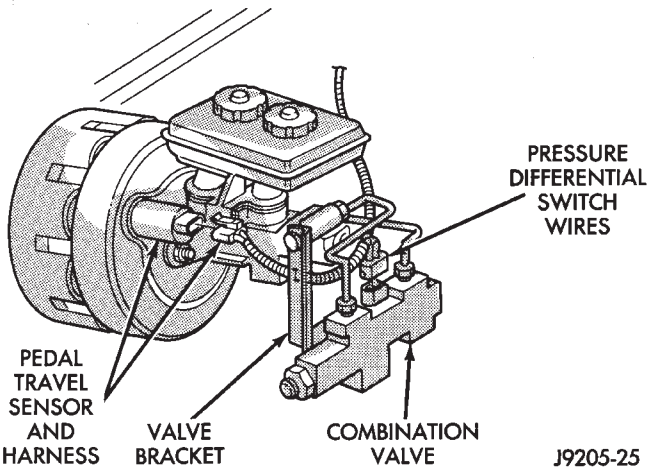


Fig. 20 Combination Valve Mounting (XJ)

(8) Reconnect pressure differential switch and pedal travel sensor wires.

(9) Bleed brake system. Refer to procedure in this section.

COMBINATION VALVE REPLACEMENT—YJ

The combination valve mounting bracket is permanently attached to the valve. The bracket and valve are serviced as an assembly.

(1) Disconnect harness wires from combination valve switch.

(2) Disconnect brakelines attached to combination valve.

(3) Remove nuts attaching combination valve bracket to master cylinder mounting studs (Fig. 19).

(4) Remove valve and bracket as assembly.

(5) Start all brakelines in combination valve by hand. Tighten line fittings just enough to prevent leaks.

(6) Position valve mounting bracket on studs.

(7) Install and tighten nuts that attach combination valve bracket to studs on power brake booster.

(8) Connect wires to combination valve switch.

(9) Fill and bleed brake system.

(10) Final-tighten brakeline fittings to 18-23 N·m (160-210 in. lbs.) torque after bleeding brakes.

PARKING BRAKES

INDEX

GENERAL SERVICE INFORMATION

Parking brake adjustment is controlled by a cable tensioner mechanism. The tensioner mechanism is used on 1991 through 1994 YJ models and XJ models starting with 1992 models. The cable tensioner, once adjusted at the factory, will not need further adjustment under normal circumstances. There are only two instances when adjustment is required. The first is when a new tensioner, or cables have been installed. And the second, is when the tensioner and cables are disconnected for access to other brake components.

PARKING BRAKE OPERATION

The rear brakes are utilized for the parking brake function. They are actuated hydraulically during normal brake operation but are mechanically actuated for parking brake operation.

Parking Brake Components

The rear brakeshoes are applied by a system of levers and cables for parking brake operation. A foot or hand operated lever in the passenger compartment is the main application device. Actuating levers on the secondary brakeshoes move the shoes directly into contact with the drum braking surface. The actuating levers are interconnected by a system of cables and a tensioner mechanism. The tensioner mechanism controls parking brake adjustment.

On XJ models, the cable tensioner is part of the lever assembly. On YJ models, the tensioner and equalizer are mounted in a bracket attached to the underbody.

On YJ models, the parking brake front cable is attached to the foot pedal at one end and the cable tensioner at the other. The tensioner is connected to the equalizer which is the connecting device for the rear cables (Fig. 1).

On XJ models, the cable tensioner is connected directly to the hand lever (a front cable is not used). The tensioner rod is attached to the equalizer which is the connecting point for the rear cables (Fig. 2).

The rear cables are connected to the actuating lever on each secondary brakeshoe. The levers are attached to the brakeshoes by a pin either pressed into, or welded to the lever. A clip is used to secure the pin in the brakeshoe. The pin allows each lever to pivot independently of the brakeshoe.

Struts, installed between each brakeshoe, are used to maintain shoe alignment and equal motion when the parking brakes are applied. Each strut is equipped with a combination tension and anti-rattle spring.

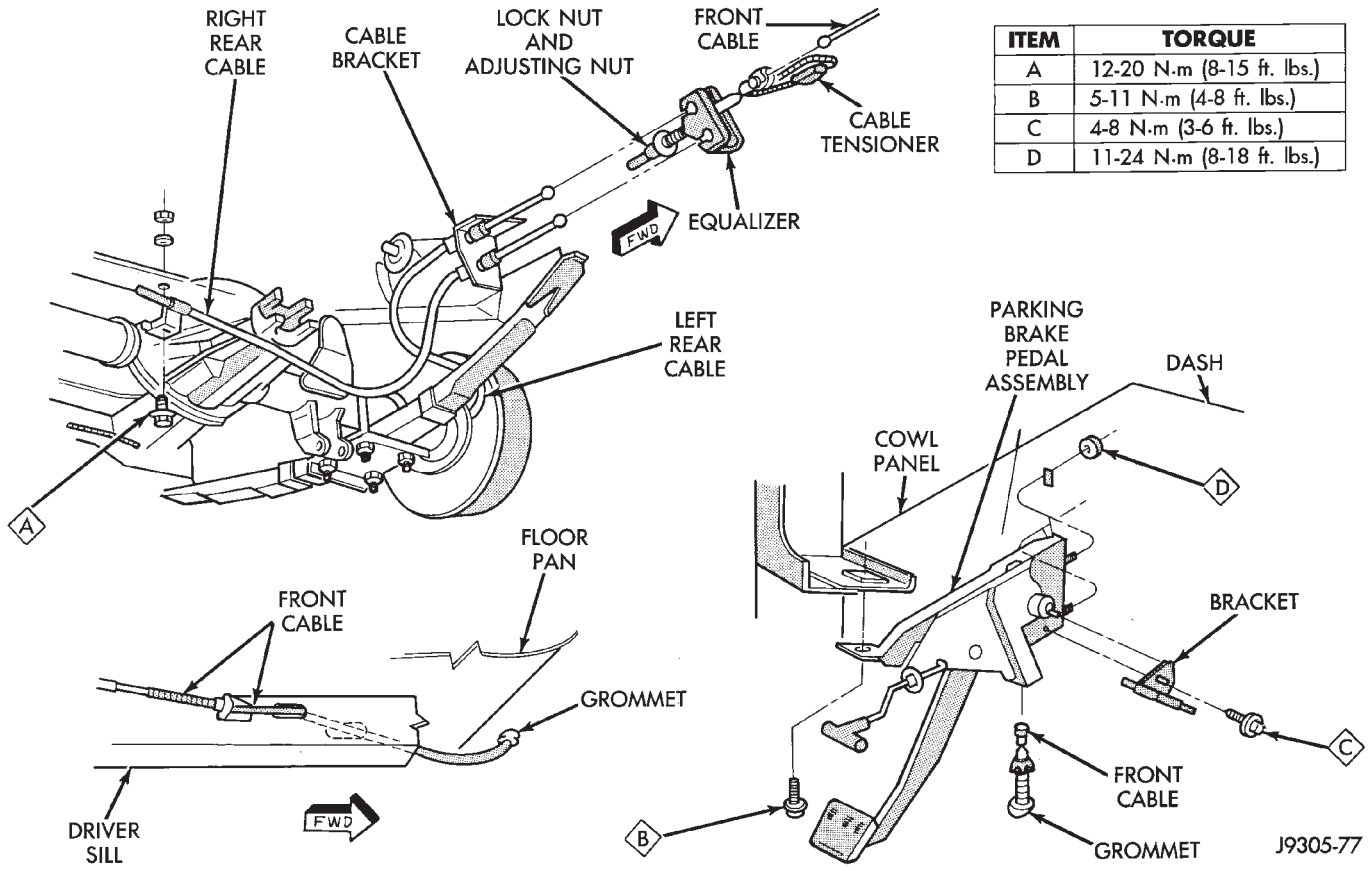
Parking Brake Application

To apply the parking brakes, the foot pedal is pressed downward, or the hand lever is pulled upward, to an engaged position. This pulls the rear brakeshoe actuating levers forward, by means of the interconnected tensioner and cables.

As the actuating lever is pulled forward, the parking brake strut (which is connected to both shoes), exerts a linear force against the primary brakeshoe. This action presses the primary shoe into contact with the drum.

Once the primary shoe contacts the brake drum, force exerted through the strut does not end. Instead, further lever movement continues to exert force against the strut; only this time, in a reverse direction. The strut force then causes the secondary shoe to pivot into contact with the drum as well.

The brakeshoes will remain engaged with the drum until the levers and cables are released. A gear type ratcheting mechanism is used to hold the pedal or lever in an applied position. Parking brake release is accomplished by means of the release handle on YJ models. Or by the hand lever release button on XJ models.



ITEM	TORQUE
A	12-20 N·m (8-15 ft. lbs.)
B	5-11 N·m (4-8 ft. lbs.)
C	4-8 N·m (3-6 ft. lbs.)
D	11-24 N·m (8-18 ft. lbs.)

Fig. 1 Parking Brake Components (YJ)

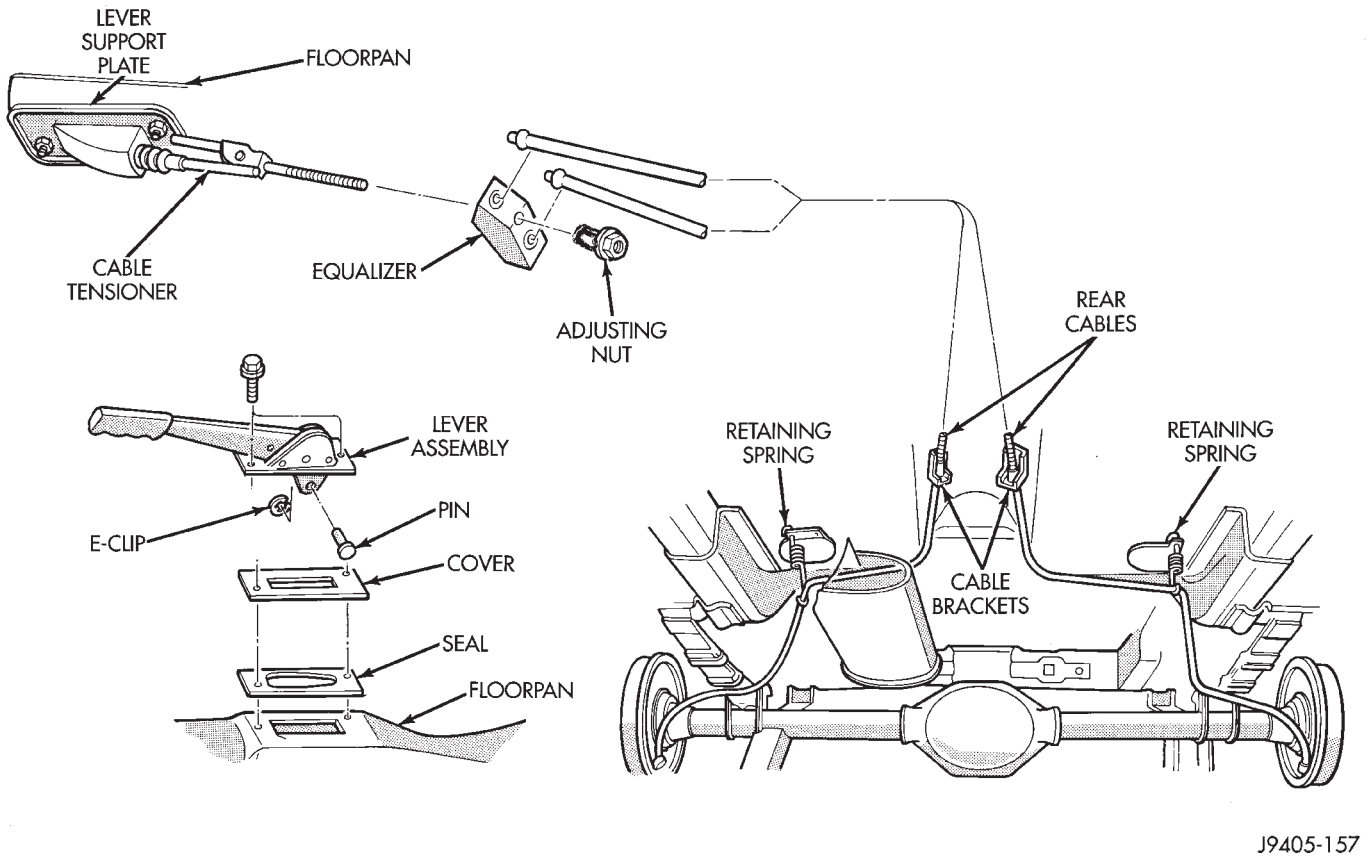


Fig. 2 Parking Brake Components (XJ)

PARKING BRAKE LEVER REMOVAL (XJ WITH MINI CONSOLE)

(1) Release parking brakes, if necessary.
(2) Raise vehicle.
(3) Remove adjusting nut from tensioner rod (Fig. 2). Then secure equalizer and rear cables to chassis with wire.
(4) Remove nuts attaching lever support plate to underside of floorpan. Then move plate aside.
(5) Lower vehicle.
(6) Remove lever assembly from floorpan.
(7) Remove tensioner cover and boot for access to lever arm (Fig. 3).
(8) Remove E-clip and pin that connect tensioner to lever arm (Fig. 3).
(9) Remove lever attaching screws from floorpan (Fig. 4).
(10) Remove lever assembly.

PARKING BRAKE LEVER INSTALLATION (XJ WITH MINI CONSOLE)

(1) Assemble lever and tensioner components (Figs. 3 and 4). Be sure E-clip is fully seated in pin (Fig. 3).
(2) Verify that tensioner boot is properly seated in cover (Fig. 5).
(3) Position lever assembly on floorpan and install lever attaching screws, if equipped.

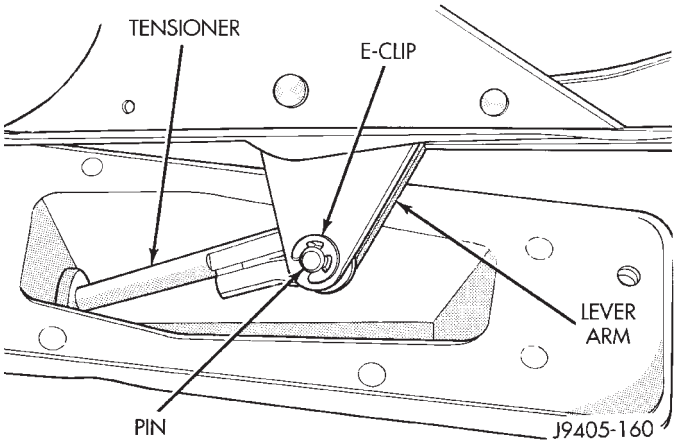


Fig. 3 Tensioner E-Clip And Retaining Pin Location

(4) Raise vehicle.
(5) Insert cable tensioner rod in equalizer and install adjusting nut on tensioner rod.
(6) Install and tighten nuts that attach lever support plate to floorpan and lever screws.
(7) Adjust parking brakes. Refer to procedure in this section.
(8) Lower vehicle and verify correct parking brake operation.

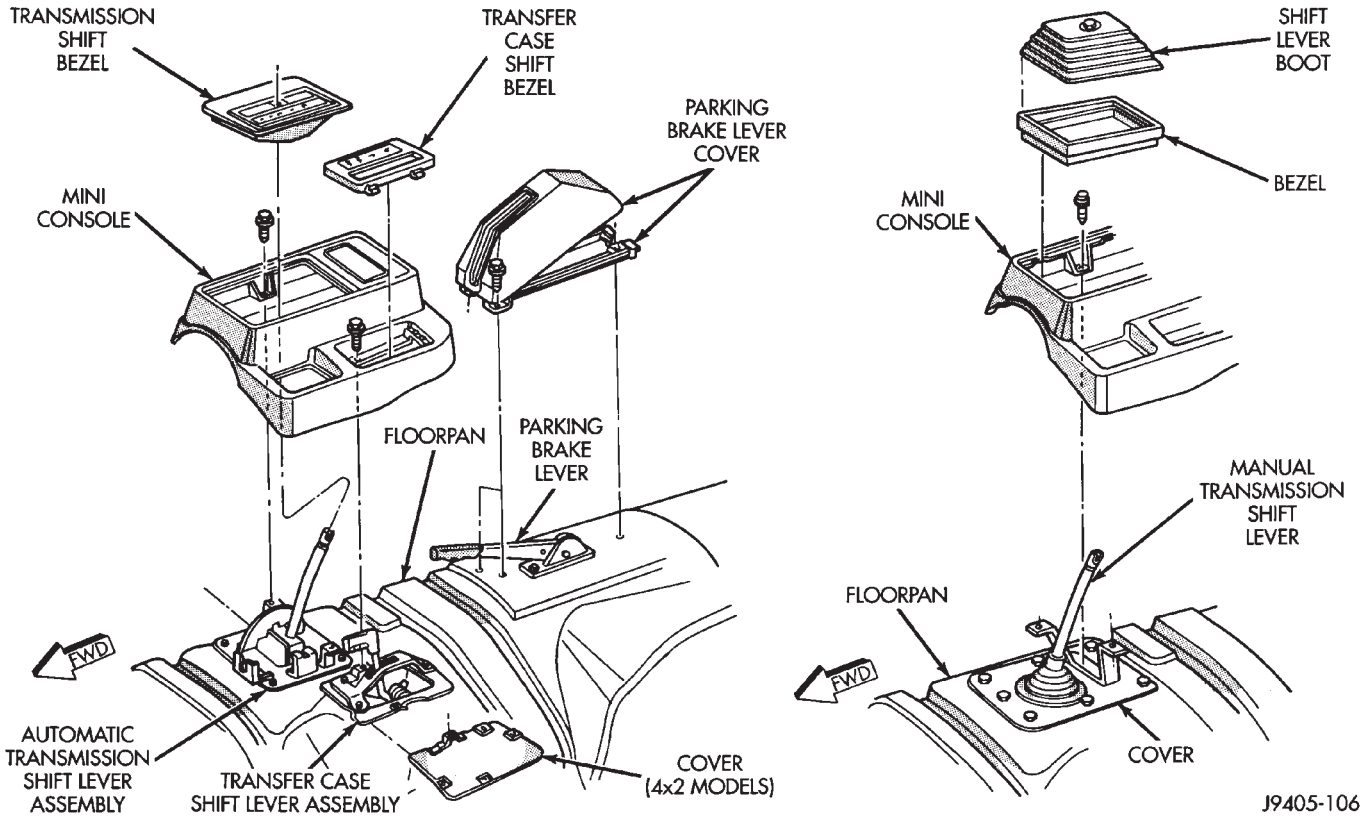


Fig. 4 Mini Console And Parking Brake Lever Cover (XJ)

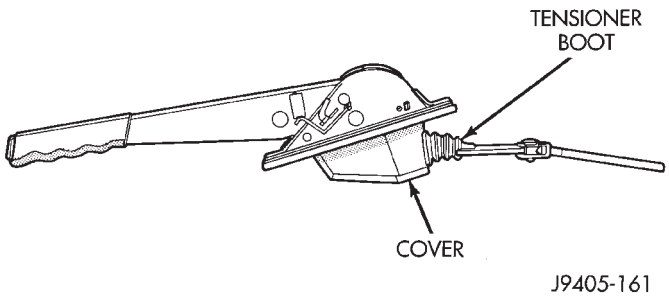


Fig. 5 Tensioner Boot Seated In Cover

PARKING BRAKE LEVER REMOVAL (XJ WITH FULL CONSOLE)

(1) Release parking brakes, if necessary.

(2) Raise vehicle.

(3) Remove adjusting nut from tensioner rod. Then temporarily secure equalizer to nearby chassis component with wire.

(4) Remove nuts attaching lever support plate to underside of floorpan.

(5) Lower vehicle.

(6) On models with manual transmission, remove shift knob, boot and bezel.

(7) On models with automatic transmission, remove shift handle cap and remove plunger, spring and T-lock (Fig. 7).

(8) Remove shift handle and shift bezel (Fig. 7).

(9) Remove console cover screws (Fig. 8).

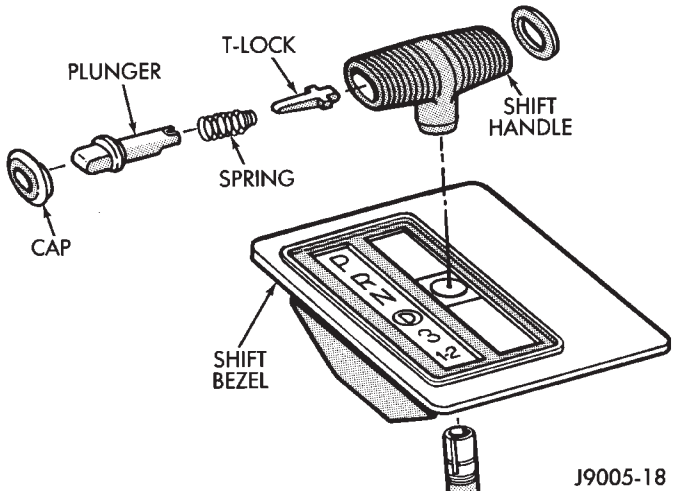


Fig. 7 Automatic Transmission Shift Handle

(10) On models with power mirror switch, pry switch out of console cover and disconnect switch connector (Fig. 8).

(11) Remove console cover from base (Fig. 9).

(12) Remove console base.

(13) Disconnect brake warning light wire connector at lever.

(14) Remove lever and cable tensioner assembly from floorpan.

(15) Move cover and boot aside for access to lever arm (Fig. 3).

(16) Remove E-clip and pin that connect tensioner to lever arm (Fig. 3).

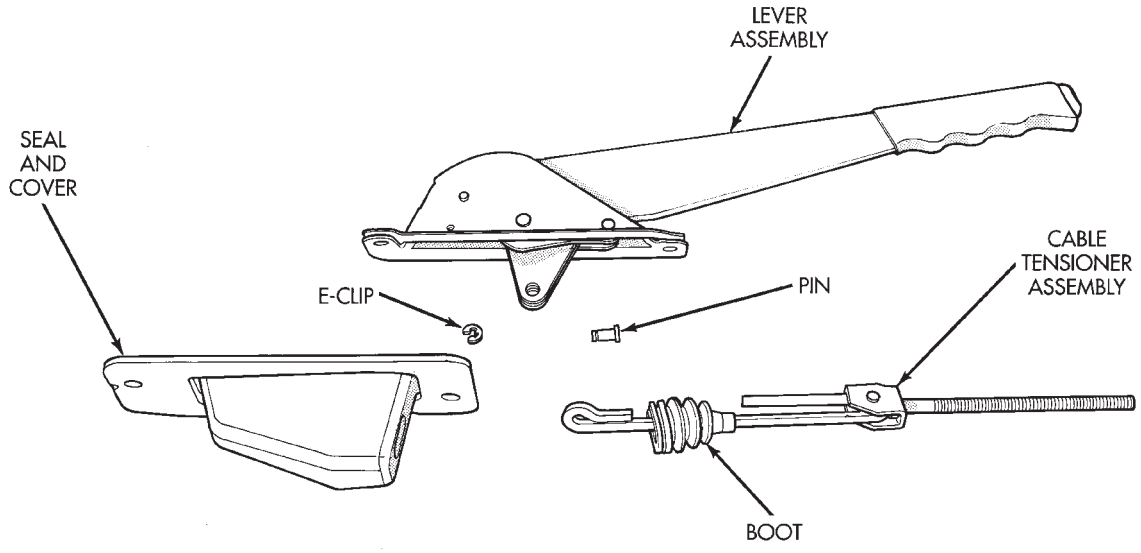


Fig. 6 Hand Lever And Cable Tensioner Components (XJ)

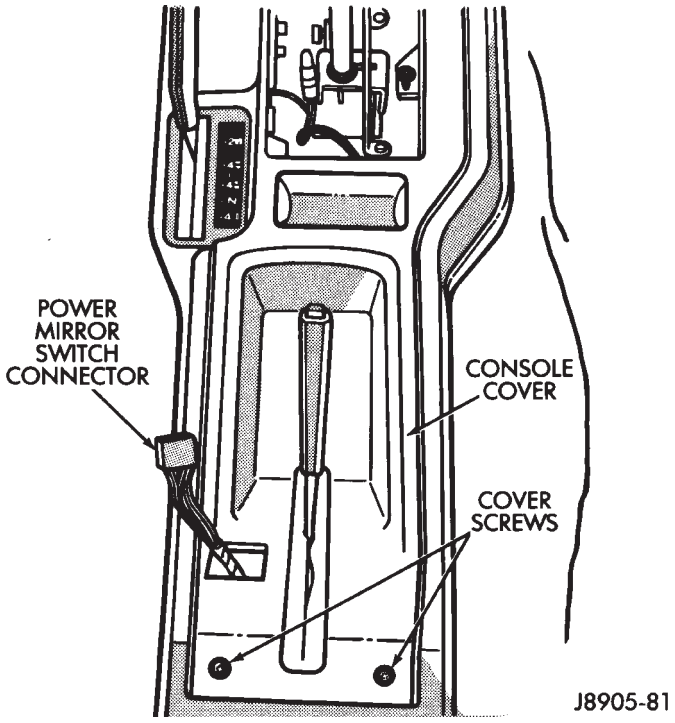


Fig. 8 Console Cover Screws And Power Mirror Switch Connector

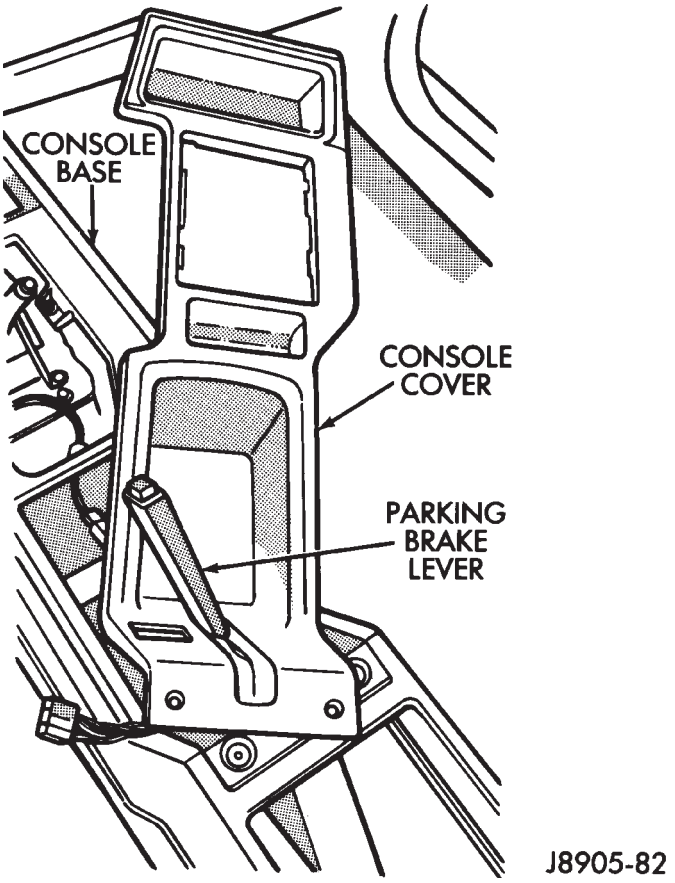


Fig. 9 Console Cover And Base

PARKING BRAKE LEVER INSTALLATION (XJ WITH FULL CONSOLE)

(1) Assemble lever and tensioner (Figs. 3 and 4). Be sure E-clip is fully engaged in retaining pin (Fig. 3).

(2) Verify that tensioner boot is fully seated in cover (Fig. 5).

(3) Position assembled lever and tensioner in floorpan.

(4) Connect brake warning light wires to switch on lever.

(5) Install console base and cover.

(6) Connect power mirror switch wire to switch and install switch in console cover.

(7) On automatic transmission models, install shift bezel and shift handle.

(8) On manual transmission models, install boot, bezel and shift knob.

(9) Raise vehicle.

(10) Insert tensioner rod in equalizer and install adjusting nut on tensioner rod.

(11) Install nuts attaching lever support plate to floorpan and lever.

(12) Adjust parking brakes. Refer to procedure in this section.

PARKING BRAKE LEVER REMOVAL (XJ WITHOUT CONSOLE)

(1) Raise vehicle.

(2) Remove nuts attaching lever support plate to underside of floorpan.

(3) Remove adjusting nut from tensioner rod. Then temporarily secure equalizer and cables to nearby chassis component with wire.

(4) Lower vehicle.

(5) Raise lever cover at rear and tilt it forward (Fig. 10).

(6) Remove cover attaching screws. Or, if cover is attached with rivets, drill out and remove cover.

(7) Disconnect brake warning light wire at lever.

(8) Remove lever and tensioner assembly from floorpan.

(9) Move cover and boot aside for access to tensioner retaining pin and clip.

(10) Remove pin and E-clip that secure tensioner to lever arm and separate lever and tensioner.

PARKING BRAKE LEVER INSTALLATION (XJ WITHOUT CONSOLE)

(1) Assemble lever and tensioner (Figs. 3 and 4).

(2) Verify that tensioner boot is properly seated in cover (Fig. 5).

(3) Position lever on floorpan and insert lever screws through floorpan. Be sure lever cover and seal are in place between lever and floorpan.

(4) Connect brake warning light wires to switch on lever.

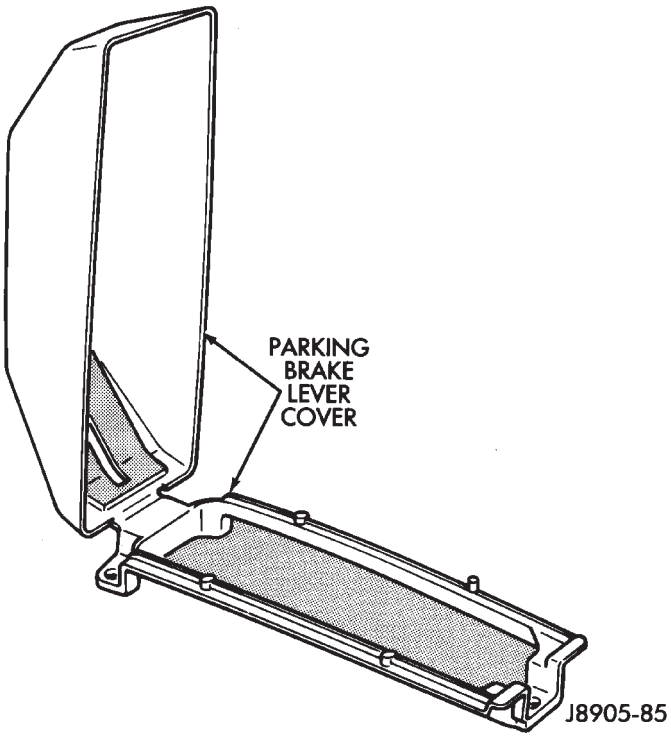


Fig. 10 Lever Cover (XJ)

(5) Install lever cover. Secure cover with new rivets, or original attaching screws.

(6) Raise vehicle.

(7) Connect tensioner to lever with retaining pin and E-clip.

(8) Install nuts attaching lever support plate to lever screws.

(9) Adjust parking brakes. Refer to procedure in this section.

PARKING BRAKE CABLE TENSIONER REPLACEMENT (XJ)

(1) Raise vehicle.

(2) Remove adjuster nut from tensioner rod. Secure equalizer and cables to nearby chassis component with wire.

(3) Remove nuts attaching lever assembly to support plate and floorpan.

(4) Lower vehicle.

(5) Remove console components and lever assembly cover.

(6) Remove lever and tensioner assembly.

(7) Move cover and boot for access to tensioner retaining pin.

(8) Remove E-clip and pin that attach tensioner to lever arm (Fig. 3).

(9) Remove tensioner from cover.

(10) Transfer boot to new tensioner if necessary.

(11) Attach tensioner to lever arm with pin and E-clip.

(12) Verify that E-clip is fully engaged in pin (Fig. 3).

(13) Align cover and seal on lever flange.

(14) Verify that tensioner boot is seated in cover (Fig. 5).

(15) Install assembled lever and tensioner in floorpan.

(16) Install necessary console components.

(17) Adjust parking brakes as described in this section.

PARKING BRAKE PEDAL REMOVAL (YJ)

(1) Raise vehicle.

(2) Loosen equalizer nuts until front cable is slack (Fig. 11).

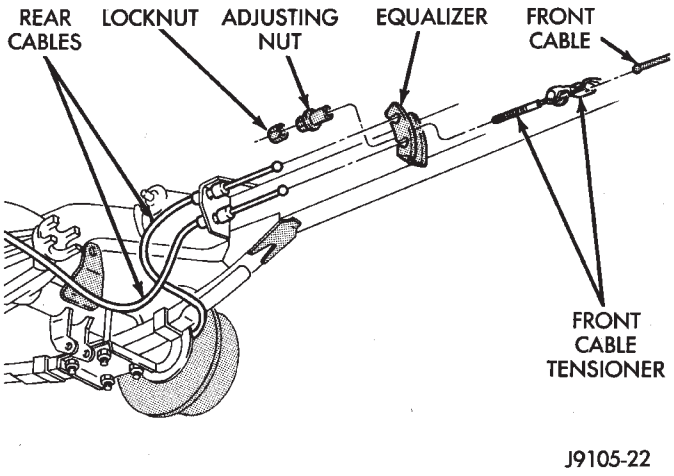


Fig. 11 Front Cable And Equalizer (YJ)

(3) Lower vehicle.

(4) Remove dash-to-instrument panel brace rod, if equipped.

(5) Disconnect warning light switch wire from pedal assembly.

(6) On some YJ models, a ground wire may be attached to upper end of bolt that secures parking brake pedal to instrument panel. Wire is secured with a nut. Be sure to remove nut and detach ground wire before proceeding. If this wire is not removed beforehand, wire and harness could be damaged when pedal assembly bolt is removed. Ground wire and attaching nut are accessible from under instrument panel.

(7) Remove bolt securing pedal assembly to instrument panel (Fig. 12).

(8) In engine compartment, remove pedal mounting stud nuts.

(9) Remove pedal assembly from panel.

(10) Disengage front cable from retainer (Fig. 12).

(11) Squeeze cable clip (Fig. 12) and pull cable out of pedal frame.

(12) Remove pedal assembly.

PARKING BRAKE PEDAL INSTALLATION (YJ)

(1) Connect front cable to pedal retainer.

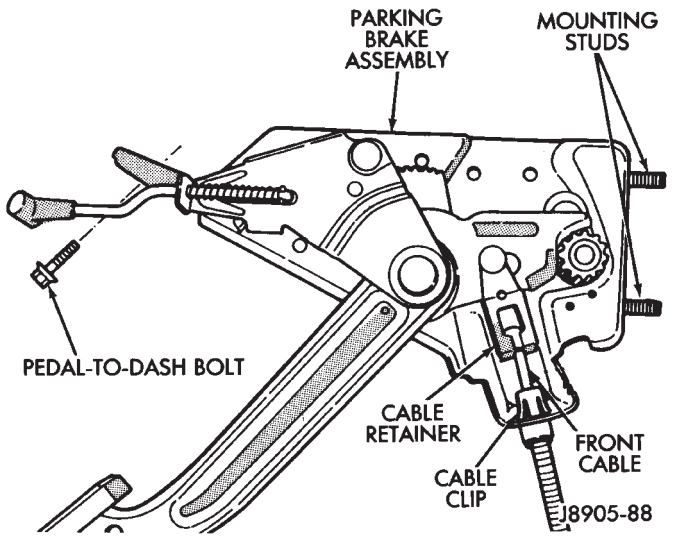


Fig. 12 Parking Brake Pedal Assembly (YJ)

(2) Position pedal assembly on panel and install mounting stud nuts and pedal-to-dash bolt.

(3) Install ground wire on upper end of pedal-to-dash bolt and secure wire with attaching nut.

(4) Connect warning light switch wire to pedal connector.

(5) Install dash-to-instrument panel brace rod, if equipped.

(6) Raise vehicle and adjust brake cables. Refer to procedure in Service Adjustment section.

PARKING BRAKE REAR CABLE REPLACEMENT (XJ)

(1) Raise vehicle and loosen equalizer nuts until rear cables are slack.

(2) Disengage cable from equalizer and remove cable clip and spring (Fig. 13).

(3) Remove rear wheel and brake drum.

(4) Remove secondary brakeshoe and disconnect cable from lever on brakeshoe.

(5) Compress cable retainer with worm drive hose clamp (Fig. 14) and remove cable from backing plate.

(6) Install new cable in backing plate. Be sure cable retainer is seated.

(7) Attach cable to lever on brakeshoe and install brakeshoe on backing plate.

(8) Adjust brakeshoes to drum with brake gauge.

(9) Install brake drum and wheel.

(10) Engage cable in equalizer and install equalizer nuts (Fig. 13).

(11) Adjust parking brakes. Refer to procedure in this section.

PARKING BRAKE FRONT CABLE REPLACEMENT (YJ)

(1) Raise vehicle.

(2) Remove equalizer nuts (Fig. 15).

(3) Remove front cable from equalizer (Fig. 15).

(4) Remove cable-to-frame bracket clip.

(5) Lower vehicle.

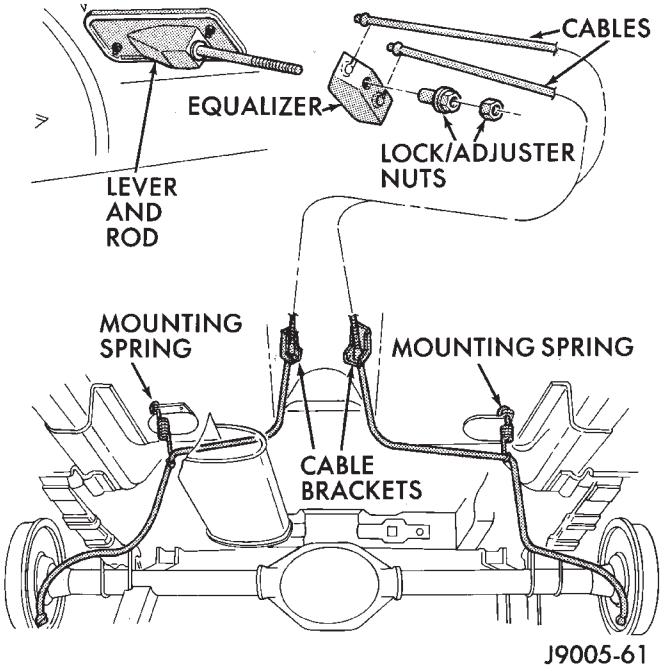


Fig. 13 Parking Brake Cables (XJ)

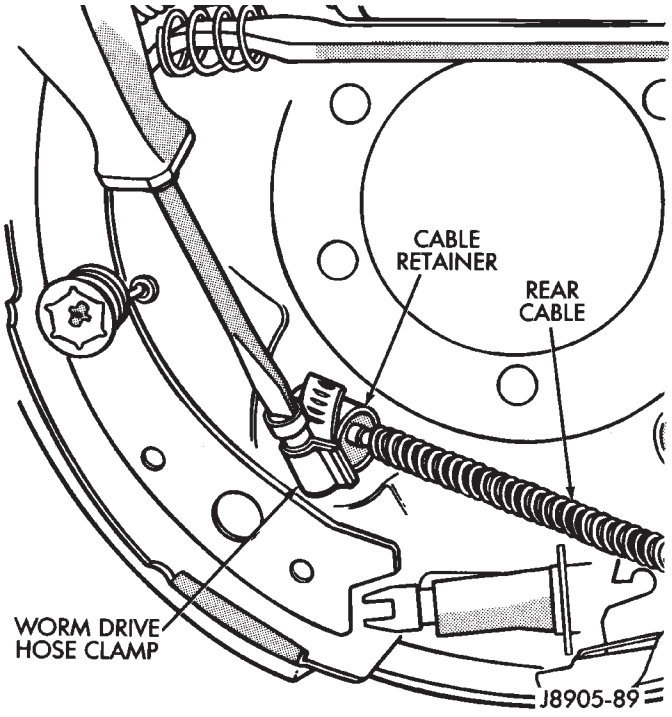


Fig. 14 Compressing Rear Cable Retainer

(6) Move front carpeting away from pedal.

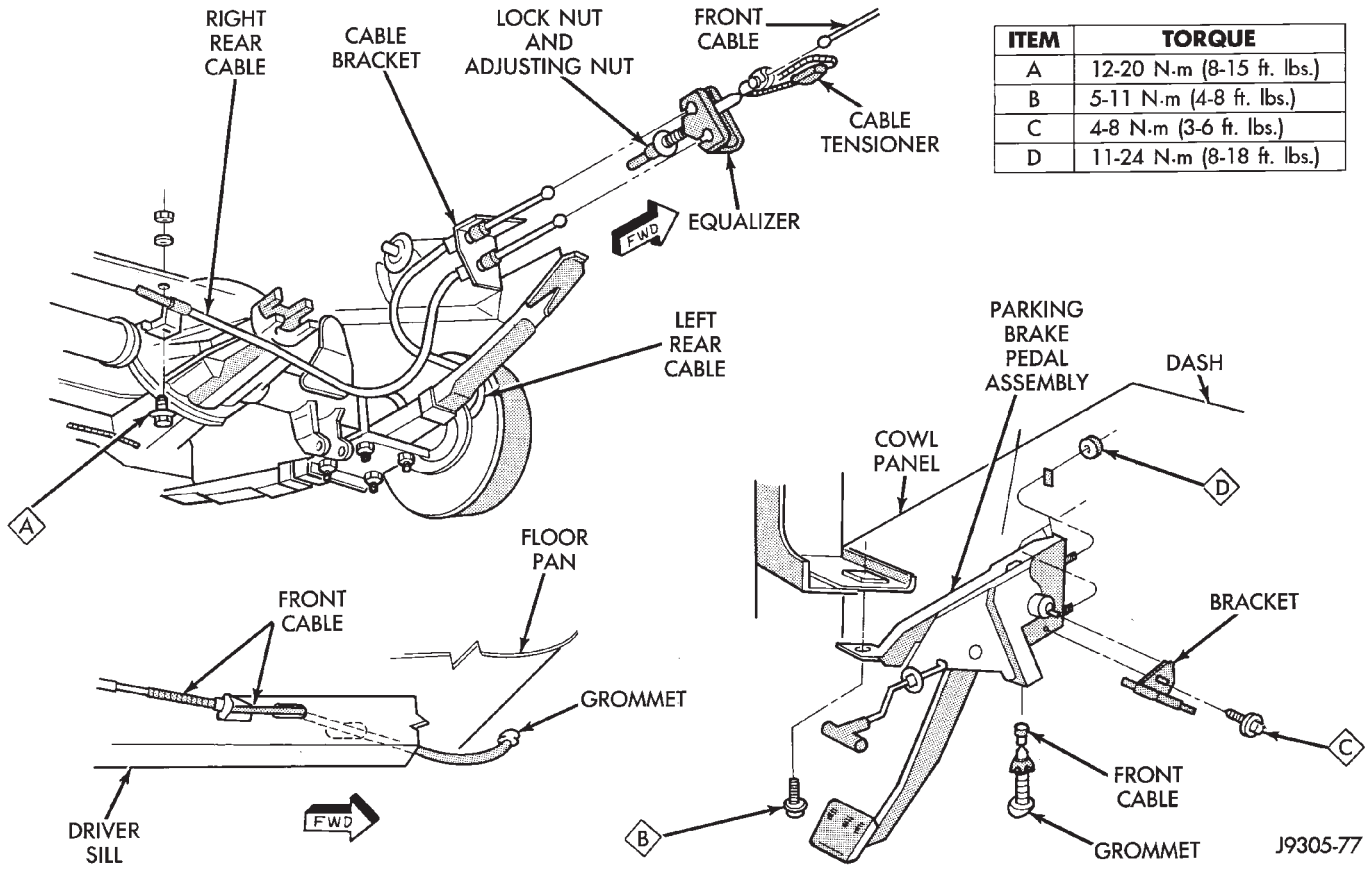
(7) Compress clip securing cable to pedal frame (Fig. 15). Use hose clamp to compress clip.

(8) Disconnect cable from pedal retainer and remove cable.

(9) Remove grommet (Fig. 15) from old cable and transfer it to new cable, if necessary.

(10) Install new cable in floorpan and connect it to pedal assembly.

(11) Seat cable grommet in floorpan.



ITEM	TORQUE
A	12-20 N·m (8-15 ft. lbs.)
B	5-11 N·m (4-8 ft. lbs.)
C	4-8 N·m (3-6 ft. lbs.)
D	11-24 N·m (8-18 ft. lbs.)

Fig. 15 Parking Brake Cables (YJ)

(12) Raise the vehicle.

(13) Install cable-to-frame retaining clip.

(14) Insert cable in equalizer and install equalizer washer and nuts.

(15) Adjust parking brakes as described in Service Adjustment section.

PARKING BRAKE REAR CABLE REPLACEMENT (YJ)

(1) Raise vehicle and loosen equalizer nuts (Fig. 15).

(2) Remove clamp and cotter pin attaching rear cable to equalizer and remove cable.

(3) Remove cable clips.

(4) Remove rear wheel and brake drum.

(5) Remove secondary brakeshoe and disconnect cable from lever on brakeshoe.

(6) Compress cable retainer with hose clamp (Fig. 14) and remove cable from backing plate.

(7) Install new cable in backing plate. Be sure cable retainer lock tabs are engaged in plate.

(8) Install secondary brakeshoe.

(9) Adjust brakeshoes to brake drum and install drum and wheel.

(10) Install cable in equalizer. Secure cable with retainer and cotter pin.

(11) Install cable clips.

(12) Adjust parking brakes. Refer to procedure in this section.

PARKING BRAKE ADJUSTMENT (XJ/YJ)

Parking brake adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected for service. When adjustment is necessary, perform adjustment only as described in the following procedure. This is necessary to avoid faulty parking brake operation.

(1) Raise vehicle.

(2) Back off tensioner adjusting nut to create slack in cables.

(3) Remove rear wheel/tire assemblies and remove brake drums.

(4) Check rear brakeshoe adjustment with standard brake gauge. Also check condition of brake parts as follows:

(a) Replace worn parts if necessary. **Excessive shoe-to-drum clearance, or worn brake components will result in faulty parking brake adjustment and operation.**

(b) Verify that parking brake cables operate freely and are not binding, or seized. Replace faulty cables, before proceeding.

(c) Adjust rear brakeshoes shoes to drum.

(5) Reinstall brake drums and wheel/tire assemblies after brakeshoe adjustment is complete.

(6) Lower vehicle enough for access to parking brake lever or foot pedal. **Then fully apply parking brakes. Leave brakes applied until adjustment is complete.**

(7) Raise vehicle again.

(8) Mark tensioner rod 6.5 mm (1/4 in.) from tensioner bracket (Fig. 16).

(9) Tighten adjusting nut at equalizer until mark on tensioner rod moves into alignment with tensioner bracket (Fig. 16). **Do not loosen/tighten equalizer adjusting nut for any reason after completing adjustment.**

(10) Lower vehicle until rear wheels are 15-20 cm (6-8 in.) off shop floor.

(11) Release parking brake lever and verify that rear wheels rotate freely without drag.

(12) Lower vehicle.

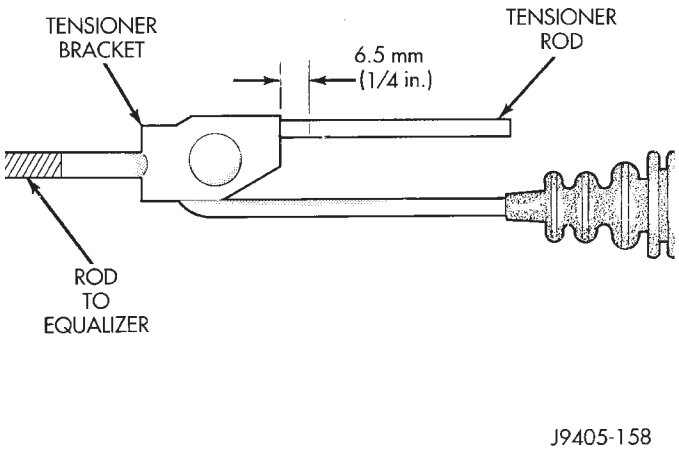


Fig. 16 Placing Adjustment Mark On Tensioner Rod

BRAKE PEDAL AND BRAKELIGHT SWITCH

INDEX

GENERAL INFORMATION

A suspended-type brake pedal is used on all models (Figs. 1 and 2). The pedal pivots on a shaft mounted in the pedal support bracket. The bracket is attached to the dash and instrument panels on all models.

A plunger-type, adjustable brakelight switch is used on all models. The switch is attached to a flange on the pedal support bracket.

BRAKE PEDAL SERVICE

The brake pedal is a serviceable component. The pedal, pivot pin, sleeve, pedal bushings and spacers/ washers are all replaceable parts. The pedal bracket can also be replaced when necessary.

BRAKE PEDAL REMOVAL

(1) Remove lower trim panel and A/C duct if necessary.

(2) Remove steering column lower trim panel and bezel.

(3) Remove necessary dash panel-to-instrument panel brace rods.

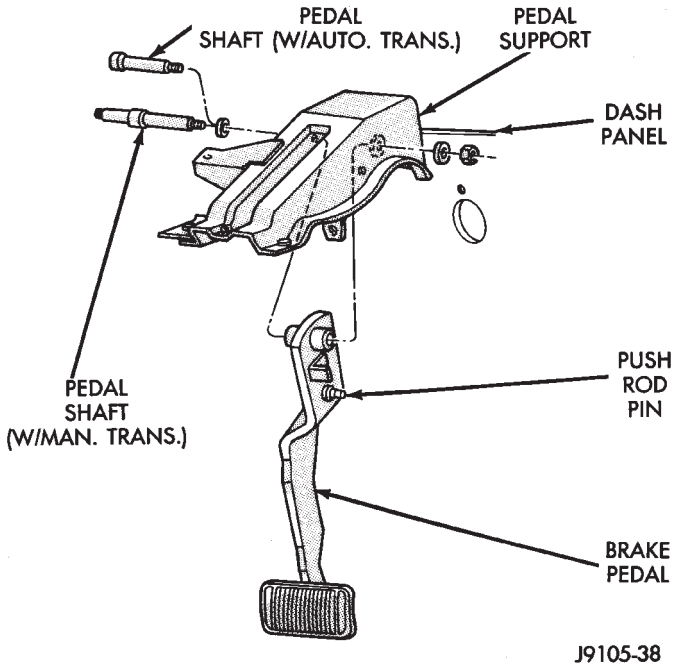


Fig. 1 Brake Pedal And Support Bracket (YJ)

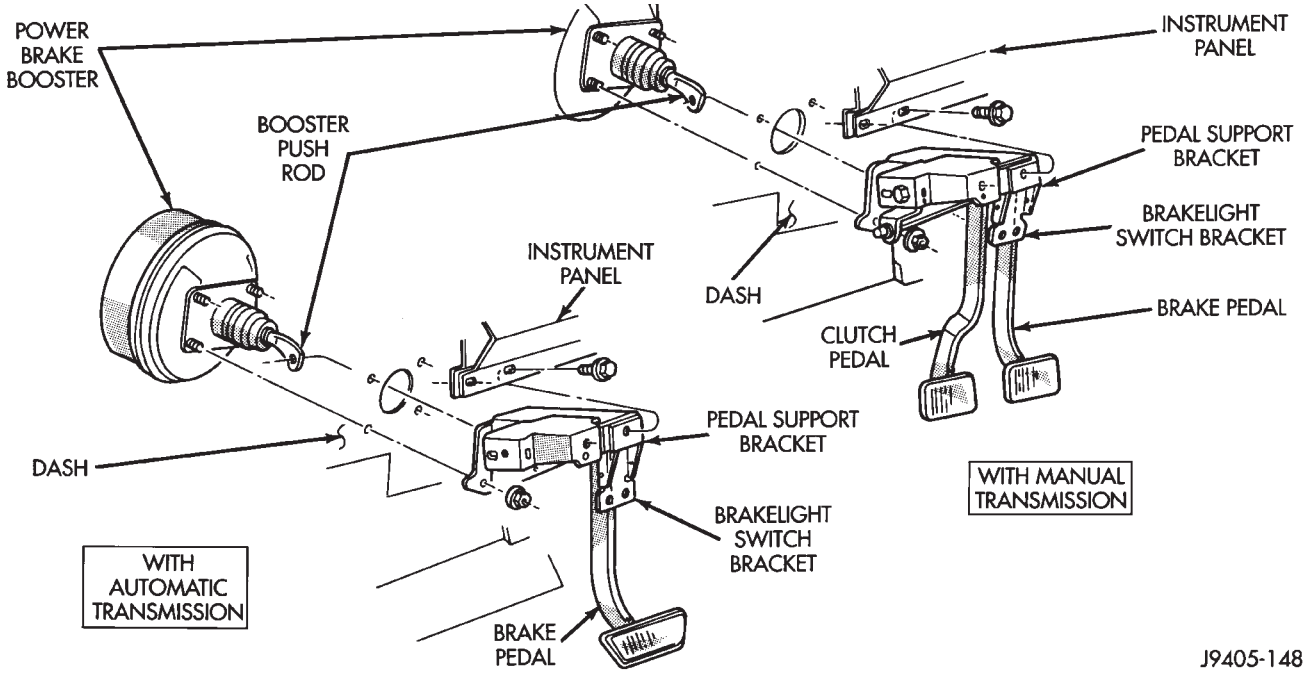


Fig. 2 Brake Pedal And Support Bracket (XJ)

(4) Remove retainer clip securing booster push rod to pedal (Fig. 3).

(5) Remove nut securing pedal shaft in support bracket.

(6) Slide pedal shaft outward for clearance and remove brake pedal.

(7) Remove pedal bushings if they are to be replaced.

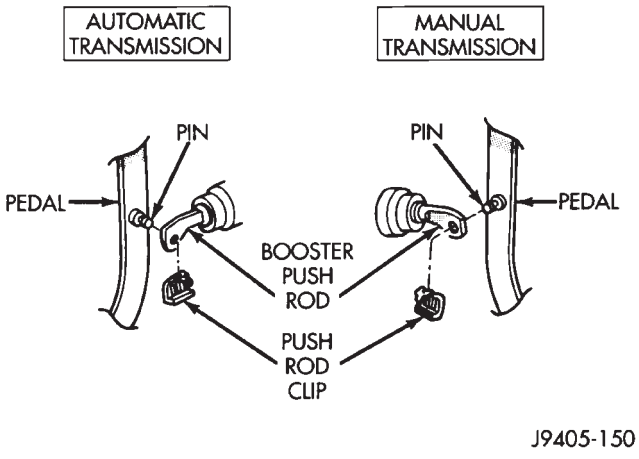


Fig. 3 Push Rod Attachment At Brake Pedal (XJ)

BRAKE PEDAL INSTALLATION

(1) Install new bushings in pedal. Lubricate bushings and pivot pin with Mopar multi mileage grease.

(2) Position pedal, sleeve and spacer(s) in bracket and install pivot pin.

(3) Install new nut on pivot pin. **Pivot pin nut is specially formed and should not be reused. Be sure to install new nut to secure pin.**

(4)) Tighten new pivot pin nut to 27 N·m (20 ft. lbs.) on models with manual transmission. Tighten nut to 35 N·m (26 ft. lbs.) on models with automatic transmission.

(5) Install booster push rod on pedal pin (Fig. 3). Secure push rod with original, or new retainer clip if necessary.

(6) Install dash brace rod, if equipped.

(7) Check and adjust brakelight switch if necessary. Refer to procedure in this section.

BRAKELIGHT SWITCH REMOVAL

The brakelight switch is mounted in the pedal support bracket and is operated by the pedal. The switch is secured in the bracket with a retainer (Fig. 4).

(1) Remove steering column cover and lower trim panel for switch access, if necessary.

(2) Disconnect switch wires.

(3) Thread switch out of retainer, or rock switch up/down and pull it rearward out of retainer.

(4) Inspect switch retainer. Replace retainer if worn, distorted, loose, or damaged.

BRAKELIGHT SWITCH INSTALLATION

(1) Insert replacement switch in retainer. Thread switch into place or rock it up/down until switch plunger touches brake pedal.

(2) Connect switch wires.

(3) Check switch operation. Adjust switch position if necessary. Refer to procedures in this section.

(4) Install trim panels (if removed).

BRAKELIGHT SWITCH ADJUSTMENT

A plunger-type brakelight switch is used on XJ and YJ models (Fig. 4). The switch plunger is actuated directly by the brake pedal.

The switch internal contacts are open when the brake pedal is in the released position. Brake application moves the pedal away from the switch allowing the plunger to extend. As the plunger extends, the switch internal contacts close completing the circuit to the brakelights.

A circular, metal clip is used to secure the switch to the bracket on the pedal support. The clip has tangs that seat in the threads of the switch plunger barrel.

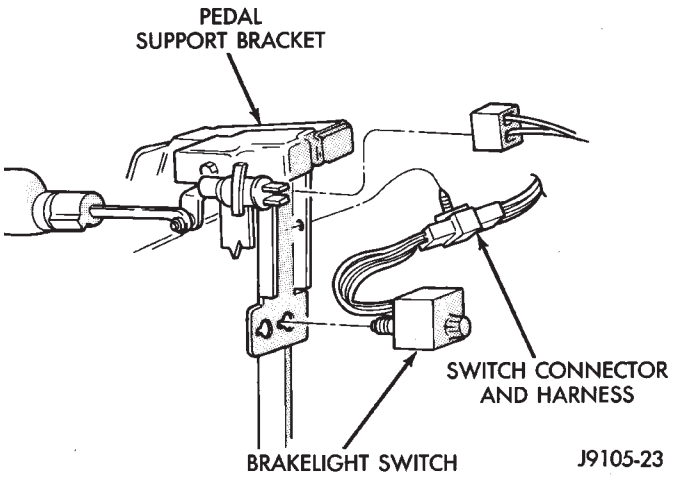


Fig. 4 Brakelight Switch Mounting And Location (XJ/YJ)

SWITCH ADJUSTMENT PROCEDURE

(1) Check switch adjustment. Move the brake pedal forward by hand and note operation of the switch plunger. Plunger should be fully extended when pedal free play is taken up and brake application begins. A clearance of approximately 3 mm (1/8 in.) should exist between plunger and pedal at this point.

(a) If switch-to-pedal clearance is OK and brakelights operate correctly, adjustment is not required.

(b) If switch plunger does not fully extend and clearance between pedal and switch barrel is insufficient, adjust switch position as described in step (2).

(2) Grasp brake pedal and pull it rearward as far as possible. Switch plunger barrel will "ratchet" rearward in retaining clip to correct position.

(3) Verify brakelight switch operation and proper clearance between switch plunger and brake pedal.

CAUTION: Be very sure the brake pedal returns to a fully released position after adjustment. The switch can interfere with full pedal return if too far forward. The result will be brake drag caused by partial brake application.

SPECIFICATIONS

BRAKE TORQUE SPECIFICATIONS

Description	Torque
Acceleration Sensor Screws:	
at sensor	8-9 N•m (71-83 in. lbs.)
at bracket	1-2 N•m (13-18 in. lbs.)
Brake Booster Mounting Nuts	41 N•m (30 ft. lbs.)
Brakeline Fittings At:	
combination valve	18-24 N•m (160-210 in. lbs.)
front brake hose	15-18 N•m (130-160 in. lbs.)
HCU	14-16 N•m (125-140 in. lbs.)
master cylinder primary outlet	14-16 N•m (125-140 in. lbs.)
master cylinder secondary outlet	15-18 N•m (135-160 in. lbs.)
rear brakeline (to hose)	15-18 N•m (130-160 in. lbs.)
wheel cylinder	15-18 N•m (130-160 in. lbs.)
Brake Pedal Support Bolt	23-34 N•m (200-300 in. lbs.)
Brake Pedal Pivot Bolt/Nut	27-35 N•m (20-26 ft. lbs.)
Caliper Mounting Bolts	10-20 N•m (7-15 ft. lbs.)
Combination Valve Adaptor Fittings	23-27 N•m (200-240 in. lbs.)
ECU Mounting Screws	8-13 N•m (75-115 in. lbs.)

Description	Torque
Front Brake Hose Bracket Screw	4-6 N•m (34-50 in. lbs.)
Front Brake Hose Fitting Bolt	24-38 N•m (216-336 in. lbs.)
Front Wheel Sensor Bracket Bolt	4-6 N•m (34-50 in. lbs.)
HCU Bracket Attaching Nuts	10-13 N•m (92-112 in. lbs.)
Master Cylinder Attaching Nuts	13-25 N•m (115-220 in. lbs.)
Parking Brake Cable Retainer Nut	1-2 N•m (12-16 in. lbs.)
Parking Brake Lever Screws	10-14 N•m (85-125 in. lbs.)
Parking Lever Bracket Screws	10-14 N•m (85-125 in. lbs.)
Rear Axle Vent Fitting	11-18 N•m (100-160 in. lbs.)
Rear Brake Hose Bracket Screw	8-9 N•m (74-82 in. lbs.)
Rear Sensor Axle Bracket Bolt	8-9 N•m (74-82 in. lbs.)
Rear Sensor Bolt	12-14 N•m (10-11 ft. lbs.)
Support Plate Bolts/Nuts	43-61 N•m (32-45 ft. lbs.)
Wheel Cylinder Bolts	10 N•m (90 in. lbs.)
Wheel Lug Nuts	120 N•m (88 ft. lbs.)

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CLUTCH

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GENERAL INFORMATION

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CLUTCH COMPONENTS

MECHANICAL COMPONENTS

The clutch mechanism in XJ/YJ models with manual transmission consists of a single, dry-type clutch disc and a diaphragm style clutch cover. A hydraulic linkage is used to operate the clutch disc and cover.

The transmission input shaft is supported in the crankshaft by a bearing. A sleeve type release bearing is used to engage and disengage the clutch cover pressure plate.

The release bearing is operated by a release fork in the clutch housing. The fork pivots on a ball stud mounted inside the housing. The release fork is actuated by a hydraulic slave cylinder mounted in the housing. The slave cylinder is operated by a clutch master cylinder mounted on the dash panel. The cylinder push rod is connected to the clutch pedal.

The clutch disc has cushion springs in the disc hub. The clutch disc facing is riveted to the hub. The facing is made from a non-asbestos material. The clutch cover pressure plate is a diaphragm type with a one-piece spring and multiple release fingers. The pressure plate release fingers are preset during manufacture and are not adjustable.

HYDRAULIC LINKAGE COMPONENTS

The hydraulic linkage consists of a clutch master cylinder with integral reservoir, a clutch slave cylinder and an interconnecting fluid line.

The clutch master cylinder push rod is connected to the clutch pedal. The slave cylinder push rod is connected to the clutch release fork. The master cylinder is mounted on the driver side of the dash panel adjacent to the brake master cylinder and booster assembly. This positioning is similar for both left and right hand drive models.

CLUTCH LINKAGE FLUID

The integral clutch master cylinder reservoir, slave cylinder and fluid lines are prefilled with fluid prior to assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. In fact, **the reservoir fluid level will actually increase as normal clutch wear occurs. For this reason, it is important to avoid overfilling, or removing fluid from the reservoir.**

If inspection or diagnosis indicates additional fluid may be needed, use Mopar brake fluid, or an equivalent meeting standards SAE J1703 and DOT 3. Do not use any other type of fluid.

CLUTCH COMPONENT LUBRICATION

Proper clutch component lubrication is important to satisfactory operation. Using the correct lubricant and not overlubricating are equally important. Apply recommended lubricant sparingly to avoid disc and pressure plate contamination.

Clutch and transmission components requiring lubrication are:

- pilot bearing
- release lever pivot ball stud
- release lever contact surfaces
- release bearing bore
- clutch disc hub splines
- clutch pedal pivot shaft bore
- clutch pedal bushings
- input shaft splines

- input shaft pilot hub
- transmission front bearing retainer slide surface

Never apply grease to any part of the clutch cover, or disc.

RECOMMENDED LUBRICANTS

Use Mopar multi-purpose grease for the clutch pedal bushings and pivot shaft. Use Mopar high temperature grease (or equivalent) for all other lubrication requirements. Apply recommended amounts and do not overlubricate.

CLUTCH OPERATION

Leverage, spring force and friction are what make the clutch work. The disc serves as the friction element. The diaphragm spring acting on the pressure plate provides the apply (or clamping) force. And the pedal, hydraulic linkage, release lever and bearing provide the leverage.

The clutch cover, which is bolted to the flywheel, is the component that clamps the disc against the flywheel. The cover is actually an assembly consisting of the cover, diaphragm spring, pressure plate, and fulcrum components.

It is the clutch cover pressure plate that actually clamps the clutch disc against the flywheel. Pressure plate force is supplied by the diaphragm spring.

The disc has a splined hub for installation on the transmission input shaft splines. The splined hub is what connects the disc to the transmission.

The clutch linkage uses hydraulic pressure to operate the clutch. The clutch master cylinder is connected to the clutch pedal and the slave cylinder is connected to the release lever. In operation, pressing the clutch pedal develops fluid pressure in the clutch master cylinder. This pressure is then transmitted directly to the slave cylinder via the connecting line. In turn, the slave cylinder operates the clutch release lever.

The clutch release bearing is mounted on the transmission front bearing retainer. The bearing is attached to the release lever which moves the bearing in and out of contact with the diaphragm spring.

In operation, slave cylinder force causes the release lever to pivot toward the clutch. This action moves the release bearing into direct contact with the diaphragm spring fingers. As additional force is applied, the release bearing pushes the spring fingers inward relieving spring force on the pressure plate. At this point, the clutch disc is disengaged and freewheeling.

The process of clutch re-engagement, is simply the reverse of what occurs during disengagement. Releasing pedal pressure removes linkage pressure. The release bearing moves away from the spring which again applies clamping force on the disc through the pressure plate.

CLUTCH DIAGNOSIS

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GENERAL DIAGNOSIS INFORMATION

Unless the cause of a clutch problem is obvious, accurate problem diagnosis will usually require a road test to confirm a problem. Component inspection will then be required to determine the actual problem cause.

During a road test, drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If chatter, grab, slip, or improper release is experienced, remove and inspect the clutch components. However, if the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault. Careful observation during the test will help narrow the problem area.

CLUTCH PROBLEM CAUSES

CONTAMINATION

Fluid contamination is a frequent cause of clutch malfunctions. Oil, water, or clutch fluid on the clutch contact surfaces will cause faulty operation. The usual result is chatter, slip and grab.

During inspection, note if any components are contaminated with oil, hydraulic fluid, or water/road splash.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Oil leakage produces a residue of oil on the housing interior and on the clutch cover and flywheel. Heat buildup caused by slippage between the cover, disc and flywheel, can sometimes bake the oil residue onto the components. The glaze-like residue ranges in color from amber to black.

Road splash contamination means dirt/water is entering the clutch housing due to loose bolts, housing cracks, or through hydraulic line openings. Driving through deep water puddles can force water/road splash into the housing through such openings.

Clutch fluid leaks are from loose or damaged slave cylinder fluid lines and connecting fittings. However, clutch fluid leaks will usually be noted and corrected before severe contamination occurs.

CLUTCH MISALIGNMENT

Clutch components must be in proper alignment with the crankshaft and transmission input shaft. Misalignment caused by excessive runout or warpage of any clutch component will cause grab, chatter and improper clutch release.

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.

Common causes of runout are:

- heat warpage
- improper machining
- incorrect bolt tightening
- improper seating on crankshaft flange shoulder
- foreign material on crankshaft flange

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. However, minor flywheel scoring can be cleaned up by hand with 180 grit emery, or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar Lock And Seal. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

Clutch Cover 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. To avoid warping the cover, the bolts must tightened alternately (diagonal pattern) and evenly (2-3 threads at a time) to specified torque.

Clutch Housing Misalignment

Clutch housing alignment is important to proper clutch operation. The housing maintains alignment between the crankshaft and transmission input shaft. Misalignment can cause clutch noise, hard shifting, incomplete release and chatter. It can also result in premature wear of the pilot bearing, cover release fingers and clutch disc. In severe cases, misalignment can also cause premature wear of the transmission input shaft and shaft bearing.

Housing misalignment is generally caused by incorrect seating on the engine or transmission, loose housing bolts, missing alignment dowels or housing damage. Infrequently, misalignment may also be caused by housing mounting surfaces that are not completely parallel. Misalignment can be corrected with shims.

INSTALLATION METHODS AND PARTS USAGE

Distortion of clutch components during installation and the use of non-standard components are additional causes of clutch malfunction.

Improper clutch cover bolt tightening can distort the cover. The usual result is clutch grab, chatter and rapid wear. Tighten the cover bolts as described in Clutch Service section.

An improperly seated flywheel and/or clutch housing are additional causes of clutch failure. Improper seating will produce misalignment and additional clutch problems.

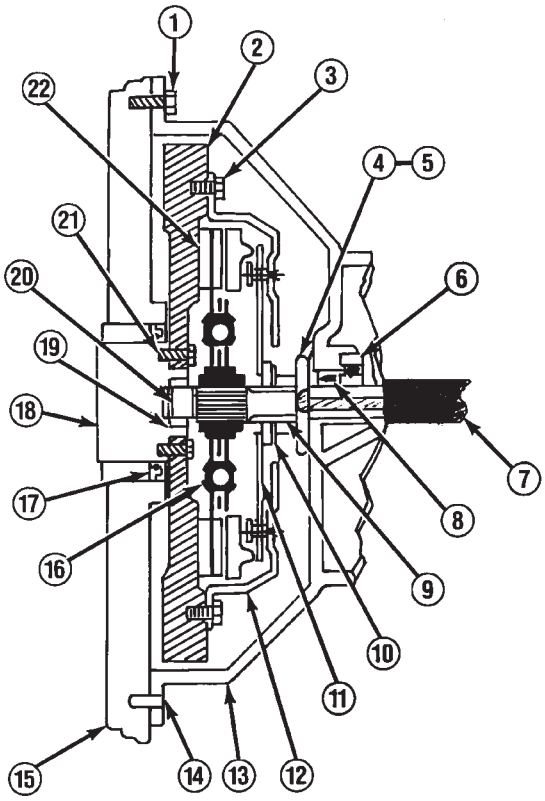
The use of non-standard or low quality parts will also lead to problems and wear. Use recommended factory quality parts to avoid comebacks.

INSPECTION AND DIAGNOSIS CHARTS

The clutch inspection chart (Fig. 1) outlines items to be checked before and during clutch installation. Use the chart as a check list to help avoid overlooking potential problem sources during service operations.

The diagnosis charts describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns.

The charts are provided as a convenient reference when diagnosing faulty clutch operation.



1 Check clutch housing bolts. Tighten if loose. Be sure housing is fully seated on engine block.

2 Check flywheel. Scuff sand face to remove glaze. Clean surface with wax and grease remover. Replace flywheel if severely scored, worn or cracked. Secure flywheel with new bolts (if removed). Do not reuse old bolts. Use Mopar Lock N'Seal on bolts.

3 Tighten clutch cover bolts 2-3 threads at a time, alternately and evenly (in a diagonal pattern) to specified torque. Failure to do so could warp the cover.

4 Check release fork. Replace fork if bent or worn. Make sure pivot and bearing contact surfaces are lubricated.

5 Check release fork pivot (in housing). Be sure pivot is secure and ball end is lubricated.

6 Transmission input shaft bearing will cause noise, chatter, or improper release if damaged. Check condition before installing transmission.

7 Check slave cylinder. Replace it if leaking. Be sure cylinder is properly secured in housing and cylinder piston is seated in release fork.

8 Check input shaft seal if clutch cover and disc were oil covered. Replace seal if worn, or cut.

9 Inspect release bearing slide surface of trans. front bearing retainer. Surface should be smooth, free of nicks, scores. Replace retainer if necessary. Lubricate slide surface before installing release bearing.

10 Do not replace release bearing unless actually faulty. Replace bearing only if seized, noisy, or damaged.

11 Check clutch cover diaphragm spring and release fingers. Replace cover if spring or fingers are bent, warped, broken, cracked. Do not tamper with factory spring setting as clutch problems will result.

12 Check condition of clutch cover. Replace clutch cover if plate surface is deeply scored, warped, worn, or cracked. Be sure cover is correct size and properly aligned on disc and flywheel.

13 Inspect clutch housing. Be sure bolts are tight. Replace housing if damaged.

14 Verify that housing alignment dowels are in position before installing housing.

15 Clean engine block surface before installing clutch housing. Dirt, grime can produce misalignment.

16 Make sure side of clutch disc marked "flywheel side" is toward flywheel.

17 Check rear main seal if clutch disc and cover were oil covered. Replace seal if necessary.

18 Check crankshaft flange (if flywheel is removed). Be sure flange is clean and flywheel bolt threads are in good condition.

19 Check pilot bearing. Replace bearing if damaged. Lube with Mopar high temp. bearing grease before installation.

20 Check transmission input shaft. Disc must slide freely on shaft splines. Lightly grease splines before installation. Replace shaft if splines or pilot bearing hub are damaged.

21 Check flywheel bolt torque. If bolts are loose, replace them. Use Mopar Lock N'Seal to secure new bolts.

22 Check clutch disc facing. Replace disc if facing is charred, scored, flaking off, or worn. Also check runout of new disc. Runout should not exceed 0.5 mm (0.02 in.).

J9406-6

Fig. 1 Clutch Inspection Points

CLUTCH SLIPS

Condition Found	Cause	Correction
1. Disc facing worn out.	a) Normal wear. b) Driver frequently "rides" (slips) clutch. Results in rapid wear overheating. c) Insufficient clutch cover diaphragm spring tension.	Replace clutch disc. Also replace cover if spring is weak or pressure plate surface is damaged.
2. Clutch disc facing contaminated with oil, grease, or clutch fluid.	a) Leak at rear main seal or at transmission input shaft seal. b) Excessive amount of grease applied to input shaft splines. c) Road splash, water entering housing. d) Slave cylinder leaking.	a), b), c), d) Replace leaking seals. Apply less grease to input shaft splines. Replace clutch disc (do not clean and reuse). Clean clutch cover and reuse only if cover is in good condition. Replace slave cylinder if leaking.
3. Clutch is running partially disengaged.	Release bearing sticking–binding. Does not return to normal running position.	Verify that bearing is actually binding, then replace bearing and transmission front bearing retainer if sleeve surface is damaged.
4. Flywheel height incorrect.	Flywheel surface improperly machined. Too much stock removed or surface is tapered.	Replace flywheel.
5. Wrong disc or pressure plate installed.	Incorrect parts order or model number.	Replace with correct parts. Compare old and new parts before installation.
6. Clutch disc, cover and/or diaphragm spring, warped, distorted.	a) Rough handling (impact) bent cover, spring, or disc. b) Incorrect bolt tightening sequence and method caused warped cover.	Install new disc or cover as needed. Follow installation/tightening instructions.
7. Facing on flywheel side of disc torn, gouged, worn.	Flywheel surface scored and nicked.	Reduce scores and nicks by sanding or surface grinding. Replace flywheel if scores–nicks are deeper than .002-.004 inch.
8. Clutch disc facing burnt (charred). Flywheel and cover pressure plate surfaces heavily glazed.	a) Frequent operation under high loads or hard acceleration conditions. b) Driver frequently "rides" (slips) clutch. Results in rapid wear and overheating of disc and cover.	Scuff sand flywheel. Replace clutch cover and disc. Alert driver to problem cause.

J9006-21

IMPROPER CLUTCH RELEASE

Condition Found	Cause	Correction
1. Clutch disc warped.	New disc not checked for axial runout before installation.	Replace disc. Be sure runout of new disc is less than .5 mm (.020 in.).
2. Clutch disc binds on input shaft splines.	a) Clutch disc hub splines damaged during installation. b) Input shaft splines rough, damaged. c) Corrosion, rust formations on splines of disc and input shaft.	Clean, smooth and lubricate disc and shaft spines. Replace disc and/or input shaft if splines are severely damaged.
3. Clutch disc rusted to flywheel and/or pressure plate.	Occurs in vehicles stored, or not driven for extended periods of time. Also occurs after steam cleaning if vehicle is not used for extended period.	Remove clutch cover and disc. Sand rusted surfaces clean with 180 grit paper. Replace disc cover, and flywheel if corrosion is severe.
4. Clutch disc facing sticks to flywheel.	Vacuum may form in pockets over rivet heads in clutch disc. Occurs as clutch cools down after use.	Drill 1/16 inch diameter hole through rivets and scuff sand disc facing with 180 grit paper.
5. Clutch disc too thick.	Wrong disc installed.	Replace disc.
6. Pilot bushing seized or loose.	a) Bushing cocked during installation. b) Bushing defective. c) Bushing not lubricated. d) Clutch misalignment.	a), b), c), d) Lubricate and install new bushing. Check and correct any misalignment.
7. Clutch will not disengage properly.	a) Low clutch fluid level. b) Clutch cover loose. c) Wrong clutch disc. d) Disc bent, distorted during installation. e) Clutch cover diaphragm spring bent or wraped during transmission instalation. f) Clutch disc installed backwards. g) Release fork bent or fork pivot is loose or damaged. h) Clutch master or slave cylinder fault.	a) Top off reservoir and check for leaks. b) Tighten bolts. c) Install correct disc. d) Repalce disc. e) Replace cover. f) Remove and reinstall disc correctly. Be sure disc side marked "to flywheel" is actually toward flywheel. g) Replace fork and pivot if worn or damaged. h) Replace master and slave cylinder as assembly.

J9006-22

CLUTCH GRAB/CHATTER

Condition Found	Cause	Correction
1. Clutch disc facing covered with oil, grease, or clutch fluid.	a) Oil leak at rear main or input shaft seal.	a) Correct leak and replace disc (do not clean and reuse the disc).
	b) Too much grease applied to splines or disc and input shaft.	b) Apply lighter grease coating to splines and replace disc (do not clean and reuse the disc).
2. Clutch disc and/or cover warped, or disc facings exhibit unusual wear or appear to be wrong type.	Incorrect or substandard parts.	Replace disc and/or cover with correct parts.
3. Clutch master or slave cylinder plunger dragging–binding.	a) Master or slave cylinder components worn or corroded.	a) Replace both cylinders as assembly (and reservoir).
4. No fault found with clutch components.	a) Problem actually related to suspension or driveline component.	a) Further diagnosis required. Check engine/transmission mounts, propeller shafts and U-joints, tires, suspension attaching parts and other driveline components as needed.
	b) Engine related problem.	b) Check EFI and igniton systems.
5. Partial engagement of clutch disc (one side worn–opposite side glazed and lightly worn).	a) Clutch pressure plate position setting incorrect or modified.	a) Replace clutch cover and disc.
	b) Clutch cover, spring, or release fingers bent, distorted (rough handling, improper assembly).	b) Replace clutch cover and disc.
	c) Clutch disc damaged or distorted.	c) Replace disc.
	d) Clutch misalignment.	d) Check alignment and runout of flywheel, disc, or cover and/or clutch housing. Correct as necessary.

J9006-23

CLUTCH NOISE

Condition Found	Cause	Correction
1. Clutch components damaged or worn out prematurely.	Incorrect or sub-standard clutch parts.	Replace with parts of correct type and quality.
2. Pilot bearing damaged.	a) Bearing cocked during installation. b) Bearing not lubricated prior to installation. c) Bearing defect. d) Clutch misalignment.	a), b), c) Replace bearing. Be sure it is properly seated and lubricated before installing clutch. d) Check and correct misalignment caused by excessive runout of flywheel, disc, cover or clutch housing. Replace input shaft if bearing hub is damaged.
3. Loose components.	Attaching bolts loose at flywheel, cover, or clutch housing.	Tighten bolts to specified torque. Replace any clutch bolts that are damaged.
4. Components appear overheated. Hub of disc cracked or torsion damper springs are distorted or broken.	Frequent high load, full throttle operation.	Replace parts as needed. Alert driver to condition causes.
5. Contact surface of release bearing damaged.	a) Clutch cover incorrect, or release fingers are bent or distorted causing damage. b) Release bearing defect. c) Release bearing misaligned.	a) Replace clutch cover and bearing. b) Replace bearing. c) Check and correct runout of clutch components. Check front bearing retainer sleeve surface. Replace if damaged.
6. Release bearing is noisy.	Release bearing defect.	Replace bearing.
7. Clutch pedal squeak.	a) Pivot pin loose. b) Pedal bushings worn out or cracked.	Tighten pivot pin. Replace bushings if worn or damaged. Lubricate pin and bushings with silicone base lubricator chassis grease.

J9206-10

CLUTCH SERVICE

INDEX

CLUTCH SAFETY PRECAUTIONS

WARNING: EXERCISE CARE WHEN SERVICING CLUTCH COMPONENTS. DUST AND DIRT ON CLUTCH PARTS USE MAY CONTAIN ASBESTOS FIBERS. 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.

CLUTCH COVER AND DISC REMOVAL

(1) Remove transmission. Refer to procedures in Group 21.

(2) If original clutch cover will be reinstalled, mark position of cover on flywheel for assembly reference. Use paint or a scriber for this purpose.

(3) If clutch cover is to be replaced, cover bolts can be removed in any sequence. However, if original cover will be reinstalled, loosen cover bolts evenly and in rotation to relieve spring tension equally. This is necessary avoid warping cover.

(4) Remove cover bolts and remove cover and disc (Fig. 2).

CLUTCH COVER AND DISC INSTALLATION

(1) Lightly scuff sand flywheel face with 180 grit emery cloth. Then clean surface with a wax and grease remover.

(2) Lubricate pilot bearing with Mopar high temperature bearing grease.

(3) Check runout and free operation of new clutch disc as follows:

(a) Slide disc onto transmission input shaft splines. Disc should slide freely on splines.

(b) Leave disc on shaft and check face runout with dial indicator. Check runout at disc hub and about 6 mm (1/4 in.) from outer edge of facing.

(c) Face runout should not exceed 0.5 mm (0.020 in.). Obtain another clutch disc if runout exceeds this limit.

(4) Position clutch disc on flywheel. Be sure side of disc marked flywheel side is positioned against flywheel (Fig. 2). If disc is not marked, be sure flat side of disc hub is toward flywheel.

(5) Insert clutch alignment tool in clutch disc (Fig. 3).

(6) Insert alignment tool in pilot bearing and position disc on flywheel. Be sure disc hub is positioned correctly. Side of hub marked Flywheel Side should face flywheel (Fig. 2). If disc is not marked, place flat side of disc against flywheel.

(7) Position clutch cover over disc and on flywheel (Fig. 3).

(8) Install clutch cover bolts finger tight.

(9) Tighten cover bolts evenly and in rotation a few threads at a time. **Cover bolts must be tightened evenly and to specified torque to avoid distorting cover. Tightening torques are 31 N·m (23 ft. lbs.) on 2.5L engines and 54 N·m (40 ft. lbs.) on 4.0L engines.**

(10) Apply light coat of Mopar high temperature bearing grease to pilot bearing hub and splines of transmission input shaft. **Do not overlubricate shaft splines. This will result in grease contamination of disc.**

(11) Install transmission (Fig. 4). Refer to procedures in Group 21.

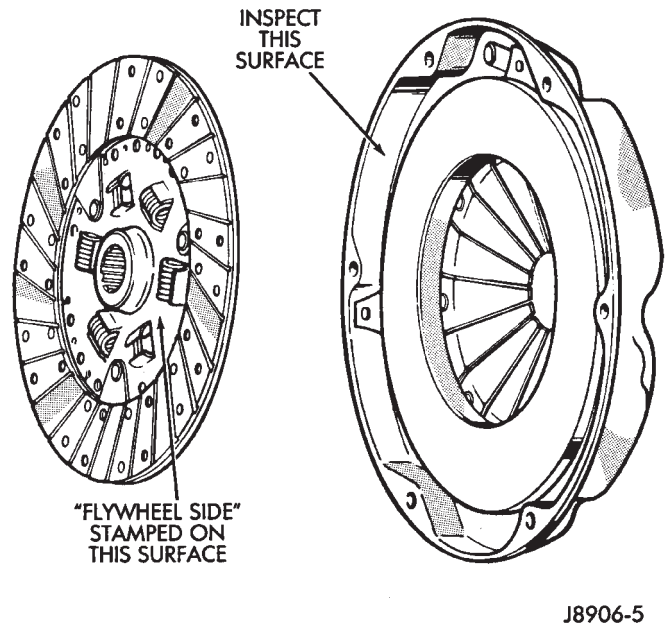


Fig. 2 Clutch Disc Position

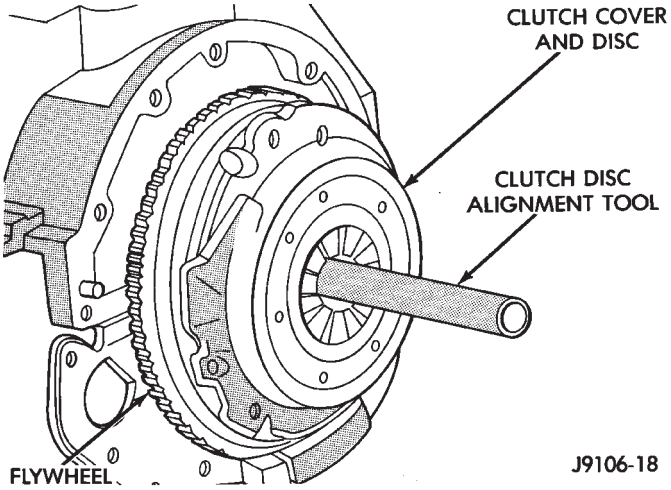


Fig. 3 Typical Method Of Aligning Clutch Disc

RELEASE BEARING REPLACEMENT

(1) Remove transmission as described in Group 21.

(2) Disconnect release bearing from release lever and remove bearing (Fig. 5).

(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 in any way.

(5) Lubricate crankshaft pilot bearing with Mopar high temperature bearing grease. Apply grease to end of long shank, small diameter flat blade screwdriver. Then insert tool through clutch disc hub to reach bearing.

(6) Lubricate input shaft splines, bearing retainer slide surface, fork pivot and release fork pivot surface with Mopar high temperature grease.

(7) Install new release bearing. Be sure bearing is properly secured to release fork.

(8) Install transmission as described in Group 21.

PILOT BEARING REPLACEMENT

(1) Remove transmission. Refer to Group 21 for procedure.

(2) Remove clutch cover and disc.

(3) Remove pilot bearing. Use internal (blind hole) puller such those as supplied in Snap On Tool Set CG40CB to remove bearing.

(4) Lubricate new bearing with Mopar high temperature bearing grease.

(5) Start new bearing into crankshaft by hand. Then seat bearing with clutch alignment tool (Fig. 6).

(6) Lightly scuff sand flywheel surface with 180 grit emery cloth. Then clean surface with wax and grease remover.

(7) Install clutch disc and cover as described in this section.

(8) Install transmission. Refer to Group 21 for procedure.

CLUTCH HOUSING REPLACEMENT

The AX 15 clutch housing is removable and can be replaced when the transmission is out of the vehicle.

The bolts attaching the housing to the transmission case are located inside the housing (Fig. 7). Recommended tightening torque for the clutch housing-to-transmission bolts is 38 N·m (28 ft. lbs.).

Be sure the transmission and housing mating surfaces are clean before installing an original, or replacement clutch housing. Dirt/foreign material trapped between the housing and transmission will cause misalignment. If misalignment is severe enough, the result will be clutch drag, incomplete release and hard shifting.

CLUTCH HYDRAULIC LINKAGE REMOVAL

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. Also note that removal/installation procedures for right and left hand drive models are basically the same. Only master cylinder location is different.

(1) Raise vehicle.

(2) Remove fasteners attaching slave cylinder to clutch housing.

(3) Remove slave cylinder from clutch housing (Fig. 8).

(4) Disengage clutch fluid line from body clips.

(5) Lower vehicle.

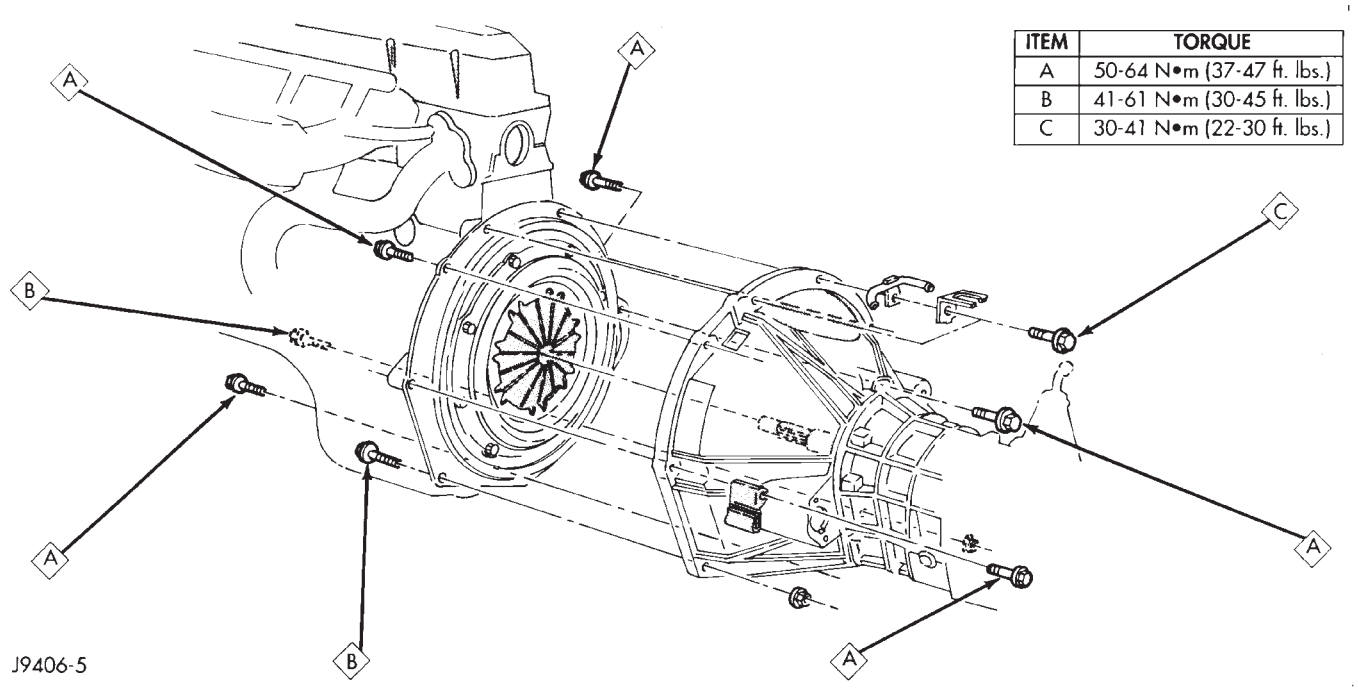


Fig. 4 Manual Transmission Mounting

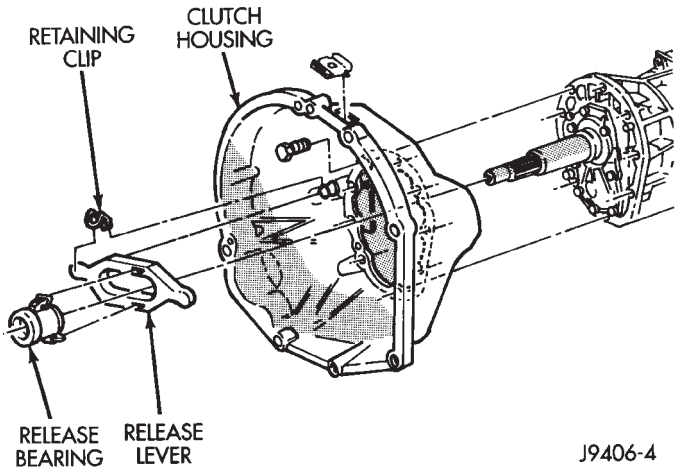


Fig. 5 Release Bearing Attachment

(6) Verify that cap on clutch master cylinder reservoir is tight. This is necessary to avoid undue spillage during removal.

(7) Remove clutch master cylinder attaching nuts. Note that one nut is accessible from engine compartment and one nut is accessible from under instrument panel (Figs. 9 and 10).

(8) Remove clip securing clutch master cylinder push rod to pedal and slide push rod off pedal pin.

(9) If pedal pin is equipped with bushing, inspect condition of bushing and replace it if worn or damaged.

(10) Remove clutch hydraulic linkage through engine compartment.

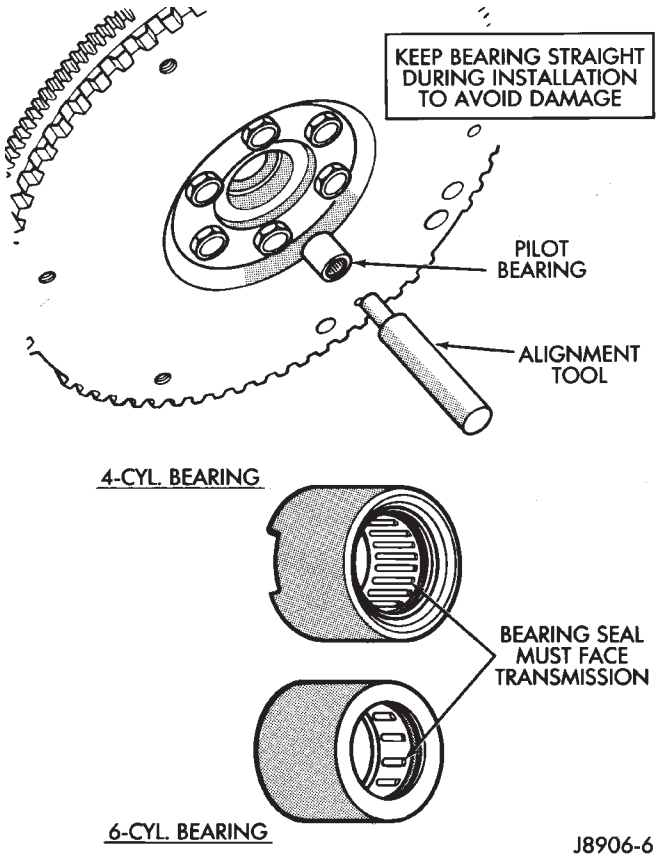
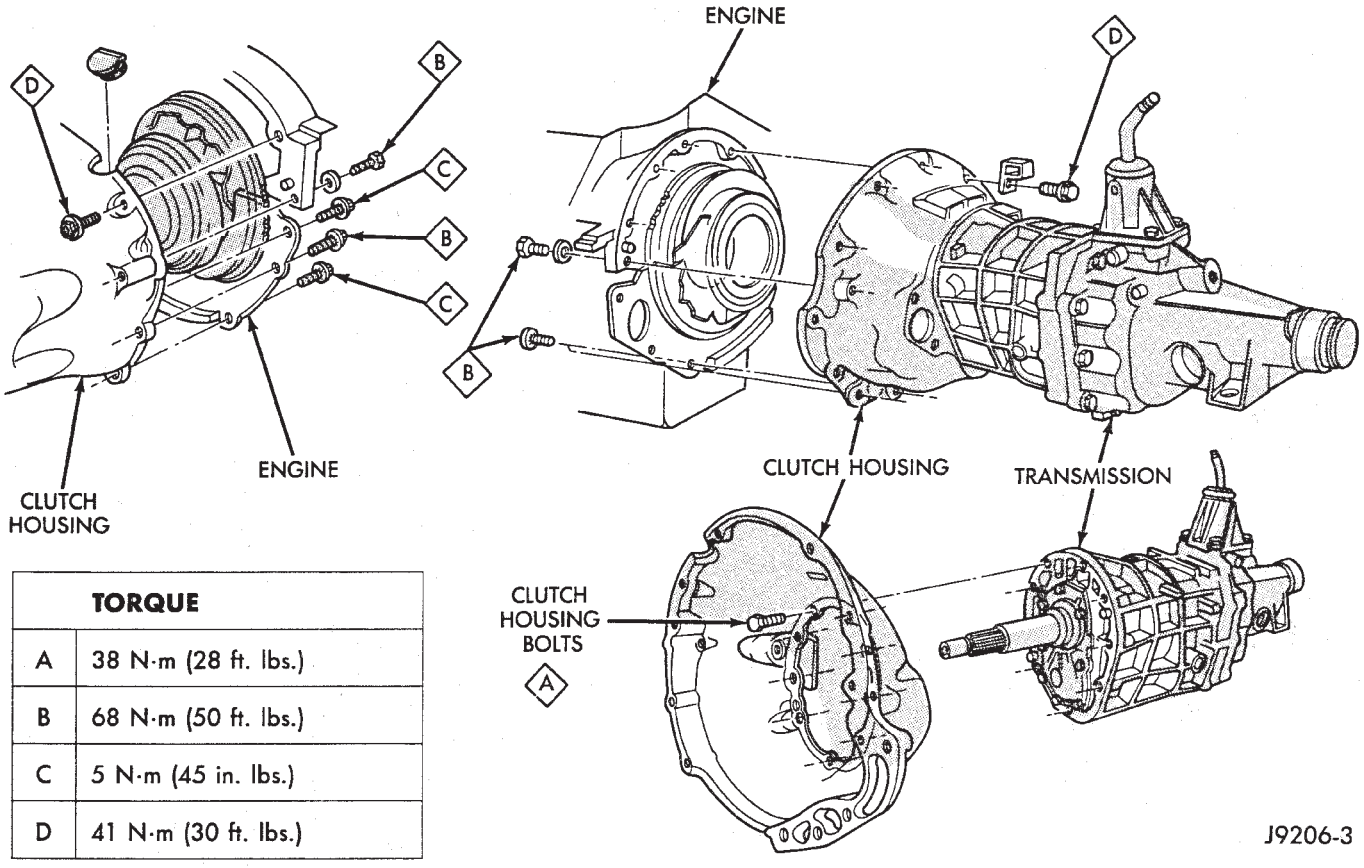


Fig. 6 Pilot Bearing Installation

CLUTCH HYDRAULIC LINKAGE INSTALLATION

(1) Be sure reservoir cover on clutch master cylinder is tight to avoid spills.



TORQUE	
A	38 N·m (28 ft. lbs.)
B	68 N·m (50 ft. lbs.)
C	5 N·m (45 in. lbs.)
D	41 N·m (30 ft. lbs.)

Fig. 7 Clutch Housing Attachment

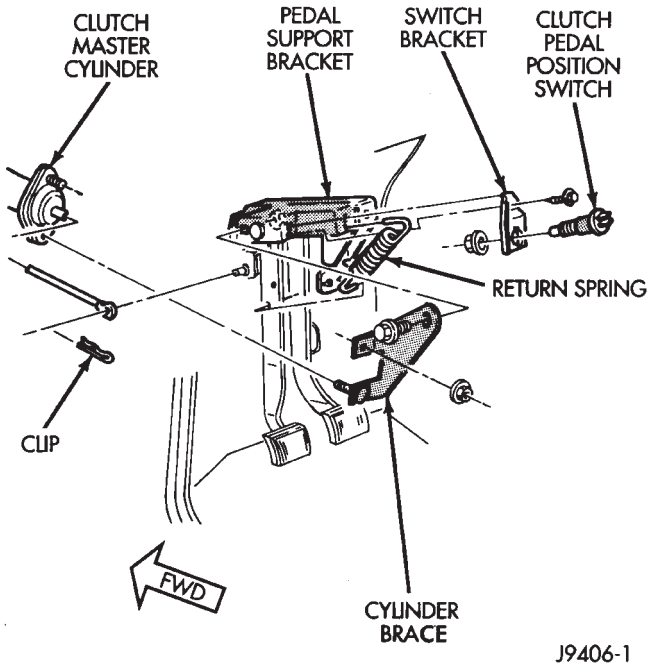


Fig. 8 Slave Cylinder Attachment

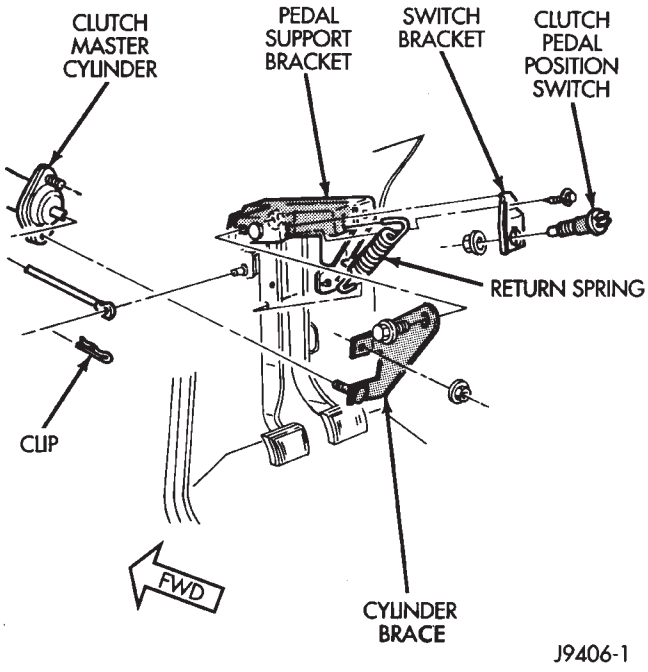


Fig. 9 Clutch Master Cylinder And Push Rod Attachment (Left Hand Drive Models)

(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 (Fig. 11).

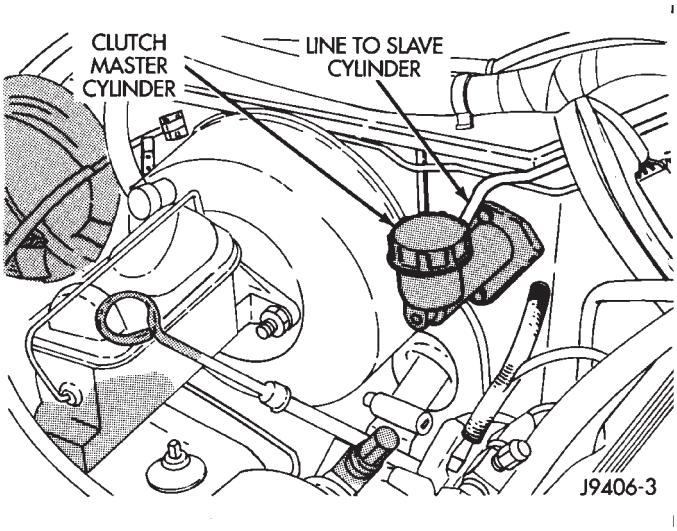


Fig. 10 Clutch Master Cylinder Location (Right Hand Drive Models)

(4) Attach clutch master cylinder push rod to pin on clutch pedal. Secure rod with new clip if necessary.

(5) Install and tighten clutch master cylinder attaching nuts to 23-34 N·m (200-300 in. lbs.) torque.

(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 23-34 N·m (200-300 in. lbs.) torque.

(9) Secure clutch fluid line in body clips and lower vehicle.

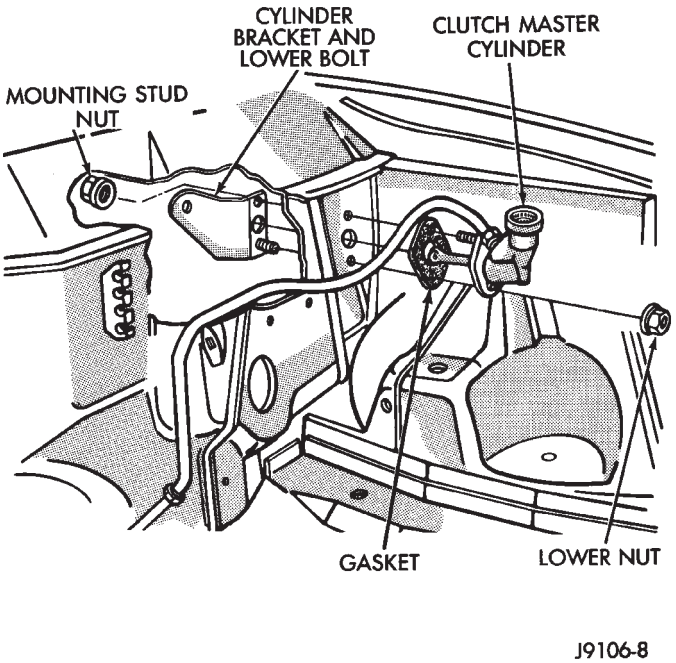


Fig. 11 Clutch Master Cylinder Mounting (Typical)

CLUTCH FLUID LEVEL

The clutch fluid reservoir, master cylinder, slave cylinder and fluid lines are prefilled with fluid at the factory during assembly operations.

The hydraulic system should not require additional fluid under normal circumstances. In fact, **the reservoir fluid level will actually increase as normal clutch wear occurs. For this reason, it is important to avoid overfilling, or removing fluid from the reservoir.**

If inspection or diagnosis indicates additional fluid may be needed, use Mopar brake fluid, or an equivalent meeting standards SAE J1703 and DOT 3. Do not use any other type of fluid.

Clutch fluid level is checked at the master cylinder reservoir (Fig. 12). An indicator ring is provided either on the side, or interior rim of the reservoir (Fig. 13).

Be sure to wipe the reservoir and cover clean before removing the cover. This will avoid having dirt or foreign material fall into the reservoir during a fluid level check.

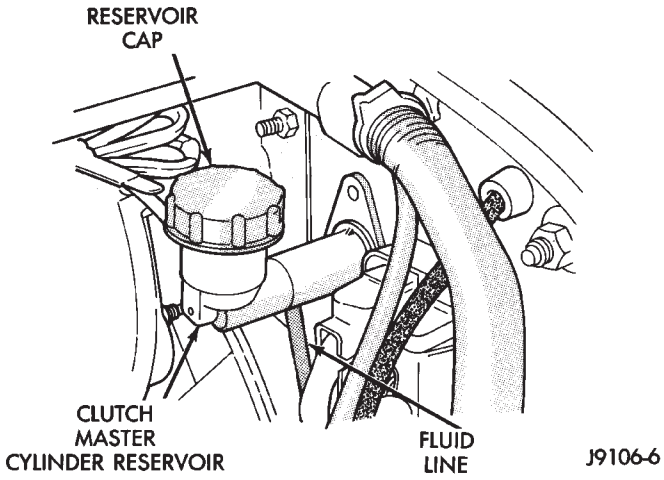


Fig. 12 Clutch Master Cylinder Reservoir And Cap

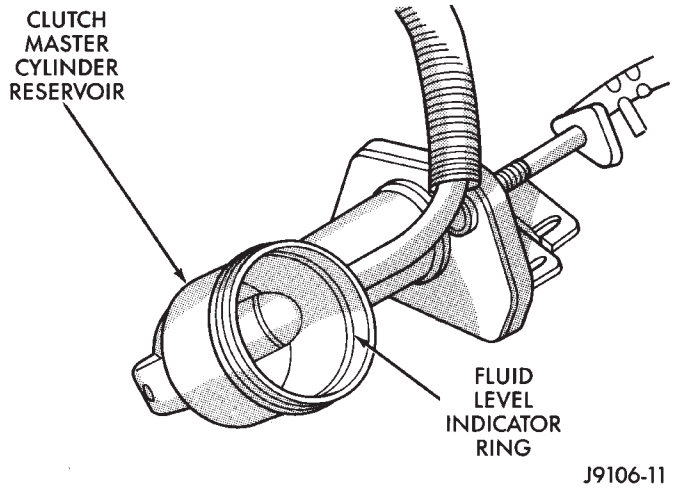
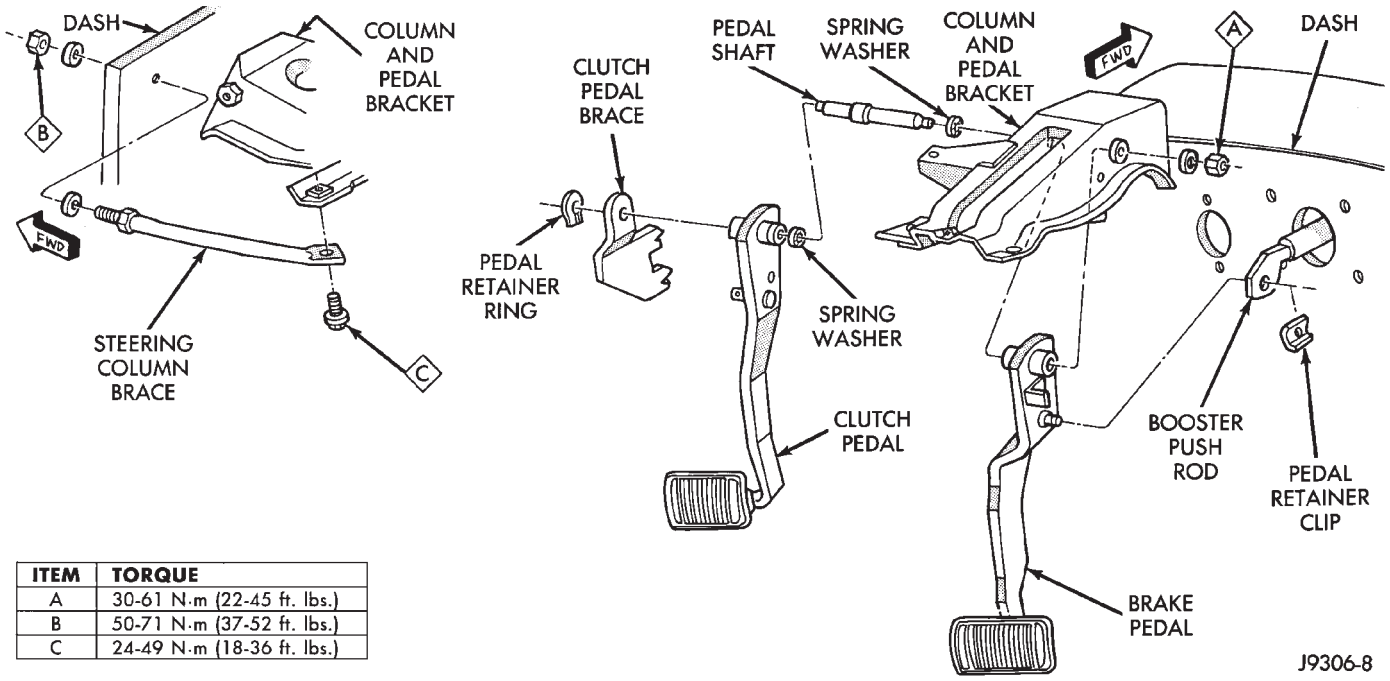


Fig. 13 Reservoir Fluid Level Indicator Ring



ITEM	TORQUE
A	30-61 N·m (22-45 ft. lbs.)
B	50-71 N·m (37-52 ft. lbs.)
C	24-49 N·m (18-36 ft. lbs.)

Fig. 14 Clutch Pedal Mounting (YJ)

CLUTCH PEDAL REMOVAL

(1) Remove instrument panel lower trim cover for extra working clearance.

(2) Remove retainer clip and washers that attach clutch master cylinder push rod to pedal.

(3) On YJ, remove retaining ring securing pedal to pivot shaft (Fig. 14). On XJ, remove nut securing pedal to pivot shaft (Fig. 15).

(4) Move pedal pivot shaft to right and slide pedal off shaft.

CLUTCH PEDAL INSTALLATION

(1) Lubricate clutch pedal pivot shaft and pedal bushings or sleeve with Mopar multi-mileage grease.

(2) Position pedal on pivot shaft and through brace. Secure pedal with washer and retaining ring on YJ, or with washer and nut on XJ.

(3) Install clutch master cylinder push rod on pedal. Secure rod with washer(s) and new cotter pin.

(4) Install instrument panel lower trim cover, if removed.

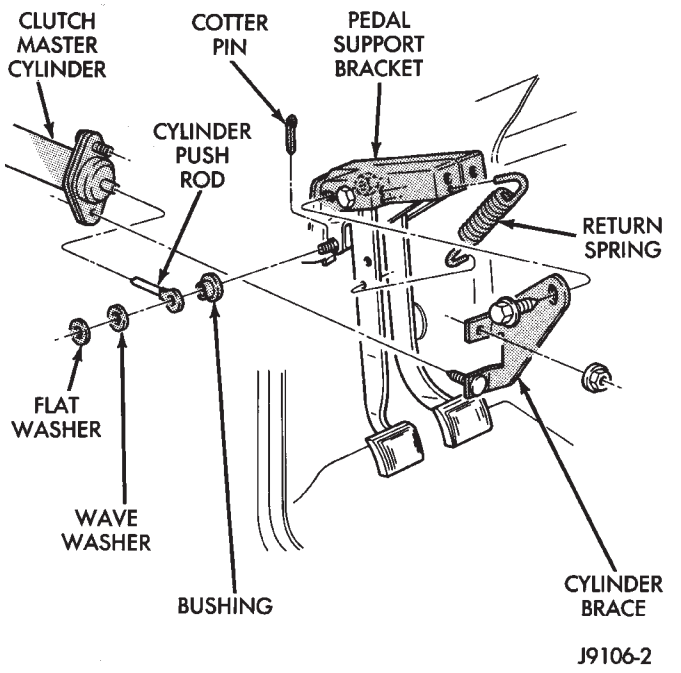


Fig. 15 Clutch Pedal Mounting (XJ)

FLYWHEEL SERVICE

Inspect the flywheel whenever the clutch disc, cover and housing are removed for service. Check condition of the flywheel face, hub, ring gear teeth, and flywheel bolts.

Minor scratches, burrs, or glazing on the flywheel face can be reduced with 180 grit emery cloth. However, the flywheel should be replaced if the disc contact surface is severely scored, heat checked, cracked, or obviously worn.

Flywheel machining is not recommended. The flywheel surface is manufactured with a unique contour that would be negated by machining. However, cleanup of minor flywheel scoring can be performed by hand with 180 grit emery, or with surface grinding equipment. Replace the flywheel if scoring is deeper than 0.0762 mm (0.003 in.).

Heavy stock removal by grinding is **not recommended.** Excessive stock removal can result in flywheel cracking or warpage after installation. It can also weaken the flywheel and interfere with proper clutch release.

Check flywheel runout if misalignment is suspected. 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 dial indicator on a stud installed in place of one of the flywheel attaching bolts.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout.

Check condition of the flywheel hub and attaching bolts. Replace the flywheel if the hub exhibits cracks in the area of the attaching bolt holes.

Install new attaching bolts whenever the flywheel is replaced and use Mopar Lock N' Seal, or Loctite 242 on the replacement bolt threads.

Recommended flywheel bolt torques are:

- 142 N·m (105 ft. lbs.) for 6-cylinder flywheels
- 68 N·m (50 ft. lbs.) plus an additional turn of 60° for 4-cylinder flywheels

Inspect the teeth on the starter ring gear. **If the teeth are worn or damaged, the flywheel should be replaced as an assembly. This is the recommended and preferred method of repair.**

In cases where a new flywheel is not readily available, a replacement ring gear can be installed. However, the following precautions must be observed to avoid damaging the flywheel and replacement gear.

(a) Mark position of the old gear for alignment reference on the flywheel. Use a scriber for this purpose.

(b) Wear protective goggles or approved safety glasses. Also wear heat resistent gloves when handling a heated ring gear.

(c) Remove the old gear by cutting most of the way through it (at one point) with an abrasive cutoff wheel. Then complete removal with a cold chisel or punch.

(d) The ring gear is a shrink fit on the flywheel. This means the gear must be expanded by heating in order to install it. **The method of heating and expanding the gear is extremely important.** Every surface of the gear must be heated at the same time to produce uniform expansion. An oven or similar enclosed heating device must be used. Temperature required for uniform expansion is approximately 375° F.

CAUTION: Do not use an oxy/acetylene torch to remove the old gear, or to heat and expand a new gear. The high temperature of the torch flame can cause localized heating that will damage the flywheel. In addition, using the torch to heat a replacement gear will cause uneven heating and expansion. The torch flame can also anneal the gear teeth resulting in rapid wear and damage after installation.

(e) The heated gear must be installed evenly to avoid misalignment or distortion. A shop press and suitable press plates should be used to install the gear if at all possible.

(f) Be sure to wear eye and hand protection. Heat resistent gloves and safety goggles are needed for personal safety. Also use metal tongs, vise grips, or similar tools to position the gear as necessary for installation.

(g) Allow the flywheel and ring gear to cool down before installation. Set the assembly on a workbench and let it cool in normal shop air.

CAUTION: Do not use water, or compressed air to cool the flywheel. The rapid cooling produced by water or compressed air can distort, or crack the gear and flywheel.

TORQUE SPECIFICATIONS

Component	Foot Pounds	N·m	Inch Pounds	N·m
Clutch Cover Bolts:				
4-Cylinder	23	31		
6-Cylinder	40	54		
Concentric Bearing Fluid Fitting			132	15
Clutch Cylinder Mounting Bolts/Nuts	19	26		
Clutch Cylinder Hydraulic Line Fitting:				
4-Cylinder			132	15
6-Cylinder			190	21
Clutch Housing-to-Engine Bolts:				
M12 x 1.75	55	75		
3/8-16	27	37		
7/16-14	43	58		
Clutch Housing Cover (4-Cylinder):				
Upper Bolt	16	22		
Lower Bolt	55	75		
Clutch Housing-to-Transmission Bolt:				
AX 15	28	38		
AX 5	28	38		
Starter Motor Dowel Bolt	33	45		
U-Joint Clamp Bolts			170	19
Rear Support-to-Crossmember Bolt	33	45		
Crossmember-to-Frame Rail Bolt	30	41		

COOLING SYSTEM

CONTENTS

GENERAL INFORMATION

Throughout this group, references are made to particular vehicle models by alphabetical designation (XJ or YJ) or by the particular vehicle nameplate. A chart showing a breakdown of alphabetical designations is included in the Introduction section at the beginning of this manual.

COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible, 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.

An optional factory installed heavy duty cooling package is available on most models. The package consists of a radiator that has an increased number of cooling fins. XJ models equipped with a 4.0L 6 cylinder engine and heavy duty cooling and/or air conditioning also have an auxiliary electric cooling fan.

COOLING SYSTEM COMPONENTS

The cooling system consists of:

- A radiator
- Cooling fan (mechanical and/or electrical)
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler (if equipped with an automatic transmission)
- Coolant
- Water pump
- Hoses and hose clamps

SYSTEM COOLANT ROUTING

For cooling system flow routings, refer to Figs. 1, 2, 3 or 4.

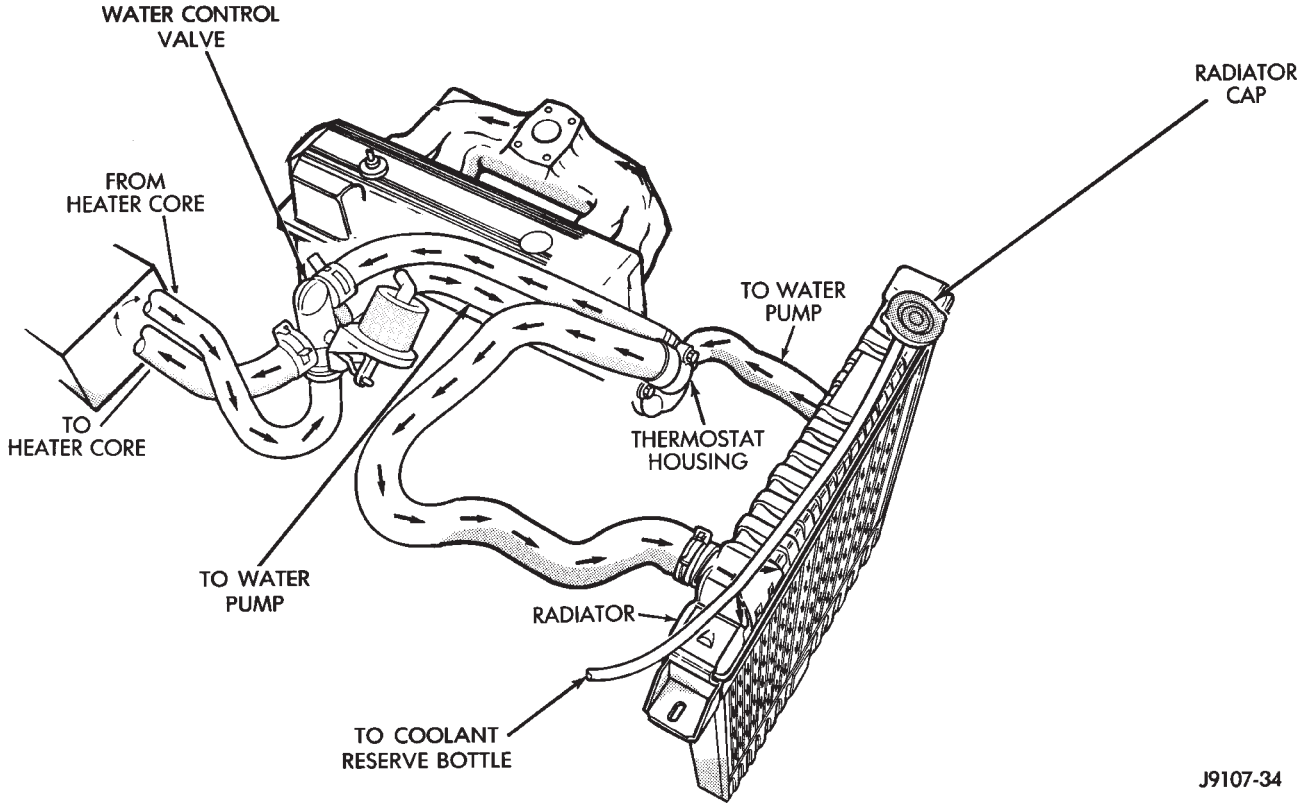


Fig. 1 Coolant Flow—XJ Models with 2.5L Engine—Typical

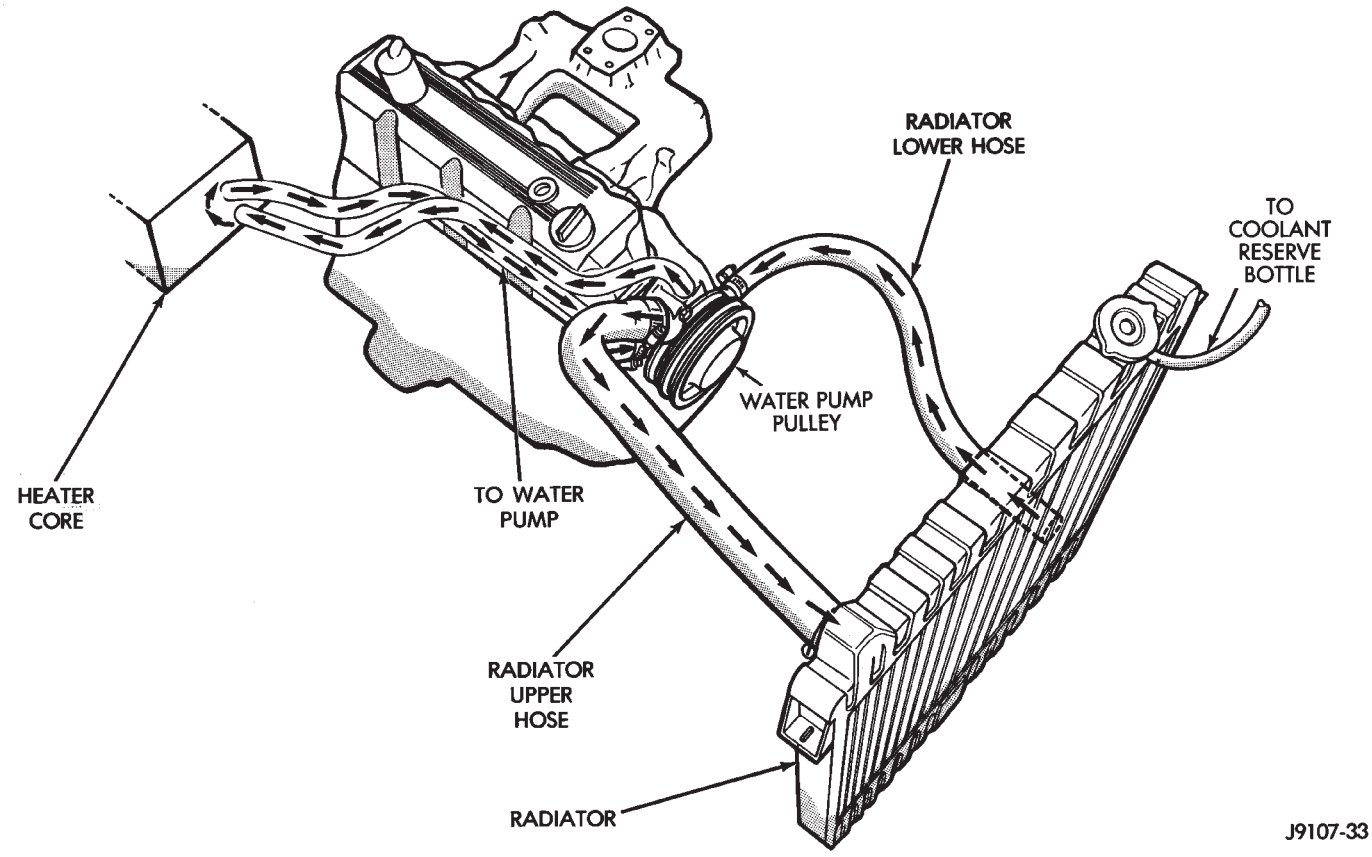


Fig. 2 Coolant Flow—YJ Models with 2.5L Engine—Typical

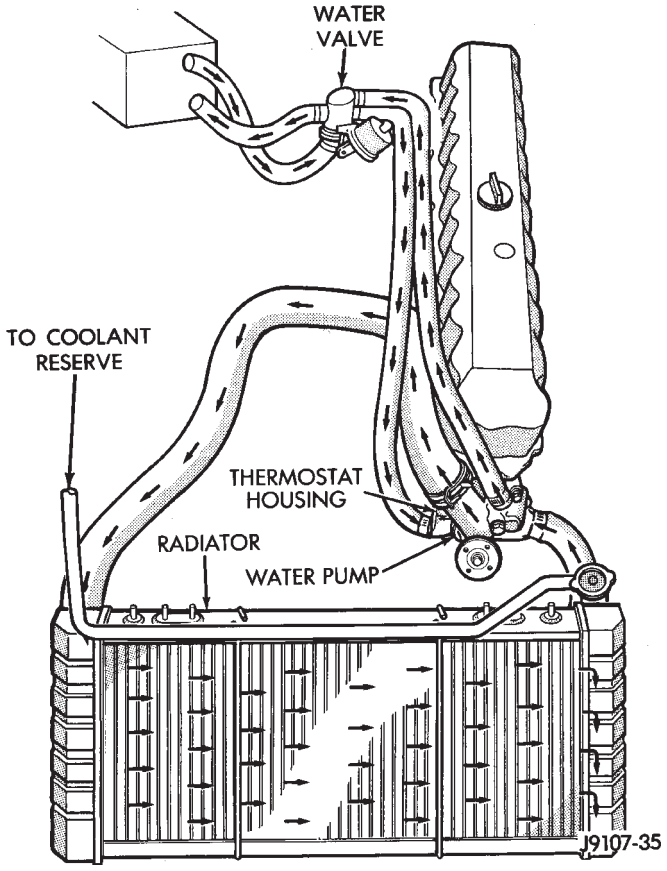


Fig. 3 Coolant Flow—XJ Models with 4.0L Engine—Typical

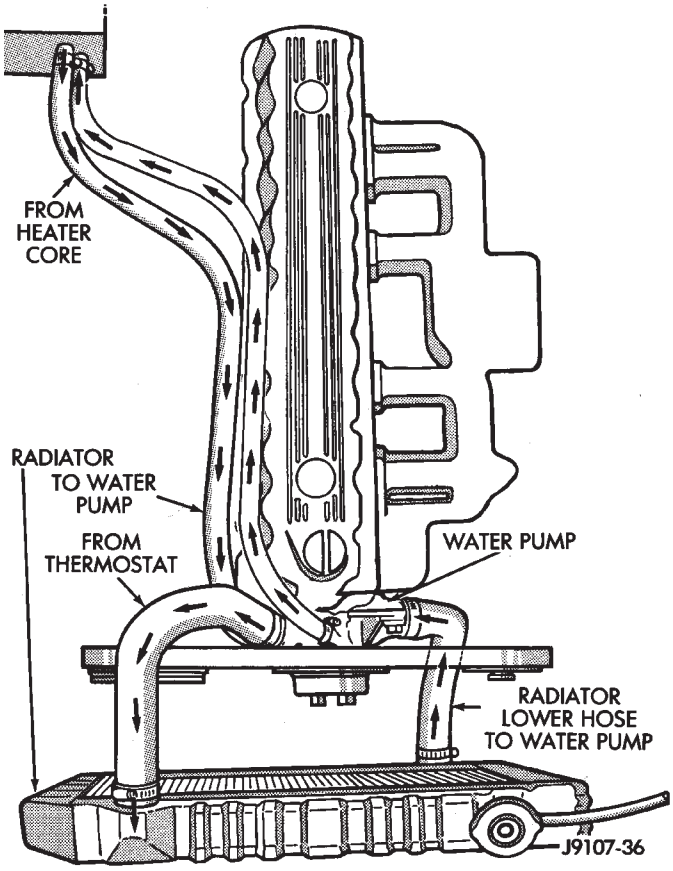


Fig. 4 Coolant Flow—YJ Models with 4.0L Engine—Typical

DIAGNOSIS

INDEX

ON-BOARD DIAGNOSTICS (OBD)

FOR COOLING SYSTEM COMPONENTS

The powertrain control module (PCM) has been programmed to monitor the certain following cooling system components:

- If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) number 17 can be observed at the Check Engine Lamp.
- If an open or shorted condition has developed in the relay circuit controlling the electric radiator fan, a Diagnostic Trouble Code (DTC) number 35 can be observed at the Check Engine Lamp.

If the problem is sensed in a monitored circuit often enough to indicate an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. If the problem is repaired or ceases to exist, the PCM cancels the DTC after 51 engine starts.

Certain criteria must be met for a DTC to be entered into PCM memory. The criteria may be a specific range of engine rpm, engine temperature and/or input voltage to the PCM.

A DTC indicates that the PCM has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

It is possible that a DTC for a monitored circuit may not be entered into memory even though a malfunction has occurred. Refer to On-Board Diagnostics (OBD) in Group 14, Fuel Systems for additional information.

ACCESSING DIAGNOSTIC TROUBLE CODES

A stored Diagnostic Trouble Code (DTC) can be displayed by cycling the ignition key On-Off-On-Off-On within three seconds and observing the Malfunction Indicator Lamp. This lamp was formerly referred to as the Check Engine Lamp. The lamp is located on the instrument panel.

They can also be displayed through the use of the Diagnostic Readout Box (DRB) scan tool. The DRB connects to the data link connector in the engine compartment (Figs. 5 or 6). For operation of the DRB, refer to the appropriate Powertrain Diagnostic Procedures service manual.

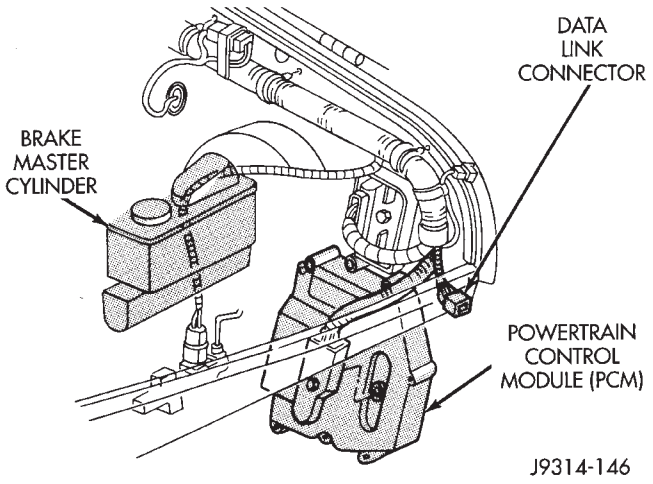


Fig. 5 Data Link Connector—YJ Models—Typical

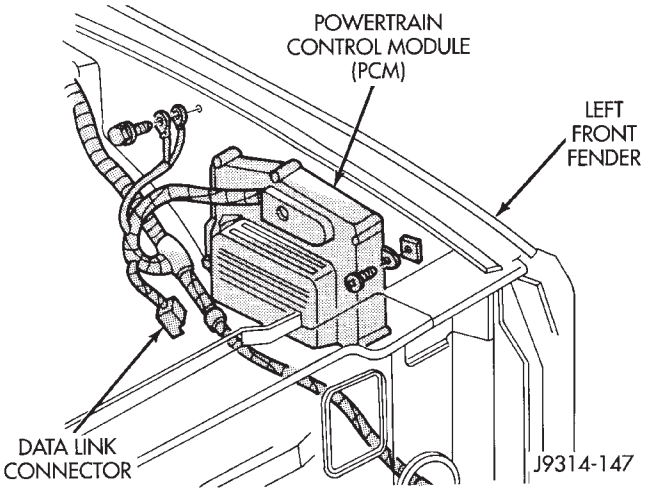


Fig. 6 Data Link Connector—XJ Models—Typical

EXAMPLES:

- If the lamp flashes 1 time, pauses and flashes 7 more times, a flashing Diagnostic Trouble Code (DTC) number 17 is indicated.
- If the lamp flashes 3 times, pauses and flashes 5 more times, a flashing Diagnostic Trouble Code (DTC) number 35 is indicated.

After any stored DTC information has been observed, the display will end with a flashing DTC number 55. This will indicate the end of all stored information.

ERASING TROUBLE CODES

After the problem has been repaired, the DRB scan tool must be used to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause.

1. PROLONGED IDLE, VERY HIGH AMBIENT TEMPERATURE, SLIGHT TAIL WIND AT IDLE, SLOW TRAFFIC, TRAFFIC JAMS, HIGH SPEED, OR STEEP GRADES:

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed for more air flow is recommended.

2. TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

3. AIR CONDITIONING; ADD-ON OR AFTER MARKET:

A maximum cooling package should have been ordered with vehicle if add-on or after market A/C is installed. If not, maximum cooling system components should be installed for model involved per manufacturer's specifications.

4. RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect cooling system. This may be:

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts (incorrect water pump rotating in wrong direction)
- Reconditioned radiator or cooling system refilling (possibly under-filled or air trapped in system).

If investigation reveals none of the above as a cause for engine overheating complaint, refer to following Symptom and Action chart.

SYMPTOM AND ACTION—SEE PRELIMINARY CHECKS FIRST

Symptom	Action
Blinking Engine Temperature Warning Light Or High Gauge Indication-Without Coolant Loss	Normal with temporary operation with heavy load, towing a trailer, high outdoor temperatures, and/or on a steep grade.
Coolant Loss	Improper refilling procedures can result in trapped air in the system. Subsequent operation of the pressure cap and coolant reserve system will deaereate the cooling system. A low coolant level will then result in the coolant reserve tank. Add coolant. If condition persists, see System Diagnosis.
Hot Vehicle (Not Engine): **Heat Damage,** **Hot Carpet, Seat,** **Hot Catalytic Converter,** **Smoke, Burnt Odor**	Check heat shielding, exhaust system, engine emission controls, ignition timing, engine misfiring.
Hot Engine: **Crackling Noise** **Hot Smell** **Severe Local Hot Spots**	A moderate amount of sound from heating metal can be expected with any vehicle. However, a crackling sound from the thermostat housing, a hot smell and/or severe local hot spots on an engine can indicate; blocked coolant passages, bad casting, core sand deposits and subsequent blockage, cracked cylinder block or head, or blown cylinder head gasket.
Coolant Reserve/ Overflow Tank Level Changes	Level changes are to be expected as coolant volume fluctuates with engine temperature. During operation at higher temperatures and/or under heavy loads, the coolant level in the reserve tank may increase above the FULL level indicated on the bottle. If the level in the tank is between the ADD and FULL marks when the engine is at normal operating temperature, the level should return to within that range when the engine returns to normal operating conditions.
Coolant Not Returning To Radiator	Coolant will not return to the radiator if the radiator cap vent valve does not function, if an air leak destroys vacuum, or if the overflow passage is blocked or restricted. Inspect all portions of the overflow passage, pressure cap, filler neck nipple, hose, and passages within the tank for vacuum leak only. Coolant return failure will be evident by a low level in the radiator. Reserve tank level should increase during heat-up.
4.0L Engine Only (XJ models): Electric Auxiliary Cooling Fan	The Fan will run when the air conditioning compressor is engaged regardless of coolant temperature. If fan runs when compressor is not engaged, and coolant temperature in the radiator outlet tank is below 88°C (190°F), Consult Group 8, Electrical Section.

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SYSTEM DIAGNOSIS

Condition	Possible Cause	Correction
NOISE	(1) Fan contacting shroud.	(1) Reposition shroud and inspect engine mounts.
	(2) Loose water pump impeller.	(2) Replace pump.
	(3) Glazed fan belt.	(3) Replace belt.
	(4) Loose fan belt.	(4) Adjust fan belt tension.
	(5) Rough surface on drive pulley.	(5) Replace pulley.
	(6) Water pump bearing worn.	(6) Remove belt to isolate. Replace pump.
	(7) Belt alignment.	(7) Check pulley alignment. Repair as necessary.
COOLANT LOSS— BOILOVER	**Refer to Overheating Causes in addition to the following items.**	
	(1) Overfilled cooling system.	(1) Reduce coolant level to proper specification.
	(2) Quick shutdown after hard (hot) run.	(2) Allow engine to run at fast idle prior to shutdown.
	(3) Air in system, resulting in occasional "burping" of coolant.	(3) Purge system.
	(4) Insufficient antifreeze, allowing coolant boiling point to be too low.	(4) Add antifreeze to raise boiling point.
	(5) Antifreeze deteriorated because of age of contamination.	(5) Replace coolant.
	(6) Leaks due to loose hose clamps, loose nuts, bolts, drain plugs, faulty hoses, or defective radiator.	(6) Pressure test system to locate source of leak(s), then repair as necessary.
	(7) Faulty head gasket.	(7) Replace head gasket.
	(8) Cracked head, manifold, or block.	(8) Replace as necessary.
	(9) Faulty radiator cap.	(9) Replace cap.
COOLANT ENTRY INTO CRANKCASE OR CYLINDER(S)	(1) Low cylinder head bolt torque.	(1) Replace gasket, retorque head.
	(2) Faulty head gasket.	(2) Replace head gasket.
	(3) Crack in head, manifold or block.	(3) Replace as necessary.
COOLANT RESERVE SYSTEM INOPERATIVE	(1) Coolant level low.	(1) Replenish coolant to FULL mark.
	(2) Leak in system.	(2) Pressure test to isolate leak and repair as necessary.
	(3) Overflow tube clogged or leaking.	(3) Repair as necessary.
	(4) Recovery bottle vent restricted.	(4) Remove restriction.
LOW TEMPERATURE GAUGE INDICATION — UNDERCOOLING	(1) Thermostat stuck open.	(1) Replace thermostat.
	(2) Faulty gauge or sending unit.	(2) Repair or replace faulty component.

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SYSTEM DIAGNOSIS (CONT.)

Condition	Possible Cause	Correction
HIGH TEMPERATURE GAUGE INDICATION — OVERHEATING	(1) Coolant level low.	(1) Replenish coolant.
	(2) Fan belt loose.	(2) Adjust fan belt tension.
	(3) Radiator hose(s) collapsed.	(3) Replace hose(s).
	(4) Radiator airflow blocked.	(4) Remove restriction (bug screen, fog lamps, etc.).
	(5) Faulty coolant expansion bottle cap.	(5) Replace coolant expansion bottle cap.
	(6) Air trapped in cooling system.	(6) Purge air.
	(7) Heavy-traffic driving.	(7) Operate at fast idle in neutral intermittently to cool engine.
	(8) Incorrect cooling system component(s) installed.	(8) Install proper component(s).
	(9) Faulty thermostat.	(9) Replace thermostat.
	(10) Water pump shaft broken or impeller loose.	(10) Replace water pump.
	(11) Radiator tubes clogged.	(11) Flush radiator.
	(12) Cooling system clogged.	(12) Flush system.
	(13) Casting flash in cooling passages.	(13) Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs.
	(14) Brakes dragging.	(14) Repair brakes.
	(15) Excessive engine friction.	(15) Repair engine.
	(16) Antifreeze concentration over 68%.	(16) Lower antifreeze concentration percentage.
	(17) Faulty gauge or sending unit.	(17) Repair or replace faulty component.
	(18) Loss of coolant flow caused by leakage or foaming.	(18) Repair or replace leaking component, replace coolant.
	(19) Faulty cooling fan operation.	(19) Check cooling fan operation.
NO COOLANT FLOW THROUGH HEATER CORE	(1) Restricted return inlet in water pump.	(1) Remove restriction.
	(2) Heater hose collapsed or restricted.	(2) Remove restriction or replace hose.
	(3) Restricted heater core.	(3) Remove restriction or replace core.
	(4) Restricted outlet in thermostat housing.	(4) Remove flash or restriction.
	(5) Intake manifold bypass hole in cylinder head restricted.	(5) Remove restriction.
	(6) Intake manifold coolant passage restricted.	(6) Remove restriction or replace intake manifold.
	(7) Heater valve controls not functioning.	(7) Repair controls (see Heating and Air Conditioning Group 24).
	(8) Heater valve stuck in closed position.	(8) Repair or replace as necessary.

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SERVICE PROCEDURES

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WATER PUMPS—GENERAL INFORMATION

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a drive belt on all engines.

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has a small hole to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

CAUTION: All engines are equipped with a reverse (counter-clockwise) rotating water pump and viscous fan drive assembly. REVERSE is stamped or imprinted on the cover of the viscous fan drive and inner side of the fan. The letter R is stamped into the back of the water pump impeller (Fig. 1).

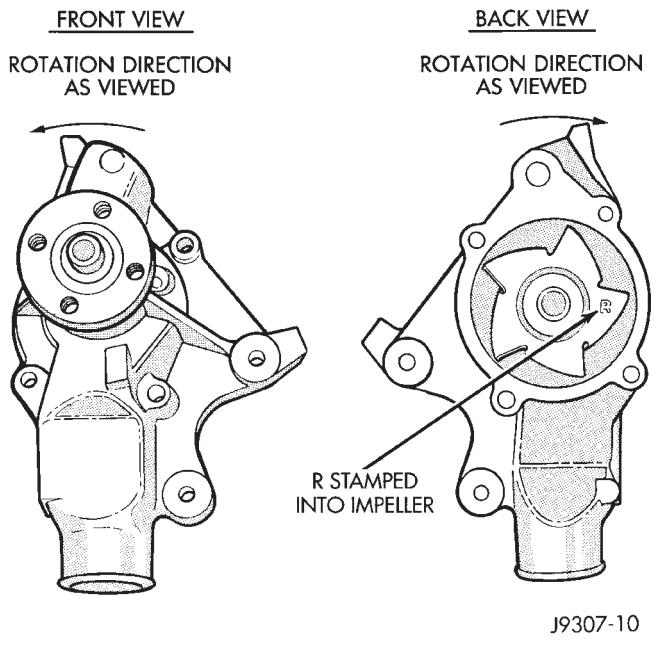

Fig. 1 Reverse Rotating Water Pump—Typical

Engines from previous model years, depending upon application, may have been equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine overheating.

A quick test to determine if the pump is working is to check if the heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

WATER PUMP TESTS

LOOSE IMPELLER

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Drain the cooling system.
(2) Loosen the fan belt(s).
(3) Disconnect the lower radiator hose from the water pump.
(4) Bend a stiff clothes hanger or welding rod as shown in (Fig. 2).
(5) Position the rod in the water pump inlet and attempt to hold the impeller while turning the fan blades. If equipped with a viscous fan drive, turn the water pump shaft with a breaker bar and socket attached to a mounting flange nut. If the impeller is loose and can be held with the rod while the fan blades are turning, the pump is defective. If the impeller turns, the pump is OK.

Connect the hose and install the coolant, or proceed with repairs.

INSPECTING FOR INLET RESTRICTIONS

Inadequate heater performance may be caused by a metal casting restriction in the water pump heater hose inlet.

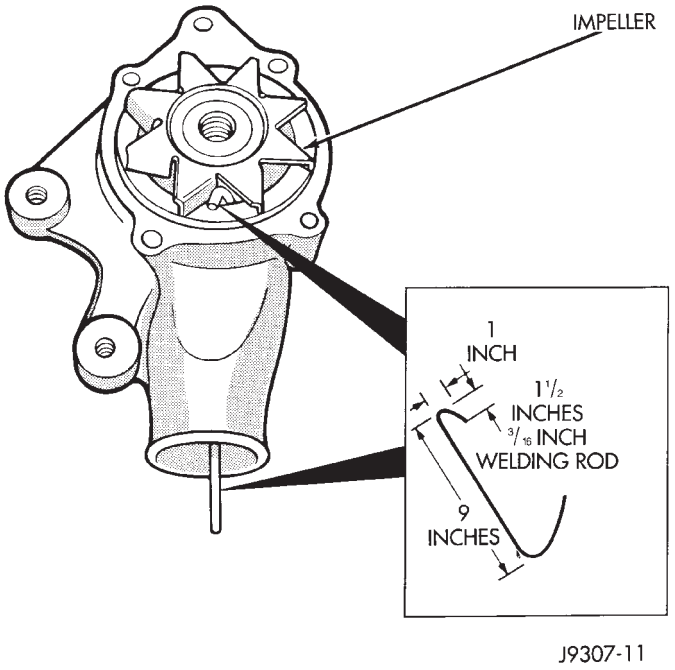

Fig. 2 Impeller Test—Typical

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Drain sufficient coolant from the radiator to decrease the level below the water pump heater hose inlet.

(2) Remove the heater hose.

(3) Inspect the inlet for metal casting flash or other restrictions.

Remove the pump from engine before removing restriction to prevent contamination of the coolant with debris. Refer to Water Pump Removal.

WATER PUMPS—REMOVAL/INSTALLATION

REMOVAL—ALL MODELS

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

CAUTION: All engines have a reverse (counterclockwise) rotating water pump. The letter R is stamped into the back of the water pump impeller (Fig. 1) to identify. Engines from previous model years, depending upon application, may be equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine over heating.

The water pump impeller is pressed on the rear of the pump shaft and bearing assembly. The water pump is serviced only as a complete assembly.

WARNING: DO NOT REMOVE THE BLOCK DRAIN PLUG(S) OR LOOSEN RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain coolant into a clean container for reuse.

(1) Disconnect negative battery cable at battery.

(2) Drain the cooling system. Refer to Draining Cooling System in this group.

(3) **XJ models with 4.0L engine equipped with A/C or heavy duty cooling system:**

Loosen (but do not remove at this time) the four water pump pulley-to-water pump hub mounting bolts (Fig. 3).

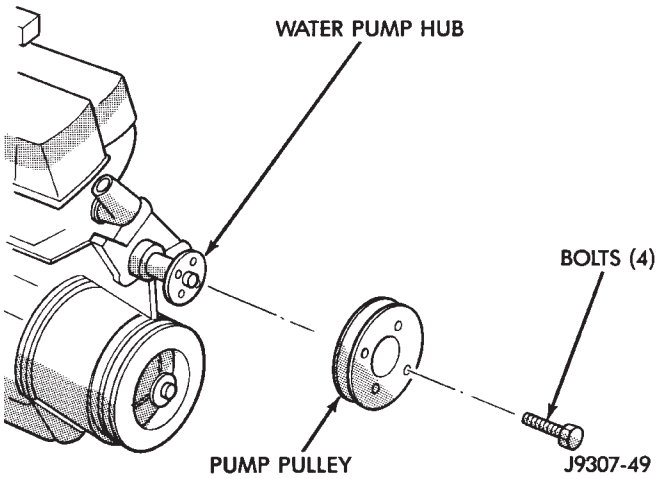

Fig. 3 Water Pump Pulley Bolts

XJ models with 4.0L engine without A/C or heavy duty cooling system; or any 2.5L engines; or any YJ models:

Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts (Fig. 4).

The engine accessory drive belt must be removed prior to removing the fan (if installed at pump) or fan pulley.

(4) Remove engine drive belt as follows:

(a) Loosen two rear power steering pump mounting bolts A (Fig. 5).

(b) Loosen upper pump pivot bolt B and lower lock nut C (Figs. 6 or 7).

(c) Loosen pump adjusting bolt D (Fig. 5) until belt can be removed.

(d) Remove belt.

(5) Check condition of all pulleys.

(6) The power steering pump must be removed from its cast mounting bracket to gain access to bolt

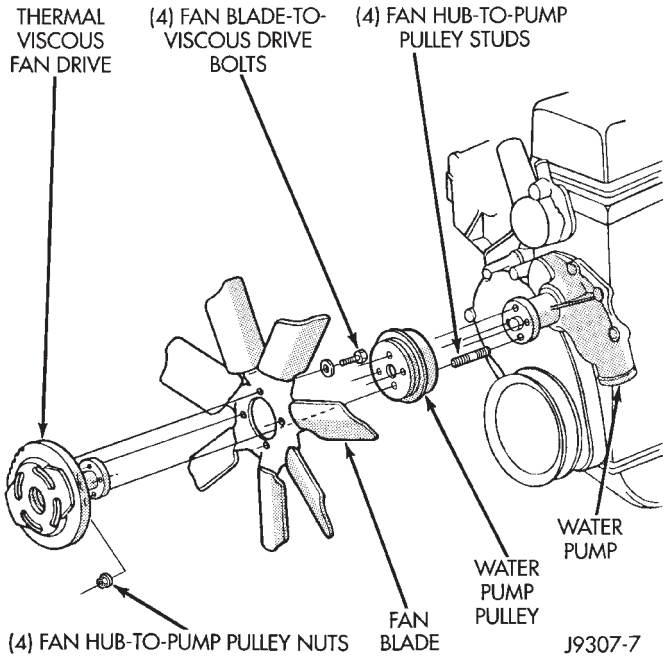

Fig. 4 Fan Mounting Nuts

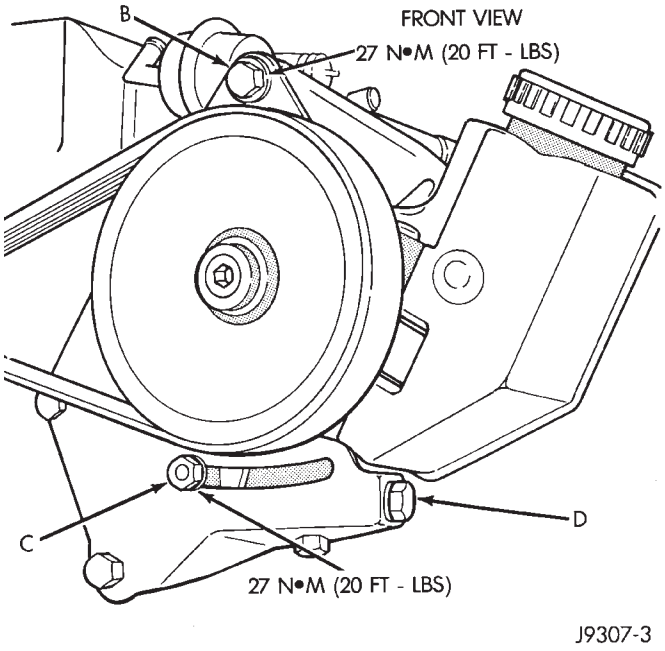

Fig. 6 P.S. Pump Front Mounting Bolt/Locknut—Typical

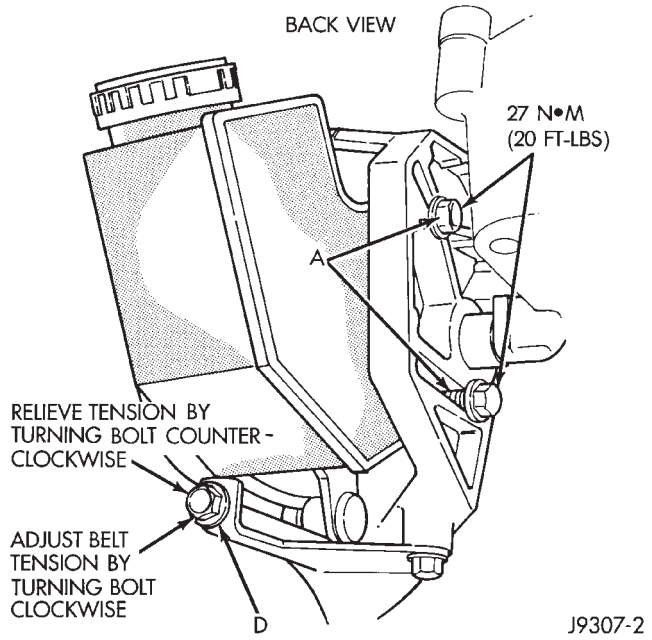

Fig. 5 P.S. Pump Rear Mounting Bolts—Typical

E. Bracket mounting bolt E is located behind the power steering pump (Fig. 7).

(7) Remove two bolts A (Fig. 5).

(8) Remove locknut C and belt adjustment bolt D (Figs. 6 or 7).

(9) Remove bolt B (Fig. 6). Position power steering pump to the side. Hold pump in position with wire. Do not disconnect hydraulic lines from pump.

(10) Remove bolts E, F and G (Fig. 7) and remove pump mounting bracket.

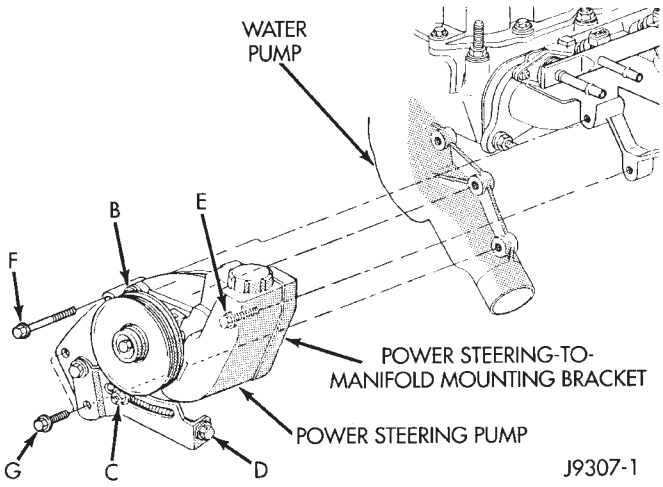

Fig. 7 Bracket Mounting Bolts—Typical

(11) Remove idler pulley mounting bolt and remove idler pulley. This must be done to gain clearance for the water pump mounted heater hose fitting when water pump is being removed. Note position of pulley spacers after removal.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (FIG. 8). 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.

(12) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting.

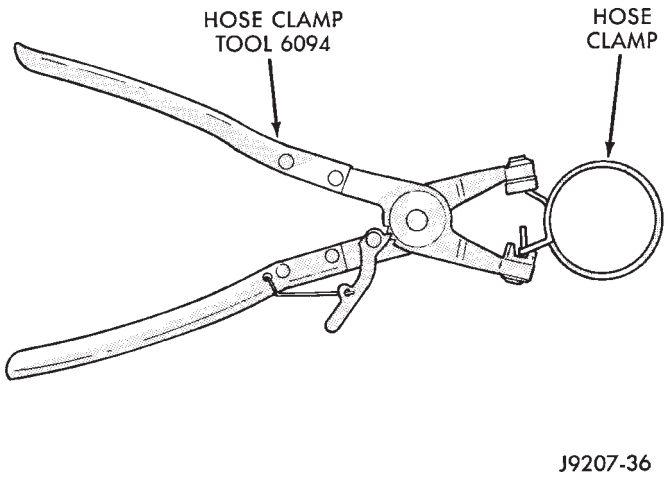

Fig. 8 Hose Clamp Tool—Typical

(13) Remove four nuts or bolts (refer to the previous step #3).

(14) Remove the fan assembly and pulley (if fan is installed at pump), or remove the pulley from the vehicle.

(15) Remove the four pump mounting bolts (Fig. 9) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

(16) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

INSTALLATION—ALL MODELS

(1) If pump is being replaced, install the heater hose fitting to the pump. Use a sealant on the fitting such as Mopar™ Thread Sealant With Teflon. Refer to the directions on the package.

(2) Clean the gasket mating surfaces. If the original pump is used, remove any deposits or other foreign material. Inspect the cylinder block and water pump mating surfaces for erosion or damage from cavitation.

(3) Install the gasket and water pump (the gasket is installed dry). Tighten mounting bolts to 30 N·m (22 ft. lbs.) torque. Rotate the shaft by hand to be sure it turns freely.

(4) Connect the radiator and heater hoses to the water pump.

(5) Position water pump pulley to water pump hub.

(6) If equipped with a water pump mounted fan, install fan and four nuts to water pump hub. If not

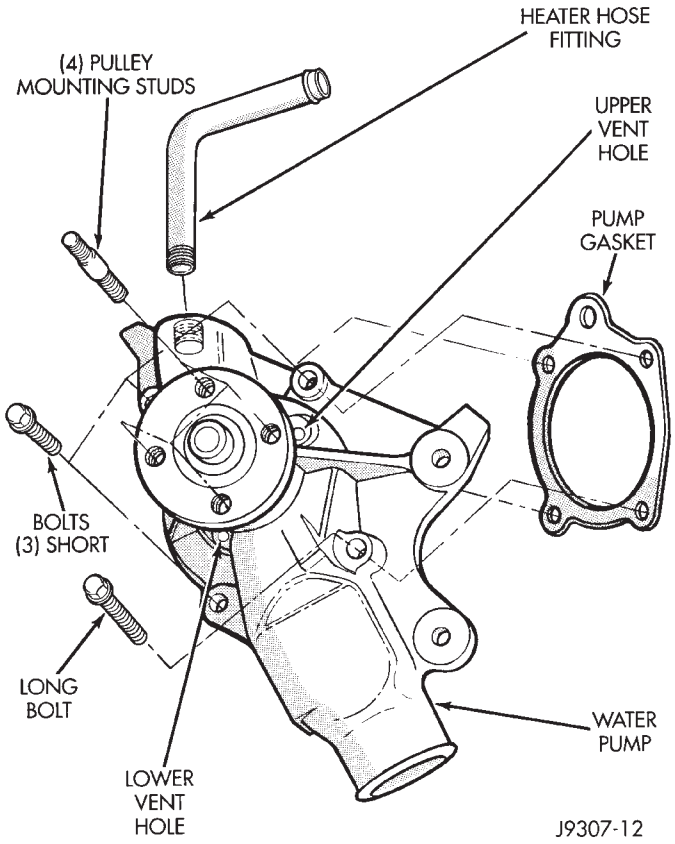

Fig. 9 Water Pump Remove/Install—Typical

equipped with a water pump mounted fan, install four pump hub bolts. Tighten bolts (or nuts) to 27 N·m (20 ft. lbs.) torque.

(7) Position power steering pump bracket to engine. Install bolts E, F and G (Fig. 7). Tighten bolts F and G to 38 N·m (28 ft. lbs.) torque. Tighten bolt E to 27 N·m (20 ft. lbs.) torque.

(8) Position power steering pump to mounting bracket. Install pivot bolt B (Fig. 6) finger tight. Install locknut C and adjustment bolt D (Figs. 6 or 7) finger tight.

(9) Install two adjustment bolts A (Fig. 6) finger tight.

(10) Install idler pulley.

CAUTION: When installing the serpentine engine 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 Figs. 10, 11, 12 or 13 for appropriate belt routing. You may also refer to the Belt Routing Label in the vehicle engine compartment.

(11) Position drive belt to pulleys.

(12) Tighten belt adjustment bolt D (Fig. 5) to the proper tension. Refer to the Specifications section at the end of this group for belt tension.

(13) Tighten bolts A (Fig. 5) to 27 N·m (20 ft. lbs.) torque.

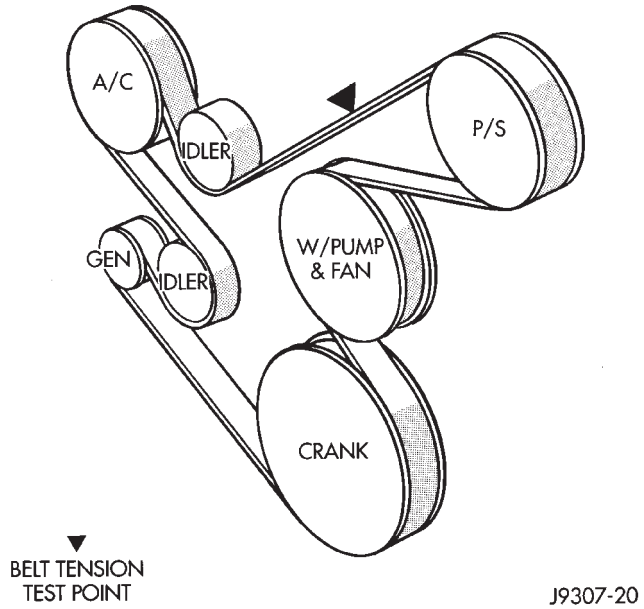

Fig. 10 YJ Models with 4.0L Engine and XJ Models with 2.5L Engine—With A/C

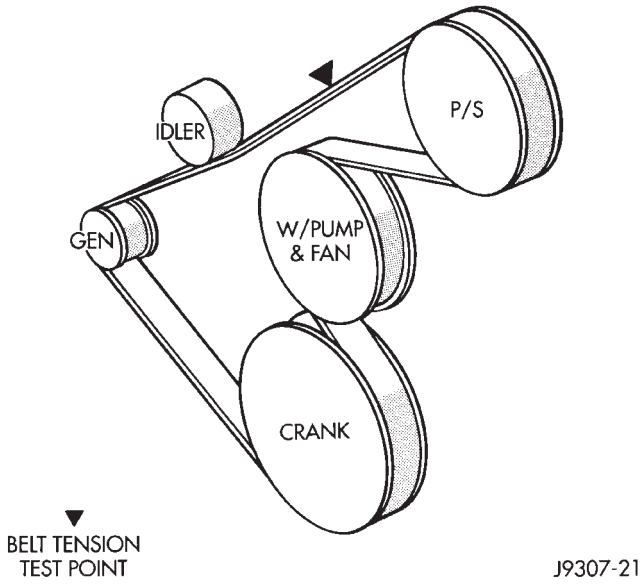

Fig. 11 YJ Models With 2.5L or 4.0L Engine and XJ Models with 2.5L Engine—Without A/C

(14) Tighten pivot bolt B (Fig. 6) to 27 N·m (20 ft. lbs.) torque.

(15) Tighten locknut C (Fig. 6) to 27 N·m (20 ft. lbs.) torque.

(16) After the power steering pump has been tightened, recheck belt tension.

(17) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(18) Connect battery cable to battery.

(19) Start and warm the engine. Check for leaks.

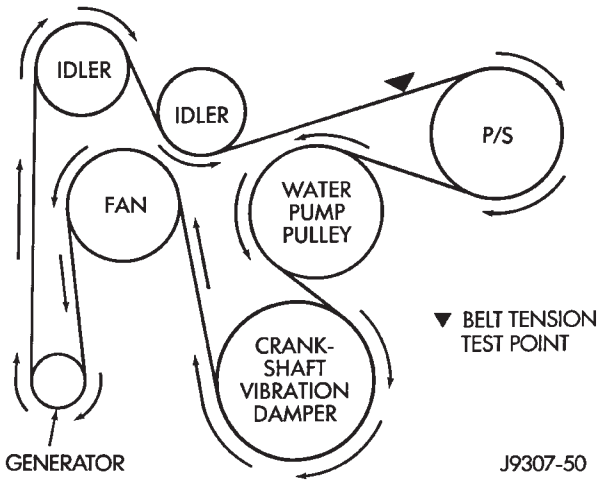

Fig. 12 XJ Models with 4.0L Engine—Without A/C

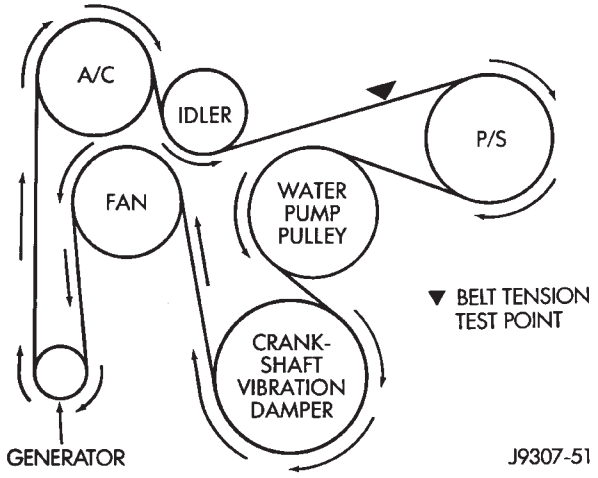

Fig. 13 XJ Models With 4.0L Engine—With A/C

THERMOSTAT

DESCRIPTION AND OPERATION

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 warmup and overall temperature control.

An arrow plus the word **UP** is stamped on the front flange next to the air bleed. The words **TO RAD** are stamped on one arm of the thermostat. They indicate the proper installed position.

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.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

ON-BOARD DIAGNOSTICS

XJ and YJ models are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. The DTC number for low coolant temperature is 17. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or heater performance unless a DTC number 17 is present. Refer to the Diagnosis section of this group for other probable causes. For other DTC numbers, refer to On-Board Diagnostics in the General Diagnosis section of group 14, Fuel Systems.

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures manual for diagnostic information and operation of the DRB scan tool.

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Drain the coolant from the radiator until the level is below the thermostat housing.

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. 14). 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.

(2) Remove radiator upper hose and heater hose at thermostat housing.

(3) Disconnect wiring connector at engine coolant temperature sensor.

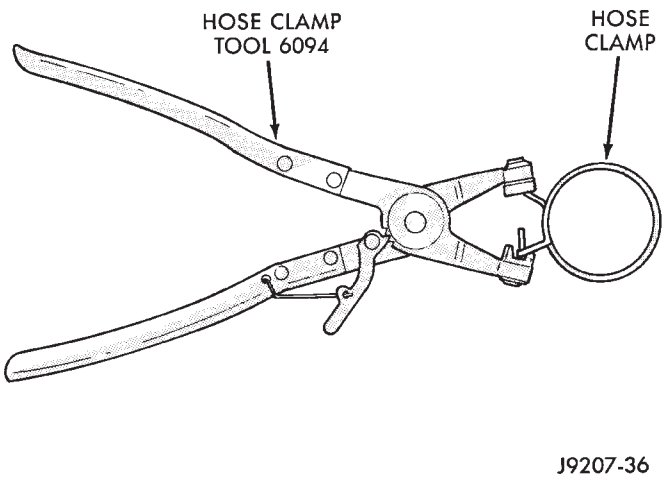

Fig. 14 Hose Clamp Tool—Typical

(4) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 15). Discard old gasket.

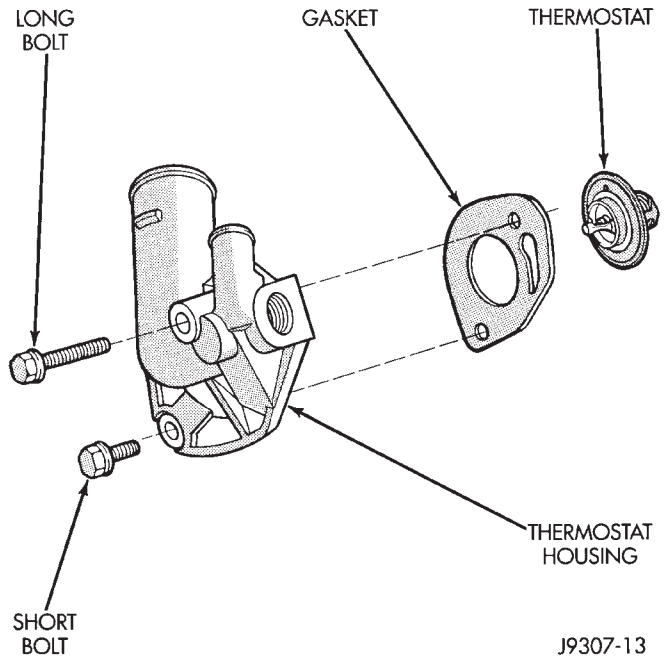

Fig. 15 Thermostat Removal/Installation

(5) Clean the gasket mating surfaces.

INSTALLATION

(1) Install the replacement thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position.

(a) Observe the recess groove in the engine cylinder head (Fig. 16).

(b) Position thermostat in groove with arrow and air bleed hole on outer flange pointing up.

(2) Install replacement gasket and thermostat housing.

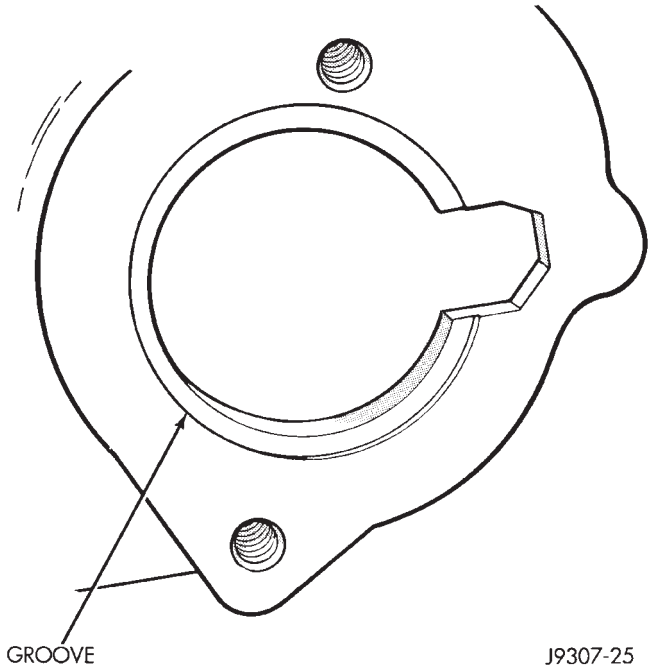

Fig. 16 Thermostat Recess

CAUTION: Tightening the thermostat housing unevenly or with the thermostat out of its recess, may result in a cracked housing.

(3) Tighten the housing bolts to 20 N·m (15 ft. lbs.) torque.
(4) Install hoses to thermostat housing.
(5) Install electrical connector to coolant temperature sensor.
(6) Be sure that the radiator draincock is tightly closed. Fill the cooling system to the correct level with the required coolant mixture. Refer to Refilling Cooling System in this group.
(7) Start and warm the engine. Check for leaks.

COOLANT

GENERAL INFORMATION

The cooling system is designed around the coolant. Coolant flows through the engine water jackets absorbing heat produced during engine operation. The coolant carries heat to the radiator and heater core. Here it is transferred to the ambient air passing through the radiator and heater core fins. The coolant also removes heat from the automatic transmission fluid in vehicles equipped with an automatic transmission.

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 (-35°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-ADDITIVES

Coolant should be maintained at the specified level with a mixture of ethylene glycol-based antifreeze and low mineral content water. Only use an antifreeze containing ALUGARD 340-2 ™.

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

COOLANT SERVICE

It is recommended that the cooling system be drained and flushed at 84,000 kilometers (52,500 miles), or 3 years, whichever occurs first. Then every two years, or 48,000 kilometers (30,000 miles), whichever occurs first.

COOLANT LEVEL CHECK—ROUTINE

Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant reserve/overflow tank.

The coolant reserve/overflow system provides a quick visual method for determining coolant level without removing radiator pressure cap. With engine idling and at normal operating temperature, observe coolant level in reserve/overflow tank. The coolant level should be between ADD and FULL marks.

ADDING ADDITIONAL COOLANT—ROUTINE

Do not remove radiator cap to add coolant to system. When adding coolant to maintain correct level, do so at coolant reserve/overflow tank. Use a 50/50 mixture of ethylene-glycol antifreeze containing Alugard 340-2 ™ and low mineral content water. Remove radiator cap only for testing or when refilling system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system, which produces corrosion.

COOLANT LEVEL CHECK-SERVICE

The cooling system is closed and designed to maintain coolant level to top of radiator.

WARNING: DO NOT OPEN RADIATOR DRAINCOCK WITH ENGINE RUNNING OR WHILE ENGINE IS HOT AND COOLING SYSTEM IS UNDER PRESSURE.

When vehicle servicing requires a coolant level check in radiator, drain several ounces of coolant from radiator drain cock. Do this while observing coolant reserve/overflow system tank. The coolant level in reserve/overflow tank should drop slightly. If not, inspect for a leak between radiator and coolant reserve/overflow system connection. Remove radiator cap. The coolant level should be to top of radiator. If not and if coolant level in reserve/overflow tank is at ADD mark, check for:

- An air leak in coolant reserve/overflow tank or its hose
- An air leak in radiator filler neck
- Leak in pressure cap seal to radiator filler neck

LOW COOLANT LEVEL-AERATION

If the coolant level in radiator drops below top of radiator core tubes, air will enter cooling system.

Low coolant level can cause thermostat pellet to be suspended in air instead of coolant. This will cause thermostat to open later, which in turn causes higher coolant temperature. Air trapped in cooling system also reduces amount of coolant circulating in heater core resulting in low heat output.

DEAERATION

As the engine operates, any air trapped in cooling system gathers under the radiator cap. The next time the engine is operated, thermal expansion of coolant will push any trapped air past radiator cap into the coolant reserve/overflow tank. Here it escapes to the atmosphere into the tank. When the engine cools down the coolant, it will be drawn from the reserve/overflow tank into the radiator to replace any removed air.

DRAINING COOLING SYSTEM

ALL MODELS—EXCEPT XJ WITH 4.0L ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

DO NOT remove the radiator cap when draining the coolant from the reserve/overflow tank. Open the radiator draincock and when the tank is empty, remove the radiator cap. The coolant does not have to be removed from the tank unless the system is being refilled with a fresh mixture.

(1) Drain the coolant from the radiator by loosening the draincock.

(2) Drain coolant from engine as follows:

(a) On 2.5L engines (all models) by removing drain plug at left rear side of block.

(b) On 4.0L engines by removing the drain plug or coolant temperature sensor on the left side of the block (Fig. 17).

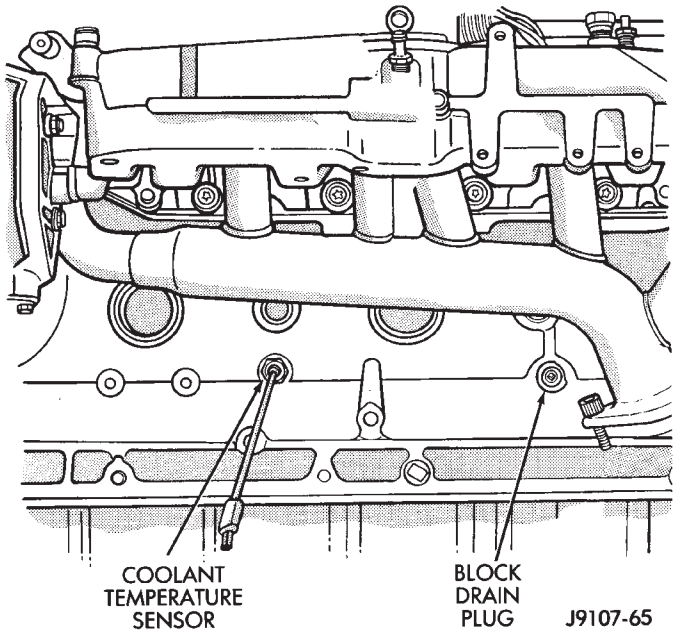

Fig. 17 Draining Coolant—4.0L Engine

XJ MODELS WITH 4.0L ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Remove radiator pressure cap.

(2) For access to radiator draincock, remove radiator grille (Fig. 18).

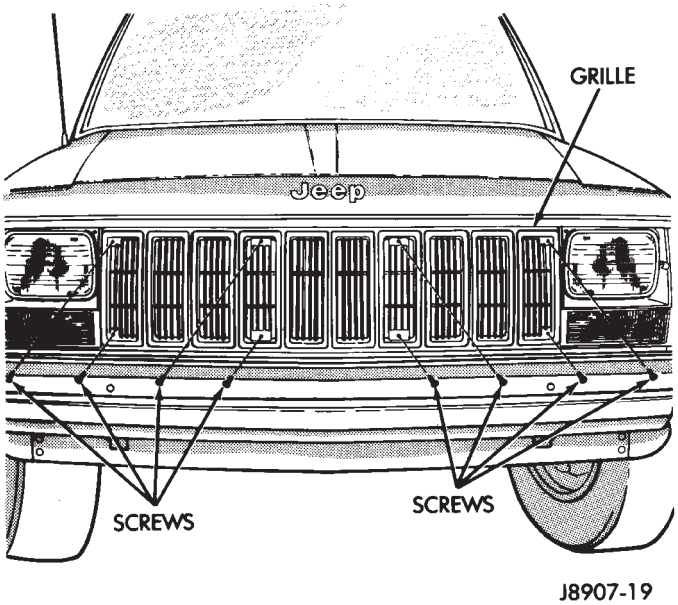

Fig. 18 Draincock Access—XJ Models with 4.0L Engine

(3) Attach one end of a 24 inch long X 1/4 inch ID hose to the radiator draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator.

(4) Drain coolant from engine by removing the drain plug and coolant temperature sensor on left side of block (Fig. 17).

REFILLING COOLING SYSTEM

YJ MODELS

(1) Remove draining hose. Tighten the radiator draincock and the cylinder block drain plug(s).

(2) Fill system using a 50/50 mixture of water and antifreeze. This is described in the Coolant section of this group. Fill the radiator to the top and install the radiator cap. Add sufficient coolant to the reserve/overflow tank to raise the level to the FULL mark.

(3) Operate the engine with the radiator cap and reserve/overflow tank cap in place. After the engine has reached the normal operating temperature, shut the engine off and allow it to cool.

(4) Add coolant to the reserve/overflow tank as necessary. **Only add coolant when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

XJ MODELS

(1) Tighten the radiator draincock and the cylinder block drain plug(s). If removed, install coolant temperature sensor (4.0L engine).

(2) Fill system using a 50/50 mixture of water and antifreeze as described in the Coolant section of this group. Fill radiator to top and install radiator cap. Add sufficient coolant to reserve/overflow tank to raise level to FULL mark.

(3) With heater control unit in the HEAT position, operate engine with radiator cap in place.

(4) After engine has reached normal operating temperature, shut engine off and allow it to cool.

(5) Add coolant to reserve/overflow tank as necessary. **Only add coolant when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.**

COOLING SYSTEM CLEANING/REVERSE FLUSHING

CAUTION: The cooling system normally operates at 97-to-124 kPa (14-to-18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

CLEANING

Drain cooling system and refill with water. Run engine with radiator cap installed until upper radiator hose is hot. Stop engine and drain water from system. If water is dirty, fill system with water, run engine and drain system. Repeat until water drains clean.

REVERSE FLUSHING

Reverse flushing of 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.

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-124 kPa (14-to-18 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. 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: On XJ models, 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 and install thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

CAUTION: Be sure instructions on the container are followed.

TESTING COOLING SYSTEM FOR LEAKS

ULTRAVIOLET LIGHT METHOD

All Jeep™ models have a leak detection additive added to the cooling system before they leave the factory. The additive is highly visible under ultraviolet light (black light). If the factory original coolant has been drained, pour one ounce of additive into the cooling system. The additive is available through the part's department. Place the heater control unit in HEAT position. Start and operate the engine until the radiator upper hose is warm to the touch. Aim the black light (tool 7138 or an equivalent), at the components to be checked. If leaks are present, the black light will cause the additive to glow a bright green color.

The black light can be used along with a pressure tester to determine if any external leaks exist (Fig. 19).

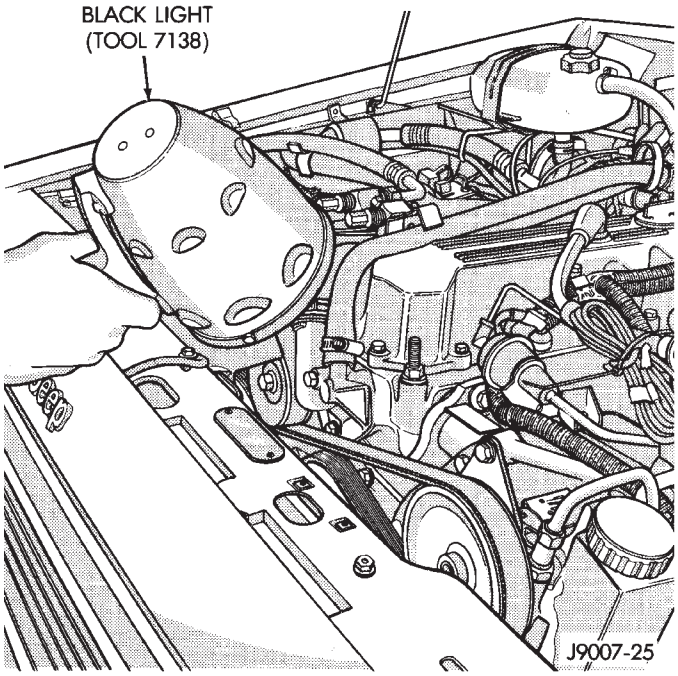

Fig. 19 Leak Detection Using Black Light—Typical

PRESSURE TESTER METHOD

The engine should be at the normal operating temperature. Recheck the system cold if the cause of coolant loss is not located during warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove the radiator pressure cap from the filler neck and check the coolant level. Push down on the cap to disengage it from the stop tabs. Wipe the inner part of the filler neck and examine the lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect the reserve/overflow tank tube for internal obstructions. Insert a wire through the tube to be sure it is not obstructed.

Inspect the cams on the outside part of the filler neck. If the cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully. Attach pressure tester 7700 or an equivalent to the radiator filler neck (Fig. 20).

Operate the tester pump to apply 124 kPa (18 psi) pressure to the system. If the hoses enlarge excessively or bulge while testing, replace as necessary. Observe the gauge pointer and determine the condition of the cooling system according to the following criteria:

- Holds Steady: If the pointer remains steady for two minutes, there are no serious coolant leaks in the system. However, there could be an internal leak that does not appear with normal system test pressure. Inspect for interior leakage or do the Internal

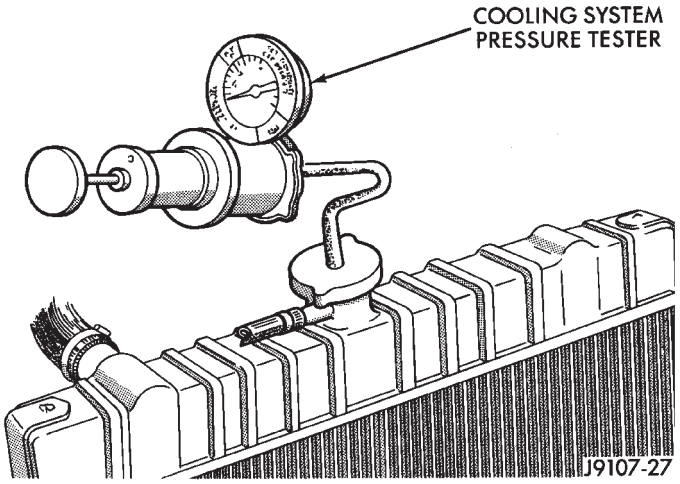

Fig. 20 Pressurizing System—Typical

Leakage Test. Do this if it is certain that coolant is being lost and no leaks can be detected.

- Drops Slowly: Shows a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect the radiator, hoses, gasket edges and heater. Seal any small leak holes with a Sealer Lubricant or equivalent. Repair leak holes and reinspect the system with pressure applied.
- Drops Quickly: Shows that a serious leakage is occurring. Examine the system for serious external leakage. If no leaks are visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove the oil pan drain plug and drain a small amount of engine oil. Coolant, being heavier will drain first, or operate engine to churn oil, then examine dipstick for water globules. Inspect the transmission dipstick for water globules. Inspect the transmission fluid cooler for leakage. Operate the engine without the pressure cap on the radiator until thermostat opens.

Attach a Pressure Tester to the filler neck. If pressure builds up quickly, a leak exists as result of a faulty cylinder head gasket or crack in the engine. Repair as necessary.

WARNING: DO NOT ALLOW PRESSURE TO EXCEED 124 KPA (18 PSI). TURN THE ENGINE OFF. TO RELEASE THE PRESSURE, ROCK THE TESTER FROM SIDE TO SIDE. WHEN REMOVING THE TESTER, DO NOT TURN THE TESTER MORE THAN 1/2 TURN IF THE SYSTEM IS UNDER PRESSURE.

If there is no immediate pressure increase, pump the Pressure Tester until the indicated pressure is within the system range. Vibration of the gauge pointer indicates compression or combustion leakage into the cooling system.

WARNING: DO NOT DISCONNECT THE SPARK PLUG WIRES WHILE THE ENGINE IS OPERATING.

CAUTION: Do not operate the engine with a spark plug shorted for more than a minute. The catalytic converter may be damaged.

Isolate the compression leak by shorting each spark plug to the cylinder block. The gauge pointer should stop or decrease vibration when spark plug for leaking cylinder is shorted. This happens because of the absence of combustion pressure.

COMBUSTION LEAKAGE TEST (WITHOUT PRESSURE TESTER)

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

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.

Drain sufficient coolant to allow for thermostat removal. Refer to Thermostat Replacement. Disconnect the water pump drive belt.

Disconnect the upper radiator hose from the thermostat housing. Remove the housing and thermostat. Install the thermostat housing.

Add coolant to the radiator to bring the level to within 6.3 mm (1/4 in) of the top of the thermostat housing.

CAUTION: Avoid overheating. Do not operate the engine for an excessive period of time. Open the draincock immediately after the test to eliminate boil over of coolant.

Start the engine and accelerate rapidly three times (to approximately 3000 rpm) while observing the coolant. If internal engine combustion gases are leaking into the cooling system, bubbles will appear in the coolant. If bubbles do not appear, there is no internal combustion gas leakage.

COOLANT RESERVE/OVERFLOW SYSTEM

The 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 cover minor leaks and evaporation or boiling losses.

The coolant reserve/overflow system consists of a radiator mounted pressurized cap, a plastic reserve/overflow tank (Figs. 21, 22 or 23), a tube connecting the radiator and tank, and an overflow tube on the side of the tank.

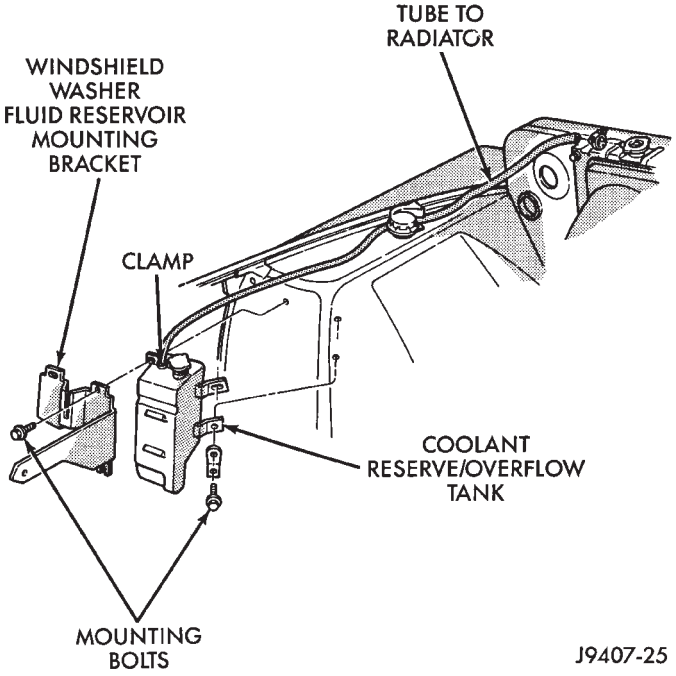

Fig. 21 Reserve/Overflow Tank—YJ Models

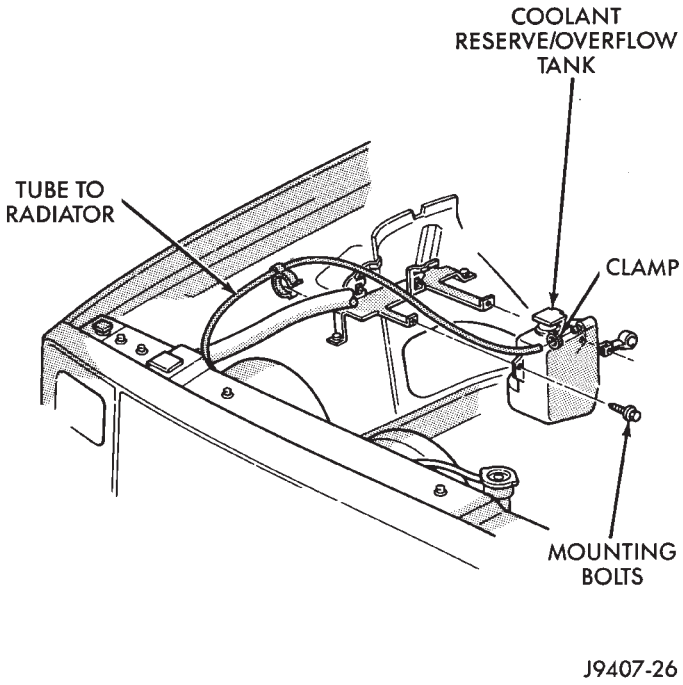

Fig. 22 Reserve/Overflow Tank—XJ Models—Except Right Hand Drive

TANK REMOVAL/INSTALLATION

(1) Remove the tube clamp at the tank and remove tube.

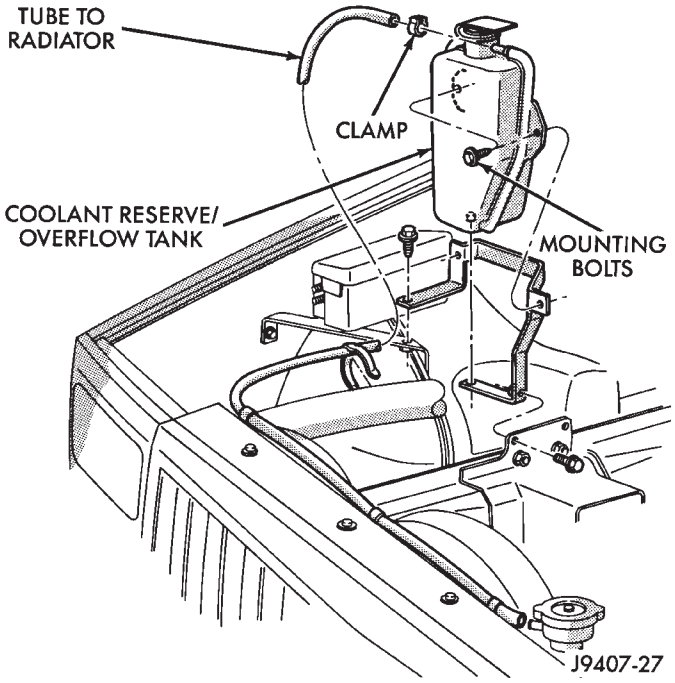

Fig. 23 Reserve/Overflow Tank—XJ Models—With Right Hand Drive

(2) On YJ models, remove the windshield washer reservoir and its mounting bracket.

(3) Remove the tank mounting bolts and remove tank.

(4) Reverse the preceding steps for installation.

RADIATOR PRESSURE CAP

All radiators are equipped with a pressure cap. This cap releases pressure at some point within a range of 83-110 kPa (12-16 psi). The pressure relief point (in pounds) is engraved on top of the cap (Fig. 24).

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap (Fig. 24) contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 83-110 kPa (12-16 psi).

A vent valve in the center of the cap allows a small coolant flow through the cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in reserve/overflow tank to be drawn through connecting hose into radiator. If the vacuum valve is stuck shut, radiator hoses will collapse on cool-down.

A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

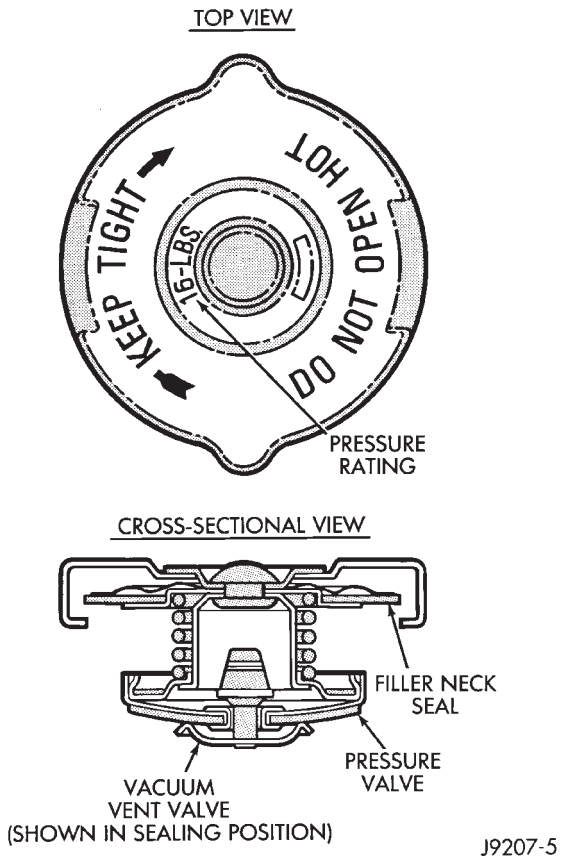

Fig. 24 Radiator Pressure Cap

RADIATOR CAP-TO-FILLER NECK SEAL—PRESSURE RELIEF CHECK

With radiator cap installed on filler neck, remove coolant reserve/ overflow tank hose from nipple on filler neck. Connect a hand operated vacuum pump to nipple. Operate pump until a reading of 47-to-61 kPa (14-to-18 in. Hg) appears on gauge. If the reading stays steady, or drops slightly and then remains steady, the pressure valve seal is good. Replace radiator cap if reading does not hold.

WARNING: THE WARNING WORDS -DO NOT OPEN HOT- ON THE RADIATOR PRESSURE CAP (FIG. 24) ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, THE RADIATOR CAP SHOULD NOT BE REMOVED WHILE THE SYSTEM IS HOT AND/OR UNDER PRESSURE.

There is no need to remove the radiator cap **except** for the following purposes:

(1) To check and adjust antifreeze freeze point.
(2) To refill system with new antifreeze.
(3) For conducting service procedures.
(4) When checking for vacuum leaks.

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING RADIATOR CAP. WITH A RAG, SQUEEZE RADIATOR UPPER HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER THE CAP AND WITHOUT PUSHING DOWN, ROTATE CAP COUNTER-CLOCKWISE TO THE FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH OVERFLOW HOSE INTO COOLANT RESERVE/OVERFLOW TANK. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO TANK AND SYSTEM PRESSURE DROPS, REMOVE RADIATOR CAP COMPLETELY.

PRESSURE TESTING RADIATOR CAPS

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install the cap on pressure tester (tool 7700 or an equivalent) (Fig. 25).

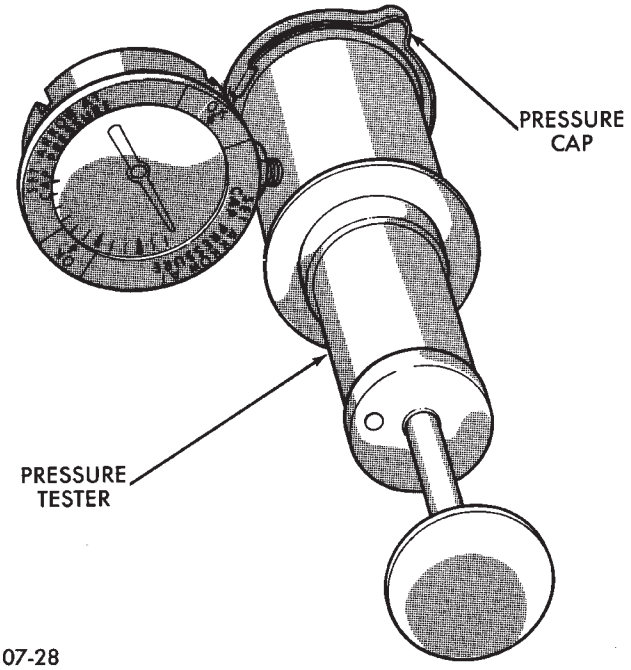

Fig. 25 Pressure Testing Radiator Pressure Cap

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 83-to-110 kPa (12-to-16 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 83-to-110 kPa (12-to-16 psi) range for 30 seconds or more. If the pointer drops quickly, replace the cap.

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.

RADIATORS

GENERAL INFORMATION

All radiators are down flow types except XJ models with 4.0L engines. Radiators in XJ models equipped with the 4.0L six-cylinder engine, are the cross flow type. Plastic tanks are used on all radiators.

CAUTION: Plastic tanks, while stronger than brass, are subject to damage by impact, such as wrenches.

If plastic tank has been damaged, plastic tank and/or O-rings are available for service repair. Tank replacement should be done by qualified personal with proper equipment.

RADIATOR COOLANT FLOW CHECK

The following procedure will determine if coolant is flowing through the cooling system.

If engine is cold, idle engine until normal operating temperature is reached. Then feel the upper radiator hose. If hose is hot, the thermostat is open and water is circulating through cooling system.

RADIATOR REMOVAL/INSTALLATION

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS, RADIATOR CAP, OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain 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. 26). 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.

XJ MODELS WITH 2.5L ENGINE

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Observe the previous **WARNINGS.** Remove radiator cap.

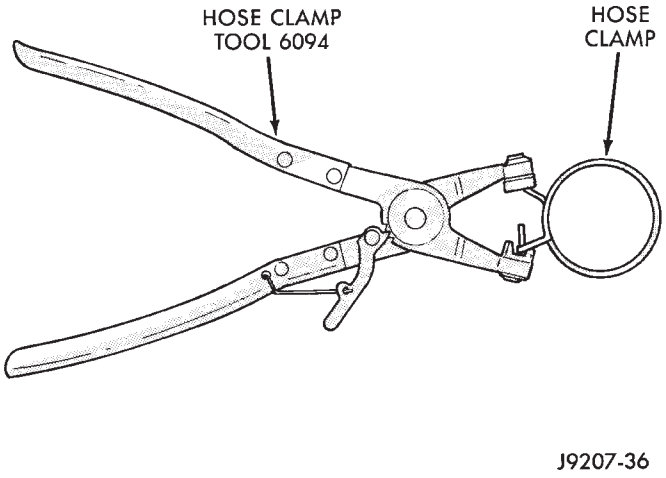

Fig. 26 Hose Clamp Tool—Typical

(3) Position drain pan under draincock. Open radiator draincock. Drain radiator.

(4) Remove radiator upper and lower hose clamps and hoses.

(5) Remove alignment dowel E-clip from radiator lower mounting bracket (Fig. 27).

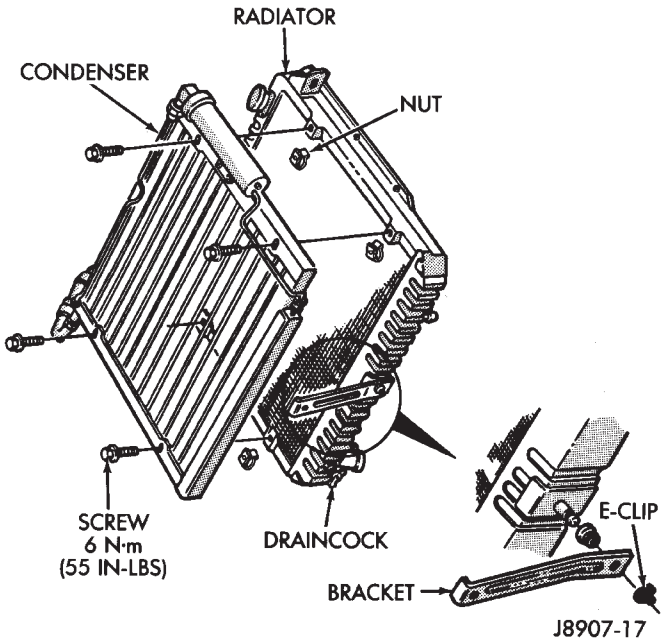

Fig. 27 Radiator Remove/Install—XJ Models—2.5L Engine

(6) Disconnect coolant reserve/overflow tank hose from radiator.

(7) Remove radiator fan shroud mounting bolts (Fig. 28). Push shroud back against front of engine.

(8) If equipped, disconnect and plug automatic transmission fluid cooler lines.

(9) Remove radiator top mounting bolts (Fig. 28).

(10) Remove the radiator grille mounting screws. Remove grille (Fig. 29).

(11) Remove the air conditioning condenser-to-radiator mounting bolt. Use an open end wrench to re-

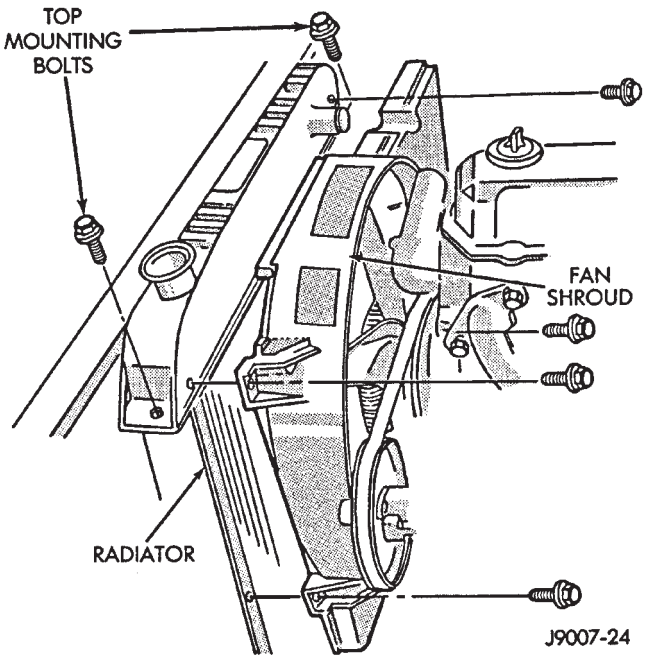

Fig. 28 Shroud Remove/Install—XJ Models With 2.5L Engine

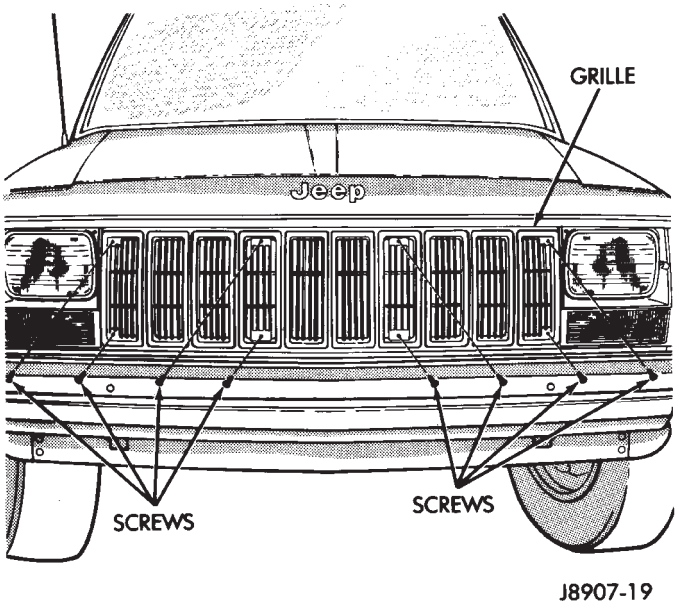

Fig. 29 Grille Remove/Install—Cherokee Models With 2.5L Engine

move bottom bolts (Fig. 30).

(12) Lift radiator straight up and out of vehicle. Take care not to damage radiator fins.

INSTALLATION

(1) Install radiator behind air conditioning condenser with bottom alignment dowel inserted into radiator lower mounting bracket.

(2) Install E-clip to alignment dowel.

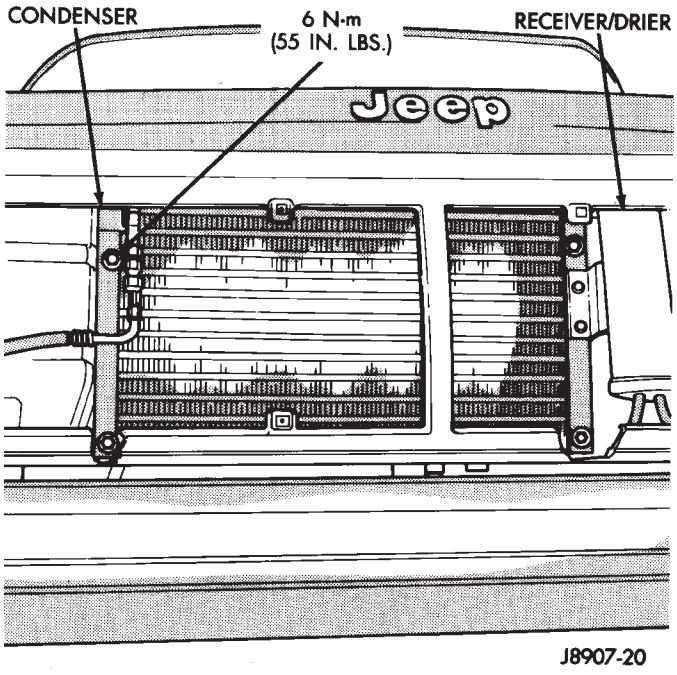

Fig. 30 Condenser Mounting Bolts—XJ Models With 2.5L Engine

(3) Tighten the four condenser-to-radiator mounting bolts to 6.2 N·m (55 in. lbs.) torque.

(4) Install radiator grille.

(5) Tighten radiator top mounting bolts to 6 N·m (55 in. lbs.) torque.

(6) If equipped, connect automatic transmission fluid cooler lines to radiator.

(7) Install the radiator fan shroud. Connect the coolant reserve/overflow tank hose.

(8) Connect radiator hoses and install hose clamps.

(9) Connect negative battery cable.

(10) Close the draincock.

(11) Fill cooling system with correct coolant.

(12) Install radiator cap.

(13) Check and adjust automatic transmission fluid level (if equipped).

XJ MODELS WITH 4.0L ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain 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. 26). 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.

REMOVAL

(1) Disconnect negative battery cable at battery.
(2) Observe the previous **WARNINGS.**
(3) Remove pressure cap.
(4) For access to radiator draincock, remove radiator grille (Fig. 29).
(5) Attach one end of a 24 inch long X 1/4 inch ID hose to the radiator draincock. Put the other end into a clean container. Open draincock and drain radiator.
(6) If equipped, disconnect electric cooling fan electrical connector (Fig. 31).

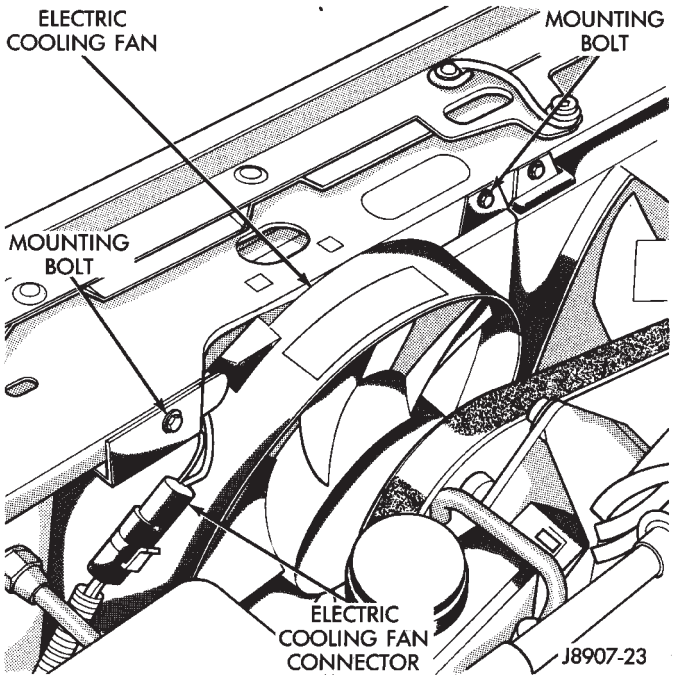

Fig. 31 Auxiliary Fan—Remove/Install

(7) Remove electric fan mounting bolts. Lift fan straight up and out of engine compartment.
(8) Remove the mechanical (non-electrical) fan shroud mounting bolts. Lift shroud up until alignment tabs at the bottom are clear of slots in bracket at bottom of radiator (Fig. 32). Place shroud over mechanical fan.

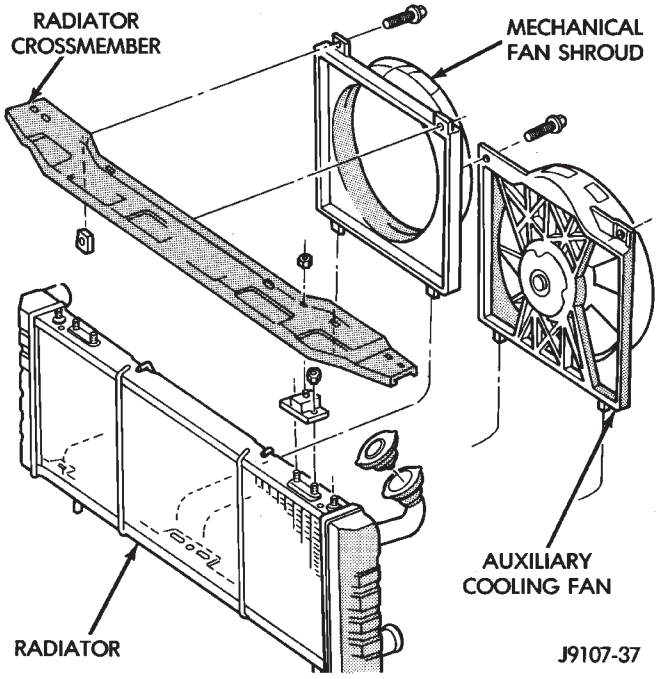

Fig. 32 Auxiliary Fan and Mechanical Fan Shroud—Remove/Install—Typical

(9) If equipped, disconnect and plug automatic transmission fluid cooler lines. If equipped with remote cooler, remove line to cooler from bracket at bottom of radiator.
(10) Disconnect radiator upper and lower hoses.
(11) Mark the position of the hood latch striker on the radiator crossmember and remove hood latch striker.
(12) Remove radiator upper crossmember bracket.
(13) Remove radiator upper crossmember.
(14) If equipped with air conditioning, separate radiator from condenser by removing condenser-to-radiator mounting brackets (Fig. 33).
(15) Lift radiator straight up and out of engine compartment taking care not to damage fins.

INSTALLATION

The radiator has two alignment dowels. They are located on the bottom tank and fit into rubber grommets in the radiator lower crossmember.
(1) Lower radiator into engine compartment. Position alignment dowels into grommets in radiator lower crossmember (Fig. 34).
(2) If equipped with air conditioning, attach condenser to radiator with mounting brackets (Fig. 33).
(3) Install radiator upper crossmember.
(4) Install radiator upper crossmember bracket.
(5) Install hood latch striker.
(6) Connect radiator upper and lower hoses.

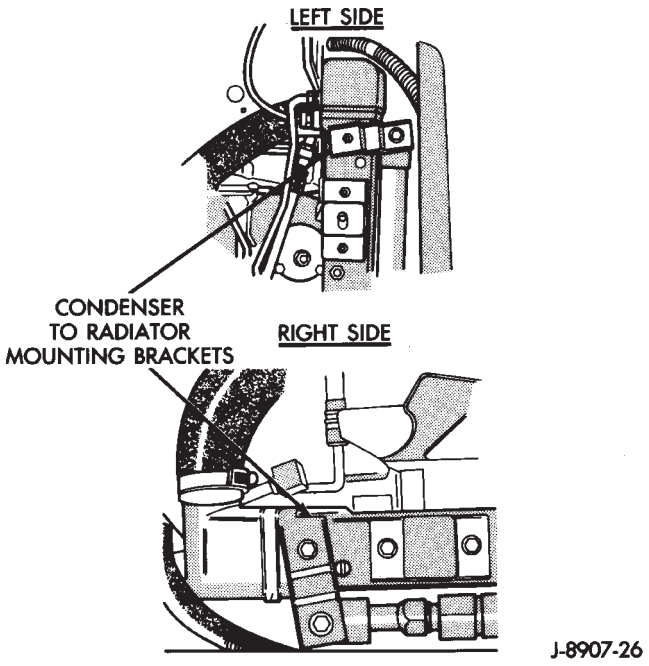

Fig. 33 Condenser-to-Radiator Mounting Brackets—XJ with 4.0L Engine

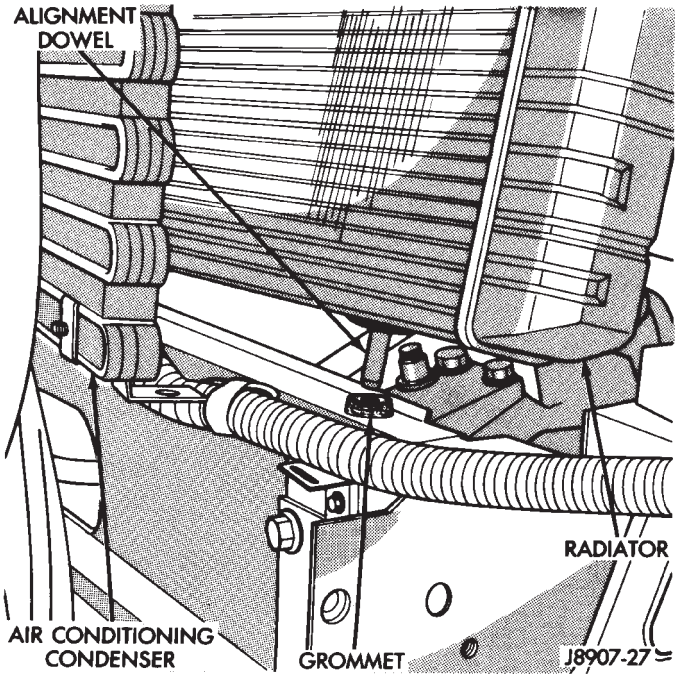

Fig. 34 Radiator Installation—XJ Models with 4.0L Engine

(7) If equipped, connect automatic transmission fluid cooler lines. If equipped with remote cooler, attach cooler line to bracket at bottom of radiator.

(8) Install electric cooling fan (if equipped). Insert alignment tabs at bottom of fan shroud into slots in bracket at bottom of radiator. Tighten mounting bolts to 4 N·m (36 in. lbs.) torque.

(9) Connect electric cooling fan electrical connector.

(10) Install mechanical cooling fan shroud. Insert alignment tabs at bottom of shroud into slots in bracket at bottom of radiator. Tighten mounting bolts to 4 N·m (36 in. lbs.) torque (Fig. 32).

(11) Close radiator draincock.

(12) Install grille.

(13) Connect negative battery cable.

(14) Fill cooling system with correct coolant. Refer to the Coolant section of this group.

(15) Install pressure cap.

(16) Check and adjust automatic transmission fluid level (if equipped).

YJ MODELS

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain 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. 26). 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.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Observe the previous **WARNINGS.** Remove the radiator cap.

(3) Position drain pan under draincock. Open radiator draincock and drain radiator.

(4) Remove radiator upper and lower hose clamps and hoses.

(5) Disconnect coolant reserve/overflow tank hose from radiator.

(6) Remove fan shroud bolts and push shroud back onto fan (Fig. 35).

(7) If equipped, disconnect and plug automatic transmission fluid cooler lines.

(8) Remove radiator attaching bolts.

(9) Lift radiator straight up and out of vehicle taking care not to damage radiator fins.

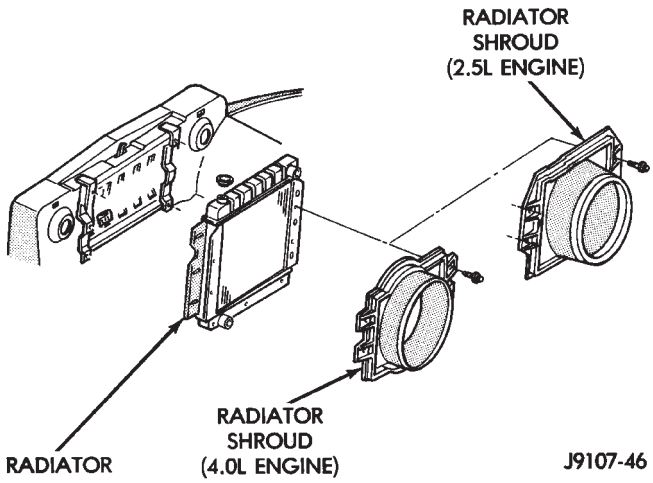

Fig. 35 Radiator—Remove/Install—YJ Models

INSTALLATION

(1) Install the radiator. Tighten the mounting bolts to 8 N·m (6 ft. lbs.) torque (Fig. 35).

(2) Close radiator draincock.

(3) Install fan shroud. Tighten mounting bolts to 16 N·m (11 ft. lbs.) torque.

(4) If equipped, remove plugs and connect automatic transmission fluid cooler lines.

(5) Connect radiator hoses and install hose clamps.

(6) Connect negative battery cable.

(7) Fill cooling system with correct coolant. Refer to the Coolant section of this group.

(8) Connect reserve/overflow tank hose.

(9) Install radiator cap.

(10) Check and adjust automatic transmission fluid level (if equipped).

COOLING SYSTEM HOSES

Rubber hoses route coolant to and from the radiator, intake manifold and heater core. All XJ models equipped with air conditioning have a coolant control valve. This is located in-line with the heater core inlet and outlet hoses. It controls coolant flow to the heater core when the air conditioning system is in operation.

Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

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. 36). 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.

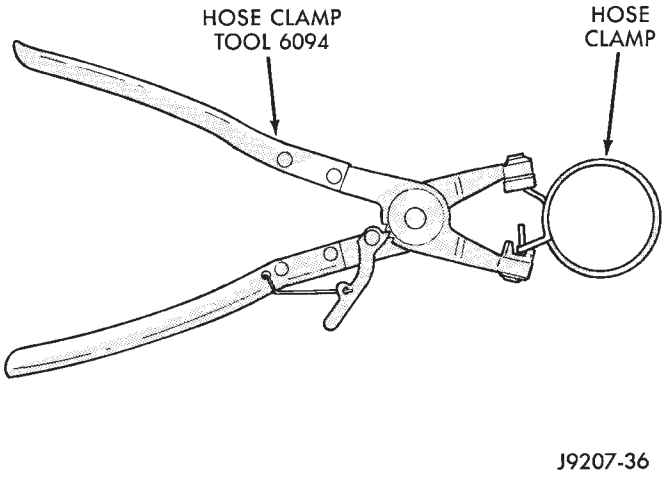

Fig. 36 Hose Clamp Tool—Typical

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when the system is pressurized.

For all vehicles: In areas where specific routing clamps are not provided, be sure that hoses are positioned with sufficient clearance. Check clearance from exhaust manifolds and pipe, fan blades, drive belts and sway bars. Improperly positioned hoses can be damaged, resulting in coolant loss and engine overheating.

Ordinary worm gear type hose clamps (when equipped) can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, the hose clamps should be tightened to 4 N·m (34 in. lbs.) torque. Do not over tighten hose clamps.**

When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the internal spring.

COOLING SYSTEM FANS

All models are equipped with a mechanical temperature controlled fan. The viscous fan drive is a torque-and-temperature-sensitive clutch unit. It automatically increases or decreases fan speed to provide proper engine cooling. XJ models equipped with a 4.0L engine may also have an auxiliary electrical fan. This is with models that have air conditioning and/or heavy duty cooling.

VISCOUS FAN DRIVE OPERATION

The viscous fan drive (Fig. 37) is a silicone-fluid-filled coupling. On some engines it connects the fan assembly to the fan/water pump pulley. 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. A bimetallic spring coil is located on the front face. 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.

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 from the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

CAUTION: Engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

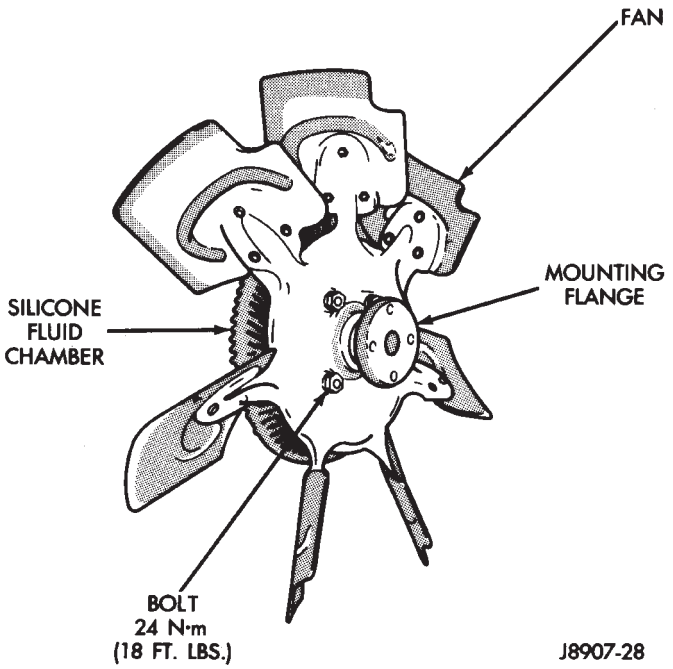

Fig. 37 Viscous Fan Drive—Typical

VISCOUS FAN DRIVE TEST

The cooling system must be in good condition. This is checked prior to performing the following test. It also will ensure against excessively high coolant temperature.

CAUTION: 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 with the timing light (strobe light) aimed at the fan blades. Within ten minutes the air temperature (indicated on the dial thermometer) should be 88° C (190° F). Satisfactory operation of the fan drive requires that it engage before or at 88° C (190° F). Engagement is distinguishable by a definite increase in flow noise. The timing light also will indicate an increase in the speed of the fan.

(7) When the air temperature reaches 88° C (190° F), remove the plastic sheet. Satisfactory operation of the viscous fan requires the air temperature to drop 20° F (11° C) or more. A definite decrease of audible-fan-air-flow-noise should be noticed. Replace defective fan assemblies.

VISCOUS FAN DRIVE REPLACEMENT

REMOVAL

Some engines have the mechanical fan/viscous fan drive assembly mounted directly to the water pump hub (Fig. 38). It may also be mounted to a hub/bearing attached to an aluminum bracket on the right front side of engine (Fig. 39).

(1) Loosen but do not remove at this time, the four fan hub mounting nuts (Figs. 38 or 39).

(2) Remove accessory serpentine drive belt. Refer to Belt Service in the Engine Accessory Drive Belt section of this group.

(3) Some models with certain engines may require the removal of the fan shroud to remove the viscous fan drive. The fan shroud and fan blade/viscous fan drive should be removed from the vehicle as one assembly.

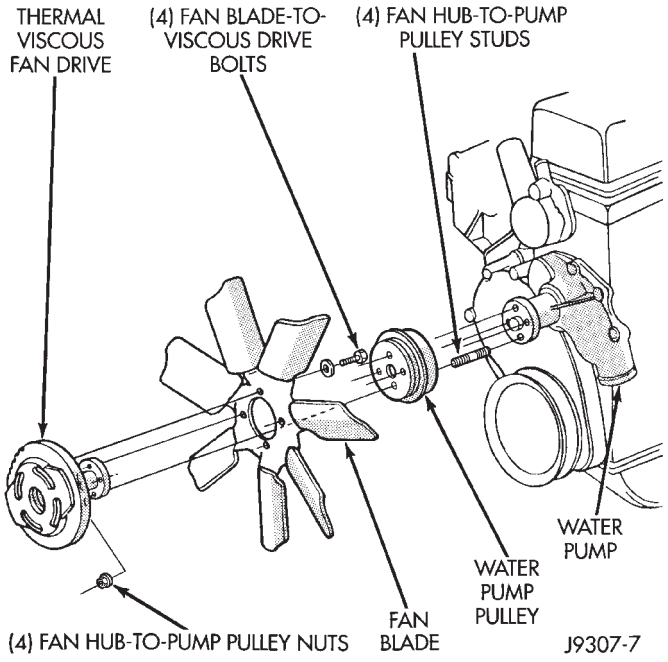

Fig. 38 Water Pump Mounted Cooling Fan

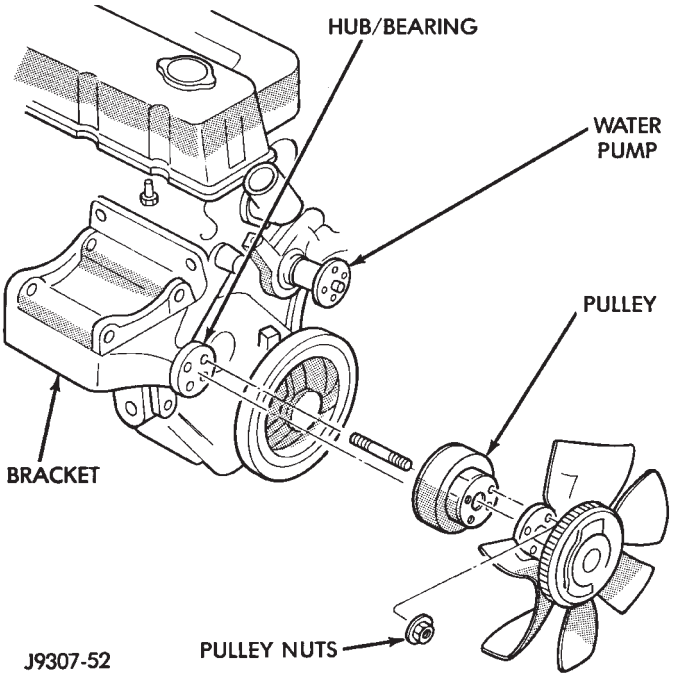

Fig. 39 Bracket Mounted Cooling Fan

(4) Remove four fan hub mounting nuts (Figs. 38 or 39) and remove fan/viscous fan drive assembly from vehicle.

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.

INSTALLATION

(1) Assemble fan blade to viscous fan drive. Tighten mounting bolts to 27 N·m (20 ft. lbs.) torque.

(2) Position mounting flange of fan blade/viscous fan drive assembly onto hub. Install four nuts and tighten to 24 N·m (18 ft. lbs.) torque. Tighten the first two nuts 180 degrees apart. Then tighten last two nuts.

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 appropriate Engine Accessory Drive Belt Schematic in this group for correct belt routing.

(3) Install accessory drive belts. Tension belts to specifications. Refer to the Specifications section at the end of this group.

FAN BLADE INSPECTION

The fan blades cannot be repaired. If the fan is damaged, it must be replaced. Inspect the fan blades as follows:

Lay fan blade assembly on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF NOT WITHIN SPECIFICATIONS.

Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If the fan blade assembly is replaced because of mechanical damage, the water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

AUXILIARY ELECTRIC COOLING FAN—XJ MODELS WITH 4.0L ENGINE

OPERATION

XJ models equipped with a 4.0L engine may also have an auxiliary electrical fan. This is with models that have air conditioning and/or heavy duty cooling. The fan is controlled by the cooling fan relay, which is located in the Power Distribution Center (PDC). For location of relay within the PDC (Fig. 40), refer to label on PDC cover.

When coolant temperature is above 88°C (190°F), the powertrain control module (PCM) grounds the relay. Battery voltage is then applied to the fan

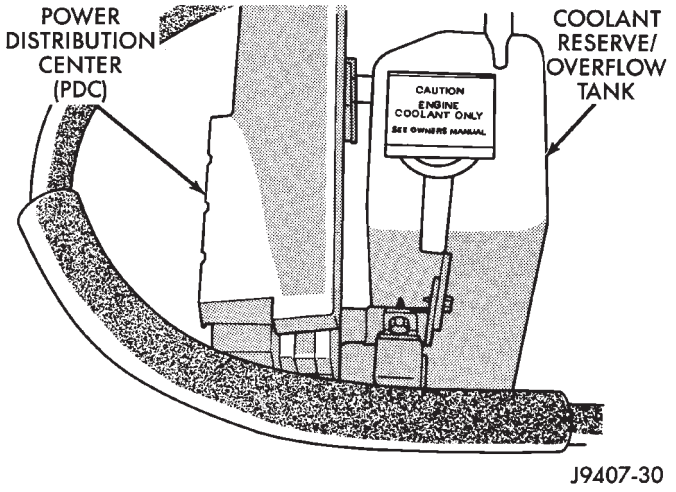

Fig. 40 PDC—XJ Models

through the relay. When coolant temperature is below 88°C (190°F), the PCM opens the ground path to the relay. This will prevent the cooling fan from being energized.

Whenever the air conditioning is used, the PCM engages the auxiliary cooling fan. It provides a ground path to the cooling fan relay.

DIAGNOSIS

The powertrain control module (PCM) will enter a diagnostic trouble code (DTC) number 35 in memory if it detects a problem in the auxiliary cooling fan relay or circuit. This will be read as a flashing signal at the instrument panel mounted Malfunction Indicator Lamp (formerly referred to as the Check Engine Lamp). Refer to On-Board Diagnostics in Group 14, Fuel Systems for information on accessing a DTC.

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures manual for diagnostic information and operation of the DRB scan tool.

REMOVAL

The auxiliary fan is attached to the radiator upper crossmember behind the radiator.

(1) Remove the fan retaining bolts from radiator upper crossmember (Fig. 41).

(2) Disconnect the electric fan connector.

(3) Lift fan straight up and out of vehicle.

INSTALLATION

(1) Align lower retaining tabs of fan shroud with slots in bracket at bottom of radiator. Push fan down into position.

(2) Tighten the mounting bolts to 4 N·m (31 in. lbs.) torque.

(3) Connect auxiliary cooling fan electrical connector.

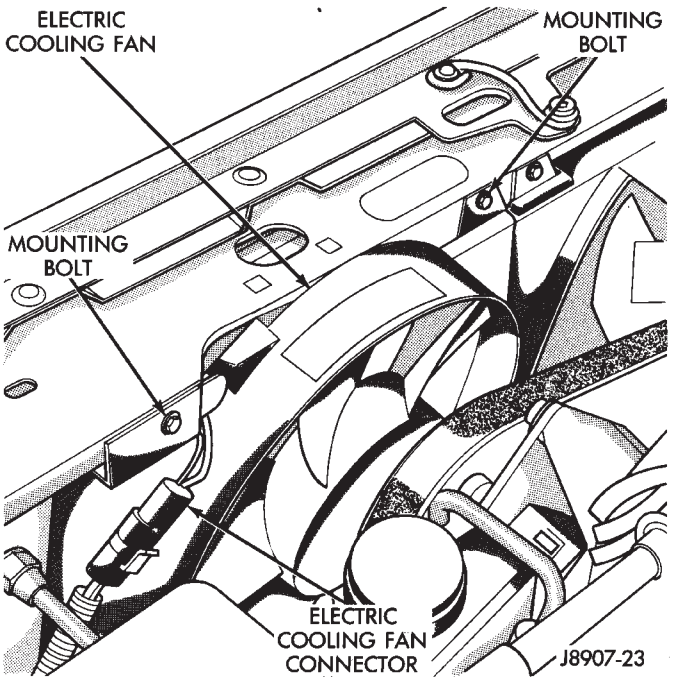

Fig. 41 Auxiliary Fan—Remove/Install

TRANSMISSION OIL COOLERS

WATER-TO-OIL COOLER

All models equipped with an automatic transmission are equipped with a transmission oil cooler mounted internally within the radiator tank. This internal cooler is supplied as standard equipment on all models equipped with an automatic transmission.

Transmission oil is cooled when it passes through this separate cooler. In case of a leak in the internal radiator mounted transmission oil cooler, engine coolant may become mixed with transmission fluid or transmission fluid may enter engine cooling system. Both cooling system and transmission should be drained and inspected if the internal radiator mounted transmission cooler is leaking.

Also refer to the section on Transmission Air-to-Oil Coolers. This auxiliary air-to-oil cooler is an option on most engine packages.

REPLACING WATER-TO-OIL COOLER IN RADIATOR SIDE TANK

The internal transmission oil cooler located within the radiator is not serviceable. If it requires service, the radiator must be replaced.

Once the repaired or replacement radiator has been installed, fill the cooling system and inspect for leaks. Refer to the Refilling Cooling System and Testing Cooling System For Leaks sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and remove the transmission oil pan. Inspect for sludge and/or rust. Inspect for a dirty or plugged inlet filter. If none of these conditions are found, the transmission

and torque convertor may not require reconditioning. Refer to Group 21 for automatic transmission servicing.

AIR-TO-OIL COOLER

An auxiliary air-to-oil transmission oil cooler is available with most engine packages.

On XJ and YJ models, the cooler is located in front of the radiator or A/C condenser (if equipped) and behind the grill (Figs. 42 or 43). It is mounted to the front frame crossmember.

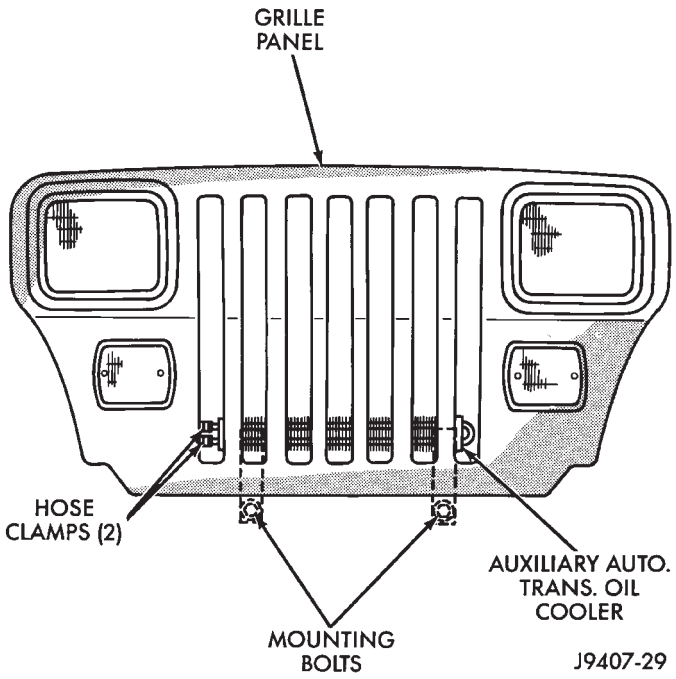

Fig. 42 Auxiliary Air-To-Oil Cooler—YJ Models

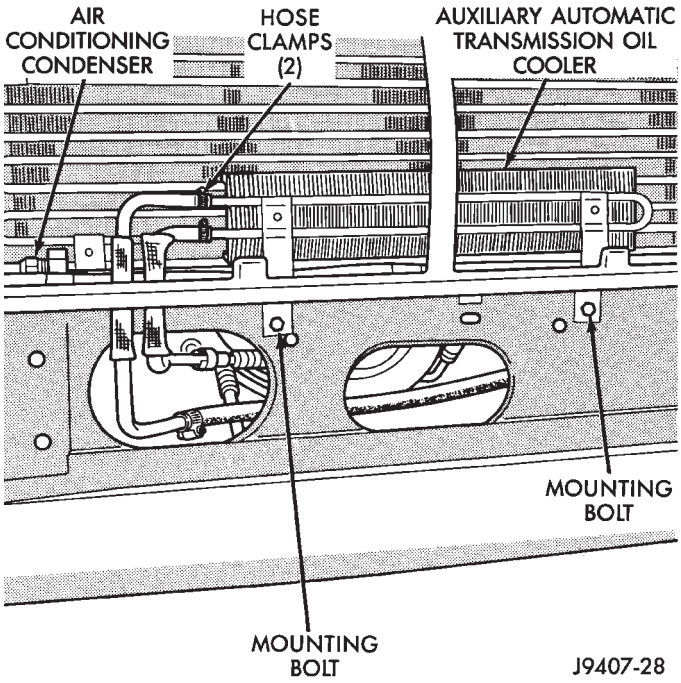

Fig. 43 Auxiliary Air-To-Oil Cooler—XJ Models

The auxiliary oil coolers on all models operate in conjunction with the internal radiator mounted main oil cooler. The transmission oil is routed through the main cooler first, then the auxiliary cooler, before returning to the transmission.

REMOVAL/INSTALLATION—XJ MODELS

(1) Remove the grill. Refer to Group 23, Body.
(2) Place a drain pan below the transmission oil cooler.
(3) Remove the two hose clamps at oil cooler inlet and outlet tubes (Fig. 42).
(4) Remove the two oil cooler mounting bolts (Fig. 42).
(5) Remove the oil cooler from vehicle.
(6) Reverse the preceding operation for installation. Tighten the two clamps 2 N·m (15 in. lbs.) torque.

REMOVAL/INSTALLATION—YJ MODELS

(1) Remove fan shroud and radiator. Refer to Group 7, Cooling for procedures.
(2) Remove the air conditioning filter/drier mounting bolts.

CAUTION: Before proceeding with the next step, be sure to wear safety glasses. The A/C system is under pressure even with the system off.

(3) Remove the A/C condenser mounting bolts (Fig. 44).

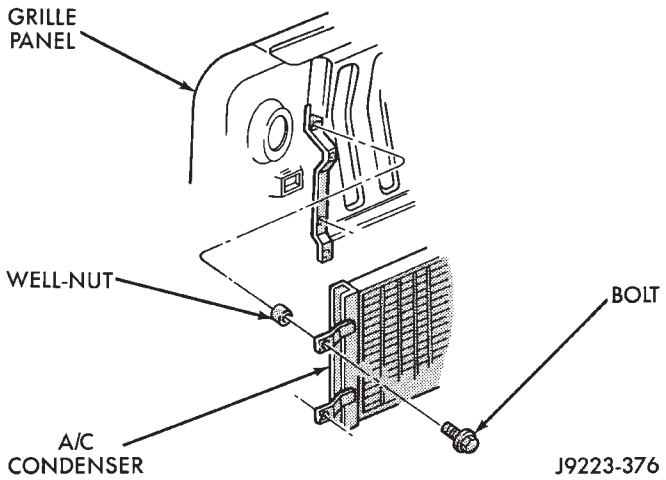

Fig. 44 Condenser Mounting Bolts—YJ Models

(4) Carefully tilt the A/C condenser rearward for access to the auxiliary transmission oil cooler.
(5) Place a drain pan below the oil cooler.
(6) Remove the two hose clamps at oil cooler inlet and outlet tubes (Fig. 43).
(7) Remove the two oil cooler mounting bolts (Fig. 43).
(8) Remove the oil cooler from vehicle.
(9) Reverse the preceding operation for installation. Tighten the two clamps 2 N·m (15 in. lbs.) torque.

ENGINE ACCESSORY DRIVE BELTS

INDEX

GENERAL INFORMATION

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to water pump rotating in wrong direction. Refer to the appropriate engine Belt Schematic in this group for the correct belt routing. Or, refer to the Belt Routing Label located in the engine compartment.

BELT DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 1), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 1). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Serpentine Accessory Drive Belt Diagnosis charts for further belt diagnosis.

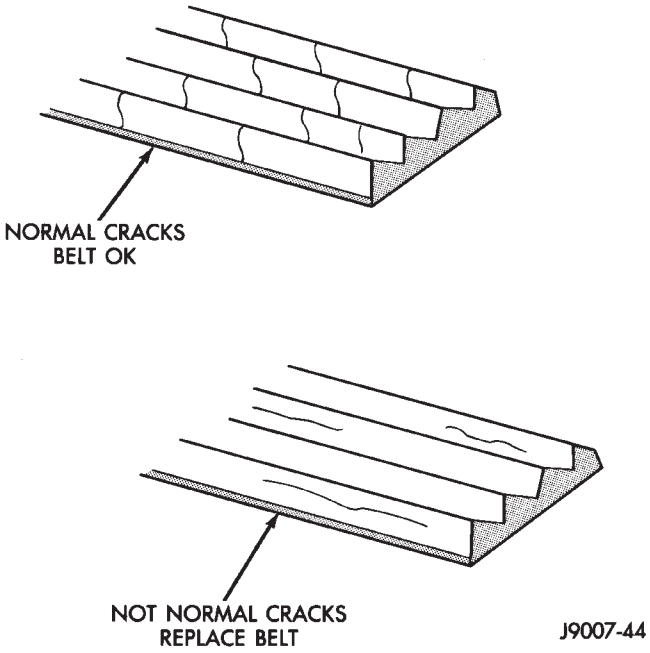

Fig. 1 Serpentine Belt Wear Patterns

SERPENTINE DRIVE BELT DIAGNOSIS

Condition	Possible Cause	Correction
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY)	(1) Foreign objects imbedded in pulley grooves.	(1) Remove foreign objects from pulley grooves. Replace belt.
	(2) Installation damage.	(2) Replace belt.
RIB OR BELT WEAR	(1) Pulley(s) misaligned.	(1) Align pulley(s).
	(2) Abrasive environment.	(2) Clean pulley(s). Replace belt if necessary.
	(3) Rusted pulley(s).	(3) Clean rust from pulley(s).
	(4) Sharp or jagged pulley groove tips.	(4) Replace pulley.
	(5) Rubber deteriorated.	(5) Replace belt.
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	(1) Belt has mistracked from pulley groove.	(1) Replace belt.
	(2) Pulley groove tip has worn away rubber to tensile member.	(2) Replace belt.
BELT SLIPS	(1) Belt slipping because of insufficient tension.	(1) Adjust tension.
	(2) Belt or pulley subjected to substance (belt dressing, oil, ethylene glycol) that has reduced friction.	(2) Replace belt and clean pulleys.
	(3) Driven component bearing failure.	(3) Replace faulty component bearing.
	(4) Belt glazed and hardened from heat and excessive slippage.	(4) Replace belt.
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY)	(1) Belt tension either too high or too low.	(1) Adjust belt tension.
	(2) Pulley(s) not within design tolerance.	(2) Replace pulley(s).
	(3) Foreign object(s) in grooves.	(3) Remove foreign objects from grooves.
	(4) Pulley misalignment.	(4) Align pulley(s).
	(5) Belt cordline is broken.	(5) Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	(1) Excessive tension.	(1) Replace belt and adjust tension to specification.
	(2) Tensile members damaged during belt installation.	(2) Replace belt.
	(3) Severe misalignment.	(3) Align pulley(s).
	(4) Bracket, pulley, or bearing failure.	(4) Replace defective component and belt.
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	(1) Belt slippage.	(1) Adjust belt.
	(2) Bearing noise.	(2) Locate and repair.
	(3) Belt misalignment.	(3) Align belt/pulley(s).
	(4) Belt-to-pulley mismatch.	(4) Install correct belt.

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SERPENTINE DRIVE BELT DIAGNOSIS (CONT.)

Condition	Possible Cause	Correction
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION) (Continued)	(5) Driven component induced vibration.	(5) Locate defective driven component and repair.
	(6) System resonant frequency induced vibration.	(6) Vary belt tension within specifications. Replace belt.
TENSION SHEETING FABRIC FAILURE (WOVEN FABRIC ON OUTSIDE CIRCUMFERENCE OF BELT HAS CRACKED OR SEPARATED FROM BODY OF BELT)	(1) Tension sheeting contacting stationary object.	(1) Correct rubbing condition.
	(2) Excessive heat causing woven fabric to age.	(2) Replace belt.
	(3) Tension sheeting splice has fractured.	(3) Replace belt.
CORD EDGE FAILURE (TENSILE MEMBER EXPOSED AT EDGES OF BELT OR SEPARATED FROM BELT BODY)	(1) Excessive tension.	(1) Adjust belt tension.
	(2) Belt contacting stationary object.	(2) Correct as necessary.
	(3) Pulley(s) out of tolerance.	(3) Replace pulley.
	(4) Insufficient adhesion between tensile member and rubber matrix.	(4) Replace belt and adjust tension to specifications.

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BELT TENSION—EXCEPT RIGHT HAND DRIVE (RHD)

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. There are different types of adjustment gauges for checking either a serpentine or a V-type belt. Refer to the instructions supplied with the gauge. Use the correct gauge when checking belt tension. Place gauge in the middle of the section of belt being tested (between two pulleys) to check tension (Figs. 2, 3, 4 or 5). Do not allow the gauge (or gauge adapter) to contact anything but the belt.

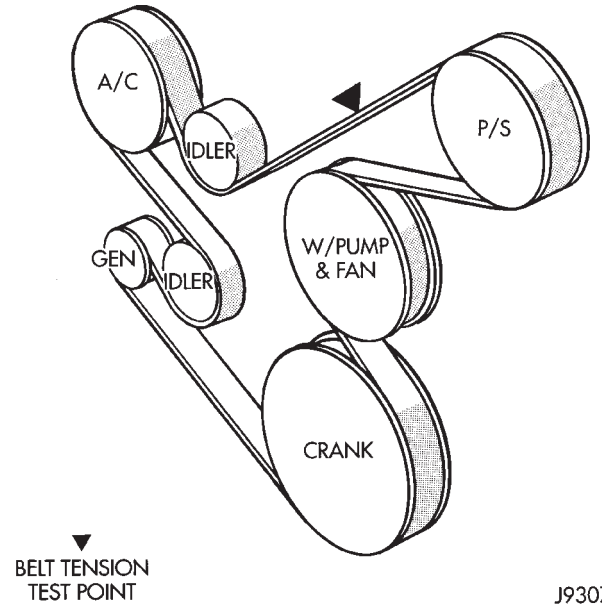


Fig. 2 YJ Models with 4.0L Engine and XJ Models with 2.5L Engine—With A/C

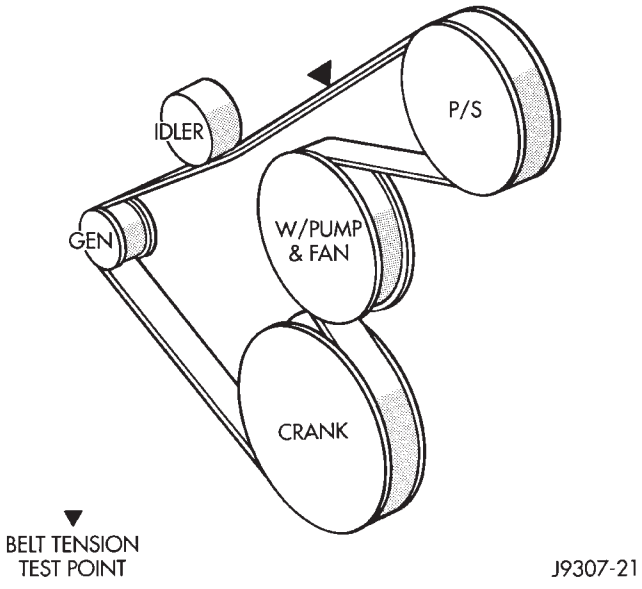


Fig. 3 YJ Models With 2.5L or 4.0L Engine and XJ Models with 2.5L Engine—Without A/C

BELT TENSION—RIGHT HAND DRIVE (RHD)

XJ MODELS WITH 4.0L ENGINE

It is not necessary to adjust belt tension on RHD vehicles if equipped with a 4.0L engine. The engine is equipped with an automatic belt tensioner (Fig. 7). The tensioner maintains correct belt tension at all times. **Due to the use of this belt tensioner, DO NOT attempt to use a belt tension gauge on this engine.**

BELT TENSION SPECIFICATIONS

Refer to the Specifications section at the end of this group.

BELT SCHEMATICS

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.

Refer to figures 2, 3, 4 or 5 for proper belt routing on vehicles with conventional left hand drive. Refer to figure 6 for proper belt routing on vehicles with right hand drive (RHD). Or, refer to the Belt Routing Label located in the vehicle engine compartment.

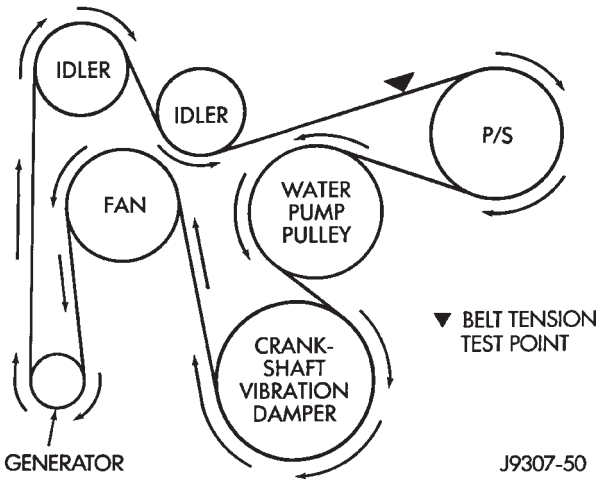


Fig. 4 XJ Models with 4.0L Engine—Without A/C—Except RHD

BELT SERVICE—EXCEPT RIGHT HAND DRIVE

The following procedures are for models equipped with conventional left hand drive. Also refer to Belt Service—With Right Hand Drive.

REPLACEMENT/ADJUSTMENT

Belt tension is adjusted at the power steering pump (or idler pulley if not equipped with power steering). To adjust belt tension or to replace belt:

(1) Loosen two rear power steering pump mounting bolts A (Fig. 8).

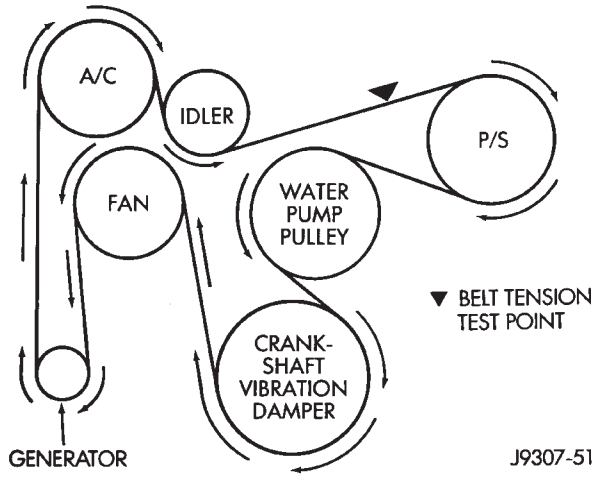


Fig. 5 XJ Models With 4.0L Engine—With A/C—Except RHD

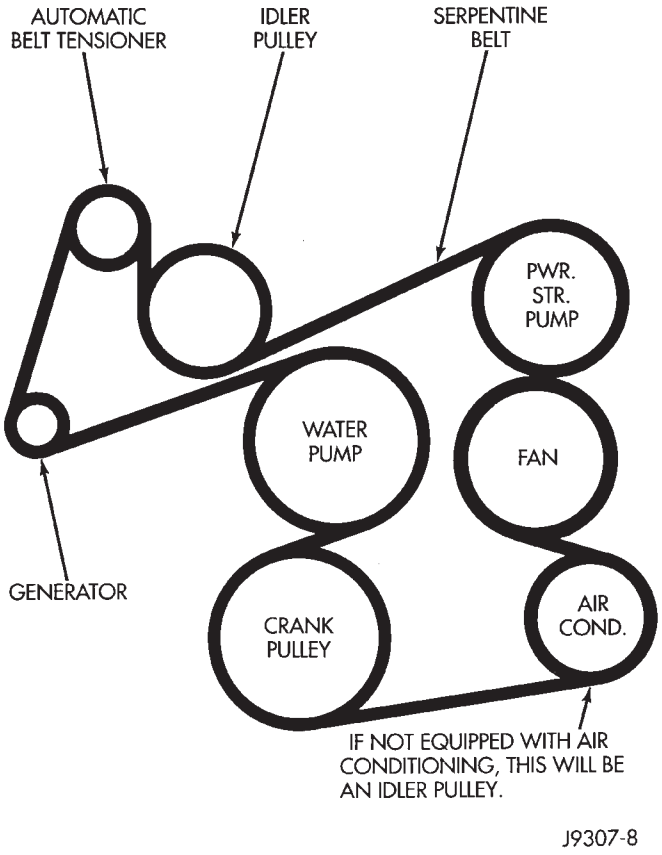


Fig. 6 XJ Models With 4.0L Engine—With A/C—With RHD

(2) Loosen upper pump pivot bolt B and lower lock nut C (Fig. 9).

(3) Loosen pump adjusting bolt D (Fig. 8).

(4) If belt is to be adjusted, refer to Drive Belt Tension specifications at the end of this group for correct tension and proceed to step 7.

If belt is to be replaced, remove belt.

(5) Check condition of all pulleys.

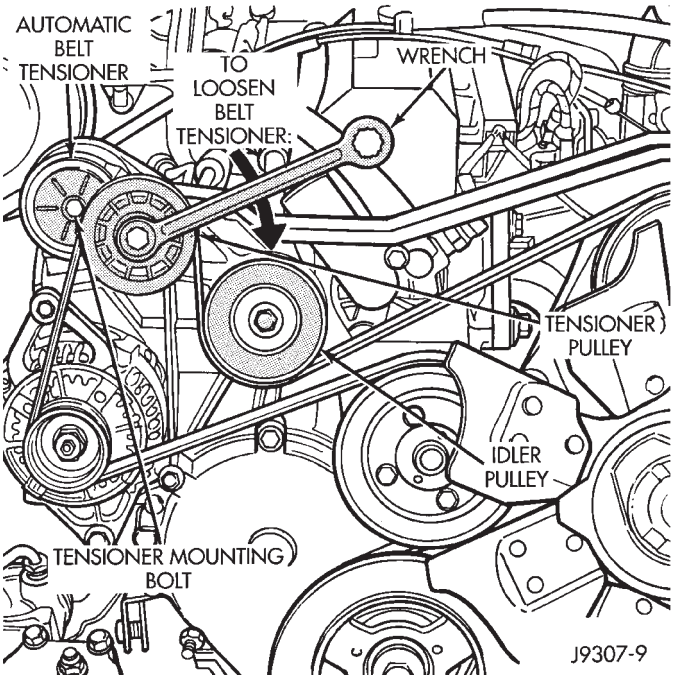


Fig. 7 Automatic Belt Tensioner—4.0L Engine With RHD

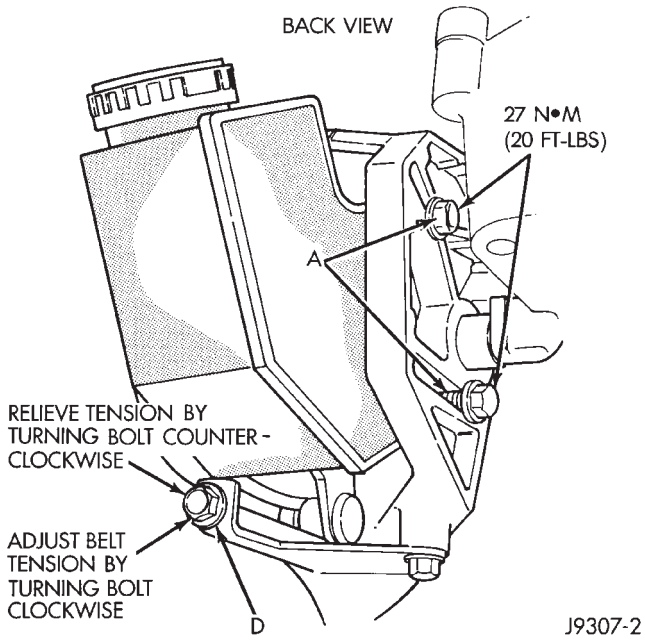


Fig. 8 P.S. Pump Rear Mounting Bolts—Typical

CAUTION: When installing the serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Figs. 2, 3, 4 or 5) for correct belt routing.

(6) Install new belt. Refer to the end of this group for Drive Belt Tension specifications.

(7) Tighten pump adjusting bolt D (Fig. 8) to attain proper belt tension.

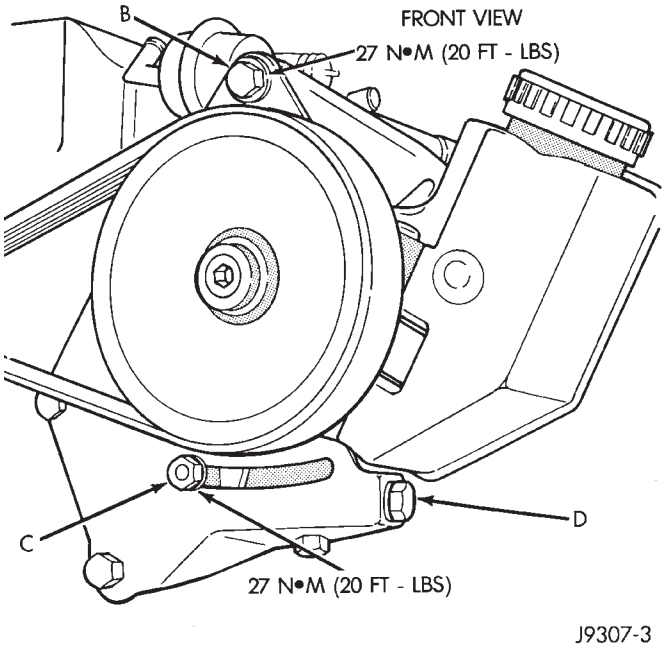


Fig. 9 P.S. Pump Front Mounting Bolt/Locknut—Typical

(8) Tighten rear pump mounting bolts, pivot bolt and lock nut to 27 N·m (20 ft. lbs.) torque.

(9) After power steering pump has been tightened into position, recheck belt tension. Adjust if necessary.

BELT SERVICE—WITH RIGHT HAND DRIVE

The following procedures are for XJ models equipped with right hand drive (RHD) and a 4.0L engine.

REMOVAL

(1) Attach a socket/wrench to the mounting bolt of the automatic tensioner pulley (Fig. 7).

(2) Rotate the tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley (Fig. 7) first. Remove belt from vehicle.

(4) Check condition and alignment of all pulleys.

INSTALLATION

(1) Position the drive belt over all pulleys **except** the idler pulley (Fig. 7).

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Fig. 6) for correct engine belt routing. The correct belt with the correct length must be used

(2) Attach a socket/wrench to the pulley mounting bolt of the automatic tensioner (Fig. 7).

(3) Rotate the socket/wrench clockwise (Fig. 7). Place the belt over the idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated in the grooves of all pulleys.

AUTOMATIC BELT TENSIONER—XJ MODELS

4.0L ENGINE WITH RIGHT HAND DRIVE

The drive belt is equipped with a spring loaded automatic belt tensioner (Fig. 10). This belt tensioner will be used with all belt configurations such as with or without air conditioning.

REMOVAL

(1) Attach a socket/wrench to the mounting bolt of the automatic tensioner pulley (Fig. 10).

(2) Rotate the tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley (Fig. 10) first. Remove belt from automatic tensioner.

(4) Remove tensioner mounting bolt (Fig. 10) from tensioner bracket. Remove tensioner from vehicle. Note alignment pin on the back of tensioner.

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

(5) Remove tensioner pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 90 N·m (65 ft. lbs.) torque.

(2) Install tensioner assembly to mounting bracket. An alignment pin is located on the back of tensioner. Align this pin to the slotted hole in the mounting bracket. Install mounting bolt and tighten to 41 N·m (30 ft. lbs.) torque. If automatic tensioner bracket-to-generator mounting bracket bolts were removed, tighten to 27 N·m (20 ft. lbs.) torque.

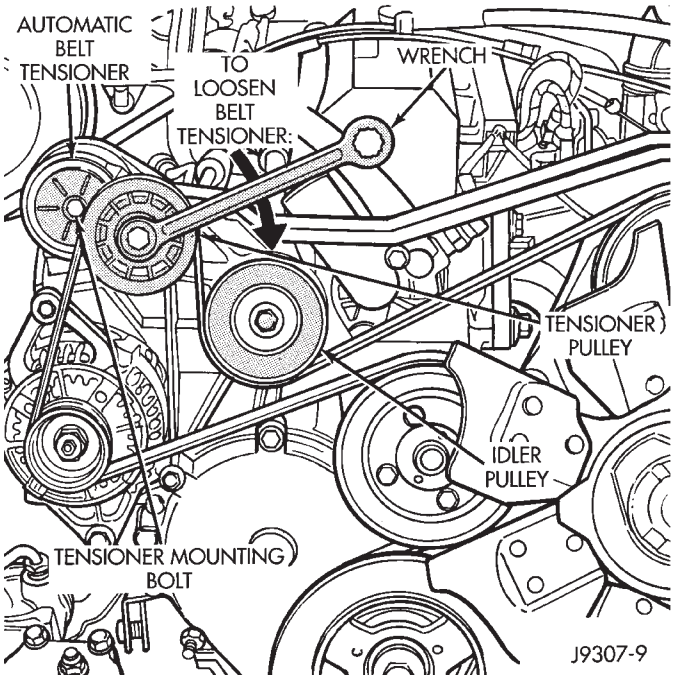


Fig. 10 Automatic Belt Tensioner—4.0L Engine With RHD

(3) Position the drive belt over all pulleys **except** the idler pulley (Fig. 10).

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Fig. 6) for correct engine belt routing. The correct belt with the correct length must be used

(4) Attach a socket/wrench to the pulley mounting bolt of the automatic tensioner (Fig. 10).

(5) Rotate the socket/wrench clockwise (Fig. 10). Place the belt over the idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

ENGINE BLOCK HEATER

GENERAL INFORMATION

DESCRIPTION AND OPERATION

An optional engine block heater is available for all models. The heater is equipped with a power cord. The cord is attached to an engine compartment component with tie-straps. The heater warms the engine providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in a core hole of the engine cylinder block (in place of a freeze plug) with the heating element immersed in engine coolant. Connect the power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three-wire extension cord.

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE.

BLOCK HEATER SPECIFICATIONS

- 2.5L Engine: 115 Volts 400 Watts
- 4.0L Engine: 120 Volts 600 Watts

REMOVAL

Refer to correct illustration (Figures 11, 12 or 13) when servicing block heater.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(1) Drain coolant from radiator and engine cylinder block.

(2) Unplug power cord from block heater.

(3) Loosen screw in center of block heater (Figs. 11, 12 or 13).

(4) Remove block heater from cylinder block.

INSTALLATION

(1) Thoroughly clean the engine core hole and the block heater seat.

(2) Insert block heater assembly into core hole with element loop pointing **Up.**

(3) Seat block heater flush against block face. Tighten mounting screw to 3.6 N·m (32 in. lbs.) torque.

(4) Fill cooling system with coolant. Pressurize system and inspect for leaks.

(5) Plug power cord into block heater. Route cord away from moving parts, linkages and exhaust system components. Secure cord in place with tie-straps.

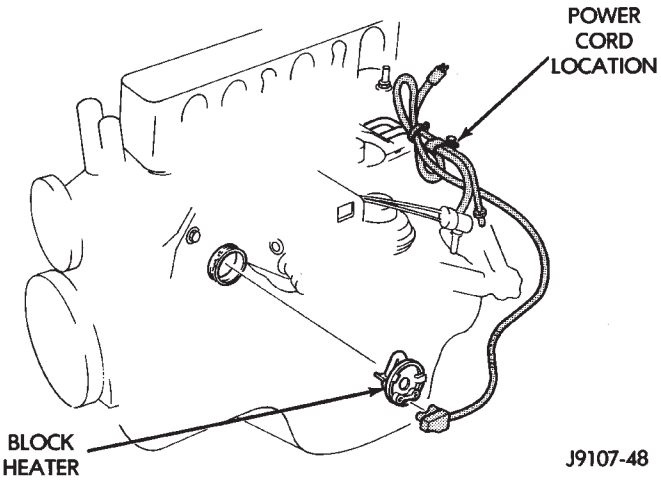


Fig. 11 Heater and Cord—XJ with 2.5L Engine

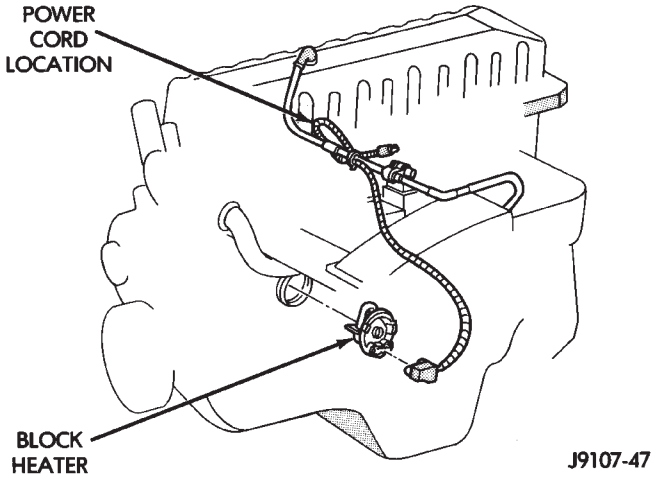


Fig. 12 Heater and Cord—XJ with 4.0L Engine

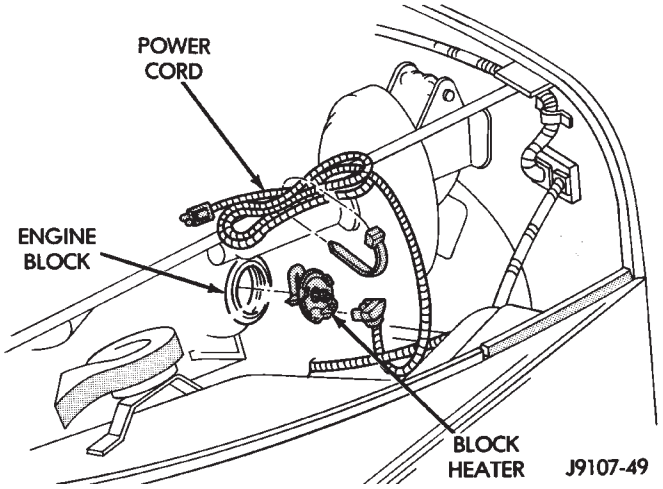


Fig. 13 Heater and Cord—YJ Models

SPECIFICATIONS

GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. **If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label.** The VECI label is located in the engine compartment.

DRIVE BELT TENSION

Belt tension can be adjusted only on models equipped with conventional left hand drive. Refer to the following Belt Tension—Except RHD Models chart for specifications.

It is not necessary to adjust belt tension on right hand drive (RHD) vehicles if equipped with a 4.0L engine. The engine is equipped with an automatic belt tensioner. The tensioner maintains correct belt tension at all times. **Due to the use of this belt tensioner, DO NOT attempt to use a belt tension gauge on this engine.** Refer to Automatic Belt Tensioner for additional information.

BELT TENSION—EXCEPT RHD MODELS

* **800-900 N (180-200 lbs. force)**
(With ** new serpentine belt)

* **623-712 N (140-160 lbs. force)**
(With ** used serpentine belt)

** Belt is considered new if it has been used 15 minutes or less.

* Specifications for use with a belt tension gauge. Refer to operating instructions supplied with gauge.

J9307-54

COOLING SYSTEM CAPACITIES

MODEL	ENGINE		COOLING CAPACITY		COOLING PACKAGE		RADIATOR		A/C	MECHANICAL FAN (VISCOUS DRIVE)			AUXILIARY* ELECTRIC FAN		
	2.5L	4.0L	QTS.	LITERS	STD.	HD.	ROWS OF TUBES	FINS PER INCH		DIA. (INCH)	NO. OF BLADES	BLADE PITCH (INCH)	DIA. (INCH)	NO. OF BLADES	BLADE PITCH (INCH)
XJ	•		10.0	9.5	•		1	15		16.0	5	2.5			
	•		10.0	9.5		•	1	20	•	16.0	5	2.5			
		•	12.0	11.4	•		1	19		15.0	7	1.88			
		•	12.0	11.4	•		1	19	•	15.0	7	1.88	11.0	6	1.75
		•	12.0	11.4		•	2	19		15.0	7	1.88	11.0	6	1.75
		•	12.0	11.4		•	2	19	•	15.0	7	1.88	11.0	6	1.75
YJ	•		9.0	8.5	•		1	15		15.0	5	2.5			
		•	10.5	9.9	•		2	15		17.25	5	2.58			
		•	10.5	9.9	•		2	15	•	17.25	5	2.58			

* 4.0L ENGINE WITH HEAVY DUTY COOLING AND/OR AIR CONDITIONING

J9407-22

TORQUE

DESCRIPTION	TORQUE
Generator Pivot Bolt	38 N•m (28 ft. lbs.)
Generator Rear Adj. Bolt	27 N•m (20 ft. lbs.)
Auto. Trans. Auxiliary Oil Cooler Mtg. Screws 4.0L	2 N•m (18 in. lbs.)
Auxiliary Electric Cooling Fan Mtg. Screws 4.0L	4 N•m (36 in. lbs.)
Condenser-to-Radiator Screws XJ Vehicles W/2.5L Eng	6 N•m (55 in. lbs.)
Fan Blade Assy.-to-Viscous Fan Drive	24 N•m (18 ft. lbs.)
Viscous Fan Drive Assy.-to-Water Pump	27 N•m (20 ft. lbs.)
Fan Shroud Mtg. Bolts XJ W/2.5L	2 N•m (20 in. lbs.)
Fan Shroud Mtg. Screws YJ Vehicle	16 N•m (12 ft. lbs.)
Fan Shroud Mtg. Screws 4.0L Eng.	4 N•m (31 in. lbs.)
Engine Cyl. Block Heater	4 N•m (32 in. lbs.)
Radiator Mtg. Bolts XJ Vehicles	8 N•m (6 ft. lbs.)
Radiator Mounting Bolts XJ with 2.5L	6 N•m (55 in. lbs.)
Thermostat Housing	20 N•m (15 ft. lbs.)
Water Pump 2.5L and 4.0L	30 N•m (22 ft. lbs.)

J9407-24

ELECTRICAL

GROUP INDEX

BATTERY/STARTING/CHARGING SYSTEMS DIAGNOSTICS

CONTENTS

GENERAL INFORMATION

The battery, starting, and charging systems operate with one another, and therefore, must be thoroughly tested as a complete system. In order for the vehicle to start and charge properly, it must have a battery that will perform to specifications. The starter motor, generator, wiring, and electronics also must perform within specifications. Group 8A covers starting (Fig. 1) and charging (Fig. 2) system diagnostic procedures. These procedures include the most basic conventional methods to On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp will be required.

All OBD sensing systems are monitored by the PCM. The PCM will store in memory any detectable failure in the monitored circuits. Refer to Using On-Board Diagnostic System in this group for more information.

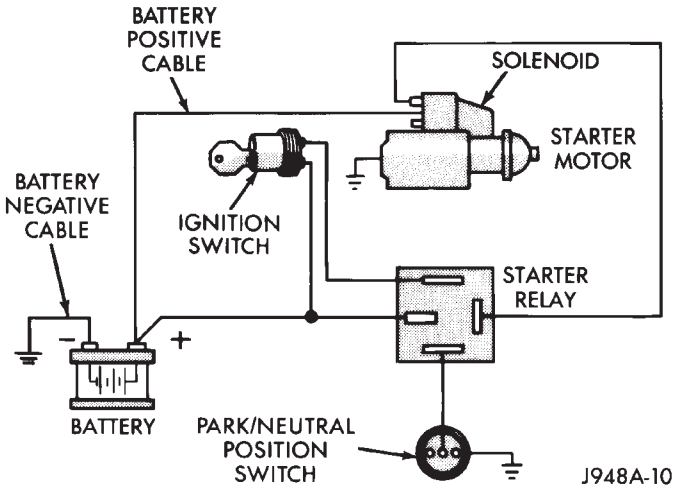


Fig. 1 Starting System Components (Typical)

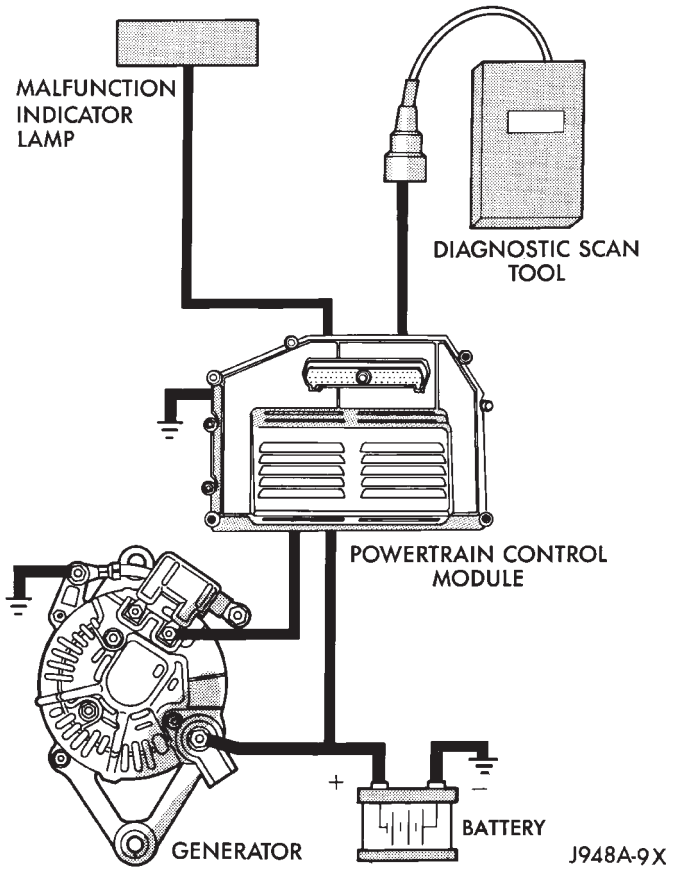


Fig. 2 Charging System Components

BATTERY TEST PROCEDURES

INDEX

GENERAL INFORMATION

The battery stores, stabilizes, and produces electrical current. A battery must be able to accept a charge and produce high-amperage current output over an extended period. A chemical reaction occurs between the sulfuric acid solution (electrolyte) and the lead +/− plates in each cell of the battery. As the battery discharges, the plates collect the acid from the electrolyte. When the charging system charges the battery, water is converted to sulfuric acid in the battery. The amount of acid (specific gravity) in the electrolyte can be measured with a hydrometer. The battery is vented to release gases that are created when the battery is being charged. The battery top, posts, and terminals should be cleaned when other underhood maintenance is performed.

WARNING: DO NOT ATTEMPT TO ASSIST BOOST, CHARGE, OR TEST BATTERY WHEN ELECTROLYTE LEVEL IS BELOW THE TOP OF THE PLATES. PERSONAL INJURY MAY OCCUR.

When the electrolyte level is below the top of the plates distilled water should be added. The battery must be completely charged. The top, posts, and terminals should be properly cleaned before diagnostic procedures are performed. See Group 8B - Battery/Starter/Generator Service, for additional information.

BATTERY TESTING GENERAL INFORMATION

Before testing a battery, clean the top of the battery case, posts and cable terminals.

Specific gravity is a ratio of the density of the electrolyte and the density of pure water. The electrolyte is composed of sulfuric acid and water. Acid makes up approximately 35% of the electrolyte by weight, or 24% by volume.

The condition of a battery may be determined from the results of 2 tests:

- hydrometer test
- ability to supply current (battery load test)

Perform the hydrometer test first. If the specific gravity is less than 1.235, (with battery at room temperature) the battery must be charged before proceeding with further testing. A battery that will not accept a charge is defective and further testing is not necessary.

Completely discharged batteries may take several hours to accept a charge. See Charging Completely Discharged Battery.

A battery that has been fully charged but does not pass the battery load test is defective.

A battery is fully charged when:

- all cells are gassing freely during charging
- 3 corrected specific gravity tests, taken at 1-hour intervals, indicate no increase in specific gravity.

ABNORMAL BATTERY DISCHARGING

(1) Corroded battery posts and terminals.

(2) Loose or worn generator drive belt.

(3) Electrical loads that exceed the output of the charging system due to equipment or accessories installed after delivery.

(4) Slow driving speeds (heavy traffic conditions) or prolonged idling with high-amperage draw systems in use.

(5) Defective circuit or component causing excess IOD. Refer to Ignition Off Draw Diagnosis in this group.

(6) Defective charging system.

(7) Defective battery.

HYDROMETER TEST

Before performing a hydrometer test, remove battery caps and check electrolyte level. Add distilled water as required.

Before testing, visually inspect battery for any damage (cracked case or cover, loose post, etc.) that would cause the battery to be defective. To use the hydrometer correctly, hold it with the top surface of the electrolyte at eye level. Refer to manufacturers instructions for correct use of hydrometer.

Remove only enough electrolyte from the battery to keep the float off the bottom of the hydrometer barrel with pressure on the bulb released. Exercise care when inserting the tip of the hydrometer into a cell to avoid damage to the separators. Damaged separators can cause premature battery failure.

Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at one fixed temperature, 80°F (26.6°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, referred to as 4 points of specific gravity. For each 10°F above 80°F (5.5°C above 26.6°C), add 4 points. For each 10°F below 80°F (5.5°C below 26.6°C), subtract 4 points. Always correct the specific gravity for temperature variation. Test the specific gravity of the electrolyte in each battery cell.

Example: A battery is tested at 10°F (-12.2°C) and has a specific gravity of 1.240. Determine the actual specific gravity as follows:

- Determine the number of degrees above or below 80°F:

  80°F - 10°F = 70°F
- Divide the result above by 10:

  70°F/10 = 7
- Multiply the result from the previous step by the temperature correction factor (0.004):

  7 x 0.004 = 0.028
- The temperature at testing was below 80°F, therefore the temperature correction is subtracted:

  1.240 - 0.028 = 1.212
- The corrected specific gravity is 1.212.

The fully charged battery should have a temperature corrected specific gravity of 1.260 to 1.290.

If the specific gravity of all cells is above 1.235, and cell variation is more than 50 points (0.050), it is an indication that the battery is unserviceable.

If the specific gravity of one or more cells is less than 1.235, charge the battery at a rate of approximately 5 amperes. Continue charging until 3 consecutive specific gravity tests, taken at 1 hour intervals, are constant.

If the cell specific gravity variation is more than 50 points (0.050) after the charge period, replace the battery.

When the specific gravity of all cells is above 1.235 and variation between cells is less than 50 points (0.050), the battery may be tested under heavy load.

BATTERY OPEN CIRCUIT VOLTAGE TEST

A battery voltage (no load) test will show state of charge of a battery that will pass the Battery Load Test described in this section. **Before proceeding with this test or Battery Load Test, completely charge battery as described in Battery Charging in this section.**

If a battery has a no load voltage reading of 12.4 volts or greater and will not endure a load test, it is defective and should be replaced. Refer to Group 8B -

Battery/Starter/Generator Service for instructions. To test battery no load voltage, perform the following operation:

(1) Before measuring open circuit voltage, the surface charge must be removed from plates. Turn headlamps on for 15 seconds then allow up to 5 minutes for voltage to stabilize.

(2) Remove both battery cables, negative first.

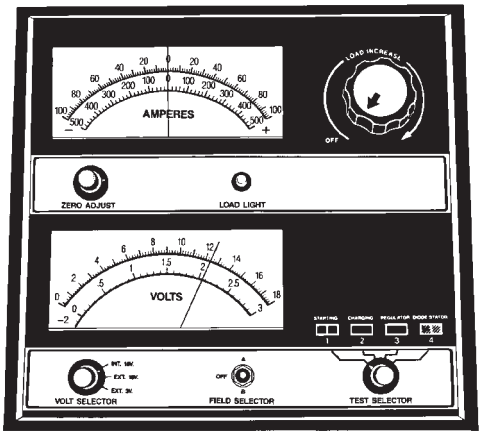
(3) Using a voltmeter connected to the battery posts (see instructions provided with voltmeter) measure open circuit voltage (Fig. 3).

This voltage reading will indicate state of charge, but will not reveal cranking capacity. Refer to Battery Open Circuit Voltage chart.

BATTERY OPEN CIRCUIT VOLTAGE

Open Circuit Volts	Percent Charge
11.7 volts or less	0%
12.0	25%
12.2	50%
12.4	75%
12.6 or more	100%

928A-3



898A-7

Fig. 3 Testing Open Circuit Voltage

BATTERY LOAD TEST

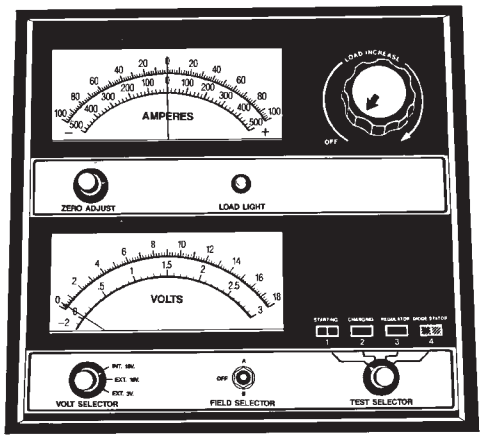
WARNING: IF BATTERY SHOWS SIGNS OF FREEZING, LEAKING, LOOSE POSTS, OR LOW ELECTROLYTE LEVEL, DO NOT TEST. ACID BURNS OR EXPLOSIVE CONDITION MAY RESULT.

A battery load test will verify the cranking ability based on the cold crank amperage rating of the battery.

Before performing battery load test, the battery must be FULLY CHARGED.

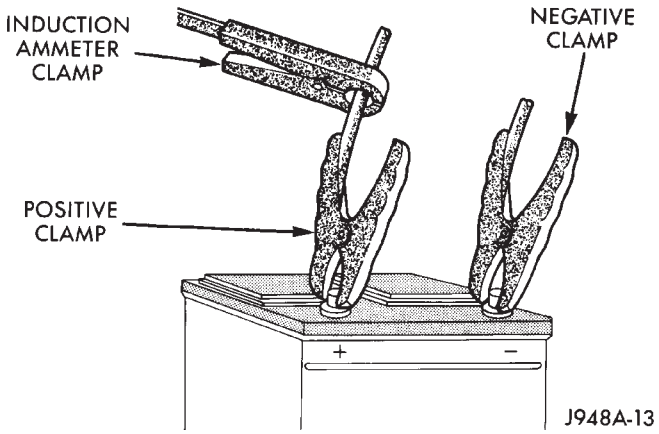
(1) Remove both battery cables, negative first. Battery top and posts should be clean.

(2) Connect a suitable volt-ammeter-load tester (Fig. 4) to the battery posts (Fig. 5). Refer to operating instructions provided with the tester being used. Check the open circuit voltage (no load) of the battery. Voltage should be equal to or greater than 12.4 volts (Fig. 5).



898A-8

Fig. 4 Volt-Amps-Load Tester (Typical)



J948A-13

Fig. 5 Volt-Ammeter-Load Tester Connections

(3) Rotate the load control knob (carbon pile rheostat) to apply a 300 amp load for 15 seconds then return the control knob to OFF (Fig. 6). This will remove the surface charge from the battery.

(4) Allow the battery to stabilize to open circuit voltage (may take up to 5 minutes).

(5) Rotate the load control knob to maintain a load (50% of cold crank amperage rating—see Specifications) for a minimum of 15 seconds (Fig. 7). After 15 seconds, record the (loaded) voltage reading and return the load control knob to OFF.

(6) Voltage drop will vary according to battery temperature at the time of the load test. Battery temperature can be estimated by the ambient temperature over the past several hours. If the battery has been charged, boosted, or loaded a few minutes prior to test, the battery would be somewhat warmer. Refer to Load Test Temperature chart for proper loaded voltage reading.

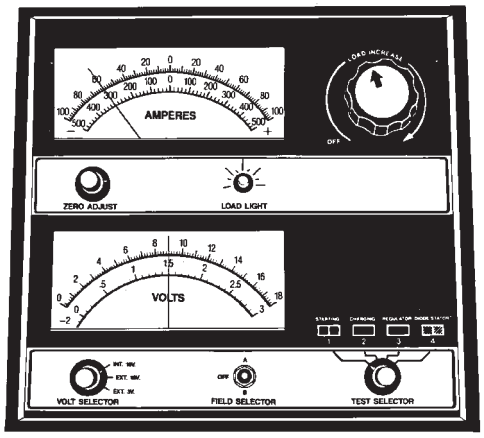


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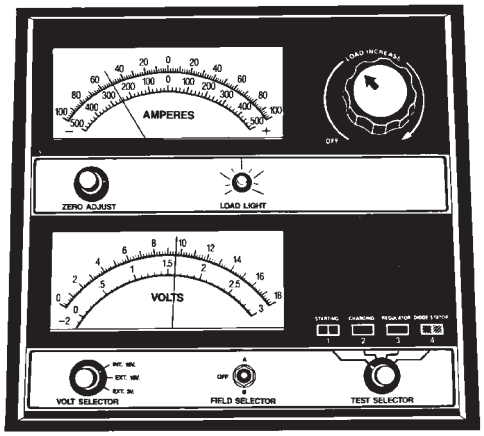
Fig. 6 Remove Surface Charge from Battery



898A-11

Fig. 7 Load 50% Cold Crank Rating Note Voltage

(7) If the voltmeter reading fell below 9.6 volts, with the battery temperature at a minimum of 70°F (21°C), replace the battery.

LOAD TEST TEMPERATURE		
Minimum Voltage	Temperature	
	F°	C°
9.6	70 and above	21 and above
9.5	60	16
9.4	50	10
9.3	40	4
9.1	30	-1
8.9	20	-7
8.7	10	-12
8.5	0	-18

J908A-4

BATTERY CHARGING

A battery is completely charged when it has:

- an open circuit voltage of 12.4 volts or more.
- has enough cranking capacity (minimum 9.6 volts when loaded for 15 seconds to 50% of cold crank amperage rating at 21°C (70°F).

An open circuit voltage of 12.4 volts or greater, indicates battery is charged enough for further testing and possible return to use.

WARNING: DO NOT CHARGE A BATTERY THAT HAS LOW ELECTROLYTE LEVEL. BATTERY MAY ARC INTERNALLY AND EXPLODE.

WARNING: EXPLOSIVE GASES FORM OVER BATTERY, DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR BATTERY.

WARNING: DO NOT ASSIST BOOST OR CHARGE A FROZEN BATTERY, CASING MAY FRACTURE.

WARNING: POISON, CAUSES SEVERE BURNS. BATTERY CONTAINS SULFURIC ACID, AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. IN EVENT OF CONTACT, FLUSH WITH WATER AND CALL PHYSICIAN IMMEDIATELY. KEEP OUT OF REACH OF CHILDREN.

CAUTION: Always disconnect the battery negative cable before charging battery to avoid damage to electrical systems. Do not exceed 16.0 volts while charging battery.

Battery electrolyte will bubble inside case while being charged properly. If the electrolyte boils or is discharged from the vent holes while charging, immediately reduce charging rate or turn OFF charger and evaluate battery condition.

Battery should not be hot to touch.

If the battery feels hot to the touch, turn OFF charger and let cool before restarting.

Some battery chargers are equipped with polarity (+ to +/- to -) sensing devices to protect the charger or battery from being damaged if improperly connected. If the battery state of charge is too low for the polarity sensor to detect, the sensor must be bypassed for charger to operate. Refer to operating instructions provided with battery charger being used.

BATTERY CHARGING TIME TABLE

Charging Amperage	5 Amps	10 Amps	20 Amps
Open Circuit Voltage	Hours Charging at 21°C		
12.25 to 12.39	6 Hrs.	3 Hrs.	1.5 Hr.
12.00 to 12.24	8 Hrs.	4 Hrs.	2 Hrs.
11.95 to 12.09	12 Hrs.	6 Hrs.	3 Hrs.
10.00 to 11.95	14 Hrs.	7 Hrs.	3.5 Hrs.
10.00 to 0	See Charging Completely Discharged Battery		

928A-19

After the battery has been charged to 12.4 volts or greater, perform a load test to determine cranking capacity. If the battery will endure a load test, return the battery to use. If battery will not endure a load test, it must be replaced. Clean and inspect battery holddowns, tray, terminals, posts, and top before completing service, see Group 8B - Battery/Starter/Generator Service.

CHARGING TIME REQUIRED

The time required to charge a battery will vary depending upon the following factors:

(1) **Size of Battery—** A completely discharged large, heavy-duty battery requires more than twice the recharging time as a completely discharged small capacity battery.

WARNING: NEVER EXCEED 20 AMPS WHEN CHARGING A COLD (-1°C/30°F) BATTERY, PERSONAL INJURY MAY RESULT.

(2) **Temperature—** A longer time will be needed to charge a battery at -18°C (0°F) than at 27°C (80°F). When a fast charger is connected to a cold battery, current accepted by battery will be very low at first. Then, in time, the battery will accept a higher rate as battery warms.

(3) **Charger Capacity—** A charger, that supplies only 5 amperes, will require a longer charging time than a charger that supplies 20 amperes or more.

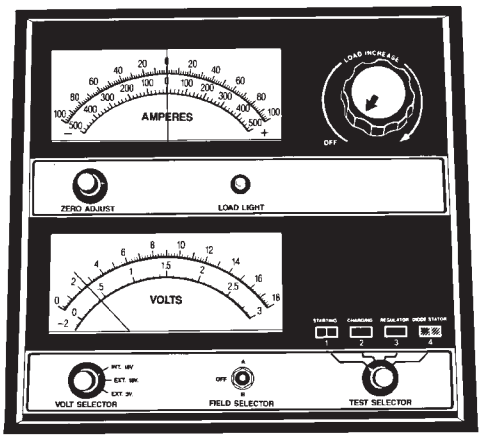
(4) **State Of Charge—** A completely discharged battery requires more charging time than a partially charged battery. Electrolyte is nearly pure water in a completely discharged battery. At first the charging current amperage will be low. As the battery charges the specific gravity of the electrolyte will rise slowly.

CHARGING COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure voltage at battery posts with a voltmeter, accurate to 1/10 volt (Fig. 8). If below 10 volts, then charge current will be low and it could take some time before it accepts a current greater than a few milliamperes. Such low current may not be detectable on ammeters built into many chargers.

(2) Connect charger leads. Some chargers feature polarity protection circuitry that prevents operation unless charger is connected to battery posts correctly. A completely discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly. This makes it appear that battery will not accept charging current. Refer to instructions provided with battery charger being used.



898A-12

Fig. 8 Voltmeter Accurate to 1/10 Volt Connected

(3) Battery chargers vary in the amount of voltage and current they provide. For time required for battery to accept measurable charger current at various voltages, refer to Charge Rate chart. If charge current is still not measurable at end of charging times, the battery should be replaced. If charge current is measurable during charging time, the battery may be good and charging should be completed in the normal manner.

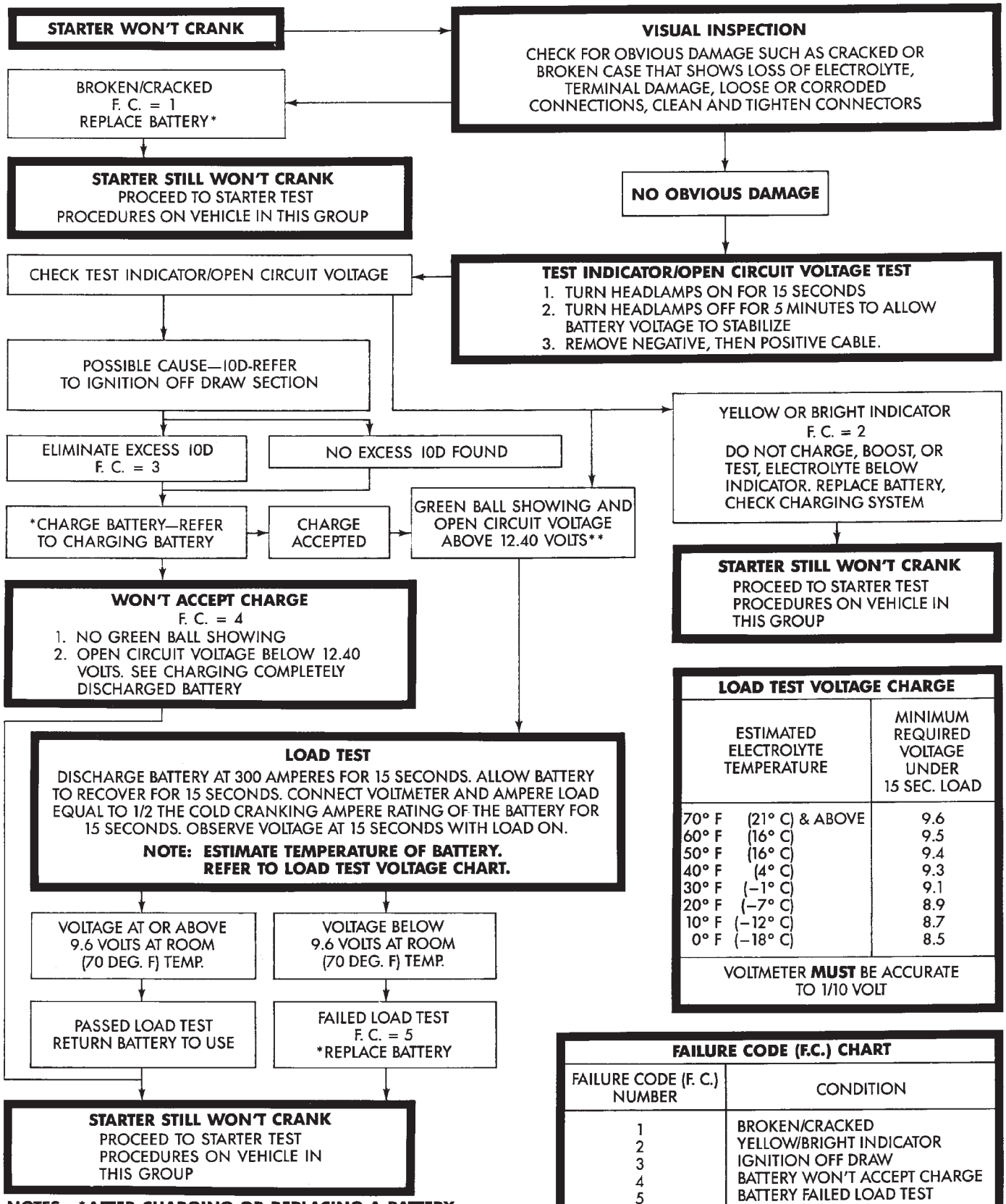
CHARGE RATE

Voltage	Hours
16.0 volts maximum	up to 4 hrs.
14.0 to 15.9 volts	up to 8 hrs.
13.9 volts or less	up to 16 hrs.

J928A-6

BATTERY DIAGNOSTICS CHART

BATTERY DIAGNOSTICS CHART



LOAD TEST VOLTAGE CHARGE	
ESTIMATED ELECTROLYTE TEMPERATURE	MINIMUM REQUIRED VOLTAGE UNDER 15 SEC. LOAD
70° F (21° C) & ABOVE	9.6
60° F (16° C)	9.5
50° F (16° C)	9.4
40° F (4° C)	9.3
30° F (−1° C)	9.1
20° F (−7° C)	8.9
10° F (−12° C)	8.7
0° F (−18° C)	8.5
VOLTMETER **MUST** BE ACCURATE TO 1/10 VOLT	

FAILURE CODE (F.C.) CHART	
FAILURE CODE (F. C.) NUMBER	CONDITION
1	BROKEN/CRACKED
2	YELLOW/BRIGHT INDICATOR
3	IGNITION OFF DRAW
4	BATTERY WON'T ACCEPT CHARGE
5	BATTERY FAILED LOAD TEST

NOTES: *AFTER CHARGING OR REPLACING A BATTERY, CHECK THE VEHICLE'S CHARGING SYSTEM, AND CLEAN AND TIGHTEN BATTERY CONNECTORS (REFER TO APPLICABLE SECTIONS OF THIS SERVICE MANUAL).

****CHECKING OPEN CIRCUIT VOLTAGE WILL MONITOR "GREEN BALL" INDICATION FOR ALL 6 CELLS.**

J938A-22

SPECIFICATIONS

BATTERY CLASSIFICATIONS AND RATINGS

Group Size	Cold Crank AMPS	Reserve Capacity (Min.)	Engine	Vehicle Series
58	430	80	2.5L & 4.0L	All
58	500	85	2.5L, 4.0L	All

J928A-1

TORQUE SPECIFICATIONS

Description	Torque
Battery Strap Screw	2 N•m (20 in. lbs.)
Battery Tray Nut	2 N•m (20 in. lbs.)
Battery Clamp Nut	2 N•m (20 in. lbs.)

J928A-7

IGNITION OFF DRAW (IOD) DIAGNOSIS

GENERAL INFORMATION

Ignition off draw refers to power being drained from the battery with the ignition switch turned off. A normal vehicle electrical system will draw from 5 to 20 milliamps. This is with the ignition switch in the OFF position, and all non-ignition controlled circuits in proper working order. A vehicle that has not been operated for approximately 20 days, may discharge the battery to an inadequate level. Battery drain should not exceed approximately 20 MA (20 milliamps = 0.020 amps).

The 20 MA are needed to supply PCM memory, digital clock memory, and ETR (electronically tuned radio) memory.

Excessive battery drain is caused by items left turned on, internally shorted generator, or intermittent short in wiring.

If the IOD is over 20 milliamperes, the defect must be found and corrected before replacing a battery. In most cases the battery can be charged and returned to service.

When a vehicle will not be used for 20 days or more (stored), remove IOD fuse in the Power Distribution Center to reduce battery discharging.

TEST PROCEDURE

Testing for higher amperage IOD must be performed first to prevent damage to most milliamp meters.

(1) Verify that all electrical accessories are OFF. Turn off all lamps, remove ignition key, and close all doors. If the vehicle is equipped with electronic accessories (illuminated entry, high line radio), allow the systems to automatically shut off (time out), up to 3 minutes.

(2) Determine that the underhood lamp is operating properly, then disconnect or remove bulb.

(3) Disconnect negative cable from battery.

(4) Connect a typical 12-volt test lamp (low wattage bulb) between the negative cable clamp and the battery negative terminal. If equipped with security alarm, cycle the key in the door to turn off the flashing lights. Make sure that the doors remain closed so that illuminated entry is not activated.

The test lamp may light brightly for up to 3 minutes or may not light at all (depending on the electrical equipment). The term brightly being used throughout the following tests, implies the brightness of the test lamp will be the same as if it were connected across the battery.

The test lamp must be securely clamped to the negative cable and battery terminal. If the test lamp becomes disconnected during any part of the IOD test, the electronic timer function will be activated and all tests must be repeated.

If the ammeter circuit is broken the Security Alarm Module will turn on parking lamps.

(5) After 3 minutes, the test lamp should turn OFF or be DIMLY lit (depending on the electrical equipment). If the test lamp remains brightly lit do not disconnect it. Remove each fuse or circuit breaker (refer to Group 8 - Wiring Diagrams) until test lamp is either OFF or DIMLY lit. This will eliminate the higher amperage draw.

If test lamp is still bright after disconnecting each fuse and circuit breaker, disconnect the wiring harness from the generator. Refer to Generator Test Procedures in this group. Do not disconnect the test lamp.

After higher amperage IOD has been corrected, low amperage IOD may be checked.

It is now safe to install milliamp meter to check for low amperage IOD.

(6) With test lamp still connected securely, clamp an ammeter between battery negative terminal and negative battery cable.

Do not open any doors or turn on any electrical accessories with the test lamp disconnected or the meter may be damaged.

(7) Disconnect test lamp. The current draw should not exceed 0.020 amp. If it exceeds 0.020 milliamps, isolate each circuit by removing circuit breakers and fuses. The meter reading drops once the high current problem is found. Repair this section of the circuit, whether it is a wiring short or component failure.

ENGINE STARTER MOTOR TEST PROCEDURES ON VEHICLE

INDEX

GENERAL INFORMATION

The starting system consists of an:

- ignition switch
- starter relay
- park/neutral position switch (automatic transmission)
- wiring harness
- battery
- starter motor with an integral solenoid.

These components form 2 separate circuits. A high amperage circuit that feeds the starter motor up to 300+ amps, and a control circuit that operates on less than 20 amps.

STARTER SYSTEM DIAGNOSTIC INSPECTIONS

Before removing any unit from the starter motor system for repair, perform the following inspections:

BATTERY INSPECTION

To determine condition of the battery, perform the testing procedure outlined in Battery Test Procedures.

WIRING INSPECTION

Inspect wiring for damage. Inspect all connections at the starter motor solenoid, park/neutral position switch (if equipped), back-up lamp switch connector, ignition switch, starter relay, and battery (including all ground connections). Clean and tighten all connections as required.

SOLENOID, RELAY AND IGNITION SWITCH INSPECTION

Inspect the solenoid, relay and switch to determine their condition. Also, if equipped with automatic transmission, inspect condition of the park/neutral position switch. Testing information can be found in the following pages.

STARTING SYSTEM COLD CRANKING TEST

(1) Battery must first pass load and voltage drop tests and be fully charged before proceeding. Refer to Battery Test Procedures.

(2) Connect a suitable volt-ampere tester to the battery terminals (Fig. 1). Refer to the operating instructions provided with the tester being used.

(3) Fully engage parking brake, place manual transmission in NEUTRAL, automatic transmission in PARK.

(4) Verify that all lamps and accessories are OFF.

(5) Remove coil secondary cable from distributor and connect to ground.

(6) Rotate and hold the ignition switch in the START position. Note cranking voltage and amperage.

(a) If voltage reads above 9.6 volts and amperage draw reads above specifications, go to Starter Feed Circuit Tests.

(b) If voltage reads 12.5 volts or greater and amperage reads below specifications, go to Starter Control Circuit Tests.

A cold engine will increase starter motor current and reduce battery voltage.

STARTER FEED CIRCUIT TESTS - (VOLTAGE DROP METHOD)

The voltage drop tests will determine if there is excessive resistance in the high current circuit. When performing these tests, it is important that the voltmeter be connected to the terminals that the cables are connected to, instead of to the cables themselves. For example, when testing between the battery and solenoid, touch the voltmeter test probes to the battery post and the solenoid threaded stud. The following operation will require a voltmeter, accurate to 1/10 of a volt.

Before performing the tests, assure the following procedures are accomplished:

- remove coil secondary cable from distributor and connect to ground
- transmission in NEUTRAL (manual transmission) or PARK (automatic transmission)
- parking brake applied
- battery is fully charged (refer to Battery Test Procedures).

STARTING SYSTEM DIAGNOSIS

TEST CONDITIONS
- PLACE GEAR SELECTOR IN PARK OR NEUTRAL AND SET PARK BRAKE OR EQUIVALENT.
- VERIFY BATTERY STATE-OF-CHARGE AND CRANKING CAPACITY, SEE BATTERY SECTION.
- CLEAN BATTERY TOP, POSTS, AND TERMINALS.
- VERIFY GENERATOR DRIVE BELT TENSION.
- DISCONNECT AND GROUND COIL CABLE.

SYMPTOM	SYMPTOM	SYMPTOM	SYMPTOM	SYMPTOM
STARTER FAILS TO ENGAGE. NO SOUNDS	STARTER FAILS TO ENGAGE SOLENOID OR RELAY CLICKS	STARTER ENGAGES, FAILS TO TURN ENGINE. DOME LIGHT DIMS	STARTER ENGAGES DRIVE CLUTCH SPINS OUT	STARTER DOES NOT DISENGAGE AFTER ENGINE STARTS
POSSIBLE CAUSE	**POSSIBLE CAUSE**	**POSSIBLE CAUSE**	**POSSIBLE CAUSE**	**POSSIBLE CAUSE**
STARTER CONTROL CIRCUIT FAULTY	RESISTANCE TOO HIGH IN STARTER FEED CIRCUIT	RESISTANCE TOO HIGH IN STARTER FEED CIRCUIT	DRIVE CLUTCH FAULTY	IGNITION SWITCH FAULTY
IGNITION SWITCH FAULTY	STARTER CONTROL CIRCUIT FAULTY	STARTER ASSEMBLY FAULTY	BROKEN TEETH ON RING GEAR	STARTER RELAY FAULTY
PARK/NEUTRAL POSITION SWITCH (AUTO TRANS.) FAULTY OR MISADJUSTED	STARTER SOLENOID FAULTY	ENGINE SEIZED	STARTER ASSEMBLY FAULTY	STARTER ASSEMBLY FAULTY
STARTER RELAY FAULTY	STARTER ASSEMBLY FAULTY			STARTER IMPROPERLY MOUNTED
STARTER ASSEMBLY FAULTY		REFER TO APPROPRIATE GROUP AND SECTION OF THIS MANUAL FOR PROPER SERVICE AND TEST PROCEDURES FOR THE COMPONENTS INVOLVED		

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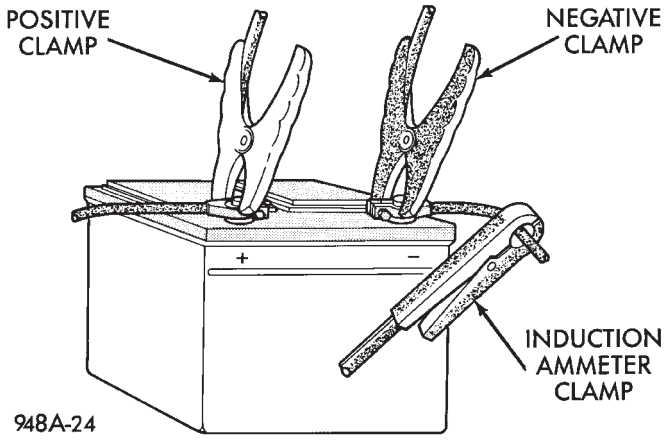


Fig. 1 Volt-Amps Tester Connections (Typical)

(1) Connect positive lead of voltmeter to battery negative post. Connect negative voltmeter lead to battery negative cable clamp (Fig. 2). Rotate and hold ignition switch in the START position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and post.

(2) Connect positive lead of voltmeter to battery positive post. Connect negative lead to battery cable positive clamp (Fig. 2). Rotate and hold ignition switch in the START position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and post.

(3) Connect a voltmeter to measure between the battery positive post and the center of the B+ starter solenoid stud (Fig. 3).

(4) Rotate and hold ignition switch in the START position. If voltage reads above 0.2 volt, correct poor

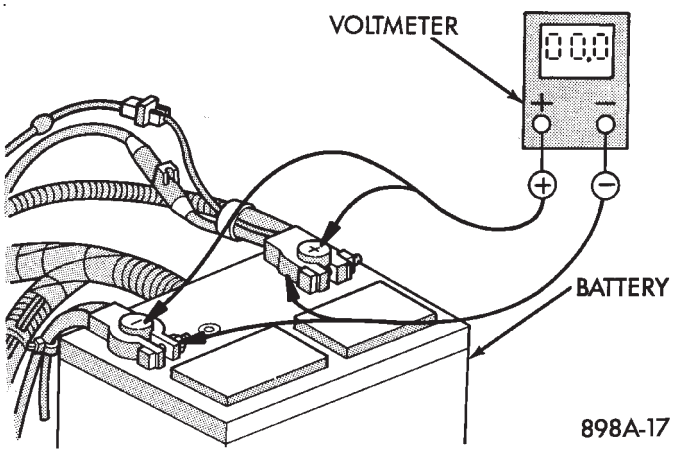


Fig. 2 Test Battery Connection Resistance

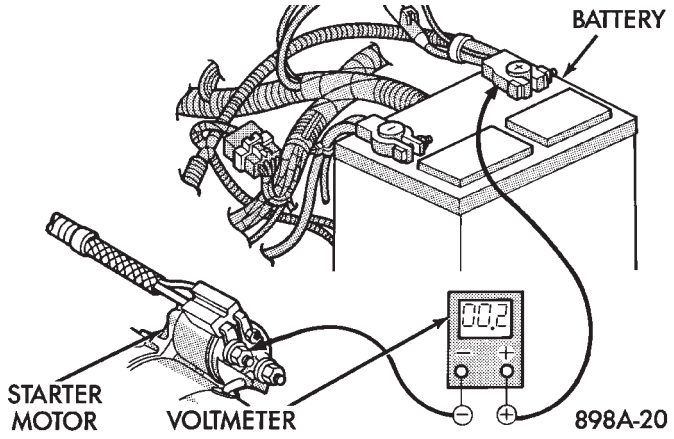


Fig. 3 Test Positive Battery Cable Resistance (Typical)

contact at battery cable to solenoid connection. If reading is still above 0.2 volt, replace positive battery cable.

(5) Connect voltmeter to measure between the battery negative post and the engine block (Fig. 4).

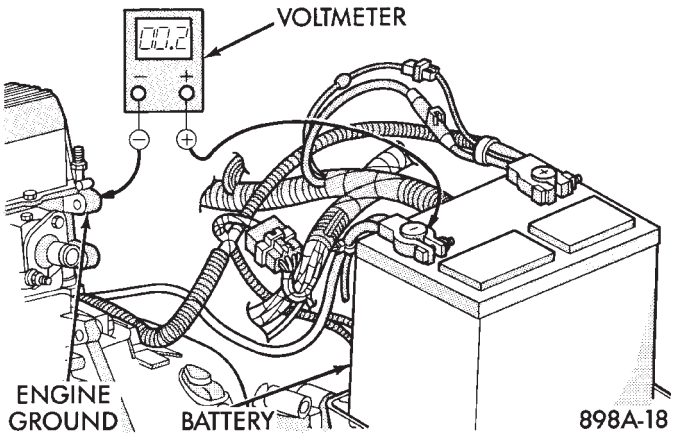


Fig. 4 Test Ground Circuit Resistance

(6) Rotate and hold ignition switch in the START position. If voltage reads above 0.2 volt, correct poor contact at ground cable attaching point. Voltage reading still above 0.2 volt, replace ground cable.

(7) Connect positive voltmeter lead to starter motor housing. Connect negative lead to battery negative terminal (Fig. 5).

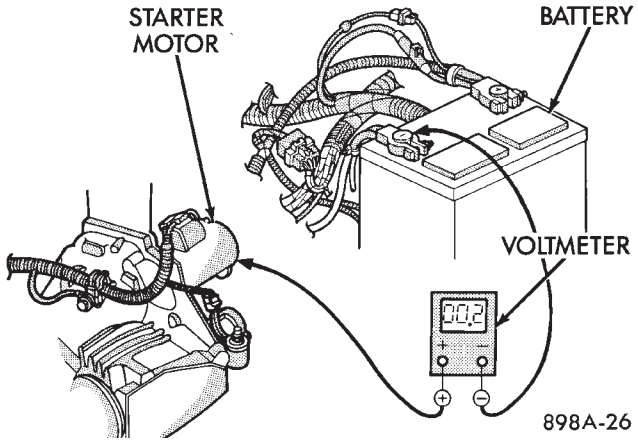


Fig. 5 Test Starter Motor Ground (Typical)

(8) Rotate and hold ignition switch in the START position. If voltage reads above 0.2 volt, correct poor starter to engine ground.

If resistance tests detect no feed circuit failures, remove the starter motor and go to Solenoid Testing.

STARTER CONTROL CIRCUIT TESTS

The starter control circuit consists of a starter solenoid, starter relay, ignition switch, park/neutral position switch (automatic transmission), and all their wiring and connections.

Testing procedures for these components are as follows and should be followed in order as described.

CAUTION: Before performing any test, disconnect distributor connector to prevent engine from starting.

SOLENOID TESTING

Refer to Group 8B - Battery/Starter/Generator Service for starter removal procedures.

(1) Disconnect field coil wire from field coil terminal.

(2) Check for continuity between solenoid terminal and field coil terminal with a continuity tester. There should be continuity (Fig. 6).

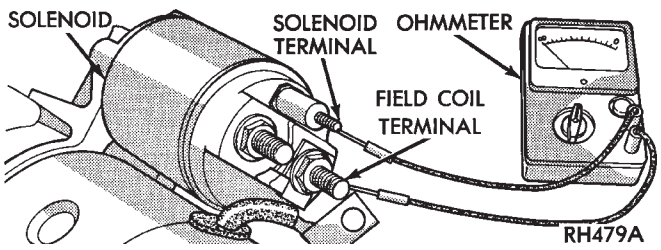


Fig. 6 Continuity Test Between Solenoid Terminal and Field Coil Terminal

(3) Check for continuity between solenoid terminal and solenoid housing. There should be continuity (Fig. 7).

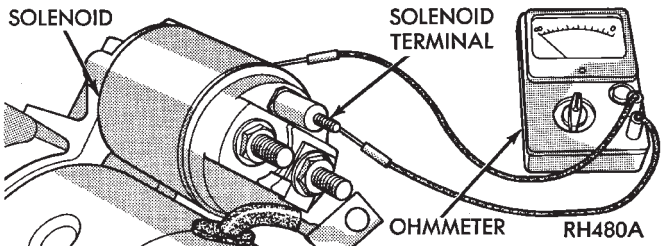


Fig. 7 Continuity Test Between Solenoid Terminal and Solenoid Case

(4) If there is continuity, solenoid is good. If there is no continuity in either test, solenoid has an open circuit and is defective. Replace starter motor.

(5) Install starter as described in Group 8B.

(6) Connect field coil wire to field coil terminal.

STARTER RELAY OPERATION/TESTING

The starter relay is in the Power Distribution Center (Figs. 8 and 9). Refer to the underside of the Power Distribution Center cover for relay location.

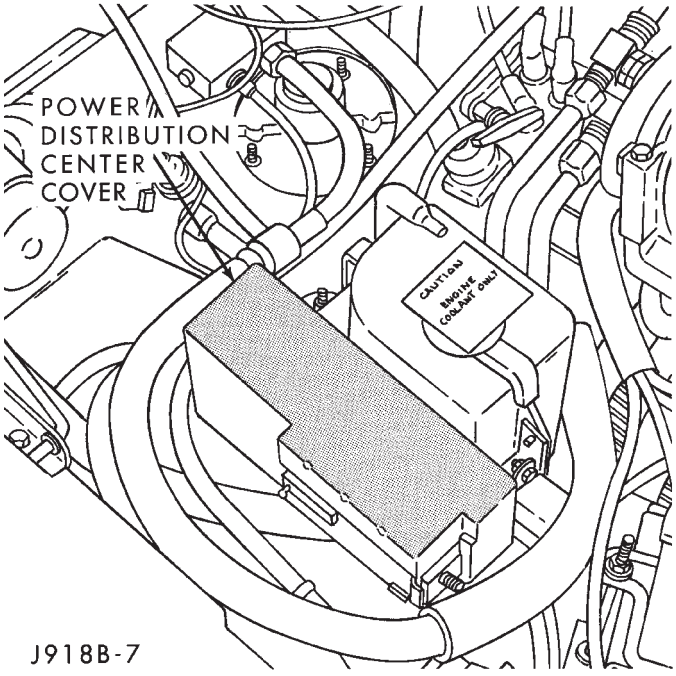


Fig. 8 Power Distribution Center—XJ

OPERATION

- Terminal No. 30 is usually connected to battery voltage and can be switched or B+ at all times.
- Terminal No. 87A is connected to terminal 30 in the de-energized position.
- Terminal No. 87 is connected to terminal 30 in the energized position which supplies battery voltage to the operated device.
- Terminal No. 86 is connected to the electromagnet and usually connected to a switched power source.

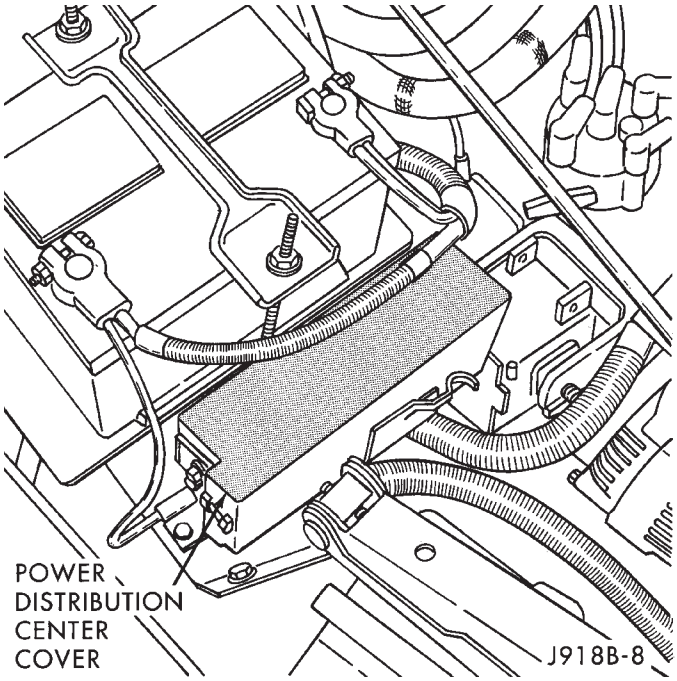
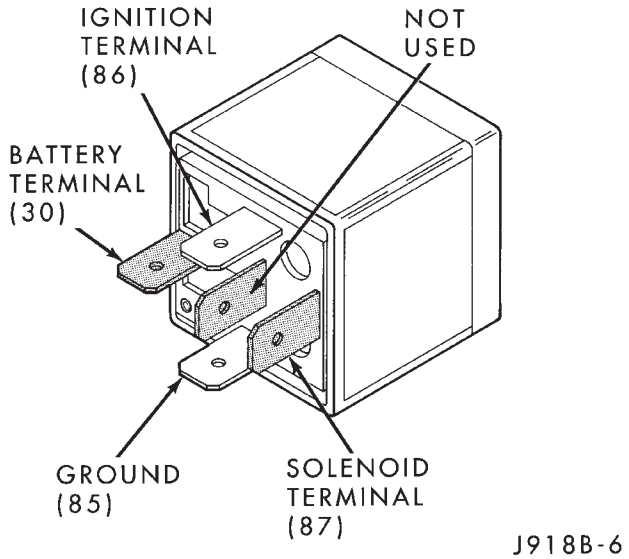


Fig. 9 Power Distribution Center—YJ

STARTER RELAY CONNECTIONS



- Terminal No. 85 is connected to the electromagnet and is usually grounded by a switch or Powertrain Control Module.

TESTING

Remove relay from Power Distribution Center to perform the following tests.

- A relay in the de-energized position should have continuity between terminal 87A and terminal 30.
- Resistance value between terminals 85 and 86 (electromagnet) is 75 ±5 ohms.
- Connect a battery to terminals 85 and 86. There should be continuity between terminal 30 and 87.

IGNITION SWITCH TEST

After testing starter solenoid and relay and they check out OK, trouble is probably with ignition switch or its wiring.

Check all wiring for opens and shorts, and connections for being loose or corroded.

PARK/NEUTRAL POSITION SWITCH

Refer to Group 21 - Transmissions for diagnostic information.

2.5L STARTER MOTOR NOISE DIAGNOSIS

If the complaint is similar to Conditions No. 1 and No. 2 of chart below, correction can be achieved by proper "shimming" according to the following procedures:

- Disconnect the battery negative cable (to prevent inadvertent starting of engine).

Two shim thicknesses are available. One is 0.381 mm (0.015 in.) and the other is 1.143 mm (0.045 in.).

If the complaint is similar to Condition No. 1, the starter motor must be moved toward the flywheel/driveplate using thinner shims (Fig. 10).

This is generally a condition that causes broken flywheel/driveplate ring gear teeth or broken starter motor housings.

If the complaint is similar to Condition No. 2, the starter motor must be moved away from the flywheel/driveplate. This is done by installing shim(s) across both mounting pads. More than one shim may be required.

CONDITION	POSSIBLE CAUSE	CORRECTION
1. VERY HIGH FREQUENCY WHINE BEFORE ENGINE STARTS; ENGINE STARTS OK.	1. Excessive distance between pinion gear and flywheel/drive plate gear.	1. Shim starter motor toward flywheel/drive plate.
2. VERY HIGH FREQUENCY WHINE AFTER ENGINE STARTS WITH IGNITION KEY RELEASED. ENGINE STARTS OK.	2. Insufficient distance between starter motor pinion gear and flywheel/drive plate runout can cause noise to be intermittent.	2. Shim starter motor away from flywheel/drive plate. Inspect flywheel/drive plate for damage; bent, unusual wear, and excessive runout. Replace flywheel/drive plate as necessary.
3. A LOUD "WHOOP" AFTER ENGINE STARTS WHILE STARTER MOTOR IS ENGAGED.	3. Most probably cause is defective overrunning clutch.	3. Replace starter motor.
4. A "RUMBLE," "GROWL," OR "KNOCK" AS STARTER MOTOR COASTS TO STOP AFTER ENGINE STARTS.	4. Most probable cause is bent or unbalanced starter motor armature.	4. Replace starter motor.

NOTE: A high frequency whine during cranking is normal for this starter motor.

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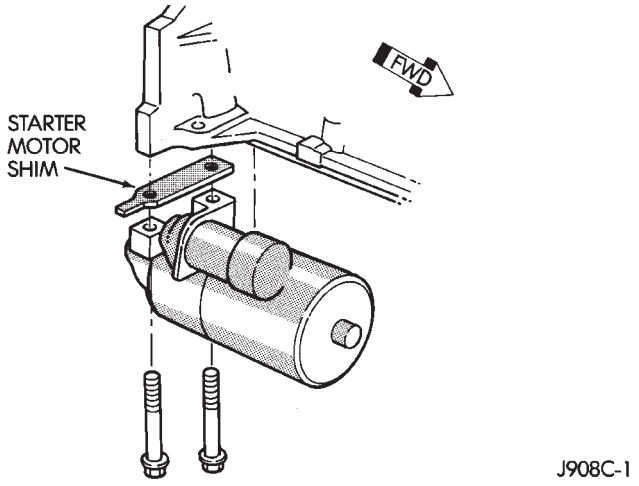


Fig. 10 Starter Motor Shimming

GENERATOR TEST PROCEDURES ON VEHICLE

INDEX

GENERAL INFORMATION

The generator is belt-driven by the engine. All engines use serpentine drive.

The amount of DC current produced by the generator is controlled by the Powertrain Control Module (PCM) (Fig. 1).

All vehicles are equipped with On-Board Diagnostics (OBD). All OBD sensing systems are monitored by the PCM. The PCM will store in electronic memory any detectable failure within the monitored circuits. Refer to Using On-Board Diagnostic System in this group for more information.

OPERATIONAL CHECK WITH BATTERY INDICATOR (BASE CLUSTER ONLY)

When operating normally, the indicator bulb will come on when the ignition switch is turned to the ON or START position. After the engine starts, the indicator bulb goes off. With the engine running, the charge indicator should come on only when there is a problem in the charging system (base cluster only).

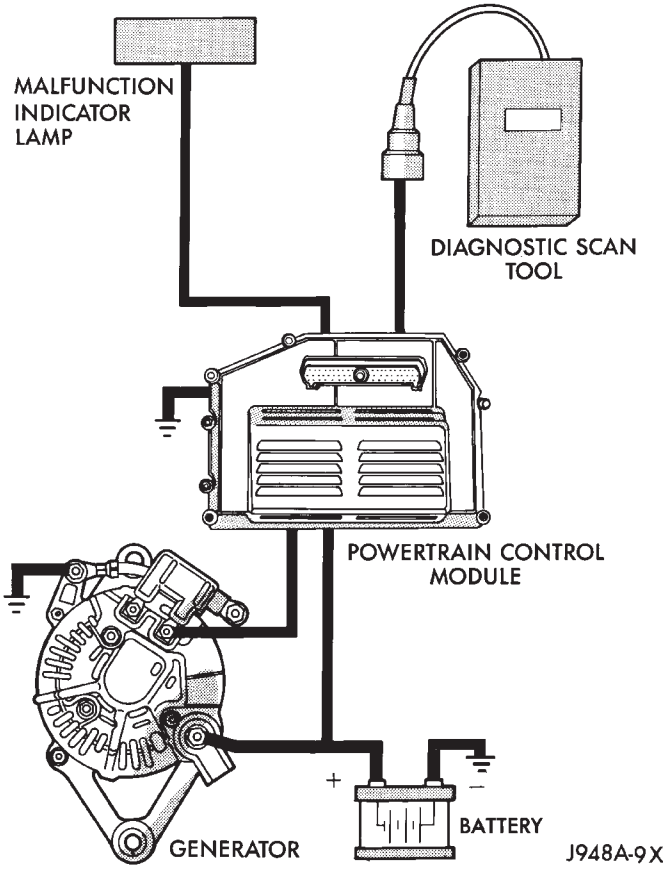


Fig. 1 Charging System Components (Typical)

OPERATIONAL CHECK WITH VOLTMETER

When the ignition switch is turned to the ON position, battery potential will register on the voltmeter. During engine cranking a lower voltage will appear on the meter. With the engine running, a voltage reading higher than the first reading (ignition in ON) should register.

DIAGNOSTIC PROCEDURES

If the indicator operates abnormally, or if an undercharged or overcharged battery condition occurs, the following procedures may be used to diagnose the charging system.

Remember that an undercharged battery is often caused by:

- accessories being left on overnight
- or by a defective switch which allows a bulb, such as a liftgate or glove box light, to stay on (refer to Ignition Off Draw Diagnosis).

VISUAL INSPECTION

- Inspect condition of battery cable terminals, battery posts, connections at engine block, starter motor solenoid and relay. They should be clean and tight. Repair as required.
- Inspect all fuses in the fuse block for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.
- Inspect the electrolyte level in the battery and add water if necessary.
- Inspect generator mounting bolts for tightness. Replace or torque bolt as required. Refer to Torque Specifications in Battery/Starter/Generator Service.
- Inspect generator drive belt condition and tension. Tension or replace belt as required. Refer to Belt Tension Specifications in Battery/Starter/Generator Service.
- Inspect connection at generator B+ output. It should be clean and tight. Repair as required.

GENERATOR OUTPUT WIRE RESISTANCE TEST

Generator output wire resistance test will show amount of voltage drop across generator output wire between generator battery terminal and battery positive post.

PREPARATION

(1) Before starting test make sure vehicle has a fully charged battery. Test and procedures on how to check for a fully charged battery are shown in Battery Test Procedures.

(2) Turn OFF ignition switch.

(3) Disconnect negative cable from battery.

(4) Disconnect generator output wire from generator output battery terminal.

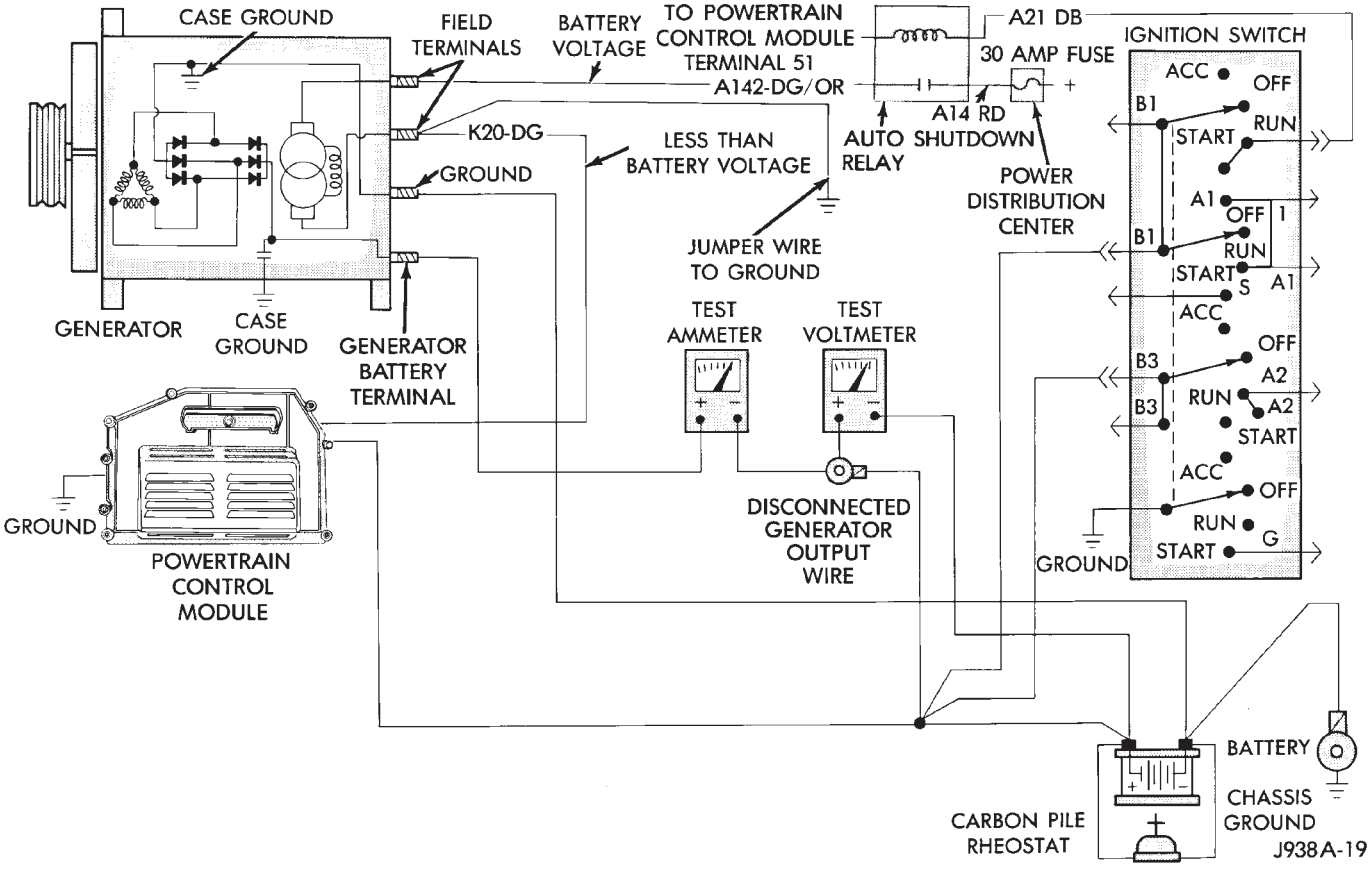


Fig. 2 Generator Output Wire Resistance Test (Typical)

(5) Connect a 0-150 ampere scale D.C. ammeter in series between generator battery terminal and disconnected generator output wire (Fig. 2). Connect positive lead to generator battery terminal and negative lead to disconnected generator output wire.

(6) Connect positive lead of a test voltmeter (range 0-18 volts minimum) to disconnected generator output wire. Connect negative lead of test voltmeter to battery positive cable at positive post.

(7) Connect one end of a jumper wire to ground and with other end probe green K20 lead wire at back of generator (Fig. 2). This will generate a DTC.

CAUTION: Do not connect green/orange A142 lead of wiring to ground. Refer to Group 8W - Wiring Diagrams for more information.

(8) Connect an engine tachometer and connect negative cable to battery.

(9) Connect a variable carbon pile rheostat between battery terminals. Be sure carbon pile is in OPEN or OFF position before connecting leads. See Load Testing in Battery Test Procedures for instructions.

TEST

(1) Start engine. Immediately after starting, reduce engine speed to idle.

(2) Adjust engine speed and carbon pile to maintain 20 amperes flowing in circuit. Observe voltmeter reading. Voltmeter reading should not exceed 0.5 volts.

RESULTS

If a higher voltage drop is indicated, inspect, clean and tighten all connections between generator battery terminal and battery positive post. A voltage drop test may be performed at each connection to locate connection with excessive resistance. If resistance tested satisfactorily, reduce engine speed, turn OFF carbon pile and turn OFF ignition switch.

(1) Disconnect negative cable from battery.

(2) Remove test ammeter, voltmeter, carbon pile, and tachometer.

(3) Remove jumper wire.

(4) Connect generator output wire to generator battery terminal. Tighten to 5 to 6 N•m (45 to 75 in. lbs.).

(5) Connect negative cable to battery.

(6) Use DRB scan tool to erase DTC.

GENERATOR OUTPUT TEST

Generator output test determines whether generator can deliver its rated current output.

PREPARATION

(1) Before starting any tests make sure vehicle has a fully charged battery. Test and procedures on how to check for a fully charged battery are shown in Battery Test Procedures.

(2) Disconnect negative cable from battery.

(3) Disconnect generator output wire at the generator battery terminal.

(4) Connect a 0-150 ampere scale D.C. ammeter in series between generator battery terminal and disconnected generator output wire (Fig. 3). Connect positive lead to generator battery terminal and negative lead to disconnected generator output wire.

(5) Connect positive lead of a test voltmeter (range 0-18 volts minimum) to generator battery terminal.

(6) Connect negative lead of test voltmeter to a good ground.

(7) Connect an engine tachometer and connect battery negative cable.

(8) Connect a variable carbon pile rheostat between battery terminals. Be sure carbon pile is in OPEN or OFF position before connecting leads. See Load Testing in Battery Test Procedures.

(9) Connect one end of a jumper wire to ground and with other end probe green K20 lead wire at back of generator (Fig. 3). This will generate a DTC.

CAUTION: Do not connect green/orange A142 lead of wiring to ground. Refer to Group 8W - Wiring Diagrams for more information.

TEST

(1) Start engine. Immediately after starting reduce engine speed to idle.

(2) Adjust carbon pile and engine speed in increments until a speed of 1250 rpm and voltmeter reading of 15 volts is obtained.

CAUTION: Do not allow voltage meter to read above 16 volts.

(3) The ammeter reading must be within limits shown for that size of generator being tested. See Generator Specifications in Battery/Starter/Generator Service.

RESULTS

(1) If reading is less than specified and generator output wire resistance is not excessive, generator should be replaced. Refer to Group 8B - Battery/Starter/Generator Service.

(2) After current output test is completed reduce engine speed, turn OFF carbon pile and turn OFF ignition switch.

(3) Disconnect negative cable from battery.

(4) Remove test ammeter, voltmeter, tachometer and carbon pile.

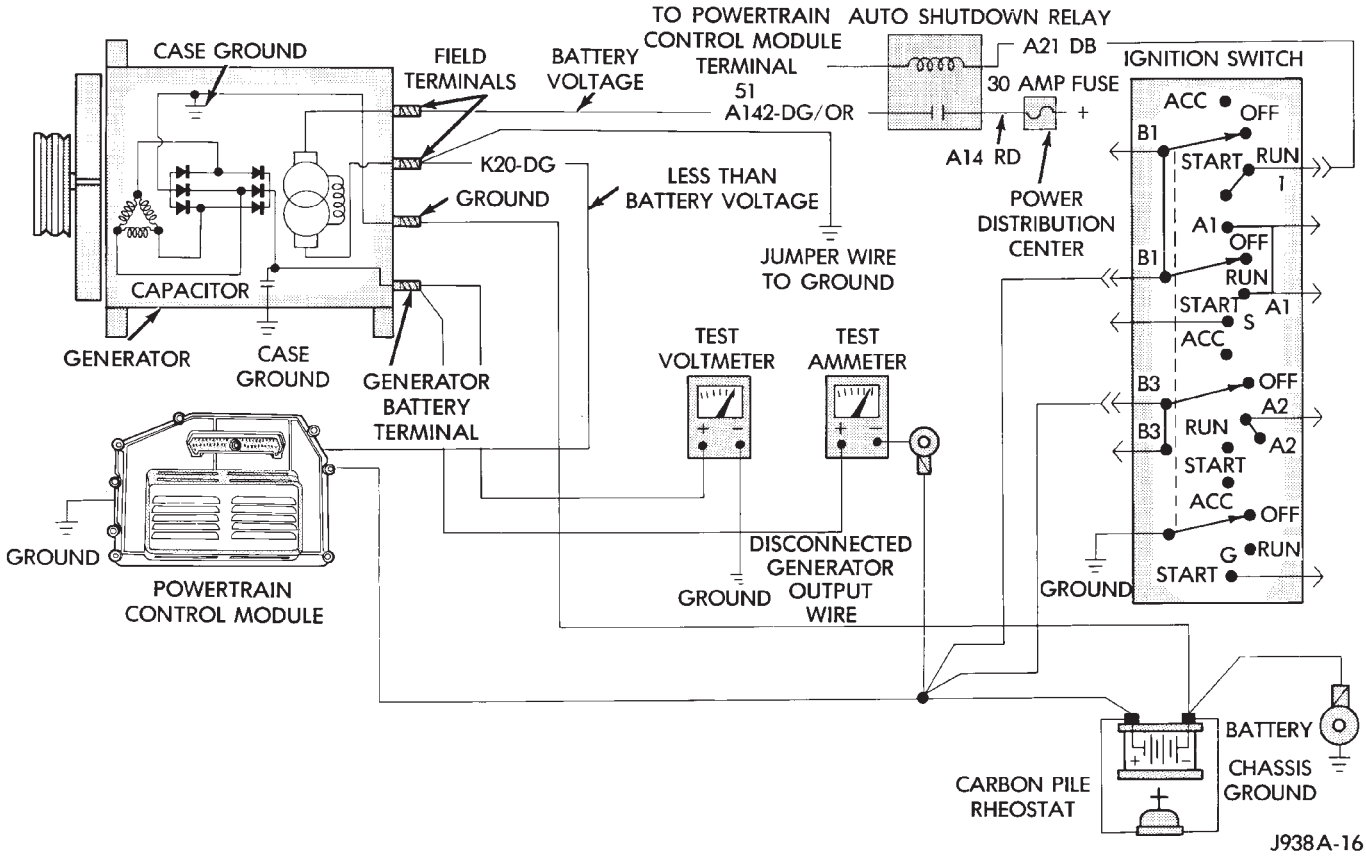


Fig. 3 Generator Current Output Test (Typical)

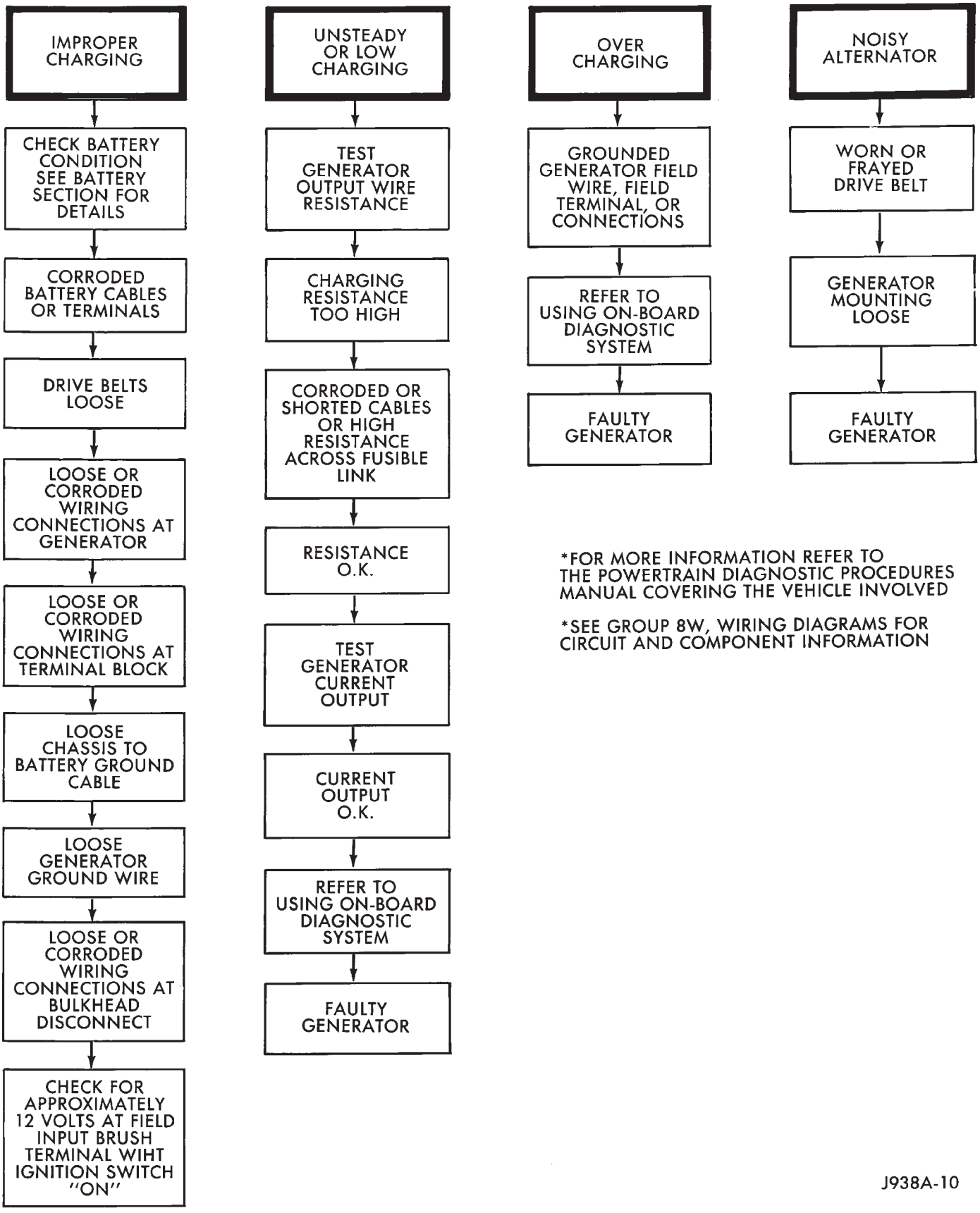
(5) Remove jumper wire (Fig. 3).

(6) Connect generator output wire to generator battery terminal. Tighten nut to 5-6 N•m (45-75 in. lbs.).

(7) Connect negative cable to battery.

(8) Use DRB scan tool to erase DTC.

CHARGING SYSTEM DIAGNOSTICS



*FOR MORE INFORMATION REFER TO THE POWERTRAIN DIAGNOSTIC PROCEDURES MANUAL COVERING THE VEHICLE INVOLVED

*SEE GROUP 8W, WIRING DIAGRAMS FOR CIRCUIT AND COMPONENT INFORMATION

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USING ON-BOARD DIAGNOSTIC SYSTEM

OPERATION OF ON-BOARD DIAGNOSTIC (OBD) SYSTEM

The Powertrain Control Module (PCM) monitors critical input and output circuits of the charging system making sure they are OK. Some are checked continuously and some are checked only under certain conditions.

If OBD system senses that one critical circuit is bad during the monitoring cycle, it will put a diagnostic trouble code into memory. Each input and output circuit monitored by the OBD system has its own diagnostic trouble code. The diagnostic trouble code (DTC) will stay in memory as long as the circuit continues to be bad. If the problem does not happen again after the fault code is put into memory, the PCM is programmed to clear the memory after 50 engine starts.

DIAGNOSTIC TROUBLE CODES (DTC)

Diagnostic trouble codes are two-digit numbers flashed on Malfunction Indicator (Check Engine) Lamp that identify which circuit is bad. In most cases they do not identify which component in a circuit is bad. A trouble code description can be read using the DRB scan tool. Refer to Group 14 - Fuel Systems for more information. Therefore, a DTC is only a symptom, not necessarily the cause for the problem. In some cases, because of the design of the driveability test procedure, a DTC can be the reason for the problem. It is important that the test procedure be followed to understand what caused the DTC of the on-board diagnostic system to be set.

HOW TO USE MALFUNCTION INDICATOR (CHECK ENGINE) LAMP FOR DIAGNOSTIC TROUBLE CODES

To start this function, cycle the ignition switch ON-OFF-ON-OFF-ON within 5 seconds and any trouble code stored in the PCM will be displayed. The Malfunction Indicator (Check Engine) Lamp will display a DTC by flashing on and off. There is a short pause between flashes and a longer pause between digits. All codes displayed are two digit numbers with a 4 second pause between codes.

An example of a code is as follows:

(1) Lamp on for 2 seconds, then turns off.

(2) Lamp flashes 4 times pauses and then flashes 1 time.

(3) Lamp pauses for 4 seconds, flashes 4 times, pauses and then flashes 7 times.

The 2 codes are 41 and 47. Any number of codes can be displayed as long as they are in memory. The lamp will flash until all are displayed (55 = End of test).

CHARGING SYSTEM DIAGNOSTIC TROUBLE CODES

See Generator Diagnostic Trouble Code chart for diagnostic trouble codes which apply to the charging system. Refer to the Powertrain Diagnostic Procedures manal to diagnose an On-Board Diagnostic System, Trouble Code.

GENERATOR DIAGNOSTIC TROUBLE CODE (DTC)

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
12*	Battery Disconnect	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
41**	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
46**	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
47**	Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output.
55*	N/A	Completion of fault code display on Check Engine lamp.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

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BATTERY/STARTER/GENERATOR SERVICE

CONTENTS

BATTERY SERVICE PROCEDURES

GENERAL INFORMATION

This section covers battery removal and installation procedures only. For diagnostic procedures, refer to Group 8A - Battery/Starting/Charging Systems Diagnostics.

BATTERY MAINTENANCE

(1) Inspect cable terminals for corrosion and damage. Remove the corrosion using a wire brush, or post and terminal cleaner, and a sodium bicarbonate/water solution. Replace cables that have damaged or deformed terminals.

Be sure filler caps or vents are installed when washing battery to prevent solution from entering battery.

(2) Clean outside of battery case if the original battery is to be installed. Clean top cover with diluted ammonia or a sodium bicarbonate/water solution to remove acid film. Flush with clean water. Ensure that cleaning solution does not enter cells.

(3) Remove corrosion from the terminals with a wire brush or post and terminal cleaner. Inspect the case for cracks or other damage that would result in leakage of electrolyte.

(4) Check electrolyte level in the battery. Use a putty knife or other suitable wide tool to pry filler caps off low maintenance battery (Fig. 1). Do not use a screwdriver. Add distilled water to each cell until the liquid reaches the bottom of the vent well. DO NOT OVERFILL.

(5) Operate the engine immediately after adding water (particularly in cold weather) to assure proper mixing of the water and acid.

BATTERY REPLACEMENT—LEFT HAND DRIVE

REMOVAL

(1) Make sure ignition switch is in OFF position and all electrical accessories are OFF.

(2) Loosen the cable terminal clamps.

(3) If necessary, use a puller to remove cable terminal clamps. Remove negative cable terminal clamp first.

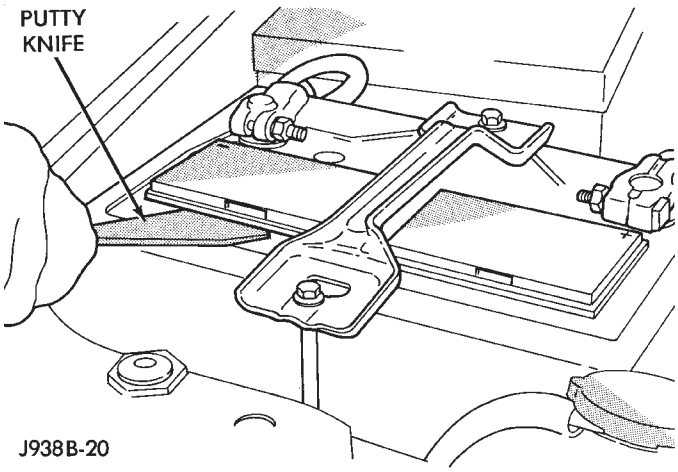

Fig. 1 Removing Filler Cap

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES ALSO SHOULD BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(4) Remove battery holddown, and remove battery from vehicle (Figs. 2 and 3).

(5) Inspect battery tray and holddowns for corrosion. Remove corrosion using a wire brush and a sodium bicarbonate/water solution. Paint any exposed bare metal. Replace damaged components (Figs. 4 and 5).

INSTALLATION

(1) Refer to Specifications to determine if battery has correct classification and rating for the vehicle.

(2) Use a hydrometer to test the battery electrolyte. Charge battery if necessary.

(3) Position battery in tray. Ensure that positive and negative terminals (posts) are correctly located. The cables must reach their terminals (posts) without stretching (Figs. 2 and 3).

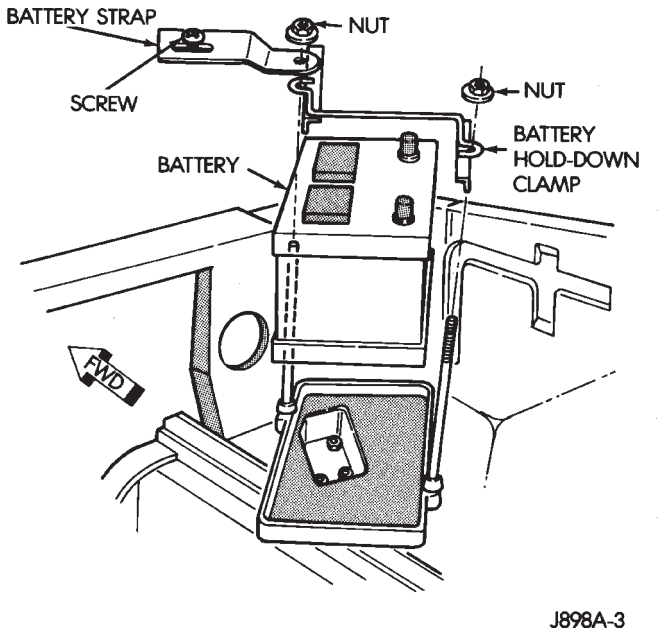

Fig. 2 Battery Holddown—XJ

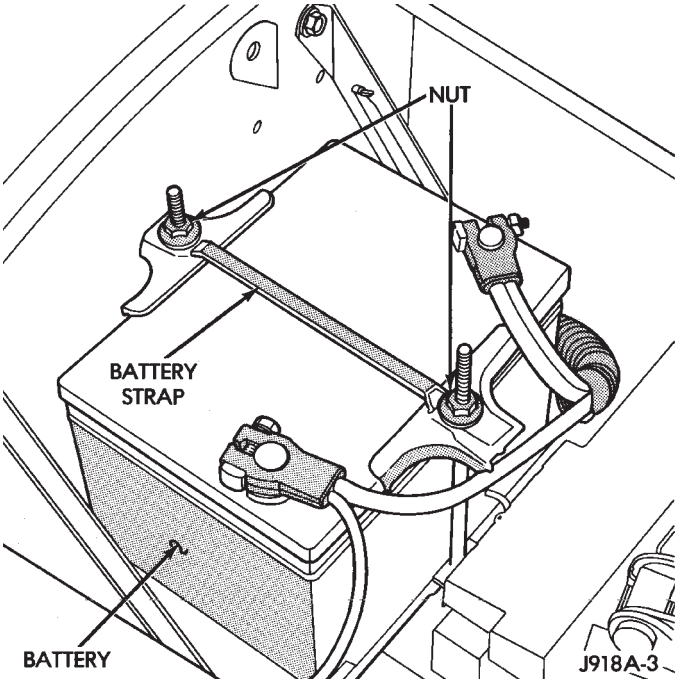

Fig. 3 Battery Holddown—YJ

(4) Ensure that tang at battery base is positioned in tray properly before tightening holddown.

CAUTION: It is imperative that the cables are connected to the battery positive-to-positive and negative-to-negative. Reverse polarity will damage the generator diodes and radio(s).

(5) Place felt washer on positive battery terminal.

(6) Connect positive cable first. Then connect negative cable. Tighten both cable terminal bolts to 8.5 N·m (75 in. lbs.).

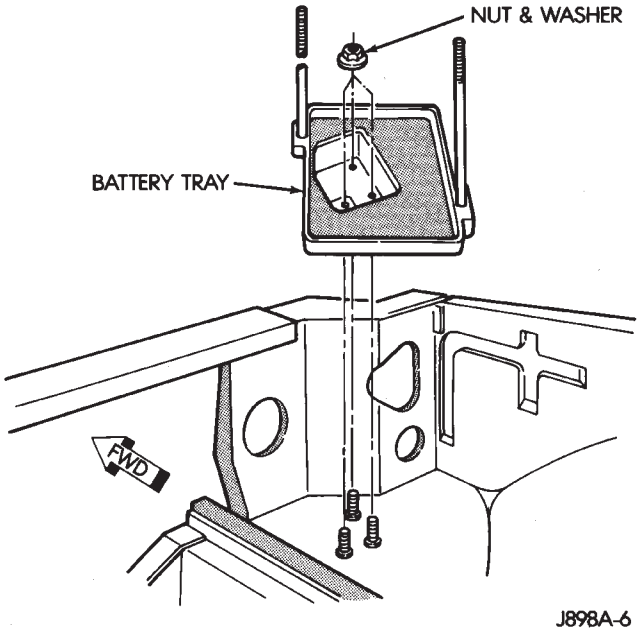

Fig. 4 Battery Tray—XJ

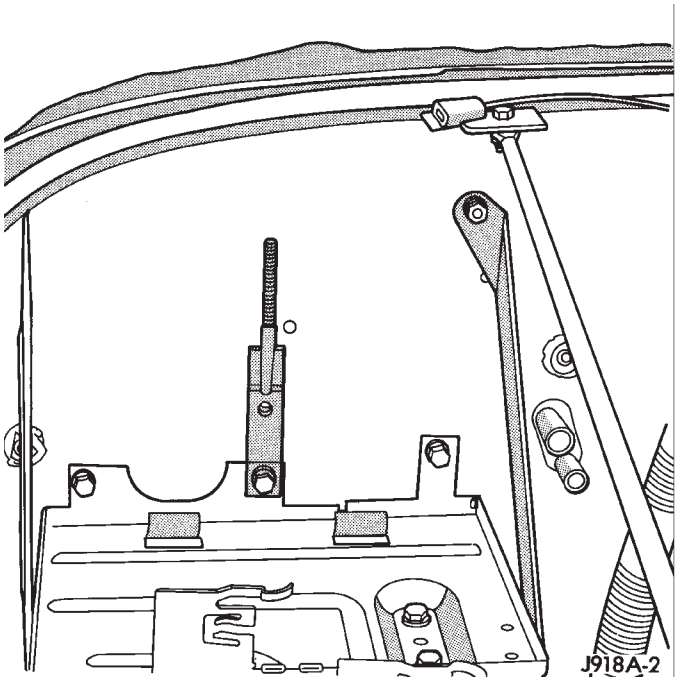

Fig. 5 Battery Tray—YJ

(7) Apply a thin coating of petroleum jelly or chassis grease to cable terminals and battery posts.

(8) Inspect negative cable connections on engine and vehicle body for condition, security and electrical continuity.

BATTERY REPLACEMENT—RIGHT HAND DRIVE

REMOVAL

(1) Make sure ignition switch is in OFF position and all electrical accessories are OFF.

(2) Remove bolt and negative cable from battery (Fig. 6).

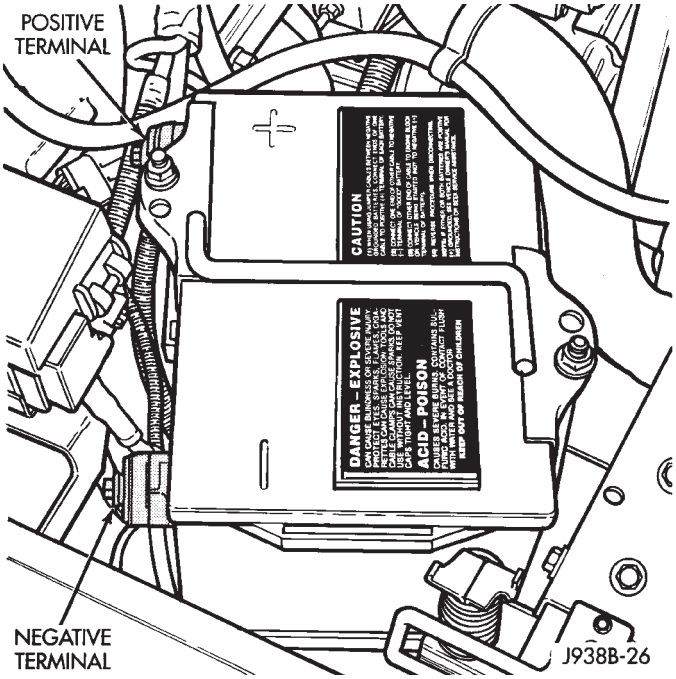

Fig. 6 Battery Cable Attachment

(3) Remove bolt and positive cable from battery.

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES ALSO SHOULD BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

(4) Remove battery holddown and battery from vehicle.

(5) Inspect battery tray and holddowns for corrosion. Remove corrosion using a wire brush and a sodium bicarbonate/water solution. Paint any exposed bare metal. Replace damaged components.

INSTALLATION

(1) Refer to Specifications to determine if battery has correct classification and rating for the vehicle.

(2) Use a hydrometer to test the battery electrolyte. Charge battery if necessary.

(3) Position battery in tray. Ensure that positive and negative terminals are correctly located. The cables must reach their terminals without stretching (Fig. 6).

(4) Ensure that battery base is positioned in tray properly before tightening holddown.

CAUTION: It is imperative that the cables are connected to the battery positive-to-positive and negative-to-negative. Reverse polarity will damage the generator diodes and radio(s).

(5) Connect positive cable first. Then connect negative cable. Tighten both cable terminal bolts to 10-20 N·m (90-178 in. lbs.).

(6) Inspect negative cable connections on engine and vehicle body for condition, security and electrical continuity.

ENGINE STARTER MOTOR SERVICE PROCEDURES

INDEX

GENERAL INFORMATION

This section will cover the starting system component service procedures only. For diagnostic procedures, refer to Group 8A - Battery/Starting/Charging Systems Diagnostics.

Starting system components: battery, starter motor, starter relay, starter solenoid, ignition switch, connecting wires and battery cables. A park/neutral position switch is used with automatic transmissions.

STARTER RELAY REPLACEMENT

The starter relay is located in the Power Distribution Center (Figs. 1 and 2). Refer to underside of Power Distribution Center cover for relay location.

(1) Disconnect negative cable from battery.
(2) Replace relay.
(3) Connect negative cable to battery.
(4) Test relay operation.

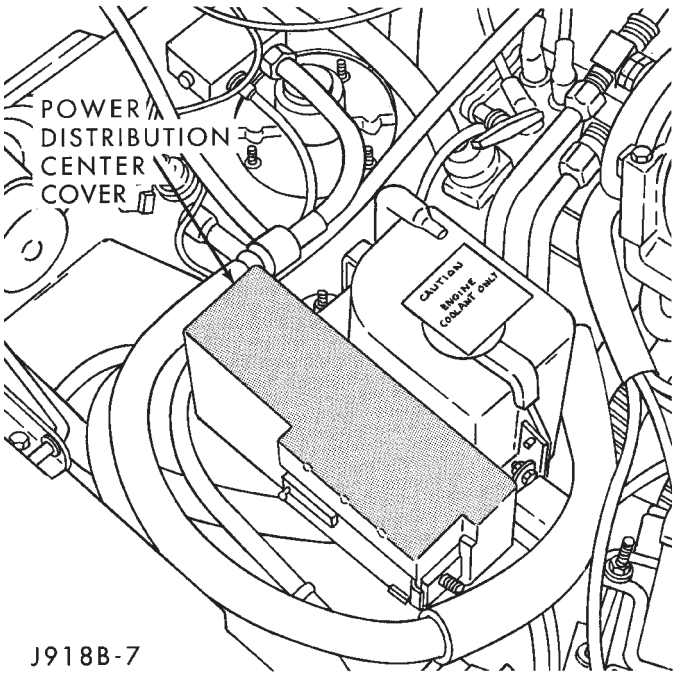

Fig. 1 Power Distribution Center—XJ

2.5L STARTER GENERAL INFORMATION

The 2.5L engine starter motor incorporates several features to create an efficient, lightweight unit.

A planetary gear system (intermediate transmission) between the electric motor and pinion shaft

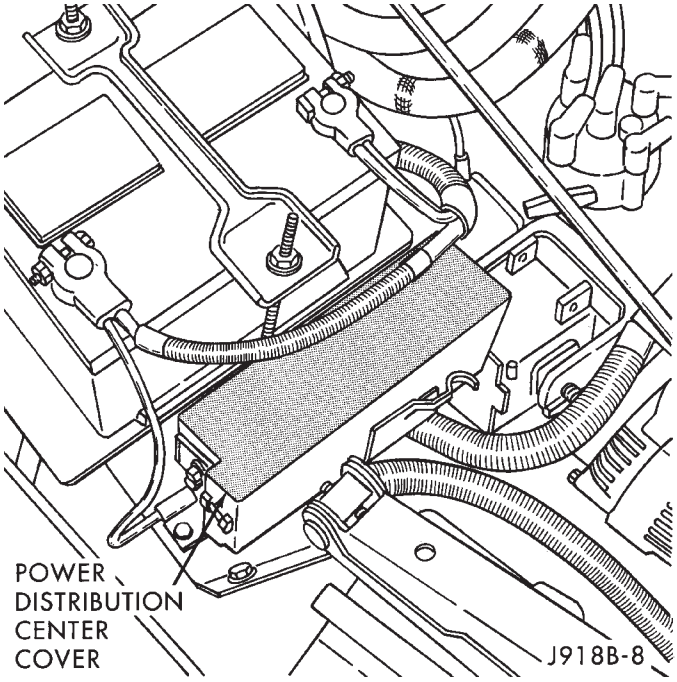

Fig. 2 Power Distribution Center—YJ

makes it possible to reduce the dimensions of the starter. This also makes it possible to obtain a higher rotational speed to produce the same torque at the pinion.

The permanent magnet field consists of six two-component high strength magnets. The magnets are aligned according to their polarity and are permanently fixed in the starter frame.

The brush holder plate consists of a plastic baseplate with four tubular brush holders.

This unit is highly sensitive to hammering, shocks and external pressure.

CAUTION: The starter motor MUST NOT BE CLAMPED in a vise by the starter frame. Doing so may damage the magnets. It may be clamped by the mounting flange ONLY.

CAUTION: Do not connect starter motor incorrectly when tests are being performed. The magnets may be damaged and rendered unserviceable.

- Ensure cleanliness when performing repairs.

• Metal chips are attracted by the magnets and may not be completely removed from the starter frame. Chips in the ring gear can lead to failure of the starter.

2.5L STARTER MOTOR REMOVAL/INSTALLATION

XJ—2.5L ENGINE

(1) Disconnect negative cable from battery.
(2) Remove exhaust clamp from bracket (Fig. 3).
(3) Remove nut and bolt from forward end of brace rod (automatic transmission only).
(4) Remove nut from lower end of brace rod (automatic transmission only).
(5) Remove brace rod and bracket (automatic transmission only).
(6) Remove nut, bolt and bracket from bell housing (manual transmission only).

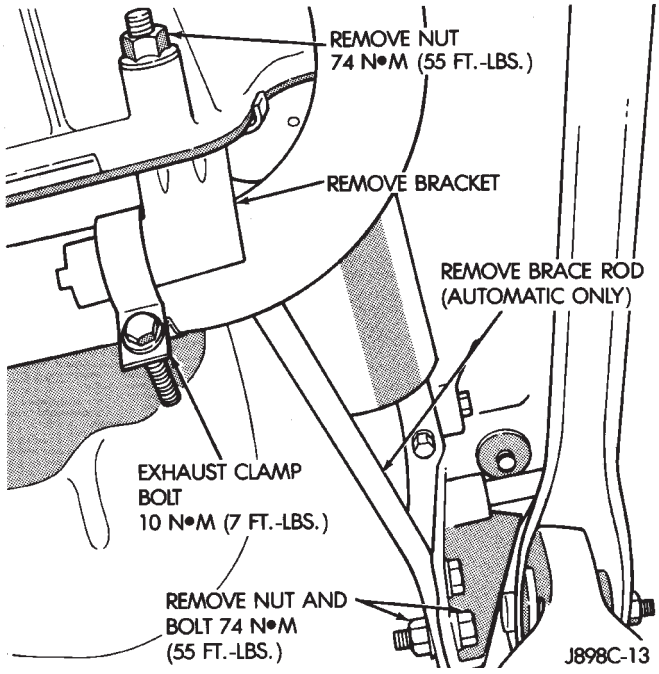

Fig. 3 Exhaust Clamp and Brace Removal—2.5L XJ

(7) Disconnect battery cable and solenoid feed wire from solenoid (Fig. 4).
(8) Remove starter motor mounting bolts, starter motor and shims.

Two shim thicknesses are available. One is 0.381 mm (0.015 in.) and the other is 1.143 mm (0.045 in.). Refer to Group 8A for proper shim selection.

(9) To install starter motor, reverse the removal procedures and torque mounting hardware as shown.
(10) Connect negative cable to battery.

YJ—2.5L ENGINE

(1) Disconnect negative cable from battery.
(2) Disconnect battery cable from starter motor B+ terminal (Fig. 5).

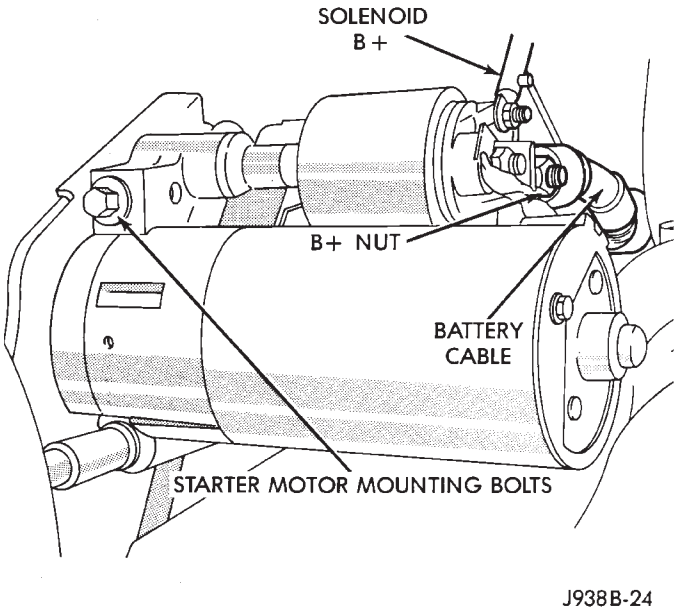

Fig. 4 Starter Motor Removal/Installation—2.5L XJ

(3) Disconnect solenoid feed wire.
(4) Remove starter motor mounting bolts.
(5) Remove starter motor and shims.

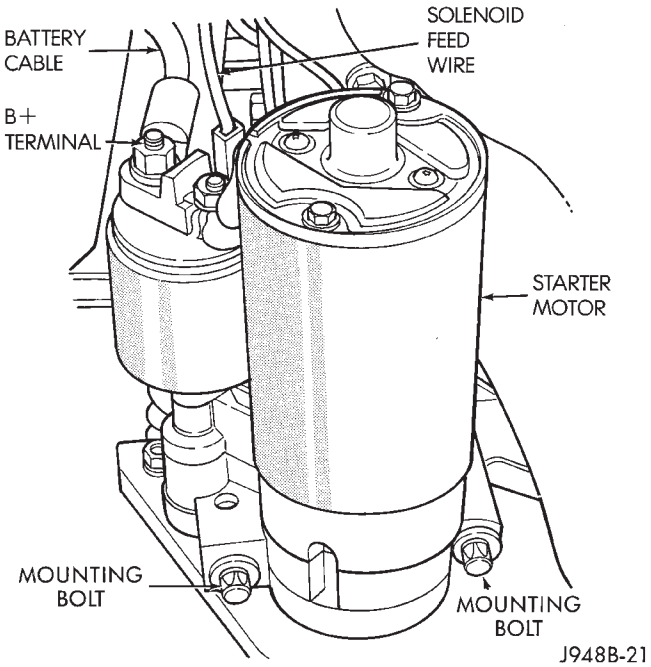

Fig. 5 Starter Motor Removal/Installation—2.5L YJ

Two shim thicknesses are available. One is 0.381 mm (0.015 in.) and the other is 1.143 mm (0.045 in.). Refer to Group 8A for proper shim selection.

(6) To install starter motor, reverse removal procedures and torque mounting hardware as shown.
(7) Connect negative cable to battery.

4.0L STARTER GENERAL INFORMATION

The Mitsubishi starter motor is a light-weight unit featuring a planetary gear drive and permanent magnets for current induction.

The planetary gear drive is splined to both the armature shaft and overrunning clutch. Starter torque is transmitted to the overrunning clutch pinion through the planetary gears which provide higher rotational speeds.

The starter magnetic field is produced by six permanent magnets. The magnets are mounted in the starter frame and positioned according to polarity. They are permanently attached to the frame and are not removable.

The starter motor is activated by a solenoid mounted on the overrunning clutch housing.

This unit is highly sensitive to hammering, shocks, and external pressure.

CAUTION: The starter motor MUST NOT BE CLAMPED in a vise by the starter frame. Doing so may damage the magnets. It may be clamped by the mounting flange ONLY.

CAUTION: Do not connect the starter motor incorrectly when performing tests. The magnets may be damaged and rendered unserviceable.

- Ensure cleanliness when performing repairs.
- Metal chips are attracted by the magnets and may not be completely removed from the starter frame. Chips in the ring gear can lead to failure of the starter.

4.0L STARTER MOTOR REMOVAL/INSTALLATION

(1) Disconnect negative cable from battery.
(2) Raise and support vehicle.
(3) Disconnect battery wire and solenoid feed wire.
(4) Remove starter lower mounting bolt (Fig. 6).
(5) Remove starter upper mounting bolt and remove starter.

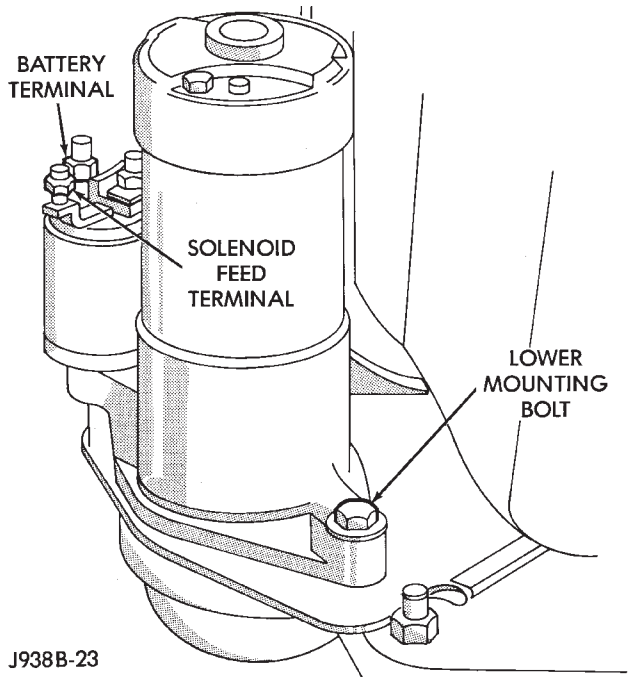

Fig. 6 Starter Motor Removal/Installation (Typical)

(6) To install starter motor, reverse the removal procedures and torque mounting hardware as shown.
(7) Remove vehicle support and lower vehicle.
(8) Install negative cable to battery.

PARK/NEUTRAL POSITION SWITCH

Refer to Group 21 for diagnostic, removal and installation procedures.

Check linkage adjustment before replacing the switch.

GENERATOR SERVICE PROCEDURES

GENERAL

The generator is belt-driven by the engine. All engines use serpentine drive. This section will cover generator removal and installation. The generator is not serviceable. Information covering on-vehicle testing can be found in Group 8A - Battery/Starting/Charging Systems Diagnostics.

GENERATOR REPLACEMENT—LEFT HAND DRIVE

WARNING: FAILURE TO DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE DISCONNECTING RED (OUTPUT) WIRE CONNECTOR FROM GENERATOR CAN RESULT IN INJURY.

ALL YJ AND XJ WITH 2.5L ENGINE

Belt tension is adjusted at the power steering pump (or idler pulley if not equipped with power steering). To replace generator:

(1) Disconnect negative cable from battery.

(2) Loosen rear mounting bolts (Fig. 1 or 2).

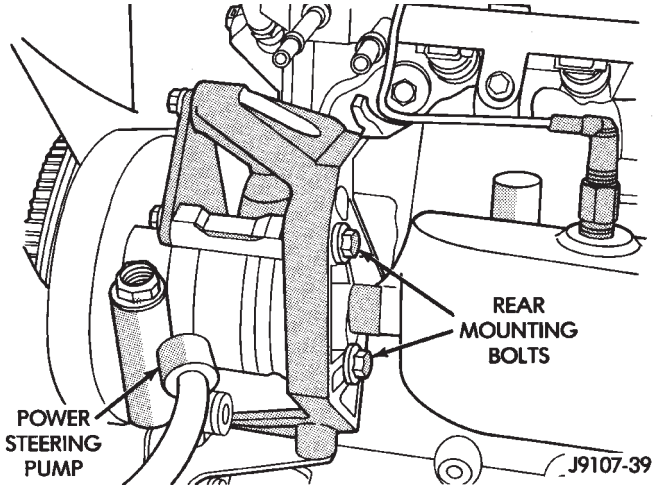

Fig. 1 Powering Steering Pump Rear Mounting Bolts—Except XJ With 4.0L

(3) Loosen power steering pump/idler pulley pivot bolt and lock nut (Fig. 3 or 4).

(4) Loosen adjusting bolt to remove belt.

(5) Remove generator B+ terminal nut, 2 field terminal nuts, ground and harness holddown nuts (Fig. 5). Remove wire connector assembly.

(6) Remove 2 generator mounting bolts and remove generator from vehicle.

(7) Install generator with 2 mounting bolts. Torque bolts to 55 N·m (41 ft. lbs.).

(8) Attach generator wires.

CAUTION: Never force a belt over a pulley rim using a screwdriver as the synthetic fiber may be damaged.

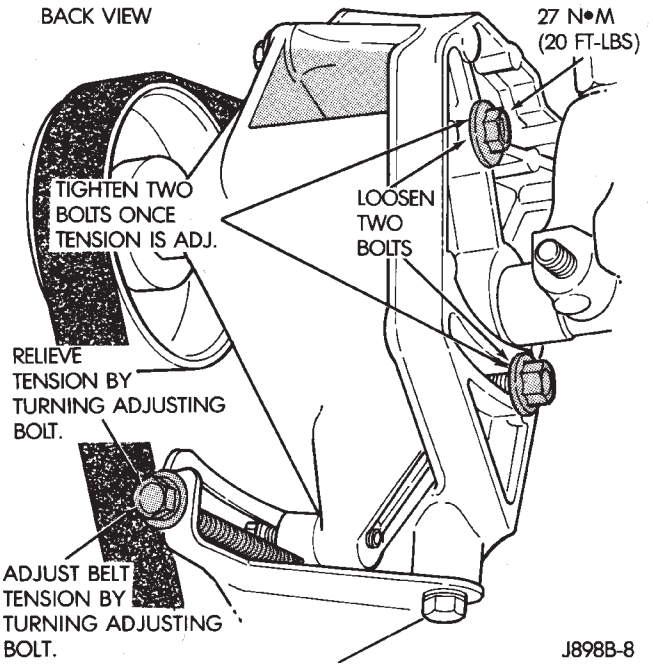

Fig. 2 Idler Pulley Rear Mounting Bolts—Except XJ With 4.0L

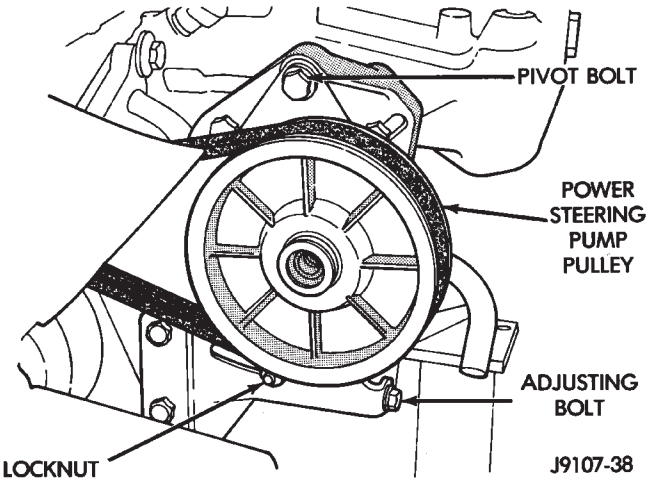

Fig. 3 Power Steering Pump Front Mounting Bolts—Except XJ With 4.0L

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The engine may overheat because the water pump will be rotating in the wrong direction if the belt is installed incorrectly. Refer to the belt routing label in engine compartment, or see Group 7 - Belt Schematics.

(9) Place serpentine belt over pulley.

(10) Belt tension adjustment is made at power steering pump or idler pulley (Figs. 1 or 2).

(11) Turn adjusting bolt until belt has correct tension. See Belt Tension in Specifications.

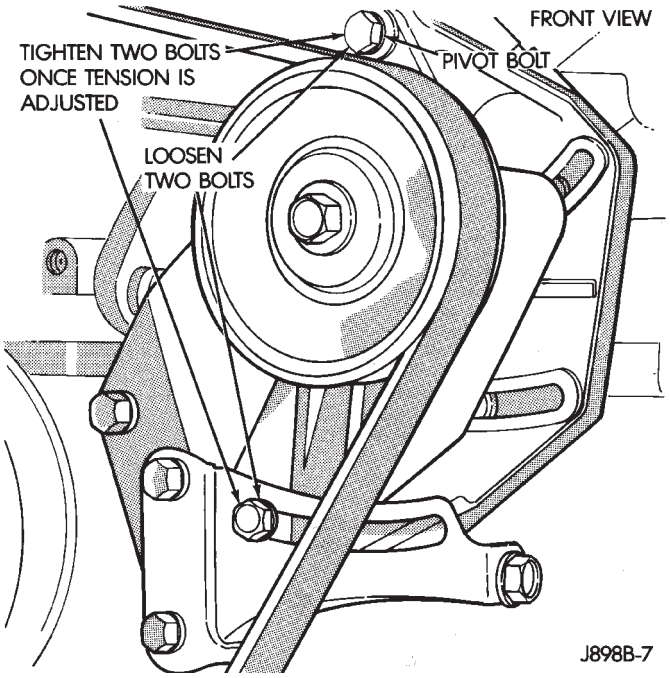

Fig. 4 Idler Pulley Front Mounting Bolts—Except XJ With 4.0L

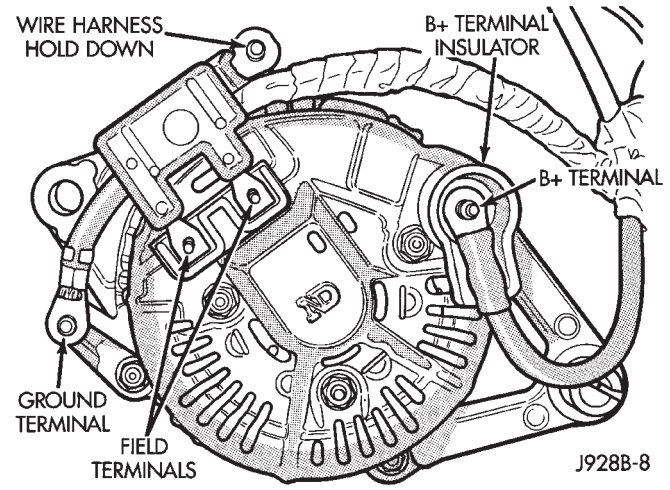

Fig. 5 Remove or Install Connector Assembly

(12) Tighten rear mounting bolts, pivot bolt, and lock nut to 27 N·m (20 ft. lbs.) torque.

(13) Connect negative cable to battery.

XJ WITH 4.0L ENGINE

Belt tension is adjusted at the power steering pump.

To replace generator:

(1) Disconnect negative cable from battery.

(2) Loosen rear mounting bolts (Fig. 6).

(3) Loosen power steering pump pivot bolt and lock nut (Fig. 7).

(4) Loosen adjusting bolt to remove belt.

(5) Raise and support vehicle.

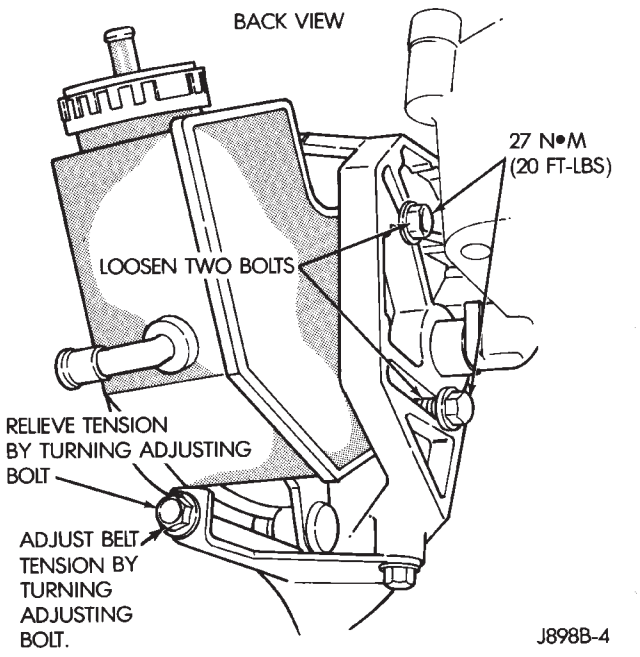

Fig. 6 Powering Steering Pump Rear Mounting Bolts—XJ With 4.0L

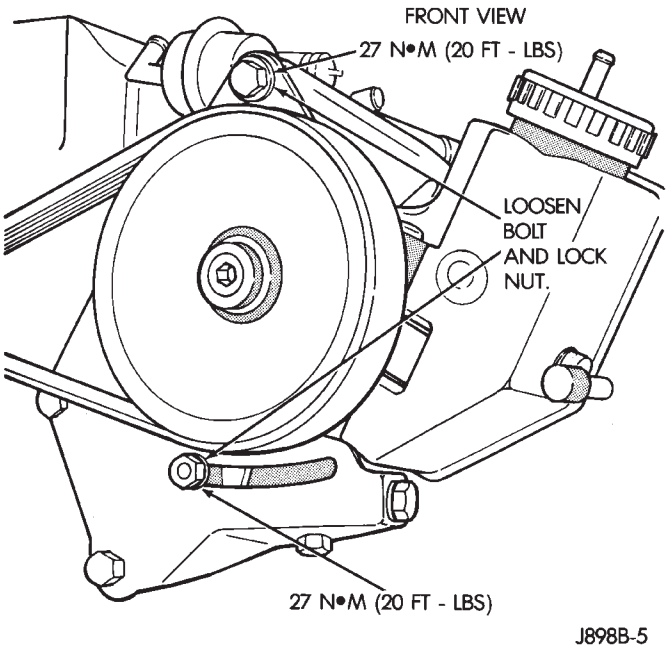

Fig. 7 Powering Steering Pump Front Mounting Bolts—XJ With 4.0L

(6) Remove generator B+ terminal nut, 2 field terminal nuts, ground and harness holddown nuts (Fig. 5). Remove wire connector assembly.

(7) Remove 2 generator mounting bolts and remove generator from vehicle.

(8) Install generator with two mounting bolts. Torque bolts to 55 N·m (41 ft. lbs.).

(9) Attach generator wires.

CAUTION: Never force a belt over a pulley rim using a screwdriver as the synthetic fiber may be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The engine may overheat because the water pump will be rotating in the wrong direction if the belt is installed incorrectly. Refer to the belt routing label in engine compartment, or see Group 7 - Belt Schematics.

(10) Place serpentine belt over pulley.
(11) Belt tension adjustment is made at power steering pump (Fig. 6).
(12) Turn adjusting bolt until belt has correct tension. See Belt Tension in Specifications.
(13) Tighten rear mounting bolts, pivot bolt, and lock nut to 27 N·m (20 ft. lbs.) torque.
(14) Remove support and lower vehicle.
(15) Connect negative cable to battery.

GENERATOR REPLACEMENT—RIGHT HAND DRIVE

The generator used on the right hand drive is the same as used on left hand drive. However, the mounting and accessory drive belt installation are different.

WARNING: FAILURE TO DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE DISCONNECTING RED (OUTPUT) WIRE CONNECTOR FROM GENERATOR CAN RESULT IN INJURY.

(1) Remove negative cable from battery.
(2) Remove 2 screws holding electric cooling fan (Fig. 8).
(3) Unplug electric cooling fan connector.
(4) Pull fan up and out of vehicle.
(5) Remove generator drive belt. See Group 7 - Cooling System, for instructions.
(6) Remove generator mounting bolts.
(7) Position generator to gain access to all of the wire connectors.

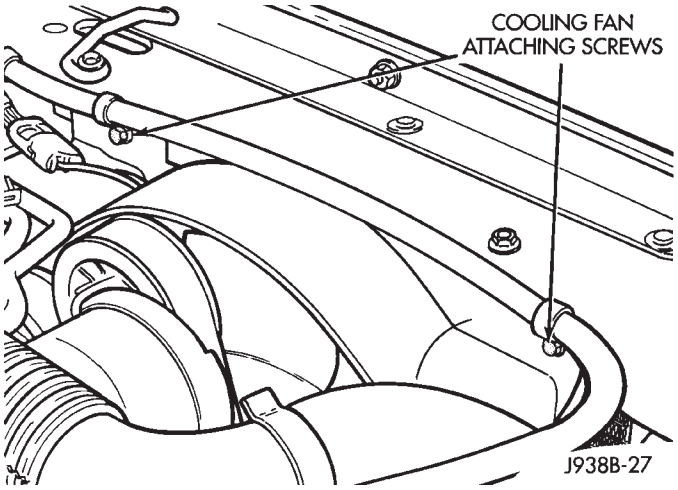

Fig. 8 Electric Cooling Fan Removal/Installation

(8) Remove B+ terminal nut, 2 field terminal nuts, ground and harness holddown nuts (Fig. 9). Remove wire connector assembly.

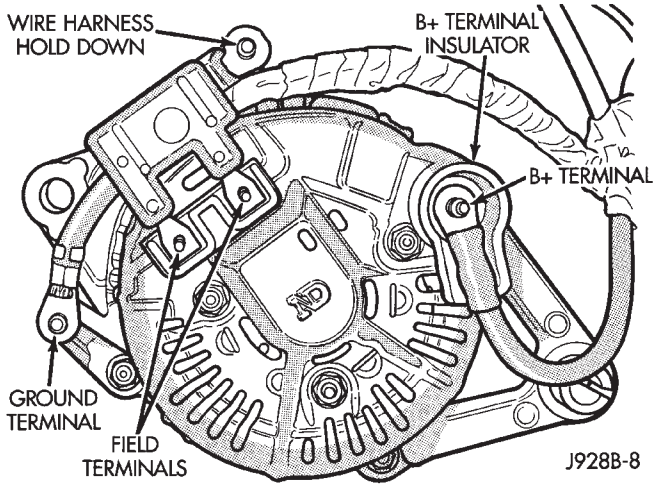

Fig. 9 Remove or Install Connector Assembly

(9) Remove generator from vehicle.
(10) To install generator, reverse the removal procedures. Refer to Group 7 for belt installation.
(11) Tighten battery cable bolts to 10-20 N·m (90-178 in. lbs.).

SPECIFICATIONS

BATTERY CLASSIFICATIONS AND RATINGS—LEFT HAND DRIVE

Group Size	Cold Crank AMPS	Reserve Capacity (Min.)	Engine	Vehicle Series
58	430	80	2.5L & 4.0L	All
58	500	85	2.5L, 4.0L	All

J928A-1

BATTERY CLASSIFICATIONS AND RATINGS—RIGHT HAND DRIVE

Group Size	Cold Crank AMPS	Reserve Capacity (Min.)	Engine	Vehicle Series
75	650	93	4.0L	Postal

J938A-24

BATTERY TORQUE SPECIFICATIONS

Description	Torque
Battery Strap Screw	2 N•m (20 in. lbs.)
Battery Tray Nut	2 N•m (20 in. lbs.)
Battery Clamp Nut	2 N•m (20 in. lbs.)

J928A-7

BELT TENSION

Type of Belt	New Belt N (lbs-f)	Used Belt (lbs-f)
Serpentine Belt	800-900 (180-200)	623-712 (140-160)
V-Belt	533-711 (120-160)	400-511 (90-115)

J918C-17

4.0L ENGINES

4.0L STARTER MOTOR AND SOLENOID TESTING SPECIFICATIONS

Description	Specifications @ 20°C (68°F)
No Load Test With 11.2 volts Max. Amps Min. RPM	 80 2500
Solenoid Hold-in Winding Voltage	3.5 Min.
Pull-in Winding Voltage	7.8 Max.

J948B-17

STARTING SYSTEM COLD CRANKING SPECIFICATIONS

Battery Test Voltage	12.5 Volts
Cold Cranking Voltage (Minimum)	9.6 Volts
Cold Cranking Amps	130 Amps

J918B-17

STARTER MOTOR TORQUE SPECIFICATIONS

COMPONENTS	TORQUE
Starter Motor Mounting Bolts	Upper 55 N•m (40 ft. lbs.) Lower 41 N•m (30 ft. lbs.)
Starter Solenoid Battery Cable Nut	10 N•m (90 in. lbs.)
Starter Solenoid B+ Nut	6 N•m (55 in. lbs.)

J938B-22

2.5L ENGINES

2.5L STARTER MOTOR SPECIFICATIONS

Description	Specifications @ 20°C (68°F)
No Load Test With 11.5 volts Max. Amps Min. RPM	 75 2900
Solenoid Hold-in Winding Voltage	2.6V-3.5V Max.
Solenoid Pull-in Winding Voltage	6V-7.5V Max.
Starter Type	DW 1.4

J928B-24

STARTING SYSTEM COLD CRANKING SPECIFICATIONS

Battery Test Voltage	12.5 Volts
Cold Cranking Voltage (Min.)	9.6 Volts
Cold Cranking Amps	160 Amps

J918B-19

STARTER MOTOR TORQUE SPECIFICATIONS

COMPONENTS	TORQUE
Starter Motor Mounting Bolts	45 N•m (33 ft. lbs.)
Starter Solenoid Battery Cable Nut	10 N•m (90 in. lbs.)
Starter Solenoid B+ Nut	6 N•m (55 in. lbs.)

J928B-23

GENERATOR SPECIFICATIONS

TORQUE SPECIFICATIONS

COMPONENT	TORQUE
Generator Mounting Bolts	55 N·m (41 ft. lbs.)
Power Steering Pump (or Idler Pulley) Mounting Bolts	27 N·m (20 ft. lbs.)

J948B-18

OUTPUT VOLTAGE SPECIFICATIONS

PCM Temperature °C (°F)	Acceptable Voltage Range
– 40 to – 6.7 (– 40 to 20)	14.5 to 15.0
– 6.7 to 26.7 (20 to 80)	13.87 to 15.0
26.7 to 60 (80 to 140)	13.25 to 14.37
60 to 71.1 (140 to 160)	13.25 to 13.75

J938B-25

Type	Part Number	Engine	Rating
Nippondenso	56005684	2.5L & 4.0L	75
Nippondenso	56005685	2.5L & 4.0L	90

J918C-11

OVERHEAD CONSOLE

CONTENTS

DESCRIPTION

The overhead console includes:

- a compass/temperature display
- reading and courtesy lights for the front and rear seats
- the receiver for the keyless entry system
- storage compartment for remote garage door opener
- storage compartment for sunglasses.

COMPASS

The compass will display the direction the vehicle is pointed, using the eight major compass headings (Examples: North is "N", Northeast is "NE"). It does not display the headings in actual degrees. The display is turned on/off using the TEMP/COMP button on the left of the display.

The compass is a self calibrating unit that should not require recalibration. The only calibration that may prove necessary is to drive the vehicle in 3 complete circles, on level ground, in not less than 48 seconds. This will "reorient" the unit to its vehicle. The unit also will compensate for magnetism the vehicle may acquire during its life. Care should be used to avoid putting anything magnetic on the roof of the vehicle.

The unit can compensate for some magnetic fields in the body. The use of magnetic attachments like antenna mounts or repair order "hats" placed directly on the roof can exceed the compensation ability of the unit. Magnetic bit drivers used on the fasteners to hold the assembly to the roof header can also affect operation. If the vehicle roof should become magnetized, then the degaussing and calibration procedures may be required to restore proper operation.

If the compass functions but accuracy is suspect, it may be necessary to perform a variation adjustment. This procedure allows the unit to accommodate variations in the earth's magnetic field strength based on geographic location.

If the compass has blanked out and only CAL appears, degaussing may be necessary to remove residual magnetic fields.

THERMOMETER

The ambient temperature display can be changed from Fahrenheit to Celsius using the U.S./METRIC button on the right of the display. The temperature reported is not an instant reading of conditions but an average temperature. It may take the unit several minutes to react to a major change such as driving out of a heated garage into winter temperatures.

When the ignition switch is turned OFF, the last displayed temperature reading stays in memory. When the ignition switch is turned ON again the thermometer will display the memory temperature for one minute; then update the display to the actual temperature within five minutes.

READING AND COURTESY LAMPS

All reading and courtesy lamps in the overhead console are activated by the door courtesy circuit. When all four doors and the liftgate are closed the lamps can be activated by depressing the corresponding lens. When any door or the liftgate is open, the switches are disabled. They will not turn the lamps off.

MAP AND COURTESY LAMPS

These lamps offer several unique features. Both the map and courtesy lamps can be turned on with the integral "Soft Touch" switch. Pushing this switch energizes an electrical circuit, which in turn directs power to the light. The map lamps are unaffected by the door switches, while the courtesy lamps are turned on with the opening of any door. When any door is open, the "Soft Touch" switches are disabled, you cannot turn the lights off with these switches.

DIAGNOSTIC PROCEDURES

Follow the appropriate diagnostic flow chart:

- Chart 1 describes the procedures for compass and display problems.
- Chart 2 describes the procedures for illumination lamp problems.
- Chart 3 describes the procedures for outside temperature measuring problems.

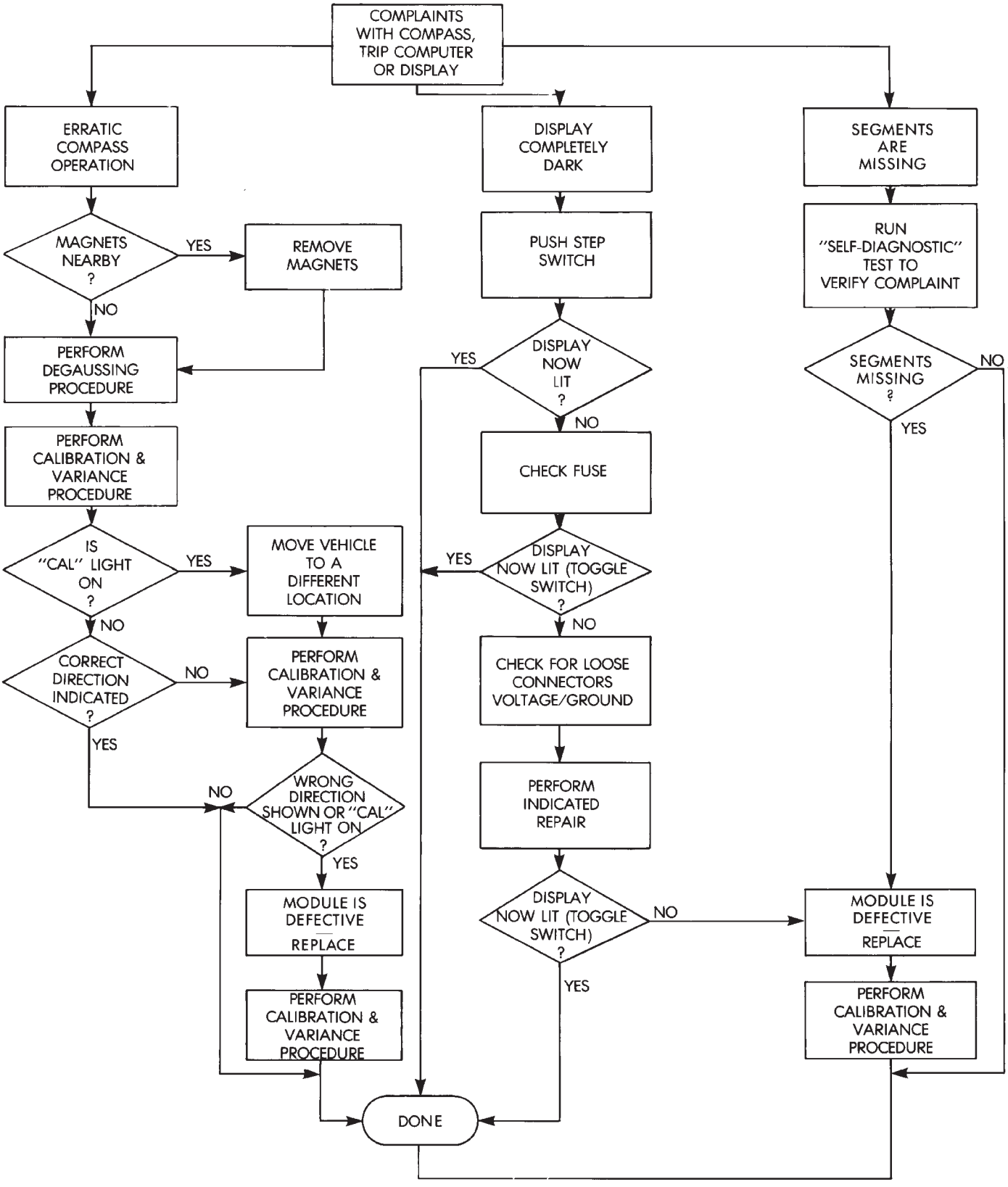

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Chart 1

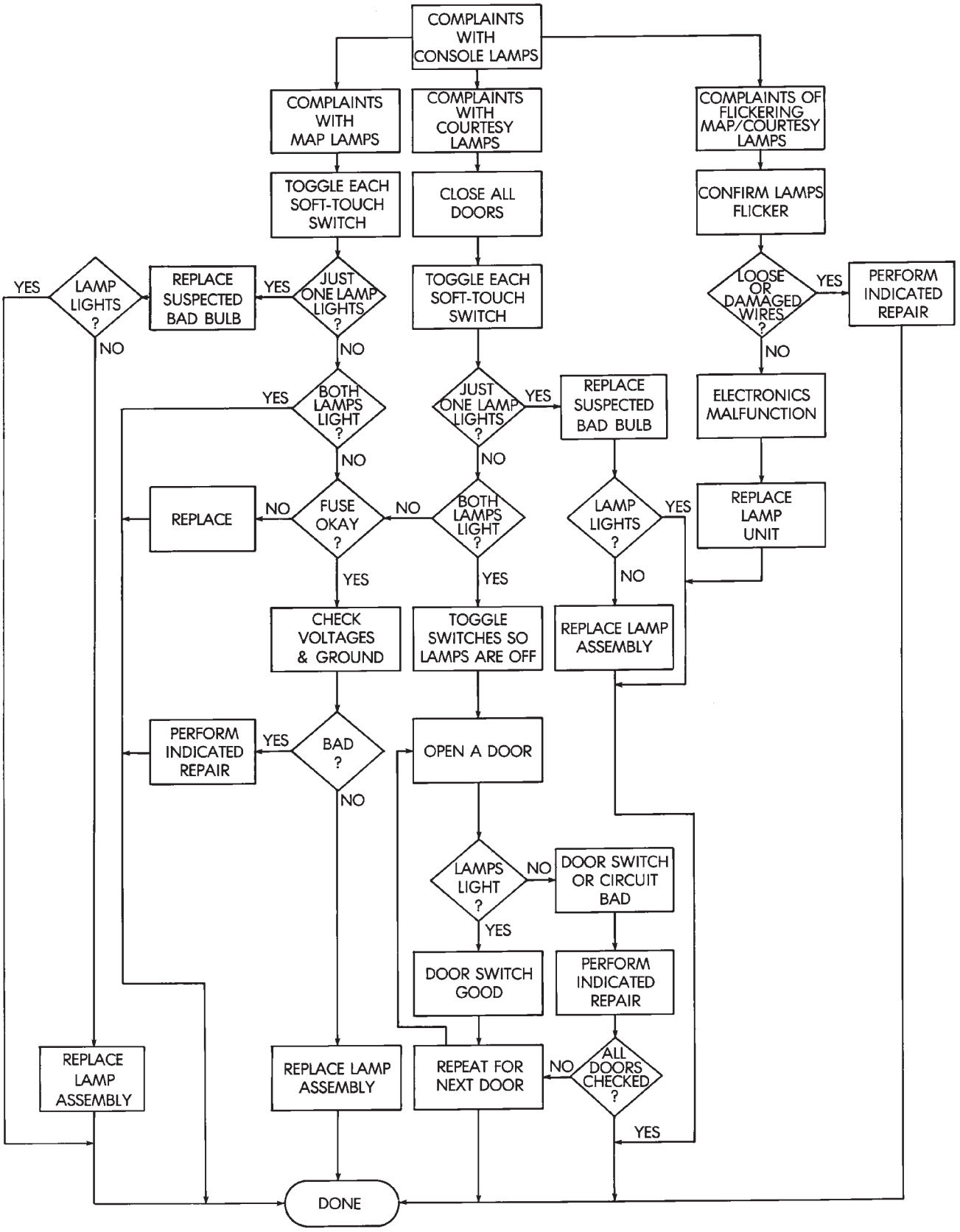

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Chart 2

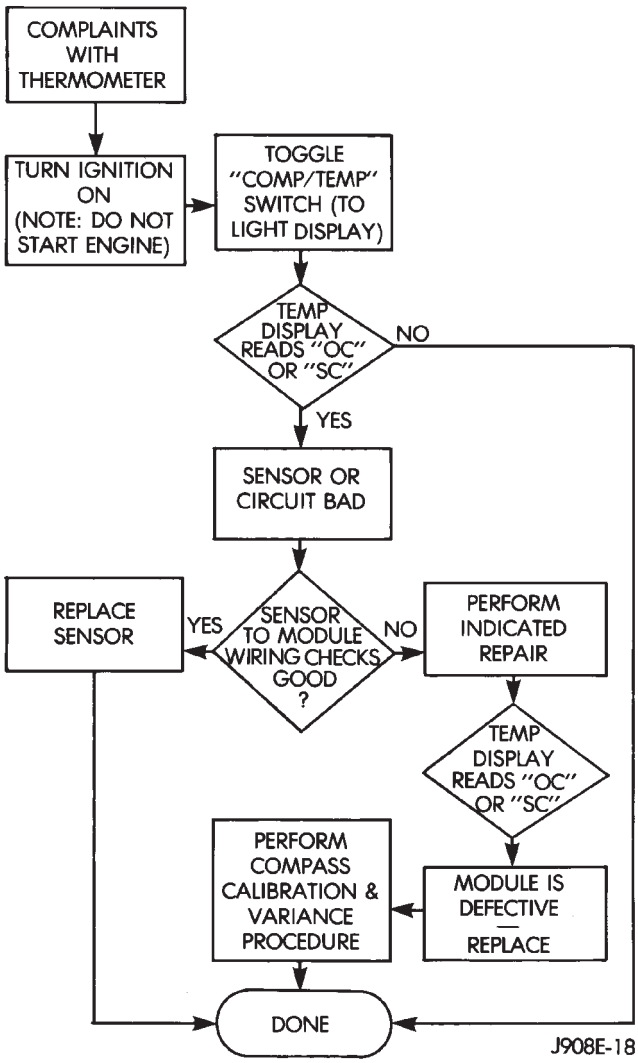


Chart 3

COMPASS REPAIR PROCEDURES

VARIATION ADJUSTMENT PROCEDURE

Variance is the difference between magnetic North and geographic North. In some areas the difference between magnetic and geographic north is great enough to cause the compass to give false readings. If this occurs, the variance must be set.

To set the variance:

(1) Turn ignition switch to the ON position.

(2) Depress both buttons and holddown until VAR light appears. This takes about 5 seconds.

(3) Release both buttons.

(4) Using the map (Fig. 1) find your geographic location and note the zone number.

(5) Press the U.S./METRIC button to sequentially go through the numbers until the zone number for your area appears in the display.

(6) Press the COMP/TEMP button to enter this zone number.

(7) Confirm correct directions are indicated.

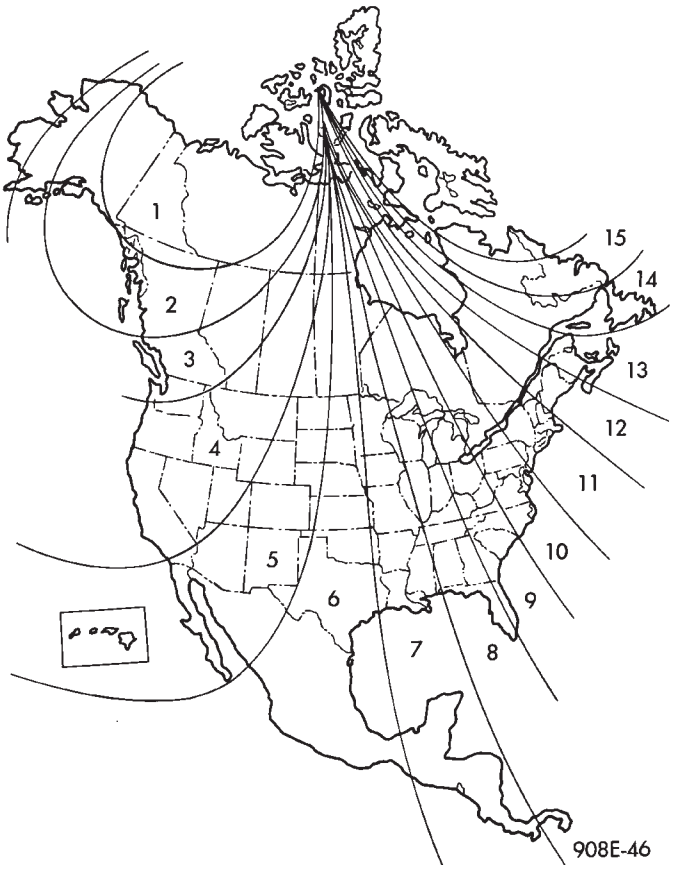


Fig. 1 Variance Settings

COMPASS CALIBRATION PROCEDURE

CAUTION: DO NOT use magnetic tools when servicing the overhead console.

CAUTION: DO NOT place any external magnets such as magnetic roof mount antennas, in the vicinity of the compass.

Do not attempt to set compass near large metal objects such as other vehicles, large buildings or bridges. The compass features an "Auto-Cal" design which simplifies the calibration procedure. During normal driving this feature automatically updates the compass calibration. This takes into account incremental changes in magnetism the vehicle may see over its lifetime.

Whenever the compass is calibrated manually, the variation number must also be reset.

Calibrate the compass as follows:

(1) Start the engine.

(2) Depress both buttons on the compass and hold down until CAL light appears. This takes about 10 seconds and appears about 5 seconds after the VAR light appears.

(3) Release buttons.

(4) Drive vehicle on a level surface that is away from metal objects through three or more complete

circles, in not less than 48 seconds. The CAL light will go off and the compass is now calibrated.

(5) Reset variation number. This step must be done every time step 2 is performed.

If CAL light does not go off, either there is excessive magnetism near the compass or the unit is defective. Repeat the degaussing and calibration procedures at least one more time.

If the wrong direction is still indicated, the area selected may be too close to a magnetic source. Repeat the calibration procedure in another location.

DEGAUSSING PROCEDURE

The tool used to degauss or demagnetize the forward console attaching screw and roof panel is the Miller Tool 6029. Equivalent units must be rated as continuous duty for 110/115 volts, 60Hz with a field strength of over 350 gauss at 1/4 inch beyond the tip of the probe.

In this degaussing procedure the degaussing tool is used to demagnetize both the roof panel and console forward mounting screw.

(1) Be sure the ignition switch is in the OFF position before you begin the degaussing procedures.

CAUTION: Keep the degaussing tool at least 2 inches away from the compass area when plugging it in.

(2) Plug the degaussing tool into a standard 110/115 volt AC outlet.

CONSOLE FORWARD MOUNTING SCREW

(3) Slowly approach the head of the forward mounting screw with the plastic coated tip of the degaussing tool. Contact the head of the screw for about two seconds.

(4) With the degaussing tool still energized, slowly back it away from the screw until the tool is at least 2 inches from the screw head then unplug the tool.

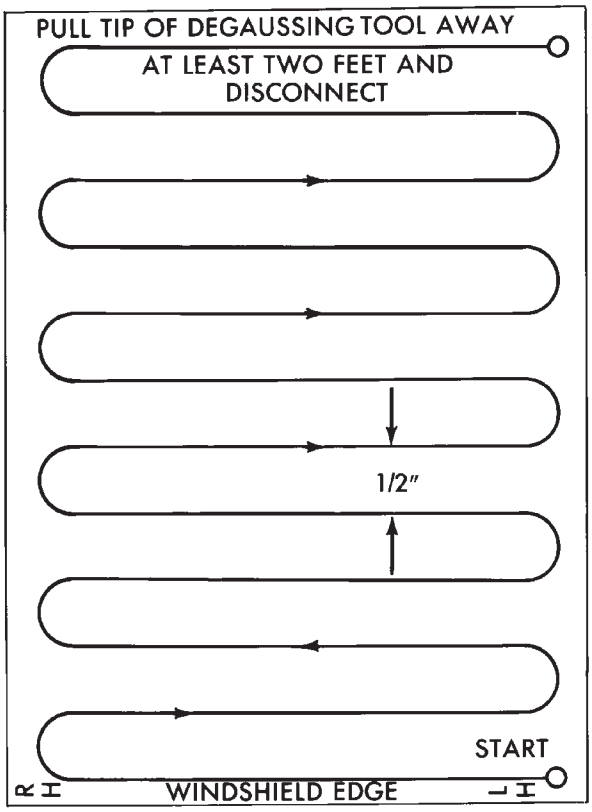
ROOF PANEL

(5) Place an 8 1/2 X 11 piece of paper on the center of the roof at the windshield, oriented lengthwise from front to rear. The purpose of the paper is protect the roof panel from scratches and define the area to be degaussed (Fig. 2). Figure 2 shows the recommended sweep pattern of 1/2 inch between passes in a sweeping zig-zag pattern.

(6) Plug in the degaussing tool. Keep the tool at least 2 inches away from the compass unit.

(7) Slowly approach the center of the roof panel at the windshield with the degaussing tool plugged in.

(8) Contact the roof panel with the tip of the tool (be sure template is in place to avoid scratching the roof panel). Using slow sweeping motions of 1/2 inch between sweeps, move the tool approximately 4″ either side of the centerline and at least 11 inches back from the windshield.



J908E-27

Fig. 2 Roof Degaussing Pattern

(9) With the degaussing tool still energized, slowly back it away from the roof panel until the tip is at least 2 inches from the roof then unplug the tool.

(10) Calibrate the compass and set the variance as described.

SELF-DIAGNOSTIC TEST

The self-diagnostic test is used to verify the compass is working properly electrically. This can be used to confirm that the display and all of its segments are operating properly. Initiate the self-diagnostic test as follows:

(1) With the ignition switch in the OFF position simultaneously press and hold the COMP/TEMP button and the US/METRIC button.

(2) Turn ignition switch to ON.

(3) Continue to hold both buttons until the display performs a walking segment test. In this test all of the compass points are displayed along with various number combinations. These combinations verify that all segments work. To repeat the test, press the COMP/TEMP button.

(4) Press the US/METRIC button, and all segments will light simultaneously for about 2 seconds. To repeat the test, press the COMP/TEMP button.

(5) Press the US/METRIC button to return to normal operation.

(6) Should any segment in any of the digit positions fail to light, the unit is defective and should be replaced.

THERMOMETER AND SENSOR SYSTEM REPAIR PROCEDURES

This portion of the display consists of a sensor, the circuit and display devoted to the temperature measuring and display. The sensor is mounted at the center of the vehicle below the grille, behind the front bumper (Fig. 3).

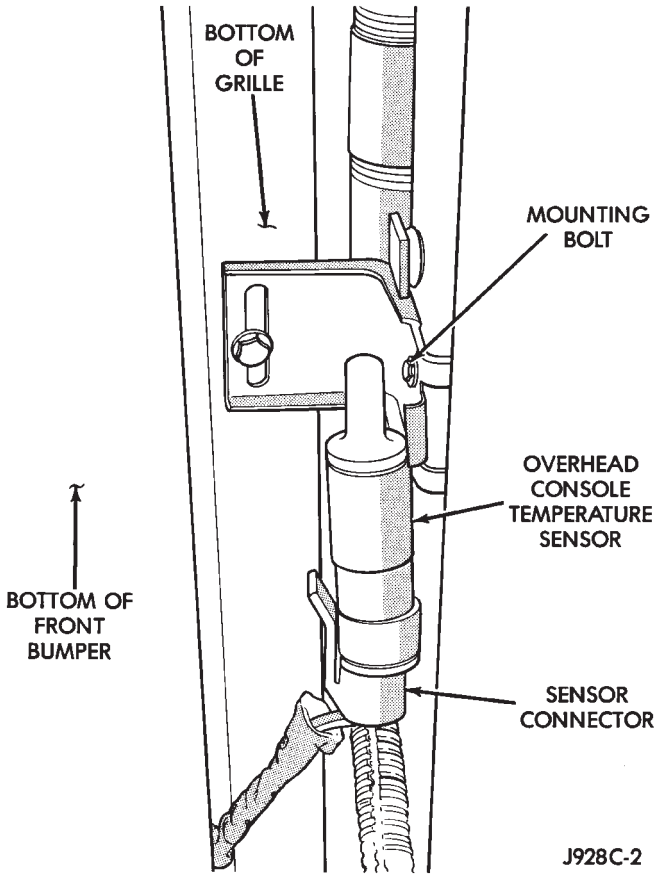


Fig. 3 Temperature Sensor Viewed From Underneath Vehicle

If an electrical component breaks it will diagnose as an open or short circuit. The system reports SC when the sensor is exposed to temperatures in excess of 140°F or if the circuit is shorted. If the temperature is below -40°F or an open exists, the system will display OC.

To diagnose the temperature sensor perform the following procedures. If the sensor and wiring are OK then the electronic module is defective and should be replaced.

SENSOR TEST

(1) Turn the ignition switch to OFF.

(2) Measure resistance of sensor. At -40°F the resistance is 336K ohms. At 140°F the resistance is 2.488K ohms. If resistance is NOT between these two values, then the sensor is faulty. Replace the sensor.

CIRCUIT TEST

(1) Locate temperature sensor and disconnect harness connector.

(2) Short the pins on the harness connector by using a jumper wire.

(3) Remove the overhead console as described in Console Repair Procedures.

(4) Check continuity between pins 10 and 11 of compass/temperature harness connector (Fig. 4). If an open circuit is detected, repair as required.

(5) Remove jumper wire on temperature sensor harness connector. Check continuity between pins 10 and 11 of compass/temperature harness connector (Fig. 4). If a short is detected, repair as required.

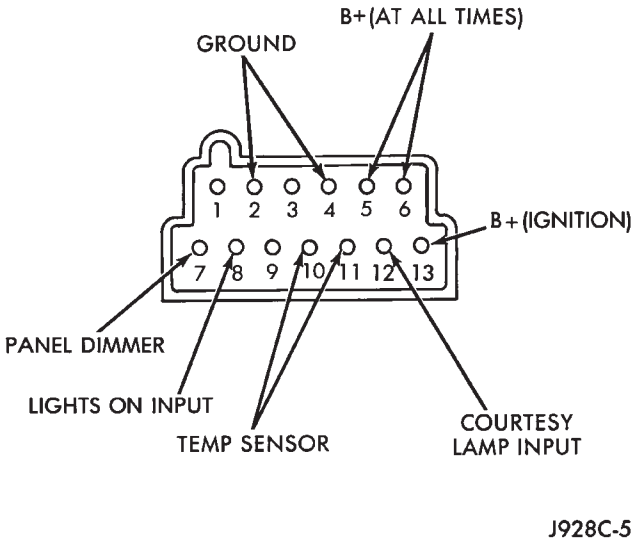


Fig. 4 Compass/Temperature Harness Connector

CONSOLE REPAIR PROCEDURES

(1) Remove screw forward of the compass unit (Fig. 5).

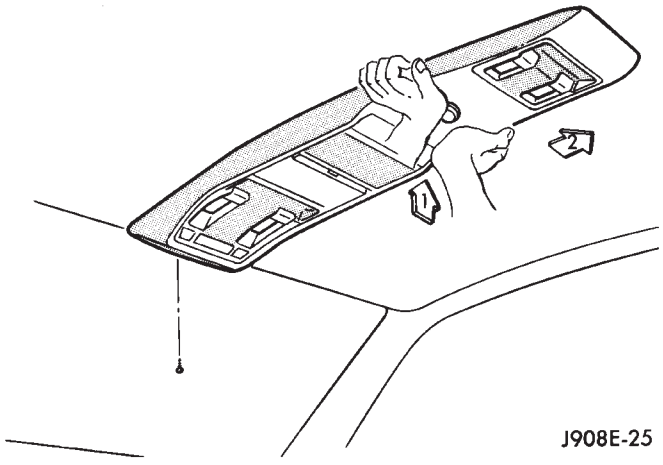


Fig. 5 Remove/Install Overhead Console

(2) Flex housing outward while pressing upward to disengage the housing from the rear bracket (arrow 1) (Fig. 5).

(3) Slide console rearward until the console detaches from the front mounting bracket (arrow 2) (Fig. 5).

(4) While pressing up on rear of console (arrow 1), slide console forward holding front away from headliner (arrow 2). Move console forward until the rear detaches from headliner and becomes free (Fig. 6).

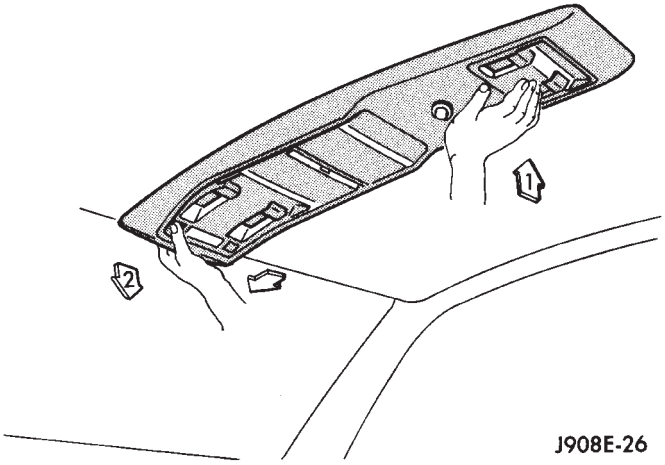


Fig. 6 Remove/Install Overhead Console

(5) Disconnect wire harnesses from keyless entry and compass (Figs. 7 and 8).

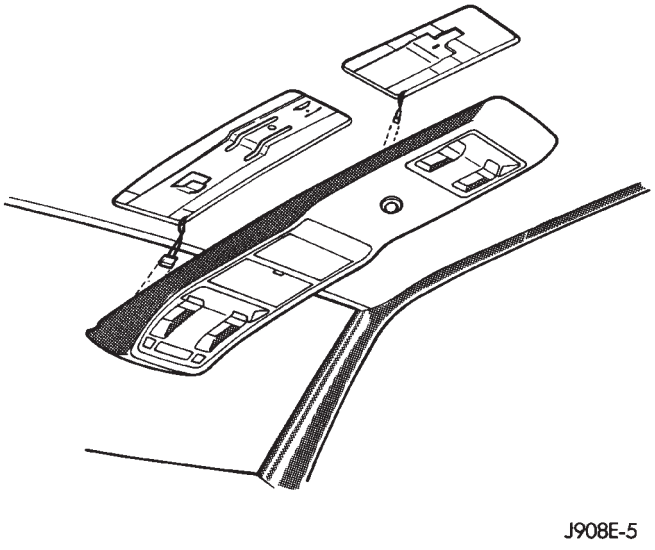


Fig. 7 Disconnect Wire Harnesses

(6) To install the overhead console, reverse the removal procedures. Be sure to flex housing outward near the keyless entry receiver until the console snaps onto the rear mounting bracket.

BULB REPLACEMENT

(1) With a large paper clip or wire (approximately 0.06 in. diameter) make a hook in the end. Insert into the hole in the lens and pull downward (Fig. 9).

(2) Set lens aside and replace bulb.

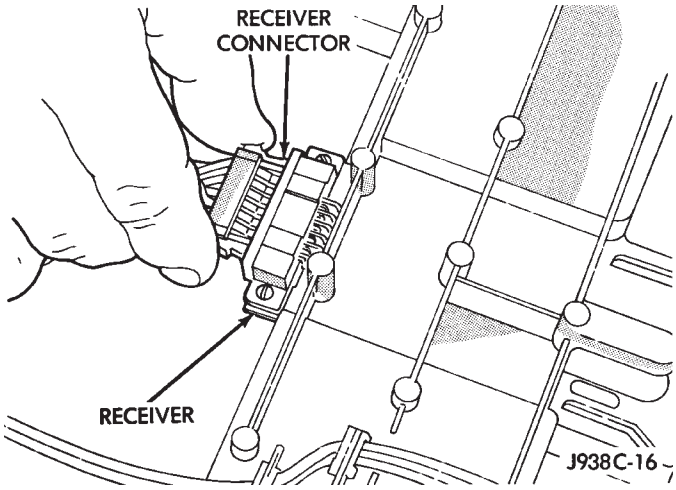


Fig. 8 Keyless Entry Connector

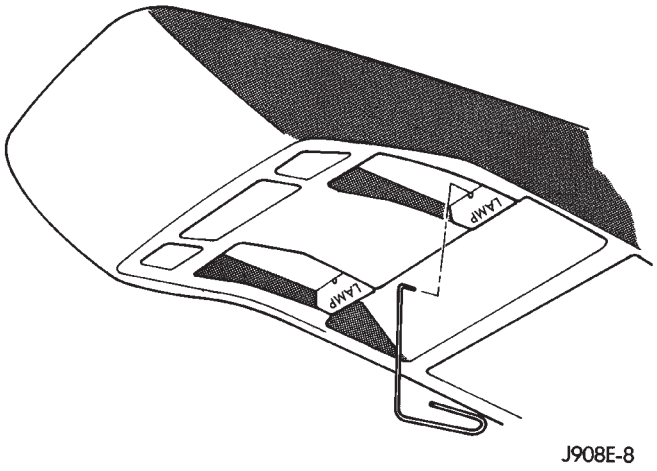


Fig. 9 Map Lamp Lens Removal

(3) Replace lens by inserting tab on thin portion of lens into mating slot on console and push upwards on opposite end of lens (Fig. 10).

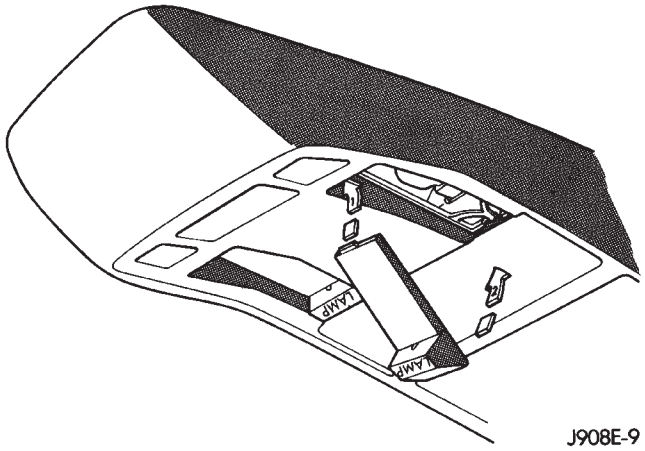


Fig. 10 Map Lamp Lens Installation

SUNGLASS BIN AND SPRING ASSEMBLY

(1) Open sunglass bin door.

(2) Remove cover plate (Fig. 11).

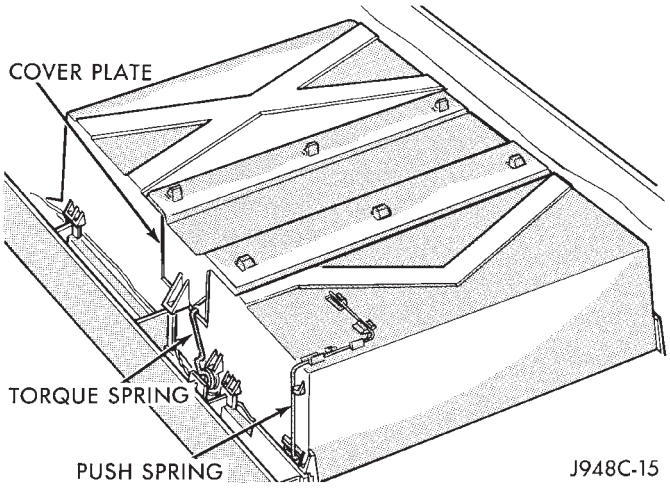


Fig. 11 Remove Cover Plate From Sunglass Bin

(3) Unhook torque spring from wall and put in down position as shown by arrow (Fig. 12).

(4) Remove sunglass bin door by flexing the center panel and removing the side of the door with the gear first (Fig. 13). The gear side of the door has a short pivot rod. Slide door out of the compartment.

(5) Remove and discard push spring (Fig. 11).

(6) Install new push spring as shown. This may require flexing the housing in that area for clearance.

(7) Install new sunglass bin door in the open position as follows:

(a) Make sure the torque spring lines up with the slot in the longer pivot rod then insert the longer pivot rod (Fig. 13).

(b) Flex the center panel and snap in the short pivot rod.

(c) Hook torque spring back over the wall (Fig. 11).

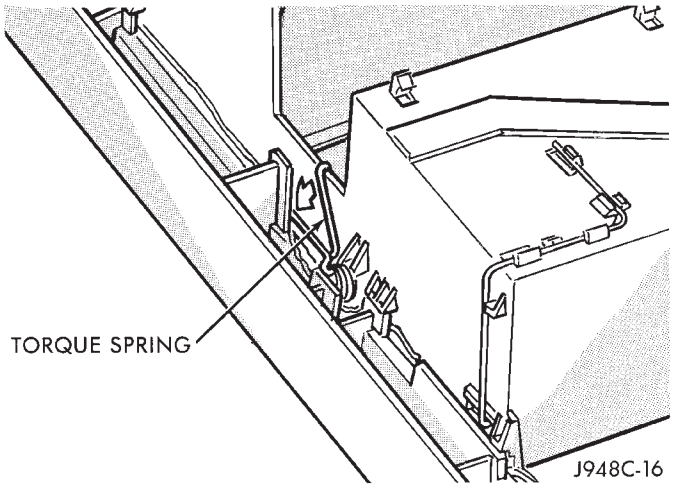


Fig. 12 Release Torque Spring

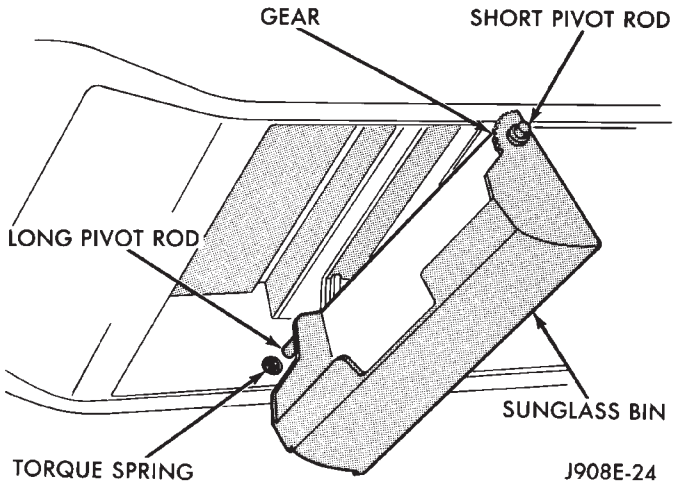


Fig. 13 Remove Sunglass Bin

(d) Cycle door several times to ensure that the door functions properly.

(8) Snap cover plate back in position as shown (Fig. 11). Some pressure from the inside of the bins may be required to engage all 6 snaps.

IGNITION SYSTEMS

CONTENTS

COMPONENT IDENTIFICATION/SYSTEM OPERATION

INDEX

GENERAL INFORMATION

Throughout this group, references are made to particular vehicle models by alphabetical designation (XJ or YJ) or by the particular vehicle nameplate. A chart showing a breakdown of alphabetical designations is included in the Introduction group at the beginning of this manual.

This section of the group, Component Identification/System Operation, will discuss ignition system operation and will identify ignition system components.

For diagnostic procedures and adjustments, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of ignition system components, refer to the Component Removal/Installation section of this group.

For other useful information, refer to On-Board Diagnostics in the General Diagnosis sections of Group 14, Fuel System in this manual.

For operation of the DRB Scan Tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

An Ignition specifications section is included at the end of this group. A general Maintenance Schedule (mileage intervals) for ignition related items can be found in Group 0, Lubrication and Maintenance. This schedule can also be found in the Owners Manual.

IGNITION SYSTEMS

A multi-port, fuel injected engine is used on all models. The ignition system is controlled by the Powertrain Control Module (PCM) on all engines. The PCM was formerly referred to as the SBEC or engine controller.

The ignition system consists of:

- Spark Plugs
- Ignition Coil
- Secondary Ignition Cables
- Ignition distributor (contains rotor and camshaft position sensor)
- Powertrain Control Module (PCM)
- Crankshaft Position Sensor

AUTOMATIC SHUT DOWN (ASD) RELAY

The automatic shut down (ASD) relay is located in the Power Distribution Center (PDC) near the battery (Fig. 1 or 2). As one of its functions, it will supply battery voltage to the ignition coil. The ground circuit for the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM regulates ASD relay operation by switching the ground circuit on-and-off.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the ignition distributor (Figs. 3 or 4) on all engines.

The camshaft position sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a

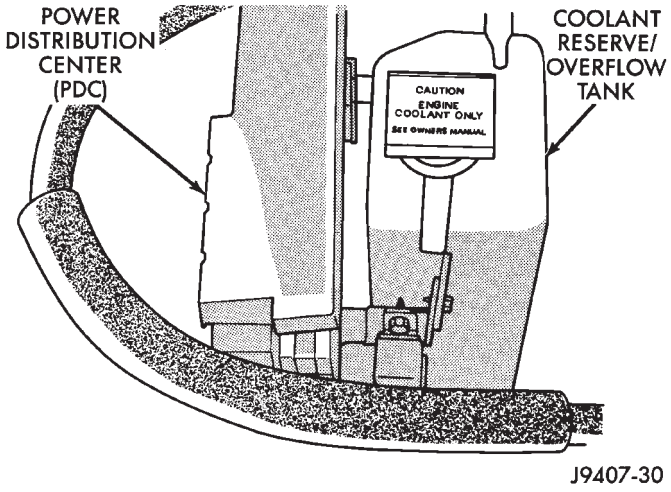


Fig. 1 PDC—XJ Models

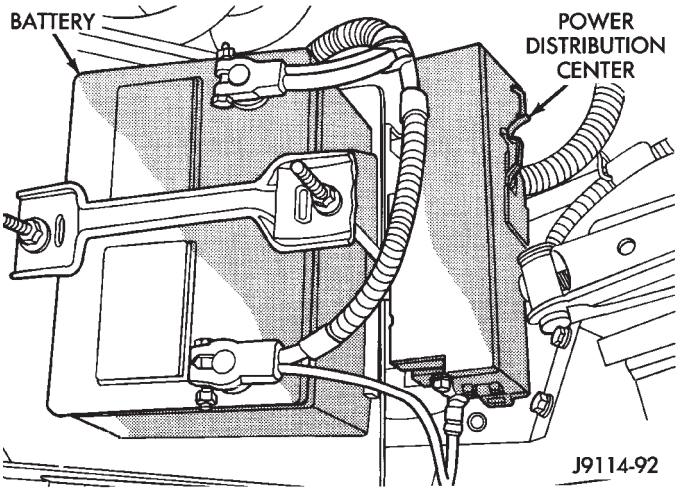


Fig. 2 PDC—YJ Models

rotating pulse ring (shutter) on the distributor shaft (Fig. 4). The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

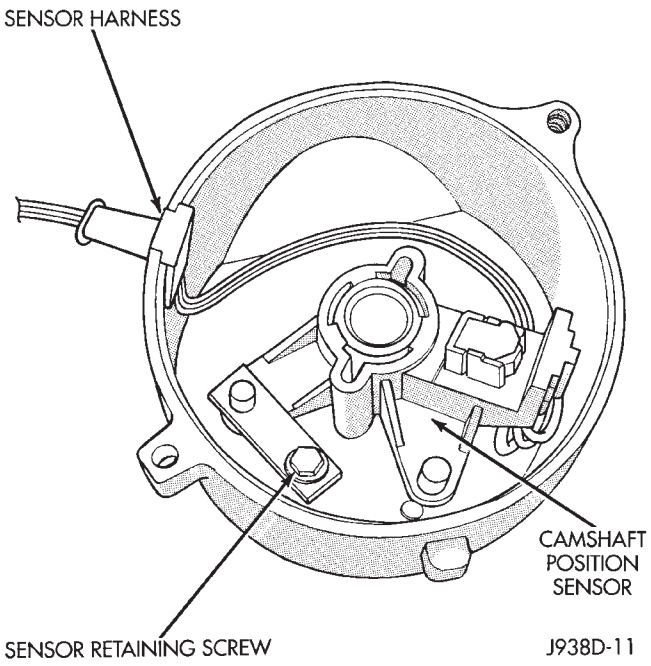


Fig. 3 Camshaft Position Sensor—Typical

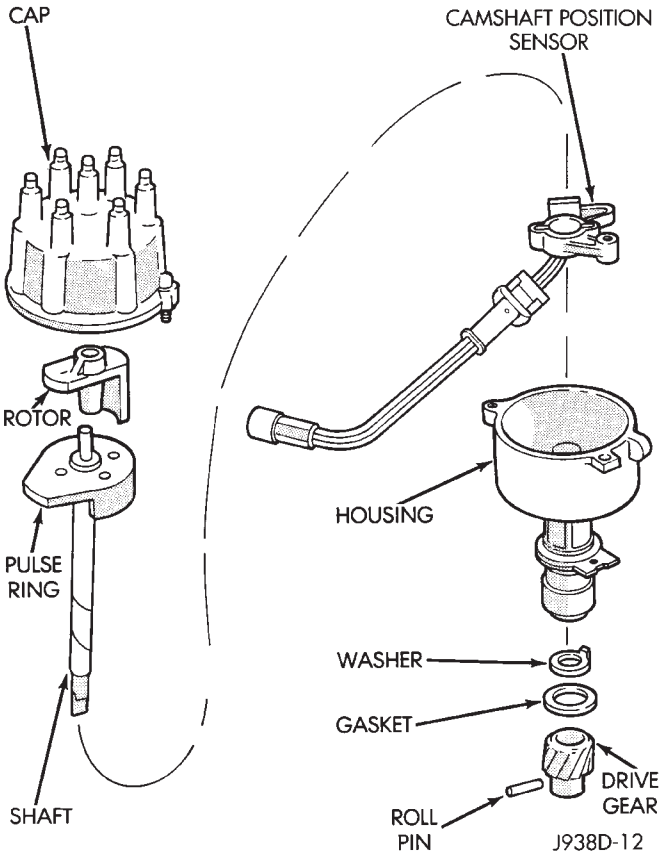


Fig. 4 Distributor—Typical

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted to the transmission bellhousing at the left/rear side of the engine block (Figs. 5, 6 or 7).

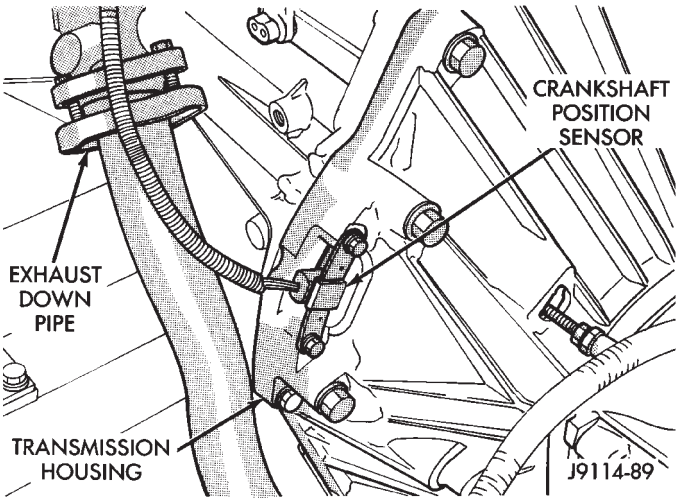


Fig. 5 Crankshaft Position Sensor—2.5L Engine—Typical

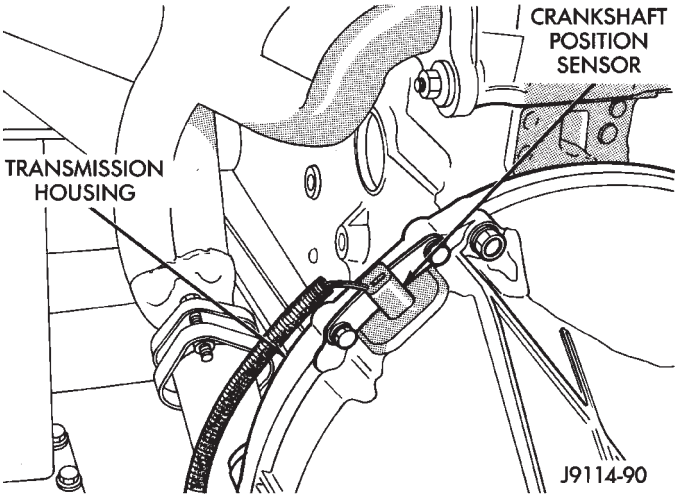


Fig. 6 Crankshaft Position Sensor—4.0L Engine—All Except YJ models With Automatic Transmission

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

SENSOR OPERATION

The flywheel/drive plate has groups of four notches at its outer edge. On 4.0L 6 cylinder engines there are three sets of notches (Figs. 9 or 10). On 2.5L 4 cylinder engines there are two sets of notches (Fig. 8).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input

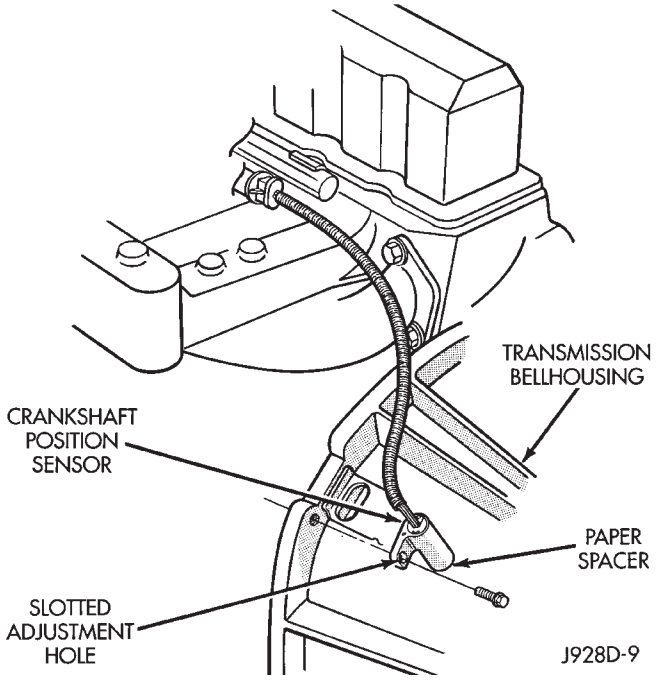


Fig. 7 Crankshaft Position Sensor—4.0L Engine—YJ models With Automatic Transmission

to the PCM. For each engine revolution there are two groups of four pulses generated on 2.5L 4 cylinder engines. There are 3 groups of four pulses generated on 4.0L 6 cylinder engines.

The trailing edge of the fourth notch, which causes the pulse, is four degrees before top dead center (TDC) of the corresponding piston.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this sensor, refer to the Component Removal/Installation section of this group.

DISTRIBUTORS

All engines are equipped with a camshaft driven mechanical distributor containing a shaft driven distributor rotor. All distributors are equipped with an internal camshaft position (fuel sync) sensor. This sensor provides fuel injection synchronization and cylinder identification.

The distributors on the 2.5L and 4.0L engines do not have built in centrifugal or vacuum assisted advance. Base ignition timing and all timing advance is controlled by the Powertrain Control Module (PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable on any of these engines.**

The distributor is locked in place by a notch on the distributor housing. The distributor holddown clamp bolt passes through this notch when installed. Because the distributor position is locked when in-

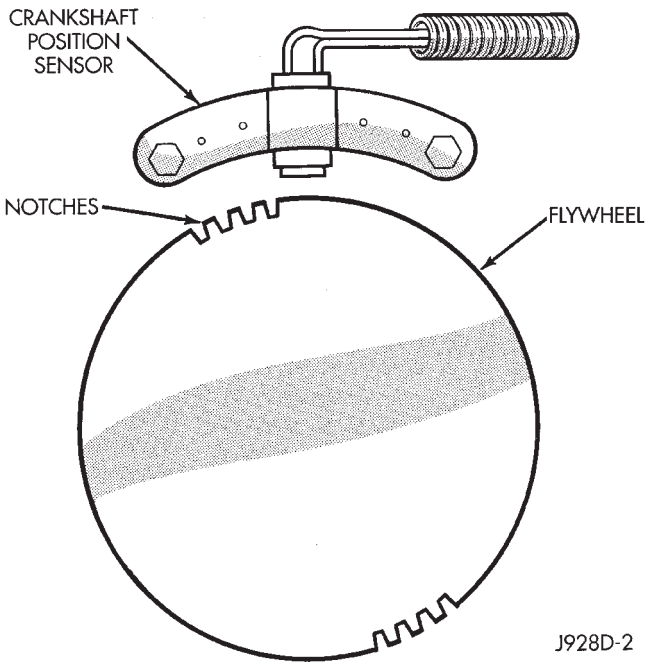


Fig. 8 Sensor Operation—2.5L Engine

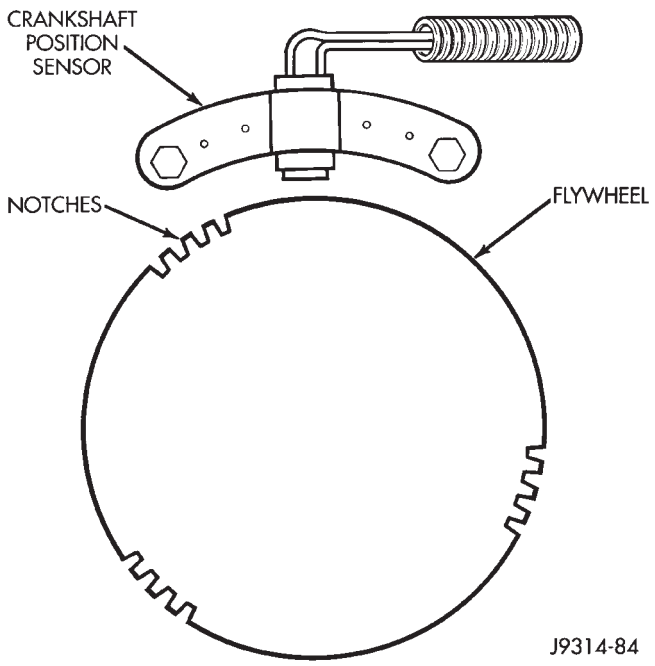


Fig. 9 Sensor Operation—4.0L Engine—All Except YJ Models With Automatic Transmission

stalled, its rotational position can not be changed. **Do not attempt to modify the distributor housing to get distributor rotation. Distributor position will have no effect on ignition timing.**

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

For component testing, refer to the Diagnostics/Service Procedures section of this group.

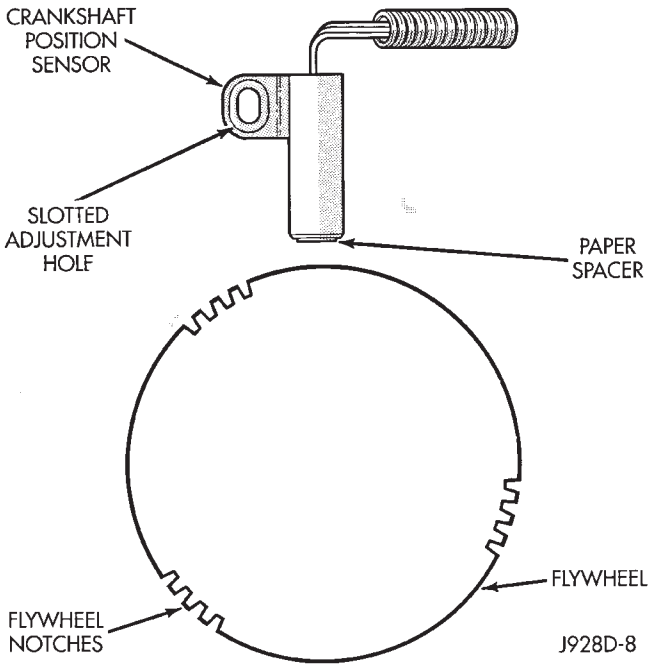


Fig. 10 Sensor Operation—4.0L Engine—YJ Models With Automatic Transmission

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

IGNITION COIL

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay.

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Base ignition timing is not adjustable. 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.

The ignition coil is mounted to a bracket on the side of the engine (Fig. 11).

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor provides an input voltage to the Powertrain Control Module (PCM) relating coolant temperature. The PCM uses this input, along with inputs from other sensors, to determine injector pulse width and ignition timing.

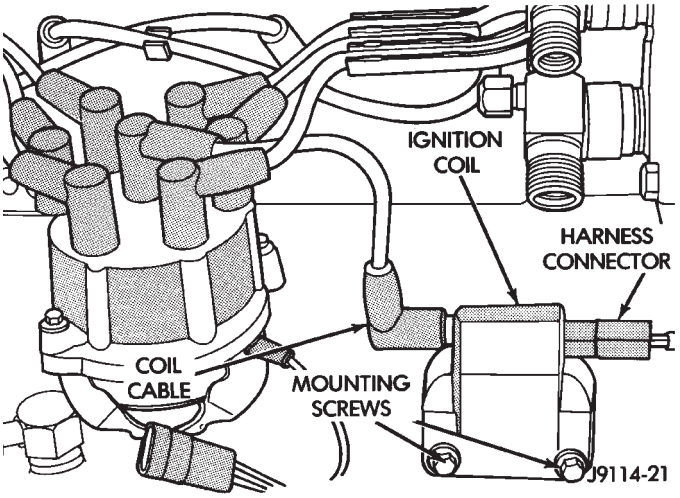


Fig. 11 Ignition Coil—Typical

As coolant temperature varies, the sensor resistance will change, resulting in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in the Open Loop Cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds, until normal operating temperatures are reached. Refer to Modes Of Operation in Group 14, Fuel System for a description of Open and Closed Loop operation.

This sensor is installed in the thermostat housing (Fig. 12).

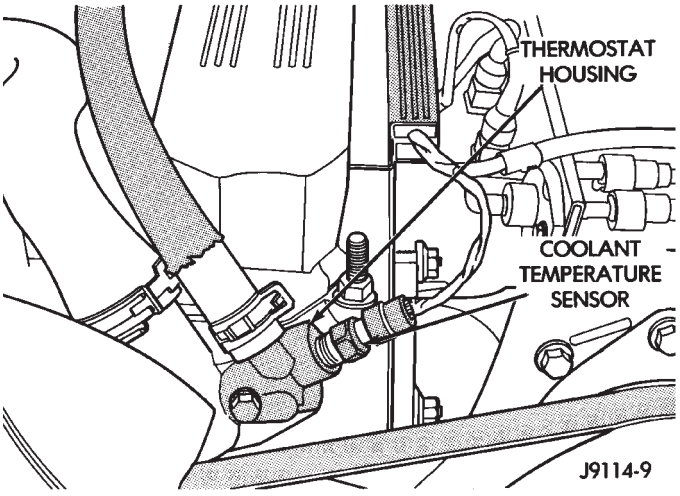


Fig. 12 Coolant Temperature Sensor—Typical

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

The sensor element extends into the intake manifold air stream. It provides an input voltage to the Powertrain Control Module (PCM) indicating intake manifold air temperature. The input from this sensor is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance will change. This will result in a different input voltage to the PCM. For more information, refer to Group 14, Fuel System.

This sensor is installed in the intake manifold (Fig. 13, 4.0L engine or Fig. 14, 2.5L engine).

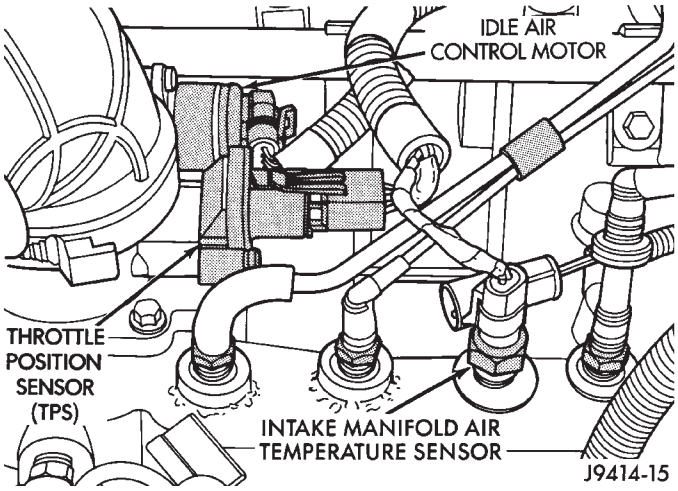


Fig. 13 Air Temperature Sensor Location—4.0L Engine

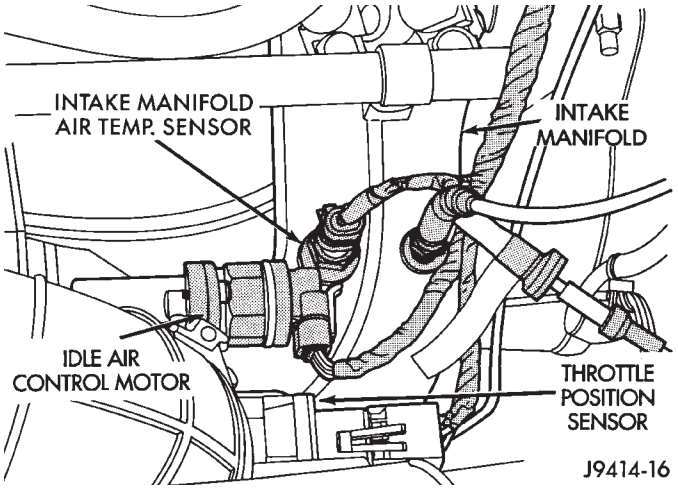


Fig. 14 Air Temperature Sensor Location—2.5L Engine

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the Powertrain Control Module (PCM). As engine load changes, manifold pressure varies, causing the MAP

sensor voltage to change. This change results in a different input voltage to the PCM. The input voltage level supplies the PCM with information. This relates to ambient barometric pressure during engine start-up (cranking) and to engine load while the engine is running. The PCM uses this input, along with inputs from other sensors, to adjust air-fuel mixture.

For more information, refer to Group 14, Fuel System.

The MAP sensor is located in the engine compartment near the rear of engine cylinder head (valve) cover (Fig. 15). It is connected to the throttle body with a vacuum hose and to the PCM electrically.

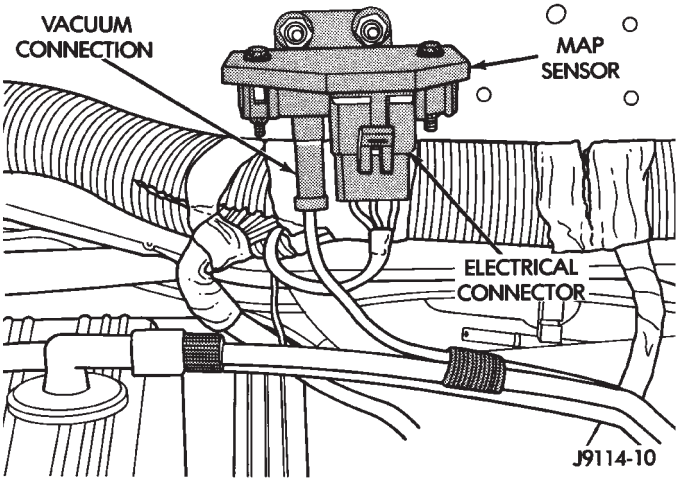


Fig. 15 MAP Sensor—Typical

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

POWERTRAIN CONTROL MODULE (PCM)

The PCM was formerly referred to as the SBEC or engine controller. On XJ models, the PCM is located in the engine compartment next to the air cleaner (Fig. 16). On YJ models, the PCM is located in the engine compartment behind the windshield washer fluid reservoir (Fig. 17).

The ignition system is controlled by the PCM.

Base ignition timing by rotation of distributor is not adjustable. The PCM opens and closes the ignition coil ground circuit to operate the ignition coil. This is done to adjust ignition timing, both initial (base) and advance, for changing engine operating conditions.

The amount of electronic spark advance provided by the PCM is determined by five input factors: Engine coolant temperature, engine rpm, intake manifold air temperature, intake manifold absolute pressure and throttle position.

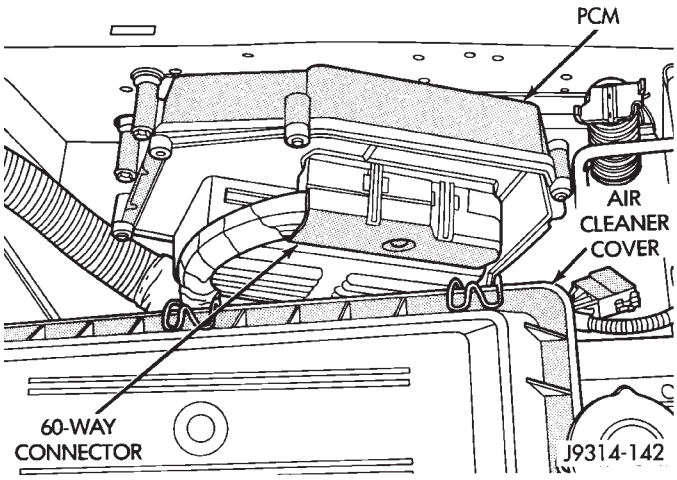


Fig. 16 PCM Location—XJ Models

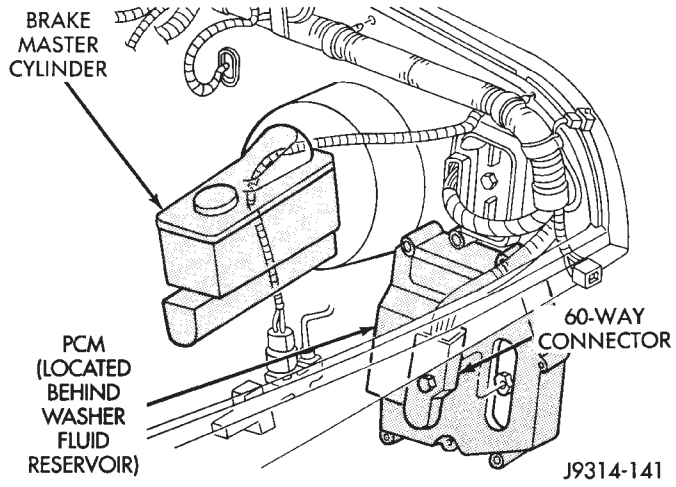


Fig. 17 PCM Location—YJ Models

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

For diagnostics, refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

THROTTLE POSITION SENSOR

The sensor is mounted on the throttle body (Figs. 18 or 19). It is connected to the throttle blade shaft. The sensor is a variable resistor. It provides the Powertrain Control Module (PCM) with an input signal (voltage) that represents throttle blade position. As the position of the throttle blade changes, the resistance of the sensor changes.

The PCM supplies approximately 5 volts to the sensor. The sensor output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the sensor. This will vary in an approximate range of from 1 volt at minimum throttle opening (idle), to 4 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the sensor input to determine

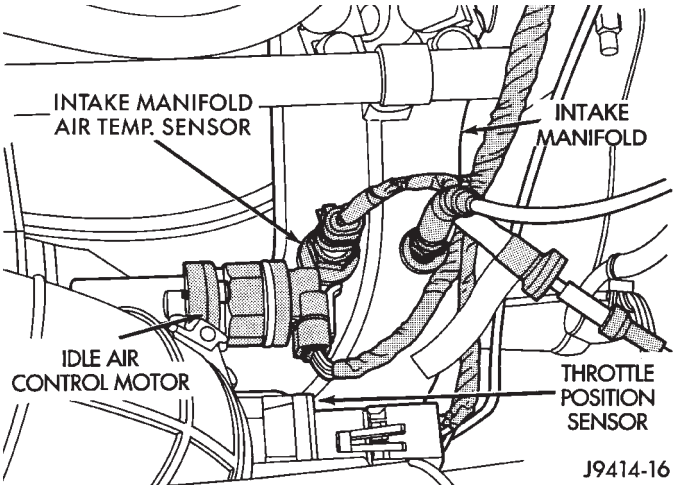


Fig. 18 Throttle Position Sensor—2.5L Engine

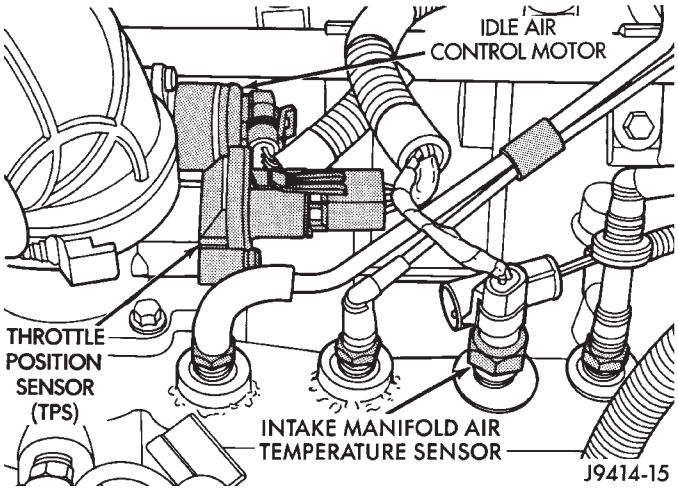


Fig. 19 Throttle Position Sensor—4.0L Engine

current engine operating conditions. It will also adjust fuel injector pulse width and ignition timing.

For component testing, refer to the Diagnostics/Service Procedures section of this group.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

DIAGNOSTICS/SERVICE PROCEDURES

INDEX

GENERAL INFORMATION

This section of the group, Diagnostics/Service Procedures, will discuss basic ignition system diagnostics and service adjustments.

For system operation and component identification, refer to the Component Identification/System Operation section of this group.

For removal or installation of ignition system components, refer to the Component Removal/Installation section of this group.

For other useful information, refer to On-Board Diagnostics in the General Diagnosis sections of Group 14, Fuel System in this manual.

For operation of the DRB Scan Tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

AUTOMATIC SHUT DOWN (ASD) RELAY

Refer to Relays—Operation/Testing in the Group 14, Fuel System section of this service manual.

CAMSHAFT POSITION SENSOR TEST

The camshaft position sensor is located in the distributor on all engines.

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

2.5L OR 4.0L ENGINE

For this test, an analog voltmeter is needed. Do not remove the distributor connector from the distributor. Using small paper clips, insert them into the backside of the distributor wire harness connector to make contact with the terminals. Be sure that the connector is not damaged when inserting the paper clips. Attach voltmeter leads to these paper clips.

(1) Connect the positive (+) voltmeter lead into the sensor output wire. This is at done the distributor wire harness connector. For wire identification, refer to Group 8W, Wiring Diagrams.

(2) Connect the negative (-) voltmeter lead into the ground wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(3) Set the voltmeter to the 15 Volt DC scale.

(4) Remove distributor cap. Rotate (crank) engine with starter until pulse ring (Fig. 1) enters the magnetic pickup on camshaft position sensor. Distributor rotor should be pointed in 9 o'clock position. The movable pulse ring should now be within the sensor pickup.

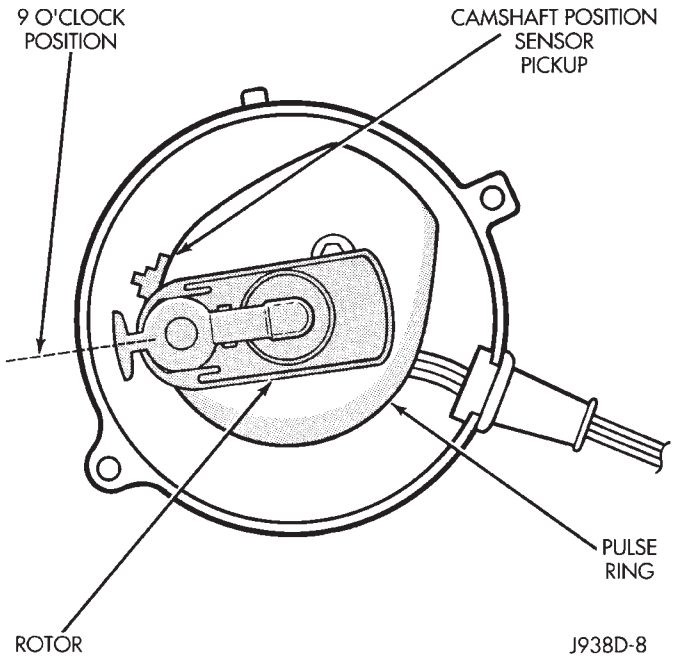


Fig. 1 Pulse Ring/Rotor Position—Typical

(5) Turn ignition key to ON position. Voltmeter should read approximately 5.0 volts.

(6) If voltage is not present, check the voltmeter leads for a good connection.

(7) If voltage is still not present, check for voltage at the supply wire. For wire identification, refer to Group 8W, Wiring Diagrams.

(8) If voltage is not present at supply wire, check for voltage at pin 7 of Powertrain Control Module (PCM) 60-way connector. Leave the PCM connector connected for this test.

(9) If voltage is still not present, perform vehicle test using the DRB scan tool.

(10) If voltage is present at pin 7, but not at the supply wire:

(a) Check continuity between the supply wire. This is checked between the distributor connector and pin 7 at the PCM. If continuity is not present, repair the harness as necessary.

(b) Check for continuity between the camshaft position sensor output wire and pin 44 at the PCM. If continuity is not present, repair the harness as necessary.

(c) Check for continuity between the ground circuit wire at the distributor connector and ground. If continuity is not present, repair the harness as necessary.

(11) While observing the voltmeter, crank the engine with ignition switch. The voltmeter needle should fluctuate between 0 and 5 volts while the engine is cranking. This verifies that the camshaft position sensor in the distributor is operating properly and a sync pulse signal is being generated.

If sync pulse signal is not present, replacement of the camshaft position sensor is necessary.

For removal or installation of ignition system components, refer to the Component Removal/Installation section of this group.

For system operation and component identification, refer to the Component Identification/System Operation section of this group.

CRANKSHAFT POSITION SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The sensor is located on the transmission bellhousing at the left/rear side of the engine block (Figs. 2, 3 or 4).

(1) Near the rear of intake manifold, disconnect sensor pigtail harness connector from main wiring harness.

(2) Place an ohmmeter across terminals B and C (Fig. 5). Ohmmeter should be set to 1K-to-10K scale for this test. The meter reading should be open (no resistance). Replace sensor if a low resistance is indicated.

For removal or installation of ignition system components, refer to the Component Removal/Installation section of this group.

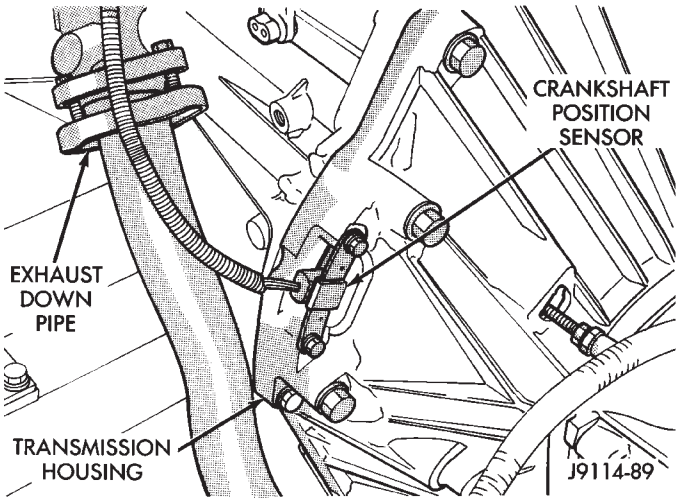


Fig. 2 Crankshaft Position Sensor—2.5L Engine—Typical

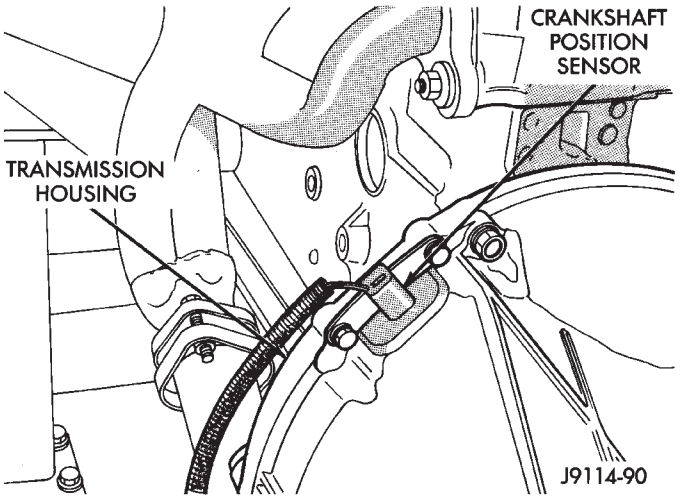


Fig. 3 Crankshaft Position Sensor—4.0L Engine—All Except YJ models With Auto. Trans.

DISTRIBUTOR CAP

INSPECTION

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers, or damaged rotor button (Figs. 6 and 7). Also check for white deposits on the inside (caused by condensation entering the cap through cracks). Replace any cap that displays charred or eroded terminals. The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

If replacement of the distributor cap is necessary, transfer spark plug cables from the original cap to the new cap. This should be done one cable at a time. Each cable is installed onto the tower of the new cap that corresponds to its tower position on the original cap. Fully seat the cables onto the towers. If neces-

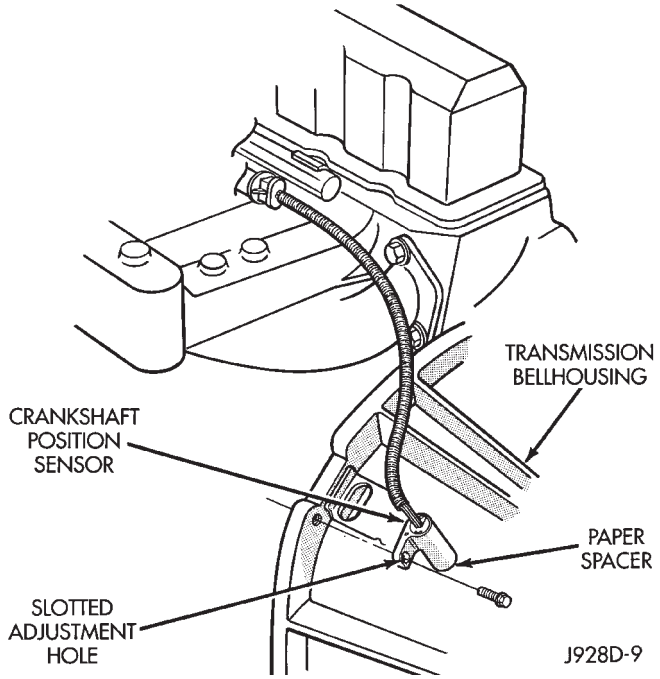


Fig. 4 Crankshaft Position Sensor—4.0L Engine—YJ models With Auto. Trans.

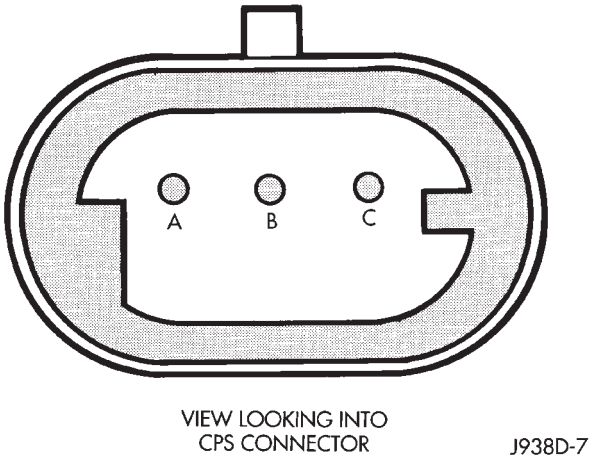


Fig. 5 Crankshaft Position Sensor Connector

sary, refer to the engine Firing Order diagrams (Figs. 8 or 9).

DISTRIBUTOR ROTOR

Visually inspect the rotor (Fig. 10) for cracks, evidence of corrosion, or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

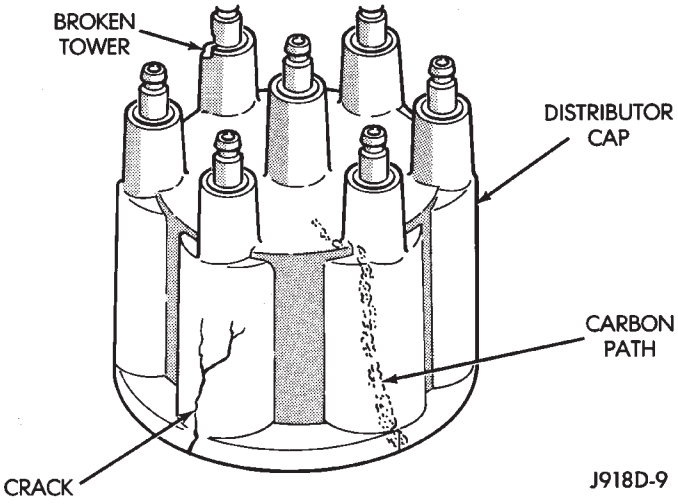


Fig. 6 Cap Inspection—External—Typical

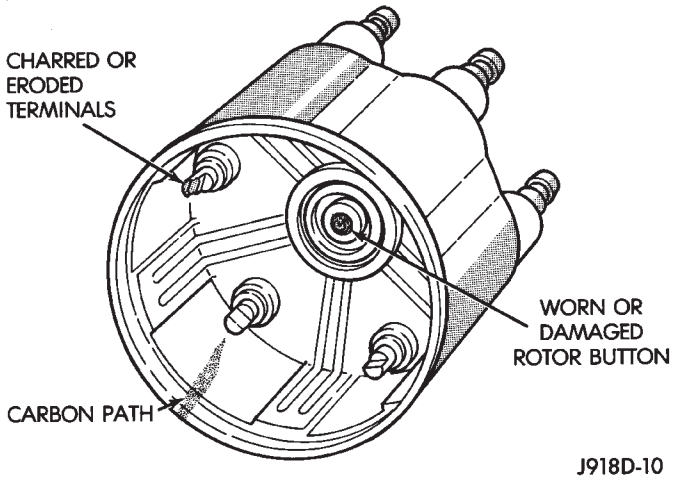


Fig. 7 Cap Inspection—Internal—Typical

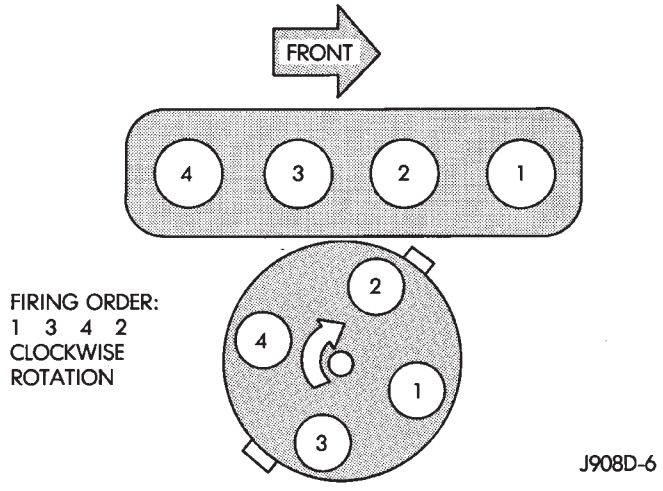


Fig. 8 Firing Order—2.5L 4 Cylinder Engine

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

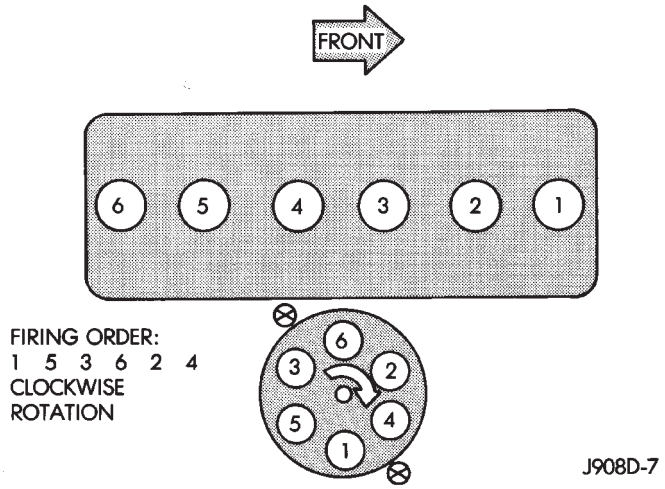


Fig. 9 Firing Order—4.0L 6 Cylinder Engine

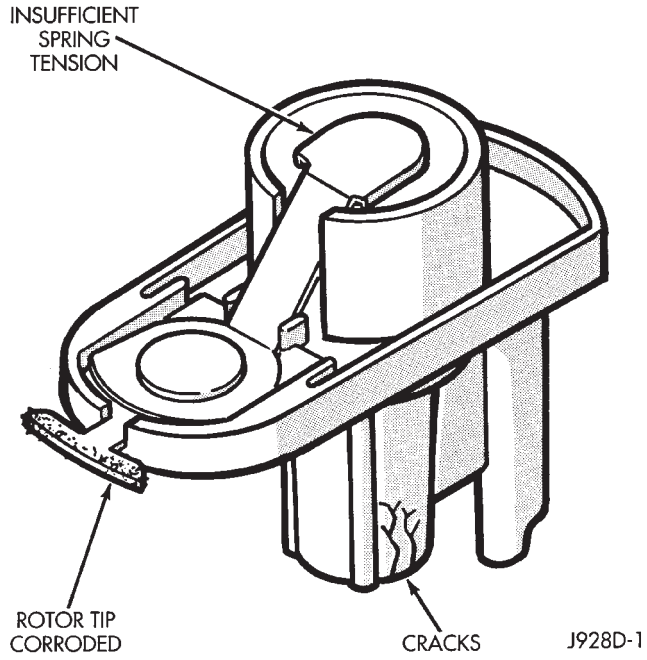


Fig. 10 Rotor Inspection—Typical

IGNITION COIL

To perform a complete test of the ignition coil and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the coil only, refer to the following:

The ignition coil (Fig. 11) is designed to operate without an external ballast resistor.

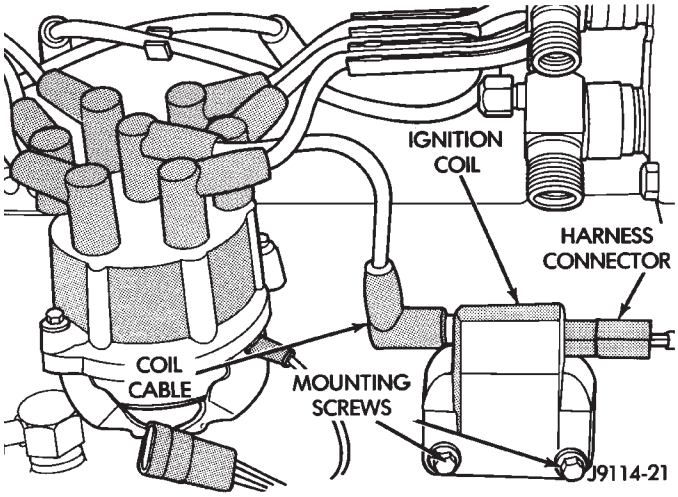


Fig. 11 Ignition Coil—Typical

Inspect the ignition coil for arcing. Test the coil according to coil tester manufacturer's instructions. Test the coil primary and secondary resistance. Replace any coil that does not meet specifications. Refer to the Ignition Coil Resistance chart.

If the ignition coil is being replaced, the secondary spark plug cable must also be checked. Replace cable if it has been burned or damaged.

Arcing at the tower will carbonize the cable nipple, which if it is connected to a new ignition coil, will cause the coil to fail.

If the secondary coil cable shows any signs of damage, it should be replaced with a new cable and new terminal. Carbon tracking on the old cable can cause arcing and the failure of a new ignition coil.

IGNITION COIL RESISTANCE

COIL (MANUFACTURER)	PRIMARY RESISTANCE 21–27°C (70–80°F)	SECONDARY RESISTANCE 21–27°C (70–80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

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ENGINE COOLANT TEMPERATURE SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The sensor is installed in the thermostat housing (Fig. 12).

(1) Disconnect wire harness connector from sensor (Fig. 12).

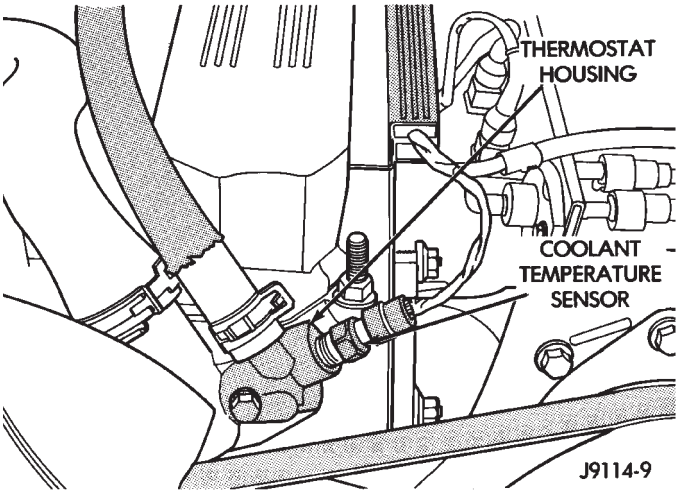

Fig. 12 Coolant Temperature Sensor—Typical

(2) Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance should be less than 1340 ohms at normal engine operating idle temperature. For resistance values, refer to the Sensor Resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

(3) Test continuity of the wire harness. This is done between Powertrain Control Module (PCM) wire harness connector terminal-2 and the sensor connector terminal. Also check continuity between wire harness terminal-4 to the sensor connector terminal. Repair the wire harness if an open circuit is indicated.

IGNITION SECONDARY CIRCUIT DIAGNOSIS

CHECKING FOR SPARK

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose. Grasp the boot (not the cable) and pull it off with a steady, even force.

(1) Disconnect the ignition coil secondary cable from center tower of the distributor cap. Hold the cable terminal approximately 12 mm (1/2 in.) from a good engine ground (Fig. 13).

SENSOR RESISTANCE (OHMS)

TEMPERATURE		RESISTANCE (OHMS)	
C	F	MIN	MAX
−40	−40	291,490	381,710
−20	−4	85,850	108,390
−10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

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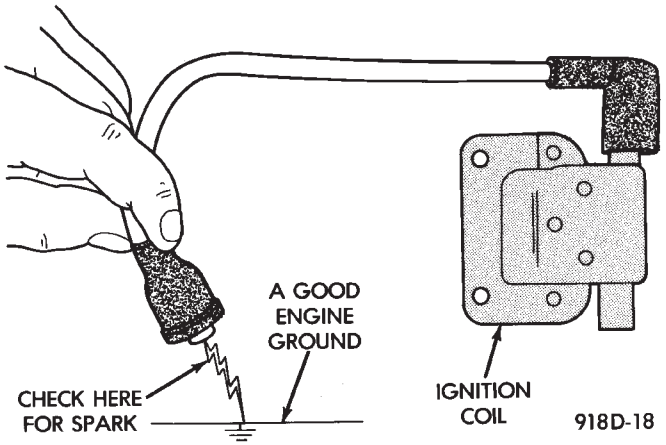

Fig. 13 Checking for Spark—Typical

WARNING: BE VERY CAREFUL WHEN THE ENGINE IS CRANKING. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE FITTING CLOTHING.

(2) Rotate (crank) the engine with the starter motor and observe the cable terminal for a steady arc. If steady arcing does not occur, inspect the secondary coil cable. Refer to Spark Plug Cables in this group. Also inspect the distributor cap and rotor for cracks or burn marks. Repair as necessary. If steady arcing occurs, connect ignition coil cable to the distributor cap.

(3) Remove a cable from one spark plug.

(4) Using insulated pliers, hold the cable terminal approximately 12 mm (1/2 in.) from the engine cylinder head or block while rotating the engine with the starter motor. Observe the spark plug cable terminal for an arc. If steady arcing occurs, it can be expected that the ignition secondary system is operating correctly. If steady arcing occurs at the spark plug cables, but the engine will not start, connect the DRB scan tool. Refer to the Powertrain Diagnostic Procedures service manual for DRB operation.

FAILURE TO START TEST

To prevent unnecessary diagnostic time and wrong test results, the previous Checking For Spark test should be performed prior to this test.

WARNING: SET PARKING BRAKE OR BLOCK THE DRIVE WHEELS BEFORE PROCEEDING WITH THIS TEST.

(1) Unplug the ignition coil harness connector at the coil (Fig. 14).

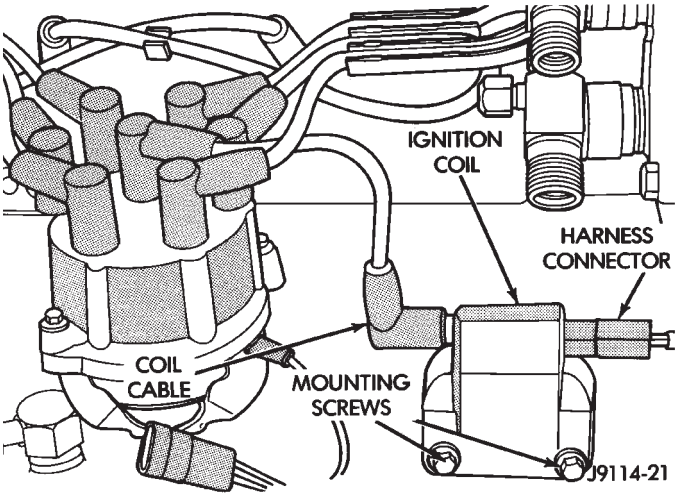

Fig. 14 Coil Harness Connector—Typical

(2) Connect a set of small jumper wires (18 gauge or smaller) between the ignition coil and coil electrical connector (Fig. 15).

(3) Determine that sufficient battery voltage (12.4 volts) is present for the starting and ignition systems.

(4) Crank the engine for 5 seconds while monitoring the voltage at the coil positive terminal:

- If the voltage remains near zero during the entire period of cranking, refer to On-Board Diagnostics in Group 14, Fuel Systems. Check the powertrain control module (PCM) and auto shut down relay.
- If voltage is at near battery voltage and drops to zero after 1-2 seconds of cranking, check the camshaft position sensor-to-PCM circuit. Refer to On-Board Diagnostics in Group 14, Fuel Systems.
- If voltage remains at near battery voltage during the entire 5 seconds, turn the key off. Remove the

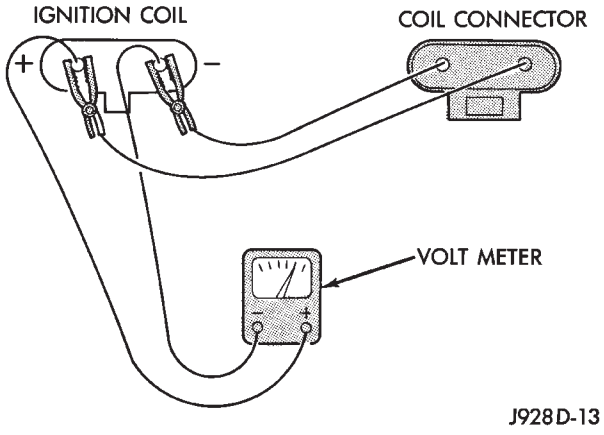

Fig. 15 Coil Terminals—Typical

60-way connector (Fig. 16) from the PCM. Check 60-way connector for any spread terminals.

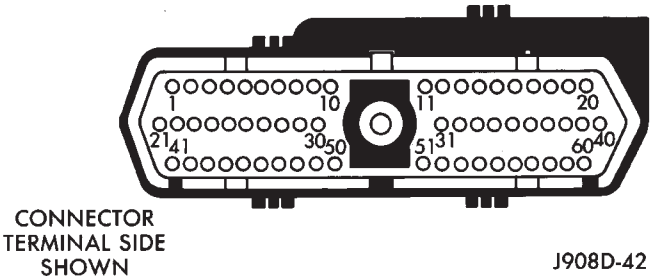

Fig. 16 PCM 60-Way Connector

(5) Remove test lead from the coil positive terminal. Connect an 18 gauge jumper wire between the battery positive terminal and the coil positive terminal.

(6) Make the special jumper shown in Figure 17. Using the jumper, **momentarily** ground terminal-19 of the 60-way connector. A spark should be generated at the coil cable when the ground is removed.

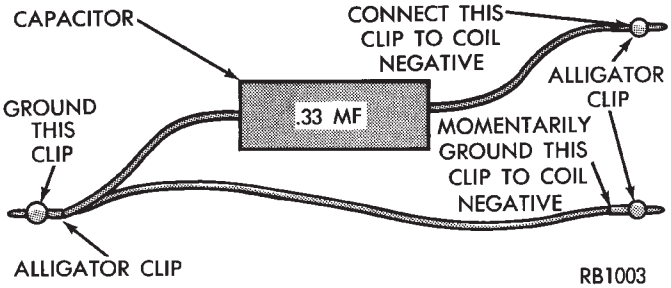

Fig. 17 Special Jumper Ground-to-Coil Negative Terminal

(7) If spark is generated, replace the powertrain control module (PCM).

(8) If spark is not seen, use the special jumper to ground the coil negative terminal directly.

(9) If spark is produced, repair wiring harness for an open condition.

(10) If spark is not produced, replace the ignition coil.

IGNITION TIMING

Base (initial) ignition timing is NOT adjustable on any of the 2.5L 4 cylinder or 4.0L 6 cylinder engines. Do not attempt to adjust ignition timing by rotating the distributor.

Do not attempt to modify the distributor housing to get distributor rotation. Distributor position will have no effect on ignition timing.

All ignition timing functions are controlled by the powertrain control module (PCM). Refer to On-Board Diagnostics in the Multi-Port Fuel Injection—General Diagnosis section of Group 14, Fuel Systems for more information. Also refer to the appropriate Powertrain Diagnostics Procedures service manual for operation of the DRB Scan Tool.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the wire harness connector from the sensor (Figs. 18 or 19).

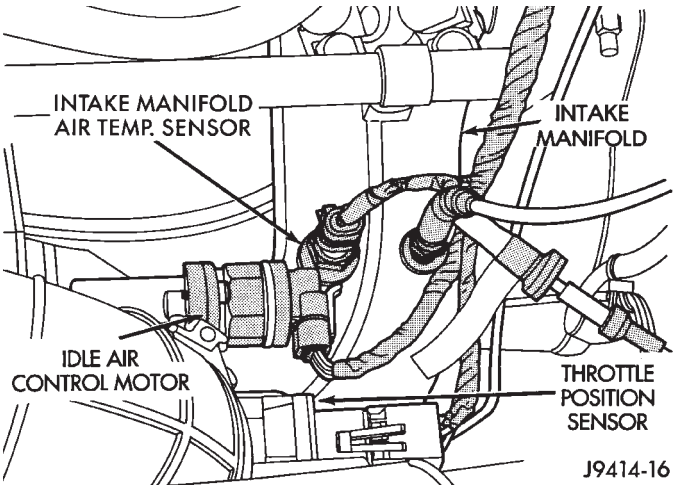

Fig. 18 Air Temperature Sensor—2.5L Engine

(2) Test the resistance of the sensor with a input impedance (digital) volt-ohmmeter. Do not remove the sensor from the engine for testing. For resistance values, refer to the Sensor Resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

(3) Test the resistance of the wire harness. This is done between the Powertrain Control Module (PCM) wire harness connector terminal-21 and the sensor connector terminal. Also check continuity between terminal-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

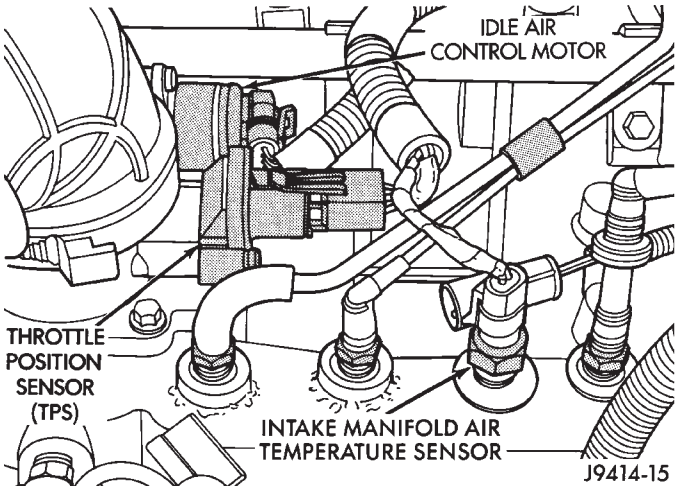

Fig. 19 Air Temperature Sensor—4.0L Engine

SENSOR RESISTANCE (OHMS)

TEMPERATURE		RESISTANCE (OHMS)	
C	F	MIN	MAX
−40	−40	291,490	381,710
−20	−4	85,850	108,390
−10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

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MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The MAP sensor is located on the cowl panel near the rear of the engine cylinder head (valve) cover (Fig. 20).

(1) Inspect the sensor vacuum hose connections at the throttle body and sensor (Fig. 20). Repair as necessary.

CAUTION: When testing the sensor, be sure that the harness wires are not damaged by the test meter probes.

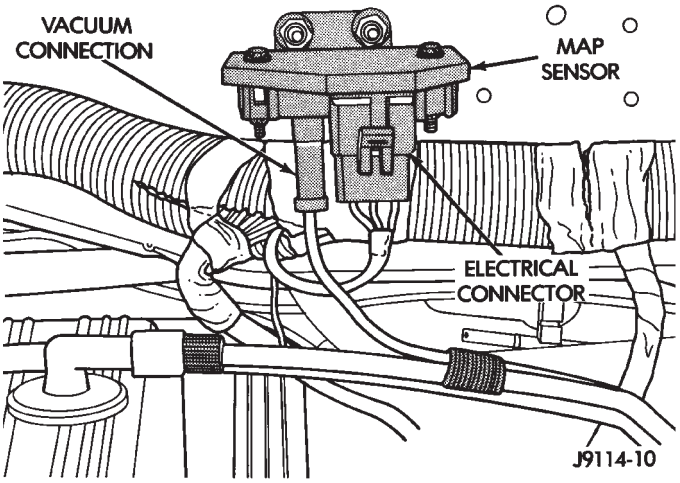

Fig. 20 MAP Sensor—Typical

(2) Test the sensor output voltage at the sensor connector between terminals A and B as marked on the sensor body (Fig. 21). This is done with the ignition switch ON and the engine OFF. Output voltage should be 4-to-5 volts. **The voltage should drop to 1.5-to-2.1 volts with a hot, neutral idle speed condition.**

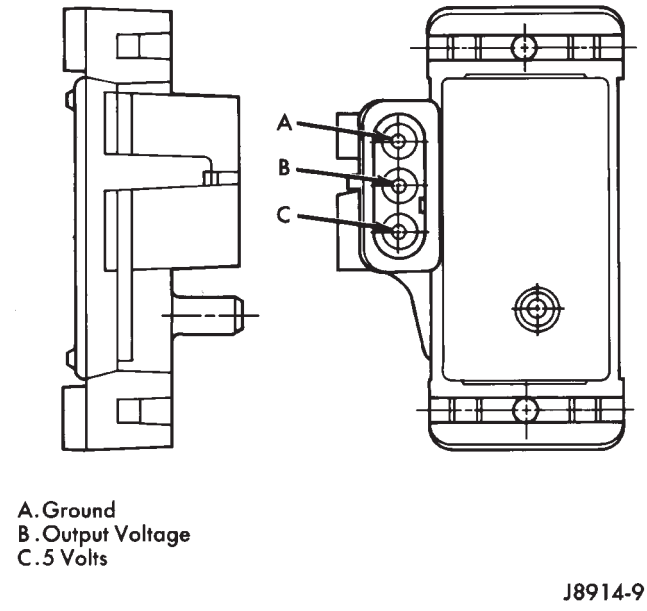

Fig. 21 MAP Sensor Test—Typical

(3) Test Powertrain Control Module (PCM) terminal-1 for the same voltage described above to verify the wire harness condition. Repair as necessary.

(4) Test sensor supply voltage at sensor connector between terminals A and C with the ignition ON. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at terminal-6 of the corresponding Powertrain Control Module (PCM) wire harness connector. Repair or replace the wire harness as necessary.

(5) Test the sensor ground circuit at sensor connector terminal-A and PCM connector terminal-4. Repair the wire harness if necessary.

(6) Test the sensor ground circuit at the PCM connector between terminal-4 and terminal-11 with an ohmmeter. If the ohmmeter indicates an open circuit, inspect for a defective sensor ground connection. Refer to Group 8W, Wiring for location of ground connection. If the ground connection is good, replace the PCM. If terminal-4 has a short circuit to 12 volts, correct this condition before replacing the PCM.

POWERTRAIN CONTROL MODULE (PCM)

The PCM (formerly called the SBEC or engine controller) is located in the engine compartment behind the windshield washer fluid tank on YJ models (Fig. 22). It is located in the engine compartment next to the air cleaner on XJ models (Fig. 23).

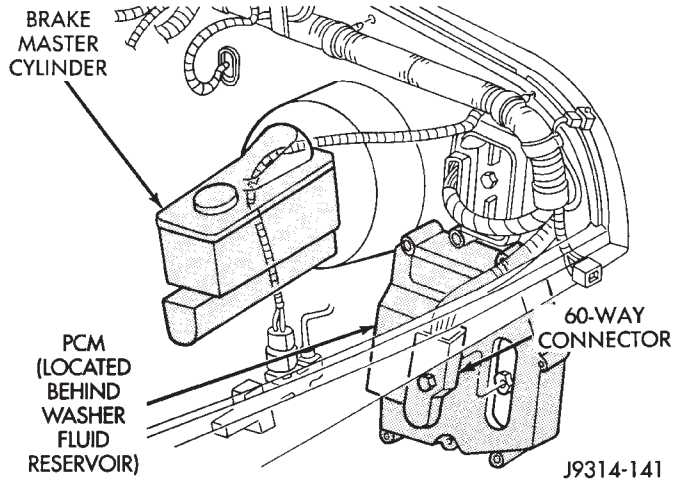

Fig. 22 PCM Location—YJ Models

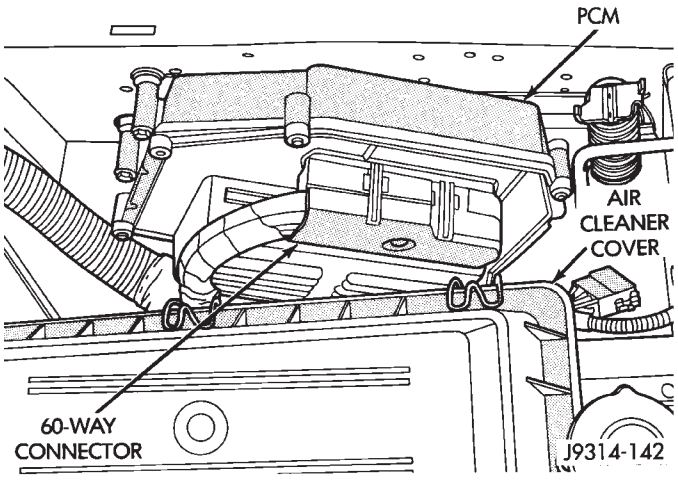

Fig. 23 PCM Location—XJ Models

The ignition system is controlled by the PCM.

For removal and installation of this component, refer to the Component Removal/Installation section of this group.

For diagnostics, refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

SPARK PLUGS

For spark plug removal, cleaning, gap adjustment and installation, refer to the Component Removal/Installation section of this group.

Faulty carbon and/or gas fouled plugs generally cause hard starting, but they will clean up at higher engine speeds. Faulty plugs can be identified in a number of ways: poor fuel economy, power loss, decrease in engine speed, hard starting and, in general, poor engine performance.

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. An isolated plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in the maintenance chart in Group 0, Lubrication and Maintenance.

Spark plugs that have low mileage may be cleaned and reused if not otherwise defective. Refer to the following Spark Plug Condition section of this group.

CONDITION

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. 24). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

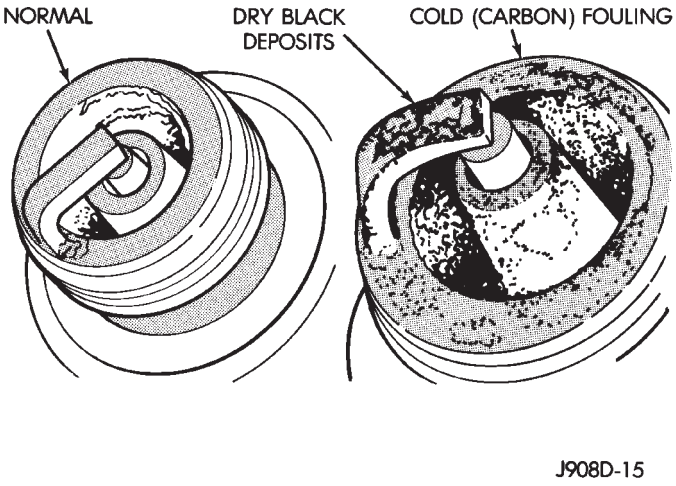

Fig. 24 Normal Operation and Cold (Carbon) Fouling

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 24). 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 filter or repeated short operating times (short trips).

ELECTRODE GAP BRIDGING

Electrode gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 25). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

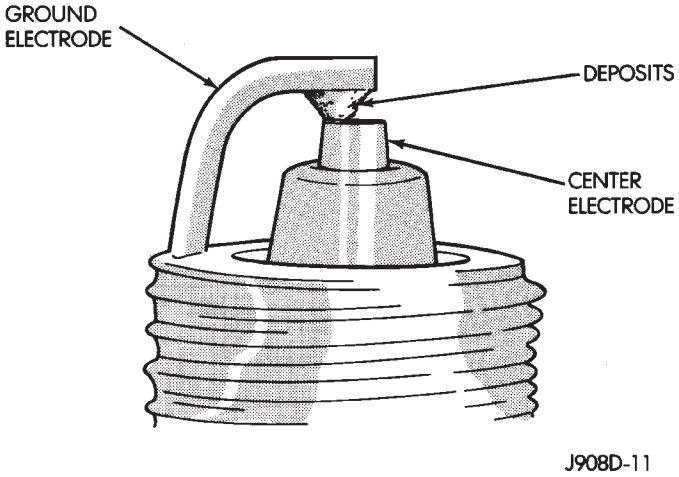

Fig. 25 Electrode Gap Bridging

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 26). 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.

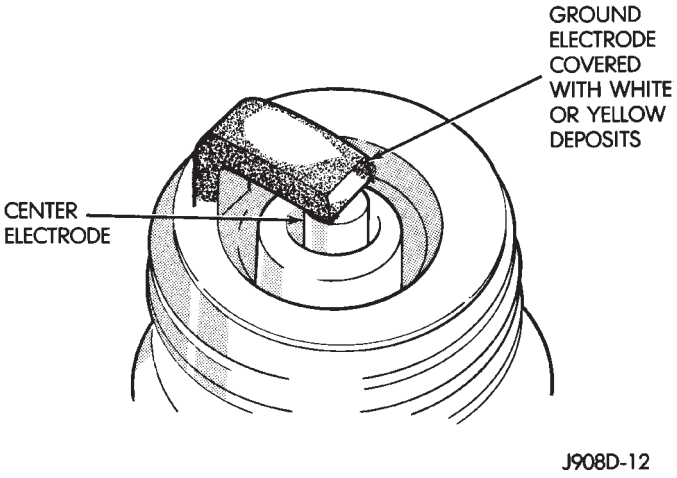

Fig. 26 Scavenger Deposits

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 27). Spark plugs with this condition must be replaced.

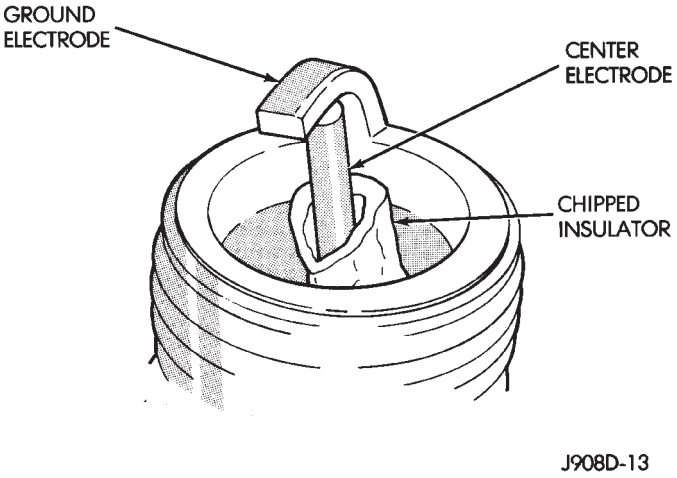

Fig. 27 Chipped Electrode Insulator

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. 28). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced, or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

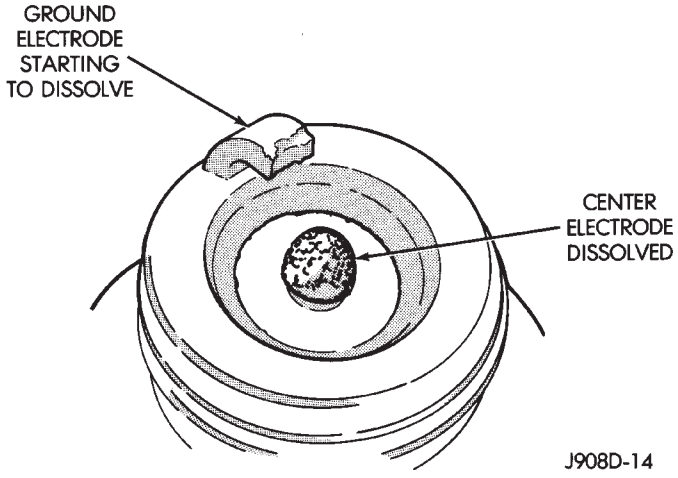

Fig. 28 Preignition Damage

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 29). The increase in electrode gap will be considerably in excess of 0.001 inch per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

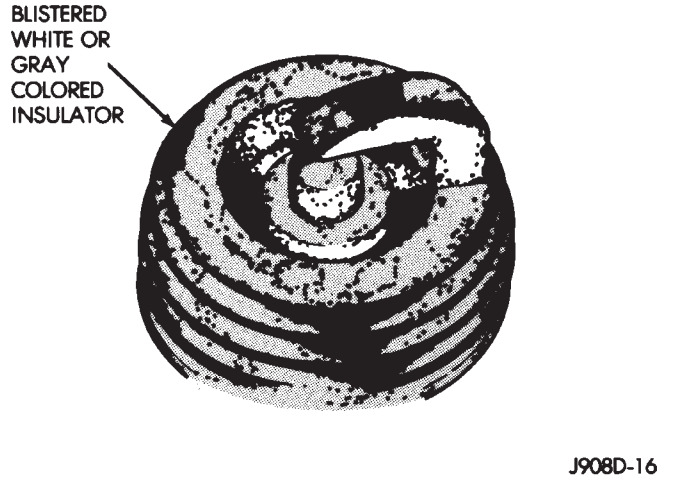

Fig. 29 Spark Plug Overheating

SPARK PLUG SECONDARY CABLES

TESTING

Spark plug cables are sometimes referred to as secondary ignition cables or secondary wires. The cables transfer electrical current from the distributor to individual spark plugs at each cylinder. The spark plug cables are of nonmetallic construction and have a built in resistance. The cables provide suppression of radio frequency emissions from the ignition system.

Check the high-tension cable connections for good contact at the ignition coil, distributor cap towers and spark plugs. Terminals should be fully seated. The terminals and spark plug covers should be in good condition. Terminals should fit tightly to the ignition coil, distributor cap and spark plugs. The spark plug cover (boot) of the cable should fit tight around the spark plug insulator. Loose cable connections can cause corrosion and increase resistance, resulting in shorter cable service life.

Clean the high tension cables with a cloth moistened with a nonflammable solvent and wipe dry. Check for brittle or cracked insulation.

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. Remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

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To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

For removal and installation of spark plug cables, refer to Spark Plug Secondary Cables in the Component Removal/Installation section.

THROTTLE POSITION SENSOR TEST

To perform a complete test of this sensor and its circuitry, refer to the DRB scan tool. Also refer to the appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The throttle position sensor can be tested with a digital voltmeter. The center terminal of the sensor connector is the output terminal (Figs. 30 or 31).

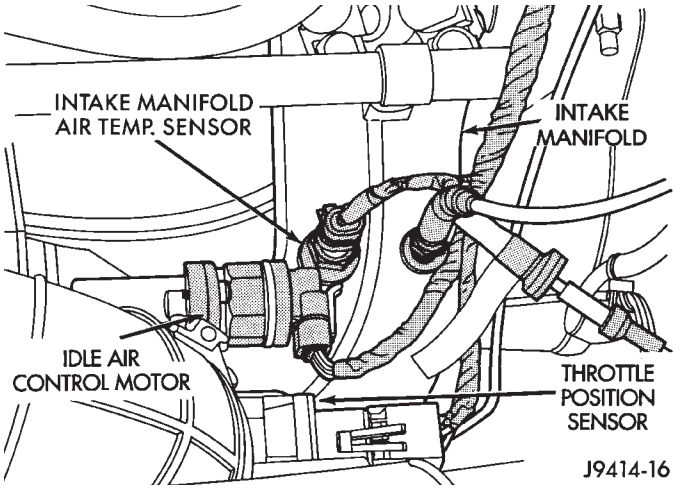

Fig. 30 Sensor—2.5L Engine

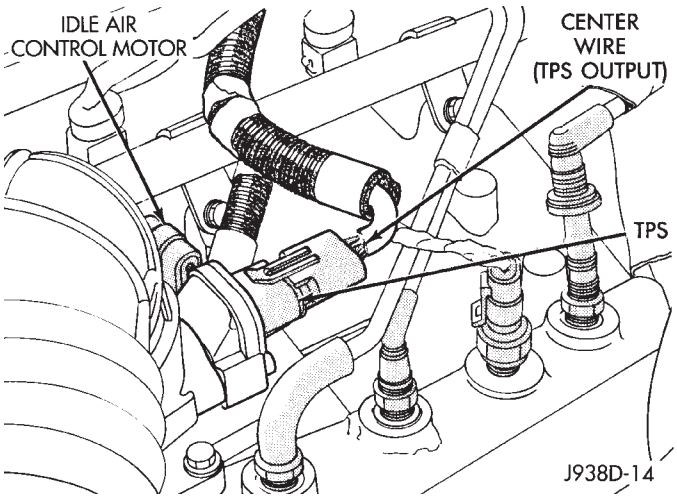

Fig. 31 Sensor—4.0L Engine

With the ignition key in the ON position and engine not running, check the sensor output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, sensor output voltage should be greater than 200 millivolts. At wide open throttle, sensor output voltage must be less than 4.8 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

OXYGEN SENSOR TESTS

For diagnosis, removal or installation, refer to Group 14, Fuel Systems in this manual.

ON-BOARD DIAGNOSTICS (OBD)

FOR IGNITION SYSTEM COMPONENTS

The powertrain control module (PCM) has been programmed to monitor certain ignition system circuits:

EXAMPLE:

If a reference signal is not being detected during engine cranking from the crankshaft position sensor, a Diagnostic Trouble Code (DTC) number 11 can be observed at the Check Engine Lamp.

If the problem is sensed in a monitored circuit often enough to indicate an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. If the problem is repaired or ceases to exist, the PCM cancels the DTC after 51 engine starts.

Certain criteria must be met for a DTC to be entered into PCM memory. The criteria may be a specific range of engine rpm, engine temperature and/or input voltage to the PCM.

A DTC indicates that the PCM has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

It is possible that a DTC for a monitored circuit may not be entered into memory even though a malfunction has occurred. Refer to On-Board Diagnostics (OBD) in Group 14, Fuel Systems for additional information.

ACCESSING DIAGNOSTIC TROUBLE CODES

A stored Diagnostic Trouble Code (DTC) can be displayed by cycling the ignition key On-Off-On-Off-On within three seconds and observing the Malfunction Indicator Lamp. This lamp was formerly referred to as the Check Engine Lamp. The lamp is located on the instrument panel.

They can also be displayed through the use of the Diagnostic Readout Box (DRB) scan tool. The DRB connects to the data link connector in the engine compartment (Figs. 32 or 33). For operation of the DRB, refer to the appropriate Powertrain Diagnostic Procedures service manual.

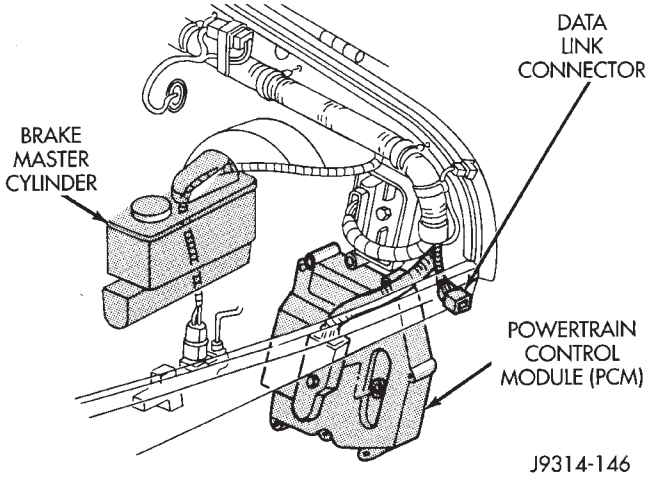

Fig. 32 Data Link Connector—YJ Models—Typical

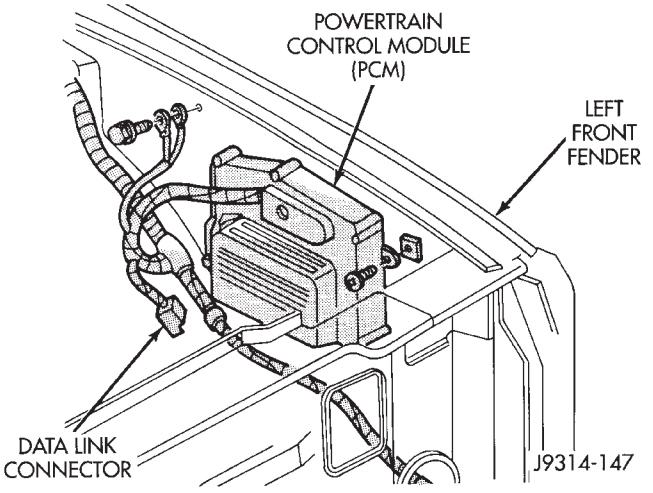

Fig. 33 Data Link Connector—XJ Models—Typical

EXAMPLES:

- If the lamp flashes 1 time, pauses and flashes 1 more time, a flashing Diagnostic Trouble Code (DTC) number 11 is indicated.
- If the lamp flashes 3 times, pauses and flashes 5 more times, a flashing Diagnostic Trouble Code (DTC) number 35 is indicated.

After any stored DTC information has been observed, the display will end with a flashing DTC number 55. This will indicate the end of all stored information.

ERASING TROUBLE CODES

After the problem has been repaired, the DRB scan tool must be used to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

COMPONENT REMOVAL/INSTALLATION

INDEX

GENERAL INFORMATION

This section of the group, Component Removal/Installation, will discuss the removal and installation of ignition system components.

For basic ignition system diagnostics and service adjustments, refer to the Diagnostics/Service Procedures section of this group.

For system operation and component identification, refer to the Component Identification/System Operation section of this group.

AUTOMATIC SHUT DOWN (ASD) RELAY

The ASD relay is installed in the Power Distribution Center (PDC) (Fig. 1). Relay location is printed on the PDC cover.

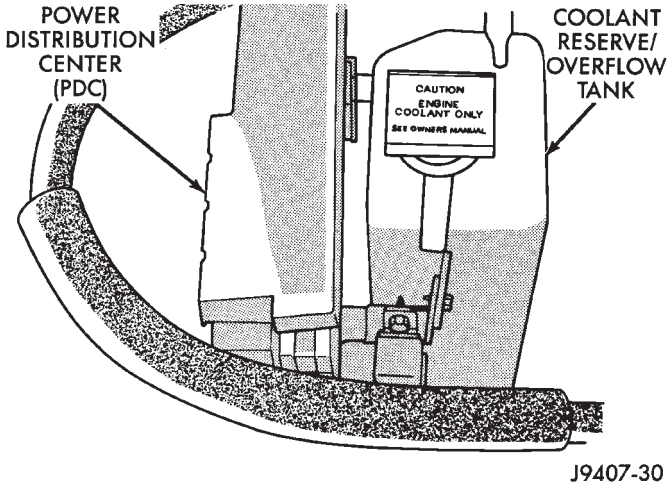

Fig. 1 PDC—XJ Models

REMOVAL

(1) Remove the PDC cover.

(2) Remove the relay by lifting straight up.

INSTALLATION

(1) Check the condition of relay wire terminals at PDC before installing relay. Repair as necessary.

(2) Push the relay into the connector.

(3) Install the relay cover.

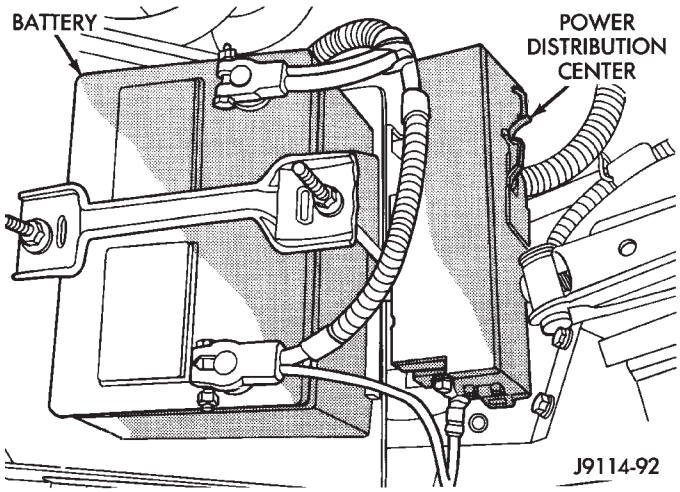

Fig. 2 PDC—YJ Models

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor.

REMOVAL

(1) Remove the distributor. Refer to Distributor Removal.

(2) Remove the distributor rotor.

CAUTION: Do not position the distributor in a vise when removing or installing the drive gear roll pin. Support the distributor with wooden blocks.

(3) Mark the position of the gear and the shaft in line with the roll pin. The gear **MUST** be installed back to its original position on the distributor shaft.

(4) Using a small pin punch and hammer, remove the distributor gear roll (spring) pin (Fig. 3).

(5) Lightly tap the end of the distributor shaft until distributor gear and thrust washer are removed.

(6) Slide the distributor shaft out of the distributor housing.

(7) Remove the camshaft position sensor mounting screw and positioning arm (Fig. 4).

(8) Slide the wire harness grommet out of the distributor housing. Remove the camshaft position sensor.

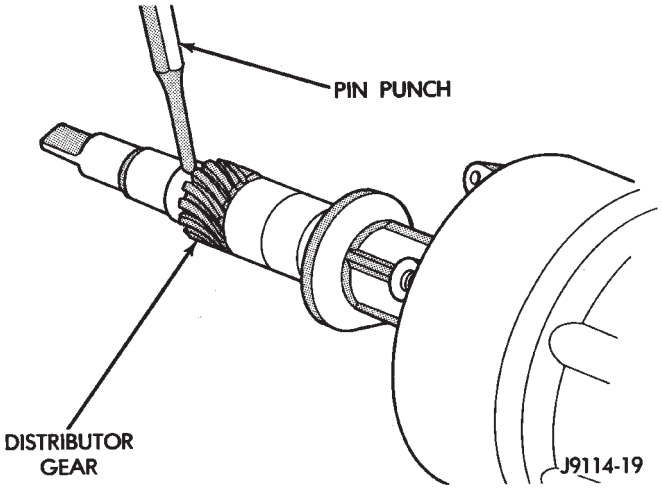

Fig. 3 Distributor Gear—Removal/Installation

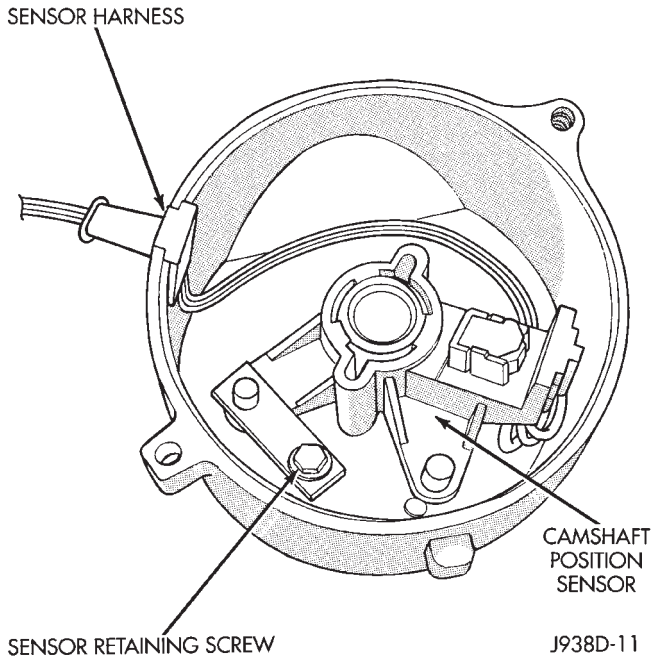

Fig. 4 Camshaft Position Sensor

INSTALLATION

(1) Position the camshaft position sensor in the distributor housing. Place the wire harness grommet into the opening in the distributor housing.

(2) Install retaining arm and retaining screw.

(3) Install distributor shaft into distributor housing. Make sure the upper thrust washer is installed on the shaft.

(4) Position thrust washer and drive gear on distributor shaft.

(5) Note the previous **CAUTION** and install distributor drive gear roll pin.

(6) Install rotor.

(7) Install distributor.

CRANKSHAFT POSITION SENSOR

The crankshaft position sensor is mounted in the transmission bellhousing at the left/rear side of the engine block (Figs. 5, 6 or 7).

On all 2.5L and 4.0L engines (except YJ models with an automatic transmission and 4.0L engine) the sensor is attached with two bolts. The 2.5L engine, when equipped with an automatic transmission, will have the sensor mounted with two nuts.

On YJ models with a 4.0L engine and automatic transmission, the sensor uses a single slotted hole to adjust its depth. A paper/cardboard type spacer with self-adhesive (Fig. 7) is attached to the bottom of the sensor to set this depth. After the engine has been started (and after sensor installation), this temporary spacer will be sheared off. New factory replacement sensors are equipped with this spacer. If the original sensor is to be reinstalled, such as with transmission and/or flywheel removal, a new spacer **MUST** be installed.

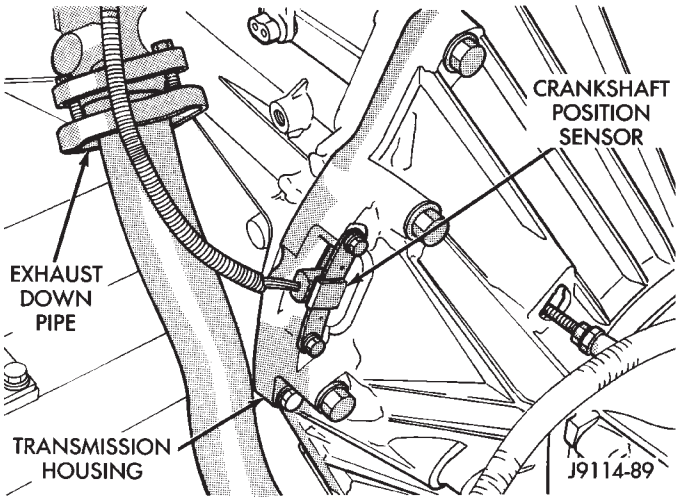

Fig. 5 Crankshaft Position Sensor—2.5L Engine—Typical

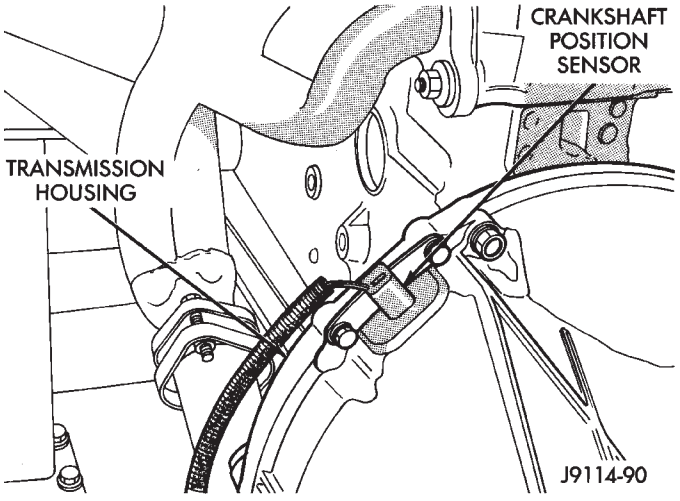

Fig. 6 Crankshaft Position Sensor—4.0L Engine—All Except YJ models With Automatic Transmission

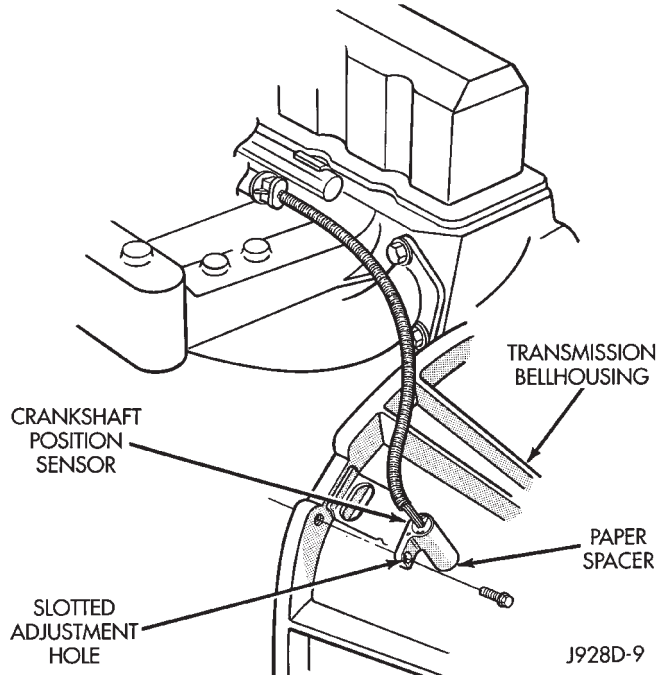

Fig. 7 Crankshaft Position Sensor—4.0L Engine—YJ models With Automatic Transmission

REMOVAL—ALL ENGINES

(1) Near the rear of the intake manifold, disconnect the pigtail harness (on the sensor) from the main electrical harness.

(2) Remove the nut holding sensor wire clip to fuel rail mounting stud.

(3) Depending upon application, remove either the sensor mounting bolt(s) or nuts.

(4) Remove the sensor.

(5) Remove clip from sensor wire harness.

INSTALLATION—ALL EXCEPT YJ MODELS WITH 4.0L ENGINE AND AUTOMATIC TRANSMISSION

(1) Install the sensor flush against the opening in the transmission housing.

(2) Install and tighten the two sensor mounting bolts (or nuts) to 19 N·m (14 ft. lbs.) torque.

CAUTION: On some models, two bolts used to secure the sensor to the transmission. These bolts are specially machined to correctly space the unit to the flywheel. Do not attempt to install any other bolts.

(3) Connect the electrical connector to the sensor.

(4) Install clip on sensor wire harness.

(5) Install clip over fuel rail mounting stud. Install clip mounting nut.

INSTALLATION—YJ MODELS WITH 4.0L ENGINE AND AUTOMATIC TRANSMISSION

(1) Be sure the paper/cardboard spacer (Fig. 7) has been installed to the bottom of the new sensor.

If original sensor is being reinstalled (such as with transmission or flywheel removal), clean bottom of the sensor before installation. Obtain a new spacer and remove the paper backing. Install the self-adhesive side to bottom of sensor. This spacer **MUST** be installed. If spacer is not installed, sensor will be damaged when engine is started.

(2) Position sensor to transmission bellhousing and install mounting bolt finger tight.

(3) Gently seat (push down) the sensor until the paper spacer contacts the outer edge of the flywheel.

(4) Tighten sensor mounting bolt (Fig. 7) to 17-to-21 N·m (13-to-16 ft. lbs.) torque.

(5) Connect the electrical connector to sensor.

(6) Install the clip to sensor wire harness.

(7) Install clip over fuel rail mounting stud. Install clip mounting nut.

ENGINE COOLANT TEMPERATURE SENSOR

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

REMOVAL

The sensor is installed in the thermostat housing (Fig. 8).

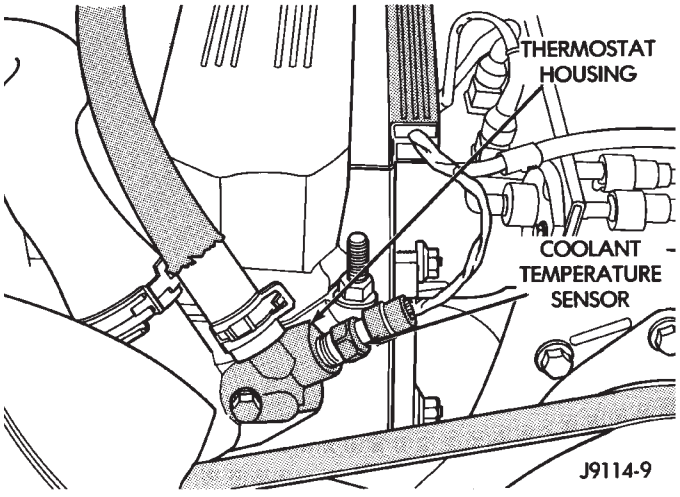

Fig. 8 Coolant Temperature Sensor—Typical

(1) Drain cooling system until the coolant level is below the cylinder head. For cooling system draining, refer to Group 7, Cooling.

(2) Disconnect the coolant temperature sensor wire connector.

(3) Remove the sensor from the thermostat housing (Fig. 8).

INSTALLATION

(1) Install coolant temperature sensor into the thermostat housing. Tighten to 28 N·m (21 ft. lbs.) torque.

(2) Connect the wire connector.

(3) Fill the cooling system. Refer to group 7, Cooling System.

DISTRIBUTOR

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

The camshaft position sensor is located in the distributor on all engines (Fig. 9).

Refer to Fig. 9 for an exploded view of the distributor.

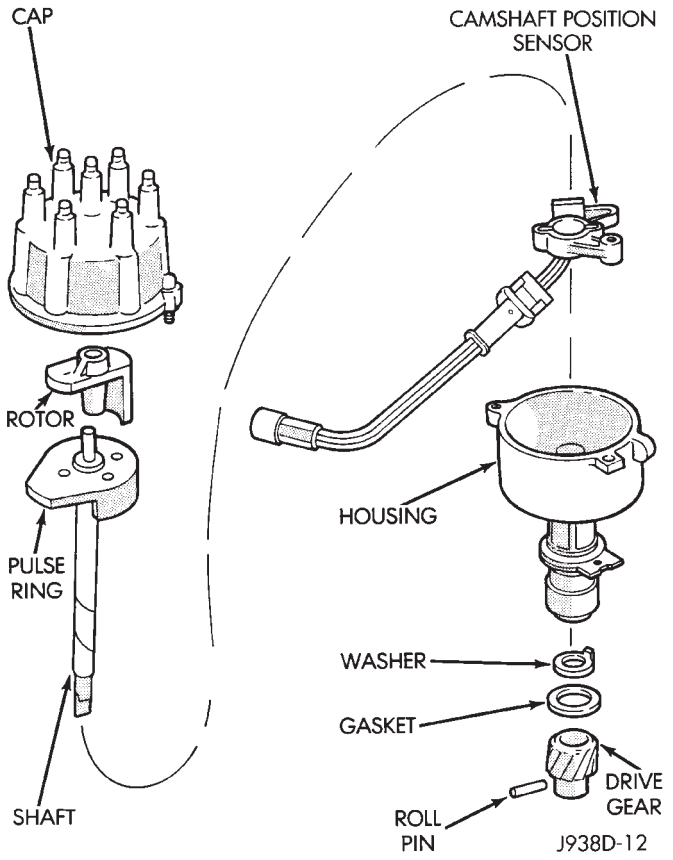

Fig. 9 Distributor—2.5L/4.0L Engines—Typical

REMOVAL—2.5L ENGINE

(1) Disconnect the negative battery cable at the battery.

(2) Disconnect coil secondary cable at coil.

(3) Remove distributor cap from distributor (2 screws). Do not remove cables from cap.

(4) Disconnect the distributor wiring harness from the main engine harness.

(5) Scribe a mark on the distributor housing in line with the tip of the rotor. Note the position of the rotor and distributor housing. This is in relation to the surrounding engine components as reference points for installing the distributor.

(6) Remove the distributor holddown bolt and clamp.

(7) Remove the distributor from engine by lifting straight up. Remove and discard old distributor-to-engine block gasket. Note that the rotor will rotate slightly in a counterclockwise direction while lifting up the distributor. Note this position after removal.

INSTALLATION—2.5L ENGINE

ENGINE NOT ROTATED AFTER REMOVAL

This procedure assumes that the engine was not rotated with distributor out of engine.

(1) Clean the distributor mounting hole area of the engine block.

(2) Install a new distributor-to-engine block gasket.

There is a fork on the distributor housing where the housing seats against the engine block. The slot in the fork aligns with the distributor holddown bolt hole in the engine block. The distributor is correctly installed when the rotor is correctly positioned. This is with the slot in the fork aligned with the holddown bolt hole in the cylinder block. Because of the fork on the distributor housing, initial ignition timing is not adjustable (the distributor cannot be rotated).

(3) Position the distributor shaft in the cylinder block. If the engine was not rotated while the distributor was removed, perform the following:

- Align the rotor tip with the scribe mark on the distributor housing during removal. Turn the rotor approximately 1/8-turn counterclockwise past the scribe mark.

CAUTION: Be sure that the distributor shaft fully engages into the oil pump drive gear shaft. It may be necessary to slightly rotate (bump) the engine. This is done while applying downward hand force on the distributor body. It should fully engage the distributor shaft with the oil pump drive gear shaft.

- Slide the distributor shaft down into the engine.

It may be necessary to move the rotor and shaft (slightly) to engage the distributor shaft with the slot in the oil pump shaft. The same may have to be done to engage the distributor gear with the camshaft gear. However, the rotor should align with the scribe mark when the distributor shaft is down in place.

- Install the distributor holddown clamp and bolt. Tighten the bolt to 23 N·m (17 ft. lbs.) torque.

(4) Install the distributor cap (with the ignition cables) on the distributor housing (Fig. 10). Tighten distributor cap holddown screws to 3 N·m (26 in. lbs.) torque.

(5) Connect the distributor wiring harness to the main engine harness.

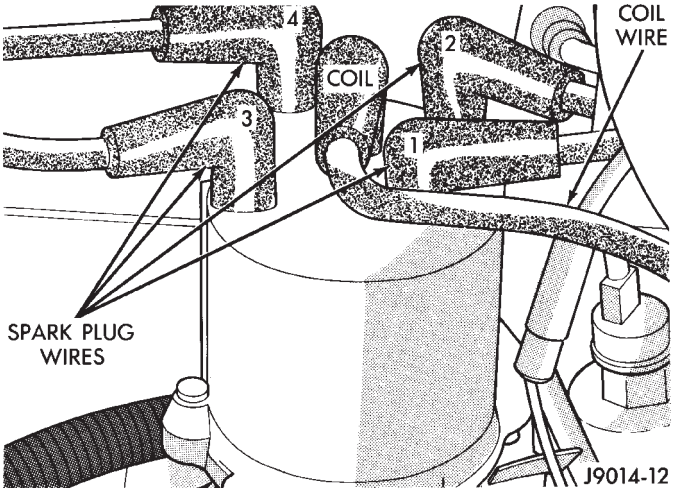

Fig. 10 Spark Plug Cable Positions—2.5L Engine

CAUTION: Do not puncture the spark plug cables or boots to make the connection. Use proper adapters.

(6) Connect battery cable to battery.

ENGINE ROTATED AFTER REMOVAL

There is a fork on the distributor housing where the housing seats against the engine block. The slot in the fork aligns with the hole for the distributor holddown bolt in the engine block. The distributor is correctly installed when the rotor is correctly positioned. This is when the slot in the fork is aligned with the hole for the distributor holddown bolt in the cylinder block. Because of the fork on the distributor housing, initial ignition timing is not adjustable (the distributor cannot be rotated).

(1) If the engine was rotated while the distributor was removed, it will be necessary to establish timing according to following procedure:

- Remove the No. 1 spark plug. Hold a finger over the spark plug hole and rotate the engine until compression pressure is felt. Slowly continue to rotate the engine. Do this until the timing index on vibration damper pulley aligns with top dead center (TDC) mark (0 degree) on timing degree scale. Always rotate the engine in direction of normal rotation. Do not turn the engine backward to align the timing marks.
- Using a flat blade screwdriver, rotate the oil pump gear. Do this to position the gear slot on the oil pump shaft slightly before the 11 o'clock position (Fig. 11).
- With the distributor cap removed, install the distributor with the rotor located just past the 2 o'clock position (Fig. 12).

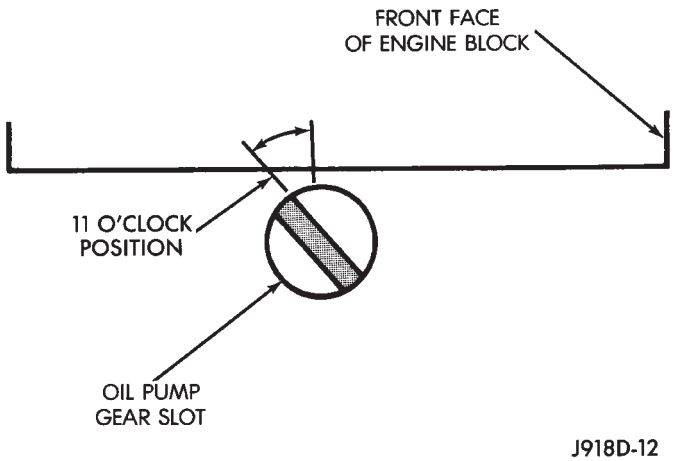

Fig. 11 Align Oil Pump Gear Slot—2.5L Engine

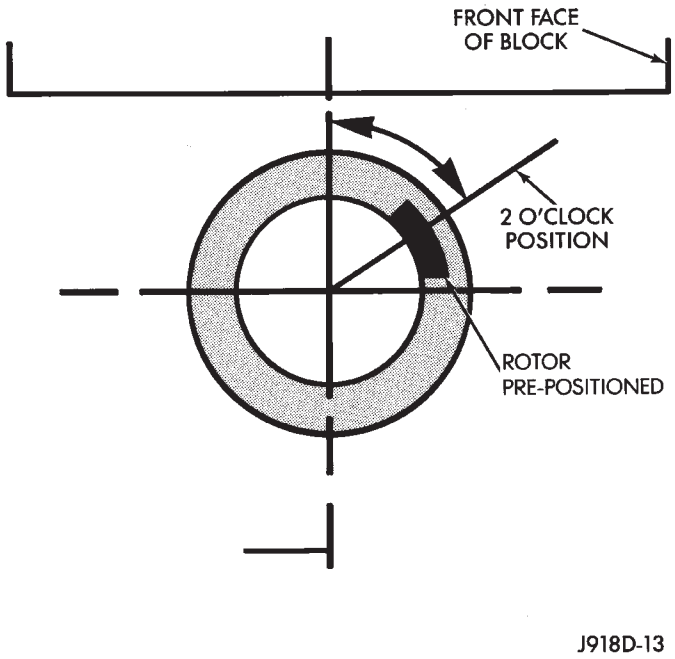

Fig. 12 Distributor Installation—2.5L Engine

- When distributor is fully engaged in its correct location, the rotor should be just past the 3 o'clock position (Fig. 13).
- Install the distributor holddown clamp and bolt. Tighten the holddown bolt to 23 N·m (17 ft. lbs.) torque.

CAUTION: If the distributor cap is incorrectly positioned on distributor housing, the cap or rotor may be damaged when engine is started.

(2) Install the distributor cap (with ignition cables) on the distributor housing. Be sure that the cap fits securely on rim of the distributor housing.

(3) Connect the distributor wiring harness to the main engine harness.

CAUTION: Do not puncture the spark plug cables or boots to make the connection. Use proper adapters.

REMOVAL—4.0L ENGINE

The distributor used in the 4.0L engine contains an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

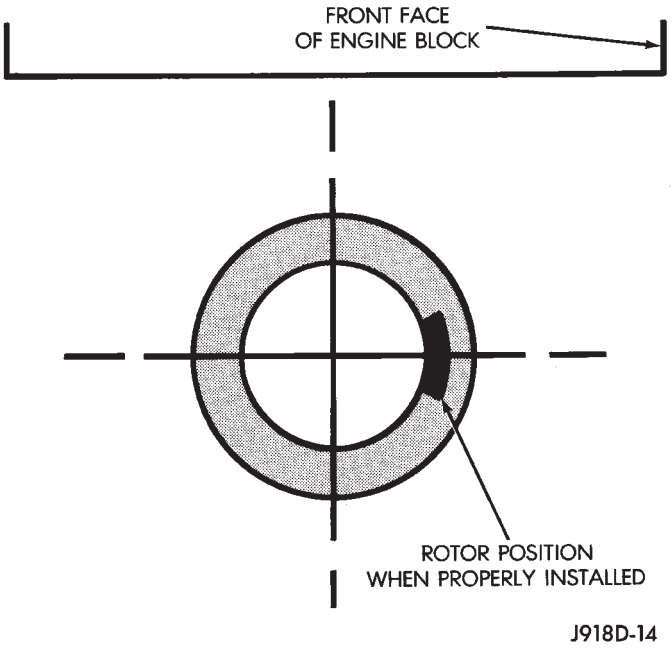

Fig. 13 Distributor Rotor Position—2.5L Engine

The camshaft position sensor is located in the distributor on all engines (Fig. 9).

Refer to figure 9 for an exploded view of the distributor.

(1) Disconnect the negative battery cable at battery.

(2) On XJ models equipped with A/C, remove the electrical cooling fan and shroud assembly from the radiator. This will provide room to turn the engine with a socket and ratchet using the vibration damper bolt.

(3) Scribe a mark on the distributor housing. Do this below the left side of (past) the number one spark plug cable post of the distributor cap. This will be used as a reference for #1 cylinder firing position (Fig. 14).

(4) Remove the distributor cap from distributor (2 screws).

(5) Turn the engine in a clockwise direction until the rotor is approaching the scribe mark on the distributor housing. Then slowly turn the engine until the timing mark on the crankshaft vibration damper lines up with zero on the front cover timing scale (Fig. 15).

The timing mark is on the edge of the vibration damper closest to the engine front cover.

(6) Align the trailing edge of the rotor blade with the scribe mark on the distributor housing (Fig. 16).

(7) Remove the distributor holddown bolt and clamp.

(8) Remove the distributor from the engine by lifting straight up. Remove and discard old distributor-to-engine block gasket. Note that the rotor will rotate slightly in a counterclockwise direction while lifting up the distributor. Note this position after removal.

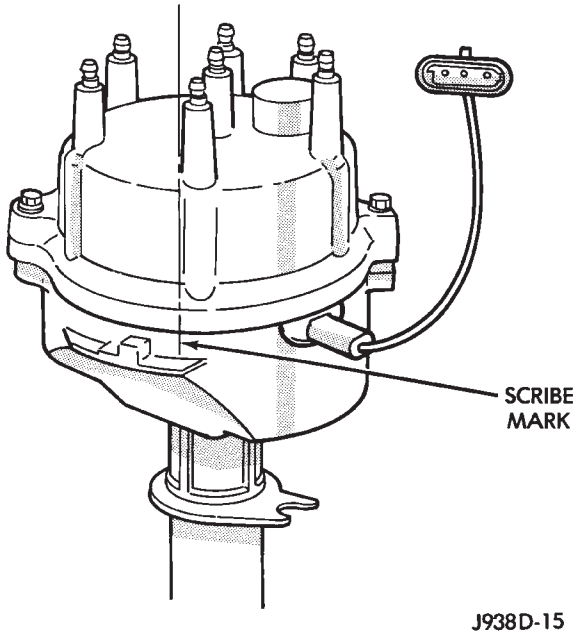

Fig. 14 Mark Distributor Housing

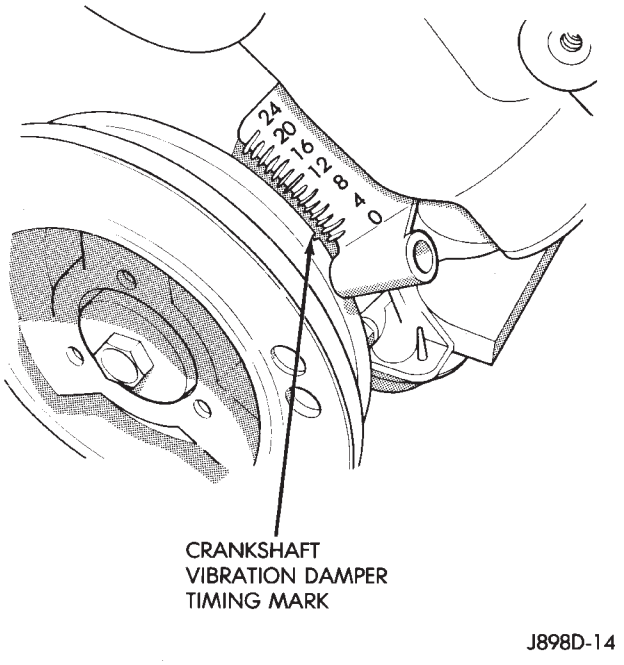

Fig. 15 Align Timing Marks

INSTALLATION—4.0L ENGINE

(1) Clean the distributor mounting area of the cylinder block.

(2) Install a replacement distributor-to-engine block gasket.

(3) Using a flat blade screwdriver, turn the oil pump gear shaft. Do this until the slot is slightly past the 11 o'clock position (Fig. 17).

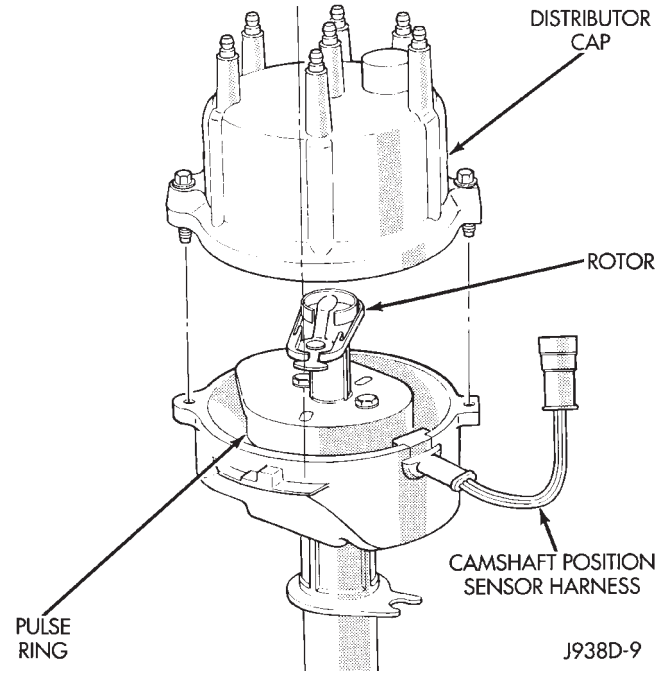

Fig. 16 Align Rotor Trailing Edge With Scribe Mark

The oil pump shaft is located down in the distributor hole.

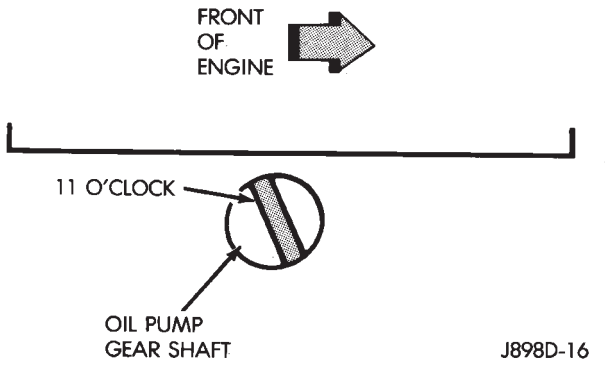

Fig. 17 Align Oil Pump Gear Shaft—4.0L Engine

(4) Install the rotor.

(5) Without engaging the distributor gear into the cam gear, position the distributor into the hole in the engine block. Be sure the distributor gasket is installed.

(6) Visually line up the holddown ear of the distributor housing with the holddown clamp hole (Fig. 18).

(7) Turn the rotor to the 4 o'clock position (Fig. 19).

(8) Slide the distributor down into the block until it seats. Keep the holddown ear aligned to the hole in the block.

(9) The rotor should be in the 5 o'clock position. This is with the trailing edge of rotor blade lined up with scribe mark on distributor housing (number one spark plug cable post location).

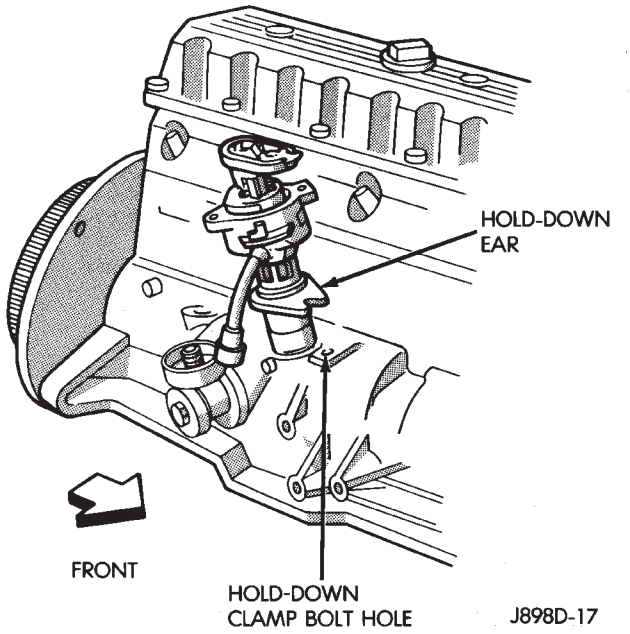

Fig. 18 Distributor Installation—Typical

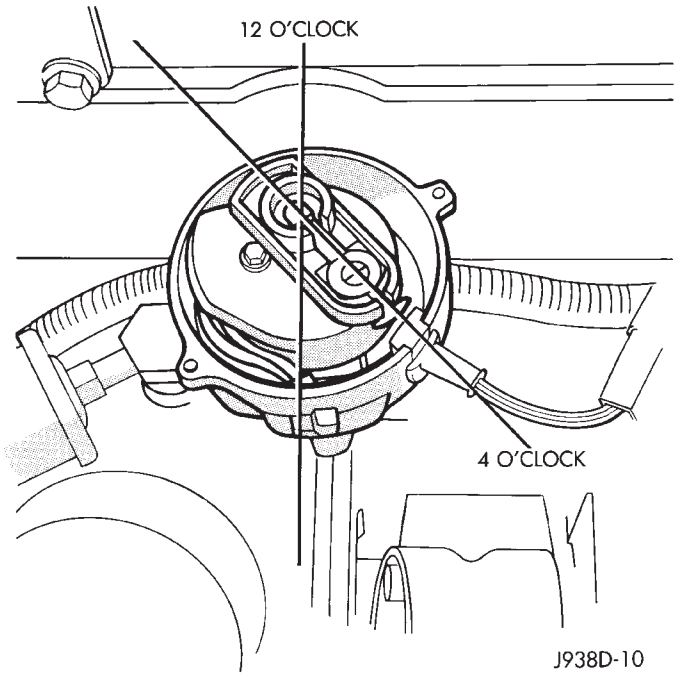

Fig. 19 Rotor Alignment

(10) Install the distributor holddown clamp bolt and tighten to 23 N·m (17 ft. lbs.) torque.

(11) Install the distributor cap and connect the distributor electrical connector.

(12) Install electrical cooling fan and shroud if applicable.

(13) Connect battery cable to battery.

IGNITION COIL

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

REMOVAL

The ignition coil is mounted to the right side of the engine block next to the distributor (Fig. 20).

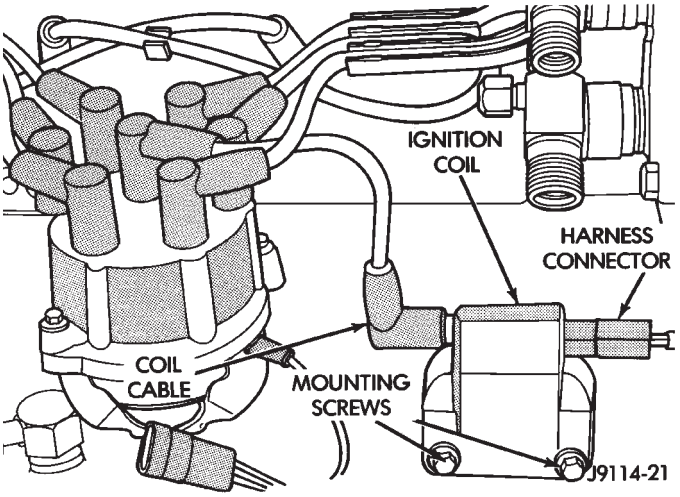

Fig. 20 Ignition Coil—Typical

(1) Disconnect the ignition coil secondary cable from ignition coil (Fig. 20).

(2) Disconnect engine harness connector from ignition coil.

(3) Remove ignition coil mounting bolts. Remove coil.

INSTALLATION

(1) Install ignition coil to bracket on cylinder block with mounting bolts.

(2) Connect engine harness connector to coil.

(3) Connect ignition coil cable to ignition coil.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR

REMOVAL

The intake manifold air temperature sensor is installed into the intake manifold plenum (Figs. 21 or 22).

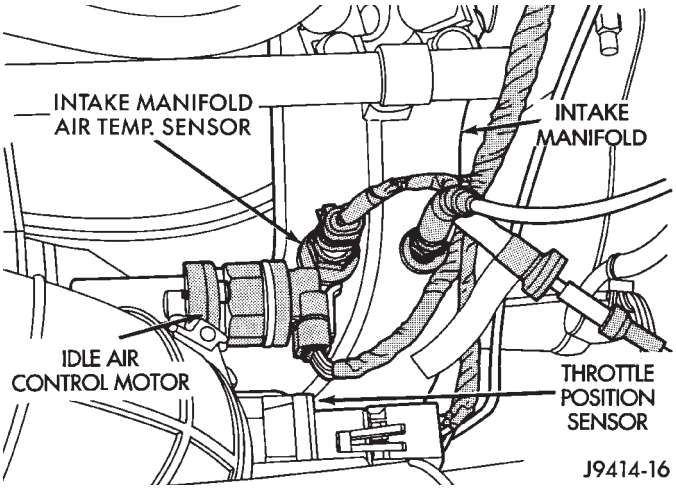

Fig. 21 Air Temperature Sensor—2.5L Engine

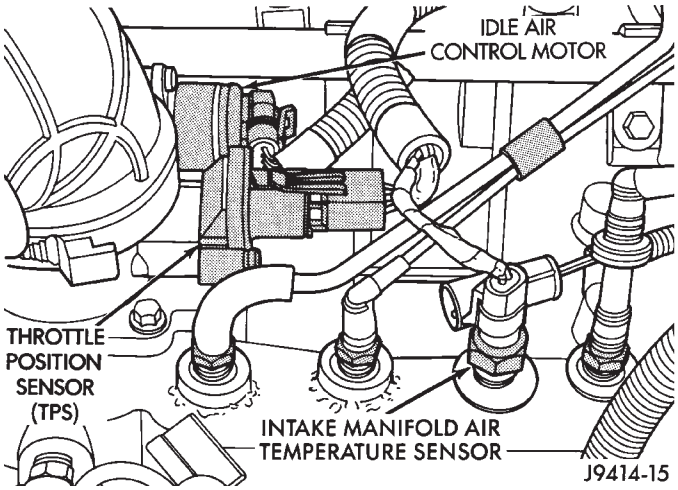

Fig. 22 Air Temperature Sensor—4.0L Engine

(1) Disconnect the electrical connector from the sensor.

(2) Remove the sensor from the intake manifold.

INSTALLATION

(1) Install the air temperature sensor into the intake manifold. Tighten the sensor to 13 N·m (10 ft. lbs.) torque.

(2) Connect the electrical connector to the sensor.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor is located on the dash panel near the rear of the engine cylinder head (valve) cover (Fig. 23).

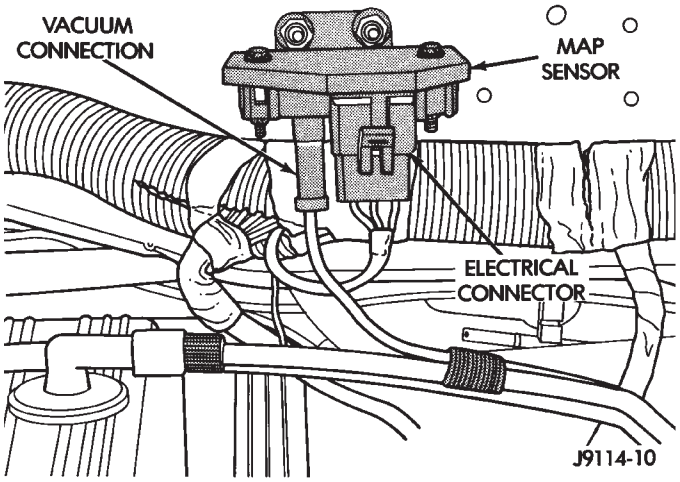

Fig. 23 MAP Sensor—Typical

REMOVAL

(1) Disconnect the MAP sensor electrical connector (Fig. 23).

(2) Disconnect the MAP sensor vacuum supply hose (Fig. 23).

(3) Remove the MAP sensor mounting nuts and remove MAP sensor.

INSTALLATION

(1) Install MAP sensor to dash panel and secure with mounting nuts.
(2) Install the MAP sensor vacuum supply hose.
(3) Connect the MAP sensor electrical connector.

OXYGEN (O2S) SENSOR

For diagnostics and removal/installation procedures, refer to Group 14, Fuel Systems, in this manual.

POWERTRAIN CONTROL MODULE (PCM)

The PCM was formerly referred to as the SBEC or engine controller.

XJ MODELS

On XJ models, the PCM is located in the engine compartment next to the air cleaner (Fig. 24).

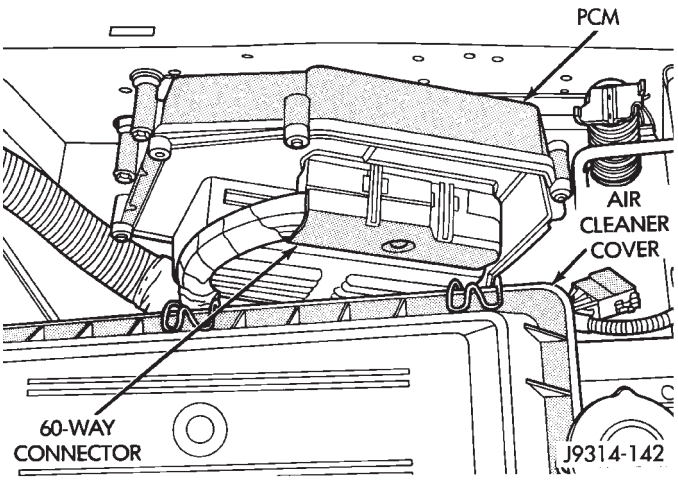

Fig. 24 PCM Location—XJ Models

REMOVAL

(1) Disconnect negative battery cable at battery.
(2) Loosen 60-way connector mounting screw until connector can be disengaged from PCM.
(3) Pull 60-way connector straight back from PCM.
(4) Remove PCM mounting bolts.
(5) Remove PCM from vehicle.

INSTALLATION

(1) Check the pins in the PCM 60-way electrical connector for damage. Repair as necessary.
(2) Install PCM. Tighten mounting bolts to 1 N·m (9 in. lbs.) torque.
(3) Engage 60-way connector into PCM. Tighten connector mounting screw to 4 N·m (35 in. lbs.) torque.
(4) Connect battery cable to battery.

YJ MODELS

On YJ models, the PCM is located in the engine compartment behind the windshield washer fluid reservoir (Fig. 25).

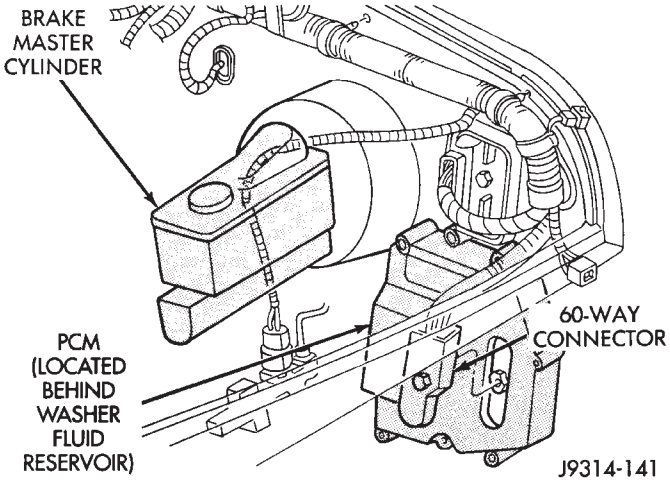

Fig. 25 PCM Location—YJ Models

REMOVAL

(1) Disconnect negative battery cable at battery.
(2) Remove windshield washer fluid reservoir.
(3) Loosen 60-way connector mounting screw until connector can be disengaged from PCM.
(4) Pull 60-way connector straight back from PCM.
(5) Remove PCM mounting bolts.
(6) Remove PCM from vehicle.

INSTALLATION

(1) Check the pins in the PCM 60-way electrical connector for damage. Repair as necessary.
(2) Install PCM. Tighten mounting bolts to 1 N·m (9 in. lbs.) torque.
(3) Engage 60-way connector into PCM. Tighten connector mounting screw to 4 N·m (35 in. lbs.) torque.
(4) Connect battery cable to battery.
(5) Install washer fluid reservoir.

SPARK PLUGS

PLUG REMOVAL

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot. Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.
(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area around the spark plug. This will help prevent foreign material from entering the combustion chamber.
(3) Remove the spark plug using a quality socket with a rubber or foam insert.
(4) Inspect the spark plug condition. Refer to Spark Plugs in the Diagnostics/Service Procedures section of this group.

PLUG CLEANING

The plugs may be cleaned using commercially available spark plug cleaning equipment. After

cleaning, file the center electrode flat with a small point file or jewelers file before adjusting gap.

PLUG GAP ADJUSTMENT

Check the spark plug gap with a gap gauge tool. If the gap is not correct, adjust it by bending the ground electrode (Fig. 26). **Never attempt to adjust the gap by bending the center electrode.**

SPARK PLUG GAP

- 2.5L Engine Spark Plug Gap: .89 mm (.035 in).
- 4.0L Engine Spark Plug Gap: .89 mm (.035 in).

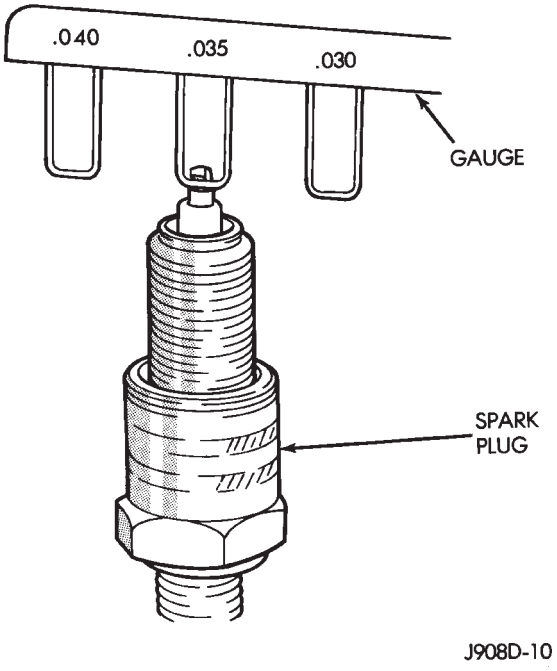

Fig. 26 Setting Spark Plug Gap—Typical

PLUG INSTALLATION

Always tighten spark plugs to the specified torque. Over tightening can cause distortion. This may result in a change in the spark plug gap.

When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs, or short circuit the cables to ground.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten the spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) Install spark plug cables over spark plugs.

SPARK PLUG SECONDARY CABLES

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose. Grasp the boot (not the cable) and pull it off with a steady, even force.

Install cables into the proper engine cylinder firing order (Figs. 27 or 28).

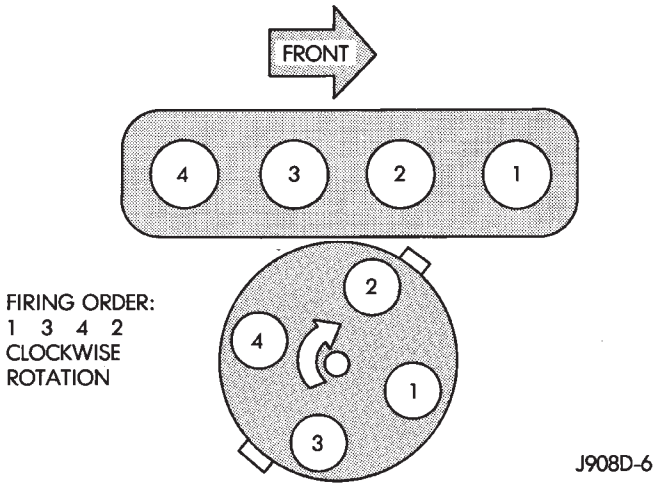

Fig. 27 Engine Firing Order—2.5L Engine

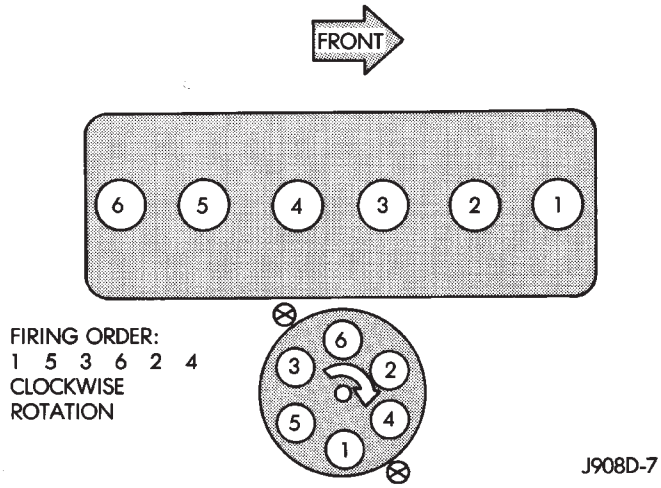

Fig. 28 Engine Firing Order—4.0L Engine

When replacing the spark plug and coil cables, route the cables correctly and secure in the proper retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could also cause cross ignition of the plugs, or short circuit the cables to ground.

When installing new cables, make sure a positive connection is made. A snap should be felt when a good connection is made between the plug cable and the distributor cap tower.

THROTTLE POSITION SENSOR (TPS)

For diagnostics and removal/installation procedures, refer to Group 14, Fuel Systems, in this manual.

IGNITION SWITCH

INDEX

GENERAL INFORMATION

The ignition switch is mounted (under the instrument panel) on the lower section of the steering column. The headlamp dimmer switch is mounted beside the ignition switch (Fig. 1). Both of these switches (ignition and dimmer) share the same mounting screws.

The switch is connected to the ignition key lock assembly by a remote actuator rod. This remote actuator rod fits into an access hole on the bottom of the ignition switch (Fig. 2).

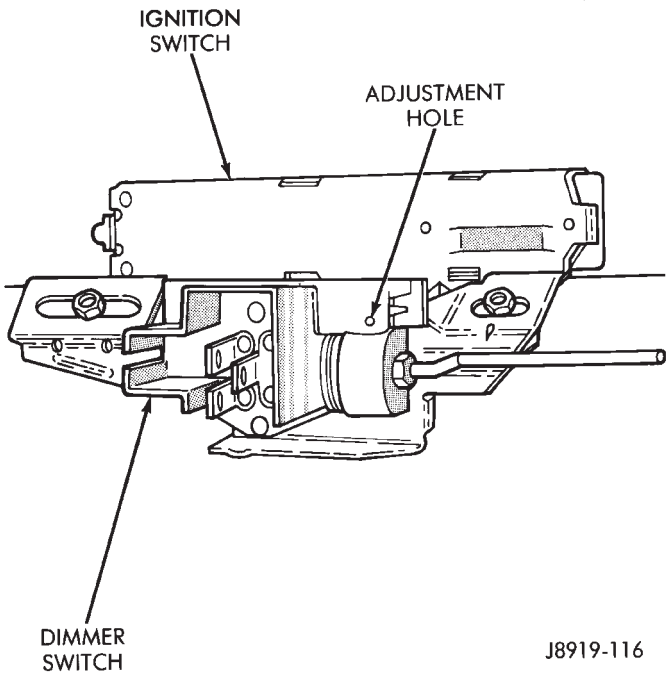

Fig. 1 Ignition Switch/Headlamp Dimmer Switch—Typical

IGNITION SWITCH REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) XJ models: Remove the lower instrument panel trim assembly. YJ models: Remove the windshield wiper intermittent control module and its bracket (if equipped).

(3) Place the ignition key lock in ACCESSORY position.

(4) Remove the two headlamp dimmer switch attaching nuts. Lift the switch from steering column while disengaging actuator rod.

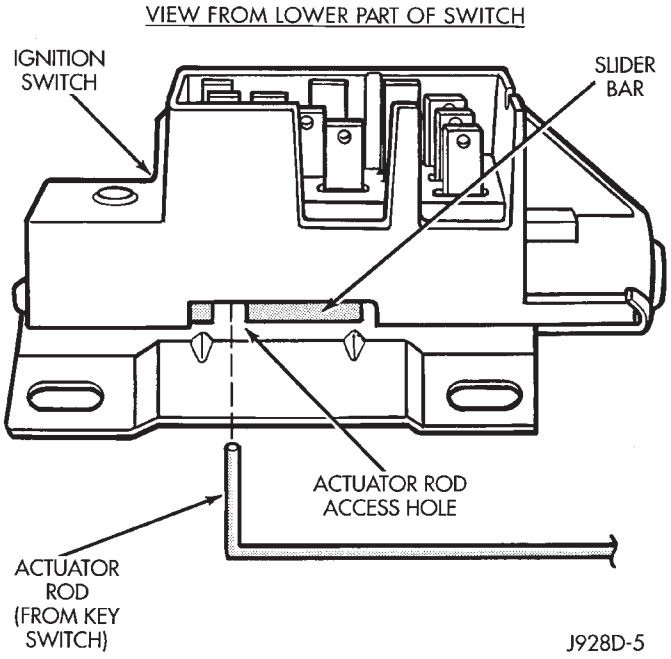

Fig. 2 Ignition Switch/Remote Actuator Rod—Typical

Before removing dimmer switch, tape the two remote control actuator rods (ignition switch and dimmer) to the steering column. This will prevent accidental disengagement from the upper part of the steering column.

(5) Remove the ignition switch-to-steering column attaching screws.

(6) Disengage the ignition switch from the remote actuator rod by lifting straight up. Remove switch from steering column.

(7) Remove wiring from switch as follows:

Two electrical connectors are used to connect all wiring to the ignition switch. One of the connectors is installed (interlocked) over the top of the other connector. Remove wiring from switch by disconnecting the (black) harness connector first and then the other connector. Remove the switch from the vehicle.

IGNITION SWITCH TESTING

To test the ignition switch circuity and continuity, proceed as follows. Place the slide bar (on the ignition switch) (Fig. 2) into the detent position to be tested. An ohmmeter or continuity light may be used to check switch continuity. Refer to the Ignition

Switch Continuity Tests chart for continuity tests. Refer to (Fig. 3) for the lettered/numbered terminal positions. **All wiring must be disconnected from the ignition switch before performing any continuity testing.**

There are five positions on the ignition switch. The switch positions (in order) are: ACCESSORY, OFF-LOCK, OFF, ON AND START (Figs. 4 or 5). Each position has a detent stop (except START), which is spring loaded to release when the key is released.

The maximum voltage drop between any two connected terminals should not exceed 12.5 millivolts per amp. For example: If a 10 amp load is drawn through the switch, maximum voltage drop should be 10 x 0.0125 or 0.125 volt.

IGNITION SWITCH CONTINUITY TESTS

SWITCH DETENT POSITION	NORMAL CIRCUIT CONTINUITY
START	Between I-1, B-1 and S. G-1 and G-2 to switch case (ground).
ON	Between I-1, A, I-3 to B-1, B-2 and B-3.
OFF	Between B-1, B-2 and B-3 only.
OFF-LOCK	Between B-1, B-2 and B-3 only.
ACCESS.	Between A and B-2.
Note: Circuits B-1, B-2 and B-3 are commonly connected and will show continuity at all times.	

J928D-7

IGNITION SWITCH INSTALLATION/ADJUSTMENT

(1) Place the key lock switch in the ACCESSORY position.

(2) Place the slider bar (in the ignition switch) (Fig. 2) into the ACCESSORY detent position.

(3) Connect the wiring to the switch as follows: Install the non-black (colored) connector first and then the black (colored) connector to the ignition switch. One connector will interlock the other connector.

(4) Slip the remote actuator rod into the access hole on the switch (Fig. 2). Install the switch to the steering column. Be careful not to move the slider bar (on the switch) out of the ACCESSORY detent position. Remove the ignition switch actuator rod securing-tape from steering column.

(5) Install the two ignition switch-to-steering column screws finger tight. **Do not tighten screws at this time.**

(6) Adjust ignition switch as follows:

(a) Non-tilt steering column: While holding key lock switch in ACCESSORY position, gently slide ignition switch **up** (towards steering wheel). This will remove slack from switch. Tighten attaching

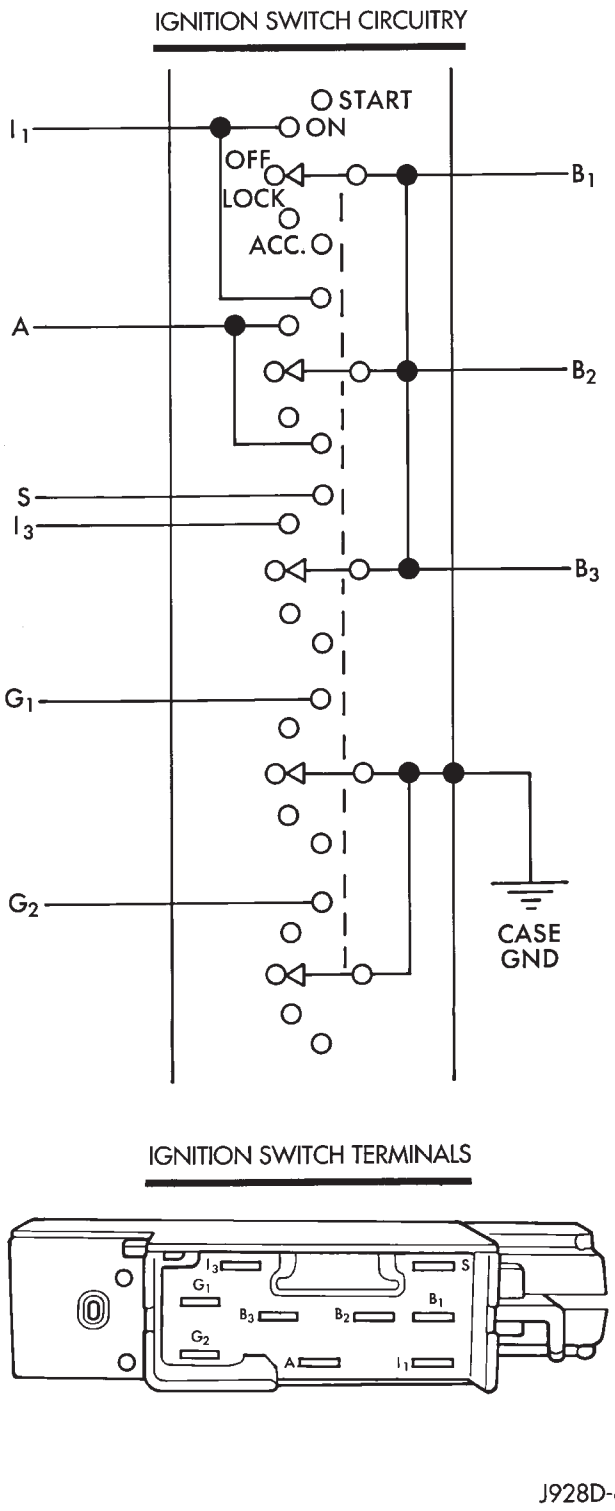

Fig. 3 Ignition Switch Terminals/Circuits

screws. Do not allow the ignition switch to move from the ACCESSORY detent position.

(b) Tilt steering column: While holding the key lock switch in the ACCESSORY position, gently slide the ignition switch **down** (away from steering wheel) to remove slack from switch. Tighten at-

taching screws. Do not allow the ignition switch to move from the ACCESSORY detent position.

Because the ignition switch and the headlamp dimmer switch share the same two mounting screws, one of the screws must be removed from the ignition switch. This must be done **after** the ignition switch has been adjusted and **before** the dimmer switch has been installed. Remove one screw. **Do not** remove the stud/nut.

(7) Install the headlamp dimmer switch as follows: Slip switch into actuator rod and position over the ignition switch. Install screws finger tight. Remove the dimmer switch actuator rod securing-tape from steering column.

(8) Adjust dimmer switch as follows: Depress the switch slightly and insert a 3/32-inch drill bit into the adjustment hole (Fig. 1). This is done to prevent horizontal switch movement.

(9) Move switch toward steering wheel to remove any lash from switch actuator rod. Tighten dimmer and ignition switch fasteners to 4 N·m (35 in. lbs.) torque.

(10) XJ models: Install the lower instrument panel trim assembly. YJ models: Install the windshield wiper intermittent control module and its bracket (if equipped).

(11) Install the negative battery cable.

Test dimmer switch. Test ignition switch operation in all switch positions. If equipped with a tilt steering column, test operation of dimmer switch and ignition switch in all tilt positions.

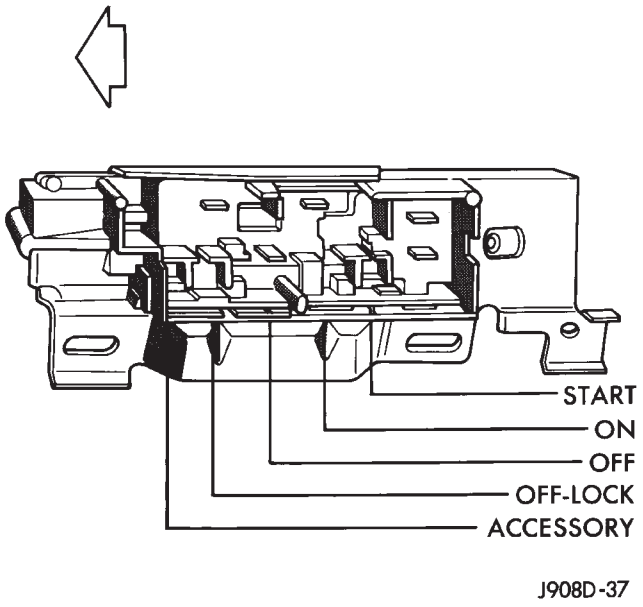

Fig. 4 Detent Positions—Non-Tilt Steering Column

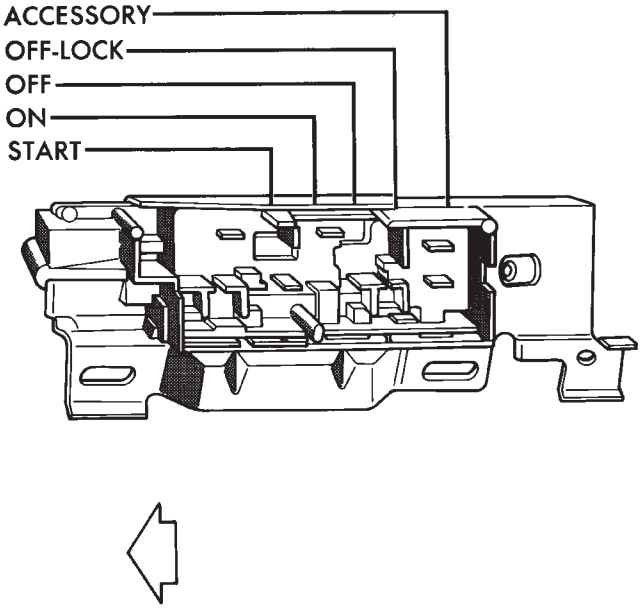

Fig. 5 Detent Positions—Tilt Steering Column

SPECIFICATIONS

GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. **If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label.** The VECI label is located in the engine compartment.

SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L/4.0L	RC12LYC	0.89 mm (0.035 in.)

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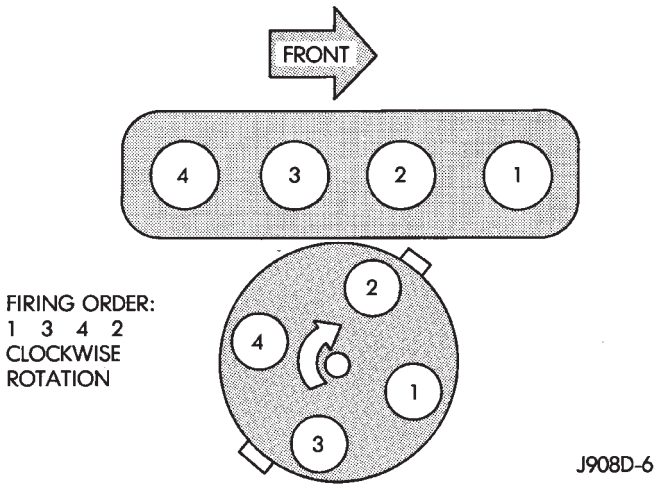
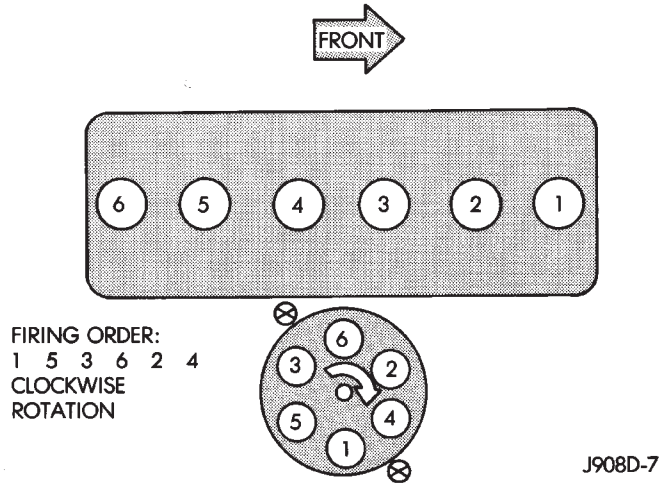
ENGINE FIRING ORDER—2.5L ENGINE



ENGINE FIRING ORDER—4.0L ENGINE



TORQUE

DESCRIPTION	TORQUE
Coolant Temperature Sensor	28 N·m (21 ft. lbs.)
Crankshaft Position Sensor	19 N·m (15 ft. lbs.)
Distributor Hold Down Bolt	23 N·m (17 ft. lbs.)
PCM Mounting Screws	1 N·m (9 in. lbs.)
PCM 60-Way Electrical Connector	4 N·m (35 in. lbs.)
Headlamp Dimmer Switch/Ignition Switch Mounting Screws/Nuts	4 N·m (35 in. lbs.)
Intake Manifold Air Temperature Sensor	28 N·m (20 ft. lbs.)
Oxygen Sensor	30 N·m (22 ft. lbs.)
Spark Plugs-All Engines	37 N·m (27 ft. lbs.)

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INSTRUMENT PANEL AND GAUGES

GROUP INDEX

INSTRUMENT PANEL AND GAUGES—XJE

CONTENTS

INSTRUMENT CLUSTER GENERAL INFORMATION

INDEX

With the ignition switch in the ON or START position, voltage supplied to the instrument cluster is limited by fuse #17. The voltage is supplied to all the gauges and indicator lamps through the instrument cluster printed circuit.

With the ignition switch in the OFF position, voltage is not supplied to the instrument cluster and the gauges do not indicate any vehicle condition.

VOLTMETER

The voltmeter measures battery or generator output voltage, whichever is greater.

OIL PRESSURE GAUGE

The oil pressure gauge pointer position is controlled by a magnetic field created by electrical current flow through the coils within the gauge. A change in current flow will change the magnetic field which changes the pointer position. The oil pressure sender is a variable resistor that changes electrical resistance with a change in oil pressure (values shown in Specifications chart).

OIL PRESSURE INDICATOR LAMP

Voltage is supplied to one side of the indicator bulb and the oil pressure switch is connected to the other side. When oil pressure is too low the switch closes providing a path to ground, and the indicator bulb lights.

COOLANT TEMPERATURE GAUGE

The coolant temperature gauge pointer position is controlled by a magnetic field created by electrical current flow through the coils within the gauge. A change in current flow will change the magnetic field which changes the pointer position. The coolant temperature sensor is a thermistor that changes electrical resistance with a change in coolant temperature (values shown in Specifications chart).

COOLANT TEMPERATURE INDICATOR LAMP

Voltage is supplied to one side of the indicator bulb and the coolant temperature switch is connected to the

other side. When coolant temperature is too high the switch closes providing a path to ground, and the indicator bulb lights.

TACHOMETER

The tachometer displays the engine speed (RPM). With the engine running, the tachometer receives an engine speed signal from the Powertrain Control Module pin 43 (values shown in Specifications chart).

SPEEDOMETER/ODOMETER SYSTEM

The speedometer/odometer system consists of an electric speedometer and pushbutton reset odometer mounted in the cluster. The system also includes the wire harness from the cluster to the vehicle speed sensor at the transmission, and the adapter and pinion in the transmission. A signal is sent from a transmission mounted vehicle speed sensor to the speedometer/odometer circuitry through the wiring harness. Refer to Group 21 - Transmission for selecting the proper pinion, and selecting and indexing the proper adapter.

FUEL GAUGE

The fuel gauge pointer position is controlled by a magnetic field created by electrical current flow through the coils within the gauge. A change in current flow will change the magnetic field which changes the pointer position. The fuel level sender is a variable resistor that changes electrical resistance with a change of the level of fuel in the tank (values shown in Specifications chart).

LOW FUEL WARNING LAMP

The low fuel warning lamp will light when the fuel level falls below approximately 4 gallons. A low fuel warning module controls when the lamp will light. When the module senses 66.5 ohms or less from the fuel level sender for 10 continuous seconds, the lamp will light. The lamp will remain on until the module senses 63.5 ohms or more from the fuel level sender for 20 continuous seconds.

UPSHIFT INDICATOR LAMP

Vehicles equipped with manual transmissions have an optional upshift indicator lamp. The lamp is controlled by the Powertrain Control Module. The lamp lights to indicate when the driver should shift to the next highest gear for best fuel economy. The Powertrain Control Module will turn the lamp off after 3 to 5 seconds if the upshift is not performed. The lamp will remain off until the vehicle stops accelerating and is brought back to the range of lamp operation or shifted into another gear.

The indicator lamp is normally illuminated when the ignition switch is turned ON and is turned off when the engine is started. The lamp will be lighted during engine operation according to engine speed and load.

BRAKE INDICATOR LAMP

The brake indicator lamp warns the driver that the parking brake is applied or that hydraulic pressure in the split brake system is unequal.

Voltage is supplied through the brake indicator bulb to 3 switches. A path to ground for the current is available if:

- The brake warning switch is closed (with unequal brake system hydraulic pressures), or
- The ignition switch is in the START position (to test the bulb), or
- The park brake switch is closed (with the parking brake applied).

ANTI-LOCK BRAKE SYSTEM (ABS) INDICATOR LAMP

The anti-lock brake system (ABS) lamp lights to indicate a system self-check is in process at vehicle start-up. If light remains on after start-up or comes on and stays on while driving, it may indicate that the ABS system has detected a malfunction or has become inoperative.

4WD INDICATOR LAMP

COMMAND-TRAC 4WD

The PART TIME lamp lights when the vehicle is engaged in four-wheel drive mode. Voltage is supplied to one side of the indicator bulb. A switch in the transfer case area is connected to the other side of the indicator bulb. When the switch is closed, a path to ground is provided and the indicator bulb lights.

SELECT-TRAC 4WD

The four-wheel drive icon or FULL TIME lamp lights when the vehicle is engaged in full time four-wheel drive mode. The PART TIME lamp lights when the vehicle is in part time four-wheel drive mode. Voltage is supplied to one side of the indicators. Switches in the transfer case area are connected to the other side of the indicator bulbs. When a switch is closed, a path to ground is provided and the indicator bulb lights.

MALFUNCTION INDICATOR LAMP (CHECK ENGINE)

The Malfunction Indicator Lamp (Check Engine) lights each time the ignition switch is turned ON and stays on for 3 seconds as a bulb test.

If the PCM receives an incorrect signal or no signal from certain sensors or emission related systems the lamp is turned on (pin 32 of PCM). This is a warning that the PCM has recorded a system or sensor malfunction. In some cases when a diagnostic trouble code is declared the PCM will go into a limp-in mode in an attempt to keep the system operating. It signals an immediate need for service.

The lamp also can be used to display diagnostic trouble codes (DTC). Cycle the ignition switch ON, OFF, ON, OFF, ON within 5 seconds. This will allow any trouble codes stored in the PCM memory to be displayed in a series of flashes representing digits.

INSTRUMENT CLUSTER DIAGNOSIS

INDEX

SPEEDOMETER/ODOMETER INOPERATIVE

(1) Check for continuity in the wire between the vehicle speed sensor and cluster connector pin A5.

(2) With the ignition switch in the ON position, check for battery voltage across pin A8 (B+) and pin B2 (ground).

(3) Perform vehicle speed sensor test. Refer to the appropriate vehicle Diagnostic Test Procedures manual.

(4) If all the previous tests prove good, replace speedometer/odometer.

GAUGES AND INDICATORS INOPERATIVE

(1) Remove and inspect fuse #17. Replace as required.

(2) Measure resistance at instrument cluster connector terminal A3. Meter should read zero ohms. If not, repair open to ground.

VOLTMETER INOPERATIVE

(1) Turn ignition switch to ON. Voltmeter should read battery voltage. If not, go to step 2.

(2) Measure voltage at instrument cluster connector terminal A8. Meter should read battery voltage. If OK, replace meter. If not, repair open to fuse #17.

OIL PRESSURE GAUGE INOPERATIVE

(1) Turn ignition switch to ON.

(2) Disconnect oil pressure sender connector (Fig. 1). Needle goes to H. If not, go to step 3.

(3) Touch oil pressure sender connector to ground. Needle goes to L. If OK, replace sender. If not, repair open to gauge (instrument cluster connector terminal B7).

OIL PRESSURE INDICATOR INOPERATIVE

(1) Turn ignition switch to ON.

(2) Touch oil pressure switch connector to ground. Lamp should light. If OK, replace switch. If bulb is OK, repair open to instrument cluster connector terminal B7.

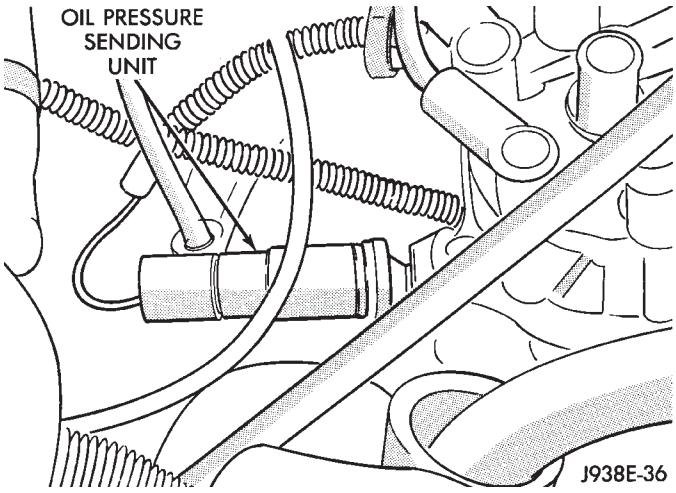


Fig. 1 Oil Pressure Sending Unit—4.0L

COOLANT TEMPERATURE GAUGE INOPERATIVE

(1) Turn ignition switch to ON.

(2) Disconnect coolant temperature sender connector. Needle goes to C. If not, go to step 3.

(3) Touch coolant temperature sender connector to ground. Needle goes to H. If OK, replace sender. If not, repair open to gauge (instrument cluster connector terminal A1).

COOLANT TEMPERATURE INDICATOR INOPERATIVE

(1) Turn ignition switch to ON.

(2) Touch coolant temperature indicator connector to ground. Lamp should light. If OK, replace switch. If bulb is OK, repair open to instrument cluster connector terminal A1.

TACHOMETER INOPERATIVE

Tachometer input is from the Powertrain Control Module pin 43. Use the DRB scan tool to test.

FUEL GAUGE INOPERATIVE

(1) Turn ignition switch to ON.

(2) Disconnect fuel gauge sender connector. Needle should go to E.

(3) Connect a jumper between terminal A and B on the body half of the fuel gauge sender connector. The gauge should move to F. If gauge is OK, replace sender. If not, go to step 4.

(4) Measure resistance of sender. Meter should read 105 to 5 ohms. If OK, go to step 5. If not, replace sender.

(5) Check for an open between sender connector and gauge. If OK, replace gauge. If not, repair open to gauge.

LOW FUEL WARNING INOPERATIVE

(1) Turn ignition switch to ON.

(2) Disconnect terminal B1 of the instrument cluster connector. Wait at least 10 seconds. Lamp (LED) should light. If OK, replace sender. If not, replace low fuel warning module.

UPSHIFT INDICATOR INOPERATIVE

(1) Turn ignition switch to ON.

(2) Ground pin 7 of connector B. Lamp should light. If not, replace bulb. If OK, continue with step 3.

(3) Turn ignition switch to OFF. Check for continuity between connector B pin 2 and pin 54 of the Powertrain Control Module. If OK, replace PCM. If not, repair open.

BRAKE INDICATOR INOPERATIVE

(1) Turn ignition switch to ON. Apply parking brake, brake warning switch connector unplugged.

(2) Jumper brake warning switch connector terminal B to ground. Lamp should light. If bulb is OK, repair open to indicator.

(3) Turn ignition switch to OFF. Measure resistance between brake warning switch connector terminal A and ground. Meter should read zero ohms. If OK, check switch and/or brake system. If not, repair open to park brake switch ground.

4WD INDICATOR INOPERATIVE

(1) Apply parking brake, start engine, vehicle in 4WD Lock or 4WD.

(2) Unplug switch and touch harness side of wire to ground. Lamp should light. If OK, check switch operation, replace if bad. If bulb is OK, repair open to indicator.

LOW WASHER INDICATOR INOPERATIVE

(1) Turn ignition switch to ON.

(2) Jumper 12 volts to fluid level switch connector terminal B. Lamp should light. If not, go to step 3.

(3) Measure resistance between terminal B and ground. Meter should read zero ohms. If not, repair open to bulb. If OK, go to step 4.

(4) Measure voltage at fluid level switch connector terminal A. Meter should read battery voltage. If OK, replace switch. If not, repair open to fuse.

MALFUNCTION INDICATOR LAMP (CHECK ENGINE)

(1) Turn ignition switch to ON.

(2) Jumper Powertrain Control Module terminal 2 to ground. Lamp should light. If bulb is OK, check for open to instrument cluster connector terminal 2.

ANTI-LOCK INDICATOR

(1) Turn ignition switch to ON.

(2) Jumper instrument cluster connector terminal 6 to ground. Lamp should light. If bulb is OK, check wiring for an open to module. Refer to Group 5 - Brakes.

SEAT BELT INDICATOR

Jumper instrument cluster connector terminal 15 to 12 volts. Lamp should light. If not, replace bulb. If OK, check wiring for an open to buzzer module. Refer to Group 8U - Chime/Buzzer Warning Systems.

RADIO/CLOCK ILLUMINATION

With the ignition switch in ACCESSORY or ON, power comes from the radio fuse. It then goes through the normally closed contacts of the radio illumination relay to the radio at connector terminal 11.

Pulling the headlamp switch to ON energizes the radio illumination relay. This closes the normally open contacts of the relay, and the brightness for the radio display is controlled by the headlamp switch rheostat. The back-lighting for the radio is also controlled by the headlamp rheostat through radio connector terminal 10.

Refer to Group 8F - Audio Systems, for radio illumination relay diagnosis.

INSTRUMENT PANEL LAMPS

Voltage is supplied at all times from the 40 amp Maxi fuse (located in the Power Distribution Center) through the park lamps fuse to the headlamp switch. The circuit continues through the instrument lamps fuse to the individual instrument panel lamps to ground. Lamp brightness is controlled by turning the headlamp switch knob.

DIAGNOSIS

(1) Turn parking lamps ON.

(2) Check park lamps fuse. Replace as required.

(3) Check instrument lamps fuse. Replace as required.

(4) Measure voltage at battery side of instrument lamps fuse with rheostat turned counterclockwise to clockwise (LO to HI). Meter should read zero volts to battery voltage. If not, replace headlamp switch.

(5) Measure resistance at ground side of instrument lamps fuse with parking lamps OFF. Meter should read almost zero ohms (except bulb filament). If not, repair open to ground. If zero ohms, 12 volt supply wire from fuse is shorted to ground, repair short.

INSTRUMENT CLUSTER SERVICE PROCEDURES

INDEX

INSTRUMENT CLUSTER REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove 4 instrument panel bezel attaching screws and remove instrument panel bezel. Bezel is snap fit at locations shown (Fig. 2).

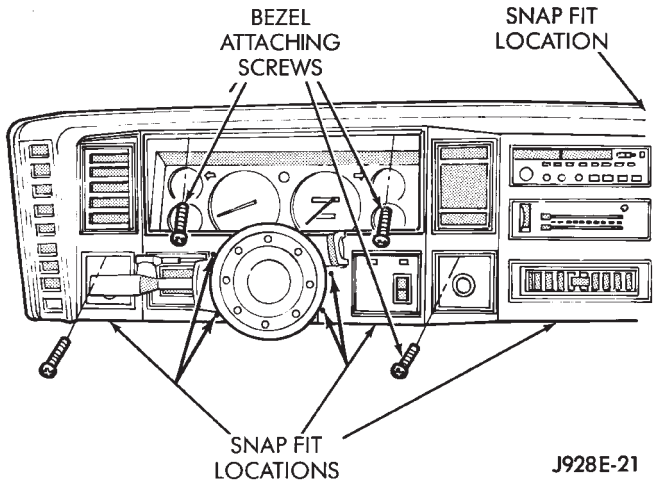


Fig. 2 Instrument Bezel Removal/Installation—XJ

(3) Remove cigar lighter housing attaching screws (Fig. 3).

(4) Remove switch housing attaching screws (if equipped).

(5) Remove instrument panel cluster attaching screws.

(6) Pull out cluster assembly far enough to disconnect 2 multiple plugs and remove instrument cluster.

To install cluster, reverse the removal procedures.

GAUGE REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove cluster lens and gauge bezel (Fig. 4). If equipped with trip odometer, gently pull knob off trip odometer push pin.

(2) Remove gauge attaching screws from rear of mounting bezel. Remove gauge from front.

(3) Install gauge. Install attaching screws.

(4) Install cluster bezel and lens.

(5) Install knob on trip odometer push pin.

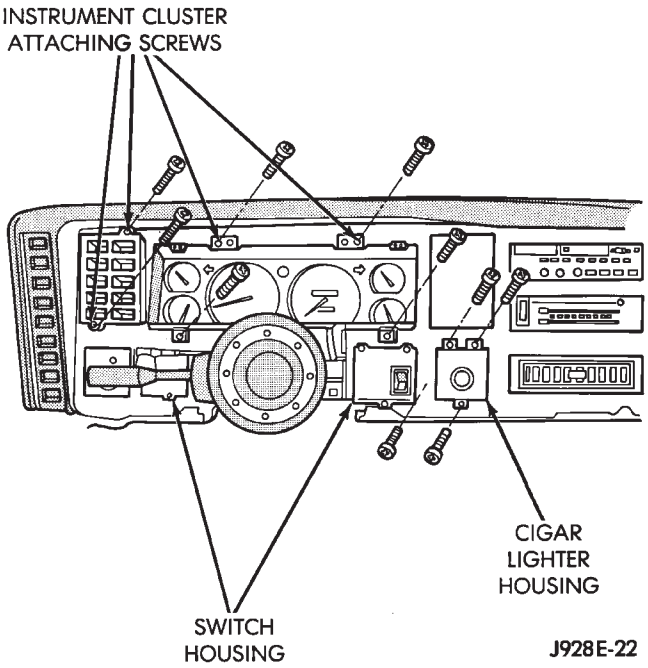


Fig. 3 Instrument Cluster Removal/Installation—XJ

SPEEDOMETER REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove cluster lens and gauge bezel. If equipped with trip odometer, gently pull knob off trip odometer push pin.

(2) Remove 6 mounting screws from cluster housing.

(3) Remove 3 screws from rear of cluster housing (Fig. 5).

(4) Remove speedometer assembly including circuit board.

(5) Install speedometer with 3 screws.

(6) Install gauge bezel and lens.

(7) Install knob on trip odometer push pin.

TACHOMETER REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove cluster lens and gauge bezel. If equipped with trip odometer, gently pull knob off trip odometer push pin.

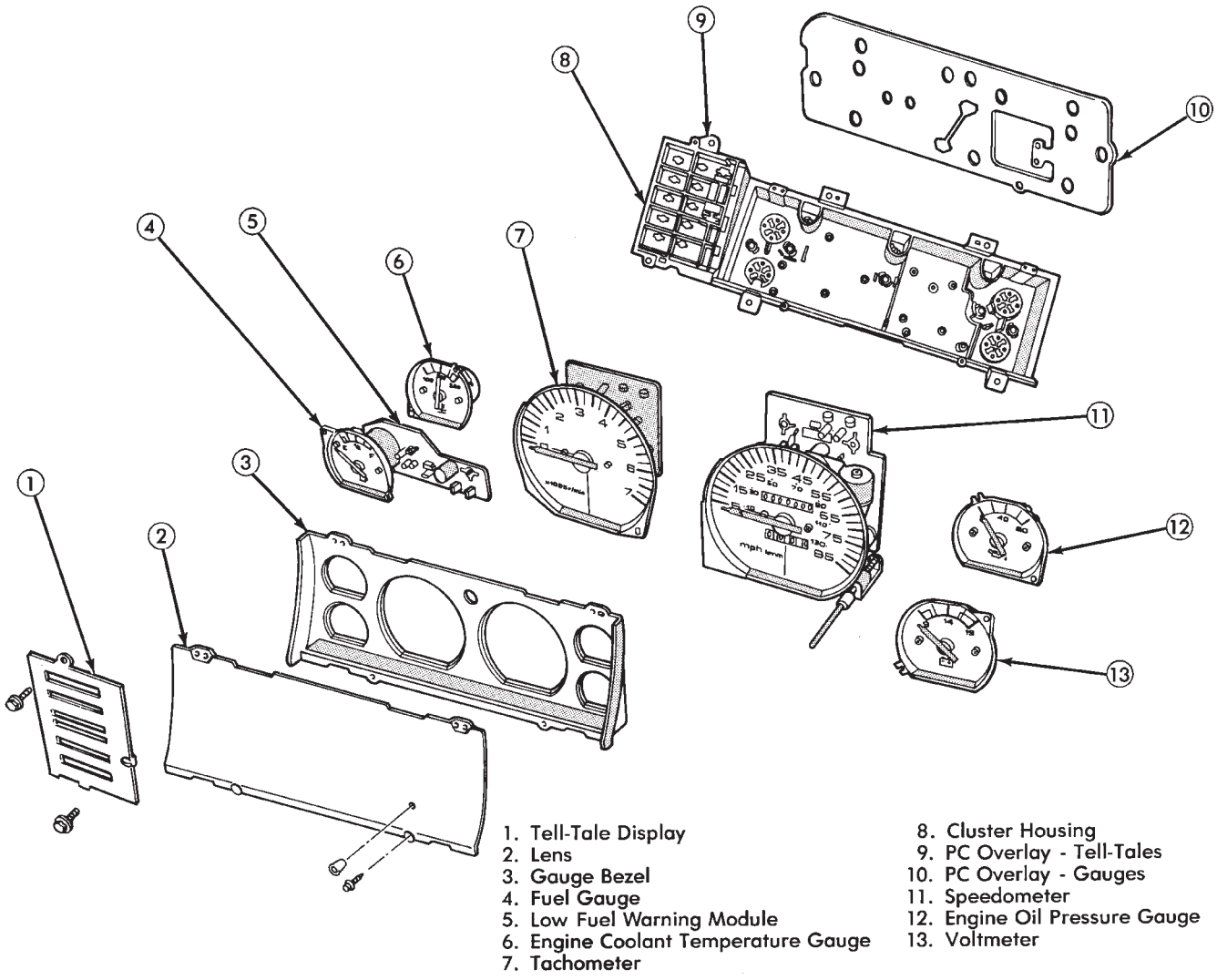


Fig. 4 Instrument Cluster

(2) Remove 3 attaching screws from rear of cluster housing.

(3) Remove tachometer assembly including circuit board.

(4) Install tachometer. Install attaching screws.

(5) Install gauge bezel and lens.

(6) Install knob on trip odometer push pin.

PRINTED CIRCUIT REPLACEMENT—INSTRUMENT CLUSTER REMOVED

DISASSEMBLY

(1) Remove all attaching screws for gauges, tachometer, and speedometer that are contacting printed circuit (Fig. 5).

(2) Remove screw holding the cluster connector retaining strap to bezel. Remove strap and pivot connector down (Figs. 6 and 7).

(3) Remove lamp sockets from circuit board.

(4) Remove printed circuit including connector.

There is a separate printed circuit for the warning lights that is removed by removing the lamp sockets.

ASSEMBLY

(1) Position printed circuit, including connector, on the back of the instrument panel cluster.

(2) Remove gauge bezel and lens.

(3) Hold components in place and install screws.

(4) Install lamp sockets.

(5) Pivot connector up and install retaining strap.

(6) Install gauge bezel and cluster lens.

GEAR SELECTOR INDICATOR REPLACEMENT—INSTRUMENT CLUSTER REMOVED

(1) Remove screws from rear of mounting bezel holding fuel gauge in place.

(2) Remove 2 screws holding gear selector indicator (Fig. 8).

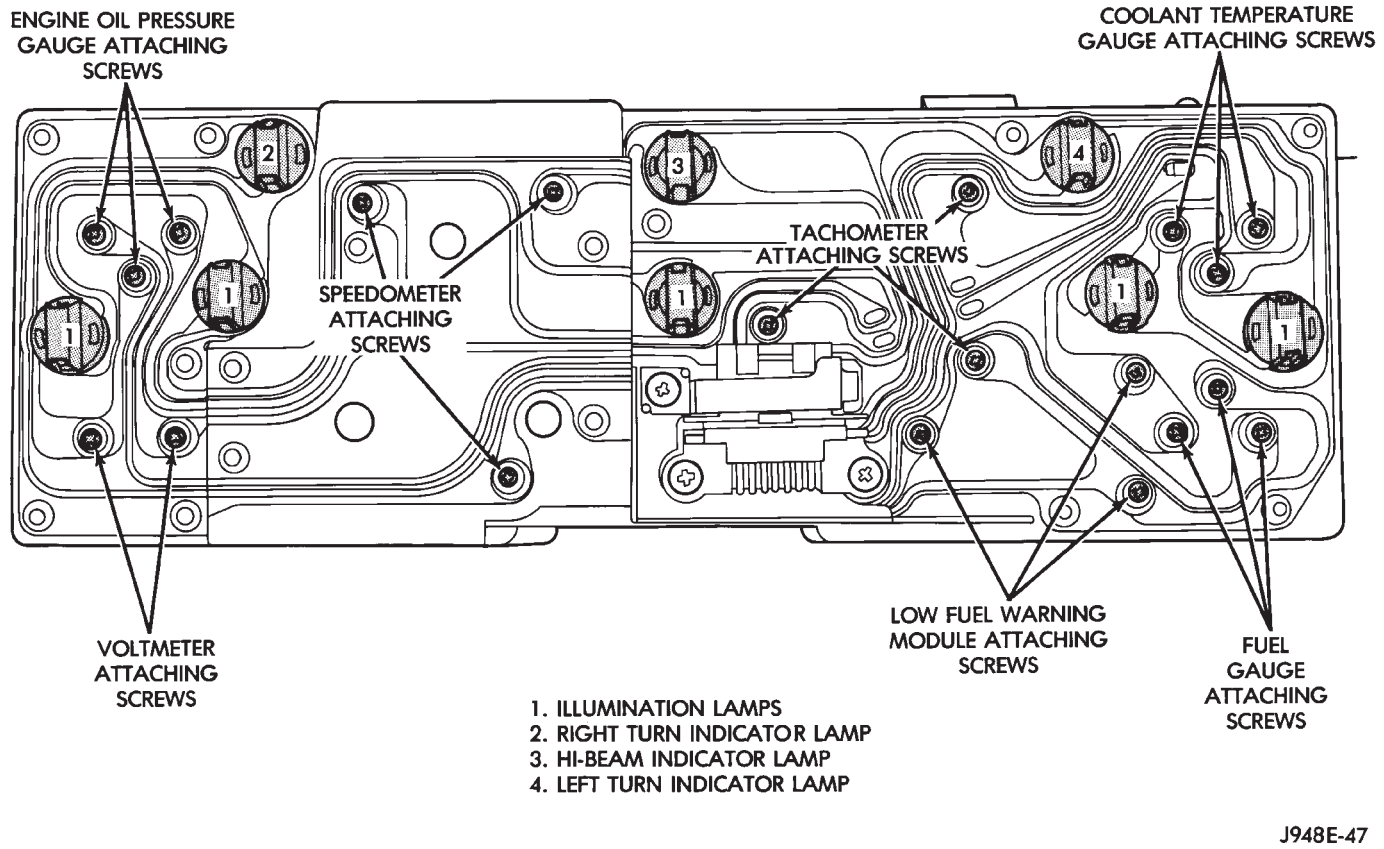


Fig. 5 Printed Circuit Removal/Installation

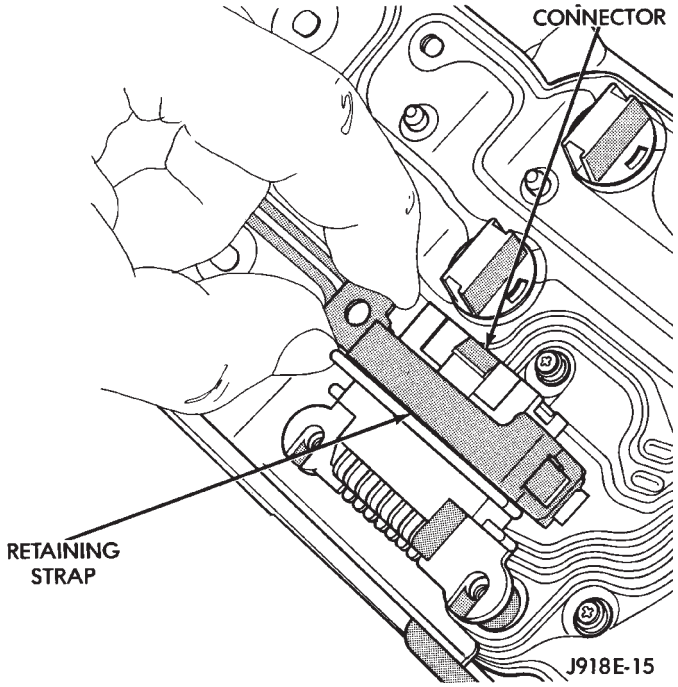


Fig. 6 Cluster Connector Retaining Strap

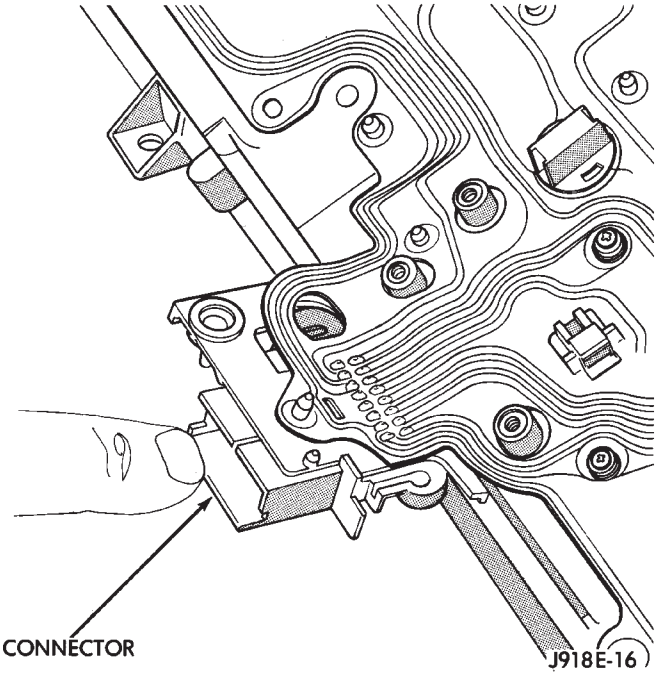


Fig. 7 Printed Circuit And Cluster Connector

(3) Pull cable and clip through hole in the mounting bezel and remove indicator.

(4) Install indicator and cluster.

(5) To adjust indicator, place transmission in PARK.

(6) Align pointer on indicator with PARK position.

(7) Install clip to steering column shroud.

(8) Move transmission shift lever to check proper alignment.

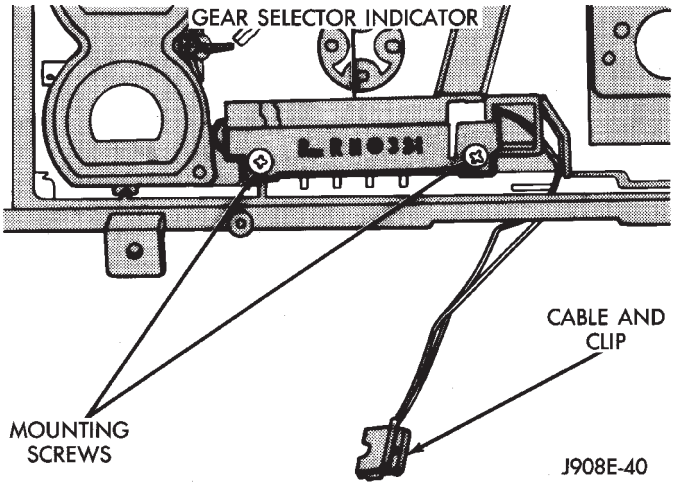


Fig. 8 Gear Selector Indicator

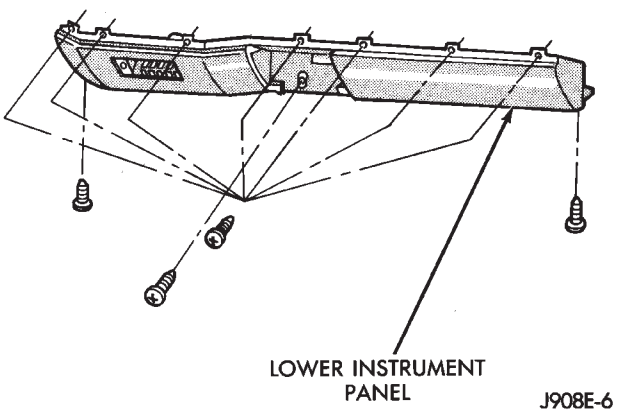


Fig. 10 Lower Instrument Panel Removal/Installation

INSTRUMENT PANEL REPLACEMENT (Fig. 9)

(1) Disconnect negative cable from battery.

(2) Remove:

- Parking brake release handle
- lower heat/AC duct below steering column
- ash receiver
- lower instrument panel (Fig. 10)
- cluster bezel
- cluster assembly
- clock (if equipped)
- radio and heater control panel
- instrument panel switches
- headlamp switch

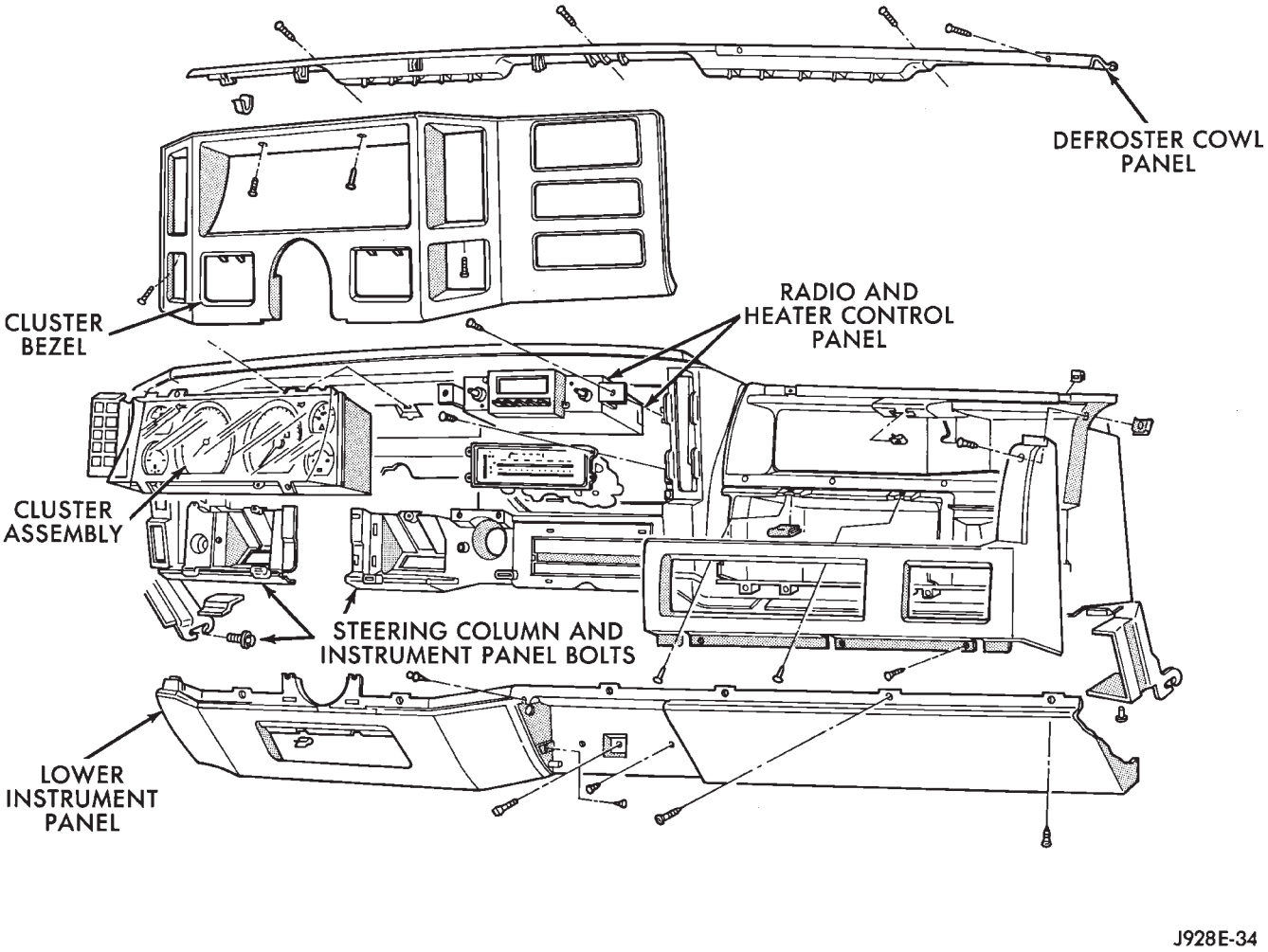


Fig. 9 Instrument Panel Exploded View

- antenna connector
- blower motor resistors
- ground lead
- disconnect glove box light
- defroster cowl panel

Remove driver's side heat/AC outlet to gain access to left hand defroster cowl panel retaining clip to aid in removal (Fig. 11).

- instrument panel attaching bolts
- steering column attaching bolts
- instrument panel assembly

The instrument panel wiring harness is attached to the back of the instrument panel assembly and must be installed correctly for installation.

(3) To install instrument panel, position instrument panel assembly on side mounting bolts (Fig. 12).

(4) Route wiring harnesses and secure instrument panel assembly mounting points.

(5) Connect tube to lap cooler.

(6) Reverse the removal procedures to finish instrument panel installation.

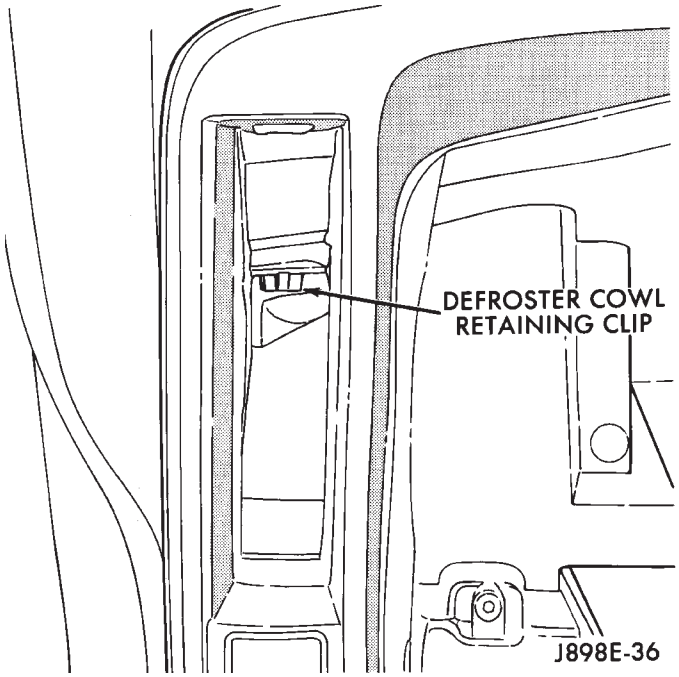


Fig. 11 Driver's Side Defroster Cowl Retaining Clip

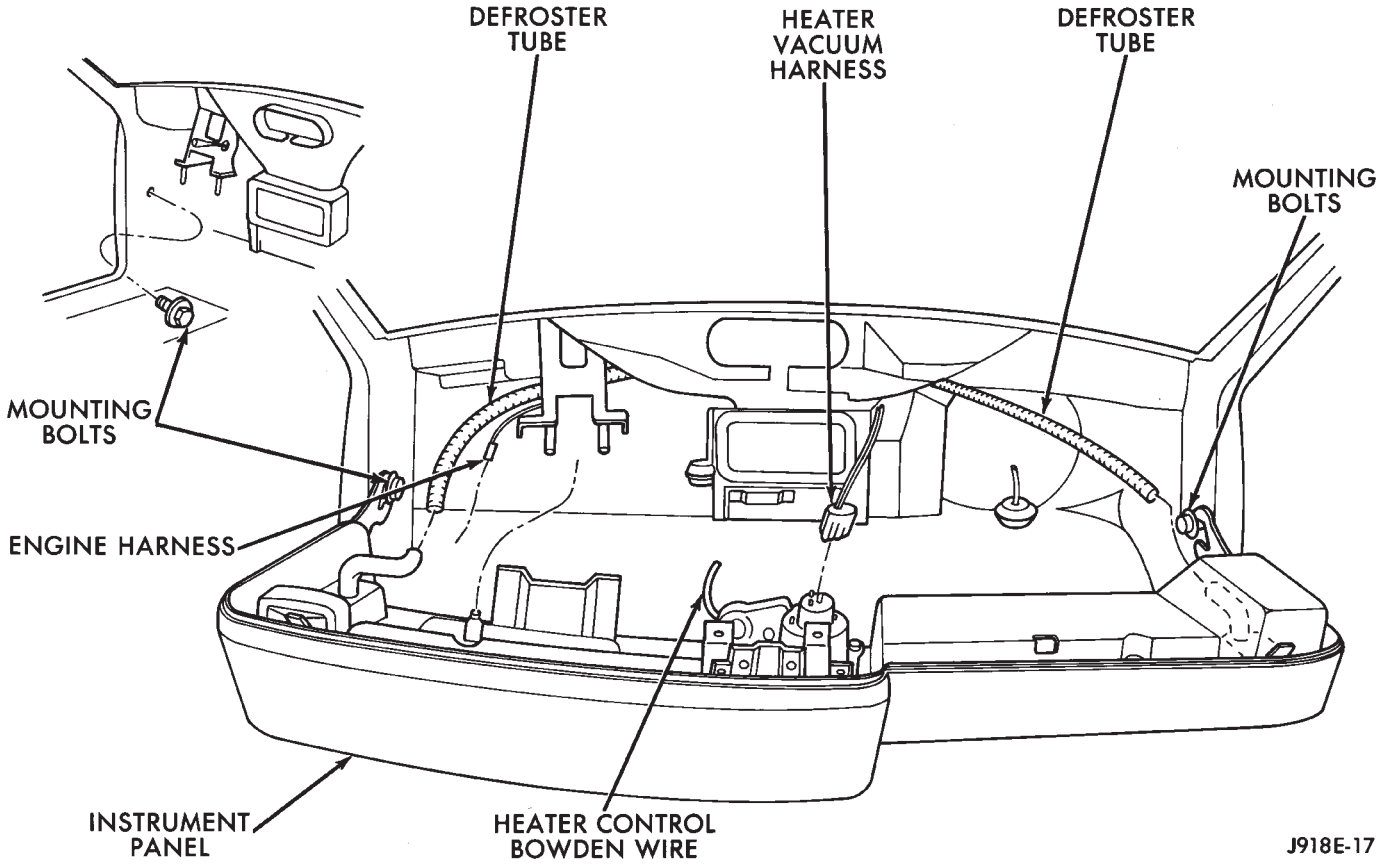
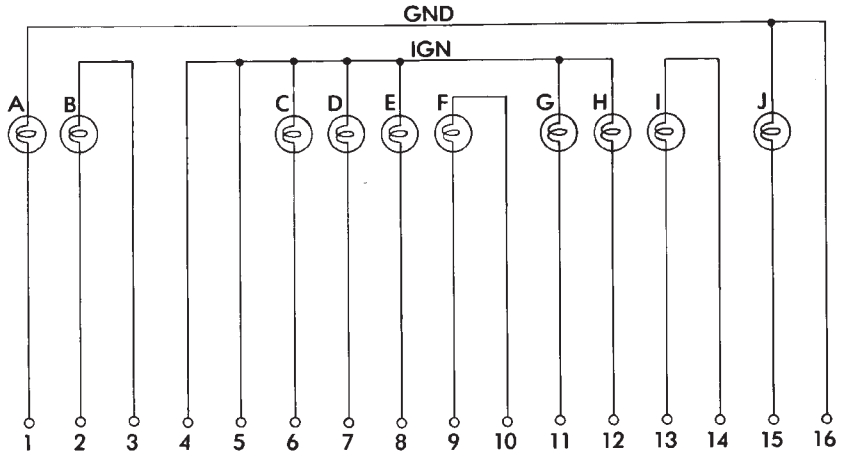
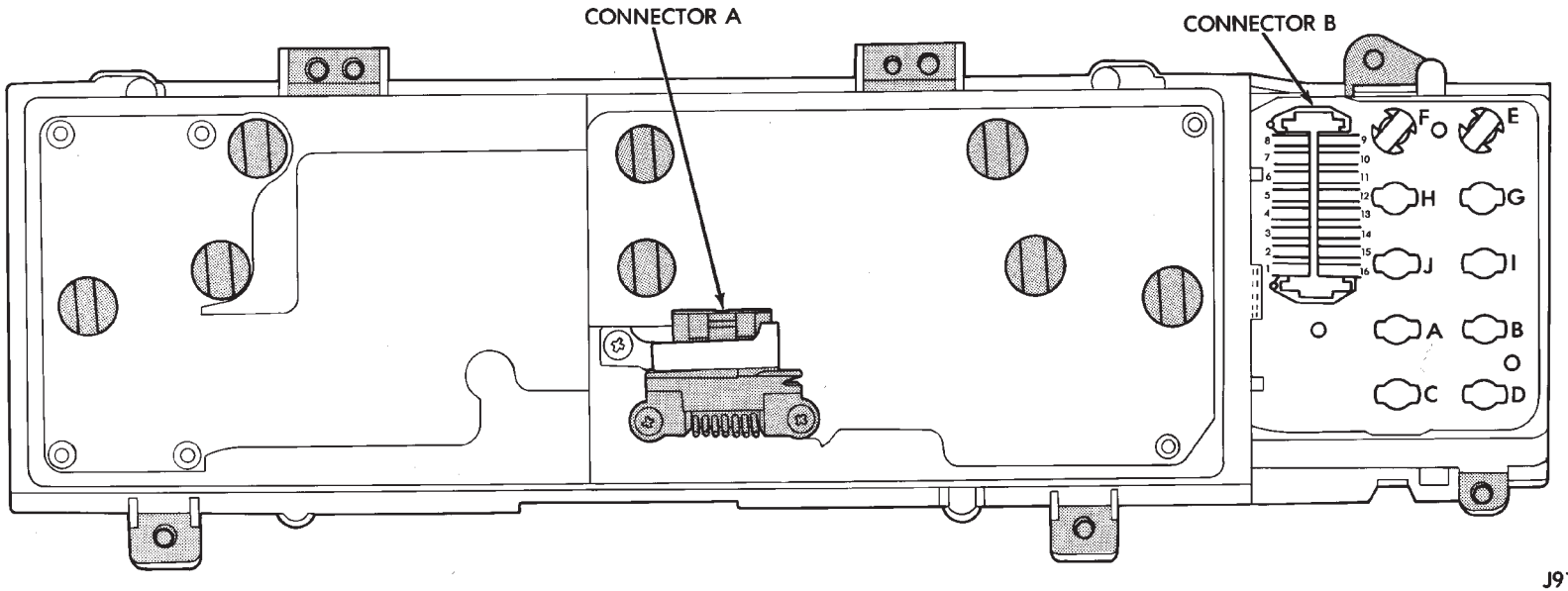


Fig. 12 Instrument Panel Installation

CONNECTOR B
INDICATORS



NO.	LAMP	TERMINAL NAME
1	A	LOW WASHER
2	B	CHECK ENGINE
3	B	IGN
4		IGN
5		IGN
6	C	CHECK ANTILOCK
7	D	UP SHIFT
8	E	BRAKE
9	F	SECURITY
10	F	BATT
11	G	FULL TIME
12	H	PART TIME
13	I	MAINT REQD
14	I	IGN
15	J	SEAT BELT
16		GND



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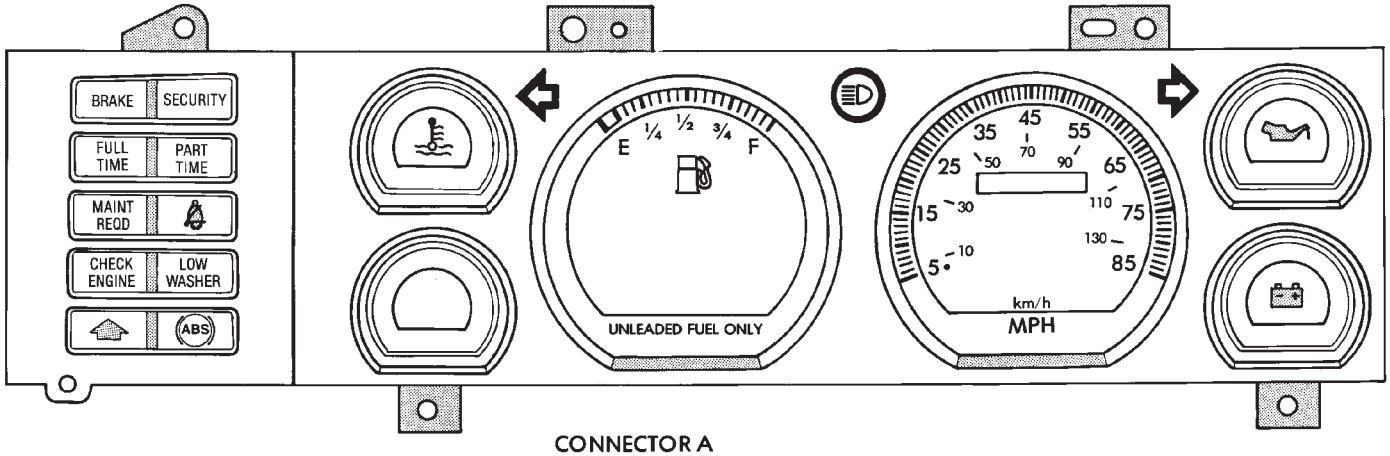
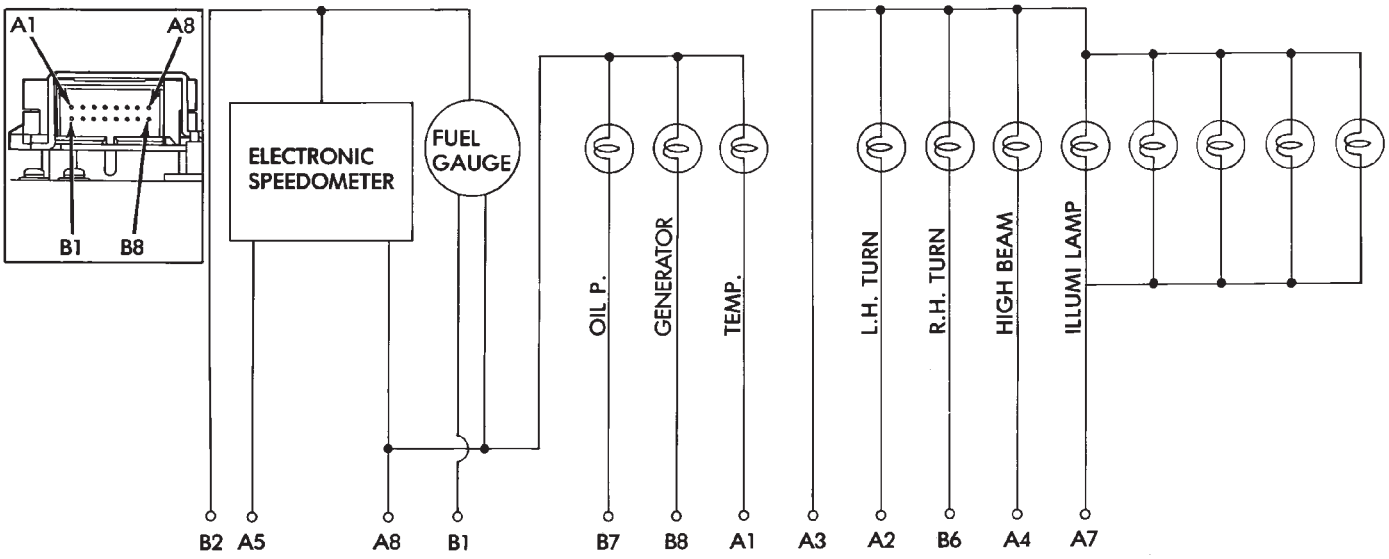
INSTRUMENT CLUSTERS

LOW LINE CLUSTER

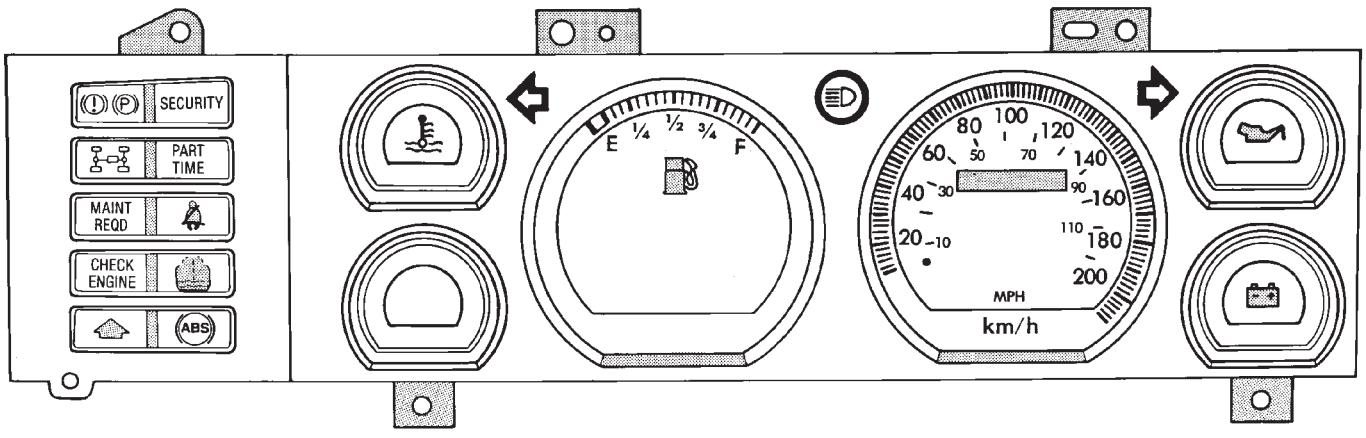
USA



CONNECTOR A



CANADA



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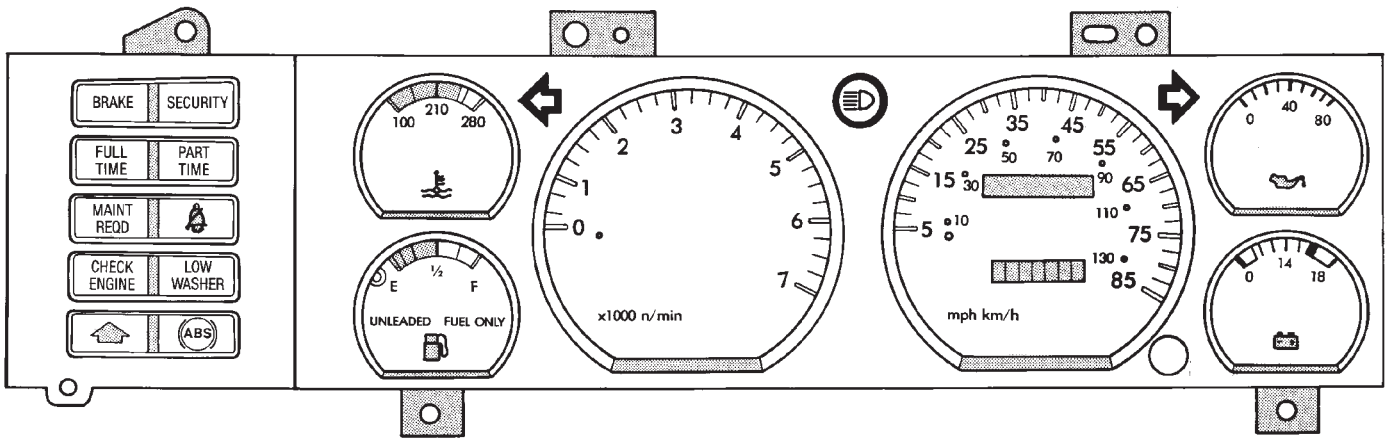
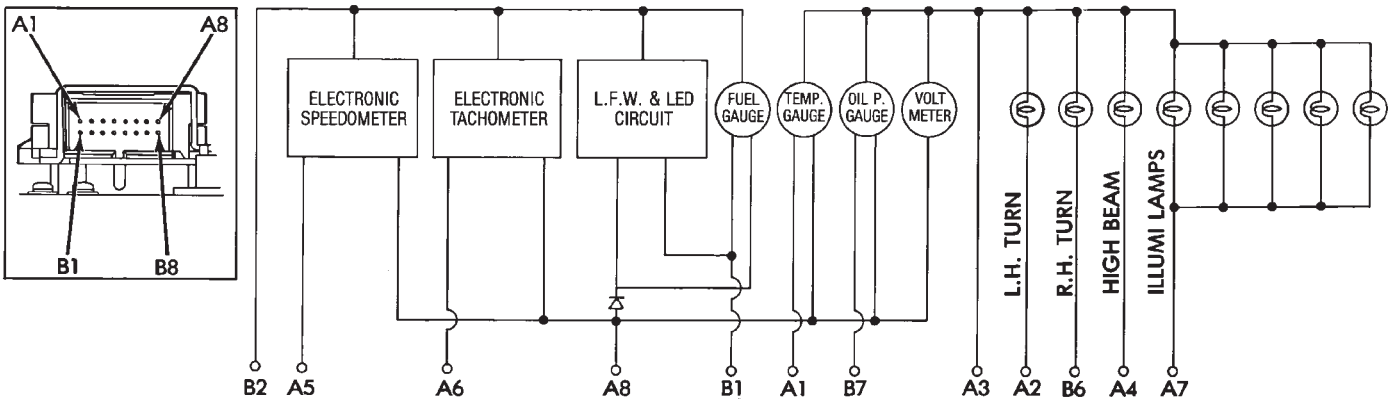
HIGH LINE CLUSTER

USA



CONNECTOR A



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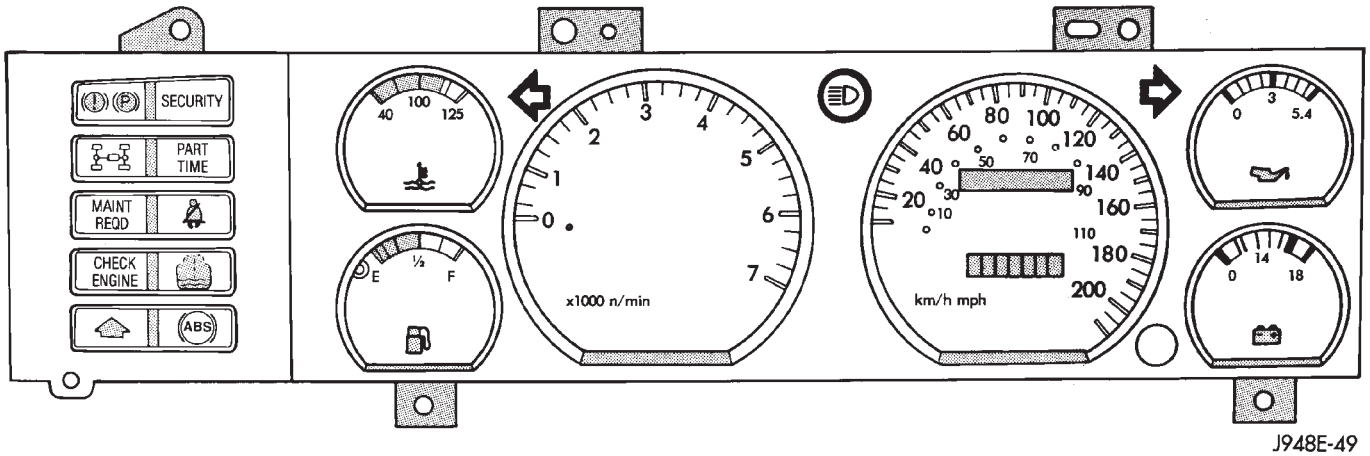

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SPECIFICATIONS

INSTRUMENT CLUSTER GAUGES

OIL PRESSURE GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
0 psi Grad. ± 2°	1 ohm
40 psi Grad. ± 3½°	46 ohms
80 psi Grad. ± 3°	87 ohms

TEMPERATURE GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
100°F Grad. ± 3½°	1365 ohms
220°F Grad. ± 2½°	93.5 ohms
260°F Grad. ± 2½°	55.1 ohms

FUEL GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
Empty Grad. +0° −4°	105 ohm
1/2 Full Grad. ± 3½°	33 ohms
Full Grad. + 6° −0°	5 ohms

VOLTMETER CALIBRATION

VOLTAGE INPUT	POINTER POSITION
12V	12V Grad. ±6°
16V	16V Grad. ±3°

TACHOMETER CALIBRATION

ENGINE	FREQUENCY	INDICATION
4 & 6 CYLINDER	66.7 HZ	2000 RPM ± 140
	166.7 HZ	5000 RPM ± 140

SPEEDOMETER CALIBRATION

ENGINE	FREQUENCY	INDICATION
4 & 6 CYLINDER	44.4 HZ	20 mph −1.5 +4.5
	122.2 HZ	55 mph −.3 +3.3
	166.5 HZ	75 mph −.3 +3.3

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INSTRUMENT PANEL AND GAUGES—YJE

CONTENTS

INSTRUMENT CLUSTER GENERAL INFORMATION

SPEEDOMETER/ODOMETER SYSTEM

The speedometer/odometer system consists of an electric speedometer and pushbutton reset odometer mounted in the cluster. The system also includes the wire harness from the cluster to the vehicle speed sensor at the transmission, and the adapter and pinion in the transmission. A signal is sent from a transmission mounted vehicle speed sensor to the speedometer/odometer circuitry through the wiring harness. Refer to Group 21 - Transmission for selecting the proper pinion, and selecting and indexing the proper adapter.

TACHOMETER

The tachometer displays the engine speed (RPM). With the engine running, the tachometer receives an engine speed signal from the Powertrain Control Module pin 43 (values shown in Specifications chart).

INDICATOR LAMPS

The Brake, Upshift (2.5L with 5 speed transmission except California), and Malfunction Indicator (Check Engine) lamps are located in the indicator lamp panel above the steering column. The lamps share a common battery feed connection through the ignition switch and fuse #9.

The turn signals, high beam indicator, seat belt reminder, hazard lamp, master lighting and illumination bulbs are supplied battery voltage through various switches and share a common ground.

INSTRUMENT CLUSTER DIAGNOSIS

INDEX

SPEEDOMETER

(1) Raise vehicle.

(2) Disconnect the vehicle speed sensor connector.

(3) Connect a voltmeter between the black wire pin of the connector and ground.

(4) Turn the ignition switch to the ON position.

(5) Check for approximately 5 volts. If OK, perform vehicle speed sensor test. Refer to the appropriate Powertrain Diagnostic Procedures manual. If not OK, continue with step 6.

(6) Turn ignition switch to OFF position.

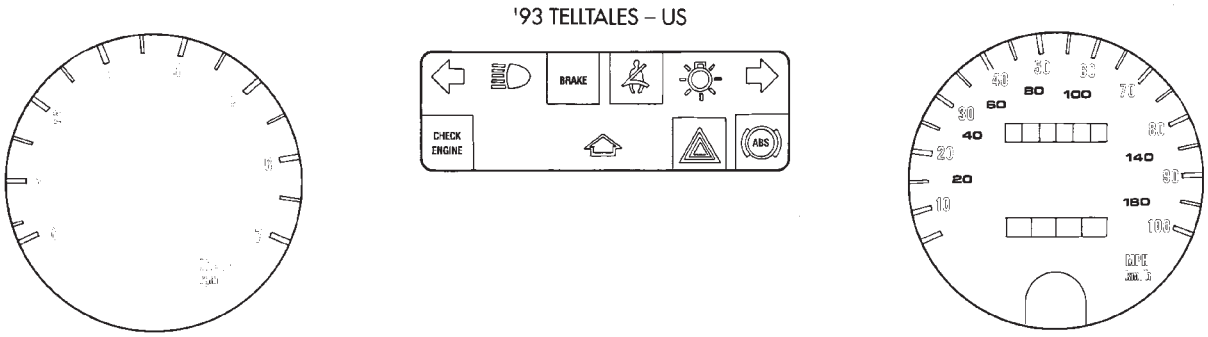
(7) Check continuity between vehicle speed sensor connector and terminal 13 of instrument cluster connector. If OK, replace speedometer. If not OK, repair open circuit.

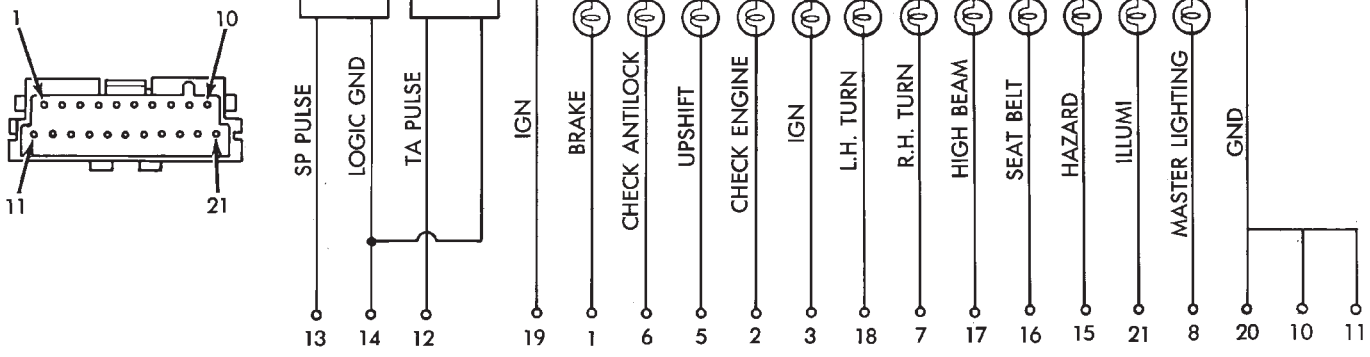
TACHOMETER

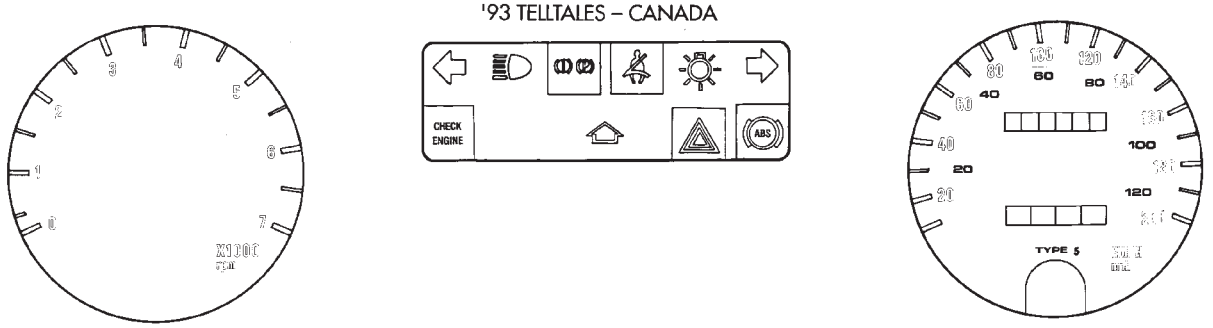
(1) Tachometer input is from the Powertrain Control Module (PCM) pin 43. Use the DRB scan tool to perform actuator test. If OK, continue with step 2. If not, replace PCM.

(2) Check for continuity between cluster connector pin 12 and PCM pin 43. If OK, replace tachometer. If not, repair open circuit.

INSTRUMENT CLUSTER







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DIAGNOSING—ALL LAMPS OUT

(1) Inspect fuse #9. Replace as required.

(2) Measure voltage at instrument cluster connector terminal 20. Meter should read zero ohms. If not, repair open to ground.

UPSHIFT INDICATOR LAMP

Vehicles equipped with manual transmissions have an optional upshift indicator lamp. The lamp is controlled by the PCM. The lamp lights to indicate when the driver should shift to the next highest gear for best fuel economy. The PCM will turn the lamp off after 3 to 5 seconds if the upshift is not performed. The lamp will remain off until the vehicle stops accelerating and is brought back to the range of lamp operation or shifted into another gear.

The indicator lamp is normally illuminated when the ignition switch is turned ON and it is turned off when the engine is started. The lamp will be lighted during engine operation according to engine speed and load.

(1) Turn ignition switch to ON.

(2) Ground pin 2 of cluster connector. Lamp should light. If not, replace bulb. If OK, continue with step 3.

(3) Turn ignition switch to OFF. Check for continuity between cluster connector pin 2 and pin 54 of the PCM. If not, repair open. If OK, refer to DRB scan tool actuator test of upshift indicator.

BRAKE INDICATOR LAMP

The brake indicator is a dual function lamp. It will indicate an unequal pressure condition in the split brake hydraulic system and it also will indicate when the parking brake is engaged. Separate switches are used for each indicator lamp function. A switch mounted on the brake pedal assembly will close a ground circuit whenever the parking brakes are applied. A second switch is installed in the brake hydraulic lines near the master cylinder. If the switch is balanced by equal pressure on both ends of the switch valve, the valve remains centered and the lamp remains off. If the valve is shifted by unequal pressure between the front or rear brake hydraulic systems, the lamp circuit is connected to ground. To make sure the brake lamp is functional before the vehicle is driven, it is illuminated through a ground circuit when the ignition switch is turned to the START position.

(1) Turn ignition switch to ON.

(2) Ground pin 1 of the cluster connector. Lamp should light. If not, replace bulb. If OK, continue with step 3.

(3) Turn ignition switch to OFF. Check for continuity to park brake switch and brake warning switch.

MALFUNCTION INDICATOR LAMP (CHECK ENGINE)

The Malfunction Indicator Lamp (Check Engine) illuminates each time the ignition switch is turned ON and stays on for 3 seconds as a bulb test.

If the PCM receives an incorrect signal or no signal from certain sensors or emission related systems the lamp is turned on (pin 32 of PCM). This is a warning that the PCM has recorded a system or sensor malfunction. In some cases when a diagnostic fault is declared the PCM will go into a limp-in mode in an attempt to keep the system operating. It signals an immediate need for service.

The lamp also can be used to display diagnostic trouble codes (DTC). Cycle the ignition switch ON, OFF, ON, OFF, ON within 5 seconds. This will allow any DTC's stored in the PCM memory to be displayed in a series of flashes representing digits.

(1) Turn ignition switch to ON.

(2) Ground pin 4 of cluster connector. Lamp should light. If not, replace bulb. If OK, continue with step 3.

(3) Turn ignition switch to OFF. Check for continuity between cluster connector pin 4 and PCM cavity 32. If OK, replace PCM. If not, repair open.

SEAT BELT REMINDER LAMP

Apply 12 volts to terminal 16 of cluster connector. Lamp should light. If not, replace bulb. If OK, check wiring for an open to buzzer module. Refer to Group 8U - Chime/Buzzer Warning Systems.

INSTRUMENT PANEL ILLUMINATION LAMPS

The instrument panel illumination lamps share two common connections. There is a splice after fuse #10 that connects the lamps to battery feed. There is also a splice that connects all lamps to ground. Because they share these common connection points in a parallel circuit, the illumination lamps will all come on at the same time. It also means one or more lamps can be out without affecting the operation of the other lamps.

On the battery side of the circuit, the headlamp switch illumination rheostat/switch and panel lamps fuse receive battery feed in series from the park/tail fuse. In the park lamp position, the headlamp switch completes the circuit from the park/tail fuse to the illumination rheostat/switch and panel lamps fuse.

The illumination rheostat contains a variable resistor that allows the driver to vary illumination intensity from off to full brightness.

DIAGNOSIS

(1) Turn parking lamps ON.

(2) Check fuse #10. Replace as required.

(3) Measure voltage at battery side of fuse #10 with rheostat turned counterclockwise to clockwise (LO to HI). Meter should read zero volts to battery voltage. If not, replace headlamp switch.

(4) Measure resistance at ground side of fuse #10 with parking lamps OFF. Meter should read almost zero ohms (except bulb filament). If not, repair open to ground. If zero ohms, 12 volt supply wire from fuse is shorted to ground, repair short.

INSTRUMENT CLUSTER SERVICE PROCEDURES

INDEX

INSTRUMENT CLUSTER REPLACEMENT

(1) Remove 6 shroud screws (Fig. 1).

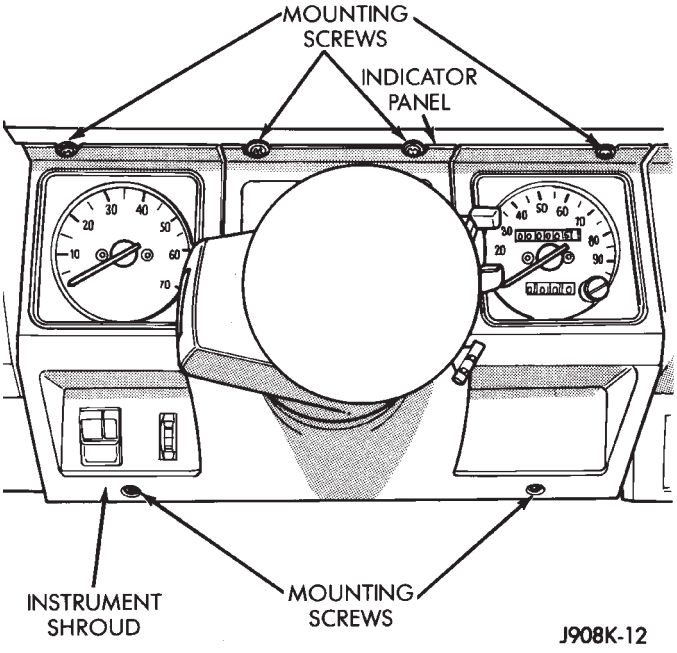

Fig. 1 Instrument Shroud Removal/Installation

(2) Slide shroud toward steering wheel.

(3) Remove 3 screws holding right side switch panel (Fig. 2).

(4) Remove 3 screws holding left side switch bezel.

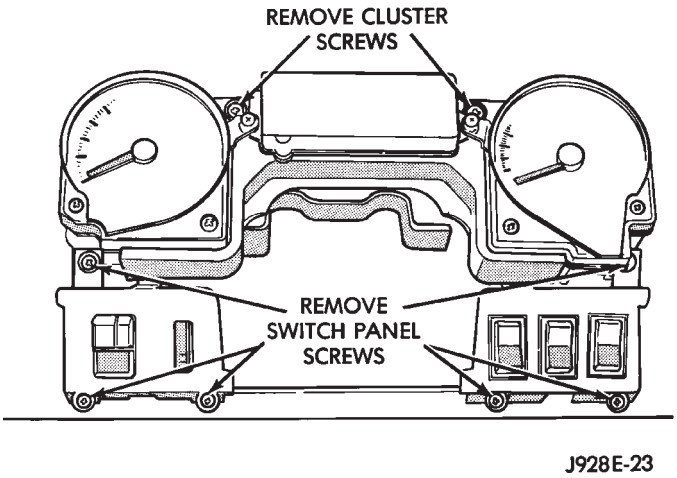

Fig. 2 Cluster Removal

(5) Remove 2 screws holding cluster in place.

(6) Lift up top of cluster. Roll cluster out between steering column and instrument panel far enough to reach connector located behind tachometer.

(7) Disconnect cluster connector and remove cluster (Fig. 3).

(8) To install cluster, reverse the removal procedures.

TACHOMETER REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove instrumentation shroud (Fig. 1). Refer to Instrument Cluster Replacement.

(3) Remove cluster as described in Instrument Cluster replacement.

(4) Remove 3 screws and tachometer lens (Fig. 4).

(5) Gently pry up clip to release lens from bezel (Fig. 5).

(6) Remove 3 screws from rear of housing (Fig. 6). Remove tachometer.

(7) Install tachometer with 3 screws.

(8) Snap lens into place.

(9) Install lens with 3 screws.

(10) To install the cluster, reverse the removal procedures.

SPEEDOMETER REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove instrument shroud (Fig. 1). Refer to Instrument Cluster Replacement.

(3) Remove cluster as described in Instrument Cluster Replacement.

(4) Remove 3 screws and speedometer lens (Fig. 7).

(5) Gently pry up clip to release lens from bezel (Fig. 5).

(6) Remove 3 screws from rear of housing (Fig. 8). Remove speedometer.

(7) Install speedometer with 3 screws.

(8) Snap lens into place.

(9) Install lens with 3 screws.

(10) To install the cluster, reverse the removal procedures.

INDICATOR BEZEL REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove instrumentation shroud (Fig. 1).

(3) Remove 3 screws and tachometer lens (Fig. 4).

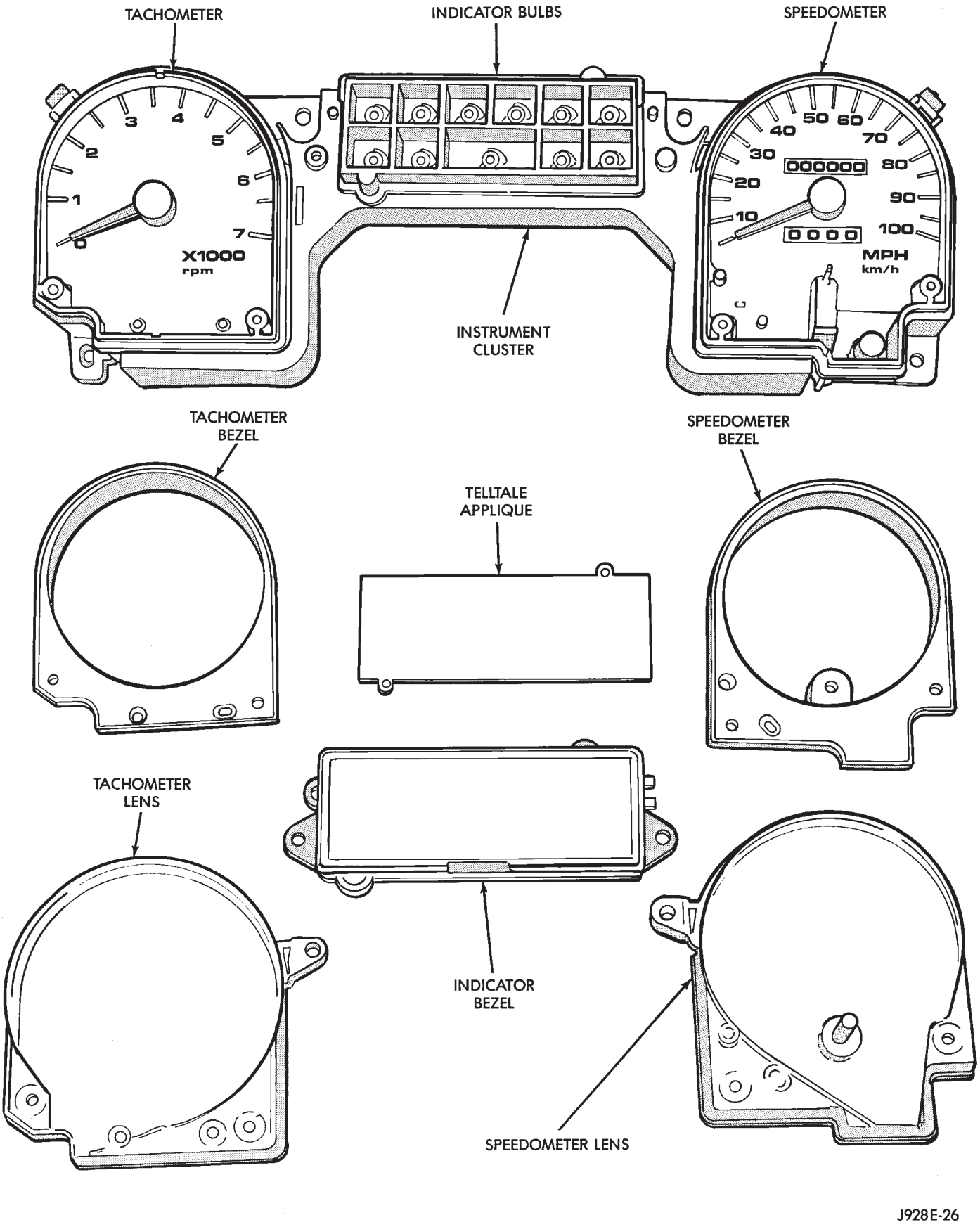

Fig. 3 Instrument Cluster

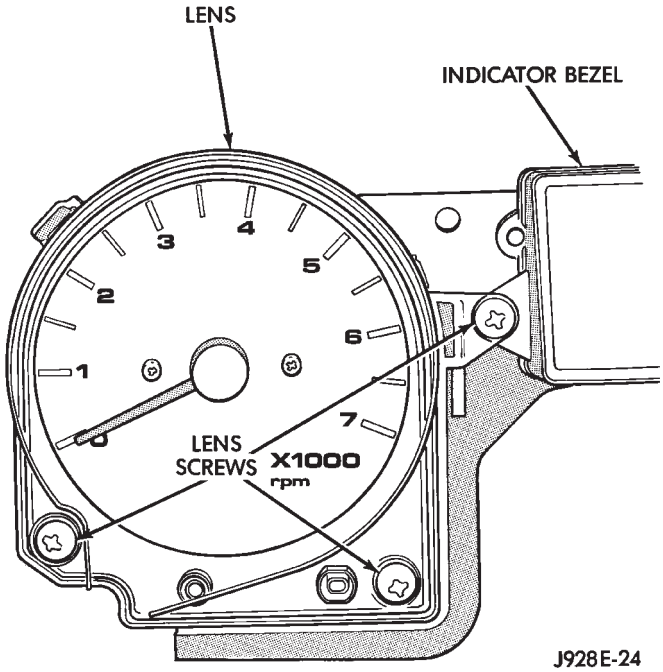

Fig. 4 Tachometer Lens

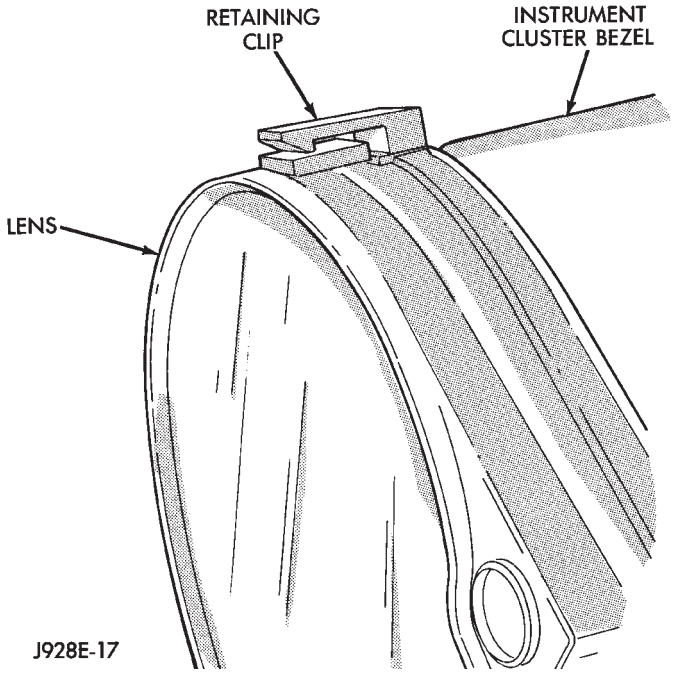

Fig. 5 Cluster Lens Retaining Clip

(4) Gently pry up clip to release lens from bezel (Fig. 5).

(5) Remove 3 screws and speedometer lens (Fig. 7).

(6) Gently pry up clip to release lens from bezel (Fig. 5).

(7) Remove indicator bezel (Fig. 3).

(8) Lift indicator panel off locating pins.

(9) Reverse removal procedures to install new panel and bezel.

(10) Install speedometer and tachometer lenses.

(11) Install shroud.

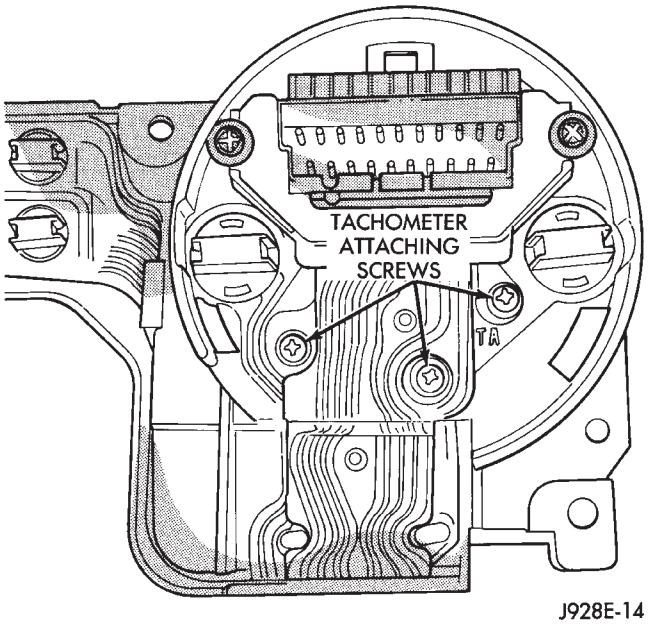

Fig. 6 Tachometer Removal/Installation

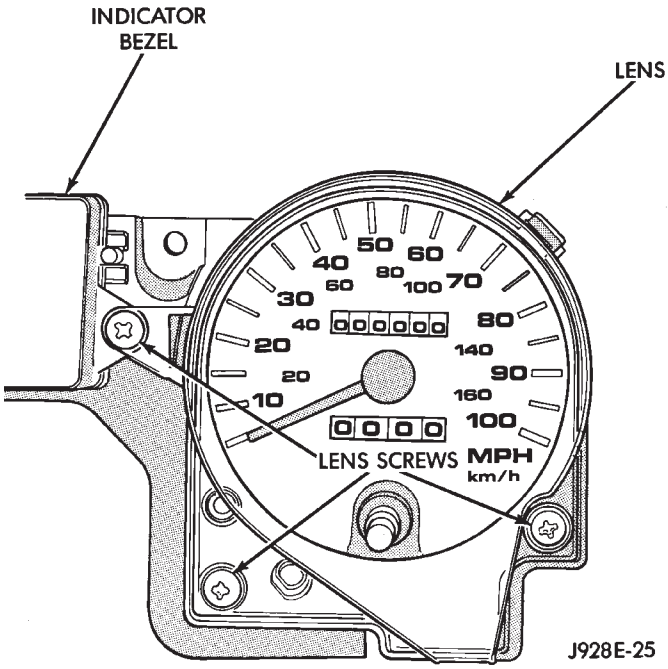

Fig. 7 Speedometer Lens

(12) Install negative cable to battery.

INSTRUMENT CLUSTER BULB REPLACEMENT

Refer to Printed Circuit Replacement for bulb replacement.

PRINTED CIRCUIT REPLACEMENT

Remove cluster as described in cluster replacement.

DISASSEMBLY

(1) Remove all attaching screws for speedometer and tachometer (Fig. 9).

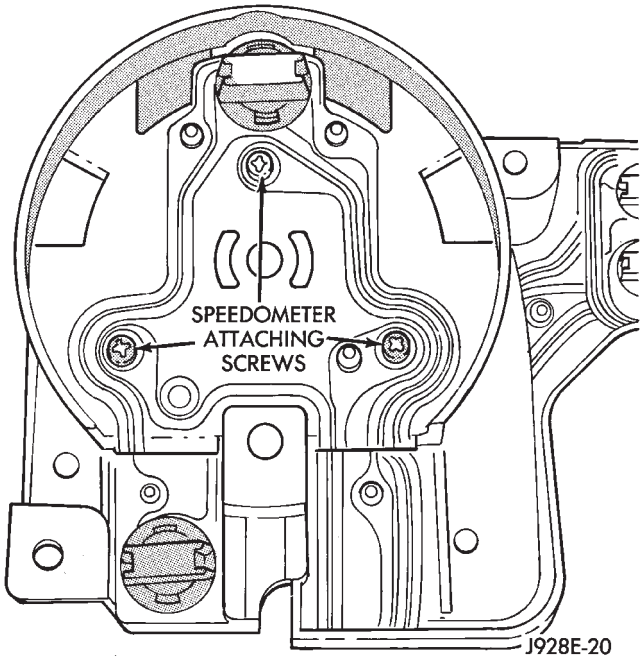

Fig. 8 Speedometer Removal/Installation

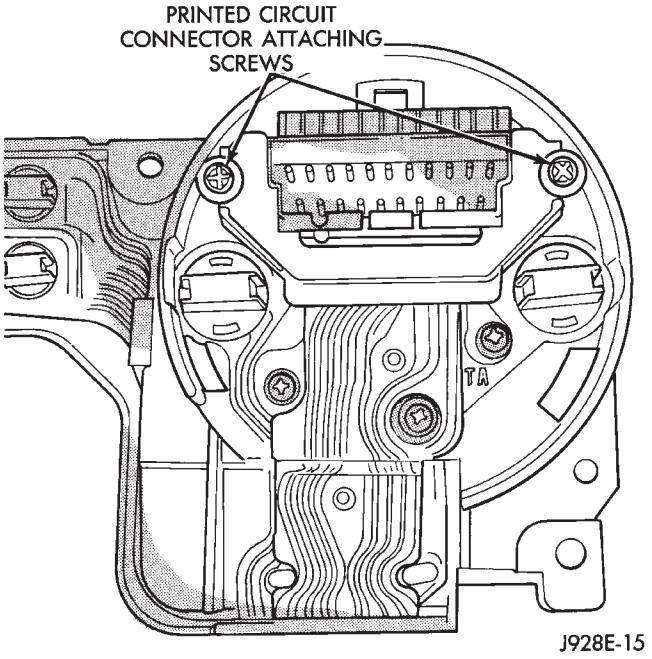

Fig. 10 Printed Circuit Connector Attaching Screws

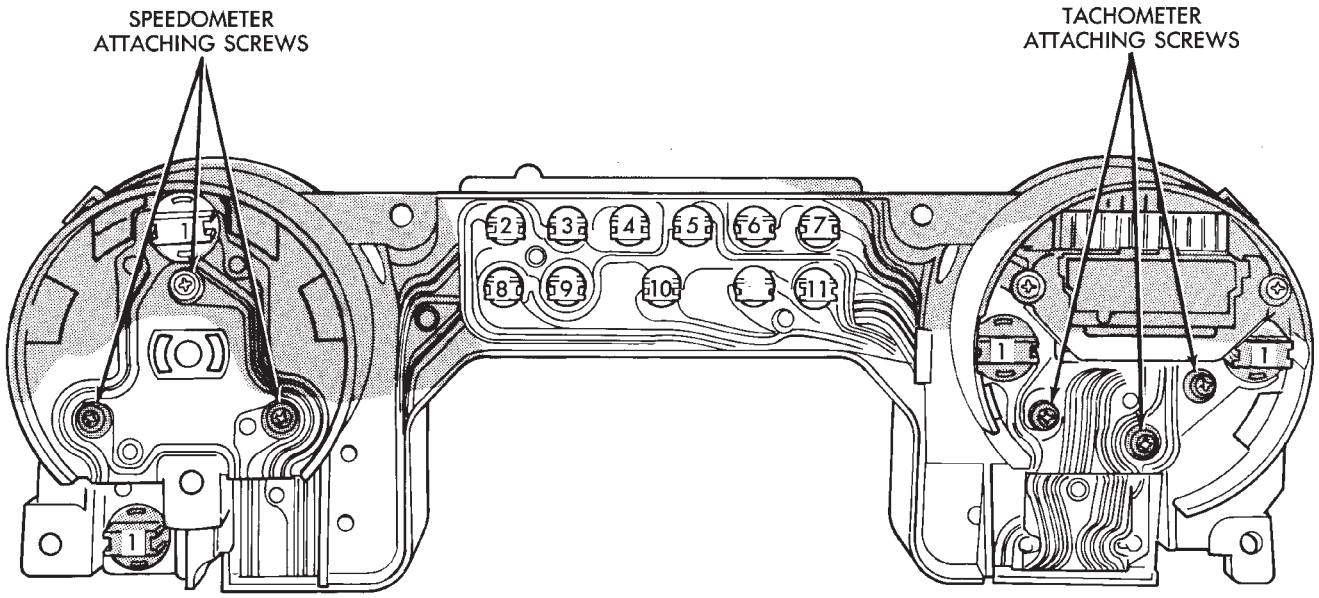

Fig. 9 Printed Circuit Removal/Installation

(2) Remove 2 screws holding cluster connector retaining plate to housing (Fig. 10).

(3) To remove plate, slide it toward bottom of housing (Fig. 11).

(4) Remove lamp sockets from circuit board.

(5) Remove printed circuit including connector.

ASSEMBLY

(1) Position printed circuit, including connector, on the back of instrument panel cluster.

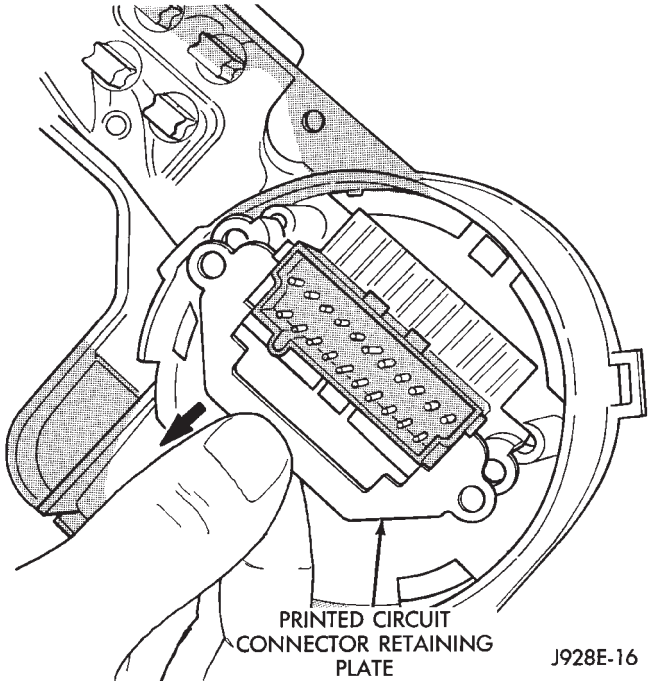

Fig. 11 Cluster Connector Retaining Strap

(2) Remove gauge bezel and lens.
(3) Hold components in place and install screws.
(4) Install lamp sockets.
(5) Pivot connector up and install retaining plate.
(6) Install gauge bezel and cluster lens.

HEADLAMP SWITCH/ILLUMINATION RHEOSTAT

(1) Disconnect negative cable from battery.
(2) Remove instrument cluster shroud (Fig. 1).
(3) Remove 3 screws holding switch bezel (Fig. 12).
(4) Remove 2 screws from the appropriate switch to be replaced (Fig. 13).
(5) Remove the switch connector.
(6) Reverse the removal procedures for installation.

REAR DEFOGGER/FOG LAMP/REAR WIPER SWITCHES

(1) Disconnect negative cable from battery.
(2) Remove instrument cluster shroud (Fig. 1).
(3) Remove 3 screws holding switch bezel (Fig. 14).
(4) Remove the switch connector.
(5) Release tabs holding switch and remove switch.
(6) Reverse the removal procedures for installation.

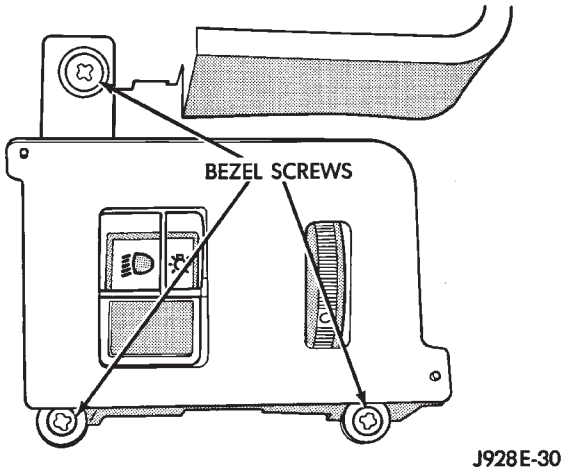

Fig. 12 Left Hand Instrument Panel Switch Bezel.

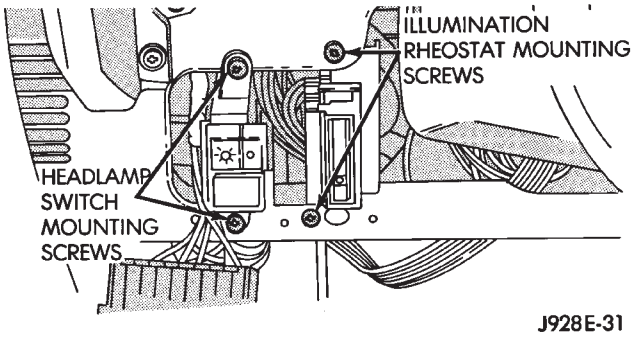

Fig. 13 Headlamp Switch/Illumination Rheostat

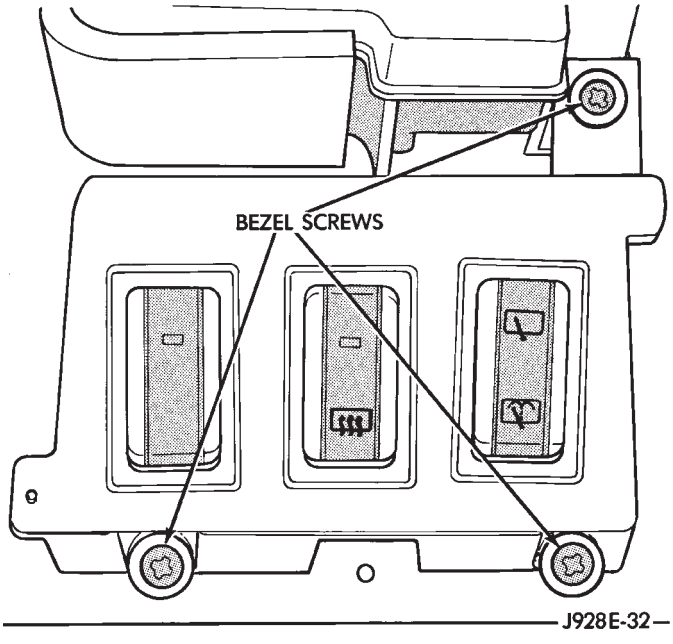

Fig. 14 Right Hand Instrument Panel Switch Bezel

GAUGE PACKAGE GENERAL INFORMATION

The gauge package contains 4 gauges and the 4 wheel drive indicator. The gauges have a common battery feed from fuse #9 and ignition switch. Although they have separate power sources, the 4 gauges share a common ground connection.

The voltmeter indicates electrical system voltage. When the engine is not running, the voltage registered is from the battery. After the engine is started, charging system voltage is indicated. In the gauge package, the voltmeter forms a parallel connection across the battery feed and ground.

The remaining gauges - oil pressure, fuel and coolant temperature - are connected to individual sender units. Variable resistors in the senders will change the amount of current allowed to flow through the gauge coils. As current flow through the coils varies, the position of the indicator needle also will vary.

The 4 gauges are connected to battery feed, ground and the sender units through a printed circuit mounted on the back of the gauge housing.

GAUGE PACKAGE DIAGNOSIS

ALL GAUGES INOPERATIVE (Fig. 15)

(1) Check the fuse #9. Replace as required.

(2) Turn ignition switch to ON and measure voltage at battery side of fuse #9. Meter should read battery voltage. If not, repair open from ignition switch.

(3) Unplug gauge package connector from gauge package.

(4) Turn ignition switch to OFF and measure resistance from instrument cluster connector terminals 1 and 13 to a clean chassis ground. Meter should read zero ohms. If not, repair open to ground.

(5) Turn ignition switch to ON and measure voltage at instrument cluster connector terminals 2 and 12. Meter should read battery voltage. If not, repair open from fuse panel.

ONE GAUGE INOPERATIVE

Does not apply to voltmeter.

OIL PRESSURE SENDER

(1) Turn ignition switch to ON.

(2) Unplug oil pressure sender connector from oil pressure sender.

(3) Touch connector to engine block (ground). Gauge should read at low end of scale.

(4) When connector is NOT touching ground (open circuit) gauge should read at high end of scale. If OK replace sender. If not, proceed with step 5.

(5) Check circuit between sender and gauge for an open. Repair as required. If wiring is OK, replace gauge.

COOLANT TEMPERATURE SENDER

(1) Turn ignition switch to ON.

(2) Unplug coolant temperature sender connector from coolant temperature sender.

(3) Touch connector to engine block (ground). Gauge should read at high end of scale.

(4) When connector is NOT touching ground (open circuit) gauge should read at low end of scale. If OK replace sender. If not, proceed with step 5.

(5) Check circuit between sender and gauge for an open. Repair as required. If wiring is OK, replace gauge.

FUEL GAUGE SENDER

(1) Turn ignition switch to ON.

(2) Separate fuel gauge sender connector from fuel gauge sender near tank.

(3) Ground the center wire of the body harness side of the connector. The gauge should read at low end of scale. If OK, check sending unit (step 4). If not, check circuit between connector and gauge. Repair as required. If circuit is OK, replace gauge.

(4) Turn ignition switch to OFF.

(5) Measure resistance from fuel gauge sender connector center terminal to a clean chassis ground. Meter readings should correspond to those shown in Specifications. If not OK, replace sender. If OK, repair open from fuel gauge sender connector to ground.

PRINTED CIRCUIT

(1) Turn ignition switch to ON.

(2) Unplug gauge package connector from gauge package.

(3) Measure resistance from gauge package terminal 12 (fuel and coolant temperature gauge) or from terminal 2 (voltmeter and oil pressure gauge) to gauge battery terminal. Meter should read zero ohms. If not, replace/repair printed circuit.

(4) Measure resistance from gauge package terminal 13 (fuel and coolant temperature gauge) or from terminal 1 (voltmeter and oil pressure gauge) to gauge ground terminal. Meter should read zero ohms. If not, replace/repair printed circuit. If zero ohms, replace gauge.

GAUGE CALIBRATION VALUES

Use the charts in Specifications. The calibration of the gauge can be checked. If the indicator needle is not in the correct position, replace the gauge.

4WD INDICATOR

The four-wheel drive indicator lamp circuit is completed by the Command-Trac switch located below the battery.

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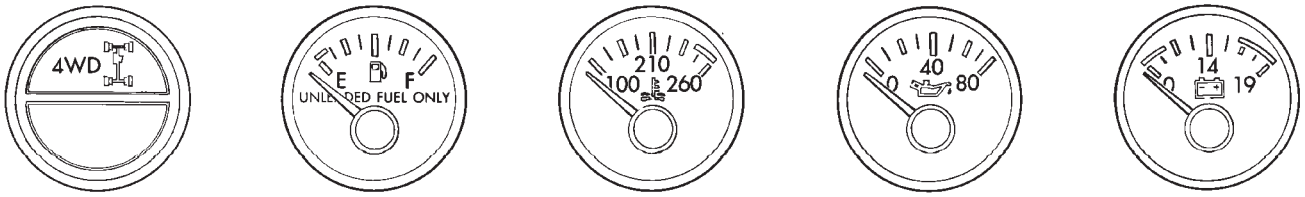

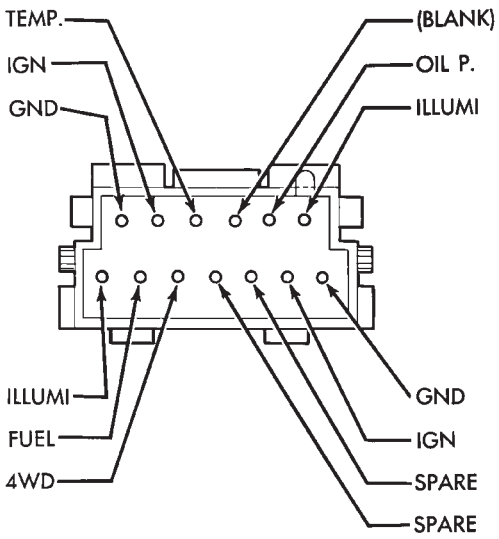

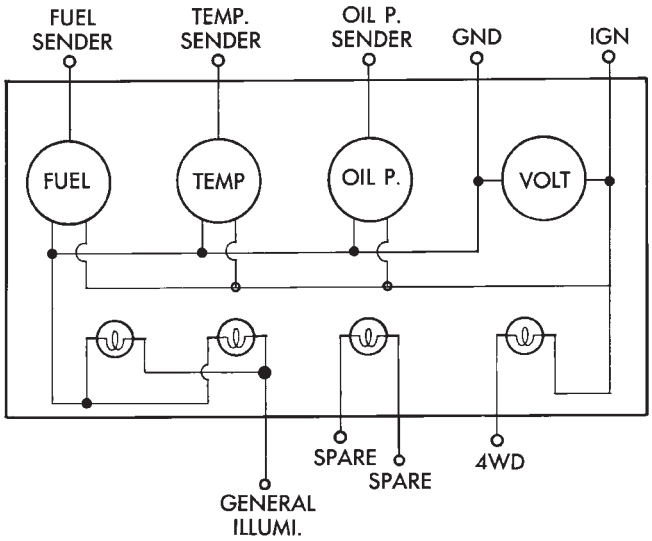

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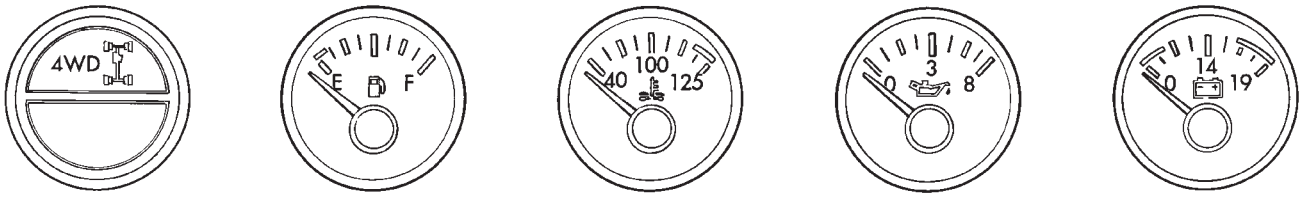

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Fig. 15 Gauge Package Wiring Schematic—YJ

GAUGE PACKAGE SERVICE PROCEDURES

PRINTED CIRCUIT REMOVAL

DISASSEMBLY

(1) Remove all gauge attaching screws (Fig. 16).

(2) Remove screw holding the cluster connector retaining plate to the housing (Fig. 16).

(3) To remove the plate, slide it toward the bottom of the housing (Fig. 17).

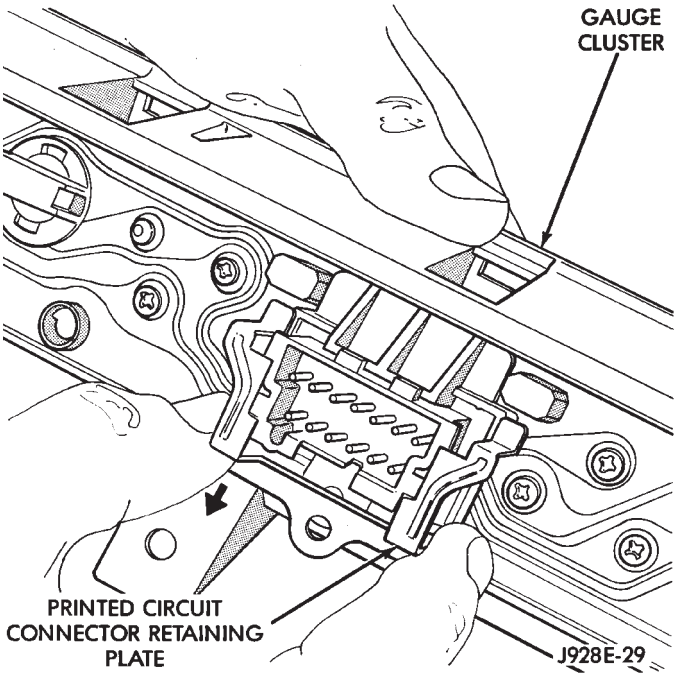

Fig. 17 Cluster Connector Retaining Plate

(4) Remove the lamp sockets from the circuit board.

(5) Remove the printed circuit including the connector.

ASSEMBLY

(1) Position the printed circuit, including connector, on the back of the instrument panel cluster.

(2) Remove gauge bezel and lens.

(3) Hold the components in place and install the screws.

(4) Install the lamp sockets.

(5) Pivot connector up and install retaining plate.

(6) Install gauge bezel and cluster lens.

GAUGE CLUSTER REPLACEMENT

(1) Remove 6 bezel screws (Fig. 18).

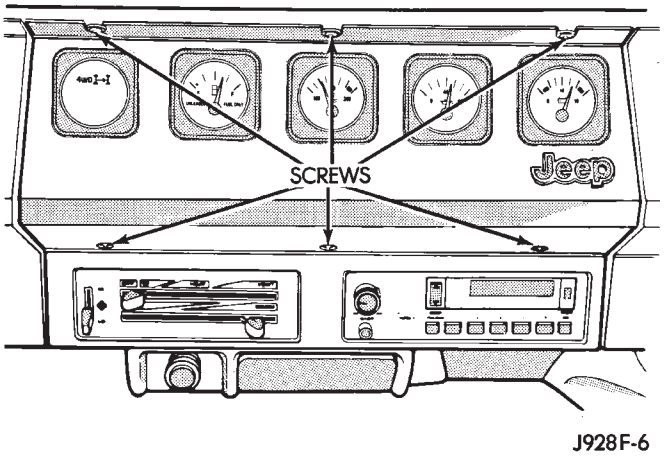

Fig. 18 Gauge Cluster Bezel Removal/Installation

(2) Remove 6 gauge housing mounting screws (Fig. 19).

(3) Unplug the connector from cluster.

(4) To install, reverse the removal procedure.

GAUGE PACKAGE GAUGE REPLACEMENT

This procedure is to be performed with the gauge cluster removed.

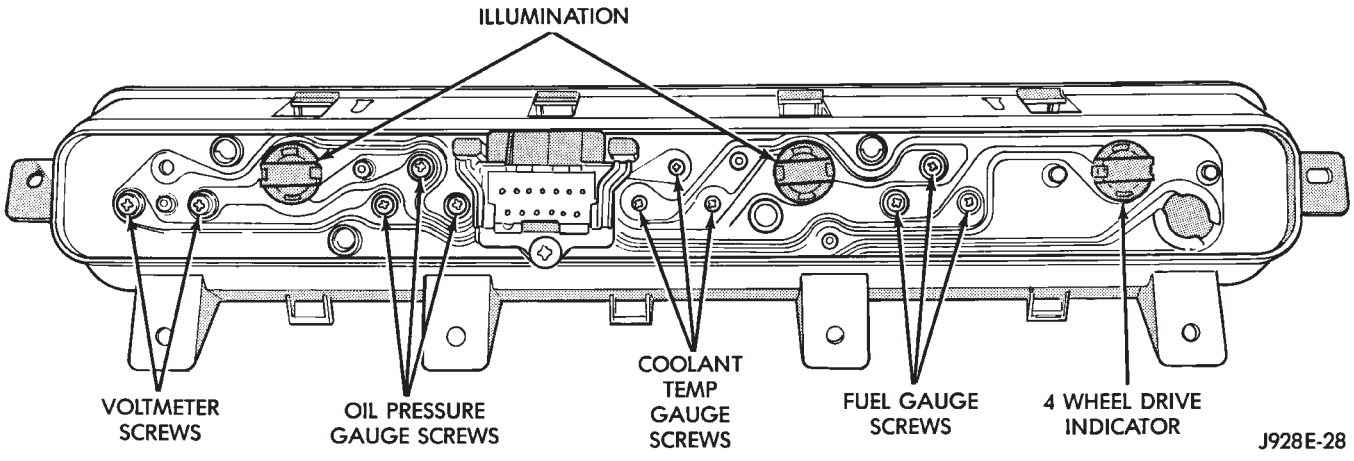

Fig. 16 Gauge Package Printed Circuit Removal/Installation

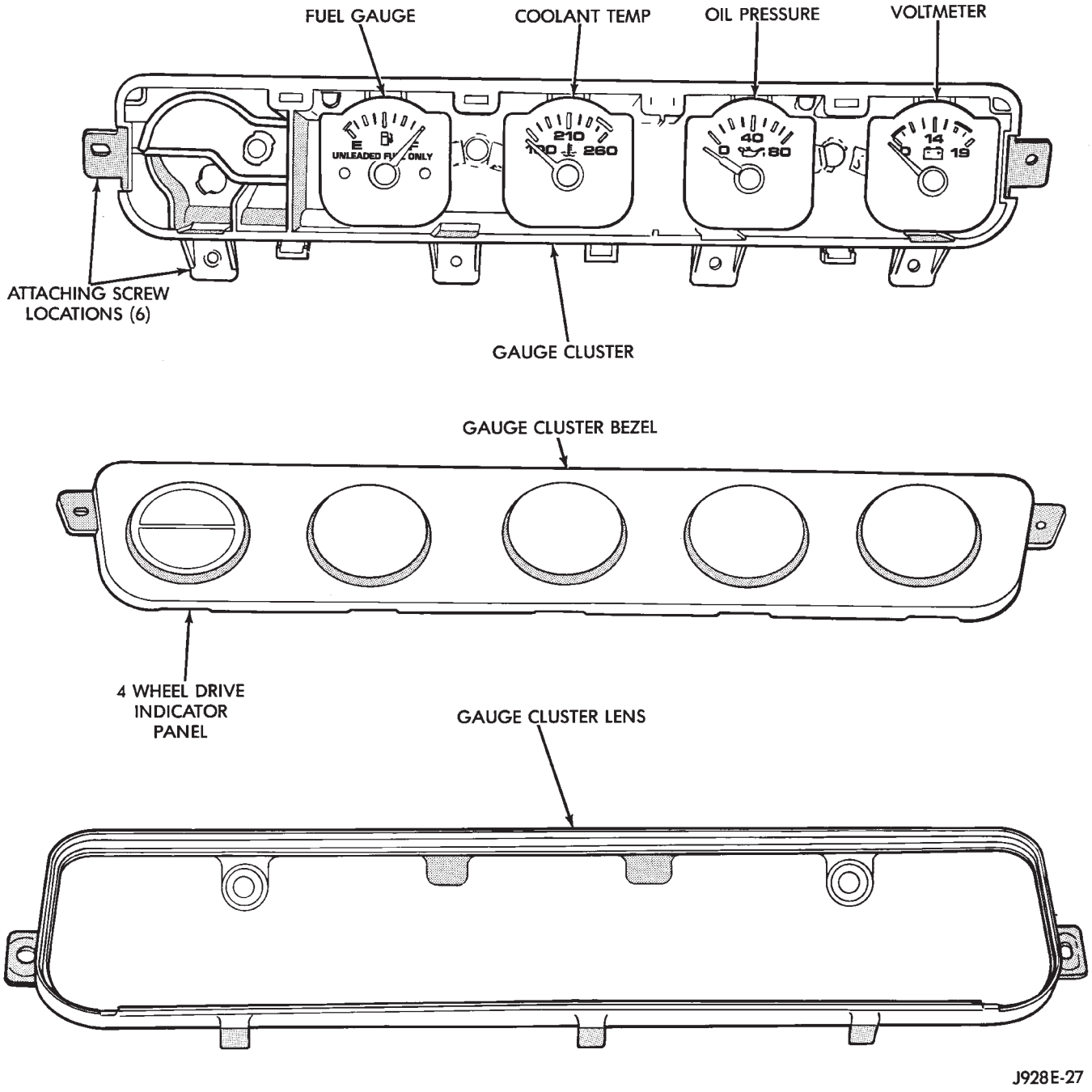

Fig. 19 Gauge Cluster Exploded View

(1) Remove 2 screws from lens.
(2) Remove lens by tilting off of lower hooks (Fig. 20).
(3) Remove bezel.
(4) Remove screws holding appropriate gauge.
(5) To install, insert gauge into housing.
(6) Install screws as required.
(7) Install bezel.
(8) Install lens.

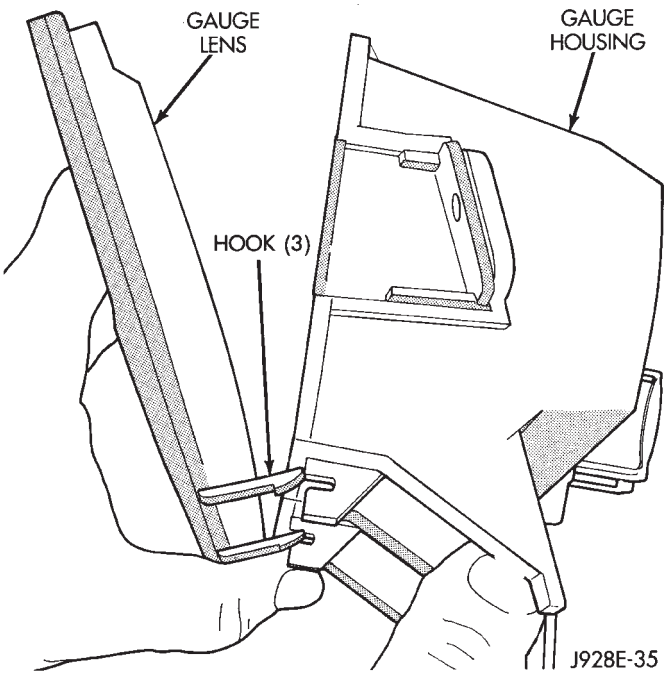

Fig. 20 Gauge Package Lens Removal

SPECIFICATIONS

INSTRUMENT PANEL GAUGES

OIL PRESSURE GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
0 psi Grad. ± 3°	1 ohm
40 psi Grad. ± 3.6°	47 ohms
80 psi Grad. ± 3.6°	89 ohms

FUEL GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
Empty Grad. +0° −5°	1 ohm
1/2 Full Grad. ± 3.6°	44 ohms
Full Grad. − 0° +6°	88 ohms

TEMPERATURE GAUGE CALIBRATION

POINTER POSITION	RESISTANCE
100°F Grad. ± 3.5°	1365 ohms
210°F Grad. ± 2.5°	115 ohms
240°F Grad. ± 2.5°	55.1 ohms

VOLTMETER CALIBRATION

POINTER POSITION	VOLTAGE INPUT
12V Grad. ± 6°	12V ± 0.02V
16V Grad. ± 3°	16V ± 0.02V

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INSTRUMENT CLUSTER GAUGES

SPEEDOMETER CALIBRATION

ENGINE	FREQUENCY	INDICATION
4 & 6 CYLINDER	44.4 HZ	20 mph +0 −1.5
	122.2 HZ	55 mph +3.3 −0.3
	166.7 HZ	75 mph +3.3 −0.3
	55.2 HZ	40 km/h +6 −0
	110.4 HZ	80 km/h +8 −0
	165.6 HZ	120 km/h +10 −0

TACHOMETER CALIBRATION

ENGINE	FREQUENCY	INDICATION
4 & 6 CYLINDER	33.3 HZ	1000 RPM ±150
	100 HZ	3000 RPM ±250
	200 HZ	6000 RPM ±250

J928E-8

AUDIO SYSTEMS

CONTENTS

GENERAL INFORMATION

DESCRIPTION

Each radio receives ignition feed from an ignition switch controlled fuse. There is an additional in-line fuse in the back of the radio chassis. The in-line fuse will blow in the event an internal short occurs.

The electronically tuned radio (ETR)/cassette models protect the vehicle from a radio failure with an in-line fuse located in the rear of the radio chassis (Fig. 1).

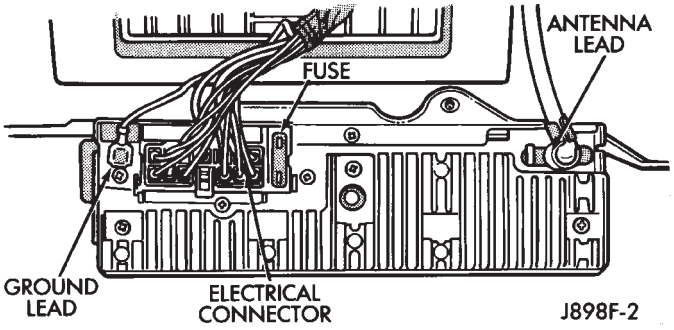


Fig. 1 In-Line Fuse Location

XJ/YJ vehicles are equipped with an Ignition-Off Draw (IOD) fuse that is removed when the vehicles are shipped from the factory. This fuse is in the Power Distribution Center to prevent battery discharge during storage. For specific location refer to Group 8W - Wiring Diagrams.

The IOD fuse is in the radio memory circuitry and should be checked if the memory (time or radio station programming) is inoperative.

All radios are connected to the radio illumination relay. When the ignition switch is in ON or ACCESSORY and the radio illumination relay remains deenergized, the radio receives battery voltage via the relay from the:

- (20 amp #7 fuse YJ)
- (15 amp #2 fuse XJ).

The radio illumination relay is energized when the headlamp switch is used to turn on the parklamps or headlamps. Battery voltage is switched to the dim display input of the radio through the relay contacts. The radio panel illumination is dimmed for night driving.

The ETR models require an additional battery feed connection to the (10 amp #F16 fuse-YJ), (10 amp #9 fuse-XJ) to retain the radio's memory when the ignition switch is turned OFF.

ETR models are self-compensating. A radio trimmer adjustment is not required.

DIAGNOSIS

RADIO INOPERATIVE

Turn ignition switch to ON

- Inspect the (#7-YJ), (#2-XJ) fuse and replace if necessary.
- Measure voltage at battery side of the fuse. There should be 12 volts. If not, repair open from ignition switch.
- Inspect in-line fuse at rear of radio and replace if necessary.

Turn ignition switch to OFF.

- Disconnect radio connector. Measure resistance from radio ground pin to a clean chassis ground. There should be zero ohms. If not, repair open between radio connector and ground.

NO AUDIO OUTPUT ON ONE OR MORE SPEAKERS

Refer to Radio Connector Pins.

FRONT SPEAKERS

- Radio OFF, radio connector disconnected. Measure resistance between radio left front feed and return connector pins. Measure between right front feed and return connector pins. The meter should read 5 to 8 ohms. If the meter reading is correct, remove radio for service. If not, repair wiring or replace speakers as required.

REAR SPEAKERS

• Radio OFF, radio connector disconnected. Measure resistance between radio left rear feed and return connector pins. Measure between right rear feed and return connector pins. The meter should read 5 to 8 ohms. If meter reading is correct remove radio for service. If not, repair wiring or replace speakers as required.

DISTORTED AUDIO OUTPUT ON ONE OR MORE SPEAKERS

• With the radio ON, substitute known good speaker or speakers. If the sound is still distorted, remove radio for service.

WEAK OR NO RECEPTION; NO AUDIO OUTPUT; BACKGROUND NOISE PRESENT

Ignition switch in ON, radio ON.

• Inspect antenna cable and connector at radio and tighten or repair as necessary.

• Unplug coax cable and connectors from radio. Measure resistance from center conductor to coaxial shield. The meter should read infinite resistance (open). If it does not, replace antenna assembly.

• Measure resistance of antenna mast to tip of center conductor at radio end of cable. The meter should read 0 to 0.5 ohms. If it does not, replace lead-in cable or antenna assembly.

• Measure resistance from coaxial shield to chassis ground (vehicle body). The meter should read zero ohms. If it does not, ground antenna base to vehicle body, or replace antenna assembly as required

For all problems with no or low audio output not resolved by these tests, remove radio for service.

MEMORY DOES NOT OPERATE

• Inspect (F16 in Power Distribution Center-YJ), (#9 in Fuse Panel-XJ) fuse and replace if necessary.

• Measure voltage at battery side of previously referenced fuse. There should be 12 volts at battery side of fuse. If not, check the Maxi fuse.

Refer to Group 8W - Wiring Diagrams.

• Measure voltage at radio connector pin 4. There should be 12 volts. If meter reading is correct, remove radio for service. If not, repair open from fuse.

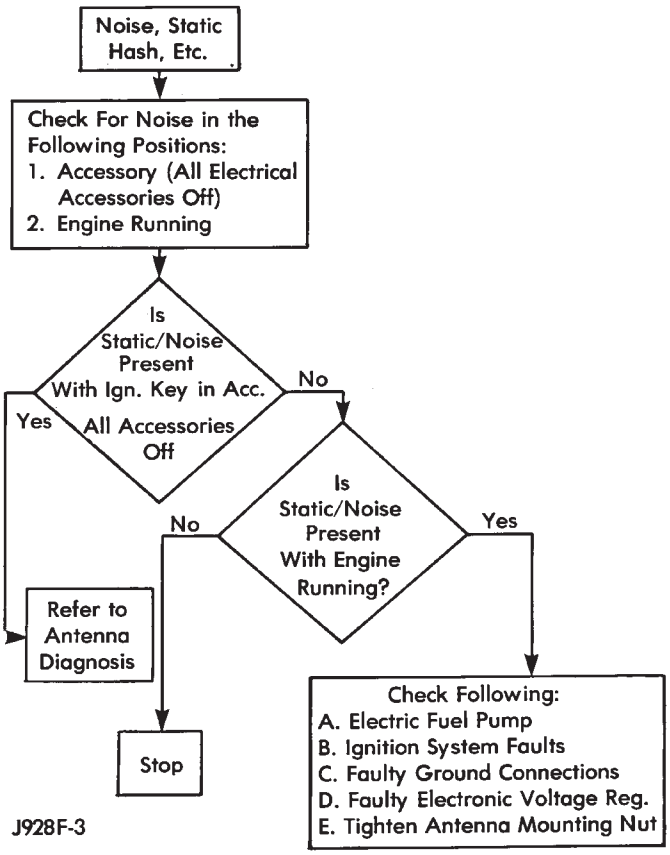
RADIO DISPLAY ILLUMINATION (PARKLAMPS AND HEADLAMPS OPERATING NORMALLY)

Headlamp switch OFF, radio ON.

• Measure voltage at radio connector pin 10. There should be 12 volts. If not, go to next step. If OK, remove radio for repair by authorized outlet.

• Measure voltage at illumination relay pin 3. There should be 12 volts. If 12 volts present, replace illumination relay. If not, repair open in circuit.

RADIO NOISE DIAGNOSIS



RADIO DISPLAY ILLUMINATION DIMMING CIRCUIT

Turn headlamp switch to PARKLAMPS for voltage tests; turn headlamp switch to OFF for resistance tests.

• Separate relay connector from radio illumination relay. Measure resistance from relay connector pin 2 to a clean chassis ground. The meter should read zero ohms. If not, repair open between relay connector and ground.

• Measure voltage at radio illumination relay pin 5. There should be battery voltage. If not repair open from headlamp switch.

• Measure voltage at radio illumination relay pin 4. Voltage should vary with dimmer switch. If OK, go to next step. If not, repair open circuit between pin 4 and interior lamp rheostat.

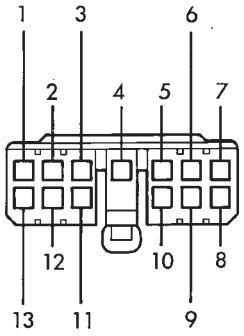
• Measure voltage at radio illumination relay pin 10. Voltage should vary with dimmer switch. If OK, remove radio for repair by authorized outlet. If not, replace radio illumination relay.

NOISE INTERFERENCE CHANGES WITH ENGINE SPEED

• Inspect connections at: generator, ignition module, antenna coaxial ground, radio ground, body to engine block ground (braided ground strap). Repair as required.

• Inspect secondary ignition system components: wire routing and condition, distributor cap and rotor, ignition coil, spark plugs. Reroute or replace as required.

RADIO CONNECTOR PINS



1 — RIGHT REAR FEED
2 — RIGHT FRONT FEED
3 — ACC./IGN
4 — BATTERY
5 — BLANK
6 — LEFT REAR FEED
7 — LEFT FRONT FEED
8 — LEFT REAR RETURN
9 — LEFT FRONT RETURN
10 — DISPLAY DIMMING
11 — PANEL DIMMING
12 — RIGHT FRONT RETURN
13 — RIGHT REAR RETURN

NOTE: FOR WIRE COLORS REFER TO GROUP 8W—WIRING DIAGRAMS

J938F-11

RADIO ILLUMINATION RELAY

XJ

The radio illumination relay is in the relay center. The relay center is located on the lower instrument panel trim cover, right of the steering column (Fig. 2).

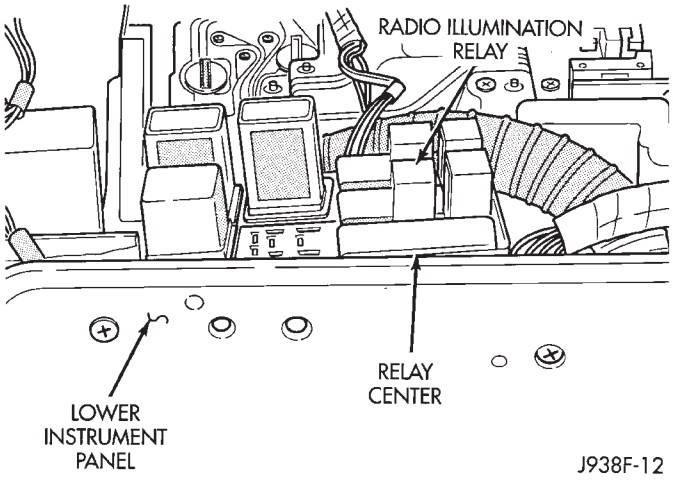


Fig. 2 Radio Illumination Relay

YJ

The radio illumination relay is taped to the harness above the radio.

XJ SERVICE PROCEDURES

RADIO REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove instrument panel bezel attaching screws (Fig. 1) and remove the bezel.

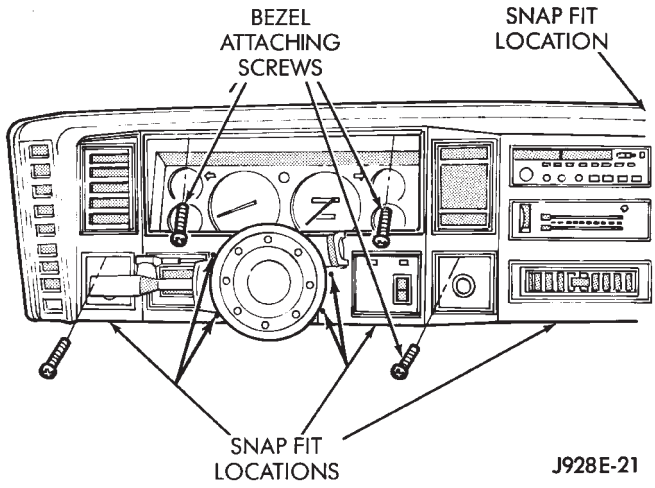


Fig. 1 Instrument Bezel Removal/Installation

(3) Remove radio attaching screws (Fig. 2).

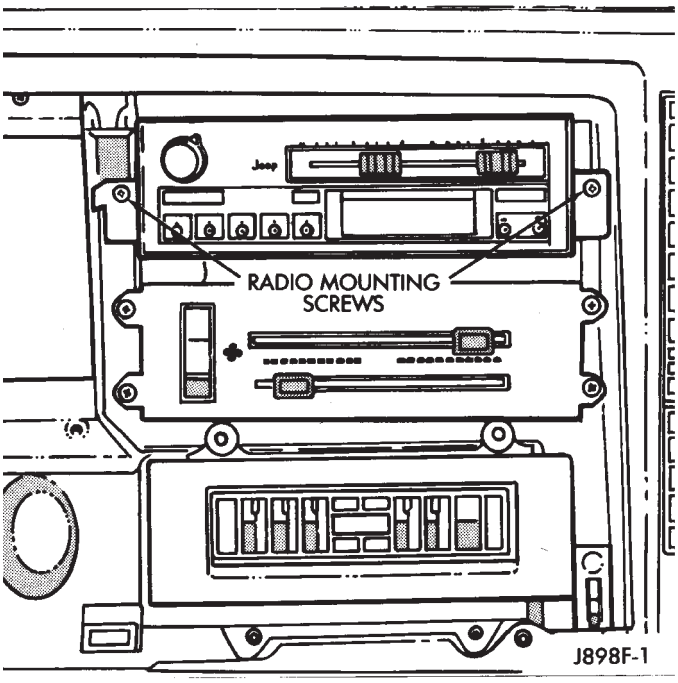


Fig. 2 Remove/Install Radio Mounting Screws

(4) Disconnect radio electrical connector, ground lead and antenna lead (Fig. 3).

(5) To install radio, route harness above and to the right of the radio cavity. Install the radio making sure that clip on top of radio (Fig. 4) is installed in mating slot of dash.

(6) Reverse removal procedures to finish installing the radio.

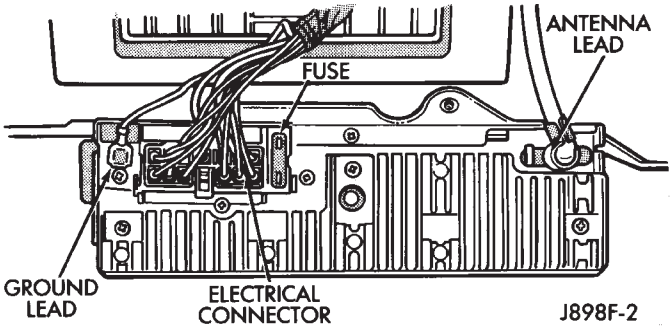


Fig. 3 Disconnect/Connect Radio Wiring Harnesses

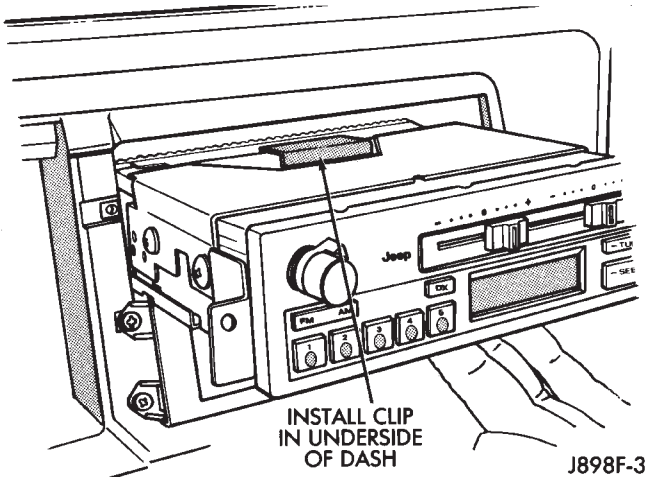


Fig. 4 Install Clip In Underside of Dash

RADIO SPEAKERS

INSTRUMENT PANEL MOUNTED SPEAKERS

(1) Remove park brake retaining screw from lower instrument panel (Fig. 5).

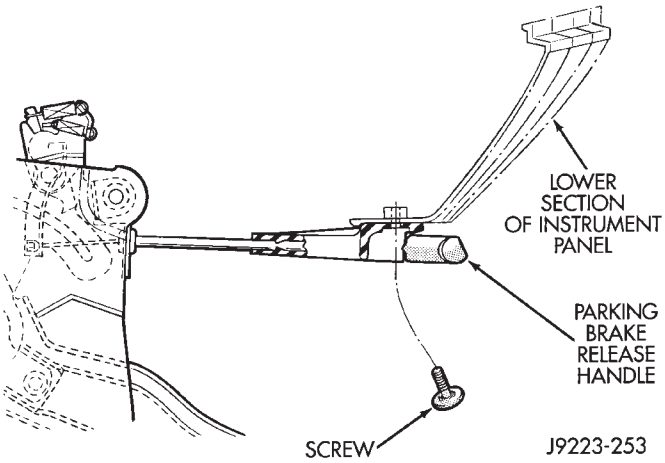


Fig. 5 Park Brake Release Handle

(2) Remove retaining screws and the lower instrument panel (Fig. 6).

(3) Unplug wire harness connector.

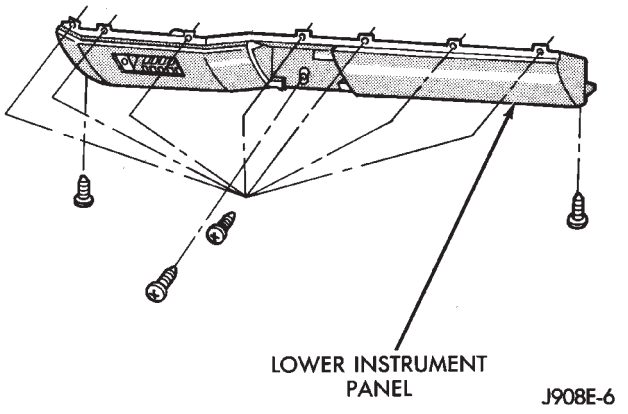


Fig. 6 Lower Instrument Panel Removal/Installation

(4) Remove speaker screws and speaker from lower instrument panel (Fig. 7).

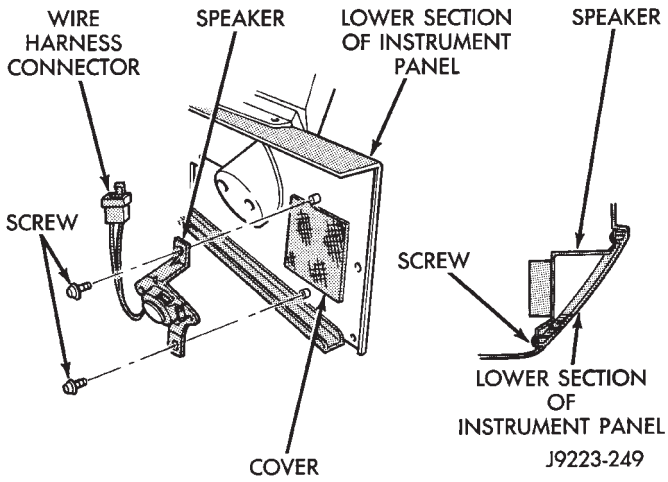


Fig. 7 Tweeter Speaker Removal/Installation

(5) To install speaker, reverse the removal procedures.

FRONT DOOR-MOUNTED RADIO SPEAKERS

(1) Remove interior door latch release assembly and control panel retaining screws (Fig. 8).

(2) Disconnect control linkage and wire harness connector.

(3) Remove latch release and control panel assembly.

(4) Remove armrest lower retaining screws.

(5) Swing armrest downward to a vertical position. This is necessary to disconnect armrest from upper retainer clip (Fig. 9).

(6) Pull armrest straight out from trim panel.

(7) Remove trim panel with a wide flat blade tool (Fig. 10).

To aid in removal of trim panel, start at the bottom of the panel.

(8) Remove speaker attaching screws and disconnect speaker at wire harness.

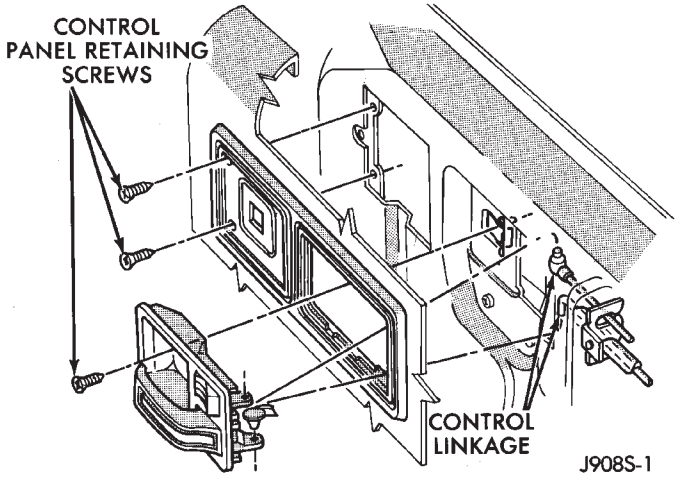


Fig. 8 Power Window Control Panel Removal/ Installation

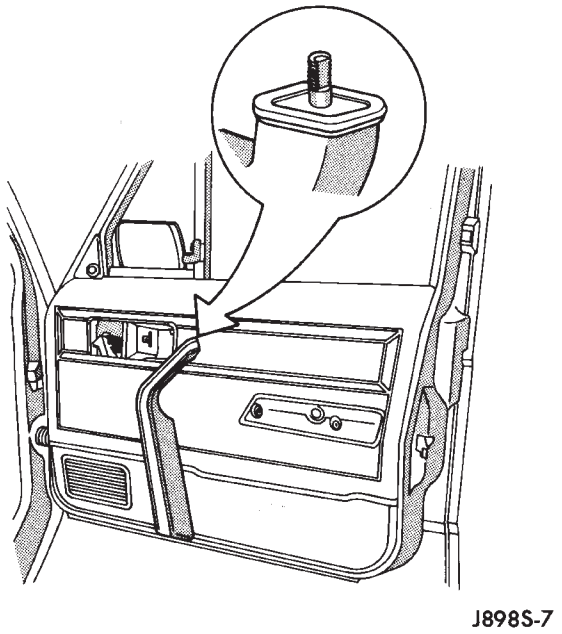


Fig. 9 Armrest Retainer Clip

(9) To install a speaker, connect the speaker wire harness and reverse the removal procedure.

REAR LIFTGATE-MOUNTED RADIO SPEAKER

REMOVAL

(1) Remove 2 screws at top outside edges of liftgate trim panel.

(2) Remove trim panel with a wide flat blade tool (Fig. 11).

To aid in removal of trim panel, start at the bottom of the panel.

(3) Remove speaker attaching screws (Fig. 12).

(4) Disconnect speaker at wiring harness and remove speaker.

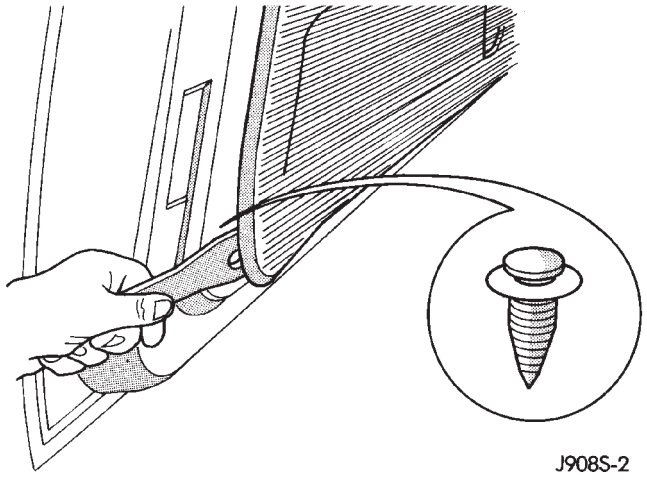


Fig. 10 Trim Panel Removal

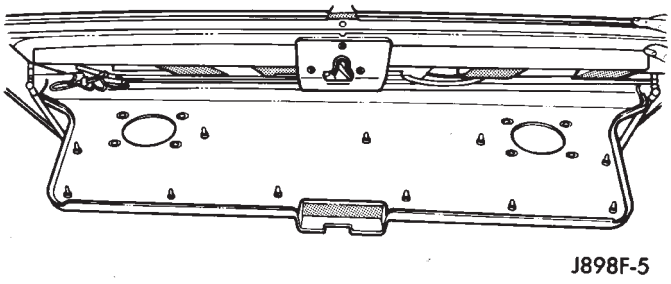


Fig. 11 Liftgate Trim Panel Removal

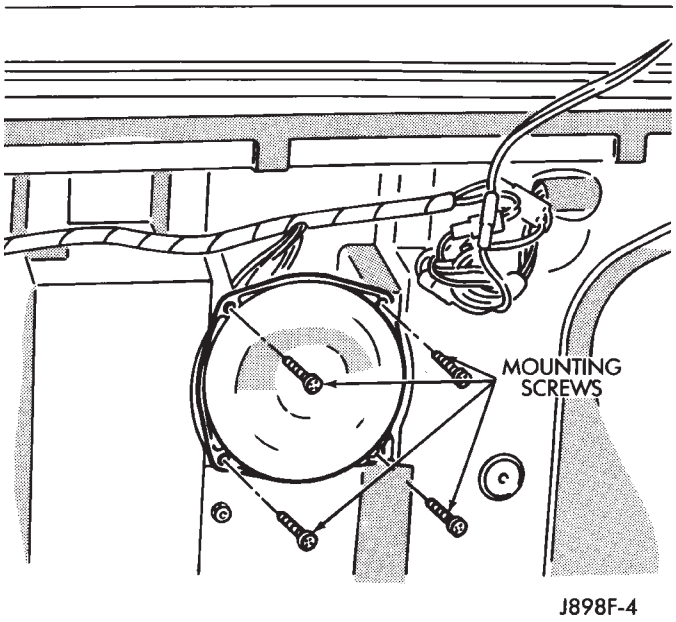


Fig. 12 Liftgate Speaker

INSTALLATION

(1) Connect speaker at wiring harness.
(2) Install speaker.
(3) Install trim panel by pushing in the plastic trees.
(4) Install door panel screws.

YJ SERVICE PROCEDURES

RADIO REPLACEMENT

(1) Disconnect negative cable from battery.
(2) Remove gauge cluster panel bezel attaching screws (Fig. 1).

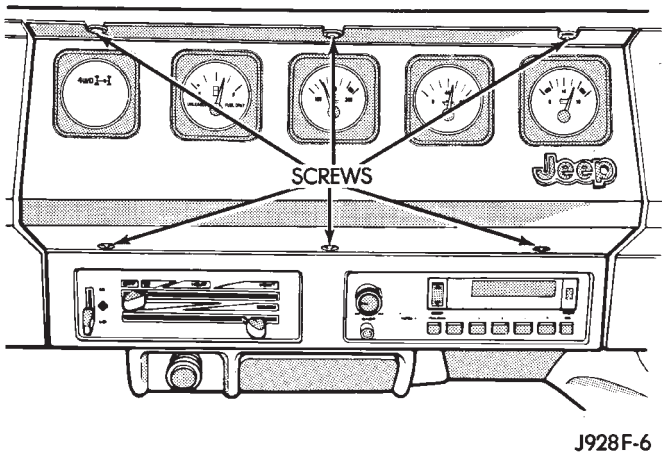


Fig. 1 Gauge Cluster Bezel Removal/Installation

(3) Remove radio bezel.
(4) Remove radio attaching screws.
(5) Disconnect radio antenna cable.
(6) Disconnect radio wire harness.
(7) Remove radio.
(8) To install radio, reverse the removal procedures.

RADIO SPEAKERS

PASSENGER SIDE

The speaker is located behind grille panel at right end of the instrument panel.

(1) Reach up behind instrument panel and remove 4 stamped nuts holding the speaker in place.
(2) Disconnect speaker electrical connector and remove speaker.

DRIVERS SIDE

The speaker is located behind grille panel at left end of the dash panel.

(1) Remove nuts that attach the parking brake pedal assembly mounting studs to the dash panel. The nuts are accessible from the engine compartment (Fig. 2).

CAUTION: If vehicle is equipped with a rear window wiper, there is a ground wire attached to top of bolt that attaches the pedal assembly to the instrument panel.

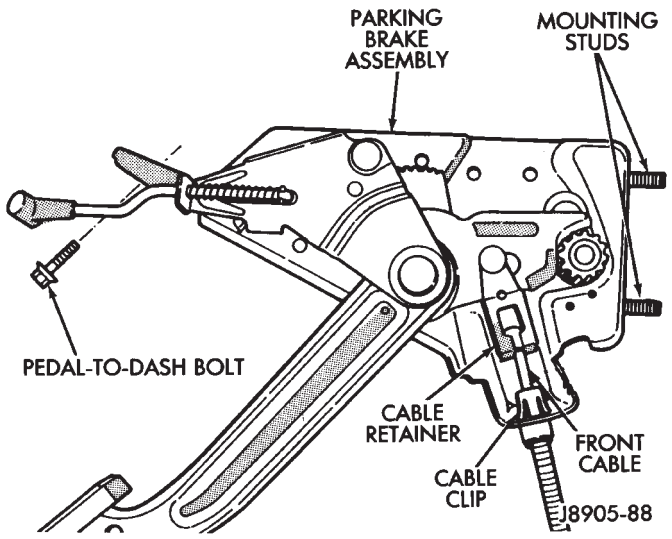


Fig. 2 Parking Brake Assembly

(2) Remove bolt that attaches the pedal assembly to the instrument panel and allow pedal assembly to fall out of the way.

(3) Reach up behind instrument panel and remove 4 stamped nuts holding speaker in place.

(4) Disconnect speaker electrical connector and remove speaker.

SOUND BAR—SPEAKER REMOVAL

(1) Pull sound bar padding away from bar on the passenger side (Fig. 3).

(2) Disconnect speaker harness connector located on the passenger side at the sound bar.

(3) Remove screws holding speaker grille and speaker to bar.

(4) Disconnect wires from speaker and remove speaker.

(5) To install speaker, reverse the removal procedures.

SOUND BAR REPLACEMENT

(1) Disconnect speaker harness connector located on the passenger side at the sound bar (Fig. 3)

(2) Remove bolts attaching the sound bar side flanges to the right and left side bars.

(3) Open zipper on sport bar cover.

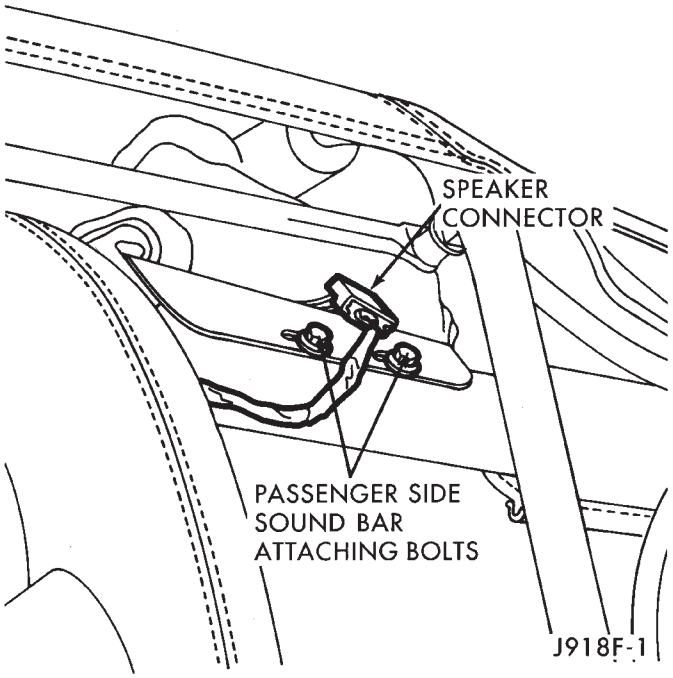


Fig. 3 Sound Bar Speaker Connector

(4) Remove bolts attaching the sound bar brackets to the sport bar (located on the rear of the sport bar) (Fig. 4). Slip brackets through the sport bar cover.

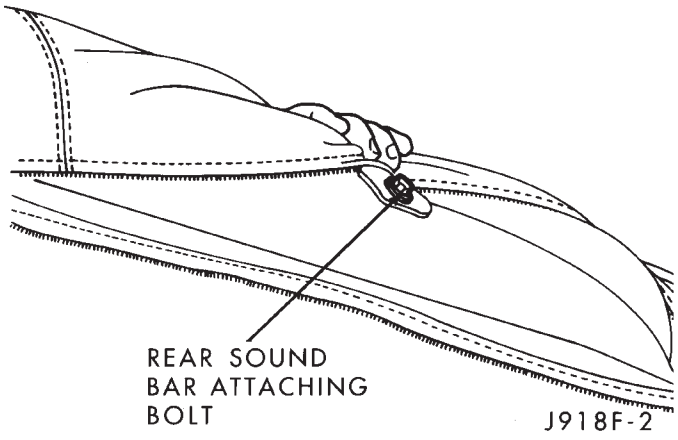


Fig. 4 Rear Sound Bar Attaching Bolt

(5) To install the sound bar, reverse the removal procedures.

RADIO ANTENNA

INDEX

GENERAL INFORMATION

AM/FM radio model antennas must have a good ground to eliminate static. The antenna mast is connected to the inner wire of the coaxial cable and is not grounded to any part of the vehicle. The coaxial shield (the wire mesh) surrounding the center conductor wire of the antenna lead-in cable is grounded to the radio and the antenna base.

REPLACEMENT

XJ

(1) Remove the fender inner splash panel mounting nuts (Fig. 1) and move the panel aside to gain access to the antenna base and cable.

The splash panel screws may be covered with undercoating.

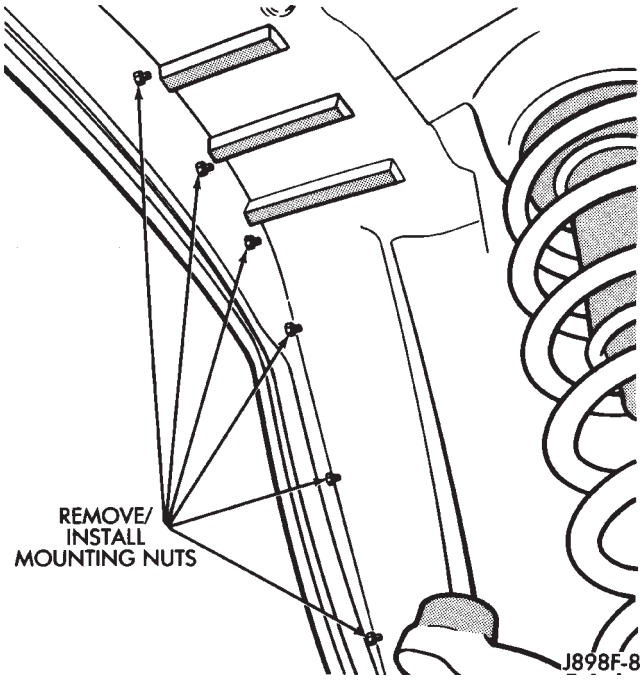


Fig. 1 Remove/Install Fender Inner Splash Panel

(2) Remove the antenna mast, nut and antenna pad from the top of the fender (Fig. 2).

(3) Remove the passenger side kick panel.

(4) Disconnect the antenna lead (Fig. 3) by pulling apart while twisting the metal connectors. DO NOT PULL ON THE COAXIAL CABLE.

(5) Pull the rubber grommet out of the kick panel.

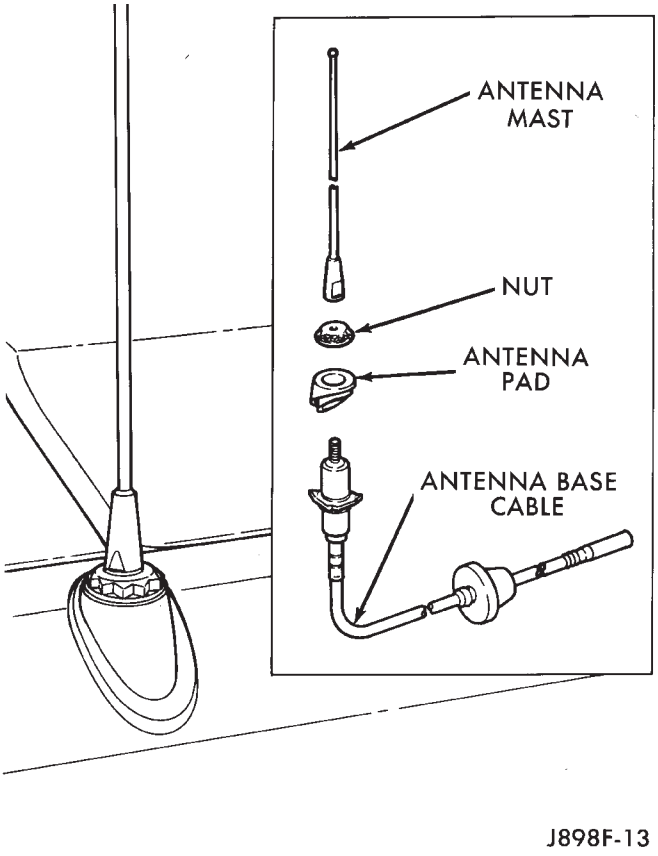


Fig. 2 Remove/Install Nut and Antenna Pad

(6) Remove the antenna assembly from inside the wheel well.

(7) To install the antenna, reverse the removal procedure.

(8) Verify antenna and radio operation.

(9) Apply 3M Rubberized Undercoating, or equivalent to the splash panel screws.

YJ

(1) Remove the radio as described in Radio Replacement.

(2) Remove three screws holding the antenna base and pad to the body (Fig. 4).

(3) Pull the antenna and cable out of the vehicle.

(4) To install the antenna, make sure the antenna pad is placed over the cable and guide the cable under the instrument panel.

(5) Secure the antenna base and pad with three screws.

(6) Install the antenna into the radio and install the radio.

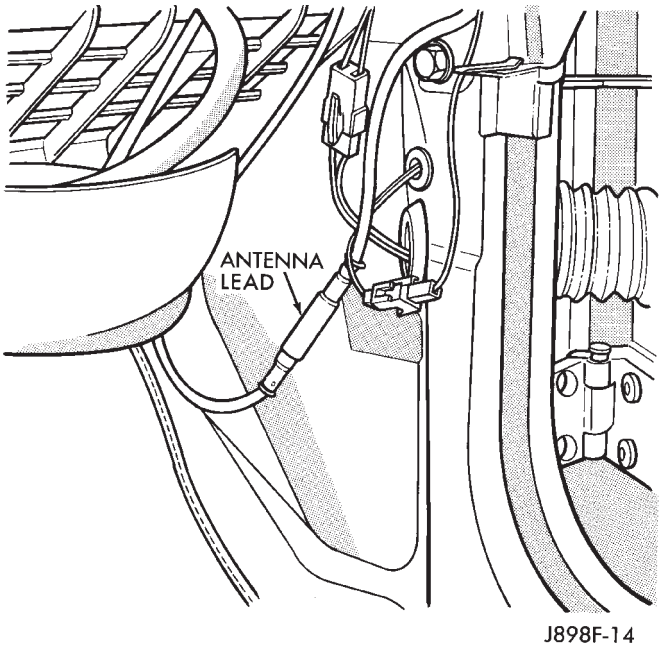


Fig. 3 Disconnect Antenna Lead

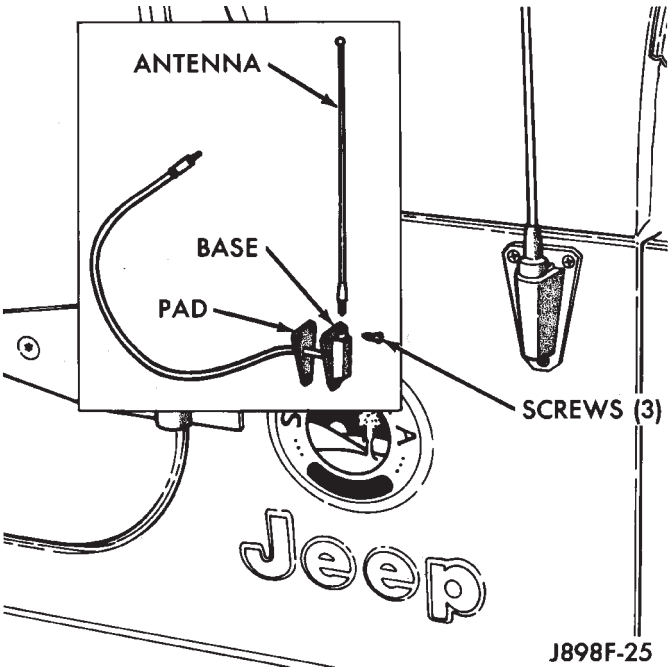


Fig. 4 Antenna Removal/Install - YJ

ANTENNA TESTS

Antenna ground continuity is checked with an ohmmeter. The following four tests are required (Fig. 5):

- Mast-to-ground test 1.
- Tip of mast-to-tip of conductor test 2.
- Body ground-to-battery ground test 3.
- Body ground-to-coaxial shield test 4.

Ohmmeter test lead connections are shown in the following schematic.

MAST-TO-GROUND TEST 1.

Test 1 determines if the antenna mast is insulated from the base. Procedure is as follows:

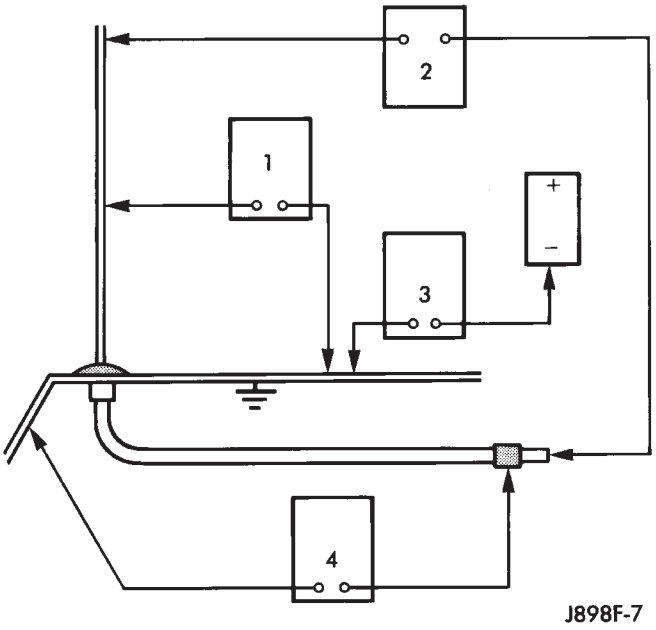


Fig. 5 Antenna Tests

- Connect one ohmmeter lead to tip of antenna mast and the other lead to the antenna base.
- With the antenna disconnected from the radio, there should not be continuity.

TIP OF MAST-TO-TIP OF CONDUCTOR TEST 2.

Test 2 checks the antenna for an open circuit as follows:

- Disconnect the antenna cable from the radio.
- Connect one ohmmeter test lead to tip of mast. Connect remaining lead to tip of antenna cable lead-in (the part inserted into the radio).
- Continuity should exist (ohmmeter should only register a fraction of an ohm). High or infinite resistance suggests damage to the base and cable assembly that should be replaced.

BODY GROUND-TO-BATTERY GROUND TEST 3.

Test 3 checks condition of the vehicle body ground connection as follows:

- Connect one ohmmeter test lead to the vehicle fender and the other lead to the battery negative post.
- Resistance should be less than one ohm.
- If resistance is more than one ohm, check the braided ground strap connected to the engine and vehicle body for being loose, corroded, or damaged. Repair as necessary.

BODY GROUND-TO-COAXIAL SHIELD TEST 4.

Test 4 checks condition of the ground between the antenna base and vehicle body as follows:

- Connect one ohmmeter test lead to the fender and the other lead to the crimp on the coaxial shield.
- Resistance should be less then one ohm.
- If resistance is more then one ohm, replace the antenna base attaching screws with new cadmium plated screws.

HORNS

CONTENTS

GENERAL INFORMATION

For XJ/YJ vehicles battery voltage is applied to the horn relay through a fuse.

When the horn switch is depressed, the horn relay is grounded, pulling the contact closed and providing battery voltage to the horns.

A slip ring and brush arrangement in the steering wheel allows the switch circuit to maintain contact while allowing rotation of the steering wheel.

On XJ models, a cadmium-plated ground screw is used to attach the horn(s) to the body. Do not substitute other types of ground screws as they may become corroded and cause a loss of ground.

XJ

REPLACEMENT

(1) Raise and support the vehicle.

(2) Remove the splash shield.

(3) Remove horn mounting bolt and horn mounted on the drivers side (Fig. 1).

(4) Remove wire from horn.

(5) To install horn, reverse the removal procedures.

DIAGNOSIS AND REPAIR

Refer to Group 8W - Wiring Diagrams for a complete circuit diagram.

HORN RELAY

- Inspect 25 amp, #11 fuse. Replace fuse as required.
- Depress horn switch. The relay contacts should click. If OK, go to HORNS. If not, go to next step.
- Remove the horn relay located in the relay center. The relay center is on the lower instrument panel trim cover just right of the steering column (Fig. 2). There should be 12 volts at relay connector pins 1 and 2. If not, repair open in circuit to relay.
- Depress horn switch. Measure resistance between relay connector pin 5 and ground. The meter should read zero ohms. If not, repair open to horn switch ground.
- Measure resistance between relay connector pin 4 and ground. The meter should read almost zero ohms (horn resistance) If OK, replace relay. If not, repair open in circuit between relay and horns.

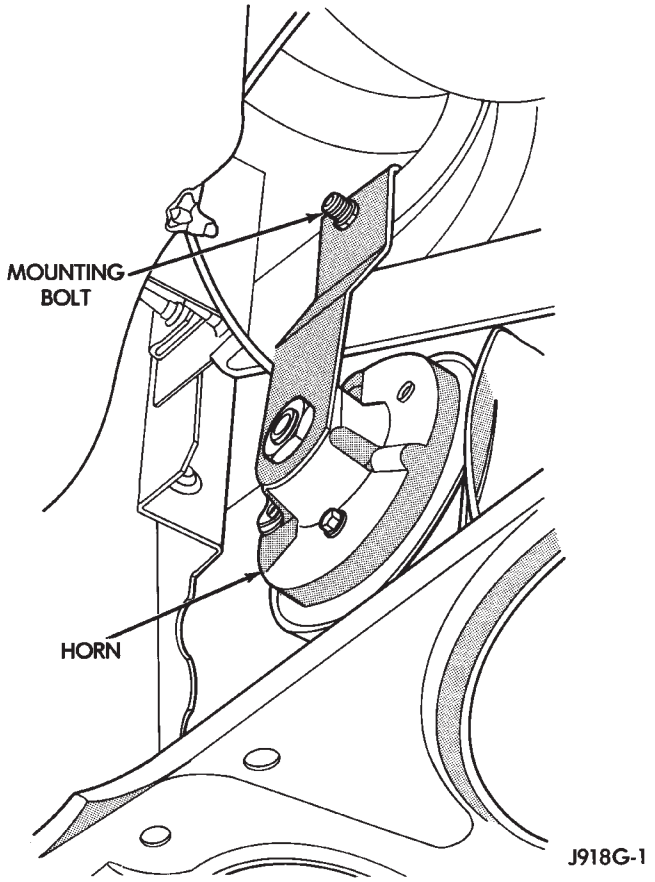


Fig. 1 Drivers Side Horn

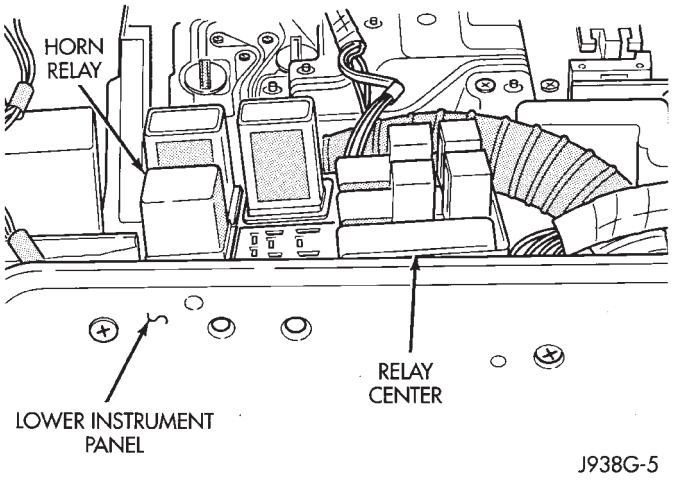


Fig. 2 Horn Relay

HORNS

- Disconnect horn connector. Depress horn switch. There should be 12 volts at the horn connector. If not, repair open to relay.
- Measure the resistance between the horn bracket and chassis ground. The meter should read zero ohms. If not, check mounting screw for corrosion and replace as necessary.
- If above steps do not identify a problem, replace horns.

YJ

Wrangler/YJ horns are located on the drivers side inner fender.

REPLACEMENT

(1) Disconnect wire harness connector from the horn (Fig. 3).

(2) Remove horn and bracket mounting bolt. Horn and bracket are removed as an assembly.

(3) To install, reverse the removal procedures.

DIAGNOSIS AND REPAIR

Refer to Group 8W - Wiring Diagrams for a complete circuit diagram.

HORN RELAY

- Inspect 10 amp fuse, #F15, located in the power distribution center (PDC). Replace fuse as required.
- Depress horn switch. The relay contacts should click. If OK, go to HORN. If not, go to next step.
- Remove relay from PDC. There should be 12 volts at cavities 2 and 5. If not, repair open in circuit to relay.
- Depress horn switch. Measure resistance between relay cavity 1 and ground. The meter should read zero ohms. If not, repair open to horn switch ground.
- Measure resistance between relay cavity 4 and ground. The meter should read almost zero ohms (horn resistance) If OK, replace relay. If not, repair open in circuit between relay and horn.

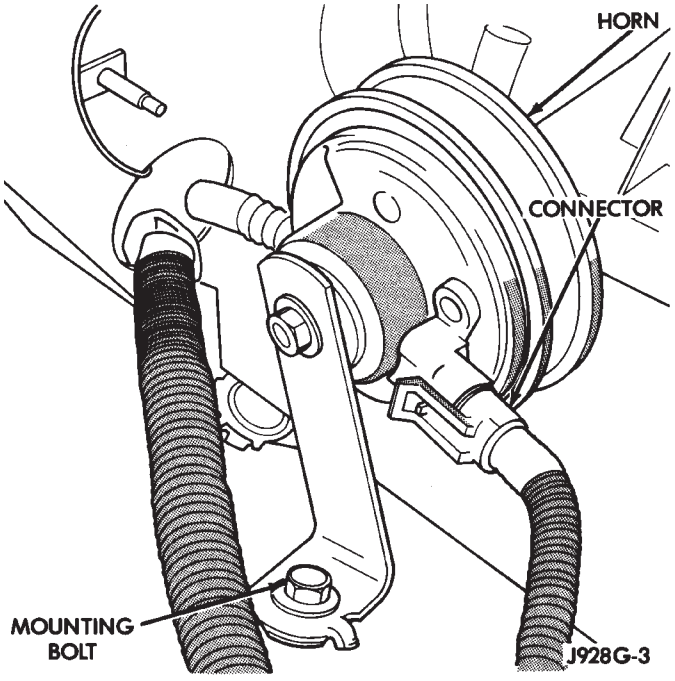


Fig. 3 Horn Removal/Installation—YJ

HORN

- Disconnect horn connector. Depress horn switch. There should be 12 volts at the horn connector pin A. If not, repair open to relay.
- Measure the resistance between the horn connector pin B and chassis ground. The meter should read zero ohms. If not, repair open to ground.
- If above steps do not identify a problem, replace horn.

HORN SWITCH (HORN PAD) REPLACEMENT

(1) Disconnect negative cable from battery.
(2) Remove horn button by pulling straight up.
(3) Remove horn button components (Fig. 4).
(4) To install the switch, reverse the removal procedures.

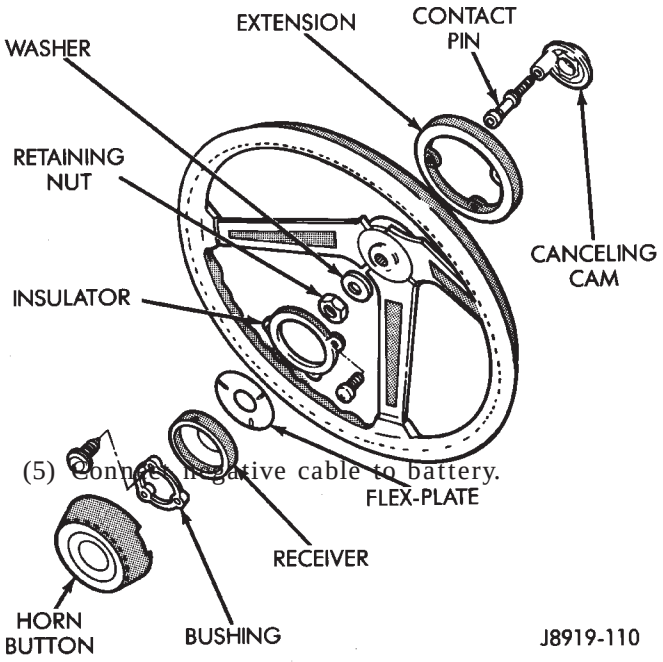


Fig. 4 Steering Wheel Removal/Installation

(5) Connect negative cable to battery.

TORQUE SPECIFICATIONS

COMPONENT	TORQUE
Horn Bracket Screw	20 N·m (15 ft. lbs.)

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VEHICLE SPEED CONTROL SYSTEM

CONTENTS

GENERAL INFORMATION

The vehicle speed control system (Fig. 1) is electrically actuated and vacuum operated. The turn signal lever on the steering column incorporates a slide switch that has three positions OFF, ON or RESUME. A SET button is in the end of the lever. This device is designed to operate at speeds above approximately 35 mph.

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

TO ACTIVATE: Put ON/OFF switch in ON position. When the desired speed is achieved, push and release the SET button to turn on and engage the system. Remove foot from accelerator. Speed will be maintained at this level.

TO DEACTIVATE: A soft tap of the brake pedal, normal brake application or depressing the clutch pedal while the system is engaged will disengage speed control without erasing memory. A sudden increase in engine speed may be experienced if the clutch pedal is depressed while the speed control system is engaged. Moving the slide switch to the OFF position or turning the ignition OFF also disengages the system and in addition erases the memory.

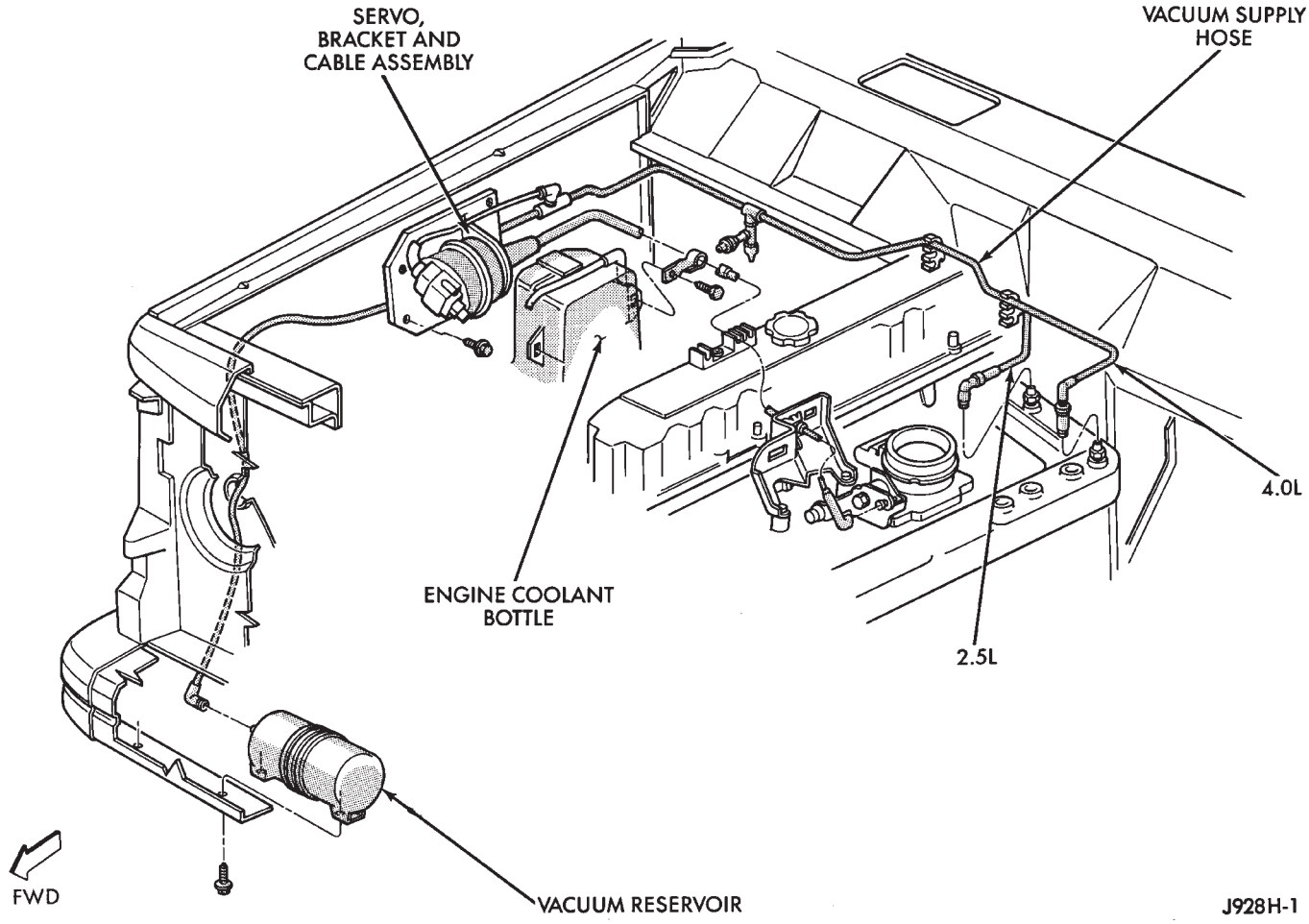


Fig. 1 Speed Control System

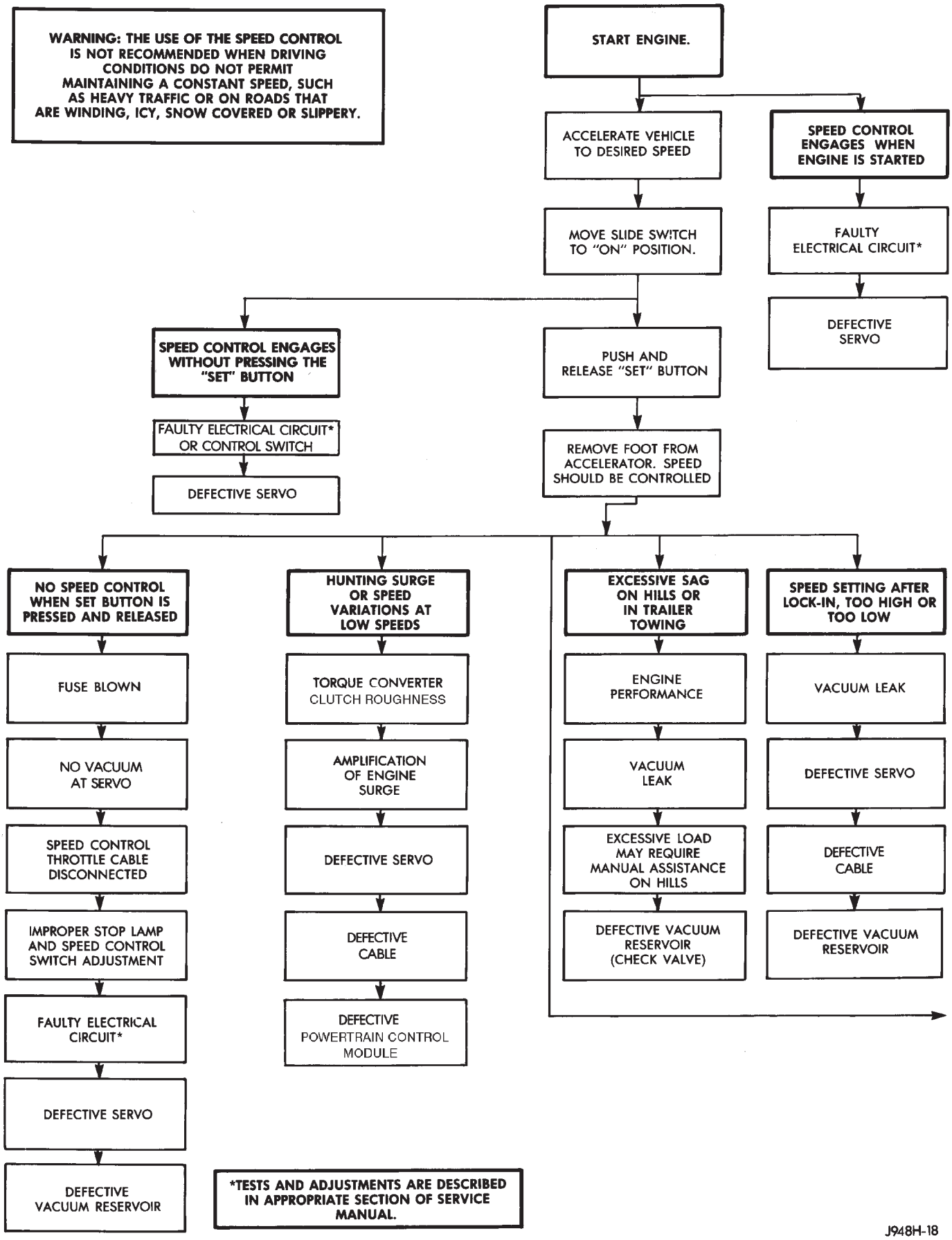
TO RESUME AFTER BRAKING: After disengaging the speed control system by tapping the brake pedal or clutch pedal, push the RESUME/ACCEL button to return vehicle to the previously set speed.

SET/COAST: Speed can be decreased by holding SET button against stop until desired speed is attained. Releasing the button engages the system at that speed. A decrease in speed also can be attained by tapping brake pedal lightly disengaging system. When desired speed has been obtained push and release SET button.

TO ACCELERATE FOR PASSING: Depress accelerator as needed. When passing is completed, release accelerator and vehicle will return to previous speed setting. There may be a slight (3-7 mph) speed loss before the vehicle recovers to the set speed.

TAP-UP: When the speed control system is engaged, tapping the RESUME/ACCEL button will increase the speed setting by 2 mph (3 km/h). The system will respond to multiple tap-ups.

TO ACCELERATE: While speed control is engaged, hold the RESUME/ACCEL button depressed and release at a new desired speed. This will allow the vehicle to accelerate and set at a higher speed setting.


WARNING: THE USE OF THE SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED OR SLIPPERY.
START ENGINE.
ACCELERATE VEHICLE TO DESIRED SPEED
SPEED CONTROL ENGAGES WHEN ENGINE IS STARTED
MOVE SLIDE SWITCH TO "ON" POSITION.
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
SPEED CONTROL ENGAGES WITHOUT PRESSING THE "SET" BUTTON
FAULTY ELECTRICAL CIRCUIT* OR CONTROL SWITCH
DEFECTIVE SERVO
PUSH AND RELEASE "SET" BUTTON
REMOVE FOOT FROM ACCELERATOR. SPEED SHOULD BE CONTROLLED
NO SPEED CONTROL WHEN SET BUTTON IS PRESSED AND RELEASED
FUSE BLOWN
NO VACUUM AT SERVO
SPEED CONTROL THROTTLE CABLE DISCONNECTED
IMPROPER STOP LAMP AND SPEED CONTROL SWITCH ADJUSTMENT
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
DEFECTIVE VACUUM RESERVOIR
HUNTING SURGE OR SPEED VARIATIONS AT LOW SPEEDS
TORQUE CONVERTER CLUTCH ROUGHNESS
AMPLIFICATION OF ENGINE SURGE
DEFECTIVE SERVO
DEFECTIVE CABLE
DEFECTIVE POWERTRAIN CONTROL MODULE
EXCESSIVE SAG ON HILLS OR IN TRAILER TOWING
ENGINE PERFORMANCE
VACUUM LEAK
EXCESSIVE LOAD MAY REQUIRE MANUAL ASSISTANCE ON HILLS
DEFECTIVE VACUUM RESERVOIR (CHECK VALVE)
SPEED SETTING AFTER LOCK-IN, TOO HIGH OR TOO LOW
VACUUM LEAK
DEFECTIVE SERVO
DEFECTIVE CABLE
DEFECTIVE VACUUM RESERVOIR
*TESTS AND ADJUSTMENTS ARE DESCRIBED IN APPROPRIATE SECTION OF SERVICE MANUAL.
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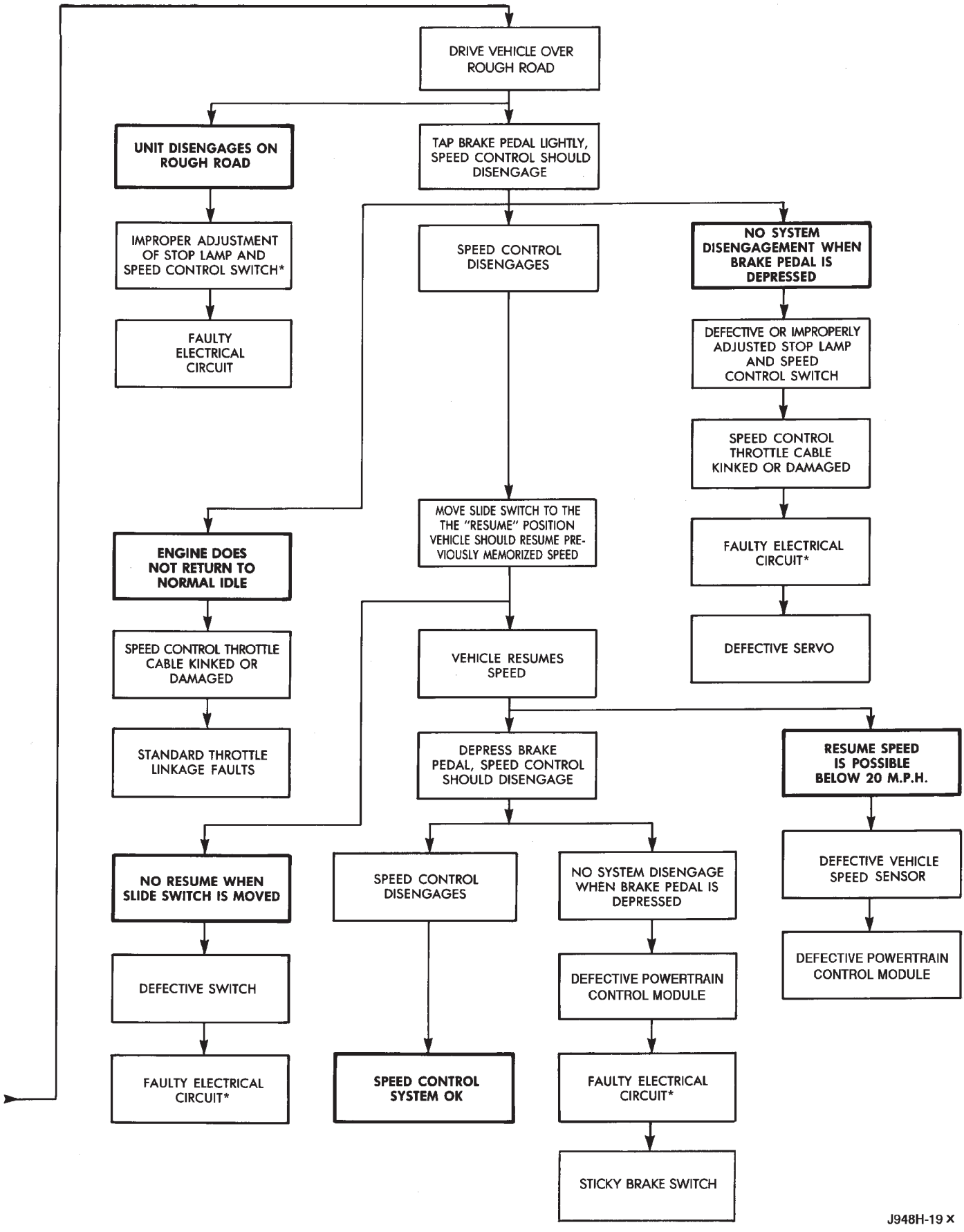
DRIVE VEHICLE OVER ROUGH ROAD
UNIT DISENGAGES ON ROUGH ROAD
IMPROPER ADJUSTMENT OF STOP LAMP AND SPEED CONTROL SWITCH*
FAULTY ELECTRICAL CIRCUIT
TAP BRAKE PEDAL LIGHTLY, SPEED CONTROL SHOULD DISENGAGE
SPEED CONTROL DISENGAGES
MOVE SLIDE SWITCH TO THE THE "RESUME" POSITION VEHICLE SHOULD RESUME PREVIOUSLY MEMORIZED SPEED
VEHICLE RESUMES SPEED
DEPRESS BRAKE PEDAL, SPEED CONTROL SHOULD DISENGAGE
SPEED CONTROL DISENGAGES
SPEED CONTROL SYSTEM OK
NO SYSTEM DISENGAGEMENT WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE OR IMPROPERLY ADJUSTED STOP LAMP AND SPEED CONTROL SWITCH
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
ENGINE DOES NOT RETURN TO NORMAL IDLE
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
STANDARD THROTTLE LINKAGE FAULTS
NO RESUME WHEN SLIDE SWITCH IS MOVED
DEFECTIVE SWITCH
FAULTY ELECTRICAL CIRCUIT*
NO SYSTEM DISENGAGE WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE POWERTRAIN CONTROL MODULE
FAULTY ELECTRICAL CIRCUIT*
STICKY BRAKE SWITCH
RESUME SPEED IS POSSIBLE BELOW 20 M.P.H.
DEFECTIVE VEHICLE SPEED SENSOR
DEFECTIVE POWERTRAIN CONTROL MODULE

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TEST PROCEDURES

INDEX

ROAD TEST

Refer to Operational Check (Road Test) section to verify reports of speed control system malfunction.

INOPERATIVE SYSTEM

Road test vehicle to verify reports of speed control system malfunction. An inspection should be made for loose electrical and vacuum connections at the servo.

Check for correct installation of the vacuum check valve in the hose from servo to vacuum source. The word VAC on the valve must point toward the vacuum source.

Corrosion should be removed from electrical terminals and a light coating of Mopar MultiPurpose Grease, or equivalent, applied.

Inspection also should be made to verify that both ends of the speed control cable are securely attached.

CHECKING FOR DIAGNOSTIC TROUBLE CODE

(1) When trying to verify a speed control system electronic malfunction use a DRB scan tool to find the cause (refer to Powertrain Diagnostic Procedures manual).

If DRB is not available, the Diagnostic Trouble Code (DTC) may be determined with the following method:

(a) With key inserted in ignition switch, cycle switch to ON position 3 times. On third cycle, leave switch in ON position.

(b) After switch has been cycled 3 times, observe Malfunction Indicator Lamp (**CHECK ENGINE)** on instrument cluster. If a DTC is present, the code will be displayed in a series of flashes representing digits. Three flashes in rapid succession, a slight pause, then 4 flashes in rapid succession would indicate DTC 34.

(2) If a DTC 34 is observed, perform tests in the sections Electrical Tests at Servo and Electrical Tests at Powertrain Control Module.

If a DTC 15 is observed, perform test for a faulty vehicle speed sensor.

(3) Correct any problems found when performing these tests and recheck for DTC if changes were made.

VEHICLE SPEED SENSOR TEST

For testing of the vehicle speed sensor and related components, refer to Powertrain Diagnostic Procedures manual.

VEHICLE SPEED CONTROL SYSTEM ELECTRICAL TESTS

Vehicle speed control systems may be tested using two different methods. One involves use of a DRB scan tool. If this test method is desired, refer to Powertrain Diagnostic Procedures manual.

The other test method uses a voltmeter. The voltmeter method is described in the following tests.

If any information is needed concerning wiring, refer to Section 8W - Wiring Diagrams.

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.

ELECTRICAL TESTS AT SERVO

(1) Turn ignition switch to the ON position. With speed control switch in the ON position, setup a voltmeter to read battery voltage and connect negative lead to a good chassis ground.

(2) Disconnect 4-way connector going to servo (Figs. 2 and 3). Blue wire with red tracer of main harness 4-way connector should read approximately battery voltage. If not, check for loose connections, brake switch adjustment or, repair main harness as necessary.

(3) Connect a jumper wire between male and female terminals of blue wire with red tracer. The other 3 male terminals from servo should show battery voltage. If not, replace servo.

(4) Using an ohmmeter, connect one lead to a good body ground. Touch other lead to black wire terminal in 4-way connector of main harness. Meter should show continuity. If not, repair ground circuit as necessary.

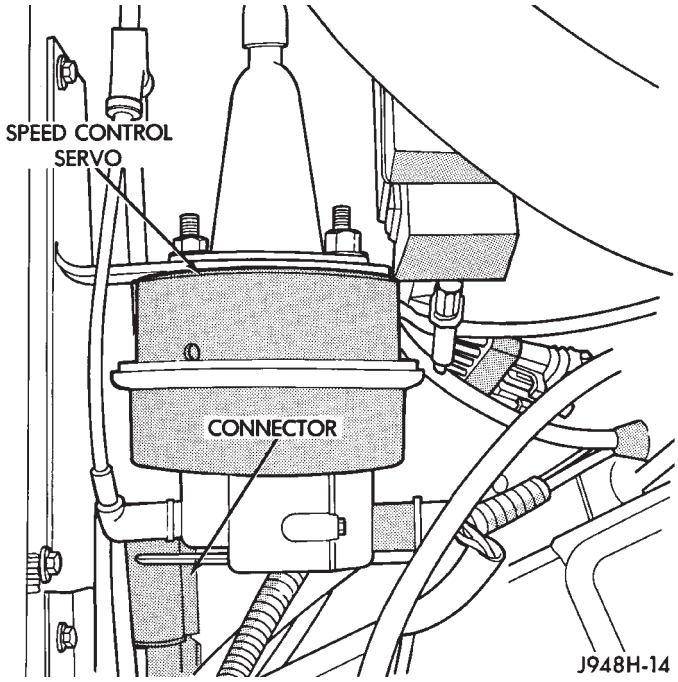


Fig. 2 Servo And Harness Connector—Left Hand Drive

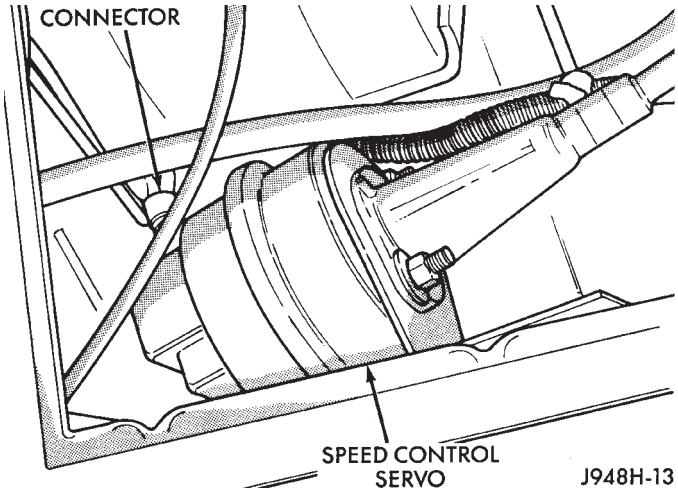


Fig. 3 Servo And Harness Connector—Right Hand Drive

ELECTRICAL TESTS AT POWERTRAIN CONTROL MODULE

(1) Unplug 60-way connector from Powertrain Control Module, located on drivers side fender (Fig. 4).

(2) Connect negative lead of voltmeter to a good body ground near module.

(3) For the following tests, ignition switch must be in ON position. Refer to Fig. 5 for controller terminal locations. Touch positive lead of voltmeter to terminal in cavity number 33. With speed control switch in OFF position, voltmeter should read 0 volts. With speed control switch in ON position, voltmeter should read battery voltage. If not, repair main harness as necessary.

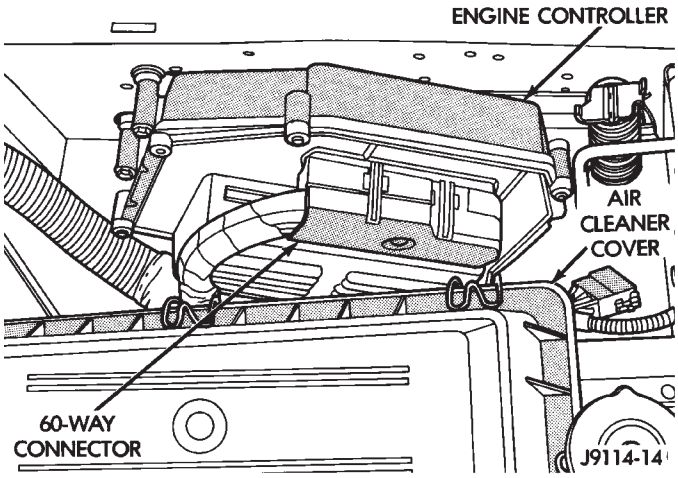


Fig. 4 Powertrain Control Module and Connector Location

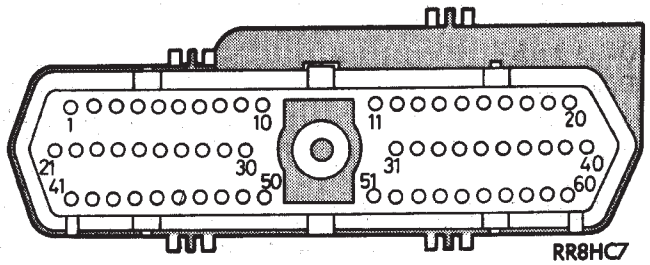


Fig. 5 Powertrain Control Module 60-Way Connector Shown from Terminal End

(4) Touch positive lead of the voltmeter to terminal in cavity number 53. As in step (3), voltmeter should read 0 volts with switch in OFF position and battery voltage with switch in ON position.

(5) Touch positive lead of voltmeter to terminal in cavity number 48. With speed control switch in OFF position, voltmeter should read 0 volts. With switch in ON position, voltmeter should read battery voltage. Pressing SET button should cause voltmeter to change from battery voltage to 0 volts for as long as the switch is held. If not, perform the speed control switch test. If the switch is not at fault, then check main harness and repair as necessary.

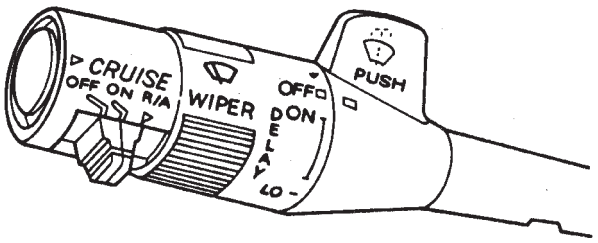
(6) Touch positive lead of voltmeter to terminal in cavity number 50. The voltmeter should read 0 volts with speed control switch in either OFF or ON position. With switch in either RESUME or SET position, voltmeter should read battery voltage. If not, perform the speed control switch test. If the switch is not at fault, then check main harness and repair as necessary.

(7) Touch positive lead of voltmeter to terminal in cavity number 49. The voltmeter should read 0 volts with switch in OFF position. With switch in ON position, voltmeter should read battery voltage. The voltmeter will continue to read battery voltage when either the SET or RESUME switch is pressed. If not,

perform the speed control switch test. If switch is not at fault, then check main harness and repair as necessary.

(8) Using an ohmmeter, connect one lead to a good body ground and touch other lead to terminal in cavity number 29. With brake pedal released, meter should show continuity. When pedal is depressed, meter should show open circuit.

SPEED CONTROL SWITCH (TURN SIGNAL LEVER) TEST



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STOP LAMP SPEED CONTROL SWITCH TEST

(1) Disconnect double connector at switch pigtail and connect a 12 volt source to either terminal. Connect a test lamp between other terminal and a good ground. The test lamp should be on when brake pedal is in normal position. The test light should go off when brake pedal is depressed approximately 3/8 of an inch.

(2) If test lamp does not respond properly, the stop lamp switch is defective or out of adjustment.

(3) Stop lamp switch adjustment is detailed in Group 5 - Brakes section of this manual.

VACUUM SUPPLY TEST

(1) Disconnect vacuum hose at servo or vacuum reservoir and install a vacuum gauge in hose (Fig. 6).

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) If vacuum does not meet this requirement, check for vacuum leaks or poor engine performance.

OPERATIONAL CHECK (ROAD TEST)

The following sequential checks are performed with the speed switch ON and vehicle speed faster than 35 mph:

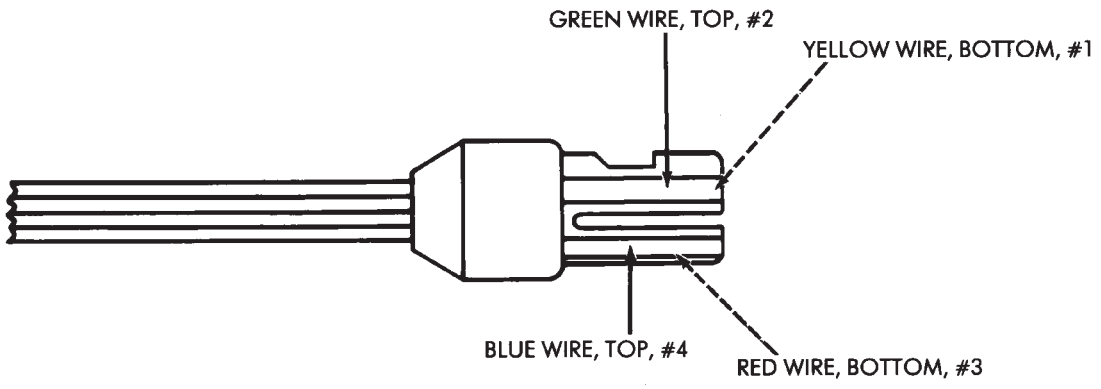
(1) Press the SET button in end of multi-function lever. Vehicle should maintain set speed.

(2) Hold SET button in, and remove foot from accelerator. Vehicle should coast to a slower speed.

(3) Release SET button. Speed control will engage and hold a slower speed, provided the speed remains above 35 mph.

SET/COAST (S/C) SW	POSITION SLIDER	1-2	1-3	1-4	2-3	2-4	3-4
Normal	Off	O	O	O	O	O	O
Normal	On	O	O	O	O	C	O
Normal	R/A	C	O	C	O	C	O
Depressed	Off	O	O	O	C	O	O
Depressed	On	O	O	O	C	C	C
Depressed	R/A	C	C	C	C	C	C

C —CLOSED (ZERO OHMS)
O —OPEN (∞ (INFINITE))



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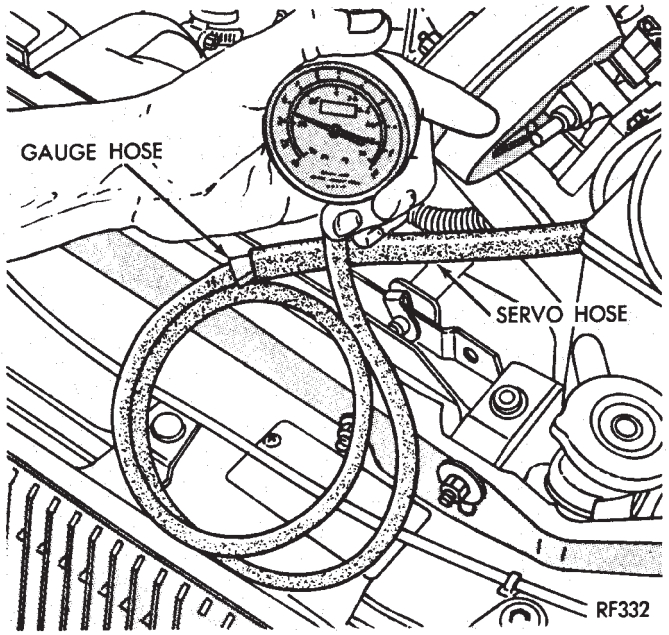

Fig. 6 Vacuum Gauge Test

(4) Slide speed switch to RESUME/ACCEL and hold it there. Vehicle should accelerate.

(5) Release speed switch back to ON. Vehicle will hold the new faster speed, if SET speed button has been pressed.

(6) Tap brake pedal. Vehicle will decelerate.

If vehicle has a manual transmission, repeat test, but depress the clutch pedal.

(7) Slide speed switch momentarily RESUME/ACCEL. Vehicle will accelerate to former set speed.

(8) While cruising, accelerate, then remove foot from accelerator. Vehicle will coast back to set speed.

(9) While speed control is engaged, tap SET button. Vehicle speed will increase 2 mph for each time SET button is tapped.

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
15**	No Vehicle Speed Sensor Signal	No vehicle distance (speed) sensor signal detected during road load conditions.
34*	Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
	or	
	Speed Control Switch Always Low	Speed Control switch input below the minimum acceptable voltage.
	or	
	Speed Control Switch Always High	Speed Control switch input above the maximum acceptable voltage.
55*	N/A	Completion of fault code display on Check Engine lamp.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

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SERVICE PROCEDURES

INDEX

SPEED CONTROL SERVO REPLACEMENT

REMOVAL

(1) Disconnect vacuum hose at servo (Figs. 1 and 2).
(2) Disconnect electrical connector at servo.
(3) Remove 2 nuts from cable sleeve.
(4) Pull speed control cable away from servo to expose cable retaining clip.
(5) Remove clip attaching cable to servo.
(6) Pull servo away from mounting bracket.

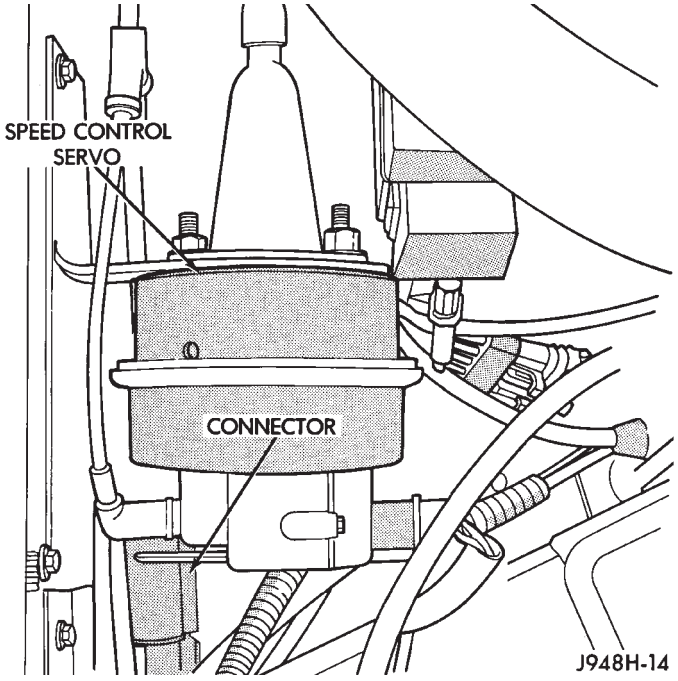


Fig. 1 Speed Control Servo—Left Hand Drive

INSTALLATION

(1) Insert servo studs through holes in servo mounting bracket.
(2) With throttle blocked to full open position, align hole in cable sleeve with hole in servo pin and install retaining clip.
(3) Insert servo studs through holes in cable sleeve.
(4) Install 2 attaching nuts and tighten to 6 N·m (50 in. lbs.).
(5) Connect vacuum hose to servo.
(6) Connect electrical connector to servo terminals.

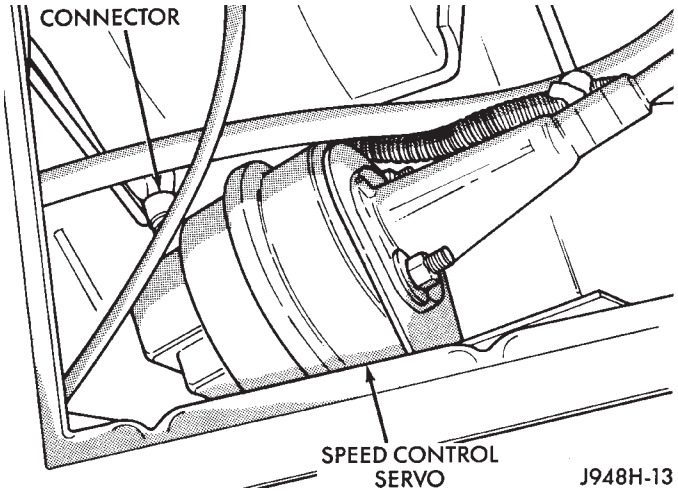


Fig. 2 Speed Control Servo—Right Hand Drive

SERVO CABLE REPLACEMENT

CAUTION: Use finger pressure only to remove the speed control cable connector at the bell crank. Pliers or screwdriver can break connector requiring complete cable replacement.

(1) Using finger pressure only, remove speed control cable connector at bell crank by pushing connector off the bell crank (Fig. 3). DO NOT try to pull connector off perpendicular to the bell crank.
(2) Squeeze tabs on speed control cable and push out of locking plate (Fig. 4).
(3) Pull cable out of cable guide.
(4) Remove 2 nuts and cable housing from servo.
(5) Release cable clip from servo cable and remove servo cable.
(6) To install, reverse the removal procedure.

SPEED CONTROL SWITCH REPLACEMENT

(1) Disconnect negative cable from battery.
(2) Remove horn button with a push and turn motion.
(3) Remove horn button components (Fig. 5).
(4) Turn ignition switch to LOCK position and remove steering wheel nut and washer.
(5) Scribe an alignment mark on the steering in line with the mark already existing on the end of the steering column.

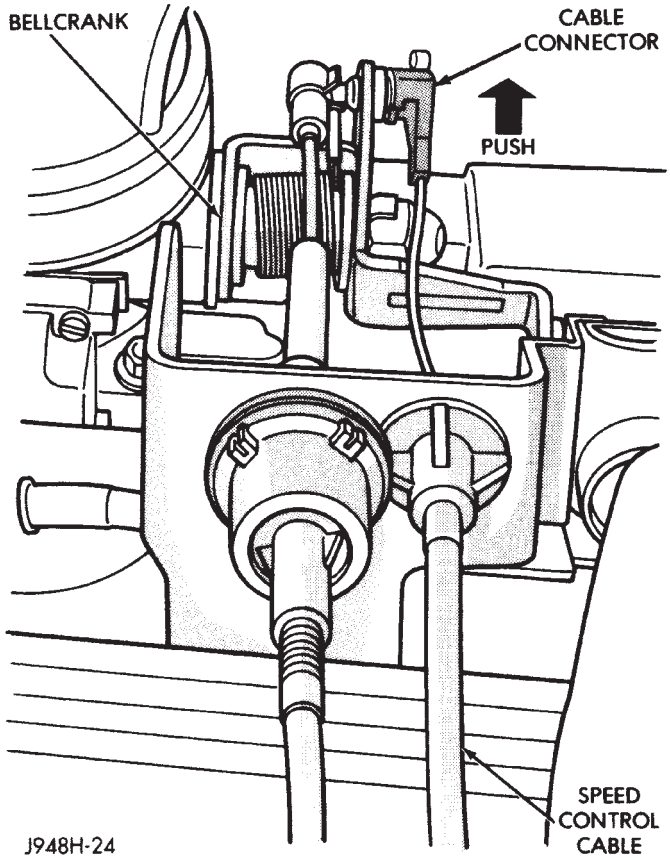


Fig. 3 Remove Bell Crank Connector

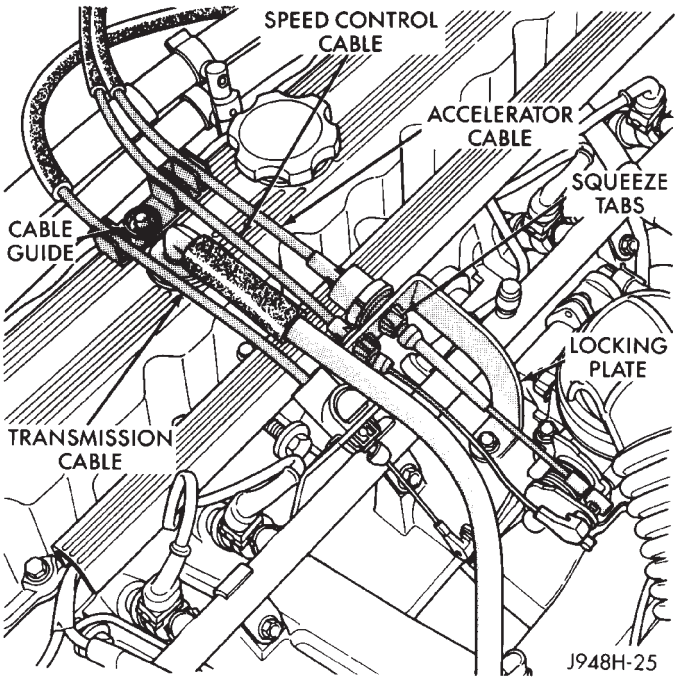


Fig. 4 Remove/Install Speed Control Cable to Locking Plate

(6) Remove vibration damper from the steering column hub, if equipped.

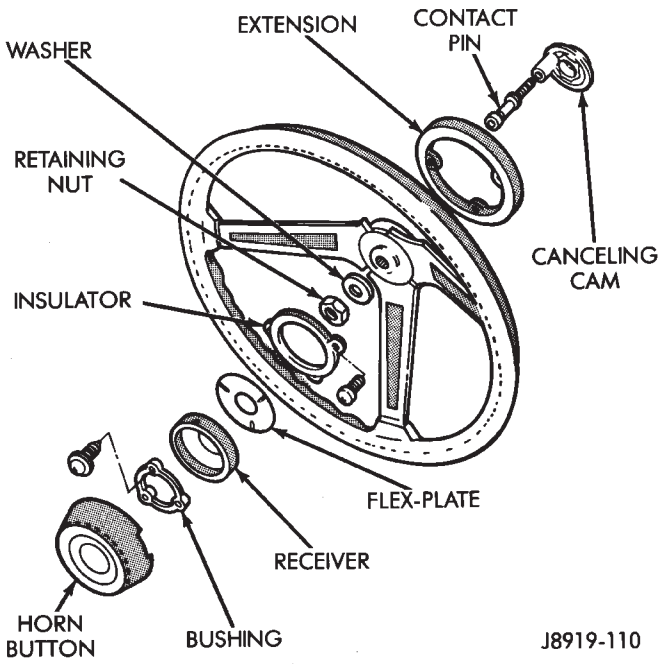


Fig. 5 Steering Wheel Removal/Installation

(7) Remove steering wheel using a steering wheel puller.

WARNING: TO REMOVE THE STEERING SHAFT SNAP RING IN THE FOLLOWING STEP, THE LOCKPLATE MUST BE COMPRESSED. DO NOT ATTEMPT TO REMOVE THE LOCKPLATE WITHOUT COMPRESSOR TOOL C4156 AS THE LOCKPLATE IS UNDER HEAVY SPRING TENSION.

(8) Compress lockplate with compressor tool C4156.

(9) Remove steering shaft snap ring (Fig. 6). Discard snap ring. It is not reusable.

(10) Remove compressor tool.

(11) Remove lockplate, cancelling cam, and upper bearing preload spring.

(12) Remove horn button components from canceling cam.

(13) Remove screw and hazard warning switch knob.

(14) Remove actuator arm attaching screw.

(15) Remove turn signal switch attaching screws.

(16) Unplug speed control switch connector.

(17) Pull speed control harness out of the column.

(18) Insert ignition key in lock cylinder and turn key to ON position.

(19) Remove key warning buzzer switch and retaining clip with a paper clip inserted below retainer so that retainer is flattened (Fig. 7).

Do not attempt to remove buzzer switch and clip separately. The clip could fall into the column jacket.

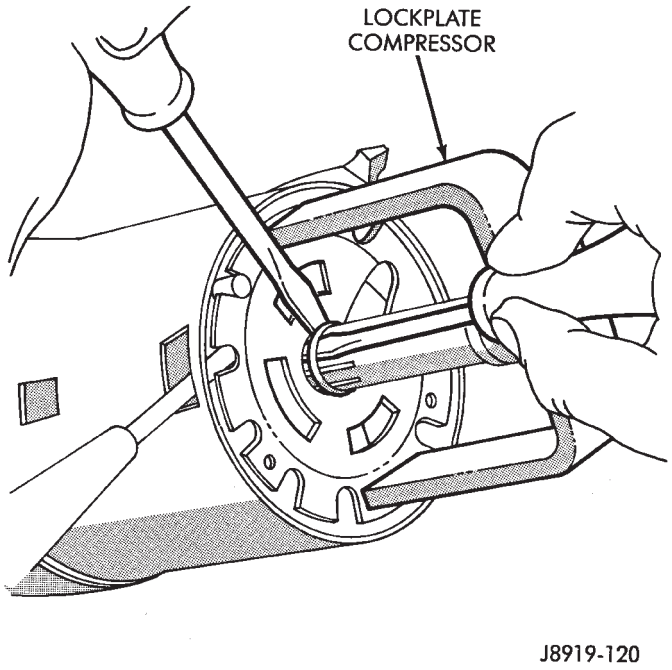


Fig. 6 Lockplate Removal

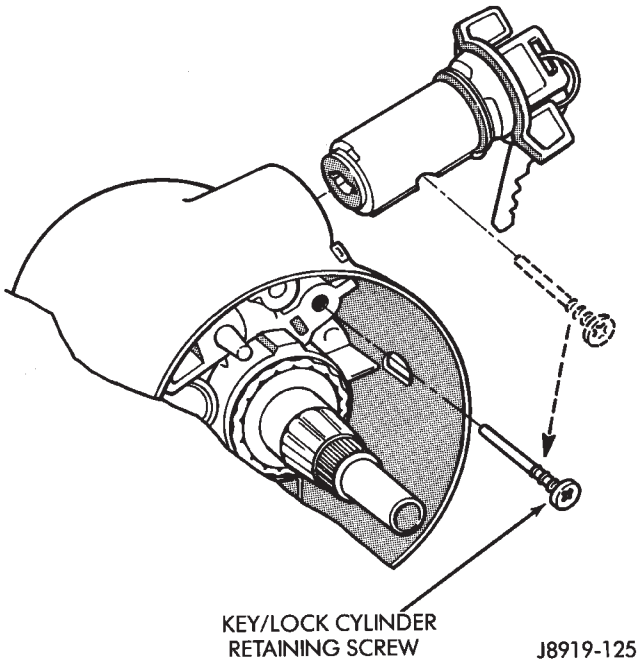


Fig. 8 Lock Cylinder Removal/Installation

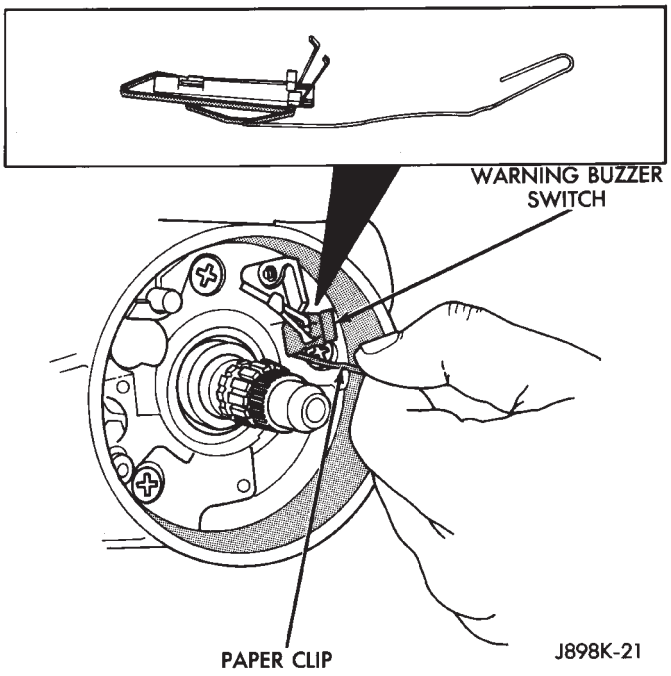


Fig. 7 Buzzer Switch Removal

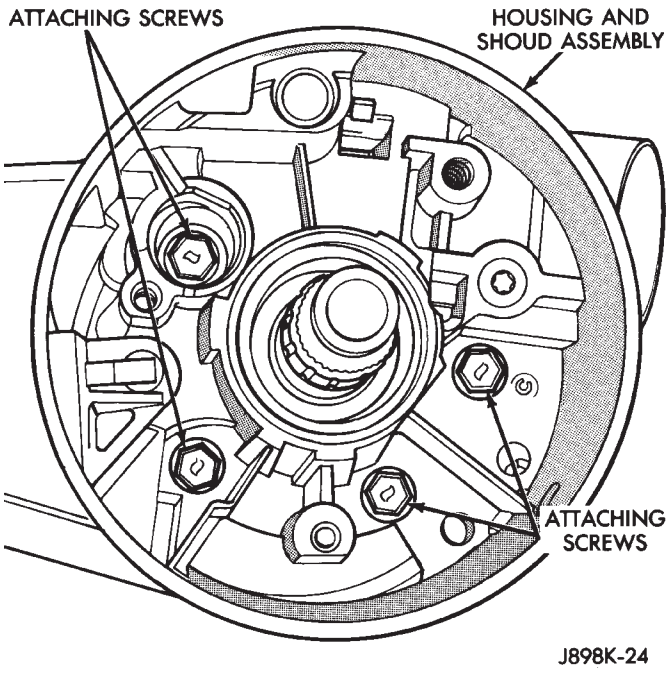


Fig. 9 Steering Column Housing Removal/Installation

(20) Remove ignition lock cylinder retaining screw and pull lock cylinder out of column housing (Fig. 8).

(21) Remove screws that attach housing and shroud assembly to column jacket and carefully remove housing and shroud assembly (Fig. 9).

Do not let dimmer switch rod, lock pin or lock rack fall out.

(22) Remove turn signal/wiper lever by pulling it straight out of column.

(23) Remove wiper switch cover from back of housing and shroud assembly (Fig. 10). If equipped with column shift, remove screw holding the cover on.

(24) Remove pivot screw from housing and remove wiper switch.

(25) Install a new switch and switch cover.

(26) Push on dimmer switch rod to make sure it is connected then carefully position housing and shroud assembly to column (Fig. 11).

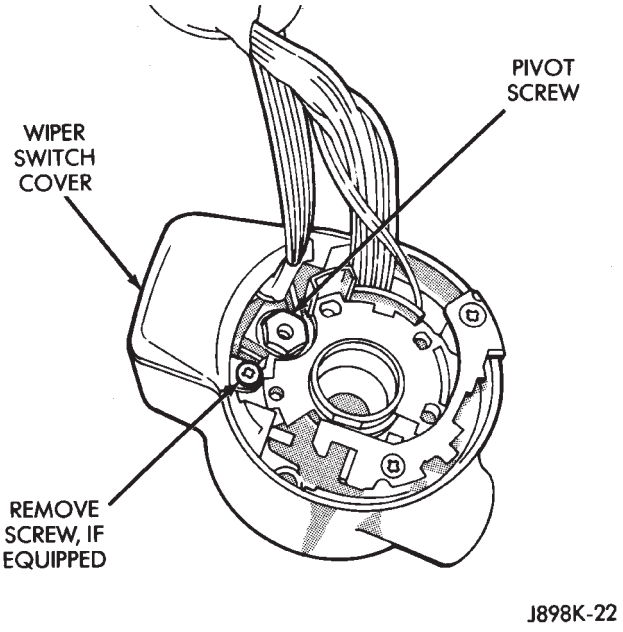


Fig. 10 Remove Pivot Screw

Make sure nylon spring retainer on the lock pin is positioned forward of retaining slot of lock rack (Fig. 11).

Position the first tooth of gear (farthest from the block tooth) with the most forward tooth of lock rack.

(27) Install screws that attach housing and shroud assembly to column jacket and carefully mate housing and shroud assembly.

(28) Insert key and lock cylinder and test that the lock pin extends fully when key is moved to lock position.

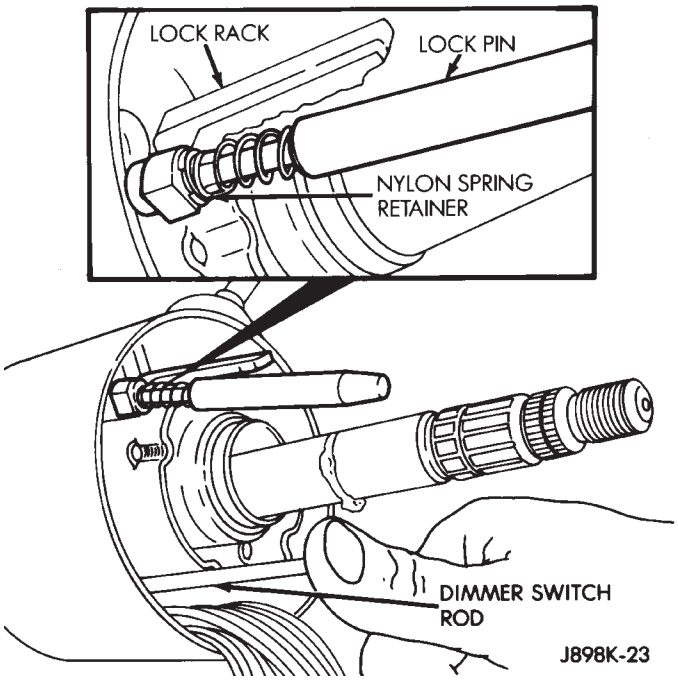


Fig. 11 Check Dimmer Switch Rod and Lock Pin

(29) To install remaining parts, reverse the removal procedures.

CAUTION: When installing a wiper switch, make sure wires are laying flat on bottom inside column.

On vehicles equipped with column shift, install PRNDL cable clip with shift indicator on N. Move selector through the range and make sure it lines up with each letter.

(30) Install steering wheel. Tighten steering wheel nut to 34 N·m (25 ft. lbs.) torque.

TURN SIGNALS AND HAZARD WARNING FLASHER

CONTENTS

TURN SIGNALS—XJ

Refer to Section 8W - Wiring Diagrams for circuit wiring diagram.

DESCRIPTION

With the turn signal lever in its up or down position and the ignition switch in ACCESSORY or ON, current flows through the:

- turn/hazard switch
- selected turn indicator bulb
- front and rear turn signal bulbs
- and the front side marker bulb.

With the headlamps OFF, the turn and front side marker lamps flash in unison. **With the headlamps ON, the turn and front side marker lamps flash alternately.**

DIAGNOSIS—TURN SIGNAL INOPERATIVE

(1) A turn signal indicator that does not flash usually indicates a burned out turn signal bulb. Check for and replace if defective. System should now function properly. If not, go to next step.

High generator output voltage can burn out lamps rapidly.

(2) Remove and inspect 20 amp #8 fuse. Replace if necessary. If OK, go to next step.

(3) Remove turn flasher, light blue can, located in upper left corner of fuse block.

(4) Turn ignition switch to ACCESSORY. Check for battery voltage at flasher bottom cavity on fuse block. If OK, go to next step. If not, repair open circuit in wiring between turn flasher and #8 fuse.

(5) Turn ignition switch to ACCESSORY. Move turn signal lever up or down. Replace turn flasher with known good flasher. The lamps should flash. If not, replace original flasher and go to next step.

(6) Turn ignition switch to OFF. Follow procedure for turn/hazard switch replacement to locate steering column connector. Unplug connector.

(7) Turn ignition switch to ACCESSORY. Check for battery voltage at connector terminal L. If OK, replace turn/hazard switch and check that lamps flash. If not, repair open circuit in wiring between turn flasher and steering column connector terminal L.

HAZARD LAMPS—XJ

Refer to Section 8W - Wiring Diagrams for circuit wiring diagram.

DESCRIPTION

With the hazard switch ON, current flows through the:

- hazard flasher
- the turn/hazard switch
- two front turn signal bulbs
- two rear turn signal bulbs
- two front side marker bulbs
- and two turn indicator bulbs.

All of these bulbs will flash on and off.

DIAGNOSIS—HAZARD LAMPS INOPERATIVE

(1) Inspect 20 amp #F13 fuse in Power Distribution Center (PDC). The PDC is located in the engine compartment, passenger side. For location of fuse, check underside of PDC cover. Replace if necessary. If OK, go to next step.

(2) Remove hazard flasher (tin can) located in fuse block.

(3) Check for battery voltage at the terminal on the right (3 o'clock). If OK, go to next step. If not, repair open circuit in wiring between #F13 fuse and hazard flasher right terminal.

(4) Replace hazard flasher with known good flasher. Activate hazard warning switch. Lamps should flash. If not, replace original flasher and go to next step.

(5) Follow procedure for turn/hazard switch replacement to locate steering column connector. Unplug connector.

(6) Check for battery voltage at connector terminal K. If OK, replace turn/hazard switch. If not, repair open circuit in wiring between hazard flasher and steering column connector terminal K.

TURN SIGNALS—YJ

Refer to Section 8W - Wiring Diagrams for circuit wiring diagram.

DESCRIPTION

With the turn signal lever in its up or down position and the ignition switch in ACCESSORY or ON, current flows through the:

- turn/hazard switch
- selected turn indicator bulb
- front and rear turn signal bulbs
- front side marker bulb

With the headlamps OFF, the turn and side marker lamps flash in unison. **With the headlamps ON, the turn and side marker lamps flash alternately.**

DIAGNOSING—TURN SIGNAL INOPERATIVE

(1) A turn signal indicator that does not flash usually indicates a burned out turn signal bulb. Check for and replace if defective. System should now function properly. If not, go to next step.

High generator output voltage can burn out lamps rapidly.

(2) Locate fuse block under driver's side of instrument panel.

(3) Remove and inspect 15 amp #4 fuse. Replace if necessary. If OK, go to next step.

(4) Remove turn flasher, light blue can, located in fuse block.

(5) Turn ignition switch to ACCESSORY. Check for battery voltage at cavity on left (closest to hazard flasher can). If OK, go to next step. If not, repair open circuit in wiring between turn flasher and #4 fuse.

(6) Turn ignition switch to ACCESSORY. Move turn signal lever up or down. Replace turn flasher with known good flasher. The lamps should flash. If not, replace original flasher and go to next step.

(7) Turn ignition switch to OFF. Follow procedure for turn/hazard switch replacement to locate steering column connector. Unplug connector.

(8) Turn ignition switch to ACCESSORY. Check for battery voltage at connector terminal L. If OK, replace turn/hazard switch. If not, repair open circuit in wiring between turn flasher and steering column connector terminal L.

HAZARD LAMPS—YJ

Refer to Section 8W - Wiring Diagrams for circuit wiring diagram.

DESCRIPTION

With the hazard switch ON, current flows through the:

- hazard flasher
- turn/hazard switch
- two front turn signal bulbs
- two rear turn signal bulbs
- two front side marker bulbs
- two turn indicator bulbs.

All of these bulbs will flash on and off.

DIAGNOSIS—HAZARD LAMPS INOPERATIVE

(1) Inspect 20 amp #F5 fuse in Power Distribution Center (PDC). The PDC is located in the engine compartment, passenger side. For location of fuse, check underside of PDC cover. Replace if necessary. If OK, go to next step.

(2) Remove hazard flasher (tin can) located in fuse block.

(3) Check for battery voltage at the terminal on the left. If OK, go to next step. If not, repair open circuit in wiring between #F5 fuse and hazard flasher left terminal.

(4) Replace hazard flasher with known good flasher. Activate hazard warning switch. Lamps should flash. If not, replace original flasher and go to next step.

(5) Follow procedure for turn/hazard switch replacement to locate steering column connector. Unplug connector.

(6) Check for battery voltage at connector terminal K. If OK, replace turn/hazard switch. If not, repair open circuit in wiring between hazard flasher and steering column connector terminal K.

TURN/HAZARD SWITCH REPLACEMENT - ALL MODELS

(1) Disconnect negative cable from battery.

(2) Remove the horn button with a push and turn motion.

(3) Remove the horn button components (Fig. 1).

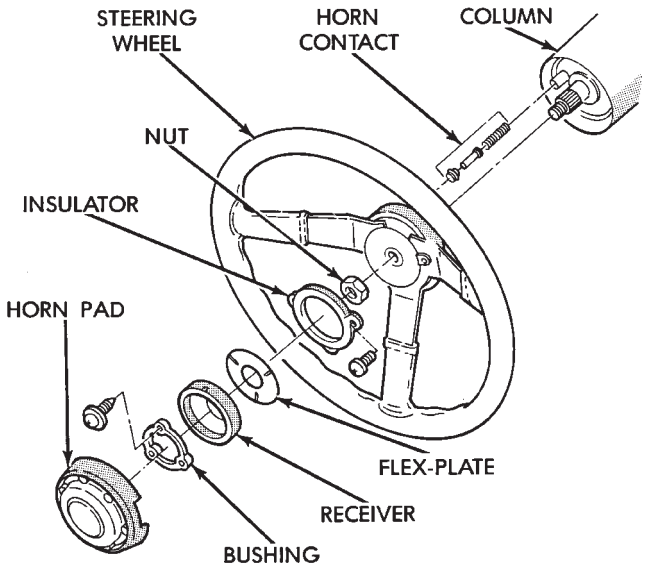


Fig. 1 Steering Wheel Removal/Installation

(4) Turn ignition switch to LOCK position and remove steering wheel nut and washer.

(5) Scribe an alignment mark on the steering in line with the mark already existing on the end of the steering column.

(6) Remove vibration damper from the steering column hub, if equipped.

(7) Remove the steering wheel using a steering wheel puller. DO NOT hammer on puller or end of steering shaft.

WARNING: TO REMOVE THE STEERING SHAFT SNAP RING IN THE FOLLOWING STEP, THE LOCKPLATE MUST BE COMPRESSED. DO NOT ATTEMPT TO REMOVE THE LOCKPLATE WITHOUT COMPRESSOR TOOL C4156 AS THE LOCKPLATE IS UNDER HEAVY SPRING TENSION.

(8) Compress lockplate with compressor tool C4156.

(9) Remove steering shaft snap ring (Fig. 2). Discard snap ring. It is not reusable.

(10) Remove compressor tool.

(11) Remove lockplate, cancelling cam, and upper bearing preload spring.

(12) Remove horn button components from canceling cam.

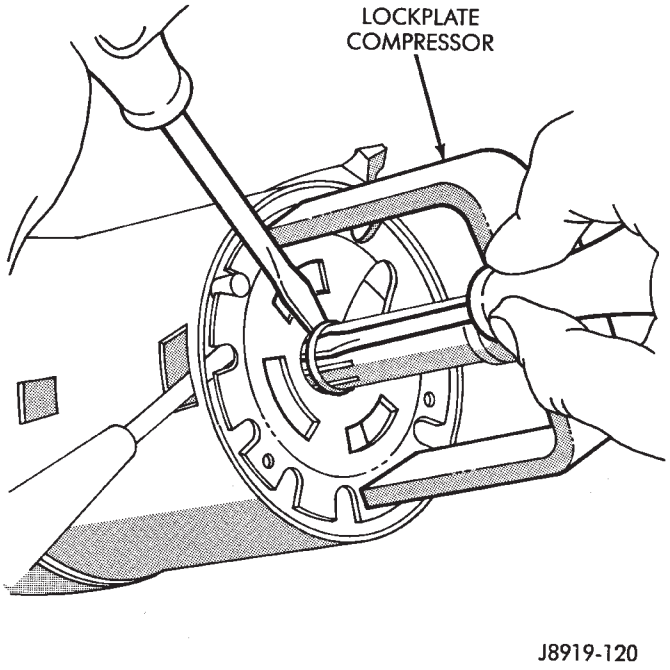


Fig. 2 Lockplate Removal

(13) Remove the screw and hazard warning switch knob.

(14) Remove dimmer switch actuator arm attaching screw (Fig. 3).

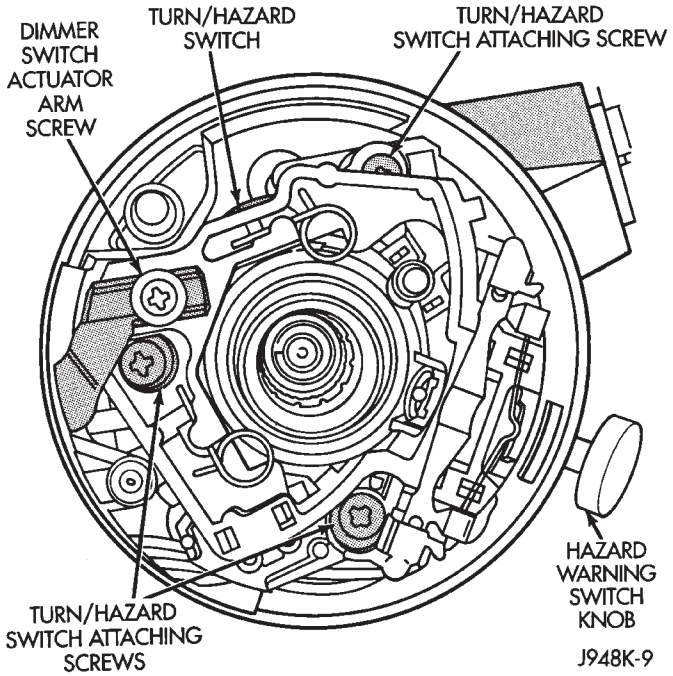


Fig. 3 Turn/Hazard Switch And Dimmer Actuating Arm Screws

(15) Remove turn/hazard switch attaching screws.

(16) **XJ**—Remove lower instrument panel cover trim panel.

(17) **YJ**

(a) Remove 6 housing screws (Fig. 4).

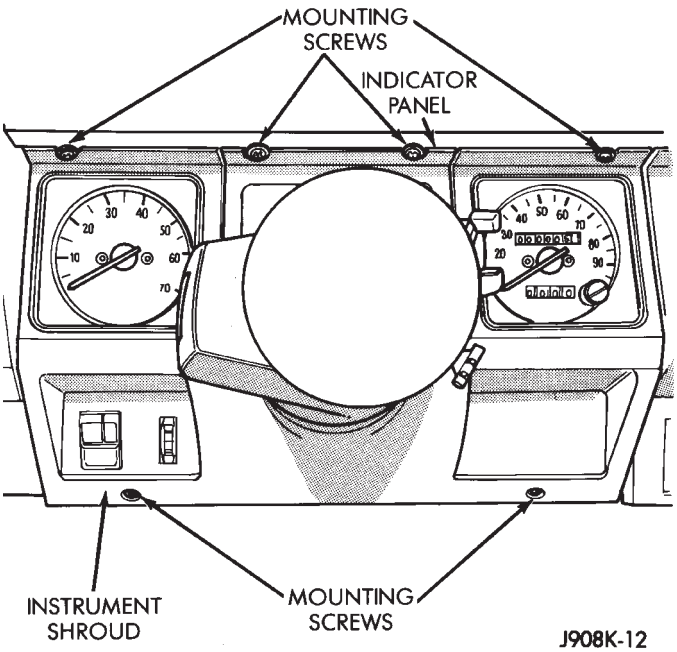


Fig. 4 Instrument Housing Removal/Installation—YJ

(b) Slide housing toward steering wheel.

(18) Remove cover under column.

(19) If vehicle is equipped with a column shift, remove PRNDL cable clip (Fig. 5).

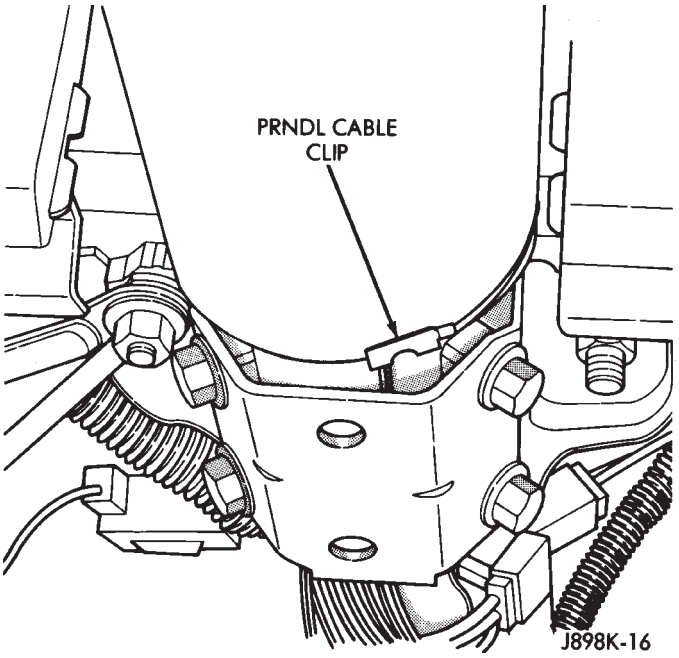


Fig. 5 PRNDL Cable Clip Removal/Installation

(20) Remove 2 nuts holding steering column bracket to brake sled (Fig. 6).

(21) Remove 4 bolts holding steering column bracket to column.

(22) Loosen column brace mounting nut at drivers side kick panel. This will allow column to drop.

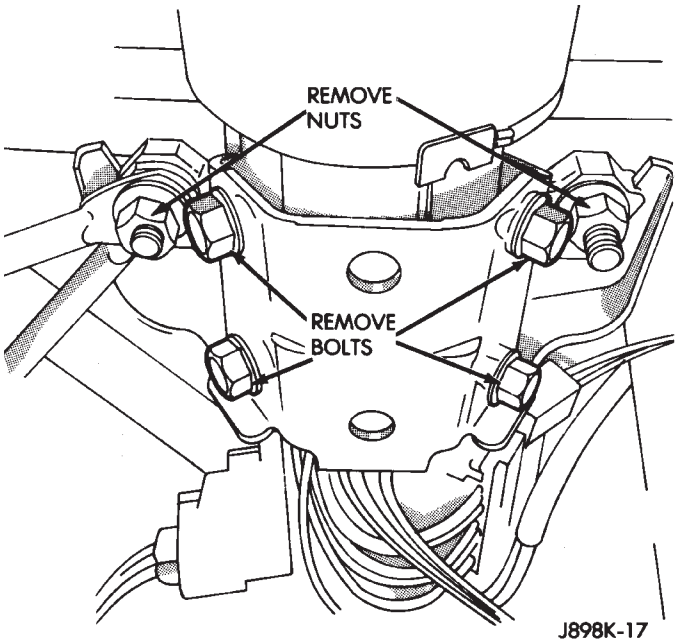


Fig. 6 Lower Steering Column

(23) Push turn/hazard connector up and out of steering column connector (Fig. 7).

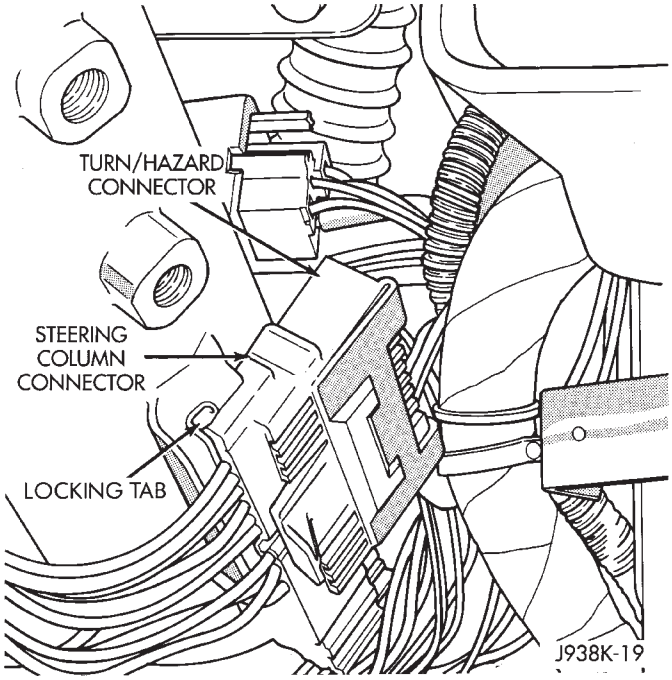


Fig. 7 Turn/Hazard Switch And Steering Column Connectors

(24) Pry up locking tabs of steering column connector and remove connector from column bracket.

(25) Tape connector to wires as shown (Fig. 8).

(26) Remove plastic harness cover by pulling it up and over the weld nuts then open and slide the cover off the harness (Fig. 9).

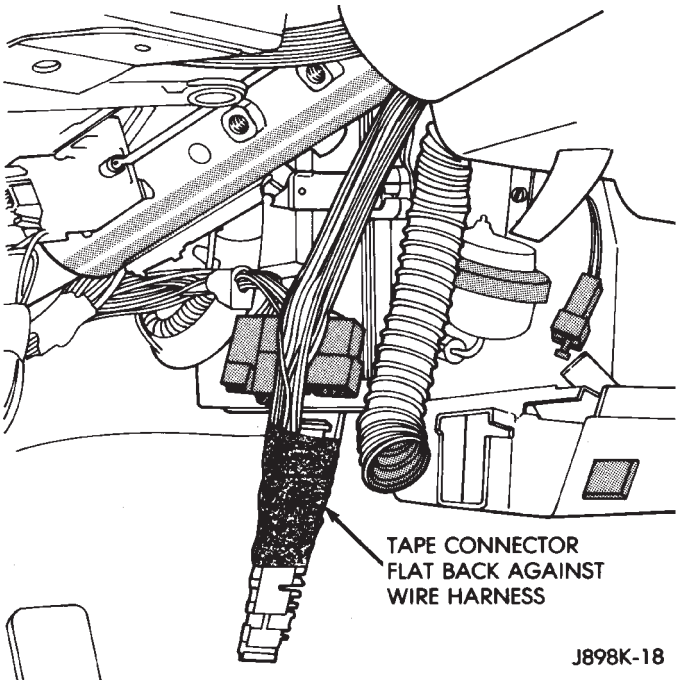


Fig. 8 Tape Wiper Switch Connector

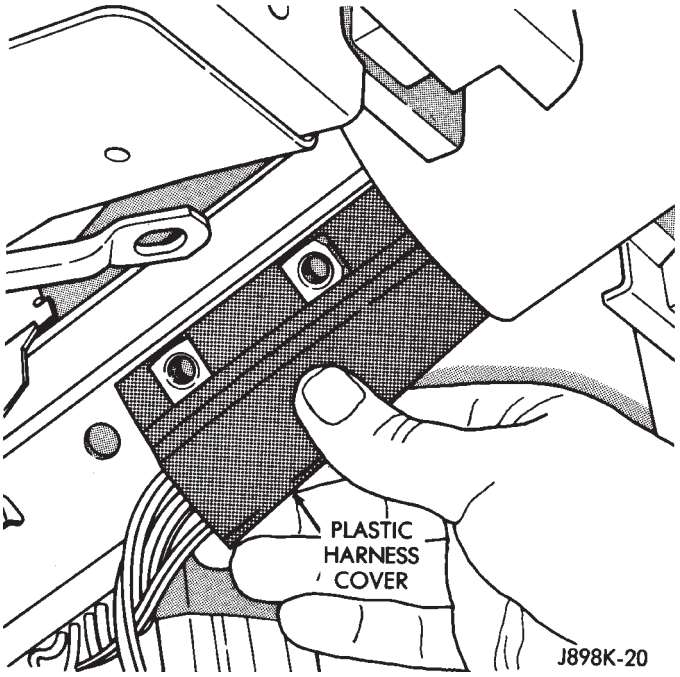


Fig. 9 Remove Plastic Harness Cover

(27) Remove the turn/hazard switch. Pull the switch and wire harness straight up and out of the housing.

(28) To install a new switch, reverse the removal procedure.

CAUTION: When installing a turn/hazard switch, make sure wires are laying flat on bottom inside column.

On vehicles equipped with column shift, install the PRNDL cable clip with the shift indicator on N (neutral). Move the selector through the range and make sure it lines up with each letter.

(29) Adjust the headlamp dimmer switch as described in Group 8L - Lamps.

WINDSHIELD WIPERS

CONTENTS

XJ

INDEX

FRONT WIPERS/WASHERS

GENERAL

Two-speed electric windshield wipers and electric washers are standard equipment. An optional intermittent wiper system provides a pause between wipe cycles for use during conditions of very light precipitation.

The windshield wipers can be operated with the windshield wiper switch only when the ignition switch is in the ON or ACCESSORY position. A circuit breaker located in the fuse block protects the circuitry of the wiper system.

WIPERS

The standard windshield wiper circuit contains three components; wiper/washer switch, motor, and front washer pump. Both standard and intermittent circuits are the same, except that the intermittent circuit requires a module and delay resistance in the wiper switch. Both circuits receive battery feed from, and are protected by a 5.5 amp circuit breaker.

In the standard wiper circuit, the switch connects the motor directly to battery feed for low and high speed operation. In the intermittent circuit, the switch supplies battery feed to the intermittent wiper module, which then supplies the motor. In the delay position, the module is connected with the variable resistor in the wiper switch. The value of the resistance is used by the module to charge a capacitor, which triggers the amount of delay between wipes.

The wiper motor has an arrangement of brushes providing the two wiper speeds. When the wipers are turned off, the park switch maintains current to the motor until the wipers reach the park position on the windshield.

The park arm in the motor assembly is connected to the park switch and is driven by the motor. When the wiper switch is turned off, current flows through the contact and the module to the motor until the wipers reach the park position.

CAUTION: The wiper arms and blades must not be moved manually from side to side or damage may result.

WASHERS

With the washer switch ON, current flows through the washer pump to ground. The front washer pump runs as long as the driver holds the switch ON. On standard wipers, the washer switch automatically moves the wiper switch to LO when the washer is turned on. On intermittent wipers, the wiper module runs the wiper motor on LO. Turning the switch to OFF stops the wipers.

If the washer knob is depressed while the wiper switch is in the OFF position, the wiper control will operate for approximately 3 wipes and automatically turn OFF.

WINDSHIELD WIPER MOTOR

REMOVAL

(1) Remove wiper arm assemblies by lifting blade off windshield and pulling out on the tab (Fig. 1) to lock wiper arm in UP position.

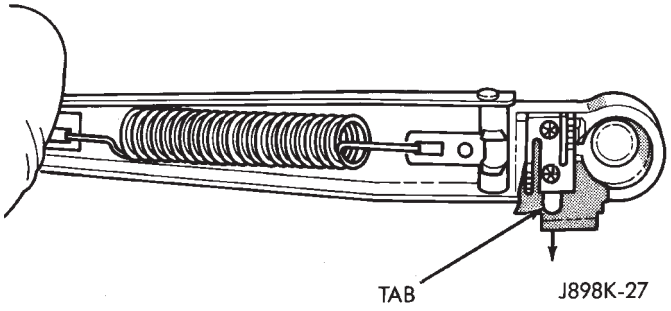


Fig. 1 Wiper Arm Removal

(2) Remove cowl trim panel. Disconnect the washer hose. Remove the cowl mounting bracket attaching nuts (Fig. 2) and pivot pin attaching screws.

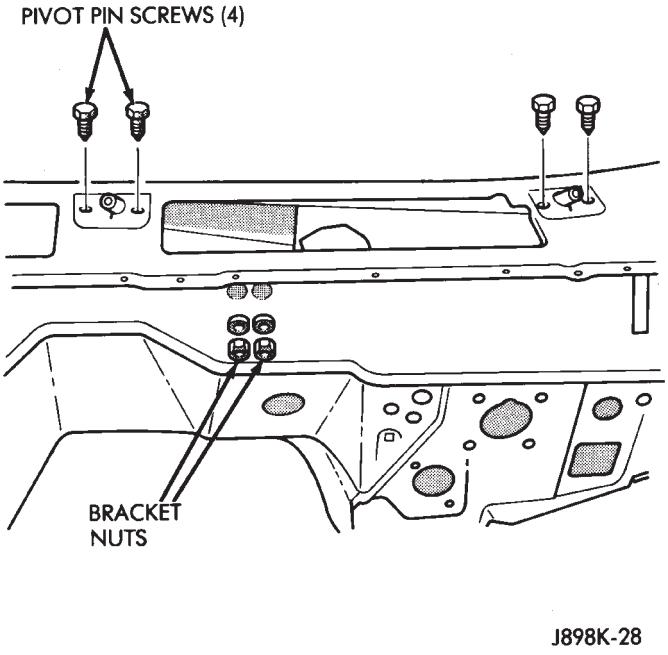


Fig. 2 Pivot Assembly Removal

(3) Disconnect wiring harness and remove the assembly.

(4) Remove the plastic motor cover.

(5) Remove bolts and nuts holding motor to linkage and remove motor.

The wiper motor is shrouded in a protective rubber boot. Care should be taken not to puncture the boot during removal or installation.

INSTALLATION

(1) Install motor to linkage.

(2) Install wiper motor and linkage assembly into the cowl cavity.

(3) Position cowl mounting bracket and install the attaching nuts. Install pivot pin attaching screws. Tighten the screws and nuts to 4 N·m (35 in. lbs.) torque.

(4) Connect the wire harness.

(5) Connect the washer hose and install cowl trim panel.

(6) Install the wiper arm assemblies and position as shown (Fig. 3).

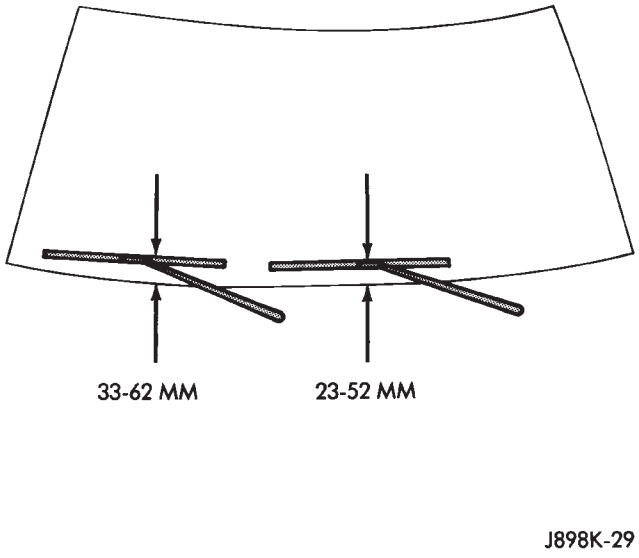


Fig. 3 Windshield Wiper Arm Installation

WASHER PUMP REPLACEMENT—LEFT HAND DRIVE

(1) Remove 2 washer reservoir attaching screws (Fig. 4) and 1 nut (Fig. 5).

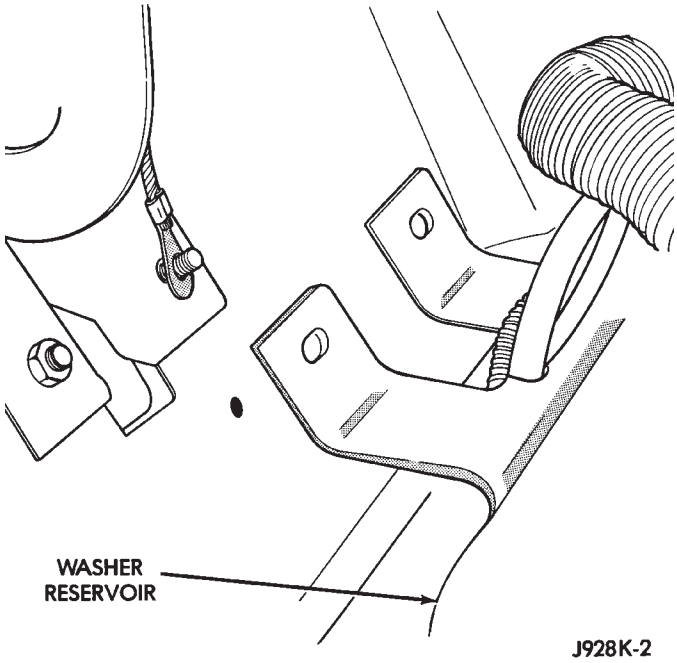


Fig. 4 Washer Reservoir Upper Attaching Screws

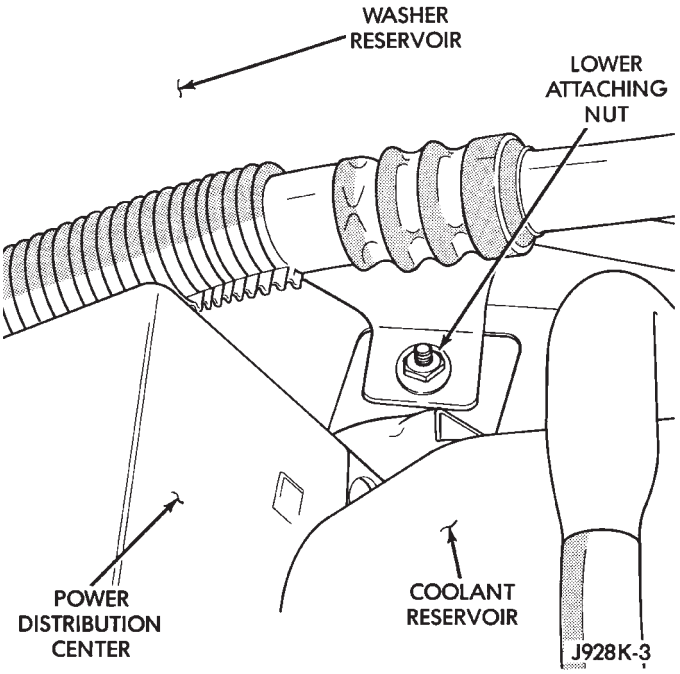


Fig. 5 Washer Reservoir Lower Attaching Nut

(2) Disconnect hose from pump(s) (Fig. 6).

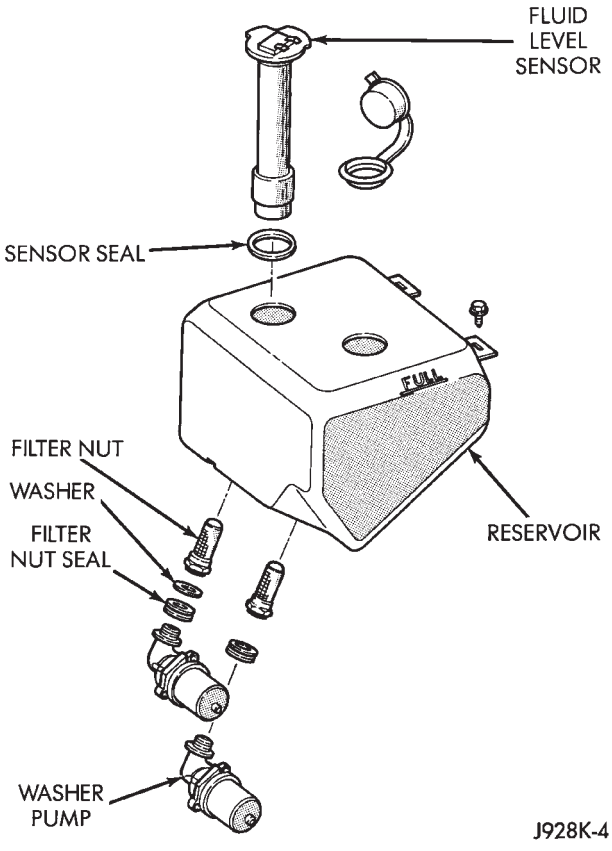


Fig. 6 Washer Reservoir and Pumps—Typical Left Hand Drive

(3) Drain washer reservoir.

(4) Using a deep socket, remove filter nut(s) from bottom inside reservoir and remove pump.

(5) Reverse the removal procedure to install a new pump(s).

WASHER PUMP REPLACEMENT—RIGHT HAND DRIVE

(1) Remove 3 washer reservoir mounting screws (Fig. 7).

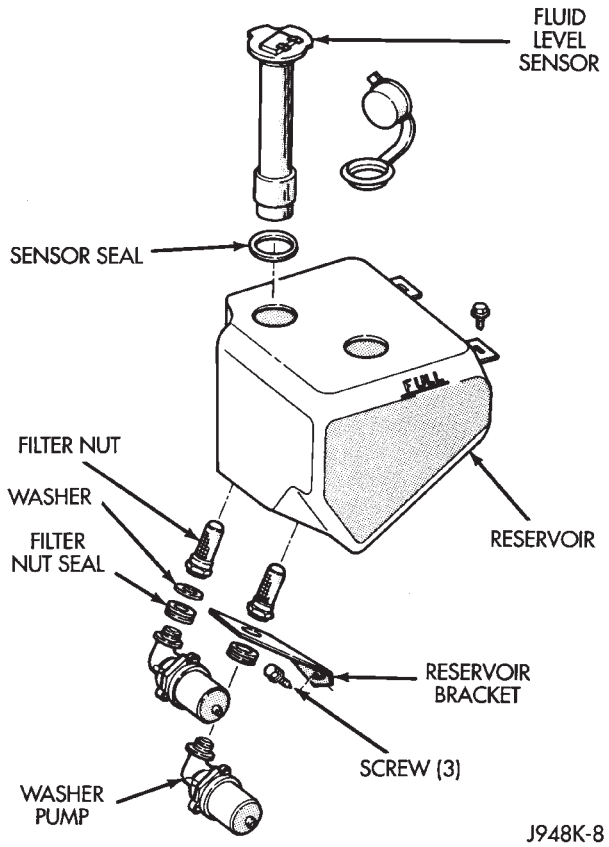


Fig. 7 Washer Reservoir and Pump

(2) Disconnect hose from pumps.

(3) Drain washer reservoir.

(4) Using a deep socket, remove filter nuts from bottom inside of reservoir and remove pump.

(5) Reverse the removal procedures to install a new pump.

DIAGNOSING WINDSHIELD WIPERS

(1) Remove in-line circuit breaker near fuse block and turn ignition switch to ACCESSORY or ON.

- Measure voltage at battery side of circuit breaker cavity. Meter should read battery voltage. If not, repair wiring from ignition switch.
- Measure resistance across circuit breaker terminals. Meter should read zero ohms. If not, replace failed circuit breaker.

(2) Unplug wiper motor side wiring harness connector from wiper switch side harness connector (non-intermittent), or from intermittent wiper module at base of steering column. Turn ignition switch to ACCESSORY or ON.

• Measure voltage at unplugged wiper motor side harness connector terminal D. Meter should read battery voltage. If not, repair wiring from circuit breaker.
• Turn ignition switch to OFF and measure resistance from unplugged wiper motor side harness connector terminal G to ground. Meter should read zero ohms. If not, repair wiring to ground.

(3) Leave ignition switch in OFF, and back probe wiring harness connector at wiper motor (Fig. 8). Measure resistance from terminal 4 of wiper motor side of connector to ground. Meter should read zero ohms. If not, repair wiring to ground.

(4) If equipped with intermittent wipers, turn ignition switch to ACCESSORY or ON. Turn wiper switch to LOW or HIGH. Unplug wiring harness connector (wiper switch side) from intermittent wiper module. Then plug both connectors that have been removed from intermittent wiper module into each other.

CAUTION: DO NOT move the wiper switch to DELAY with the intermittent wiper module removed from the circuit. If the switch is moved to the DELAY position during the next step, the switch will be damaged.

• Test wiper operation in LOW and HIGH speed modes, and test washer operation. If these modes were inoperative, but are OK now, replace failed intermittent wiper module.

(4) To test the wiper/washer switch, see Wiper Switch Testing. Turn ignition switch to OFF. Position the wiper switch as indicated, and back probe switch side of wiper switch connector. If switch tests OK, go to step 5. If not, replace switch and go to step 6.

(5) To further test the wiper/washer switch, turn ignition switch to ACCESSORY or ON. Position the wiper switch as indicated in the tests below, and back probe switch side of wiper switch connector.
• Measure voltage at terminal E with wiper switch in LOW, MIST and with washer switch depressed. Meter should read battery voltage. If not, replace switch.
• Measure voltage at connector terminal C with wiper switch in HIGH. Meter should read battery voltage. If not, replace switch.
• With wiper switch in LOW or HIGH, measure voltage at connector terminal F, then move wiper switch to OFF. Meter shold read battery voltage until wipers park and then zero volts. If OK, go to step 6. If not, check wiring to wiper motor, then go to step 6.

(6) To test the wiper motor, turn the ignition switch to ACCESSORY or ON. Position the wiper switch and back probe the motor connector (Fig. 8) as indicated.

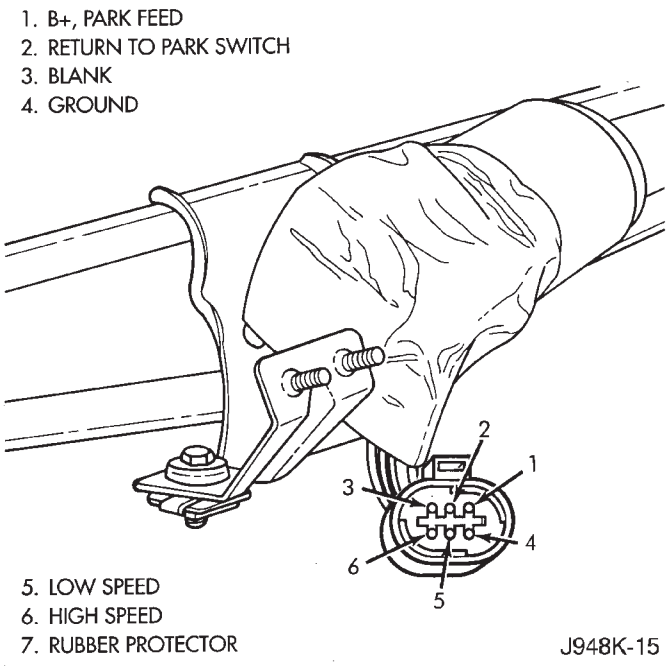


Fig. 1 Windshield Wiper Connector

• Wiper switch in any position, measure voltage at terminal 1. Meter should read battery voltage. If not, repair wiring from circuit breaker.
• Wiper switch in LOW, measure voltage at terminal 5. Meter should read battery voltage. If OK, but wipers do not operate, replace failed wiper motor. If not, repair wiring from switch or intermittent wiper module connector.
• Wiper switch in HIGH, measure voltage at terminal 6. Meter should read battery voltage. If OK, but wipers do not operate, replace failed wiper motor. If not, repair wiring from switch or intermittent wiper module connector.
• Wiper switch in LOW or HIGH, voltmeter connected to terminal 2. Turn wiper switch to OFF and observe meter. Meter should read battery voltage when switch goes to OFF, then zero volts after wipers park. If battery voltage is present, but wipers fail to park; or, if no battery voltage present, replace failed wiper motor.

DIAGNOSING WINDSHIELD WASHER (NON-INTERMITTENT)

(1) Unplug washer pump connector.
• Measure resistance between terminal A at pump and a clean chassis ground. Meter should read zero ohms. If not, repair open to ground.

(2) Turn ignition switch to ACCESSORY and washer switch to ON.
• Measure voltage at washer pump connector terminal B. Meter should read battery voltage. If OK, replace washer pump. If not, go to next step.

• Measure voltage at wiper/washer switch connector terminal B. Meter should read battery voltage. If OK, repair open to washer pump. If not, replace switch.

DIAGNOSING WINDSHIELD WASHER (INTERMITTENT)

(1) Unplug washer pump connector.

• Measure resistance between terminal B at pump and a clean chassis ground. Meter should read zero ohms. If not, repair open to ground.

(2) Turn ignition switch to ACCESSORY and washer switch to ON.

• Measure voltage at wipe module switch connector terminal B (pink wire). Meter should read battery voltage. If not, replace wiper switch.

• Measure voltage at wipe module motor connector terminal B (brown wire). Meter should read battery voltage. If not, replace module.

• Measure voltage at washer pump connector terminal A at pump. Meter should read battery voltage. If OK, replace pump. If not, repair open from wipe module.

INTERMITTENT WIPER MODULE

The intermittent wiper module is non-serviceable. Refer to the wiring schematic for connector call outs.

The intermittent wiper module is attached to the lower instrument panel cover near the steering column with a patch of velcro.

LIFTGATE WIPER

GENERAL

The rear wiper motor contains electronic controls to provide three operating modes.

• Intermittent wipe with a 5 to 8 second delay between sweeps.

• Constant wipe that operates in conjunction with a washer.

• Park mode that operates when ignition or rear wiper switch is turned OFF.

The rear wiper switch is located in the instrument panel and is supplied current when the ignition switch is in the ON position. When the switch is placed in the intermittent wipe position it provides current to the rear wiper motor. When it is held in the wash/wipe position it provides current to both the motor and the rear washer pump. The switch is spring loaded in the wash/wipe position.

REMOVAL

(1) Remove the wiper arm assembly from the pivot pin by depressing the tab (Fig. 1) and pulling straight out.

(2) Slide clip along hose until clip is off hose mounting.

(3) Disconnect the washer hose.

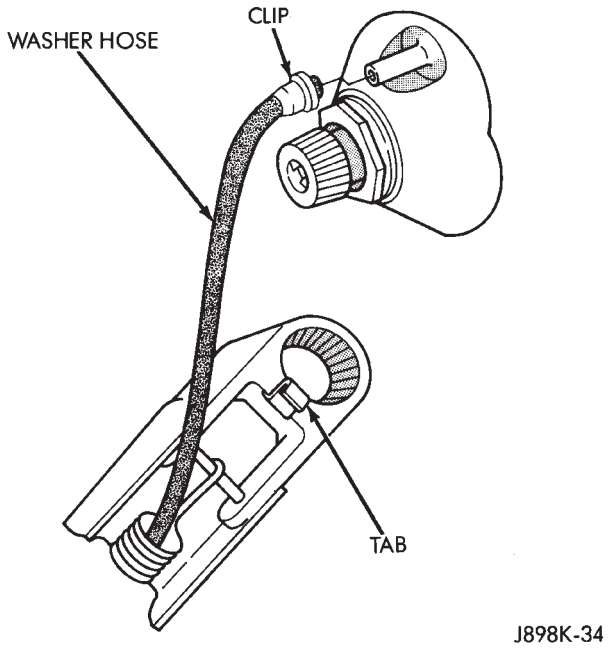


Fig. 1 Rear Wiper Arm Removal

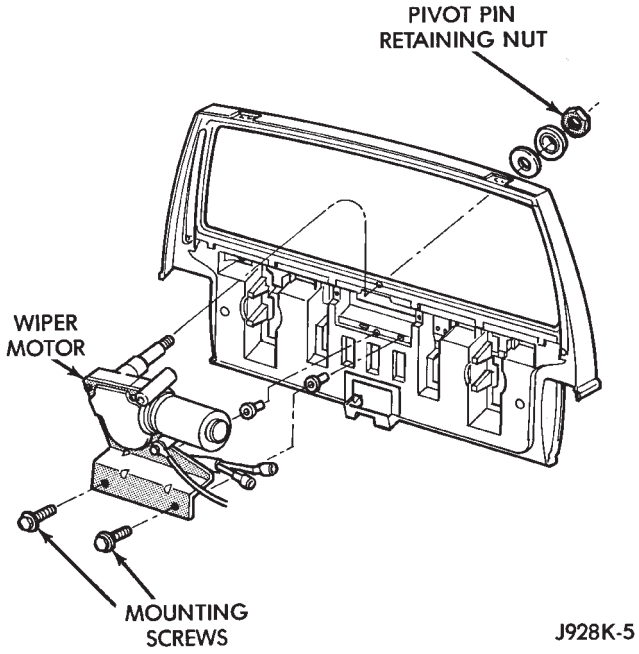


Fig. 2 Rear Wiper Motor Removal/Installation

(4) Remove pivot pin retaining nut.

(5) Remove external bezel and seal.

(6) Remove the liftgate interior trim panel.

(7) Disconnect the wiper motor at the wiring harness.

(8) Remove the wiper motor mounting screws.

(9) Remove the wiper motor.

INSTALLATION

(1) Position the motor (Fig. 2) in the liftgate cavity with the pivot pin protruding through the hole in the liftgate.

(2) Install the mounting screws.
(3) Connect the wiring harness.
(4) Install the pivot pin, seal, bezel and attaching nut (Fig. 2). Torque nut to 4 N·m (32 in. lbs.).
(5) Connect interior washer hose.

Lubricate the bezel nipples with a small amount of water and then install the washer hoses.

(6) Install the liftgate trim panel.
(7) Install the wiper arm assembly and connect the external washer hose to the bezel.
(8) Slide the clip along the hose until it is over hose mount.

The blade should be parallel to window opening and no closer than 5mm to window seal when operated on a wet window (Fig. 3).

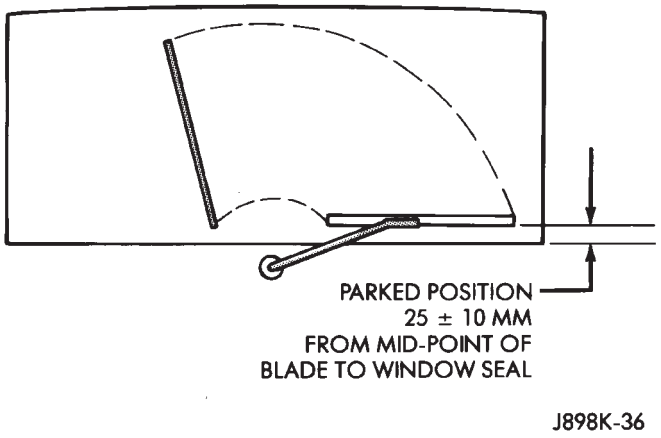


Fig. 3 Rear Wiper Arm Positioning

WASHER PUMP REPLACEMENT

The washer pump for the liftgate is located next to the front washer pump on the washer reservoir in the engine compartment. For replacement refer to the front washer pump replacement procedure.

LIFTGATE WIPER SWITCH REPLACEMENT

(1) Remove the instrument panel bezel; see Instrument Panel and Components Section for the procedure.
(2) Remove the switch housing panel.
(3) Unplug the switch connector. Slightly depress the switch mounting tabs and remove the switch (Fig. 4).

DIAGNOSING REAR WIPER

(1) Remove and inspect 25 amp, #1 fuse. Replace as required.
(2) Turn ignition switch to ACCESSORY and rear wiper switch to WASH.
• Measure voltage at rear wiper switch terminal B. Meter should read battery voltage. If not, repair open to #1 fuse.
• Measure voltage at rear wiper switch terminals A, C and D. Meter should read battery voltage. If not, replace switch.

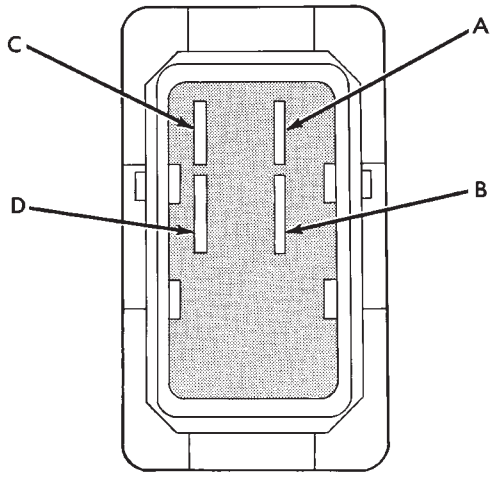


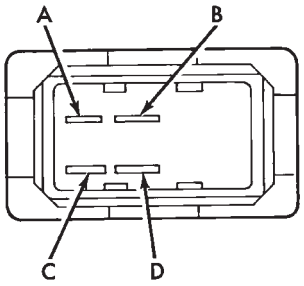
Fig. 4 Rear Wiper Switch

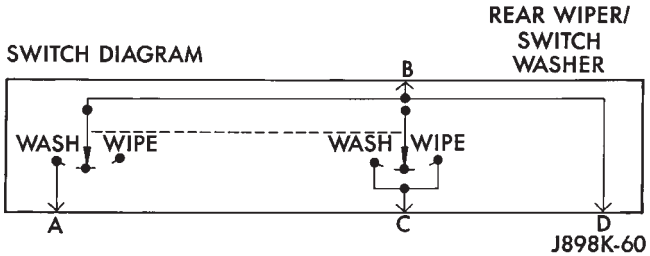
(3) Turn ignition switch to ACCESSORY, place rear wiper switch in WIPE. Measure voltage at rear wiper switch terminal C. Meter should read battery voltage. If not, replace switch.
(4) Remove liftgate cover and measure resistance from rear wiper motor terminal 1 to a good ground. Meter should read zero ohms. If not, repair open to ground splice.
(5) Turn ignition switch to ACCESSORY and rear wiper switch to WASH.
• Measure voltage at motor connector terminals 2, 3 and 4. Meter should read battery voltage. If OK, replace wiper motor. If not, repair open(s) to rear wiper switch.

DIAGNOSING REAR WIPER WASHER

(1) Turn ignition switch to ACCESSORY and place rear wiper/washer switch in WASH.
• Operate rear wiper motor. If motor does not operate check the 25 amp #1 fuse.
(2) Turn ignition switch to ACCESSORY and unplug rear washer pump connector.
• Measure resistance at pump connector terminal B (ignition switch OFF). Meter should read zero ohms. If not, repair open to ground.
• Measure voltage at pump connector terminal A, switch in WASH. Meter should read battery voltage. If OK, replace pump. If not, go to step 3.
(3) Remove switch and reconnect below instrument panel. Backprobe switch connector with ignition switch in ACCESSORY.
• Measure voltage at switch connector terminal B. Meter should read battery voltage. If not, repair open to fuse.
• Measure voltage at switch connector terminal A, switch in WASH. Meter should read battery voltage. If not, replace switch.

REAR WIPER/WASHER SWITCH TESTING





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SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
OFF (NORMAL)	B AND A	NO
	B AND C	NO
WIPE	B AND C	YES
	B AND A	NO
WASH	A AND B	YES
	B AND C	YES

J908K-17

TORQUE SPECIFICATIONS XJ

Component	Torque
Front Window Wiper Pivot Screws and Cowl Bracket Nut	4 N•m (35 in. lbs.)
Rear Window Wiper Pivot – Liftgate	5 N•m (44 in. lbs.)
Rear Window Wiper Motor Mounting Bracket – Liftgate	5 N•m (40 in. lbs.)

J918K-14

YJ

INDEX

FRONT WIPERS/WASHERS GENERAL INFORMATION

The non-intermittent windshield wiper circuit contains three components; control switch, motor and washer pump. The intermittent circuit contains the same components and a wiper module that provides the delay function. Both circuits receive battery feed from and are protected by a 5.3 amp circuit breaker.

In the non-intermittent wiper circuit, the switch connects the motor directly to ignition feed for low and high speed operation. In the intermittent circuit, the switch supplies ignition feed to the delay module, which then supplies the motor. In the delay position, the module is connected with the variable resistor in the wiper switch. The value of the resistance is used by the solid state module to charge a capacitor, which triggers the amount of delay between wipes.

The wiper motor has an arrangement of brushes providing the two wiper speeds. When the wipers are turned off, the park switch maintains current to the motor until the wipers reach the park position on the windshield.

The washer pump receives ignition feed either directly from the wiper switch or from the intermittent module. In either case the electric motor will drive the washer pump.

The wiper motor is mounted on the lower left corner of the windshield.

FRONT WIPER BLADE REPLACEMENT

Rotate the wiper blade release (Fig. 1) clockwise. This will release the wiper blade from the pivot pin.

CAUTION: Take care to ensure that the wiper arm does not strike the windshield after the wiper blade has been removed.

To install, place the blade assembly on the wiper arm and snap the blade assembly into position.

FRONT WIPER ARM REPLACEMENT

(1) Pull the wiper arm forward.

(2) Insert an ice pick type tool into the hole (Fig. 2).

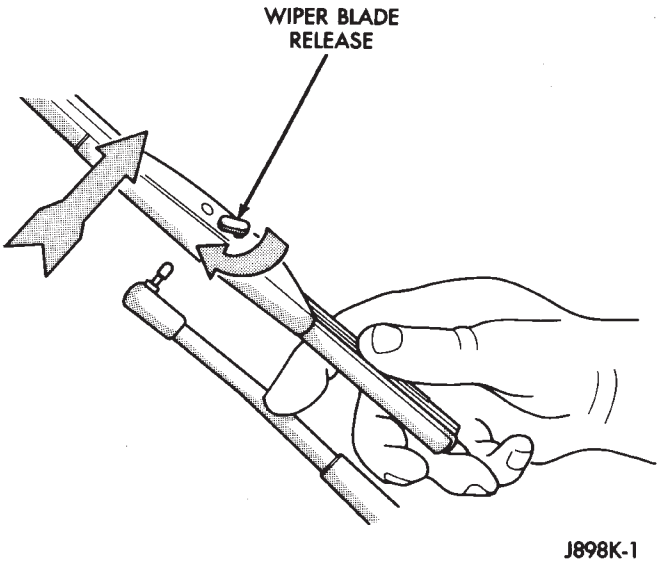


Fig. 1 Wiper Blade Removal

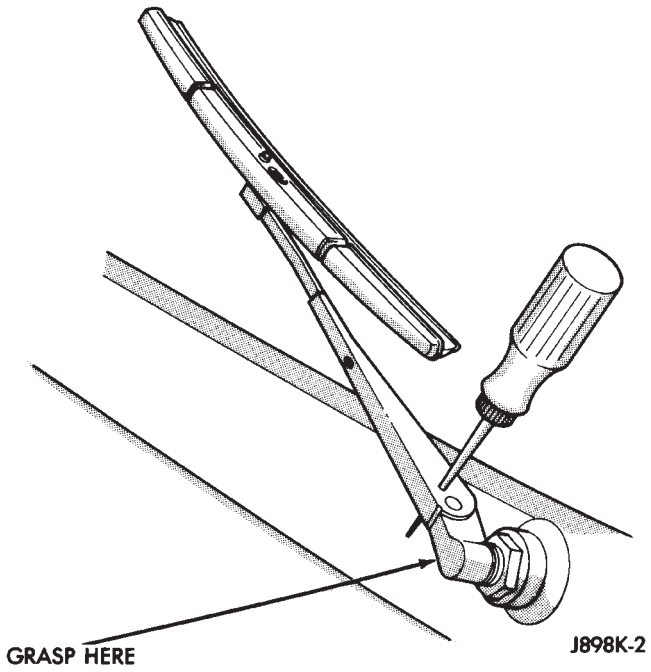


Fig. 2 Wiper Arm Removal/Installation

(3) Grasp the wiper arm above the pivot nut.
(4) Pull and remove the wiper arm assembly.
(5) To install, push the wiper arm over the pivot shaft. Be sure the pivot shaft is in the park position and the wiper arm is positioned correctly on the windshield (Fig. 3).

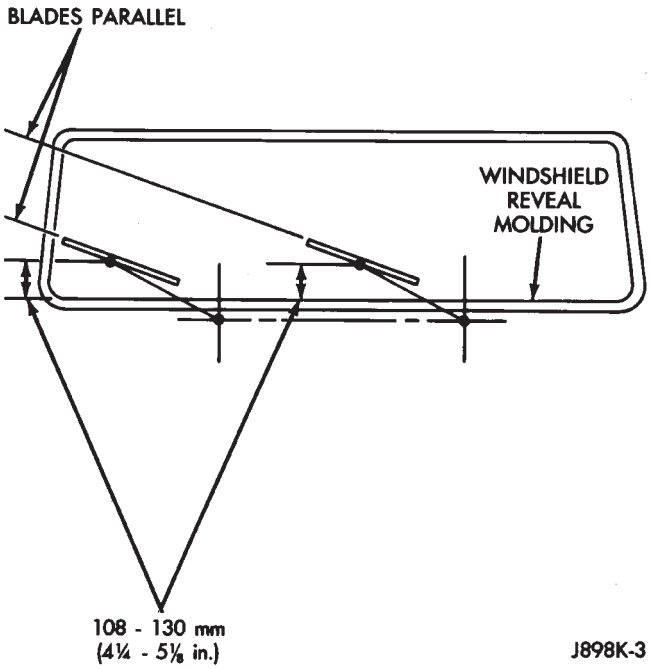


Fig. 3 Wiper Arm Positioning

FRONT WIPER ARM AND PIVOT ASSEMBLY REPLACEMENT

REMOVAL

(1) Remove the left and right wiper arms.
(2) Remove the nuts attaching the pivots to the windshield frame.
(3) Remove the necessary hard or soft top components from the windshield frame.
(4) Remove the windshield holddown bolts in the lower corners of the instrument panel and fold the windshield forward.
(5) Remove wiper motor mounting screws (Fig. 4).
(6) Disconnect wiper linkage drive arm (Fig. 5).
(7) Remove motor wiring clip from base of windshield frame.
(8) Remove 4 inboard screws holding seal to bottom of windshield frame (protruding screw ends interfere with pivot link removal and installation).
(9) Grasp motor and pull motor and drive arm out of access hole (Fig. 6).
(10) Remove pivot shaft assembly through access hole.
(11) Pry drive arm off the motor pivot. DO NOT remove pivot attaching nut (Fig. 7).

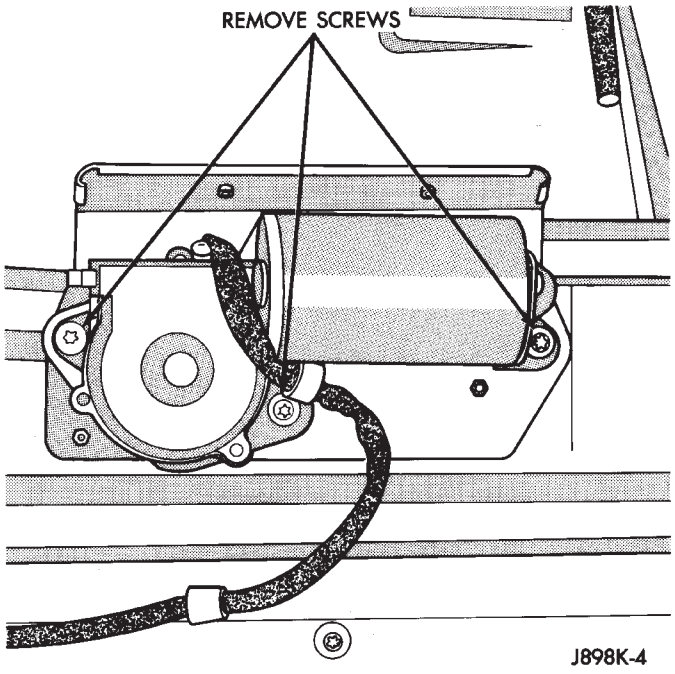


Fig. 4 Remove Wiper Motor Mounting Screws

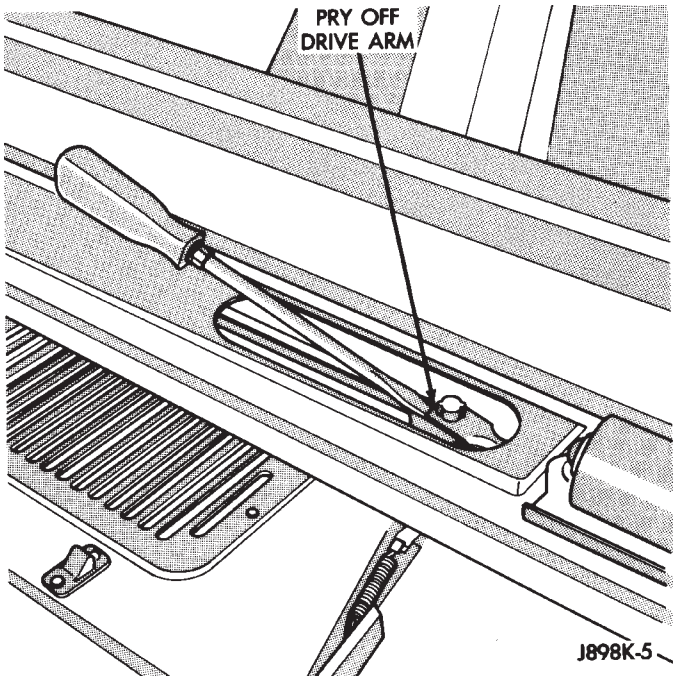


Fig. 5 Disconnect Drive Arm

INSTALLATION

(1) Install wiper linkage drive arm onto motor (Fig. 8).
(2) Install pivot shaft assembly in windshield frame.
(3) Install motor and drive arm in windshield frame.
(4) Install weatherstrip screws.
(5) Connect wiper linkage drive arm to pivot shaft (Fig. 9).

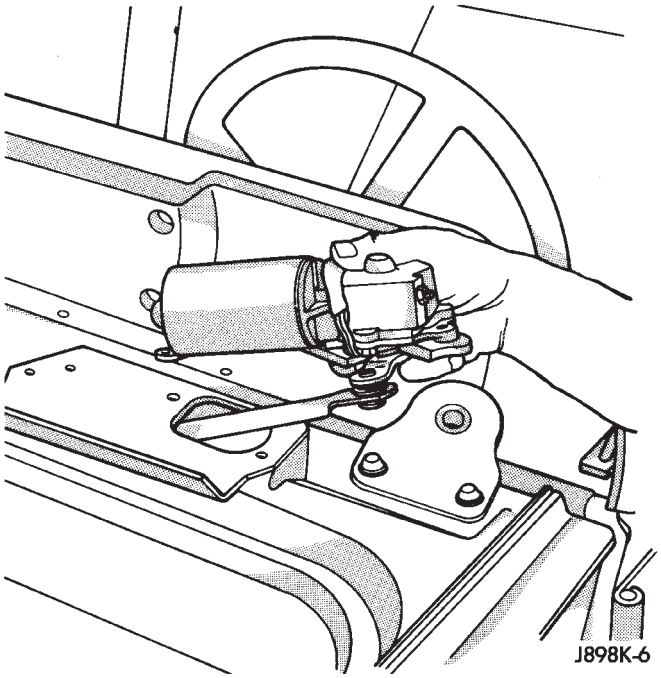


Fig. 6 Remove Wiper Motor and Drive Arm

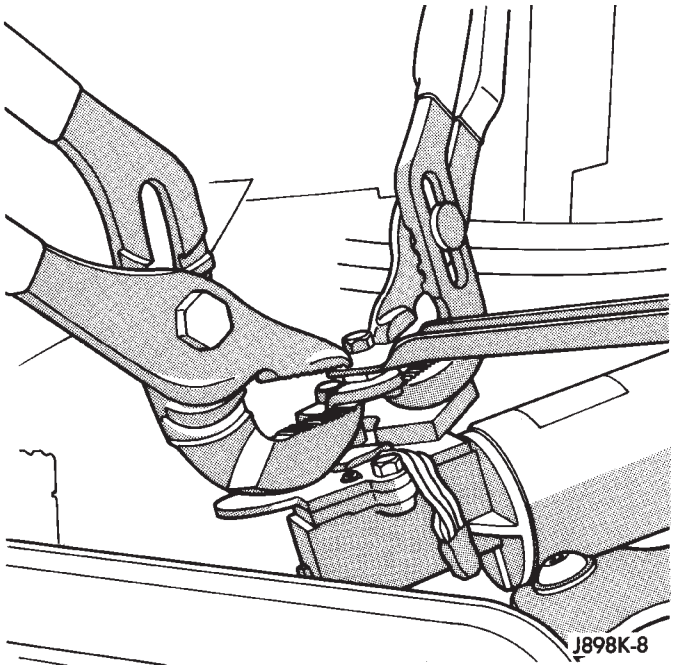


Fig. 8 Install Drive Arm On Motor

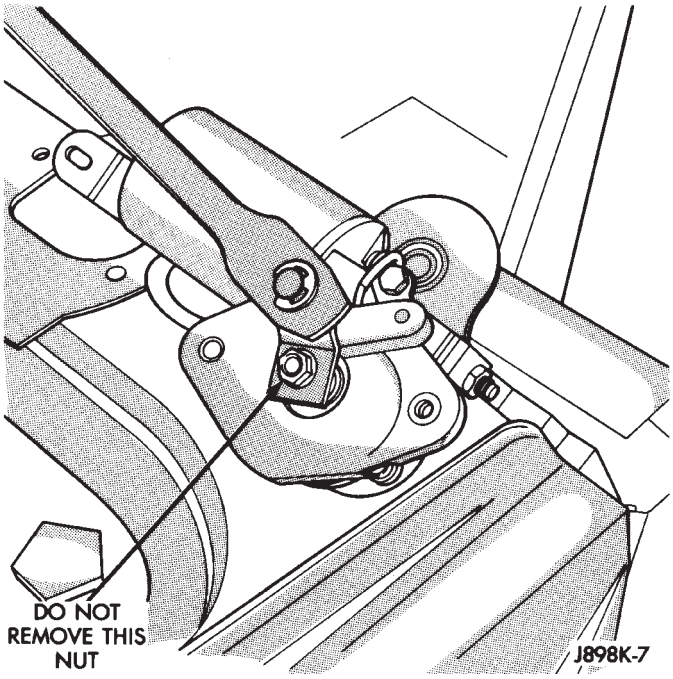


Fig. 7 Drive Arm Removal

(6) Install motor mounting screws. Tighten screws to 10.5 N·m (96 in. lbs.).

Be sure wire harness is not pinched or cut when windshield frame is rotated to upright position.

(7) Raise windshield to upright position and install left and right windshield holddown bolts.

(8) Install nuts attaching pivots to windshield frame. Tighten nuts to 10 N·m (7.5 ft. lbs.).

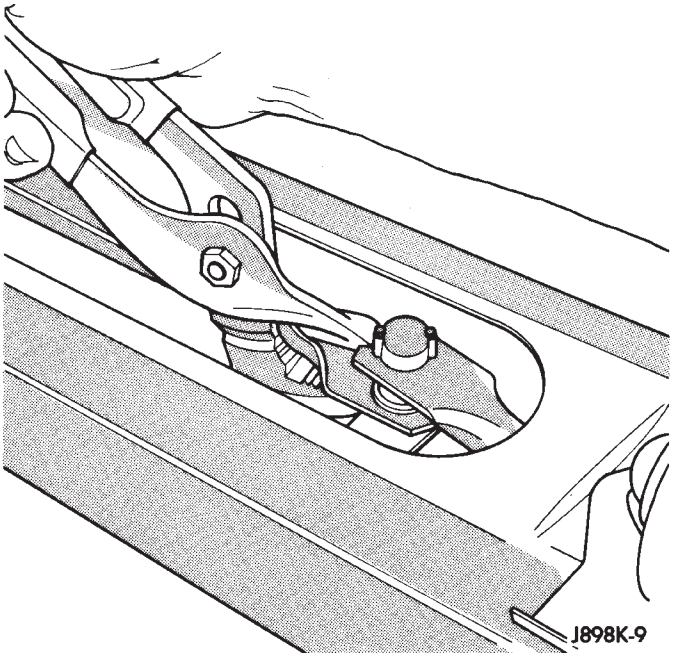


Fig. 9 Connect Drive Arm To Pivot Shaft

(9) Turn wipers on to allow motor to cycle to park position.

(10) Install left and right wiper arms (Fig. 3).

(11) Install necessary top components on windshield frame.

FRONT WIPER MOTOR

REMOVAL

(1) Remove the necessary hard or soft top components from the windshield frame.

(2) Remove the windshield holddown bolts in the lower corners of the instrument panel.
(3) Remove wiper motor mounting screws (Fig. 4).
(4) Remove wiper motor harness retaining clip located on bottom of windshield.
(5) Disconnect the wiper linkage drive arm (Fig. 5)
(6) Grasp the motor and pull the motor and drive arm out of the access hole (Fig. 6).
(7) Pry the drive arm off the motor pivot. DO NOT remove the pivot attaching nut (Fig. 7).
(8) Remove 2 screws holding intermittent wipe module bracket to bottom of instrument panel.
(9) Reach up behind instrument panel and disconnect wiper motor harness.
(10) Remove wiper motor.

INSTALLATION

(1) Install wire harness through hole in top of instrument panel.
(2) Connect wiper motor connector behind instrument panel.
(3) Install intermittent wipe module bracket to bottom of instrument panel.
(4) Turn wipers on to allow motor to cycle to park position.
(5) Install wiper linkage drive arm onto motor (Fig. 8).
(6) Install motor and drive arm in the windshield frame.
(7) Connect wiper linkage drive arm to pivot shaft (Fig. 9).
(8) Install motor mounting screws. Tighten screws to 10.5 N·m (96 in. lbs.).
(9) Install wire harness retaining clip on bottom of windshield.

Be sure wire harness is not pinched or cut when windshield frame is rotated to upright position.

(10) Raise windshield to upright position and install left and right windshield holddown bolts.
(11) Install the necessary top components on windshield frame.

WASHER PUMP REPLACEMENT

(1) Remove 3 washer reservoir mounting screws (Fig. 10).
(2) Disconnect hose(s) from pump.
(3) Drain washer reservoir.
(4) Using a deep socket, remove filter nut from bottom inside reservoir and remove pump.
(5) Reverse the removal procedure to install a new pump.

DIAGNOSING WINDSHIELD WIPERS

(1) Remove in-line circuit breaker near fuse block and turn ignition switch to ACCESSORY or ON.

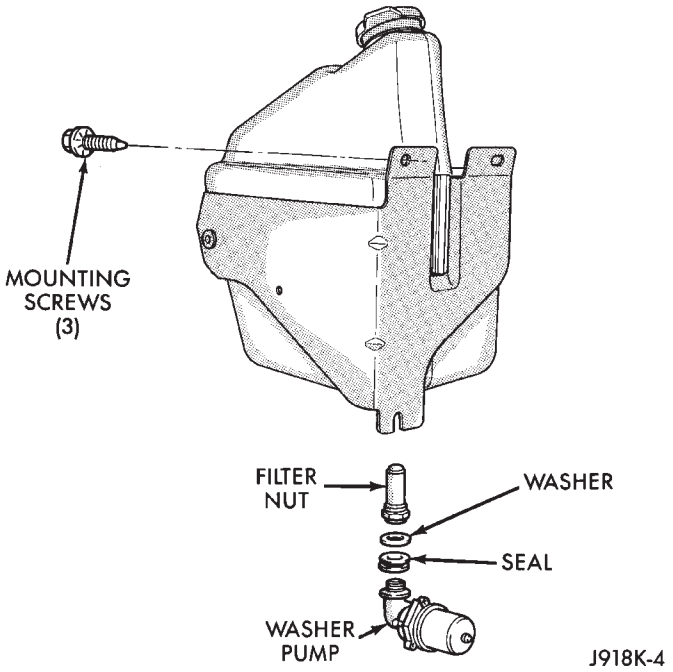


Fig. 10 YJ Washer Reservoir and Pump

- Measure voltage at battery side of circuit breaker cavity. Meter should read battery voltage. If not, repair wiring from ignition switch.
- Measure resistance across circuit breaker terminals. Meter should read zero ohms. If not, replace failed circuit breaker.

(2) Unplug wiper motor side wiring harness connector from wiper switch side harness connector (non-intermittent), or from intermittent wiper module at base of steering column. Turn ignition switch to ACCESSORY or ON.

- Measure voltage at unplugged wiper motor side harness connector terminal D. Meter should read battery voltage. If not, repair wiring from circuit breaker.
- Turn ignition switch to OFF and measure resistance from unplugged wiper motor side harness connector terminal G to ground. Meter should read zero ohms. If not, repair wiring to ground.

(3) Leave ignition switch in OFF, and back probe wiring harness connector at wiper motor. Measure resistance from terminal E of wiper motor side of connector to ground. Meter should read zero ohms. If not, repair wiring to ground.

(4) If equipped with intermittent wipers, turn ignition switch to ACCESSORY or ON. Turn wiper switch to LOW or HIGH. Unplug wiring harness connector (wiper switch side) from intermittent wiper module. Then plug both connectors that have been removed from intermittent wiper module into each other.

CAUTION: DO NOT move the wiper switch to DELAY with the intermittent wiper module removed from the circuit. If the switch is moved to the DELAY position during the next step, the switch will be damaged.

• Test wiper operation in LOW and HIGH speed modes, and test washer operation. If these modes were inoperative, but are OK now, replace failed intermittent wiper module.

(4) To test the wiper/washer switch, see Wiper Switch Testing. Turn ignition switch to OFF. Position the wiper switch as indicated, and back probe switch side of wiper switch connector. If switch tests OK, go to step 5. If not, replace switch and go to step 6.

(5) To further test the wiper/washer switch, turn ignition switch to ACCESSORY or ON. Position the wiper switch as indicated in the tests below, and back probe switch side of wiper switch connector.

• Measure voltage at terminal E with wiper switch in LOW, MIST and with washer switch depressed. Meter should read battery voltage. If not, replace switch.

• Measure voltage at connector terminal C with wiper switch in HIGH. Meter should read battery voltage. If not, replace switch.

• With wiper switch in LOW or HIGH, measure voltage at connector terminal F, then move wiper switch to OFF. Meter shold read battery voltage until wipers park and then zero volts. If OK, go to step 6. If not, check wiring to wiper motor, then go to step 6.

(6) To test the wiper motor, turn the ignition switch to ACCESSORY or ON. Position the wiper switch and back probe the motor connector as indicated.

• Wiper switch in any position, measure voltage at terminal B. Meter should read battery voltage. If not, repair wiring from circuit breaker.

• Wiper switch in LOW, measure voltage at terminal A. Meter should read battery voltage. If OK, but wipers do not operate, replace failed wiper motor. If not, repair wiring from switch or intermittent wiper module connector.

• Wiper switch in HIGH, measure voltage at terminal H. Meter should read battery voltage. If OK, but wipers do not operate, replace failed wiper motor. If not, repair wiring from switch or intermittent wiper module connector.

• Wiper switch in LOW or HIGH, voltmeter connected to terminal D. Turn wiper switch to OFF and observe meter. Meter should read battery voltage when switch goes to OFF, then zero volts after wipers park. If battery voltage is present, but wipers fail to park; or, if no battery voltage present, replace failed wiper motor.

DIAGNOSING NON-INTERMITTENT WINDSHIELD WASHER

Refer to Group 8W - Wiring Diagrams.

(1) Measure resistance from washer pump connector terminal B to a clean chassis ground. Meter should read zero ohms. If not, repair open between terminal B and ground.

(2) Turn ignition switch to ON and press washer switch.

• Measure voltage at switch connector terminal B. Meter should read battery voltage. If not, replace wiper/washer switch.

• Measure voltage at washer pump connector terminal A. Meter should read battery voltage. If OK, replace pump. If not, repair open between switch connector and pump connector.

DIAGNOSING INTERMITTENT WINDSHIELD WASHER

Refer to Group 8W - Wiring Diagrams.

(1) Measure resistance from washer pump connector terminal B to a clean chassis ground. Meter should read zero ohms. If not, repair open between terminal B and ground.

(2) Turn ignition switch to ON and rotate washer switch tab forward.

• Measure voltage at wiper/washer switch connector terminal B located at intermittent wipe module. Meter should read battery voltage. If not, replace wiper switch.

• Measure voltage at intermittent wipe module connector terminal B (to washer pump). Meter should read battery voltage. If not, replace intermittent wipe module.

• Measure voltage at washer pump connector terminal A. Meter should read battery voltage. If OK, replace pump. If not, repair open from intermittent wipe module connector terminal B.

REAR WIPER ARM REPLACEMENT

(1) Install wiper arm remover, Snap On A192 or equivalent, on wiper arm (Fig. 11). Lift arm and then remove from pivot shaft.

CAUTION: Do not use a screwdriver or other prying tool to remove an arm. This may distort it in a way that will allow it to come off the pivot shaft in the future, despite how carefully it is installed. NEVER push or bend the spring clip in the base of the arm in an attempt to release the arm. This clip is self releasing.

(2) To install, reverse the removal procedure.

(3) Wet the window and check the park position by operating the wiper motor several times.

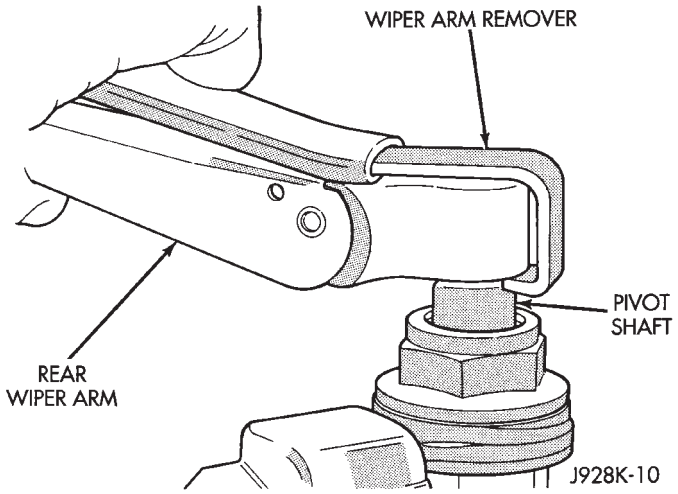


Fig. 11 Removing Liftgate Wiper Arm

REAR WASHER PUMP REPLACEMENT

The washer pump for the rear window is located next to the front washer pump on the washer reservoir in the engine compartment (Fig. 12). For replacement refer to the front washer pump replacement procedure.

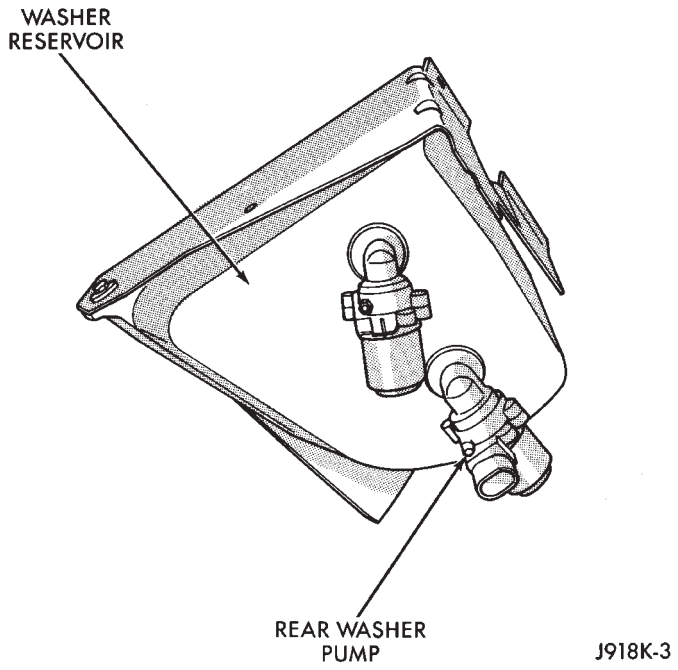


Fig. 12 Rear Washer Pump

REAR WIPER SWITCH REPLACEMENT

(1) Remove the instrumentation shroud; see Instrument Panel, Indicator Bezel Replacement.

(2) Remove the switch housing panel.

(3) Unplug the switch connector. Slightly depress the switch mounting tabs and remove the switch (Fig. 13).

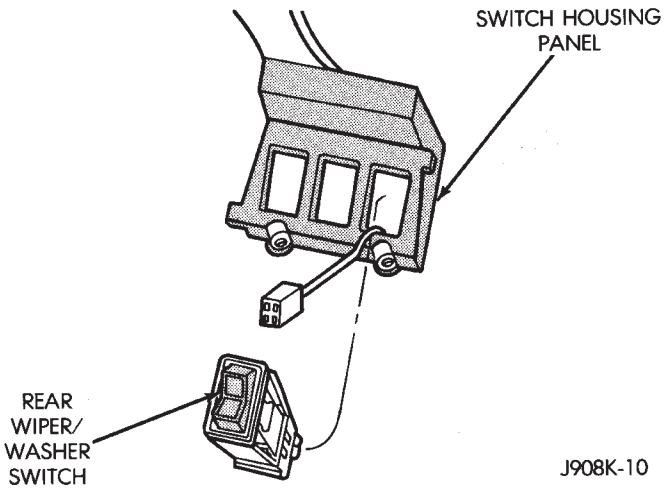


Fig. 13 Rear Wiper Switch

REAR WIPER MOTOR REPLACEMENT

(1) Remove wiper arm from motor (refer to Wiper Arm Replacement).

(2) Remove pivot shaft retaining nut.

(3) Remove motor trim cover (Fig. 14).

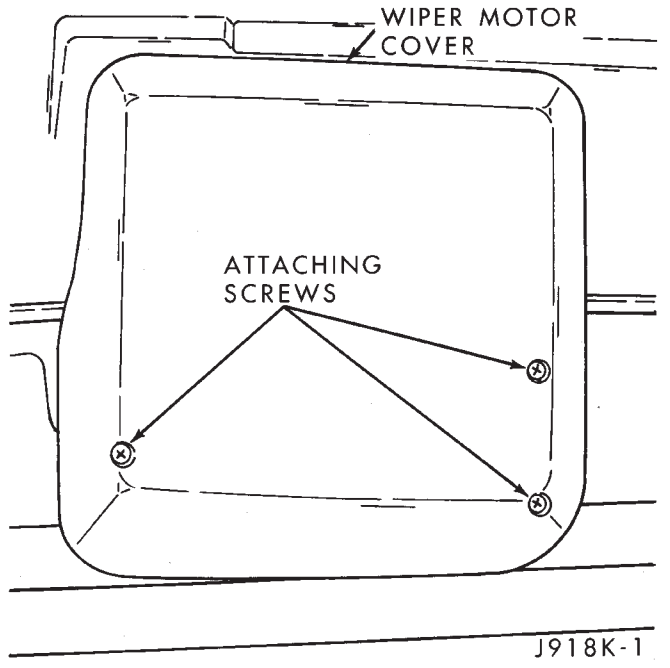


Fig. 14 Rear Wiper Motor Cover

(4) Disconnect electrical connector (Fig. 15).

(5) Remove hinge nut holding motor to top.

(6) To install, reverse the removal procedures.

WASHER NOZZLE REPLACEMENT

(1) From inside the vehicle remove the motor trim cover.

(2) Remove the washer hose from the back of the washer nozzle.

(3) Remove the nut holding the nozzle to the glass.

(4) Install the new washer nozzle.

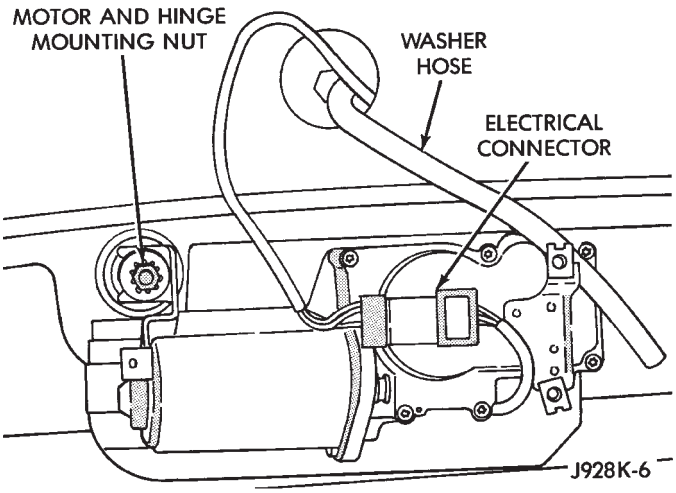


Fig. 15 Rear Wiper Motor

DIAGNOSING REAR WIPER/WASHER

Refer to Group 8W - Wiring Diagrams.

(1) Turn ignition switch to ON and rear wiper/ washer switch to WASH.

- Measure voltage at switch connector terminal P. Meter should read battery voltage. If not, check 20 amp, fuse #1.
- Measure voltage at switch connector terminal B. Meter should read battery voltage. If not, replace switch.
- Measure voltage at switch connector terminal A. Meter should read battery voltage. If not, replace switch.

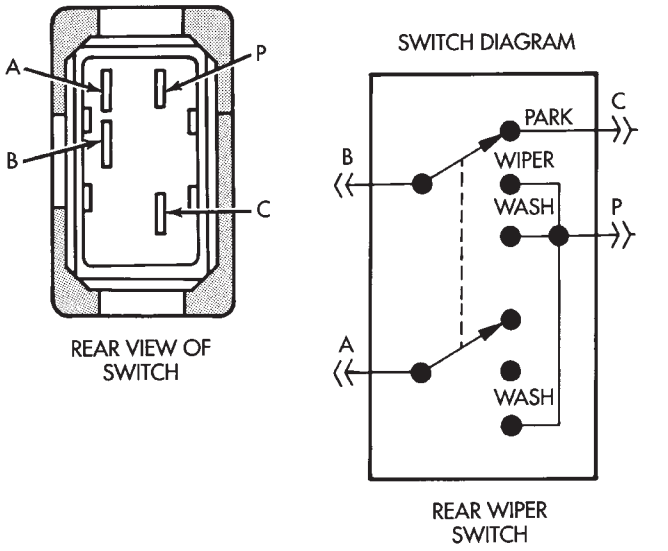
(2) Turn ignition switch to ON and unplug rear washer pump connector.

- Measure resistance at pump connector black wire to ground. Meter should read zero ohms (ignition OFF). If not, repair open to ground.
- Measure voltage at pump connector brown/white wire, switch in WASH. Meter should read battery voltage. If OK, replace pump. If not, check wiring.

(3) Turn ignition switch to ON, unplug rear wiper motor connector and place wiper switch in WIPE.

- Measure resistance at motor connector terminal B to ground. Meter should read zero ohms. If not, repair open to ground.
- Measure voltage at motor connector terminal A. Meter should read battery voltage. If not, check wiring to fuse.
- Measure voltage at motor connector terminal C. Meter should read battery voltage. If OK, replace motor. If not, repair open to switch.

REAR WIPER/WASHER SWITCH TESTING



SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
OFF (NORMAL)	P AND B	NO
	P AND A	NO
WIPE	P AND B	YES
	P AND A	NO
WASH	P AND B	YES
	P AND A	YES

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WIPER CONTROL SWITCH REPLACEMENT

(1) Disconnect negative cable from battery.
(2) Remove horn button with a push and turn motion.
(3) Remove horn button components (Fig. 1).

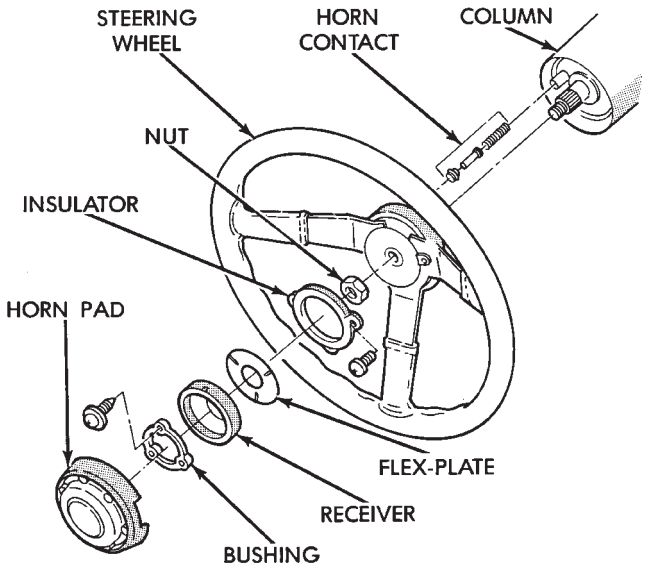


Fig. 1 Steering Wheel Removal/Installation

(4) Turn ignition switch to the LOCK position and remove the steering wheel nut and washer.
(5) Scribe an alignment mark on the steering in line with the mark already existing on the end of the steering column.
(6) Remove vibration damper from the steering column hub, if equipped.
(7) Remove steering wheel using a steering wheel puller. DO NOT hammer on puller or end of steering shaft.

WARNING: TO REMOVE THE STEERING SHAFT SNAP RING IN THE FOLLOWING STEP, THE LOCKPLATE MUST BE COMPRESSED. DO NOT ATTEMPT TO REMOVE THE LOCKPLATE WITHOUT COMPRESSOR TOOL C4156 AS THE LOCKPLATE IS UNDER HEAVY SPRING TENSION.

(8) Compress lockplate with compressor tool C4156.
(9) Remove steering shaft snap ring (Fig. 2). Discard snap ring. It is not reusable.
(10) Remove compressor tool.
(11) Remove lockplate, cancelling cam, and upper bearing preload spring.
(12) Remove horn button components from canceling cam.

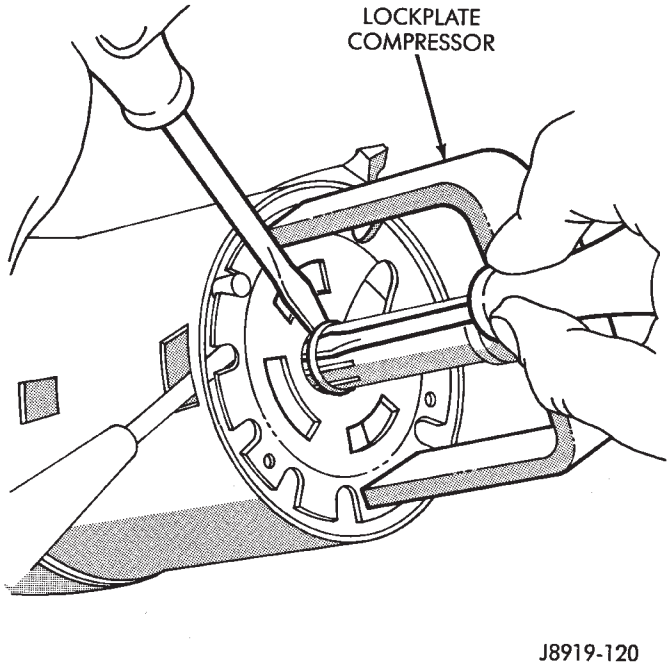


Fig. 2 Lockplate Removal

(13) Remove screw and hazard warning switch knob.
(14) Remove dimmer switch actuator arm attaching screw (Fig. 3).

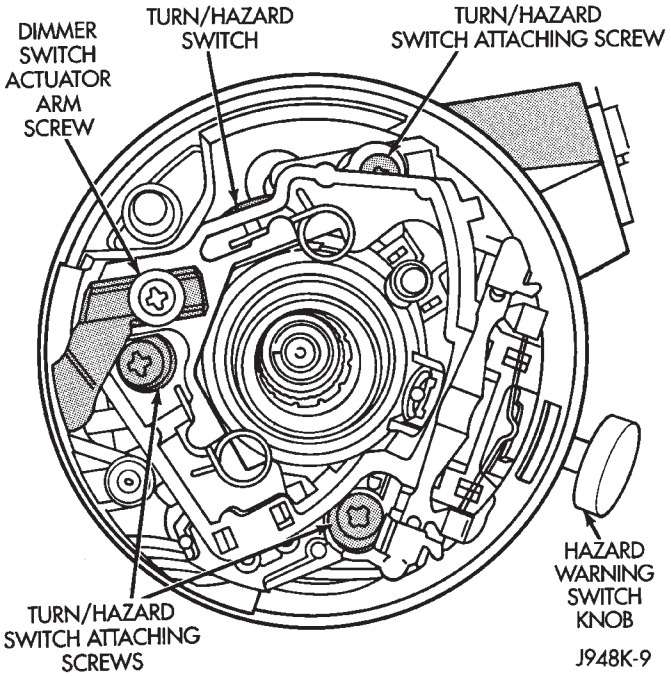


Fig. 3 Turn/Hazard Switch And Dimmer Actuating Arm Screws

(15) Remove turn/hazard switch attaching screws (Fig. 3).
(16) **XJ** Remove lower instrument panel cover trim panel.

(17) **YJ**

(a) Remove 6 shroud screws (Fig. 4).

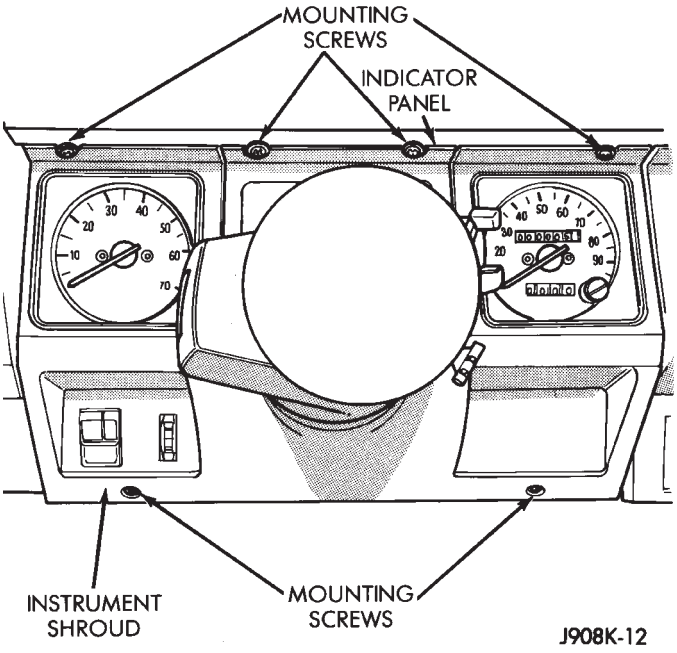


Fig. 4 Instrument Shroud Removal/Installation—YJ

(b) Slide shroud toward steering wheel.

(18) Remove cover under column.

(19) If vehicle is equipped with a column shift, remove PRNDL cable clip (Fig. 5).

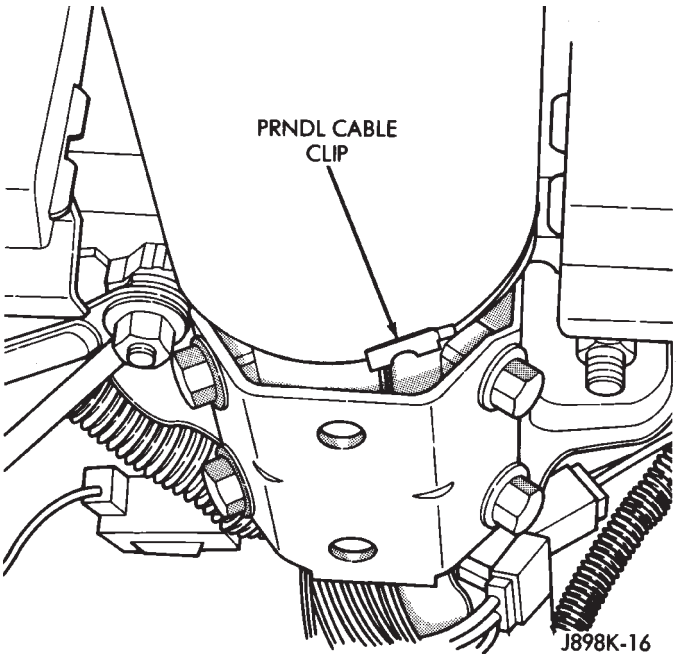


Fig. 5 PRNDL Cable Clip Removal/Installation

(20) Remove 2 nuts holding steering column bracket to brake sled (Fig. 6).

(21) Remove 4 bolts holding steering column brace to column.

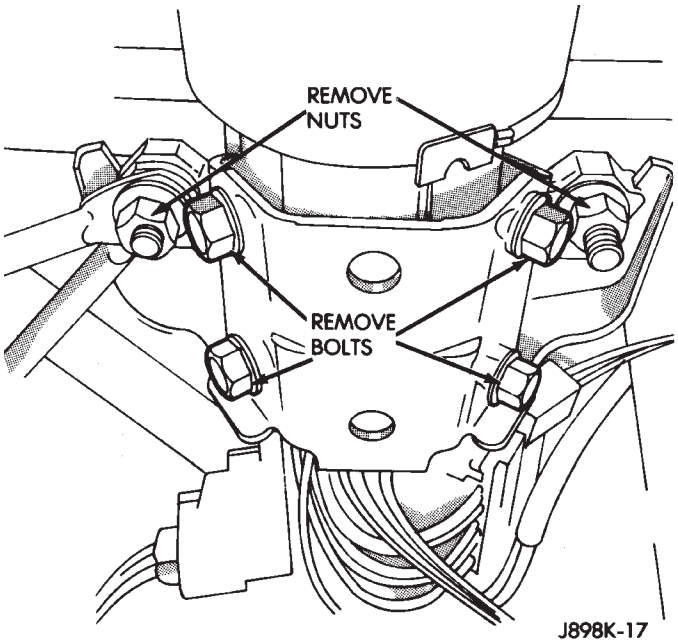


Fig. 6 Lower Steering Column Mounting

(22) Loosen column brace mounting nut at drivers side kick panel. This will allow column to drop.

(23) Unplug wiper switch connector.

(24) Tape connector to wires (Fig. 7).

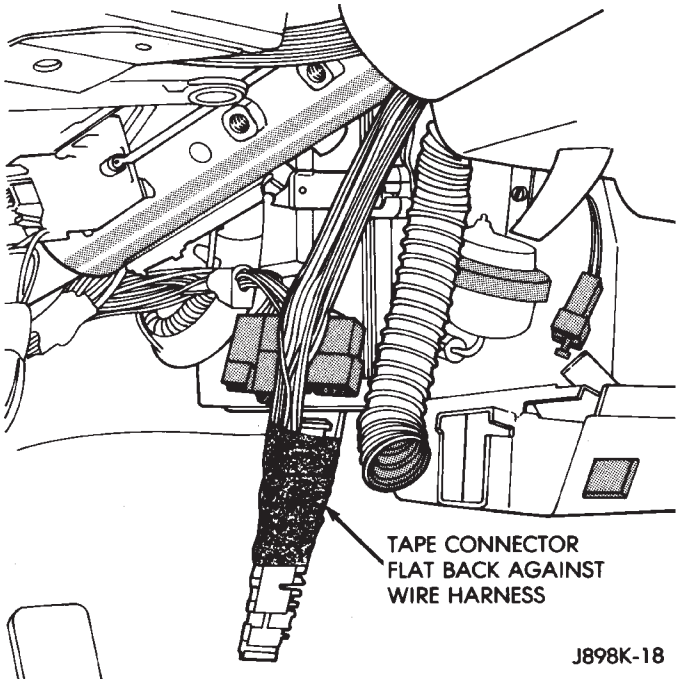


Fig. 7 Tape Wiper Switch Connector

(25) Push turn/hazard connector up and out of steering column connector (Fig. 8).

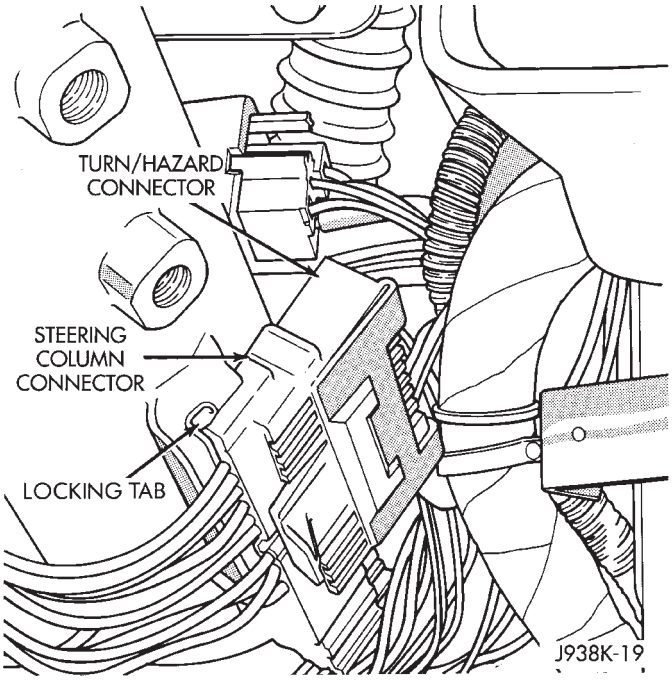


Fig. 8 Turn/Hazard Switch And Steering Column Connectors

(26) Pry up locking tabs of steering column connector and remove connector from column bracket.

(27) Remove plastic harness cover by pulling it up and over weld nuts then open and slide the cover off harness (Fig. 9).

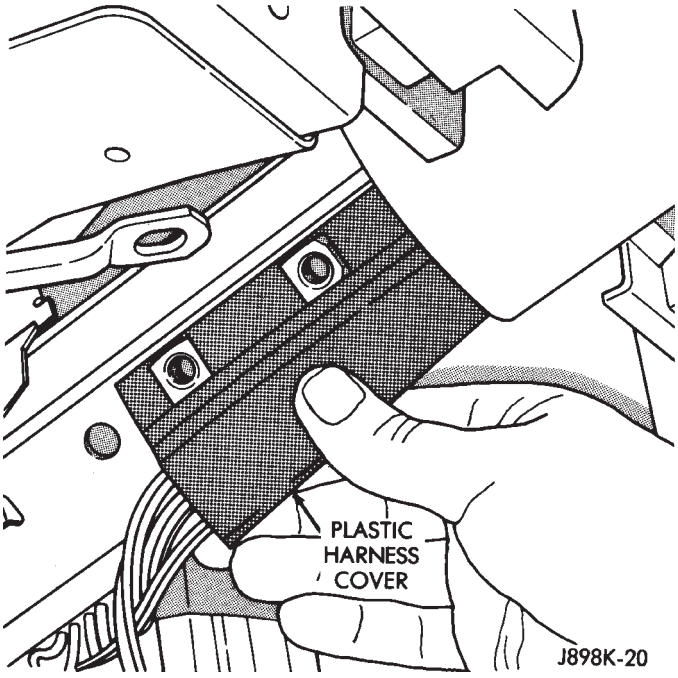


Fig. 9 Remove Plastic Harness Cover

(28) Pull turn/hazard switch out of column far enough to allow access to remaining screws.

(29) Insert ignition key in lock cylinder and turn ignition switch to ON position.

(30) Remove key warning buzzer switch and retaining clip with a paper clip inserted below retainer so that retainer is flattened (Fig. 10).

Do not attempt to remove buzzer switch and clip separately. The clip could fall into the column jacket.

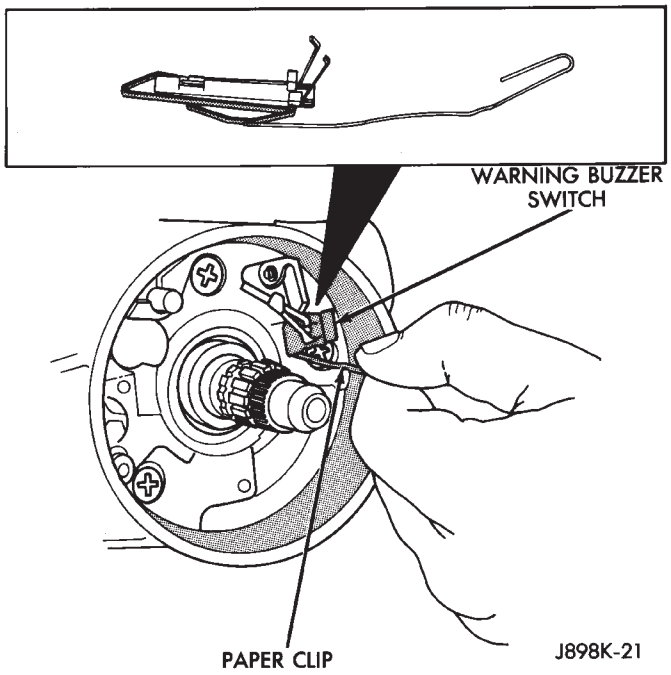


Fig. 10 Buzzer Switch Removal

(31) Remove ignition lock cylinder retaining screw and pull lock cylinder out of column housing (Fig. 11).

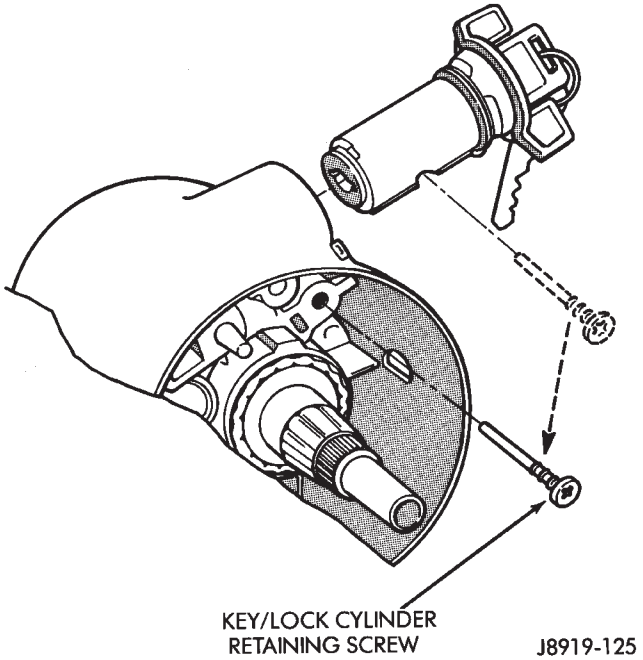


Fig. 11 Lock Cylinder Removal/Installation

(32) Remove screws that attach housing and shroud assembly to column jacket and carefully remove housing and shroud assembly (Fig. 12).

DO NOT let dimmer switch rod, lock pin or lock rack fall out.

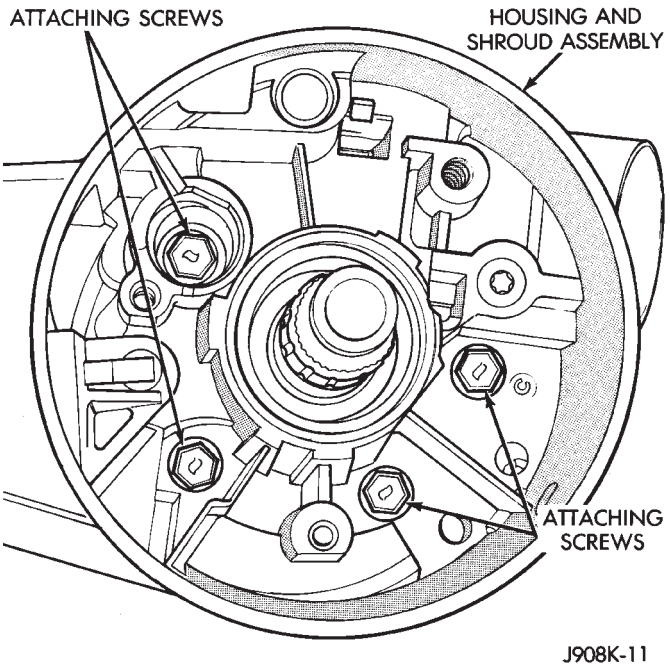


Fig. 12 Steering Column Housing Removal/Installation

(33) Remove turn/hazard/wiper lever by pulling it straight out of column.

(34) Remove wiper switch cover from back of housing and shroud assembly (Fig. 13). If equipped with column shift, remove screw holding the cover on.

(35) Remove pivot screw from housing and remove wiper switch.

(36) Install a new switch and switch cover.

(37) Push on dimmer switch rod to make sure it is connected then carefully position housing and shroud assembly to column (Fig. 14).

Make sure nylon spring retainer on lock pin is positioned forward of the retaining slot of lock rack (Fig. 14).

Position first tooth of gear (farthest from the block tooth) with the most forward tooth of lock rack.

(38) Install screws that attach housing and shroud assembly to column jacket and carefully mate housing and shroud assembly.

(39) Insert key and lock cylinder and test that lock pin extends fully when key is moved to lock position.

(40) To install remaining parts, reverse removal procedures.

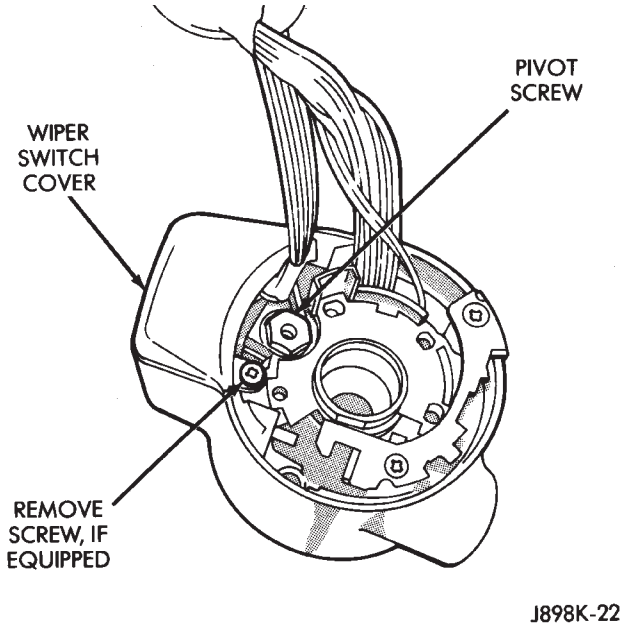


Fig. 13 Remove Pivot Screw

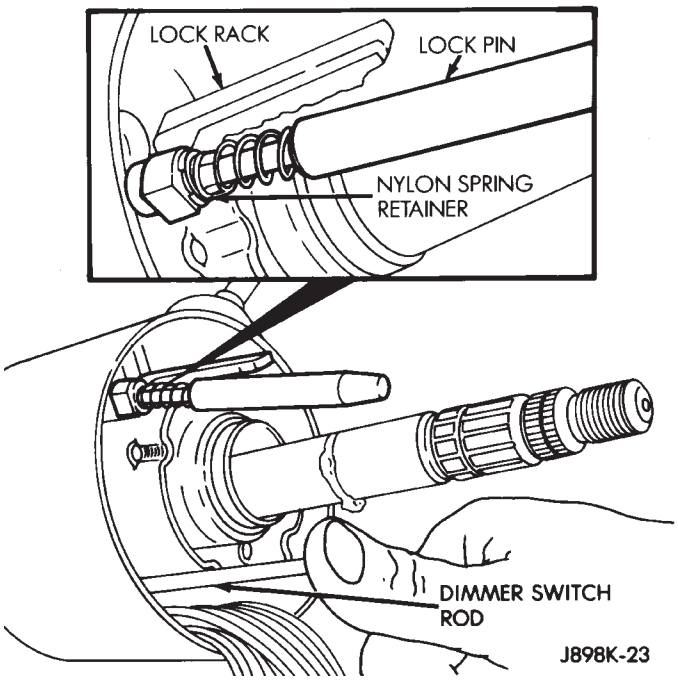


Fig. 14 Check Dimmer Switch Rod and Lock Pin

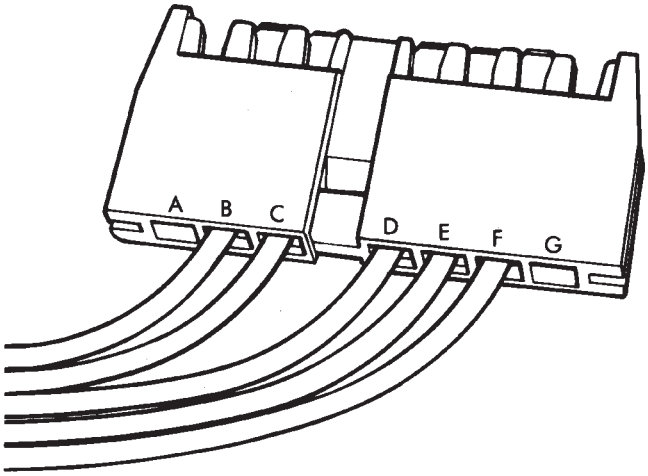
CAUTION: When installing a wiper switch, make sure wires are laying flat on bottom inside of column.

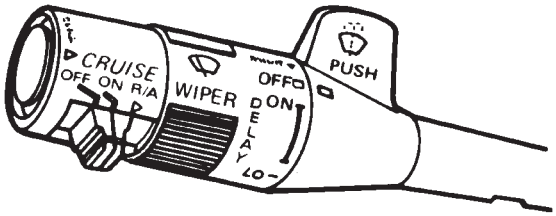
On vehicles equipped with column shift, install PRNDL cable clip with shift indicator on N (neutral). Move selector through the range and make sure it lines up with each letter.

(41) Install steering wheel. Tighten steering wheel nut to 34 N·m (25 ft. lbs.) torque.

WIPER SWITCH TESTING

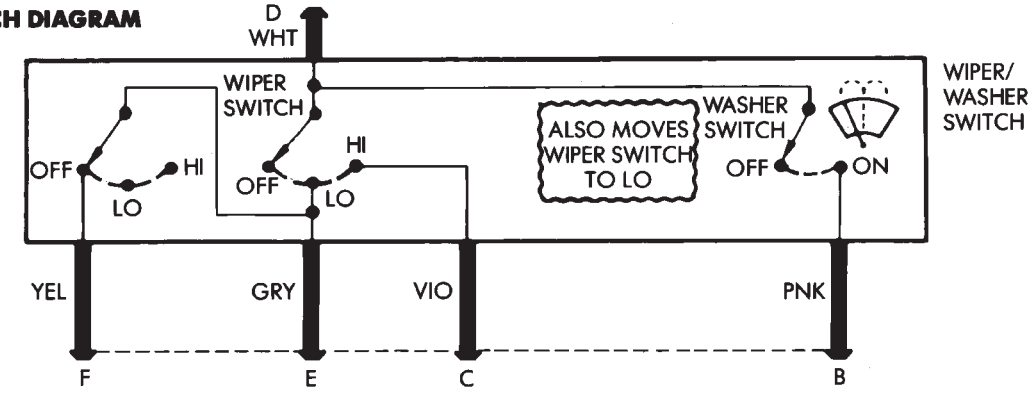
STANDARD WIPER WASHER





B - WASHER PINK
C - HI VIOLET
D - IGNITION WHITE
E - LO/PARK GRAY
F - OFF/PARK YELLOW

SWITCH DIAGRAM



SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
Off	E and F	Yes
	All Others	No
Lo	D and E	Yes
	All Others	No
Hi	C and D	Yes
	All Others	No
Wash	B and D	Yes
	D and E	Yes
	All Others	No

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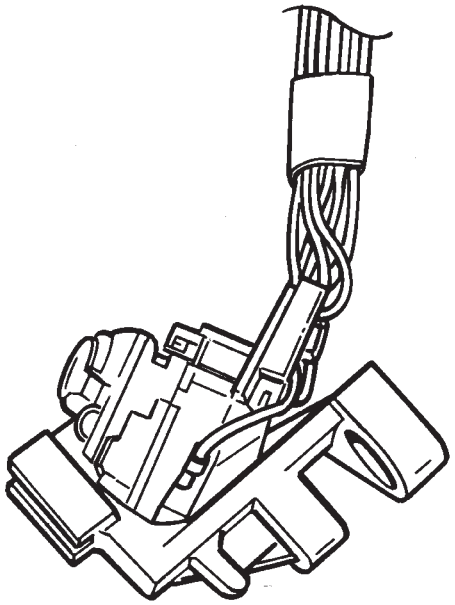
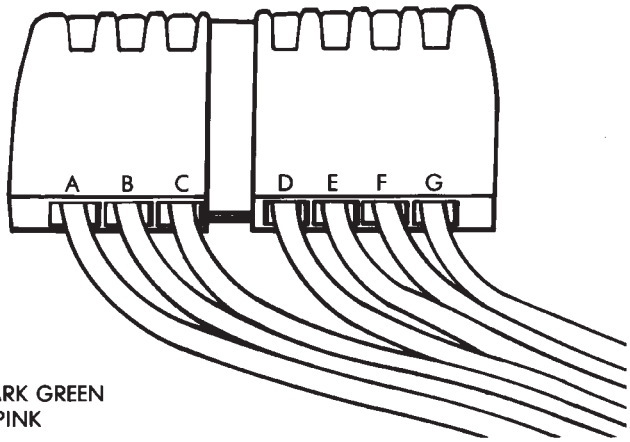
INTERMITTENT WIPER WASHER

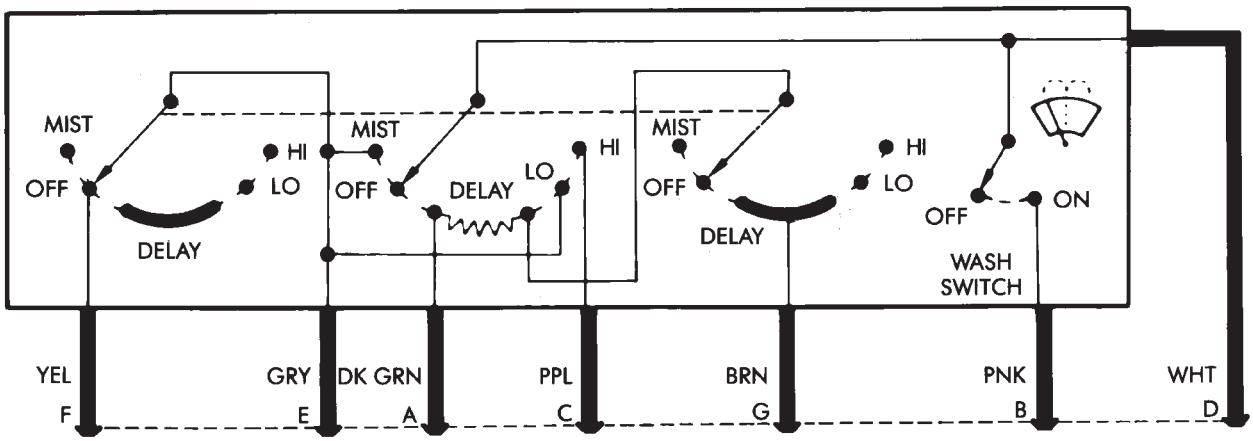




A - DELAY DARK GREEN
B - WASHER PINK
C - HI VIOLET
D - IGNITION WHITE
E - LO/MIST PARK GRAY
F - OFF/PARK YELLOW
G - DELAY BROWN

SWITCH DIAGRAM

WIPER/WASHER SWITCH



SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
Off	E and F	Yes
	All Others	No
Lo	D and E	Yes
	All Others	No
Hi	C and D	Yes
	All Others	No
Wash/Mist	B and D	Yes
	D and E	Yes
	All Others	No
Delay	A and G	152-480K ohms

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LAMPS

CONTENTS

EXTERIOR LAMPS

INDEX

SERVICE INFORMATION

Exterior lamp circuits are comprised of the headlamp circuit, fog lamp circuit, and tail/side marker/park lamp circuit. Battery voltage is controlled by both the headlamp ON/OFF switch and headlamp dimmer switch.

The dimmer switch functions as a fog lamp switch. Voltage is applied to the fog lamp switch only when the dimmer switch is in the low beam position.

HEADLAMP TROUBLE DIAGNOSIS—XJ VEHICLES

LOW AND HIGH BEAM INOPERATIVE BOTH HEADLAMPS

(1) Place the headlamp switch in the ON position.

(2) Test the 40 amp fuse for continuity. If bad, replace fuse.

(3) Insert the test probe into terminal 5 of the front lamp wire harness connector. Measure the resistance from terminal 5 to body ground. The ohmmeter should indicate zero ohms. If not OK, repair the open circuit in the harness to body ground.

(4) Disconnect the front lamp wire connector. Measure resistance between connector terminals 5 and 2. Next measure between terminal 5 and 7. The ohmmeter should indicate zero ohms for both measurements. If not OK, replace the headlamp bulbs.

(5) Measure the voltage between the dimmer switch wire connector terminal 2 and body ground. The voltmeter should indicate battery voltage. If not OK, continue with the next step.

The dimmer switch is integral with the turn signal and is located on the steering column. The dimmer switch switches the headlamp beam when the turn signal lever is pulled rearward.

(6) Disconnect the dimmer switch wire connector and place the headlamp switch in the OFF position. Measure the resistance from terminal 2 to vehicle body ground. The ohmmeter should indicate infinite resistance. If OK, replace the headlamp switch and continue with the next step. If not OK, repair the short circuit in the wire harness that leads to terminal 2.

(7) Measure the resistance from the dimmer switch wire harness connector terminal 1 to vehicle body ground. The ohmmeter should indicate zero ohms. If OK, continue with the next step. If not OK, repair the short circuit in the wire harness that leads to terminal 1.

(8) Measure the resistance from the dimmer switch wire harness connector terminal 3 to vehicle body ground. The ohmmeter should indicate zero ohms. If OK, test the dimmer switch. Replace, if defective. Connect the wire harness connector to the dimmer switch. If not defective, repair the short circuit in the wire harness that leads to terminal 3.

LOW OR HIGH BEAM INOPERATIVE BOTH HEADLAMPS

(1) Place the headlamp switch in the OFF position. Disconnect the dimmer switch wire harness connector.

(2) Measure the resistance from the dimmer switch connector terminal 1 to body ground. The ohmmeter should indicate zero ohms. If not OK, repair the open circuit in the wire harness that leads to the headlamp bulbs.

(3) Measure the resistance from the dimmer switch connector terminal 3 to vehicle body ground. The ohmmeter should indicate zero ohms. If OK, replace the dimmer switch. If not OK, repair the open circuit in the wire harness that leads to headlamp bulbs.

HEADLAMP TROUBLE DIAGNOSIS—YJ VEHICLES

(1) Place the headlamp switch in the ON position.

(2) Place the headlamp dimmer switch in the HIGH or LOW position.

(3) Disconnect the wire harness connectors from the headlamp bulbs.

(4) If applicable, measure voltage between each headlamp bulb wire connector terminal B and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in wire harness between connector and dimmer switch.

(5) If applicable, measure the voltage between each headlamp bulb connector terminal C and body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness between the connector and the dimmer switch.

(6) Measure the resistance from each headlamp bulb connector terminal A to body ground. The ohmmeter should indicate zero ohms. If not OK, repair the open circuit in the wire harness between the connectors and vehicle body ground.

SWITCH TESTS

HEADLAMP—ALL VEHICLES

(1) Refer to the applicable wiring diagram for terminal reference.

(2) Place the headlamp switch in the ON position.

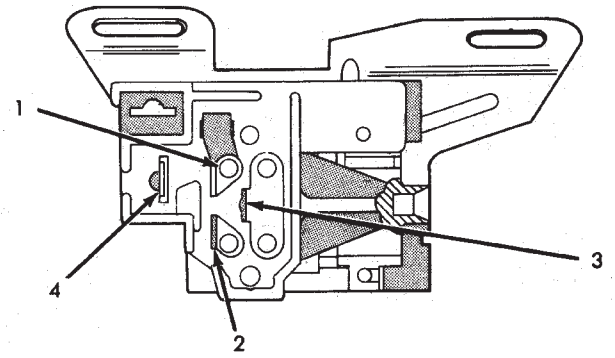
(3) Measure the voltage between the headlamp switch connector voltage supply terminal and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness between the fuse and the switch connector terminal.

(4) Measure the voltage between the headlamp switch connector battery voltage OUT terminal and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, replace the headlamp switch.

DIMMER SWITCH—ALL VEHICLES

(1) Place the headlamp switch in the ON position. Place the dimmer switch in the HIGH or LOW beam position, as applicable.

(2) Measure the voltage between the dimmer switch connector voltage supply terminal and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness between the headlamp switch and the dimmer switch.



1. HIGH BEAM
2. LOW BEAM
3. HEAD LAMP FEED (FROM LAMP SWITCH)
4. FEED FROM HEADLAMP SWITCH FOR FLASH TO PASS

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Fig. 1 Headlamp Dimmer Switch Terminals

(3) Place the dimmer switch in the LOW beam position. Measure the voltage between the dimmer switch connector low beam voltage OUT terminal and body ground. The voltmeter should indicate battery voltage. If not OK, replace the dimmer switch.

(4) Place the dimmer switch in the HIGH beam position. Measure the voltage between the dimmer switch connector high beam voltage OUT terminal and body ground. Voltmeter should indicate battery voltage. If not OK, replace dimmer switch.

HEADLAMP BULB REPLACEMENT

REMOVAL

(1) Remove the screws and the headlamp bezel (Figs. 2 and 3).

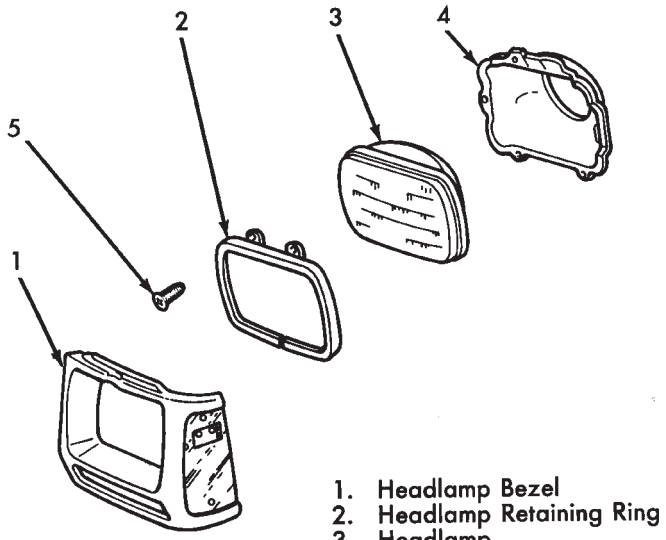


Fig. 2 Headlamp Components—XJ Vehicles

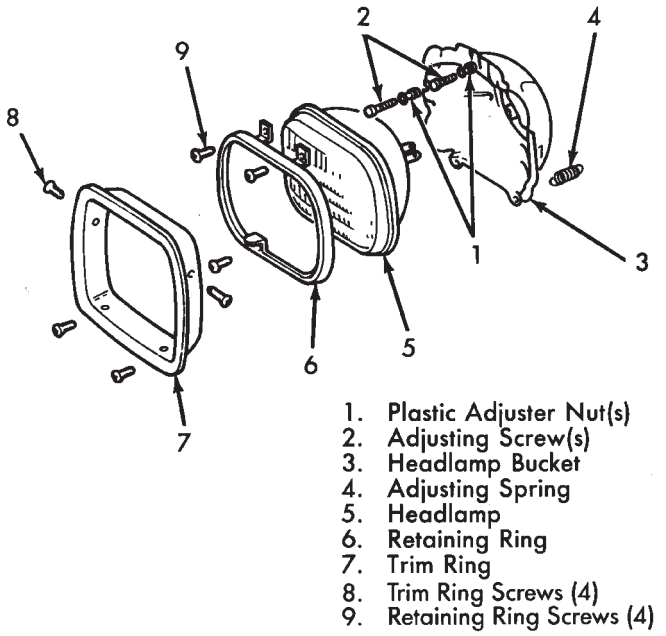


Fig. 3 Headlamp Components—YJ Vehicles

(2) Remove the screws and headlamp bulb retaining ring.

(3) Disconnect the headlamp bulb wire harness connector and remove the bulb from the bucket.

INSTALLATION

(1) Position the bulb in the bucket and connect the wire harness connector.

(2) Position retaining ring on the headlamp bulb and install screws.

(3) Install the headlamp bezel. Tighten the screws securely.

HEADLAMP BEAM ADJUSTMENT

SERVICE INFORMATION

The following headlamp beam adjustment procedures apply to all Jeep® vehicles. The headlamp beam must be adjusted with the headlamps on LOW beam. The headlamp beam can be adjusted either with the use of mechanical headlamp aimers or by the use of an aiming screen (Fig. 4).

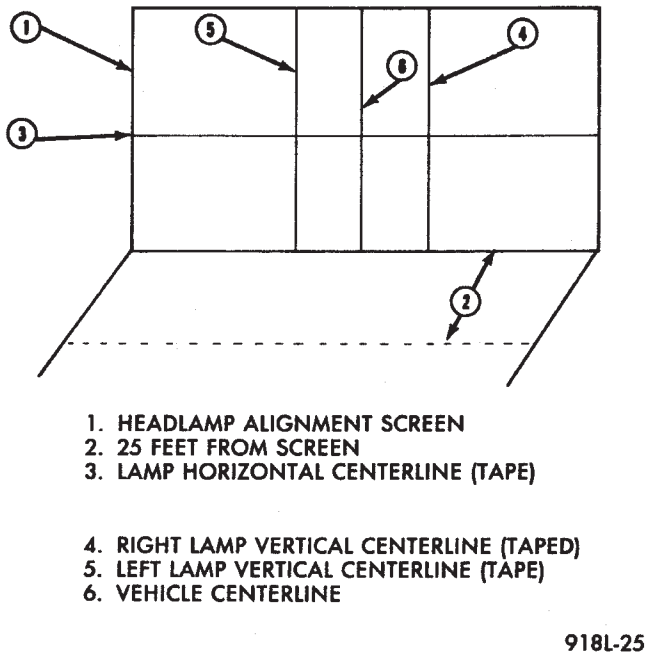


Fig. 4 Headlamp "Aiming" Screen

ADJUSTMENT WITH MECHANICAL AIMERS

Use Headlamp Aimer C-4466-A (J25300-A) and follow instructions supplied with equipment.

Adjust headlamps so that the beam horizontal position is at 0 and beam vertical position is 25 mm (1 in) downward.

ADJUSTMENT WITH AIMING SCREEN

PREPARATION

When an aiming screen is to be used for headlamp aim adjustment, use following procedure.

(1) Position the vehicle in dark area with a level floor and with a screen (wall) that has a white surface.

(2) Refer to Figure 4. Mark a reference line (2) on the floor 7.62 meters (25 feet) away from and parallel to the screen/wall (1).

(3) Move vehicle with the headlamps located directly above the 7.62-meters (25-feet) reference line.

(4) Equalize all the tire pressures.

(5) Rock vehicle from side to side to stabilize the springs and shock absorbers.

(6) Use tape to attach a vehicle centerline on the screen/wall (6). Ensure that it is aligned with and represents the centerline of the vehicle.

(7) Measure distance between the vehicle headlamp centers. Divide this distance by two. Measure the one/half distance outward from each side of the vehicle centerline (6). Use tape to attach the right and left lamp vertical centerline (4 and 5) on the screen/wall (6).

(8) Measure the distance from the center of each headlamp to the floor.

(9) Measure the lamp-to-floor distance upward from the floor at each lamp vertical centerline (4 and 5). Use tape to attach the lamp horizontal centerline (3) on the screen/wall.

ADJUSTMENT

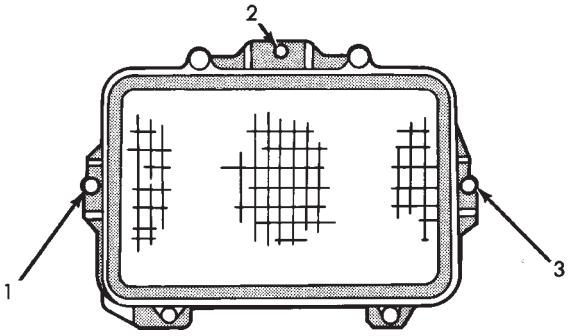
(1) Remove screws and both headlamp bezels.

(2) Clean front of the headlamps.

(3) Place headlamps on LOW beam.

(4) Cover front of the headlamp that is not being adjusted.

(5) Turn vertical adjustment screw until the headlamp beam pattern on screen/wall is similar to the pattern depicted in Figure 6.



1. HORIZONTAL ADJ. SCREW - RH
2. VERTICAL ADJ. SCREW
3. HORIZONTAL ADJ. SCREW - LH

J908L-24

Fig. 5 Headlamp Beam Adjustment Screws—XJ/YJ Vehicles

When using a headlamp aiming screen:

- adjust the headlamps so that the beam horizontal position is at 0; and
- adjust the beam vertical position is 25 mm (1 in) downward from the lamp horizontal centerline.

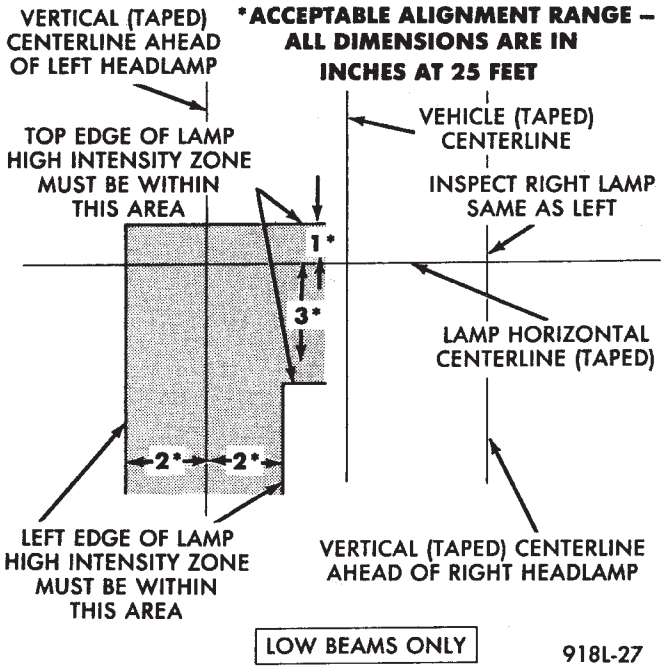


Fig. 6 Headlamp Beam Pattern—Typical

(6) Rotate the horizontal adjustment screw until the headlamp beam pattern on the aiming screen/wall similar to the pattern in Figure 6.

(7) Cover front of the headlamp that has been adjusted and adjust the other headlamp beam as instructed above.

(8) Install headlamp bezels. Tighten the screws securely.

HEADLAMP SWITCH REPLACEMENT

REMOVAL—XJ VEHICLES

(1) Disconnect battery negative cable.

(2) Place headlamp switch control knob in the headlamp ON position.

(3) Depress the switch shaft release/retainer button via the underside of the instrument panel. Pull the switch control shaft knob outward.

(4) Remove the headlamp switch spanner nut from the front of the instrument panel (Fig. 8).

(5) Disconnect the wire harness connector from the switch.

(6) Remove the headlamp switch from the instrument panel.

INSTALLATION—XJ VEHICLES

(1) Install the headlamp switch in the instrument panel and connect the wire harness connector.

(2) Install the headlamp switch spanner nut.

(3) Insert the headlamp switch control shaft in the spanner nut and force it into the switch.

(4) Connect the battery negative cable.

REMOVAL—YJ VEHICLES

(1) Disconnect the battery negative cable.

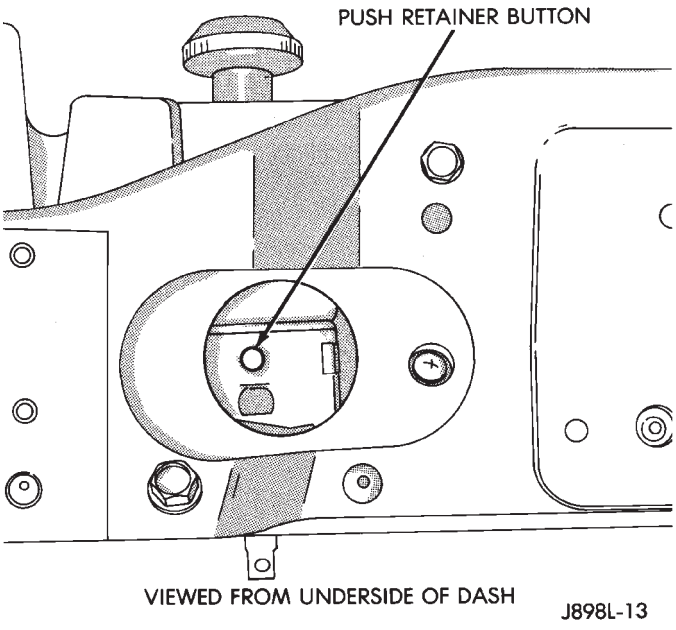


Fig. 7 Headlamp Switch Shaft Removal—XJ Vehicles

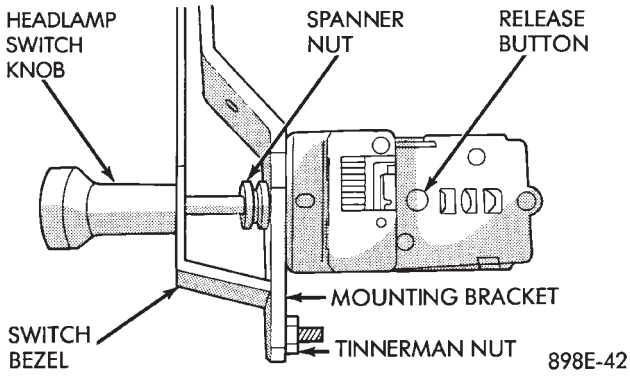


Fig. 8 Headlamp Switch—Typical

(2) Remove the I/P shroud retaining screws (Fig. 9).

(3) Move the I/P shroud toward the steering wheel.

(4) Apply upward force to the I/P shroud and downward force to the indicator panel. This will release the indicator panel holding tabs (Fig. 10).

(5) Remove the shroud from the instrument panel.

(6) Remove the headlamp switch retaining screws (Fig. 11).

(7) Disconnect the headlamp switch wire harness connector.

(8) Remove the headlamp switch from the instrument panel cavity.

INSTALLATION—YJ VEHICLES

(1) Position headlamp switch in the instrument panel and connect the wire harness connector to the switch.

(2) Install the headlamp switch screws. Tighten the screws.

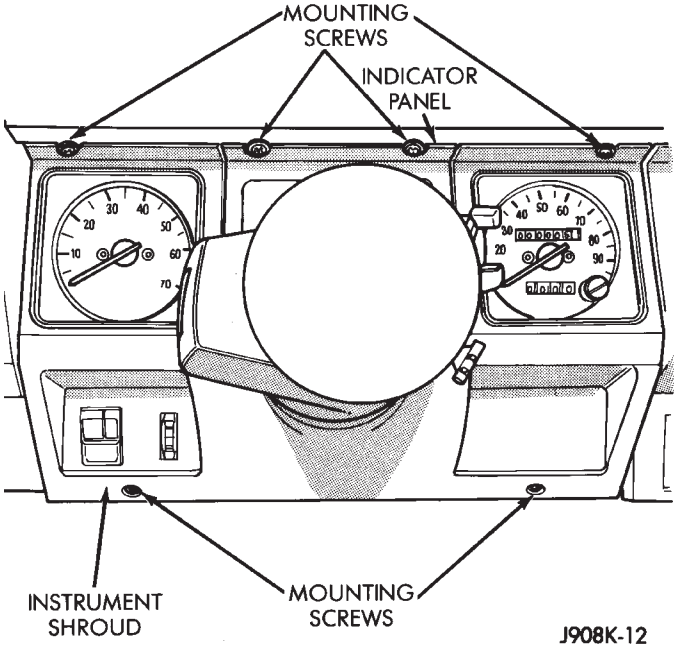


Fig. 9 Instrument Panel Shroud—YJ Vehicles

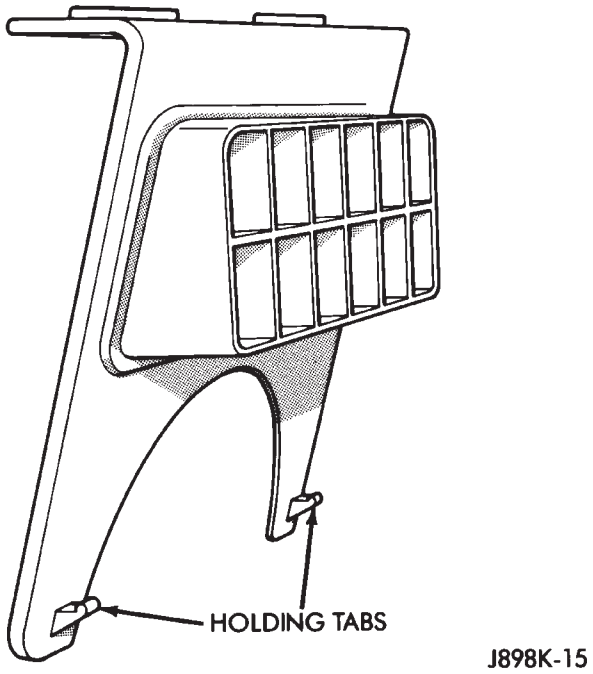


Fig. 10 Indicator Panel Holding Tabs—YJ Vehicles

(3) Position the I/P shroud under the steering column.

(4) Slide the indicator panel holding tabs into the shroud notches.

(5) Place the assembled I/P shroud over the indicator lamp gasket.

(6) Install and tighten the indicator panel screws.

(7) Install the remaining shroud screws. Tighten the screws.

(8) Connect the battery negative cable.

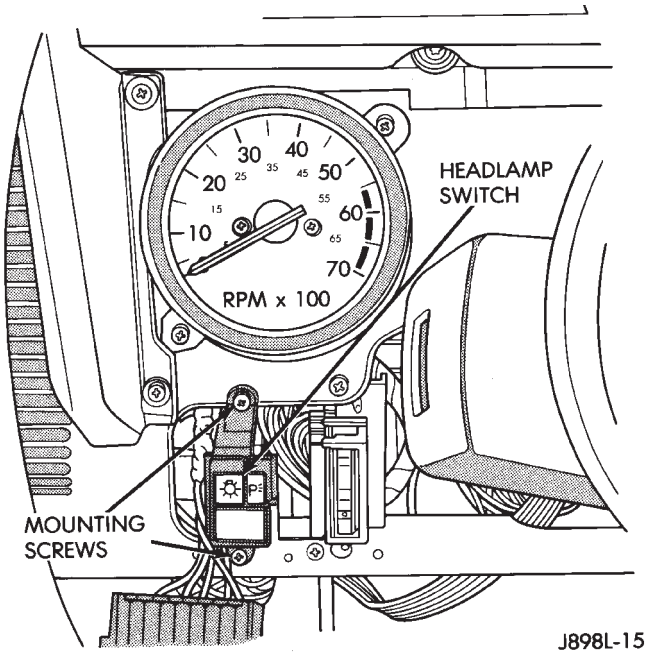


Fig. 11 Headlamp Switch—YJ Vehicles

HEADLAMP DIMMER SWITCH REPLACEMENT

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove the lower instrument panel (Fig. 12) and continue with step 4.

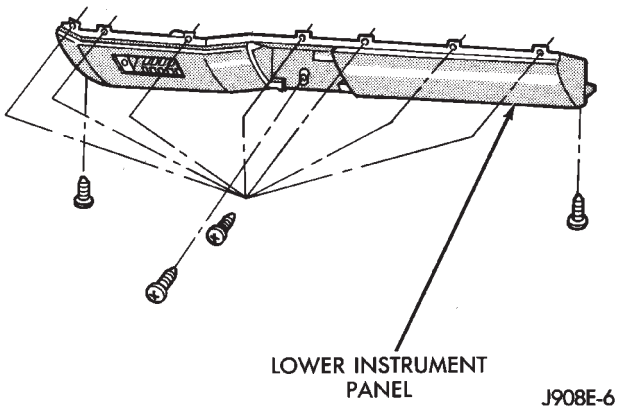


Fig. 12 Lower Instrument Panel—XJ Vehicles

(3) **YJ vehicles:**

- remove the I/P shroud retaining screws (Fig. 13).
- move the I/P shroud toward the steering wheel;
- apply upward force to the I/P shroud and downward force to the indicator panel — this will release the indicator panel holding tabs (Fig. 14);
- remove the shroud from the instrument panel;
- support the A/C evaporator housing;
- remove the A/C evaporator housing-to-instrument panel screws (Fig. 15);

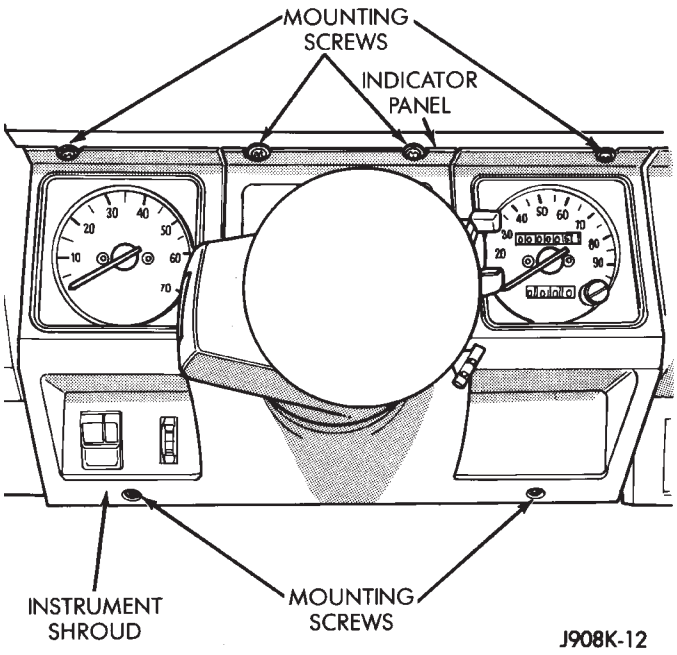


Fig. 13 Instrument Panel Shroud—YJ Vehicles

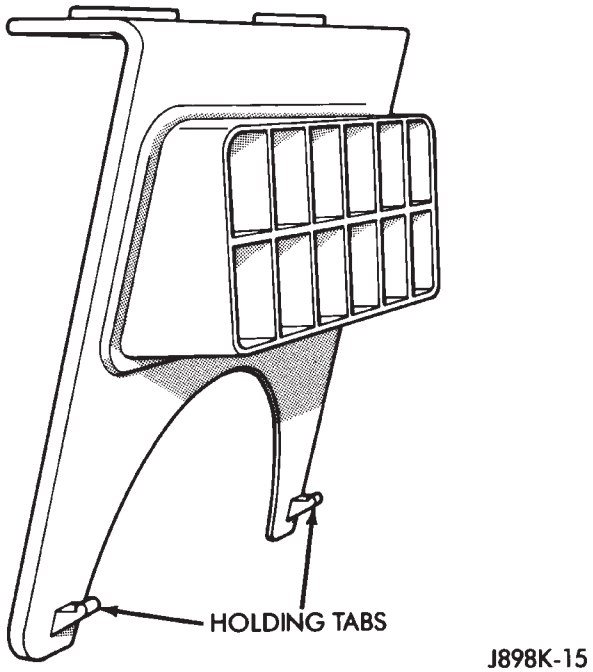


Fig. 14 Indicator Panel Holding Tabs—YJ Vehicles

- remove the A/C evaporator housing support bracket screw;
- remove the support and lower the A/C evaporator housing; and
- continue with step 4.

(4) Disconnect the dimmer switch wire harness connector.

(5) Tape the dimmer switch actuator rod to the steering column.

(6) Remove the dimmer switch screws and detach the switch from the rod.

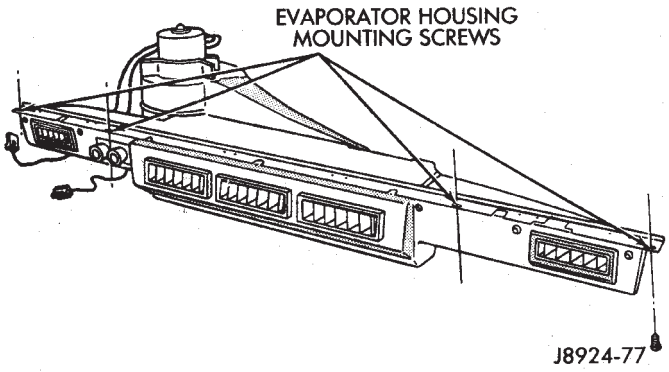


Fig. 15 A/C Evaporator Housing—YJ Vehicles

INSTALLATION

(1) Force the dimmer switch onto the actuator rod and install screws. **DO NOT tighten the retaining screws at this time.**

(2) Remove the tape attaching the actuator rod to the steering column.

(3) Adjust the dimmer switch as follows:

- compress the switch and insert a 3/32-inch diameter drill bit into the adjustment hole (Fig. 16);
- the drill bit will prevent any horizontal movement of the switch;

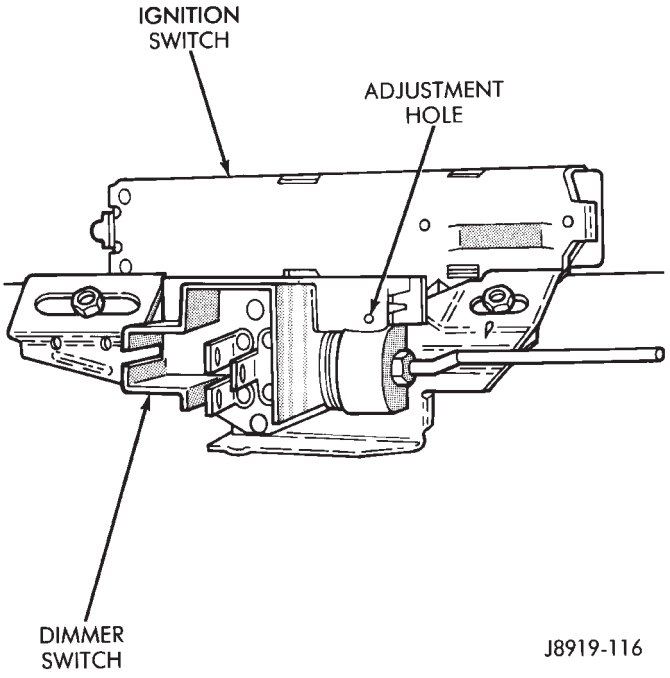


Fig. 16 Headlamp Dimmer Switch Adjustment

- move the switch toward the steering wheel to remove any existing actuator rod lash;
- tighten screws with 4 N·m (35 in. lbs.) torque.
- connect battery negative cable;
- remove drill bit and test the switch operation; and
- re-adjust the switch, if necessary.

(4) **XJ vehicles** — install the lower instrument panel (Fig. 12)

(5) **YJ vehicles:**

- position the I/P shroud under the steering column;
- slide the indicator panel holding tabs (Fig. 14) into the shroud notches;
- place the assembled I/P shroud over the indicator lamp gasket;
- install and tighten screws;
- install and tighten remaining shroud screws;
- raise and support the A/C evaporator housing (Fig. 15); and
- install the evaporator housing-to-instrument panel screws and evaporator support bracket screw.

SIDE MARKER LAMP BULB REPLACEMENT

REMOVAL—XJ VEHICLES

(1) Remove the screws from the side marker lamp lens and housing. Separate lens and housing from the headlamp bezel (Fig. 17).

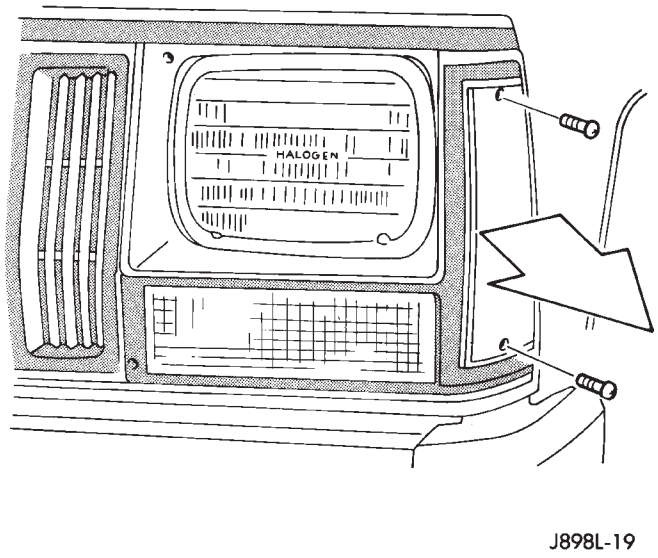


Fig. 17 Side Marker Lamp—XJ Vehicles

(2) Remove the bulb and socket from the back side of the lamp housing.

(3) Remove bulb from socket.

INSTALLATION—XJ VEHICLES

(1) Install a replacement bulb in the socket.

(2) Install bulb and socket in the back of side marker lamp housing.

(3) Position the side marker lens and housing on the headlamp bezel (Fig. 17).

(4) Install the side marker lamp screws. Tighten the screws.

REMOVAL—YJ VEHICLES

(1) Remove side marker bulb socket via the underside of the fender. Rotate it one-third turn and separate it from the side marker lamp housing (Fig. 18).

(2) Remove the bulb from the socket by pulling it straight outward.

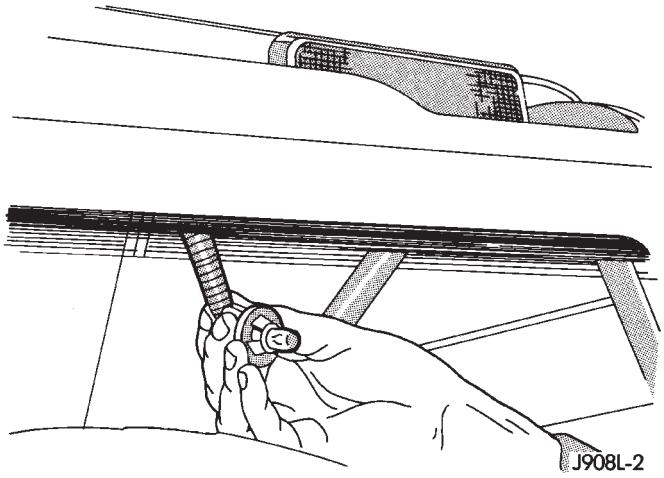


Fig. 18 Side Marker Lamp Bulb—YJ Vehicles

INSTALLATION—YJ VEHICLES

(1) Install a replacement bulb in the socket.

(2) Install the bulb and socket in the side marker lamp housing (Fig. 18).

FRONT PARK/TURN SIGNAL LAMP BULB REPLACEMENT

REMOVAL—XJ VEHICLES

(1) Remove the headlamp bezel screw and the side marker lamp lens/housing screw (Fig. 19).

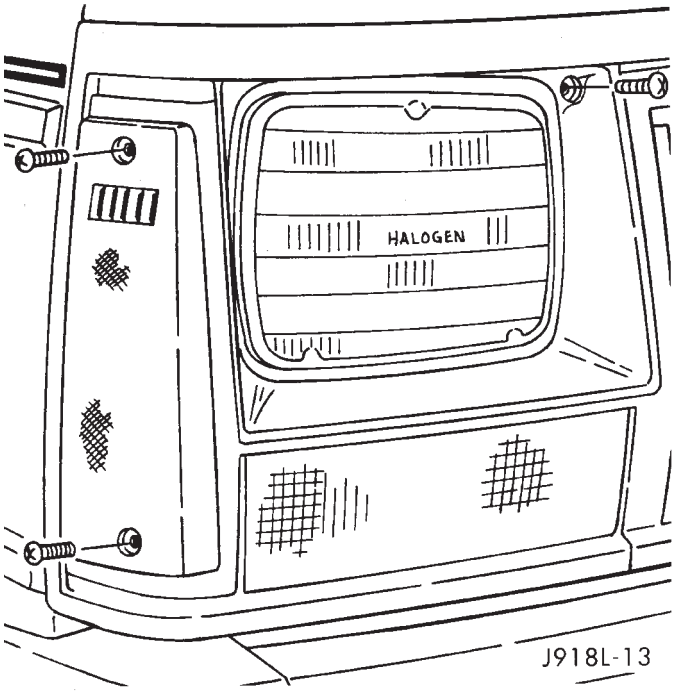


Fig. 19 Headlamp Bezel & Side Marker Lamp—XJ Vehicles

(2) Separate the side marker lamp from the headlamp bezel and remove the screws from the headlamp bezel (Fig. 20).

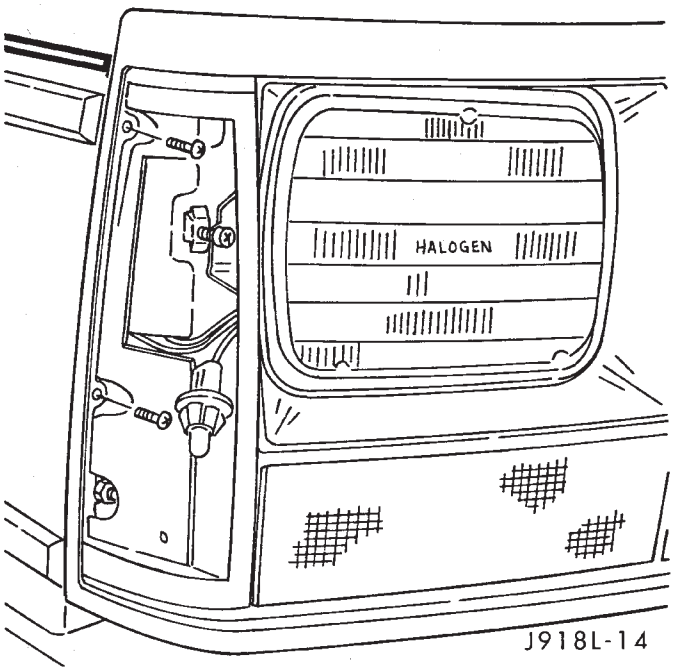


Fig. 20 Headlamp Bezel Removal/Installation

(3) Remove screws from the park/turn signal lamp housing (Fig. 21).

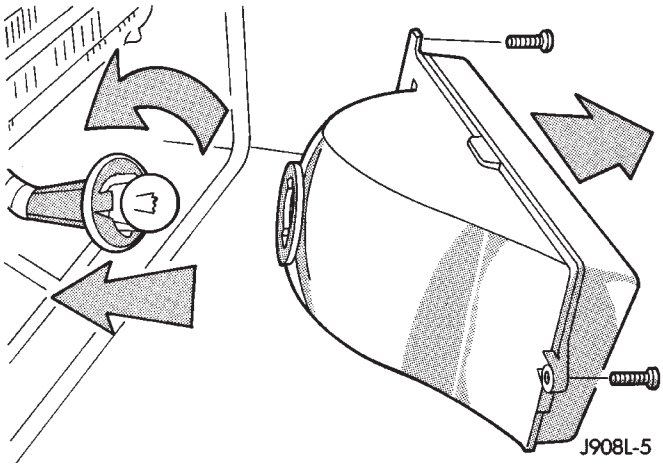


Fig. 21 Park/Turn Signal Lamp Housing Removal

(4) Separate the lamp housing from the headlamp bezel.

(5) Rotate the bulb socket one-third turn and remove it from the lamp housing.

(6) Remove bulb from socket.

INSTALLATION—XJ VEHICLES

(1) Install a replacement bulb in the socket.

(2) Install bulb and socket in the lamp housing.

(3) Position the park/turn signal lamp housing on the headlamp bezel.

(4) Install lamp housing screws. Tighten the screws.

(5) Install the outer screws in the headlamp bezel. Tighten the screws.

(6) Position the side marker lamp lens/housing on the headlamp bezel.

(7) Install side marker lamp lens/housing screws and headlamp bezel (Fig. 19). Tighten the screws.

REMOVAL—YJ VEHICLES

(1) Remove the park/turn signal lamp housing screws (Fig. 22).

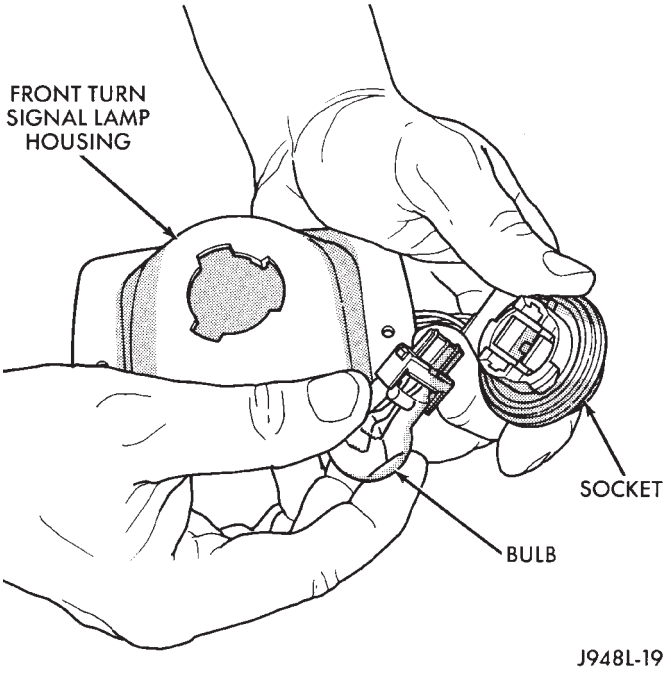


Fig. 22 Park/Turn Signal Lamp Bulb Replacement—YJ Vehicles

(2) Separate the park/turn signal lamp housing from the grille panel.

(4) Turn the bulb socket and remove it from the lamp housing.

(3) Pull the bulb straight out of the socket.

INSTALLATION—YJ VEHICLES

(1) Install a replacement bulb in the socket.

(2) Install the bulb and socket in the lamp housing.

(3) Position the park/turn signal lamp housing at the opening in the grille panel.

(4) Install the lamp housing retaining screws. Tighten the screws securely.

BACK-UP/REAR TURN SIGNAL/TAIL LAMP BULB REPLACEMENT

REMOVAL—XJ VEHICLES

(1) Remove the tail lamp housing upper retaining screws. Slide the lamp housing upward off the lower screw and separate it from the rear of the vehicle.

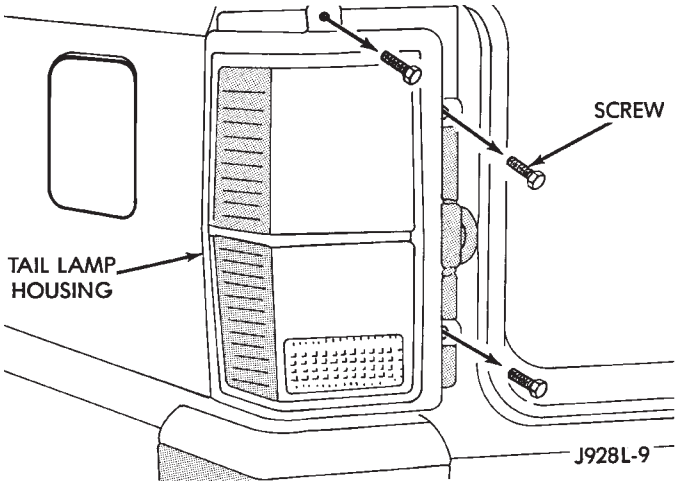


Fig. 23 Tail Lamp Housing—XJ Vehicles

(2) Rotate the bulb socket one-third turn and remove the bulb socket from the lamp housing.

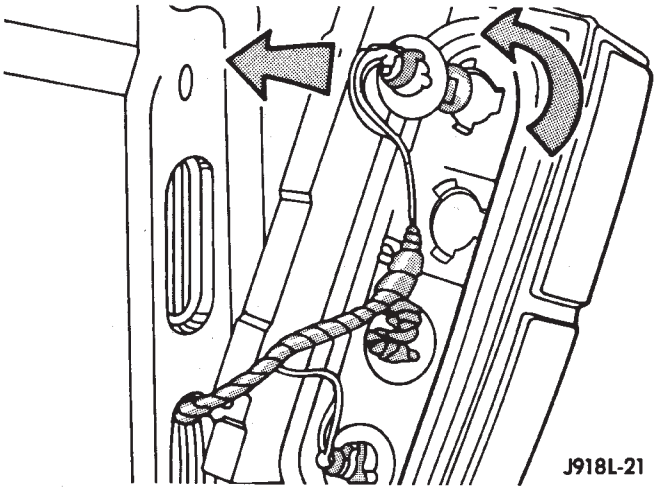


Fig. 24 Bulb Socket Removal—XJ Vehicles

(3) Remove the bulb from the socket.

INSTALLATION—XJ VEHICLES

(1) Install a replacement bulb in the socket.

(2) Install the bulb and socket in the lamp housing.

(3) Position the lamp housing in the opening at the rear of the vehicle.

(4) Install the lamp housing screws. Tighten the screws securely.

REMOVAL—YJ VEHICLES

(1) Remove the lens retaining screws from the tail lamp housing (Fig. 25).

(2) Separate the lens from the tail lamp housing.

(3) Remove the bulb from the lamp socket.

INSTALLATION—YJ VEHICLES

(1) Install a replacement bulb in the lamp socket.

(2) Position the lens on the lamp housing.

(3) Install the lens retaining screws. Tighten the screws securely.

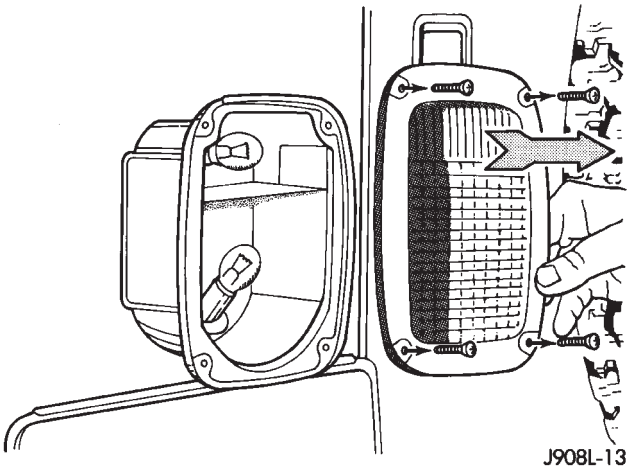


Fig. 25 Back-up/Rear Turn Signal/Tail Lamp Bulb Replacement—YJ Vehicles

LICENSE PLATE LAMP

REMOVAL—XJ VEHICLES

(1) Remove screws and the license plate lamp visor from the liftgate (Fig. 26).

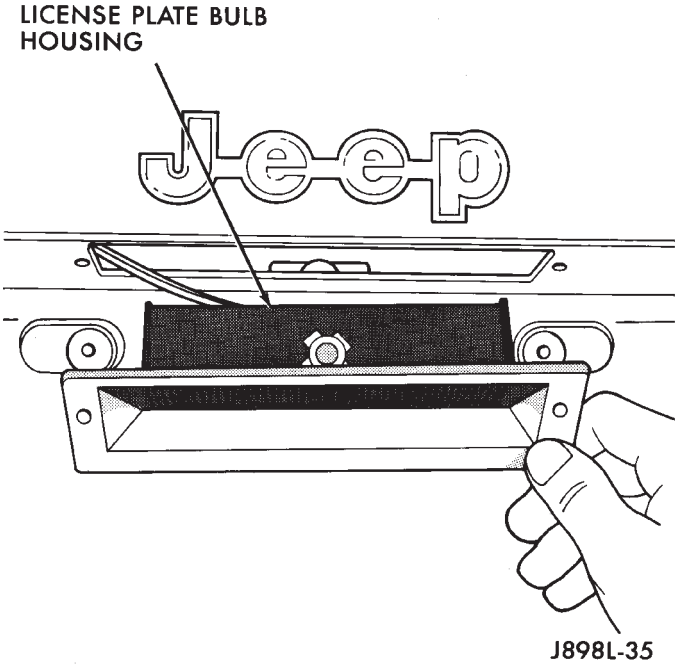


Fig. 26 License Plate Lamp Visor

(2) Remove the bulb from the lamp socket.

INSTALLATION—XJ VEHICLES

(1) Install a replacement bulb in the lamp socket.

(2) Position the license plate lamp visor on the liftgate and install screws. Tighten the screws securely.

CENTER HIGH MOUNTED STOP LAMP (CHMSL)—XJ

The CHMSL is mounted at the top of the rear window and has two bulbs (Fig. 27).

(1) Raise liftgate.
(2) Remove CHMSL access door (Fig. 28)
(3) Remove CHMSL lamp mounting screws.
(4) Remove CHMSL lamp assembly.
(5) Replace bulbs if necessary (Fig. 29).

To install, reverse removal procedure.

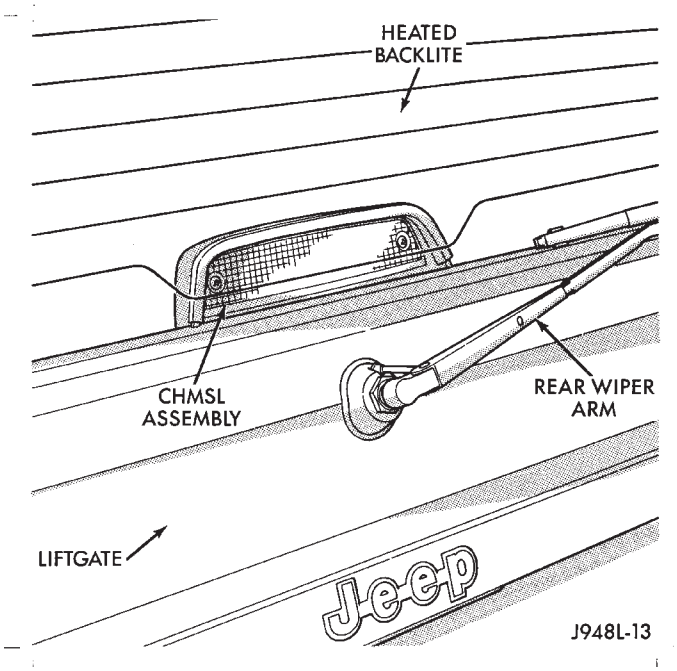


Fig. 27 Center High Mounted Stop Lamp (CHMSL) Assembly

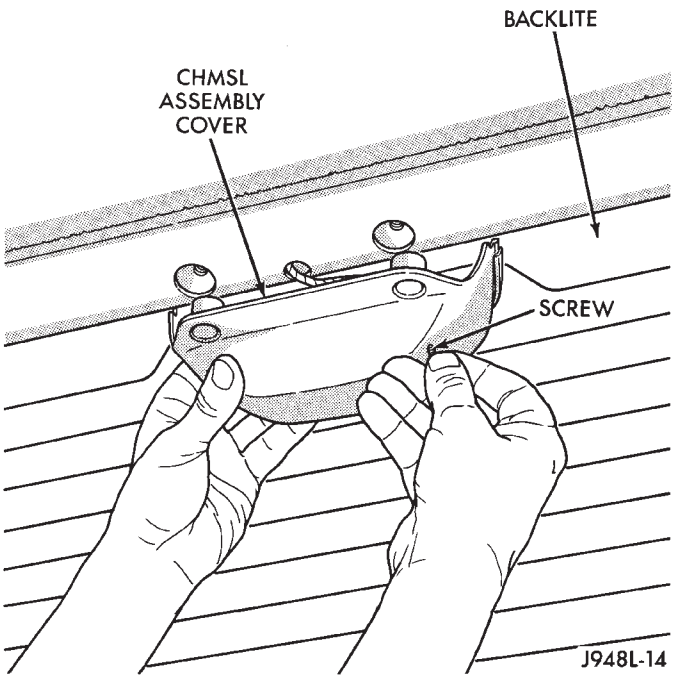


Fig. 28 Removing CHMSL Access Door

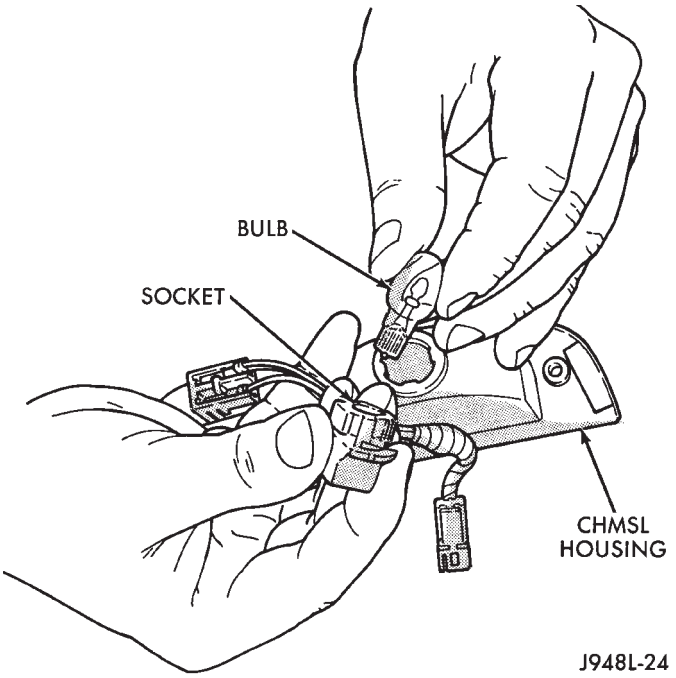


Fig. 29 Replacing CHMSL Bulb

CENTER HIGH MOUNTED STOP LAMP (CHMSL)—YJ

The CHMSL is mounted on top of a bracket that attaches to the spare tire carrier (Fig. 30).

(1) Remove the CHMSL lens (Fig. 31).

(2) Remove CHMSL lamp housing (Fig. 32)

(5) Replace bulbs if necessary.

To install, reverse removal procedure.

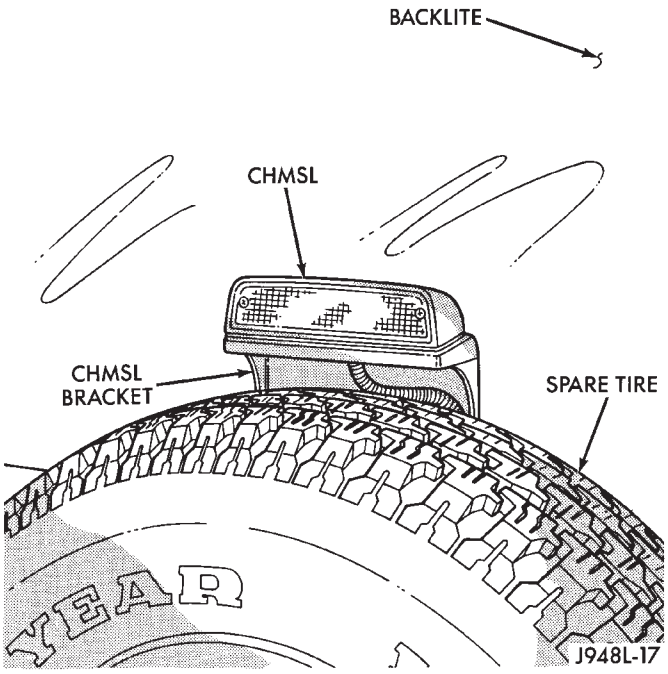


Fig. 31 Removing CHMSL Access Door

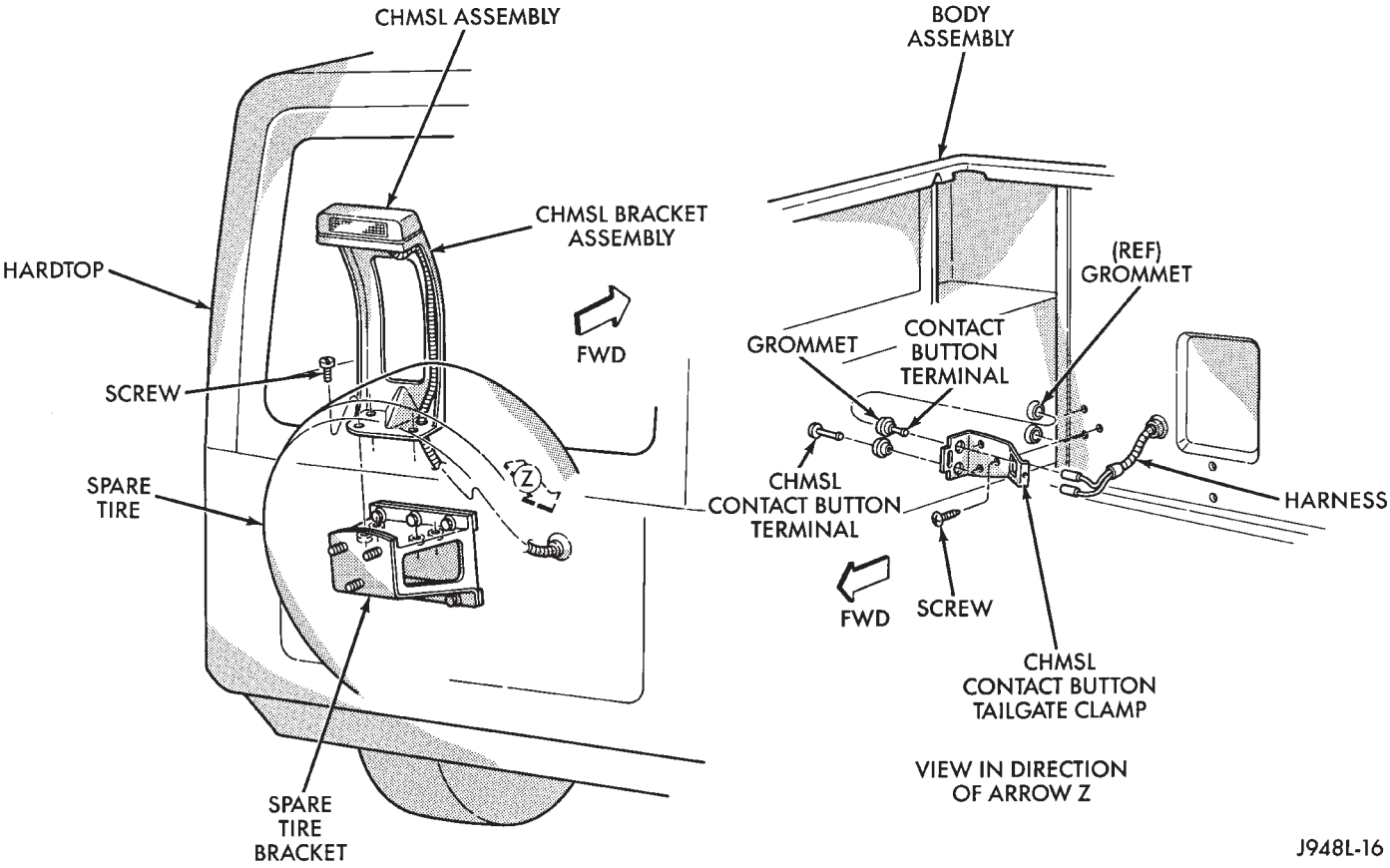


Fig. 30 Center High Mounted Stop Lamp (CHMSL) Bracket Assembly

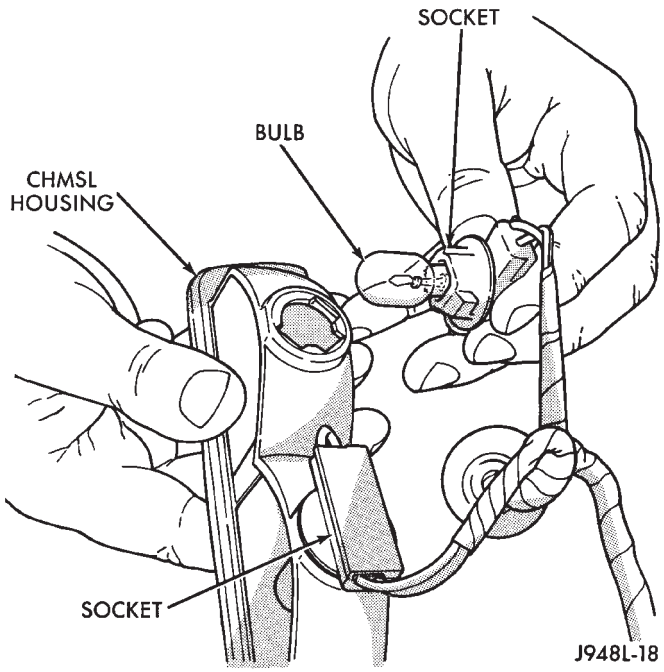


Fig. 32 Replacing CHMSL Bulb

FOG LAMP SERVICE INFORMATION

Fog lamps can be operated **ONLY** when the headlamps are on LOW beam. If the headlamps are switched to HIGH beam, the fog lamps will not operate.

Also, the fog lamps ON display on the switch will:
- be illuminated when the headlamps are switched to LOW beam; and
- be extinguished when the headlamps are switched to HIGH beam.

FOG LAMP TROUBLE DIAGNOSIS

ONE FOG LAMP INOPERATIVE

(1) Place the headlamp switch in the full ON position, the dimmer switch in the LOW beam position and the fog lamp switch in the ON position.

(2) Disconnect the applicable fog lamp wire harness connector (Fig. 33).

(3) Measure the resistance between the lamp connector terminals. The ohmmeter should indicate zero ohms. If not OK, replace the bulb.

(4) Measure the resistance between the wire harness connector ground terminal and vehicle body ground. The ohmmeter should indicate zero ohms. If not OK, repair the open circuit in the wire harness to vehicle body ground.

(5) Measure the voltage between the wire harness connector voltage supply terminal and body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness that leads to the source of battery voltage.

BOTH FOG LAMPS INOPERATIVE

(1) Place headlamp switch in the full ON position.

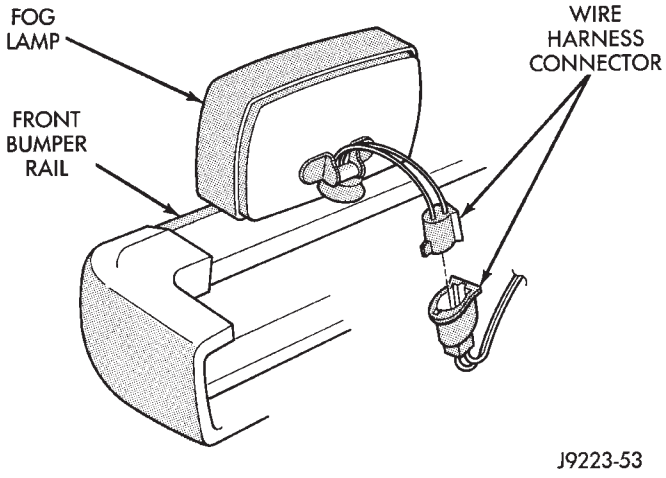


Fig. 33 Fog Lamp & Wire Harness Connector—XJ Vehicles

The dimmer switch in the LOW beam position. The fog lamp switch in the ON position.

(2) Measure the voltage between the fog lamp switch wire harness connector terminal B and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness that leads to the headlamp dimmer switch circuit.

(3) Measure the voltage between the fog lamp switch connector terminal C and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, replace the fog lamp switch.

(4) Measure the voltage between the fog lamp relay connector terminal 1 and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness that leads to the power distribution center/PDC.

(5) Measure the voltage between the fog lamp relay connector terminal 5 and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness that leads to the fog lamp switch.

(6) Measure the voltage between the fog lamp relay connector terminal 2 and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness that leads to vehicle body ground.

(7) Measure the voltage between the fog lamp relay connector terminal 4 and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, replace the relay.

FOG LAMP BEAM ADJUSTMENT

Use an "aiming" screen for fog lamp beam aim adjustment.

PREPARATION

Prior to adjustment, the following preparation is required.

(1) Position the vehicle in dark area with a level floor and with a screen (wall) that has a white surface.

(2) Mark a reference line on the floor 7.62 meters (25 feet) away from and parallel to the "aiming" screen/wall.

(3) Position vehicle with the fog lamps located directly above the 7.62-meters (25-feet) reference line.

(4) Equalize all the tire pressures.

(5) Rock the vehicle from side to side to stabilize the springs and shock absorbers.

(6) Refer to Figure 34. Use tape to attach a vehicle centerline on the screen/wall. Ensure that it is aligned with and represents the centerline of the vehicle.

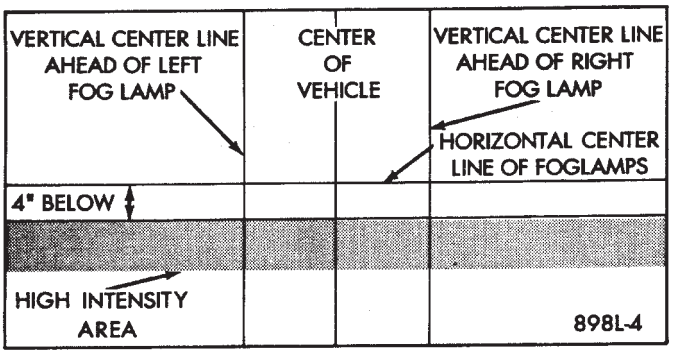


Fig. 34 Fog Lamp Beam Pattern

(7) Measure the distance between the vehicle fog lamp centers. Divide this distance by two. Measure the one/half distance outward from each side of the vehicle centerline. Use tape to attach the right and left fog lamp vertical centerline on the screen/wall.

(8) Measure the distance from the center of each fog lamp to the floor.

(9) Measure the lamp-to-floor distance upward from the floor at each lamp vertical centerline. Use tape to attach the lamp horizontal centerline on the screen/wall.

BEAM ADJUSTMENT

(1) Loosen the fog lamp attaching hardware at the support bracket.

(2) Place the headlamp and fog lamp switches in the ON position.

(3) Ensure that the headlamp dimmer switch is in the LOW beam position.

(4) Adjust the fog lamp beams according to the following guidelines:

- a properly adjusted fog lamp (up/down adjustment) will project a beam pattern on the screen similar to the pattern depicted in Figure 28; and
- each fog lamp should be centered (left/right adjustment) on the screen left/right vertical center line.

(5) Tighten the fog lamp support bracket hardware.

FOG LAMP BULB/ELEMENT REPLACEMENT

REMOVAL

(1) For YJ vehicles, remove the screws that attach the stone shield and the reflector to the lamp housing. Remove the stone shield and reflector from the lamp housing (Fig. 35).

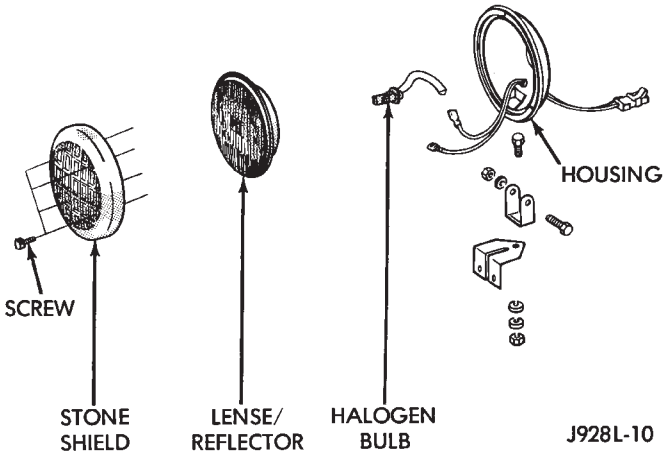


Fig. 35 Fog Lamp—YJ Vehicles

(2) For XJ vehicles, remove the screws that attach the bezel and lens to the lamp housing. Remove the bezel and the lens from the lamp housing (Fig. 36).

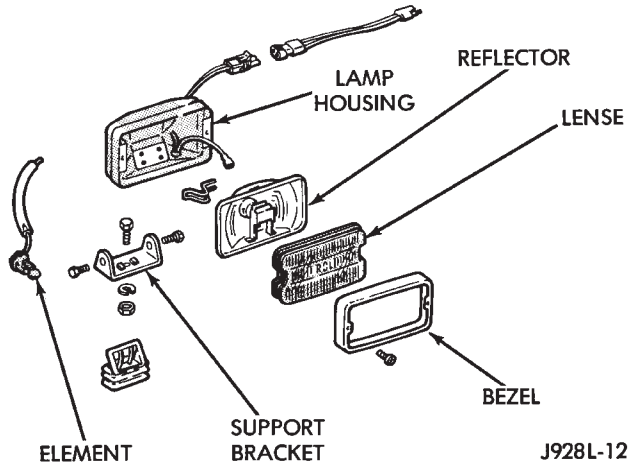


Fig. 36 Fog Lamp—XJ Vehicles

(3) Remove the bulb/element holder from the lens/reflector.

(4) Remove the bulb/element from the holder.

REMOVAL

CAUTION: Always handle replacement quartz bulbs/elements with a clean cloth. DO NOT handle quartz bulbs/elements with bare hands.

(1) Use a clean cloth to install a replacement bulb holder.

(2) Install the bulb holder in the lens/reflector.

(3) For XJ vehicles, position the bezel and the lens on the lamp housing. Install the screws that attach the bezel and lens to the lamp housing. Tighten the screws securely.

(4) For YJ vehicles, position the stone shield and reflector on the lamp housing. Install the screws that attach the stone shield and the reflector to the lamp housing. Tighten the screws securely.

FOG LAMP SWITCH REPLACEMENT

REMOVAL—XJ VEHICLES

The fog lamp switch is located on the instrument panel at the left of the steering column.

(1) Remove instrument panel bezel attaching screws and remove the bezel (Fig. 37).

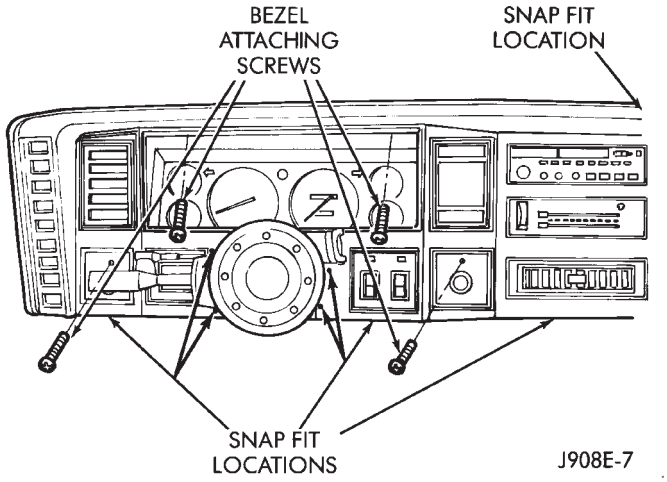


Fig. 37 Instrument Panel Bezel—XJ Vehicles

(2) Remove the fog lamp switch cover.

(3) Disconnect the wire harness connector from the switch.

(4) Squeeze the tabs on the side of the switch and remove the switch from the instrument panel cavity.

INSTALLATION—XJ VEHICLES

(1) Squeeze the tabs on the side of the fog lamp switch and insert the switch in the instrument panel cavity.

(2) Connect the wire harness connector to the switch.

(3) Install the fog lamp switch cover.

(4) Position the bezel on the instrument panel and install the attaching screws. Tighten the screws securely.

REMOVAL—YJ VEHICLES

The fog lamp switch is located on the instrument panel at the right of the steering column. The fog lamp circuit relay is located below the left headlamp.

(1) Disconnect the battery negative cable.

(2) Remove the I/P shroud retaining screws (Fig. 36).

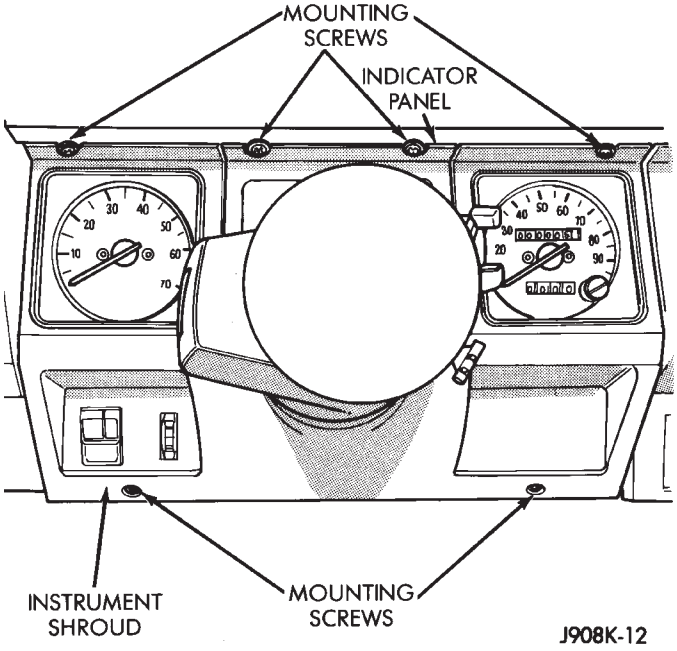


Fig. 38 Instrument Panel Shroud—YJ Vehicles

(3) Move the I/P shroud toward the steering wheel.

(4) Apply upward force to the I/P shroud and downward force to the indicator panel. This will release the indicator panel holding tabs (Fig. 39).

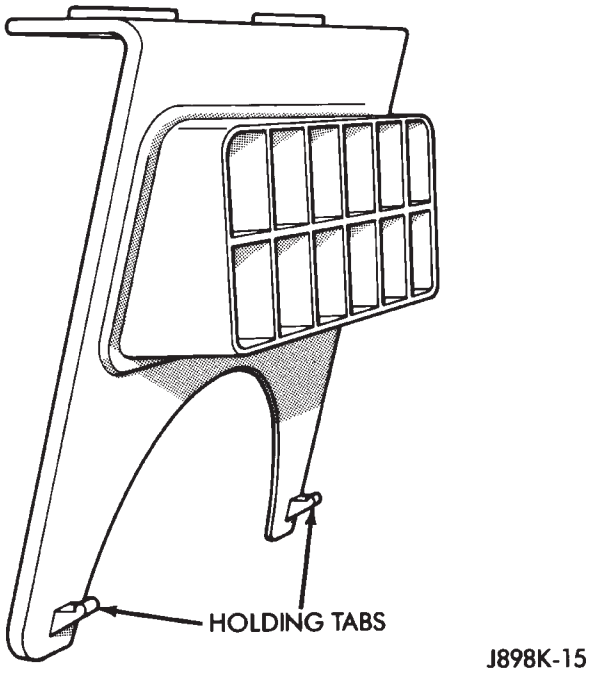


Fig. 39 Indicator Panel Holding Tabs—YJ Vehicles

(5) Remove the shroud from the instrument panel.

(6) Remove the fog lamp switch retaining screws.

(7) Disconnect the wire harness connector from the fog lamp switch.

(8) Remove the fog lamp switch from the instrument panel cavity.

INSTALLATION—YJ VEHICLES

(1) Position the fog lamp switch in the instrument panel cavity and connect the wire harness connector to the switch.

(2) Install the fog lamp switch retaining screws. Tighten the screws securely.

(3) Position the I/P shroud under the steering column.

(4) Slide the indicator panel holding tabs into the shroud notches.

(5) Place the assembled I/P shroud over the indicator lamp foam gasket.

The foam gasket located on the back side of the indicator panel overlay is fragile. If it is either torn or distorted, replace it.

(6) Install and tighten the indicator panel retaining screws.

(7) Install the remaining shroud screws. Tighten the screws securely.

(8) Connect the battery negative cable.

FOG LAMP REPLACEMENT

REMOVAL—XJ VEHICLES

(1) Disconnect the fog lamp wire harness connector (Fig. 40).

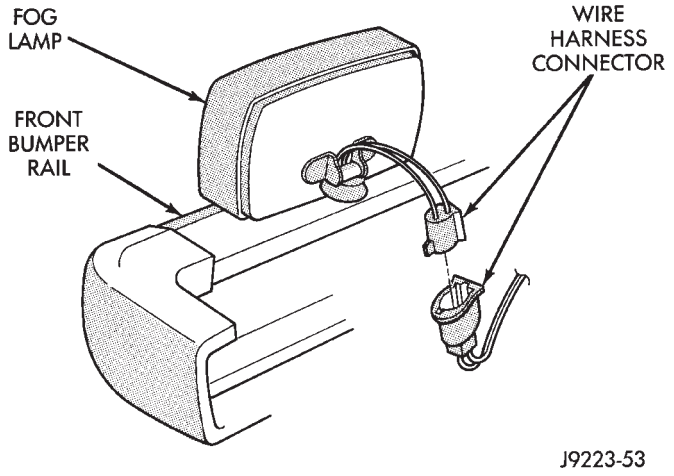


Fig. 40 Fog Lamp Wire Harness Connector—XJ Vehicles

(2) Remove the retaining nut and washer from each side of the support bracket and remove the fog lamp from the support bracket (Fig. 41).

INSTALLATION—XJ VEHICLES

(1) Position the fog lamp in the support bracket and install the washer and nut at each side of the bracket. Tighten the nuts securely.

(2) Connect the fog lamp wire harness connector.

REMOVAL—YJ VEHICLES

(1) Disconnect the fog lamp wire harness connector.

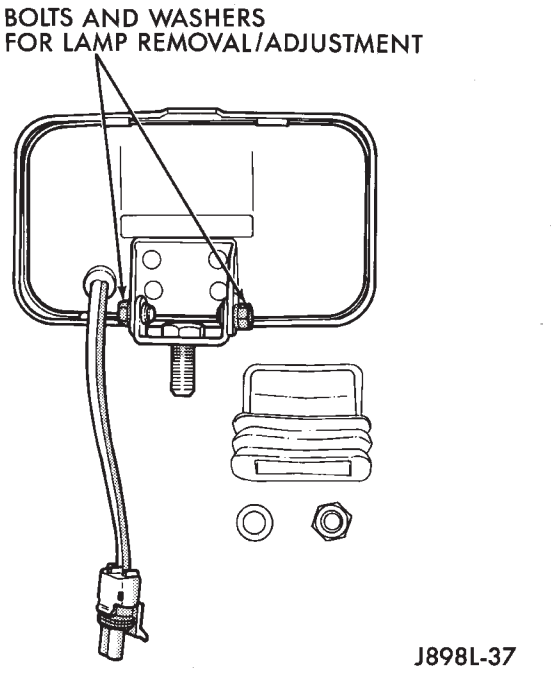


Fig. 41 Fog Lamp—XJ Vehicles

(2) Remove the fog lamp nut(s), washers(s) and bolt(s) from the support bracket.

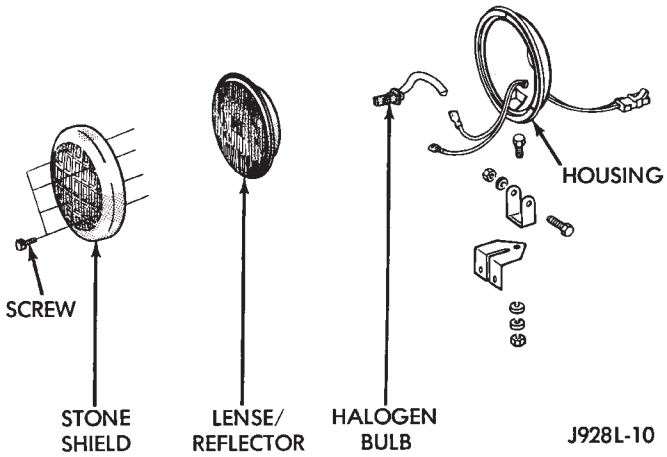


Fig. 42 Round-Shaped Fog Lamp

(3) Remove the fog lamp from the support bracket.

INSTALLATION—YJ VEHICLES

(1) Position the fog lamp on the support bracket.

(2) Install the fog lamp bolt(s), washer(s) and nut(s) in the support bracket.

(3) Connect the fog lamp wire harness connector.

SENTINEL HEADLAMP DELAY MODULE—XJ VEHICLES

SERVICE INFORMATION

The Headlamp Module delays the de-activation of the headlamps for 45 ±15 seconds after the ignition

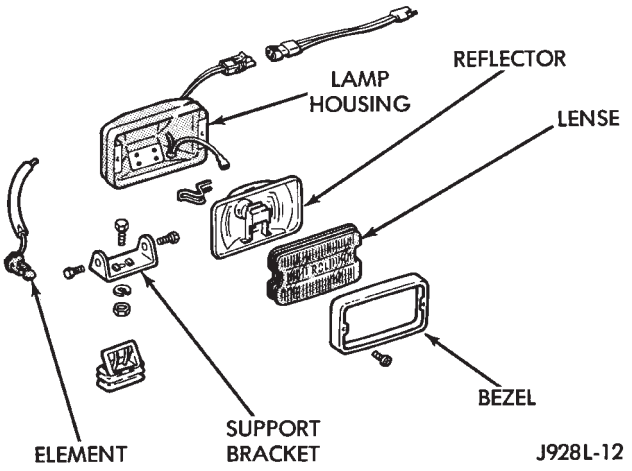


Fig. 43 Rectangular-Shaped Fog Lamp

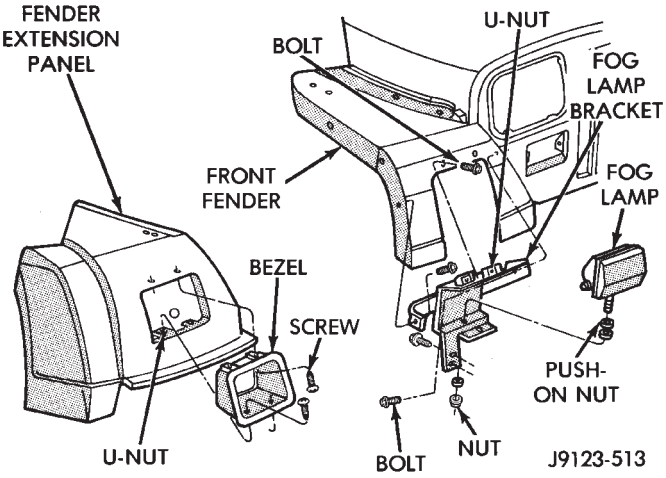


Fig. 44 Fog Lamp—YJ Renegade

switch is turned OFF. The driver engages the module by turning the ignition switch OFF, then turning the headlamps OFF.

The headlamp delay module is located behind the I/P next to the headlamp switch.

HEADLAMP DELAY MODULE REPLACEMENT—XJ VEHICLES

The headlamp delay module is attached to the inside of the instrument panel to the right of the headlamp switch.

REMOVAL

(1) Remove the lower instrument panel.

(2) Remove the screw that attaches the module to the inside of the instrument panel.

(3) Disconnect the wire harness connector and remove the module from the instrument panel.

INSTALLATION

(1) Position the module inside the I/P and connect the wire harness connector to the module.

(2) Install the screw that attaches the module to the inside of the instrument panel.

(3) Remove the lower instrument panel.

HEADLAMP DELAY FUNCTION TROUBLE DIAGNOSIS—XJ VEHICLES

DELAY FUNCTION INOPERATIVE

(1) Remove, inspect and test the HD LP DLY fuse. Replace if defective.

(2) Remove the delay module from the I/P. Do not disconnect the wire harness connector. Turn the ignition switch to the RUN position. Place the headlamp switch in headlamps ON position. Turn the ignition to the OFF position for a resistance test.

(3) Measure the resistance from the delay module terminal 4 to vehicle body ground. The ohmmeter should indicate zero ohms. If not, repair the open circuit in the wire harness to vehicle body ground.

(4) Measure the voltage between the delay module terminal 8 and vehicle body ground. The voltmeter should indicate battery voltage. If not, repair the open circuit in the wire harness to the instrument cluster indicator connector terminal 14.

(5) Measure the voltage between the delay module terminal 6 and vehicle body ground. The voltmeter should indicate battery voltage. If not, repair the open circuit in the wire harness to the headlamp switch.

(6) Measure the voltage between the delay module terminal 2 and vehicle body ground. The voltmeter should indicate battery voltage. If not, repair the open circuit in the wire harness to the fuse.

DAYTIME RUNNING LIGHTS (CANADA ONLY)

SERVICE INFORMATION

The Daytime Running Lights (Headlamps) System is installed on vehicles manufactured for sale in Canada only. The headlamps are illuminated when the ignition switch is turned to the ON position. The DRL module receives a vehicle-moving signal from the vehicle speed sensor. This provides a constant **headlamps-on** condition as long as the vehicle is moving. The lamps are illuminated at less than 50 percent of normal intensity.

DRL MODULE REPLACEMENT

REMOVAL—XJ VEHICLES

The Daytime Running Lights (DRL) module is located on the right fender inner panel adjacent to the dash panel (Fig. 45).

(1) Disconnect the wire harness connector from the module.

(2) Remove the screws that attach the module to the fender inner panel.

(3) Remove the module from the fender inner panel.

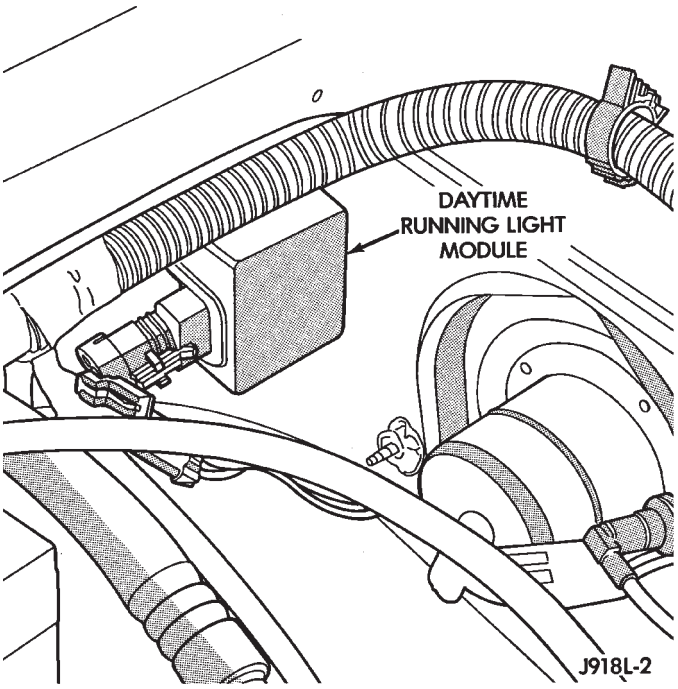


Fig. 45 Daytime Running Lights (DRL) Module—XJ Vehicles

INSTALLATION—XJ VEHICLES

(1) Position the module on the right fender inner panel.

(2) Install the attaching screws. Tighten the screws securely.

(3) Connect the wire harness connector to the module.

REMOVAL—YJ VEHICLES

The daytime running light module is located on the left fender inner panel below the engine air cleaner housing.

(1) Remove the engine air cleaner housing for access to the DRL module.

(2) Disconnect the wire harness connector from the module.

(3) Remove the screws that attach the module to the fender inner panel.

(4) Remove the module from the fender inner panel.

INSTALLATION—YJ VEHICLES

(1) Position the DRL module on the left, fender inner panel.

(2) Install the attaching screws. Tighten the screws securely.

(3) Connect the wire harness connector to the module.

(4) Install the air cleaner housing.

UNDERHOOD LAMP SERVICE INFORMATION

When equipped, the underhood lamp is installed on the hood right, rear inner panel for all Jeep® vehicles. The lamp is illuminated when the hood is opened. The switch provides automatic ON/OFF functions each time the hood is opened and closed.

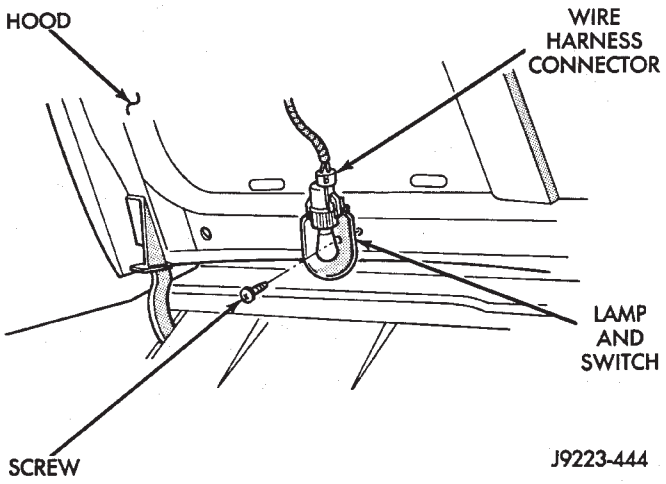


Fig. 46 Underhood Lamp—XJ Vehicles

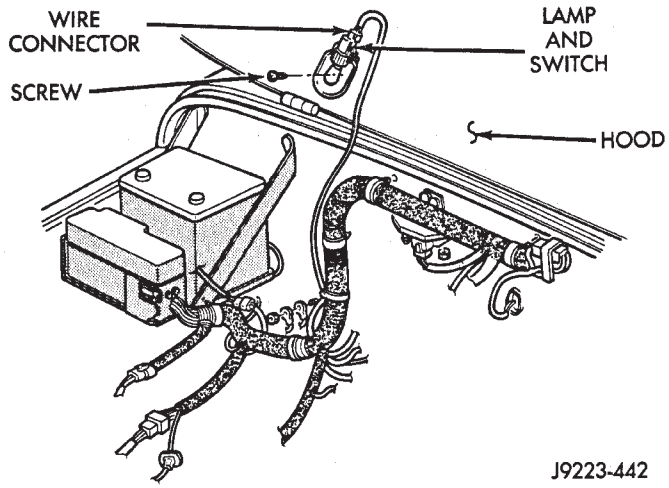


Fig. 47 Underhood Lamp—YJ Vehicles

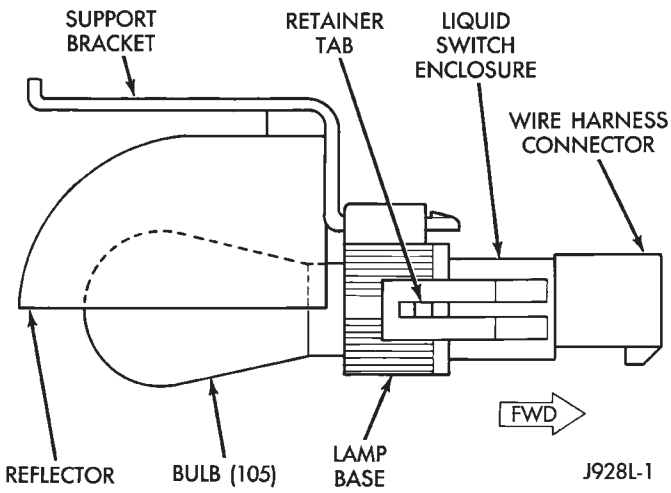


Fig. 48 Underhood Lamp Components

UNDERHOOD LAMP BULB REPLACEMENT

REMOVAL—ALL VEHICLES

(1) Disconnect the wire harness connector from the underhood lamp.

(2) Rotate the bulb counter-clockwise and remove it from the lamp base socket.

INSTALLATION—ALL VEHICLES

(1) Insert a replacement bulb in the lamp base socket and rotate it clockwise.

(2) Connect the wire harness connector to the lamp.

UNDERHOOD LAMP REPLACEMENT

REMOVAL—ALL VEHICLES

(1) Disconnect the wire harness connector from the lamp.

(2) Rotate the bulb counter-clockwise and remove it from the lamp base socket.

(3) Remove the screw that attaches the lamp reflector and support bracket to the hood inner panel.

(4) Remove the lamp from the hood inner panel.

INSTALLATION—ALL VEHICLES

(1) Position the underhood lamp on the hood inner panel.

(2) Install the attaching screw through the lamp and into the hood panel. Tighten the screw securely.

(3) Insert a replacement bulb in the lamp base socket and rotate it clockwise.

(4) Connect the wire harness connector to the lamp.

INTERIOR LAMPS

INDEX

DOME/COURTESY LAMP SERVICE INFORMATION

XJ VEHICLES

Voltage is applied at all times via the dome lamp fuse to each of the interior lamp bulbs. The interior lamp bulbs illuminate when they are connected to body ground via the switch:

- headlamp switch,
- glove box switch,
- door pillar switch, and
- liftgate switch (if the cargo lamp is ON.)

If equipped with Security Alarm Module, refer to Group 8Q—Vehicle Theft Security System.

YJ VEHICLES

The dome/cargo and courtesy lamps are controlled via ON/OFF switches. The ON/OFF switches are in the lamp ground circuits. Voltage via the dome/courtesy lamp fuse is applied directly to the lamp bulbs. When either door is opened, the door pillar switch contacts close and provide a direct path to vehicle body ground.

The cargo/cargo and courtesy lamps can also be turned on via the interior lamp illumination rheostat.

DOME/COURTESY LAMP TROUBLE DIAGNOSIS

ALL LAMPS INOPERATIVE

(1) Rotate the headlamp switch rheostat clockwise. The lamps should light. If not OK, remove, inspect and test the dome lamp fuse. Replace if bad.

(2) If the fuse is OK, repair the open circuit in the wire harness to vehicle body ground.

ONE LAMP INOPERATIVE

(1) Measure the resistance across the bulb holder terminals. The ohmmeter should indicate zero ohms. If not, replace the bulb.

(2) Measure the voltage between the voltage side of the bulb holder and vehicle body ground. The voltmeter should indicate battery voltage. If not, repair the open circuit in the wire harness to the splice.

LAMPS INOPERATIVE WITH ONE OR MORE DOORS OPENED

(1) Remove the inoperative switch from the door pillar and connect the switch wire directly to ground. The lamp should light.

(2) If not, check for an open circuit in black (ground) wire. Repair as necessary. If lamps still do not light, replace the switch.

LIGHTED VANITY MIRROR

SERVICE INFORMATION—XJ VEHICLES

Both the driver and the front passenger sunvisor can be equipped with a lighted vanity mirror. A lamp located at each side of the vanity mirror. The lamps are switched ON automatically when the mirror cover is lifted (Fig. 1).

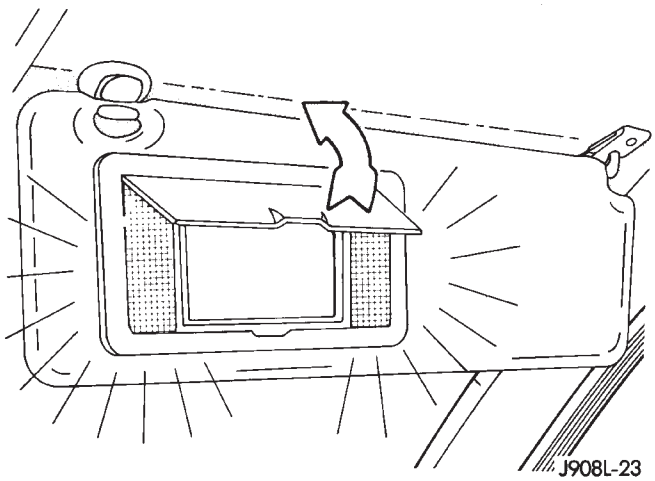


Fig. 1 Lighted Vanity Mirror

Voltage is applied directly to the vanity lamp bulbs via the dome lamp fuse.

LIGHTED VANITY MIRROR TROUBLE DIAGNOSIS

VANITY LAMPS INOPERATIVE

(1) Remove, inspect and test the dome lamp fuse. Replace if defective.

(2) Test the dome lamp operation. If OK, go to the next step. If not OK, repair the open circuit in the wire harness from the splice.

(3) Measure the voltage between the pink wire on the switch connector and vehicle body ground. The voltmeter should indicate battery voltage. If not OK, repair the open circuit in the wire harness from the splice.

(4) Connect a jumper wire from the ground side of the switch to a good vehicle body ground. Measure the resistance to vehicle body ground. The ohmmeter should indicate zero ohms. If not, repair the open circuit in the wire harness to vehicle body ground.

DOME LAMP REPLACEMENT

REMOVAL—XJ VEHICLES

(1) Remove the dome lamp lens by squeezing it at both sides. This will separate the lens retainer tabs from the lamp housing shoulders.

(2) Pull the lens downward to remove it from the lamp housing.

(3) Remove the lamp housing retainer clips (Fig. 2).

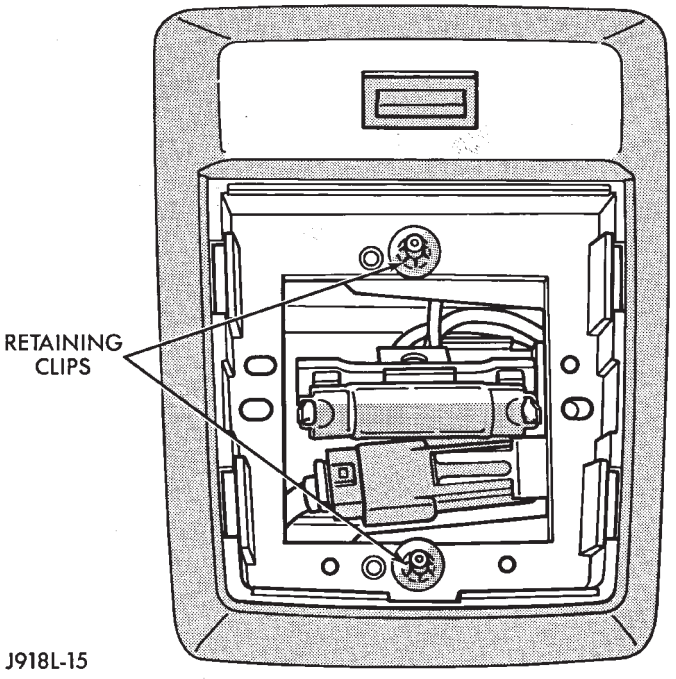


Fig. 2 Dome Lamp Removal/Installation—XJ Vehicles

(4) Disconnect the wire harness connector.

(5) Remove the lamp housing from the headliner cavity.

INSTALLATION—XJ VEHICLES

(1) Position the dome lamp housing at the headliner cavity.

(2) Connect the wire harness connector.

(3) Install the lamp housing retainer clips (Fig. 2).

(4) Position the lens at the lamp housing and force it upward into the housing until the retainer tabs are seated on the lamp housing shoulders.

HARDTOP DOME/CARGO LAMP BULB REPLACEMENT—YJ VEHICLES

REMOVAL

(1) Remove the dome/cargo lamp lens by squeezing it at both sides. This will separate the lens retainer tabs from the lamp housing shoulders (Fig. 3).

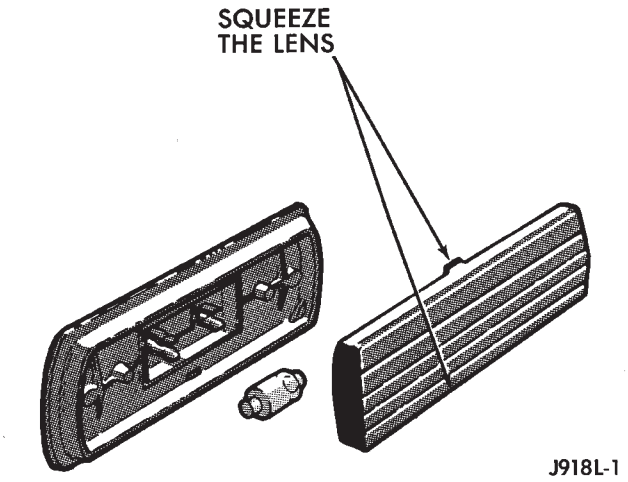


Fig. 3 Hardtop Dome/Cargo Lamp—YJ Vehicles

(2) Remove the lens from the lamp housing.

(3) Pull the bulb straight out to remove from the bulb holder.

INSTALLATION

(1) Insert the replacement bulb in the bulb holder.

(2) Position lens at the lamp housing and force it into the housing until the retainer tabs are seated.

OVERHEAD CONSOLE—XJ VEHICLES

MAP READING LAMP LENS REMOVAL

(1) Make a straight hook at the end of a large paper clip or wire (approximately 1.5-mm/0.06-in diameter).

(2) Insert the wire hook into the hole in the lamp lens and pull downward to detach the lens from the lamp housing (Fig. 4).

MAP READING LAMP LENS INSTALLATION

(1) Insert the tab at the front of the lamp lens into the slot in the lamp housing—shown by arrow 1 in Figure 5.

(2) Force the rear of the lens upward until it is seated in the lamp housing—shown by arrow 2 in Figure 5.

ILLUMINATED ENTRY SYSTEM SERVICE INFORMATION

The Illuminated Entry System that is activated by the system relay (TAN). The relay is located on a bracket (with 3 relays) behind the instrument panel. The relay receives input from the door pillar

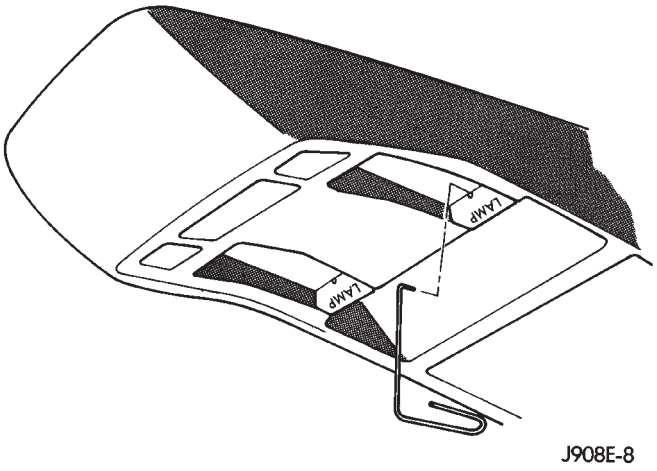


Fig. 4 Map Reading Lamp Lens Removal

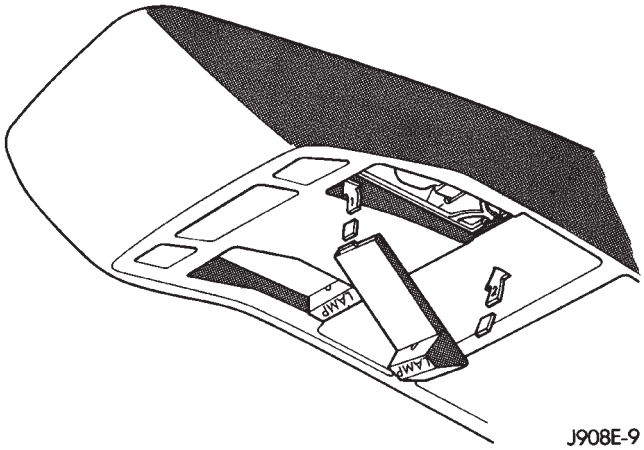


Fig. 5 Map Reading Lamp Lens Installation

switches, the keyless entry system, and the ignition switch (when in the RUN position). When correct input is received, the entry module timer immediately begins the timing-out process. The timing-out process requires approximately 30 ±6 seconds.

The illuminated entry system also operates when a door is opened to exit the vehicle. When the door is closed the interior illumination will continue for the remaining portion of the 30 seconds.

ILLUMINATED ENTRY SYSTEM TROUBLE DIAGNOSIS

The Illuminated Entry System relay is located on a bracket behind the instrument panel.

(1) Ensure that the ignition switch is in the Off position.

(2) Open and immediately close the driver-side door. The interior courtesy lamps should immediately illuminate.

(3) Open driver-side door, enter the vehicle, close the door and turn the ignition switch to the RUN position. The courtesy lamps should go out. Turn the ignition switch to the OFF position before exiting vehicle.

(4) When exiting the vehicle, the courtesy lamps should remain illuminated after the door is closed.

(5) From outside the vehicle, open and close the passenger-side door. The courtesy lamps should illuminate.

RELAY BENCH TEST

(1) Attach a "jumper" wire to pin 1. Momentarily connect pin 1 (battery negative terminal/ground) to pin 4. The test bulb should light for 30 ±6 seconds, then go out. If not, replace the relay.

(2) Momentarily connect pin 1 (battery negative terminal/ground) to pin 4. The test bulb should light. Attach a "jumper" wire to pin 5 and momentarily connect pin 5 to pin 2. The test bulb should go out. If not, replace the relay.

(3) Momentarily connect pin 1 (battery negative terminal/ground) to pin 3. The test bulb should light. Next, momentarily connect pin 5 to pin 2 (B+) and the test bulb should go out. If not, replace the relay.

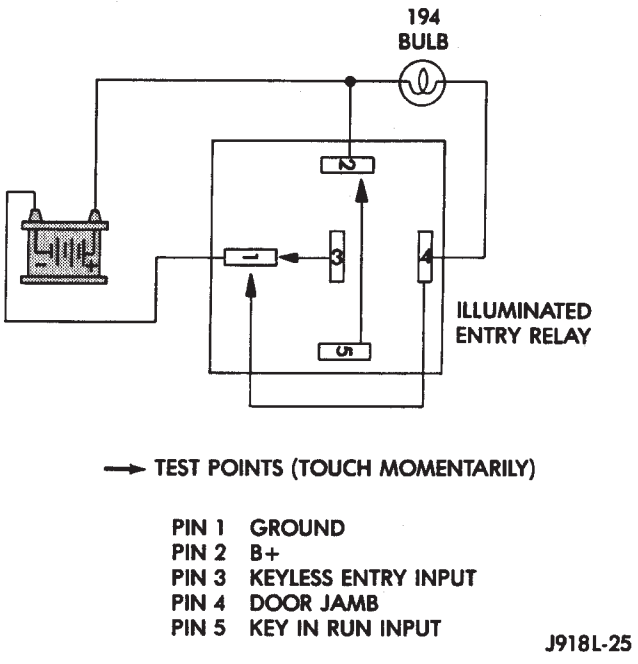
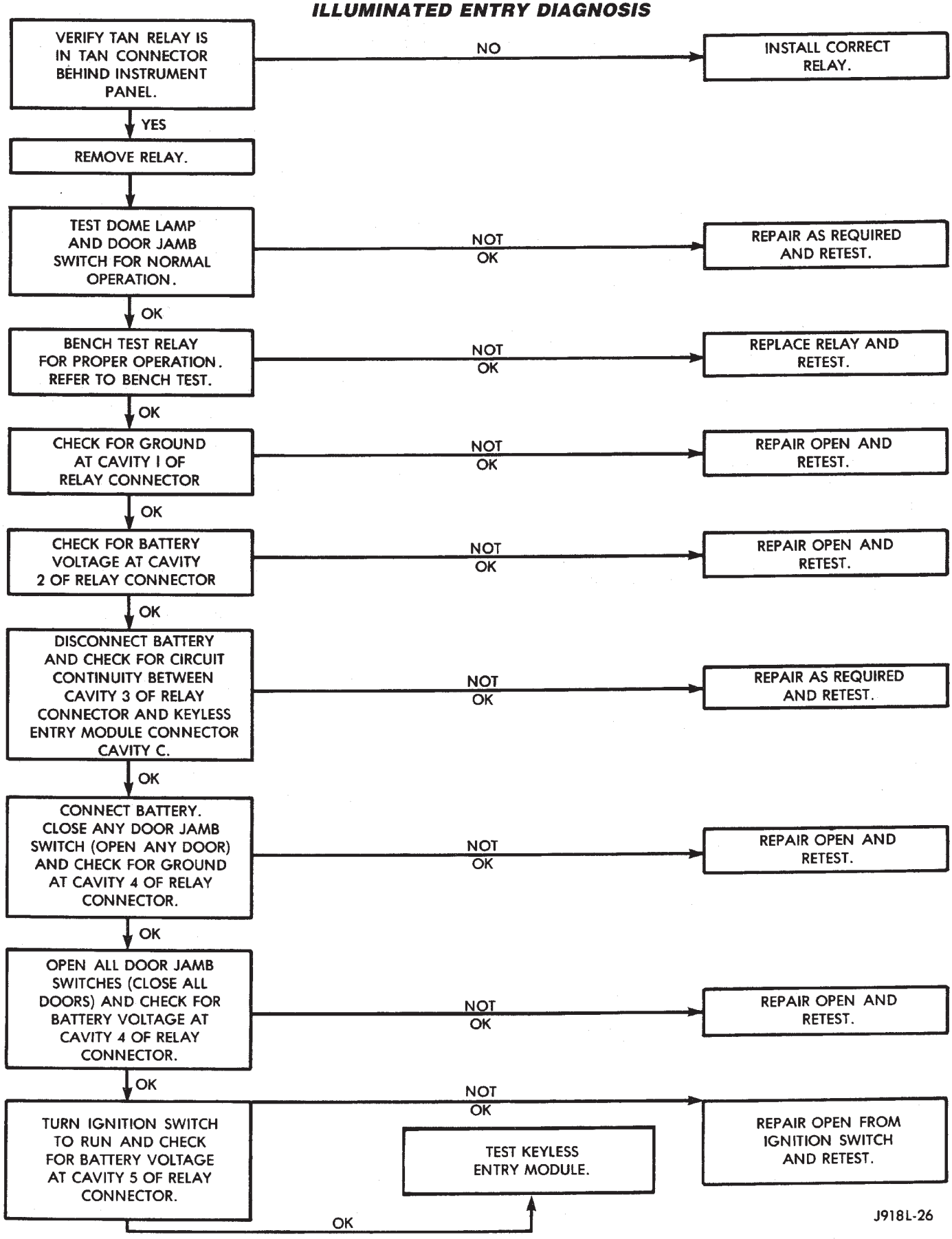


Fig. 6 Relay Bench Test

ILLUMINATED ENTRY SYSTEM TROUBLE DIAGNOSIS

ILLUMINATED ENTRY DIAGNOSIS



SPECIFICATIONS

XJ EXTERIOR LAMPS

EXTERIOR LAMPS	BULB TYPE
Backup Lamps (2)	1156
Front Park/Turn Lamps (2)	2057NA
Front Side Marker Lamps (2)	194
Cherokee Headlights (2)	H 6054
Rear License Plate Lamp (1)	168
Stop/Tail Lamps (2)	2057
Turn Signal Lamps (2)	1156
Underhood Lamp (1)	105

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XJ INTERIOR LAMPS

INTERIOR LAMPS	BULB TYPE
Under Panel Courtesy Lamp (2)	168
Dome Lamp (1)	561
Dome/Reading Lamp (2)	906
Dome/Reading Lamp (1)	561
Cargo Lamp (1)	561
Lighted Vanity Mirror (2)	74
Ashtray Lamp (1)	1891
Cigarette Lighter Lamp (1)	53
Climate Control Lamp (2)	74
Rocker Switch Lamp (1)	37 (As Required)
Transfer Case Lamp (1)	658
Automatic Transmission Floor Shift Lamp (1)	658
Glove Box Lamp (1)	194
Overhead Console (4)	912

J928L-6

YJ EXTERIOR LAMPS

EXTERIOR LAMPS	BULB TYPE
Back-Up Lamps (2)	1156
Front Park/Turn Lamps (2)	2057
Front Side Marker Lamps (2)	194
Headlamps	H6054
Stop/Tail/Turn Lamps (2)	1157
Underhood Lamp (1)	105

J928L-11

YJ INTERIOR LAMPS

INTERIOR LAMPS	BULB TYPE
Courtesy Lamps, Under Dash Panel (2)	89
Dome—Cargo (Hardtop Models Only)	212
Ash Tray Lamp	1891
Cigarette Lighter Lamp	53
Heater Control Lamp	194
Rocker Switch Indicator Lamp (Fog Lamps and Rear Window Defogger)	74
Automatic Transmission Indicator Lamp	1445
Glove Box Lamp	194

J908L-35

REAR WINDOW DEFOGGER

CONTENTS

GENERAL

INDEX

Using heating elements bonded to the rear window glass, the rear defogger will clear condensation, frost and light snow coverings from the rear window.

The horizontal grid lines and vertical bus bar lines, printed and baked on inside surface of the rear window glass, comprise an electrical circuit. The electrically conductive lines are composed of a silver-ceramic material which when baked on glass becomes bonded to the glass and is highly resistant to abrasion.

The electrical current required to produce the heat in the grid is supplied through a relay and driver operated switch. When the switch is momentarily depressed, the relay senses a voltage change. This voltage change causes the relay to change state and complete a circuit to energize the relay. Once the relay energizes, the contacts close connecting the grid to battery power.

On the XJ, the power circuit to the grid is protected by the 25 amp, #18 fuse in the fuse box. Power for fuse #18 comes from the power distribution center, fuse #F10. Power for the relay is protected by the 20 amp, #8 fuse located in the fuse box.

On the YJ, the grid is protected by a 25 amp #6 fuse, located in the fuse box. Power for the relay is protected by 15 amp #9 fuse, located in the fuse box.

To defog the rear window, momentarily depress the rocker switch. A light on the rocker switch will illuminate indicating that the defogger is operating.

If the ignition switch is ON the first activation of the defog/defrost feature will last for 10 minutes. Succeeding activations will last for 5 minutes unless the ignition switch is turned OFF; then it will recycle back to 10 minutes for the first activation.

To stop defogger operation, momentarily push the switch a second time.

CAUTION: Use care when washing the inside of the rear window to prevent damage to the defogger heating elements. Use a soft cloth and a mild washing solution. Wiping motions should be parallel to the heating elements. Also, keep all objects a safe distance from the window to prevent damaging the heating elements.

REAR WINDOW DEFOGGER GRID TEST

It is possible, that a break may exist or occur in an individual grid line resulting in no current flow through the line. When a grid has an open circuit, the area of glass normally cleared by that grid remains fogged or iced unless, and until it is cleared by the adjacent grids.

With the engine running at idle, push the rear window defogger switch to the ON position and release. The pilot lamp in the rocker switch should light, indicating defogger operation.

Using a 12-volt DC voltmeter, contact the positive lead to the feed side vertical bus element on the inside surface of the glass. Contact the negative lead to the ground side bus element. Meter should read between 11 and 13 volts. Connect the negative lead of the voltmeter to a good ground; the meter reading should be constant.

Keep the negative lead connected to ground. Use the positive lead and carefully contact each grid at the approximate centerline of the window.

A voltage drop of one-half the full amount, approximately 6 volts, indicates a good grid or closed circuit.

A voltage drop of 12 volts at the centerline indicates a break in the grid between the positive voltmeter lead and the ground.

No voltage drop (0 volts) at the centerline indicates a break in the grid between the centerline and the voltage source or lead.

The exact location of the break can be pinpointed by moving positive voltmeter lead to the left or right along grid. An abrupt change in the voltage reading will be noticed. The break is at that point in the grid.

REAR WINDOW DEFOGGER GRID REPAIR

Locate the broken or open grid.

Use the grid repair kit (available as a service part) by using the following procedure:

(1) Mark the location of the broken or open grid on the exterior surface of the glass using a suitable marking pencil.

(2) Lightly rub the area to be repaired (inside the rear window) using fine steel wool. Clean the area with alcohol.

(3) Attach two strips of masking tape to the inside surface of the rear window (above and below the break in the grid) (Fig. 1).

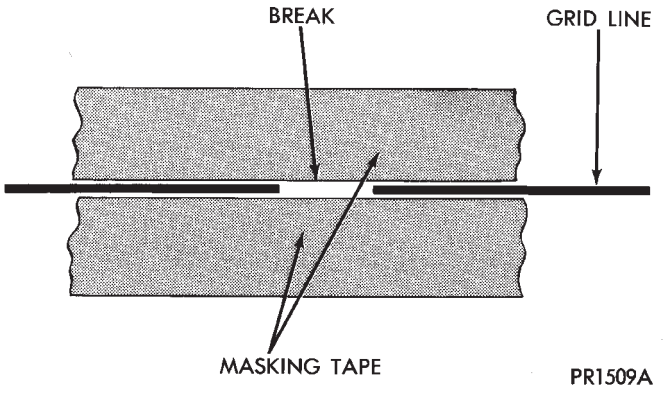


Fig. 1 Grid Line Repair (Typical)

(4) Remove package separator clamp and mix plastic conductive epoxy thoroughly. Fold in half and cut center corner to dispense epoxy.

(5) Apply conductive epoxy through slit in masking tape. Overlap both ends of the break.

(6) For a terminal or pigtail replacement, mask adjacent areas so epoxy can be extended onto line and buss bar. Apply a thin layer of epoxy to area where terminal was fastened and to adjacent line.

(7) Apply a thin layer of conductive epoxy on terminal and place terminal on desired location. To prevent terminal from moving while the epoxy is curing, it must be wedged or clamped.

(8) Carefully remove masking tape from grid line.

(9) Allow epoxy to cure 24 hours at room temperature or use heat gun with a 260°-371°C (500°-700°F) range for 15 minutes. Hold gun approximately 254mm (10 inches) from repaired area.

(10) After conductive epoxy is properly cured remove wedge from terminal and check out operation of rear window defogger. Do not attach connectors until curing is complete.

WARNING: REPAIR KIT MAY CAUSE SKIN OR EYE IRRITATION.

CONTAINS EPOXY RESIN AND AMINE TYPE HARDENER, HARMFUL IF SWALLOWED. AVOID CONTACT WITH SKIN AND EYES. FOR SKIN, WASH AFFECTED AREAS WITH SOAP AND WATER. DO NOT TAKE INTERNALLY. IF TAKEN INTERNALLY, INDUCE VOMITING; CALL A PHYSICIAN IMMEDIATELY. IF IN CONTACT WITH EYES, FLUSH WITH PLENTY OF WATER. USE WITH ADEQUATE VENTILATION. DO NOT USE NEAR FIRE OR FLAME. CONTENTS CONTAIN 3% FLAMMABLE SOLVENTS.

WARNING: KEEP OUT OF REACH OF CHILDREN.

SWITCH TESTING

DIAGNOSIS

Refer to Group 8W - Wiring Diagrams for a complete circuit diagram.

BATTERY, IGNITION & FUSES

- Check fuses #6 and #9 (YJ), or #8 and #18 fuse (XJ). Replace as required.
- If the fuses are not blown check the battery side of #18 fuse (XJ) or fuse #6 (YJ) for battery voltage. If battery voltage is not present replace the Maxi fuse located in the power distribution center.
- Check the ignition side of fuse #9 (YJ), fuse #8 (XJ) for battery voltage. If battery voltage is not present check for an open from the ignition switch.

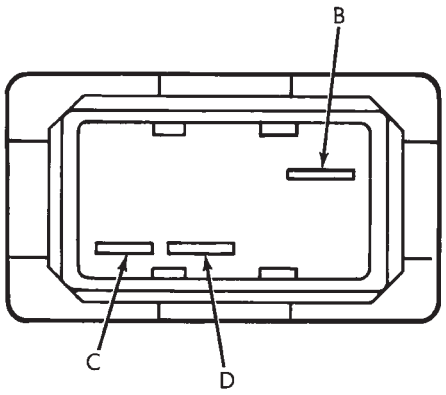
DEFOGGER SWITCH

Defogger switch connector separated from defogger switch; turn ignition switch to ON for voltage tests; turn ignition switch to OFF for resistance tests

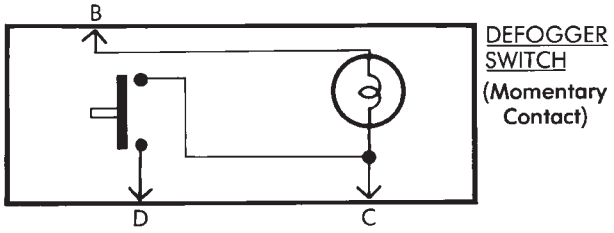
- Measure voltage at defogger switch connector terminal D. The meter should read approximately 5 volts momentarily. If not, repair open from relay.
- Refer to switch diagram for resistance tests. If values do not match, replace defogger switch.

DEFOGGER RELAY

Defogger relay connector separated from defogger relay; turn ignition switch to ON for voltage tests; turn ignition switch to OFF for resistance tests



SWITCH DIAGRAM



SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
On/Off	B and D	Almost zero ohms (bulb filament) with switch button depressed
On/Off	D and C	
At Rest (Neutral)	B and C	Almost zero ohms (bulb filament)

J928N-1X

• Measure voltage at relay connector terminal 4. The meter should read battery voltage. If not, repair open to fuse #18 (XJ), or fuse #9 (YJ).
• Measure voltage at relay connector terminal 5. The meter should read battery voltage. If not, repair open from #8 fuse XJ, or fuse #6 YJ.
• Measure resistance between relay connector terminal 1 and left side (driver's side) of defogger grid. The meter should read zero ohms. If not, repair open between relay connector and left side of defogger grid.
• Measure resistance between relay connector terminal 2 and a clean chassis ground. The meter should read zero ohms. If not, repair open between relay connector and ground.
• Connect relay connector and measure voltage at terminal 3. The meter should read approximately 5 volts. If not, replace defogger relay.

INDICATOR LAMP

Refer to switch diagram for resistance tests. If values do not match, replace defogger switch.

DEFOGGER GRID

Turn defogger switch to ON; turn ignition switch to ON for voltage tests; turn ignition switch to OFF for resistance tests

• Measure voltage at left side (driver's side) of defogger grid. The meter should read battery voltage. If not, repair open from defogger relay.
• Measure resistance for right side of defogger grid to a clean chassis ground. The meter should read zero ohms. If not, repair open between right side of defogger grid and ground.

XJ

REAR WINDOW DEFOGGER SWITCH REPLACEMENT

(1) Remove the instrument panel bezel; see 8E-Instrument Panel and Gauges section for the procedure.

(2) Remove the switch housing panel.

(3) Unplug the switch connector. Slightly depress the switch mounting tabs and remove the switch.

REAR DEFOGGER RELAY

The rear defogger relay is in the relay center. The relay center is located on the lower instrument panel trim cover just right of the steering column.

(1) Remove the rear defogger relay (red) from the relay center (Fig. 2).

(2) To install the relay, reverse the removal procedures.

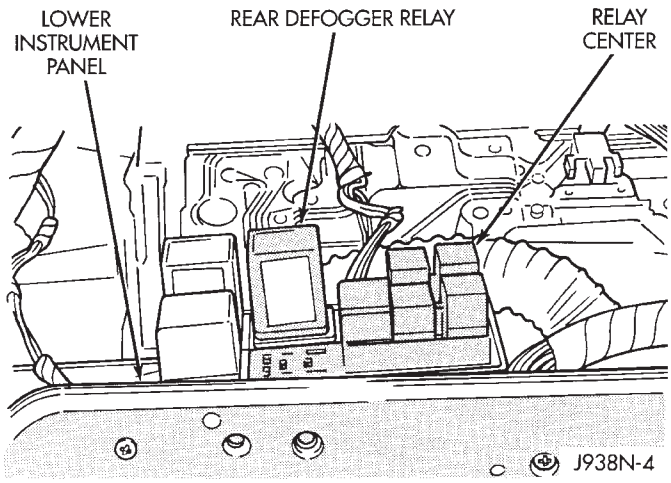


Fig. 2 Rear Defogger Relay Location—XJ

YJ

REAR WINDOW DEFOGGER SWITCH REPLACEMENT

(1) Remove 6 shroud screws (Fig. 3).

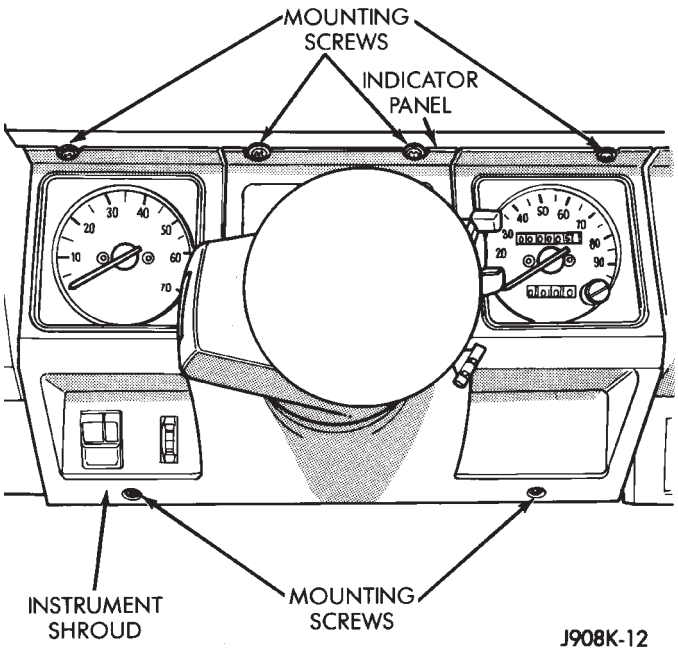


Fig. 3 Instrument Shroud Removal/Installation—YJ

(2) Slide shroud toward the steering wheel.

(3) Remove 3 screws (Fig. 4).

(4) Unplug the connector from the defogger switch.

(5) Squeeze the ends of the switch to release the plastic retaining fingers and push outward.

(6) To install, depress the rear window defogger switch into the bezel until the retaining fingers lock behind the bezel.

(7) Plug the connector on the switch.

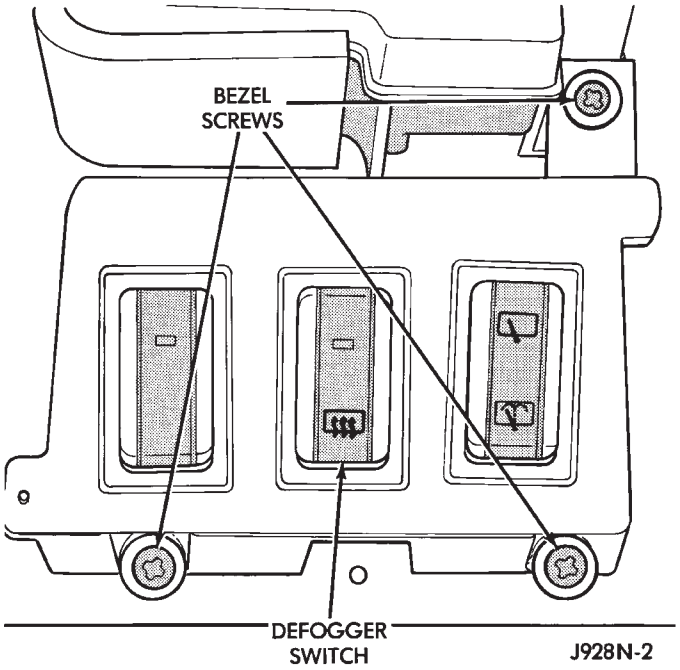


Fig. 4 Defogger Switch—YJ

(8) Install the bezel with 3 screws.

(9) Install the shroud with 6 screws.

REAR DEFOGGER RELAY

The rear defogger relay is in the relay center. The relay center is located on the lower instrument panel trim cover just right of the steering column.

(1) Remove the rear defogger relay (red) from the relay center (Fig. 2).

(2) To install the relay, reverse the removal procedures.

POWER DOOR LOCKS

CONTENTS

POWER LOCKS

INDEX

GENERAL

The door lock actuators, including liftgate, are controlled by two-way switches. To lock the doors, push down on either switch. To unlock doors from inside the vehicle push upward on either switch.

The power door locks do not lock or unlock the doors from outside the vehicle. Insert the key into the lock cylinder to lock or unlock each individual door.

DESCRIPTION

The door locks are operated by reversible motors that receive voltage from fuse #13 in the fuse panel. Voltage is applied to the driver's side door lock switch and the passenger's side door lock switch through the #9 fuse. With the driver's side door lock switch in LOCK, voltage is applied through the switch to the door lock relay coil. The relay coil is energized which closes the circuit from the circuit breaker to the lock motor. The motor is grounded by the unlock relay.

The passenger's side door lock window switch operates the same as the driver's door switch. The voltage and ground paths are reversed to unlock the doors.

The power door lock operates with battery power and, therefore, is independent of the ignition switch.

DIAGNOSING POWER DOOR LOCKS

If vehicle has Keyless Entry and the door locks operate properly using door switches but do not work with transmitter, refer to Keyless Entry in this group.

NO DOOR LOCKS OPERATE USING DOOR LOCK SWITCHES

(1) Inspect fuse #13. Replace if necessary. If OK, measure voltage at battery side of fuse. There should be 12 volts. If not, repair open from Power Distribution Center.

(2) Remove door switch and measure voltage at terminal 1. Meter should read battery voltage. If not, repair open to #9 fuse.

(3) The power window relays are in the relay center. The relay center is located on the lower instrument panel trim cover just right of the steering column (Fig. 1). Remove both relays.

(4) Measure resistance between lock and unlock relay terminal 4 (87A) and ground. Meter should read zero ohms. If not, repair open to ground.

(5) Measure voltage at terminal 5 (87) of both the lock and unlock relays. Meter should read battery voltage. If OK, next step. If not, repair open to circuit breaker.

(6) Measure resistance at terminal 2 (85) of both the lock and unlock relays. Meter should read zero ohms. If not, repair open to ground.

(7) Hold driver's side switch in LOCK position. Measure voltage at lock relay terminal 1 (86). Meter should read battery voltage. If OK, next step. If not, repair open to driver's side switch.

(8) Hold driver's side switch in UNLOCK position. Measure voltage at unlock relay terminal 1 (86). Meter should read battery voltage. If OK, next step. If not, repair open to driver's side switch.

(9) Hold driver's side switch in LOCK position. Measure voltage at lock relay terminal 3 (30). Meter should read battery voltage. If OK, next step. If not, replace lock relay.

(10) Hold driver's side switch in UNLOCK position. Measure voltage at unlock relay terminal 3 (30). Meter should read battery voltage. If OK, check connections and door motor. If not, replace unlock relay.

(11) Repeat procedures for passenger's side switch.

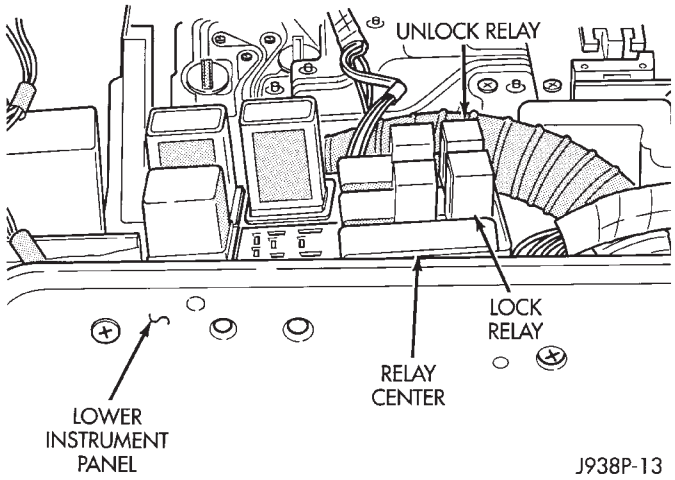
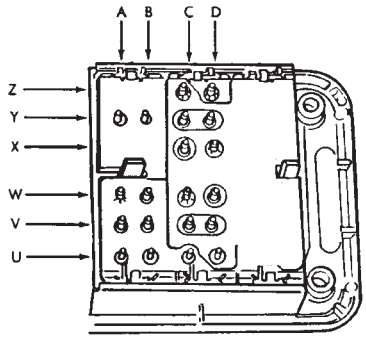
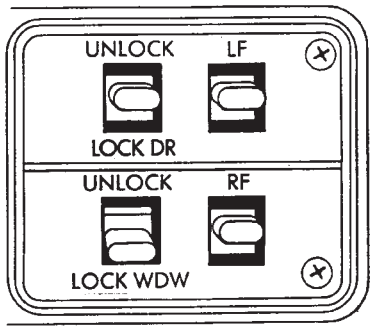


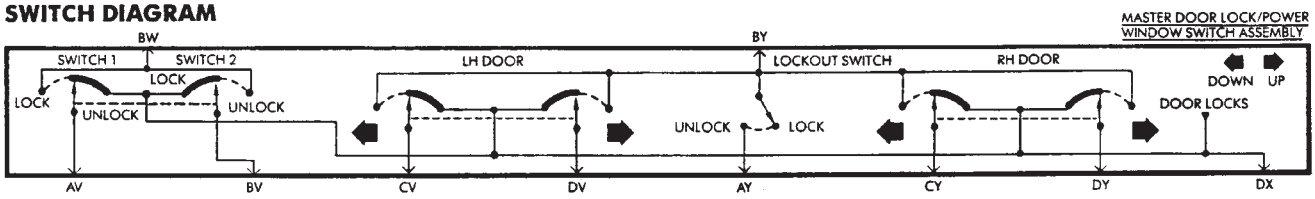
Fig. 1 Door Lock/Unlock Relays

DRIVERS DOOR POWER LOCK SWITCH—2-DOOR LEFT HAND DRIVE





SWITCH DIAGRAM



SWITCH TEST
Switch Grounds

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	DX and: AV, BV, CV DV, CY, DY	Yes
	BW and DX	No
	BY and DX	No

SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
Unlock	BW and BV	Yes
Lock	BW and AV	Yes

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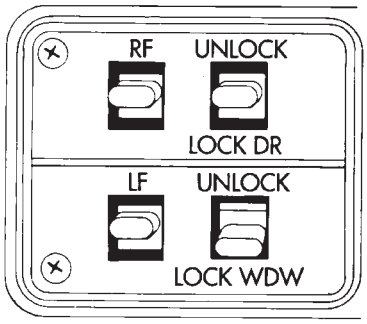
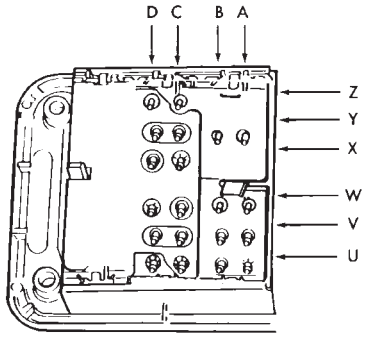
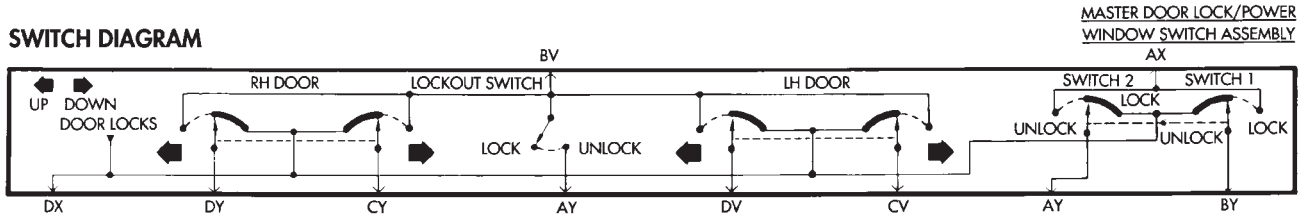
DRIVERS DOOR POWER LOCK SWITCH—2-DOOR RIGHT HAND DRIVE





SWITCH DIAGRAM



SWITCH TEST
Switch Grounds

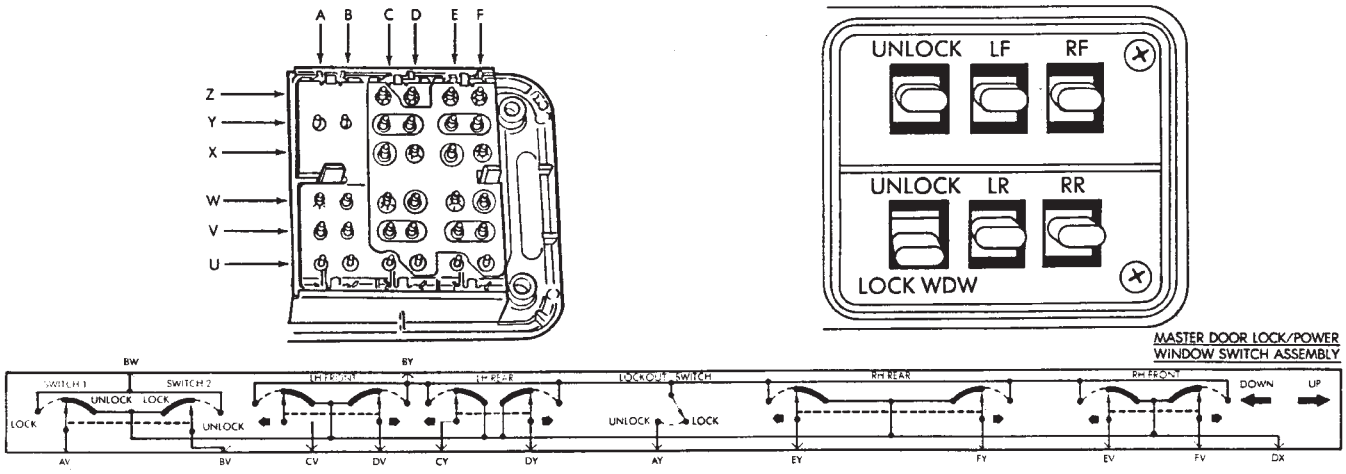
SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	DX and: AV, BV, CV DV, CY, DY	Yes
	BW and DX	No
	BY and DX	No

SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
Unlock	AX and AY	Yes
Lock	AX and BY	Yes

J948P-7

DRIVERS DOOR POWER LOCK SWITCH—4-DOOR



SWITCH TEST
Switch Grounds

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	DX and: AV, BV, CV, DV, CY, DY, EY, FY, EV, FV	Yes
	BW and DX	No
	BY and DX	No

SWITCH TEST

SWITCH POSITION	TERMINALS	ZERO OHMS
Unlock	BW and BV	Yes
Lock	BW and AV	Yes

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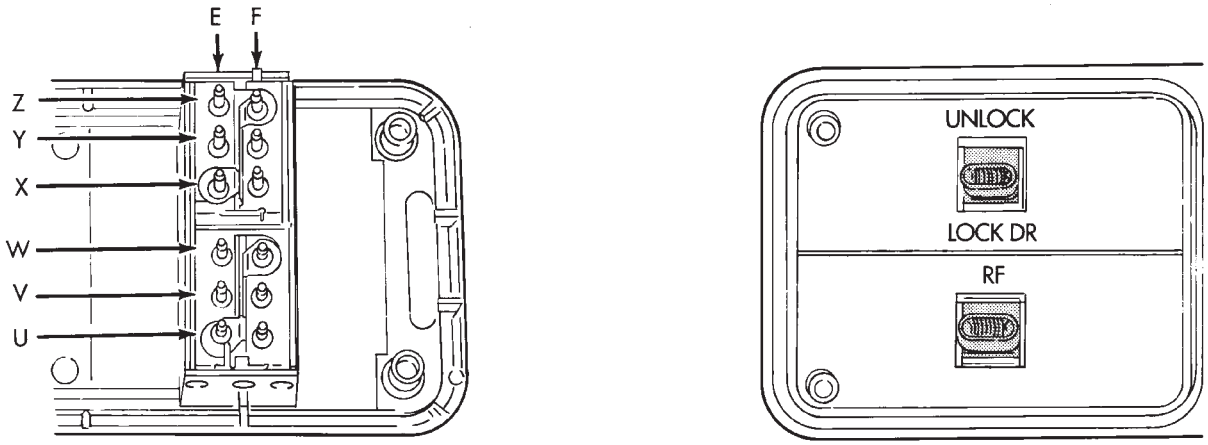
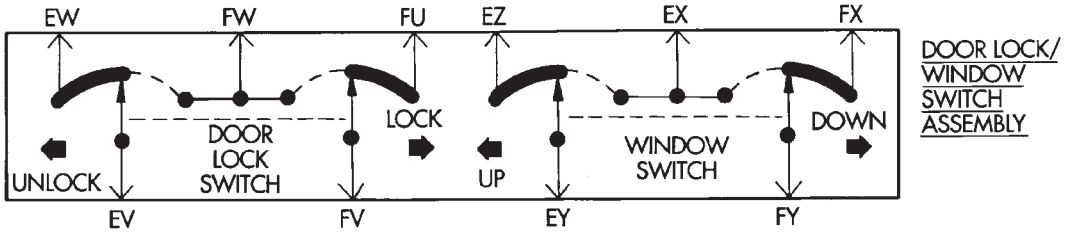
PASSENGER DOOR LOCK SWITCH



SWITCH DIAGRAM



SWITCH TEST
Lock Switch

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	EW and EV	Yes
	FU and FV	Yes
	All Others	No
Unlock	EW and EV	Yes
	FW and FV	Yes
	All Others	No
Lock	FU and FV	Yes
	FW and EV	Yes
	All Others	No

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ACTUATOR MOTOR STALL TEST

To test the actuator motor, connect an ammeter in series with the motor and operate the door switch. Replace the actuator motor if current draw exceeds 8 amps at room temperature or if the actuator does not complete its travel in less than one second. Refer to Solenoid and Latch Assembly Replacement procedures.

SWITCH REPLACEMENT

(1) Remove the interior door latch release assembly and control panel retaining screws (Fig. 2).

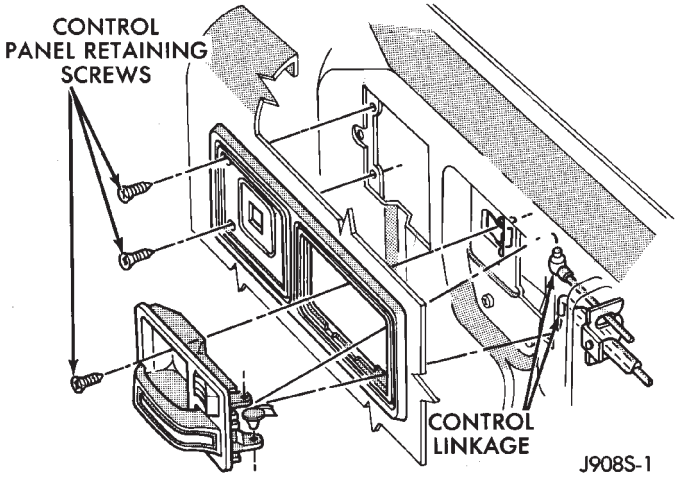


Fig. 2 Power Window/Lock Control Panel Removal/ Installation

(2) Disconnect the control linkage and the wire harness connector.

(3) Remove the latch release and control panel assembly.

(4) The switch is retained to the panel with clips (Fig. 3). Push in on the retainer part of the clip and pry the clips.

(5) To install switch, position switch and press in retainer clips until they snap into position.

SOLENOID AND LATCH ASSEMBLY REPLACEMENT

(1) Remove interior door latch release assembly and control panel retaining screws (Fig. 2).

(2) Disconnect control linkage and wire harness connector.

(3) Remove latch release and control panel assembly.

(4) Remove armrest lower retaining screws.

(5) Swing armrest downward to a vertical position. This is necessary to disconnect armrest from upper retainer clip (Fig. 4).

(6) Pull armrest straight out from trim panel.

(7) Remove trim panel with a wide flat blade tool (Fig. 5).

To aid in removal of trim panel, start at bottom of panel.

(8) Remove plastic water dam sheet.

(9) Remove latch retaining screws (Fig. 6).

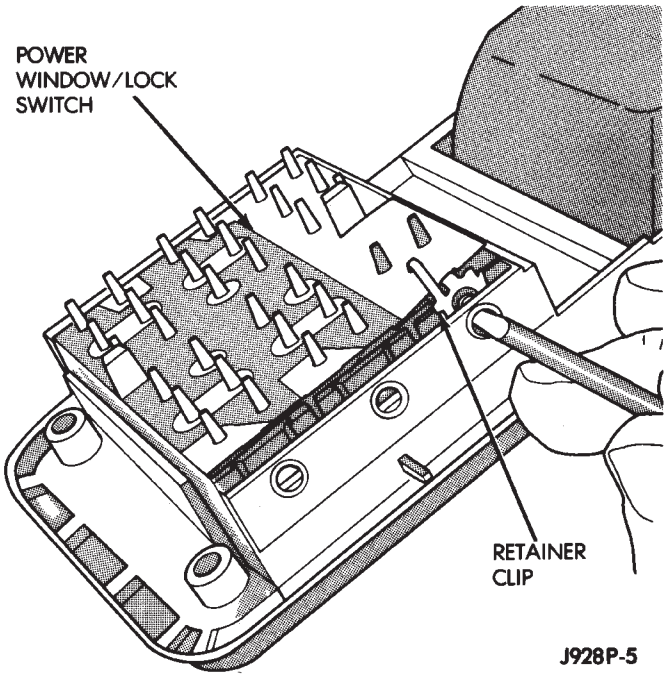


Fig. 3 Power Lock Switch Removal

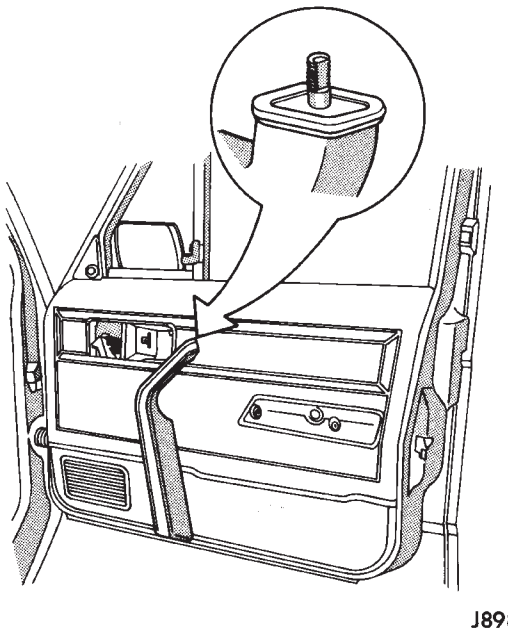


Fig. 4 Armrest Retainer Clip

(10) Grind out or drill out the lock solenoid rivets and remove solenoid with latch assembly and remote control rods (Fig. 7).

(11) Place lock solenoid, latch and remote control rods in door.

(12) Attach lock solenoid to door panel with pop rivets or nuts and screws.

(13) Attach latch. Tighten screws to 9 N·m (7 ft. lbs.) torque.

(14) Install door trim panel and plastic water dam sheet.

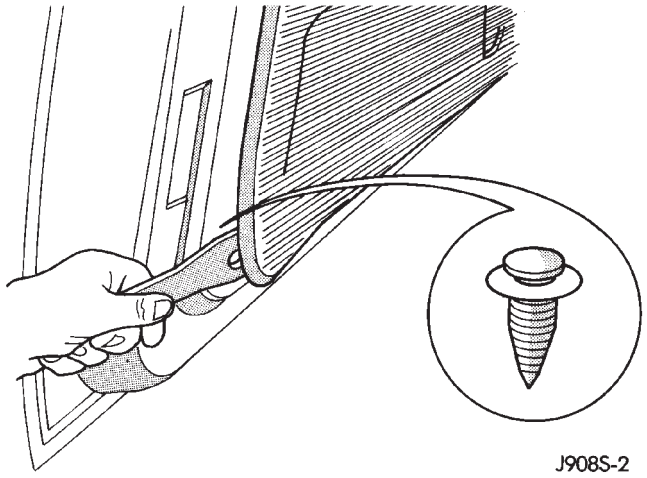


Fig. 5 Trim Panel Removal

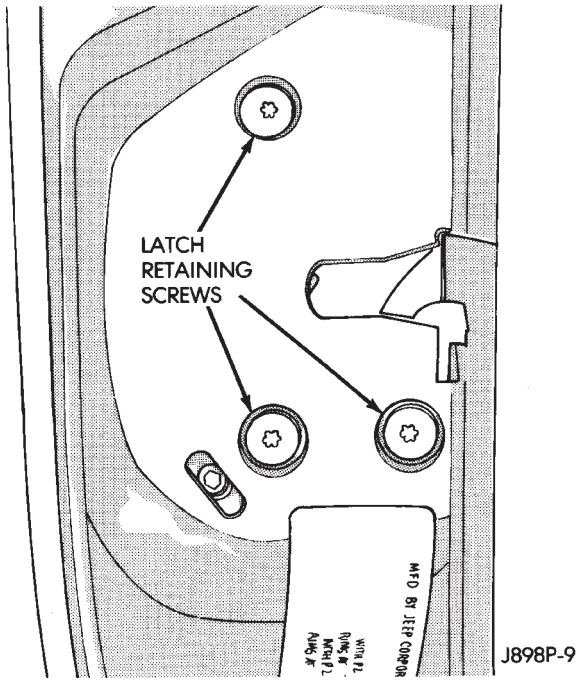


Fig. 6 Latch Removal/Installation

(15) Using an adhesive/sealant, install plastic water dam sheet.

(16) Place trim panel in installation position and press in the nylon retainers.

(17) Install armrest.

(18) Install latch release assembly and control panel.

LIFTGATE LOCK CYLINDER REPLACEMENT

(1) Remove 2 screws at the top outside edges of the liftgate trim panel.

(2) Remove trim panel with a wide flat blade tool (Fig. 8).

To aid in removal of trim panel, start at bottom of panel.

(3) Disconnect lock actuator linkage clip (Fig. 9).

(4) Remove 3 latch retaining screws (Fig. 10).

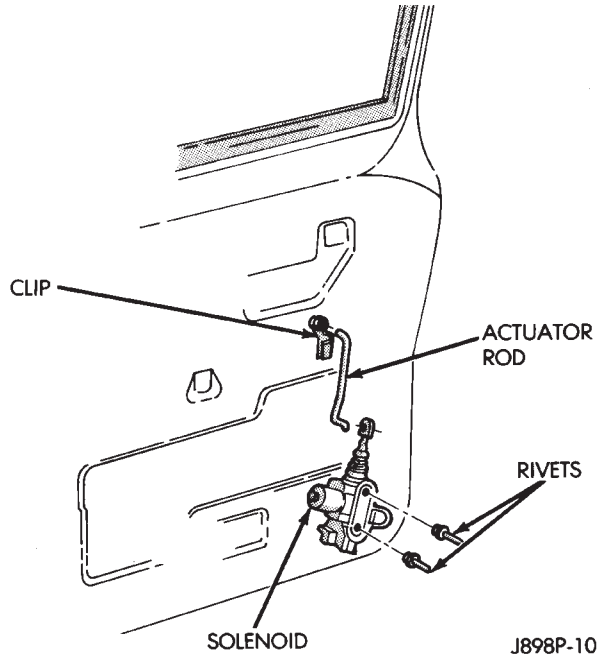


Fig. 7 Solenoid Removal/Installation

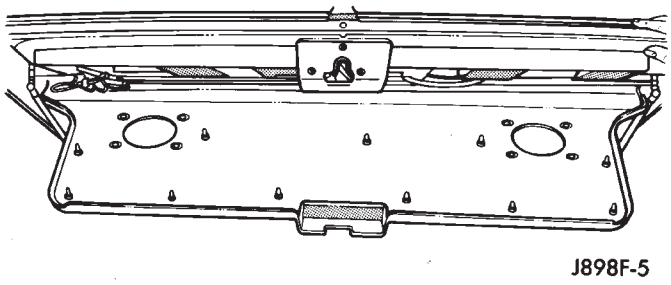


Fig. 8 Liftgate Trim Panel Removal

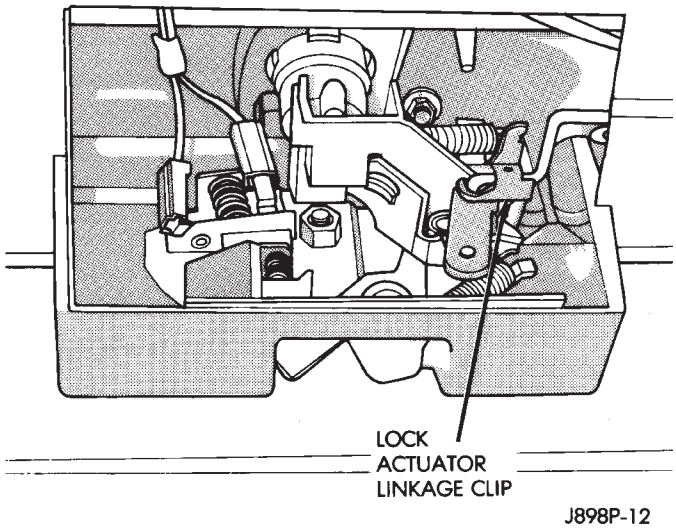


Fig. 9 Lock Actuator Linkage Clip

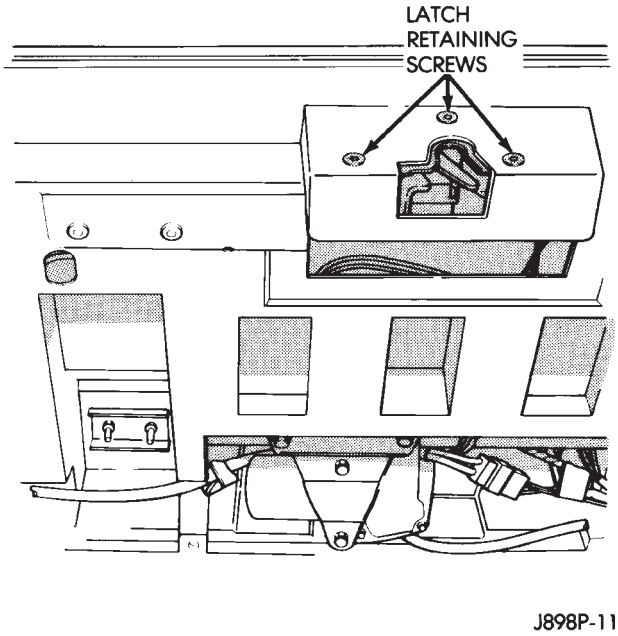


Fig. 10 Latch Assembly Removal/Installation

(5) Remove latch.
(6) Drill out 2 rivets and remove solenoid.
(7) To install solenoid, reverse the removal procedures.
(8) Tighten latch screws to 9 N·m (7 ft. lbs.) torque.

KEYLESS ENTRY

INDEX

SYSTEM DESCRIPTION

The keyless entry system consists of a portable remote control transmitter and a receiver mounted in the overhead console or between the sun visors. System operation is based on a coded infrared signal from the transmitter to the receiver. The transmitter is programmed into the receiver providing the correct programming sequence is met.

When the keyless entry system is activated, the corresponding relay operates to supply voltage to the motors. The use of either relay determines the polarity of the voltage that is supplied to the door lock motors.

When the keyless entry system is used, the transmitter sends a signal to the keyless entry module. If the doors are unlocked, the module activates a transistor switch to apply voltage to the lock relay coil. The coil is energized to close the normally open contacts of the lock relay. Battery voltage from the relay is applied to the door lock motors to lock the doors. Current flows in the same path to ground as it does when the master door lock switch is used.

When the doors are locked, the keyless entry module applies voltage to the unlock relay coil and a similar action takes places to unlock the doors.

TRANSMITTER

The pocket size, solid state transmitter operates on (2) 3-volt lithium (CR1616) batteries (Fig. 1). The transmitter is activated by pressing either the LOCK or UNLOCK button. This closes the internal contacts that complete the battery circuit.

The battery voltage activates the transmitter diode which in turn generates a coded infrared signal. The signal is transmitted as pulses of infrared light.

If the red LED on the side of the transmitter does not light when the transmitter is activated, the batteries are low.

RECEIVER

The receiver is in circuit with the electric door lock system. The coded infrared signal is picked up by the receiver diode and is shaped, amplified and decoded by an integrated circuit within the receiver. If the signal

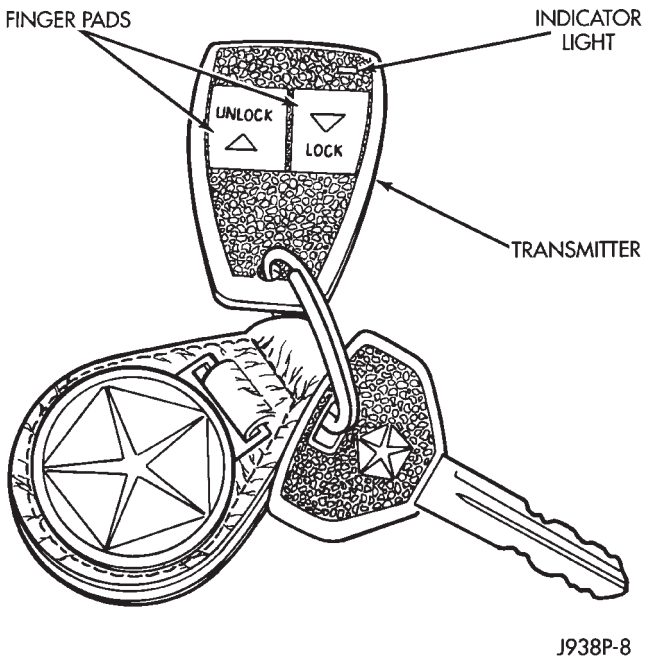


Fig. 1 Keyless Entry Transmitter

code received matches the code in the receiver memory circuit, the receiver triggers the door lock/unlock relays. The relays complete the circuit to the electric door lock solenoid to either lock or unlock the doors.

SYSTEM OPERATION

To activate the system, aim the transmitter diode toward the receiver and press the transmitter signal button to lock or unlock the doors as desired.

Effective transmitter range is 4.75 meters (15 ft.) with the transmitter positioned no more than 45 degrees from the receiver centerline.

For complete circuit diagrams refer to Group 8W - Wiring Diagrams.

TRANSMITTER PROGRAMMING

Up to 4 Transmitter Identification Codes (TIC's) can be programed into the receiver at any given time.

(1) Open the driver's door of the vehicle. Leave it open through the programming procedure.

(2) Move the mechanical door lock lever to the LOCK position.

(3) Turn the ignition switch to the ON position.

(4) Within 20 seconds, aim a transmitter at the receiver dome and press the LOCK button for at least 5 seconds. Once the receiver accepts the programming code, the driver's door will unlock.

(5) Once the first transmitter has been programmed, additional transmitters (up to 4) may be programmed into the receiver. Within 20 seconds of the previous transmitter programming, move the mechanical door lock lever to the LOCK position. Aim another transmitter at the receiver dome and press the LOCK button for at least 5 seconds. The door lock will cycle again.

(6) To lock the programmed codes into the receiver, the ignition switch must be turned OFF and back ON within 20 seconds after programming the last transmitter's code. At that time, all previous codes are erased from the module.

DIAGNOSING POWER DOOR LOCKS

NO DOOR LOCKS OPERATE, USING TRANSMITTER

(1) Measure resistance at keyless entry module terminal 10. Meter should read zero ohms. If not, repair open to ground.

(2) Measure voltage at keyless entry module terminal 1. Meter should read battery voltage. **Battery voltage must be at least 9 volts for this system to operate.** If not, repair open to #9 fuse.

(3) Jumper test leads keyless entry module terminal 1 to terminal 3. Doors should lock. If OK, replace module. If not, repair open from terminal 3 to lock relay terminal 1.

(4) Jumper test leads keyless entry module terminal 1 to terminal 4. Door should unlock. If OK, replace module. If not, repair open from terminal 4 to unlock relay terminal 1.

TRANSMITTER SERVICE

If the receiver malfunctions, only the receiver will have to be replaced. The new receiver will have to be reprogrammed. If a transmitter is lost, replace the transmitter and reprogram the receiver.

Batteries may not be supplied with some replacement transmitters. Be sure to check a replacement transmitter before attempting to activate the system.

TRANSMITTER BATTERY REPLACEMENT

(1) Separate transmitter at middle seam (Fig. 2).

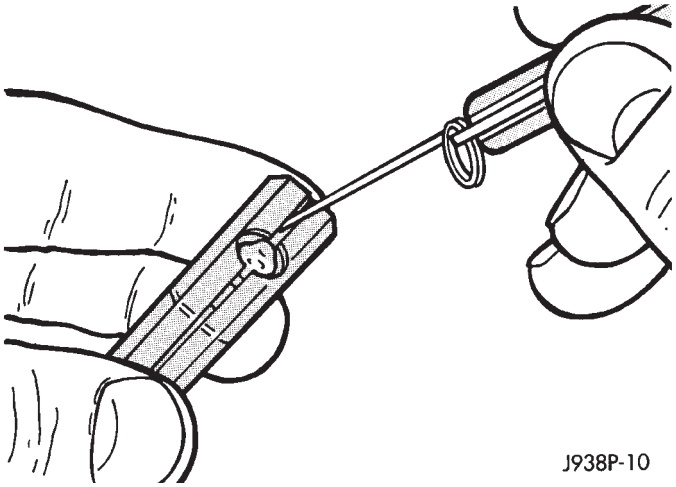
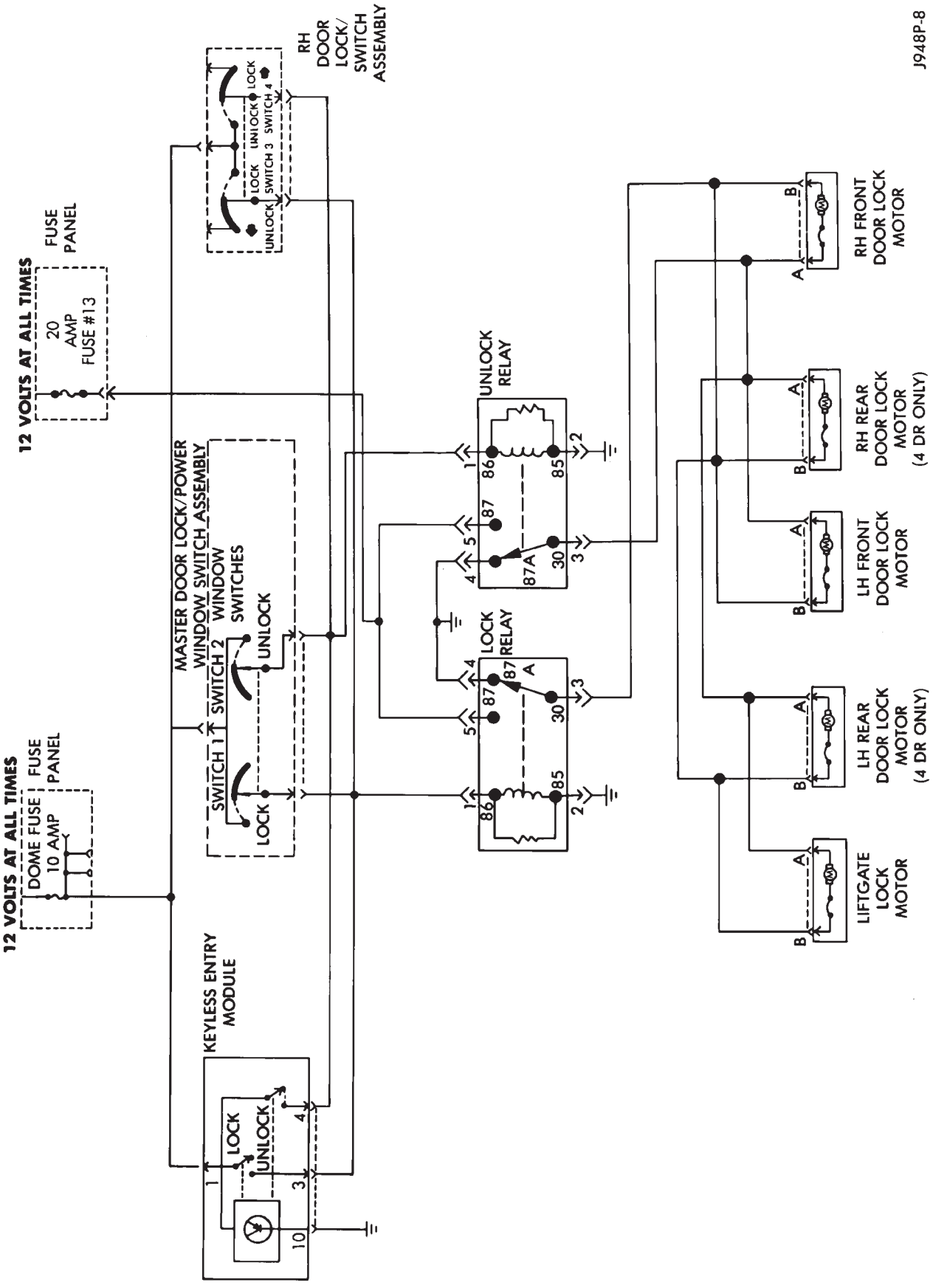


Fig. 2 Separate Transmitter Halves



POWER DOOR LOCKS

(2) Remove and discard old batteries (Figs. 3, 4).

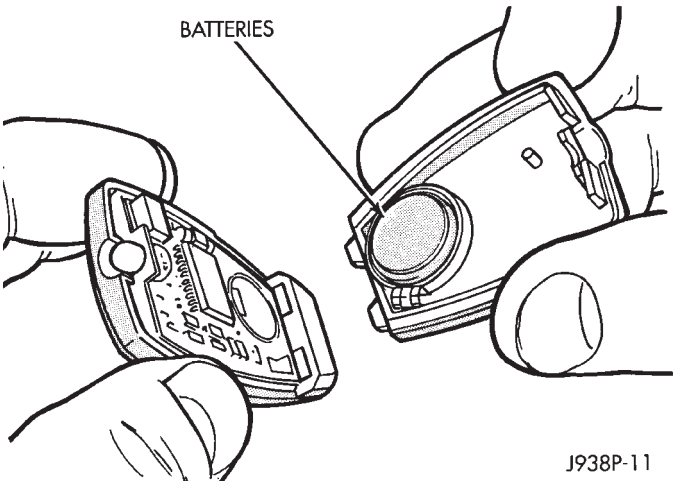


Fig. 3 Battery Removal

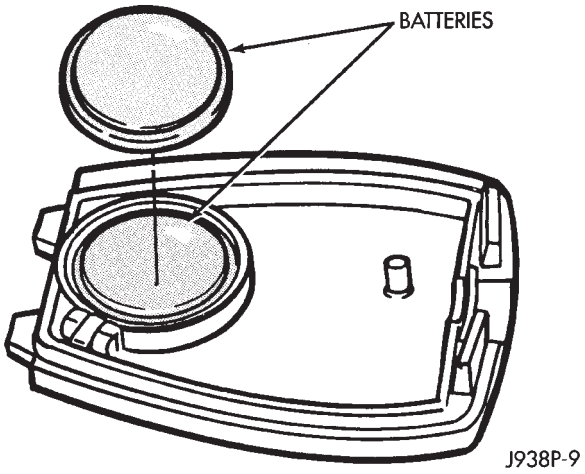


Fig. 4 Battery Installation

(3) Install the new CR 1616 batteries. Be sure the batteries are installed according to polarity as shown on the transmitter battery receptacles.

(4) Assemble the transmitter and verify the correct battery installation. The voltage indicator light will glow when the batteries are properly installed.

RECEIVER SERVICE

WITH OVERHEAD CONSOLE

(1) Remove screw forward of compass unit (Fig. 5).

(2) Flex housing outward while pressing upward to disengage housing from the rear bracket (arrow 1) (Fig. 5).

(3) Slide console rearward until the console detaches from the front mounting bracket (arrow 2) (Fig. 5).

(4) While pressing up on rear of console (arrow 1), slide console forward holding front away from headliner (arrow 2). Move console forward until the rear detaches from headliner and becomes free (Fig. 6).

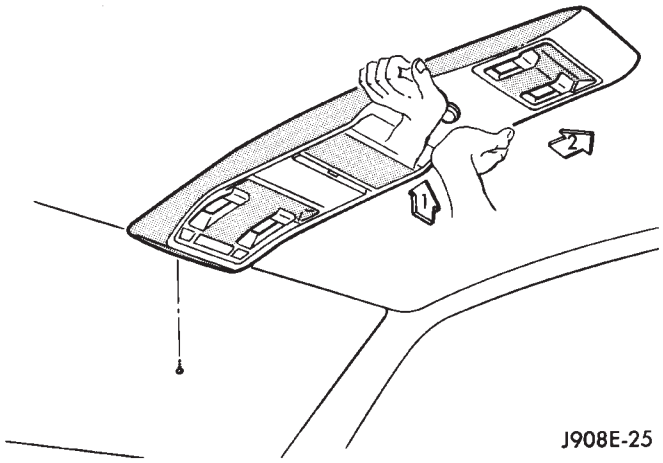


Fig. 5 Remove/Install Overhead Console

(5) Disconnect wire harnesses from keyless entry

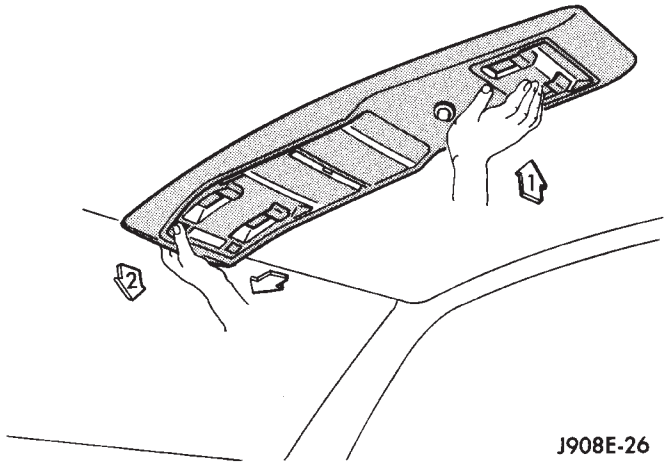


Fig. 6 Remove/Install Overhead Console

and compass (Figs. 7 and 8).

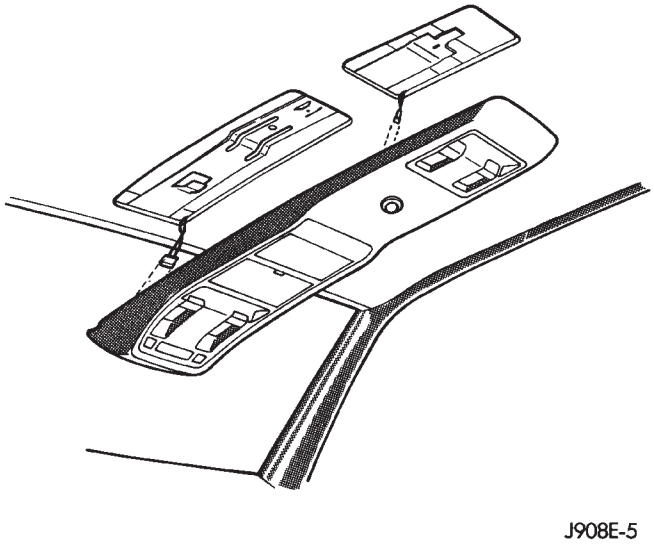


Fig. 7 Disconnect Wire Harnesses

(6) Pinch forward area of receiver cover and release clips. Slide cover out from under rib (Fig. 9).

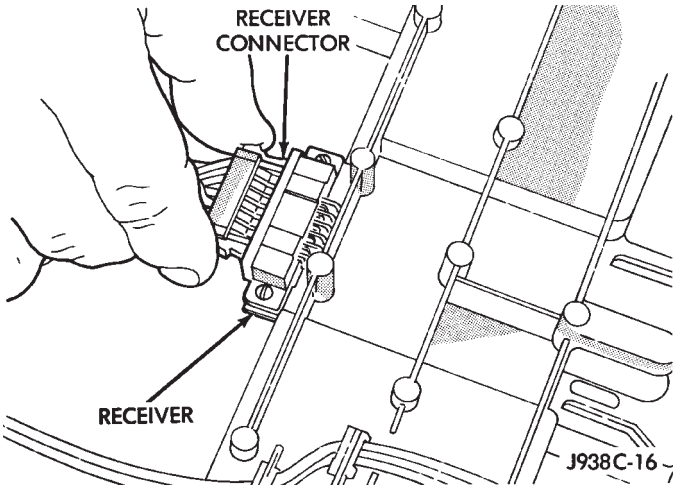


Fig. 8 Keyless Entry Harness Connector

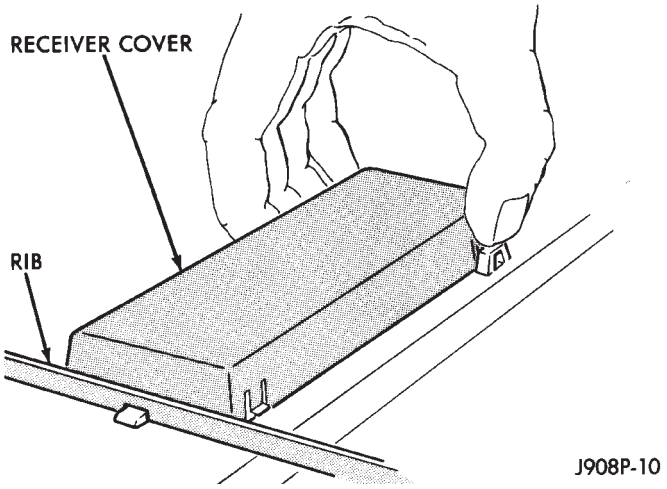


Fig. 9 Keyless Entry Receiver Cover Removal/ Installation

(7) Remove screw and printed circuit board.

(8) To install the overhead console, reverse the removal procedures. Be sure to flex housing outward near the keyless entry receiver until the console snaps onto the rear mounting bracket.

WITHOUT OVERHEAD CONSOLE

(1) Remove 2 screws attaching receiver housing to headlining (Fig. 10).

(2) Pull housing toward rear of vehicle to disengage clip.

(3) Disconnect receiver harness connector.

(4) Remove circuit board from housing.

(5) Reverse the removal procedures to install the receiver.

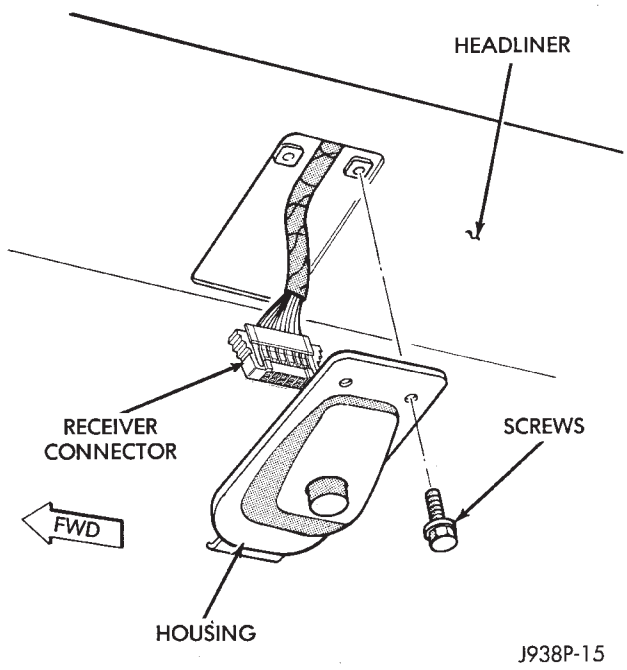


Fig. 10 Remove/Install Keyless Entry Housing

DOOR LOCK/UNLOCK RELAY REPLACEMENT

The power door lock/unlock relays are in the relay center. The relay center is located on the lower instrument panel trim cover just right of the steering column (Fig. 11). Remove both relays.

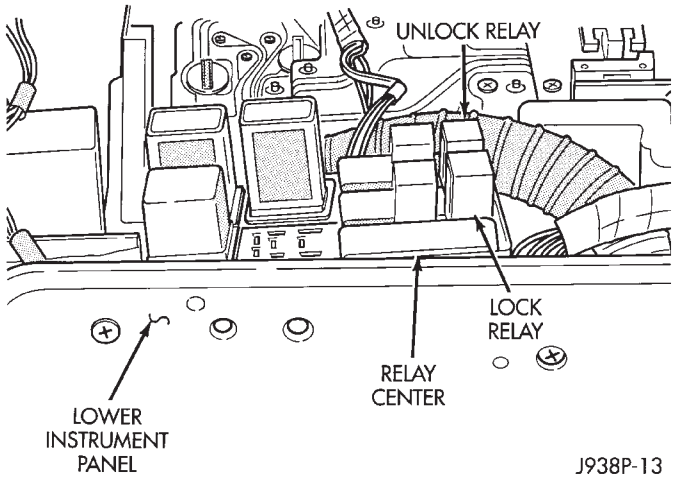


Fig. 11 Door Lock/Unlock Relays

(1) Remove the appropriate relay from the relay center.

(2) To install the new relay(s) reverse the removal procedure.

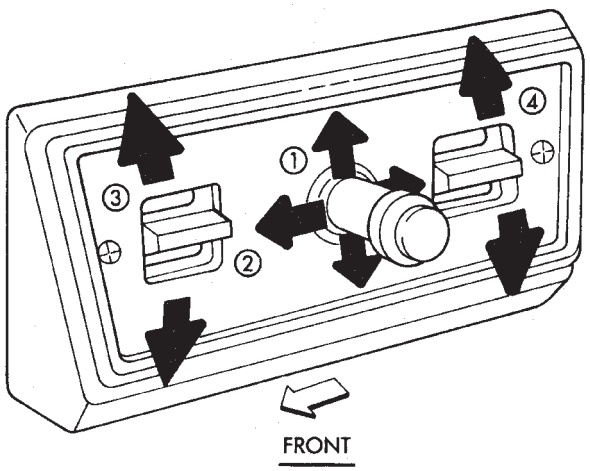
POWER SEATS

CONTENTS

GENERAL

The power seat can be adjusted in 6 different directions (Fig. 1). The control switch is on the lower outboard side of the seat.

The front lever on the switch raises or lowers (tilts) the front of the seat cushion. The center lever raises or lowers the complete seat by moving the switch up or down. The center lever also moves the seat forward or rearward by moving the switch forward or rearward. The rear lever raises or lowers (tilts) the back of the seat cushion.



1. SEAT UP AND DOWN
2. SEAT FORWARD AND REARWARD
3. SEAT TILT (FRONT UP AND DOWN)
4. SEAT TILT (REAR UP AND DOWN)

J918R-1

Fig. 1 Power Seat Switch

There are 3 reversible motors that operate the power seat. The front and rear of the seat are operated by different motors. They can be raised or lowered independently of each other. Moving the center position seat switch to either the UP or DOWN position, runs both the front and rear motors at the same time.

The forward-rearward motor is operated by the center position seat switch. When the switch is held in the FORWARD position, battery voltage is applied through the switch contacts to pin S3 and the forward-rearward motor. The motor is grounded through pin S4 and the contacts of the back switch to pin 2 and to ground. The motor runs to drive the seat forward until the switch is released.

With the switch in the REAR position, pin S4 receives battery voltage and pin S3 is grounded. This reversed polarity causes the motor to run in the opposite direction and drive the seat backward.

The front motor works in a similar way when the front height switch is operated.

To raise the entire seat, the center position seat switch is held in the UP position. This applies battery voltage to both pins S1 and S5 and the front and rear motors. Pins S2 and S6 are grounded through the down switches and the lower switch. Both motors run to drive the entire seat up. A similar action occurs to move the entire seat down.

Each motor contains a self-resetting circuit breaker to protect it from overload. Consecutive or frequent resetting must not be allowed to continue. Make necessary repairs.

DIAGNOSIS

Refer to Group 8W-Wiring Diagrams for a complete circuit diagram.

Before any testing is attempted the battery should be fully charged and all connections and pins cleaned and tightened to insure proper continuity and grounds.

With the dome light on, apply switch in direction of the failure. If the dome light dims, the seat may be jamming. Check for binding. If the dome light does not dim, then proceed with the following electrical tests.

SEAT MOTOR ASSEMBLY

- Position seat switch to move all 3 seat motors. The seat should move in all directions. If not, go to No Seat Motors Operate. If one or more motors operate, refer to switch testing.

Test seat switch. If OK, replace defective motor.

NO SEAT MOTORS OPERATE

Circuit breaker installed.

- Probe 30 amp circuit breaker, cavity #16 on fuse panel. If battery voltage is present, replace circuit breaker.

• Remove switch mounting screws and measure voltage at red wire at switch. Meter should read battery voltage. If not, repair open to circuit breaker.
• Measure resistance at black wire at switch. Meter should read zero ohms. If OK, replace switch. If not, repair open to ground.

SWITCH TESTING

POWER SEAT MOTOR REPLACEMENT

(1) Disconnect power seat wire harness at motor.
(2) Remove bolts attaching seat frame to floor pan and remove seat.
(3) Disconnect motor ground wire.

CAUTION: Take care to avoid excessive bending of the 3 drive cables when removing/installing the motor assembly.

(4) Remove screws attaching motor assembly to seat frame and remove motor assembly and mounting spacers (Fig. 3).

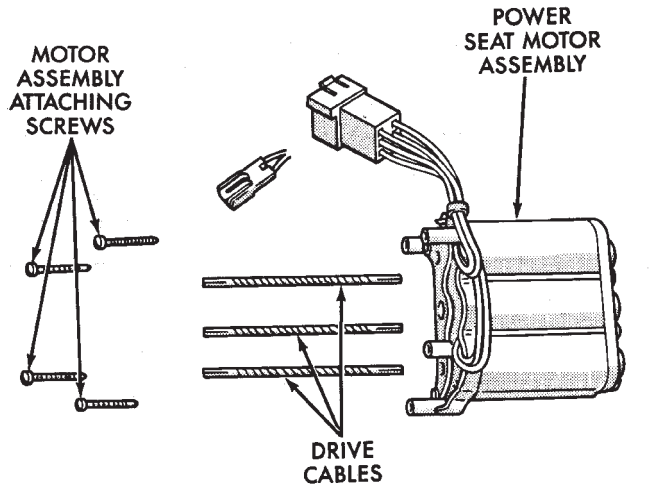


Fig. 3 Power Seat Motor Assembly

(5) To install power seat motor, reverse the removal procedures. *DRIVER SIDE*

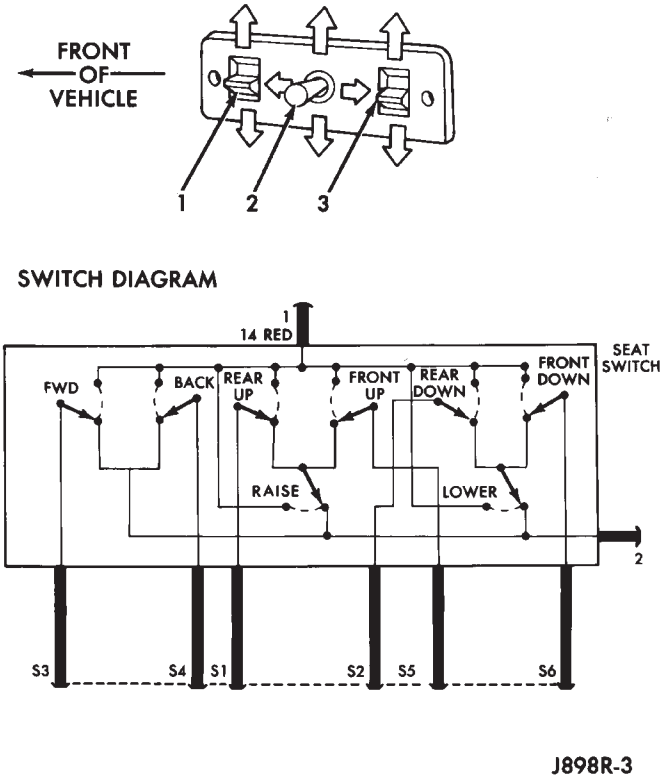
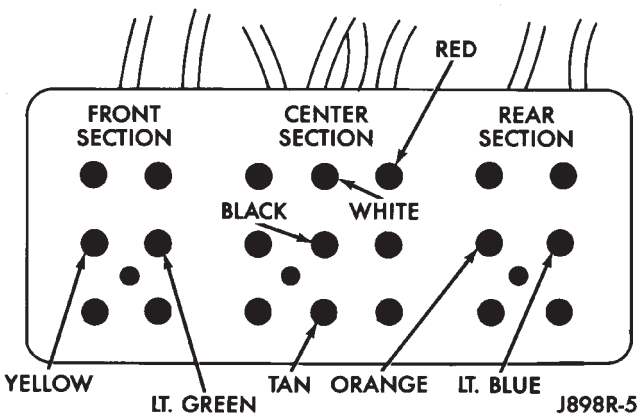


Fig. 2 Switch Diagram



SWITCH TEST
SWITCHES 1, 2 AND 3 (GROUNDS)

SWITCH POSITION	TERMINALS	ZERO OHMS
OFF (NORMAL)	2 AND: S1, S2, S3, S4, S5 AND S6	YES
	1 AND 2	NO

SWITCH TEST
SWITCH 1

SWITCH POSITION	TERMINALS	ZERO OHMS
UP (FRONT)	1 AND S5	YES
DOWN (FRONT)	1 AND S6	YES

SWITCH TEST
SWITCH 2

SWITCH POSITION	TERMINALS	ZERO OHMS
UP (RAISE)	1 AND S1	YES
	1 AND S5	YES
DOWN (LOWER)	1 AND S2	YES
	1 AND S6	YES
FORWARD (FWD)	1 AND S3	YES
BACKWARD (BACK)	1 AND S4	YES

SWITCH TEST
SWITCH 3

SWITCH POSITION	TERMINALS	ZERO OHMS
UP (REAR)	1 AND S1	YES
DOWN (REAR)	1 AND S2	YES

J898R-4

POWER WINDOWS

CONTENTS

DESCRIPTION

All XJ vehicles, equipped with power windows, have a cable driven window regulator system. A permanent magnet motor moves each power window. Each motor raises or lowers the glass when voltage is supplied to the motor. The direction the motor turns depends on the polarity of the supply voltage. The control switches control the supply voltage polarity.

With the ignition switch in the ON position voltage from the 60 amp fuse in the Power Distribution Center is applied through the power window circuit breaker. Power then goes to the master switch terminal BY and to the passenger's window switches.

When the driver's window switch is moved UP, the contacts close a current path to:

- terminal DV
- driver's side front window motor
- terminal CV
- the DOWN contact of the driver's side front window to ground.

The motor then moves the glass up.

Current flows in a similar way when the UP contact in one of the passenger's window switches is closed. Current flow through the passenger's window motors must go through the driver's and the passenger's window switches before it reaches ground.

Each motor is protected by a built-in circuit breaker. If a window switch is held on too long with the window obstructed or after the window is fully up or down, the circuit breaker opens the circuit. The circuit breaker resets automatically as it cools. Do not allow frequent or consecutive resetting of the circuit breaker to continue.

DIAGNOSIS (Figs. 1 and 2)

For information concerning wiring or connectors, refer to Group 8W - Wiring Diagrams.

NO WINDOWS OPERATE

- Measure voltage at power window feed connector at fuse panel. Meter should read battery voltage. If not, replace 60 amp fuse in Power Distribution Center.
- Turn ignition switch to OFF and measure resistance from side of cigar lighter socket to ground. Meter should read zero ohms. If not, repair open to ground.
- Remove master door lock/power window switch assembly mounting screws. Measure resistance at BLK wire (terminal DX) at driver's side switch. Meter should read zero ohms. If not, repair open to ground splice of instrument panel harness.
- Turn ignition switch to ON and measure voltage at terminal BY at driver's side switch. Meter should read battery voltage. If not, repair open to circuit breaker.
- Operate window switch. If the windows move up and down go to Switch Testing.
- Perform Switch Test Driver's Door. If switch passes test, replace defective motors.

ONE WINDOW OPERATES

Remove door panel of inoperative window, probe harness side of unplugged motor connector.

- Measure voltage at terminal A of connector, holding switch in the DOWN position. Meter should read battery voltage. If not, repair open back to master switch. If additional switch is in circuit (not driver's side motor), refer to Switch Testing.
- Measure resistance at terminal B of connector, holding switch in the DOWN position. Meter should read zero ohms. Caution, maintain DOWN position while meter lead is attached. If not, repair open back to master switch. If additional switch is in circuit (not driver's side motor), refer to Switch Testing. If both tests are OK, replace regulator.

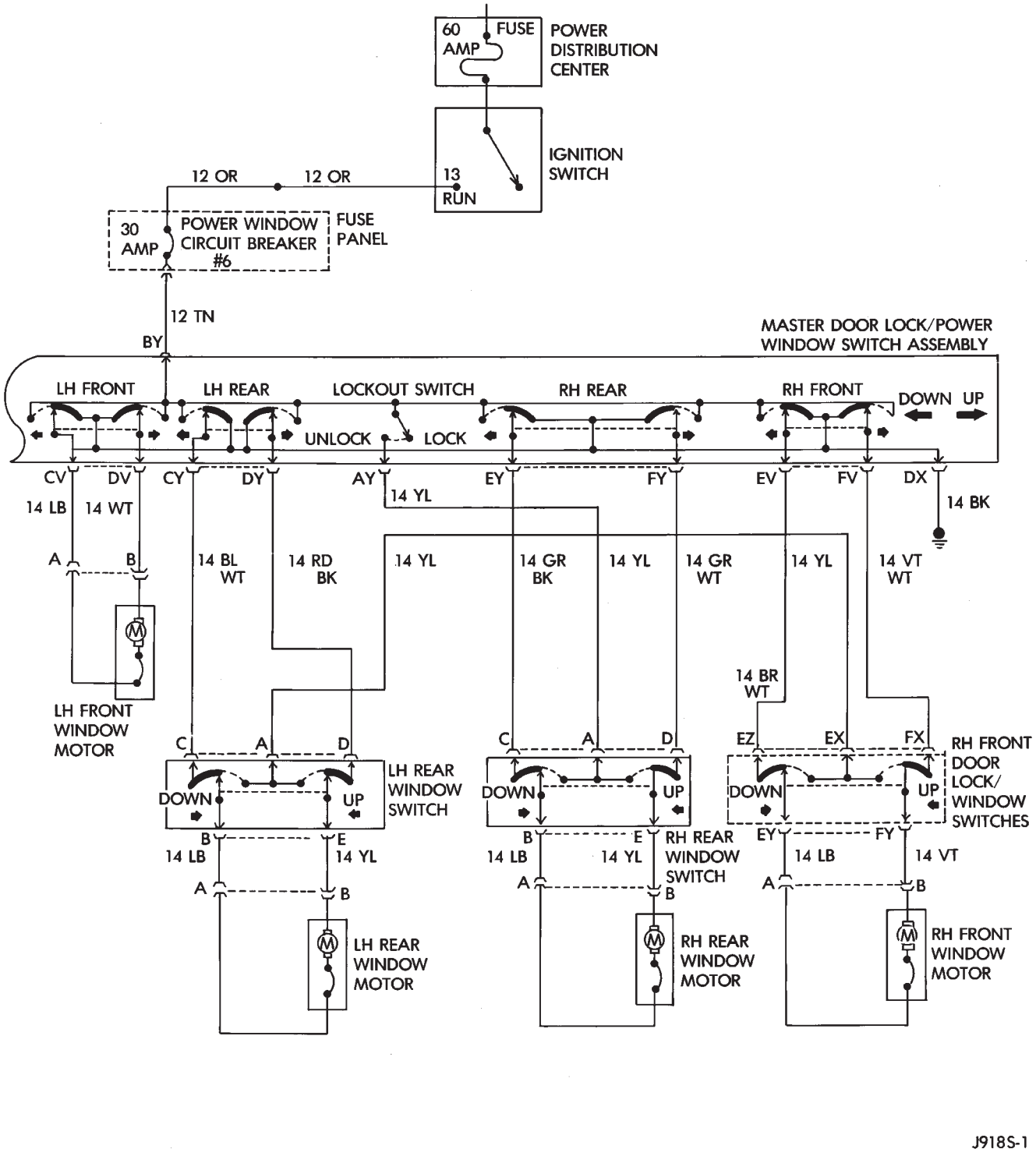


Fig. 1 Power Windows 4-Door—XJ

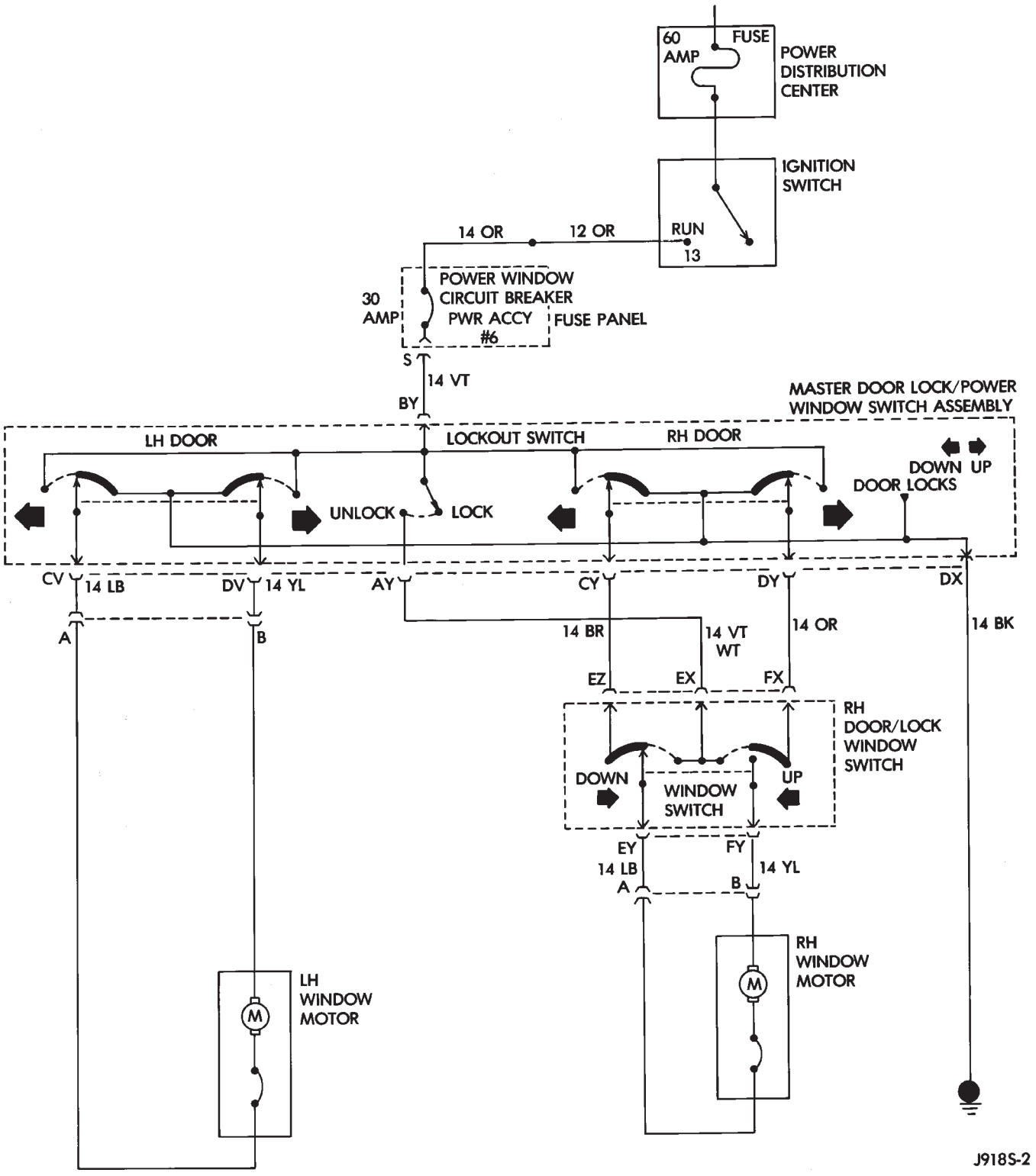


Fig. 2 Power Windows 2-Door—XJ LEFT HAND DRIVE

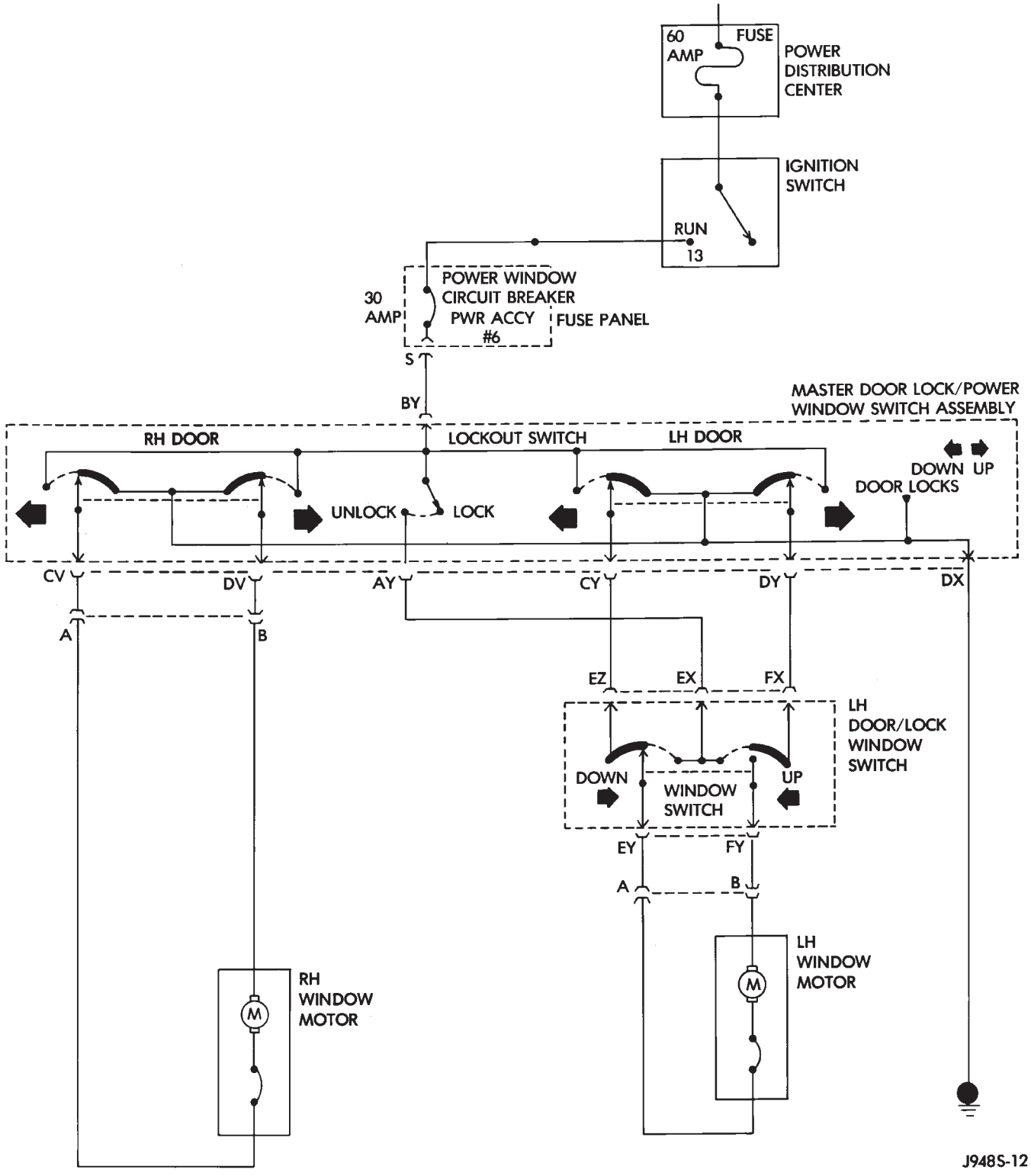
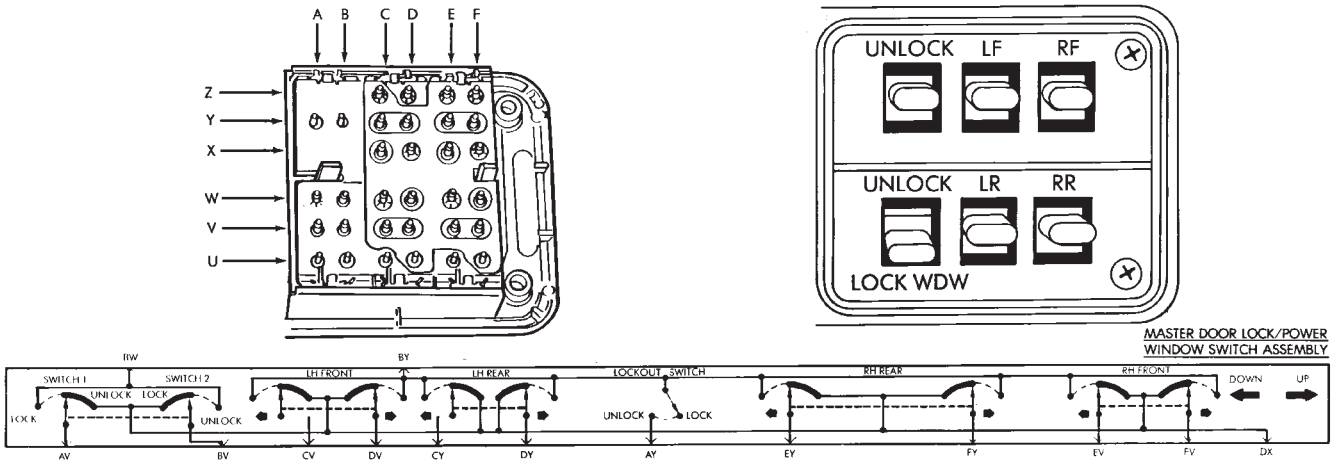


Fig. 3 Power Windows 2-Door—XJ RIGHT HAND DRIVE

SWITCH TESTING

DRIVERS DOOR POWER WINDOW SWITCH—4-DOOR



SWITCH TEST
Switch Grounds

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	DX and: AV, BV, CV, DV, CY, DY, EY, FY, EV, FV	Yes
	BW and DX	No
	BY and DX	No

SWITCH TEST
LH Front

SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BY and DV	Yes
Down	BY and CV	Yes

SWITCH TEST
LH Rear

SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BY and DY	Yes
Down	BY and CY	Yes

SWITCH TEST
Lockout Switch

SWITCH POSITION	TERMINALS	ZERO OHMS
Up (Unlock)	AY and BY	Yes
Down (Lock)	AY and BY	No

SWITCH TEST
RH Rear

SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BY and FY	Yes
Down	BY and EY	Yes

SWITCH TEST
RH Front

SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BY and FV	Yes
Down	BY and EV	Yes

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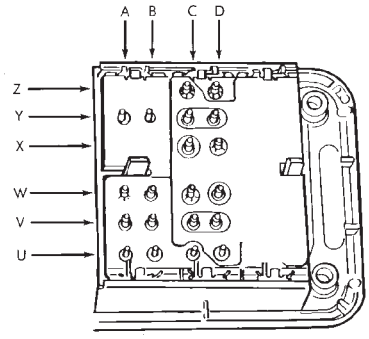
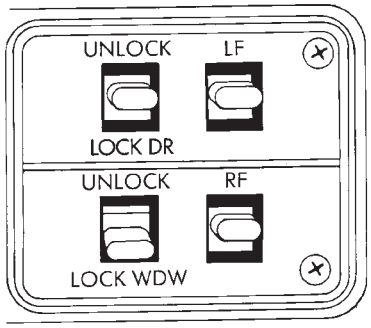
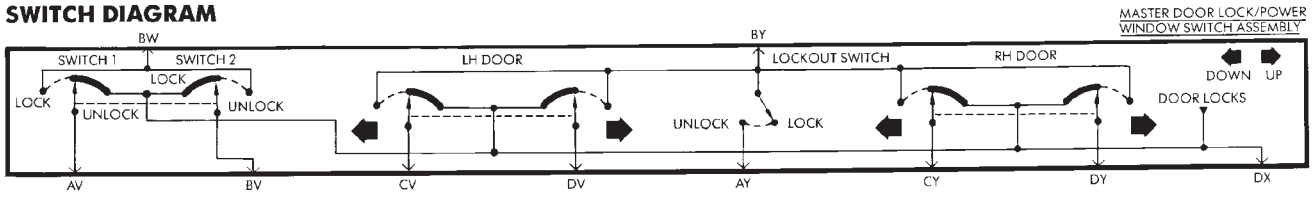
DRIVERS DOOR POWER WINDOW SWITCH—2-DOOR LEFT HAND DRIVE





SWITCH DIAGRAM



SWITCH TEST
Switch Grounds

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	DX and: AV, BV, CV DV, CY, DY	Yes
	BW and DX	No
	BY and DX	No

SWITCH TEST
LH Door

SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BY and DV	Yes
Down	BY and CV	Yes

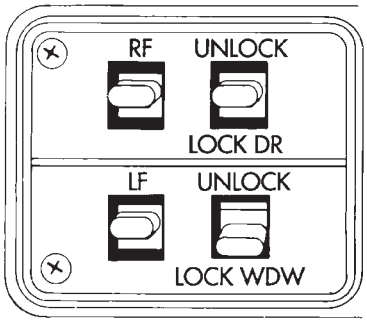
SWITCH TEST
RH Door

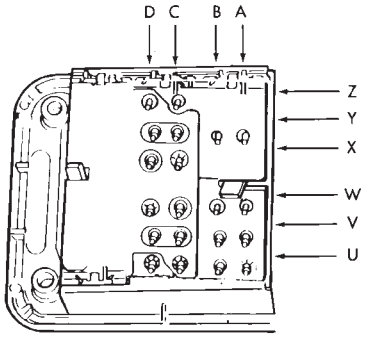
SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BY and DY	Yes
Down	BY and CY	Yes

SWITCH TEST
Lockout Switch

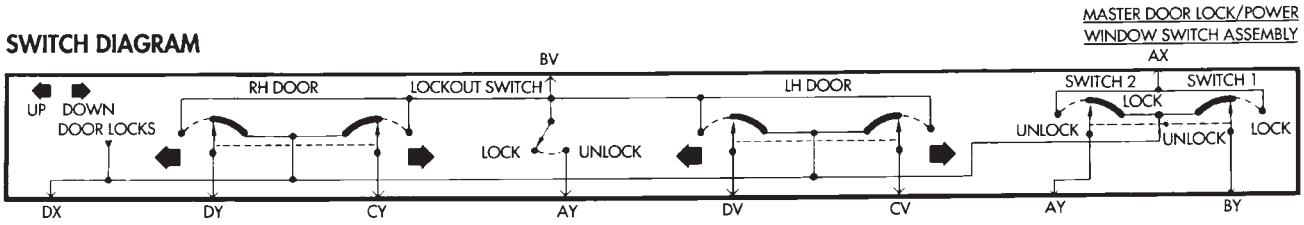
SWITCH POSITION	TERMINALS	ZERO OHMS
Up (Unlock)	AY and BY	Yes
Down (Lock)	AY and BY	No

DRIVERS DOOR POWER WINDOW SWITCH—2-DOOR RIGHT HAND DRIVE





SWITCH DIAGRAM



SWITCH TEST
Switch Grounds

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	DX and: BY, AY, CV DV, CY, DY	Yes
	AX and DX	No
	BV and DX	No

SWITCH TEST
LH Door

SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BV and DV	Yes
Down	BV and CV	Yes

SWITCH TEST
RH Door

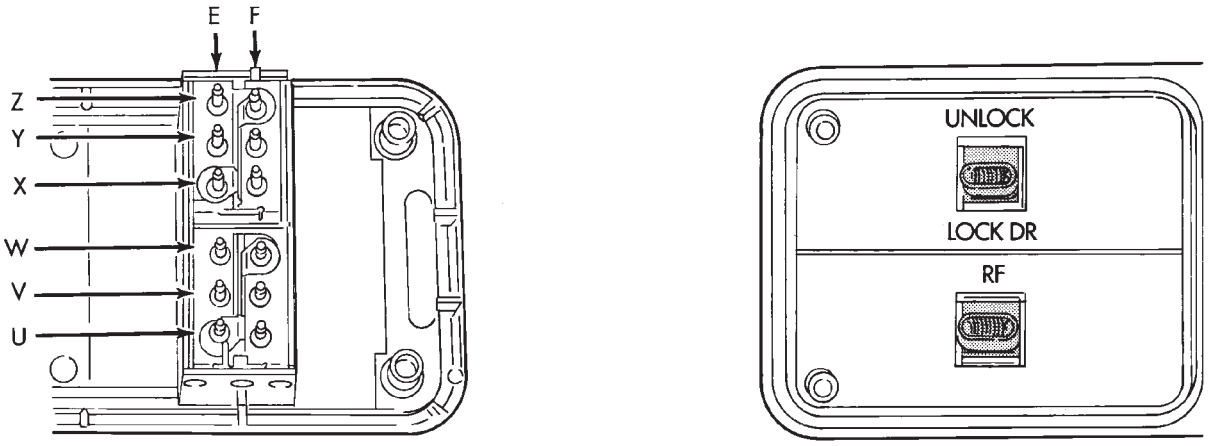
SWITCH POSITION	TERMINALS	ZERO OHMS
Up	BV and DY	Yes
Down	BV and CY	Yes

SWITCH TEST
Lockout Switch

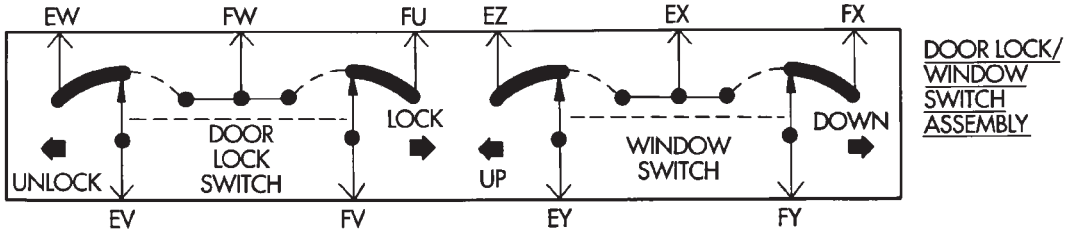
SWITCH POSITION	TERMINALS	ZERO OHMS
Up (Unlock)	AV and BV	Yes
Down (Lock)	AV and BV	No

J948S-11

PASSENGER DOOR WINDOW SWITCH



SWITCH DIAGRAM



SWITCH TEST
Window Switch

SWITCH POSITION	TERMINALS	ZERO OHMS
Off (Normal)	EY and EZ	Yes
	FY and FX	Yes
	All Others	No
Up	EY and EZ	Yes
	EX and FY	Yes
	All Others	No
Down	EX and EY	Yes
	FX and FY	Yes
	All Others	No

J948S-13

WINDOW REGULATOR REPLACEMENT

REMOVAL

(1) Remove the interior door latch release assembly and control panel retaining screws (Fig. 4).

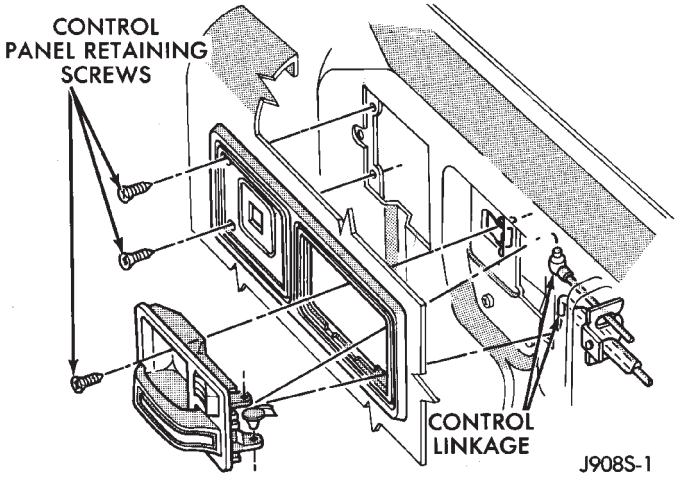


Fig. 4 Power Window Control Panel Removal/ Installation

(2) Disconnect the control linkage and the wire harness connector.

(3) Remove the latch release and control panel assembly.

(4) Remove the armrest lower retaining screws.

(5) Swing the armrest downward to a vertical position. This is necessary to disconnect the armrest from the upper retainer clip (Fig. 5).

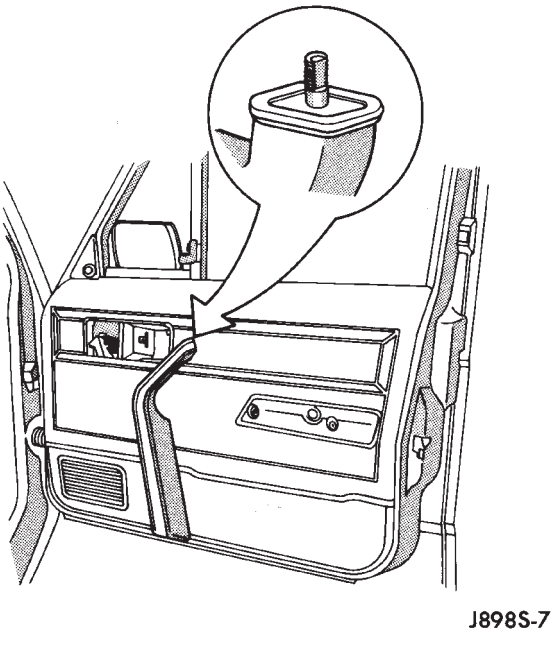


Fig. 5 Armrest Retainer Clip

(6) Pull the armrest straight out from the trim panel.

To aid in removal of the trim panel, start at the bottom of the panel.

(7) Remove the trim panel with a wide flat blade tool (Fig. 6).

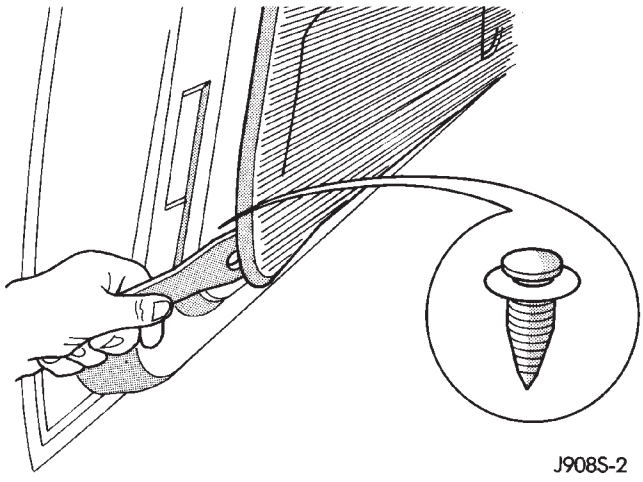


Fig. 6 Trim Panel Removal

(8) Remove the plastic water dam sheet.

(9) Grind the heads off 2 rivets holding reinforcement to door (Fig. 8). Knock rivets out with a hammer and punch.

(10) Adjust window to allow access to Torx head screw (Fig. 7).

(11) Remove 2 screws holding bottom of regulator to door.

(12) Remove door glass attaching Torx head screw (Fig. 7).

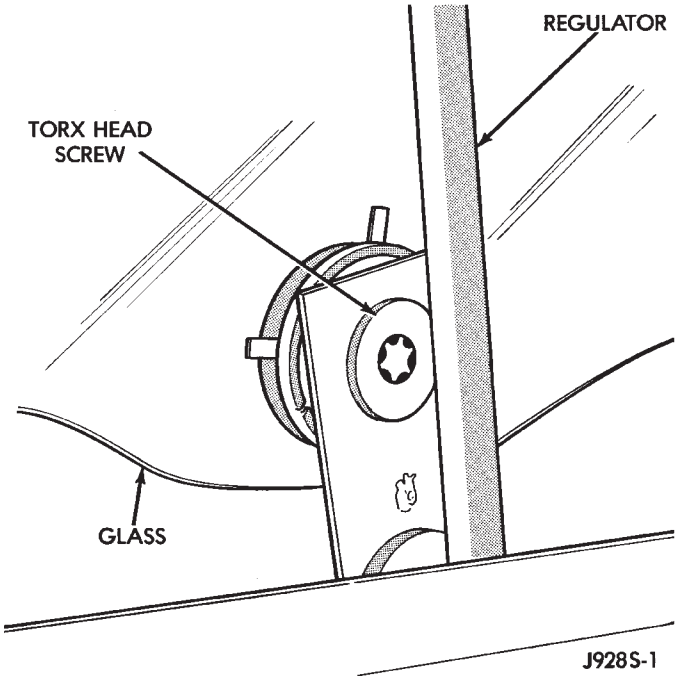


Fig. 7 Remove/Install Glass Attaching Screw

(13) Pull glass to the full up position and tape glass to door.

(14) Disconnect wire harness connector from the window regulator.

(15) Remove remaining window regulator attaching screws (Fig. 8).

(16) Remove window regulator.

INSTALLATION

(1) Place regulator inside door.

(2) Attach regulator to door using screws or the hardware kit supplied with a new regulator. DO NOT install the 2 screws that hold the bottom of the regulator.

(3) Connect wire harness connector to regulator.

(4) Attach door glass with Torx head screw (Fig. 7). Tighten door glass screw to 3.3 N·m (30 in. lbs.) torque.

(5) Install the last 2 screws.

(6) Using 3M 08044 or 3M 08041 adhesive/sealant, install plastic water dam sheet.

(7) Place trim panel in the installation position and press in nylon retainers.

(8) Install the armrest.

(9) Install latch release assembly and control panel.

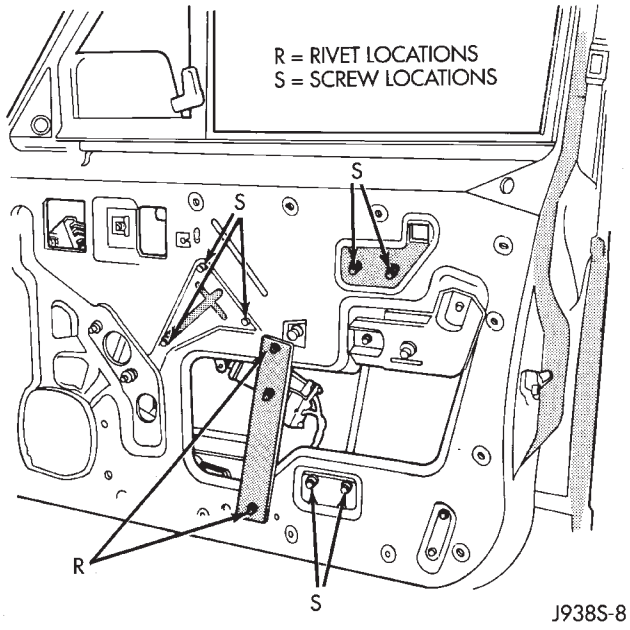


Fig. 8 Window Regulator Removal

POWER MIRRORS

CONTENTS

GENERAL

For information concerning wiring or connectors, refer to Group 8W - Wiring Diagrams.

The mirror control switch contains two separate switches, the operating switch and the selector switch.

Each mirror has two reversible motors: one to adjust the mirror view up and down, the other to adjust the mirror view right and left. The driver operates three switches that control the polarity of the voltage to the motors. The mirror select switch directs these control voltages to either the right or left mirror.

The mirror select switch must be set to L or R to direct current flow. If the mirror select switch is set on R and the up-down switch is moved to the UP position, the voltage path is:

- through the U contact of switch 1
- to pin E
- to the up-down motor in the right mirror.

The ground path is:

- through pin D
- through the mirror select switch contacts
- to the U contacts of switch 3 and switch 2
- to pin F
- to ground.

The right motor runs and tilts the mirror up.

If the switch is pushed to the DOWN position, the same motor receives voltage. Now the polarity is reversed, with pin E grounded. The motor runs in the opposite direction.

The right mirror left-right motor operates in a similar manner when the control switch is moved to the L or R positions.

The left mirror works the same way as the right mirror when mirror select switch is moved to L position and control switch is operated.

DIAGNOSIS

For information concerning wiring or connectors, refer to Group 8W - Wiring Diagrams.

- Open door. Dome lamps should light. If not, check dome fuse.

Remove switch, unplug switch connector

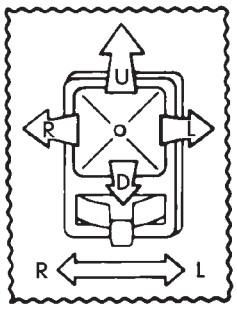
- Measure resistance at mirror switch connector pin F. Meter should read zero ohms, If not, repair open to ground.
- Measure voltage at mirror switch connector pin G. Meter should read battery voltage. If not, repair open to dome fuse.

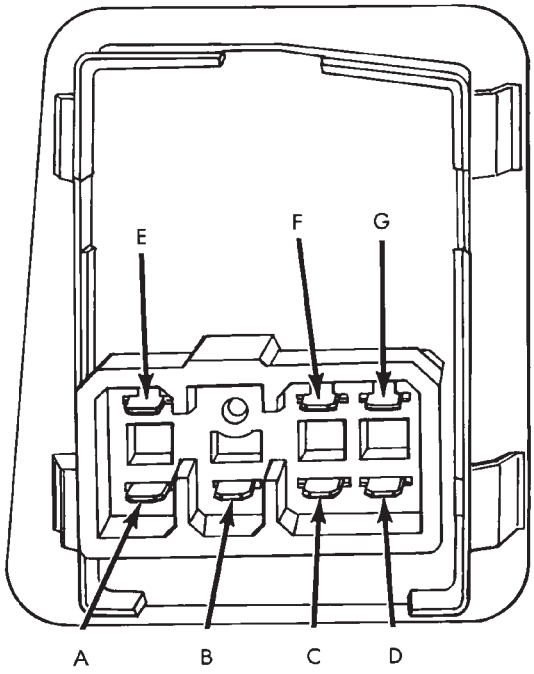
Install a jumper lead from pin E to pin F.

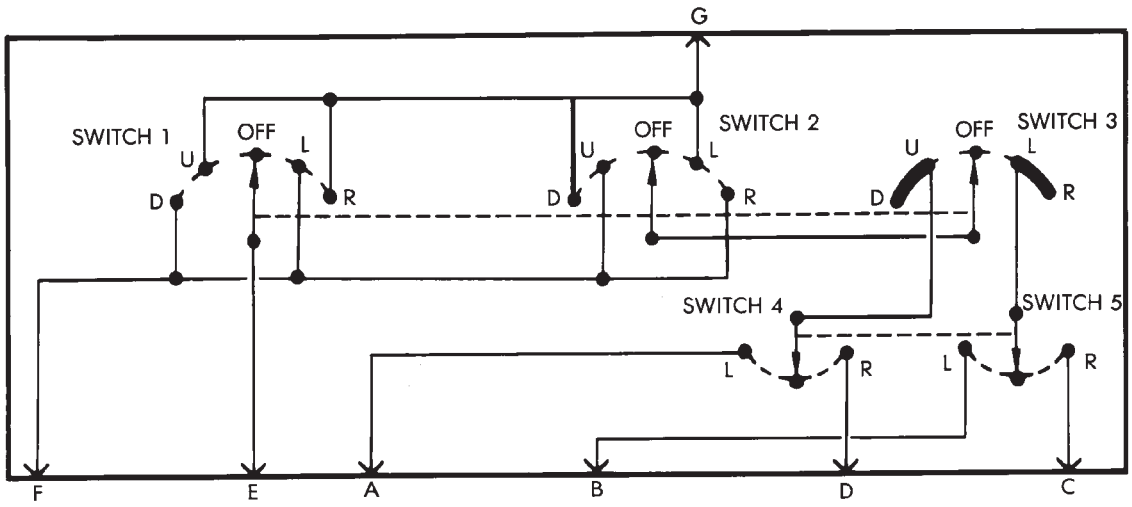
- Connect a jumper lead from pin G to: pin A; pin B; pin C and then pin D. If the mirror moves, replace switch. If not, repair open to motor and/or replace motor.

POWER MIRROR SWITCH TESTING

POWER MIRROR SWITCH







J928T-1

SWITCH TEST WITH SWITCH IN LEFT (L) POSITION

SWITCH POSITION	TERMINALS	ZERO OHMS
Push Down (D)	A and G	Yes
	E and F	Yes
	All Others	No
Push Up (U)	A and F	Yes
	E and G	Yes
	All Others	No
Off (Normal)	All Others	No
Push Left (L)	B and G	Yes
	E and F	Yes
	All Others	No
Push Right (R)	B and F	Yes
	E and G	Yes
	All Others	No

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SWITCH TEST WITH SWITCH IN RIGHT (R) POSITION

SWITCH POSITION	TERMINALS	ZERO OHMS
Push Down (D)	D and G	Yes
	E and F	Yes
	All Others	No
Push Up (U)	D and F	Yes
	E and G	Yes
	All Others	No
Off (Normal)	All Others	No
Push Left (L)	C and G	Yes
	E and F	Yes
	All Others	No
Push Right (R)	C and F	Yes
	E and G	Yes
	All Others	No

J918T-2

POWER MIRROR SWITCH REPLACEMENT

(1) Using a wide flat blade tool, pry the switch housing away from the center console (Fig. 1).

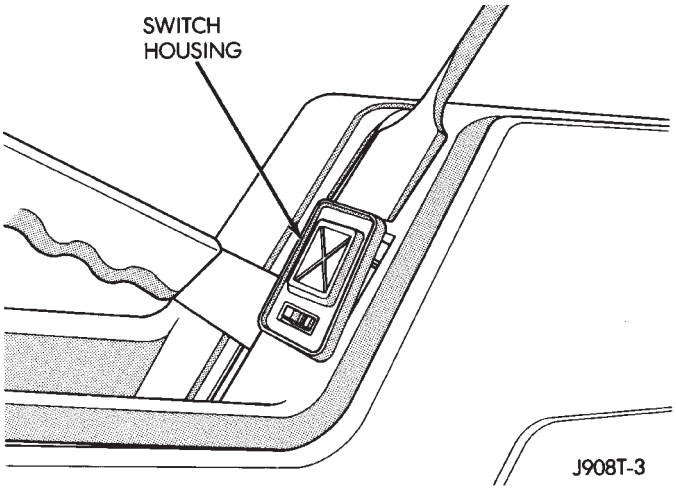


Fig. 1 Power Mirror Switch Removal/Installation—XJ

(2) Disconnect switch connector and remove switch.

(3) To install a new switch, reverse the removal procedure.

POWER MIRROR REPLACEMENT

(1) Remove interior door latch release assembly and control panel retaining screws (Fig. 2).

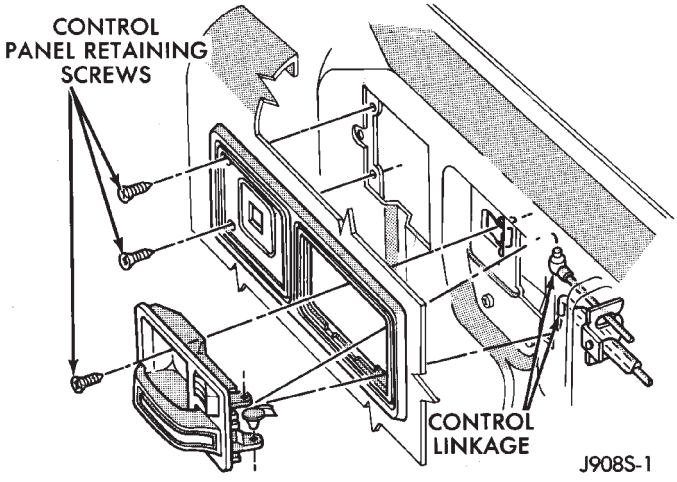


Fig. 2 Power Window Control Panel Removal/ Installation

(2) Disconnect control linkage and wire harness connector.

(3) Remove latch release and control panel assembly.

(4) Remove armrest lower retaining screws.

(5) Swing armrest downward to a vertical position. This is necessary to disconnect the armrest from the upper retainer clip (Fig. 3).

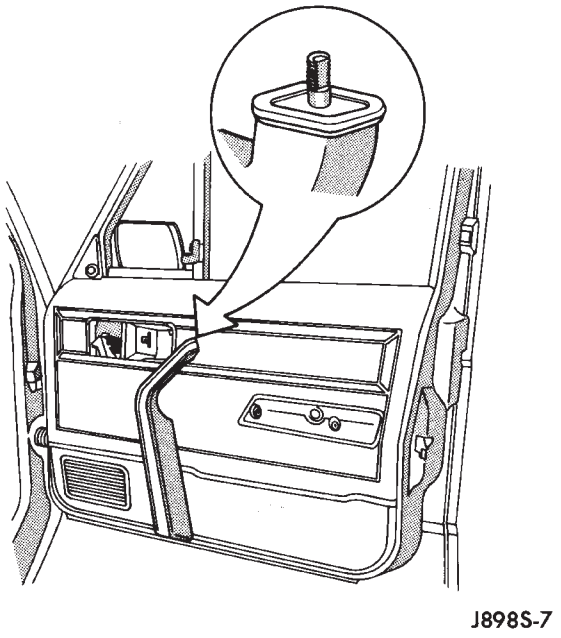


Fig. 3 Armrest Retainer Clip

(6) Pull the armrest straight out from the trim panel.

(7) Remove the trim panel with a wide flat blade tool (Fig. 4).

To aid in removal of the trim panel, start at the bottom of the panel.

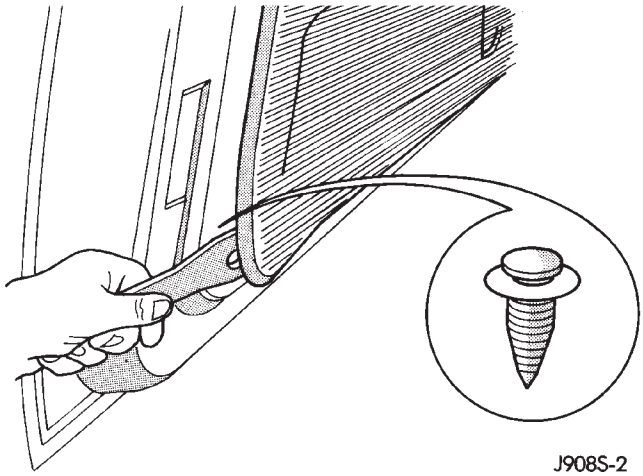


Fig. 4 Trim Panel Removal

(8) Remove screw holding mirror trim cover (Fig. 5).

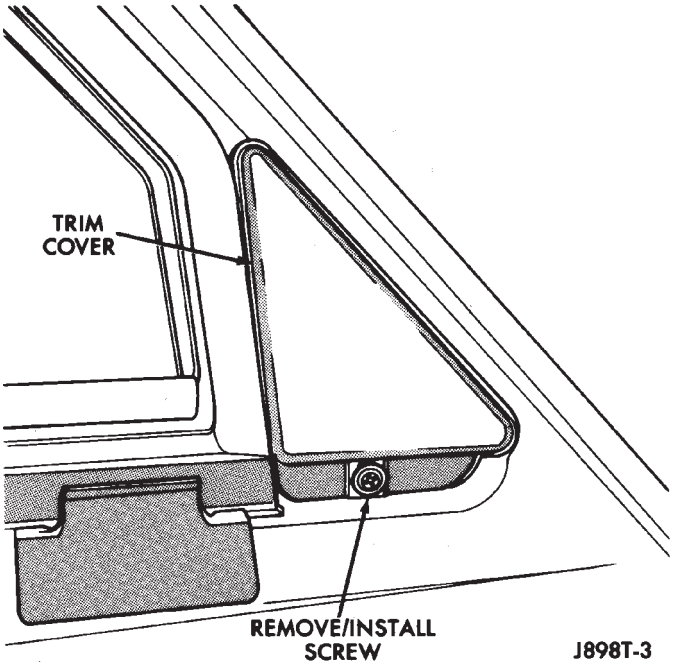


Fig. 5 Power Mirror Trim Cover—XJ

(9) Disconnect power mirror wire harness at connector in door.

(10) Pull harness up through door.

(11) Remove 3 screws holding mirror to door (Fig. 6).

(12) To install a power mirror, reverse the removal procedure.

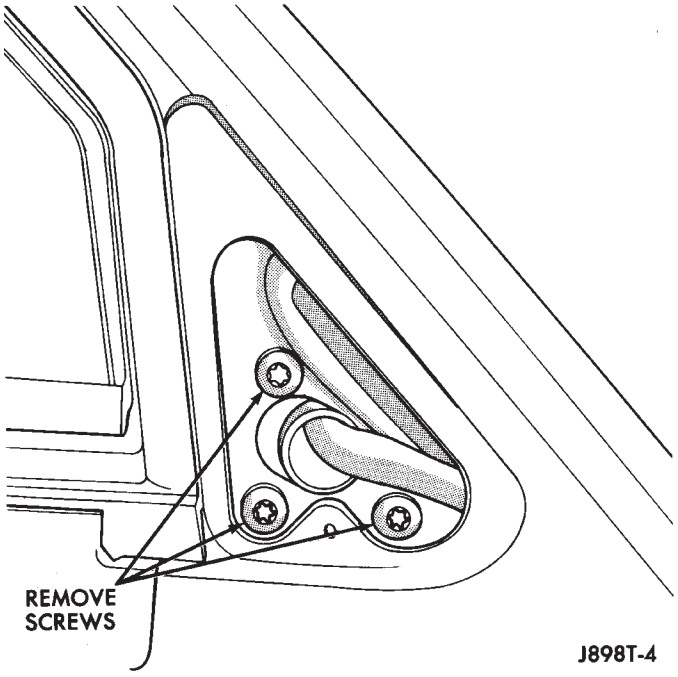


Fig. 6 Power Mirror Removal/Installation—XJ

CHIME/BUZZER WARNING SYSTEMS

CONTENTS

GENERAL

The buzzer or optional chime module is mounted on the left side of the fuse block (above and to the left of the brake/clutch pedal). The buzzer or chime sounds an audible warning tone in any of the following conditions:

- Vehicle lights are ON when the ignition has been switched OFF and the key is removed and then the driver's door is opened (except YJ).
- The key is in the ignition and the driver's door is open (On some vehicles, the buzzer will not sound if the ignition switch is in the ON position).
- The ignition is switched ON and the driver's seat belt is not buckled. Buzzer will quit after 4 to 8 seconds. Besides the buzzer, a seat belt indicator lamp turns on as a reminder to fasten seat belt.

OPERATION/DIAGNOSIS

OPERATION

Battery voltage for module operation is supplied to two pins. Voltage is always present at pin 7. Pin 1 receives voltage when the ignition switch is in the ON or START position.

SEAT BELT WARNING

The seat belt warning system uses both visual and audible signals. These consist of a buzzer that is part of a combined seat belt and key warning buzzer and a red light on the instrument panel.

The system will always illuminate the seat belt warning lamp for four to eight seconds when the ignition switch is turned to the ON position. Also, only if the driver does not fasten his seat belt, the buzzer will sound during the same time interval. Passenger belts are not connected to the system.

A timed buzzer-relay is used to operate the system for the time period. It has a time delay mechanism and buzzer assembly. Only the driver's seat belt buckle has a switch that is connected to the system.

KEY-IN-IGNITION WARNING

To sound the key-in-ignition warning, the following must occur:

- the ignition key warning switch must be closed
- the driver's door jamb switch must be closed.

These conditions ground pin 6 of the module. These switches are closed when the key is in the ignition and the driver's door is open.

On some vehicles the chime/buzzer will not sound if the door is open and the key is in the ON position.

LIGHTS-ON WARNING (EXCEPT YJ)

To sound the lights-on warning, the following must occur:

- the headlamp switch must be closed
- the driver's door jamb switch must be closed.

These conditions ground pin 6 of the module. These switches are closed when the headlamp switch is ON and the driver's door is open.

DIAGNOSIS

If the buzzer/chime unit does not operate as described, check the two fuses for pins 1 and 7 (Figs. 1 and 2) and replace as required. If the fuses are not defective, perform the following tests to determine if the problem is in the module or in the wiring. Using a flat head screwdriver, release the locking plastic clip while carefully pulling out the module. Plug in a known good module and check its operation. If the problem is not corrected by replacing the module, remove the module and continue as follows:

VOLTAGE TESTS

Ignition in ON position, measure between the following pins and vehicle ground.

- Measure voltage at buzzer/chime module connector pin 1. Meter should read battery voltage. If not, repair open to ignition switch.

Turn ignition OFF and remove the key from the ignition.

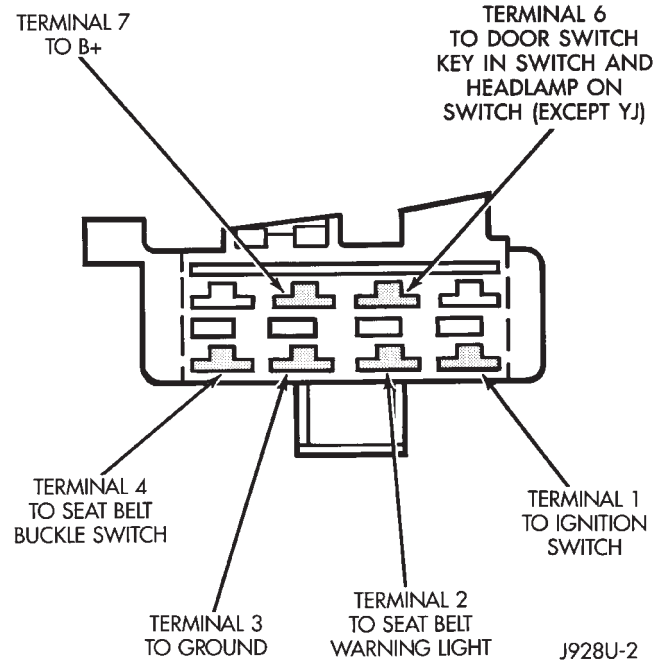


Fig. 1 Buzzer Module Connector Terminal Identification—Pin Side

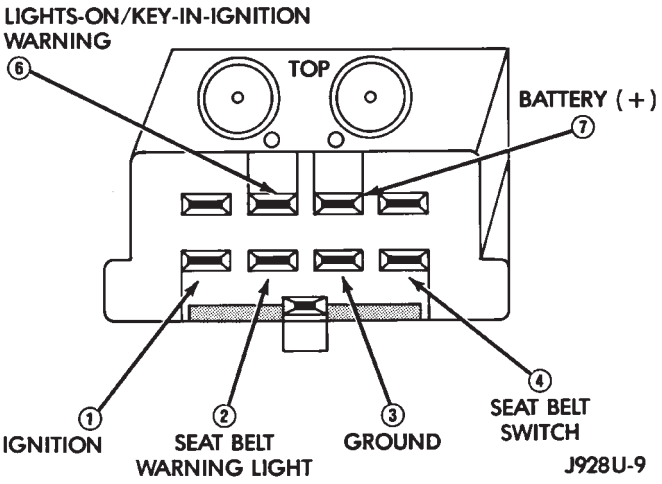


Fig. 2 Buzzer Module Terminal Identification

• Measure voltage at buzzer/chime module connector pin 7. Meter should read battery voltage. If not, repair open to fuse.

RESISTANCE TESTS

CAUTION: Before using an ohmmeter, turn ignition switch OFF and disconnect negative cable from battery to avoid damaging the meter.

Measure between the following pins and vehicle ground.

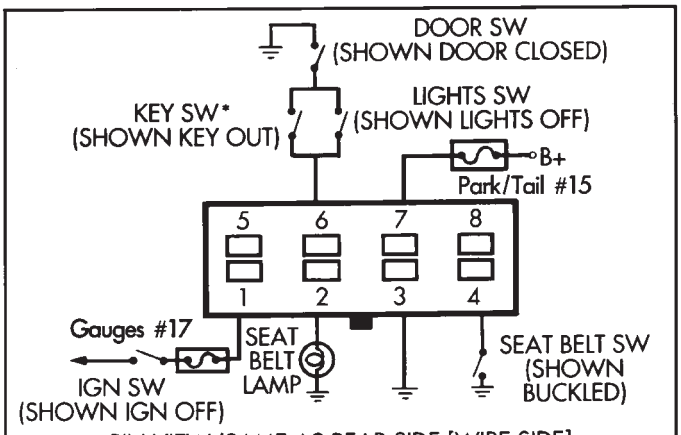
• Buzzer/chime module connector pin 2. Meter should read almost zero ohms (bulb filament). If not, replace seat belt indicator bulb.

• Buzzer/chime module connector pin 3. Meter should read zero ohms. If not, repair open to ground.

• Buzzer/chime module connector pin 4. Drivers seat belt not buckled. Meter should read zero ohms. If not, repair open to ground (or buckle switch may be defective). Meter should read open circuit if drivers seat belt is buckled. If not, repair short to ground (or buckle switch may be defective).

• Buzzer/chime module connector pin 6. Open driver's door, key in ignition (in OFF position). Meter should read zero ohms. If not, repair open to ground.

• Buzzer/chime module connector pin 6. Remove key from ignition. Open driver's door, headlamp switch ON (except YJ), meter should read zero ohms. If not, repair open to ground.



PIN VIEW (SAME AS REAR SIDE [WIRE SIDE] CONNECTOR VIEW)

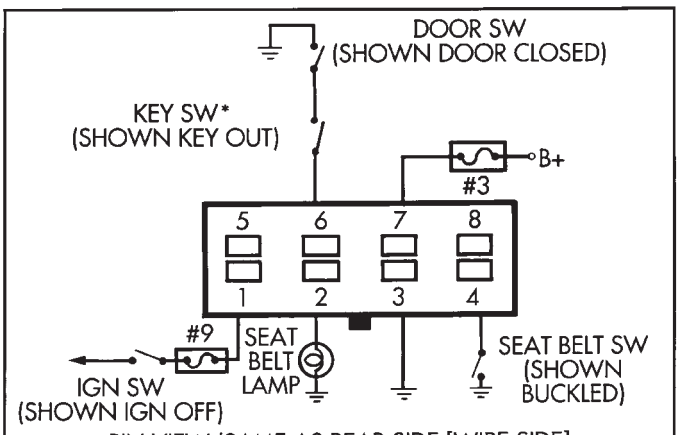
X = Do Not Care

FUNCTION	DESCRIPTION	IGN.	SEAT BELT	DRIVER'S DOOR	KEY	HEAD LAMPS
Seat Belt Reminder	4 to 8 Second Tone and Lamp Output	On / Off	Not Bckld	X	X	X
	4 to 8 Second Lamp Output Only	On / Off	Bckld	X	X	X
Key and Head Lamp Reminder*	Continuous, Steady Tone	X	X	Open	In	X
					X	On

*On some vehicles, the key switch opens when the ignition is switched on.

J928U-10

Fig. 3 Buzzer Module Schematic—XJ



PIN VIEW (SAME AS REAR SIDE [WIRE SIDE] CONNECTOR VIEW)

X = Do Not Care

FUNCTION	DESCRIPTION	IGN.	SEAT BELT	DRIVER'S DOOR	KEY
Seat Belt Reminder	4 to 8 Second Tone and Lamp Output	On / Off	Not Bckld	X	X
	4 to 8 Second Lamp Output Only	On / Off	Bckld	X	X
Key Reminder*	Continuous, Steady Tone	X	X	Open	In
					X

*On some vehicles, the key switch opens when the ignition is switched on.

J928U-1

Fig. 4 Buzzer Module Schematic—YJ

IGNITION KEY WARNING SWITCH REPLACEMENT

(1) Disconnect negative cable from battery.
(2) Remove horn button with a push and turn motion.
(3) Remove horn button components (Fig. 1).

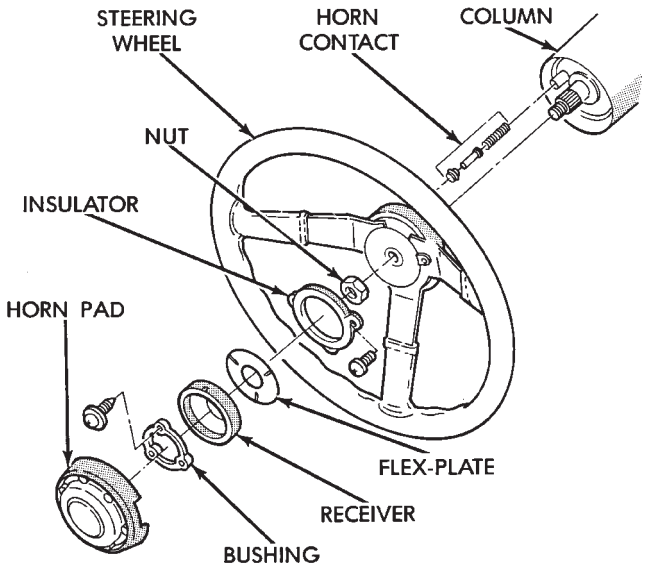


Fig. 1 Steering Wheel Removal/Installation

(4) Turn key to LOCK position and remove steering wheel nut and washer.
(5) Scribe an alignment mark on steering wheel in line with mark already existing on end of steering column.
(6) Remove vibration damper from steering column hub, if equipped.
(7) Remove steering wheel using a steering wheel puller. DO NOT hammer on puller or end of steering shaft.

WARNING: TO REMOVE THE STEERING SHAFT SNAP RING IN THE FOLLOWING STEP, THE LOCKPLATE MUST BE COMPRESSED. DO NOT ATTEMPT TO REMOVE THE LOCKPLATE WITHOUT COMPRESSOR TOOL C4156 AS THE LOCKPLATE IS UNDER HEAVY SPRING TENSION.

(8) Compress lockplate with compressor tool C4156.
(9) Remove steering shaft snap ring (Fig. 2). Discard snap ring. It is not reusable.
(10) Remove compressor tool.
(11) Remove lockplate, cancelling cam, and upper bearing preload spring.
(12) Remove horn button components from canceling cam.

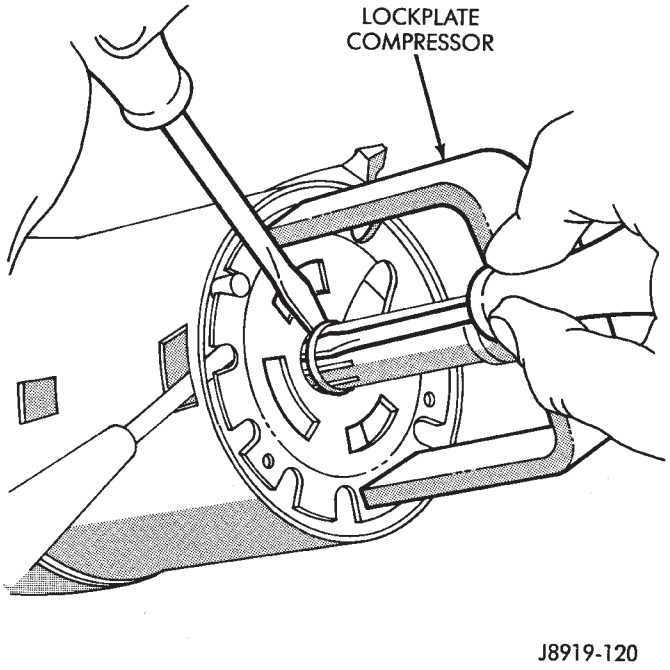


Fig. 2 Lockplate Removal

(13) Remove screw and hazard warning switch knob.
(14) Remove dimmer switch actuator arm attaching screw (Fig. 3).

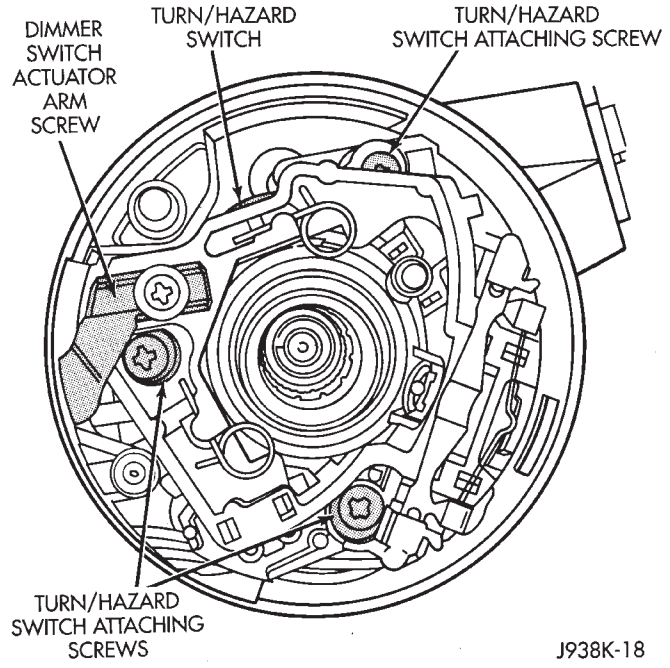


Fig. 3 Turn/Hazard Switch And Dimmer Actuating Arm Screws

(15) Remove turn/hazard switch attaching screws (Fig. 3).
(16) Unplug wiper switch connector.
(17) Push turn/hazard connector up and out of

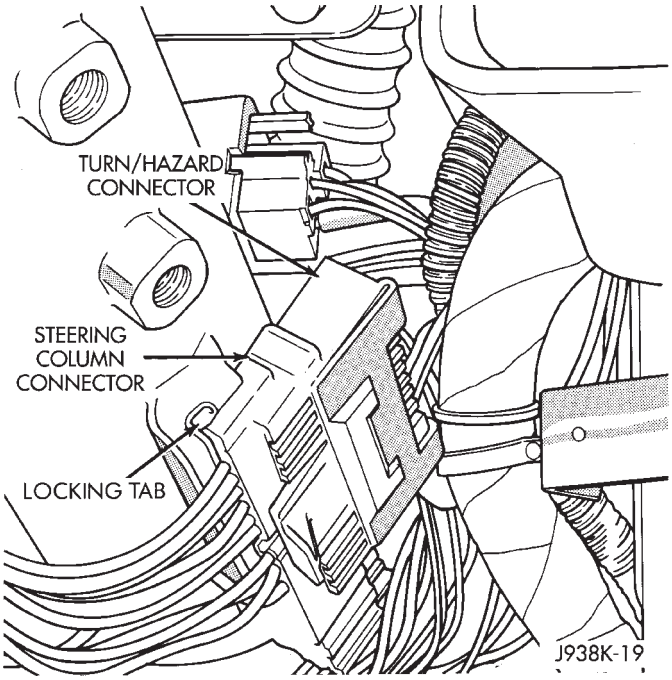


Fig. 4 Turn/Hazard Switch And Steering Column Connectors

steering column connector (Fig. 4).

(18) Pry up locking tabs of steering column connector and remove connector from column bracket.

(19) Pull turn/hazard switch out of the column far enough to allow access to remaining screws.

(20) Insert ignition key in the lock cylinder and turn key to ON position.

(21) Remove key warning buzzer switch and retaining clip with a paper clip. Insert paper clip below retainer so that retainer is flattened (Fig. 5).

Do not attempt to remove buzzer switch and clip separately. The clip could fall into the column jacket.

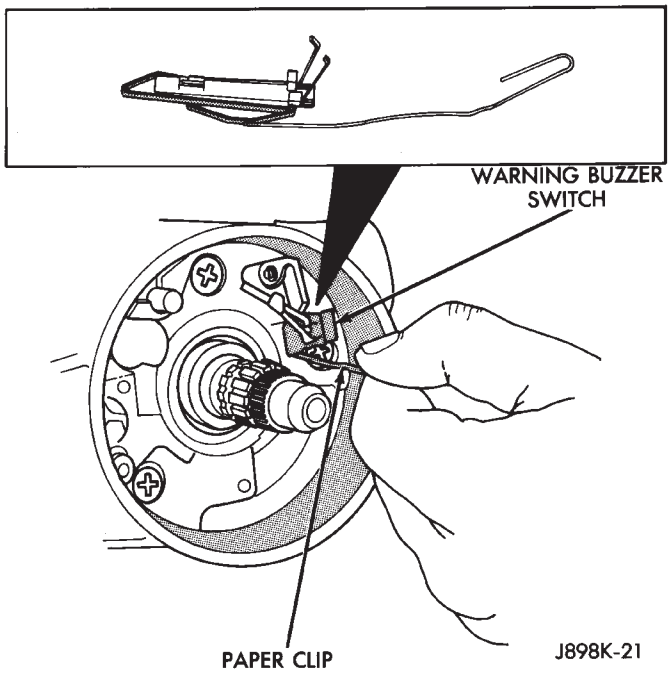


Fig. 5 Buzzer Switch Removal

(22) Reverse the removal procedures to assemble steering column.

(23) Install steering wheel. Tighten steering wheel nut to 34 N·m (25 ft. lbs.) torque.

WIRING DIAGRAMS

CONTENTS

GENERAL INFORMATION

INDEX

The wiring diagrams contain the latest information at the time of publication.

Throughout this group references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

SECONDARY IGNITION WIRING

Secondary ignition wiring is shown in Figures 1 and 2. For additional information on ignition systems or distributor operation refer to Group 8D Ignition Systems.

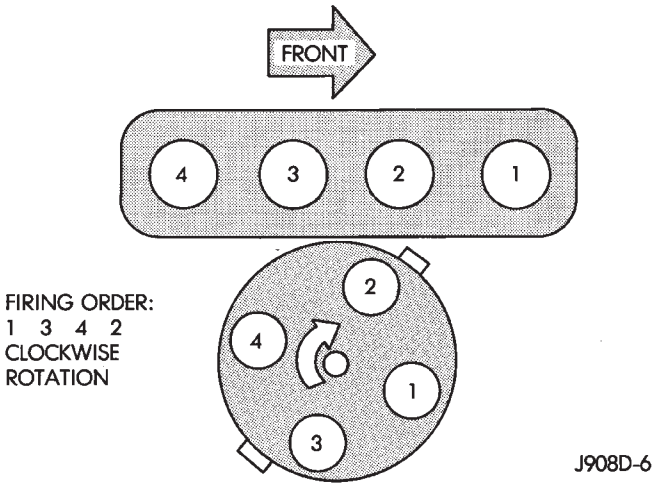


Fig. 1 Secondary Ignition Wiring 2.5L

WIRING DIAGRAM SHEETS AND INDEXES

The diagrams are organized to show the basic vehicle and all of its options. Add-on or non-factory options are not covered. The diagram pages are identified by a sheet number which is located at the lower right or left hand corner of each sheet. **Page numbers at the top of each page do not apply to diagram sheets.**

Diagram sheets show all information relating to the system. This includes feeds, grounds, switch internal circuity, connectors, splices, and pin identification for controllers and modules. All components, switches, and relays are shown in the at rest position with the key removed from the ignition and the doors closed.

In certain instances a wire may be referenced to another sheet. When this happens, the wire will be identified as to where it is going.

The index used for the diagrams is located at the beginning of the section. The main system and all related components are covered.

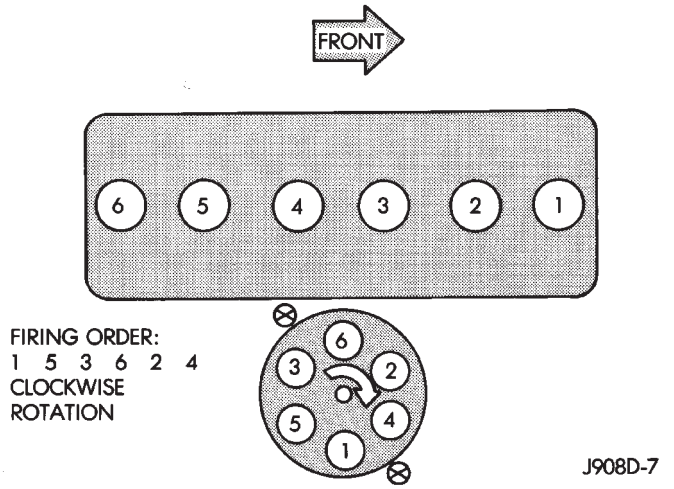


Fig. 2 Secondary Ignition Wiring 4.0L

WIRE CODE IDENTIFICATION

Each wire shown in the diagrams contains a code (Fig. 3) which identifies the main circuit, part of the main circuit, gauge of wire, and color. The color is shown as a two letter code which can be identified by referring to the Wire Color Code Chart (Fig. 4). If the wire has a tracer and it is a standard color an asterisk will follow the main wire color. If the tracer is non-standard the main wire color will have a slash (/) after it followed by the tracer color.

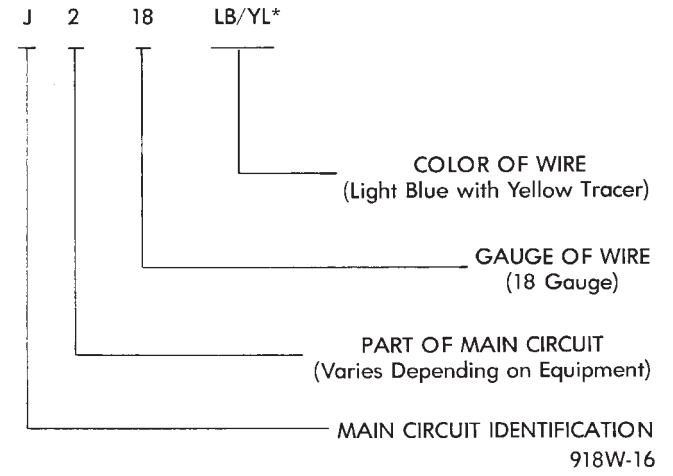


Fig. 3 Wire Color Code Identification

CIRCUIT IDENTIFICATION

All circuits in the diagrams use an alpha/numeric code to identify the wire and its function. To identify which circuit code applies to a system, refer to the Circuit Identification Code Chart. This chart shows the main circuits only and does not show the secondary codes that may apply to some models.

LOCATING A SYSTEM

To locate a system or component in the diagrams, refer to the alphabetical index at the front of the diagrams. Determine the diagram sheet number. Sheet numbers are located at the lower right or left hand corner of each sheet. **Page numbers at the top of the page do not apply to diagram sheets.**

COLOR CODE	COLOR	STANDARD TRACER COLOR	COLOR CODE	COLOR	STANDARD TRACER CODE
BL	BLUE	WT	OR	ORANGE	BK
BK	BLACK	WT	PK	PINK	BK OR WT
BR	BROWN	WT	RD	RED	WT
DB	DARK BLUE	WT	TN	TAN	WT
DG	DARK GREEN	WT	VT	VIOLET	WT
GY	GRAY	BK	WT	WHITE	BK
LB	LIGHT BLUE	BK	YL	YELLOW	BK
LG	LIGHT GREEN	BK	*	WITH TRACER	

918W-136

Fig. 4 Wire Color Code Chart

The index identifies the main system and all components that relate to that system. There are also sections of the index that identify specific components only (for example modules, lamps, etc.). Refer to a components name in the index if you are unclear as to what a system may be called.

Diagram sheets are arranged starting with the battery and fuses. Then working into charging, starting, and ignition systems. After this they start at the front of the vehicle and work to rear. The diagrams end with connector identification pages.

COMPONENT IDENTIFICATION

When looking for a components location in the vehicle refer to the Component Identification section index. This section shows the wire harness routing and the components location in the vehicle. When using this section refer to the wiring diagrams for the general location of the component. Then use the component identification index to locate the proper figure number.

SPLICE LOCATIONS

Splice locations are indicated in the diagrams by a diamond with a splice circuit code within it (Fig. 5 example 1). If there is more than one splice per circuit a small box will be connected to it with the splice number in it (Fig. 5 example 2).

To locate a splice in the wiring harness determine the splice number from the wiring diagrams then refer to the splice location index. This section shows the general location of the splice in the harness.

MAIN CIRCUIT IDENTIFICATION

CIRCUIT	DESCRIPTION	CIRCUIT	DESCRIPTION
A	Battery Feed: Fused and Unfused	P	Power Assist System: Locks, Mirrors
B	ABS System	Q	Power Assist System: Windows
C	Air Conditioning System	R	Airbag System
D	CCD (+), CCD (-)	S	Air Suspension, Automatic Load Leveling
E	Interior Lamp Illumination	T	Electronic Automatic Transaxle
F	Battery Feed: Fused and Unfused	V	Windshield Wipers and Washers, Vehicle Speed Control System
G	Sensors, Sending Units, Switches		
K	Powertrain Central Module	W	Power Assist System: Windows
L	Exterior Lighting, Stop Lamp Switch	X	Horn, Radio, Radio Speakers, Power Locks
M	Interior Lamps	Z	Ground Circuits: Includes power and signal grounds for PCM

938W-17

EXAMPLE 1 EXAMPLE 2

918W-18

Fig. 5 Wiring Splice Examples

CONNECTORS

The connectors shown in the diagram sheets are viewed from the terminal end unless otherwise specified. For viewing bulkhead, powertrain control module, and transmission control module connectors refer to the rear of the wiring diagrams. This area shows major connectors and identifies pin and cavity information.

The connectors shown in the diagrams are identified in two ways. The first is an actual view of the connector. This view shows the connector and which cavity the wire is in.

The second way is with the use of arrows to indicate the connector. This is done when the connector is to large to be shown on the diagram page. A box placed next to the connector identifies the connector and the cavity the wire is in. In certain instances there may be more than one connector in the same location. When this happens the connector identification box will have a number placed in it. Refer to the rear of the diagrams for a complete pin out of the connector.

TROUBLESHOOTING WIRING PROBLEMS

When troubleshooting wiring problems there are six steps which can aid in the procedure. The steps are listed and explained below.

(1) Verify the problem.

(2) Verify any related symptoms. Do this by performing operational checks on components that are in the same circuit as the problem area. Refer to the wiring diagrams fuse application chart for circuit identification.

(3) Analyze the symptoms. Use the wiring diagrams to determine what the circuit is doing, where the problem most likely is occurring and where the diagnosis will continue.

(4) Isolate the problem area.

(5) Repair the problem.

(6) Verify proper operation. For this step check for proper operation of all items on the circuit repaired. Refer to the wiring diagram fuse application chart for circuit identification.

FUSIBLE LINKS

Vehicle wiring harnesses are equipped with fusible links to protect against harness damage in the event of a short in the system. Fusible links are color coded to indicate wire gauge and size. Refer to the fusible link chart for color and gauge identification (Fig. 6).

Wire and Gauge	Color Code	Color
12 Ga.	BK	Black
14 Ga.	RD	Red
16 Ga.	DB	Dark Blue
18 Ga.	GY	Gray
20 Ga.	OR	Orange
22 Ga.	WT	White

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Fig. 6 Fusible Link Chart

FUSIBLE LINK REPLACEMENT

CAUTION: Do not replace blown fusible links with a standard wire. Only use fusible type wire with hypalon insulation or damage to the electrical system could occur. Also make sure correct gauge of wiring is used. Refer to the wiring diagrams for proper gauge and color.

When a fusible link blows it is important to find out what the problem is. They are placed in the electrical system for protection against shorts to ground. This can be caused by a component failure or various wiring failures. **Do not just replace the fusible link to correct the problem.**

When diagnosing a faulty fusible link it is important to check the wire carefully. In some instances the link may be blown and it will not show through the insulation, the wire should be checked over its entire length for internal breaks.

(1) Disconnect battery negative cable.

(2) Cut out the blown portion of the fusible link.

(3) Strip 1 inch of insulation from each end of the existing fusible link.

(4) Place a piece of heat shrink tubing over one side of the fusible link. Make sure the tubing will be long enough to cover and seal the entire repair area.

(5) Cut a replacement piece of fusible link approximately two inches longer than the piece removed.

(6) Remove one inch of insulation from each end of the replacement fusible link.

(7) Spread the strands of wire apart on each of the exposed wires (Fig. 7 example 1).

(8) Push the two ends of the wire together until the strands of wire are close to the insulation (Fig. 7 example 2).

(9) Twist the wires together (Fig. 7 example 3).

(10) Solder the wires together using rosin core type solder only. **Do not use acid core type solder.**

(11) 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.

(12) Secure the fusible link to the existing ones to prevent chafing or damage to the insulation.

(13) Connect battery and test affected systems.

WIRING REPAIR

When replacing or repairing a wire, it is important that the correct gauge be used as shown in the wiring diagrams. The wires must also be held securely in place to prevent damage to the insulation.

(1) Disconnect battery negative cable.

(2) Remove 1 inch of insulation from each end of the wire.

(3) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

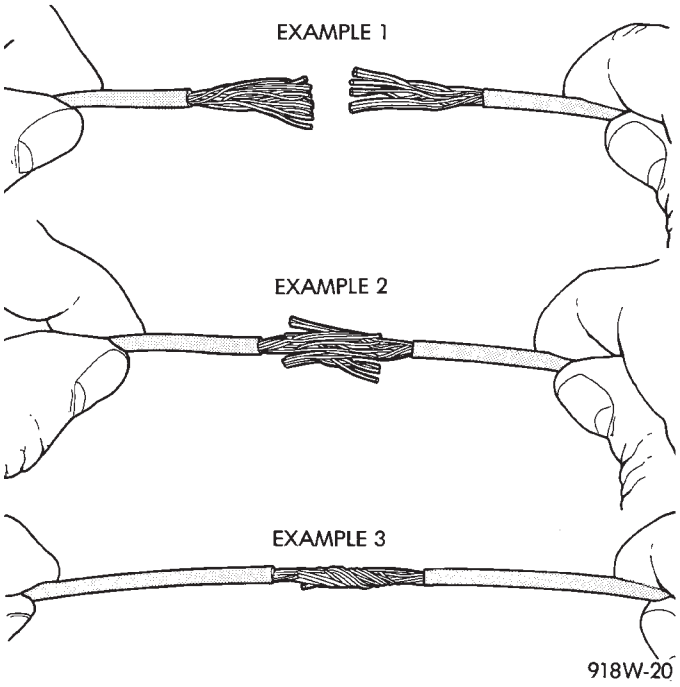

Fig. 7 Wire Repair

(4) Spread the strands of the wire apart on each of the exposed wires (Fig. 7 example 1).

(5) Push the two ends of wire together until the strands of wire are close to the insulation (Fig. 7 example 2).

(6) Twist the wires together (Fig. 7 example 3).

(7) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(8) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(9) Secure the wire to the existing ones to prevent chafing or damage to the insulation.

(10) Connect battery and test affected systems.

CONNECTOR REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector to be repaired from its mating half.

(3) Remove connector locking wedge (Fig. 8).

(4) Position the connector locking finger away from the terminal while pulling on the wire to remove the terminal from the connector (Fig. 9).

(5) Reset the terminal locking tang, if it has one.

(6) Insert the removed wire in the same cavity on the repair connector.

(7) Repeat steps four through six for each wire in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin out identification refer to the wiring diagrams.

(8) Insert the connector locking wedge into the repaired connector.

(9) Connect connector to its mating half.

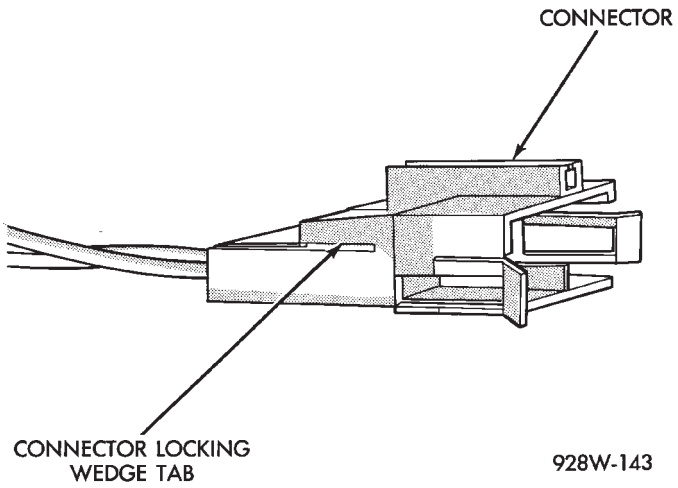

Fig. 8 Connector Locking Wedge Tab (Typical)

(10) Connect battery and test affected systems.

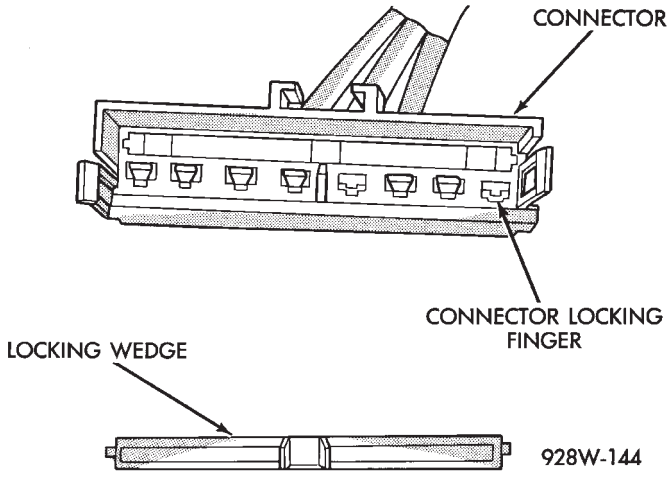

Fig. 9 Connector Locking Finger and Locking Wedge (Typical)

CONNECTOR AND TERMINAL ASSEMBLY REPLACEMENT

(1) Disconnect Battery.

(2) Disconnect the connector being repaired from its mating half.

(3) Cut off the existing wire connector directly behind the insulator and remove six inches of tape from the harness.

(4) Stagger cut all wires on the harness side about 1/2 inch apart (Fig. 10).

(5) Remove 1 inch of insulation from each wire on the harness side.

(6) Stagger cut the matching wires on the repair connector assembly in the opposite order as was done on the harness side of the repair (allow extra length for soldered connections). Check that the overall length is the same as the original (Fig. 10).

(7) Remove 1 inch of insulation from each wire.

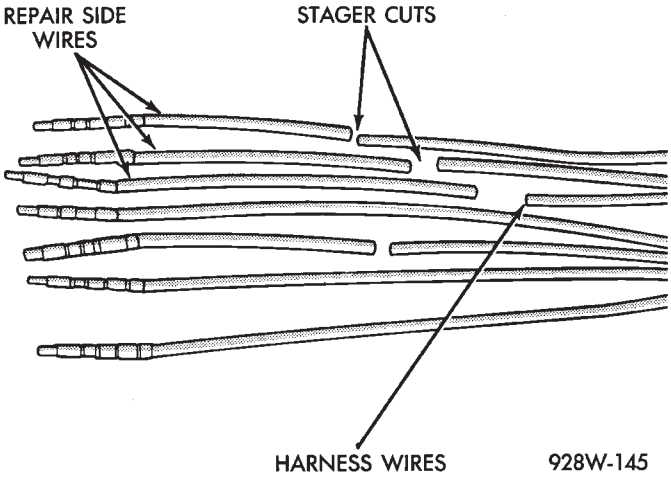

Fig. 10 Stagger Cutting Wires

(8) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(9) Spread the strands of the wire apart on each of the exposed wires (Fig. 7 example 1).

(10) Push the two ends of wire together until the strands of wire are close to the insulation (Fig. 7 example 2).

(11) Twist the wires together (Fig. 7 example 3).

(12) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(13) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(14) Repeat steps 8 through 13 for each wire.

(15) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(16) Reconnect the repaired connector.

(17) Connect battery and test affected systems.

TERMINAL REPLACEMENT

(1) Disconnect battery.

(2) Disconnect the connector being repaired from its mating half.

(3) Remove connector locking wedge (Fig. 8).

(4) Position the connector locking finger away from the terminal while pulling on the wire to remove the terminal from the connector (Fig. 9).

(5) Cut the wire 6 inches from the back of the connector.

(6) Remove 1 inch of insulation from the wire on the harness side.

(7) Select a wire from the terminal repair assembly that best matches the color wire being repaired.

(8) Cut the repair wire to the proper length and remove 1 inch of insulation.

(9) Place a piece of heat shrink tubing over one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(10) Spread the strands of the wire apart on each of the exposed wires (Fig. 7 example 1).

(11) Push the two ends of wire together until the strands of wire are close to the insulation (Fig. 7 example 2).

(12) Twist the wires together (Fig. 7 example 3).

(13) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(14) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing.

(15) Insert the repaired wire into the connector.

(16) Install the connector locking wedge and reconnect the connector to its mating half.

(17) Re-tape the wire harness starting 1-1/2 inches behind the connector and 2 inches past the repair.

(18) Connect battery and test affected systems.

SYMBOLS, FUSES AND ABBREVIATIONS

Various symbols are used throughout the wiring diagrams. These symbols can be identified by referring to the symbol identification chart (Fig. 11).

Certain abbreviations are also used in the diagrams. These have been developed in such a way that there meaning should be clear. For fuse block, relay bank, and power distribution center information refer to the fuse charts and relay bank index.

CAUTION: When replacing a blown fuse it is important to replace it with a fuse having the correct amperage rating. The use of a fuse with a rating other than indicated may result in an electrical overload. If a proper rated fuse continues to blow, it indicates a problem that should be corrected.

	LEGEND OF SYMBOLS USED ON WIRING DIAGRAMS		
+	POSITIVE		CONNECTOR
−	NEGATIVE		MALE CONNECTOR
	GROUND		FEMALE CONNECTOR
	FUSE		DENOTES WIRE CONTINUES ELSEWHERE
	GANG FUSES WITH BUSS BAR		DENOTES WIRE GOES TO ONE OF TWO CIRCUITS
	CIRCUIT BREAKER		SPLICE
	CAPACITOR	J2 2	SPLICE IDENTIFICATION
Ω	OHMS		THERMAL ELEMENT
	RESISTOR	TIMER	TIMER
	VARIABLE RESISTOR		MULTIPLE CONNECTOR
	SERIES RESISTOR		OPTIONAL WIRING WITH / WIRING WITHOUT
	COIL		"Y" WINDINGS
	STEP UP COIL	88:88	DIGITAL READOUT
	OPEN CONTACT		SINGLE FILAMENT LAMP
	CLOSED CONTACT		DUAL FILAMENT LAMP
	CLOSED SWITCH		L.E.D. — LIGHT EMITTING DIODE
	OPEN SWITCH	T	THERMISTOR
	CLOSED GANGED SWITCH		GAUGE
	OPEN GANGED SWITCH		SENSOR
	TWO POLE SINGLE THROW SWITCH		FUEL INJECTOR
	PRESSURE SWITCH	#36	DENOTES WIRE GOES THROUGH BULKHEAD DISCONNECT
	SOLENOID SWITCH	#19 STRG COLUMN	DENOTES WIRE GOES THROUGH STEERING COLUMN CONNECTOR
	MERCURY SWITCH	INST PANEL #14	DENOTES WIRE GOES THROUGH INSTRUMENT PANEL CONNECTOR
	DIODE OR RECTIFIER	ENG #7	DENOTES WIRE GOES THROUGH GROMMET TO ENGINE COMPARTMENT
	BY-DIRECTIONAL ZENER DIODE		DENOTES WIRE GOES THROUGH GROMMET
	MOTOR		HEATED GRID ELEMENTS
	ARMATURE AND BRUSHES		908W-191

Fig. 11 Symbol Identification

FUSE CHARTS AND RELAY BANKS

INDEX

CAVITY	AMP/COLOR	ITEMS FUSED
1	20 AMP YL	Rear Window Wiper
2		Not Used
3	15 Amp LT BL	Stop Lamps
4	15 Amp LT BL	Turn Signals
5	10 Amp RD	Automatic Shut-Down Relay, Fuel Pump Relay, P.C.M.
6	25 Amp NAT	Heated Rear Window
7	20 Amp YL	Cigar Lighter, Radio, Illumination Lamps
8	20 Amp YL	Headlamp Switch, Side Marker Lamps
9	15 Amp LT BL	Combination Buzzer, Warning Lamps, Gauges, Heated Rear Window Relay, Back-Up Lamps, A/C Compressor Clutch Relay
10	5 Amp TN	Instrument Panel Illumination Lamps
11	5.3 Amp C/BRKR	Windshield Wipers/Windshield Washer
12	25 Amp NAT	Blower Motor, A/C Compressor Clutch

CAVITY	AMP/COLOR	ITEMS FUSED
13		Not Used
14		Not Used
15		Not Used
16		Not Used

AMPS	FUSE	COLOR CODE
5	TN	Tan
15	LT BL	Light Blue
20	YL	Yellow
25	NAT	Natural
30	GN	Green

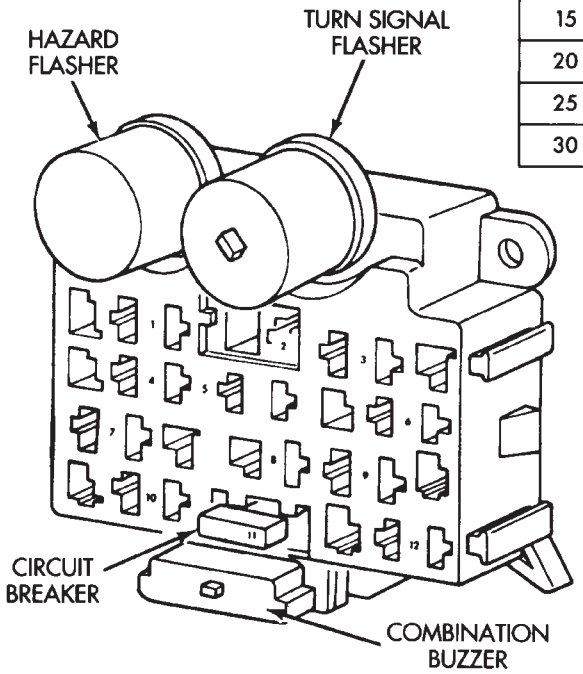

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Fig. 1 Fuse Panel YJ

CAVITY	AMP/COLOR	ITEMS FUSED
1	25 AMP NAT	REAR WIPER, REAR WASHER
2	15 AMP LT BL	RADIO, RADIO CLOCK ILLUMINATION, CIGAR LIGHTER, DOME LAMP
3	10 AMP RD	IGNITION 3-RUN
4	15 AMP LT BL	FLASH TO PASS
5	30 AMP NAT	BLOWER MOTOR
6	30 AMP C/BRKR	POWER WINDOWS
7	2 AMP PK	ANTILOCK BRAKES
8	20 AMP YL	TURN SIGNAL FLASHER
9	10 AMP RD	ILLUMINATED ENTRY, RADIO, COURTESY LIGHTS, GLOVE BOX; CARGO; DOME LAMPS
10		NOT USED
11	25 AMP NAT	HEADLAMP DELAY MODULE, HORNS
12		NOT USED
13	20 AMP YL	POWER DOOR LOCKS
14	10 AMP RD	POWER ANTENNA
15	15 AMP LT BL	I.P. LAMPS, CLOCK, RADIO/CLOCK ILLUMINATION, REAR LAMPS, FRONT LAMPS
16	30 AMP C/BRKR	POWER SEATS, TRAILER TOW
17	7.5 AMP VT	INSTRUMENT CLUSTER GAUGES, HEADLAMP DELAY MODULE, CHIME MODULE
18	25 AMP NAT	HEATED REAR WINDOW
19	5 AMP TN	INSTRUMENT PANEL LAMPS
20		NOT USED

AMPS	FUSE	COLOR CODE
2	PK	PINK
5	TN	TAN
7.5	VT	VIOLET
10	RD	RED
15	LT BL	LIGHT BLUE
20	YL	YELLOW
25	NAT	NATURAL
30		

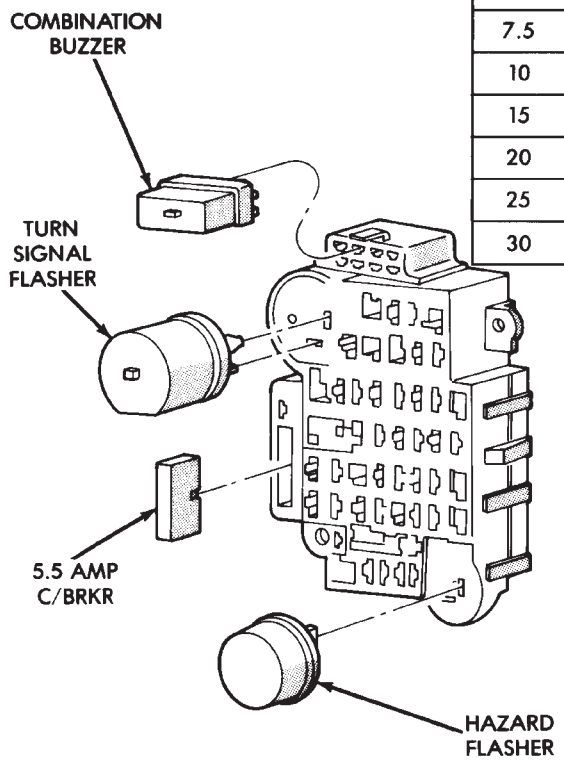

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Fig. 2 Fuse Panel XJ

FUSE	AMPS	COLOR	DESCRIPTION	TYPE
F1	30	Green	Fuel Pump/Automatic Shutdown	Maxi
F2	50	Red	Charging	Maxi
F3	50	Red	Battery Acc. Feed	Maxi
F4	40	Amber	Ignition/Engine Starter Feed	Maxi
F5	20	Yellow	Hazard Flasher Feed	Maxi
F6	50	Red	Charging	Maxi
F7	30	Green	Headlamp Feed	Maxi
F8	20	Yellow	I.O.D./Horn Feed	Maxi

FUSE	AMPS	COLOR	DESCRIPTION	TYPE
F9	40	Amber	ABS Pump Relay	Maxi
F10	30	Green	ABS Power Relay	Maxi
F11				
F12				
F13	2	Gray	ABS Control Module	Mini
F14				
F15	10	Red	Horn/Horn Relay	Mini
F16	10	Red	I.O.D.	

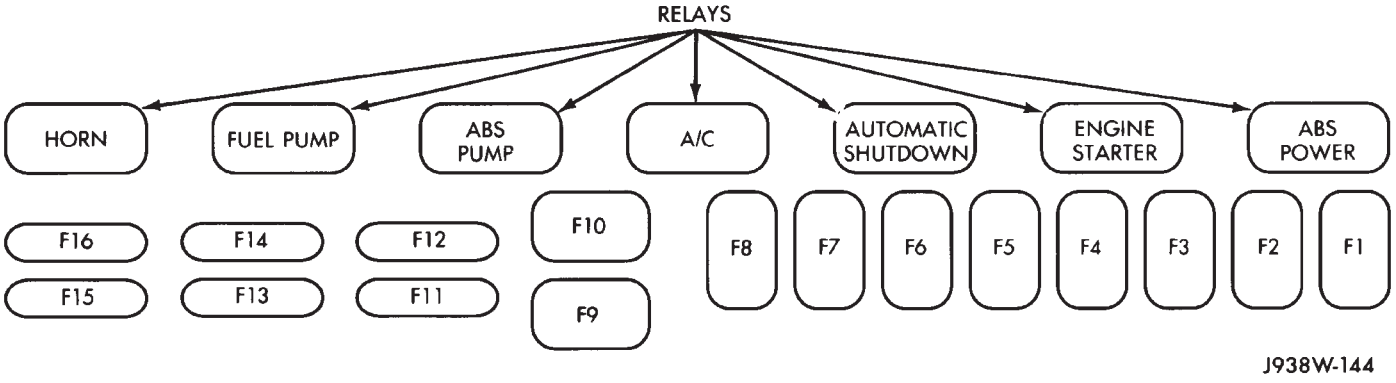

Fig. 3 Power Distribution Center YJ

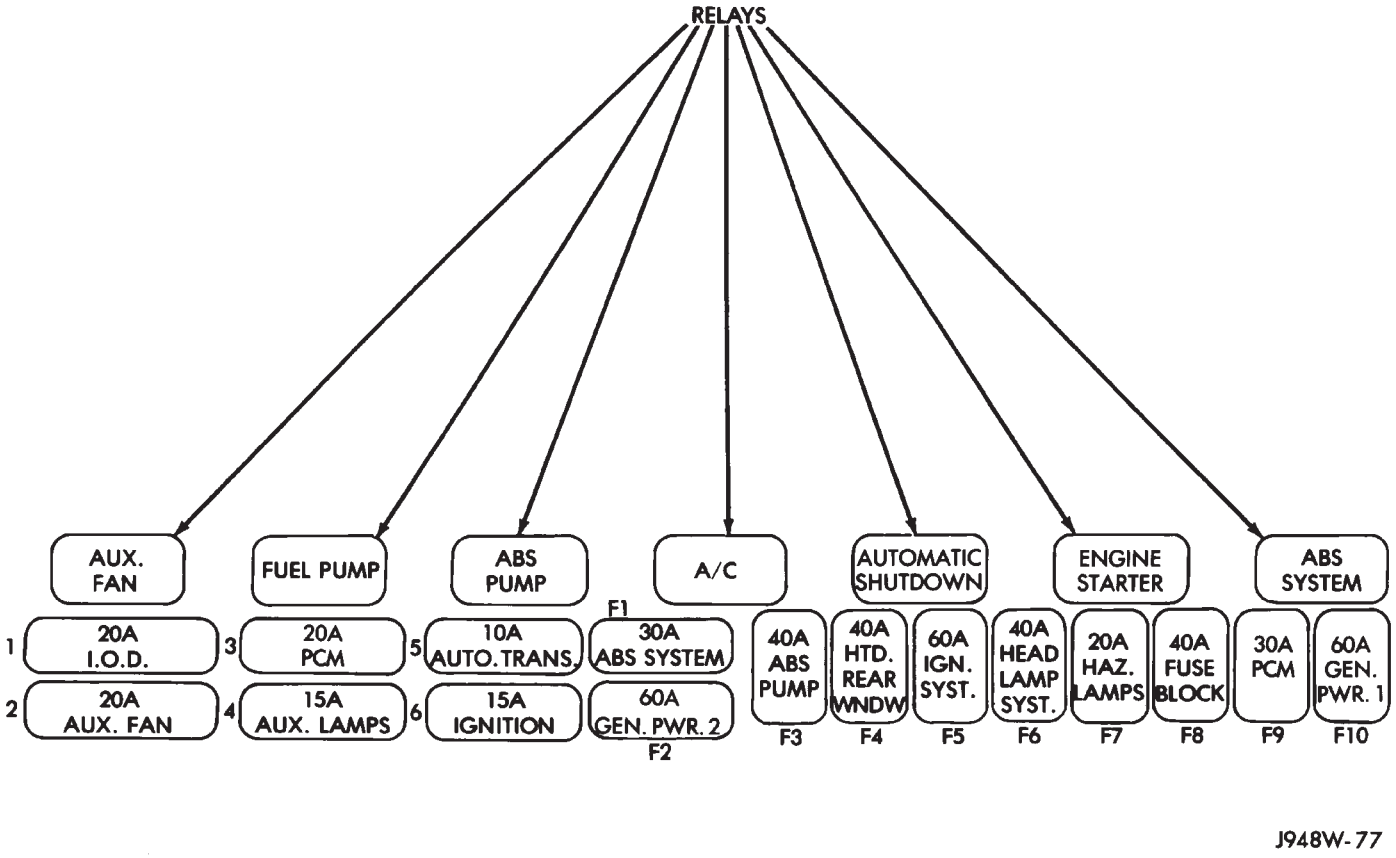

Fig. 4 Power Distribution Center XJ

WIRING AND COMPONENT IDENTIFICATION

CONTENTS

The wiring and components shown in this section are divided into sections by vehicle line. When locating a specific wire routing or component, first turn to the appropriate index, then look up the **figure number** that refers to the component. **Page numbers at the top of the page do not refer to figure numbers.**

YJ

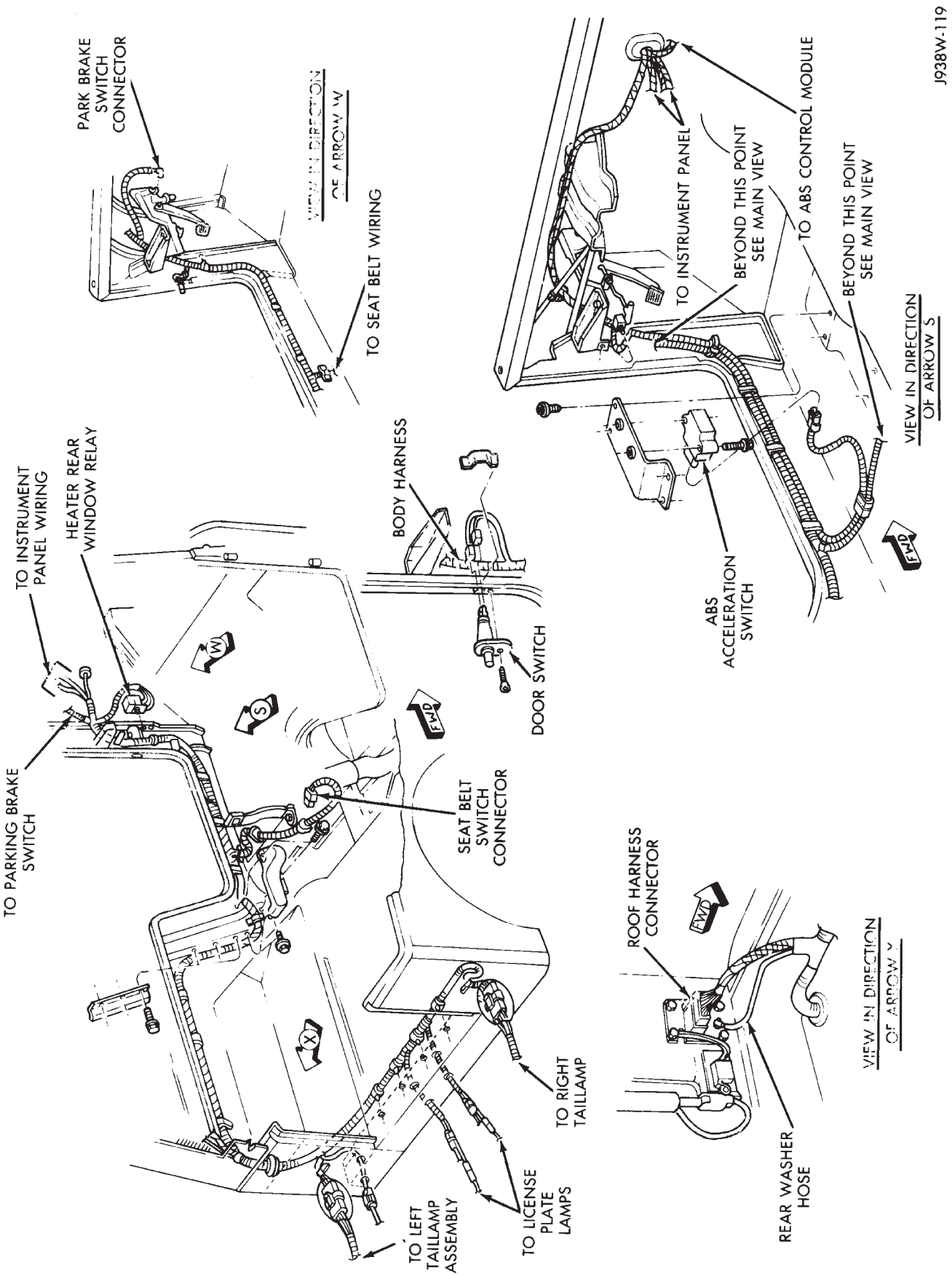

Fig. 1 Body Wiring YJ

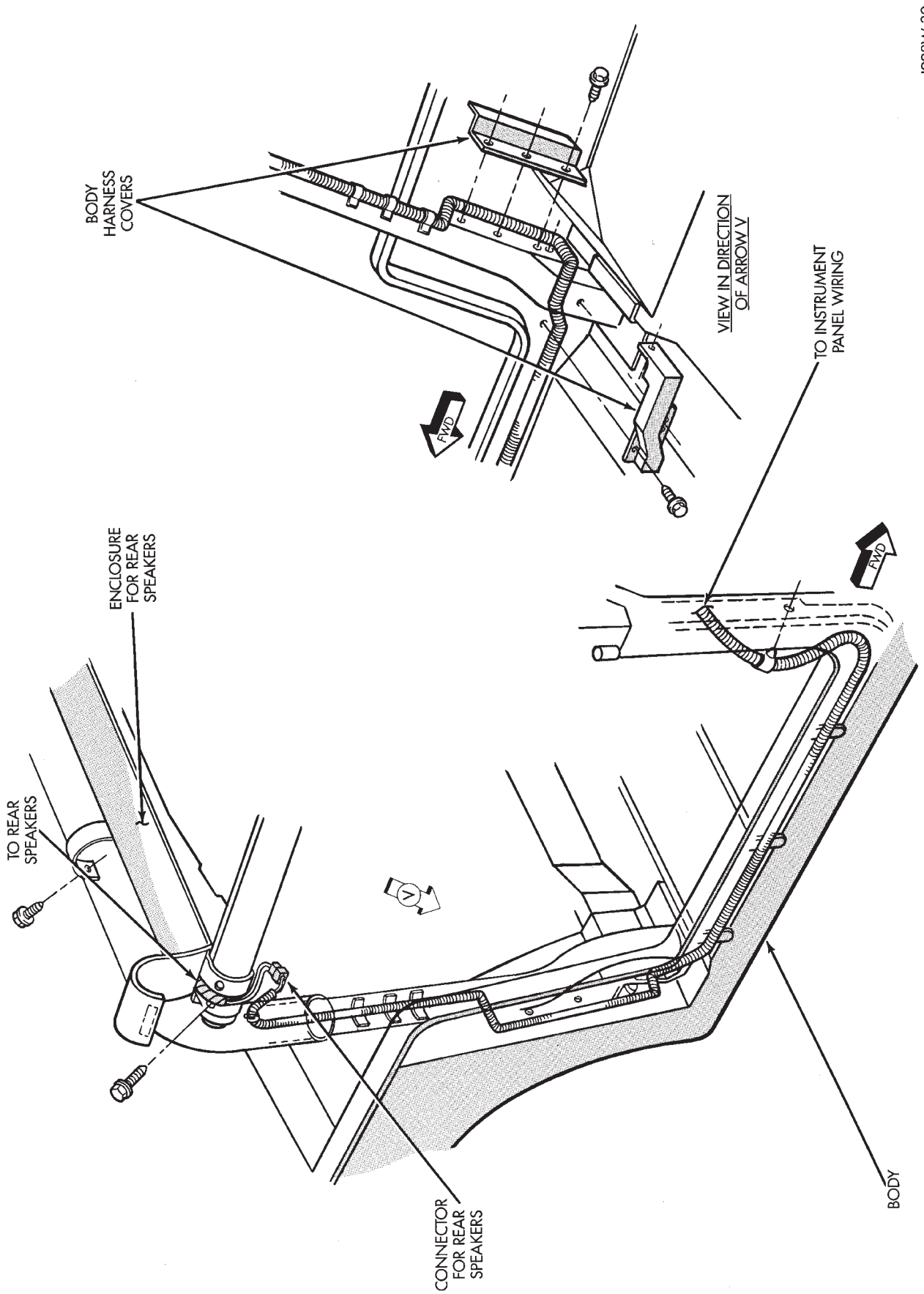

Fig. 2 Body Wiring YJ

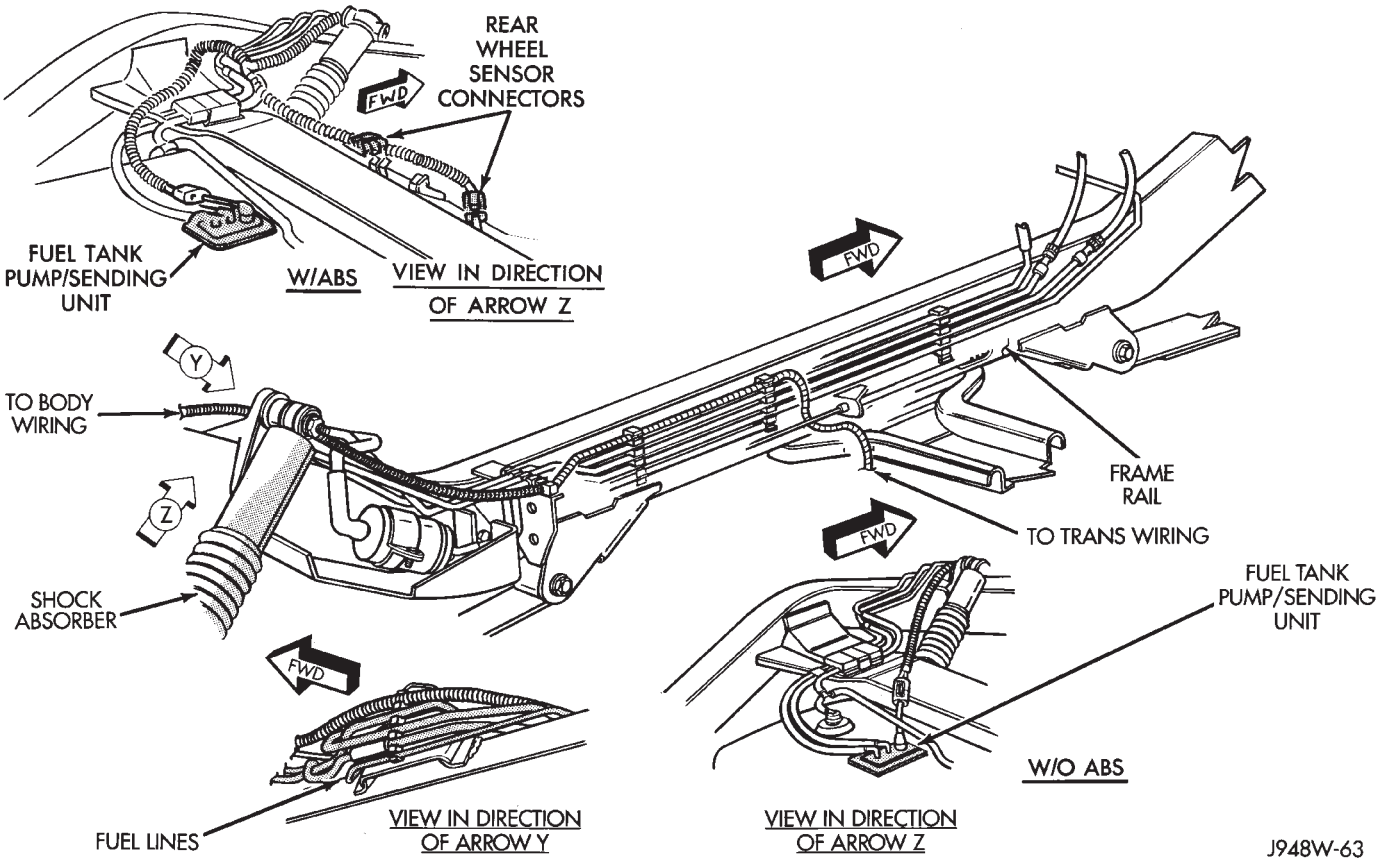

Fig. 3 Chassis Wiring YJ

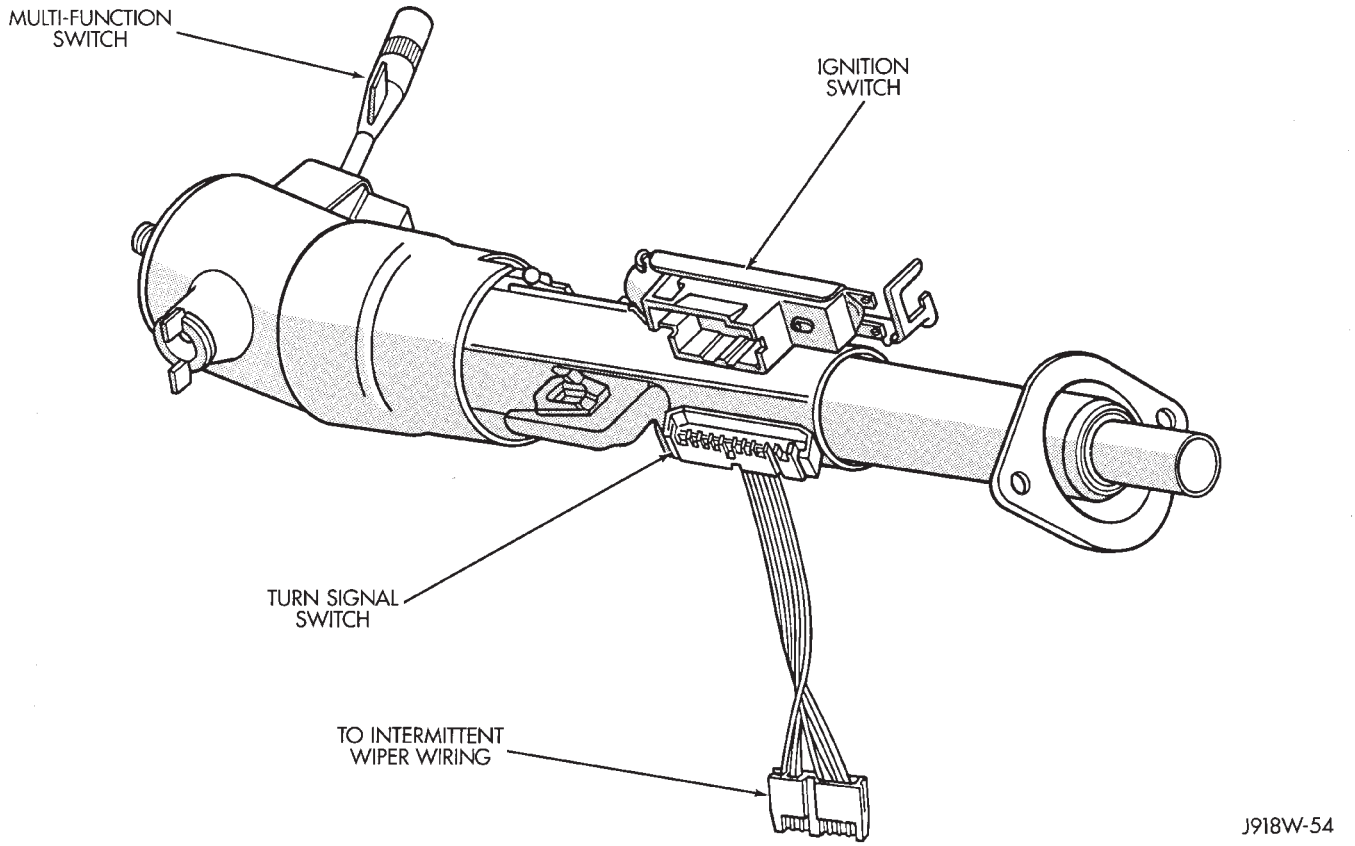

Fig. 4 Steering Column Wiring YJ

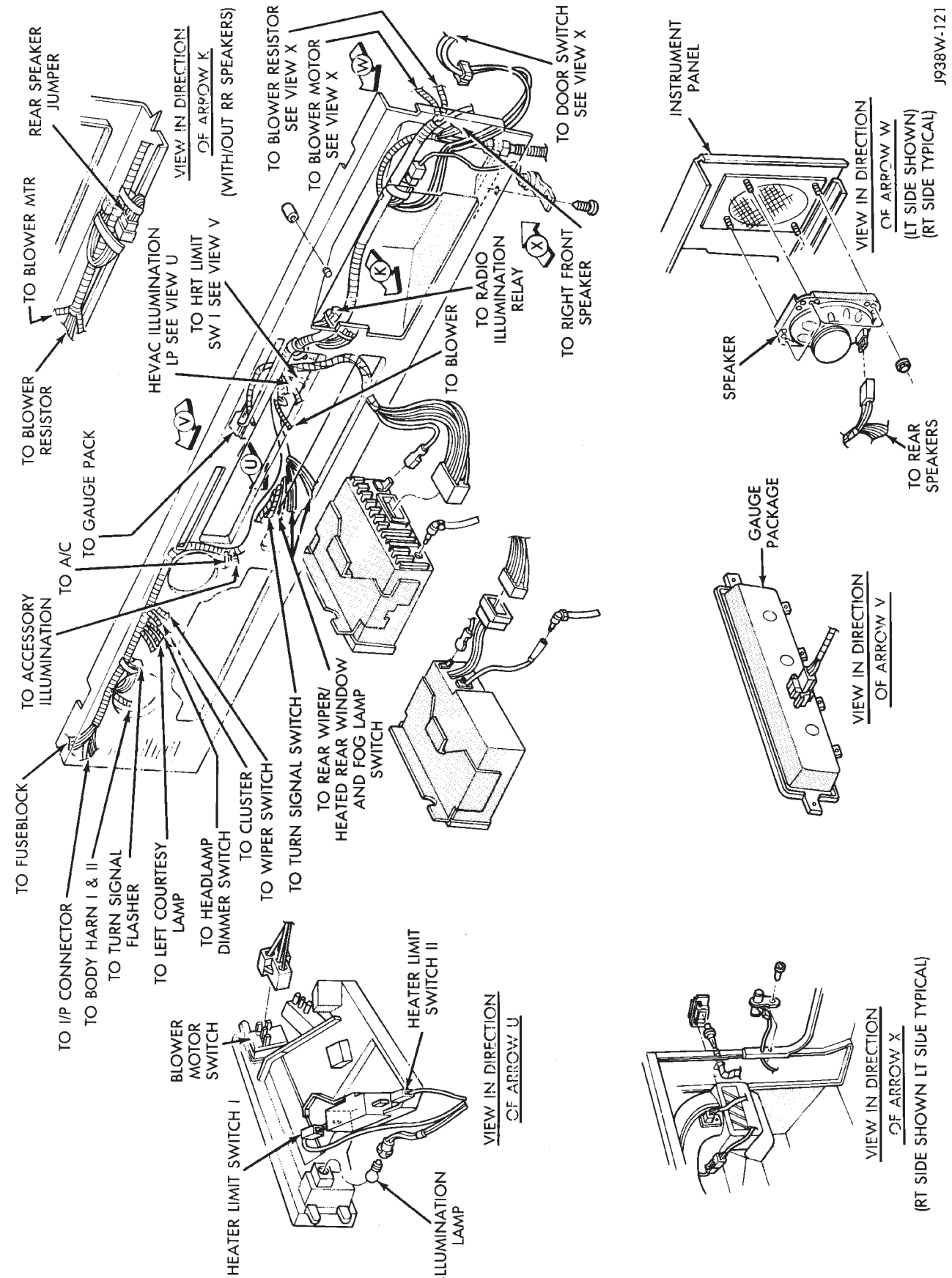

Fig. 5 Instrument Panel Wiring YJ

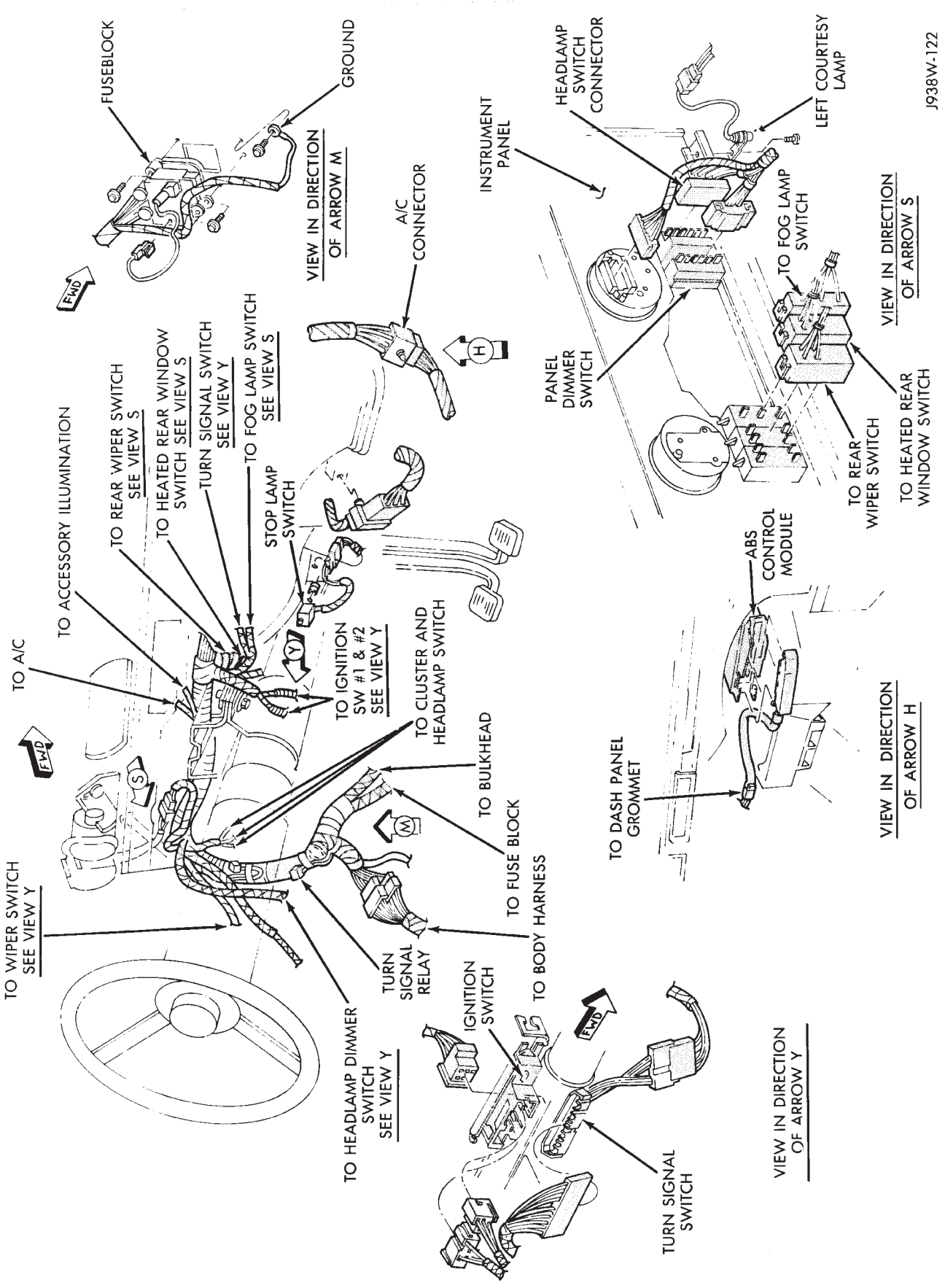

Fig. 6 Instrument Panel Wiring YJ

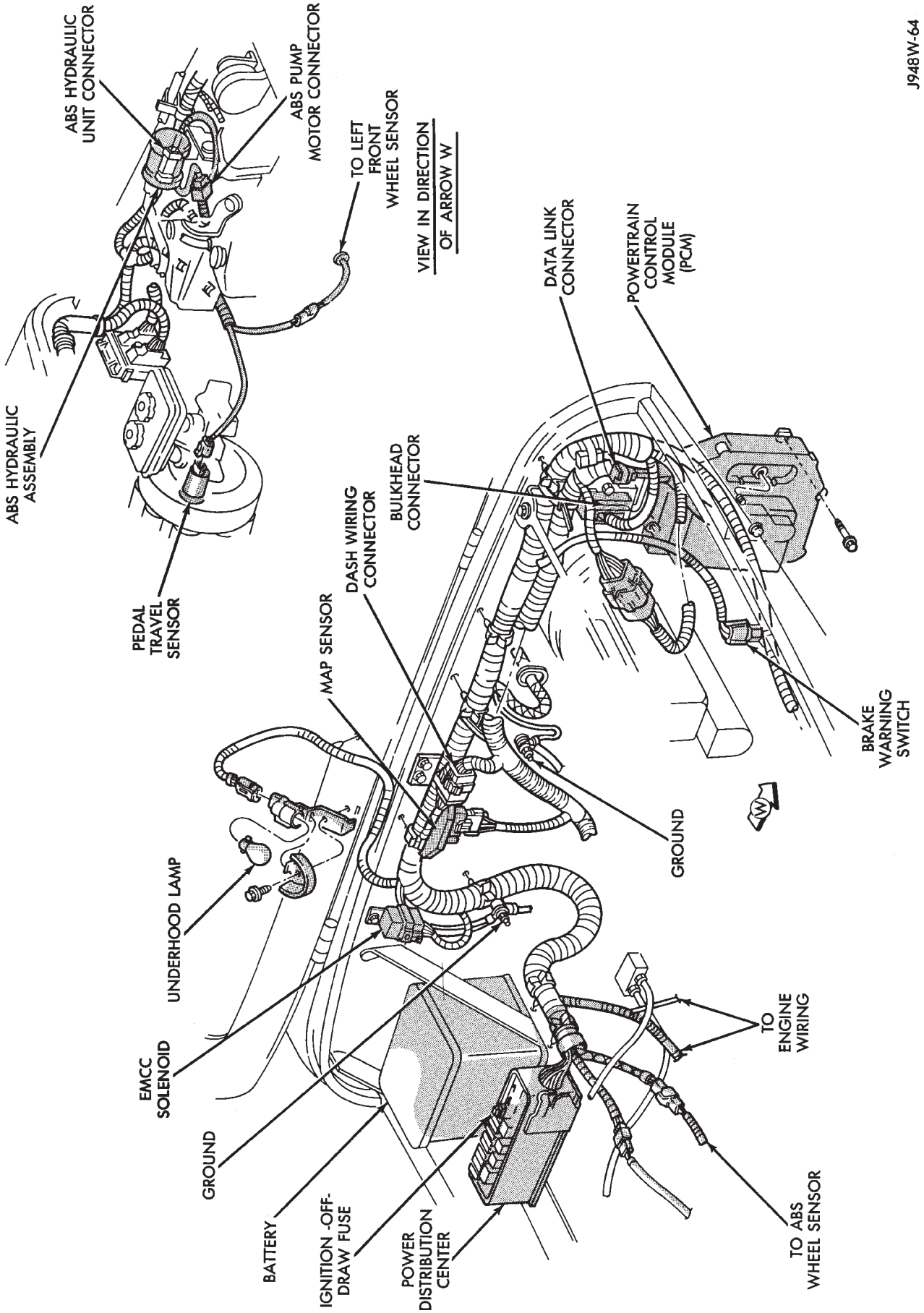

Fig. 7 Engine Compartment Wiring YJ

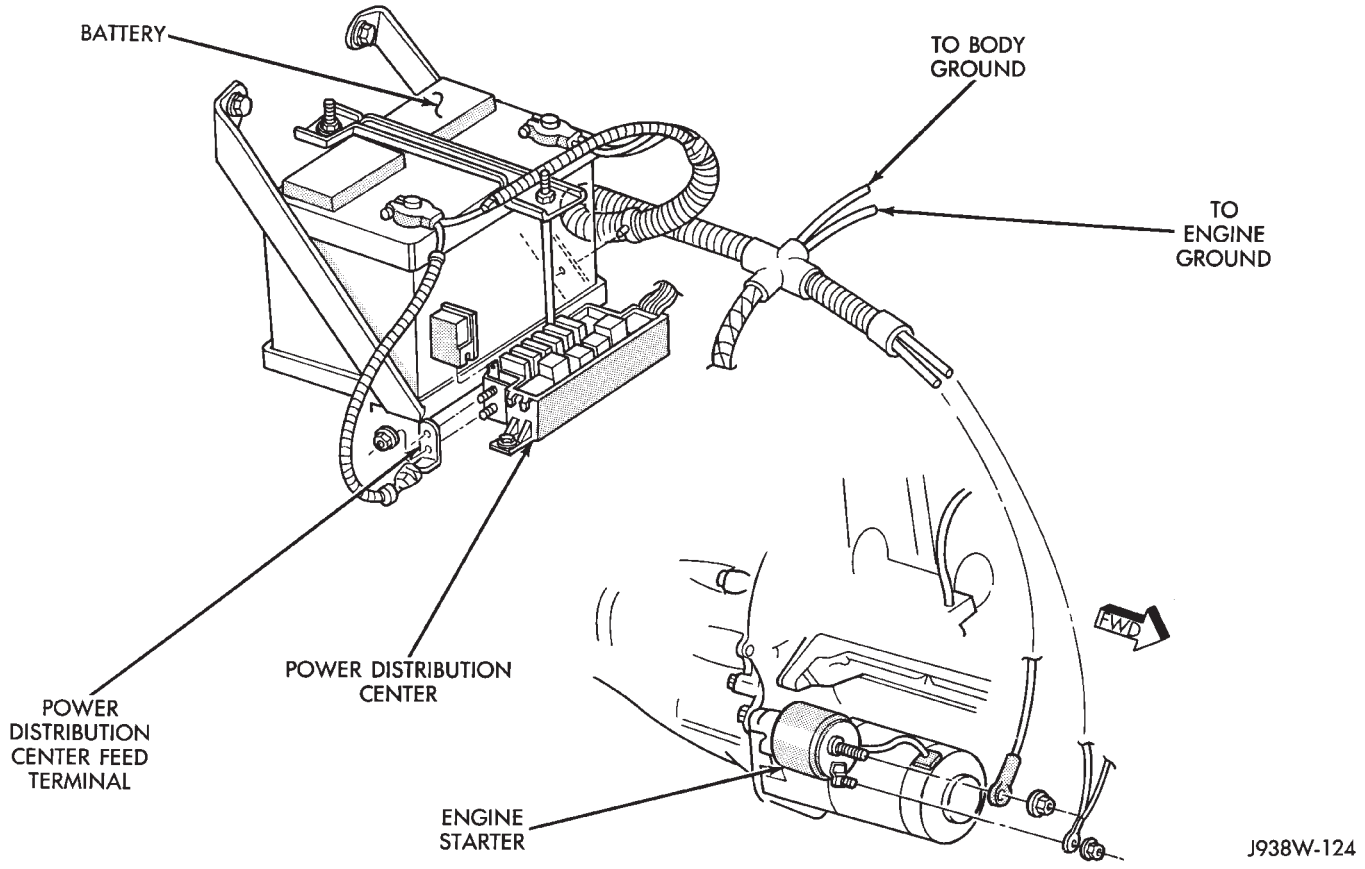

Fig. 8 Battery and Starter Wiring YJ

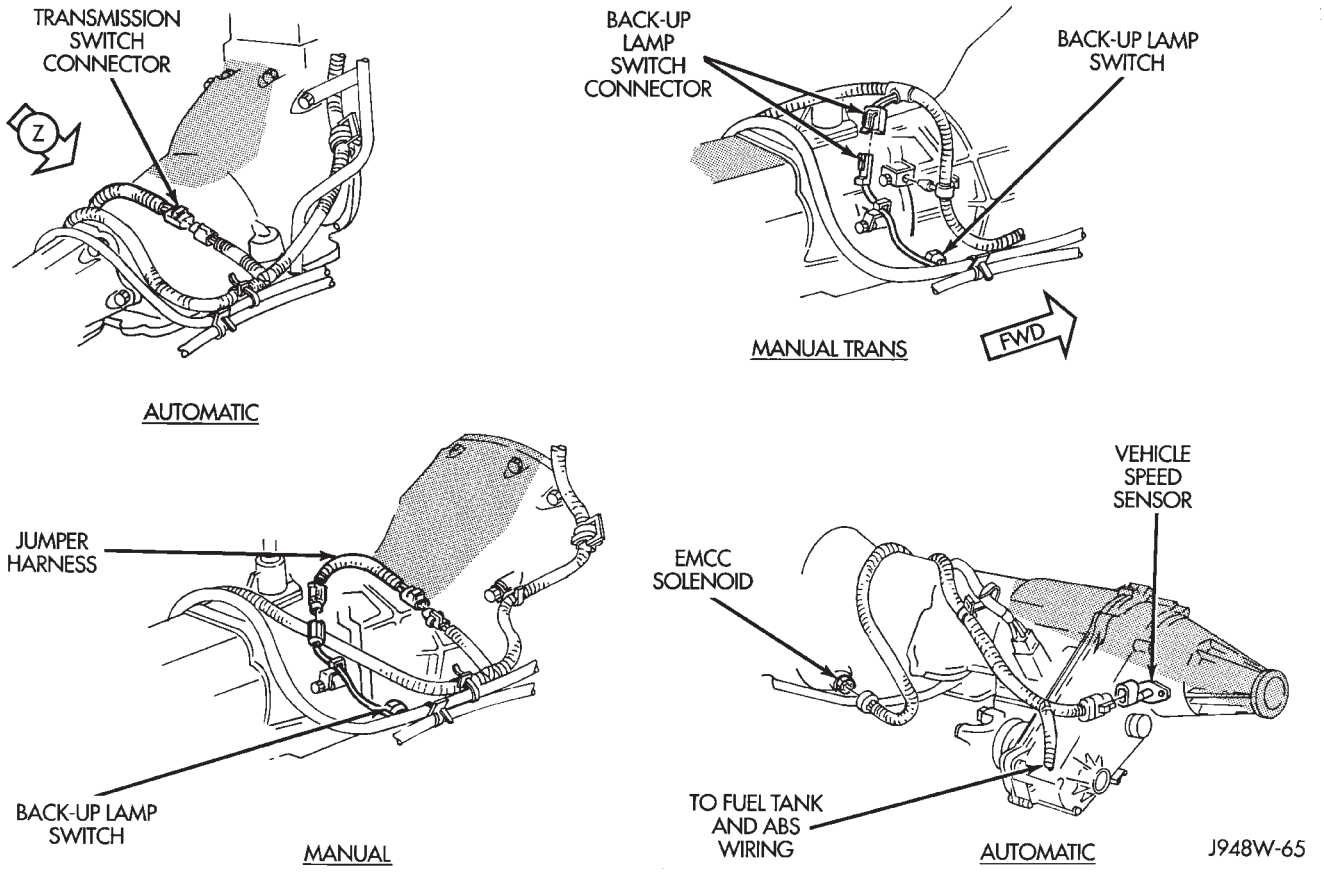

Fig. 9 Transmission Wiring YJ

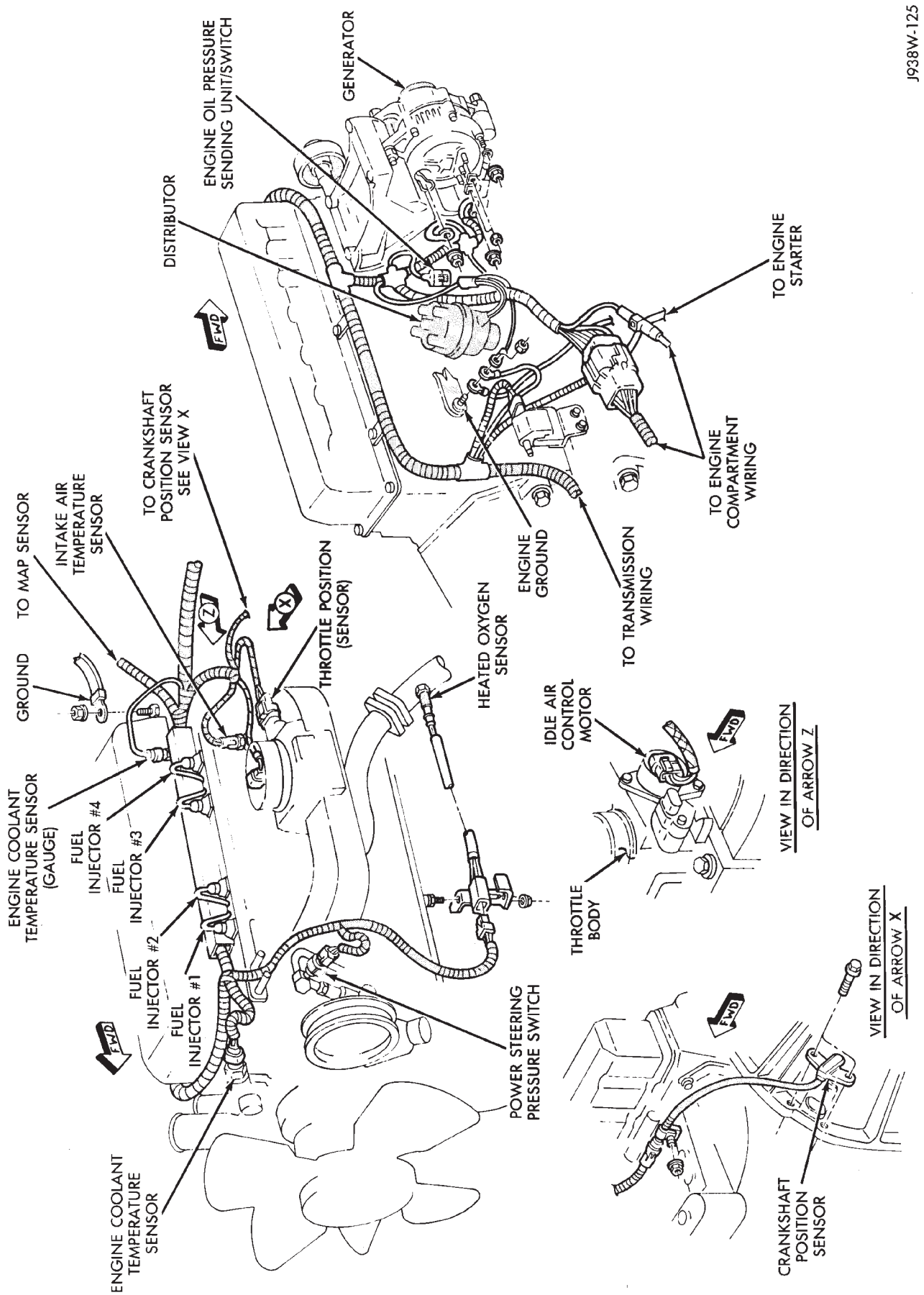

Fig. 10 Engine Wiring 2.5L YJ

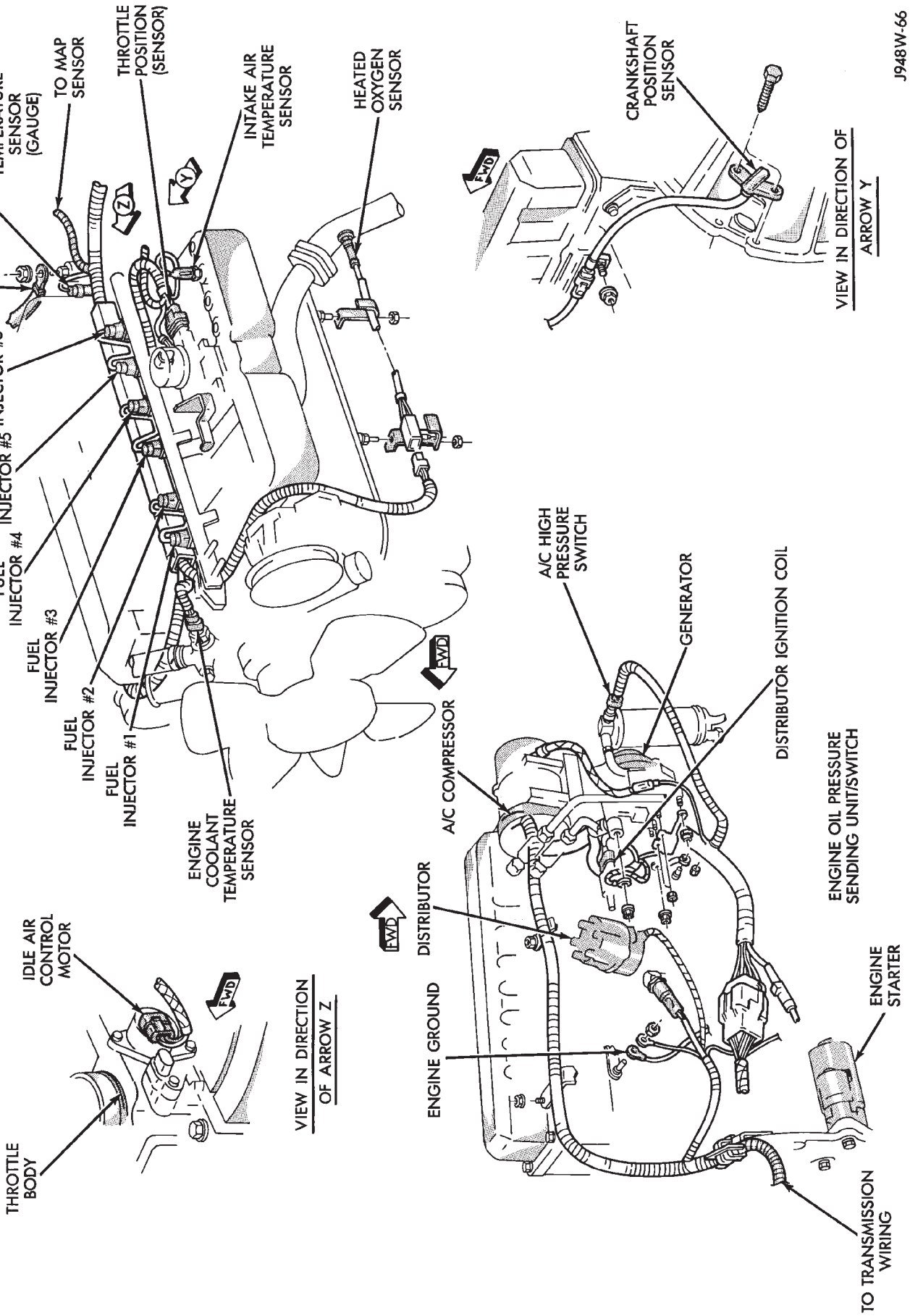

Fig. 11 Engine Wiring 4.0L YJ

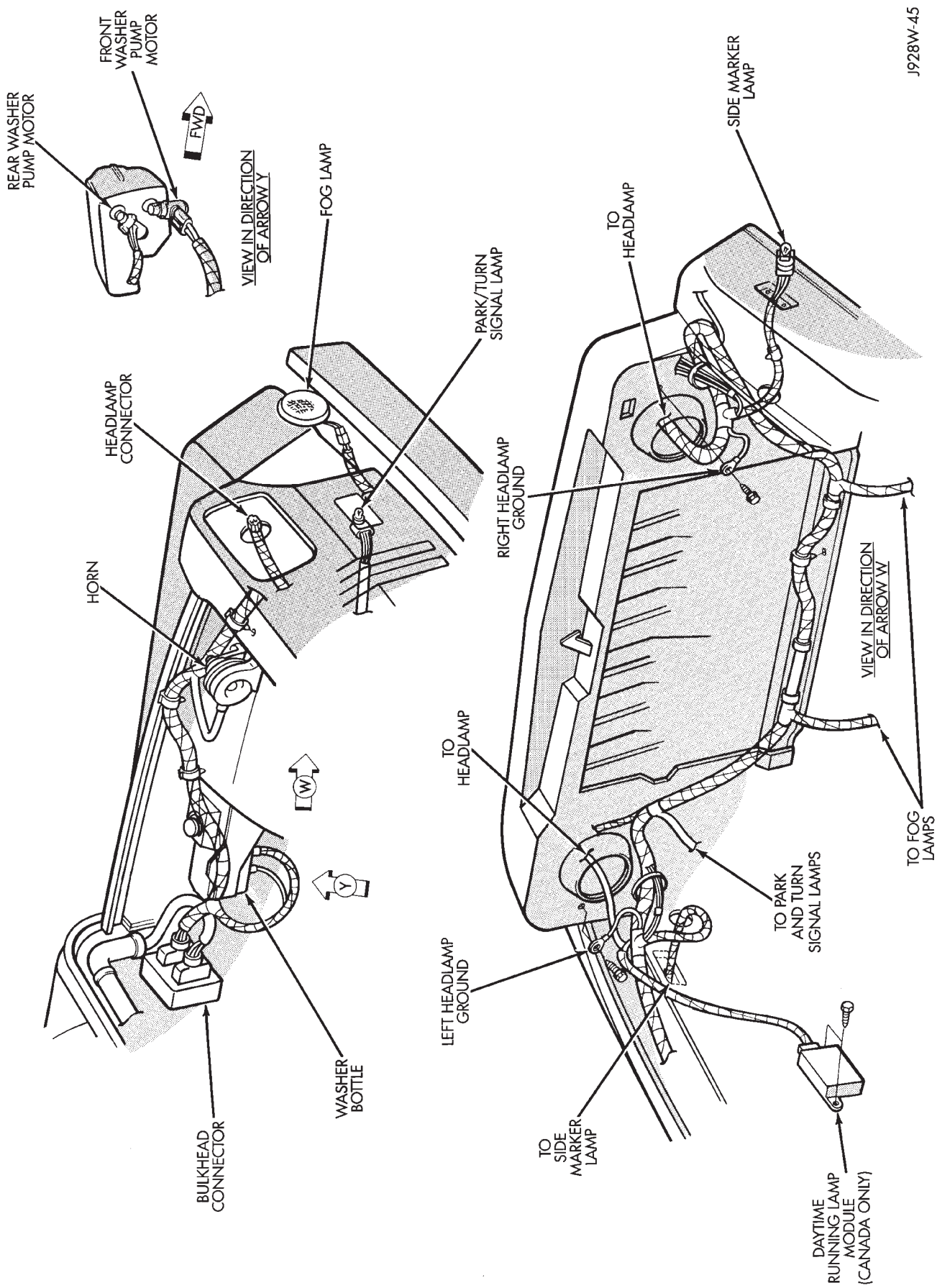

Fig. 12 Front End Wiring YJ

XJ

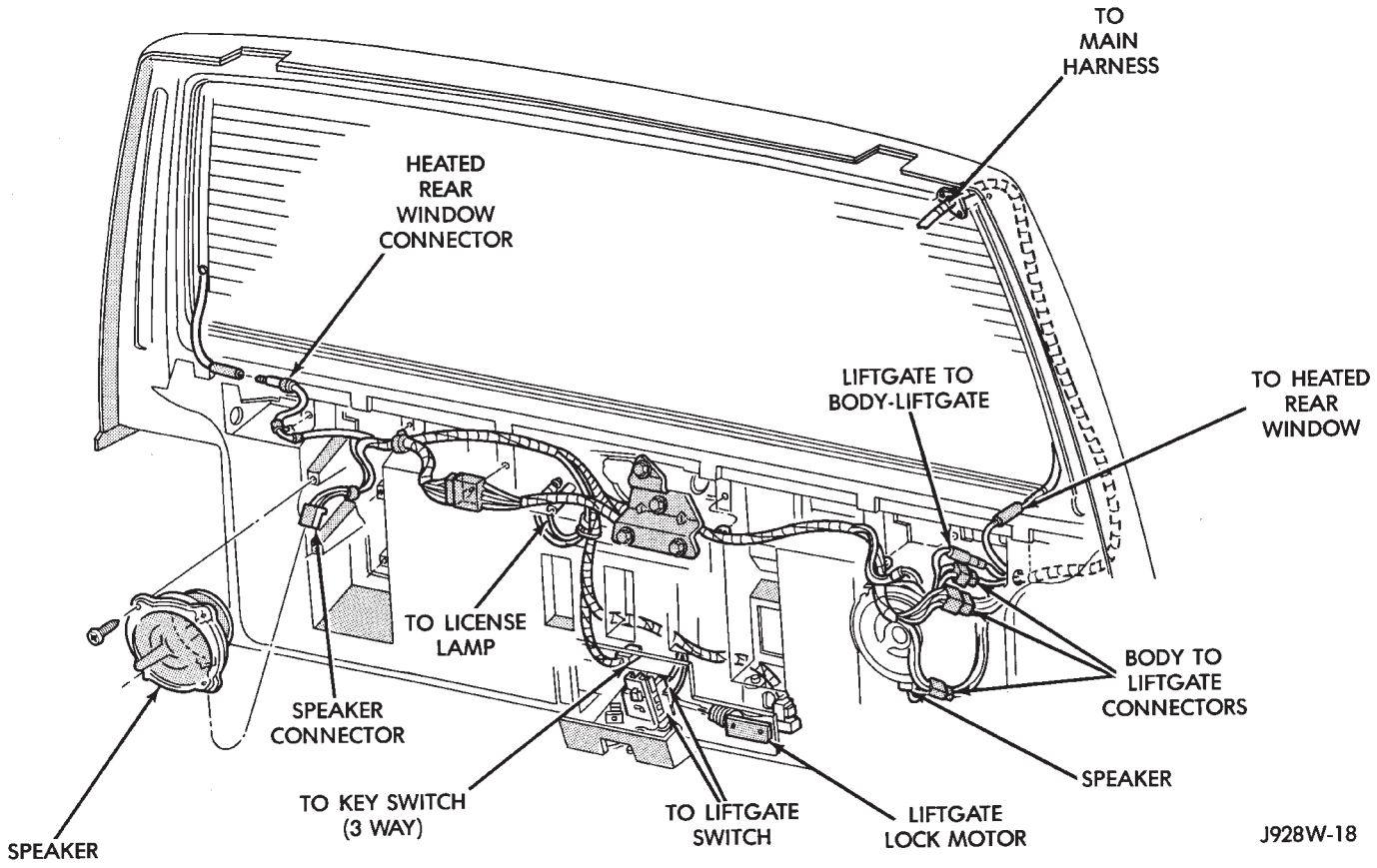

Fig. 1 Liftgate Wiring XJ

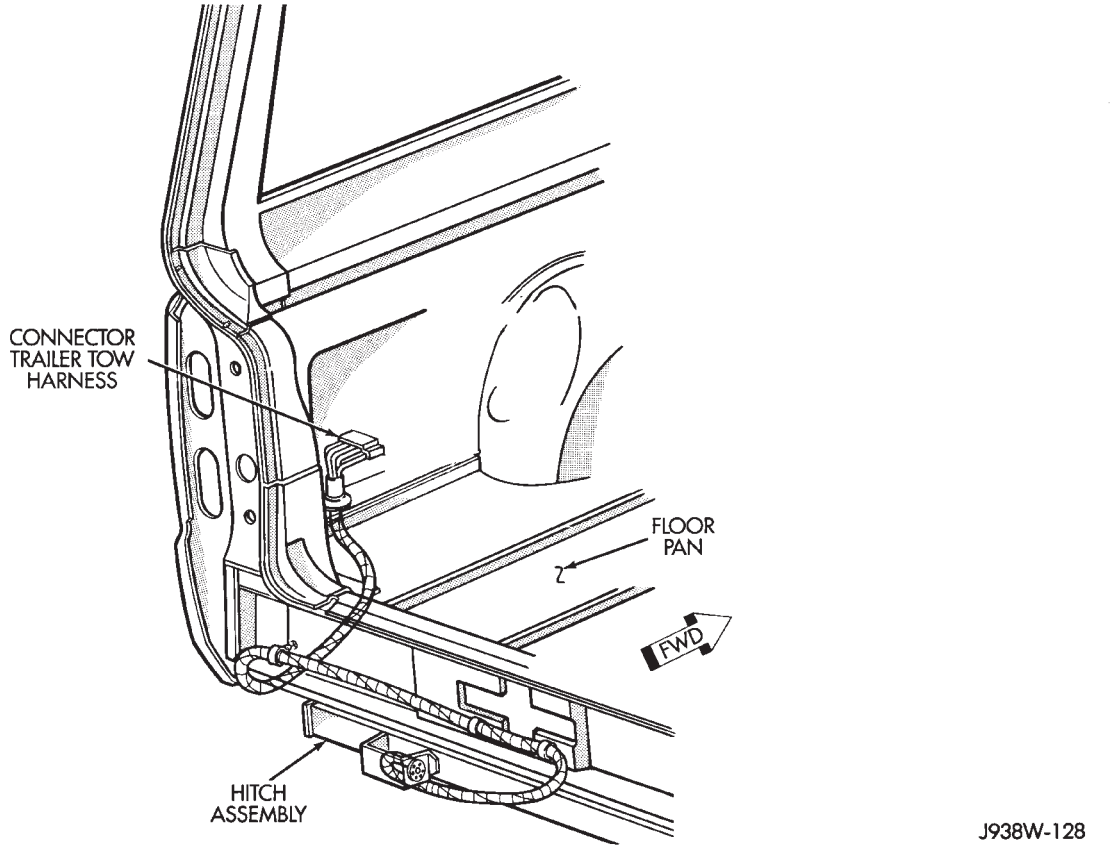

Fig. 2 Trailer Tow Wiring XJ

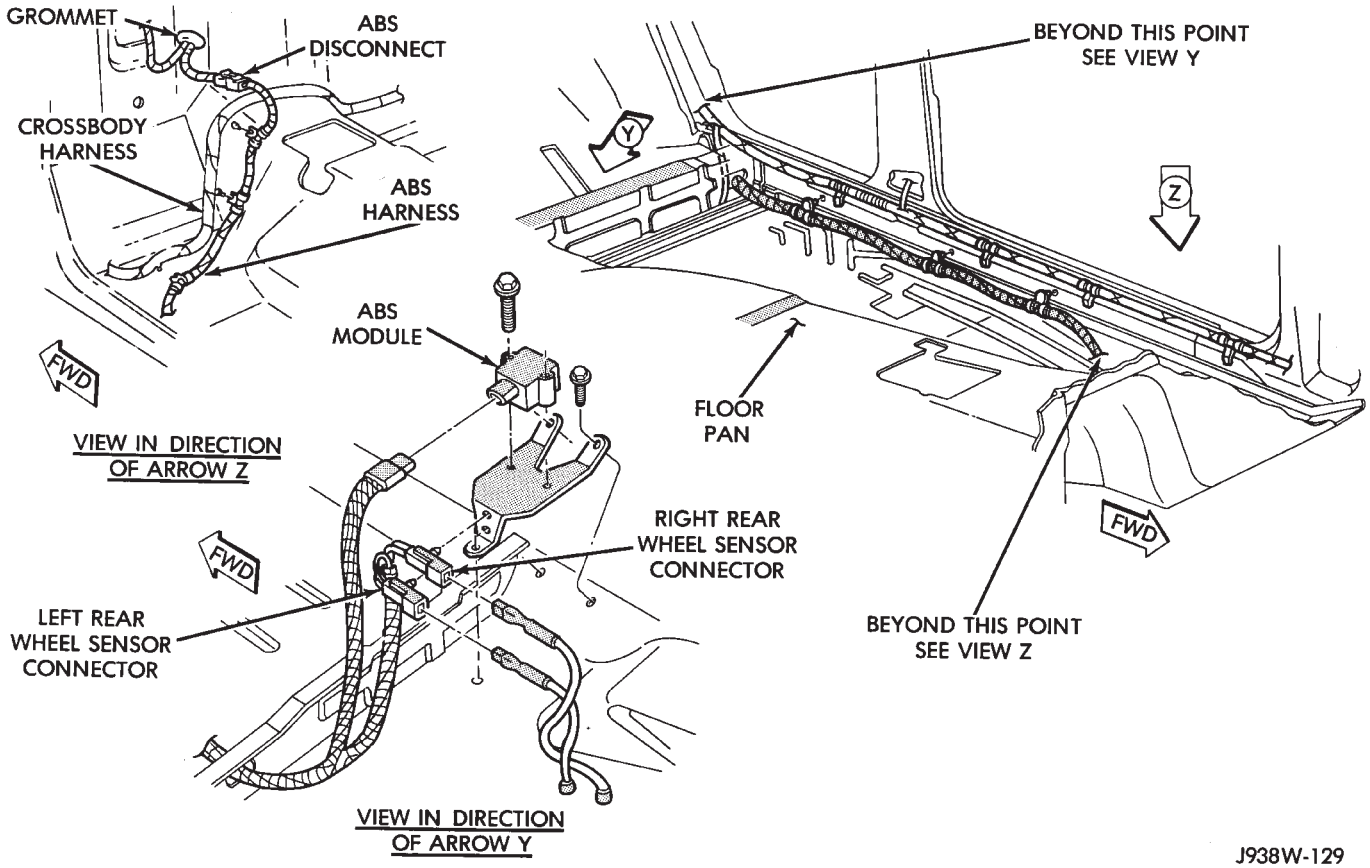

Fig. 3 Anti-Lock Brake System Wiring XJ

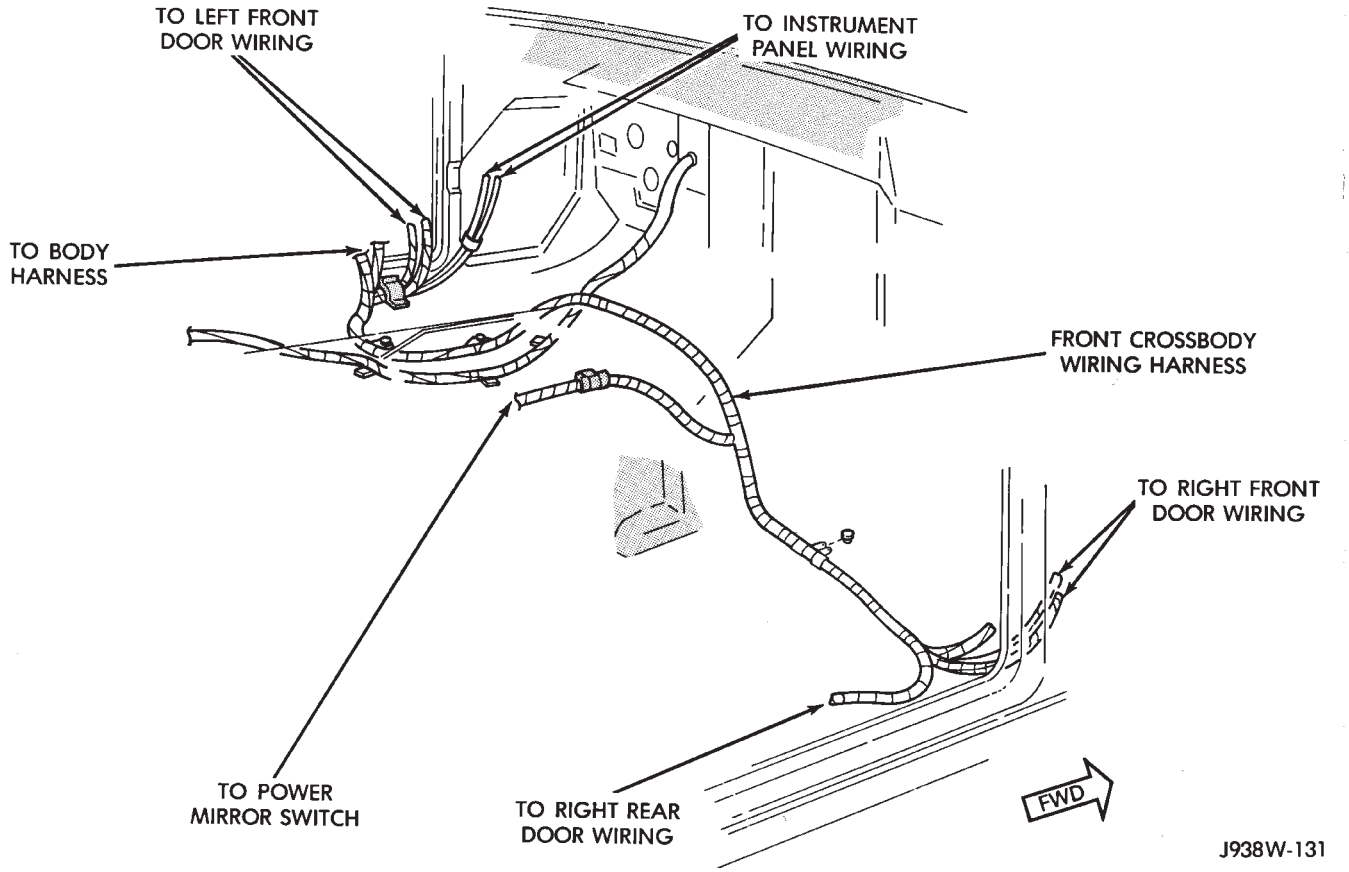

Fig. 4 Front Cross-body Wiring XJ

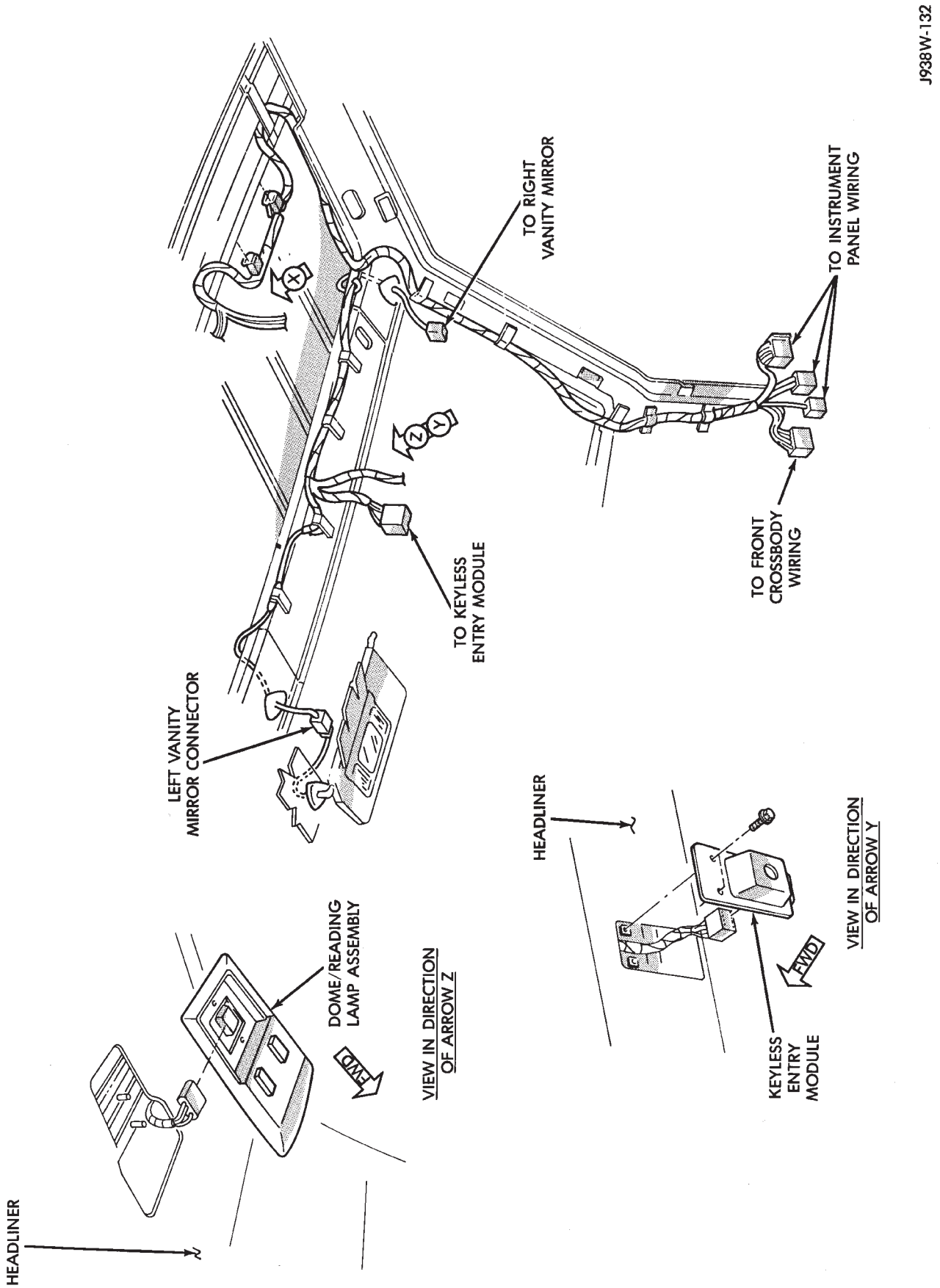

Fig. 5 Roof Wiring XJ

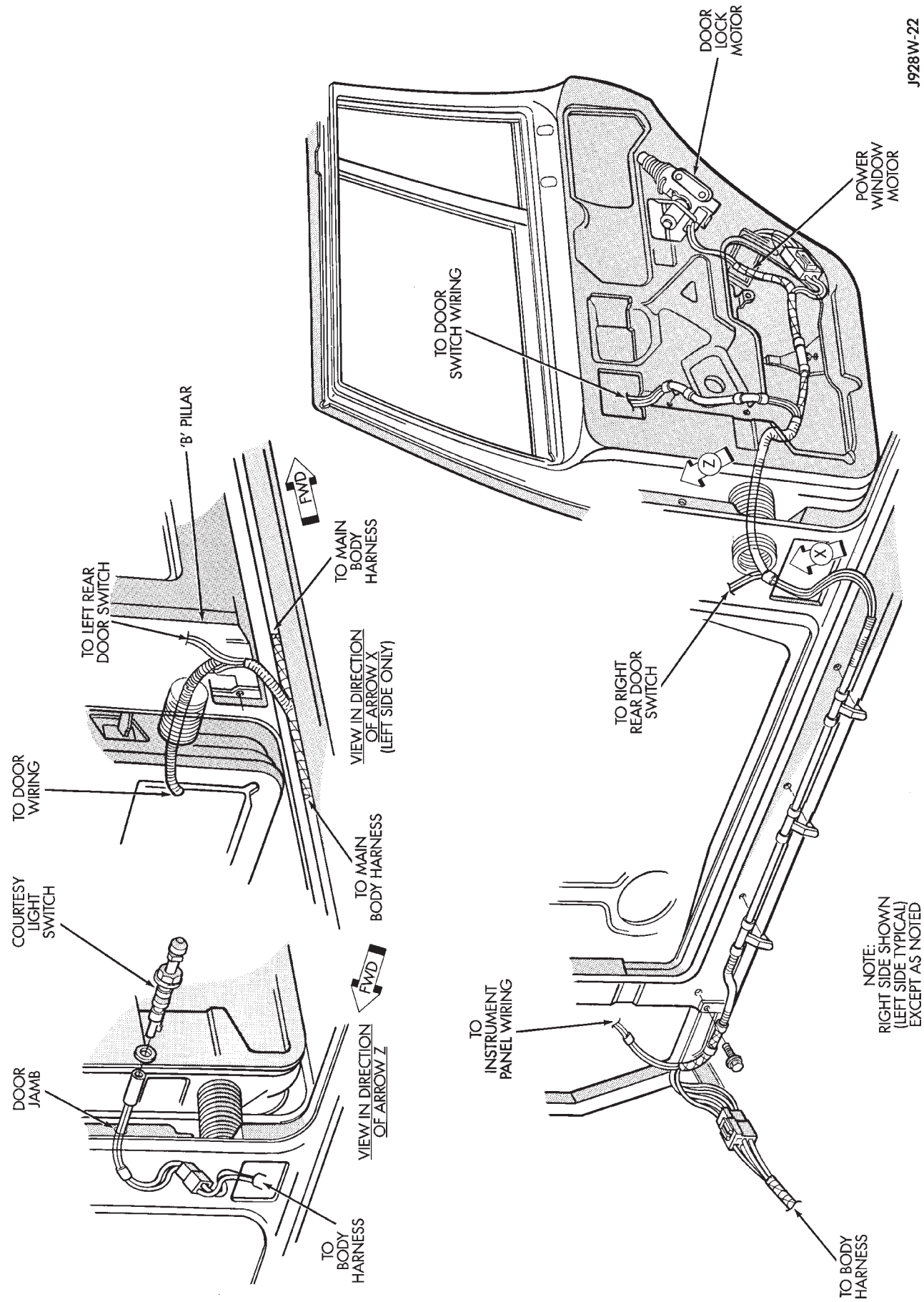

Fig. 6 Rear Door Wiring XJ

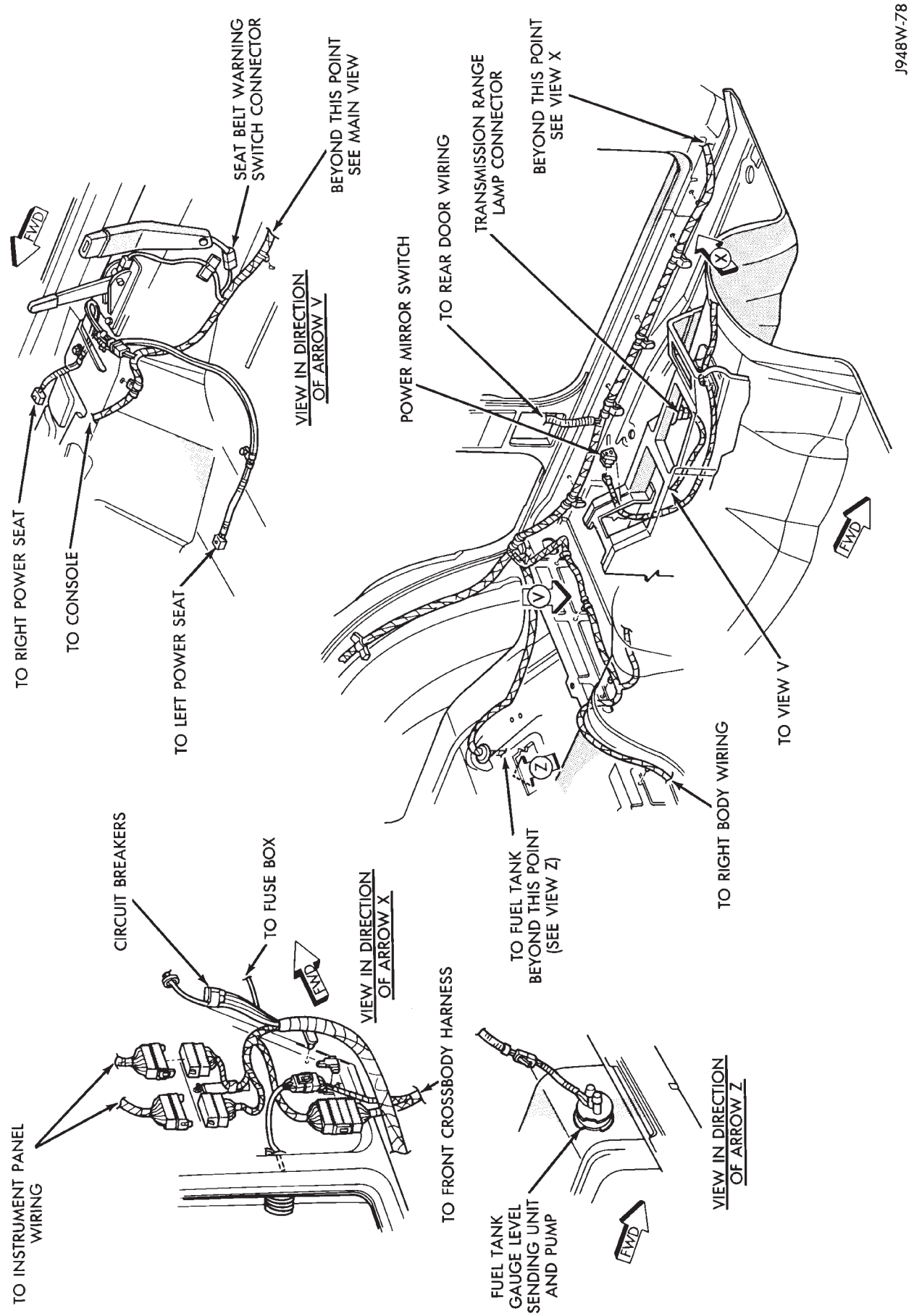

Fig. 7 Body Wiring XJ

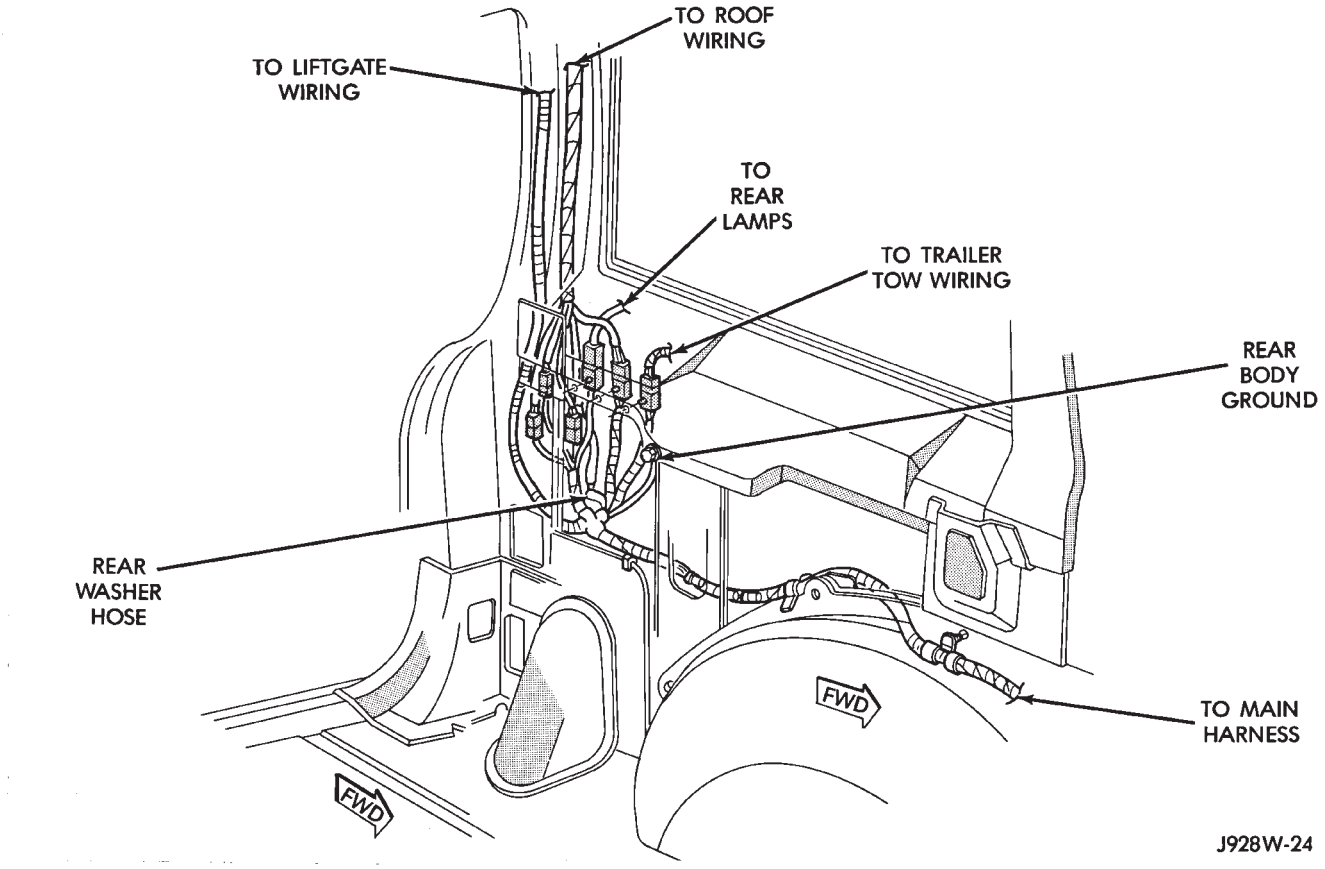

Fig. 8 Body Wiring XJ

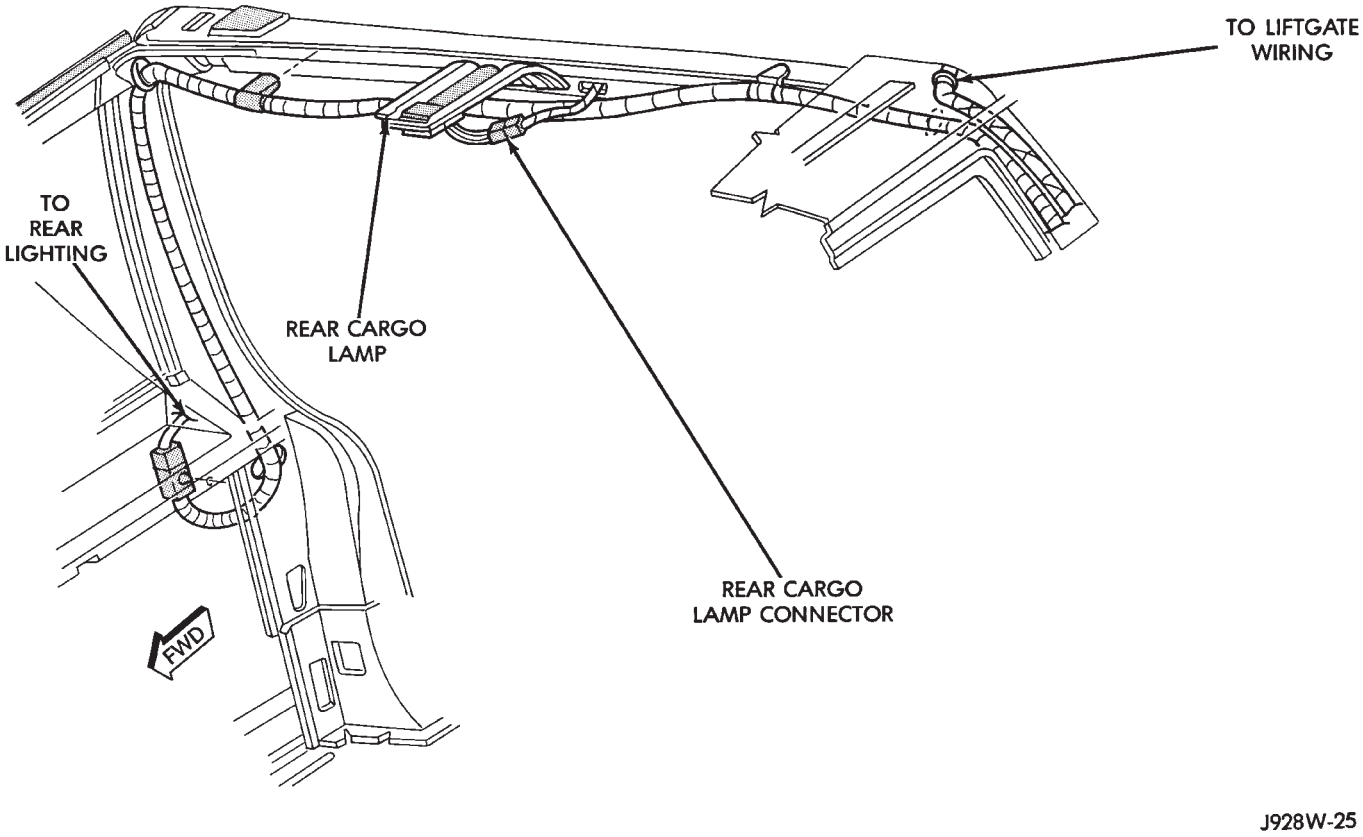

Fig. 9 Roof Wiring (Rear) XJ

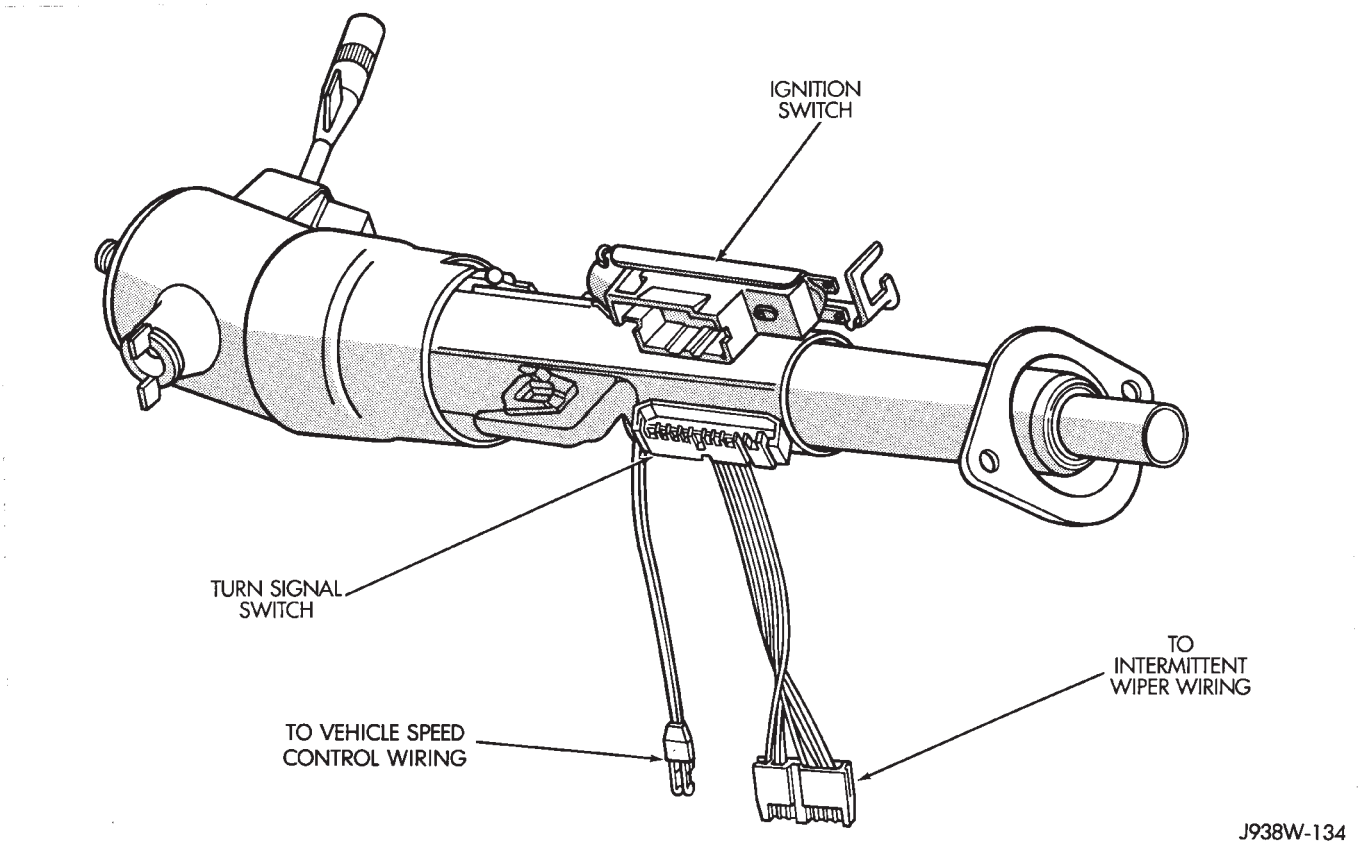

Fig. 10 Steering Column Wiring XJ

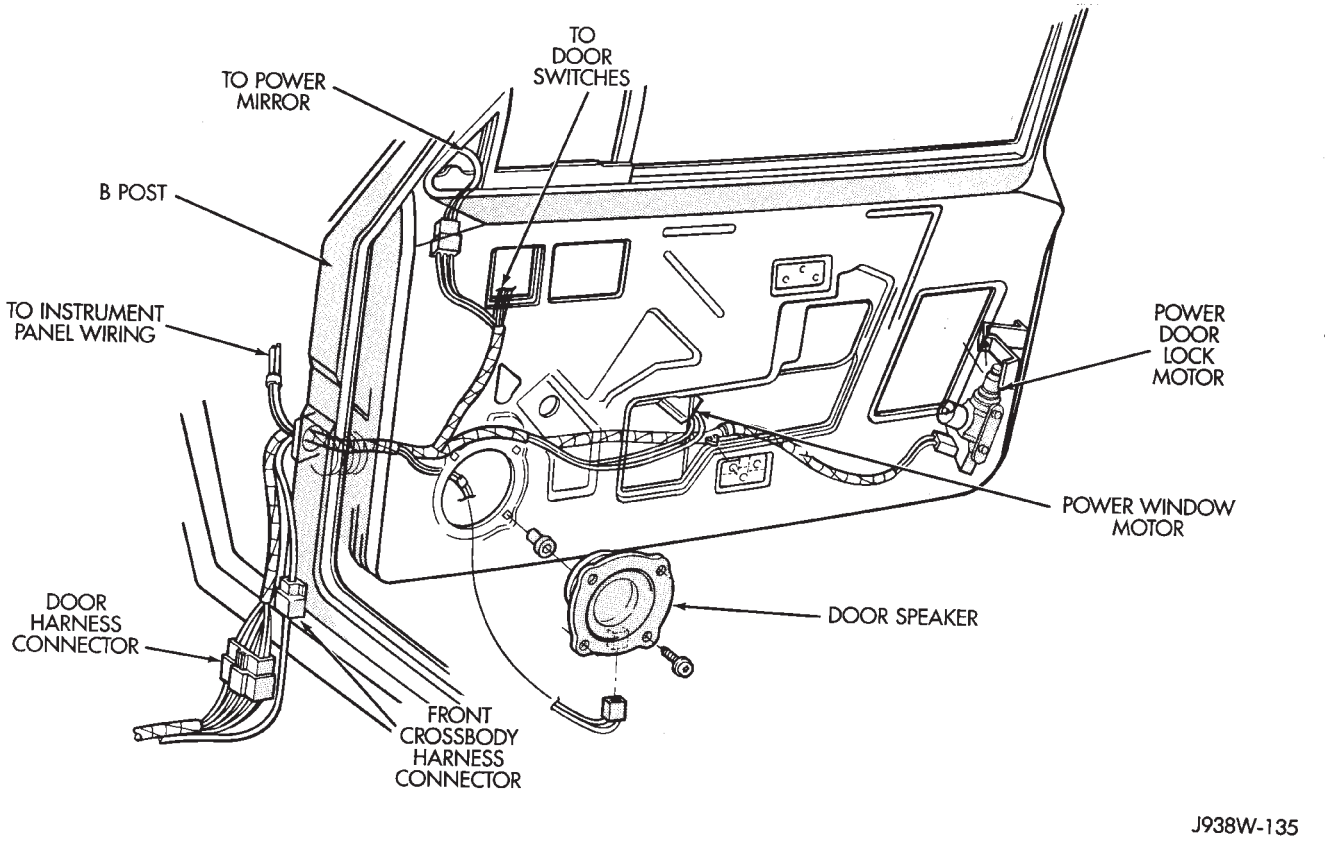

Fig. 11 Door Wiring (Front) XJ

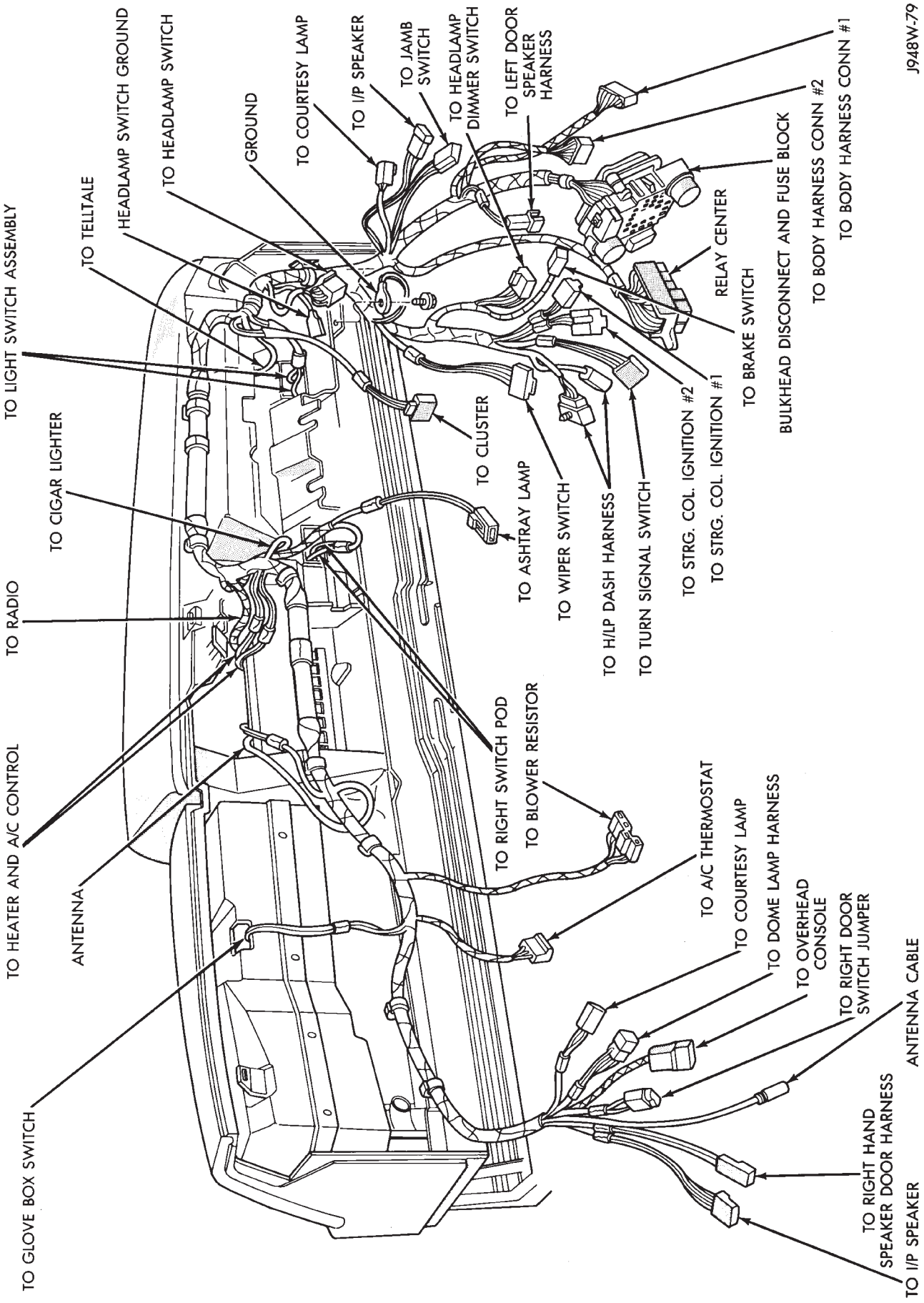

Fig. 12 Instrument Panel Wiring XJ

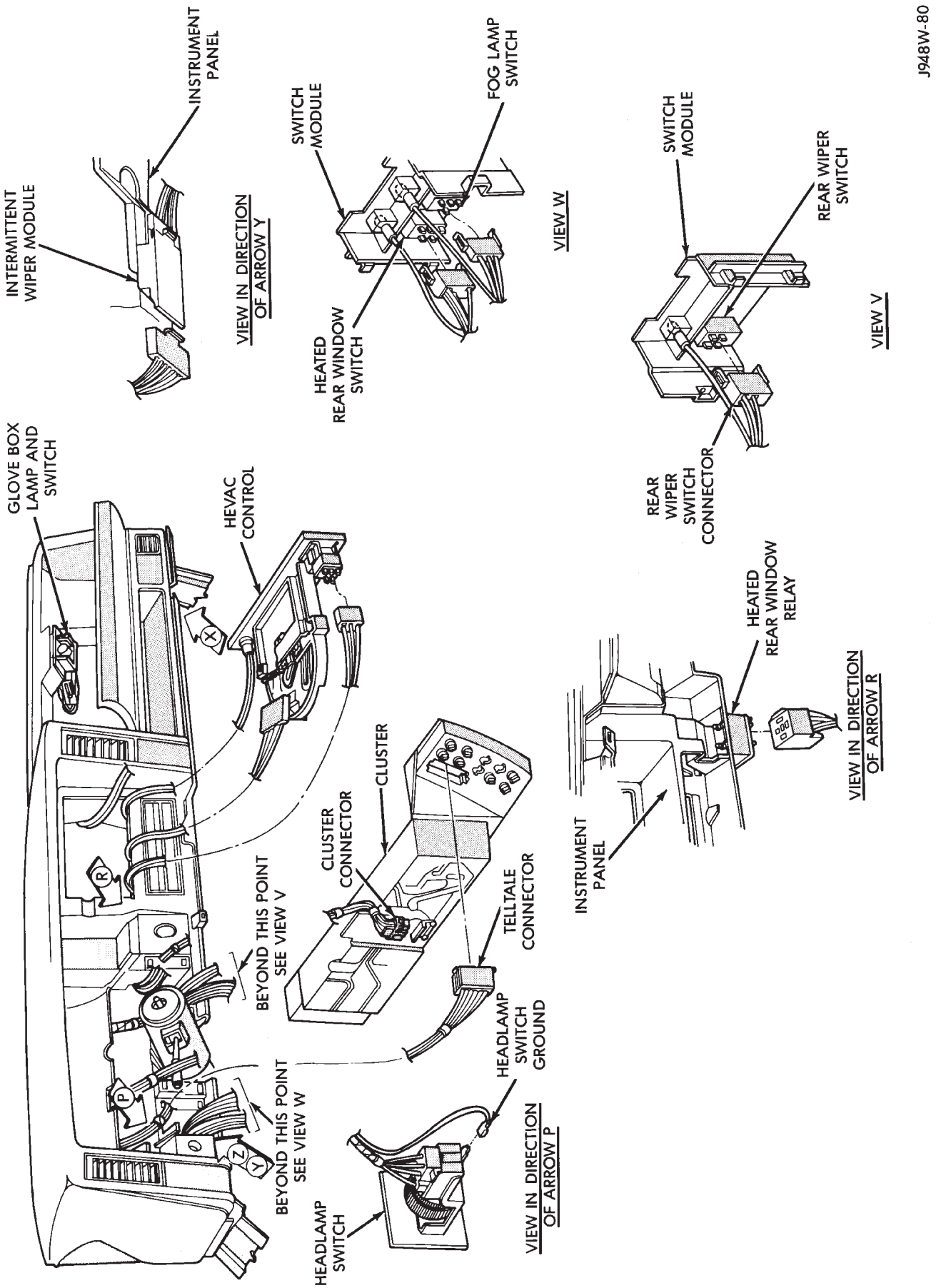

Fig. 13 Instrument Panel Wiring XJ

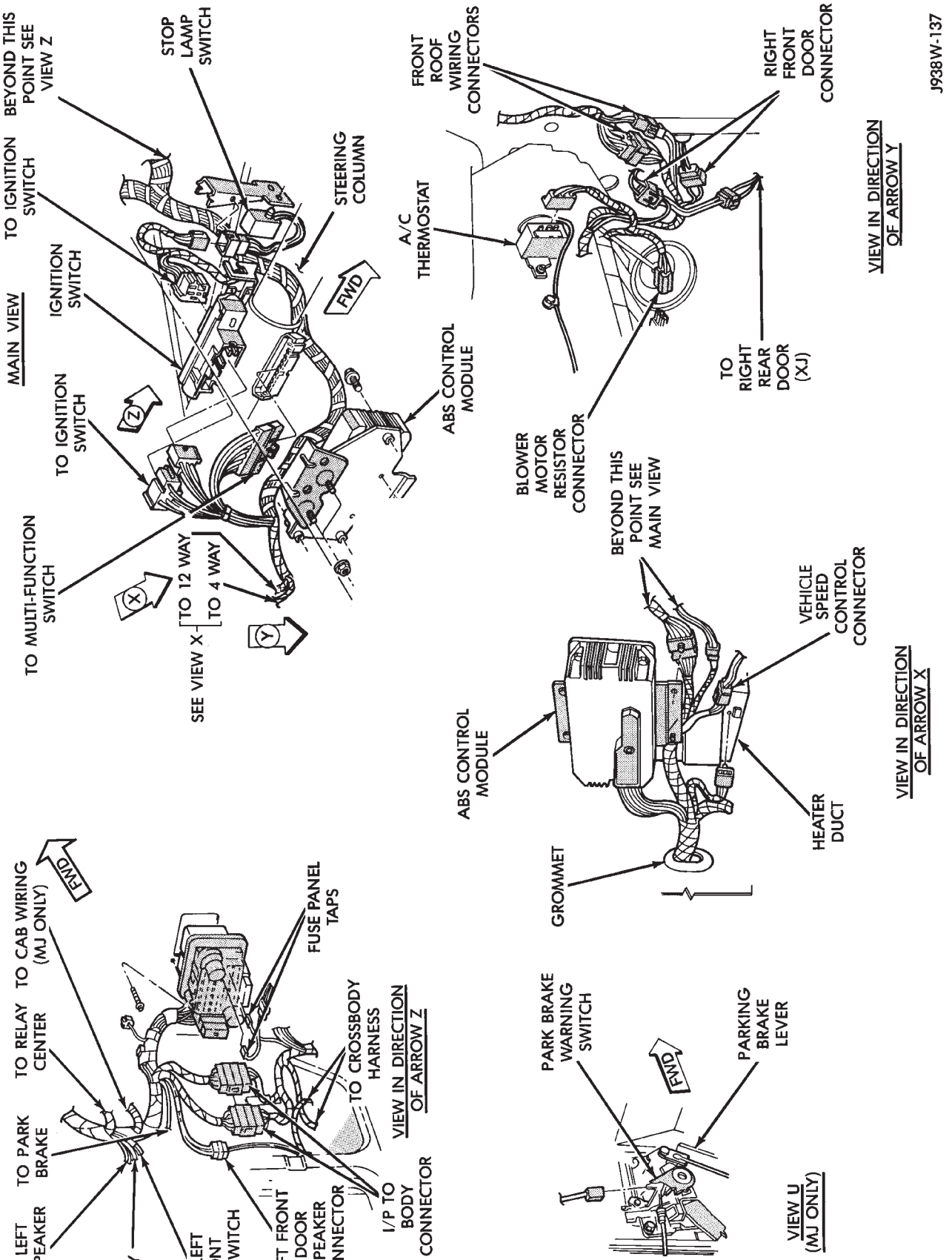

Fig. 14 Instrument Panel to Body Wiring XJ

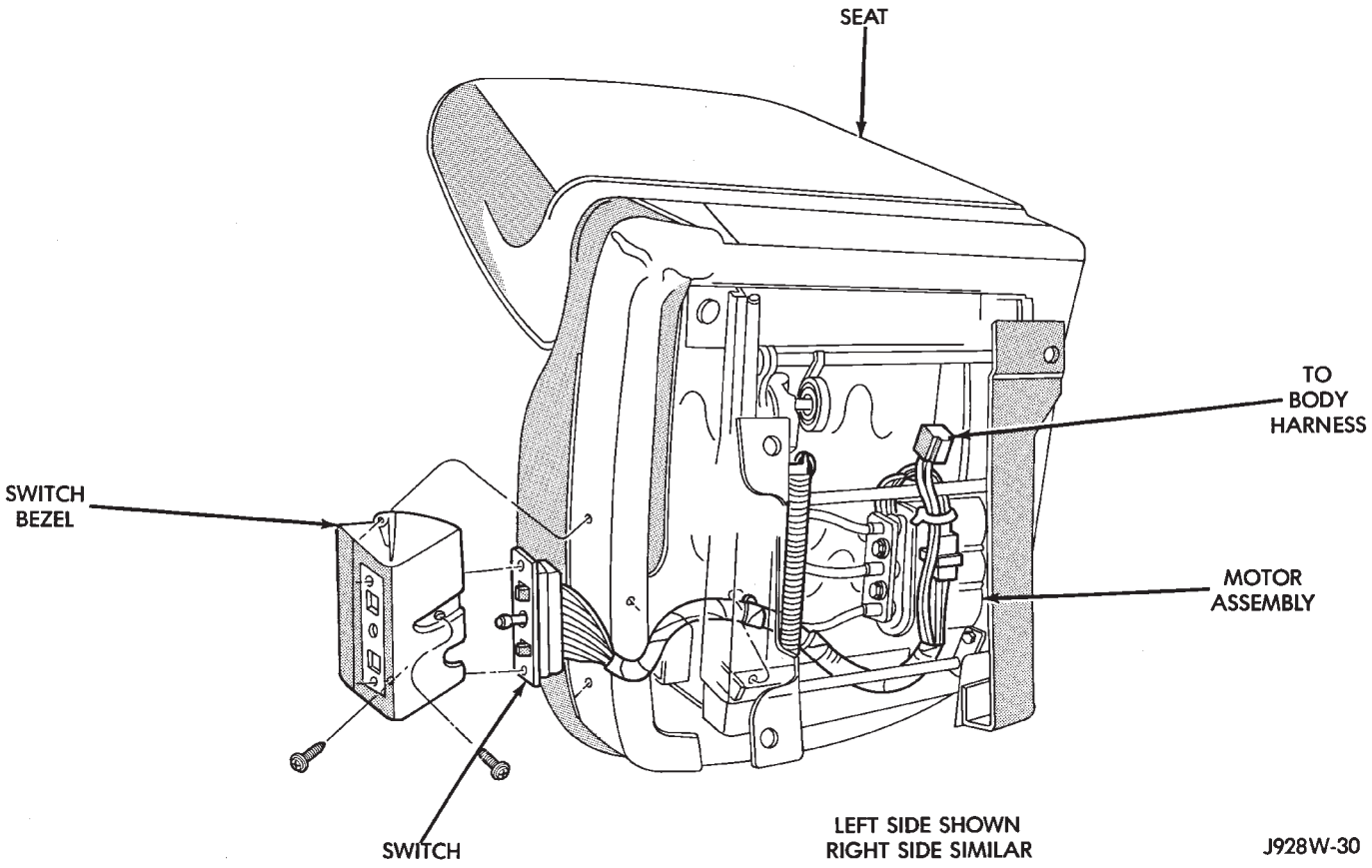

Fig. 15 Power Seat Wiring XJ

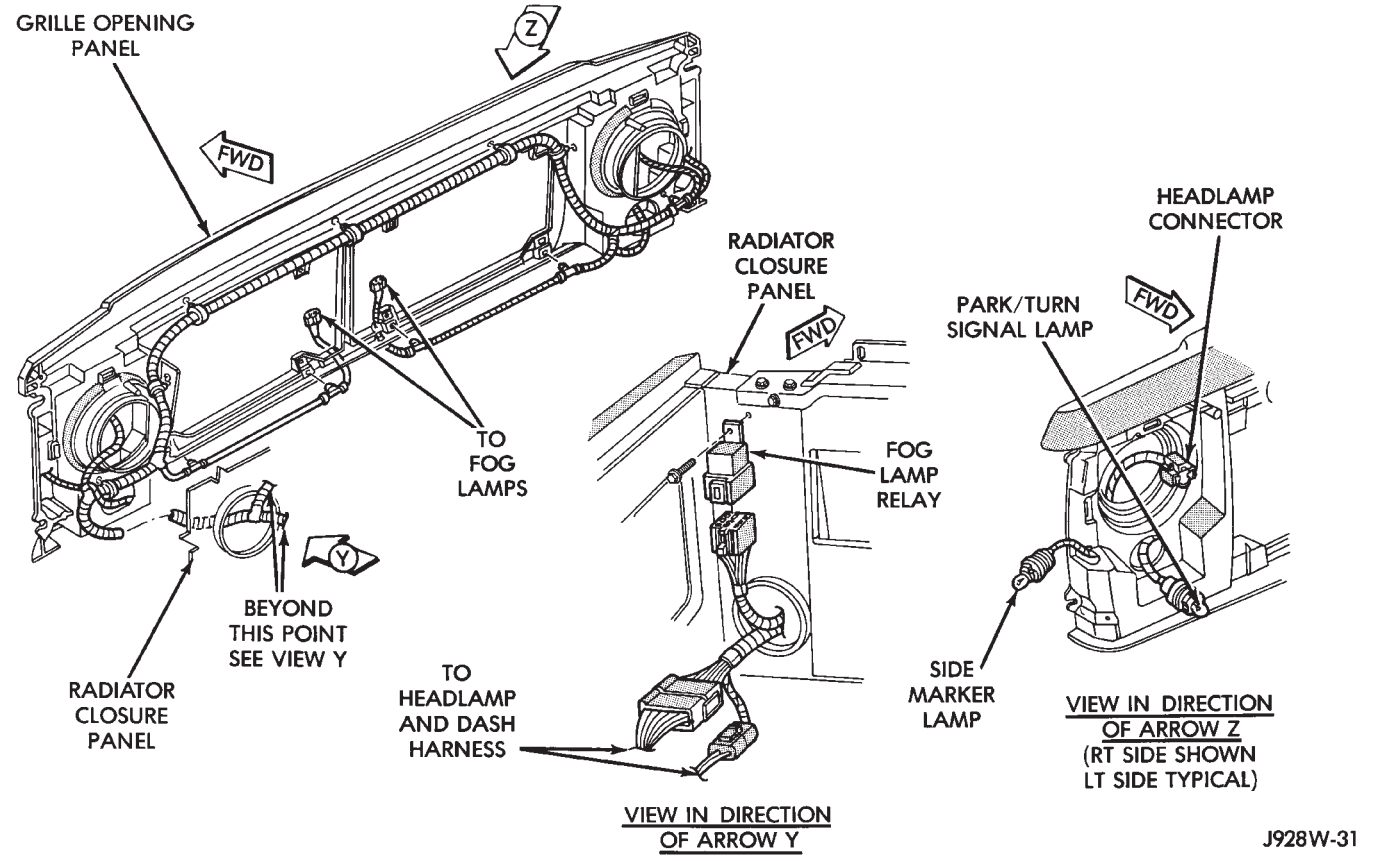

Fig. 16 Front End Wiring XJ

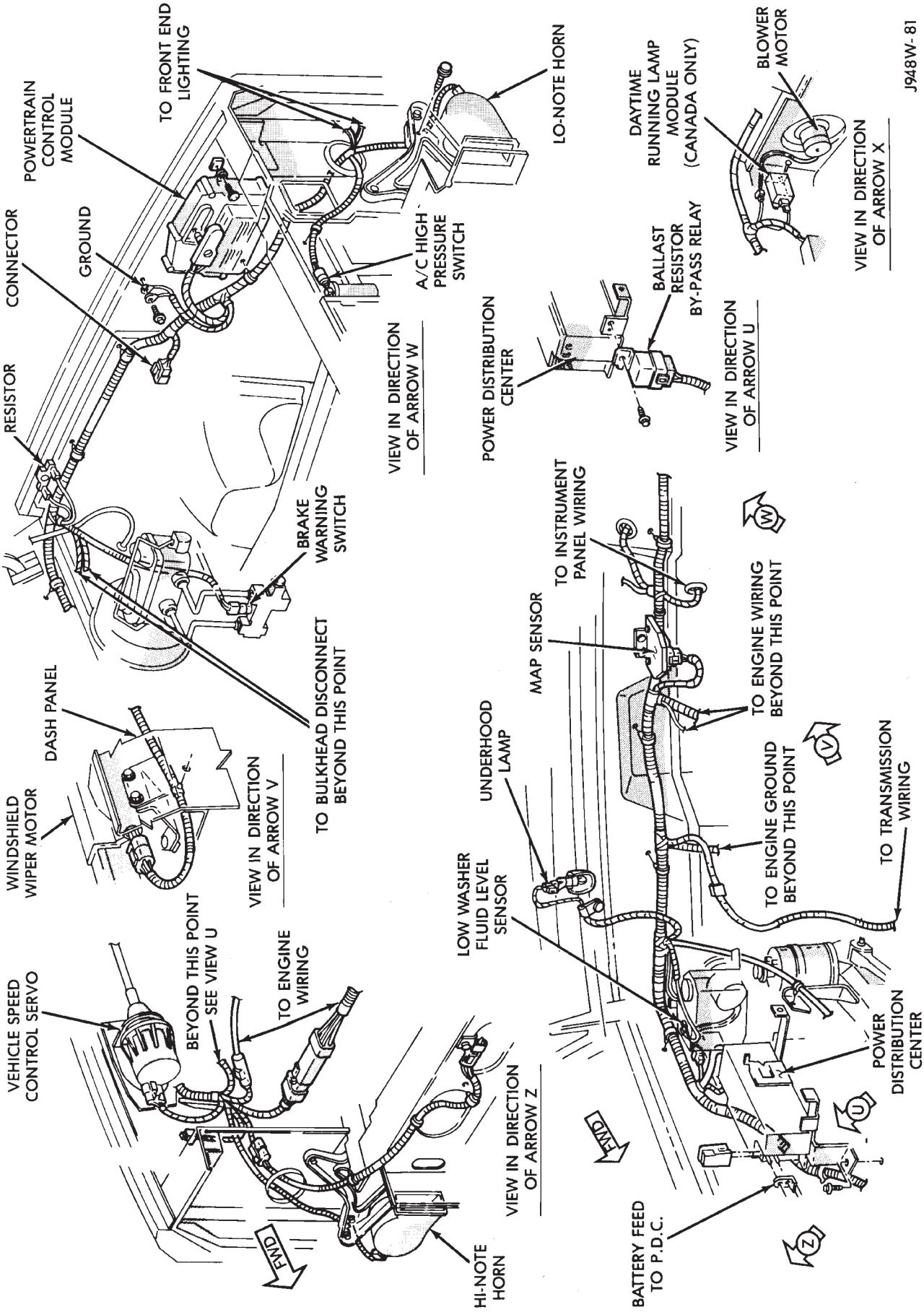

Fig. 17 Engine Compartment Wiring 2.5L XJ

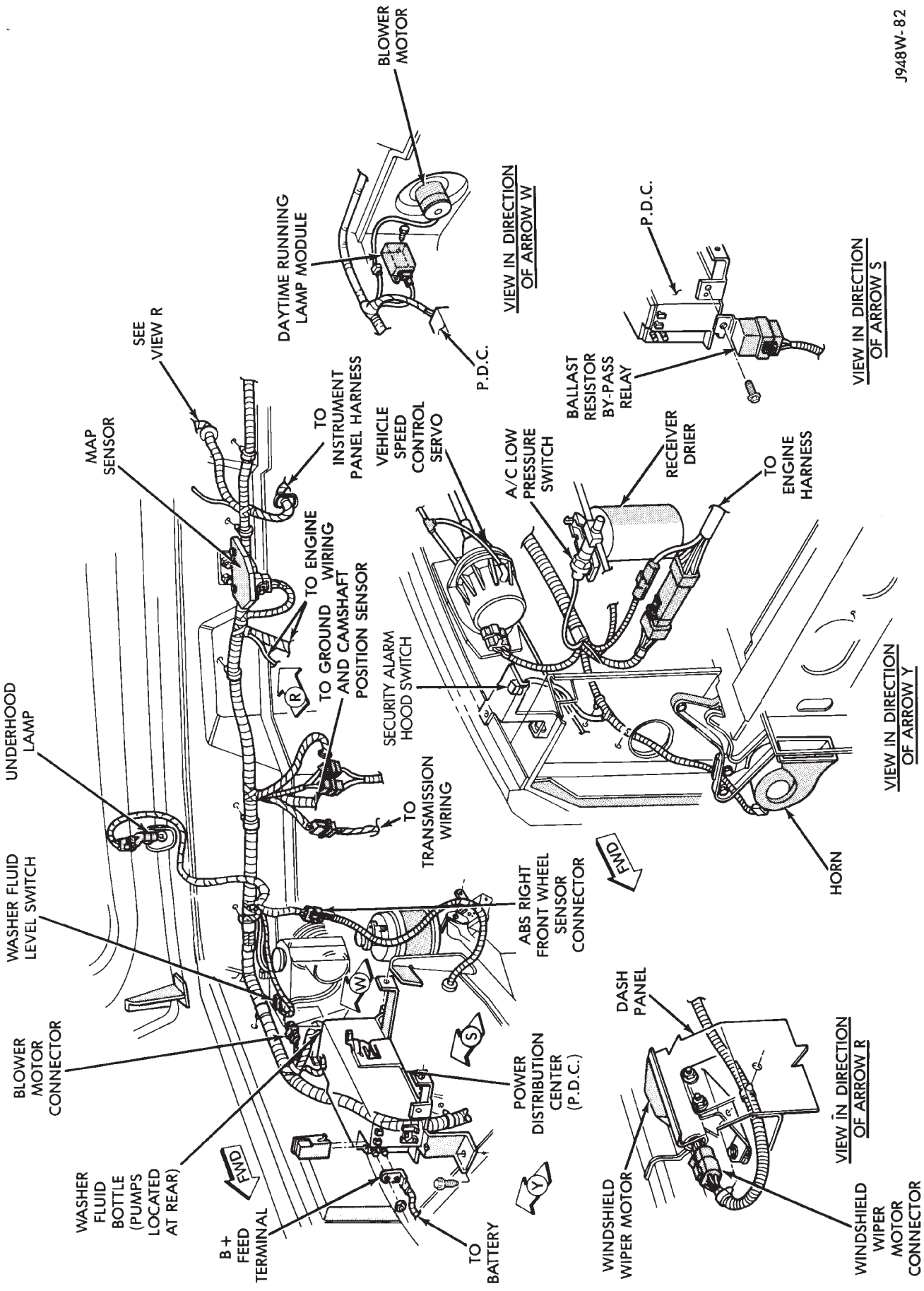

Fig. 18 Engine Compartment Wiring 4.0L XJ

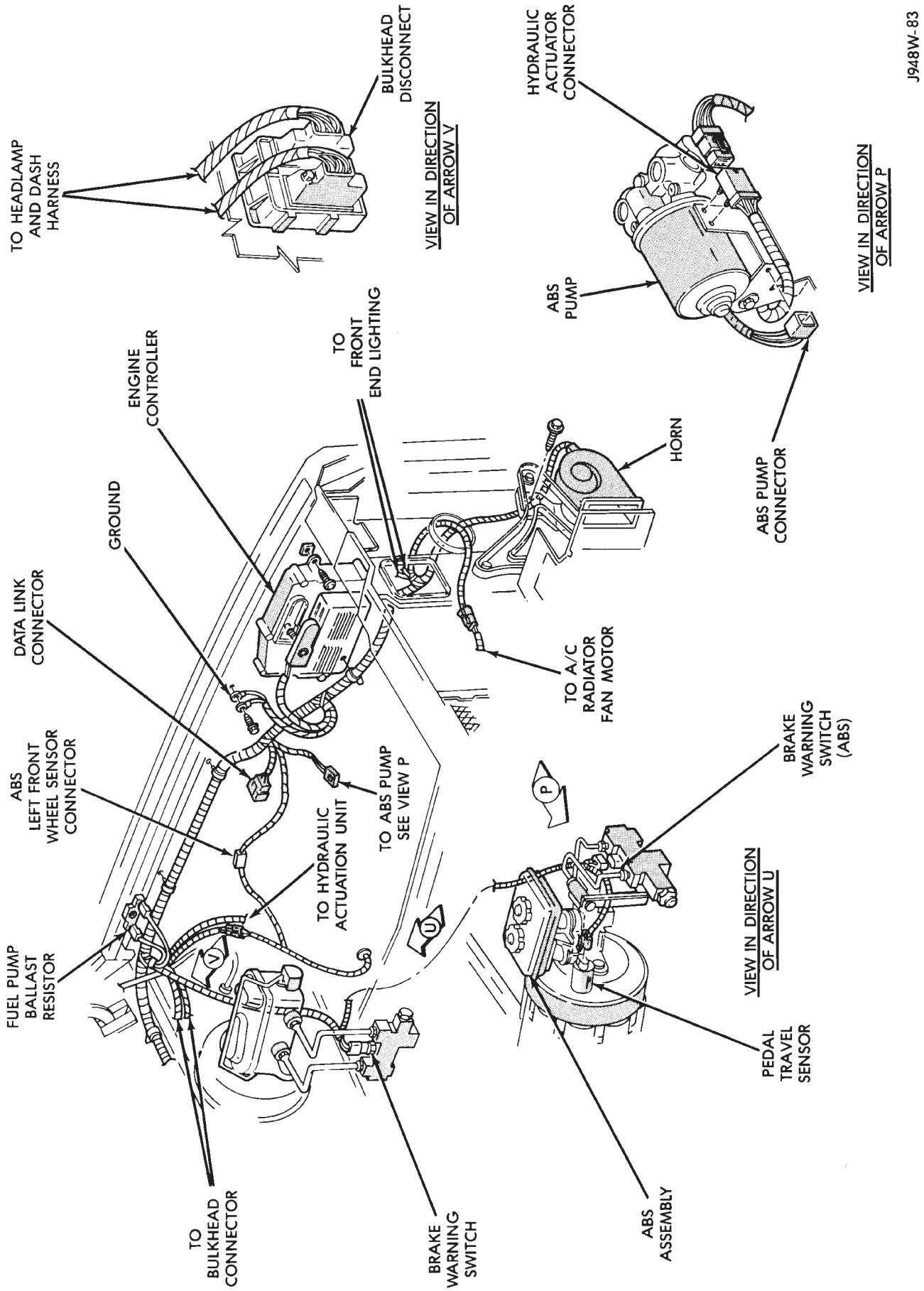

Fig. 19 Engine Compartment Wiring 4.0L XJ

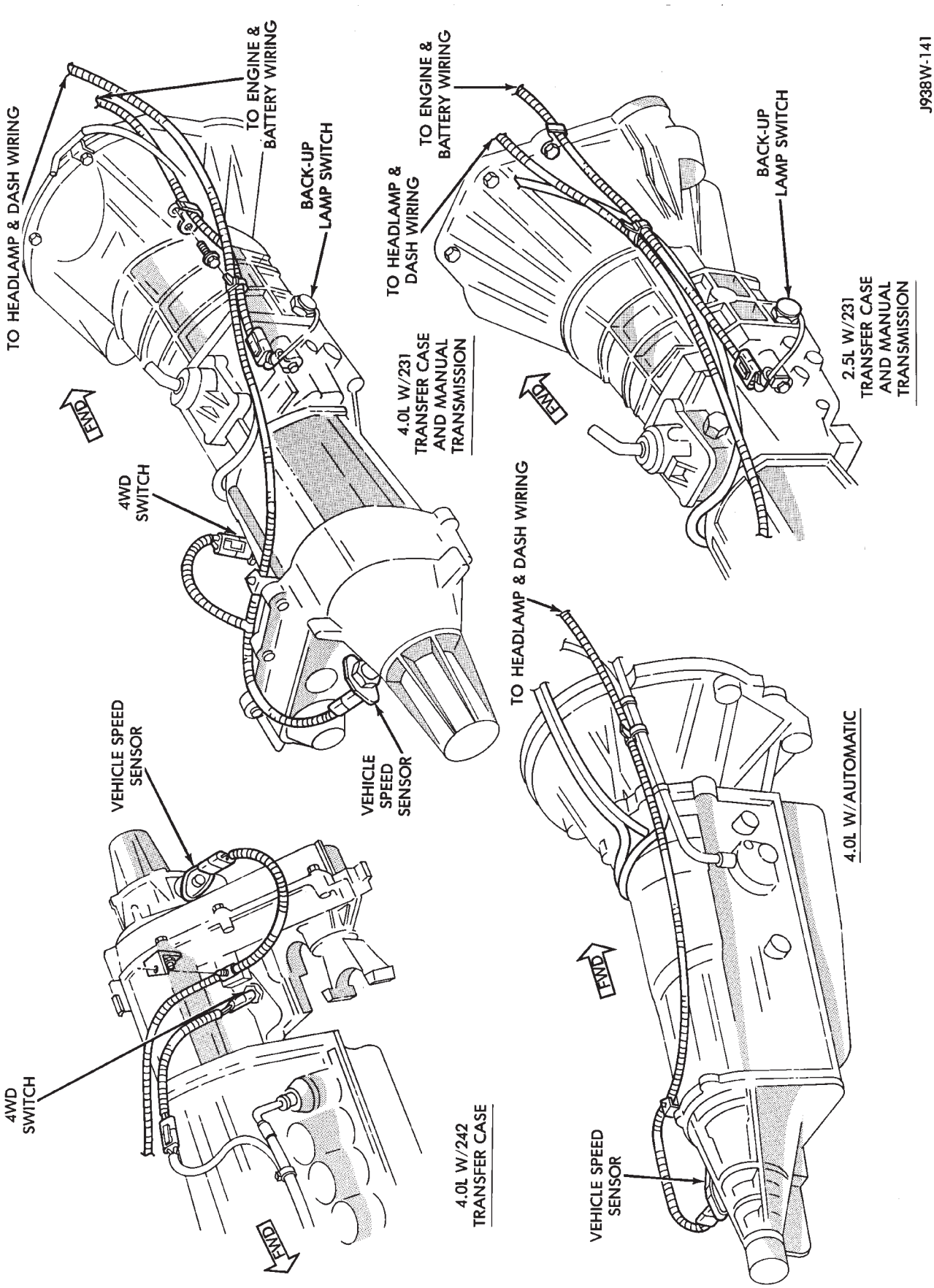

Fig. 20 Transmission Wiring XJ

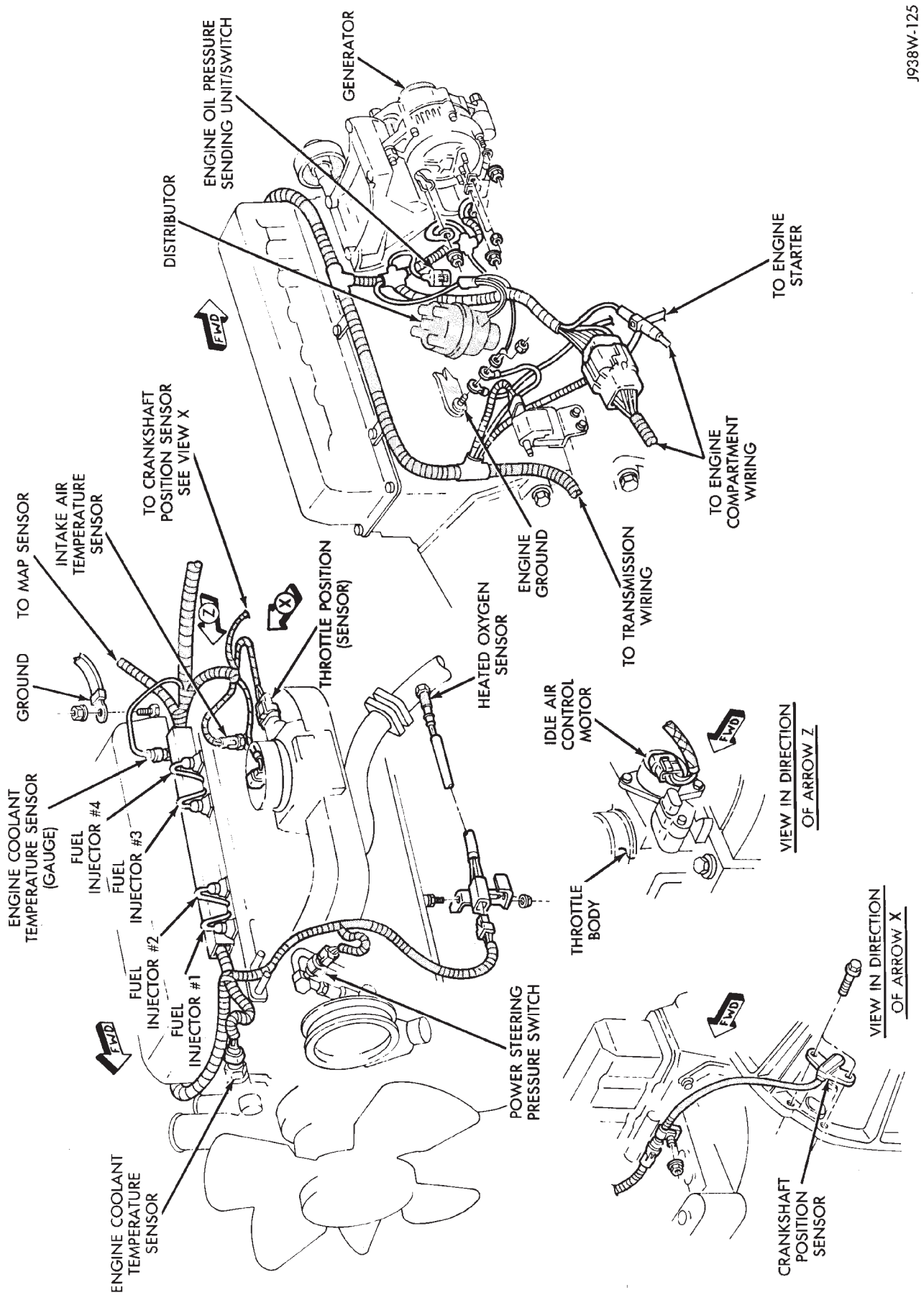

Fig. 21 Engine Wiring 2.5L XJ

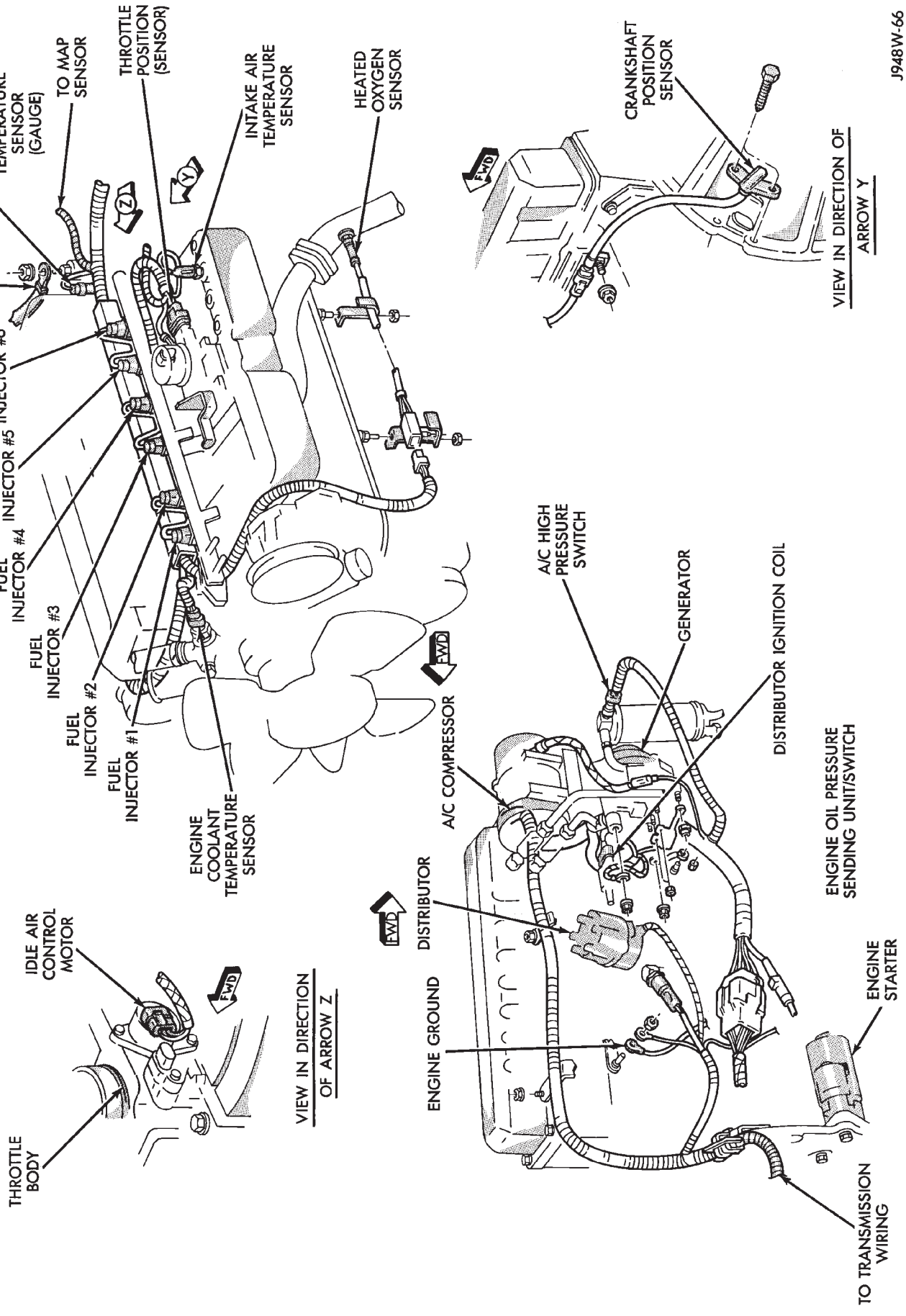

Fig. 22 Engine Wiring 4.0L XJ

XJ RHD

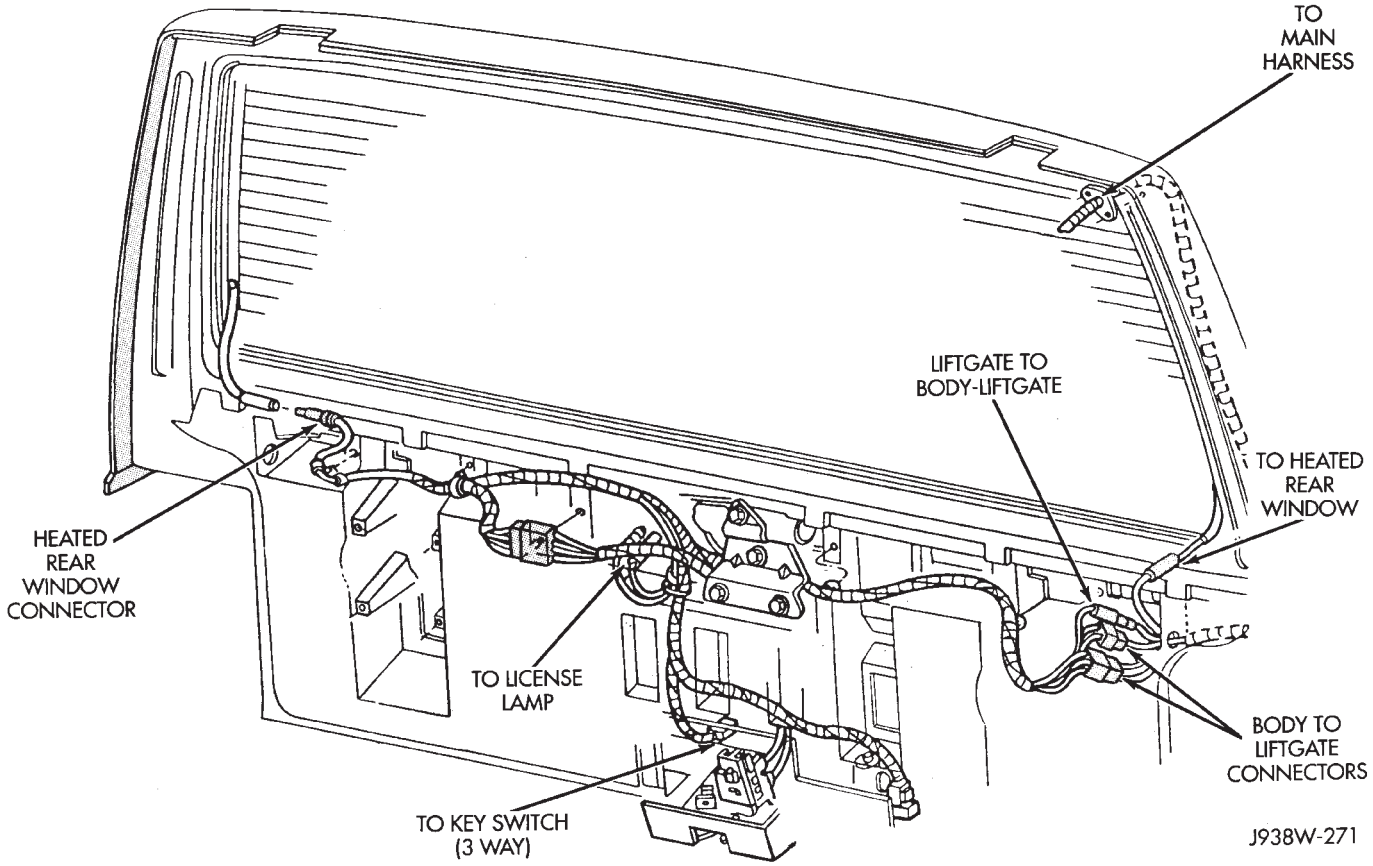

Fig. 1 Liftgate Wiring (RHD)

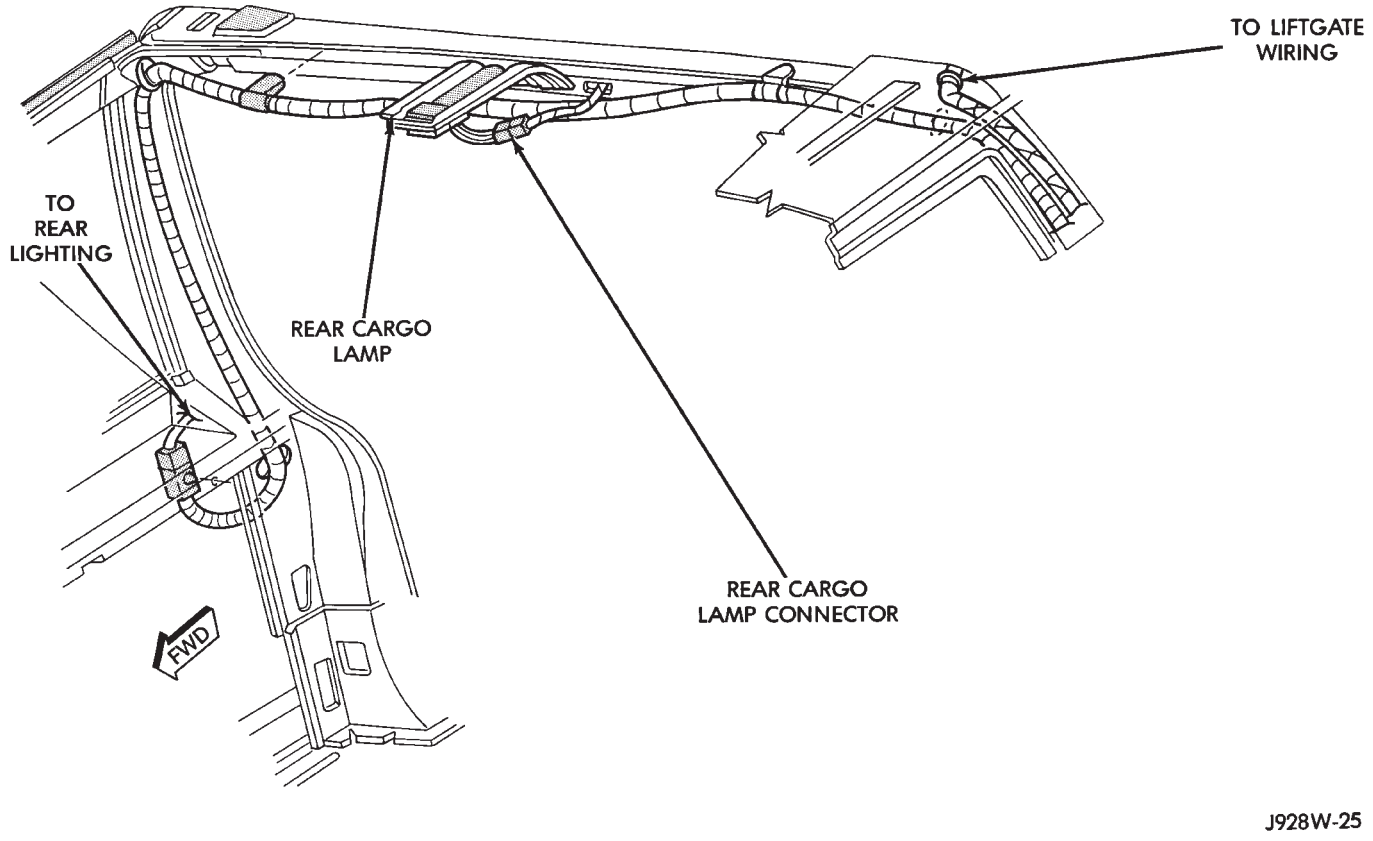

Fig. 2 Roof Wiring (Rear) (RHD)

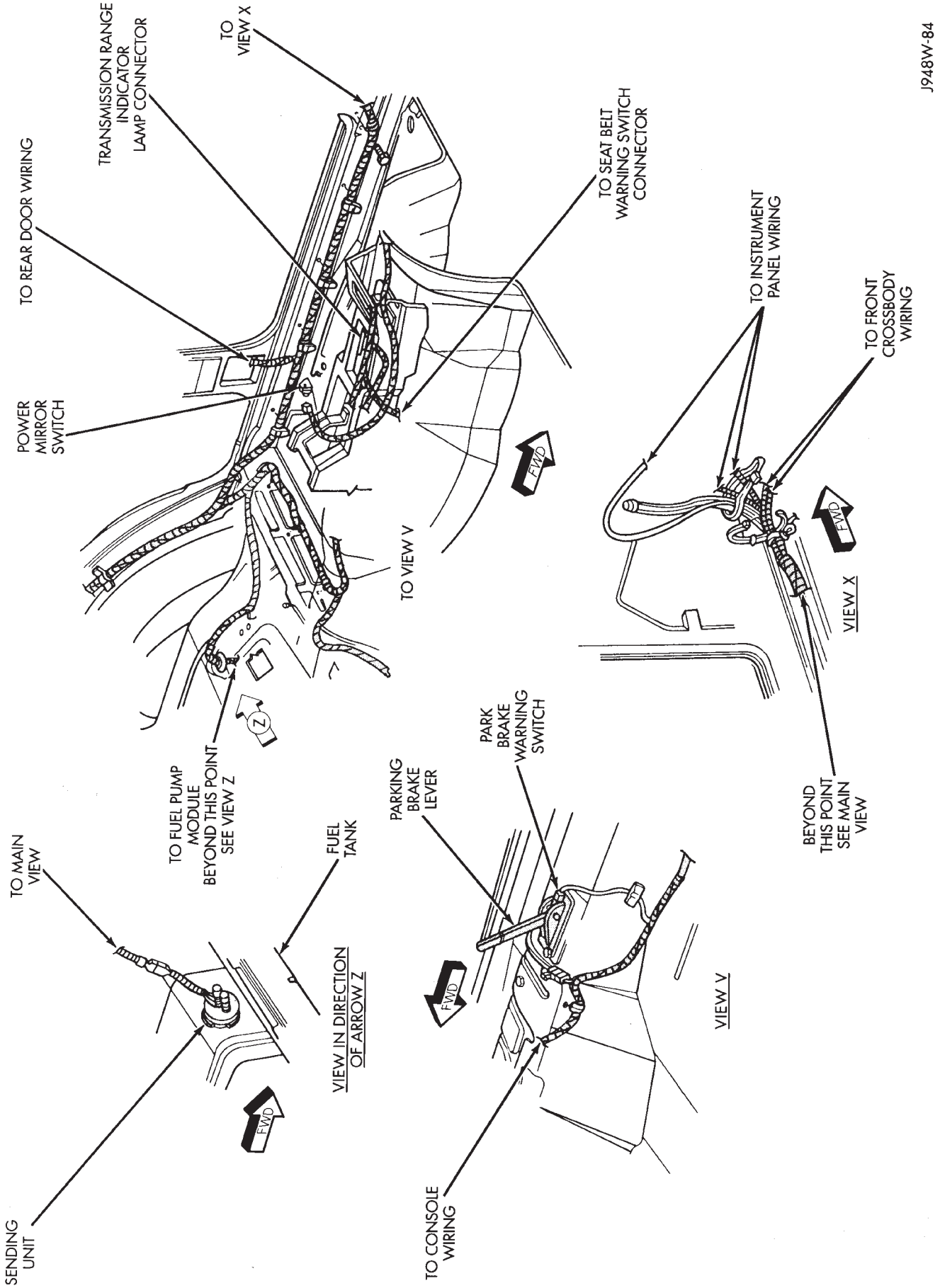

Fig. 3 Body Wiring (RHD)

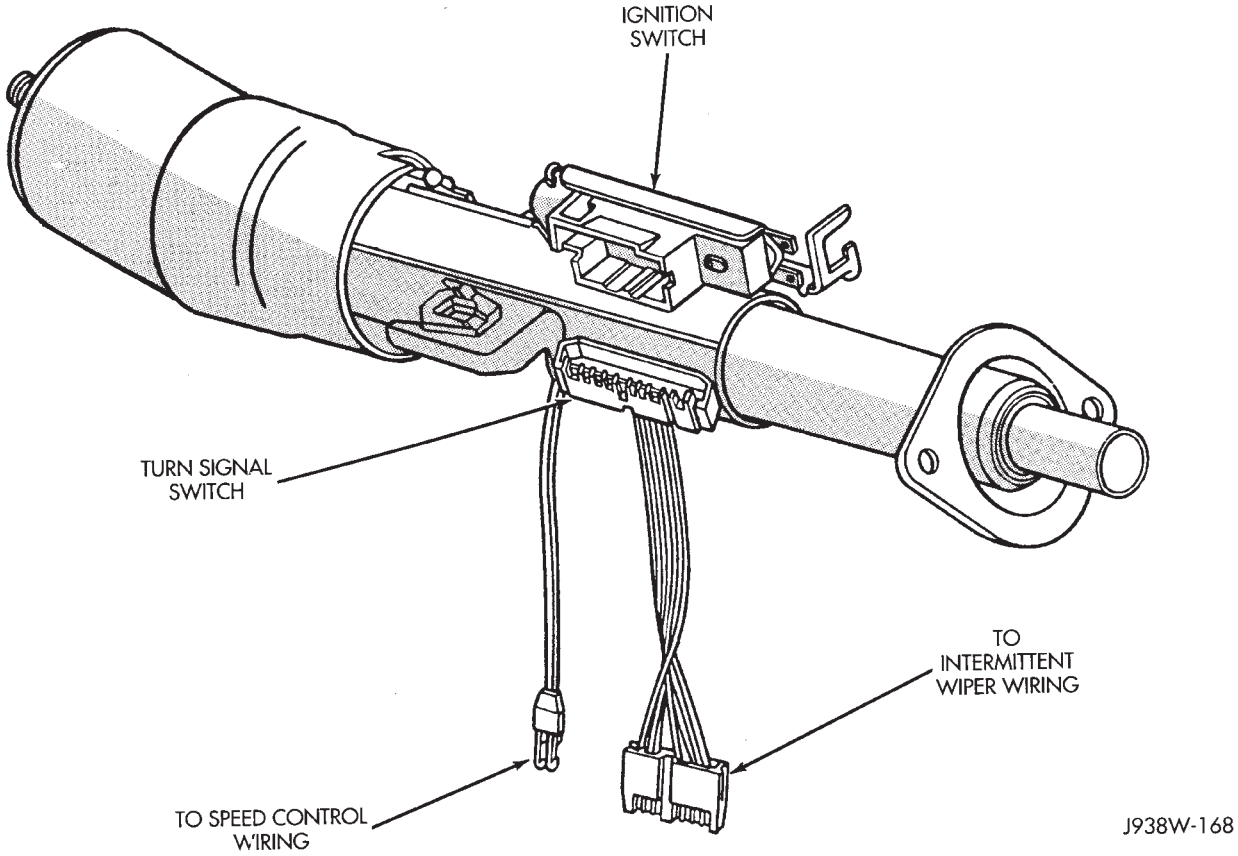

Fig. 4 Steering Column Wiring (RHD)

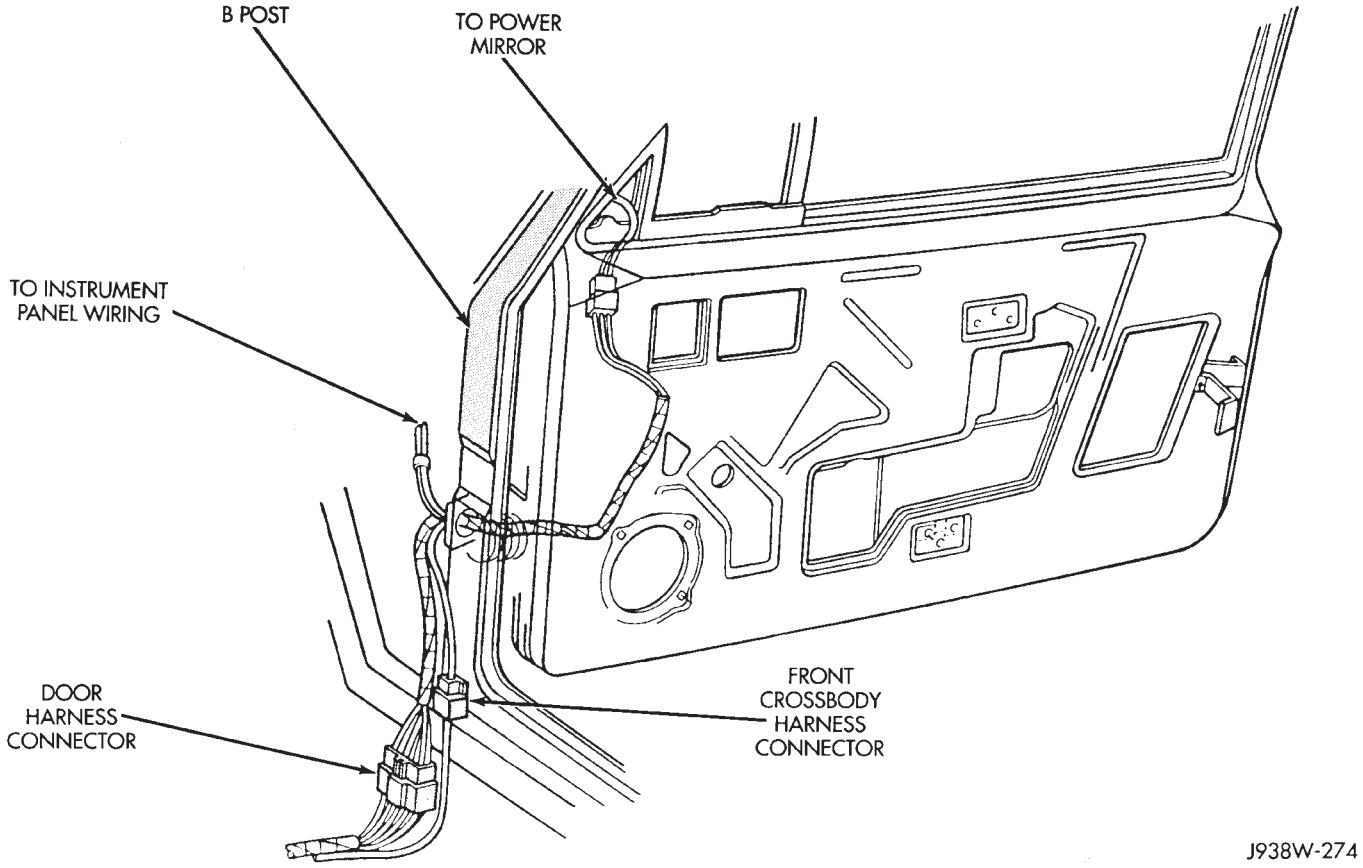

Fig. 5 Door Wiring (RHD)

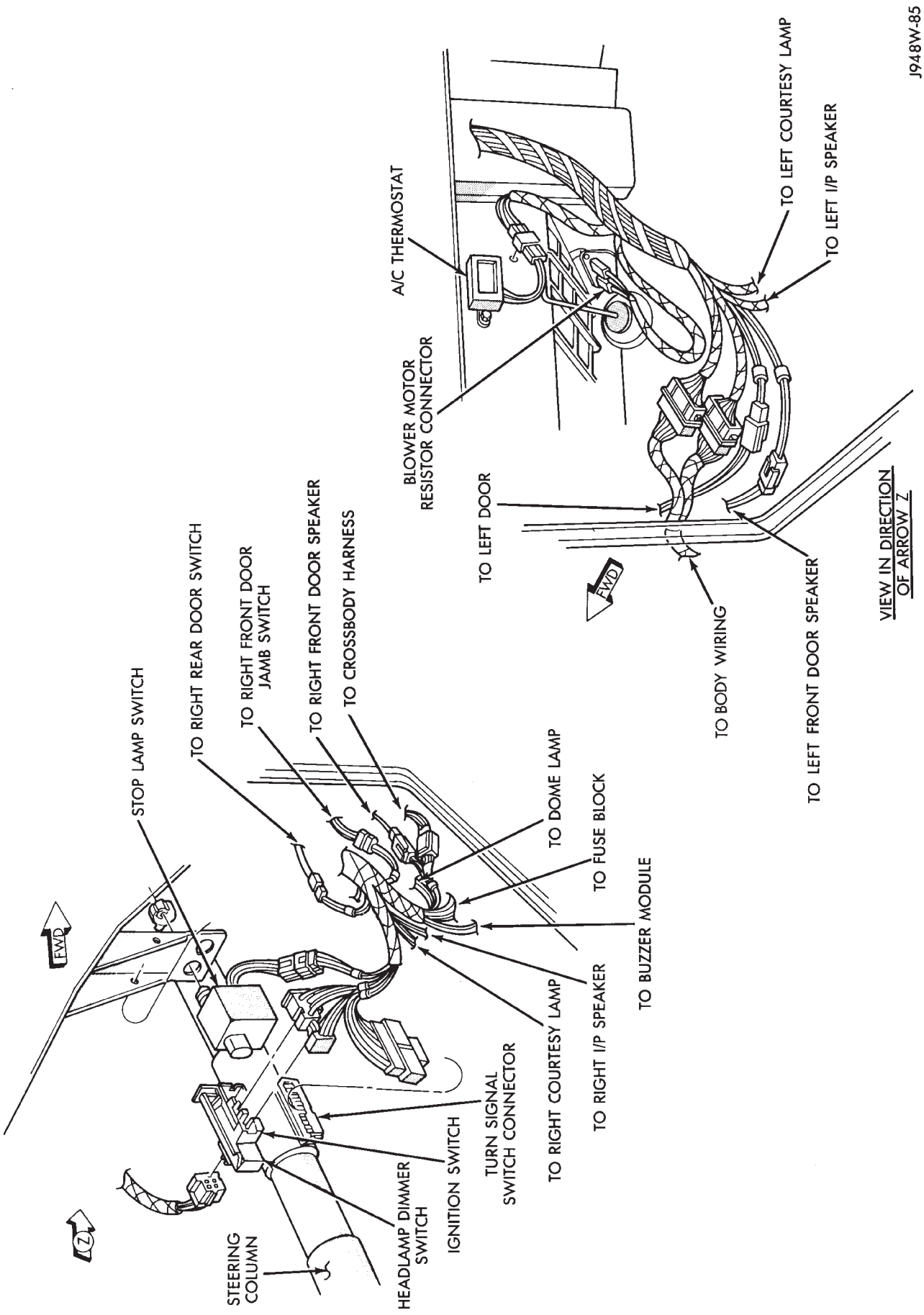

Fig. 6 Instrument Panel Wiring-Routing (RHD)

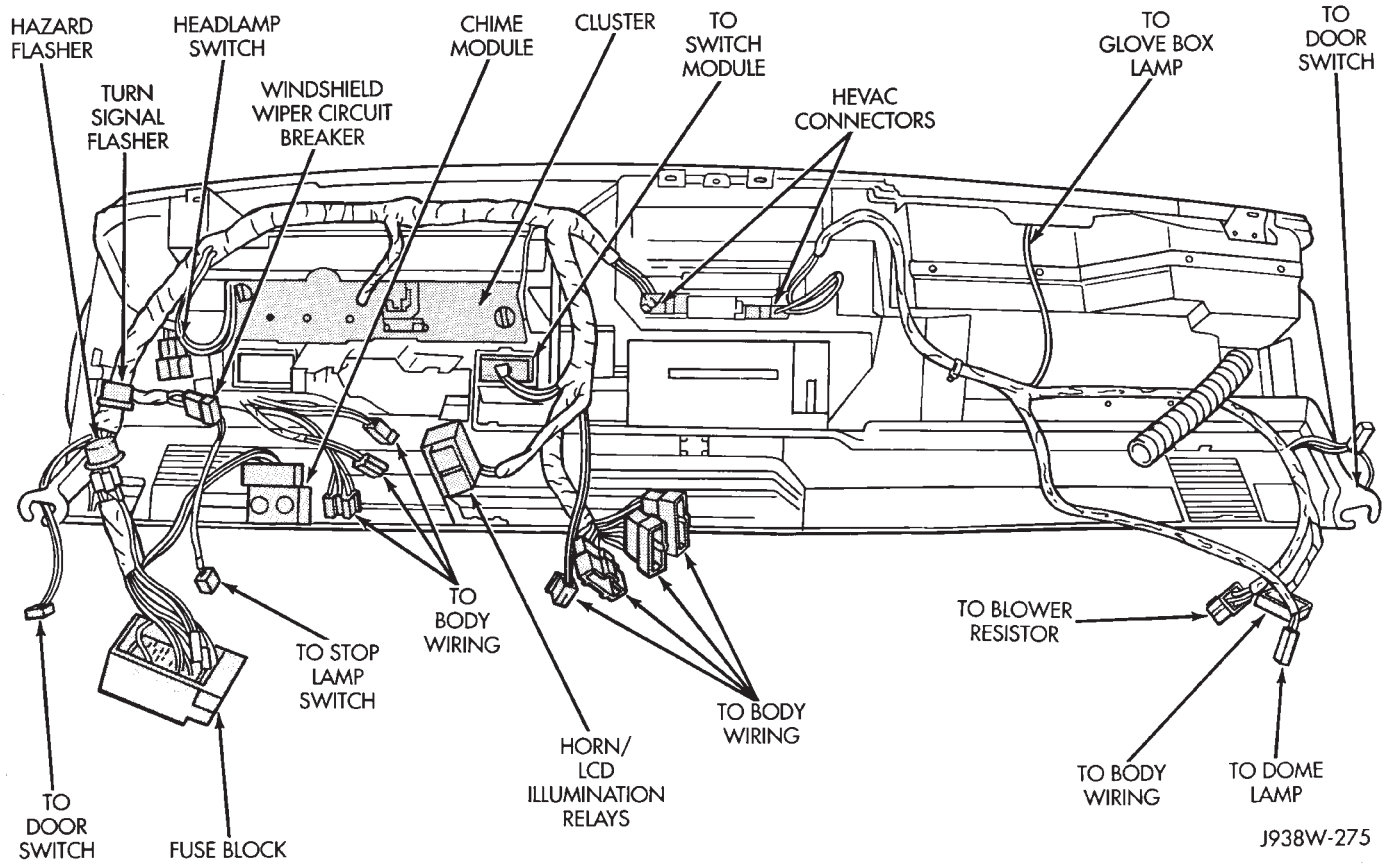

Fig. 7 Instrument Panel Wiring-Connections (RHD)

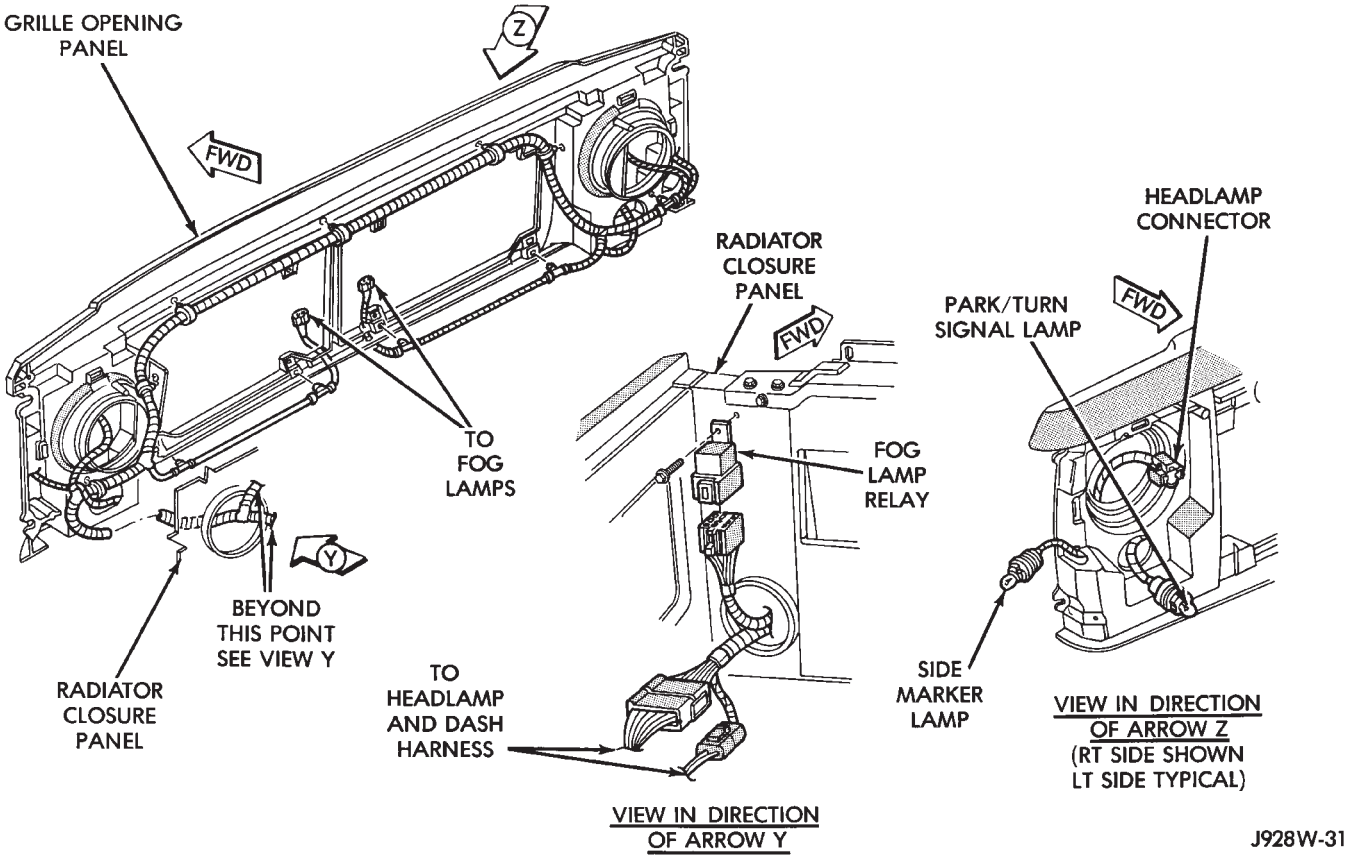

Fig. 8 Front End Wiring (RHD)

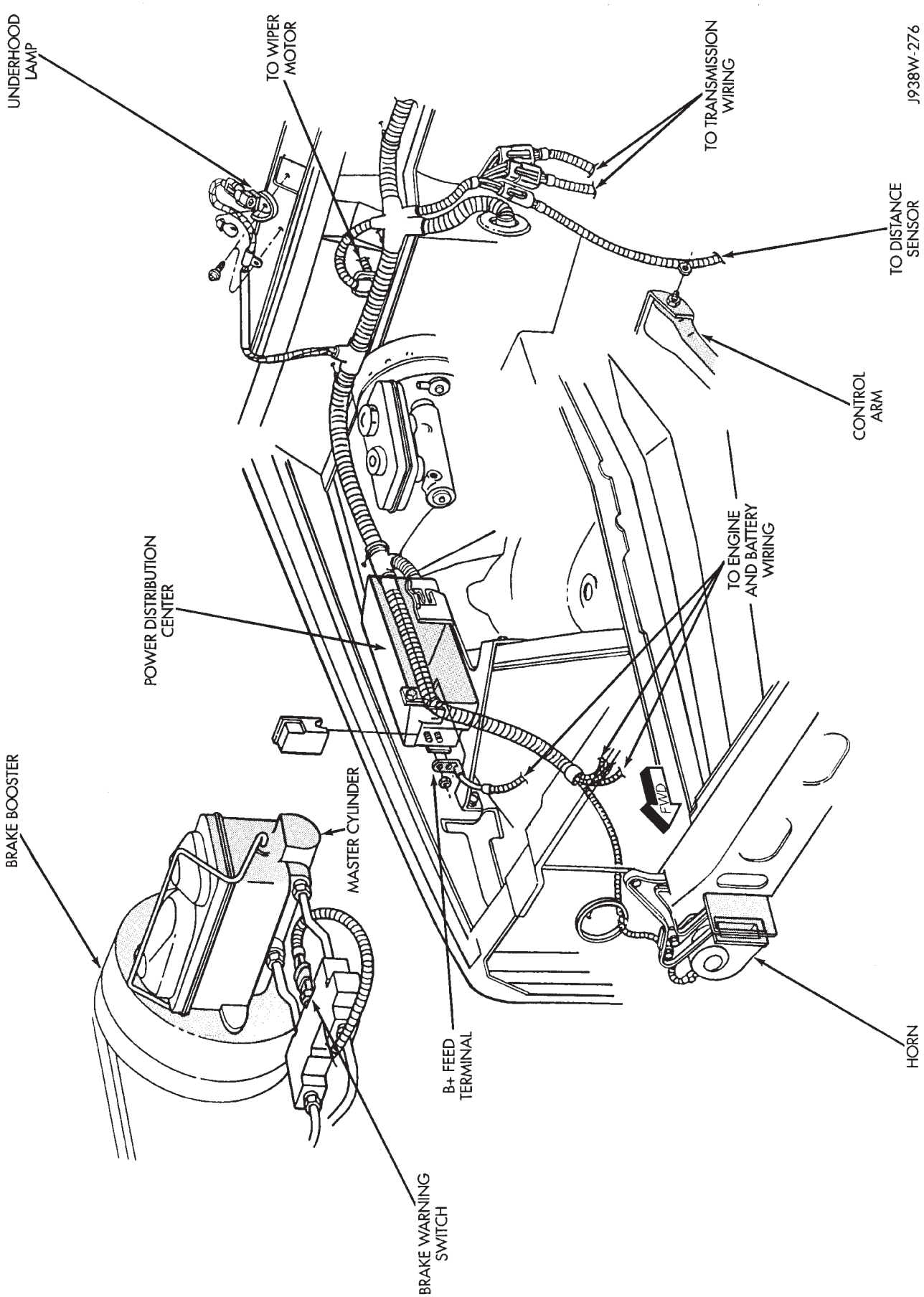

Fig. 9 Engine Compartment Wiring (RHD)

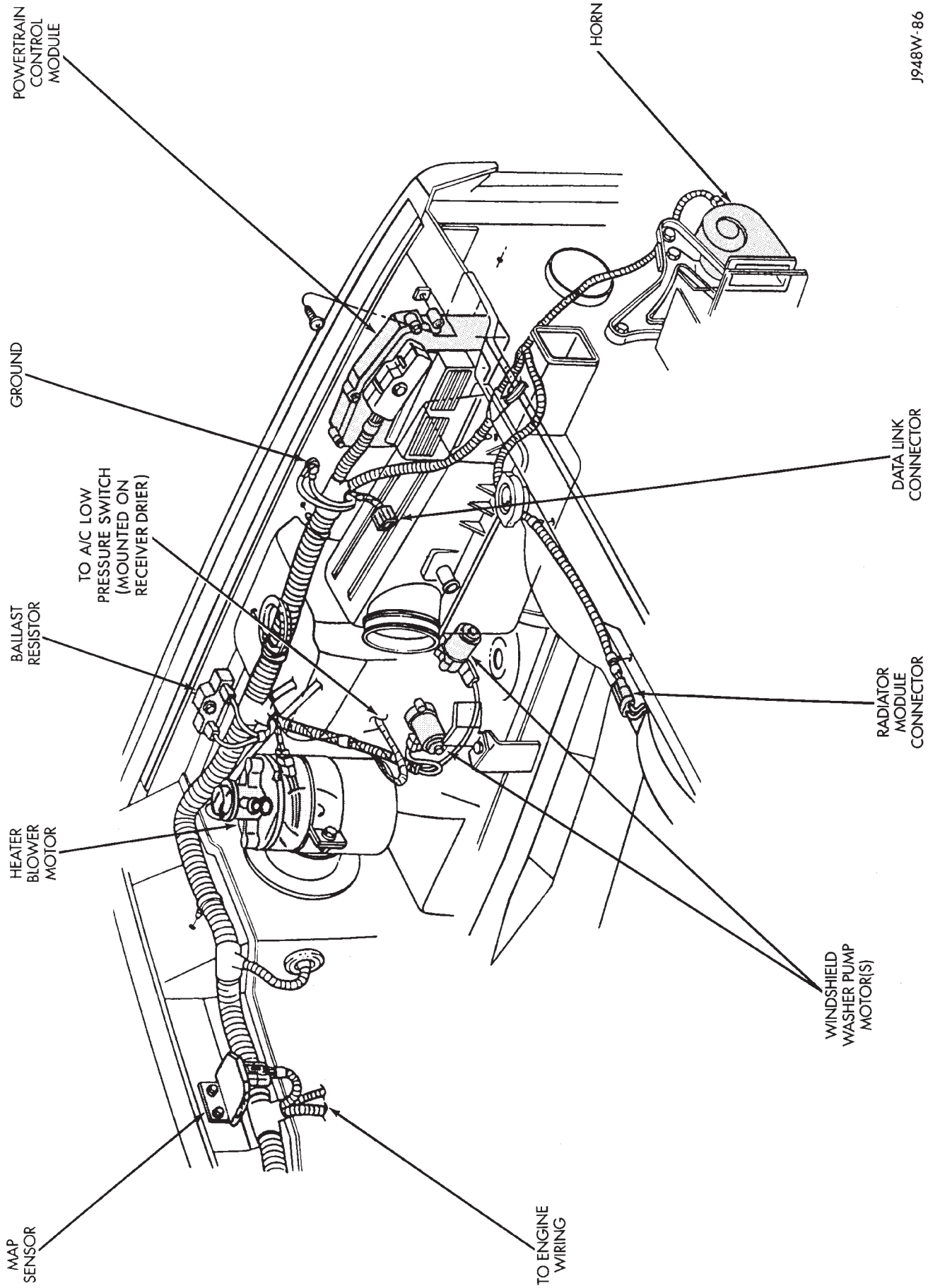

Fig. 10 Engine Compartment Wiring (RHD)

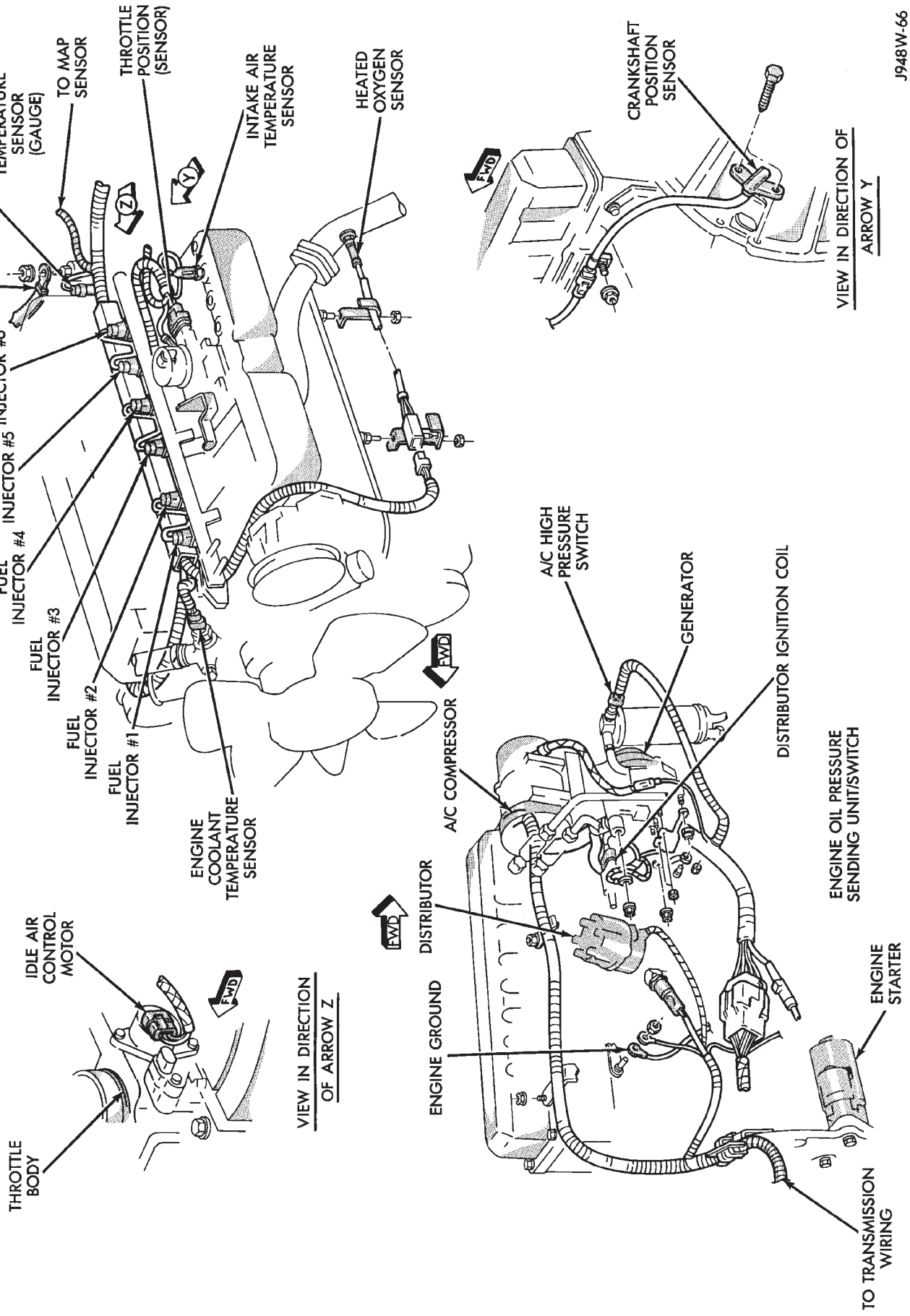

Fig. 11 Engine Wiring 4.0L (RHD)

SPLICE LOCATIONS

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The splice locations shown in this section are divided into sections by vehicle line. When locating a specific splice first, turn to the appropriate index, then look up the **figure number** that refers to the splice. **Page numbers at the top of the page do not refer to figure numbers.**

YJ SPLICE LOCATIONS

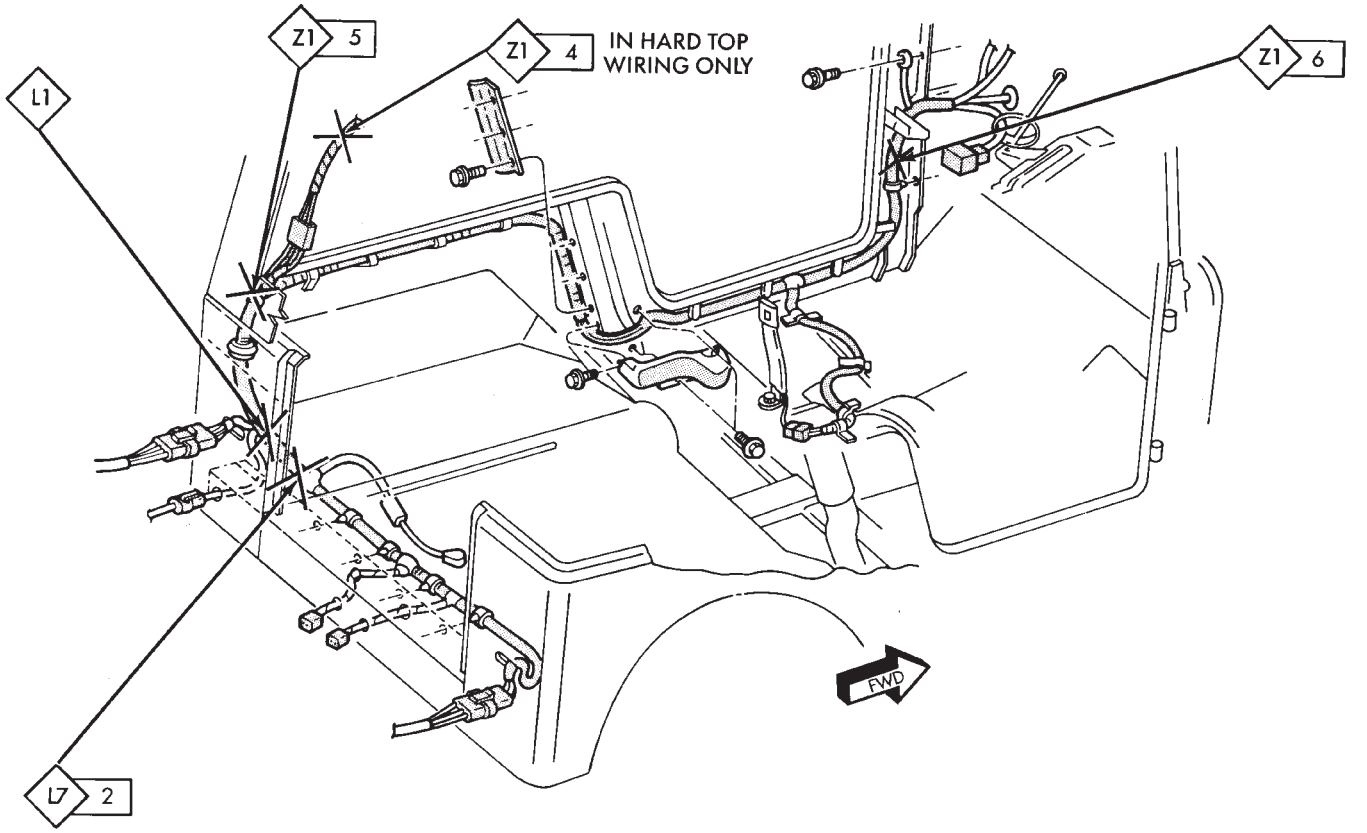

Fig. 1 Body Splices YJ

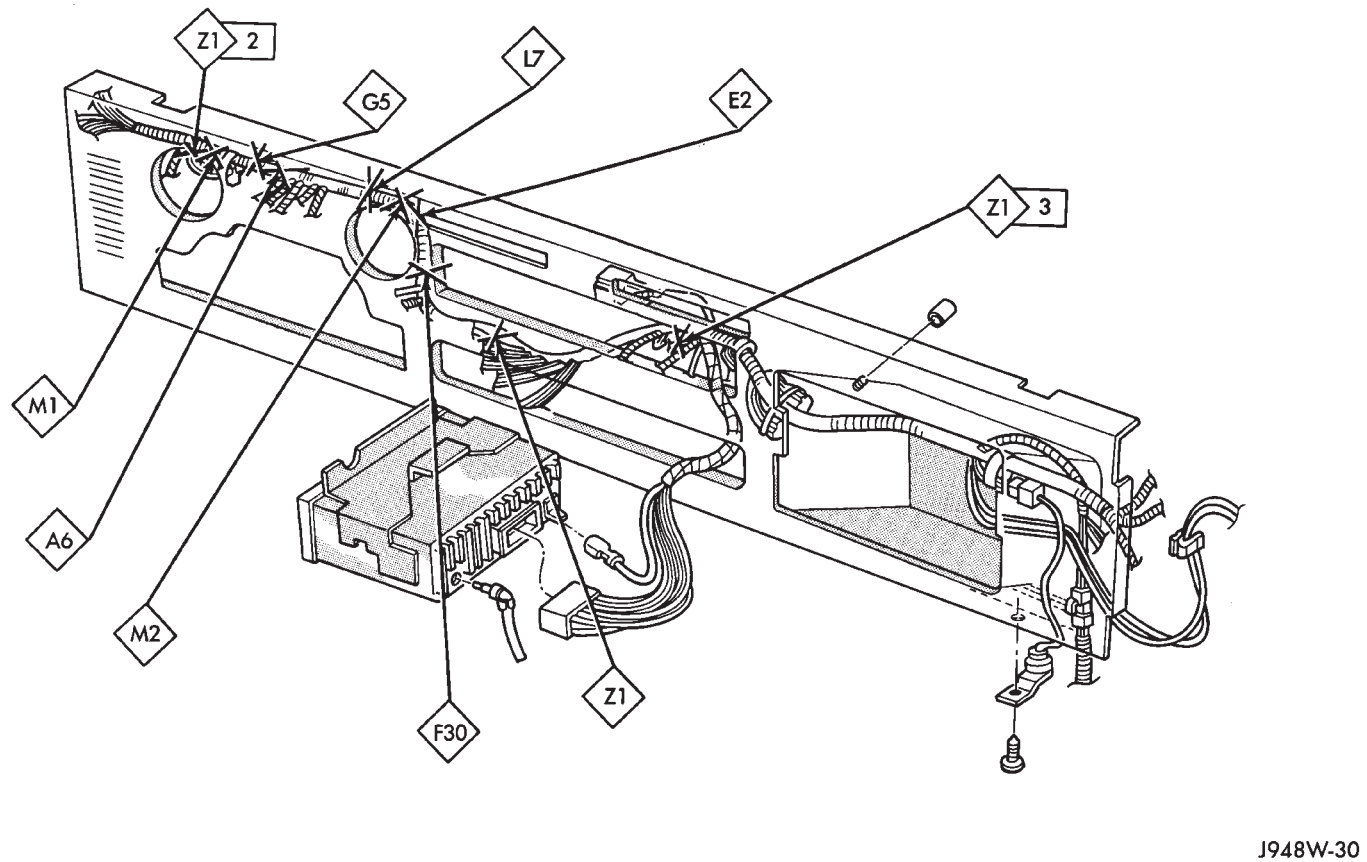

Fig. 2 Instrument Panel Splices YJ

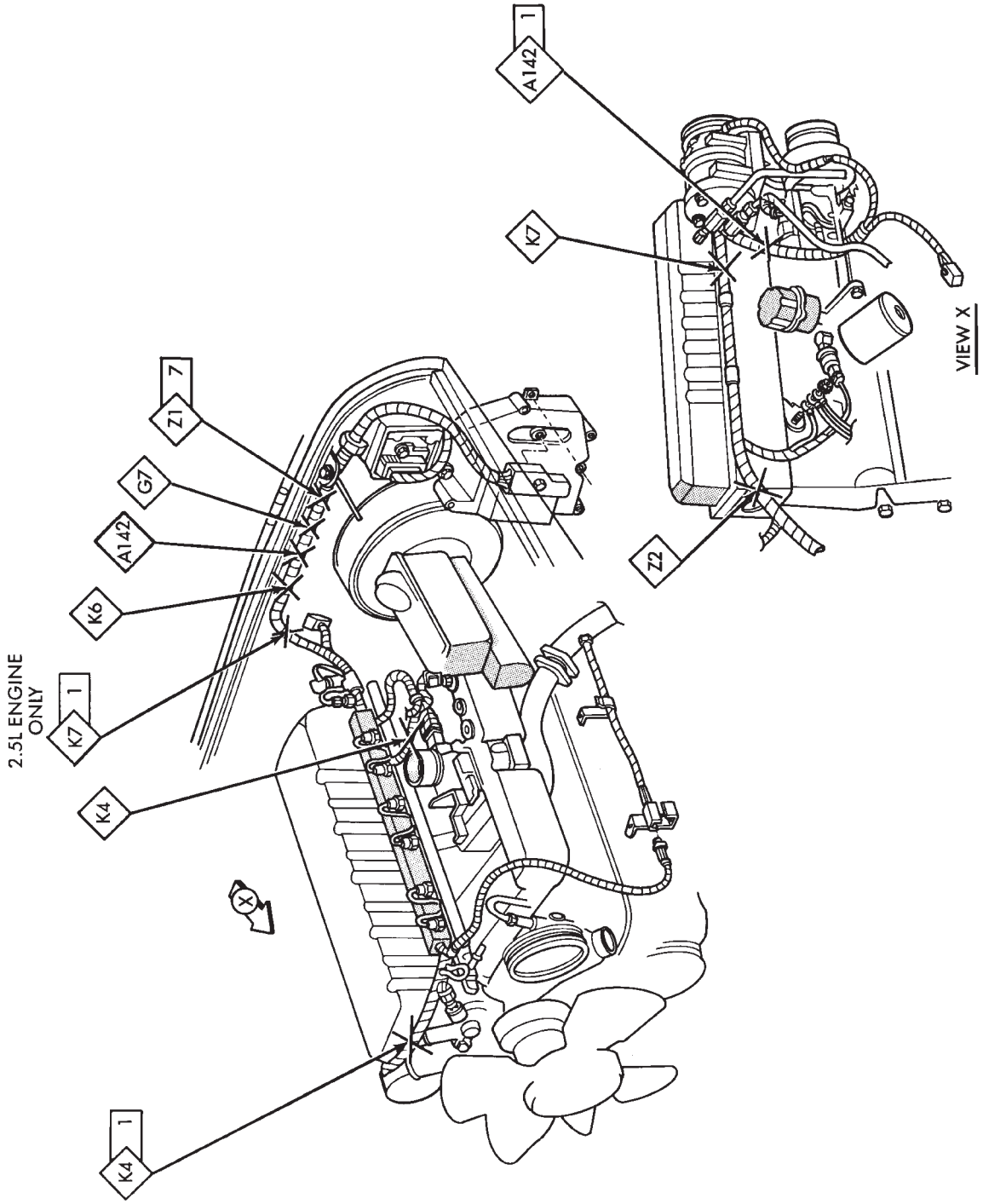

Fig. 3 Engine Wiring Splices YJ

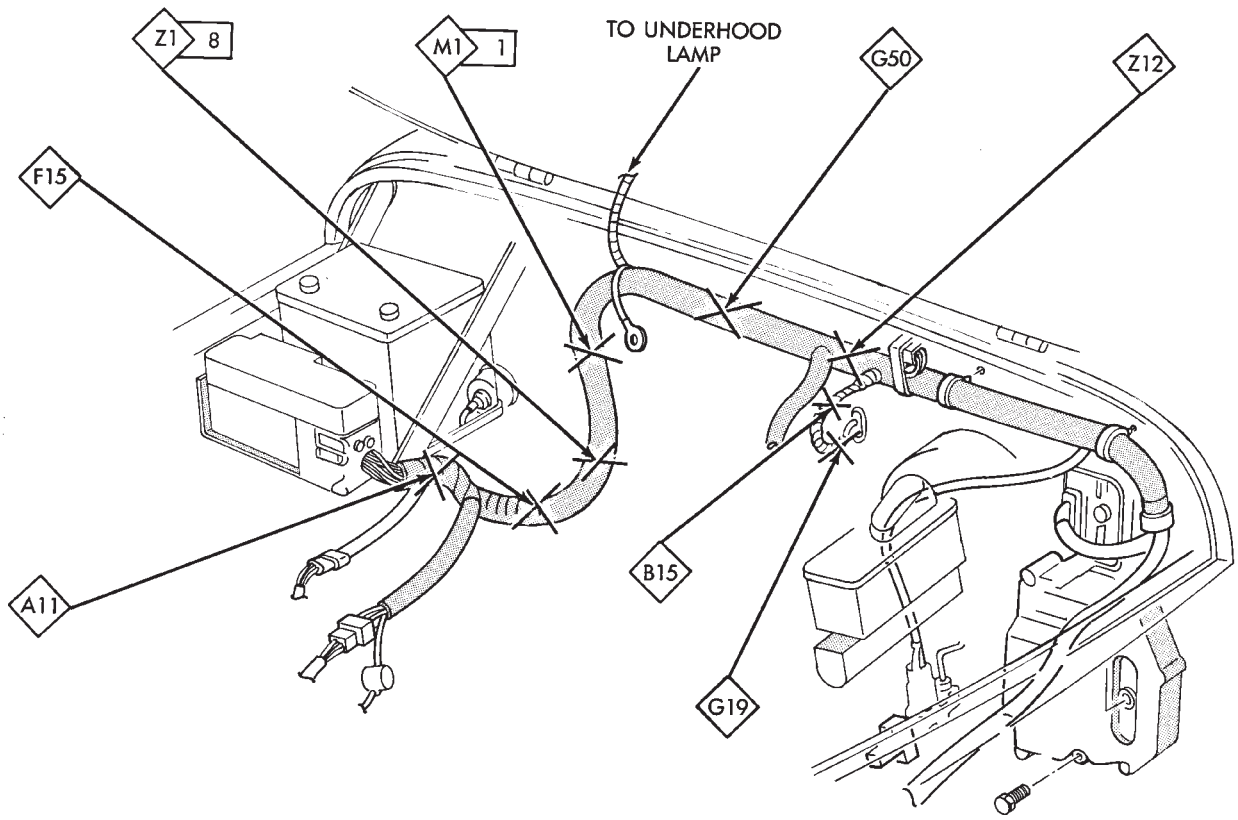

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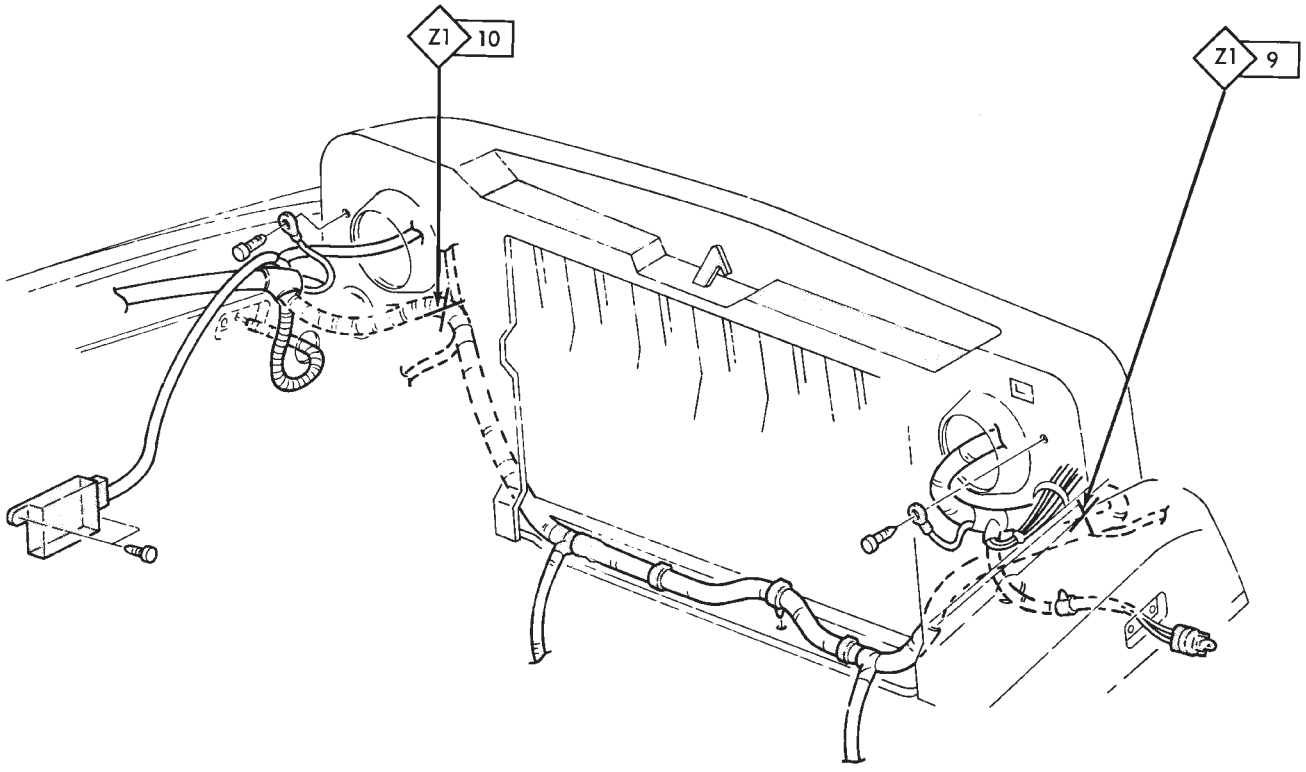
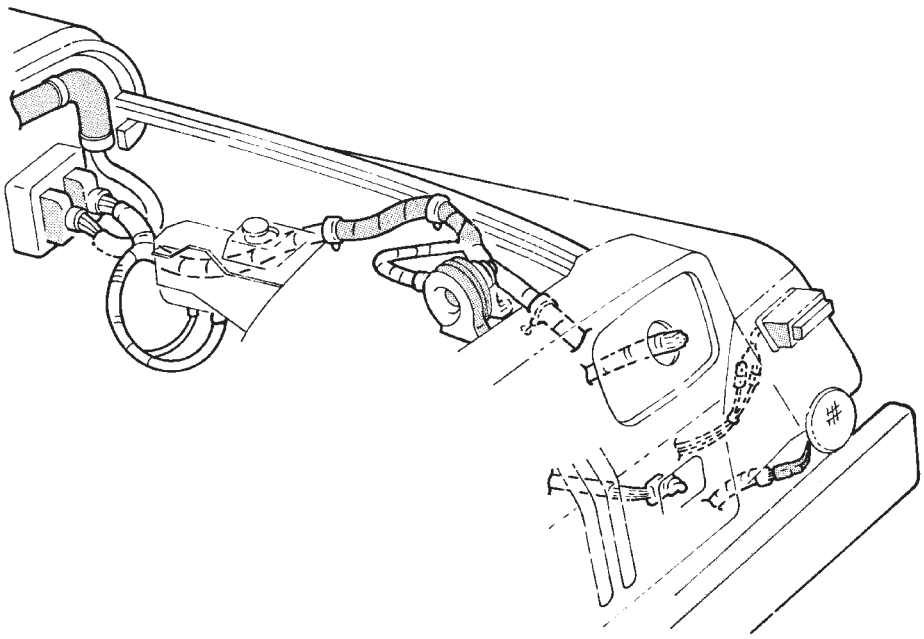
Fig. 4 Dash Panel Splices YJ



J938W-69

Fig. 5 Front End Splices YJ



J938W-70

Fig. 6 Front End Splices YJ

XJ SPLICE LOCATIONS

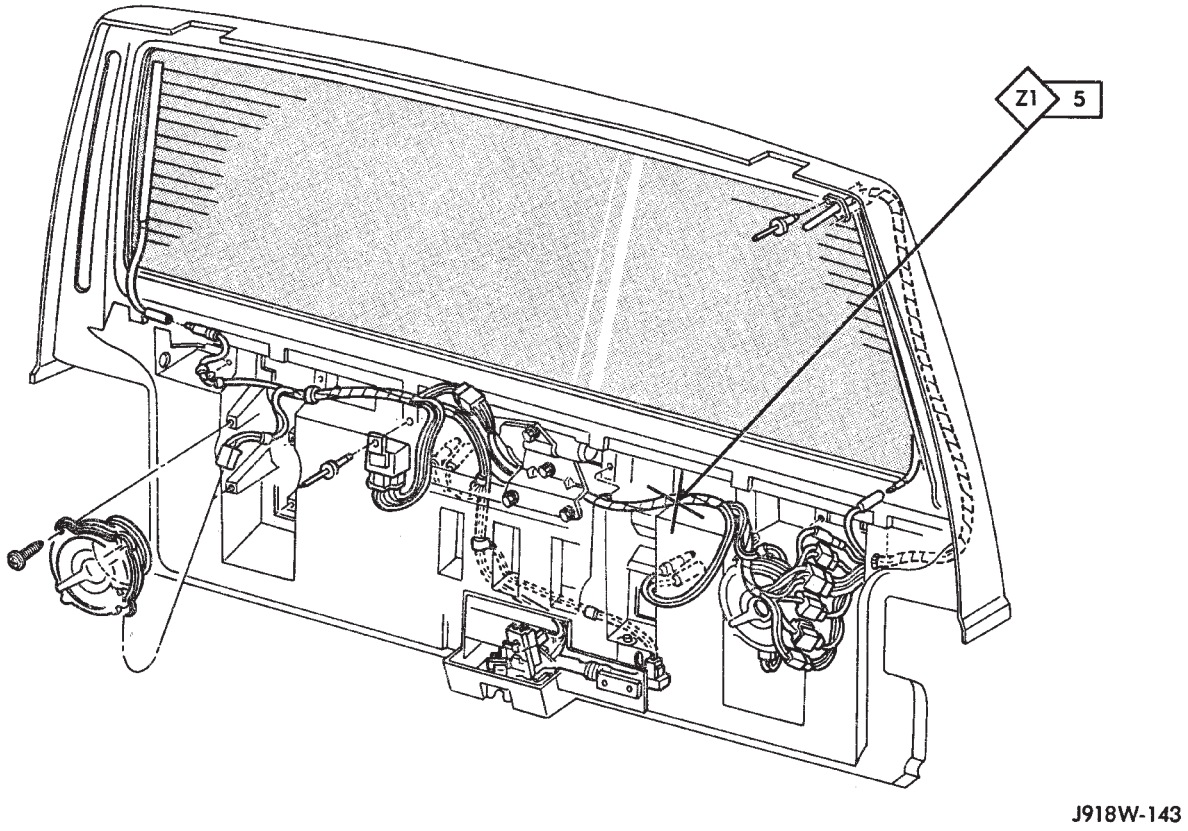


Fig. 1 Liftgate Splices XJ

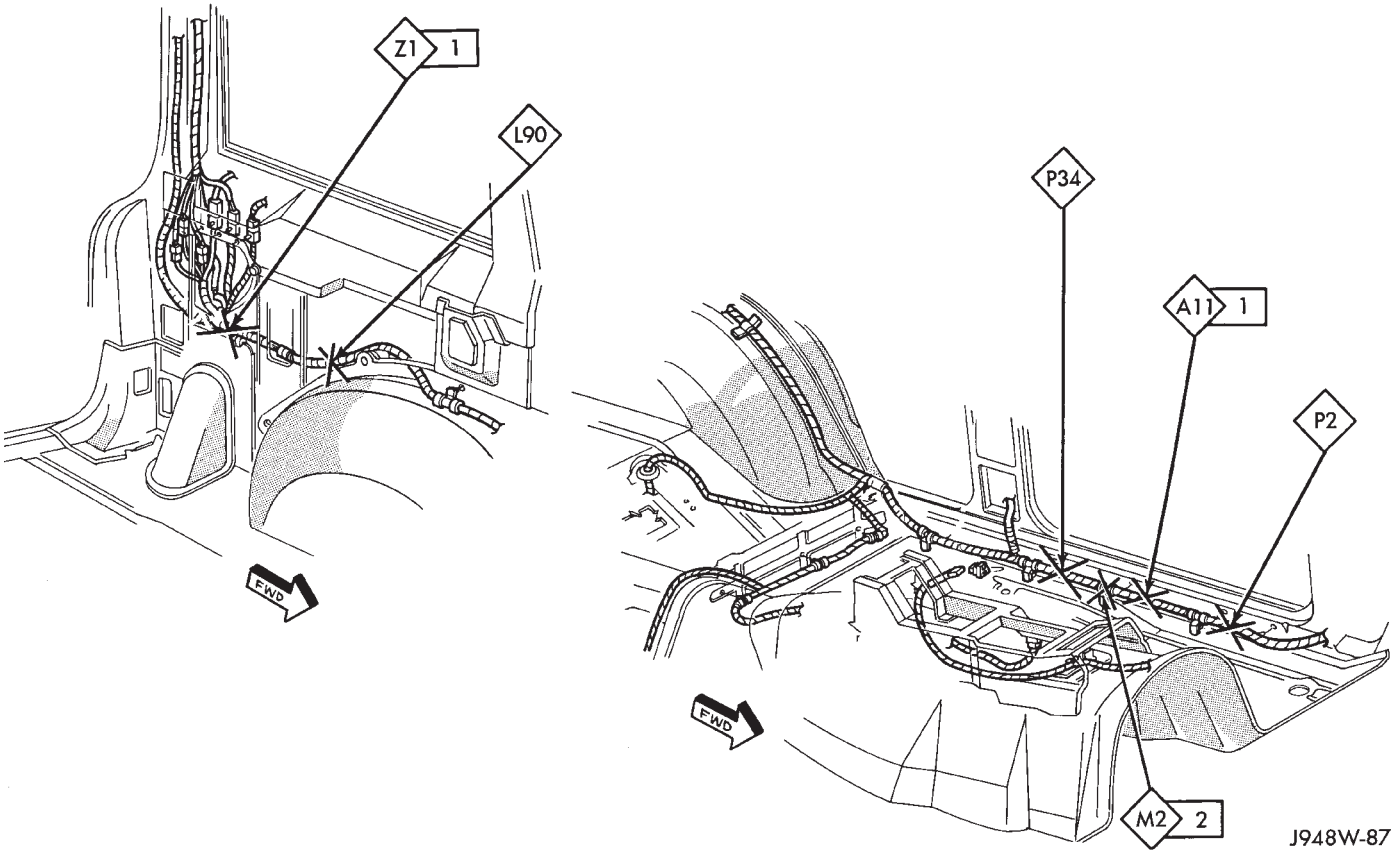


Fig. 2 Body Splices XJ

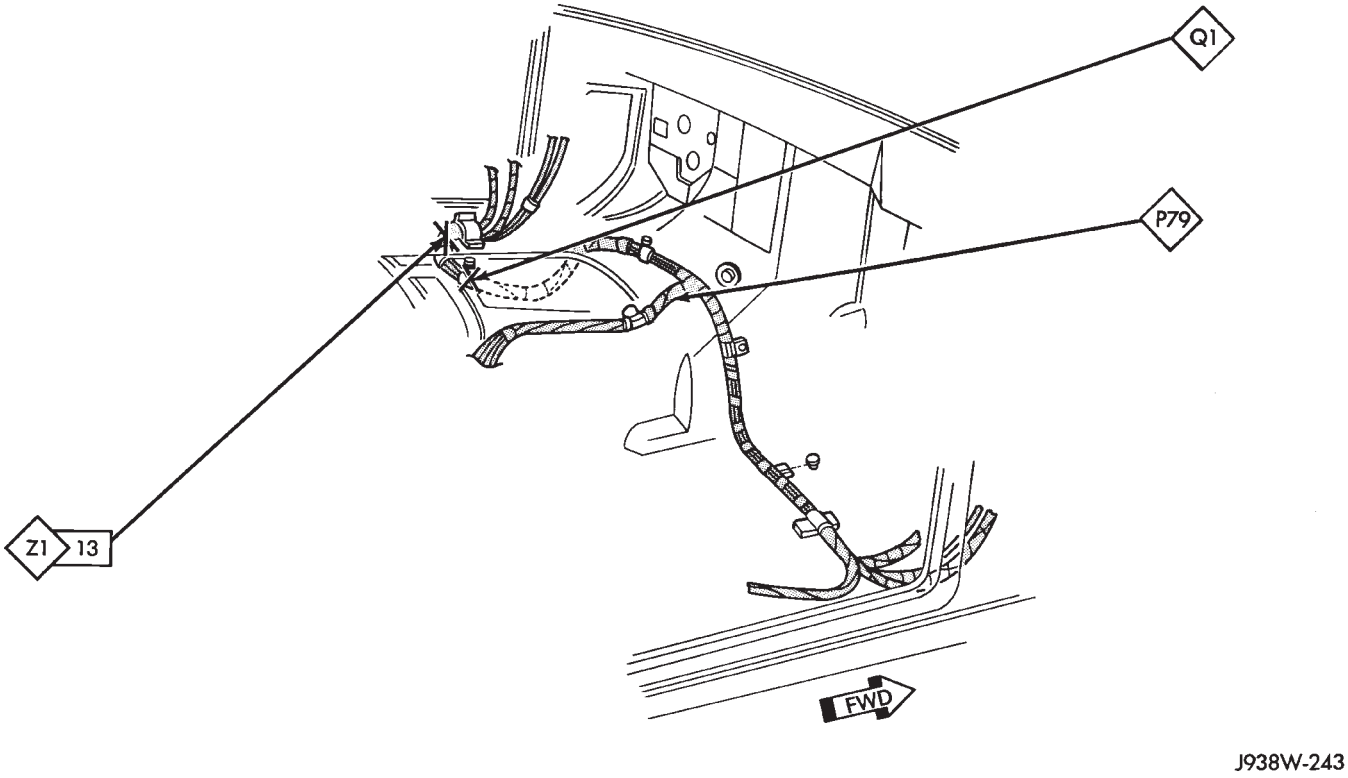


Fig. 3 Cross-body Splices XJ

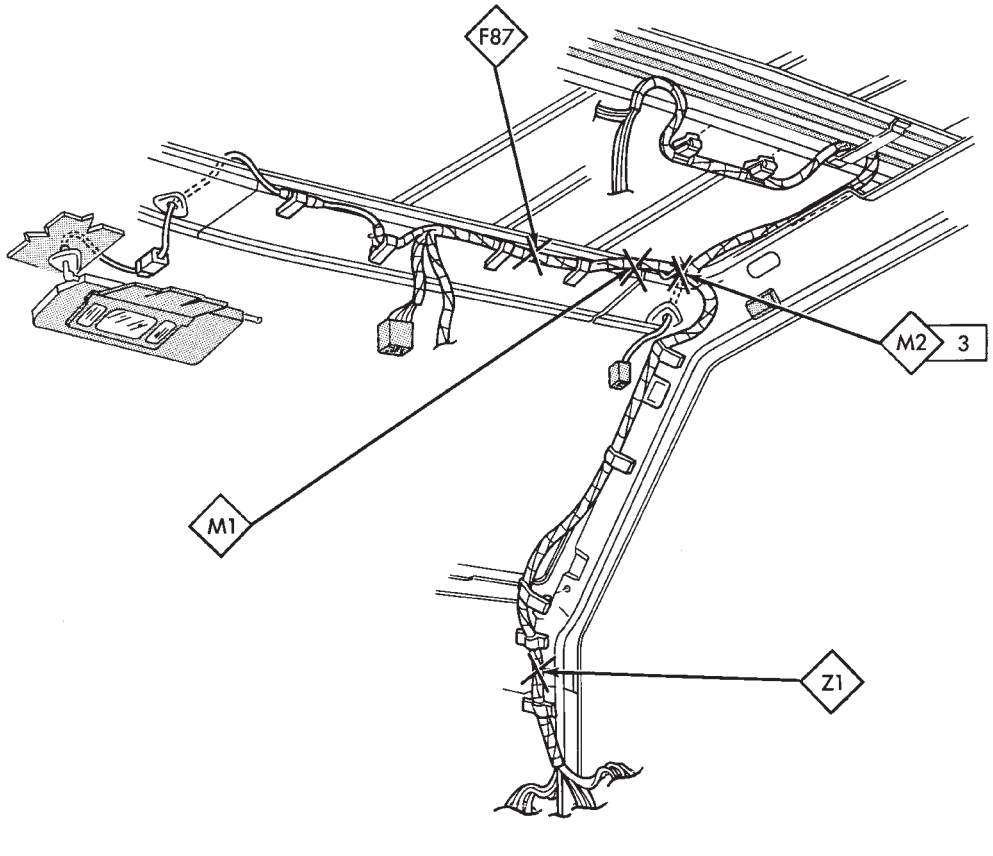


Fig. 4 Roof Splices XJ

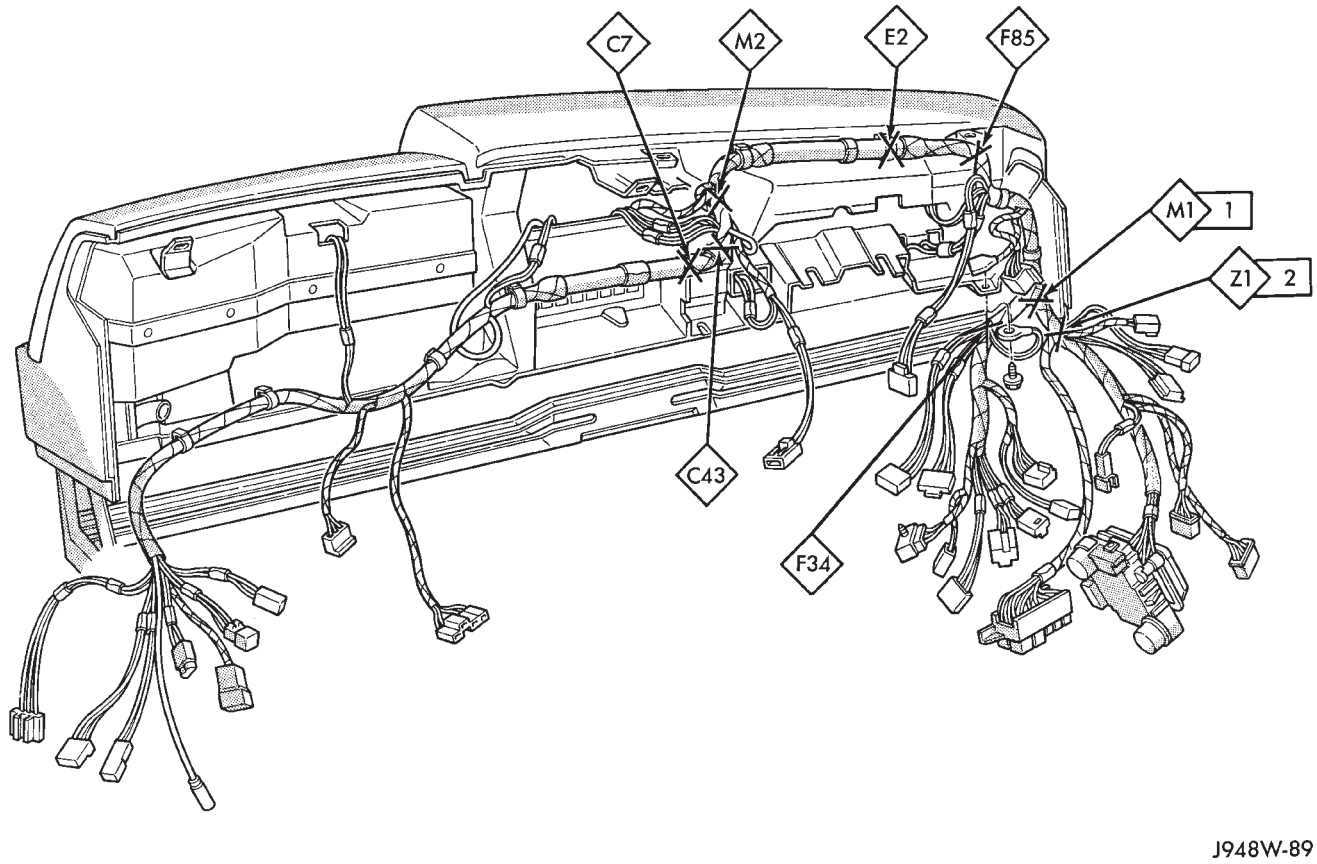


Fig. 5 Instrument Panel Splices XJ

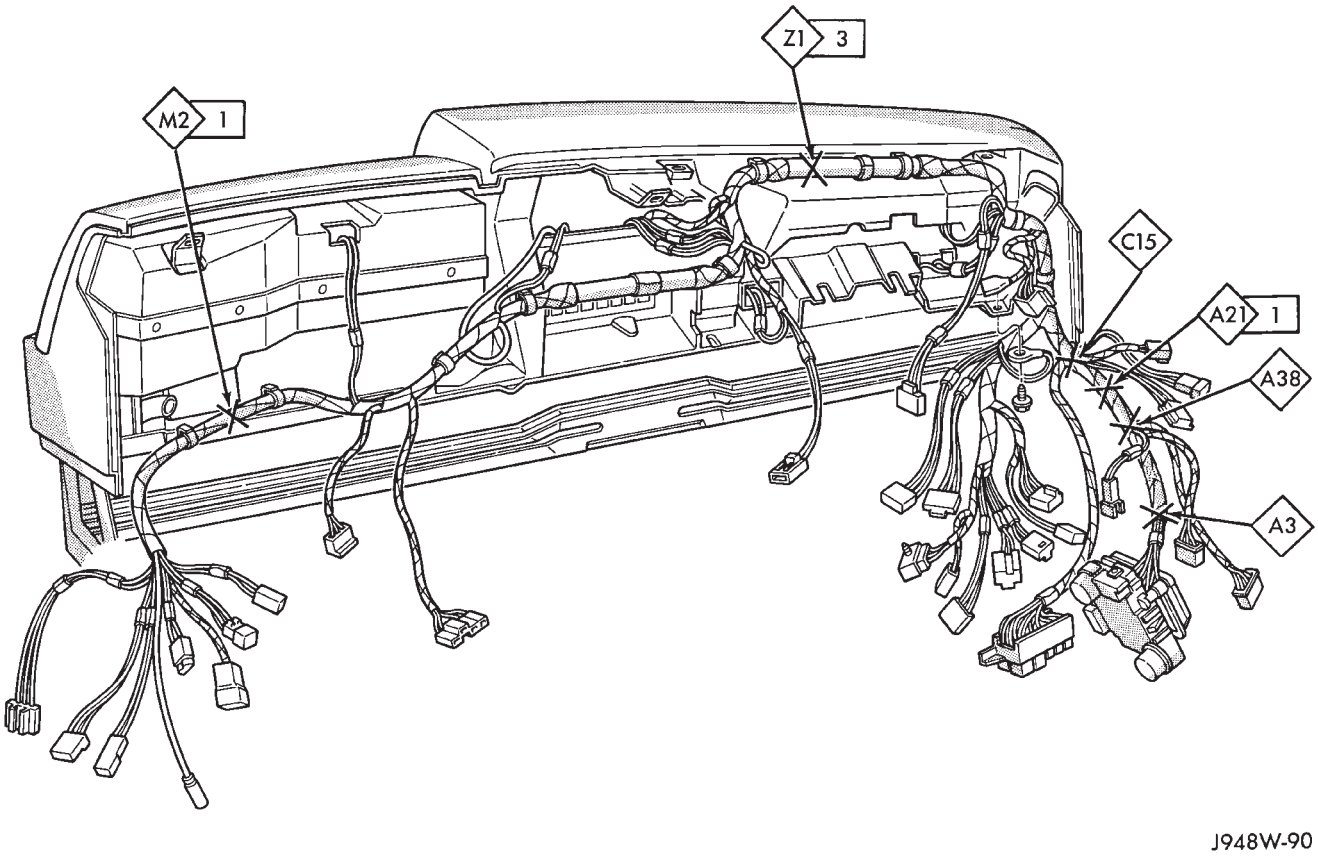


Fig. 6 Instrument Panel Splices XJ

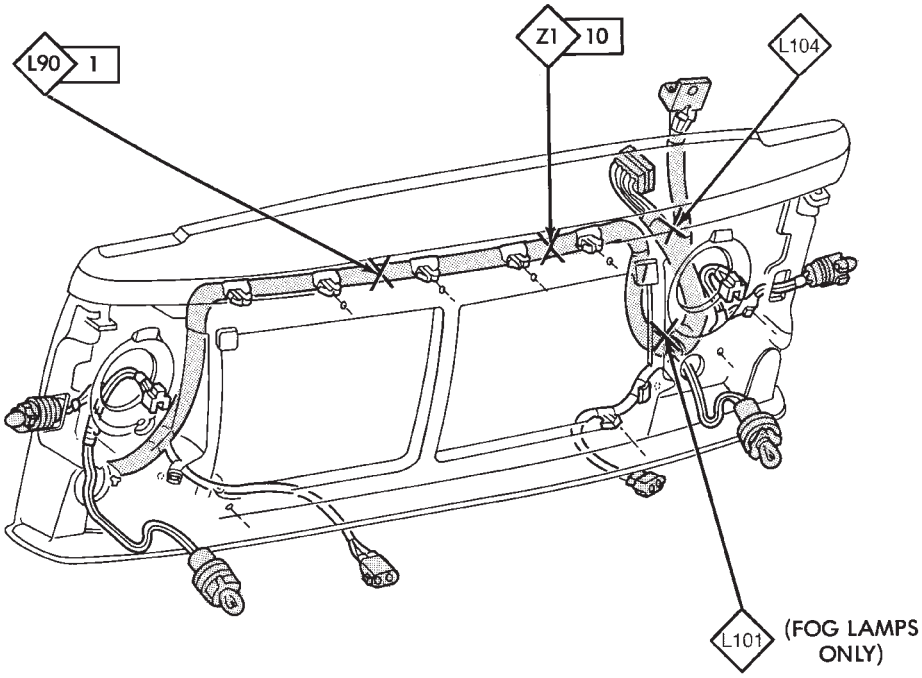


Fig. 7 Front End Splices XJ

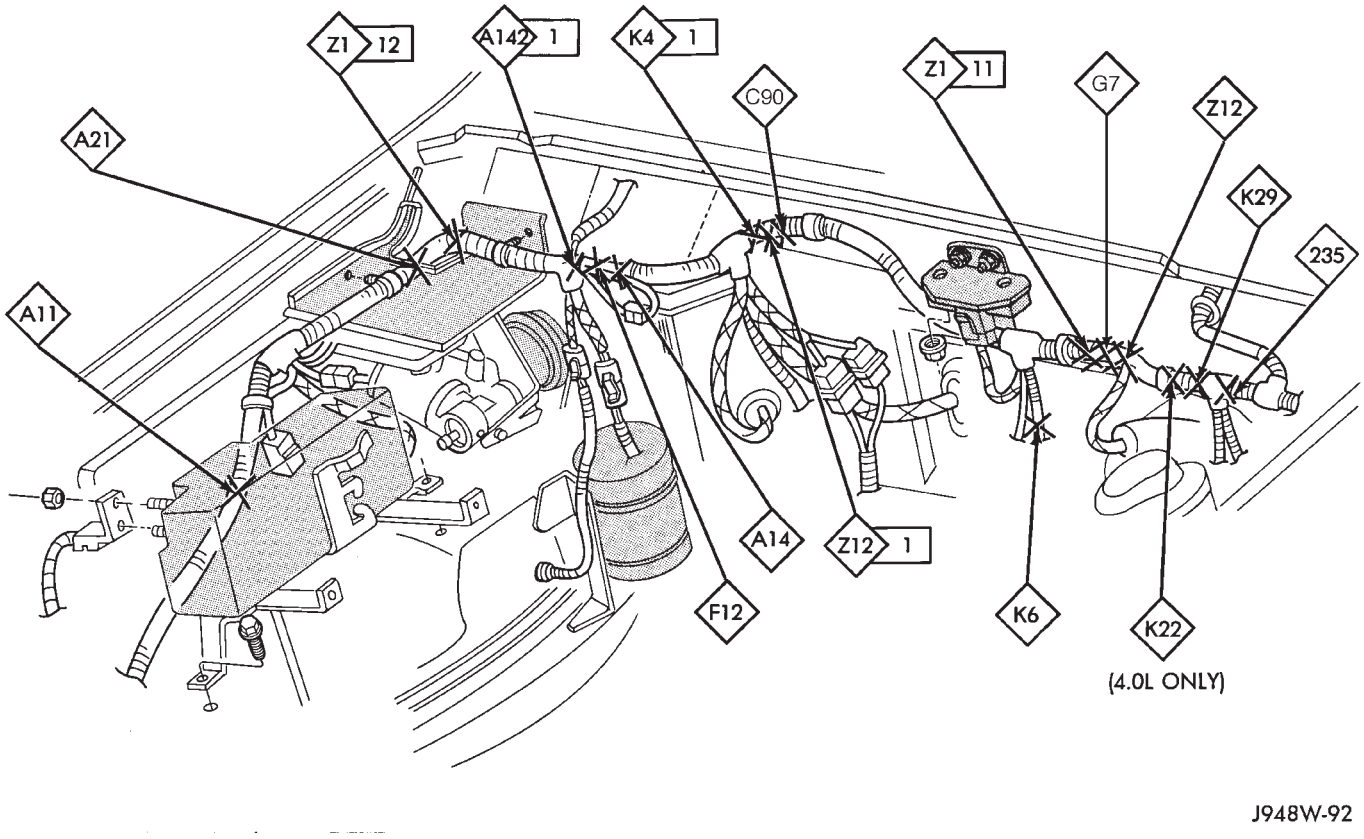


Fig. 8 Engine Compartment Splices XJ

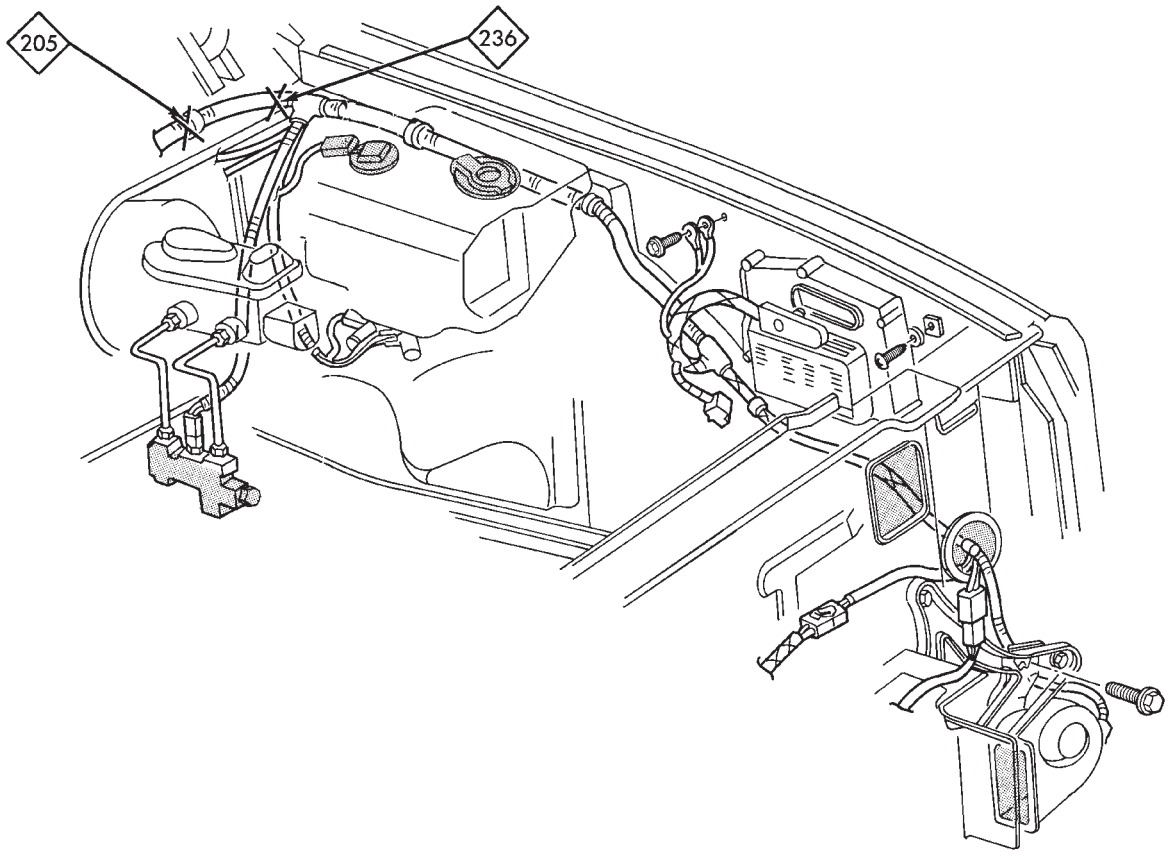


Fig. 9 Engine Compartment Splices XJ

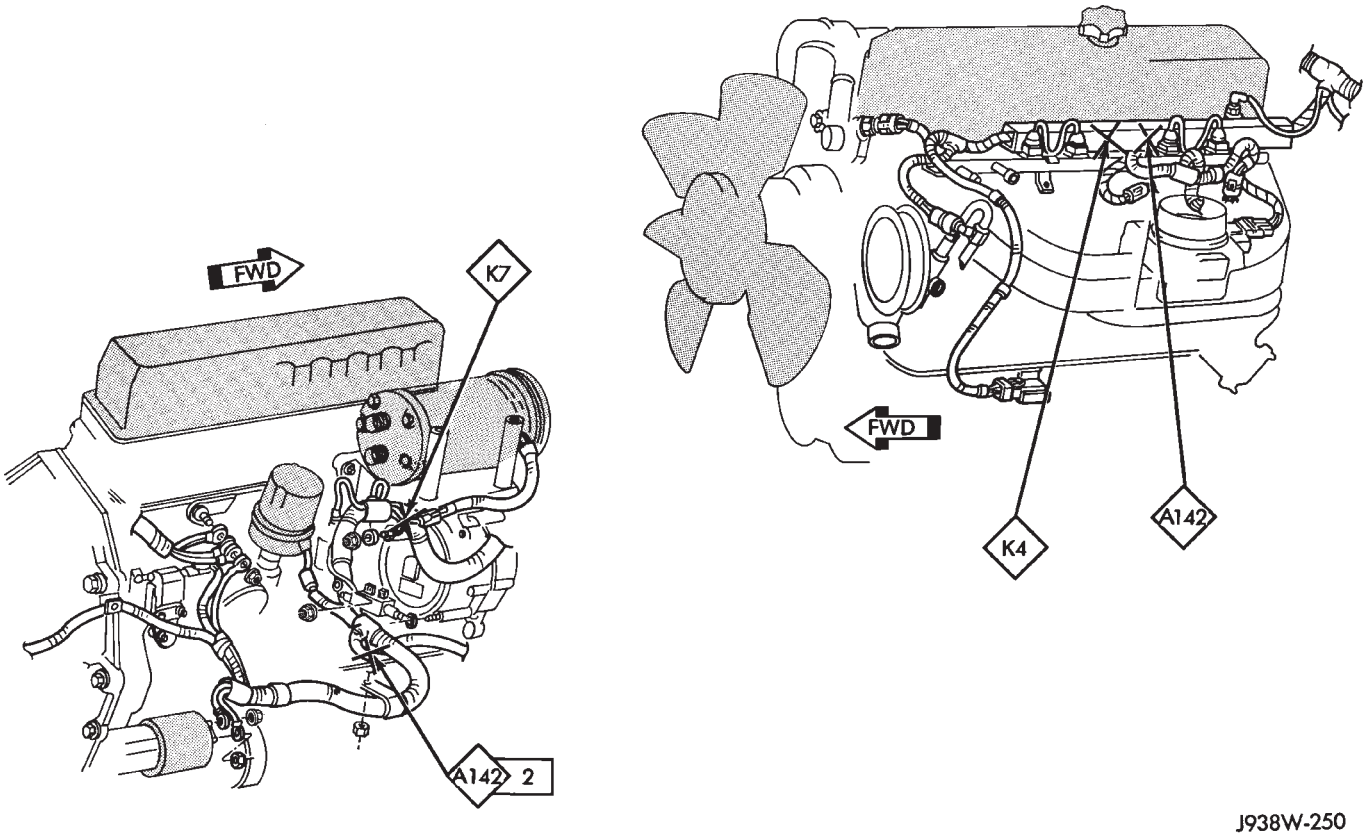


Fig. 10 Engine Splices 2.5L XJ

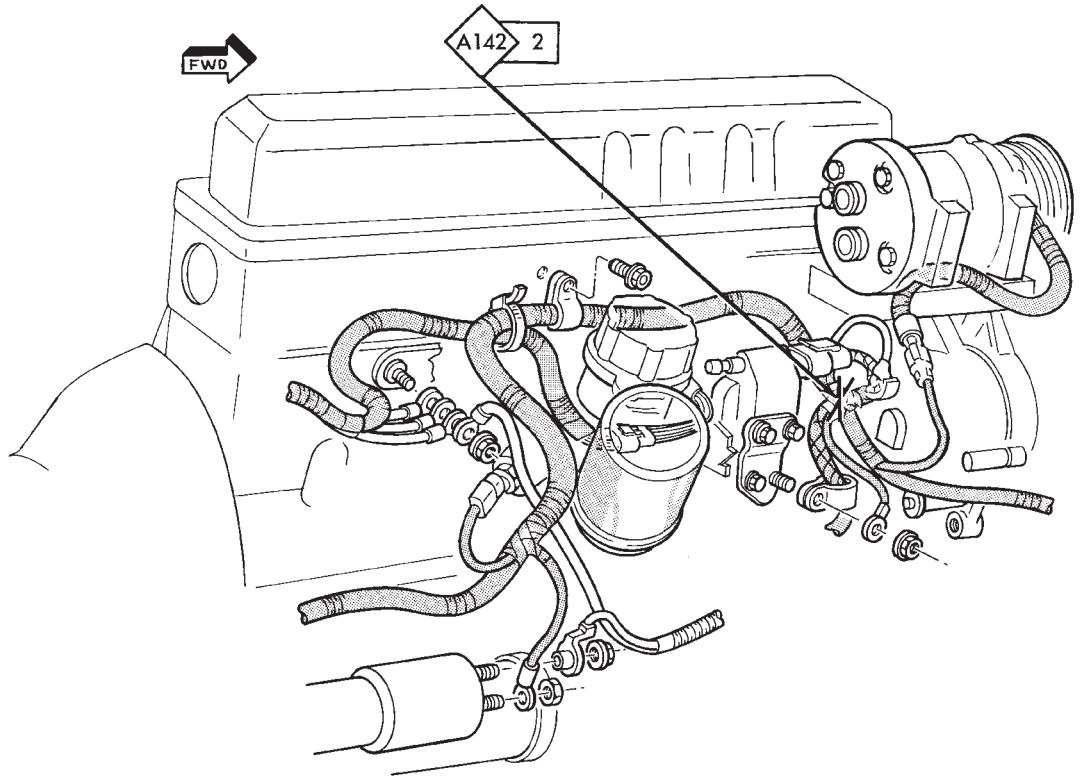


Fig. 11 Engine Splices 4.0L XJ

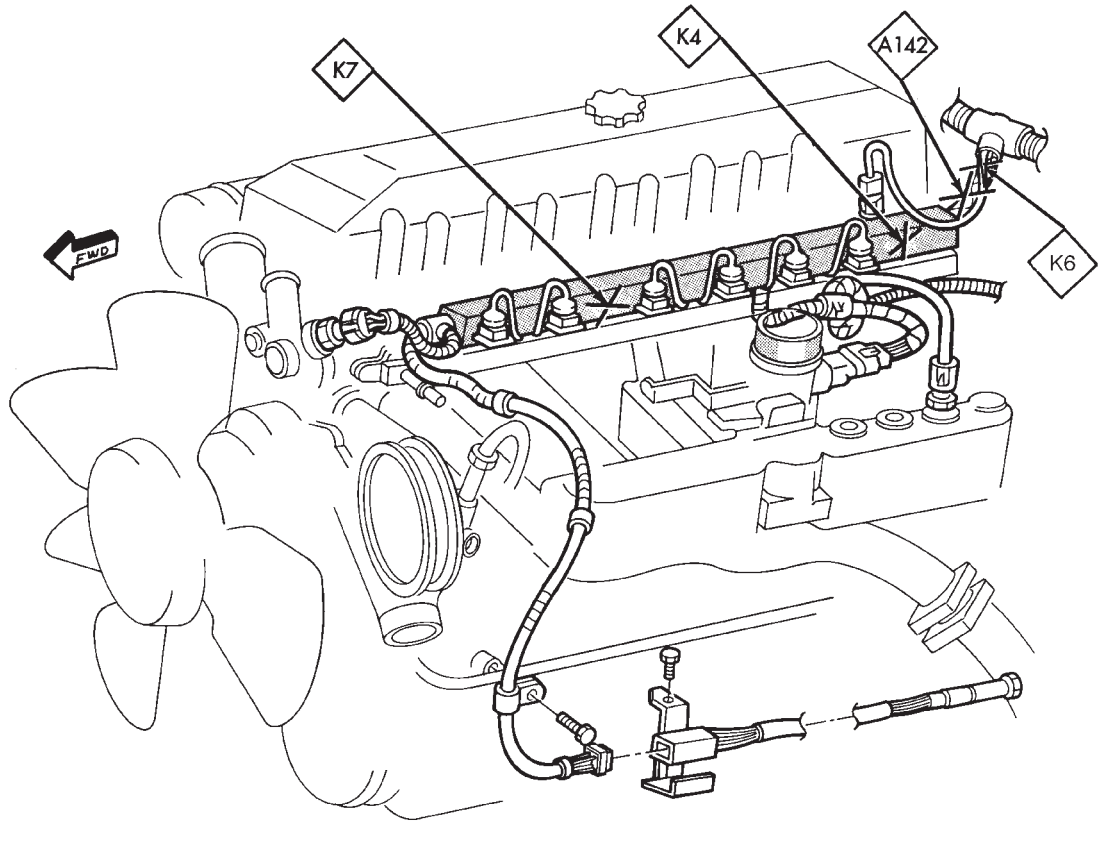


Fig. 12 Engine Splices 4.0L XJ

XJ RHD SPLICE LOCATIONS

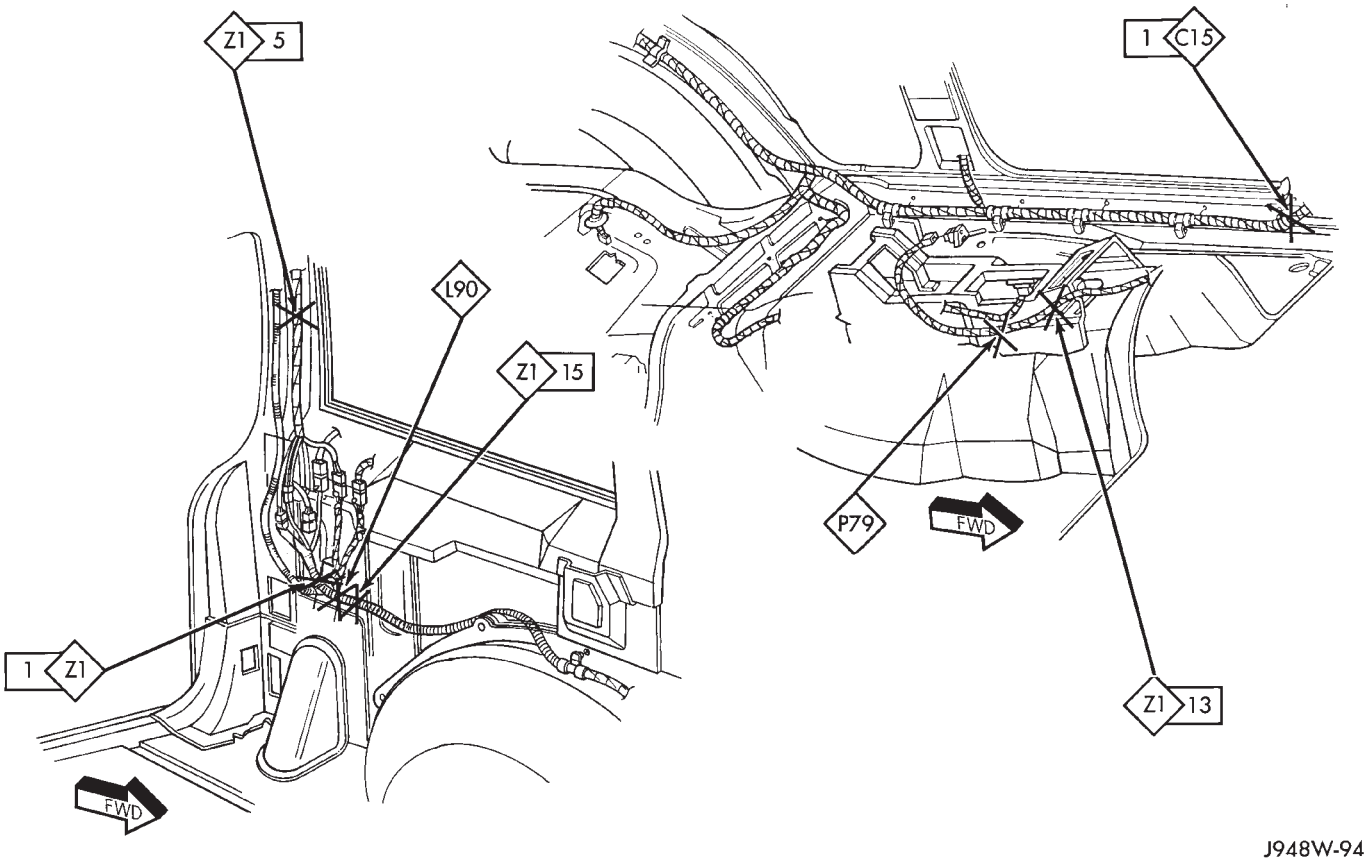


Fig. 1 Rear Body Splices

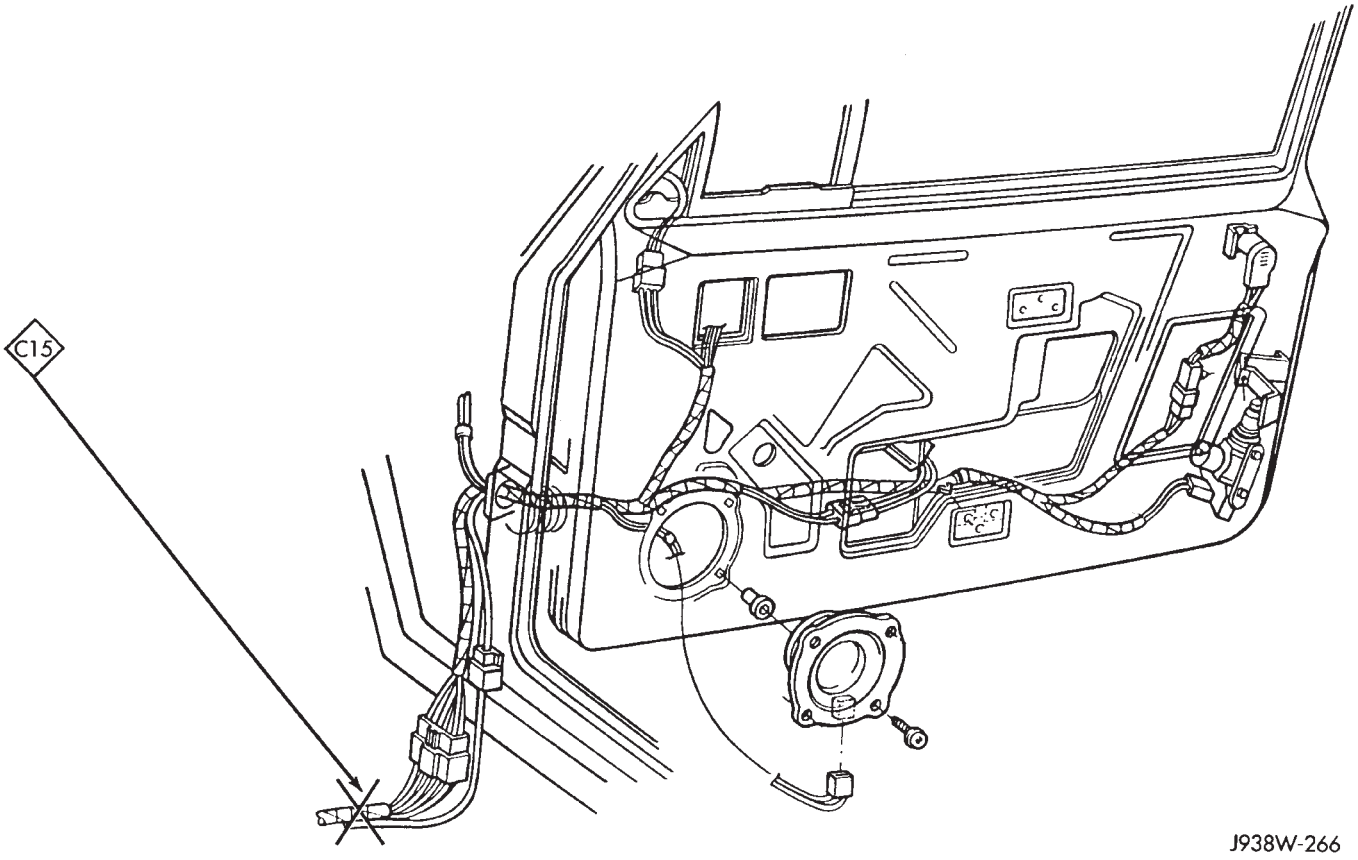


Fig. 2 Cross-body Splices

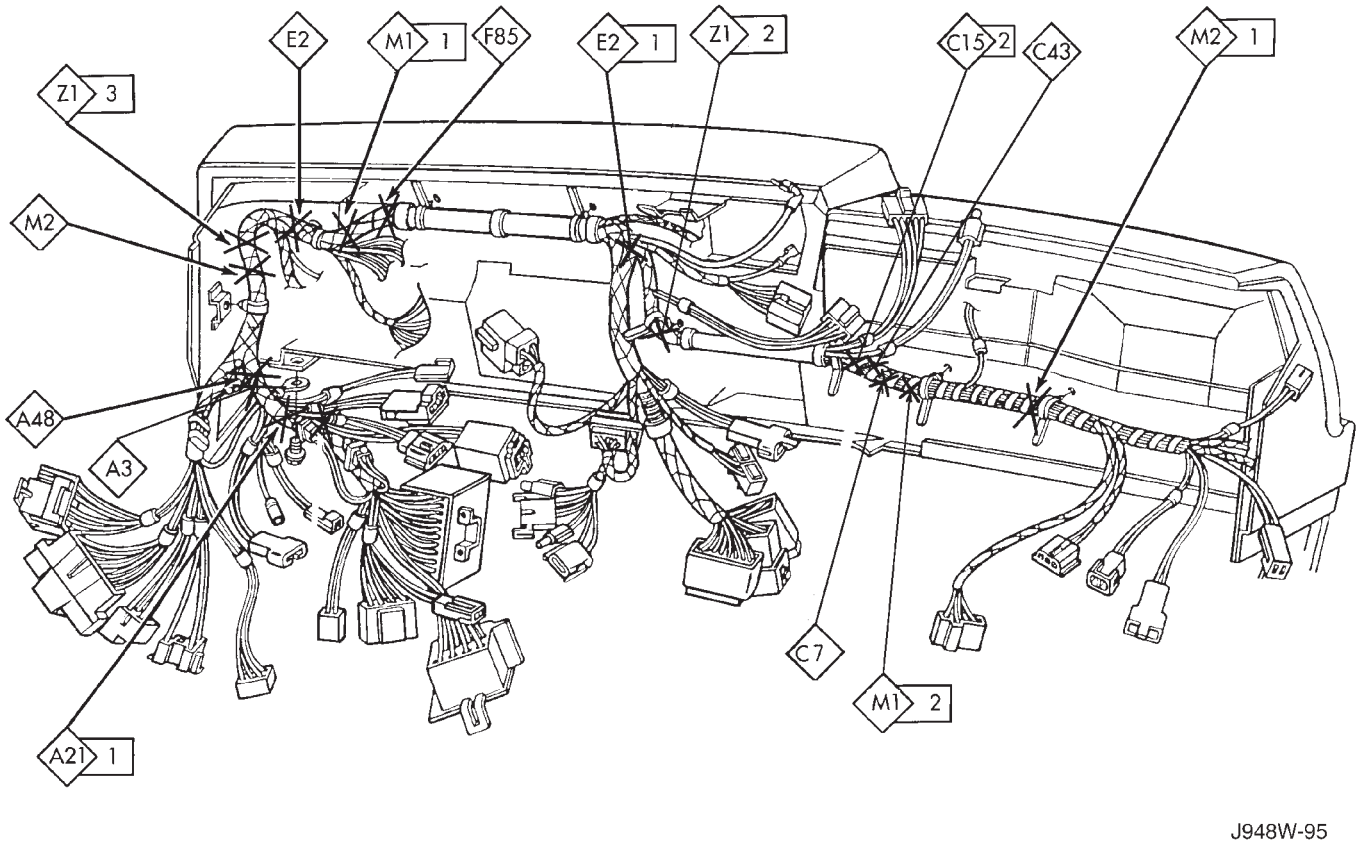


Fig. 3 Instrument Panel Splices

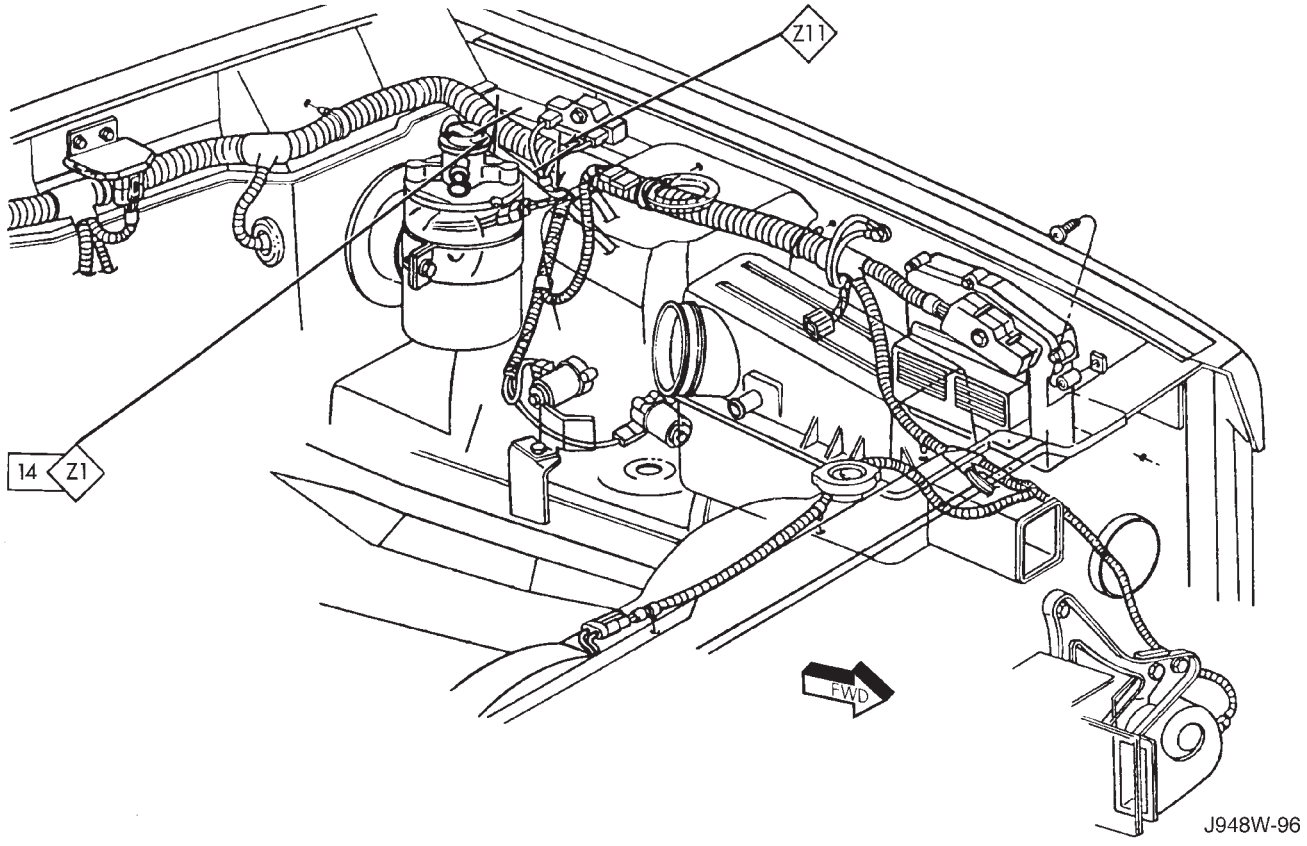


Fig. 4 Engine Compartment Splices

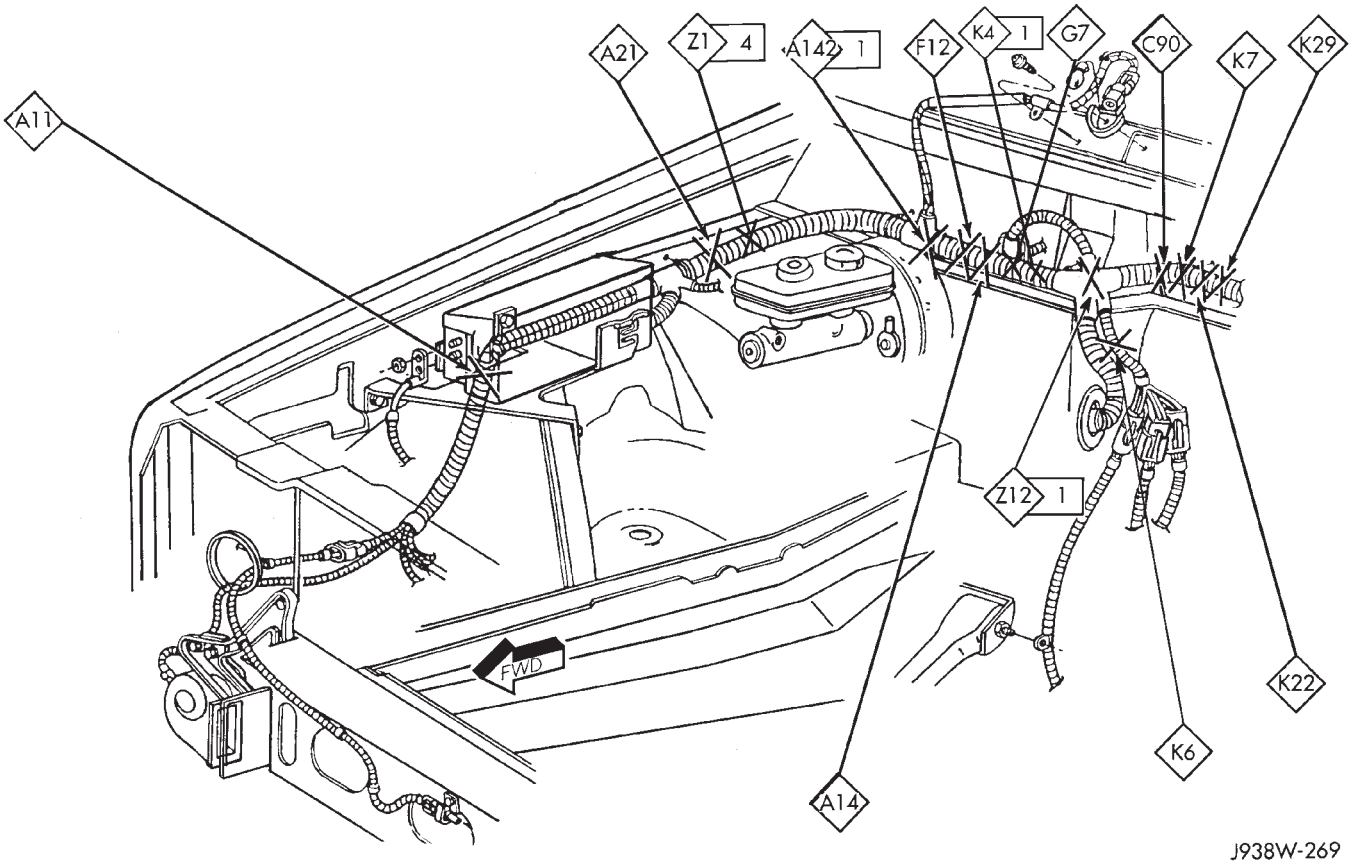


Fig. 5 Engine Compartment Splices

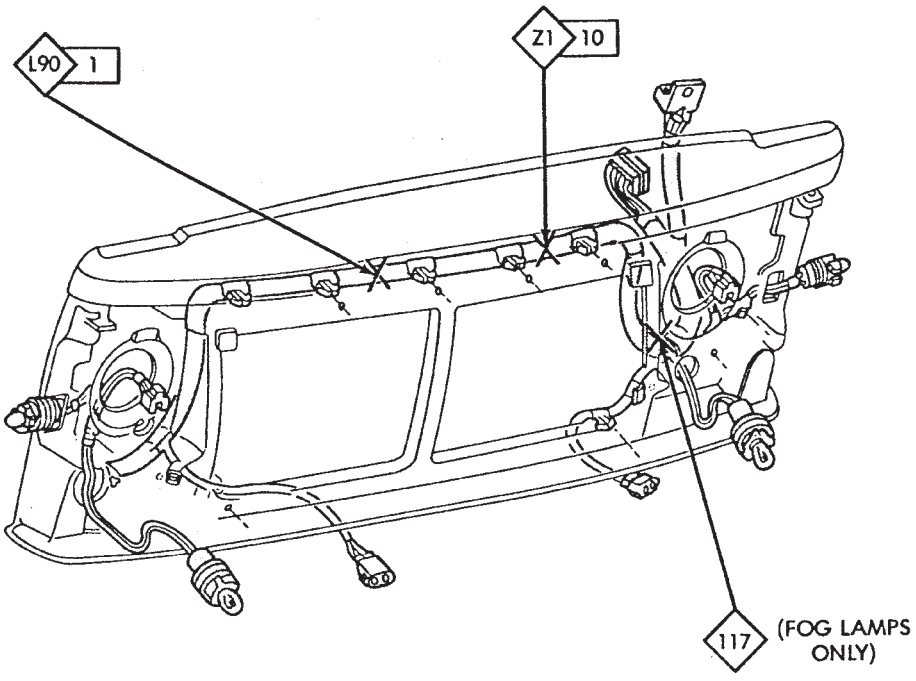


Fig. 6 Front End Splices

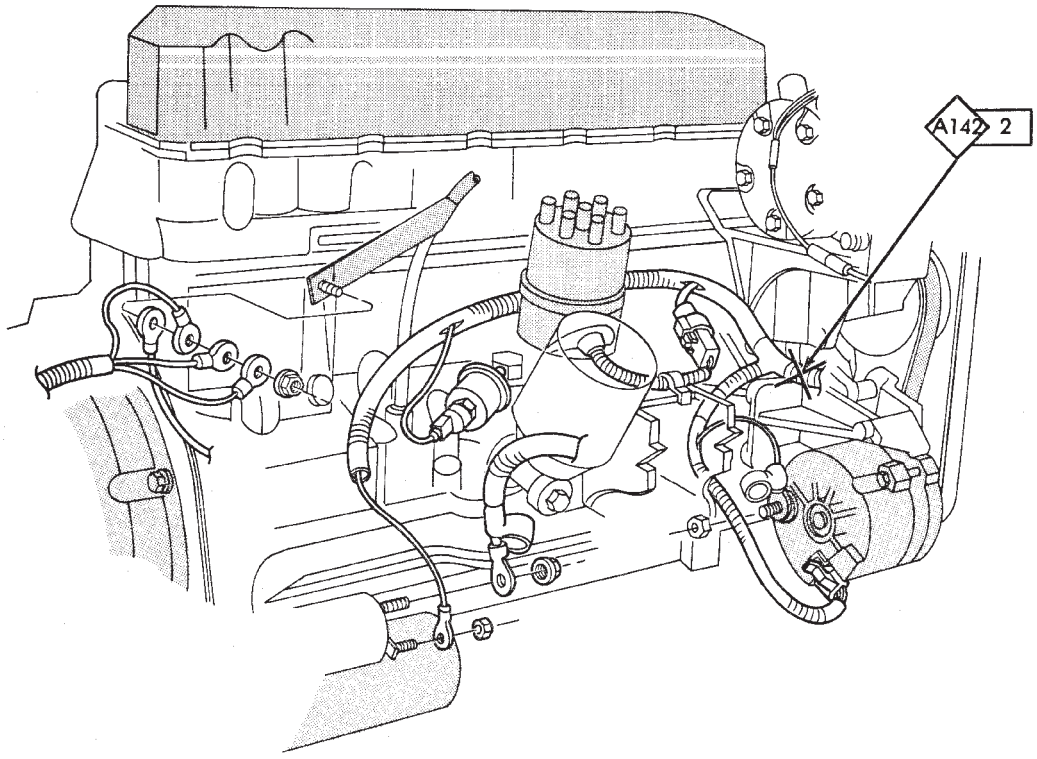


Fig. 7 Engine Splices 4.0L

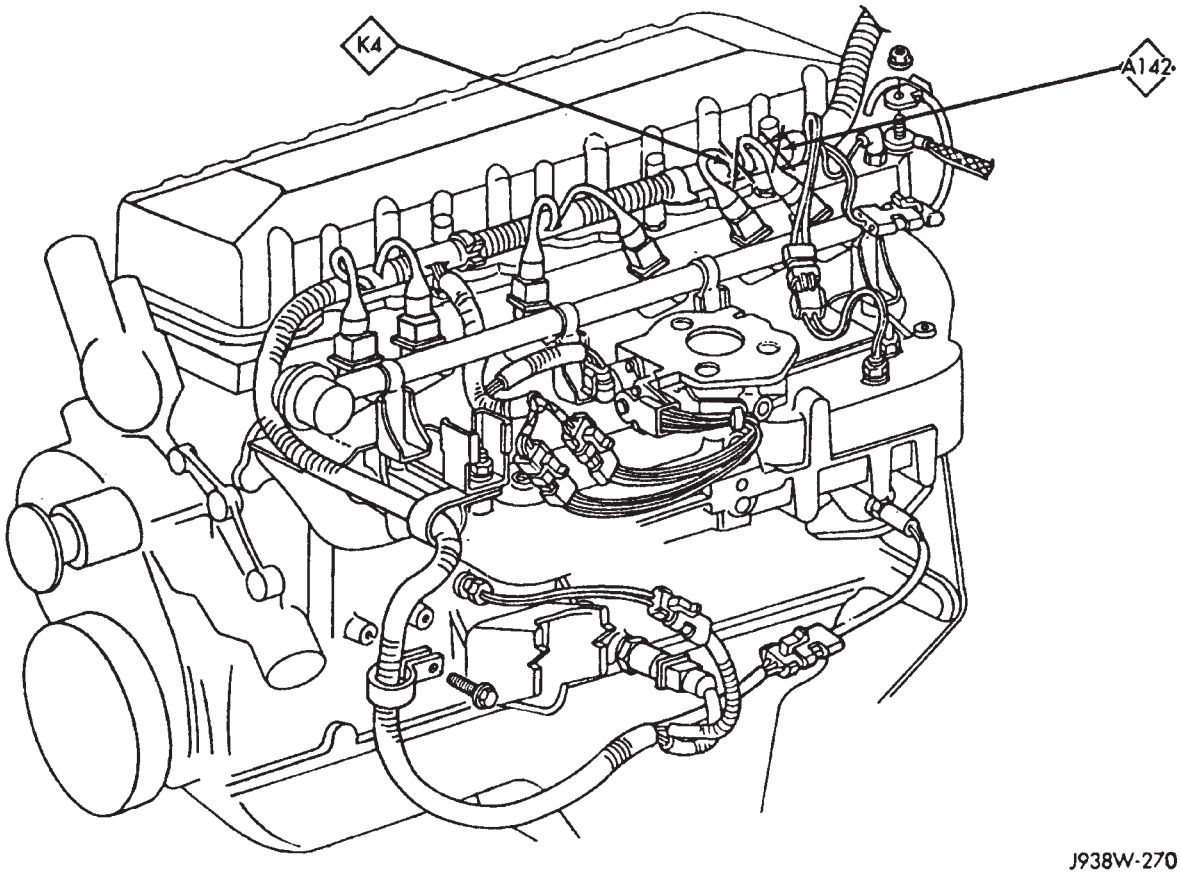
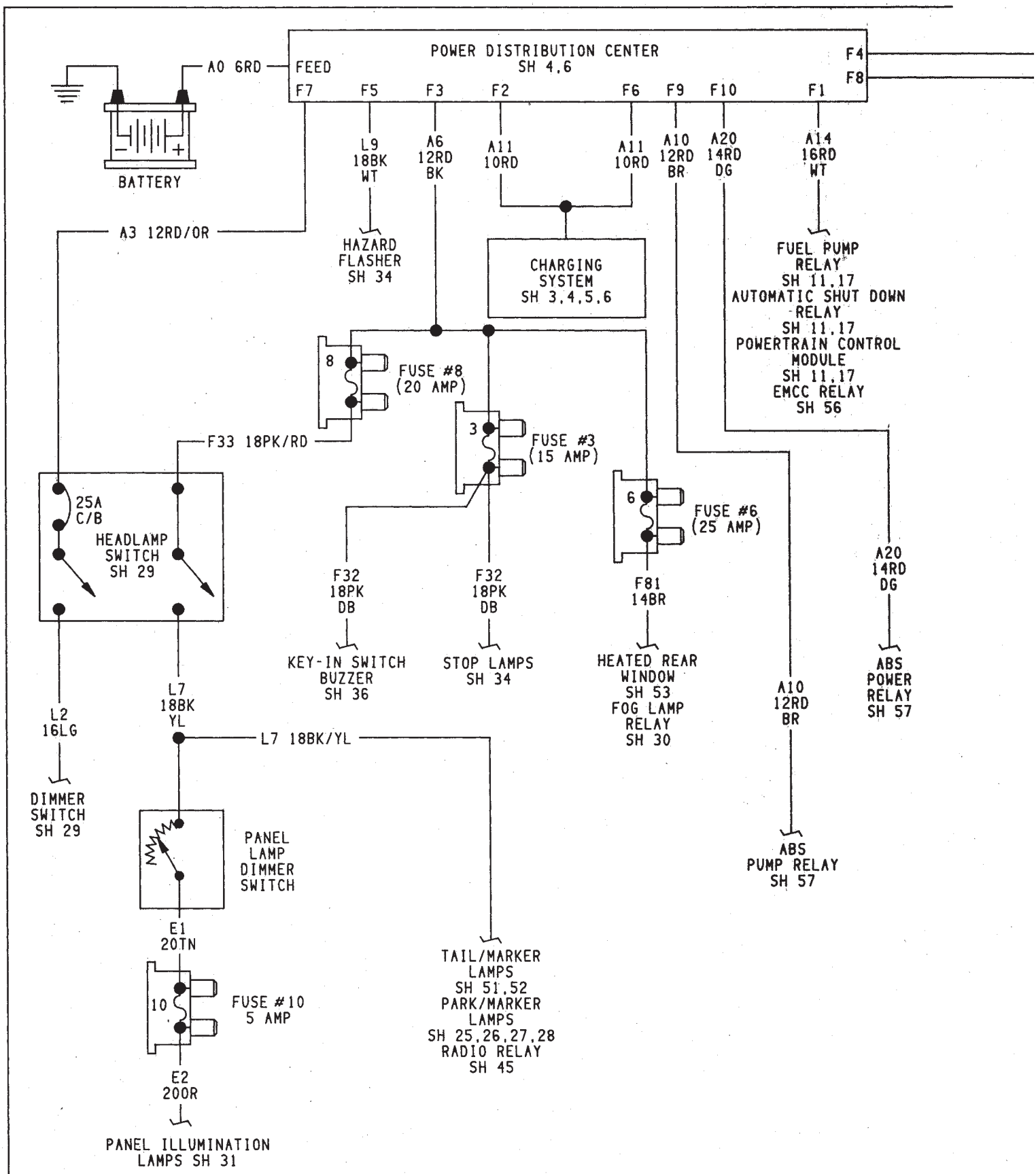


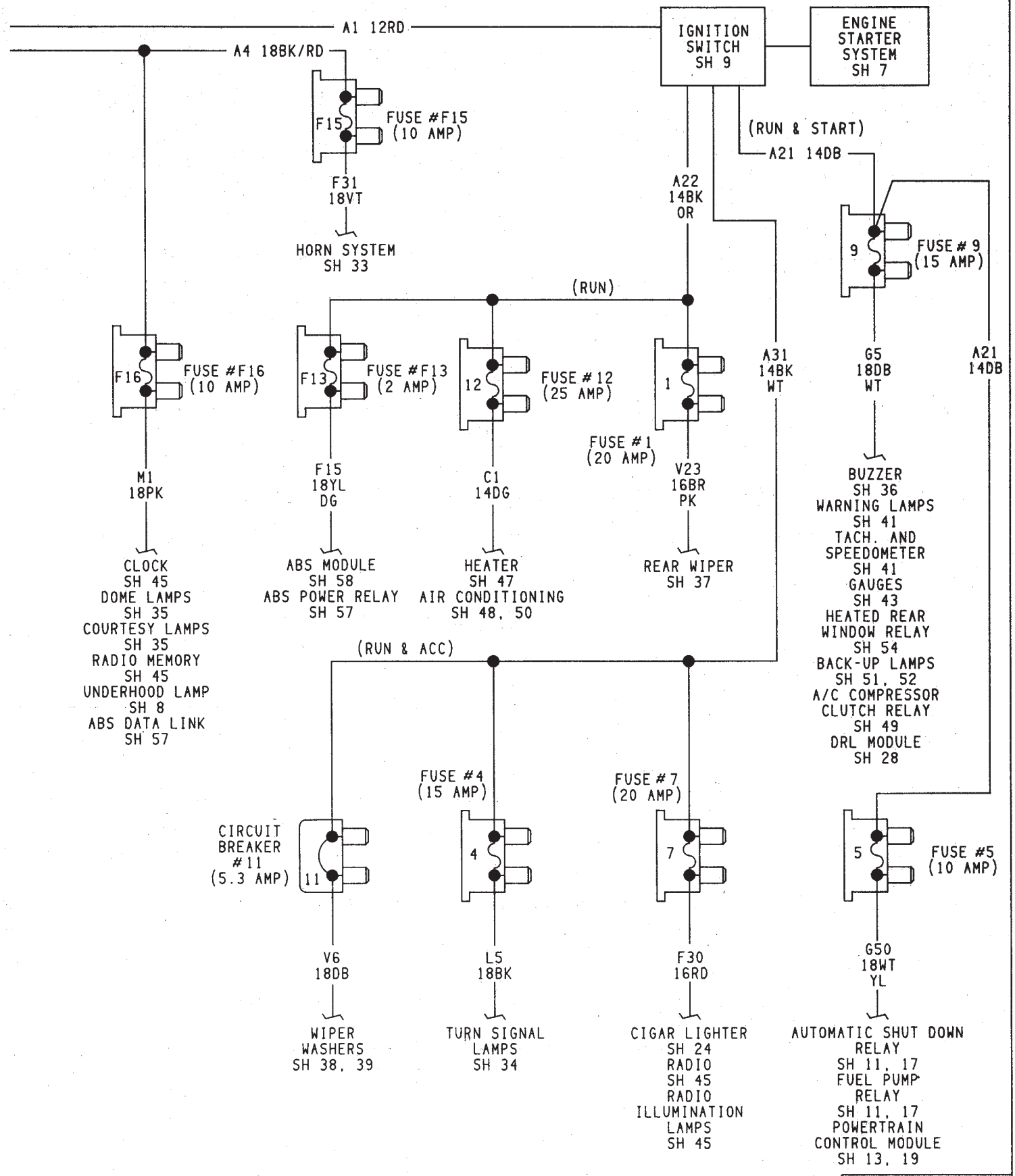
Fig. 8 Engine Splices 4.0L

WIRING DIAGRAMS YJ

ALPHABETICAL INDEX



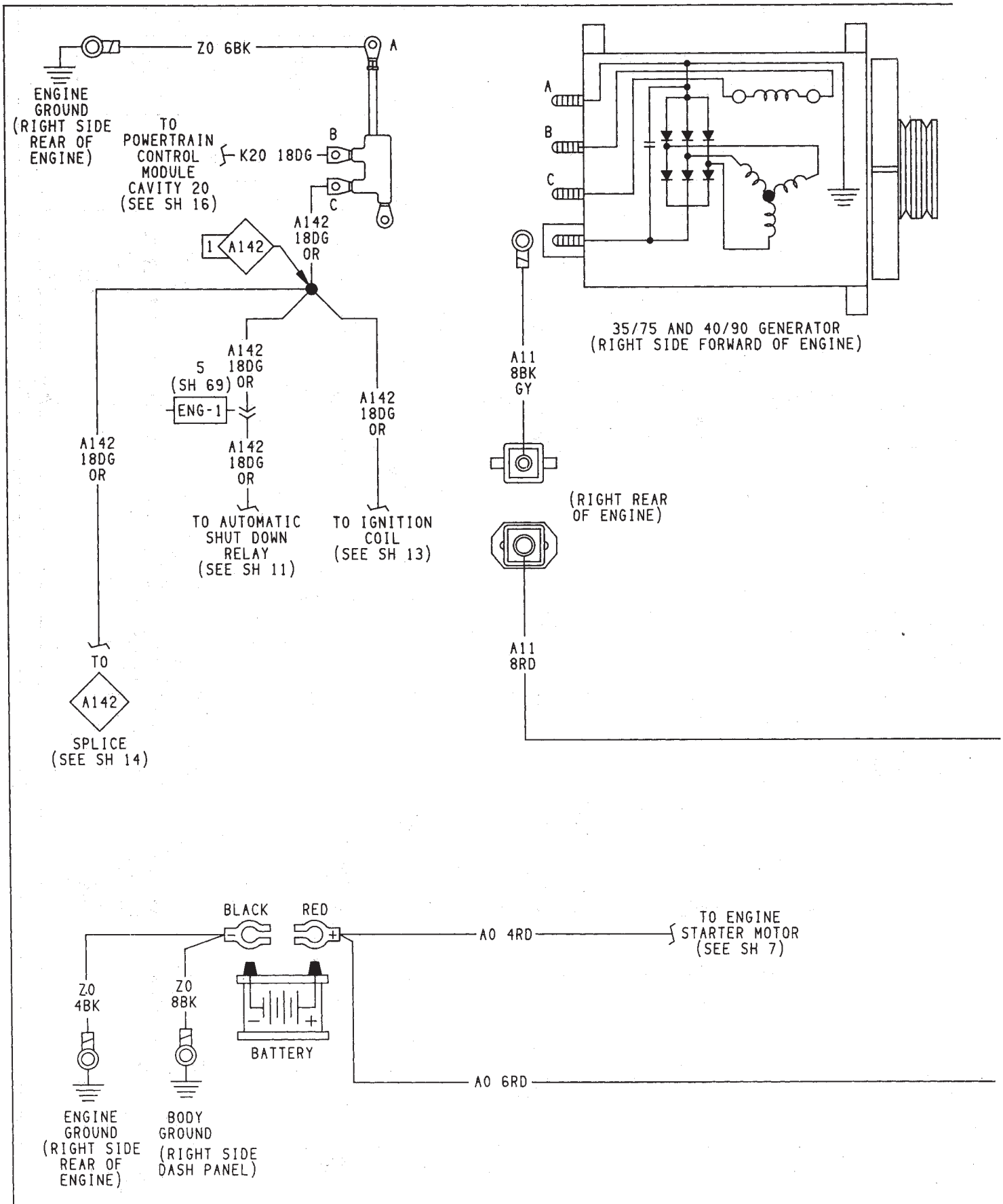
YJ 1 FUSE APPLICATION CHART J948W-5



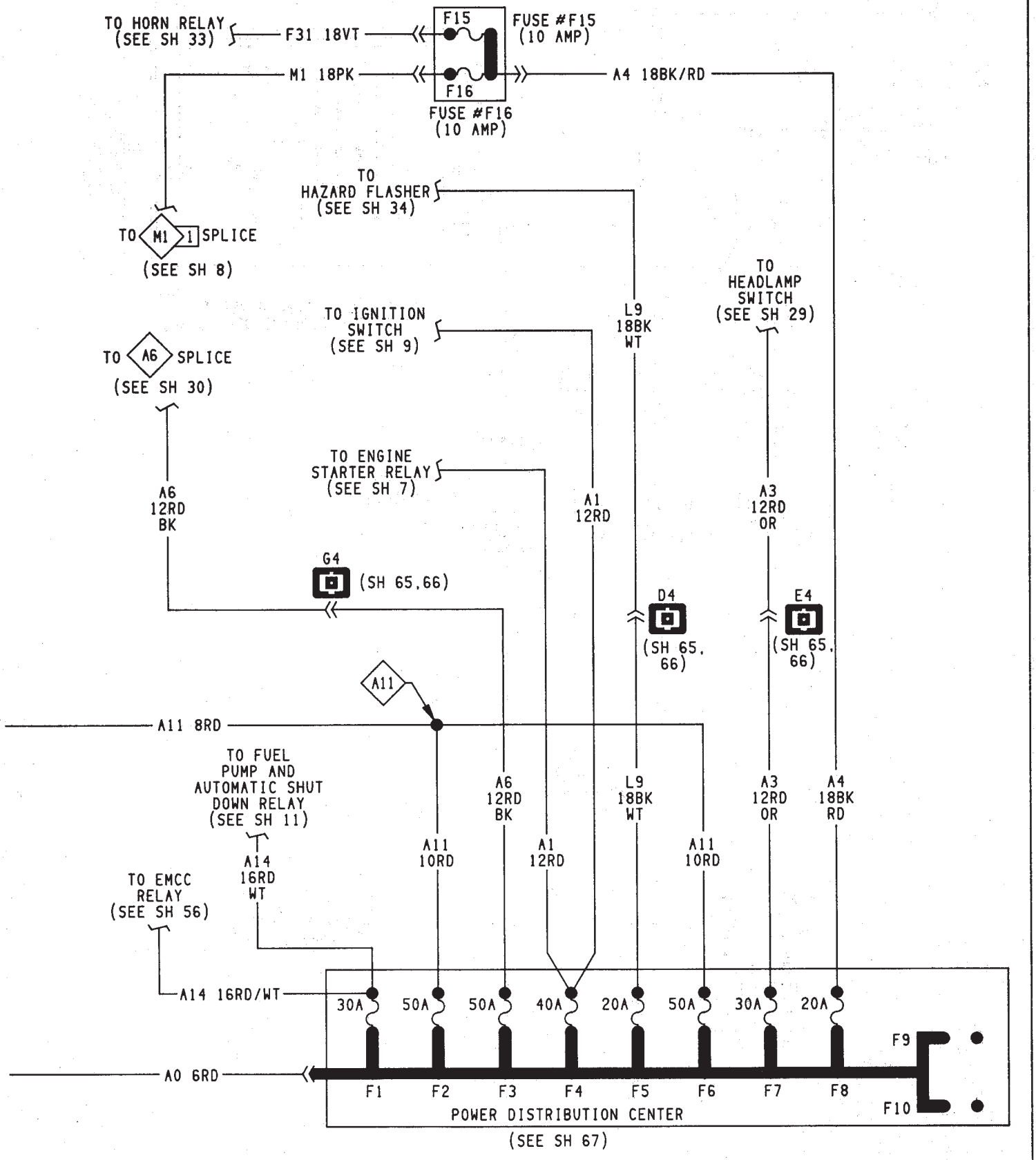
J948W-5

FUSE APPLICATION CHART

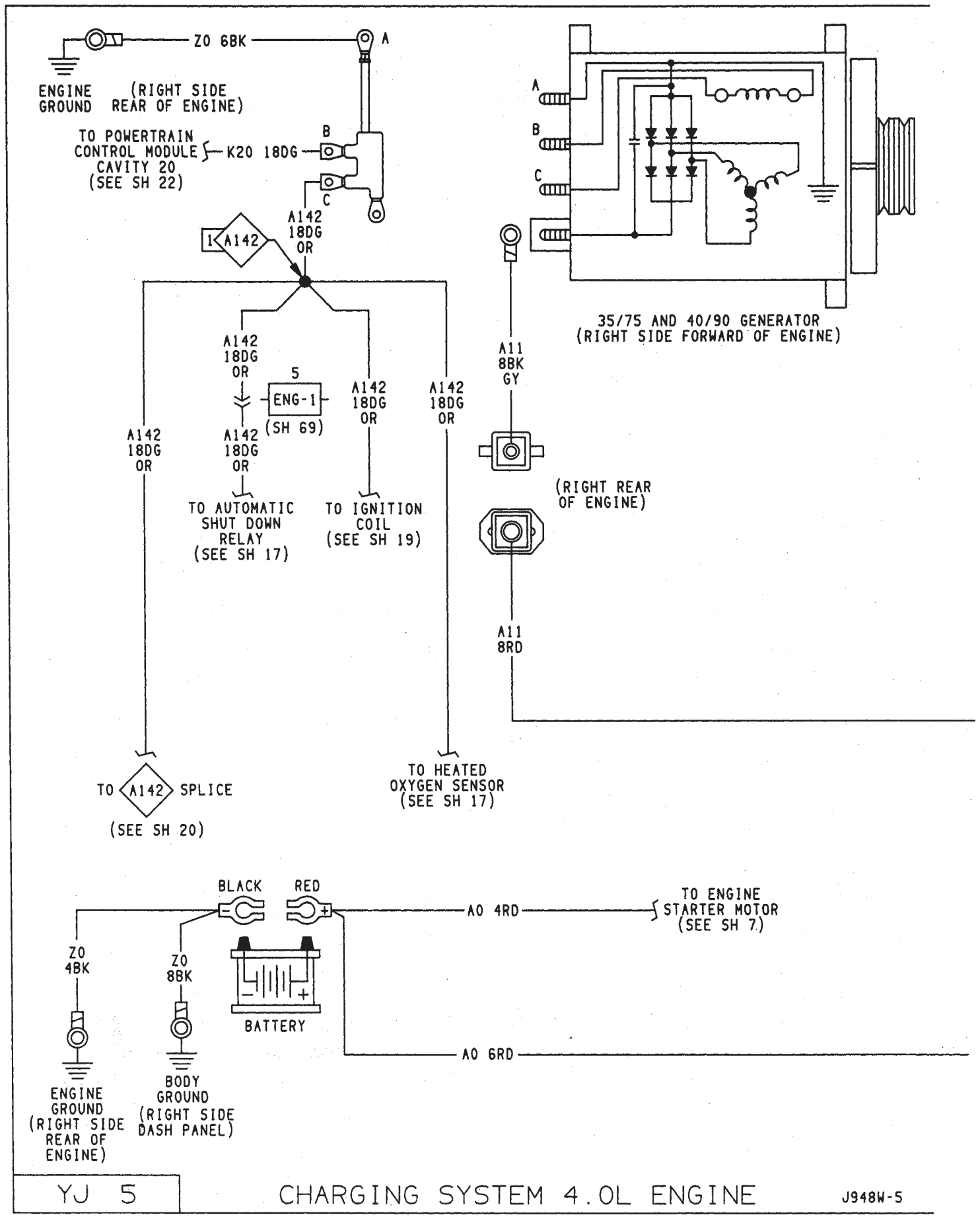
YJ 2



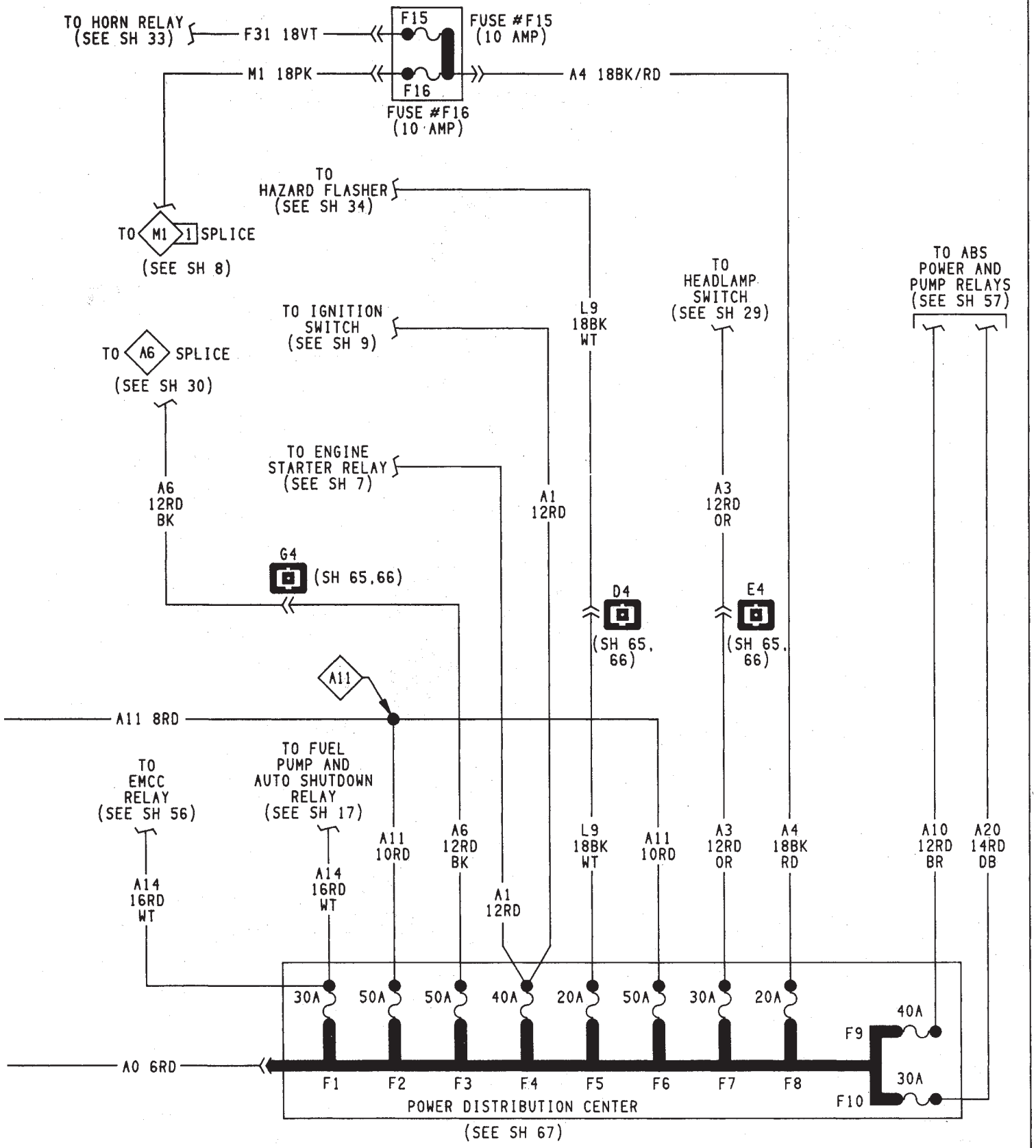
YJ 3 CHARGING SYSTEM 2.5L ENGINE J948W-5



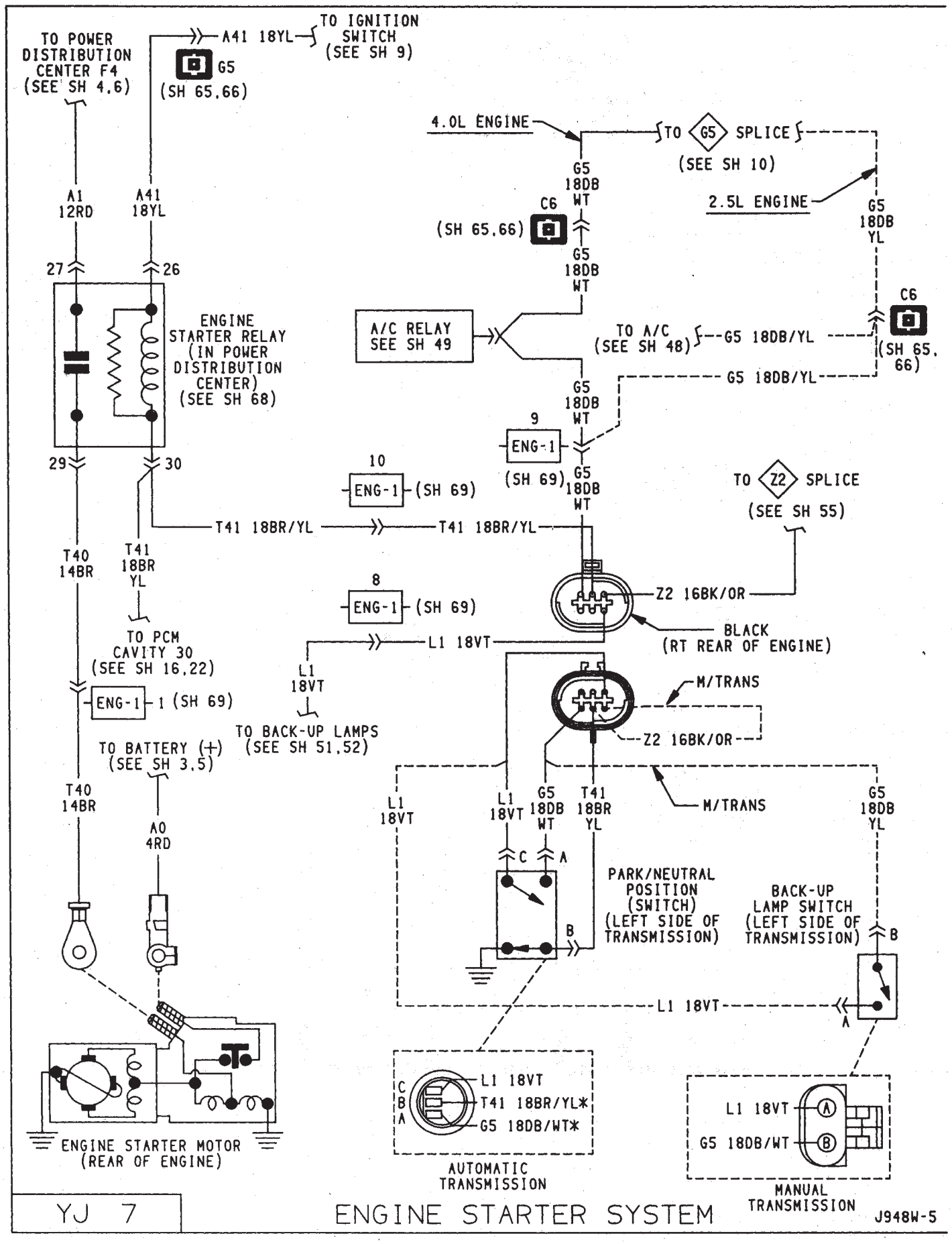
J948W-5 CHARGING SYSTEM 2.5L ENGINE YJ 4



YJ 5 CHARGING SYSTEM 4.0L ENGINE J948W-5



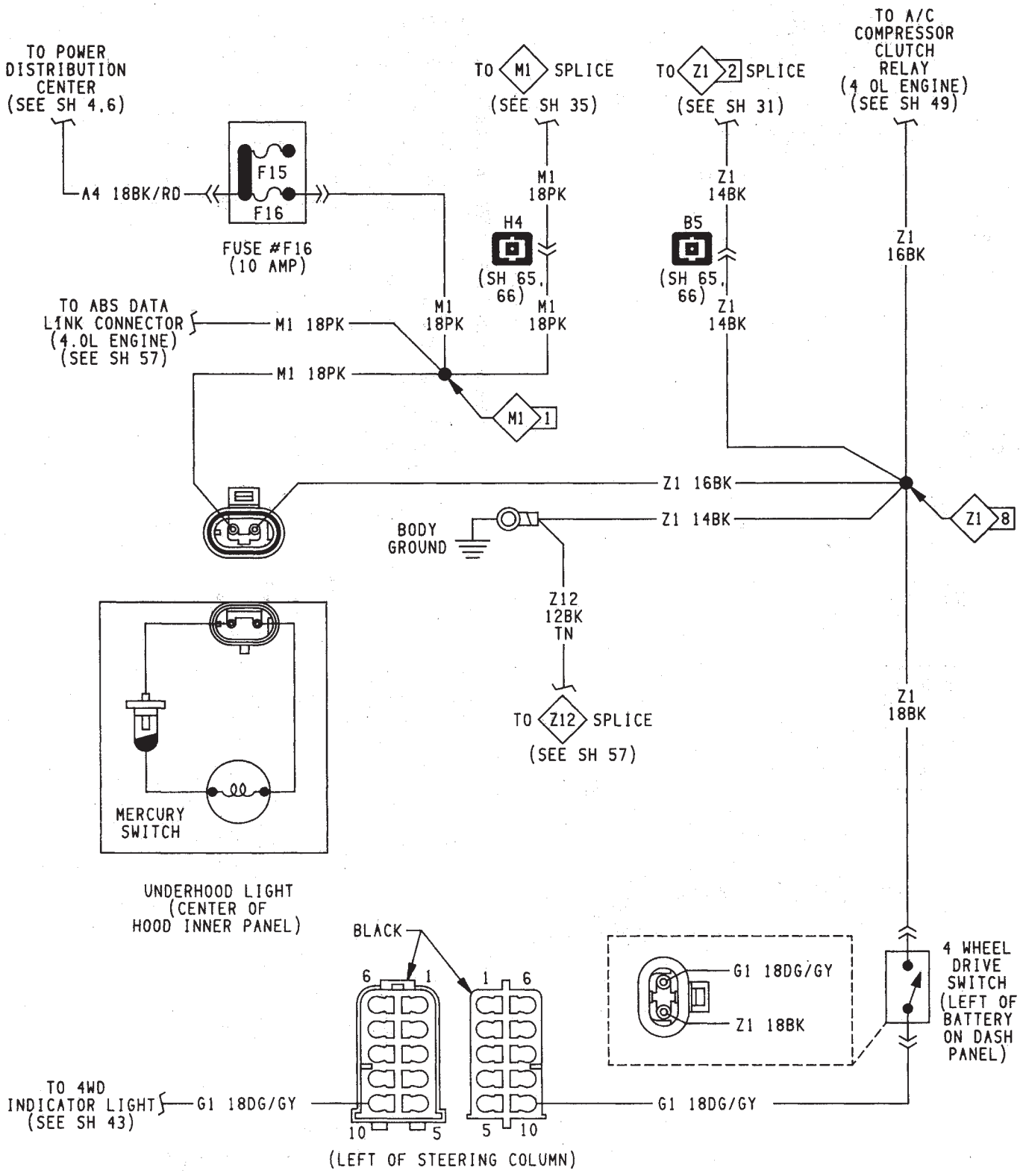
J948W-5 CHARGING SYSTEM 4.0L ENGINE YJ 6



YJ 7

ENGINE STARTER SYSTEM

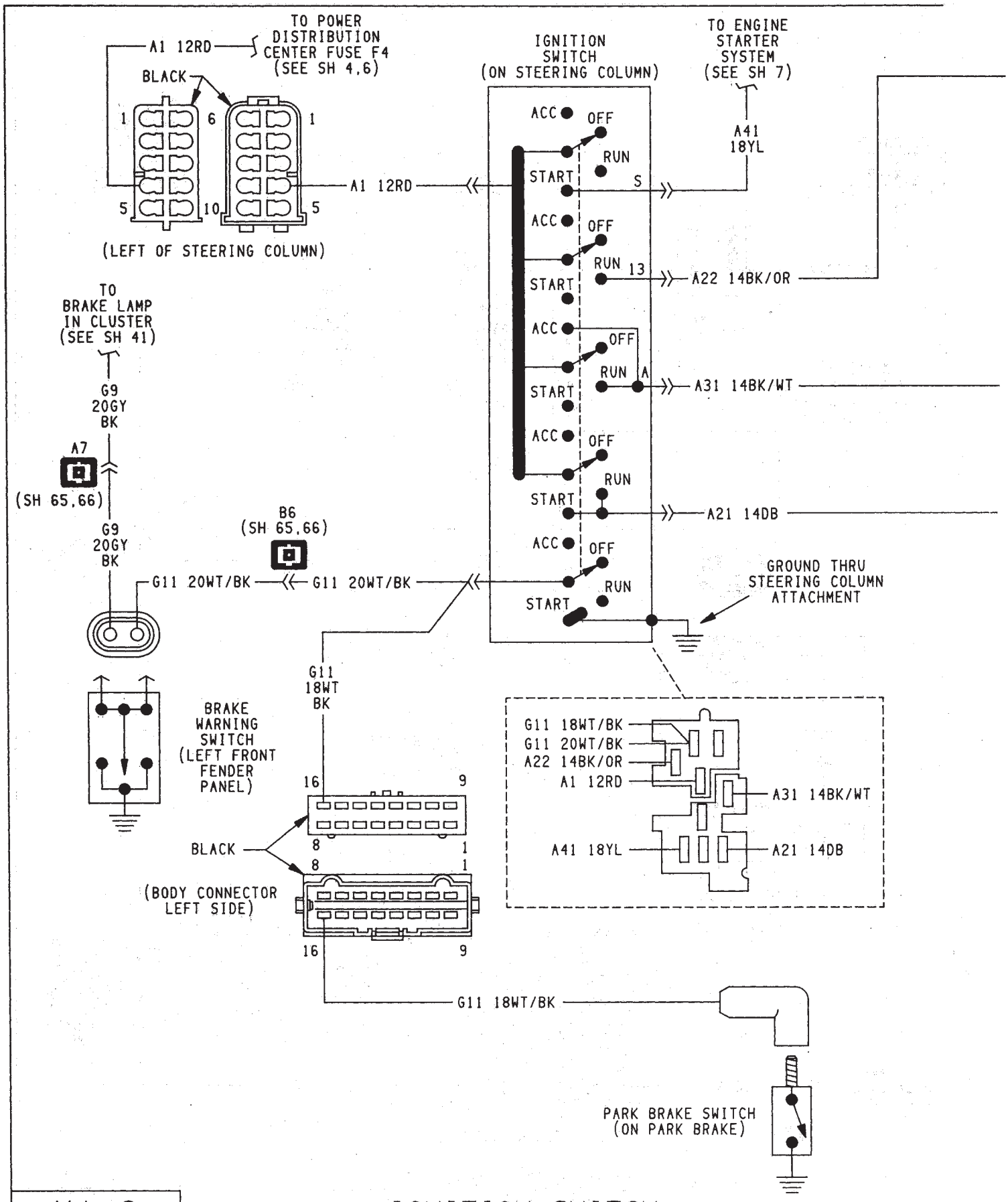
J948W-5



4WD COMMAND TRAC SWITCH UNDERHOOD LIGHT

J948W-5

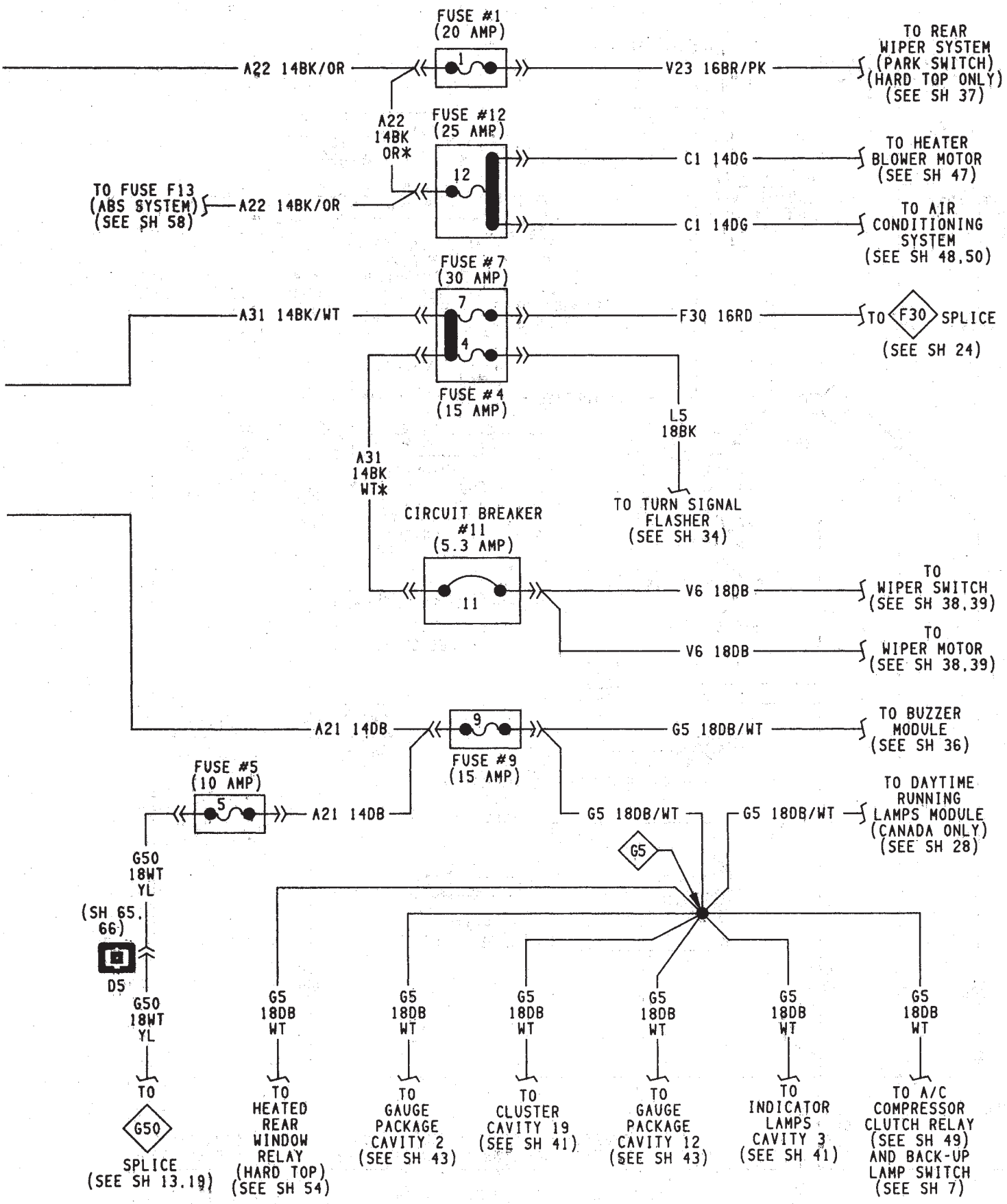
YJ 8



YJ 9

IGNITION SWITCH

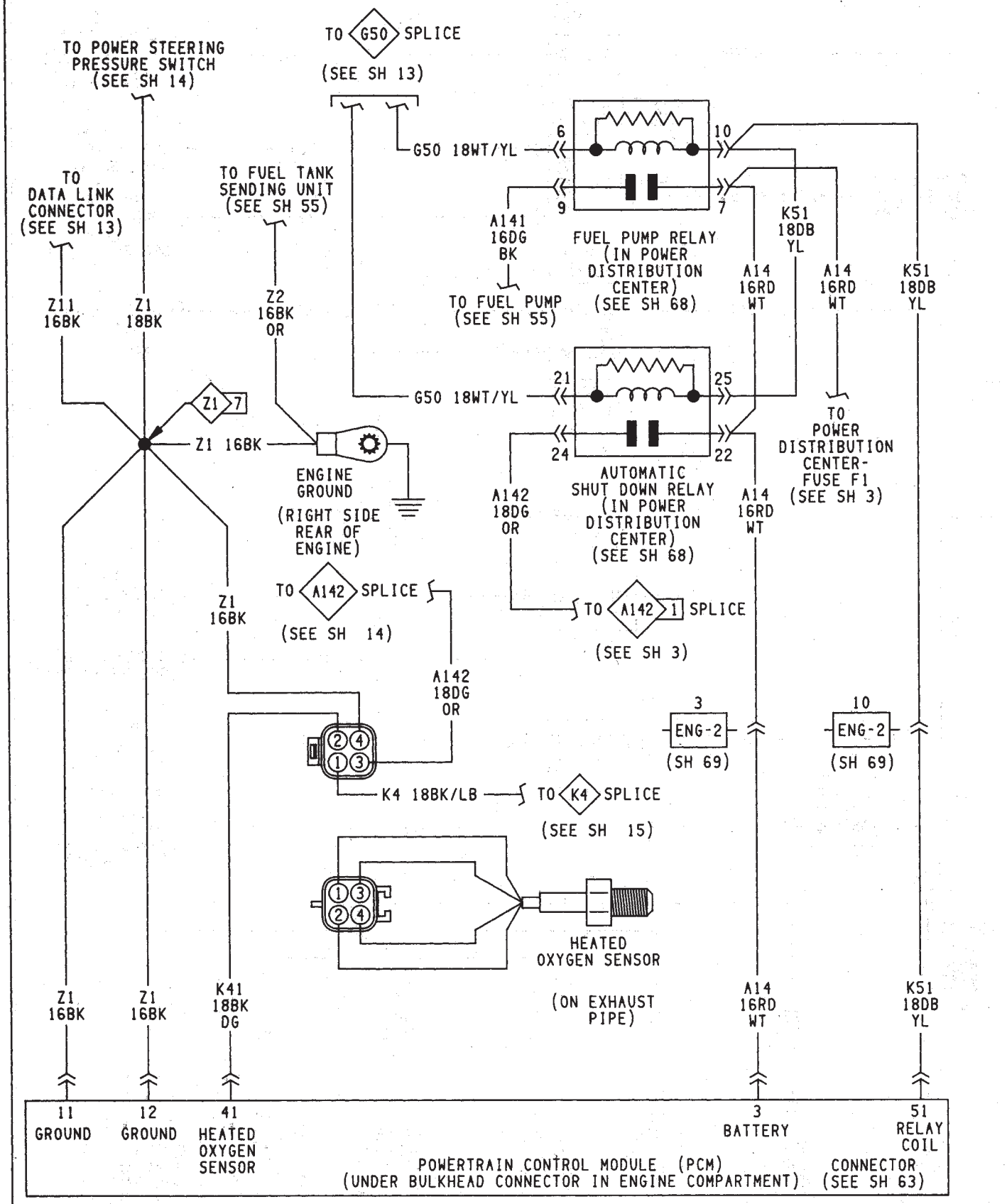
J948W-5



J948W-5

IGNITION SWITCH

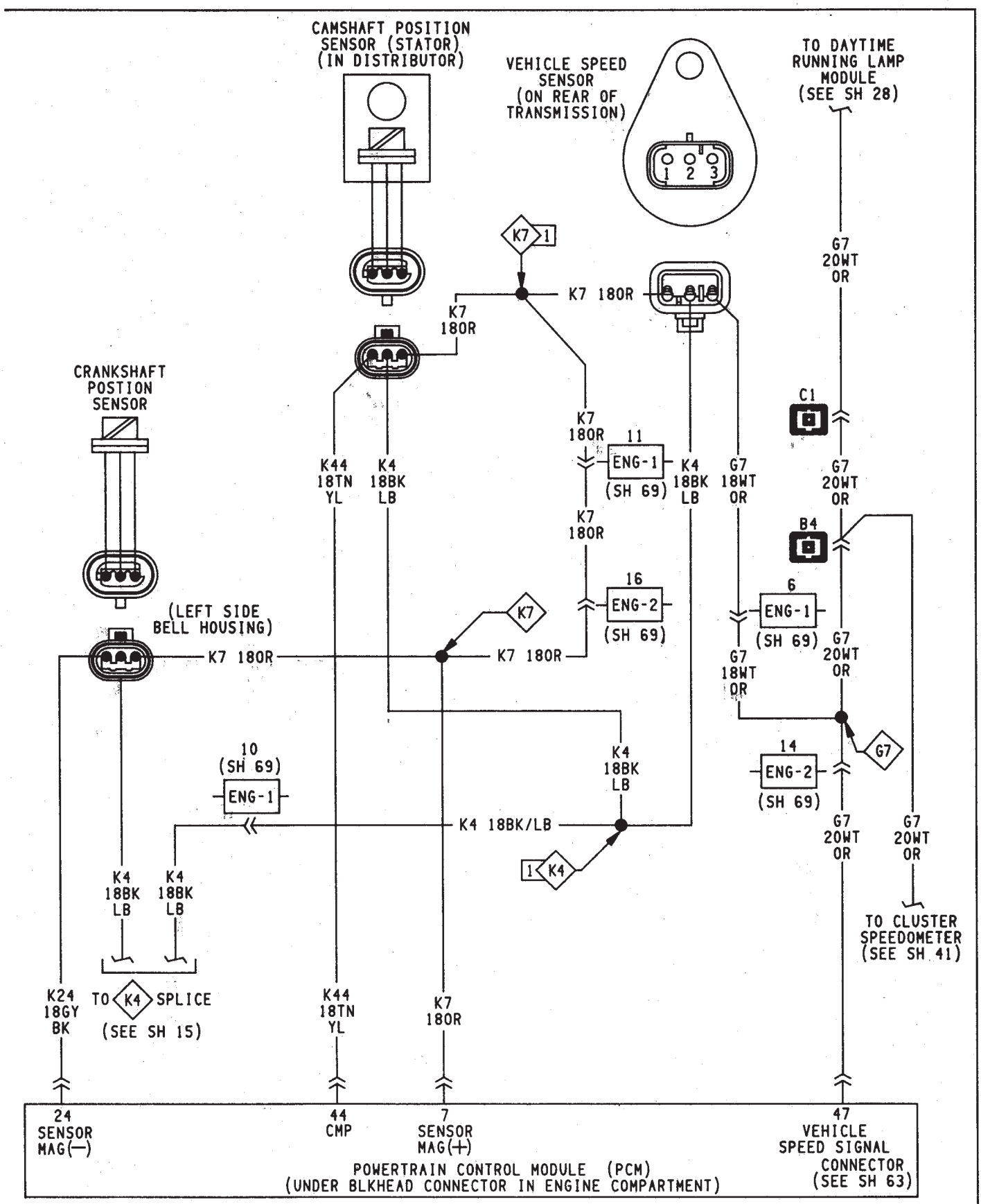
YJ 10



FUEL INJECTION
IGNITION SYSTEM 2.5L ENGINE

YJ 11

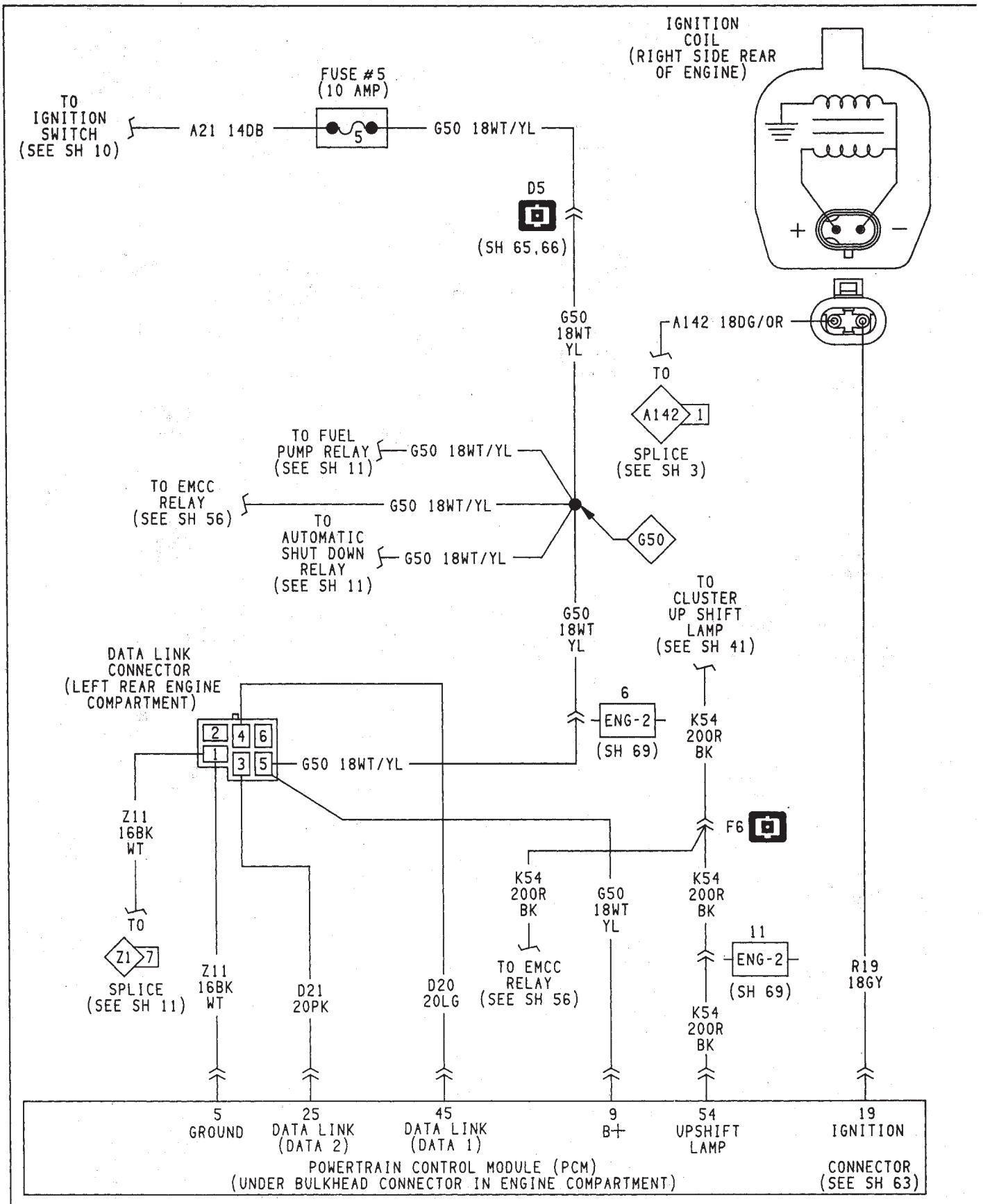
J948W-5



FUEL INJECTION
IGNITION SYSTEM 2.5L ENGINE

J948W-5

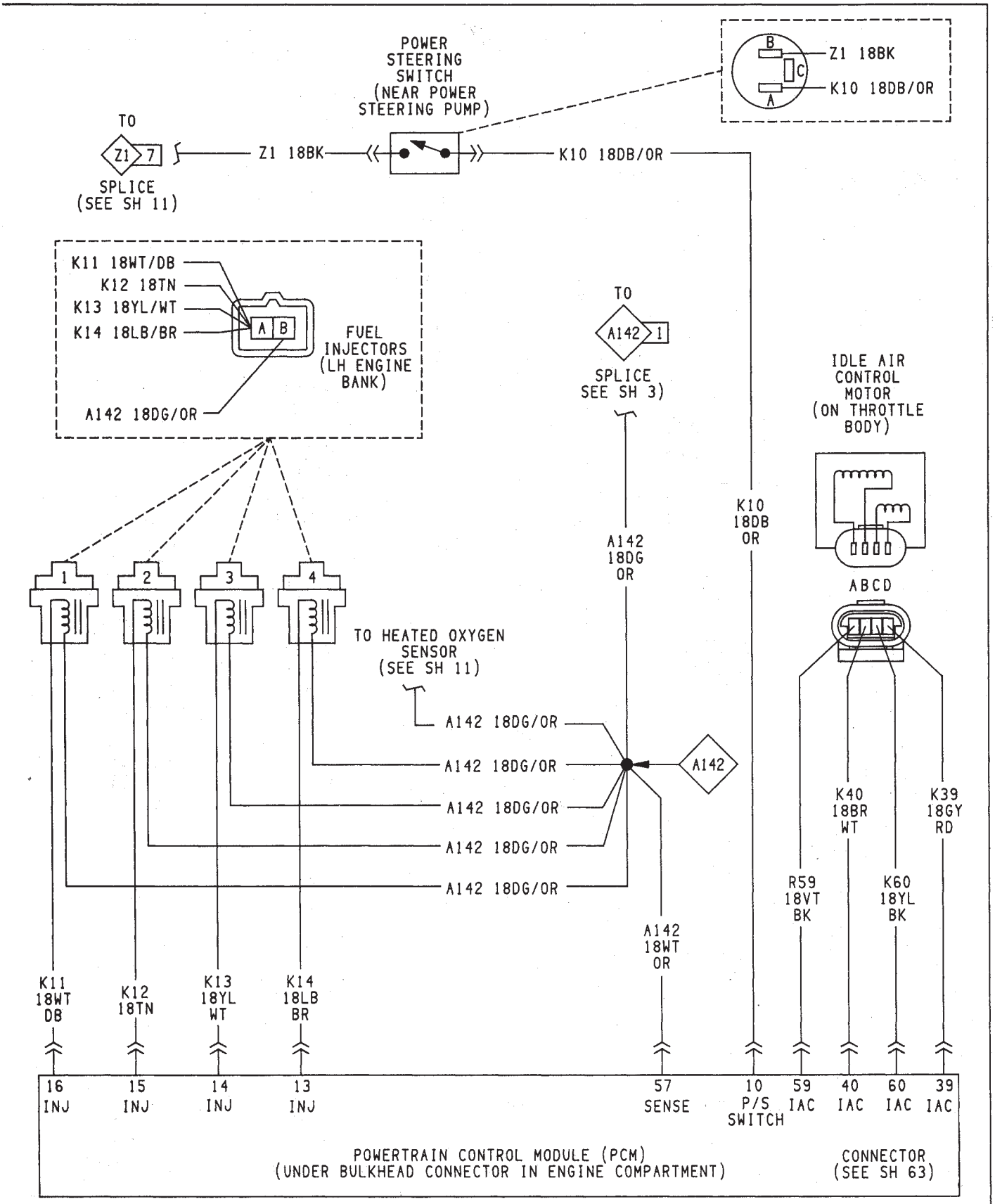
YJ 12



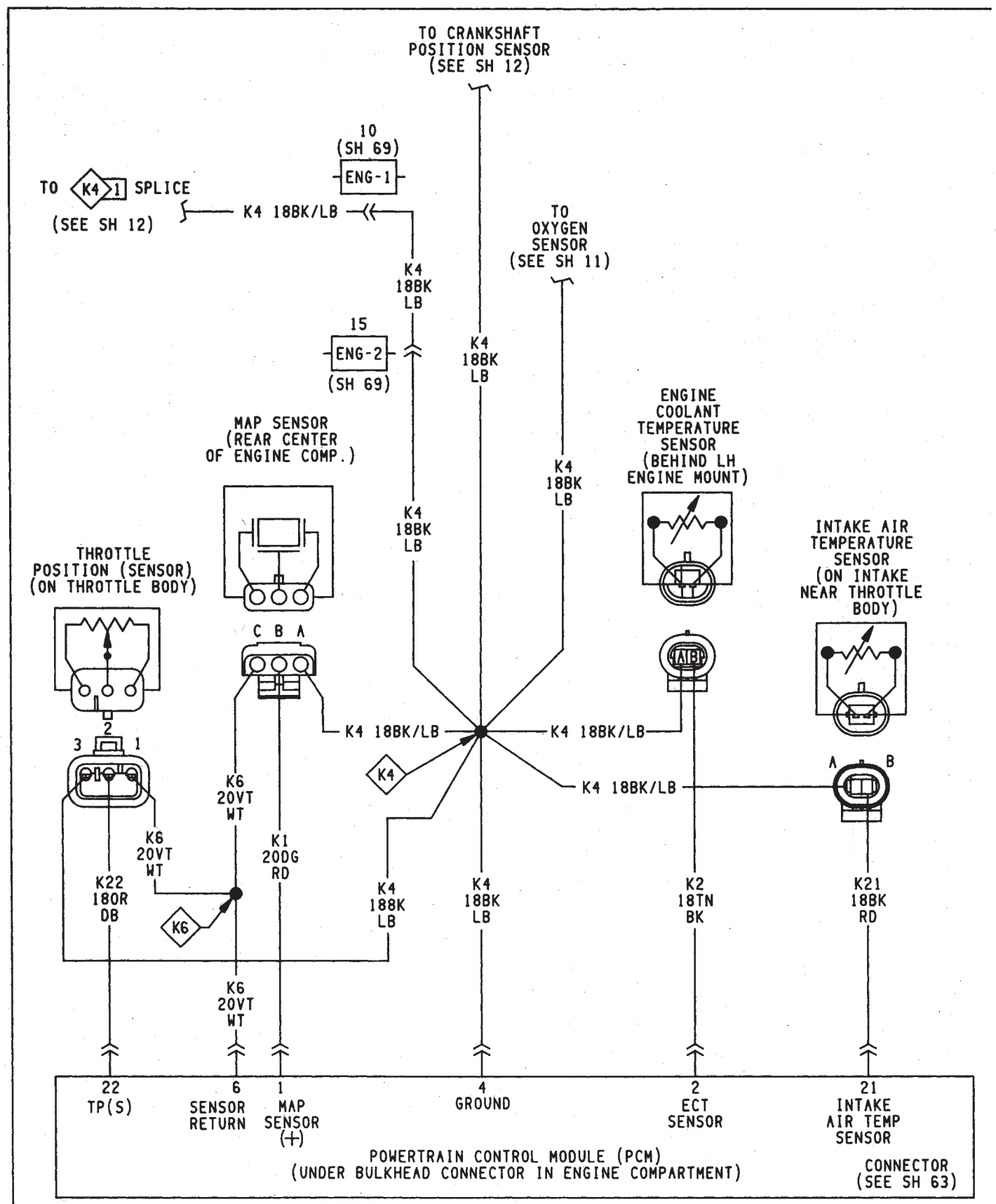
FUEL INJECTION
IGNITION SYSTEM 2.5L ENGINE

YJ 13

J948W-5



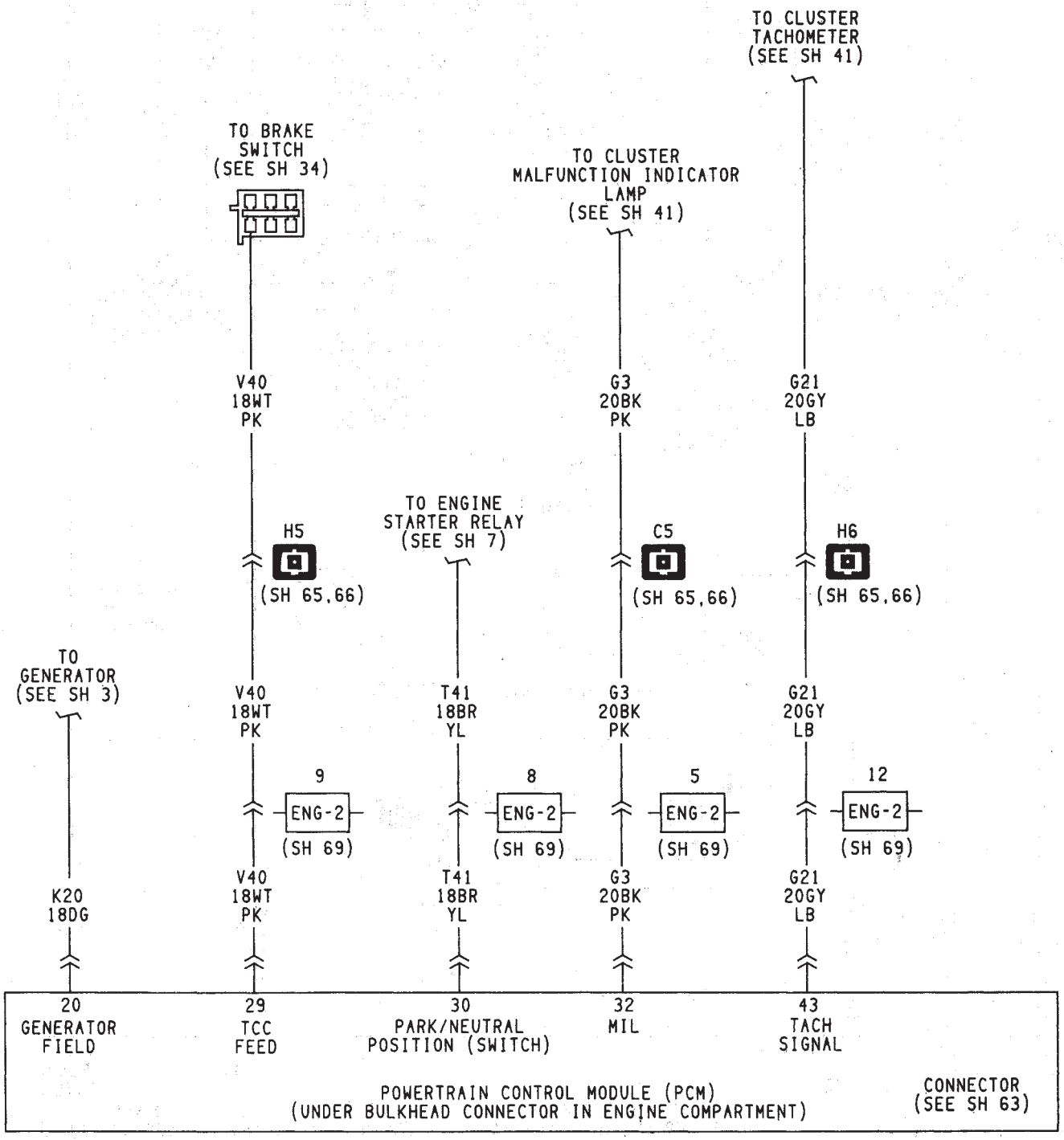
FUEL INJECTION
IGNITION SYSTEM 2.5L ENGINE



FUEL INJECTION
IGNITION SYSTEM 2.5L ENGINE

YJ 15

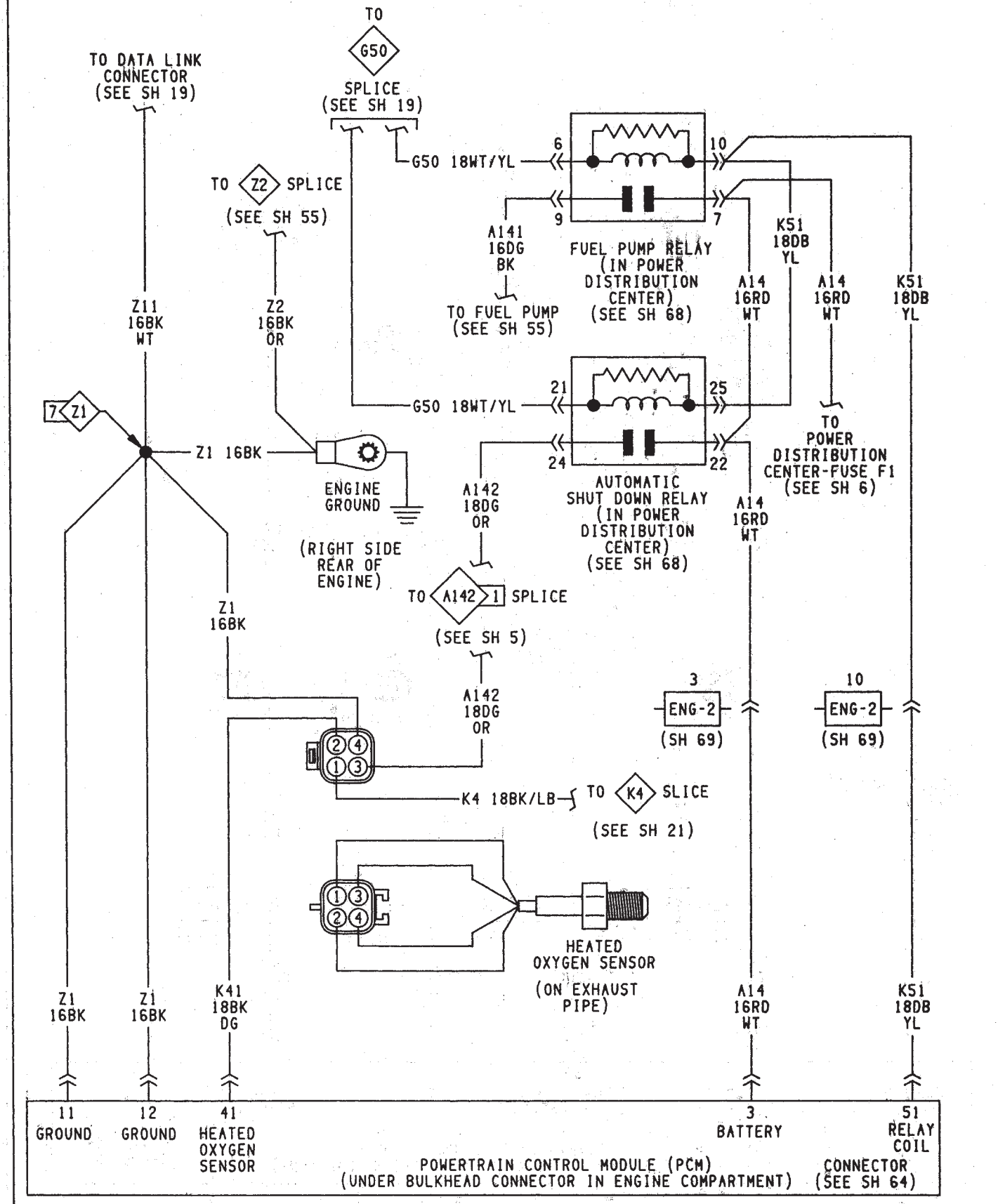
J948W-5



FUEL INJECTION
IGNITION SYSTEM 2.5L ENGINE

J948W-5

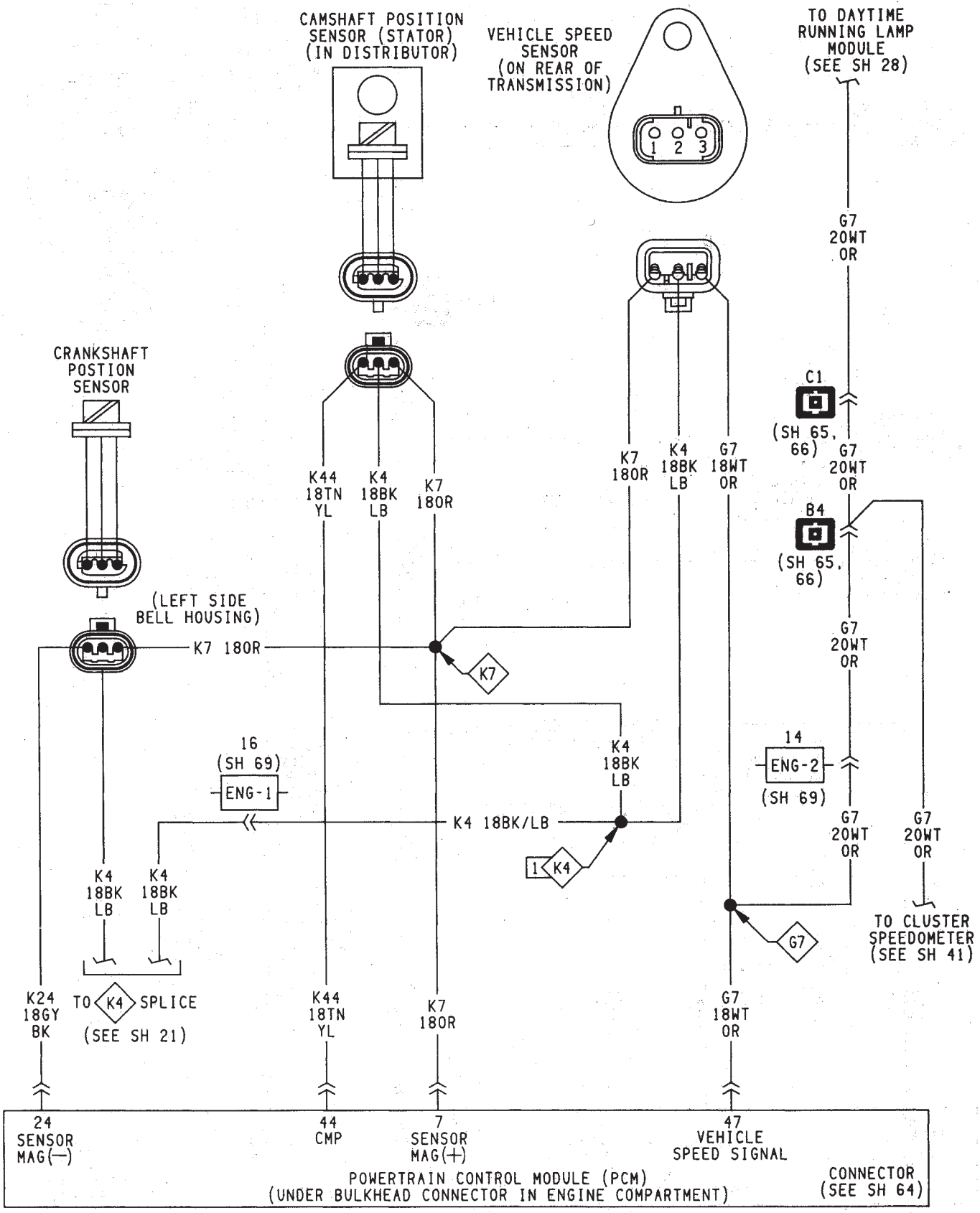
YJ 16



FUEL INJECTION
IGNITION SYSTEM 4.0L ENGINE

YJ 17

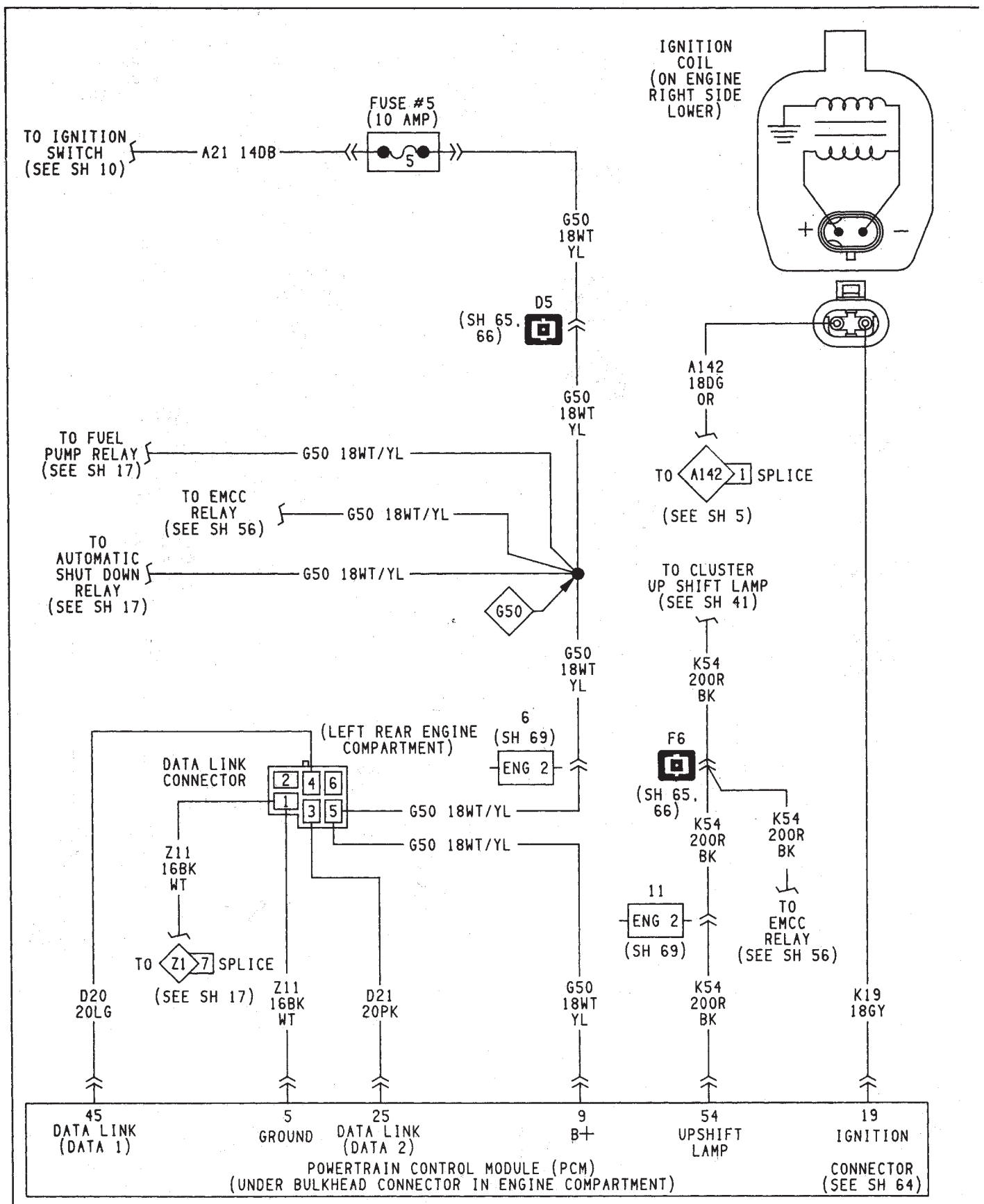
J948W-5



FUEL INJECTION
IGNITION SYSTEM 4.0L ENGINE

J948W-5

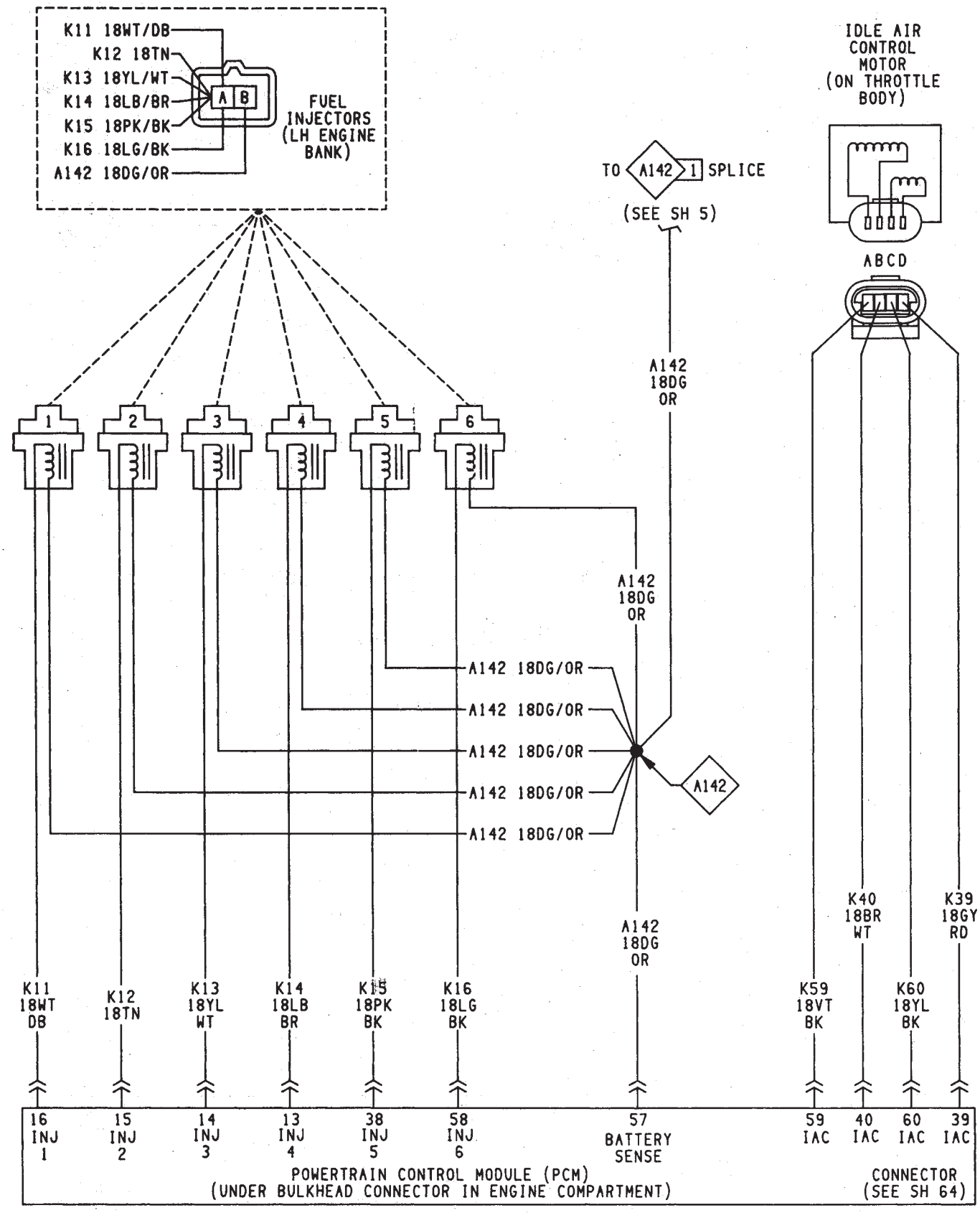
YJ 18



FUEL INJECTION
IGNITION SYSTEM 4.0L ENGINE

YJ 19

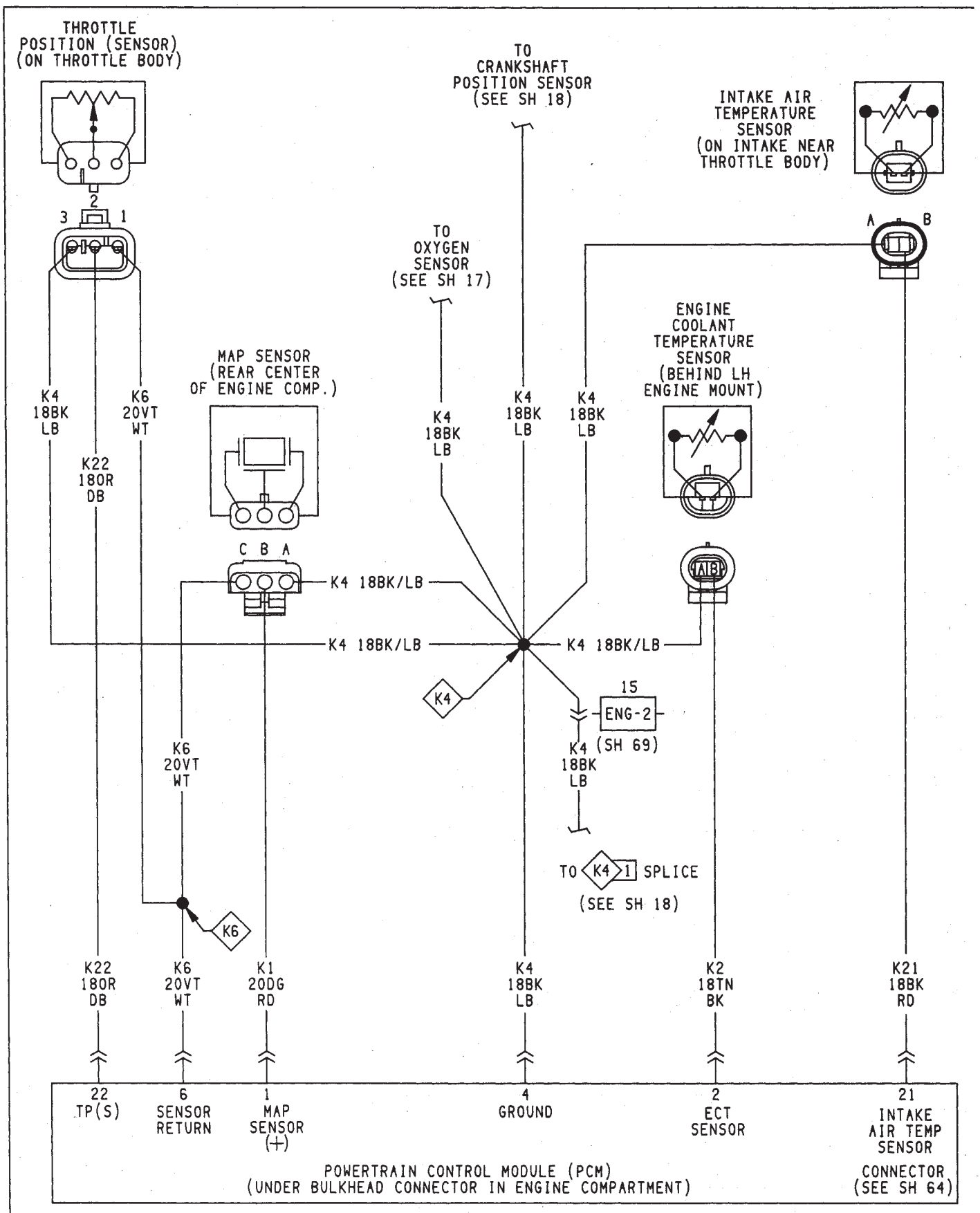
J948W-5



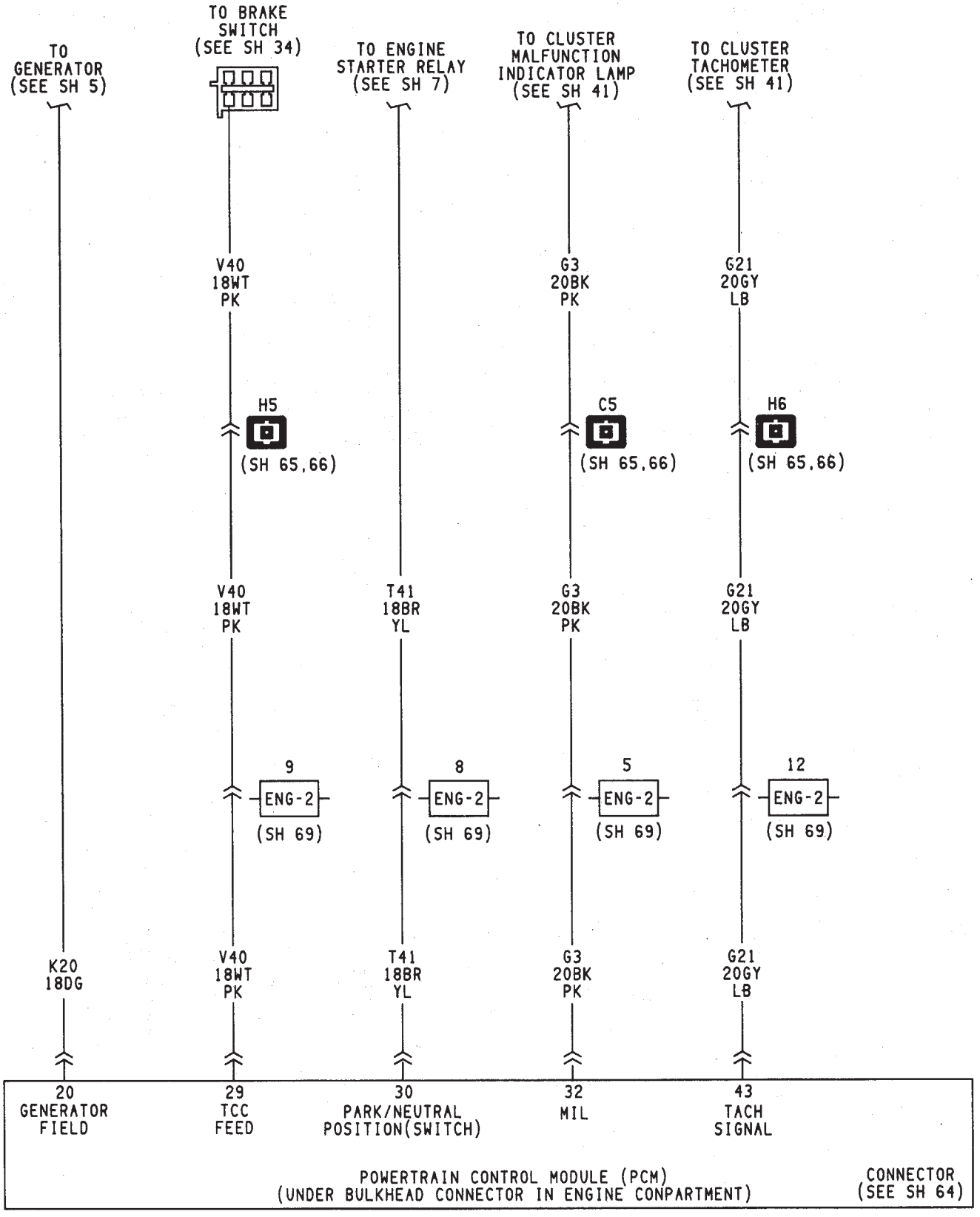
FUEL INJECTION
IGNITION SYSTEM 4.0L ENGINE

J948W-5

YJ 20



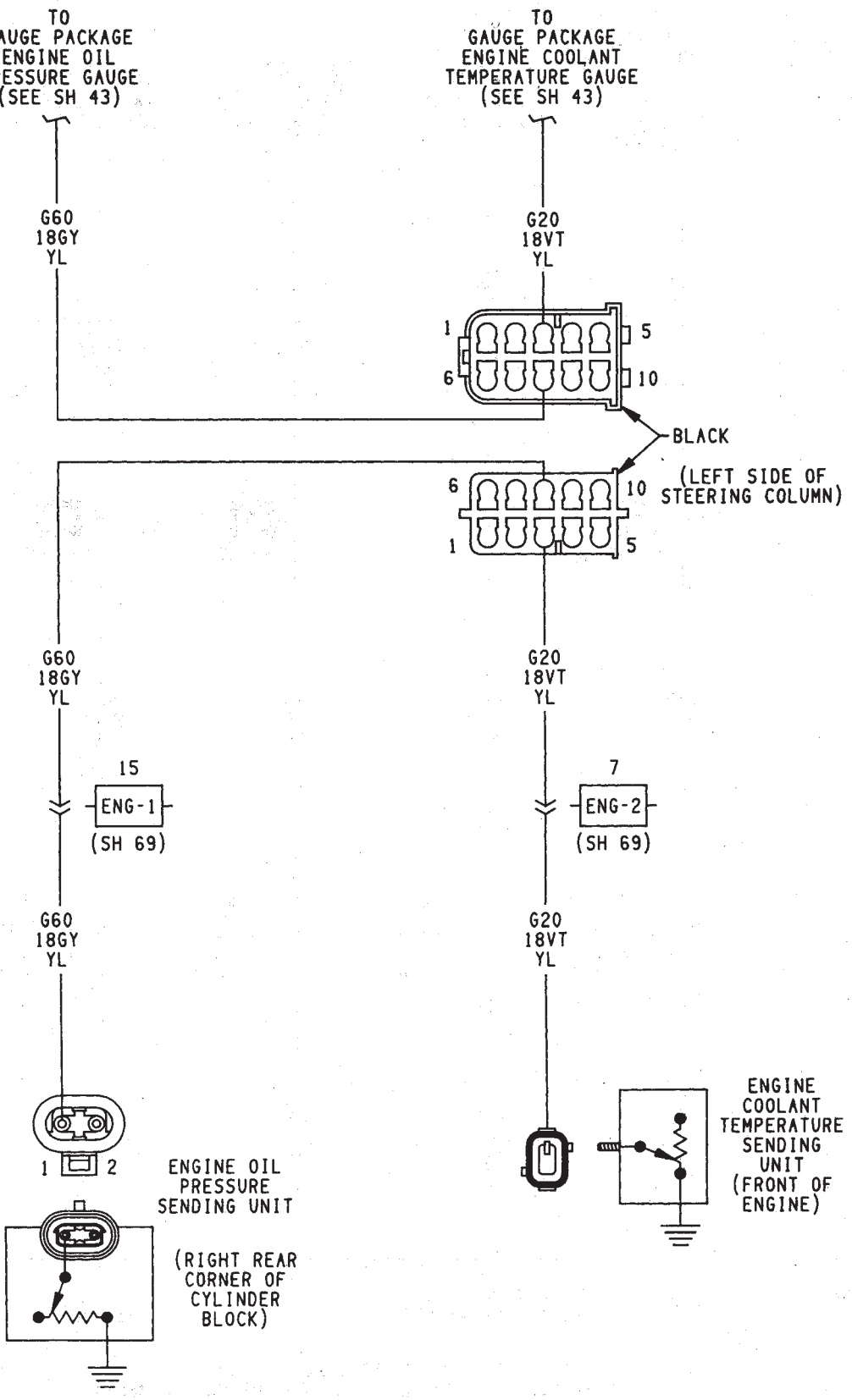
FUEL INJECTION
YJ 21 IGNITION SYSTEM 4.0L ENGINE J948W-5



FUEL INJECTION
IGNITION SYSTEM 4.0L ENGINE

J948W-5

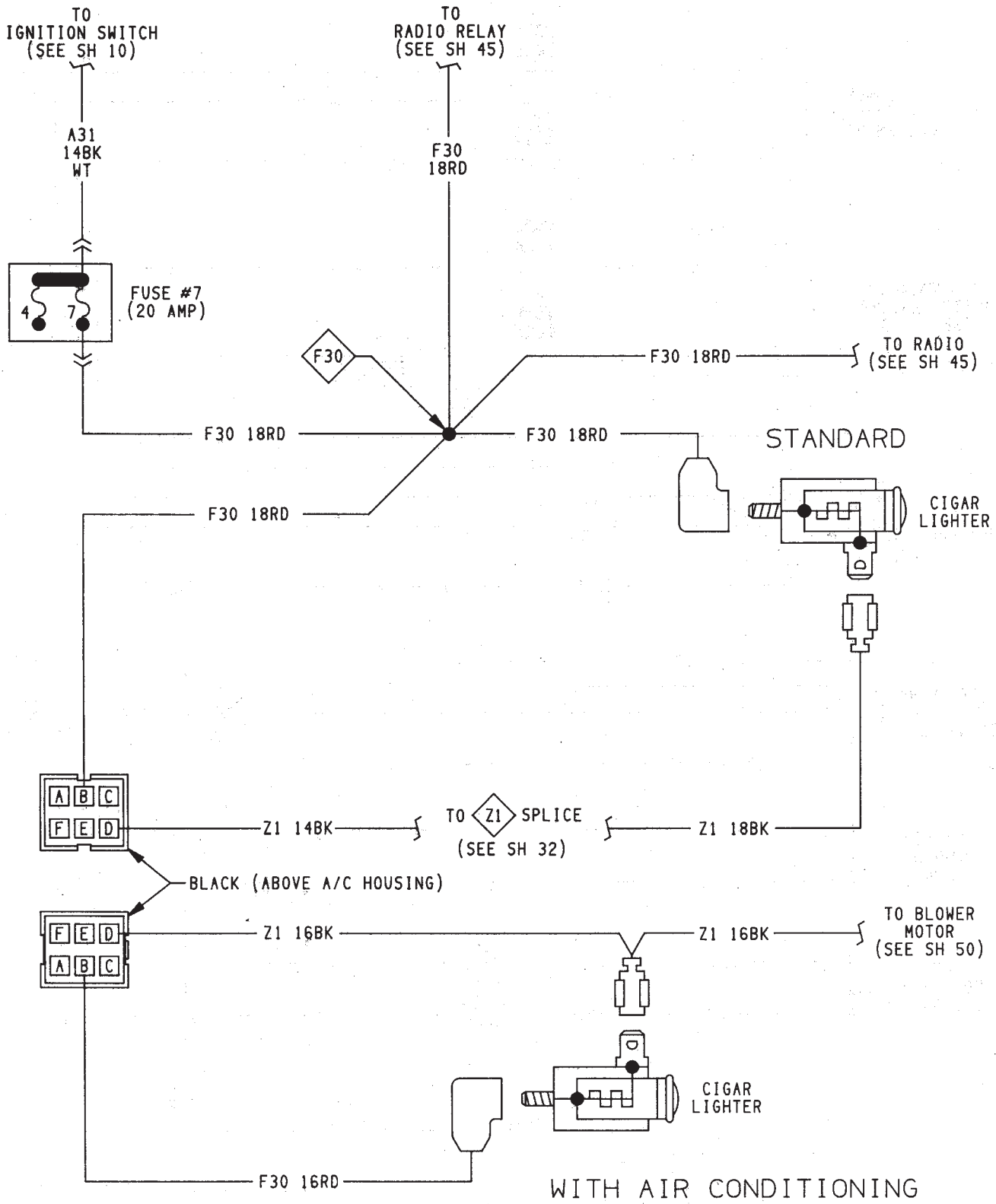
YJ 22

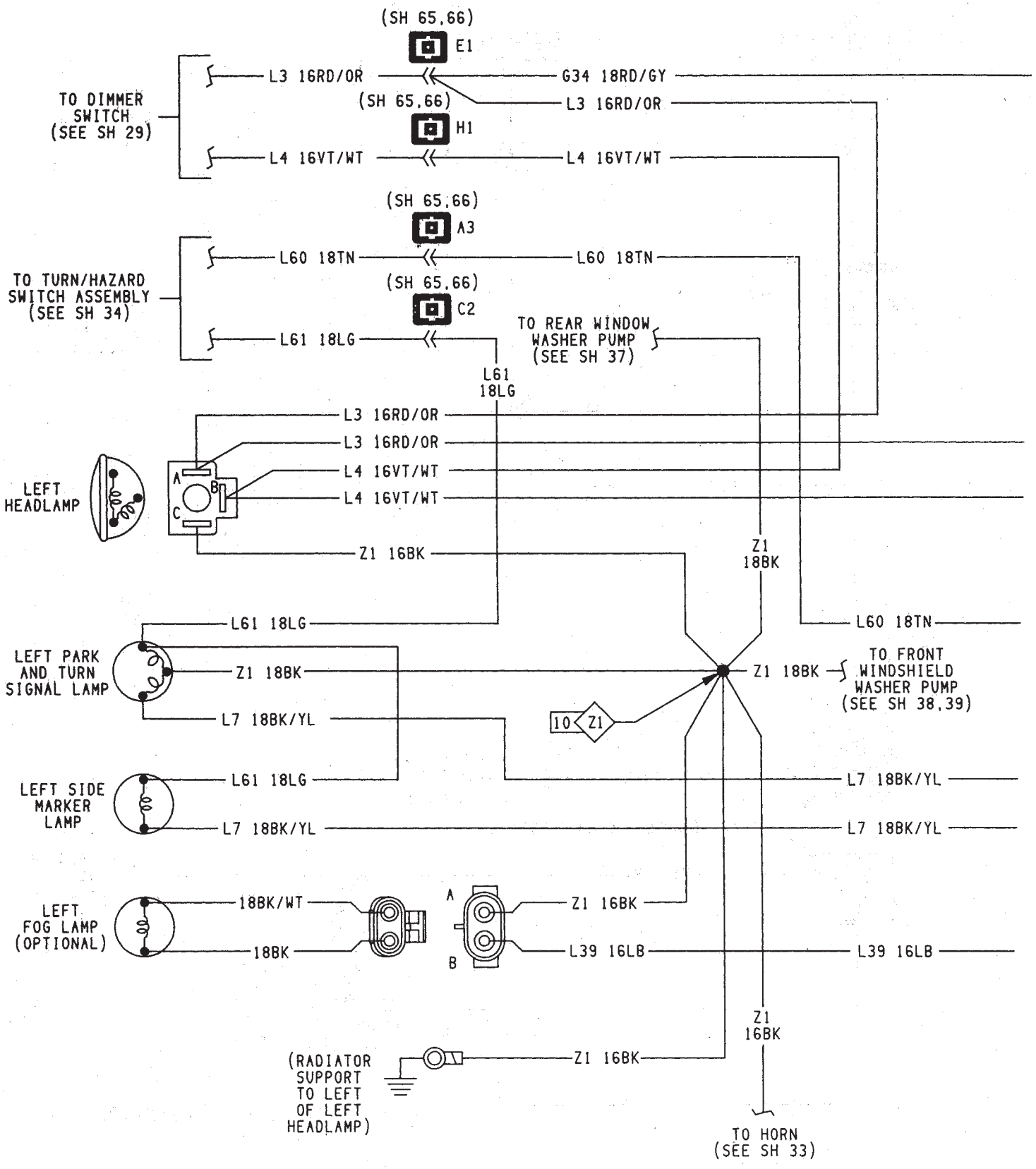


ENGINE OIL PRESSURE AND TEMPERATURE SYSTEM

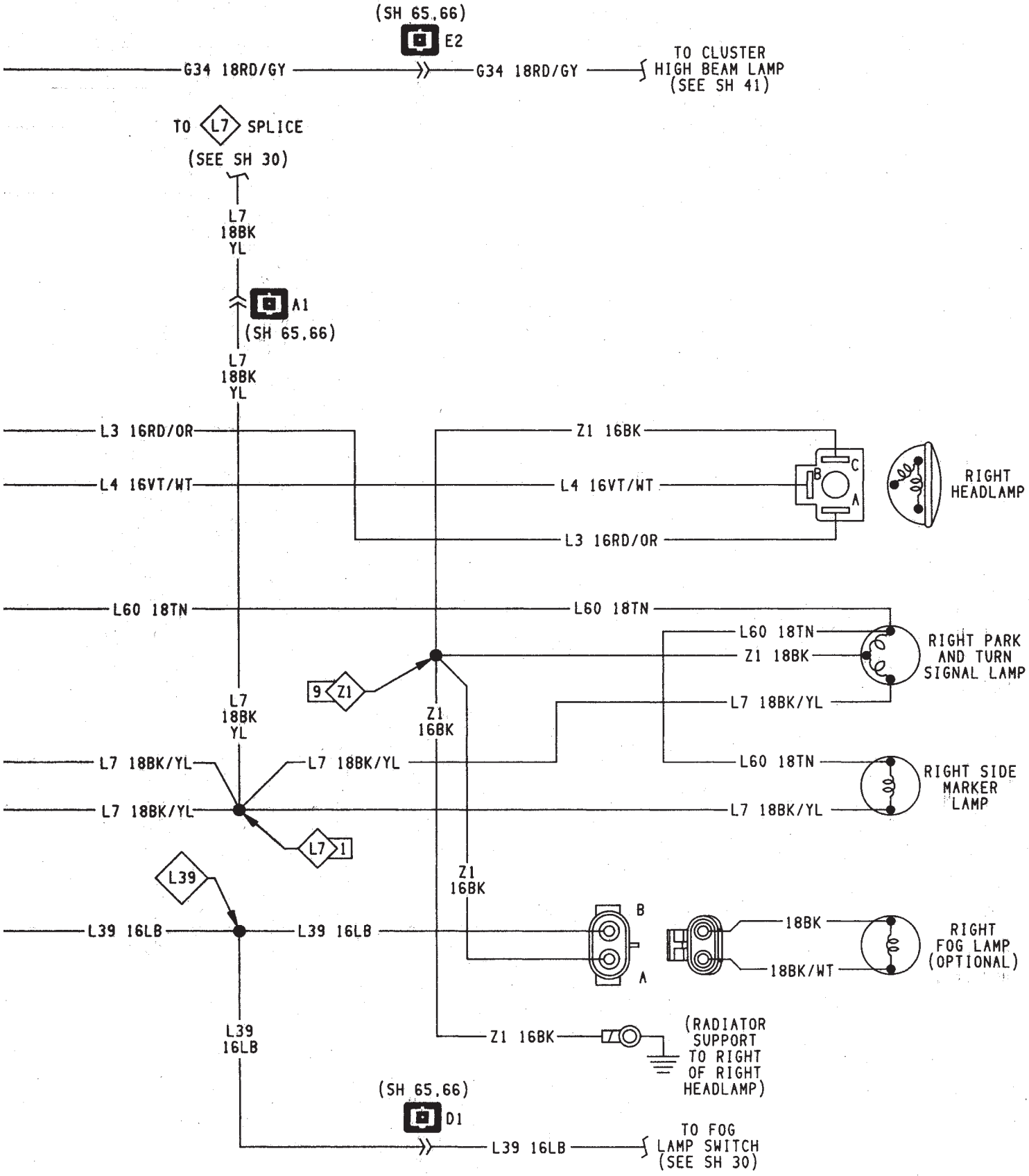
YJ 23

J948W-5


TO
IGNITION SWITCH
(SEE SH 10)
TO
RADIO RELAY
(SEE SH 45)
A31
14BK
WT
F30
18RD
FUSE #7
(20 AMP)
4
7
F30
F30 18RD
TO RADIO
(SEE SH 45)
F30 18RD
F30 18RD
STANDARD
F30 18RD
CIGAR
LIGHTER
A B C
F E D
Z1 14BK
TO Z1 SPLICE
(SEE SH 32)
Z1 18BK
BLACK (ABOVE A/C HOUSING)
F E D
A B C
Z1 16BK
Z1 16BK
TO BLOWER
MOTOR
(SEE SH 50)
CIGAR
LIGHTER
F30 16RD
WITH AIR CONDITIONING



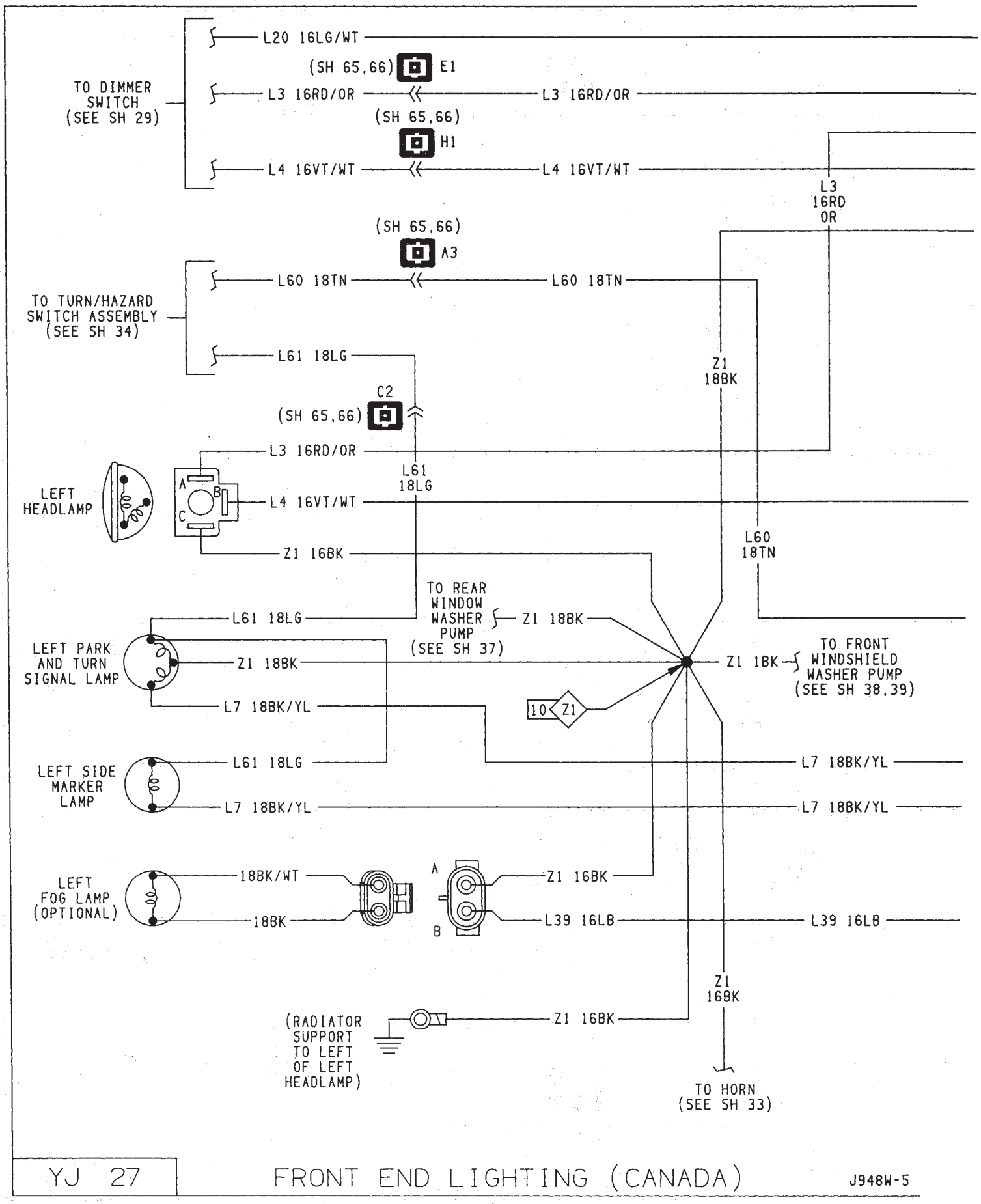
YJ 25 FRONT END LIGHTING J948W-5



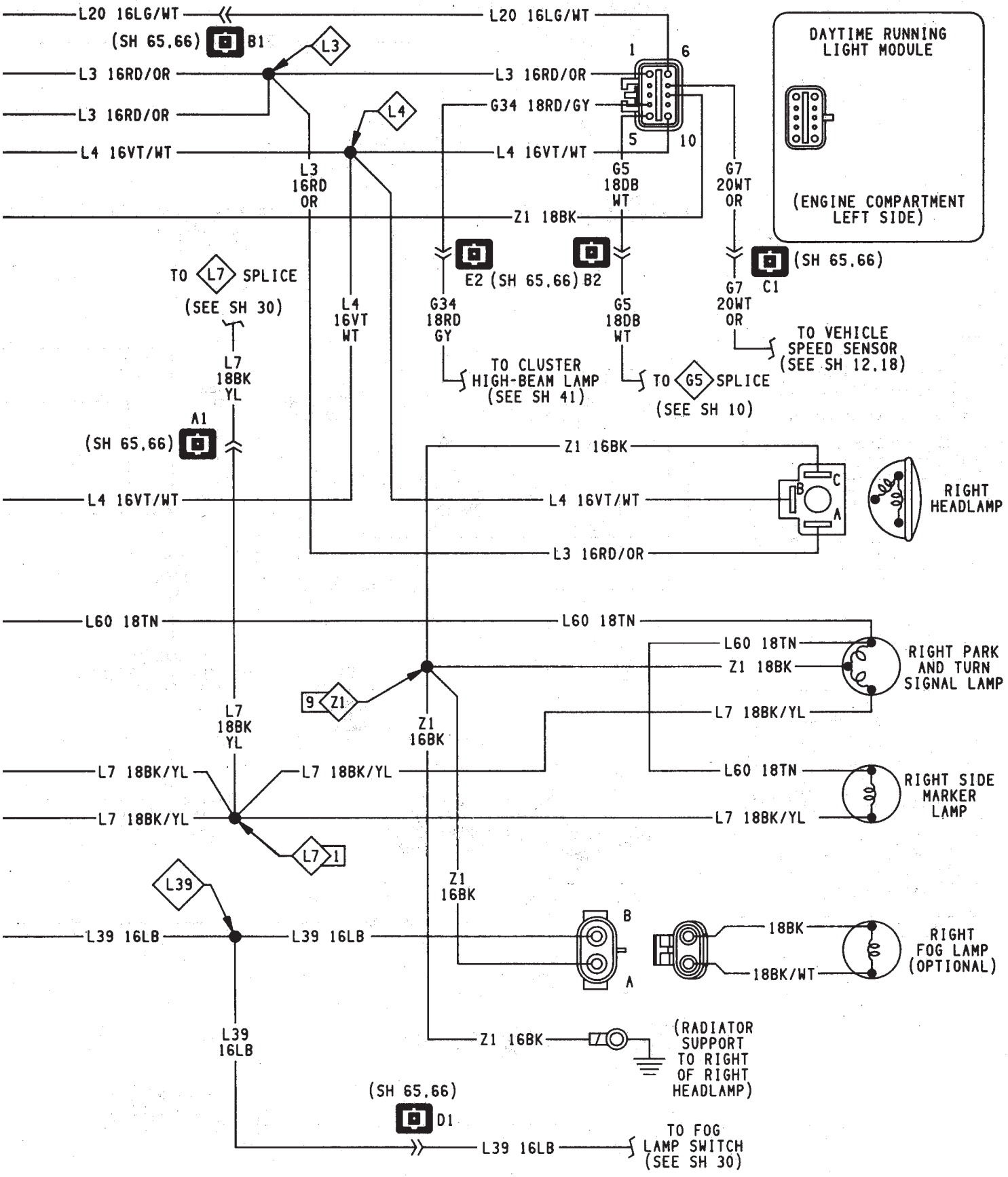
J948W-5

FRONT END LIGHTING

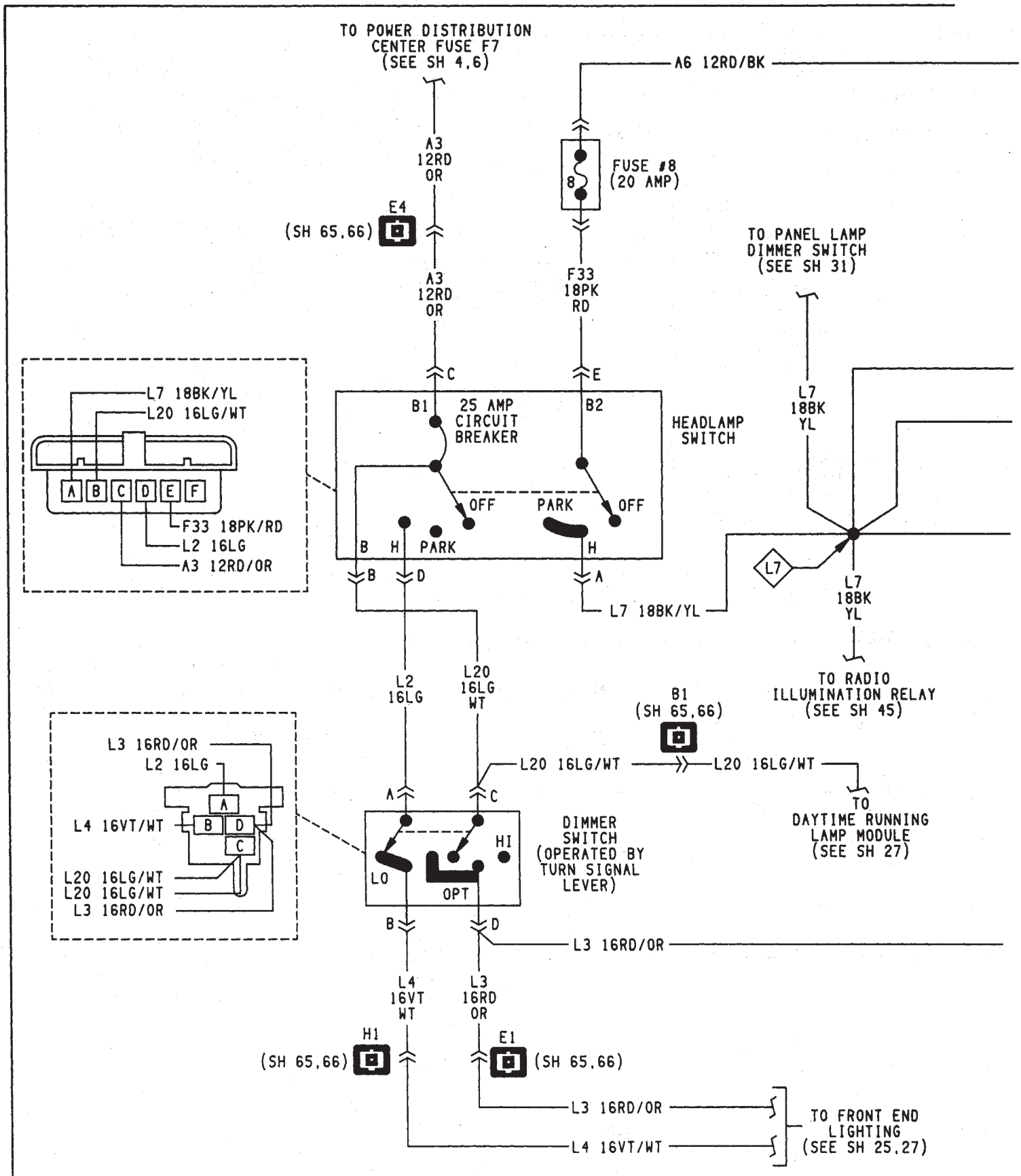
YJ 26



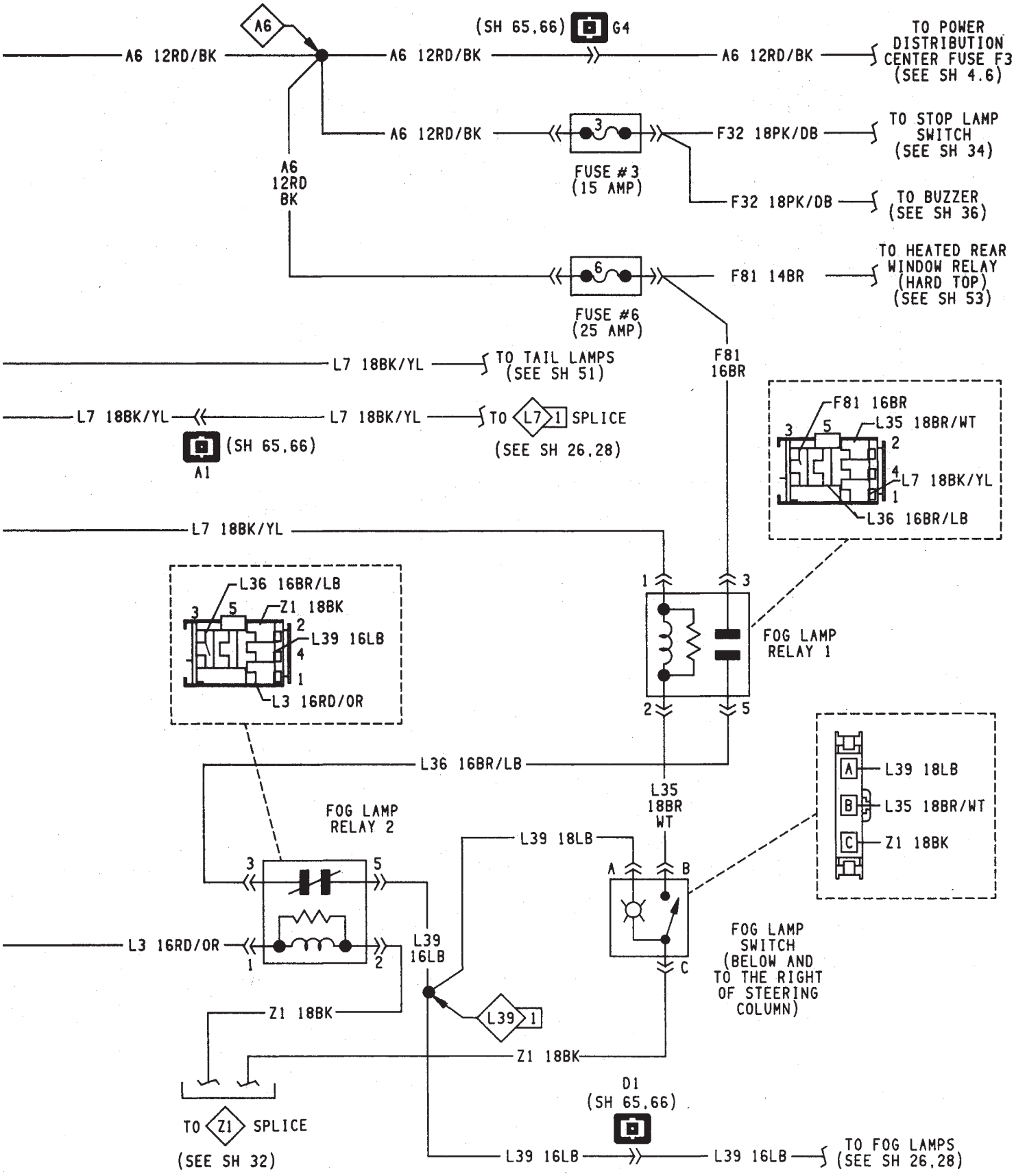
YJ 27 FRONT END LIGHTING (CANADA) J948W-5

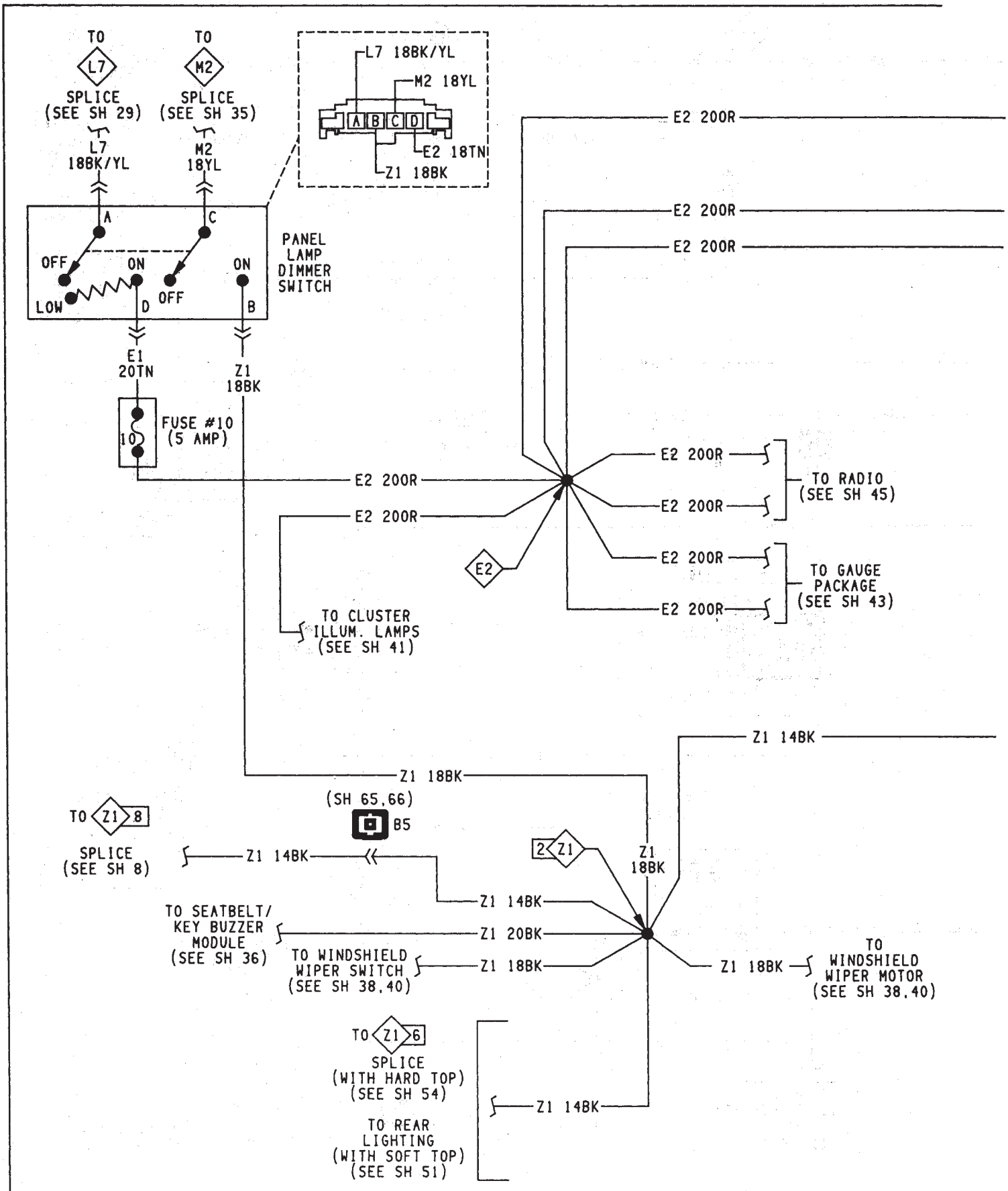


J948W-5 FRONT END LIGHTING (CANADA) YJ 28

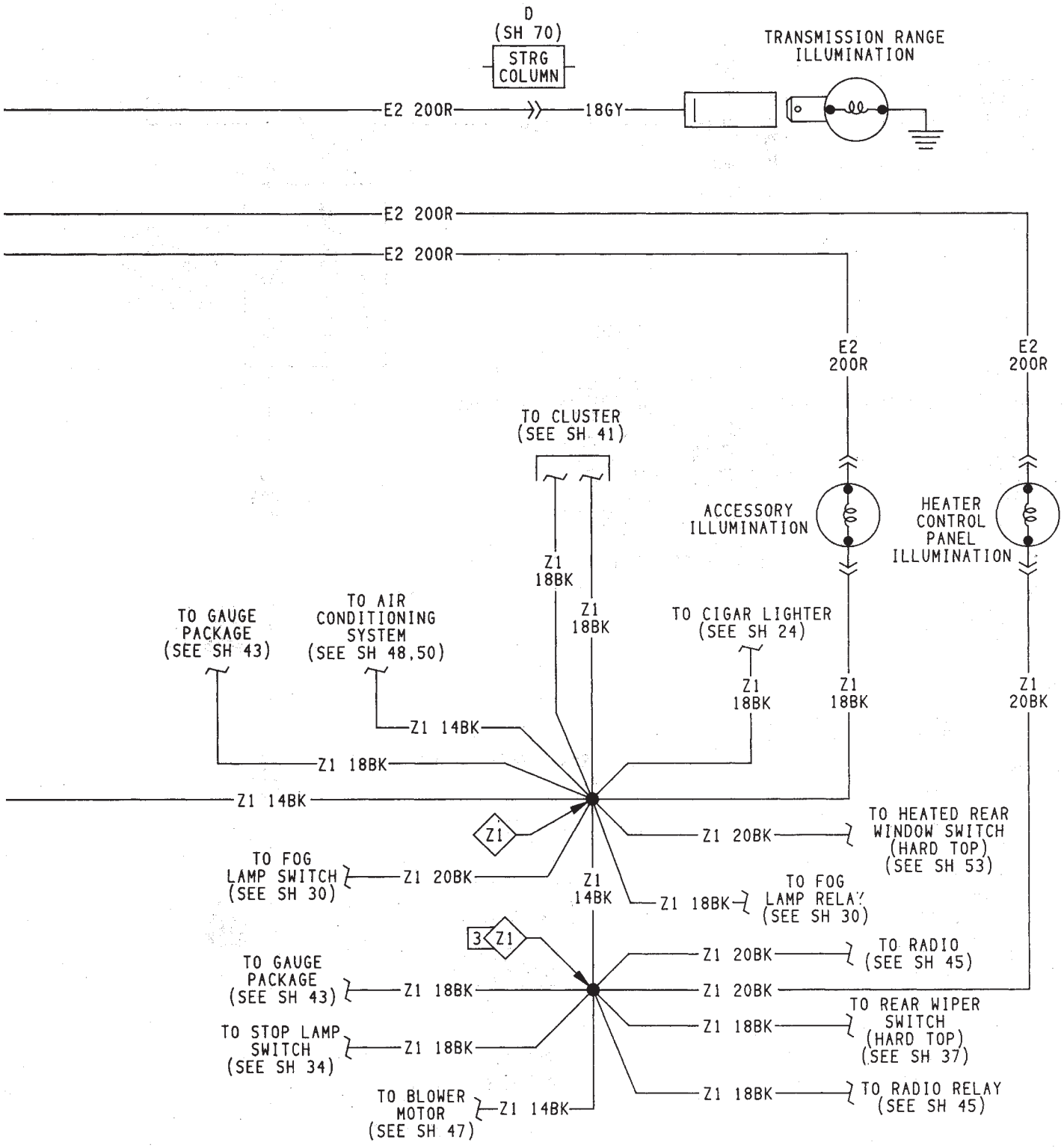


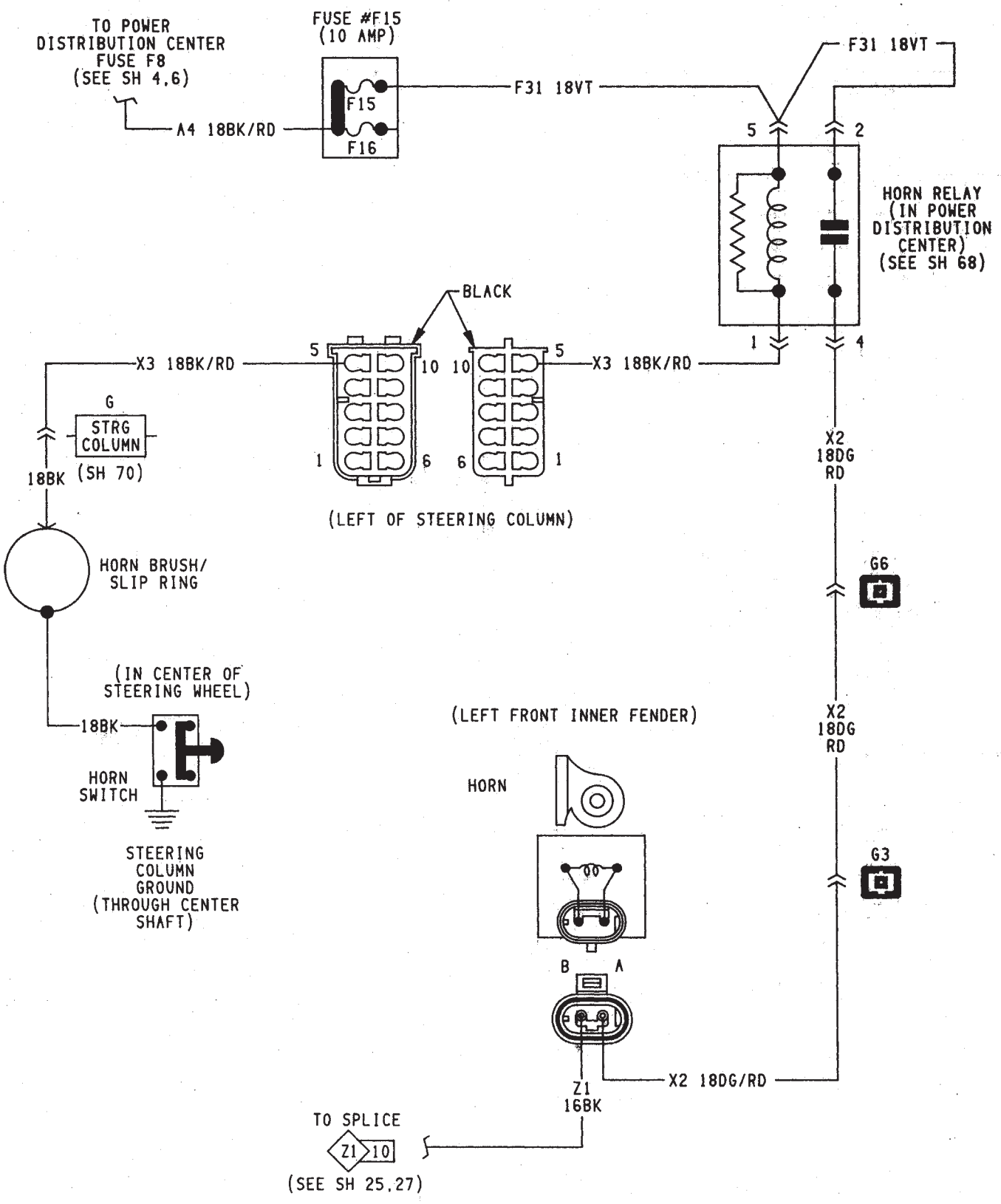
YJ 29 HEADLAMP SWITCH J948W-5

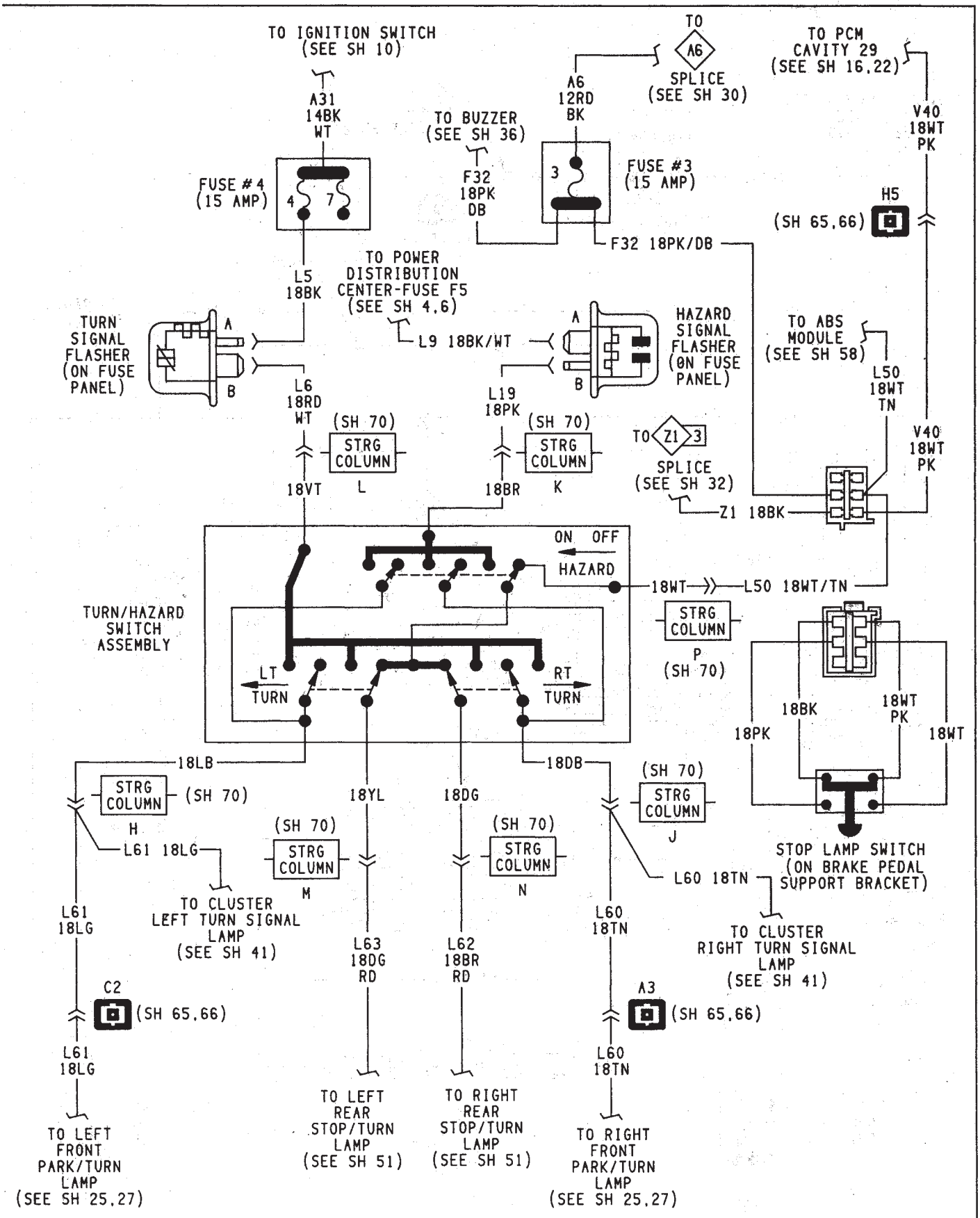

A6
A6 12RD/BK
(SH 65,66) G4
TO POWER DISTRIBUTION CENTER FUSE F3 (SEE SH 4.6)
A6 12RD/BK
3
F32 18PK/DB
TO STOP LAMP SWITCH (SEE SH 34)
FUSE #3 (15 AMP)
F32 18PK/DB
TO BUZZER (SEE SH 36)
A6 12RD BK
6
F81 14BR
TO HEATED REAR WINDOW RELAY (HARD TOP) (SEE SH 53)
FUSE #6 (25 AMP)
F81 16BR
L7 18BK/YL
TO TAIL LAMPS (SEE SH 51)
L7 18BK/YL
TO L7 1 SPLICE
(SEE SH 26,28)
(SH 65,66)
A1
F81 16BR
L35 18BR/WT
L7 18BK/YL
L36 16BR/LB
L36 16BR/LB
Z1 18BK
L39 16LB
L3 16RD/OR
FOG LAMP RELAY 1
FOG LAMP RELAY 2
L35 18BR WT
L39 18LB
A
B
C
L39 18LB
L35 18BR/WT
Z1 18BK
FOG LAMP SWITCH (BELOW AND TO THE RIGHT OF STEERING COLUMN)
L3 16RD/OR
L39 16LB
Z1 18BK
L39 1
Z1 18BK
TO Z1 SPLICE
(SEE SH 32)
D1
(SH 65,66)
L39 16LB
L39 16LB
TO FOG LAMPS (SEE SH 26,28)



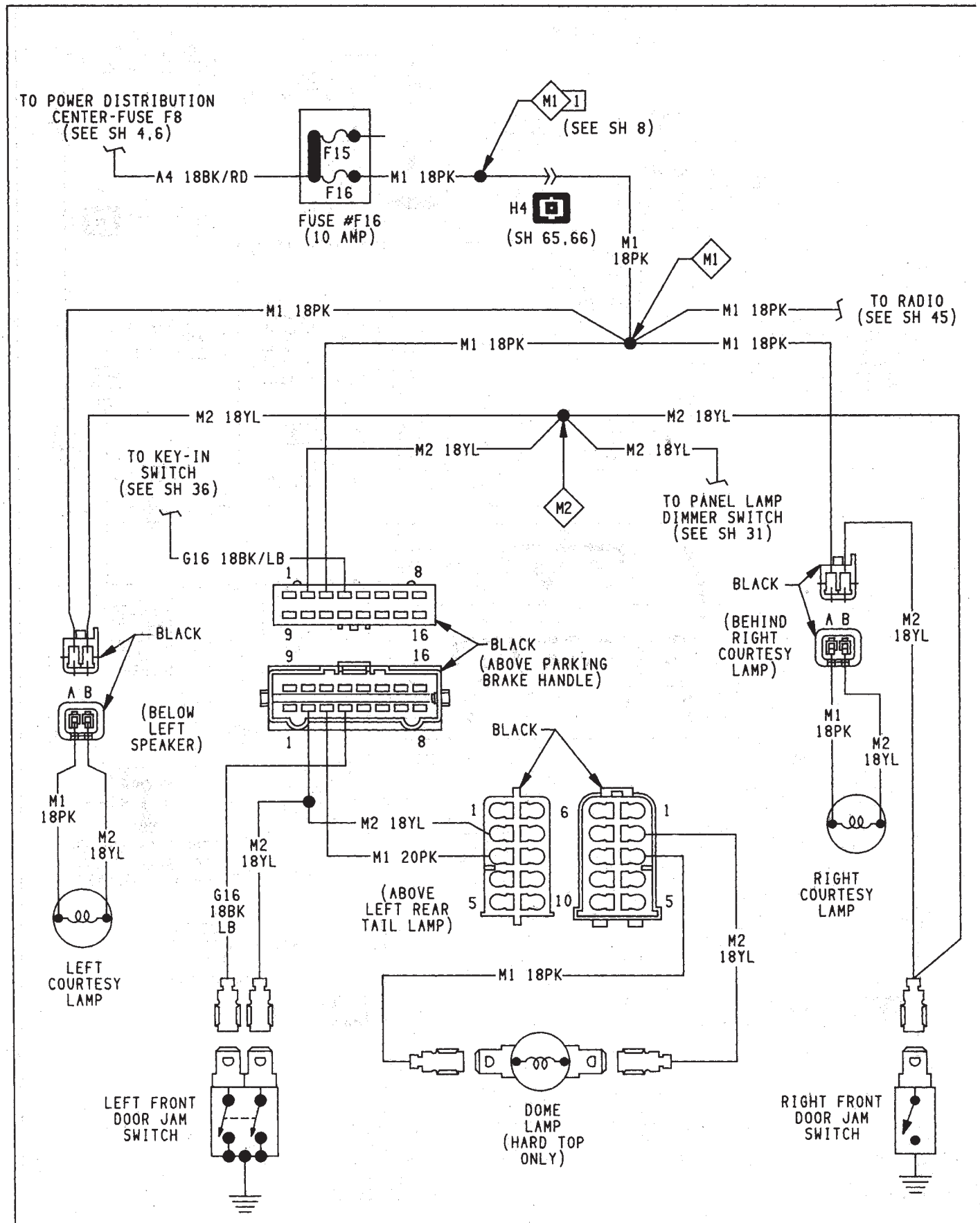
YJ 31 PANEL LAMPS DIMMER SWITCH J948W-5


D
(SH 70)
STRG COLUMN
E2 200R
18GY
TRANSMISSION RANGE ILLUMINATION
E2 200R
E2 200R
E2 200R
E2 200R
TO CLUSTER (SEE SH 41)
ACCESSORY ILLUMINATION
HEATER CONTROL PANEL ILLUMINATION
Z1 18BK
Z1 18BK
TO GAUGE PACKAGE (SEE SH 43)
TO AIR CONDITIONING SYSTEM (SEE SH 48,50)
TO CIGAR LIGHTER (SEE SH 24)
Z1 18BK
Z1 18BK
Z1 20BK
Z1 14BK
Z1 18BK
Z1 14BK
Z1
TO HEATED REAR WINDOW SWITCH (HARD TOP) (SEE SH 53)
TO FOG LAMP SWITCH (SEE SH 30)
Z1 20BK
Z1 14BK
Z1 18BK
TO FOG LAMP RELAY (SEE SH 30)
3 Z1
Z1 20BK
TO RADIO (SEE SH 45)
TO GAUGE PACKAGE (SEE SH 43)
Z1 18BK
Z1 20BK
TO REAR WIPER SWITCH (HARD TOP) (SEE SH 37)
TO STOP LAMP SWITCH (SEE SH 34)
Z1 18BK
Z1 18BK
TO BLOWER MOTOR (SEE SH 47)
Z1 14BK
Z1 18BK
TO RADIO RELAY (SEE SH 45)

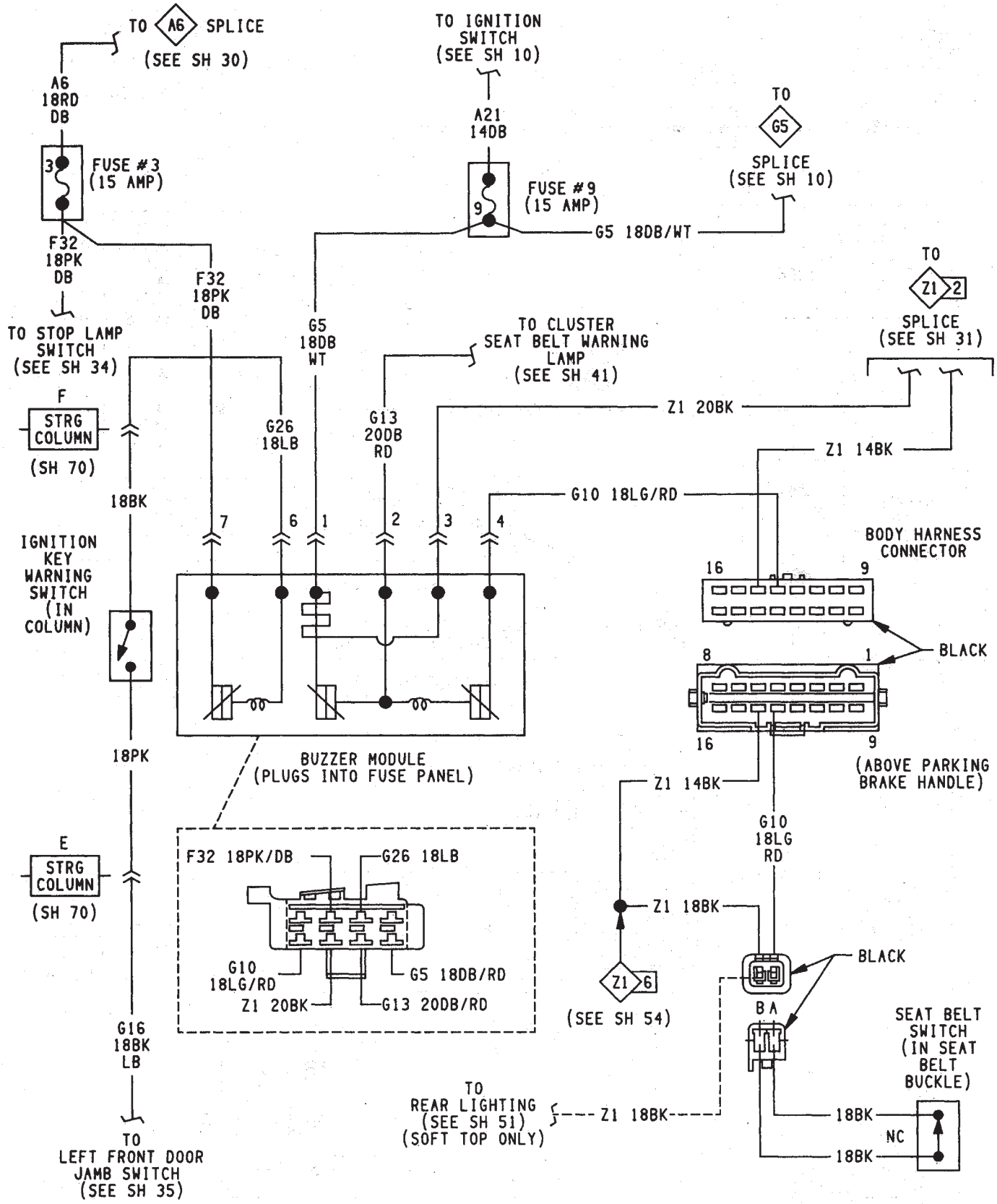

TO POWER DISTRIBUTION CENTER FUSE F8 (SEE SH 4,6)
A4 18BK/RD
FUSE #F15 (10 AMP)
F15
F16
F31 18VT
F31 18VT
5
2
1
4
HORN RELAY (IN POWER DISTRIBUTION CENTER) (SEE SH 68)
BLACK
X3 18BK/RD
X3 18BK/RD
5
10
10
5
1
6
6
1
(LEFT OF STEERING COLUMN)
G
STRG COLUMN
18BK
(SH 70)
X2 18DG RD
G6
HORN BRUSH/ SLIP RING
(IN CENTER OF STEERING WHEEL)
18BK
HORN SWITCH
STEERING COLUMN GROUND (THROUGH CENTER SHAFT)
(LEFT FRONT INNER FENDER)
HORN
X2 18DG RD
G3
B
A
X2 18DG/RD
Z1 16BK
TO SPLICE
Z1 10
(SEE SH 25,27)



J948W-5 STOP/TURN AND HAZARD FLASHER SYSTEMS | YJ 34



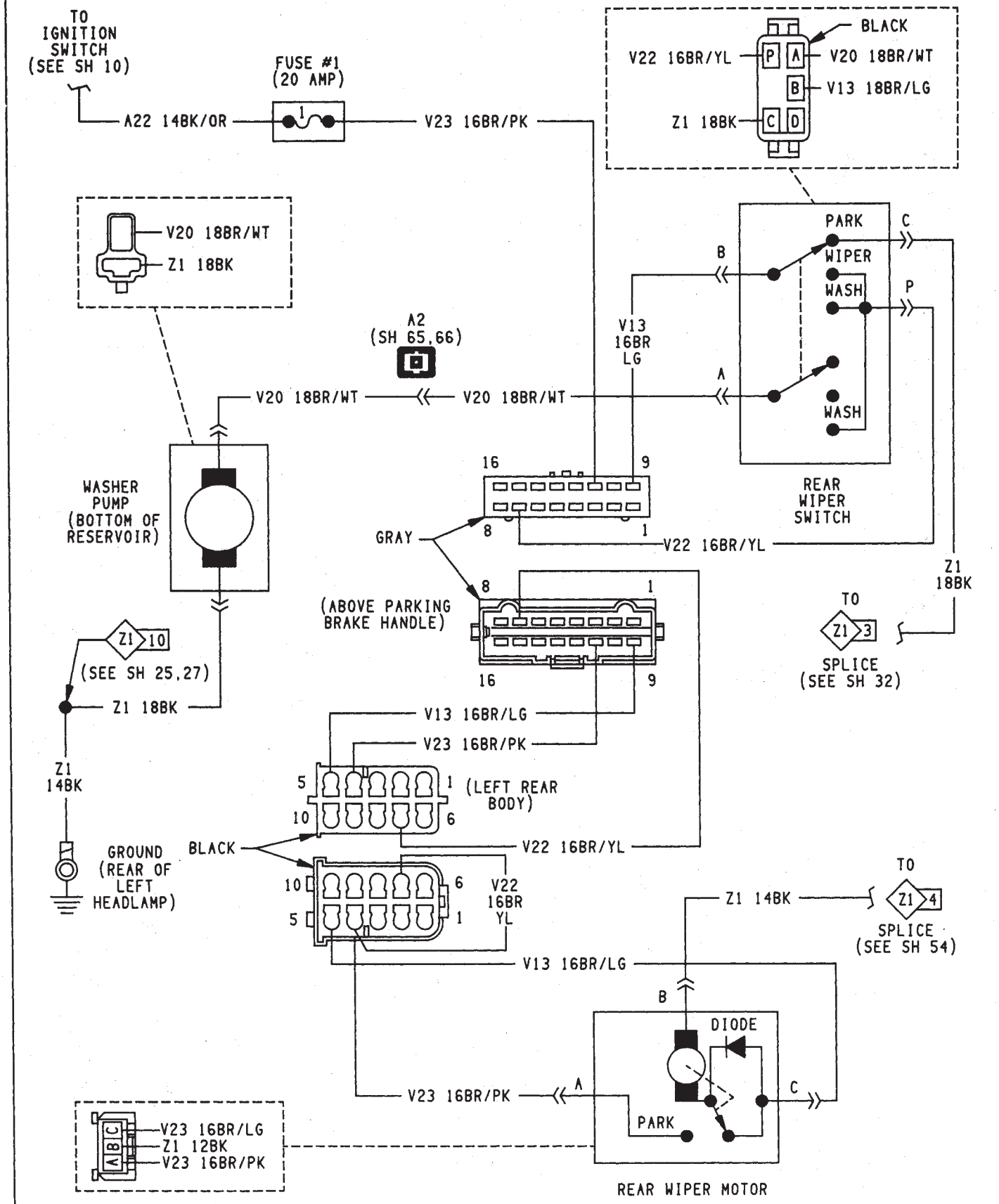
YJ 35 DOME AND COURTESY LAMPS J948W-5



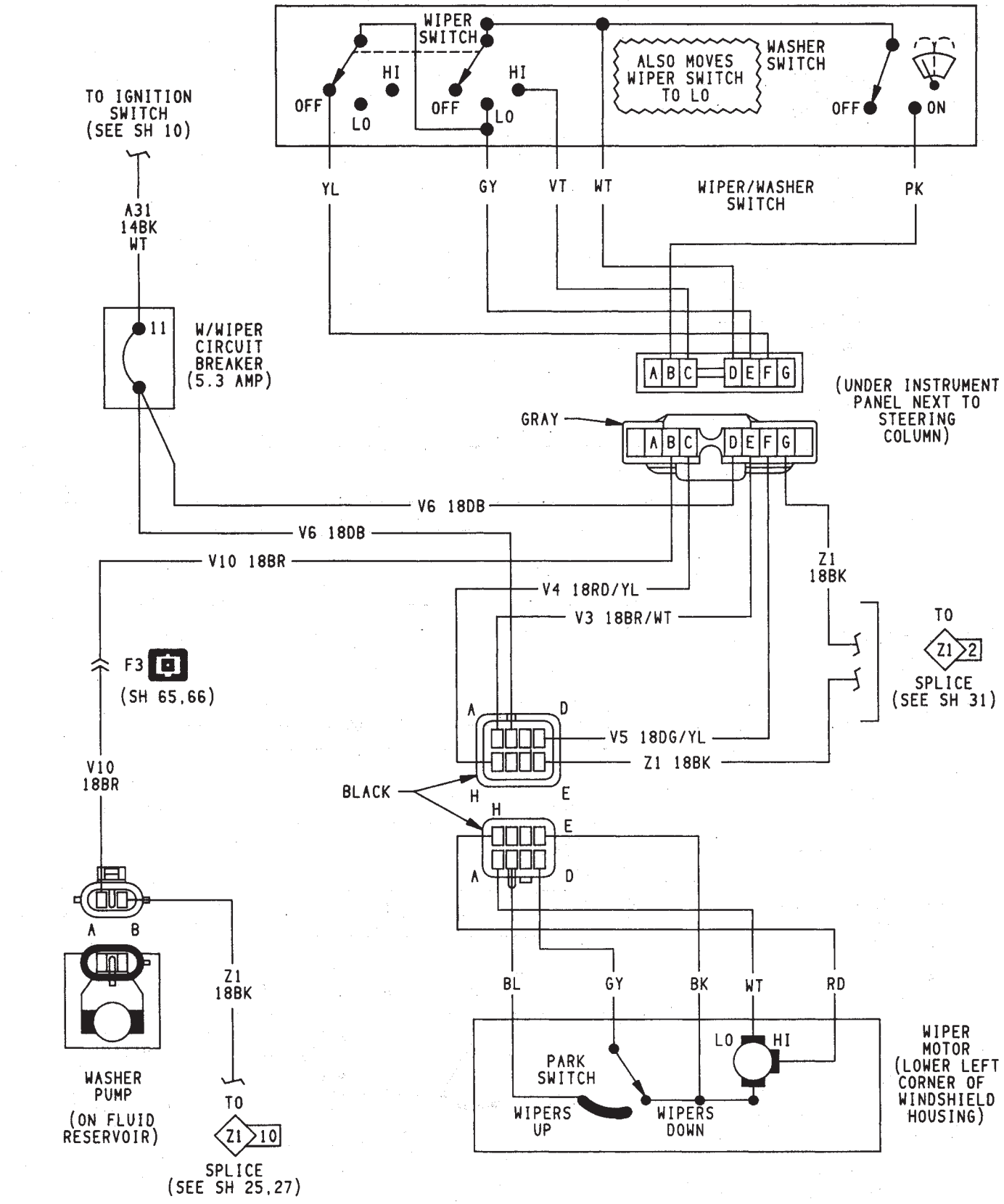
SEATBELT/IGNITION KEY
WARNING BUZZER

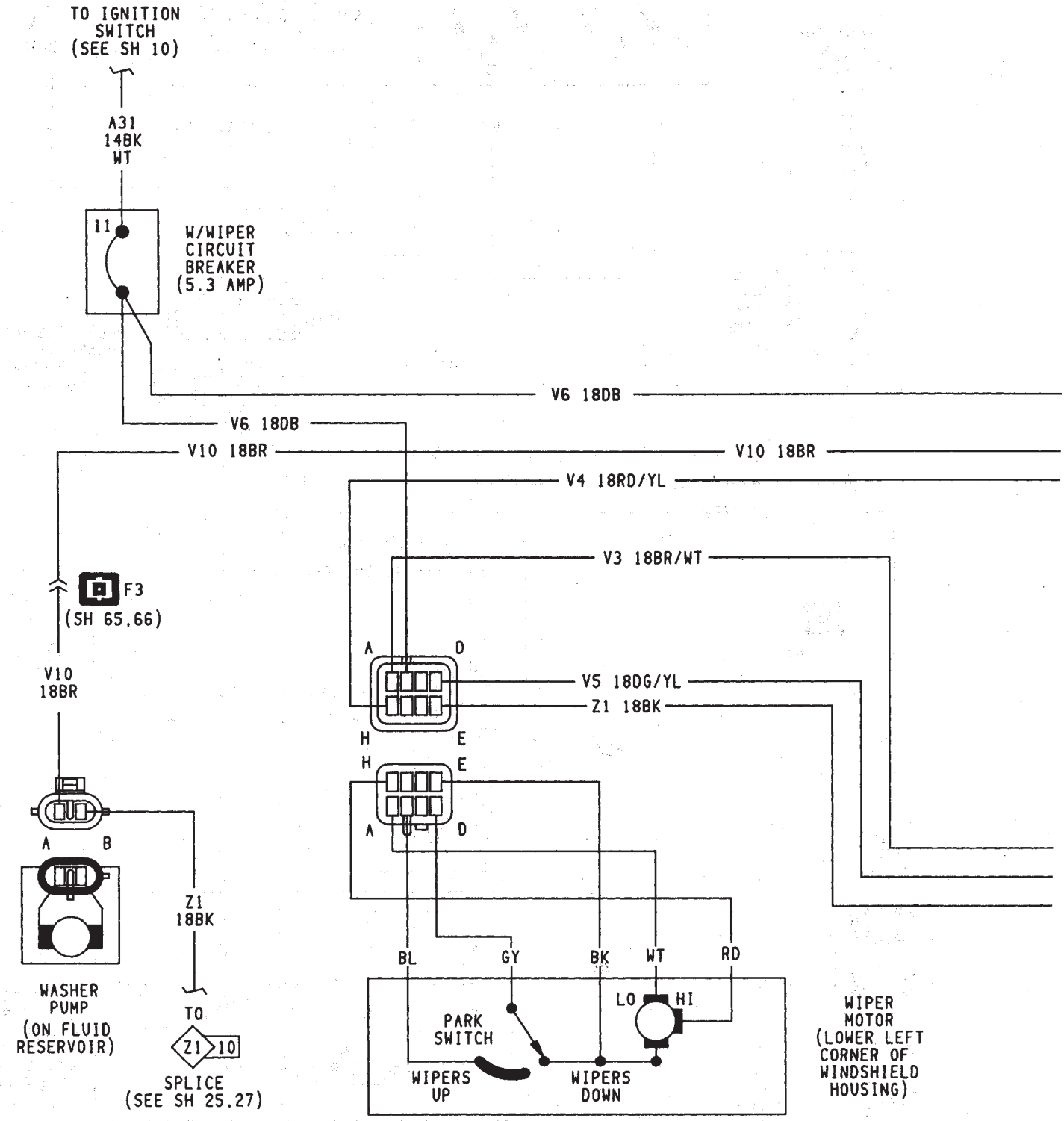
J948W-5

YJ 36

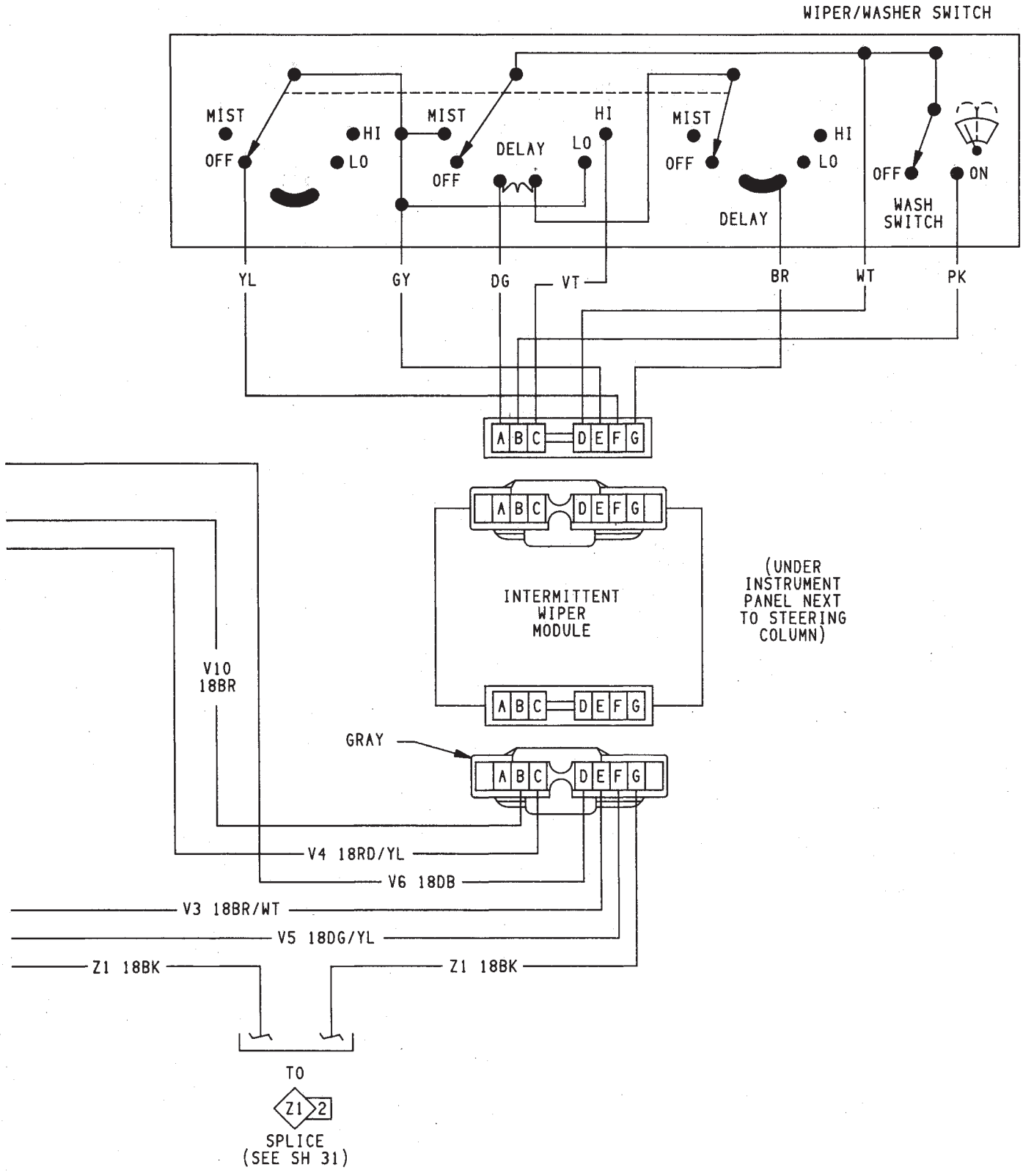


YJ 37 REAR WIPER/WASHER SYSTEM J948W-5

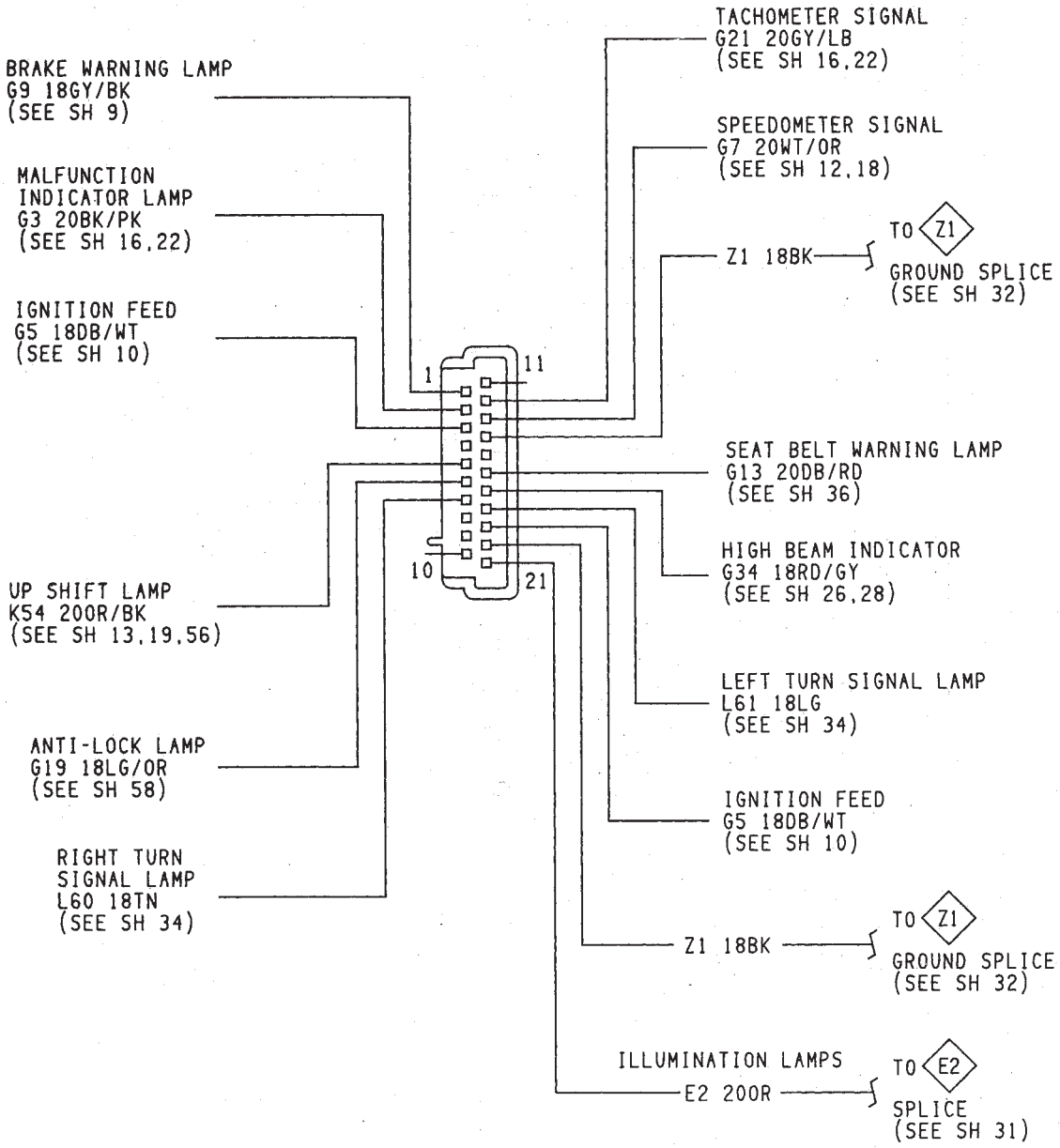

WIPER SWITCH
OFF
HI
LO
OFF
HI
LO
ALSO MOVES WIPER SWITCH TO LO
WASHER SWITCH
OFF
ON
TO IGNITION SWITCH (SEE SH 10)
A31 14BK WT
YL
GY
VT
WT
WIPER/WASHER SWITCH
PK
11
W/WIPER CIRCUIT BREAKER (5.3 AMP)
A B C D E F G
(UNDER INSTRUMENT PANEL NEXT TO STEERING COLUMN)
GRAY
V6 18DB
V6 18DB
V10 18BR
V4 18RD/YL
V3 18BR/WT
Z1 18BK
TO Z1 2 SPLICE (SEE SH 31)
F3 (SH 65,66)
A D
V5 18DG/YL
Z1 18BK
V10 18BR
BLACK
H E
H E
A D
A B
Z1 18BK
BL
GY
BK
WT
RD
LO HI
PARK SWITCH
WIPERS UP
WIPERS DOWN
WIPER MOTOR (LOWER LEFT CORNER OF WINDSHIELD HOUSING)
WASHER PUMP (ON FLUID RESERVOIR)
TO Z1 10 SPLICE (SEE SH 25,27)



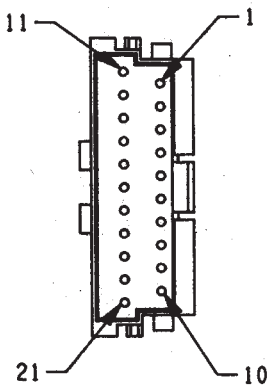
YJ 39 INTERMITTENT WIPER SYSTEM J948W-5

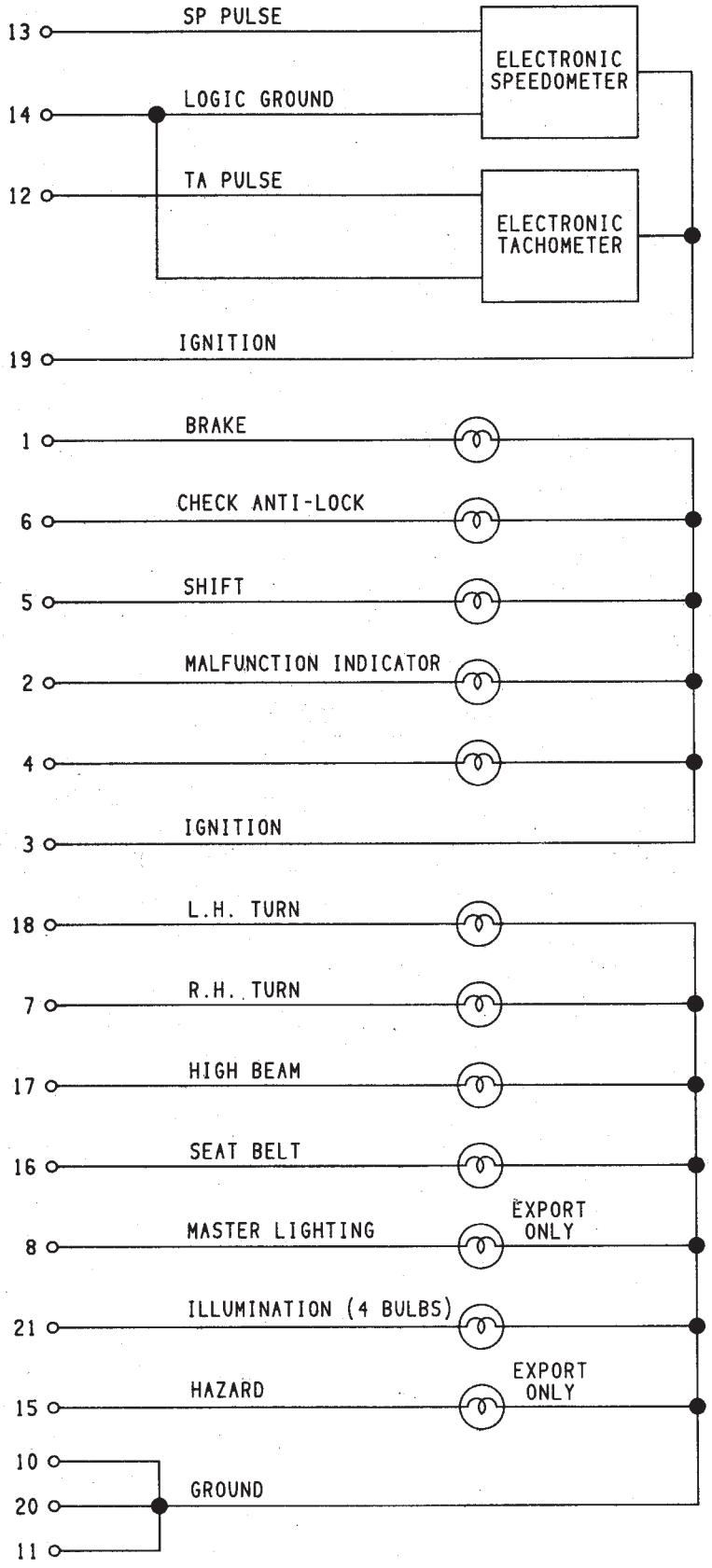


J948W-5 INTERMITTENT WIPER SYSTEM YJ 40

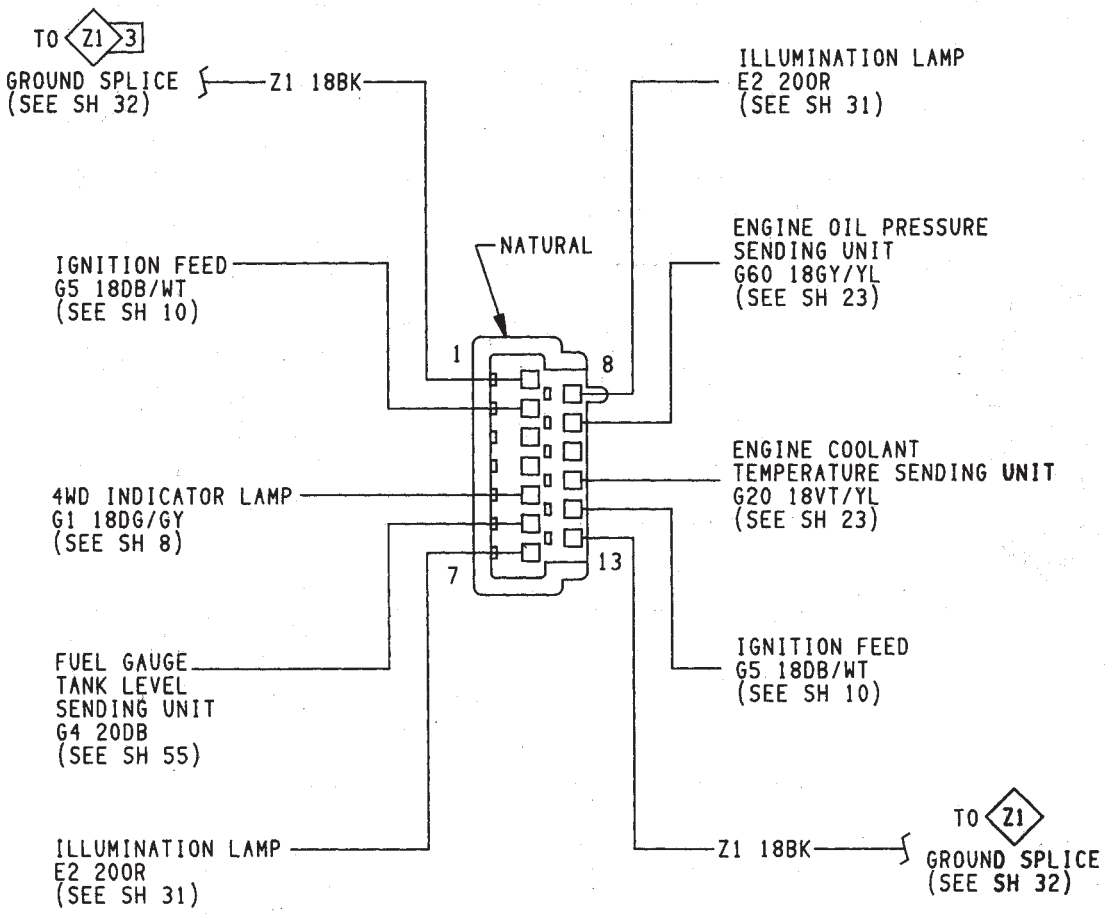


YJ 41 CLUSTER CONNECTOR J948W-5

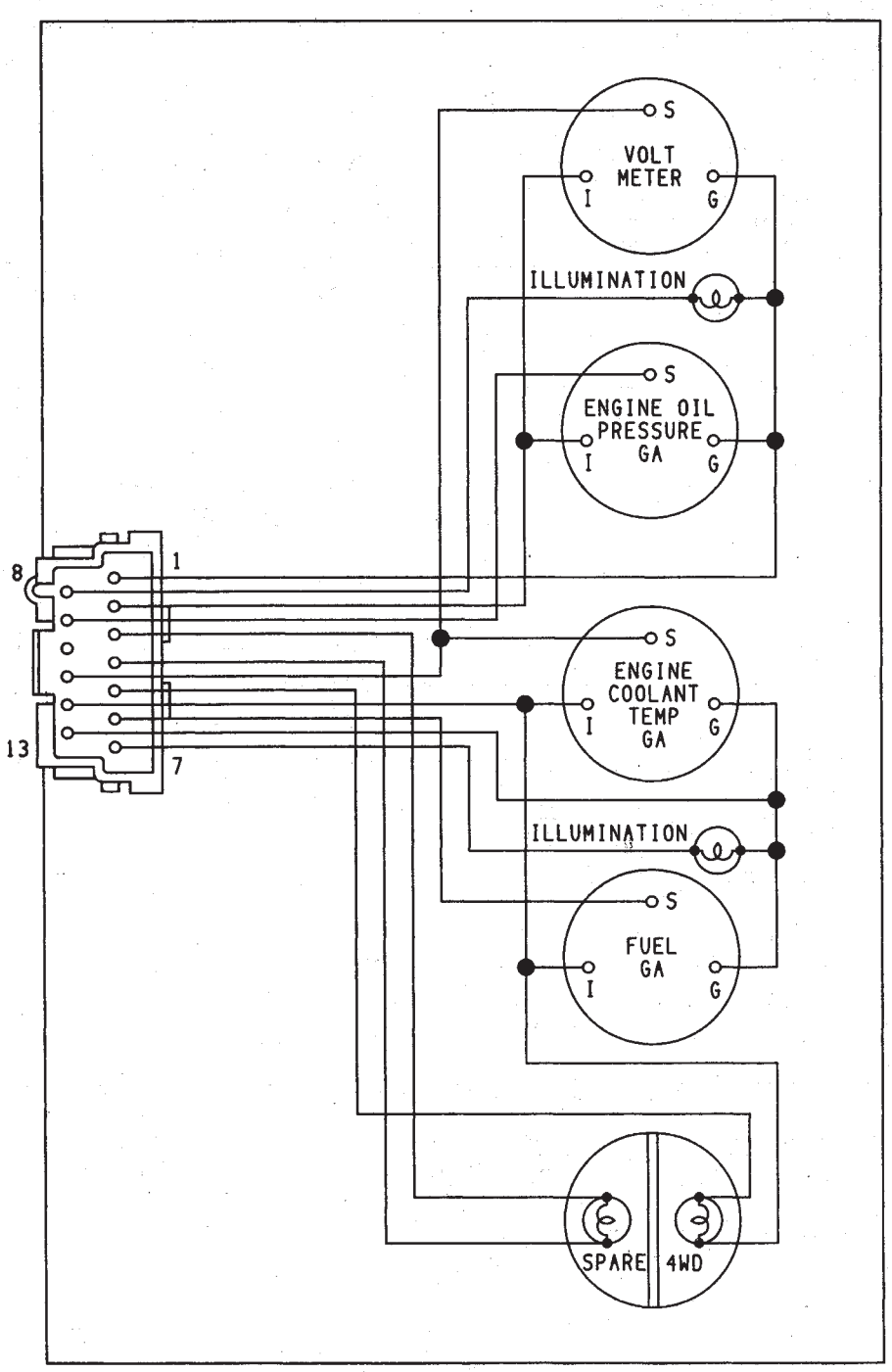




J948W-5 ELECTRICAL SCHEMATIC OF CLUSTER YJ 42



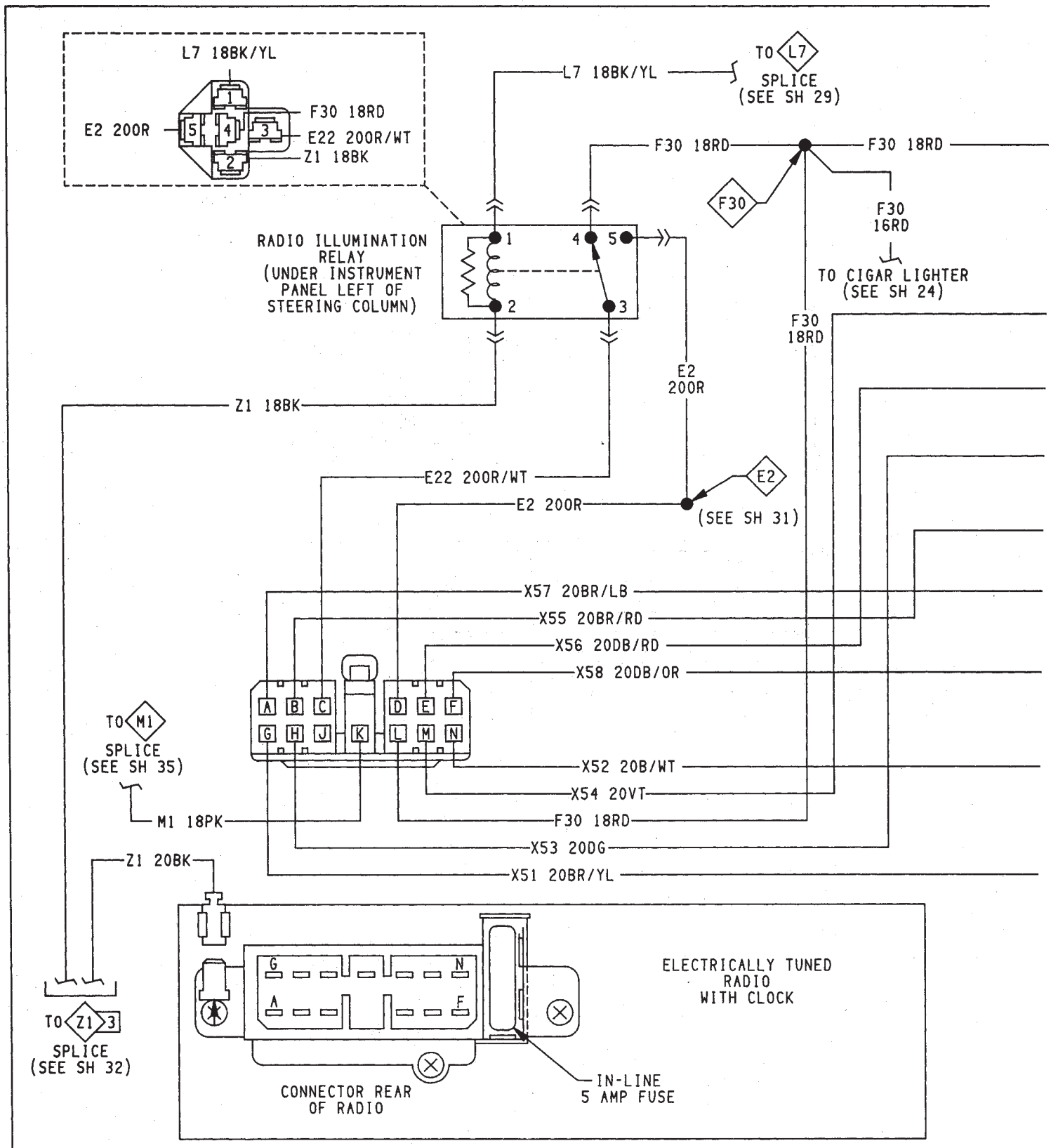
YJ 43 GAUGE PACKAGE CONNECTOR J948W-5

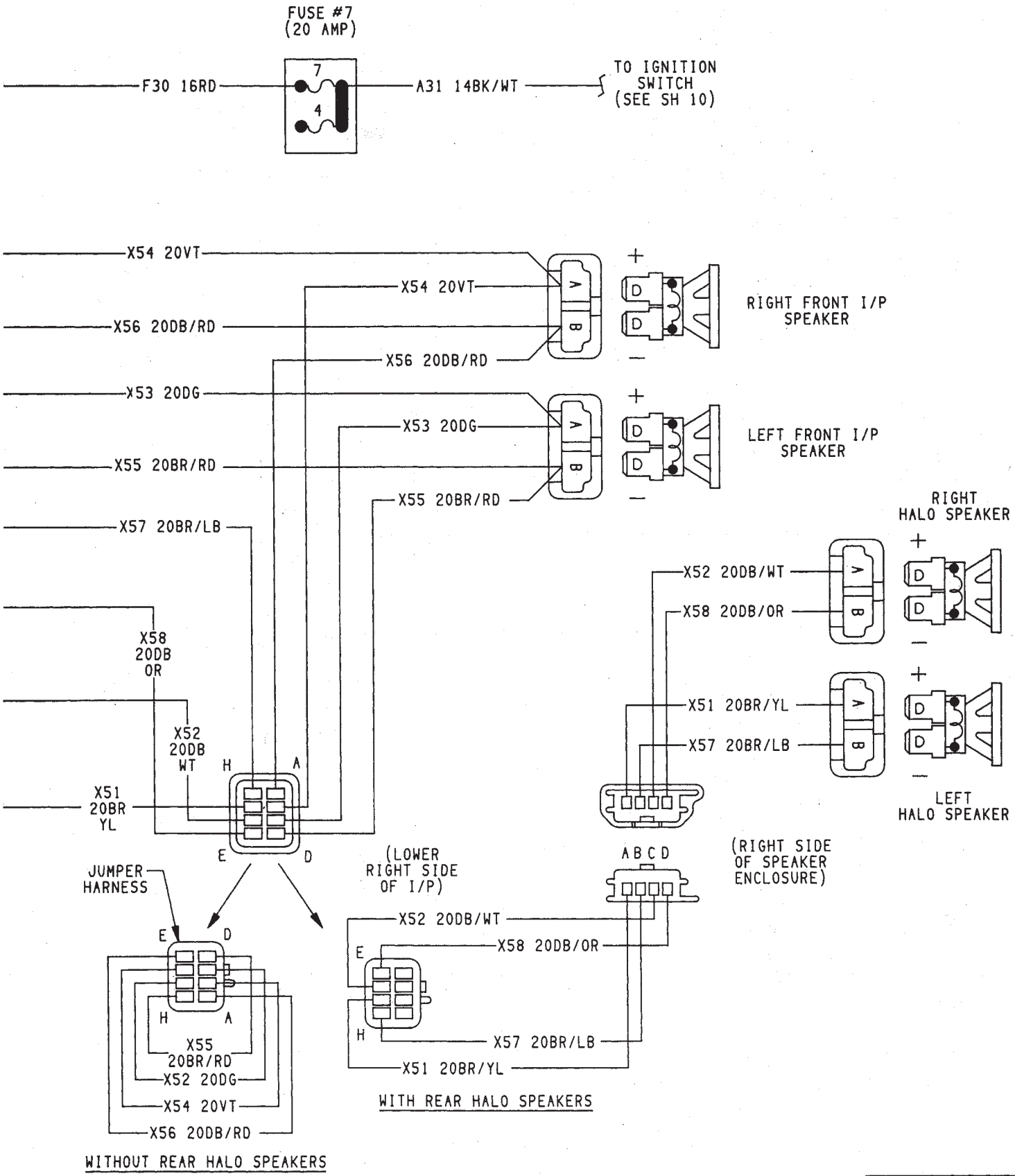


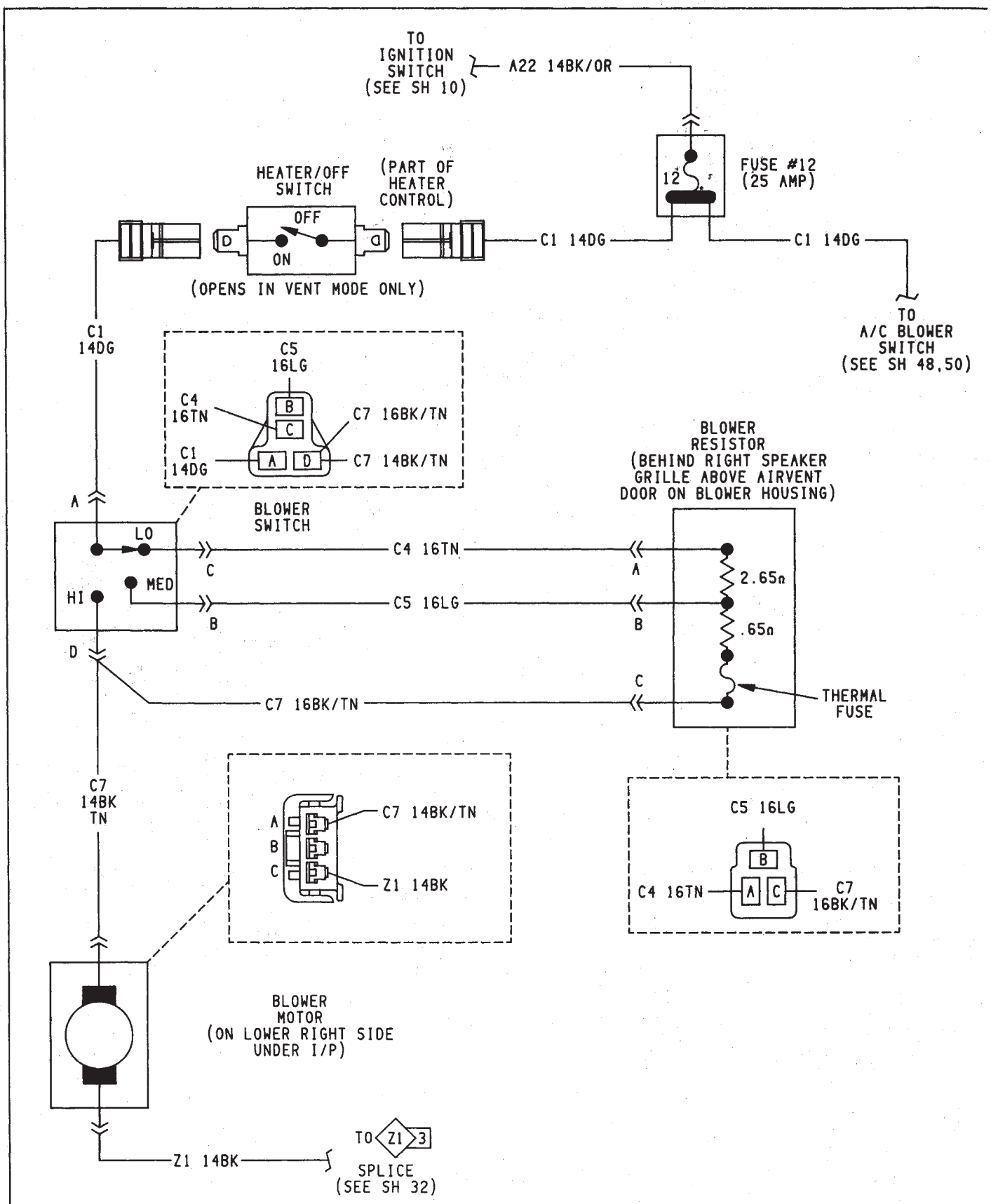
ELECTRICAL SCHEMATIC OF GAUGE PACKAGE

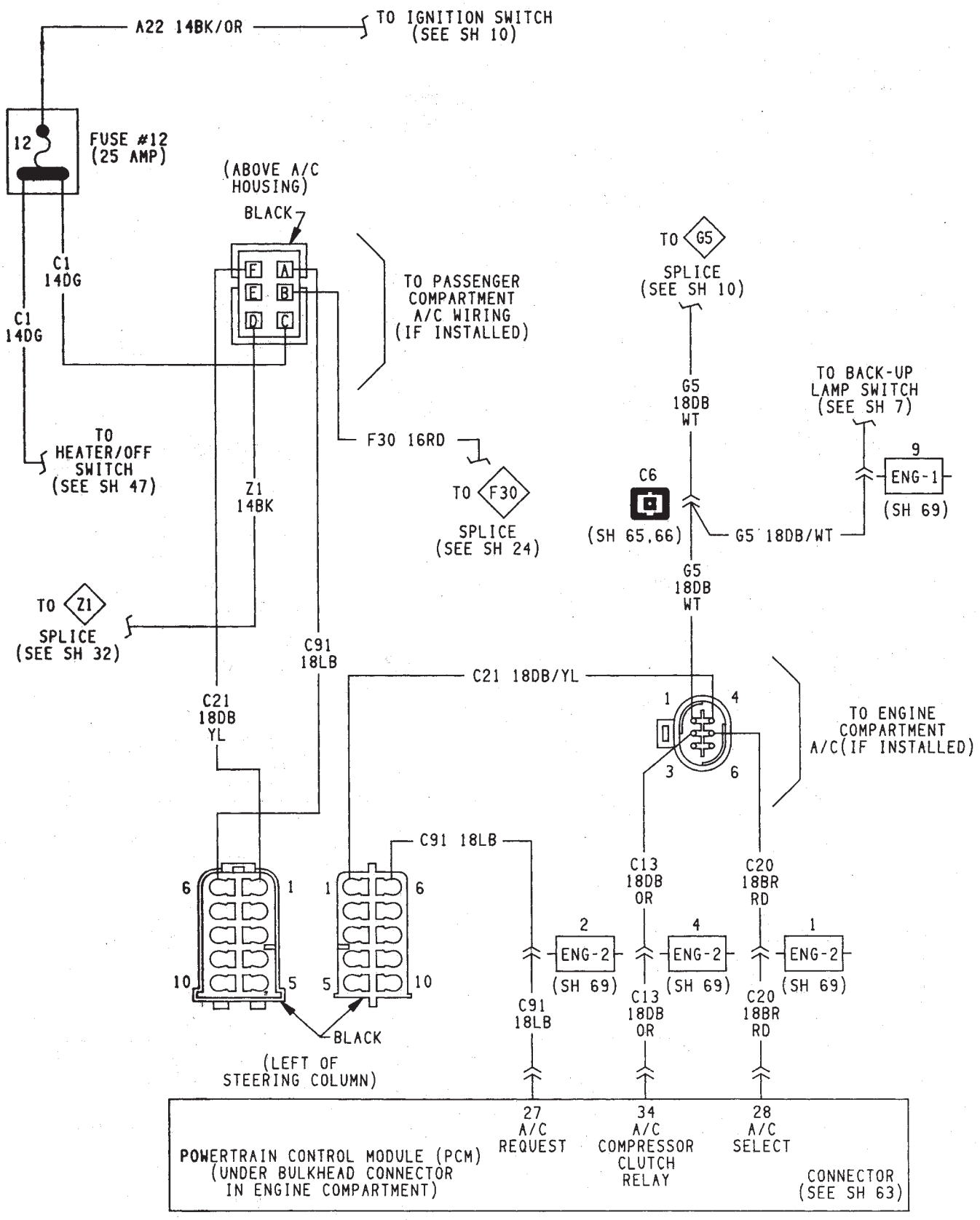
J948W-5

YJ 44

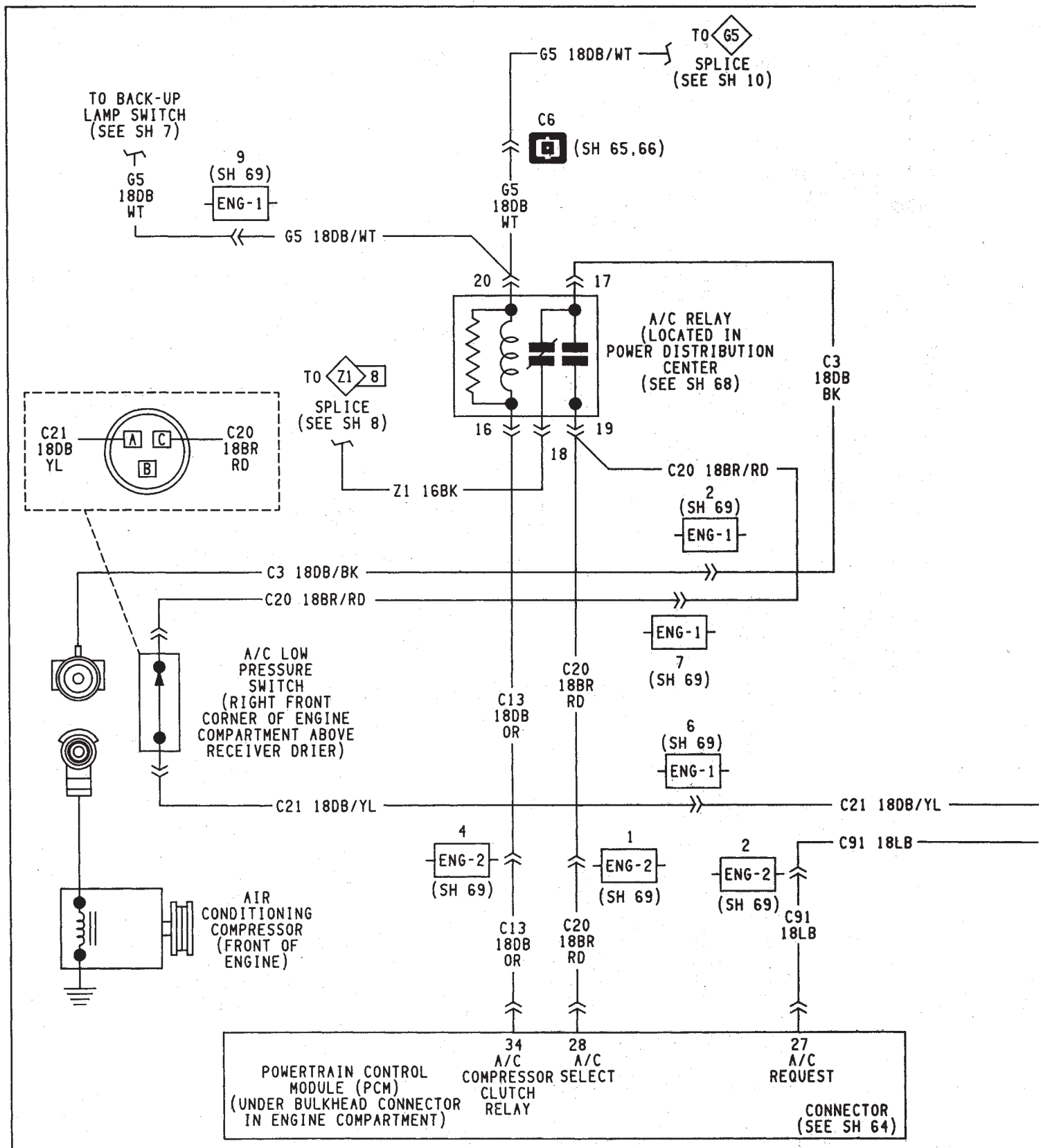

L7 18BK/YL
E2 200R
F30 18RD
E22 200R/WT
Z1 18BK
TO L7
SPLICE
(SEE SH 29)
L7 18BK/YL
F30 18RD
F30 18RD
F30
F30
16RD
TO CIGAR LIGHTER
(SEE SH 24)
RADIO ILLUMINATION
RELAY
(UNDER INSTRUMENT
PANEL LEFT OF
STEERING COLUMN)
F30
18RD
E2
200R
Z1 18BK
E22 200R/WT
E2
E2 200R
(SEE SH 31)
X57 20BR/LB
X55 20BR/RD
X56 20DB/RD
X58 20DB/OR
TO M1
SPLICE
(SEE SH 35)
X52 20B/WT
X54 20VT
M1 18PK
F30 18RD
X53 20DG
Z1 20BK
X51 20BR/YL
TO Z1 3
SPLICE
(SEE SH 32)
ELECTRICALLY TUNED
RADIO
WITH CLOCK
CONNECTOR REAR
OF RADIO
IN-LINE
5 AMP FUSE


FUSE #7
(20 AMP)
7
4
F30 16RD
A31 14BK/WT
TO IGNITION
SWITCH
(SEE SH 10)
X54 20VT
X56 20DB/RD
X53 20DG
X55 20BR/RD
X57 20BR/LB
X58
20DB
OR
X52
20DB
WT
X51
20BR
YL
H
A
E
D
A
B
D
RIGHT FRONT I/P
SPEAKER
LEFT FRONT I/P
SPEAKER
RIGHT
HALO SPEAKER
LEFT
HALO SPEAKER
X52 20DB/WT
X58 20DB/OR
X51 20BR/YL
X57 20BR/LB
(RIGHT SIDE
OF SPEAKER
ENCLOSURE)
A B C D
JUMPER
HARNESS
(LOWER
RIGHT SIDE
OF I/P)
X52 20DB/WT
X58 20DB/OR
X57 20BR/LB
X51 20BR/YL
WITH REAR HALO SPEAKERS
X55
20BR/RD
X52 20DG
X54 20VT
X56 20DB/RD
WITHOUT REAR HALO SPEAKERS

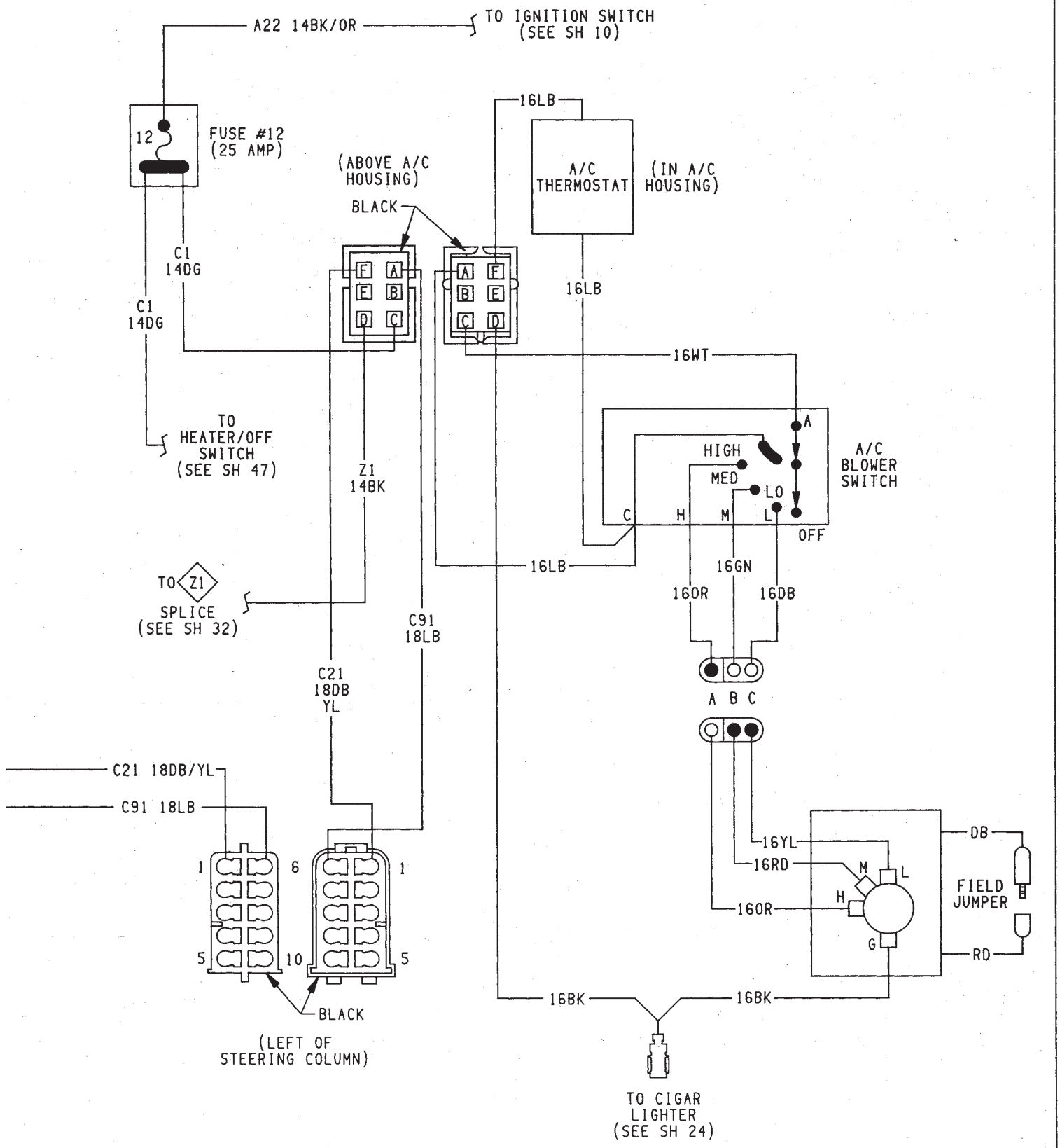

TO IGNITION SWITCH (SEE SH 10)
A22 14BK/OR
FUSE #12 (25 AMP)
12
HEATER/OFF SWITCH
(PART OF HEATER CONTROL)
OFF
ON
D
(OPENS IN VENT MODE ONLY)
C1 14DG
C1 14DG
TO A/C BLOWER SWITCH (SEE SH 48,50)
C1 14DG
C5 16LG
C4 16TN
C7 16BK/TN
C1 14DG
C7 14BK/TN
BLOWER RESISTOR (BEHIND RIGHT SPEAKER GRILLE ABOVE AIRVENT DOOR ON BLOWER HOUSING)
BLOWER SWITCH
LO
MED
HI
C4 16TN
C5 16LG
C7 16BK/TN
2.65Ω
.65Ω
THERMAL FUSE
C7 14BK TN
C7 14BK/TN
Z1 14BK
C5 16LG
C4 16TN
C7 16BK/TN
BLOWER MOTOR (ON LOWER RIGHT SIDE UNDER I/P)
Z1 14BK
TO Z1 3
SPLICE (SEE SH 32)

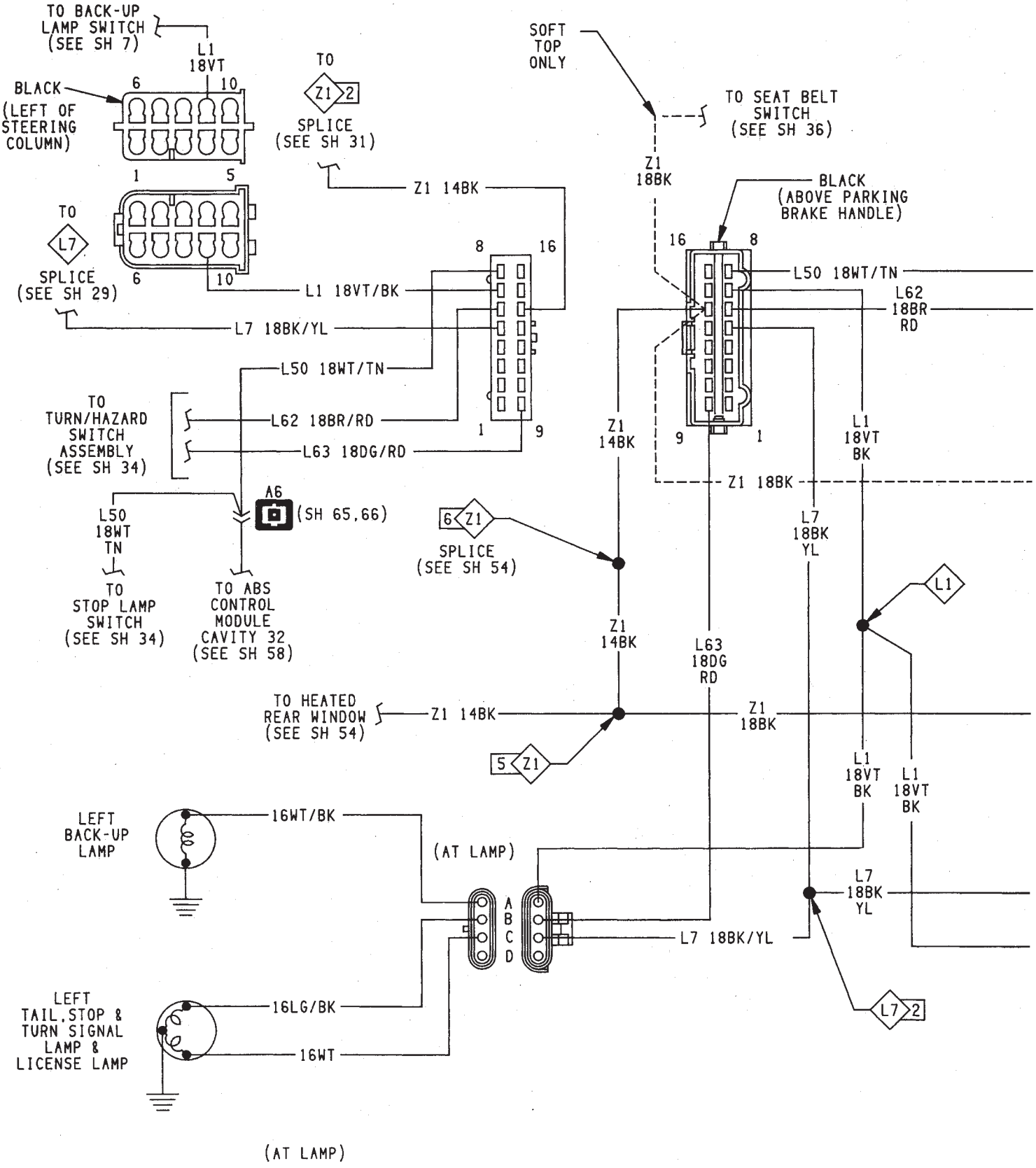


J948W-5 PROVISIONS FOR AIR CONDITIONING-2.5L | YJ 48

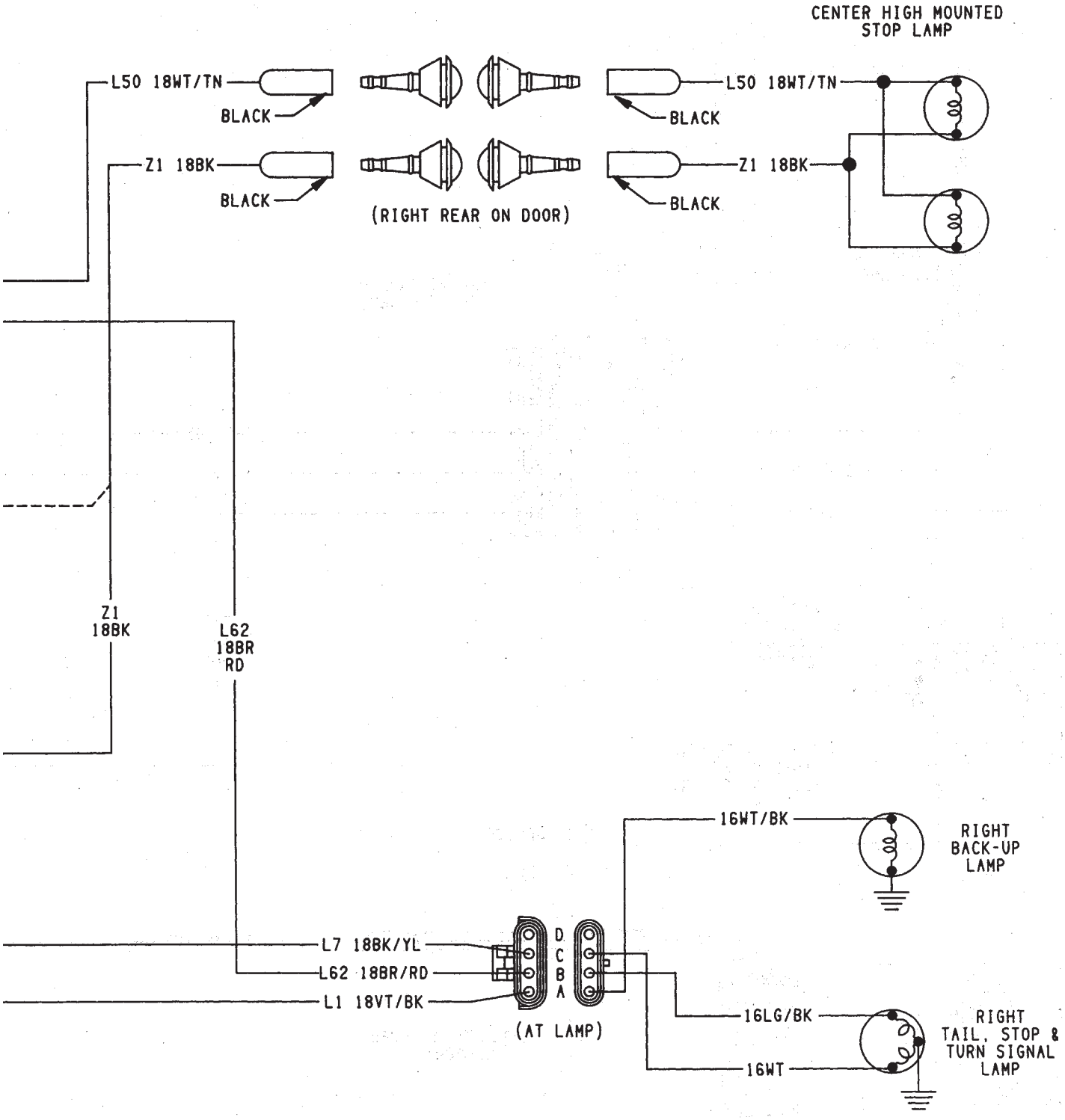


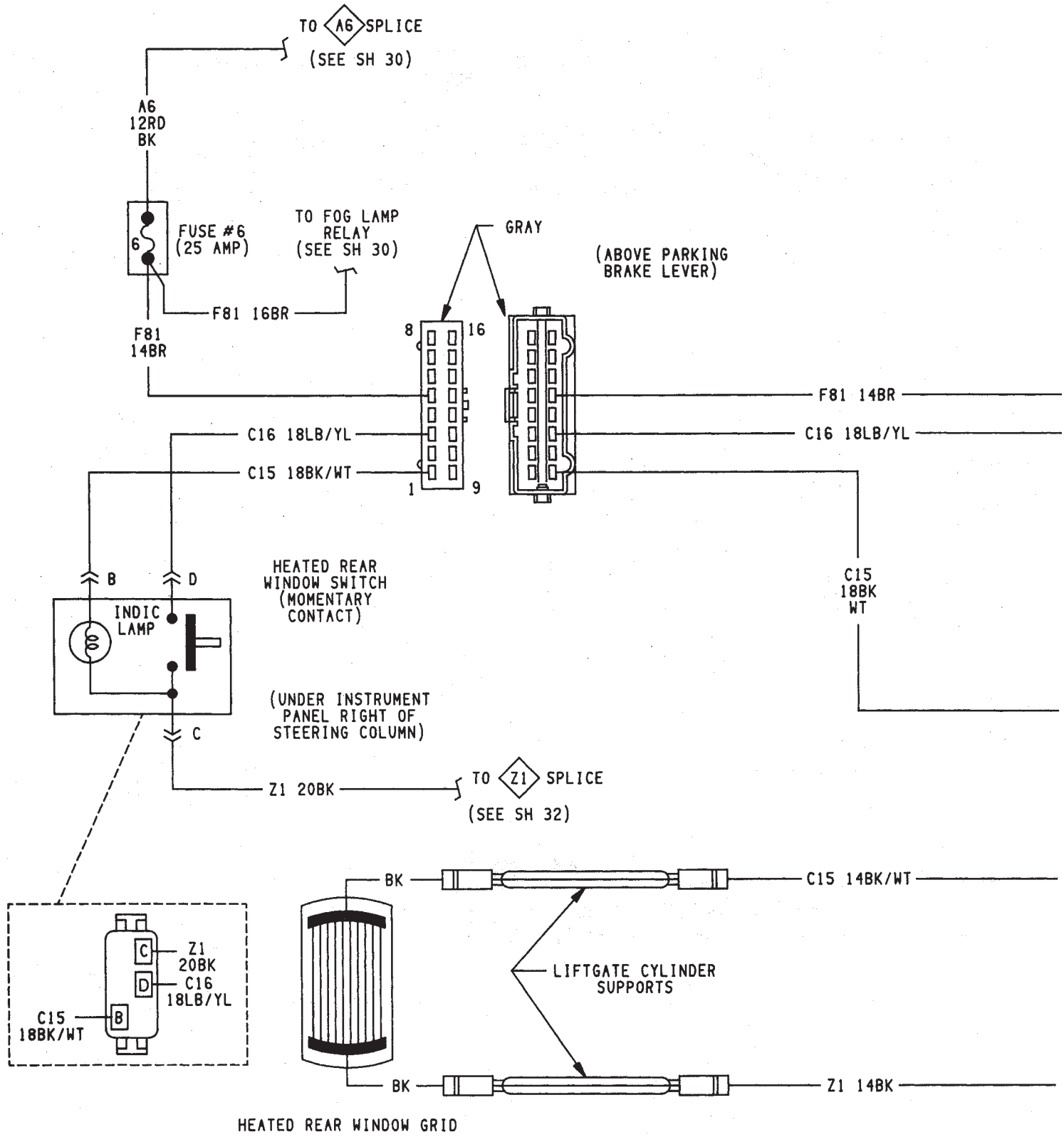
YJ 49 AIR CONDITIONING SYSTEM-4.0L J948W-5

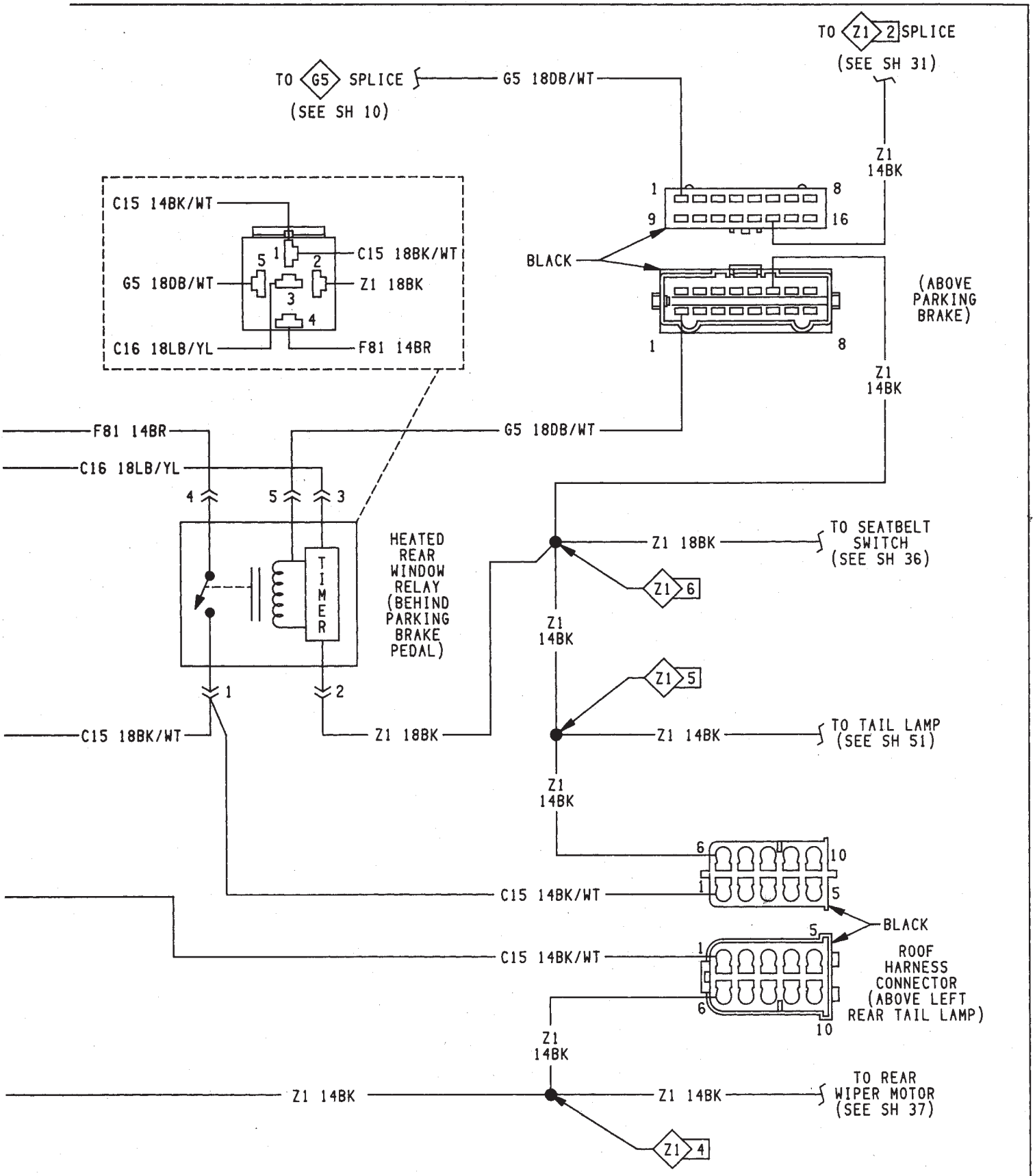

A22 14BK/OR
TO IGNITION SWITCH (SEE SH 10)
12
FUSE #12 (25 AMP)
16LB
A/C THERMOSTAT
(IN A/C HOUSING)
(ABOVE A/C HOUSING)
BLACK
C1 14DG
C1 14DG
16LB
16WT
TO HEATER/OFF SWITCH (SEE SH 47)
Z1 14BK
A
HIGH
MED
LO
A/C BLOWER SWITCH
C H M L
OFF
TO Z1 SPLICE (SEE SH 32)
16LB
16GN
160R
16DB
C91 18LB
C21 18DB YL
A B C
C21 18DB/YL
C91 18LB
16YL
16RD
160R
M
L
H
G
DB
FIELD JUMPER
RD
1
6
1
5
10
5
BLACK
(LEFT OF STEERING COLUMN)
16BK
16BK
TO CIGAR LIGHTER (SEE SH 24)



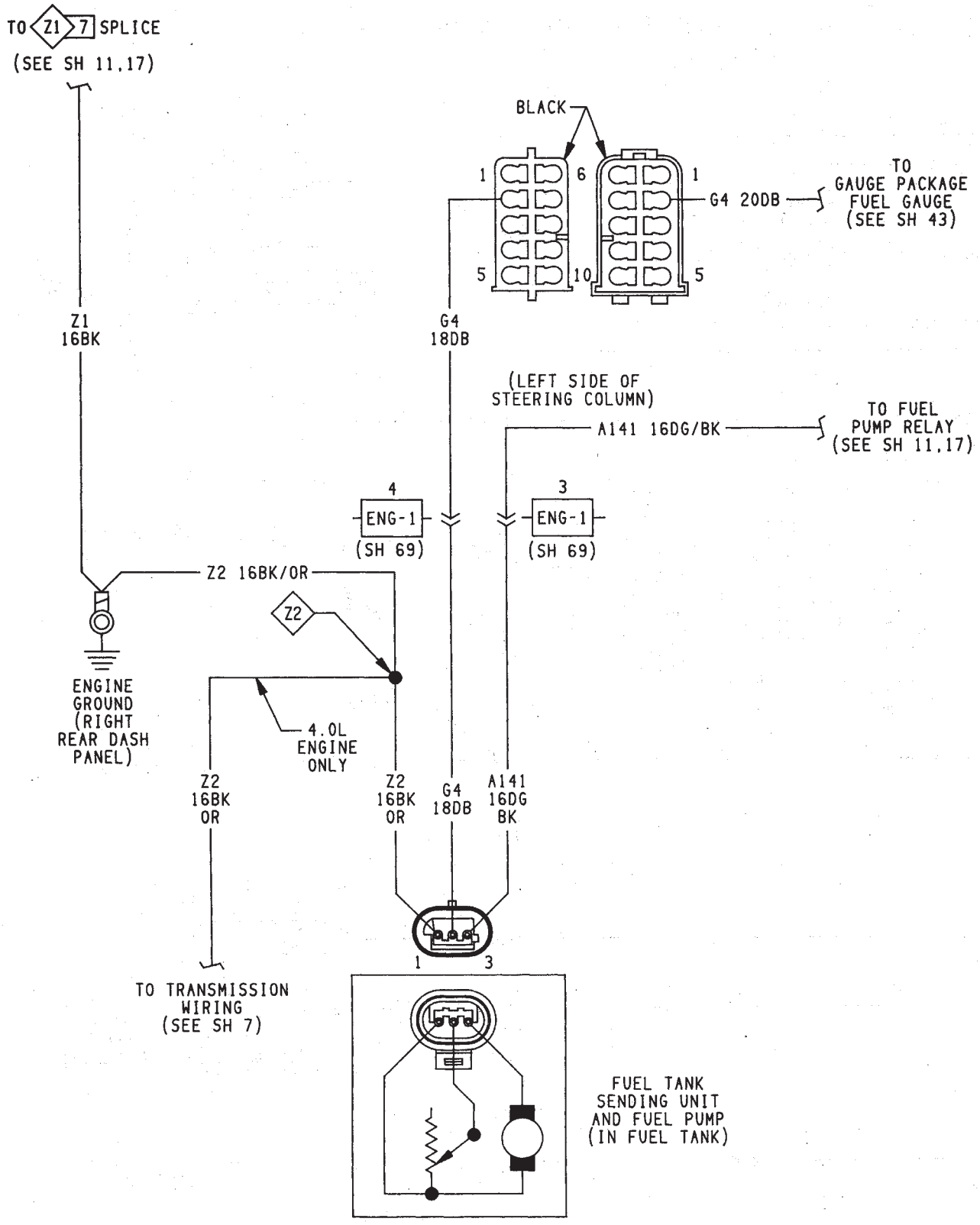
YJ 51 REAR LIGHTING J948W-5


CENTER HIGH MOUNTED STOP LAMP
L50 18WT/TN
BLACK
Z1 18BK
BLACK
(RIGHT REAR ON DOOR)
L50 18WT/TN
BLACK
Z1 18BK
BLACK
Z1 18BK
L62 18BR RD
16WT/BK
RIGHT BACK-UP LAMP
L7 18BK/YL
L62 18BR/RD
L1 18VT/BK
D
C
B
A
(AT LAMP)
16LG/BK
16WT
RIGHT TAIL, STOP & TURN SIGNAL LAMP

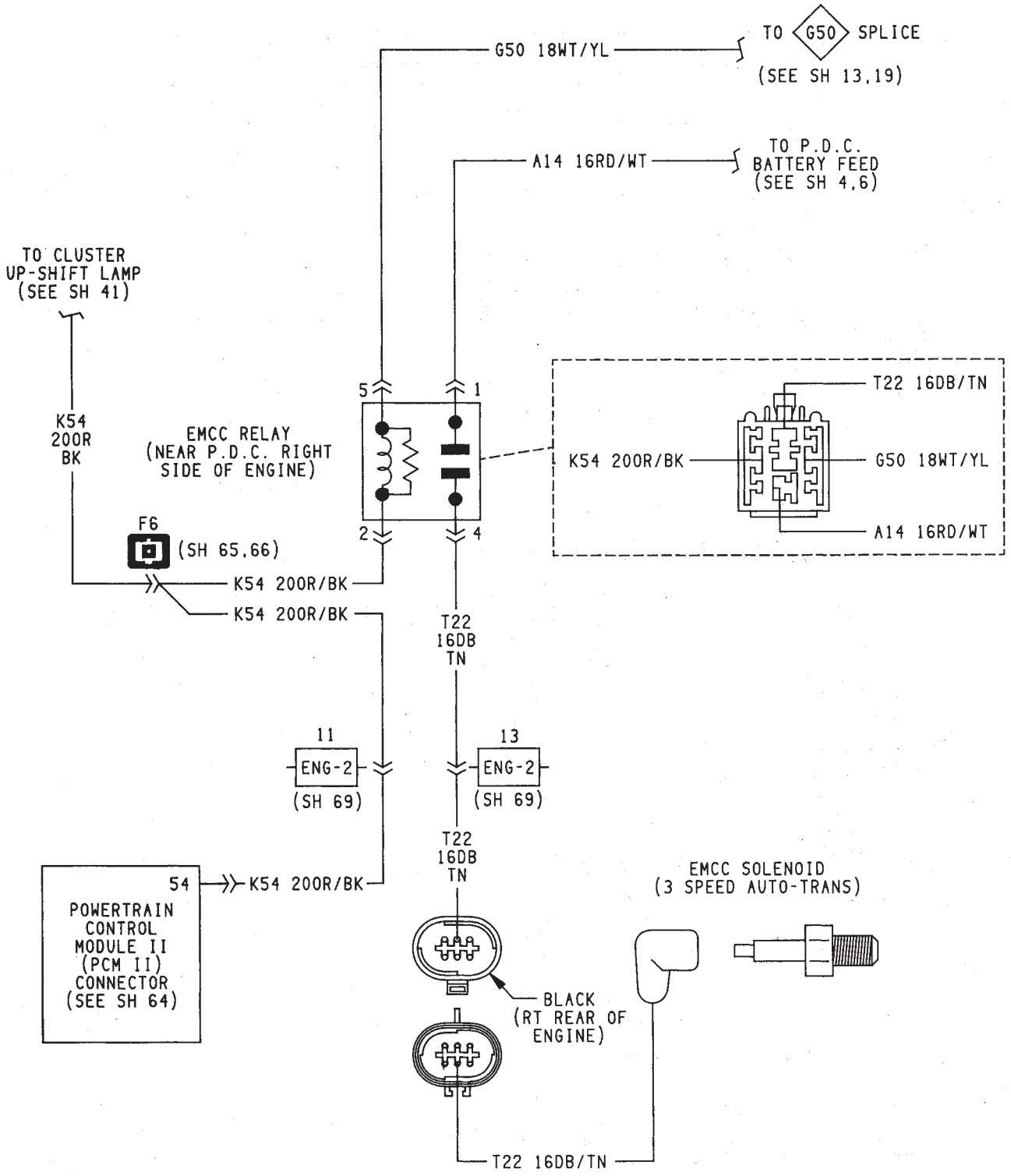

TO A6 SPLICE
(SEE SH 30)
A6
12RD
BK
6
FUSE #6
(25 AMP)
TO FOG LAMP
RELAY
(SEE SH 30)
F81 16BR
F81
14BR
GRAY
(ABOVE PARKING
BRAKE LEVER)
8
16
1
9
F81 14BR
C16 18LB/YL
C15 18BK/WT
C16 18LB/YL
B
D
C
INDIC
LAMP
HEATED REAR
WINDOW SWITCH
(MOMENTARY
CONTACT)
(UNDER INSTRUMENT
PANEL RIGHT OF
STEERING COLUMN)
C15
18BK
WT
Z1 20BK
TO Z1 SPLICE
(SEE SH 32)
C
D
B
Z1
20BK
C16
18LB/YL
C15
18BK/WT
BK
C15 14BK/WT
LIFTGATE CYLINDER
SUPPORTS
BK
Z1 14BK
HEATED REAR WINDOW GRID



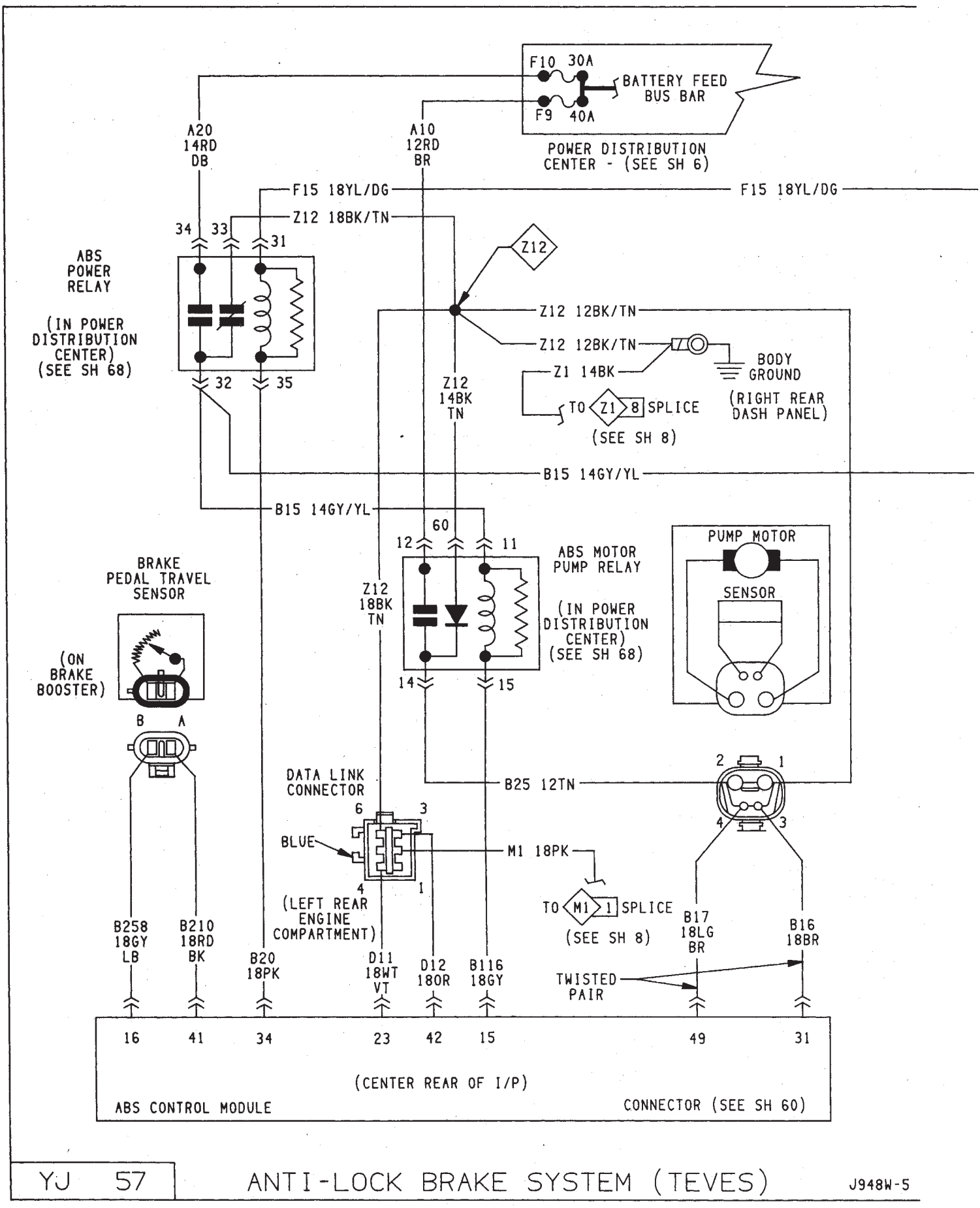
J948W-5 HEATED REAR WINDOW SYSTEM YJ 54



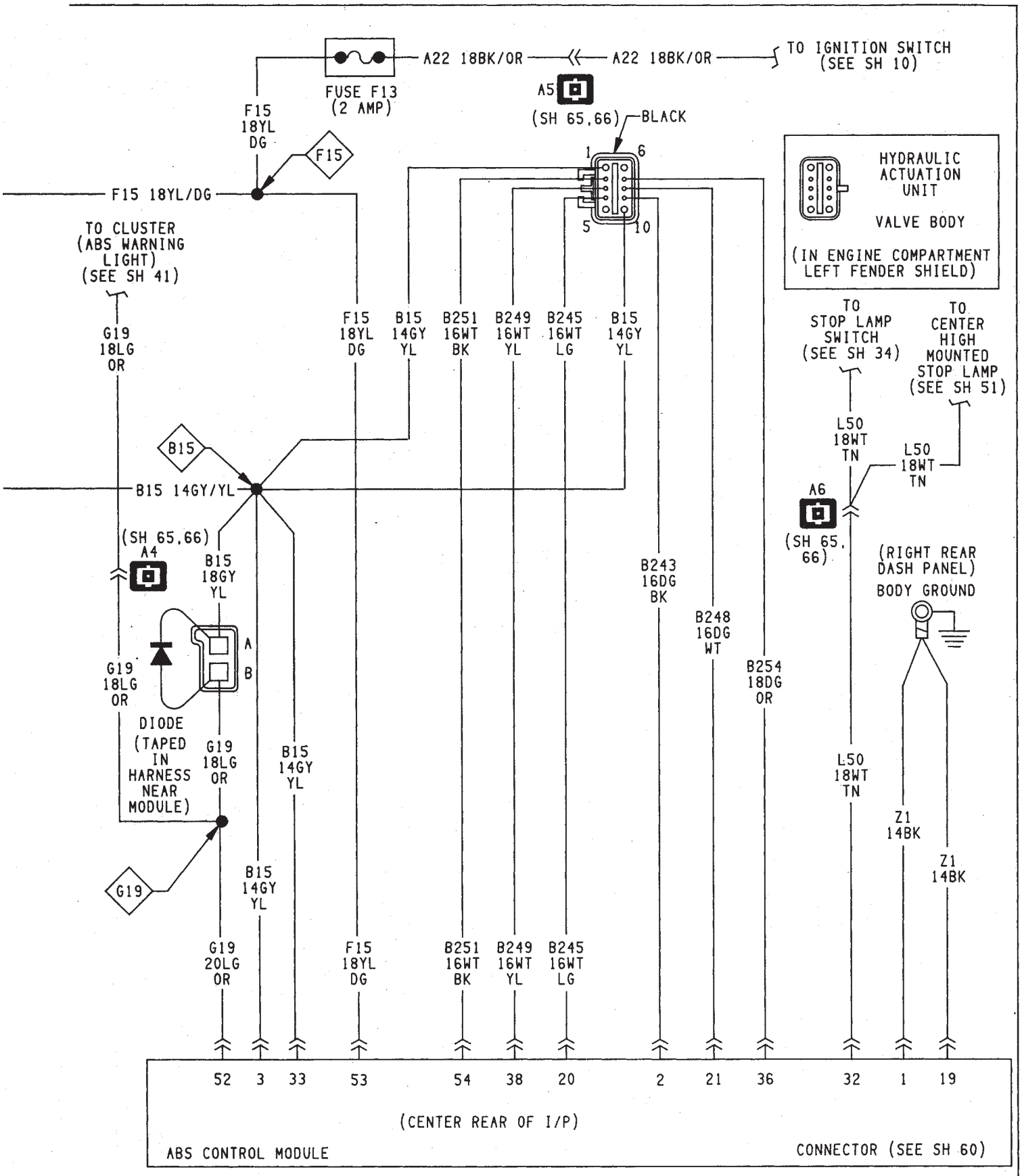
YJ 55 FUEL TANK SYSTEM J948W-5



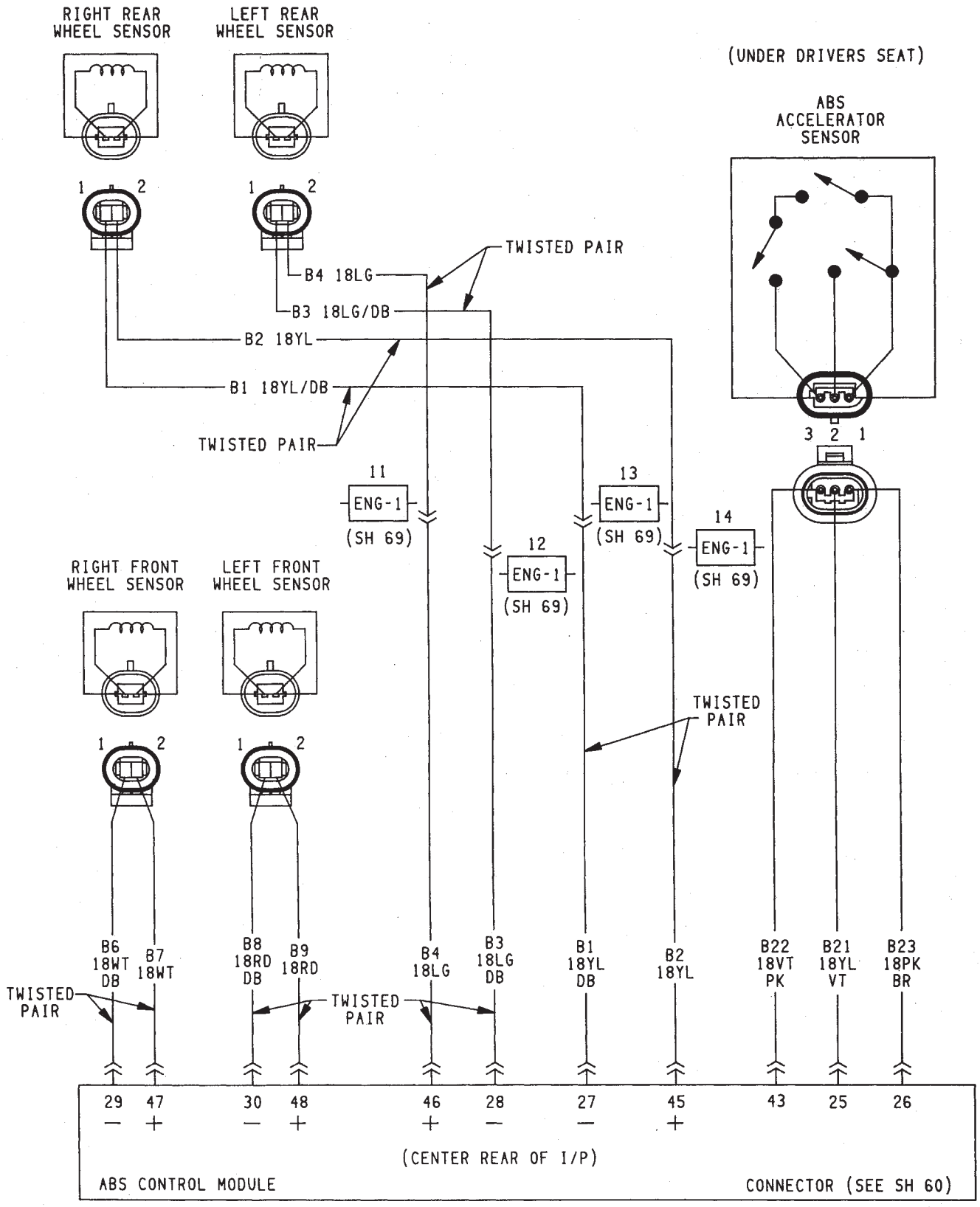
EMCC
3-SPEED AUTOMATIC TRANSMISSION



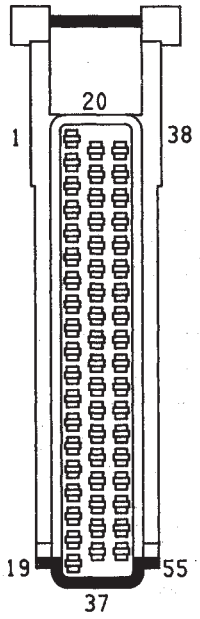
YJ 57 ANTI-LOCK BRAKE SYSTEM (TEVES) J948W-5



J948W-5 ANTI-LOCK BRAKE SYSTEM (TEVES) YJ 58



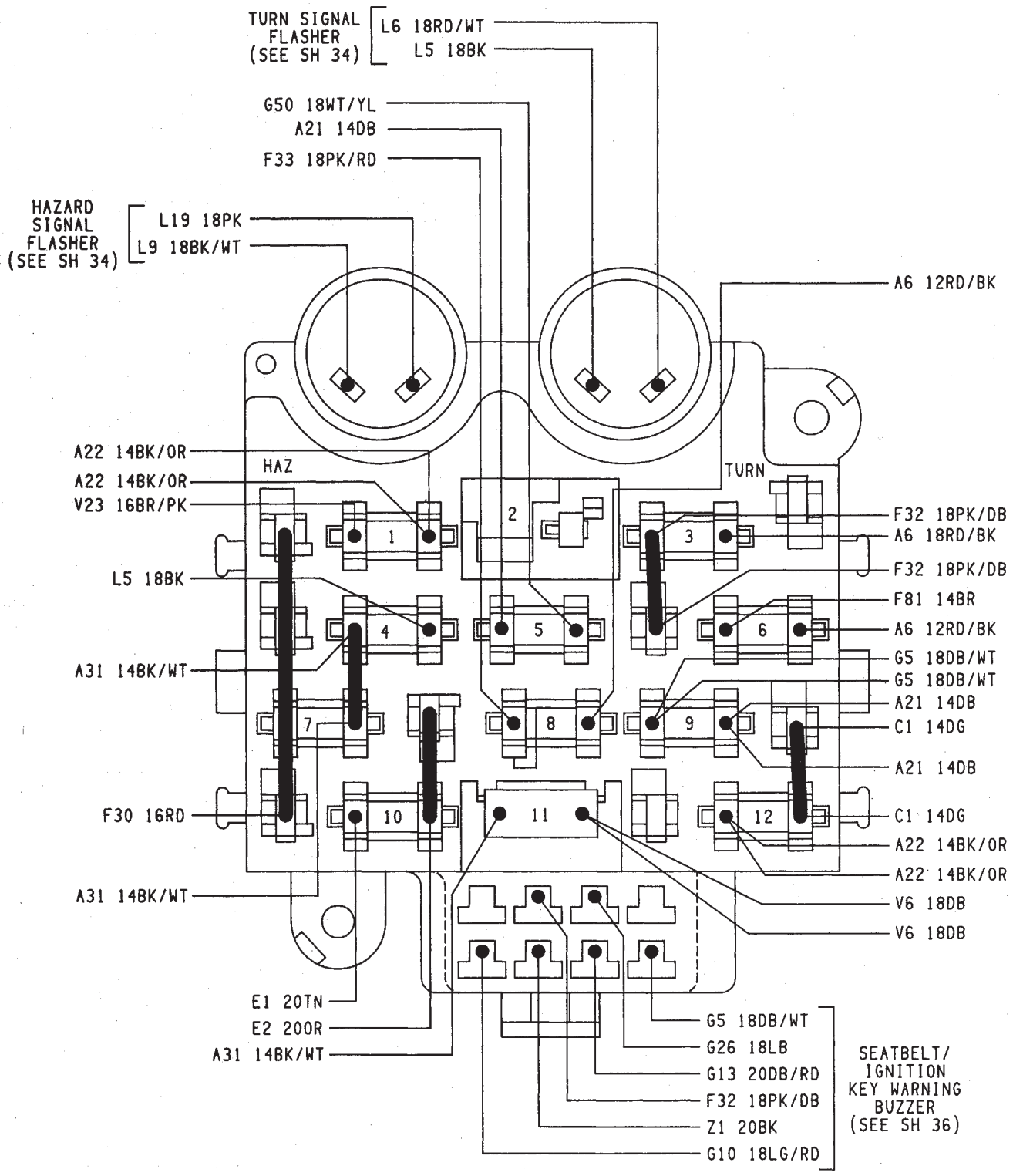
YJ 59 ANTI-LOCK BRAKE SYSTEM (TEVES) J948W-5

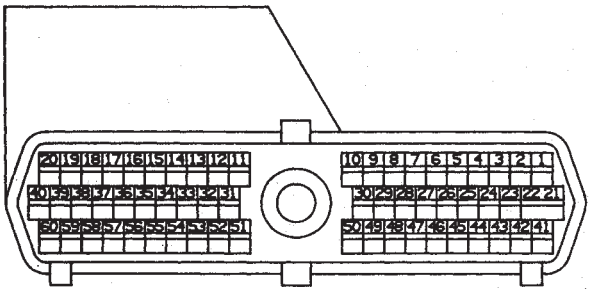


VIEWED FROM
TERMINAL END

CAV	IGNITION SYSTEM CIRCUITS	
1	Z1 14BK	GROUND
2	B243 16DG/BK	LEFT FRONT DECAY VALVE
3	B15 14GY/YL	POWER REFERENCE
4	—	—
5	—	—
6	—	—
7	—	—
8	—	—
9	—	—
10	—	—
11	—	—
12	—	—
13	—	—
14	—	—
15	B116 18GY	PUMP CONTROL
16	B258 18GY/LB	PEDAL TRAVEL SENSOR
17	—	—
18	—	—
19	Z1 14BK	GROUND
20	B245 16WT/LG	LEFT FRONT ISOLATE VALVE
21	B248 16DG/WT	RIGHT FRONT DECAY VALVE
22	—	—
23	D11 18WT/VT	DATA LINK - CCD BUS (+)
24	—	—
25	B21 18YL/VT	G SWITCH - 1 (ACCEL SENSOR)
26	B23 18PK/BR	SWITCH TEST SIGNAL
27	B1 18YL/DB	RIGHT REAR SENSOR (-)
28	B3 18LG/DB	LEFT REAR SENSOR (-)
29	B6 18WT/DB	RIGHT FRONT SENSOR (-)
30	B8 18RD/DB	LEFT FRONT SENSOR (-)
31	B16 18BR	MOTOR SENSOR (-)
32	L50 18WT/TN	BRAKE SIGNAL
33	B15 14GY/YL	SYSTEM POWER
34	B20 18PK	POWER CONTROL RELAY
35	—	—
36	B254 16DG/OR	REAR DECAY VALVE
37	—	—
38	B249 16WT/YL	RIGHT FRONT ISOLATE VALVE
39	—	—
40	—	—
41	B210 18RD/BK	PEDAL TRAVEL SENSOR GROUND
42	D12 18OR	DATA LINK - CCD BUS (-)
43	B22 18VT/PK	G SWITCH - 2 (ACCEL SENSOR)
44	—	—
45	B2 18YL	RIGHT REAR SENSOR (+)
46	B4 18LG	LEFT REAR SENSOR (+)
47	B7 18WT	RIGHT FRONT SENSOR (+)
48	B9 18RD	LEFT FRONT SENSOR (+)
49	B17 18LG/BR	MOTOR SENSOR (+)
50	—	—
51	—	—
52	G19 20LG/OR	WARNING LIGHT (YELLOW)
53	F15 18YL/OG	IGNITION 12V
54	B251 16WT/BK	REAR ISOLATE VALVE
55	—	—

FUSE NUMBER	AMPS	COLOR	DESCRIPTIONS	SHEET
1	20	YELLOW	REAR WIPERS	2,10,37
2	———	———	———	—
3	15	LT BLUE	STOP LAMPS & BUZZER	1,30,34,36
4	15	LT BLUE	TURN SIGNAL LAMPS	2,10,34
5	10	RED	A.S.D. & FUEL PUMP RELAYS	2,10,13,19
6	25	NATURAL	HEATED REAR WINDOW	1,30,53
7	20	YELLOW	CIGAR LIGHTER & ACC	2,10,24,46
8	20	YELLOW	RUNNING LIGHTS	1,29
9	15	LT BLUE	BUZZER,GAUGES & WARNING LIGHTS & RELAYS & BACKUP LAMPS	2,10,36
10	5	TAN	PANEL ILLUM. LAMPS	1,31
11	5.3 C/B	GOLD	FRONT WIPERS & WASHERS	2,10,38,39
12	25	NATURAL	HEATER & A/C	2,10,47,48,50


TURN SIGNAL FLASHER (SEE SH 34)
L6 18RD/WT
L5 18BK
G50 18WT/YL
A21 14DB
F33 18PK/RD
HAZARD SIGNAL FLASHER (SEE SH 34)
L19 18PK
L9 18BK/WT
A6 12RD/BK
A22 14BK/OR
HAZ
A22 14BK/OR
V23 16BR/PK
TURN
F32 18PK/DB
A6 18RD/BK
L5 18BK
F32 18PK/DB
F81 14BR
A6 12RD/BK
A31 14BK/WT
G5 18DB/WT
G5 18DB/WT
A21 14DB
C1 14DG
A21 14DB
F30 16RD
C1 14DG
A22 14BK/OR
A22 14BK/OR
A31 14BK/WT
V6 18DB
V6 18DB
E1 20TN
E2 200R
A31 14BK/WT
G5 18DB/WT
G26 18LB
G13 20DB/RD
F32 18PK/DB
Z1 20BK
G10 18LG/RD
SEATBELT/ IGNITION KEY WARNING BUZZER (SEE SH 36)
1
2
3
4
5
6
7
8
9
10
11
12

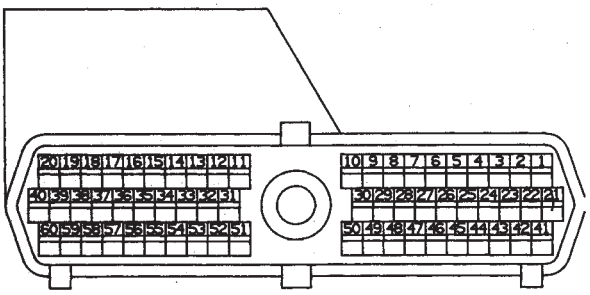


VIEWED FROM WIRE END OF CONNECTOR

CAV	ECM SYSTEM CIRCUITS	
1	K1 20DG/RD	MAP SENSOR (+)
2	K2 18TN/BK	ENGINE COOLANT TEMP.SENSOR
3	A14 16RD/WT	BATTERY
4	K4 18BK/LB	SENSOR GROUND
5	Z11 16BK/WT	GROUND SENSOR FOR FUEL
6	K6 20VT/WT	SENSOR RETURN
7	K7 18OR	VEHICLE SPEED SENSOR·MAG(+)
8	—	—
9	G5 18DB/WT	IGNITION I·START AND RUN
10	K10 18DB/OR	POWER STEERING SENSOR FEED
11	Z1 16BK	GROUND
12	Z1 16BK	GROUND
13	K14 18LB/BR	INJECTOR NO.4
14	K13 18YL/WT	INJECTOR NO.3
15	K12 18TN	INJECTOR NO.2
16	K11 18WT/DB	INJECTOR NO.1
17	—	—
18	—	—
19	K19 18GY	IGNITION
20	K20 18DG	GENERATOR FIELD
21	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR
22	K22 18OR/DB	THROTTLE POSITION (SENSOR)
23	—	—
24	K24 18GY/BK	VEHICLE SPEED SENSOR MAG(—)
25	D21 20PK	DATA LINK (DATA·2)
26	—	—
27	C91 18LB	A/C REQUEST
28	C20 18BR	A/C SELECT
29	V40 18WT/PK	TCC FEED (BRAKE)
30	T41 18BR/YL	PARK/NEUTRAL POSITION(SWITCH)
31	—	—
32	G3 20BK/PK	MALFUNCTION INDICATOR LAMP
33	—	—
34	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY
35	—	—
36	—	—
37	—	—
38	—	—
39	K39 18GY/RD	IDLE AIR CONTROL STEPPER
40	K40 18BR/WT	IDLE AIR CONTROL STEPPER
41	K41 18BK/DG	HEATED OXYGEN SENSOR
42	—	—
43	G21 20GY/LB	BUFFERED TACH SIGNAL
44	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
45	D20 20LG	DATA LINK (DATA·1)
46	—	—
47	G7 20WT/OR	VEHICLE SPEED SIGNAL
48	—	—
49	—	—
50	—	—
51	K51 18DB/YL	FUEL PUMP RELAY COIL
52	—	—
53	—	—
54	K54 20OR/BK	UPSHIFT LAMP
55	—	—
56	—	—
57	A142 18VT/BK	ASD BATTERY SENSE
58	—	—
59	K59 18VT/BK	IDLE AIR CONTROL STEPPER
60	K60 18YL/BK	IDLE AIR CONTROL STEPPER

POWERTRAIN CONTROL MODULE CONNECTOR (2.5L ENGINE)

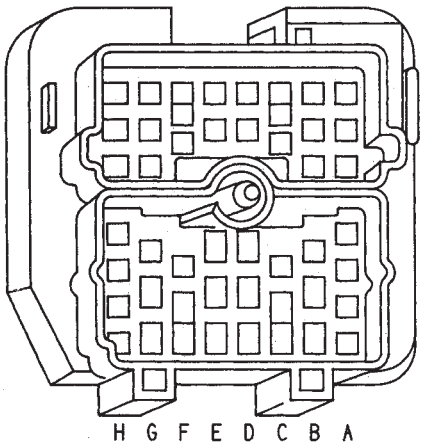
J948W-5



VIEWED FROM WIRE END OF CONNECTOR

CAV	ECM SYSTEM CIRCUITS	
1	K1 20DG/RD	MAP SENSOR (+)
2	K2 18TN/BK	ENGINE COOLANT TEMP.SENSOR
3	A14 16RD/WT	BATTERY
4	K4 18BK/LB	SENSOR GROUND
5	Z11 16BK/WT	GROUND SENSOR FOR FUEL
6	K6 20VT/WT	SENSOR RETURN
7	K7 18OR	VEHICLE SPEED SENSOR·MAG(+)
8	—	—
9	G5 18DB/WT	IGNITION I·START AND RUN
10	—	—
11	Z1 16BK	GROUND
12	Z1 16BK	GROUND
13	K14 18LB/BR	INJECTOR NO.4
14	K13 18YL/WT	INJECTOR NO.3
15	K12 18TN	INJECTOR NO.2
16	K11 18WT/DB	INJECTOR NO.1
17	—	—
18	—	—
19	K19 18GY	IGNITION
20	K20 18DG	GENERATOR FIELD
21	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR
22	K22 18OR/DB	THROTTLE POSITION (SENSOR)
23	—	—
24	K24 18GY/BK	VEHICLE SPEED SENSOR MAG(—)
25	D21 20BK	DATA LINK (DATA·2)
26	—	—
27	C91 18LB	A/C REQUEST
28	C20 18BR	A/C SELECT
29	V40 18WT/PK	TCC FEED (BRAKE)
30	T41 18BR/YL	PARK/NEUTRAL POSITION(SWITCH)
31	—	—
32	G3 20BK/PK	MALFUNCTION INDICATOR LAMP
33	—	—
34	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY
35	—	—
36	—	—
37	—	—
38	K15 18PK/BK	INJECTOR NO.5
39	K39 18GY/RD	IDLE AIR CONTROL STEPPER
40	K40 18BR/WT	IDLE AIR CONTROL STEPPER
41	K41 18BK/DG	HEATED OXYGEN SENSOR
42	—	—
43	G21 20GY/LB	BUFFERED TACH SIGNAL
44	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
45	D20 20LG	DATA LINK (DATA·1)
46	—	—
47	G7 20WT/OR	VEHICLE SPEED SIGNAL
48	—	—
49	—	—
50	—	—
51	K51 18DB/YL	FUEL PUMP RELAY COIL
52	—	—
53	—	—
54	K54 20OR/BK	UPSHIFT LAMP
55	—	—
56	—	—
57	A142 18DG/OR	ASD BATTERY SENSE
58	K16 18LG/BK	INJECTOR NO.6
59	K59 18VT/BK	IDLE AIR CONTROL STEPPER
60	K60 18YL/BK	IDLE AIR CONTROL STEPPER

POWERTRAIN CONTROL MODULE CONNECTOR (4.0L ENGINE)



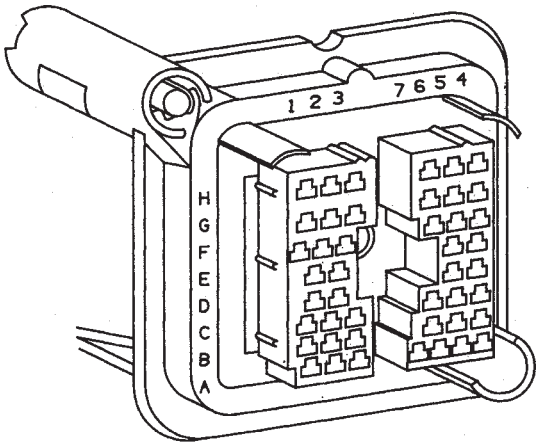
ENGINE COMPARTMENT

CAV	ENGINE COMPARTMENT CIRCUITS		SHEET
A1	L7 18BK/YL	PARKING LAMPS	26,28,30
A2	V20 18BR/WT	REAR WASHER PUMP	37
A3	L60 18TN	RIGHT TURN SIGNAL LAMPS	25,27,34
A4	G19 20LG/BR	ABS WARNING LIGHT	58
A5	A22 18BK/OR	IGNITION FEED (RUN ONLY)	58
A6	L50 18WT/TN	STOP LAMP	51,58
A7	G9 20GY/BK	BRAKE WARNING SWITCH	9
B1	L20 16LG/WT	DAYTIME RUNNING LAMPS	28,29
B2	G5 18DB/WT	DAYTIME RUNNING LAMPS	28
B3	—	—	—
B4	G7 18WT/OR	VEHICLE SPEED SIGNAL	12,18
B5	Z1 14BK	GROUND	8,31
B6	G11 20WT/BK	BRAKE BULB CHECK	9
C1	G7 18WT/OR	VEHICLE SPEED SENSOR	12,18,28
C2	LG1 18LG	LEFT TURN SIGNAL LAMPS	25,27,34
C3	—	—	—
C4	—	—	—
C5	G3 20BK/PK	MALFUNCTION INDICATOR LAMP GROUND	16,22
C6	G5 18DB/WT	BACKUP LAMP SWITCH & A/C RELAY	7,48,49
D1	L39 16LB	FOG LAMP FEED	26,28,30
D2	—	—	—
D4	L9 18BK/WT	HAZARD FLASHER FEED	4,6
D5	G50 18WT/YL	IGNITION I-START AND RUN	10,13,19
E1	L3 16RD/OR	HIGH BEAM HEADLAMPS	25,27,29
E1	G34 18RD/GY	HIGH BEAM INDIC LP W/O DRL	25
E2	G34 18RD/GY	HIGH BEAM INDIC LP W/O DRL	26
E2	G34 18RD/GY	HIGH BEAM INDIC LP WITH DRL	28
E4	A3 12RD/OR	HEADLAMP SWITCH FEED	4,6,29
E5	—	—	—
F1	—	—	—
F2	—	—	—
F3	V10 18BR	WINDSHIELD WASHER PUMP FEED	38,39
F4	—	—	—
F5	—	—	—
(2) F6	K54 20OR/BK	UPSHIFT SWITCH AND EMCC RELAY	13,19,56
G1	—	—	—
G2	—	—	—
G3	X2 18DG/RD	HORN	33
G4	A6 12RD/BK	FUSEBLOCK FEED	4,6,30
G5	A41 18YL	STARTER RELAY-CRANK	7
G6	X2 18DG/RD	HORN RELAY	33
H1	L4 16VT/WT	LOW BEAM HEADLAMPS	25,27,29
H2	—	—	—
H3	—	—	—
H4	M1 18PK	I.O.D. BATTERY FEED	8,35
H5	V40 18WT/PK	STOP LAMP SWITCH	16,22,34
H6	G21 20GY/LB	TACHOMETER SIGNAL	16,22

BULKHEAD CONNECTOR

J948W-5

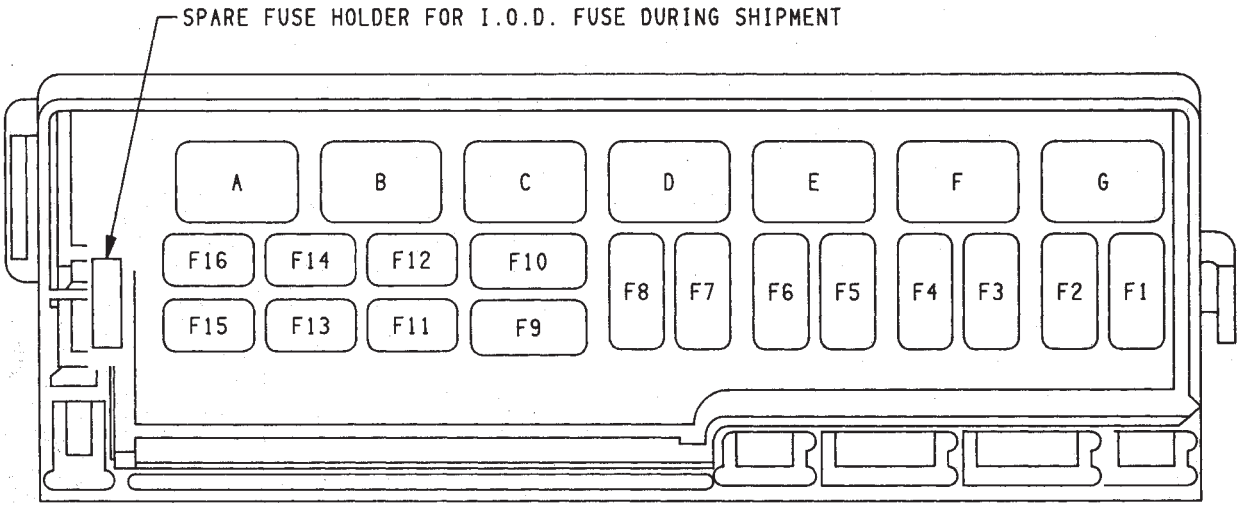
	CAV	INSTRUMENT PANEL CIRCUITS	
	A1	L7 18BK/YL	PARKING LAMPS FEED
	A2	V20 18BR/WT	REAR WASHER PUMP (HARD TOP)
	A3	L60 18TN	RIGHT TURN SIGNAL LAMPS
	A4	G19 20LG/OR	ABS WARNING LIGHT
	A5	A22 14BK/OR	IGNITION FEED (RUN ONLY)
	A6	L50 18WT/TN	STOP LAMP FEED
	A7	G9 20GY/BK	BRAKE WARNING INDICATOR LAMP
	B1	L20 16LG/WT	HEADLAMP DIMMER SWITCH
	B2	G5 18DB/WT	SPLICE (FUSE BLOCK)
	B3	—	—
(2)	B4	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
	B5	Z1 14BK	GROUND
	B6	G11 20WT/BK	BRAKE WARNING SWITCH
(2)	C1	G7 20WT/OR	VEHICLE SPEED SENSOR SIGNAL
	C2	L61 18LG	LEFT TURN SIGNAL LAMPS
	C3	—	—
	C4	—	—
	C5	G3 20BK/PK	MALFUNCTION INDICATOR LAMP GROUND
	C6	G5 18DB/WT	BACK-UP LAMP SWITCH & A/C RELAY
	D1	L39 16LB	FOG LAMPS
	D2	—	—
	D4	L9 18BK/WT	HAZARD FLASHER FEED
	D5	G50 18WT/YL	IGNITION I·START AND RUN
	E1	L3 16RD/OR	DIMMER SWITCH-HIGH BEAM
	E2	G34 18RD/GY	HIGH BEAM INDICATOR LAMP
	E4	A3 12RD/OR	HEADLAMP SWITCH
	E5	—	—
	F1	—	—
	F2	—	—
	F3	V10 18BR	WINDSHIELD WASHER PUMP FEED
	F4	—	—
	F5	—	—
	F6	K54 20OR/BK	UPSHIFT INDICATOR
	G1	—	—
	G2	—	—
	G3	X2 18DG/RD	HORN
	G4	A6 12RD/BK	FUSEBLOCK FEED
	G5	A41 18YL	IGNITION SWITCH-START
	G6	X2 18DG/RD	HORN RELAY
	H1	L4 16VT/WT	DIMMER SWITCH-LOW BEAM
	H2	—	—
	H3	—	—
	H4	M1 18PK	I.O.D. BATTERY FEED
	H5	V40 18WT/PK	STOP LAMP SWITCH
	H6	G21 20GY/LB	TACHOMETER SIGNAL



INSTRUMENT PANEL

(2) INDICATES-2 WIRES IN CAVITY

RELAY	DESCRIPTION
A	HORN RELAY
B	FUEL PUMP RELAY
C	ABS PUMP RELAY
D	A/C COMPRESSOR CLUTCH RELAY
E	AUTOMATIC SHUT DOWN RELAY
F	ENGINE STARTER RELAY
G	ABS POWER RELAY

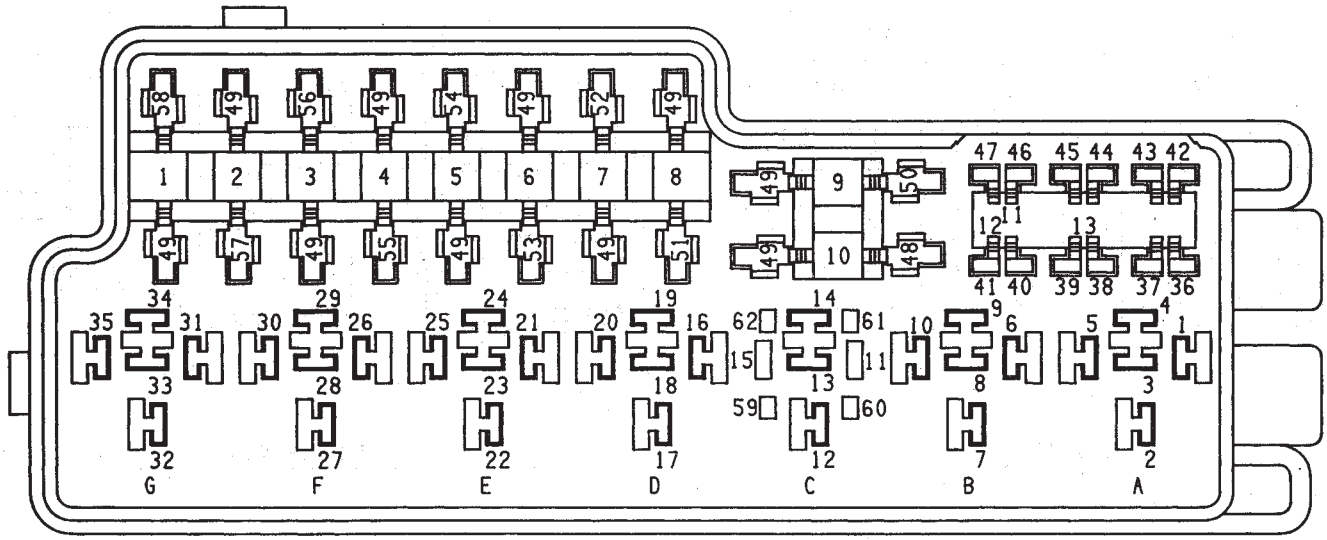


FUSE	AMPS	COLOR	DESCRIPTION	TYPE
F1	30A	GREEN	FUEL PUMP & AUTOMATIC SHUT DOWN	MAXI FUSE
F2	50A	RED	CHARGING CICUIT	
F3	50A	RED	BATTERY ACC FEED	
F4	40A	AMBER	IGNITION & ENGINE STARTER FEED	
F5	20A	YELLOW	HAZARD FLASHER FEED	
F6	50A	RED	CHARGING CIRCUIT	
F7	30A	GREEN	HEADLAMP FEED	
F8	20A	YELLOW	I.O.D. & HORN FEED	
F9	40A	AMBER	ABS PUMP RELAY	
F10	30A	GREEN	ABS POWER RELAY	
F11				MINI FUSE
F12				
F13	2A	GRAY	ABS CONTROL MODULE	
F14				
F15	10A	RED	HORN / HORN RELAY	
F16	10A	RED	I.O.D. CIRCUITS	

YJ 67

POWER DISTRIBUTION CENTER
IDENTIFICATION COVER

J948W-5



VIEWED FROM TERMINAL SIDE
(LOCATED ON RIGHT SIDE OF ENGINE COMPARTMENT)

A	HORN RELAY
CAV	CIRCUIT
1	X3 18BK/RD
2	F31 18VT
4	X2 18DG/RD
5	F31 18VT
	F31 18VT

(SEE SH 33)

B	FUEL PUMP RELAY
CAV	CIRCUIT
6	G50 18WT/YL
7	A14 16RD/WT
	A14 16RD/WT
9	A141 16DG/BK
10	K51 18DB/YL
	K51 18DB/YL

(SEE SH 11,17)

C	ABS PUMP RELAY
CAV	CIRCUIT
11	B15 18GY/YL
12	A10 12RD/BR
14	B25 12TN
15	B116 18GY
60	Z12 18BK/TN

(SEE SH 57)

D	A/C COMPRESSOR CLUTCH RELAY
CAV	CIRCUIT
16	C13 18DB/OR
17	C3 16DB/BK
18	Z1 16BK
19	C20 18BR/RD
	C20 18BR/RD
20	G5 18DB/WT
	G5 18DB/WT

(SEE SH 49)

E	AUTOMATIC SHUT DOWN
CAV	CIRCUIT
21	G50 18WT/YL
22	A14 16RD/WT
	A14 16RD/WT
24	A142 18DG/OR
25	K51 18DB/YL

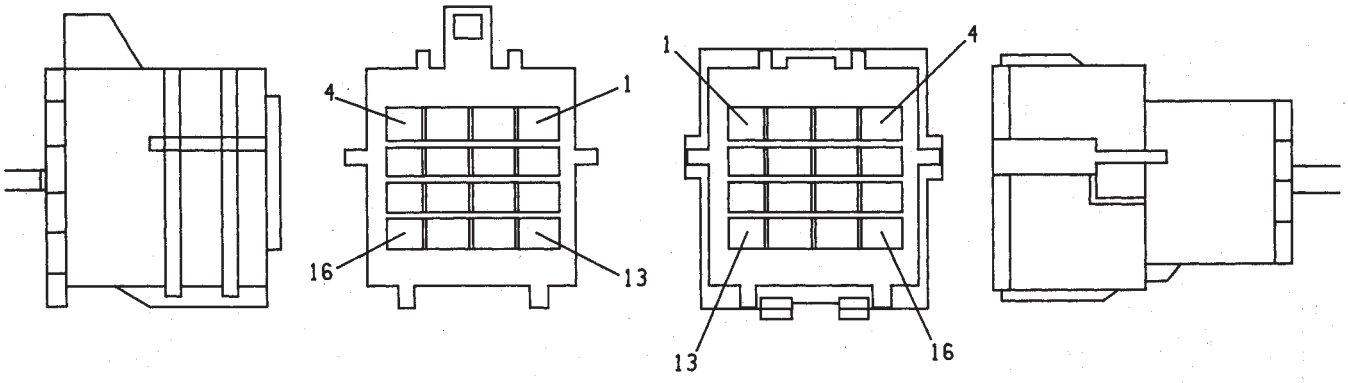
(SEE SH 11,17)

F	ENGINE STARTER RELAY
CAV	CIRCUIT
26	A41 18YL
27	A1 12RD
29	T40 14BR
30	T41 18BR/YL
	T41 18BR/YL

(SEE SH 7)

G	ABS POWER RELAY
CAV	CIRCUIT
31	F15 18YL/DG
32	B15 14GY/YL
	B15 18GY/YL
33	Z12 18BK/TN
34	A20 14RD/DB
35	B20 18PK

(SEE SH 57)



ENGINE WIRING

HEADLAMP & DASH WIRING

	4.0L ENGINE	2.5L ENGINE
CAV	CIRCUIT INFO	CIRCUIT INFO
1	C20 18BR/RD	C20 18BR/RD
2	C91 18LB	C91 18LB
3	A14 16RD/WT	A14 16RD/WT
4	C13 18DB/OR	C13 18DB/OR
5	G3 20BK/PK	G3 20BK/PK
6	G50 18WT/YL	G50 18WT/YL
7	G20 18VT/YL	G20 18VT/YL
8	T41 18BR/YL	T41 18BR/YL
9	V40 18WT/PK	V40 18WT/PK
10	K51 18DB/YL	K51 18DB/YL
11	K54 20OR/BK	K54 20OR/BK
12	G21 20GY/LB	G21 20GY/LB
13	T22 16DB/TN	T22 16DB/TN
14	G7 18WT/OR	G7 18WT/OR
15	K4 18BK/LB	K4 18BK/LB
16		K7 18OR

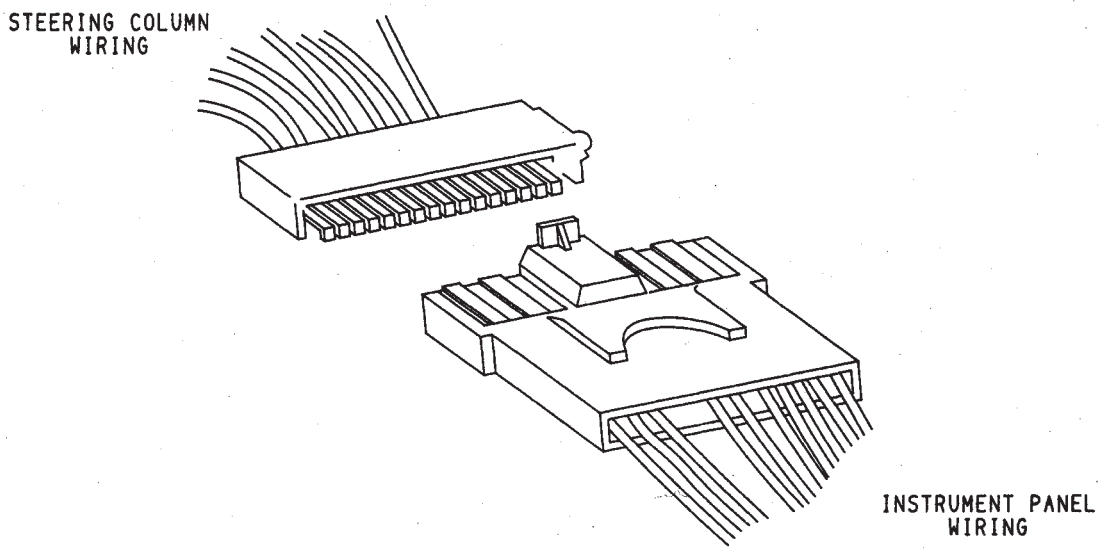
	4.0L ENGINE	2.5L ENGINE
CAV	CIRCUIT INFO	CIRCUIT INFO
1	T40 14BR	T40 14BR
2	C3 18DB/BK	
3	A141 16DG/BK	A141 16DG/BK
4	G4 18DB	G4 18DB
5	A142 18DG/OR	A142 18DG/OR
6	C21 18DB/YL	G7 18WT/OR
7	C20 18BR/RD	
8	L1 18VT	L1 18VT
9	G5 18DB/WT	G5 18DB/WT
10	T41 18BR/YL	T41 18BR/YL
11	B4 18LG	K7 18OR
12	B3 18LG/DB	
13	B1 18YL/DB	
14	B2 18YL	
15	G60 18GY/YL	G60 18GY/YL
16	K4 18BK/LB	K4 18BK/LB

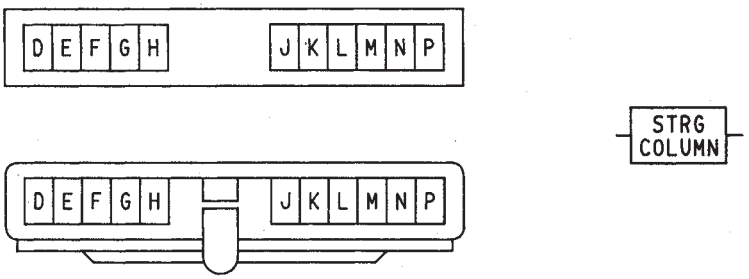
ENG-2

CONNECTOR LOCATED LEFT SIDE - NEAR BULKHEAD

ENG-1

CONNECTOR LOCATED RIGHT SIDE - NEAR ALTERNATOR

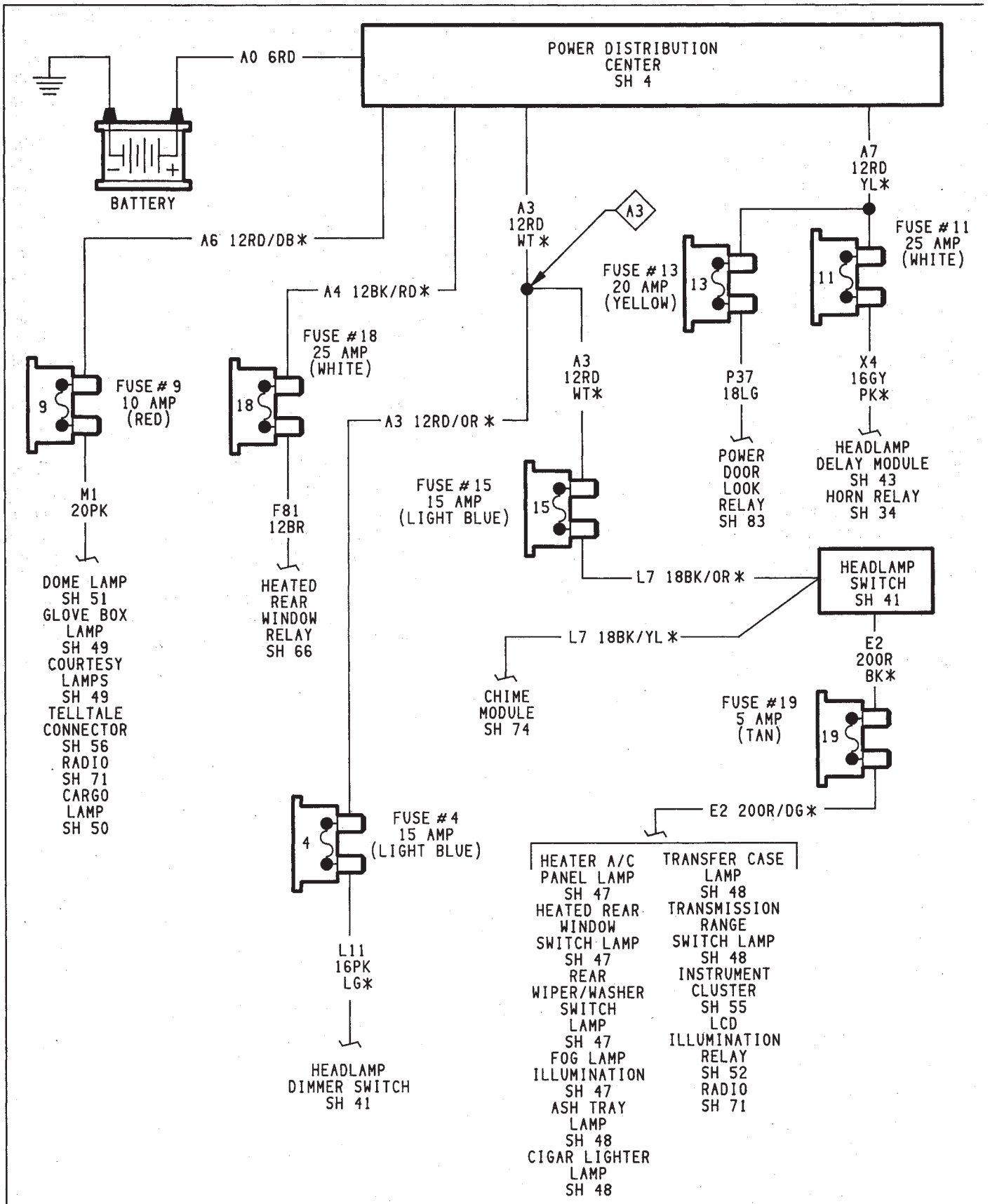




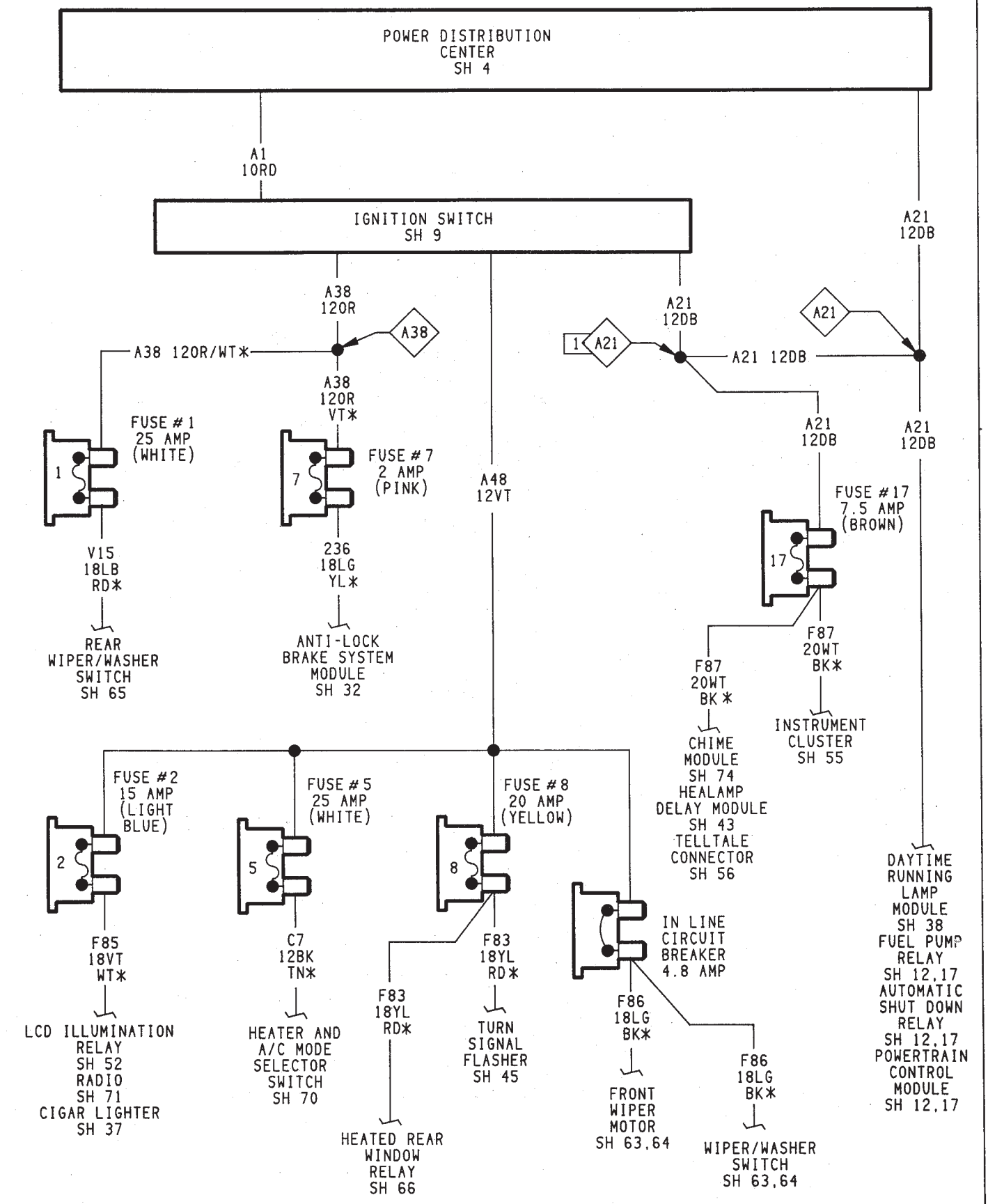
CAV	TURN SIGNAL SWITCH CIRCUITS		SHEET
P	L50 18WT/TN	STOP LAMPS	34
N	L62 18BR/RD	RIGHT TURN-REAR	34
M	L63 18DG/RD	LEFT TURN-REAR	34
L	L6 18RD/WT	TURN SIGNAL FLASHER	34
K	L19 18PK	HAZARD FLASHER	34
J	L60 18TN	RIGHT TURN-FRONT/INDICATOR	34
J	L60 18TN	RIGHT TURN-FRONT/INDICATOR	34
H	L61 18LG	LEFT TURN-FRONT/INDICATOR	34
H	L61 18LG	LEFT TURN-FRONT/INDICATOR	34
G	X3 18BK/RD	HORN SWITCH	33
F	G26 18LB	IGNITION KEY WARNING SWITCH	36
E	G16 18BK/LB	IGNITION KEY WARNING SWITCH	36
D	E2 200R	TRANSMISSION RANGE ILLUMINATION	32

WIRING DIAGRAMS XJ

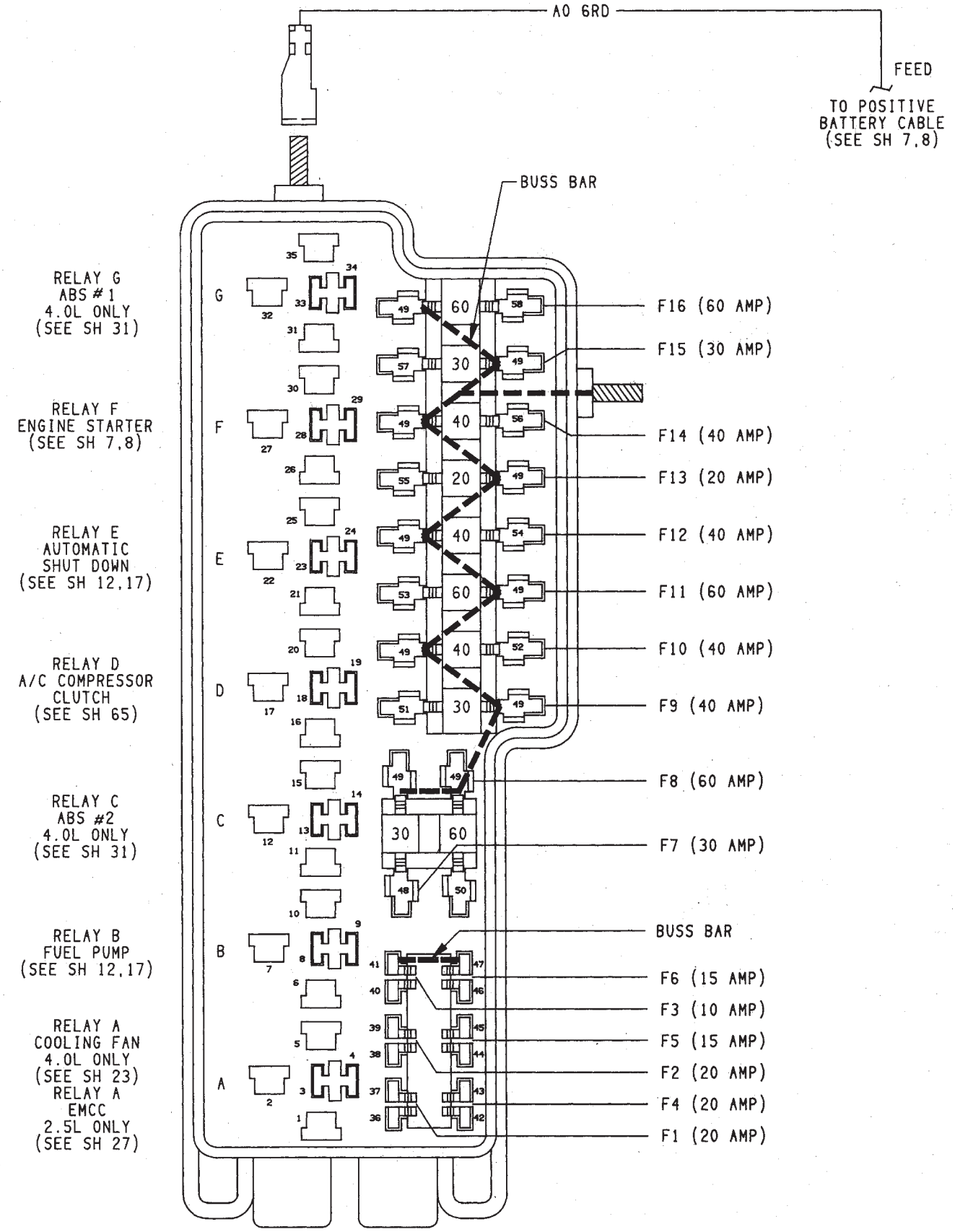
INDEX



XJ 1 FUSE APPLICATION CHART J948W-7



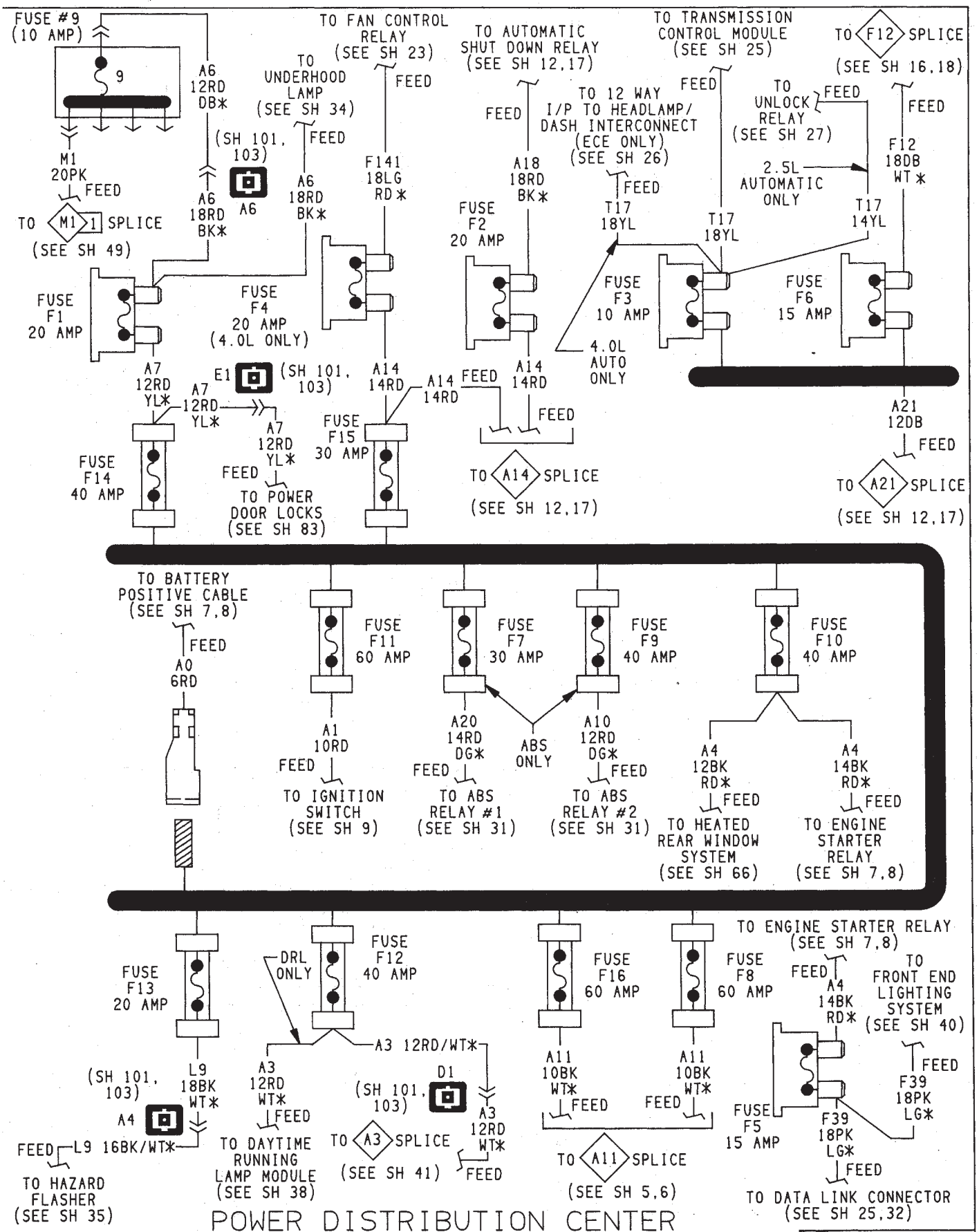
J948W-7 FUSE APPLICATION CHART XJ 2



POWER DISTRIBUTION CENTER IDENTIFICATION

XJ 3

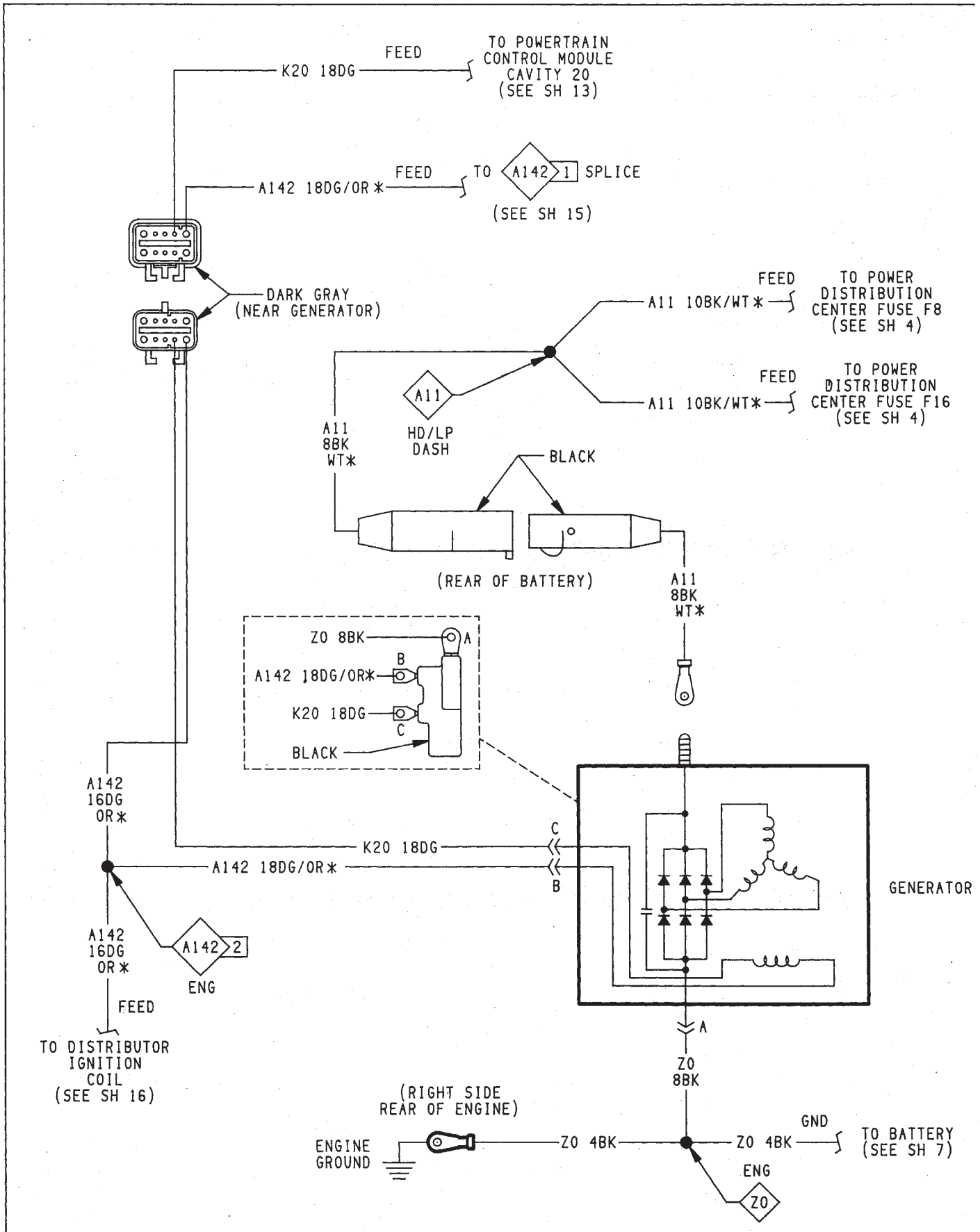
J948W-7



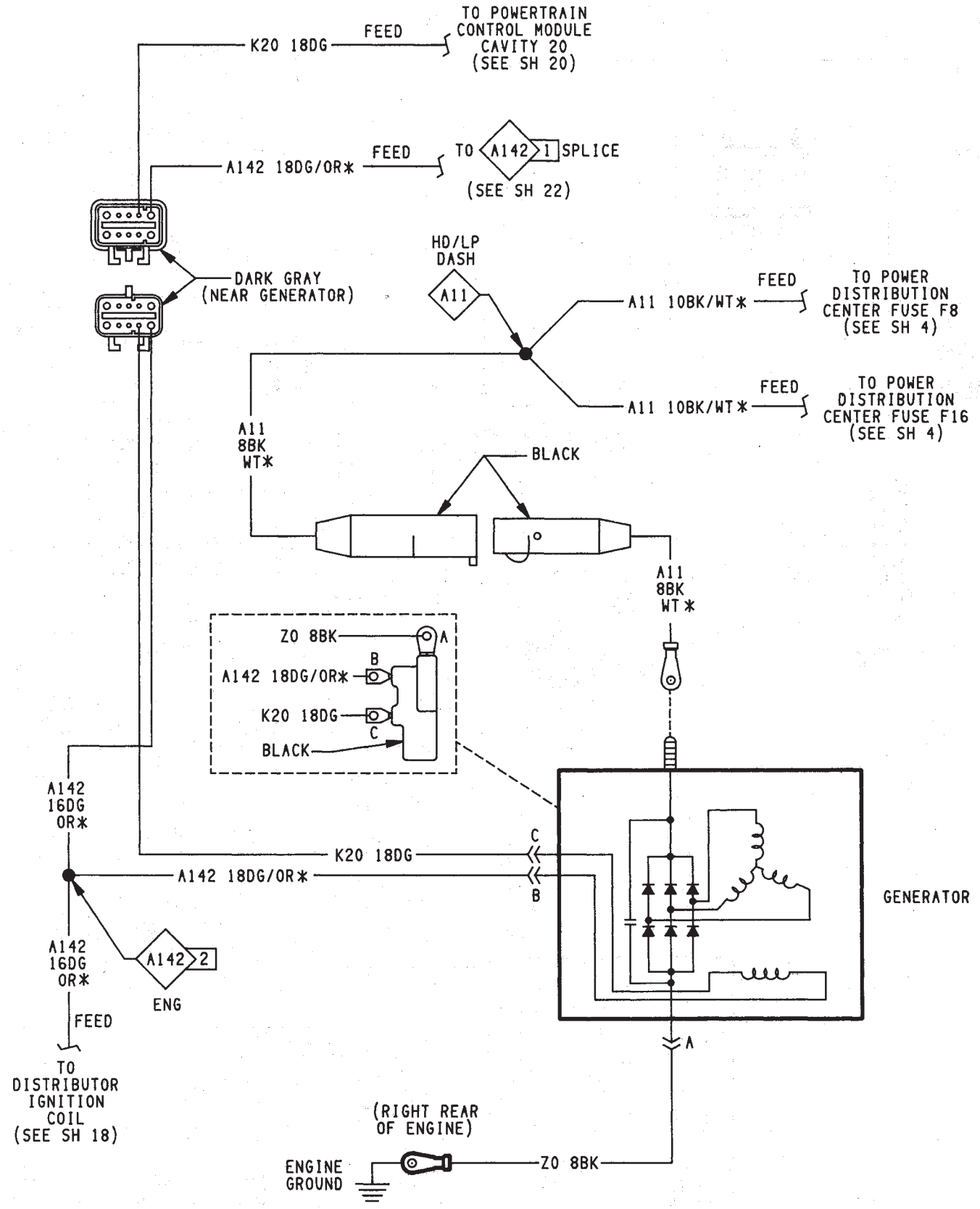
POWER DISTRIBUTION CENTER APPLICATION CHART

J948W-7

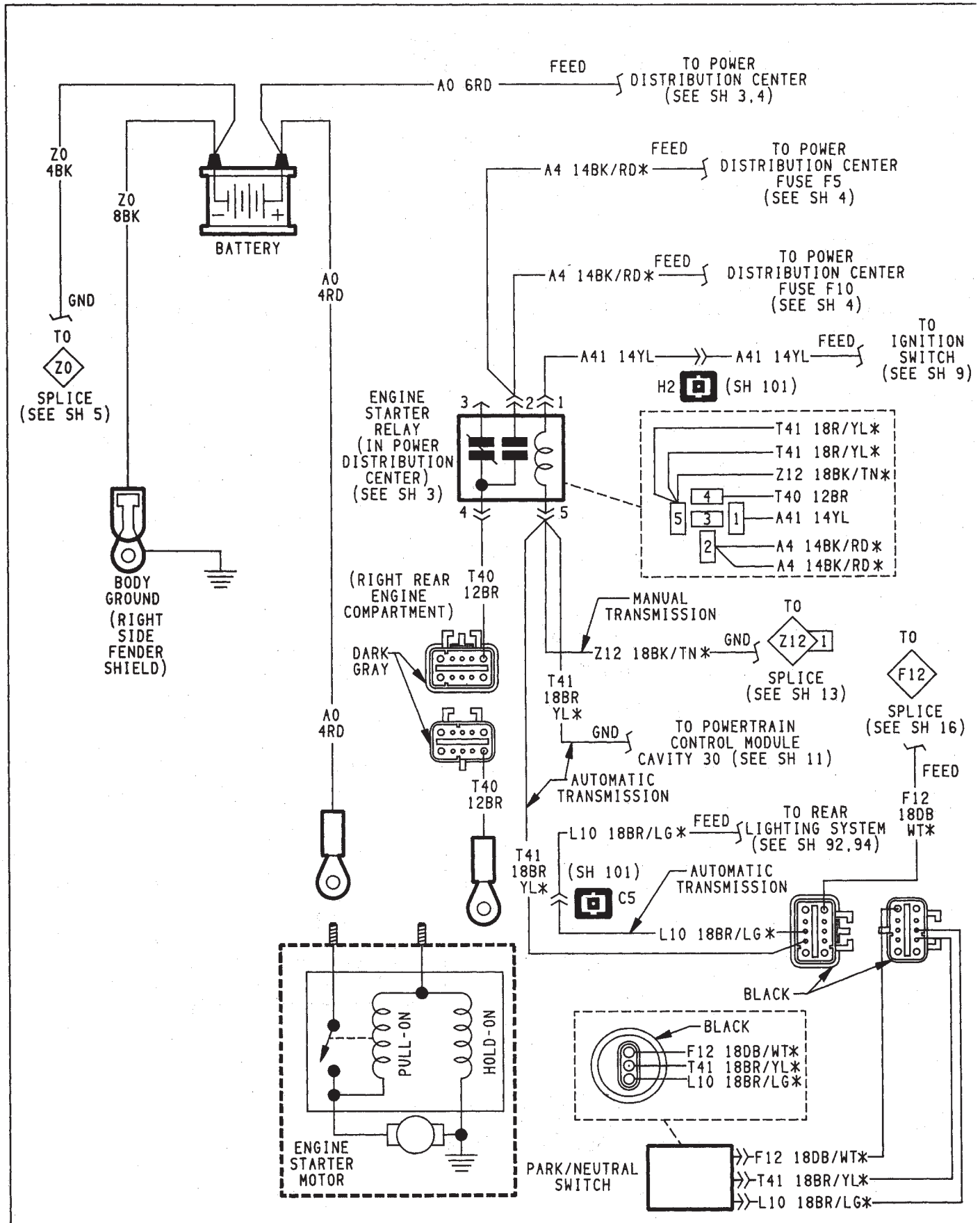
XJ 4



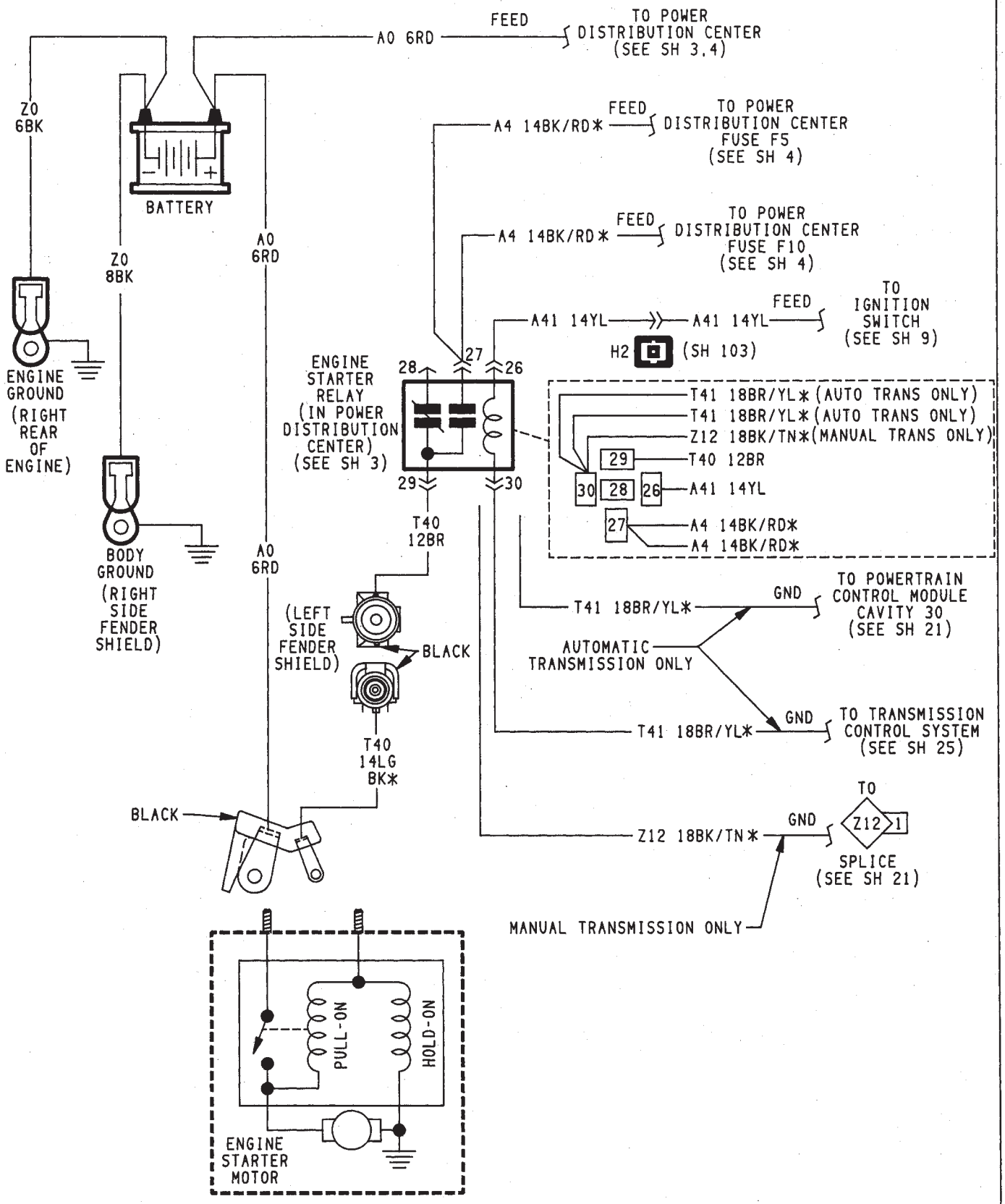
XJ 5 CHARGING SYSTEM 2.5L ENGINE J948W-7



J948W-7 CHARGING SYSTEM 4.0L ENGINE XJ 6



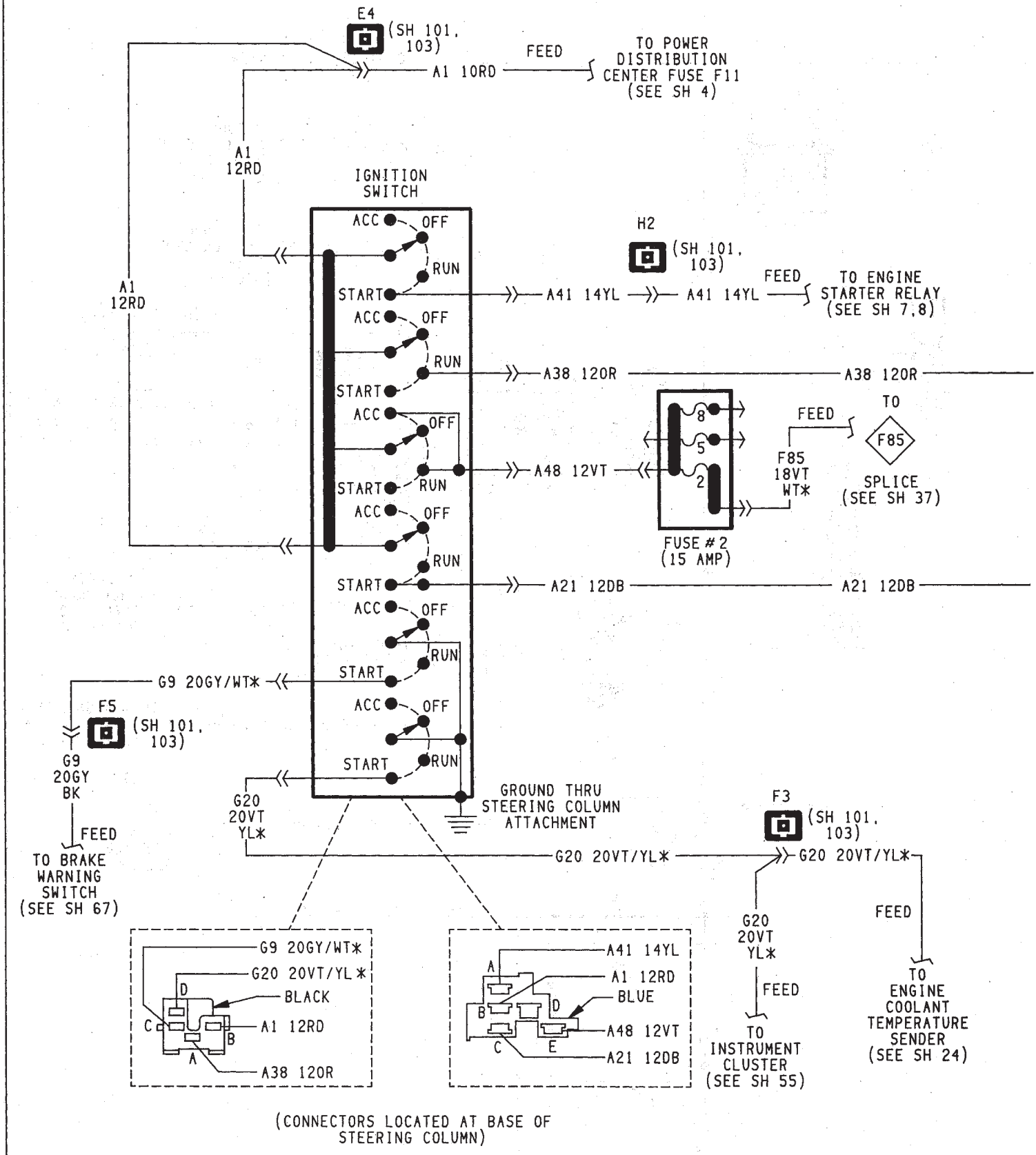
XJ 7 — 2.5L ENGINE STARTER SYSTEM — J948W-7

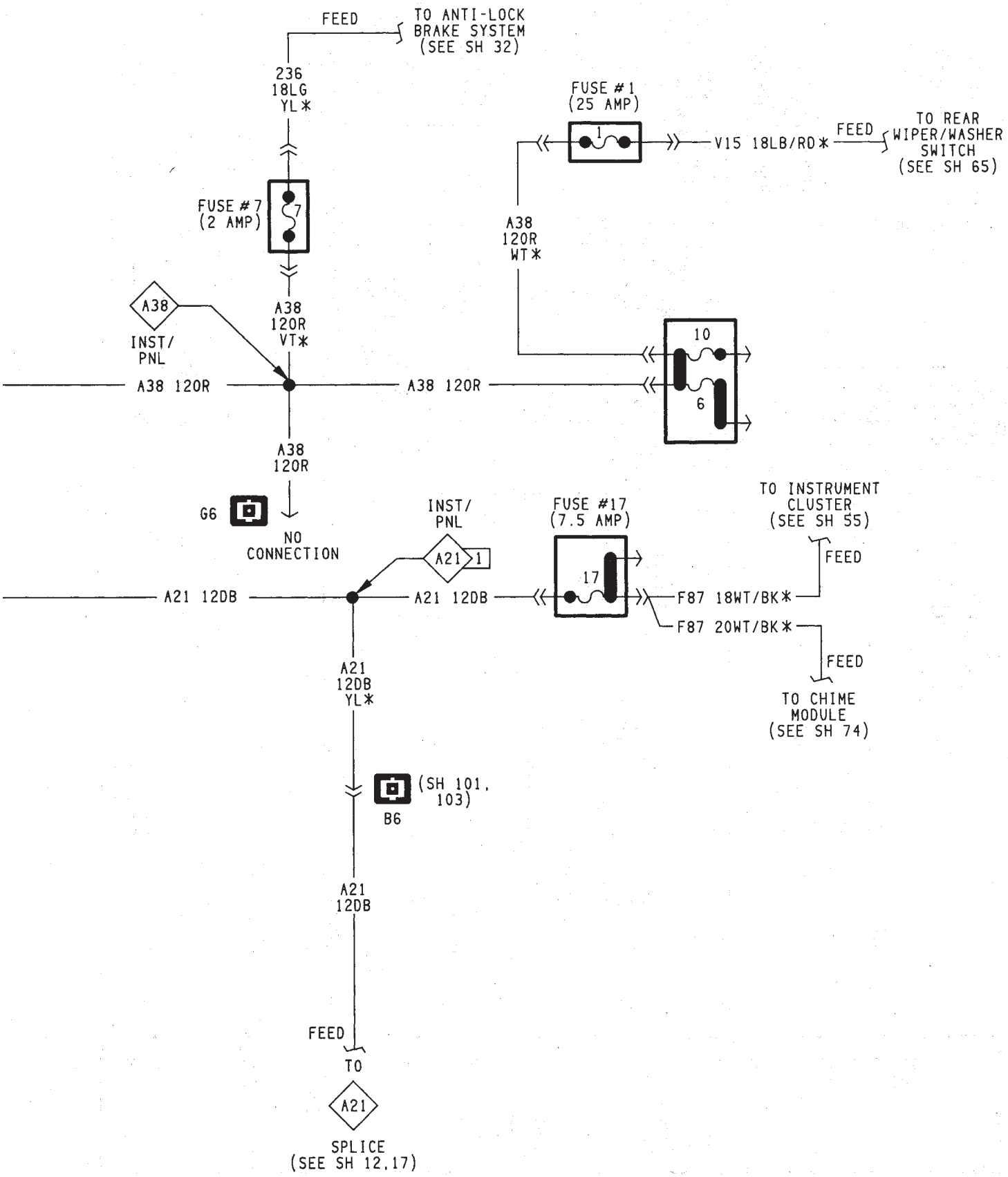


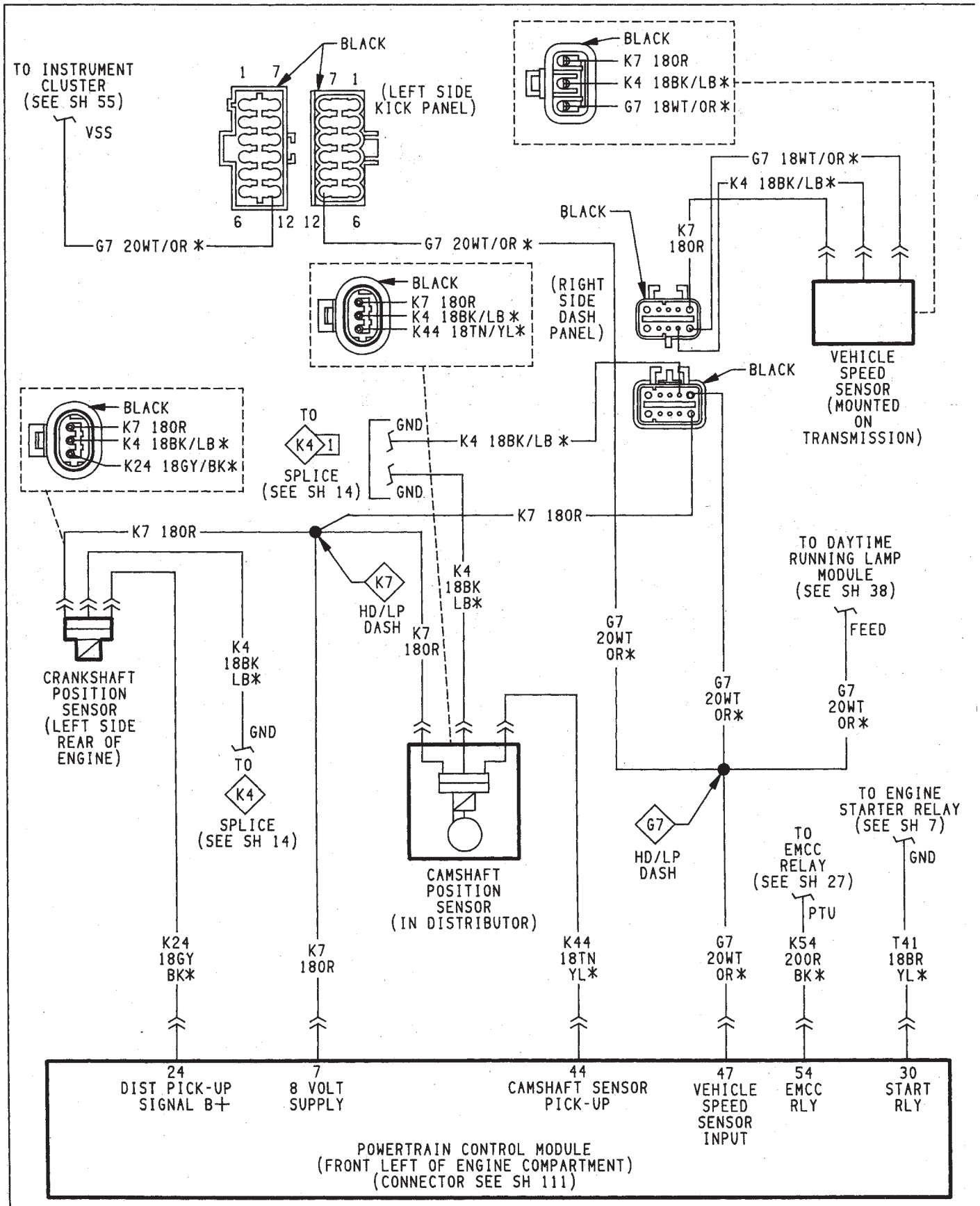
J948W-7

4.0L ENGINE STARTER SYSTEM

XJ 8


E4
(SH 101, 103)
FEED
TO POWER DISTRIBUTION CENTER FUSE F11 (SEE SH 4)
A1 10RD
A1 12RD
IGNITION SWITCH
ACC
OFF
RUN
START
H2
(SH 101, 103)
A41 14YL
FEED
TO ENGINE STARTER RELAY (SEE SH 7,8)
A38 120R
A48 12VT
A21 12DB
FUSE #2 (15 AMP)
F85 18VT WT*
TO F85 SPLICE (SEE SH 37)
G9 20GY/WT*
F5
(SH 101, 103)
G9 20GY BK
TO BRAKE WARNING SWITCH (SEE SH 67)
G20 20VT YL*
GROUND THRU STEERING COLUMN ATTACHMENT
F3
(SH 101, 103)
G20 20VT/YL*
TO INSTRUMENT CLUSTER (SEE SH 55)
TO ENGINE COOLANT TEMPERATURE SENDER (SEE SH 24)
BLACK
BLUE
(CONNECTORS LOCATED AT BASE OF STEERING COLUMN)

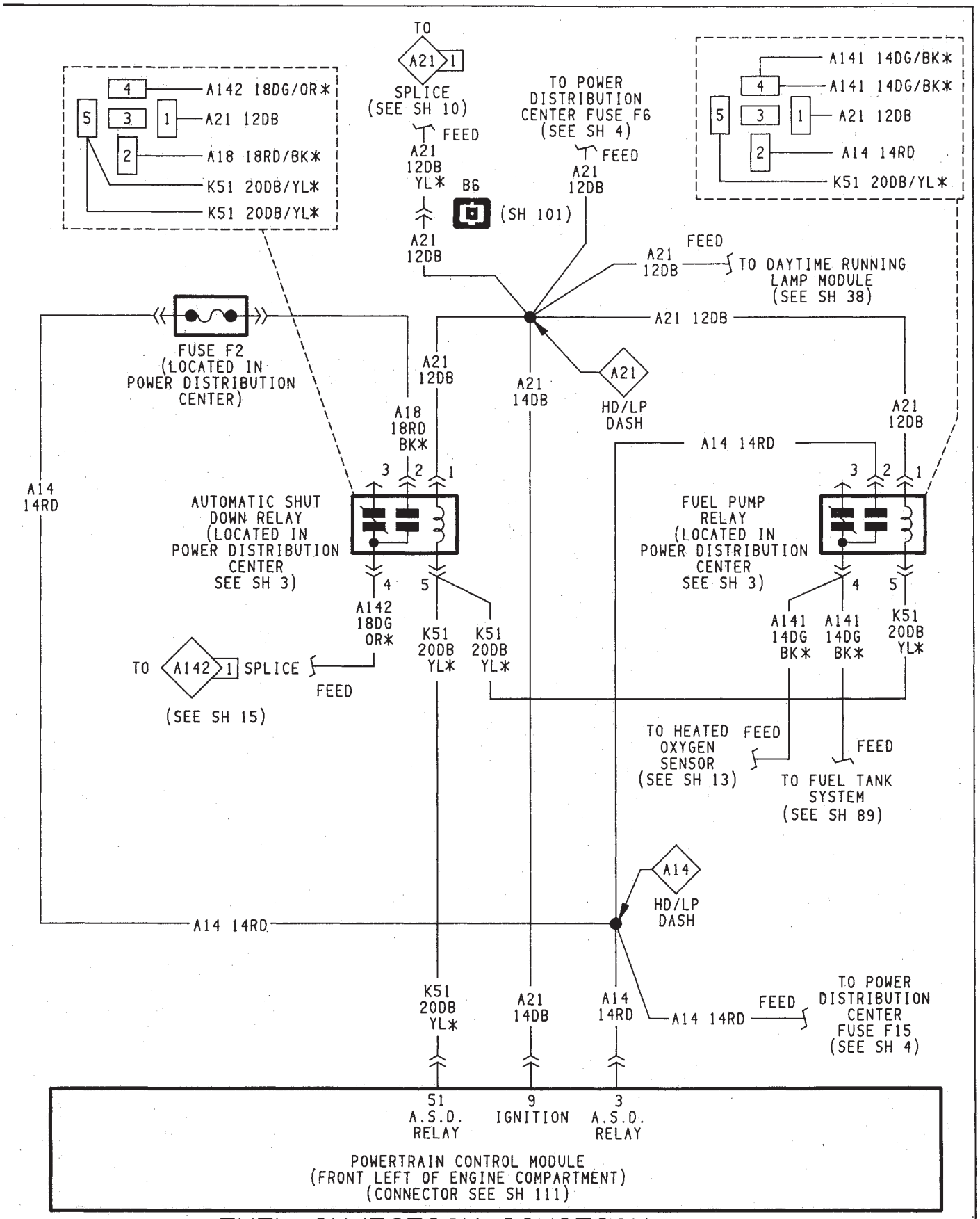

FEED
TO ANTI-LOCK BRAKE SYSTEM (SEE SH 32)
236 18LG YL*
FUSE #1 (25 AMP)
1
V15 18LB/RD*
FEED
TO REAR WIPER/WASHER SWITCH (SEE SH 65)
FUSE #7 (2 AMP)
7
A38 120R WT*
A38
INST/ PNL
A38 120R VT*
10
6
A38 120R
A38 120R
A38 120R
G6
NO CONNECTION
INST/ PNL
A21
1
FUSE #17 (7.5 AMP)
17
TO INSTRUMENT CLUSTER (SEE SH 55)
FEED
A21 12DB
A21 12DB
A21 12DB
F87 18WT/BK*
F87 20WT/BK*
FEED
TO CHIME MODULE (SEE SH 74)
A21 12DB YL*
(SH 101, 103)
B6
A21 12DB
FEED
TO
A21
SPLICE (SEE SH 12,17)



XJ 11

FUEL INJECTION IGNITION SYSTEM (2.5L ENGINE)

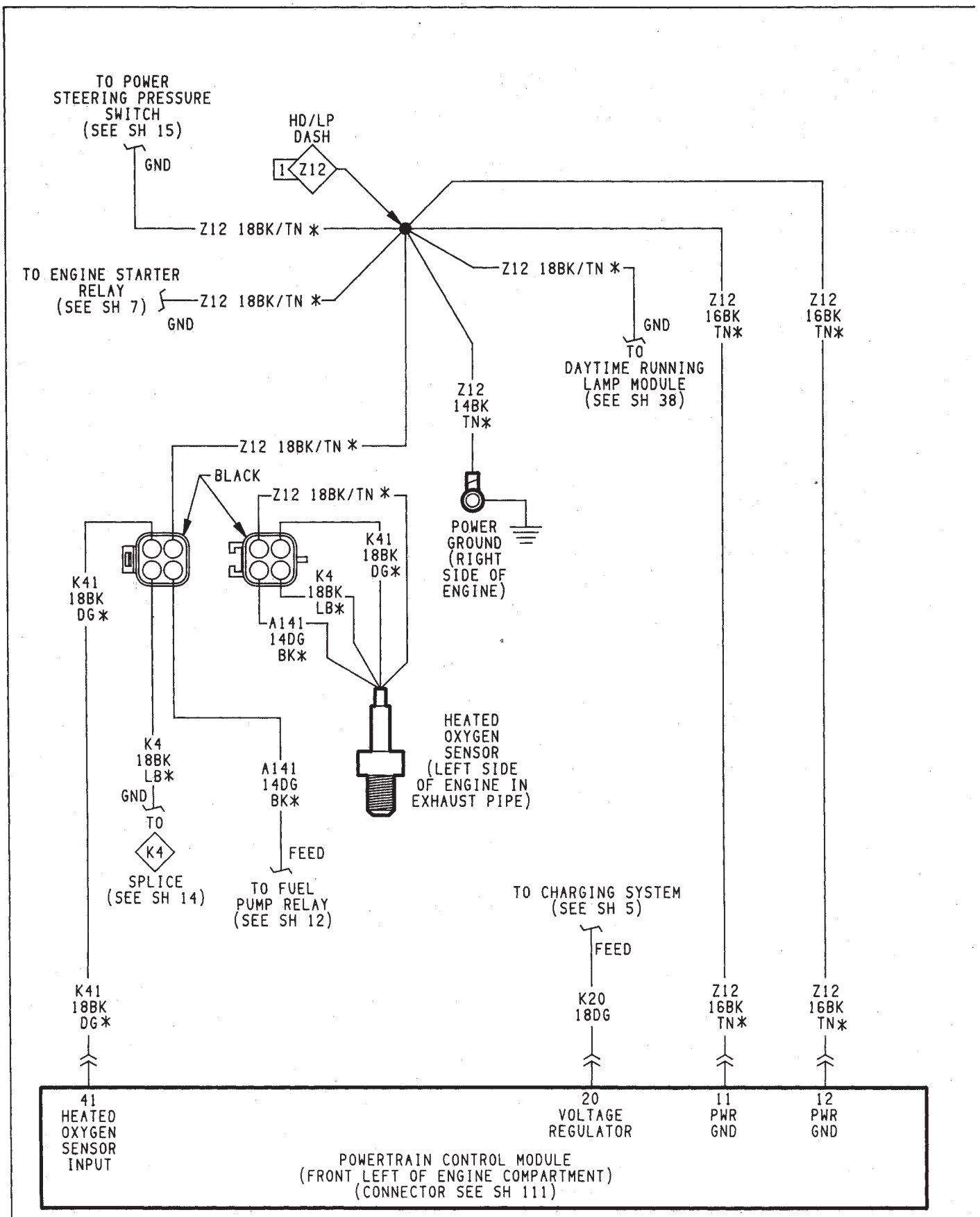
J948W-7



FUEL INJECTION IGNITION SYSTEM (2.5L ENGINE)

J948W-7

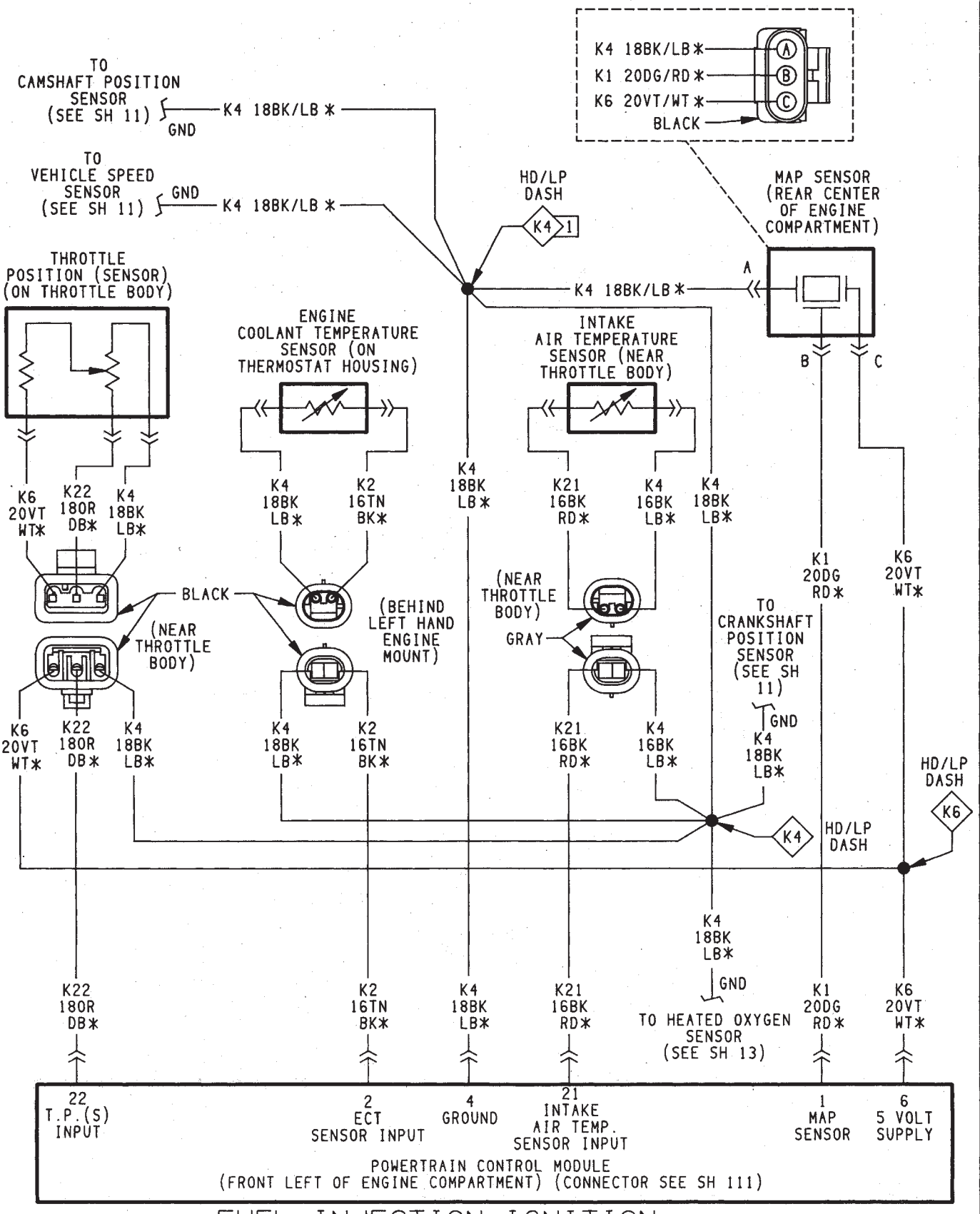
XJ 12



XJ 13

FUEL INJECTION IGNITION SYSTEM (2.5L ENGINE)

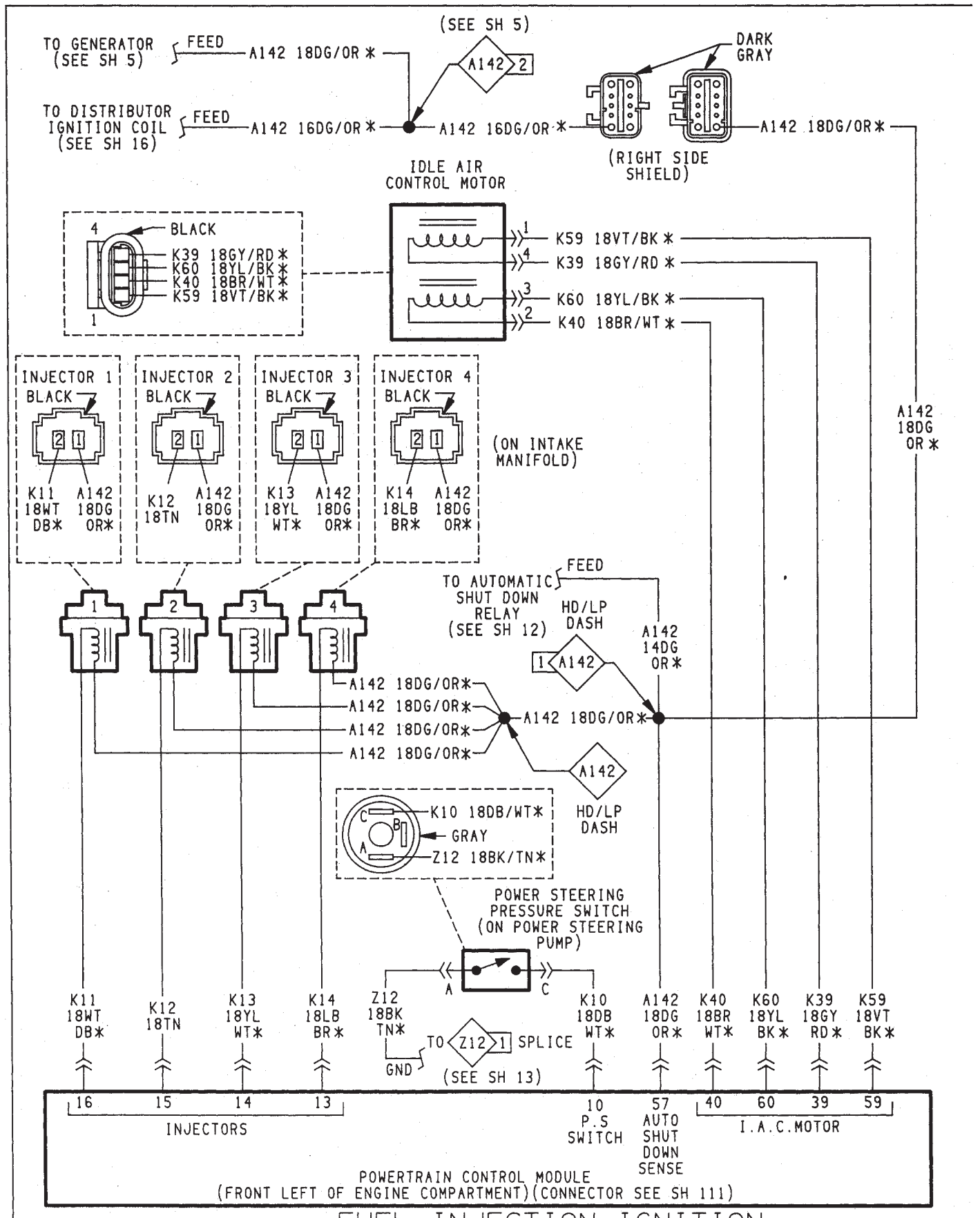
J948W-7



FUEL INJECTION IGNITION SYSTEM (2.5L ENGINE)

J948W-7

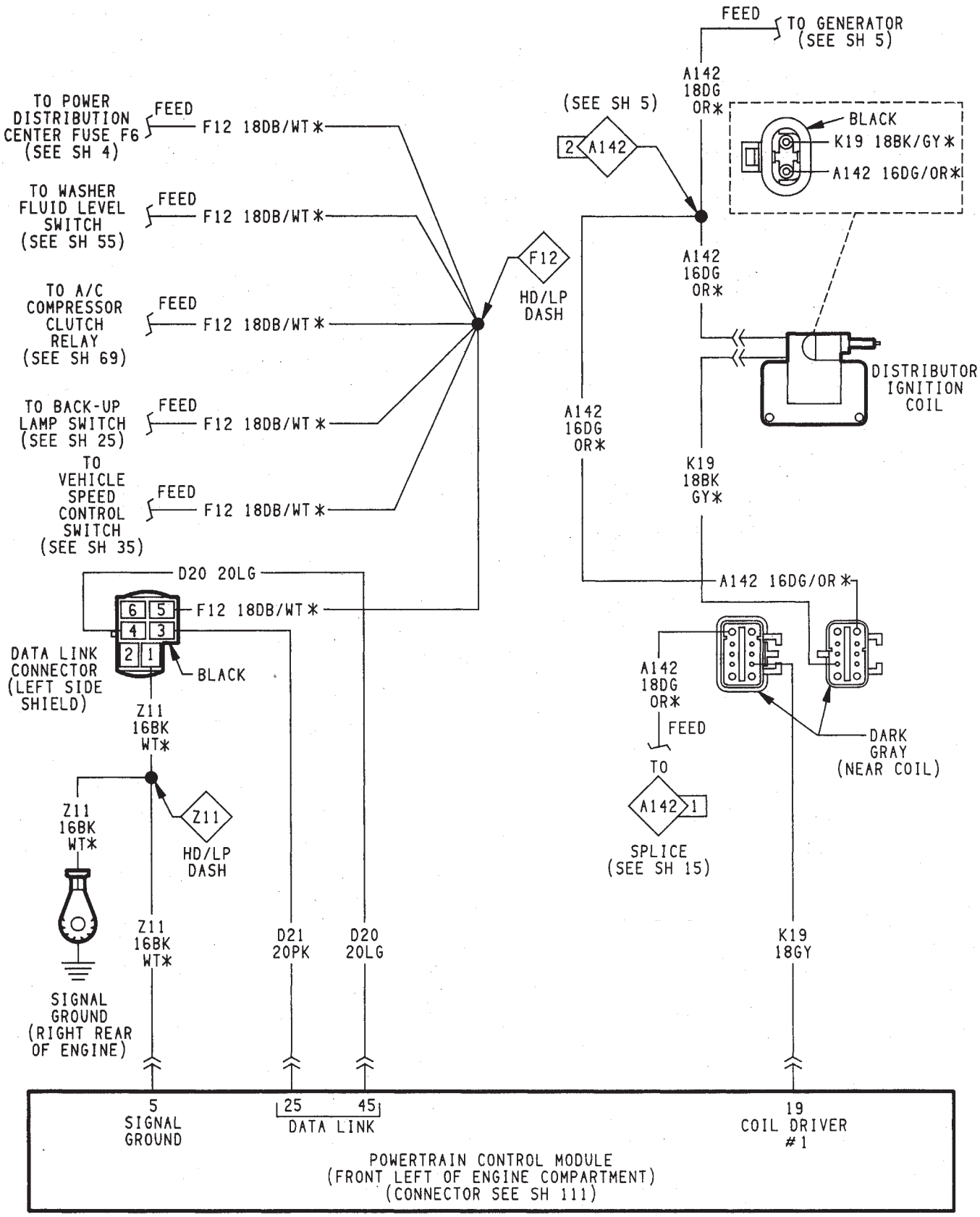
XJ 14



XJ 15

FUEL INJECTION IGNITION SYSTEM (2.5L ENGINE)

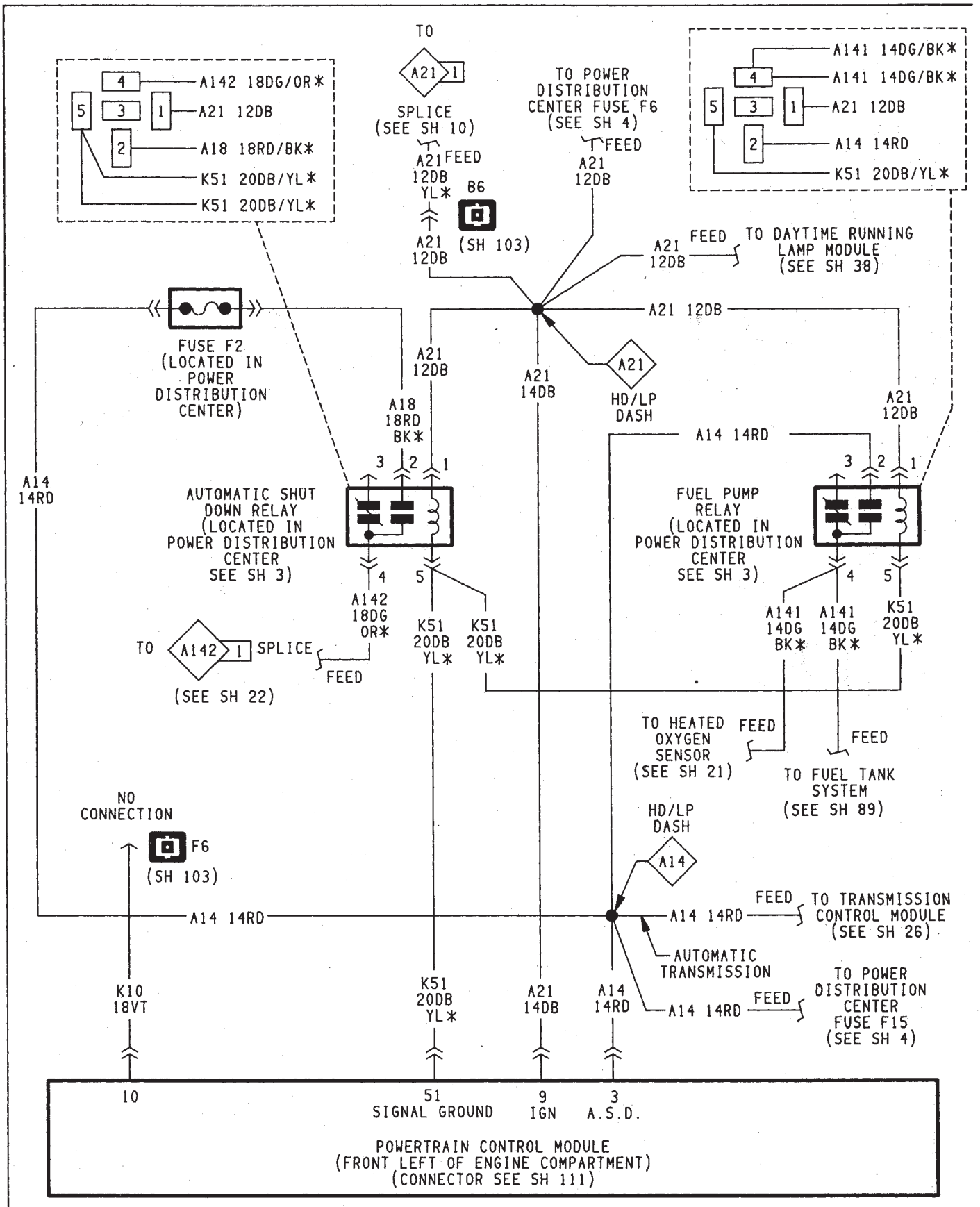
J948W-7



FUEL INJECTION IGNITION SYSTEM (2.5L ENGINE)

J948W-7

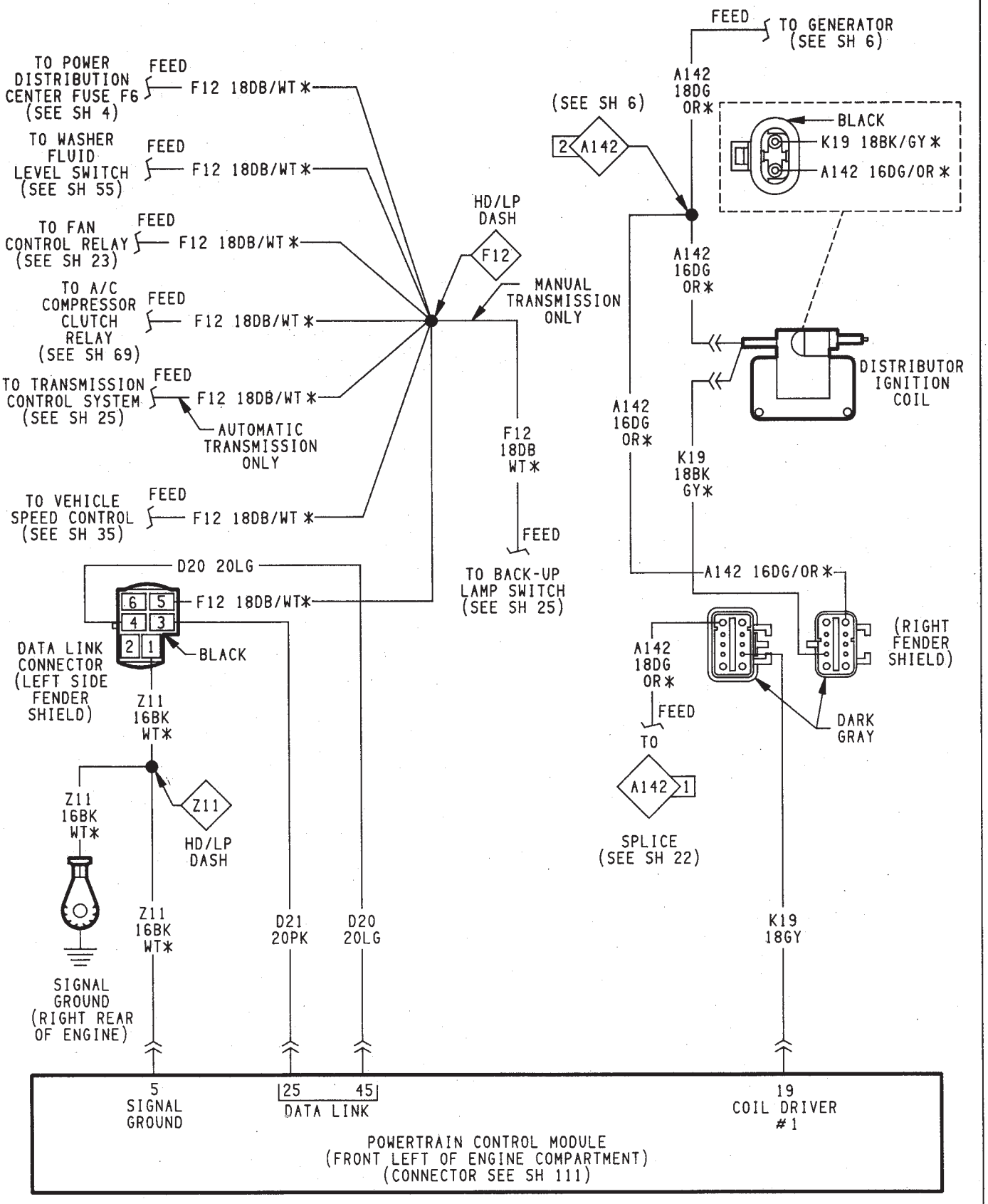
XJ 16



FUEL INJECTION IGNITION SYSTEM (4.0L ENGINE)

XJ 17

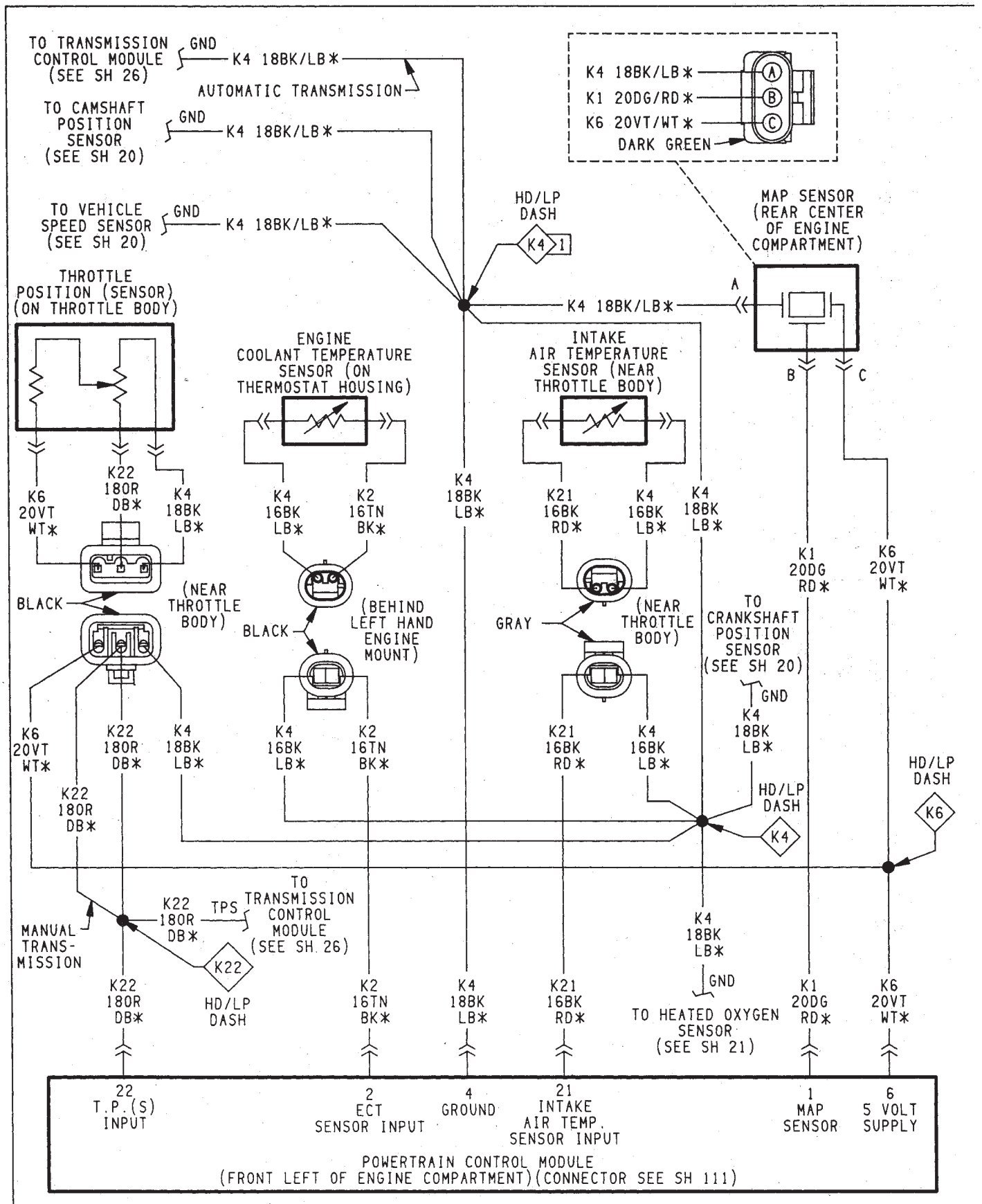
J948W-7



FUEL INJECTION IGNITION SYSTEM (4.0L ENGINE)

J948W-7

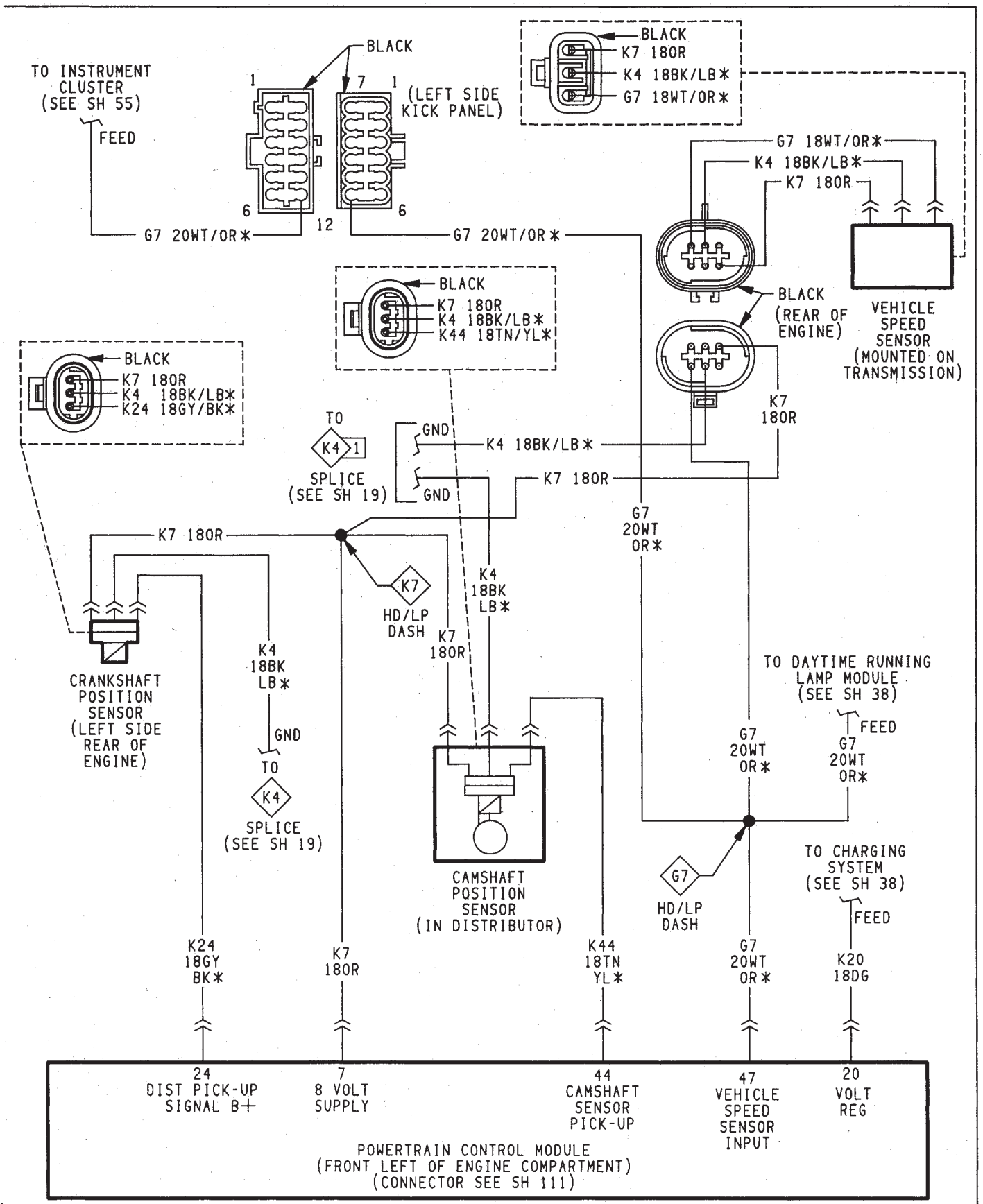
XJ 18



FUEL INJECTION IGNITION SYSTEM (4.0L ENGINE)

XJ 19

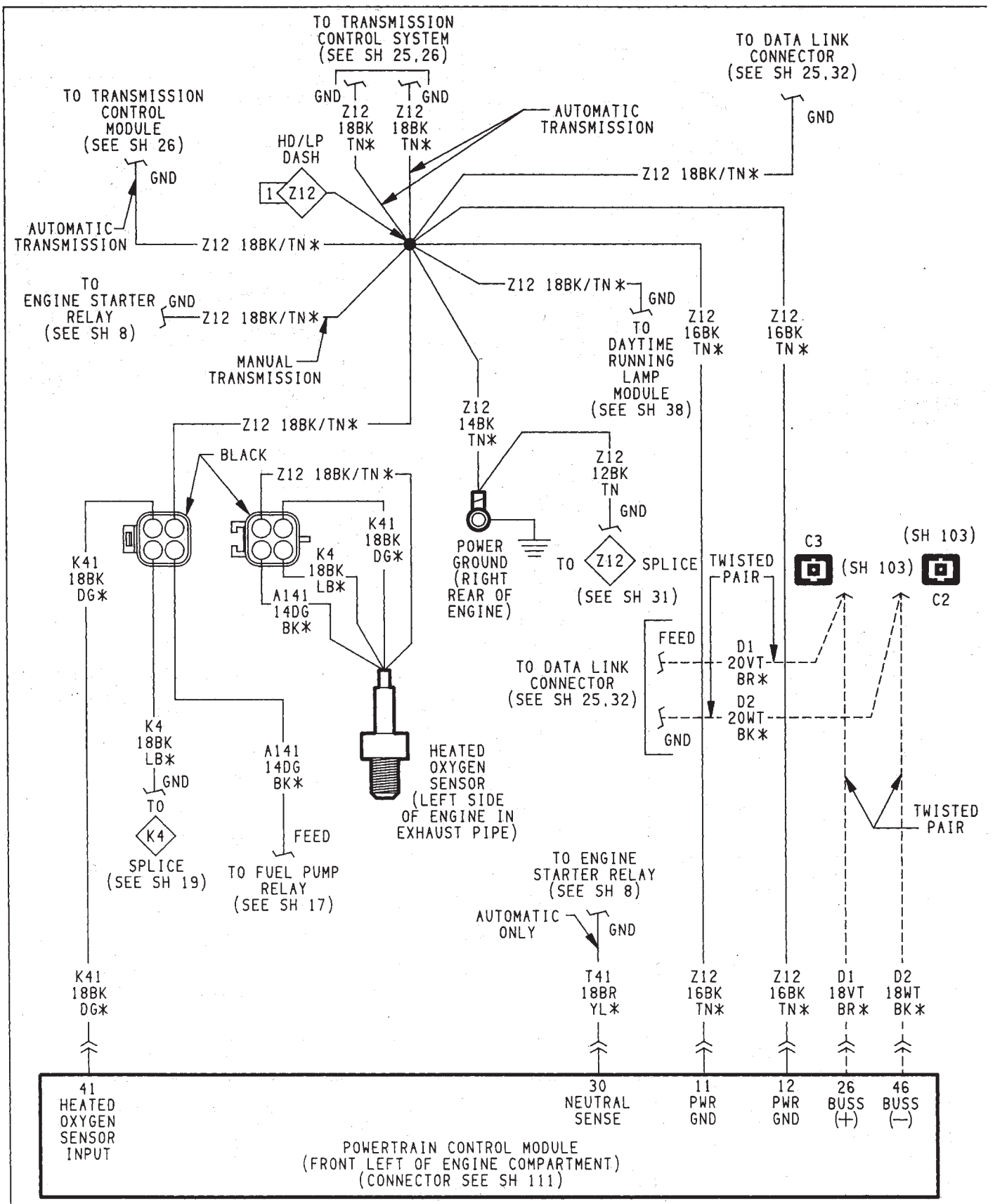
J948W-7



FUEL INJECTION IGNITION SYSTEM (4.0L ENGINE)

J948W-7

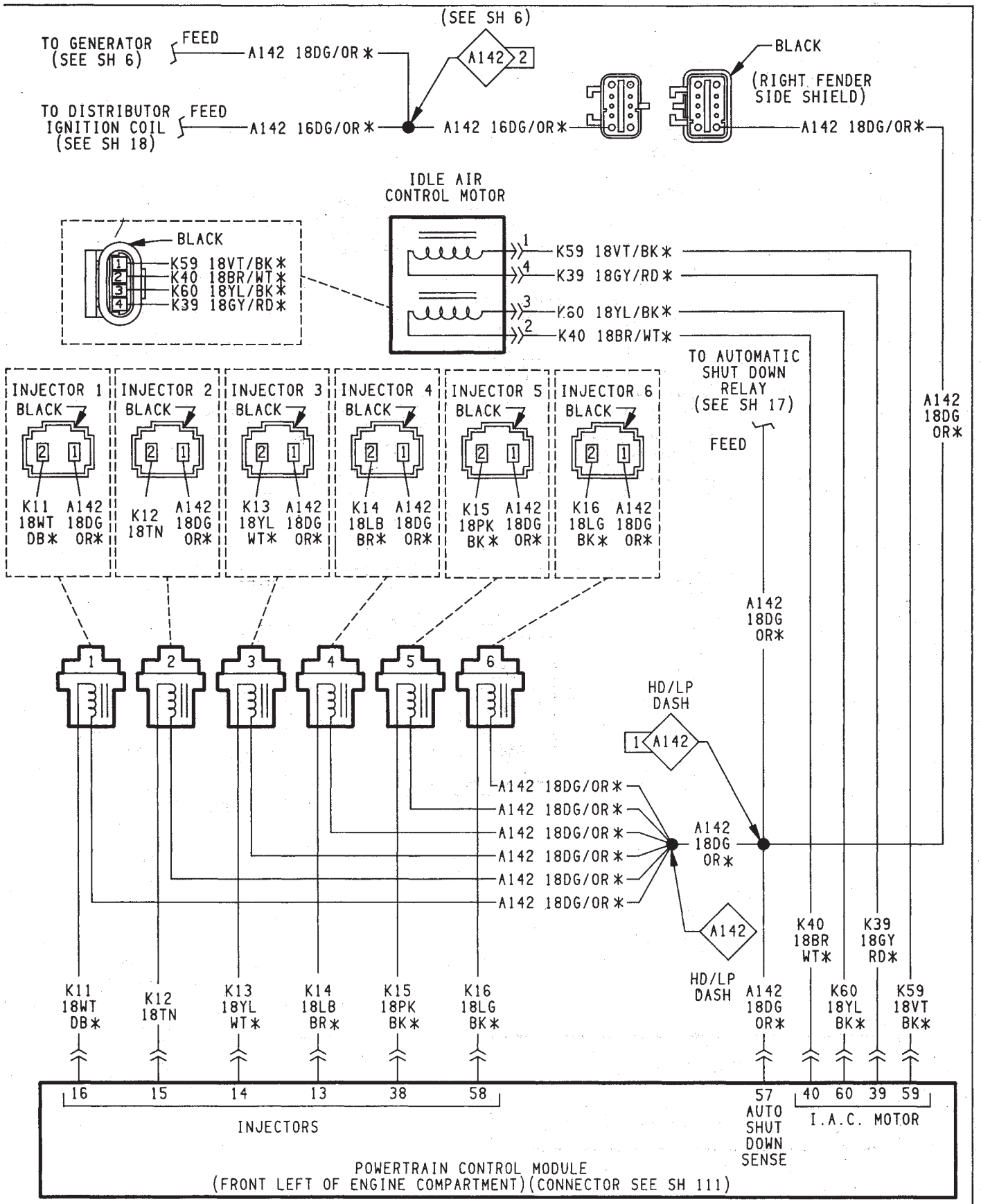
XJ 20



FUEL INJECTION IGNITION SYSTEM (4.0L ENGINE)

XJ 21

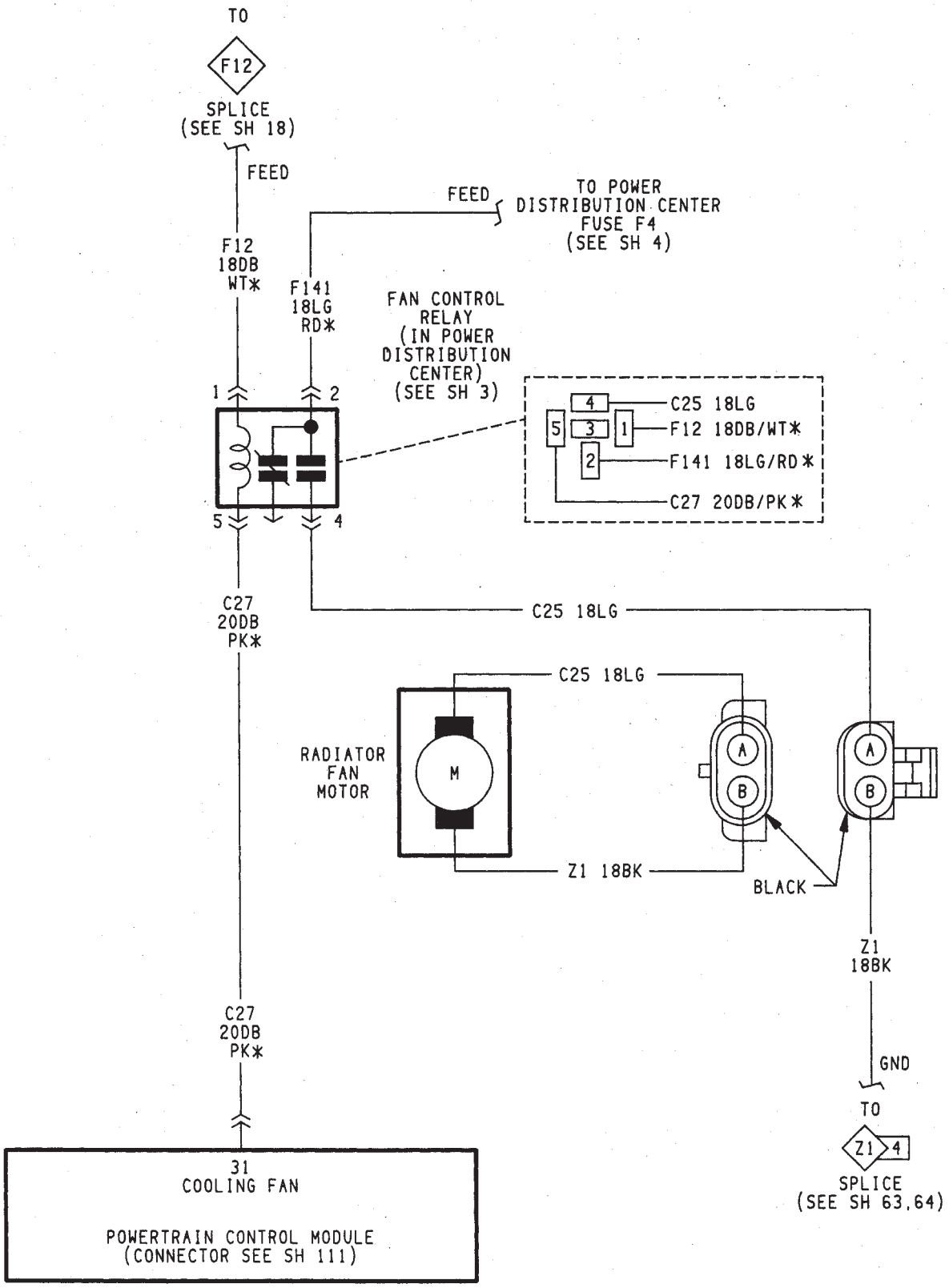
J948W-7



FUEL INJECTION IGNITION SYSTEM (4.0L ENGINE)

J948W-7

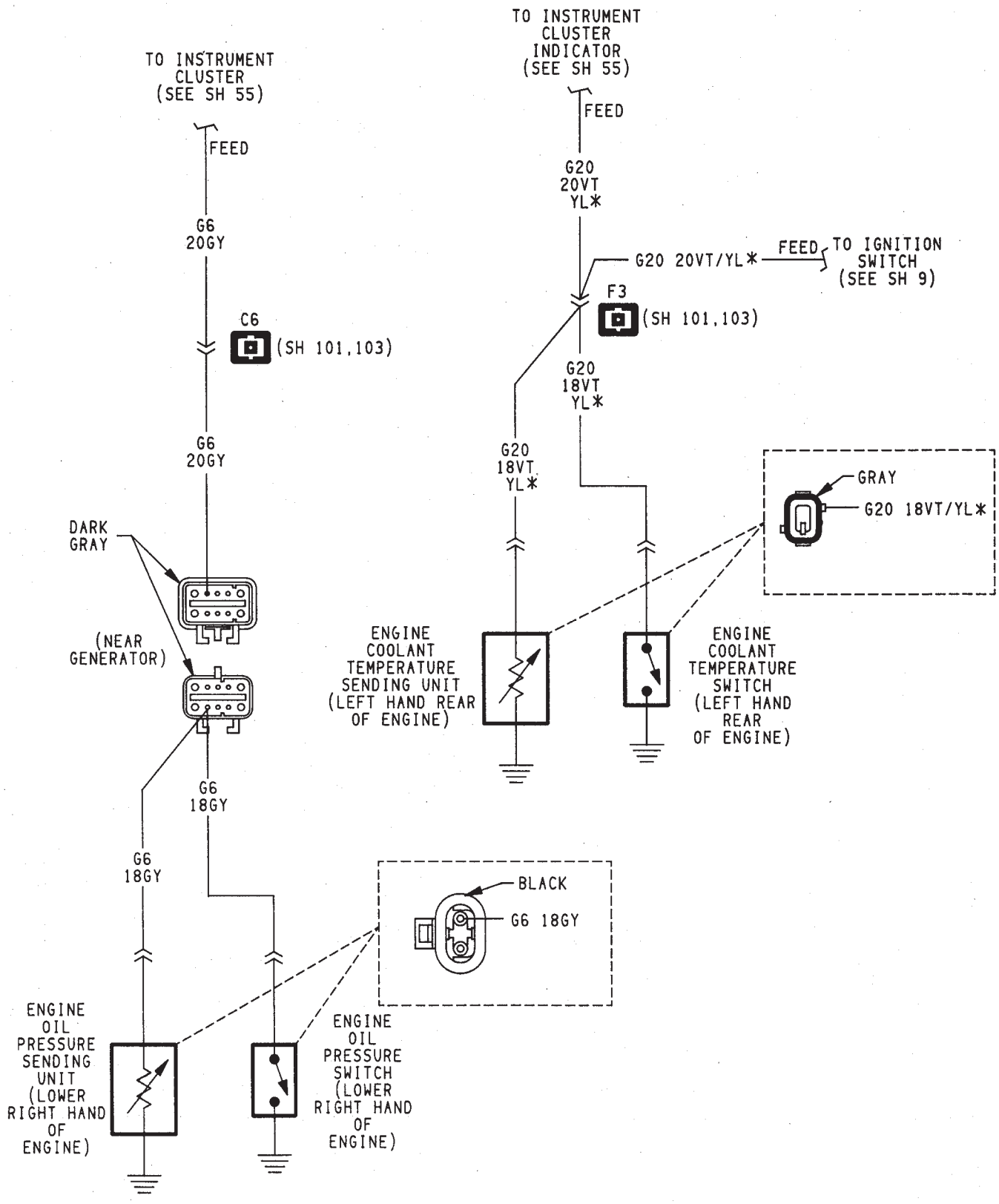
XJ 22



XJ 23

4.0L HEAVY DUTY COOLING

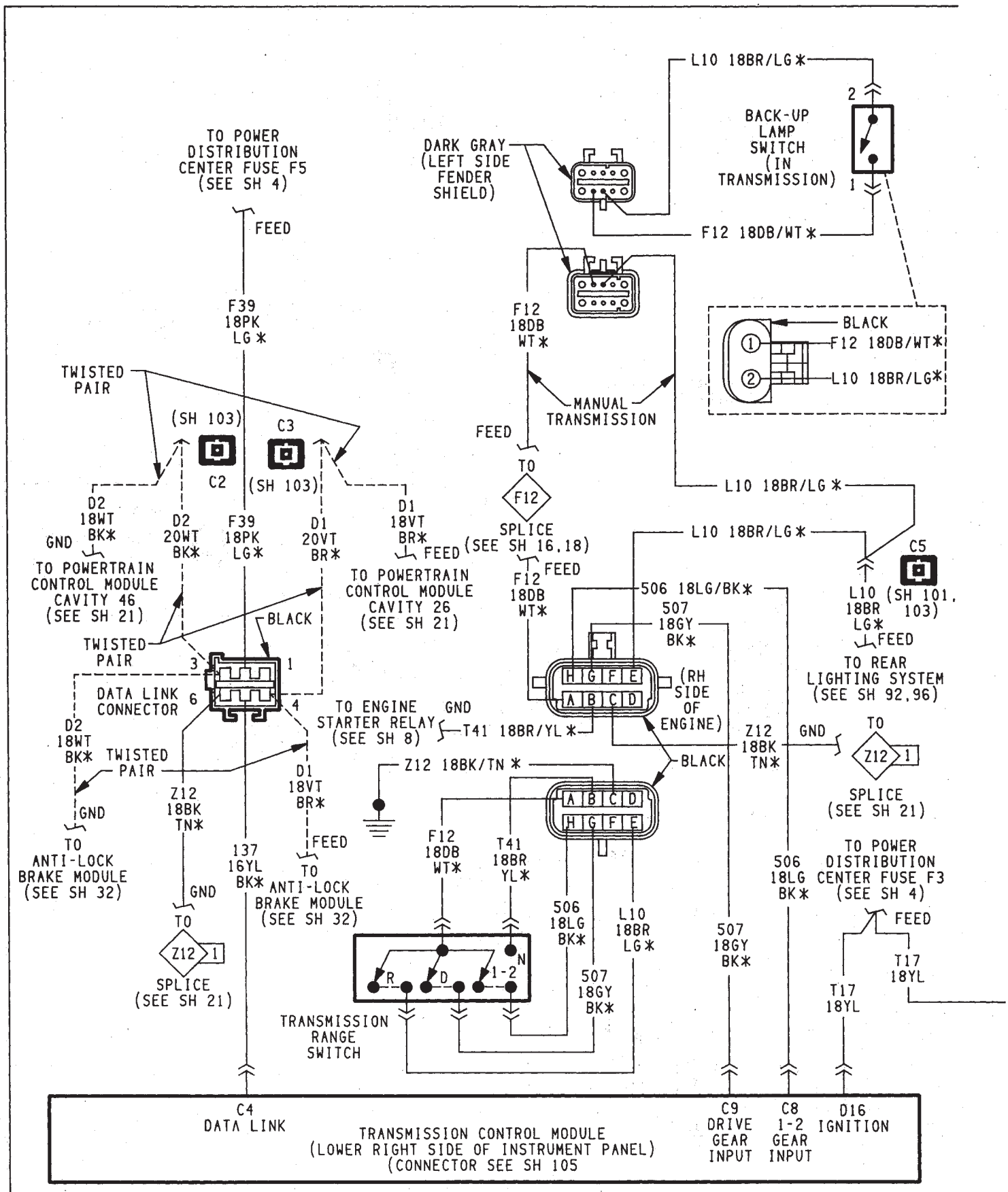
J948W-7



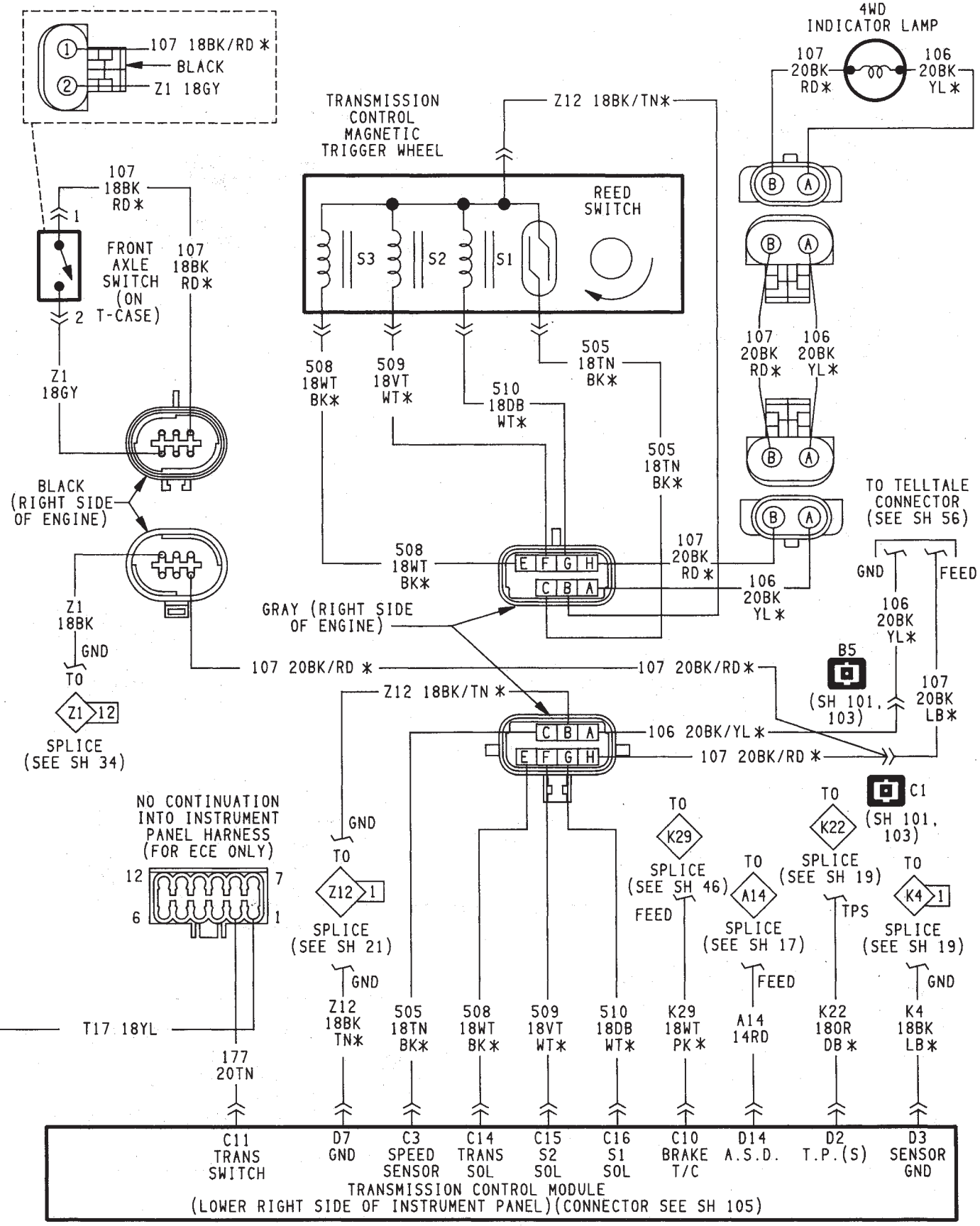
ENGINE OIL PRESSURE AND TEMPERATURE SYSTEM

J948W-7

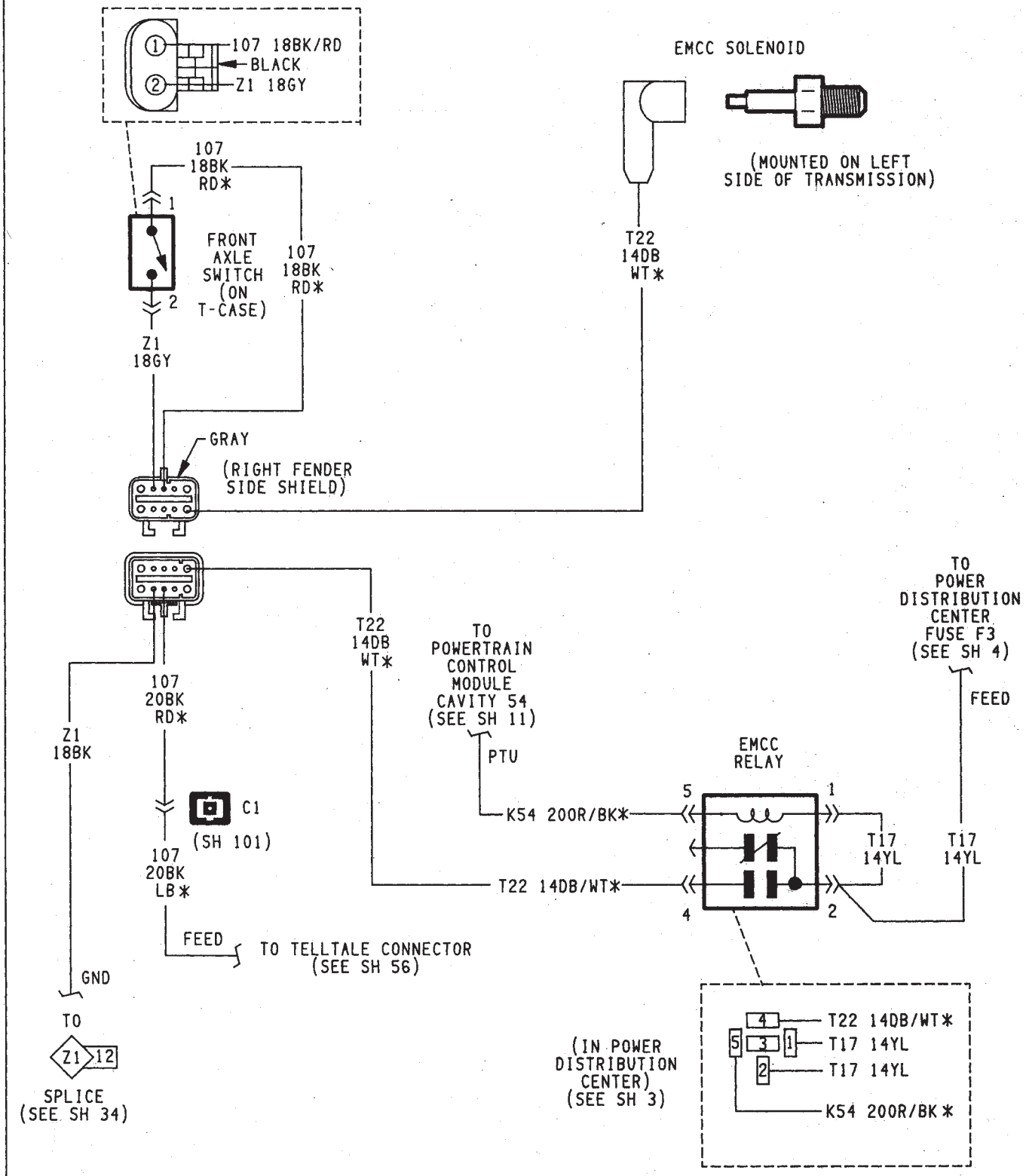
XJ 24



XJ 25 TRANSMISSION CONTROL SYSTEM J948W-7



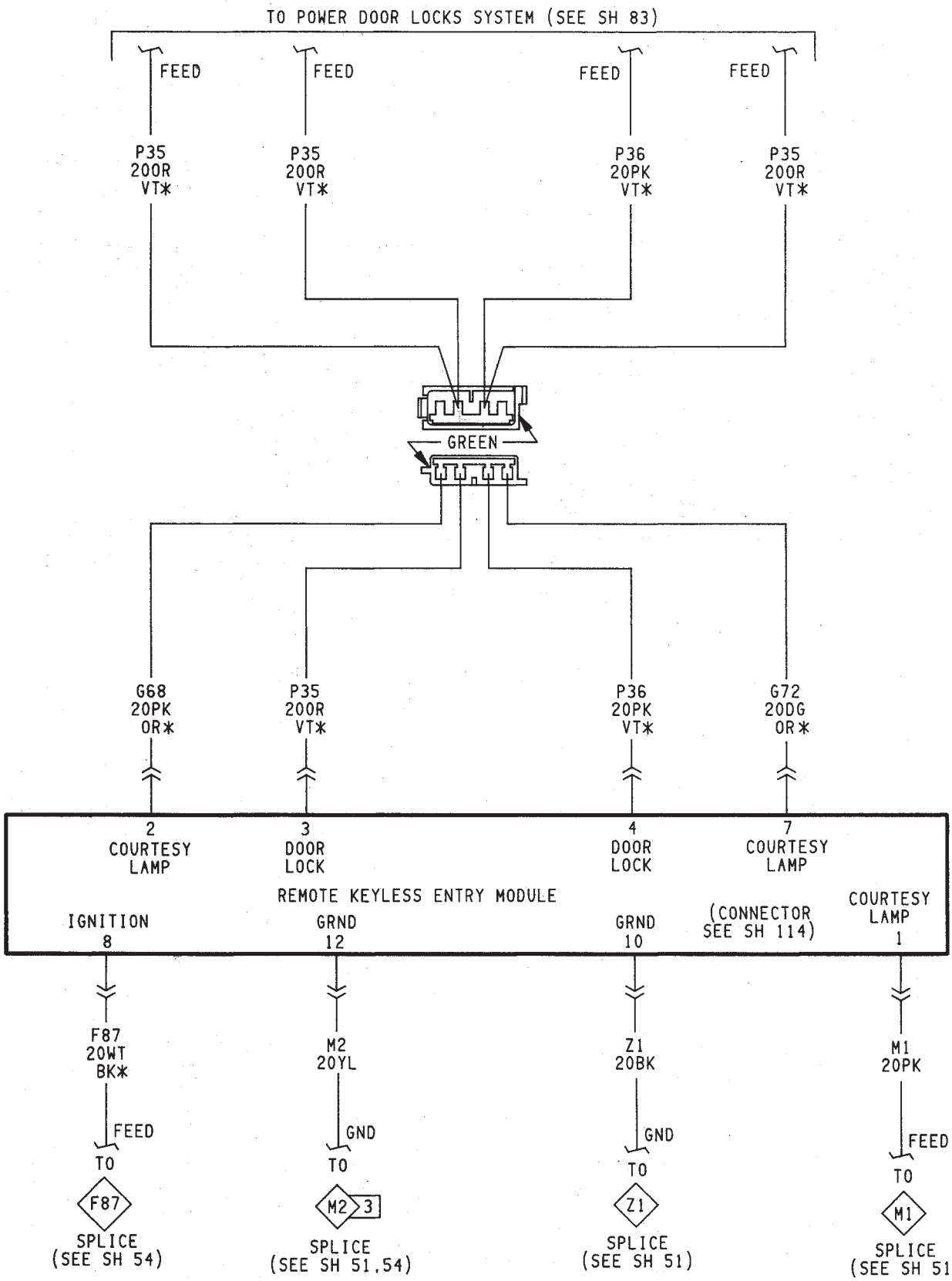
J948W-7 TRANSMISSION CONTROL SYSTEM XJ 26



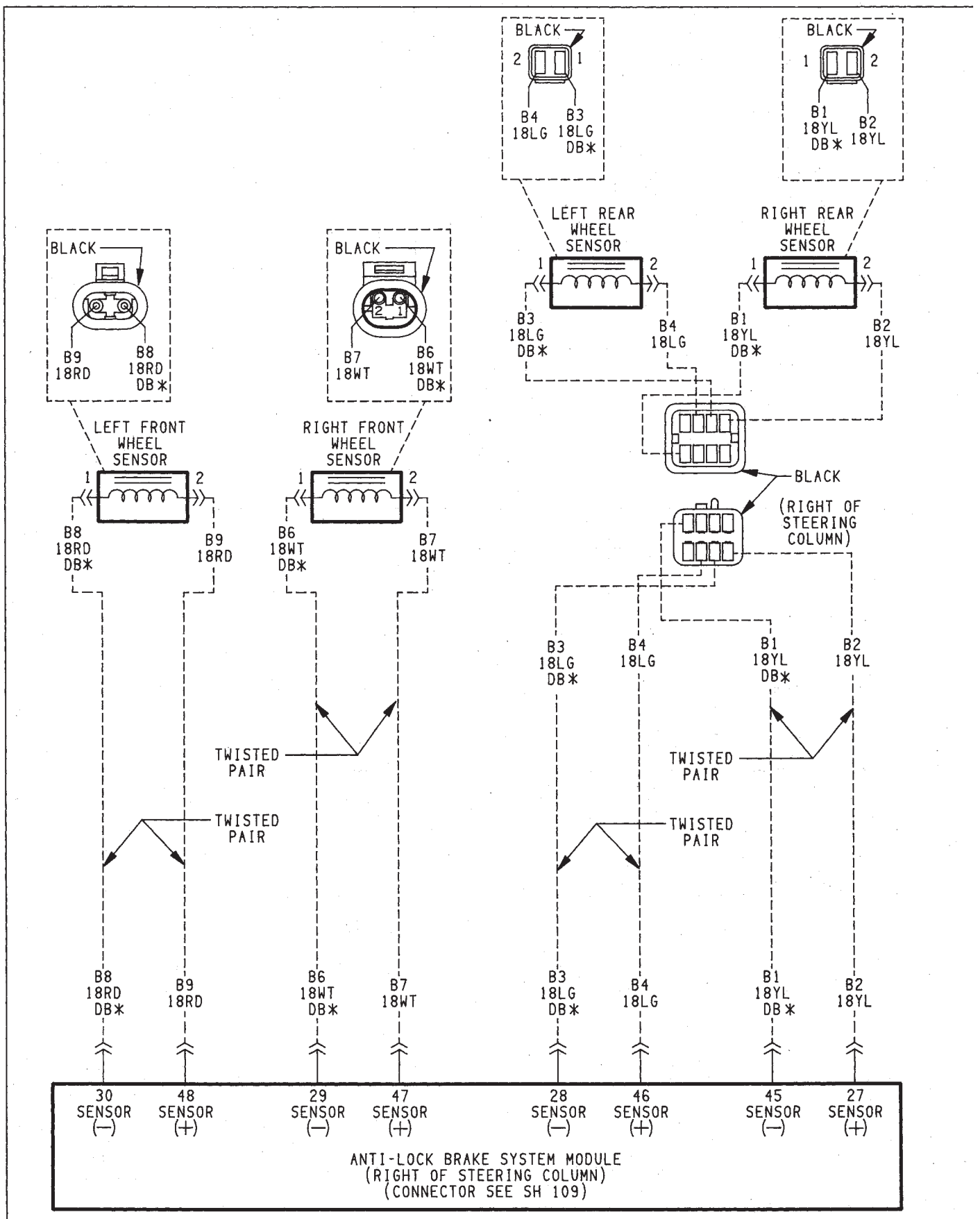
2.5L AUTOMATIC TRANSMISSION CONTROL SYSTEM

XJ 27

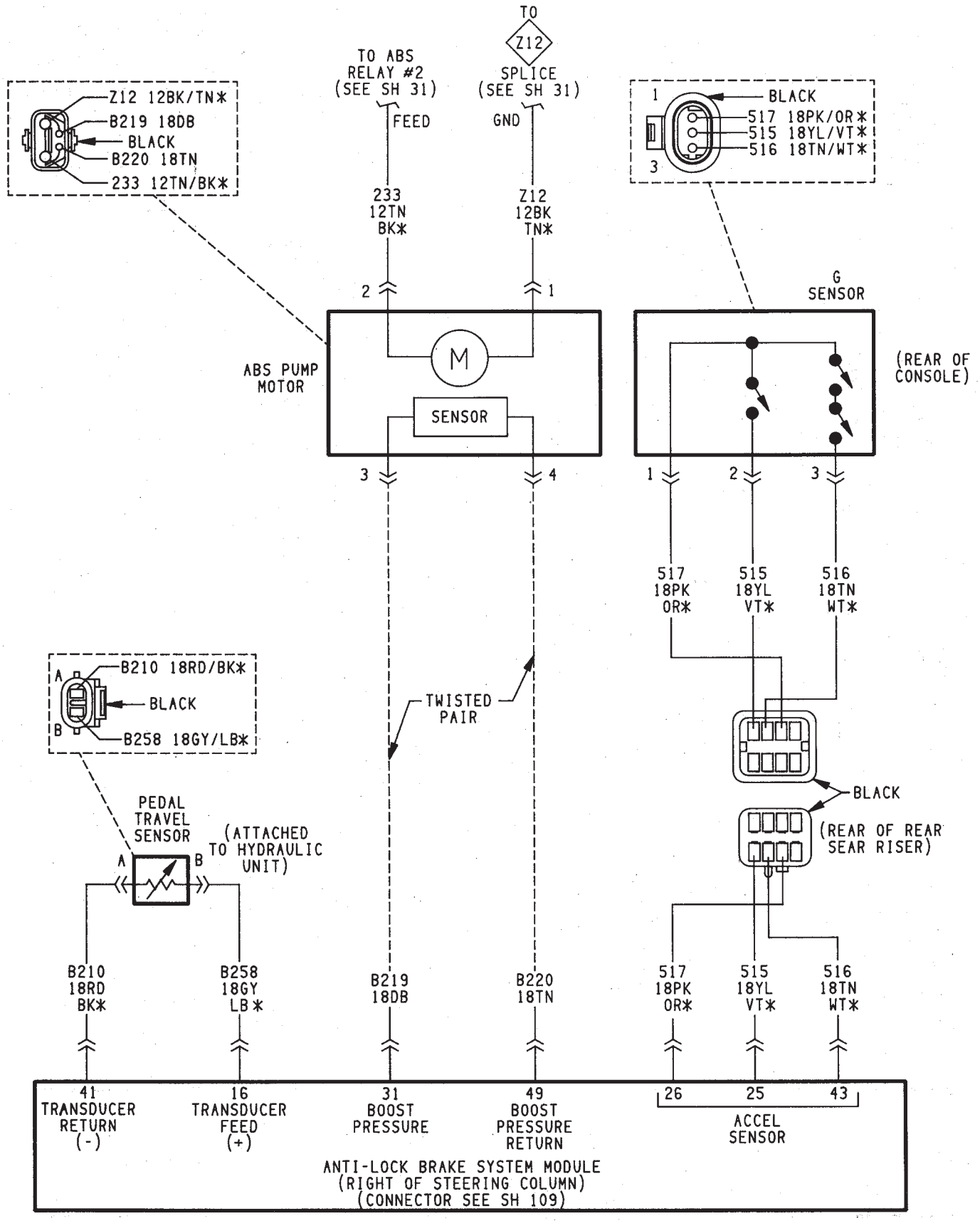
J948W-7



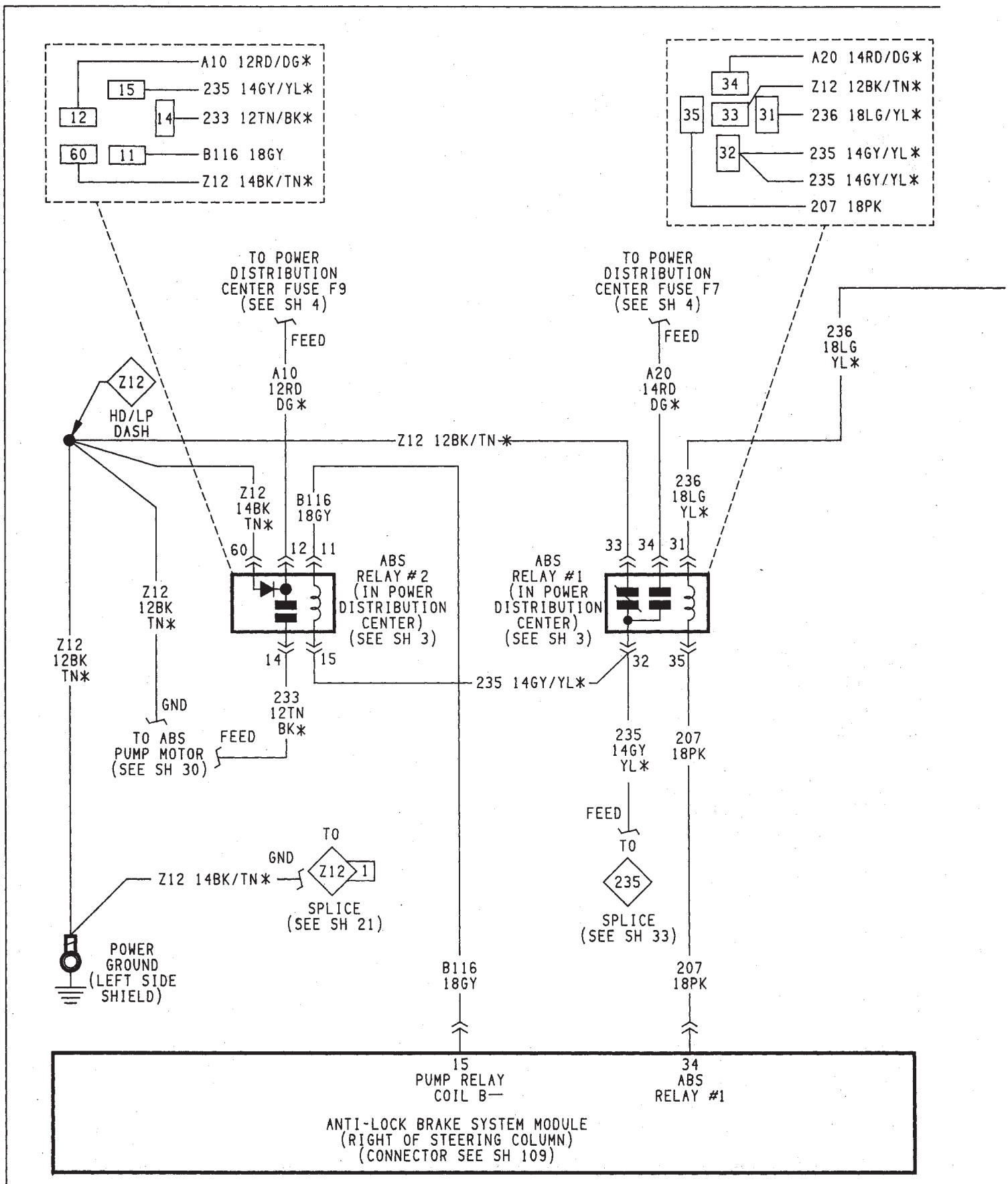
J948W-7 REMOTE KEYLESS ENTRY SYSTEM XJ 28



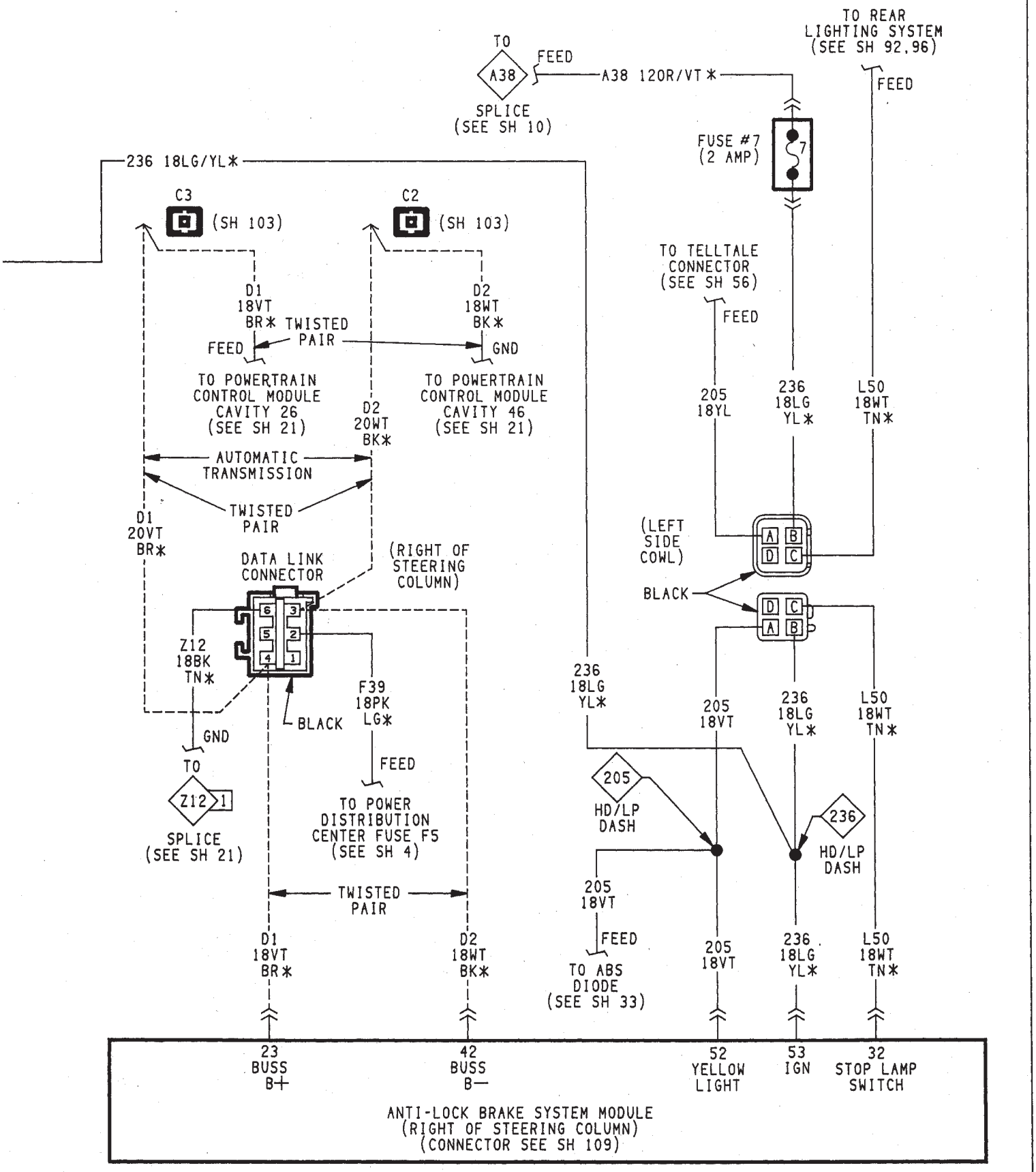
XJ 29 ANTI-LOCK BRAKING SYSTEM J948W-7

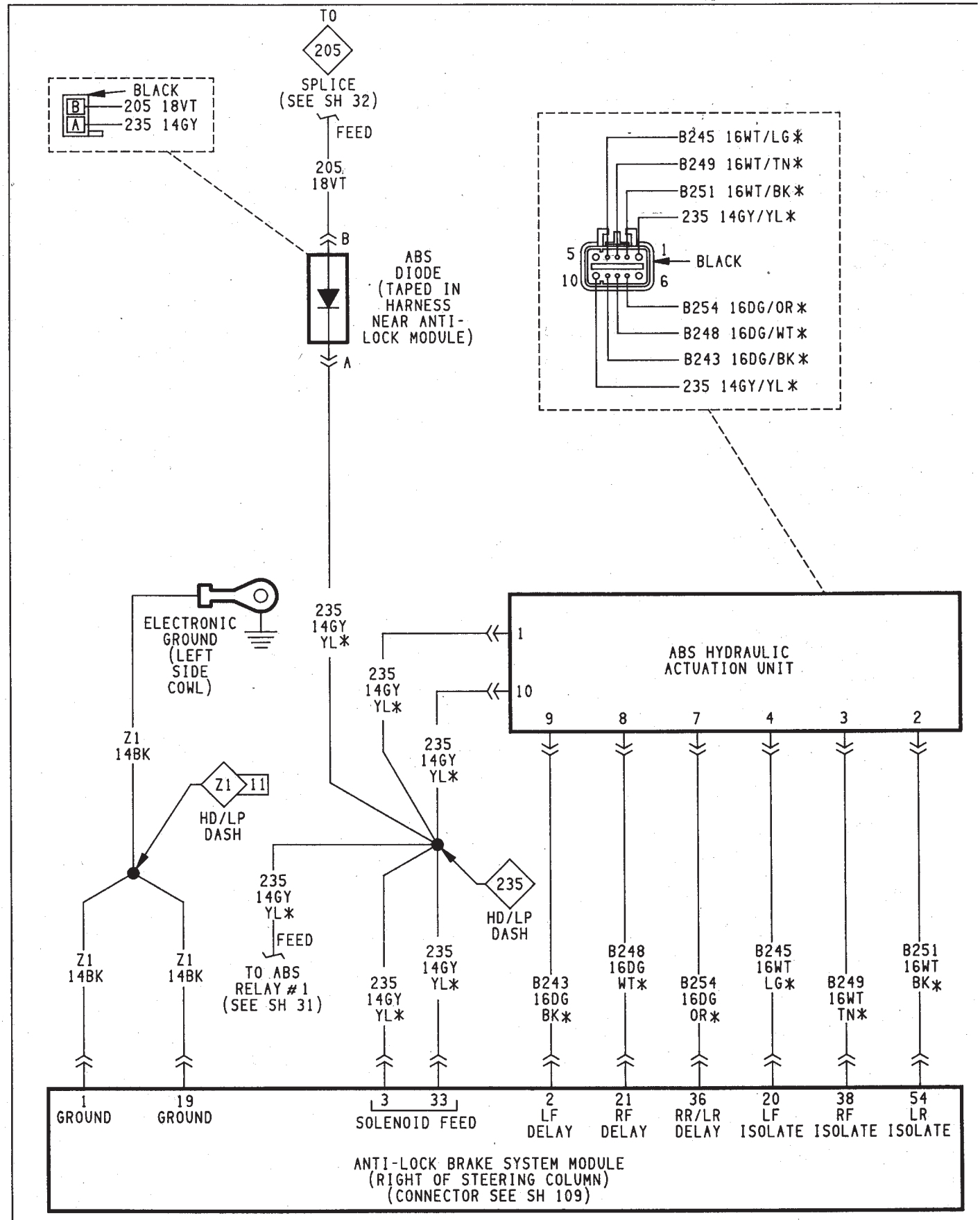


J948W-7 ANTI-LOCK BRAKING SYSTEM XJ 30

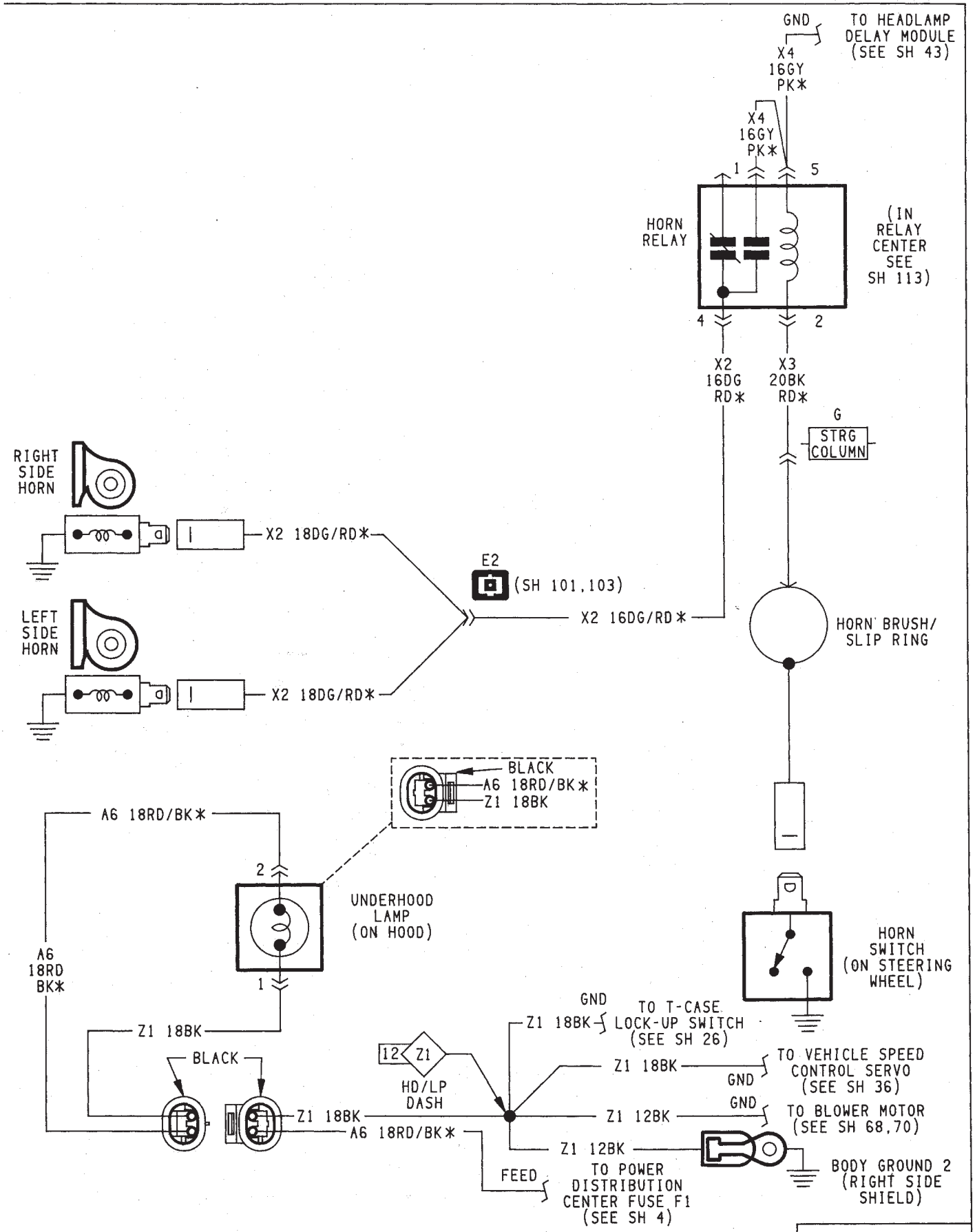


XJ 31 ANTI-LOCK BRAKING SYSTEM J948W-7


TO
A38
FEED
SPLICE
(SEE SH 10)
A38 120R/VT*
TO REAR
LIGHTING SYSTEM
(SEE SH 92,96)
FEED
FUSE #7
(2 AMP)
7
236 18LG/YL*
C3
(SH 103)
C2
(SH 103)
TO TELLTALE
CONNECTOR
(SEE SH 56)
FEED
D1
18VT
BR* TWISTED
PAIR
FEED
D2
18WT
BK*
GND
TO POWERTRAIN
CONTROL MODULE
CAVITY 26
(SEE SH 21)
TO POWERTRAIN
CONTROL MODULE
CAVITY 46
(SEE SH 21)
D2
20WT
BK*
205
18YL
236
18LG
YL*
L50
18WT
TN*
AUTOMATIC
TRANSMISSION
TWISTED
PAIR
D1
20VT
BR*
(LEFT
SIDE
COWL)
A B
D C
BLACK
D C
A B
DATA LINK
CONNECTOR
(RIGHT OF
STEERING
COLUMN)
6 3
5 2
4 1
Z12
18BK
TN*
F39
18PK
LG*
BLACK
GND
TO
Z12 1
SPLICE
(SEE SH 21)
FEED
TO POWER
DISTRIBUTION
CENTER FUSE F5
(SEE SH 4)
236
18LG
YL*
205
18VT
236
18LG
YL*
L50
18WT
TN*
205
HD/LP
DASH
236
HD/LP
DASH
TWISTED
PAIR
205
18VT
FEED
TO ABS
DIODE
(SEE SH 33)
D1
18VT
BR*
D2
18WT
BK*
205
18VT
236
18LG
YL*
L50
18WT
TN*
23
BUSS
B+
42
BUSS
B—
52
YELLOW
LIGHT
53
IGN
32
STOP LAMP
SWITCH
ANTI-LOCK BRAKE SYSTEM MODULE
(RIGHT OF STEERING COLUMN)
(CONNECTOR SEE SH 109)



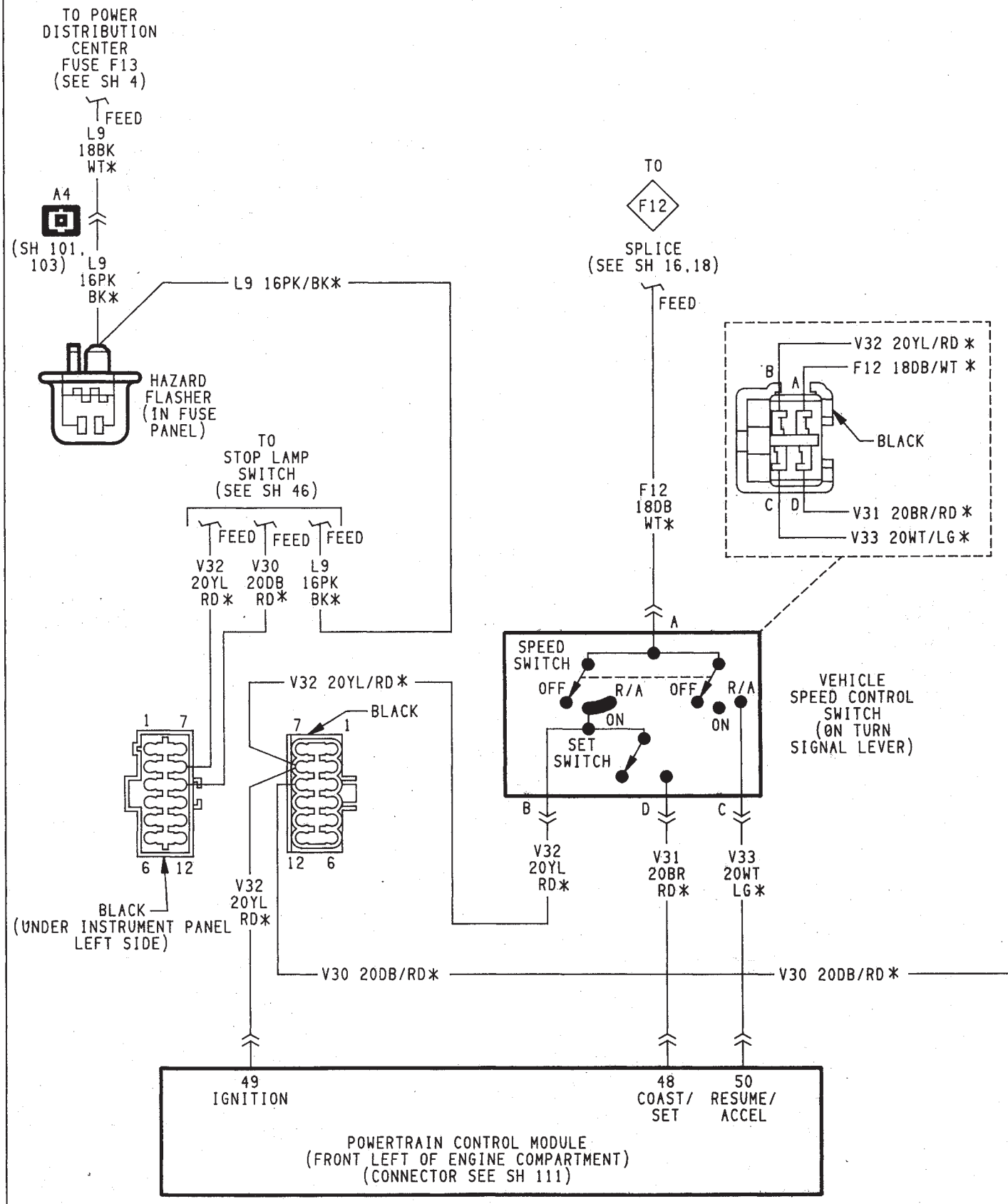
XJ 33 ANTI-LOCK BRAKING SYSTEM J948W-7



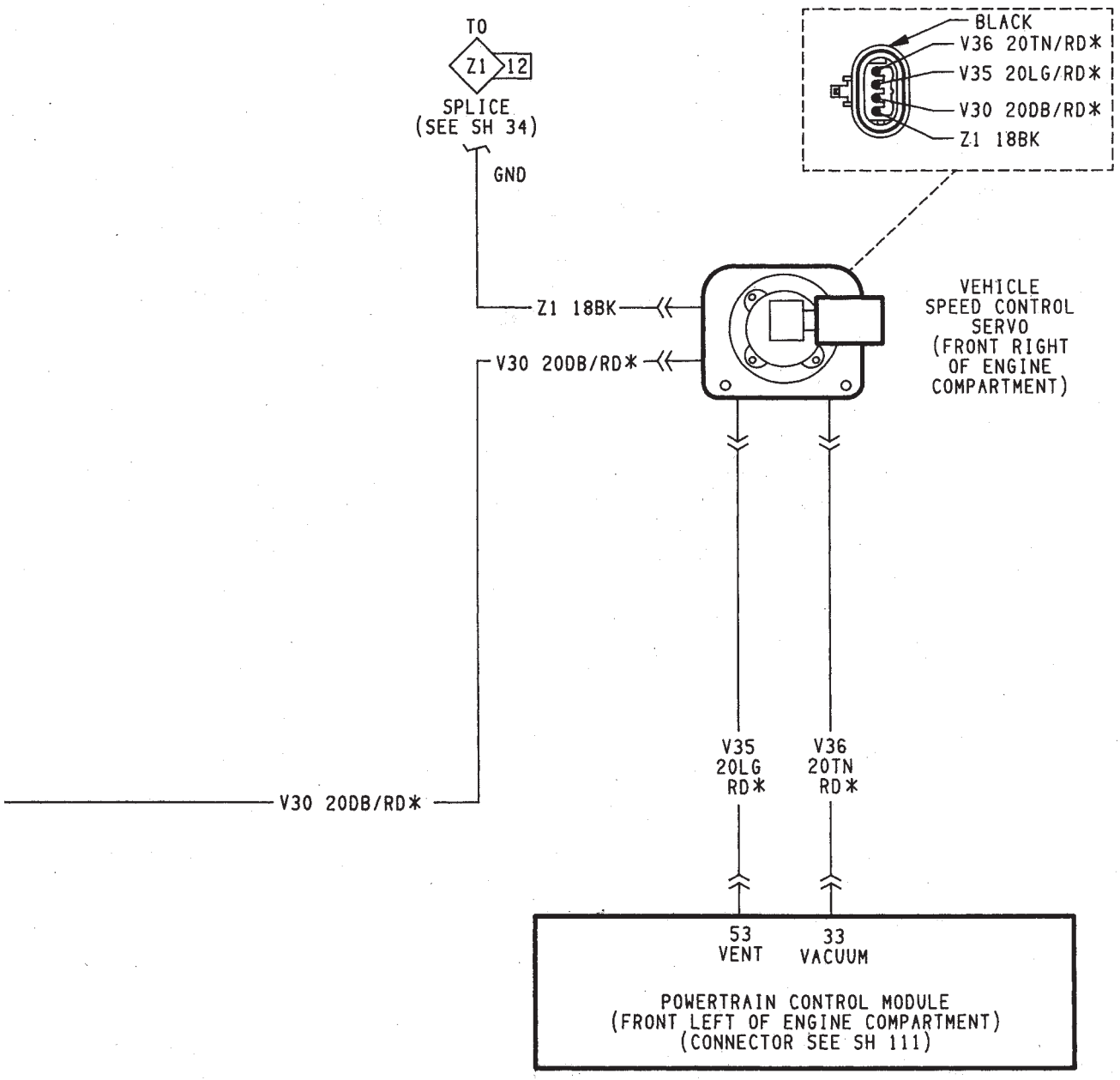
J948W-7

UNDERHOOD LAMP/HORN SYSTEM

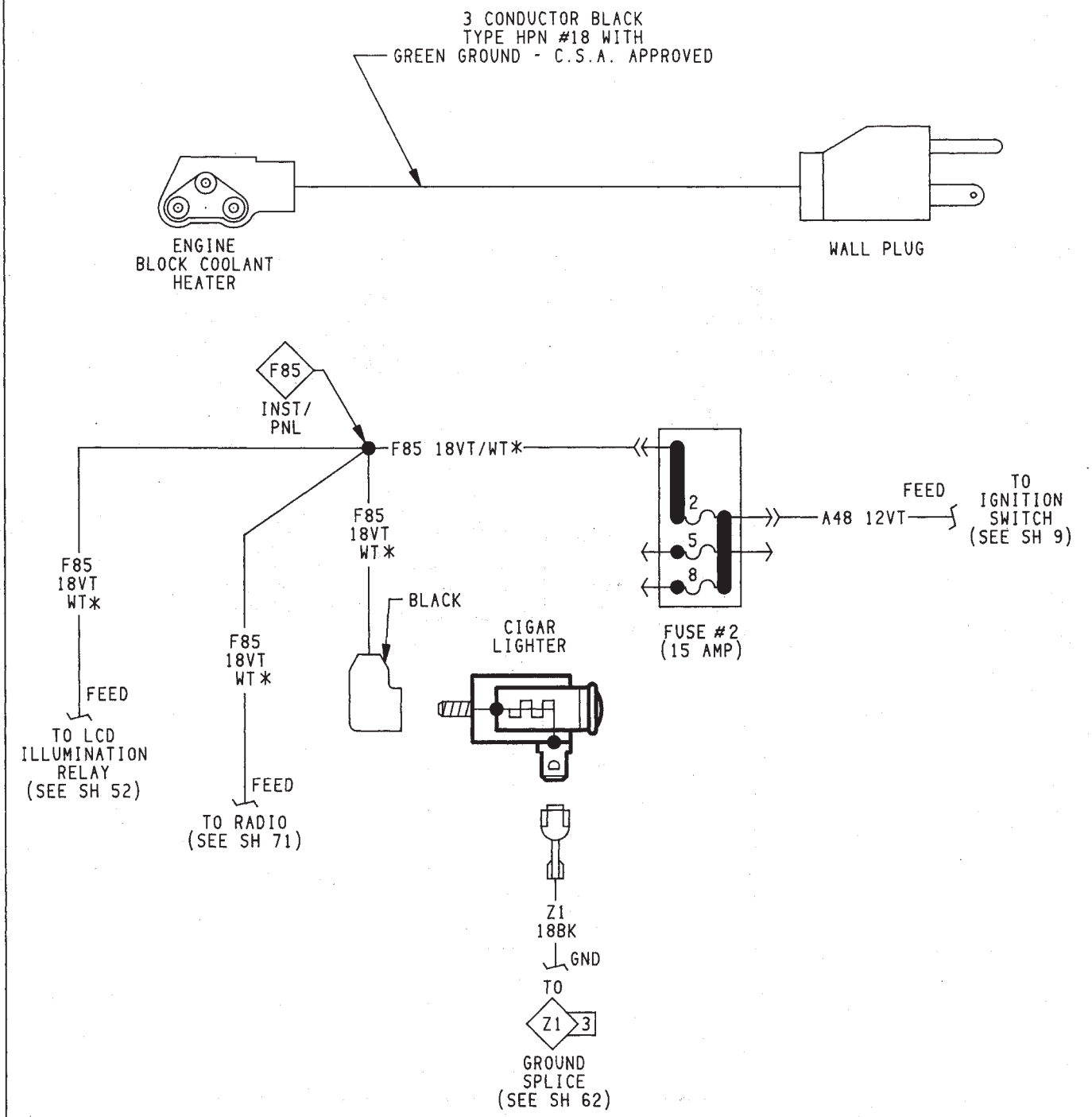
XJ 34



XJ 35 VEHICLE SPEED CONTROL SYSTEM J948W-7



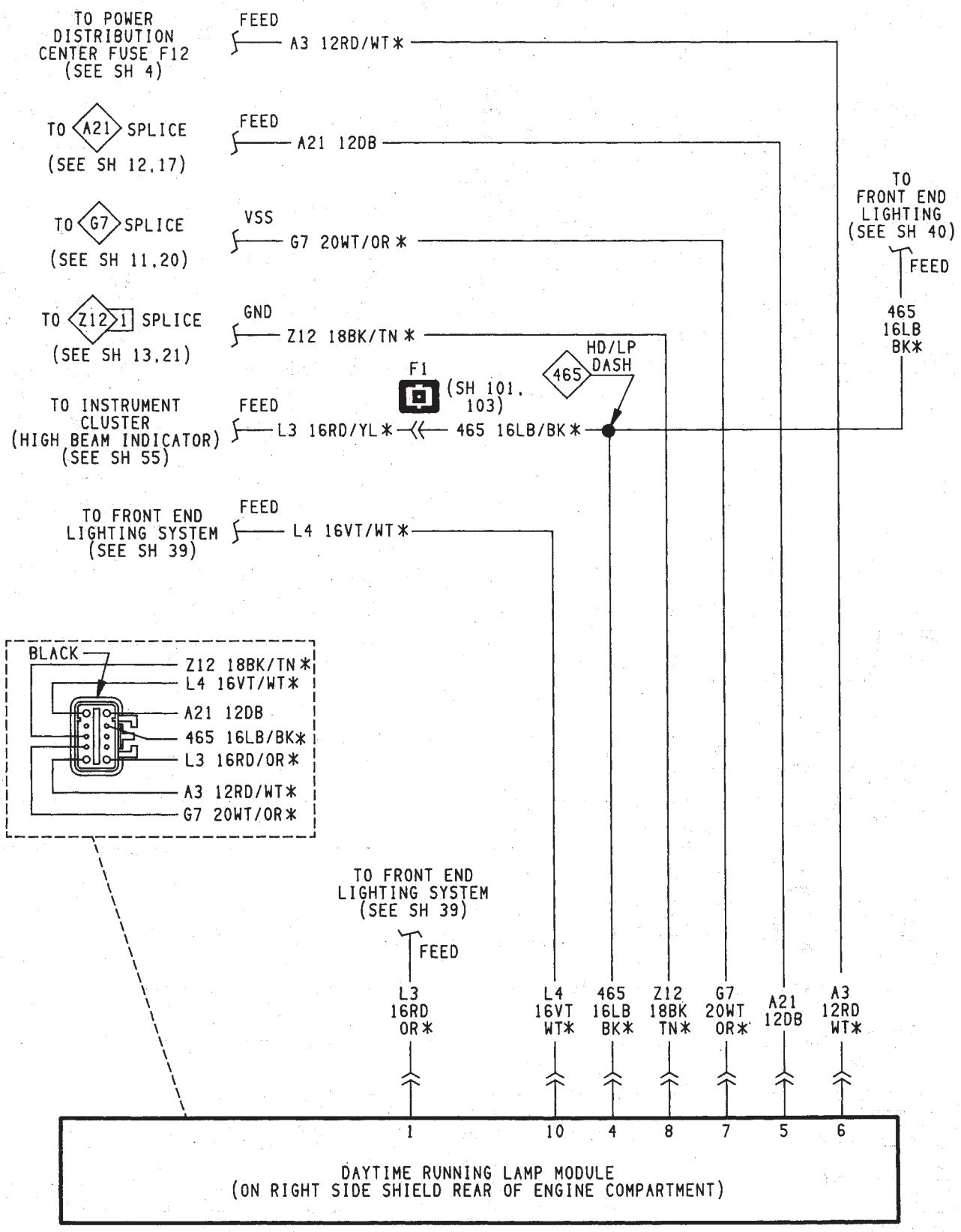
J948W-7 VEHICLE SPEED CONTROL SYSTEM XJ 36



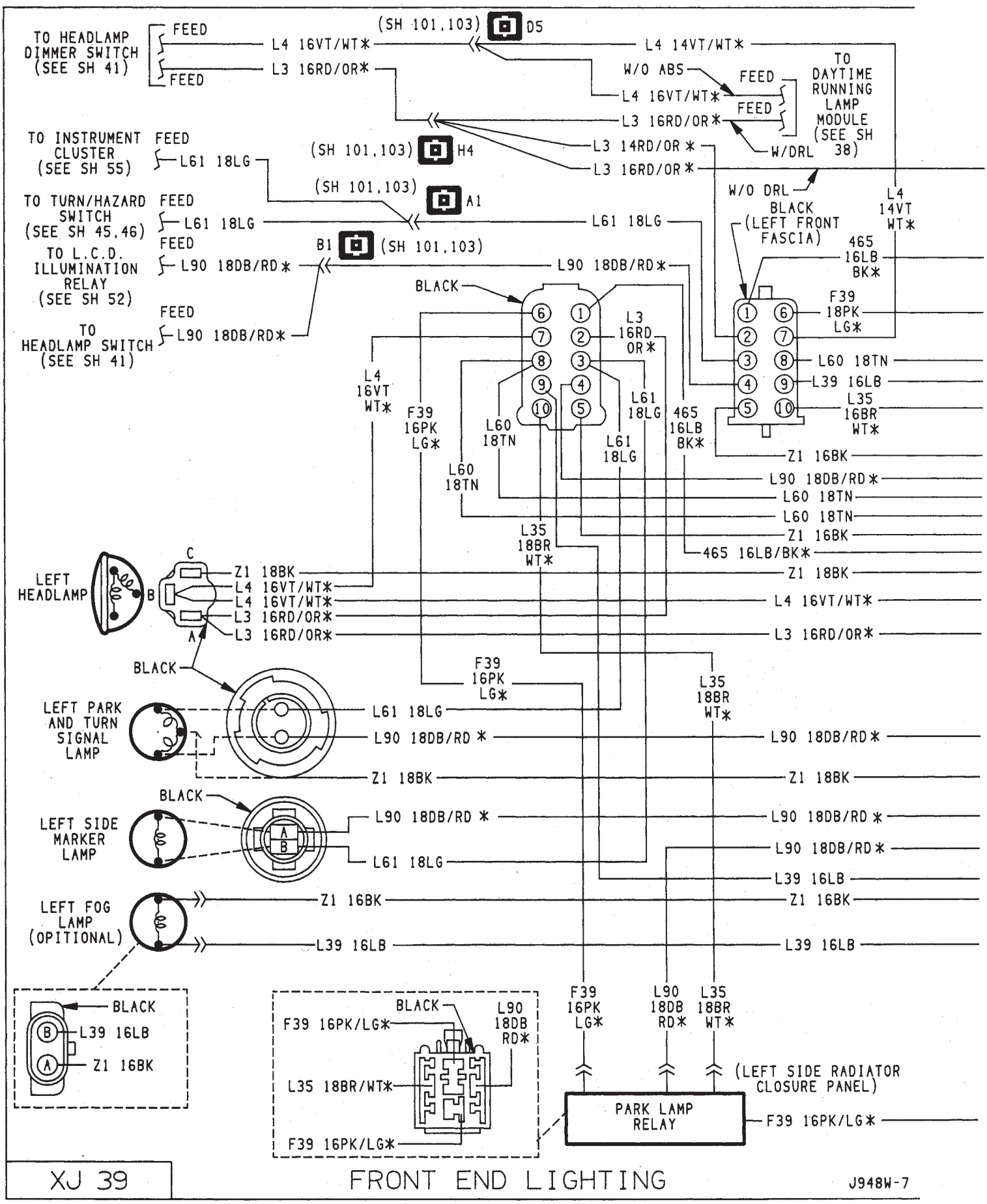
ENGINE BLOCK
COOLANT HEATER/CIGAR LIGHTER

XJ 37

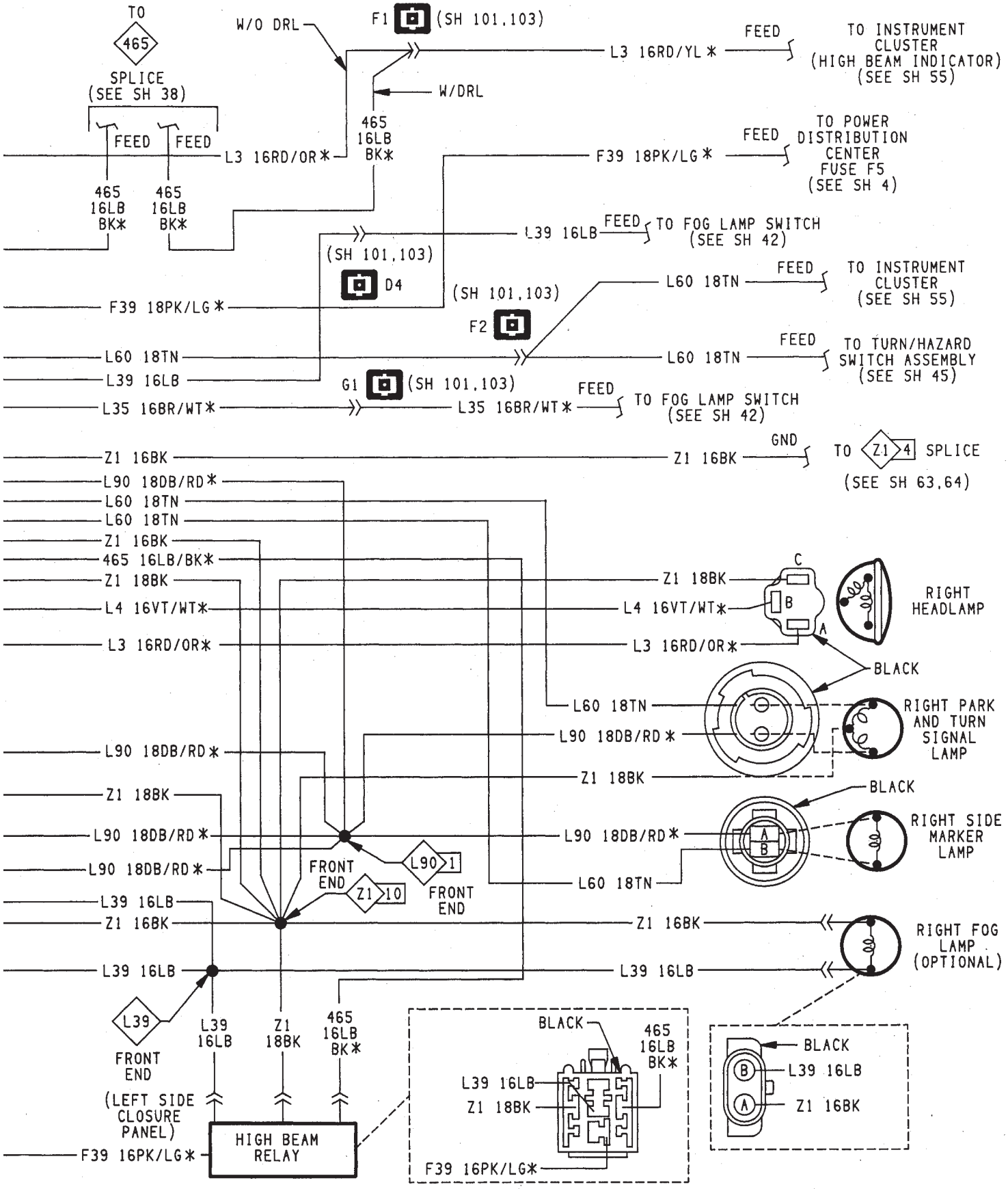
J948W-7



J948W-7 DAYTIME RUNNING LAMP SYSTEM XJ 38



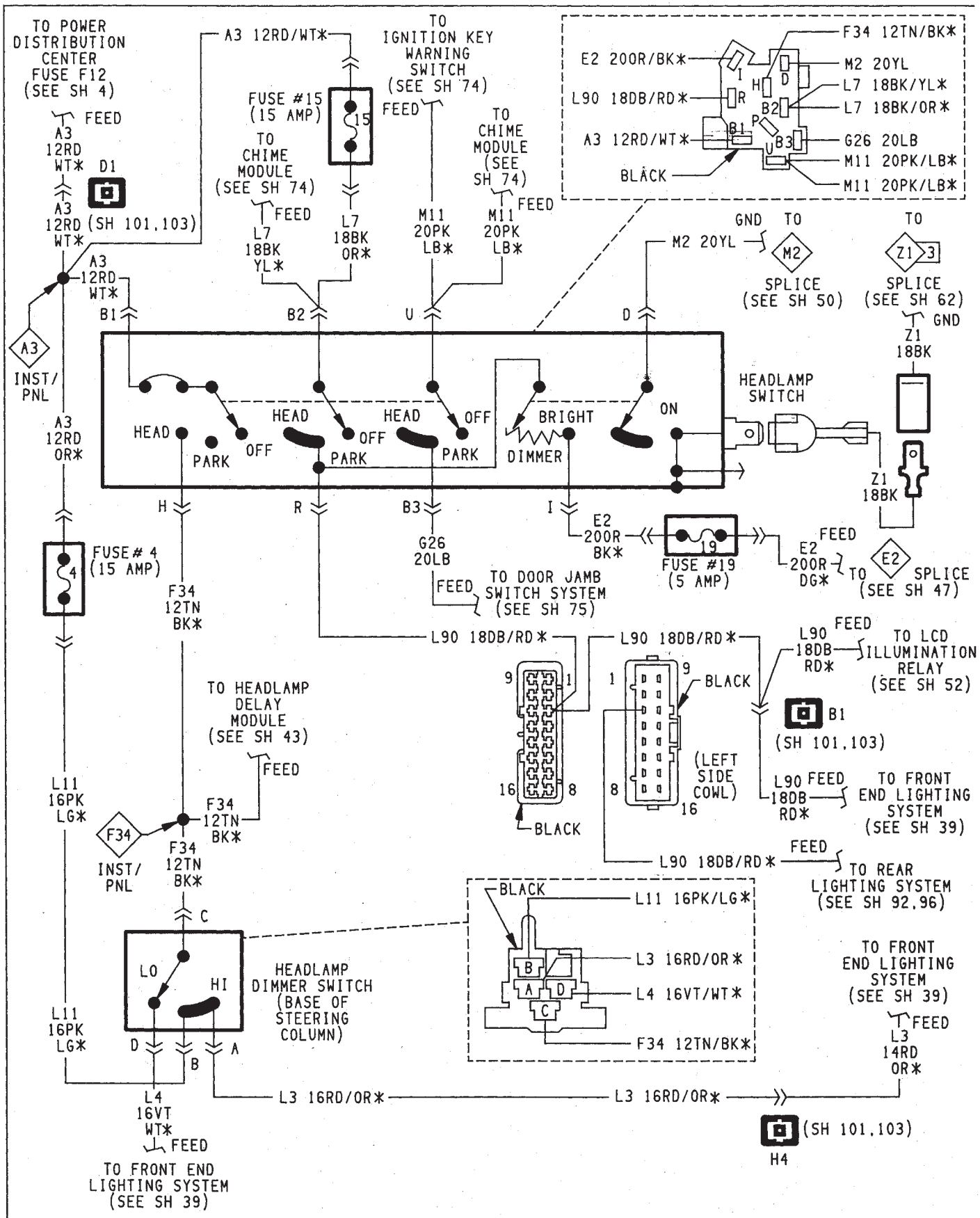
XJ 39 FRONT END LIGHTING J948W-7



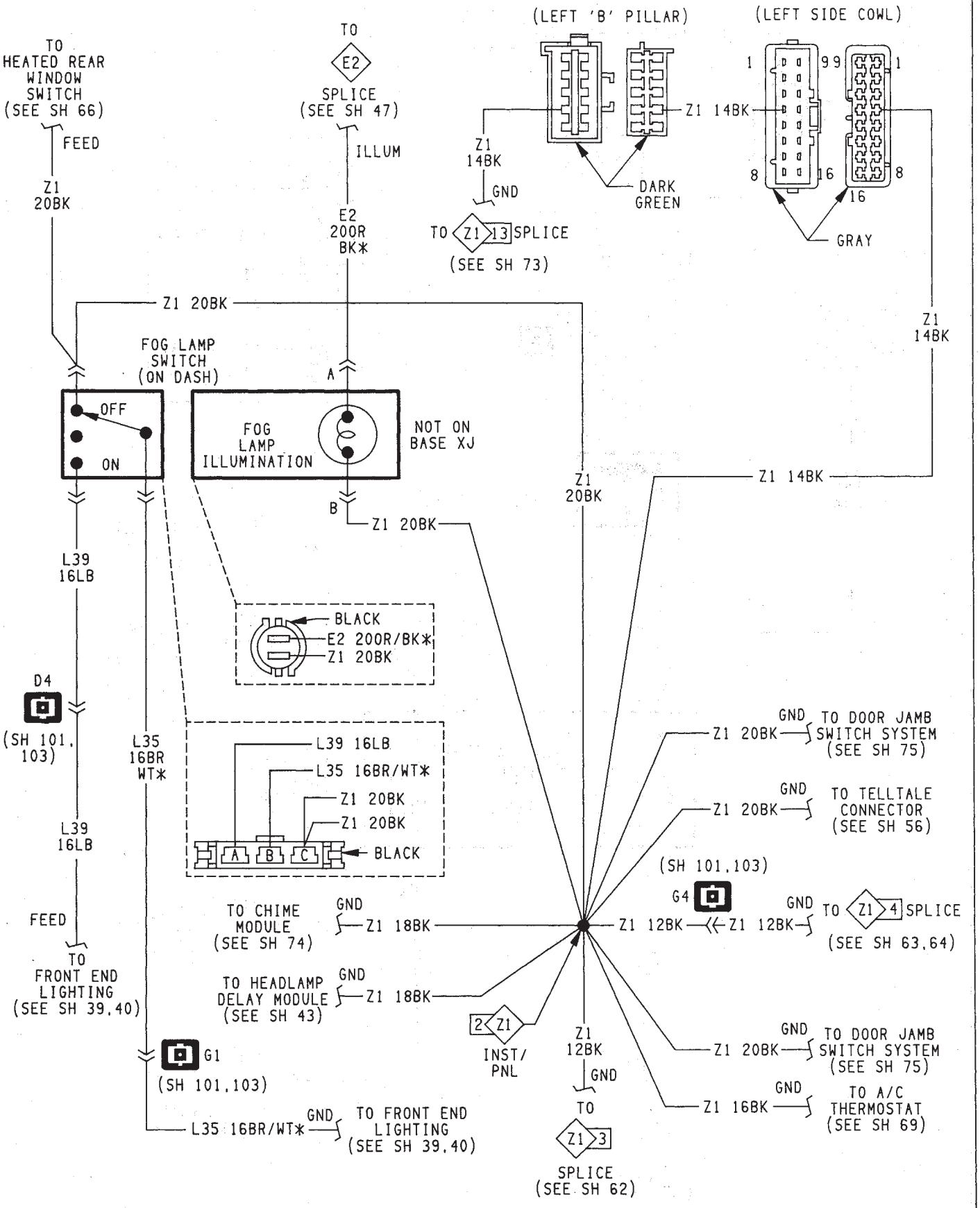
J948W-7

FRONT END LIGHTING

XJ 40



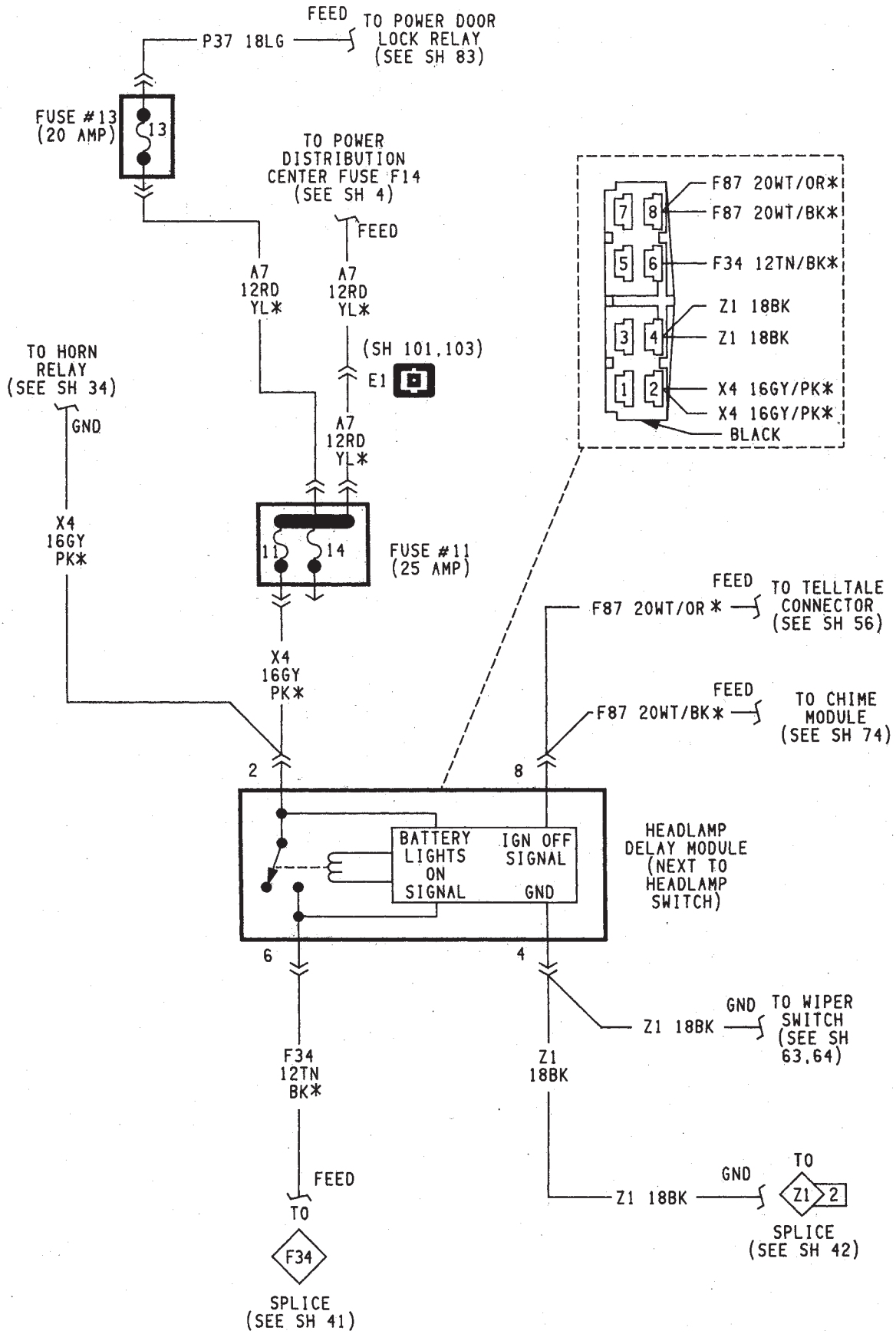
XJ 41 HEADLAMP SWITCH J948W-7



J948W-7

HEADLAMP SWITCH

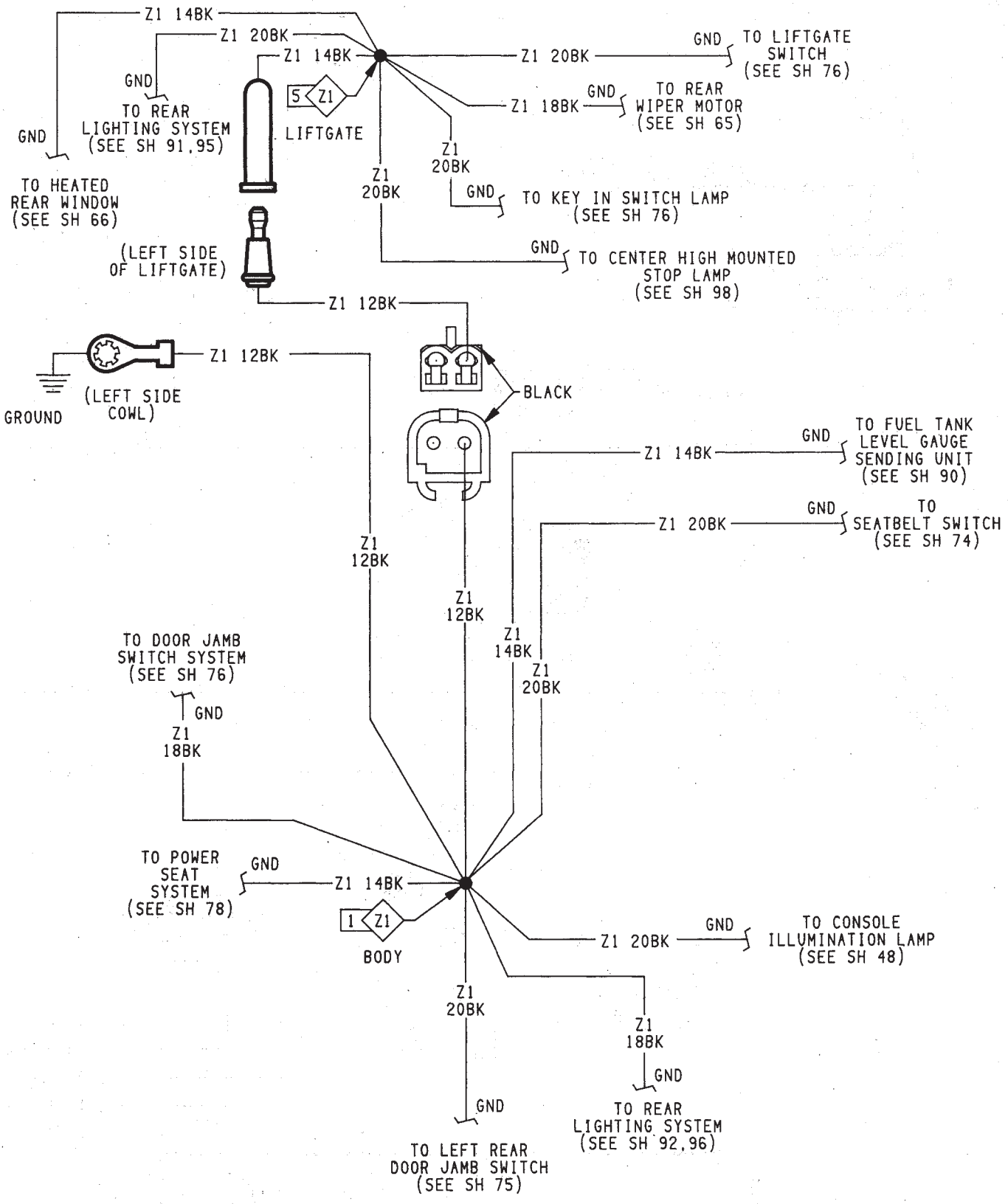
XJ 42



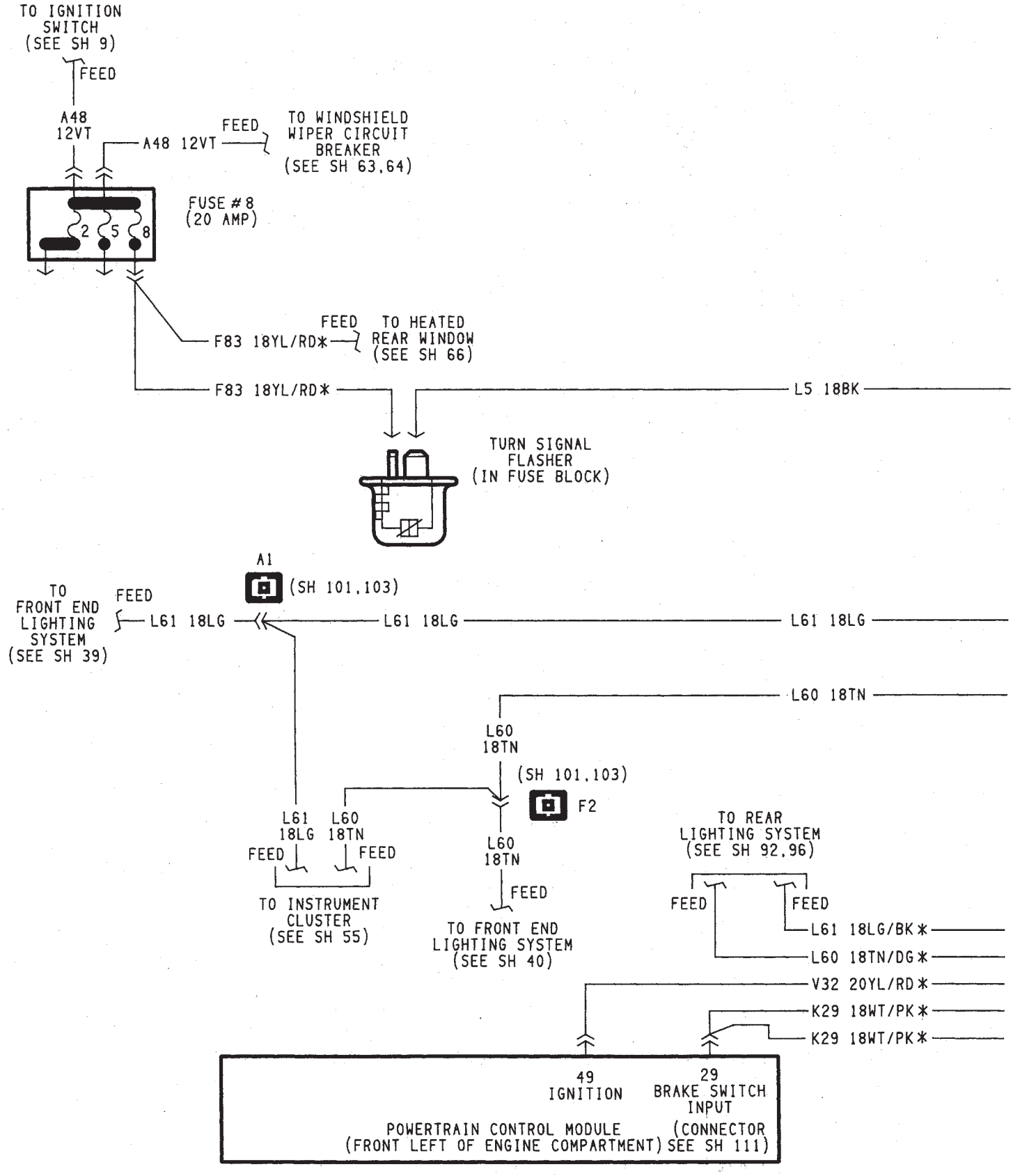
XJ 43

HEADLAMP DELAY MODULE

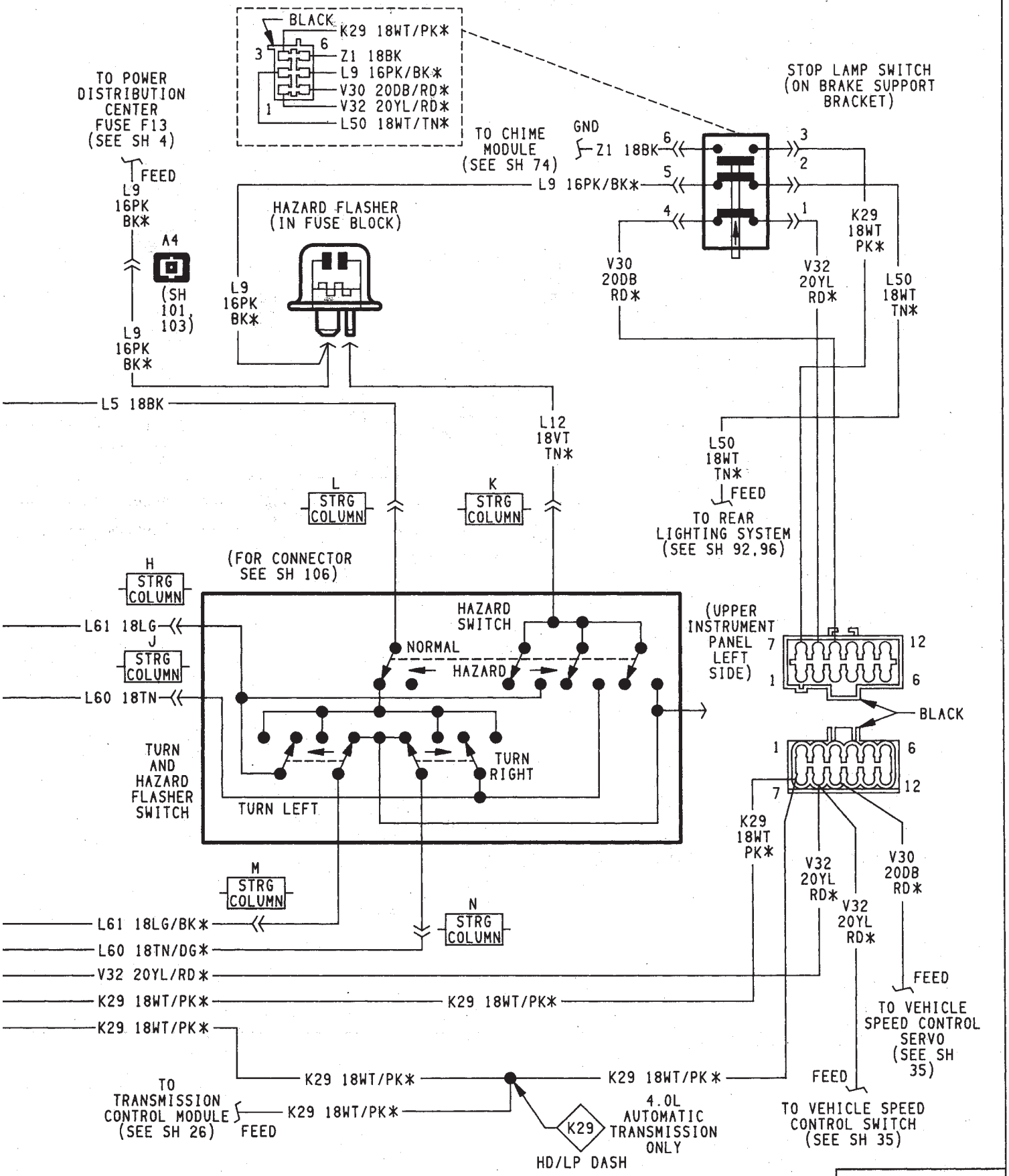
J948W-7


Z1 14BK
Z1 20BK
Z1 14BK
Z1 20BK
GND
TO LIFTGATE SWITCH (SEE SH 76)
GND
TO REAR LIGHTING SYSTEM (SEE SH 91,95)
5 Z1
LIFTGATE
Z1 18BK
GND
TO REAR WIPER MOTOR (SEE SH 65)
GND
TO HEATED REAR WINDOW (SEE SH 66)
Z1 20BK
Z1 20BK
GND
TO KEY IN SWITCH LAMP (SEE SH 76)
(LEFT SIDE OF LIFTGATE)
GND
TO CENTER HIGH MOUNTED STOP LAMP (SEE SH 98)
Z1 12BK
Z1 12BK
GROUND
(LEFT SIDE COWL)
BLACK
Z1 14BK
GND
TO FUEL TANK LEVEL GAUGE SENDING UNIT (SEE SH 90)
Z1 20BK
GND
TO SEATBELT SWITCH (SEE SH 74)
Z1 12BK
Z1 12BK
Z1 14BK
Z1 20BK
TO DOOR JAMB SWITCH SYSTEM (SEE SH 76)
GND
Z1 18BK
TO POWER SEAT SYSTEM (SEE SH 78)
GND
Z1 14BK
1 Z1
BODY
Z1 20BK
GND
TO CONSOLE ILLUMINATION LAMP (SEE SH 48)
Z1 20BK
Z1 18BK
GND
GND
TO LEFT REAR DOOR JAMB SWITCH (SEE SH 75)
TO REAR LIGHTING SYSTEM (SEE SH 92,96)

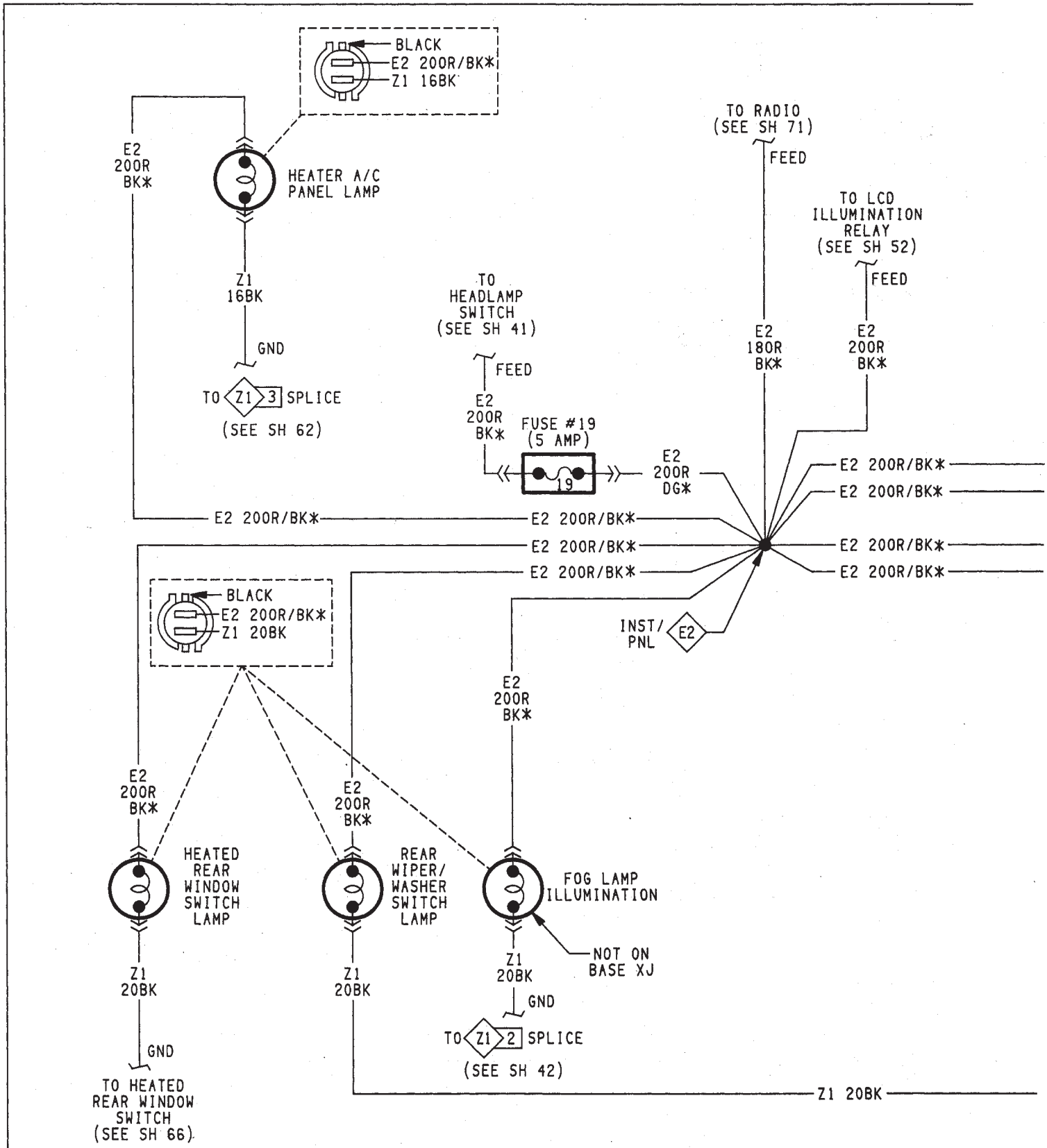
BODY GROUND



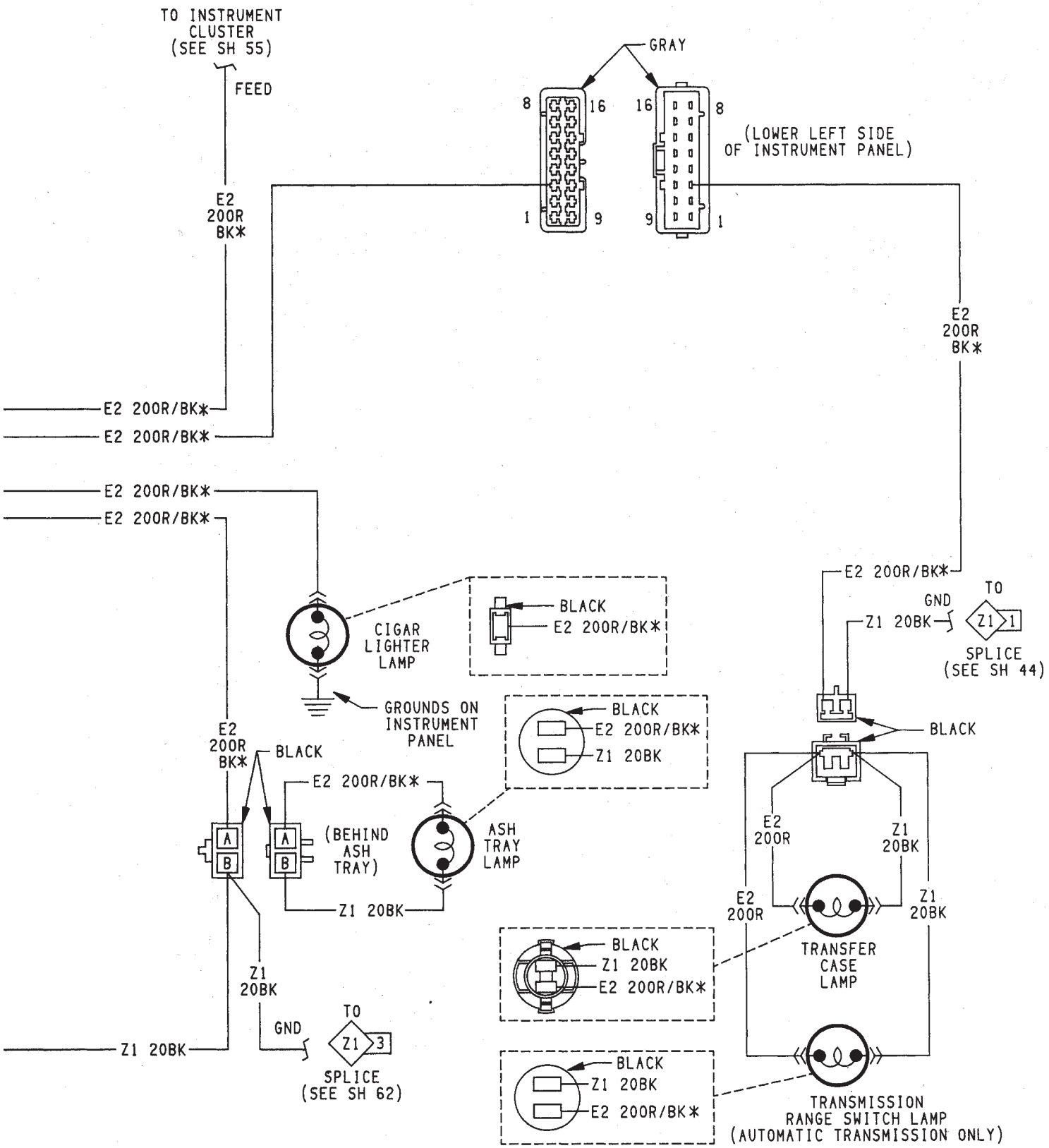
XJ 45 STOP/TURN AND HAZARD SYSTEM J948W-7

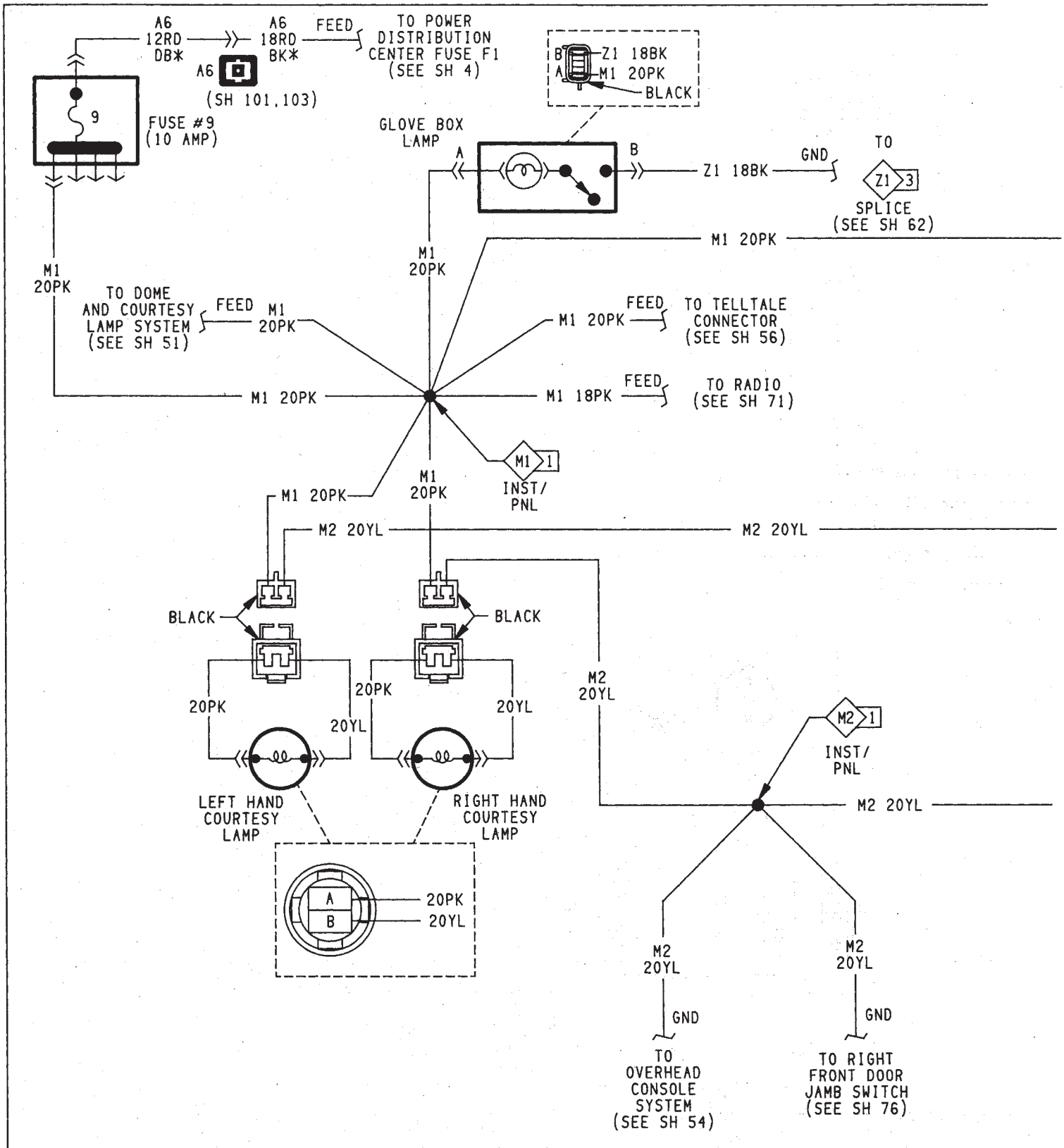


J948W-7 STOP/TURN AND HAZARD SYSTEM XJ 46



XJ 47 INSTRUMENT PANEL ILLUMINATION J948W-7

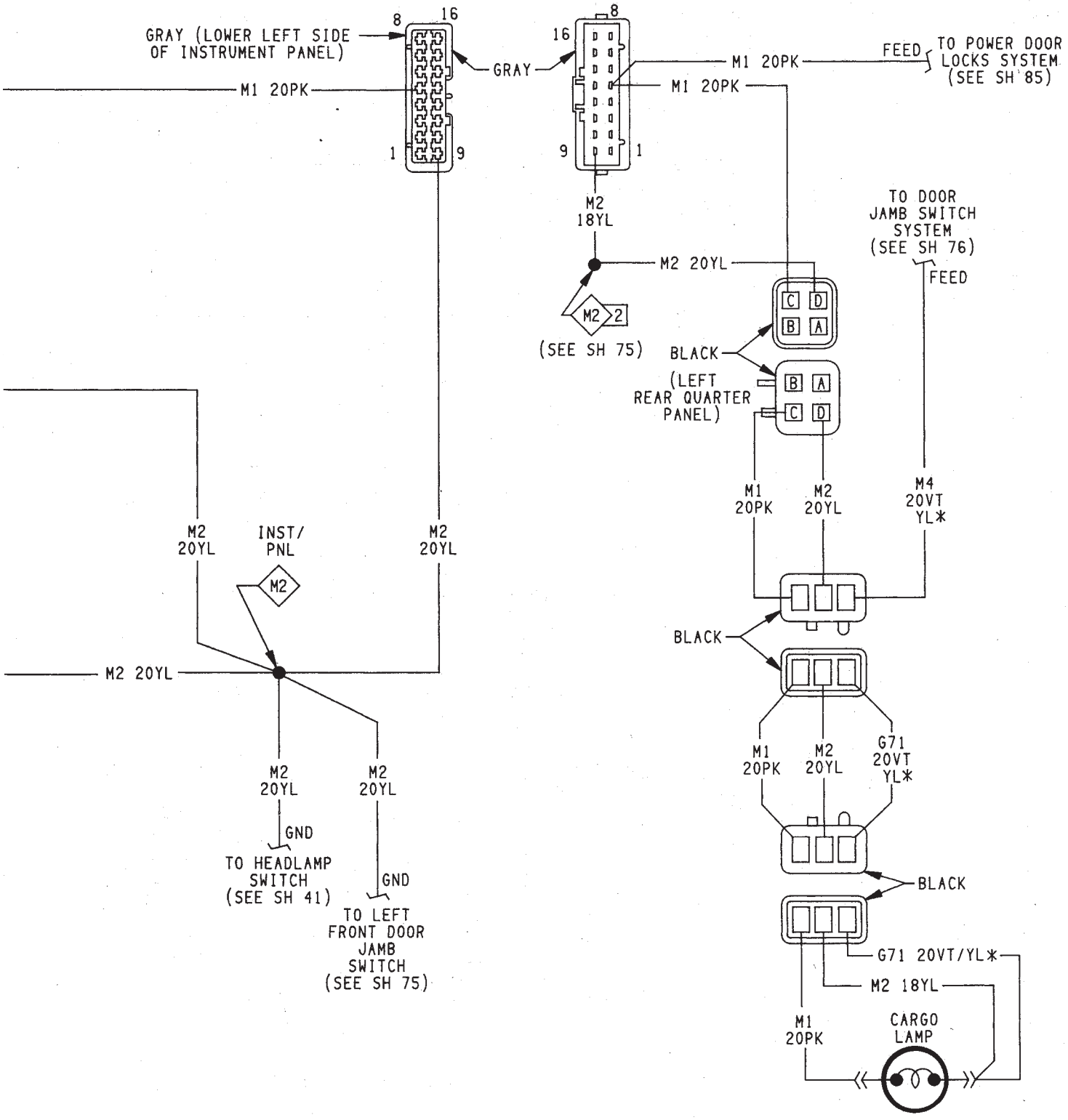

TO INSTRUMENT CLUSTER (SEE SH 55)
FEED
E2 200R BK*
GRAY
8
16
16
8
1
9
9
1
(LOWER LEFT SIDE OF INSTRUMENT PANEL)
E2 200R BK*
E2 200R/BK*
E2 200R/BK*
E2 200R/BK*
E2 200R/BK*
CIGAR LIGHTER LAMP
BLACK
E2 200R/BK*
GROUNDS ON INSTRUMENT PANEL
BLACK
E2 200R/BK*
Z1 20BK
E2 200R BK*
BLACK
E2 200R/BK*
A
B
A
B
(BEHIND ASH TRAY)
ASH TRAY LAMP
Z1 20BK
Z1 20BK
GND
TO
Z1
3
SPLICE (SEE SH 62)
Z1 20BK
BLACK
Z1 20BK
E2 200R/BK*
BLACK
Z1 20BK
E2 200R/BK*
E2 200R/BK*
GND
TO
Z1
1
Z1 20BK
SPLICE (SEE SH 44)
BLACK
E2 200R
Z1 20BK
E2 200R
Z1 20BK
TRANSFER CASE LAMP
TRANSMISSION RANGE SWITCH LAMP (AUTOMATIC TRANSMISSION ONLY)



XJ 49

DOME AND COURTESY LAMPS

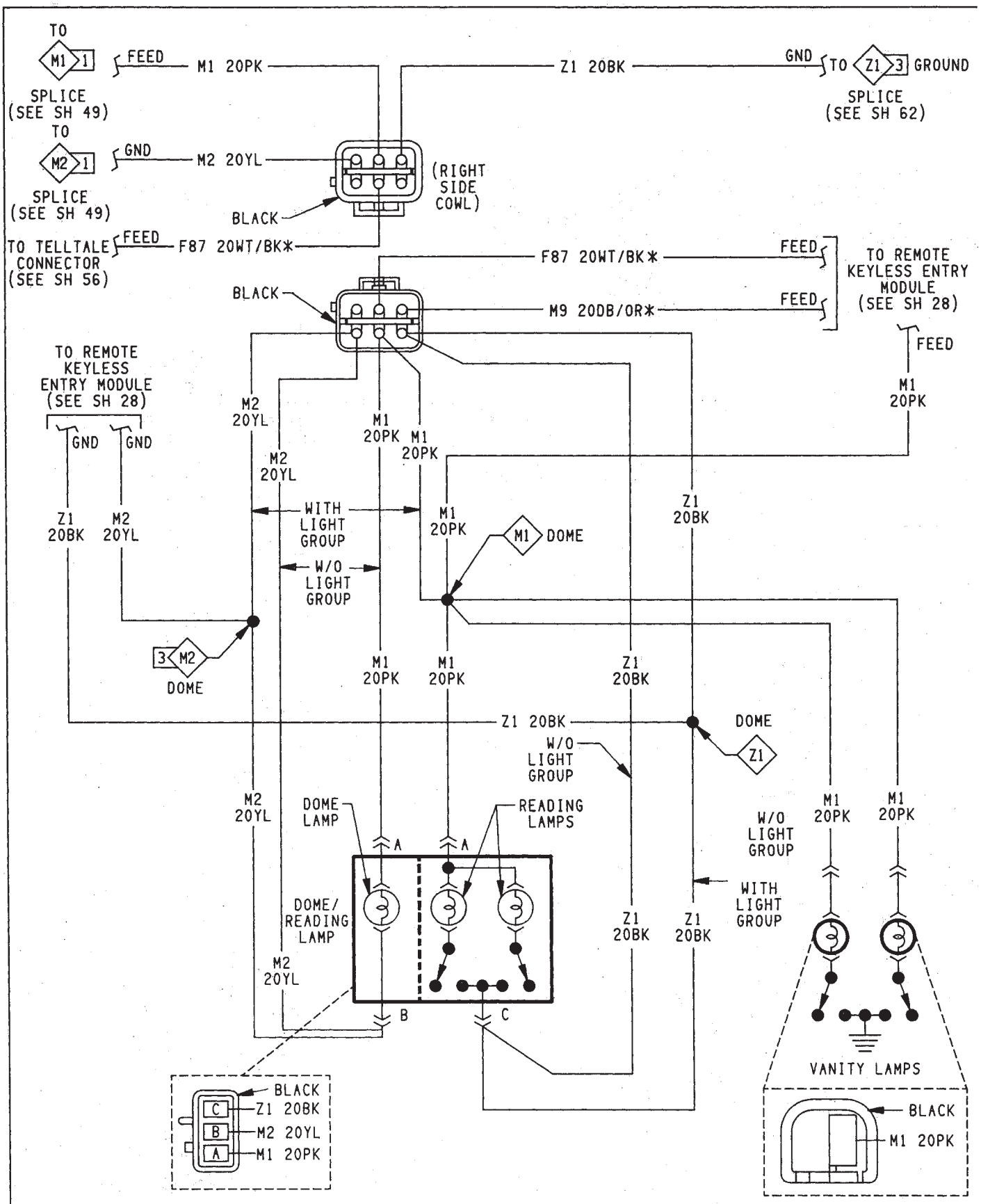
J948W-7



J948W-7

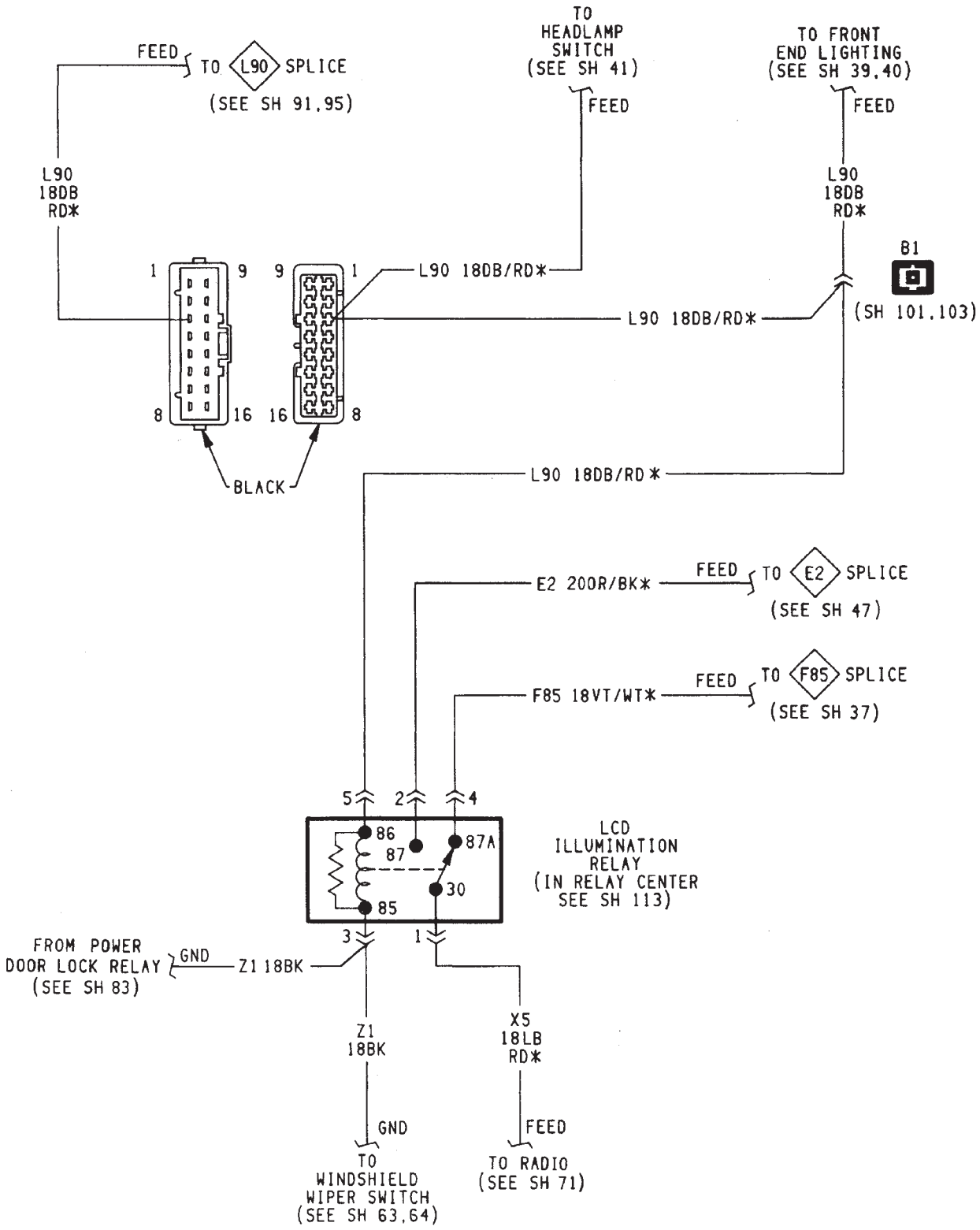
DOME AND COURTESY LAMPS

XJ 50



XJ 51 DOME AND COURTESY LAMPS J948W-7

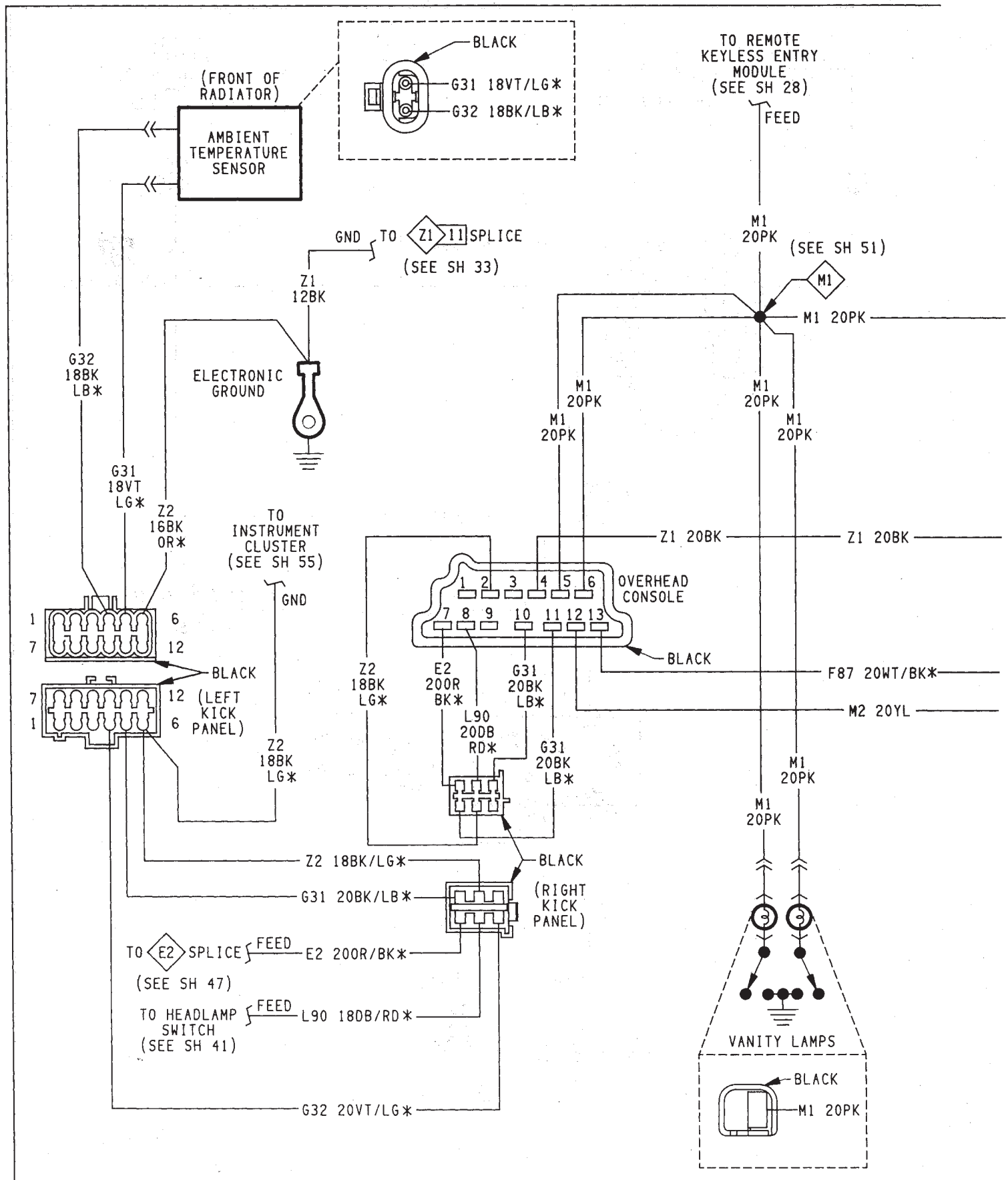
1994 Jeep
Publication No. 81-370-4146
TSB 08-09-94 February 18, 1994



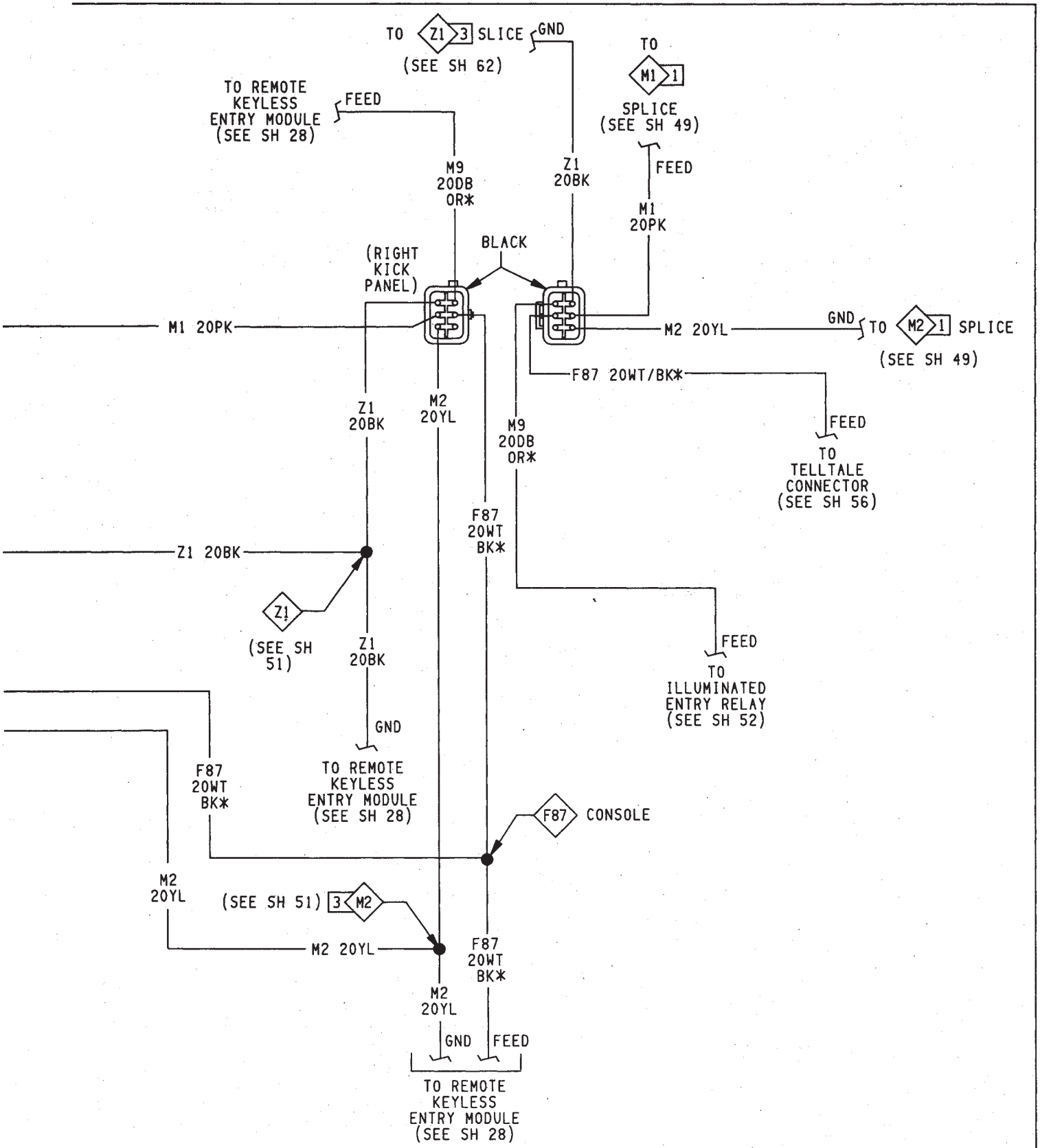
J948W-7

L.C.D. ILLUMINATION RELAY

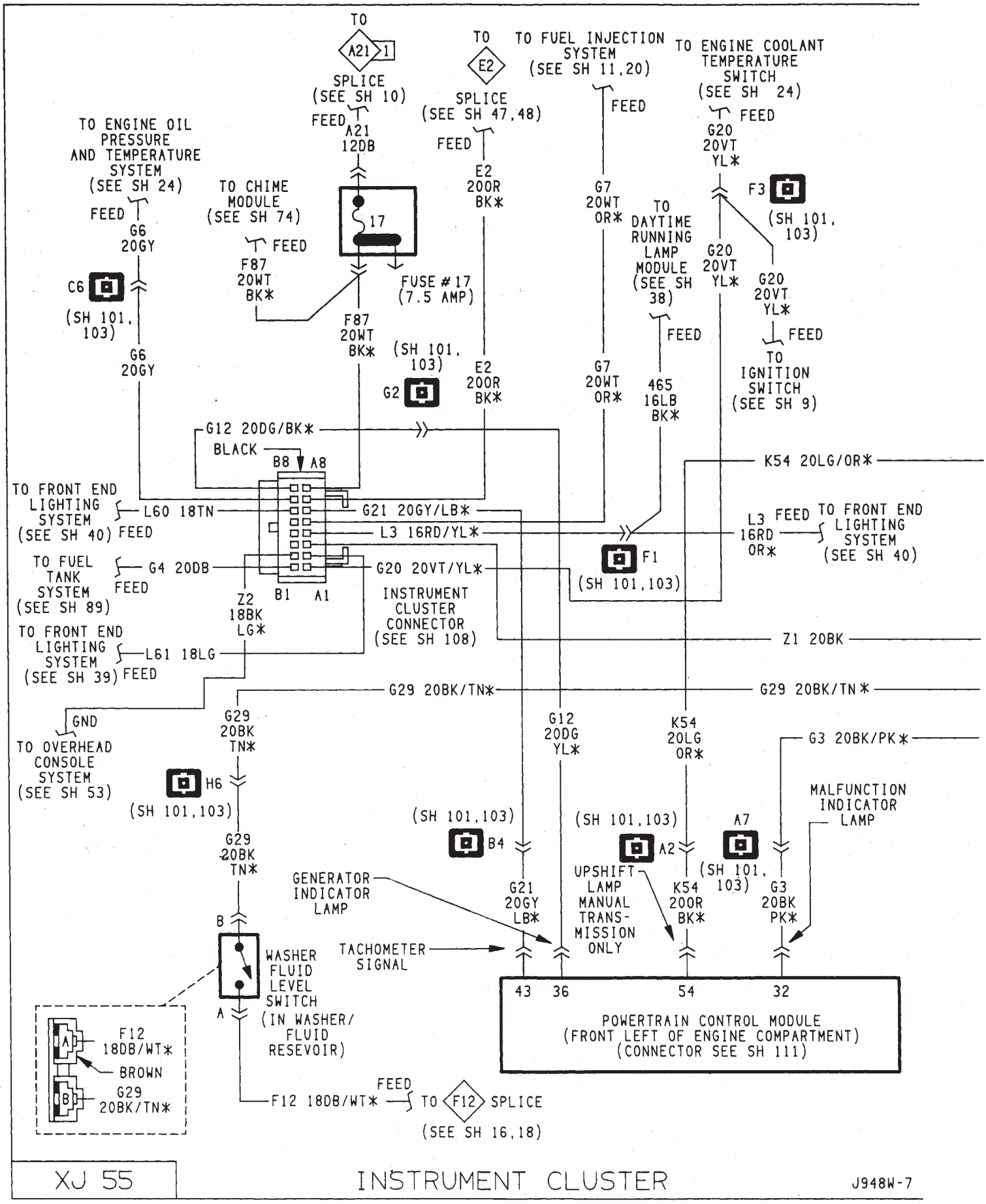
XJ 52



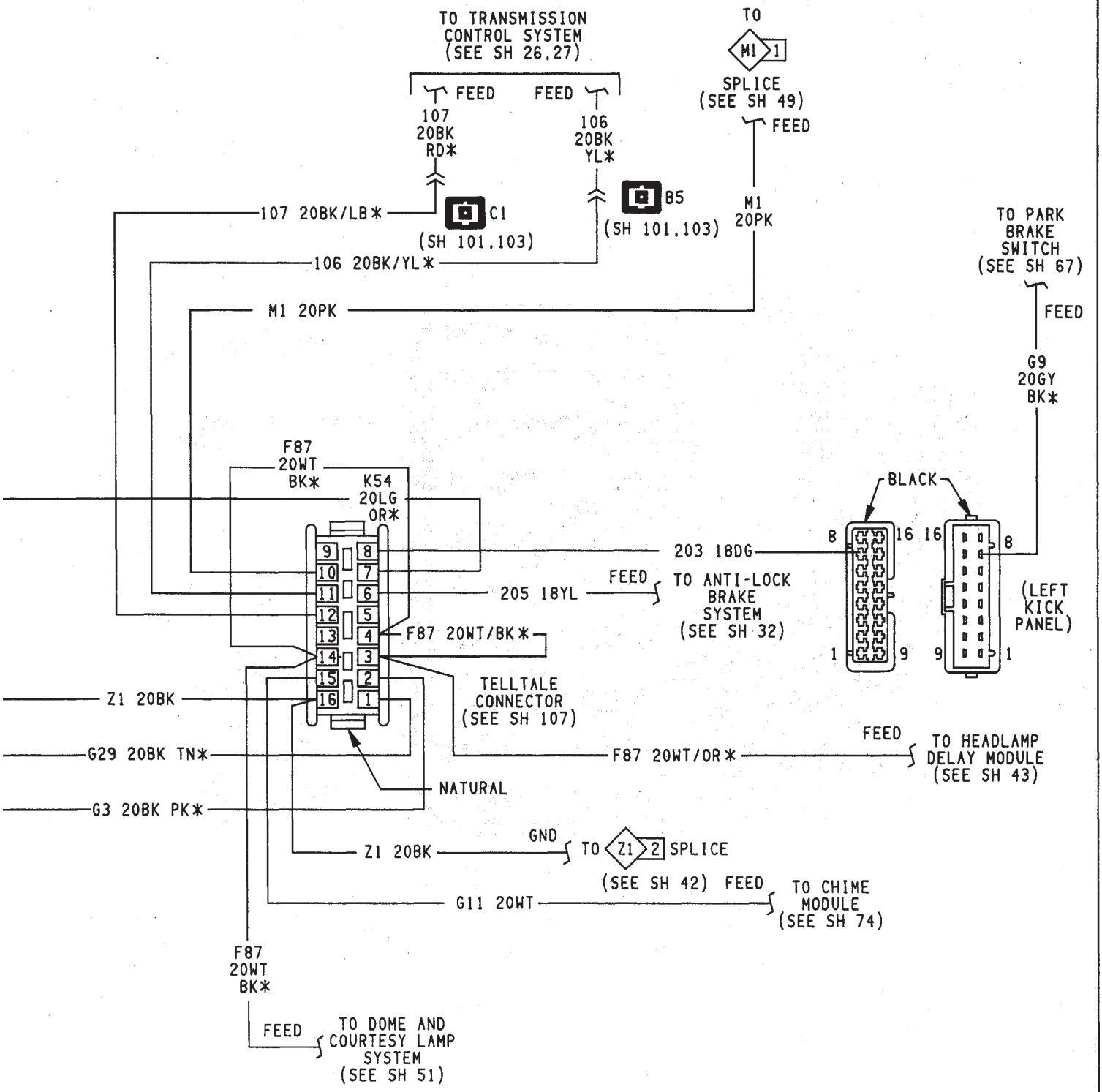
XJ 53 OVERHEAD CONSOLE SYSTEM J948W-7

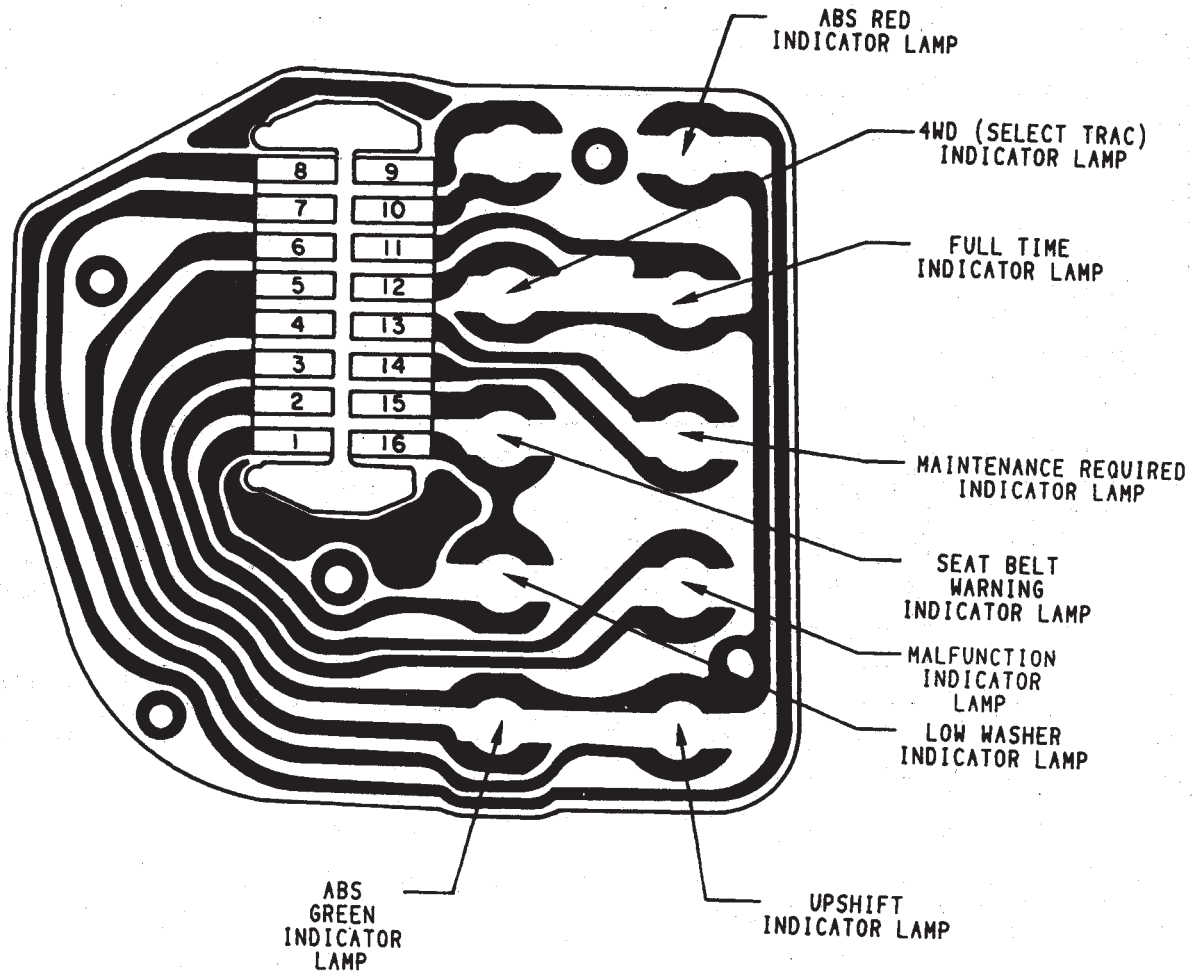


J948W-7 OVERHEAD CONSOLE SYSTEM XJ 54



XJ 55 INSTRUMENT CLUSTER J948W-7

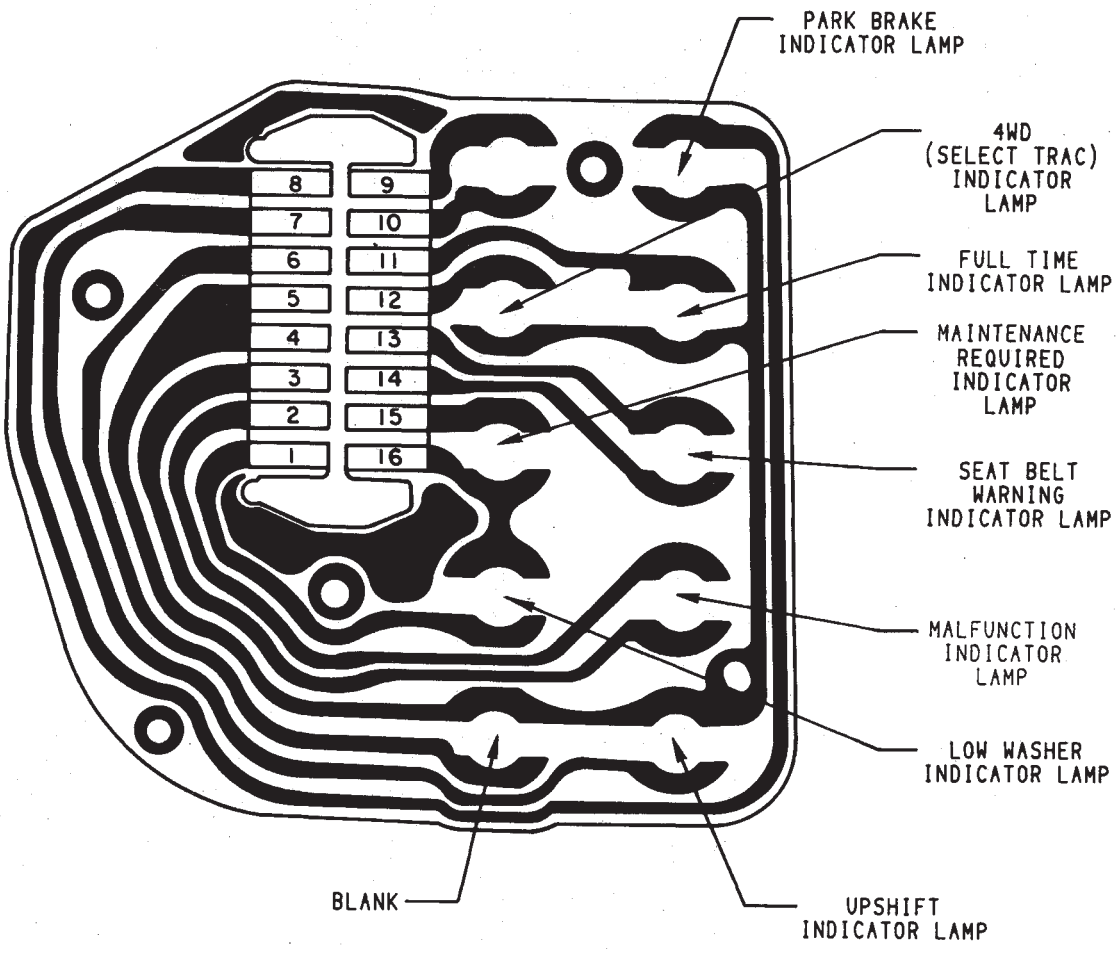

TO TRANSMISSION CONTROL SYSTEM (SEE SH 26,27)
FEED
FEED
107 20BK RD*
106 20BK YL*
107 20BK/LB*
C1
(SH 101,103)
B5
(SH 101,103)
106 20BK/YL*
TO M1 1 SPLICE (SEE SH 49)
FEED
M1 20PK
M1 20PK
TO PARK BRAKE SWITCH (SEE SH 67)
FEED
G9 20GY BK*
F87 20WT BK*
K54 20LG OR*
BLACK
203 18DG
205 18YL
FEED
TO ANTI-LOCK BRAKE SYSTEM (SEE SH 32)
F87 20WT/BK*
TELLTALE CONNECTOR (SEE SH 107)
Z1 20BK
G29 20BK TN*
G3 20BK PK*
NATURAL
F87 20WT/OR*
FEED
TO HEADLAMP DELAY MODULE (SEE SH 43)
(LEFT KICK PANEL)
GND
TO Z1 2 SPLICE
(SEE SH 42)
Z1 20BK
FEED
TO CHIME MODULE (SEE SH 74)
G11 20WT
F87 20WT BK*
FEED
TO DOME AND COURTESY LAMP SYSTEM (SEE SH 51)



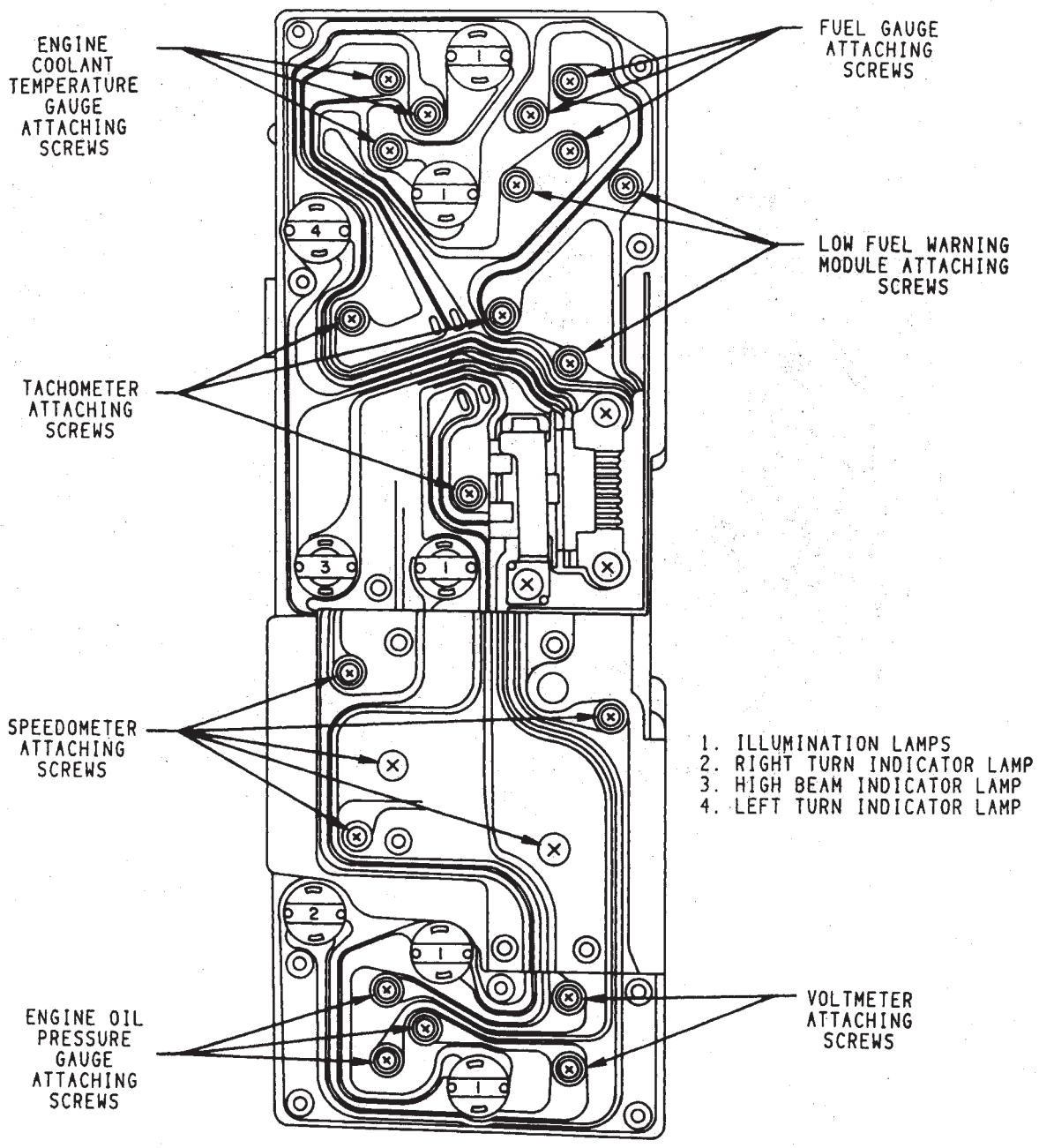
INSTRUMENT CLUSTER
INDICATOR PRINTED
CIRCUIT BOARD
(WITH ABS)

XJ 57

J948W-7



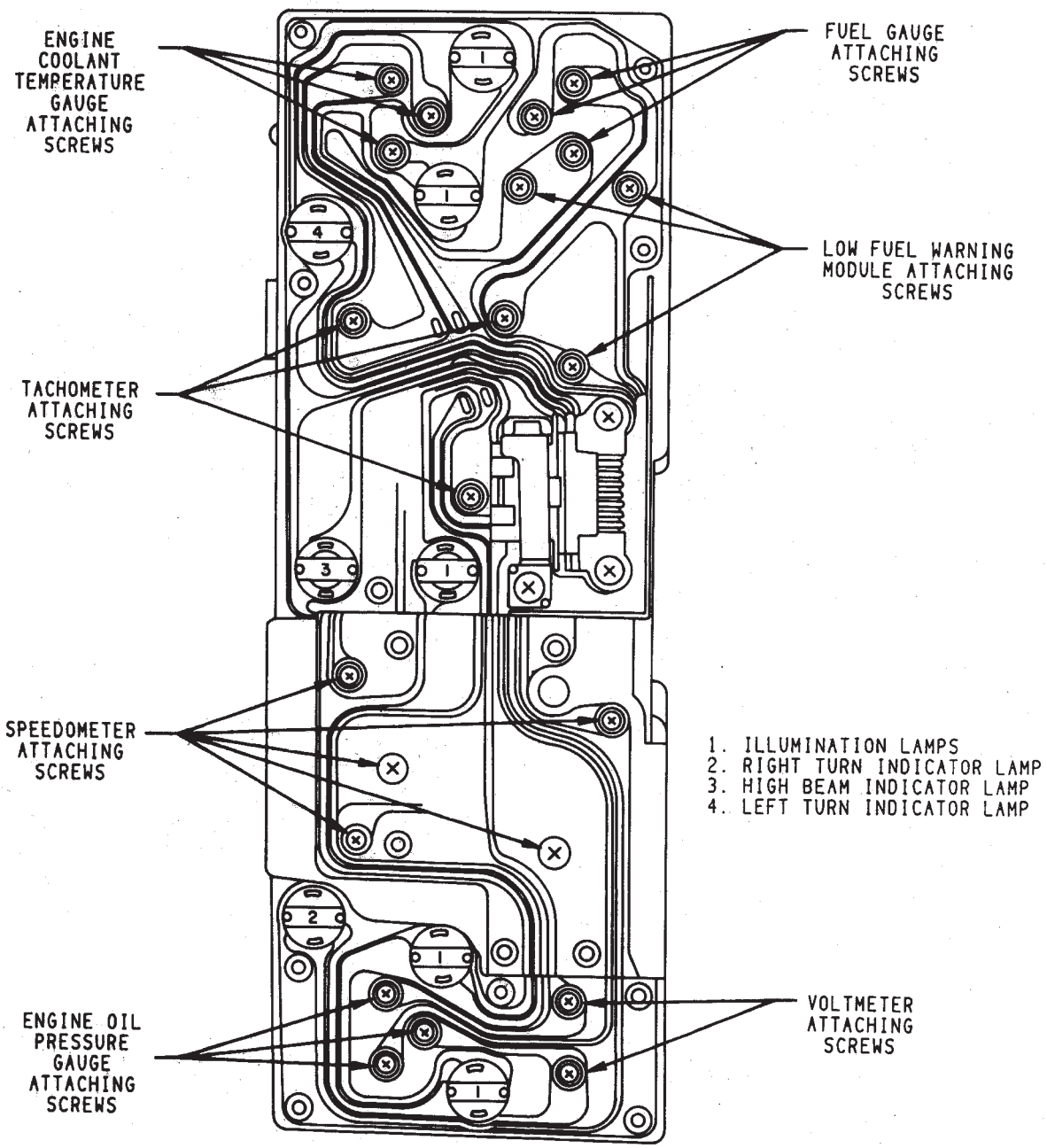
INSTRUMENT CLUSTER INDICATOR PRINTED CIRCUIT BOARD (WITHOUT ABS)



STANDARD INSTRUMENT CLUSTER
PRINTED CIRCUIT BOARD

XJ 59

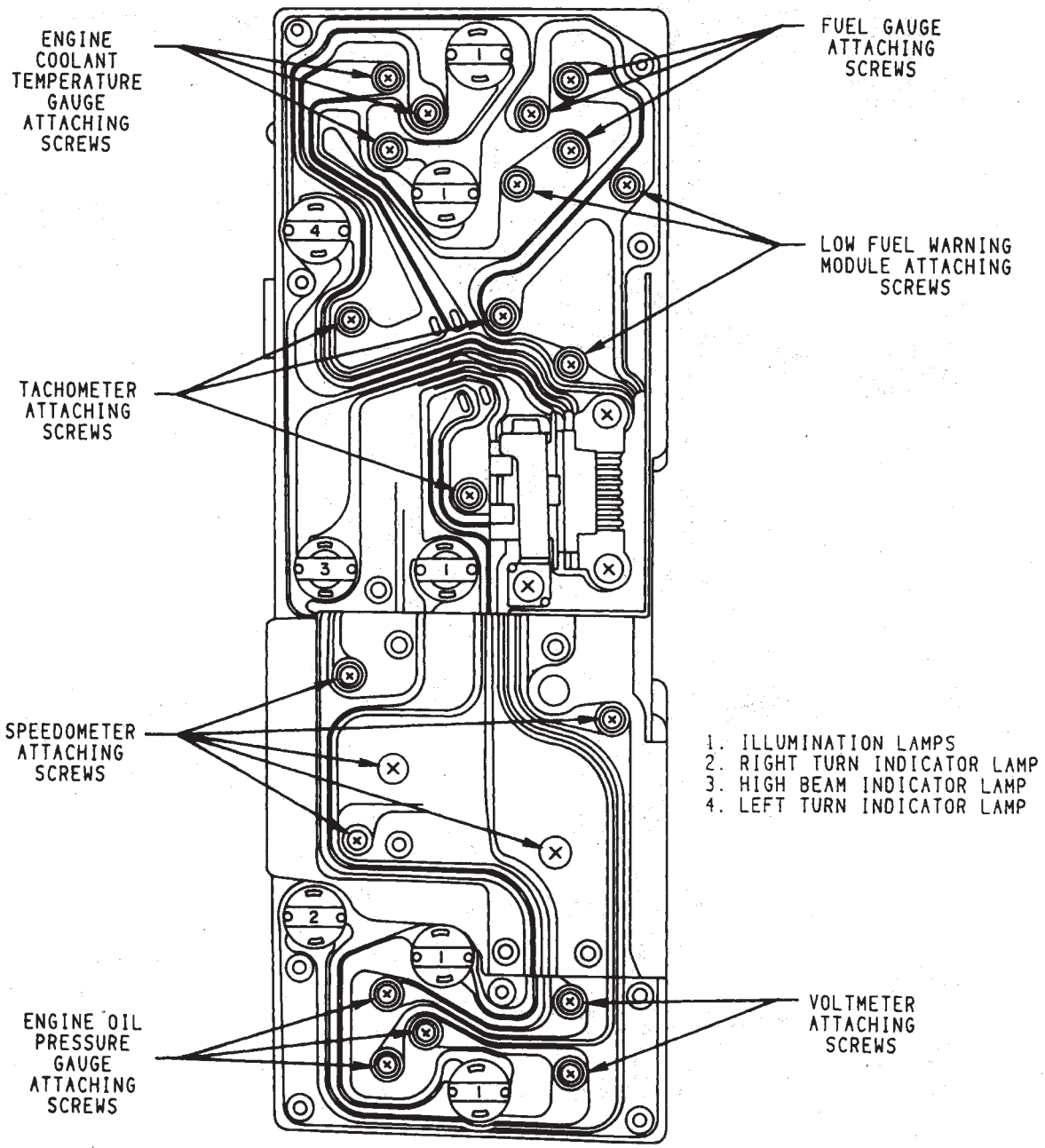
J948W-7



LO-LINE INSTRUMENT CLUSTER
PRINTED CIRCUIT BOARD

J948W-7

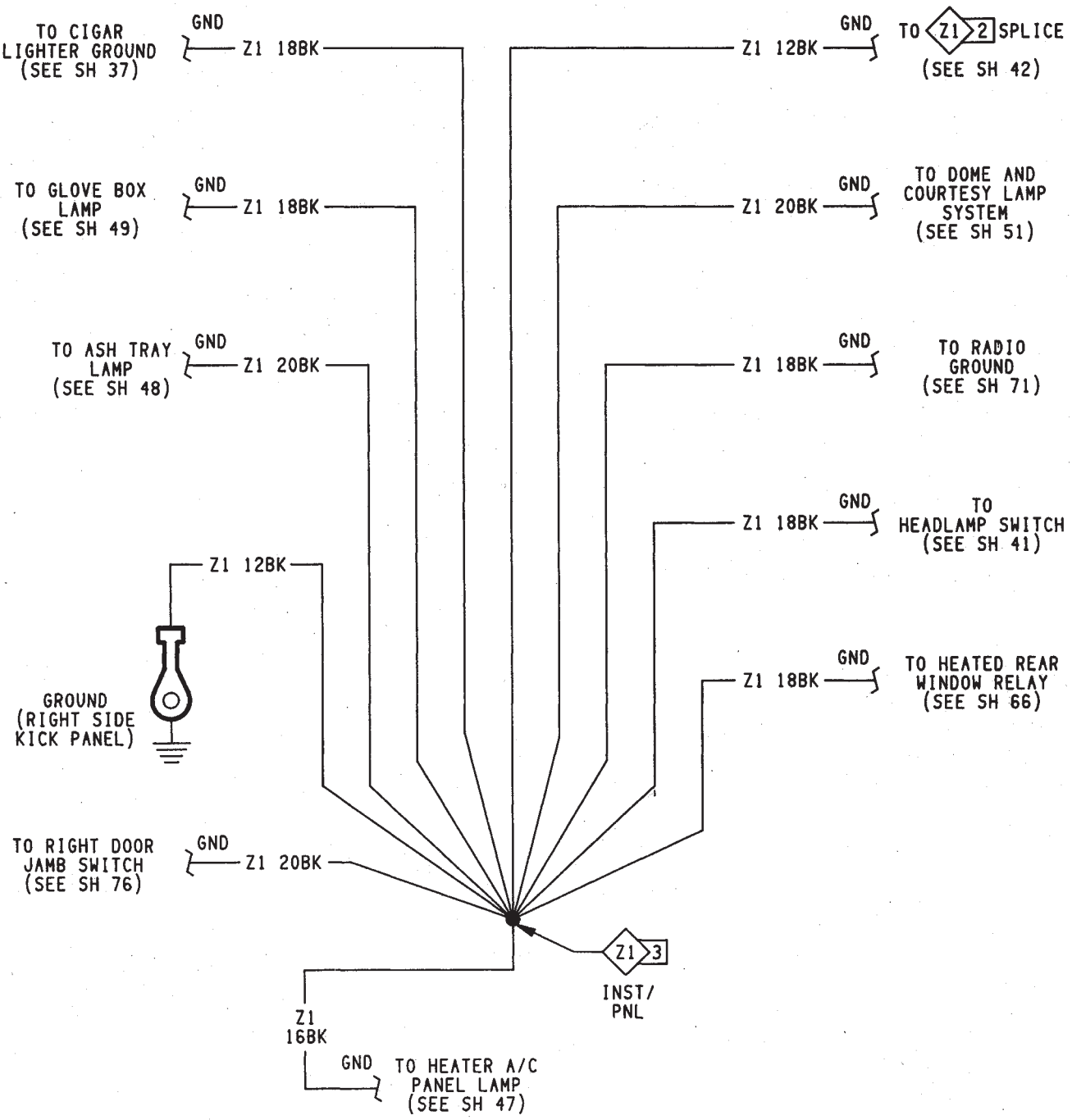
XJ 60



HI-LINE INSTRUMENT CLUSTER
PRINTED CIRCUIT BOARD

XJ 61

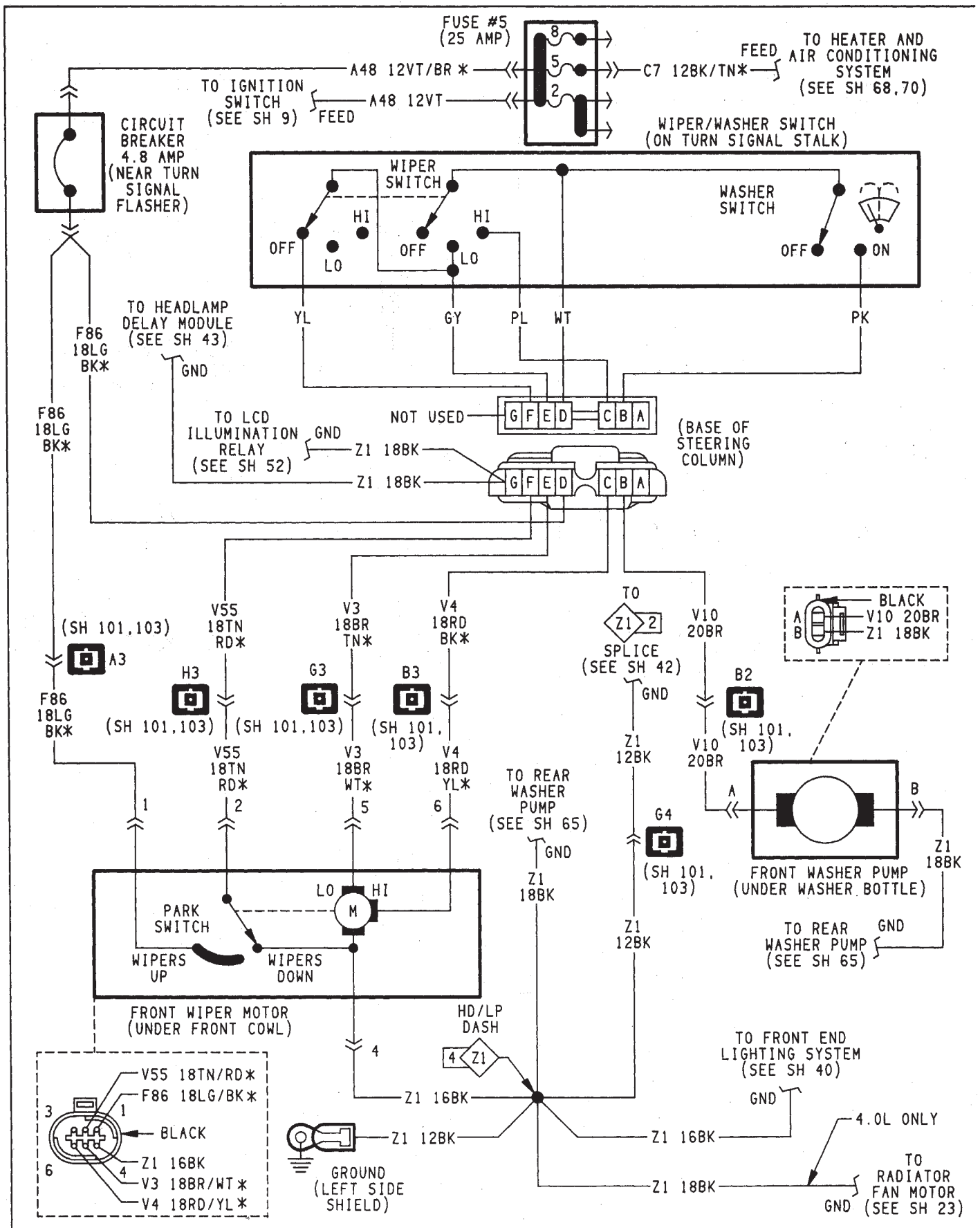
J948W-7



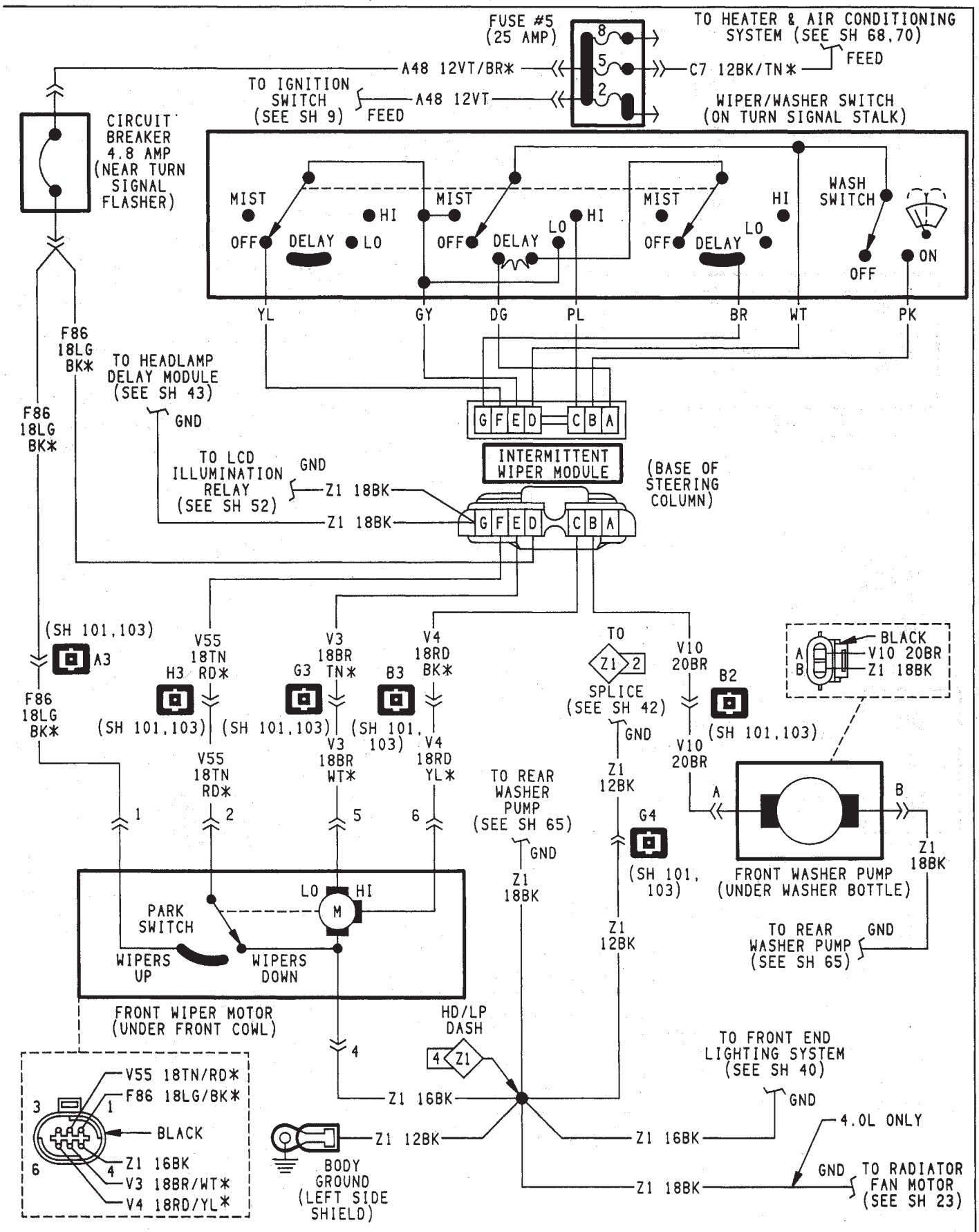
J948W-7

INSTRUMENT PANEL GROUND

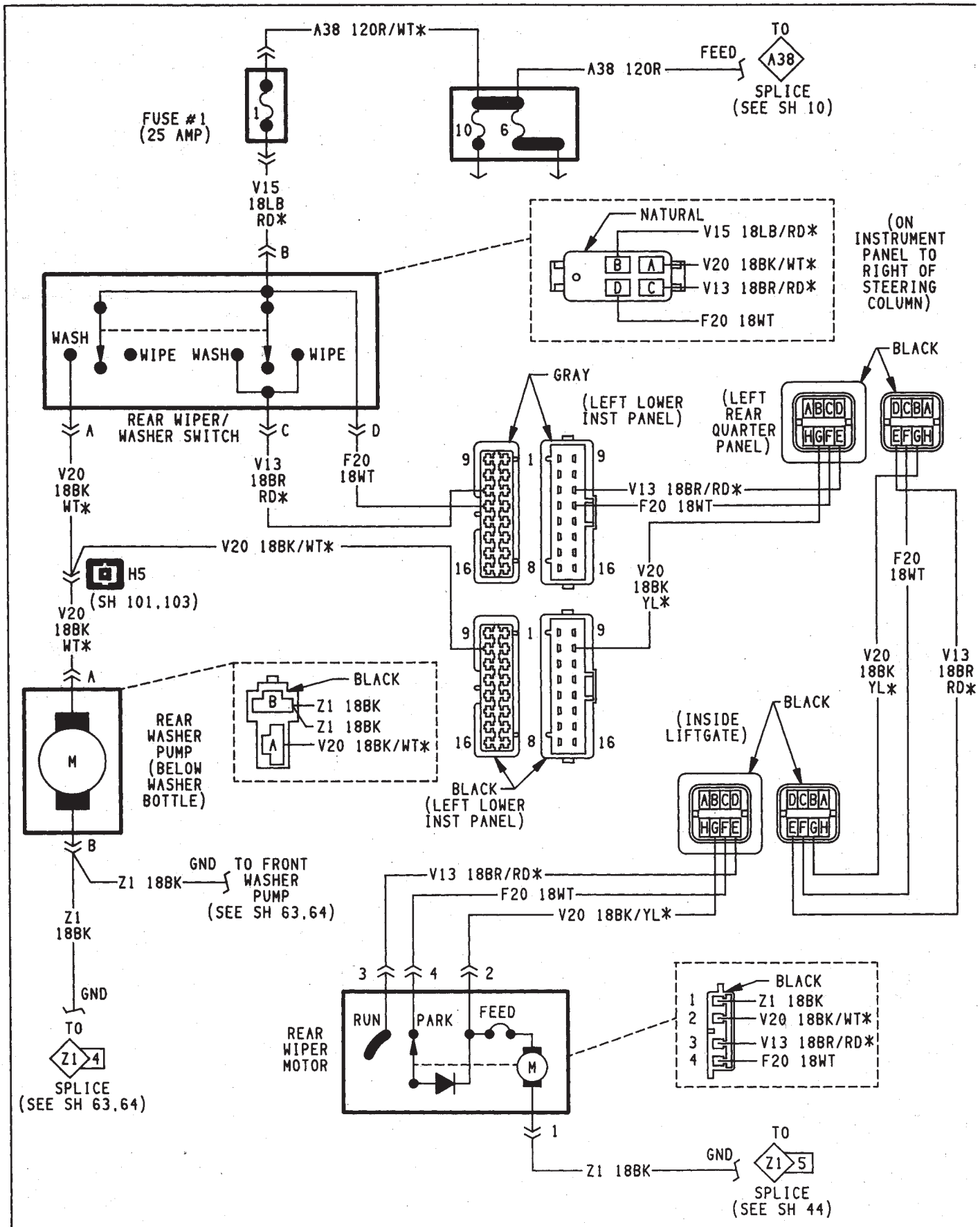
XJ 62



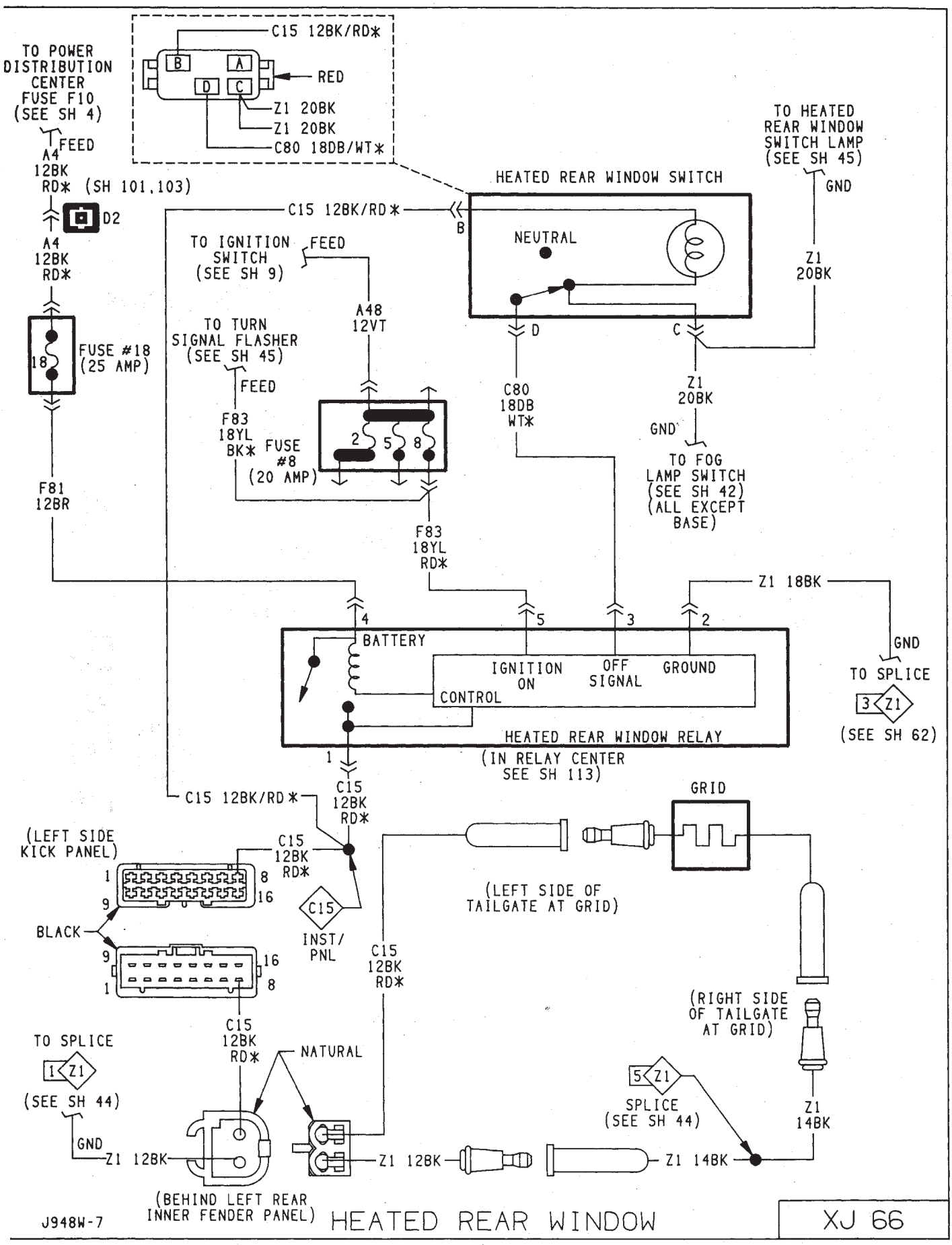
XJ 63 FRONT WIPERS/WASHER (STANDARD) J948W-7

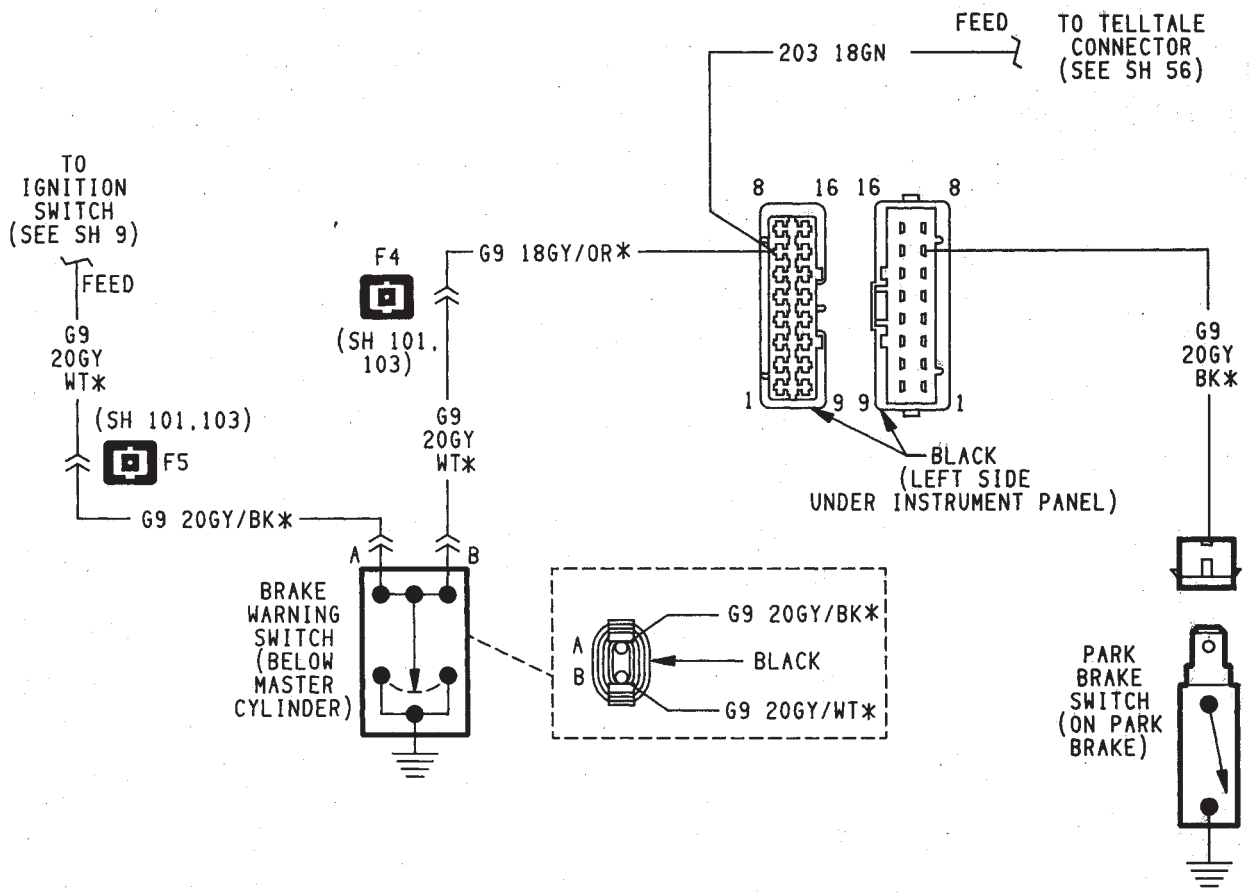


J948W-7 FRONT WIPERS/WASHER (INTERMITTENT) XJ 64



XJ 65 REAR WIPER/WASHER J948W-7

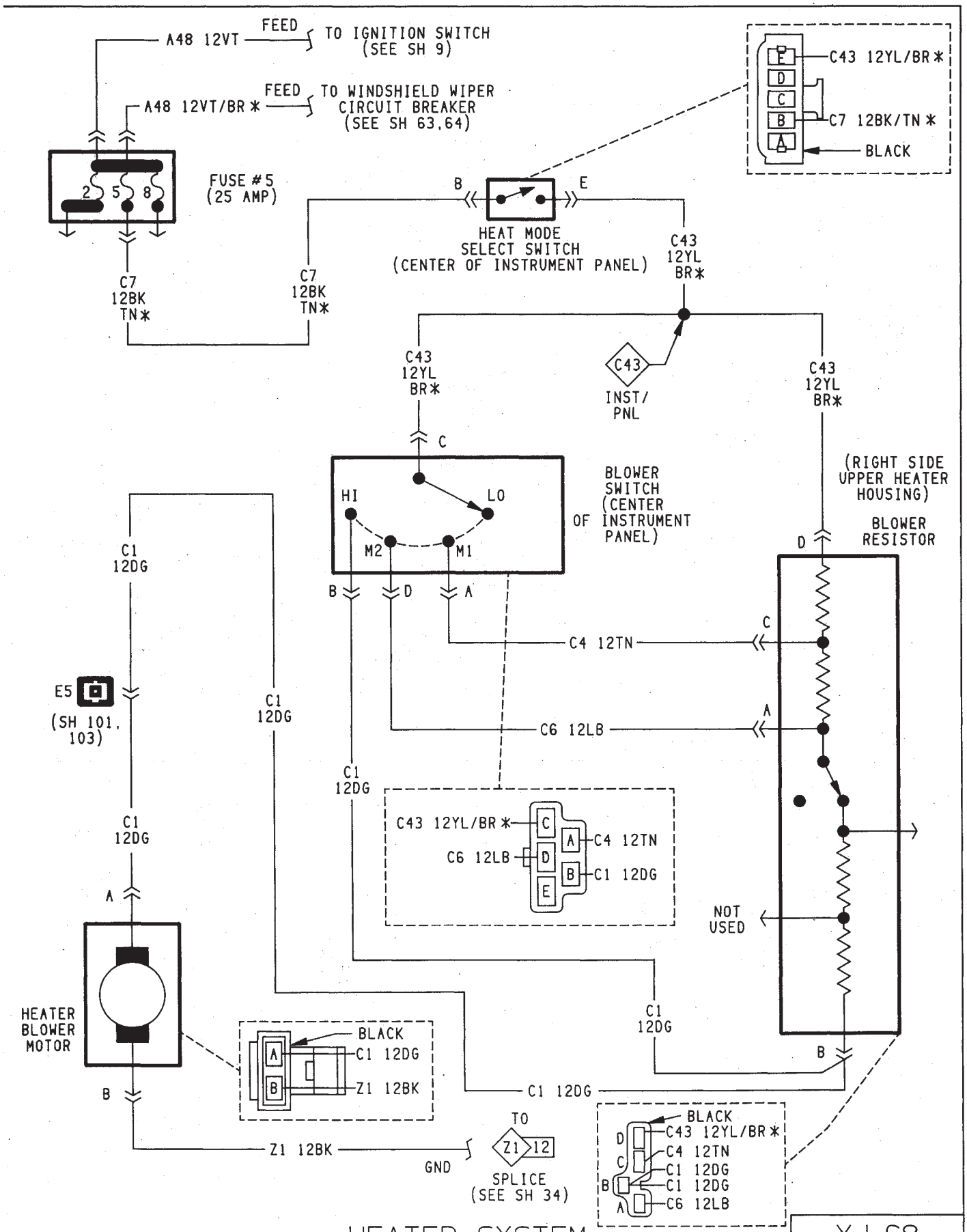

C15 12BK/RD*
B
A
D
C
RED
Z1 20BK
Z1 20BK
C80 18DB/WT*
TO POWER DISTRIBUTION CENTER FUSE F10 (SEE SH 4)
FEED
A4 12BK RD* (SH 101,103)
D2
A4 12BK RD*
FUSE #18 (25 AMP)
F81 12BR
HEATED REAR WINDOW SWITCH
NEUTRAL
TO HEATED REAR WINDOW SWITCH LAMP (SEE SH 45)
GND
Z1 20BK
C15 12BK/RD*
TO IGNITION SWITCH (SEE SH 9)
FEED
A48 12VT
TO TURN SIGNAL FLASHER (SEE SH 45)
FEED
F83 18YL BK* FUSE #8 (20 AMP)
2 5 8
F83 18YL RD*
C80 18DB WT*
Z1 20BK
GND
TO FOG LAMP SWITCH (SEE SH 42) (ALL EXCEPT BASE)
Z1 18BK
GND
TO SPLICE
3 Z1
(SEE SH 62)
4 5 3 2
BATTERY
IGNITION ON
OFF SIGNAL
GROUND
CONTROL
HEATED REAR WINDOW RELAY
(IN RELAY CENTER SEE SH 113)
1
C15 12BK RD*
C15 12BK/RD*
GRID
(LEFT SIDE KICK PANEL)
C15 12BK RD*
1 8 9 16
BLACK
9 16 1 8
C15
INST/ PNL
(LEFT SIDE OF TAILGATE AT GRID)
C15 12BK RD*
(RIGHT SIDE OF TAILGATE AT GRID)
TO SPLICE
1 Z1
(SEE SH 44)
GND
Z1 12BK
C15 12BK RD*
NATURAL
5 Z1
SPLICE (SEE SH 44)
Z1 14BK
Z1 12BK
Z1 12BK
Z1 14BK
(BEHIND LEFT REAR INNER FENDER PANEL)
J948W-7
HEATED REAR WINDOW
XJ 66



XJ 67

PARKING BRAKE SWITCH

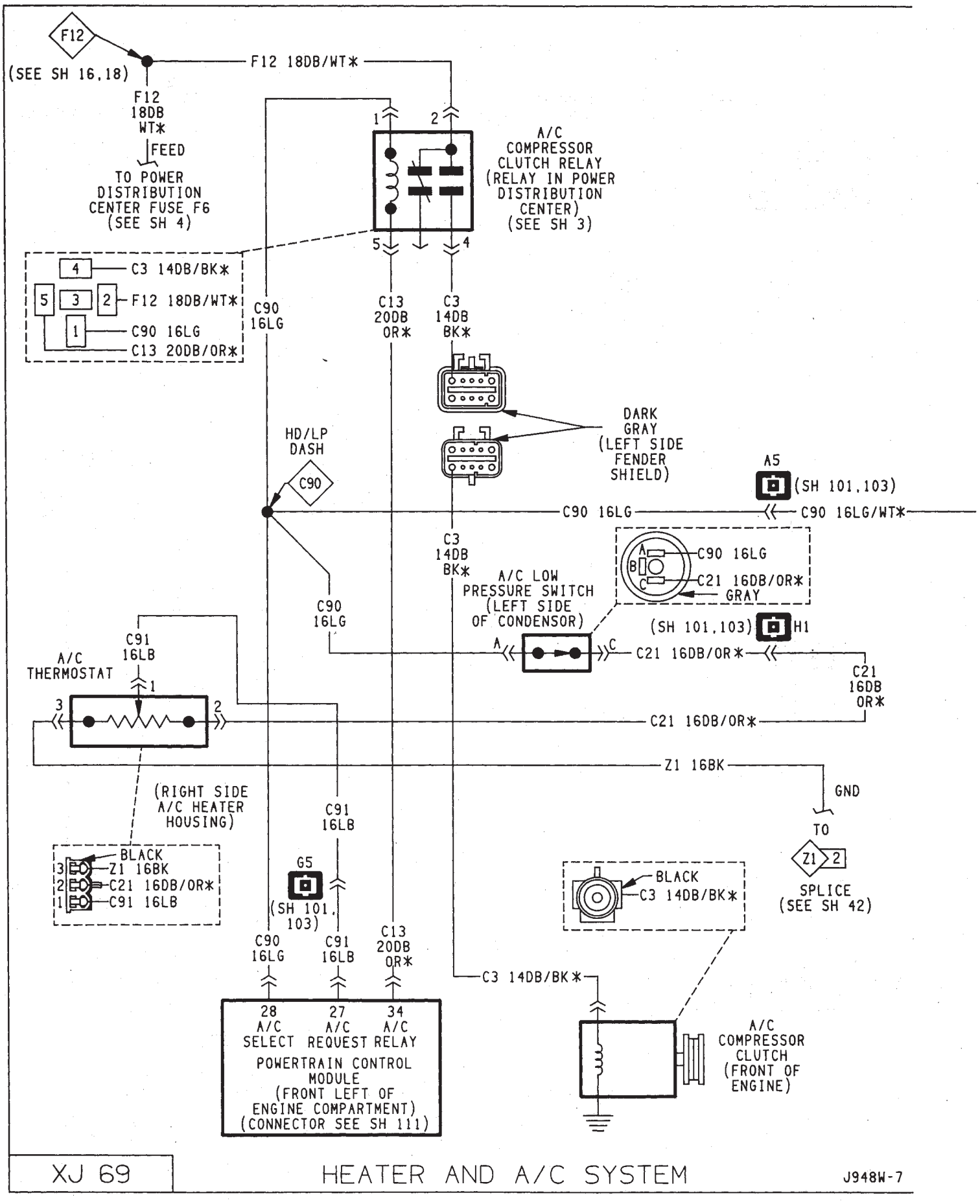
J948W-7



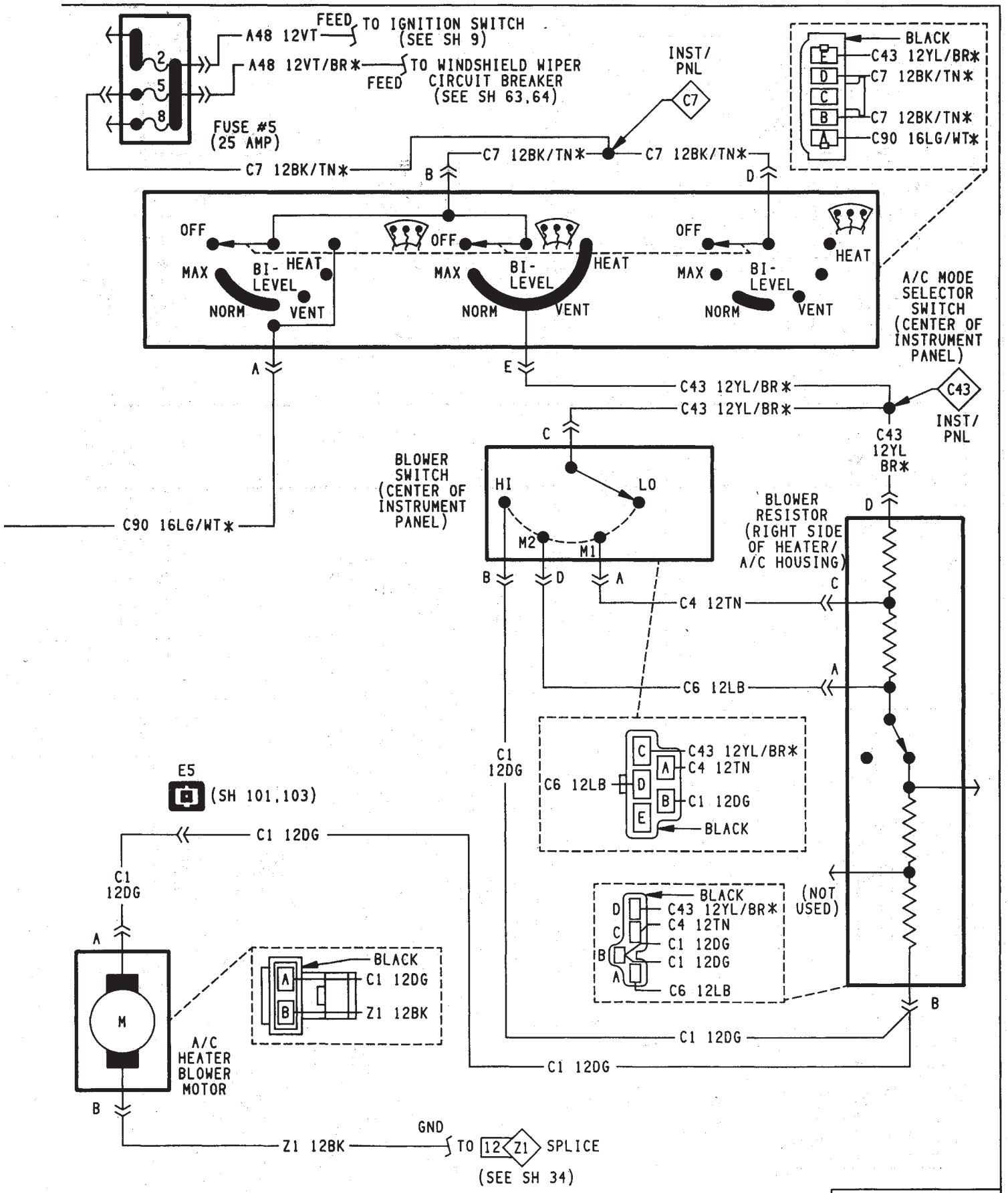
J948W-7

HEATER SYSTEM

XJ 68



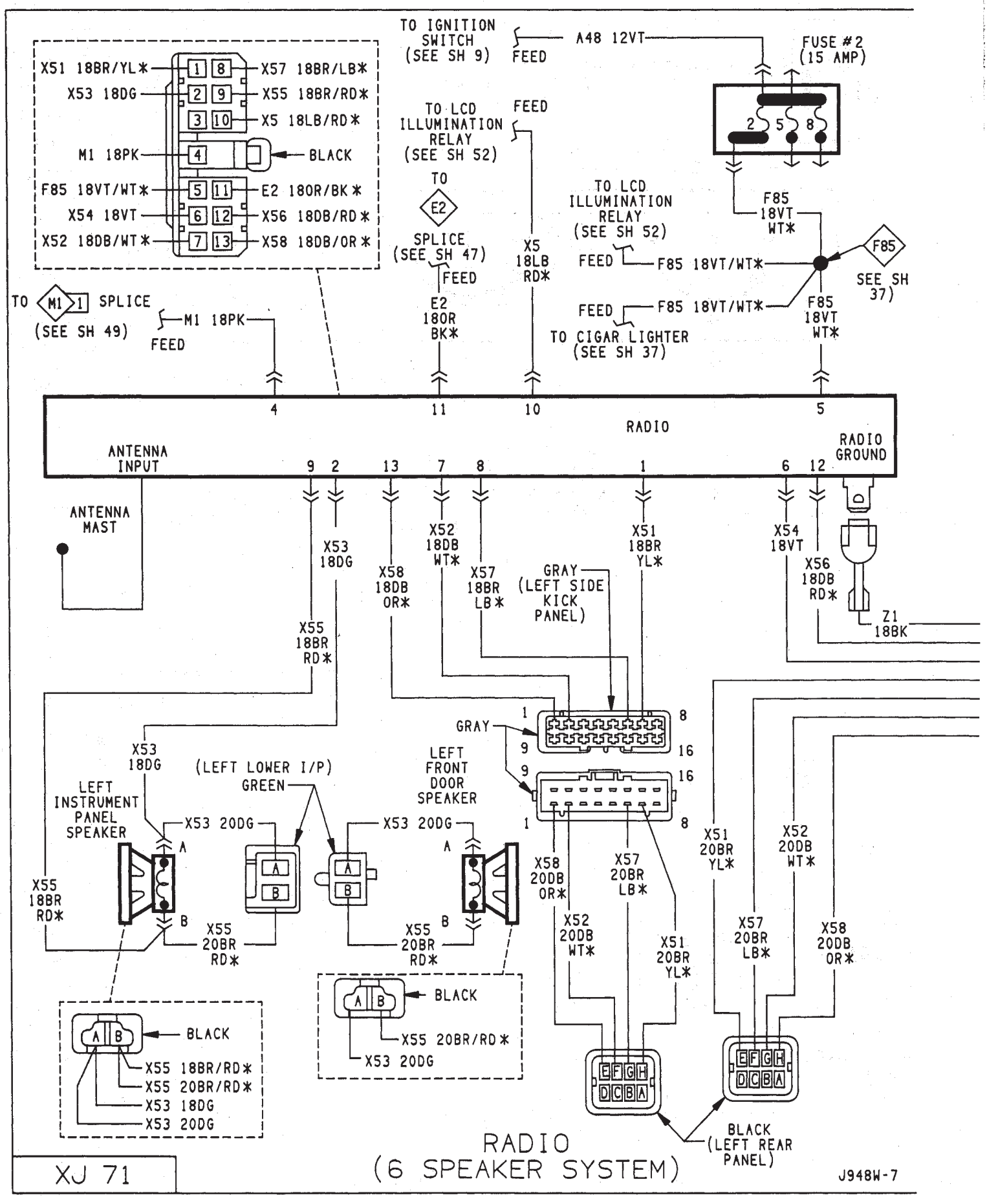
XJ 69 HEATER AND A/C SYSTEM J948W-7

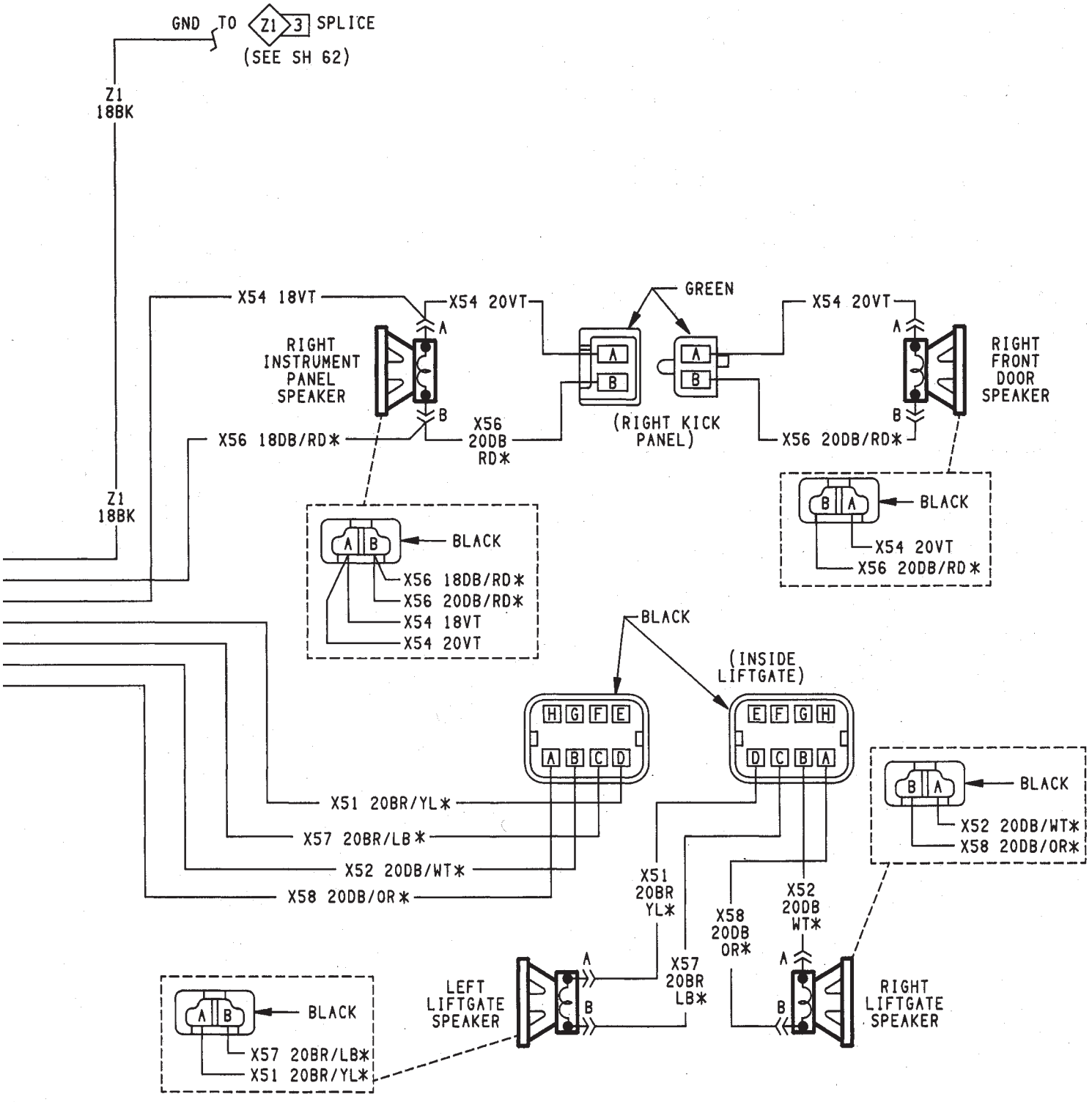


J948W-7

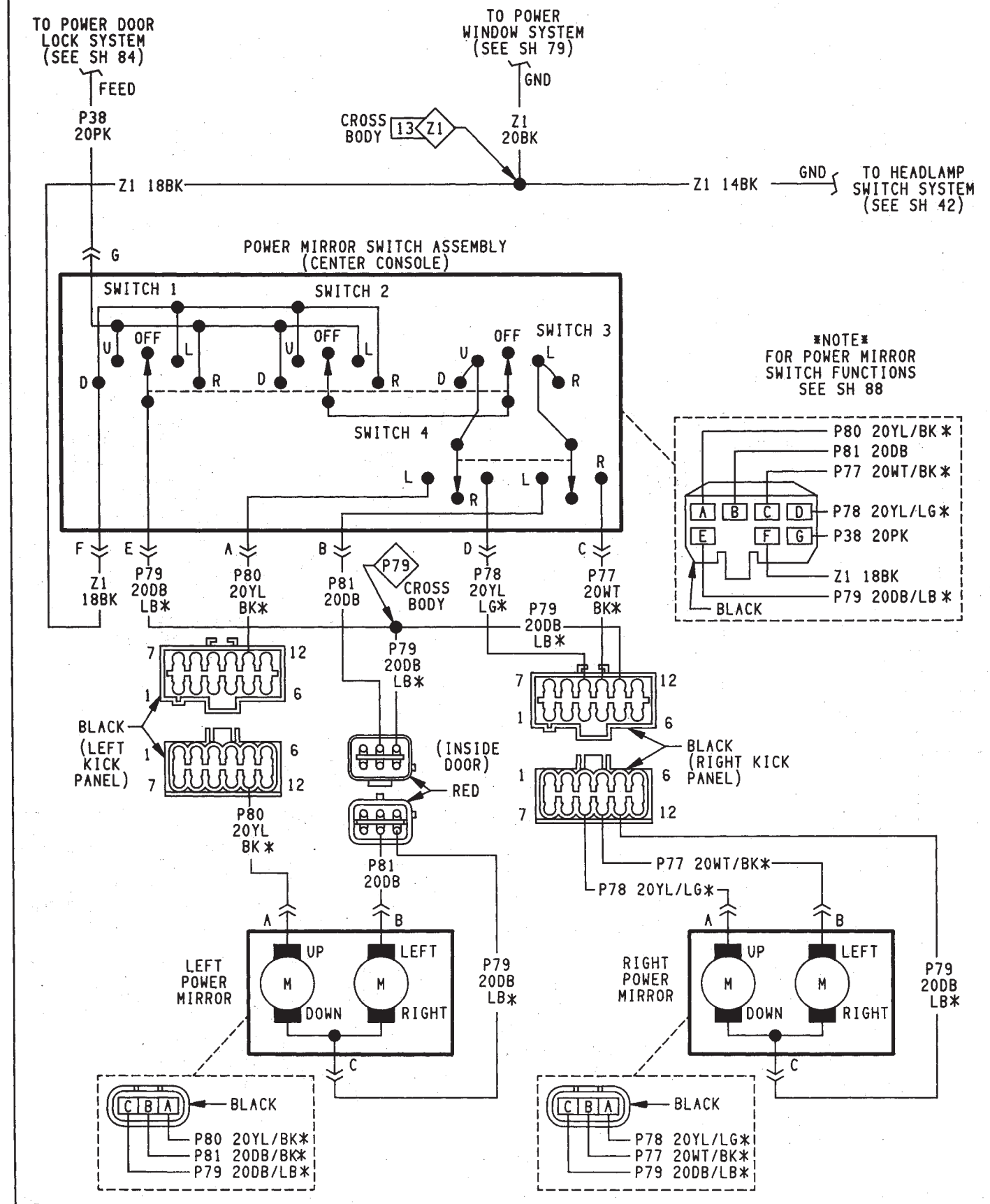
HEATER AND A/C SYSTEM

XJ 70

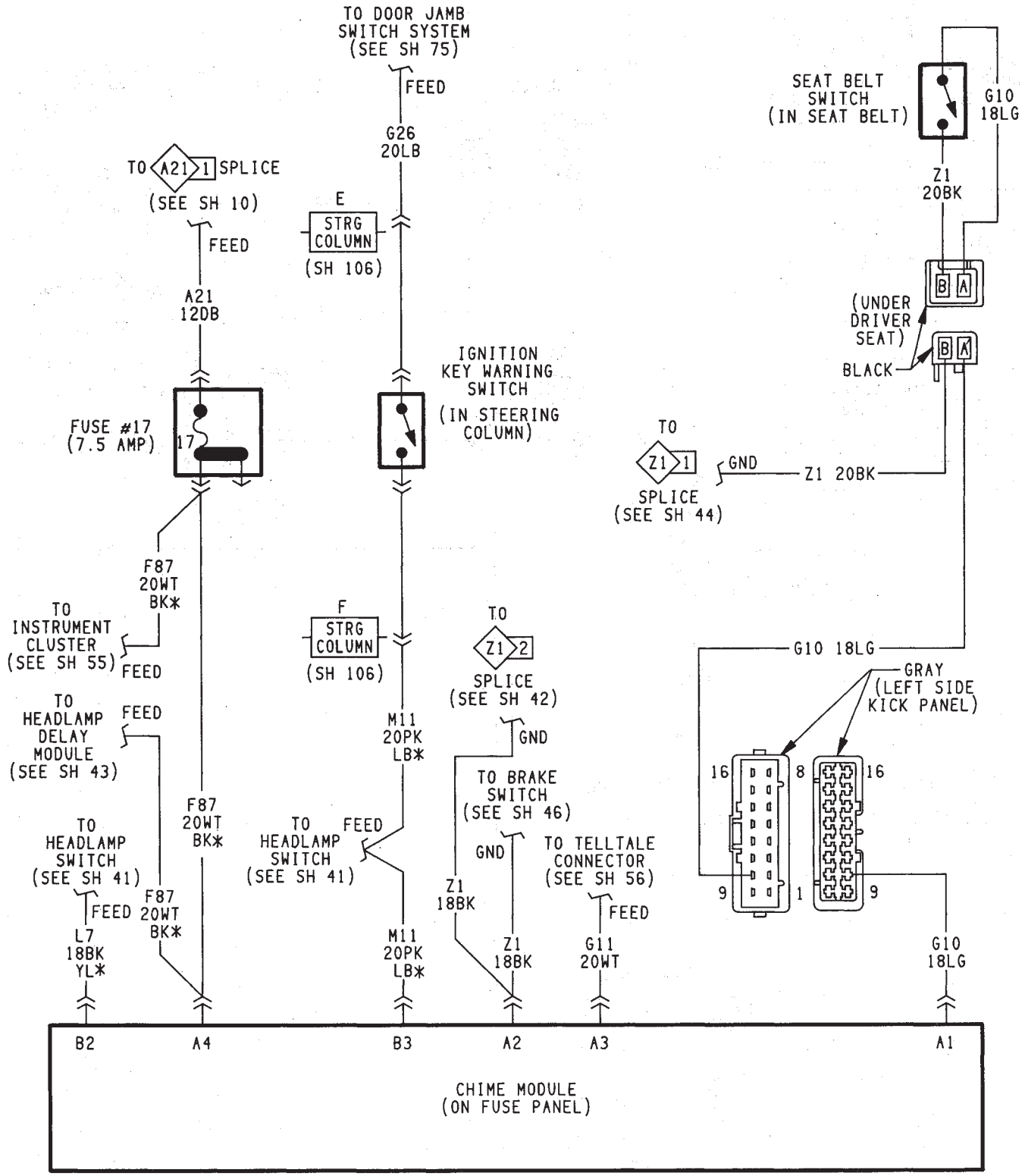

TO IGNITION SWITCH (SEE SH 9)
FEED
A48 12VT
FUSE #2 (15 AMP)
X51 18BR/YL*
X53 18DG
M1 18PK
F85 18VT/WT*
X54 18VT
X52 18DB/WT*
X57 18BR/LB*
X55 18BR/RD*
X5 18LB/RD*
BLACK
E2 18OR/BK*
X56 18DB/RD*
X58 18DB/OR*
TO LCD ILLUMINATION RELAY (SEE SH 52)
FEED
TO E2 SPLICE (SEE SH 47)
FEED
E2 18OR BK*
X5 18LB RD*
TO LCD ILLUMINATION RELAY (SEE SH 52)
FEED
F85 18VT/WT*
F85 18VT WT*
F85 SEE SH 37)
TO M1 1 SPLICE (SEE SH 49)
M1 18PK
FEED
FEED
F85 18VT/WT*
TO CIGAR LIGHTER (SEE SH 37)
F85 18VT WT*
4
11
10
5
RADIO
ANTENNA INPUT
RADIO GROUND
9 2 13 7 8 1 6 12
ANTENNA MAST
X53 18DG
X58 18DB OR*
X52 18DB WT*
X57 18BR LB*
GRAY (LEFT SIDE KICK PANEL)
X51 18BR YL*
X54 18VT
X56 18DB RD*
Z1 18BK
X55 18BR RD*
GRAY
1 8
9 16
9 16
1 8
X53 18DG
(LEFT LOWER I/P)
GREEN
LEFT FRONT DOOR SPEAKER
LEFT INSTRUMENT PANEL SPEAKER
X53 20DG
X53 20DG
A
B
X55 18BR RD*
X55 20BR RD*
X55 20BR RD*
X58 20DB OR*
X57 20BR LB*
X52 20DB WT*
X51 20BR YL*
X51 20BR YL*
X52 20DB WT*
X57 20BR LB*
X58 20DB OR*
BLACK
X55 18BR/RD*
X55 20BR/RD*
X53 18DG
X53 20DG
BLACK
X55 20BR/RD*
X53 20DG
E F G H
D C B A
BLACK (LEFT REAR PANEL)
RADIO
(6 SPEAKER SYSTEM)
XJ 71
J948W-7



RADIO
(6 SPEAKER SYSTEM)



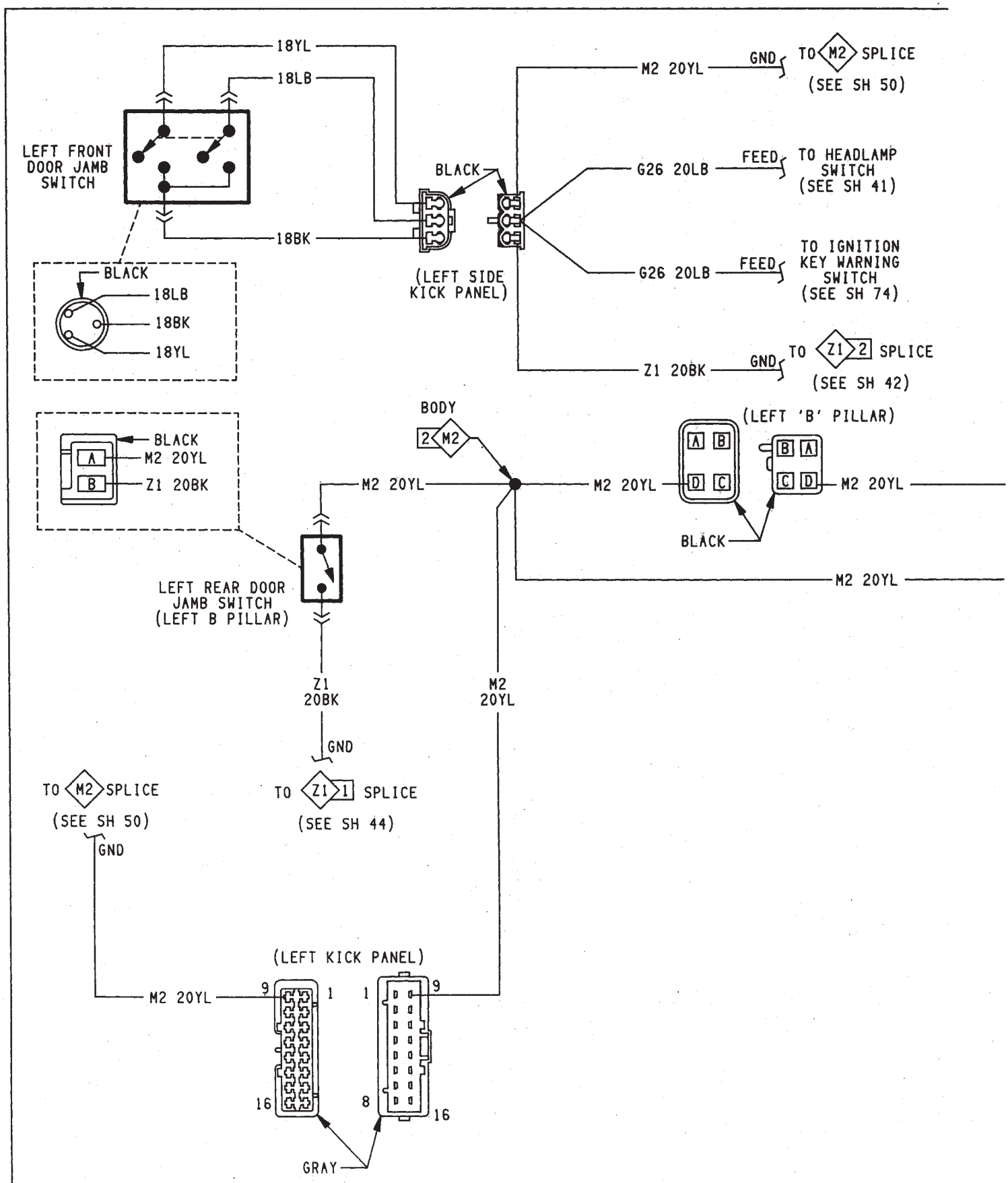
XJ 73 POWER MIRROR SYSTEM J948W-7



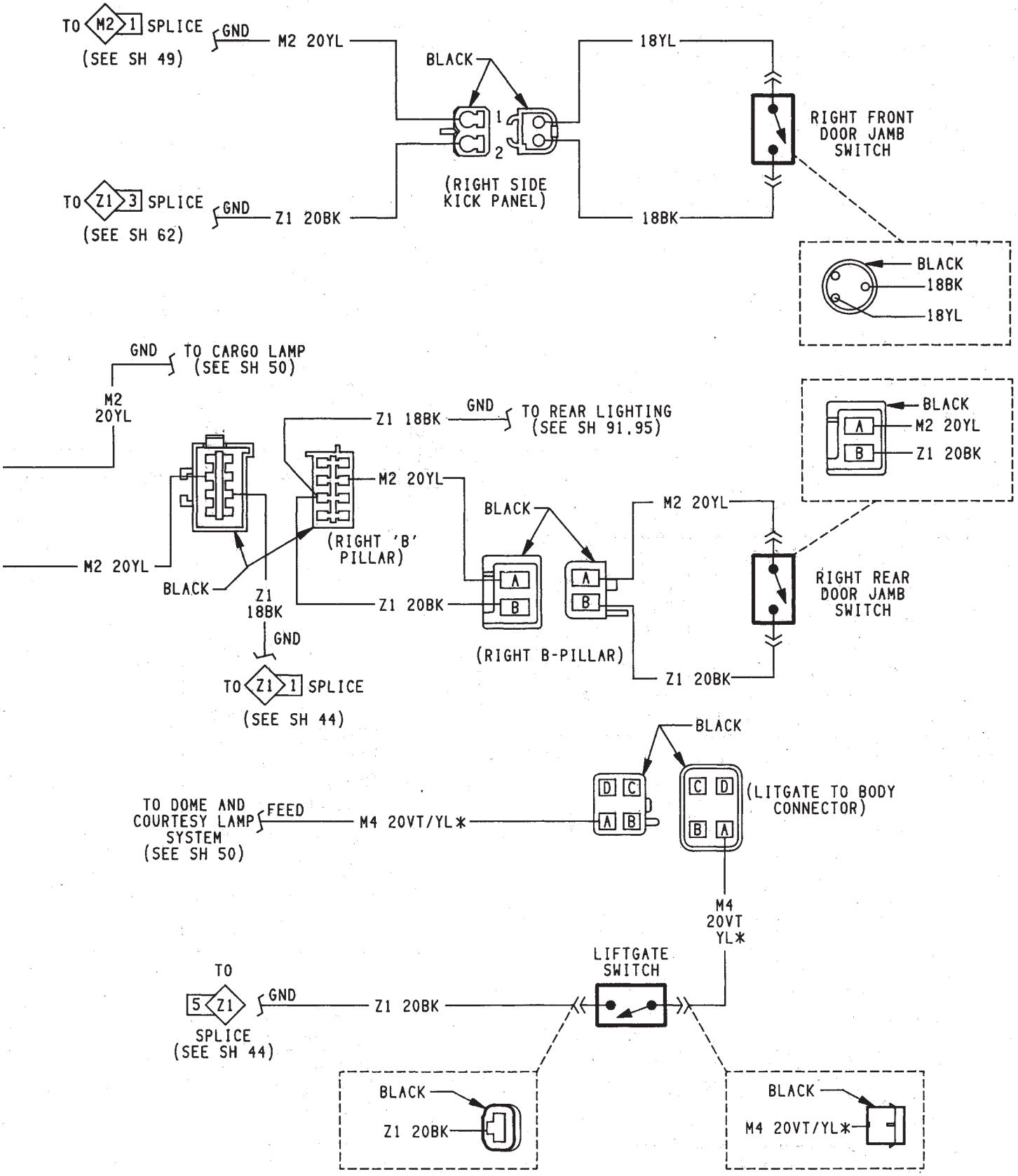
J948W-7

CHIME MODULE

XJ 74



XJ 75 DOOR JAMB SWITCH SYSTEM J948W-7

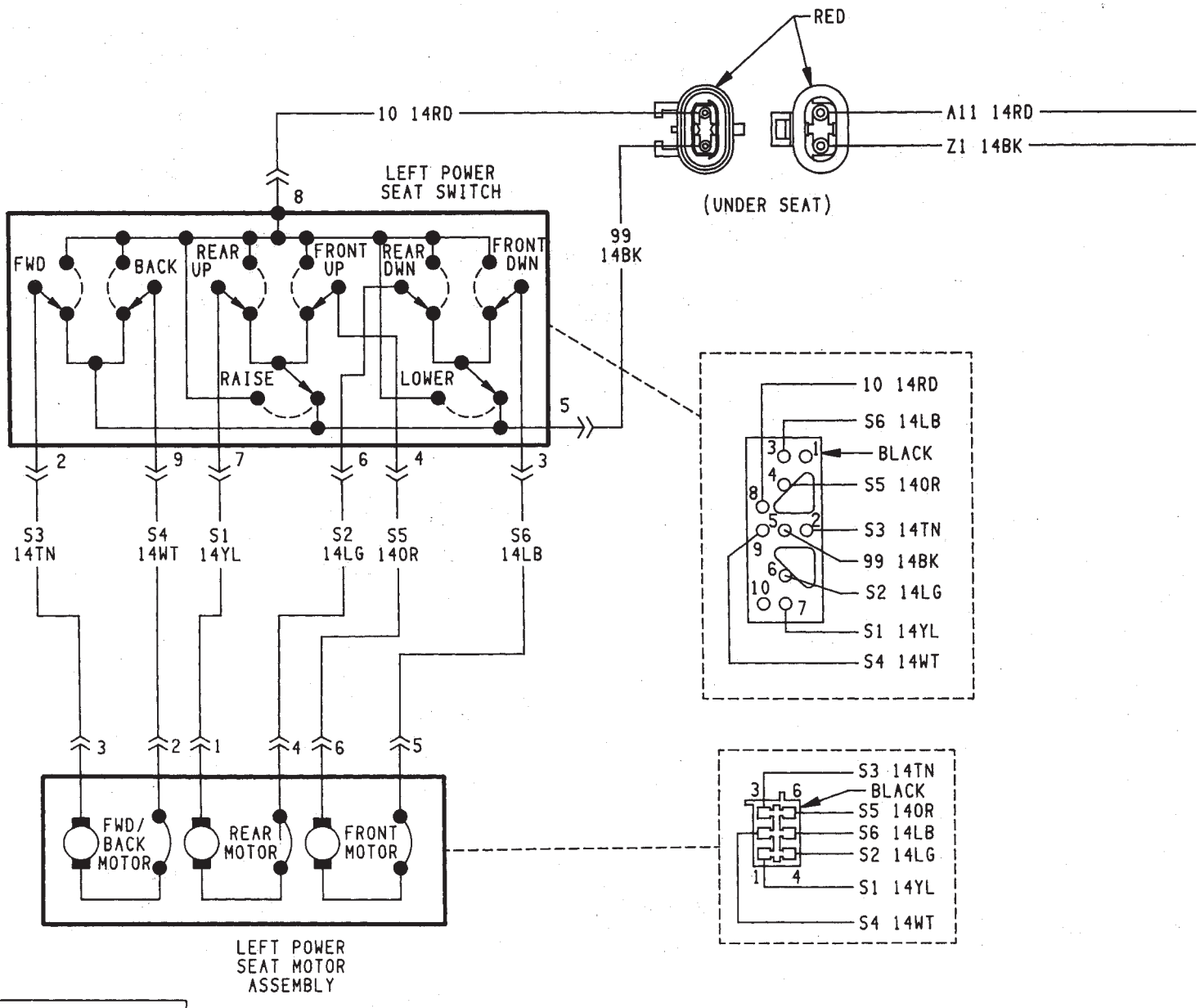


J948W-7

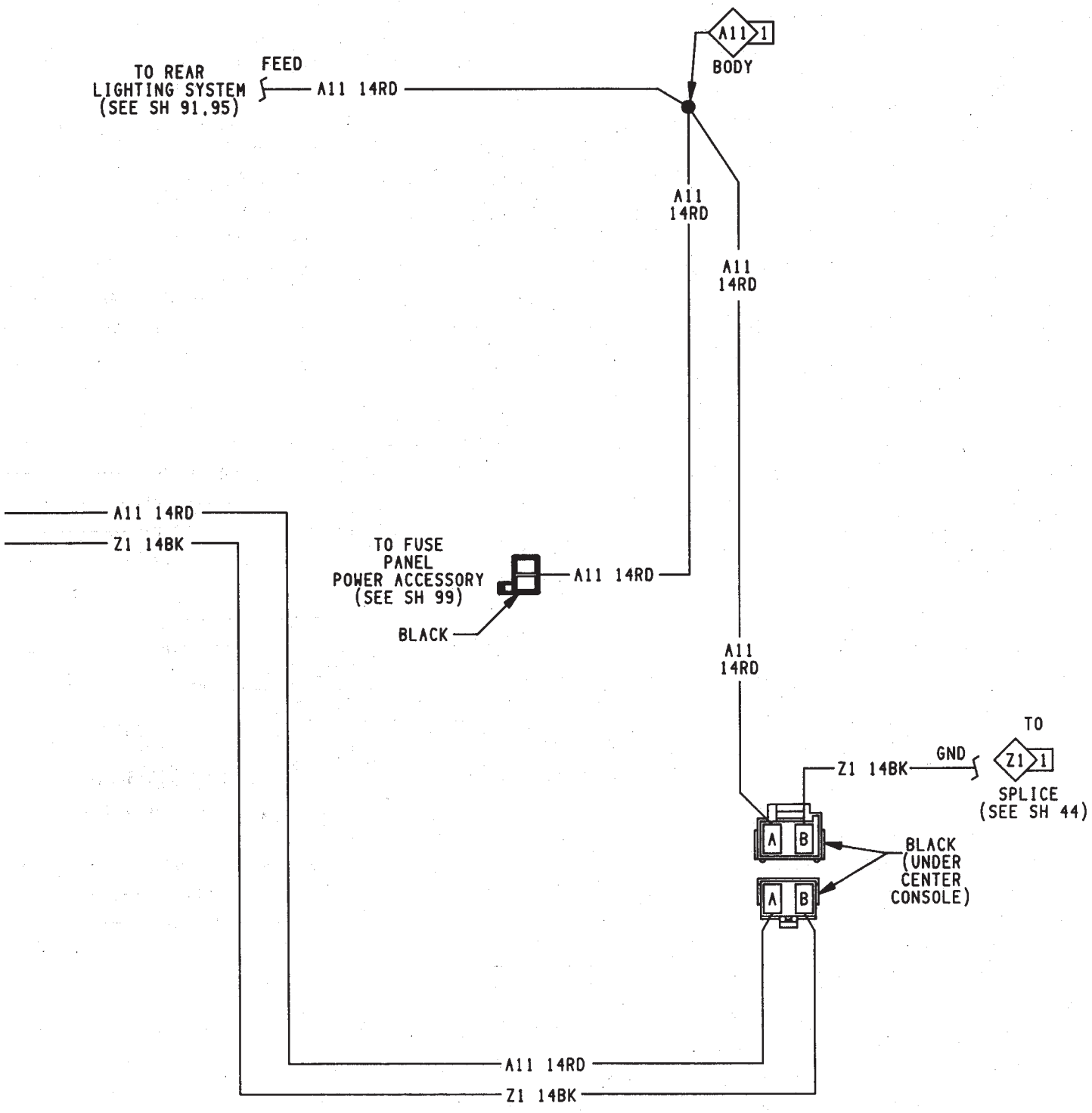
DOOR JAMB SWITCH SYSTEM

XJ 76

POWER SEAT MOTOR INSULATOR POLARITY		
B+ POLARITY	B− POLARITY	SEAT MOVEMENT
TN	WT	FORWARD
WT	TN	REARWARD
YL	LG	REAR UP
LG	YL	REAR DOWN
OR	LB	FRONT UP
LB	OR	FRONT DOWN
RD	—	FEED
—	BK	GROUND



XJ 77 POWER SEAT J948W-7


A11 1
BODY
TO REAR LIGHTING SYSTEM (SEE SH 91,95)
FEED
A11 14RD
A11 14RD
A11 14RD
A11 14RD
Z1 14BK
TO FUSE PANEL POWER ACCESSORY (SEE SH 99)
A11 14RD
BLACK
A11 14RD
TO
GND
Z1 14BK
Z1 1
SPLICE (SEE SH 44)
A
B
A
B
BLACK (UNDER CENTER CONSOLE)
A11 14RD
Z1 14BK

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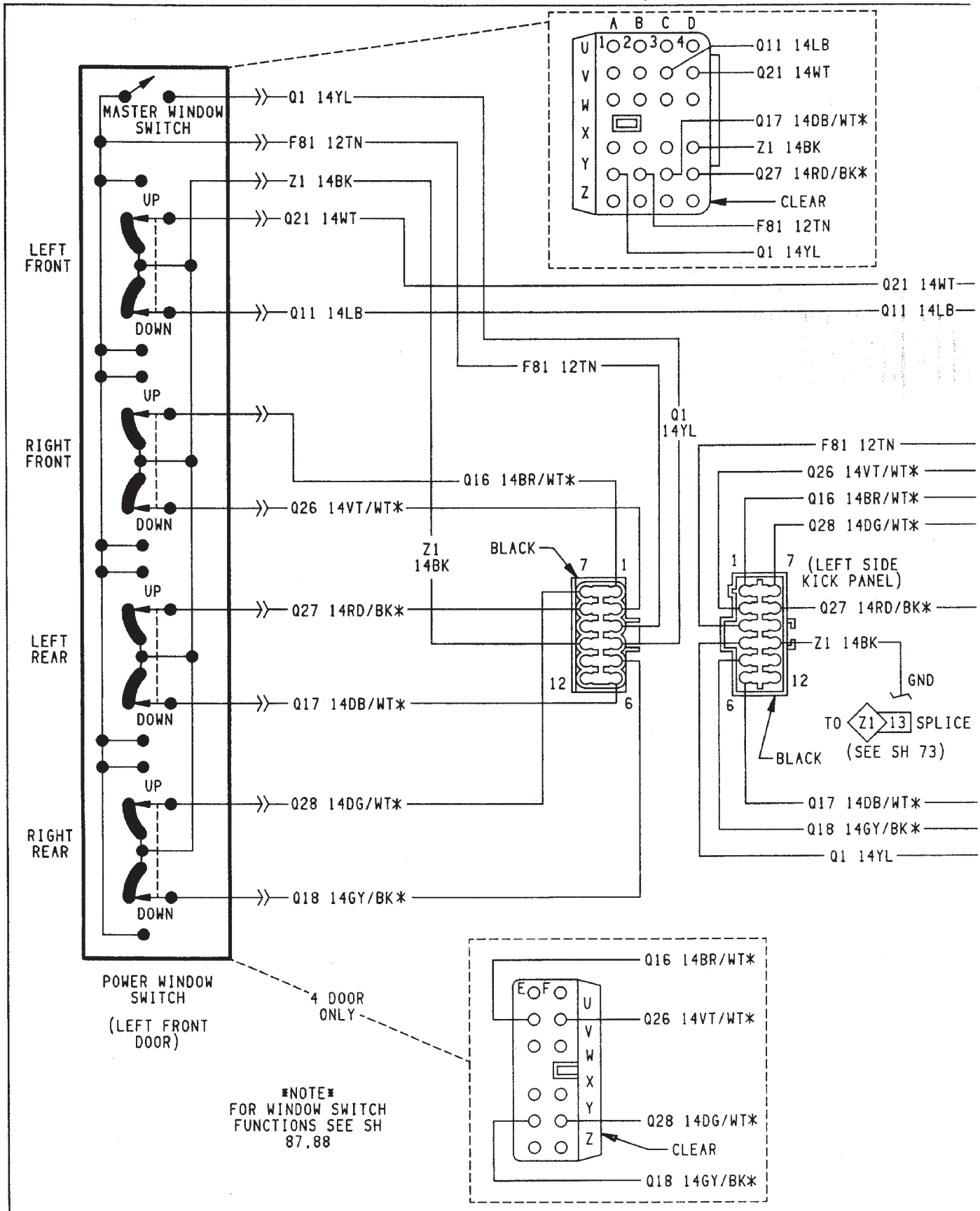
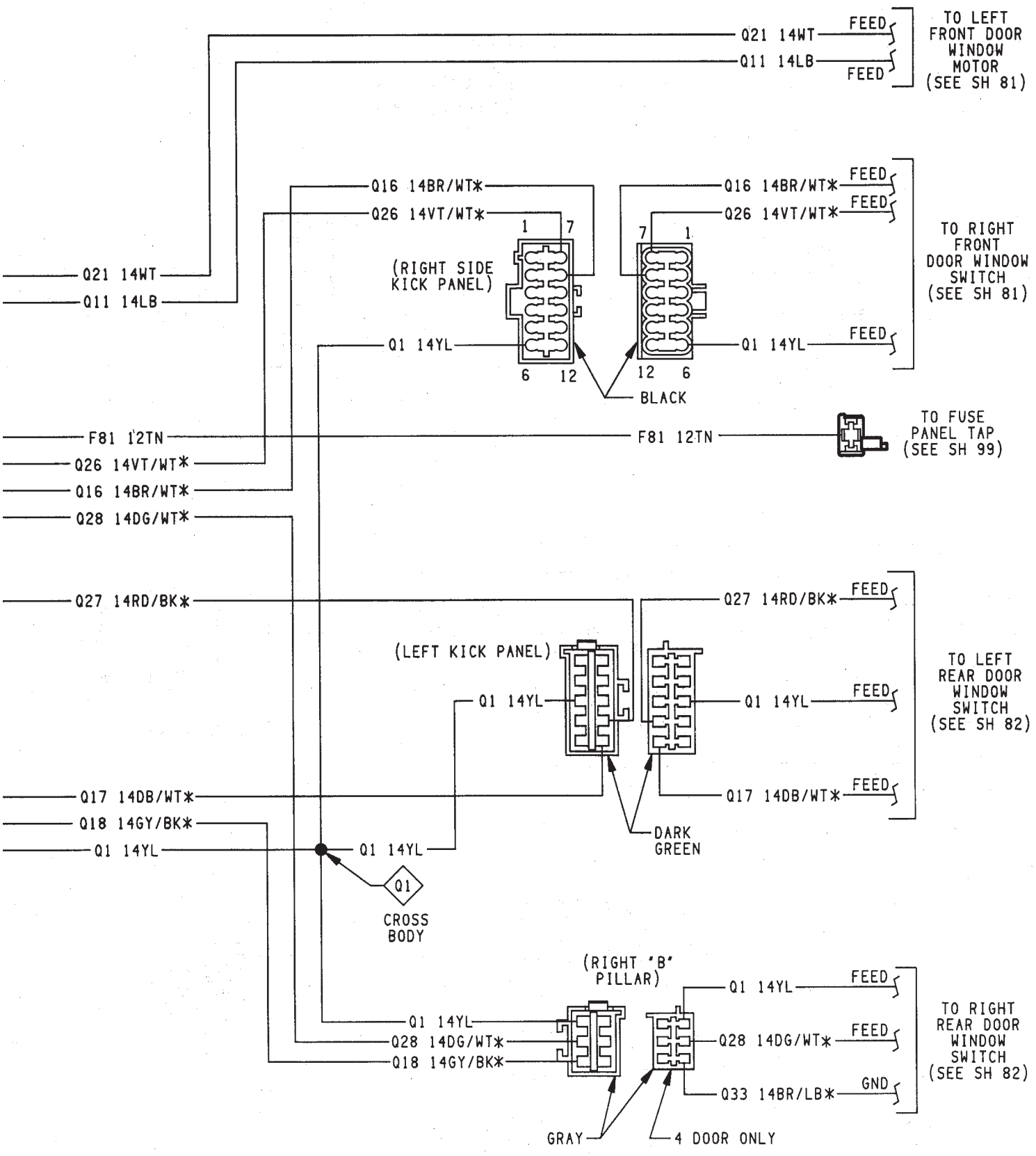
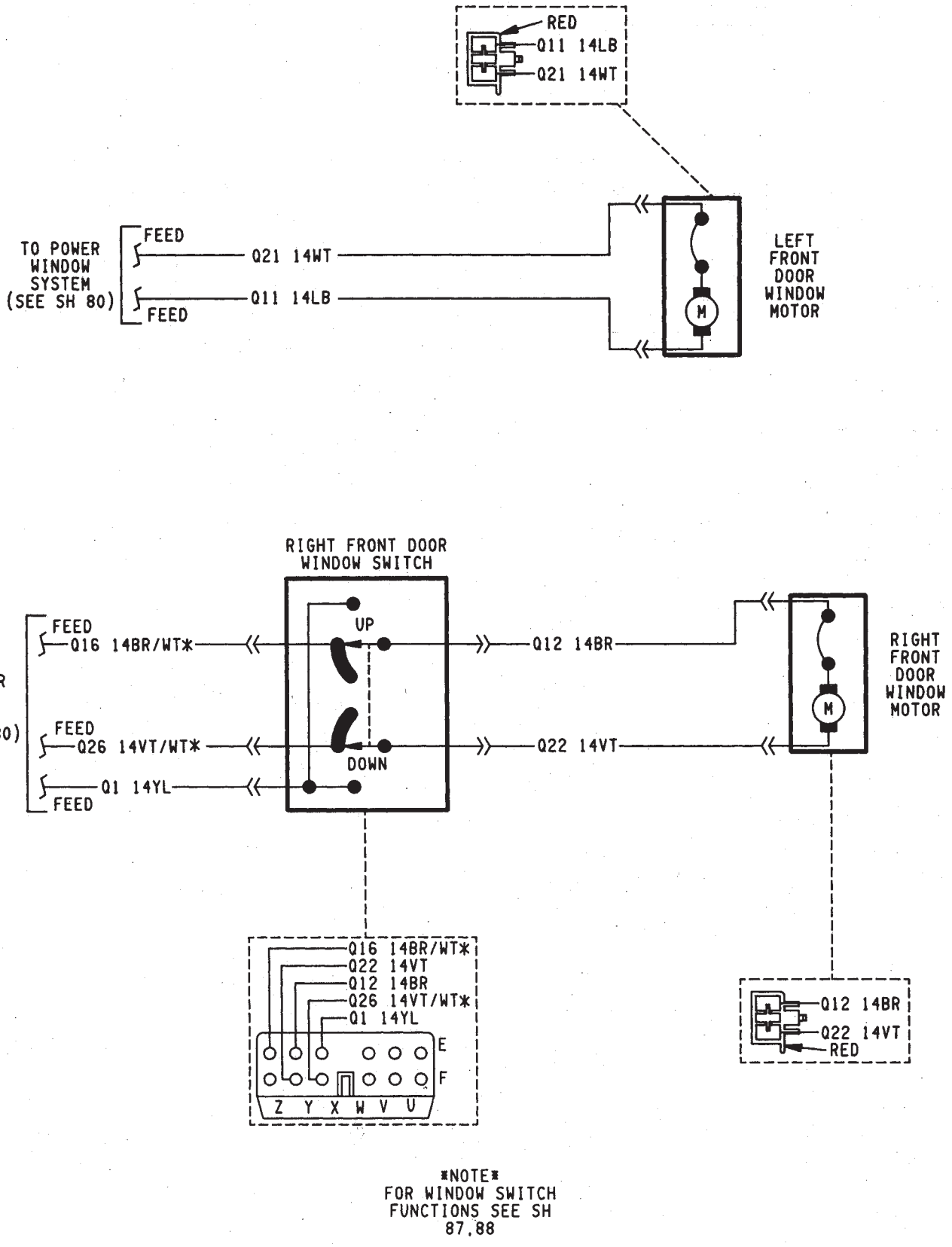
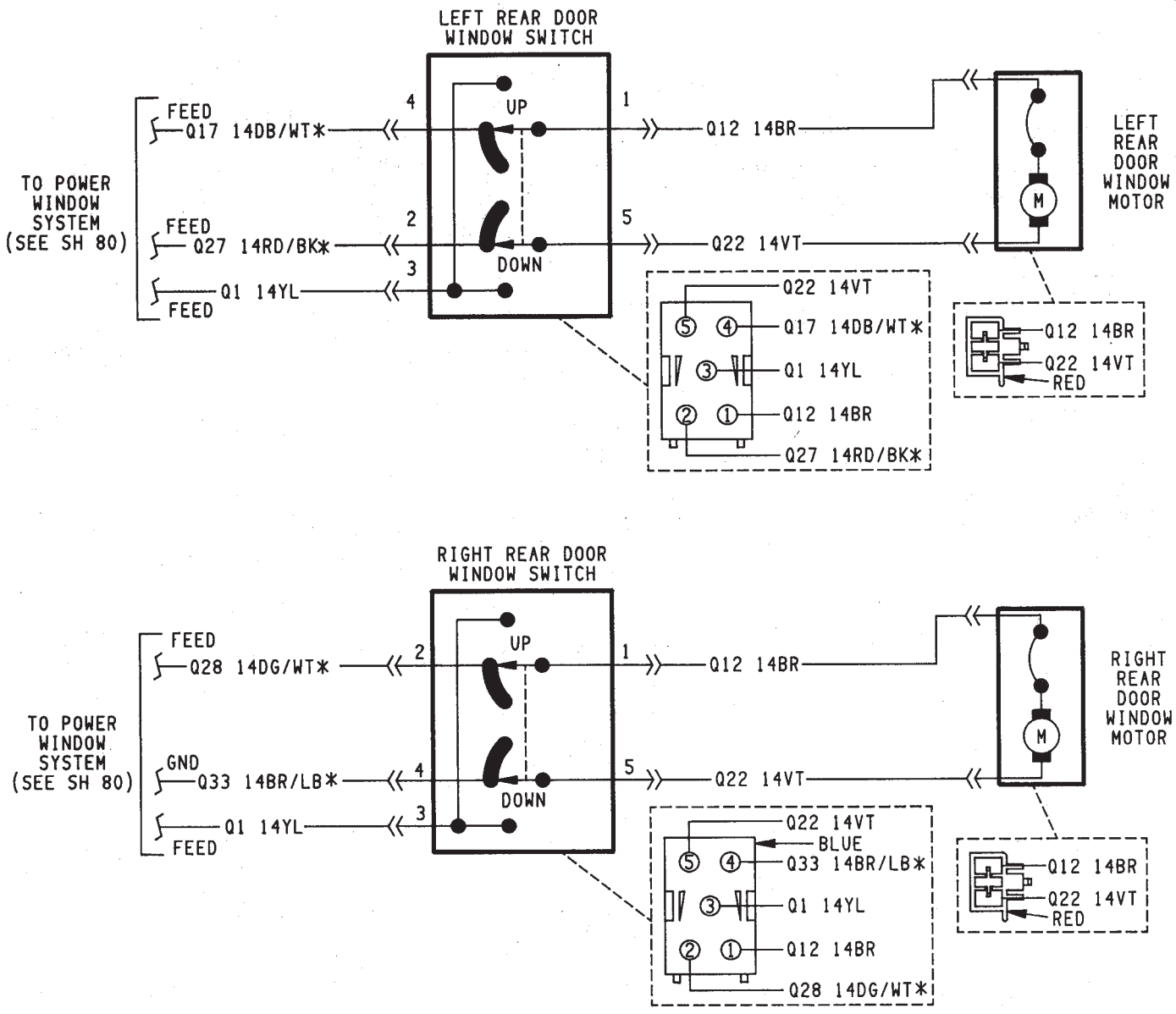



Q21 14WT
FEED
Q11 14LB
FEED
TO LEFT FRONT DOOR WINDOW MOTOR (SEE SH 81)
Q16 14BR/WT*
Q26 14VT/WT*
(RIGHT SIDE KICK PANEL)
1
7
6
12
Q1 14YL
BLACK
12
6
7
1
Q16 14BR/WT*
FEED
Q26 14VT/WT*
FEED
Q1 14YL
FEED
TO RIGHT FRONT DOOR WINDOW SWITCH (SEE SH 81)
F81 12TN
F81 12TN
TO FUSE PANEL TAP (SEE SH 99)
Q26 14VT/WT*
Q16 14BR/WT*
Q28 14DG/WT*
Q27 14RD/BK*
Q27 14RD/BK*
FEED
(LEFT KICK PANEL)
Q1 14YL
Q1 14YL
FEED
Q17 14DB/WT*
FEED
TO LEFT REAR DOOR WINDOW SWITCH (SEE SH 82)
Q17 14DB/WT*
Q18 14GY/BK*
Q1 14YL
Q1 14YL
DARK GREEN
Q1
CROSS BODY
(RIGHT 'B' PILLAR)
Q1 14YL
Q28 14DG/WT*
Q18 14GY/BK*
Q1 14YL
FEED
Q28 14DG/WT*
FEED
Q33 14BR/LB*
GND
TO RIGHT REAR DOOR WINDOW SWITCH (SEE SH 82)
GRAY
4 DOOR ONLY


RED
Q11 14LB
Q21 14WT
TO POWER WINDOW SYSTEM (SEE SH 80)
FEED
Q21 14WT
Q11 14LB
FEED
M
LEFT FRONT DOOR WINDOW MOTOR
RIGHT FRONT DOOR WINDOW SWITCH
TO POWER WINDOW SYSTEM (SEE SH 80)
FEED
Q16 14BR/WT*
FEED
Q26 14VT/WT*
Q1 14YL
FEED
UP
DOWN
Q12 14BR
Q22 14VT
M
RIGHT FRONT DOOR WINDOW MOTOR
Q16 14BR/WT*
Q22 14VT
Q12 14BR
Q26 14VT/WT*
Q1 14YL
E
F
Z Y X W V U
Q12 14BR
Q22 14VT
RED
NOTE
FOR WINDOW SWITCH FUNCTIONS SEE SH 87,88



NOTE
FOR WINDOW SWITCH FUNCTIONS SEE SH 87,88

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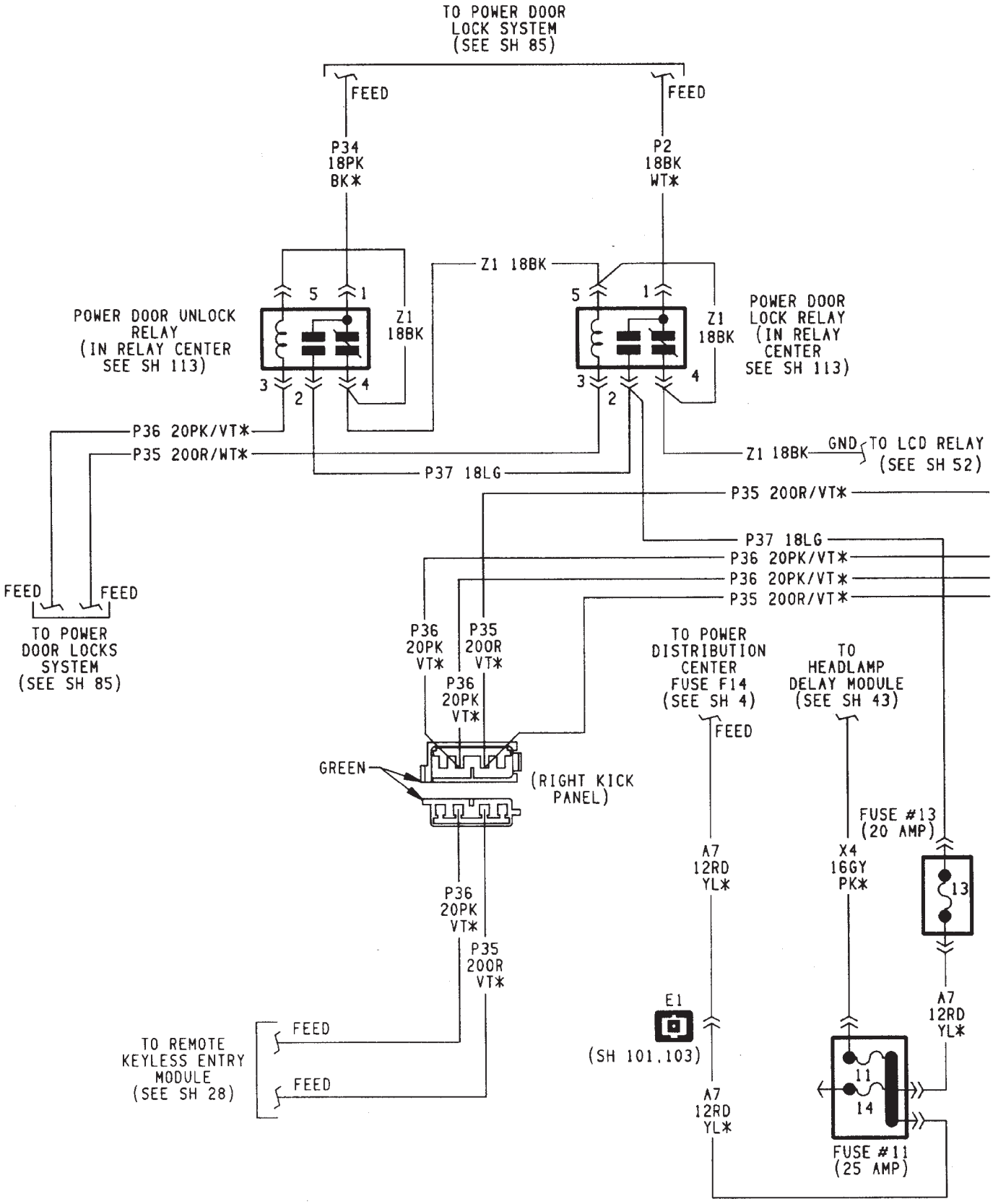
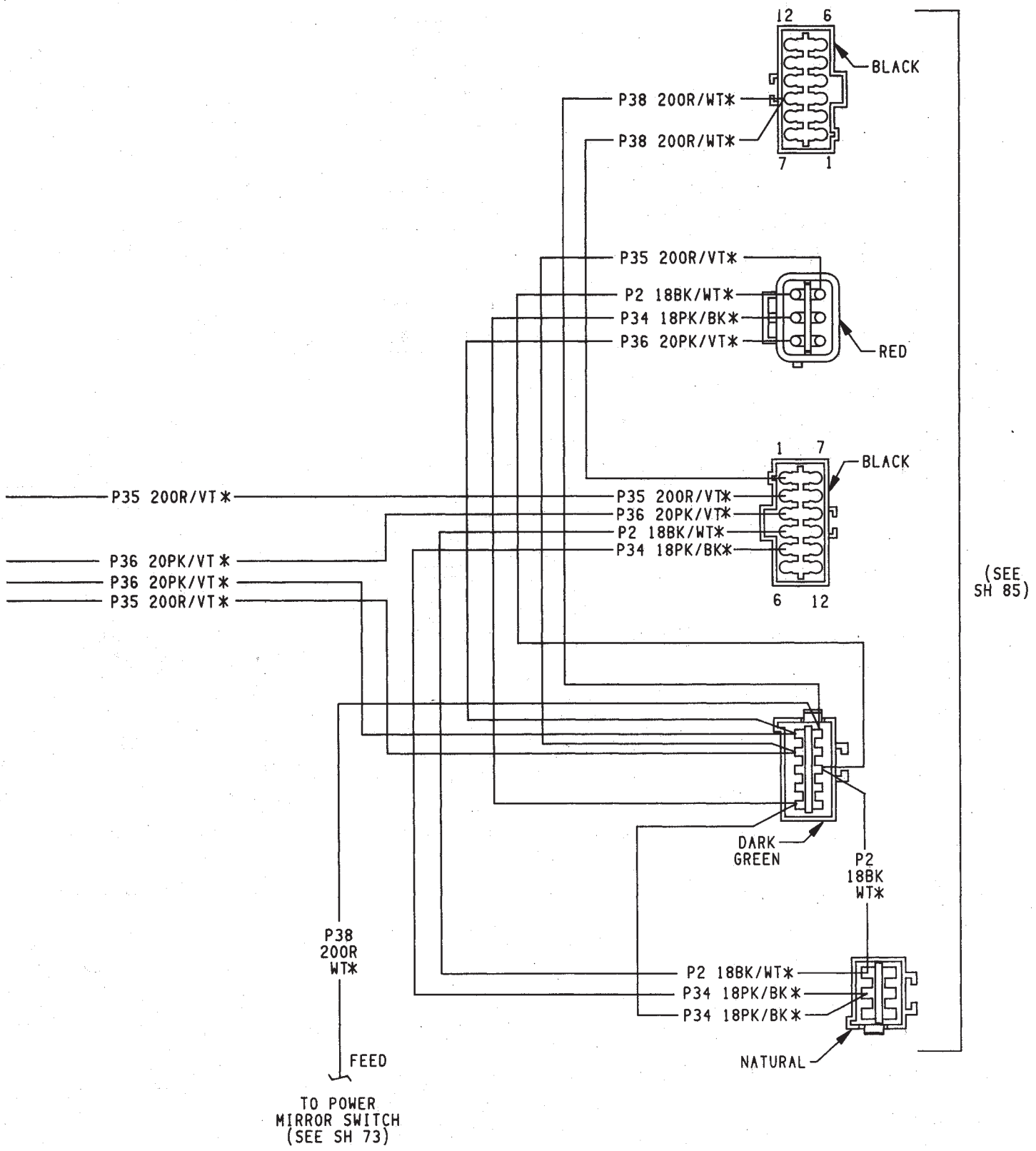
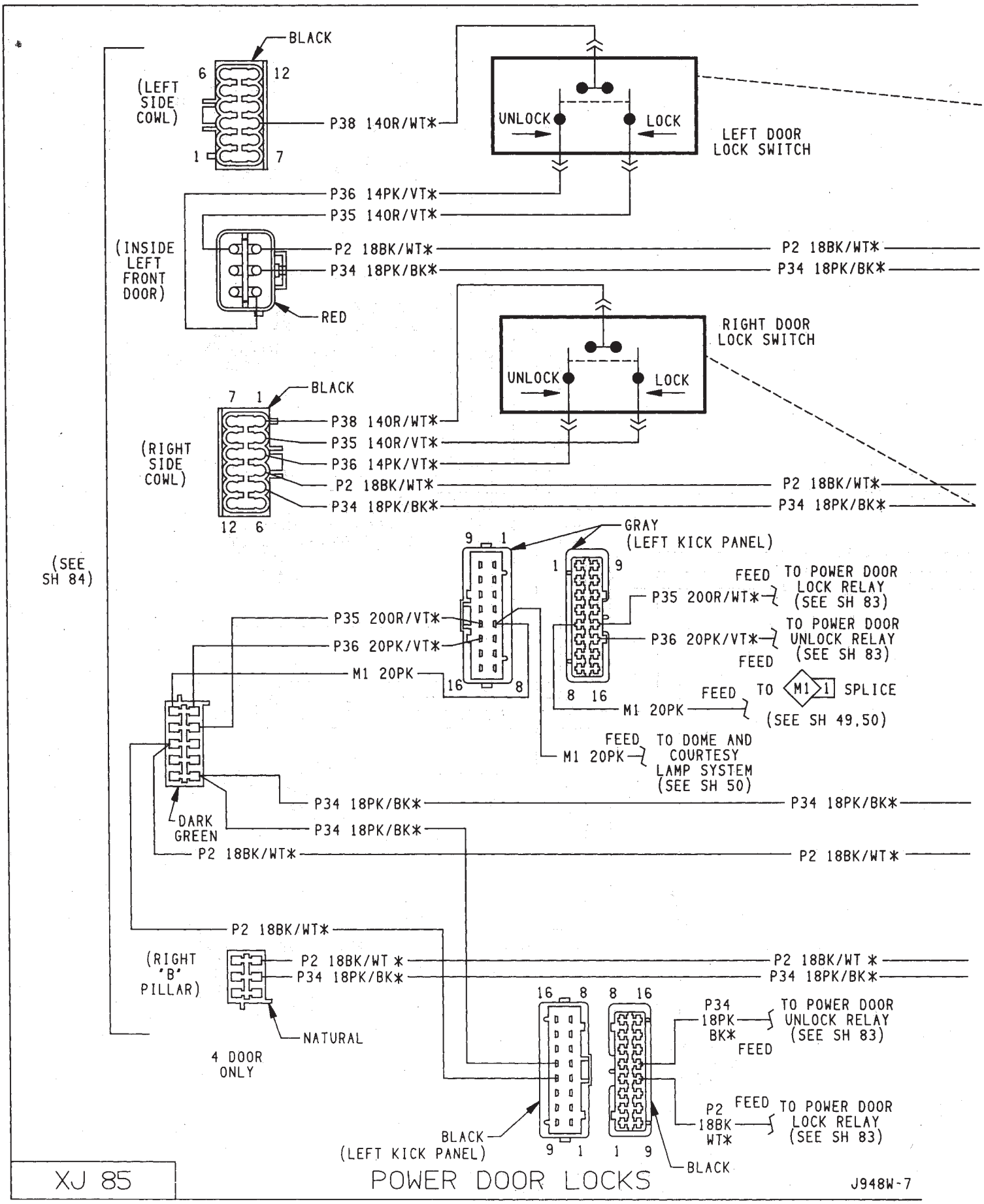


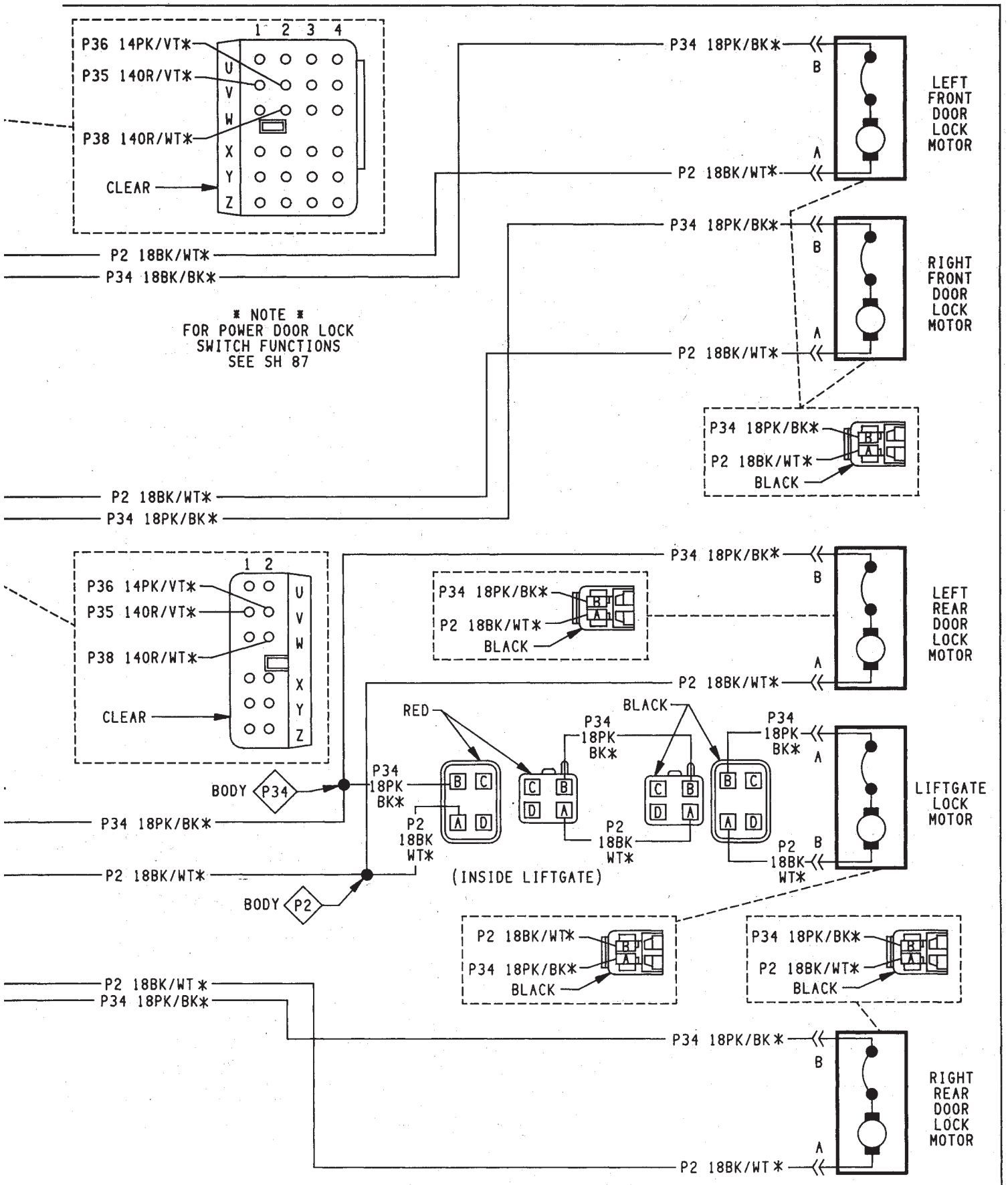
XJ 83

POWER DOOR LOCKS

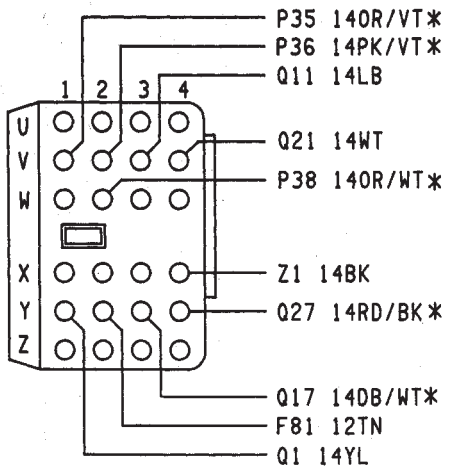
J948W-7


12 6
BLACK
P38 200R/WT*
P38 200R/WT*
7 1
P35 200R/VT*
P2 18BK/WT*
P34 18PK/BK*
P36 20PK/VT*
RED
1 7
BLACK
P35 200R/VT*
P35 200R/VT*
P36 20PK/VT*
P36 20PK/VT*
P2 18BK/WT*
P36 20PK/VT*
P34 18PK/BK*
P35 200R/VT*
6 12
(SEE SH 85)
DARK GREEN
P2 18BK WT*
P38 200R WT*
P2 18BK/WT*
P34 18PK/BK*
P34 18PK/BK*
NATURAL
FEED
TO POWER MIRROR SWITCH (SEE SH 73)


BLACK
(LEFT SIDE COWL)
6
12
1
7
P38 14OR/WT*
UNLOCK
LOCK
LEFT DOOR LOCK SWITCH
P36 14PK/VT*
P35 14OR/VT*
(INSIDE LEFT FRONT DOOR)
P2 18BK/WT*
P34 18PK/BK*
RED
P2 18BK/WT*
P34 18PK/BK*
RIGHT DOOR LOCK SWITCH
UNLOCK
LOCK
7
1
BLACK
(RIGHT SIDE COWL)
P38 14OR/WT*
P35 14OR/VT*
P36 14PK/VT*
P2 18BK/WT*
P34 18PK/BK*
12
6
P2 18BK/WT*
P34 18PK/BK*
(SEE SH 84)
9
1
GRAY
(LEFT KICK PANEL)
1
9
FEED
TO POWER DOOR LOCK RELAY (SEE SH 83)
P35 20OR/WT*
P35 20OR/VT*
P36 20PK/VT*
TO POWER DOOR UNLOCK RELAY (SEE SH 83)
FEED
M1 20PK
16
8
8
16
FEED
TO
M1
1
SPLICE
M1 20PK
(SEE SH 49,50)
FEED
M1 20PK
TO DOME AND COURTESY LAMP SYSTEM (SEE SH 50)
P34 18PK/BK*
P34 18PK/BK*
DARK GREEN
P34 18PK/BK*
P2 18BK/WT*
P2 18BK/WT*
P2 18BK/WT*
(RIGHT 'B' PILLAR)
P2 18BK/WT*
P34 18PK/BK*
P2 18BK/WT*
P34 18PK/BK*
NATURAL
4 DOOR ONLY
16
8
8
16
P34 18PK BK*
TO POWER DOOR UNLOCK RELAY (SEE SH 83)
FEED
P2 18BK WT*
FEED
TO POWER DOOR LOCK RELAY (SEE SH 83)
BLACK
(LEFT KICK PANEL)
9
1
1
9
BLACK
XJ 85
POWER DOOR LOCKS
J948W-7

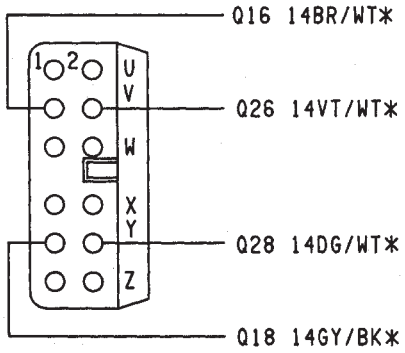


J948W-7 POWER DOOR LOCKS XJ 86



LEFT FRONT DOOR CONNECTORS
WINDOW LIFT SWITCH FUNCTION
AND DOOR LOCK SWITCH FUNCTION

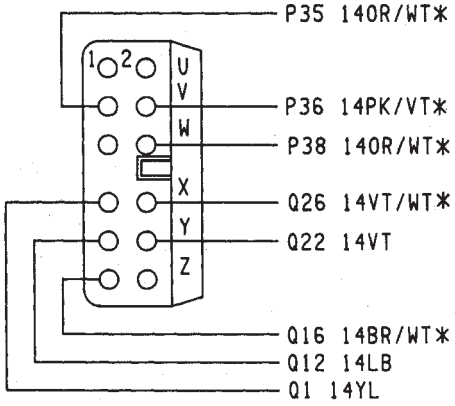
B+ POLARITY	B− POLARITY	WINDOW MOVEMENT
WT	LB	LT FRONT UP
LB	WT	LT FRONT DOWN
BR/WT*	VT/WT*	RT FRONT UP
VT/WT*	BR/WT*	RT FRONT DOWN
TN	BK	FEED AND GROUND
RD/BK*	DB/WT*	LT REAR UP (4 DOOR ONLY)
DB/WT*	RD/BK*	LT REAR DOWN (4 DOOR ONLY)
DG/WT*	GY/BK*	RT REAR UP (4 DOOR ONLY)
GY/BK*	DG/WT*	RT REAR DOWN (4 DOOR ONLY)



B+ POLARITY	B− POLARITY	DOOR LOCK FUNCTION ALL DOORS
OR/VT*	—	LOCK
PK/VT*	—	UNLOCK
OR/WT*	—	FEED B+

RIGHT FRONT DOOR LOCK AND SWITCH
CONNECTOR WINDOW LIFT SWITCH FUNCTION
AND DOOR LOCK SWITCH FUNCTION

B+ POLARITY	B− POLARITY	WINDOW MOVEMENT
BR	VT	RT FRONT UP(DOOR SWITCH)
VT	BR	RT FRONT DOWN(DOOR SWITCH)
BR/WT*	VT/WT*	RT FRONT UP(MASTER SWITCH)
VT/WT*	BR/WT*	RT FRONT DOWN(MASTER SWITCH)
YL	—	FEED



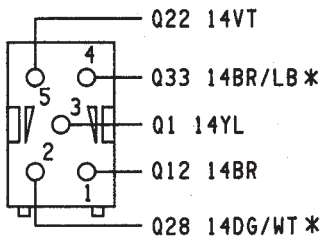
B+ POLARITY	B− POLARITY	DOOR LOCK FUNCTION ALL DOORS
OR/VT*	—	LOCK FROM DOOR SWITCH
PK/VT*	—	UNLOCK FROM DOOR SWITCH
OR/WT*	—	FEED B+

FRONT DOOR LOCK
AND WINDOW SWITCH FUNCTIONS

J948W-7

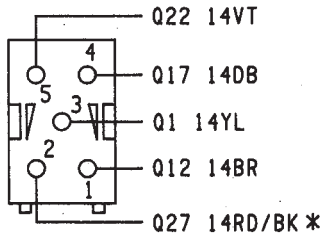
LEFT REAR DOOR WINDOW CONNECTOR
AN WINDOW LIFT SWITCH FUNCTION

B+ POLARITY	B— POLARITY	WINDOW MOVEMENT
BR	VT	LT REAR UP (DOOR SWITCH)
VT	BR	LT REAR DOWN (DOOR SWITCH)
RD/BK*	DB	LT REAR UP (MASTER SWITCH)
DB	RD/BK*	LT REAR DOWN (MASTER SWITCH)
YL	—	FEED



RIGHT REAR DOOR WINDOW CONNECTOR
AN WINDOW LIFT SWITCH FUNCTION

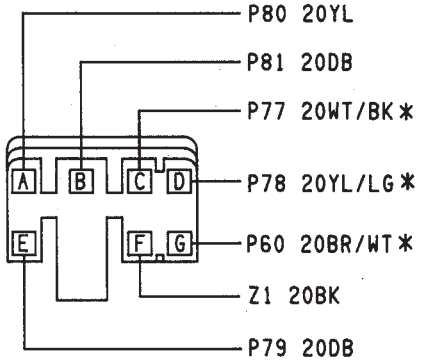
B+ POLARITY	B— POLARITY	WINDOW MOVEMENT
BR	VT	RT REAR UP (DOOR SWITCH)
VT	BR	RT REAR DOWN (DOOR SWITCH)
DG/WT*	BR/LB*	RT REAR UP (MASTER SWITCH)
BR/LB*	DG/WT*	RT REAR DOWN (MASTER SWITCH)
YL	—	FEED



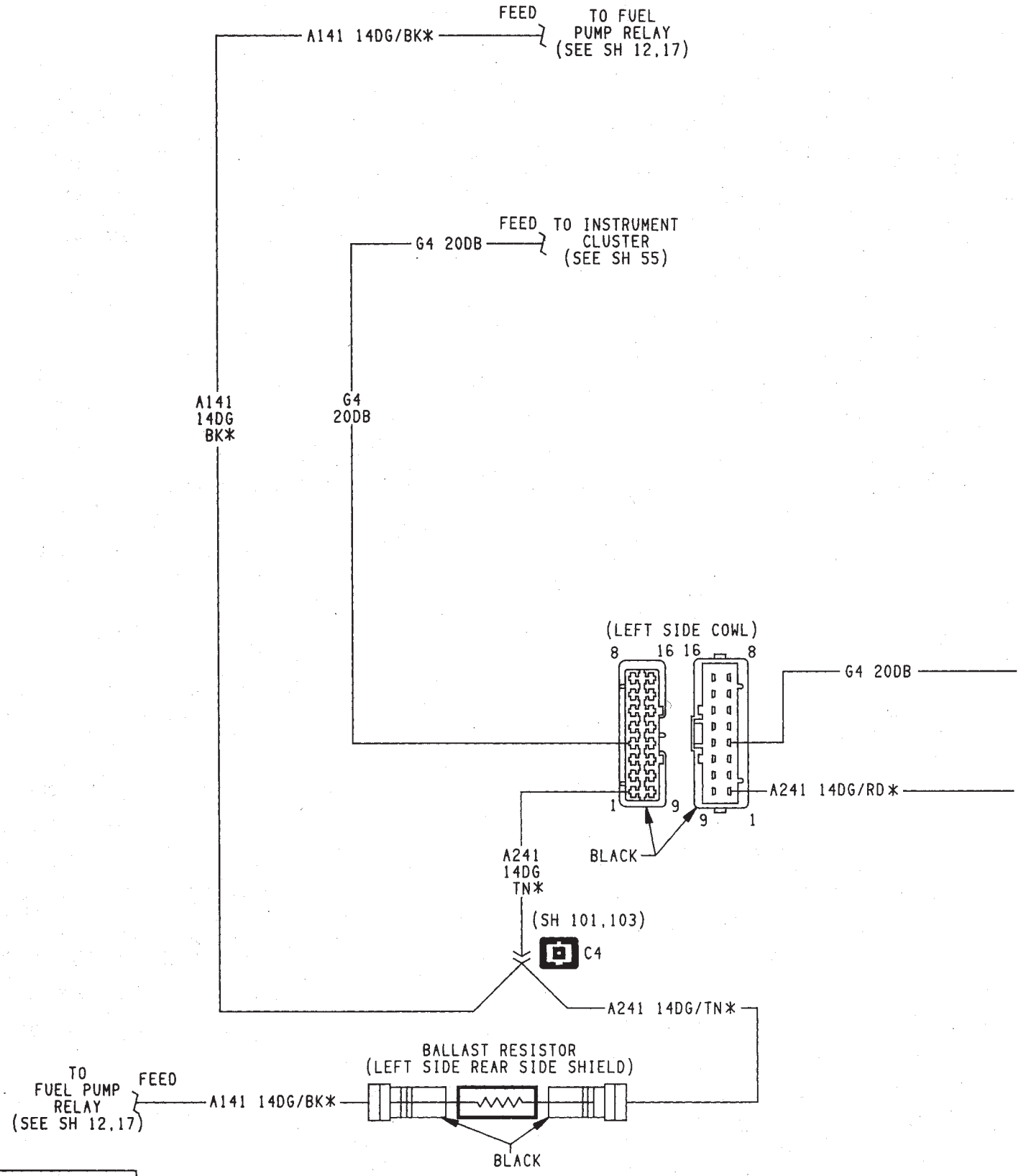
REAR DOOR WINDOW SWITCH FUNCTIONS

POWER MIRROR CONNECTOR
AND SWITCH FUNCTION

B+ POLARITY	B— POLARITY	WINDOW MOVEMENT
P79 20DB	P80 20YL	LEFT MIRROR - UP
P80 20YL	P79 20DB	LEFT MIRROR - DOWN
P79 20DB	P78 20YL/LG*	RIGHT MIRROR - UP
P78 20YL/LG*	P79 20DB	RIGHT MIRROR - DOWN
P79 20DB	P81 20DB	LEFT MIRROR - RIGHT
P81 20DB	P79 20DB	LEFT MIRROR - LEFT
P79 20DB	P77 20WT/BK*	RIGHT MIRROR - RIGHT
P77 20WT/BK*	P79 20DB	RIGHT MIRROR - LEFT
P60 20BR/WT*	——	FEED
——	Z1 20BK	GROUND



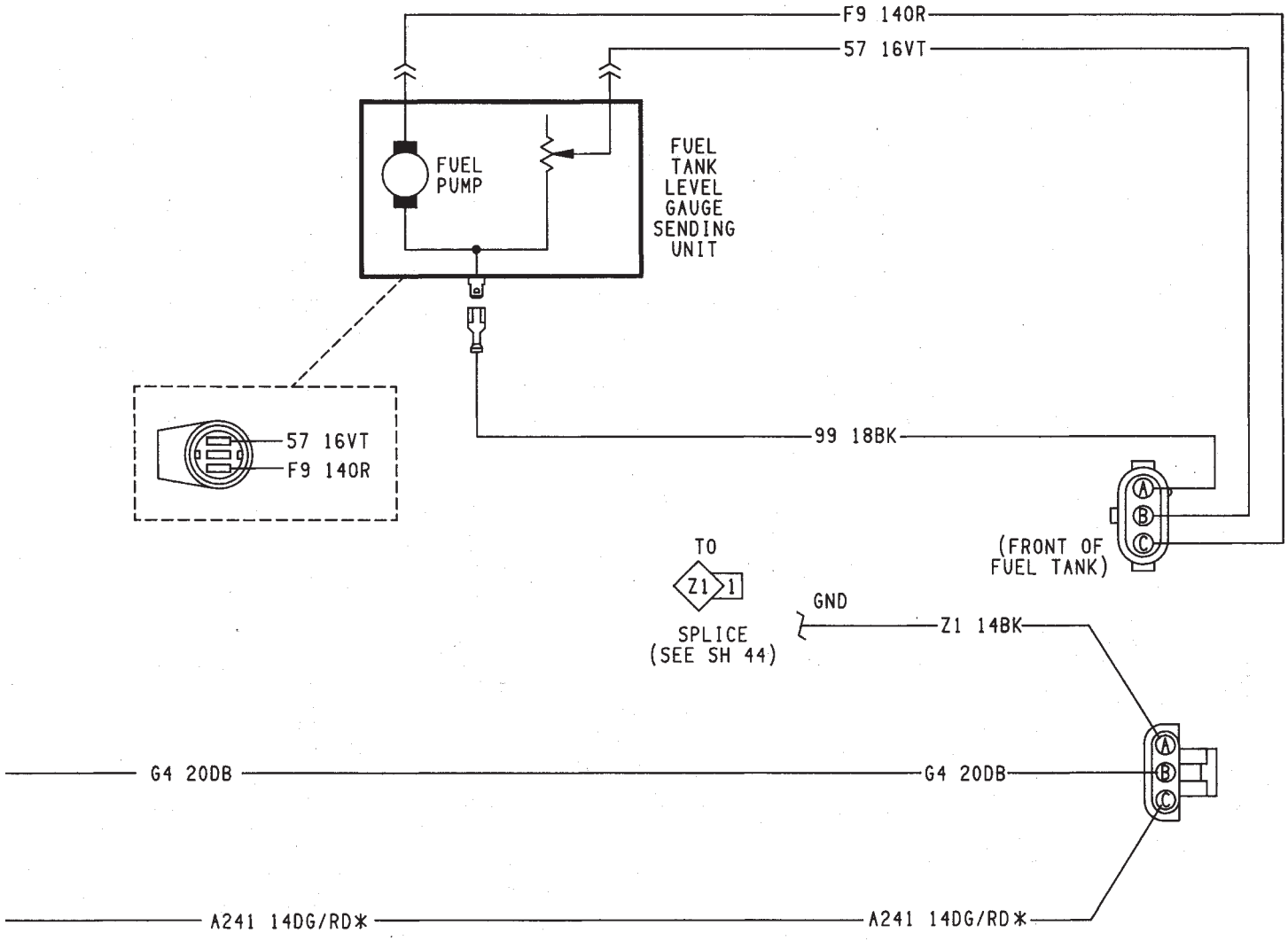
POWER MIRROR SWITCH FUNCTIONS

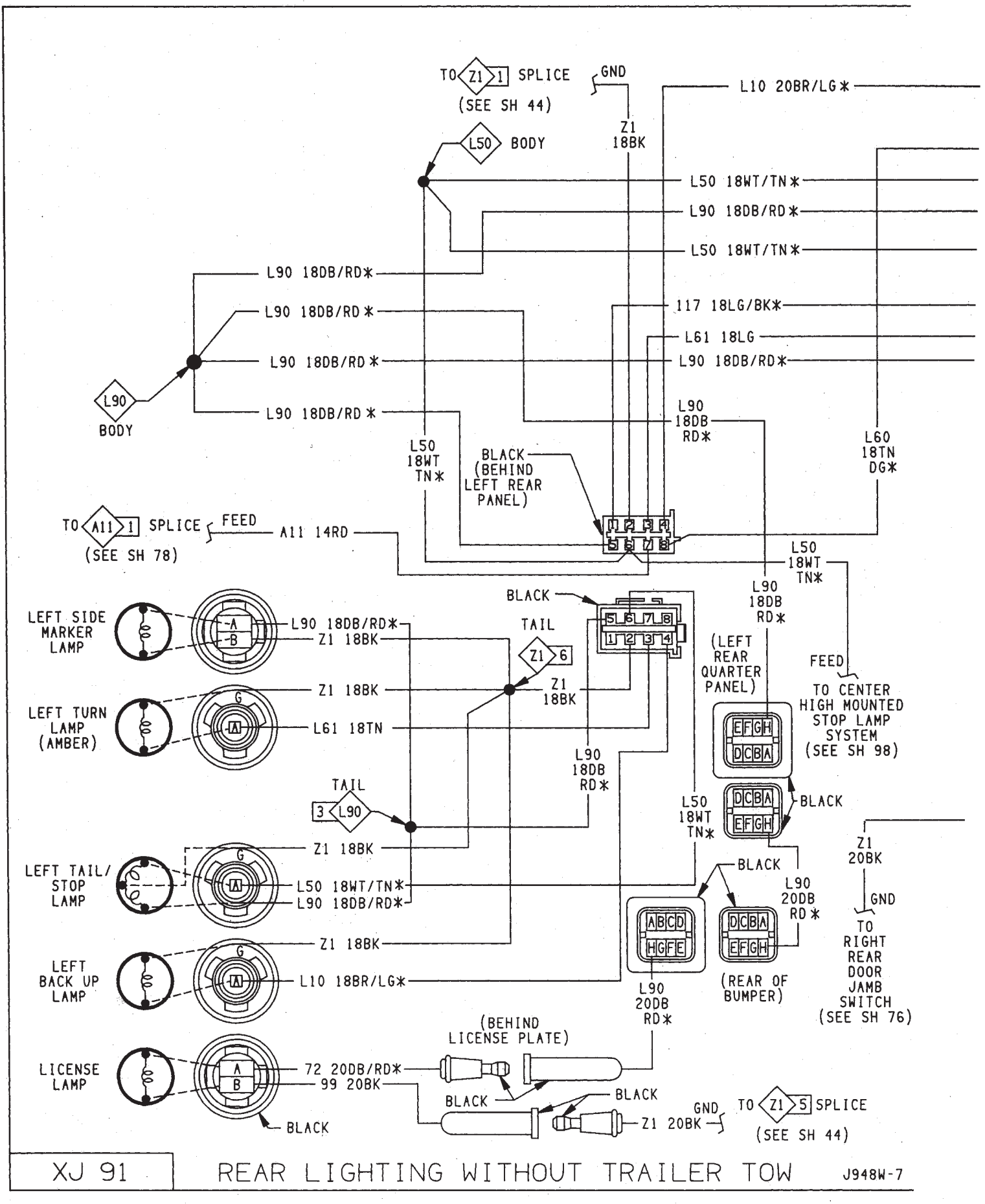


XJ 89

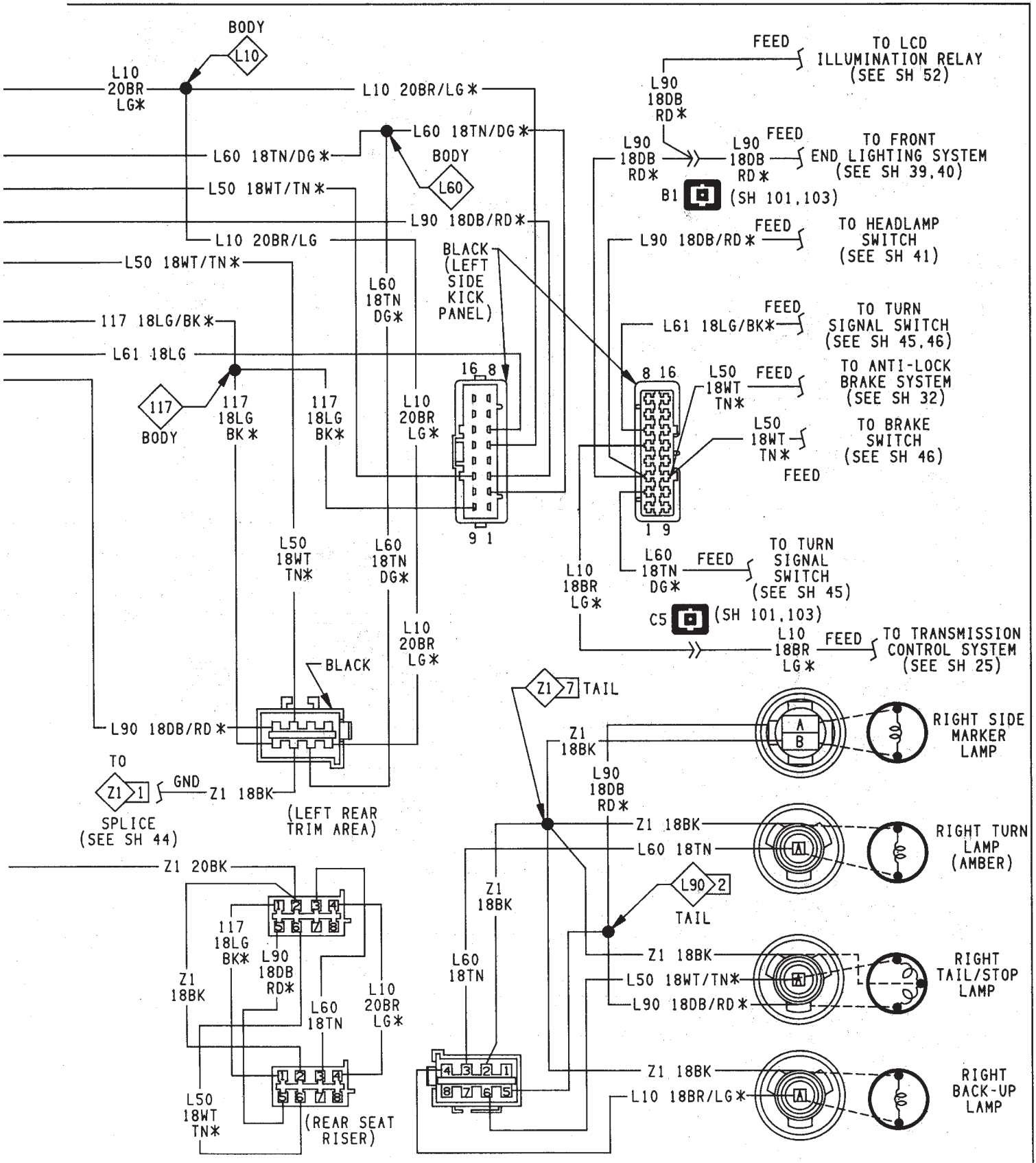
FUEL TANK SYSTEM

J948W-7

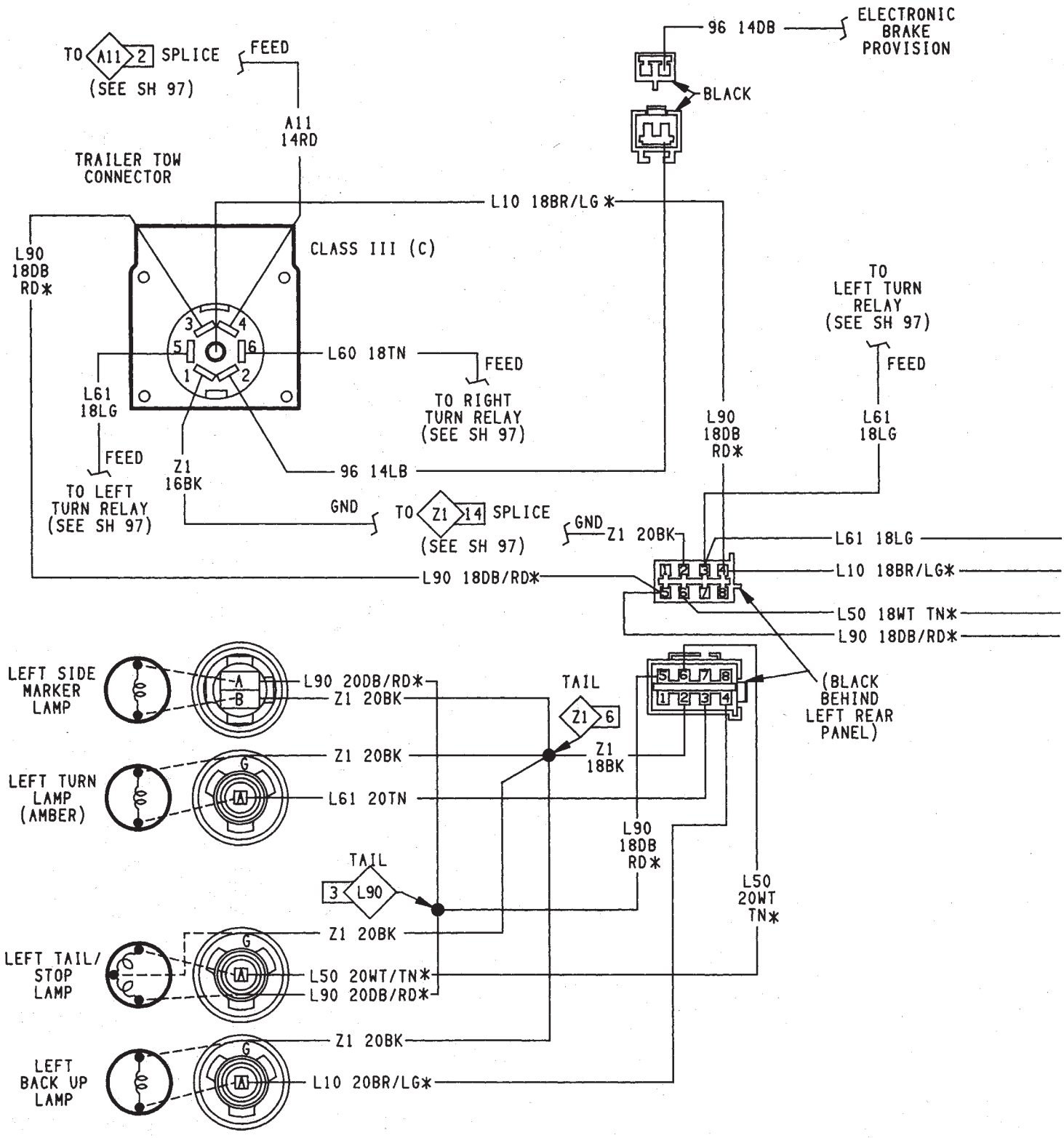

F9 140R
57 16VT
FUEL PUMP
FUEL TANK LEVEL GAUGE SENDING UNIT
57 16VT
F9 140R
99 18BK
A
B
C
(FRONT OF FUEL TANK)
TO
Z1 1
SPLICE (SEE SH 44)
GND
Z1 14BK
G4 20DB
G4 20DB
A241 14DG/RD*
A241 14DG/RD*



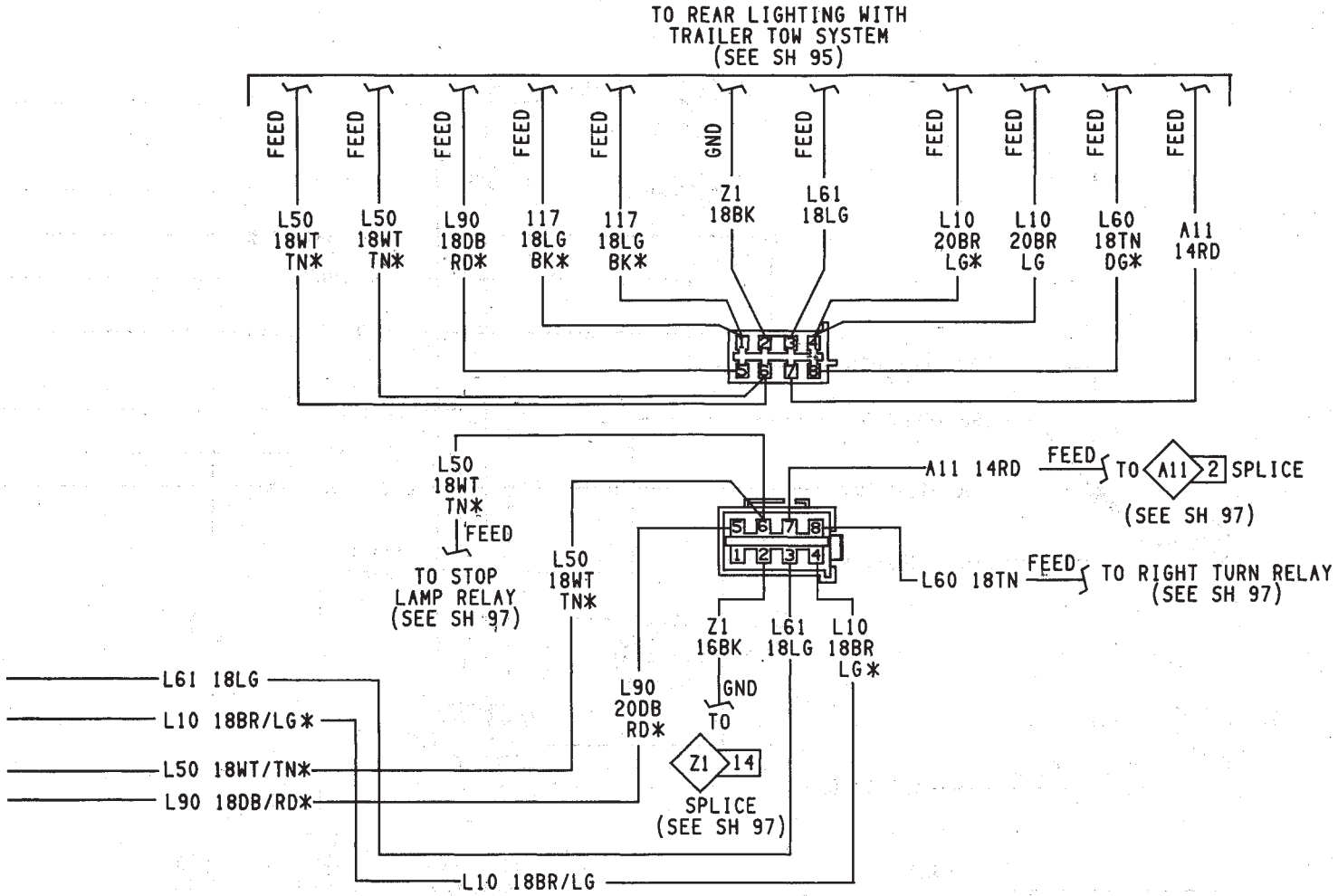
XJ 91 REAR LIGHTING WITHOUT TRAILER TOW J948W-7



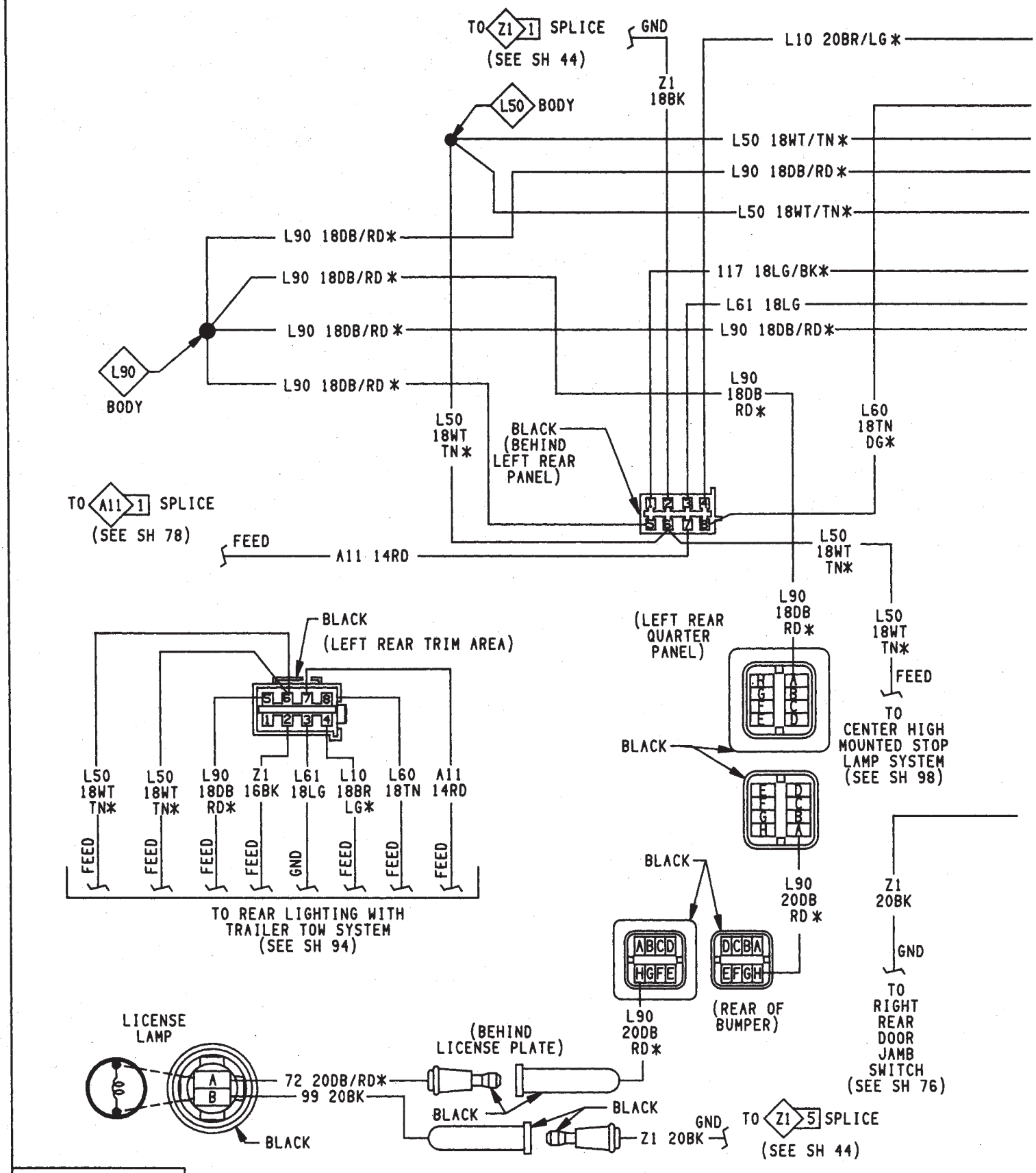
J948W-7 REAR LIGHTING WITHOUT TRAILER TOW XJ 92



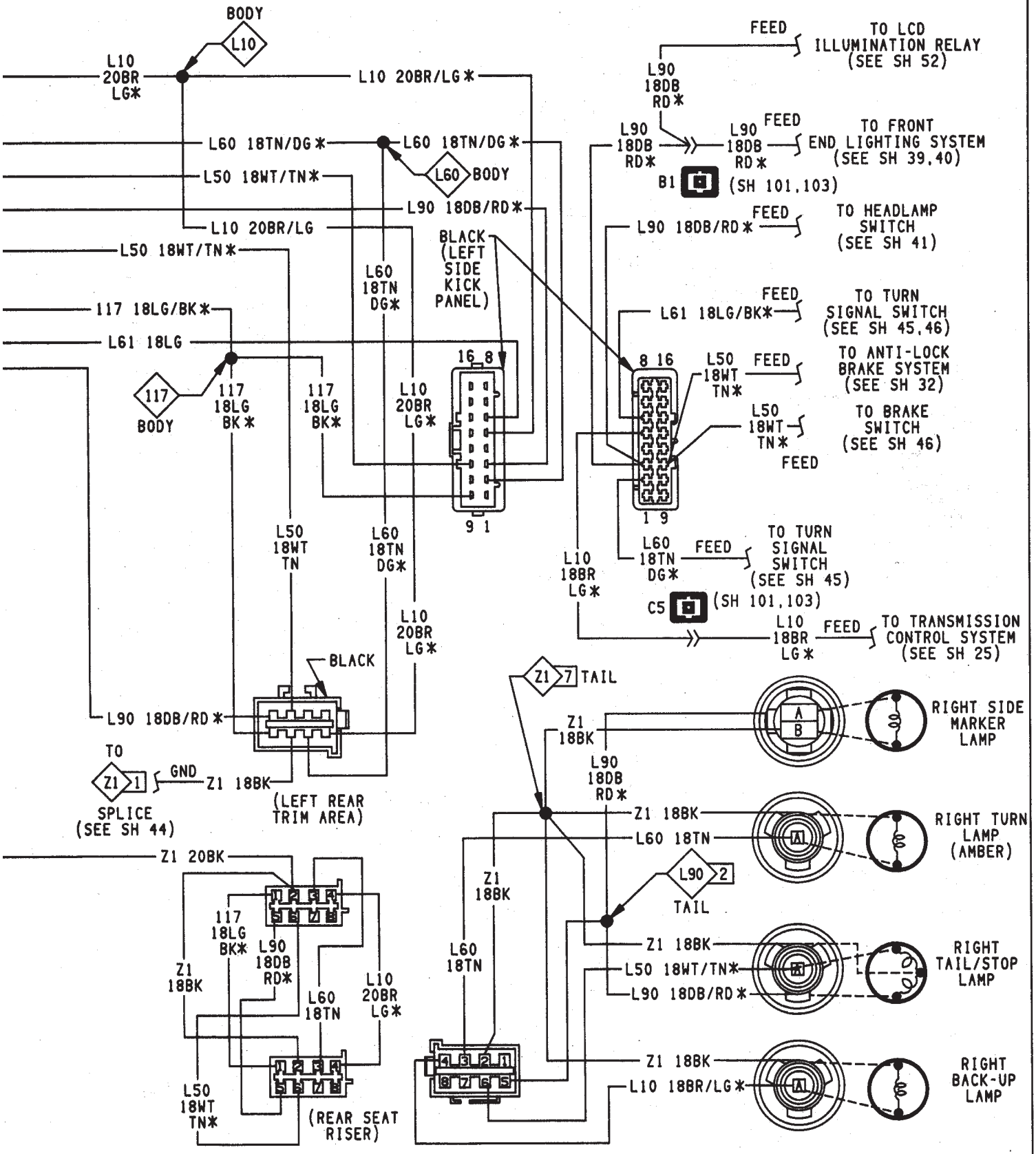
XJ 93 REAR LIGHTING WITH TRAILER TOW J948W-7



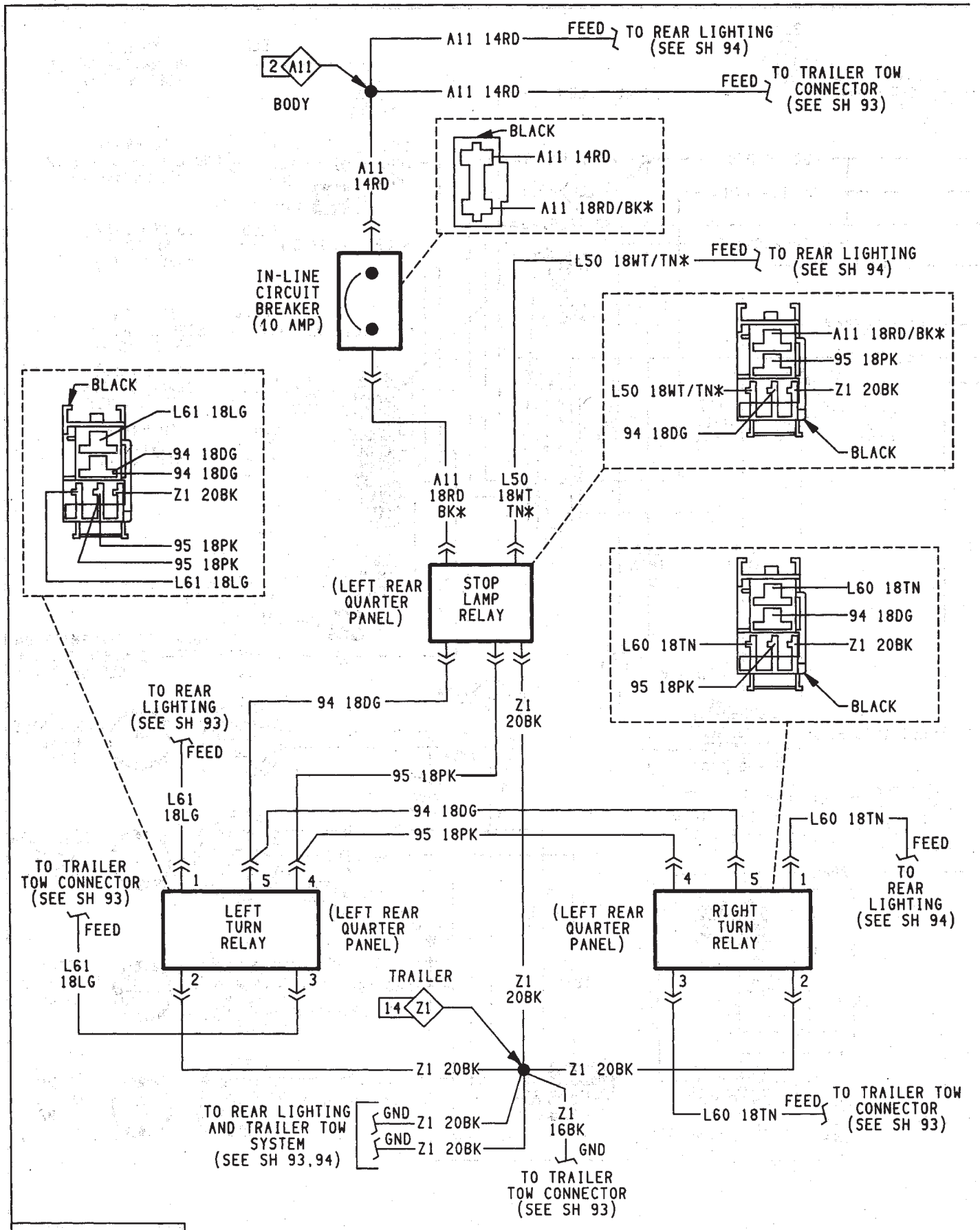
J948W-7 REAR LIGHTING WITH TRAILER TOW XJ 94



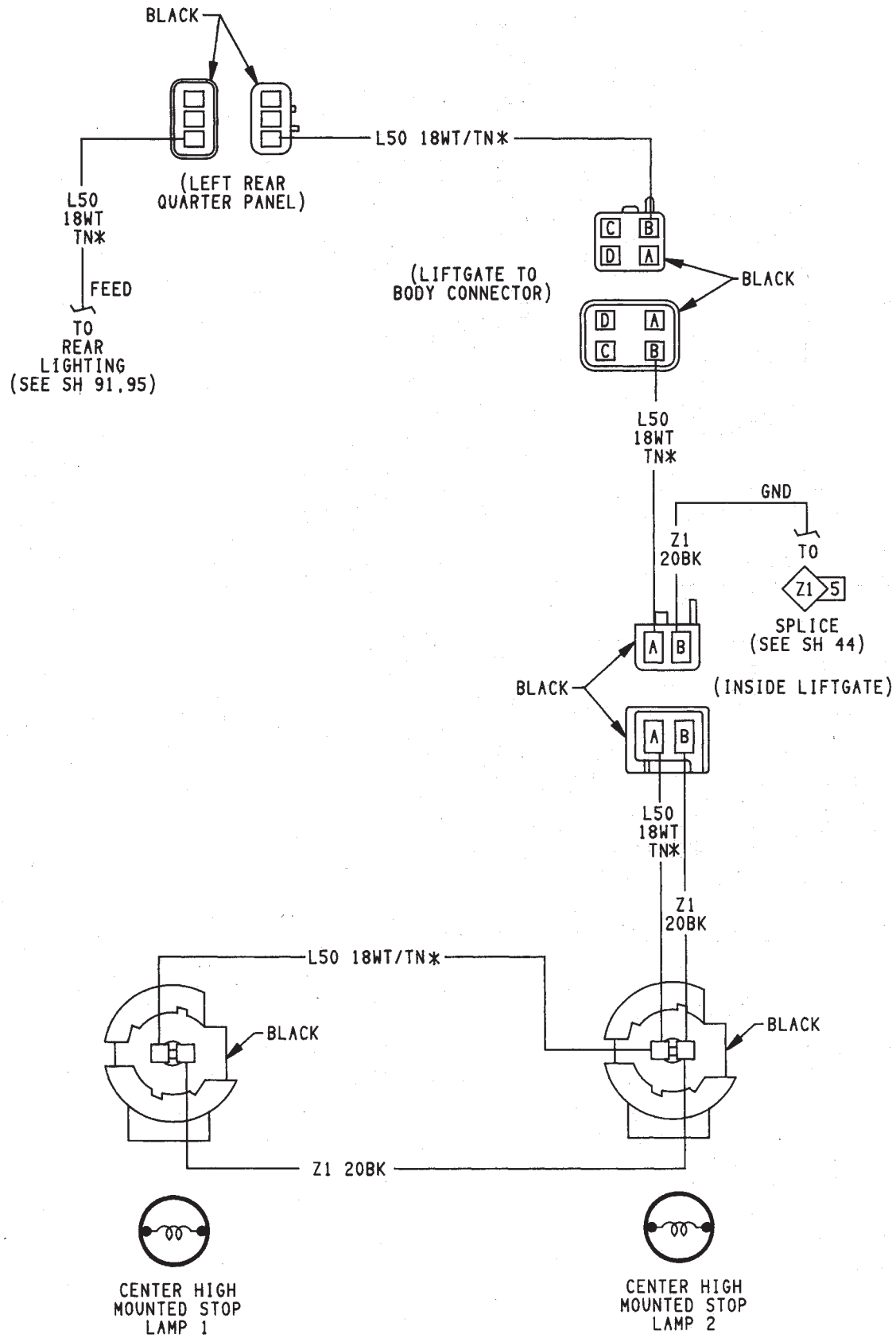
XJ 95 REAR LIGHTING WITH TRAILER TOW J948W-7



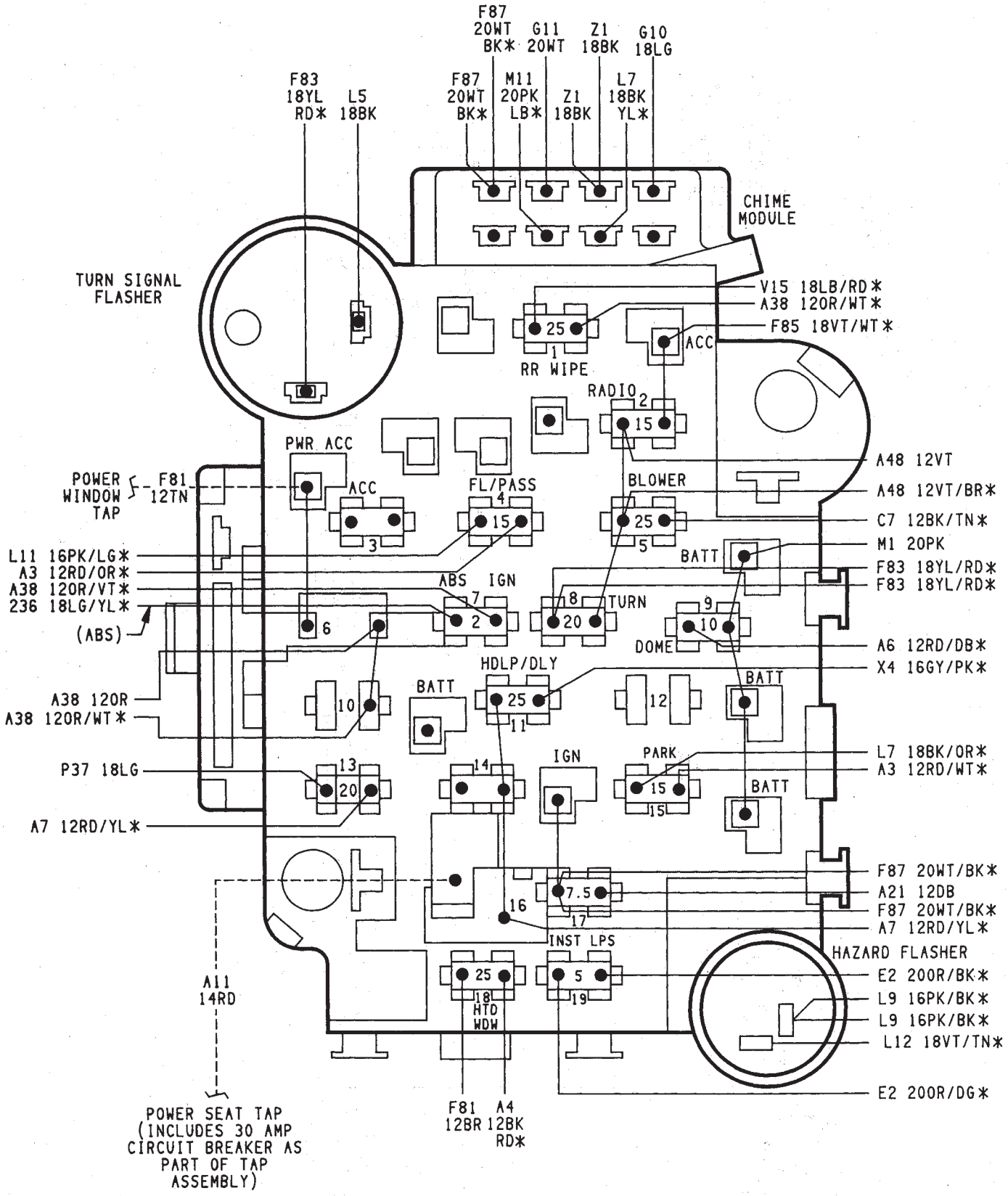
J948W-7 REAR LIGHTING WITH TRAILER TOW XJ 96



XJ 97 REAR LIGHTING WITH TRAILER TOW J948W-7

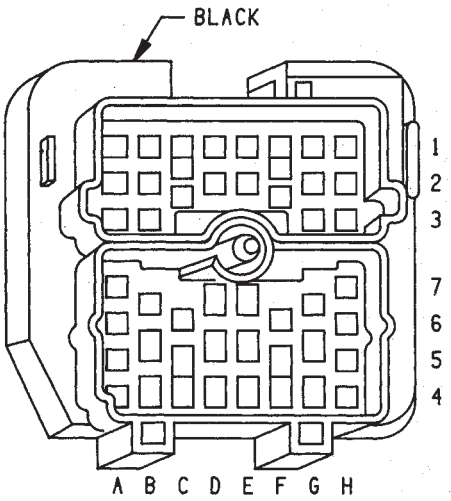


J948W-7 CENTER HIGH MOUNTED STOP LAMP XJ 98



XJ 99 FUSE PANEL J948W-7

FUSE NUMBER	AMPS	COLOR	SHEET
1	25	WHITE	2,10,65
2	15	LIGHT BLUE	2,9,37,71
3	—	—	—
4	15	LIGHT BLUE	1,41
5	25	WHITE	2,63,64,68,70
6	—	—	—
7	2	PINK	2,10,32
8	20	YELLOW	2,45,66
9	10	RED	1,4,49
10	—	—	—
11	25	WHITE	1,43,83
12	—	—	—
13	20	YELLOW	1,43,83
14	—	—	—
15	15	LIGHT BLUE	1,41
16	—	—	—
17	7.5	BROWN	2,10,55,74
18	25	WHITE	1,66
19	5	TAN	1,41,47

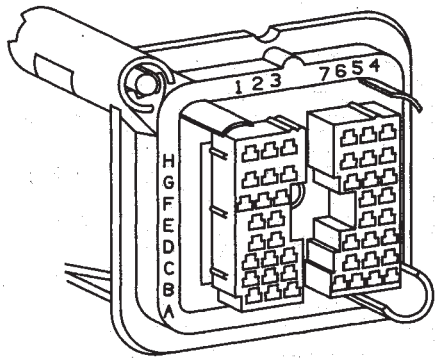


VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
A1	L61 18LG	LEFT FRONT TURN SIGNAL	39,45
A2	K54 200R/BK*	UPSHIFT INDICATOR LAMP	55
A3	F86 18LG/BK*	FUSED IGNITION 'C'	63,64
A4	L9 18BK/WT*	HAZARD FLASHER FEED	4,35,46
A5	C90 16LG	A/C SELECT SIGNAL	69
A6	A6 18RD/BK*	BATTERY FEED	4,49
A7	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	55
B1	L90 18DB/RD*	PARK LAMP FEED	39,41,52,92,96
B2	V10 20BR	WINDSHIELD WASHER PUMP FEED	63,64
B3	V4 18RD/YL*	WINDSHIELD WIPER (HIGH SPEED)	63,64
B4	G21 20GY/LB*	TACHOMETER SIGNAL	55
B5	106 20BK/YL*	4-WHEEL DRIVE SYSTEM	26,56
B6	A21 12DB	IGNITION START/RUN	10,12
C1	107 20BK/RD*	4 WHEEL LOCK LAMP	27,56
C2	—	—	—
C3	—	—	—
C4	A241 14DG/TN*	BALLAST RESISTOR	89
C4			
C5	L10 18BR/LG*	BACK-UP LAMP FEED	7,25,92,96
C6	G6 20GY	ENGINE OIL PRESSURE INDICATOR	24,55
D1	A3 12RD/WT*	HEADLAMP SWITCH FEED	4,41
D2	A4 12BK/RD*	HEATED REAR WINDOW FEED	66
D4	L39 16LB	FOG LAMPS FEED	40,42
D5	L4 16VT/WT*	HEADLAMP (LOW BEAM)	39
D5	L4 14VT/WT*	HEADLAMP (LOW BEAM)	39
E1	A7 12RD/YL*	BATTERY FEED	4,43,83
E2	X2 18DG/RD*	HORN FEED	34
E2	X2 18DG/RD*	HORN FEED	34
E4	A1 10RD	IGNITION SWITCH FEED	9
E5	C1 12DG	BLOWER MOTOR FEED	68,70
F1	465 16LB/BK*	HIGH BEAM INDICATOR W/DRL	38,40,55
F1	L3 16RD/OR*	HIGH BEAM INDICATOR W/O DRL	38,40,55
F2	L60 18TN	RIGHT FRONT TURN SIGNAL	40,45
F3	G20 18VT/YL*	ENGINE COOLANT TEMPERATURE	9,24,55
F4	G9 20GY/WT*	BRAKE WARNING LAMP SWITCH	67
F5	G9 20GY/BK*	BRAKE WARNING LAMP SWITCH	9,67
G1	L35 16BR/WT*	FOG LAMP RELAY	40,42
G2	G12 20DG/YL*	CHECK GAUGE LAMP	55
G3	V3 18BR/WT*	WINDSHIELD WIPER (LOW SPEED)	63,64
G4	Z1 12BK	GROUND	42,63,64
G5	C91 16LB	A/C REQUEST	69
H1	C21 16DB/OR*	A/C PRESSURE SWITCH	69
H2	A41 14YL	ENGINE STARTER RELAY	7,9
H3	V55 18TN/RD*	WINDSHIELD WIPER (PARK SIGNAL)	63,64
H4	L3 16RD/OR*	HEADLAMP (HIGH BEAM)	39,41
H4	L3 14RD/OR*	HEADLAMP (HIGH BEAM)	39
H5	V20 18BK/WT*	REAR WASHER FEED	65
H6	G29 20BK/TN*	LOW WASHER FLUID LEVEL INDICATOR	55

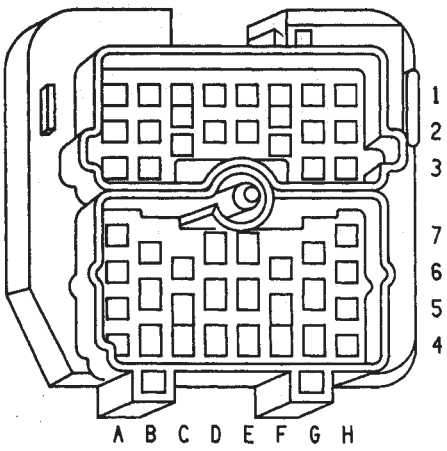
45-WAY BULKHEAD DISCONNECT (2.5L ENGINE)

CAV	CIRCUIT	FUNCTION	SHEET
A1	L61 18LG	LEFT FRONT TURN SIGNAL	39,45
A1	L61 18LG	LEFT FRONT TURN SIGNAL	39,45
A2	K54 20LG/OR*	UPSHIFT INDICATOR LAMP	55
A3	F86 18LG/BK*	FUSED IGNITION 'C'	63,64
A4	L9 16PK/BK*	HAZARD FLASHER FEED	4,35,46
A5	C90 16LG/WT*	A/C SELECT SIGNAL	69
A6	A6 12RD/DB*	BATTERY FEED	4,49
A7	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	55
B1	L90 18DB/RD*	PARK LAMP FEED	39,41,52, 92,96
B1	L90 18DB/RD*	PARK LAMP FEED	
B2	V10 20BR	WINDSHIELD WASHER PUMP FEED	63,64
B3	V4 18RD/BK*	WINDSHIELD WIPER (HIGH SPEED)	63,64
B4	G21 20GY/LB*	TACHOMETER SIGNAL	55
B5	106 20BK/YL*	4 WHEEL DRIVE INDICATOR LAMP	26,56
B6	A21 12DB/YL*	IGNITION START/RUN	10,12
C1	107 20BK/LB*	4 WHEEL LOCK LAMP	27,56
C2	—	—	—
C3	—	—	—
C4	A241 14DG/TN*	BALLAST RESISTOR	89
C5	L10 18BR/LG*	BACK-UP LAMP FEED	7,25,92,96
C6	G6 20GY	ENGINE OIL PRESSURE INDICATOR	24,55
D1	A3 12RD/WT*	HEADLAMP SWITCH FEED	4,41
D2	A4 12BK/RD*	HEATED REAR WINDOW FEED	66
D4	L39 16LB	FOG LAMPS FEED	40
D5	L4 16VT/WT*	HEADLAMP (LOW BEAM)	39
E1	A7 12RD/YL*	BATTERY FEED	4,43,83
E2	X2 16DG/RD*	HORN FEED	34
E4	A1 12RD	IGNITION SWITCH FEED	9
E4	A1 12RD	IGNITION SWITCH FEED	9
E5	C1 12DG	BLOWER MOTOR FEED	68,70
F1	L3 16RD/YL*	HEADLAMP (HIGH BEAM)	38,40,55
F2	L60 18TN	RIGHT FRONT TURN SIGNAL	40,45
F2	L60 18TN	RIGHT FRONT TURN SIGNAL	40,45
F3	G20 20VT/YL*	ENGINE COOLANT TEMPERATURE	9,24,55
F3	G20 20VT/YL*	ENGINE COOLANT TEMPERATURE	9,24,55
F4	G9 18GY/OR*	BRAKE WARNING LAMP SWITCH	67
F5	G9 20GY/WT*	BRAKE WARNING LAMP SWITCH	67
G1	L35 16BR/WT*	FOG LAMP RELAY	40,42
G2	G12 20DG/BK*	CHECK GAUGE LAMP	55
G3	V3 18BR/TN*	WINDSHIELD WIPER (LOW SPEED)	63,64
G4	Z1 12BK	GROUND	42,63,64
G5	C91 16LB	A/C REQUEST	69
G6	A38 12OR	IGNITION RUN	10
H1	C21 16DB/OR*	A/C PRESSURE SWITCH	69
H2	A41 14YL	ENGINE STARTER RELAY	7,9
H3	V55 18TN/RD*	WINDSHIELD WIPER (PARK SIGNAL)	63,64
H4	L3 16RD/OR*	HEADLAMP (HIGH BEAM)	39,41
H5	V20 18BK/WT*	REAR WASHER PUMP MOTOR FEED	65
H5	V20 18BK/WT*	REAR WASHER FEED	65
H6	G29 20BK/TN*	LOW WASHER FLUID LEVEL INDICATOR	55



VIEWED FROM TERMINAL END

45-WAY BULKHEAD DISCONNECT (2.5L ENGINE)



VIEWED FROM TERMINAL END

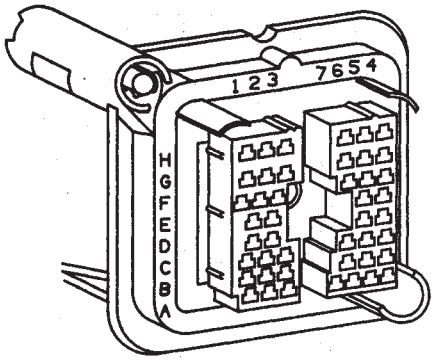
CAV	CIRCUIT	FUNCTION	SHEET
A1	L61 18LG	LEFT FRONT TURN SIGNAL	39,45
A2	K54 20LG/OR *	UPSHIFT INDICATOR LAMP	55
A3	F86 18LG/BK *	FUSED IGNITION 'C'	63,64
A4	L9 18BK/WT *	HAZARD FLASHER FEED	4,35,46
A5	C90 16LG	A/C SELECT SIGNAL	69
A6	A6 18RD/BK *	BATTERY FEED	4,49
A7	G3 20BK/PK *	MALFUNCTION INDICATOR LAMP	55
B1	L90 18DB/RD *	PARK LAMP FEED	39,41,52,92,96
B2	V10 20BR	WINDSHIELD WASHER PUMP FEED	63,64
B3	V4 18RD/YL *	WINDSHIELD WIPER (HIGH SPEED)	63,64
B4	G21 20GY/LB *	TACHOMETER SIGNAL	55
B5	106 20BK/YL *	4 WHEEL DRIVE SWITCH	26,56
B6	A21 12DB	IGNITION START/RUN	10,17
C1	107 20BK/RD *	4 WHEEL LOCK LAMP	26,56
C1	107 20BK/RD *	4 WHEEL LOCK LAMP	26
C2	D2 20WT/BK *	SERIAL BUSS (B−)	21,25,32
C2	D2 18WT/BK *	SERIAL BUSS (B−)	21,25,32
C3	D1 20VT/BR *	SERIAL BUSS (B+)	21,25,32
C3	D1 18VT/BR *	SERIAL BUSS (B+)	21,25,32
C4	A241 14DG/TN *	BALLAST RESISTOR	89
C4	—	—	—
C5	L10 18BR/LG *	BACK-UP LAMP FEED	7,25,92,96
C6	G6 20GY	ENGINE OIL PRESSURE INDICATOR	24,55
D1	A3 12RD/WT *	HEADLAMP SWITCH FEED	4,41
D2	A4 12BK/RD *	HEATED REAR WINDOW FEED	66
D4	L39 16LB	FOG LAMPS FEED	40,42
D5	L4 16VT/WT *	HEADLAMP (LOW BEAM)	39
D5	L4 14VT/WT *	HEADLAMP (LOW BEAM)	39
E1	A7 12RD/YL *	BATTERY FEED	4,43,83
E2	X2 18DG/RD *	HORN FEED	34
E2	X2 18DG/RD *	HORN FEED	34
E4	A1 10RD	IGNITION SWITCH FEED	9
E5	C1 12DG	BLOWER MOTOR FEED	68,70
F1	465 16LB/BK *	HIGH BEAM INDICATOR W/DRL	38,40,55
F1	L3 16RD/OR *	HIGH BEAM INDICATOR W/O DRL	40,55
F2	L60 18TN	RIGHT FRONT TURN SIGNAL	40,45
F3	G20 18VT/YL *	ENGINE COOLANT TEMPERATURE	9,24,55
F4	G9 20GY/WT *	BRAKE WARNING LAMP SWITCH	67
F5	G9 20GY/BK *	BRAKE WARNING LAMP SWITCH	9,67
F6	K10 18VT	IDLE INCREASE (POLICE)	17
G1	L35 16BR/WT *	FOG LAMP RELAY	40,42
G2	G12 20DG/YL *	CHECK GAUGE LAMP	55
G3	V3 18BR/WT *	WINDSHIELD WIPER (LOW SPEED)	63,64
G4	Z1 12BK	GROUND	42,63,64
G5	C91 16LB	A/C REQUEST	69
H1	C21 16DB/OR *	A/C PRESSURE SWITCH	69
H2	A41 14YL	ENGINE STARTER RELAY	8,9
H3	V55 18TN/RD *	WINDSHIELD WIPER (PARK SIGNAL)	63,64
H4	L3 16RD/OR *	HEADLAMP (HIGH BEAM)	39,41
H4	L3 14RD/OR *	HEADLAMP (HIGH BEAM)	39
H5	V20 18BK/WT *	REAR WASHER FEED	65
H6	G29 20BK/TN *	LOW WASHER FLUID LEVEL INDICATOR	55

45-WAY BULKHEAD DISCONNECT (4.0L ENGINE)

XJ 103

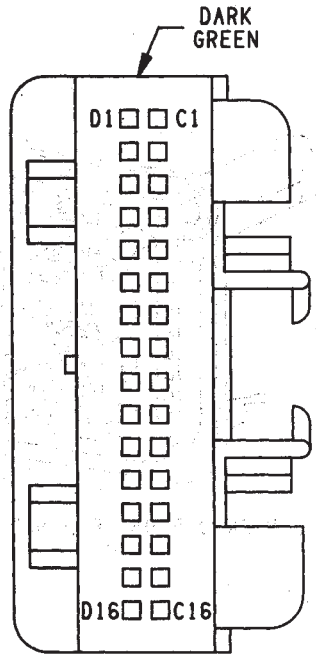
J948W-7

CAV	CIRCUIT	FUNCTION	SHEET
A1	L61 18LG	LEFT FRONT TURN SIGNAL	39,45
A1	L61 18LG	LEFT FRONT TURN SIGNAL	39,45
A2	K54 20LG/OR *	UPSHIFT INDICATOR LAMP	55
A3	F86 18LG/BK *	FUSED IGNITION 'C'	63,64
A4	L9 16PK/BK *	FLASHER FEED	4,35,46
A5	C90 16LG/WT *	A/C SELECT SIGNAL	69
A6	A6 12RD/DB *	BATTERY FEED	4,49
A7	G3 20BK/PK *	MALFUNCTION INDICATOR LAMP	55
B1	L90 18DB/RD *	PARK LAMP FEED	39,41,52
B1	L90 18DB/RD *	PARK LAMP FEED	92,96
B2	V10 20BR	WINDSHIELD WASHER PUMP FEED	63,64
B3	V4 18RD/BK *	WINDSHIELD WIPER (HIGH SPEED)	63,64
B4	G21 20GY/LB *	TACHOMETER SIGNAL	55
B5	106 20BK/YL *	FULL TIME INDICATOR LAMP	26,56
B6	A21 12DB/YL *	IGNITION START/RUN	10,17
C1	107 20BK/LB *	4 WHEEL LOCK LAMP	26,56
C2	—	—	—
C3	—	—	—
C4	A241 14DG/TN *	BALLAST RESISTOR	89
C5	L10 18BR/LG *	BACK-UP LAMP FEED	7,25,92,96
C6	G6 20GY	ENGINE OIL PRESSURE INDICATOR	24,55
D1	A3 12RD/WT *	HEADLAMP SWITCH FEED	4,41
D2	A4 12BK/RD *	HEATED REAR WINDOW FEED	66
D4	L39 16LB	FOG LAMPS FEED	40
D5	L4 16VT/WT *	HEADLAMP (LOW BEAM)	39
E1	A7 12RD/YL *	BATTERY FEED	4,43,83
E2	X2 16DG/RD *	HORN FEED	34
E4	A1 12RD	IGNITION SWITCH FEED	9
E4	A1 12RD	IGNITION SWITCH FEED	9
E5	C1 12DG	BLOWER MOTOR FEED	68,70
F1	L3 16RD/YL *	HEADLAMP (HIGH BEAM)	38,40,55
F2	L60 18TN	RIGHT FRONT TURN SIGNAL	40,45
F2	L60 18TN	RIGHT FRONT TURN SIGNAL	40,45
F3	G20 20VT/YL *	ENGINE COOLANT TEMPERATURE	9,24,55
F3	G20 20VT/YL *	ENGINE COOLANT TEMPERATURE	9,24,55
F4	G9 18GY/OR *	BRAKE WARNING LAMP SWITCH	67
F5	G9 20GY/WT *	BRAKE WARNING LAMP SWITCH	67
G1	L35 16BR/WT *	FOG LAMP RELAY	40,42
G2	G12 20DG/BK *	CHECK GAUGE LAMP	55
G3	V3 18BR/TN *	WINDSHIELD WIPER (LOW SPEED)	63,64
G4	Z1 12BK	GROUND	42,63,64
G5	C91 16LB	A/C REQUEST	69
G6	A38 12OR	IGNITION RUN	10
H1	C21 16DB/OR *	A/C PRESSURE SWITCH	69
H2	A41 14YL	ENGINE STARTER RELAY	8,9
H3	V55 18TN/RD *	WINDSHIELD WIPER (PARK SIGNAL)	63,64
H4	L3 16RD/OR *	HEADLAMP (HIGH BEAM)	39,41
H5	V20 18BK/WT *	REAR WASHER PUMP MOTOR FEED	65
H5	V20 18BK/WT *	REAR WASHER FEED	65
H6	G29 20BK/TN *	LOW WASHER FLUID LEVEL INDICATOR	55



VIEWED FROM TERMINAL END

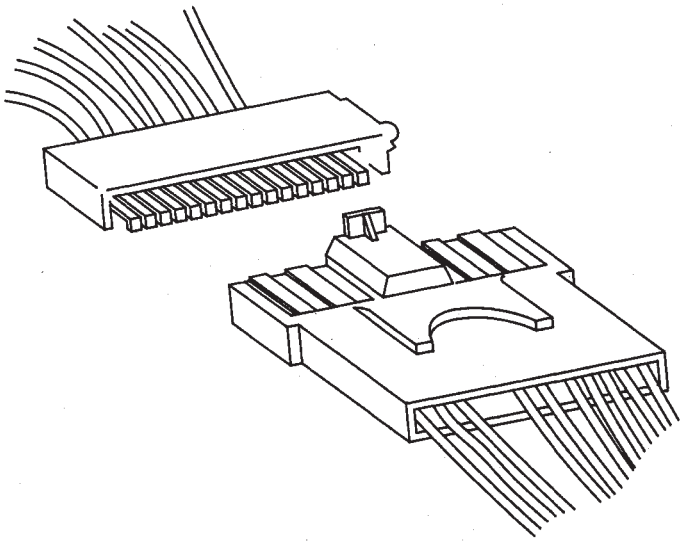
45-WAY BULKHEAD DISCONNECT (4.0L ENGINE)

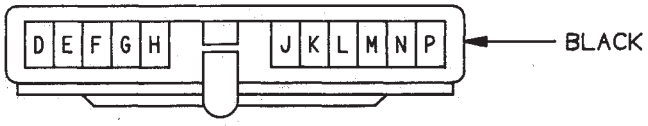


VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
C1	—	—	—
C2	—	—	—
C3	505 18TN/BK *	TRANSMISSION OUTPUT SPEED SENSOR	26
C4	137 16YL/BK *	TRANSMISSION DATA LINK CONNECTOR	25
C5	—	—	—
C6	—	—	—
C7	—	—	—
C8	506 18LG/BK *	1-2 GEAR INPUT	25
C9	507 18GY/BK *	DRIVE GEAR INPUT	25
C10	K29 18WT/PK *	BRAKE SENSE SIGNAL	26
C11	177 20TN	TRANSMISSION SWITCH POWER MODE	26
C12	—	—	—
C13	—	—	—
C14	508 18WT/BK*	TRANSMISSION SOLENOID	26
C15	509 18VT/WT*	SOLENOID S2	26
C16	510 18DB/WT*	SOLENOID S1	26
D1	—	—	—
D2	K22 18OR/DB*	THROTTLE POSITION (SENSOR)	26
D3	K4 18BK/LB *	SENSOR GROUND	26
D4	—	—	—
D5	—	—	—
D6	—	—	—
D7	Z12 18BK/TN*	POWER GROUND	26
D8	—	—	—
D9	—	—	—
D10	—	—	—
D11	—	—	—
D12	—	—	—
D13	—	—	—
D14	A14 14RD	AUTOMATIC SHUT DOWN RELAY	26
D15	—	—	—
D16	T17 18YL	MODULE FEED (IGNITION)	25

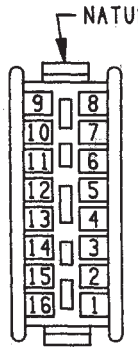
TRANSMISSION CONTROL MODULE (TCM) CONNECTOR





VIEWED FROM TERMINAL END

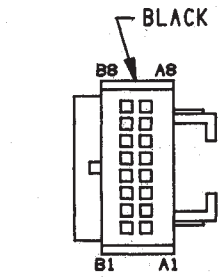
CAV	CIRCUIT	FUNCTION	SHEET
P	—	—	—
N	L60 18TN/DG *	RIGHT REAR TURN SIGNAL	46
M	L61 18LG/BK *	LEFT REAR TURN SIGNAL	46
L	L5 18BK	TURN SIGNAL FLASHER	46
K	L12 18VT/TN *	HAZARD FLASHER	46
J	L60 18TN	RIGHT FRONT TURN SIGNAL	46
H	L61 18LG	LEFT FRONT TURN SIGNAL	46
G	X3 20BK/RD *	HORN SWITCH	34
F	M11 20PK/LB *	SWITCHED COURTESY LAMP FEED	74
E	G26 20LB	IGNITION KEY WARNING SWITCH	74
D	—	—	—



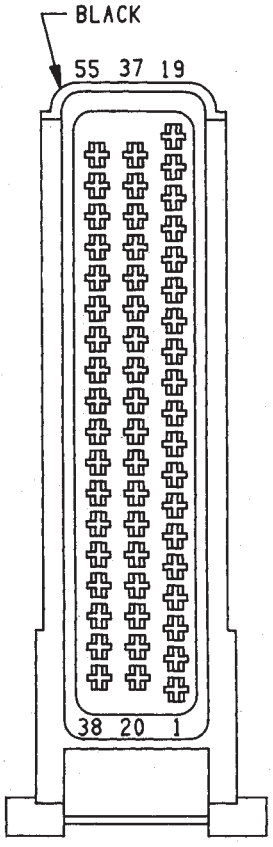
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	G29 20BK/TN*	LOW WASHER FLUID LEVEL INDICATOR	56
2	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	56
3	F87 20WT/OR*	FUSE IGNITION 'D'	56
3	F87 20WT/BK*	FUSE IGNITION 'D'	56
4	F87 20WT/BK*	FUSE IGNITION 'D'	56
4	F87 20WT/BK*	FUSE IGNITION 'D'	56
5	—	—	—
6	205 18YL	ABS YELLOW LAMP	56
7	K54 20LG/OR*	UPSHIFT INDICATOR LAMP	56
8	203 18DG	BRAKE PRESSURE/PARK BRAKE LAMP	56
9	—	—	—
10	M1 20PK	COURTESY LAMP	56
11	106 20BK/YL*	4WD SWITCH	56
12	107 20BK/LB*	4WD LAMP	56
13	—	—	—
14	F87 20WT/BK*	FUSE IGNITION 'D'	56
14	F87 20WT/BK*	FUSE IGNITION 'D'	56
15	G11 20WT	SEAT BELT LAMP	56
16	Z1 20BK	GROUND	56
16	Z1 20BK	GROUND	56

CAV	CIRCUIT	FUNCTION	SHEET
A1	G20 20VT/YL*	ENGINE COOLANT TEMPERATURE	55
A2	L61 18LG	LEFT TURN INDICATOR LAMP	55
A3	Z1 20BK	GROUND	55
A4	L3 16RD/YL*	HEADLAMP (HIGH BEAM)	55
A5	G7 20WT/OR*	VEHICLE SPEED SIGNAL	55
A6	G21 20GY/LB*	TACHOMETER SIGNAL	55
A7	E2 20OR/BK*	PANEL ILLUMINATION	55
A8	F87 20WT/BK*	FUSED IGNITION 'D'	55
B1	G4 20DB	FUEL GAUGE	55
B2	Z2 18BK/LG	LOGIC GROUND	55
B3	—	—	—
B4	—	—	—
B5	—	—	—
B6	L60 18TN	RIGHT TURN INDICATOR LAMP	55
B7	G6 20GY	ENGINE OIL PRESSURE INDICATOR	55
B8	G12 20DG/BK*	CHECK GAUGE LAMP	55



VIEWED FROM TERMINAL END



VIEWED FROM TERMINAL END

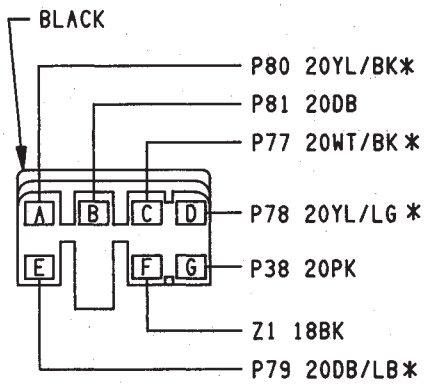
	CAV	CIRCUIT	FUNCTION	SHEET
	1	Z1 14BK	GROUND	33
	2	B243 16DG/BK *	LEFT FRONT DELAY VALVE	33
	3	235 14GY/YL *	SOLENOID (12 VOLTS)	33
	15	B116 18GY	PUMP RELAY COIL (B—)	31
	16	B258 18GY/LB *	TRANSDUCER FEED (+)	30
	19	Z1 14BK	GROUND	33
	20	B245 16WT/LG *	LEFT FRONT ISOLATE VALVE	33
	21	B248 16DG/WT *	RIGHT FRONT DELAY VALVE	33
*	23	D1 18VT/BR *	SERIAL BUSS (B+)	32
	25	515 18YL/VT *	ACCEL SENSOR	30
	26	517 18PK/OR *	ACCEL SENSOR	30
*	27	B2 18YL	RIGHT REAR WHEEL SENSOR (+)	29
*	28	B3 18LG/DB *	LEFT REAR WHEEL SENSOR (—)	29
*	29	B6 18WT/DB *	RIGHT FRONT WHEEL SENSOR (—)	29
*	30	B8 18RD/DB *	LEFT FRONT WHEEL SENSOR (—)	29
*	31	B219 18DB	BOOST PRESSURE	30
	32	L50 18WT/TN *	STOP LAMP FEED	32
	33	235 14GY/YL *	SOLENOID (12 VOLTS)	33
	34	207 18PK	ABS RELAY #1	31
	36	B254 16DG/OR *	RIGHT AND LEFT REAR DELAY VALVE	33
	38	B249 16WT/TN *	RIGHT FRONT ISOLATE VALVE	33
	41	B210 18RD/BK *	TRANSDUCER RETURN (—)	30
*	42	D2 18WT/BK *	SERIAL BUSS (B—)	32
	43	516 18TN/WT *	ACCEL SENSOR	30
*	45	B1 18YL/DB *	RIGHT REAR WHEEL SENSOR (—)	29
*	46	B4 18LG	LEFT REAR WHEEL SENSOR (+)	29
*	47	B7 18WT	RIGHT FRONT WHEEL SENSOR (+)	29
*	48	B9 18RD	LEFT FRONT WHEEL SENSOR (+)	29
*	49	B220 18TN	BOOST PRESSURE RETURN	30
	52	205 18VT	YELLOW LAMP	32
	53	236 18LG/YL *	IGNITION (12 VOLTS)	32
	54	B251 16WT/BK *	LEFT REAR ISOLATE VALVE	33

* INDICATES TWISTED PAIRS D1+D2, B1+B2, B3+B4, B6+B7, B8+B9, B219+B220

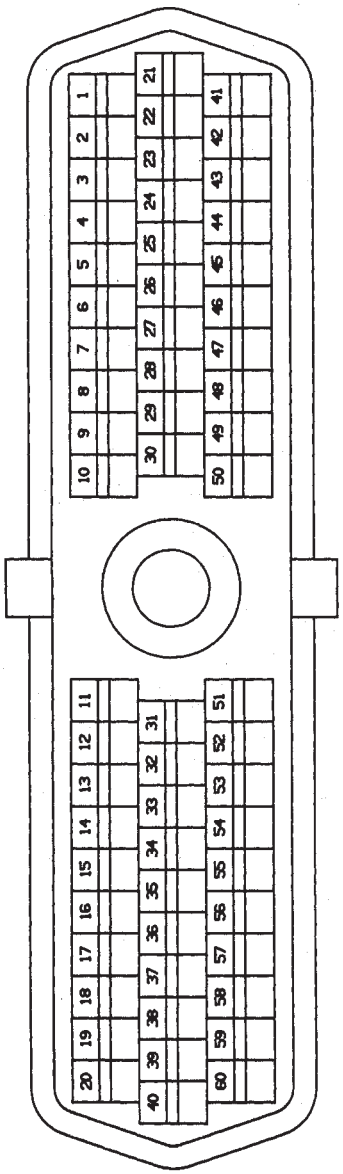
ANTI-LOCK BRAKE CONTROL MODULE CONNECTOR

J948W-7

CAV	CIRCUIT	FUNCTION	SHEET
A	P80 20YL/BK*	UP/DOWN MOTOR (LEFT)	73
B	P81 20DB	RIGHT/LEFT MOTOR (LEFT)	73
C	P77 20WT/BK*	RIGHT/LEFT MOTOR (RIGHT)	73
D	P78 20YL/LG*	UP/DOWN MOTOR (RIGHT)	73
E	P79 20DB/LB*	MIRROR RETURN	73
F	Z1 18BK	GROUND	73
G	P38 20PK	MIRROR FEED (B+)	73



VIEWED FROM TERMINAL END

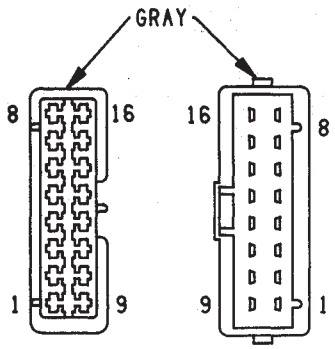


VIEWED FROM WIRE END

* INDICATES TWISTED PAIR

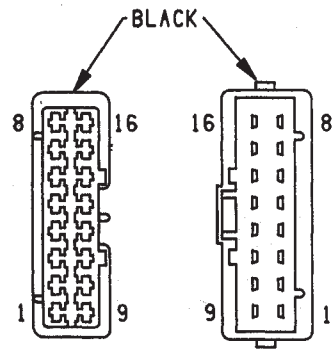
	CAV	CIRCUIT	FUNCTION	SHEET
	1	K1 20DG/RD *	MAP SENSOR	14,19
	2	K2 16TN/BK *	ENGINE COOLANT TEMPERATURE SENSOR	14,19
	3	A14 14RD	AUTOMATIC SHUT DOWN RELAY	12,17
	4	K4 18BK/LB *	SENSOR GROUND	14,19
	5	Z11 16BK/WT *	SIGNAL GROUND	16,18
	6	K6 20VT/WT *	5 VOLT SUPPLY	14,19
	7	K7 18OR	8 VOLT SUPPLY	11,20
	8	—	—	—
	9	A21 14DB	IGNITION START/RUN	12,17
	10	K10 18VT	POWER STEERING SWITCH (2.5L)	15,17
	11	Z12 16BK/TN *	POWER GROUND	13,21
	12	Z12 16BK/TN *	POWER GROUND	13,21
	13	K14 18LB/BR *	INJECTOR 4	15,22
	14	K13 18YL/WT *	INJECTOR 3	15,22
	15	K12 18TN	INJECTOR 2	15,22
	16	K11 18WT/DB *	INJECTOR 1	15,22
	17	—	—	—
	18	—	—	—
	19	K19 18GY	IGNITION COIL DRIVER #1	16,18
	20	K20 18DG	VOLTAGE REGULATOR	13,20
	21	K21 16BK/RD *	INTAKE AIR TEMPERATURE SENSOR	14,19
	22	K22 18OR/DB *	THROTTLE POSITION (SENSOR)	14,19
	23	—	—	—
	24	K24 18GY/BK *	DISTRIBUTOR IGNITION SENSOR	11,20
	25	D21 20PK	SERIAL COMMUNICATION INTERFACE	16,18
*	26	D1 18VT/BR *	SERIAL BUSS B+ (4.0L AUTO ONLY)	21
	27	C91 16LB	A/C REQUEST	69
	28	C90 16LG	A/C SELECT	69
	29	K29 18WT/PK *	BRAKE SENSE SIGNAL	45
	30	T41 18BR/YL *	NEUTRAL SENSE (A/TRANS ONLY)	11,21
	31	C27 20DB/PK *	COOLING FAN (4.0L ONLY)	23
	32	G3 20BK/PK *	MALFUNCTION INDICATOR LAMP	55
	33	V36 20TN/RD *	VEHICLE SPEED CONTROL (VACUUM)	36
	34	C13 20DB/OR *	A/C COMPRESSOR CLUTCH RELAY COIL GROUND	69
	35	—	—	—
	36	G12 20DG/YL *	CHECK GAUGE LAMP	55
	37	—	—	—
	38	K15 18PK/BK *	INJECTOR 5 (4.0L ONLY)	22
	39	K39 18GY/RD *	IDLE AIR CONTROL (OPEN)	15,22
	40	K40 18BR/WT *	IDLE AIR CONTROL (CLOSE)	15,22
	41	K41 18BK/DG *	HEATED OXYGEN SENSOR INPUT	13,21
	42	—	—	—
	43	G21 20GY/LB *	TACHOMETER SIGNAL	55
	44	K44 18TN/YL *	CAMSHAFT POSITION SENSOR	11,20
	45	D20 20LG	SERIAL COMMUNICATION INTERFACE	16,18
*	46	D2 18WT/BK *	SERIAL BUSS B— (4.0L AUTO ONLY)	21
	47	G7 20WT/OR *	VEHICLE SPEED SENSOR SIGNAL	11,20
	48	V31 20BR/RD *	VEHICLE SPEED CONTROL (SET)	35
	49	V32 20YL/RD *	VEHICLE SPEED CONTROL (IGNITION)	35,45
	50	V33 20WT/LG *	VEHICLE SPEED CONTROL (RESUME)	35
	51	K51 20DB/YL *	AUTOMATIC SHUT DOWN RELAY	12,17
	52	—	—	—
	53	V35 20LG/RD *	VEHICLE SPEED CONTROL (VENT)	36
	54	K54 20OR/BK *	UPSHIFT INDICATOR LAMP	11,55
	55	—	—	—
	56	—	—	—
	57	A142 18DG/OR *	INJ/SENSE/GENERATOR FEED	15,22
	58	K16 18LG/BK *	INJECTOR 6 (4.0L ONLY)	22
	59	K59 18VT/BK *	IDLE AIR CONTROL (CLOSE)	15,22
	60	K60 18YL/BK *	IDLE AIR CONTROL (CLOSE)	15,22

XJ 111 POWERTRAIN CONTROL MODULE (PCM) CONNECTOR J948W-7



VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	X58 18DB/OR*	RIGHT REAR SPEAKER (B—)	71
2	X52 18DB/WT*	RIGHT REAR SPEAKER (B+)	71
3	E2 20OR/BK*	PANEL ILLUMINATION	48
4	Z1 14BK	GROUND	42
5	M1 20PK	COURTESY LAMP	50,85
6	X57 18BR/LB*	LEFT REAR SPEAKER (B—)	71
7	X51 18BR/YL*	LEFT REAR SPEAKER (B+)	71
8	—	—	—
9	M2 20YL	SWITCHED GROUND	50,75
10	G10 18LG	SEAT BELT SWITCH	74
11	V13 18BR/RD*	REAR WIPER RUN	65
12	F20 18WT	REAR WIPER PARK	65
13	P35 20OR/WT*	RELAY (LOCK)	85
14	P36 20PK/VT*	RELAY (UNLOCK)	85
15	—	—	—
16	—	—	—



VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	A241 14DG/TN*	FUEL PUMP	89
2	L60 18TN/DG*	RIGHT REAR TURN SIGNAL	92,96
3	L90 18DB/RD*	PARK LAMP FEED	41,52,92,96
3	L90 18DB/RD*	PARK LAMP FEED	41,52,92,96
4	G4 20DB	FUEL GAUGE	89
5	L10 18BR/LG*	BACK-UP LAMP FEED	92,96
6	L61 18LG/BK*	LEFT REAR TURN SIGNAL	92,96
7	G9 18GY/OR*	BRAKE WARNING LAMP SWITCH	67
7	203 18DG	BRAKE PRESSURE/PARK BRAKE LAMP	67
8	C15 12BK/RD*	HEATED REAR WINDOW FEED	66
9	—	—	—
10	V20 18BK/WT*	REAR WASHER FEED	65
11	L50 18WT/TN*	STOP LAMP FEED	92,96
11	L50 18WT/TN*	STOP LAMP FEED	92,96
12	P2 18BK/WT*	RELAY TO POWER LOCK MOTOR	85
13	P34 18PK/BK*	DOOR LOCK MOTOR B+ UNLOCK	85
14	—	—	—
15	—	—	—
16	—	—	—

1994 Jeep
Publication No. 81-370-4146
TSB 08-09-94 February 18, 1994

POWER DOOR LOCK RELAY

CAV	CIRCUIT INFORMATION
A1	P2 18BK/WT*
A2	P37 18LG
A2	P37 18LG
A3	P35 20OR/WT*
A4	Z1 18BK
A4	Z1 18BK
A5	Z1 18BK
A5	Z1 18BK

LOCATION A

POWER DOOR UNLOCK RELAY

CAV	CIRCUIT INFORMATION
B1	P34 18PK/BK*
B2	P37 18LG
B3	P36 20PK/VT*
B4	Z1 18BK
B4	Z1 18BK
B5	Z1 18BK

LOCATION B

LCD RELAY

CAV	CIRCUIT INFORMATION
C1	X5 18LB/RDK*
C2	E2 20OR/BK*
C3	Z1 18BK
C3	Z1 18BK
C4	F85 18VT/WT*
C5	L90 18DB/RD*

LOCATION C

HEATED REAR WINDOW RELAY

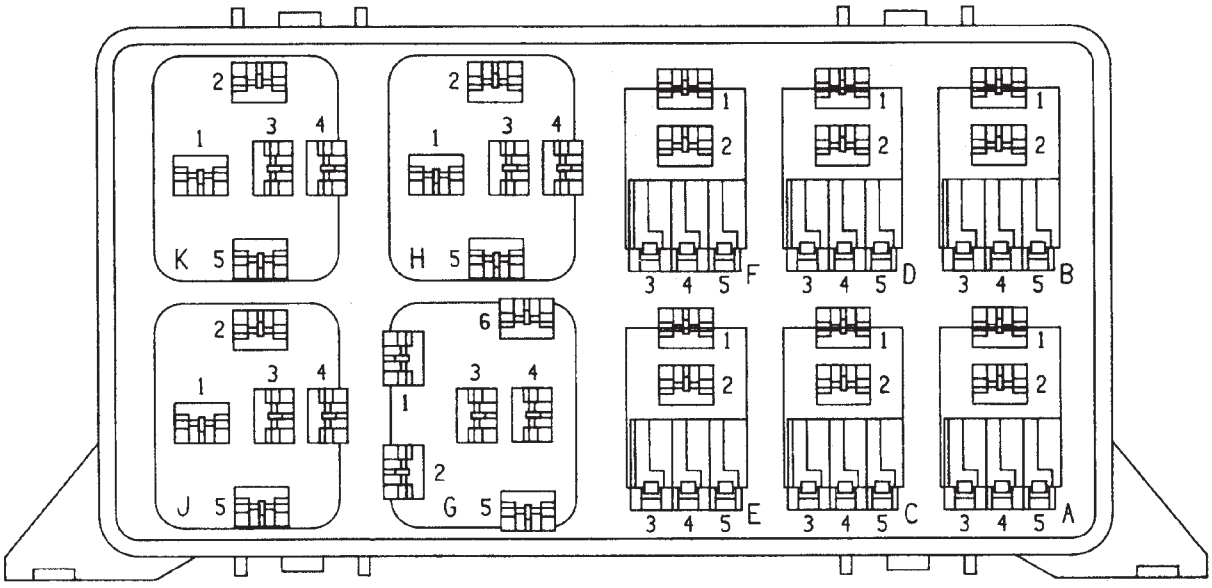
CAV	CIRCUIT INFORMATION
H1	C15 12BK/RD*
H2	Z1 18BK
H3	C80 18DB/RD*
H4	F81 12BR
H5	F83 18YL/RD*

LOCATION H

HORN RELAY

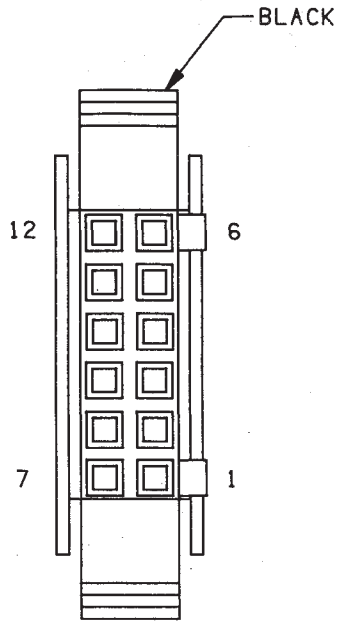
CAV	CIRCUIT INFORMATION
J1	X4 16GY/PK*
J2	X3 20BK/RD*
J4	X2 16DG/RD*
J5	X4 16GY/PK*
J5	X4 16GY/PK*

LOCATION J



VIEWED FROM TERMINAL END

XJ 113 RELAY CENTER IDENTIFICATION J948W-7



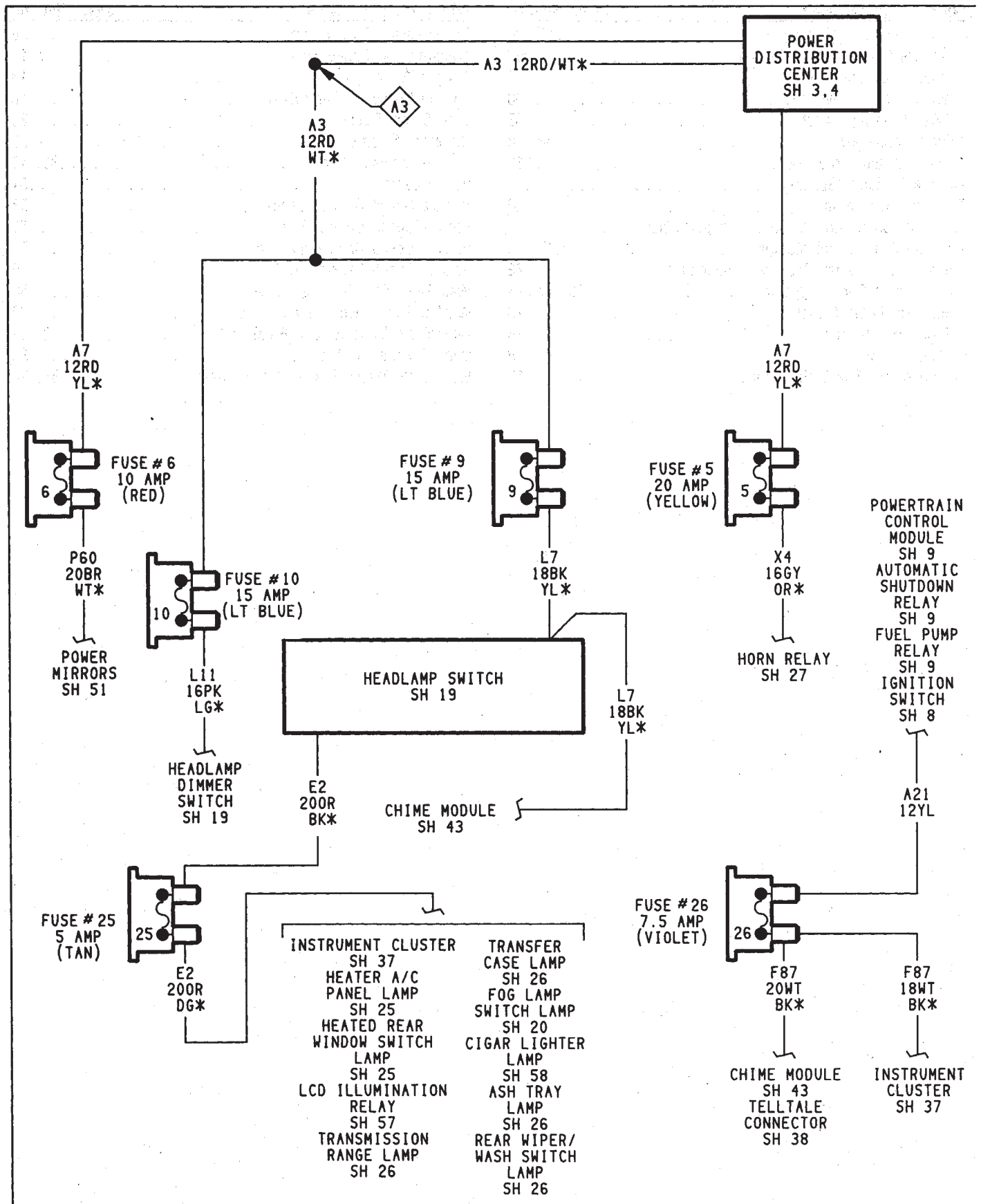
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	M1 20PK	COURTESY LAMP	28
2	G68 20PK/OR *	COURTESY LAMP	28
3	P35 20OR/VT *	RELAY (LOCK)	28
4	P36 20PK/VT *	RELAY (UNLOCK)	28
5	—	—	—
6	—	—	—
7	G72 20DG/OR *	COURTESY LAMP	28
8	F87 20WT/BK *	FUSE IGNITION 'D'	28
9	—	—	—
10	Z1 20BK	GROUND	28
11	—	—	—
12	M2 20YL	SWITCHED GROUND	28

REMOTE KEYLESS ENTRY
MODULE CONNECTOR

WIRING DIAGRAMS XJ-RHD

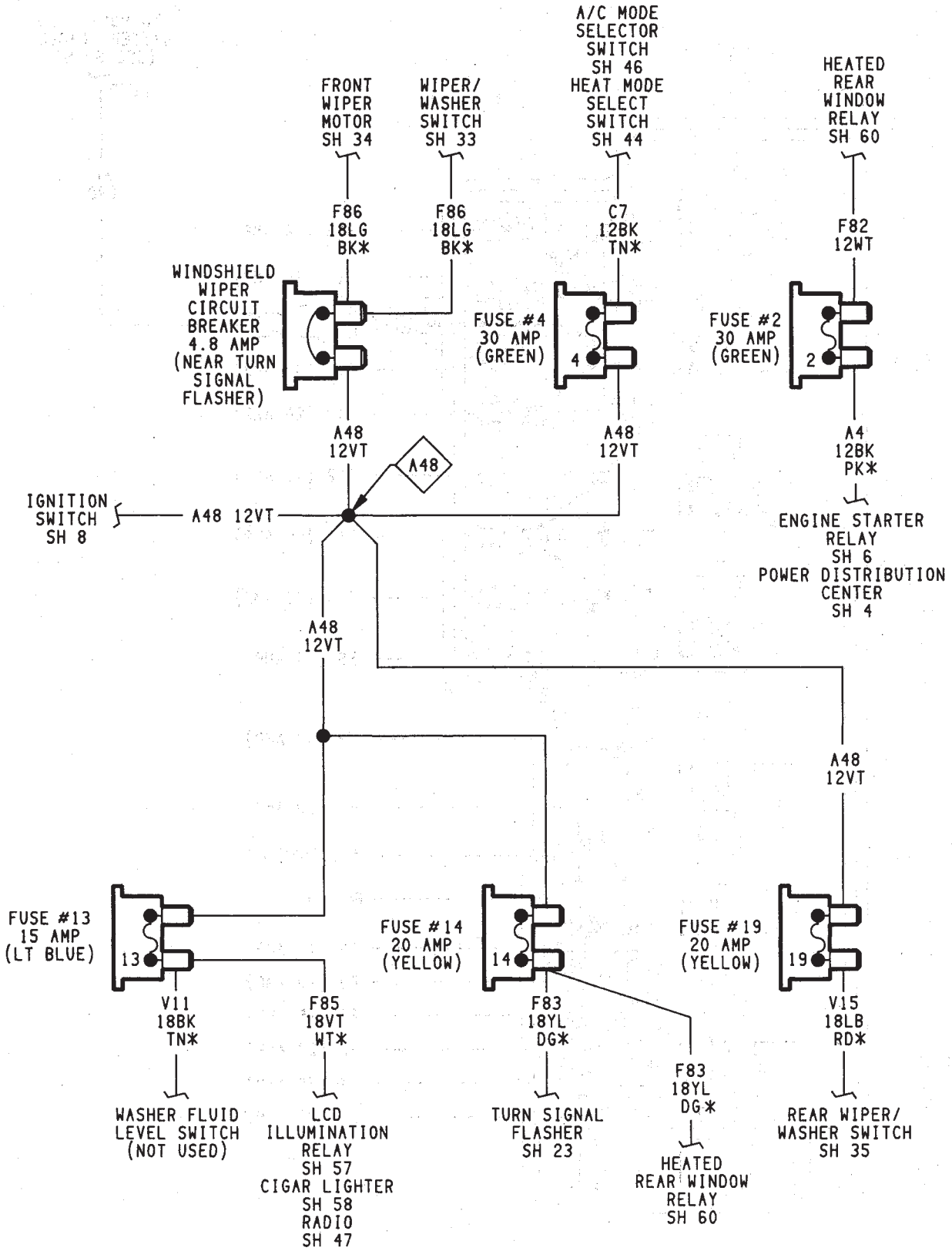
INDEX



XJ-RHD 1

FUSE APPLICATION CHART

J948W-13



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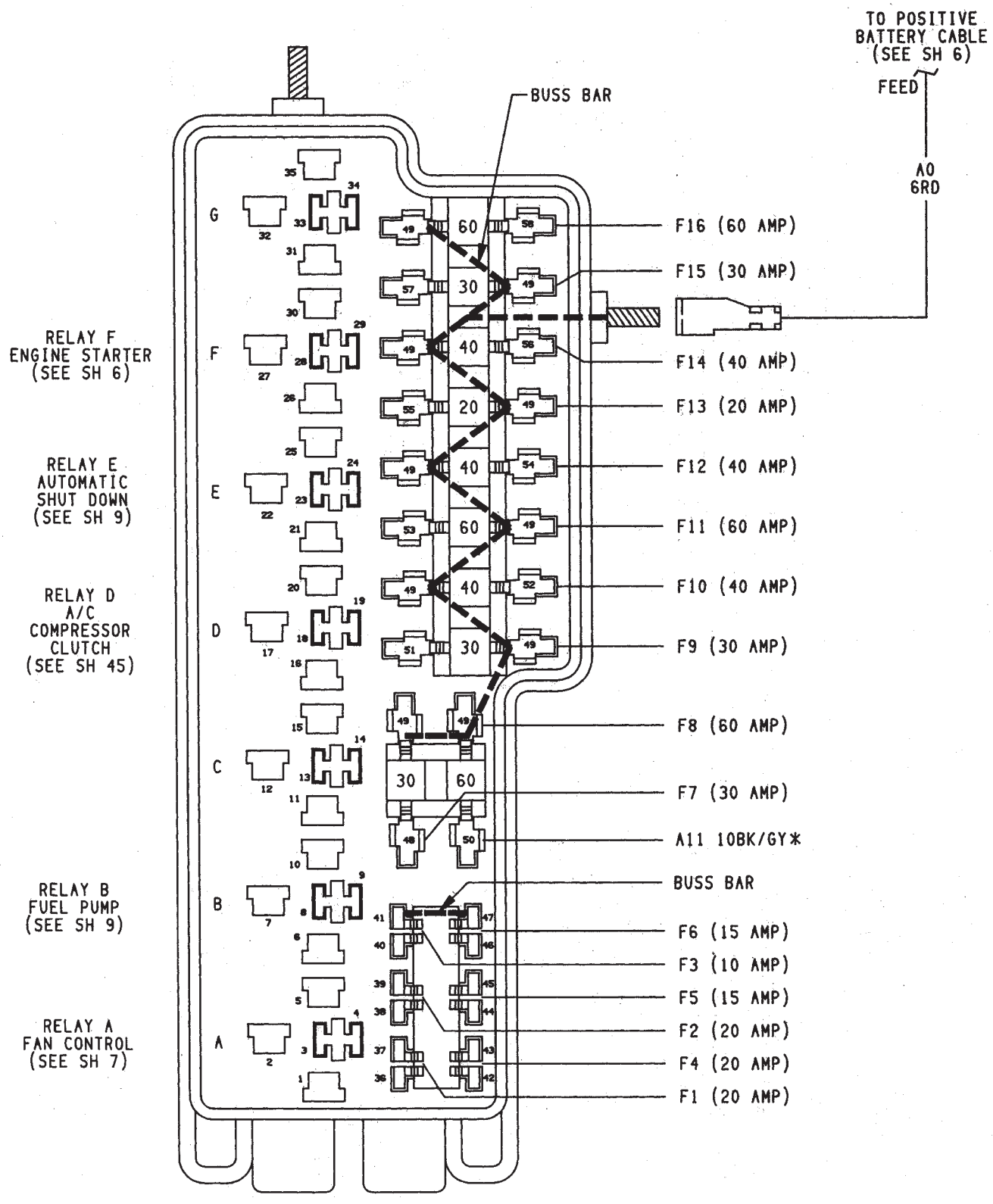
FUSE APPLICATION CHART

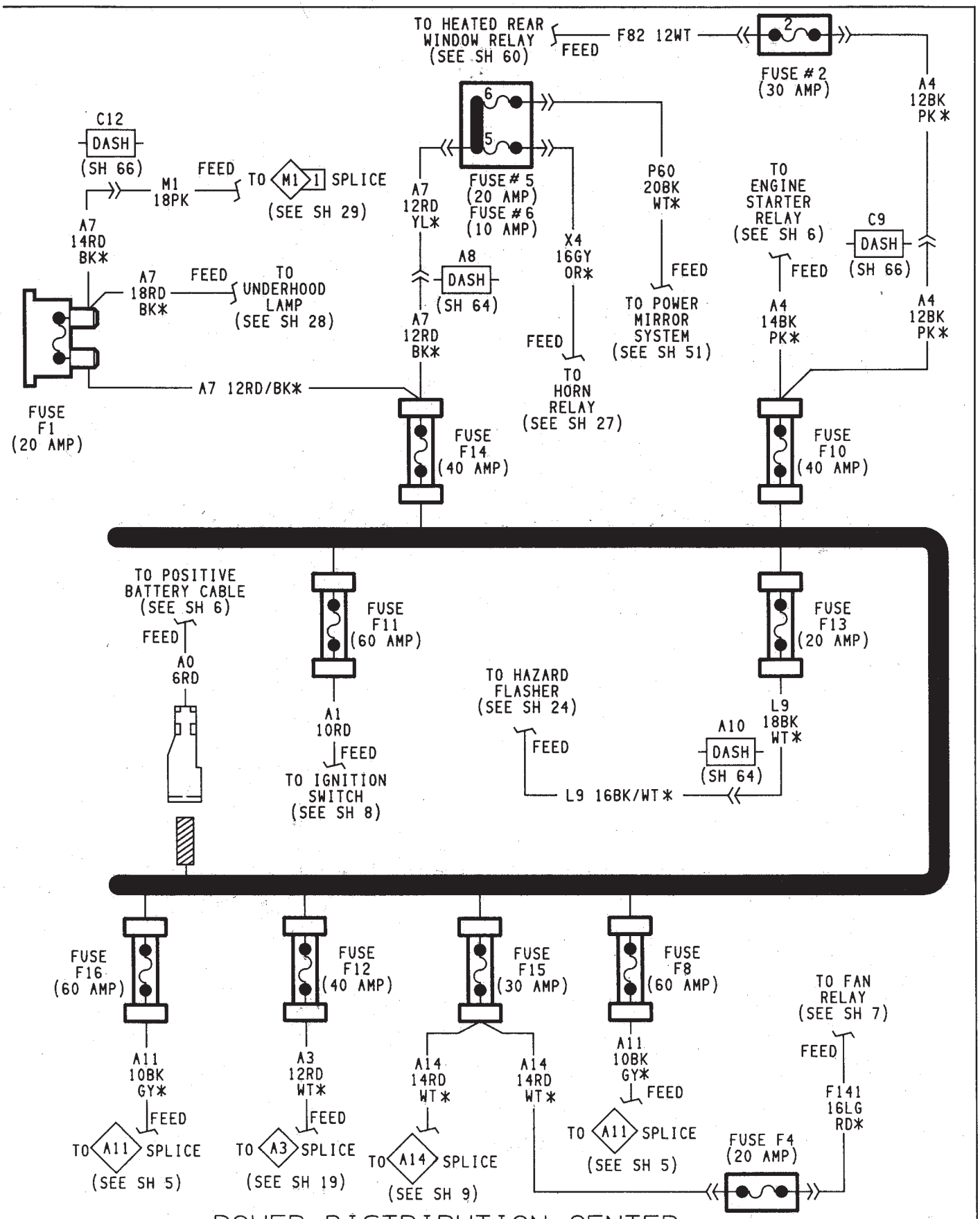
XJ-RHD 2



POWER DISTRIBUTION CENTER IDENTIFICATION

XJ-RHD 3

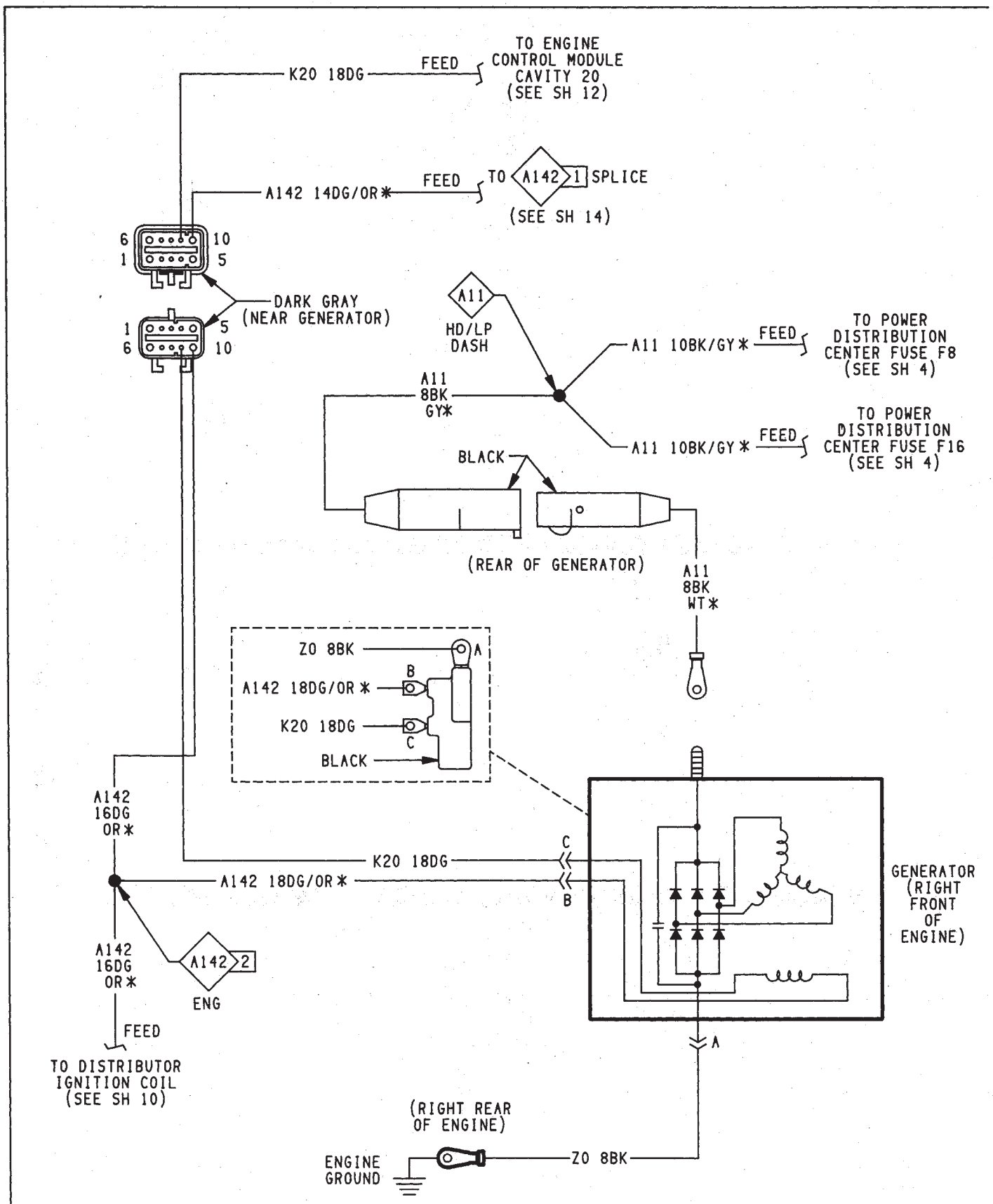
J948W-13



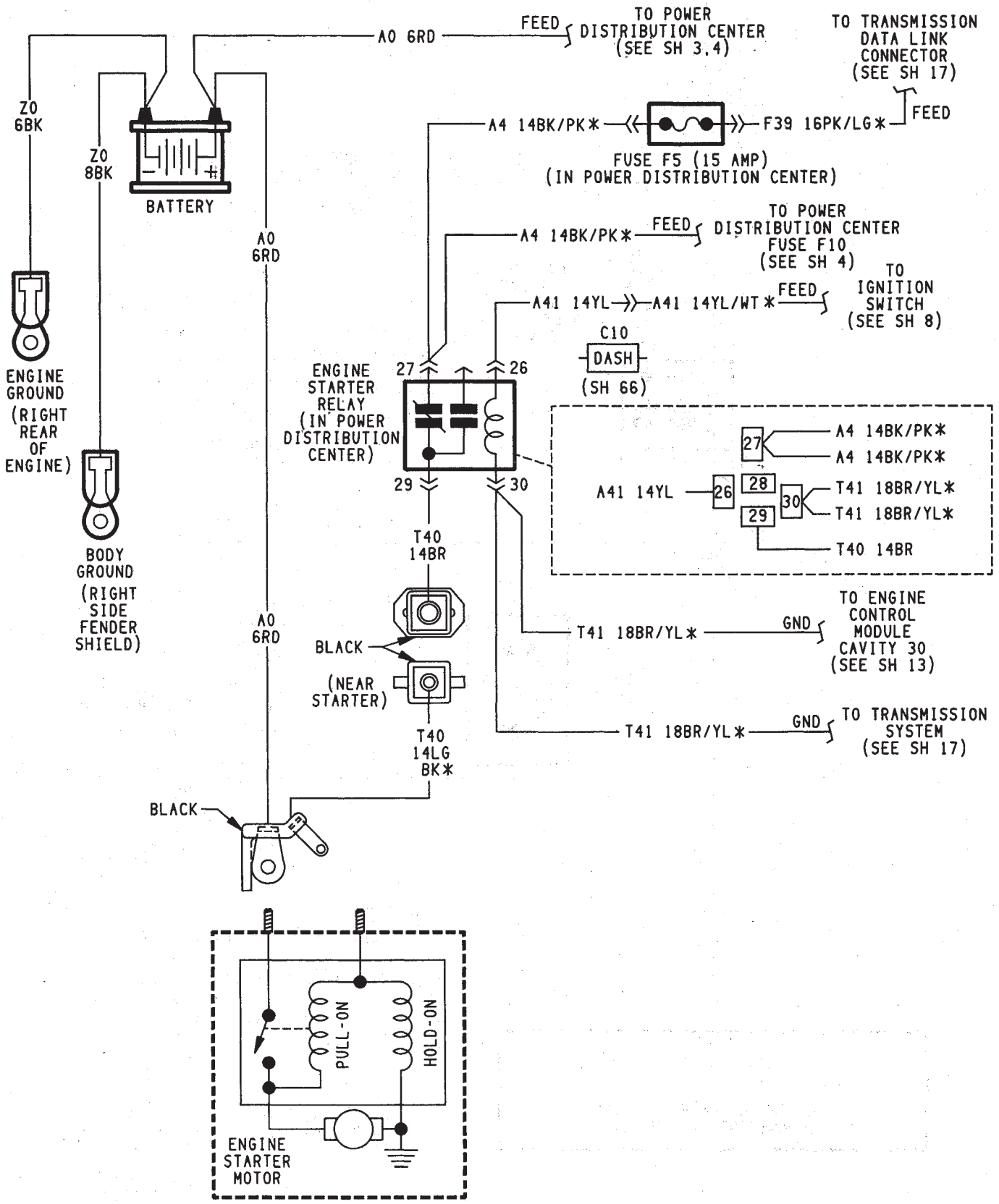
POWER DISTRIBUTION CENTER APPLICATION CHART

J948W-13

XJ-RHD 4



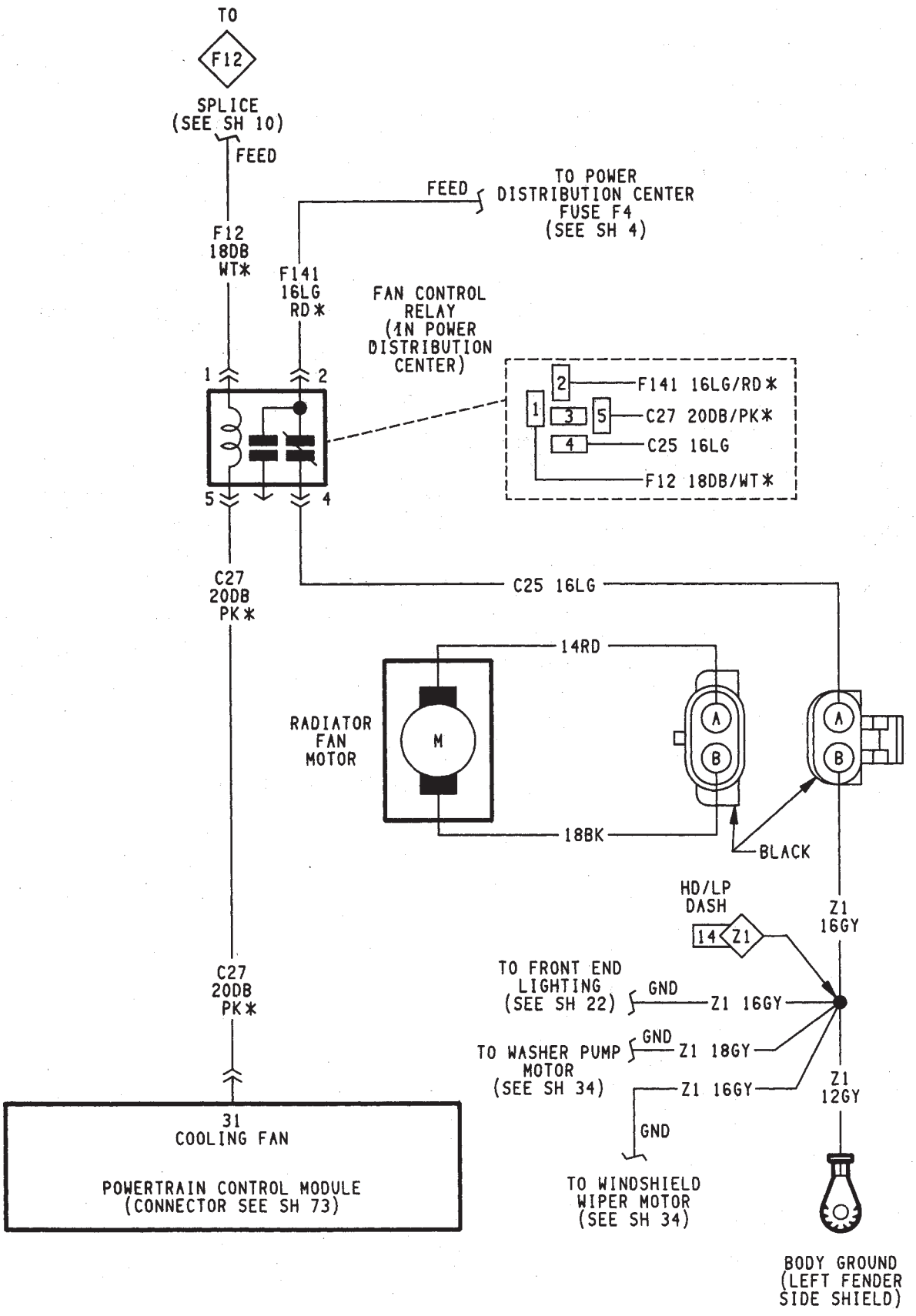
XJ-RHD 5 CHARGING SYSTEM 4.0L ENGINE J948W-13



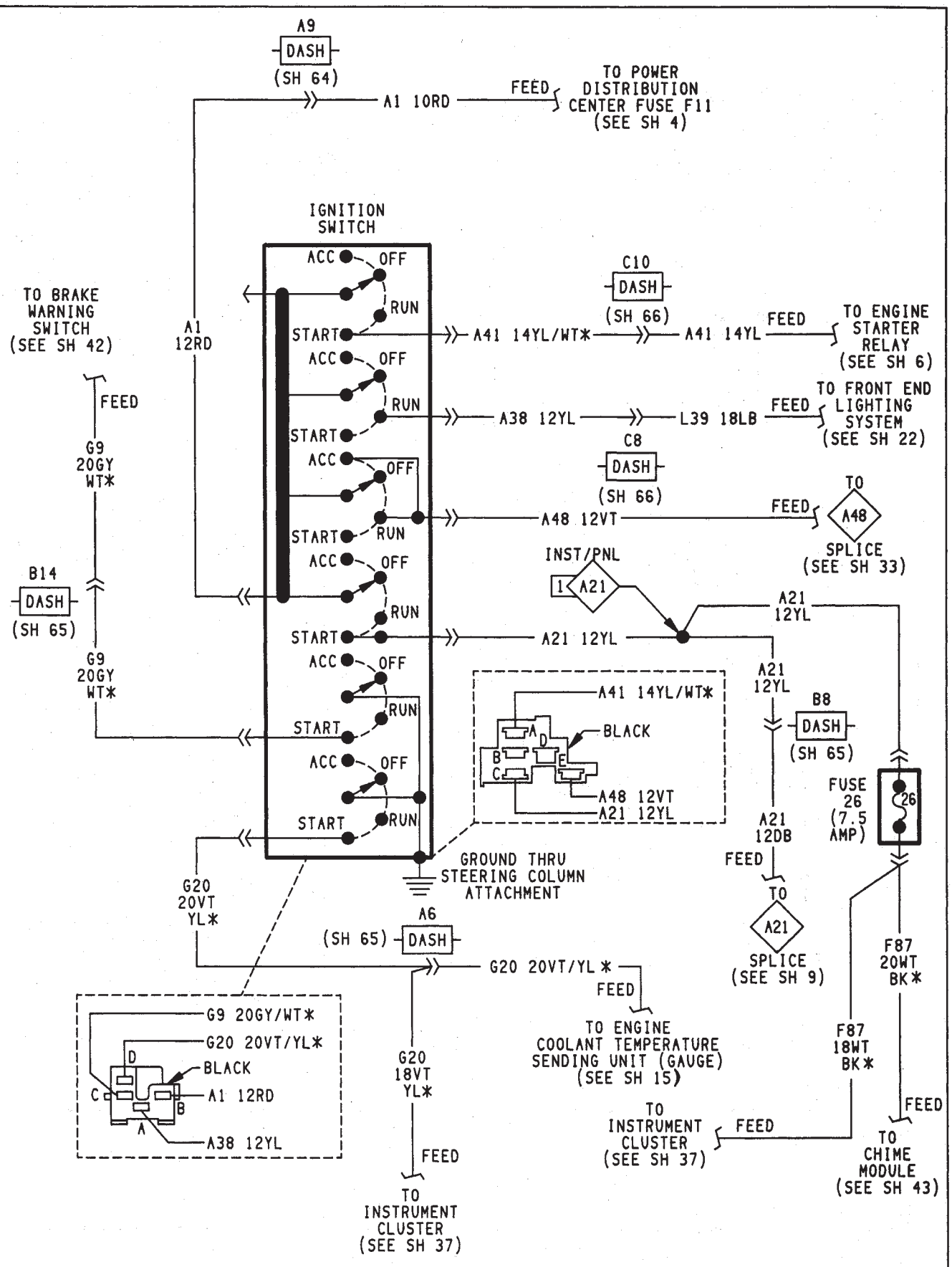
J948W-13

4.0L STARTER SYSTEM

XJ-RHD 6



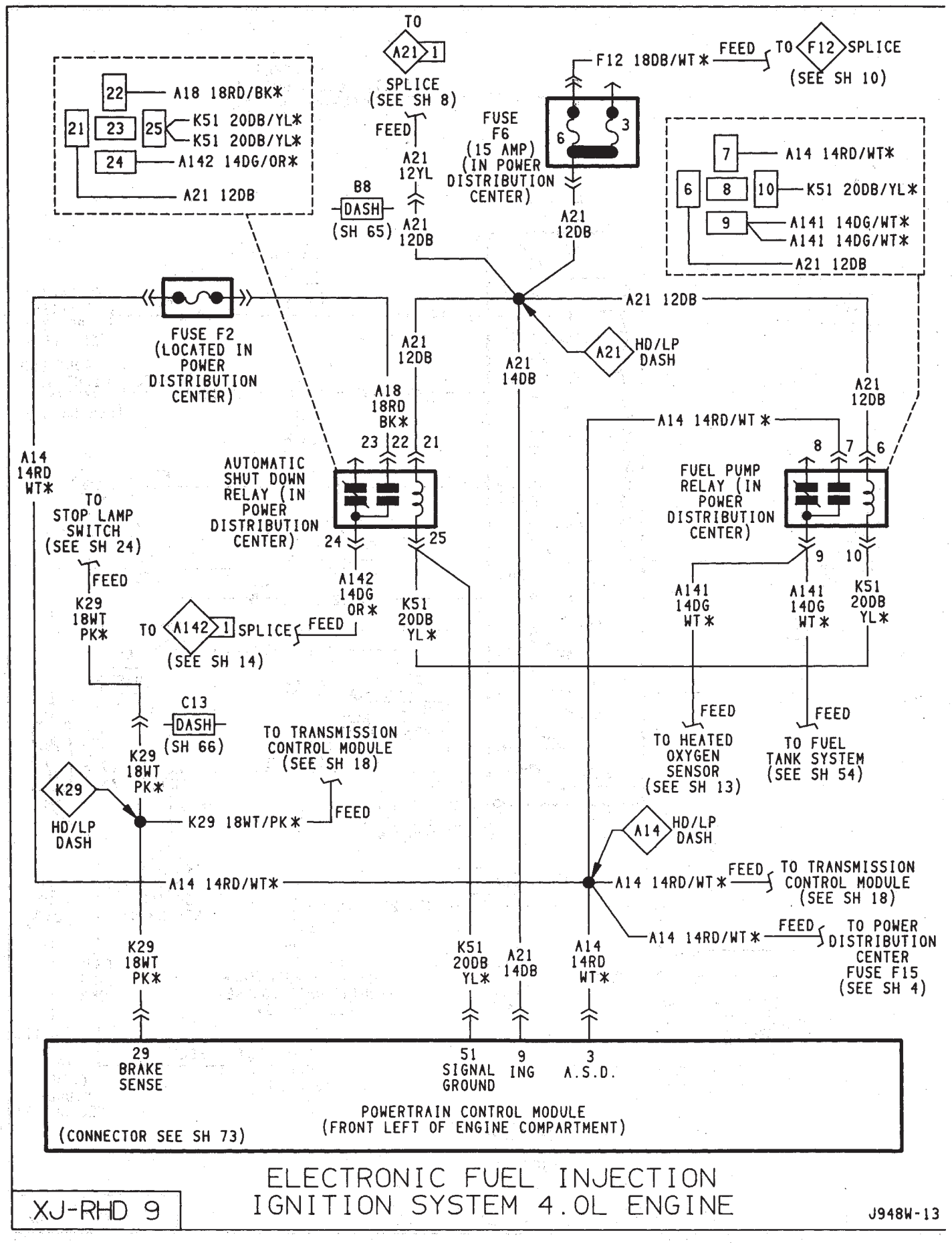
XJ-RHD 7 — 4.0L HEAVY DUTY COOLING — J948W-13



J948W-13

IGNITION SWITCH

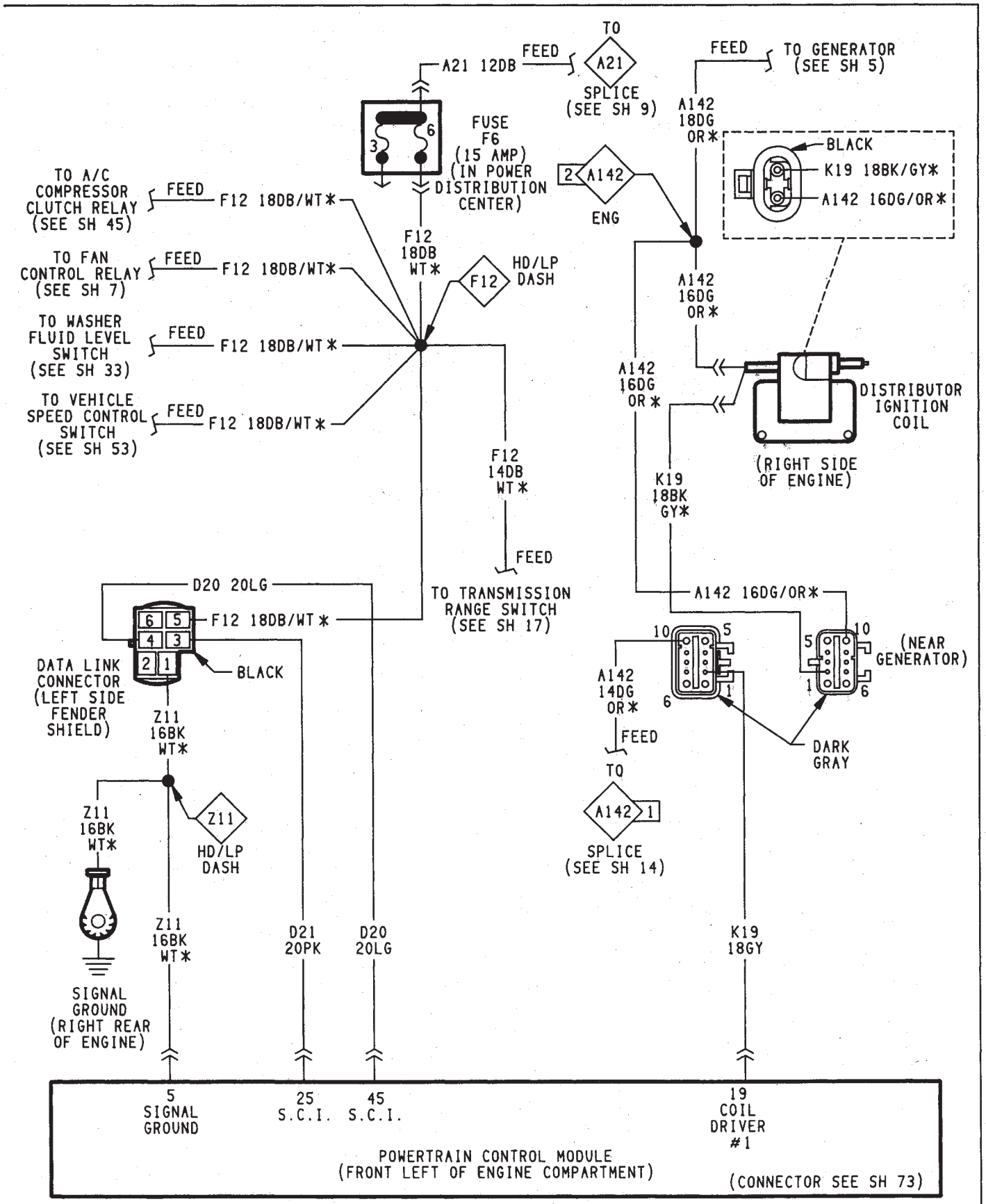
XJ-RHD 8



ELECTRONIC FUEL INJECTION IGNITION SYSTEM 4.0L ENGINE

XJ-RHD 9

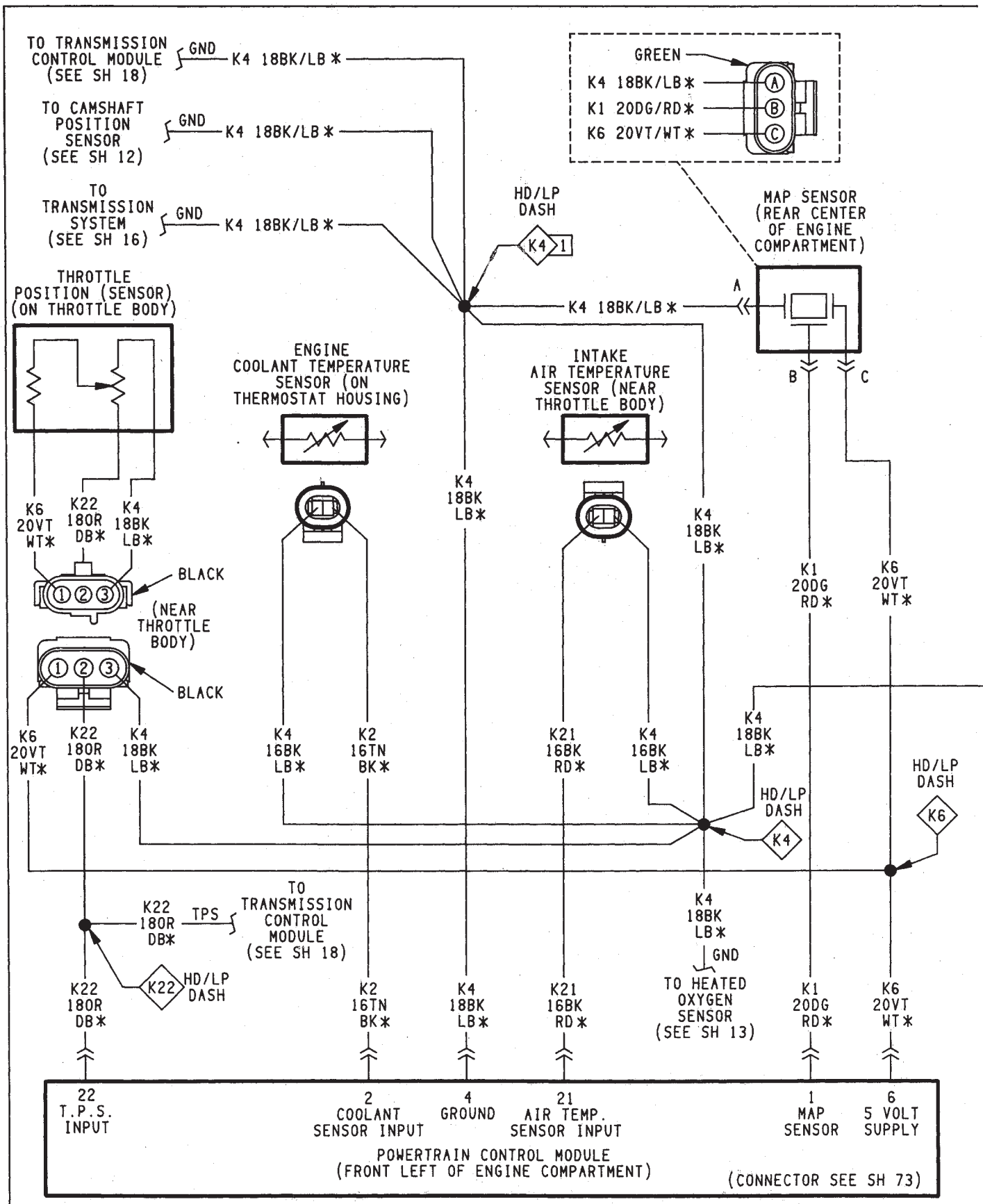
J948W-13



ELECTRONIC FUEL INJECTION IGNITION SYSTEM 4.0L ENGINE

J948W-13

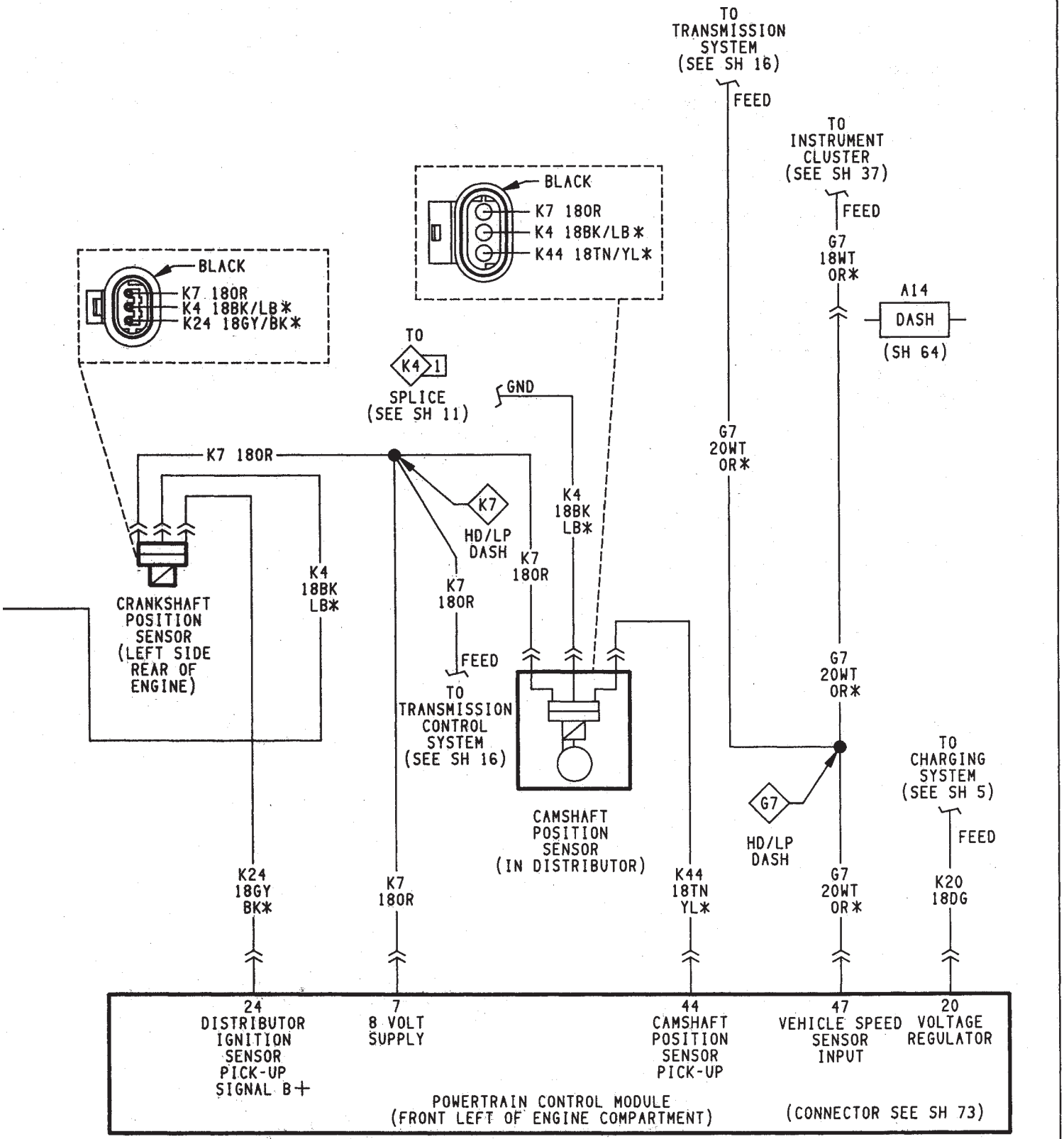
XJ-RHD 10



ELECTRONIC FUEL INJECTION IGNITION SYSTEM 4.0L ENGINE

XJ-RHD 11

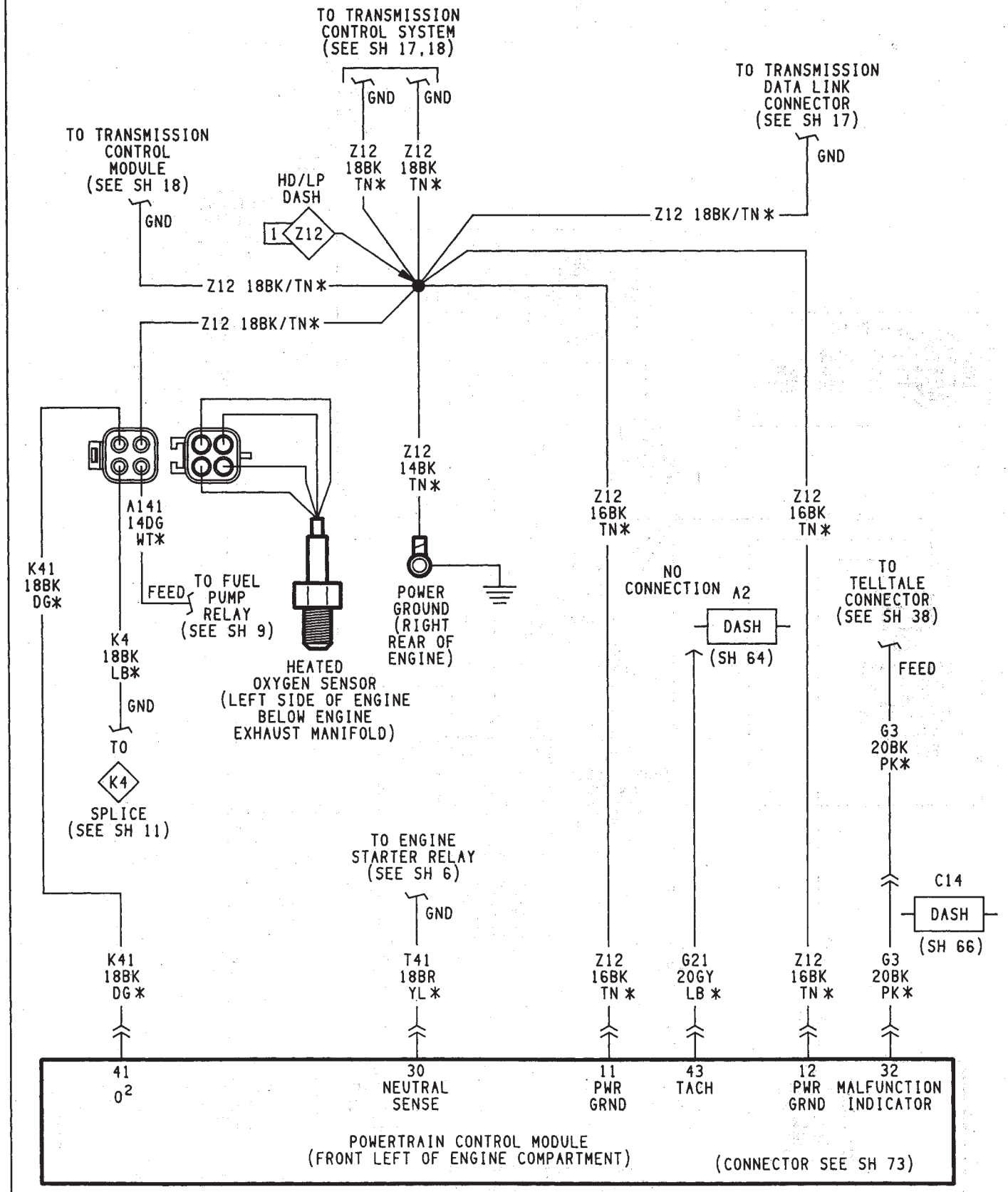
J948W-13



ELECTRONIC FUEL INJECTION IGNITION SYSTEM 4.0L ENGINE

J948W-13

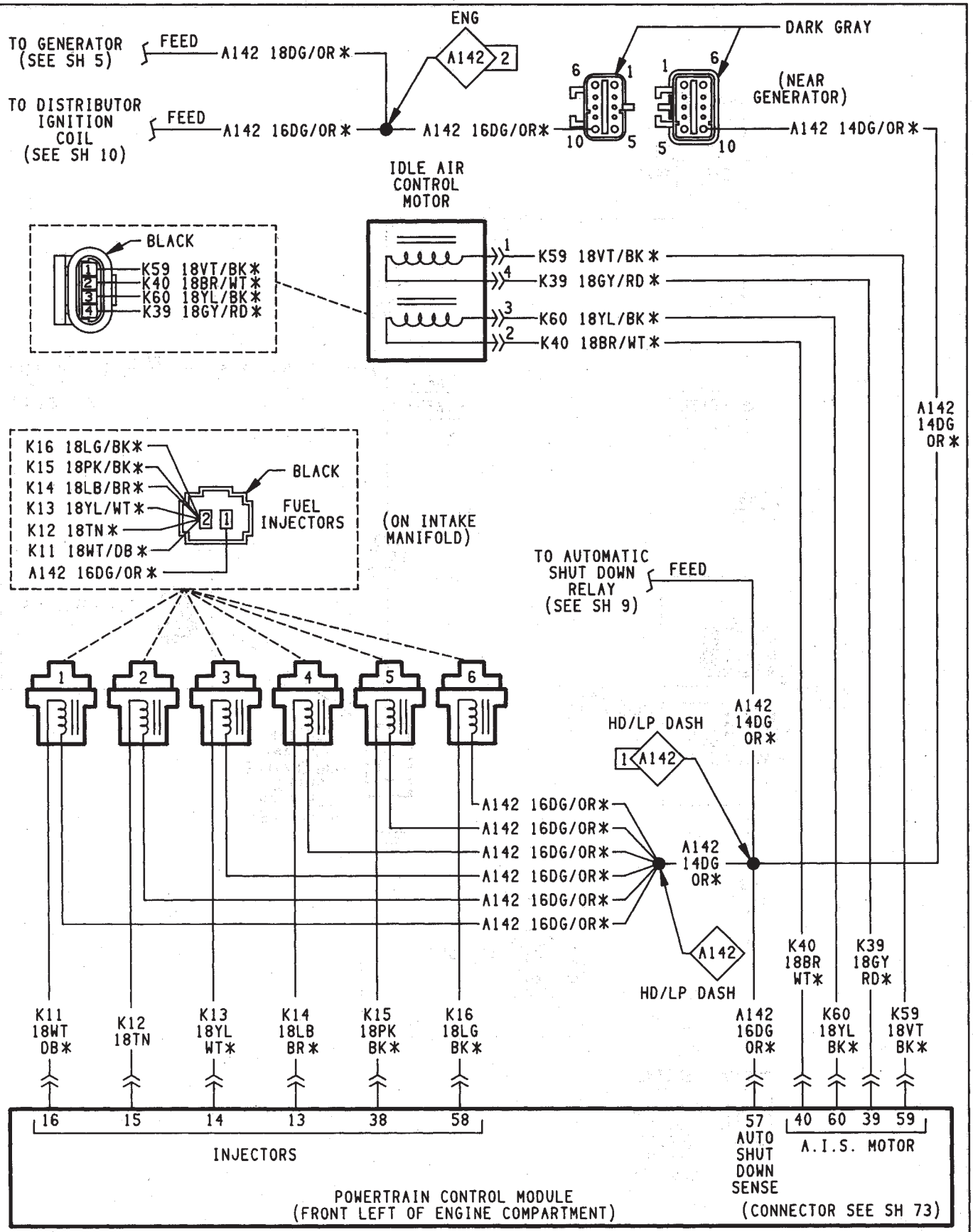
XJ-RHD 12



ELECTRONIC FUEL INJECTION IGNITION SYSTEM 4.0L ENGINE

XJ-RHD 13

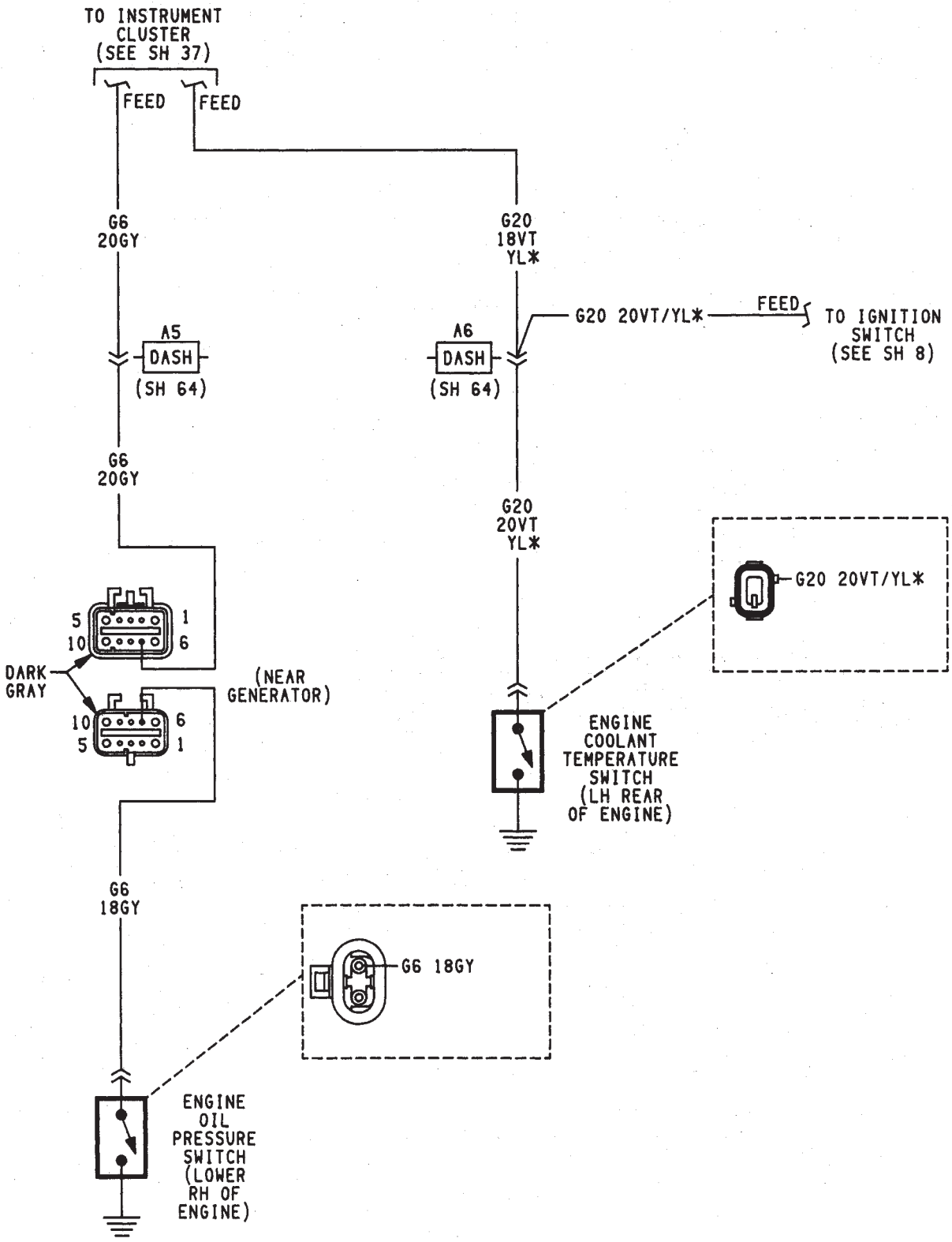
J948W-13



ELECTRONIC FUEL INJECTION IGNITION SYSTEM 4.0L ENGINE

J948W-13

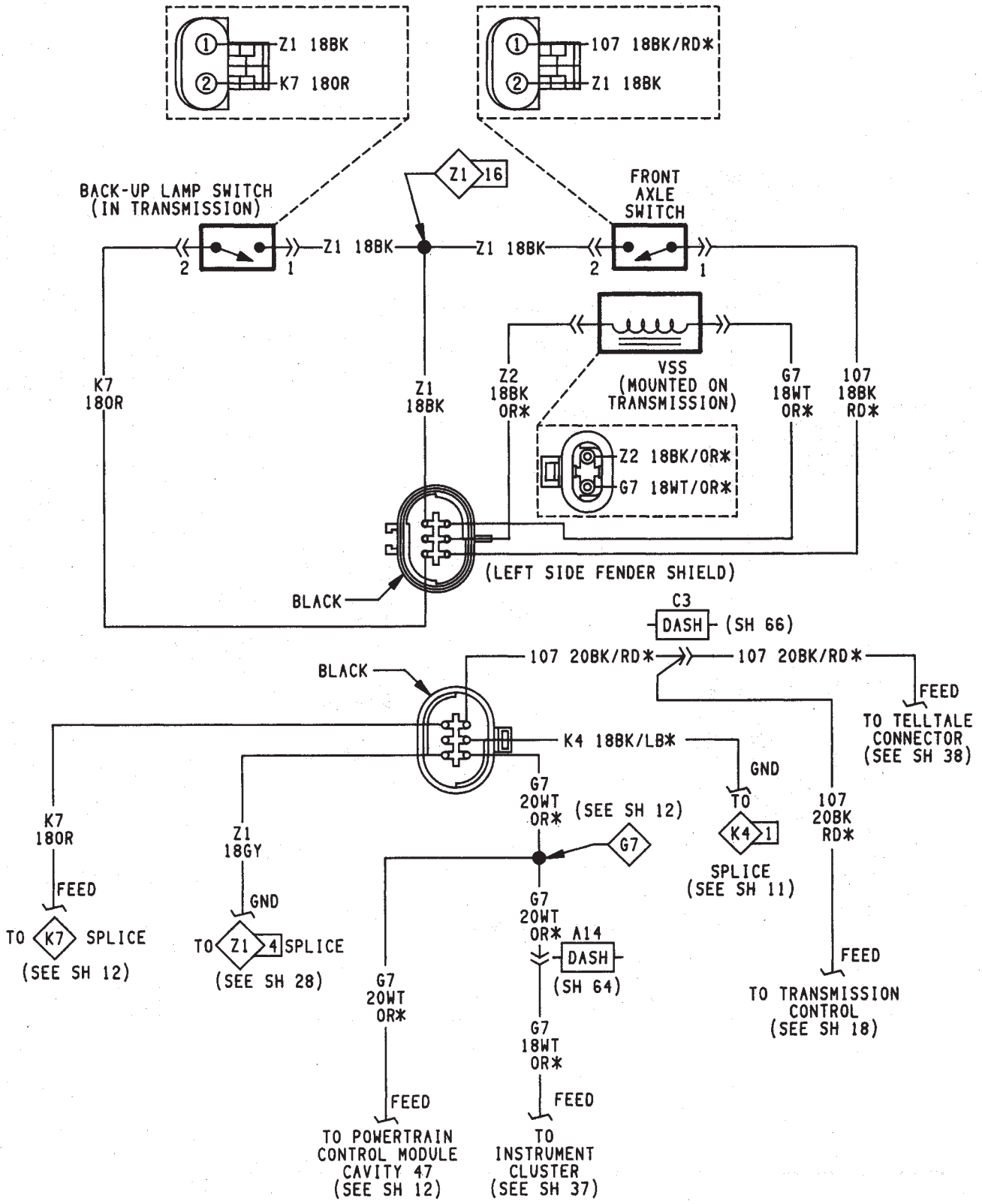
XJ-RHD 14

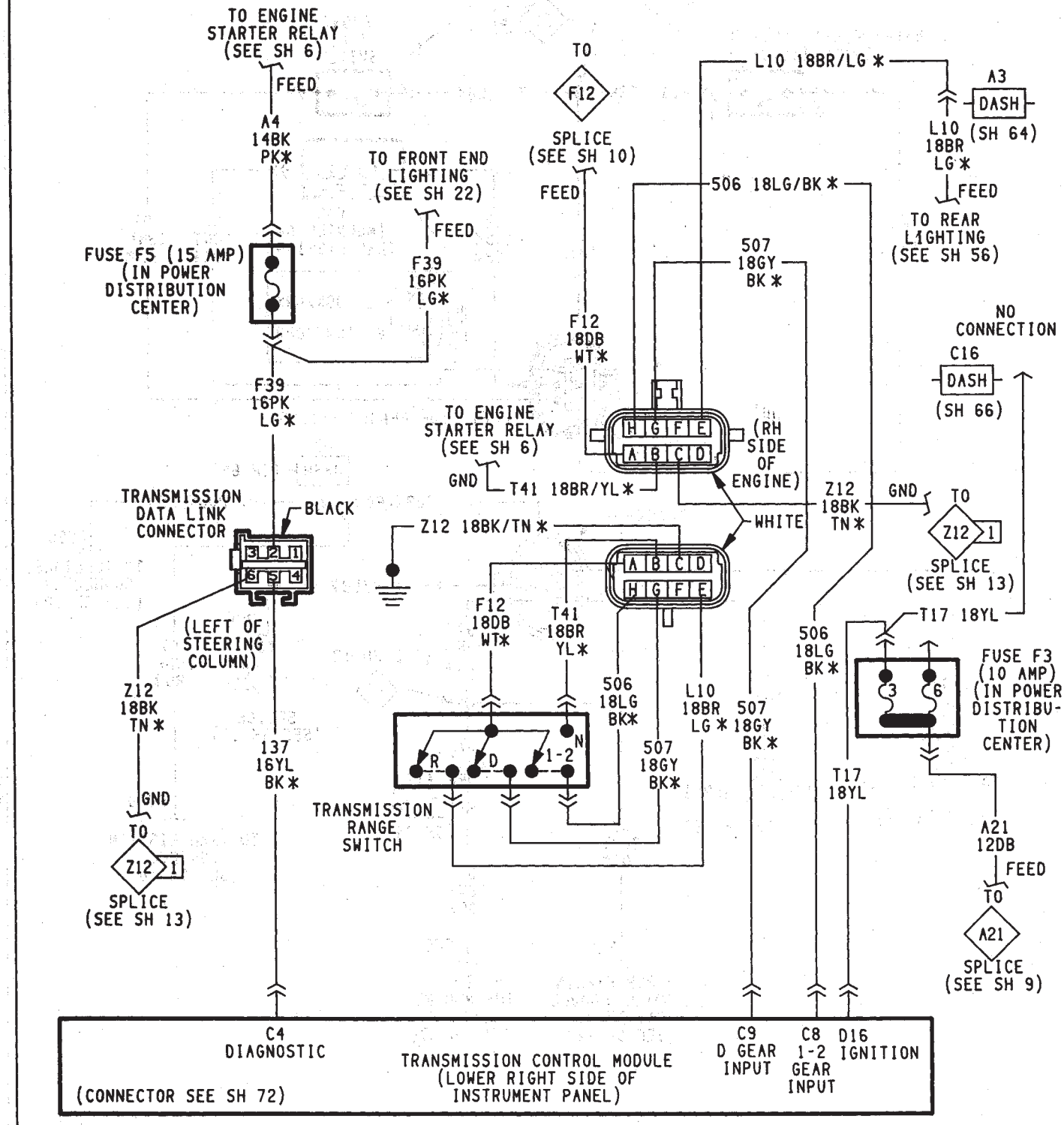


ENGINE OIL PRESSURE AND TEMPERATURE SYSTEM

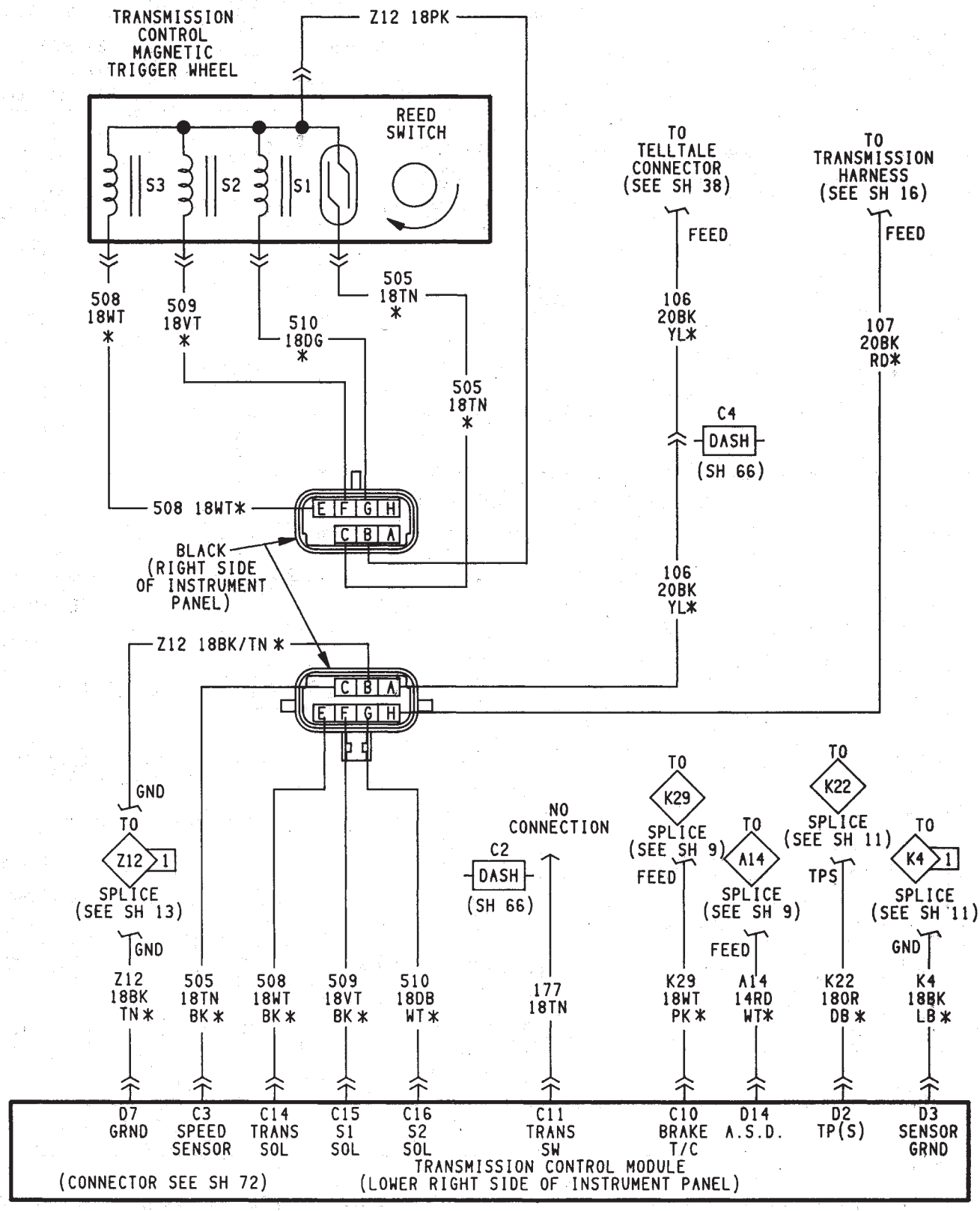
XJ-RHD 15

J948W-13

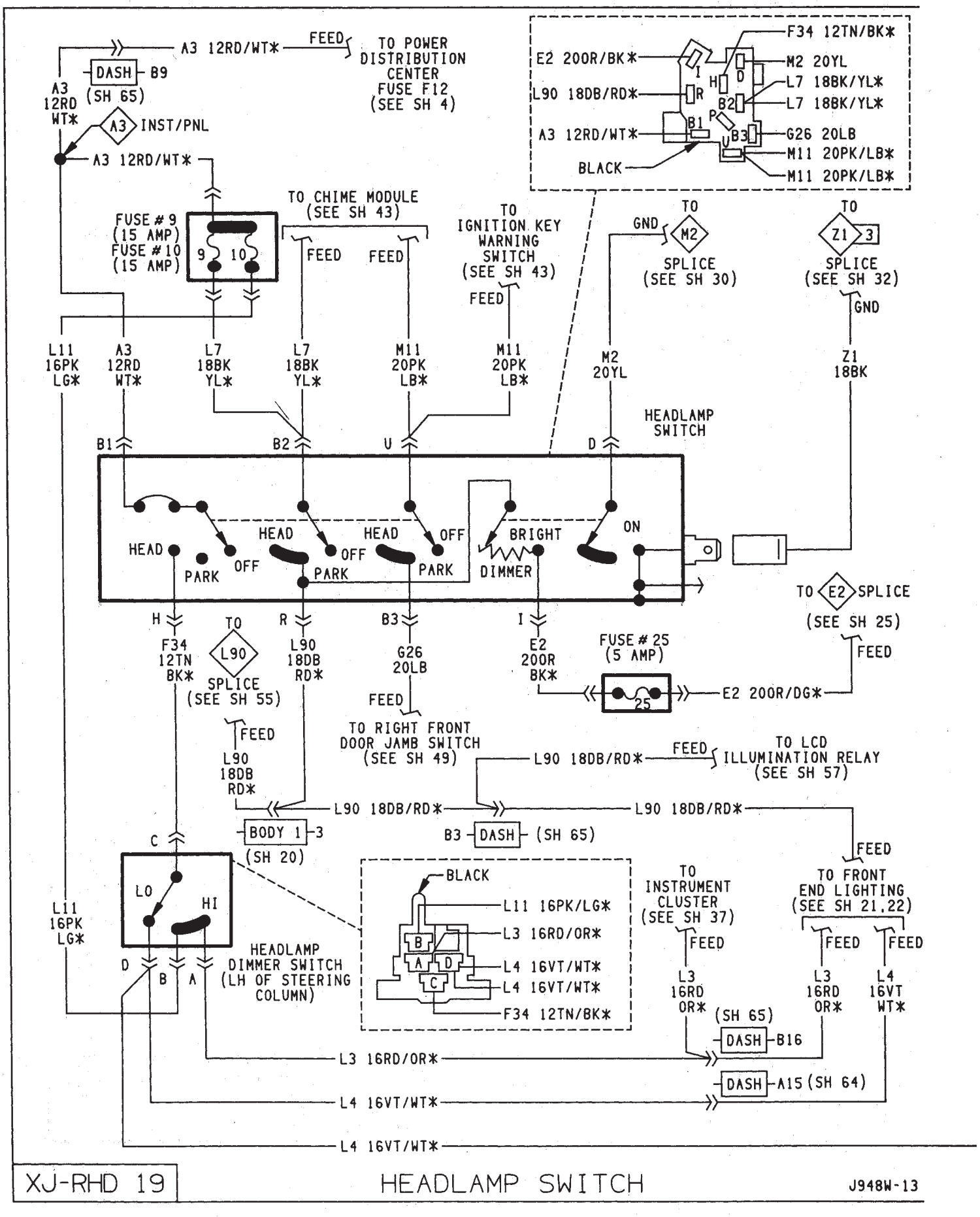

Z1 18BK
K7 180R
107 18BK/RD*
Z1 18BK
BACK-UP LAMP SWITCH (IN TRANSMISSION)
Z1 16
FRONT AXLE SWITCH
Z1 18BK
Z1 18BK
2
1
2
1
K7 180R
Z1 18BK
Z2 18BK OR*
VSS (MOUNTED ON TRANSMISSION)
G7 18WT OR*
107 18BK RD*
Z2 18BK/OR*
G7 18WT/OR*
(LEFT SIDE FENDER SHIELD)
BLACK
C3
DASH
(SH 66)
107 20BK/RD*
107 20BK/RD*
FEED
TO TELLTALE CONNECTOR (SEE SH 38)
BLACK
K4 18BK/LB*
GND
TO
K4 1
SPLICE (SEE SH 11)
G7 20WT OR* (SEE SH 12)
G7
107 20BK RD*
K7 180R
FEED
TO K7 SPLICE
(SEE SH 12)
Z1 18GY
GND
TO Z1 4 SPLICE
(SEE SH 28)
G7 20WT OR*
G7 20WT OR* A14
DASH
(SH 64)
FEED
TO TRANSMISSION CONTROL (SEE SH 18)
G7 20WT OR*
G7 18WT OR*
FEED
TO POWERTRAIN CONTROL MODULE CAVITY 47 (SEE SH 12)
FEED
TO INSTRUMENT CLUSTER (SEE SH 37)



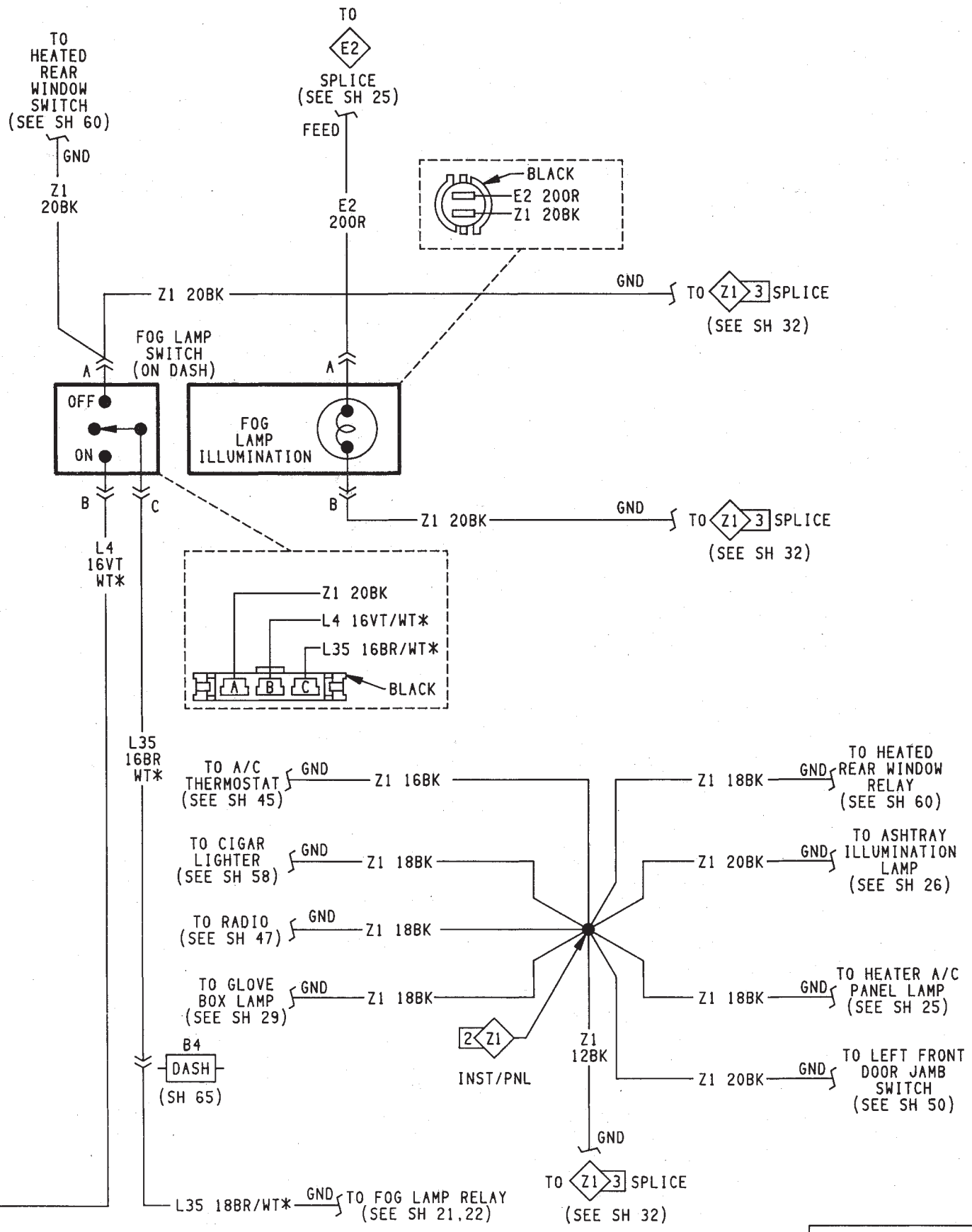
XJ-RHD 17 TRANSMISSION CONTROL SYSTEM 4.0L J948W-13



J948W-13 TRANSMISSION CONTROL SYSTEM 4.0L XJ-RHD 18



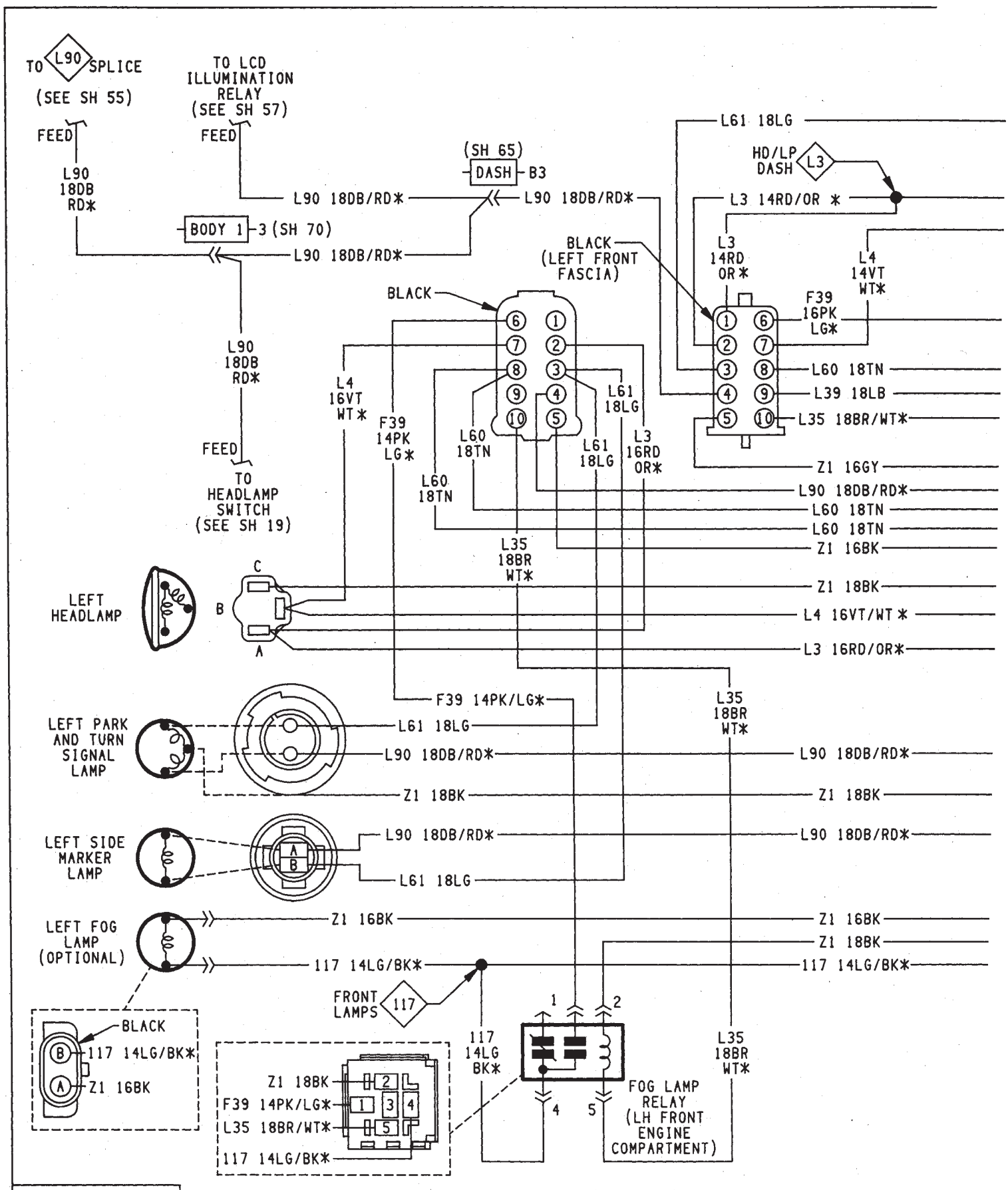
XJ-RHD 19 HEADLAMP SWITCH J948W-13



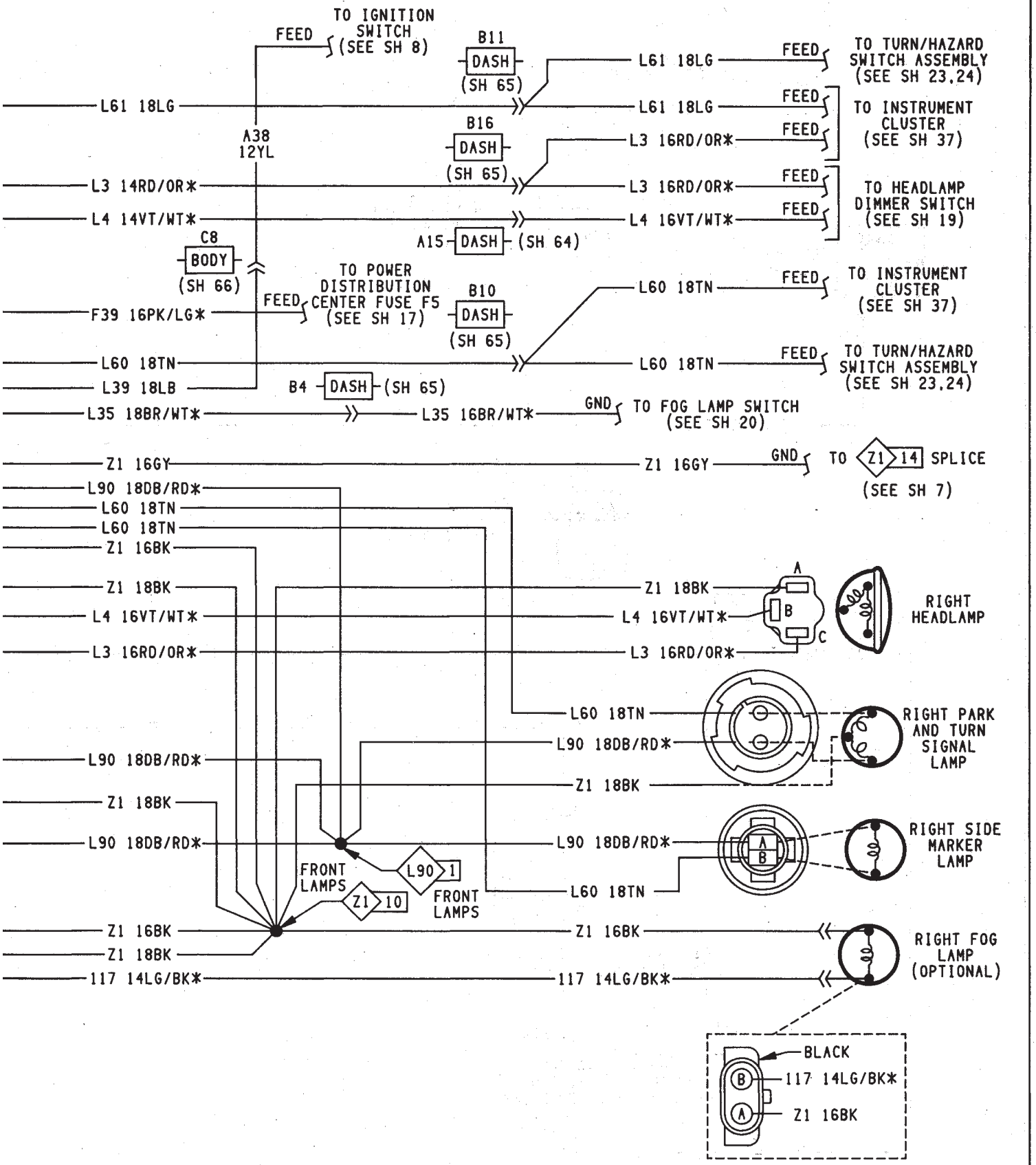
J948W-13

HEADLAMP SWITCH

XJ-RHD 20



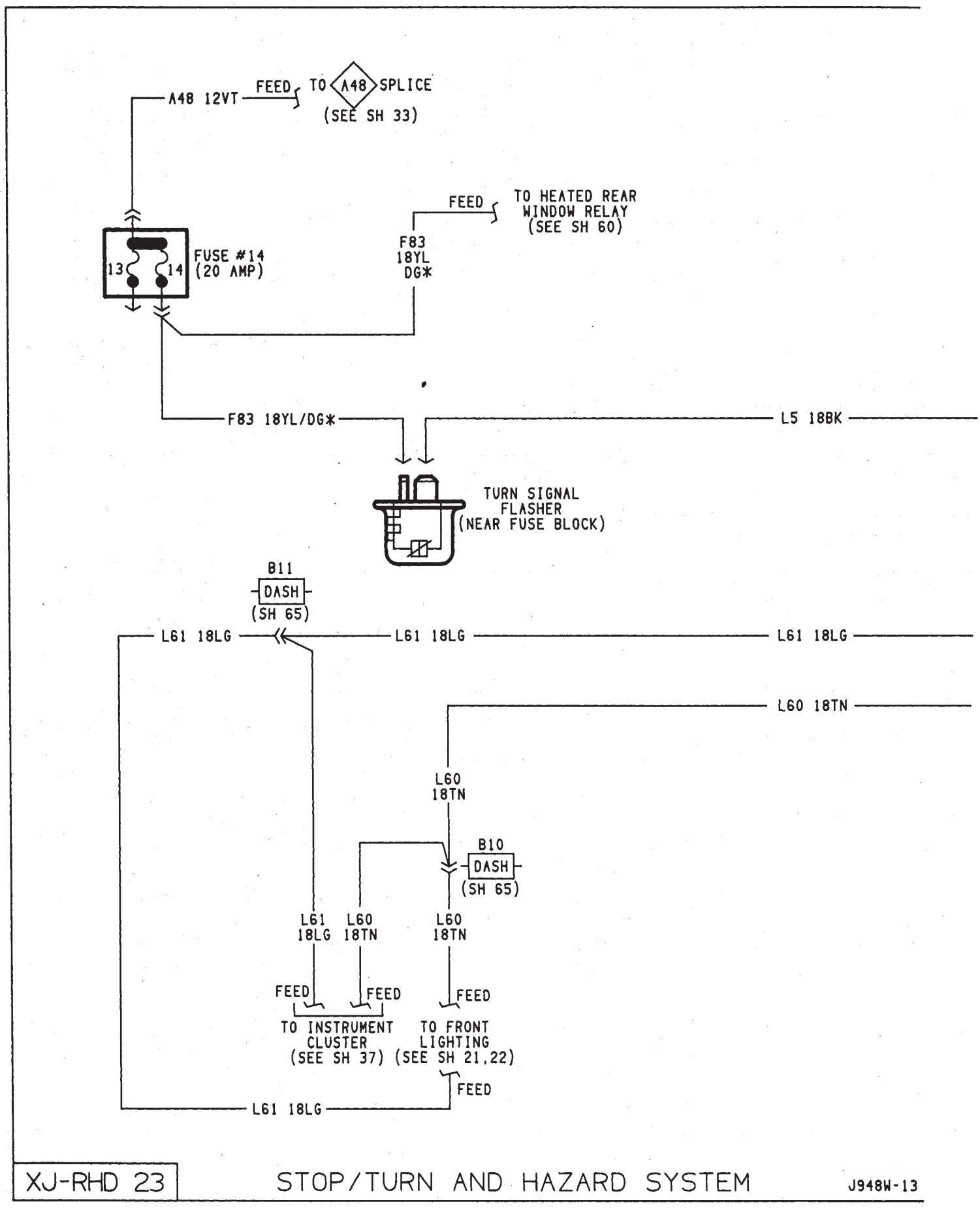
XJ-RHD 21 FRONT END LIGHTING J948W-13



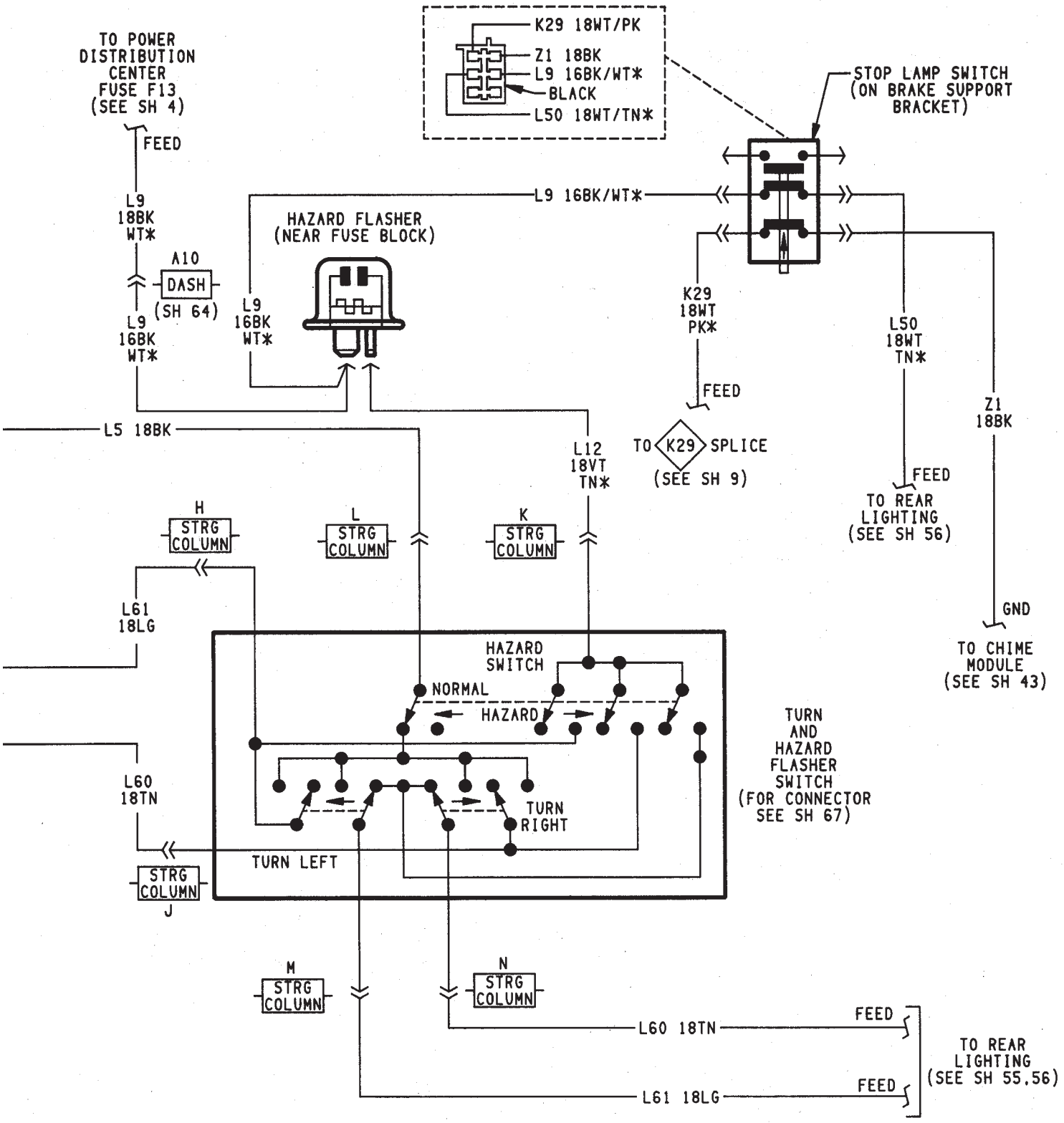
J948W-13

FRONT END LIGHTING

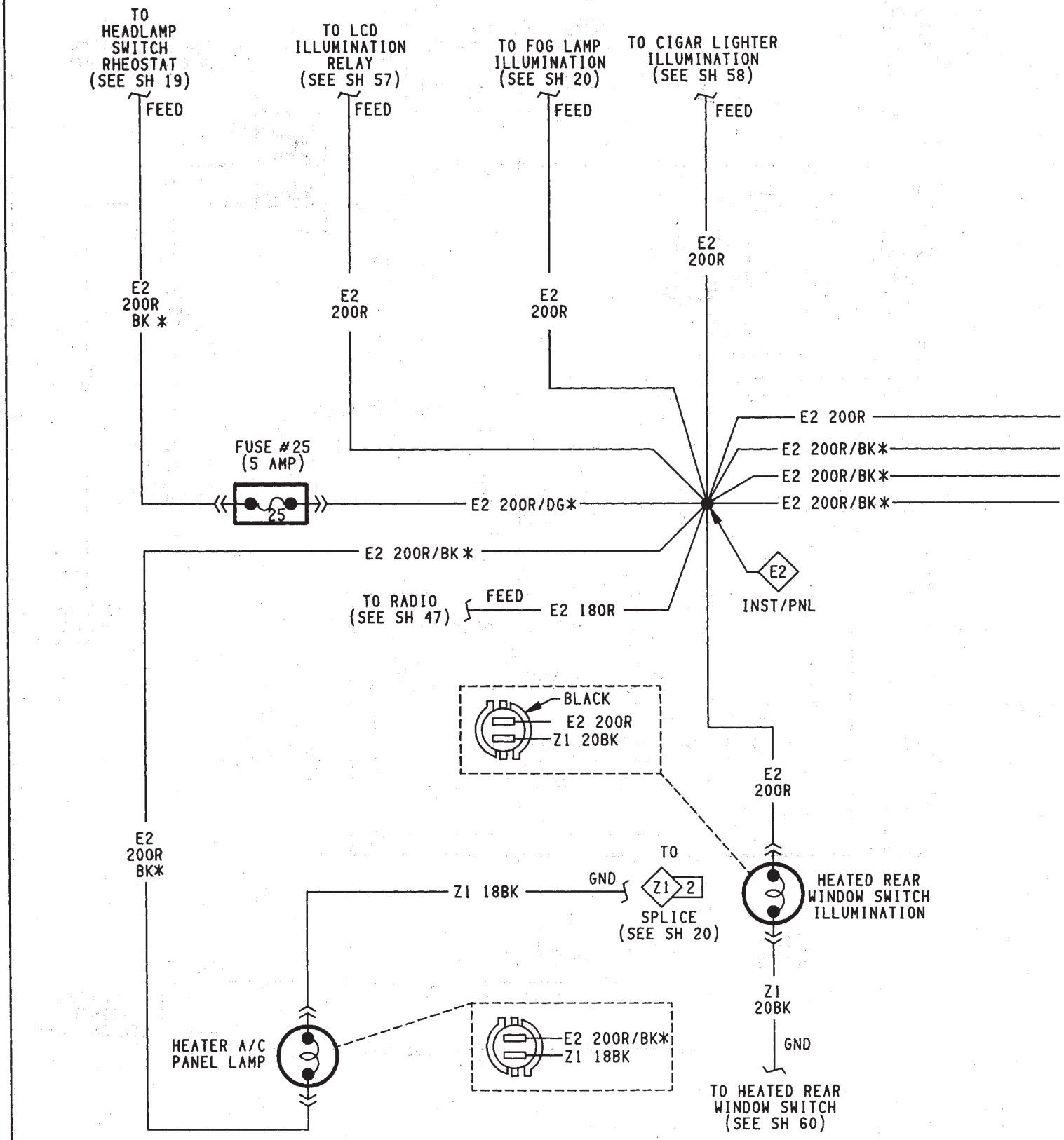
XJ-RHD 22



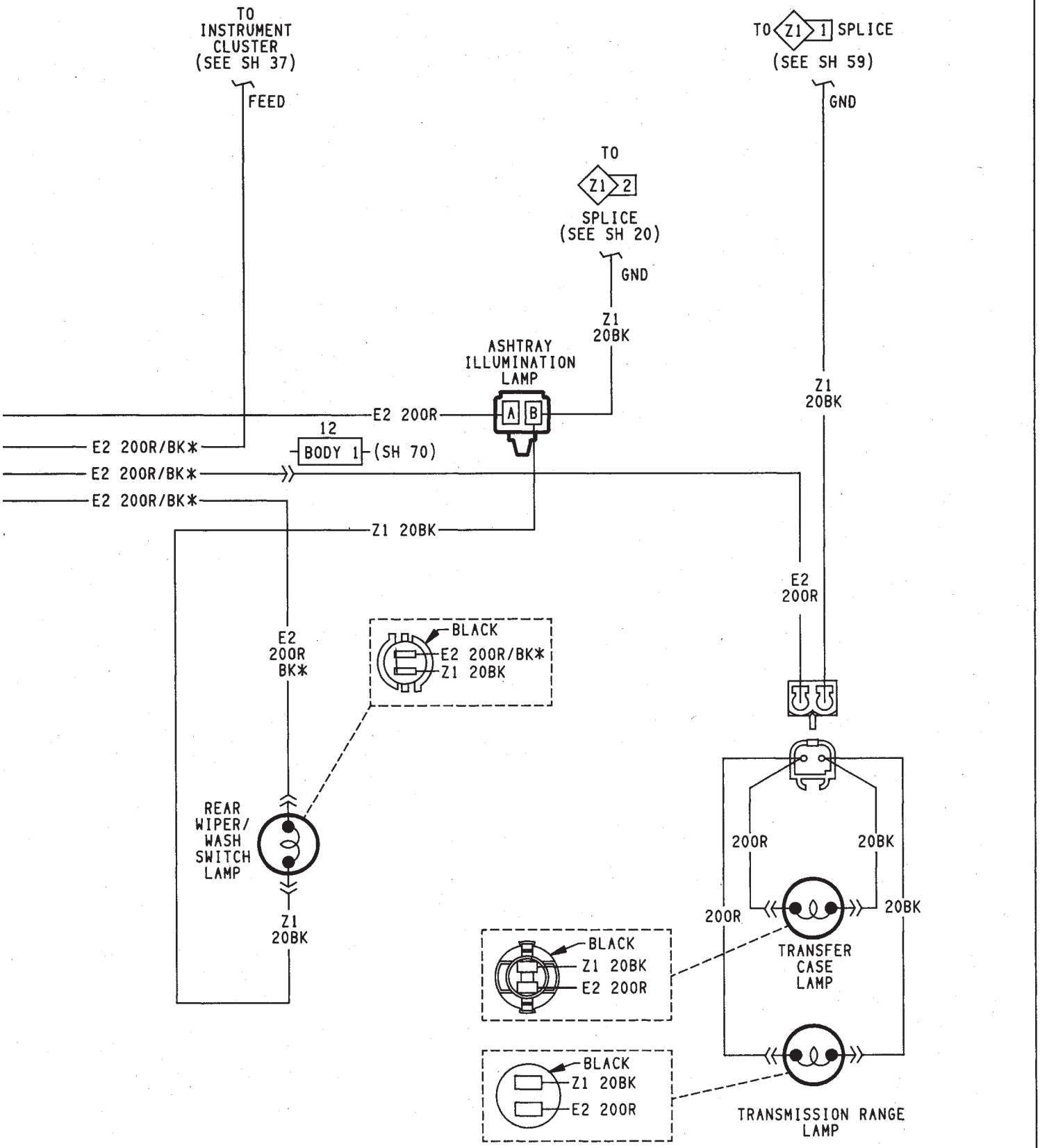
XJ-RHD 23 STOP/TURN AND HAZARD SYSTEM J948W-13



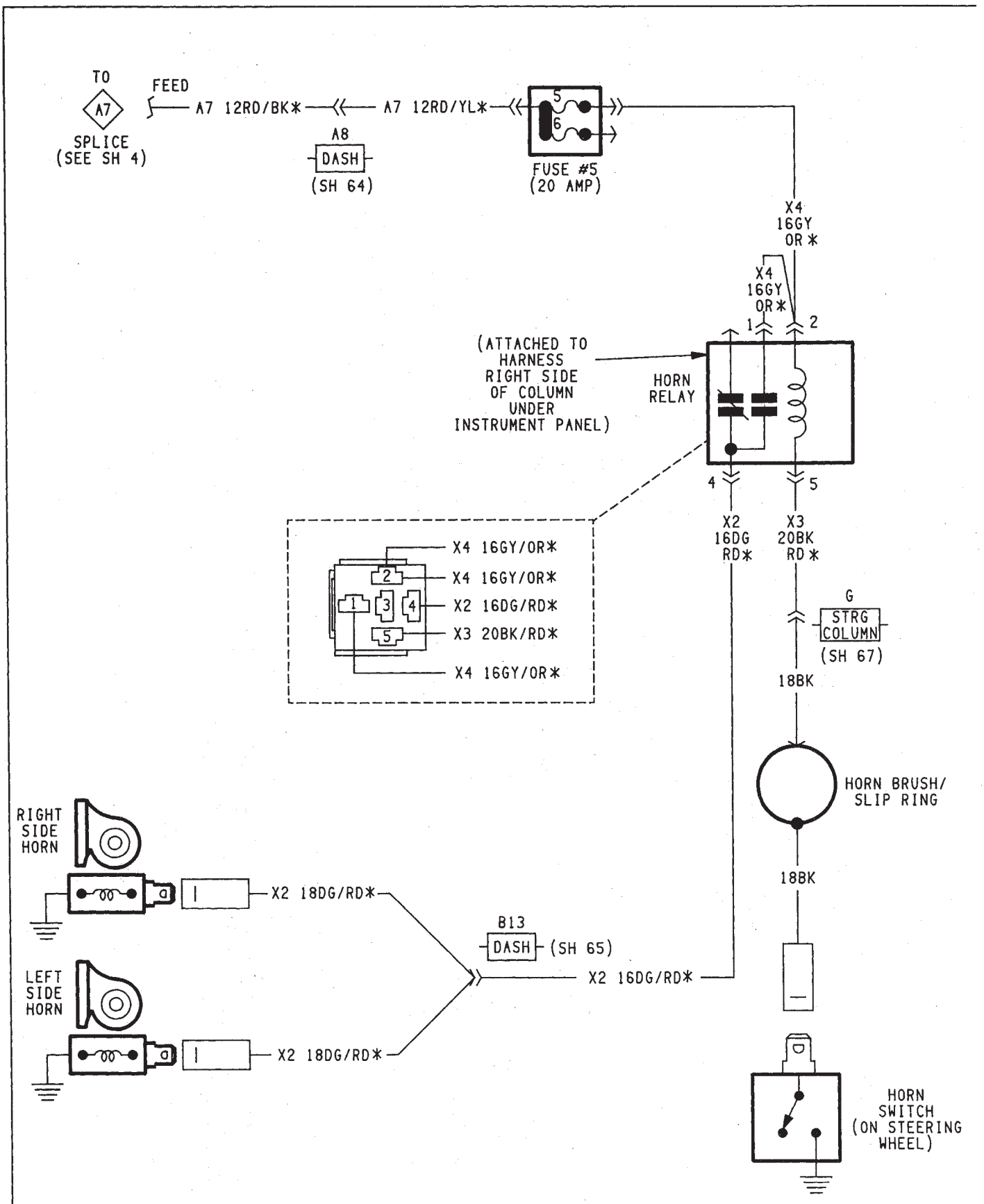
J948W-13 STOP/TURN AND HAZARD SYSTEM XJ-RHD 24



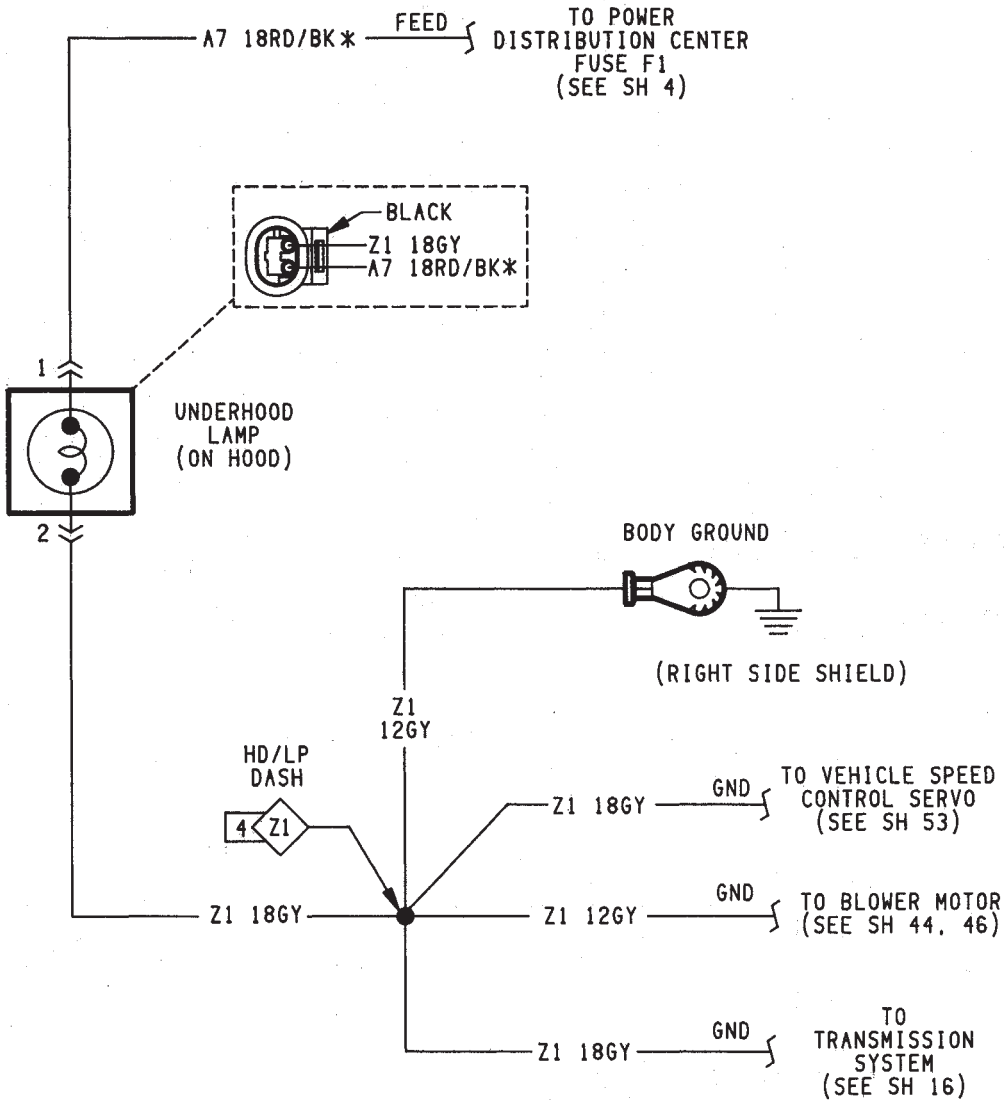
XJ-RHD 25 INSTRUMENT PANEL ILLUMINATION J948W-13

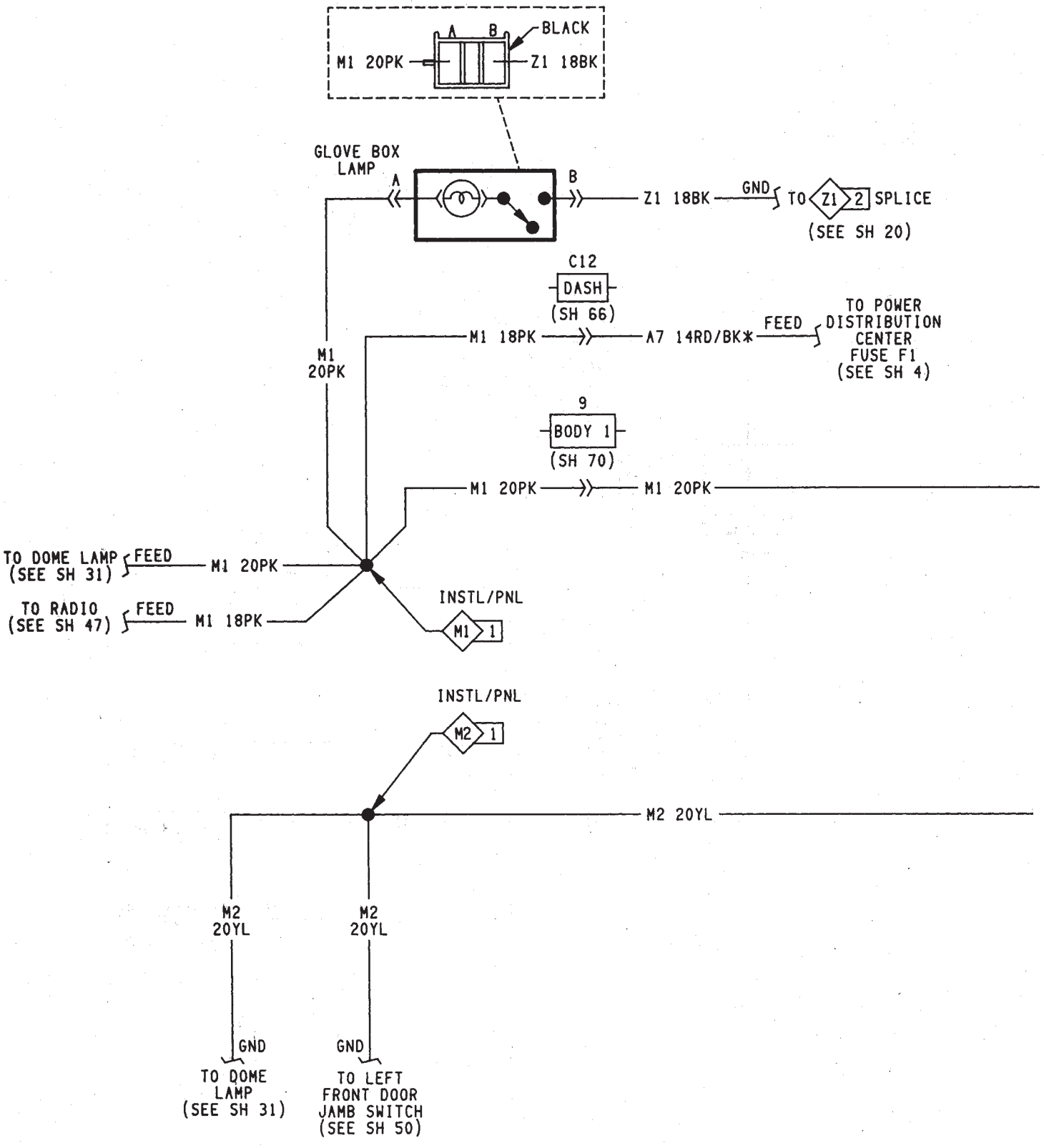


J948W-13 INSTRUMENT PANEL ILLUMINATION XJ-RHD 26



XJ-RHD 27 HORN SYSTEM J948W-13

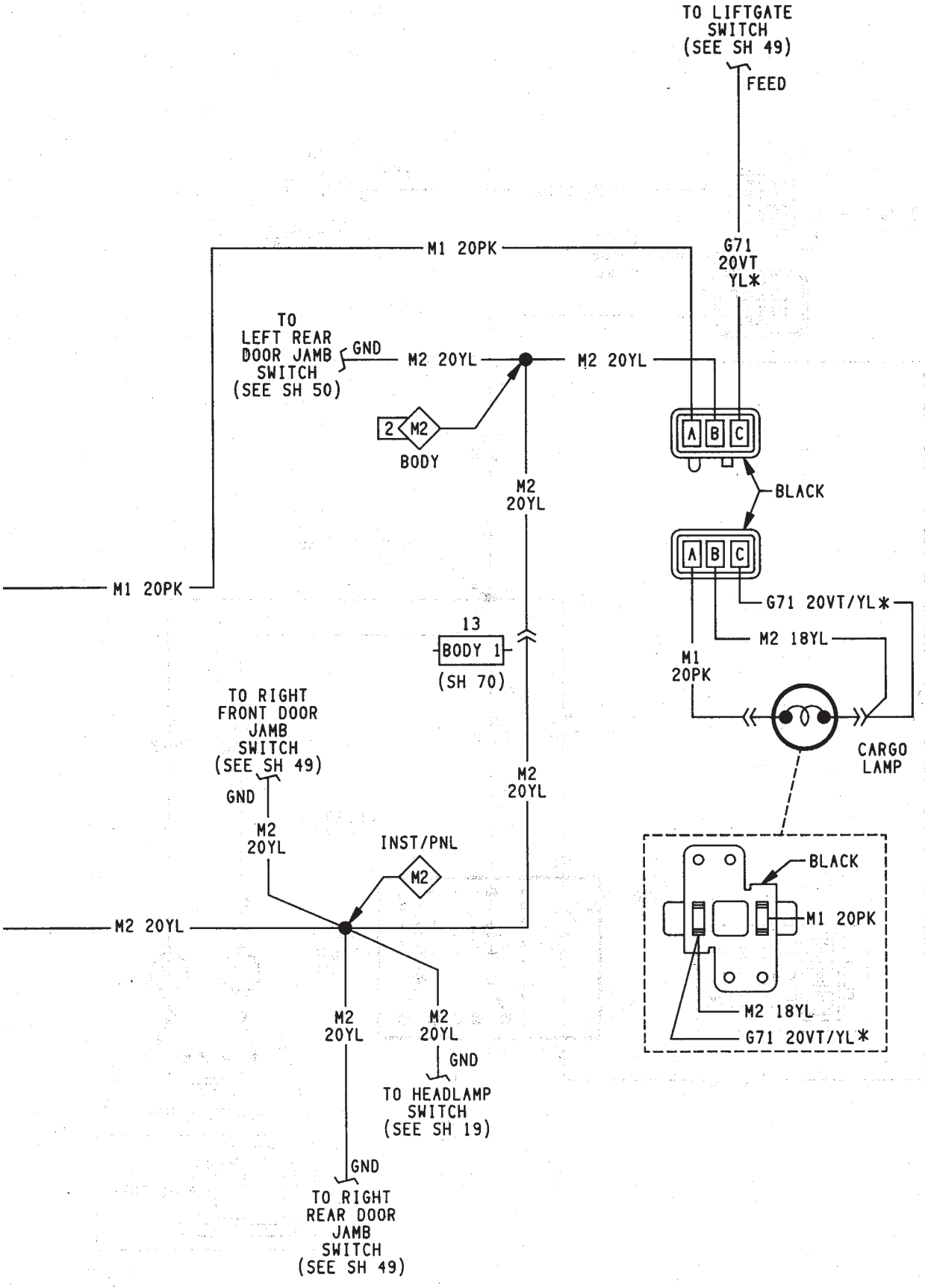

A7 18RD/BK*
FEED
TO POWER DISTRIBUTION CENTER FUSE F1 (SEE SH 4)
BLACK
Z1 18GY
A7 18RD/BK*
1
2
UNDERHOOD LAMP (ON HOOD)
BODY GROUND
(RIGHT SIDE SHIELD)
Z1 12GY
HD/LP DASH
4
Z1
Z1 18GY
GND
TO VEHICLE SPEED CONTROL SERVO (SEE SH 53)
Z1 18GY
Z1 12GY
GND
TO BLOWER MOTOR (SEE SH 44, 46)
Z1 18GY
GND
TO TRANSMISSION SYSTEM (SEE SH 16)



XJ-RHD 29

DOME AND COURTESY LAMPS

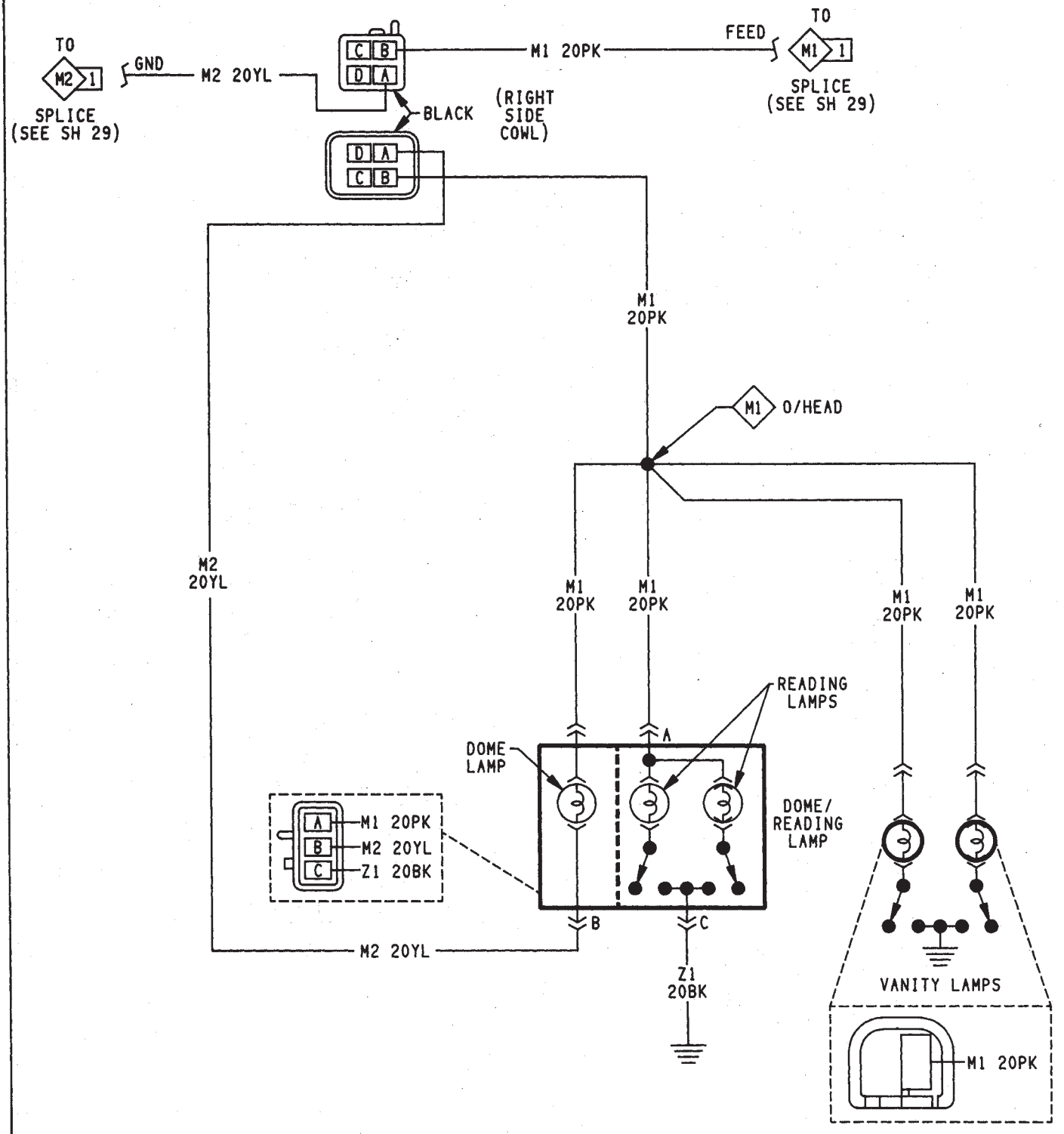
J948W-13



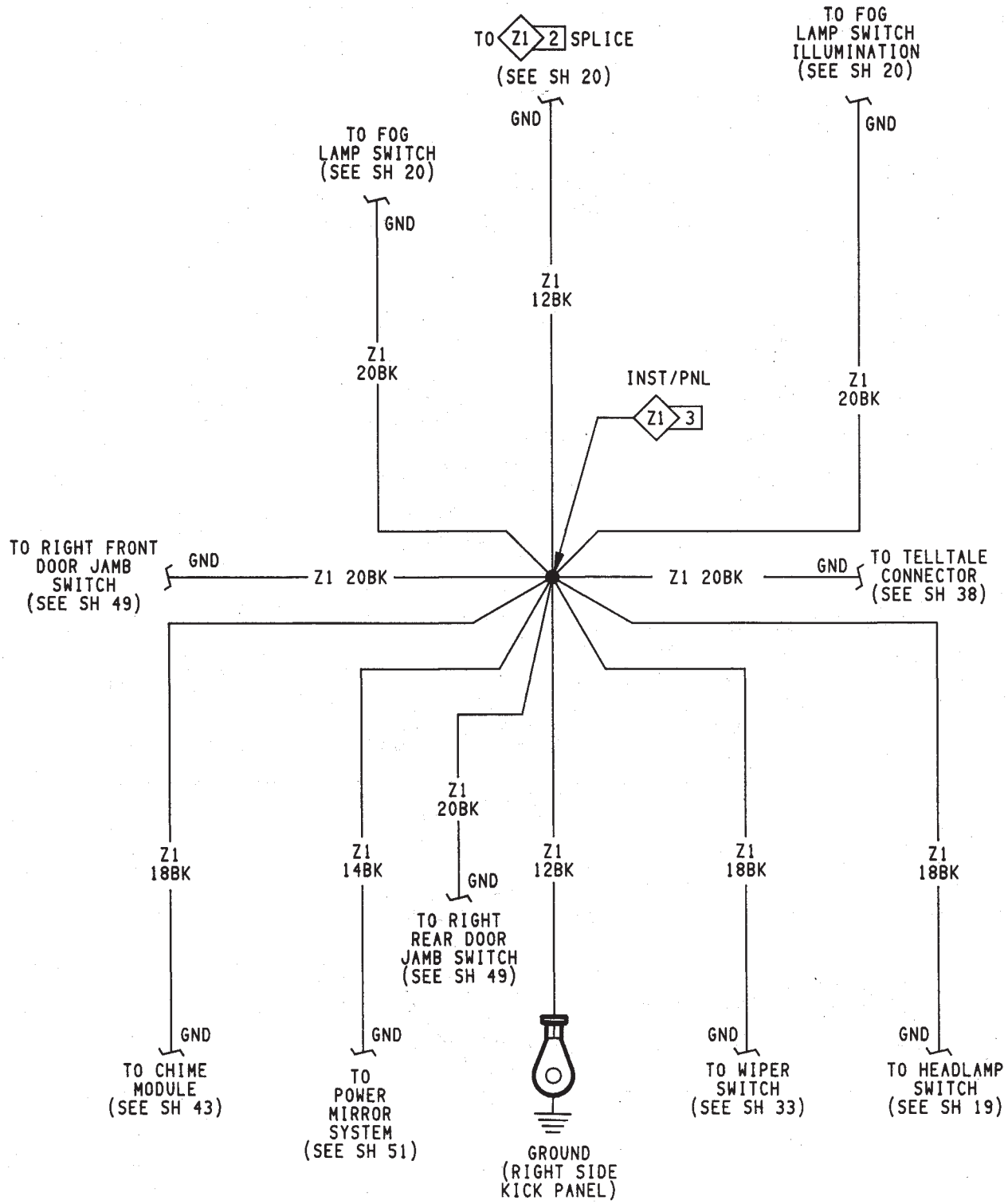
J948W-13

DOME AND COURTESY LAMPS

XJ-RHD 30



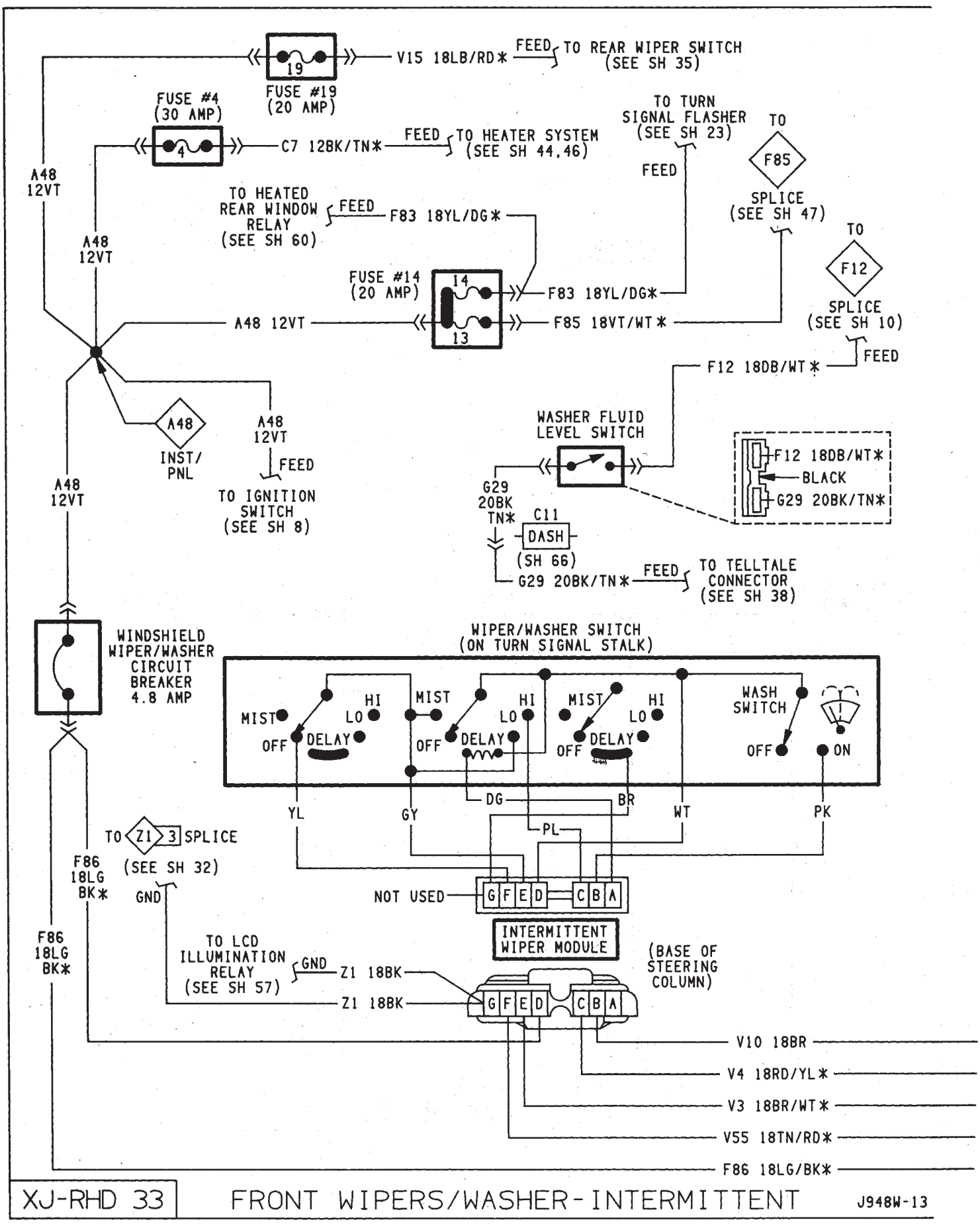
XJ-RHD 31 DOME AND COURTESY LAMPS J948W-13



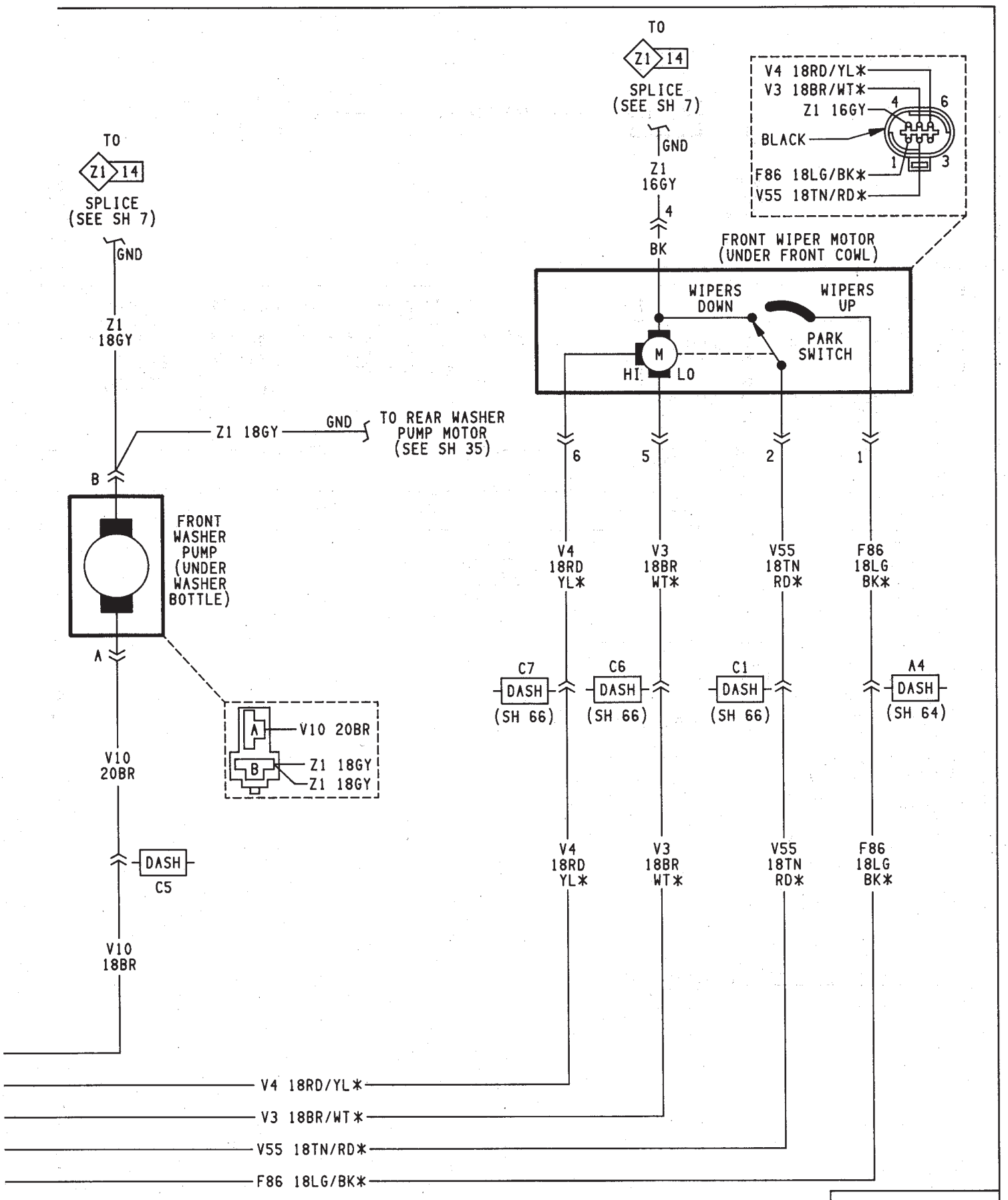
J948W-13

INSTRUMENT PANEL GROUND

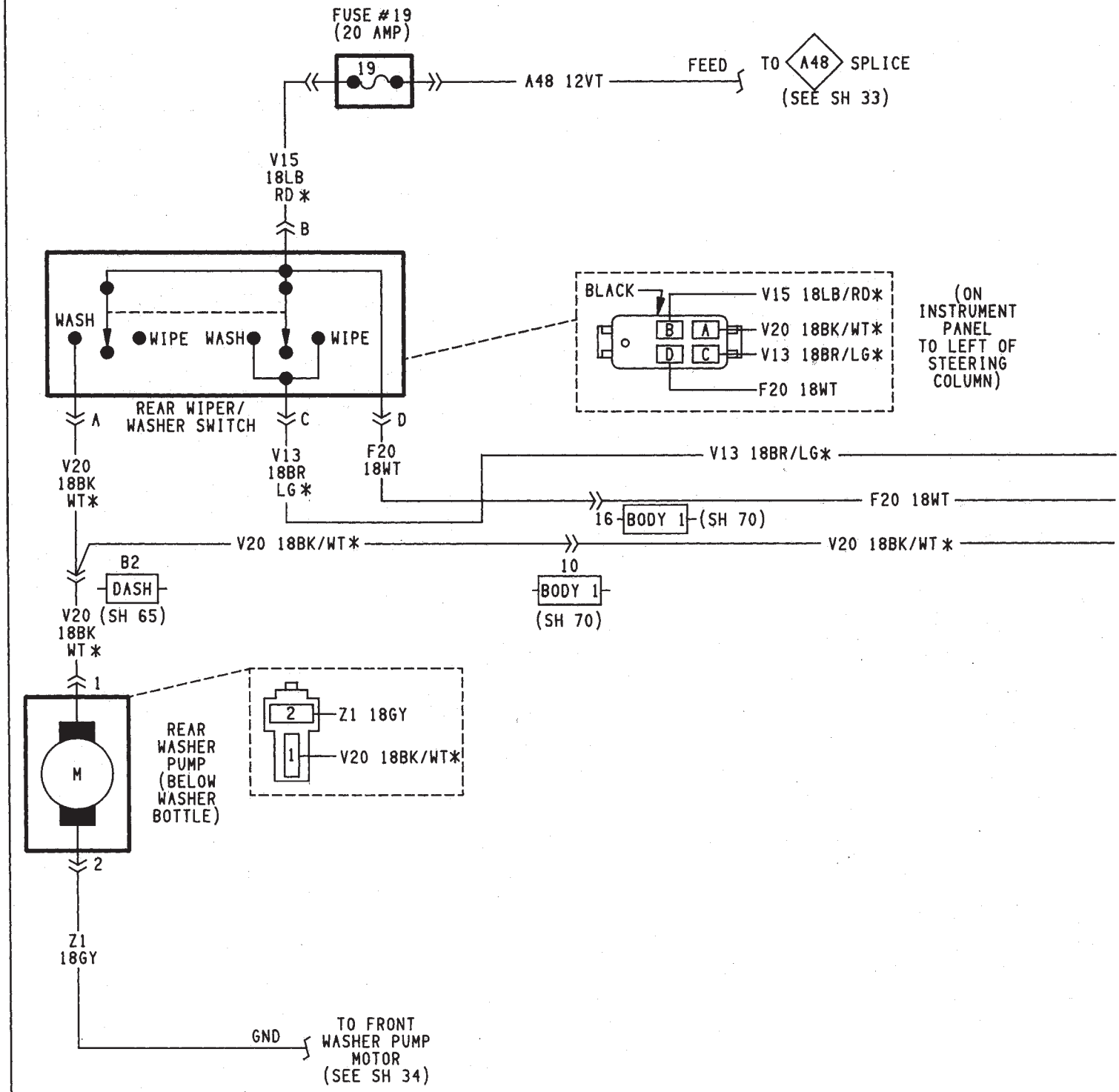
XJ-RHD 32



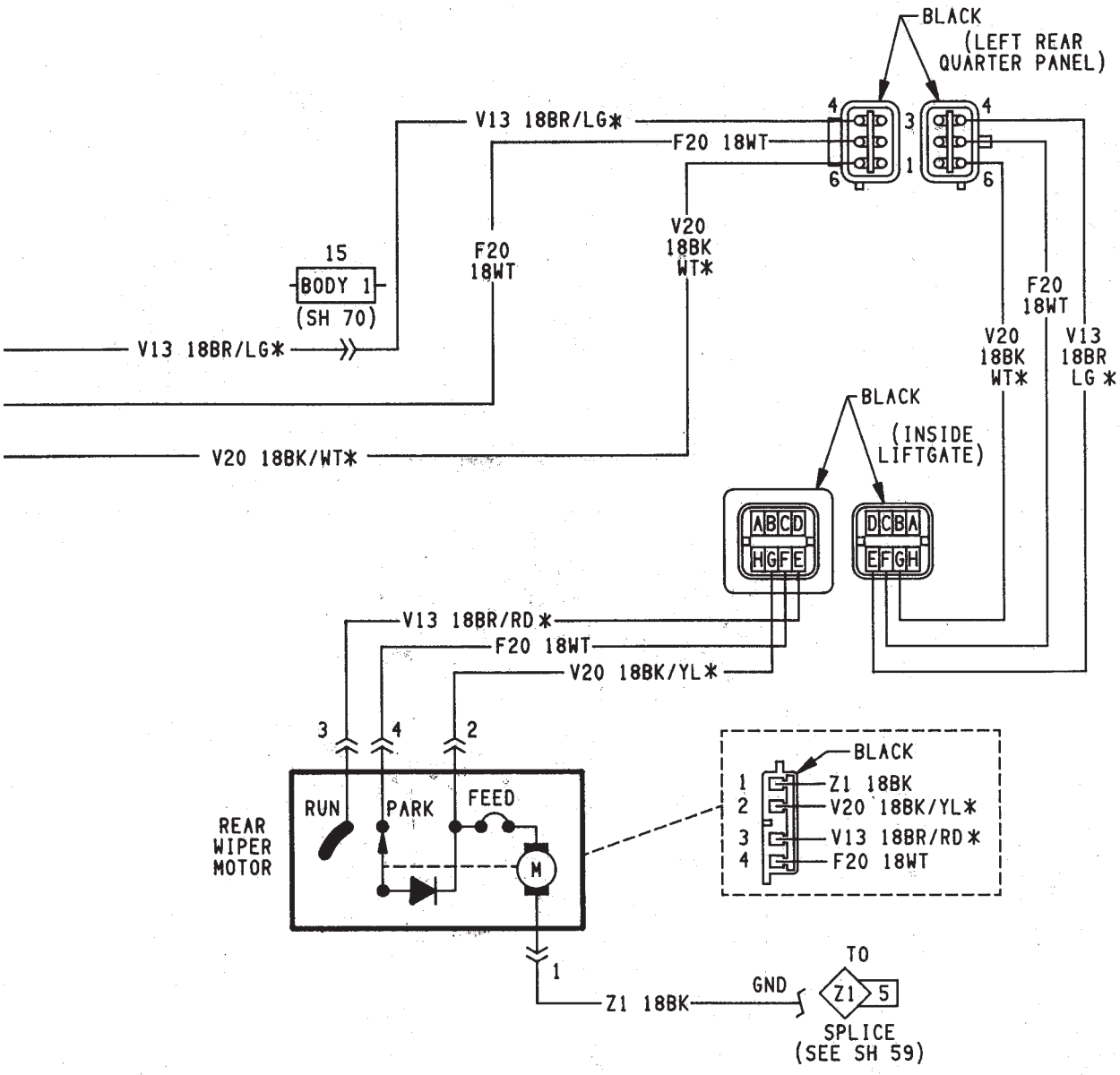
XJ-RHD 33 FRONT WIPERS/WASHER - INTERMITTENT J948W-13

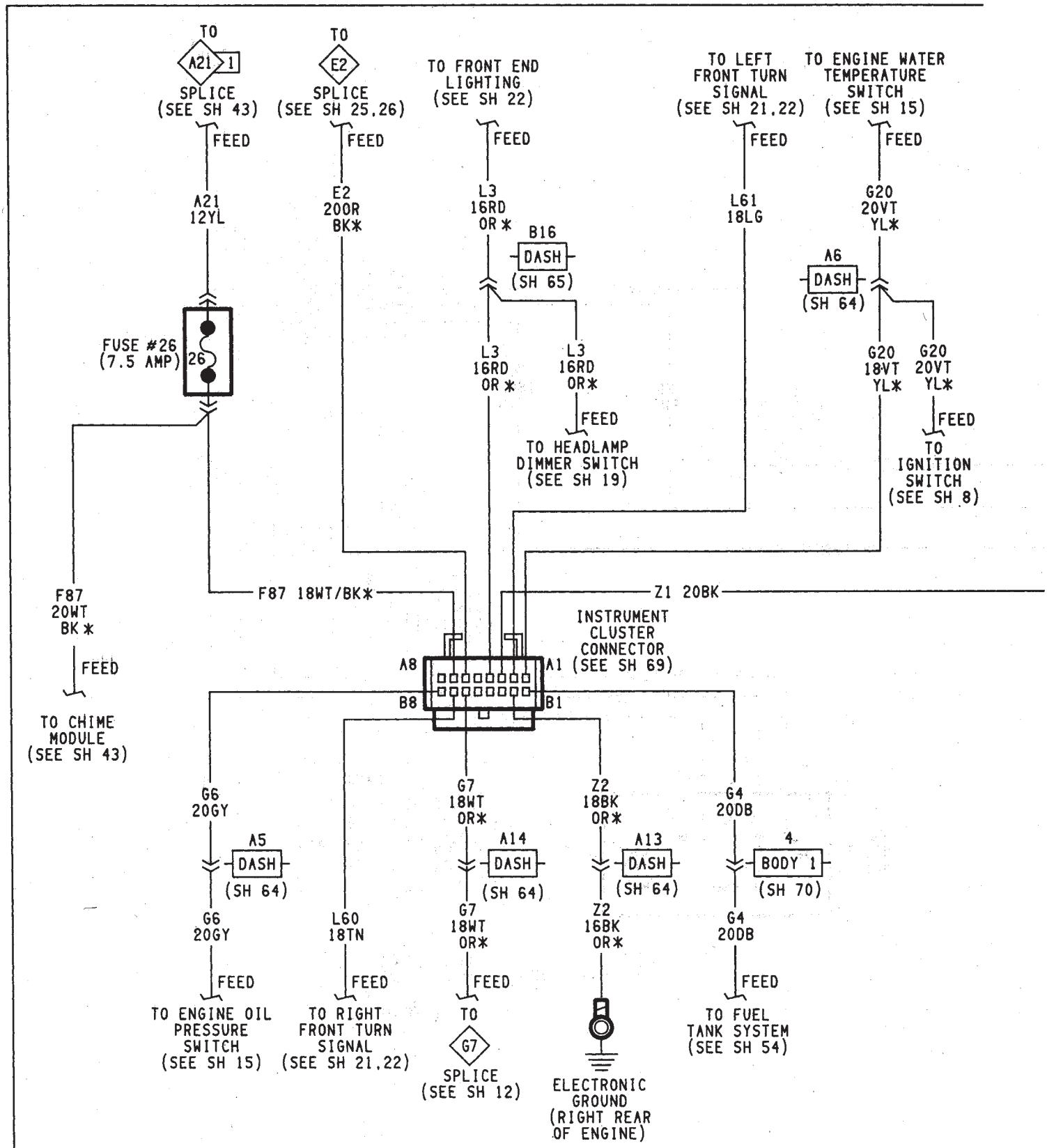


J948W-13 FRONT WIPERS/WASHER - INTERMITTENT XJ-RHD 34

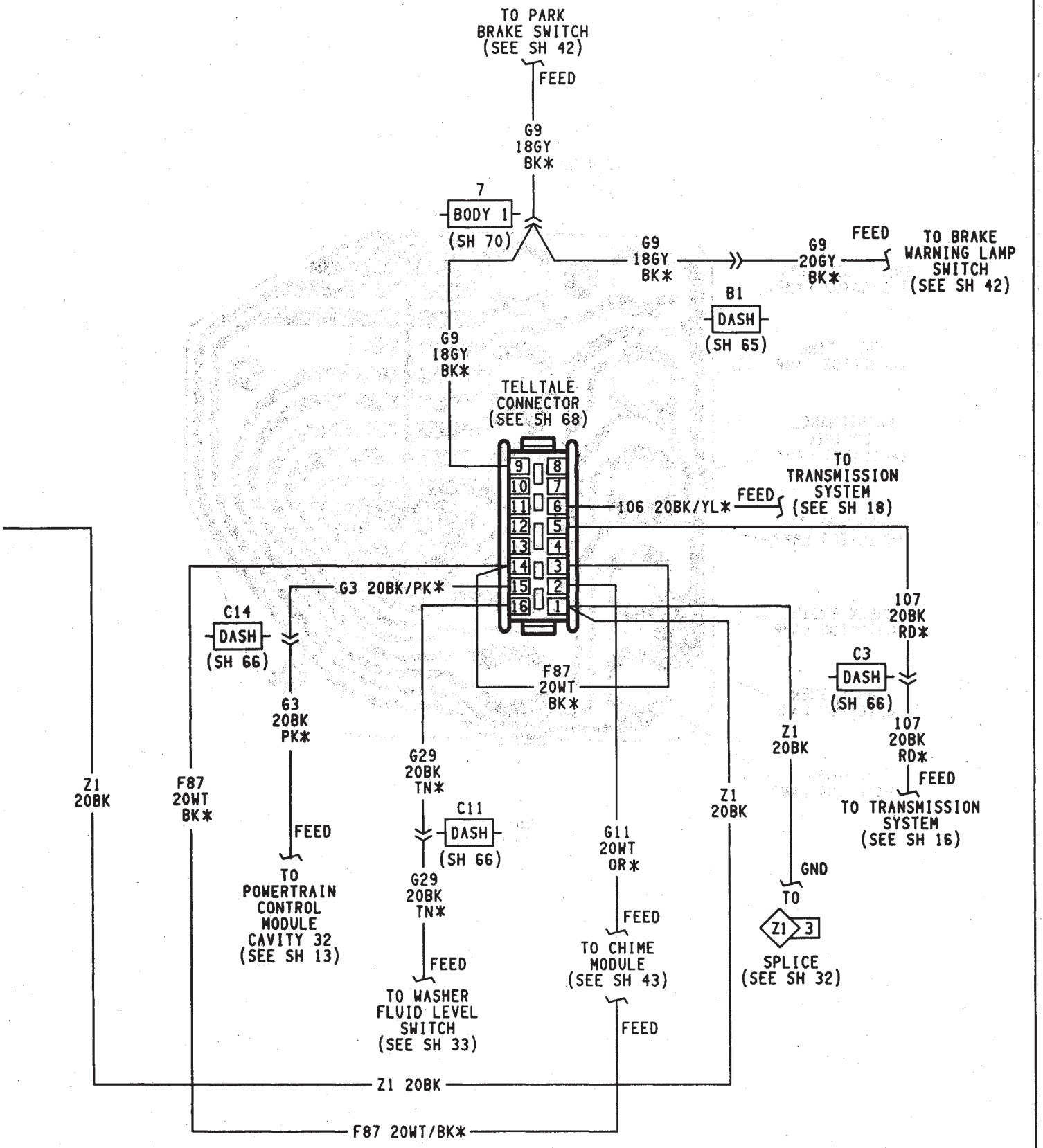


XJ-RHD 35 REAR WIPER/WASHER J948W-13


BLACK
(LEFT REAR
QUARTER PANEL)
V13 18BR/LG*
F20 18WT
V20
18BK
WT*
15
BODY 1
(SH 70)
F20
18WT
V13 18BR/LG*
V20 18BK/WT*
F20
18WT
V20
18BK
WT*
V13
18BR
LG *
BLACK
(INSIDE
LIFTGATE)
ABCD
HGFE
DCBA
EFGH
V13 18BR/RD*
F20 18WT
V20 18BK/YL*
3
4
2
REAR
WIPER
MOTOR
RUN
PARK
FEED
M
BLACK
1 Z1 18BK
2 V20 18BK/YL*
3 V13 18BR/RD*
4 F20 18WT
1
Z1 18BK
GND
TO
Z1 5
SPLICE
(SEE SH 59)



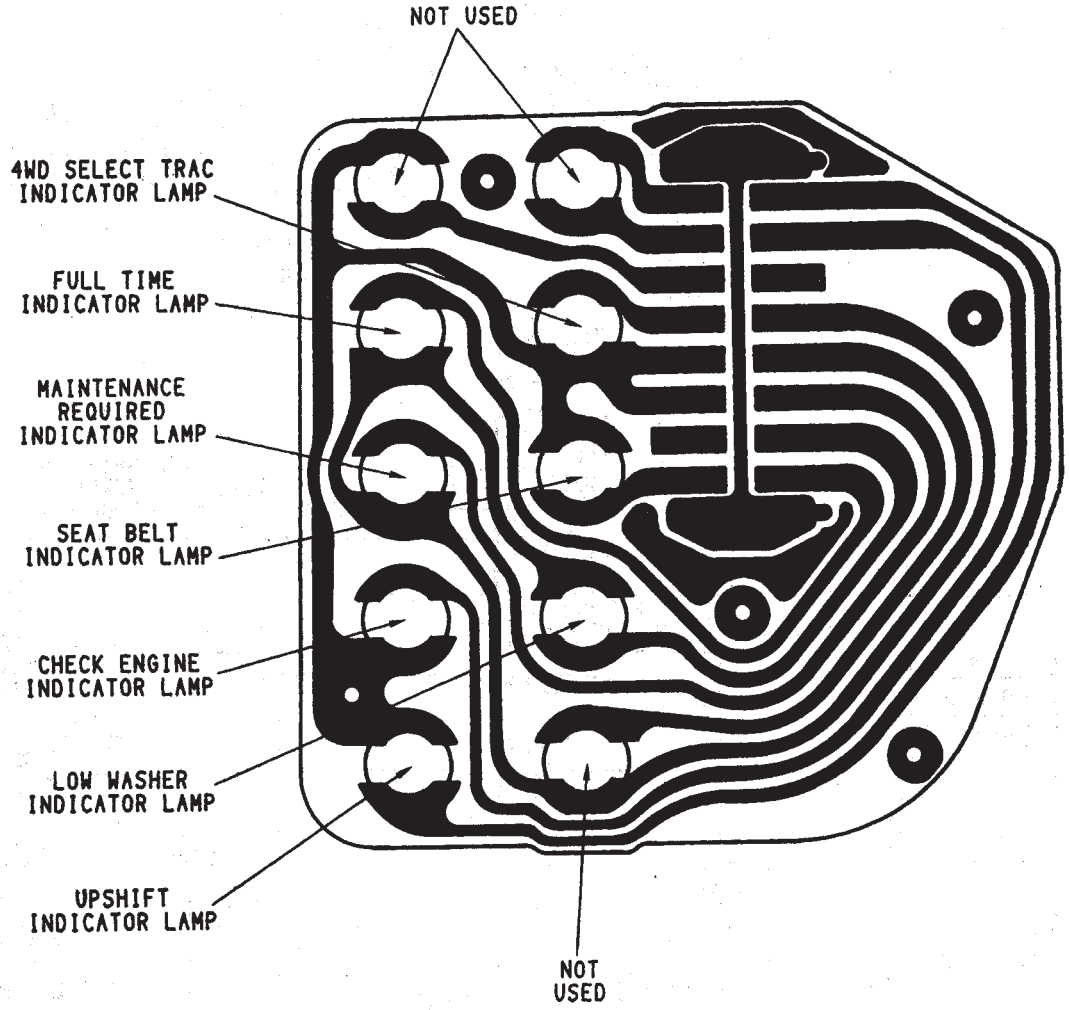
XJ-RHD 37 INSTRUMENT CLUSTER J948W-13



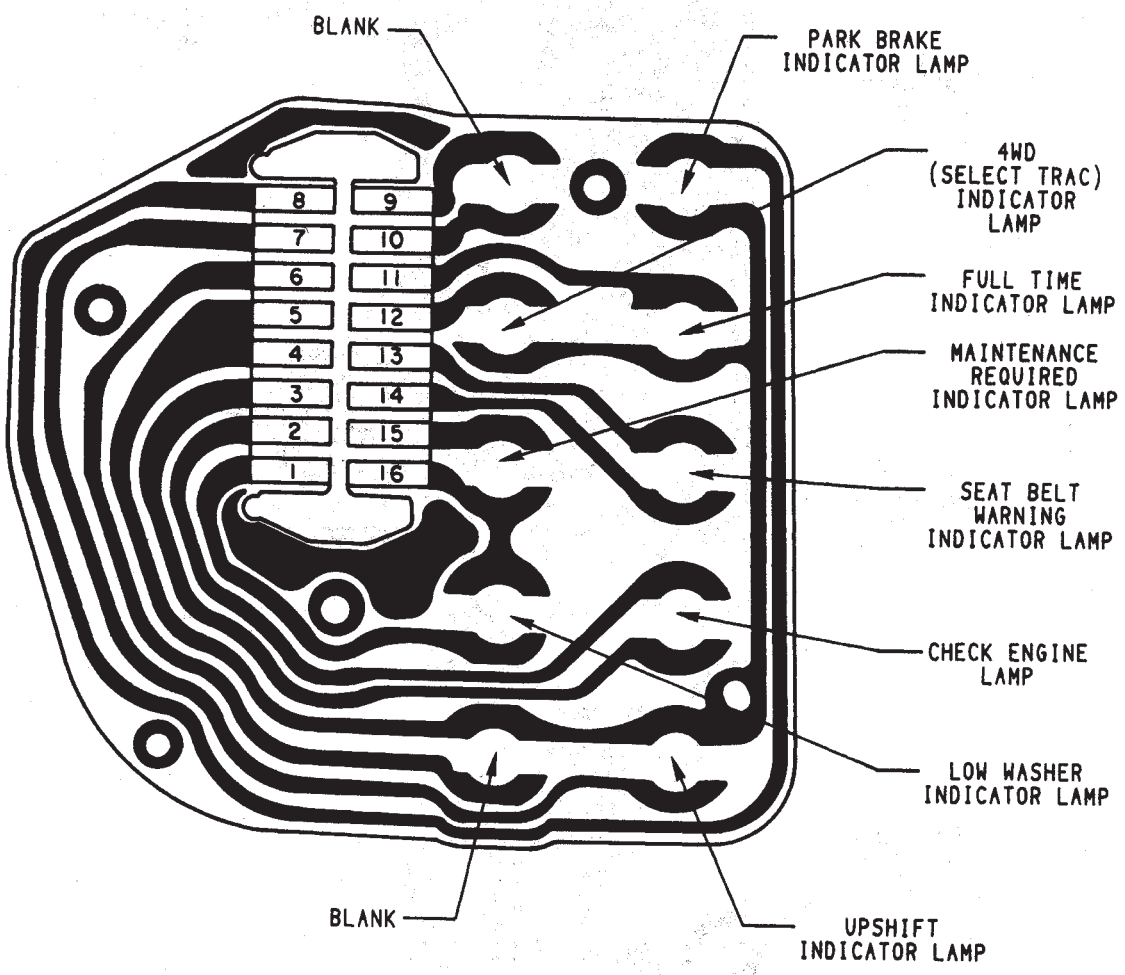
J948W-13

TELLTALE CONNECTOR

XJ-RHD 38



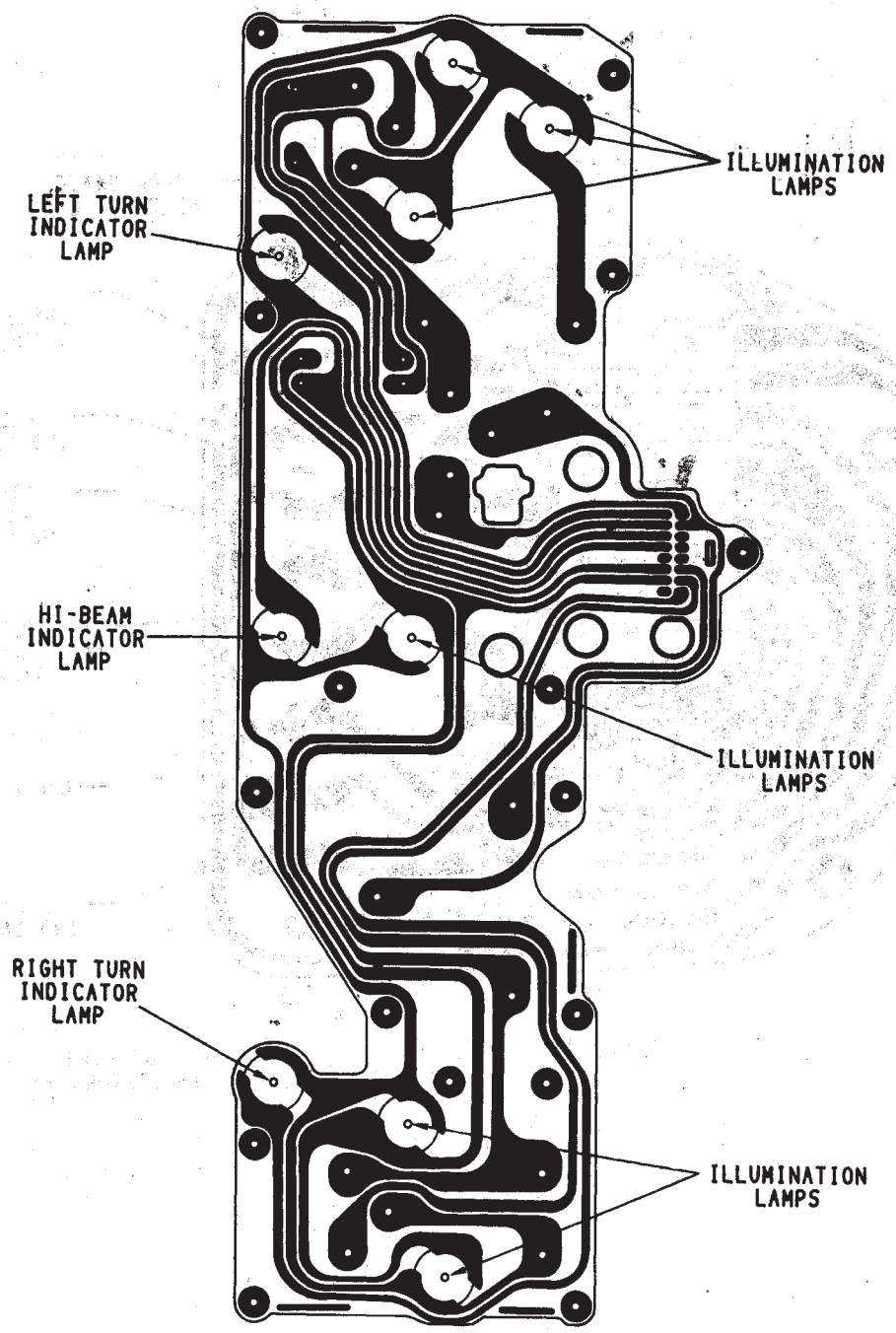
XJ-RHD 39 TELLTALE PRINTED CIRCUIT BOARD J948W-13



INSTRUMENT CLUSTER INDICATOR
PRINTED CIRCUIT BOARD

J948W-13

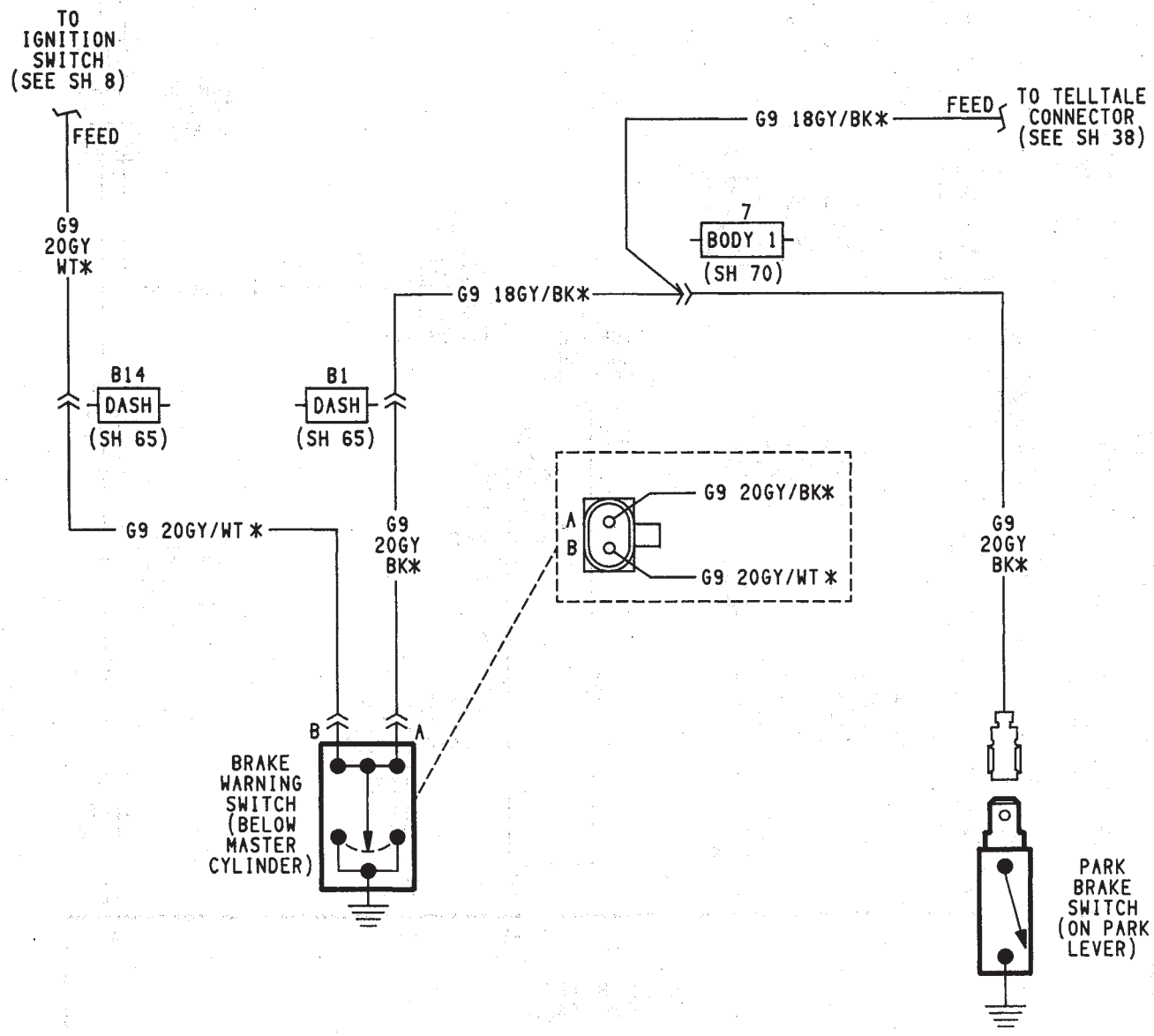
XJ-RHD 40



XJ-RHD 41

STANDARD INSTRUMENT CLUSTER PRINTED CIRCUIT BOARD

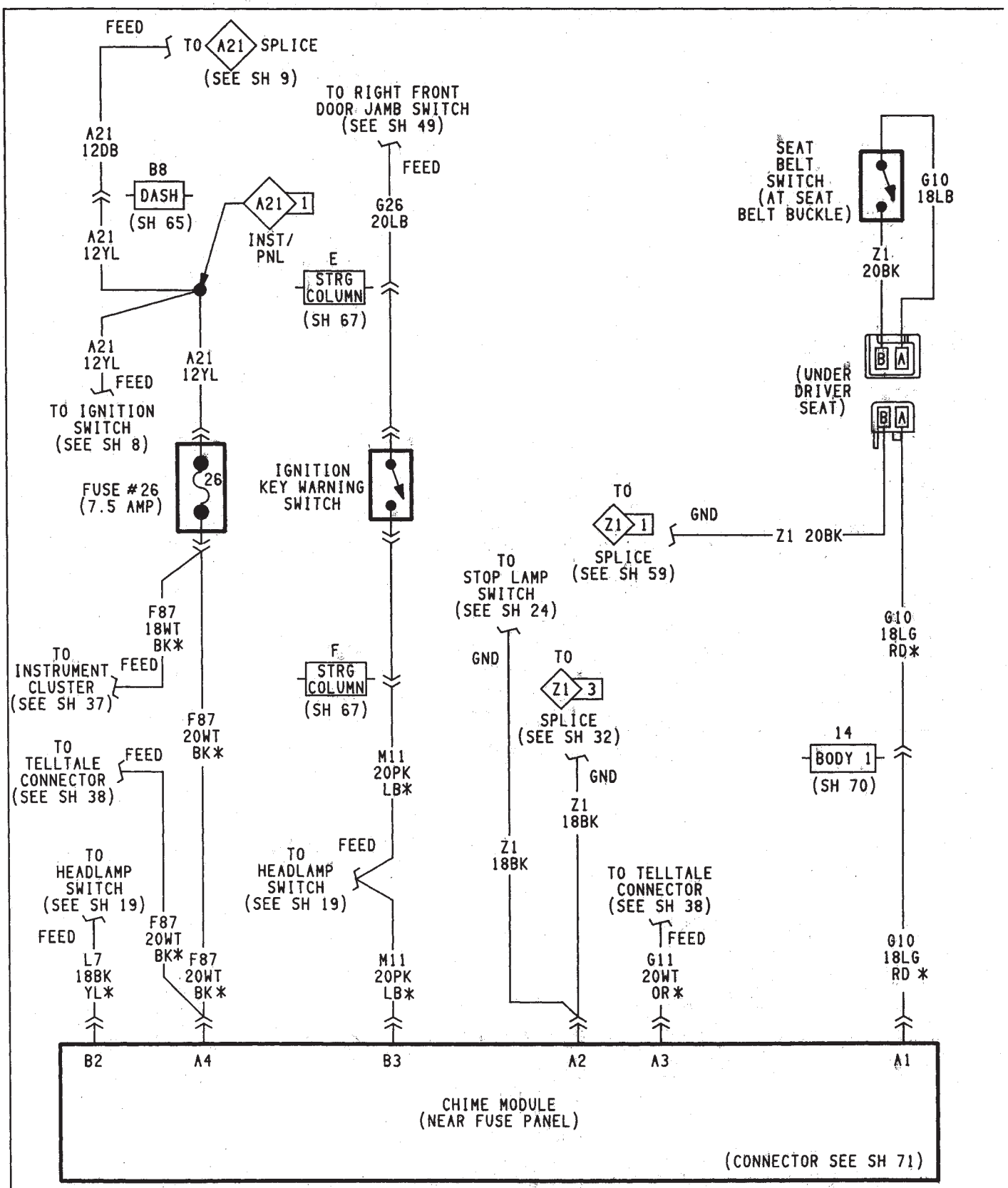
J948W-13



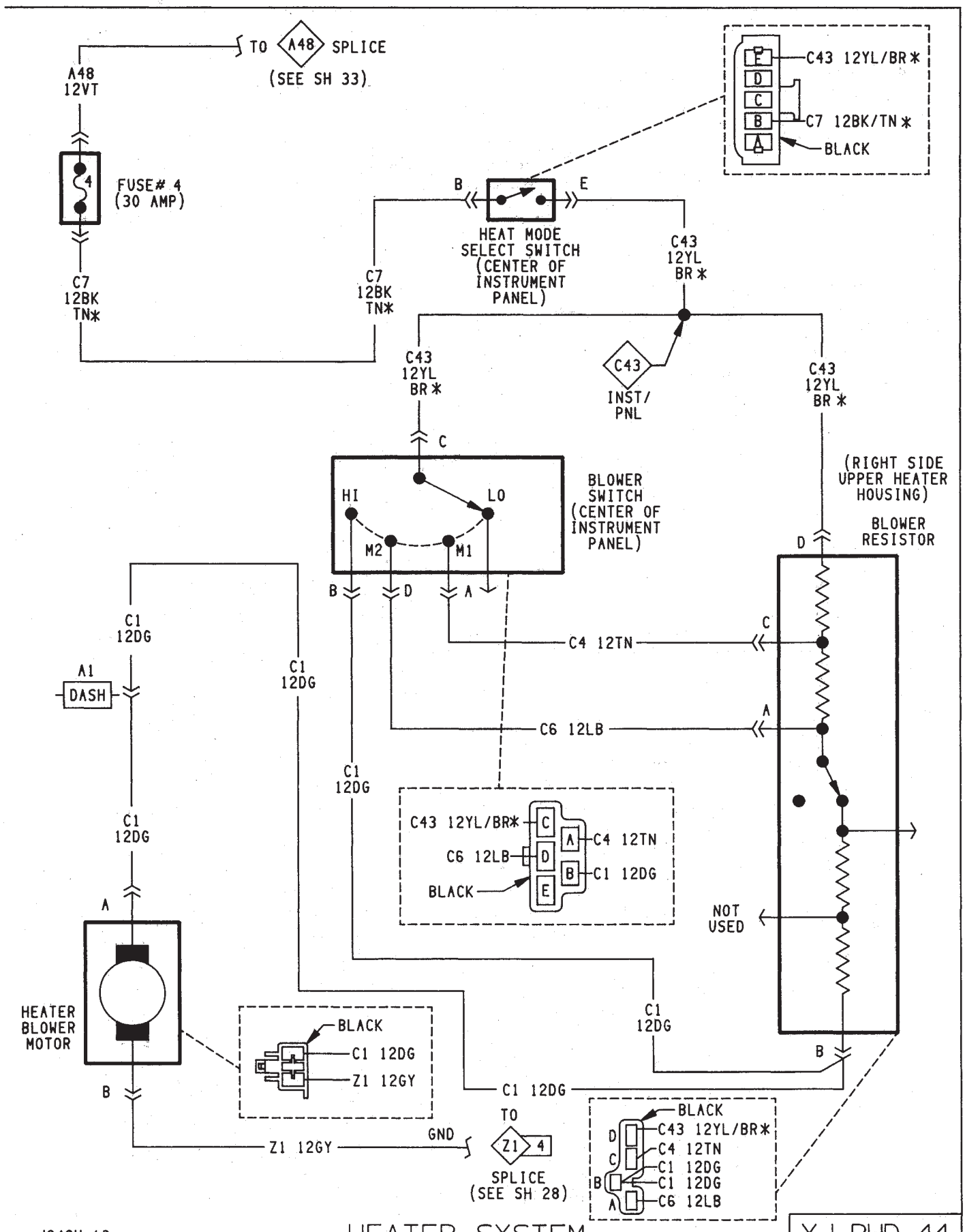
J948W-13

PARKING BRAKE SWITCH

XJ-RHD 42



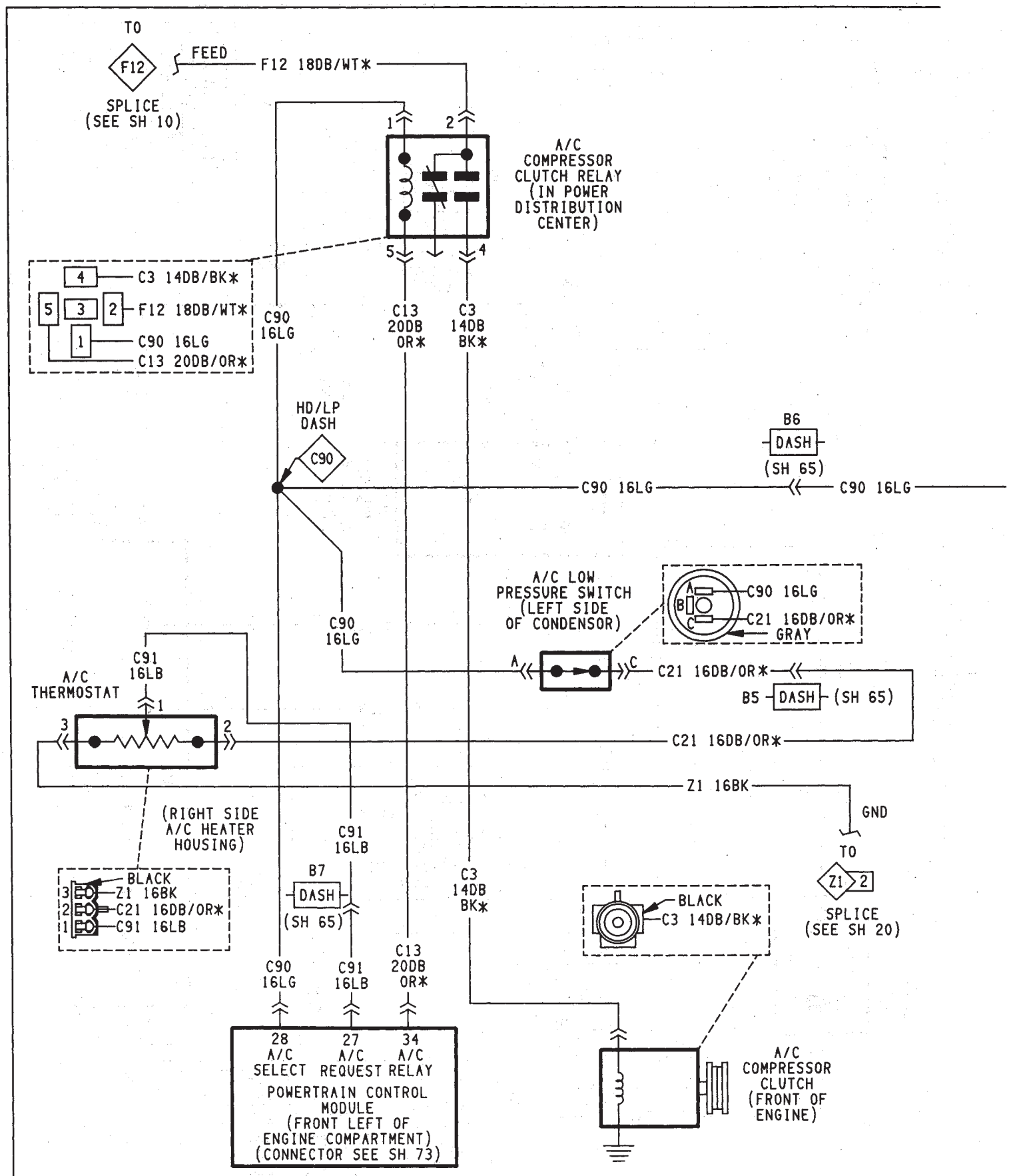
XJ-RHD 43 CHIME MODULE J948W-13



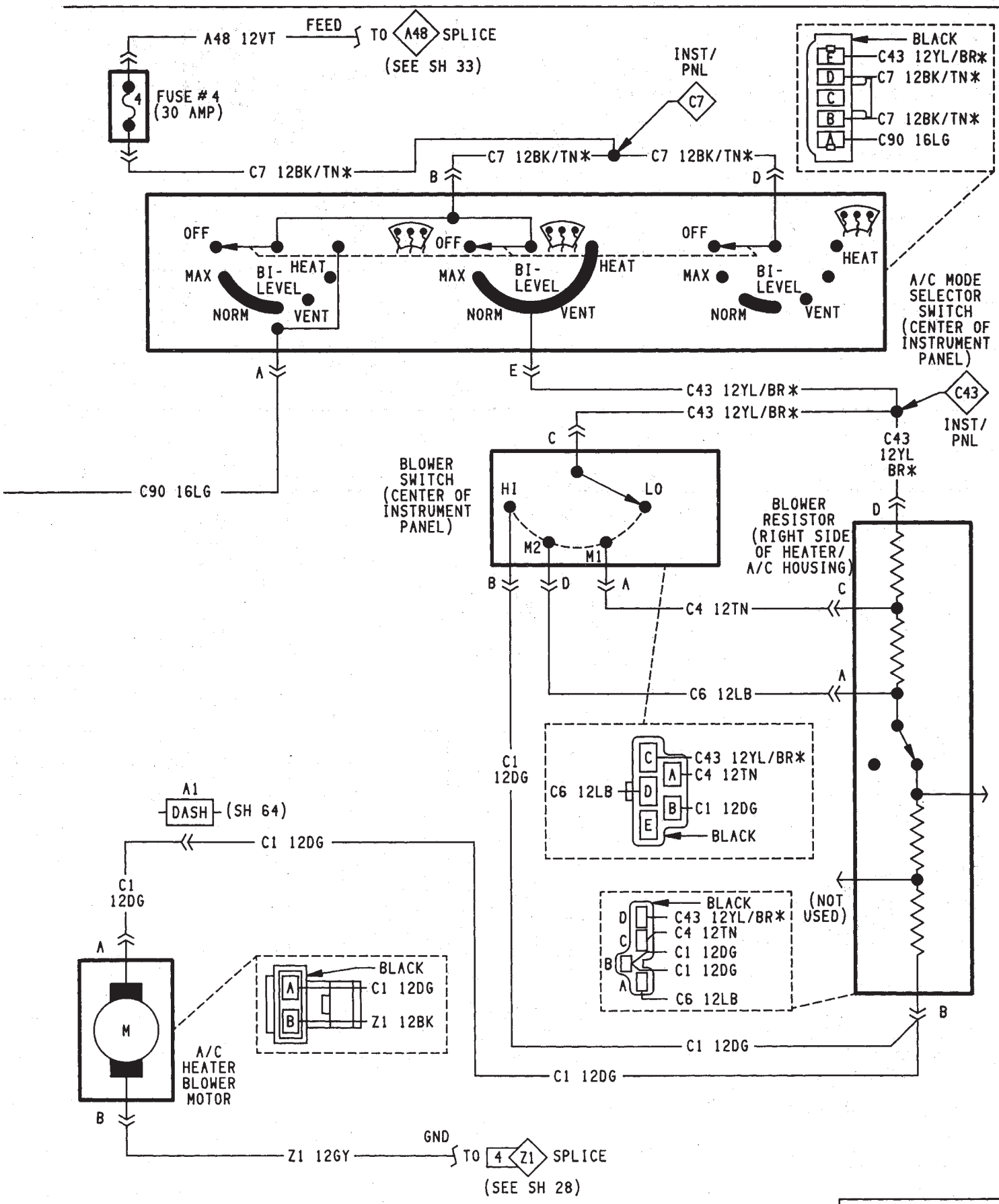
J948W-13

HEATER SYSTEM

XJ-RHD 44



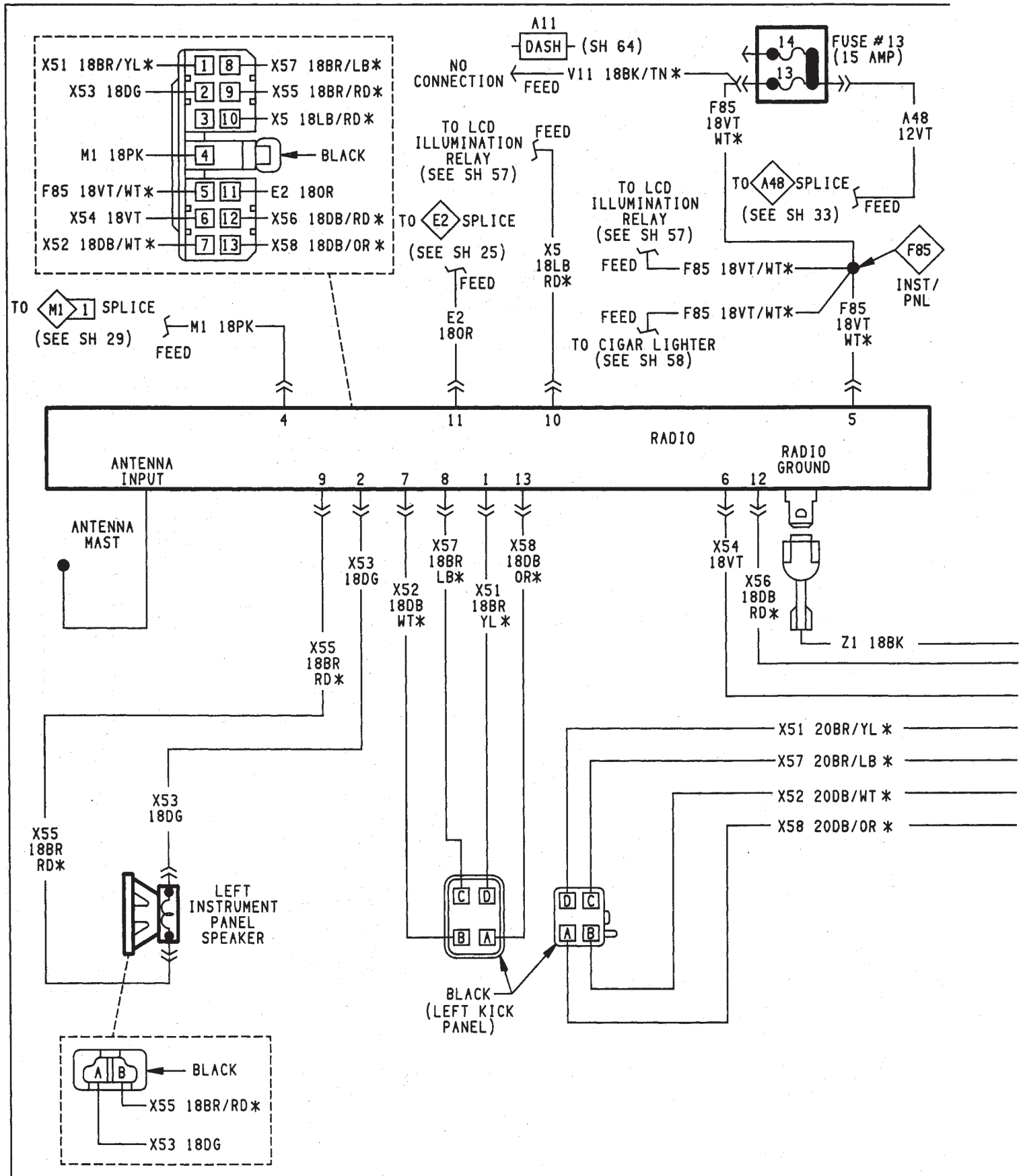
XJ-RHD 45 HEATER AND A/C SYSTEM J948W-13



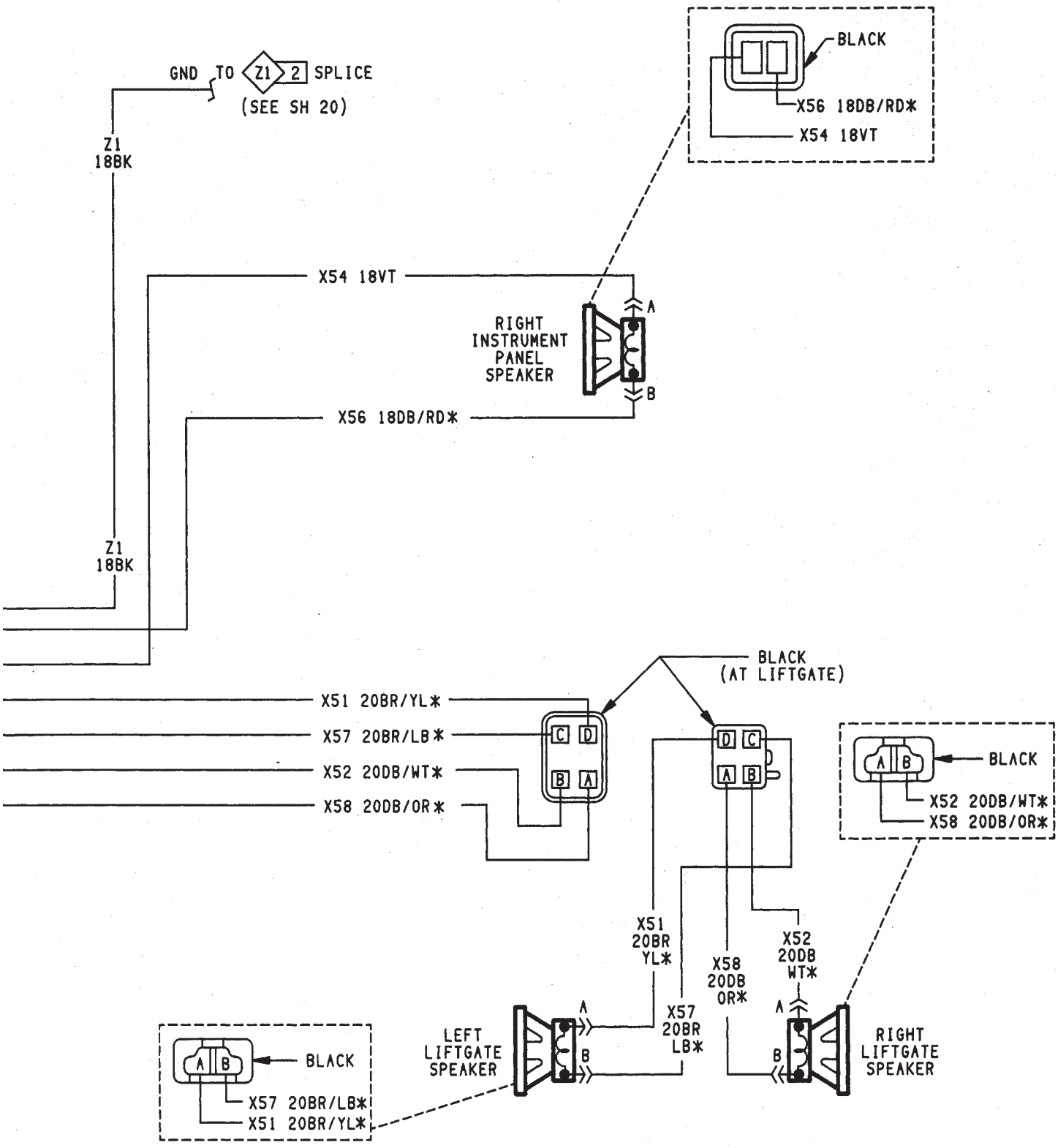
J948W-13

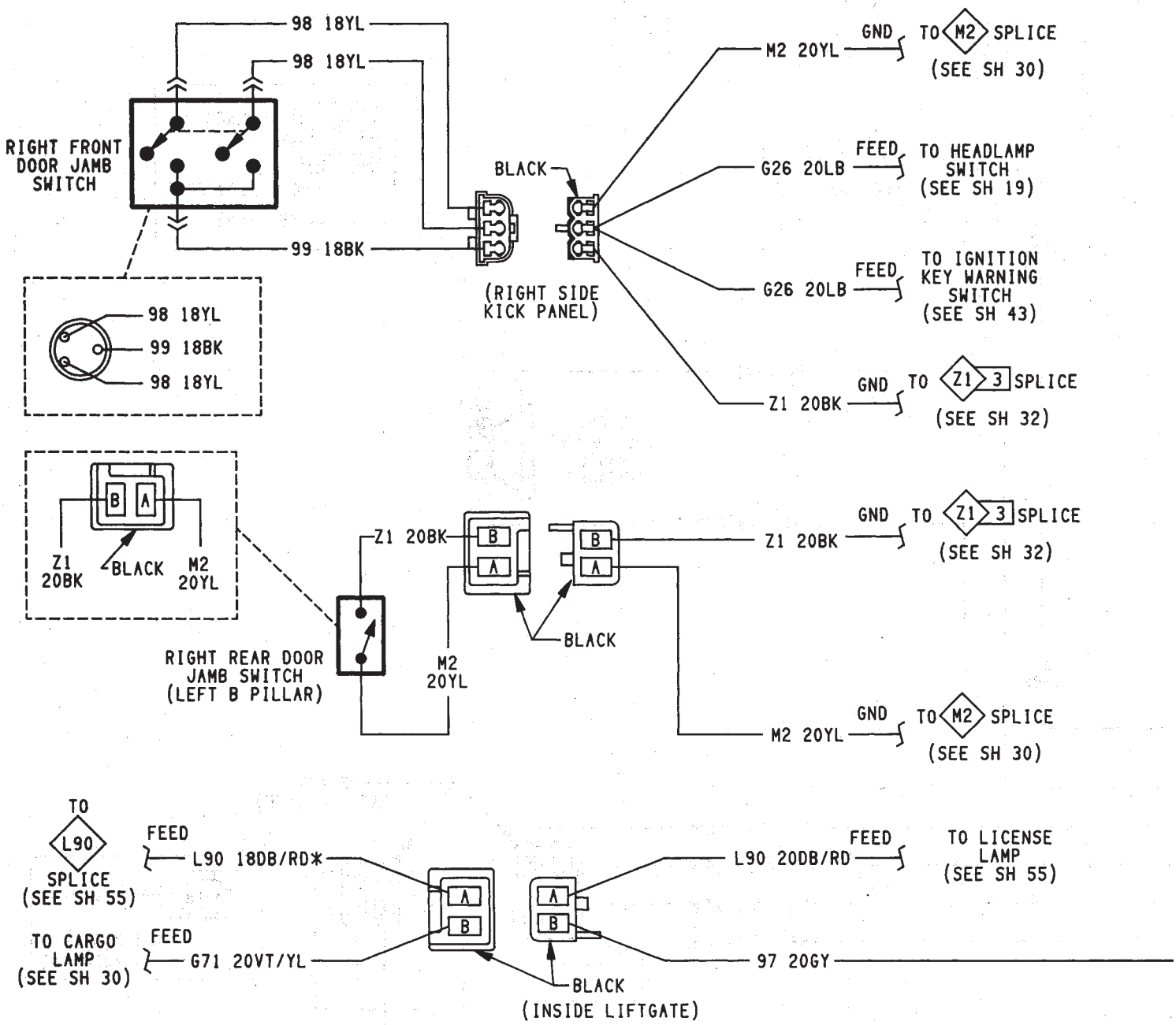
HEATER AND A/C SYSTEM

XJ-RHD 46

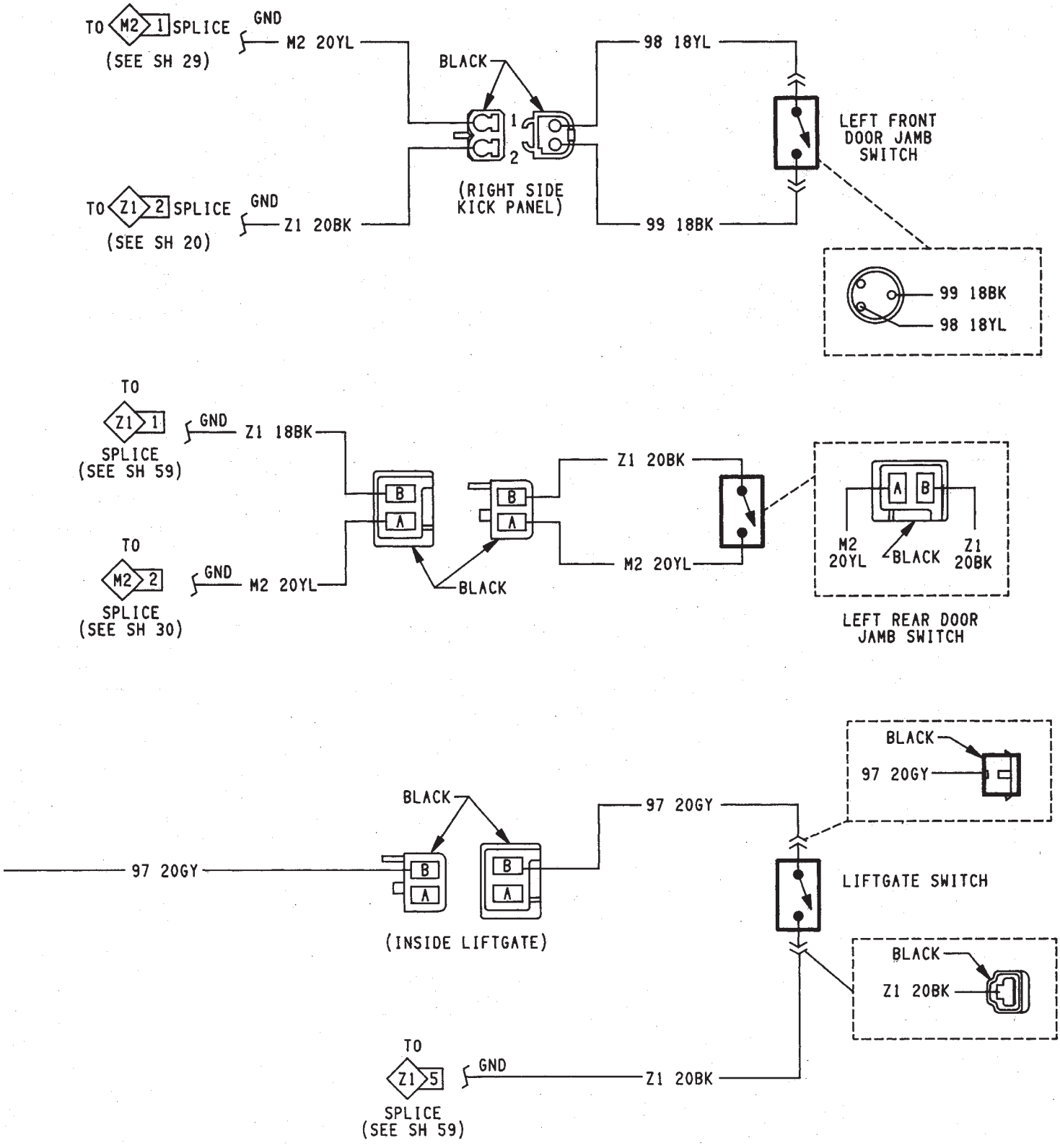


XJ-RHD 47 RADIO J948W-13

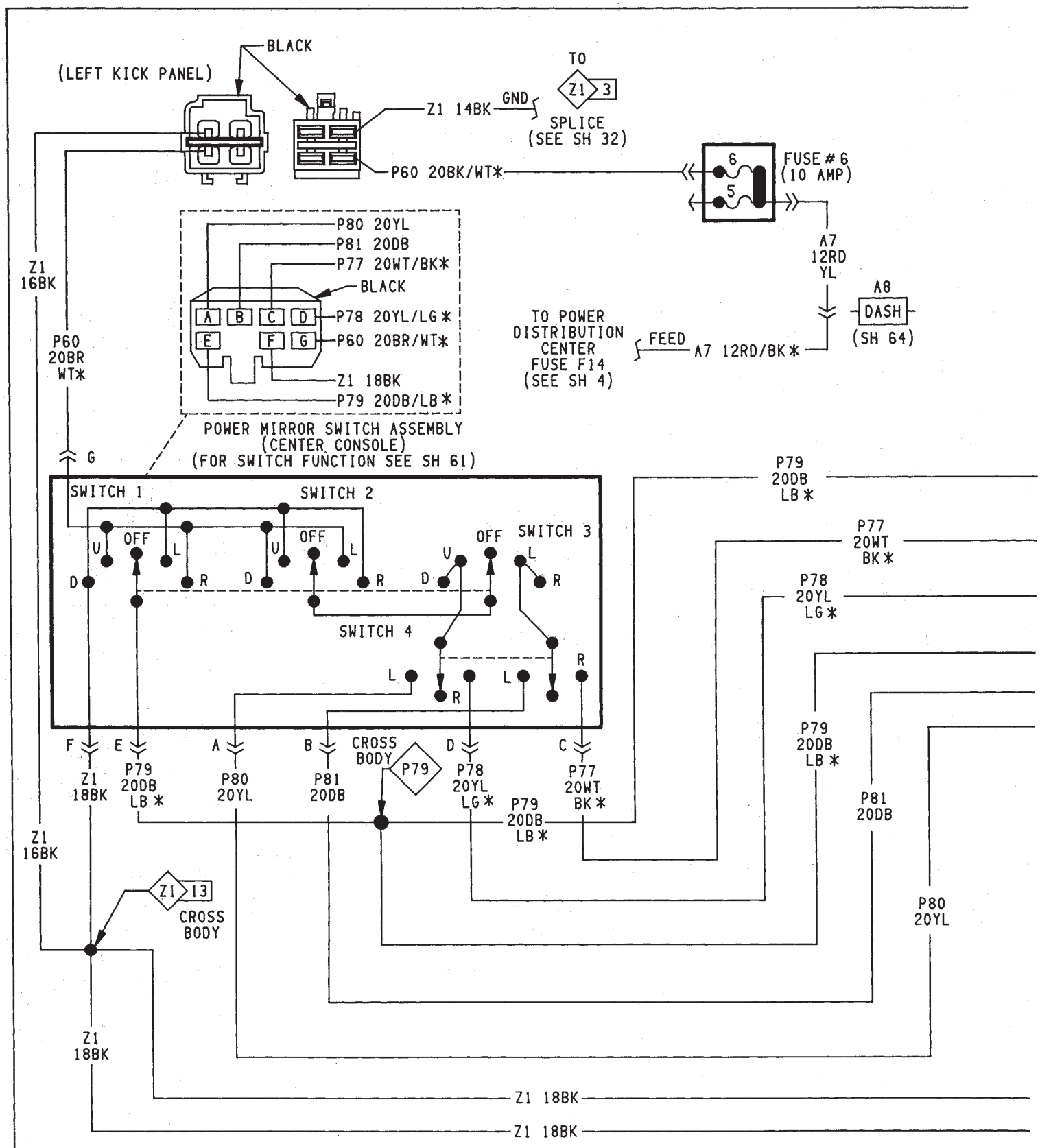

GND TO Z1 2 SPLICE
(SEE SH 20)
Z1
18BK
BLACK
X56 18DB/RD*
X54 18VT
X54 18VT
RIGHT
INSTRUMENT
PANEL
SPEAKER
A
B
X56 18DB/RD*
Z1
18BK
BLACK
(AT LIFTGATE)
X51 20BR/YL*
X57 20BR/LB*
X52 20DB/WT*
X58 20DB/OR*
C D
B A
D C
A B
A B
BLACK
X52 20DB/WT*
X58 20DB/OR*
X51
20BR
YL*
X58
20DB
OR*
X52
20DB
WT*
X57
20BR
LB*
LEFT
LIFTGATE
SPEAKER
RIGHT
LIFTGATE
SPEAKER
A B
BLACK
X57 20BR/LB*
X51 20BR/YL*

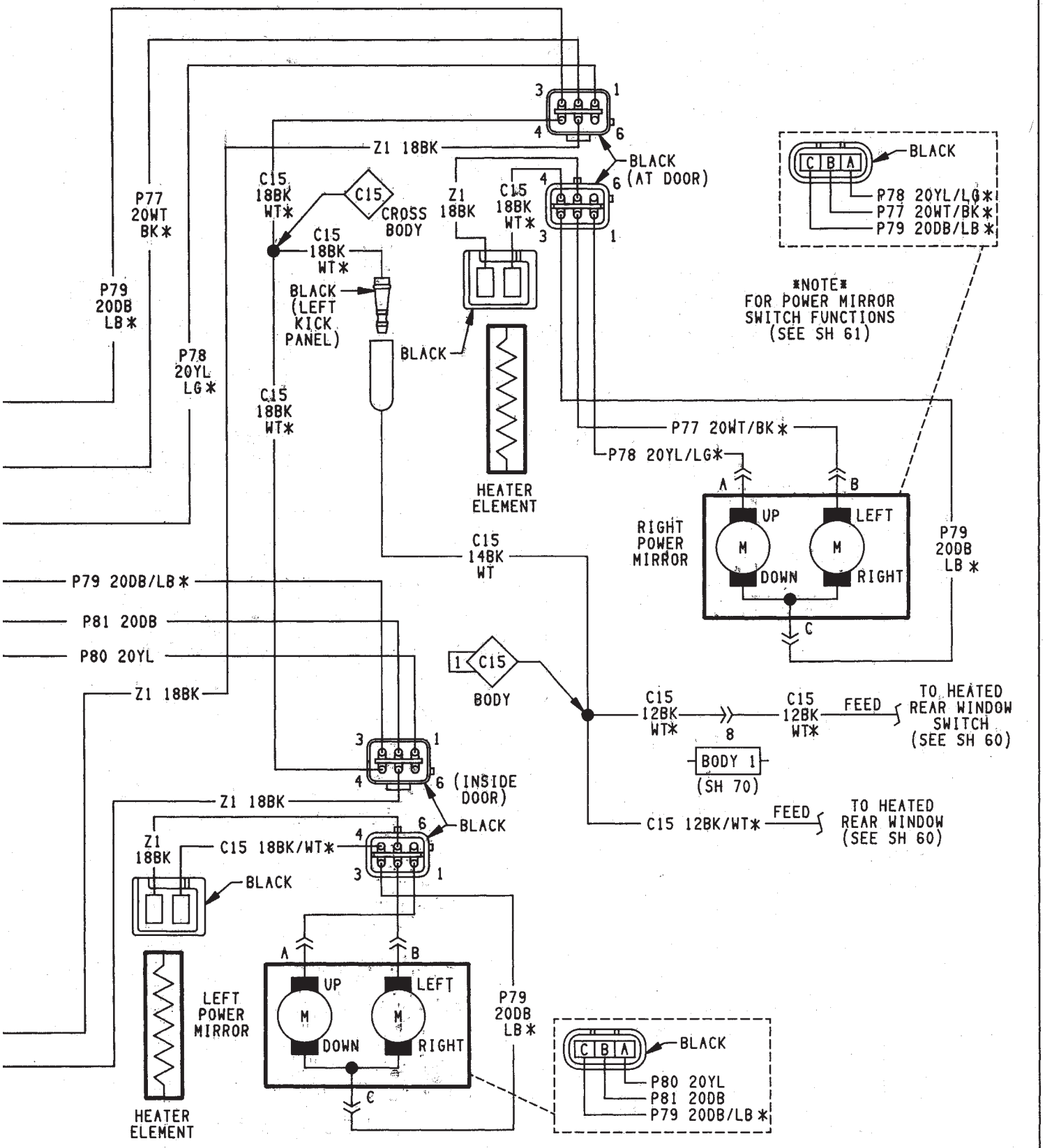


XJ-RHD 49 DOOR JAMB SWITCH SYSTEM J948W-13



J948W-13 DOOR JAMB SWITCH SYSTEM XJ-RHD 50


BLACK
(LEFT KICK PANEL)
TO
Z1 3
Z1 14BK
GND
SPLICE
(SEE SH 32)
P60 20BK/WT*
6
5
FUSE # 6
(10 AMP)
A7
12RD
YL
A8
DASH
(SH 64)
TO POWER
DISTRIBUTION
CENTER
FUSE F14
(SEE SH 4)
FEED
A7 12RD/BK*
Z1
16BK
P60
20BR
WT*
P80 20YL
P81 20DB
P77 20WT/BK*
BLACK
P78 20YL/LG*
P60 20BR/WT*
Z1 18BK
P79 20DB/LB*
A B C D
E F G
POWER MIRROR SWITCH ASSEMBLY
(CENTER CONSOLE)
(FOR SWITCH FUNCTION SEE SH 61)
G
SWITCH 1
SWITCH 2
SWITCH 3
SWITCH 4
U
OFF
L
D
R
P79
20DB
LB*
P77
20WT
BK*
P78
20YL
LG*
F
E
A
B
CROSS
BODY
P79
D
C
Z1
18BK
P79
20DB
LB*
P80
20YL
P81
20DB
P78
20YL
LG*
P77
20WT
BK*
Z1
16BK
Z1 13
CROSS
BODY
Z1 18BK
Z1 18BK



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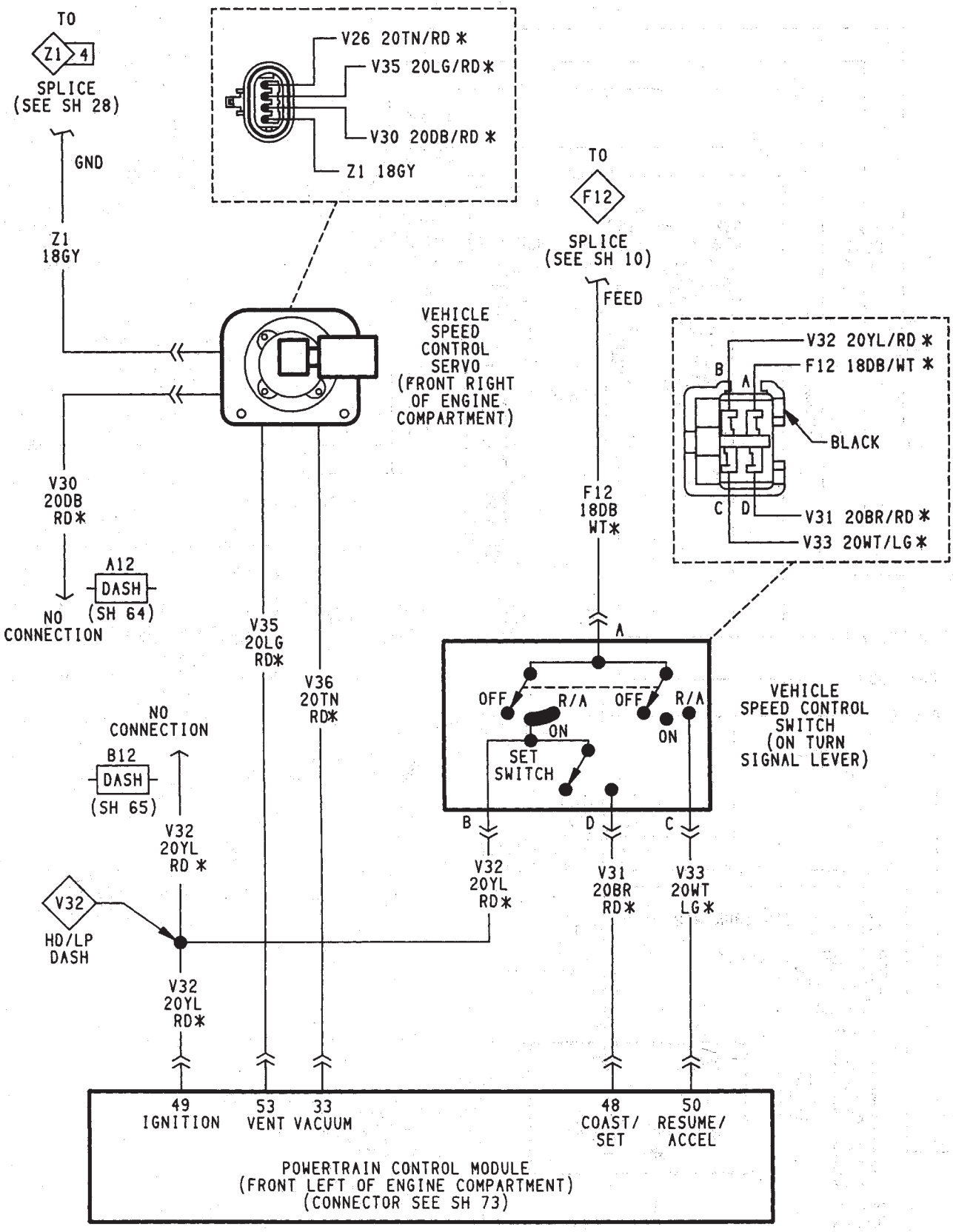
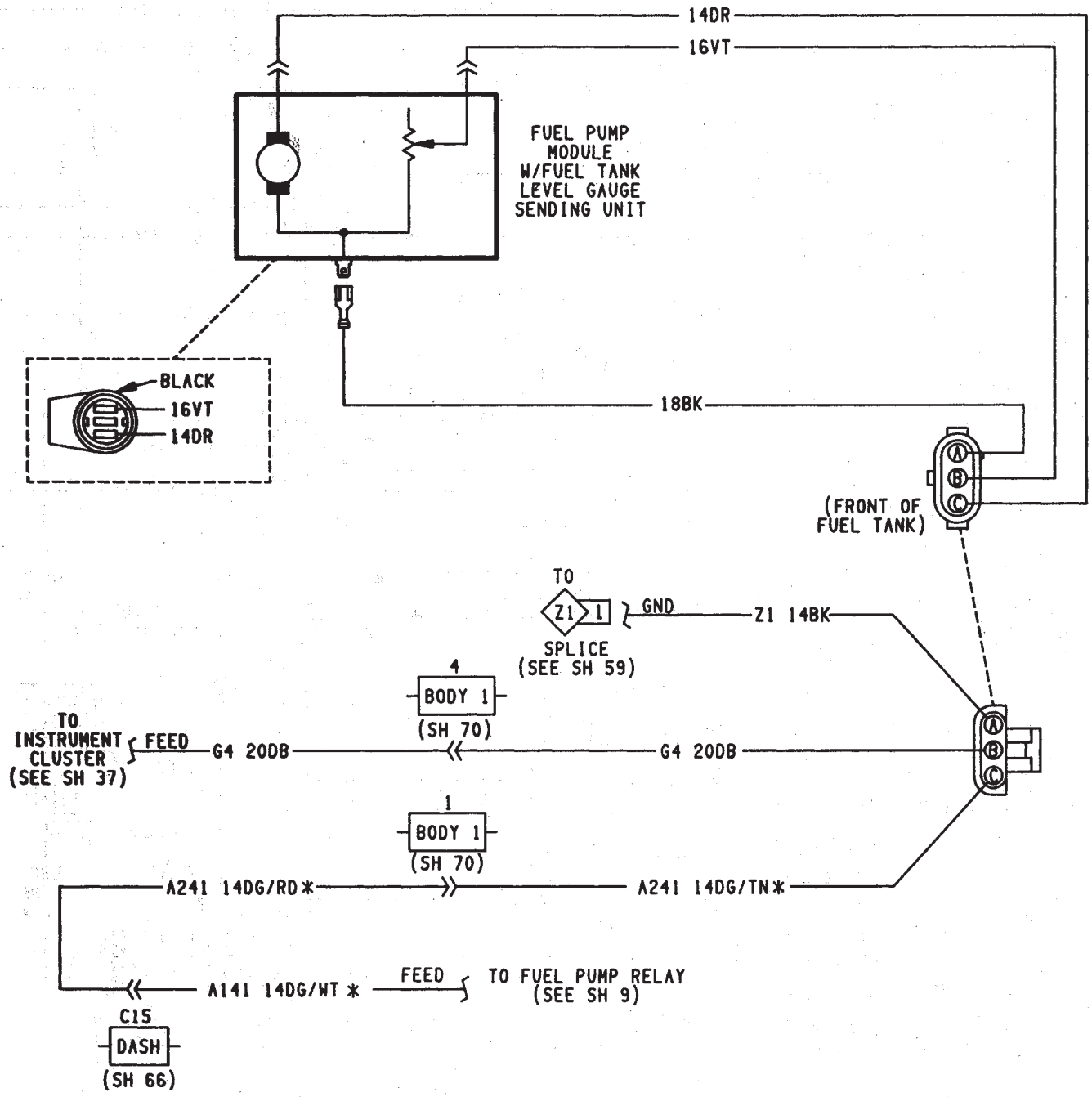
POWER MIRRORS

XJ-RHD 52



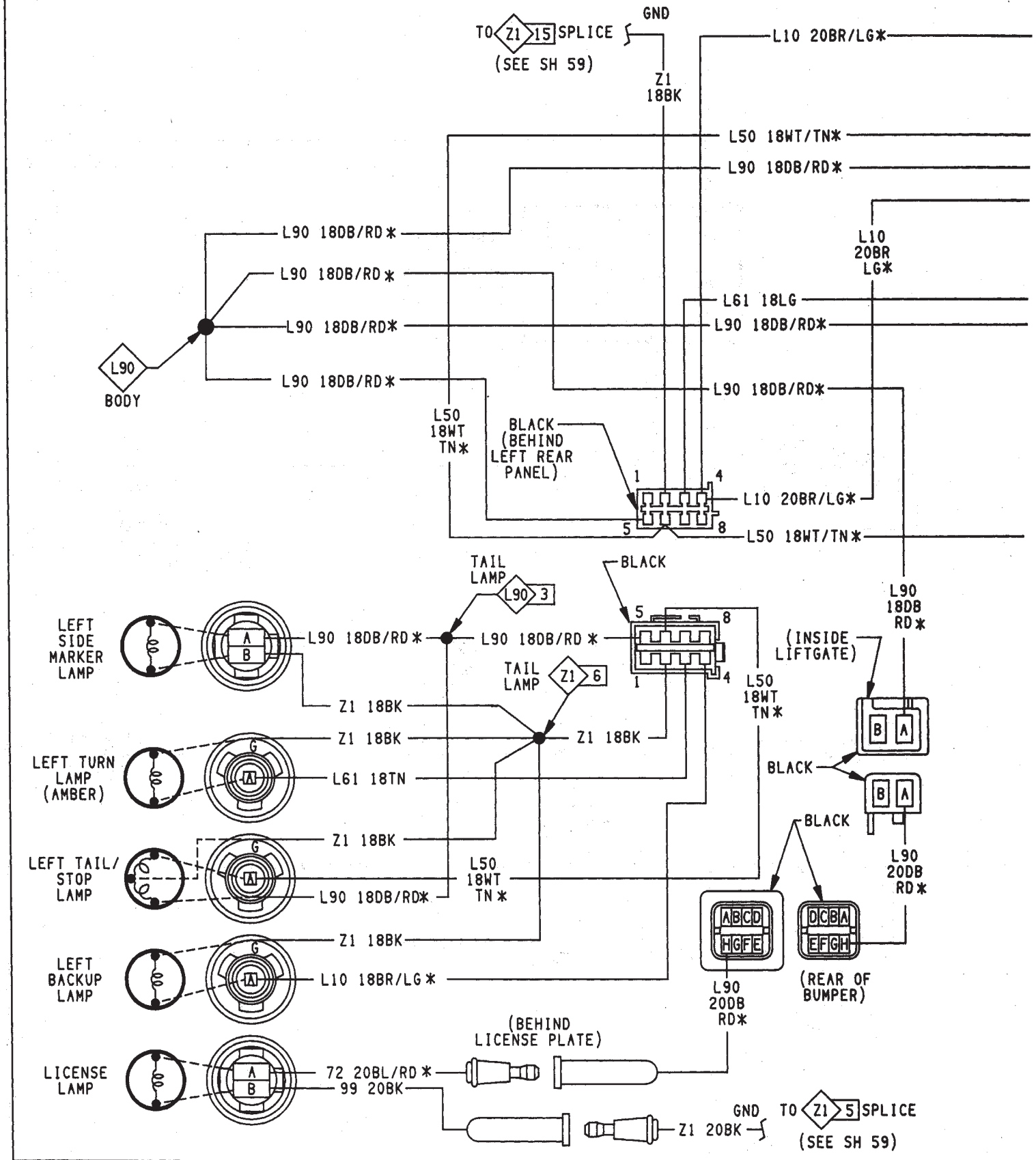
XJ-RHD 53 VEHICLE SPEED CONTROL SYSTEM J948W-13



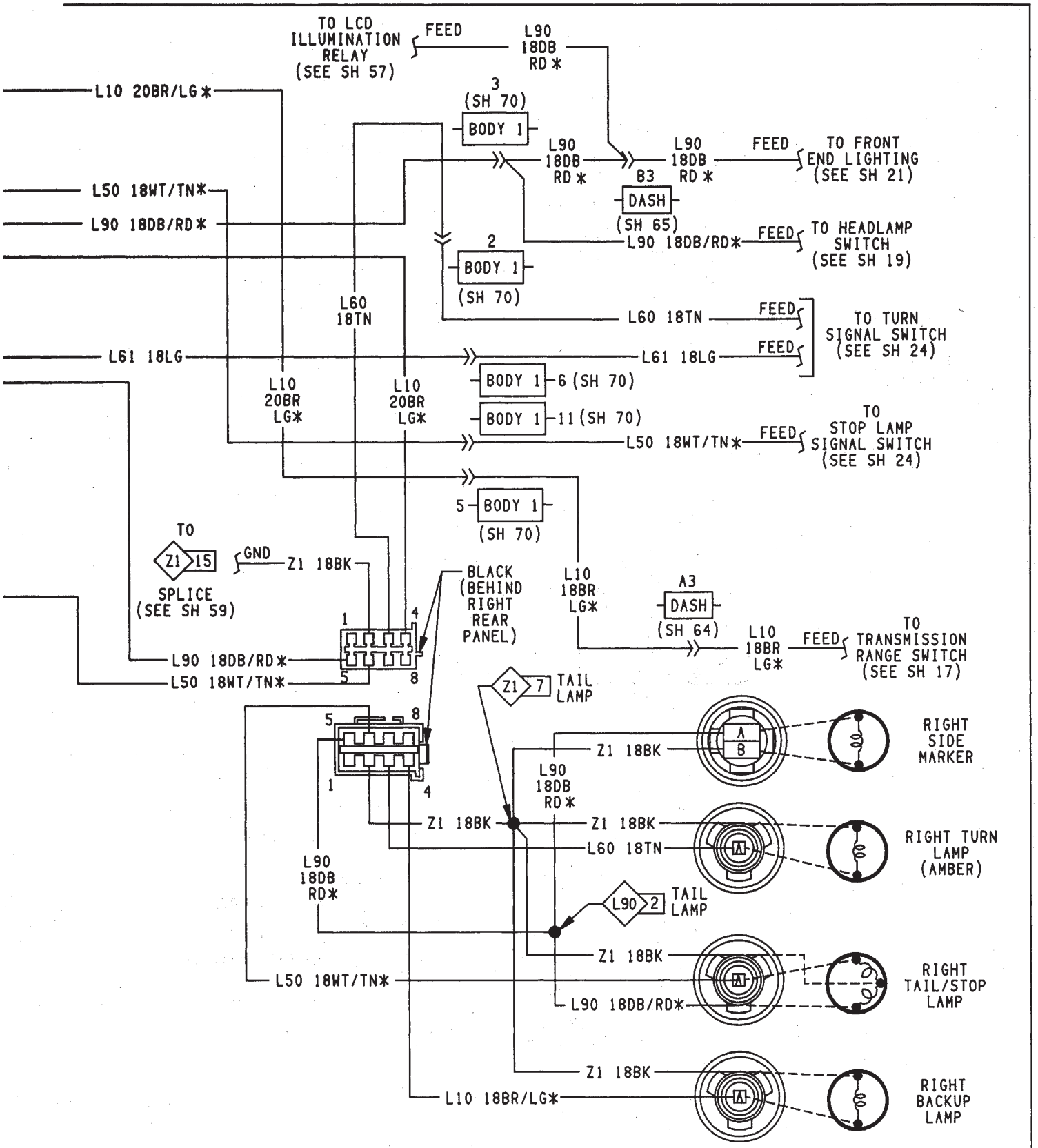
J948W-13

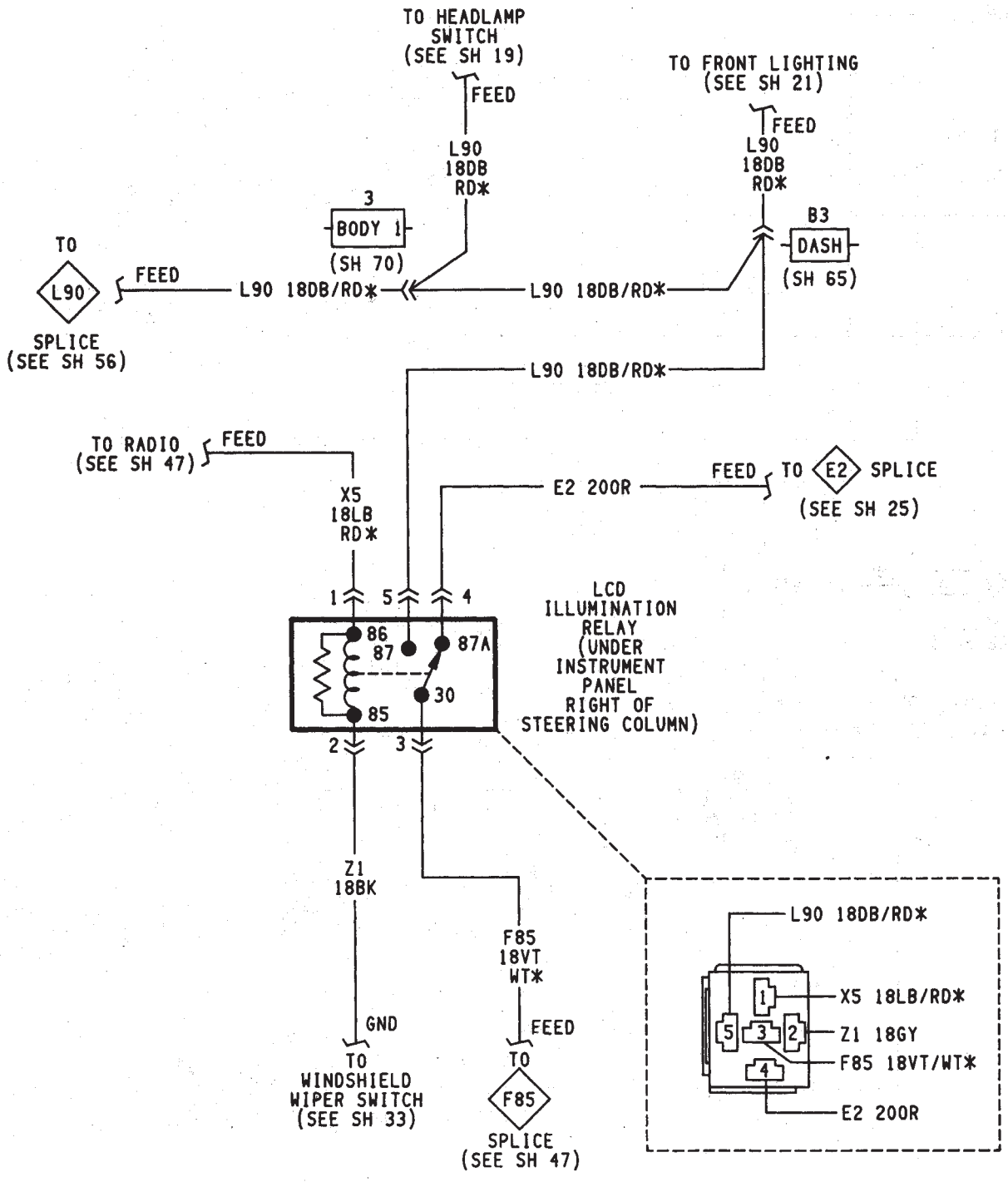
FUEL TANK SYSTEM

XJ-RHD 54

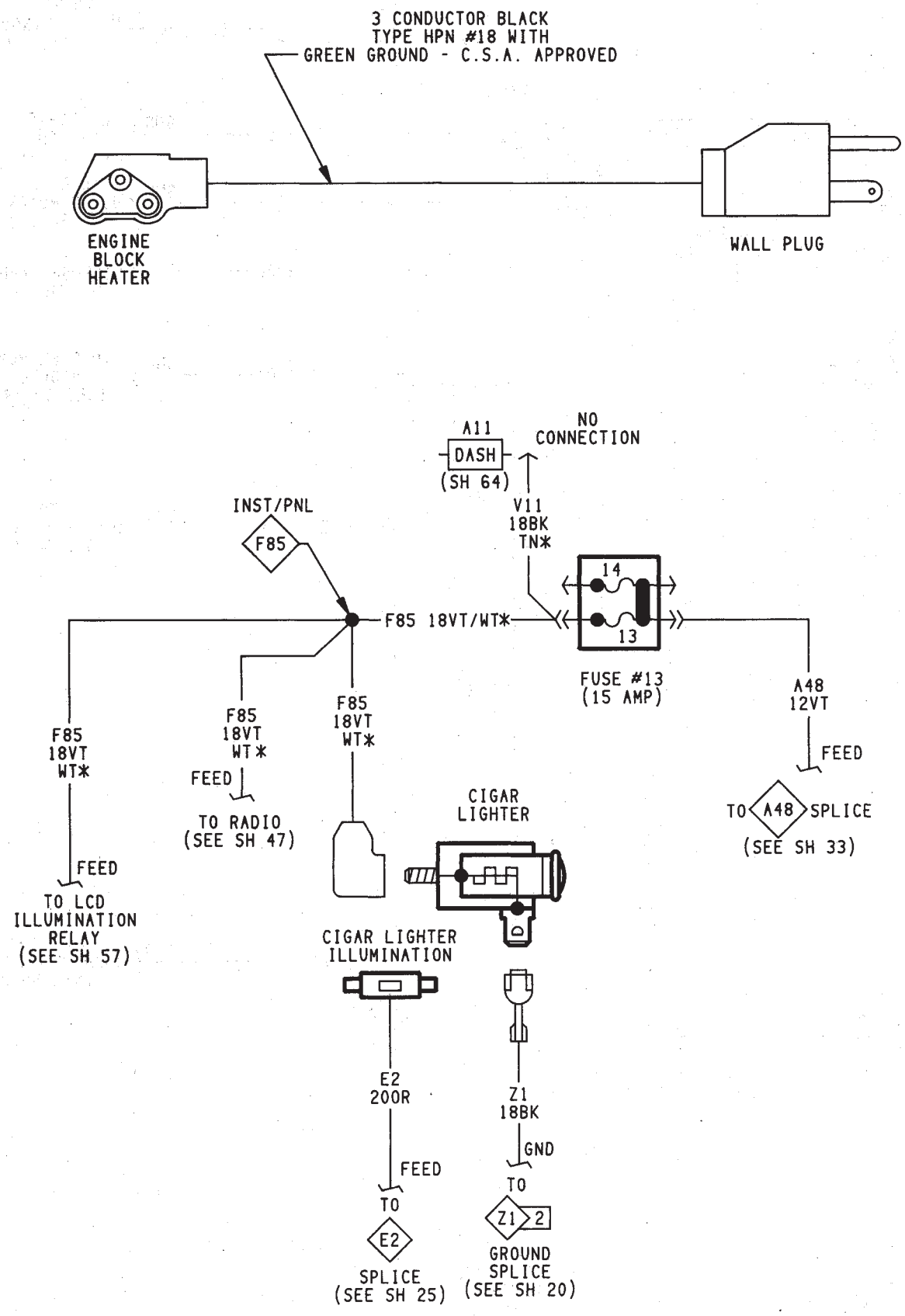


XJ-RHD 55 REAR LIGHTING J948W-13

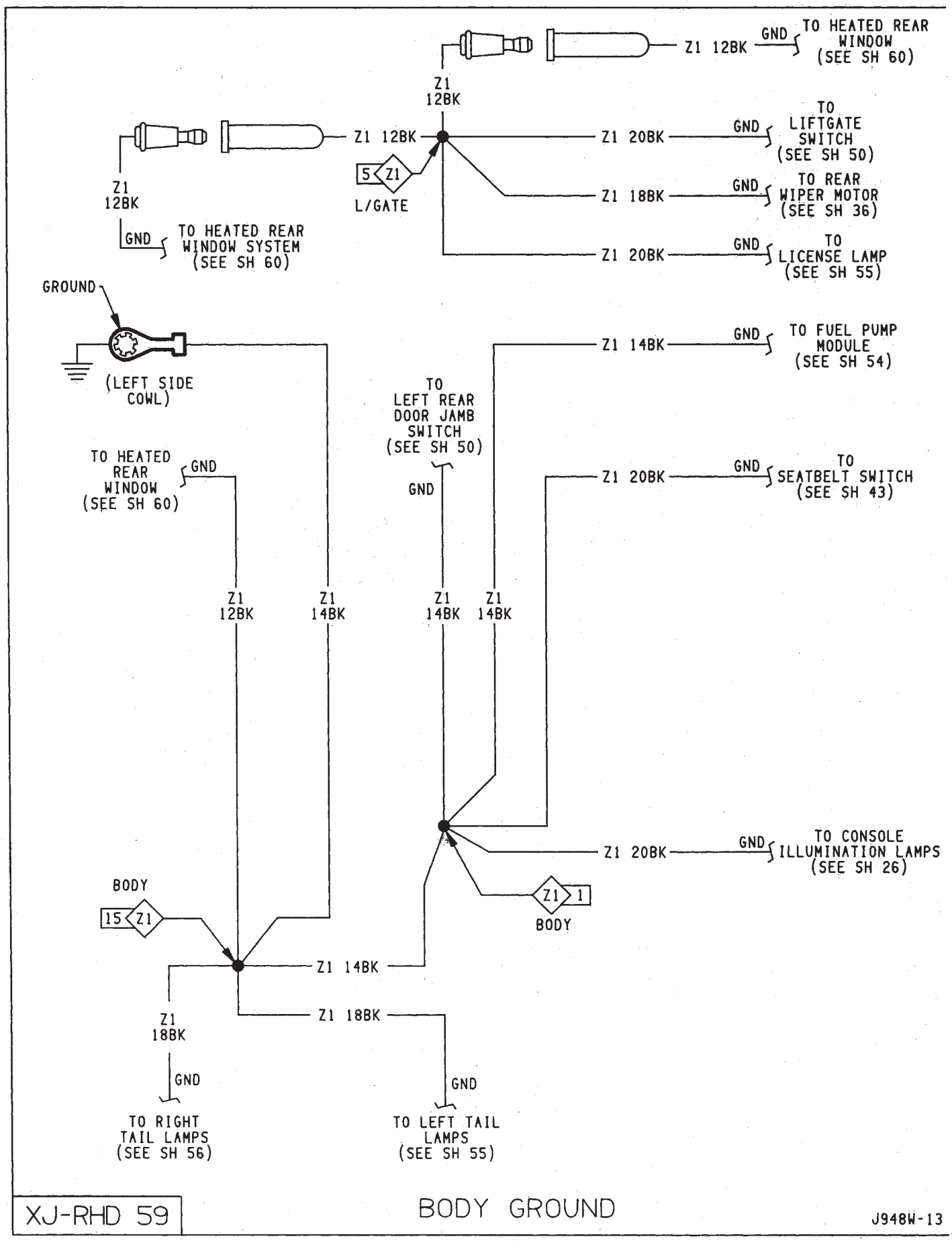

TO LCD ILLUMINATION RELAY (SEE SH 57)
FEED
L90 18DB RD*
L10 20BR/LG*
3 (SH 70)
BODY 1
L90 18DB RD*
L90 18DB RD*
FEED
TO FRONT END LIGHTING (SEE SH 21)
B3
DASH
(SH 65)
L50 18WT/TN*
L90 18DB/RD*
L90 18DB/RD*
FEED
TO HEADLAMP SWITCH (SEE SH 19)
2
BODY 1
(SH 70)
L60 18TN
L60 18TN
FEED
FEED
TO TURN SIGNAL SWITCH (SEE SH 24)
L61 18LG
L61 18LG
BODY 1
6 (SH 70)
L10 20BR LG*
L10 20BR LG*
BODY 1
11 (SH 70)
L50 18WT/TN*
FEED
TO STOP LAMP SIGNAL SWITCH (SEE SH 24)
5
BODY 1
(SH 70)
TO
Z1 15
GND
Z1 18BK
SPLICE (SEE SH 59)
BLACK (BEHIND RIGHT REAR PANEL)
L10 18BR LG*
A3
DASH
(SH 64)
L10 18BR LG*
FEED
TO TRANSMISSION RANGE SWITCH (SEE SH 17)
L90 18DB/RD*
L50 18WT/TN*
Z1 7
TAIL LAMP
Z1 18BK
RIGHT SIDE MARKER
L90 18DB RD*
Z1 18BK
Z1 18BK
L60 18TN
RIGHT TURN LAMP (AMBER)
L90 18DB RD*
L90 2
TAIL LAMP
Z1 18BK
L50 18WT/TN*
L90 18DB/RD*
RIGHT TAIL/STOP LAMP
Z1 18BK
L10 18BR/LG*
RIGHT BACKUP LAMP



XJ-RHD 57 LCD ILLUMINATION RELAY J948W-13



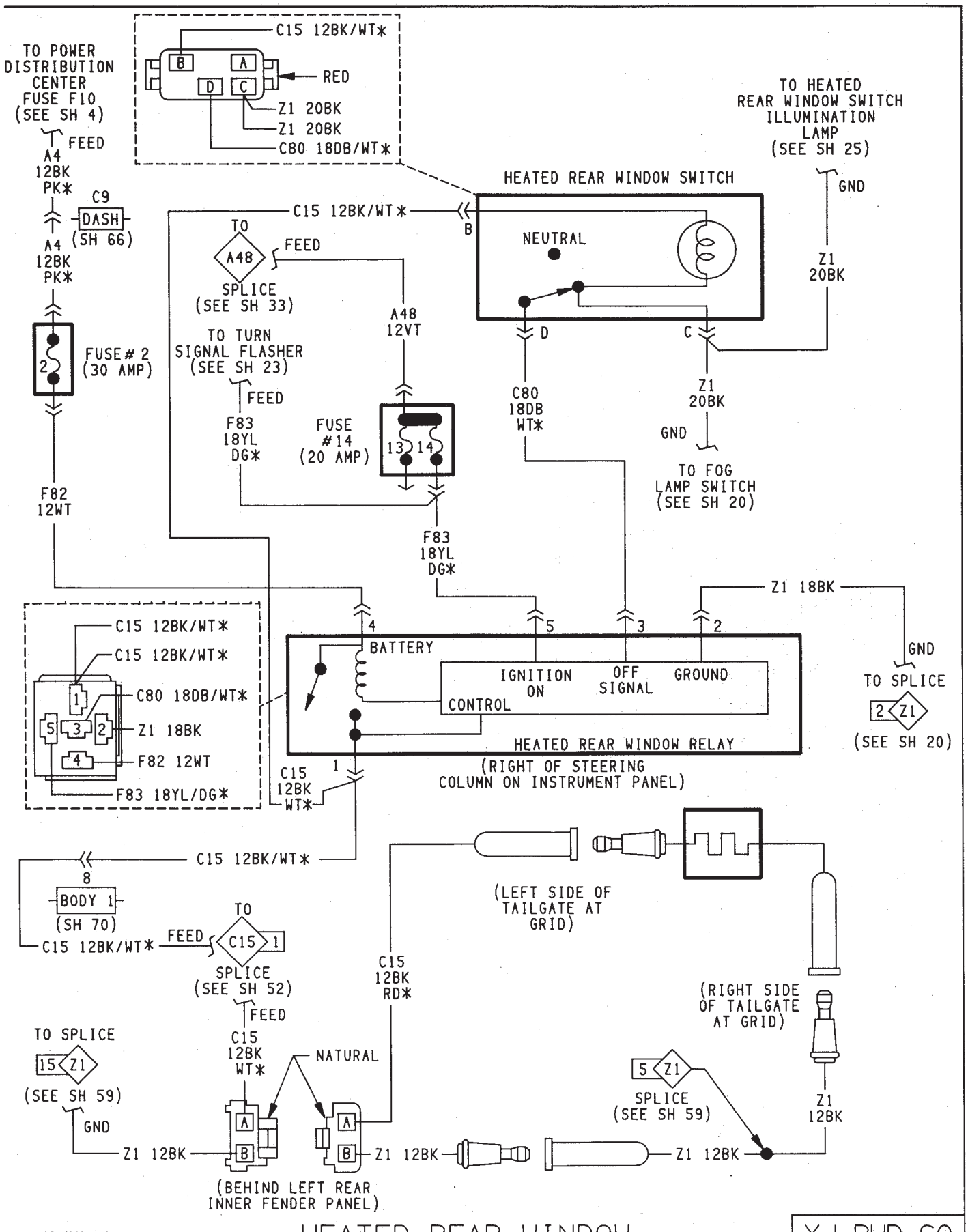
J948W-13 ENGINE BLOCK HEATER/CIGAR LIGHTER XJ-RHD 58



XJ-RHD 59

BODY GROUND

J948W-13



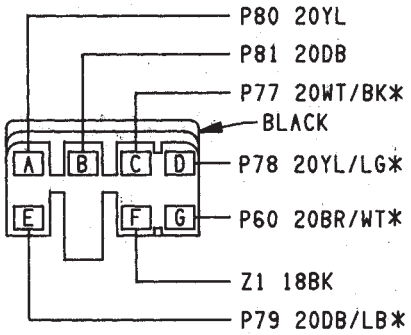
J948W-13

HEATED REAR WINDOW

XJ-RHD 60

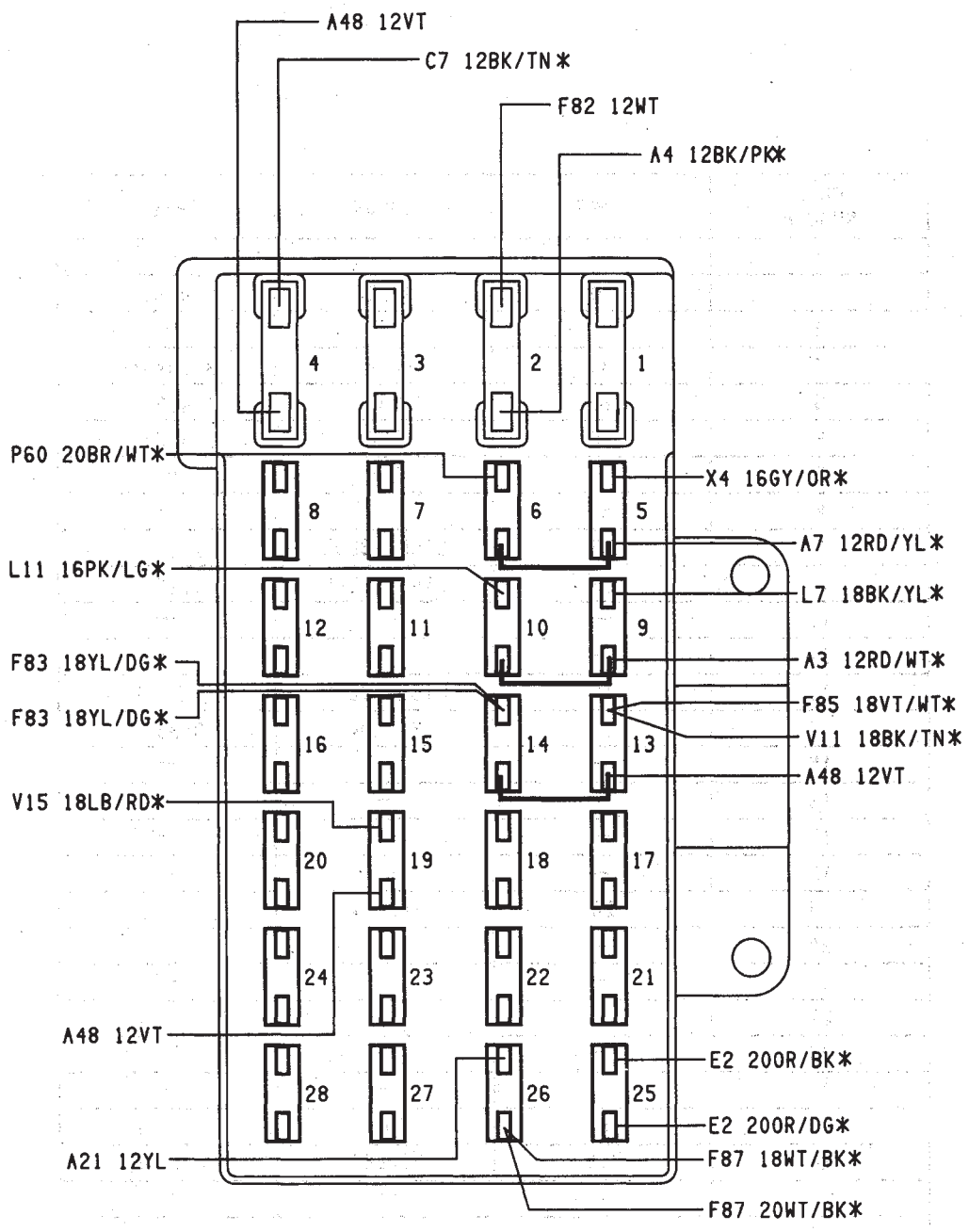
POWER MIRROR CONNECTOR
AND SWITCH FUNCTION

B+ POLARITY	B− POLARITY	MIRROR MOVEMENT
P79 20DB/LB*	P80 20YL	LEFT MIRROR — UP
P80 20YL	P79 20DB/LB*	LEFT MIRROR — DOWN
P79 20DB/LB*	P78 20YL/LG*	RIGHT MIRROR — UP
P78 20YL/LG*	P79 20DB/LB*	RIGHT MIRROR — DOWN
P79 20DB/LB*	P81 20DB	LEFT MIRROR — RIGHT
P81 20DB	P79 20DB/LB*	LEFT MIRROR — LEFT
P79 20DB/LB*	P77 20WT/BK*	RIGHT MIRROR — RIGHT
P77 20WT/BK*	P79 20DB/LB*	RIGHT MIRROR — LEFT
P60 20BR/WT*	—	FEED
—	Z1 18BK	GROUND



POWER MIRROR CONNECTOR
AND FUNCTIONS

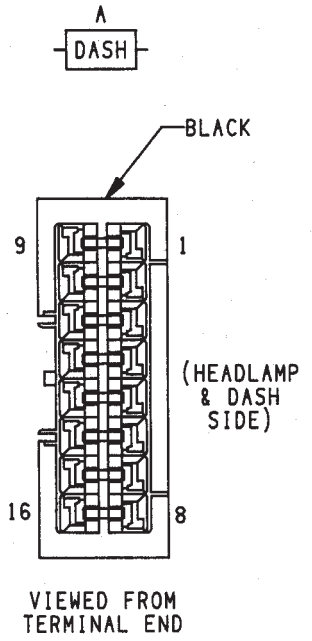
J948W-13



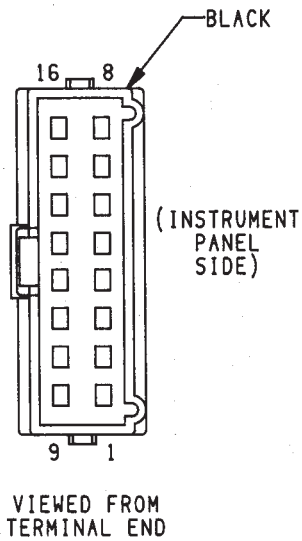
VIEWED FROM TERMINAL END

FUSE NUMBER	AMPS	COLOR	SHEET
1	—	—	—
2	30	GREEN	2,4,60
3	—	—	—
4	30	GREEN	2,33,44,46
5	20	YELLOW	1,4,27
6	10	RED	1,4,51
7	—	—	—
8	—	—	—
9	15	LIGHT BLUE	1,19
10	15	LIGHT BLUE	1,19
11	—	—	—
12	—	—	—
13	15	LIGHT BLUE	2,47,58
14	20	YELLOW	2,23,33,60
15	—	—	—
16	—	—	—
17	—	—	—
18	—	—	—
19	20	YELLOW	2,33,35
20	—	—	—
21	—	—	—
22	—	—	—
23	—	—	—
24	—	—	—
25	5	TAN	1,19,25
26	7.5	VIOLET	1,8,37,43
27	—	—	—
28	—	—	—

FUSE PANEL

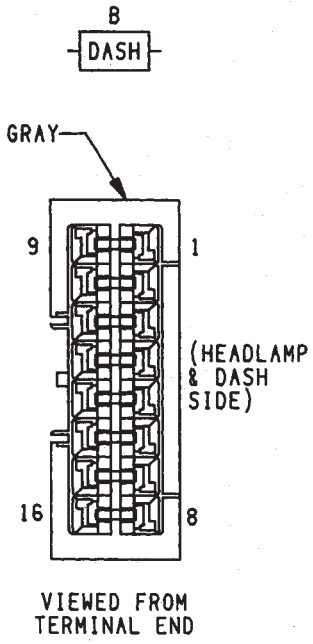


CAV	CIRCUIT	FUNCTION	SHEET
1	C1 12DG	BLOWER MOTOR FEED	44,46
2	G21 20GY/LB*	TACHOMETER SIGNAL	13
3	L10 18BR/LG*	REVERSE LAMP SIGNAL	17,56
4	F86 18LG/BK*	FUSED IGNITION	34
5	G6 20GY	OIL GAUGE SENDING UNIT	15,37
6	G20 20VT/YL*	ENGINE TEMPERATURE	8,15,37
7	—	—	—
8	A7 12RD/BK*	FUSEBLOCK FEED	4,27,51
9	A1 10RD	BATTERY FEED IGNITION	8
10	L9 18BK/WT*	HAZARD FLASHER FEED	4,24
11	—	—	—
12	V30 20DB/RD*	STOP LAMP SWITCH	53
13	Z2 16BK/OR*	LOGIC GROUND	37
14	G7 20WT/OR*	VEHICLE SPEED SIGNAL	12,16,37
15	L4 14VT/WT*	HEADLAMP (LOW-BEAM)	19,22
16	—	—	—

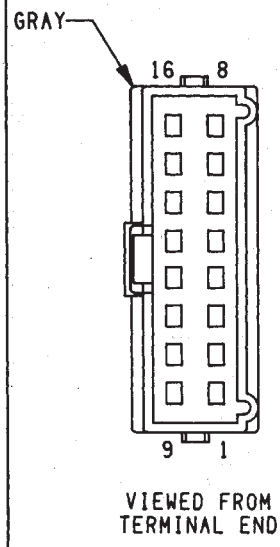


CAV	CIRCUIT	FUNCTION	SHEET
1	C1 12DG	BLOWER MOTOR FEED	44,46
2	—	—	—
3	L10 18BR/LG*	REVERSE LAMP SIGNAL	17,56
4	F86 18LG/BK*	FUSED IGNITION	34
5	G6 20GY	OIL GAUGE SENDING UNIT	15,37
6	G20 20VT/YL*	ENGINE TEMPERATURE	8,15,37
6	G20 18VT/YL*	ENGINE TEMPERATURE	8,15,37
7	—	—	—
8	A7 12RD/YL*	FUSEBLOCK FEED	4,27,51
9	A1 12RD	BATTERY FEED IGNITION	8
10	L9 16BK/WT*	HAZARD FLASHER FEED	4,24
11	V11 18BK/TN*	WASHER FLUID SWITCH	47,58
12	—	—	—
13	Z2 18BK/OR*	LOGIC GROUND	37
14	G7 18WT/OR*	VEHICLE SPEED SIGNAL	12,16,37
15	L4 16VT/WT*	HEADLAMP (LOW-BEAM)	19,22
16	—	—	—

J948W-13 DASH TO INSTRUMENT PANEL CONNECTOR A | XJ-RHD 64

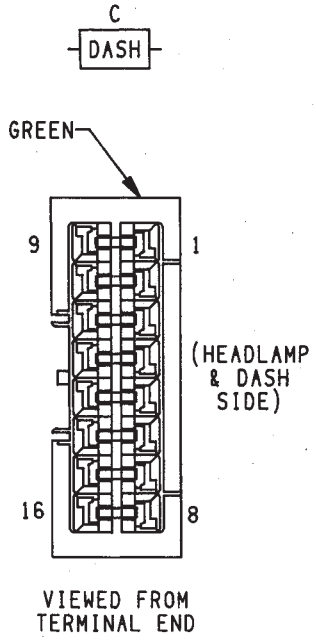


CAV	CIRCUIT	FUNCTION	SHEET
1	G9 20GY/BK*	BRAKE WARNING LAMP SWITCH	38,42
2	V20 18BK/WT*	REAR WASHER PUMP GROUND	35
3	L90 18DB/RD*	PARK LAMPS	19,21,56,57
4	L35 18BR/WT*	FOG LAMP RELAY	20,22
5	C21 16DB/OR*	A/C DAMPED PRESSURE SWITCH	45
6	C90 16LG	A/C SELECT SIGNAL	45
7	C91 16LG	A/C LOAD SIGNAL	45
8	A21 12DB	IGNITION START/RUN	8,9,43
9	A3 12RD/WT*	BATTERY FEED TO HEADLAMP	19
10	L60 18TN	RIGHT FRONT TURN SIGNAL	22,23
11	L61 18LG	LEFT REAR TURN SIGNAL	22,23
12	V32 20YL/RD*	VEHICLE SPEED CONTROL (IGNITION)	53
13	X2 18DG/RD*	HORN FEED	27
13	X2 18DG/RD*	HORN FEED	27
14	G9 20GY/WT*	BRAKE BULB CHECK	8,42
15	—	—	—
16	L3 14RD/OR*	HEADLAMP (HIGH-BEAM)	19,22,37

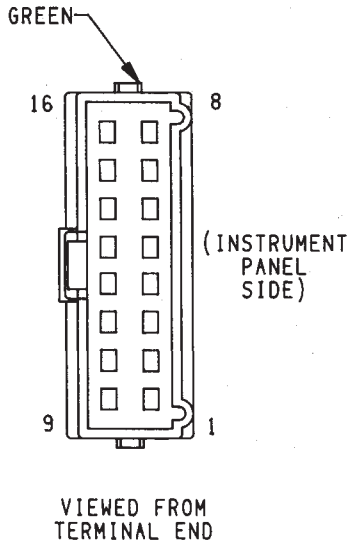


CAV	CIRCUIT	FUNCTION	SHEET
1	G9 18GY/BK*	BRAKE WARNING LAMP SWITCH	38,42
2	V20 18BK/WT*	REAR WASHER PUMP GROUND	35
2	V20 18BK/WT*	REAR WASHER PUMP GROUND	35
3	L90 18DB/RD*	PARK LAMPS	19,21,56,57
3	L90 18DB/RD*	PARK LAMPS	19,21,56,57
4	L35 16BR/WT*	FOG LAMP RELAY	20,22
5	C21 16DB/OR*	A/C DAMPED PRESSURE SWITCH	45
6	C90 16LG	A/C SELECT SIGNAL	45
7	C91 16LG	A/C LOAD SIGNAL	45
8	A21 12YL	IGNITION START/RUN DIAGNOSTIC	8,9,43
9	A3 12RD/WT*	BATTERY FEED TO HEADLAMP	19
10	L60 18TN	RIGHT FRONT TURN SIGNAL	22,23
10	L60 18TN	RIGHT FRONT TURN SIGNAL	22,23
11	L61 18LG	LEFT REAR TURN SIGNAL	22,23
11	L61 18LG	LEFT REAR TURN SIGNAL	22,23
12	—	—	—
13	X2 16DG/RD*	HORN FEED	27
14	G9 20GY/WT*	BRAKE BULB CHECK	8,42
15	—	—	—
16	L3 16RD/OR*	HEADLAMP (HIGH-BEAM)	19,22,37
16	L3 16RD/OR*	HEADLAMP (HIGH-BEAM)	19,22,37

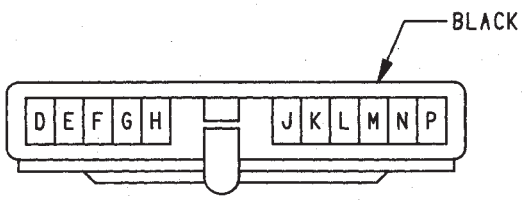
XJ-RHD 65 DASH TO INSTRUMENT PANEL CONNECTOR B J948W-13



CAV	CIRCUIT	FUNCTION	SHEET
1	V55 18TN/RD*	PARK SIGNAL RETURN	34
2	177 18TN	TRANSMISSION SWITCH	18
3	107 20BK/RD*	FOUR WHEEL LAMP	16,38
3	107 20BK/RD*	FOUR WHEEL LAMP	16
4	106 20BK/YL*	FOUR WHEEL LAMP	18
5	V10 20BR	WINDSHIELD WASHER	34
6	V3 18BR/WT*	WINDSHIELD WIPER-LOW	34
7	V4 18RD/YL*	WINDSHIELD WIPER-HIGH	34
8	L39 18LB	FOG LAMPS FEED	8,22
9	A4 12BK/PK*	HEATED REAR WINDOW	4,60
10	A41 14YL	ENGINE STARTER RELAY	6,8
11	G29 20BK/TN*	LOW WASHER FLUID	33,38
12	A7 14RD/BK*	INTERIOR LAMPS	4,29
13	K29 18WT/PK*	BRAKE SENSE SIGNAL	9
14	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	13,38
15	A141 14DG/WT*	FUEL PUMP FEED	54
16	T17 18YL	FUSED IGNITION	17



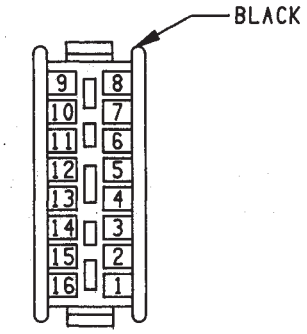
CAV	CIRCUIT	FUNCTION	SHEET
1	V55 18TN/RD*	PARK SIGNAL RETURN	34
2	—	—	—
3	107 20BK/RD*	FOUR WHEEL LAMP	16,38
4	106 20BK/YL*	FOUR WHEEL LAMP	18
5	V10 18BR	WINDSHIELD WASHER	34
6	V3 18BR/WT*	WINDSHIELD WIPER-LOW	34
7	V4 18RD/YL*	WINDSHIELD WIPER-HIGH	34
8	A38 12YL	IGNITION RUN	8,22
9	A4 12BK/PK*	HEATED REAR WINDOW	4,60
10	A41 14YL/WT*	ENGINE STARTER RELAY	6,8
11	G29 20BK/TN*	LOW WASHER FLUID	33,38
12	M1 18PK	INTERIOR LAMPS SWITCH	4,29
13	K29 18WT/PK*	BRAKE SENSE SIGNAL	9
14	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	13,38
15	A241 14DG/TN*	FUEL PUMP FEED	54
16	—	—	—



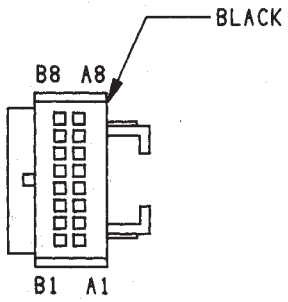
VIEWED FROM
TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
P	—	—	—
N	L60 18TN	RIGHT TURN-REAR INDICATOR	24
M	L61 18LG	LEFT TURN-REAR INDICATOR	24
L	L5 18BK	TURN SIGNAL FLASHER	24
K	L12 18VT/TN*	HAZARD FLASHER	24
J	L60 18TN	RIGHT TURN-FRONT INDICATOR	24
H	L61 18LG	LEFT TURN-FRONT INDICATOR	24
G	X3 20BK/RD*	HORN SWITCH	27
F	M11 20PK/LB*	SWITCHED COURTESY LAMP FEED	43
E	G26 20LB	IGNITION KEY WARNING SWITCH	43
D	—	—	—

XJ-RHD 67 STEERING COLUMN CONNECTOR 11 WAY J948W-13



CAV	CIRCUIT	FUNCTION	SHEET
1	Z1 20BK	GROUND	38
1	Z1 20BK	GROUND	38
2	G11 20WT/OR*	CHIME	38
3	F87 20WT/BK*	FUSED IGNITION	38
4	—	—	—
5	107 20BK/RD*	FOUR WHEEL LAMP	38
6	106 20BK/YL*	FOUR WHEEL LAMP	38
7	—	—	—
8	—	—	—
9	G9 18GY/BK*	BRAKE SWITCH	38
10	—	—	—
11	—	—	—
12	—	—	—
13	—	—	—
14	F87 20WT/BK*	FUSED IGNITION	38
14	F87 20WT/BK*	FUSED IGNITION	38
15	G3 20BK/PK*	ENGINE OIL PRESSURE	38
16	G29 20BK/TN*	WASHER FLUID SWITCH	38



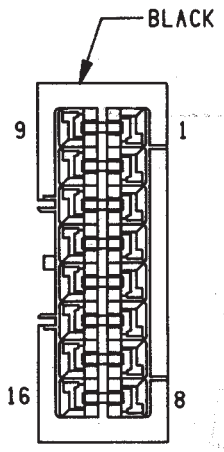
VIEWED FROM
TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
A1	G20 18VT/YL*	ENGINE TEMPERATURE	37
A2	L61 18LG	LEFT TURN INDICATOR LAMP	37
A3	Z1 20BK	GROUND	37
A4	L3 16RD/OR*	HEADLAMP (HIGH-BEAM)	37
A5	—	—	—
A6	E2 20OR/BK*	PANEL ILLUMINATION	37
A7	F87 18WT/BK*	FUSED IGNITION	37
A8	—	—	—
B1	G4 20DB	FUEL GAUGE	37
B2	Z2 18BK/OR*	LOGIC GROUND	37
B3	—	—	—
B4	—	—	—
B5	—	—	—
B6	G7 18WT/OR*	VEHICLE SPEED SIGNAL	37
B7	L60 18TN	RIGHT TURN INDICATOR LAMP	37
B8	G6 20GY	ENGINE OIL PRESSURE	37

INSTRUMENT CLUSTER CONNECTOR
16 WAY

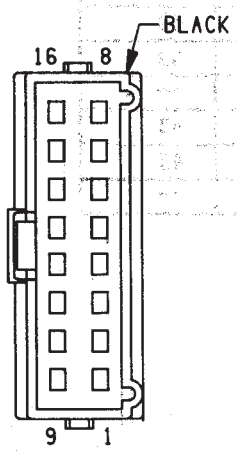
J948W-13

BODY 1



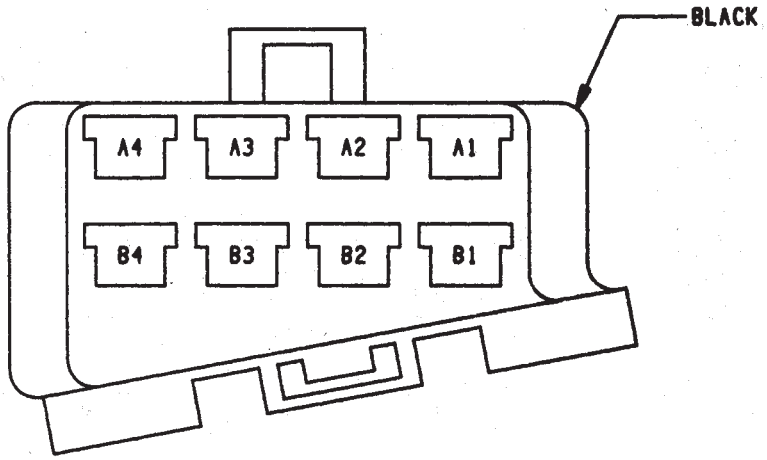
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	A241 14DG/TN*	FUEL PUMP FEED	54
2	L60 18TN	RIGHT REAR SIGNAL AND IND	56
3	L90 18DB/RD*	PARK LAMPS	19,21,56,57
3	L90 18DB/RD*	PARK LAMPS	19,21,56,57
4	G4 20DB	FUEL GAUGE FROM TANK	37,54
5	L10 18BR/LG*	REVERSE LAMP SIGNAL	56
6	L61 18LG	LEFT REAR SIGNAL AND IND	56
7	G9 18GY/BK*	BRAKE WARNING LAMP SWITCH	38,42
7	G9 18GY/BK*	BRAKE PRESSURE LIGHT/PARK	38,42
8	C15 12BK/WT*	HEATED REAR WINDOW	52,60
9	M1 20PK	DOOR SWITCH	29
10	V20 18BK/WT*	REAR WASHER FEED RETURN	35
11	L50 18WT/TN*	STOP LAMP SIGNAL	56
12	E2 20OR/BK*	I/P ILLUMINATION	26
13	M2 20YL	DOOR SWITCH GROUND	30
14	G10 18LG/RD*	SEAT BELT SWITCH	43
15	V13 18BR/LG*	REAR WIPE SWITCH	36
16	F20 18WT	REAR WIPE SWITCH	35



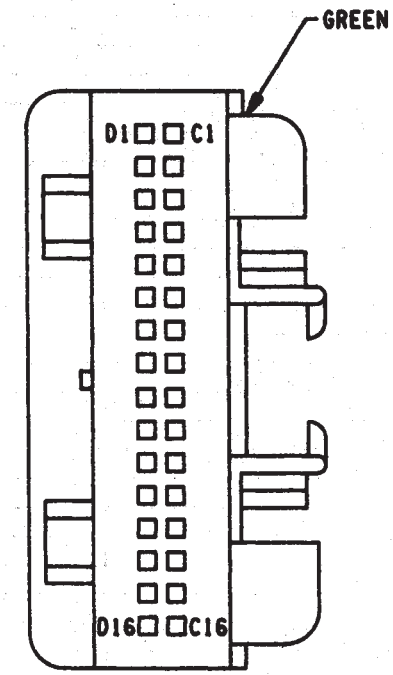
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
1	A241 14DG/TN*	FUEL PUMP FEED	54
2	L60 18TN	RIGHT REAR SIGNAL AND IND	56
3	L90 18DB/RD*	PARK LAMPS	19,21,56,57
4	G4 20DB	FUEL GAUGE FROM TANK	37,54
5	L10 20BR/LG*	REVERSE LAMP SIGNAL	56
6	L61 18LG	LEFT REAR SIGNAL AND IND	56
7	G9 20GY/BK*	BRAKE WARNING LAMP SWITCH	38,42
8	C15 12BK/WT*	HEATED REAR WINDOW	52,60
9	M1 20PK	DOOR SWITCH	29
10	V20 18BK/WT*	REAR WASHER FEED RETURN	35
11	L50 18WT/TN*	STOP LAMP SIGNAL	56
12	E2 20OR	I/P ILLUMINATION	26
13	M2 20YL	DOOR SWITCH GROUND	30
14	G10 18LG/RD*	SEAT BELT SWITCH	43
15	V13 18BR/LG*	REAR WIPE SWITCH	36
16	F20 18WT	REAR WIPE SWITCH	35



VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
A1	G10 18LG/RD*	SEATBELT WARNING SWITCH	43
A2	Z1 18BK	GROUND	43
A2	Z1 18BK	GROUND	43
A3	G11 20WT/OR*	SEATBELT	43
A4	F87 20WT/BK*	FUSED IGNITION	43
A4	F87 20WT/BK*	FUSED IGNITION	43
B1	—	—	—
B2	L7 18BK/YL*	TAIL,LICENSE,SIDE MARKER LAMPS	43
B3	M11 20PK/LB*	SWITCHED COURTESY LAMP FEED	43
B4	—	—	—



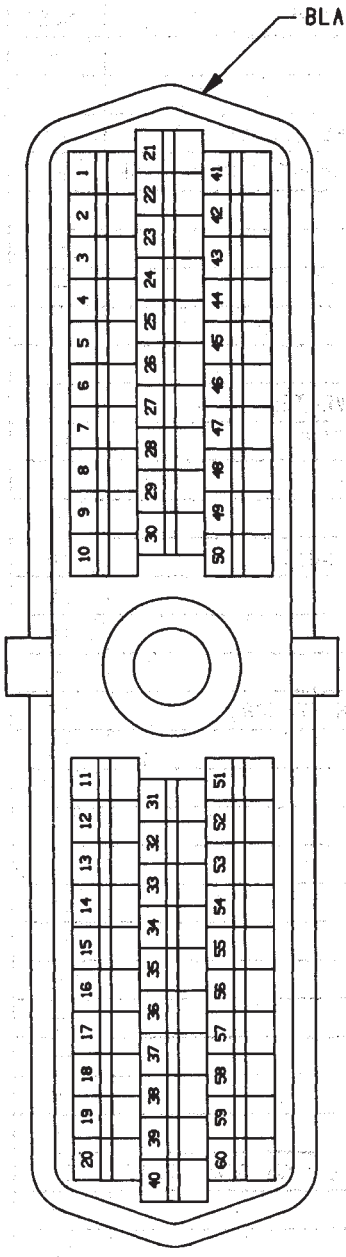
VIEWED FROM TERMINAL END

CAV	CIRCUIT	FUNCTION	SHEET
C1	—	—	—
C2	—	—	—
C3	505 18TN/BK*	TRANSMISSION SPEED SENSOR	18
C4	137 16YL/BK*	TRANSMISSION DIAGNOSTIC CONNECTOR	17
C5	—	—	—
C6	—	—	—
C7	—	—	—
C8	506 18LG/BK*	1-2 GEAR INPUT	17
C9	507 18GY/BK*	DRIVE GEAR INPUT	17
C10	K29 18WT/PK*	BRAKE/TORQUE CONVERTER	18
C11	177 18TN	TRANSMISSION SWITCH	18
C12	—	—	—
C13	—	—	—
C14	508 18WT/BK*	TRANSMISSION SOLENOID	18
C15	509 18VT/BK*	S2 SOLENOID	18
C16	510 18DB/WT*	S1 SOLENOID	18
D1	—	—	—
D2	K22 18OR/DB*	THROTTLE POSITION(SENSOR)	18
D3	K4 18BK/LB*	SENSOR GROUND	18
D4	—	—	—
D5	—	—	—
D6	—	—	—
D7	Z12 18BK/TN*	GROUND	18
D8	—	—	—
D9	—	—	—
D10	—	—	—
D11	—	—	—
D12	—	—	—
D13	—	—	—
D14	A14 14RD/WT*	FUEL PUMP AUTOMATIC SHUT DOWN RELAY	18
D15	—	—	—
D16	T17 18YL	FUSED IGNITION	17

TRANSMISSION CONTROL MODULE (AUTOMATIC TRANSMISSION) 32 WAY CONNECTOR

J948W-13

XJ-RHD 72



VIEWED FROM WIRE END

CAV	CIRCUIT	FUNCTION	SHEET
1	K1 20DG/RD*	MAP SENSOR	11
2	K2 16TN/BK*	ECU INPUT	11
3	A14 14RD/WT*	AUTOMATIC SHUT DOWN RELAY	9
4	K4 18BK/LB*	SENSOR GROUND	11
5	Z11 16BK/WT*	SIGNAL GROUND	10
6	K6 20VT/WT*	SENSOR 5 VOLT SUPPLY	11
7	K7 18OR	8 VOLT SUPPLY	12
8	—	—	—
9	A21 14DB	IGNITION	9
10	—	—	—
11	Z12 16BK/TN*	POWER GROUND	13
12	Z12 16BK/TN*	POWER GROUND	13
13	K14 18LB/BR*	INJECTOR 4	14
14	K13 18YL/WT*	INJECTOR 3	14
15	K12 18TN	INJECTOR 2	14
16	K11 18WT/DB*	INJECTOR 1	14
17	—	—	—
18	—	—	—
19	K19 18GY	DRIVER #1	10
20	K20 18DG	VOLTAGE REGULATOR	12
21	K21 16BK/RD*	INTAKE AIR TEMPERATURE SENSOR INPUT	11
22	K22 18OR/DB*	THROTTLE POSITION (SENSOR) INPUT	11
23	—	—	—
24	K24 18GY/BK*	CRANKSHAFT POSITION SENSOR	12
25	D21 20PK	SERIAL COMMUNICATION INTERFACE	10
26	—	—	—
27	C91 16LB	A/C REQUEST	45
28	C90 16LG	A/C SELECT	45
29	K29 18WT/PK*	BRAKE SWITCH INPUT	9
30	T41 18BR/YL*	NEUTRAL SENSE (A/TRANS ONLY)	13
31	C27 20DB/PK*	ENGINE COOLING FAN	7
32	G3 20BK/PK*	MALFUNCTION INDICATOR LAMP	13
33	V36 20TN/RD*	VEHICLE SPEED CONTROL (VACUUM)	53
34	C13 20DB/OR*	A/C RELAY	45
35	—	—	—
36	—	—	—
37	—	—	—
38	K15 18PK/BK*	INJECTOR 5	14
39	K39 18GY/RD*	STEPPER IDLE AIR CONTROL #4	14
40	K40 18BR/WT*	STEPPER IDLE AIR CONTROL #2	14
41	K41 18BK/DG*	HEATED OXYGEN SENSOR	13
42	—	—	—
43	G21 20GY/LB*	TACHOMETER	13
44	K44 18TN/YL*	CAMSHAFT POSITION SENSOR	12
45	D20 20LG	SERIAL COMMUNICATION INTERFACE	10
46	—	—	—
47	G7 20WT/OR*	VEHICLE SPEED SENSOR INPUT	12
48	V31 20BR/RD*	VEHICLE SPEED CONTROL (SET)	53
49	V32 20YL/RD*	VEHICLE SPEED CONTROL (IGNITION)	53
50	V33 20WT/LG*	VEHICLE SPEED CONTROL (RESUME)	53
51	K51 20DB/YL*	AUTOMATIC SHUT DOWN RELAY	9
52	—	—	—
53	V35 20LG/RD*	VEHICLE SPEED CONTROL (VENT)	53
54	—	—	—
55	—	—	—
56	—	—	—
57	A142 16DG/OR*	AUTOMATIC SHUTDOWN SENSE	14
58	K16 18LG/BK*	INJECTOR 6	14
59	K59 18VT/BK*	STEPPER IDLE AIR CONTROL #1	14
60	K60 18YL/BK*	STEPPER IDLE AIR CONTROL #3	14

XJ-RHD 73 POWERTRAIN CONTROL MODULE 60 WAY CONNECTOR J948W-13

ENGINES

CONTENTS

STANDARD SERVICE PROCEDURES

INDEX

FORM-IN-PLACE GASKETS

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. Bead size, continuity and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar Silicone Rubber Adhesive Sealant and Mopar Gasket Maker). Each have different properties and cannot be used interchangeably.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Make sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. Be certain the material surrounds each mounting hole. Excess material

can 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 the material off location.

ENGINE PERFORMANCE

To provide best vehicle performance and lowest vehicle emissions, it is most important that the tune-up be done accurately. Use the specifications listed on the Vehicle Emission Control Information label found on the engine compartment hood.

(1) Test battery specific gravity. Add water, if necessary. Clean and tighten battery connections.

(2) Test cranking amperage draw (refer to Group 8B, Battery/Starter Service for the proper procedures).

(3) Tighten the intake manifold bolts (refer to Group 11, Exhaust System and Intake Manifold for the proper specifications).

(4) Perform cylinder compression test:

(a) Check engine oil level and add oil, if necessary.

(b) Drive the vehicle until engine reaches normal operating temperature.

(c) Select a route free from traffic and other forms of congestion, observe all traffic laws and briskly accelerate through the gears several times. The higher engine speed may help clean out valve seat deposits which can prevent accurate compression readings.

CAUTION: DO NOT overspeed the engine.

(d) 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.

(e) Disconnect coil wire from distributor and secure to good ground to prevent a spark from starting a fire.

(f) Be sure throttle blades are fully open during the compression check.

(g) Insert compression gage adaptor into the No.1 spark plug hole. Crank engine until maximum pressure is reached on gauge. Record this pressure as No.1 cylinder pressure.

(h) Repeat Step 4g for all remaining cylinders.

(i) Compression should not be less than 689 kPa (100 psi) and not vary more than 172 kPa (25 psi) from cylinder to cylinder.

(j) If cylinder(s) have abnormally low compression pressures, repeat steps 4a through 4h.

(k) If the same cylinder(s) repeat an abnormally low reading, it could indicate the existence of a problem in the cylinder.

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.

(5) Clean or replace spark plugs as necessary. Adjust gap (refer to Group 8D, Ignition System for gap adjustment and torque).

(6) Test resistance of spark plug cables (refer to Group 8D, Ignition System).

(7) Inspect the primary wire. Test coil output voltage, primary and secondary resistance. Replace parts as necessary (refer to Group 8D, Ignition System and make necessary adjustment).

(8) Set ignition timing to specifications (refer to Specification Label on engine compartment hood).

(9) Perform a combustion analysis.

(10) Test fuel pump for pressure and vacuum (refer to Group 14, Fuel System for the proper specifications).

(11) Inspect air filter element (refer to Group 0, Lubrication and Maintenance for the proper procedure).

(12) Inspect crankcase ventilation system (refer to Group 0, Lubrication and Maintenance for the proper procedure).

(13) For emission controls refer to Group 25, Emission Controls System for service procedures.

(14) Inspect and adjust accessory belt drives (refer to Group 7, Cooling System for the proper adjustments).

(15) Road test vehicle as a final test.

HONING CYLINDER BORES

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823 equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or 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). 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. 1).

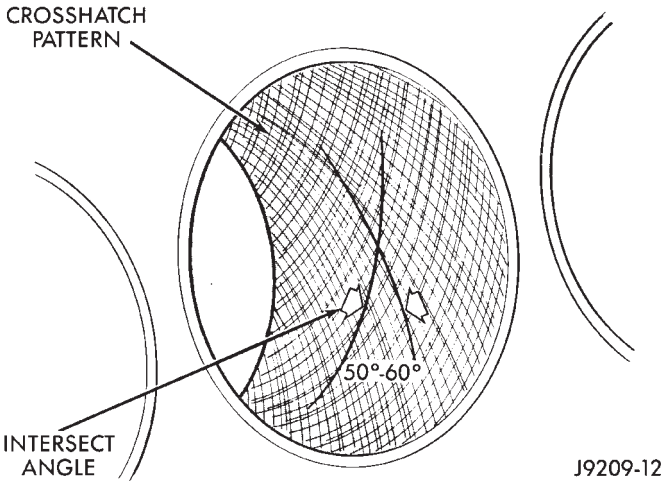


Fig. 1 Cylinder Bore Crosshatch Pattern

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

MEASURING WITH PLASTIGAGE

CRANKSHAFT MAIN BEARING CLEARANCE

Engine crankshaft bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedures for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) The total clearance of the main bearings can only be determined by removing the weight of the crankshaft. This can be accomplished by either of two methods:

METHOD - 1 (PREFERRED)—Shim the bearings adjacent to the bearing to be checked. This will remove the clearance between upper bearing shell and the crankshaft. Place a minimum of 0.254 mm (0.010 inch) shim between the bearing shell and the adjacent bearing cap. Tighten the bolts to 18 N·m (13 ft. lbs.) torque.

- **ALL ENGINES**—When checking No.1 main bearing; shim No.2 main bearing.
- **ALL ENGINES**—When checking No.2 main bearing; shim No.1 and No.3 main bearing.
- **ALL ENGINES**—When checking No.3 main bearing; shim No.2 and No.4 main bearing.
- **ALL ENGINES**—When checking No.4 main bearing; shim No.3 and No.5 main bearing.
- **2.5L ENGINE**—When checking No.5 main bearing; shim No.4 main bearing.
- **4.0L ENGINE**—When checking No.5 main bearing; shim No.4 and No.6 main bearing.
- **4.0L ENGINE**—When checking No.6 main bearing; shim No.5 and No.7 main bearing.
- **4.0L ENGINE**—When checking No.7 main bearing; shim No.6 main bearing.

Remove all shims before assembling engine.

METHOD - 2 (ALTERNATIVE)—The weight of the crankshaft is supported by a jack under the counterweight adjacent to the bearing being checked.

(3) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 2). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in that area. Tighten the bearing cap bolts of the bearing being checked to 108 N·m (80 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

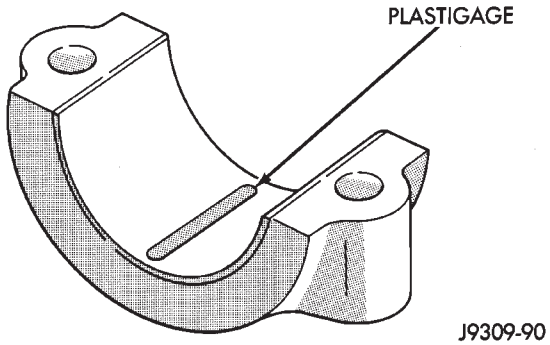


Fig. 2 Placement of Plastigage in Bearing Shell

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 3). Plastigage generally comes in 2 scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken (refer to Engine Specifications).

(5) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 inch) range is usually the most appropriate for checking engine bearing clearances.

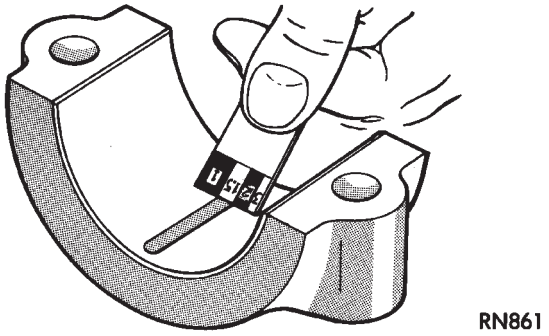


Fig. 3 Clearance Measurement

CONNECTING ROD BEARING CLEARANCE

Engine connecting rod bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedures for the use of Plastigage:

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 2). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.

(3) The crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the rod cap with Plastigage in place be assembled. Tighten the rod cap nut to 45 N·m (33 ft. lbs.) torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 3). Plastigage generally comes in 2 scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken (refer to Engine Specifications).

(5) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 inch) range is usually the most appropriate for checking engine bearing clearances.

REPAIR DAMAGED OR WORN THREADS

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole.

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.

SERVICE ENGINE ASSEMBLY (SHORT BLOCK)

A service replacement engine assembly (short block) may be installed whenever the original cylinder block is defective or damaged beyond repair. It consists of the cylinder block, crankshaft, piston and rod assemblies. If needed, the camshaft must be procured separately and installed before the engine is installed in the vehicle.

A short block is identified with the letter "S" stamped on the same machined surface where the build date code is stamped for complete engine assemblies.

Installation includes the transfer of components from the defective or damaged original engine. Follow the appropriate procedures for cleaning, inspection and torque tightening.

HYDROSTATIC LOCK

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (refer to Group 14, Fuel System).

(2) Disconnect the negative cable from the battery.

(3) Inspect air cleaner, induction system and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the plugs from the engine.

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (i.e. coolant, fuel, oil, etc.).

(7) Make sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 37 N·m (27 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil (refer to Group 0, Lubrication and Maintenance).

(15) Connect the negative cable to the battery.

(16) Start the engine and check for any leaks.

ENGINE DIAGNOSIS

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine tune-ups.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

Refer to the Service Diagnosis—Performance chart and the Service Diagnosis—Mechanical chart for possible causes and corrections of malfunctions. Refer to Group 14, Fuel System for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that 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.
- Cylinder Combustion Pressure Leakage Test.
- Engine Cylinder Head Gasket Failure Diagnosis.
- Intake Manifold Leakage Diagnosis.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

METHOD 1

(1) Start the engine.

(2) Open the acetylene valve of an oxyacetylene torch. DO NOT ignite.

(3) Pass the torch tip over the exposed gasket area (EDGE) between the manifold and the engine cylinder head.

(4) If the engine speed increases, the manifold has an air leak.

METHOD 2

(1) Start the engine.

(2) Apply engine oil to the exposed gasket area (EDGE) between the manifold and the engine cylinder head.

(3) If oil is forced into the manifold and if smoke is visible from the exhaust tailpipe, the manifold has an air leak.

CYLINDER COMPRESSION PRESSURE TEST

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

Refer to Engine Specifications for the correct engine compression pressures.

ENGINE CYLINDER HEAD GASKET FAILURE DIAGNOSIS

A leaking engine cylinder head gasket usually results in loss of power, loss of coolant and engine misfiring.

An engine cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

- An engine cylinder head gasket leaking between adjacent cylinders is indicated by a loss of power and/or engine misfire.
- An engine cylinder head gasket leaking between a cylinder and an adjacent water jacket is indicated by coolant foaming or overheating and loss of coolant.

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders; follow the procedures outlined in Cylinder Compression Pressure Test. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50-70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

Remove the radiator cap.

Start the engine and allow it to warm up until the engine thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

If bubbles are not visible, install a radiator pressure tester and pressurize the coolant system.

If a cylinder is leaking combustion pressure into the water jacket, the tester pointer will pulsate with every combustion stroke of the cylinder.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

Check the coolant level and fill as required. DO NOT install the radiator cap.

Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1 379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

Perform the test 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 radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH CARBURETOR/THROTTLE BODY	Intake valve not seated properly.	Inspect valve. Reface or replace, if necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve not seated properly.	Inspect valve.Reface or replace, if necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaks or crack in cylinder block.	Remove cylinder head and inspect. Replace, if necessary.
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaks or crack in cylinder block or head between adjacent cylinders.	Remove cylinder head and inspect. Replace gasket or head, if necessary.
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston ring(s); cracked piston; worn rings and/or cylinder wall.	Inspect for broken ring(s) or piston. Measure ring gap and cylinder diameter, taper, and out-of-round. Replace affected part, if necessary.

J8909-78

SERVICE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT START	1. Weak battery. 2. Corroded or loose battery connections. 3. Faulty starter. 4. Moisture on ignition wires and distributor cap. 5. Faulty ignition cables. 6. Faulty coil or control unit. 7. Incorrect spark plug gap. 8. Incorrect ignition timing. 9. Dirt or water in fuel system. 10. Faulty fuel pump.	1. Test battery specific gravity. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals. 3. Refer to Group 8A, Battery/Starter/Charging System Diagnostics. 4. Wipe wires and cap clean and dry. 5. Replace any cracked or shorted cables. 6. Test and replace, if necessary (refer to Group 8D, Ignition System). 7. Set gap (refer to Group 8D, Ignition System). 8. Refer to Group 8D, Ignition System. 9. Clean system and replace fuel filter. 10. Install new fuel pump (refer to Group 14, Fuel System).
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set too low. 2. Idle mixture too lean or too rich. 3. Leak in intake manifold. 4. Worn or burned distributor rotor. 5. Incorrect ignition wiring. 6. Faulty coil. 7. EGR valve leaking.	1. Refer to Group 14, Fuel System. 2. Refer to Group 14, Fuel System. 3. Inspect intake manifold gasket and vacuum hoses. Replace, if necessary (refer to Group 11, Exhaust System & Intake Manifold). 4. Install new distributor rotor. 5. Install correct wiring. 6. Test and replace, if necessary (refer to Group 8D, Ignition System). 7. Test and replace, if necessary (refer to Group 25, Emissions Control System).
ENGINE LOSS OF POWER	1. Incorrect ignition timing. 2. Worn or burned distributor rotor. 3. Worn distributor shaft. 4. Dirty or incorrectly gapped spark plugs. 5. Dirt or water in fuel system. 6. Faulty fuel pump. 7. Incorrect valve timing. 8. Blown cylinder head gasket. 9. Low compression. 10. Burned, warped or pitted valves. 11. Plugged or restricted exhaust system. 12. Faulty ignition cables. 13. Faulty coil.	1. Refer to Group 8D, Ignition System. 2. Install new distributor rotor. 3. Remove and repair distributor (refer to Group 8D, Ignition System). 4. Clean plugs and set gap (refer to Group 8D, Ignition System). 5. Clean system and replace fuel filter. 6. Install new fuel pump. 7. Correct valve timing. 8. Install new cylinder head gasket. 9. Test compression of each cylinder. 10. Install new valves. 11. Install new parts, as necessary. 12. Replace any cracked or shorted cables. 13. Test and replace, as necessary (refer to Group 8D, Ignition System).
ENGINE MISSES ON ACCELERATION	1. Dirty or gap set too wide in spark plug. 2. Incorrect ignition timing. 3. Dirt in fuel system. 4. Burned, warped or pitted valves. 5. Faulty coil.	1. Clean spark plugs and set gap (refer to Group 8D, Ignition System). 2. Refer to Group 8D, Ignition System. 3. Clean fuel system. 4. Install new valves. 5. Test and replace, if necessary, (refer to Group 8D, Ignition System).
ENGINE MISSES AT HIGH SPEED	1. Dirty or gap set too wide in spark plug. 2. Worn distributor shaft. 3. Worn or burned distributor rotor. 4. Faulty coil. 5. Incorrect ignition timing. 6. Dirty injector in throttle body. 7. Dirt or water in fuel system.	1. Clean spark plugs and set gap (refer to Group 8D, Ignition System). 2. Remove and repair distributor (refer to Group 8D, Ignition System). 3. Install new distributor rotor. 4. Test and replace, as necessary (refer to Group 8D, Ignition System). 5. Refer to Group 8D, Ignition System. 6. Clean injector. 7. Clean system and replace fuel filter.

J9209-7

SERVICE DIAGNOSIS—MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Low oil pressure. 4. Dirt in tappets 5. Bent push rods. 6. Worn rocker arms. 7. Worn tappets. 8. Worn valve guides. 9. Excessive runout of valve seats on valve faces.	1. Check for correct oil level (refer to Group 0, Lubrication and Maintenance). 2. Change oil (refer to Group 0, Lubrication and Maintenance). 3. Check engine oil level. 4. Clean hydraulic tappets. 5. Install new push rods. 6. Inspect oil supply to rocker arms. 7. Install new hydraulic tappets. 8. Ream and install new valves with oversize stems. 9. Grind valve seats and valves.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance). 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Replace crankshaft or grind journals. 6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of-round, worn. 7. Loose flywheel or torque converter.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance). 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Check No. 3 main bearing for wear on flanges. 6. Grind journals or replace crankshaft. 7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn parts in oil pump. 6. Thin or diluted oil. 7. Excessive bearing clearance. 8. Oil pump relief valve stuck. 9. Oil pump suction tube loose, bent or cracked 10. Oil pump cover warped or cracked.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and check main bearing oil clearance. 4. Install new oil filter. 5. Replace worn parts or pump. 6. Change oil to correct viscosity. 7. Measure bearings for correct clearance. 8. Remove valve and inspect, clean and install. 9. Remove oil pan and install new tube, if necessary. 10. Install new oil pump.
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part.	1. Replace the gasket. 2. Tighten, repair or replace the part.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn, scuffed or broken rings. 2. Carbon in oil ring slot. 3. Rings fitted too tightly in grooves. 4. Worn valve guides. 5. Leaking intake gasket. 6. Leaking valve guide seals. 7. Dislodged valve guide seals.	1. Hone cylinder bores and install new rings. 2. Install new rings. 3. Remove the rings. Check grooves. If grooves are not proper width, replace piston. 4. Ream guides and replace valves with oversize valves and seals. 5. Replace gasket and tighten intake manifold to proper torque. 6. Replace seals. 7. Seat valve guide seals or replace, as needed.

J9209-14

2.5L ENGINE SERVICE PROCEDURES

INDEX

GENERAL INFORMATION

The 2.5 liter (150 CID) four-cylinder engine is an In-line, lightweight, overhead valve engine (Fig. 1).

Engine Type	In-line 4 Cylinder
Bore and Stroke	98.4 × 81.0 mm (3.88 × 3.19 in.)
Displacement	2.5L (150 cu. in.)
Compression Ratio	9.1:1
Torque	
(XJ Vehicles)	202 N·m (149 ft. lbs.) @ 3250 rpm
(YJ Vehicles)	189 N·m (139 ft. lbs.) @ 3250 rpm
Firing Order	1–3–4–2
Lubrication	Pressure Feed—Full Flow Filtration
Engine Oil Capacity	3.8L (4 Quarts)
Cooling System	Liquid Cooled—Forced Circulation
Cooling System Capacity	
(XJ Vehicles)	9.5L (10 Quarts)
(YJ Vehicles)	8.5L (9 Quarts)
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron
Cylinder Head	Cast Nodular Iron
Camshaft	Cast Nodular Iron
Pistons	Aluminum Alloy (with Struts)
Pistons Combustion Cavity	Double Quench
Connecting Rods	Cast Nodular Iron

J9409-19

Fig. 1 Engine Description

This engine is designed for unleaded fuel.

The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in good fuel economy.

The cylinders are numbered 1 through 4 from front to rear. The firing order is 1-3-4-2 (Fig. 2).

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within five main bearings and the camshaft rotates within four bearings.

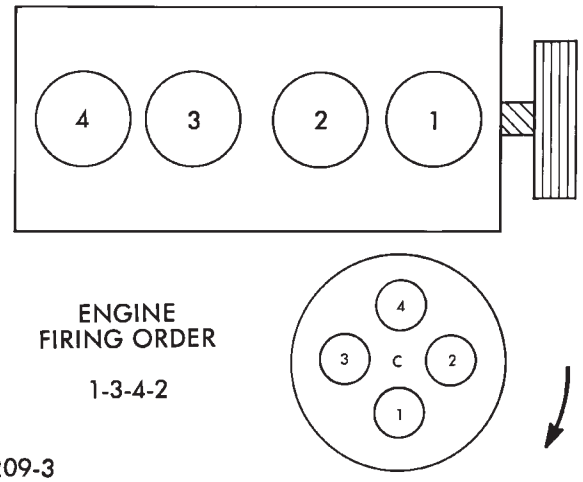


Fig. 2 Engine Firing Order

BUILD DATE CODE

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.3 and No.4 cylinders (Fig. 3).

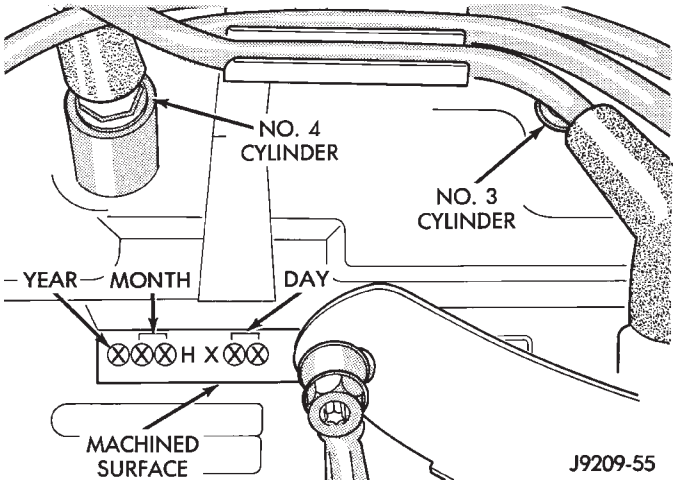


Fig. 3 Build Date Code Location

The digits of the code identify:

(1) 1st Digit—The year (4 = 1994).

(2) 2nd & 3rd Digits—The month (01 - 12).

(3) 4th & 5th Digits—The engine type/fuel system/compression ratio (HX = A 2.5 liter (150 CID) 9.1:1 compression ratio engine with a multi-point fuel injection system).

(4) 6th & 7th Digits—The day of engine build (01 - 31).

FOR EXAMPLE: Code * 401HX23 * identifies a 2.5 liter (150 CID) engine with a multi-point fuel injection system, 9.1:1 compression ratio and built on January 23, 1994.

OVERSIZE AND UNDERSIZE COMPONENT CODES

Some engines may be built with oversize or undersize components such as:

- Oversize cylinder bores.
- Oversize camshaft bearing bores.
- Undersize crankshaft main bearing journals.
- Undersize connecting rod journals.

These engines are identified by a letter code (Fig. 4) stamped on the oil filter boss near the distributor (Fig. 5).

CODE	COMPONENT	UNDERSIZE
P	One or more connecting rod bearing journals	0.254 mm (0.010 in)
M	All crankshaft main bearing journals	0.254 mm (0.010 in)
PM	All crankshaft main bearing journals and one or more connecting rod journals	0.254 mm (0.010 in)
CODE	**COMPONENT**	**OVERSIZE**
B	All cylinder bores	0.254 mm (0.010 in)
C	All camshaft bearing bores	0.254 mm (0.010 in)

J8909-54

Fig. 4 Oversize and Undersize Component Codes

ENGINE MOUNTS—FRONT

The front mounts support the engine at each side. These supports are made of resilient rubber.

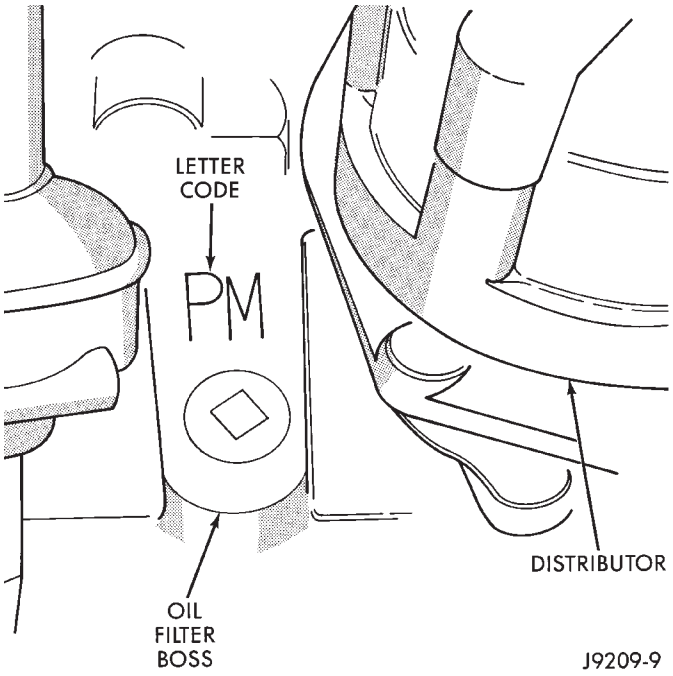


Fig. 5 Oversize and Undersize Component Code Location

REMOVAL—XJ VEHICLES

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Support the engine.

(4) Remove through bolt nut (Fig. 6). DO NOT remove the through bolt.

(5) Remove the retaining bolts/nuts from the support cushions (Fig. 6).

(6) Remove the through bolt.

(7) Remove the support cushions.

INSTALLATION—XJ VEHICLES

(1) If the engine support bracket was removed, position the LEFT bracket (Fig. 6) and the RIGHT bracket with generator brace (Fig. 7) onto the cylinder block. Install the bolts and stud nuts.

(a) RIGHT SIDE (Fig. 7)—Tighten the bolts to 61 N·m (45 ft. lbs.) torque. Tighten the stud nuts to 46 N·m (34 ft. lbs.) torque.

(b) LEFT SIDE (Fig. 6)—Tighten the bolts to 61 N·m (45 ft. lbs.) torque.

(2) If the support cushion brackets were removed, position the brackets onto the lower front sill (Figs. 6 and 8). Install the bolts and stud nuts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque and the stud nuts to 41 N·m (30 ft. lbs.) torque.

(3) Place the support cushions onto the support cushion brackets (Fig. 6). Tighten the right support cushion nuts to 65 N·m (48 ft. lbs.) torque. Tighten the left support cushion bolt/nut to 41 N·m (30 ft. lbs.) torque.

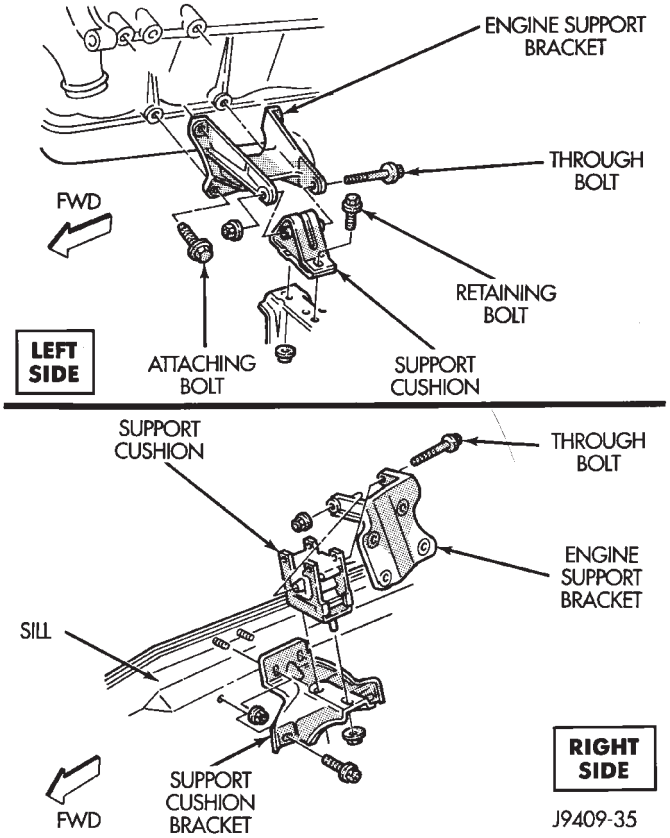


Fig. 6 Front Mounts—XJ Vehicles

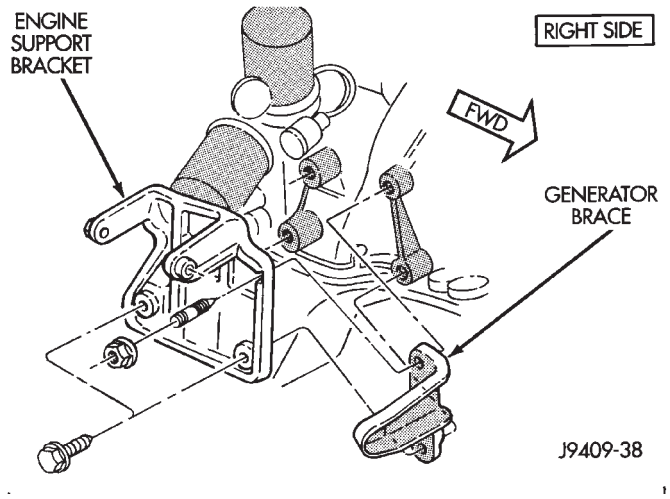


Fig. 7 Engine Support Bracket—Right Side

(4) Install the through bolt and the retaining nut (Fig. 6). Tighten the through bolt nut to 65 N·m (48 ft. lbs.) torque.

(5) Remove the engine support.

(6) Lower the vehicle.

(7) Connect negative cable to battery.

REMOVAL—YJ VEHICLES

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

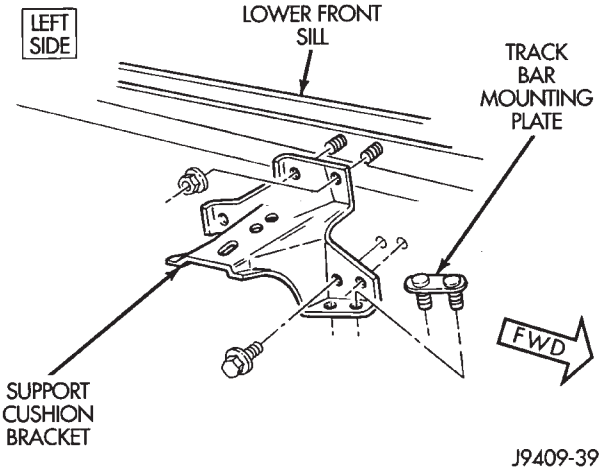


Fig. 8 Support Cushion Bracket—Left Side

(3) Support the engine.

(4) Remove through bolt nut (Fig. 9). DO NOT remove the through bolt.

(5) Remove the retaining bolts/nuts from the support cushions (Fig. 9).

(6) Remove the through bolt.

(7) Remove the engine support cushions.

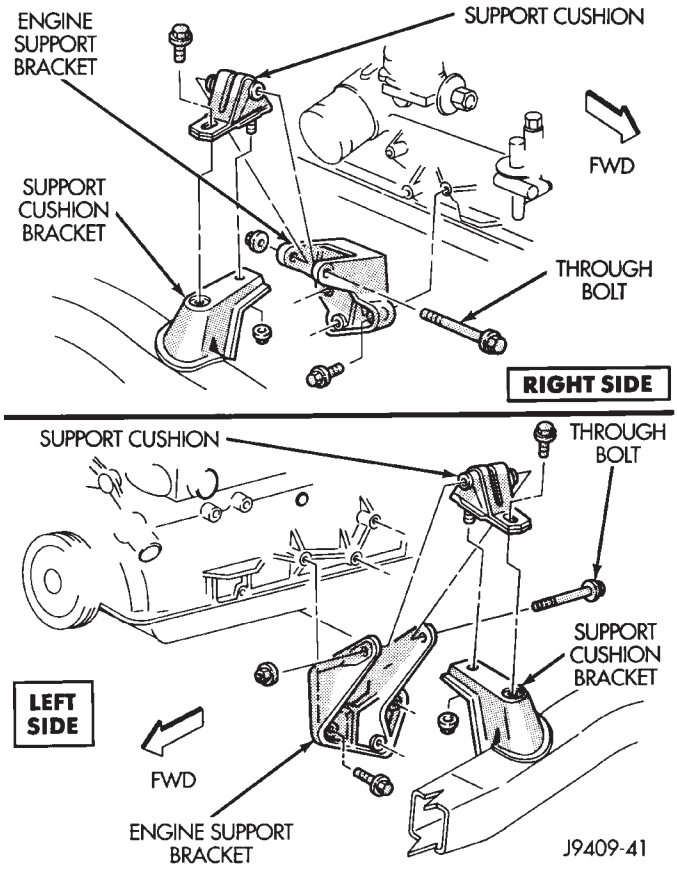


Fig. 9 Front Mounts—YJ Vehicles

INSTALLATION—YJ VEHICLES

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Fig. 9). Tighten the bolts to 62 N·m (46 ft. lbs.) torque.

(2) Place the support cushion on the support cushion bracket (Fig. 9). Install the support cushion retaining bolts and nuts. Tighten the bolts/nuts to 52 N·m (38 ft. lbs.) torque.

(3) Install the through bolt and the retaining nut (Fig. 9). Tighten the through bolt nut to 69 N·m (51 ft. lbs.) torque.

(4) Remove the engine support.

(5) Lower the vehicle.

(6) Connect negative cable to battery.

ENGINE MOUNT—REAR

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

REMOVAL—XJ VEHICLES

(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 (Figs. 10 and 11). Remove the crossmember.

(4) **MANUAL TRANSMISSION:**

(a) Remove the support cushion nuts and remove the cushion.

(b) If necessary, remove the bolts holding the transmission support bracket to the transmission (Fig. 10). Remove the bracket.

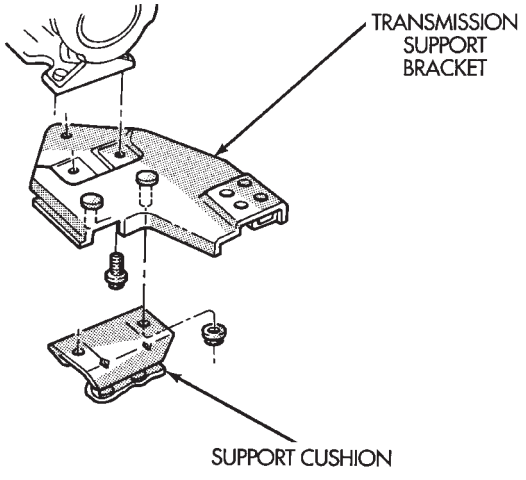


Fig. 10 Rear Mount—XJ Vehicles (Manual Transmission)

(5) **AUTOMATIC TRANSMISSION:**

(a) Remove the support cushion bolts and remove the cushion and the transmission support bracket.

(b) If necessary on 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission (Fig. 11). Remove the adaptor bracket.

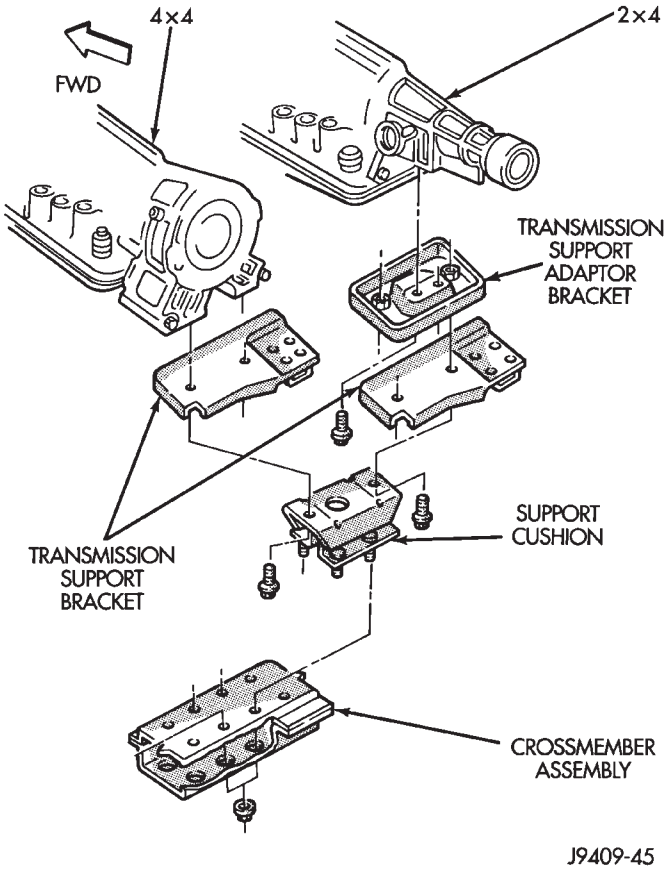


Fig. 11 Rear Mount—XJ Vehicles (Automatic Transmission)

INSTALLATION—XJ VEHICLES

(1) **MANUAL TRANSMISSION:**

(a) If removed, position the transmission support bracket to the transmission and install the bolts. Tighten the bolts to 43 N·m (32 ft. lbs.) torque.

(b) Position the support cushion onto the transmission support bracket. Install and tighten the nuts to 46 N·m (34 ft. lbs.) torque.

(2) **AUTOMATIC TRANSMISSON:**

(a) If removed, position the transmission support adaptor bracket (2WD vehicles) to the transmission and install the bolts. Tighten the bolts to 75 N·m (55 ft. lbs.) torque.

(b) Position the transmission support bracket and support cushion to the transmission and install the bolts. Tighten the bolts to 75 N·m (55 ft. lbs.) torque.

(3) Position the crossmember onto the support cushion studs and install the nuts. Tighten the nuts to 22 N·m (192 in. lbs.) torque.

(4) Install the 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.

REMOVAL—YJ VEHICLES

(1) Disconnect negative cable from battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the nuts holding the support cushion to the skid plate (Figs. 12 and 13).
(4) Remove the skid plate bolts and the skid plate.
(5) **MANUAL TRANSMISSION:**
(a) Remove the bolts holding the support cushion and torque arm bracket to the transmission (Fig. 12).
(b) Remove the support cushion and torque arm bracket.

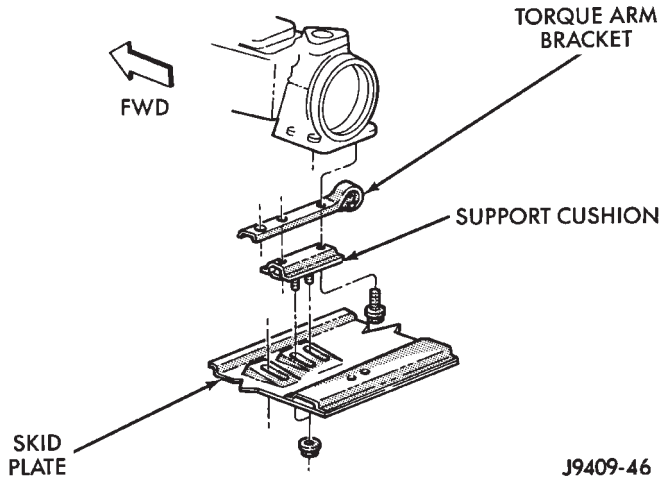


Fig. 12 Rear Mount—YJ Vehicles (Manual Transmission)

(6) **AUTOMATIC TRANSMISSION:**
(a) Remove the bolts and nuts holding the support cushinon to the torque arm bracket (Fig 13). Remove the support cushion.
(b) Remove the bolts holding the torque arm bracket to the transmission (Fig. 13). Remove the torque arm bracket.

INSTALLATION—YJ VEHICLES

(1) **MANUAL TRANSMISSION:**
(a) Position the torque arm bracket and support cushion to the transmission and install the bolts (Fig. 12).
(b) Tighten the bolts to 54 N·m (40 ft. lbs.) torque.
(2) **AUTOMATIC TRANSMISSION:**
(a) Position the torque arm bracket to the transmission and install the bolts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.
(b) Position the support cushion to the torque arm bracket and install the bolts and nuts. Tighten the nuts to 54 N·m(40 ft. lbs.) torque.

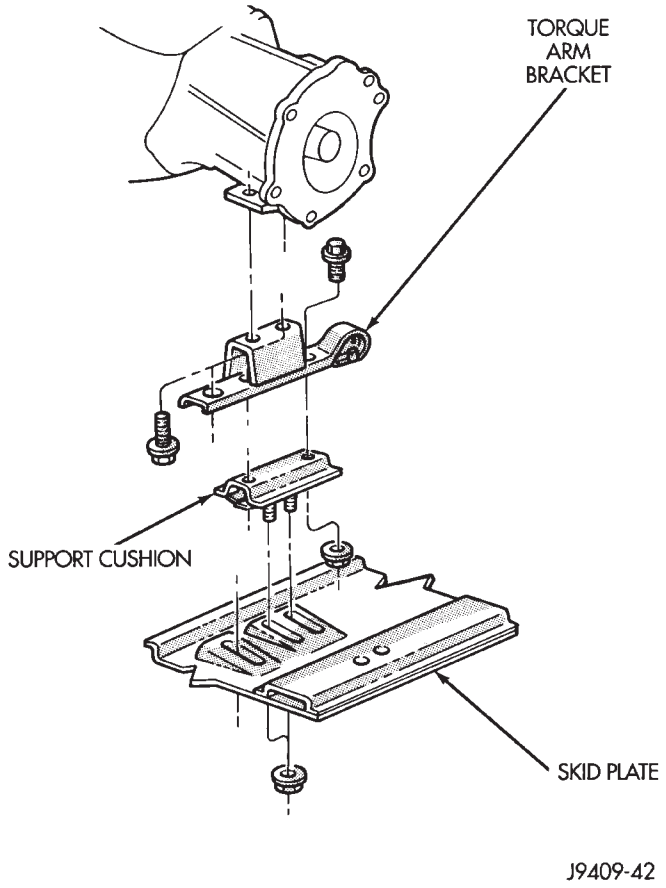


Fig. 13 Rear Mount—YJ Vehicles (Automatic Transmission)

(3) Position the skid plate to the studs of the support cushion and install the nuts (Figs. 12 and 13). Tighten the stud nuts to 54 N·m (40 ft. lbs.) torque.
(4) Install the skid plate bolts to the sill and tighten to 88 N·m (65 ft. lbs.) torque.
(5) Remove the transmission support.
(6) Lower the vehicle.
(7) Connect negative cable to battery.

ENGINE DAMPER

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the top and bottom damper nuts (Fig. 14).
(3) Remove the outer retainers and bushings (Fig. 14).
(4) Remove the top damper bracket nut and bolts (Fig. 14).
(5) Remove the bracket, inner retainers, bushings and the damper (Fig. 14).

INSTALLATION

(1) Install the damper on the lower bracket with the lower inner retainer and bushing in place.

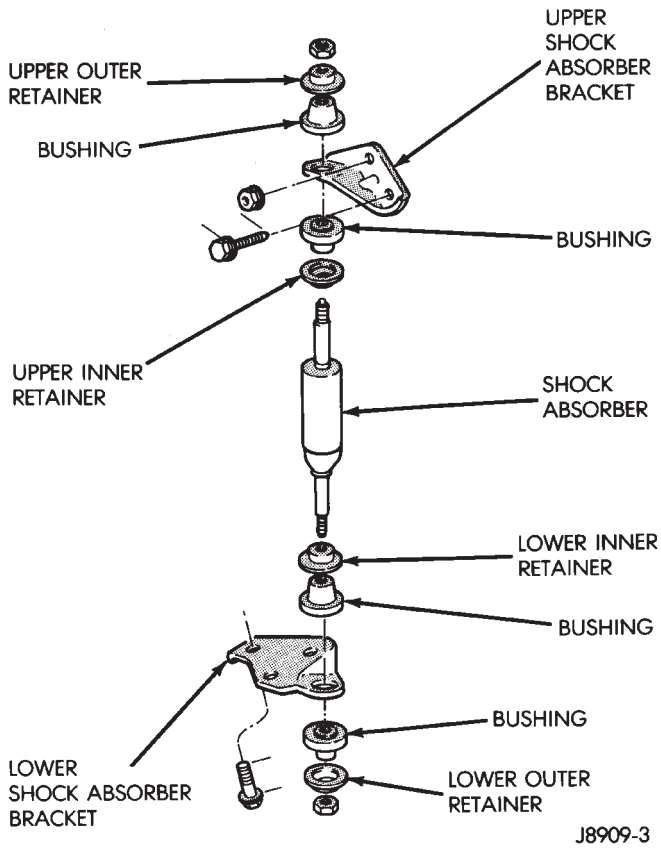


Fig. 14 Engine Damper

(2) Install the upper inner retainer and bushing on the top of the damper.

(3) Position the upper damper bracket over the damper and install the stud nut and bolts.

(4) Tighten the stud nut to 23 N·m (17 ft. lbs.) torque. Tighten the bracket bolts to 61 N·m (45 ft. lbs.) torque.

(5) Install the bushing, upper outer retainer and damper nut.

(6) Install the bushing, lower outer retainer and damper nut.

(7) Tighten the upper and lower damper nuts.

(8) Connect negative cable to battery.

ENGINE ASSEMBLY—XJ VEHICLES

REMOVAL

(1) Disconnect the battery cables. Remove the battery.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Remove the lower radiator hose.

(5) Remove the upper radiator hose and coolant recovery hose (Fig. 15).

(6) Remove the fan shroud (Fig. 15).

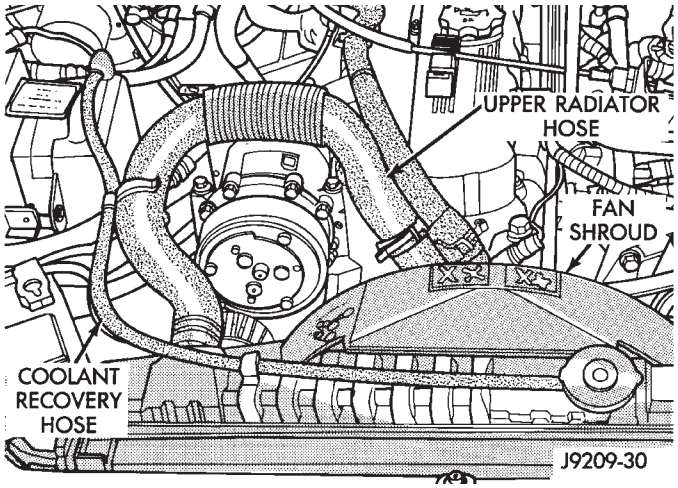


Fig. 15 Upper Radiator Hose, Coolant Recovery Hose & Fan Shroud

(7) Disconnect the transmission fluid cooler tubing (automatic transmission).

(8) Remove the radiator/condenser (if equipped with air conditioning).

(9) Remove fan assembly and install a 5/16 x 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(10) Disconnect the heater hoses (Figs. 16 and 17).

(11) Disconnect the throttle linkages (Fig. 16), speed control cable (if equipped) and throttle valve rod.

(12) Disconnect the oxygen sensor wire connector.

(13) Disconnect the wires from the starter motor solenoid.

(14) Disconnect all fuel injection harness connections.

(15) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the two retaining tabs against the fuel tube (Fig. 16). Pull the fuel tube and retainer from the quick-connect fitting (refer to Group 14, Fuel System for the proper procedure).

(16) Remove the fuel line bracket from the intake manifold.

(17) Remove the air cleaner assembly (Fig. 18).

(18) If equipped with air conditioning, remove the service valves and cap the compressor ports.

(19) Remove the power brake vacuum check valve from the booster, if equipped.

(20) If equipped with power steering (Fig. 18):

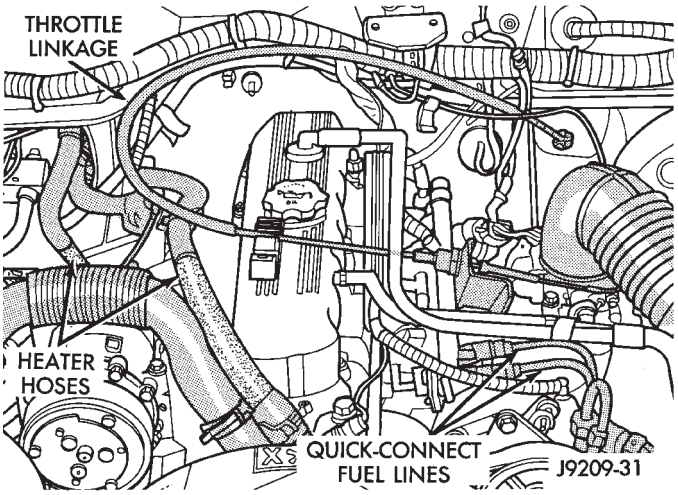


Fig. 16 Heater Hoses (LH Drive Vehicles), Throttle Linkage & Quick-Connect Fuel Lines

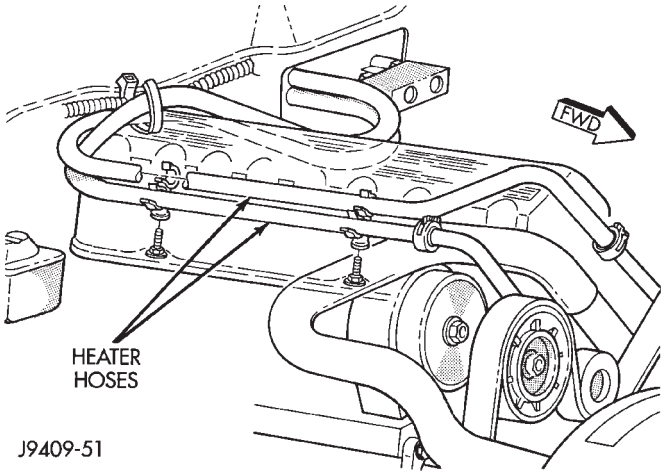


Fig. 17 Heater Hoses (RH Drive Vehicle)

(a) Disconnect the power steering hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign material from entering the system.

(21) Disconnect the coolant hoses from the rear of the intake manifold.

(22) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(23) Raise the vehicle.

(24) Remove the oil filter.

(25) Remove the starter motor.

(26) Disconnect the exhaust pipe from the exhaust manifold.

(27) Remove the flywheel/converter housing access cover.

(28) If equipped with an automatic transmission, mark the converter and drive plate location in reference to each other and remove the converter-to-drive plate bolts.

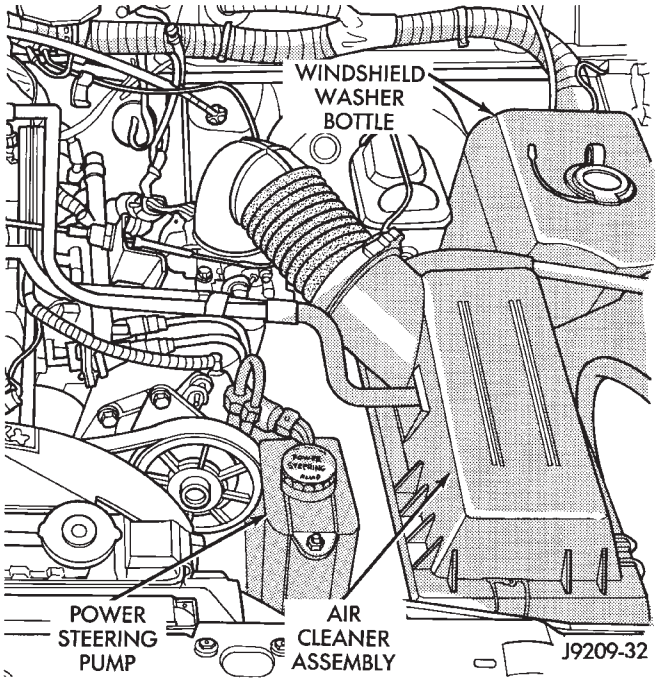


Fig. 18 Air Cleaner and Power Steering Pump

(29) Remove the upper flywheel/converter housing bolts and loosen the bottom bolts.

(30) Remove the engine support cushion-to-engine compartment bracket bolts.

(31) Remove the engine shock damper bracket from the sill.

(32) Lower the vehicle.

(33) Attach a lifting device to the engine.

(34) Raise the engine slightly off the front supports.

(35) Place a support stand under the converter or flywheel housing.

(36) Remove the remaining bottom converter or flywheel housing bolts.

(37) Lift the engine out of the engine compartment and install on an engine stand.

(38) Install the oil filter to keep foreign material out of the engine.

INSTALLATION

(1) Remove the oil filter.

(2) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

(3) If equipped with a manual transmission:

(a) Insert the transmission shaft into the clutch spline.

(b) Align the flywheel housing with the engine.

(c) Install and tighten the flywheel housing lower bolts finger tight.

(4) If equipped with an automatic transmission:

(a) Align the transmission torque converter housing with the engine.

(b) Loosely install the converter housing lower bolts and install the next higher bolt and nut on each side.

(c) Tighten all 4 bolts finger-tight.

(5) Install the engine support cushions (if removed).

(6) Lower the engine and engine support cushions onto the engine compartment brackets.

(7) Remove the engine lifting device.

(8) Raise the vehicle.

(9) If equipped with an automatic transmission:

(a) Install the converter-to-drive plate bolts. Ensure the installation reference marks are aligned. Tighten the bolts to 54 N·m (40 ft. lbs.) torque.

(b) Install the converter-housing access cover.

(c) Install the exhaust pipe support.

(10) Install the remaining converter or flywheel housing bolts.

(11) Install the starter motor and connect the cable. Tighten the bolts to 45 N·m (33 ft. lbs.) torque.

(12) Tighten the engine support cushing through-bolt nuts.

(13) Install the remaining flywheel/converter housing bolts. Tighten the bolts to 38 N·m (28 ft. lbs.) torque.

(14) Connect the exhaust pipe to the manifold.

(15) Install the oil filter.

(16) Lower the vehicle.

(17) Connect the coolant hoses and tighten the clamps.

(18) If equipped with power steering:

(a) Remove the protective caps

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(19) Remove the pulley-to-water pump flange alignment capscrew and install the fan and spacer or Tempatrol fan assembly.

(20) Install the fan shroud and radiator/condenser (if equipped with air conditioning).

(21) Connect the radiator hoses.

(22) Connect the automatic transmission fluid cooler pipes, if equipped.

(23) Connect the oxygen sensor wire connector.

(24) Connect the throttle valve rod and retainer. Connect the throttle cable and install the rod. Install the throttle valve rod spring.

(25) Connect the speed control cable, if equipped.

(26) Connect the fuel supply and return lines to the throttle body.

(27) Connect all the vacuum hoses and wire connectors.

(28) Connect the service valves to the A/C compressor ports, if equipped with air conditioning.

(29) Fill the power steering reservoir.

(30) Connect the battery cables.

(31) Install the hood.

(32) Install the air cleaner.

(33) Start the engine and inspect for leaks.

(34) Fill the cooling system.

(35) Stop the engine and check the fluid levels. Add fluid, as required.

ENGINE ASSEMBLY—YJ VEHICLES

REMOVAL

(1) Place a protective cloth over the windshield frame. Raise the hood and rest it on the windshield frame (Fig. 19).

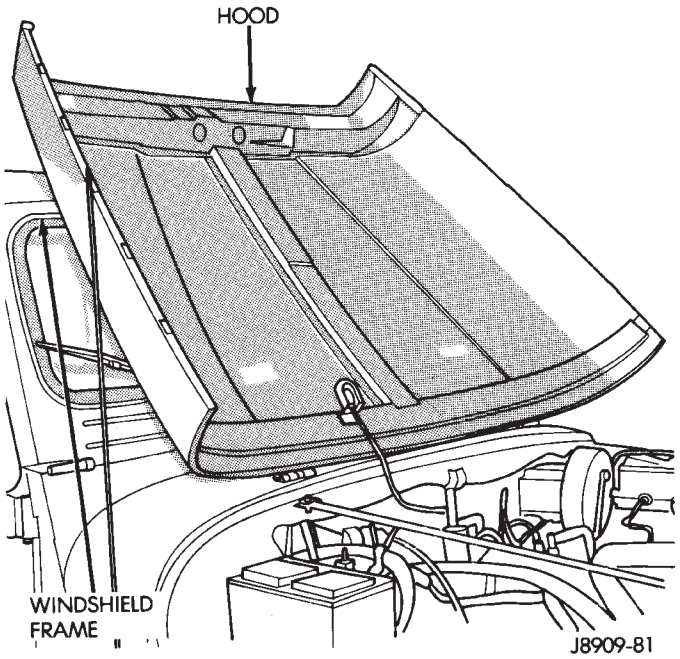


Fig. 19 Hood on Windshield Frame

(2) Disconnect the battery cable clamps and remove the battery.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Disconnect the wire connectors from the generator.

(5) Disconnect the ignition coil and distributor wire connectors.

(6) Disconnect the oil pressure sender wire connector.

(7) Disconnect the wires at the starter motor solenoid and injection wire harness connector.

(8) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the two retaining tabs against the fuel tube (Fig. 20). Pull the fuel tube and retainer from the quick-connect fitting (refer to Group 14, Fuel System for the proper procedure).

(9) Remove the fuel line bracket from the intake manifold.

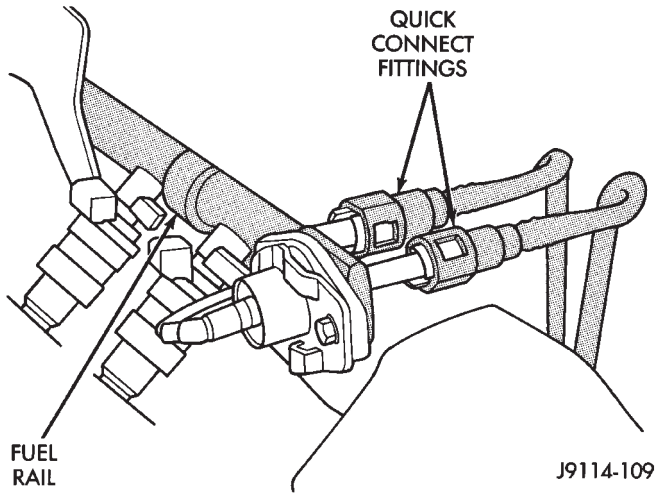


Fig. 20 Fuel Line Quick-Connect Couplings

(10) Disconnect the engine ground strap.

(11) Remove the air cleaner assembly.

(12) Disconnect the vacuum purge hose at the fuel vapor canister tee.

(13) Disconnect the idle speed actuator wire connector.

(14) Disconnect the throttle cable and remove it from the bracket.

(15) Disconnect the throttle rod at the bellcrank.

(16) Disconnect the speed control cable, if equipped.

(17) Disconnect the oxygen sensor wire connector.

(18) Disconnect the upper and lower radiator hoses at the radiator.

(19) Disconnect the coolant hoses from the rear of the intake manifold and thermostat housing.

(20) Disconnect the heater hoses.

(21) Remove the fan shroud screws.

(22) Remove the radiator attaching bolts.

(23) Remove the radiator and fan shroud.

(24) Remove the fan and spacer or Tempatrol fan assembly.

(25) Install a 5/16 X 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(26) Remove the power brake vacuum check valve from the booster, if equipped.

(27) If equipped with power steering:

(a) Disconnect the hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(28) Lift the vehicle and support it with support stands.

(29) Remove the oil filter.

(30) Remove the starter motor.

(31) Remove the flywheel housing access cover.

(32) Remove the engine support cushion-to-bracket through bolts.

(33) Disconnect the exhaust pipe from the manifold.

(34) Remove the upper flywheel housing bolts and loosen the bottom bolts.

(35) Remove the engine shock damper bracket from the sill.

(36) Lower the vehicle.

(37) Attach a lifting device to the engine.

(38) Raise the engine off the front supports.

(39) Place a support stand under the flywheel housing.

(40) Remove the remaining flywheel housing bolts.

(41) Lift the engine out of the engine compartment and install on an engine stand.

(42) Install the oil filter to keep foreign material out of the engine.

INSTALLATION

(1) Remove the oil filter.

(2) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

(3) Insert the transmission shaft into the clutch spline.

(4) Align the flywheel housing with the engine.

(5) Install and finger tighten the flywheel housing lower bolts.

(6) Install the engine support cushions (if removed).

(7) Remove the support stand from beneath the flywheel housing.

(8) Lower the engine and engine support cushions onto the engine compartment brackets. Ensure that the bolt holes are aligned. Install the bolts and tighten.

(9) Remove the engine lifting device.

(10) Raise the vehicle.

(11) Attach the engine shock damper bracket to the sill.

(12) Attach the exhaust pipe to the manifold. Install and tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(13) Install the flywheel housing access cover.

(14) Install the remaining flywheel housing bolts. Tighten the bolts to 38 N·m (28 ft. lbs.) torque.

(15) Install the starter motor and connect the cable. Tighten the bolts to 45 N·m (33 ft. lbs.) torque.

(16) Install the oil filter.

(17) Lower the vehicle.

(18) Connect the coolant hoses and tighten the clamps.

(19) If equipped with power steering:

(a) Remove the protective caps

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(20) Remove the pulley-to-water pump flange alignment capscrew and install the fan and spacer or Tempatrol fan assembly.

(21) Tighten the serpentine drive belt according to the specifications listed in Group 7, Cooling System.

(22) Install the fan shroud and radiator.

(23) Connect the radiator hoses.

(24) Connect the heater hoses.

(25) Connect the throttle valve rod and retainer.

(26) Connect the throttle cable and install the rod.

(27) Install the throttle valve rod spring.

(28) Connect the speed control cable, if equipped.

(29) Connect the oxygen sensor wire connector.

(30) Install the vacuum hose and check valve on the brake booster.

(31) Connect the coolant temperature sensor wire connector.

(32) Connect the idle speed actuator wire connector.

(33) Connect the fuel inlet and return hoses at the fuel rail. Verify that the quick-connect fitting assembly fits securely over the fuel lines by giving the fuel lines a firm tug.

(34) Install the fuel line bracket to the intake manifold.

(35) Connect all fuel injection wire connections.

(36) Install the engine ground strap.

(37) Connect the ignition coil wire connector.

(38) Remove the coolant temperature sending unit to permit air to escape from the block. Fill the cooling system with coolant. Install the coolant temperature sending unit when the system is filled.

(39) Install the battery and connect the battery cables.

(40) Install the air cleaner bonnet to the throttle body.

(41) Install the air cleaner.

(42) Lower the hood and secure in place.

(43) Start the engine and inspect for leaks.

(44) Stop the engine and check the fluid levels. Add fluid, as required.

ENGINE CYLINDER HEAD COVER

A cured gasket is part of the engine cylinder head cover.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover (Fig. 1).

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover (Fig. 1).

(4) Remove the engine cylinder head cover mounting bolts.

(5) Remove the engine cylinder head cover.

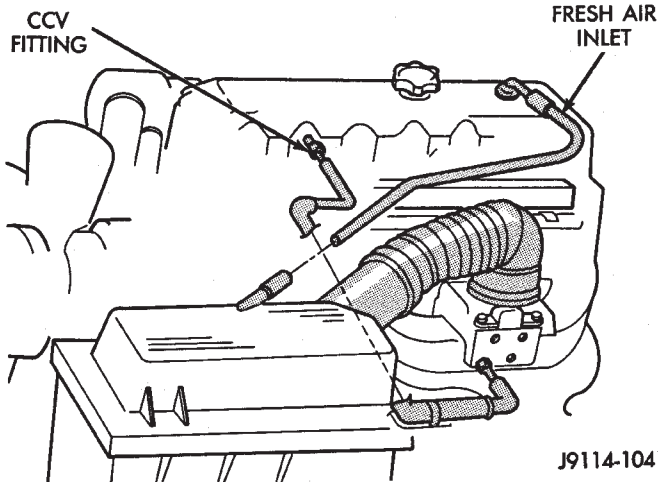


Fig. 1 Engine Cylinder Head Cover

CLEANING

Remove any original sealer from the cover sealing surface of the engine cylinder head and clean the surface using a fabric cleaner.

Remove all residue from the sealing surface using a clean, dry cloth.

INSPECTION

Inspect the engine cylinder head cover for cracks. Replace the cover, if cracked.

The original grey gasket material should NOT be removed. If sections of the gasket material are missing or are compressed, replace the engine cylinder head cover. However, sections with minor damage such as small cracks, cuts or chips may be repaired with a hand held applicator. The new material must be smoothed over to maintain gasket height. Allow the gasket material to cure prior to engine cylinder head cover installation.

INSTALLATION

(1) If a replacement cover is installed, transfer the CCV valve grommet the oil filler cap from the original cover to the replacement cover.

(2) Install engine cylinder head cover. Tighten the mounting bolts to 10 N·m (85 in. lbs.) torque.

(3) Connect the CCV hoses (Fig. 1).
(4) Connect negative cable to battery.

ROCKER ARMS

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Remove the capscrews at each bridge and pivot assembly (Fig. 2). Alternately loosen the capscrews one turn at a time to avoid damaging the bridges.
(3) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.
(4) Remove the bridges, pivots and corresponding pairs of rocker arms (Fig. 2). Place them on a bench in the same order as removed.
(5) Remove the push rods and place them on a bench in the same order as removed.

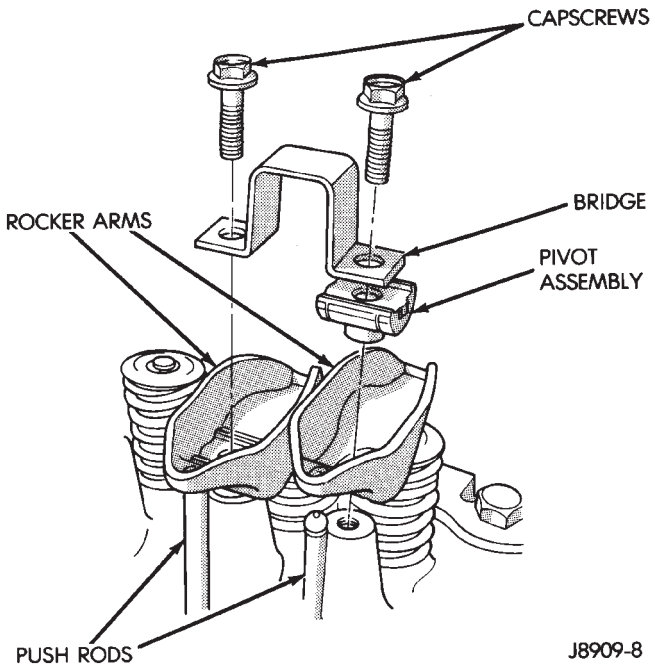


Fig. 2 Rocker Arm Assembly

CLEANING

Clean all the components with cleaning solvent.
Use compressed air to blow out the oil passages in the rocker arms and push rods.

INSPECTION

Inspect the pivot surface area of each rocker arm. Replace any that are scuffed, pitted, cracked or excessively worn.
Inspect the valve stem tip contact surface of each rocker arm and replace any rocker arm that is deeply pitted.
Inspect each push rod end for excessive wear and replace as required. If any push rod is excessively worn because of lack of oil, replace it and inspect the corresponding hydraulic tappet for excessive wear.
Inspect the push rods for straightness by rolling them on a flat surface or by shining a light between the push rod and the flat surface.
A wear pattern along the length of the push rod is not normal. Inspect the engine cylinder head for obstruction if this condition exists.

INSTALLATION

(1) Lubricate the ball ends of the push rods with Mopar Engine Oil Supplement, or equivalent and install push rods in their original locations. Ensure that the bottom end of each push rod is centered in the tappet plunger cap seat.
(2) Using Mopar Engine Oil Supplement, or equivalent, lubricate the area of the rocker arm that the pivot contacts. Install rocker arms, pivots and bridge above each cylinder in their originally position.
(3) Loosely install the capscrews through each bridge.
(4) At each bridge, tighten the capscrews alternately, one turn at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.
(5) Install the engine cylinder head cover.

ENGINE CYLINDER HEAD

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Disconnect negative cable from battery.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAIN COCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(2) Drain the coolant and disconnect the hoses at the engine thermostat housing. DO NOT waste reusable coolant. If the solution is clean and is being drained only to service the engine or cooling system, drain the coolant into a clean container for reuse.
(3) Remove the air cleaner assembly.
(4) Remove the engine cylinder head cover.
(5) Remove the capscrews, bridge and pivot assemblies and rocker arms (Fig. 2).
(6) Remove the push rods (Fig. 2). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**
(7) Loosen the serpentine drive belt at the power steering pump, if equipped or at the idler pulley (refer to Group 7, Cooling System for the proper procedure).
(8) If equipped with air conditioning, perform the following:

(a) Remove the bolts from the A/C compressor mounting bracket and set the compressor aside.

(b) Remove the air conditioner compressor bracket bolts from the engine cylinder head.

(c) Loosen the through bolt at the bottom of the bracket.

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) Remove the fuel lines and vacuum advance hose.

(11) Remove the intake and engine exhaust manifolds from the engine cylinder head (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(12) Disconnect the ignition wires and remove the spark plugs.

(13) Disconnect the temperature sending unit wire connector.

(14) Remove the ignition coil and bracket assembly.

(15) Remove the engine cylinder head bolts.

(16) Remove the engine cylinder head and gasket (Fig. 3).

(17) If this was the first time the bolts were removed, put a paint dab on the top of the bolt. If the bolts have a paint dab on the top of the bolt or it isn't known if they were used before, discard the bolts.

(18) Stuff clean lint free shop towels into the cylinder bores.

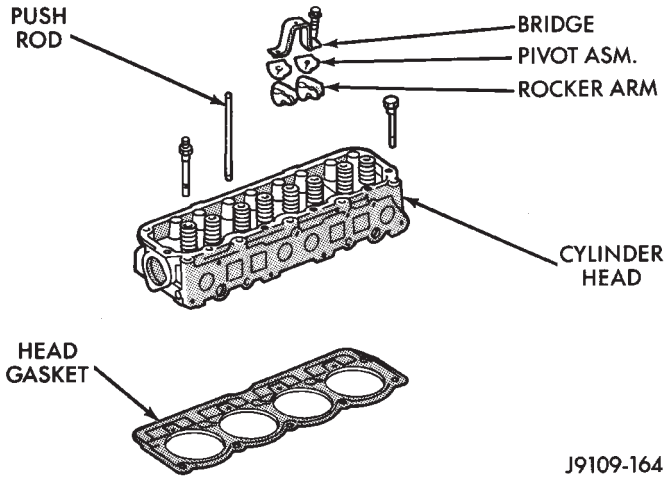


Fig. 3 Engine Cylinder Head Assembly

CLEANING

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

INSTALLATION

The engine cylinder head gasket is a composition gasket. The gasket is to be installed DRY. **DO NOT use a gasket sealing compound on the gasket.**

If the engine cylinder head is to be replaced and the original valves used, measure the valve stem diameter. Only standard size valves can be used with a service replacement engine cylinder head unless the replacement head valve stem guide bores are reamed to accommodate oversize valve stems. Remove all carbon buildup and reface the valves.

(1) Fabricate two engine cylinder head alignment dowels from used head bolts (Fig. 4). Use the longest head bolt. Cut the head of the bolt off below the hex head. Then cut a slot in the top of the dowel to allow easier removal with a screwdriver.

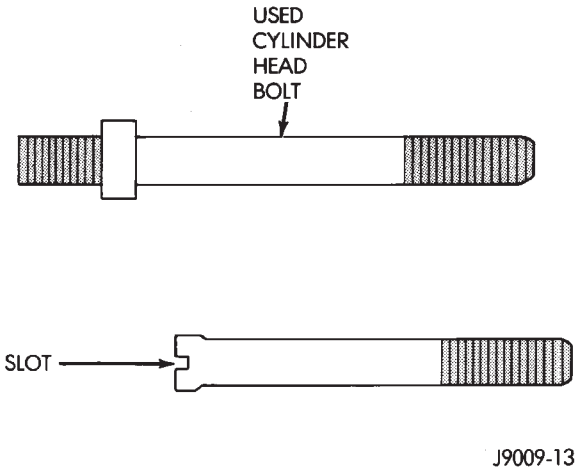


Fig. 4 Fabricate Alignment Dowels

(2) Install one dowel in bolt hole No.10 and the other dowel in bolt hole No.8 (Fig. 5).

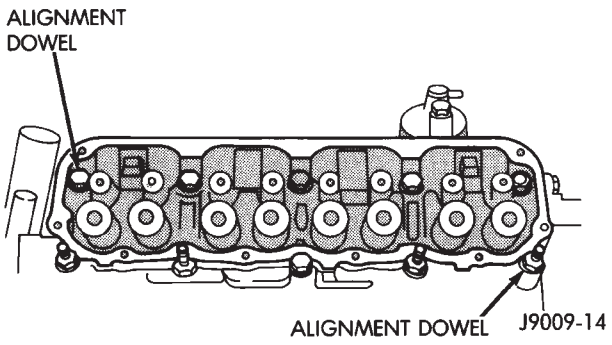


Fig. 5 Alignment Dowel Locations

(3) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(4) Place the engine cylinder head gasket (with the numbers facing up) over the dowels.

(5) Place the engine cylinder head over the dowels.

CAUTION: Engine cylinder head bolts should be reused only once. Replace the head bolts if they were used before or if they have a paint dab on the top of the bolt.

(6) Coat the threads of bolt No.7, only, with Loctite PST sealant or equivalent.

(7) Install all head bolts, except No.8 and No.10.

(8) Remove the dowels.

(9) Install No.8 and No.10 head bolts.

(10) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 6):

(a) Tighten all bolts in sequence (1 through 10) to 30 N·m (22 ft. lbs.) torque.

(b) Tighten all bolts in sequence (1 through 10) to 61 N·m (45 ft. lbs.) torque.

(c) Check all bolts to verify they are set to 61 N·m (45 ft. lbs.) torque.

(d) Tighten bolts (in sequence):

- Bolts 1 through 6 to 149 N·m (110 ft. lbs.) torque.
- Bolt 7 to 136 N·m (100 ft. lbs.) torque.
- Bolts 8 through 10 to 149 N·m (110 ft. lbs.) torque.

CAUTION: During the final tightening sequence, bolt No.7 will be tightened to a lower torque than the rest of the bolts. DO NOT overtighten bolt No.7.

(e) Check all bolts in sequence to verify the correct torque.

(f) If not already done, clean and mark each bolt with a dab of paint after tightening. Should you encounter bolts which were painted in an earlier service operation, replace them.

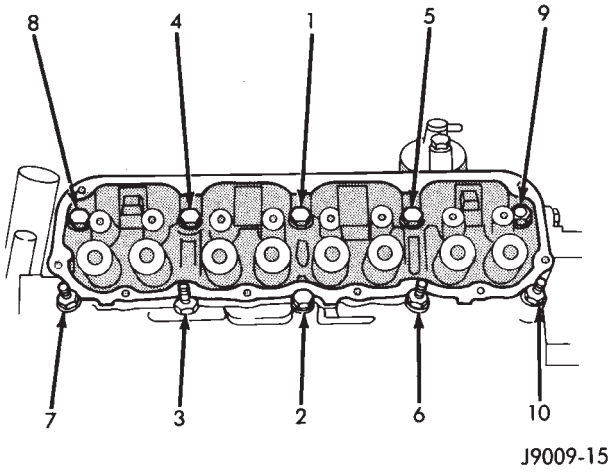


Fig. 6 Engine cylinder head Bolt Tightening Sequence

(11) Install the ignition coil and bracket assembly.

(12) Connect the temperature sending unit wire connector.

(13) Install the spark plugs and tighten to 37 N·m (27 ft. lbs.) torque. Connect the ignition wires.

(14) Install the intake and exhaust manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(15) Install the fuel lines and the vacuum advance hose.

(16) If equipped, attach the power steering pump and bracket.

(17) Install the push rods, rocker arms, pivots and bridges in the order they were removed.

(18) Install the engine cylinder head cover.

(19) Attach the air conditioning compressor mounting bracket to the engine cylinder head and block. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(20) Attach the air conditioning compressor to the bracket. Tighten the bolts to 27 N·m (20 ft. lbs.) torque.

CAUTION: The serpentine drive belt must be routed correctly. Incorrect routing can cause the water pump to turn in the opposite direction causing the engine to overheat.

(21) Install the serpentine drive belt and correctly tension the belt (refer to Group 7, Cooling System for the proper procedure).

(22) Install the air cleaner and ducting.

(23) Install the engine cylinder head cover.

(24) Connect the hoses to the thermostat housing and fill the cooling system to the specified level (refer to Group 7, Cooling Systems for the proper procedure).

(25) The automatic transmission throttle linkage and cable must be adjusted after completing the engine cylinder head installation (refer to Group 21, Transmissions for the proper procedures).

(26) Install the temperature sending unit and connect the wire connector.

(27) Connect the fuel pipe and vacuum advance hose.

(28) Connect negative cable to battery.

(29) Connect the upper radiator hose and heater hose at the thermostat housing.

(30) Fill the cooling system. Check for leaks.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN DIRECT LINE WITH THE FAN. DO NOT PUT HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(31) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

VALVE SPRINGS AND OIL SEALS

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

Each valve spring is held in place by a retainer and a set of conical valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove the engine cylinder head cover.

(2) Remove capscrews, bridge and pivot assemblies and rocker arms for access to each valve spring to be removed.

(3) Remove push rods. Retain the push rods, bridges, pivots and rocker arms in the same order and position as removed.

(4) Inspect the springs and retainer for cracks and possible signs of weakening.

(5) Remove the spark plug(s) adjacent to the cylinder(s) below the valve springs to be removed.

(6) Install a 14 mm (1/2 inch) (thread size) air hose adaptor in the spark plug hole.

(7) Connect an air hose to the adapter and apply air pressure slowly. Maintain at least 621 kPa (90 psi) of air pressure in the cylinder to hold the valves against their seats. For vehicles equipped with an air conditioner, use a flexible air adaptor when servicing the No.1 cylinder.

(8) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 7).

(9) Remove valve spring and retainer (Fig. 7).

(10) Remove valve stem oil seals (Fig. 7). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (Intake) or EXH (Exhaust). DO NOT mix the seals.

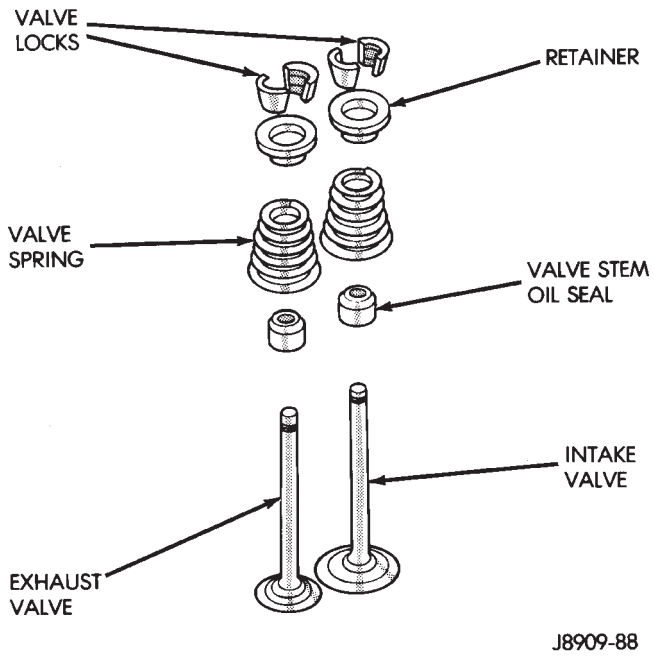


Fig. 7 Valve and Valve Components

INSPECTION

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

INSTALLATION

CAUTION: Install oil seals carefully to prevent damage from the sharp edges of the valve spring lock grove.

(1) Lightly push the valve seal over the valve stem and valve guide boss. Be sure the seal is completely seated on the valve guide boss.

(2) Install valve spring and retainer.

(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.

(4) Disconnect the air hose. Remove the adaptor from the spark plug hole and install the spark plug.

(5) Repeat the procedures for each remaining valve spring to be removed.

(6) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.

(7) Install the rocker arms, pivots and bridge at their original location.

(8) Tighten the bridge capscrews alternately, one at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

VALVES AND VALVE SPRINGS

This procedure is done with the engine cylinder head removed from the block.

REMOVAL

(1) Remove the engine cylinder head from the cylinder block.

(2) Use Valve Spring Compressor Tool MD-998772A and compress each valve spring.

(3) Remove the valve locks, retainers, springs and valve stem oil seals. Discard the oil seals.

(4) Use an Arkansas smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.

(5) Remove the valves, and place them in a rack in the same order as removed.

VALVE CLEANING

Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

Clean all grime and gasket material from the engine cylinder head machined gasket surface.

INSPECTION

Inspect for cracks in the combustion chambers and valve ports.

Inspect for cracks on the exhaust seat.

Inspect for cracks in the gasket surface at each coolant passage.

Inspect valves for burned, cracked or warped heads.

Inspect for scuffed or bent valve stems.

Replace valves displaying any damage.

VALVE REFACING

(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 0.787 mm (0.031 inch) must remain (Fig. 8). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

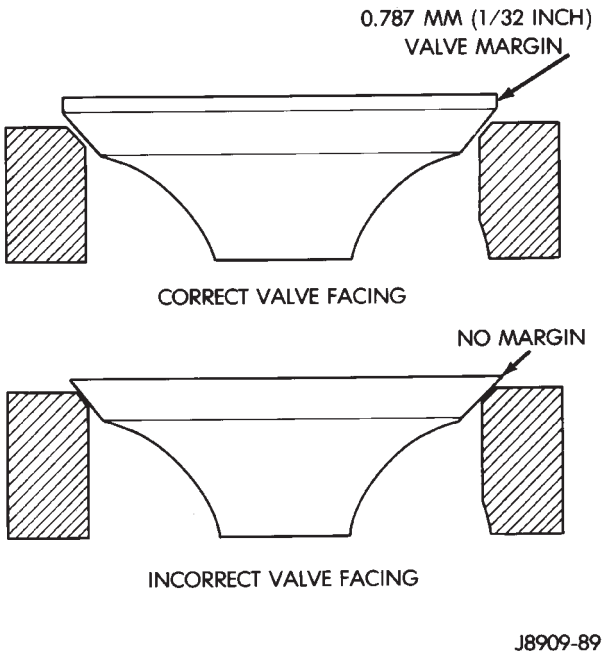


Fig. 8 Valve Facing Margin

VALVE SEAT REFACING

(1) Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.

(2) Use tapered stones to obtain the specified seat width when required.

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.)—(Fig. 9).

VALVE STEM OIL SEAL REPLACEMENT

Valve stem oil seals are installed on each valve stem to prevent rocker arm lubricating oil from entering the combustion chamber through the valve guide bores. One seal is marked INT (intake valve) and the other is marked EXH (exhaust valve).

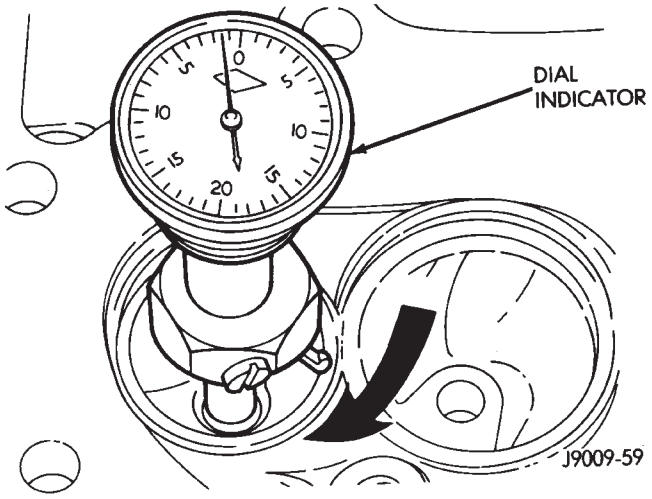


Fig. 9 Measurement of Valve Seat Runout

Replace the oil seals whenever valve service is performed or if the seals have deteriorated.

VALVE GUIDES

The valve guides are an integral part of the engine cylinder head and are not replaceable.

When the valve stem guide clearance is excessive, the valve guide bores must be reamed oversize. Service valves with oversize stems are available in 0.076 mm (0.003 inch) and 0.381 mm (0.015 inch) increments.

Corresponding oversize valve stem seals are also available and must be used with valves having 0.381 mm (0.015 inch) oversize stems.

If the valve guides are reamed oversize, the valve seats must be ground to ensure that the valve seat is concentric to the valve guide.

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

Valve stem-to-guide clearance may be measured by either of the following two methods.

PREFERRED METHOD:

(1) Remove the valve from the head.

(2) Clean the valve stem guide bore with solvent and a bristle brush.

(3) Insert a telescoping gauge into the valve stem guide bore approximately 9.525 mm (.375 inch) from the valve spring side of the head (Fig. 10).

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

(6) Compare the crosswise to lengthwise measurements to determine out-of-roundness. If the measurements differ by more than 0.0635 mm (0.0025 in.), ream the guide bore to accommodate an oversize valve stem.

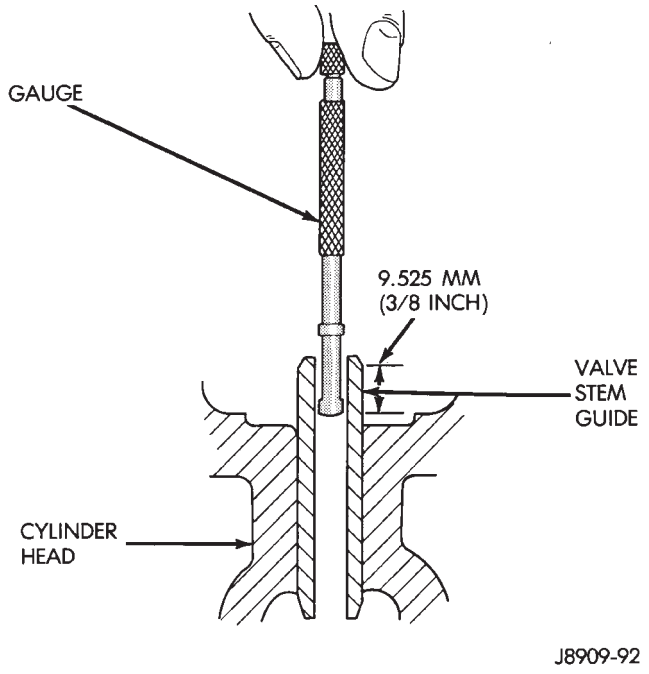


Fig. 10 Measurement of Valve Guide Bore Diameter

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD:

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 11).

(2) Correct clearance is 0.025-0.0762 mm (0.001-0.003 inch). If indicated movement exceeds the specification ream the valve guide to accommodate an oversize valve stem.

Valve seats must be ground after reaming the valve guides to ensure that the valve seat is concentric to the valve guide.

VALVE SPRING TENSION TEST

Use Valve Spring Tester C-647 and a torque wrench to test each valve spring for the specified tension value (Fig. 12).

Replace valve springs that are not within specifications.

INSTALLATION

(1) Thoroughly clean the valve stems and the valve guide bores.

(2) Lightly lubricate the stem.

(3) Install the valve in the original valve guide bore.

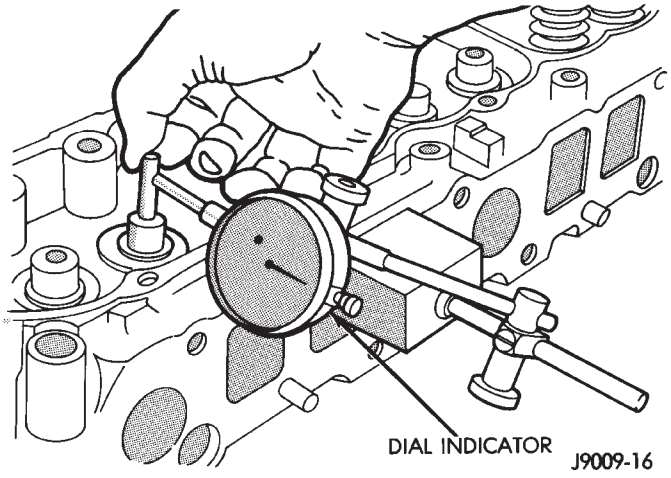


Fig. 11 Measurement of Lateral Movement Of Valve Stem

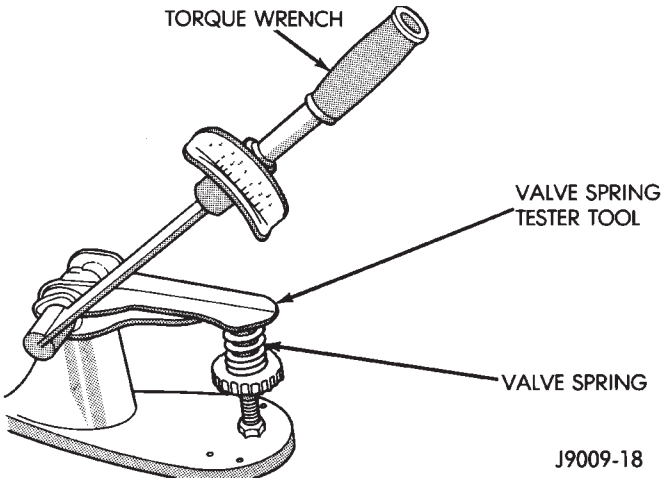


Fig. 12 Valve Spring Tester C-647

(4) Install the replacement valve stem oil seals on the valve stems. If the 0.381 mm (0.015 inch) oversize valve stems are used, oversize oil seals are required.

(5) Position the valve spring and retainer on the engine cylinder head and compress the valve spring with Valve Spring Compressor Tool MD-998772A.

(6) Install the valve locks and release the tool.

(7) Tap the valve spring from side to side with a hammer to ensure that the spring is properly seated at the engine cylinder head. Also tap the top of the retainer to seat the valve locks.

(8) Install the engine cylinder head.

HYDRAULIC TAPPETS

Retain all the components in the same order as removed.

REMOVAL

(1) Remove the engine cylinder head cover.

(2) Remove the bridge and pivot assemblies and rocker arms by removing the capscrews at each bridge. Alternately loosen each capscrew, one turn at

a time, to avoid damaging the bridges.

(3) Remove the push rods.

(4) Remove the tappets through the push rod openings in the cylinder head with Hydraulic Valve Tappet Removal/Installation Tool C-4129-A (Fig. 13).

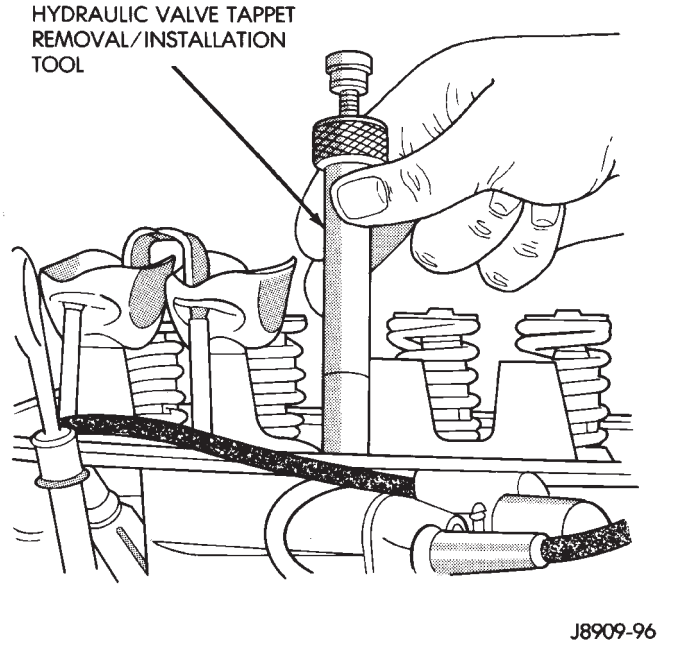


Fig. 13 Hydraulic Valve Tappet Removal/Installation Tool C-4129-A

CLEANING

Clean each tappet assembly in cleaning solvent to remove all varnish, gum and sludge deposits.

INSPECTION

Inspect for indications of scuffing on the side and base of each tappet body.

Inspect each tappet base for concave wear with a straightedge positioned across the base. If the base is concave, the corresponding lobe on the camshaft is also worn. Replace the camshaft and defective tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 14).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester 7980.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

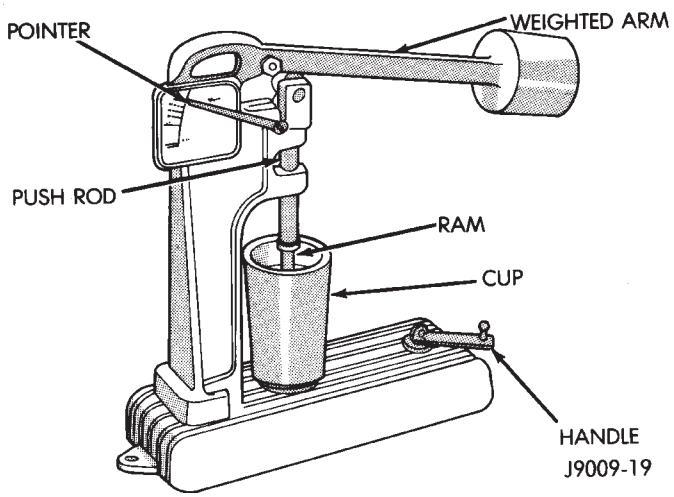


Fig. 14 Leak-Down Tester 7980

INSTALLATION

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

(1) Dip each tappet in Mopar Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool C-4129-A to install each tappet in the same bore from where it was originally removed.

(3) Install the push rods in their original locations.

(4) Install the rocker arms and bridge and pivot assemblies at their original locations. Loosely install the capscrews at each bridge.

(5) Tighten the capscrews alternately, one turn at a time, to avoid damaging the bridges. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(6) Pour the remaining Mopar Engine Oil Supplement, or equivalent over the entire valve actuating assembly. The Mopar Engine Oil Supplement, or equivalent must remain with the engine oil for at

least 1 600 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(7) Install the engine cylinder head cover.

VALVE TIMING

Disconnect the spark plug wires and remove the spark plugs.

Remove the engine cylinder head cover.

Remove the capscrews, bridge and pivot assembly, and rocker arms from above the No.1 cylinder.

Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridge.

Rotate the crankshaft until the No.4 piston is at top dead center (TDC) on the compression stroke.

Rotate the crankshaft counterclockwise (viewed from the front of the engine) 90°.

Install a dial indicator on the end of the No.1 cylinder intake valve push rod. Use rubber tubing to secure the indicator stem on the push rod.

Set the dial indicator pointer at zero.

Rotate the crankshaft clockwise (viewed from the front of the engine) until the dial indicator pointer indicates 0.305 mm (0.012 inch) travel distance (lift).

The timing notch index on the vibration damper should be aligned with the TDC mark on the timing degree scale.

If the timing notch is more than 13 mm (1/2 inch) away from the TDC mark in either direction, the valve timing is incorrect.

If the valve timing is incorrect, the cause may be a broken camshaft pin. It is not necessary to replace the camshaft because of pin failure. A spring pin is available for service replacement.

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt and fan shroud.

(3) Remove the vibration damper retaining bolt and washer.

(4) Use Vibration Damper Removal Tool 8068 to remove the damper from the crankshaft (Fig. 1).

INSTALLATION

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in position, align the keyway on the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft.

(2) Install the vibration damper retaining bolt and washer.

(3) Tighten the damper retaining bolt to 108 N·m (80 ft. lbs.) torque.

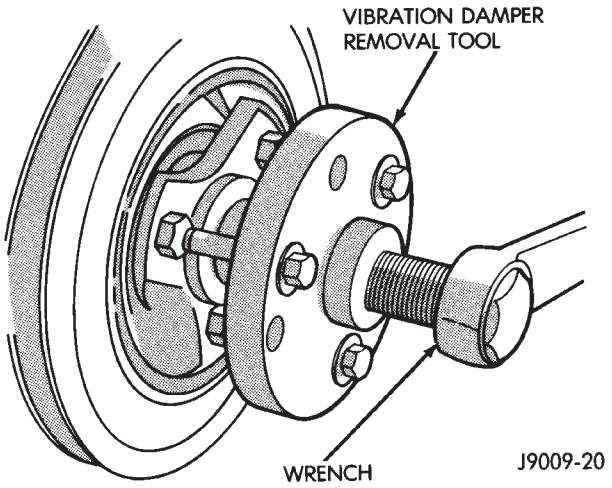


Fig. 1 Vibration Damper Removal Tool 8068

(4) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(5) Connect negative cable to battery.

TIMING CASE COVER OIL SEAL REPLACEMENT

This procedure is done with the timing case cover installed.

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt.

(3) Remove the vibration damper.

(4) Remove the radiator shroud.

(5) Carefully remove the oil seal (Fig. 2). Make sure seal bore is clean.

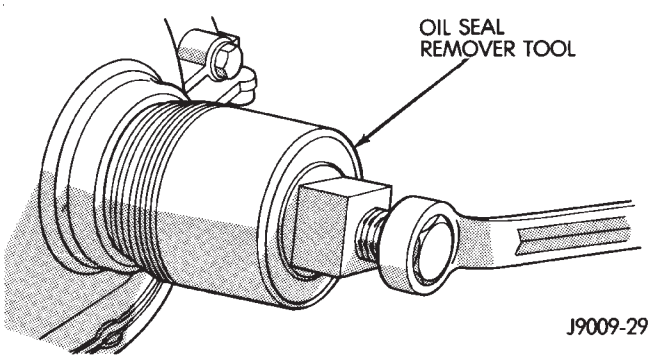


Fig. 2 Timing Case Cover Oil Seal Removal

(6) Position the replacement oil seal on Timing Case Cover Alignment and Seal Installation Tool 6139 with seal open end facing inward. Apply a light film of Perfect Seal, or equivalent, on the outside diameter of the seal. Lightly coat the crankshaft with engine oil.

(7) Position the tool and seal over the end of the crankshaft and insert a draw screw tool into Seal Installation Tool 6139 (Fig. 3). Tighten the nut against the tool until it contacts the cover.

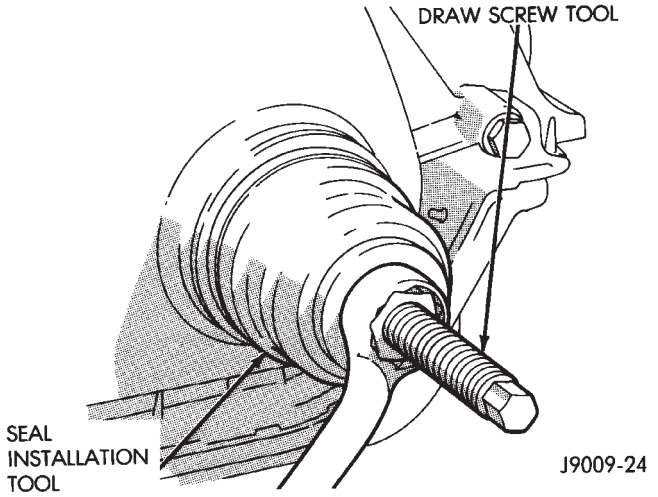


Fig. 3 Timing Case Cover Oil Seal Installation

(8) Remove the tools. Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) Install the serpentine belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(11) Install the radiator shroud.

(12) Connect negative cable to battery.

TIMING CASE COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper (Fig. 4).

(3) Remove the fan and hub assembly and remove the fan shroud.

(4) Remove the accessory drive brackets that are attached to the timing case cover.

(5) Remove the A/C compressor (if equipped) and generator bracket assembly from the engine cylinder head and move to one side.

(6) Remove the oil pan-to-timing case cover bolts and timing case cover-to-cylinder block bolts.

(7) Remove the timing case cover and gasket from the engine.

(8) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 4).

CLEANING

Clean the timing case cover, oil pan and cylinder block gasket surfaces.

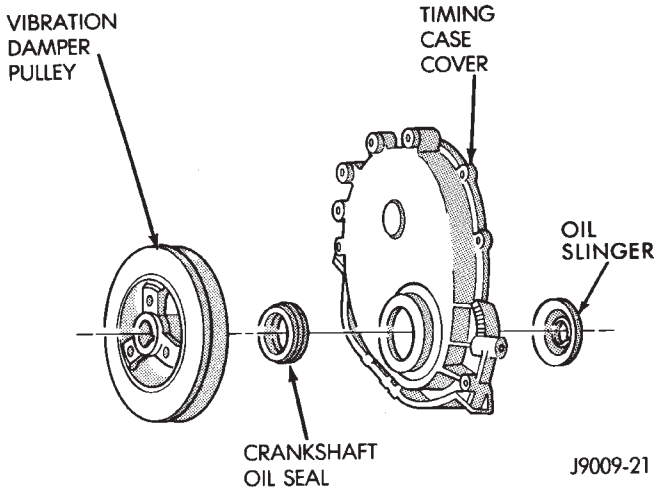


Fig. 4 Timing Case Cover Components

INSTALLATION

(1) Install a new crankshaft oil seal in the timing case cover. The open end of the seal should be toward the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

(2) Position the gasket on the cylinder block.

(3) Position the timing case cover on the oil pan gasket and the cylinder block.

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 5).

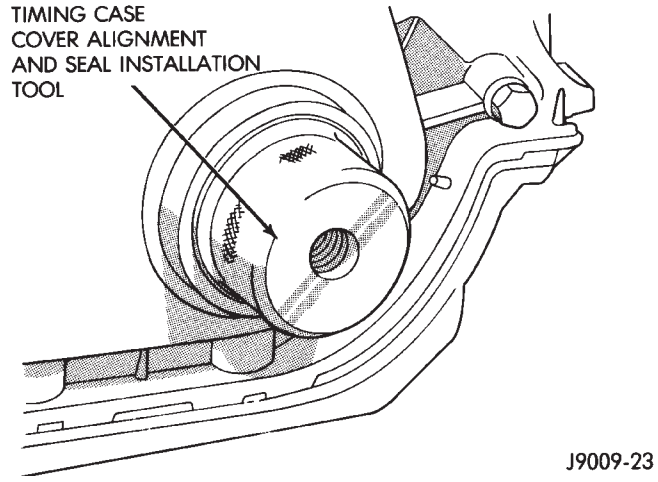


Fig. 5 Timing Case Cover Alignment and Seal Installation Tool 6139

(5) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

(6) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.

(7) Remove the cover alignment tool.

(8) Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) Install the A/C compressor (if equipped) and generator bracket assembly.

(11) Install the engine fan and hub assembly and shroud.

(12) Install the serpentine drive belt and tighten to obtain the specified tension.

(13) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

The timing chain tensioner reduces noise and prolongs timing chain life. In addition, it compensates for slack in a worn or stretched chain and maintains the correct valve timing.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud.

(3) Remove the serpentine drive belt.

(4) Remove the crankshaft vibration damper.

(5) Remove the timing case cover.

(6) Rotate crankshaft until the "0" timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 6).

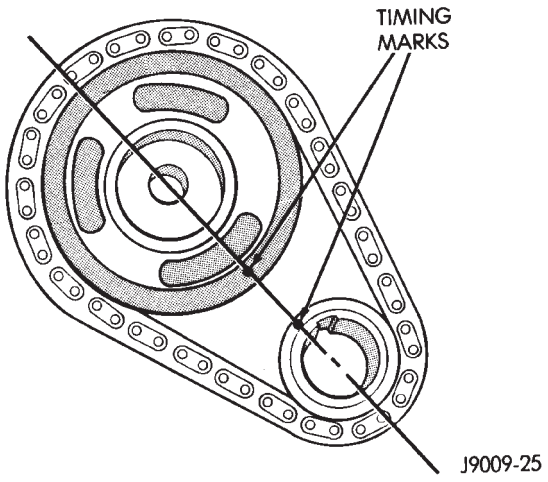


Fig. 6 Crankshaft/Camshaft Alignment

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly (Fig. 7).

(9) To replace the timing chain tensioner, the oil pan must be removed.

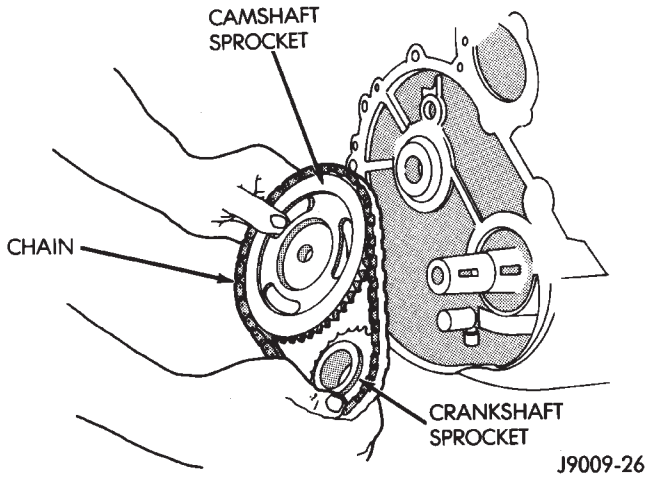


Fig. 7 Camshaft and Crankshaft Sprockets and Chain

INSTALLATION

(1) Turn the tensioner lever to the unlocked (down) position (Fig. 8).

(2) Pull the tensioner block toward the tensioner lever to compress the spring. Hold the block and turn the tensioner lever to the lock position (Fig. 8).

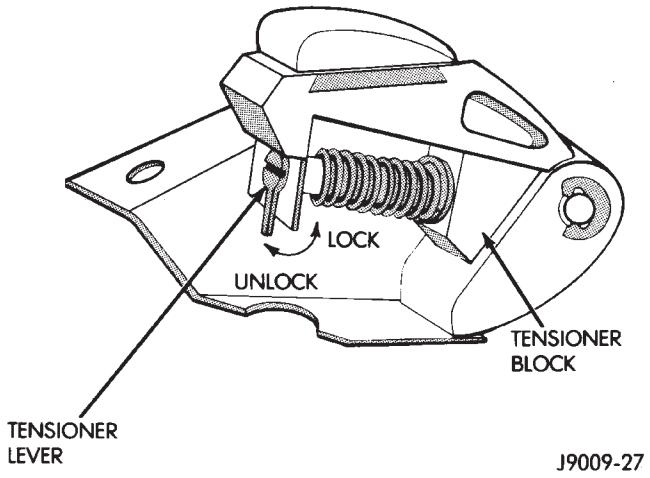


Fig. 8 Loading Timing Chain Tensioner

(3) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in the crankshaft keyway, install the crankshaft/camshaft sprockets and timing chain. Ensure the timing marks on the sprockets are properly aligned (Fig. 6).

(4) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(5) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in Fig. 9. Count the number of chain pins between the timing marks of both sprockets. There must be 20 pins.

(6) Turn the chain tensioner lever to the unlocked (down) position (Fig. 8).

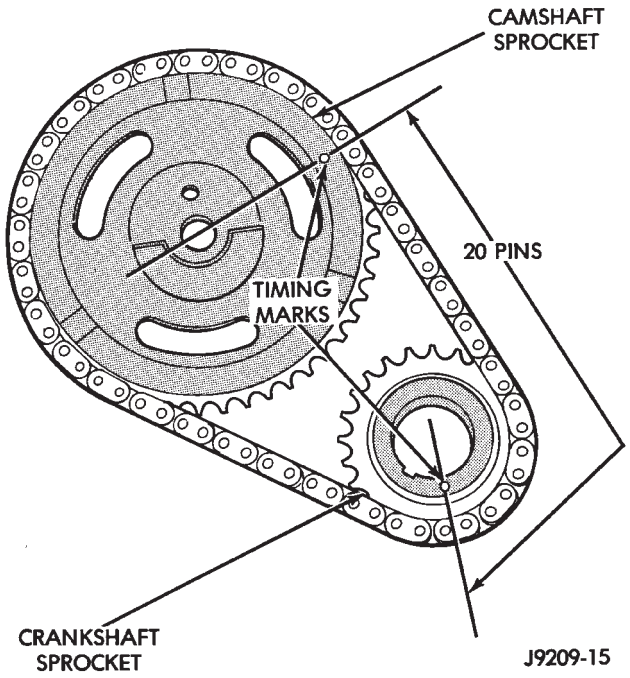


Fig. 9 Verify Sprocket/Chain Installation

(7) Install the oil slinger.
(8) Replace the oil seal in the timing case cover.
(9) Install the timing case cover and gasket.
(10) With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.
(11) Install the fan and shroud.
(12) Connect negative cable to battery.

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.
(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.
(3) Remove the radiator or radiator/condenser, if equipped with A/C (refer to Group 7, Cooling System for the proper procedure).
(4) Scribe a mark on the distributor housing in line with the lip of the rotor.
(5) Scribe a mark on the distributor housing near the clamp and continue the scribe mark on the cylinder block in line with the distributor mark.
(6) For ease of installation, note the position of the rotor and distributor housing in relation to adjacent engine components.
(7) Remove the distributor and ignition wires.
(8) Remove the engine cylinder head cover.
(9) Remove the rocker arms, bridges and pivots.
(10) Remove the push rods.
(11) Remove the hydraulic valve tappets from the engine cylinder head.
(12) Remove the vibration damper.
(13) Remove the timing case cover.
(14) Remove the timing chain and sprockets.
(15) Remove the camshaft (Fig. 10).

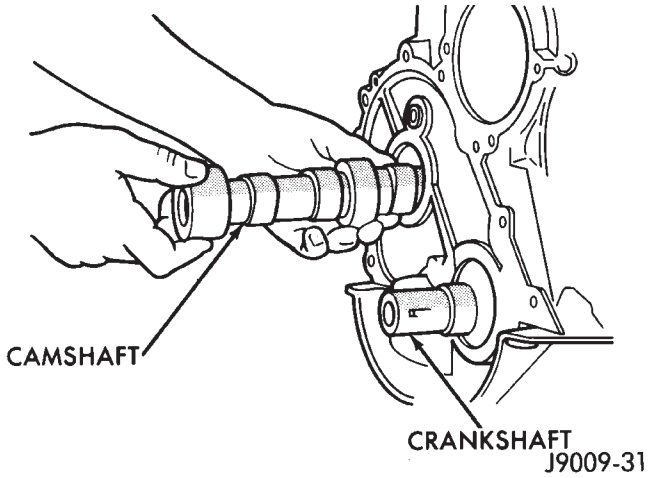


Fig. 10 Camshaft

INSPECTION

Inspect the cam lobes for wear.
Inspect the bearing journals for uneven wear pattern or finish.
Inspect the bearings for wear.
Inspect the distributor drive gear for wear.
If the camshaft appears to have been rubbing against the timing case cover, examine the oil pressure relief holes in the rear cam journal. The oil pressure relief holes must be free of debris.

INSTALLATION

(1) Lubricate the camshaft with Mopar Engine Oil Supplement, or equivalent.
(2) Carefully install the camshaft to prevent damage to the camshaft bearings (Fig. 10).
(3) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.
(4) Install the camshaft sprocket retaining bolt and washer. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.
(5) Install the timing case cover with a replacement oil seal (Fig. 11). Refer to Timing Case Cover Installation.
(6) Install the vibration damper.
(7) Install the hydraulic valve tappets.
(8) Install the push rods.
(9) Install the rocker arms, bridges and pivots.
(10) Install the engine cylinder head cover.
(11) Install the distributor and ignition wires.

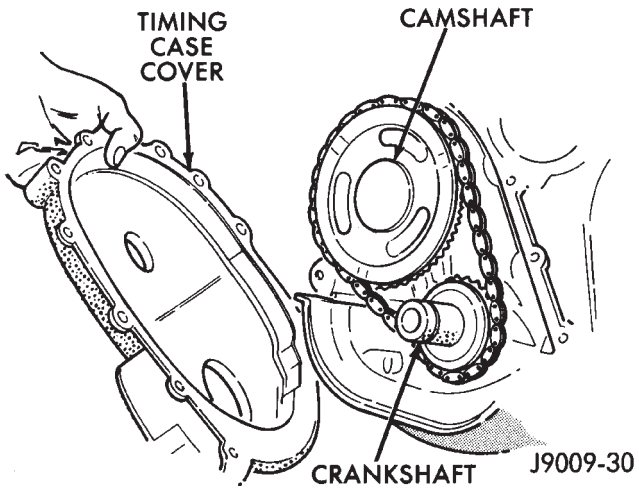


Fig. 11 Timing Case Cover

(12) Properly position the distributor rotor as follows:

(a) Remove No.1 spark plug. Hold your finger over the spark plug hole and rotate the crankshaft until compression pressure is felt. Slowly continue to rotate the crankshaft until the timing index on the vibration damper aligns with the top dead center (TDC) mark (0° on the timing degree scale). **Always rotate the crankshaft clockwise (the direction of normal rotation). DO NOT rotate the crankshaft backward to align the timing marks.**

(b) Rotate the oil pump gear so that the gear slot on the oil pump shaft is slightly past the 3 o'clock position (Fig. 12). A flat blade screwdriver can be used to rotate the gear.

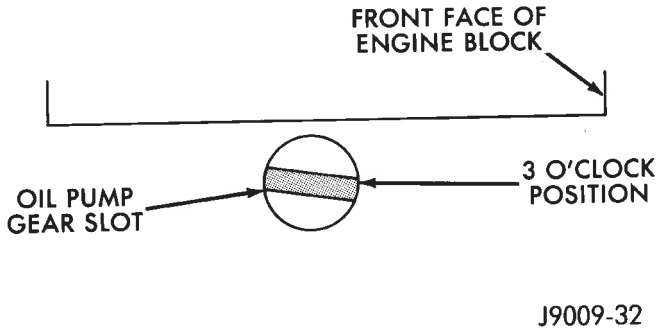


Fig. 12 Oil Pump Gear Slot Alignment

(c) Turn the distributor shaft until the rotor tip points in the direction of No.1 terminal in the distributor cap. Turn the rotor 1/8 turn counterclockwise past the position of No.1 terminal.

(d) With the distributor cap removed, start the distributor into the cylinder block with the rotor located at the 5 o'clock position (Fig. 13).

(e) Slide the distributor shaft down into the engine. Position the distributor vacuum advance mechanism housing in approximately the same location as when removed. Align the scribe mark on the distributor housing with the corresponding scribe mark on the cylinder block. The rotor should align with the position of No.1 terminal when the distributor shaft is down in place. It may be necessary to rotate the oil pump shaft with a long flat-blade screwdriver to engage the oil pump drive tang.

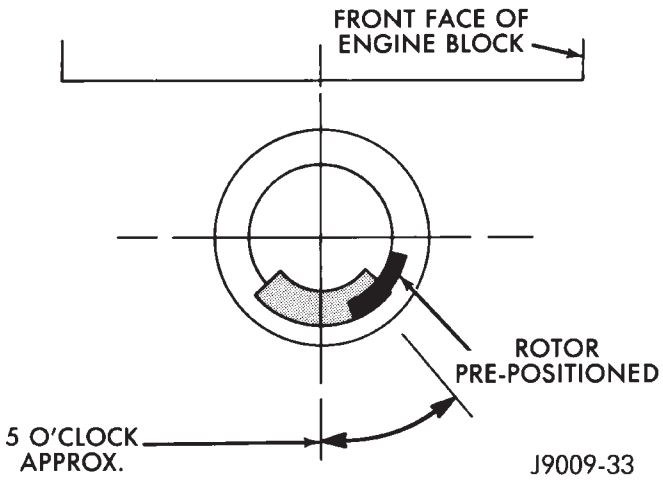


Fig. 13 Distributor Rotor Pre-Positioning

(f) Install the distributor holddown clamp and bolt. DO NOT tighten the bolt.

(g) When the distributor is fully engaged in its correct location, the rotor should be at the 6 o'clock position (Fig. 14).

(h) If the distributor is not properly installed, or if it is removed later, then the complete installation procedures must be repeated.

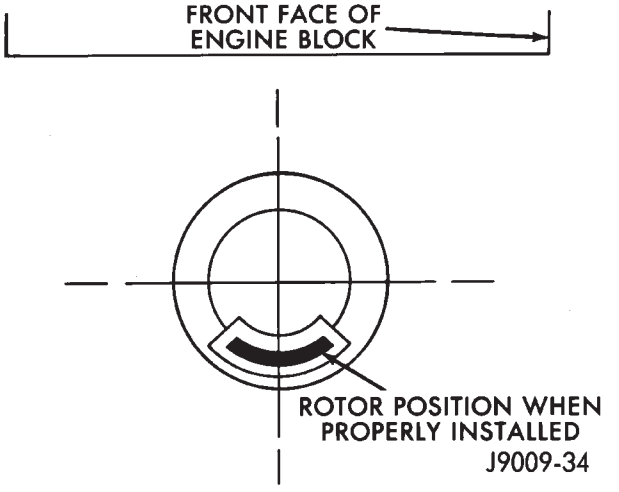


Fig. 14 Correct Rotor Position

(13) Install the radiator or radiator/condenser, if equipped with A/C.

(14) Fill the cooling system.

(15) Connect negative cable to battery.

CAMSHAFT PIN REPLACEMENT

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAIN COCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

(1) Disconnect negative cable from battery.
(2) Drain the radiator. DO NOT waste reusable coolant. Drain the coolant into a clean container.
(3) Remove the fan and shroud.
(4) Disconnect the radiator overflow tube, radiator hoses, automatic transmission fluid cooler pipes (if equipped).
(5) Remove the radiator.
(6) If equipped with air conditioning:

CAUTION: DO NOT loosen or disconnect any air conditioner system fittings. Move the condenser and receiver/drier aside as a complete assembly.

(a) Remove the A/C compressor serpentine drive belt idler pulley.
(b) Disconnect and remove the generator.
(c) Remove the A/C condenser attaching bolts and move the condenser and receiver/drier assembly up and out of the way.
(7) Remove the serpentine drive belt.
(8) Remove the crankshaft vibration damper.
(9) Remove the timing case cover. Clean the gasket material from the cover.
(10) Rotate crankshaft until the crankshaft sprocket timing mark is closest to and on the center line with the camshaft sprocket timing mark (Fig. 15).

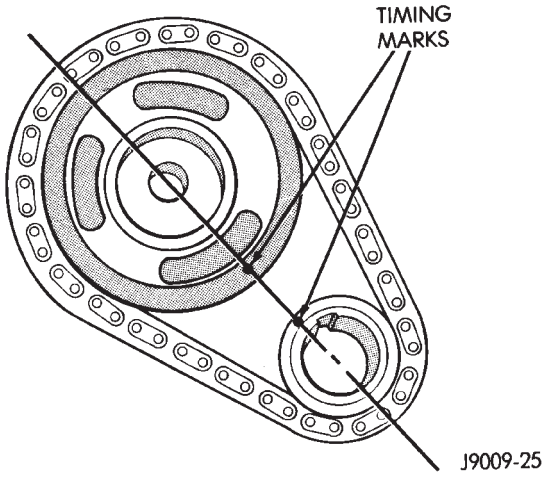


Fig. 15 Timing Chain Alignment

(11) Remove camshaft sprocket retaining bolt.
(12) Remove the crankshaft oil slinger.
(13) Remove the sprockets and chain as an assembly (Fig. 16).

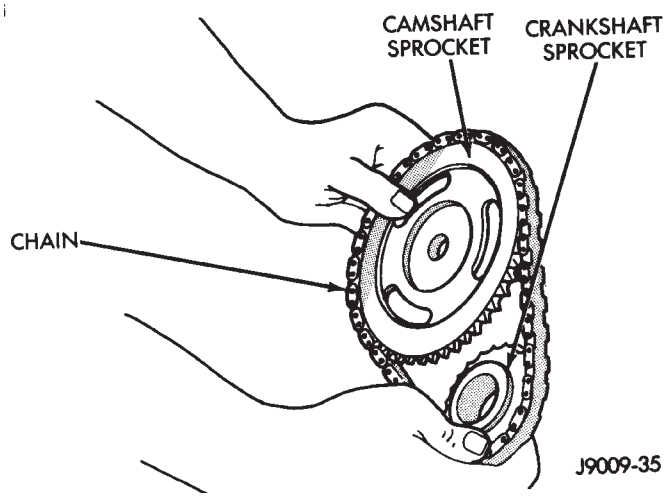


Fig. 16 Camshaft and Crankshaft Sprocket and Chain

CAUTION: The following procedural step must be accomplished to prevent the camshaft from damaging the rear camshaft plug during pin installation.

(14) Inspect the damaged camshaft pin.
(15) If the pin is a spring-type pin, remove the broken pin by inserting a self-tapping screw into the pin and carefully pulling the pin from the camshaft.
(16) If the pin is a dowel-type pin, center-punch it. Ensure the exact center is located when center-punching the pin.

CAUTION: Cover the opened oil pan area to prevent metal chips from entering the pan.

(17) Drill into the pin center with a 4 mm (5/32 inch) drill bit.
(18) Insert a self-tapping screw into the drilled pin and carefully pull the pin from the camshaft.

CAMSHAFT BEARINGS

The camshaft rotates within four steel-shelled, babbitt-lined bearings that are pressed into the cylinder block and then line reamed. The camshaft bearing bores and bearing diameters are not the same size. They are stepped down in 0.254 mm (0.010 inch) increments from the front bearing (largest) to the rear bearing (smallest). This permits easier removal and installation of the camshaft. The camshaft bearings are pressure lubricated.

It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available.

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face.

INSTALLATION

(1) Clean the camshaft pin hole.

(2) Compress the center of the replacement spring pin with vise grips.

(3) Carefully drive the pin into the camshaft pin hole until it is seated.

(4) Install the camshaft sprocket, crankshaft sprocket and timing chain with the timing marks aligned (Fig. 15).

(5) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in Fig. 17. Count the number of chain pins between the timing marks of both sprockets. There must be 20 pins.

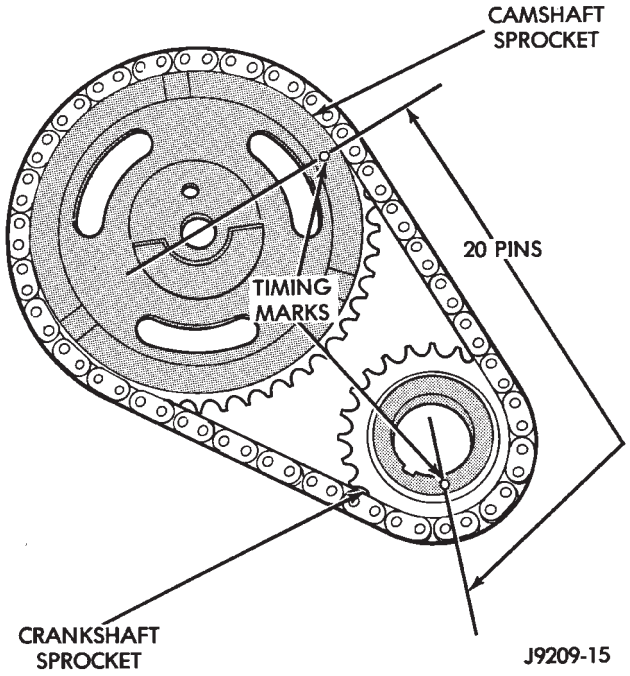


Fig. 17 Verify Crankshaft/Camshaft Installation

(6) Install the crankshaft oil slinger.

(7) Tighten the camshaft sprocket bolt to 108 N·m (80 ft. lbs.) torque.

(8) Check the valve timing.

(9) Coat both sides of the replacement timing case cover gasket with gasket sealer. Apply a 3 mm (1/8 inch) bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent to the joint formed at the timing case cover and cylinder block.

(10) Position the timing case cover on the oil pan gasket and the cylinder block.

(11) Place Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening of the cover (Fig. 18).

(12) Install the timing case cover-to-cylinder block bolts. Install the oil pan-to-timing case cover bolts.

(13) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m

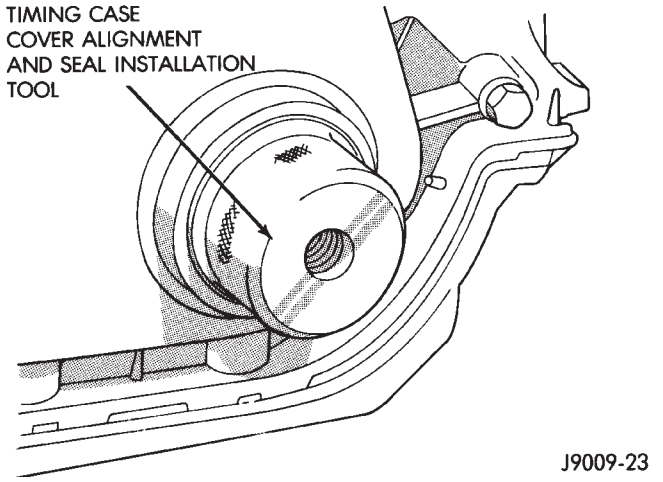


Fig. 18 Timing Case Cover Alignment and Seal Installation Tool 6139

(120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.

(14) Remove the cover alignment tool and install a replacement oil seal into the cover.

(15) Install the vibration damper on the crankshaft.

(16) Lubricate and tighten the damper bolt to 108 N·m (80 ft. lbs.) torque.

(17) If equipped with air conditioning:

(a) Install the A/C compressor serpentine drive belt idler pulley.

(b) Install the generator.

(c) Install the A/C condenser and receiver/drier assembly.

(18) Install the serpentine drive belt on the pulleys and tighten (refer to Group 7, Cooling System for the specifications and procedures).

(19) Install the radiator. Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped. Fill the cooling system.

(20) Install the fan and shroud.

(21) Connect negative cable to battery.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Disconnect the exhaust pipe at the engine exhaust manifold.

(5) Disconnect the exhaust hanger at the catalytic converter and lower the pipe.

(6) Remove the engine starter motor.

(7) Remove the flywheel/torque converter housing access cover.

(8) Position a jack stand directly under the engine vibration damper.

(9) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(10) Remove the engine mount through bolts.

(11) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(12) Remove the oil pan bolts. Carefully remove the oil pan and gasket.

CLEANING

Clean the block and pan gasket surfaces.

INSTALLATION

(1) Fabricate 4 alignment dowels from 1 1/2 x 1/4 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 1).

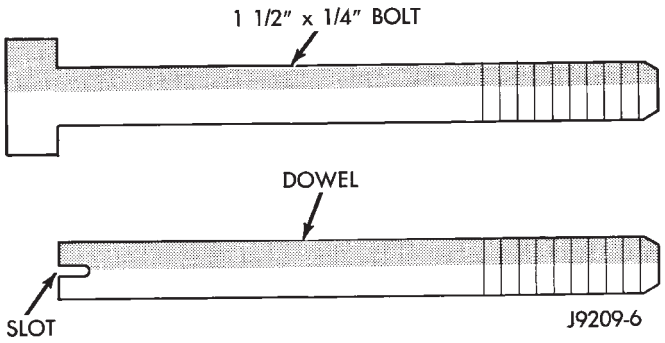


Fig. 1 Fabrication of Alignment Dowels

(2) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 2).

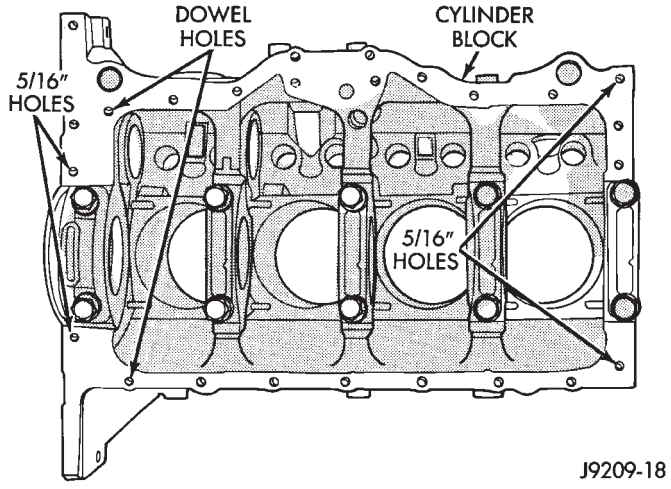


Fig. 2 Position of Dowels in Cylinder Block

(3) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(4) Position the oil pan over the dowels and onto the gasket.

(5) Install the 1/4 inch oil pan bolts. Tighten these bolts to 14 N·m (120 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 3). Tighten these bolts to 18 N·m (156 in. lbs.) torque.

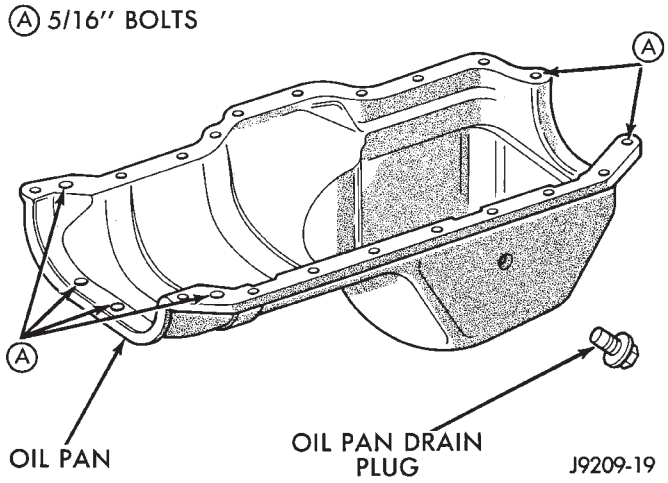


Fig. 3 Position of 5/16 inch Oil Pan Bolts

(6) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 14 N·m (120 in. lbs.) torque.

(7) Lower the engine until it is properly located on the engine mounts.

(8) Install the through bolts and tighten the nuts.

(9) Lower the jack stand and remove the piece of wood.

(10) Install the flywheel/torque converter housing access cover.

(11) Install the engine starter motor.

(12) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(13) Install the oil pan drain plug (Fig. 3). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(14) Lower the vehicle.

(15) Connect negative cable to battery.

(16) Fill the oil pan with engine oil to the specified level.

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.

(17) Start the engine and inspect for leaks.

OIL PUMP

The positive-displacement gear-type oil pump is driven by the distributor shaft, which is driven by a gear on the camshaft. Oil is siphoned into the pump through an inlet tube and strainer assembly that is pressed into the pump body.

The pump incorporates a nonadjustable pressure relief valve to limit maximum pressure to 517 kPa

(75 psi). In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear remains in mesh with the camshaft gear.

REMOVAL

(1) Drain the engine oil.
(2) Remove the oil pan.
(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 4).

CAUTION: If the oil pump is not to be serviced, DO NOT disturb position of oil inlet tube and strainer assembly in pump body. If the tube is moved within the pump body, a replacement tube and strainer assembly must be installed to assure an airtight seal.

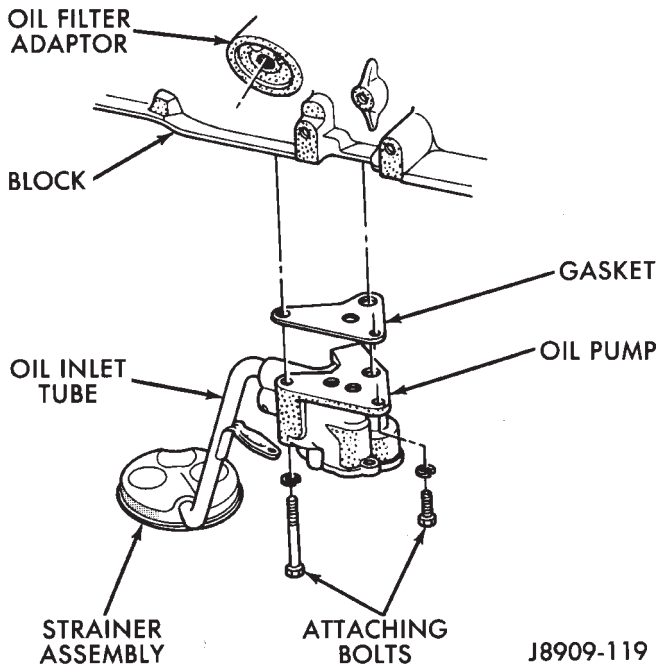


Fig. 4 Oil Pump Assembly

INSTALLATION

(1) Install the oil pump on the cylinder block using a replacement gasket. Tighten the short bolt to 14 N·m (10 ft. lbs.) torque and the long bolt to 23 N·m (17 ft. lbs.) torque.
(2) Install the oil pan.
(3) Fill the oil pan with oil to the specified level.

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 89.6 kPa (13 psi) at 600 rpm. The MAXIMUM oil pump pressure is 255-517 kPa (37-75 psi) at 1600 rpm or more.

PISTONS AND CONNECTING RODS

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Remove the rocker arms, bridges and pivots.
(3) Remove the push rods.
(4) Remove the engine cylinder head.
(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the ridge from the top end of the cylinder walls. Use a protective cloth to collect the cuttings.
(6) Raise the vehicle.
(7) Drain the engine oil.
(8) Remove the oil pan and gasket.
(9) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 1).

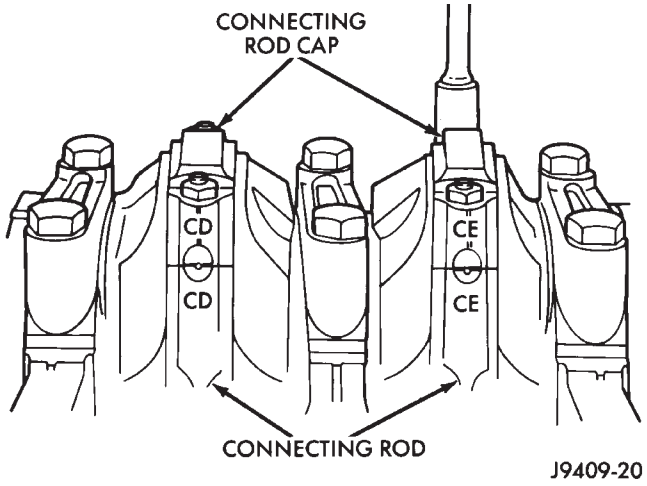


Fig. 1 Stamped Connecting Rods and Caps

(10) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

(11) Have an assistant push the piston/connecting rod assemblies up and through the top of the cylinder bores (Fig. 2).

INSPECTION—CONNECTING ROD

CONNECTING ROD BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Figs. 3 and 4). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 5). Replace any bearing that shows abnormal wear.

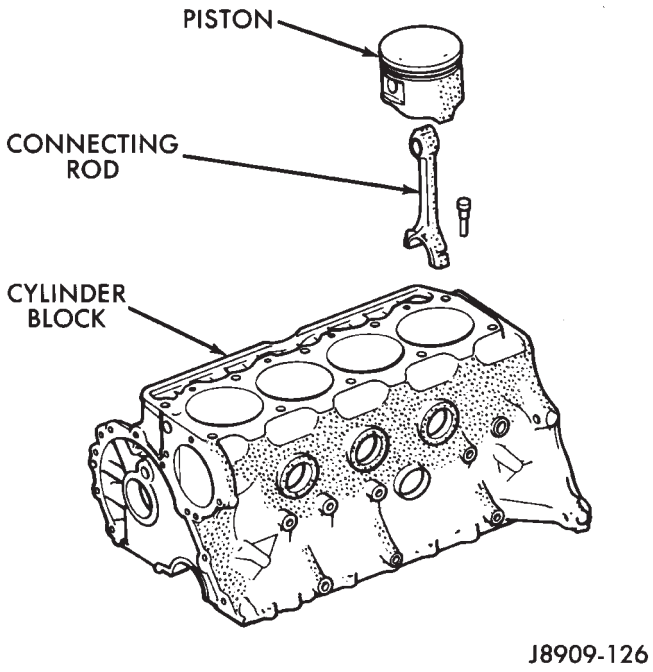


Fig. 2 Removal of Connecting Rod and Piston Assembly

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

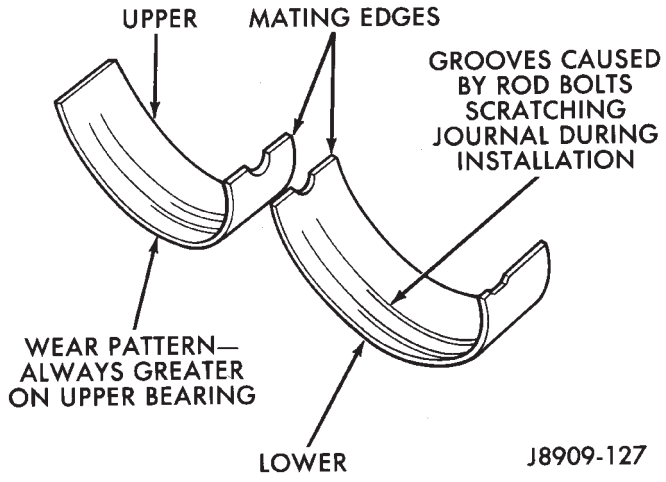


Fig. 3 Connecting Rod Bearing Inspection

CONNECTING RODS

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.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

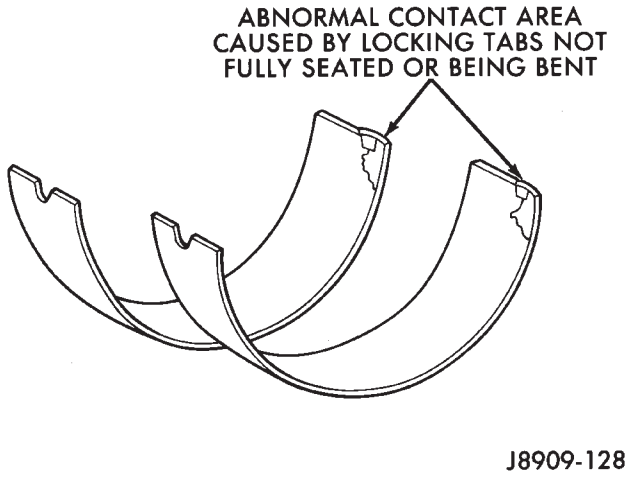


Fig. 4 Locking Tab Inspection

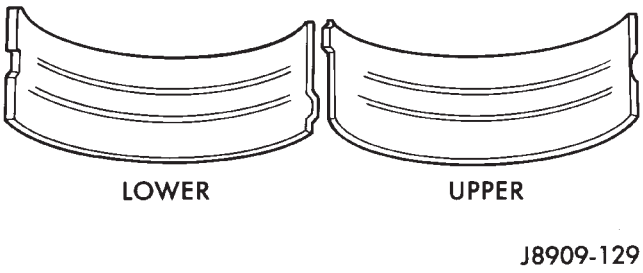


Fig. 5 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 6). Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

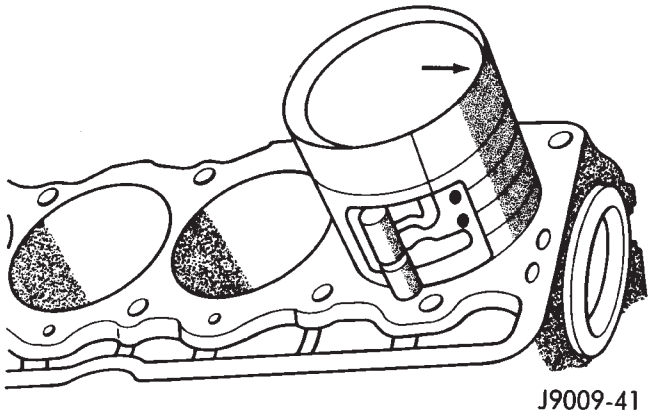


Fig. 6 Rod and Piston Assembly Installation

(5) 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.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(7) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 7). 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.**

(8) 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.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance (refer to Connecting Rod Bearing Fitting Chart).

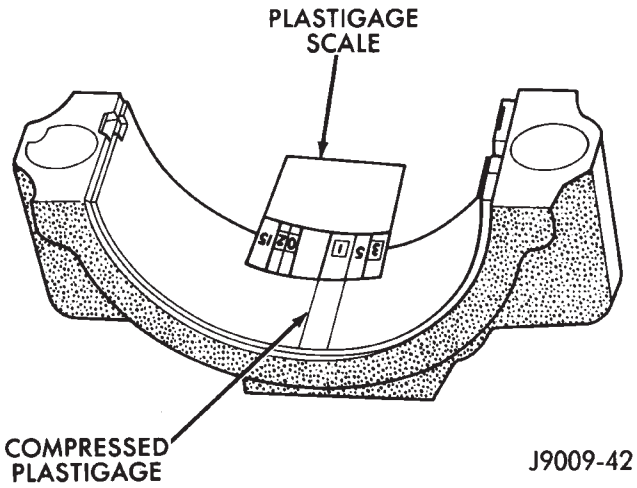


Fig. 7 Measuring Bearing Clearance with Plastigage

FOR EXAMPLE: If the initial clearance was 0.0762 mm (0.003 inch), 0.025 mm (0.001 inch) undersize inserts would reduce the clearance by 0.025 mm (0.001 inch). The clearance would be 0.002 inch and within specification. A 0.051 mm (0.002 inch) undersize insert would reduce the initial clearance an additional 0.013 mm (0.0005 inch). The clearance would then be 0.038 mm (0.0015 inch).

(11) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(12) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 45 N·m (33 ft. lbs.) torque.

CONNECTING ROD BEARING FITTING CHART

Crankshaft Journal		Corresponding Connecting Rod Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079-53.1901 mm (2.0948-2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901-53.1724 mm (2.0941-2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717-52.9539 mm (2.0855-2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

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SIDE CLEARANCE MEASUREMENT

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.

PISTON FITTING

MICROMETER METHOD

(1) Measure the inside diameter of the cylinder bore at a point 58.725 mm (2-5/16 inches) below top of bore.

(2) Measure outside diameter of the piston. Because pistons are cam ground, measure at right angle to piston pin at center line of pin (Fig. 8).

The difference between cylinder bore diameter and piston diameter is piston-to-bore clearance.

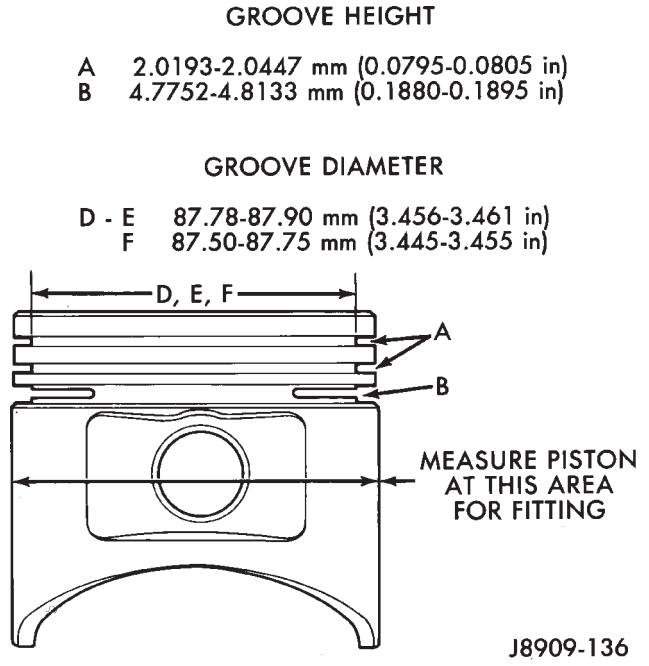

Fig. 8 Piston Dimensions

FEELER GAUGE METHOD

(1) Remove the rings from the piston.

(2) Insert a long 0.025 mm (0.001 inch) feeler gauge into the cylinder bore.

(3) Insert the piston, top first, into cylinder bore alongside the feeler gauge. With entire piston inserted into cylinder bore, the piston should not bind against feeler gauge.

(4) Repeat steps with a long 0.051 mm (0.002 inch) feeler gauge. The piston should bind.

(5) If the piston binds on 0.025 mm (0.001 inch) feeler gauge, the piston is too large or cylinder bore is too small. If the piston does not bind on 0.051 mm (0.002 inch) feeler gauge, the piston is too small for cylinder bore. Pistons up to 0.102 mm (0.004 inch) undersize may be enlarged by knurling or shot-peening. Replace pistons that are 0.102 mm (0.004 inch) or more undersize.

PISTON PIN

REMOVAL

Piston pins are press-fitted into the connecting rods and require no locking device.

(1) Position the piston and connecting rod assembly on an arbor press.

(2) Apply force to a piloted driver and press the pin completely out of the connecting rod and piston assembly (Fig. 9). Note position of the pin through the gauge window of removal support tool.

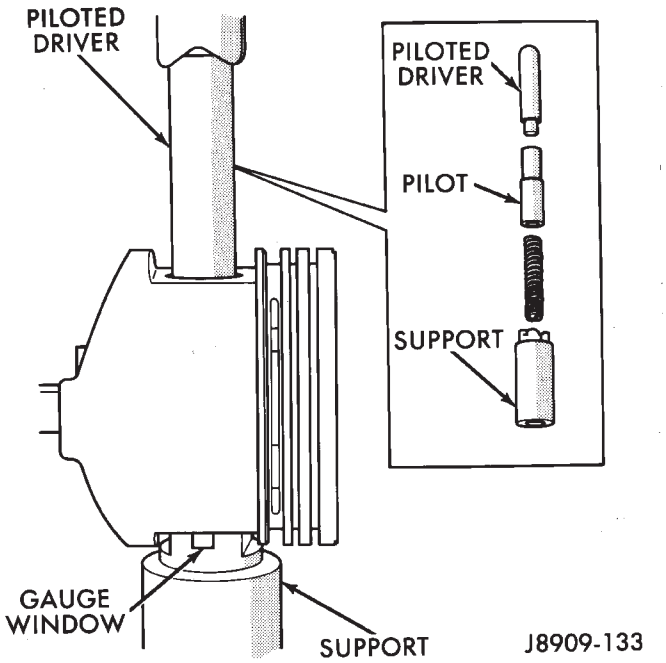

Fig. 9 Piston Pin Removal/Installation

INSPECTION

(1) Inspect the piston pin and pin bore in the connecting rod for nicks and burrs. Remove as necessary. Never reuse a piston pin after it has been installed in and removed from a connecting rod.

(2) With the pin removed from the piston and connecting rod, clean and dry piston pin bores and the replacement piston pin.

(3) Position the piston so that the pin bore is in vertical position. Insert the pin in bore. At room temperature, the replacement pin should slide completely through the pin bore in piston by force of gravity.

(4) Replace piston if pin jams in the pin bore.

INSTALLATION

(1) Insert the piston pin pilot through the piston and connecting rod pin bores. Ensure that the arrow on the piston crown is pointing up (Fig. 10).

(2) Position the pin pilot, piston and connecting rod on a support with the squirt hole of the connecting rod to the left-hand side (Fig. 10).

(3) Insert piston pin through the upper piston pin bore and into the connecting rod pin bore.

(4) Position the piloted driver inside the piston pin (Fig. 9).

(5) Using an arbor press, press the piston pin through the connecting rod and piston bores until pin pilot indexes with mark on the support. The piston pin requires a 8 900 N (2,000 pounds) press-fit. If little effort is required to install piston pin in a connecting rod, or if the rod moves laterally on the pin, the connecting rod must be replaced.

(6) Remove the piston and connecting rod assembly from the press. The pin should be centered in the connecting rod (±0.792 mm or ±0.0312 inch) and float in the piston pin bore.

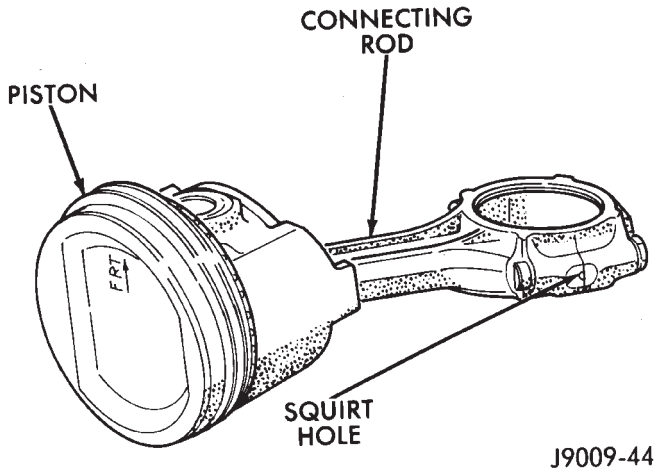

Fig. 10 Correct Alignment—Piston and Connecting Rod

PISTON RING FITTING

(1) Carefully clean the carbon from all ring grooves. Oil drain openings in the oil ring groove and pin boss must be clear. DO NOT remove metal from the grooves or lands. This will change ring-to-groove clearances and will damage the ring-to-land seating.

(2) Be sure the piston ring grooves are free of nicks and burrs.

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 11). Rotate the ring in the groove. It must move freely around circumference of the groove.

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 12). The correct compression ring end gap is 0.25-0.51 mm (0.010-0.020 inch). The correct oil control ring end gap is 0.381-1.397 mm (0.015-0.055 inch).

(5) Install the oil control rings according to instructions in the package. It is not necessary to use a

	Millimeters	Inches
No. 1 Compression	0.025-0.081 (0.043 Preferred)	0.001-0.0032 (0.0017 Preferred)
No. 2 Compression	0.025-0.081 (0.043 Preferred)	0.001-0.0032 (0.0017 Preferred)
Oil Control	0.025-0.241 (0.08 Preferred)	0.001-0.0095 (0.003 Preferred)

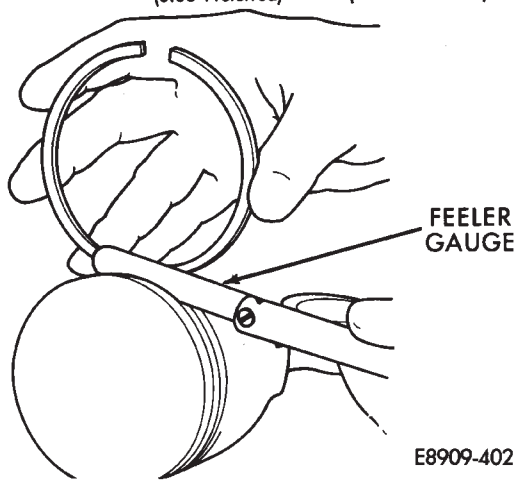

Fig. 11 Ring Side Clearance Measurement

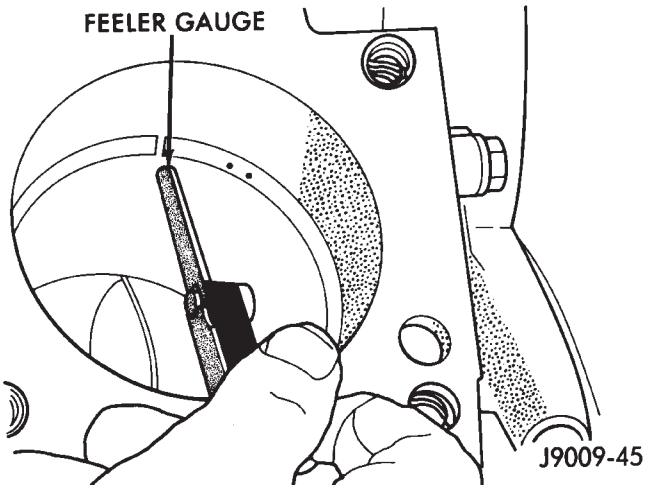

Fig. 12 Ring Gap Measurement

tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(6) The two compression rings are different and cannot be interchanged. The top ring (Fig. 13) is a moly ring (the scraping edge is gray in color). The second ring (Fig. 14) is a black cast iron ring (the scraping edge is black in color when new). The compression rings may also be identified by 1 or 2 dots on the top surface of the ring (Figs. 13 and 14).

(7) The second compression ring (black cast iron) has a chamfer on the BOTTOM of the inside edge (Fig. 15). This ring may also have 2 dots located on the top surface.

(8) Using a ring installer, install the second compression ring with the chamfer facing down (Fig. 16). The two dots will be facing up.

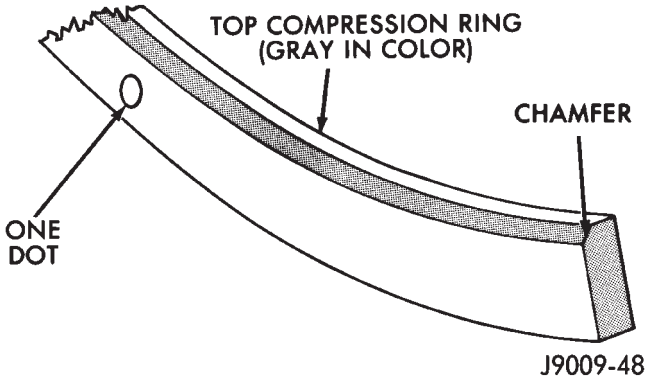

Fig. 13 Top Compression Ring Identification

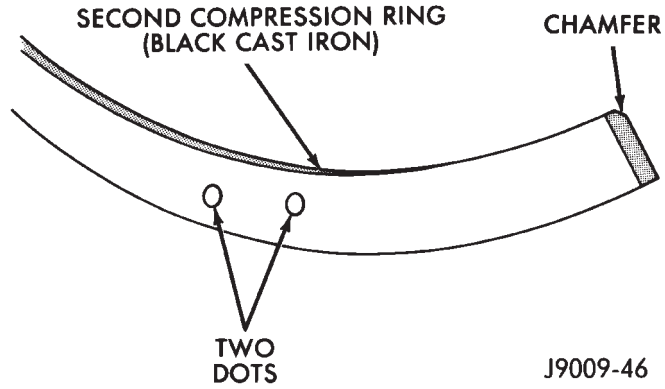

Fig. 14 Second Compression Ring Identification

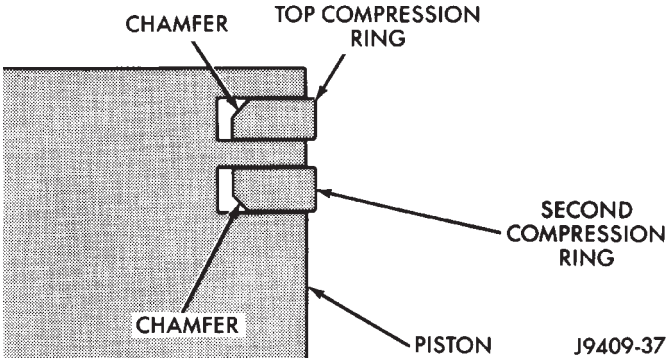

Fig. 15 Compression Ring Chamfer Location

(9) The top compression ring (the scraping edge is gray in color) has a chamfer on the TOP of the inside edge (Fig. 15). This ring may also have 1 dot located on the top surface.

(10) Using a ring installer, install the top ring with the chamfer facing up (Fig. 16). The dot will be facing up.

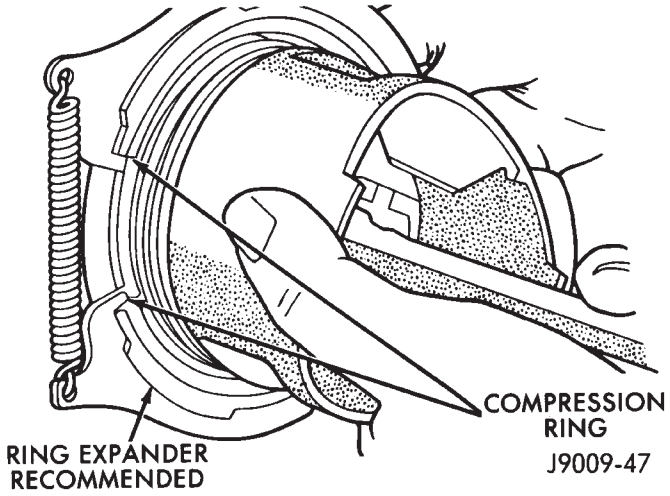

Fig. 16 Compression Ring Installation

(11) Position the gaps on the piston (Fig. 17):

- Oil spacer - Gap on center line of piston pin bore.
- Oil rails - Gap 180° apart on centerline of piston skirt.
- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

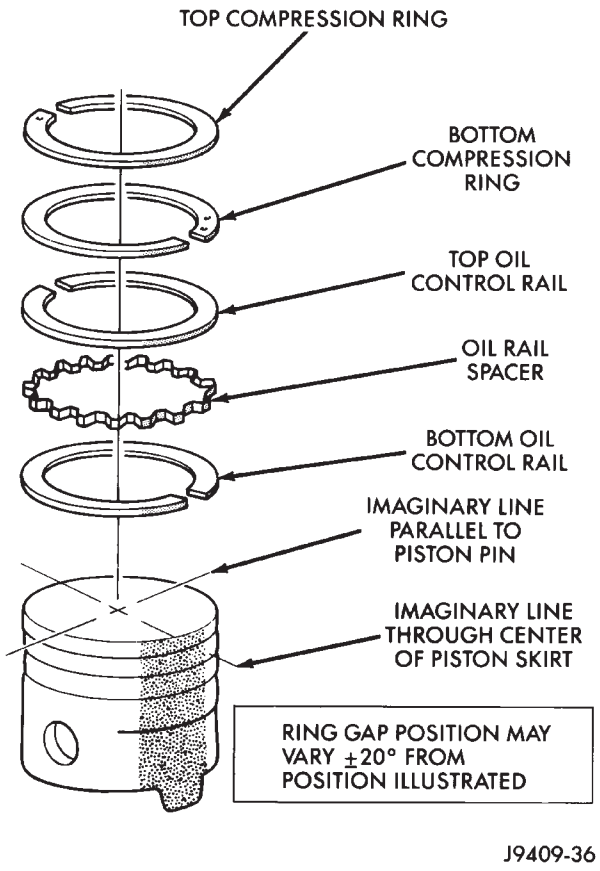

Fig. 17 Ring Gap Position

CLEANING

Clean the cylinder bores thoroughly. Apply a light film of clean engine oil to the bores with a clean lint-free cloth.

INSTALLATION

(1) Install the piston rings on the pistons if removed.

(2) Lubricate the piston and rings with clean engine oil.

CAUTION: Ensure that connecting rod bolts do not scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(3) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 18).

(4) Ensure the arrow on the piston top points to the front of the engine (Fig. 18).

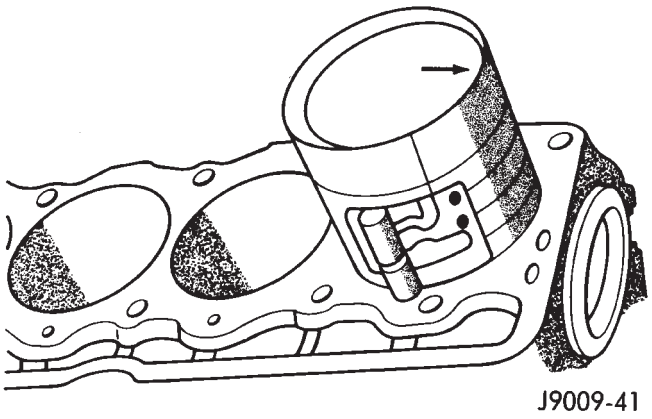

Fig. 18 Rod and Piston Assembly Installation

(5) Raise the vehicle.

Each bearing insert is fitted to its respective journal to obtain the specified clearance between the bearing and the journal. In production, the select fit is obtained by using various-sized, color-coded bearing inserts as listed in the Connecting Rod Bearing Fitting Chart. The color code appears on the edge of the bearing insert. The size is not stamped on inserts used for production of engines.

The rod journal is identified during the engine production by a color-coded paint mark on the adjacent cheek or counterweight toward the flange (rear) end of the crankshaft. The color codes used to indicate journal sizes are listed in the Connecting Rod Bearing Fitting Chart.

When required, upper and lower bearing inserts of different sizes may be used as a pair (refer to Connecting Rod Bearing Fitting Chart). A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce clearance 0.013 mm (0.0005 inch).

CAUTION: DO NOT intermix bearing caps. Each connecting rod and bearing cap are stamped with the cylinder number. The stamp is located on a machined surface adjacent to the oil squirt hole that faces the camshaft side of the cylinder block.

(6) Install the connecting rod bearing caps and inserts in the same positions as removed.

CAUTION: Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(7) Install the oil pan and gaskets as outlined in the installation procedure.

(8) Lower the vehicle.

(9) Install the engine cylinder head, push rods, rocker arms, bridges, pivots and engine cylinder head cover.

(10) Fill the crankcase with engine oil.

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the spark plugs.

(3) Raise the vehicle.

(4) Remove the oil pan and oil pump.

(5) Remove only one main bearing cap and lower insert at a time (Fig. 1).

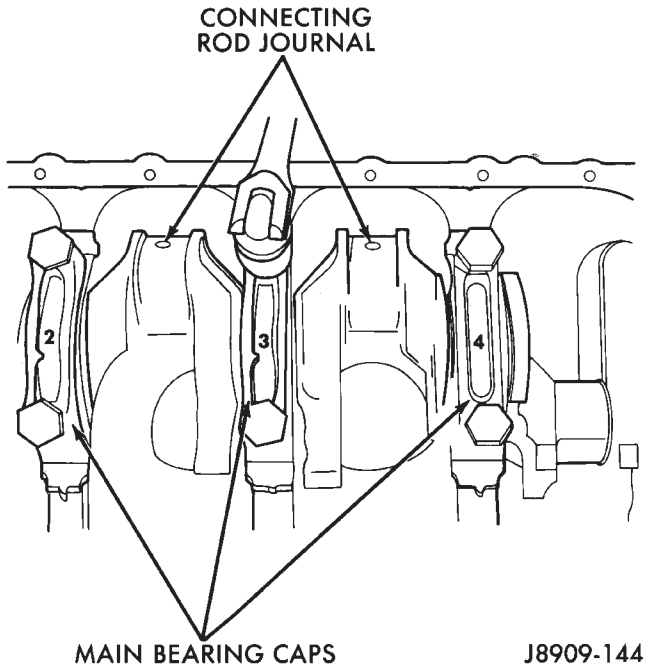

Fig. 1 Removing Main Bearing Caps and Lower Inserts

(6) Remove the lower insert from the bearing cap.

(7) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 2). With the cotter pin tool in place, rotate the crankshaft so that the upper bearing insert will rotate in the direction of its locking tab. Because there is no hole in the No.3 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing insert (Fig. 2). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(8) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

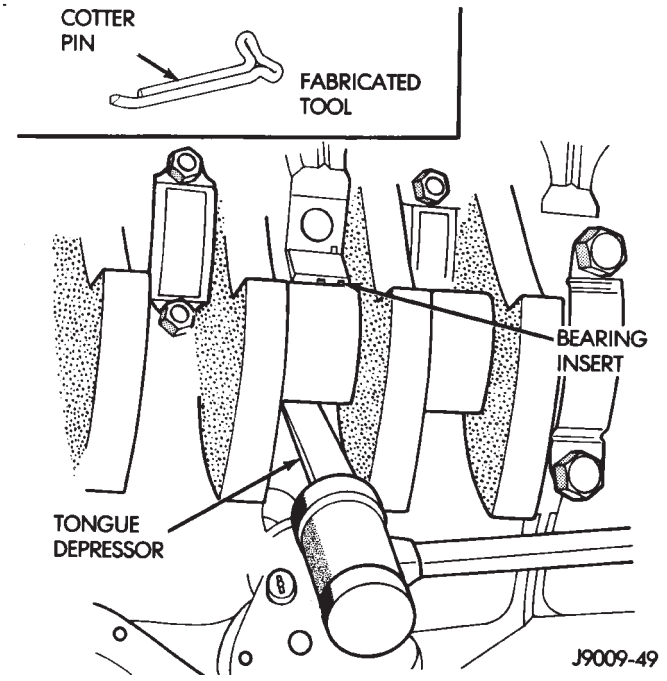

Fig. 2 Removing Upper Inserts

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 (Fig. 3).

If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

FITTING (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 5 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

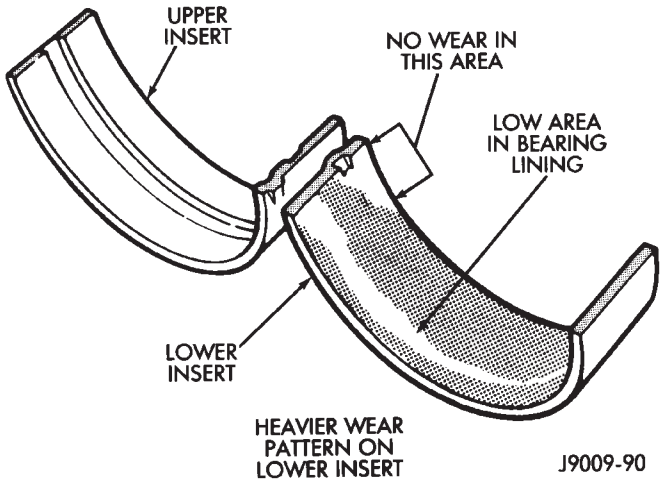

Fig. 3 Main Bearing Wear Patterns

Each bearing insert pair is selectively fitted to its respective journal to obtain the specified operating clearance. In production, the select fit is obtained by using various-sized color-coded bearing insert pairs as listed in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert. **The size is not stamped on bearing inserts used for engine production.**

The main bearing journal size (diameter) is identified by a color-coded paint mark on the adjacent cheek. The rear main journal, is identified by a color-coded paint mark on the crankshaft rear flange.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce the clearance by 0.013 mm (0.0005 inch). **Never use a pair of bearing inserts with greater than a 0.025 mm (0.001 inch) difference in size (Fig. 4).**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

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Fig. 4 Bearing Insert Pairs

When replacing inserts, the odd size inserts must be either all on the top (in cylinder block) or all on the bottom (in main bearing cap).

Once the bearings have been properly fitted, proceed to Crankshaft Main Bearing—Installation.

BEARING-TO-JOURNAL CLEARANCE (CRANKSHAFT INSTALLED)

When using Plastigage, check only one bearing clearance at a time.

Install the grooved main bearings into the cylinder block and the non-grooved bearings into the bearing caps.

Install the crankshaft into the upper bearings dry.

Place a strip of Plastigage across full width of the crankshaft journal to be checked.

Install the bearing cap and tighten the bolts to 108 N·m (80 ft. lbs.) torque.

DO NOT rotate the crankshaft. This will cause the Plastigage to shift, resulting in an inaccurate reading. Plastigage must not be permitted to crumble. If brittle, obtain fresh stock.

Remove the bearing cap. Determine the amount of clearance by measuring the width of the compressed Plastigage with the scale on the Plastigage envelope (Fig. 5). Refer to Engine Specifications for the proper clearance.

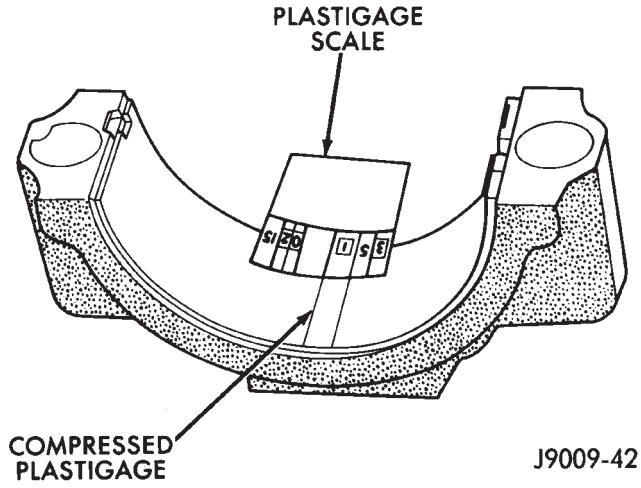

Fig. 5 Measuring Bearing Clearance with Plastigage

Plastigage should indicate the same clearance across the entire width of the insert. If clearance varies, it may indicate a tapered journal or foreign material trapped behind the insert.

If the specified clearance is indicated and there are no abnormal wear patterns, replacement of the bearing inserts is not necessary. Remove the Plastigage from the crankshaft journal and bearing insert. Proceed to Crankshaft Main Bearing—Installation.

If the clearance exceeds specification, install a pair of 0.025 mm (0.001 inch) undersize bearing inserts and measure the clearance as described in the previous steps.

The clearance indicated with the 0.025 mm (0.001 inch) undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance.

FOR EXAMPLE: If the clearance was 0.0762 mm (0.003 inch) originally, a pair of 0.0254 mm (0.001 inch) undersize inserts would reduce the clearance by 0.0254 mm (0.001 inch). The clearance would then be 0.0508 mm (0.002 inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

CAUTION: Never use a pair of inserts that differ more than one bearing size as a pair.

FOR EXAMPLE: DO NOT use a standard size upper insert and a 0.051 mm (0.002 inch) undersize lower insert.

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts, measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

If journals 1 through 5 diameters are less than 63.4517 mm (2.4981 inches), replace crankshaft or grind crankshaft down to accept the appropriate undersize bearing inserts.

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (refer to Cylinder Block - Disassemble).

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 and out of round is 0.013 mm (0.0005 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.

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

INSTALLATION

(1) Lubricate the bearing surface of each insert with engine oil.

(2) Loosen all the main bearing caps. Install the main bearing upper inserts.

(3) Install the lower bearing inserts into the main bearing caps.

(4) Install the main bearing cap(s) and lower insert(s).

(5) Clean the rear main bearing cap (No.5) mating surfaces.

MAIN BEARING FITTING CHART

Crankshaft Journals #1 - #4		Corresponding Crankshaft Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.5025-63.4898 mm (2.5001-2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898-63.4771 mm (2.4996-2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4771-63.4644 mm (2.4991-2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4644-63.4517 mm (2.4986-2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485-63.2358 mm (2.4901-2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

Crankshaft Journals #5 Only		Corresponding Crankshaft Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.4873-63.4746 mm (2.4995-2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4746-63.4619 mm (2.4990-2.4985 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4619-63.4492 mm (2.4985-2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492-63.4365 mm (2.4980-2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333-63.2206 mm (2.4895-2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

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(6) Apply Loctite 515, or equivalent on the rear bearing cap (Fig. 6). The bead should be 3 mm (0.125 in) thick. DO NOT apply Loctite 515, or equivalent to the lip of the seal.

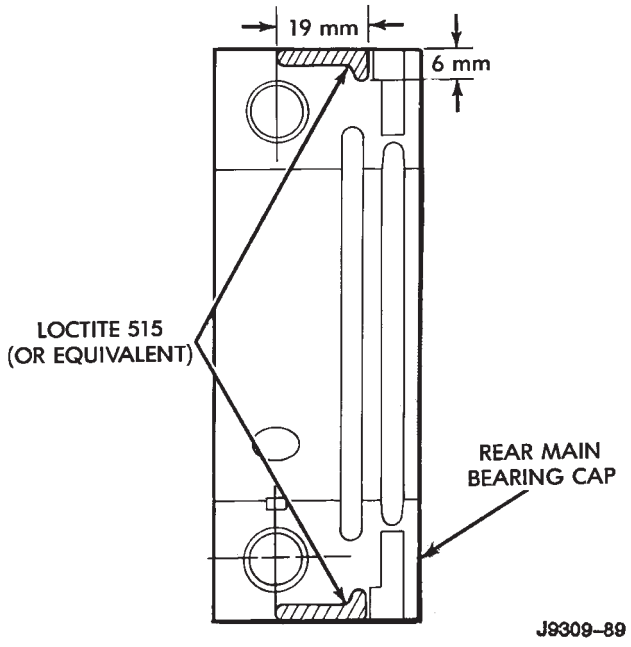

Fig. 6 Location of Loctite 515 (or equivalent)

(7) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

(8) Tighten the bolts of caps 1, 3, 4 and 5 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.

(9) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.2 to 54 N·m (40 ft. lbs.) torque. Then tighten to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

(10) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

(11) Check crankshaft end play. Crankshaft end play is controlled by the thrust bearing which is flange and installed at the No.2 main bearing position.

(a) Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.

(b) Position the dial indicator rod so that it is parallel to the center line of the crankshaft.

(c) Pry the crankshaft forward, position the dial indicator to zero.

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 7). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

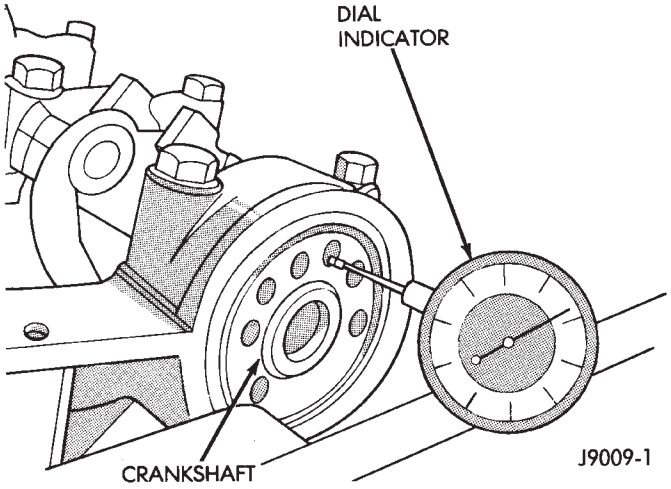

Fig. 7 Crankshaft End Play Measurement

(e) If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace the thrust bearing and measure end play. If end play is still not within specification, replace the crankshaft.

If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

(12) Install the oil pan.

(13) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(14) Lower the vehicle.

(15) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(16) Fill the oil pan with engine oil to the full mark on the dipstick level.

(17) Connect negative cable to battery.

REAR MAIN OIL SEALS

REMOVAL

(1) Remove the flywheel or converter drive plate. Discard the old bolts.

(2) Pry out the seal from around the crankshaft flange (Fig. 8).

INSTALLATION

(1) Coat the outer lip of the replacement rear main bearing seal with engine oil.

(2) Carefully position the seal into place. Use rear main Seal Installer Tool 6271 to install the seal flush with the cylinder block.

CAUTION: The felt lip must be located inside the flywheel mounting surface. If the lip is not positioned correctly the flywheel could tear the seal.

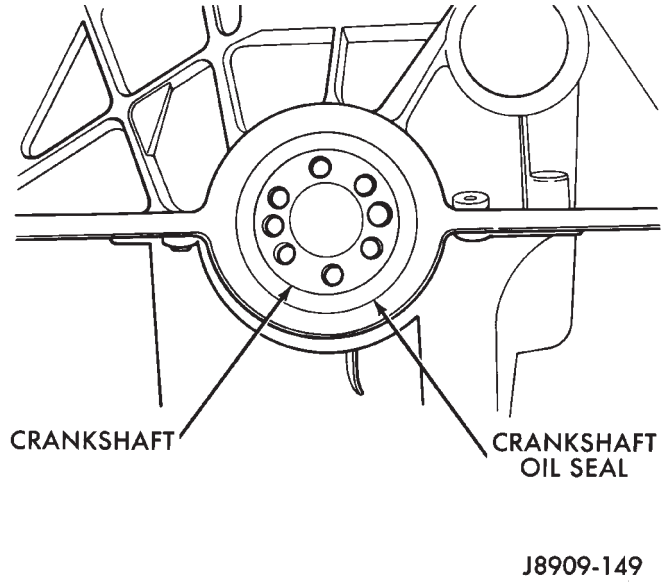

Fig. 8 Replacement of Rear Crankshaft Oil Seal

(3) Install the flywheel or converter drive plate. New bolts MUST be used when installing the flywheel or converter plate. Tighten the new bolts to 68 N·m (50 ft. lbs.) torque. Turn the bolts an additional 60°.

CYLINDER BLOCK

Remove the Engine Assembly from the vehicle.

DISASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Drain the engine oil. Remove and discard the oil filter.

(2) Remove the water pump from the cylinder block.

(3) Remove the distributor from the cylinder block.

(4) Remove the vibration damper.

(5) Remove the timing case cover and lay the cover upside down.

(6) Position a drift punch into the slot in the back of the cover and tap the old seal out.

(7) Remove the timing chain bumper.

(8) Remove the oil slinger from crankshaft.

(9) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly.

(10) Remove the camshaft.

(11) Remove the oil pan and gasket.

(12) Remove the timing chain tensioner.

(13) Remove the front and rear oil galley plugs.

(14) Remove the connecting rods and the pistons. Remove the connecting rod and piston assemblies through the top of the cylinder bores.

(15) Remove the crankshaft.

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 filter bypass hole (Fig. 9).

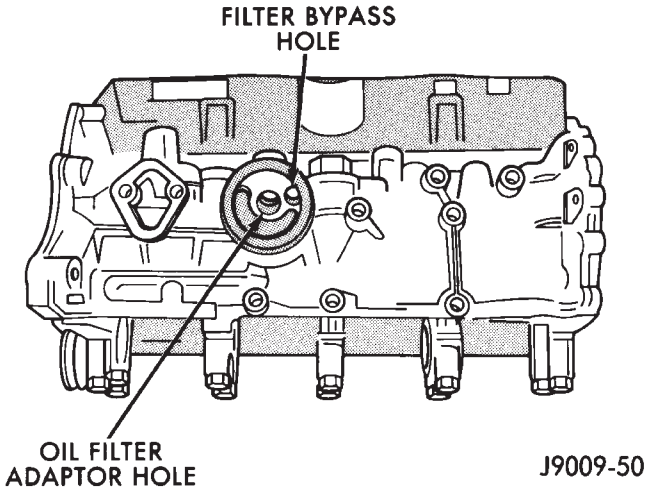

Fig. 9 Oil Filter Adaptor Hole

- The front and rear oil galley holes (Figs. 10 and 11).

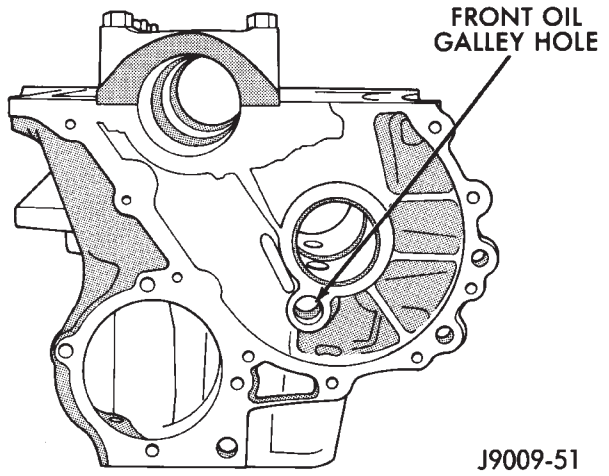

Fig. 10 Front Oil Galley Hole

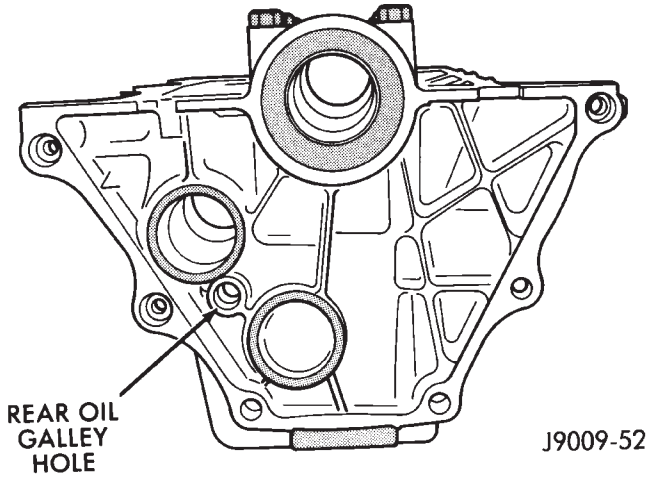

Fig. 11 Rear Oil Galley Hole

• The feed holes for the crankshaft main bearings.

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 41 N·m (30 ft. lbs.) torque.

INSPECTION—CYLINDER BORE

(1) Use a bore gauge to measure each cylinder bore diameter (Fig. 12). If a bore gauge is not available, use an inside micrometer.

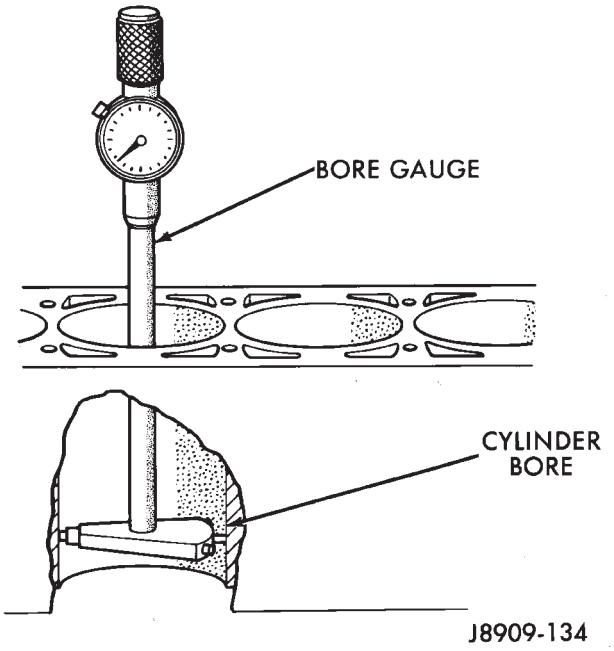

Fig. 12 Cylinder Bore Measurement

(2) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the bottom of the bore.

(3) Determine taper by subtracting the smaller diameter from the larger diameter.

(4) Rotate measuring device 120° and repeat steps above. Finally, rotate the device another 120° and repeat measurements.

(5) Determine out-of-roundness by comparing the difference between each 120° measurement.

(6) 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 must be bored and then honed to accept an oversize piston. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

HONING—CYLINDER BORE

The honing operation should be closely coordinated with the fitting of pistons and rings. This will ensure specified clearances are maintained.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

ASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Install the crankshaft.
(2) Install the connecting rods and the pistons through the top of the cylinder bores.
(3) Install the front and rear oil galley plugs.
(4) Install the timing chain tensioner.
(5) Install the camshaft.
(6) Install the sprockets and chain as an assembly.
(7) Install the oil slinger to the crankshaft.
(8) Install the timing chain bumper.
(9) Install the timing case cover seal.
(10) Install the timing case cover.
(11) Install the oil pan gasket and oil pan.
(12) Install the vibration damper.
(13) Install the water pump. Tighten the mounting bolts to 31 N·m (270 in. lbs.) torque.
(14) Remove the distributor from the cylinder block.
(15) Lubricate the oil filter seal with clean engine oil. Tighten oil filter to 18 N·m (13 ft. lbs.) torque.
(16) Install the engine into the vehicle.
(17) Fill the engine with clean lubrication oil (refer to Group 0, Lubrication and Maintenance).
(18) Fill the cooling system (refer to Group 7, Cooling System for the proper procedures).

SPECIFICATIONS

ENGINE SPECIFICATIONS

Camshaft

Hydraulic Tappet Clearance	Zero Lash
Bearing Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Bearing Journal Diameter	
No.1	51.54 - 51.56 mm (2.029 - 2.030 in)
No.2	51.28 - 51.31 mm (2.019 - 2.020 in)
No.3	51.03 - 51.05 mm (2.009 - 2.010 in)
No.4	50.78 - 50.80 mm (1.999 - 2.000 in)
Base Circle Runout	0.03 mm - max. (0.001 in - max.)
Camshaft Lobe Lift	6.731 mm (0.265 in)
Valve Lift	10.77 mm (0.424 in)
Intake Valve Timing	
Opens	16°BTDC
Closes	74°ABDC
Exhaust Valve Timing	
Opens	60°BBDC
Closes	30°ATDC
Valve Overlap	46°
Intake Duration	270°
Exhaust Duration	270°

Crankshaft

End Play	0.038 - 0.165 mm (0.0015 - 0.0065 in)
Main Bearing Journal Dia	63.489 - 63.502 mm (2.4996 - 2.5001 in)
Main Bearing Journal Width	
No.1	27.58 - 27.89 mm (1.086 - 1.098 in)
No.2	32.28 - 32.33 mm (1.271 - 1.273 in)
No.3-4-5	30.02 - 30.18 mm (1.182 - 1.188 in)
Main Bearing Clearance	0.03 - 0.06 mm (0.001 - 0.0025 in)
Preferred	0.051 mm (0.002 in)
Connecting Rod Journal Dia	53.17 - 53.23 mm (2.0934 - 2.0955 in)
Connecting Rod Journal Width	27.18 - 27.33 mm (1.070 - 1.076 in)
Out-of-Round (Max. All Journals)	0.013 mm (0.0005 in)
Taper (Max. - All Journals)	0.013 mm (0.0005 in)

Cylinder Block

Deck Height	236.73 mm (9.320 in)
Deck Clearance	0.000 mm (0.000 in)
Cylinder Bore Diameter	
Standard	98.45 - 98.48 mm (3.8759 - 3.8775 in)
Taper (Max.)	0.025 mm (0.001 in)
Out-of-Round (Max.)	0.025 mm (0.001 in)
Tappet Bore Diameter	23.000 - 23.025 mm (0.9055 - 0.9065 in)
Flatness	0.03 mm per 25 mm (0.001 in per 1 in) 0.05 mm per 152 mm (0.002 in per 6 in) 0.20 mm - max. for total length (0.008 in - max. for total length)
Main Bearing Bore Dia	68.3514 - 68.3768 mm (2.691 - 2.692 in)

Connecting Rods

Total Weight (Less Bearing)	657 - 665 grams (23.17 - 23.45 oz)
Length (Center-to-Center)	155.52 - 155.62 mm (6.123 - 6.127 in)
Piston Pin Bore Diameter	23.59 - 23.62 mm (0.9288 - 0.9298 in)
Bore (Less Bearings)	56.08 - 56.09 mm (2.2080 - 2.2085 in)
Bearing Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Preferred	0.044 - 0.050 mm (0.0015 - 0.0020 in)
Side Clearance.	0.25 - 0.48 mm (0.010 - 0.019 in)
Twist (Max.)	0.001 mm per mm (0.001 in per in)
Bend (Max.)	0.001 mm per mm (0.001 in per in)

Cylinder Compression Pressure

Ratio	9.1:1
Pressure Range	827 - 1 034 kPa (120 - 150 psi)
Max. Variation Between Cylinders	206 kPa (30 psi)

ENGINE SPECIFICATIONS (CONT.)

Cylinder Head

Combustion Chamber	49.9 - 52.9 cc (3.04 - 3.23 cu. in.)
Valve Guide I.D. (Integral)	7.95 - 7.97 mm (0.313 - 0.314 in)
Valve Stem-to-Guide Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Intake Valve Seat Angle	44.5°
Exhaust Valve Seat Angle	44.5°
Valve Seat Width	1.02 - 1.52 mm (0.040 - 0.060 in)
Valve Seat Runout	0.064 mm (0.0025 in)
Flatness	0.03 mm per 25 mm (0.001 in per 1 in) 0.05 mm per 152 mm (0.002 in per 6 in) 0.20 mm - max. for total length (0.008 in - max. for total length)

Rocker Arms, Push Rods & Tappets

Rocker Arm Ratio	1.6:1
Push Rod Length	241.300 - 241.808 mm (9.500 - 9.520 in)
Push Rod Diameter	7.92 - 8.00 mm (0.312 - 0.315 in)
Hydraulic Tappet Diameter	22.962 - 22.974 mm (0.904 - 0.9045 in)
Tappet-to-Bore Clearance	0.025 - 0.063 mm (0.001 - 0.0025 in)

Valves

Length (Tip - to - Gauge Dimension Line)	
Intake	124.435 - 125.070 mm (4.899 - 4.924 in)
Exhaust	125.120 - 125.755 mm (4.927 - 4.952 in)
Valve Stem Diameter	7.899 - 7.925 mm (0.311 - 0.312 in)
Stem-to-Guide Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Valve Head Diameter	
Intake	48.387 - 48.641 mm (1.905 - 1.915 in)
Exhaust	37.973 - 38.227 mm (1.495 - 1.505 in)
Valve Face Angle	
Intake	45°
Exhaust	45°
Tip Refinishing (Max. Allowable)	0.25 mm (0.010 in)

Valve Springs

Free Length (Approx.)	49.962 mm (1.967 in)
Spring Tension	
Valve Closed	360 - 396 N @ 41.656 mm (81 - 89 lbf @ 1.640 in)
Valve Open	845 - 934 N @ 30.886 mm (190 - 210 lbf @ 1.216 in)
Inside Diameter	24.08 - 24.59 mm (0.948 - 0.968 in)

Pistons

Weight (Less Pin)	563 - 567 grams (19.86 - 20.00 oz)
Piston Pin Bore (Centerline-to-Piston Top)	40.61 - 40.72 mm (1.599 - 1.603 in)
Piston-to-Bore Clearance	0.033 - 0.053 mm (0.0013 - 0.0021 in)
Preferred	0.033 - 0.038 mm (0.0013 - 0.0015 in)
Piston Ring Gap Clearance	
Compression Rings	0.25 - 0.51 mm (0.010 - 0.020 in)
Oil Control Steel Rails	0.381 - 1.397 mm (0.015 - 0.055 in)
Piston Ring Side Clearance	
Compression Rings	0.025 - 0.081 mm (0.001 - 0.0032 in)
Preferred	0.025 mm (0.001 in)
Oil Control Ring	0.025 - 0.216 mm (0.001 - 0.0085 in)
Preferred	0.08 mm (0.003 in)
Piston Ring Groove Height	
Compression Rings	2.019 - 2.045 mm (0.0795 - 0.0805 in)
Oil Control Ring	4.78 - 4.80 mm (0.1880 - 0.1895 in)
Piston Ring Groove Diameter	
Compression Rings	87.78 - 87.90 mm (3.456 - 3.461 in)
Oil Control Ring	87.50 - 87.75 mm (3.445 - 3.455 in)
Piston Pin Bore Diameter	23.647 - 23.655 mm (0.9310 - 0.9313 in)
Piston Pin Diameter	23.637 - 23.640 mm (0.9306 - 0.9307 in)
Piston-to-Pin Clearance	0.0076 - 0.0178 mm (0.0003 - 0.0007 in)
Preferred	0.015 mm - Loose (0.0006 in - Loose)
Piston-to-Pin Connecting Rod (Press Fit)	8.9 kN (2000 lb f)

ENGINE SPECIFICATIONS (CONT.)

Oil Pump

Gear-to-Body Clearance (Radial)	0.051 - 0.102 mm (0.002 - 0.004 in)
Preferred	0.051 mm (0.002 in)
Gear End Clearance	
Plastigage	0.051 - 0.152 mm (0.002 - 0.006 in)
Preferred	0.051 mm (0.002 in)
Feeler Gauge	0.1016 - 0.2032 mm (0.004 - 0.008 in)
Preferred	0.1778 mm (0.007 in)

Oil Pressure

Min. Pressure (600 rpm)	89.6 kPa (13 psi)
At Idle Speed (800 rpm)	172 - 241 kPa (25 - 35 psi)
At 1600 rpm & higher	255 - 517 kPa (37 - 75 psi)
Oil Pressure Relief	517 kPa (75 psi)

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TORQUE SPECIFICATIONS

Description	Torque
A/C Compressor Bracket-to-Engine Bolts	34 N•m (25 ft. lbs.)
A/C Compressor Mounting Bolts	27 N•m (20 ft. lbs.)
A/C Low Pressure Service Valve Nut	38 N•m (28 ft. lbs.)
Block Heater Nut	1.8 N•m (16 in. lbs.)
Camshaft Sprocket Bolt	108 N•m (80 ft. lbs.)
Connecting Rod Nuts	45 N•m (33 ft. lbs.)
Converter Plate Bolts	68 N•m (50 ft. lbs.) +60° (+60°)
Cylinder Block Drain Plugs	41 N•m (30 ft. lbs.)
Cylinder Head Bolts	
(#1–10 & #12–14)	149 N•m (110 ft. lbs.)
(#11)	135 N•m (100 ft. lbs.)
Cylinder Head Cover Bolts	10 N•m (85 in. lbs.)
Drive Plate-to-Torque Converter Bolts	54 N•m (40 ft. lbs.)
Engine Shock Damper Stud Nuts	23 N•m (17 ft. lbs.)
Engine Mounts—Front	
Engine Support Bracket Bolts (XJ)	61 N•m (45 ft. lbs.)
Stud Nuts (XJ—Right Side)	46 N•m (34 ft. lbs.)
Bolts (YJ)	62 N•m (46 ft. lbs.)
Support Cushion	
Nuts (XJ—Right Side)	65 N•m (48 ft. lbs.)
Bolts/Nuts (XJ—Left Side)	41 N•m (30 ft. lbs.)
Bolts/Nuts (YJ)	52 N•m (38 ft. lbs.)
Support Cushion Bracket—(XJ)	
Bolts	54 N•m (40 ft. lbs.)
Stud Nuts	41 N•m (30 ft. lbs.)
Support Cushion Thru-Bolt	
XJ Vehicles	65 N•m (48 ft. lbs.)
YJ Vehicles	69 N•m (51 ft. lbs.)
Engine Mount—Rear	
Crossmember-to-Sill Bolts (XJ-Automatic)	41 N•m (30 ft. lbs.)
Skid Plate/Support Cushion Stud Nuts (YJ)	54 N•m (40 ft. lbs.)
Skid Plate-to-Sill Bolts (YJ)	88 N•m (65 ft. lbs.)
Support Cushion/Crossmember Nuts (XJ)	22 N•m (192 in. lbs.)
Support Cushion/Support Bracket Nuts (XJ Manual)	46 N•m (34 ft. lbs.)
Support Cushion/Torque Arm Bracket Nuts (YJ-Automatic)	54 N•m (40 ft. lbs.)
Torque Arm Bracket Bolts (YJ-Automatic)	54 N•m (40 ft. lbs.)

Description	Torque
Engine Mount—Rear (Cont.)	
Torque Arm Bracket/Support Cushion Bolts (YJ-Manual)	54 N•m (40 ft. lbs.)
Transmission Support Bracket Bolts (XJ-Manual)	43 N•m (32 ft. lbs.)
Transmission Support Bracket/Support Cushion Bolts (XJ 4WD Automatic)	75 N•m (55 ft. lbs.)
Transmission Support Adaptor Bracket Bolts (XJ 2WD Auto)	75 N•m (55 ft. lbs.)
Exhaust Manifold/Pipe Nuts	27 N•m (20 ft. lbs.)
Flywheel/Converter Housing Bolts	38 N•m (28 ft. lbs.)
Flywheel/Crankshaft Bolts	143 N•m (105 ft. lbs.)
Front Cover-to-Block Bolts (1/4-20)	7 N•m (60 in. lbs.)
Front Cover-to-Block Bolts (5/16-18)	22 N•m (192 in. lbs.)
Fuel Pump Bolts	22 N•m (16 ft. lbs.)
Generator Adjusting Bolt	24 N•m (18 ft. lbs.)
Generator Pivot Bolt/Nut	38 N•m (28 ft. lbs.)
Generator Mounting Bracket-to-Engine Bolts	38 N•m (28 ft. lbs.)
Generator Mounting/Head Bolts	45 N•m (33 ft. lbs.)
Main Bearing Bolts	108 N•m (80 ft. lbs.)
Oil Filter	18 N•m (13 ft. lbs.)
Oil Filter Connector	54 N•m (40 ft. lbs.)
Oil Galley Plug	41 N•m (30 ft. lbs.)
Oil Pan Bolts (1/4-20)	14 N•m (129 in. lbs.)
(5/16-18)	18 N•m (156 in. lbs.)
Oil Pan Drain Plug	34 N•m (25 ft. lbs.)
Oil Pump Attaching Bolts	
Short Bolts	14 N•m (10 ft. lbs.)
Long Bolts	23 N•m (17 ft. lbs.)
Oil Pump Cover Bolts	8 N•m (70 in. lbs.)
Power Steering Pump Pressure Hose Nut	52 N•m (38 ft. lbs.)
Rocker Arm Assembly-to-Cylinder Head Capscrews	28 N•m (21 ft. lbs.)
Spark Plugs	37 N•m (27 ft. lbs.)
Starting Motor Mounting Bolts	45 N•m (33 ft. lbs.)
Thermostat Housing	18 N•m (13 ft. lbs.)
Vibration Damper Bolts	108 N•m (80 ft. lbs.)
Water Pump/Block Bolts	31 N•m (270 in. lbs.)

J9409-43

4.0L ENGINE SERVICE PROCEDURES

INDEX

GENERAL INFORMATION

The 4.0 Liter (242 CID) six-cylinder engine is an In-line, lightweight, overhead valve engine (Fig. 1).

Engine Type	In-line 6 Cylinder
Bore and Stroke	98.4×87.4mm (3.88×3.44 in.)
Displacement	4.0L (242 cu. in.)
Compression Ratio	8.7:1
Torque	
(XJ Vehicles)	305 N·m (225 ft. lbs.) @ 4000 rpm
(YJ Vehicles)	298 N·m (220 ft. lbs.) @ 4000 rpm
Firing Order	1–5–3–6–2–4
Lubrication	Pressure Feed—Full Flow Filtration
Engine Oil Capacity	5.7L (6 Quarts)
Cooling System	Liquid Cooled—Forced Circulation
Cooling System Capacity	
(XJ Vehicles)	11.4L (12 Quarts)
(YJ Vehicles)	9.9L (10.5 Quarts)
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron
Cylinder Head	Cast Iron
Camshaft	Cast Iron
Pistons	Aluminum Alloy (with Struts)
Pistons Combustion Cavity	Double Quench
Connecting Rods	Cast Iron

J9409-22

Fig. 1 Engine Description

This engine is designed for unleaded fuel.

The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in good fuel economy.

The cylinders are numbered 1 through 6 from front to rear. The firing order is 1-5-3-6-2-4 (Fig. 2).

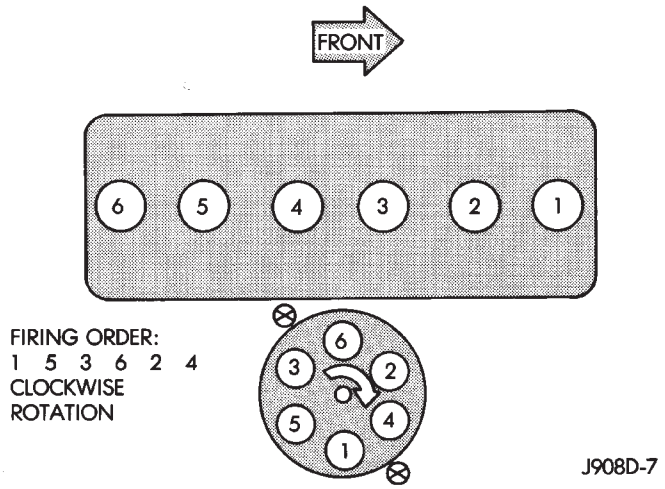

Fig. 2 Engine Firing Order

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within seven main bearings. The camshaft rotates within four bearings.

BUILD DATE CODE

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.2 and No.3 cylinders (Fig. 3).

The digits of the code identify:

(1) 1st Digit—The year (4 = 1994).

(2) 2nd & 3rd Digits—The month (01 - 12).

(3) 4th & 5th Digits—The engine type/fuel system/compression ratio (MX = A 4.0 Liter (242 CID) 8.7:1 compression ratio engine with a multi-point fuel injection system).

(4) 6th & 7th Digits—The day of engine build (01 - 31).

FOR EXAMPLE: Code * 401MX12 * identifies a 4.0 liter (242 CID) engine with a multi-point fuel injection system, 8.7:1 compression ratio and built on January 12, 1994.

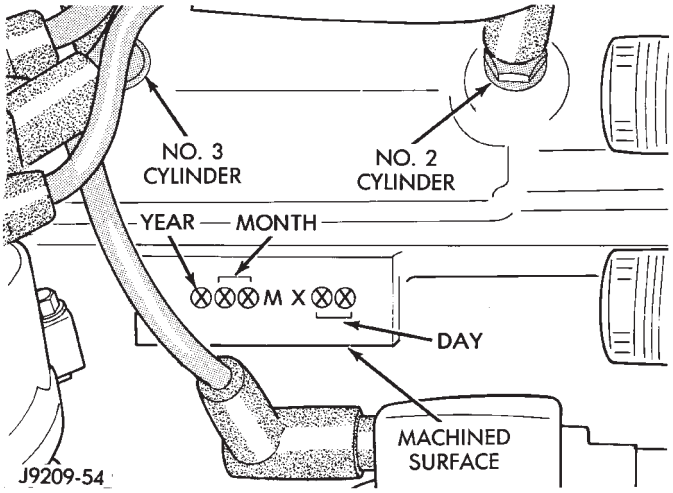

Fig. 3 Build Date Code Location

OVERSIZE AND UNDERSIZE COMPONENT CODES

Some engines may be built with oversize or undersize components such as:

- Oversize cylinder bores.
- Oversize camshaft bearing bores.
- Undersize crankshaft main bearing journals.
- Undersize connecting rod journals.

These engines are identified by a letter code (Fig. 4) stamped on a boss between the ignition coil and the distributor (Fig. 5).

CODE	COMPONENT	UNDERSIZE
P	One or more connecting rod bearing journals	0.254 mm (0.010 in)
M	All crankshaft main bearing journals	0.254 mm (0.010 in)
PM	All crankshaft main bearing journals and one or more connecting rod journals	0.254 mm (0.010 in)
CODE	**COMPONENT**	**OVERSIZE**
B	All cylinder bores	0.254 mm (0.010 in)
C	All camshaft bearing bores	0.254 mm (0.010 in)

J8909-54

Fig. 4 Oversize and Undersize Component Codes

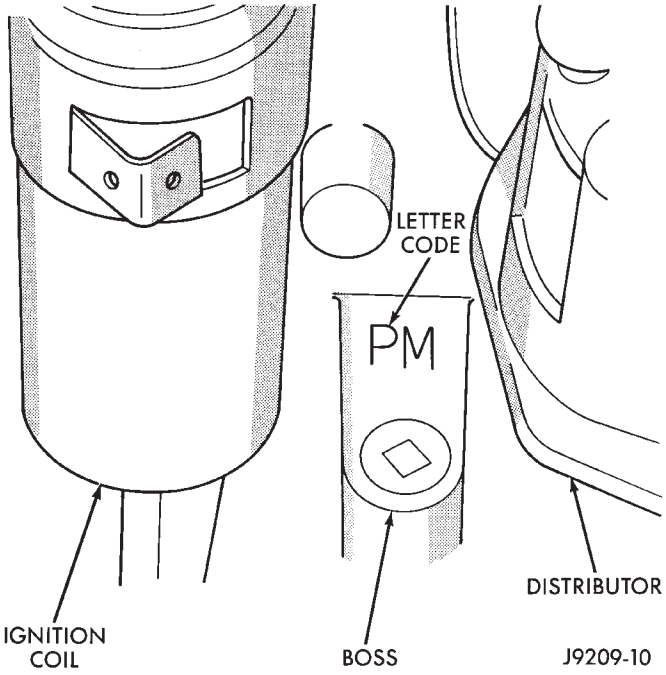

Fig. 5 Oversize and Undersize Component Code Location

ENGINE MOUNTS—FRONT

The front mounts support the engine at each side. These supports are made of resilient rubber.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise the vehicle.
(3) Support the engine.
(4) Remove the nut from the through bolt (Figs. 6 and 7). DO NOT remove the through bolt.
(5) Remove the retaining bolts/nuts from the support cushions (Figs. 6 and 7).
(6) Remove the through bolt.
(7) Remove the support cushions.

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Figs. 6 and 7). Tighten the engine support bracket bolts:

- XJ Vehicles—61 N·m (45 ft. lbs.) torque.
- YJ Vehicles—62 N·m (46 ft. lbs.) torque.

(2) ON XJ VEHICLES, if the support cushion bracket was removed, position the bracket onto the lower front sill (Fig. 8). Install support cushion bracket bolts/nuts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque. Tighten the nuts to 41 N·m (30 ft. lbs.) torque.
(3) Place the support cushion into position on the support cushion bracket (Figs. 6 and 7). Install and tighten the bolts/nuts:

- XJ Vehicles—41 N·m (30 ft. lbs.) torque.
- YJ Vehicles—52 N·m (38 ft. lbs.) torque.

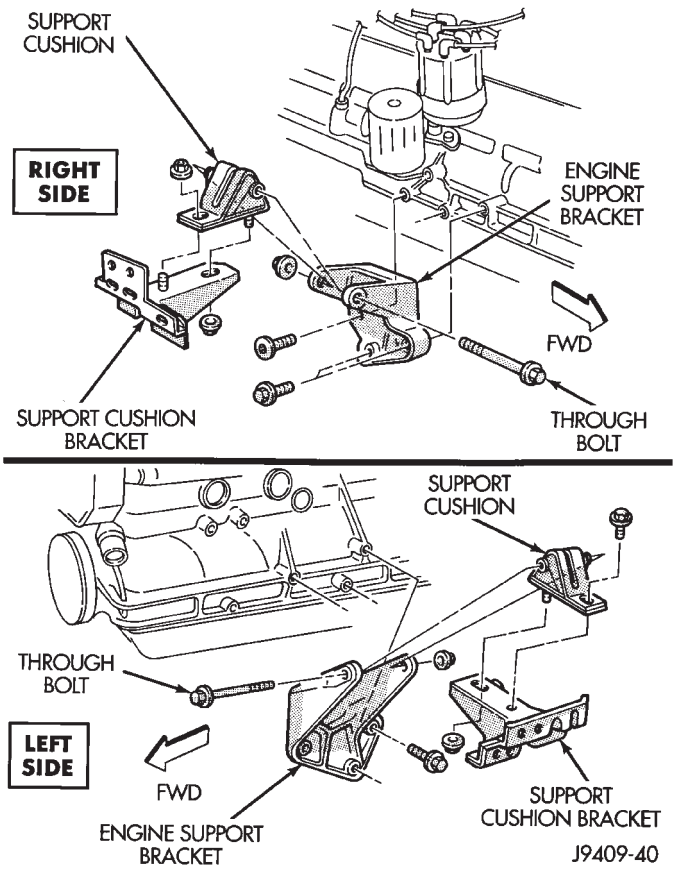

Fig. 6 Front Mounts—XJ Vehicles

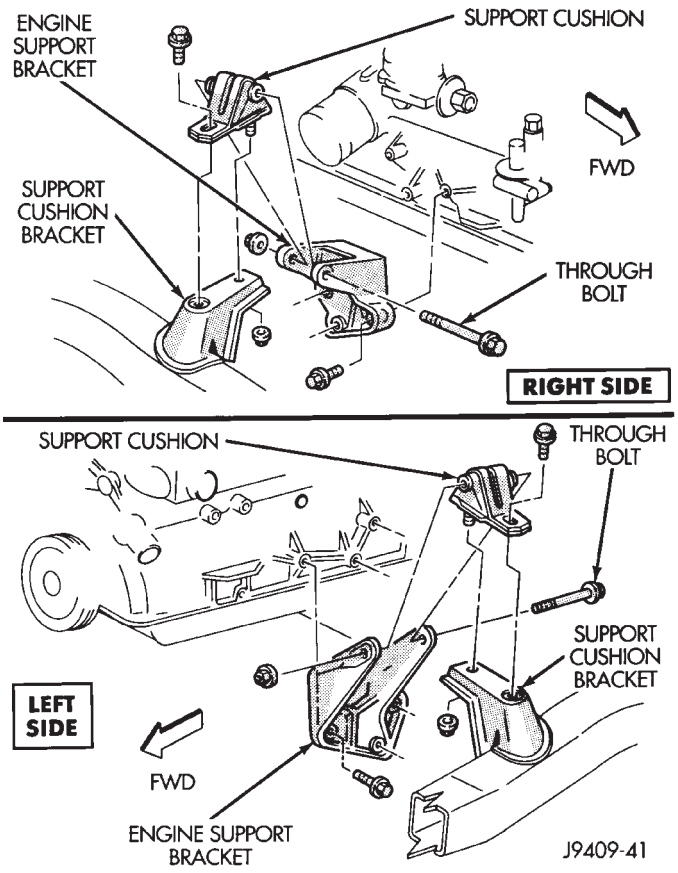

Fig. 7 Front Mounts—YJ Vehicles

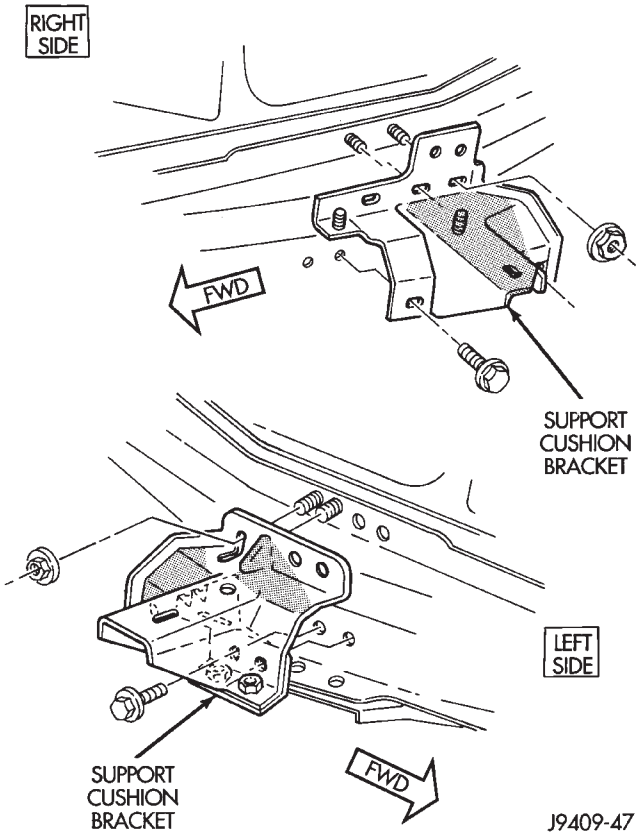

Fig. 8 Support Cushion Bracket—XJ Vehicles

(4) Install the through bolt and the retaining nut (Figs. 6 and 7). Tighten the through bolt nut:

- XJ Vehicles—65 N·m (48 ft. lbs.) torque.
- YJ Vehicles—69 N·m (51 ft. lbs.) torque.

(5) Remove the engine support.

(6) Lower the vehicle.

(7) Connect negative cable to battery.

ENGINE MOUNT—REAR

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

REMOVAL—XJ VEHICLES

(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 (Figs. 9 and 10). Remove the crossmember.

(4) **MANUAL TRANSMISSION (Fig. 9):**

(a) Remove the support cushion nuts and remove the cushion.

(b) Remove the transmission support bracket bolts and remove the bracket from the transmission.

(5) **AUTOMATIC TRANSMISSION (Fig. 10):**

(a) Remove the support cushion bolts and remove the cushion and the support bracket from the transmission (4WD) or from the adaptor bracket (2WD).

(b) On 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission (Fig. 10). Remove the adaptor bracket.

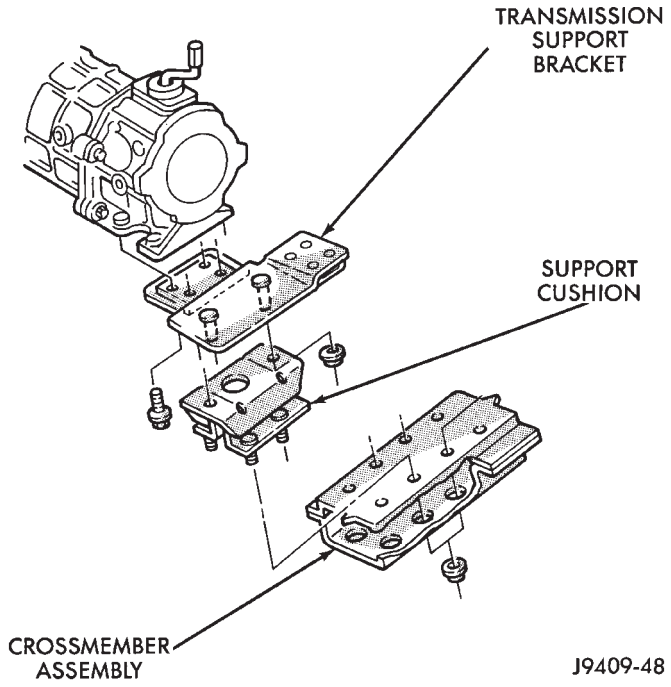

Fig. 9 Rear Mount—XJ Vehicles (Manual Transmission)

INSTALLATION—XJ VEHICLES

(1) **MANUAL TRANSMISSION:**

(a) Install the transmission support bracket to the transmission. Install the bolts and tighten to 46 N·m (34 ft. lbs.) torque.

(b) Install the support cushion to the support bracket. Install the nuts and tighten to 75 N·m (55 ft. lbs.) torque.

(2) **AUTOMATIC TRANSMISSION:**

(a) 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.

(b) 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.

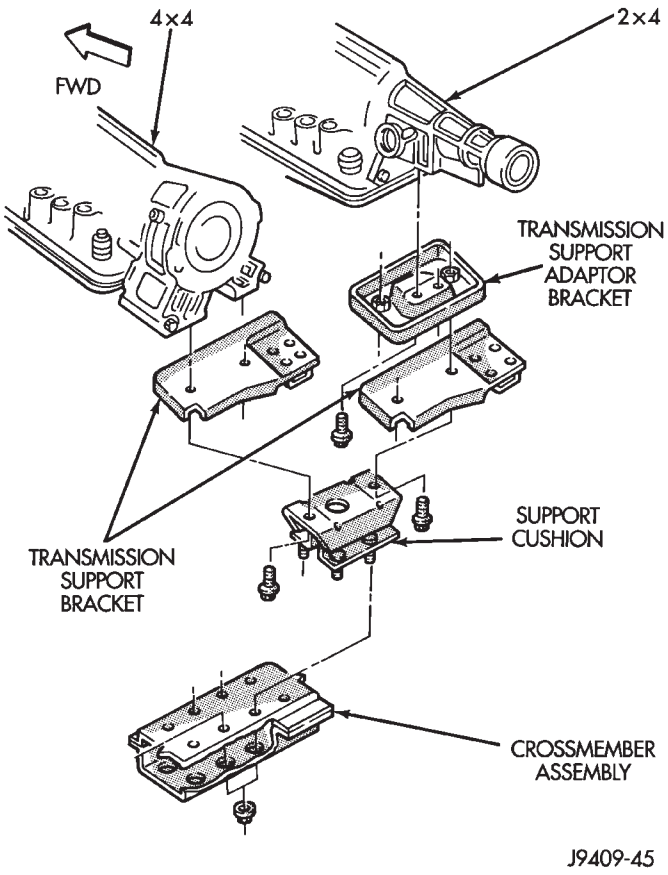

Fig. 10 Rear Mount—XJ Vehicles (Automatic Transmission)

REMOVAL—YJ VEHICLES

(1) Disconnect negative cable from battery.

(2) Raise the vehicle and support the transmission.

(3) **MANUAL TRANSMISSION (Fig. 11):**

(a) Remove the nuts holding the support cushion and the insulator to the skid plate. Remove the upper nut from the insulator stud.

(b) Remove the skid plate bolts and the skid plate. Remove the insulator stud assembly.

(c) Remove the support cushion nuts. Remove the support cushion from the torque arm bracket.

(d) Remove the torque arm bracket bolts and remove the bracket from the transmission.

(4) **AUTOMATIC TRANSMISSION (Fig. 12):**

(a) Remove the nuts holding the support cushion to the skid plate. Remove the skid plate.

(b) Remove the bolts and nuts holding the support cushion to the torque arm bracket. Remove the support cushion.

(c) Remove the bolts holding the torque arm bracket to the transmission. Remove the torque arm bracket.

INSTALLATION—YJ VEHICLES

(1) **MANUAL TRANSMISSION:**

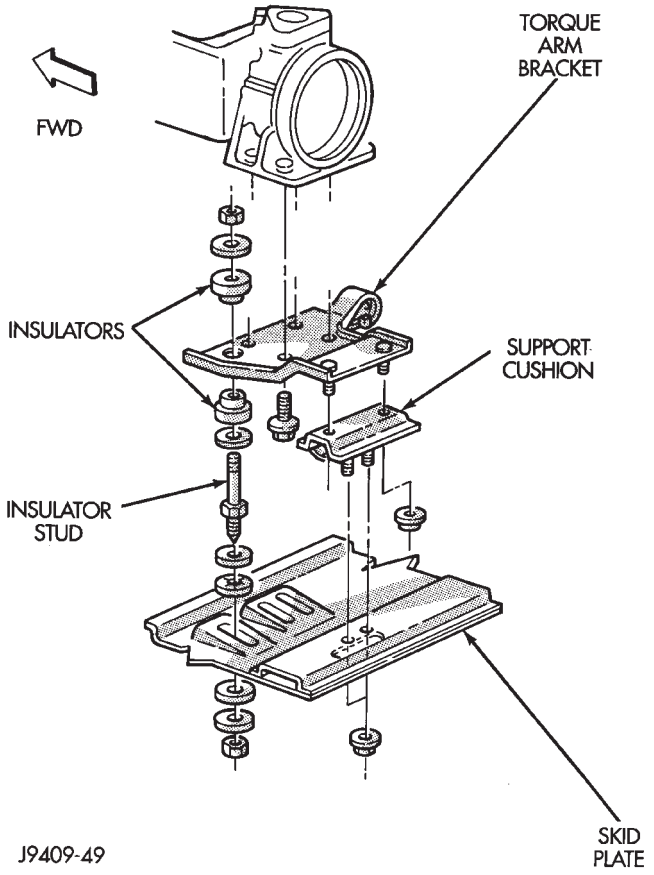

Fig. 11 Rear Mount—YJ Vehicles (Manual Transmission)

(a) Position the torque arm bracket to the transmission. Install the bolts and tighten to 54 N·m (40 ft. lbs.) torque.

(b) Position the support cushion onto the torque arm bracket. Install the nuts and tighten to 54 N·m (40 ft. lbs.) torque.

(c) Position the insulator stud assembly and upper nut (Fig. 11). Position the skid plate to the studs of the support cushion and the insulator stud (Fig. 11). Install the support cushion stud nuts and tighten to 54 N·m (40 ft. lbs.) torque. Install the lower stud nut and tighten the upper and lower insulator stud nuts to 41 N·m (30 ft. lbs.) torque.

(2) **AUTOMATIC TRANSMISSION:**

(a) Position the torque arm bracket to the transmission. Install the bolts and tighten to 54 N·m (40 ft. lbs.) torque.

(b) Position the support cushion onto the torque arm bracket. Install the bolts/nuts and tighten to 54 N·m (40 ft. lbs.) torque.

(c) Position the skid plate to the studs of the support cushion and install the nuts. Tighten the support cushion stud nuts to 54 N·m (40 ft. lbs.) torque.

(3) Install the skid plate bolts to the sill and tighten to 88 N·m (65 ft. lbs.) torque.

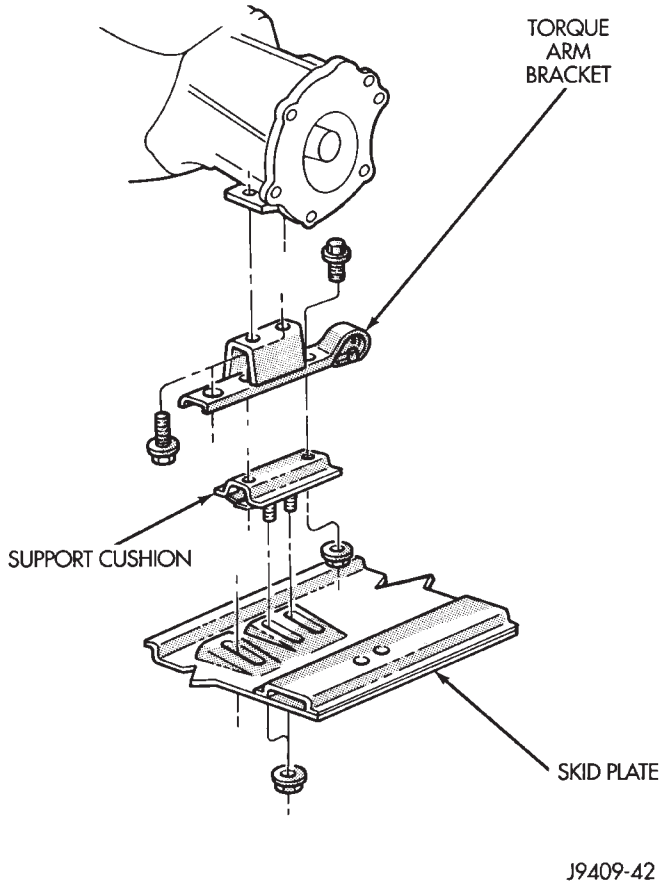

Fig. 12 Rear Mount—YJ Vehicles (Automatic Transmission)

(4) Remove the transmission support.

(5) Lower the vehicle.

(6) Connect negative cable to battery.

ENGINE ASSEMBLY—XJ VEHICLES

REMOVAL

(1) Disconnect the battery cables. Remove the battery.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Remove the lower radiator hose.

(5) Remove the upper radiator hose and coolant recovery hose (Fig. 13).

(6) Remove upper radiator support retaining bolts and remove radiator support.

(7) Remove the fan shroud (Fig. 13) and electric cooling fan.

(8) Disconnect the transmission fluid cooler tubing (automatic transmission).

(9) Disconnect radiator fan switch wire connector.

(10) **Vehicles with Air Conditioning:**

(a) Discharge the A/C condenser.

(b) Remove the service valves and cap the compressor ports.

(11) Remove the radiator or radiator/condenser (if equipped with A/C).

(12) Remove the fan assembly from the idler pulley.

(13) Disconnect the heater hoses at the engine thermostat housing and water pump (Figs. 13 and 14).

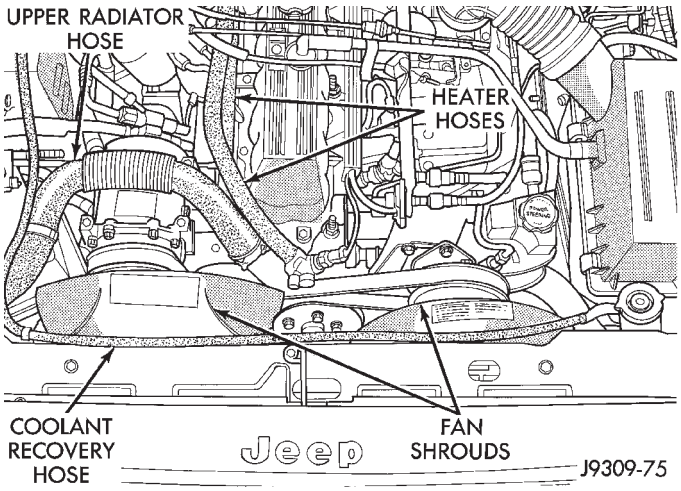

Fig. 13 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Heater hoses

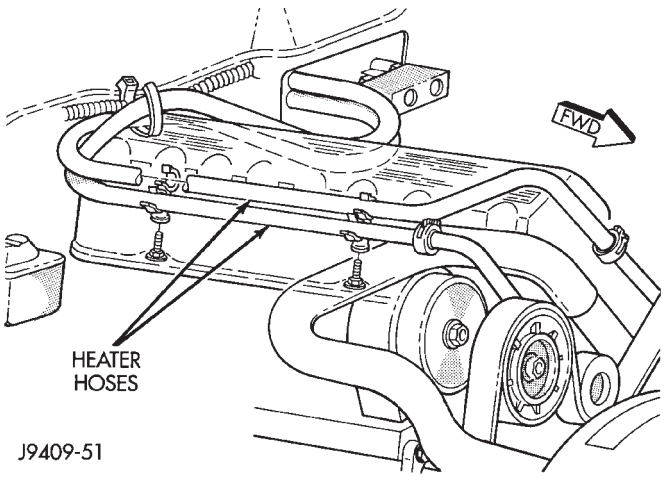

Fig. 14 Heater Hoses (RH Drive Vehicle)

(14) Disconnect the throttle linkages (Fig. 15).

(15) Disconnect the speed control cable (if equipped)—(Fig. 15).

(16) Disconnect the line pressure cable (if equipped with automatic transmission).

(17) Disconnect injection system wire harness connector at the dash panel.

(18) Disconnect the distributor electrical connection and the oil pressure switch connector.

(19) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the two retaining tabs against the fuel tube (Fig. 15). Pull the fuel tube and retainer from the quick-connect fitting (refer to Group 14, Fuel System for the proper procedure).

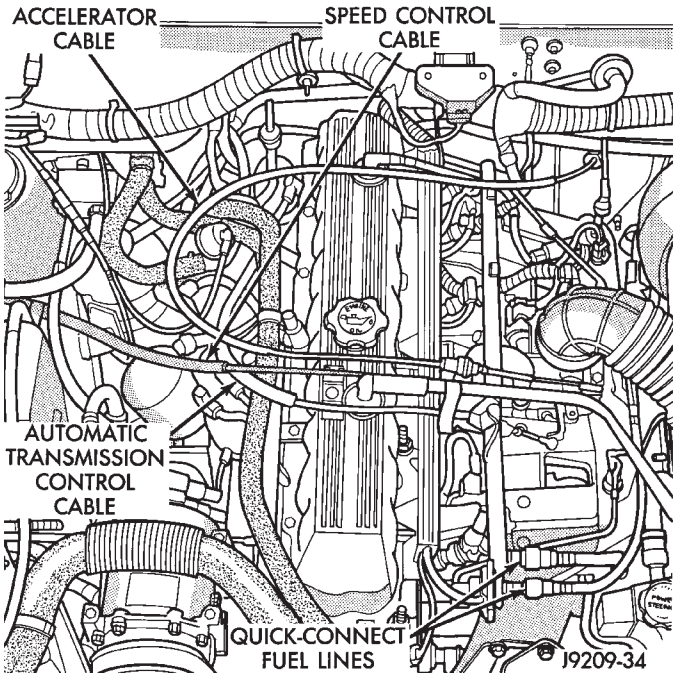

Fig. 15 Accelerator Cable, Speed Control Cable, Automatic Transmission Control Cable & Quick-Connect Fuel Lines

(20) Remove the fuel line bracket from the intake manifold.

(21) Remove the air cleaner assembly (Fig. 16).

(22) Remove the power brake vacuum check valve from the booster, if equipped.

(23) If equipped with power steering (Fig. 16):

(a) Disconnect the hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(24) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(25) Raise and support the vehicle.

(26) Disconnect the wires from the starter motor solenoid.

(27) Remove the starter motor.

(28) Disconnect the exhaust pipe from the manifold.

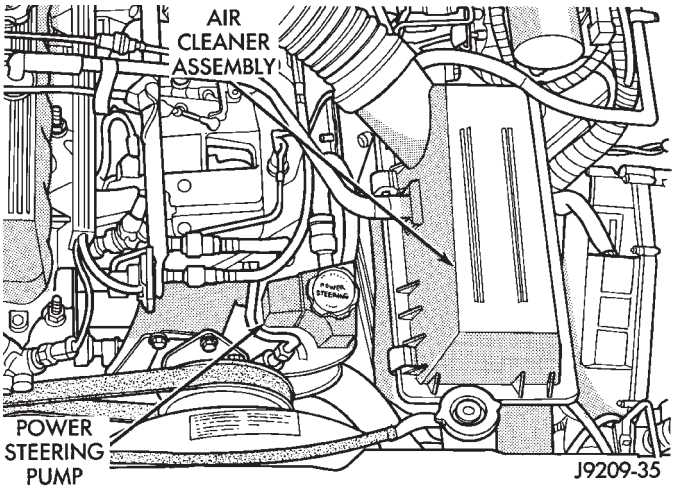

Fig. 16 Air Cleaner Assembly & Power Steering Pump

(29) Disconnect the engine speed sensor wire connection.

(30) Remove the exhaust pipe support.

(31) Remove the flywheel/converter housing access cover.

(32) **Vehicles with Automatic Transmission:**

(a) Mark the converter and drive plate location.

(b) Remove the converter-to-drive plate bolts.

(33) Remove the upper flywheel/converter housing bolts and loosen the bottom bolts.

(34) Remove the engine mount cushion-to-engine compartment bracket bolts.

(35) Lower the vehicle.

(36) Attach a lifting device to the engine.

(37) Raise the engine off the front supports.

(38) Place a support or floor jack under the converter (or flywheel) housing.

(39) Remove the remaining converter (or flywheel) housing bolts.

(40) Lift the engine out of the engine compartment.

INSTALLATION

CAUTION: When installing the engine into a vehicle equipped with an automatic transmission, be careful not to damage the trigger wheel on the flywheel.

(1) Attach a lifting device to the engine and lower the engine into the engine compartment. For easier installation, it may be necessary to remove the engine mount cushions from the engine mount bracket as an aide in alignment of the engine to the transmission.

(2) **Vehicles with Manual Transmission:**

(a) Insert the transmission shaft into the clutch spline.

(b) Align the flywheel housing with the engine.

(c) Install and tighten the flywheel housing lower bolts finger tight.

(3) **Vehicles with Automatic Transmission:**

(a) Align the transmission torque converter housing with the engine.

(b) Loosely install the converter housing lower bolts and install the next higher bolt and nut on each side.

(c) Tighten all 4 bolts finger tight.

(4) Install the engine mount cushions (if removed).

(5) Lower the engine and engine mount cushions onto the engine compartment brackets. Install the bolts and finger tighten the nuts.

(6) Remove the engine lifting device.

(7) Raise and support the vehicle.

(8) Install the remaining flywheel/converter housing bolts. Tighten all bolts to 38 N·m (28 ft. lbs.) torque.

(9) **Vehicles with Automatic Transmission:**

(a) Install the converter-to-drive plate bolts.

(b) Ensure the installation reference marks are aligned.

(10) Install the flywheel/converter housing access cover.

(11) Install the exhaust pipe support and tighten the screw.

(12) Tighten the engine mount-to-bracket bolts.

(13) Connect the engine speed sensor wire connections and tighten the screws.

(14) Connect the exhaust pipe to the manifold.

(15) Install the starter motor and connect the cable.

(16) Connect the wires to the starter motor solenoid.

(17) Lower the vehicle.

(18) Connect all the vacuum hoses and wire connectors identified during engine removal.

(19) If equipped with power steering:

(a) Remove the protective caps

(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(c) Fill the pump reservoir with fluid.

(20) Install the power brake vacuum check valve to the booster, if equipped.

(21) Connect the fuel inlet and return hoses at the fuel rail. Verify that the quick-connect fitting assembly fits securely over the fuel lines by giving the fuel lines a firm tug.

(22) Install the fuel line bracket to the intake manifold.

(23) Connect the distributor electrical connector and oil pressure switch connector.

(24) Connect the injection system wire harness connector on the dash panel.

(25) Connect the line pressure cable (if equipped with automatic transmission).

(26) Connect the speed control cable, if equipped.

(27) Connect the throttle cable linkages.

(28) Connect the heater hoses at the engine thermostat housing and water pump.
(29) Install the fan assembly to the idler pulley.
(30) Install the radiator or radiator/condenser (if equipped with A/C).
(31) Connect the service valves to the A/C compressor ports, if equipped with A/C.
(32) Charge the air conditioner system.
(33) Connect radiator fan switch wire.
(34) Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped.
(35) Install the fan shroud, electric cooling fan and radiator/condenser (if equipped with A/C).
(36) Install upper radiator support.
(37) Connect the upper radiator hose and tighten the clamp.
(38) Connect the lower radiator hose and tighten the clamp.
(39) Fill the cooling system with reusable coolant and/or new coolant.
(40) Align the hood to the scribe marks. Install the hood.
(41) Connect the vacuum harness connector.
(a) Firmly push the connectors together ensuring that the retaining tabs are engaged.
(b) Insert the vacuum connector assembly into the retaining bracket on the intake manifold.
(42) Install the air cleaner assembly.
(43) Install the battery and connect the battery cable.

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.

(44) Start the engine, inspect for leaks and correct the fluid levels, as necessary.

ENGINE ASSEMBLY—YJ VEHICLES

REMOVAL

(1) Place a protective cloth over the windshield frame. Raise the hood and rest it on the windshield frame (Fig. 17).
(2) Disconnect the battery cables. Remove the battery.

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

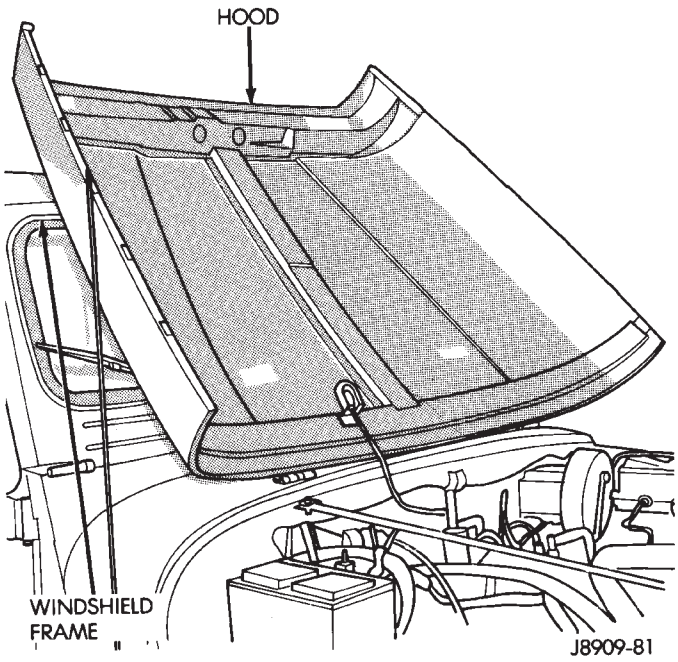

Fig. 17 Hood on Windshield Frame

(4) Disconnect the wire connectors from the generator.
(5) Disconnect the ignition coil and distributor wire connectors.
(6) Disconnect the oil pressure sender wire connector.
(7) Disconnect the wires at the starter motor solenoid and injection wire harness connector.
(8) Disconnect the quick-connect fuel lines at the fuel rail and return line by squeezing the retaining tabs against the fuel tube (Fig. 18). Pull the fuel tube and retainer from the quick-connect fitting (refer to Group 14, Fuel System for the proper procedure).
(9) Remove the fuel line bracket from the intake manifold.
(10) Disconnect the engine ground strap.
(11) Remove the air cleaner (Fig. 18).
(12) Disconnect the vacuum purge hose at the fuel vapor canister tee.
(13) Disconnect the idle speed actuator wire connector.
(14) Disconnect the throttle cable and remove it from the bracket (Fig. 18).
(15) Disconnect the throttle rod at the bellcrank.
(16) Disconnect the speed control cable, if equipped (Fig. 18).
(17) Disconnect the oxygen sensor wire connector.
(18) Remove the upper radiator hose and coolant recovery hose (Fig. 19).
(19) Disconnect lower radiator hoses at the radiator.

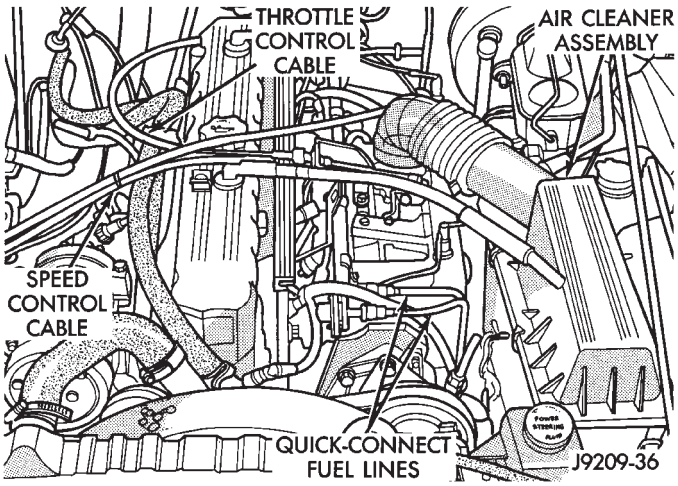

Fig. 18 Fuel Line Quick-Connect Couplings, Air Cleaner Assembly, Throttle & Speed Control Cables

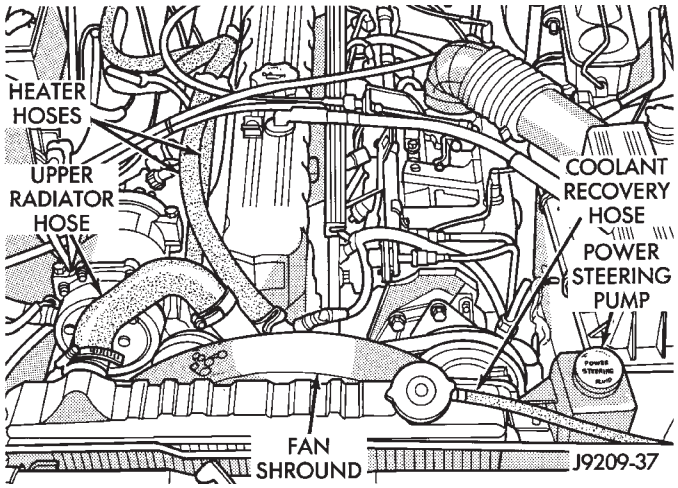

Fig. 19 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Power Steering Pump

(20) Disconnect the coolant hoses from the rear of the intake manifold and thermostat housing.

(21) Remove the fan shroud screws.

(22) Remove the radiator attaching bolts.

(23) Remove the radiator and fan shroud (Fig. 19). Refer to Group 7, Cooling System for the proper procedure.

(24) Remove the fan and spacer or Tempatrol fan assembly.

(25) Install a 5/16 X 1/2-inch SAE capscrew through fan pulley into water pump flange. This will maintain the pulley and water pump in alignment when crankshaft is rotated.

(26) Remove the power brake vacuum check valve from the booster, if equipped.

(27) If equipped with power steering (Fig. 19):

(a) Disconnect the hoses from the fittings at the steering gear.

(b) Drain the pump reservoir.

(c) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(28) Lift the vehicle and support it with support stands.

(29) Remove the starter motor.

(30) Remove the flywheel housing access cover.

(31) Remove the engine support cushion-to-bracket through bolts.

(32) Disconnect the exhaust pipe from the manifold.

(33) Remove the upper flywheel housing bolts and loosen the bottom bolts.

(34) Lower the vehicle.

(35) Attach a lifting device to the engine.

(36) Raise the engine off the front supports.

(37) Place a support stand under the flywheel housing.

(38) Remove the remaining flywheel housing bolts.

(39) Lift the engine out of the engine compartment and install on an engine stand.

INSTALLATION

(1) Lift the engine off the stand and lower it into the engine compartment. For easier installation, it may be useful to remove the engine support cushions from the engine support brackets as an aide for alignment of the engine-to-transmission.

(2) Insert the transmission shaft into the clutch spline.

(3) Align the flywheel housing with the engine.

(4) Install and finger tighten the flywheel housing lower bolts.

(5) Install the engine support cushions (if removed).

(6) Remove the support stand from beneath the flywheel housing.

(7) Lower the engine and engine support cushions onto the engine compartment brackets. Ensure that the bolt holes are aligned. Install the bolts and tighten the nuts.

(8) Remove the engine lifting device.

(9) Raise the vehicle.

(10) Attach the exhaust pipe to the manifold. Install and tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(11) Install the flywheel housing access cover.

(12) Install the remaining flywheel housing bolts. Tighten the bolts to 38 N·m (28 ft. lbs.) torque.

(13) Install the starter motor and connect the cable. Tighten the bolts to 45 N·m (33 ft. lbs.) torque.

(14) Lower the vehicle.

(15) Connect the coolant hoses and tighten the clamps.

(16) Remove the pulley-to-water pump flange alignment capscrew and install the fan and spacer or Tempatrol fan assembly.

(17) Tighten the serpentine drive belt according to the specifications listed in Group 7, Cooling System.
(18) Install the fan shroud and radiator (refer to Group 7, Cooling System for the proper procedure).
(19) Connect the radiator hoses.
(20) Connect the throttle valve rod and retainer.
(21) Connect the throttle cable and install the rod.
(22) Install the throttle valve rod spring.
(23) Connect the speed control cable, if equipped.
(24) Connect the oxygen sensor wire connector.
(25) Install the vacuum hose and check valve on the brake booster.
(26) Connect the coolant temperature sensor wire connector.
(27) Connect the idle speed actuator wire connector.
(28) Connect the fuel inlet and return hoses at the fuel rail. Verify that the quick-connect fitting assembly fits securely over the fuel lines by giving the fuel lines a firm tug.
(29) Install the fuel line bracket to the intake manifold.
(30) Connect all fuel injection wire connections.
(31) Install the engine ground strap.
(32) Connect the ignition coil wire connector.
(33) Remove the coolant temperature sending unit to permit air to escape from the block. Fill the cooling system with coolant. Install the coolant temperature sending unit when the system is filled.
(34) If equipped with power steering:
(a) Remove the protective caps
(b) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.
(c) Fill the pump reservoir with fluid.
(35) Install the battery and connect the battery cables.
(36) Install the air cleaner bonnet to the throttle body.
(37) Install the air cleaner.
(38) Lower the hood and secure in place.
(39) Start the engine and inspect for leaks.
(40) Stop the engine and check the fluid levels. Add fluid, as required.

ENGINE CYLINDER HEAD COVER

A cured gasket is part of the engine cylinder head cover.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover (Fig. 1).
(3) Disconnect the fresh air inlet hose from the engine cylinder head cover (Fig. 1).
(4) Remove the engine cylinder head cover mounting bolts.
(5) Remove the engine cylinder head cover.

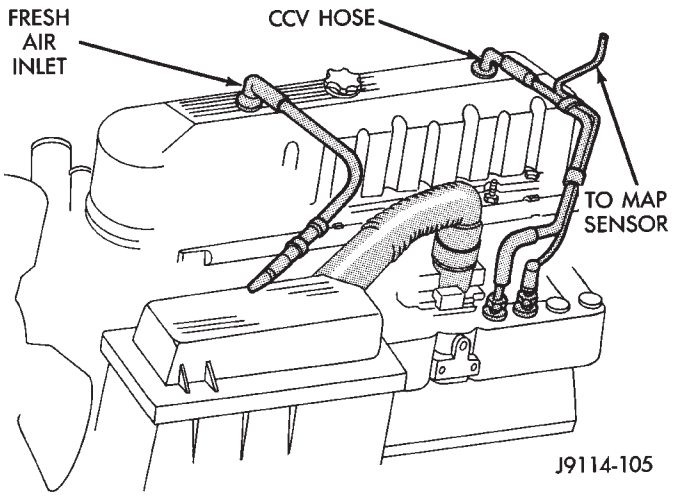

Fig. 1 Engine Cylinder Head Cover

CLEANING

Remove any original sealer from the cover sealing surface of the engine cylinder head and clean the surface using a fabric cleaner.
Remove all residue from the sealing surface using a clean, dry cloth.

INSPECTION

Inspect the engine cylinder head cover for cracks. Replace the cover, if cracked.
The original grey gasket material should NOT be removed. If sections of the gasket material are missing or are compressed, replace the engine cylinder head cover. However, sections with minor damage such as small cracks, cuts or chips may be repaired with a hand held applicator. The new material must be smoothed over to maintain gasket height. Allow the gasket material to cure prior to engine cylinder head cover installation.

INSTALLATION

(1) If a replacement cover is installed, transfer the CCV valve grommet and oil filler cap from the original cover to the replacement cover.
(2) Install engine cylinder head cover. Tighten the mounting bolts to 10 N·m (85 in. lbs.) torque.
(3) Connect the CCV hoses (Fig. 1).
(4) Connect negative cable to battery.

ROCKER ARMS

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Remove the capscrews at each bridge and pivot assembly (Fig. 2). Alternately loosen the capscrews one turn at a time to avoid damaging the bridges.

(3) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.

(4) Remove the bridges, pivots and corresponding pairs of rocker arms (Fig. 2). Place them on a bench in the same order as removed.

(5) Remove the push rods and place them on a bench in the same order as removed.

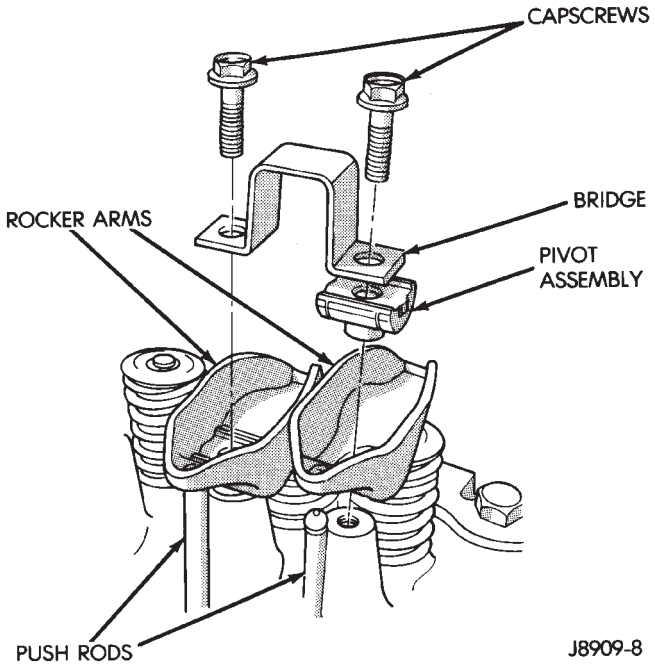

Fig. 2 Rocker Arm Assembly

CLEANING

Clean all the components with cleaning solvent.

Use compressed air to blow out the oil passages in the rocker arms and push rods.

INSPECTION

Inspect the pivot surface area of each rocker arm. Replace any that are scuffed, pitted, cracked or excessively worn.

Inspect the valve stem tip contact surface of each rocker arm and replace any rocker arm that is deeply pitted.

Inspect each push rod end for excessive wear and replace as required. If any push rod is excessively worn because of lack of oil, replace it and inspect the corresponding hydraulic tappet for excessive wear.

Inspect the push rods for straightness by rolling them on a flat surface or by shining a light between the push rod and the flat surface.

A wear pattern along the length of the push rod is not normal. Inspect the engine cylinder head for obstruction if this condition exists.

INSTALLATION

(1) Lubricate the ball ends of the push rods with Mopar Engine Oil Supplement, or equivalent and install push rods in their original locations. Ensure that the bottom end of each push rod is centered in the tappet plunger cap seat.

(2) Using Mopar Engine Oil Supplement, or equivalent, lubricate the area of the rocker arm that the pivot contacts. Install rocker arms, pivots and bridge above each cylinder in their originally position.

(3) Loosely install the capscrews through each bridge.

(4) At each bridge, tighten the capscrews alternately, one turn at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(5) Install the engine cylinder head cover.

ENGINE CYLINDER HEAD

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Disconnect negative cable from battery.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAIN COCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(2) Drain the coolant and disconnect the hoses at the engine thermostat housing. DO NOT waste reusable coolant. If the solution is clean and is being drained only to service the engine or cooling system, drain the coolant into a clean container for reuse.

(3) Remove the air cleaner assembly.

(4) Remove the engine cylinder head cover.

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms (Fig. 2).

(6) Remove the push rods (Fig. 2). **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Loosen the serpentine drive belt at the power steering pump, if equipped or at the idler pulley (refer to Group 7, Cooling System for the proper procedure).

(8) If equipped with air conditioning, perform the following:

(a) Remove the bolts from the A/C compressor mounting bracket and set the compressor aside.

(b) Remove the air conditioner compressor bracket bolts from the engine cylinder head.

(c) Loosen the through bolt at the bottom of the bracket.

(9) If equipped, disconnect the power steering pump bracket. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) Remove the fuel lines and vacuum advance hose.

(11) Remove the intake and engine exhaust manifolds from the engine cylinder head (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(12) Disconnect the ignition wires and remove the spark plugs.

(13) Disconnect the temperature sending unit wire connector.

(14) Remove the ignition coil and bracket assembly.

(15) Remove the engine cylinder head bolts. Bolt No.14 cannot be removed until the head is moved forward (Fig. 3). Pull bolt No.14 out as far as it will go and then suspend the bolt in this position (tape around the bolt).

(16) Remove the engine cylinder head and gasket (Fig. 3).

(17) If this was the first time the bolts were removed, put a paint dab on the top of the bolt. If the bolts have a paint dab on the top of the bolt or it isn't known if they were used before, discard the bolts.

(18) Stuff clean lint free shop towels into the cylinder bores.

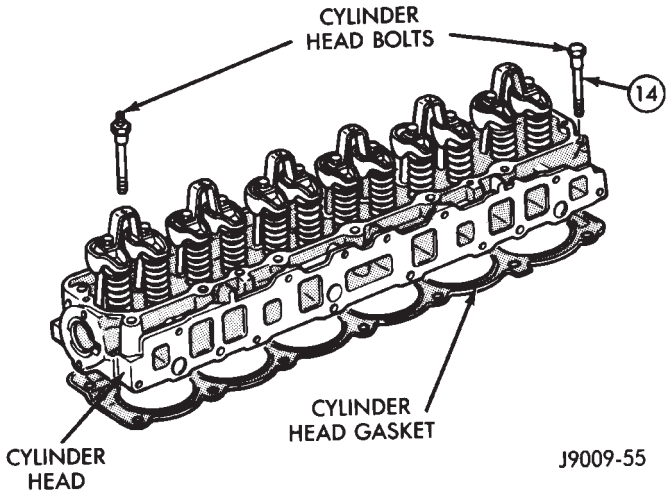

Fig. 3 Engine Cylinder Head Assembly

CLEANING

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and engine exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

INSTALLATION

The engine cylinder head gasket is a composition gasket. The gasket is to be installed DRY. **DO NOT use a gasket sealing compound on the gasket.**

If the engine cylinder head is to be replaced and the original valves used, measure the valve stem diameter. Only standard size valves can be used with a service replacement engine cylinder head unless the replacement head valve stem guide bores are reamed to accommodate oversize valve stems. Remove all carbon buildup and reface the valves.

(1) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(2) Position the engine cylinder head gasket (with the numbers facing up) onto the cylinder block.

CAUTION: Engine cylinder head bolts should be reused only once. Replace the head bolts if they were used before or if they have a paint dab on the top of the bolt.

(3) With bolt No.14 held in place (tape around bolt), install the engine cylinder head. Remove the tape from bolt No.14.

(4) Coat the threads of stud bolt No.11 with Loctite 592 sealant, or equivalent.

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 4):

(a) Tighten all bolts in sequence (1 through 14) to 30 N·m (22 ft. lbs.) torque.

(b) Tighten all bolts in sequence (1 through 14) to 61 N·m (45 ft. lbs.) torque.

(c) Check all bolts to verify they are set to 61 N·m (45 ft. lbs.) torque.

(d) Tighten bolts (in sequence):

- Bolts 1 through 10 to 149 N·m (110 ft. lbs.) torque.
- Bolt 11 to 136 N·m (100 ft. lbs.) torque.
- Bolts 12 through 14 to 149 N·m (110 ft. lbs.) torque.

CAUTION: During the final tightening sequence, bolt No.11 will be tightened to a lower torque than the rest of the bolts. DO NOT overtighten bolt No.11.

(e) Check all bolts in sequence to verify the correct torque.

(f) If not already done, clean and mark each bolt with a dab of paint after tightening. Should you encounter bolts which were painted in an earlier service operation, replace them.

(6) Install the ignition coil and bracket assembly.

(7) Connect the temperature sending unit wire connector.

(8) Install the spark plugs and tighten to 37 N·m (27 ft. lbs.) torque. Connect the ignition wires.

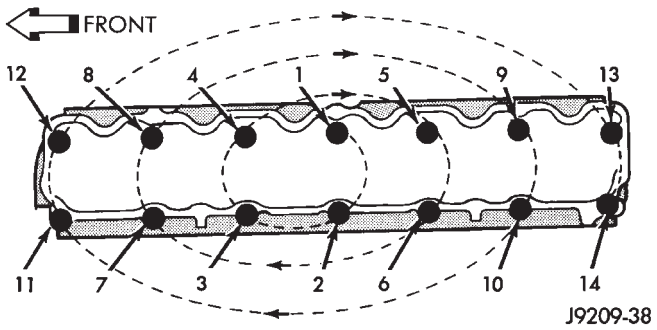

Fig. 4 Engine Cylinder Head Bolt Tightening Sequence

(9) Install the intake and engine exhaust manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(10) Install the fuel lines and the vacuum advance hose.

(11) If equipped, attach the power steering pump and bracket.

(12) Install the push rods, rocker arms, pivots and bridges in the order they were removed.

(13) Install the engine cylinder head cover.

(14) Attach the air conditioner compressor mounting bracket to the engine cylinder head and block. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(15) Attach the air conditioning compressor to the bracket. Tighten the bolts to 27 N·m (20 ft. lbs.) torque.

CAUTION: The serpentine drive belt must be routed correctly. Incorrect routing can cause the water pump to turn in the opposite direction causing the engine to overheat.

(16) Install the serpentine drive belt and correctly tension the belt (refer to Group 7, Cooling System for the proper procedure).

(17) Install the air cleaner and ducting.

(18) Install the engine cylinder head cover.

(19) Connect the hoses to the engine thermostat housing and fill the cooling system to the specified level (refer to Group 7, Cooling Systems for the proper procedure).

(20) The automatic transmission throttle linkage and cable must be adjusted after completing the engine cylinder head installation (refer to Group 21, Transmissions for the proper procedures).

(21) Install the temperature sending unit and connect the wire connector.

(22) Connect the fuel pipe and vacuum advance hose.

(23) Connect negative cable to battery.

(24) Connect the upper radiator hose and heater hose at the engine thermostat housing.

(25) Fill the cooling system. Check for leaks.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN DIRECT LINE WITH THE FAN. DO NOT PUT HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(26) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the engine thermostat opens. Add coolant, if required.

VALVE SPRINGS AND OIL SEALS

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

Each valve spring is held in place by a retainer and a set of conical valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove the engine cylinder head cover.

(2) Remove capscrews, bridge and pivot assemblies and rocker arms for access to each valve spring to be removed.

(3) Remove push rods. Retain the push rods, bridges, pivots and rocker arms in the same order and position as removed.

(4) Inspect the springs and retainer for cracks and possible signs of weakening.

(5) Remove the spark plug(s) adjacent to the cylinder(s) below the valve springs to be removed.

(6) Install a 14 mm (1/2 inch) (thread size) air hose adaptor in the spark plug hole. An adaptor can be constructed by welding an air hose connection to the body of a spark plug with the porcelain removed.

(7) Connect an air hose to the adapter and apply air pressure slowly. Maintain at least 621 kPa (90 psi) of air pressure in the cylinder to hold the valves against their seats. For vehicles equipped with an air conditioner, use a flexible air adaptor when servicing the No.1 cylinder.

(8) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 5).

(9) Remove valve spring and retainer (Fig. 5).

(10) Remove valve stem oil seals (Fig. 5). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (Intake) or EXH (Exhaust). DO NOT mix the seals.

INSPECTION

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

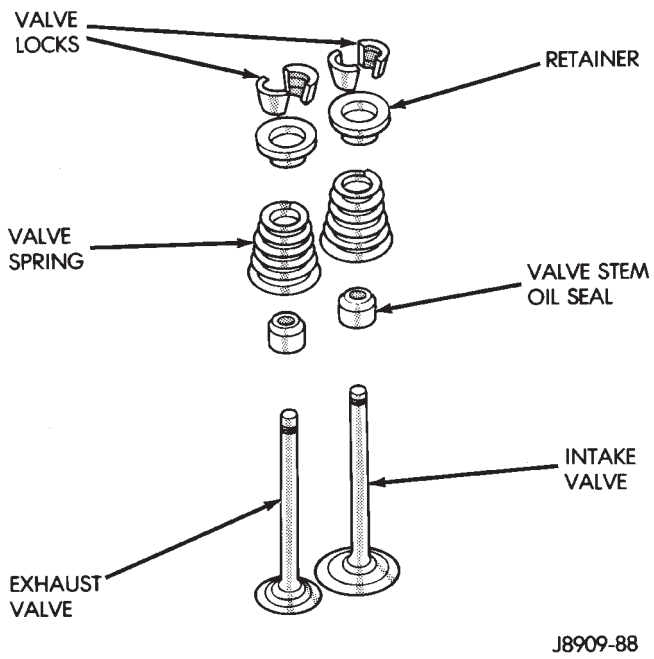

Fig. 5 Valve and Valve Components

INSTALLATION

CAUTION: Install oil seals carefully to prevent damage from the sharp edges of the valve spring lock grove.

(1) Lightly push the valve seal over the valve stem and valve guide boss. Be sure the seal is completely seated on the valve guide boss.

(2) Install valve spring and retainer.

(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.

(4) Disconnect the air hose. Remove the adaptor from the spark plug hole and install the spark plug.

(5) Repeat the procedures for each remaining valve spring to be removed.

(6) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.

(7) Install the rocker arms, pivots and bridge at their original location.

(8) Tighten the bridge capscrews alternately, one at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

VALVES AND VALVE SPRINGS

This procedure is done with the engine cylinder head removed from the block.

REMOVAL

(1) Remove the engine cylinder head from the cylinder block.

(2) Use Valve Spring Compressor Tool MD-998772A and compress each valve spring.

(3) Remove the valve locks, retainers, springs and valve stem oil seals. Discard the oil seals.

(4) Use an Arkansas smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.

(5) Remove the valves, and place them in a rack in the same order as removed.

VALVE CLEANING

Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

Clean all grime and gasket material from the engine cylinder head machined gasket surface.

INSPECTION

Inspect for cracks in the combustion chambers and valve ports.

Inspect for cracks on the exhaust seat.

Inspect for cracks in the gasket surface at each coolant passage.

Inspect valves for burned, cracked or warped heads.

Inspect for scuffed or bent valve stems.

Replace valves displaying any damage.

VALVE REFACING

(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 0.787 mm (0.031 inch) must remain (Fig. 6). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

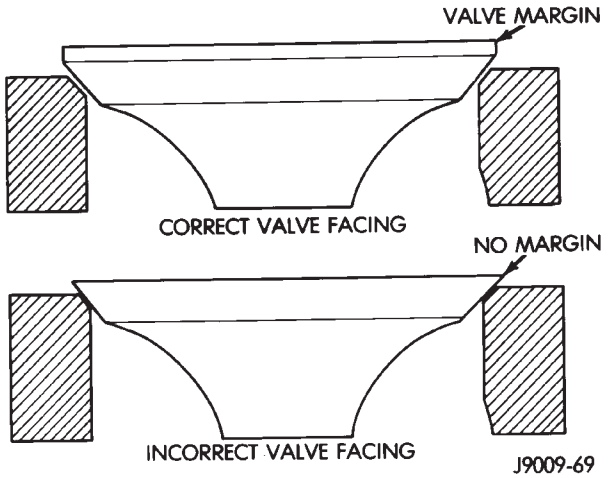

Fig. 6 Valve Facing Margin

VALVE SEAT REFACING

(1) Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified an-

gle with a good dressing stone. Remove only enough metal to provide a smooth finish.

(2) Use tapered stones to obtain the specified seat width when required.

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.)—(Fig. 7).

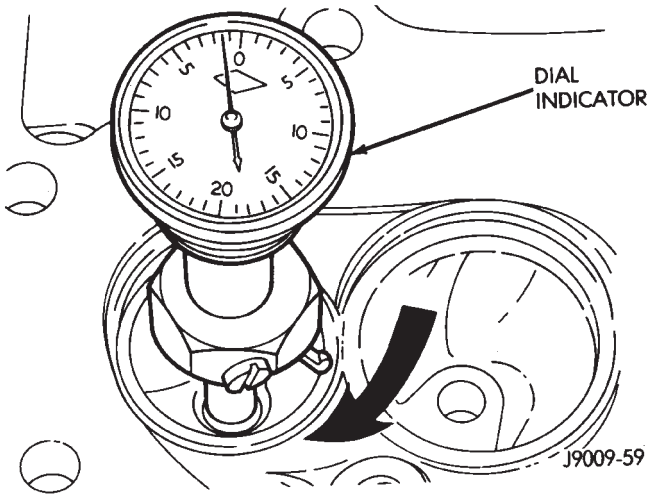

Fig. 7 Measurement of Valve Seat Runout

VALVE STEM OIL SEAL REPLACEMENT

Valve stem oil seals are installed on each valve stem to prevent rocker arm lubricating oil from entering the combustion chamber through the valve guide bores. One seal is marked INT (intake valve) and the other is marked EXH (exhaust valve).

Replace the oil seals whenever valve service is performed or if the seals have deteriorated.

VALVE GUIDES

The valve guides are an integral part of the engine cylinder head and are not replaceable.

When the valve stem guide clearance is excessive, the valve guide bores must be reamed oversize. Service valves with oversize stems are available in 0.076 mm (0.003 inch) and 0.381 mm (0.015 inch) increments.

Corresponding oversize valve stem seals are also available and must be used with valves having 0.381 mm (0.015 inch) oversize stems.

If the valve guides are reamed oversize, the valve seats must be ground to ensure that the valve seat is concentric to the valve guide.

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

Valve stem-to-guide clearance may be measured by either of the following two methods.

PREFERRED METHOD:

(1) Remove the valve from the head.

(2) Clean the valve stem guide bore with solvent and a bristle brush.

(3) Insert a telescoping gauge into the valve stem guide bore approximately 9.525 mm (.375 inch) from the valve spring side of the head (Fig. 8).

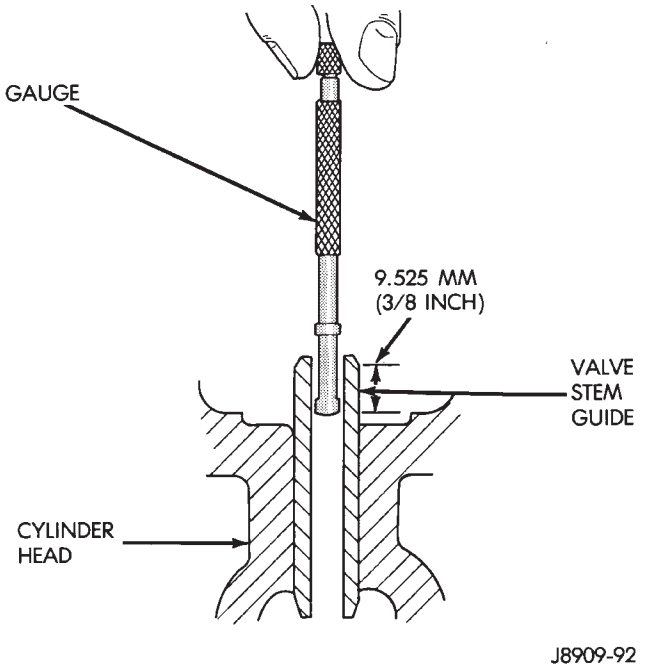

Fig. 8 Measurement of Valve Guide Bore Diameter

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

(6) Compare the crosswise to lengthwise measurements to determine out-of-roundness. If the measurements differ by more than 0.0635 mm (0.0025 in.), ream the guide bore to accommodate an oversize valve stem.

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD:

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 9).

(2) Correct clearance is 0.025-0.0762 mm (0.001-0.003 inch). If indicated movement exceeds the specification ream the valve guide to accommodate an oversize valve stem.

Valve seats must be ground after reaming the valve guides to ensure that the valve seat is concentric to the valve guide.

VALVE SPRING TENSION TEST

Use Valve Spring Tester C-647 and a torque wrench to test each valve spring for the specified tension value (Fig. 10).

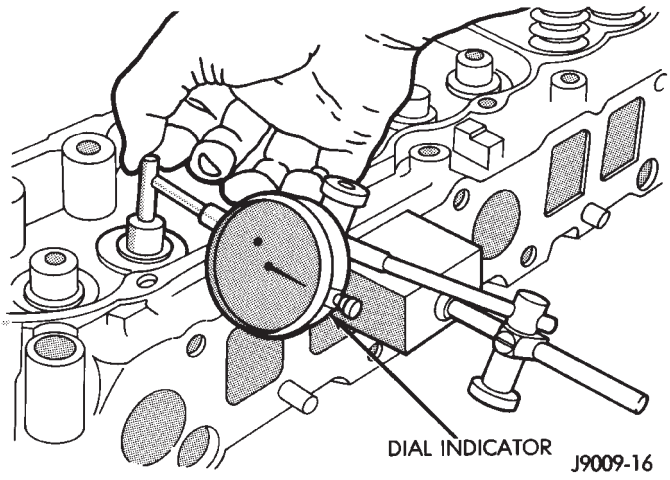

Fig. 9 Measurement of Lateral Movement of Valve Stem

Replace valve springs that are not within specifications.

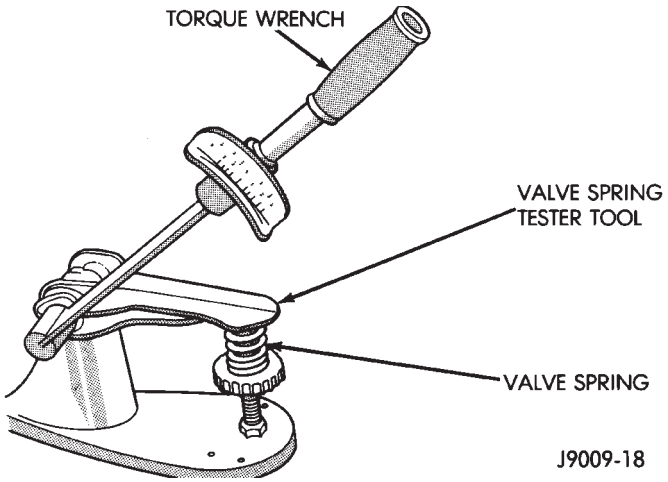

Fig. 10 Valve Spring Tester C-647

INSTALLATION

(1) Thoroughly clean the valve stems and the valve guide bores.

(2) Lightly lubricate the stem.

(3) Install the valve in the original valve guide bore.

(4) Install the replacement valve stem oil seals on the valve stems. If the 0.381 mm (0.015 inch) oversize valve stems are used, oversize oil seals are required.

(5) Position the valve spring and retainer on the engine cylinder head and compress the valve spring with Valve Spring Compressor Tool MD-998772A.

(6) Install the valve locks and release the tool.

(7) Tap the valve spring from side to side with a hammer to ensure that the spring is properly seated at the engine cylinder head. Also tap the top of the retainer to seat the valve locks.

(8) Install the engine cylinder head.

HYDRAULIC TAPPETS

Retain all the components in the same order as removed.

REMOVAL

(1) Remove the engine cylinder head cover.

(2) Remove the bridge and pivot assemblies and rocker arms by removing the capscrews at each bridge. Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridges.

(3) Remove the push rods.

(4) Remove the intake and engine exhaust manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedure).

(5) Remove the engine cylinder head and gasket.

(6) Remove the tappets through the push rod openings in the cylinder block with Hydraulic Valve Tappet Removal/Installation Tool C-4129-A (Fig. 11).

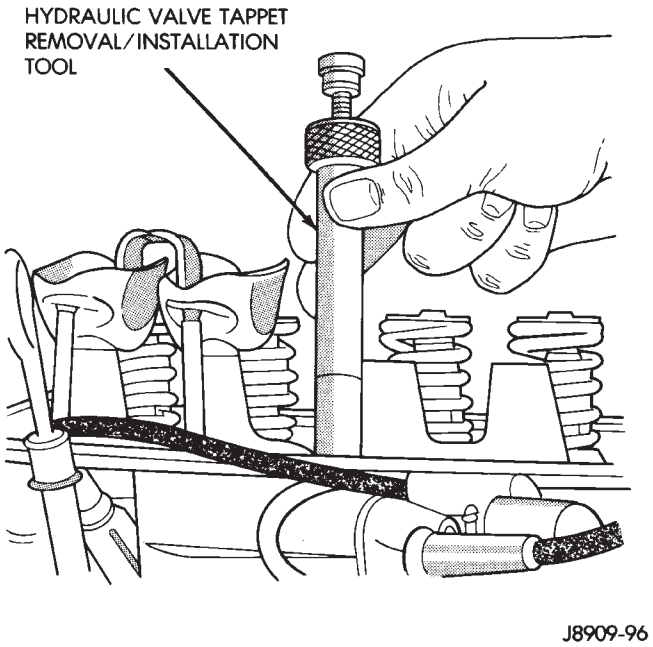

Fig. 11 Hydraulic Valve Tappet Removal/Installation Tool C-4129-A

CLEANING

Clean each tappet assembly in cleaning solvent to remove all varnish, gum and sludge deposits.

INSPECTION

Inspect for indications of scuffing on the side and base of each tappet body.

Inspect each tappet base for concave wear with a straightedge positioned across the base. If the base is concave, the corresponding lobe on the camshaft is also worn. Replace the camshaft and defective tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 12).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester 7980.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

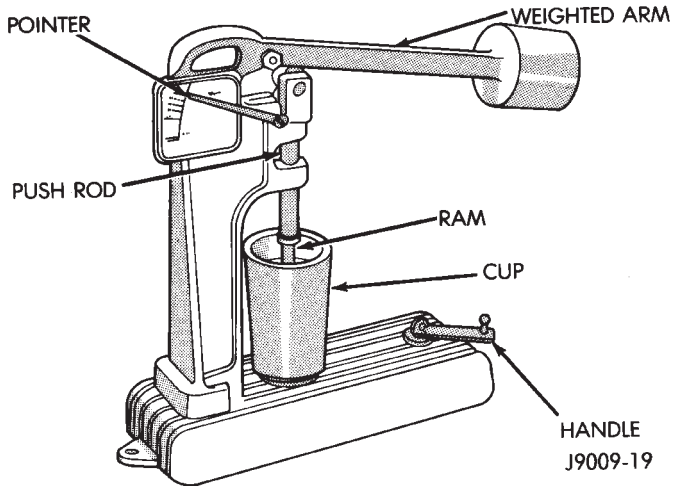

Fig. 12 Leak-Down Tester 7980

INSTALLATION

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

(1) Dip each tappet in Mopar Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool C-4129-A to install each tappet in the same bore from where it was originally removed.

(3) Install the exhaust and intake manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedure).

(4) Install the engine cylinder head and gasket.

(5) Install the push rods in their original locations.

(6) Install the rocker arms and bridge and pivot assemblies at their original locations. Loosely install the capscrews at each bridge.

(7) Tighten the capscrews alternately, one turn at a time, to avoid damaging the bridges. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(8) Pour the remaining Mopar Engine Oil Supplement, or equivalent over the entire valve actuating assembly. The Mopar Engine Oil Supplement, or equivalent must remain with the engine oil for at least 1 609 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(9) Install the engine cylinder head cover.

VALVE TIMING

Disconnect the spark plug wires and remove the spark plugs.

Remove the engine cylinder head cover.

Remove the capscrews, bridge and pivot assembly, and rocker arms from above the No.1 cylinder.

Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridge.

Rotate the crankshaft until the No.6 piston is at top dead center (TDC) on the compression stroke.

Rotate the crankshaft counterclockwise (viewed from the front of the engine) 90°.

Install a dial indicator on the end of the No.1 cylinder intake valve push rod. Use rubber tubing to secure the indicator stem on the push rod.

Set the dial indicator pointer at zero.

Rotate the crankshaft clockwise (viewed from the front of the engine) until the dial indicator pointer indicates 0.305 mm (0.012 inch) travel distance (lift).

The timing notch index on the vibration damper should be aligned with the TDC mark on the timing degree scale.

If the timing notch is more than 13 mm (1/2 inch) away from the TDC mark in either direction, the valve timing is incorrect.

If the valve timing is incorrect, the cause may be a broken camshaft pin. It is not necessary to replace the camshaft because of pin failure. A spring pin is available for service replacement.

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt and fan shroud.

(3) Remove the vibration damper retaining bolt and washer.

(4) Use Vibration Damper Removal Tool 8068 to remove the damper from the crankshaft (Fig. 1).

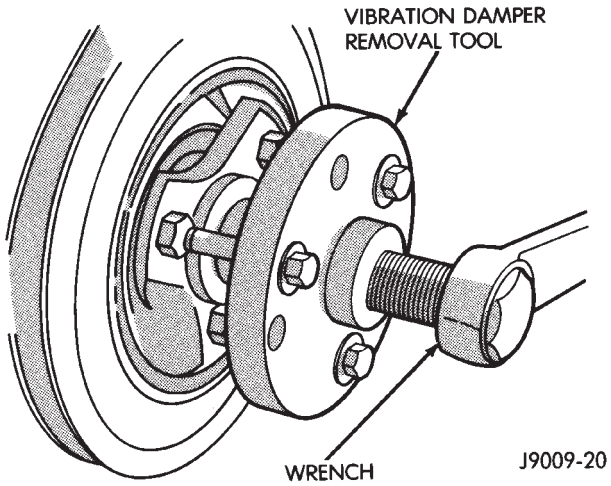

Fig. 1 Vibration Damper Removal Tool 8068

INSTALLATION

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in position, align the keyway on the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft.

(2) Install the vibration damper retaining bolt and washer.

(3) Tighten the damper retaining bolt to 108 N·m (80 ft. lbs.) torque.

(4) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(5) Connect negative cable to battery.

TIMING CASE COVER OIL SEAL REPLACEMENT

This procedure is done with the timing case cover installed.

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt.

(3) Remove the vibration damper.

(4) Remove the radiator shroud.

(5) Carefully remove the oil seal (Fig. 2). Make sure seal bore is clean.

(6) Position the replacement oil seal on Timing Case Cover Alignment and Seal Installation Tool 6139 with seal open end facing inward. Apply a light film of Perfect Seal, or equivalent, on the outside diameter of the seal. Lightly coat the crankshaft with engine oil.

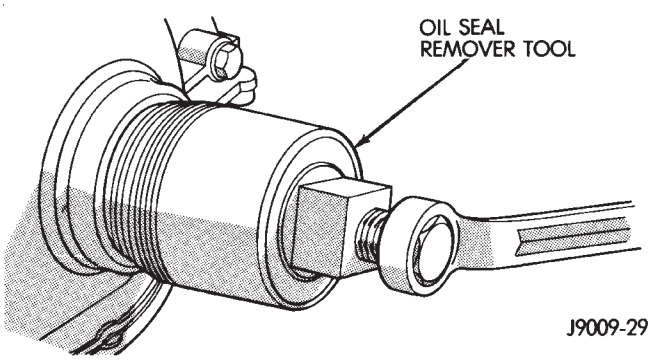

Fig. 2 Timing Case Cover Oil Seal Removal

(7) Position the tool and seal over the end of the crankshaft and insert a draw screw tool into Seal Installation Tool 6139 (Fig. 3). Tighten the nut against the tool until it contacts the cover.

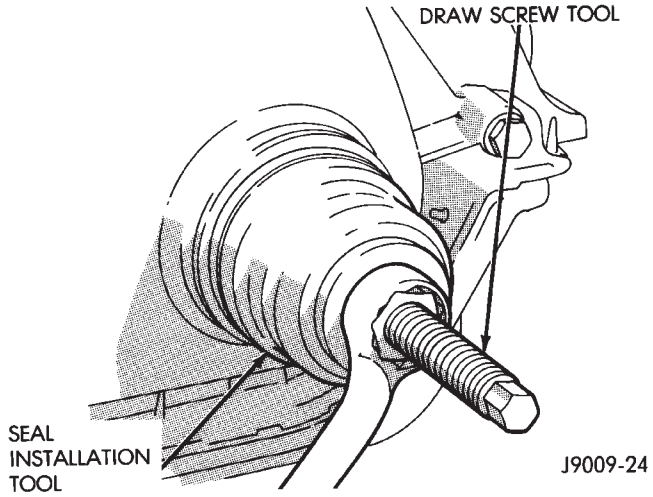

Fig. 3 Timing Case Cover Oil Seal Installation

(8) Remove the tools. Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) Install the serpentine belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(11) Install the radiator shroud.

(12) Connect negative cable to battery.

TIMING CASE COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper (Fig. 4).

(3) Remove the fan and hub assembly and remove the fan shroud.

(4) Remove the accessory drive brackets that are attached to the timing case cover.

(5) Remove the A/C compressor (if equipped) and generator bracket assembly from the engine cylinder head and move to one side.

(6) Remove the oil pan-to-timing case cover bolts and timing case cover-to-cylinder block bolts.

(7) Remove the timing case cover and gasket from the engine. Make sure the tension spring and thrust pin do not fall out of the preload bolt.

(8) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 4).

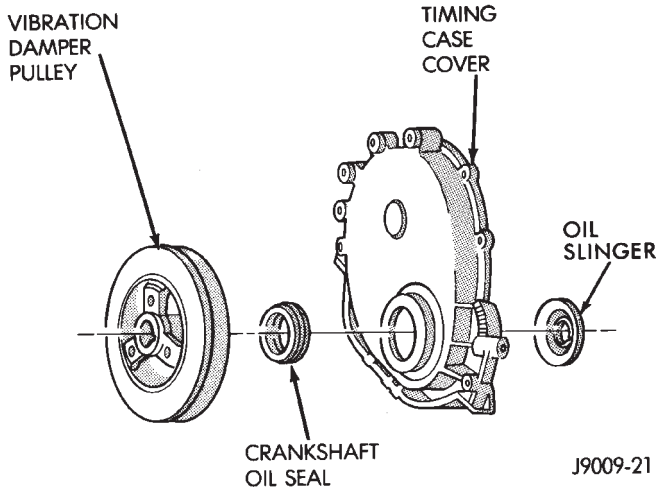

Fig. 4 Timing Case Cover Components

CLEANING

Clean the timing case cover, oil pan and cylinder block gasket surfaces.

INSTALLATION

(1) Install a new crankshaft oil seal in the timing case cover. The open end of the seal should be toward the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

(2) Position the gasket on the cylinder block.

(3) Position the timing case cover on the oil pan gasket and the cylinder block. Make sure the tension spring and thrust pin are in place in the camshaft preload bolt.

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 5).

(5) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

(6) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.

(7) Remove the cover alignment tool.

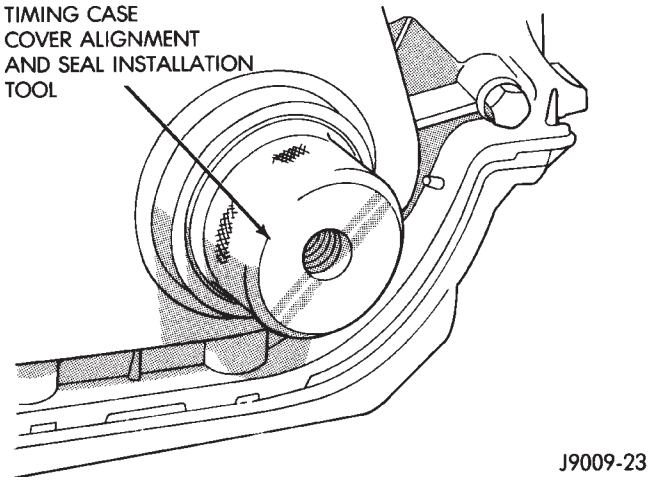

Fig. 5 Timing Case Cover Alignment and Seal Installation Tool 6139

(8) Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) Install the A/C compressor (if equipped) and generator bracket assembly.

(11) Install the engine fan and hub assembly and shroud.

(12) Install the serpentine drive belt and tighten to obtain the specified tension.

(13) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud.

(3) Remove the serpentine drive belt.

(4) Remove the crankshaft vibration damper.

(5) Remove the timing case cover.

(6) Rotate crankshaft until the "0" timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 6).

(7) Remove the oil slinger from the crankshaft.

(8) Remove the tension spring and thrust pin from the preload bolt (Fig. 7). Remove the camshaft sprocket retaining preload bolt and washer.

(9) Remove the crankshaft sprocket, camshaft sprocket and timing chain as an assembly.

Installation of the timing chain with the timing marks on the crankshaft and camshaft sprockets properly aligned ensures correct valve timing. A worn or stretched timing chain will adversely affect valve timing. If the timing chain deflects more than

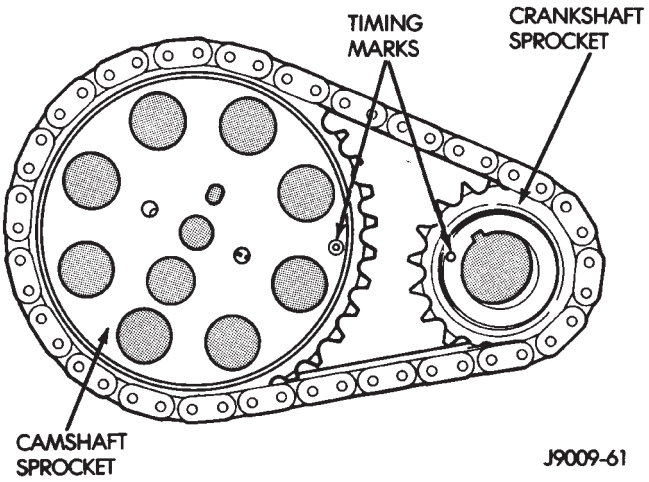

Fig. 6 Crankshaft/Camshaft Alignment—Typical

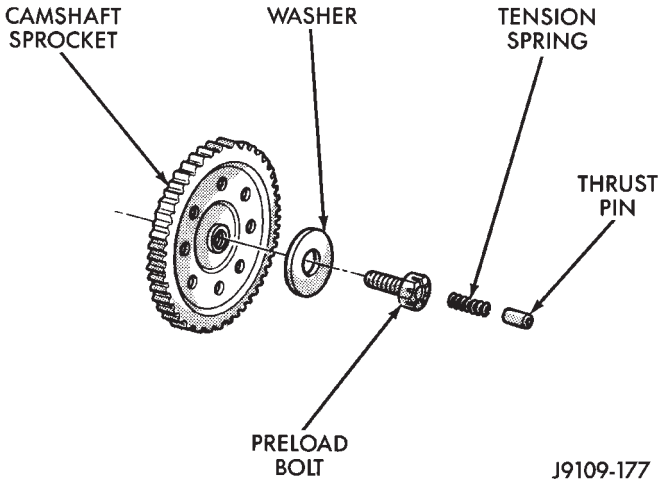

Fig. 7 Camshaft Sprocket Preload Bolt

12.7 mm (1/2 inch) replace it. The correct timing chain has 48 pins. A chain with more than 48 pins will cause excessive slack.

INSTALLATION

Assemble the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned (Fig. 6).

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in the keyway on the crankshaft, install the assembly on the crankshaft and camshaft.

(2) Install the camshaft sprocket retaining preload bolt and washer (Fig. 7). Tighten the preload bolt to 108 N·m (80 ft. lbs.) torque.

(3) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in Fig. 8. Count the number of chain pins between the timing marks of both sprockets. There must be 15 pins.

(4) Install the crankshaft oil slinger.

(5) Replace the oil seal in the timing case cover.

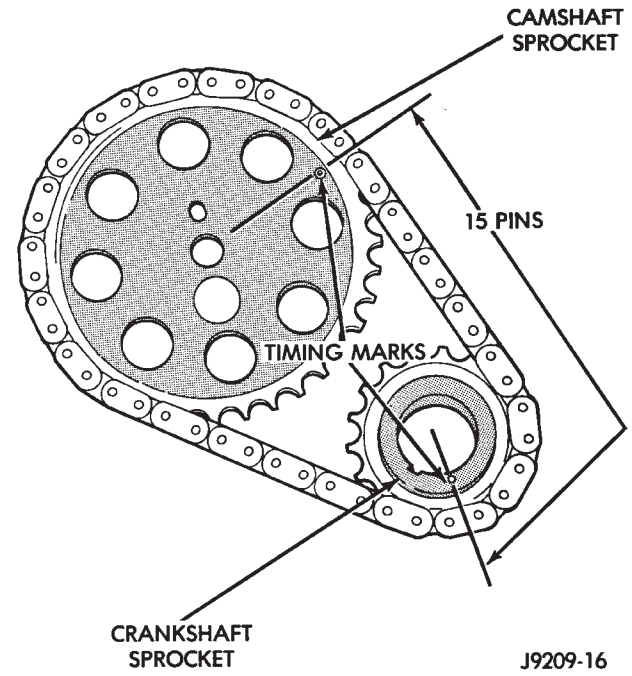

Fig. 8 Verify Sprocket/Chain Installation—Typical

(6) Lubricate the tension spring, thrust pin and pin bore in the preload bolt with Mopar Engine Oil Supplement, or equivalent. Install the spring and thrust pin in the preload bolt head (Fig. 6).

(7) Install the timing case cover and gasket.

(8) With the key installed in the crankshaft keyway, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(9) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling System for the proper procedure).

(10) Install the fan and hub (or Tempatrol fan) assembly. Install the shroud.

(11) Connect negative cable to battery.

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.

(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.

(3) Remove the radiator or radiator/condenser, if equipped with A/C (refer to Group 7, Cooling System for the proper procedure).

(4) Remove the air conditioner condenser and receiver/drier assembly as a charged unit, if equipped (refer to Group 24, Heating and Air Conditioning).

(5) Remove the distributor cap and mark the position of the rotor.
(6) Remove the distributor and ignition wires.
(7) Remove the engine cylinder head cover.
(8) Remove the rocker arms, bridges and pivots.
(9) Remove the push rods.
(10) Remove the engine cylinder head and gasket.
(11) Remove the hydraulic valve tappets from the engine cylinder head.
(12) Remove the vibration damper.
(13) Remove the timing case cover.
(14) Remove the timing chain and sprockets.
(15) Remove the front bumper and/or grille, as required.
(16) Remove the camshaft (Fig. 9).

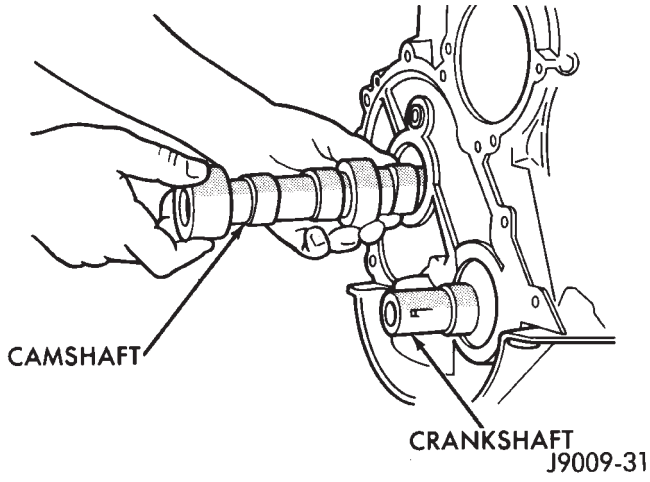

Fig. 9 Camshaft

INSPECTION

Inspect the cam lobes for wear.
Inspect the bearing journals for uneven wear pattern or finish.
Inspect the bearings for wear.
Inspect the distributor drive gear for wear.
If the camshaft appears to have been rubbing against the timing case cover, examine the oil pressure relief holes in the rear cam journal. The oil pressure relief holes must be free of debris.

INSTALLATION

(1) Lubricate the camshaft with Mopar Engine Oil Supplement, or equivalent.
(2) Carefully install the camshaft to prevent damage to the camshaft bearings (Fig. 9).
(3) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.
(4) Install the camshaft sprocket retaining preload bolt. Tighten the bolt to 108 N·m (80 ft. lbs.) torque.
(5) Lubricate the tension spring, the thrust pin and the pin bore in the preload bolt with Mopar Engine Oil Supplement, or equivalent. Install the spring and thrust pin in the preload bolt head.
(6) Install the timing case cover with a replacement oil seal (Fig. 10). Refer to Timing Case Cover Installation.
(7) Install the vibration damper (Fig. 10).

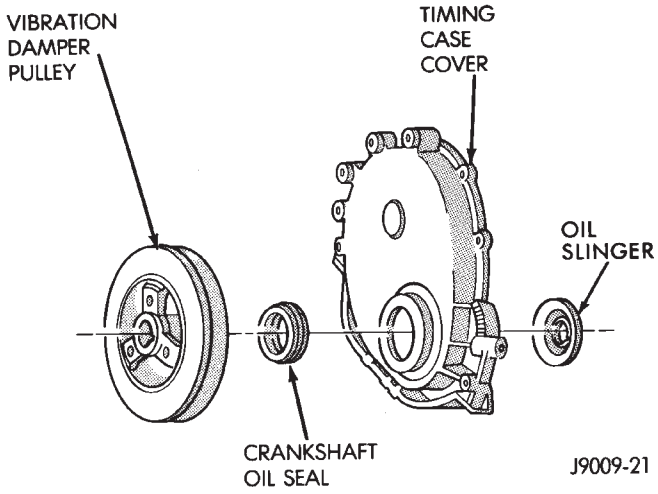

Fig. 10 Timing Case Cover Components

(8) Install the hydraulic valve tappets.
(9) Install the engine cylinder head.
(10) Install the push rods.
(11) Install the rocker arms and pivot and bridge assemblies. Tighten each of the capscrews for each bridge alternately, one turn at a time, to avoid damaging the bridge.
(12) Install the engine cylinder head cover.
(13) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling System for the proper procedure).
(14) Rotate the crankshaft until the No.1 piston is at the TDC position on the compression stroke.
(15) Install the distributor, cap and ignition wires. Install the distributor so that the rotor is aligned with the mark made during removal. The rotor should be aligned with the No.1 cylinder spark plug terminal on the cap when the distributor housing is fully seated on the cylinder block.

During installation, lubricate the hydraulic valve tappets and all valve components with Mopar Engine Oil Supplement, or equivalent. The Mopar Engine Oil Supplement, or equivalent must remain with the engine oil for at least 1 609 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(16) Install the A/C condenser and receiver/drier assembly, if equipped (refer to Group 24, Heating and Air Conditioning).

CAUTION: Both service valves must be opened before the air conditioning system is operated.

(17) Install the radiator, connect the hoses and fill the cooling system to the specified level (refer to Group 7, Cooling System for the proper procedure).

(18) Check the ignition timing and adjust as necessary.
(19) Install the grille and bumper, if removed.
(20) Connect negative cable to battery.

CAMSHAFT PIN REPLACEMENT

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAIN COCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

(1) Disconnect negative cable from battery.
(2) Drain the radiator. DO NOT waste reusable coolant. Drain the coolant into a clean container.
(3) Remove the fan and shroud.
(4) Disconnect the radiator overflow tube, radiator hoses, automatic transmission fluid cooler pipes (if equipped).
(5) Remove the radiator.
(6) If equipped with air conditioning:

CAUTION: DO NOT loosen or disconnect any air conditioner system fittings. Move the condenser and receiver/drier aside as a complete assembly.

(a) Remove the A/C compressor serpentine drive belt idler pulley.
(b) Disconnect and remove the generator.
(c) Remove the A/C condenser attaching bolts and move the condenser and receiver/drier assembly up and out of the way.
(7) Remove the serpentine drive belt.
(8) Remove the crankshaft vibration damper.
(9) Remove the timing case cover. Clean the gasket material from the cover.
(10) Remove the thrust pin and tension spring from the preload bolt head.
(11) Rotate crankshaft until the crankshaft sprocket timing mark is closest to and on the center line with the camshaft sprocket timing mark (Fig. 11).
(12) Remove the camshaft sprocket preload retaining bolt and washer.
(13) Remove the crankshaft oil slinger.
(14) Remove the sprockets and chain as an assembly.

CAUTION: The following procedural step must be accomplished to prevent the camshaft from damaging the rear camshaft plug during pin installation.

(15) Inspect the damaged camshaft pin.
(16) If the pin is a spring-type pin, remove the broken pin by inserting a self-tapping screw into the pin and carefully pulling the pin from the camshaft.

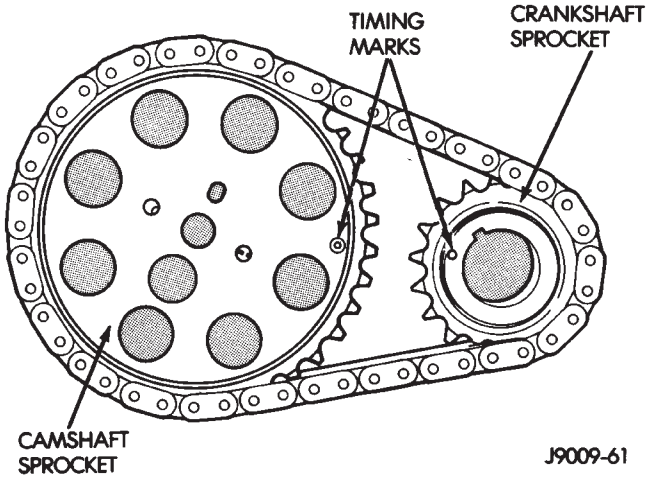

Fig. 11 Timing Chain Alignment—Typical

(17) If the pin is a dowel-type pin, center-punch it. Ensure the exact center is located when center-punching the pin.

CAUTION: Cover the opened oil pan area to prevent metal chips from entering the pan.

(18) Drill into the pin center with a 4 mm (5/32 inch) drill bit.
(19) Insert a self-tapping screw into the drilled pin and carefully pull the pin from the camshaft.

CAMSHAFT BEARINGS

The camshaft rotates within four steel-shelled, babbitt-lined bearings that are pressed into the cylinder block and then line reamed. The camshaft bearing bores and bearing diameters are not the same size. They are stepped down in 0.254 mm (0.010 inch) increments from the front bearing (largest) to the rear bearing (smallest). This permits easier removal and installation of the camshaft. The camshaft bearings are pressure lubricated.

It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available.

Camshaft end play is maintained by the load placed on the camshaft by the sprocket preload bolt tension spring and thrust pin.

INSTALLATION

(1) Clean the camshaft pin hole.
(2) Compress the center of the replacement spring pin with vise grips.
(3) Carefully drive the pin into the camshaft pin hole until it is seated.
(4) Install the camshaft sprocket, crankshaft sprocket and timing chain with the timing marks aligned (Fig. 11).
(5) To verify correct installation of the timing chain, turn the crankshaft to position the camshaft sprocket timing mark as shown in Fig. 12. Count the

number of chain pins between the timing marks of both sprockets. There must be 15 pins.

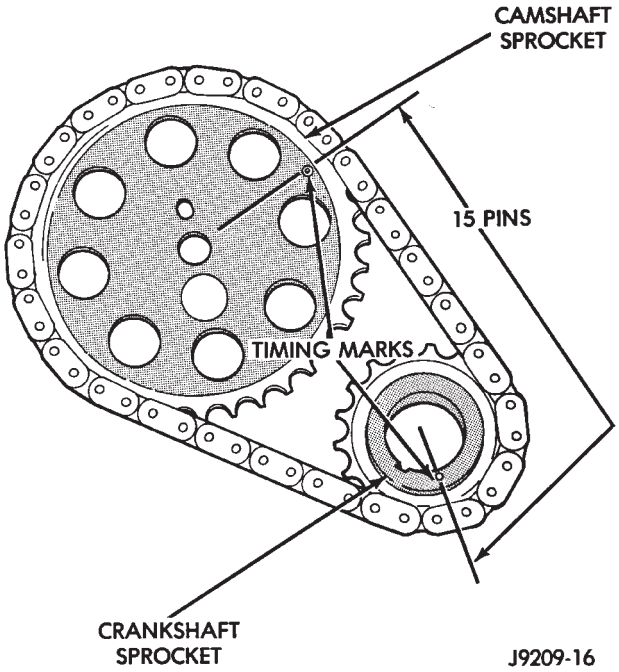

Fig. 12 Verify Crankshaft/Camshaft Installation—Typical

(6) Install the crankshaft oil slinger.

(7) Tighten the camshaft sprocket preload bolt to 108 N·m (80 ft. lbs.) torque.

(8) Check the valve timing.

(9) Lubricate the tension spring, the thrust pin and the pin bore in the preload bolt with Mopar Engine Oil Supplement, or equivalent. Install the spring and thrust pin in the preload bolt head.

(10) Coat both sides of the replacement timing case cover gasket with gasket sealer. Apply a 3 mm (1/8 inch) bead of Mopar Silicone Rubber Adhesive Sealant, or equivalent to the joint formed at the oil pan and cylinder block.

(11) Position the timing case cover on the oil pan gasket and the cylinder block.

(12) Place Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 13).

(13) Install the timing case cover-to-cylinder block bolts. Install the oil pan-to-timing case cover bolts.

(14) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 14 N·m (120 in. lbs.) torque. Tighten the oil pan-to-cover 5/16 inch bolts to 18 N·m (156 in. lbs.) torque.

(15) Remove the cover alignment tool and install a replacement oil seal into the cover.

(16) Install the vibration damper on the crankshaft.

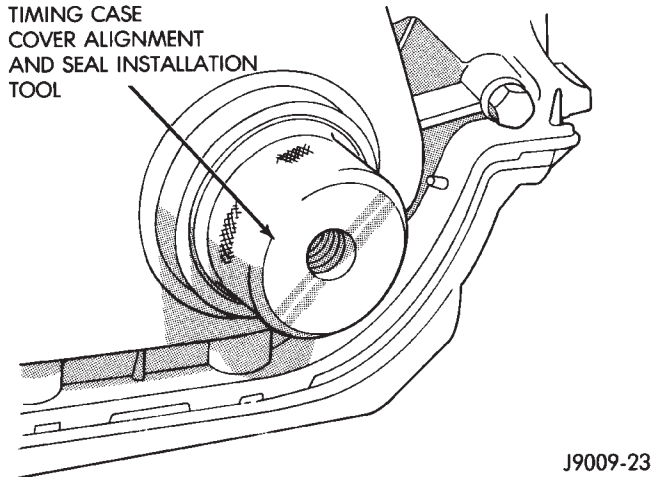

Fig. 13 Timing Case Cover Alignment and Seal Installation Tool 6139

(17) Lubricate and tighten the damper bolt to 108 N·m (80 ft. lbs.) torque.

(18) If equipped with air conditioning:

(a) Install the A/C compressor serpentine drive belt idler pulley.

(b) Install the generator.

(c) Install the A/C condenser and receiver/drier assembly.

(19) Install the serpentine drive belt on the pulleys and tighten (refer to Group 7, Cooling System for the specifications and procedures).

(20) Install the radiator. Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped. Fill the cooling system.

(21) Install the fan and shroud.

(22) Connect negative cable to battery.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Disconnect the exhaust pipe at the exhaust manifold.

(5) Disconnect the exhaust hanger at the catalytic converter and lower the pipe.

(6) Remove the starter motor.

(7) Remove the engine flywheel/transmission torque converter housing access cover.

(8) If equipped with an oil level sensor, disconnect the sensor.

(9) Position a jack stand directly under the engine vibration damper.

(10) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(11) Remove the engine mount through bolts.

(12) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(13) Remove the oil pan bolts. Carefully slide the oil pan and gasket to the rear. If equipped with an oil level sensor, take care not to damage the sensor.

CLEANING

Clean the block and pan gasket surfaces.

INSTALLATION

(1) Fabricate 4 alignment dowels from 1 1/2 x 1/4 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 1).

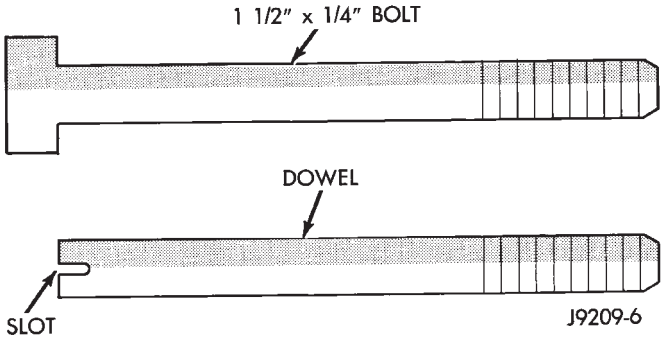

Fig. 1 Fabrication of Alignment Dowels

(2) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 2).

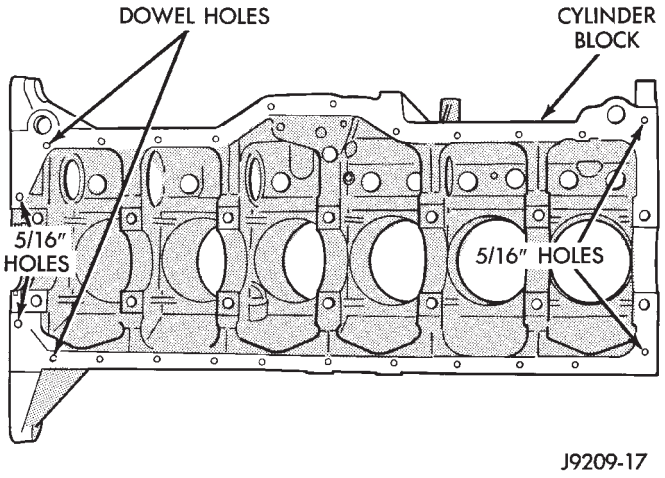

Fig. 2 Position of Dowels in Cylinder Block

(3) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(4) Position the oil pan over the dowels and onto the gasket. If equipped with an oil level sensor, take care not to damage the sensor.

(5) Install the 1/4 inch oil pan bolts. Tighten these bolts to 14 N·m (120 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 3). Tighten these bolts to 18 N·m (156 in. lbs.) torque.

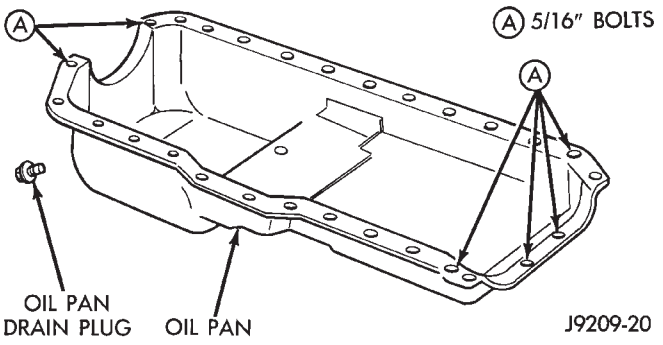

Fig. 3 Position of 5/16 inch Oil Pan Bolts

(6) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 14 N·m (120 in. lbs.) torque.

(7) Lower the engine until it is properly located on the engine mounts.

(8) Install the through bolts and tighten the nuts.

(9) Lower the jack stand and remove the piece of wood.

(10) If equipped with an oil level sensor, connect the sensor.

(11) Install the engine flywheel/transmission torque converter housing access cover.

(12) Install the engine starter motor.

(13) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(14) Install the oil pan drain plug (Fig. 3). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(15) Lower the vehicle.

(16) Connect negative cable to battery.

(17) Fill the oil pan with engine oil to the specified level.

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.

(18) Start the engine and inspect for leaks.

OIL PUMP

A gear-type oil pump is mounted at the underside of the cylinder block opposite the No.4 main bearing.

The pump incorporates a nonadjustable pressure relief valve to limit maximum pressure to 517 kPa (75 psi). In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear remains in mesh with the camshaft gear.

REMOVAL

(1) Drain the engine oil.

(2) Remove the oil pan.

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 4).

CAUTION: If the oil pump is not to be serviced, DO NOT disturb position of oil inlet tube and strainer assembly in pump body. If the tube is moved within the pump body, a replacement tube and strainer assembly must be installed to assure an airtight seal.

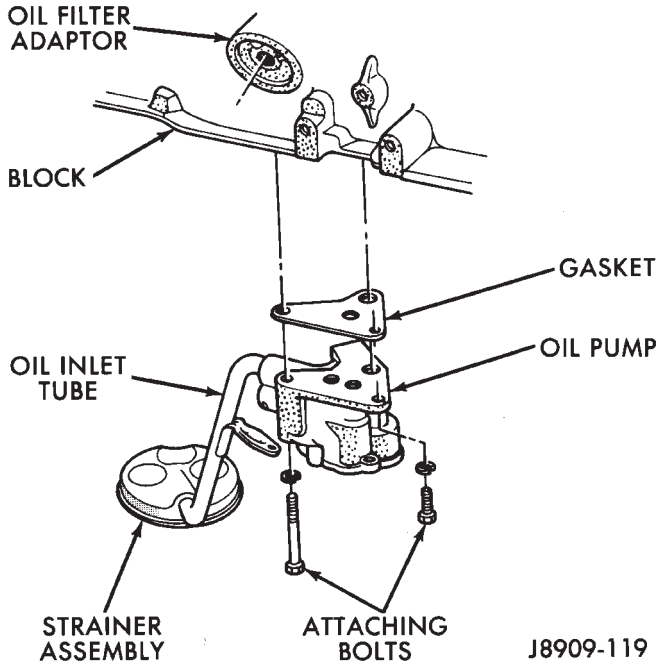

Fig. 4 Oil Pump Assembly

INSTALLATION

(1) Install the oil pump on the cylinder block using a replacement gasket. Tighten the short bolt to 14 N·m (10 ft. lbs.) torque and the long bolt to 23 N·m (17 ft. lbs.) torque.

(2) Install the oil pan.

(3) Fill the oil pan with oil to the specified level.

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 89.6 kPa (13 psi) at 600 rpm. The MAXIMUM oil pump pressure is 255-517 kPa (37-75 psi) at 1600 rpm or more.

PISTONS AND CONNECTING RODS

REMOVAL

(1) Remove the engine cylinder head cover.

(2) Remove the rocker arms, bridges and pivots.

(3) Remove the push rods.

(4) Remove the engine cylinder head.

(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the ridge from the top end of the cylinder walls. Use a protective cloth to collect the cuttings.

(6) Raise the vehicle.

(7) Drain the engine oil.

(8) Remove the oil pan and gasket.

(9) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 1).

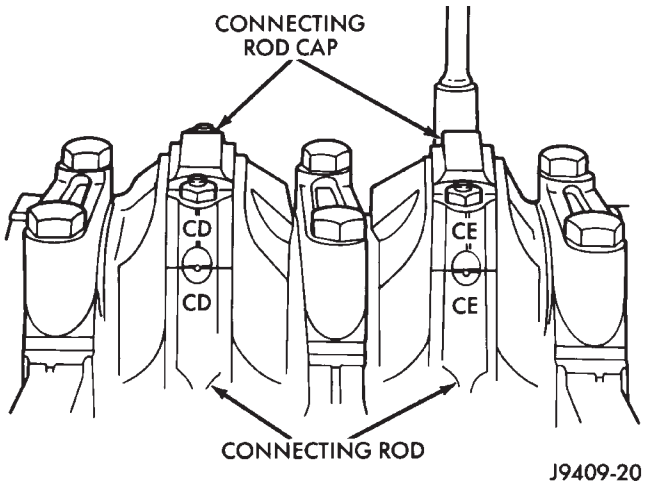

Fig. 1 Stamped Connecting Rods and Caps

(10) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

(11) Have an assistant push the piston/connecting rod assemblies up and through the top of the cylinder bores (Fig. 2).

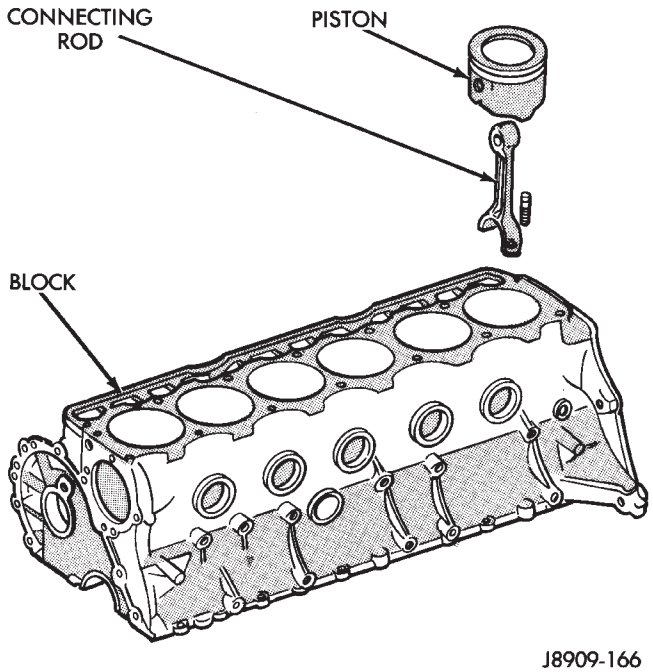

Fig. 2 Removal of Connecting Rod and Piston Assembly

INSPECTION—CONNECTING ROD

CONNECTING ROD BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Figs. 3 and 4). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 5). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

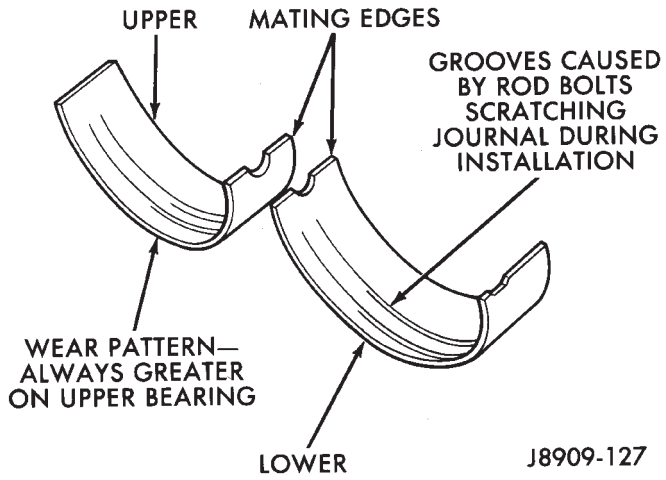

Fig. 3 Connecting Rod Bearing Inspection

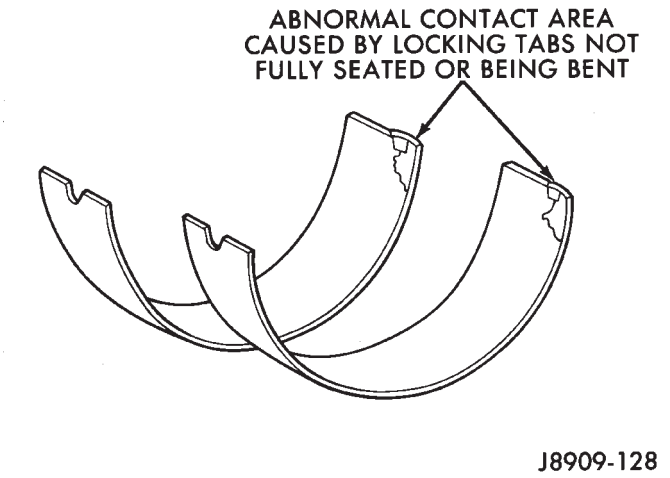

Fig. 4 Locking Tab Inspection

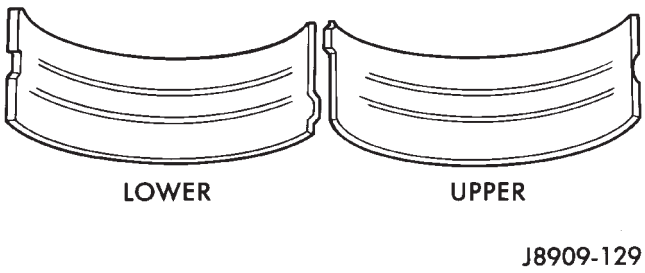

Fig. 5 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

CONNECTING RODS

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.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 6). Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

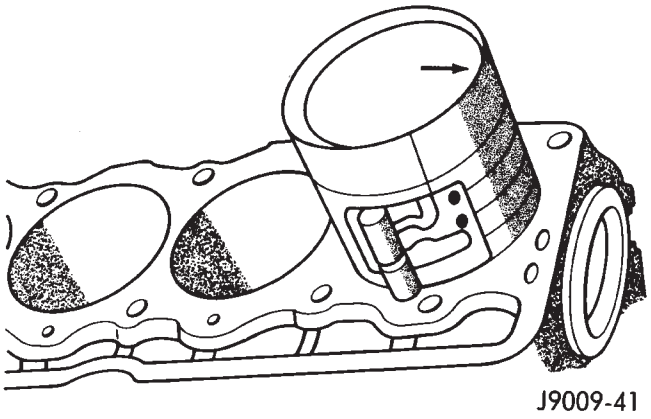

Fig. 6 Rod and Piston Assembly Installation

(5) 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.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(7) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 7). 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.

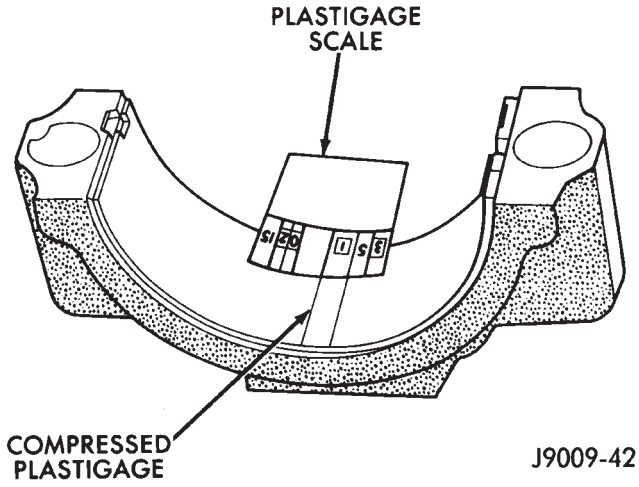

Fig. 7 Measuring Bearing Clearance with Plastigage

(8) 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.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance (refer to Connecting Rod Bearing Fitting Chart).

FOR EXAMPLE: If the initial clearance was 0.0762 mm (0.003 inch), 0.025 mm (0.001 inch) undersize inserts would reduce the clearance by 0.025 mm (0.001 inch). The clearance would be 0.002 inch and within specification. A 0.051 mm (0.002 inch) undersize insert would reduce the initial clearance an additional 0.013 mm (0.0005 inch). The clearance would then be 0.038 mm (0.0015 inch).

(11) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(12) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 45 N·m (33 ft. lbs.) torque.

SIDE CLEARANCE MEASUREMENT

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.

PISTON FITTING

MICROMETER METHOD

(1) Measure the inside diameter of the cylinder bore at a point 58.725 mm (2-5/16 inches) below top of bore.

(2) Measure outside diameter of the piston. Because pistons are cam ground, measure at right angle to piston pin at center line of pin (Fig. 8).

CONNECTING ROD BEARING FITTING CHART

Crankshaft Journal		Corresponding Connecting Rod Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	53.2257-53.2079 mm (2.0955-2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079-53.1901 mm (2.0948-2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901-53.1724 mm (2.0941-2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717-52.9539 mm (2.0855-2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

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The difference between cylinder bore diameter and piston diameter is piston-to-bore clearance.

GROOVE HEIGHT

A 2.0193-2.0447 mm (0.0795-0.0805 in)
B 4.7752-4.8133 mm (0.1880-0.1895 in)

GROOVE DIAMETER

D - E 87.78-87.90 mm (3.456-3.461 in)
F 87.50-87.75 mm (3.445-3.455 in)

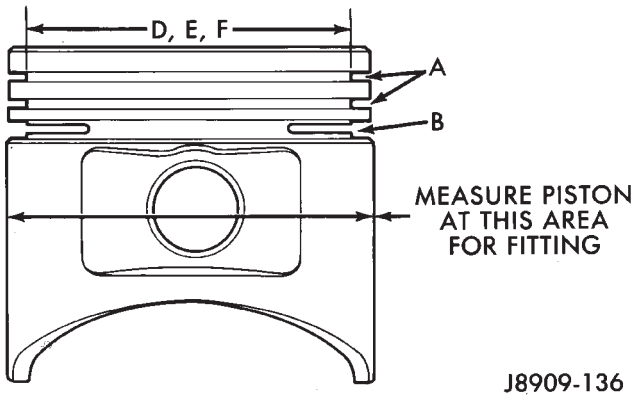

Fig. 8 Piston Dimensions

FEELER GAUGE METHOD

(1) Remove the rings from the piston.

(2) Insert a long 0.025 mm (0.001 inch) feeler gauge into the cylinder bore.

(3) Insert the piston, top first, into cylinder bore alongside the feeler gauge. With entire piston inserted into cylinder bore, the piston should not bind against feeler gauge.

(4) Repeat steps with a long 0.051 mm (0.002 inch) feeler gauge. The piston should bind.

(5) If the piston binds on 0.025 mm (0.001 inch) feeler gauge, the piston is too large or cylinder bore is too small. If the piston does not bind on 0.051 mm (0.002 inch) feeler gauge, the piston is too small for cylinder bore. Pistons up to 0.102 mm (0.004 inch) undersize may be enlarged by knurling or shot-peening. Replace pistons that are 0.102 mm (0.004 inch) or more undersize.

PISTON PIN

REMOVAL

Piston pins are press-fitted into the connecting rods and require no locking device.

(1) Position the piston and connecting rod assembly on an arbor press.

(2) Apply force to a piloted driver and press the pin completely out of the connecting rod and piston assembly (Fig. 9). Note position of the pin through the gauge window of removal support tool.

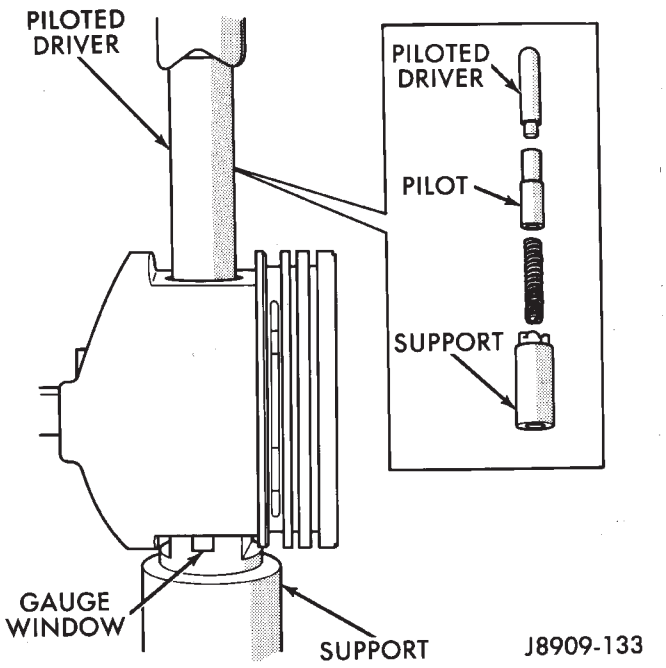

Fig. 9 Piston Pin Removal/Installation

INSPECTION

(1) Inspect the piston pin and pin bore in the connecting rod for nicks and burrs. Remove as necessary. Never reuse a piston pin after it has been installed in and removed from a connecting rod.

(2) With the pin removed from the piston and connecting rod, clean and dry piston pin bores and the replacement piston pin.

(3) Position the piston so that the pin bore is in vertical position. Insert the pin in bore. At room temperature, the replacement pin should slide completely through the pin bore in piston by force of gravity.

(4) Replace piston if pin jams in the pin bore.

INSTALLATION

(1) Insert the piston pin pilot through the piston and connecting rod pin bores. Ensure that the arrow on the piston crown is pointing up (Fig. 10).

(2) Position the pin pilot, piston and connecting rod on a support with the squirt hole of the connecting rod to the left-hand side (Fig. 10).

(3) Insert piston pin through the upper piston pin bore and into the connecting rod pin bore.

(4) Position the piloted driver inside the piston pin (Fig. 9).

(5) Using an arbor press, press the piston pin through the connecting rod and piston bores until pin pilot indexes with mark on the support. The piston pin requires a 8 900 N (2,000 pounds) press-fit. If little effort is required to install piston pin in a connecting rod, or if the rod moves laterally on the pin, the connecting rod must be replaced.

(6) Remove the piston and connecting rod assembly from the press. The pin should be centered in the connecting rod (±0.792 mm or ±0.0312 inch) and float in the piston pin bore.

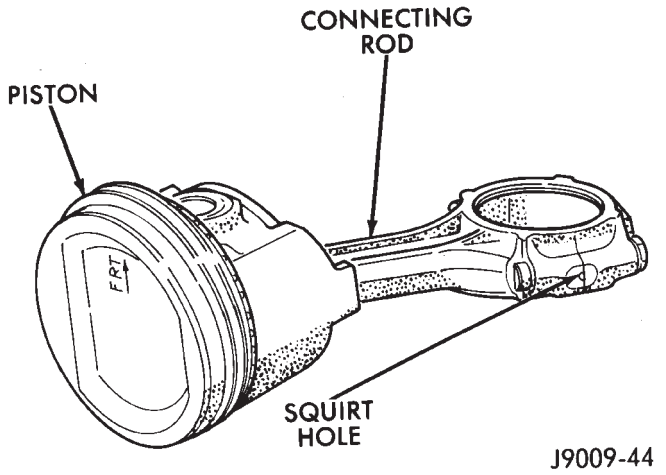

Fig. 10 Correct Alignment—Piston and Connecting Rod

PISTON RING FITTING

(1) Carefully clean the carbon from all ring grooves. Oil drain openings in the oil ring groove and pin boss must be clear. DO NOT remove metal from the grooves or lands. This will change ring-to-groove clearances and will damage the ring-to-land seating.

(2) Be sure the piston ring grooves are free of nicks and burrs.

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 11). Rotate the ring in the groove. It must move freely around circumference of the groove.

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 12). The correct compression ring end gap is 0.25-0.51 mm (0.010-0.020 inch). The correct oil control ring end gap is 0.381-1.397 mm (0.015-0.055 inch).

(5) Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(6) The two compression rings are different and cannot be interchanged. The top ring (Fig. 13) is a moly ring (the scraping edge is gray in color). The second ring (Fig. 14) is a black cast iron ring (the scraping edge is black in color when new). The compression rings may also be identified by 1 or 2 dots on the top surface of the ring (Figs. 13 and 14).

(7) The second compression ring (black cast iron) has a chamfer on the BOTTOM of the inside edge (Fig. 15). This ring may also have 2 dots located on the top surface.

	Millimeters	Inches
No. 1 Compression	0.025-0.081 (0.043 Preferred)	0.001-0.0032 (0.0017 Preferred)
No. 2 Compression	0.025-0.081 (0.043 Preferred)	0.001-0.0032 (0.0017 Preferred)
Oil Control	0.025-0.241 (0.08 Preferred)	0.001-0.0095 (0.003 Preferred)

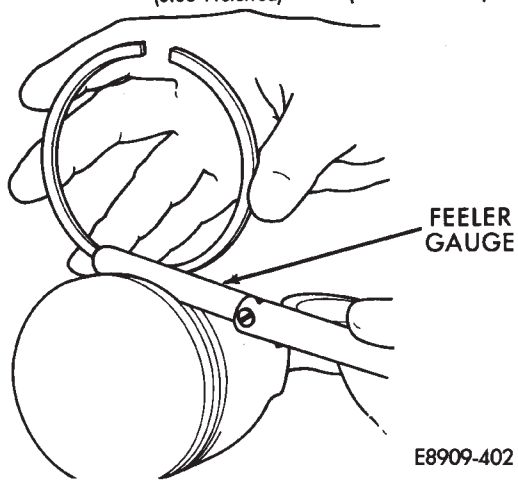

Fig. 11 Ring Side Clearance Measurement

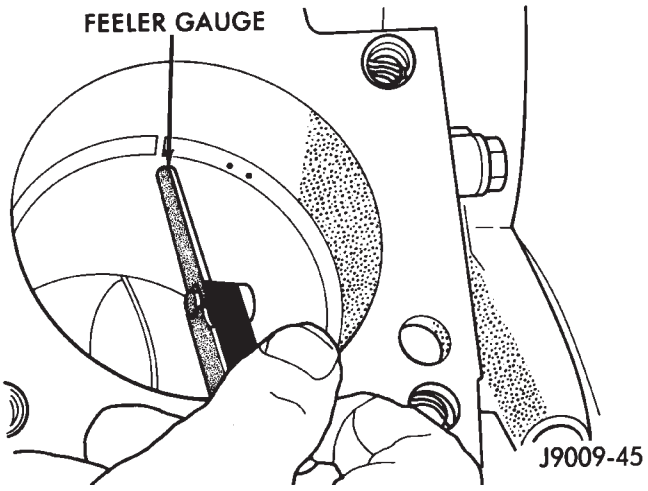

Fig. 12 Ring Gap Measurement

(8) Using a ring installer, install the second compression ring with the chamfer facing down (Fig. 16). The two dots will be facing up.

(9) The top compression ring (the scraping edge is gray in color) has a chamfer on the TOP of the inside edge (Fig. 15). This ring may also have 1 dot located on the top surface.

(10) Using a ring installer, install the top ring with the chamfer facing up (Fig. 16). The dot will be facing up.

(11) Position the gaps on the piston (Fig. 17):

- Oil spacer - Gap on center line of piston pin bore.
- Oil rails - Gap 180° apart on centerline of piston skirt.
- No. 2 Compression ring - Gap 180° from top oil rail gap.

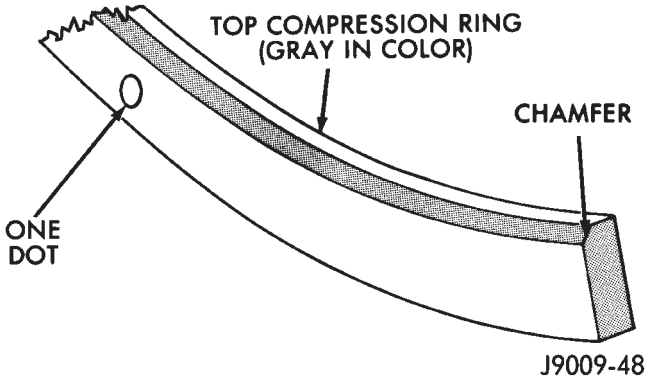

Fig. 13 Top Compression Ring Identification

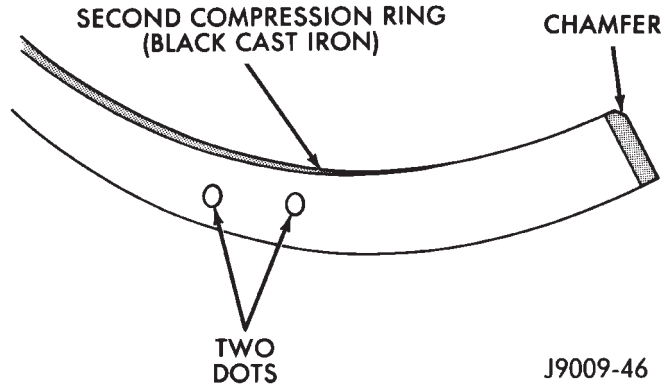

Fig. 14 Second Compression Ring Identification

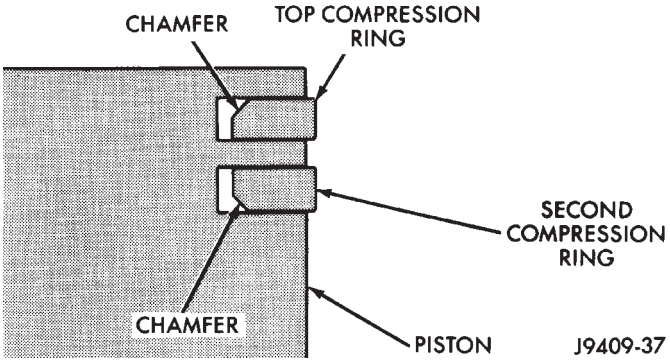

Fig. 15 Compression Ring Chamfer Location

• No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

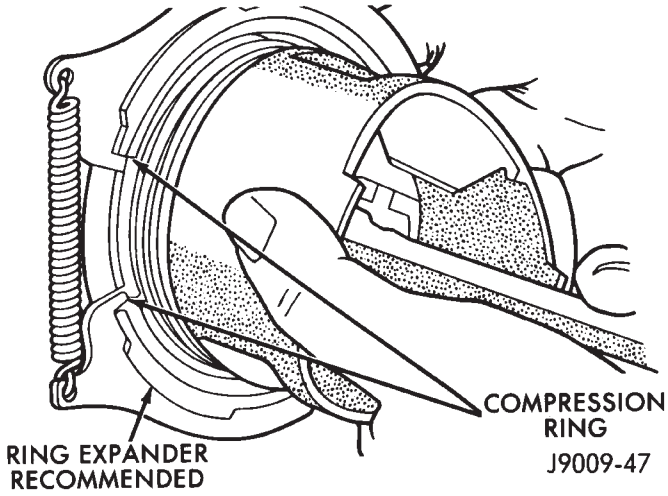

Fig. 16 Compression Ring Installation

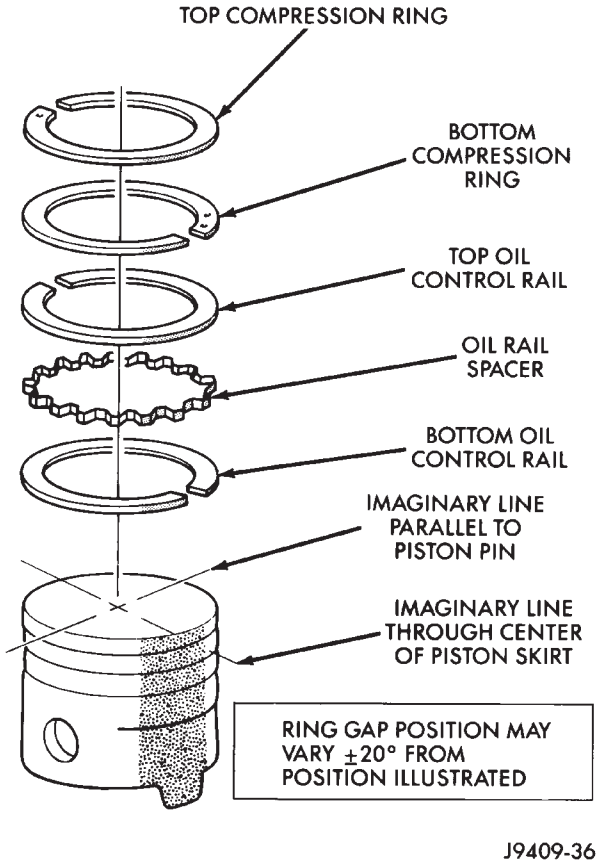

Fig. 17 Ring Gap Position

CLEANING

Clean the cylinder bores thoroughly. Apply a light film of clean engine oil to the bores with a clean lint-free cloth.

INSTALLATION

(1) Install the piston rings on the pistons if removed.

(2) Lubricate the piston and rings with clean engine oil.

CAUTION: Ensure that connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(3) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 18).

(4) Ensure the arrow on the piston top points to the front of the engine (Fig. 18).

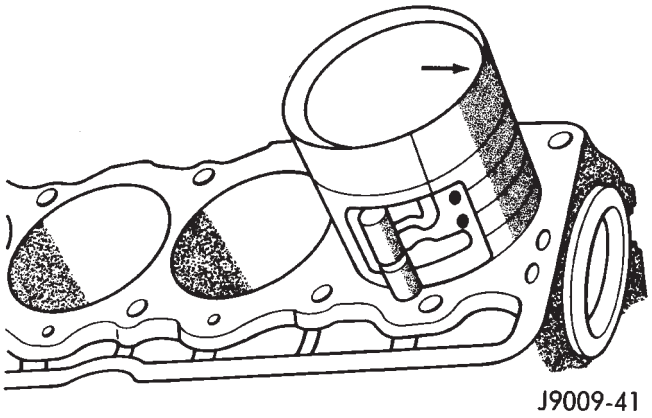

Fig. 18 Rod and Piston Assembly Installation

(5) Raise the vehicle.

Each bearing insert is fitted to its respective journal to obtain the specified clearance between the bearing and the journal. In production, the select fit is obtained by using various-sized, color-coded bearing inserts as listed in the Connecting Rod Bearing Fitting Chart. The color code appears on the edge of the bearing insert. The size is not stamped on inserts used for production of engines.

The rod journal is identified during the engine production by a color-coded paint mark on the adjacent cheek or counterweight toward the flange (rear) end of the crankshaft. The color codes used to indicate journal sizes are listed in the Connecting Rod Bearing Fitting Chart.

When required, upper and lower bearing inserts of different sizes may be used as a pair (refer to Connecting Rod Bearing Fitting Chart). A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce clearance 0.013 mm (0.0005 inch).

CAUTION: DO NOT intermix bearing caps. Each connecting rod and bearing cap are stamped with the cylinder number. The stamp is located on a machined surface adjacent to the oil squirt hole that faces the camshaft side of the cylinder block.

(6) Install the connecting rod bearing caps and inserts in the same positions as removed.

CAUTION: Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(7) Install the oil pan and gaskets as outlined in the installation procedure.

(8) Lower the vehicle.

(9) Install the engine cylinder head, push rods, rocker arms, bridges, pivots and engine cylinder head cover.

(10) Fill the crankcase with engine oil.

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the spark plugs.

(3) Raise the vehicle.

(4) Remove the oil pan and oil pump.

(5) Remove only one main bearing cap and lower insert at a time (Fig. 1).

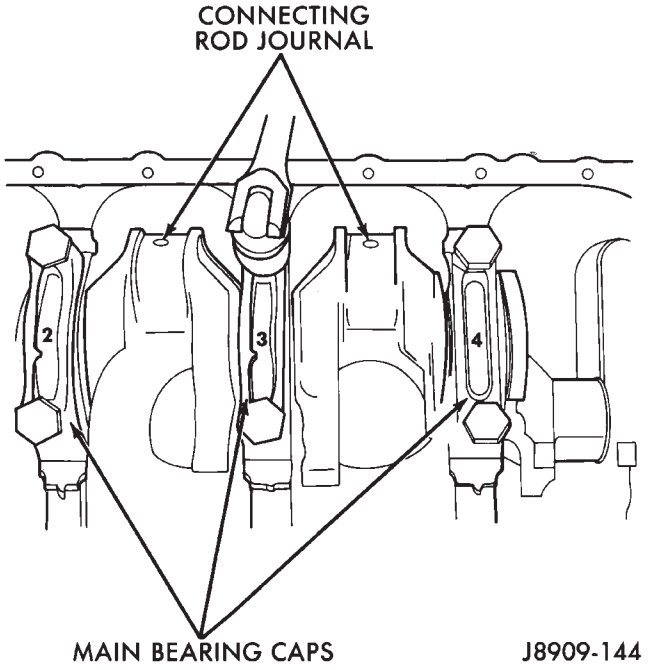

Fig. 1 Removing Main Bearing Caps and Lower Inserts

(6) Remove the lower insert from the bearing cap.

(7) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 2). With the cotter pin tool in place, rotate the crankshaft so that the upper bearing insert will rotate in the direction of its locking tab. Because there is no hole in the No.3 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing insert (Fig. 2). After moving

the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(8) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

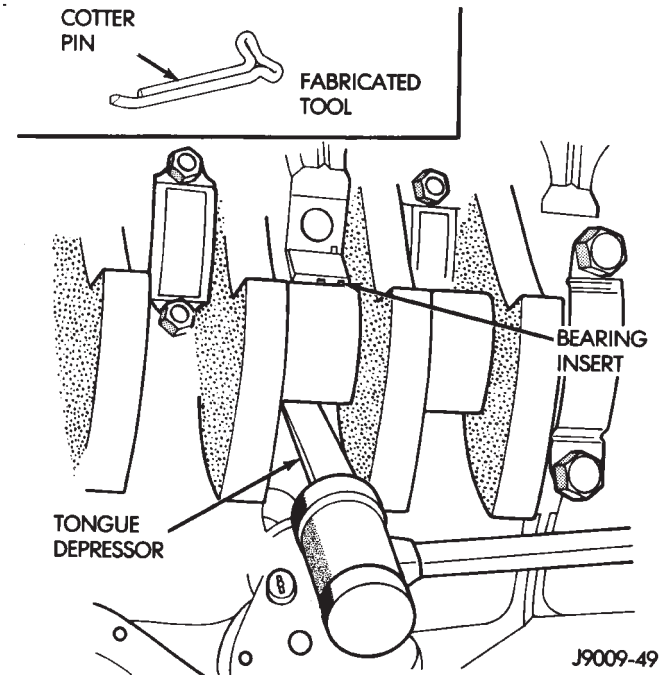

Fig. 2 Removing Upper Inserts

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 (Fig. 3).

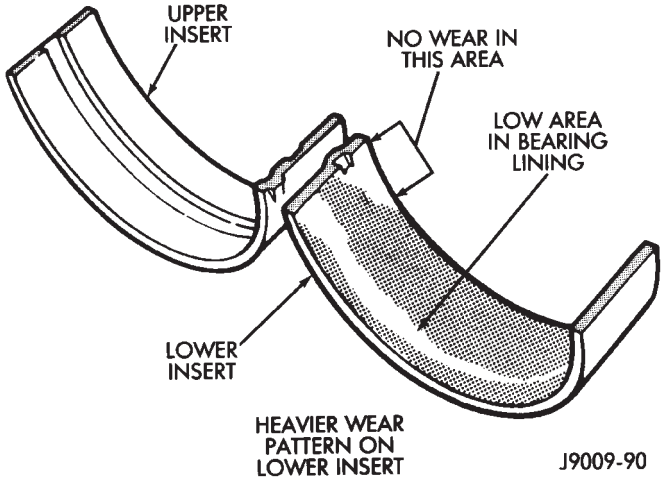

Fig. 3 Main Bearing Wear Patterns

If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

FITTING (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 7 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

Each bearing insert pair is selectively fitted to its respective journal to obtain the specified operating clearance. In production, the select fit is obtained by using various-sized color-coded bearing insert pairs as listed in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert. **The size is not stamped on bearing inserts used for engine production.**

The main bearing journal size (diameter) is identified by a color-coded paint mark on the adjacent cheek. The rear main journal, is identified by a color-coded paint mark on the crankshaft rear flange.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce the clearance by 0.013 mm (0.0005 inch). **Never use a pair of bearing inserts with greater than a 0.025 mm (0.001 inch) difference in size (Fig. 4).**

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

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Fig. 4 Bearing Insert Pairs

When replacing inserts, the odd size inserts must be either all on the top (in cylinder block) or all on the bottom (in main bearing cap).

Once the bearings have been properly fitted, proceed to Crankshaft Main Bearing—Installation.

BEARING-TO-JOURNAL CLEARANCE (CRANKSHAFT INSTALLED)

When using Plastigage, check only one bearing clearance at a time.

Install the grooved main bearings into the cylinder block and the non-grooved bearings into the bearing caps.

Install the crankshaft into the upper bearings dry.

Place a strip of Plastigage across full width of the crankshaft journal to be checked.

Install the bearing cap and tighten the bolts to 108 N·m (80 ft. lbs.) torque.

DO NOT rotate the crankshaft. This will cause the Plastigage to shift, resulting in an inaccurate reading. Plastigage must not be permitted to crumble. If brittle, obtain fresh stock.

Remove the bearing cap. Determine the amount of clearance by measuring the width of the compressed Plastigage with the scale on the Plastigage envelope (Fig. 5). Refer to Engine Specifications for the proper clearance.

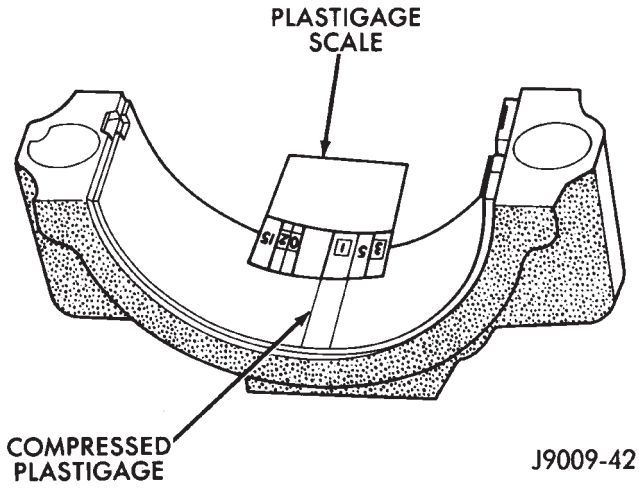

Fig. 5 Measuring Bearing Clearance with Plastigage

Plastigage should indicate the same clearance across the entire width of the insert. If clearance varies, it may indicate a tapered journal or foreign material trapped behind the insert.

If the specified clearance is indicated and there are no abnormal wear patterns, replacement of the bearing inserts is not necessary. Remove the Plastigage from the crankshaft journal and bearing insert. Proceed to Crankshaft Main Bearing—Installation.

If the clearance exceeds specification, install a pair of 0.025 mm (0.001 inch) undersize bearing inserts and measure the clearance as described in the previous steps.

The clearance indicated with the 0.025 mm (0.001 inch) undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance.

FOR EXAMPLE: If the clearance was 0.0762 mm (0.003 inch) originally, a pair of 0.0254 mm (0.001 inch) undersize inserts would reduce the clearance by 0.0254 mm (0.001 inch). The clearance would then be 0.0508 mm (0.002 inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

CAUTION: Never use a pair of inserts that differ more than one bearing size as a pair.

FOR EXAMPLE: DO NOT use a standard size upper insert and a 0.051 mm (0.002 inch) undersize lower insert.

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts, measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

Replace the crankshaft or grind to accept the appropriate undersize bearing inserts if:

- Journal diameters 1 through 6 are less than 63.4517 mm (2.4981 inches)
- Journal 7 diameter is less than 63.4365 mm (2.4975 inches).

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (refer to Cylinder Block - Disassemble).

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 and out of round is 0.013 mm (0.0005 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 Cylinder Block - Assemble and Crankshaft Main Bearings - Installation).

INSTALLATION

(1) Lubricate the bearing surface of each insert with engine oil.

(2) Loosen all the main bearing caps. Install the main bearing upper inserts.

(3) Install the lower bearing inserts into the main bearing caps.

(4) Install the main bearing cap(s) and lower insert(s).

(5) Tighten the bolts of caps 1, 2, 4, 5, 6, and 7 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.

(6) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.3 to 54 N·m (40 ft. lbs.) torque. Then tighten to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

(7) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

MAIN BEARING FITTING CHART

Crankshaft Journals #1 - #6		Corresponding Crankshaft Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.5025-63.4898 mm (2.5001-2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898-63.4771 mm (2.4996-2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4771-63.4644 mm (2.4991-2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4644-63.4517 mm (2.4986-2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485-63.2358 mm (2.4901-2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

Crankshaft Journals #7 Only		Corresponding Crankshaft Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.4873-63.4746 mm (2.4995-2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4746-63.4619 mm (2.4990-2.4985 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4619-63.4492 mm (2.4985-2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492-63.4365 mm (2.4980-2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333-63.2206 mm (2.4895-2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

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(8) Check crankshaft end play. Crankshaft end play is controlled by the thrust bearing which is flange and installed at the No.2 main bearing position.

(a) Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.

(b) Position the dial indicator rod so that it is parallel to the center line of the crankshaft.

(c) Pry the crankshaft forward, position the dial indicator to zero.

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 6). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

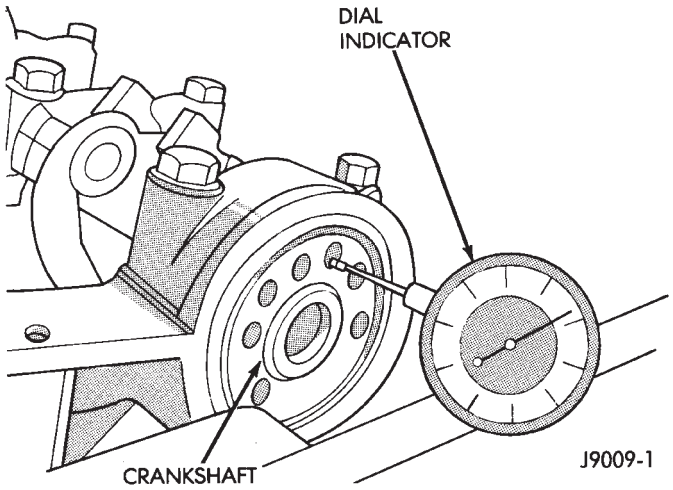

Fig. 6 Crankshaft End Play Measurement

(e) If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace the thrust bearing and measure end play. If end play is still not within specification, replace the crankshaft.

If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

(9) Install the oil pan.

(10) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(11) Lower the vehicle.

(12) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(13) Fill the oil pan with engine oil to the full mark on the dipstick level.

(14) Connect negative cable to battery.

REAR MAIN OIL SEALS

The crankshaft rear main bearing oil seal consists of two half pieces of viton with a single lip that effectively seals the rear of the crankshaft. Replace the upper and lower seal halves as a unit to ensure leak-free operation.

REMOVAL

(1) Remove the engine flywheel or converter drive plate.

(2) Remove the oil pan.

(3) Remove the rear main bearing cap (No.7).

(4) Push the upper seal out of the groove. Ensure that the crankshaft and seal groove are not damaged.

(5) Remove the lower half of the seal from the bearing cap.

INSTALLATION

(1) Wipe the seal surface area of the crankshaft until it is clean.

(2) Apply a thin coat of engine oil.

(3) Coat the lip of the seal with engine oil.

(4) Carefully position the upper seal into the groove in the cylinder block. The lip of the seal faces toward the front of the engine.

(5) Place the lower half of the seal into bearing cap No.7 (Fig. 7).

(6) Coat the outer curved surface of the lower seal with soap and the lip of the seal with engine oil (Fig. 7).

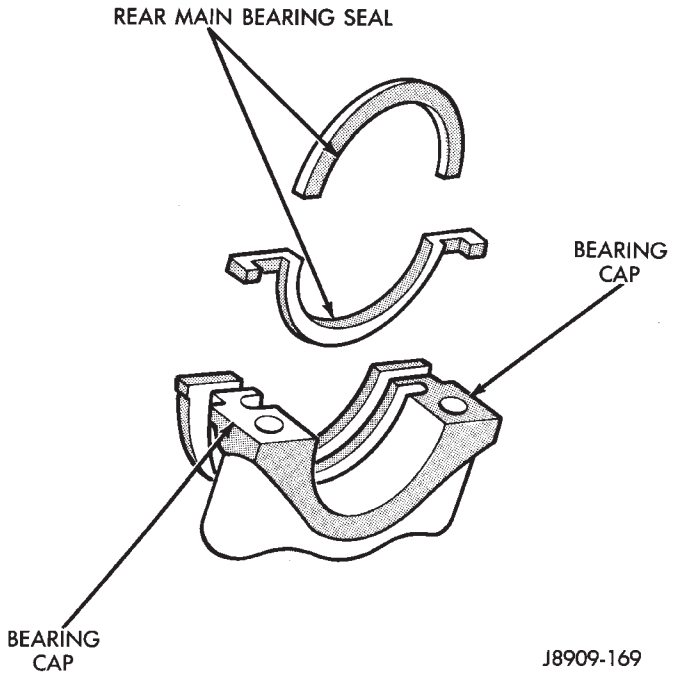

Fig. 7 Rear Main Bearing Oil Seal

(7) Position the lower seal into the bearing cap recess and seat it firmly. Be sure the seal is flush with the cylinder block pan rail.

(8) Apply Loctite 515, or equivalent on the rear bearing cap (Fig. 8). The bead should be 3 mm (0.125 in) thick. DO NOT apply Loctite 515, or equivalent to the lip of the seal.

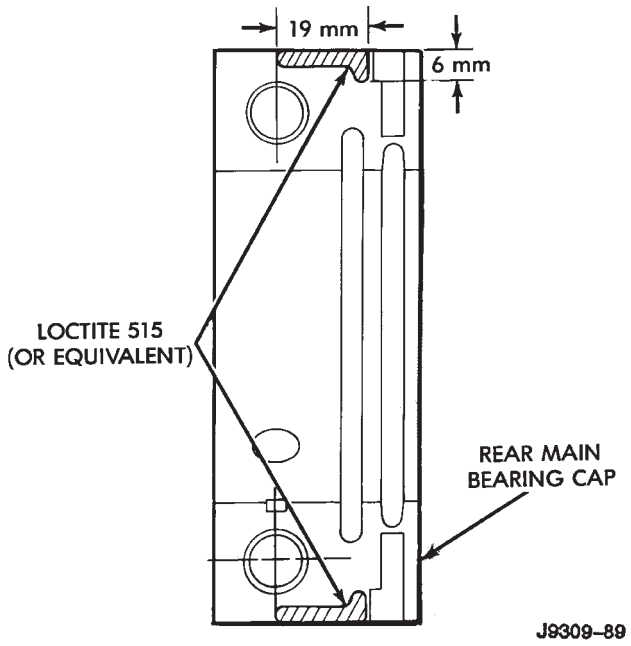

Fig. 8 Location of Loctite 515 (or equivalent)

(9) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

(10) Tighten all main bearing bolts to 108 N·m (80 ft. lbs.) torque.

(11) Install the oil pan gasket and oil pan.

(12) Install the engine flywheel or converter drive plate.

CYLINDER BLOCK

Remove the Engine Assembly from the vehicle.

DISASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Drain the engine oil. Remove and discard the oil filter.

(2) Remove the water pump from the cylinder block.

(3) Remove the vibration damper.

(4) Remove the timing case cover and lay the cover upside down.

(5) Position a drift punch into the slot in the back of the cover and tap the old seal out.

(6) Remove the oil slinger from crankshaft.

(7) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly.

(8) Remove the camshaft.

(9) Remove the oil pan and gasket.

(10) Remove the front and rear oil galley plugs.

(11) Remove the oil pump.

(12) Remove the connecting rods and the pistons. Remove the connecting rod and piston assemblies through the top of the cylinder bores.

(13) Remove the crankshaft.

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 filter bypass hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

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 41 N·m (30 ft. lbs.) torque.

INSPECTION—CYLINDER BORE

(1) Use a bore gauge to measure each cylinder bore diameter (Fig. 9). If a bore gauge is not available, use an inside micrometer.

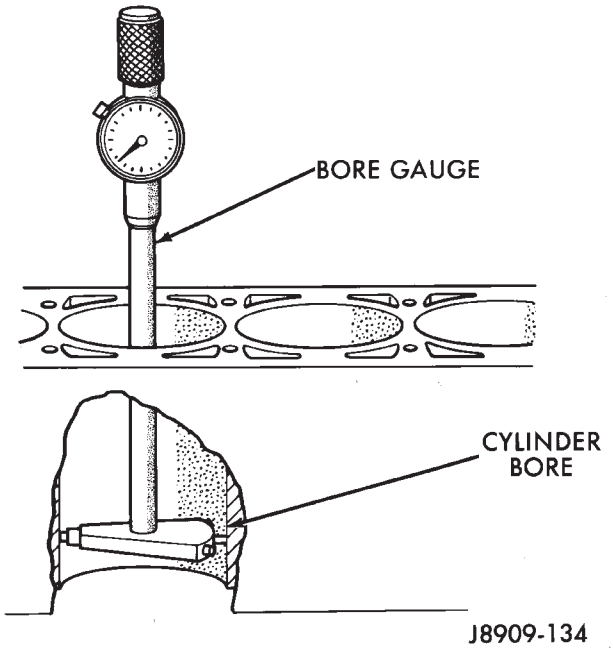

Fig. 9 Cylinder Bore Measurement

(2) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the bottom of the bore.

(3) Determine taper by subtracting the smaller diameter from the larger diameter.

(4) Rotate measuring device 120° and repeat steps above. Finally, rotate the device another 120° and repeat measurements.

(5) Determine out-of-roundness by comparing the difference between each 120° measurement.

(6) 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 must be bored and then honed to accept an oversize

piston. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

HONING—CYLINDER BORE

The honing operation should be closely coordinated with the fitting of pistons and rings. This will ensure specified clearances are maintained.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

ASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Install the crankshaft.

(2) Install the connecting rods and the pistons through the top of the cylinder bores.

(3) Install the oil pump.

(4) Install the oil pan and gasket.

(5) Install the camshaft.

(6) Install the sprockets and chain as an assembly.

(7) Install the oil slinger from the crankshaft.

(8) Install the timing case cover seal.

(9) Install the timing case cover.

(10) Install the vibration damper.

(11) Install the water pump. Tighten the mounting bolts to 31 N·m (270 in. lbs.) torque.

(12) Lubricate the oil filter seal with clean engine oil. Tighten oil filter to 18 N·m (13 ft. lbs.) torque.

(13) Install the engine into the vehicle.

(14) Fill the engine with clean lubrication oil (refer to Group 0, Lubrication and Maintenance).

(15) Fill the cooling system (refer to Group 7, Cooling System for the proper procedures).

SPECIFICATIONS

ENGINE SPECIFICATIONS

Camshaft

Hydraulic Tappet Clearance	Zero Lash
Bearing Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Bearing Journal Diameter	
No.1	51.54 - 51.56 mm (2.029 - 2.030 in)
No.2	51.28 - 51.31 mm (2.019 - 2.020 in)
No.3	51.03 - 51.05 mm (2.009 - 2.010 in)
No.4	50.78 - 50.80 mm (1.999 - 2.000 in)
Base Circle Runout	0.03 mm - max. (0.001 in - max.)
Camshaft Lobe Lift	6.43 mm (0.253 in)
Valve Lift	10.29 mm (0.405 in)
Intake Valve Timing	
Opens	15°BTDC
Closes	75°ABDC
Exhaust Valve Timing	
Opens	59°BBDC
Closes	31°ATDC
Valve Overlap	46°
Intake Duration	270°
Exhaust Duration	270°

Crankshaft

End Play	0.038 - 0.165 mm (0.0015 - 0.0065 in)
Main Bearing Journal Diameter	
No.1-6	63.489 - 63.502 mm (2.4996 - 2.5001 in)
No.7	63.449 - 63.487 mm (2.4980 - 2.4995 in)
Main Bearing Journal Width	
No.1	27.58 - 27.89 mm (1.086 - 1.098 in)
No.3	32.28 - 32.33 mm (1.271 - 1.273 in)
No.2-4-5-6-7	30.02 - 30.18 mm (1.182 - 1.188 in)
Main Bearing Clearance	0.03 - 0.06 mm (0.001 - 0.0025 in)
Preferred	0.051 mm (0.002 in)
Connecting Rod Journal Dia.	53.17 - 53.23 mm (2.0934 - 2.0955 in)
Connecting Rod Journal Width	27.18 - 27.33 mm (1.070 - 1.076 in)
Out-of-Round (Max. All Journals)	0.013 mm (0.0005 in)
Taper (Max. - All Journals)	0.013 mm (0.0005 in)

Cylinder Block

Deck Height	240.03 - 240.18 mm (9.450 - 9.456 in)
Deck Clearance (Below Block)	0.546 mm (0.0215 in)
Cylinder Bore Diameter	
Standard	98.45 - 98.48 mm (3.8759 - 3.8775 in)
Taper (Max.)	0.025 mm (0.001 in)
Out-of-Round	0.025 mm (0.001 in)
Tappet Bore Diameter.	23.000 - 23.025 mm (0.9055 - 0.9065 in)
Flatness	0.03 mm per 25 mm (0.001 in per 1 in) 0.05 mm per 152 mm (0.002 in per 6 in) 0.20 mm - max. for total length (0.008 in - max. for total length)
Main Bearing Bore Dia.	68.3514 - 68.3768 mm (2.691 - 2.692 in)

Connecting Rods

Total Weight (Less Bearing)	657 - 665 grams (23.17 - 23.45 oz)
Length (Center-to-Center)	155.52 - 155.62 mm (6.123 - 6.127 in)
Piston Pin Bore Diameter	23.59 - 23.62 mm (0.9288 - 0.9298 in)
Bore (Less Bearings)	56.08 - 56.09 mm (2.2080 - 2.2085 in)
Bearing Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Preferred	0.044 - 0.050 mm (0.0015 - 0.0020 in)
Side Clearance.	0.25 - 0.48 mm (0.010 - 0.019 in)
Twist (Max.)	0.001 mm per mm (0.001 in per in)
Bend (Max.)	0.0005 mm per mm (0.0005 in per in)

Cylinder Compression Pressure

Ratio	8.7:1
Pressure Range	827 - 1 034 kPa (120 - 150 psi)
Max. Variation Between Cylinders	206 kPa (30 psi)

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ENGINE SPECIFICATIONS (CONT.)

Cylinder Head

Combustion Chamber	55.22 - 58.22 cc (3.37 - 3.55 cu. in.)
Valve Guide I.D. (Integral)	7.9 mm (0.312 in)
Valve Stem-to-Guide Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Intake Valve Seat Angle	44.5°
Exhaust Valve Seat Angle	44.5°
Valve Seat Width	1.02 - 1.52 mm (0.040 - 0.060 in)
Valve Seat Runout	0.064 mm (0.0025 in)
Flatness	0.03 mm per 25 mm (0.001 in per 1 in) 0.05 mm per 152 mm (0.002 in per 6 in) 0.20 mm - max. for total length (0.008 in - max. for total length)

Rocker Arms, Push Rods & Tappets

Rocker Arm Ratio	1.6:1
Push Rod Length	244.856 - 245.364 mm (9.640 - 9.660 in)
Push Rod Diameter	7.92 - 8.00 mm (0.312 - 0.315 in)
Hydraulic Tappet Diameter	22.962 - 22.974 mm (0.904 - 0.9045 in)
Tappet-to-Bore Clearance	0.025 - 0.063 mm (0.001 - 0.0025 in)

Valves

Length (Tip-to-Gauge Dimension Line)	
Intake	122.479 - 122.860 mm (4.822 - 4.837 in)
Exhaust	122.860 - 123.241 mm (4.837 - 4.852 in)
Valve Stem Diameter	7.899 - 7.925 mm (0.311 - 0.312 in)
Stem-to-Guide Clearance	0.025 - 0.076 mm (0.001 - 0.003 in)
Valve Head Diameter	
Intake	48.387 - 48.641 mm (1.905 - 1.915 in)
Exhaust	37.973 - 38.227 mm (1.495 - 1.505 in)
Valve Face Angle	
Intake	45°
Exhaust	45°
Tip Refinishing (Max. Allowable)	0.25 mm (0.010 in)

Valve Springs

Free Length (Approx.)	49.962 mm (1.967 in)
Spring Tension	
Valve Closed	360 - 396 N @ 41.656 mm (81 - 89 lbf @ 1.640 in)
Valve Open	845 - 934 N @ 30.886 mm (190 - 210 lbf @ 1.216 in)
Inside Diameter	24.08 - 24.59 mm (0.948 - 0.968 in)

Pistons

Weight (Less Pin)	563 - 567 grams (19.86 - 20.00 oz)
Piston Pin Bore (Centerline-to-Piston Top)	40.61 - 40.72 mm 1.599 - 1.603 in)
Piston-to-Bore Clearance	0.033 - 0.053 mm (0.0013 - 0.0021 in)
Preferred	0.033 - 0.038 mm (0.0013 - 0.0015 in)
Piston Ring Gap Clearance	
Compression Rings	0.25 - 0.51 mm (0.010 - 0.020 in)
Oil Control Steel Rails	0.25 - 0.64 mm (0.010 - 0.025 in)
Piston Ring Side Clearance	
Compression Rings	0.025 - 0.081 mm (0.001 - 0.0032 in)
Preferred	0.025 mm (0.001 in)
Oil Control Ring	0.025 - 0.241 mm (0.001 - 0.0095 in)
Preferred	0.08 mm (0.003 in)
Piston Ring Groove Height	
Compression Rings	2.019 - 2.045 mm (0.0795 - 0.0805 in)
Oil Control Ring	4.78 - 4.80 mm (0.1880 - 0.1895 in)
Piston Ring Groove Diameter	
Compression Rings	88.30 - 88.55 mm (3.476 - 3.486 in)
Oil Control Ring	90.35 - 90.60 mm (3.557 - 3.566 in)
Piston Pin Bore Diameter	23.647 - 23.655 mm (0.9310 - 0.9313 in)
Piston Pin Diameter	23.637 - 23.640 mm (0.9306 - 0.9307 in)
Piston-to-Pin Clearance	0.0076 - 0.0178 mm - Loose (0.0003 - 0.0007 in - Loose)
Preferred	0.013 mm (0.0005 in)
Piston-to-Pin Connecting Rod (Press Fit)	8.9 kN (2000 lb f)

ENGINE SPECIFICATIONS (CONT.)

Oil Pump

Gear-to-Body Clearance (Radial)	0.051 - 0.102 mm (0.002 - 0.004 in)
Preferred	0.051 mm (0.002 in)
Gear End Clearance	
Plastigage	0.051 - 0.152 mm (0.002 - 0.006 in)
Preferred	0.051 mm (0.002 in)
Feeler Gauge	0.1016 - 0.2032 mm (0.004 - 0.008 in)
Preferred	0.1778 mm (0.007 in)

Oil Pressure

At Idle Speed (600 rpm)	89.6 kPa (13 psi)
At 1600 rpm & higher.	255 - 517 kPa (37 - 75 psi)
Oil Pressure Relief.	517 kPa (75 psi)

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TORQUE SPECIFICATIONS

Description	Torque
A/C Compressor Bracket-to-Engine Bolts	34 N•m (25 ft. lbs.)
A/C Compressor Mounting Bolts	27 N•m (20 ft. lbs.)
A/C Low Pressure Service Valve Nut	38 N•m (28 ft. lbs.)
Block Heater Nut	1.8 N•m (16 in. lbs.)
Camshaft Sprocket Bolt	108 N•m (80 ft. lbs.)
Connecting Rod Nuts	45 N•m (33 ft. lbs.)
Cylinder Block Drain Plugs	41 N•m (30 ft. lbs.)
Cylinder Head Bolts	
(#1–10 & #12–14)	149 N•m (110 ft. lbs.)
(#11)	135 N•m (100 ft. lbs.)
Cylinder Head Cover Bolts	10 N•m (85 in. lbs.)
Engine Mounts—Front	
Engine Support Bracket	
Bolts (XJ)	61 N•m (45 ft. lbs.)
Bolts (YJ)	62 N•m (46 ft. lbs.)
Support Cushion	
Bolts/Nuts (XJ)	41 N•m (30 ft. lbs.)
Bolts/Nuts (YJ)	52 N•m (38 ft. lbs.)
Support Cushion Bracket—(XJ)	
Bolts	54 N•m (40 ft. lbs.)
Stud Nuts	41 N•m (30 ft. lbs.)
Support Cushion Thru-Bolt	
XJ Vehicles	65 N•m (48 ft. lbs.)
YJ Vehicles	69 N•m (51 ft. lbs.)
Engine Mount—Rear	
Crossmember-to-Sill Bolts	
(XJ-Automatic)	41 N•m (30 ft. lbs.)
Insulator Stud Assembly Nut	41 N•m (30 ft. lbs.)
Skid Plate/Support Cushion	
Stud Nuts (YJ)	54 N•m (40 ft. lbs.)
Skid Plate-to-Sill Bolts (YJ)	88 N•m (65 ft. lbs.)
Support Cushion/Crossmember	
Nuts (XJ)	22 N•m (192 in. lbs.)
Support Cushion/Support Bracket	
Nuts (XJ Manual)	75 N•m (55 ft. lbs.)
Support Cushion/Torque Arm	
Bracket Nuts (YJ)	54 N•m (40 ft. lbs.)
Torque Arm Bracket Bolts	
(YJ-Automatic)	54 N•m (40 ft. lbs.)

Description	Torque
Engine Mount—Rear (Cont.)	
Torque Arm Bracket/Support Cushion	
Bolts (YJ-Manual)	54 N•m (40 ft. lbs.)
Transmission Support Adaptor Bracket	
Bolts (XJ 2WD Auto)	75 N•m (55 ft. lbs.)
Transmission Support Bracket	
Bolts (XJ-Manual)	46 N•m (34 ft. lbs.)
Transmission Support Bracket/Support	
Cushion Bolts (XJ Automatic)	75 N•m (55 ft. lbs.)
Exhaust Manifold/Pipe Nuts	27 N•m (20 ft. lbs.)
Flywheel/Converter Housing Bolts	38 N•m (28 ft. lbs.)
Flywheel/Crankshaft Bolts	143 N•m (105 ft. lbs.)
Front Cover-to-Block Bolts (1/4-20)	7 N•m (60 in. lbs.)
Front Cover-to-Block Bolts (5/16-18)	22 N•m (192 in. lbs.)
Fuel Pump Bolts	22 N•m (16 ft. lbs.)
Generator Adjusting Bolt	24 N•m (18 ft. lbs.)
Generator Pivot Bolt/Nut	38 N•m (28 ft. lbs.)
Main Bearing Bolts	108 N•m (80 ft. lbs.)
Oil Filter	18 N•m (13 ft. lbs.)
Oil Filter Adaptor Bolts	102 N•m (75 ft. lbs.)
Oil Galley Plug	41 N•m (30 ft. lbs.)
Oil Pan Bolts (1/4-20)	14 N•m (120 in. lbs.)
(5/16-18)	18 N•m (156 in. lbs.)
Oil Pan Drain Plug	34 N•m (25 ft. lbs.)
Oil Pump Attaching Bolts	
Short Bolts	14 N•m (10 ft. lbs.)
Long Bolts	23 N•m (17 ft. lbs.)
Oil Pump Cover Bolts	8 N•m (70 in. lbs.)
Power Steering Pump Pressure Hose Nut	52 N•m (38 ft. lbs.)
Rocker Arm Assembly-to-Cylinder Head Capscrews	28 N•m (21 ft. lbs.)
Spark Plugs	37 N•m (27 ft. lbs.)
Starting Motor Mounting Bolts	45 N•m (33 ft. lbs.)
Thermostat Housing	18 N•m (156 in. lbs.)
Vibration Damper Bolts	108 N•m (80 ft. lbs.)
Water Pump/Block Bolts	31 N•m (270 in. lbs.)

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EXHAUST SYSTEM AND INTAKE MANIFOLD

CONTENTS

EXHAUST SYSTEM

GENERAL INFORMATION

The basic exhaust system consists of an engine exhaust manifold, exhaust pipe with oxygen sensor, catalytic converter, exhaust heat shield(s), muffler and exhaust tailpipe (Fig. 1).

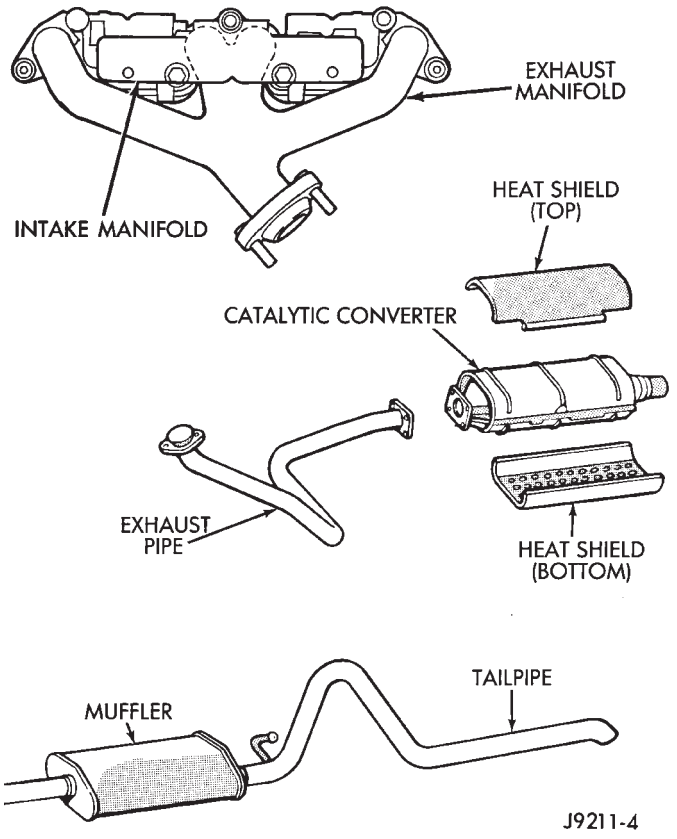

Fig. 1 Typical Exhaust System

The exhaust system uses a single muffler with a single monolithic-type catalytic converter.

The 4.0L engines use a seal between the engine exhaust manifold and exhaust pipe to assure a tight seal and strain free connections.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it may amplify objectionable noises originating from the engine or body.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screw or bolt threads, corrosion damage and worn, cracked or broken hangers. Replace all components that are badly corroded or damaged. DO NOT attempt to repair.

When replacement is required, use original equipment parts (or their equivalent). This will assure proper alignment and provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

CATALYTIC CONVERTER

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.

EXHAUST HEAT SHIELDS

Exhaust heat shields are needed to protect both the vehicle and the environment from the high temperatures developed by the catalytic converter. The catalytic converter releases additional heat into the exhaust system. Under severe operating conditions, the temperature increases in the area of the con-

verter. Such conditions can exist when the engine misfires or otherwise does not operate at peak efficiency.

DO NOT remove spark plug wires from plugs or by any other means short out cylinders. Failure of the catalytic converter can occur due to a temperature increase caused by unburned fuel passing through the converter.

DO NOT allow the engine to operate at fast idle for extended periods (over 5 minutes). This condition may result in excessive temperatures in the exhaust system and on the floor pan.

EXHAUST SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE	1. Leaks at pipe joints. 2. Burned or blown-out muffler. 3. Burned or rusted-out exhaust pipe. 4. Exhaust pipe leaking at manifold flange. 5. Exhaust manifold cracked or broken. 6. Leak between exhaust manifold and cylinder head. 7. Restriction in muffler or tail pipe.	1. Tighten clamps at leaking joints. 2. Replace muffler assembly. Check exhaust system. 3. Replace exhaust pipe. 4. Tighten connection attaching nuts. 5. Replace exhaust manifold. 6. Tighten exhaust manifold to cylinder head stud nuts or bolts. 7. Remove restriction, if possible. Replace muffler or tail pipe, as necessary.
LEAKING EXHAUST GASES	1. Leaks at pipe joints. 2. Damaged or improperly installed gaskets.	1. Tighten clamps at leaking joints. 2. Replace gaskets, as necessary.
ENGINE HARD TO WARM UP OR WILL NOT RETURN TO NORMAL IDLE	1. Blocked crossover passage in intake manifold. 2. Thermostat broken.	1. Remove restriction or replace intake manifold. 2. Replace thermostat.

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SERVICE PROCEDURES

INDEX

EXHAUST PIPE—XJ VEHICLES

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with heat valve lubricant (Fig. 1). Allow 5 minutes for penetration.

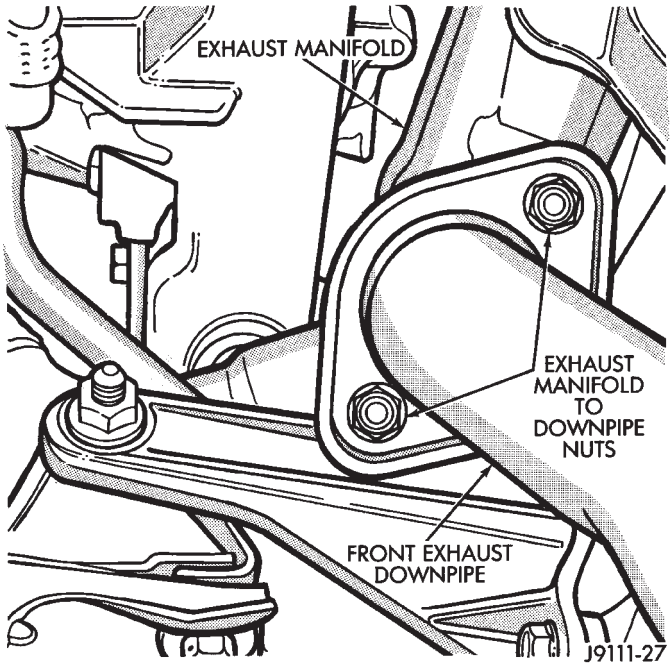

Fig. 1 Exhaust Pipe-to-Engine Exhaust Manifold Nuts

(3) Remove the oxygen sensor from the exhaust pipe (Fig. 2).

(4) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal (4.0L engine, only).

(5) Support the transmission and remove the transmission support crossmember.

(6) Remove the clamp nuts and clamp (Fig. 3). To remove the exhaust pipe from the catalytic converter,

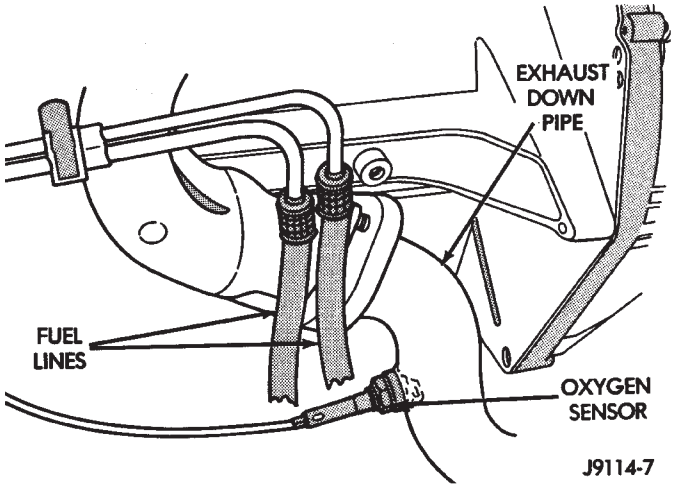

Fig. 2 Oxygen Sensor

apply heat until the metal becomes cherry red. Disconnect the exhaust pipe from the catalytic converter (Fig. 3). Remove the exhaust pipe.

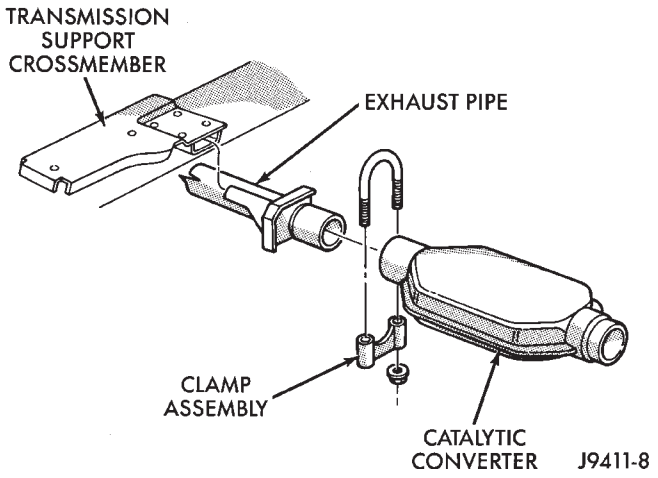

Fig. 3 Exhaust Pipe-to-Catalytic Converter Connection

CLEANING

Clean the mating surfaces of the engine exhaust manifold flange and the exhaust pipe.

INSTALLATION

(1) Assemble exhaust pipe to manifold and catalytic converter loosely to permit proper alignment of all parts.

(2) Use a new clamp at the exhaust pipe to catalytic converter connection and tighten the nuts to 61 N·●m (45 ft. lbs.) torque.

(3) Connect the exhaust pipe to the engine exhaust manifold using new nuts. Install a new seal between the exhaust manifold and the exhaust pipe (4.0L engine, only). Tighten the nuts to 31 N·m (23 ft. lbs.) torque (Fig. 1).

(4) Align the transmission support crossmember to the exhaust pipe (Fig. 3) and position on the sill. Tighten the crossmember-to-sill bolts to 41 N·m (30 ft. lbs.) torque. Remove the support from the transmission.

(5) Coat the oxygen sensor with anti-seize compound. Install the sensor and tighten the nut to 48 N·m (35 ft. lbs.) torque.

(6) Lower the vehicle.

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

EXHAUST PIPE—YJ VEHICLES

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the bolts and nuts with heat valve lubricant (Fig. 4). Allow 5 minutes for penetration.

(3) Remove the oxygen sensor from the exhaust pipe (Fig. 2).

(4) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal (4.0L engine, only).

(5) Remove the clamp nuts and clamp (Fig. 5). To remove the exhaust pipe from the catalytic converter, apply heat until the metal becomes cherry red. Disconnect the exhaust pipe from the catalytic converter and slide the pipe out of the transmission torque arm insulator (Fig. 5). Remove the exhaust pipe.

CLEANING

Clean the mating surfaces of the engine exhaust manifold flange and the exhaust pipe.

INSTALLATION

(1) Slide the exhaust pipe into the transmission torque arm insulator and onto the catalytic converter (Fig. 5).

(2) Connect the exhaust pipe to the engine exhaust manifold using new nuts. Install a new seal between the exhaust manifold and the exhaust pipe (4.0L engine, only). DO NOT tighten the nuts at this time.

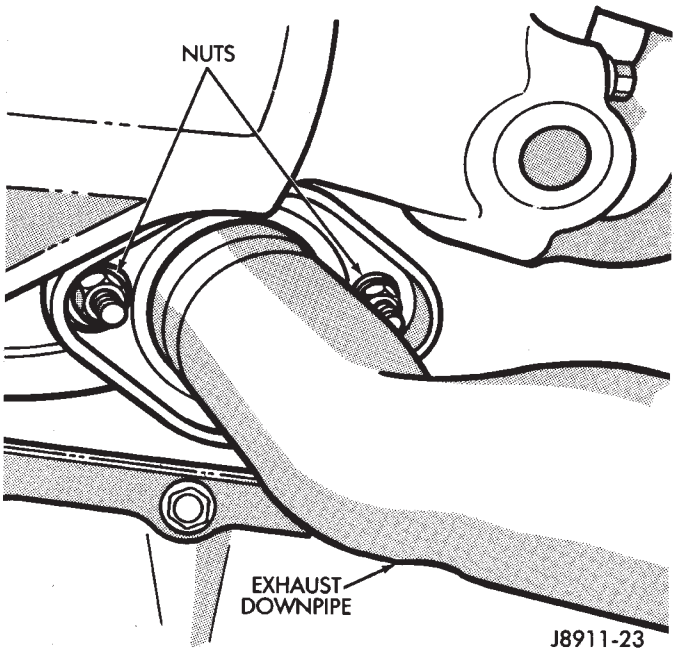

Fig. 4 Exhaust Pipe-to-Engine Exhaust Manifold Nuts

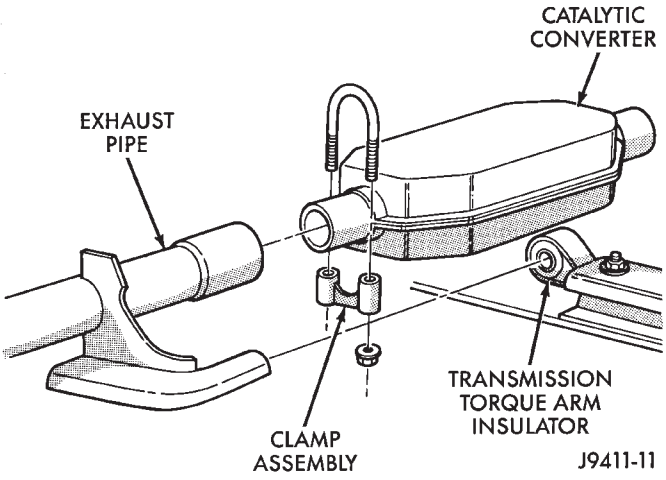

Fig. 5 Exhaust Pipe-to-Catalytic Converter Connection—YJ Vehicles

(3) Align the exhaust pipe.

(4) Use a new clamp at the exhaust pipe to catalytic converter connection and tighten the nuts to 61 N·m (45 ft. lbs.) torque.

(5) Tighten the exhaust pipe-to-engine exhaust manifold nuts to 31 N·m (23 ft. lbs.) torque.

(6) Coat the oxygen sensor with anti-seize compound. Install the sensor and tighten the nut to 48 N·m (35 ft. lbs.) torque.

(7) Lower the vehicle.

(9) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

CATALYTIC CONVERTER

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the clamp from the catalytic converter and muffler connection (Fig. 6). Remove the clamp from the catalytic converter and exhaust pipe connection (Figs. 3 and 5).

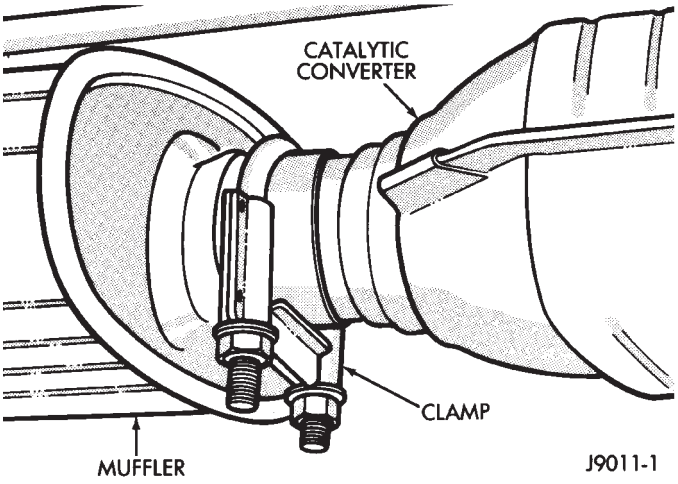

Fig. 6 Catalytic Converter-to-Muffler Connection

(3) Heat the catalytic converter connections with an oxyacetylene torch until the metal becomes cherry red.

(4) While the metal is still cherry red, twist the muffler assembly back and forth to separate it from the catalytic converter.

(5) While the metal is still cherry red, disconnect the exhaust pipe from the catalytic converter (Figs. 3 and 5).

INSTALLATION

(1) Connect the catalytic converter to the exhaust pipe (Figs. 3 and 5). Use a new clamp and tighten the nuts to 61 N·m (45 ft. lbs.) torque.

(2) Install the muffler onto the catalytic converter until the alignment tab is inserted into the alignment slot.

(3) Install a new clamp at the muffler and catalytic converter connection (Fig. 6). Tighten the clamp nuts to 61 N·m (45 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER AND EXHAUST TAILPIPE—XJ VEHICLES

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 LINES.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the front muffler clamp from the catalytic converter and muffler connection (Fig. 6).

(3) Remove the rear exhaust tailpipe hanger clamp (Fig. 7) and remove the exhaust tailpipe from the front exhaust tailpipe hanger (Fig. 8).

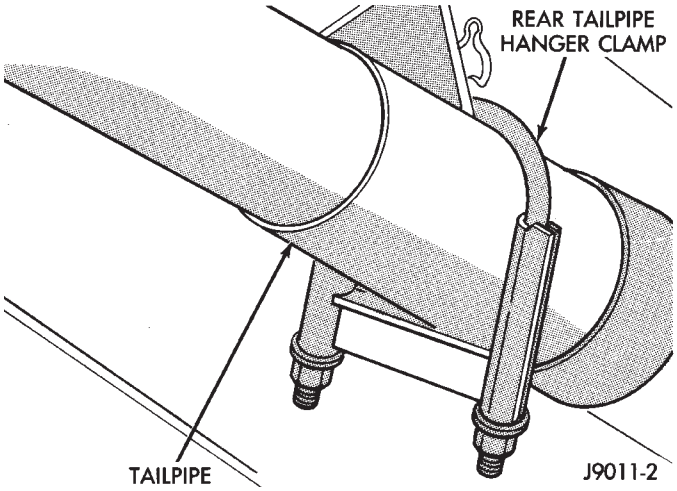

Fig. 7 Rear Exhaust Tailpipe Hanger Clamp

(4) Heat the catalytic converter-to-muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(5) While the metal is still cherry red, remove the exhaust tailpipe/muffler assembly from the catalytic converter.

(6) Remove the exhaust tailpipe from the muffler:

- To remove an original equipment exhaust tailpipe/muffler combination, cut the exhaust tailpipe close to the muffler. Collapse the part remaining in the muffler and remove.
- To remove a service exhaust tailpipe/muffler combination, apply heat until the metal becomes cherry

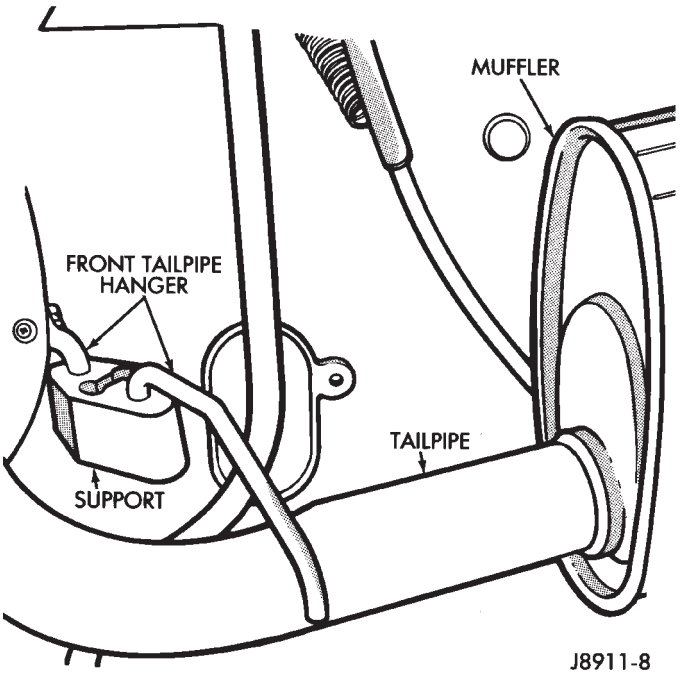

Fig. 8 Front Exhaust Tailpipe Hanger

red. Remove the exhaust tailpipe/muffler clamp and twist the exhaust tailpipe out of the muffler.

INSTALLATION

(1) Install the muffler onto the catalytic converter. Install the clamp and tighten the nuts finger tight.

(2) Install the exhaust tailpipe into the rear of the muffler.

(3) Install the exhaust tailpipe/muffler assembly on the rear exhaust tailpipe hanger. Make sure that the exhaust tailpipe has sufficient clearance from the floor pan.

(4) Install the remaining clamps and the front exhaust tailpipe hanger.

(5) Tighten the nuts on the muffler-to-catalytic converter clamp to 61 N·m (45 ft. lbs.) torque (Fig. 6). Tighten the nuts on the rear exhaust tailpipe clamp to 14 N·m (10 ft. lbs.) torque (Fig. 7).

(6) Lower the vehicle.

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

MUFFLER AND EXHAUST TAILPIPE—YJ VEHICLES

All original equipment exhaust systems are manufactured with the exhaust tailpipe welded to the muffler. Service replacement mufflers and exhaust tailpipes are clamped together.

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

REMOVAL

(1) Raise the vehicle and support the rear of the vehicle by the side rails and allow the axle to hang free.

(2) Remove the front muffler clamp from the catalytic converter and muffler connection (Fig. 6).

(3) Remove the exhaust tailpipe hanger/bracket (Fig. 9).

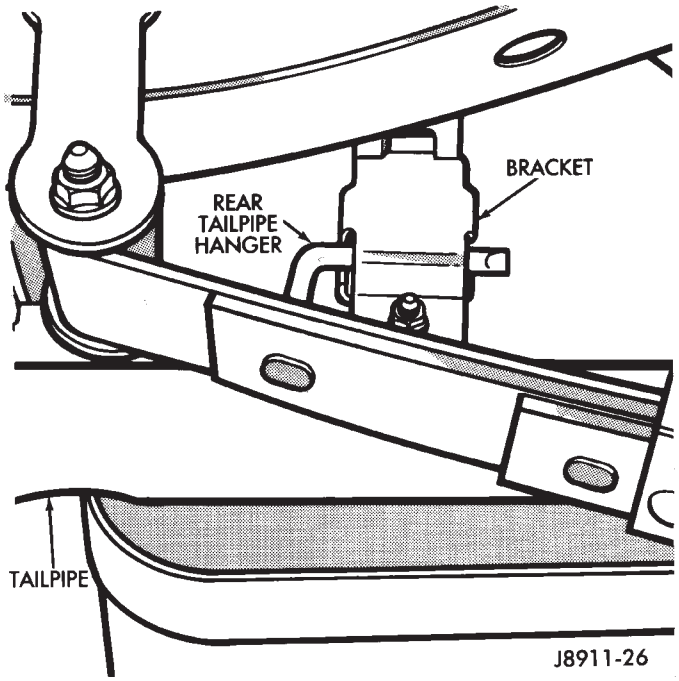

Fig. 9 Rear Exhaust Tailpipe Hanger/Bracket

(4) Remove the exhaust tailpipe from the front exhaust tailpipe hanger (Fig. 10).

(5) Heat the converter-to-muffler connection with an oxyacetylene torch until the metal becomes cherry red.

(6) While the metal is still cherry red, place a block of wood against the front of the muffler and drive the muffler rearward to disengage.

(7) Remove the exhaust tailpipe/muffler assembly.

(8) Remove the exhaust tailpipe from the muffler:

- To remove an original equipment exhaust tailpipe/muffler combination, cut the exhaust tailpipe close to the muffler. Collapse the part remaining in the muffler and remove.
- To remove a service exhaust tailpipe/muffler combination, remove the exhaust tailpipe/muffler clamp. Heat the exhaust tailpipe-to-muffler connection with an oxyacetylene torch until the metal becomes cherry red. While the metal is still cherry red, twist the exhaust tailpipe out of the muffler.

INSTALLATION

(1) Install the muffler onto the catalytic converter outlet. Ensure that the locator on the converter aligns with the notch on the muffler, if so equipped. Install the clamp and tighten the nuts finger tight.

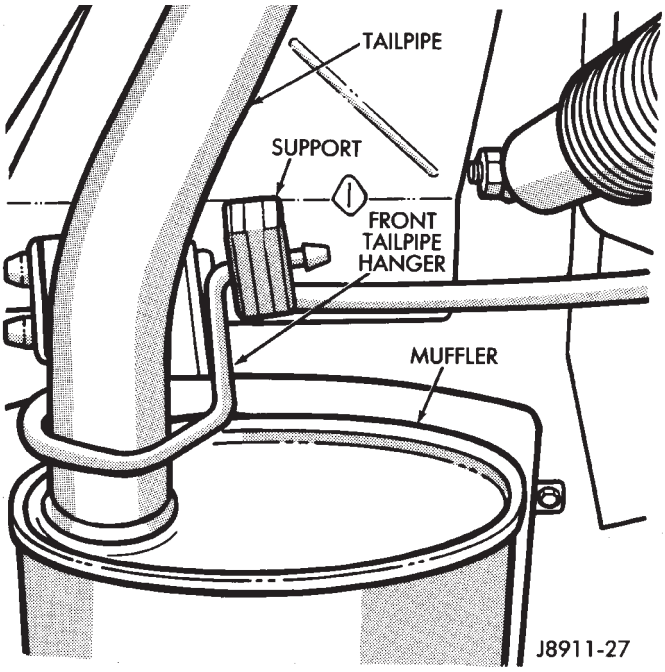

Fig. 10 Front Exhaust Tailpipe Hanger

(2) Install the exhaust tailpipe into the muffler outlet. Ensure that the locator on the exhaust tailpipe aligns with the notch on the muffler, if so equipped. Install the clamp and tighten the nuts finger tight.

(3) Install the front exhaust tailpipe supports and the rear exhaust tailpipe hanger. Ensure that the exhaust tailpipe has sufficient clearance from the floor pan and shields.

(4) Tighten the nuts on the muffler-to-catalytic converter and the muffler-to-exhaust tailpipe clamps to 61 N·m (45 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Start the engine and inspect for exhaust leaks and contact with the body panels and shields.

ENGINE EXHAUST MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove all components attached to the intake manifold.

(3) Raise the vehicle.

(4) Disconnect the exhaust pipe from the engine exhaust manifold.

(5) Lower the vehicle.

(6) Remove fasteners 2 through 5 and remove the intake manifold (Fig. 11).

(7) Remove fasteners 1, 6 and 7 and remove the engine exhaust manifold (Fig. 11).

CLEANING

Clean the intake and engine exhaust manifolds and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

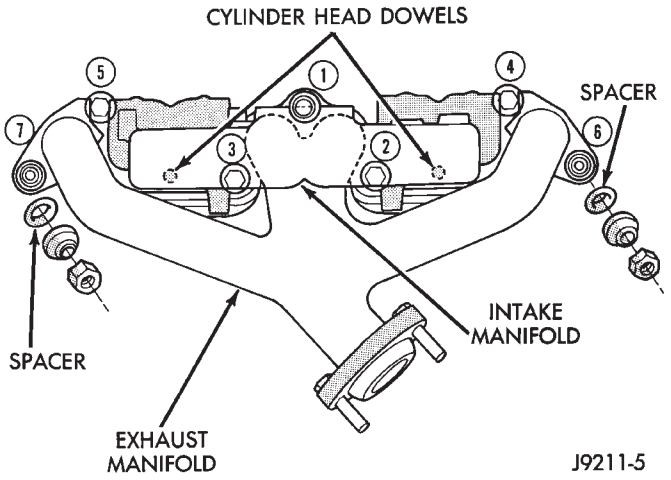

Fig. 11 Intake/Engine Exhaust Manifold Installation (2.5L Engine)

INSTALLATION

(1) Install a new intake manifold gasket over the alignment dowels on the cylinder head.

(2) Install the engine exhaust manifold assembly. **Exhaust manifold must be centrally located over the end studs and spacer (Fig. 11).**

(3) Tighten bolt No.1 to 41 N·m (30 ft. lbs.) torque (Fig. 11).

(4) Install the intake manifold on the cylinder head dowels (Fig. 11).

(5) Install bolts 2 through 5 (Fig. 11). Tighten these bolts to 31 N·m (23 ft. lbs.) torque.

(6) Install new engine exhaust manifold spacers over the engine exhaust manifold mounting studs in the cylinder head (Fig. 11).

(7) Tighten nuts 6 and 7 to 31 N·m (23 ft. lbs.) torque (Fig. 11).

(8) Install all components to the intake manifold.

(9) Raise the vehicle.

(10) Connect the exhaust pipe to the engine exhaust manifold. Tighten the bolts to 31 N·m (23 ft. lbs.) torque.

(11) Lower the vehicle.

(12) Connect the battery negative cable.

(13) Start the engine and check for leaks.

ENGINE EXHAUST MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifolds on the 4.0L engine must be removed and installed together. The manifolds use a common gasket at the cylinder head.

Refer to Intake Manifold—4.0L Engine in this section for the proper removal and installation procedures.

INTAKE MANIFOLD—2.5L ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the air inlet hose from the throttle body and air cleaner.

(3) Loosen the accessory drive belt tension and remove the belt from the power steering pump.

(4) Remove the power steering pump and brackets from the water pump and intake manifold. Support power steering pump and bracket with mechanics wire attached to the radiator upper crossmember.

(5) Remove the fuel tank filler cap to relieve the fuel tank pressure.

(6) Install the fuel tank filler cap.

(7) Disconnect fuel supply and return tube from the fuel rail (refer to Group 14, Fuel System - Quick Connect Fittings).

(8) Disconnect the accelerator cable from the throttle body and the holddown bracket.

CAUTION: When disconnecting the cruise control connector at the throttle body, DO NOT pry the connector off with pliers or screwdriver. Use finger pressure only. Prying the connector off could break it.

(9) Disconnect the electrical connectors. Pull the harnesses away from the manifold.

- The throttle position sensor.
- The idle speed control motor.
- The coolant temperature sensor at the thermostat.
- The manifold air temperature sensor at the intake manifold.
- The fuel injectors.
- The oxygen sensor.

(10) Disconnect the crankcase ventilation (CCV) vacuum hose and manifold absolute pressure (MAP) sensor vacuum hose connector at the intake manifold.

(11) Disconnect vacuum hose from vacuum port on the intake manifold.

(12) Disconnect CCV hose at the cylinder head cover (Fig. 12).

(13) Remove the molded vacuum harness.

(14) Disconnect the vacuum brake booster hose at the intake manifold.

(15) Remove bolts 2 through 5 securing the intake manifold to the cylinder head (Fig. 11). Slightly loosen bolt No.1 and nuts 6 and 7.

(16) Remove the intake manifold and gaskets. Drain the coolant from the manifold.

CLEANING

Clean the intake manifold and cylinder head mating surfaces. **DO NOT allow foreign material to enter either the intake manifold or the ports in the cylinder head.**

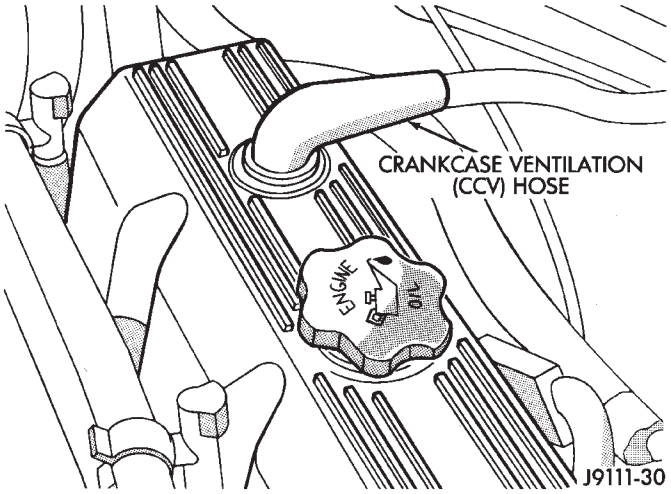

Fig. 12 Crankcase Ventilation (CCV) Hose (2.5L Engine)

INSTALLATION

(1) Install the new intake manifold gasket over the locating dowels.

(2) Position the manifold in place and finger tighten the mounting bolts.

(3) Tighten the fasteners in sequence and to the specified torque (Fig. 11).

- Fastener No.1—Tighten to 41 N·m (30 ft. lbs.) torque.
- Fasteners Nos.2 through 7—Tighten to 31 N·m (23 ft. lbs.) torque.

(4) Connect the fuel return and supply tube to the connector next to the fuel rail. Push them into the fitting until a click is heard. Verify that the connections are complete.

- First, ensure only the retainer tabs protrude from the connectors.
- Second, pull out on the fuel tubes to ensure they are locked in place.

(5) Connect the molded vacuum hoses to the vacuum port on the intake manifold and the cylinder head cover.

(6) Connect the electrical connectors.

- The throttle position sensor.
- The automatic idle speed control motor.
- The coolant temperature sensor at the thermostat housing.
- The fuel injectors.
- The air manifold temperature sensor.
- The oxygen sensor.

(7) Connect the CCV vacuum hose and MAP sensor vacuum hose connectors to the throttle body.

(8) Install the power steering pump and bracket assembly to the water pump and intake manifold.

(9) Connect the accelerator cable and cruise control cable to the holddown bracket and the throttle arm.

CAUTION: Ensure that the accessory drive belt is routed correctly. Failure to do so can cause the water pump to turn in the opposite direction resulting in engine overheating. Refer to Group 7, Cooling System for the proper procedure.

(10) Tension the accessory drive belt. Refer to Group 7, Cooling System for the proper procedure.

(11) Connect the air inlet hose to the throttle body and the air cleaner.

(12) Connect the battery negative cable.

(13) Start the engine and check for leaks.

INTAKE MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifolds on the 4.0L engine must be removed and installed together. The two manifolds use a common gasket at the cylinder head.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove air cleaner inlet hose from throttle plate assembly.

(3) Remove the air cleaner assembly.

(4) Remove the throttle cable, cruise control cable (if equipped) and the transmission line pressure cable.

(5) Disconnect all electrical connectors on the intake manifold.

(6) Disconnect and remove the fuel supply and return lines from the fuel rail assembly (refer to Group 14, Fuel System).

(7) Loosen the accessory drive belt (refer to Group 7, Cooling System). Loosen the tensioner.

(8) Remove the power steering pump and bracket from the intake manifold and set aside.

(9) Remove the fuel rail and injectors (refer to Group 14, Fuel System).

(10) Raise the vehicle.

(11) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal.

(12) Lower the vehicle.

(13) Remove the intake manifold and engine exhaust manifold.

CLEANING

Clean the mating surfaces of the cylinder head and the manifold if the original manifold is to be installed.

If the manifold is being replaced, ensure all the fitting, etc. are transferred to the replacement manifold.

INSTALLATION

(1) Install a new exhaust/intake manifold gasket over the alignment dowels on the cylinder head.

(2) Position the engine exhaust manifold to the cylinder head. Install fastener No.3 and finger tighten at this time (Fig. 13).

(3) Install intake manifold on the cylinder head dowels.

(4) Install washers and fasteners Nos.1, 2, 4, 5, 8, 9, 10 and 11 (Fig. 13).

(5) Install washers and fasteners Nos.6 and 7 (Fig. 13).

(6) Tighten the fasteners in sequence and to the specified torque (Fig. 13).

- Fasteners Nos.1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fasteners Nos.6 and 7—Tighten to 31 N·m (23 ft. lbs.) torque.
- Fasteners Nos.8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

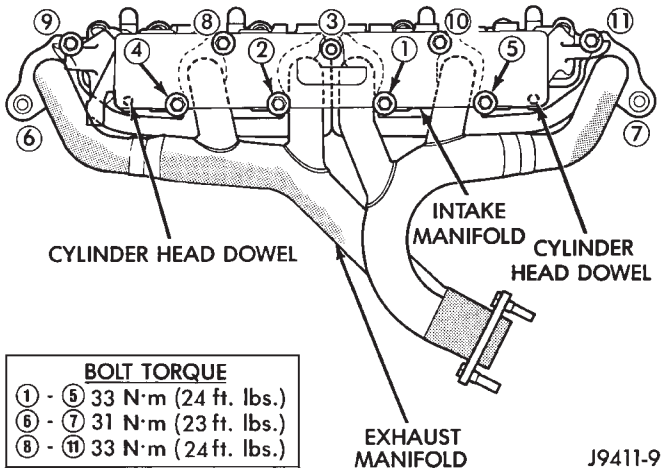

Fig. 13 Intake/Engine Exhaust Manifold Installation (4.0L Engine)

(7) Install the fuel rail and injectors.

(8) Install the power steering pump and bracket to the intake manifold. Tighten the belt to specification. Refer to Group 7, Cooling System for the proper procedures.

(9) Install the fuel supply and return lines to the fuel rail assembly. **Before connecting the fuel lines to the fuel rail replace the O-rings in the quick-connect fuel line couplings.** Refer to Group 14, Fuel System for the proper procedure.

(10) Connect all electrical connections on the intake manifold.

(11) Connect the vacuum connector on the intake manifold and install it in the bracket.

(12) Install throttle cable, cruise control cable (if equipped).

(13) Install the transmission line pressure cable (if equipped). Refer to Group 21, Transmission for the adjustment procedures.

(14) Install air cleaner assembly.

(15) Connect air inlet hose to the throttle plate assembly.

(16) Raise the vehicle on a side mounted hoist.

(17) Using a new seal, connect the exhaust pipe to the engine exhaust manifold. Tighten the bolts to 31 N·m (23 ft. lbs.) torque.

(18) Lower the vehicle.

(19) Connect the battery negative cable.

(20) Start the engine and check for leaks.

TORQUE SPECIFICATIONS

Description	Torque
Catalytic Converter/Exhaust Pipe Clamp Nuts	61 N•m (45 ft. lbs.)
Crossmember-to-Sill Bolts	41 N•m (30 ft. lbs.)
Exhaust Pipe-to-Manifold Nuts	31 N•m (23 ft. lbs.)
Exhaust Manifold Bolt #1 2.5L Engine	41 N•m (30 ft. lbs.)
Exhaust Manifold Bolts #2-5 2.5L Engine	31 N•m (23 ft. lbs.)
Exhaust/Intake Manifold Nut/ Bolts #1-5 & #8-11 4.0L Engine	33 N•m (24 ft. lbs.)
Exhaust Manifold Nuts #6 & 7 2.5L Engine	31 N•m (23 ft. lbs.)
Exhaust Manifold Nuts #6 & 7 4.0L Engine	31 N•m (23 ft. lbs.)
Intake Manifold Bolt #1 2.5L Engine	41 N•m (30 ft. lbs.)
Intake Manifold Bolts #2-5 2.5L Engine	31 N•m (23 ft. lbs.)
Muffler-to-Catalytic Converter Clamp Nuts	61 N•m (45 ft. lbs.)
Oxygen Sensor	48 N•m (35 ft. lbs.)
Rear Tail Pipe Clamp Nuts	14 N•m (10 ft. lbs.)

J9411-10

FRAME AND BUMPERS

CONTENTS

XJ UNIBODY CONSTRUCTION

INDEX

GENERAL INFORMATION

Jeep® XJ Vehicles (Fig. 1) and the cab section of Jeep® are constructed as a unitized body and frame.

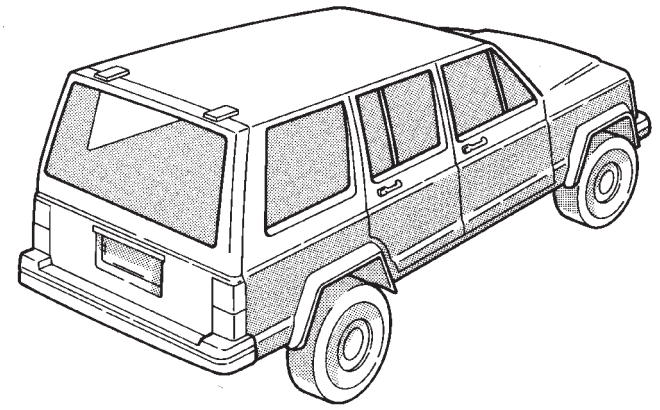

Fig. 1 Jeep® XJ

Jeep® XJ unibodies are constructed from special high-strength steel and coated metals. These types of metals reduce weight and provide strength.

COLLISION DAMAGE TORQUE

DAMAGE DIAGNOSIS

A vehicle constructed as a unibody reacts differently to the impact of a collision. While the damage at the immediate point of impact is easily recognizable, the damage must be diagnosed to expose it.

With unibody construction, there are five logical areas to examine to expose damage.

(1) Damage at the immediate point of impact—primary damage.

(2) The other (lessor) body damage—secondary damage.

(3) Damage to the exterior trim and other surface-attached components.

(4) Damage to the mechanical components.

(5) The interior trim and accessory damage.

DAMAGE REPAIR

A logical approach to the sequence of damage repair must also be used. Usually, during vehicle repair, the tasks are accomplished in the reverse order of consequence.

When there is damage to a vehicle, the alignment points must be returned too specifications. This entails:

- accurate measurement;
- repetitive measurement; and
- re-check of measurements.

Collision damage repair can be completed "right" the first time:

- if the fundamental steps for collision damage repair are correctly followed, and
- if the basic structural details of unibody construction are correctly considered.

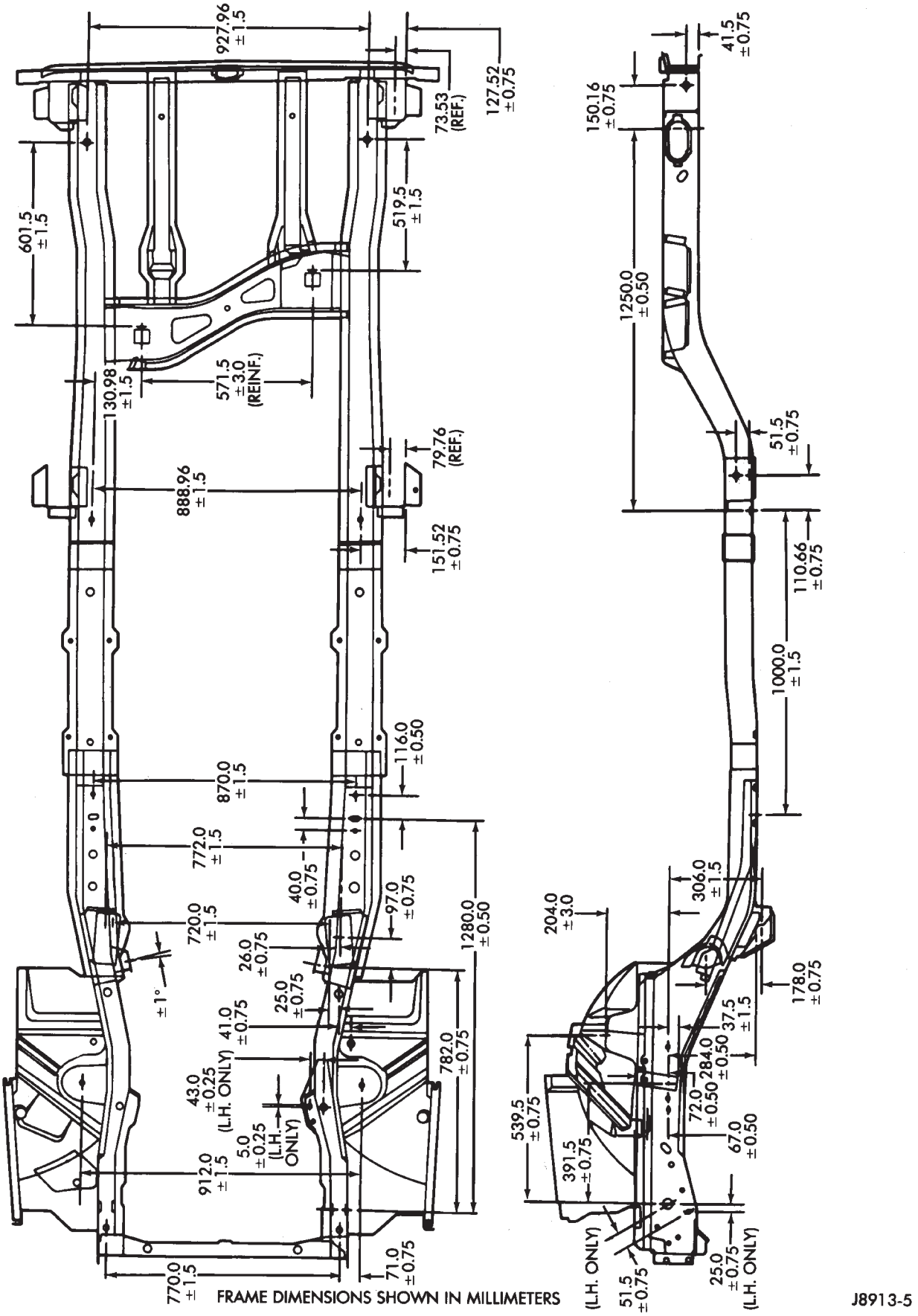

Fig. 2 Frame Alignment Reference Dimensions—XJ Vehicles

XJ BUMPERS

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FRONT BUMPER

REMOVAL/DISASSEMBLY

(1) The bumper guards, end caps and tow hooks can be removed from XJ front bumpers with the bumper attached to the vehicle. Do not remove the bumper from the vehicle if only these components require service.

If equipped with a brush guard, refer to the Brush Guard Removal within Group 23—Body Components.

(2) If equipped, disconnect the fog lamp wire harness connectors (Fig. 1).

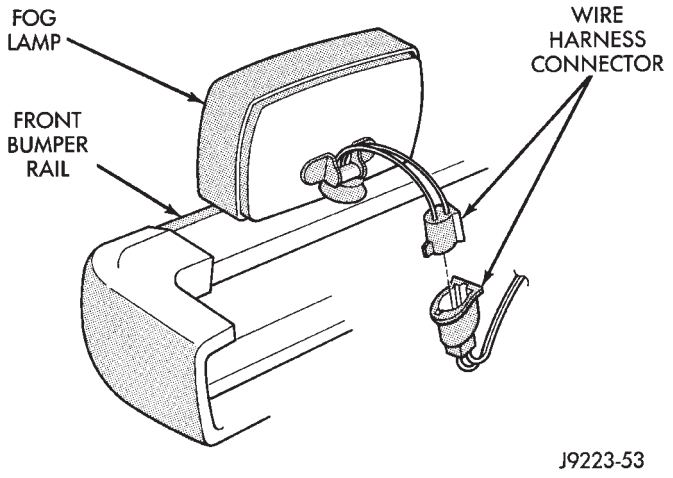

Fig. 1 Fog Lamp Wire Harness Connector

(3) Disconnect the vacuum reservoir tube harness connectors (Figs. 2 and 3).

(4) If equipped, remove the locknuts and Torx-head bolts that attach the tow hook straps (Fig. 4) to the underbody sillmember.

The retaining screws and the steering gear skid plate must be removed before the left strap can be removed from the sillmember.

(5) Detach the tow hook straps from the sillmember.

(6) Support the bumper.

(7) Remove the bolts that attach the bumper support brackets to the right and left sillmembers (Fig. 5).

(8) Remove the support and the bumper from the vehicle. 5).

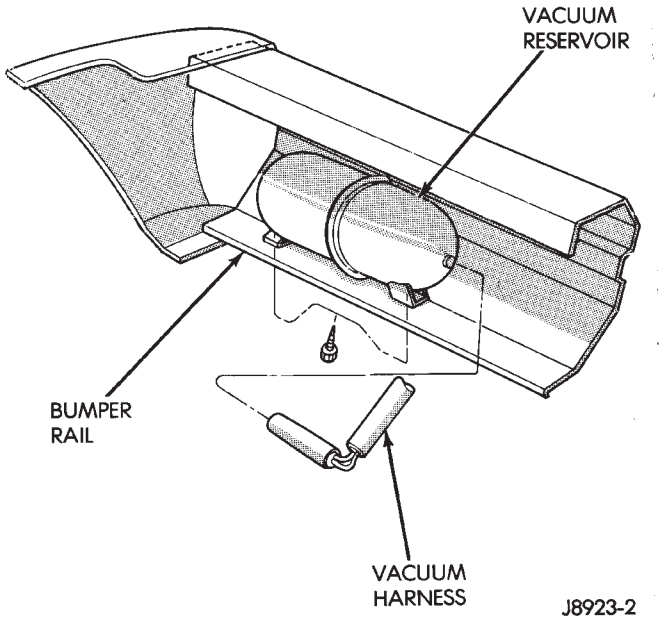

Fig. 2 Vacuum Reservoir—Left Side

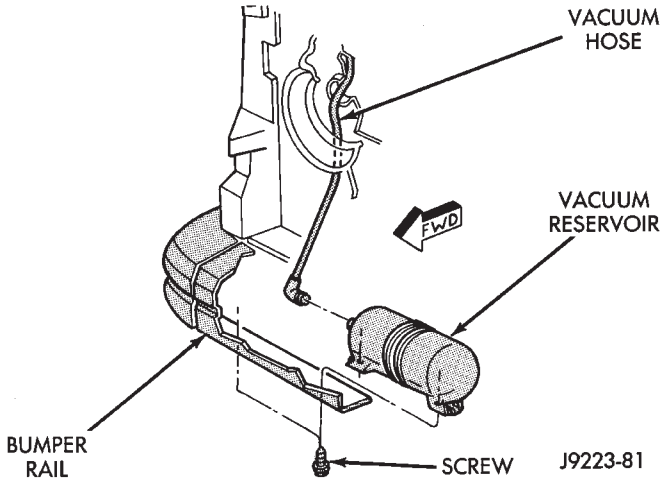

Fig. 3 Vacuum Reservoir—Right Side With Speed Control Only

(9) If equipped, remove the nuts and bolts that attach the tow hooks to the bumper support brackets.

(10) Remove the support brackets (Fig. 6), bumper guards (Fig. 7) and caps (Fig. 8) from the bumper rail.

(11) Remove the license plate bracket (Fig. 9), if equipped, from the bumper rail.

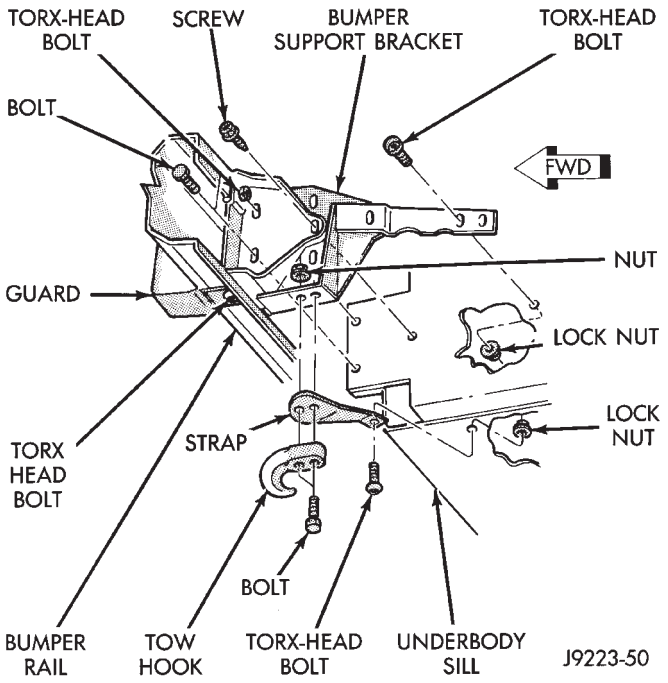

Fig. 4 Tow Hook & Strap—XJ Vehicles

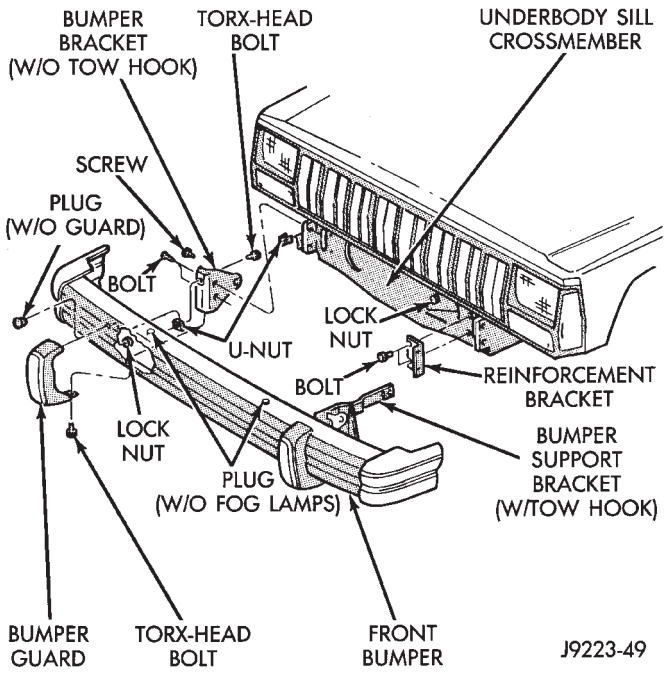

Fig. 5 Front Bumper Removal/Installation

(12) If equipped, remove the fog lamps (Fig. 10) from the bumper rail.

(13) If necessary, remove the vacuum reservoir(s) from the bumper rail.

(14) If necessary, remove the sill crossmember reinforcement brackets from the sillmembers.

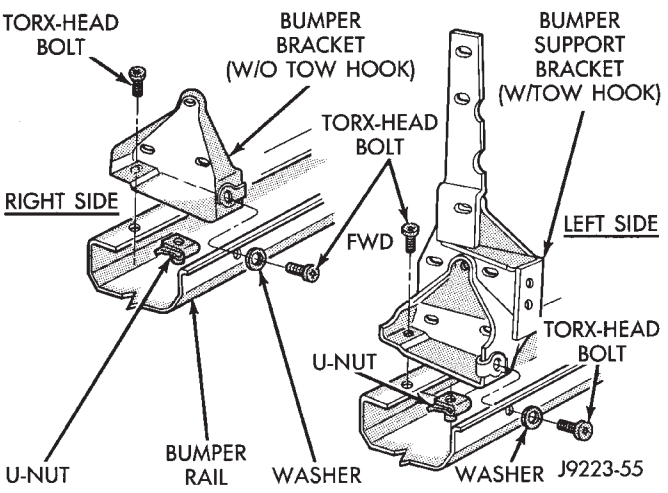

Fig. 6 Bumper Support Bracket Removal/Installation

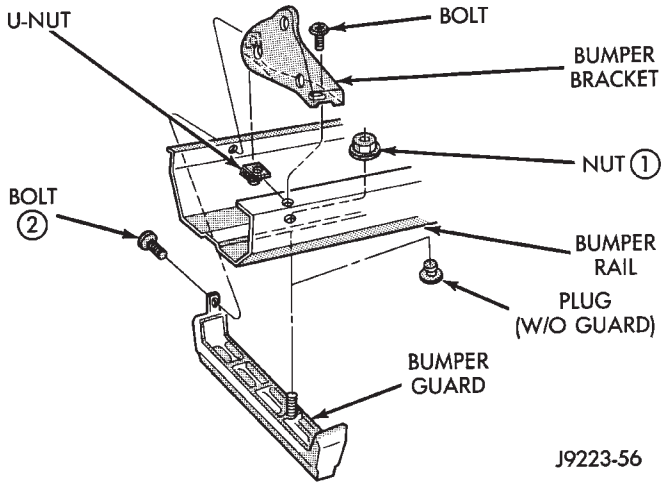

Fig. 7 Bumper Guard Removal/Installation

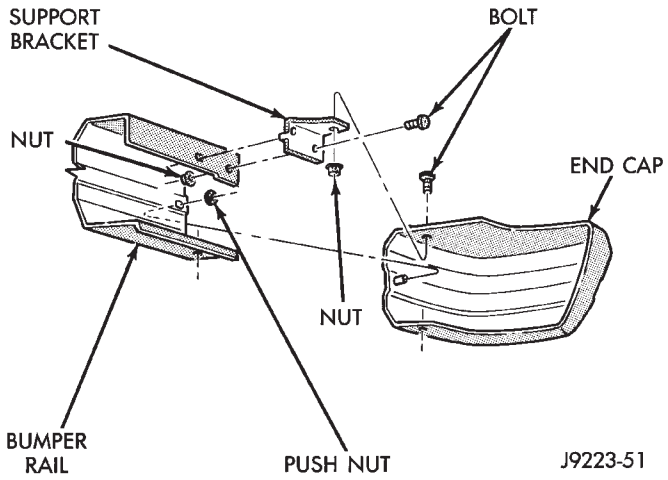

Fig. 8 Bumper End Cap Removal/Installation

ASSEMBLY/INSTALLATION

(1) If removed, install the sill crossmember reinforcement brackets on the sillmembers (Fig. 11). Tighten bolts to 56 N·m (41 ft-lbs) torque.

(2) If equipped, install the bumper support brack-

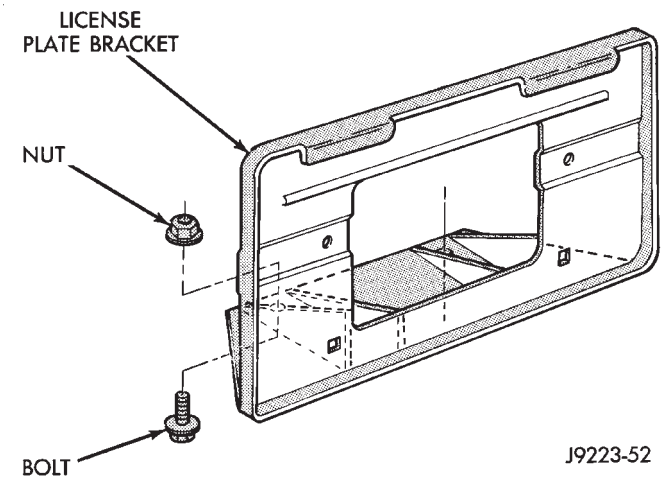

Fig. 9 Bumper License Plate Bracket Removal/ Installation

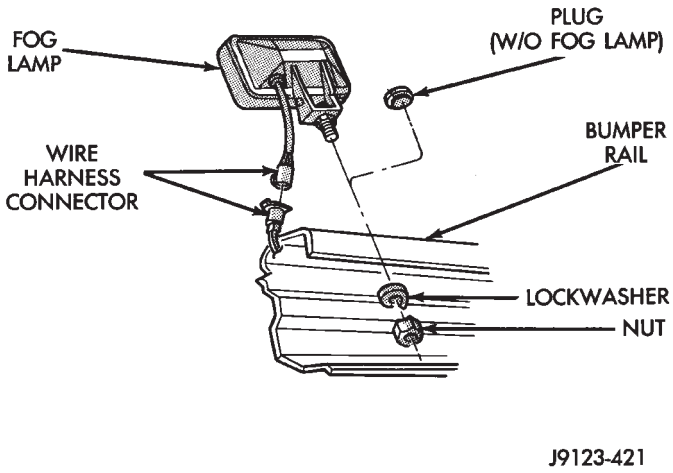

Fig. 10 Fog Lamp

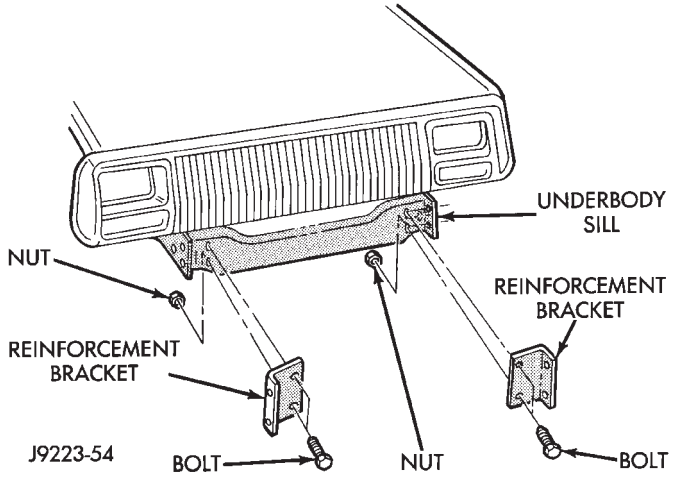

Fig. 11 Reinforcement Brackets

ets and bumper guards on the bumper rail. Tighten hardware in the sequence indicated in Figure 7. Tighten the locknuts with 20 N·m (15 ft-lbs) torque. Tighten bolts to 56 N·m (41 ft-lbs) torque.

(3) If not equipped with bumper guards, install the bumper support brackets on the bumper rail. Tighten bolts to 56 N·m (41 ft-lbs) torque.

(4) If equipped with tow hooks, install the bolts and nuts that attach them to the bumper support brackets. Tighten nuts with 100 N·m (74 ft-lbs) torque.

(5) Install the bumper end caps on the bumper rail (Fig. 8). Tighten nuts with 8 N·m (72 in-lbs) torque.

(6) Install the license plate bracket on the bumper rail. Tighten the nuts securely.

(7) If equipped, install the fog lamps on the bumper rail. Tighten the nuts securely.

(8) If removed, install the vacuum reservoir(s) on the bumper rail. Tighten the retaining screws and bolts to 8 N·m (72 in-lbs) torque.

(9) Position and support the bumper at the front of the vehicle.

(10) Attach the bumper support brackets to the right and left sillmembers and reinforcement brackets. Tighten screws and bolts to 56 N·m (41 ft-lbs) torque.

(11) If equipped, install the Torx-head bolts and locknuts that attach the tow hook straps to the underbody sillmember. Tighten locknuts with 30 N·m (22 ft-lbs) torque.

Install the steering gear skid plate and screws after the left tow hook strap has been installed.

(12) If equipped, connect the fog lamp wire harness connectors.

(13) Connect the vacuum reservoir tube harness connectors.

(14) Remove the bumper support.

FRONT TOW HOOKS

If a tow hook must be replaced or removed only for service access, remove the nuts and bolts that attach it to the bumper support bracket. When installing a tow hook, tighten nuts with 100 N·m (74 ft-lbs) torque.

If a tow hook/bumper support bracket must be replaced, refer to the following removal and installation procedures.

REMOVAL

If equipped with a brush guard, refer to the Brush Guard Removal within Group 23—Body Components.

(1) If equipped, disconnect the fog lamp wire harness connectors.

(2) Disconnect the vacuum reservoir tube harness connectors.

(3) Support the bumper.

(4) Remove the bolts that attach the bumper support brackets to the right and left sillmembers.

(5) Remove the locknuts and Torx-head bolts that attach the tow hook straps to the underbody sillmember.

The retaining screws and the steering gear skid plate must be removed before the left strap can be removed from the sillmember.

(6) Detach the tow hook straps from the sillmember.

(7) Remove the support and the bumper from the vehicle.

(8) Remove the nuts and bolts that attach the tow hooks to the bumper support brackets.

(9) Remove the tow hook from the bumper support bracket (Fig. 4).

(10) Remove the support bracket from the bumper rail.

INSTALLATION

(1) If equipped, install the bumper guard and bumper support bracket on the bumper rail. Tighten the retaining hardware in the sequence indicated in Figure 7. Tighten locknuts to 20 N·m (15 ft-lbs) torque. Tighten bolts to 56 N·m (41 ft-lbs) torque.

(2) If not equipped with bumper guards, install the bumper support bracket on the bumper rail. Tighten bolts to 56 N·m (41 ft-lbs) torque.

(3) Position the tow hook at the support bracket. Install the bolts and nuts that attach tow hook to the bumper support bracket. (Fig. 4). Tighten nuts to 100 N·m (74 ft-lbs) torque.

(4) Position and support the bumper at the front of the vehicle.

(5) Attach the bumper support brackets to the right and left sillmembers and reinforcement brackets. Tighten screws and bolts to 56 N·m (41 ft-lbs) torque.

(6) If equipped, install the Torx-head bolts and locknuts that attach the tow hook straps to the underbody sillmember. Tighten locknuts to 30 N·m (22 ft-lbs) torque.

Install the steering gear skid plate and screws after the left tow hook strap has been installed.

(7) If equipped, connect the fog lamp wire harness connectors. Connect the vacuum reservoir tube harness connectors.

(8) Remove the bumper support.

REAR BUMPER

REMOVAL

(1) For vehicles equipped with a trailer hitch, remove the hitch before removing the bumper. If necessary, refer to the removal procedure within Group 23—Body Components.

(2) Raise and support the rear of the vehicle.

(3) Support the bumper.

(4) Remove the bolts that attach the bumper support brackets to the sill crossmember (Fig. 12).

(5) Remove the support and the rear bumper from the vehicle.

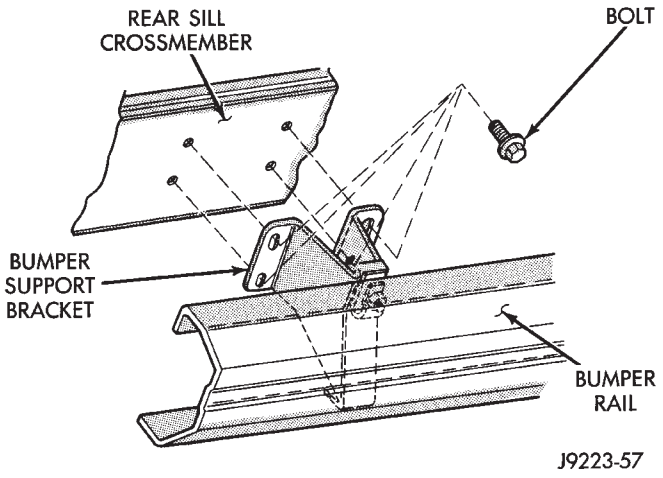

Fig. 12 Rear Bumper Removal/Installation—XJ Vehicles

(6) Remove the bumper support brackets and splash shield the bumper, if necessary (Fig. 13).

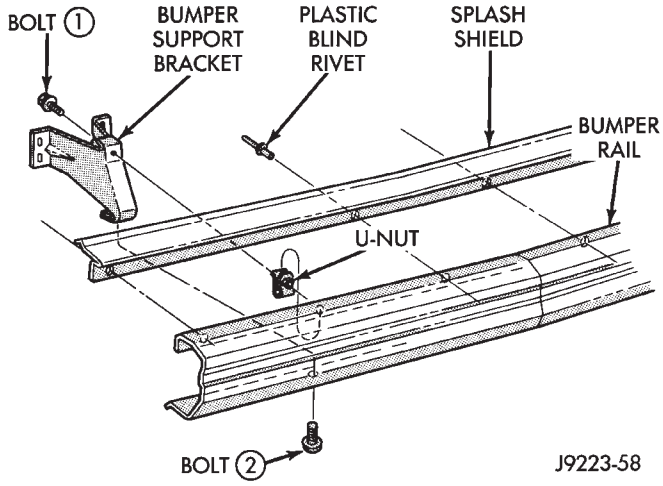

Fig. 13 Bumper Bracket & Splash Shield Removal/ Installation—XJ Vehicles

(7) Remove the bumper end caps (Fig. 14) and bumper guards from the bumper (Fig. 15), if necessary.

INSTALLATION

(1) As applicable, install the splash shield and bumper support brackets, the bumper end caps and the bumper guards.

(2) Tighten the bumper support bolts to 56 N·m (41 ft-lbs).

(3) Tighten the nuts in the sequence depicted in Figure 14. Tighten the bumper end cap plate bolt nuts to 22 N·m (16 ft-lbs) torque. Tighten the lower bolt nuts to 8 N·m (6 ft-lbs) torque.

(4) If applicable, tighten the bumper guard bolts/ nuts to 56 N·m (41 ft-lbs).

(5) Position and support the bumper with the bracket holes aligned with the sill crossmember

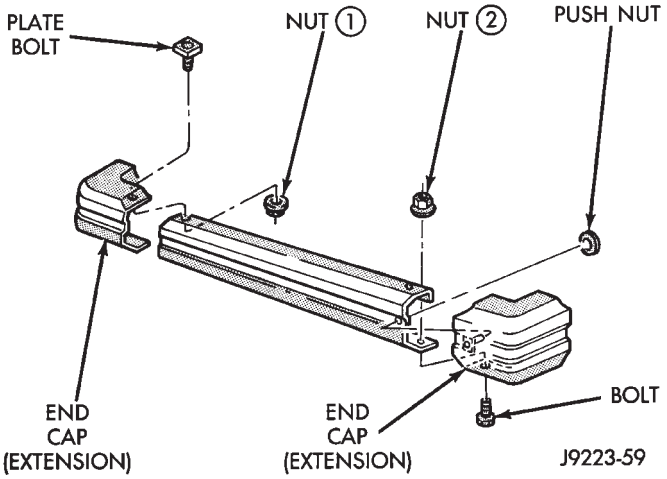

Fig. 14 Bumper End Cap Removal/Installation—XJ Vehicles

holes. Install the bracket-to-crossmember bolts. Tighten the bolts to 42 N·m (31 ft-lbs) torque.

(6) If removed, install the trailer hitch. If necessary, refer to the installation procedure within Group 23—Body Components.

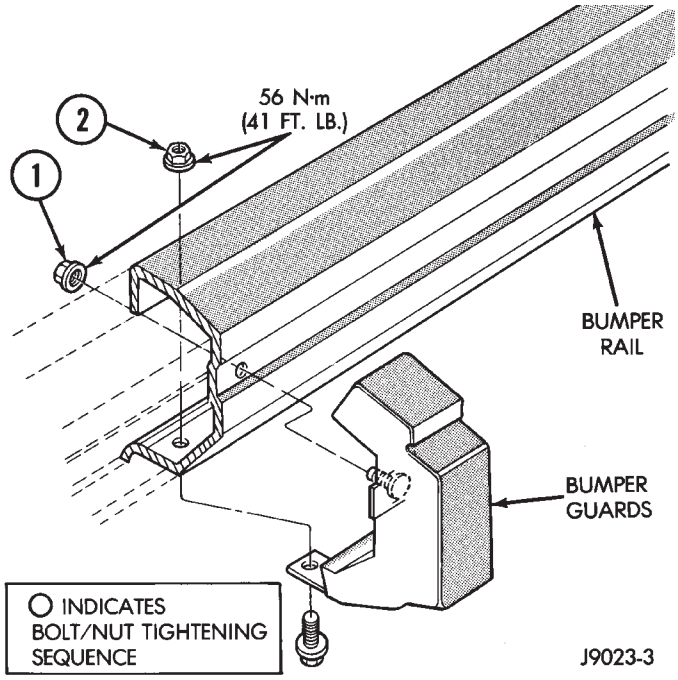

Fig. 15 Bumper Guard Removal/Installation—XJ Vehicles

YJ FRAME

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GENERAL INFORMATION

FUNCTIONS

The Jeep® YJ (Fig. 1) frame is the structural center of the vehicle. In addition to supporting the body and payload, the frame provides a station for the engine. The vehicle body is attached to the frame with holddowns (Figs. 2 and 3).

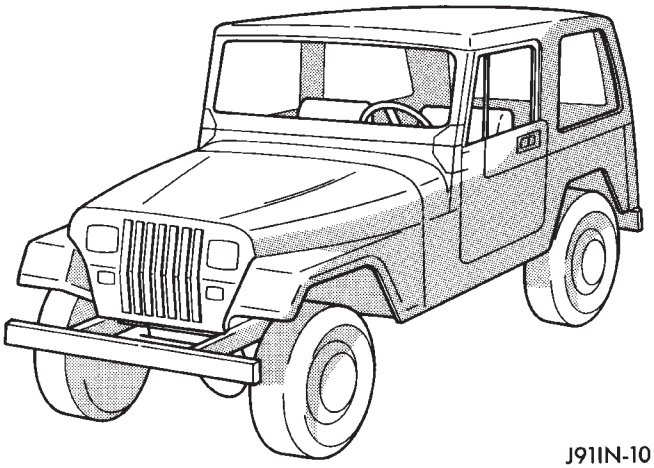

Fig. 1 Jeep® YJ

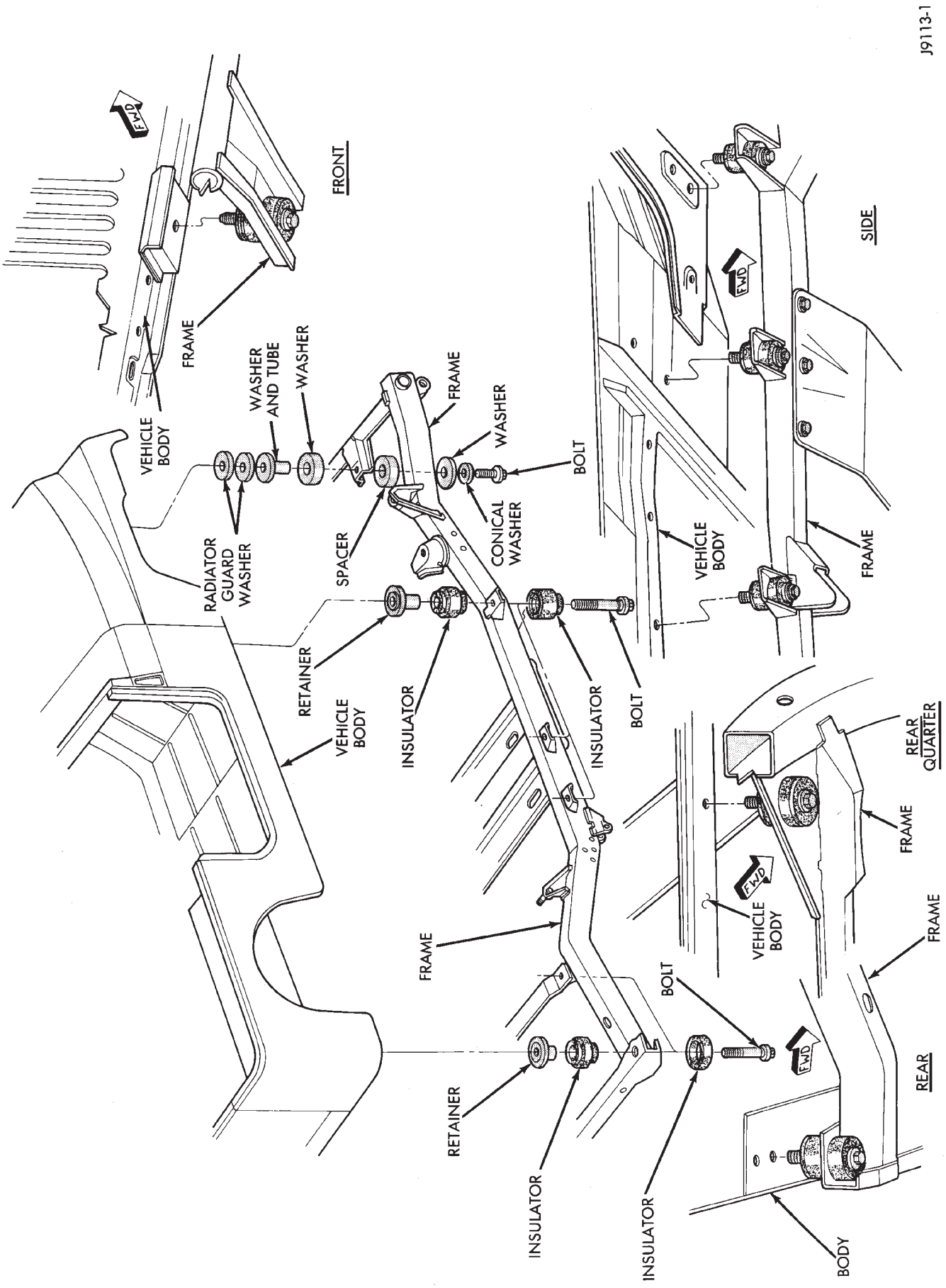

Fig. 2 Jeep® YJ Body & Frame

CONSTRUCTION

The frame is constructed of high-strength channel steel siderails and crossmembers. The crossmembers join the siderails and retain them in alignment in relation to each other. This provides resistance to frame twists and strains.

FRAME ALIGNMENT

INCORRECT ALIGNMENT

Incorrect frame alignment is usually a result of:

- collision impact, or
- the vehicle being operated with excessive loads, or
- loads not positioned in a properly distributed manner on the vehicle.

A mis-aligned frame will affect front axle and/or rear axle alignment. It can cause excessive wear and mechanical failures in the powertrain. Window glass cracks and door opening/closing problems. Vehicle performance can also be impaired.

RE-ALIGNMENT

With collision damage, it is important that the existence of any frame alignment damage be determined. If necessary, the frame should be correctly realigned. Refer to the reference dimensions listed on frame alignment dimension chart (Fig. 4).

FRAME INSPECTION/MEASUREMENTS

INSPECTION

Before proceeding with measurements, inspect all components for visible damage and other metal damage. Also, inspect all connections for loose and missing hardware.

All damaged areas must be repaired and/or the components replaced, as necessary.

MEASUREMENTS

Measure the frame for mis-alignment with the body attached to the frame. Figure 4 provides the alignment reference dimensions. The following information applies to all measurements.

(1) Place the vehicle on a level surface.

(2) If the vehicle is loaded, ensure that the vehicle weight plus the payload does not exceed the gross vehicle weight rating. Also, ensure that the load is distributed in the vehicle as evenly as possible.

(3) Measure the tire inflation pressures and adjust the pressure, if necessary.

HORIZONTAL OR DIAGONAL FRAME MEASUREMENTS

Determine the frame horizontal non-square deviation(s) according to the following procedure.

(1) Select several reference points along one frame siderail, preferably at the crossmember junctions.

(2) Transfer these reference points to the surface/floor with a plumb bob. Paper sheets can be attached to the surface below the reference points for better measurement accuracy.

(3) Locate the reference points on the other frame siderail and transfer them to the surface/floor with the same procedure as above.

(4) Move the vehicle away and measure between all the reference points diagonally from and parallel to the siderails (Fig. 5). The measurements should not differ by more than 6 mm (1/4 in).

(5) Measure the distance between the two front reference points and the distance between the two rear reference points. Divide each distance in half and indicate the two half-way points on the surface/floor. Designate the front point as “1” and the rear point as “2” (Fig. 5).

(6) Place a chalk-line between points 1 and 2 and “snap” the string.

(7) Determine how close the center line is to the diagonal intersection points A, B, C, D, E, and F in Figure 5.

(8) The reference marks on the surface/floor will provide an illustrated indication of the degree of frame misalignment.

(9) A reference point transferred from one frame siderail may be 3 mm (1/8 in) ahead or behind the reference point from the opposite siderail.

(10) Frame bow to the side should not exceed 3 mm per 2,540 mm (1/8 inch per 100 inches) in length.

(11) The overall width of the frame should not vary more than 3 mm (1/8 in) from reference point-to-reference point.

(12) Repeat steps (1) through (11) after straightening the frame to evaluate the effectiveness.

TWIST AND PARALLEL FRAME MEASUREMENTS

Determine the amount of frame twist and siderail deviation according to the following procedure.

(1) Mark the vertical measurement reference points under the frame siderails at 305-mm (12-in) intervals starting at the rear frame crossmember.

(2) Measure the vertical distance up from a level surface to each reference point located under the left and right frame siderails.

(3) The distance to a reference point under one frame siderail should be 3 mm (1/8 in) greater or less than the point under the opposite siderail.

(4) Plot the measured vertical distances to scale on a sheet of graph paper. Plot the distances so that the frame siderails are located adjacent to each other. Join the vertical distance points.

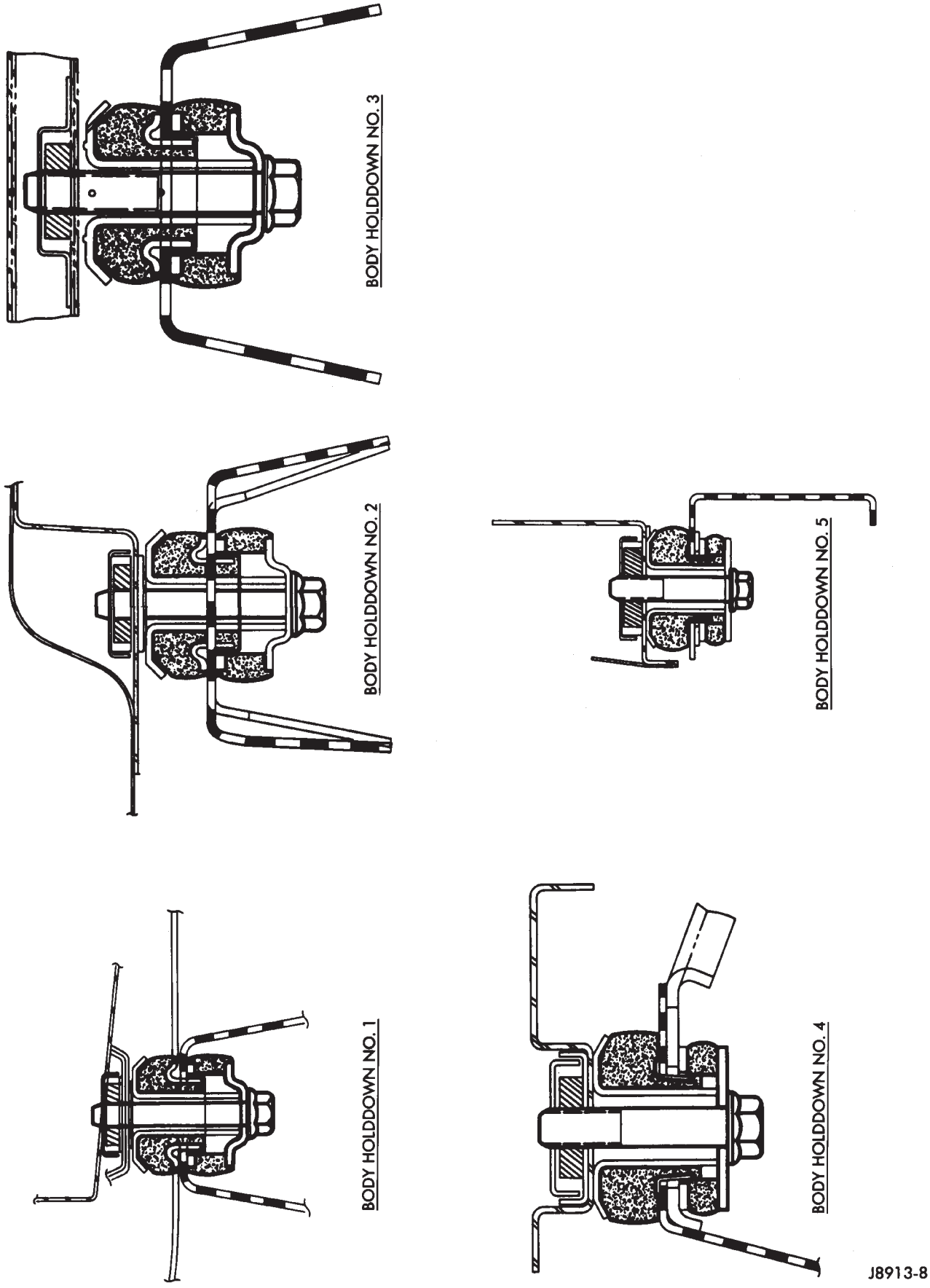

Fig. 3 Body HoldDowns—YJ Vehicles

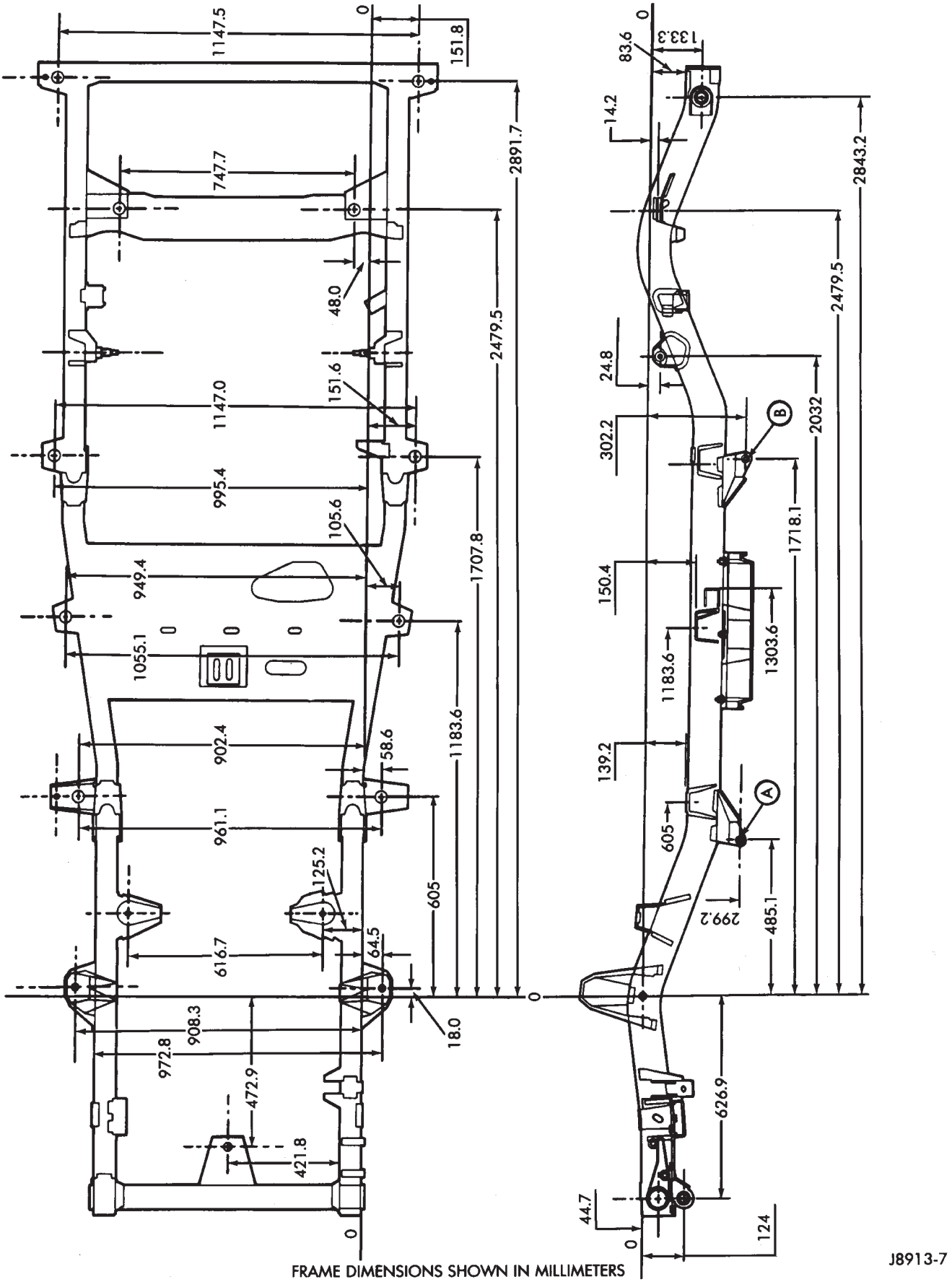

Fig. 4 Frame Alignment Dimensions—YJ Vehicles

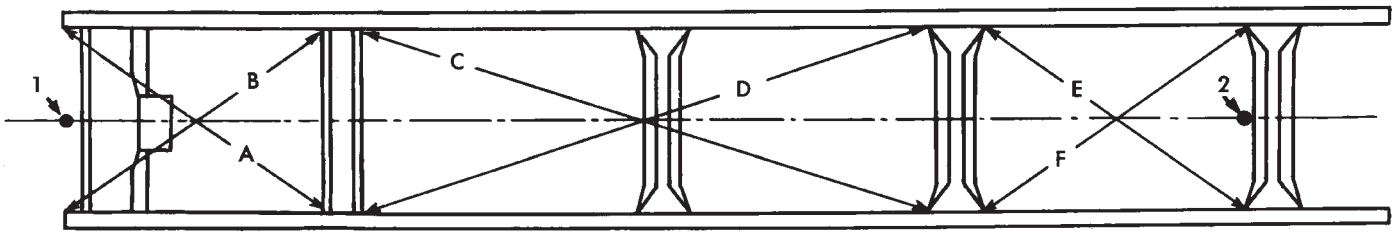

Fig. 5 Frame Alignment Reference Points—Typical

FRAME REPAIR SERVICE

When necessary, conventional vehicle frames that are bent or twisted can be straightened by application of heat. The temperature must not exceed 566°C/1050°F.

Damaged frame siderails, crossmembers, and brackets are repaired either by straightening or by replacement.

Welded joints between the frame siderails and crossmembers are not recommended.

FRAME STRAIGHTENING

A straightening repair process should be limited to frame components that are not severely damaged. The bolts, nuts and rivets should conform to the specifications as the original.

FRAME COMPONENT REPLACEMENT

An improperly straightened frame component will have harmful effects on the overall frame alignment.

FRAME COMPONENT REPAIRS

DRILLING HOLES

Holes **should not** be drilled in frame siderail flanges because this will severely reduce the frame strength. Holes drilled in the frame siderail vertical webs must be 38 mm (1 and 1/2 in) minimum from the top and bottom flanges.

Newly drilled holes should be located an acceptable distance away from any existing holes.

WELDING

It is recommended that electric welding equipment be used to weld frame siderails and crossmembers.

A damaged frame component should be closely examined for hairline cracks. Repair frame component cracks according to the following procedure.

(1) Drill a hole at each end of the crack with a 3-mm (1/8-in) diameter drill bit.

(2) "V-groove" the crack to allow good weld penetration.

(3) Weld the crack.

(4) Grind the weld surface area smooth and install a reinforcement section at the welded area.

The flanges on reinforcement channel should be less in width than the siderail flanges. Otherwise, longitudinal welds are very acceptable. Complete transverse welds should be avoided.

FRAME REPAIR HARDWARE

Bolts, nuts and rivets can be used to repair frames or to install a reinforcement section on the frame. When it is more practical to substitute a bolt for a rivet, install the next-larger-size diameter bolt to prevent the bolt from loosening.

Conical-type lockwashers are preferred over the split-ring type lockwashers. Normally, grade-5 bolts are adequate for frame repair. **Grade-3 bolts (or less) should not be used.** Tightening bolts/nuts with the correct torque is mandatory to adequately "lock" the bolt, lockwasher and nut together, and to prevent them from loosening.

YJ BUMPERS AND FRAME ATTACHED COMPONENTS

INDEX

SERVICE INFORMATION

In some cases, components in the following procedures either support, or are hidden by other components.

FRONT BUMPER

The YJ front bumper is a one-piece rail (Fig. 1). A front crossmember cover (Fig. 1) is also installed on all YJ vehicles.

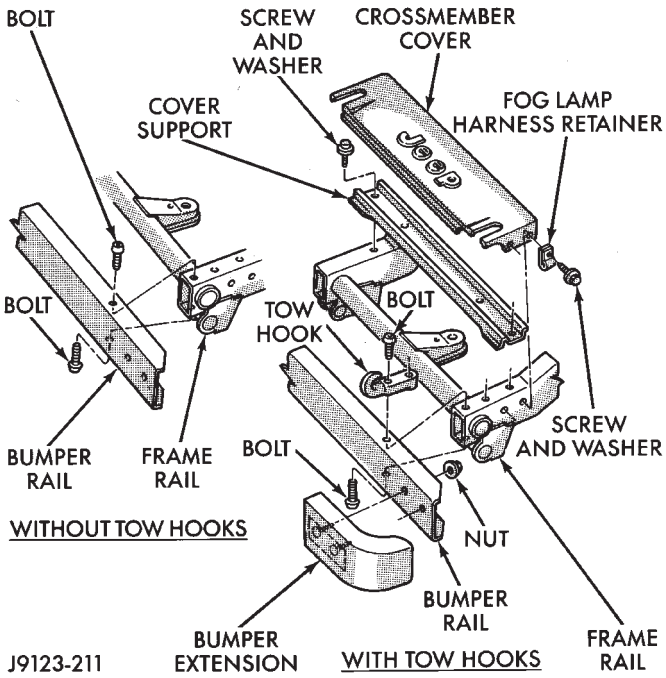

Fig. 1 Front Bumper Rail, Crossmember Cover & Tow Hooks

BUMPER REMOVAL

(1) Disconnect and remove the fog lamps, if equipped.

(2) Remove the nuts and bolts that retain the bumper extensions to the bumper rail and remove the extensions.

(3) Remove the nuts and bolts that attach the bumper rail/tow hooks to the frame rails.

(4) Remove the bumper rail from the frame rails.

BUMPER INSTALLATION

(1) Position the front bumper on the frame rails.

(2) Install the bolts and attach the front bumper rail (and tow hooks, if equipped) to the frame rails.

(3) Tighten the bolts to 102 N·m (75 ft-lbs) torque.

(4) Position the bumper extensions on the bumper rail and install the retaining bolts.

(5) Tighten the bolts to 104 N·m (77 ft-lbs) torque.

(6) Install the fog lamps, if equipped.

FRAME CROSSMEMBER COVER

REMOVAL

(1) Remove the screws that attach the crossmember cover and support to the frame rails.

(2) Remove the crossmember cover and support from the frame rails.

INSTALLATION

(1) Position the support and crossmember cover on the frame rails.

(2) Install the attaching screws.

(3) Tighten the screws to 8 N·m (72 in-lbs) torque.

TOW HOOKS

REMOVAL

(1) Remove the two bolts that attach the tow hook to the bumper rail and to the frame rail.

(2) Remove the tow hook.

INSTALLATION

(1) Position the tow hook on the bumper rail and frame rail.

(2) Install the attaching bolts.

(3) Tighten the bolts to 102 N·m (75 ft-lbs) torque.

GENERATOR SPLASH SHIELD

REMOVAL

(1) Remove the shield retaining nut and washer (Fig. 2) from the engine oil pan stud (2.5L engines only).

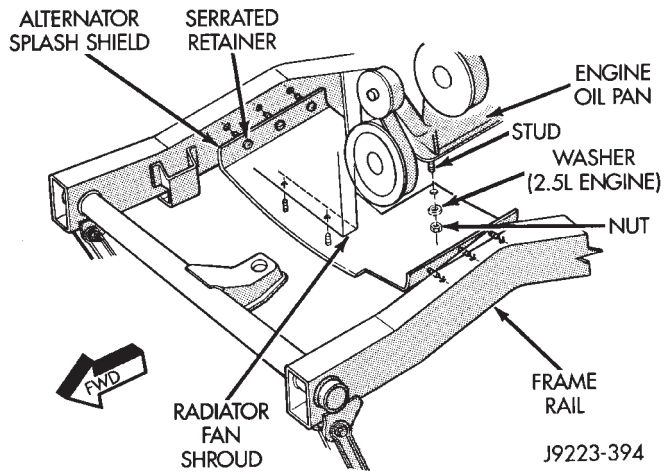

Fig. 2 Generator Splash Shield

(2) Pry the serrated retainers from the frame rail holes at each side of the vehicle.

(3) Pry the serrated retainers from the fan shroud holes (Fig. 2).

(4) Remove the shield from the vehicle.

INSTALLATION

(1) Position the generator splash shield at the fan shroud and frame rails.

(2) Force the serrated retainers into the fan shroud holes.

(3) Force the serrated retainers into the frame rail holes at each side of the vehicle.

ENGINE FRONT SUPPORT CUSHION

REMOVAL

(1) Raise and support the engine.

(2) Remove the nut and bolt that attach the engine support cushion to the engine support bracket (Figs. 3 and 4).

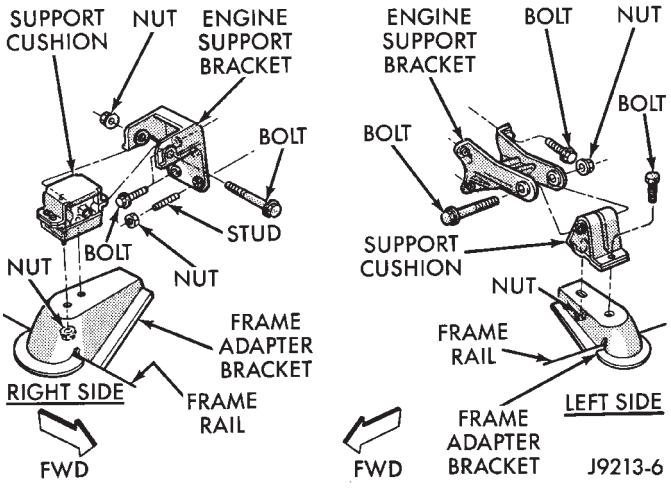

Fig. 3 Engine Support Cushion—2.5L Engine

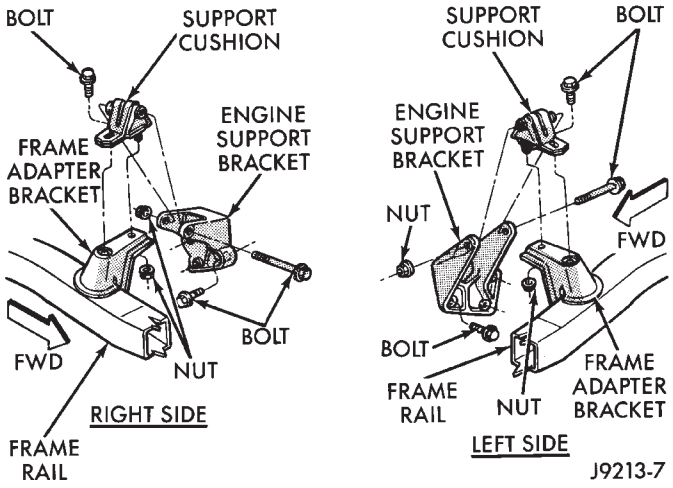

Fig. 4 Engine Support Cushion—4.0L Engine

(3) Remove the nut and bolt that attach the support cushion to the frame adapter bracket.

(4) Remove the support cushion from the frame adapter bracket.

INSTALLATION

(1) Position the support cushion on the frame adapter bracket.

(2) Install the bolt and nut that attach the engine support cushion to the frame adapter bracket. Tighten the bolt and nut to 49 N·m (36 ft-lbs) torque.

(3) Install the bolt and nut that attach the engine support cushion to the engine support bracket. Tighten the nut to 65 N·m (48 ft-lbs) torque.

(4) Remove the support and lower the engine.

TRANSFER CASE SKID PLATE

REMOVAL

(1) Raise and support the transmission.

(2) Remove the nuts that attach the transmission support cushion and torque bracket to the skid plate (Fig. 5).

(3) Separate the transmission support cushion from the skid plate.

(4) Remove the nuts and bolts that attach the skid plate to the frame.

(5) Remove the skid plate from the vehicle.

INSTALLATION

(1) Position the skid plate at the frame and transmission support cushion.

(2) Attach the skid plate to the frame.

(3) Install the nuts that attach the transmission support cushion and torque bracket to the skid plate. Tighten the nuts to 56 N·m (41 ft-lbs) torque.

(4) Remove the support and lower the transmission.

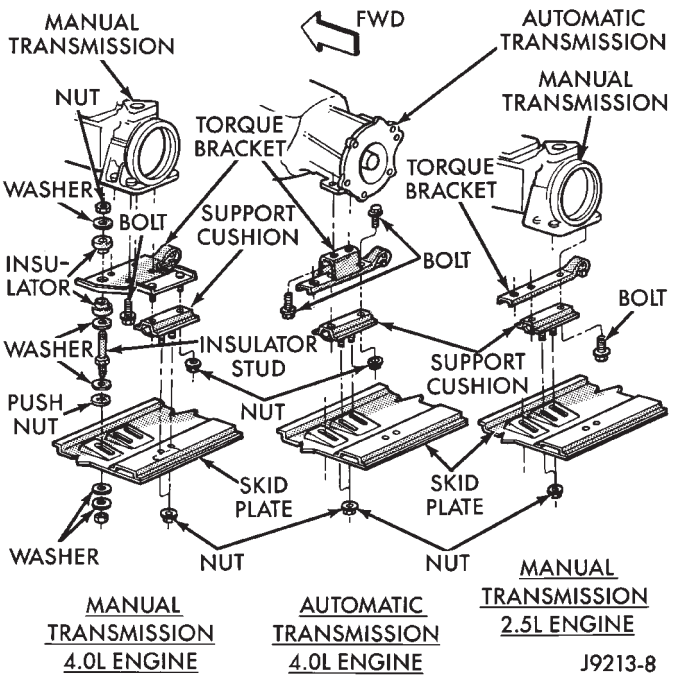

Fig. 5 Transfer Case Skid Plate

FUEL TANK SKID PLATE

REMOVAL

(1) Position a support under the fuel tank skid plate.

(2) Remove the nuts that attach the skid plate to the straps and to the crossmembers (Fig. 6).

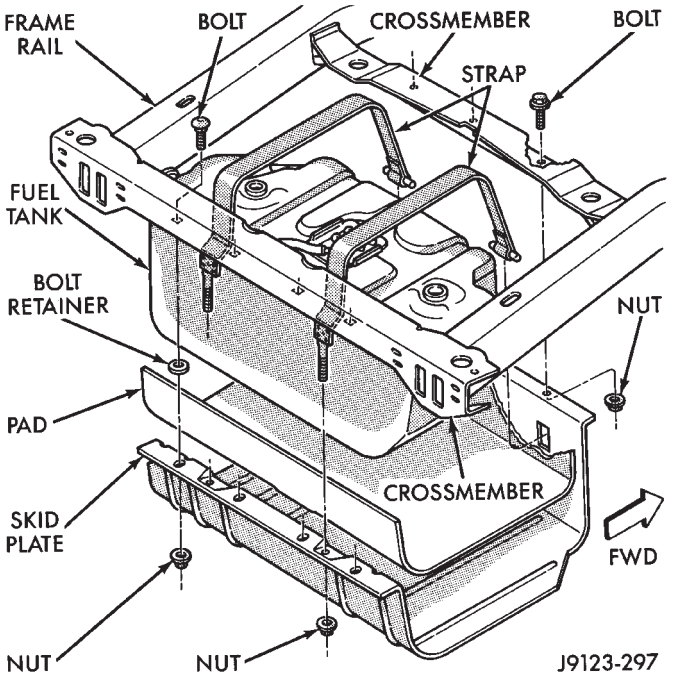

Fig. 6 Fuel Tank Skid Plate

(3) Separate the fuel tank strap from the skid plate.

(4) Support the fuel tank and remove the skid plate and the pad from the vehicle.

INSTALLATION

(1) Attach the skid plate to the fuel tank strap.

(2) Position and support the pad and skid plate under the fuel tank.

(3) Install the nuts to attach the skid plate to the straps and to the frame crossmembers. Tighten the fuel tank strap nuts to 5 N·m (40 in-lbs) torque. Tighten the skid plate-to-crossmember nuts with 16 N·m (138 in-lbs) torque.

(4) Remove the support from under the skid plate.

FUEL AND BRAKE FLUID TUBE RETAINER CLIP

REMOVAL

(1) Remove the fuel/brake fluid tubes from the retainer clip grooves (Fig. 7).

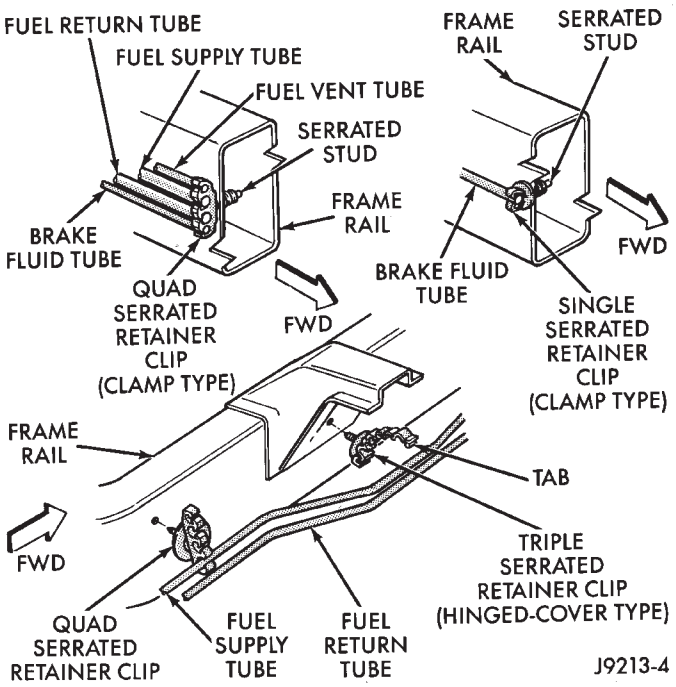

Fig. 7 Fuel & Brake Tube Serrated Retainer Clips—Typical

(2) Pry the serrated retainer clip outward and remove it from the frame rail hole.

INSTALLATION

(1) Position the serrated retainer clip at the frame rail hole.

(2) Force the serrated retainer clip inward against the frame rail.

(3) Insert the fuel/brake fluid tubes in the retainer clip grooves and press inward to seat them.

MUFFLER/TAILPIPE HANGER BRACKET

REMOVAL

(1) As applicable, detach the muffler or tailpipe hanger from the insulator (Fig. 8). Remove the insulator from the hanger bracket.

(2) As applicable, remove the nuts and bolts, or screws that attach the hanger bracket to the frame rail.

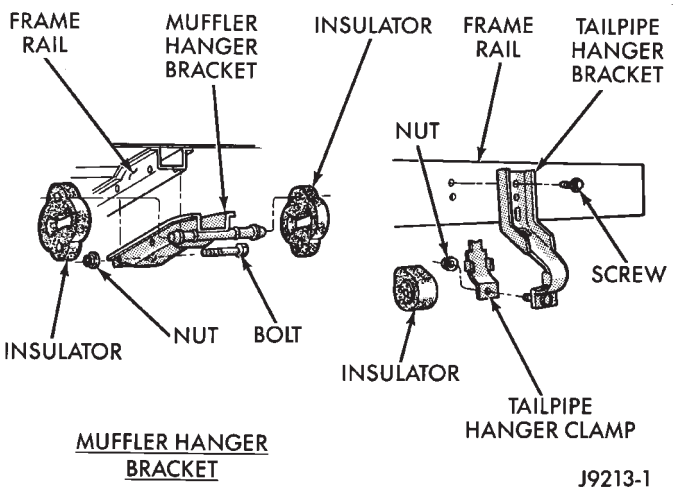

Fig. 8 Muffler/Tailpipe Hanger Bracket

(3) Remove the hanger bracket from the frame rail.

INSTALLATION

(1) Position the hanger bracket on the frame rail.

(2) As applicable, install the nuts and bolts, or screws that attach the hanger bracket to the frame rail. Tighten the nuts/screws securely.

(3) Remove the insulator from the hanger bracket.

(4) As applicable, attach the muffler or tailpipe hanger to the insulator.

MUFFLER AND TAILPIPE HEAT SHIELDS

REMOVAL

(1) If necessary, remove the muffler and tailpipe for access.

(2) Remove the retaining screws and the heat shields from the support bracket (Fig. 9).

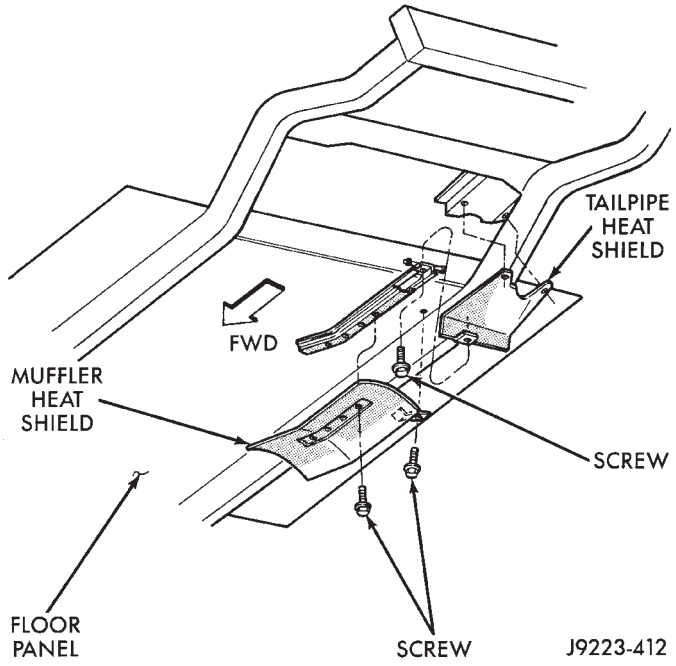

Fig. 9 Muffler & Tailpipe Heat Shield

INSTALLATION

(1) Position the heat shields on the support bracket and install screws. Tighten the screws to 5 N·m (in 44 in-lbs) torque.

(2) If removed, install the muffler and tailpipe.

FUEL FILTER SHIELD AND BRACKET

REMOVAL

(1) Remove the screws that attach the fuel filter shield to the frame rail (Figs. 10 and 11).

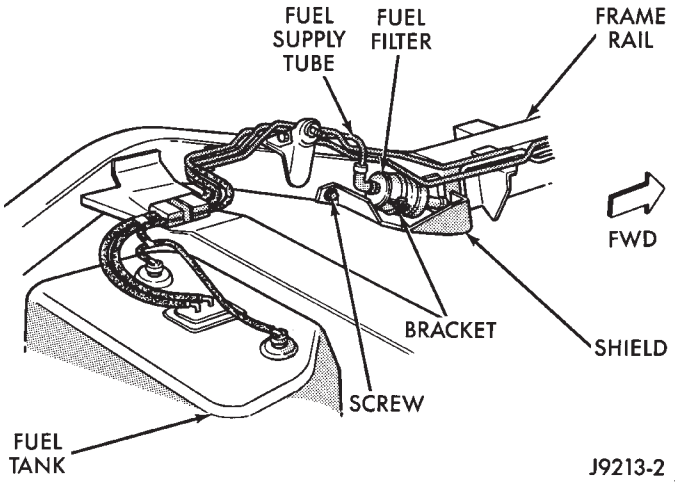

Fig. 10 Fuel Filter Shield & Bracket—Installed

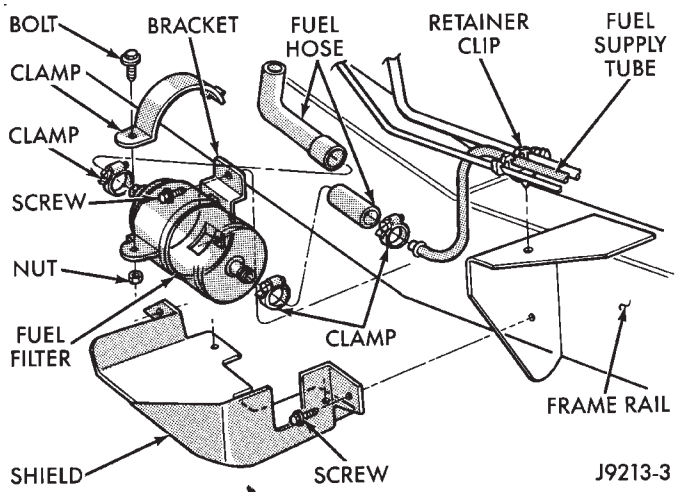

Fig. 11 Fuel Filter Shield & Bracket—Removed

(2) Remove the shield from the frame rail (Fig. 11).

(3) Remove the nut and bolt from the fuel filter bracket clamp.

(4) Remove the clamp and the fuel filter from the bracket.

(5) Remove the screws that attach the bracket to the frame rail.

(6) Remove the bracket from the frame rail.

INSTALLATION

(1) Position the fuel filter bracket on the frame rail.

(2) Install the screws that attach the bracket to the frame rail. Tighten the screws to 42 N·m (31 ft-lbs) torque.

(3) Install the fuel filter in the bracket.

(4) Position the clamp on the bracket and install bolt and nut. Tighten the nut to 8 N·m (72 in-lbs) torque.

(5) Position the fuel filter shield from the frame rail.

(6) Install the screws that attach the fuel filter shield to the frame rail. Tighten the screws to 42 N·m (31 ft-lbs) torque.

REAR JOUNCE BUMPER

REMOVAL

(1) Remove the screws that attach the jounce bumper to the frame rail (Fig. 12).

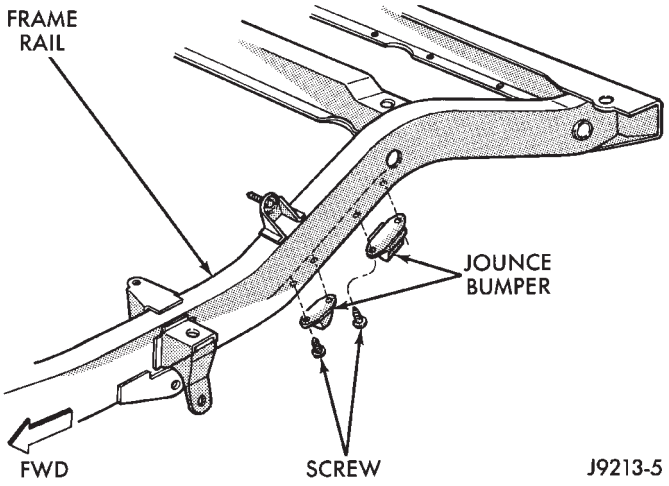

Fig. 12 Rear Jounce Bumpers

(2) Remove the jounce bumper from the frame rail.

INSTALLATION

(1) Position the jounce bumper on the frame rail.

(2) Install the screws that attach the jounce bumper to the frame rail. Tighten the screws to 20 N·m (15 ft-lbs) torque.

REAR BUMPER

When equipped with a spare tire carrier attached to the tailgate, a rear bumperette is attached to the frame (Figs. 13 and 14).

BUMPERETTE AND DRAW BAR REMOVAL

(1) Remove the bumperette and draw bar retaining nuts, bolts and washers from the frame rear crossmember (Figs. 14 and 15).

(2) Remove the bumperettes, spacers, brackets and draw bar from the rear crossmember.

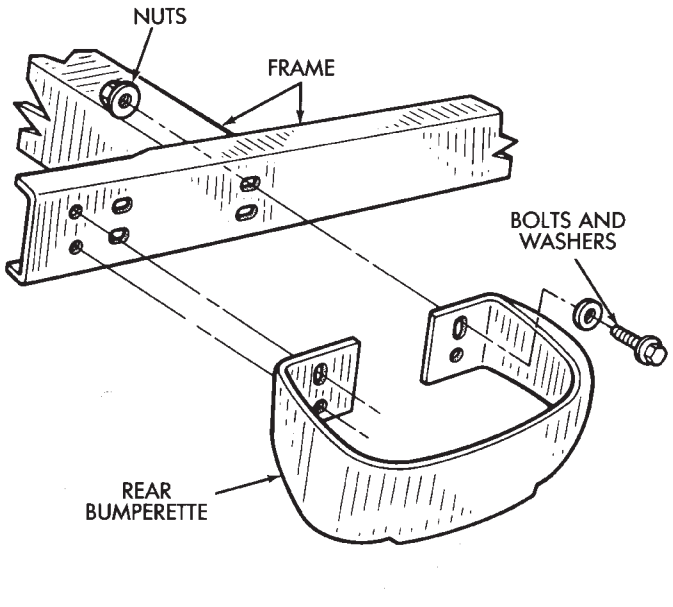

Fig. 13 Rear Bumperette

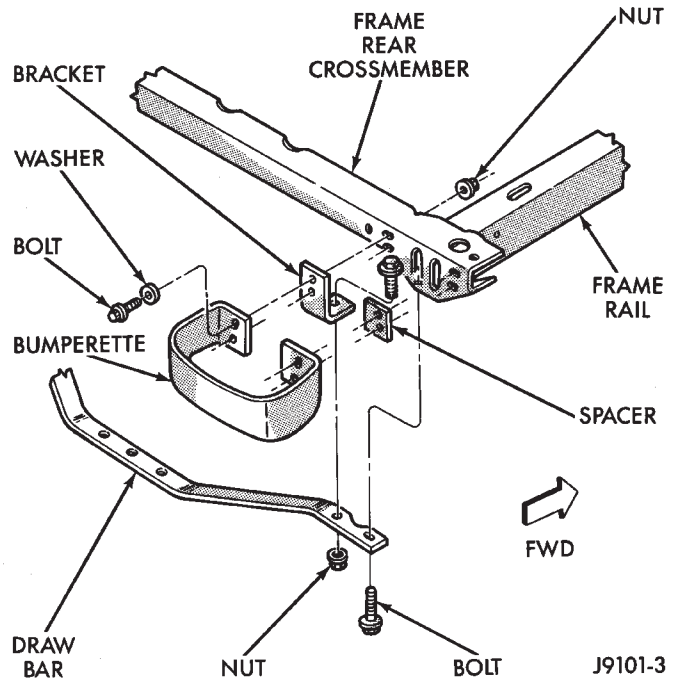

Fig. 14 Rear Bumperette & Draw Bar

INSTALLATION

(1) Position the spacers, brackets, draw bar and bumperettes on the rear crossmember.

(2) Install the retaining nuts, bolts and washers in the frame rear crossmember. Tighten the retaining nuts and bolts securely.

BODY

REMOVAL

The body is attached to the vehicle frame with bolts (Fig. 15). The body can be removed for repair, service access, or replacement, if necessary.

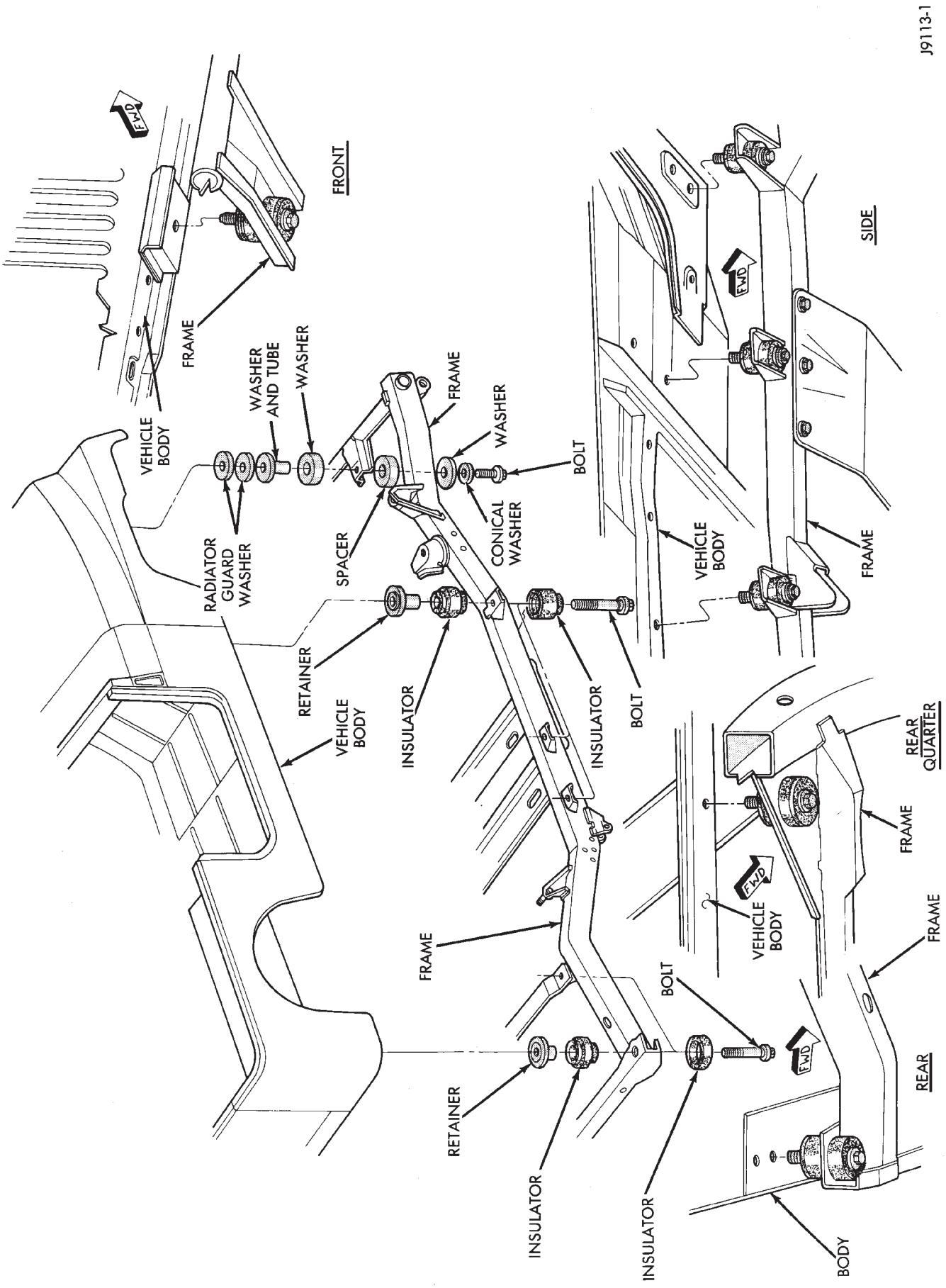

Fig. 15 Body Removal/Installation

(1) Disconnect the battery negative cable.

(2) Disconnect all wire harness connectors that connect body wire harnesses to the frame wire harnesses.

(3) Loosen the clamps and disconnect the fuel hoses from the filler nozzle (Fig. 16).

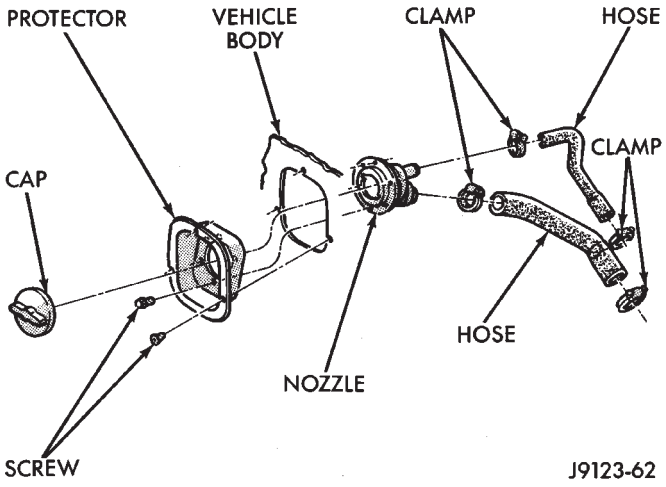

Fig. 16 Fuel Hoses & Clamps

(4) Disconnect the parking brake cable.

(5) Support the exhaust system and disconnect the support hangers.

(6) Disconnect all suspension components from the body.

(7) Disconnect all drive train components from the body.

(8) Disconnect all steering components from the body.

(9) Disconnect all engine control components from the body.

(10) Disconnect all cooling system components from the body.

(11) Disconnect all brake system components from the body.

(12) Disconnect all remaining component connections between the body and the frame.

(13) Remove bolts from the frame and body. The bolts are accessible from the underside of the frame at the following locations:

- at the rear of each frame rail;
- at each rear quarter crossmember wedge;
- at the side of each frame rail and
- at the center of the front crossmember.

(14) Identify, mark and retain the attaching hardware for installation reference.

(15) Remove the body from the frame.

INSTALLATION

(1) Position body on the frame.

(2) Install the body-to-frame attaching hardware.

(3) Connect the exhaust hangers, fuel tank hoses and parking brake cable.

(4) Connect all the wire harness connectors.

(5) Connect all disconnected vehicle components to the body. Refer to the applicable procedures within this manual.

(6) Connect the battery negative cable.

FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

Throughout this group, references are made to particular vehicle models by alphabetical designation or by the particular vehicle nameplate. A chart showing a breakdown of the alphabetical designations is included in the Introduction section at the beginning of this manual.

The **Fuel System** consists of: the fuel tank, an electric (fuel tank mounted) fuel pump and a fuel filter. It also consists of fuel tubes/lines/hoses, vacuum hoses, throttle body and fuel injectors.

The **Fuel Delivery System** consists of: the electric fuel pump, fuel filter, fuel tubes/lines/hoses, fuel rail, fuel injectors and fuel pressure regulator.

A **Fuel Return System** is used on all vehicles. The system consists of: the fuel tubes/lines/hoses that route fuel back to the fuel tank.

The **Fuel Tank Assembly** consists of: the fuel tank, filler tube, fuel gauge sending unit/electric fuel pump module, a pressure relief/rollover valve and a pressure-vacuum filler cap.

Also to be considered part of the fuel system is the **Evaporation Control System.** This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Group 25, Emission Control Systems.

FUEL USAGE STATEMENT

Your vehicle was designed to meet all emission regulations and provide excellent fuel economy using high quality unleaded gasoline. Only use unleaded gasolines having a minimum posted octane of 87.

If your vehicle develops occasional light spark knock (ping) at low engine speeds, this is not harmful. However, **continued heavy knock at high speeds can cause damage and should be reported to your dealer immediately.** Engine damage as a result of heavy knock operation may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, **those that contain detergents, corrosion and stability additives are recommended.** Using gasolines that have these additives will help improve fuel economy, reduce emissions and maintain vehicle performance. Generally, premium unleaded gasolines contain more additive than regular unleaded gasolines.

Poor quality gasoline can cause problems such as hard starting, stalling and stumble. If you experience these problems, use another brand of gasoline before considering service for the vehicle.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with materials that contain oxygen such as alcohol, MTBE and ETBE. The type and amount of oxygenate used in the blend is important. The following are generally used in gasoline blends:

ETHANOL

Ethanol (Ethyl or Grain Alcohol) properly blended, is used as a mixture of 10 percent ethanol and 90 percent gasoline. **Gasoline with ethanol may be used in your vehicle.**

METHANOL

CAUTION: DO NOT USE GASOLINES CONTAINING METHANOL. Use of methanol/gasoline blends may result in starting and driveability problems. In addition, damage may be done to critical fuel system components.

Methanol (Methyl or Wood Alcohol) is used in a variety of concentrations blended with unleaded gaso-

line. You may encounter fuels containing 3 percent or more methanol along with other alcohols called co-solvents.

Problems that are the result of using methanol/gasoline blends are not the responsibility of Chrysler Corporation. They may not be covered by the vehicle warranty.

MTBE/ETBE

Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline and up to 15 percent MTBE. Gasoline and ETBE (Ethyl Tertiary Butyl Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used in your vehicle.

CLEAN AIR GASOLINE

Many gasolines are now being blended that contribute to cleaner air, especially in those areas of the country where air pollution levels are high. These new blends provide a cleaner burning fuel and some are referred to as **Reformulated Gasoline.**

In areas of the country where carbon monoxide levels are high, gasolines are being treated with oxygenated materials such as MTBE, ETBE and ethanol.

Chrysler Corporation supports these efforts toward cleaner air and recommends that you use these gasolines as they become available.

FUEL DELIVERY SYSTEM

INDEX

FUEL PUMP MODULE

The fuel pump module is installed in the top of the fuel tank. The fuel pump module contains the following components:

- Electric fuel pump
- Fuel pump reservoir
- In-tank fuel filter
- Fuel gauge sending unit
- Fuel supply and return tube connections

The fuel pump used on all vehicles is a gear/rotor type pump. It is driven by a permanent magnet 12 volt electric motor that is immersed in the fuel tank. The electrical pump is integral with the fuel sender unit. The pump/sender assembly is installed inside the fuel tank.

The fuel pump has a check valve at the outlet end that consists of a ball held against a seat by force applied from a spring. When the pump is operating, fuel pressure overcomes spring pressure and forces the ball off its seat, allowing fuel to flow. When the pump is not operating, spring pressure forces the ball back against the seat preventing fuel backflow through the pump.

Fuel system pressure is maintained at approximately 214 kPa (31 psi). This is when the pump is operating and vacuum is supplied to the fuel pressure regulator. If vacuum is not supplied to the pressure regulator, fuel pressure will be approximately 55-69 kPa (8-10 psi) higher. This may be due to a broken or clogged vacuum line. When the fuel pump is not operating, system fuel pressure of 131-269 kPa (19-39 psi) is maintained. This is done by the fuel pump outlet check valve and the vacuum assisted fuel pressure regulator.

REMOVAL—XJ MODELS

The fuel pump/gauge sender unit assembly can be removed from the fuel tank without removing the tank from the vehicle.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

WARNING: EXTINGUISH ALL TOBACCO SMOKING PRODUCTS BEFORE SERVICING THE FUEL SYSTEM. KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Remove fuel filler cap. Perform the Fuel Pressure Release Procedure as outlined in this group.

(2) Disconnect negative battery cable.

(3) Using an approved portable gasoline siphon/storage tank, drain fuel tank until fuel level is below one quarter (1/4) full.

(4) Raise and support vehicle.

WARNING: WRAP SHOP TOWELS AROUND FUEL HOSES TO ABSORB ANY FUEL SPILLAGE DURING FUEL TANK REMOVAL.

(5) Disconnect fuel vent supply and return tubes from fittings on fuel pump module.

(6) Disconnect fuel pump module electrical harness connector from main harness.

(7) Using a brass punch and hammer, remove fuel pump module lock ring by carefully tapping it counterclockwise (Fig. 1).

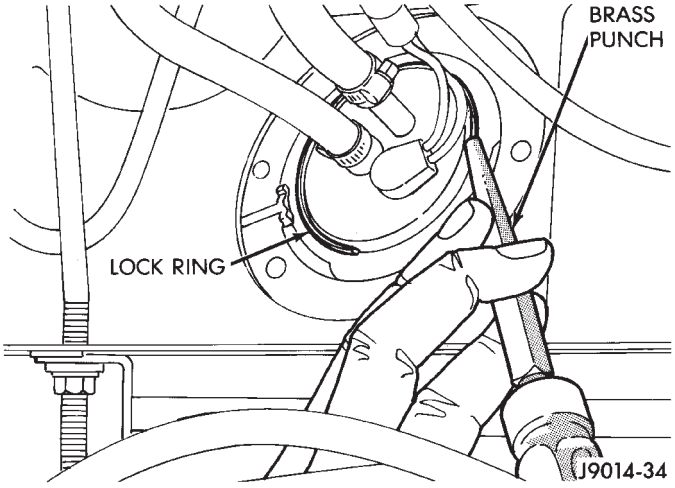

Fig. 1 Removing Lock Ring—XJ Models—Typical

(8) Remove fuel pump module and O-ring seal. Discard old O-ring and fuel pump module inlet filter.

DISASSEMBLY—XJ MODELS

(1) Remove and discard fuel pump inlet filter.

The wire terminals to the fuel pump motor are different in size and cannot be connected to the wrong terminal.

(2) Disconnect fuel pump terminal wires.

(3) Remove fuel pump outlet hose and clamp. Replace the hose if it shows any signs of fatigue or failure.

(4) Remove fuel pump top mounting bracket nut. Remove fuel pump (Fig. 2).

ASSEMBLY—XJ MODELS

Whenever the fuel pump is replaced, the fuel pump inlet filter (sock) must also be replaced.

(1) Place fuel pump top mounting bracket over top of pump.

(2) Position fuel pump into lower bracket. Slide stud of top bracket through hole in fuel pump side bracket. Tighten fuel pump top mounting nut.

(3) Install new fuel pump outlet hose. Secure with new clamps.

(4) Connect wire terminals to motor.

(5) Install new fuel pump inlet filter.

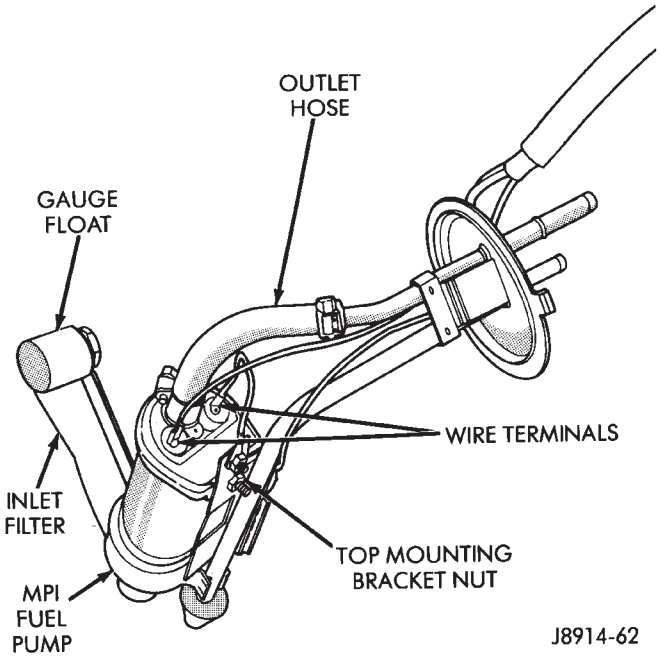

Fig. 2 Fuel Pump Module—XJ Models—Disassemble/Assemble

INSTALLATION—XJ MODELS

Whenever the fuel pump is replaced, the fuel pump inlet filter must also be replaced.

(1) Install new fuel pump inlet filter onto fuel pump.

(2) Install fuel pump module assembly and new O-ring seal. The rubber stopper on the end of the fuel return tube of the assembly must be inserted into the cup in the fuel tank reservoir (Fig. 3).

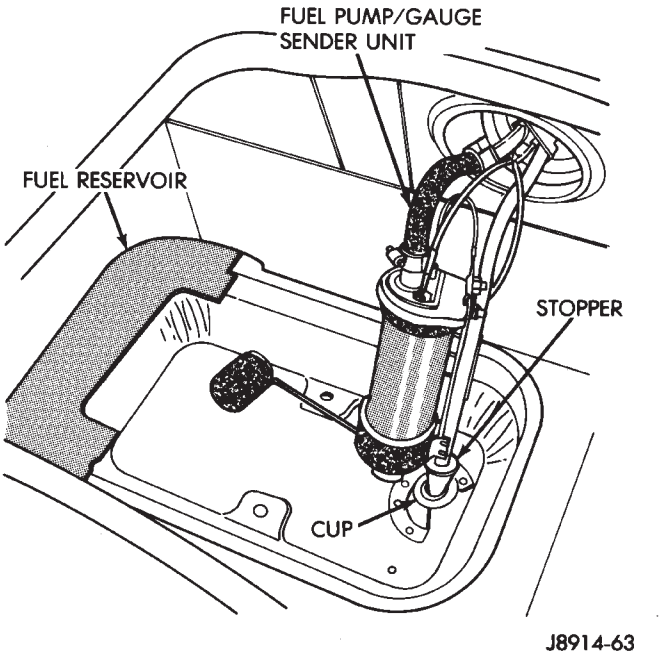

Fig. 3 Fuel Pump Module—XJ Models—Installation

(3) Using a brass punch and a hammer, install lock ring. Carefully tap lock ring clockwise until it seats against stop on fuel tank.

(4) Connect fuel supply and return hoses to fittings on fuel pump module. Tighten hose clamps.

(5) Connect fuel pump module electrical harness connector to main harness connector.

(6) Lower vehicle.

(7) Fill fuel tank. Install fuel tank cap.

(8) Connect negative battery cable.

(9) Start vehicle and inspect for leaks.

REMOVAL—YJ MODELS

The fuel tank must be removed to remove the fuel pump module.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

WARNING: EXTINGUISH ALL TOBACCO SMOKING PRODUCTS BEFORE SERVICING THE FUEL SYSTEM. KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Remove negative battery cable.

(2) Remove fuel filler cap. Perform the Fuel Pressure Release Procedure as outlined in this group.

(3) Remove fuel tank. Refer to Fuel Tank Removal—YJ Models.

(4) Remove fuel pump module assembly.

(5) Remove mounting screws. Lift assembly and gasket out of fuel tank. Discard old gasket (Fig. 4).

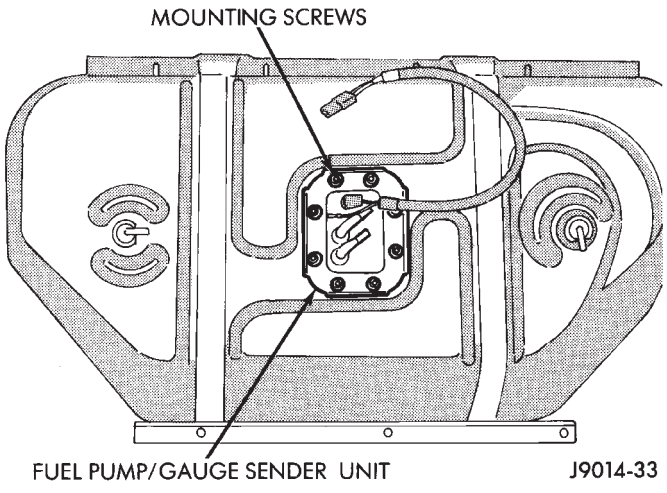

Fig. 4 Fuel Pump Module—Remove/Install—YJ Models

(6) Remove and discard fuel pump inlet filter.

DISASSEMBLY—YJ MODELS

(1) Remove and discard fuel pump inlet filter (Fig. 5).

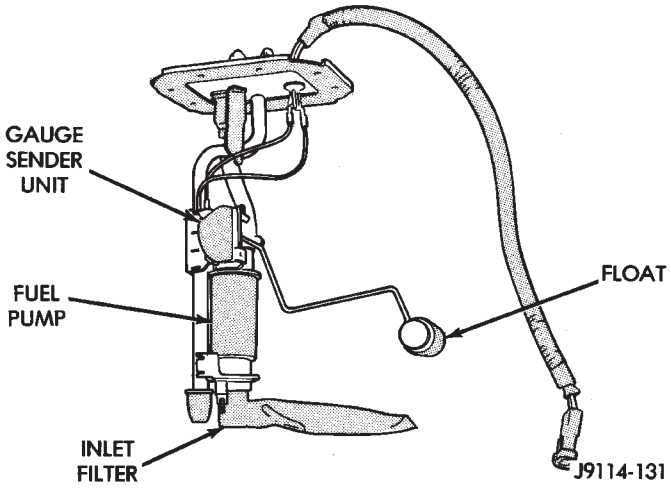

Fig. 5 Fuel Pump Module—YJ Models

The wire terminals to the fuel pump motor are different in size and cannot be connected to the wrong terminal.

(2) Disconnect fuel pump terminal wires from pump.

(3) Remove fuel pump outlet hose and clamp (Fig. 6). Replace the hose if it shows any signs of fatigue or failure.

(4) Remove fuel pump top mounting bracket nut (Fig. 6). Remove fuel pump.

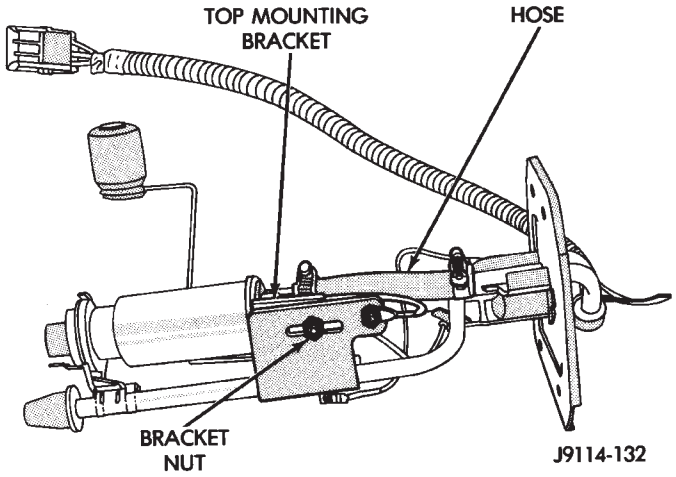

Fig. 6 Fuel Pump Removal/Installation—YJ Models

ASSEMBLY—YJ MODELS

Whenever the fuel pump is replaced, the fuel pump inlet filter (sock) must also be replaced.

(1) Place fuel pump top mounting bracket over top of pump.

(2) Position fuel pump into lower bracket. Slide stud of top bracket through hole in fuel pump side bracket. Tighten fuel pump top mounting nut.

(3) Install new fuel pump outlet hose. Secure with new clamps.
(4) Connect wire terminals to motor.
(5) Install new fuel pump inlet filter.

INSTALLATION—YJ MODELS

(1) Install a new fuel pump inlet filter.
(2) Install fuel pump module assembly with a new gasket between the assembly and tank. Tighten mounting screws to 2 N·m (18 in. lbs.) torque.
(3) Install fuel tank. Refer to Fuel Tank Installation—YJ Models.
(4) Fill fuel tank. Install fuel tank cap.
(5) Install negative battery cable.
(6) Start vehicle and check for leaks.

FUEL PUMP ELECTRICAL CONTROL

For an electrical operational description of the fuel pump, refer to the MFI System—Component Description/System Operation section of this group. See Automatic Shut Down (ASD) Relay—PCM Output.

For the 1994 model year, the ballast resistor and ballast resistor bypass relay are no longer used to control the fuel pump circuit.

FUEL PRESSURE RELEASE PROCEDURE

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING ANY FUEL SUPPLY OR FUEL RETURN SYSTEM COMPONENT.

(1) Disconnect negative battery cable.
(2) Remove fuel tank filler neck cap to release fuel tank pressure.

WARNING: DO NOT ALLOW FUEL TO SPILL ONTO THE ENGINE INTAKE OR EXHAUST MANIFOLDS. PLACE SHOP TOWELS UNDER AND AROUND THE PRESSURE PORT TO ABSORB FUEL WHEN THE PRESSURE IS RELEASED FROM THE FUEL RAIL.

WARNING: WEAR PROPER EYE PROTECTION WHEN RELEASING FUEL SYSTEM PRESSURE.

(3) Remove protective cap from pressure test port on the fuel rail (Fig. 7).
(4) Obtain the fuel pressure gauge/hose assembly from fuel pressure gauge tool set 5069. Remove the gauge from the hose.
(5) Place one end of hose (gauge end) into an approved gasoline container.
(6) Place a shop towel under the test port.
(7) To release fuel pressure, screw the other end of hose onto the fuel pressure test port.

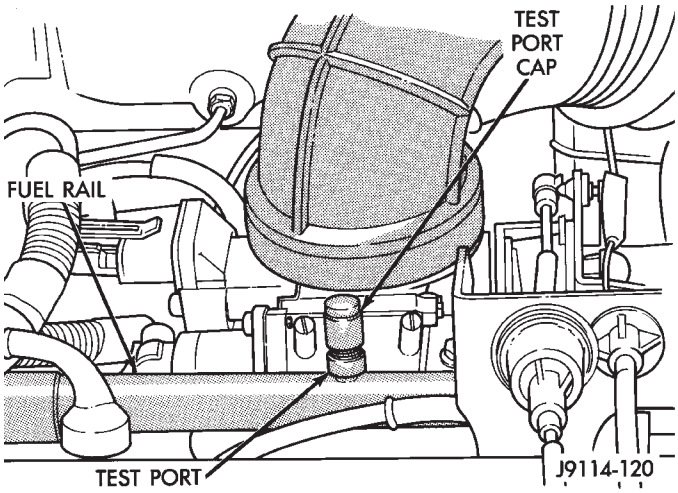

Fig. 7 Pressure Test Port—Typical

(8) After fuel pressure has been released, remove the hose from the test port.
(9) Install protective cap to fuel test port.

FUEL SYSTEM PRESSURE TEST

The fuel system is equipped with a vacuum assisted fuel pressure regulator (Fig. 8). With engine at idle speed, system fuel pressure should be approximately 214 kPa (31 psi) with the vacuum line connected to the regulator. With the vacuum line disconnected from the regulator, fuel pressure should be approximately 269 kPa (39 psi). This is 55-69 kPa (8-10 psi) higher.

(1) Remove the protective cap at the fuel rail (Fig. 7). Connect the 0-414 kPa (0-60 psi) fuel pressure gauge (from Gauge Set 5069) to test port pressure fitting on fuel rail (Fig. 9).

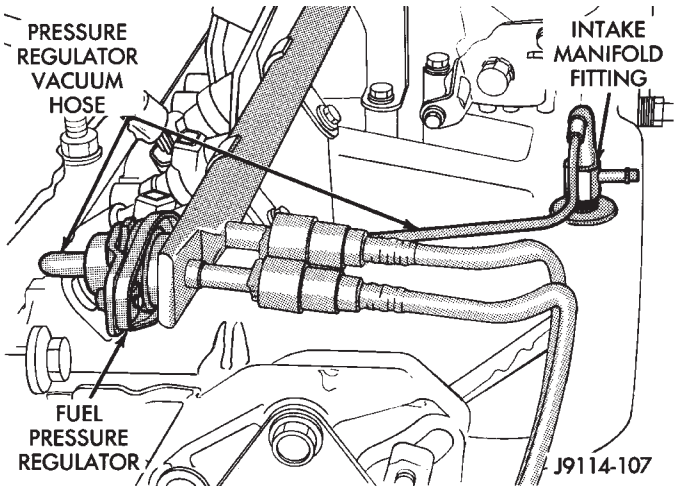

Fig. 8 Fuel Pressure Regulator—Typical

(2) Note pressure gauge reading. Fuel pressure should be approximately 214 kPa (31 psi) at idle.

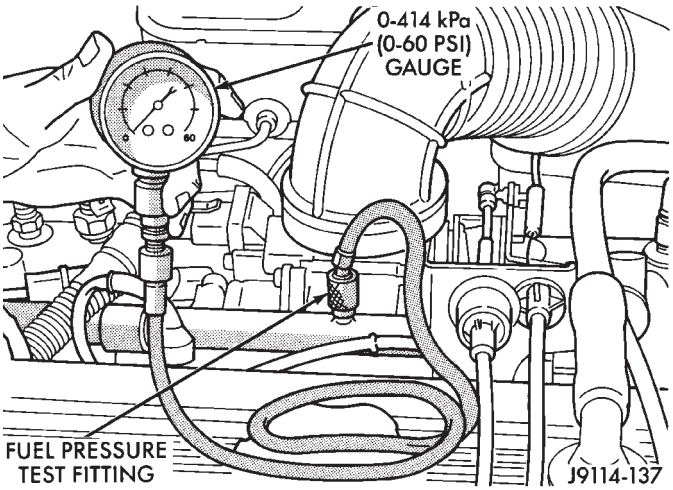

Fig. 9 Fuel Pressure Test Connection—Typical

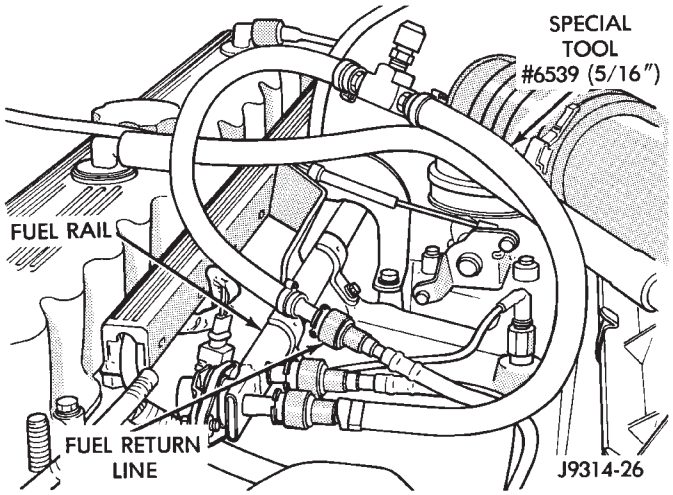

Fig. 10 Adapter Tool—Typical Connection

(3) Disconnect vacuum line (hose) at fuel pressure regulator (Fig. 8). Note gauge reading. With vacuum line disconnected, fuel pressure should rise to approximately 269 kPa (39 psi).

Fuel pressure should be approximately 55-69 kPa (8-10 psi) higher with vacuum line removed from regulator. If not, inspect pressure regulator vacuum line for leaks, kinks or blockage. If vacuum line checks OK and fuel pressure does not rise approximately 8-10 psi after disconnecting vacuum line, replace fuel pressure regulator.

The fuel pressure regulator is **not adjustable.**

(4) If fuel pressure exceeds 45 psi, check fuel return line/tube for kinks or obstructions.

If the previous tests checked good, fuel pump pressure is correct. If pump pressure was low, proceed as follows:

(5) Release fuel system pressure. Refer to the previous Fuel Pressure Release Procedure in this group.

(6) Disconnect the 5/16 inch fuel return line quick-connect fitting at fuel rail. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

Connect Fuel Line Pressure Test Adapter Tool number 6539 (5/16 in.) between the disconnected fuel return line and fuel rail (Fig. 10).

WARNING: THE FUEL SYSTEM PRESSURE IN THE FOLLOWING TEST MAY EXCEED 100 PSI. BEFORE STARTING TEST, VERIFY GOOD CONNECTIONS AT ENDS OF ADAPTER TOOL 6539. BE SURE TOOL IS LOCKED ONTO FUEL RAIL AND FUEL RETURN LINE. PULL FIRMLY ON ENDS OF TOOL TO VERIFY.

(7) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

(8) **MOMENTARILY** pinch the rubber hose portion of adapter tool 6539. Pressure should rise to approximately 75 psi within two (2) seconds. **DO NOT** pinch hose for longer than three seconds.

If fuel pump pressure rises to approximately 75 psi within two seconds, pressure is operating at its maximum and is correct.

If fuel pump pressure does not rise to approximately 75 psi within two seconds, proceed as follows:

(9) Release fuel system pressure. Refer to the previous Fuel Pressure Release Procedure in this group.

(10) Raise and support vehicle.

(11) Disconnect fuel supply line at inlet (fuel tank side) of fuel filter. Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) between fuel filter and fuel supply line.

WARNING: THE FUEL SYSTEM PRESSURE IN THE FOLLOWING TEST MAY EXCEED 100 PSI. BEFORE STARTING TEST, VERIFY GOOD CONNECTIONS AT ENDS OF ADAPTER TOOL 6631. BE SURE TOOL IS LOCKED ONTO FUEL FILTER AND FUEL SUPPLY LINE. PULL FIRMLY ON ENDS OF TOOL TO VERIFY.

(12) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

MOMENTARILY pinch the rubber hose portion of adapter tool 6631. Pressure should rise to approximately 75 psi within two (2) seconds. **DO NOT** pinch hose for longer than three seconds.

If fuel pump pressure now rises to approximately 75 psi within two seconds, but this pressure could not be met at the fuel rail, check for a plugged or restricted fuel filter. Also check the fuel supply line between fuel filter and fuel rail for kinks or obstructions. Proceed to the following Fuel Pump Capacity Test.

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure by performing the previous tests.

(1) Release the fuel system pressure from fuel system. Refer to the previous Fuel Pressure Release Procedure in this group.

(2) Disconnect the fuel supply line at fuel rail near pressure regulator. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(3) Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) into the disconnected fuel supply line. Insert the other end of tool 6631 into an approved gasoline container.

(4) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

A good fuel pump will deliver at least 1 liter of fuel per minute.

FUEL PRESSURE LEAK DOWN TEST

ENGINE OFF

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 the fuel pressure regulator.
- Fuel pressure bleeding past the check valve in the outlet end of the fuel tank mounted fuel pump.

(1) Remove protective cap at fuel rail test port (Fig. 11). With the engine off, connect an accurate 0-689 kPa (0-100 psi) fuel gauge to the pressure test port fitting on the fuel rail. The fitting on the pressure tester must be in good condition and free of any leaks before performing this test.

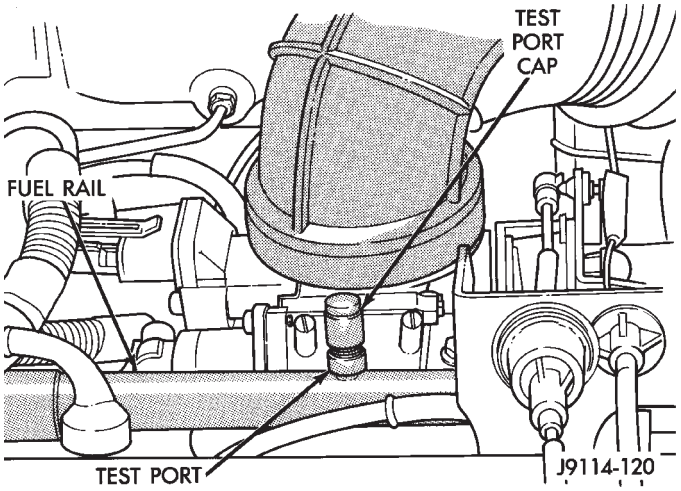

Fig. 11 Fuel Pressure Test Port—Typical

(2) Start the vehicle and let engine idle. Check fuel pressure reading on gauge. Fuel pressure should be within specifications. Refer to the previous Fuel System Pressure Tests.

(3) Shut engine off. Observe and record fuel pressure reading on gauge. Leave fuel pressure gauge connected. Allow engine to set for 30 minutes and then compare the fuel pressure reading on the gauge with the reading taken when engine was shut down. A pressure drop of up to 138 kPa (20 psi) within 30 minutes is within specifications.

(4) If the fuel pressure drop is within specifications, the fuel pump outlet check valve and fuel pressure regulator are both operating normally.

(5) If fuel pressure drop is greater than 138 kPa (20 psi), it must be determined if this drop is being caused by (in-tank mounted) fuel pump outlet check valve or fuel pressure regulator. Proceed to next step.

(6) Release the fuel system pressure from fuel system. Refer to the previous Fuel Pressure Release Procedure in this group.

(7) Disconnect both fuel lines at fuel rail near fuel pressure regulator. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(8) Connect Fuel Line Pressure Test Adapter Tool number 6631 (3/8 in.) between the disconnected fuel supply line and fuel rail (Fig. 12).

(9) Connect Fuel Line Pressure Test Adapter Tool number 6539 (5/16 in.) between the disconnected fuel return line and fuel rail (Fig. 12).

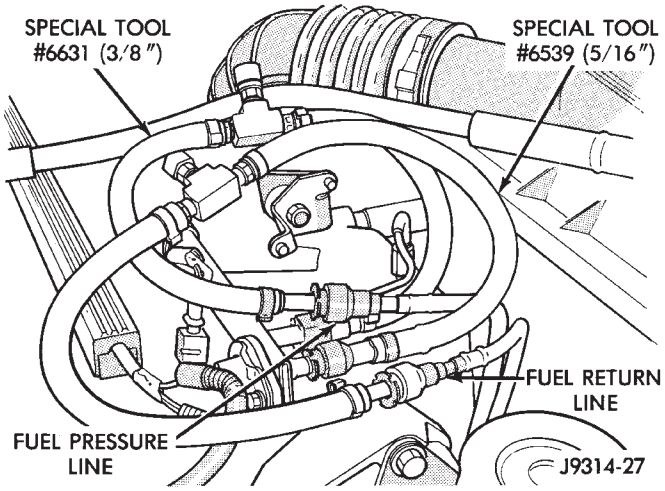

Fig. 12 Adapter Tools—Typical Connections

(10) Start engine. Observe and record fuel system pressure.

(11) Shut engine off.

(12) Clamp off the rubber hose portion of adapter tool number 6539 connected to the fuel return line. Allow engine to set for 30 minutes. If pressure has dropped more than 138 kPa (20 psi) in 30 minutes,

pressure is bleeding past the (in-tank mounted) fuel pump outlet check valve. Replace Fuel Pump Module assembly. Refer to Fuel Pump Module removal and installation in this group. If pressure drop is within specifications, proceed to next step.

(13) Clamp off the rubber hose portion of adapter tool number 6631 connected to the fuel supply line. Allow engine to set for 30 minutes. If pressure has dropped more than 138 kPa (20 psi) in 30 minutes, pressure is bleeding past the fuel pressure regulator. Replace fuel pressure regulator. Refer to Fuel Rail removal and installation in the Component Removal/ Installation section of this group.

MECHANICAL MALFUNCTIONS

Mechanical malfunctions are more difficult to diagnose with this system. The powertrain control module (PCM) has been programmed to compensate for some mechanical malfunctions such as incorrect cam timing, vacuum leaks, etc. If engine performance problems are encountered and diagnostic trouble codes are not displayed, the problem may be mechanical rather than electronic.

FUEL FILTER

The fuel filter protects the fuel injectors and fuel pressure regulator from dirt, water and other foreign matter. The filter is located under the vehicle along the frame rail (Figs. 13 or 14). Replace fuel filter at intervals specified in the Lubrication and Maintenance Schedule chart found in Group 0, Lubrication and Maintenance.

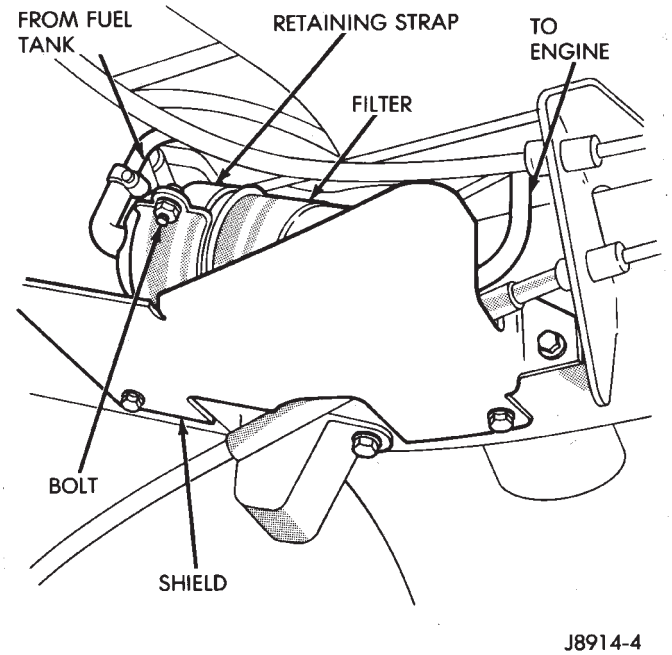

Fig. 13 Fuel Filter and Shield—YJ Models

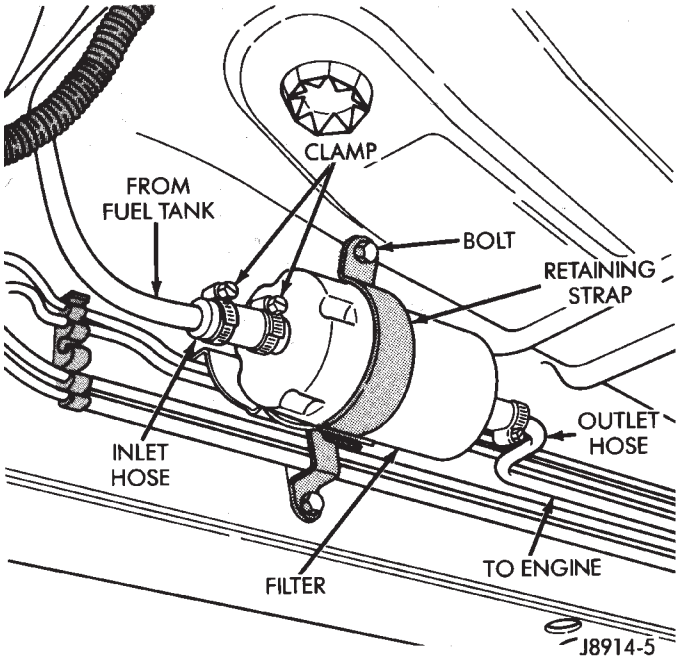

Fig. 14 Fuel Filter—XJ Models

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL FILTER.

(1) Disconnect negative battery cable. Remove fuel filler cap.

WARNING: FUEL PRESSURE MUST BE RELEASED BEFORE DISCONNECTING ANY FUEL SYSTEM COMPONENT.

(2) Release fuel system pressure. Refer to Fuel Pressure Release Procedure in this group.

(3) Raise and support vehicle.

(4) On YJ models remove the fuel filter shield (Fig. 13).

(5) Remove hoses and clamps from inlet and outlet sides of filter (Figs. 13 or 14). For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(6) Remove retaining strap bolt.

(7) Remove filter from vehicle.

INSTALLATION

CAUTION: The ends of the fuel filter are marked for correct installation. Install filter with the end marked IN towards fuel tank and the end marked OUT towards engine.

(1) Place fuel filter in retaining strap with the marked ends in the correct position.

(2) Install retaining strap bolt and tighten to 12 N·m (106 in. lbs.) torque.

(3) Install inlet and outlet hoses and hose clamps. For procedures, refer to Fuel Tubes/Lines/Hoses and Clamps. Also refer to Quick-Connect Fittings. These can be found in the Fuel Delivery System section of this group.

(4) On YJ models, install fuel filter shield (Fig. 13).

(5) Lower vehicle.

(6) Connect negative battery cable.

(7) Start engine and check for leaks.

FUEL TUBES/LINES/HOSES AND CLAMPS

Also refer to the proceeding section on Quick-Connect Fittings.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

Inspect all hose connections such as clamps, couplings and fittings to make sure they are secure and leaks are not present. The component should be replaced immediately if there is any evidence of degradation that could result in failure.

Never attempt to repair a plastic fuel line/tube. Replace as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel lines/tubes are properly routed to prevent pinching and to avoid heat sources.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high pressure fuel leaks.

Use new original equipment type hose clamps. Tighten hose clamps to 1 N·m (15 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to the previous Fuel Tubes/Lines/Hoses and Clamps section.

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type or a plastic retainer ring type.

SINGLE-TAB TYPE

This type of fitting is equipped with a single pull tab (Fig. 15). The tab is removable. After the tab is removed, the quick-connect fitting can be separated from the fuel system component.

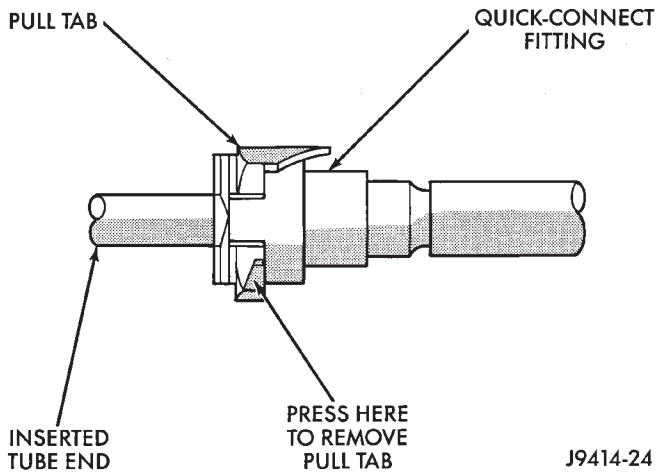

Fig. 15 Single-Tab Type Fitting

CAUTION: The interior components (O-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new pull tabs are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube/quick-connect fitting assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) Press the release tab on the side of fitting to release pull tab (Fig. 15).

CAUTION: If this release tab is not pressed prior to releasing the pull tab, the pull tab will be damaged.

(5) While pressing the release tab on the side of the fitting, use a screwdriver to pry up the pull tab (Fig. 16).

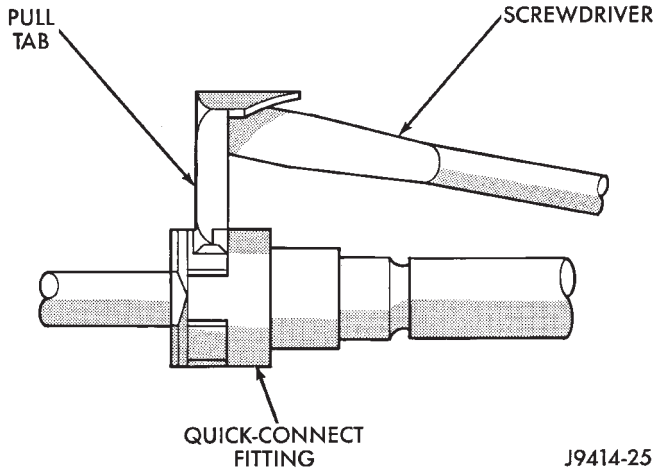

Fig. 16 Disconnecting Single-Tab Type Fitting

(6) Raise the pull tab until it separates from the quick-connect fitting (Fig. 17). Discard the old pull tab.

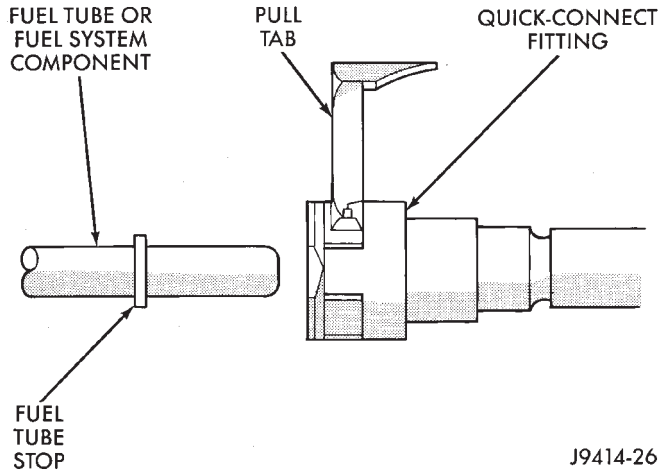

Fig. 17 Removing Pull Tab

(7) Disconnect the quick-connect fitting from the fuel system component being serviced.

(8) Inspect the quick-connect fitting body and fuel system component for damage. Replace as necessary.

(9) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(10) Insert the quick-connect fitting into the fuel tube or fuel system component until the built-on stop on the fuel tube or component rests against back of fitting.

(11) Obtain a new pull tab. Push the new tab down until it locks into place in the quick-connect fitting.

(12) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(13) Connect negative cable to battery.

(14) Start engine and check for leaks.

TWO-TAB TYPE FITTING

This type of fitting is equipped with tabs located on both sides of the fitting (Fig. 18). These tabs are supplied for disconnecting the quick-connect fitting from component being serviced.

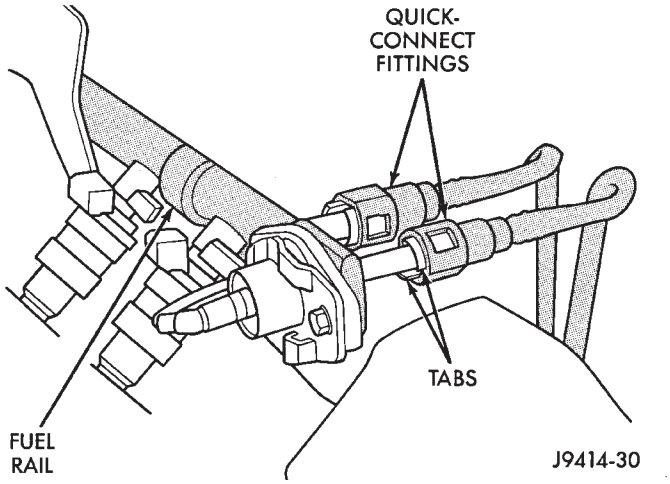

Fig. 18 Typical Two-Tab Type Quick-Connect Fitting

CAUTION: The interior components (O-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new plastic retainers are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube/quick-connect fitting assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To disconnect the quick-connect fitting, squeeze the plastic retainer tabs against the sides of the quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic re-

tainer. Pull the fitting from the fuel system component being serviced. The plastic retainer will remain on the component being serviced after fitting is disconnected. The O-rings and spacer will remain in the quick-connect fitting connector body.

(5) Inspect the quick-connect fitting body and component for damage. Replace as necessary.

CAUTION: When the quick-connect fitting was disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small screwdrivers. After removal, inspect the retainer for cracks or any damage.

(6) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(7) Insert the quick-connect fitting to the component being serviced and into the plastic retainer. When a connection is made, a click will be heard.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative cable to battery.

(10) Start engine and check for leaks.

PLASTIC RETAINER RING TYPE FITTING

This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 19) usually black in color.

CAUTION: The interior components (O-rings, spacers, retainers) of this type of quick-connect fitting are not serviced separately. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube/quick-connect fitting assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure.

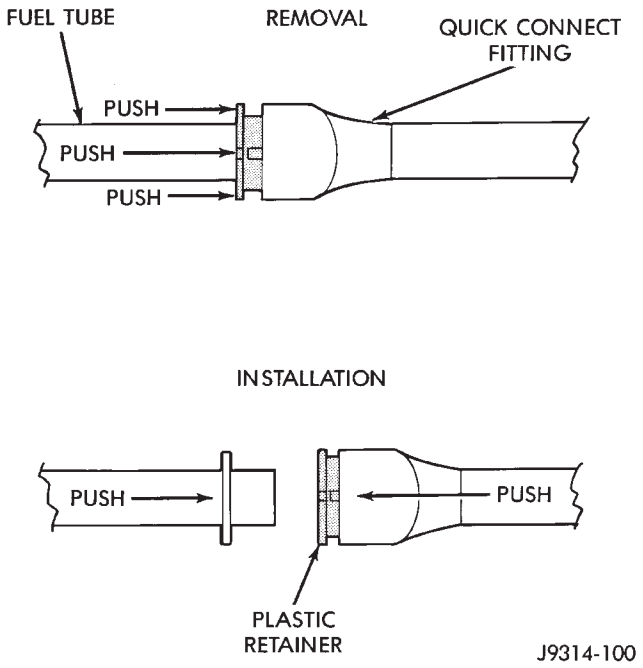

Fig. 19 Plastic Retainer Ring Type Fitting

Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To release the fuel system component from the quick-connect fitting, firmly push the fitting towards the component being serviced while firmly pushing the plastic retainer ring into the fitting (Fig. 19). With the plastic ring depressed, pull the fitting from the component. **The plastic retainer ring must be pressed squarely into the fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on the shoulder of the plastic retainer ring to aid in disconnection.**

After disconnection, the plastic retainer ring will remain with the quick-connect fitting connector body.

(5) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(6) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(7) Insert the quick-connect fitting into the component being serviced until a click is felt.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative battery cable to battery.

(10) Start engine and check for leaks.

FUEL TANKS

INDEX

GENERAL INFORMATION

All vehicles pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

All models are equipped with a pressure relief/rollover valve mounted in the top of the fuel pump module. The return line from the fuel pump to the fuel tank contains a one-way check valve.

An evaporative control system prevents raw fuel vapor from escaping into the atmosphere. Fuel vapors from the fuel tank are collected in the EVAP canister. When the engine is operating, the vapors are drawn into the intake manifold to be used in combustion. Refer to Group 25, Emission Control System for more information.

Inspect all hose/tube connections for completeness. Be sure that leaks are not present. Replace any hose that is cracked, scuffed, swelled, has rubbed against other vehicle components or shows any other sign of wear that could lead to failure. If it is necessary to replace a hose, only hose marked EFM/EFI may be used.

When installing hoses, be sure that they are routed away from contact with other vehicle components.

The hose clamps used on fuel injected vehicles are of a special rolled edge construction to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used on this system. Other types of clamps may cut into the hoses and cause high pressure fuel leaks.

FUEL TANK CAPACITIES

FUEL TANK	GALLONS*	LITERS*
XJ	20.02	76
YJ	20.0	76
YJ	15.0	57

*Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances, ambient temperature and refill procedure.

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NO-LEAD FUEL TANK FILLER TUBE

All vehicles are designed to operate using Unleaded fuels. The diameter of the opening in the fuel tank filler neck is sized to only accept unleaded fuel nozzles. Gasoline station pumps for unleaded and leaded fuels have different size nozzles. Leaded fuel nozzles are larger in diameter than unleaded nozzles. The fuel tank filler neck opening is also equipped with a deflector, which the smaller unleaded nozzle pushes back upon entering the filler neck. The deflector will prevent the larger diameter leaded fuel nozzles from entering the filler neck and will deflect fuel away from the filler neck. This happens if filling of the tank with leaded fuel is attempted.

A label is attached to the instrument panel under the fuel gauge that reads UNLEADED FUEL ONLY as a reminder to the driver. A similar label is located near the fuel tank filler.

FUEL TANK FILLER TUBE CAP

The loss of any fuel or vapor out of the filler neck is prevented by the use of a safety filler cap. This will release only under pressure of 10.9 to 13.45 kPa (1.58 to 1.95 psi). The vacuum release is between .97 and 2.0 kPa (.14 and .29 psi). This cap must be replaced by a similar unit if replacement is necessary.

CAUTION: Remove the fuel tank filler tube cap prior to removing or repairing fuel lines to relieve fuel tank pressure.

HEAT SHIELDS

The sheet metal heat shields may have to be removed when servicing the fuel tank, fuel lines or vapor vent line. The heat shields must be installed to protect the lines and tank from the heat of the exhaust system. Refer to Group 11, Exhaust System and Intake Manifold for proper installation.

FUEL TANK

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.

REMOVAL—XJ MODELS

Perform the preceding Fuel System Pressure Release Procedure.

(1) Disconnect negative battery cable.

(2) Remove the fuel filler cap. Using an approved portable gasoline siphon/storage tank, drain fuel tank.

(3) Raise and support vehicle.

(4) Disconnect fuel fill hose and fill vent hose from filler neck (Fig. 1).

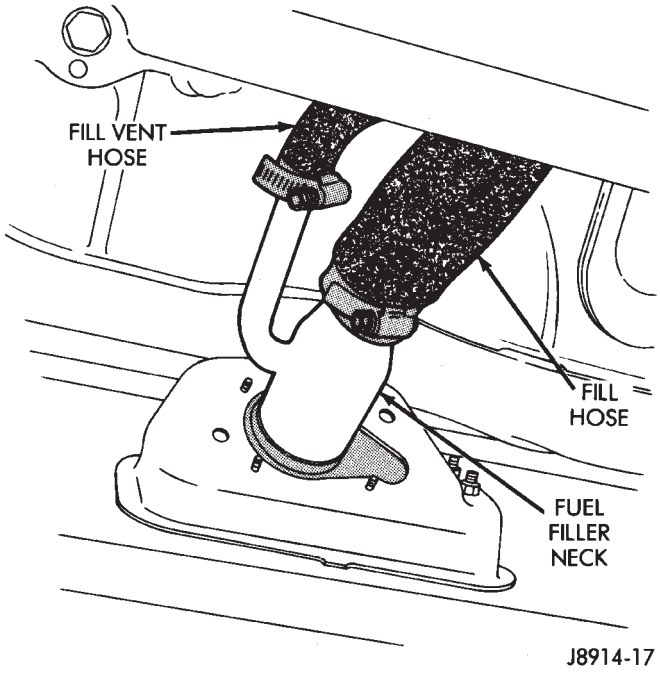

Fig. 1 Filler Neck Hoses—XJ Models

(5) Disconnect fuel pump module wire connector. Remove tie straps securing connector harness to fuel supply and return tubes.

WARNING: WRAP SHOP TOWELS AROUND FUEL HOSES TO ABSORB ANY FUEL SPILLAGE DURING FUEL TANK REMOVAL.

(6) Disconnect fuel tank vent hose from vent tube.

(7) Disconnect fuel supply and return hoses from tubes.

(8) If equipped, remove skid plate (Fig. 2).

(9) Remove fuel tank shield (Fig. 3).

(10) Center a transmission jack under the fuel tank.

(11) Remove support strap nuts. Move straps away from tank (Fig. 3).

(12) Lower fuel tank on transmission jack.

INSTALLATION—XJ MODELS

(1) Raise fuel tank into position. Connect fuel fill hose and vent hose to filler neck and tighten clamps.

(2) Wrap support straps around tank and over studs. Tighten strap nuts to 11.3 N·m (100 in. lbs.) torque.

(3) Remove transmission jack.

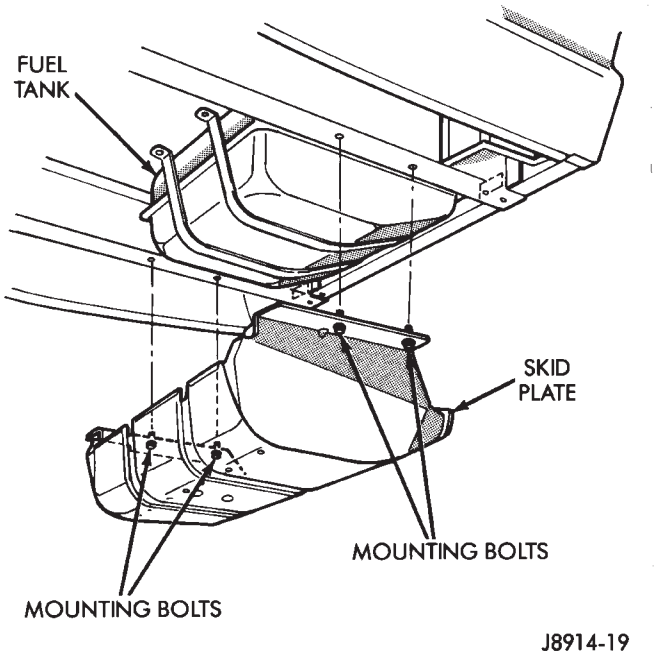

Fig. 2 Skid Plate—XJ Models

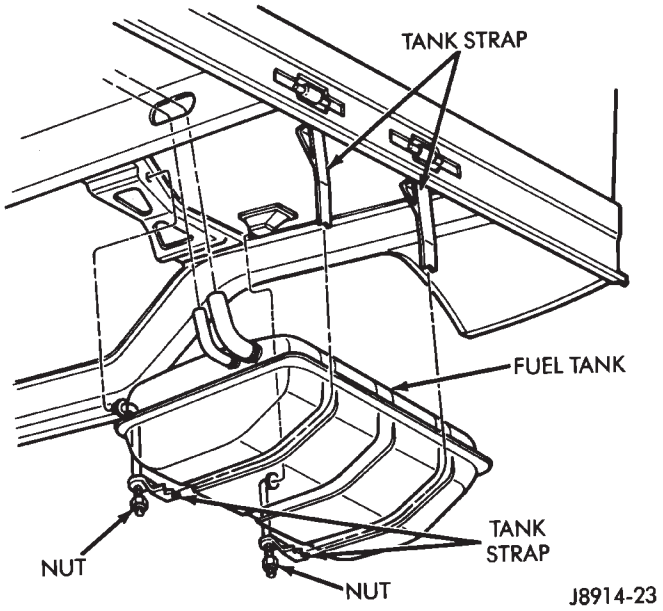

Fig. 3 Fuel Tank Remove/Install—XJ Models

(4) Install tank shield.

(5) If equipped, install tank skid plate.

(6) Connect vent hose to vent tube.

(7) Connect fuel supply hose to supply tube and fuel return hose to return tube. Tighten hose clamps.

(8) Connect fuel pump module wire connector to harness connector. Secure fuel pump module wire harness to fuel tubes with tie straps.

(9) Lower vehicle.

(10) Fill fuel tank. Install filler cap.

(11) Connect negative battery cable to battery.

(12) Start vehicle and inspect for leaks.

REMOVAL—YJ MODELS

WARNING: EXTINGUISH ALL TOBACCO SMOKING PRODUCTS BEFORE SERVICING THE FUEL SYSTEM. KEEP OPEN FLAME AWAY FROM FUEL SYSTEM COMPONENTS.

(1) Disconnect negative battery cable.

(2) Remove the fuel filler cap. Using an approved portable gasoline siphon/storage tank, drain fuel tank.

(3) Raise and support vehicle.

(4) Using a small straight blade screwdriver, pull back the stems of the push clips that secure the fuel filler neck shroud (located at bottom of left rear wheel well) in place (Fig. 4). This unlocks the push clip allowing them to be removed by pulling assembly out of shroud. Remove shroud.

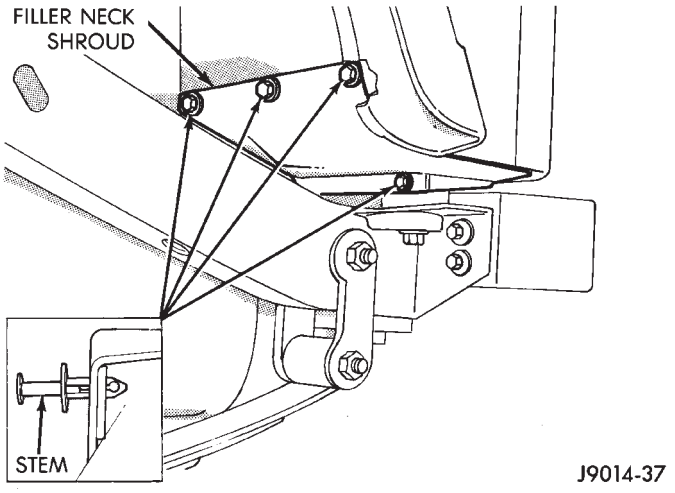

Fig. 4 Fuel Filler Neck Shroud—YJ Models

(5) Disconnect fuel fill hose and fill vent hose from filler neck (Fig. 5).

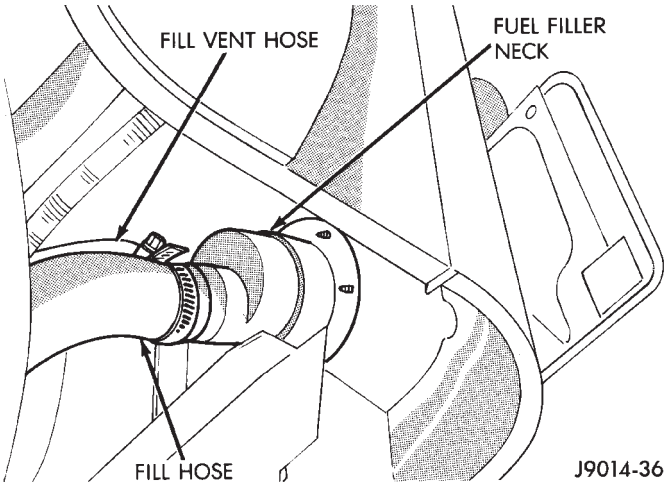

Fig. 5 Filler Neck Hoses—YJ Models

WARNING: WRAP SHOP TOWELS AROUND FUEL HOSES TO ABSORB ANY FUEL SPILLAGE DURING FUEL TANK REMOVAL.

(6) Disconnect fuel tank vent hose from vent tube. Disconnect fuel supply and return hoses from tubes (Fig. 6).

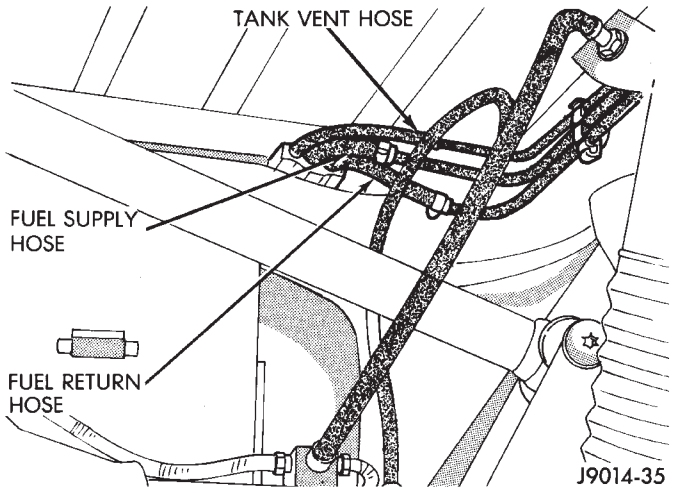

Fig. 6 Fuel Tank Hoses—YJ Models

The fuel tank and skid plate are removed as an assembly.

(7) Centrally position a transmission jack under skid plate/fuel tank assembly.

(8) Remove skid plate/fuel tank assembly mounting nuts (Fig. 7). **Do not loosen tank strap nuts.**

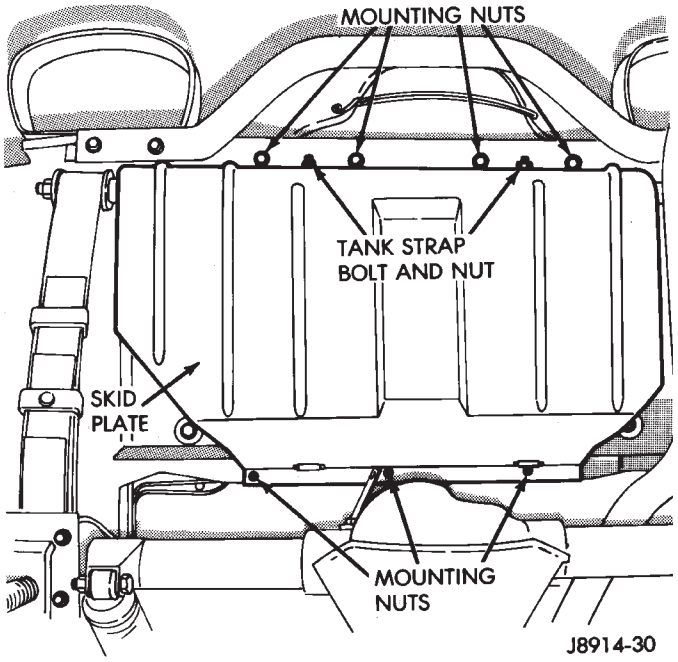

Fig. 7 Fuel Tank—Remove/Install—YJ Models

(9) Lower the skid plate/fuel tank assembly slightly and disconnect the gauge sender wire connector.

(10) Lower the fuel tank on transmission jack.

(11) Remove tank strap nuts to remove tank from skid plate.

INSTALLATION—YJ MODELS

(1) Place tank into skid plate. Wrap straps around tank with strap bolts inserted through holes in skid plate. Tighten strap nuts to 7.3 N·m (65 in. lbs.) torque.

(2) Raise skid plate/fuel tank until gauge sender wire connector can be connected to harness connector.

(3) Finish raising skid plate/fuel tank assembly into position. Tighten mounting nuts to 16 N·m (12 ft. lbs.) torque. Remove transmission jack.

(4) Connect fuel fill hose and fill vent hose to filler neck. Tighten hose clamps.

(5) Connect vent hose to vent tube.

(6) Connect fuel supply hose to the supply tube and fuel return hose to return tube. Tighten hose clamps.

(7) Install fuel filler neck shroud with push clips.

(8) Lower vehicle.

(9) Fill fuel tank. Install filler cap.

(10) Connect negative battery cable to battery.

(11) Start vehicle and inspect for leaks.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the fuel pump module. Refer to Fuel Pump Module in the Fuel Delivery System section of this group.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE

The fuel tank is equipped with a pressure relief/rollover valve (Fig. 8). The dual function valve will relieve fuel tank pressure and prevent fuel flow through the fuel tank vent tubes in the event of accidental vehicle rollover.

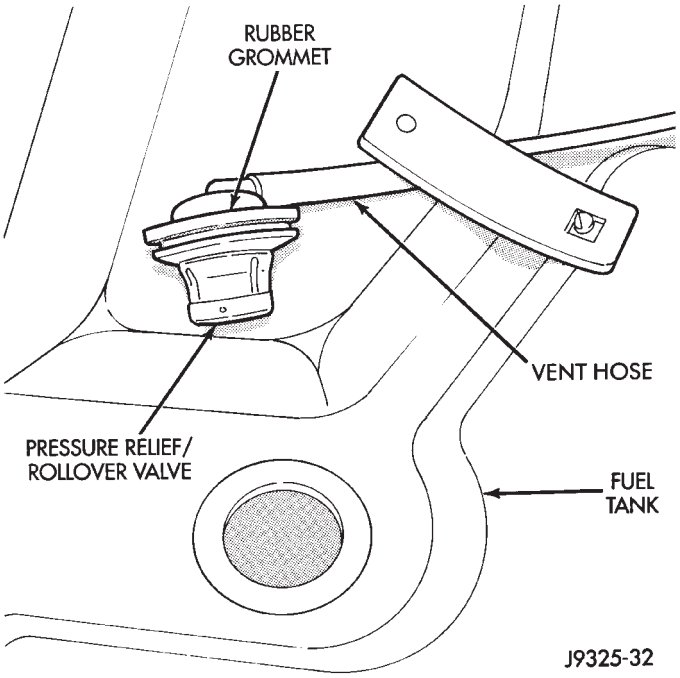

Fig. 8 Valve Location—Typical

The valve consists of a plunger, spring and orifice/guide plate (Fig. 9). The valve is normally open allowing fuel vapor to vent to the EVAP canister. Here it is stored until it can be consumed by the engine (under controlled conditions). The plunger seats in the guide plate at the orifice preventing liquid fuel from reaching the EVAP canister. This is done if bottom of plunger is contacted by fuel sloshing in tank when vehicle is cornering.

In the event of accidental vehicle rollover, the valve is inverted. In this position the plunger is forced against the guide plate and raw fuel is prevented from flowing through the valve orifice into the fuel tank vent tube.

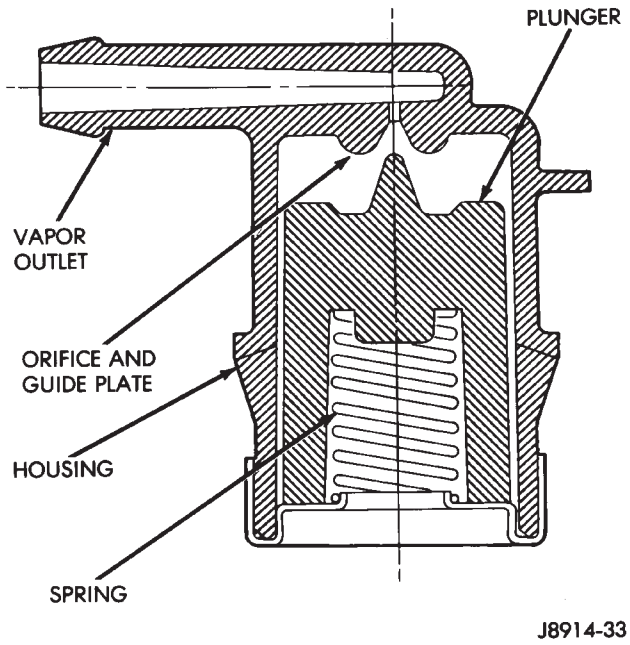

Fig. 9 Pressure Relief/Rollover Valve Operation

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE PRESSURE RELIEF/ROLLOVER VALVE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

(1) Disconnect negative battery cable.

(2) Remove the fuel filler cap and drain fuel tank. Refer to Fuel Tank Removal.

(3) Remove fuel tank. Refer to Fuel Tank Removal.

(4) The rollover valve is seated in a grommet. Remove by prying one side upward and then roll the grommet out of tank (Fig. 8).

INSTALLATION

(1) Start one side of grommet into opening in fuel tank. Using finger pressure only, press valve/grommet into place.

(2) Install fuel tank. Refer to Fuel Tank Installation.

(3) Fill fuel tank. Install fuel tank filler cap.

(4) Connect negative battery cable.

(5) Start vehicle and check for leaks.

ACCELERATOR PEDAL AND THROTTLE CABLE

GENERAL INFORMATION

The accelerator pedal is connected to the throttle body linkage by the throttle cable. The cable is protected by a plastic sheathing and is connected to the throttle body linkage by a ball socket. It is connected to the upper part of the accelerator pedal arm by a plastic retainer (clip) (Fig. 10). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) (Fig. 10) fasten the cable to the dash panel.

Dual throttle return springs (attached to the throttle shaft) are used to close the throttle.

CAUTION: Never attempt to remove or alter these springs.

ACCELERATOR PEDAL

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing the accelerator pedal or throttle cable.

REMOVAL

(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. 10). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over studs protruding from floor pan. Tighten mounting nuts to 5 N·m (36 in. lbs.) torque.

(2) Slide throttle cable into opening in top of pedal arm. Push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place.

(3) Before starting engine, operate accelerator pedal to check for any binding.

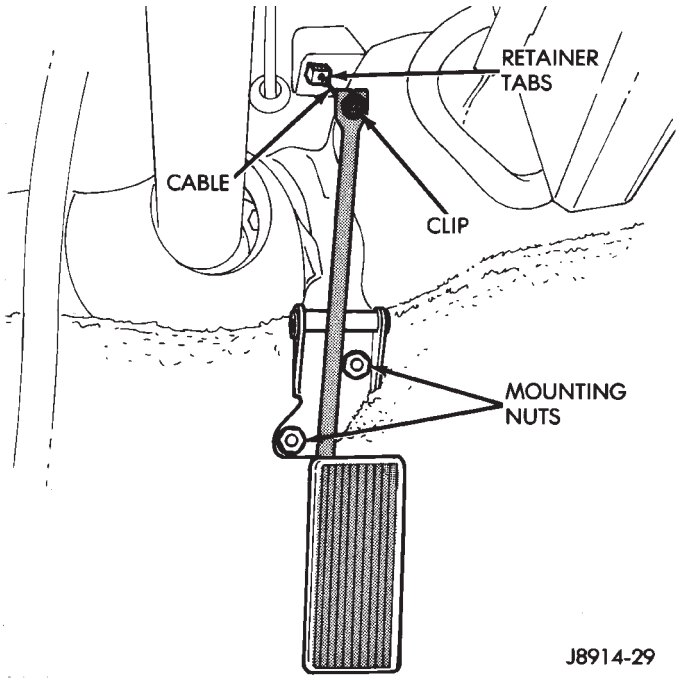

Fig. 10 Accelerator Pedal Mounting—Typical

THROTTLE CABLE

REMOVAL

(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. 10). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove the cable core wire at pedal arm.

(3) From inside the vehicle, pinch both sides of the cable housing retainer tabs (Fig. 10) at the dash panel. Remove cable housing from dash panel and pull into the engine compartment.

(4) Remove cable from clip on the engine cylinder head (valve) cover.

(5) Remove the throttle cable ball end socket at throttle body linkage (snaps off) (Fig. 11).

(6) Remove throttle cable from throttle body mounting bracket by compressing retainer tabs and pushing cable through hole in bracket. Remove throttle cable from vehicle.

INSTALLATION

(1) Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket. Connect cable ball end to throttle body linkage ball (snaps on).

(2) Snap cable into clip on the engine cylinder head (valve) cover.

(3) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(4) From inside drivers compartment, slide throttle cable core wire into opening in top of accelerator pedal arm. Push cable retainer (clip) into pedal arm opening until it snaps in place.

(5) Before starting engine, operate accelerator pedal to check for any binding.

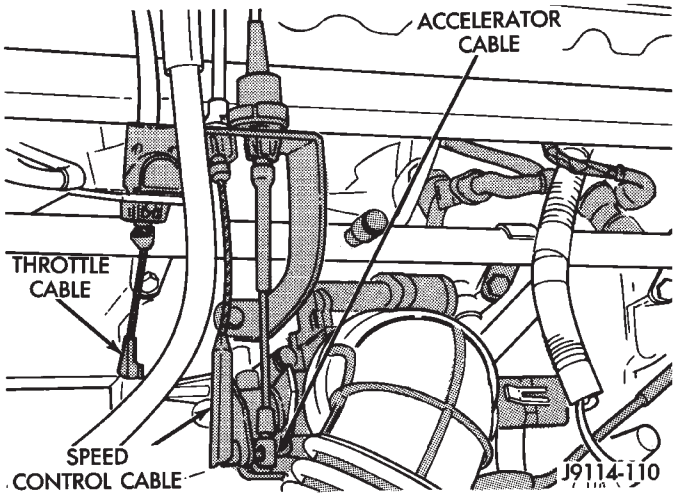

Fig. 11 Throttle (Accelerator) Cable—Typical

MULTI-PORT FUEL INJECTION (MFI)—COMPONENT DESCRIPTION/SYSTEM OPERATION

INDEX

GENERAL INFORMATION

All 2.5L 4 cylinder and 4.0L 6 cylinder engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

The Powertrain Control Module (PCM) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a preprogrammed, dual microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

Powertrain Control Module (PCM) Inputs represent the instantaneous engine operating conditions. Air-fuel mixture and ignition timing calibrations for various driving and atmospheric conditions are preprogrammed into the PCM. The PCM monitors and analyzes various inputs. It then computes engine fuel and ignition timing requirements based on these inputs. Fuel delivery control and ignition timing will then be adjusted accordingly.

Other inputs to the PCM are provided by the brake light switch, air conditioning select switch and the speed control switches. All inputs to the PCM are converted into signals.

Electrically operated fuel injectors spray fuel in precise metered amounts into the intake port directly above the intake valve. The injectors are fired in a specific sequence by the PCM. The PCM maintains an air/fuel ratio of 14.7 to 1 by constantly adjusting injector pulse width. Injector pulse width is the length of time that the injector opens and sprays fuel into the chamber. The PCM adjusts injector pulse width by opening and closing the ground path to the injector.

Manifold absolute pressure (air density) and engine rpm (speed) are the primary inputs that determine fuel injector pulse width. The PCM also monitors other inputs when adjusting air-fuel ratio.

Inputs That Effect Fuel Injector Pulse Width

- Exhaust gas oxygen content
- Engine coolant temperature
- Manifold absolute pressure (MAP)
- Engine speed
- Throttle position
- Battery voltage
- Air conditioning selection
- Transmission gear selection (automatic transmissions only)
- Speed control

The powertrain control module (PCM) adjusts ignition timing by controlling ignition coil operation. The ignition coil receives battery voltage when the ignition key is in the run or starter position. The PCM provides a ground for the ignition coil. The coil dis-

charges when the PCM supplies a ground. By switching the ground path on and off, the PCM regulates ignition timing.

The sensors and switches that provide inputs to the powertrain control module (PCM) comprise the Engine Control System. It is also comprised of the PCM Outputs (engine control devices that the are operated by the PCM).

SYSTEM DIAGNOSIS

The powertrain control module (PCM) tests many of its own input and output circuits. If a Diagnostic Trouble Code (DTC) is found in a major system, this information is stored in the PCM memory. Refer to On-Board Diagnostics in the MFI System—General Diagnosis section of this group for DTC information.

POWERTRAIN CONTROL MODULE (PCM)

The PCM operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a pre-programmed, dual microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

On XJ models, the PCM is located in the engine compartment next to the air cleaner (Fig. 1). On YJ models, the PCM is located in the engine compartment behind the windshield washer fluid reservoir (Fig. 2).

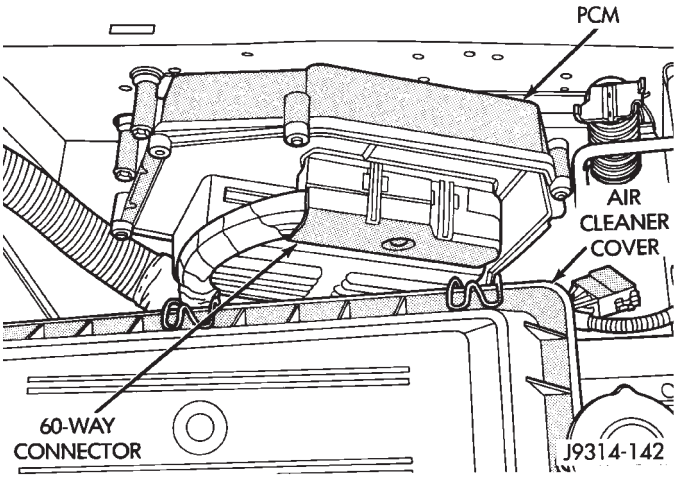

Fig. 1 PCM Location—XJ Models

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as PCM Outputs. The sensors and switches that provide inputs to the PCM are considered PCM Inputs.

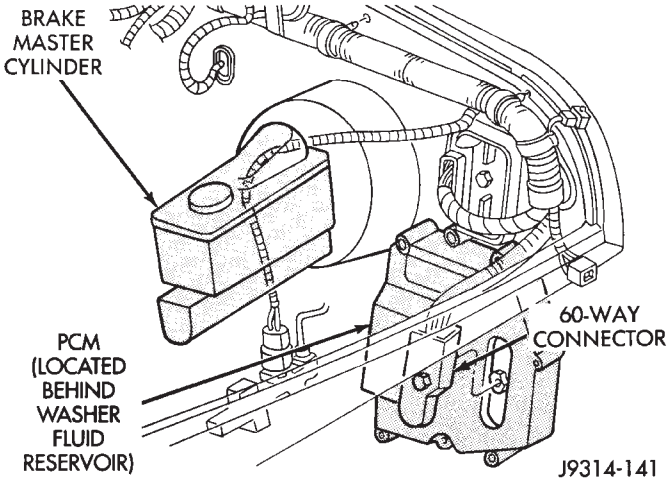

Fig. 2 PCM Location—YJ Models

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, 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.

Powertrain Control Module (PCM) Inputs:

- Generator output
- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shut down (ASD) sense
- Intake air temperature sensor
- Battery voltage
- Brake switch
- Engine coolant temperature sensor
- Crankshaft position sensor
- Ignition circuit sense (ignition switch in run position)
- Manifold absolute pressure sensor
- Overdrive/override switch
- Oxygen sensor
- Park/neutral switch (auto. trans. only)
- SCI receive (DRB scan tool connection)
- Speed control resume switch
- Speed control set switch
- Speed control on/off switch
- Camshaft position sensor signal
- Throttle position sensor
- Vehicle speed sensor
- Sensor return
- Power ground

- Signal ground

Powertrain Control Module (PCM) Outputs

- A/C clutch relay
- Idle air control (IAC) motor
- Auto shut down (ASD) relay
- Generator field
- Malfunction indicator lamp
- Fuel injectors
- Fuel pump relay
- Ignition coil
- SCI transmit (DRB scan tool connection)
- Shift indicator lamp (manual transmission only)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (on instrument panel, if equipped)
- Torque converter clutch relay (3-speed auto. trans. only)

The PCM contains a voltage convertor. This converts battery voltage to a regulated 8.0 volts. It is used to power the crankshaft position sensor and camshaft position sensor. The PCM also provides a five (5) volt supply for the Manifold Absolute Pressure (MAP) sensor and Throttle Position Sensor (TPS).

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units only.

A/C SELECT SIGNAL: When the A/C switch is in the ON position and the A/C low pressure switch is closed, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the PCM receives the A/C request signal from the evaporator switch. The input indicates that the evaporator temperature is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the IAC motor position.

If the A/C low pressure switch opens (indicating a low refrigerant level), the PCM will not receive an A/C select signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the evaporator switch opens, (indicating that evaporator is not in proper temperature range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUT DOWN (ASD) SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the power distribution center (PDC) in the engine compartment (Figs. 3 or 4). It is used to connect oxygen sensor heater element, ignition coil, generator field winding and fuel injectors to 12 volt + power supply. Also refer to Automatic Shut Down Relay—PCM Output.

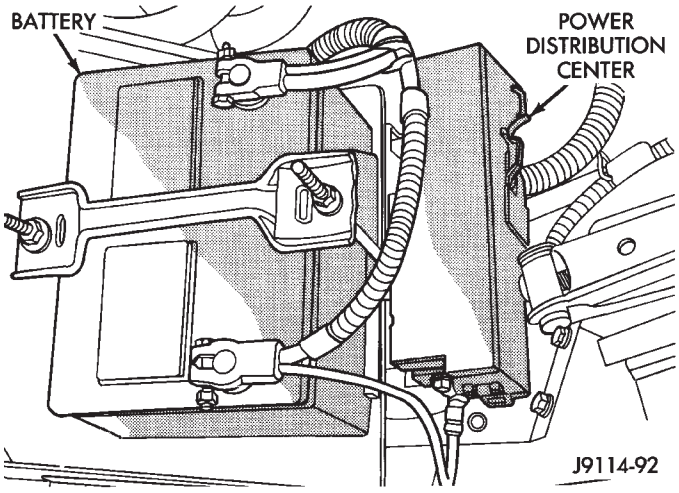

Fig. 3 Power Distribution Center—YJ Models

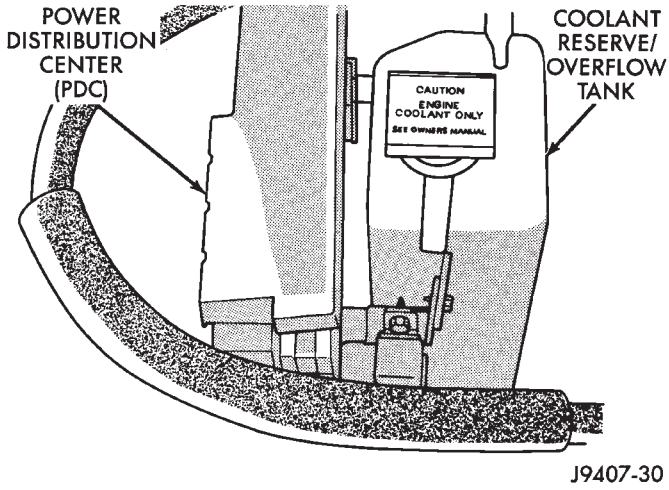

Fig. 4 Power Distribution Center—XJ Models

This input is used only to sense that the ASD relay is energized. If the PCM does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the powertrain control module (PCM). It also informs the PCM what voltage level is supplied to the ignition coil and fuel injectors.

If battery voltage is low, the PCM will increase injector pulse width (period of time that the injector is

energized). This is done to compensate for the reduced flow through injector caused by the lowered voltage.

BRAKE SWITCH—PCM INPUT

When the brake light switch is activated, the powertrain control module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM maintains idle speed to a scheduled rpm through control of the idle air control (IAC) motor. The brake switch input is also used to operate the speed control system.

CAMSHAFT POSITION SENSOR—PCM INPUT

A sync signal is provided by the camshaft position sensor located in the ignition distributor (Fig. 5). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

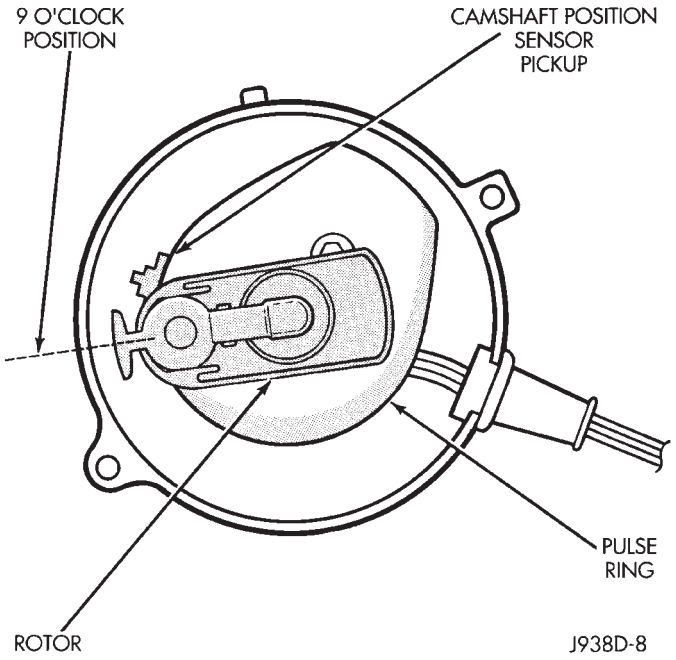

Fig. 5 Camshaft Position Sensor

DATA LINK CONNECTOR—PCM INPUT

The data link connector (diagnostic scan tool connector) links the DRB scan tool with the powertrain control module (PCM). The data link connector is located in the engine compartment (Figs. 6 or 7). For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

The data link connector uses two different pins on the PCM. One is for Data Link Transmit and the other is for Data Link Receive.

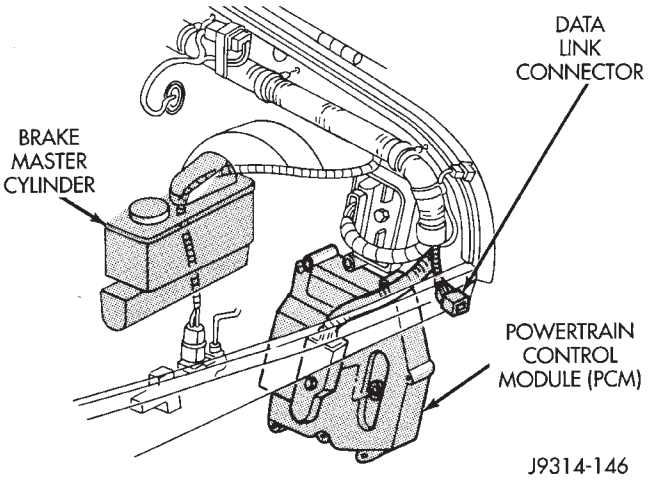

Fig. 6 Data Link Connector—YJ Models—Typical

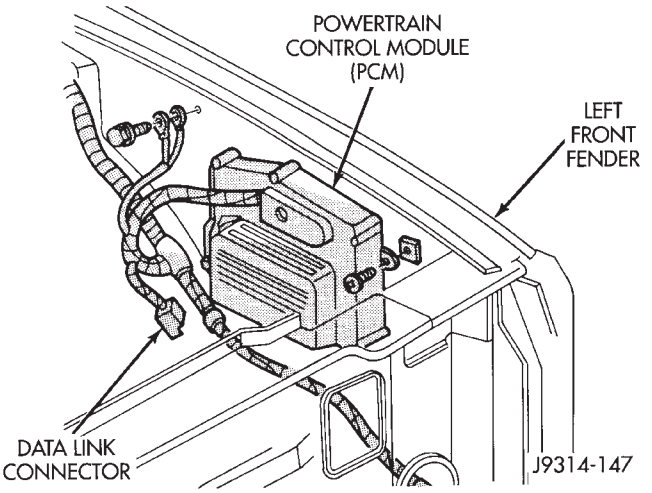

Fig. 7 Data Link Connector—XJ Models—Typical

INTAKE AIR TEMPERATURE SENSOR—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Figs. 8 or 9). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

CRANKSHAFT POSITION SENSOR—PCM INPUT

This sensor is a Hall Effect device that detects notches in the flywheel (manual transmission), or flexplate (automatic transmission).

This sensor is used to indicate to the powertrain control module (PCM) that a spark and or fuel injection event is to be required. The output from this sensor, in conjunction with the camshaft position sensor signal, is used to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

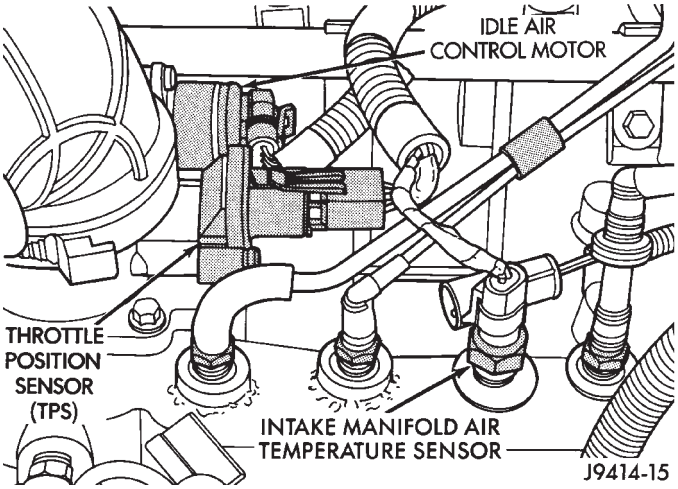

Fig. 8 Sensor Location—4.0L Engine

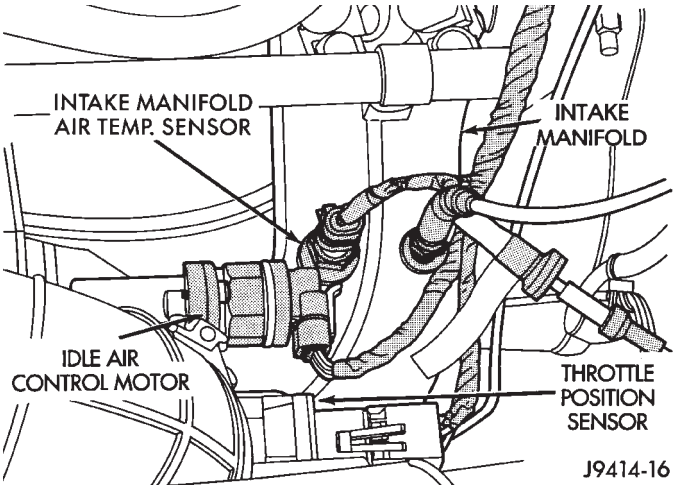

Fig. 9 Sensor Location—2.5L Engine

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor is installed in the thermostat housing (Fig. 10) and protrudes into the water jacket. The sensor provides an input voltage to the powertrain control module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor's resistance changes. The change in resistance results in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

Refer to Open Loop/Closed Loop Modes of Operation in this section of the group for more information.

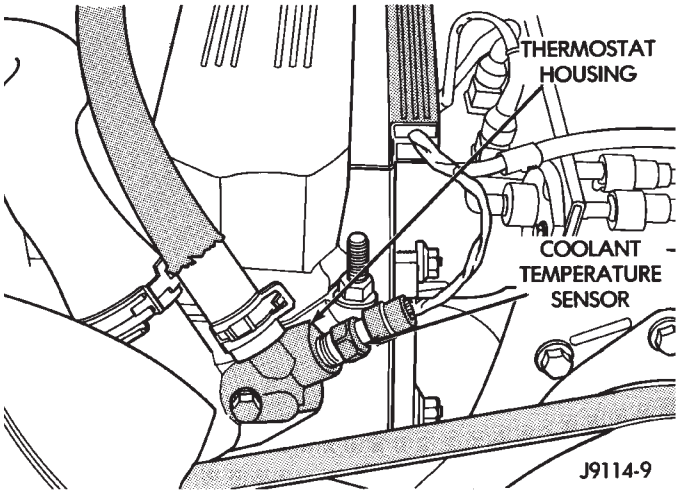

Fig. 10 Coolant Temperature Sensor—Typical

EXTENDED IDLE SWITCH—PCM INPUT

OPTIONAL POLICE PACKAGE ONLY

The extended idle switch is used to raise the engine idle speed to approximately 1000 rpm. This is when the shifter is in either the Park or Neutral position. A rocker-type 2-wire switch (extended idle switch) is mounted to the instrument panel. This switch will supply a ground circuit to the powertrain control module (PCM). **The switch is available only with 4.0L engine when supplied with the optional police package.**

For testing and diagnosis of this switch and its circuit, refer to the MFI System—General Diagnosis section of this group.

IGNITION CIRCUIT SENSE—PCM INPUT

The ignition circuit sense input tells the powertrain control module (PCM) the ignition switch has energized the ignition circuit. Refer to the wiring diagrams for circuit information.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the powertrain control module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine start-up (cranking) and engine load while the engine is running. The PCM uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted on the dash panel. The sensor is connected to the throttle body with a vacuum hose and to the PCM electrically.

OVERDRIVE/OVERRIDE SWITCH

On vehicles equipped with overdrive, the powertrain control module (PCM) regulates the 3-4 overdrive up-shift and down-shift through the overdrive solenoid.

Refer to Group 21 for more information.

OXYGEN (O2S) SENSOR—PCM INPUT

The O2S sensor is located in the exhaust down pipe (Fig. 11). It provides an input voltage to the powertrain control module (PCM) relating the oxygen content of the exhaust gas. The PCM uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

The O2S sensor produces voltages from 0 to 1 volt. This voltage will depend upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air-fuel mixture), the sensor produces a low voltage. When there is a lesser amount present (rich air-fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner.

In Closed Loop operation, the powertrain control module (PCM) monitors the O2S sensor input (along with other inputs). It then adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2S sensor input and adjusts injector pulse width to a preprogrammed value (based on other sensor inputs).

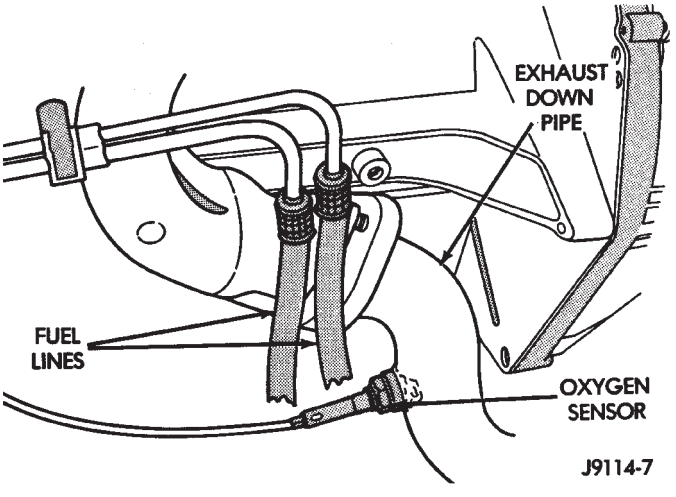

Fig. 11 Heated Oxygen Sensor Location—Typical

PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transmission housing and provides an input to the powertrain control module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width and ignition timing advance. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

POWER GROUND

The power ground is used to control ground circuits for the following powertrain control module (PCM) loads:

- Generator Field Winding
- 8 volt (PCM) power supply
- Fuel Injectors
- Ignition Coil

POWER STEERING PRESSURE SWITCH—PCM INPUT

A pressure sensing switch is included in the power steering system (mounted on the high-pressure line). This switch will be on vehicles equipped with a 2.5L engine and power steering. The switch (Fig. 12 YJ Models or Fig. 13 XJ Models) provides an input to the PCM. This input is provided during periods of high pump load and low engine rpm; such as during parking maneuvers. The PCM will then increase 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 1896 kPa ± 172 kPa (275 ± 25 psi) the PCM will increase the engine idle speed. This will prevent the engine from stalling.

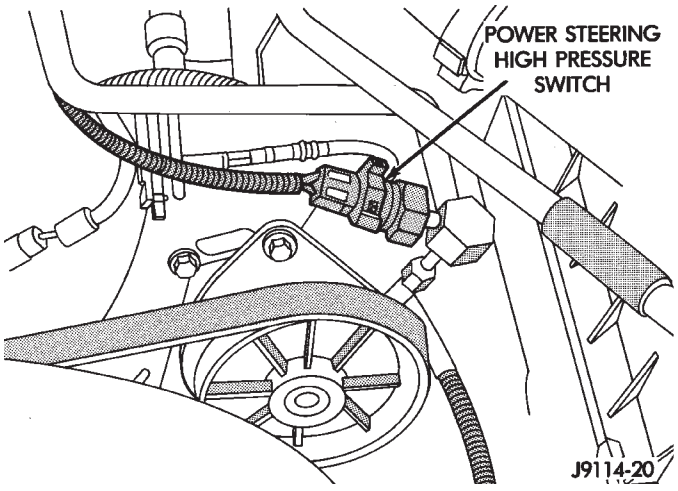

Fig. 12 Power Steering Pump Pressure Switch—YJ Models

SCI RECEIVE—PCM INPUT

SCI Receive is the serial data communication receive circuit for the DRB scan tool. The powertrain control module (PCM) receives data from the DRB through the SCI Receive circuit.

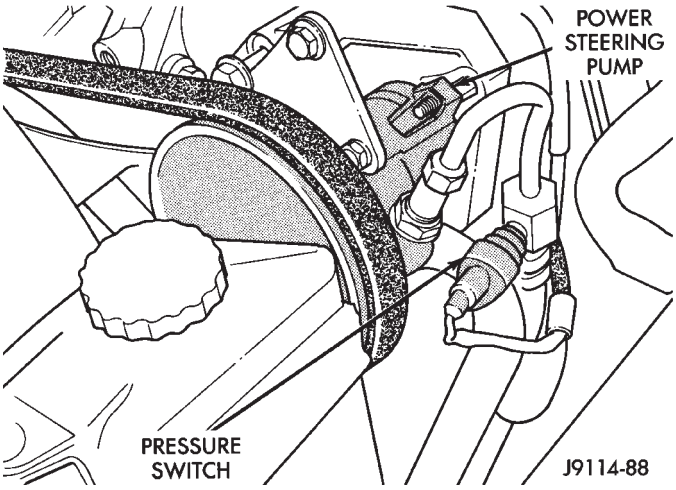

Fig. 13 Power Steering Pump Pressure Switch—XJ Models

SPEED CONTROL—PCM INPUT

The speed control system provides three separate inputs to the powertrain control module (PCM); On/Off, Set and Resume. The On/Off input informs the PCM that the speed control system has been activated. The Set input informs the PCM that a fixed vehicle speed has been selected. The Resume input indicates to the PCM that the previous fixed speed is requested.

The speed control operating range is from 50 km/h to 142 km/h (35 to 85 mph). Inputs that effect speed control operation are:

- Park/neutral switch
- Vehicle speed sensor
- Throttle position sensor

Refer to Group 8H for further speed control information.

SENSOR RETURN—PCM INPUT

Sensor Return provides a low noise ground reference for all system sensors.

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body (Figs. 14 or 15). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from 1 volt at minimum throttle opening (idle), to 4 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.

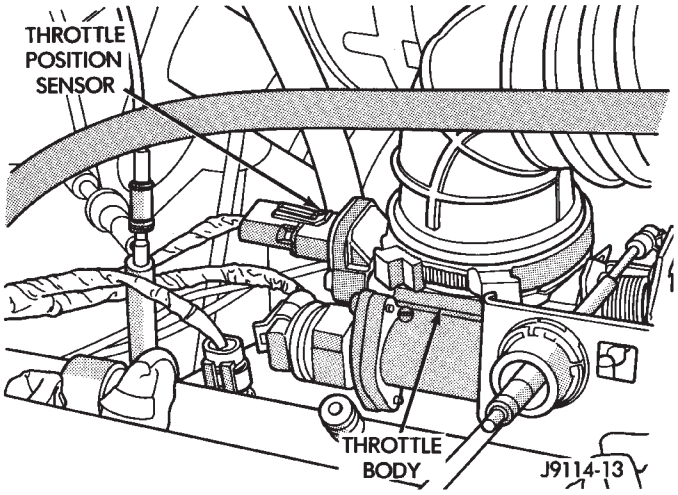

Fig. 14 Throttle Position Sensor—2.5L Engine

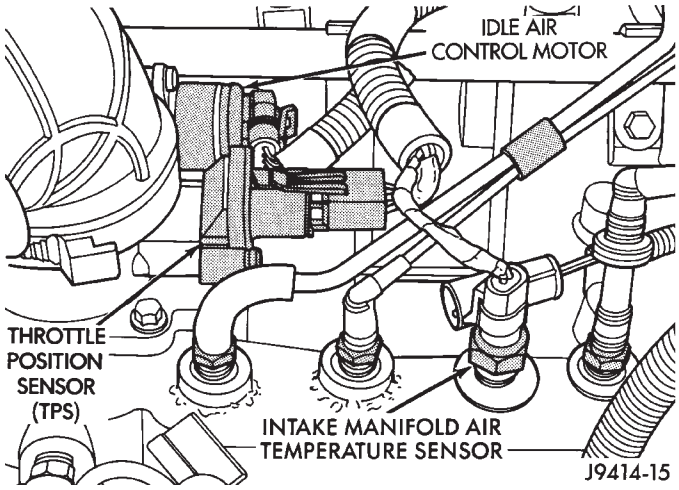

Fig. 15 Throttle Position Sensor—4.0L Engine

VEHICLE SPEED SENSOR—PCM INPUT

The vehicle speed sensor (Fig. 16) is located in the extension housing of the transmission (2 wheel drive) or on the transfer case extension housing (4 wheel drive). The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

The speed sensor generates 8 pulses per sensor revolution. These signals, in conjunction with a closed throttle signal from the throttle position sensor, indicate a closed throttle deceleration to the PCM. When the vehicle is stopped at idle, a closed throttle signal is received by the PCM (but a speed sensor signal is not received).

Under deceleration conditions, the PCM adjusts the idle air control (IAC) motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the IAC motor to maintain a desired engine speed.

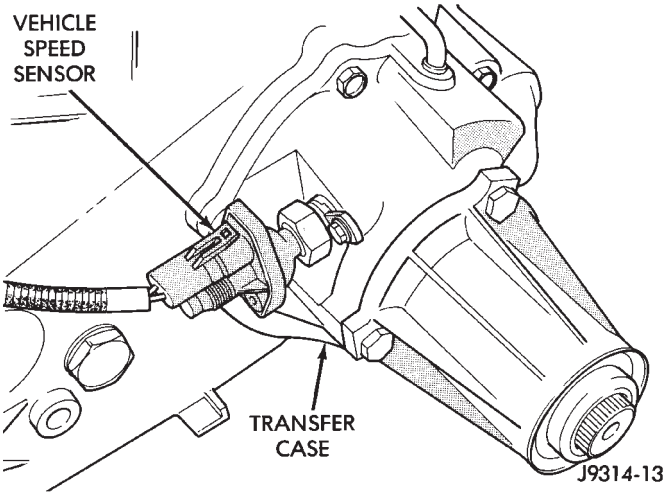

Fig. 16 Vehicle Speed Sensor—Typical

AIR CONDITIONING (A/C) CLUTCH RELAY—PCM OUTPUT

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off. The relay is located in the Power Distribution Center (PDC) (Figs. 17 or 18). For the location of the relay within the PDC, refer to label on PDC cover.

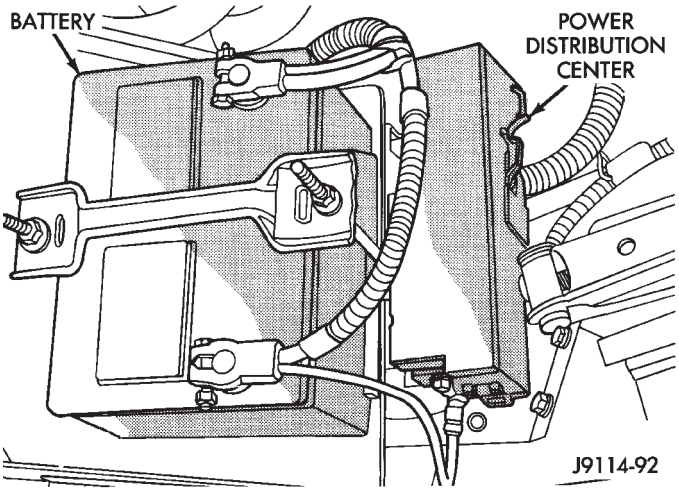

Fig. 17 PDC—YJ Models

When the PCM receives a request for A/C from A/C evaporator switch, it will adjust idle air control (IAC) motor position. This is done to increase idle speed. The PCM will then activate the A/C clutch through the A/C clutch relay. The PCM adjusts idle air control (IAC) stepper motor position to compensate for increased engine load from the A/C compressor.

By switching the ground path for the relay on and off, the PCM is able to cycle the A/C compressor clutch. This is based on changes in engine operating conditions. If, during A/C operation, the PCM senses low idle speeds or a wide open throttle condition, it will de-energize the relay. This prevents A/C clutch engagement. The relay will remain de-energized until the idle speed increases or the wide open throttle condition exceeds 15 seconds or no longer exists. The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

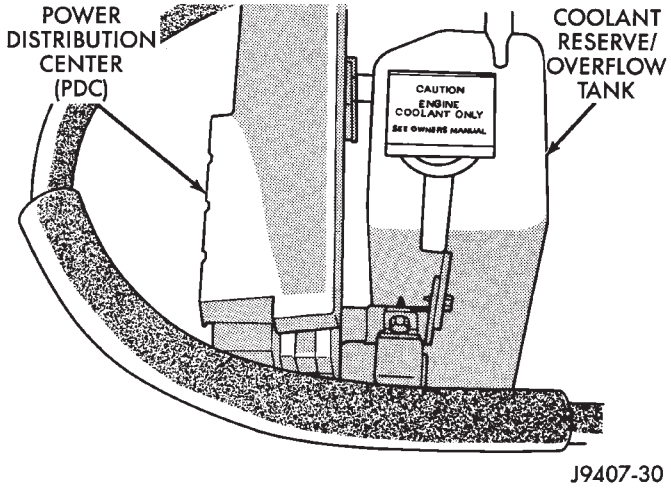

Fig. 18 PDC—XJ Models

AUTO SHUT DOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Figs. 17 or 18). For the location of this relay within the PDC, refer to label on PDC cover.

The ASD supplies battery voltage to the fuel pump, fuel injector, ignition coil, generator field winding and oxygen (O2S) sensor heating element. The ground circuit for the coil in the ASD relay is controlled by the powertrain control module (PCM). The PCM operates the relay by switching the ground circuit on and off.

The fuel pump relay is controlled by the PCM through same circuit that the ASD relay is controlled.

The powertrain control module (PCM) energizes the fuel pump through the fuel pump relay. (The PCM was formerly referred to as the SBEC or engine controller). Battery voltage is applied to the relay from the ignition switch. The relay is energized when a ground is provided by the PCM. The relay is located in the Power Distribution Center (PDC) (Figs. 17 or 18). For the location of fuel pump relay within PDC, refer to label on PDC cover.

For the 1994 model year, the ballast resistor and ballast resistor bypass relay are no longer used to control the fuel pump circuit.

DATA LINK CONNECTOR—PCM OUTPUT

Refer to the previous paragraphs on Data Link Connector—PCM Input for information.

EMR LAMP—PCM OUTPUT

The EMR lamp is not used for the 1994 model year.

FUEL PUMP RELAY—PCM OUTPUT

The PCM energizes the fuel pump through the fuel pump relay. Battery voltage is applied to the relay from the ignition switch. The relay is energized when a ground is provided by the PCM. Refer to Automatic Shut Down Relay for additional information.

FUEL INJECTORS—PCM OUTPUT

Six individual fuel injectors are used with the 4.0L 6 cylinder engine. Four individual fuel injectors are used with the 2.5L 4 cylinder engine. The injectors are attached to the fuel rail (Fig. 19).

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.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

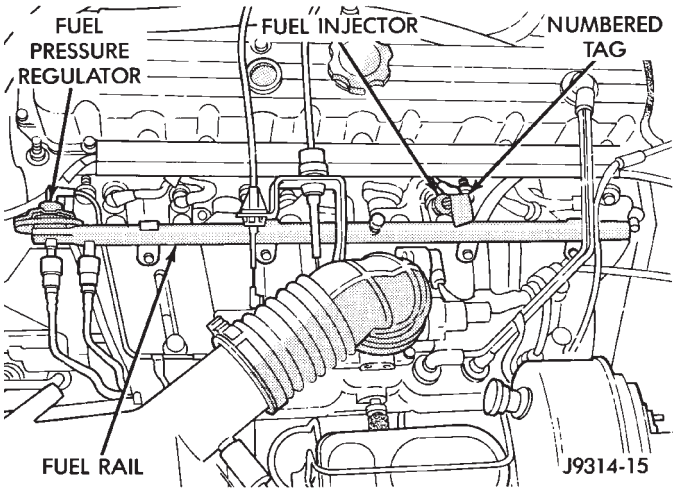

Fig. 19 Fuel Injectors—Typical

GENERATOR FIELD—PCM OUTPUT

The powertrain control module (PCM) regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for charging system information.

GENERATOR LAMP—PCM OUTPUT

IF EQUIPPED

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp on the instrument panel. For example, during low idle with all accessories turned on, the light may momentarily go on. Once the PCM corrects idle speed to a higher rpm, the light will go out. Refer to Group 8A, Battery/ Starting/Charging Systems for charging system information.

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

The IAC motor is mounted on the throttle body (Figs. 20 or 21) and is controlled by the powertrain control module (PCM).

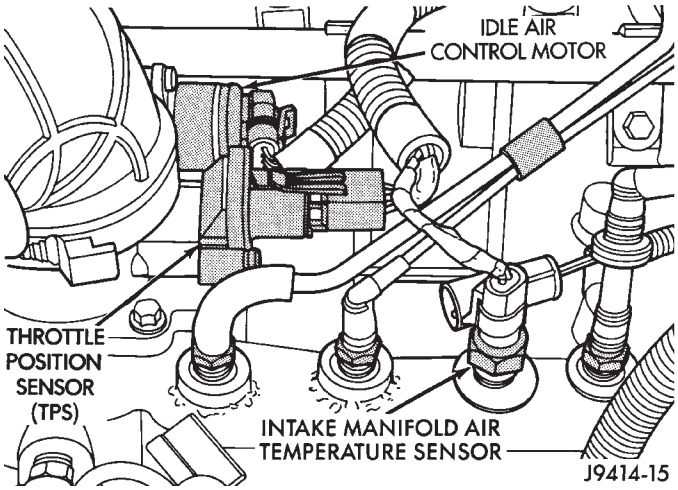

Fig. 20 IAC Motor—4.0L Engine

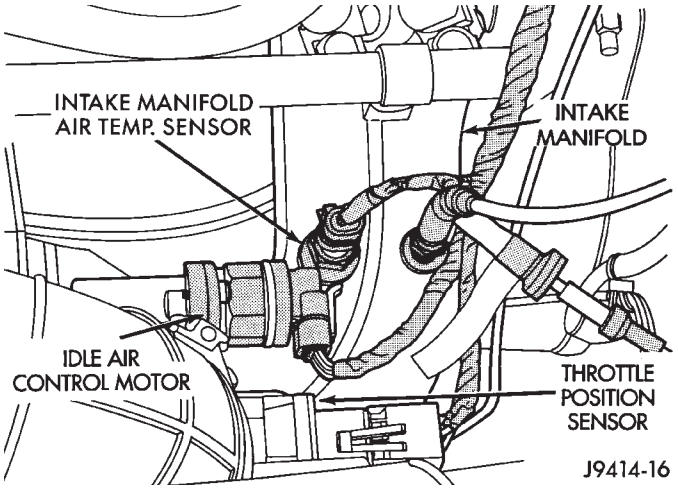

Fig. 21 IAC Motor—2.5L Engine

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle speed by mov-

ing the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

IGNITION COIL—PCM OUTPUT

System voltage is supplied to the ignition coil positive terminal. The powertrain control module (PCM) operates the ignition coil. **Base (initial) ignition timing is not adjustable.** The PCM adjusts ignition timing to meet changing engine operating conditions.

The ignition coil is located near the ignition distributor (Fig. 22).

Refer to Group 8D, Ignition System for additional information.

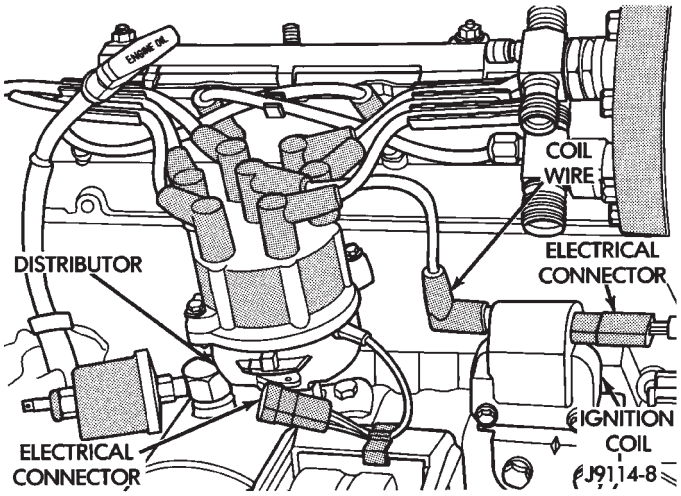

Fig. 22 Ignition Coil—Typical

MALFUNCTION INDICATOR LAMP—PCM OUTPUT

The Malfunction Indicator Lamp (formerly referred to as the Check Engine Lamp) illuminates on the instrument panel each time the ignition key is turned on. It will stay on for three seconds as a bulb test.

If the powertrain control module (PCM) receives an incorrect signal, or no signal from certain sensors or emission related systems, the lamp is turned on. This is a warning that the PCM has recorded a system or sensor malfunction. In some cases, when a problem is declared, the PCM will go into a limp-in mode. This is an attempt to keep the system operating. It signals an immediate need for service.

The lamp can also be used to display a Diagnostic Trouble Code (DTC). Cycle the ignition switch On-Off-On-Off-On within three seconds and any codes stored in the PCM memory will be displayed. This is done in a series of flashes representing digits. Refer to On-Board Diagnostics in the General Diagnosis section of this group for more information.

RADIATOR FAN RELAY—PCM OUTPUT

XJ MODELS ONLY

The electric radiator cooling fan used in XJ models (equipped with 4.0L engine, heavy duty cooling and/or air conditioning) is controlled by the powertrain control module (PCM) through radiator fan relay. The relay is energized when coolant temperature is above 103°C (217°F). It will then de-energize when coolant temperature drops to 98°C (208°F). Refer to Group 7, Cooling Systems for more information.

The relay is located in the power distribution center (PDC) (Fig. 23).

The electric radiator cooling fan is not used on YJ models.

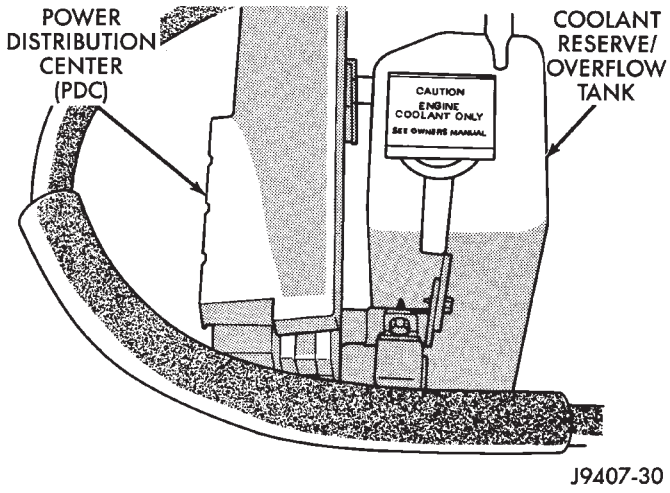

Fig. 23 PDC—XJ Models

SCI TRANSMIT—PCM OUTPUT

SCI Transmit is the serial data communication transmit circuit for the DRB scan tool. The powertrain control module (PCM) transmits data to the DRB through the SCI Transmit circuit.

SHIFT INDICATOR—PCM OUTPUT

Vehicles equipped with manual transmissions have an Up-Shift indicator lamp. The lamp is controlled by the powertrain control module (PCM). The lamp illuminates on the instrument panel to indicate when the driver should shift to the next highest gear for best fuel economy. The PCM will turn the lamp OFF after 3 to 5 seconds if the shift of gears is not performed. The up-shift light will remain off until vehicle stops accelerating and is brought back to range of up-shift light operation. This will also happen if vehicle is shifted into fifth gear.

The indicator lamp is normally illuminated when the ignition switch is turned on and it is turned off when the engine is started up. With the engine running, the lamp is turned on/off depending upon engine speed and load.

SPEED CONTROL—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed control vacuum and vent solenoids. Refer to Group 8H for speed control information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine rpm values to the instrument cluster tachometer (if equipped). Refer to Group 8E for tachometer information.

TORQUE CONVERTER CLUTCH RELAY—PCM OUTPUT

ALL 2.5L 4 CYL. WITH 3-SPEED AUTO. TRANS

4.0L 6 CYL. YJ MODELS WITH 3-SPEED AUTO. TRANS

The transmission mounted torque converter clutch (TCC) solenoid is used to control the torque converter. The solenoid is controlled through the powertrain control module (PCM) and by the TCC relay. This relay is used only on vehicles equipped with a 3-speed automatic transmission.

An electrical output signal is sent from the PCM to the TCC relay after the PCM receives information from the vehicle speed, MAP, throttle position and engine coolant temperature sensors. After the TCC relay receives this necessary information, it will send a signal to the torque converter clutch solenoid to control the torque converter.

On YJ models the TCC relay is located in the engine compartment, on the cowl panel and near the battery (Fig. 24). On XJ models the TCC relay is located in the power distribution center (PDC) (Fig. 23).

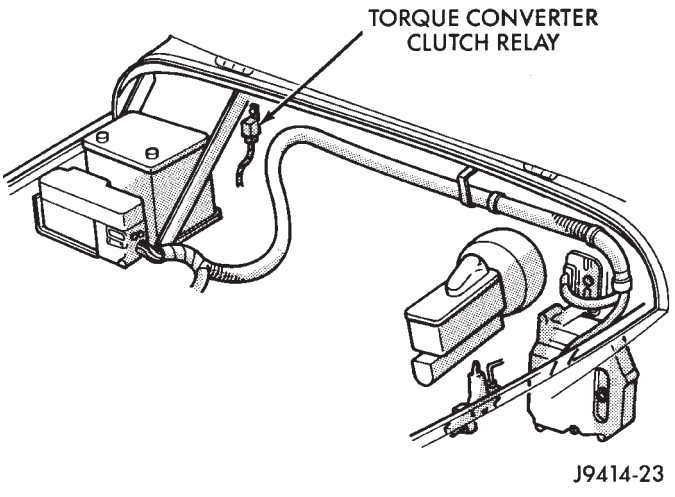

Fig. 24 TCC Relay Location—YJ Models

OPEN LOOP/CLOSED LOOP 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). There are several different modes of operation that determine how the PCM responds to the various input signals.

MODES

- Open Loop
- Closed Loop

During Open Loop modes, the powertrain control module (PCM) receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensor is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensor input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.

• Intake manifold air temperature sensor input is monitored
• Throttle position sensor (TPS) is monitored
• The auto shut down (ASD) relay is energized by the PCM for approximately three seconds.
• The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately one second unless the engine is operating or the starter motor is engaged
• The O2S sensor heater element is energized through the fuel pump relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.
• The up-shift indicator light is illuminated (manual transmission only).

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The powertrain control module (PCM) receives inputs from:
• Battery voltage
• Engine coolant temperature sensor
• Crankshaft position sensor
• Intake manifold air temperature sensor
• Manifold absolute pressure (MAP) sensor
• Throttle position sensor (TPS)
• Starter motor relay
• Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the 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 powertrain control module (PCM) receives inputs from:
• Battery voltage
• Crankshaft position sensor
• Engine coolant temperature sensor
• Intake manifold air temperature sensor
• Manifold absolute pressure (MAP) sensor
• Throttle position sensor (TPS)
• Camshaft position sensor signal (in the distributor)
• Park/Neutral Switch (Gear indicator signal—auto. trans. only)
• Air conditioning select signal (if equipped)
• Air conditioning request signal (if equipped)

Based on these inputs the following occurs:
• Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
• The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
• The PCM operates the A/C compressor clutch through the clutch relay. This is done if A/C has been selected by the vehicle operator and requested by the A/C thermostat.
• If the vehicle has a manual transmission, the up-shift light is operated by the PCM.
• When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the powertrain control module (PCM) receives inputs from:
• Air conditioning select signal (if equipped)
• Air conditioning request signal (if equipped)
• Battery voltage
• Crankshaft position sensor
• Engine coolant temperature sensor
• Intake manifold air temperature sensor
• Manifold absolute pressure (MAP) sensor
• Throttle position sensor (TPS)
• Camshaft position sensor signal (in the distributor)
• Battery voltage
• Park/Neutral Switch (gear indicator signal—auto. trans. only)
• Oxygen sensor

Based on these inputs, the following occurs:
• Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
• The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
• The PCM adjusts ignition timing by increasing and decreasing spark advance.
• The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

The optional Extended Idle Switch is used to raise the engine idle speed to approximately 1000 rpm. This is when the shifter is in either the Park or Neutral position. A rocker-type 2-wire switch (extended idle switch) is mounted to the instrument panel. This

switch will supply a ground circuit to the powertrain control module (PCM). **The switch is available only with 4.0L engine when supplied with the optional police package.**

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/Neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensor

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the powertrain control module (PCM) receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/Neutral switch (gear indicator signal—auto. trans. only)

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 battery voltage 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.

The PCM opens the ground circuit to the A/C clutch relay to disengage the A/C compressor clutch. This is done until the vehicle is no longer under deceleration (if the A/C system is operating).

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the powertrain control module (PCM) receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM opens the ground circuit to the A/C clutch relay to disengage the A/C compressor clutch. This will be done for approximately 15 seconds (if the air conditioning system is operating).

If the vehicle has a manual transmission, the upshift light is operated by the PCM.

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.

THROTTLE BODY

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 25). Fuel does not enter the intake manifold through the throt-

tle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 26) 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.

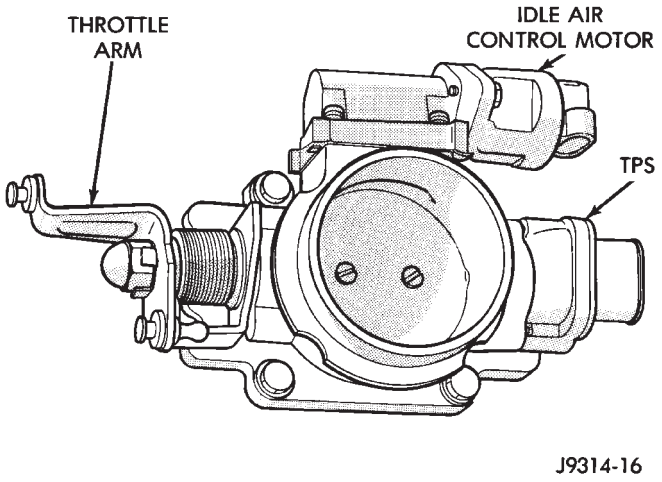

Fig. 25 Throttle Body—Typical

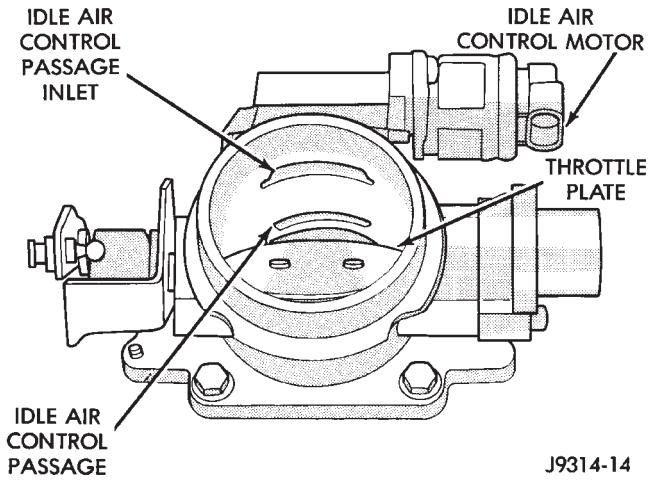

Fig. 26 Idle Air Control Passage

The throttle position sensor (TPS) and idle air control (IAC) motor are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

FUEL RAIL

The fuel rail supplies fuel to the injectors and is mounted to the intake manifold (Fig. 27). The fuel pressure regulator is attached to the rail and the fuel pressure test port is integral with the rail. The fuel rail is not repairable.

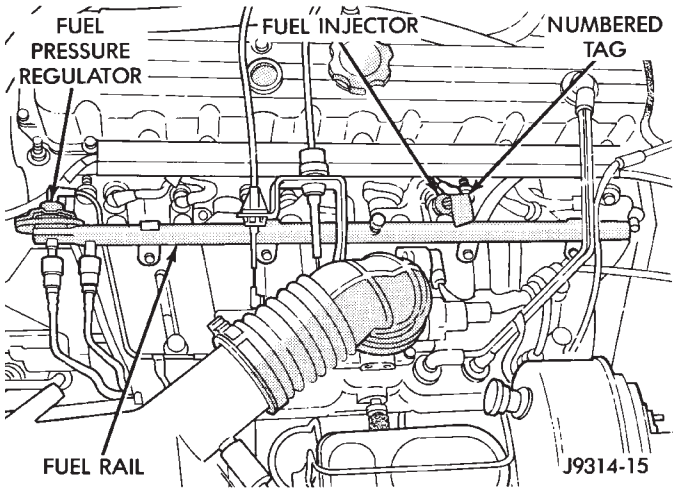

Fig. 27 Fuel Rail—Typical

FUEL PRESSURE REGULATOR

The fuel pressure regulator (Fig. 28) is a mechanical device that is not controlled by the powertrain control module (PCM).

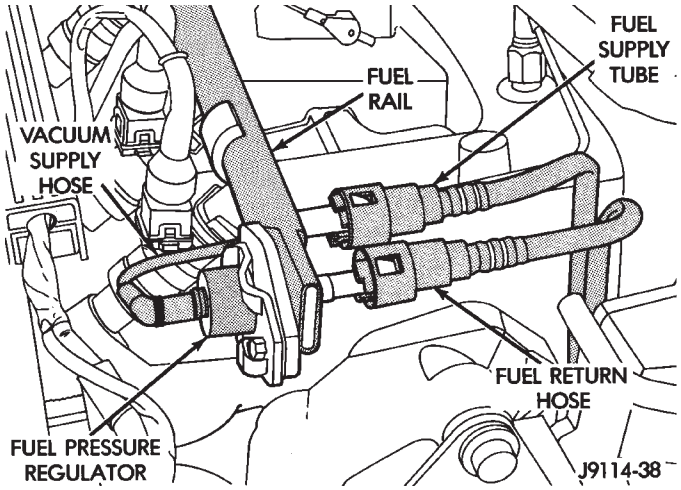

Fig. 28 Fuel Pressure Regulator—Typical

The fuel pressure regulator used is a vacuum balanced, nonadjustable type. The regulator is mounted on the output end of the fuel rail and is connected to intake manifold vacuum. The fuel return tube (to the fuel tank) is connected to the fuel pressure regulator.

The regulator is calibrated to maintain fuel system pressure at approximately 214 kPa (31 psi). This is with vacuum applied while the engine is at idle. Fuel pressure will be 55-69 kPa (8-10 psi) higher if vacuum is not applied to the regulator.

The pressure regulator contains a diaphragm, calibrated spring and a fuel return valve (Fig. 29). Fuel pressure operates on one side of the regulator, while spring pressure and intake manifold vacuum operate on the other side. Spring pressure on one side of the

diaphragm tries to force the return valve closed. Fuel pressure on other side of diaphragm, with assistance from manifold vacuum on spring side of diaphragm, act against spring pressure to open the return valve. System fuel pressure is the amount of fuel pressure required to force against spring pressure and unseat the return valve.

Without vacuum applied to the spring side of the regulator, the spring is calibrated to open the fuel return outlet. This happens when the pressure differential between the fuel injectors and the intake manifold reaches approximately 269 kPa (39 psi). Since manifold vacuum varies with engine operating conditions, the amount of vacuum applied to the spring side of the diaphragm varies. For this reason, fuel pressure varies, depending upon intake manifold vacuum. With low vacuum, such as during wide open throttle conditions, minimal vacuum assistance is available. Full spring pressure is exerted to seal the fuel outlet. This causes the system pressure to increase. With high vacuum, such as at engine idle or during vehicle deceleration, fuel pressure on one side of the diaphragm is balanced by intake manifold pressure. This is done on the spring side of the diaphragm and results in lower system fuel pressure.

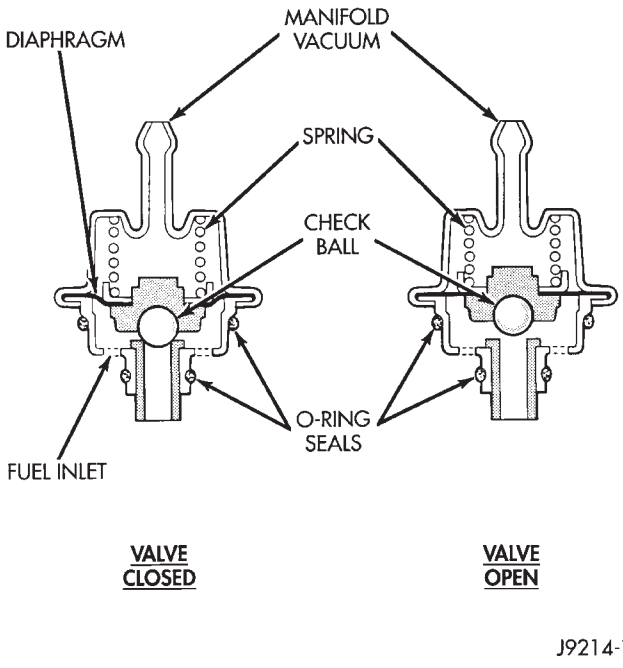

Fig. 29 Fuel Pressure Regulator Operation—Typical

MULTI-PORT FUEL INJECTION (MFI)—GENERAL DIAGNOSIS

INDEX

GENERAL INFORMATION

All 2.5L 4 cylinder and 4.0L 6 cylinder engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

VISUAL INSPECTION

A visual inspection for loose, disconnected, or incorrectly routed wires and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the 60-way connector is fully inserted into the connector of the Powertrain Control Module (PCM) (Figs. 1 or 2). Verify that the connector mounting bolt is tightened to 4 N·m (35 in. lbs.) torque.

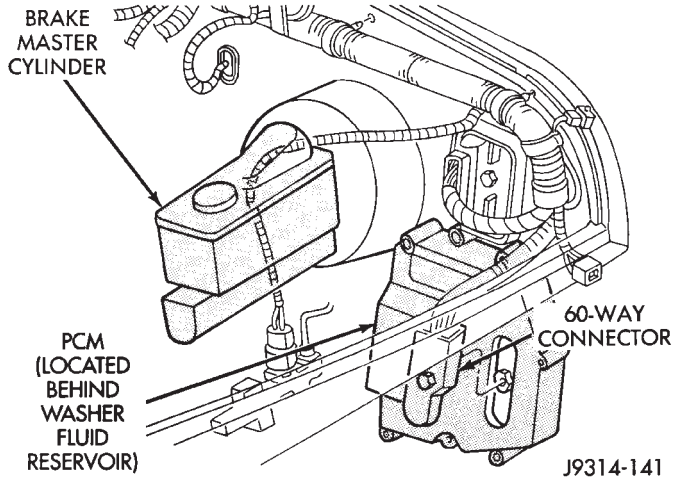

Fig. 1 PCM—YJ Models

(2) Inspect the battery cable connections. Be sure they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect ASD relay and radiator fan relay (if equipped) connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are installed in the Power Distribution Center (PDC) (Figs. 3 or 4).

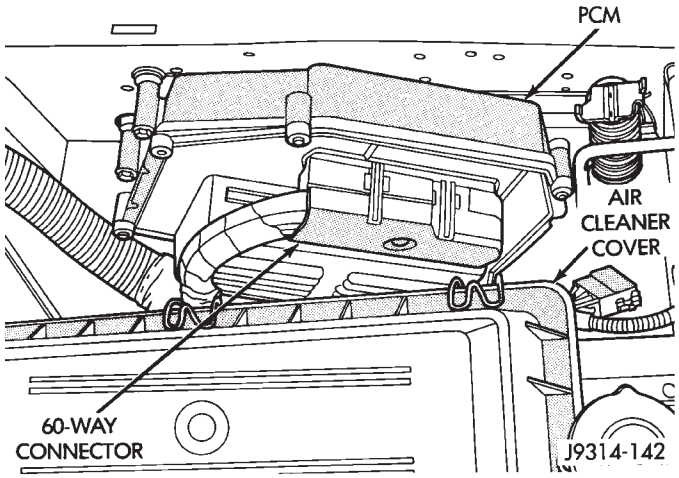

Fig. 2 PCM—XJ Models

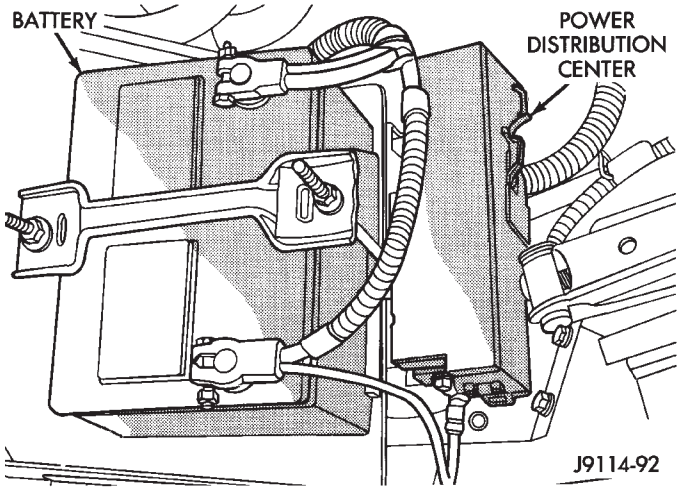

Fig. 3 PDC—YJ Models

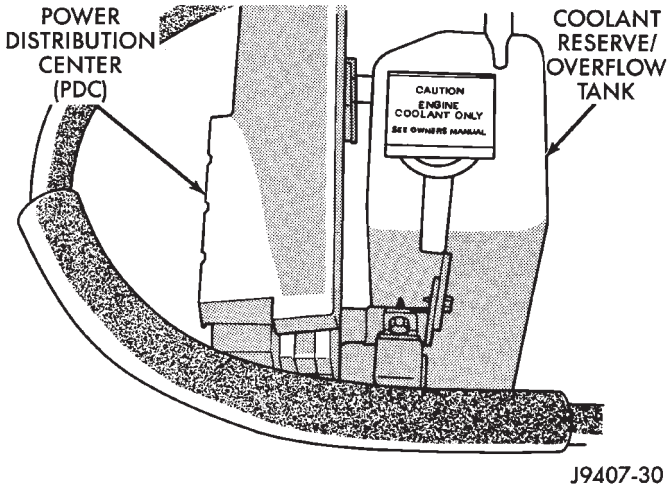

Fig. 4 PDC—XJ Models

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Figs. 5 or 6).

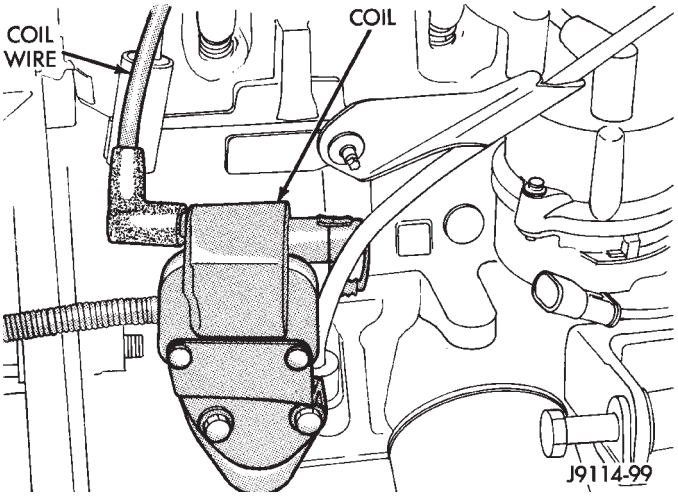

Fig. 5 Ignition Coil—2.5L Engine

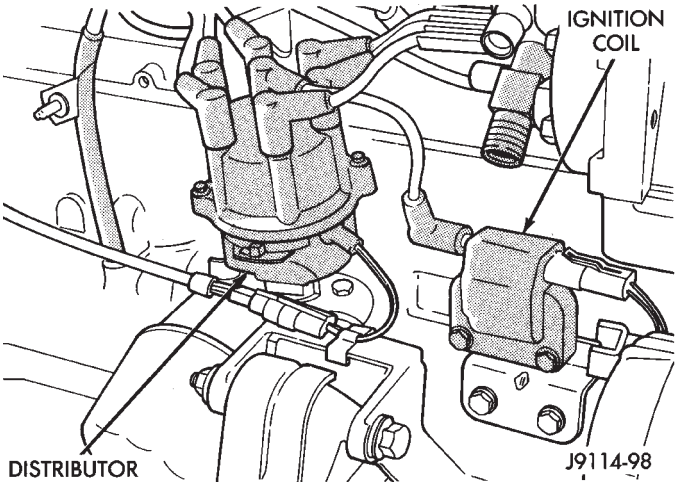

Fig. 6 Ignition Coil—4.0L Engine

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector is firmly connected to harness connector (Figs. 7 or 8). Inspect spark plug condition. Refer to Group 8D, Ignition System. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

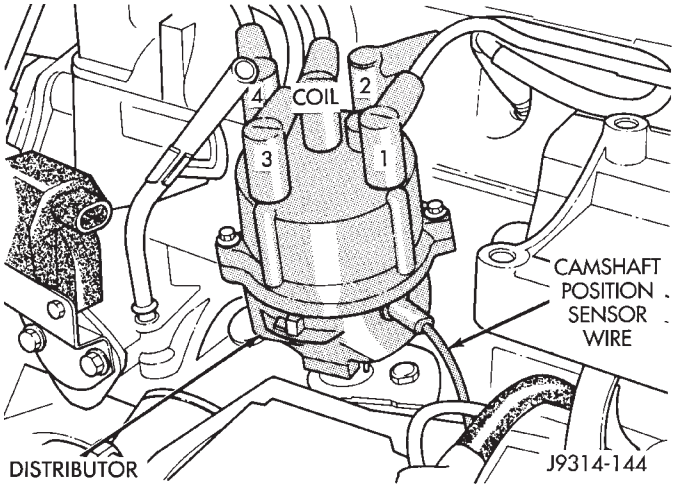

Fig. 7 Distributor and Wiring—2.5L Engine

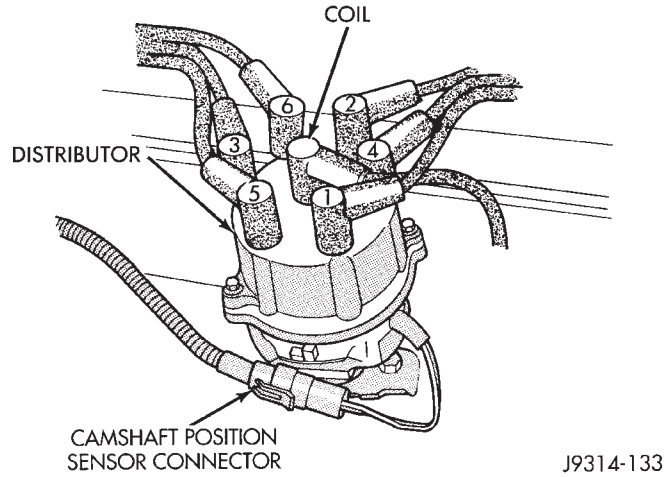

Fig. 8 Distributor and Wiring—4.0L Engine

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator (Fig. 9).

(7) Inspect the system ground connections at the cylinder block behind the engine oil dipstick tube (Fig. 10).

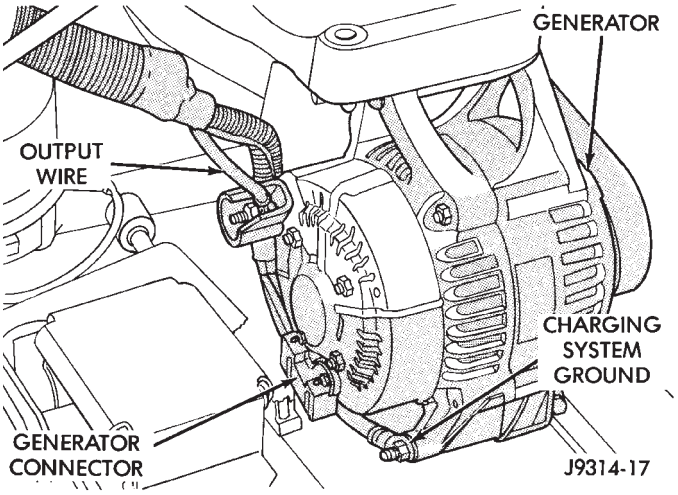

Fig. 9 Generator Connector and Output Wire Connections—Typical

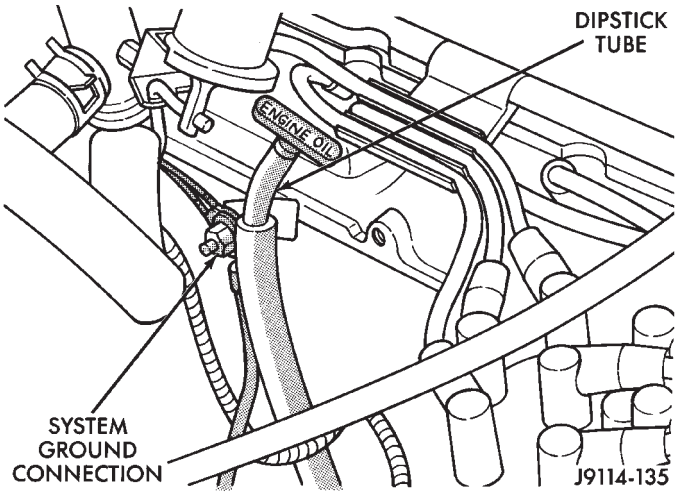

Fig. 10 System Ground Connections—Typical

(8) Verify that crankcase ventilation (CCV) fresh air hose is firmly connected to cylinder head and air cleaner covers (Figs. 11 or 12).

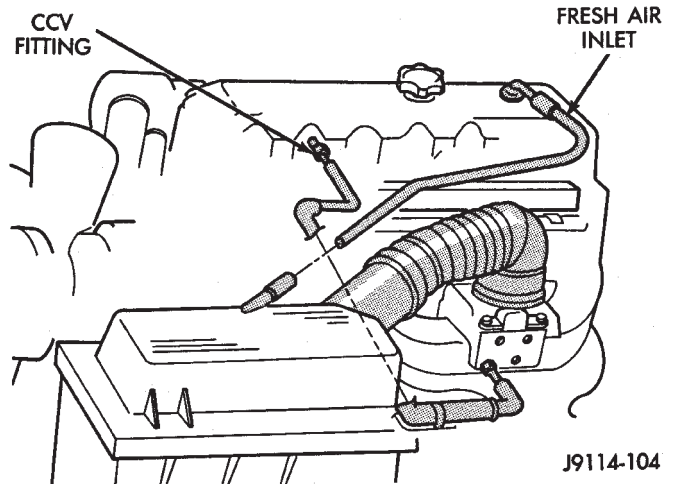

Fig. 11 CCV System—2.5L Engine

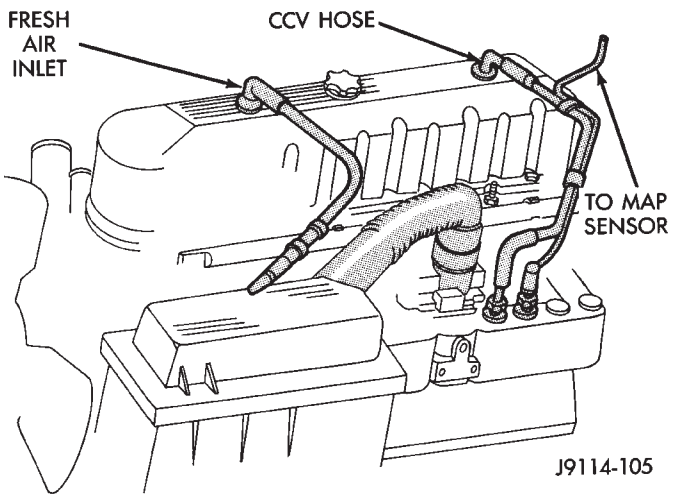

Fig. 12 CCV System—4.0L Engine

(9) Verify that vacuum hose is firmly connected to fuel pressure regulator and manifold fitting (Figs. 13 or 14).

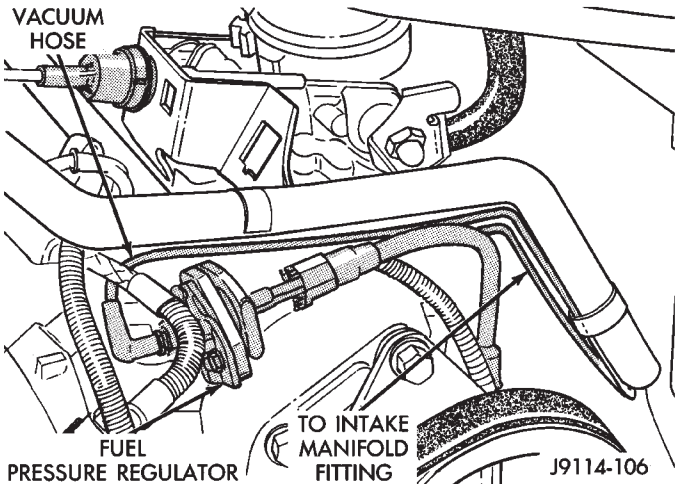

Fig. 13 Pressure Regulator Vacuum Hose—2.5L Engine

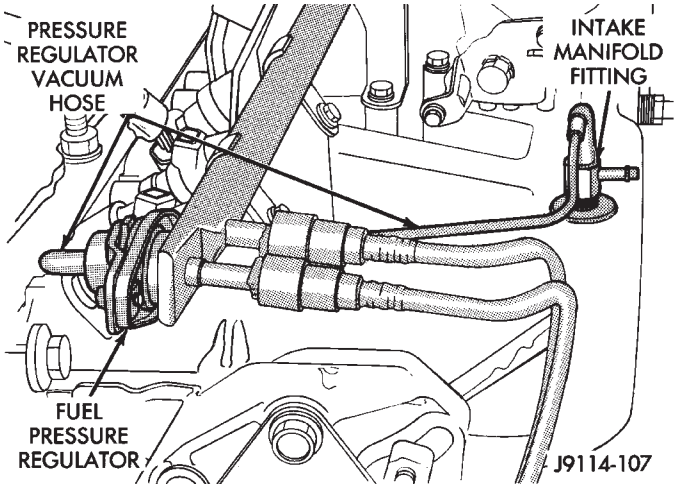

Fig. 14 Pressure Regulator Vacuum Hose—4.0L Engine

(10) Inspect fuel tube quick-connect fitting-to-fuel rail connections (Fig. 15).

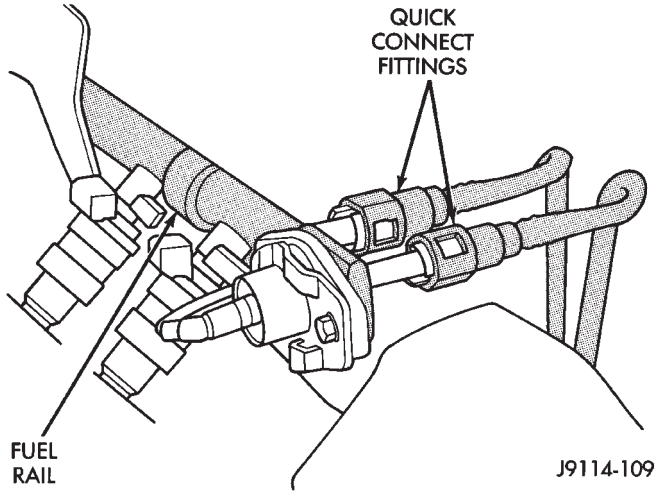

Fig. 15 Fuel Supply Tube—Typical

(11) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(12) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to the throttle arm of throttle body for any binding or restrictions (Fig. 16).

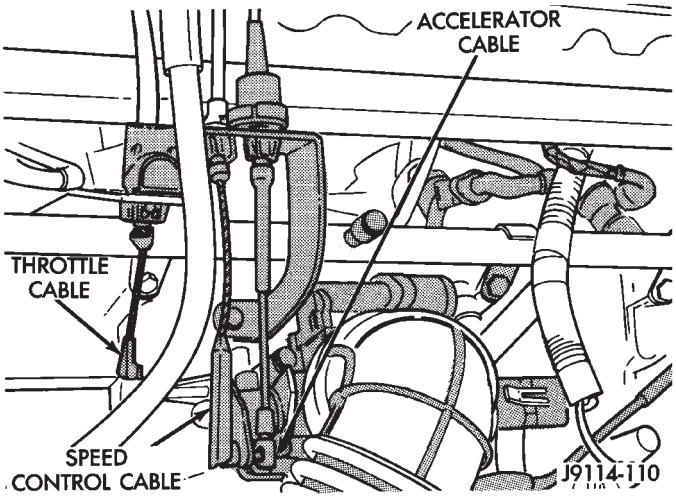

Fig. 16 Throttle Body Cables—Typical

(13) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster (Fig. 17).

(14) On XJ models equipped with 4.0L engine and A/C, verify that auxiliary cooling fan wire connector is firmly connected to harness (Fig. 18).

(15) Inspect the air cleaner inlet and air filter element for restrictions.

(16) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

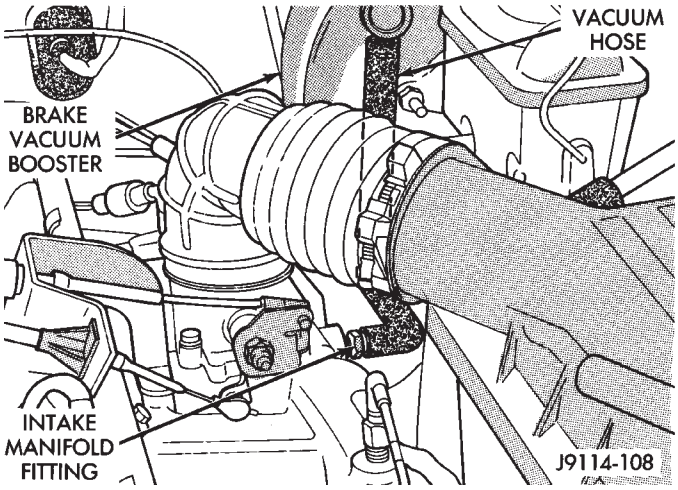

Fig. 17 Brake Vacuum Booster Hose—Typical

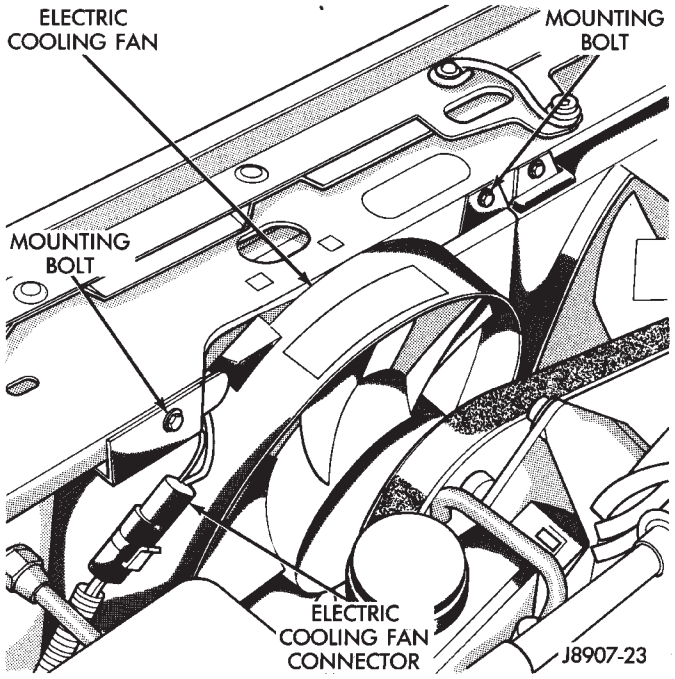

Fig. 18 Auxiliary Cooling Fan Connector—XJ with 4.0L Engine

(17) Verify that intake manifold air temperature sensor wire connector is firmly connected to harness connector (Figs. 19 or 20).

(18) Inspect engine ground strap connections at dash panel and rear cylinder head bolt (Fig. 21).

(19) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 22). Verify that vacuum hose is firmly connected to MAP sensor and to the intake manifold.

(20) Verify that fuel injector wire harness connectors are firmly connected to the fuel injectors in the correct order. Each harness connector is tagged with the number of its corresponding fuel injector (Fig. 23).

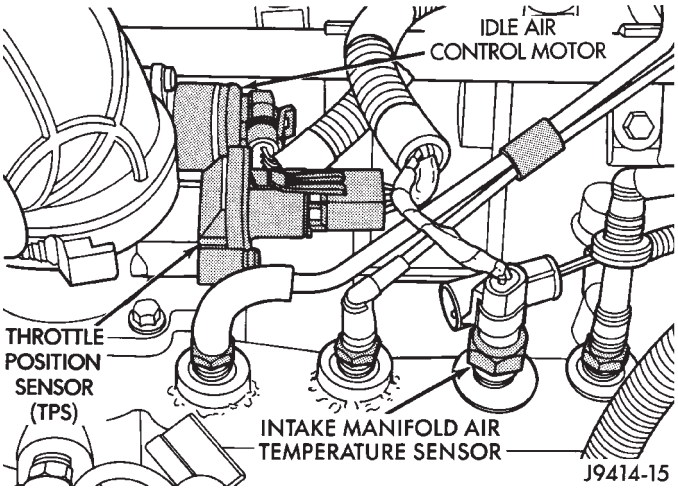

Fig. 19 Sensor Location—4.0L Engine

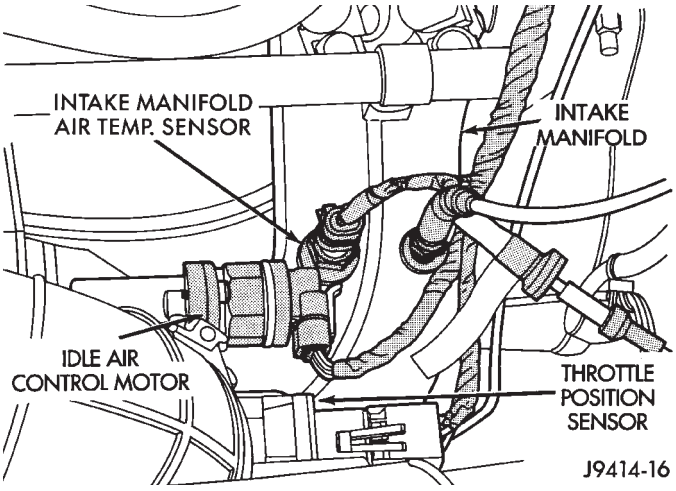

Fig. 20 Sensor Location—2.5L Engine

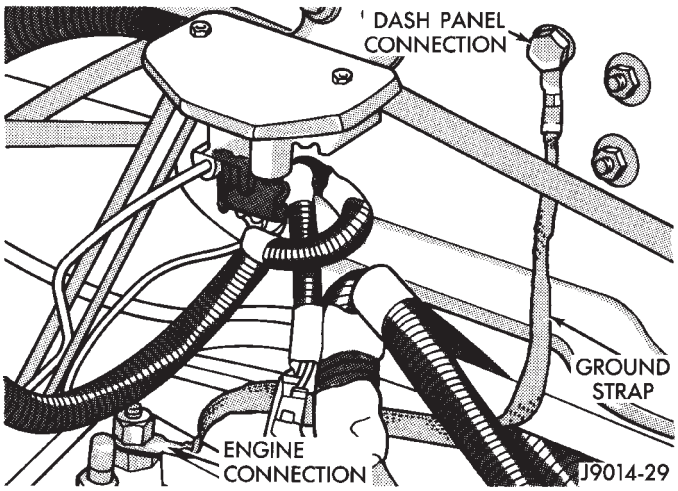

Fig. 21 Engine Ground Strap Connections—Typical

(21) Verify that harness connectors are firmly connected to idle air control (IAC) motor and throttle position sensor (TPS) (Figs. 19, 20 or 24).

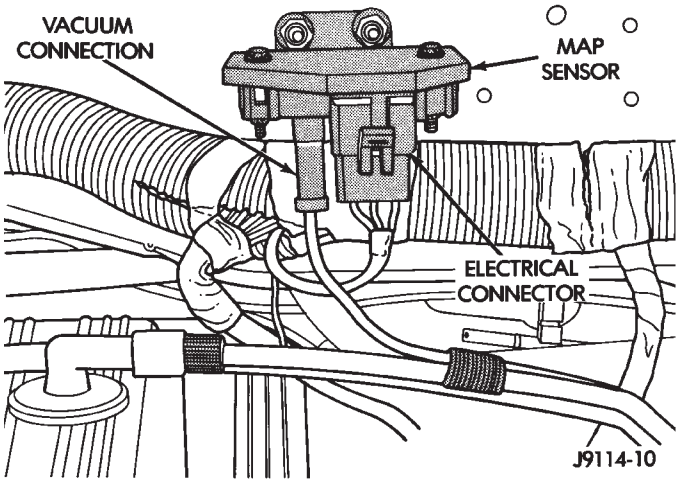

Fig. 22 MAP Sensor—Typical

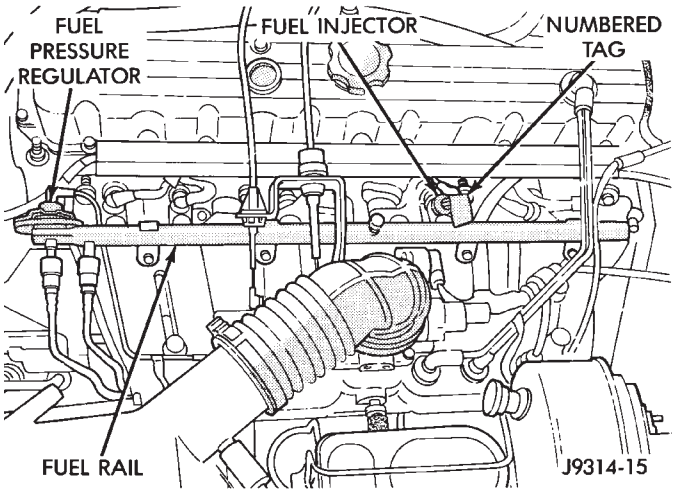

Fig. 23 Fuel Injector Wire Harness—Typical

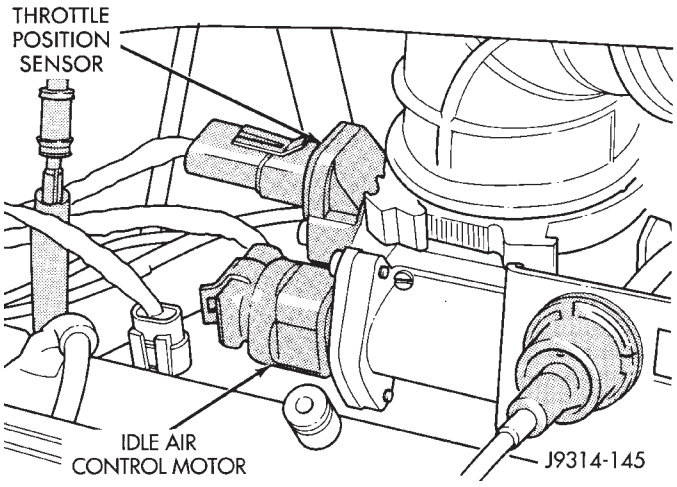

Fig. 24 IAC Motor and TPS—2.5L Engine

(22) Verify that wire harness connector is firmly connected to the coolant temperature sensor (Fig. 25).

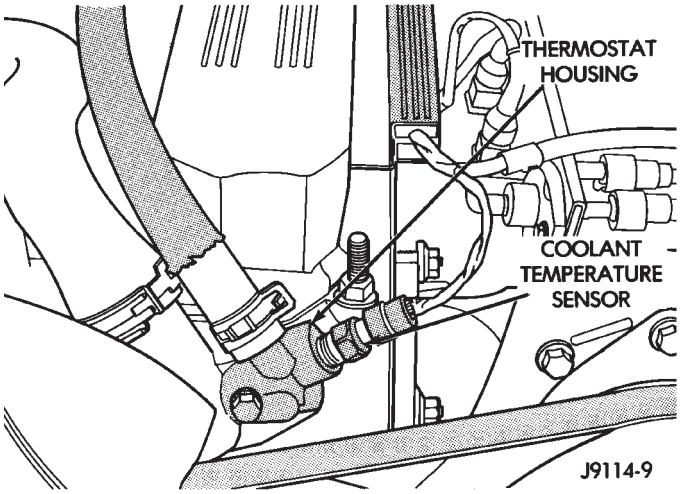

Fig. 25 Coolant Temperature Sensor—Typical

(23) Verify that oxygen sensor wire connector is firmly connected to the sensor. Inspect sensor and connector for damage (Fig. 26).

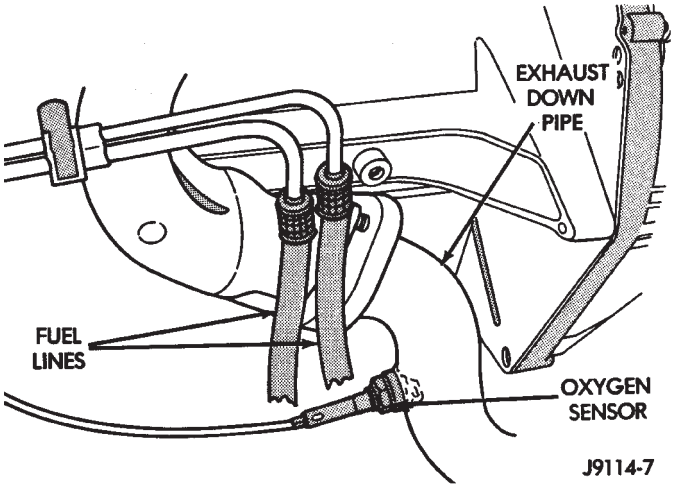

Fig. 26 Oxygen Sensor Location—Typical

(24) Raise and support the vehicle.

(25) Inspect for pinched or leaking fuel tubes. Inspect for pinched cracked or leaking fuel hoses.

(26) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(27) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral safety switch. Refer to Automatic Transmission section of Group 21.

(28) Verify that the harness connector is firmly connected to the vehicle speed sensor (Fig. 27).

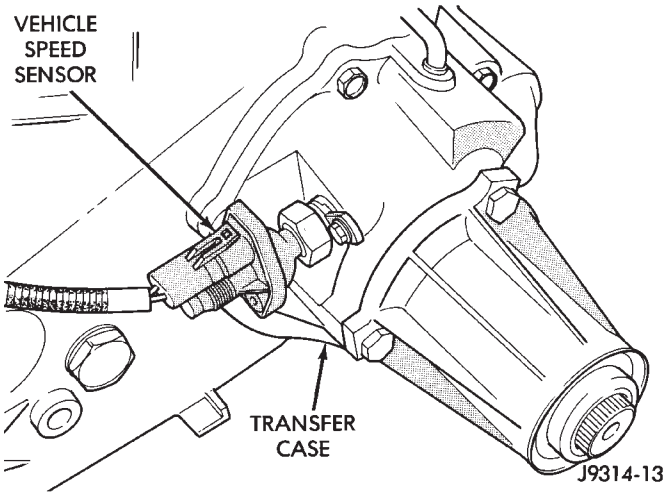

Fig. 27 Vehicle Speed Sensor—Typical

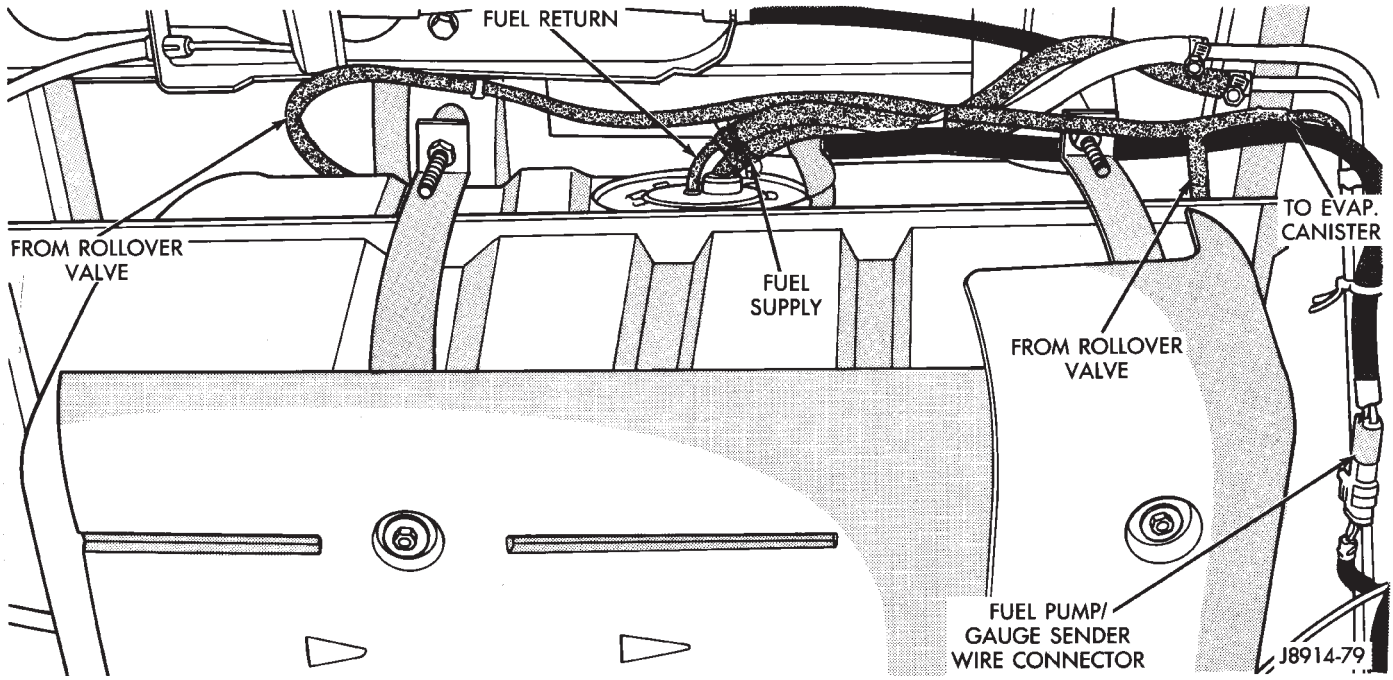

Fig. 28 Fuel Pump Module Connector and Fuel Hoses—Typical

(29) Verify that fuel pump module wire connector is firmly connected to harness connector.

(30) Inspect fuel hoses at fuel pump module for cracks or leaks (Fig. 28).

(31) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(32) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components (Fig. 29).

POWERTRAIN CONTROL MODULE (PCM) 60-WAY CONNECTOR

For PCM 60-way connector wiring schematics, refer to Group 8W, Wiring Diagrams.

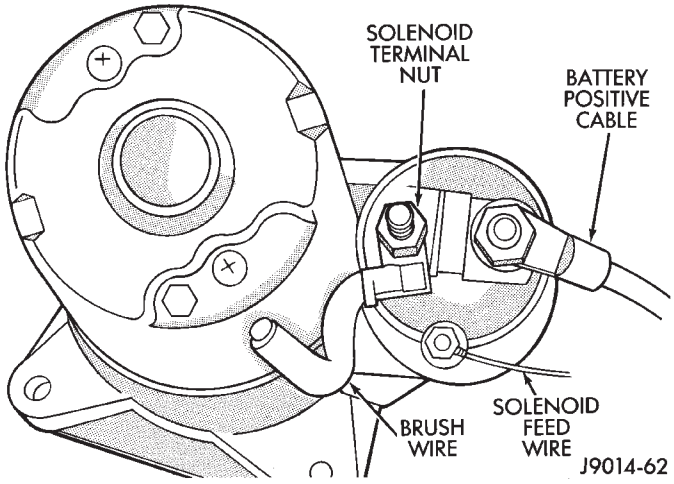

Fig. 29 Starter Solenoid Connections—Typical

SYSTEM SCHEMATICS

Fuel system schematics for the 2.5L 4 cylinder and 4.0L 6 cylinder engines are shown in figures 30, 31, 32 and 33.

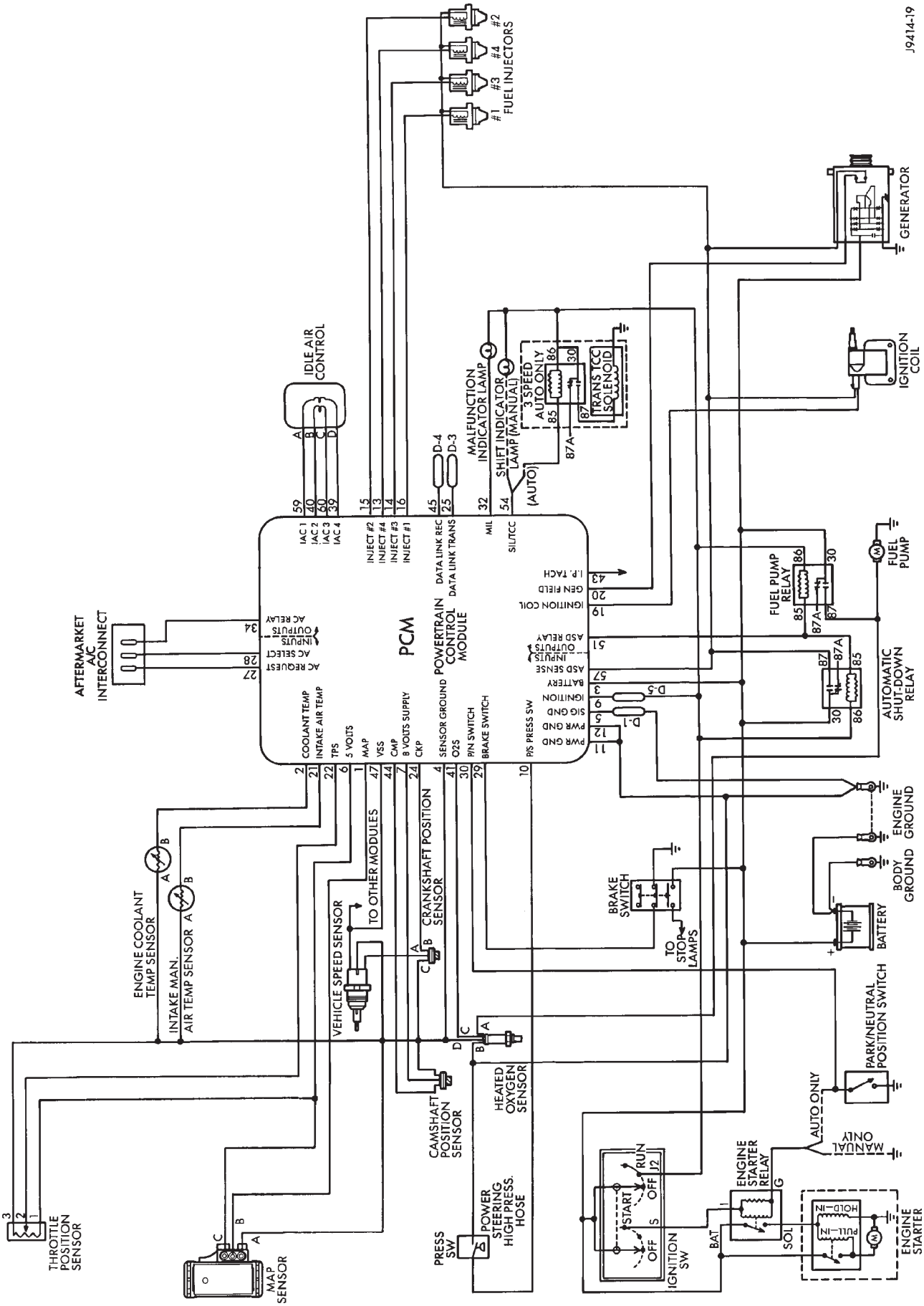

Fig. 30 System Schematic—YJ Models with 2.5L Engine

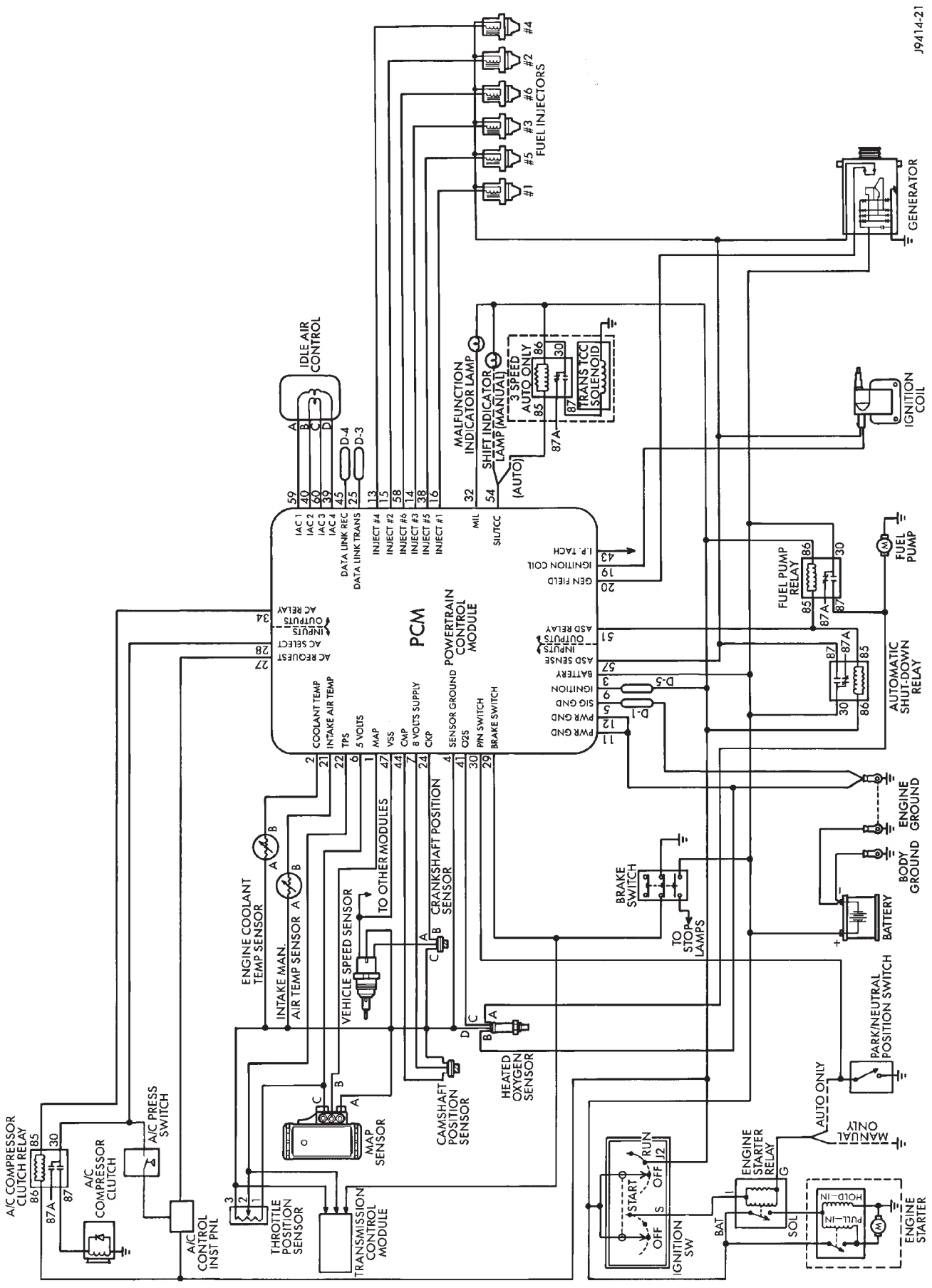

Fig. 31 System Schematic—YJ Models with 4.0L Engine

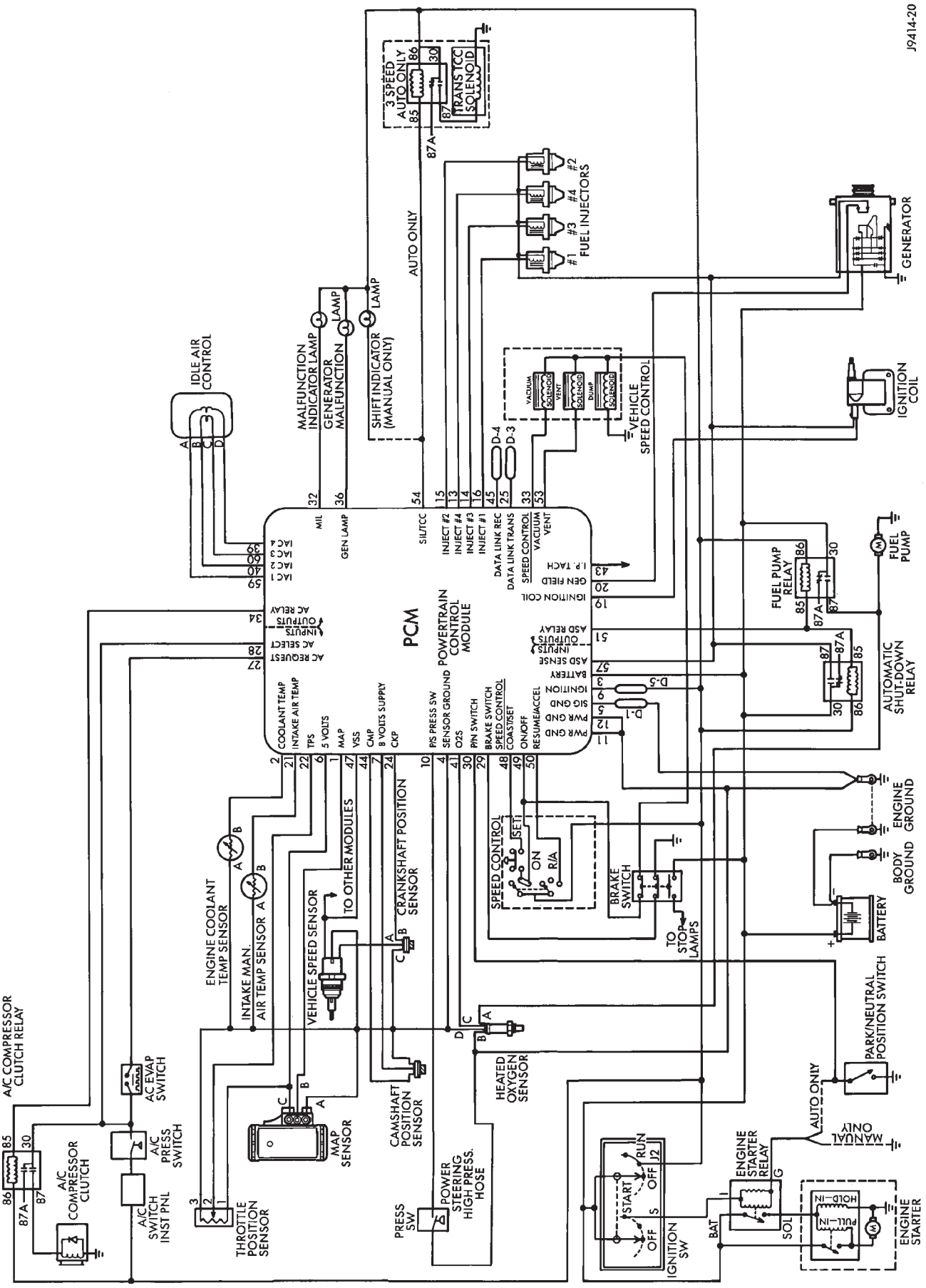

Fig. 32 System Schematic—XJ Models with 2.5L Engine

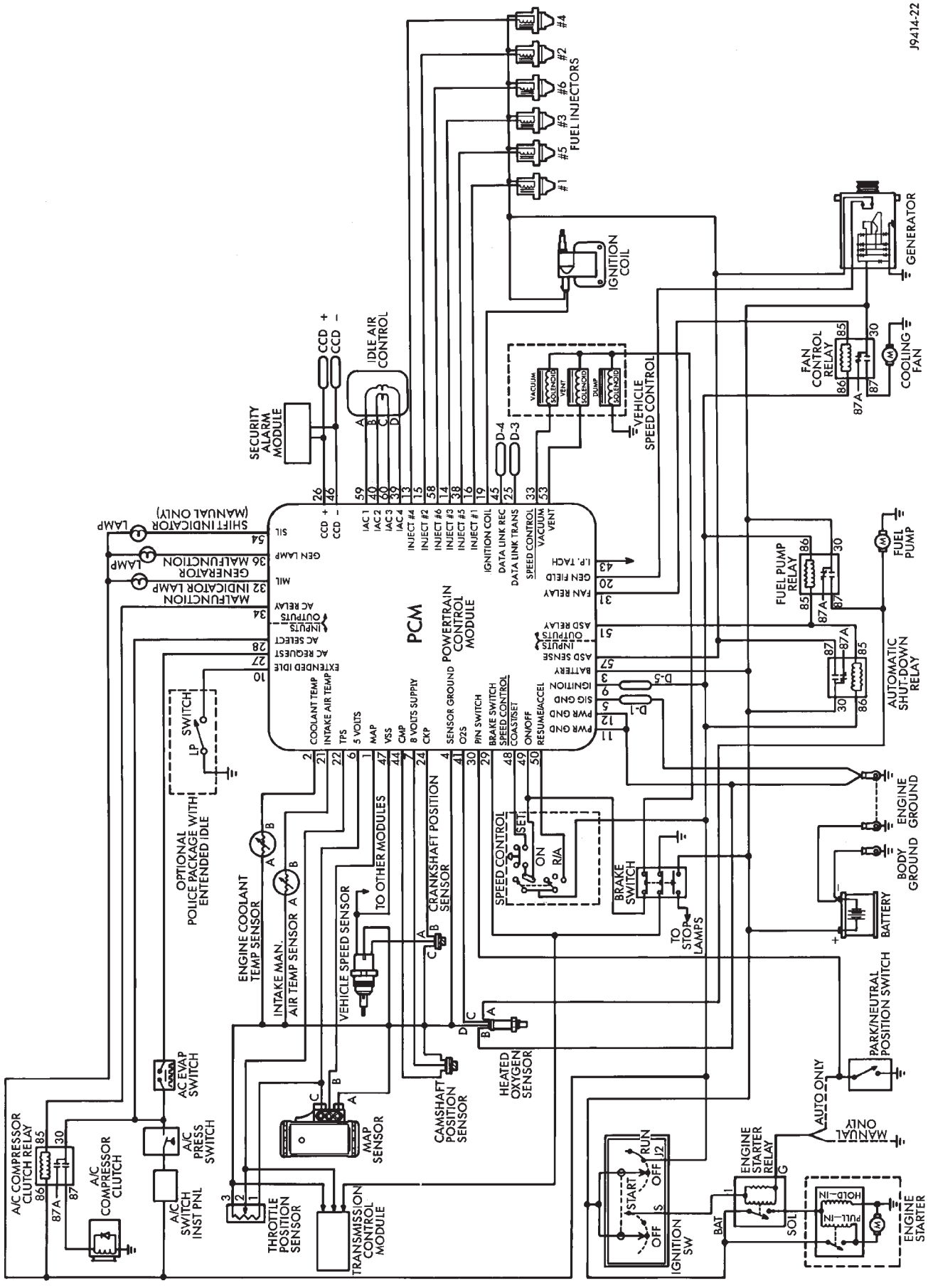

Fig. 33 System Schematic—XJ Models with 4.0L Engine

AUTOMATIC SHUT DOWN (ASD) RELAY TESTING

To perform a complete test of the ASD relay and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the relay only, refer to Relays—Operation/Testing in this section of the group.

CAMSHAFT POSITION SENSOR TEST

Refer to Group 8D, Ignition Systems, for Camshaft Position Sensor testing.

ENGINE COOLANT TEMPERATURE SENSOR TEST

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

Disconnect wire harness connector from engine coolant temperature sensor (Fig. 34).

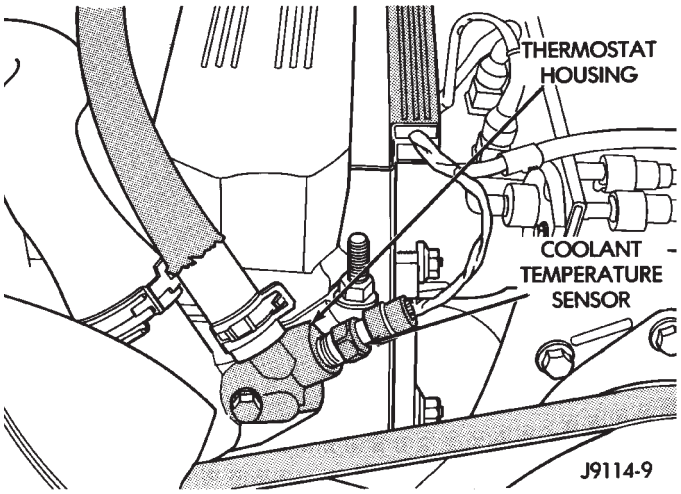

Fig. 34 Coolant Temperature Sensor—Typical

Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance should be less than 1000 ohms with the engine at its correct operating temperature. Refer to the Coolant Temperature Sensor/Manifold Air Temperature Sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test continuity of the wire harness. Do this between the Powertrain Control Module (PCM) wire harness connector terminal-2 and the sensor connector terminal. Also test continuity of wire harness terminal-4 to the sensor connector terminal. Repair the wire harness if an open circuit is indicated.

INTAKE AIR TEMPERATURE SENSOR TEST

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/MANIFOLD AIR TEMPERATURE

TEMPERATURE		RESISTANCE (OHMS)	
C	F	MIN	MAX
−40	−40	291,490	381,710
−20	−4	85,850	108,390
−10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

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Disconnect the wire harness connector from the intake manifold air temperature sensor (Figs. 35 or 36).

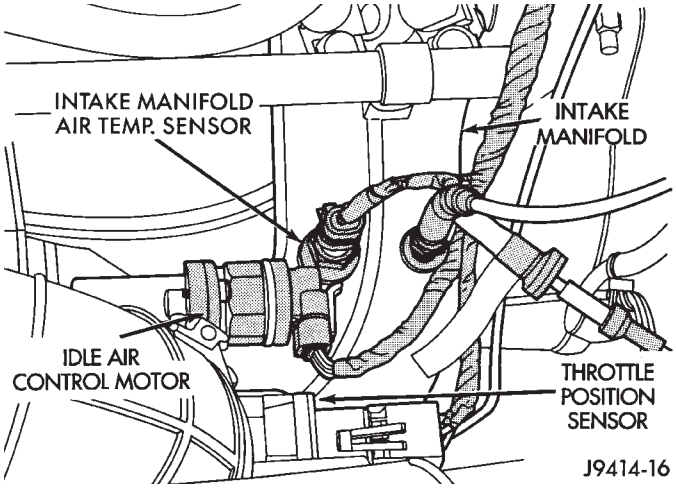


Fig. 35 Air Temperature Sensor—2.5L Engine

Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance should be less than 4000 ohms with the engine at operating temperature. The longer the engine idles, the warmer the intake manifold temperature will become. Refer to the Coolant Temperature Sensor/Manifold Air Temperature Sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test the resistance of the wire harness. Do this between the Powertrain Control Module (PCM) wire

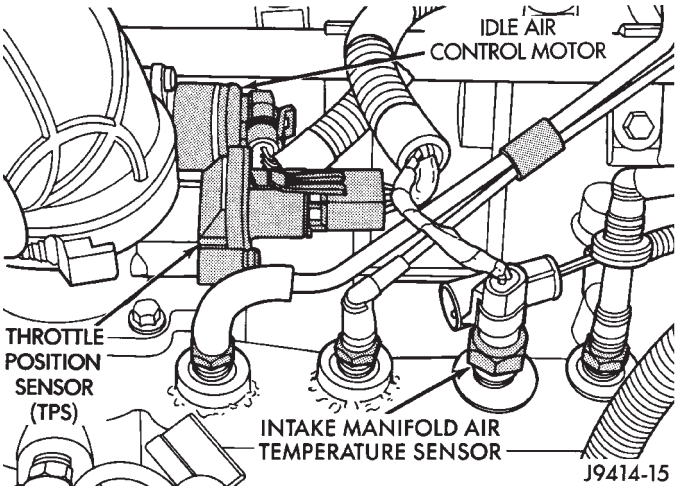


Fig. 36 Air Temperature Sensor—4.0L Engine

harness connector terminal-2 and the sensor connector terminal. Also test terminal-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

FUEL PUMP RELAY TESTING

For testing this relay, refer to Relays—Operation/ Testing in this section of the group.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

To perform a complete test of the MAP sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

Inspect the MAP sensor vacuum hose connections at the throttle body and sensor. Repair as necessary.

CAUTION: When testing, do not remove the electrical connector from MAP sensor (Fig. 37). Be sure that the MAP sensor harness wires are not damaged by the test meter probes.

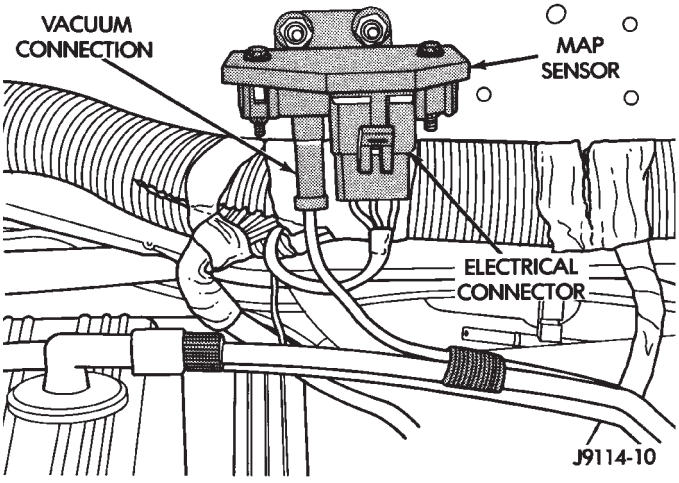


Fig. 37 MAP Sensor—Typical

Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (as marked on the sensor body) (Fig. 38). With the ignition switch ON and the engine OFF, output voltage should be 4-to-5 volts. The voltage should drop to 1.5-to-2.1 volts with a neutral-hot idle speed condition.

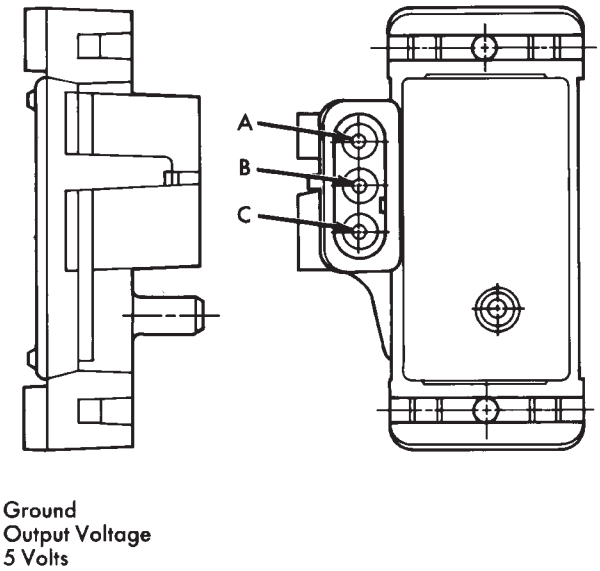


Fig. 38 MAP Sensor Connector Terminals—Typical

Test Powertrain Control Module (PCM) (terminal-5) for the same voltage described above to verify the wire harness condition. Repair as necessary.

Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 38) with the ignition ON and engine OFF. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at terminal-6 of the PCM wire harness connector. Repair or replace the wire harness as necessary.

Test the MAP sensor ground circuit at sensor connector terminal-A (Fig. 38) and PCM connector terminal-4. Repair the wire harness if necessary.

Test the MAP sensor ground circuit at the PCM connector between terminal-4 and terminal-11 with an ohmmeter. If the ohmmeter indicates an open circuit, inspect for a defective sensor ground connection. Refer to Group 8W, Wiring for location of engine grounds. If the ground connection is good, replace the PCM. If terminal-4 has a short circuit to 12 volts, correct this condition before replacing the PCM.

CRANKSHAFT POSITION SENSOR TEST

Refer to Group 8D, Ignition Systems for test procedures.

EXTENDED IDLE SWITCH TEST

OPTIONAL POLICE PACKAGE ONLY

OPERATION

The extended idle switch is used to raise the engine idle speed to approximately 1000 rpm when the shifter is in either the Park or Neutral position. A rocker-type 2-wire switch (extended idle switch) is mounted to the instrument panel. **This switch is available only with 4.0L engine when supplied with the optional police package.**

TESTING

The extended idle switch will control a ground circuit going to the powertrain control module (PCM). When a ground signal (through this switch) has been received at pin number 10 in the PCM, engine idle speed will increase.

Bring the engine to normal operating temperature and turn the extended idle switch to the ON position. Engine speed should now increase to approximately 1000 rpm when the shifter is in either the Park or Neutral position. If engine speed does not increase, apply a good ground to pin number 10 at the PCM using a small paper clip. Be careful not to damage the wiring with the paper clip. If the engine speed now increases, it can be assumed that the PCM is functioning correctly. Check the instrument panel mounted switch for a closed ground circuit when in the ON position. If the engine speed will not increase after applying a ground to pin number 10, replace the PCM. Refer to Group 8W, Wiring Diagrams for circuit and wiring information.

THROTTLE POSITION SENSOR (TPS) TEST

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The throttle position sensor (TPS) can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal (Figs. 39 or 40).

With the ignition key in the ON position, backprobe the TPS connector. Check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, TPS output voltage should must be greater than 200 millivolts. At wide open throttle, TPS output voltage must be less than 4.8 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

TORQUE CONVERTER CLUTCH RELAY TEST

To test the relay only, refer to Relays—Operation/Testing in this section of the group. To test the torque converter clutch circuit and related components, refer to the appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool.

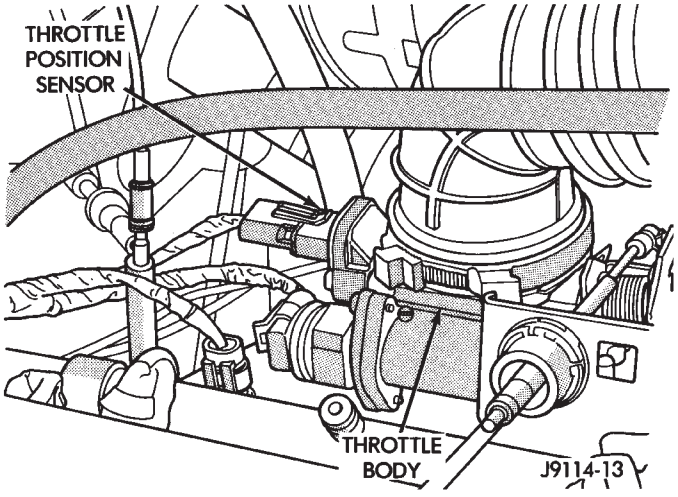


Fig. 39 TPS Testing—2.5L Engine

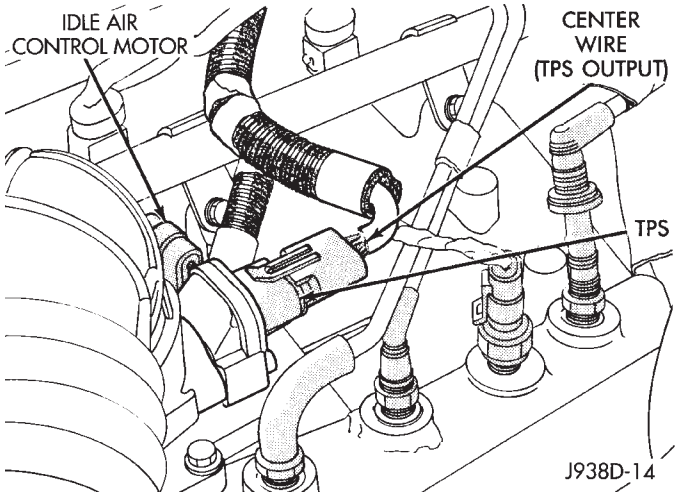


Fig. 40 TPS Testing—4.0L Engine

VEHICLE SPEED SENSOR TEST

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

OXYGEN SENSOR (O2S) HEATING ELEMENT TEST

To perform a complete test of the O2S sensor (Fig. 41) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

The oxygen sensor heating element can be tested with an ohmmeter as follows:

With the sensor at room temperature 25 degrees C (77 degrees F), disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 5 and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

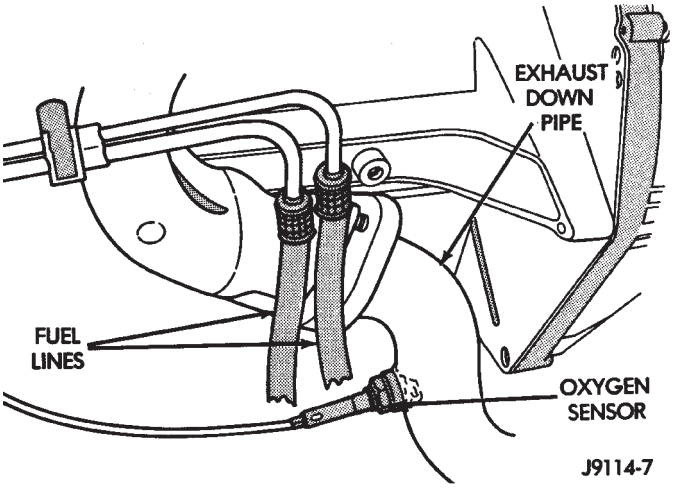


Fig. 41 Oxygen Sensor—Typical

IDLE AIR CONTROL MOTOR TEST

Idle Air Control (IAC) Motor operation can be tested using special exerciser tool number 7558 (Fig. 42).

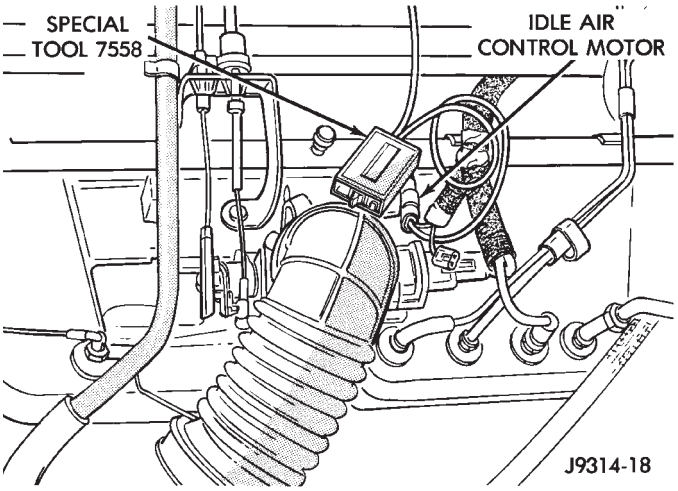


Fig. 42 IAC Motor Testing—Typical

CAUTION: Proper safety precautions must be taken when testing the idle air control motor:

- Set the parking brake and block the drive wheels
- Route all tester cables away from the cooling fans, drive belt, pulleys and exhaust components
- Provide proper ventilation while operating the engine
- Always return the engine idle speed to normal before disconnecting the exerciser tool

(1) With the ignition OFF, disconnect the IAC motor wire connector at throttle body (Fig. 42).

(2) Plug the exerciser tool number 7558 harness connector into the IAC motor.

(3) Connect the red clip of exerciser tool 7558 to battery positive terminal. Connect the black clip to negative battery terminal. The red light on the exerciser tool will flash when the tool is properly connected.

(4) Start engine.

When the switch on the tool is in the HIGH or LOW position, the light on the tool will flash. This indicates that voltage pulses are being sent to the IAC stepper motor.

(5) Move the switch to the HIGH position. The engine speed should increase. Move the switch to the LOW position. The engine speed should decrease.

(a) If the engine speed changes while using the exerciser tool, the IAC motor is functioning properly. Disconnect the exerciser tool and connect the IAC motor wire connector to the stepper motor.

(b) If the engine speed does not change, turn the ignition OFF and proceed to step (6). Do not disconnect exerciser tool from the IAC motor.

(6) Remove the IAC motor from the throttle body. Do not remove IAC motor housing from throttle body.

CAUTION: When checking IAC motor operation with the motor removed from the throttle body, do not extend the pintle (Fig. 43) more than 6.35 mm (.250 in). If the pintle is extended more than this amount, it may separate from the IAC motor. The IAC motor must be replaced if the pintle separates from the motor.

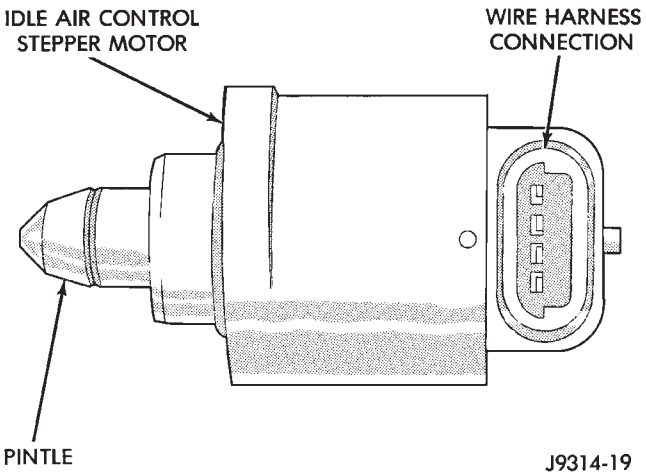


Fig. 43 Idle Air Control (IAC) Motor Pintle

(7) With the ignition OFF, cycle the exerciser tool switch between the HIGH and LOW positions. Observe the pintle. The pintle should move in-and-out of the motor.

(a) If the pintle does not move, replace the idle air control motor. Start the engine and test the replacement motor operation as described in step (5).

(b) If the pintle operates properly, check the idle air control motor bore in the throttle body bore for blockage and clean as necessary. Reinstall the idle air control motor and retest. If blockage is not

found, refer to the DRB scan tool and the appropriate Powertrain Diagnostics Procedures service manual.

RELAYS—OPERATION/TESTING

OPERATION

The following operations/tests apply to these relays only: automatic shut down (ASD), fuel pump and torque converter clutch. For operations/tests on all other relays, refer to the appropriate section of this service manual.

The relay terminal numbers from (Fig. 44) can be found on the bottom of the relay:

- Terminal number 30 is connected to battery voltage and can be switched or B+ (hot) at all times.
- Terminal number 87A is connected (a circuit is formed) to terminal 30 in the de-energized (normally OFF) position.
- Terminal number 87 is connected (a circuit is formed) to terminal 30 in the energized (ON) position. Terminal number 87 then supplies battery voltage to the component being operated.
- Terminal number 86 is connected to a switched (+) power source.
- Terminal number 85 is grounded by the powertrain control module (PCM).

TESTING

(1) Remove relay before testing.

(2) Using an ohmmeter, perform a resistance test between terminals 85 and 86. Resistance value (ohms) should be 75 ±5 ohms for resistor equipped relays.

(3) Connect the ohmmeter between terminals number 87A and 30. Continuity should be present at this time.

(4) Connect the ohmmeter between terminals number 87 and 30. Continuity should not be present at this time.

(5) Use a set of jumper wires (16 gauge or smaller). Connect one jumper wire between terminal number 85 (on the relay) to the ground side (-) of a 12 Volt power source.

(6) Attach the other jumper wire to the positive side (+) of a 12V power source. Do not connect the jumper wire to relay at this time.

CAUTION: DO NOT ALLOW THE OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THESE TESTS. DAMAGE TO OHMMETER MAY RESULT.

(7) Attach the other jumper wire (12V +) to terminal number 86. This will activate the relay. Continuity should now be present between terminals number

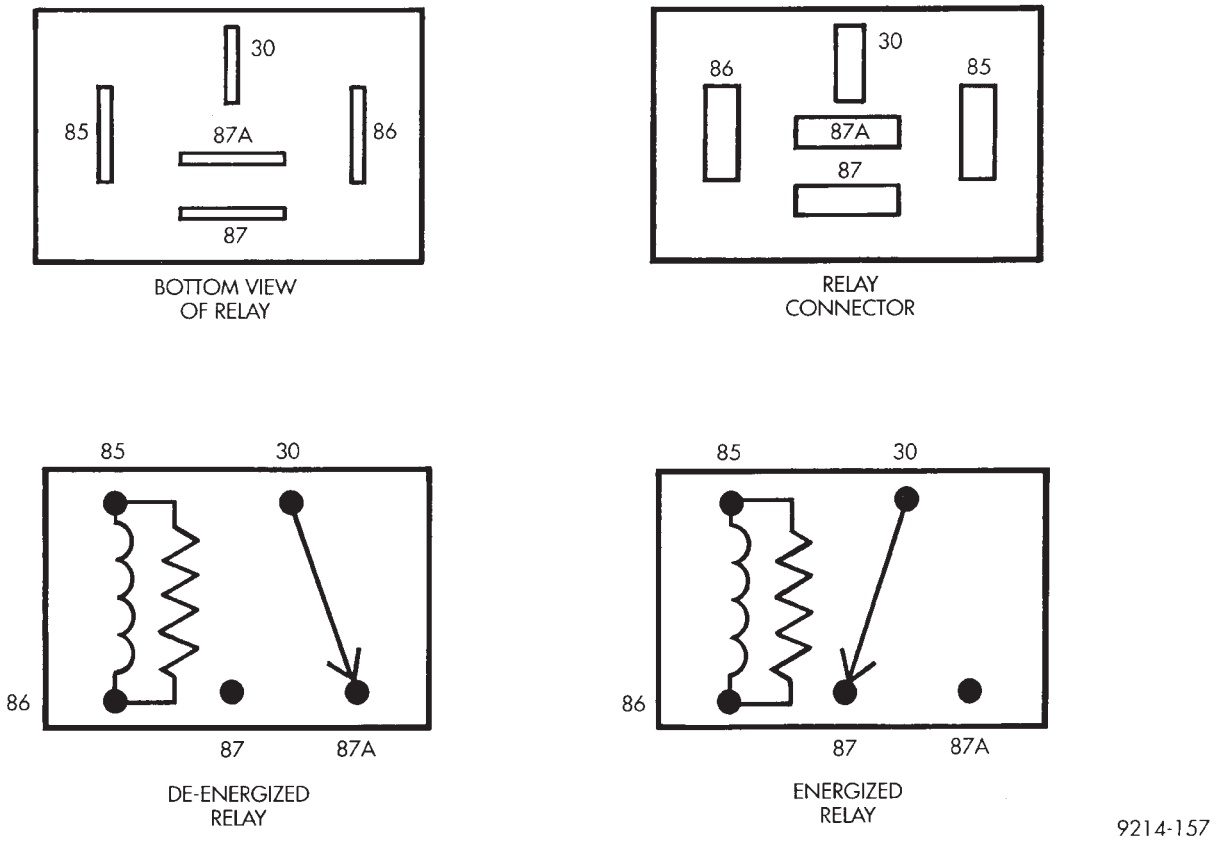


Fig. 44 Relay Terminals

87 and 30. Continuity should not be present between terminals number 87A and 30.

(8) Disconnect jumper wires from relay and 12 Volt power source.

If continuity or resistance tests did not pass, replace relay. If tests passed, refer to Group 8W, Wiring Diagrams for additional circuit information. Also refer to the appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool.

STARTER MOTOR RELAY TEST

Refer to Group 8A, Battery/Starting/Charging/System Diagnostics, for starter motor relay testing.

INJECTOR TEST

Disconnect the injector wire connector from the injector. Place an ohmmeter on the injector terminals. Resistance reading should be approximately 14.5 ohms ±1.2 ohms at 20°C (68°F). Proceed to following Injector Diagnosis chart.

FUEL SYSTEM PRESSURE TEST

Refer to the Fuel Delivery System section of this group. See Fuel System Pressure Test.

ON-BOARD DIAGNOSTICS (OBD)

The Powertrain Control Module (PCM) has been programmed to monitor many different circuits of the fuel injection system. If a problem is sensed in a monitored circuit often enough to indicate an actual problem, a Diagnostic Trouble Code (DTC) is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. If the problem is repaired or ceases to exist, the PCM cancels the DTC after 51 engine starts.

Certain criteria must be met for a diagnostic trouble code (DTC) to be entered into PCM memory. The criteria may be a specific range of engine rpm, engine temperature and/or input voltage to the PCM.

It is possible that a DTC for a monitored circuit may not be entered into memory even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. Example: assume that one of the criteria for the MAP sensor circuit is that the engine must be operating between 750 and 2000 rpm to be monitored for a DTC. If the MAP sensor output circuit shorts to ground when the engine rpm is above 2400 rpm, a 0 volt input will be seen by the PCM. A DTC will not be entered into memory because the condition does not occur within the specified rpm range.

A DTC indicates that the powertrain control module (PCM) has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

There are several operating conditions that the PCM does not monitor and set a DTC for. Refer to the following Monitored Circuits and Non-Monitored Circuits in this section.

MONITORED CIRCUITS

The powertrain control module (PCM) can detect certain problems in the fuel injection system.

Open or Shorted Circuit - The PCM can determine if sensor output (which is the input to PCM) is within proper range. It also determines if the circuit is open or shorted.

Output Device Current Flow - The PCM senses whether the output devices are hooked up.

If there is a problem with the circuit, the PCM senses whether the circuit is open, shorted to ground (-), or shorted to (+) voltage.

Oxygen Sensor - The PCM can determine if the oxygen sensor is switching between rich and lean. This is, once the system has entered Closed Loop. Refer to Open Loop/Closed Loop Modes Of Operation in the Component Description/System Operation section for an explanation of Closed (or Open) Loop operation.

NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems or conditions that could have malfunctions that result in driveability problems. A Diagnostic Trouble Code (DTC) may not be displayed for these conditions.

Fuel Pressure: Fuel pressure is controlled by the vacuum assisted fuel pressure regulator. 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 an oxygen sensor DTC to be stored in the PCM.

Secondary Ignition Circuit: The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open circuited spark plug cables.

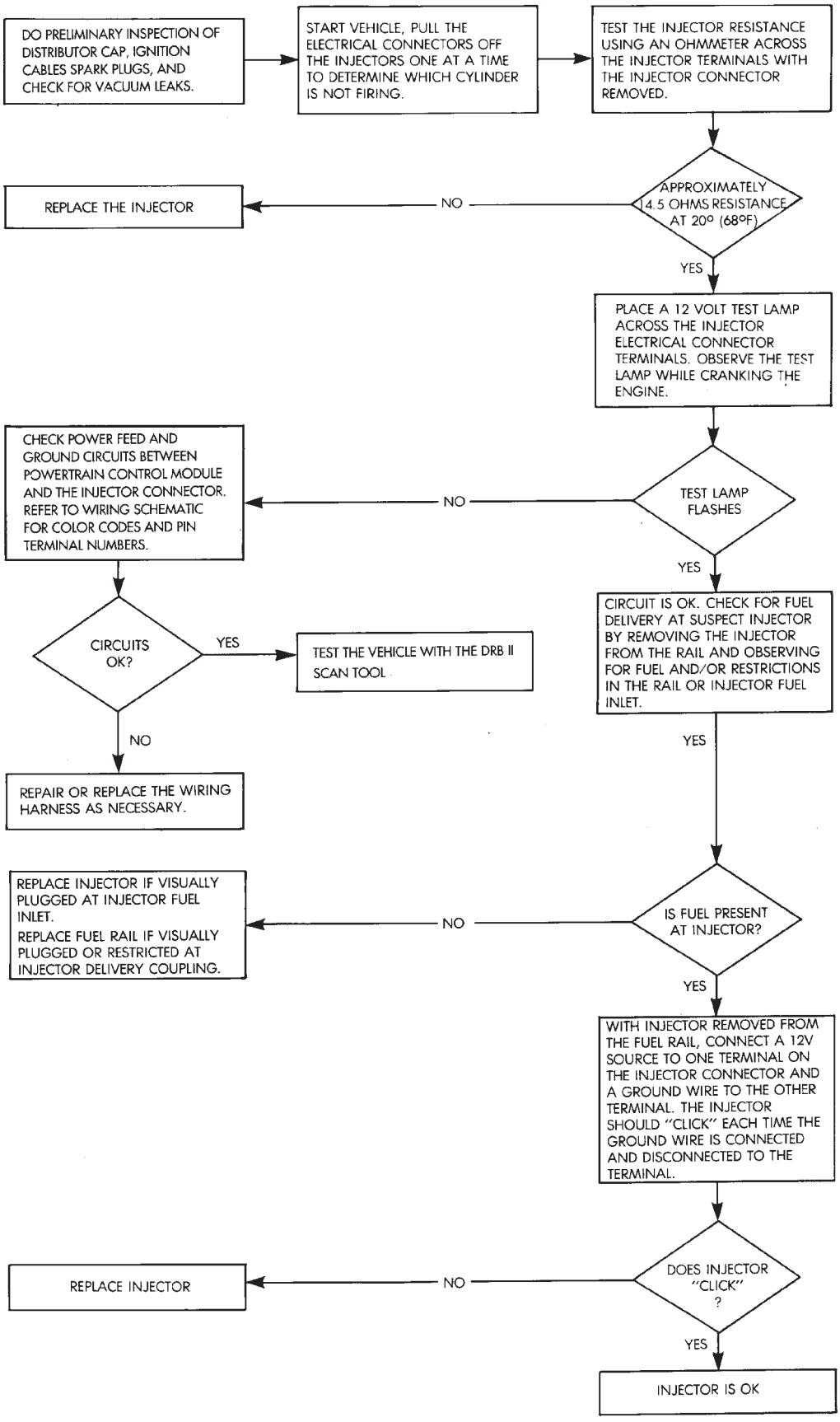
Engine Timing: The PCM cannot detect an incorrectly indexed timing chain, camshaft sprocket or crankshaft sprocket. The PCM also cannot detect an incorrectly indexed distributor. However, these could result in a rich or lean condition causing an oxygen sensor DTC to be stored in the PCM.

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.

Fuel Injector Malfunctions: The PCM cannot determine if the fuel injector is clogged, or the wrong injector is installed. However, these could result in a rich or lean condition causing an oxygen sensor DTC to be stored in the PCM.

INJECTOR DIAGNOSIS—VEHICLE RUNS ROUGH AND/OR HAS A MISS



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Excessive Oil Consumption: Although the PCM monitors exhaust stream oxygen content through oxygen sensor (closed loop), it cannot determine excessive oil consumption.

Throttle Body Air Flow: The PCM cannot detect a clogged or restricted air cleaner inlet or air filter element.

Evaporative System: The PCM will not detect a restricted, plugged or loaded EVAP canister.

Vacuum Assist: Leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices are not monitored by the PCM. However, a vacuum leak at the MAP sensor will be monitored and a diagnostic trouble code (DTC) will be generated by the PCM.

Powertrain Control Module (PCM) System Ground: The PCM cannot determine a poor system ground. However, a DTC may be generated as a result of this condition.

Powertrain Control Module (PCM) Connector Engagement: The PCM cannot determine spread or damaged connector pins. However, a DTC may be generated as a result of this condition.

HIGH AND LOW LIMITS

The powertrain control module (PCM) compares input signal voltages from each input device. It will establish high and low limits that are programmed into it for that device. If the input voltage is not within specifications and other Diagnostic Trouble Code (DTC) criteria are met, a DTC will be stored in memory. Other DTC criteria might include engine rpm limits or input voltages from other sensors or switches. The other inputs might have to be sensed by the PCM when it senses a high or low input voltage from the control system device in question.

ACCESSING DIAGNOSTIC TROUBLE CODES

A stored Diagnostic Trouble Code (DTC) can be displayed by cycling the ignition key On-Off-On-Off-On within three seconds and observing the Malfunction Indicator Lamp. This lamp was formerly referred to as the Check Engine Lamp. The lamp is located on the instrument panel.

They can also be displayed through the use of the Diagnostic Readout Box (DRB) scan tool. The DRB scan tool connects to the data link connector in the engine compartment (Figs. 45 or 46). For operation of the DRB, refer to the appropriate Powertrain Diagnostic Procedures service manual.

EXAMPLES:

- If the lamp flashes 4 times, pauses and flashes 1 more time, a flashing Diagnostic Trouble Code (DTC) number 41 is indicated.
- If the lamp flashes 4 times, pauses and flashes 6 more times, a flashing Diagnostic Trouble Code (DTC) number 46 is indicated.

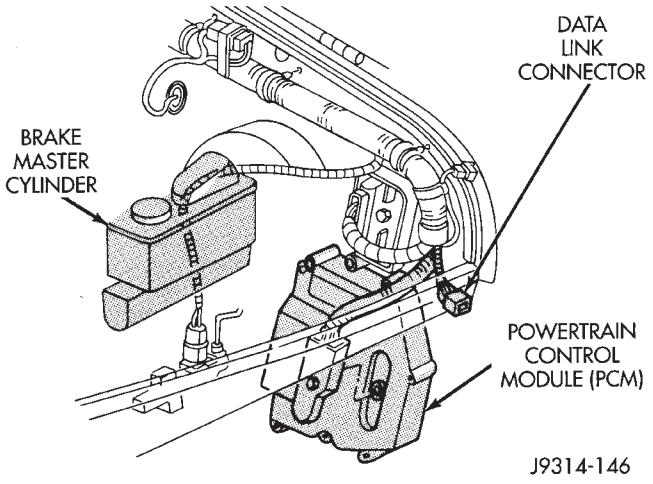

Fig. 45 Data Link Connector—YJ Models—Typical

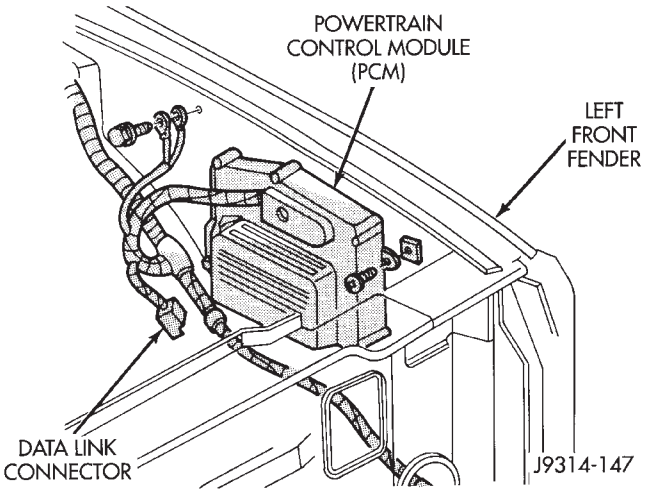

Fig. 46 Data Link Connector—XJ Models—Typical

After any stored DTC information has been observed, the display will end with a flashing DTC number 55. This will indicate the end of all stored information.

Refer to the Diagnostic Trouble Code (DTC) charts for DTC identification.

If the problem is repaired or ceases to exist, the Powertrain Control Module (PCM) cancels the DTC after 51 engine starts.

Diagnostic Trouble Codes indicate the results of a failure, but never identify the failed component directly.

The circuits of the data link connector are shown in (Fig. 47).

ERASING TROUBLE CODES

After the problem has been repaired, use the DRB scan tool to erase a Diagnostic Trouble Code (DTC). Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

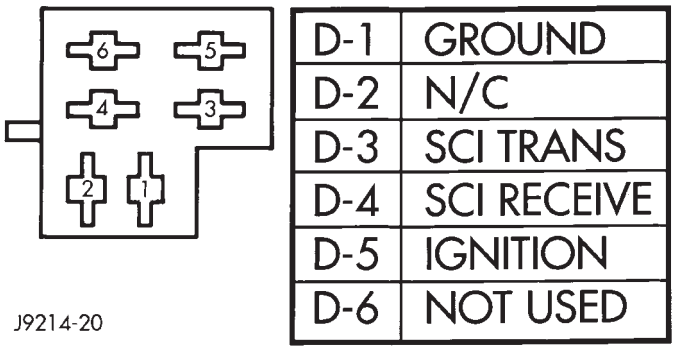

Fig. 47 Data Link Connector Schematic

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

DIAGNOSTIC TROUBLE CODE (DTC)

On the following pages, a list of diagnostic trouble codes is provided for the 2.5L 4 cylinder and 4.0L 6 cylinder engines. A DTC indicates that the powertrain control module (PCM) has recognized an abnormal signal in a circuit or the system. A DTC may indicate the result of a failure, but never identify the failed component directly.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
11*	No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
12*	Battery Disconnect	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
13**	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading at start-up.
14**	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
	or	
	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
15**	No Vehicle Speed Sensor Signal	No vehicle distance (speed) sensor signal detected during road load conditions.
17*	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	O2S Stays at Center	Neither rich or lean condition detected from the oxygen sensor input.
	or	
	O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range.
22**	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
	or	
	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
23**	Intake Air Temp Sensor Voltage Low	Intake air temperature sensor input below the minimum acceptable voltage.
	or	
	Intake Air Temp Sensor Voltage High	Intake air temperature sensor input above the maximum acceptable voltage.
24**	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
	or	
	Throttle Position Sensor Voltage Low	Throttle position sensor input below the minimum acceptable voltage.
25**	Idle Air Control Motor Circuits	A shorted condition detected in one or more of the idle air control motor circuits.
27*	Injector #1 Control Circuit	Injector #1 output driver does not respond properly to the control signal.
	or	
	Injector #2 Control Circuit	Injector #2 output driver does not respond properly to the control signal.
	or	
	Injector #3 Control Circuit	Injector #3 output driver does not respond properly to the control signal.
	or	
	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
	or	
	Injector #5 Control Circuit	Injector #5 output driver does not respond properly to the control signal.
	or	
	Injector #6 Control Circuit	Injector #6 output driver does not respond properly to the control signal.
33*	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
34*	Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
	or	
	Speed Control Switch Always Low	Speed Control switch input below the minimum acceptable voltage.
	or	
	Speed Control Switch Always High	Speed Control switch input above the maximum acceptable voltage.
35* (XJ Only)	Rad Fan Control Relay Circuits	An open or shorted condition detected in the radiator fan relay circuit.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
41**	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
42*	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
44*	Battery Temp Sensor Volts out of Limit	An open or shorted condition exists in the engine coolant temperature sensor circuit or a problem exists in the PCM's battery temperature voltage circuit.
46**	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
47**	Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output.
51**	O2S Signal Stays Below Center (Lean)	Oxygen sensor signal input indicates lean air/fuel ratio condition during engine operation.
52**	O2S Signal Stays Above Center (Rich)	Oxygen sensor signal input indicates rich air/fuel ratio condition during engine operation.
53*	Internal PCM Failure	PCM Internal fault condition detected.
	or	
	PCM Failure SPI Communications	PCM Internal fault condition detected.
54*	No Cam Sync Signal at PCM	No fuel sync (camshaft signal) detected during engine cranking.
55*	N/A	Completion of diagnostic trouble code display on the Malfunction Indicator Lamp (Check Engine Lamp).
62*	PCM Failure SPI miles not stored	Unsuccessful attempt to update SPI miles in the PCM EEPROM.
63*	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

MULTI-PORT FUEL INJECTION (MFI)—COMPONENT REMOVAL/INSTALLATION

INDEX

ACCELERATOR PEDAL AND THROTTLE CABLE

Refer to the Accelerator Pedal and Throttle Cable section of this group for removal/installation procedures.

AIR CONDITIONING (A/C) CLUTCH RELAY

The A/C clutch relay is located in the Power Distribution Center (PDC) (Figs. 1 or 2). For location of this relay within the PDC, refer to label on PDC cover.

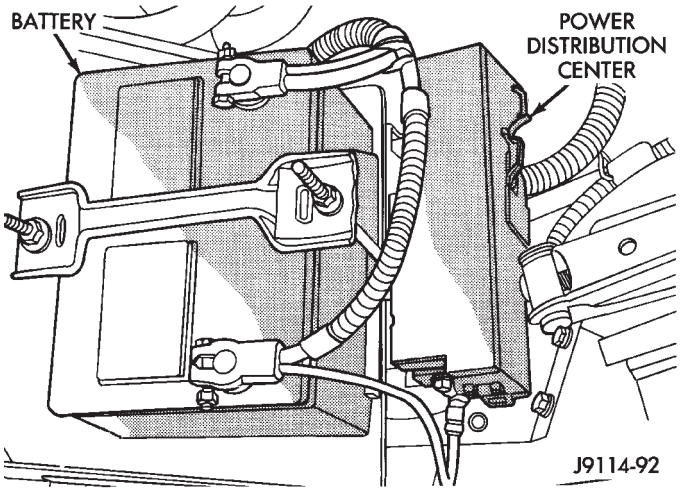

Fig. 1 PDC—YJ Models

AIR CLEANER HOUSING

Refer to Group 25, Emission Control System.

AIR FILTER

Refer to Group 25, Emission Control System.

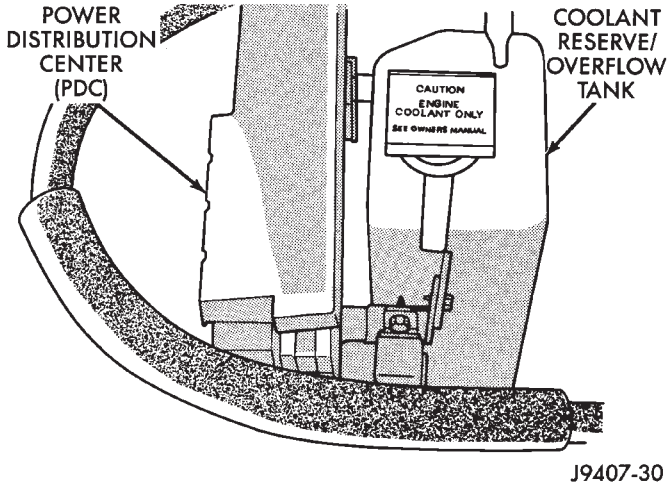

Fig. 2 PDC—XJ Models

AUTOMATIC SHUT DOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (Figs. 1 or 2) (PDC). For location of this relay within the PDC, refer to label on PDC cover.

BRAKE SWITCH

Refer to Group 5, Brakes for removal/installation procedures.

CAMSHAFT POSITION SENSOR

For removal/installation procedures, refer to Group 8D, Ignition System. See Camshaft Position Sensor.

INTAKE AIR TEMPERATURE SENSOR

The intake manifold air temperature sensor is installed into the intake manifold plenum (Figs. 3 or 4).

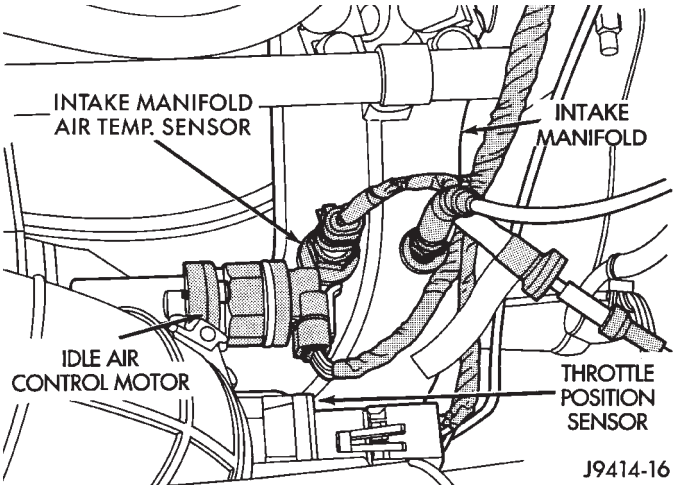

Fig. 3 Sensor Location—2.5L Engine

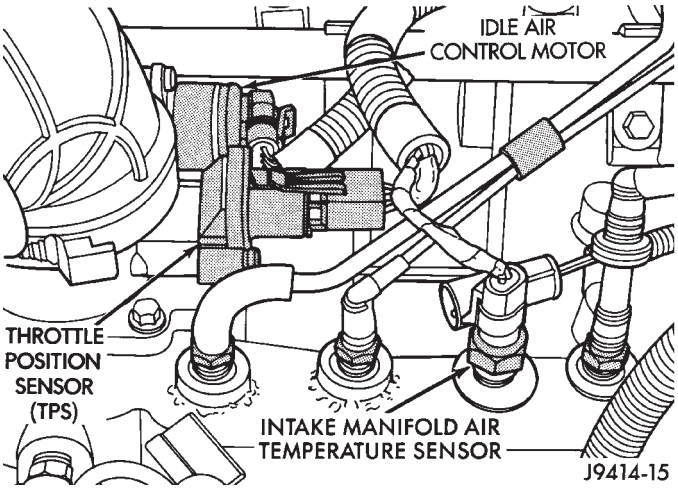

Fig. 4 Sensor Location—4.0L Engine

REMOVAL

(1) Disconnect the electrical connector from the sensor.

(2) Remove the sensor from the intake manifold.

INSTALLATION

(1) Install the sensor into the intake manifold. Tighten the sensor to 28 N·m (20 ft. lbs.) torque.

(2) Connect the electrical connector to the sensor.

CRANKSHAFT POSITION SENSOR

For description, operation and removal/installation procedures, refer to Group 8D, Ignition Systems in this manual.

ENGINE COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is installed in the thermostat housing (Fig. 5).

REMOVAL

(1) Drain cooling system until the coolant level is below the cylinder head. Observe the **WARNINGS** in Group 7, Cooling.

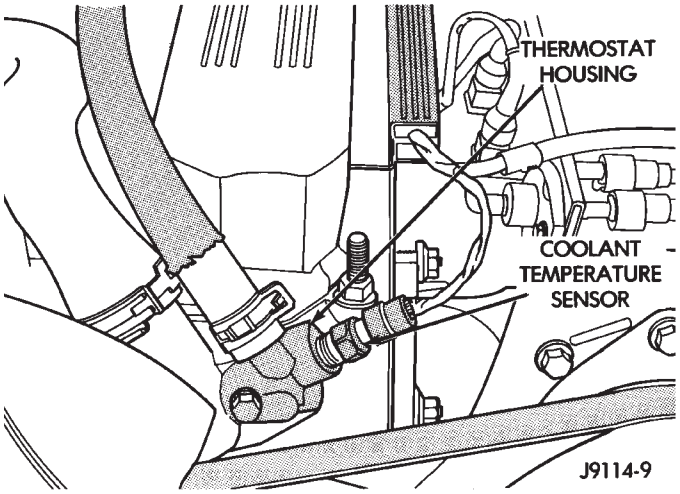

Fig. 5 Engine Coolant Temperature Sensor—Typical

(2) Disconnect the coolant temperature sensor wire connector.

(3) Remove the sensor from the thermostat housing (Fig. 5).

INSTALLATION

(1) Install coolant temperature sensor into the cylinder block. Tighten to 28 N·m (21 ft. lbs.) torque.

(2) Connect the wire connector.

(3) Fill the cooling system. Refer to Group 7, Cooling System.

FUEL FILTER

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

FUEL INJECTOR

REMOVAL

(1) Remove the fuel rail. Refer to Fuel Rail Removal in this section.

(2) Remove the clip(s) that retain the fuel injector(s) to the fuel rail (Fig. 6).

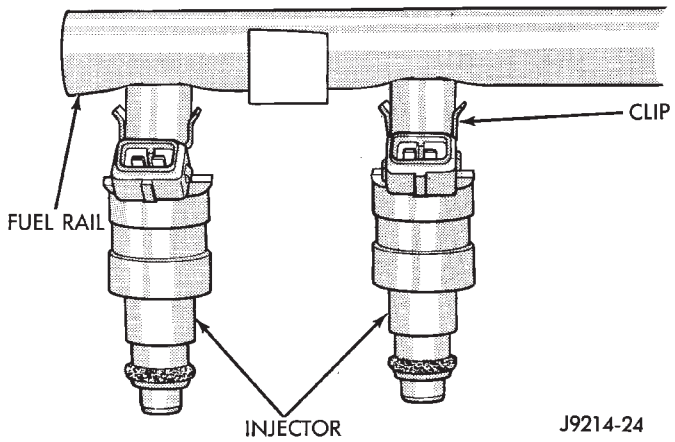

Fig. 6 Injector Retaining Clips

INSTALLATION

(1) Install the fuel injector(s) into the fuel rail assembly and install retaining clip(s).

(2) Install fuel rail. Refer to Fuel Rail Installation in this section.

(3) Start engine and check for fuel leaks.

FUEL PUMP MODULE

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

FUEL PUMP RELAY

The Fuel Pump relay is located in the Power Distribution Center (PDC) (Figs. 1 or 2). For location of this relay within the PDC, refer to label on PDC cover.

FUEL RAIL ASSEMBLY

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 131-269 KPA (19-39 PSI). THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL RAIL.

(1) Remove fuel tank filler tube cap.

(2) Disconnect the negative battery cable from battery.

(3) Perform the Fuel System Pressure Release Procedure as described in the Fuel Delivery System section of this Group.

(4) Remove and numerically attach a tag (if fuel injector is not already tagged), the injector harness connectors. Do this at each injector (Fig. 7).

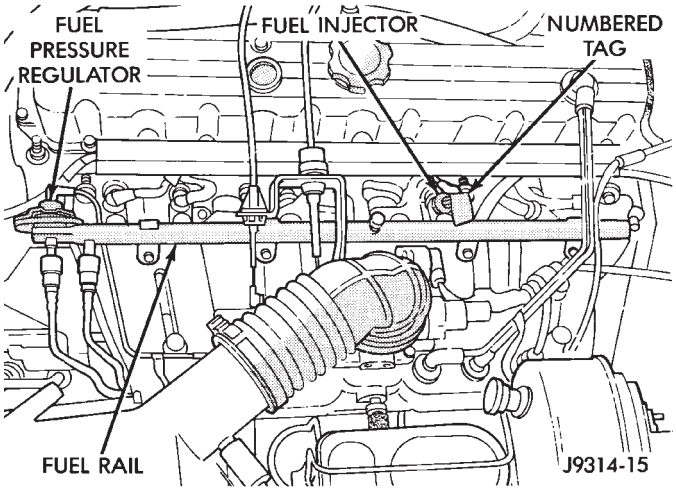

Fig. 7 Fuel Injector Harness—Typical

(5) Disconnect vacuum line from fuel pressure regulator (Fig. 7).

(6) Disconnect fuel supply line from fuel rail and the fuel return line from fuel pressure regulator (Fig. 7). Refer to Fuel Tubes/Lines/Hoses and Clamps, or Quick-Connect Fittings. These can both be found in the Fuel Delivery section of this group.

(7) Remove fuel rail mounting bolts.

On models with automatic transmissions, it may be necessary to remove automatic transmission throttle line pressure cable (and bracket). This will aid in fuel rail assembly removal.

(8) Remove fuel rail by gently rocking until all the fuel injectors are out of the intake manifold.

INSTALLATION

(1) Position tips of all fuel injectors into the corresponding injector bore in the intake manifold. Seat injectors into manifold.

(2) Tighten fuel rail mounting bolts to 27 N·m (20 ft. lbs.) torque.

(3) Connect injector harness connectors to appropriate (tagged) injector.

(4) Connect both fuel lines to fuel rail.

(5) Connect vacuum supply line to fuel pressure regulator.

(6) Install protective cap to pressure test port fitting.

(7) Install fuel tank cap.

(8) Connect negative battery cable to battery.

(9) Start engine and check for fuel leaks.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF) OF APPROXIMATELY 100 KPA (14.5 PSI). BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER OR FUEL INJECTOR, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

Refer to the Fuel Delivery System section of this group. See Fuel Pressure Release procedure.

FUEL TANKS

Refer to the Fuel Tank section of this group for removal/installation procedures.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE

Refer to the Fuel Tank section of this group for removal/installation procedures.

FUEL TUBES/LINES/HOSES AND CLAMPS

Refer to the Fuel Delivery System section of this group for removal/installation procedures. Also refer to Quick-Connect Fittings in the Fuel Delivery section of this group.

IDLE AIR CONTROL (IAC) MOTOR

The IAC motor is mounted to the throttle body adjacent to the throttle position sensor (Fig. 8).

REMOVAL

(1) Disconnect the electrical connector from the IAC motor.

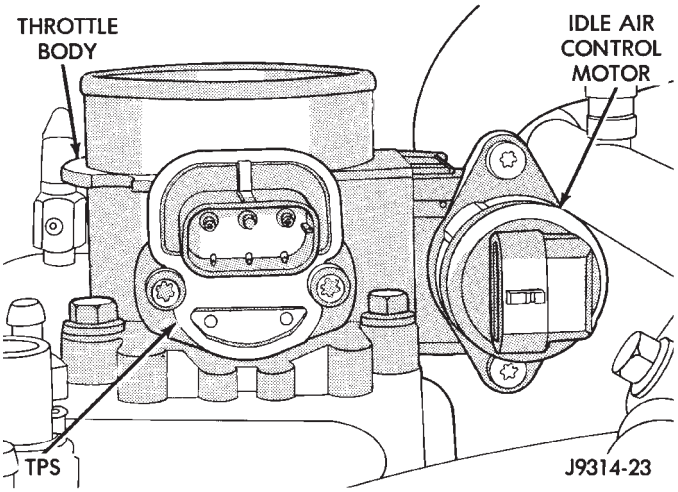

Fig. 8 Idle Air Control Motor—Removal/Installation—Typical

(2) Remove IAC motor torx head mounting bolts.
(3) Remove IAC motor.

INSTALLATION

(1) Install IAC motor into throttle body and tighten retaining bolts.
(2) Connect electrical connector to IAC motor.

IGNITION COIL

Refer to Group 8D, Ignition Systems for removal/installation procedures.

INTAKE MANIFOLD

Refer to Group 11, Exhaust System and Intake Manifold for removal/installation procedures.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor is located on the dash panel near the rear of the engine cylinder head (valve) cover (Fig. 9).

REMOVAL

(1) Disconnect the MAP sensor electrical connector (Fig. 9).
(2) Disconnect the MAP sensor vacuum supply hose (Fig. 9).
(3) Remove the MAP sensor mounting bolts and remove MAP sensor.

INSTALLATION

(1) Install MAP sensor to dash panel and secure with mounting bolts.
(2) Install the MAP sensor vacuum supply hose.
(3) Connect the MAP sensor electrical connector.

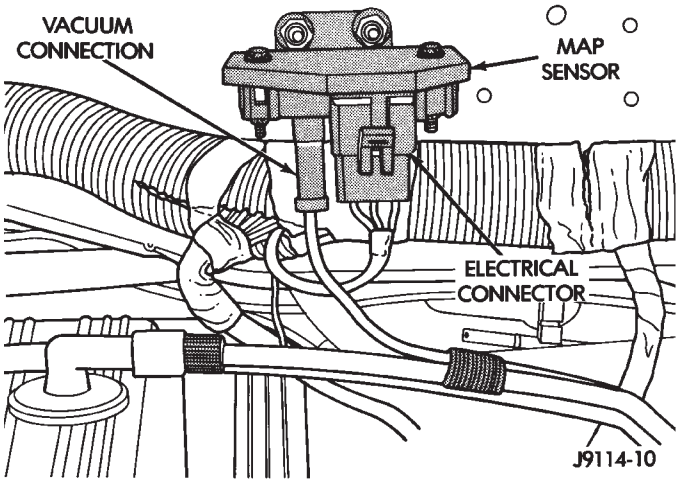

Fig. 9 MAP Sensor—Typical

OXYGEN (O2S) SENSOR

The O2S sensor is installed in the exhaust down pipe just below the exhaust manifold flange (Fig. 10).

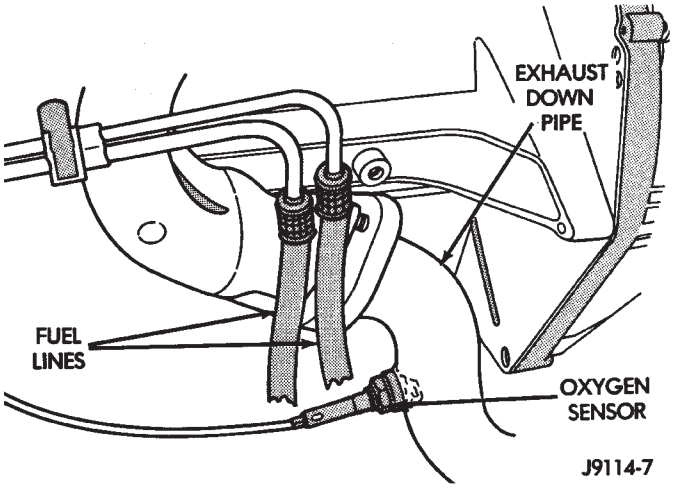

Fig. 10 Oxygen Sensor—Typical

REMOVAL

WARNING: THE EXHAUST MANIFOLD BECOMES VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support the vehicle.
(2) Separate the electrical connectors.
(3) Remove the O2S sensor from the exhaust manifold. Snap-On oxygen sensor wrench (number YA 8875) may be used for removal and installation.

INSTALLATION

Threads of new factory oxygen sensors are coated with anti-seize compound to aid in removal.

(1) Install the O2S sensor into the exhaust manifold and tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect the O2S sensor wire connector to the main harness.

(3) Lower the vehicle.

PARK NEUTRAL SWITCH

Refer to Group 21, Transmissions for park neutral switch service.

POWER STEERING PRESSURE SWITCH—2.5L ENGINE ONLY

The power steering pressure switch is installed in the power steering high pressure hose (Figs. 11 or 12).

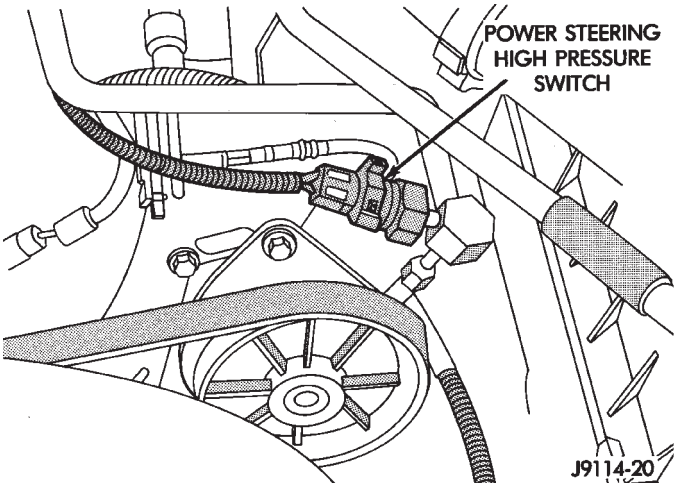

Fig. 11 Power Steering Pressure Switch—YJ Models

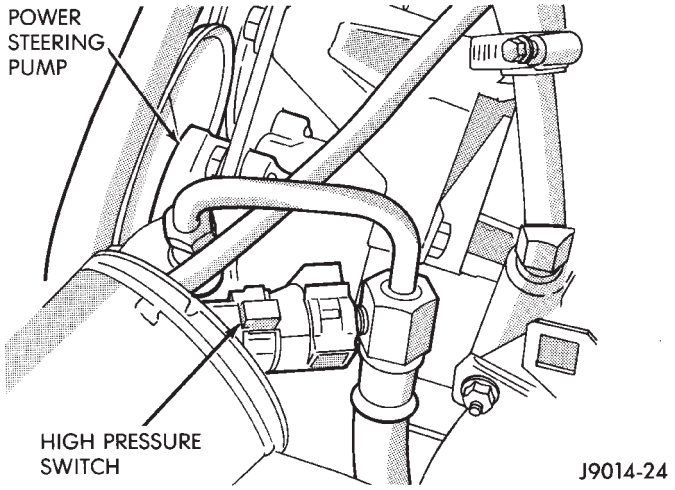

Fig. 12 Power Steering Pressure Switch—XJ Models

REMOVAL

(1) Disconnect the electrical connector from the power steering pressure switch.

(2) Place a small container or shop towel beneath the switch to collect any excess fluid.

(3) Remove the switch.

INSTALLATION

(1) Install the power steering switch.

(2) Connect the electrical connector to the switch.

(3) Check power steering fluid and add as necessary.

(4) Start the engine and again check power steering fluid. Add fluid if necessary.

POWERTRAIN CONTROL MODULE (PCM)

On XJ models, the PCM is located in the engine compartment next to the air cleaner (Fig. 13). On YJ models, the PCM is located in the engine compartment behind the windshield washer fluid reservoir (Fig. 14).

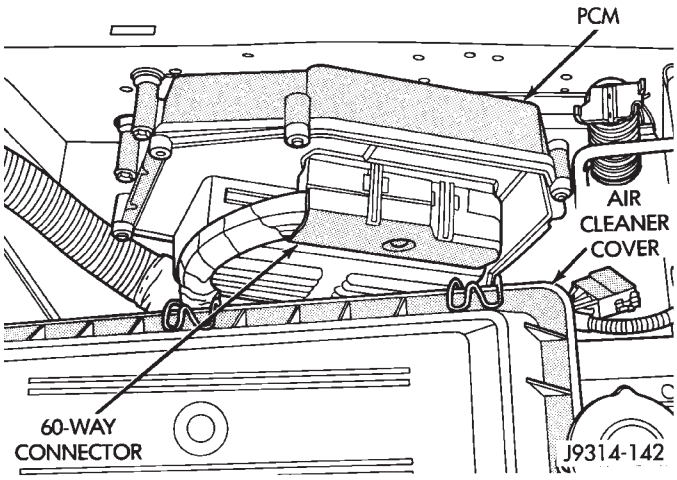

Fig. 13 PCM Location—XJ Models

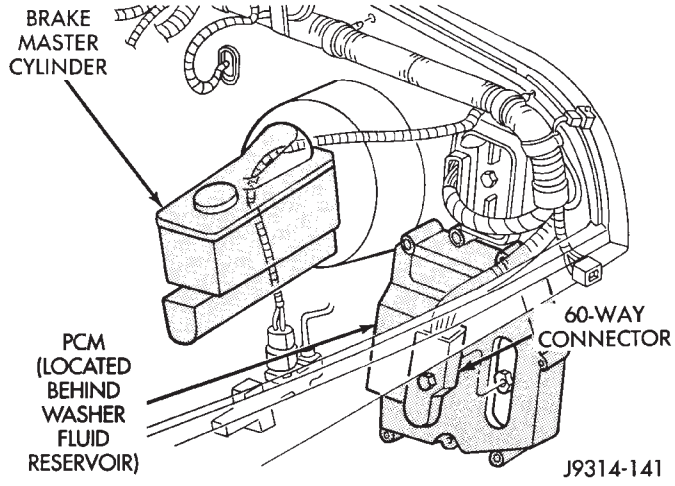

Fig. 14 PCM Location—YJ Models

REMOVAL

(1) Disconnect the negative battery cable at the battery.

(2) YJ Models Only: Remove the windshield washer fluid tank.

(3) Loosen the 60-Way connector mounting bolt (Figs. 13 or 14).

(4) Remove the electrical connector by pulling straight back.

(5) Remove the three PCM mounting bolts.

(6) Remove PCM.

INSTALLATION

(1) After the PCM electrical connector has been separated from the PCM, inspect the pins for corrosion, being spread apart, bent or misaligned. Also inspect the pin heights in the connector. If the pin heights are different, this would indicate a pin has separated from the connector. Repair as necessary.

(2) Install PCM. Tighten three mounting bolts to 1 N·m (9 in. lbs.) torque.

(3) Engage 60-way connector into PCM. Tighten connector mounting bolt to 4 N·m (35 in. lbs.) torque.

(4) YJ Models: Install windshield washer fluid tank.

(5) Connect negative cable to battery.

QUICK-CONNECT FITTINGS

Refer to the Fuel Delivery System section of this group for removal/installation procedures.

THROTTLE BODY

REMOVAL

(1) Disconnect the negative battery cable.

(2) Disconnect air cleaner hose from throttle body.

(3) Disconnect idle air control motor and throttle position sensor wire connectors.

(4) Disconnect accelerator cable, throttle cable (automatic transmission) and speed control cable (if equipped) from throttle arm (Fig. 15).

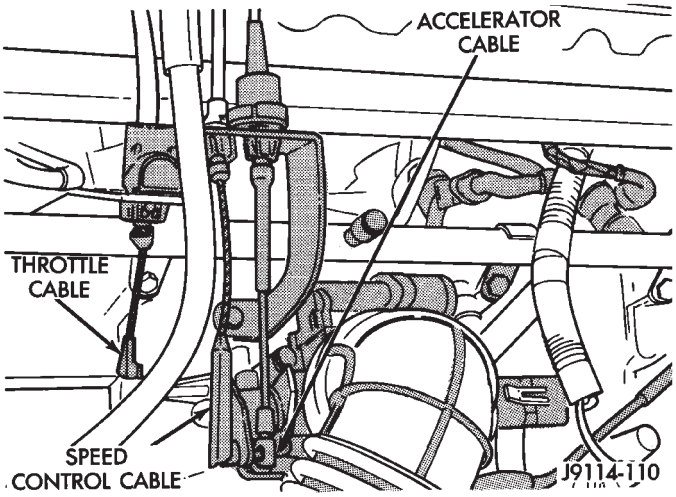

Fig. 15 Cables at Throttle Body

(5) Remove throttle body mounting bolts, throttle body and gasket. Discard old gasket (Fig. 16).

INSTALLATION

(1) Install throttle body and new gasket. Tighten throttle body mounting bolts to 12 N·m (9 ft. lbs.) torque.

(2) Connect idle air control motor and throttle position sensor wire connectors.

(3) Connect throttle linkage to throttle arm.

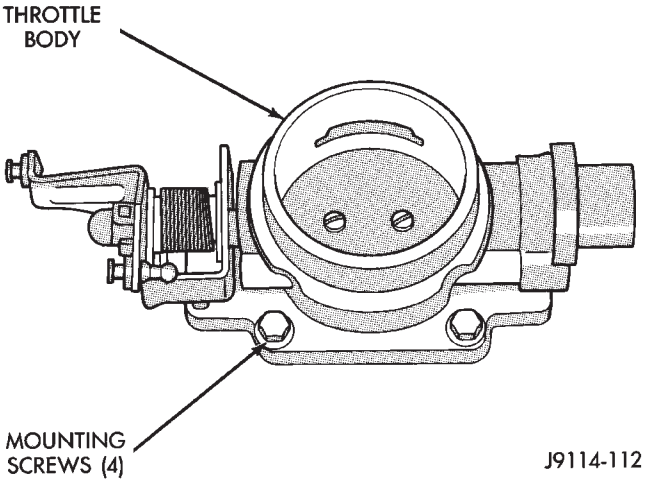

Fig. 16 Throttle Body—Removal/Installation—Typical

CAUTION: When the automatic transmission throttle cable is connected, it MUST be adjusted.

(4) If equipped with an automatic transmission, connect and adjust the transmission line pressure cable. Refer to Group 21, Transmissions for adjustment procedure.

(5) Install air cleaner hose to throttle body.

(6) Connect negative battery cable to battery.

THROTTLE POSITION SENSOR (TPS)

The TPS is mounted to the throttle body (Figs. 17 or 18).

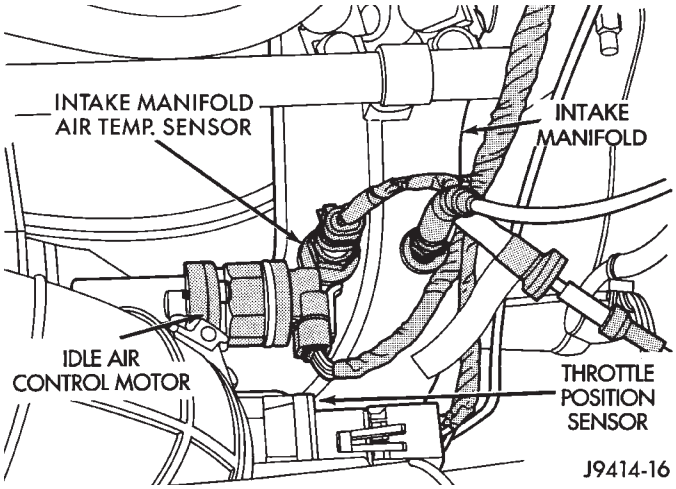

Fig. 17 TPS Location—2.5L Engine

REMOVAL

(1) Disconnect TPS electrical connector.

(2) Remove TPS mounting bolts.

(3) Remove TPS.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 19). The TPS must be installed so that it can be rotated a few degrees. (If

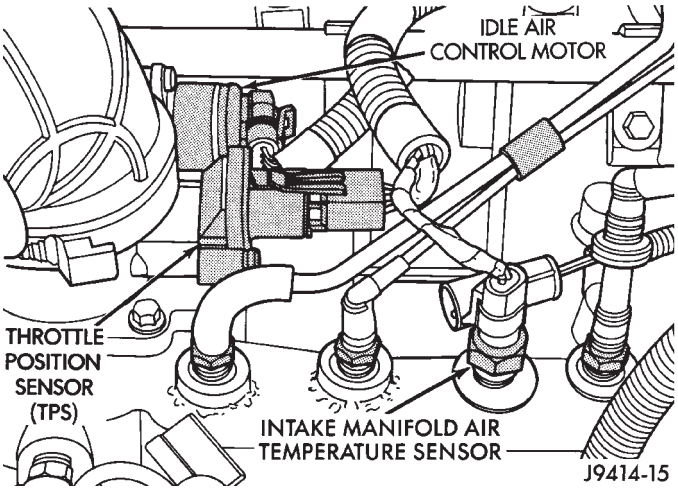

Fig. 18 TPS Location—4.0L Engine

the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

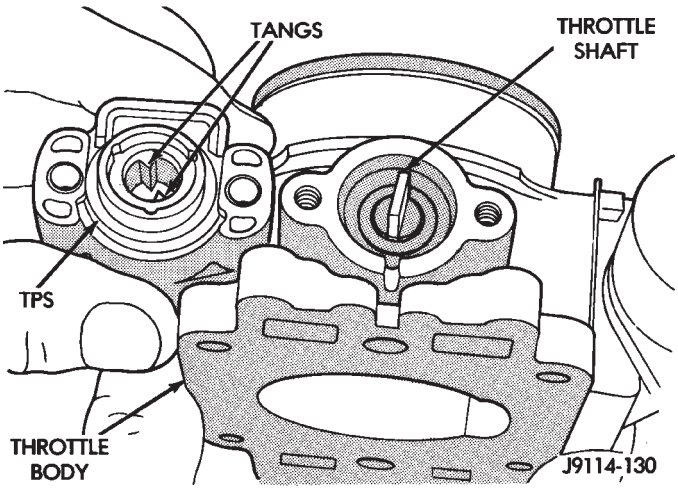

Fig. 19 Throttle Position Sensor—Installation

(1) Install the TPS and retaining bolts.

(2) Connect TPS electrical connector to TPS.

(3) Manually operate the throttle (by hand) to check for any TPS binding before starting the engine.

TORQUE CONVERTER CLUTCH RELAY

On YJ models, the TCC relay is located in the engine compartment. It is attached to the cowl panel with one bolt (Fig. 20). On XJ models, the TCC relay is located in the power distribution center (PDC) (Fig. 21). For location of this relay within the PDC, refer to label on PDC cover.

VEHICLE SPEED SENSOR

The vehicle speed sensor (Fig. 22) is located on the extension housing of the transmission on 2WD models. It is located on the transfer case on 4WD models.

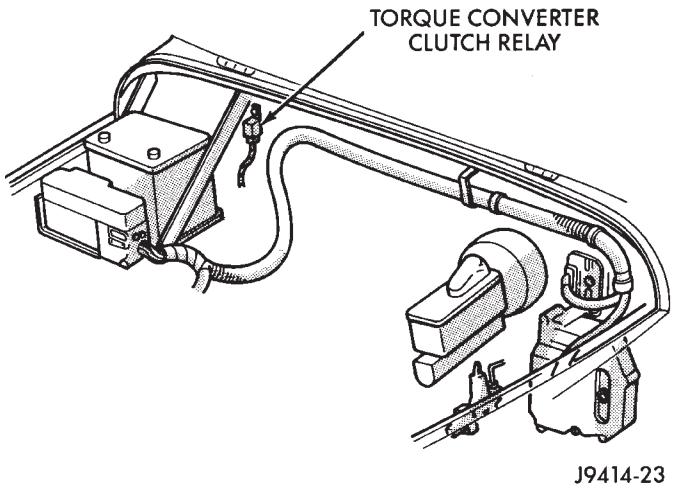

Fig. 20 TCC Relay Location—YJ Models

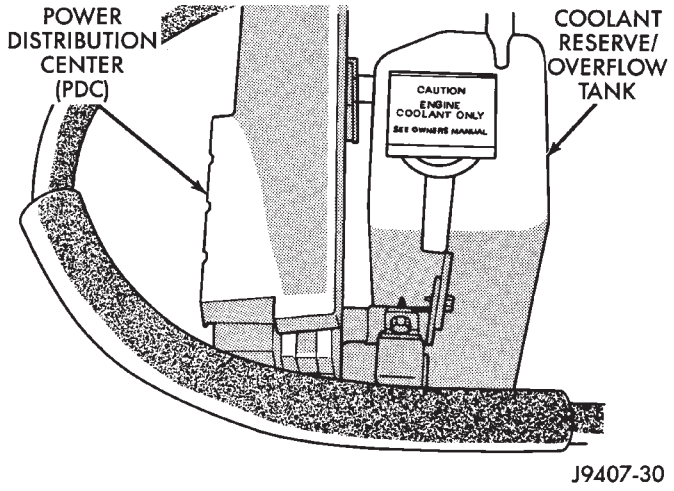

Fig. 21 Power Distribution Center—XJ Models

REMOVAL

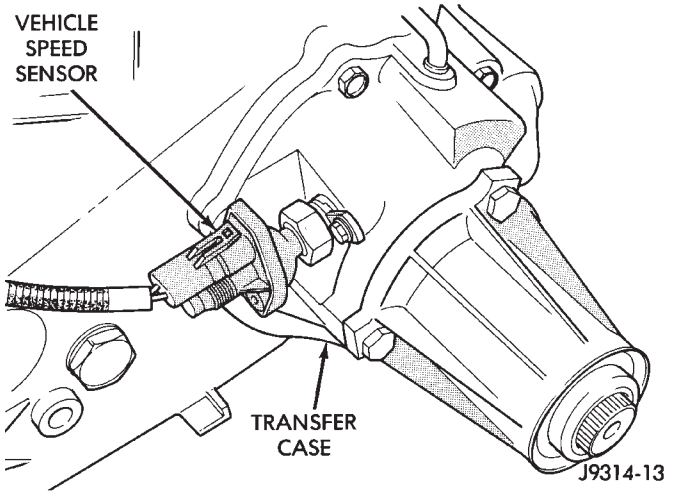

Fig. 22 Vehicle Speed Sensor Location—Typical

(1) Raise and support vehicle.

(2) Disconnect the electrical connector from the sensor.

(3) Remove the sensor mounting bolt (Fig. 23).

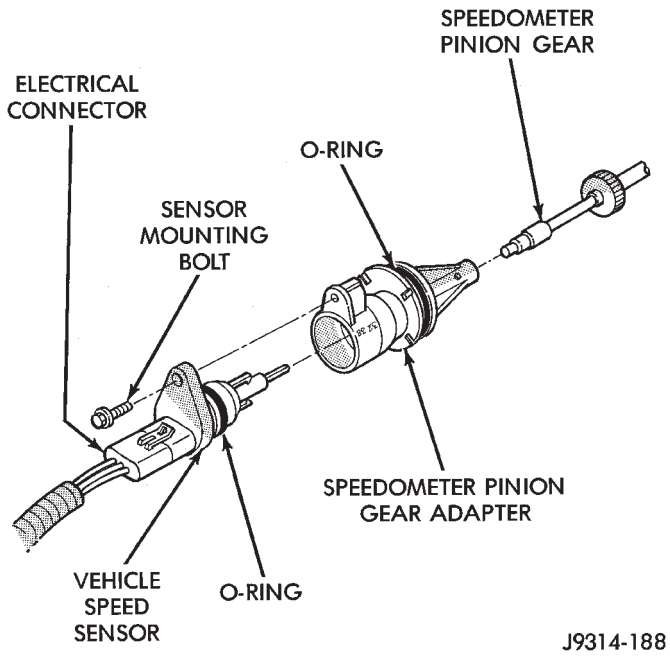

Fig. 23 Sensor Removal/Installation—Typical

(4) Remove the sensor (pull straight out) from the speedometer pinion gear adapter (Fig. 23). Do not remove the gear adapter from the transmission.

INSTALLATION

(1) Clean the inside of speedometer pinion gear adapter before installing speed sensor.

(2) Install sensor into speedometer gear adapter and install mounting bolt. **Before tightening bolt, verify speed sensor is fully seated (mounted flush) to speedometer pinion gear adapter.**

(3) Tighten sensor mounting bolt to 2.2 N·m (20 in. lbs.) torque.

(4) Connect electrical connector to sensor.

SPECIFICATIONS

GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. **If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label.** The VECI label is located in the engine compartment.

FUEL TANK CAPACITIES

FUEL TANK	GALLONS*	LITERS*
XJ	20.02	76
YJ	20.0	76
YJ	15.0	57

*Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerances, ambient temperature and refill procedure.

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FUEL SYSTEM

COMPONENT	RATING
MFI Fuel System Pressure (with vacuum applied to regulator)	214 kPa (31 psi)
MFI Fuel System Pressure (without vacuum applied to pressure regulator)	269-276 kPa (39-41 psi)
MFI Fuel System Pressure Drop (fuel pump not engaged).....	Up to 138 kPa (20 psi)
Pressure-Vacuum Filler Cap Relief..	10 kPa (1.5 psi) pressure 6 kPa (1.8 in. Hg) vacuum

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TORQUE

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	4 N·m (36 in. lbs.)
Intake Manifold Air Temperature Sensor	28 N·m (20 ft. lbs.)
Engine Coolant Temperature Sensor	28 N·m (21 ft. lbs.)
PCM Mounting Screws	1 N·m (9 in. lbs.)
PCM 60-Way Connector Screw	4 N·m (35 in. lbs.)
Fuel Filter Retaining Strap	12 N·m (106 in. lbs.)
Fuel Pump/Gauge Send. Unit-to-Fuel Tank Screws (YJ)	2 N·m (18 in. lbs.)
Fuel Pump Line Nut	25 N·m (18 ft. lbs.)
Fuel Rail Mounting Bolts	27 N·m (20 ft. lbs.)
Fuel Tank Mounting Strap Nut (XJ)	11 N·m (100 in. lbs.)
Fuel Tank Skid Plate (YJ)	7 N·m (65 in. lbs.)
Fuel Tank Mounting Strap Nut (YJ)	18 N·m (13 ft. lbs.)
Oxygen Sensor	30 N·m (23 ft. lbs.)
Throttle Body Mtg. Bolts	12 N·m (9 ft. lbs.)

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PROPELLER SHAFTS

CONTENTS

GENERAL INFORMATION

PROPELLER SHAFTS

The function of a propeller shaft is to transmit power from one point to another. The shaft is designed to send torque from the transmission (transfer case on 4WD vehicles) to the axle (Fig. 1,2).

The propeller shaft must operate through constantly changing relative angles between the transmission and axle. It must also be capable of changing length while transmitting torque. The axle rides suspended by springs in a floating motion. The prop-

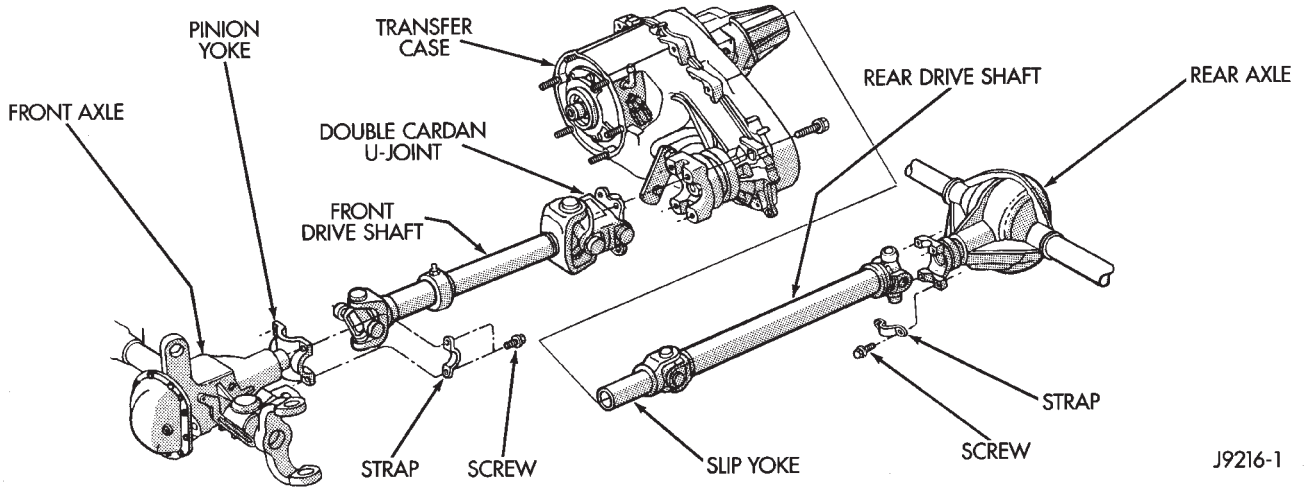


Fig. 1 Propeller Shafts (XJ Vehicles)

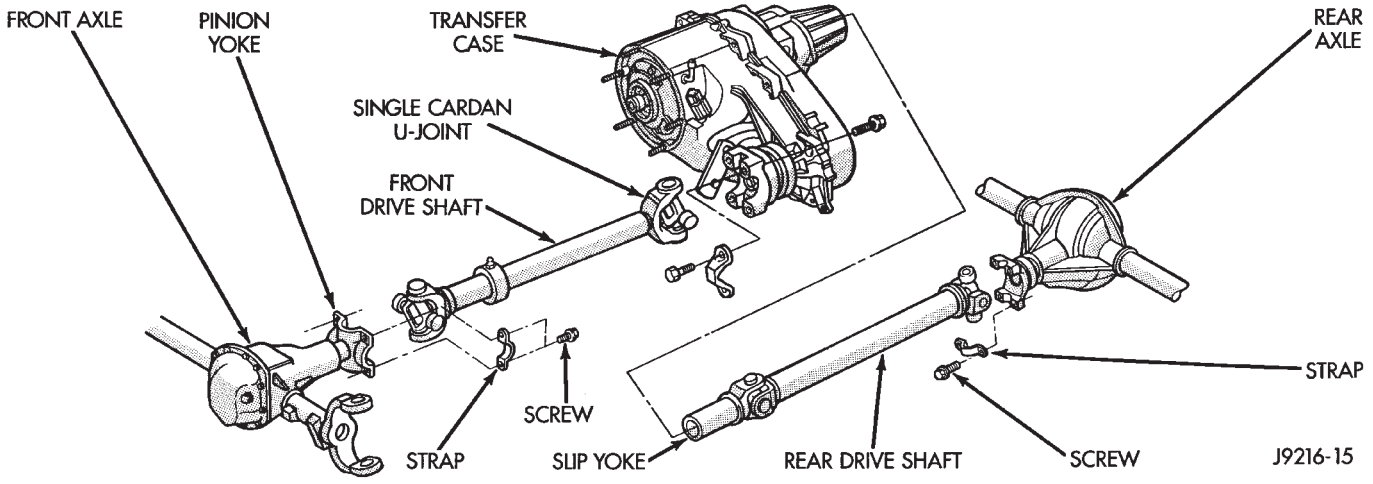


Fig. 2 Propeller Shafts (YJ Vehicles)

shaft must be able to change operating angles when going over various road surfaces. This is done through universal joints, which permit the propeller shaft to operate at different angles. The slip joints (or yokes) permit contraction or expansion (Fig. 1,2).

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

The propeller shaft is designed and built with the yoke lugs in line with each other which is called phasing. This design produces the smoothest running condition, an out of phase shaft can cause a vibration.

Before undercoating a vehicle, the propeller shaft and the U-joints should be covered. This will prevent the undercoating from causing an unbalanced condition and vibration.

CAUTION: Use exact replacement hardware for attaching the propeller shafts. The specified torque must always be applied when tightening the fasteners.

UNIVERSAL JOINTS

Two different types of U-joints are used with the propeller shafts:

- Single cardan U-joint (Fig. 3)
- Double cardan U-joint (Fig. 4)

LUBRICATION

The slip yoke and certain universal joints are equipped with zerk type lubrication fittings. They should be lubricated with a multi-purpose NLGI Grade 2 EP lubricant. All U-joints should be inspected for leakage and damage each time the vehicle is serviced. If seal leakage or damage exists, the U-joint should be replaced.

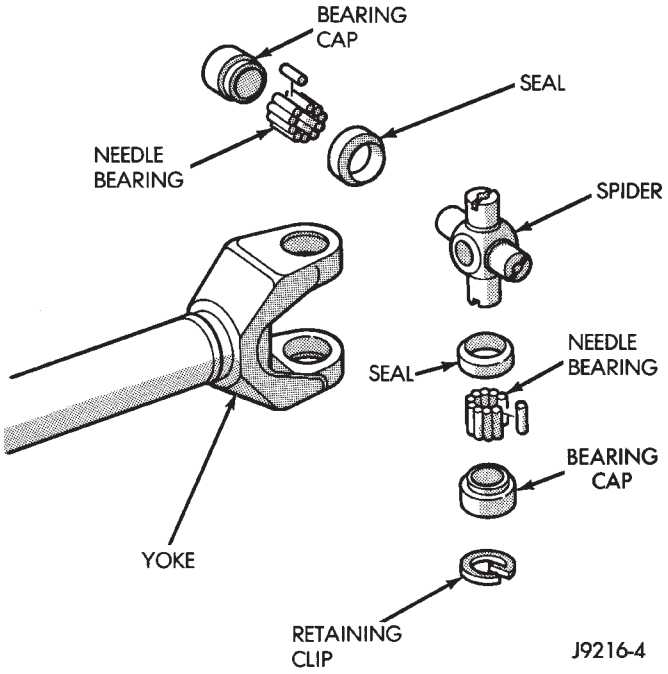
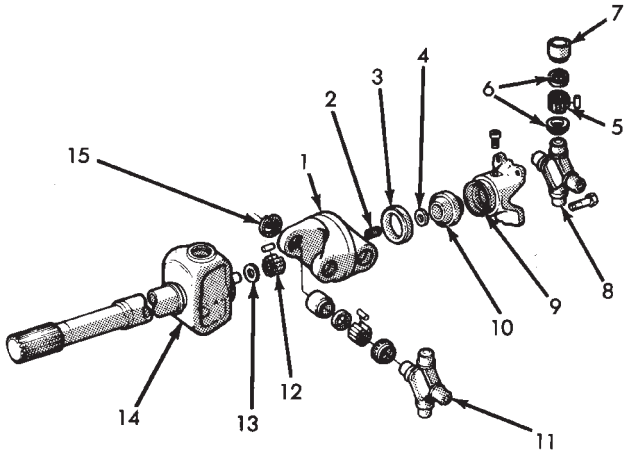


Fig. 3 Single Cardan Universal Joint



1. LINK YOKE
2. SOCKET SPRING
3. SOCKET BALL RETAINER
4. THRUST WASHER
5. NEEDLE BEARINGS
6. SEAL
7. BEARING CAP
8. REAR SPIDER
9. SOCKET YOKE
10. SOCKET BALL
11. FRONT SPIDER
12. SOCKET NEEDLE BEARINGS
13. THRUST WASHER
14. DRIVE SHAFT YOKE
15. RETAINING CLIP

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Fig. 4 Double Cardan (CV) Universal Joint

SERVICE DIAGNOSIS/PROCEDURES

INDEX

VIBRATION

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

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

Driveline vibration can also result from loose or damaged engine mounts. Refer to Group 21, Transmissions for additional information.

Propeller shaft vibration will increase as the vehicle speed is increased. A vibration that occurs within a specific speed range is not caused by propeller shaft unbalance. Defective universal joints or an incorrect propeller shaft angle are usually the cause.

UNBALANCE

If propeller shaft unbalance is suspected, it can be verified with the following procedure.

Removing and re-indexing the propeller shaft 180° may eliminate some vibrations.

- Clean all the foreign material from the propeller shaft and the universal joints.
- Inspect the propeller shaft for missing balance weights, broken welds, and bent areas. **If the propeller shaft is bent, it must be replaced.**
- Ensure the universal joints are not worn, are properly installed, and are correctly aligned with the shaft.
- Check the universal joint clamp screws torque

(1) Raise the vehicle.

(2) Remove the wheel and tires assembly. Install the wheel lug nuts to retain the brake drums.

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

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

(5) Install a screw clamp at position 1 (Fig. 1).

(6) 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.

(7) If there is no difference in vibration at the other positions, the vibration may not be propshaft unbalance.

DRIVELINE VIBRATION

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

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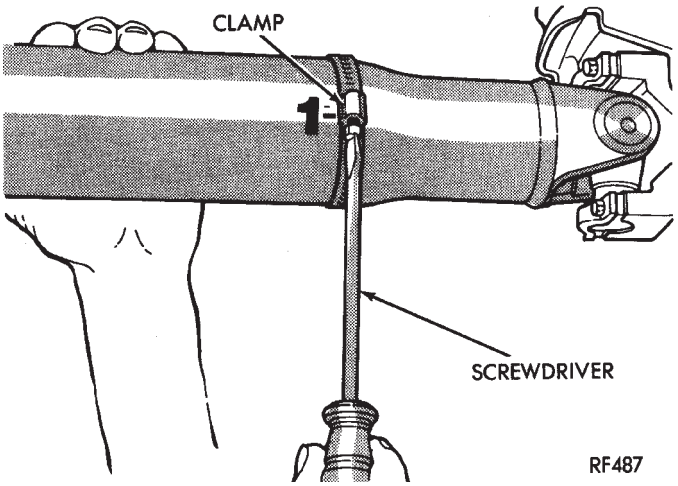

Fig. 1 Clamp Screw At Position 1

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

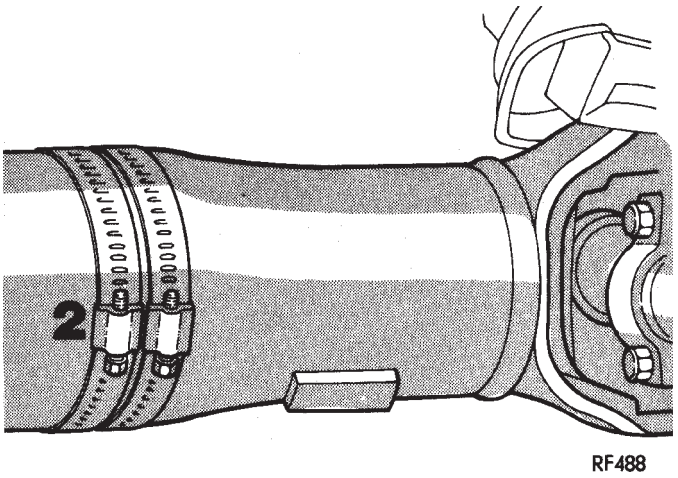

Fig. 2 Two Clamp Screws At The Same Position

(9) If the clamps cause an additional unbalance, separate the clamps (1/4 inch above and below the mark). Repeat the vibration test (Fig. 3).

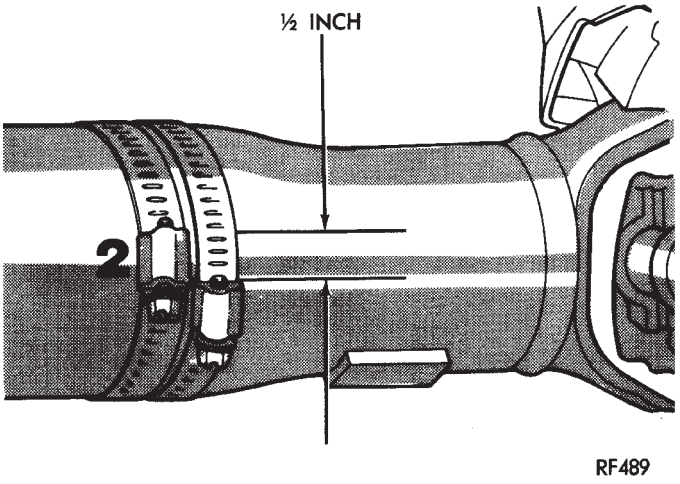

Fig. 3 Clamp Screws Separated

(10) 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.

(11) Install the wheel and tires. Lower the vehicle.

(12) If the amount of vibration remains unacceptable, apply procedures at the front end of the propeller shaft.

RUNOUT

(1) Remove dirt, rust, paint, and undercoating from the propeller shaft surface. Areas where the dial indicator will contact the shaft must be clean.

(2) The dial indicator must be installed perpendicular to the shaft surface.

(3) Measure runout at the center and ends away from welds.

(4) Refer to Runout Specifications chart.

(5) Replace the propeller shaft if the runout exceeds the limit.

RUNOUT SPECIFICATIONS

Front of shaft	0.010 in. (0.25 mm)
Center of shaft	0.015 in. (0.38 mm)
Rear of shaft	0.010 in. (0.25 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. Under 30 inches the max. runout is 0.20 inch for full length of the tube.

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UNIVERSAL JOINT ANGLE MEASUREMENT

INFORMATION

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

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

When taking universal joint angle measurements or checking phasing with two piece shafts, consider each shaft separately. On 4WD vehicles, the front shaft input (pinion shaft) angle has priority over the caster angle.

Ideally the driveline system should have;

- Angles that are in equal or opposite within 1 degree of each other

- Have a 3 degree maximum operating angle
- Have at least a 1/2 degree continuous operating (propeller shaft) angle

Engine speed (R.P.M.) is the main factor though in determining maximum allowable operating angles. As a guide to maximum normal operating angles refer to the chart listed (Fig. 4).

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

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Fig. 4 Maximum Angles and R.P.M.

INSPECTION

Before measuring universal joint angles, the following must be done.

- Inflate all tires to correct pressure
- Check angles in the same loaded or unloaded condition as when the vibration occurred. Propshaft angles will change according to the amount of load in the vehicle. Always check angles in loaded and unloaded conditions.
- Check the condition of all suspension components and verify all fasteners are torqued to specifications.
- Check the condition of the engine and transmission mounts and verify all fasteners are torqued to specifications.

MEASUREMENT

To accurately check driveline alignment, raise and support the vehicle at the axles as level as possible. Allow the wheels and propeller shaft to turn. Remove any external bearing snap rings (if equipped) from universal joint so protractor base sits flat.

(1) Rotate the shaft until transmission/transfer case output yoke bearing is facing downward.

Always make measurements from front to rear.

(2) Place Inclinometer on yoke bearing (A) parallel to the shaft (Fig. 5). Center bubble in sight glass and record measurement.

This measurement will give you the transmission or OUTPUT YOKE ANGLE (A).

(3) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing parallel to the shaft (Fig. 6). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

This measurement will give you the PROPELLER SHAFT ANGLE (C).

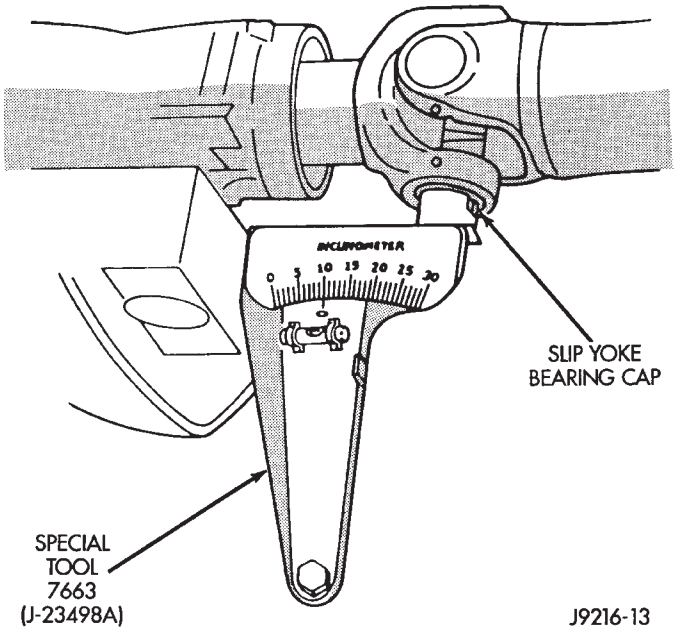


Fig. 5 Front (Output) Angle Measurement (A)

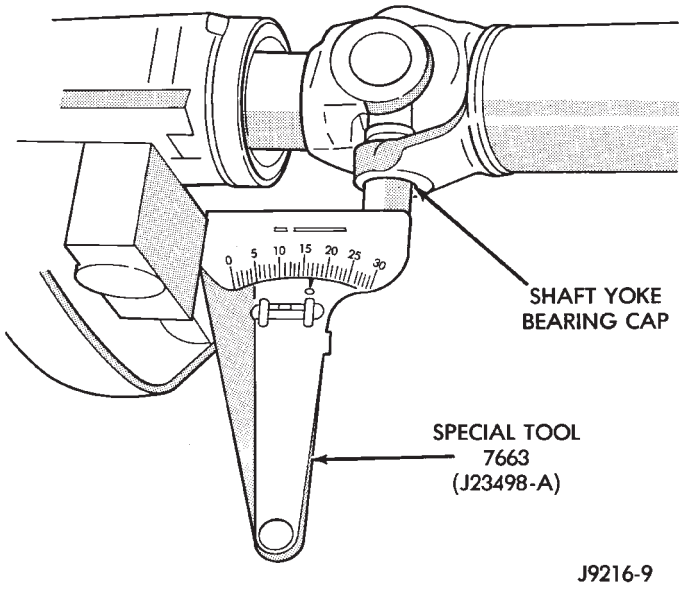


Fig. 6 Propeller Shaft Angle Measurement (C)

(4) Subtract smaller figure from larger (C minus A) to obtain transmission OUTPUT OPERATING ANGLE.

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

This measurement will give you the pinion shaft or INPUT YOKE ANGLE (B).

(6) Subtract smaller figure from larger (C minus B) to obtain axle INPUT OPERATING ANGLE.

Refer to rules given below and the example in (Fig. 8) for additional information.

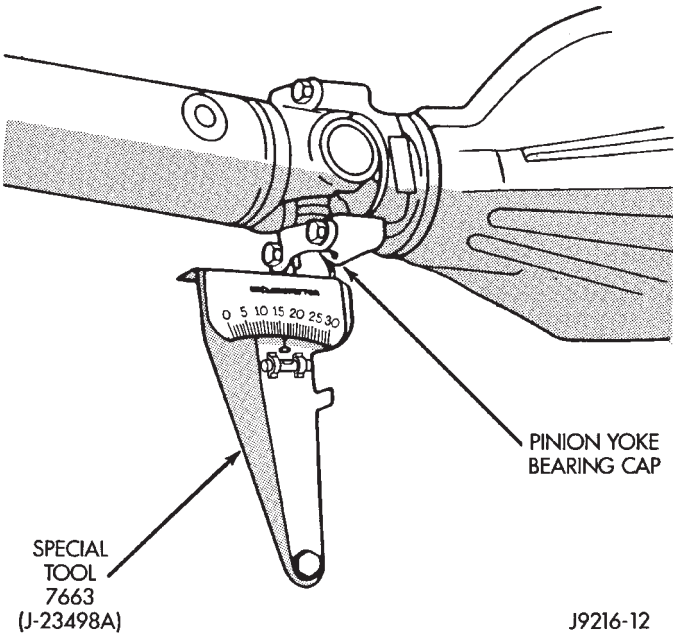


Fig. 7 Rear (Input) Angle Measurement (B)

- Good cancellation of u-joint operating angles (within 1°)
- Operating angles less than 3°
- At least 1/2 of one degree continuous operating (propeller shaft) angle

ADJUSTMENT AT AXLE WITH LEAF SPRINGS

Adjust the pinion shaft angle at the springs with tapered shims (Fig. 9). Install tapered shims between the springs and axle pad to correct the angle. Refer to Group 3, Rear Suspension and Axle for additional information.

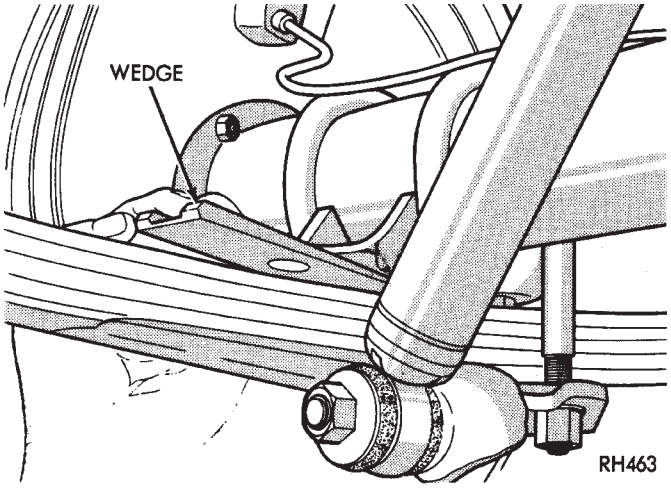
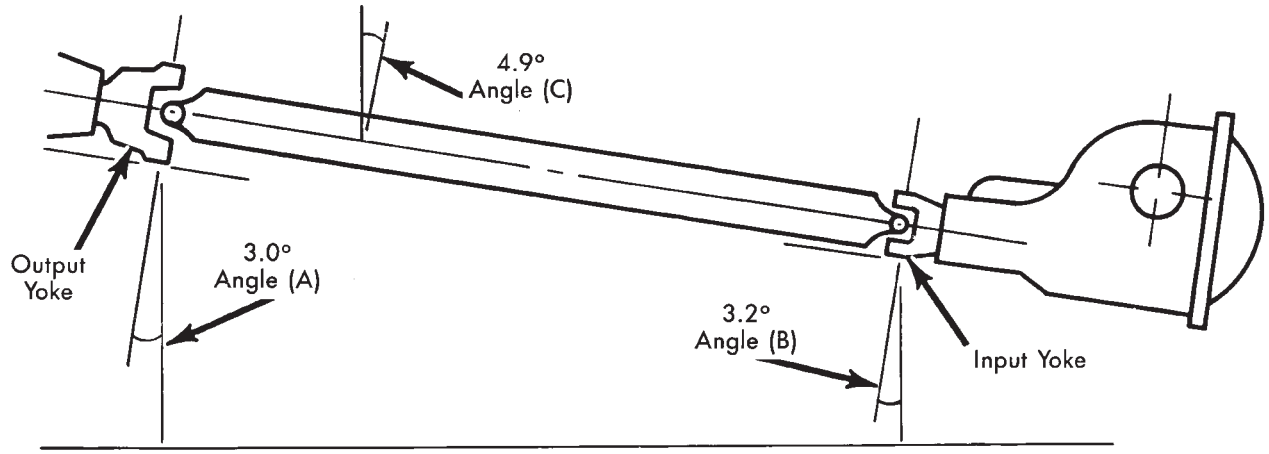


Fig. 9 Angle Adjustment at Leaf Springs



(A) Output Yoke	= 3.0°	or	4.9°
(C) Prop. Shaft	= 4.9°		-3.0°
Transmission Output Operating Angle			1.9°

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

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Fig. 8 Universal Joint Angle Example

ADJUSTMENT—XJ FRONT SHAFT

Adjust the pinion gear angle at the lower suspension arms with shims (Fig. 10). Adding shims will decrease the pinion gear shaft angle but will increase the caster angle. The pinion gear shaft angle has priority over the caster angle.

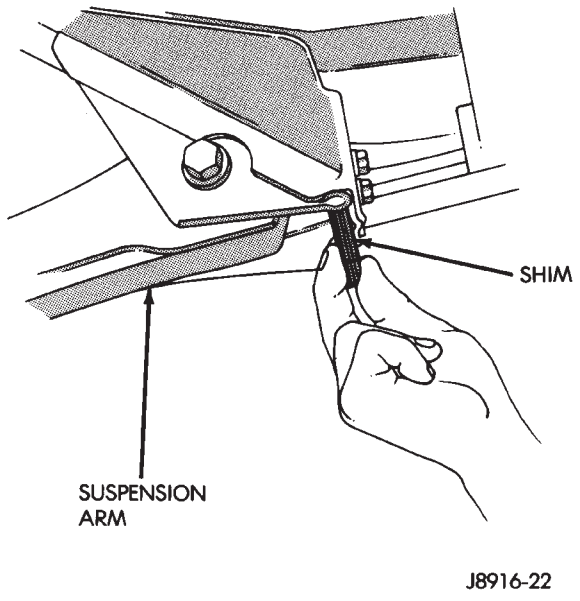

Fig. 10 Angle Adjustment—XJ Vehicles

PROPELLER SHAFT REPLACEMENT

PRECAUTIONS

Use exact replacement hardware for attaching the propeller shafts. Exact replacement will ensure safe operation. The specified torque must always be applied when tightening the fasteners.

Put reference marks on the propshaft yoke and axle or transmission yoke before service (Fig. 1). This will assure correct phasing and eliminate possible vibration.

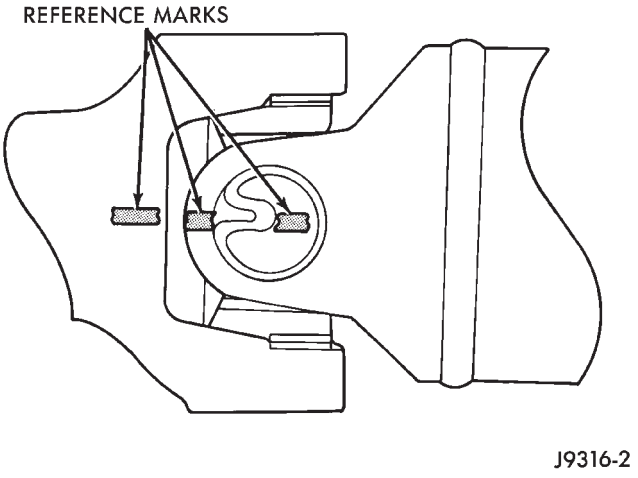

Fig. 1 Reference Marks on Yokes

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

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

FRONT—XJ VEHICLES

REMOVAL

(1) Raise the vehicle.

(2) Scribe alignment marks on the yokes at the transfer case. Place marks at the pinion shaft and at each end of the propeller shaft. These marks will be used for installation reference (Fig. 2).

(3) Remove the U-joint strap bolts at the pinion shaft yoke.

(4) Disconnect the propeller shaft at the transfer case and remove the propeller shaft.

INSTALLATION

(1) Position the propeller shaft with the yoke reference marks aligned (Fig. 1). Install the propeller shaft.

Replacement U-joint straps and bolts must be installed.

(2) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(3) Tighten the flange to transfer case bolts to 27 N·m (19.5 ft. lbs.) torque.

(4) Lower the vehicle.

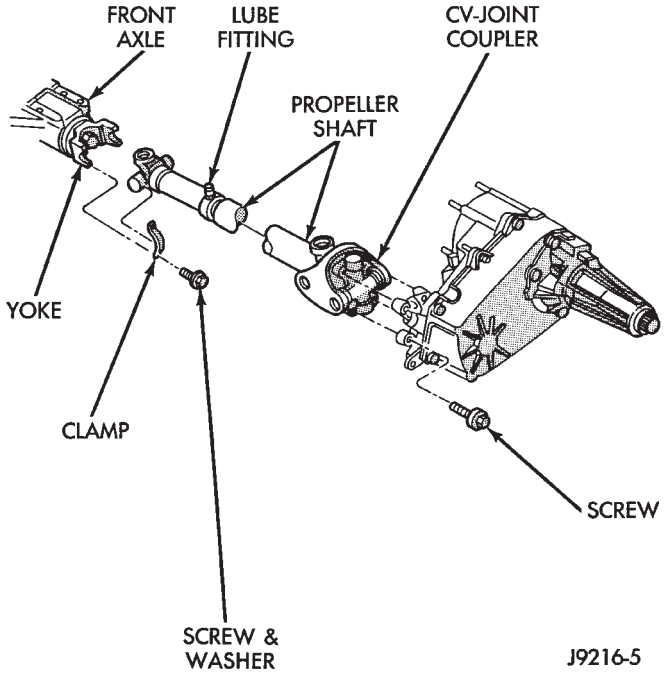

Fig. 2 Front Propeller Shaft

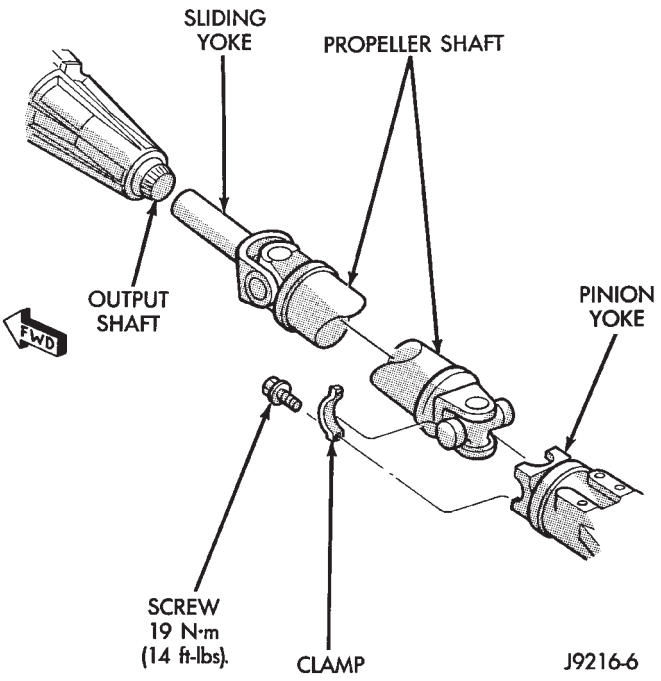

Fig. 3 Rear Propeller Shaft

REAR—XJ,YJ VEHICLES

REMOVAL

(1) Shift the transmission and transfer case (if applicable) to their Neutral positions. Raise the vehicle.

(2) Scribe alignment marks at the pinion shaft and at each end of the propeller shaft. These marks will be used for installation reference.

(3) Remove the U-joint strap bolts at the pinion shaft yoke.

(4) Slide the slip yoke off of the transmission/transfer case output shaft and remove the propeller shaft (Fig. 3).

INSTALLATION

(1) Slide the slip yoke on the transmission/transfer case output shaft. Align the installation reference marks at the axle yoke and install the propeller shaft (Fig. 3).

Replacement U-joint straps and bolts must be installed.

(2) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(3) Lower the vehicle.

FRONT—YJ VEHICLES

REMOVAL

(1) Raise the vehicle.

(2) Scribe alignment marks on the yokes at the transfer case. Place marks at the pinion shaft and at each end of the propeller shaft. These marks will be used for installation reference (Fig. 4).

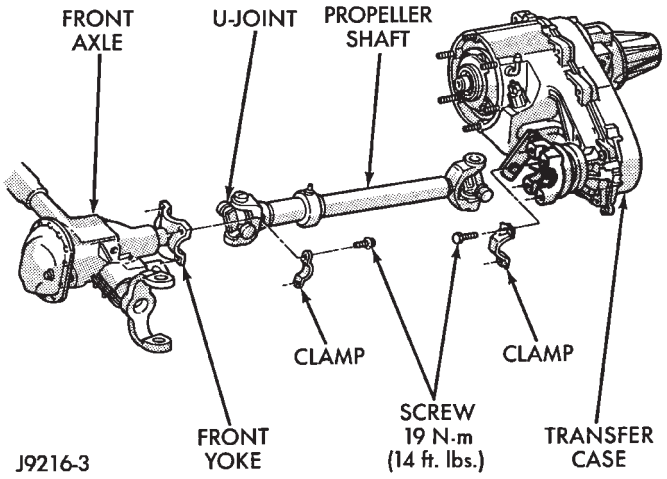

Fig. 4 YJ Front Propeller Shaft

(3) Remove the U-joint strap bolts at the pinion shaft yoke.

(4) Disconnect the propeller shaft at the transfer case and remove the propeller shaft.

INSTALLATION

(1) Position the propeller shaft with the reference marks aligned (Fig. 4). Install the propeller shaft.

Replacement U-joint straps and bolts must be installed.

(2) Tighten the U-joint strap/clamp bolts at the axle yoke to 19 N·m (14 ft. lbs.) torque.

(3) Tighten the U-joint strap/clamp to transfer case bolts to 27 N·m (19.5 ft. lbs.) torque.

(4) Tighten the U-joint strap bolts to 19 N·m (14 ft. lbs.) torque.

(5) Lower the vehicle.

UNIVERSAL JOINT REPLACEMENT

PRECAUTIONS

It is very important to put reference marks on the yokes before removal or component service (Fig. 1). This will assure correct phasing and eliminate possible vibration.

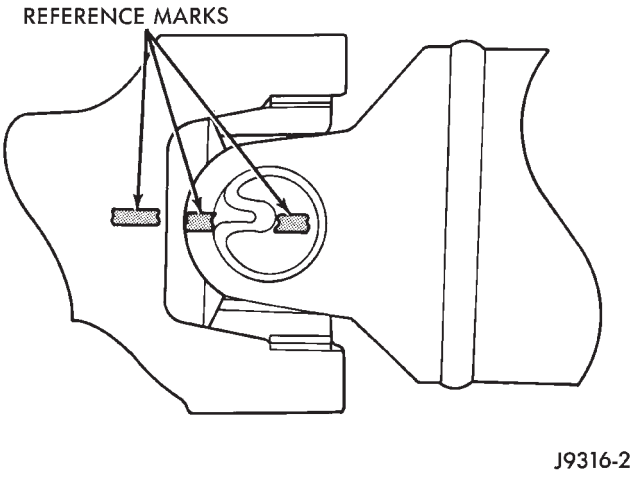

Fig. 1 Reference Marks on Yokes

SINGLE CARDAN

REMOVAL/DISASSEMBLY

Single cardan universal joints are not serviceable. If worn or leaking, they must be replaced as a unit.

(1) Remove the propeller shaft. Refer to Propeller Shaft Replacement in this Group.

(2) **Paint or score alignment marks on the yokes and propeller shaft for installation reference.**

(3) Using a soft drift, tap the outside of the bearing assembly to loosen snap ring.

(4) Remove snap rings from both sides of yoke (Fig. 2).

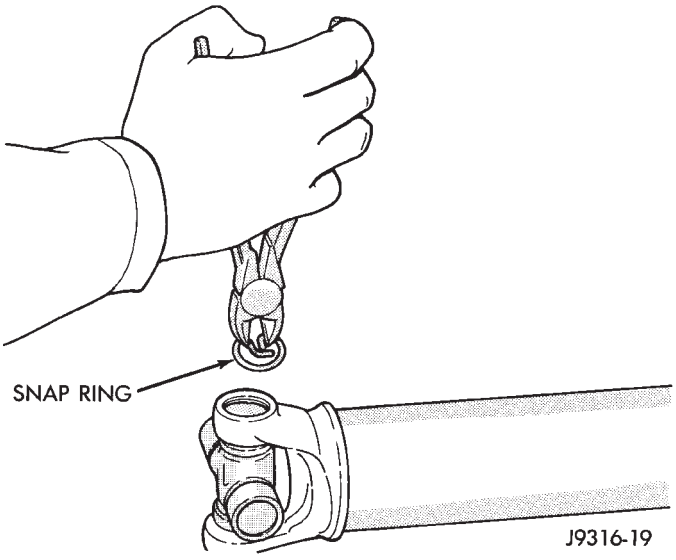

Fig. 2 Remove Snap Ring

(5) Set the yoke in an arbor press or vise with a large socket beneath it. Position the yoke with the lube fitting pointing up (if equipped). Place a smaller socket on the upper bearing assembly and press it through to release the lower bearing assembly (Fig. 3).

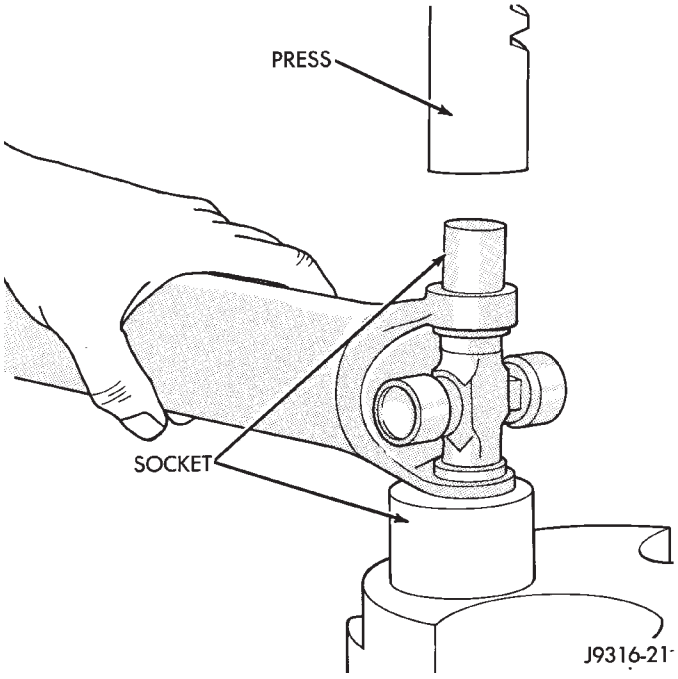

Fig. 3 Press Out Bearing

(6) If the bearing assembly will not pull out by hand after pressing, tap the base of the lug near it to dislodge.

(7) To remove the opposite bearing, turn the yoke over and straighten the cross in the open hole. Then carefully press the end of the cross until the remaining bearing can be removed (Fig. 4).

CAUTION: If the cross or bearing assembly are cocked when being pressed, the bearing assembly will score the walls of the yoke bore and ruin the yoke.

CLEANING AND INSPECTION

(1) Clean all the universal joint yoke bores with cleaning solvent and a wire brush.

(2) Inspect the yokes for distortion, cracks and worn bearing assembly bores.

ASSEMBLY/INSTALLATION

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to aid in installation.

(2) Position the cross in the yoke with its lube fitting (if equipped) pointing up (Fig. 5).

(3) Place a bearing assembly over the trunnion and align it with the cross hole (Fig. 6). Keep the needle bearings upright in the bearing assembly. A needle roller lying at the bottom will prevent proper assembly.

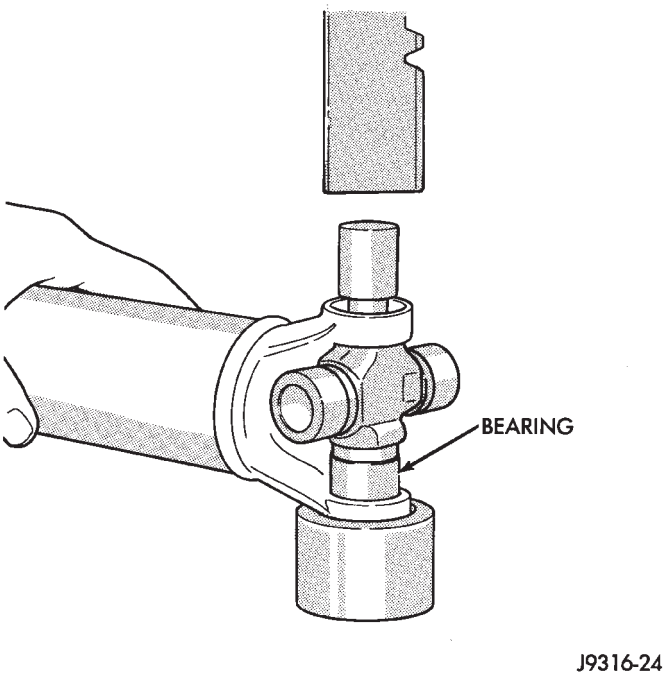

Fig. 4 Press Out Remaining Bearing

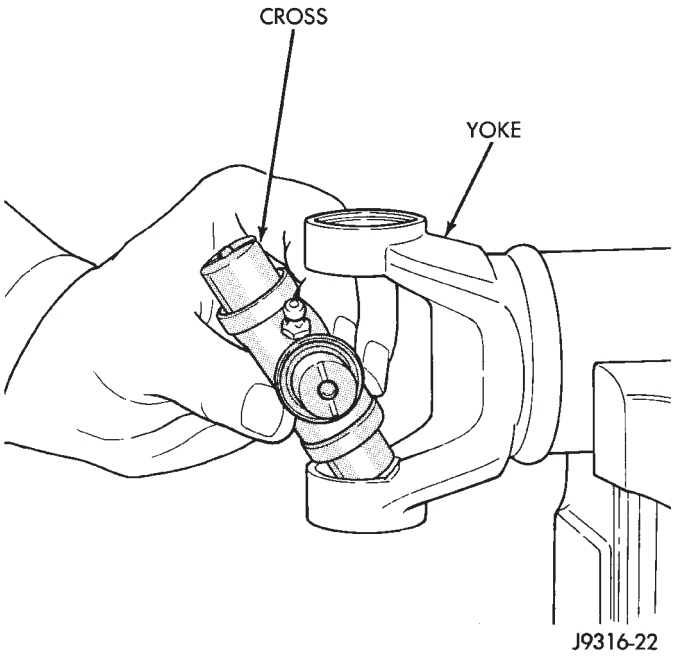

Fig. 5 Install Cross In Yoke

(4) Press the bearing assembly into the cross hole enough to install a snap ring. Install a snap ring.

(5) Repeat steps 3 and 4 to install the opposite bearing assembly. If the joint is stiff, strike the yoke with a soft hammer to seat the needle bearings. Install a snap ring.

(6) Add grease to lube fitting (if equipped).

(7) Install the propeller shaft. Refer to Propeller Shaft Replacement in this Group.

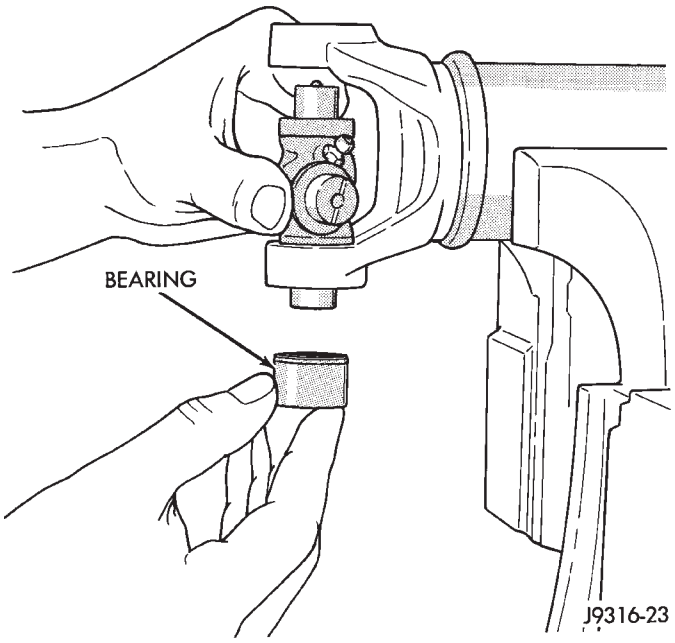

Fig. 6 Install Bearing On Trunnion

DOUBLE CARDAN (CV)

REMOVAL/DISASSEMBLY

Single cardan universal joints are not serviceable. If worn or leaking, they must be replaced as a unit.

(1) Remove the propeller shaft. Refer to Propeller Shaft Replacement in this Group.

(2) **Paint or score alignment marks on the yokes and propeller shaft for installation reference.**

(3) Remove all the bearing assembly snap rings (Fig. 7).

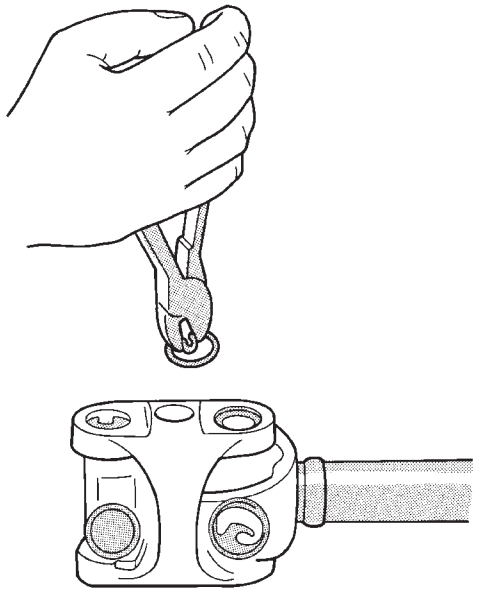

Fig. 7 Remove Snap Rings

(4) Press the bearing assembly partially from the outboard side of the center yoke, enough to grasp by vise jaws (Fig. 8). Be sure to remove any lube fittings that may interfere with removal.

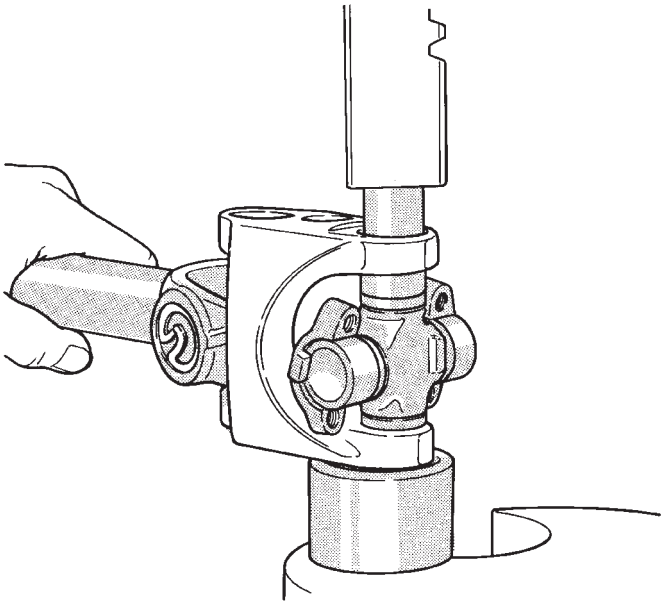

Fig. 8 Press Out Bearing

(5) Grasp the protruding bearing by vise jaws. Tap the tube yoke with a mallet and drift to dislodge from the yoke (Fig. 9).

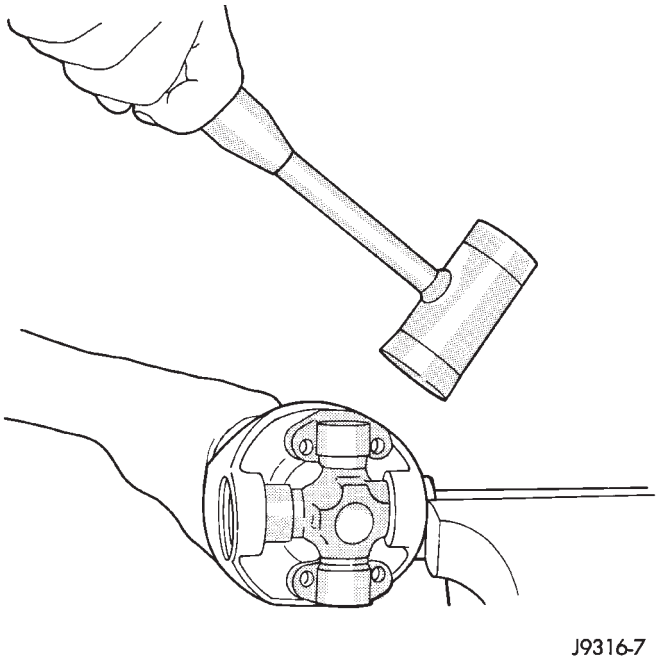

Fig. 9 Remove Bearing From Yoke

(6) Flip assembly and repeat steps 4 and 5 for removing the opposite side bearing. This will then allow removal of the cross centering kit assembly and spring (Fig. 10).

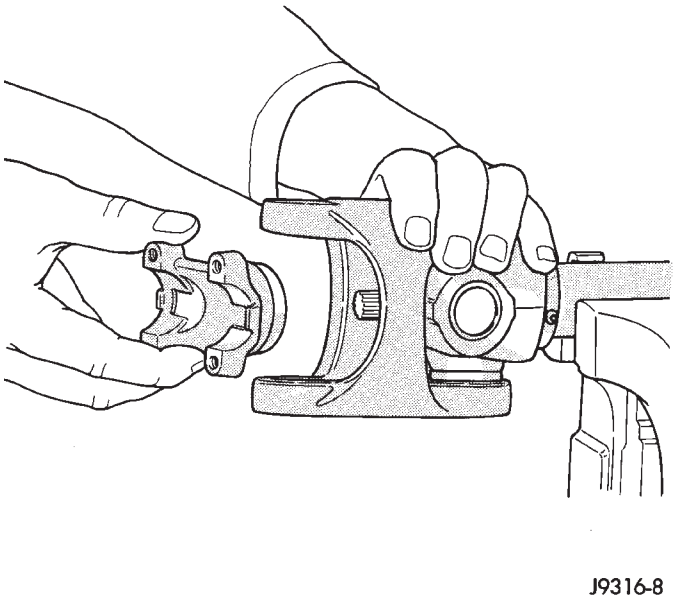

Fig. 10 Remove Centering Kit

(7) Press the remaining bearing assemblies out the other cross as described above to complete the disassembly.

CLEANING AND INSPECTION

(1) Clean all the U-joint yoke bores with cleaning solvent and a wire brush.

(2) Inspect the yokes for distortion, cracks and worn bearing assembly bores.

ASSEMBLY/INSTALLATION

During installation, ensure that the spiders and yokes are aligned to the reference marks.

(1) Fit a cross into the tube yoke (Fig. 11).

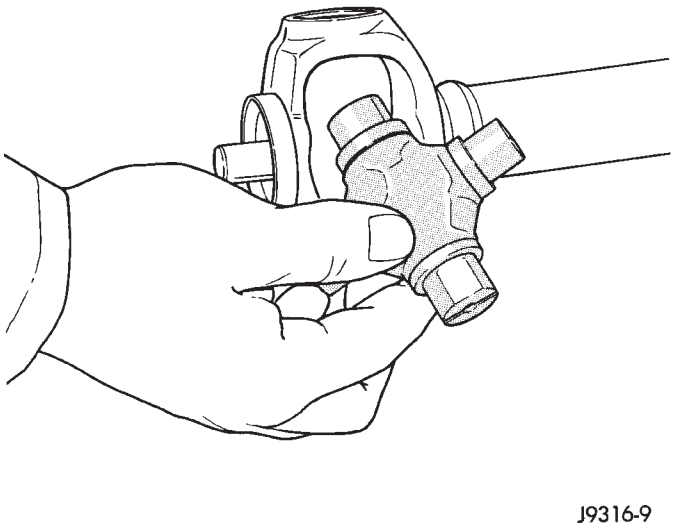

Fig. 11 Install Cross In Yoke

(2) Place a bearing assembly in a tube yoke hole and over a trunnion. Keep the needle bearings upright in the bearing assembly (Fig. 12). A needle roller lying at the bottom will prevent proper assembly. Be sure to remove any lube fittings that may interfere with removal.

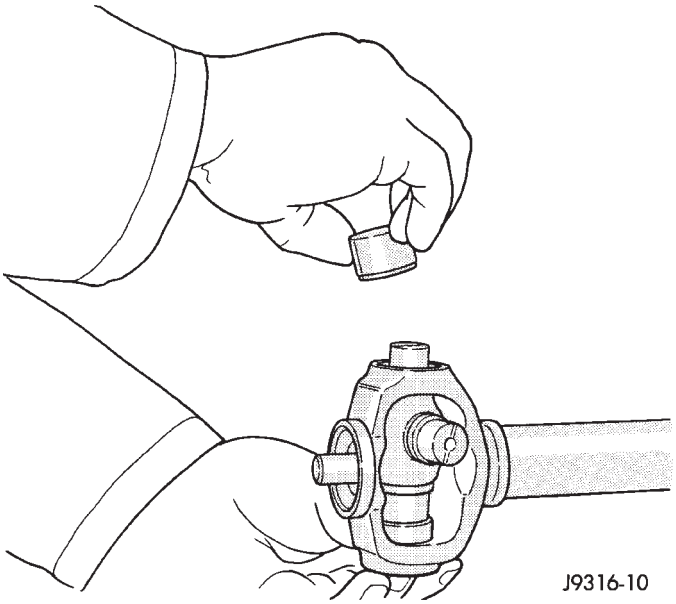

Fig. 12 Install Bearing Assembly

(3) Press the bearing assembly in place and install a snap ring (Fig. 13).

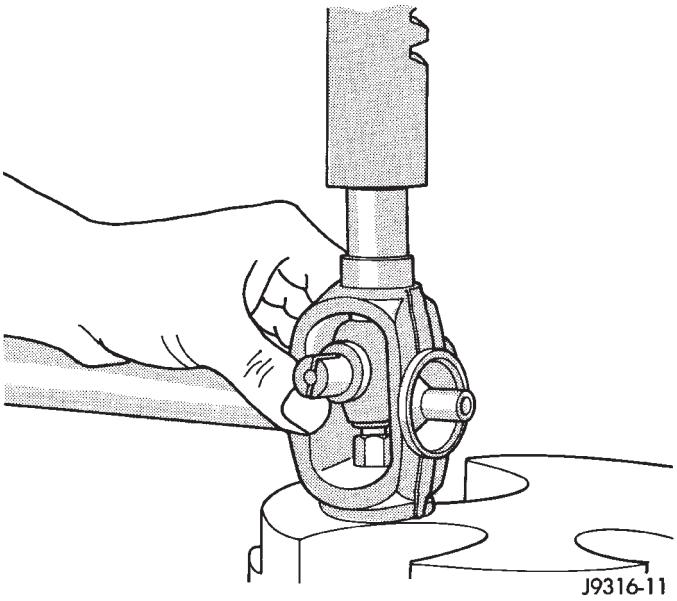

Fig. 13 Press In Bearing Assembly

(4) Flip the tube yoke and bearing assembly installation on the opposite trunnion. Install a snap ring (Fig. 14).

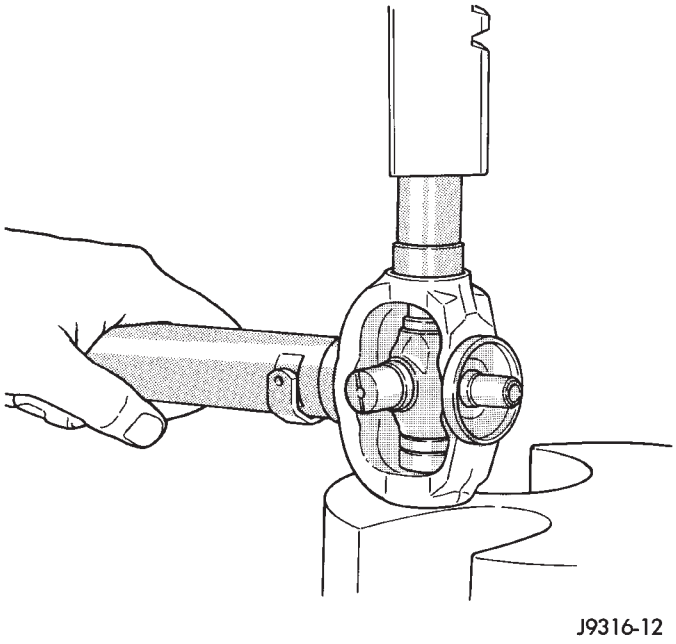

Fig. 14 Press In Bearing Assembly

(5) Fit the center yoke on the remaining two trunnions and press bearing assemblies in place, both sides (Fig. 15). Install a snap ring.

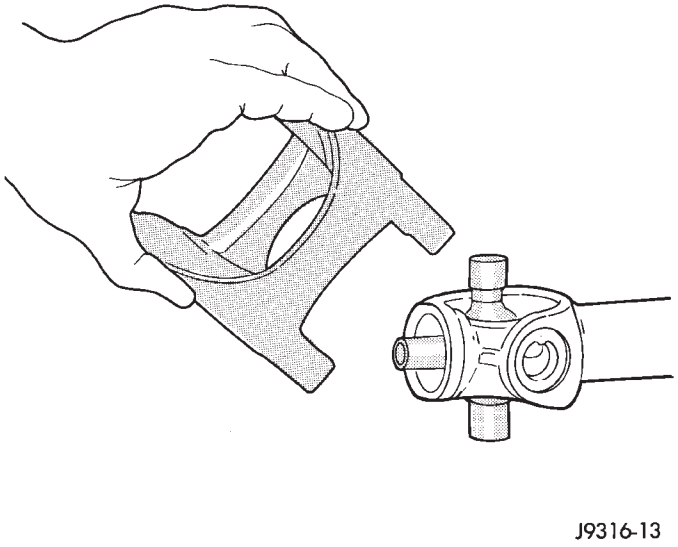

Fig. 15 Install Center Yoke

(6) Install the centering kit assembly inside the center yoke making sure the spring is in place (Fig. 16). Align the lube fitting on the centering kit with the lube fitting on the installed cross.

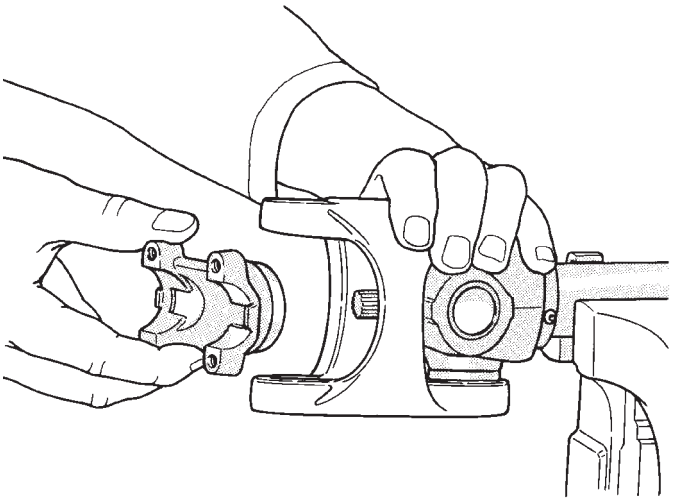

Fig. 16 Install Centering Kit

(7) Place two bearing assemblies on the remaining cross (opposite sides). Fit the open trunnions into the center yoke holes and the bearing assemblies into the centering kit (Fig. 17). Align the lube fitting on the cross with the other two lube fittings.

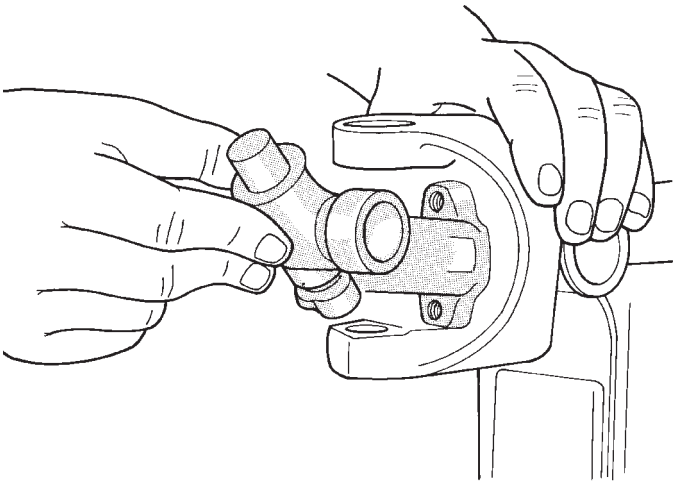

Fig. 17 Install Remaining Cross

(8) Press the remaining two bearing assemblies into place and install snap rings (Fig. 18).

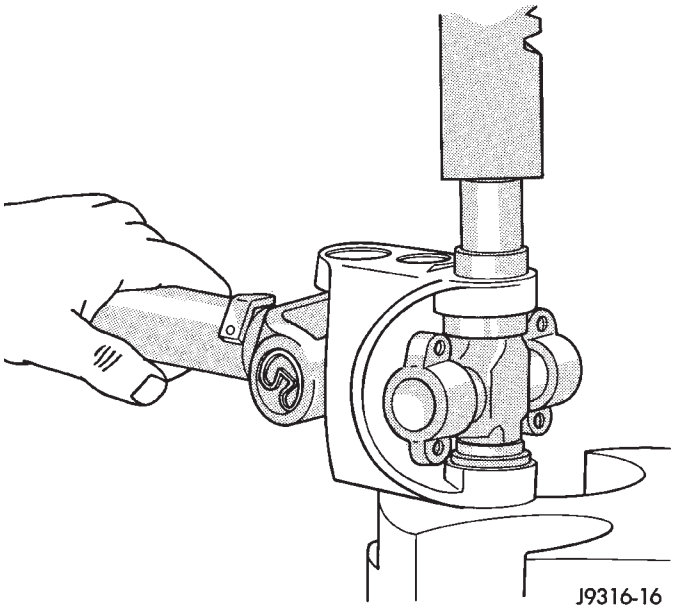

Fig. 18 Press In Bearing Assembly

(9) Tap the snap rings to allow them to seat into the grooves (Fig. 19).

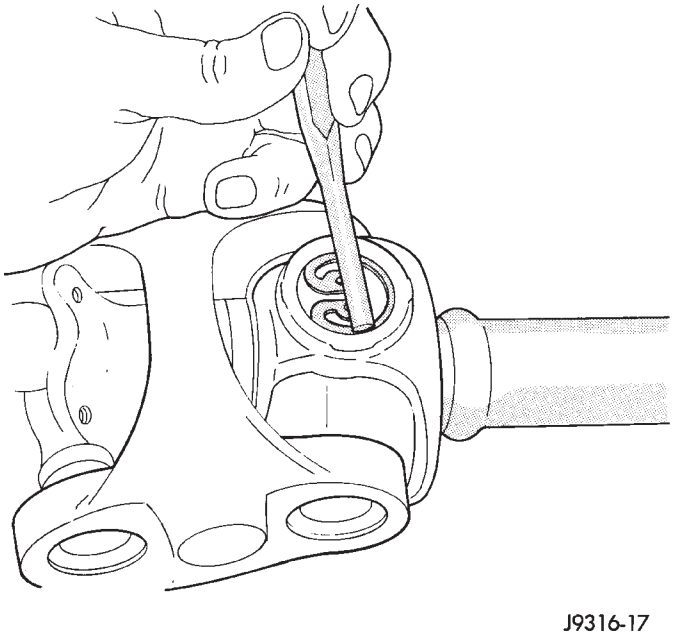

Fig. 19 Seat Snap Rings In Groove

(10) Check for proper assembly. Flex the CV joint beyond center, it should snap over-center in both directions when correctly assembled (Fig. 20).

(11) Add grease to all three lube fittings.

(12) Install the propeller shaft. Refer to Propeller Shaft Replacement in this Group.

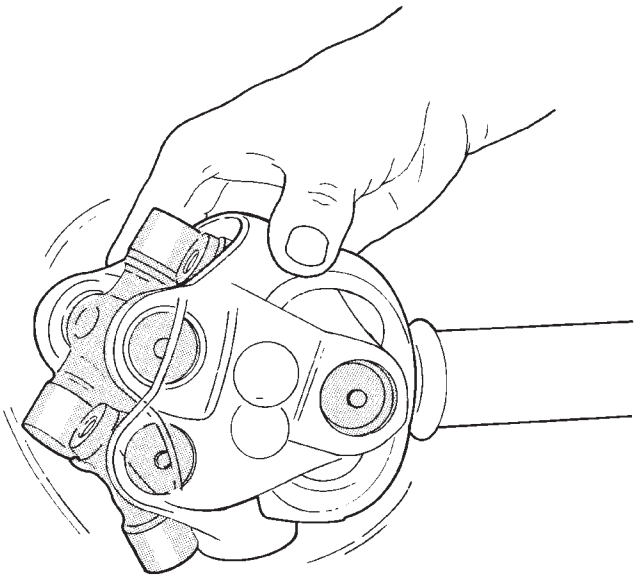

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Fig. 20 Check Assembly

TORQUE SPECIFICATIONS

PROPELLER SHAFTS AND U-JOINTS

DESCRIPTION	TORQUE
Double Cardan to Transfer Case Yoke Bolts	26 N·m (19.5 ft. lbs.)
Single Cardan Clamp Bolt to Axle Yoke	19 N·m (14 ft. lbs.)

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STEERING

CONTENTS

GENERAL INFORMATION

STEERING SYSTEM COMPONENTS

Jeep vehicles can have either a manual or power steering system (Fig. 1). A recirculating-ball type steering gear is used for both systems.

Power steering systems use;

- Steering gear
- Pressure and return fluid hoses and fittings
- Belt driven steering pump
- Integral or remote body mounted pump reservoir

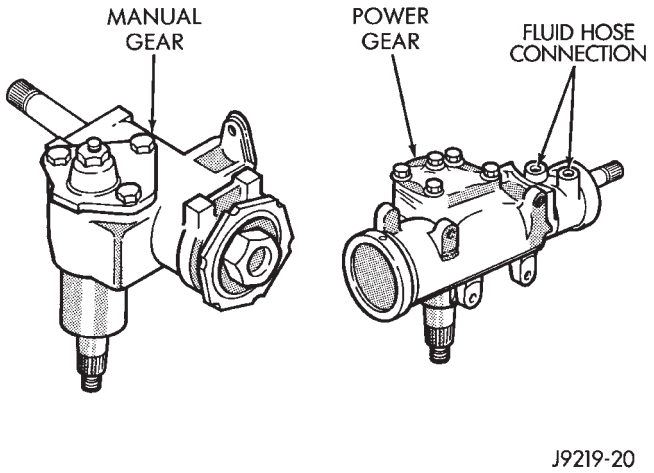


Fig. 1 Steering Gears

POWER STEERING GEAR

The steering gear is mounted on the left frame rail. The gear is joined to the intermediate shaft by a universal joint coupling. The coupling helps isolate noise and road shock from the interior.

The major internal components of the gear are the:

- Rotary valve assembly
- Steering worm shaft
- Rack piston assembly
- Pitman shaft

The movement of these parts, while turning or parking, is aided by hydraulic pressure and flow supplied by the pump. Manual steering is always available at times when the engine is not running or in the event of pump or belt failure. Steering effort is higher under such conditions.

The steering stub shaft, rotary valve, worm shaft, and rack piston assembly are all in line. The oil passages are internal within the gear housing except for pressure and return hoses between the gear and pump.

The power steering gear has a recirculating ball system. This acts as a rolling thread between the worm shaft and rack piston. The worm shaft is supported by a thrust bearing at the lower end and a bearing assembly at the upper end. When the worm shaft is turned right, the rack piston moves up in gear. Turning the worm shaft left moves the rack piston down in gear. The rack piston teeth mesh with the sector, which is part of the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the wheels through the steering linkage.

The control valve in the steering gear directs the power steering fluid to either side of the rack piston. The rack piston is assisted by hydraulic pressure. If the steering system loses hydraulic pressure, the vehicle can be controlled manually, but with higher steering effort.

An identification code located on the side cover designates the gear ratio (Fig. 2).

- Code BH designates 14:1 ratio used in XJ vehicles
- Code BF designates 13-16:1 ratio used in YJ vehicles

A recirculating-ball steering gear is used with the power (assisted) steering system (Fig. 1). The power steering gear can be adjusted and internally serviced.

POWER STEERING PUMP

Hydraulic pressure is provided for operation of the power steering gear by a belt driven power steering

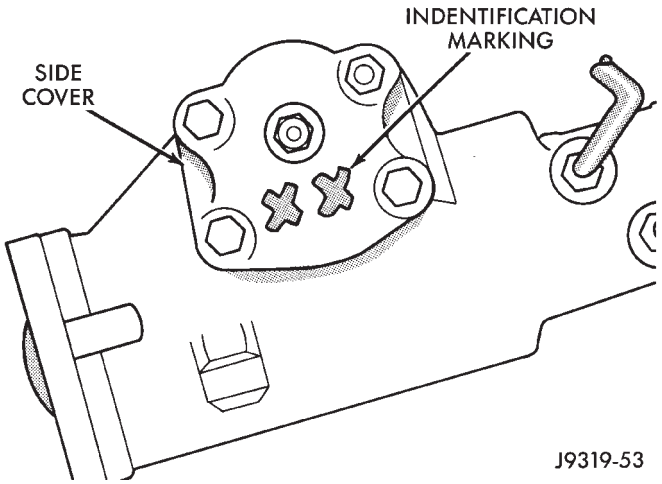


Fig. 2 Ratio Code Location

pump. The power steering pump is a constant flow rate and displacement, vane-type pump. The internal parts in the housing 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.

Power steering pumps have different pressure rates and are not interchangeable with other pumps.

The power steering pump is connected to the steering gear via high pressure and return hose. The pump shaft has a pressed-on drive pulley that is belt driven by the crankshaft pulley (Fig. 3).

XJ vehicles with 2.5L engines and all YJ vehicles: The reservoir is mounted at the front left side of the engine compartment. XJ vehicles equipped with a 4.0L engine have the reservoir attached to the pump body with spring clips.

STEERING COLUMNS

Two general types of steering columns are installed on Jeep vehicles: a fixed, non-tilt column and a tilt column (Fig. 4).

The ignition key/lock cylinder is located in the steering column. When the key/lock cylinder is turned to the LOCK position, the ignition switch and steering shaft cannot be operated. For vehicles with an automatic transmission, the lock mechanism also prevents operation of the gear shift mechanism.

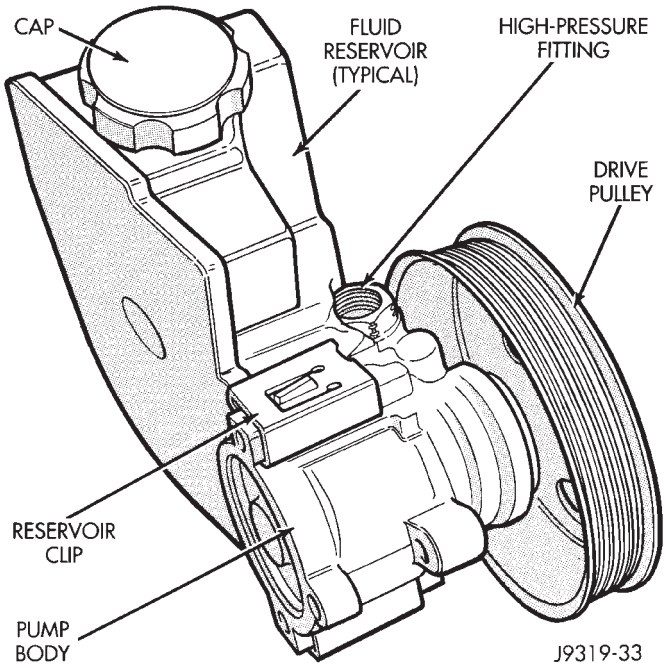


Fig. 3 TC Series Pump With Integral Reservoir

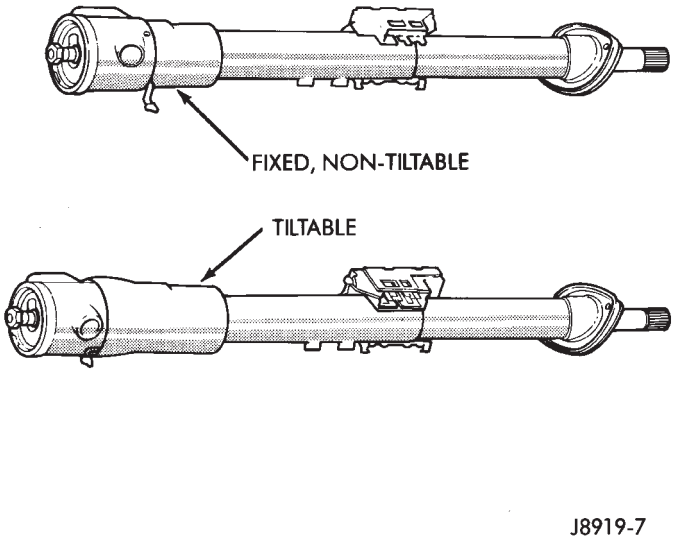


Fig. 4 Steering Columns

The center, slip-type intermediate shaft is attached to the steering gear and steering column shaft with universal joints.

Both types of steering columns have anti-theft provisions. They are energy-absorbing.

POWER STEERING SYSTEM DIAGNOSIS

PUMP PRESSURE TEST

(1) Check belt tension and adjust as necessary.

(2) Disconnect high pressure hose at gear or pump. Use a container for dripping fluid.

(3) Connect Gauge 7617 (J21567) to both hoses using adapter fitting (Fig. 1). Connect spare pressure hose to gear or pump.

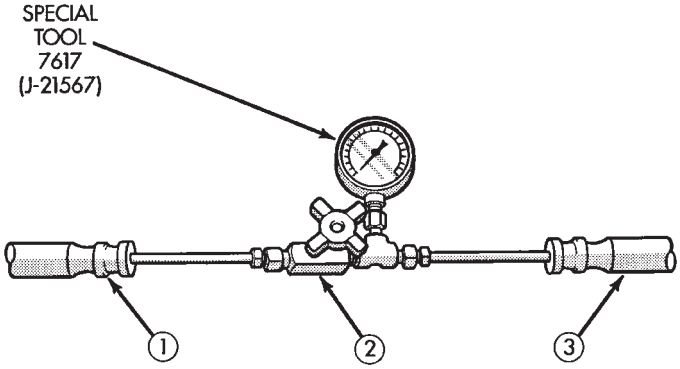


Fig. 1 Pressure Test Gauge

(4) Open the test valve completely.

(5) Start engine and let idle.

(6) Check fluid level, add fluid as necessary.

(7) Gauge should read below 862 kPa (125 psi), if above, inspect the hoses for restrictions and repair as necessary. The initial pressure should be in the range of 345-552 kPa (50-80 psi).

CAUTION: The following test procedure involves testing maximum pump pressure output and flow control valve operation. Do not leave valve closed for more than 5 seconds as the pump could be damaged.

(8) 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.

CAUTION: Do not force the pump to operate against the stops for more than 2 to 4 seconds at a time. Pump damage will result.

(9) Open the test valve, turn steering wheel extreme left and right positions against the stops. Record the highest indicated pressure at each position. Compare readings to specifications. If highest output pressures are not the same against either stop, the gear is leaking internally and must be repaired.

PUMP OPERATING SPECIFICATIONS

VEHICLE	RELIEF PRESSURE (P.S.I.) ± 50
YJ	1050
XJ	1400

J9319-89

POWER STEERING SYSTEM DIAGNOSIS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Objectionable "Hiss"	Noisy relief valve in the hydraulic pump. Steering gear valve noise is transmitted through the steering column or open air passages in the area where the column or controls pass through the floor into engine compartment.	There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. Hiss is a high frequency noise, that is present in every valve and results from high velocity fluid passing valve orifice edges. There is no relationship between this noise and performance of the steering. Do not replace the intermediate shaft or gear unless the hiss is extremely objectionable. Check the dashboard seals between the drivers area and under hood to eliminate open spaces.
Rattle Or Chuckle Noise In Steering Gear	1. Gear loose on the frame. 2. Steering linkage looseness. 3. Pressure hose touching other parts of vehicle. 4. Loose pitman arm. 5. Improper over-center adjustment. A slight rattle may occur on turns because of increase clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	1. Check the gear mounting bolts. Torque the bolts to specifications. 2. Check linkage pivot points for wear. Replace if necessary. 3. Adjust the hose position. Do not bend tubing by hand. 4. Torque the pitman arm bolt. 5. Adjust to specifications.

J9319-65

POWER STEERING SYSTEM DIAGNOSIS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Excessive Wheel Kick-Back Or Loose Steering	1. Air in the system. 2. Steering gear mounting loose. 3. Steering linkage joints worn. 4. Front wheel bearings incorrectly adjusted or worn. 5. Steering gear improperly adjusted. 6. Worn or missing poppet valve (steering gear). 7. Damaged or worn steering gear.	1. Add oil to the pump reservoir and bleed. Check hose connectors for proper torque. 2. Tighten attaching bolts to specified torque. 3. Replace loose parts. 4. Adjust the bearings or replace with new parts as necessary. 5. Adjust to specifications. 6. Replace the poppet valve. 7. Disassemble and repair the steering gear as outlined in the unit repair manual.
Vehicle Leads To One Side Or The Other (Keep In Mind The Road And Wind conditions). Test The Vehicle, Going In Both Directions, On A Flat Road.	1. Front end misaligned. 2. Unbalanced steering gear valve. If this is the cause, steering effort will be very light in direction of lead and heavy in opposite direction. 3. Steering shaft rubbing the ID of the shaft tube. 4. Steering linkage not level.	1. Adjust to specifications. 2. Replace the gear valve. 3. Align the column. 4. Adjust as required.
Momentary Increase In Effort When Turning The Wheel Quickly To The Right Or Left	1. Low oil level in the pump. 2. Pump belt slipping. 3. High internal leakage (steering gear or pump).	1. Add power steering fluid as required. 2. Tighten or replace belt. 3. Refer to "Pump Pressure Test" in this section.
Poor Return Of Steering	1. Tires under-inflated. 2. Lower coupling flange rubbing against the steering gear adjuster plug. 3. Steering wheel rubbing against directional signal housing. 4. Tight or frozen steering shaft bearings. 5. Steering linkage or ball joints binding. 6. Steering gear to column misalignment. 7. Tie rod pivots not centralized. 8. Lack of lubricant in the suspension ball joints and the steering linkage. 9. Stuck or plugged spool valve. 10. Rubber spacer binding in the shift tube. 11. Improper front end alignment. 12. Steering gear adjusted too tightly. 13. Kink in return hose.	1. Inflate to specified pressure. 2. Loosen the pinch bolt and assemble properly. 3. Adjust the steering jacket. 4. Replace the bearings. 5. Replace the affected parts. 6. Align the steering column. 7. Adjust tie rod ends as required to center pivots. 8. Lubricate. Refer to Group O – Lubrication and Maintenance. 9. Remove and clean or replace the valve. 10. Make certain the spacer is properly seated. Lubricate inside the diameter with silicone lubricant. 11. Check and adjust to specifications. 12. Adjust over-center and thrust bearing preload to specifications. 13. Replace the hose.
Steering Wheel Surges Or Jerks When Turning With Engine Running Especially During Parking	1. Low oil level in pump. 2. Loose pump belt. 3. Sticky flow control valve. 4. Insufficient pump pressure.	1. Add power steering fluid as required. 2. Adjust tension to specifications. 3. Replace or clean the control valve. 4. Refer to "Power Steering System Test" in this section.

J9319-64

POWER STEERING SYSTEM DIAGNOSIS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Steering Effort In Both Directions	1. Low tire pressure. 2. Lack of lubricant in suspension or ball joints. 3. Steering gear to column misalignment. 4. Pump belt slipping. 5. Low fluid level in reservoir. 6. High internal leakage (steering gear or pump). 7. Sticky flow control valve. 8. Lower coupling flange rubbing against steering gear adjuster plug. 9. Steering gear adjusted too tight. 10. Improper front end alignment.	1. Adjust the tire pressure. 2. Lubricate and relubricate at proper intervals. Refer to Group O – Lubrication and Maintenance. 3. Align the steering column. 4. Tighten or replace belt. 5. Fill to proper level. Inspect lines and joints for external leakage. 6. Refer to "Pump Pressure Test" in this section. 7. Replace or clean the valve. 8. Loosen the pinch bolt and assembly properly. 9. Adjust over-center and thrust bearing preload to specifications. 10. Check and adjust to specifications.
Foaming Milky Looking Power Steering Fluid, Low Level And Possible Low Pressrue	Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
Low Oil Pressure Due To Restriction In The Hose	1. Check for kinks in the hose. 2. Foreign object stuck in the hose.	1. Remove the kinks or replace the hose. 2. Remove the foreign object or replace the hose.
Low Oil Pressure Due To Steering Gear. Refer To "Power Steering System Test" In This Section	1. Pressure loss in cylinder due to worn piston ring or scored housing bore. 2. Leakage at the valve rings and valve body to the worm seal. 3. Leakage at the valve body or a loose fitting spool. 4. Damaged poppet valve.	1. Disassemble the steering gear as outlined in the unit repair manual. Inspect the ring and housing bore. Replace the affected parts. 2. Disassemble steering gear and replace seals. 3. Replace the valve. 4. Replace the poppet valve.
Low Oil Pressure Due To Steering Pump. Refer To "Pump Pressure Test" In This Section	1. Flow control valve stuck or inoperative. 2. Pressure plate not flat against the cam ring. 3. Extreme wear of cam ring. 4. Air in oil. 5. Low oil level. 6. Pump belt slipping. 7. Damaged hoses or steering gear.	1. Replace pump. 2. Replace pump. 3. Replace pump, flush system. 4. Locate source of leak and correct. Bleed the system. 5. Add power steering fluid as required. 6. Tighten or replace belt. 7. Replace as necessary.

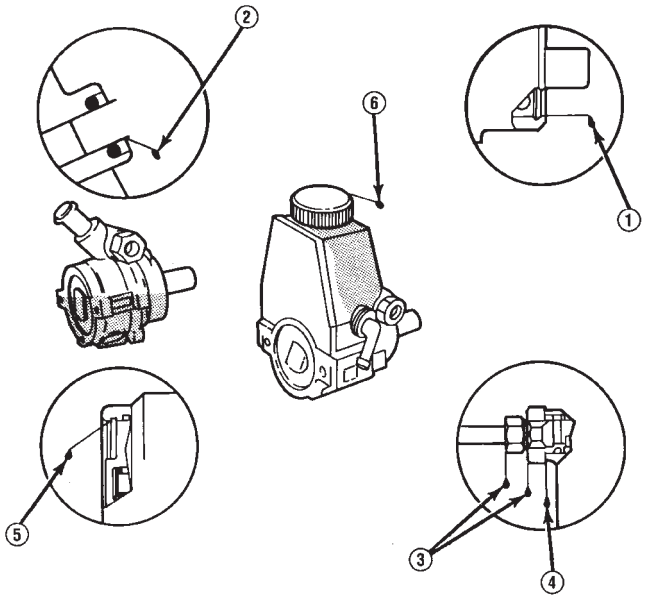
J9319-14

POWER STEERING SYSTEM DIAGNOSIS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Chirp Noise In Steering Pump	Pump belt slipping.	Tighten or replace belt.
Belt Squeal (Particularly Noticeable At Full Wheel Travel And Standstill Parking)	Pump belt slipping.	Tighten or replace belt.
Growl Noise In Steering Pump	Excessive back pressure in hoses or steering gear caused by restriction.	Locate restriction and correct.
Growl Noise In Steering Pump (Particularly Noticeable At Standstill Parking)	1. Scored pressure plates, thrust plate or rotor. 2. Extreme wear of cam ring.	1. Replace pump. 2. Replace pump.
Groan Noise In Steering Pump	1. Low oil level. 2. Air in the oil. Poor pressure hose connection.	1. Add power steering fluid as required. 2. Torque the connector. Bleed the system.
Rattle Or Knock Noise In Steering Pump	1. Pump vanes sticking in rotor slots. 2. Pressure hose touching other parts of vehicle.	1. Replace pump, flush system. 2. Adjust hose position.
Swish Noise In Steering Pump	Faulty flow control valve.	Replace pump.
Whine Noise In Steering Pump	Pump shaft bearing scored.	Replace pump.

J9319-13

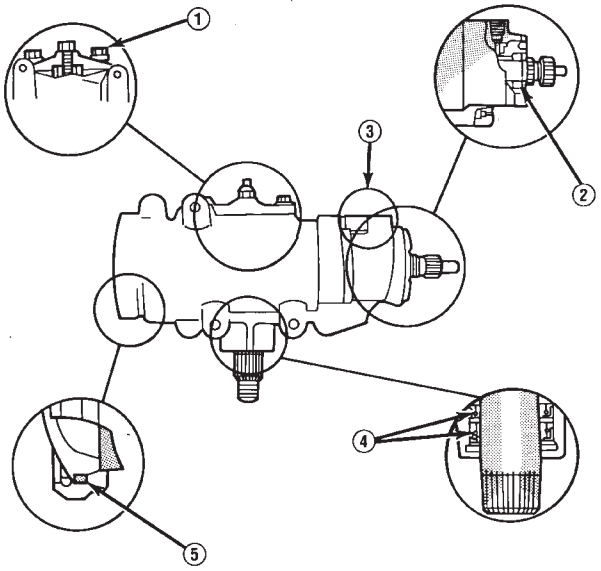
PUMP LEAKAGE DIAGNOSIS



1. BUSHING (BEARING) WORN, SEAL WORN. REPLACE PUMP.
2. REPLACE RESERVOIR O-RING SEAL.
3. TORQUE HOSE FITTING NUT TO 35 N•m (25 ft. lbs.). IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
4. TORQUE FITTING TO 75 N•m (55 ft. lbs.). IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
5. REPLACE PUMP.
6. CHECK OIL LEVEL; IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND CAP TIGHT, REPLACE THE CAP.

J9319-74

GEAR LEAKAGE DIAGNOSIS



1. SIDE COVER LEAK - TORQUE SIDE COVER BOLTS TO 60 N•m (45 FT. LBS.). REPLACE THE SIDE COVER SEAL IF THE LEAKAGE PERSISTS.
2. ADJUSTER PLUG SEAL - REPLACE THE ADJUSTER PLUG SEALS.
3. PRESSURE LINE FITTING - TORQUE THE HOSE FITTING NUT TO 27 N•m (20 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE THE SEAL.
4. PITMAN SHAFT SEALS - REPLACE THE SEALS.
5. TOP COVER SEAL - REPLACE THE SEAL.

J9319-75

POWER STEERING PUMP

INDEX

SERVICE INFORMATION

The power steering pump internal components are not serviced or adjusted. If a malfunction or an internal fluid leak occurs, the complete unit must be replaced. A reservoir, cap, and O-ring seal kit are the only service components available.

PRESSURE AND RETURN HOSE REPLACEMENT

Cap hose open ends and pump/steering gear fittings to prevent entry of foreign material.

WARNING: POWER STEERING FLUID (AND PUMP COMPONENTS) AND THE EXHAUST SYSTEM CAN BE EXTREMELY HOT IF THE ENGINE HAS BEEN RECENTLY OPERATING. DO NOT START THE ENGINE WITH ANY LOOSE OR DISCONNECTED HOSES. DO NOT ALLOW THE HOSES TO TOUCH A HOT EXHAUST MANIFOLD OR THE CATALYTIC CONVERTER.

REMOVAL

(1) Remove fasteners from hose retaining brackets at all locations.

(2) If applicable, remove pressure sensor from pressure hose (Fig. 1, 2).

(3) Disconnect pressure and return hose from the steering gear. Drain the fluid from pump and reservoir (Fig. 1, 2, 3).

(4) Disconnect pressure and return hose from the pump. Remove hoses from vehicle (Fig. 1, 2, 3).

INSTALLATION

(1) Wipe hose ends, pump and gear unions clean.

(2) Connect hose at steering gear and pump. Route hose while avoiding extreme bends or kinks. **The hose must be kept away from exhaust system components.** Do not distort hose tube ends by bending, kinking or over tightening.

(3) If applicable, install and tighten pressure sensor to 28 N·m (252 in. lbs.) torque (Fig. 1, 2).

(4) When used, the protective foam sleeves must be properly positioned on the hose to prevent chafing.

(5) Tighten fittings at pump and gear to 35 N·m (25 ft. lbs.) torque.

(6) Install clamps on return hose on gear, pump and reservoir.

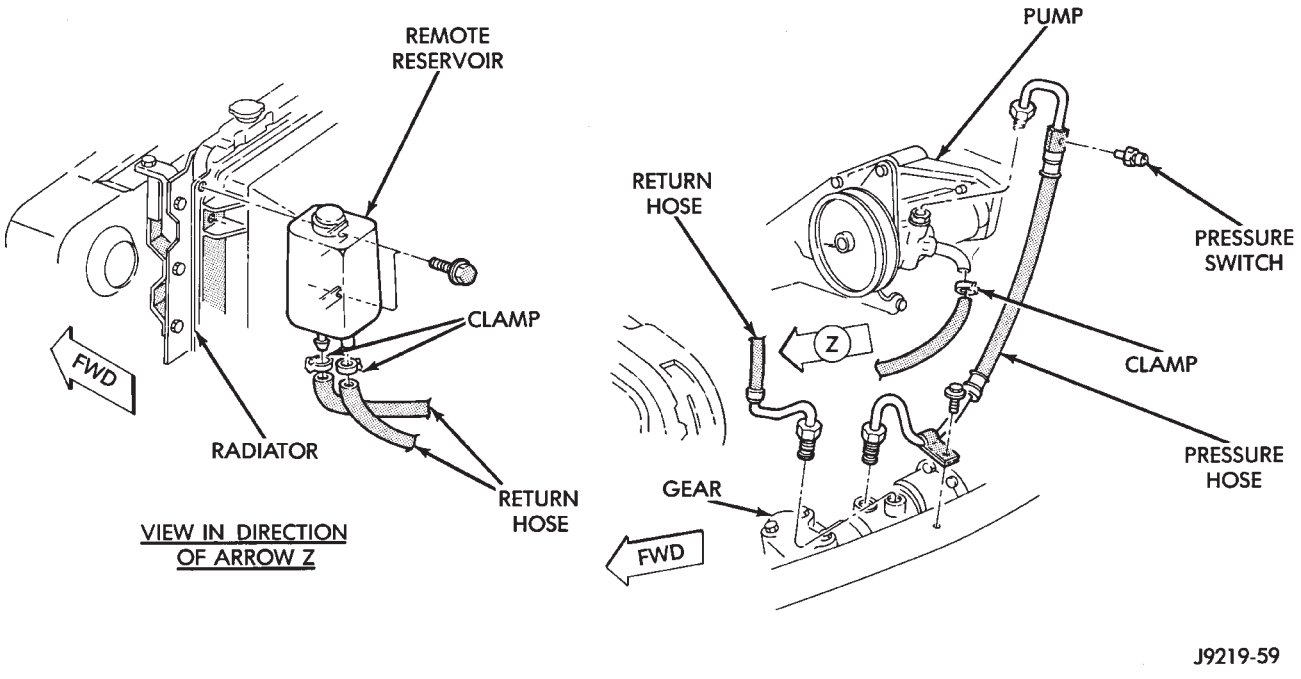


Fig. 1 Power Steering Hose YJ

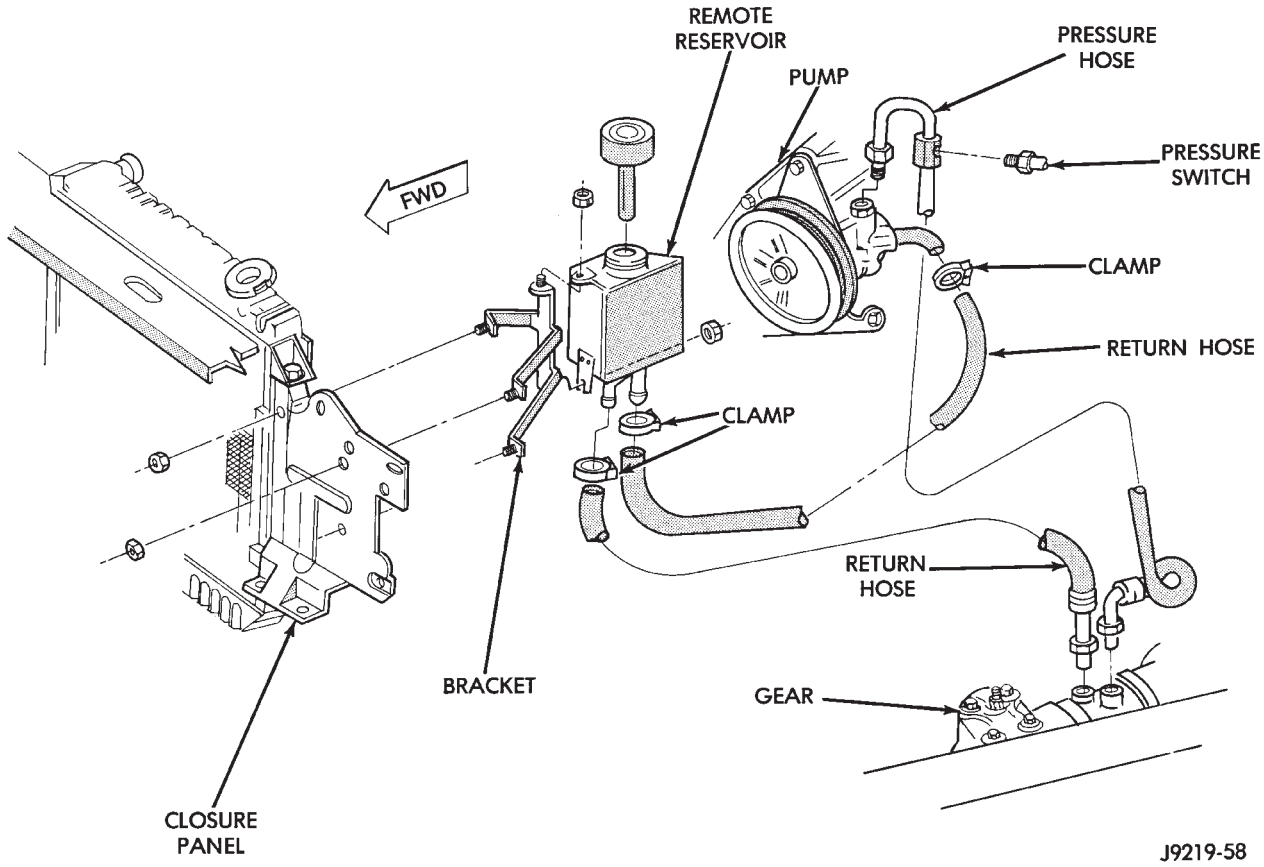


Fig. 2 Power Steering Hose XJ 4 Cylinder

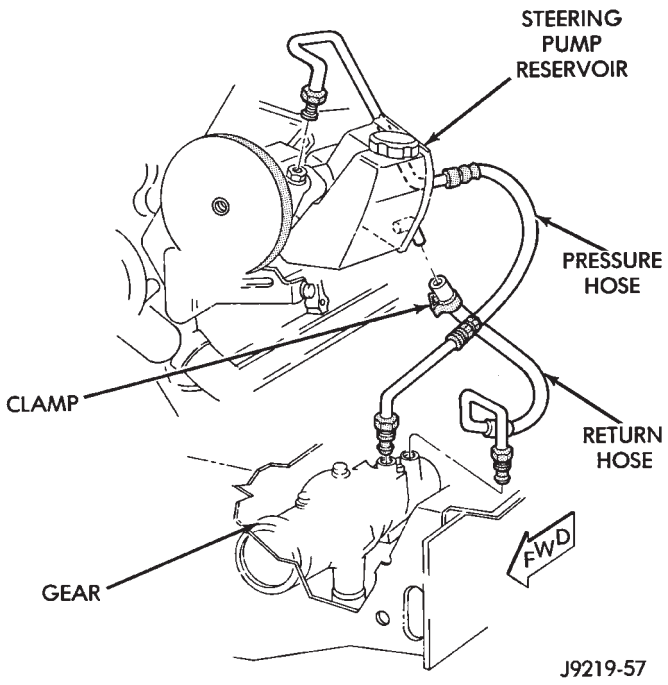


Fig. 3 Power Steering Hose XJ 6 Cylinder

(7) After installation, inspect and test for fluid leaks.

PUMP REPLACEMENT

REMOVAL

CAUTION: The drive belt tension must be released before removing the pump. If the belt is not loosened, the pump pulley could be damaged.

(1) Remove serpentine drive belt. Refer to Group 7, Cooling for additional information.
(2) Place a drain pan under pump.
(3) Remove pressure and return hoses from pump. Refer to Pressure and Return Hose Replacement in this section.
(4) Remove 2 rear bracket-to-pump bolts (Fig. 4).
(5) Remove lower nut at adjustment bracket.
(6) Remove adjuster bolt.
(7) Remove upper pivot bolt.
(8) Tilt pump forward and remove pump and front bracket assembly from engine bracket.
(9) Remove adjuster collar at lower stud on pump bracket.
(10) Remove pulley from pump. Refer to Drive Pulley Replacement in this section (Fig. 5).
(11) Remove 3 front bracket-to-pump bolts.

FASTENER TORQUE			
LETTER	N•m	IN. LBS.	FT. LBS.
A	57	—	42
B	28	250	21
C	47	—	35

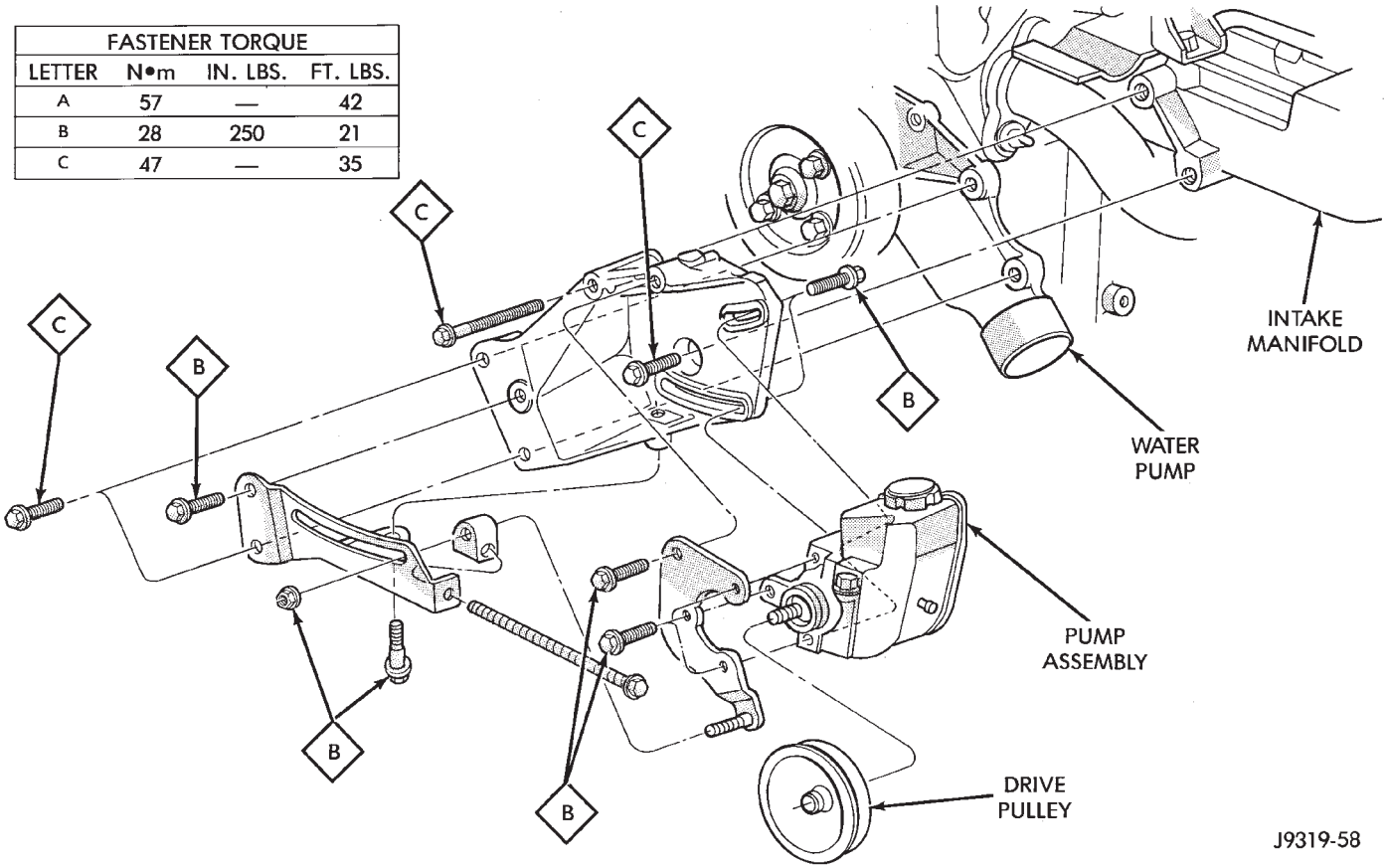


Fig. 4 Pump Mounting (4.0L I-6)

INSTALLATION

(1) Install 3 front bracket-to-pump bolts. Tighten to 28 N·m (21 ft. lbs.) torque.

(2) Install pulley on pump. Refer to Drive Pulley Replacement in this section (Fig. 6).

(3) Install adjuster collar on adjuster bracket stud (Fig. 4).

(4) Tilt pump forward and install pump onto engine bracket.

(5) Install upper pivot bolt.

(6) Install lower adjuster bolt.

(7) Install lower adjuster stud nut.

(8) Install 2 rear engine bracket to pump bolts. Tighten to 28 N·m (21 ft. lbs.) torque.

(9) Install the serpentine drive belt. Refer to Group 7, Cooling for additional information.

(10) Install the pressure and return hoses to pump. Refer to Pressure and Return Hose Replacement in this section.

(11) Add power steering fluid. Refer to Power Steering Pump Initial Operation in this section.

DRIVE PULLEY REPLACEMENT

REMOVAL

(1) Remove power steering pump. Refer to Pump Replacement in this section.

(2) Remove the drive pulley with Puller C-4333 (J-25034-B) (Fig. 5).

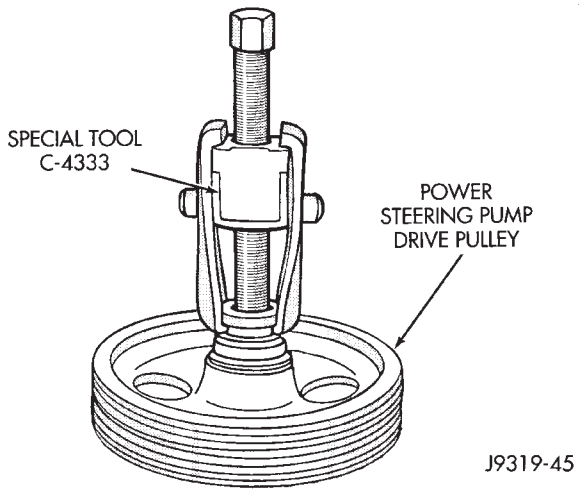


Fig. 5 Remove Drive Pulley (Typical)

Do not hammer on any part of drive pulley, damage will occur to the pump and pulley.

INSTALLATION

(1) Install the pulley with Installer C-4063 (J-25033-B) (Fig. 6). Do not use the tool adapters.

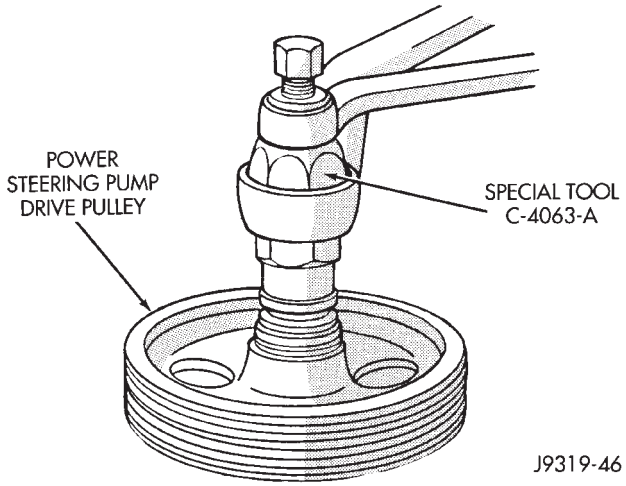


Fig. 6 Install Drive Pulley (Typical)

(2) Be sure tool and pulley remain aligned and NOT cocked with the pump shaft.

(3) Press the pulley on flush with end of pump shaft (Fig. 7).

(4) Install power steering pump. Refer to Pump Replacement in this section.

With Serpentine Belts; Run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

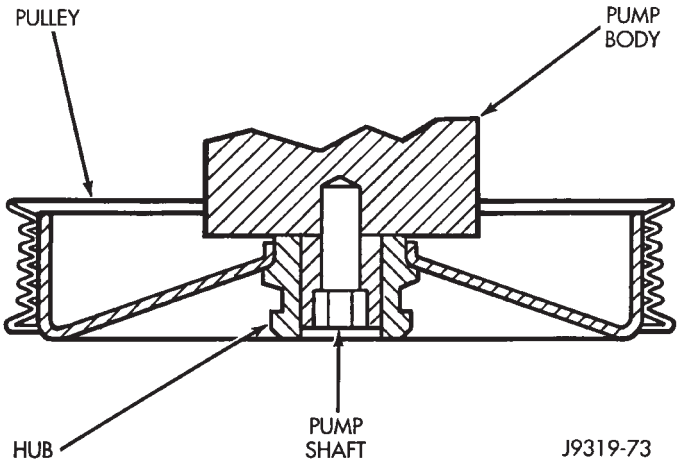


Fig. 7 Pump Shaft Location

RESERVOIR REPLACEMENT

REMOVAL

(1) Remove power steering pump. Refer to Pump Replacement in this section.

(2) Clean exterior of pump with solvent.

(3) Clamp the pump body in a soft jaw vice.

(4) Pry up tab and slide the retaining clip off (Fig. 8).

(5) Remove fluid reservoir from pump body. Remove and discard O-ring seal (Fig. 9).

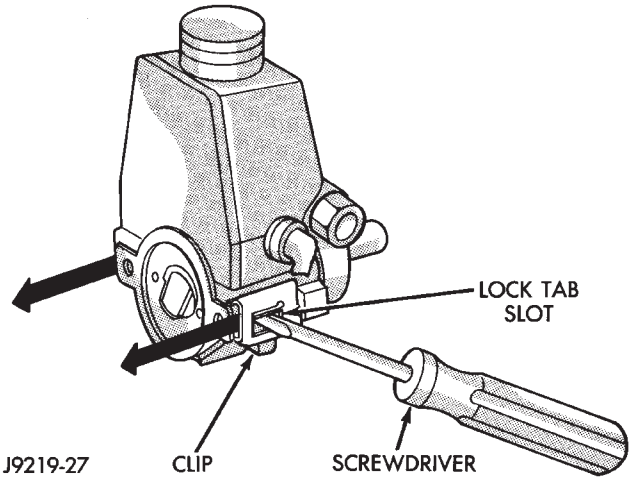


Fig. 8 Remove Reservoir Clips (Typical)

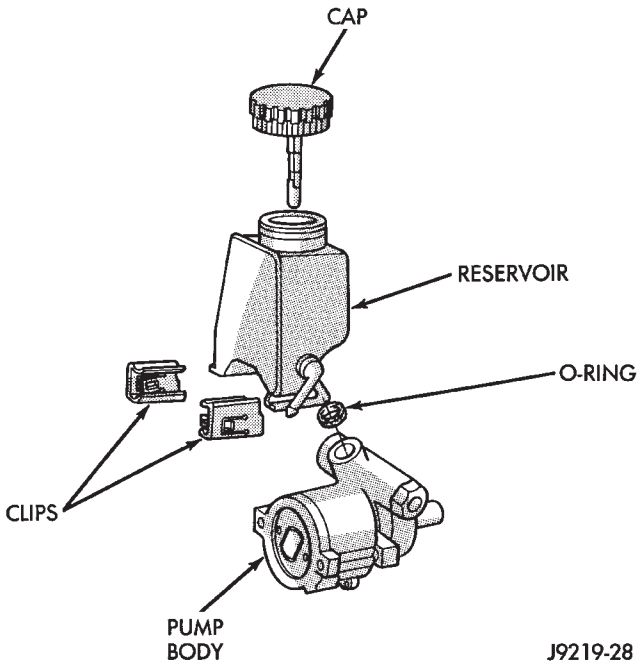


Fig. 9 Remove Reservoir (Typical)

INSTALLATION

(1) Lubricate new O-ring Seal with Mopar Power Steering Fluid or equivalent.

(2) Install O-ring seal in housing.

(3) Install reservoir onto housing.

(4) Slide and tap in reservoir retainer clips until tab locks to housing.

(5) Install power steering pump. Refer to Pump Replacement in this section.

FLOW CONTROL VALVE FITTING O-RING SEAL

REMOVAL

(1) Clean area around fitting to prevent dirt from entering pump. Remove pressure hose from pump fitting.

(2) Remove fitting from pump housing (Fig. 10). **Prevent flow control valve and spring from sliding out of housing bore.**

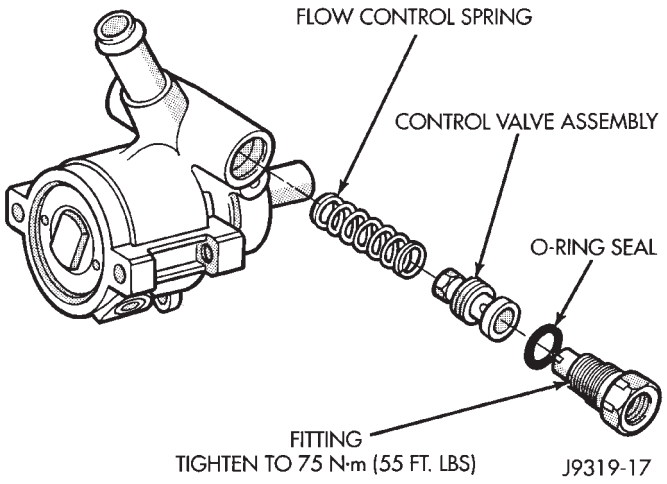


Fig. 10 Flow Control Valve Fitting

(3) Remove and discard O-ring seal.

INSTALLATION

(1) If necessary, clean and install flow control valve and spring in pump housing bore. **Be sure the hex nut end of the valve is facing in toward pump.**

(2) Install O-ring seal onto fitting (Fig. 10).

(3) Install flow control valve in pump housing and tighten to 75 N·m (55 ft. lbs.) torque.

(4) Install pressure hose to valve.

POWER STEERING PUMP—INITIAL OPERATION

CAUTION: The fluid level should be checked with engine off to prevent injury from moving components. Use only Mopar Power Steering Fluid. Do not use automatic transmission fluid. Do not overfill.

Wipe filler cap clean, then check the fluid level. The dipstick should indicate FULL COLD when the fluid is at normal temperature 21°C to 27°C (70°F to 80°F).

(1) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two (2) minutes.

(2) Start the engine and let run for a few seconds. Then turn the engine off.

(3) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

(4) Raise the front wheels off the ground.

(5) Start the engine. Slowly turn the steering wheel right and left, lightly contacting the wheel stops.

(6) Add power steering fluid if necessary.

(7) Lower the vehicle and turn the steering wheel slowly from lock to lock.

(8) Stop the engine. Check the fluid level and refill as required.

(9) If the fluid is extremely foamy, allow the vehicle to stand a few minutes and repeat the above procedure.

STEERING LINKAGE—XJ

INDEX

SERVICE INFORMATION

The steering linkage consists of a pitman arm, drag link, tie rod, and steering dampener. Adjustment sleeves are used on the tie rod and drag link for toe and steering wheel alignment.

Refer to Group 2, Front Suspension and Axle for additional information.

The tie-rod end ball stud seals should be inspected during all oil changes.

A damaged ball stud seal requires removal of the seal. Inspect the tie-rod end ball stud at the throat opening. Check for lubricant loss, contamination, ball stud wear or corrosion. If these conditions exist, replace the tie-rod. A replacement seal can be installed if lubricant is in good condition. Otherwise, a complete replacement ball stud end should be installed. Lubricate the tie-rod end with MOPAR® Multi-Mileage Lubricant, or equivalent product.

Use a Puller tool for tie rod removal. Failure to use this tool could damage the ball stud and seal (Fig. 1).

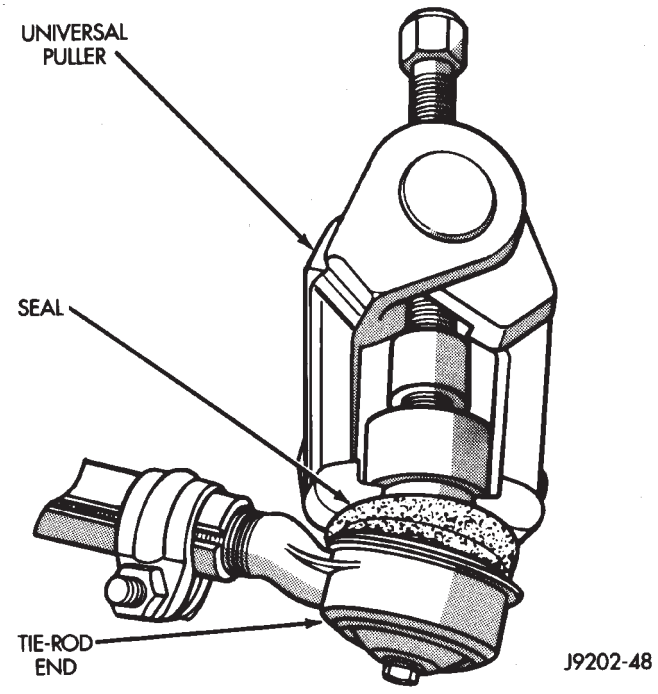


Fig. 1 Ball Stud Removal

TIE ROD

REMOVAL

(1) Remove the cotter pins and nuts at the tie rod ball studs and drag link (Fig. 2).

(2) Loosen the ball studs with a puller tool to remove the tie rod.

(3) If necessary, loosen the end clamp bolts and remove the tie rod ends from the tube.

INSTALLATION

(1) If necessary, install the tie rod ends in the tube (Fig. 2). Position the tie rod clamp as shown (Fig. 3) and tighten to 27 N·m (20 ft. lbs.) torque.

(2) Install the tie rod on the drag link and steering knuckle. Install the retaining nuts.

(3) Tighten the ball stud nut on the steering knuckle to 47 N·m (35 ft. lbs.) torque. Tighten the ball stud nut to drag link to 75 N·m (55 ft. lbs.) torque. Install new cotter pins.

DRAG LINK

REMOVAL

The drag link ball stud cannot be disassembled for service.

(1) Remove the steering dampener ball stud from the drag link with a puller tool.

(2) Remove the drag link from the steering knuckle with a puller tool. Remove the same for tie rod and pitman arm.

(3) If necessary, loosen the end clamp bolts and remove the tie rod end from the link.

INSTALLATION

(1) Install the drag link adjustment sleeve and tie rod end. Position clamp bolts as shown (Fig. 3).

(2) Position the drag link at the steering linkage (Fig. 2).

Install the nut that attach the drag link to the steering knuckle. Do the same for the tie rod and pitman arm.

(3) Tighten the nut at the steering knuckle to 47 N·m (35 ft. lbs.) torque. Tighten the pitman and tie rod ball stud nuts to 75 N·m (55 ft. lbs.) torque. Install new cotter pins.

FASTENER TORQUE			
LETTER	N•m	IN. LBS.	FT. LBS.
A	251	—	185
B			
C	74	—	55
D			
E	49	—	36
F	27	—	20

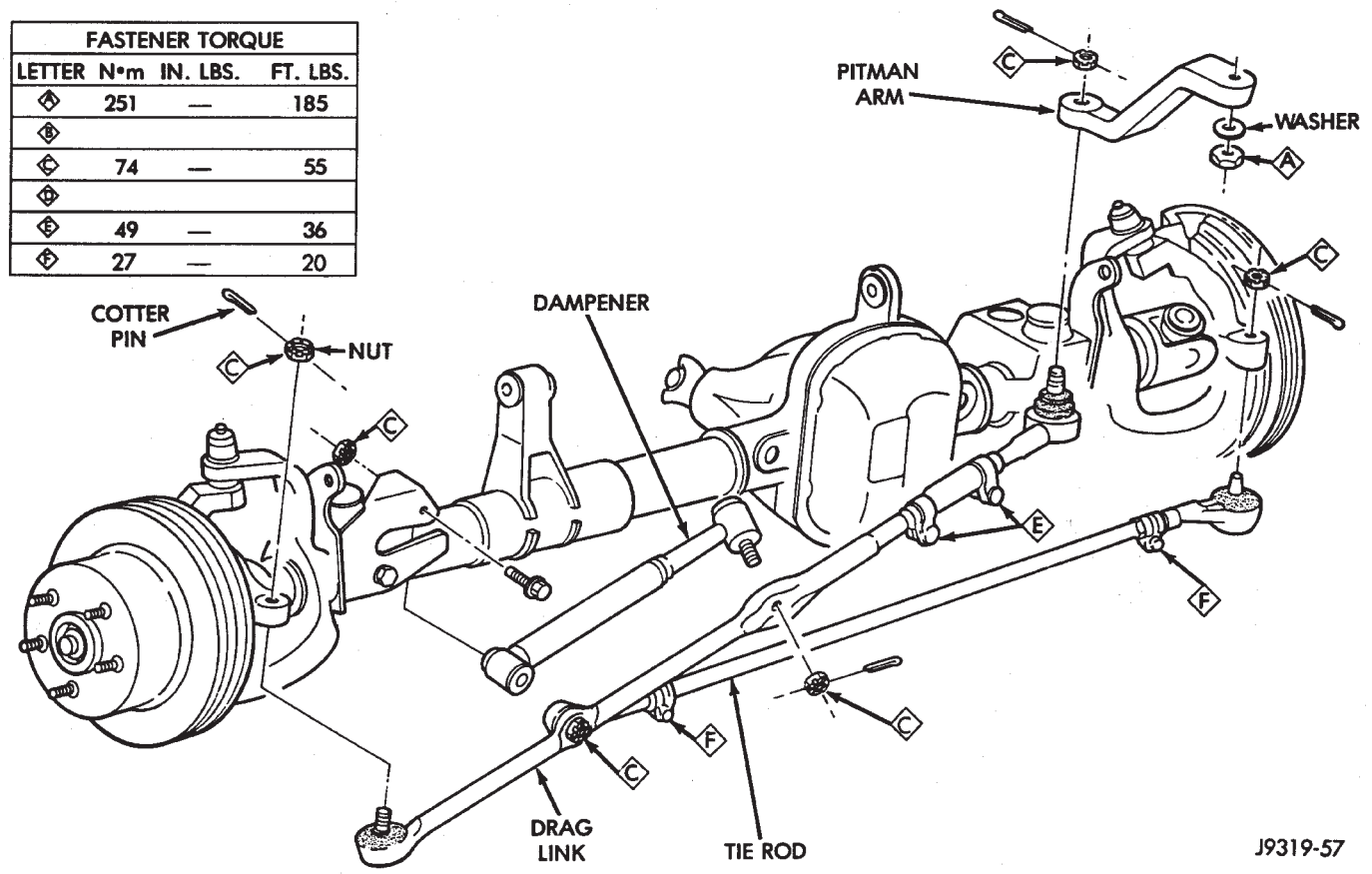


Fig. 2 Steering Linkage

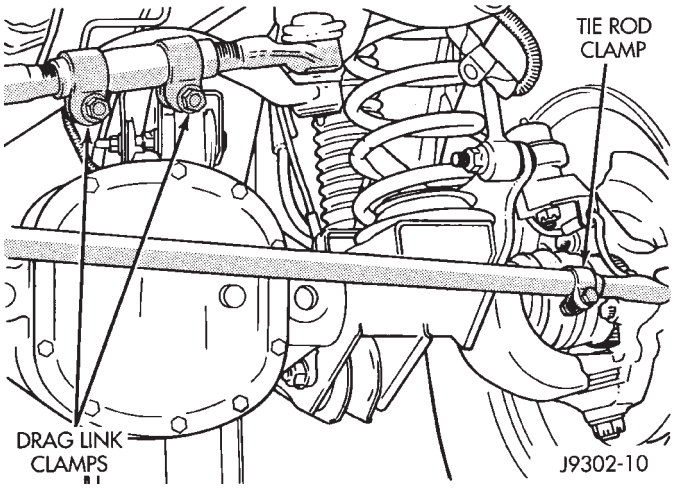


Fig. 3 Tie Rod/Drag Link Clamp Bolt

(4) Install the steering dampener onto the drag link. Tighten the nut to 47 N·m (35 ft. lbs.) torque. Install a new cotter pin.

STEERING DAMPENER

REMOVAL

(1) Place the front wheels in a straight-ahead position.

(2) Remove the steering dampener retaining nut and bolt from the axle bracket (Fig. 2).

(3) Remove the cotter pin and nut from the ball stud at the drag link (Fig. 2).

(4) Remove the steering dampener ball stud from the drag link with a puller tool.

INSTALLATION

(1) Install the steering dampener to the axle bracket and drag link.

(2) Install the steering dampener bolt in the axle bracket. Tighten the nut to 75 N·m (55 ft. lbs.) torque.

(3) Install the ball stud nut at the drag link. Tighten the nut to 75 N·m (55 ft. lbs.) torque. Install a new cotter pin.

PITMAN ARM

REMOVAL

(1) Remove the cotter pin and nut from the drag link at the pitman arm.

(2) Remove the drag link ball stud from the pitman arm with a puller.

(3) Remove the nut and washer from the steering gear shaft. Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from steering gear with Puller 7998 or C-4150 (Fig. 4).

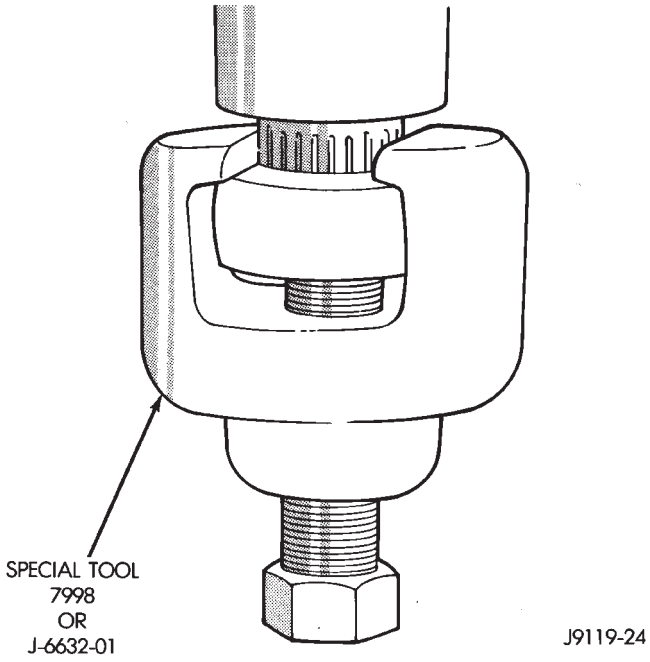


Fig. 4 Pitman Arm Removal

INSTALLATION

(1) Align and install the pitman arm on steering gear shaft.

(2) Install the washer and nut on the shaft. Tighten the nut to 251 N·m (185 ft. lbs.) torque.

(3) Install drag link ball stud to pitman arm (Fig. 4). Install and tighten nut to 74 N·m (55 ft. lbs.) torque. Install a new cotter pin.

STEERING LINKAGE—YJ

INDEX

SERVICE INFORMATION

The steering linkage consists of a pitman arm, drag link, tie rod, and steering dampener. Adjustment sleeves are used on the tie rod and drag link for toe and steering wheel alignment.

Refer to Group 2, Front Suspension and Axle for additional information.

The tie-rod end ball stud seals should be inspected during all oil changes.

A damaged ball stud seal requires removal of the seal. Inspect the tie-rod end ball stud at the throat opening. Check for lubricant loss, contamination, ball stud wear or corrosion. If these conditions exist, replace the tie-rod. A replacement seal can be installed if lubricant is in good condition. Otherwise, a complete replacement ball stud end should be installed. Lubricate the tie-rod end with MOPAR® Multi-Mileage Lubricant, or equivalent product.

Use a Puller tool for tie rod removal. Failure to use this tool could damage the ball stud and seal (Fig. 1).

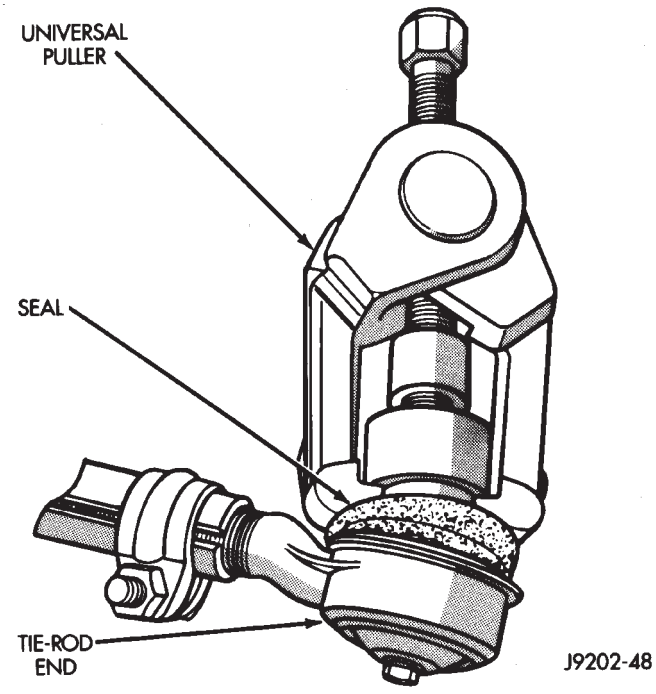


Fig. 1 Ball Stud Removal

TIE ROD

REMOVAL

(1) Remove the cotter pins and nuts at the steering knuckles and drag link (Fig. 2). Remove the steering dampener from the tie rod.

(2) Loosen the ball studs with a puller tool to remove the tie rod.

(3) If necessary, loosen the end clamp bolts and remove the tie rod end from the tube.

INSTALLATION

(1) If necessary, install the tie rod end in the tube (Fig. 2). Position the tie rod clamp as shown (Fig. 3). Tighten the ball-stud end clamp bolts to 49 N·m (36 ft. lbs.) torque.

(2) Install the tie rod on the drag link and steering knuckles. Install the retaining nuts. Install the steering dampener to the tie rod.

(3) Tighten the ball stud nut on the steering knuckle to 47 N·m (35 ft. lbs.) torque. Tighten the ball stud nut to drag link to 75 N·m (55 ft. lbs.) torque. Tighten the steering dampener nut to 74 N·m (55 ft. lbs.) torque. Install new cotter pins.

DRAG LINK

REMOVAL

(1) Remove the cotter pins and nuts at the tie rod and pitman arm (Fig. 2).

(2) Remove the drag link from the tie rod and pitman arm with a puller tool.

(3) If necessary, loosen the end clamp bolts and remove the tie rod ends from the tube.

INSTALLATION

(1) Install the drag link adjustment sleeve and tie rod ends. Position clamp bolts as shown (Fig. 3).

(2) Position the drag link at the steering linkage (Fig. 2).

Install the drag link to tie rod and pitman arm.

(3) Tighten the nut at the pitman arm to 74 N·m (55 ft. lbs.) torque. Tighten the tie rod ball stud nut to 75 N·m (55 ft. lbs.) torque. Install new cotter pins.

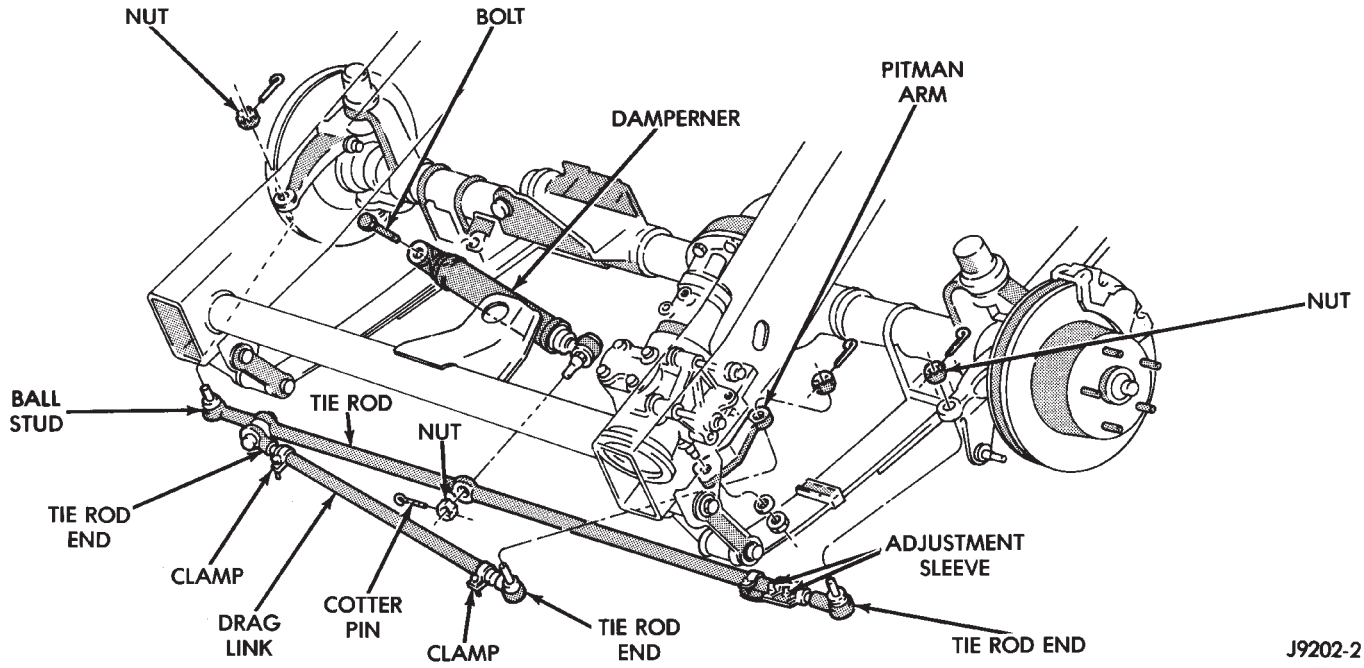


Fig. 2 Steering Linkage

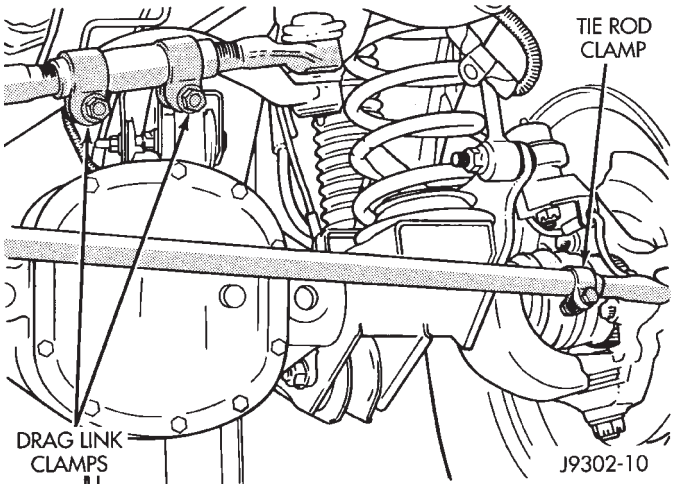


Fig. 3 Tie Rod/Drag Link Clamp Bolt

STEERING DAMPENER

REMOVAL

(1) Place the front wheels in a straight-ahead position.

(2) Remove the steering dampener retaining nut and bolt from the axle bracket (Fig. 2).

(3) Remove the cotter pin and nut from the ball stud at the tie rod (Fig. 2).

(4) Remove the steering dampener ball stud from the tie rod with a puller tool.

INSTALLATION

(1) Install the steering dampener to the axle bracket and tie rod.

(2) Install the steering dampener bolt in the axle bracket. Tighten the nut to 74 N·m (55 ft. lbs.) torque.

(3) Install the ball stud nut at the tie rod. Tighten the nut to 74 N·m (55 ft. lbs.) torque. Install a new cotter pin.

PITMAN ARM

REMOVAL

(1) Remove the cotter pin and nut from the drag link at the pitman arm.

(2) Remove the drag link ball stud from the pitman arm with a puller.

(3) Remove the nut and washer from the steering gear shaft. Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from steering gear with Puller 7998 or C-4150 (Fig. 4).

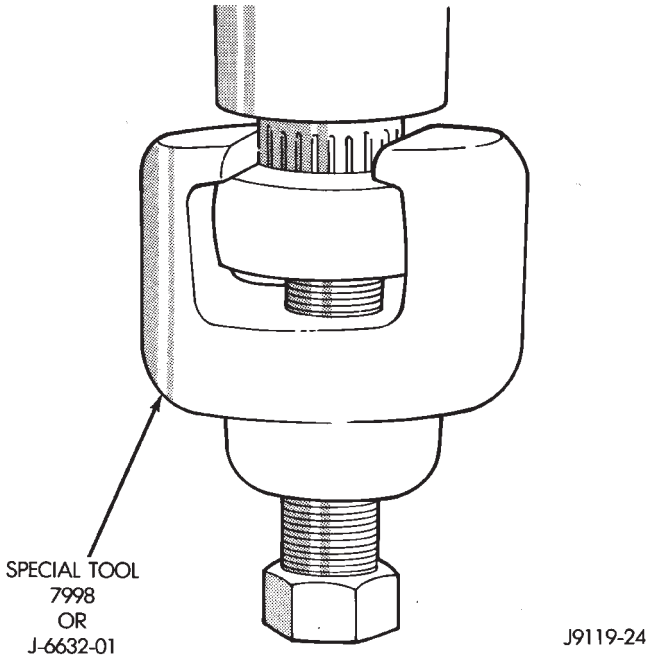


Fig. 4 Pitman Arm Removal

INSTALLATION

(1) Align and install the pitman arm on steering gear shaft.

(2) Install the washer and nut on the shaft. Tighten the nut to 251 N·m (185 ft. lbs.) torque.

(3) Install drag link ball stud to pitman arm (Fig. 4). Install and tighten nut to 74 N·m (55 ft. lbs.) torque. Install a new cotter pin.

RECIRCULATING BALL POWER STEERING GEAR

INDEX

SERVICE INFORMATION

A recirculating-ball steering gear is used with the power (assisted) steering system (Fig. 1). The power steering gear can be adjusted and internally serviced.

Discard all O-ring seals during disassembly, they are not re-usable.

Safety goggles should be worn at all times when involved with power steering gear or pump service.

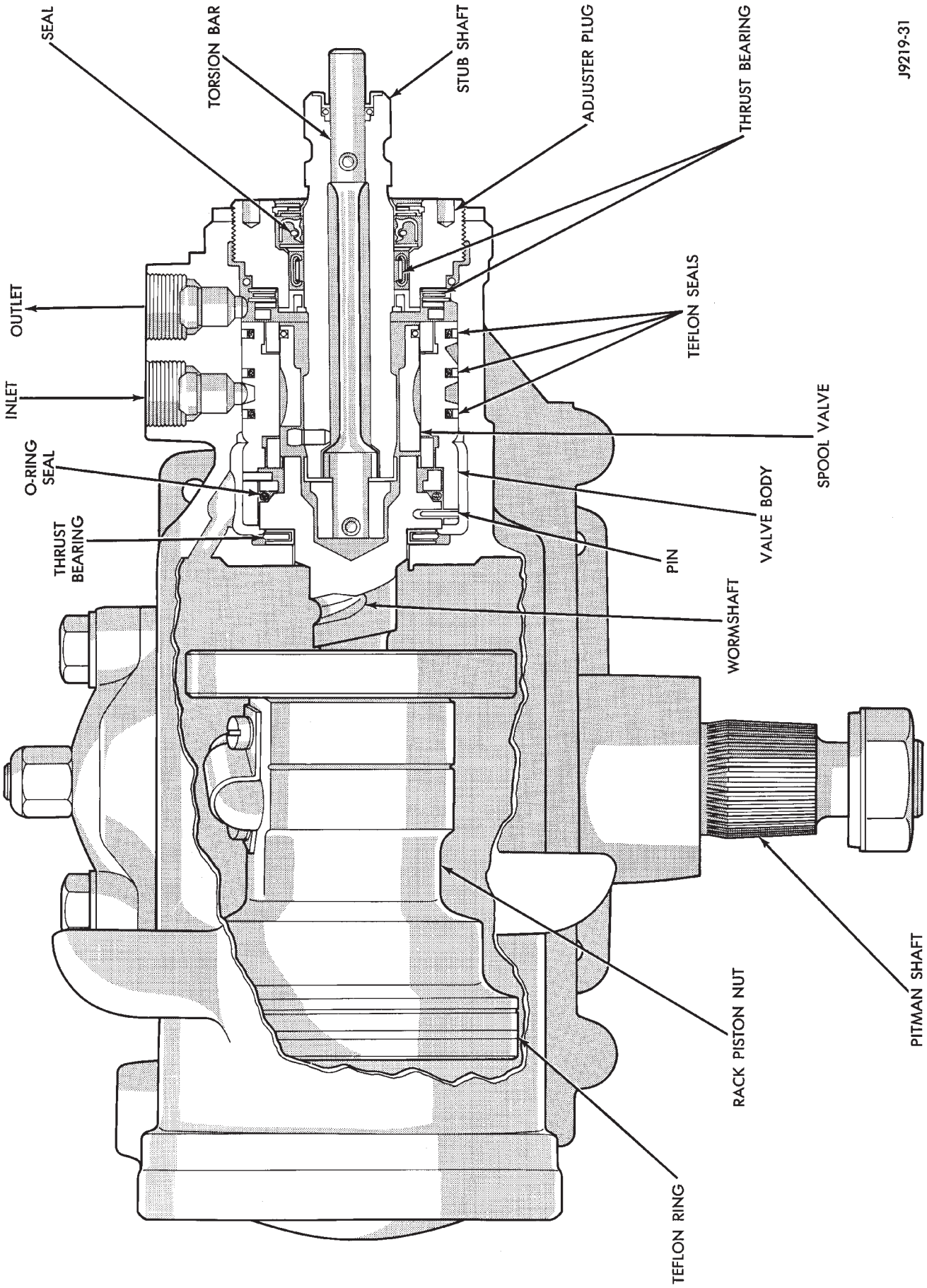


Fig. 1 Power Steering Gear

PITMAN SHAFT SEALS—IN CAR REPLACEMENT

REMOVAL

(1) Remove pitman arm from gear. Refer to Pitman Arm Removal in Steering Linkage.

(2) Clean exposed end of pitman shaft and housing. Use a wire brush to clean the shaft splines.

(3) Remove retaining ring with snap ring pliers (Fig. 2).

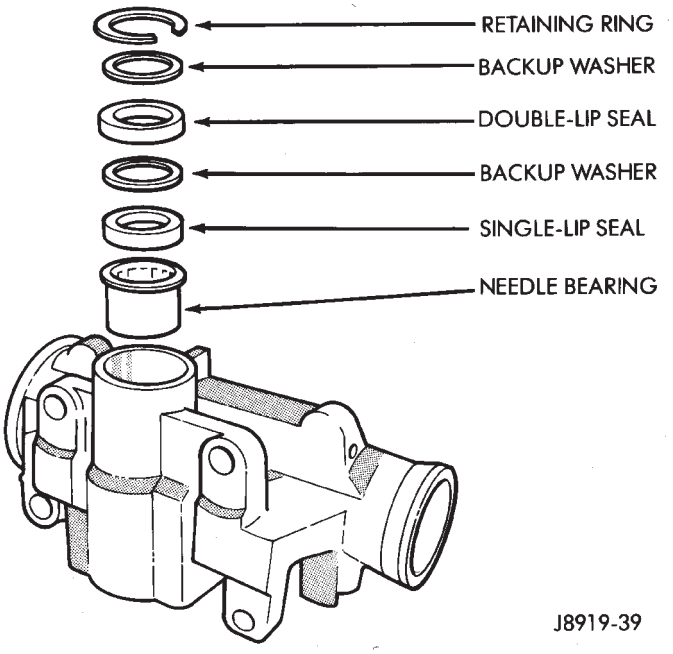


Fig. 2 Pitman Shaft Seals

CAUTION: Use care not to score the housing bore when prying out seals and washers.

(4) Remove backup washer and double lip seal with screwdriver.

- Start the engine and turn the steering wheel fully to the LEFT to force out the seals and washers.
- Stop the engine

(5) Remove backup washer and single lip seal with screwdriver.

(6) Inspect the housing for burrs and remove if necessary. Inspect the pitman shaft seal surface for roughness and pitting. If pitted replace shaft.

INSTALLATION

(1) Install single lip seal with Installer or a suitable size deep socket (Fig. 3).

(2) Coat the double lip seal and washer with grease.

(3) Install the backup washer.

(4) Install the double lip seal.

(5) Install the backup washer.

(6) Install the retainer ring with snap ring pliers.

(7) Center the steering gear.

(8) Install the pitman arm. Refer to Pitman Arm Installation in Steering Linkage.

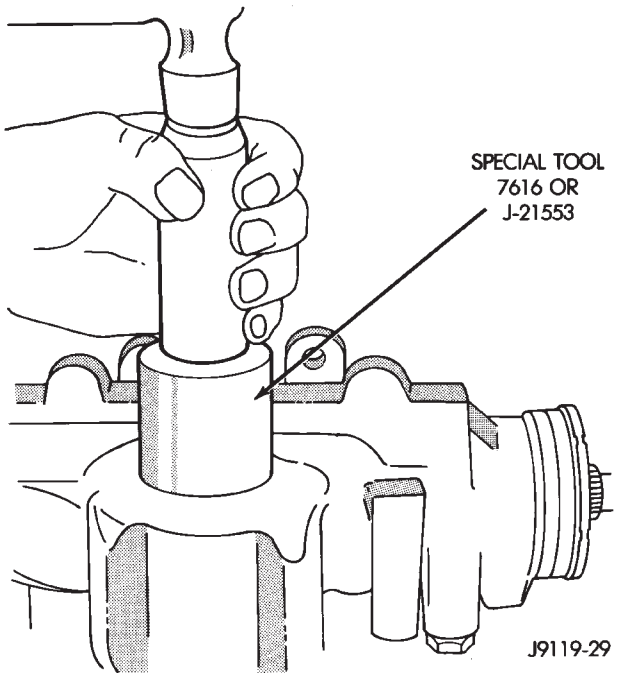


Fig. 3 Pitman Shaft Seal Installation

(9) Add power steering fluid. Refer to Power Steering Initial Operation.

INTERMEDIATE (COUPLING) SHAFT

REMOVAL

(1) Place the front wheels in the straight ahead position.

(2) Remove the shaft pinch bolt at the steering gear and column (Fig. 4, 5). Unbolt steering gear from frame rail to remove shaft. Refer to Steering Gear Replacement in this section.

INSTALLATION

(1) Align the intermediate (coupler) shaft to the steering gear and column.

(2) Position the steering gear on the frame. Refer to Steering Gear Replacement in this section.

(3) Install and tighten the pinch bolts to 34 N·m (25 ft. lbs.) torque.

STEERING GEAR REPLACEMENT

REMOVAL

(1) Place the front wheels in the straight ahead position with the steering wheel centered.

(2) Disconnect and cap the fluid hoses from steering gear. Refer to Pressure and Return Hose Replacement in this Group.

(3) Remove the column coupler shaft from the gear. Refer to the removal procedures in this section.

(4) Remove pitman arm from gear. Refer to Pitman Arm Removal in the Steering Linkage section.

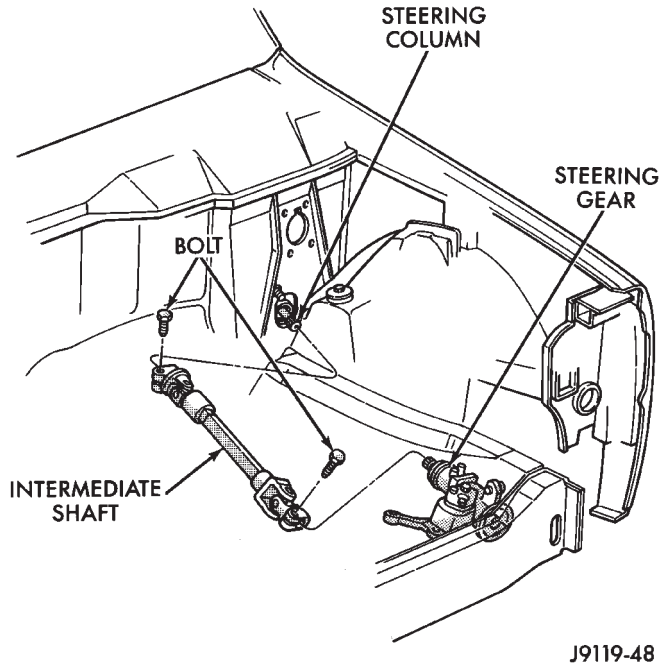


Fig. 4 Coupler Shaft—XJ

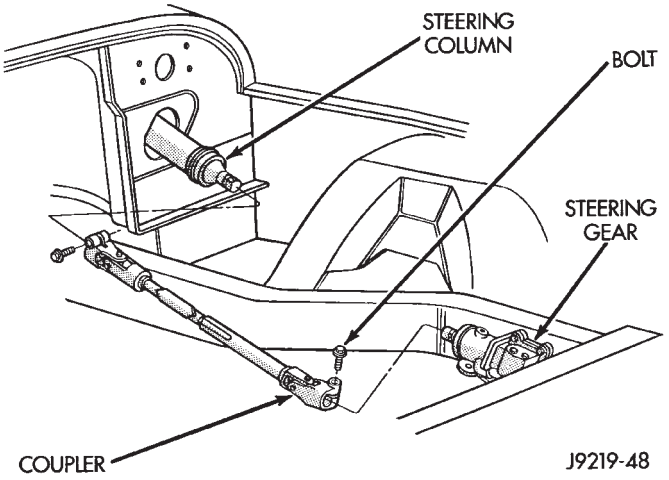


Fig. 5 Coupler Shaft—YJ

(5) Remove the steering gear retaining bolts and nuts. Remove the steering gear from the vehicle (Fig. 6, 7).

INSTALLATION

(1) Align the column coupler shaft to steering gear. Refer to Column Coupler installation in this section.

(2) Position the steering gear (and bracket) on the frame rail and install the bolts.

- XJ—Tighten the bolts to 95 N·m (70 ft. lbs.) torque
- YJ—Tighten the bolts to 105 N·m (78 ft. lbs.) torque

(3) Align and install the pitman arm. Refer to Pitman Arm Installation in the Steering Linkage section.

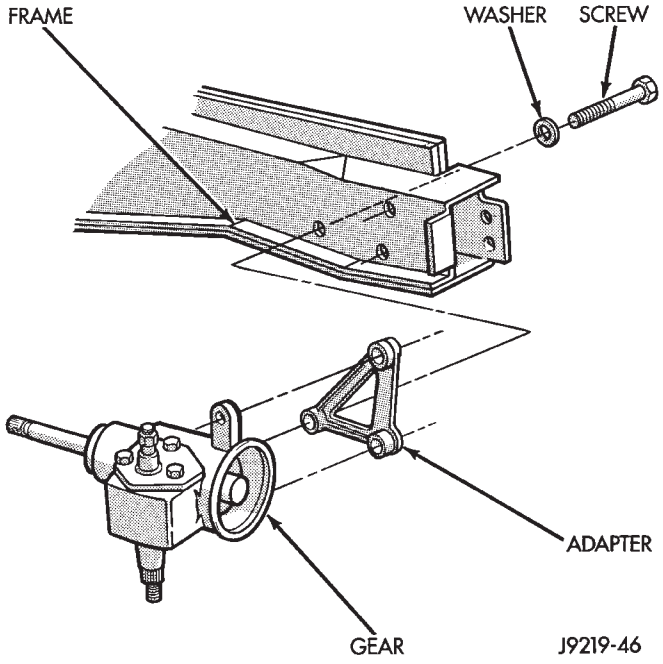


Fig. 6 Steering Gear Mounting—XJ

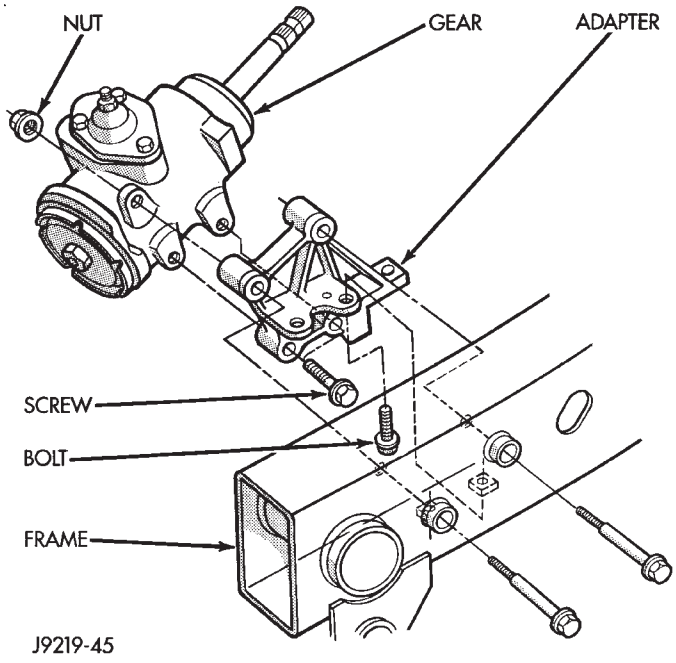


Fig. 7 Steering Gear Mounting—YJ

(4) Connect fluid hoses to steering gear. Refer to Pressure and Return Hose Replacement in this Group.

STEERING GEAR ADJUSTMENTS

SERVICE INFORMATION

Adjusting the steering gear in the vehicle is **NOT** recommended. Remove the gear from the vehicle and mount in a vise. Drain the power steering fluid and make the following adjustments in this order:

- FIRST - worm thrust bearing preload

• SECOND - over-center preload adjustment

WORM THRUST BEARING PRELOAD ADJUSTMENT

(1) Remove adjuster plug locknut (Fig. 8).

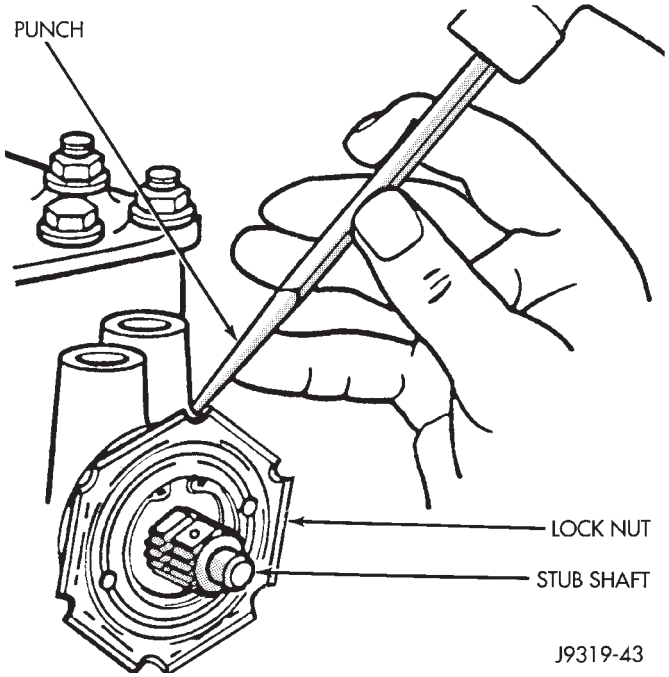


Fig. 8 Loosening the Adjuster Plug Locknut

(2) Turn the adjuster in with Spanner Wrench C-4381 (J7624). Tighten the plug and thrust bearing in the housing until firmly bottomed in housing.

(3) Place an index mark on the housing even with one of the holes in adjuster plug (Fig. 9).

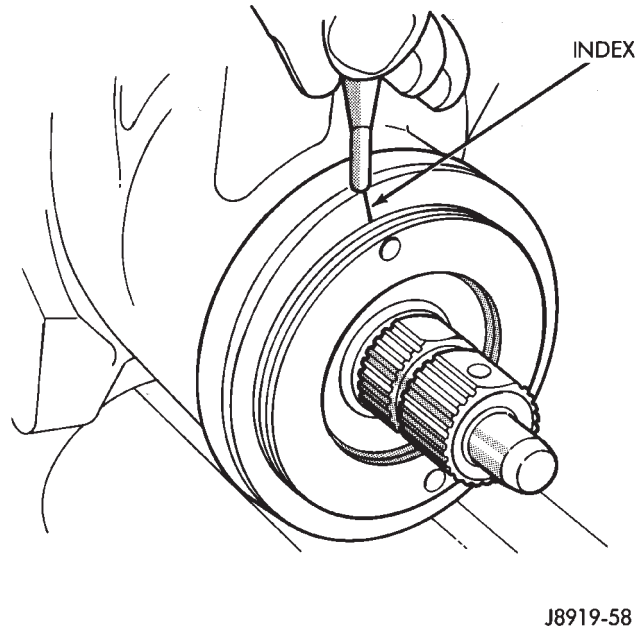


Fig. 9 Alignment Marking On Housing

(4) Measure back (counterclockwise) 13 mm (0.50 in) and mark housing (Fig. 10).

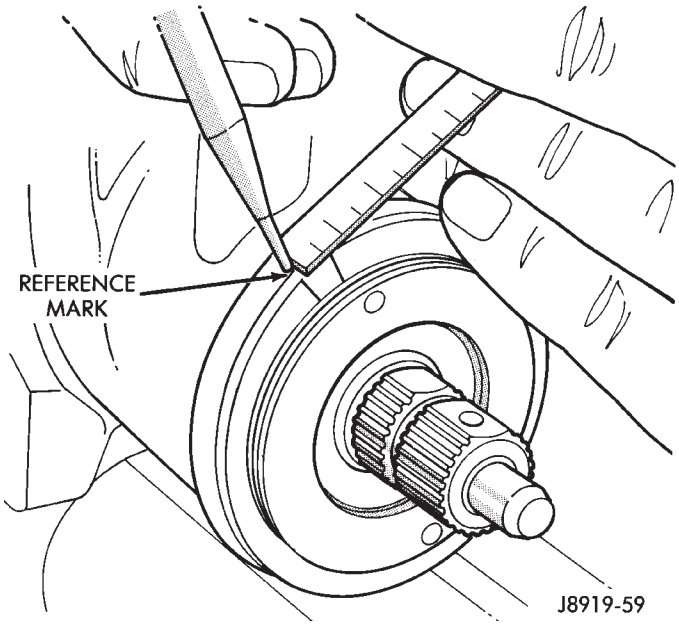


Fig. 10 Remarking The Housing

(5) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 11).

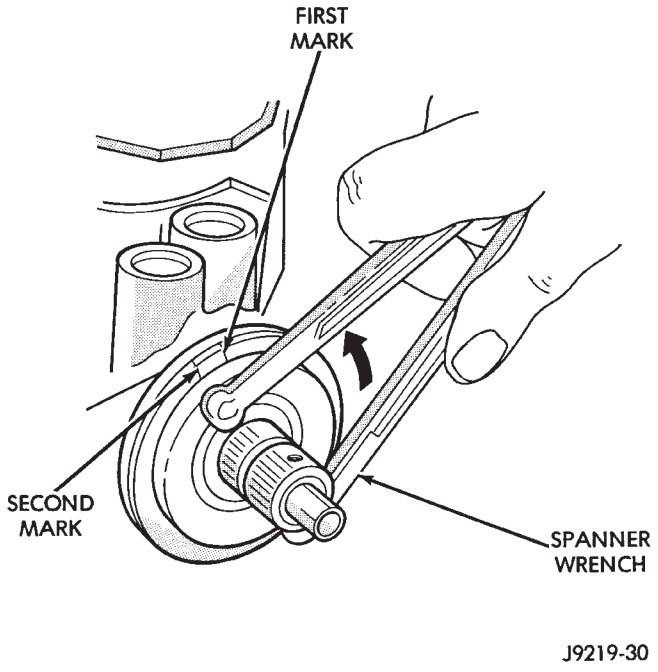


Fig. 11 Aligning To The Second Mark

(6) Install and tighten locknut to 109 N·m (80 ft. lbs.) torque. Be sure adjustment cap does not turn while tightening the locknut.

OVER-CENTER ADJUSTMENT

(1) Rotate the stub shaft from stop to stop and count the number of turns.

(2) Starting at either stop turn the stub shaft back 1/2 the total number of turns. This is the center of the gear travel (Fig. 12).

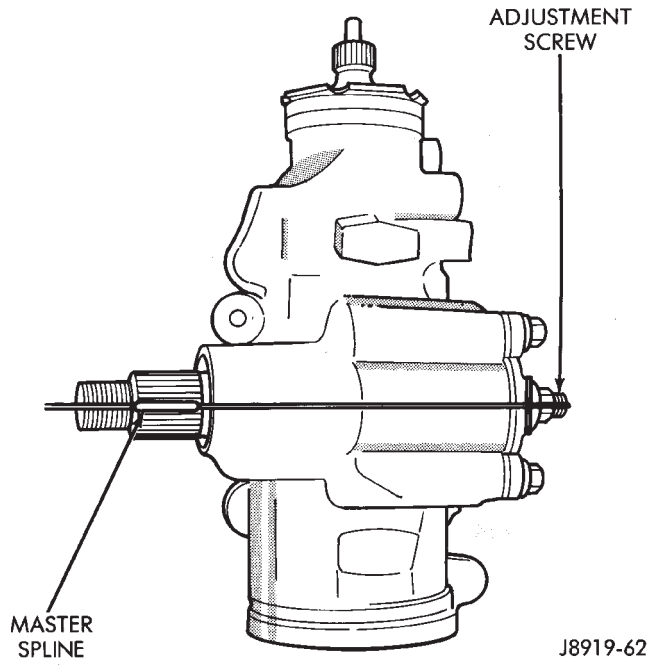


Fig. 12 Steering Gear Centered

(3) Turn the pitman shaft adjuster screw back (COUNTERCLOCKWISE) until extended, then turn back in (CLOCKWISE) one full turn.

(4) Place the torque wrench in the vertical position on the stub shaft. Rotate the wrench 45 degrees each side of the center and record the highest rotational torque on center (Fig. 13).

(5) Turn the adjuster in until torque to turn stub shaft is 0.6 to 1.2 N·m (6.0 to 10.0 in. lbs.) more than reading in Step 4.

(6) Prevent the adjuster screw from turning while tightening adjuster lock nut. Tighten the adjuster lock nut to 49 N·m (36 ft. lbs.).

GEAR DISASSEMBLY INFORMATION

CAUTION: Cleanliness is extremely important when repairing a power steering gear. Keep the bench, tools and components clean at all times. Thoroughly clean the exterior of the gear with cleaning solvent before disassembly. Drain as much of the fluid as possible. Use protective vise jaws at all times when clamping components. During assembly, lubricate all components with power steering fluid except where noted (Fig. 14).

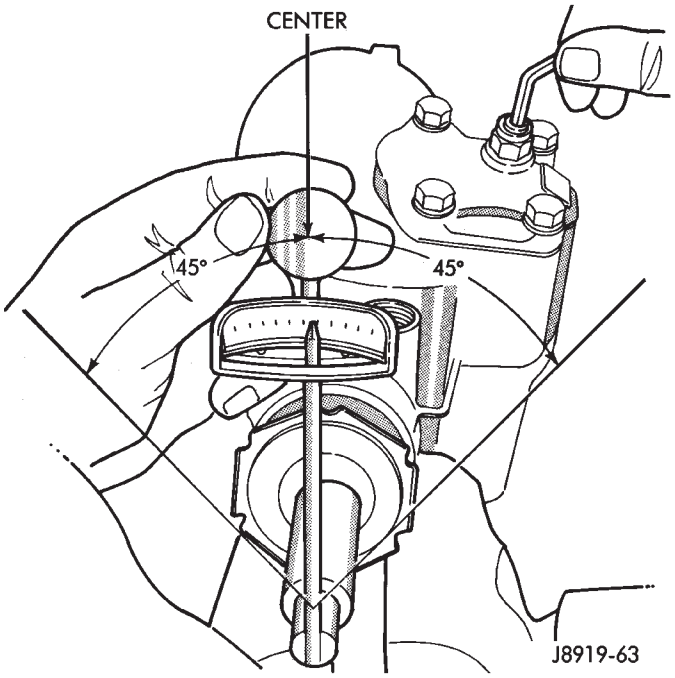


Fig. 13 Checking Over-center Rotation Torque

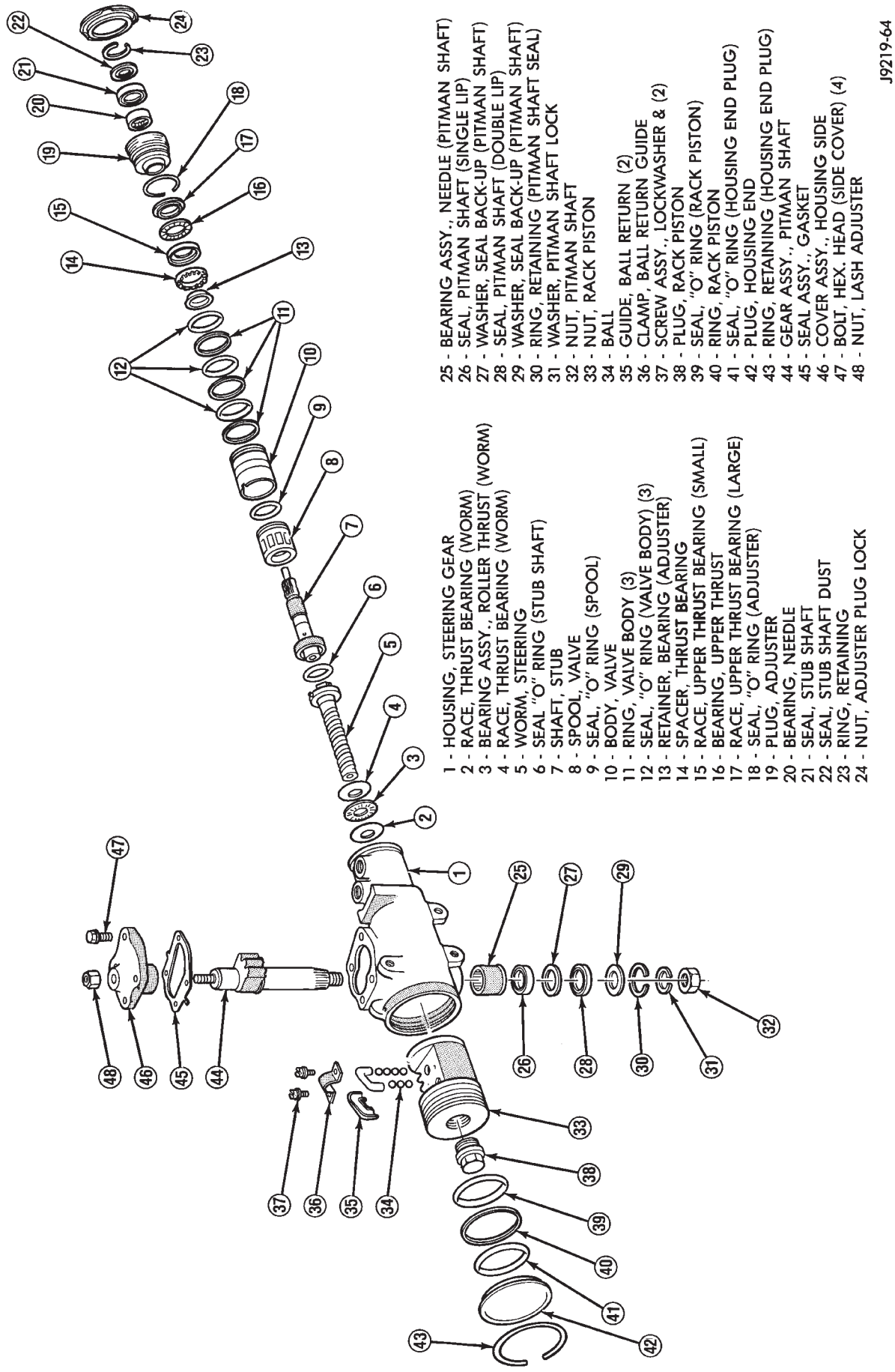


Fig. 14 Power Steering Gear

PITMAN SHAFT AND SIDE COVER REPLACEMENT

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

(2) Remove pitman arm from steering gear. Refer to Pitman Arm Removal in the Steering Linkage section.

(3) Rotate stub shaft back and forth to drain power steering fluid.

DISASSEMBLE

- Clean exposed end of pitman shaft and housing.
- Clean pitman shaft spline with a wire brush.

(1) Remove preload adjuster nut.

(2) Rotate stub shaft with socket to center gear. Remove side cover bolts.

(3) Remove side cover, gasket and pitman shaft as an assembly.

(4) Remove pitman shaft from the side cover (Fig. 15).

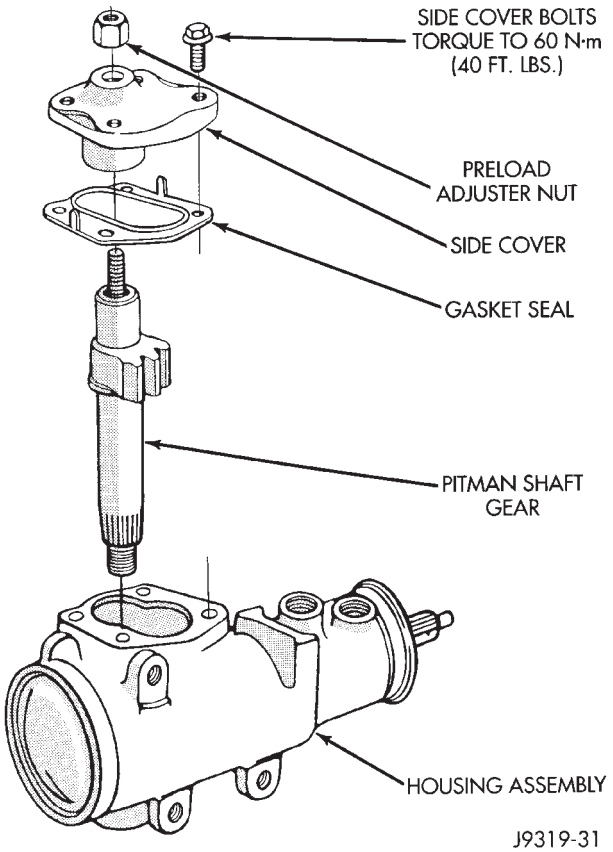


Fig. 15 Side Cover and Pitman Shaft

ASSEMBLE

(1) Install pitman shaft to side cover by screwing shaft in until it fully seats to side cover.

(2) Install preload adjuster nut. **Do not tighten nut until after pitman shaft adjustment has been made.**

(3) Install gasket to side cover and bend tabs around edges of side cover.

(4) Install pitman shaft assembly and side cover to housing.

(5) Install side cover bolts and tighten to 60 N·m (44 ft. lbs.).

(6) Adjust pitman shaft, refer to Over-Center Adjustment.

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

(2) Install pitman arm onto steering gear. Refer to Steering Linkage in this Group.

HOUSING END PLUG

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

(2) Remove pitman arm from steering gear. Refer to Steering Linkage in this Group.

(3) Rotate stub shaft back and forth to drain power steering fluid.

DISASSEMBLE

- Rotate stub shaft back and forth to drain fluid

(1) Rotate retaining ring until one end is under the hole in the housing. Unseat and force ring from groove (Fig. 16).

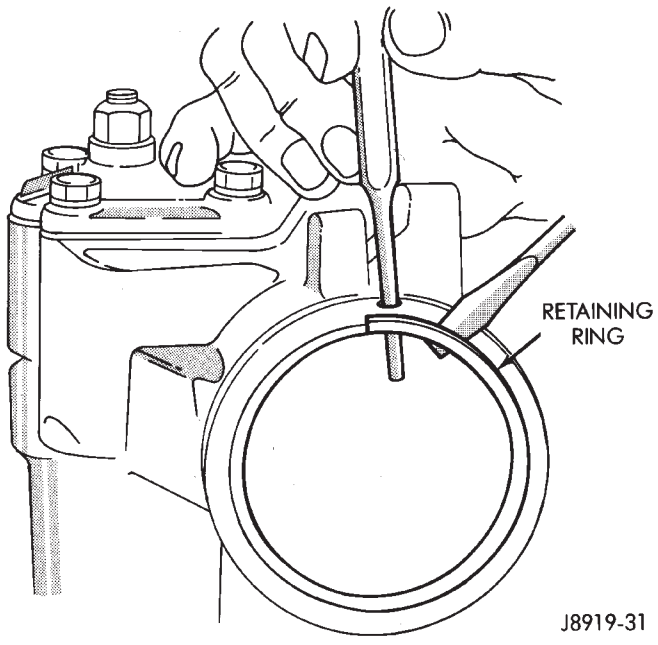


Fig. 16 End Plug Retaining Ring

(2) Rotate stub shaft slowly COUNTER-CLOCKWISE to remove end plug out from housing (Fig. 17).

CAUTION: Do not turn stub shaft any farther than necessary. The recirculating balls will drop out of the rack piston circuit and fall inside the rack piston chamber.

(3) Remove O-ring seal (Fig. 17).

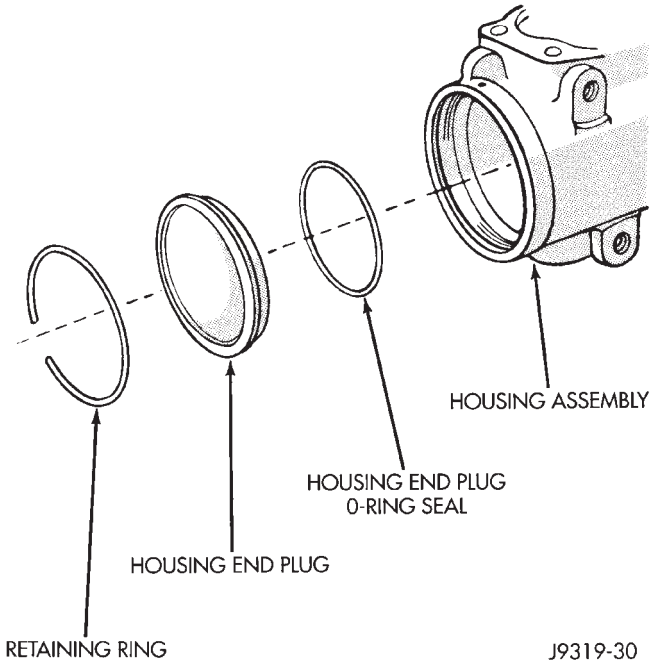


Fig. 17 End Plug Components

ASSEMBLE

- Lubricate O-ring seal with power steering fluid

(1) Install O-ring into housing.

(2) Install plug, tap lightly with a plastic mallet to seat it.

(3) Install retaining ring with open end 25 mm (1 inch) from access hole (Fig. 18).

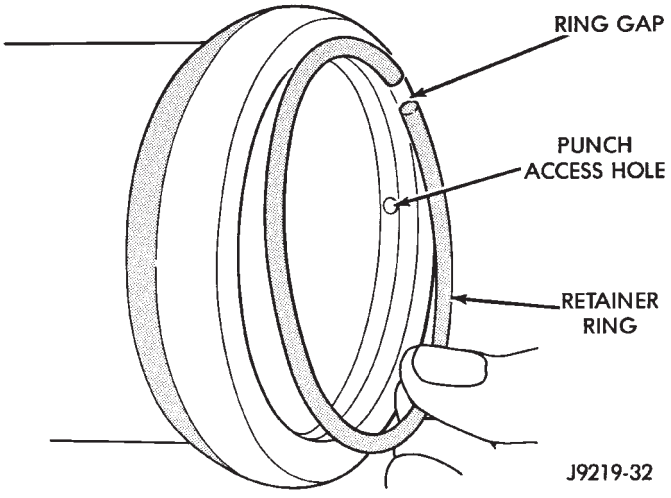


Fig. 18 Installing The Retaining Ring

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

(2) Install pitman arm onto steering gear. Refer to Steering Linkage in this Group.

ADJUSTER PLUG ASSEMBLY REPLACEMENT

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

DISASSEMBLE

(1) Remove adjuster plug lock nut from housing.

(2) Remove adjuster plug from housing with Spanner Wrench C-4381 (J7624) (Fig. 19).

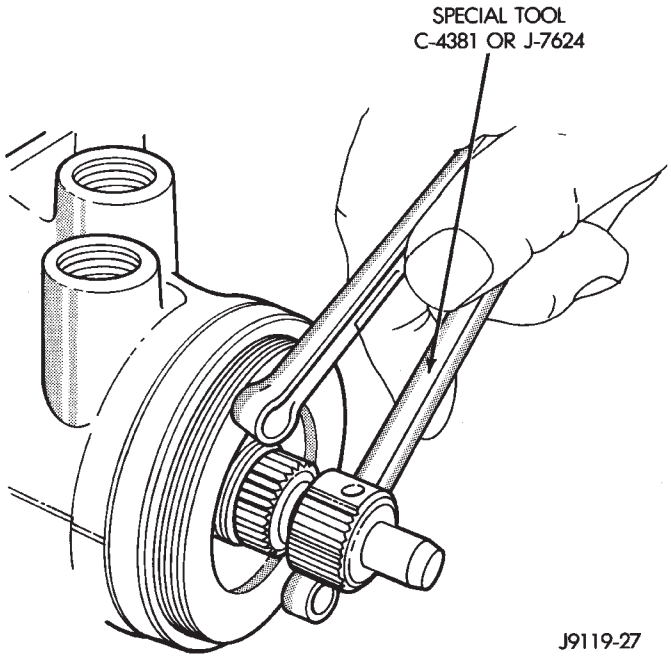


Fig. 19 Remove/Install Adjustment Plug

(3) Remove thrust washer bearing retainer from adjuster plug with screwdriver (Fig. 20).

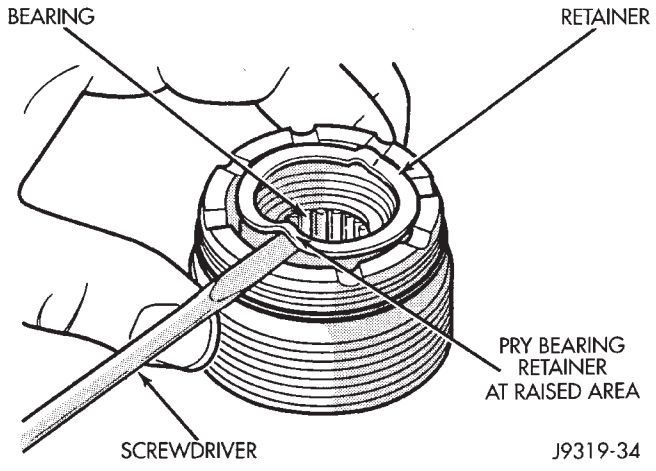


Fig. 20 Remove Retainer

(4) Remove bearing spacer, races and thrust bearing (Fig. 21).

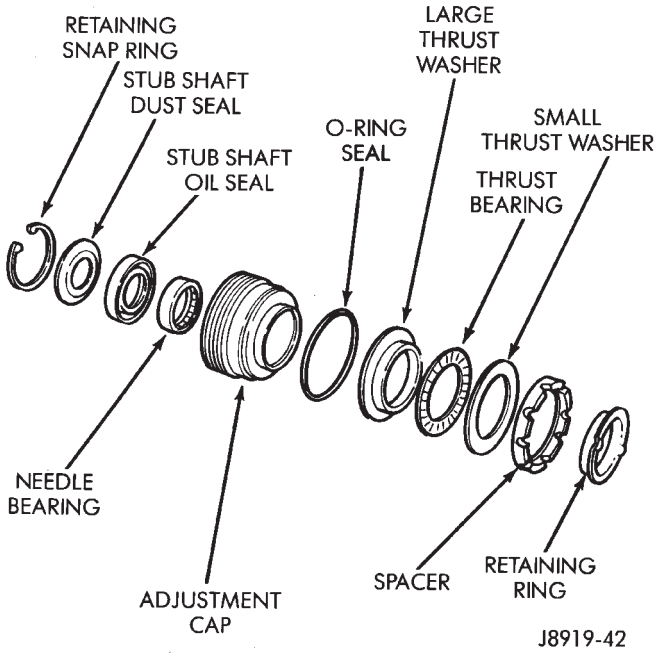


Fig. 21 Adjustment Plug (Cap) Components

(5) Remove O-ring seal.
(6) Remove retaining snap ring.
(7) Remove needle bearing, dust seal and lip seal with an appropriate tool (Fig. 22).

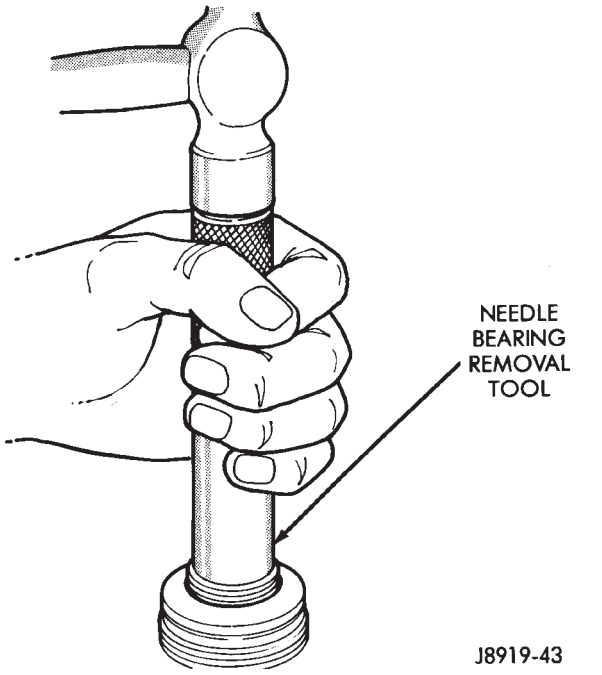


Fig. 22 Needle Bearing Removal

ASSEMBLE

CAUTION: Needle bearing must be installed with identification on bearing facing tool to prevent damage to bearing.

(1) Install needle bearing into adjuster plug with an appropriate tool.
(2) Install lip seal and dust seal into adjuster plug with an appropriate tool.
(3) Install retainer snap ring.
(4) Install O-ring seal to adjuster plug.
(5) Install large bearing race, thrust bearing, small bearing race and bearing spacer to adjuster plug.
(6) Install thrust washer bearing retainer to adjuster plug (Fig. 23).

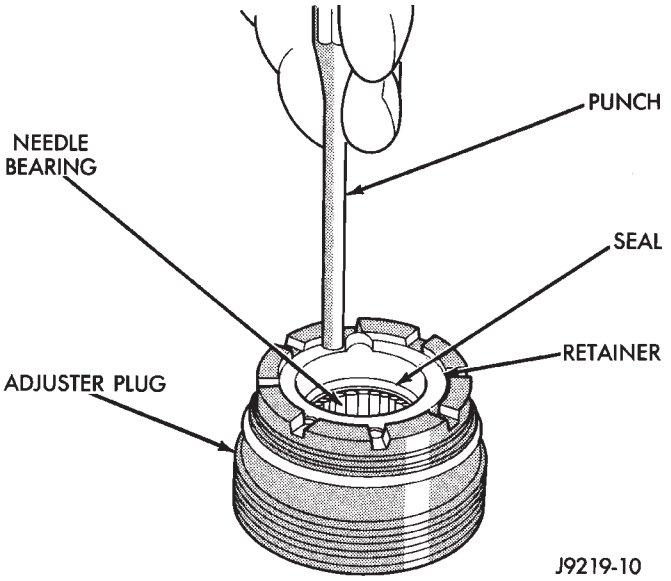


Fig. 23 Install Retainer

CAUTION: When installing adjuster plug, care should be taken NOT to cut the seals.

(7) Install adjuster plug into housing with Spanner Wrench C-4381 (J7624).
(8) Adjust bearing preload, refer to Thrust Bearing Preload Adjustment.
(9) Install adjuster plug lock nut, and using a punch (drift) in a notch, tighten securely (Fig. 24). **Hold adjuster plug to maintain alignment of the marks.**
(10) Adjust pitman shaft. Refer to Over-Center Adjustment.

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

VALVE REPLACEMENT

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

DISASSEMBLE

(1) Remove adjuster plug, refer to Adjuster Plug Assembly Replacement.

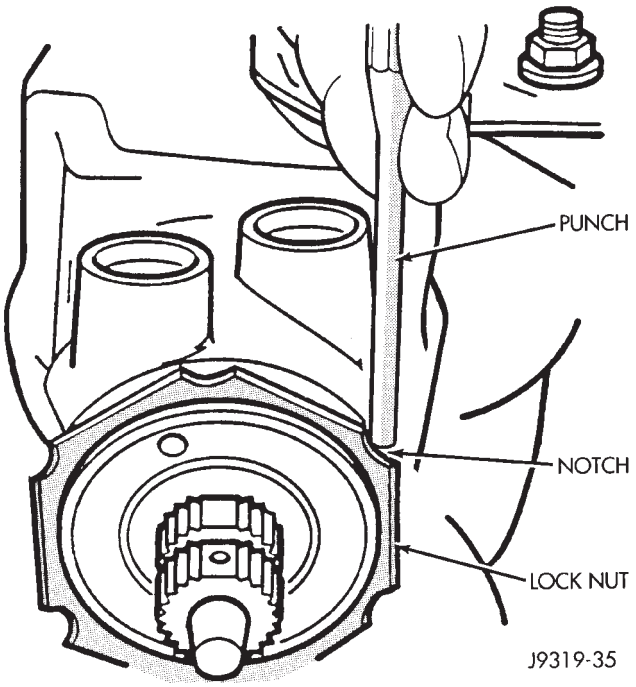


Fig. 24 Tighten Lock Nut

(2) Remove stub shaft and valve assembly (Fig. 25).

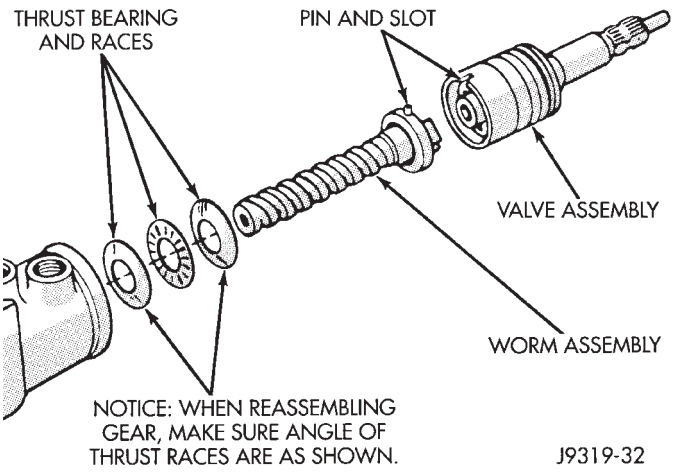


Fig. 25 Bearing, Worm and Valve Assembly

(3) Remove stub shaft from valve assembly, if necessary.

- Tap stub shaft lightly on a block of wood to loosen shaft cap
- Pull cap and valve body and disengage stub shaft pin from hole in valve body (Fig. 26).

(4) Remove valve assembly if necessary.

- Remove valve spool by pulling and rotating from valve body (Fig. 27).
- Remove valve spool O-ring seal
- Remove valve body teflon rings and O-ring seals (Fig. 28).

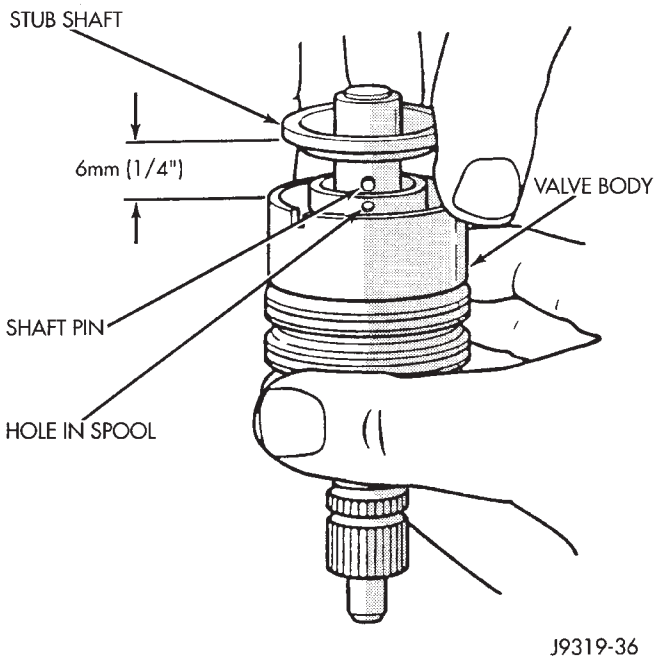


Fig. 26 Remove and Install Stub Shaft

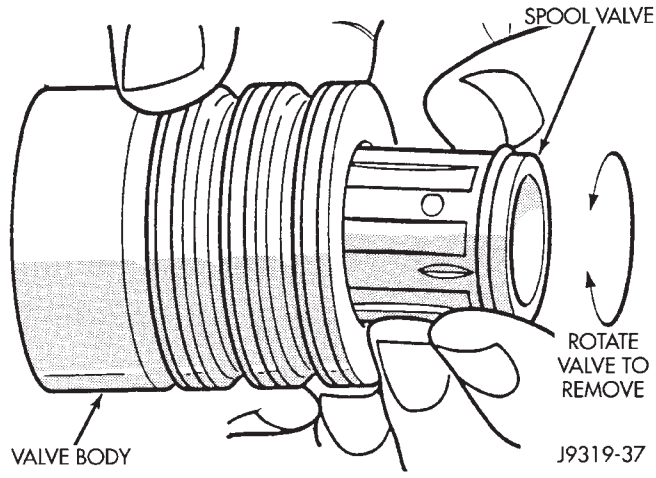


Fig. 27 Remove and Install Spool

ASSEMBLE

(1) Install valve spool O-ring seal to valve spool.

(2) Lubricate valve spool and O-ring seal with power steering fluid.

(3) Install valve spool to valve body by pushing and rotating. Hole in valve spool for stub pin must be accessible from opposite end of valve body.

(4) Assemble stub shaft to valve spool, if necessary and insert pin (Fig. 29).

- Notch in stub shaft cap MUST fully engage valve body pin and seat against valve body shoulder.

(5) Install O-ring seals and teflon rings to valve body.

(6) Lubricate O-ring seals and teflon rings with power steering fluid.

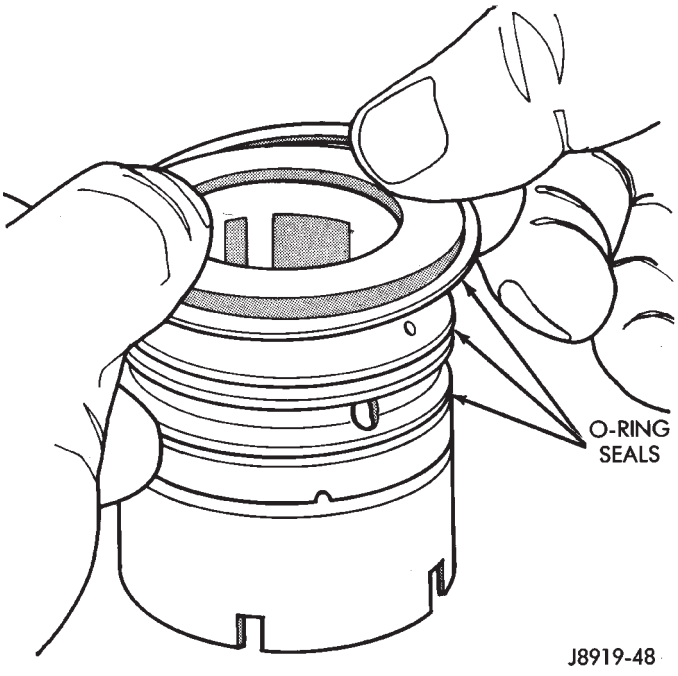


Fig. 28 Remove and Install Valve Seals

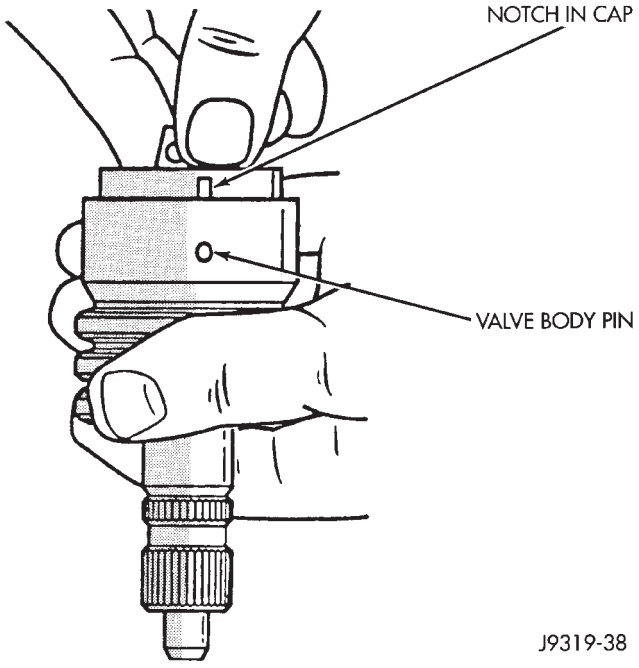


Fig. 29 Stub Shaft Installation

(7) Install stub shaft and valve assembly to worm shaft, fitting on worm shaft to slot in the valve assembly.

(8) Adjust Thrust Bearing Preload Adjustment and Over-Center Adjustment. Refer to Steering Gear Adjustments in this section.

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

RACK PISTON AND WORM SHAFT REPLACEMENT

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

DISASSEMBLE

(1) Remove pitman shaft and side cover. Refer to Side Cover and Pitman Shaft Replacement in this section.

(2) Remove housing plug end. Refer to Housing End Plug Replacement in this section.

(3) Turn stub shaft COUNTERCLOCKWISE until the rack piston begins to come out of the housing.

(4) Remove rack piston plug (Fig. 30).

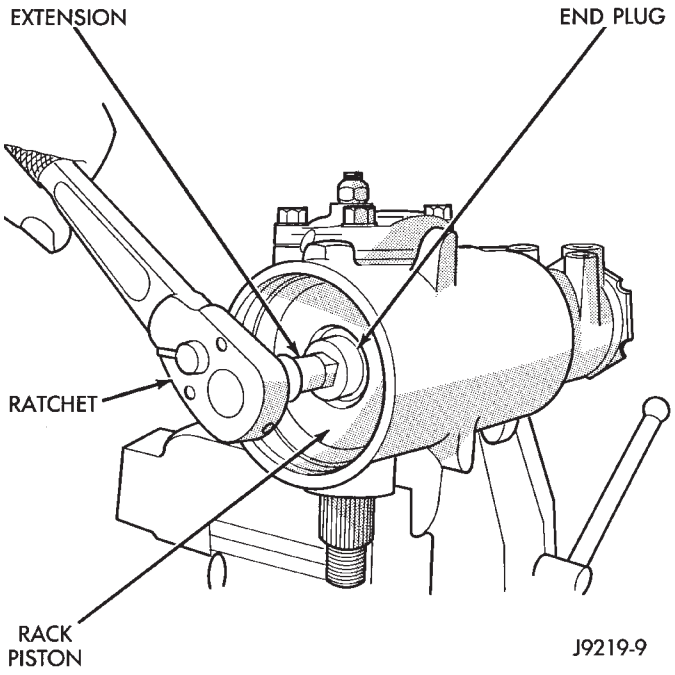


Fig. 30 Remove and Install Rack Piston End Plug

(5) Insert Arbor C-4175 (J-21552) into bore of rack piston (Fig. 31). Hold tool tightly against worm shaft while turning the stub shaft COUNTERCLOCKWISE.

• The rack piston will be forced onto the tool and hold the rack piston balls in place.

(6) Remove the rack piston, rack balls, and tool together from housing.

(7) Remove valve. Refer to Valve Replacement in this section.

(8) Remove worm shaft.

(9) Remove thrust bearing and races.

(10) Remove tool from rack piston.

(11) Remove rack piston balls.

(12) Remove screws, clamp and ball guide.

(13) Remove teflon ring and O-ring seal (Fig. 32).

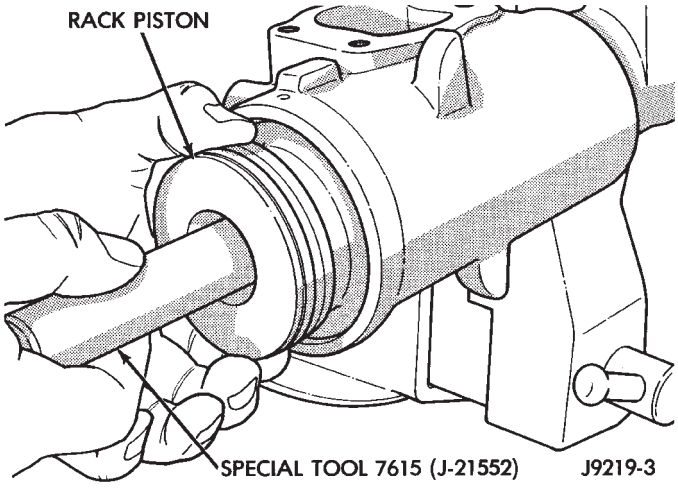


Fig. 31 Remove and Install Rack Piston

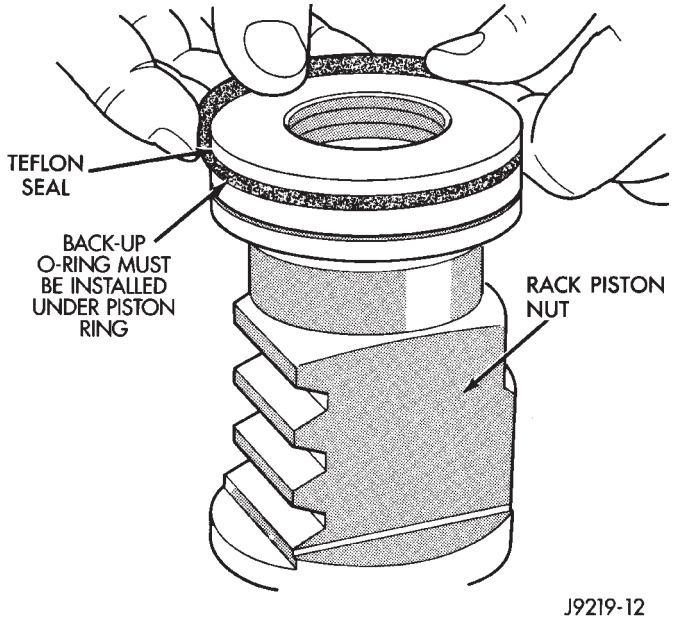


Fig. 32 Remove and Install Seal on Rack Piston

CLEAN AND INSPECTION

(1) Wash all components in clean solvent and dry with compressed air.

(2) Check for scores, nicks or burrs on the rack piston finished surface. Slight wear is normal on the worm gear surfaces.

ASSEMBLE

(1) Install O-ring seal and teflon ring and lubricate with power steering fluid.

(2) Install worm shaft to rack piston outside of housing. Fully seat worm shaft to rack piston and align worm shaft spiral groove with rack piston ball guide hole (Fig. 33).

WARNING: MAKE SURE ALL RACK PISTON BALLS ARE REINSTALLED IN THE RACK PISTON. IMPROPER INSTALLATION MAY RESULT IN PERSONAL INJURY.

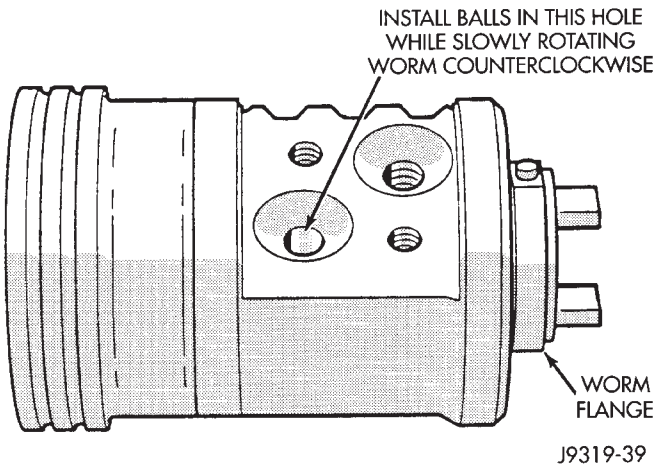


Fig. 33 Installing Balls in Rack Piston

There are 24 balls in the rack piston circuit, 12 are black and 12 are silver (Chrome). The black rack piston balls are smaller than the silver balls. THE BLACK AND SILVER BALLS MUST BE INSTALLED ALTERNATELY INTO THE RACK PISTON AND BALL GUIDE. This procedure will maintain worm shaft preload.

(3) Lubricate and install rack piston balls through return guide hole while turning wormshaft COUNTERCLOCKWISE.

(4) Install remaining balls to guide using grease or petroleum jelly at each end to hold in place (Fig. 34).

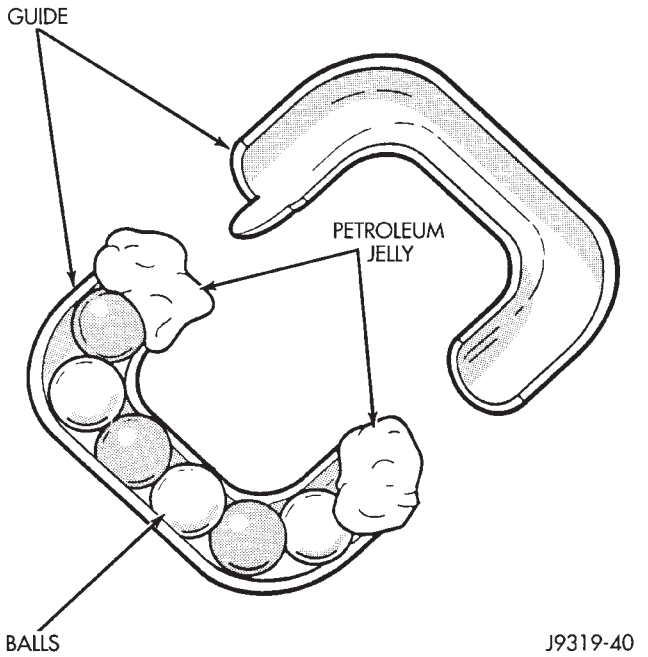


Fig. 34 Balls in the Return Guide

(5) Install guide onto rack piston and return with clamp and screws. Tighten screws to 58 N·m (43 in. lbs.) torque.

(6) Insert Arbor C-4175 (J-21552) into bore of rack piston. Hold tool tightly against worm shaft while

turning the stub shaft COUNTERCLOCKWISE.

• The rack piston will be forced onto the tool and hold the rack piston balls in place.

(7) Install the races and thrust bearing to worm shaft (Fig. 35).

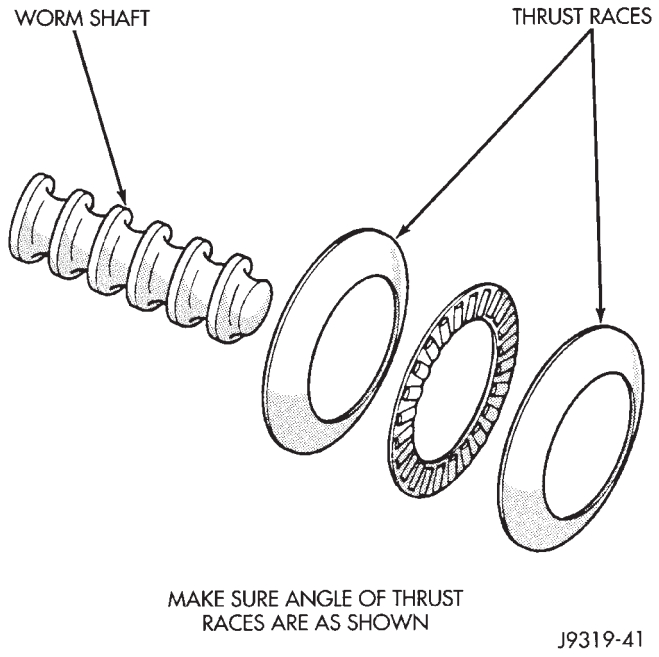


Fig. 35 Worm Shaft and Bearing

(8) Install worm shaft to housing.

(9) Install valve. Refer to Valve Replacement in this section.

(10) Install rack piston to worm shaft from tool, compress seals.

• Hold Arbor tightly against worm shaft and turn stub shaft CLOCKWISE until rack piston is seated on worm shaft.

WARNING: MAKE SURE ALL RACK PISTON BALLS ARE REINSTALLED IN THE RACK PISTON. IMPROPER INSTALLATION MAY RESULT IN PERSONAL INJURY.

(11) Install rack piston plug and tighten to 150 N·m (111 ft. lbs.) torque.

(12) Install housing end plug. Refer to Housing End Plug Replacement in this section.

(13) Install pitman shaft and side cover. Refer to Side Cover and Pitman Shaft Replacement in this section.

(14) Adjust steering gear. Refer to Steering Gear Adjustments in this section.

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

PITMAN SHAFT SEALS AND BEARING REPLACEMENT

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

DISASSEMBLE

(1) Remove pitman arm from gear. Refer to Pitman Arm Removal in Steering Linkage.

(2) Clean exposed end of pitman shaft and housing. Use a wire brush to clean the shaft splines.

(3) Remove retaining ring with snap ring pliers (Fig. 36).

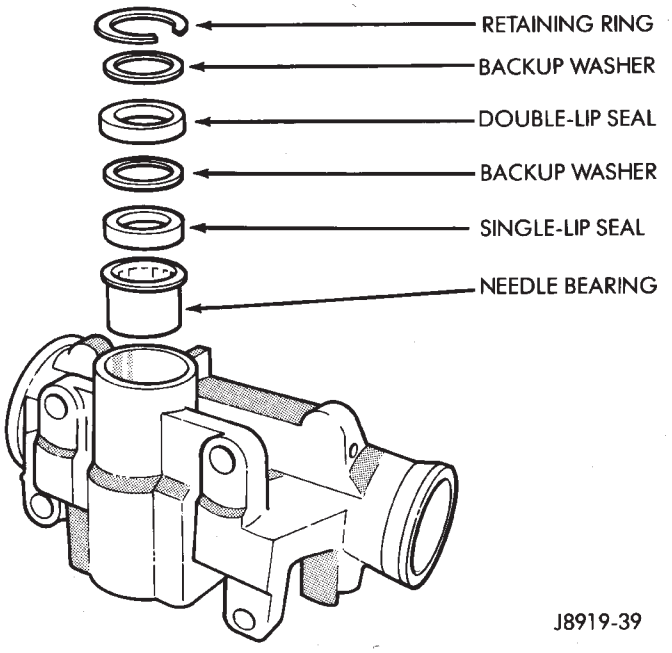


Fig. 36 Pitman Shaft Seals

CAUTION: Use care not to score the housing bore when prying out seals and washers.

(4) Remove backup washer and double lip seal with screwdriver.

(5) Remove backup washer and single lip seal with screwdriver.

(6) Inspect the housing for burrs and remove if necessary.

(7) Remove needle bearing from side cover area of housing (Fig. 37).

ASSEMBLE

(1) Install needle bearing into housing (Fig. 38).

(2) Install single lip seal with Installer or a suitable size socket (Fig. 39).

(3) Coat the double lip seal and washer with grease.

(4) Install the backup washer.

(5) Install the double lip seal.

(6) Install the backup washer.

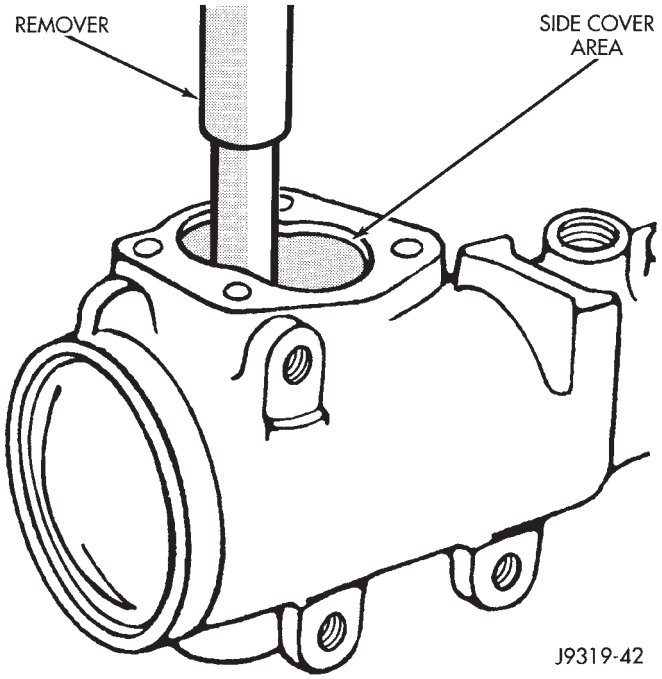


Fig. 37 Needle Bearing Removal

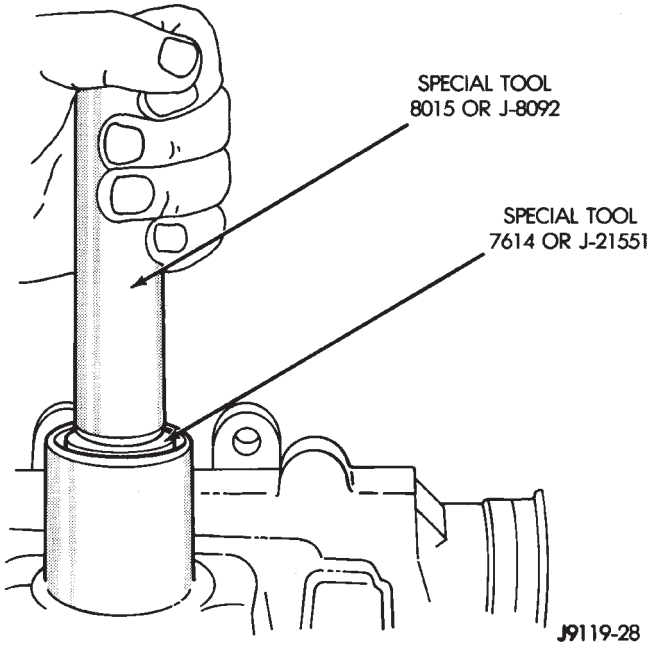


Fig. 38 Pitman Shaft Bearing Installation

(7) Install the retainer ring with snap ring pliers.

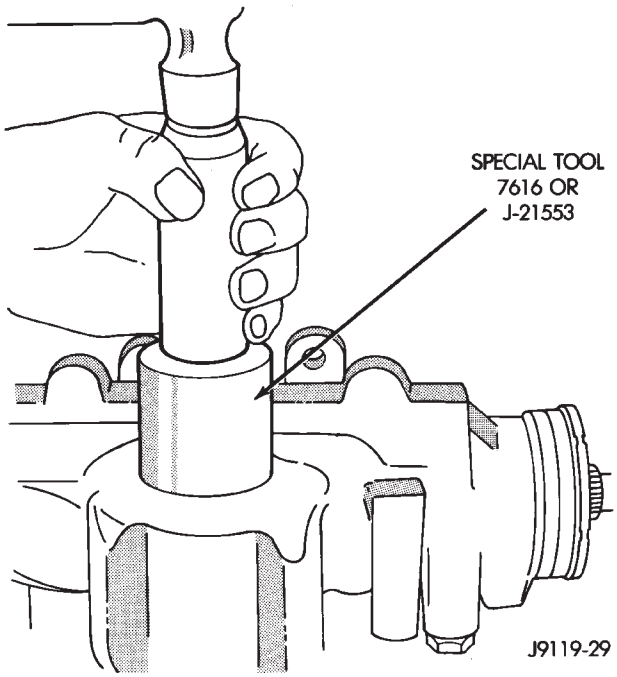


Fig. 39 Pitman Shaft Seal Installation

(8) Install the pitman shaft and side cover. Refer to Side Cover and Pitman Shaft Replacement in this section.

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

CHECK VALVE REPLACEMENT

REMOVE

(1) Remove steering gear from vehicle. Refer to Power Steering Gear Replacement in this section.

DISASSEMBLE

CAUTION: Use care not to damage the threads of the housing when prying out check valve.

(1) Remove valve by prying from housing with a small screwdriver.

ASSEMBLE

(1) Install the valve into the housing with a 3/8-inch diameter piece of tubing 100 mm (4 inches) long.

INSTALL

(1) Install steering gear. Refer to Power Steering Gear Replacement in this section.

POWER STEERING GEAR SPECIFICATIONS

Steering Gear Type . . . . . Recirculating ball with hydraulic assist.

Ratio Code (Top of Gear)
- BH, NZ 14:1
- BF, XS 13-16:1
- AL 12.7:1

Steering Gear Hydraulic Fluid . . . . . Use Mopar Power Steering Fluid, or equivalent.

Steering Gear Lubricants . . . . . Lubricate pitman shaft seals, bearings races, and rack piston recirculating balls with petroleum jelly. Lubricate all other parts with power steering fluid.

Steering Gear Adjustments:
Wormshaft Bearing Preload Torque . . . . . 0.45–1.13 N·m (4 to 10 in-lbs)

Pitman Shaft Overcenter Drag Torque:
New Gear
(less than 400 miles/640 km) . . . . . 0.45–0.90 N·m (4 to 8 in-lbs) in addition to wormshaft bearing preload but not to exceed combined total of 2 N·m (18 in-lbs).

Used Gear
(over 400 miles/640 km) . . . . 0.5–0.6 N·m (4 to 5 in-lbs) in addition to wormshaft bearing preload but not to exeed combined total of 2 N·m (18 in-lbs).

Caution: Gears must be adjusted exactly as outlined in Steering Gear Adjustments-On Bench. Failure to adhere to the recommended procedures may result in gear damage or improper steering response.

J9319-44

MANUAL STEERING GEAR

INDEX

INFORMATION

The manual steering gear installed on Jeep vehicles (Fig. 1) has a variable steering ratio.

DIAGNOSIS

PITMAN SHAFT SEAL REPLACEMENT

REMOVAL

(1) Mark pitman arm and shaft positions for reference. Remove pitman arm with Puller 7998 (J6632-01).

(2) Remove the pitman shaft seal with a small blade screw driver.

INSPECTION

(1) Inspect the condition of the steering gear lubricant. If contaminated (contains metal particles), remove and overhaul the steering gear.

INSTALLATION

(1) Lubricate the new seal with chassis lubricant.

CAUTION: A protective wrap must be used on the shaft threads/splines during seal installation. If the shaft seals are installed over exposed shaft, the seal lips could be cut or distorted. This can result in leakage after installation.

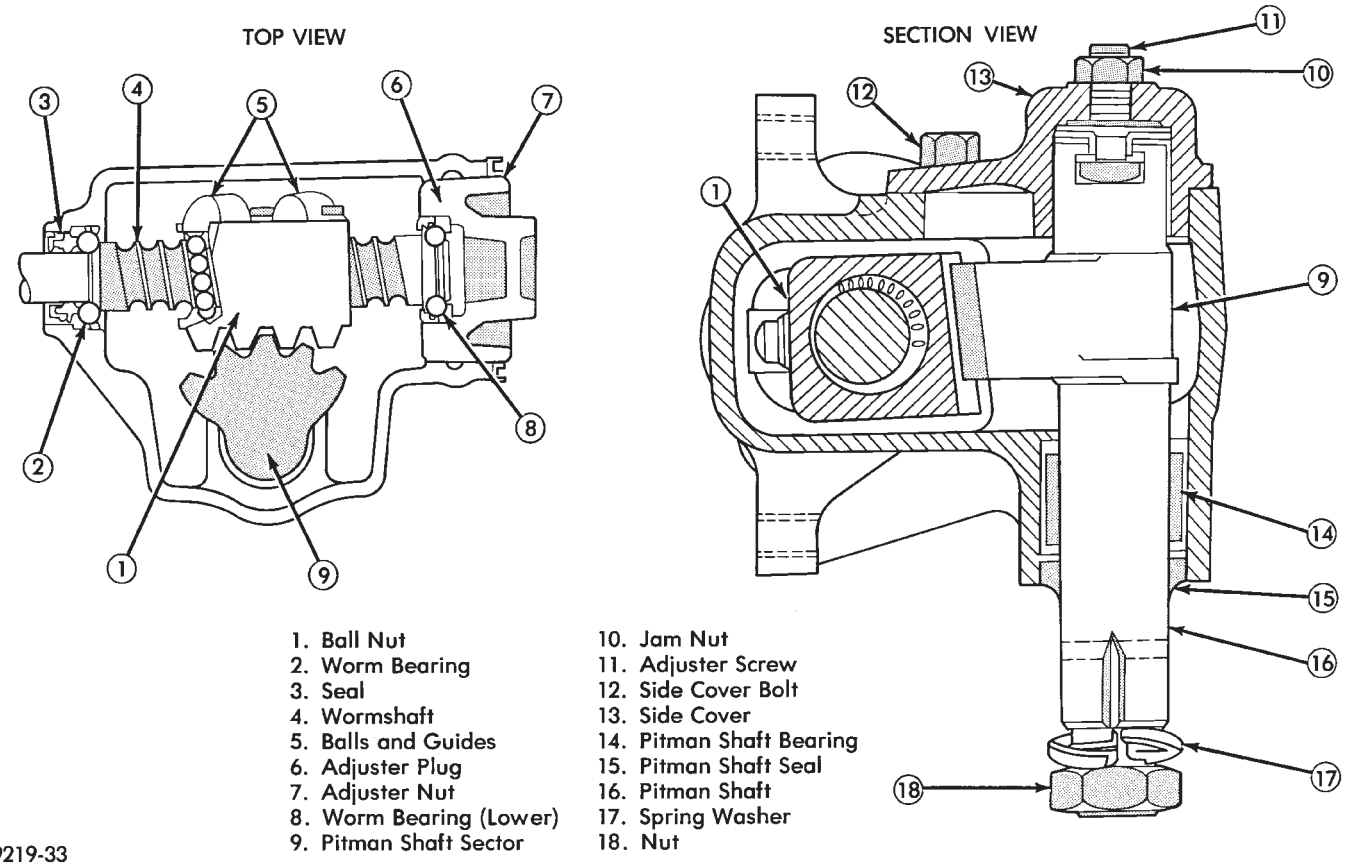


Fig. 1 Manual Steering Gear

MANUAL STEERING SYSTEM DIAGNOSIS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Rattle Or Chuckle In The Steering Gear	1. Insufficient or improper lubricant in the steering gear. 2. Pitman arm loose on the shaft or the steering gear mounting bolts loose. 3. Loose or worn steering shaft bearing. 4. Excesisve over-center lash or worm thrust bearings adjusted too loose. On turns a slight rattle may occur, due to the increased lash between ball nut and pitman shaft as gear moves off the center of "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.	1. Add lubricant as required. 2. Tighten to specified torque. 3. Replace the steering shaft bearing. 4. Adjust the steering gear to specified preloads.
Poor Return Of The Steering Wheel	1. Steering column misaligned. 2. Insufficient or improper lubricant in the steering gear or front suspension. 3. Steering gear adjusted too tight. 4. Front wheel alignment incorrect (Caster).	1. Align the column. 2. Lubricate as specified. 3. Adjust over-center and thrust bearing preload to specifications. 4. Adjust to specifications.
Excessive Play Or Looseness In The Steering System	1. Front wheel bearings loosely adjusted. 2. Steering system out of alignment. 3. Worn upper ball joints. 4. Steering wheel loose on the shaft, loose pitman arm, tie rods, steering arms or steering linkage ball nuts. 5. Tires badly worn, edge of tires rounded off. 6. Excessive over-center lash. 7. Worm thrust bearings loosely adjusted.	1. Adjust bearings or replace with new parts as necessary. 2. Align caster, camber, and toe-in. 3. Check and replace ball joints if necessary. 4. Tighten to specification, replace if worn or damaged. 5. Install new tires, and check alignment. 6. Adjust over-center preload to specifications. 7. Adjust the worm thrust bearing preload to specifications.
Hard Steering – Excessive Effort Required At The Steering Wheel	1. Low or uneven tire pressure. 2. Insufficient or improper lubricant in the steering gear or front suspension. 3. Steering shaft flexible coupling misaligned. 4. Steering gear adjusted too tight. 5. Front wheel alignment incorrect.	1. Inflate to specified pressures. 2. Lubricate as specified. Relubricate at specified intervals. 3. Align the column and couplings. 4. Adjust over-center and thrust bearing preload to specifications. 5. Check the alignment and correct as necessary.

J9219-26

(2) Wrap a single layer of plastic tape around the pitman shaft threads and splines. This will protect the replacement seals during installation.
(3) Install the seal with a suitable size socket.
(4) Remove the tape from the shaft.
(5) Center the steering gear.
(6) Align and install the pitman arm.
(7) Install the washer and retaining nut on the pitman shaft. Tighten the nut to 251 Nb1m (185 ft. lbs.) torque.

GEAR ADJUSTMENTS IN VEHICLE

REMOVE

(1) Raise and support the vehicle.
(2) Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from the shaft.
(3) Loosen the adjuster lock nut then back the adjuster plug off 1/4 turn.
(4) Remove the steering wheel horn pad.
(5) Turn the steering wheel in one direction until stopped by the gear. Then turn back 1/2 turn.

CAUTION: Do not turn the steering wheel hard against the internal stops when the linkage is removed. This could result in damage to the recirculating ball guides.

MEASURE

Place a low calibration (50 in. lbs.) torque wrench and socket on the steering wheel nut. Rotate the wrench and nut through a 90 degree arc (1/4 turn). This will measure the worm shaft bearing preload.

ADJUST WORMSHAFT BEARING PRELOAD TORQUE

(1) Adjust the preload by tightening the adjuster plug. The preload should be 0.6 to 1 N·m (5 to 8 in. lbs.) torque.

Steering column/shaft misalignment or damage will increase the amount of torque required to rotate the steering wheel. If the rotating torque is exceptionally high, inspect the steering column/shaft alignment. If the alignment is correct, remove the steering gear, determine the cause of the high preload torque, and repair as necessary.

(2) Tighten the adjuster locknut to 68 N·m (50 ft. lbs.) torque. Measure the preload torque. If necessary, adjust the preload torque again.

ADJUST OVERCENTER DRAG TORQUE

(1) Turn the steering wheel from one stop to the other and count the total numbers of turns. Turn the wheel back in reverse direction 1/2 the total number of turns to center the steering gear.
(2) Turn the over center adjusting screw in to remove all lash between the ball nut and pitman shaft sector teeth. Hold the adjustment screw and tighten the lock nut to 34 N·m (25 ft. lbs.) torque.
(3) Check the torque at the steering wheel by taking the highest reading as the wheel is turned through the center position.
(4) The overcenter drag torque should be 0.5 to 1 N·m (4 to 10 in. lbs.).
(5) If necessary, loosen the lock nut and adjust the over center adjuster screw to obtain the proper torque. Re-tighten the lock nut to the lock nut.
(6) After tightening the locknut, measure the overcenter drag torque again and readjust the torque, if necessary.

INSTALL

(1) Align the installation reference marks and install the pitman arm.
(2) Install and tighten the pitman shaft nut and washer to 251 N·m (185 ft. lbs.) torque.
(3) Install the horn button.

GEAR DISASSEMBLY

(1) Rotate the wormshaft from stop-to-stop and count the number of rotations. Rotate the wormshaft in the reverse direction 1/2 of the total number of rotations to center it and the ball nut.
(2) Remove the pitman shaft adjustment screw locknut. Remove the cover retaining bolts, cover, and gasket (Fig. 3).
(3) Slide the adjustment screw head (Fig. 3) out of the pitman shaft T-slot and remove it and the shim(s).
(4) Retain the shim(s) for end-play measurement during assembly.
(5) Remove the pitman shaft, the wormshaft bearing preload torque adjustment cap locknut, and the adjustment cap (Fig. 2).
(6) Remove the wormshaft and the ball nut (Fig. 2).
(7) Remove (pry) the pitman shaft and the wormshaft seals from the steering gear housing (Fig. 3).

WORMSHAFT AND BALL NUT DISASSEMBLY

(1) Remove the upper bearing from the wormshaft (Fig. 2).

CAUTION: Do not allow the ball nut to rotate freely and travel to either extreme end of the wormshaft. This could damage the tangs at the ends of the recirculating ball guides (Fig. 3).

(2) Remove the recirculating ball guide clamp retaining screws, the clamp and the guides (Fig. 2). Separate the half-guides and place the recirculating balls aside in a container.
(3) Hold the ball nut over a cloth. Remove the remaining recirculating balls by rotating the wormshaft back and forth.

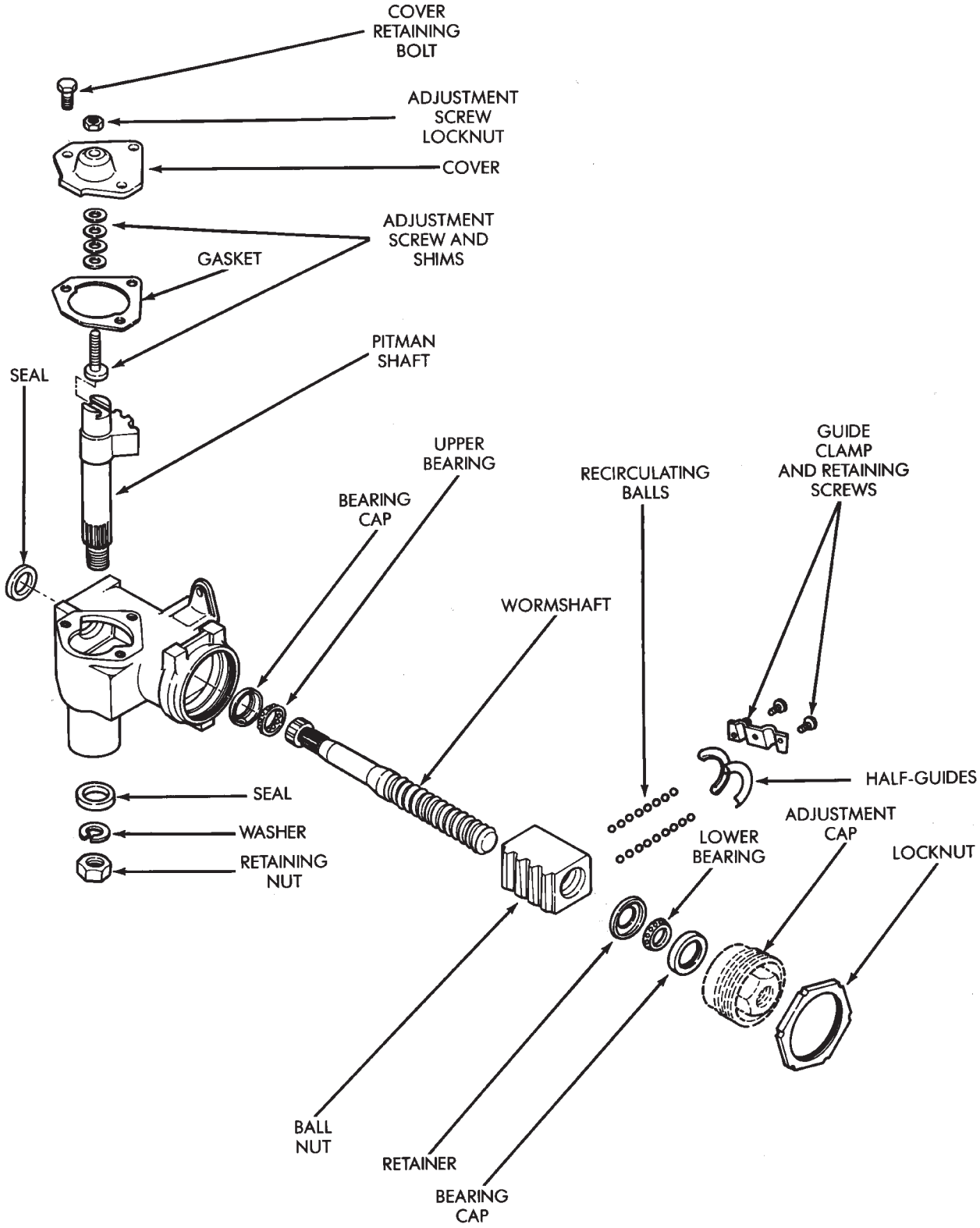


Fig. 2 Manual Steering Gear—Exploded View

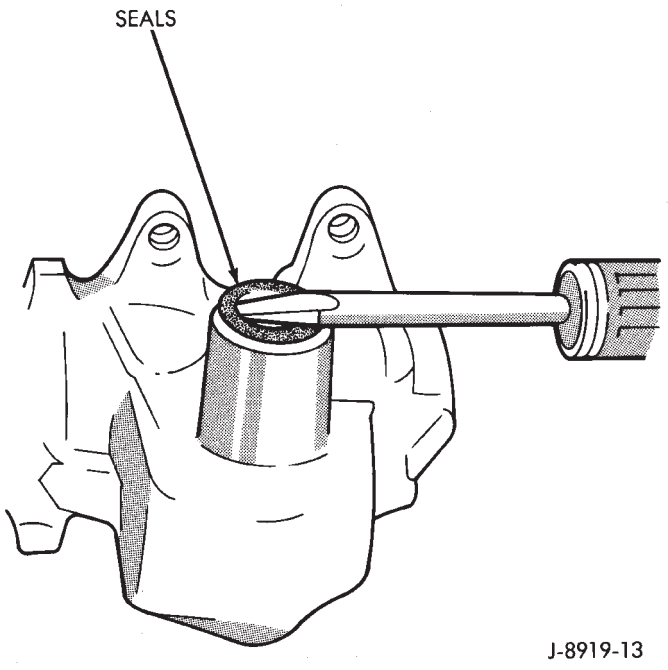


Fig. 3 Shaft Seal Removal

There are a total of 50 recirculating balls within the ball nut and the guides (25 in each circuit).

(4) Remove the wormshaft from the ball nut (Fig. 2).

CLEANING AND INSPECTION

(1) Clean all the components in a cleaning solvent and dry them with a clean cloth and/or compressed air.

(2) Inspect each component for wear, scoring, cracks, nicks and surface pitting. Replace as necessary.

WORMSHAFT AND BALL NUT ASSEMBLY

CAUTION: The ball nut teeth are wider and deeper on one side than on the other.

(1) Position the ball nut with the recirculating ball guide holes facing upward and the ball nut teeth facing downward. Install the wormshaft in the ball nut. Rotate the shaft and thread it into the nut until an equal number of shaft threads are visible at each end of the nut (Fig. 4).

(2) Install one recirculating ball in each ball guide hole. Move the wormshaft up/down and side-to-side until the balls roll into the ball nut threads at the bottom of wormshaft and support the wormshaft.

(3) Assemble and install the ball guides in the ball nut (Fig. 5).

(4) Divide the remaining 48 recirculating balls into two groups and install 24 balls in each ball nut circuit. Insert the balls in the ball nut circuits through the holes in the ball guides (Fig. 5).

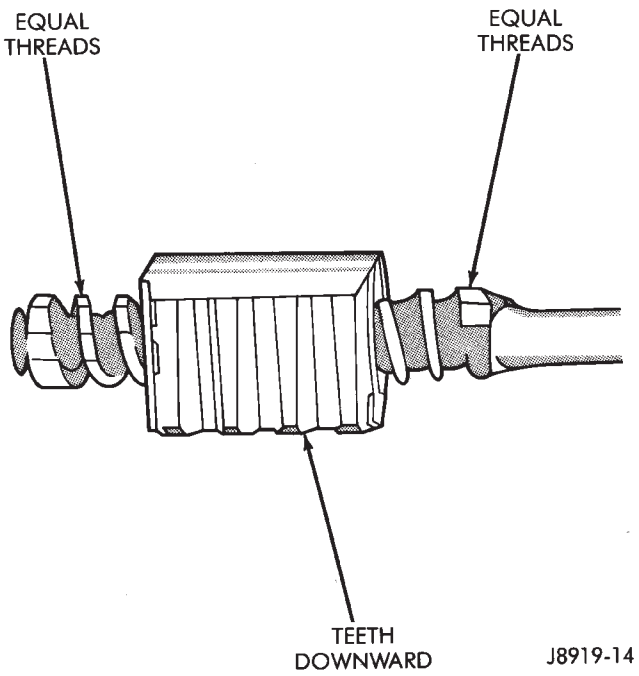


Fig. 4 Wormshaft & Ball Nut

To aid the recirculating ball installation, rotate wormshaft back and forth slightly while inserting the balls.

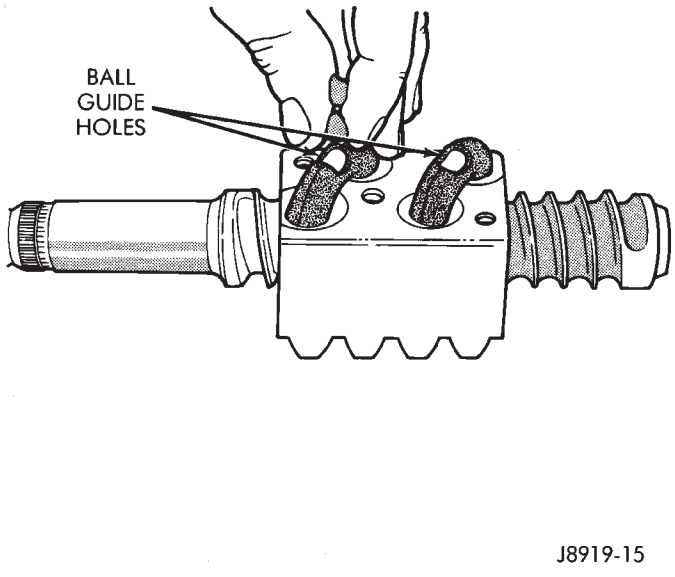


Fig. 5 Recirculating Ball Installation

(5) Place the ball guide clamp on the ball nut and install the clamp retaining screws. Tighten the screws to 14 N·m (10 ft. lbs.) torque.

CAUTION: To avoid damaging the tangs on the ball guide ends, do not allow the wormshaft to travel to the end of the thread in either direction.

(6) Lubricate the wormshaft threads with chassis lubricant. Rotate the shaft to move it in and out of the ball nut and distribute the lubricant.

(7) Lubricate the wormshaft upper bearing with chassis lubricant and install it on the wormshaft.

WORMSHAFT BEARING ADJUSTMENT CAP DISASSEMBLY

(1) Pry out and remove the wormshaft lower bearing retainer from the adjustment cap (Fig. 6).

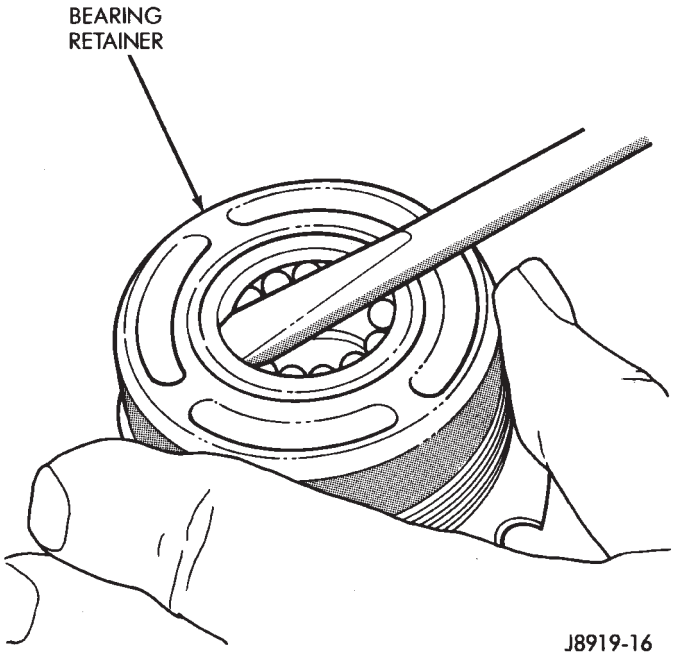


Fig. 6 Wormshaft Lower Bearing Retainer Removal

(2) Remove the wormshaft lower bearing from the adjustment cap.

CLEANING/INSPECTION

(1) Clean all the components in cleaning solvent and dry with a clean cloth only.

(2) Inspect each component for wear and damage. Replace as necessary.

WORMSHAFT BEARING ADJUSTMENT CAP ASSEMBLY

(1) Remove the lower bearing cup Remover 7837 (J-29369-1) and Slide Hammer C-637 (J-2619-01) (Fig. 7). Install a new bearing cup in the cap with a correct sized socket (Fig. 8).

(2) Lubricate the wormshaft lower bearing and place it in the bearing cup.

(3) Install the lower bearing retainer on the adjustment cap. If necessary, tap the retainer lightly with a plastic mallet to seat it.

GEAR CLEANING AND INSPECTION

(1) Clean the housing and the pitman shaft with cleaning solvent and dry them with a clean cloth and/or compressed air.

(2) Inspect the housing for cracks, porosity, damaged threads and scoring/distortion of the gasket surface area. Repair or replace as necessary.

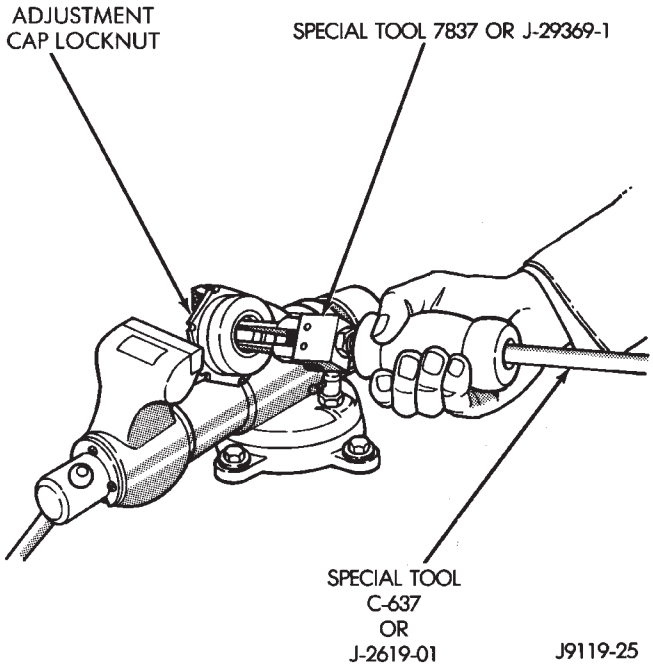


Fig. 7 Bearing Cup Removal

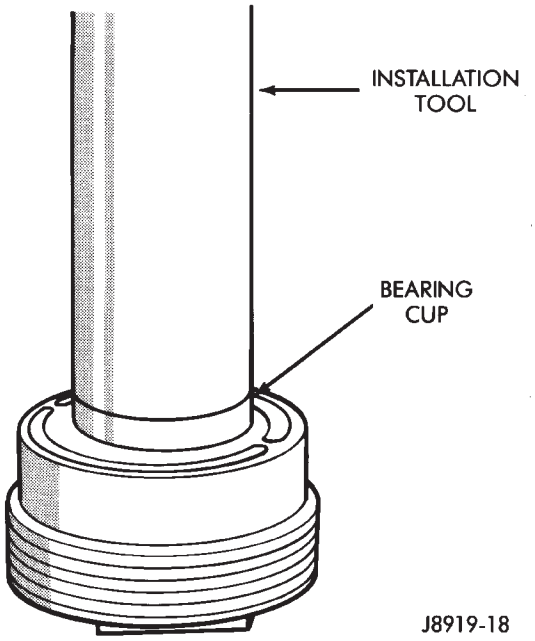


Fig. 8 Bearing Cup Installation

(3) Inspect the pitman shaft contact surface and the teeth for wear, pitting, and other damage. Replace as necessary.

(4) Insert the pitman shaft in the steering gear housing shaft bore and inspect for excessive shaft or housing shaft bore wear. The shaft should have a smooth, bind-free fit with no visible side play when installed in the shaft bore.

(5) If the shaft fit is loose but it is not visibly worn, trial fit a replacement pitman shaft in the housing shaft bore. If the replacement shaft also has

a loose fit, replace the housing. However, if the replacement pitman fits properly, replace the original pitman shaft.

(6) Measure the pitman shaft adjustment screw fit and end-play in the T-slot (Fig. 9). When installed, the adjustment screw must rotate freely and not bind in any position. Measure the end-play by inserting a feeler gauge between the screw head and the T-slot surface. **The end-play must not exceed 0.05 mm (0.002 in). If end-play exceeds the specified limit, install a replacement shim to reduce the end-play.**

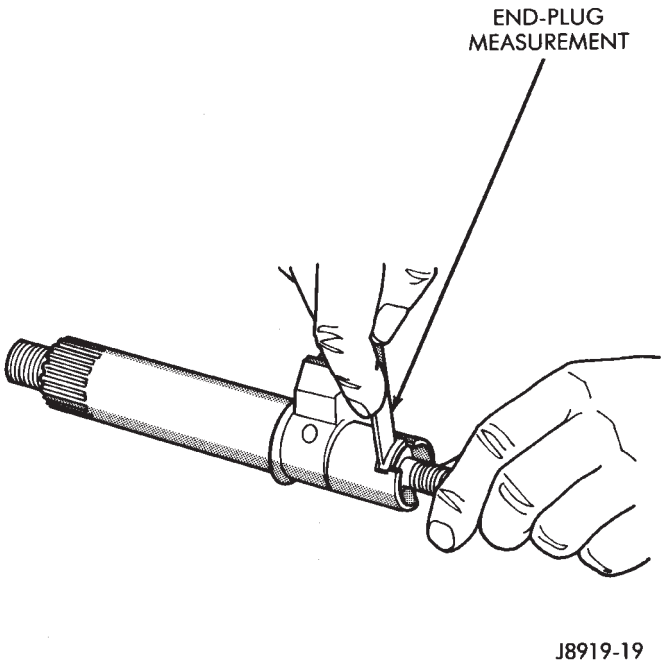


Fig. 9 Adjustment Screw End-Play Measurement

(7) Inspect the wormshaft shaft upper bearing and bearing cup for wear, looseness, flat spots, pitting, cracks, and other damage. If either the bearing or the bearing cup is damaged, both components must be replaced.

(8) If the cup fits loosely in the housing, trial fit a replacement cup. If the replacement cup also fits loosely, replace the housing. If the replacement cup fits properly, replace only the original bearing cup.

GEAR ASSEMBLY

(1) Remove wormshaft upper bearing cup with a hammer and a brass punch (Fig. 10).

(2) Install a replacement bearing cup with an appropriate installation tool (Fig. 11).

Do not install the wormshaft or the pitman shaft seals at this time.

(3) Lubricate all the components with chassis lubricant.

(4) Place the steering gear housing in a vise. Clamp the vise jaws on the housing mounting bosses only.

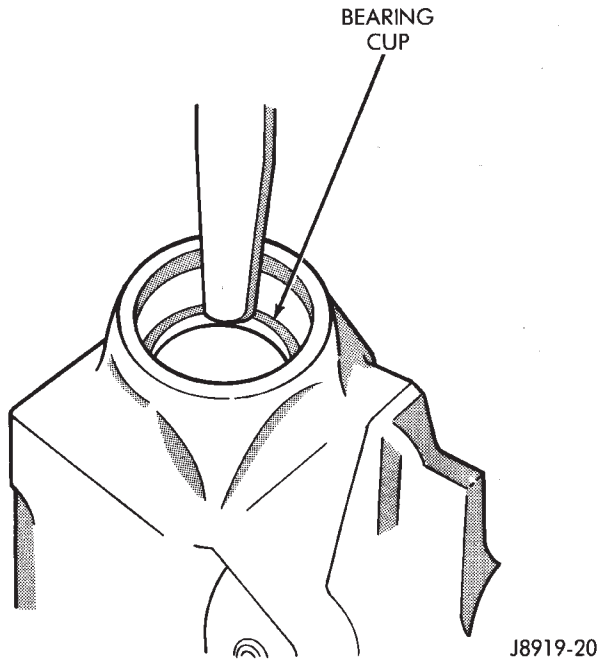


Fig. 10 Wormshaft Upper Bearing Cup Removal

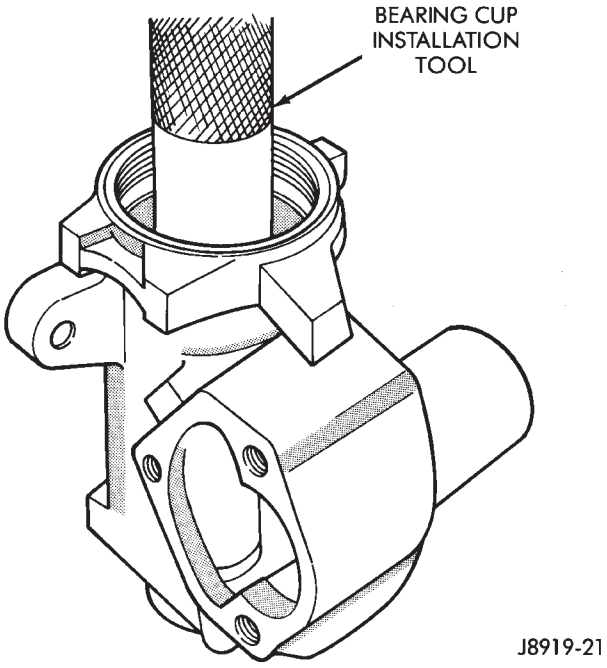


Fig. 11 Wormshaft Upper Bearing Cup Installation

(5) Install the wormshaft and ball nut in the steering gear housing.

CAUTION: Ensure that the ball nut is installed with the wide/deep side of the ball nut teeth facing toward the cover opening.

(6) Install the wormshaft bearing adjustment cap in the housing and tighten it only enough to remove the wormshaft end-play.

(7) Install the locknut on the wormshaft bearing adjustment cap but do not tighten it at this time.

(8) Pack the steering gear housing with as much chassis lubricant as possible.

Rotate the wormshaft in one direction until the ball nut ceases. Pack the end of the housing full of lubricant, rotate the shaft in the opposite direction and repeat the packing procedure.

(9) Place the ball nut (Fig. 12) in the centered position, rotate the wormshaft from stop-to-stop and count the number of rotations. Rotate wormshaft in the reverse direction 1/2 of the number of rotations to center the ball nut.

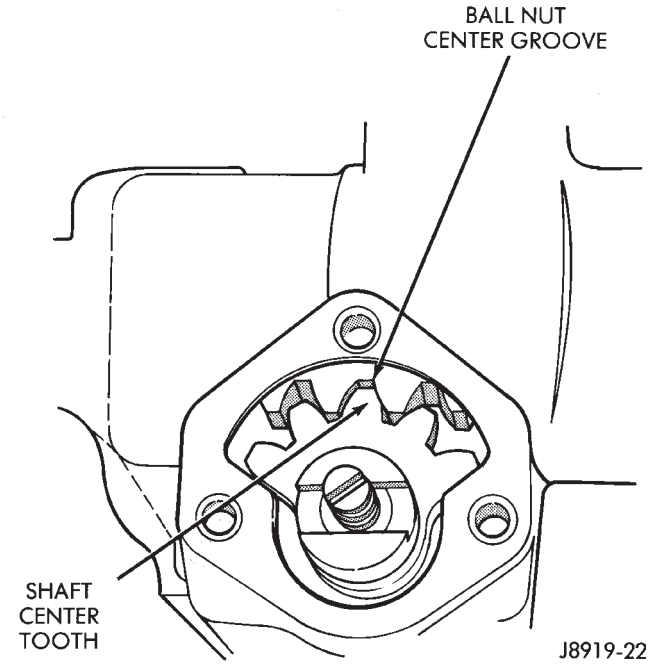


Fig. 12 Pitman Shaft & Ball Nut Engagement

(10) Lubricate the pitman shaft with chassis lubricant and insert it in the steering gear housing. Engage the center tooth on the shaft with the center groove on the ball nut.

(11) Apply chassis lubricant to the replacement housing cover gasket. Position it so that it surrounds the housing cover opening.

(12) Place the shim(s) on the adjustment screw and thread the screw into the cover to a depth of 2 to 3 threads.

(13) Slide the head of the adjustment screw into the pitman shaft T-slot. With the cover in place, rotate the screw counterclockwise to thread it into the cover. Rotate the screw until the cover almost comes in contact with the gasket.

(14) Install the cover retaining bolts finger tight only. Continue tightening the adjustment screw counterclockwise until cover is tight against the gasket, then loosen the screw 1/2 rotation.

(15) Tighten the cover bolts to 61 N·m (45 ft. lbs.) torque.

(16) Install the pitman shaft seal, refer to the replacement procedure.

(17) Rotate the wormshaft and observe the steering gear operation. With the adjustment screw and cap loose, the wormshaft should rotate freely and not bind. If the steering gear binds, repair as necessary.

(18) Inspect for lubricant leakage from the shaft seals. If there is a leak at either seal, replace the defective seal(s).

GEAR ADJUSTMENTS ON BENCH

WORM BEARING PRELOAD

(1) Tighten the worm bearing adjuster plug until it bottoms, then loosen 1/4 turn.

(2) Carefully turn the wormshaft all the way to the end of travel, then turn back 1/2 turn.

(3) Tighten adjuster plug until torque wrench indicates 0.6 to 1.0 N·m (5 to 8 in. lbs.) torque (Fig. 13).

(4) Tighten the adjuster plug locknut to 68 N·m (50 ft. lbs.) torque.

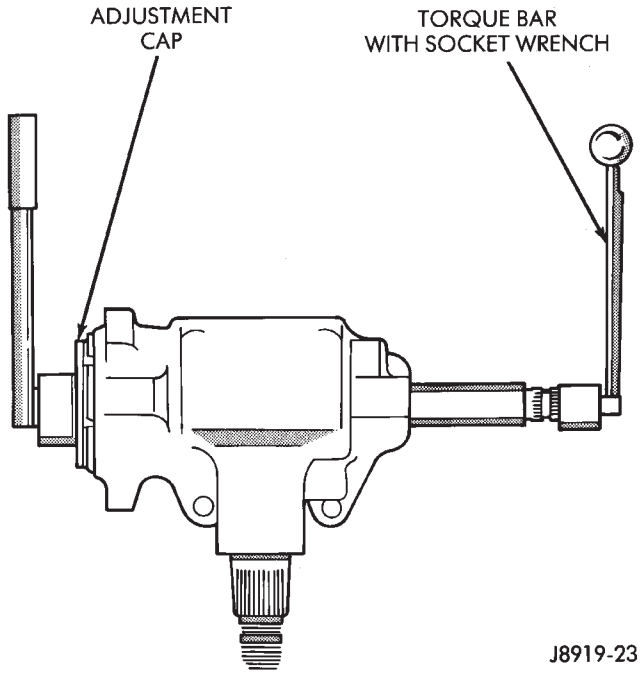


Fig. 13 Worm Bearing Preload Adjustment

OVER-CENTER PRELOAD

(1) Back off preload adjuster until it stops, then turn it in one full turn.

(2) With gear at center of travel, check torque to turn stub shaft. This will be reading #1 (Fig. 14).

(3) Turn adjuster in until torque to turn stub shaft is 0.5 to 1 N·m (4 to 10 in. lbs.) more than reading #1.

(4) Hold pitman shaft adjustment screw and tighten adjuster lock nut to 34 N·m (25 ft. lbs.) torque.

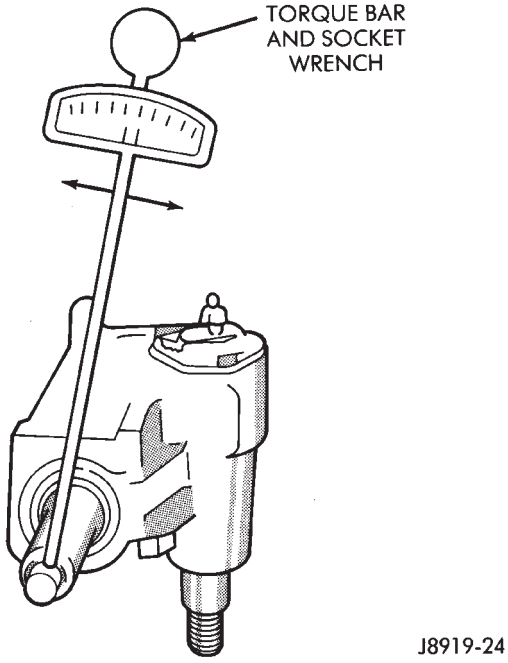


Fig. 14 Over-center Adjustment

INTERMEDIATE (COUPLER) SHAFT

REMOVAL

(1) Place the front wheels in the straight ahead position.

(2) Remove the shaft pinch bolt at the steering gear and column (Fig. 15, 16). Un-bolt steering gear from frame rail to remove shaft. Refer to Steering Gear Replacement in this section.

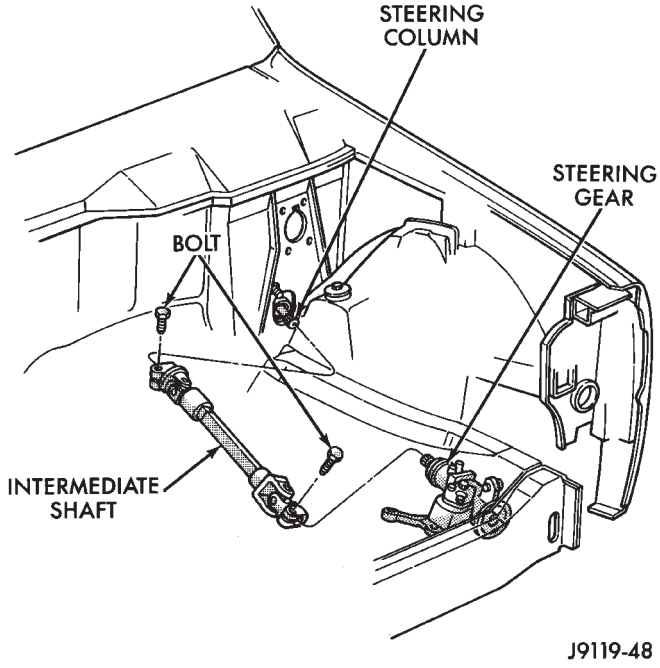


Fig. 15 Coupler Shaft—XJ

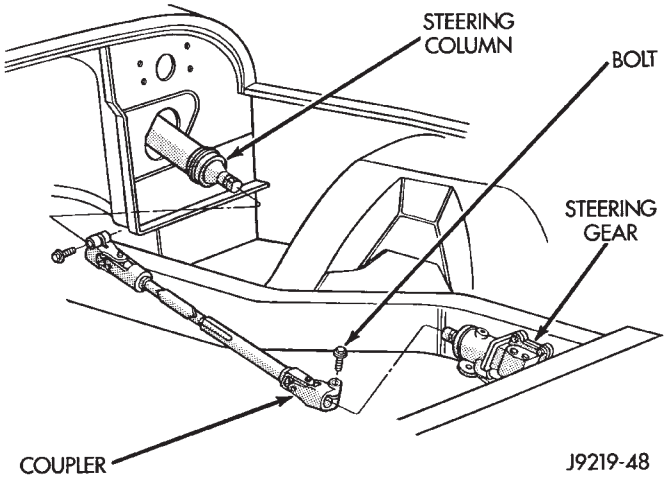


Fig. 16 Coupler Shaft—YJ

INSTALLATION

(1) Align the intermediate (coupler) shaft to the steering gear and column.

(2) Position the steering gear on the frame. Refer to Steering Gear Replacement in this section.

(3) Install and tighten the pinch bolts to 34 N·m (25 ft. lbs.) torque.

STEERING GEAR REPLACEMENT

REMOVAL

(1) Place the front wheels in the straight ahead position with the steering wheel centered.

(2) Remove the column coupler shaft from the gear. Refer to the removal procedures in this section.

(3) Remove pitman arm from gear. Refer to Pitman Arm Removal in the Steering Linkage section.

(4) Remove the steering gear retaining bolts and nuts. Remove the steering gear from the vehicle (Fig. 17, 18).

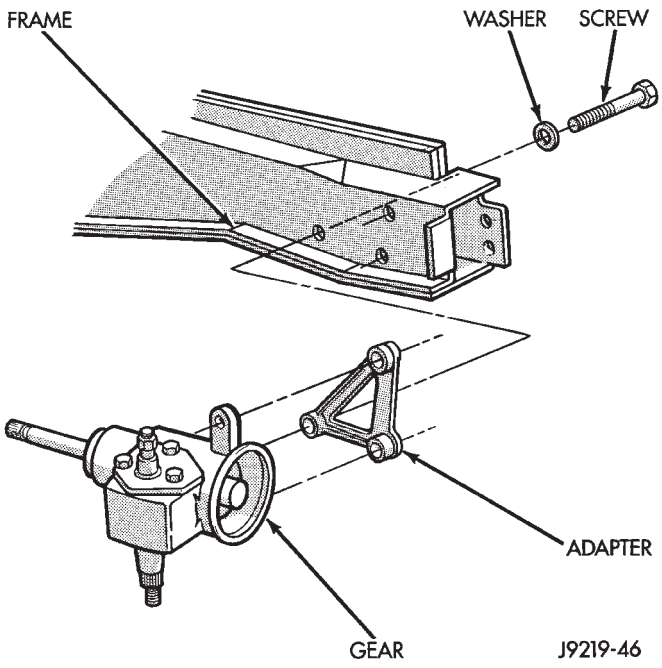


Fig. 17 Steering Gear Mounting—XJ

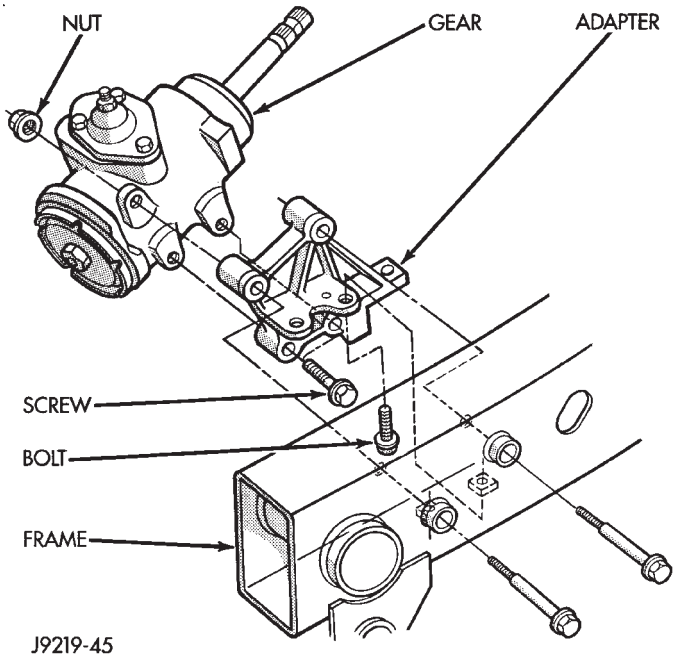


Fig. 18 Steering Gear Mounting—YJ

INSTALLATION

(1) Align the column coupler shaft to steering gear. Refer to Column Coupler installation in this section.

(2) Position the steering gear (and bracket) on the frame rail and install the bolts.

- XJ—Tighten the bolts to 95 N·m (70 ft. lbs.) torque.
- YJ—Tighten the bolts to 105 N·m (78 ft. lbs.) torque.

(3) Align and install the pitman arm. Refer to Pitman Arm Installation in the Steering Linkage section.

MANUAL STEERING GEAR SPECIFICATIONS

Wormshaft Bearing Preload Torque	0.6-0.9 N•m (5 to 8 in-lbs)
Pitman Shaft Overcenter Drag Torque	0.5-1 N•m (4 to 10 in-lbs) (in addition to above)
Maximum Steering Gear Torque	2 N•m (18 in-lbs) total (maximum)
Steering Gear Lubricant	Multi-purpose chassis grease
Steering Gear Ratio	24:1
Steering Gear Type	Recirculating Ball

J9019-2

STEERING COLUMN GENERAL SERVICE

INDEX

SERVICE INFORMATION

The column may be disassembled and reassembled. Also most steering column components can be serviced without removing the column from the vehicle. For additional information, refer to Group 8H, Electrical.

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

CAUTION: Disconnect negative (ground) cable from the battery before servicing any component on the column.

Safety goggles should be worn at all times when involved with steering column service.

STEERING WHEEL

REMOVAL

(1) Make sure the front wheels are in the **straight ahead** position.

(2) Disconnect the negative (ground) cable from the battery.

(3) Remove the horn contact components (Fig. 1).

(4) Remove the steering wheel retaining nut and the vibration dampener, if equipped. Score or paint alignment marks on the column shaft and steering wheel (if none exist) for installation reference.

(5) Remove the steering wheel with Puller 7591 (J-21232-01) (Fig. 2).

INSTALLATION

(1) Install the steering wheel with the scored or painted marks aligned.

(2) Install the retaining nut and tighten to 34 N·m (25 ft. lbs.) torque. **Force the steering wheel down on the shaft with the retaining nut only.**

(3) Install the horn contact components (Fig. 1).

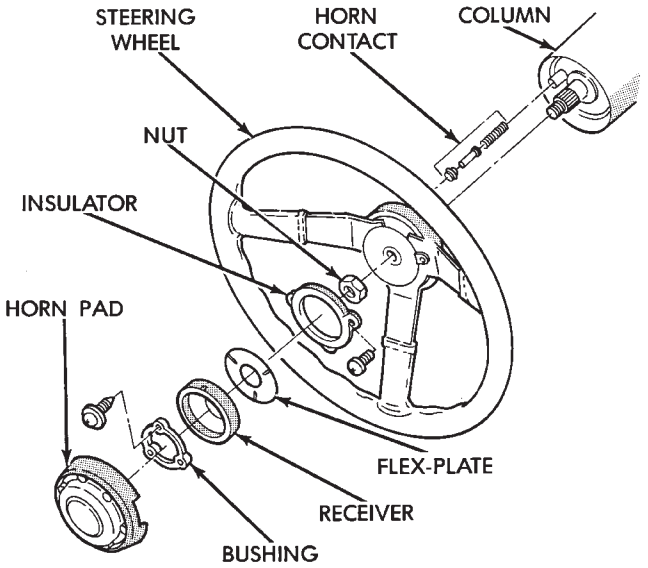
(4) Connect the battery ground (negative) cable.

PARK-LOCK CABLE—CONSOLE SHIFT AUTOMATIC

REMOVAL

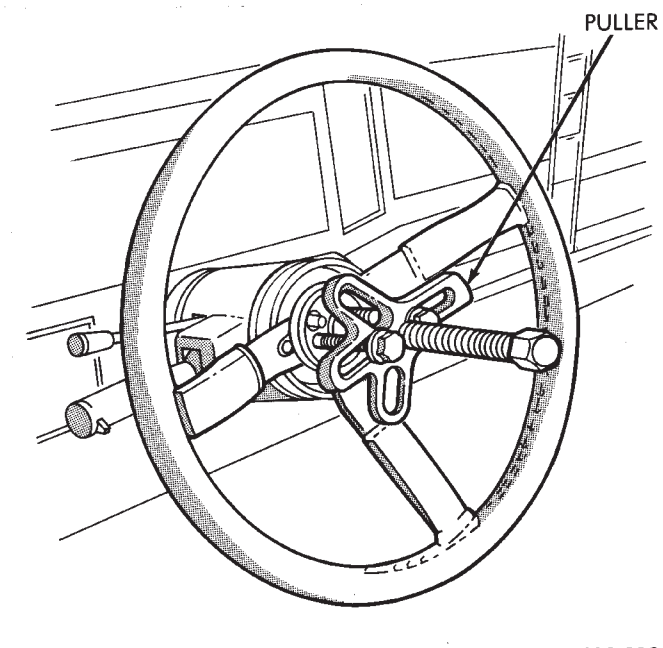
(1) Disconnect the battery negative cable.

(2) Remove the lower portion of the instrument panel, refer to Group 8E, Instrument Panel.



J9219-54

Fig. 1 Horn Pad Removal/Installation



J-8919-113

Fig. 2 Steering Wheel Removal

(3) Remove the steering column mounting bracket to instrument panel nuts. Lower the steering column. Refer to Steering Column Removal .

(4) Disconnect the park-lock cable from the steering column and bracket.

(5) Remove the center console and related trim.

(6) Pull the carpet backward to expose the cable at the gear selector lever bell-crank (Fig. 3).

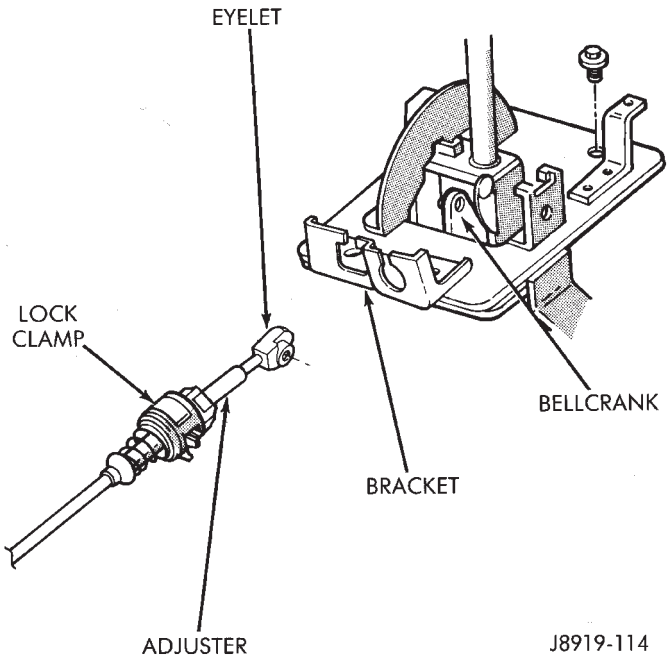


Fig. 3 Park-Lock Cable

(7) Disconnect the cable eyelet from the bell-crank (Fig. 3).

(8) Remove the cable from the shift bracket (Fig. 3).

INSTALLATION

(1) Route and install the cable.

(2) Position the carpet and install the retaining screws, the accelerator pedal bracket, the panels and the moldings.

(3) Install the center console and related trim.

(4) Raise the steering column, refer to Steering Column Removal.

(5) Install the lower portion of the instrument panel, refer to Group 8E, Instrument Panel.

(6) Connect the battery negative cable.

ADJUSTMENT

(1) Pry up the park-lock cable adjuster lock (Fig. 3).

(2) Connect the park-lock cable eyelet to the bell-crank pin (Fig. 3).

(3) Place the gear selector in park.

(4) Insert a .030 - .035 pin between the pawl and the park gate (Fig. 4).

(5) Push the spring-loaded cable adjuster forward.

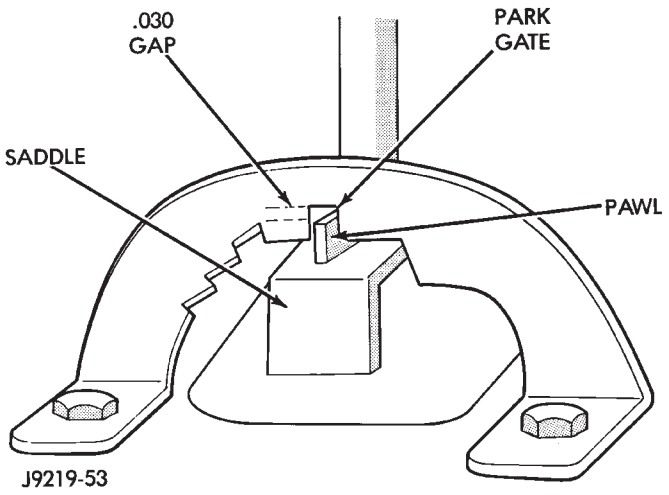


Fig. 4 Park-Lock Adjustment

(6) Lower the cable into the mounting bracket until the tabs are fully engaged in the adjuster (Fig. 3).

(7) Push the cable adjuster lock clamp downward to lock it (Fig. 3).

(8) Remove the pin from the park gate.

(9) Test the park-lock cable operation:

- Turn the ignition switch key to the LOCK position
- Press inward on the gear selector handle release button, the button should not move
- Turn the ignition switch key to the ON position
- Press inward on the gear selector handle release button
- Move the gear selector handle to the DRIVE or NEUTRAL position
- Attempt to turn the ignition switch key to the LOCK position
- If the park-lock cable is correctly adjusted, the key will not turn to the LOCK position;
- Press inward on the gear selector handle release button
- Move the gear selector handle to the PARK position
- Turn the ignition switch key to the LOCK position
- If the park-lock cable is correctly adjusted, the key will turn to the LOCK position.

(10) If additional cable adjustment is needed, slide the adjuster forward or rearward to obtain the correct position (Fig. 3).

Refer to Group 21, Transmission for additional information.

COLUMN REPLACEMENT—XJ

REMOVAL

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

(1) Make sure the front wheels are in the **straight ahead** position.

(2) Disconnect the negative (ground) cable from the battery.

(3) Remove steering wheel from column, refer to Steering Wheel-Removal.

(4) Column shift vehicles, disconnect the shift cable grommet by prying it from the shift lever (Fig. 5).

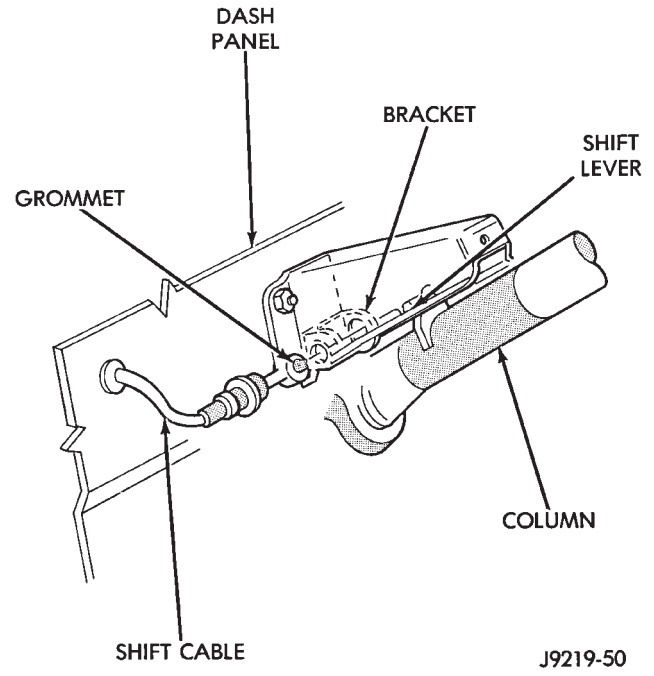


Fig. 5 Shift Cable Grommet

(5) Disconnect the column shaft to steering gear coupler upper bolt (Fig. 6).

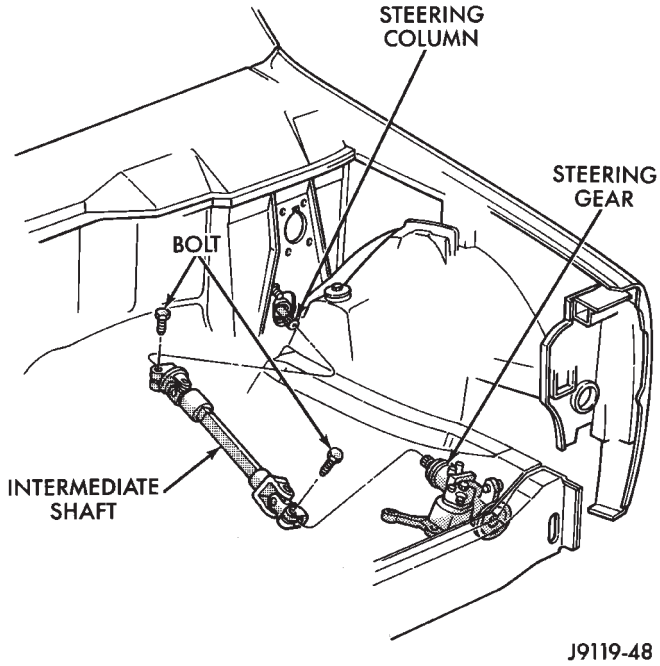


Fig. 6 Column Shaft Coupler

(6) Remove the lower portion of the instrument panel, refer to Group 8E, Instrument Panel.

(7) Column shift vehicles, disconnect the shift indicator cable from the shift housing (Fig. 7).

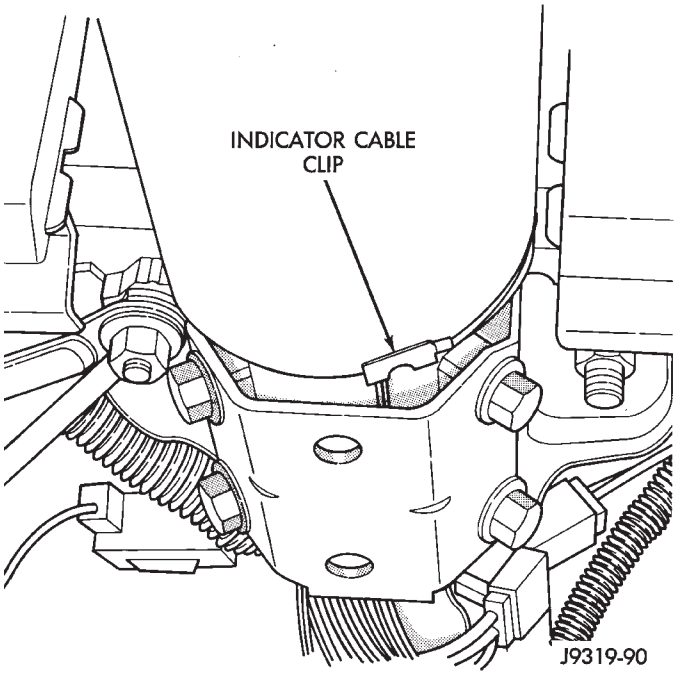


Fig. 7 Indicator Cable Clip

(8) Remove two nuts holding steering column bracket to brake sled (Fig. 8).

(9) Remove four bolts holding steering column bracket to column.

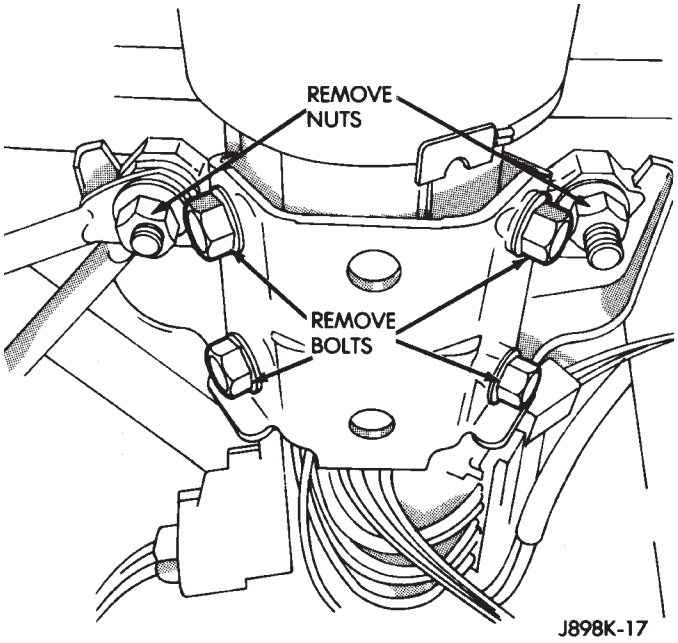


Fig. 8 Column Bracket

(10) Loosen column brace mounting nut at drivers side kick panel. This will allow column to drop.

(11) Disconnect the following items from the steering column connectors:
- Ignition switch wire harness
- Dimmer switch wire harness
- Turn signal switch wire harness
- Windshield wiper wire harness
- Cruise control wire harness (if equipped)
- Park-lock cable (if equipped)

(12) Remove the bolts that attach the toe plate to the floor pan (Fig. 9).

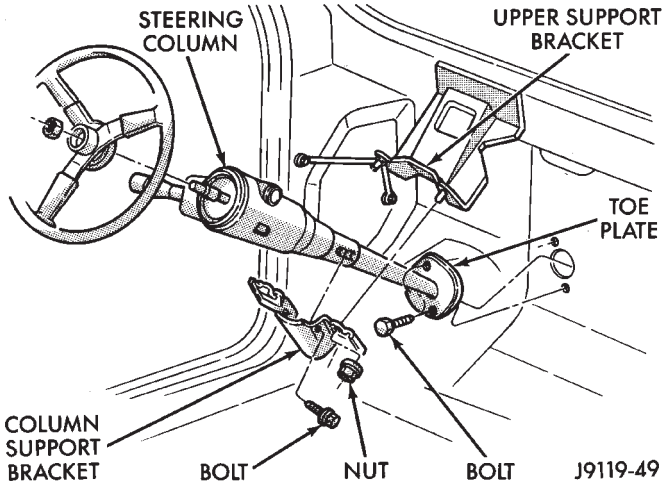


Fig. 9 Steering Column Mounting

(13) Carefully remove column from vehicle.

INSTALLATION

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

(1) Carefully position column in vehicle.

(2) Align the column shaft to steering gear coupling. Install and tighten the bolt to 34 N·m (25 ft. lbs.) torque.

(3) As applicable, connect the following items to the steering column connectors:
- Ignition switch wire harness
- Dimmer switch wire harness
- Turn signal switch wire harness
- Windshield wiper wire harness
- Cruise control wire harness (if equipped)
- Park-lock cable (if equipped)

(4) Install the support bracket on the column and tighten the bolts to 20 N·m (180 in. lbs.) torque.

(5) Raise the column up to the brake sled studs. Connect the brace to the column stud.

(6) Install and tighten the column to brake sled nuts to 30 N·m (22 ft. lbs.) torque.

(7) Column shift vehicles, install the shift cable grommet on the shift lever.

(8) Install and tighten the toe plate-to-floor pan bolts to 8 N·m (66 in. lbs.) torque.

(9) Column shift vehicles, install the shift indicator cable on the shift housing. Check operation.

(10) Install the lower portion of the instrument panel, refer to Group 8E, Instrument Panel.

(11) Install steering wheel on column, refer to Steering Wheel-Installation.

(12) Connect the negative (ground) cable to the battery.

COLUMN REPLACEMENT—YJ

REMOVAL

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

(1) Make sure the front wheels are in the **straight ahead** position.

(2) Disconnect the negative (ground) cable from the battery.

(3) Remove steering wheel from column, refer to Steering Wheel-Removal.

(4) Column shift vehicles, disconnect the shift cable grommet by prying it from the shift lever.

(5) Disconnect the column shaft to steering gear coupler upper bolt (Fig. 10).

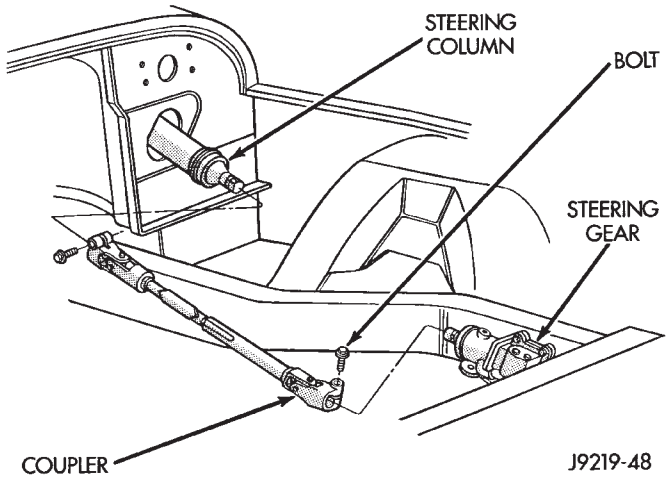


Fig. 10 Column Shaft Coupler

(6) Remove the lower portion of the instrument panel, refer to Group 8E, Instrument Panel.

(7) Remove two nuts holding steering column bracket to brake sled (Fig. 11).

(8) Remove four bolts holding steering column bracket to column.

(9) Disconnect the following items from the steering column connectors:
- Ignition switch wire harness
- Dimmer switch wire harness
- Turn signal switch wire harness
- Windshield wiper wire harness
- Cruise control wire harness (if equipped)

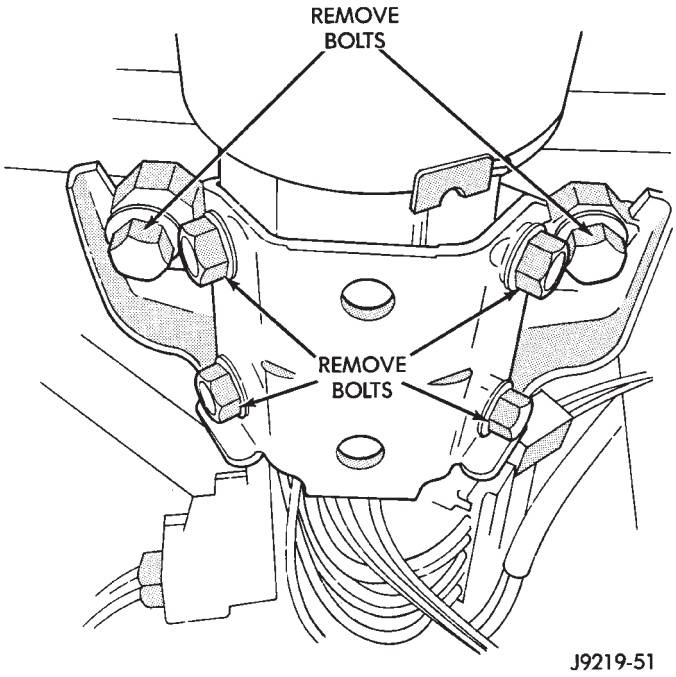


Fig. 11 Column Bracket

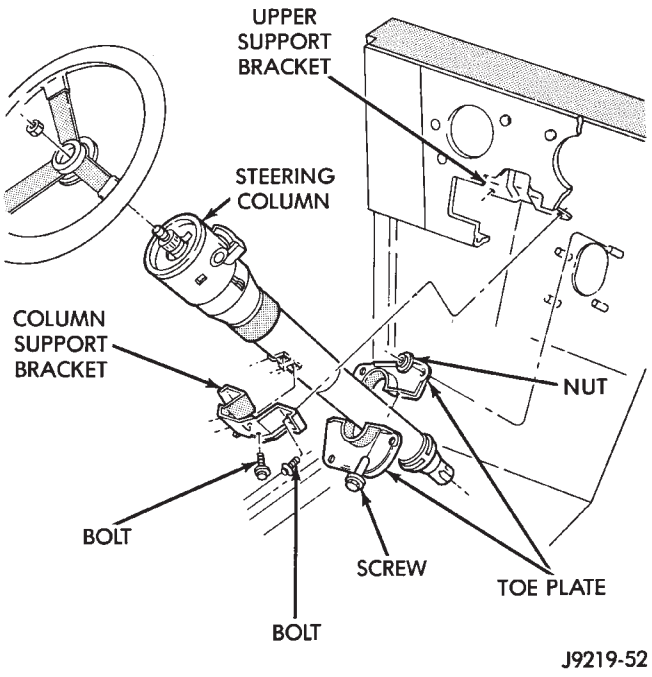


Fig. 12 Steering Column Mounting

(10) Remove the bolts that attach the toe plate to the floor pan (Fig. 12).

(11) Carefully remove column from vehicle.

INSTALLATION

CAUTION: Bumping, jolting and hammering on the steering column shaft and gear shift tube must be avoided during all service procedures.

(1) Carefully position column in vehicle.

(2) Align the column shaft to steering gear coupling. Install and tighten the bolt to 34 N·m (25 ft. lbs.) torque.

(3) As applicable, connect the following items to the steering column connectors:

- Ignition switch wire harness
- Dimmer switch wire harness
- Turn signal switch wire harness
- Windshield wiper wire harness
- Cruise control wire harness (if equipped)

(4) Install the support bracket on the column (Fig. 11) and tighten the bolts to 30 N·m (270 in. lbs.) torque.

(5) Install and tighten the column to brake sled bolts (Fig. 11) to 30 N·m (270 in. lbs.) torque.

(6) Column shift vehicles, install the shift cable grommet on the shift lever.

(7) Install and tighten the toe plate to floor pan bolts/nuts to 21.5 N·m (192 in. lbs.) torque (Fig. 12).

(8) Install the lower portion of the instrument panel, refer to Group 8E, Instrument Panel.

(9) Install steering wheel on column, refer to Steering Wheel-Installation.

(10) Connect the negative (ground) cable to the battery.

NON-TILT STEERING COLUMN

DISASSEMBLY—COLUMN OR CONSOLE SHIFT

Steering column removal from the vehicle is not necessary for;

- Lockplate cover
- Lockplate
- Steering shaft retaining ring
- Canceling cam
- Turn signal switch
- Upper bearing preload spring
- Ignition key/lock cylinder service

The steering column must be removed from the vehicle to service any other component.

(1) If the column is removed for service, fabricate a support fixture to clamp it in a vise (Fig. 1).

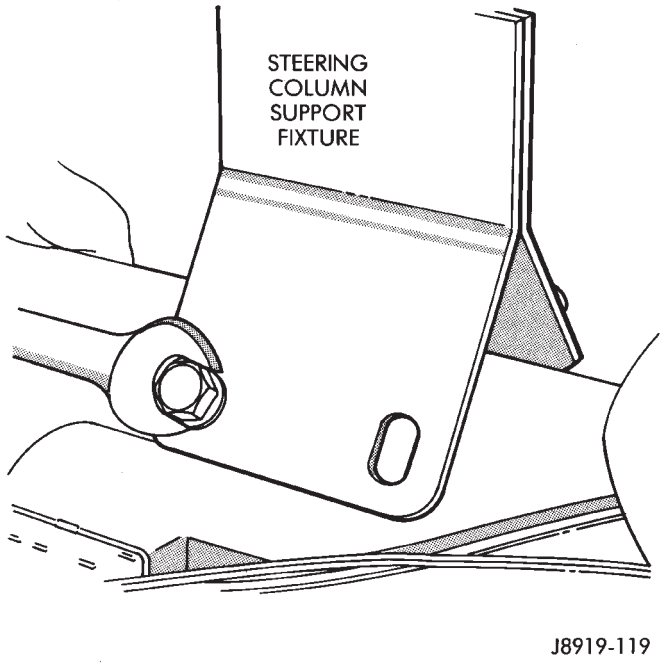


Fig. 1 Steering Column Support Fixture

(2) Remove the steering wheel. Refer to the removal procedure.

(3) Remove the lockplate cover.

WARNING: THE LOCKPLATE RETAINS A VERY STRONG, SPRING FORCE. DO NOT ATTEMPT TO REMOVE THE STEERING SHAFT RETAINING SNAP RING WITHOUT USING LOCKPLATE COMPRESSOR C-4156 (J23653-B).

(4) Compress the lockplate with Compressor C-4156 (J-23653-B) and release the steering shaft retaining snap ring (Fig. 2).

(5) Remove the lockplate compressor tool and the retaining snap ring. Discard the snap ring.

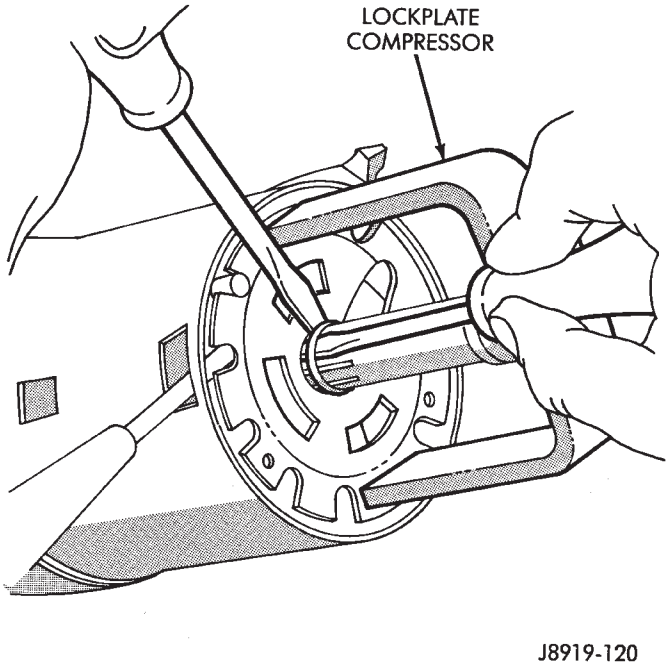


Fig. 2 Retaining Snap Ring Removal

CAUTION: When the steering shaft retaining snap ring is removed, the steering shaft is no longer retained within the column.

(6) Remove the lockplate, canceling cam, upper bearing preload spring, and the thrust washer from the steering column/shaft (Fig. 3).

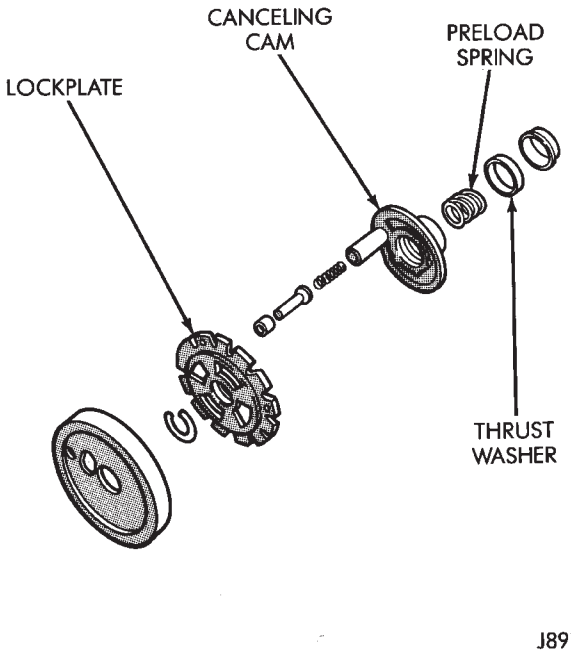


Fig. 3 Steering Column Disassembly

(7) Remove the hazard warning switch knob. Press the knob inward and remove it from the column by turning it counterclockwise.

(8) Remove the turn signal/wiper/cruise control stalk by pulling it out straight from the column. Wiper must be in the off position.

(9) Disconnect the turn signal wire harness connector from the bracket.

CAUTION: Wrap tape around the turn signal switch wire harness connector (Fig. 4) to prevent it from becoming entangled during removal.

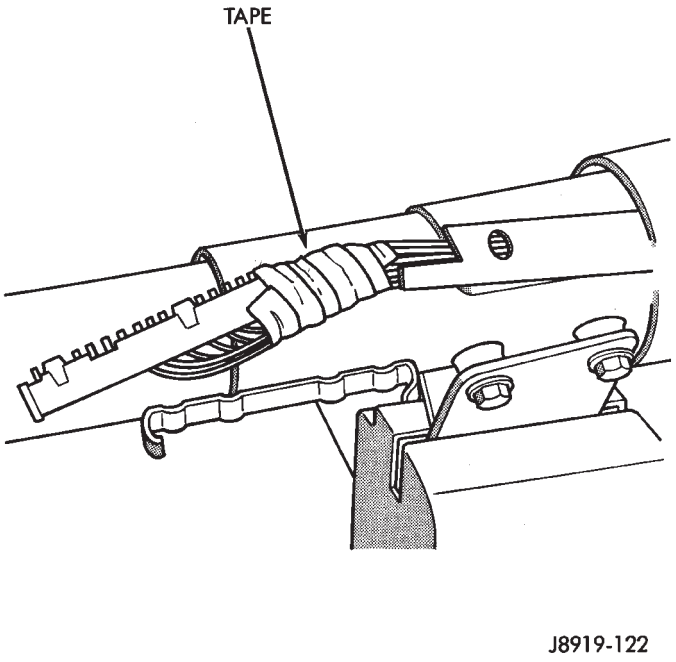


Fig. 4 Taped Turn Signal Switch Wire Harness Connector

(10) Remove the turn signal switch retaining screws (Fig. 5), dimmer switch actuator arm, to remove the switch. Guide the switch straight up and out of the steering column.

(11) Remove the wiper switch wire harness and all the other wire harnesses located within the steering column.

(12) Insert the ignition switch key into the key/lock cylinder and turn to the ON position.

CAUTION: Do not attempt to remove the key warning buzzer switch and contacts separately. If separated, the contacts can detach and drop into the steering column.

(13) Remove the key warning buzzer switch and contacts as a unit (Fig. 6). Use needle-nose pliers or a paper clip bent at a right angle (90 degrees).

(14) Turn ignition key/lock cylinder to the ON position. Insert a thin screwdriver into the slot adjacent to the switch attaching screw boss (right-hand slot).

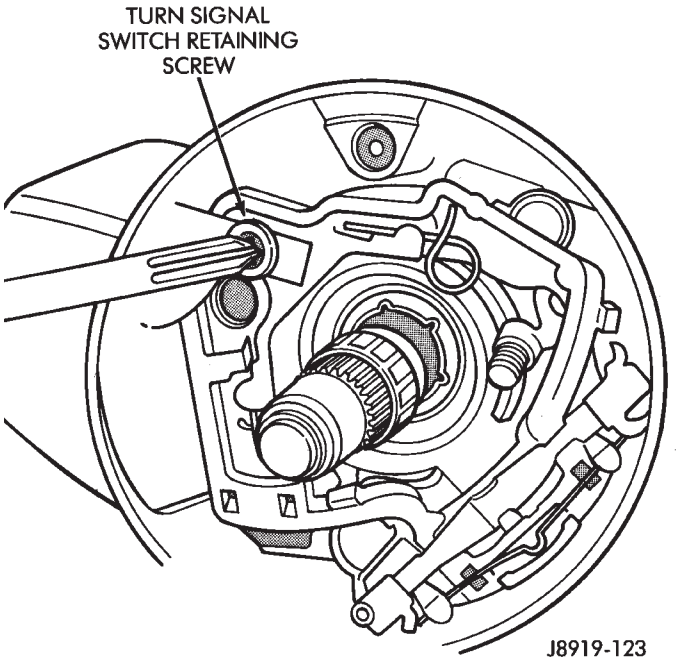


Fig. 5 Turn Signal Switch Retaining Screw

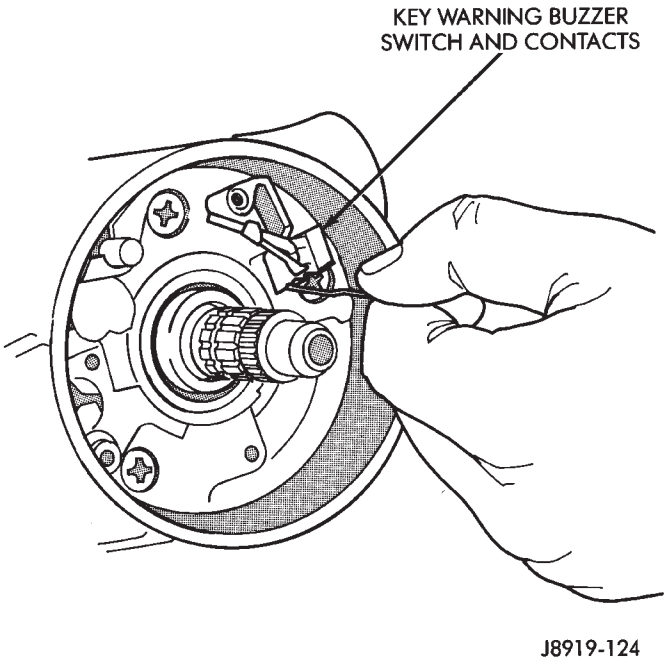


Fig. 6 Key Warning Buzzer/Contacts Removal

Depress the spring latch located at the bottom of the slot to release the key/lock cylinder. Remove the key/lock cylinder. (Fig. 7).

(15) Remove the ignition switch and the dimmer switch (Fig. 8) from the lower end of the steering column.

Proceed to Column Shift Disassembly Procedure or Console Shift Disassembly Procedure.

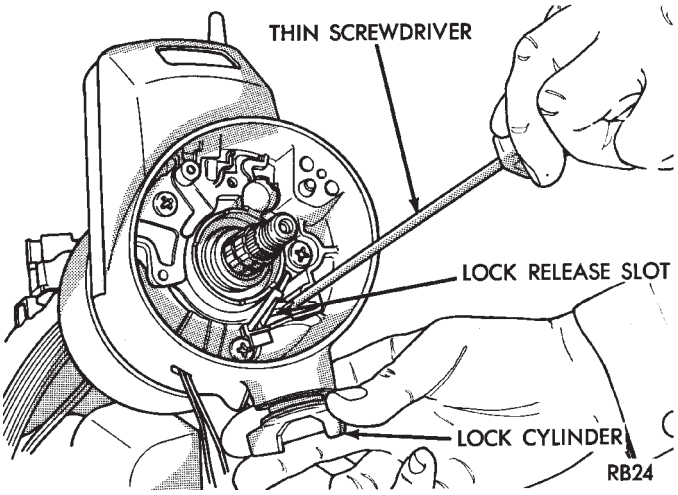


Fig. 7 Key/lock Cylinder Removal

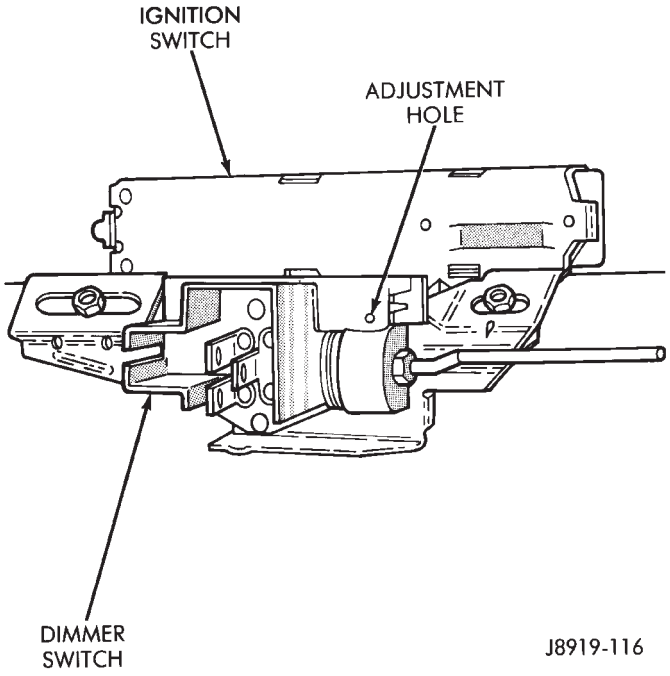


Fig. 8 Ignition Switch & Dimmer Switch

COLUMN SHIFT DISASSEMBLY

(1) Remove the gear selector lever upper pivot pin and the selector lever.

(2) Remove the upper bearing thrust washer.

(3) Remove the four screws that attach the key/lock cylinder housing to the steering column jacket. Remove the housing (Fig. 9).

(4) Remove the thrust cap from the key/lock cylinder housing (Fig. 10).

(5) Remove the ignition switch actuating rod and rack from the key/lock cylinder housing (Fig. 10).

(6) Remove the rack preload spring and the shaft lock bolt and spring from the key/lock cylinder housing. Remove the shift lever detent plate from the housing (Fig. 10).

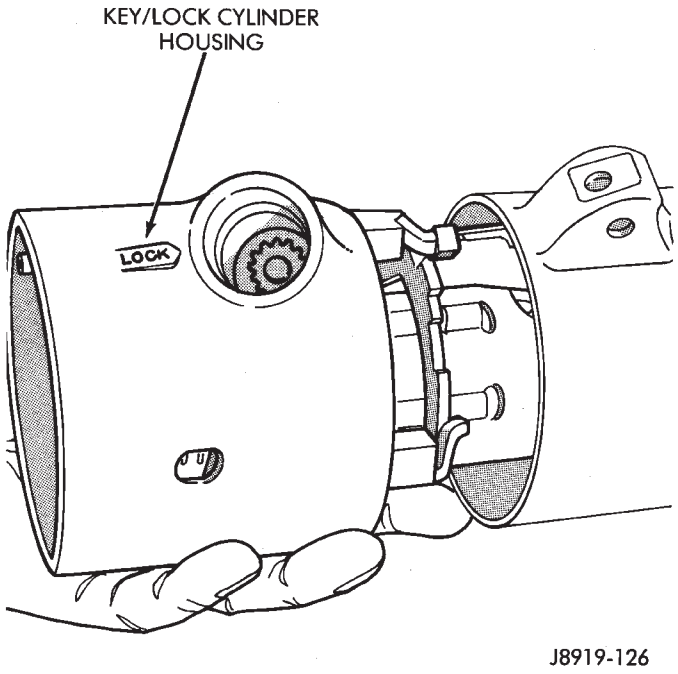


Fig. 9 Key/Lock Cylinder Housing

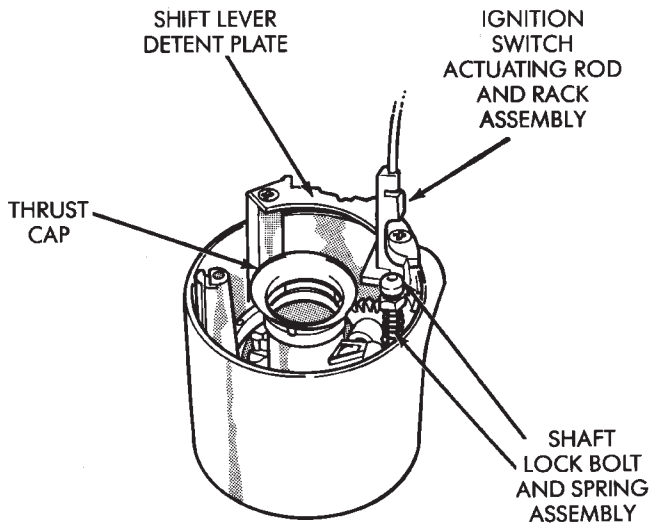


Fig. 10 Key/Lock Cylinder Housing Components

(7) Use a blunt punch to exert force on the block tooth to disengage and remove the lock sector (Fig. 11).

(8) Remove the gear selector lever housing and the shroud from the steering column jacket.

(9) Remove the gear selector lever spring from the lever housing.

The steering column must be removed from the vehicle to disassemble the remaining steering column components.

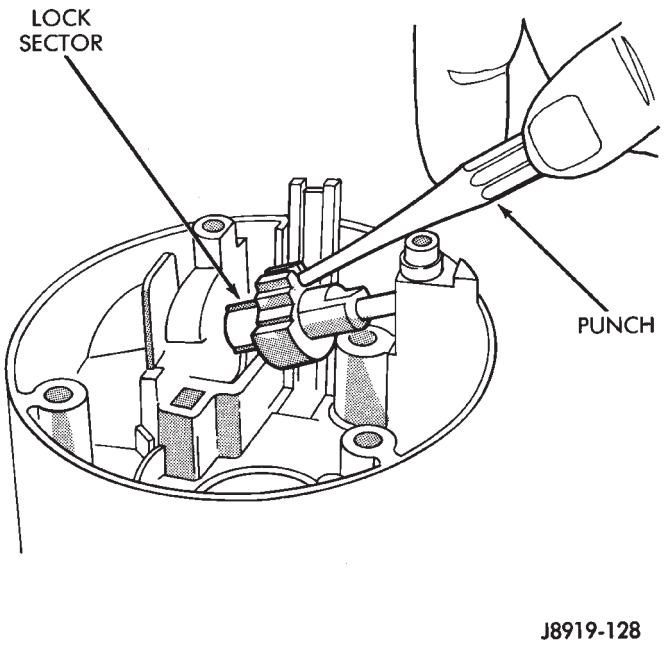


Fig. 11 Lock Sector Removal

(10) Remove the steering shaft (if not previously removed).

(11) Remove the spring clip from the steering column lower bearing retainer. Remove the retainer, the lower bearing and the adapter (Fig. 12).

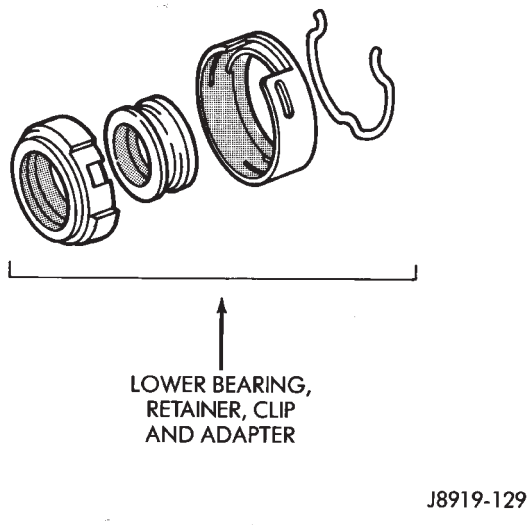


Fig. 12 Lower Bearing, Adapter, Retainer & Clip

(12) Slide out and remove the shift tube.

CONSOLE SHIFT DISASSEMBLY

(1) Remove the screws that attach the key/lock cylinder housing and the shroud to the steering column jacket (Fig. 13).

(2) Remove the dimmer switch actuator arm.

(3) Disengage the remote rod from the lock rack.

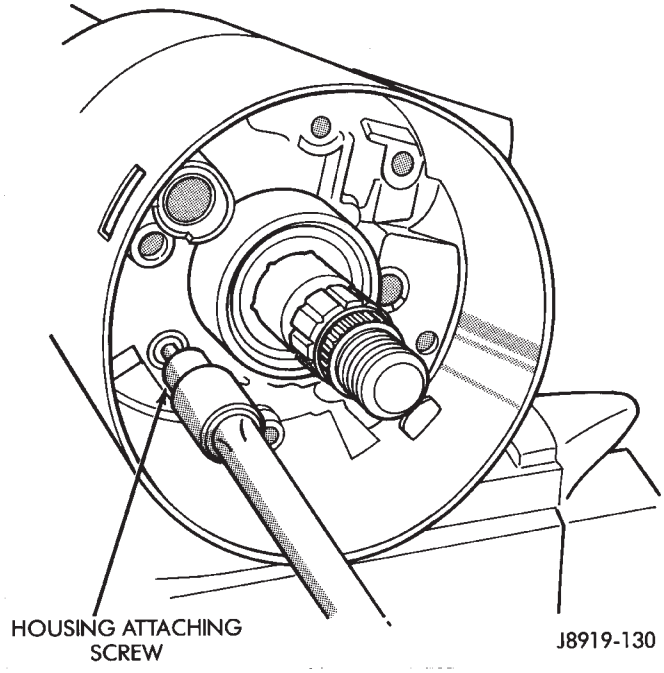


Fig. 13 Key/Lock Cylinder Housing Removal

(4) Remove the key/lock cylinder housing-to-shroud attaching screws (Fig. 14). Separate the housing and the shroud.

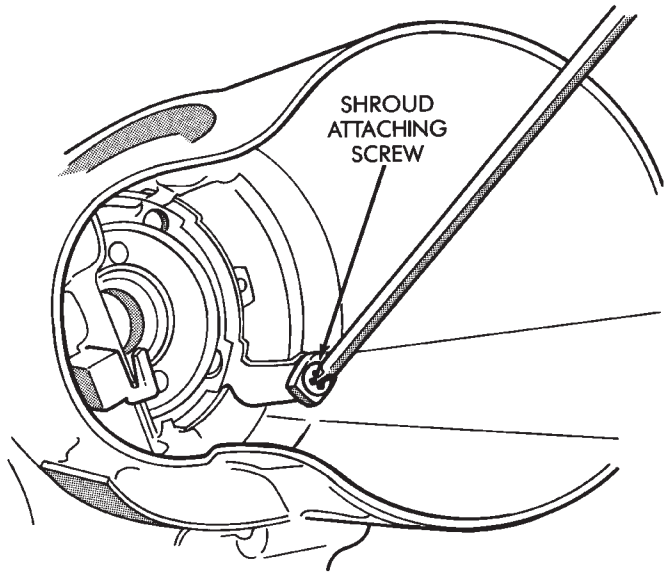


Fig. 14 Housing/Shroud Attaching Screw

(5) Remove the wave washer from the key release lever pivot. Remove the key release lever and the pivot.

(6) Remove the lock rack and the lock bolt (Fig. 15).

(7) Remove the lock rack preload spring.

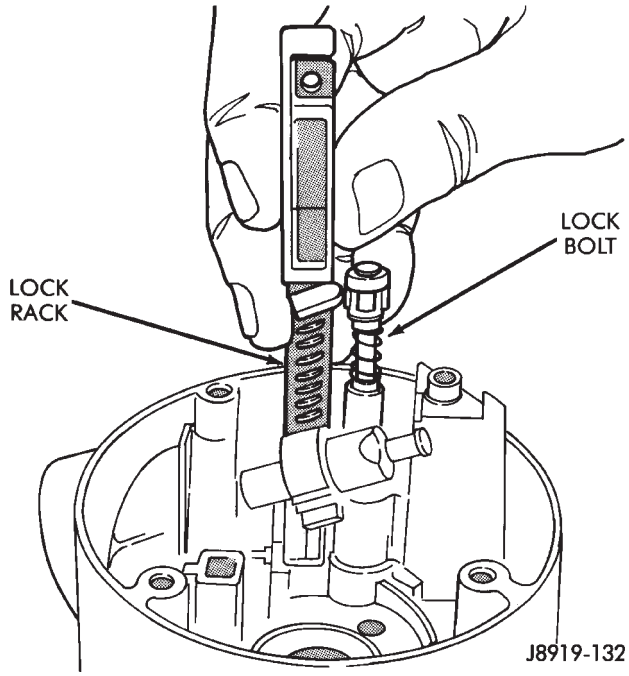


Fig. 15 Lock Rack & Lock Bolt

(8) Use a blunt punch to exert force on the block tooth to disengage and remove the lock sector (Fig. 16).

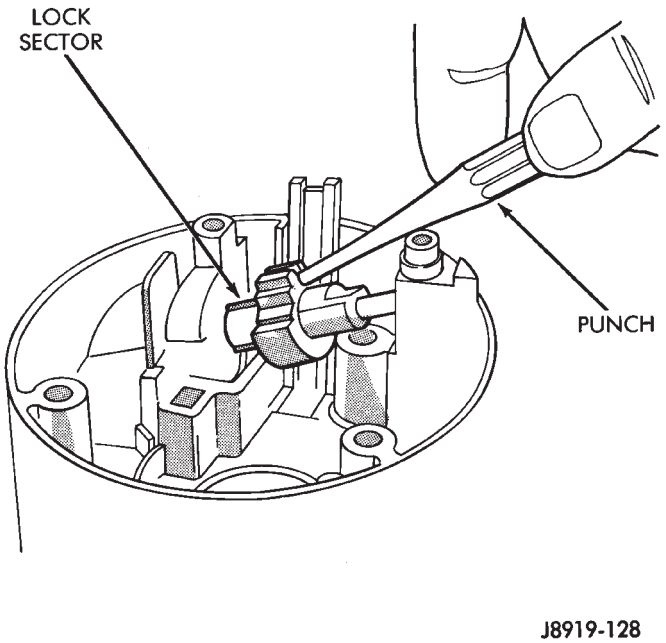


Fig. 16 Lock Sector Removal

The steering column must be removed from the vehicle to disassemble the remaining steering column components.

(9) Remove the steering shaft (if not previously removed).

(10) Remove the spring clip from the lower bearing retainer. Remove the retainer, the bearing and the adapter (Fig. 17).

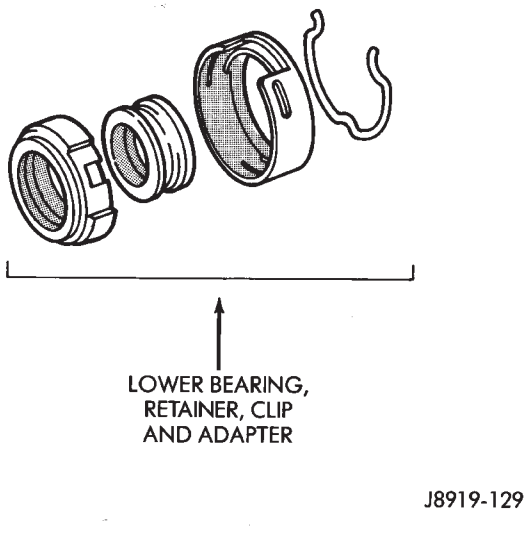


Fig. 17 Lower Bearing Components

ASSEMBLY

Proceed to Column Shift Assembly Procedure or Console Shift Assembly Procedure.

WARNING: USE ONLY THE ORIGINAL OR EXACT REPLACEMENT SCREWS, BOLTS AND NUTS TO ASSEMBLE THE STEERING COLUMN. INCORRECT SCREW OR BOLT LENGTH COULD PREVENT THE COLUMN FROM COMPRESSING WITH IMPACT (FRONT-END COLLISION). ALL FASTENERS USED FOR ASSEMBLY MUST BE TIGHTENED WITH THE CORRECT TORQUE. THIS WILL ENSURE THE COLUMN WILL BREAKAWAY WITH IMPACT.

CAUTION: Apply chassis lubricant to all the bearing, thrust and friction producing mating surfaces before assembly.

COLUMN SHIFT ASSEMBLY

(1) Insert the lock sector through the key/lock cylinder hole in the key/lock cylinder housing. Install the lock sector on the lock sector shaft (Fig. 18). Ensure that the lock sector turns freely after installation.

(2) Install the lock rack preload spring. The bowed side of the spring must contact the lock rack when the rack is installed.

(3) Assemble the lock bolt and the lock rack (Fig. 19).

(4) Install the assembled lock bolt and lock rack in the key/lock cylinder housing (Fig. 20). Mate the lock rack block tooth with the lock sector block tooth.

(5) Install the shift lever detent plate on the key/lock cylinder housing (Fig. 21).

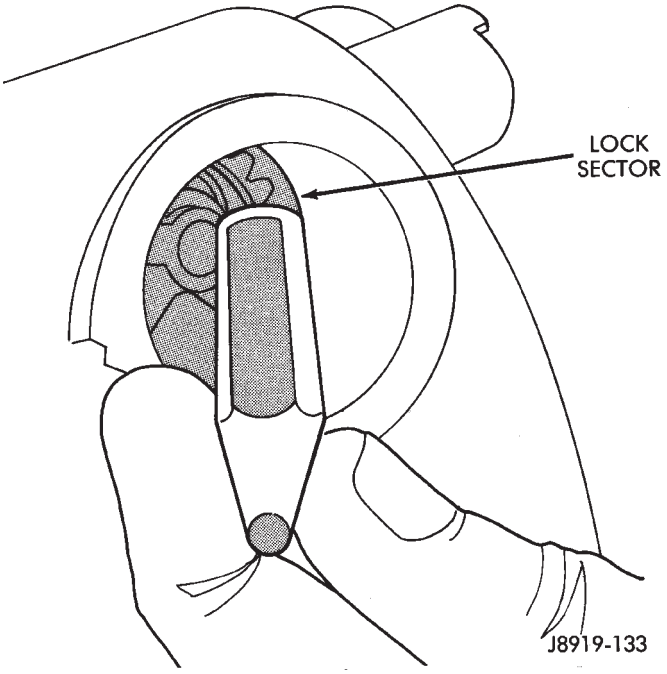


Fig. 18 Lock Sector Installation

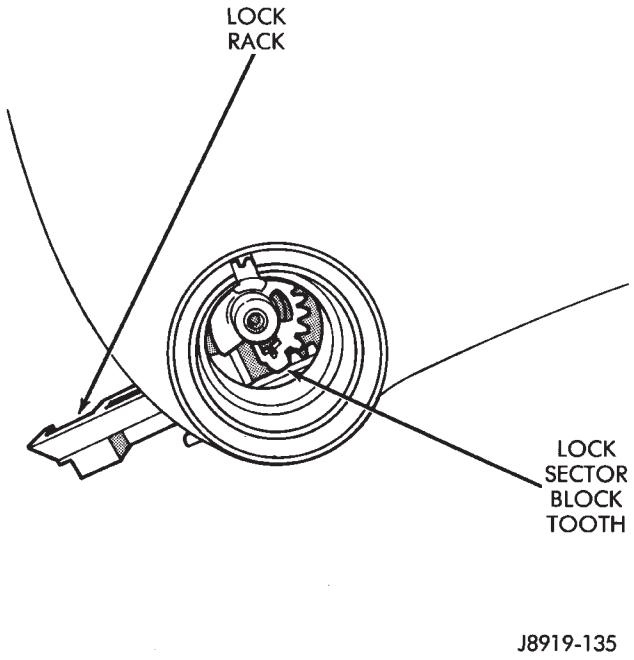


Fig. 20 Lock Bolt/Lock Rack Installation

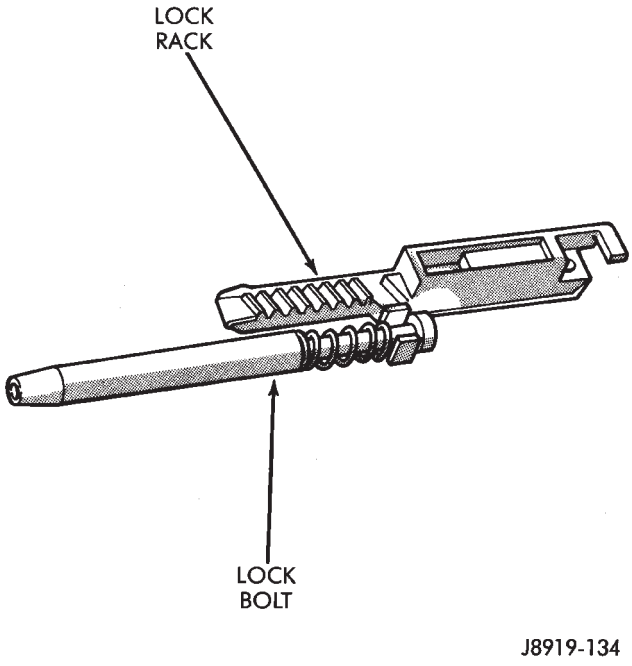


Fig. 19 Lock Bolt & Lock Rack

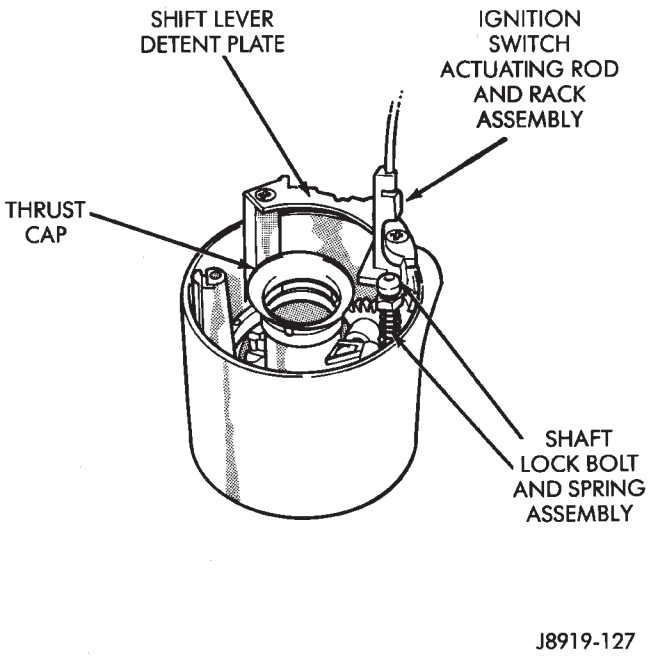


Fig. 21 Key/Lock Cylinder Housing

(6) Install the thrust cap on the key/lock cylinder housing (Fig. 21).

(7) Install the ignition switch actuating rod and rack on the key/lock cylinder housing.

(8) Insert and install the gear selector lever housing lower bearing the housing. Align the indentations in the bearing shell with the projections on the housing jacket.

(9) Install the gear selector lever spring in the lever housing.

(10) Install the gear selector lever housing and shroud on the upper end of the steering column jacket. Rotate the housing and ensure that the bearing is properly seated.

(11) Place the gear selector in the PARK position, and the lock rack pulled downward. Position and correctly seat the key/lock cylinder housing on the steering column jacket. Install and tighten the four attaching screws.

(12) Insert the shift tube in the lower end of the steering column jacket. Rotate it until the shift tube upper key slides into the gear selector housing keyway.

CONSOLE SHIFT ASSEMBLY

(1) Insert the lock sector through the key/lock cylinder hole in the cylinder housing. Install the lock sector on the lock sector shaft (Fig. 22). Ensure that the lock sector turns freely after installation.

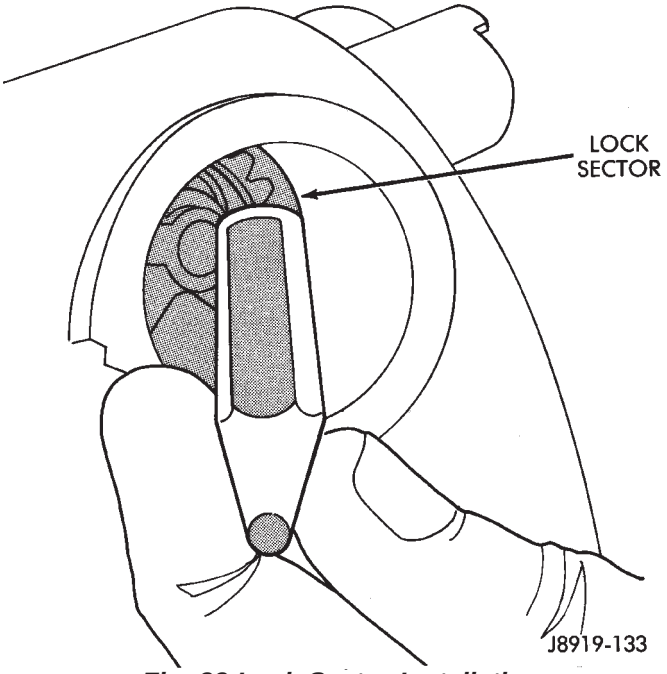


Fig. 22 Lock Sector Installation

(2) Install the lock rack preload spring. The bowed side of the spring must contact the lock rack when the rack is installed.

(3) Assemble the lock bolt and the lock rack (Fig. 23).

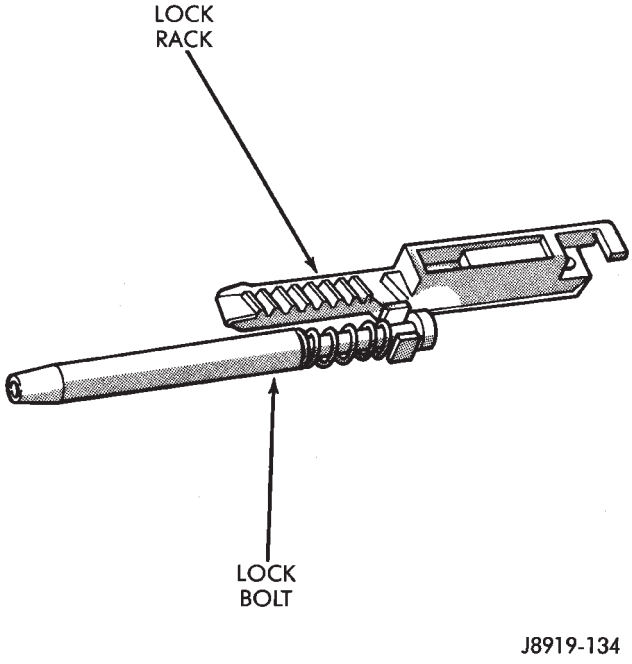


Fig. 23 Lock Bolt & Lock Rack

(4) Install the assembled lock bolt and lock rack in the cylinder housing (Fig. 24). Mate the lock rack block tooth with the lock sector block tooth.

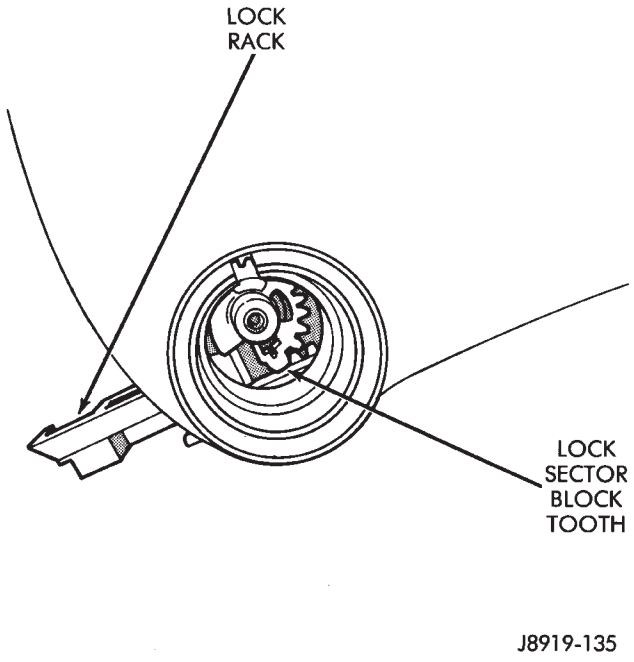


Fig. 24 Lock Bolt/Lock Rack Installation

(5) Install the key-release lever return spring over the threaded pivot post on the cylinder housing (Fig. 25).

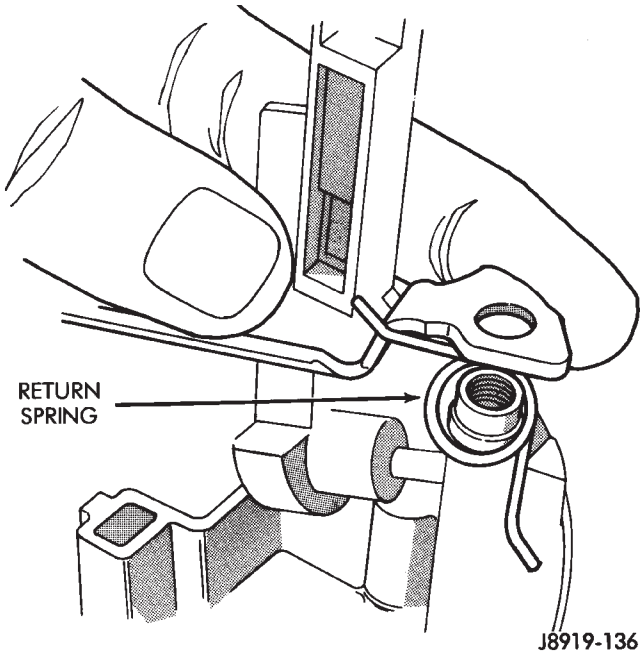


Fig. 25 Key-Release Lever Return Spring

(6) Insert the key-release lever finger into the lock rack slot. Position the hole in the lever over the threaded pivot post on cylinder housing (Fig. 26). Ensure that the inner end of the spring contacts the release lever.

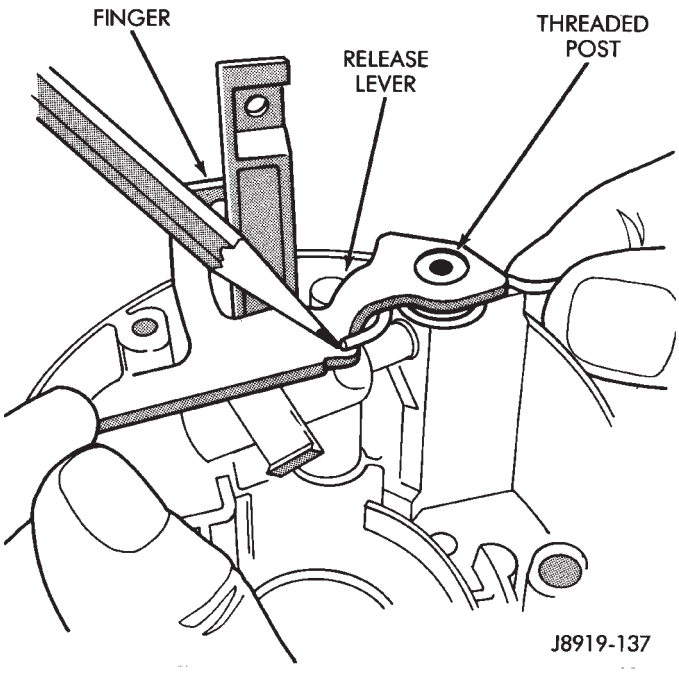


Fig. 26 Key-Release Lever Installation

(7) Raise the key-release lever slightly. Install the end of the lever spring between the lever and the boss on the housing (Fig. 27).

(8) Apply chassis lubricant to the wave washer (Fig. 27). Position it on the threaded pivot post and resting on the release lever.

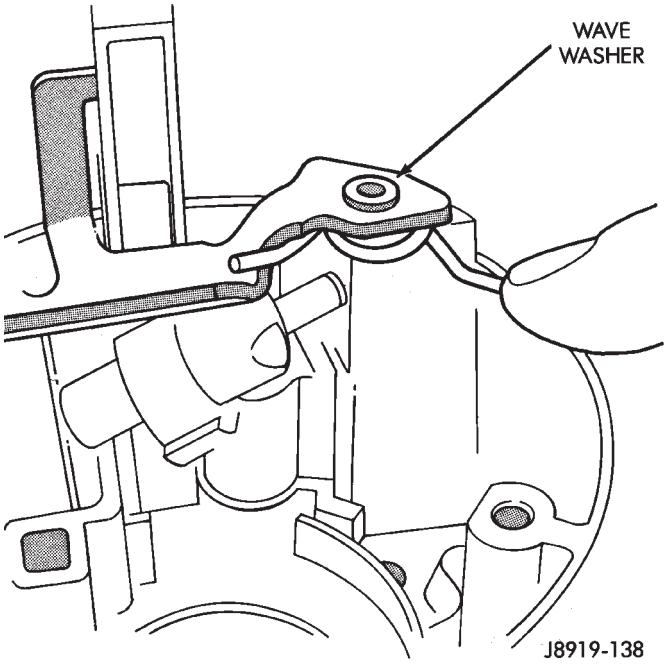


Fig. 27 Spring Positioning & Wave Washer Installation

(9) Position the shroud on the key/lock cylinder housing and install the attaching screws. Tighten the screws to 2 N·m (18 in. lbs.) torque. **Ensure that the wave washer (Fig. 27) is not displaced while attaching the shroud to the cylinder housing.**

(10) Insert the short, hooked end of the remote rod in the lock rack.

(11) Install the assembled key/lock cylinder housing and shroud on the steering column jacket. Install the attaching screws (Fig. 28). Tighten the screws to 7 N·m (60 in. lbs.) torque.

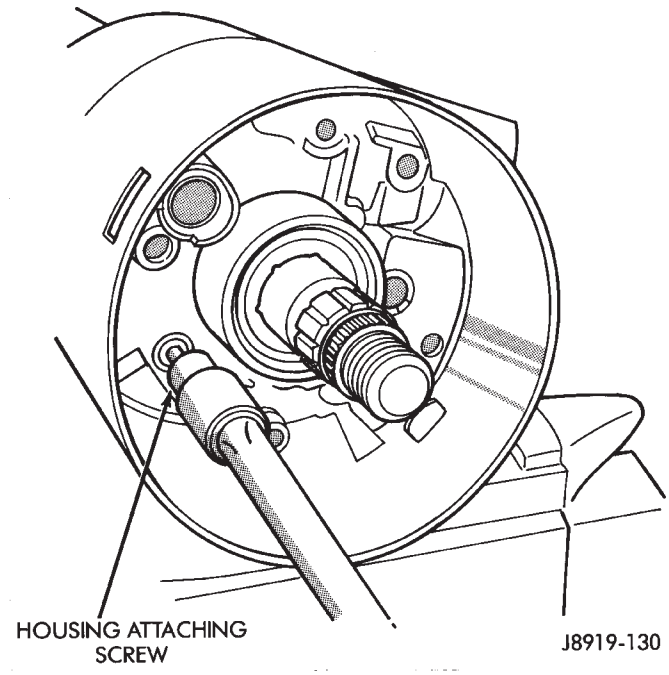


Fig. 28 Key/Lock Cylinder Housing Installation

COLUMN SHIFT OR CONSOLE SHIFT FINAL ASSEMBLY

(1) To install ignition switch lock, turn the key to the LOCK position and remove the key. This will cause the buzzer operating lever to retract in the key/lock cylinder. Now insert the key/lock cylinder into the housing far enough to contact the drive shaft (Fig. 29). Force it inward and move the ignition switch actuator rod up and down to align the components. When the components align, the key/lock cylinder will move inward and lock in place.

(2) Install the key warning buzzer switch.

(3) Install the ignition switch, refer to Ignition Switch —All Models in Group 8D, Ignition.

(4) Install the lower bearing, the adapter, the retainer and spring clip at the lower end of the steering column.

(5) Install the steering shaft through the lower end of the steering column and insert it into the upper bearing.

(6) Position the turn signal switch and wire harness in the cylinder housing. Fold the wires against the connector. Route the connector down through the steering column jacket.

(7) Install the windshield wiper wire harness and switch. Route the wire harness down through steering column jacket.

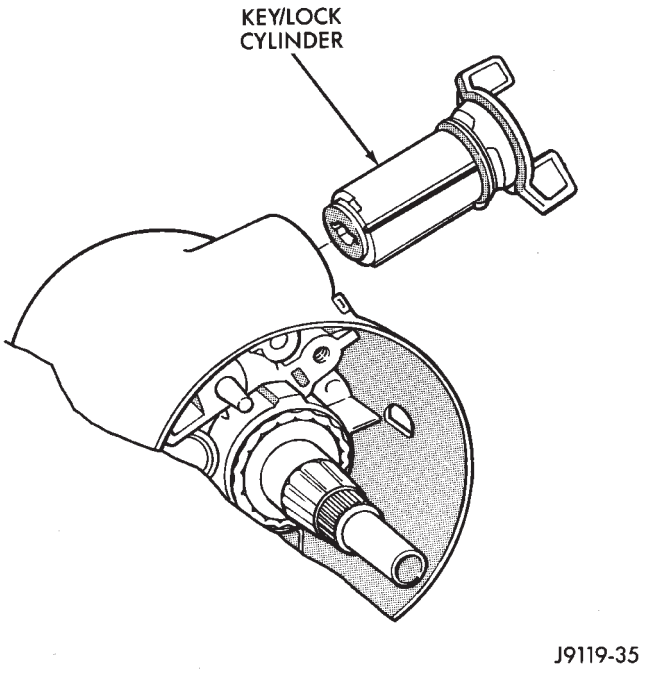


Fig. 29 Key/Lock Cylinder Installation

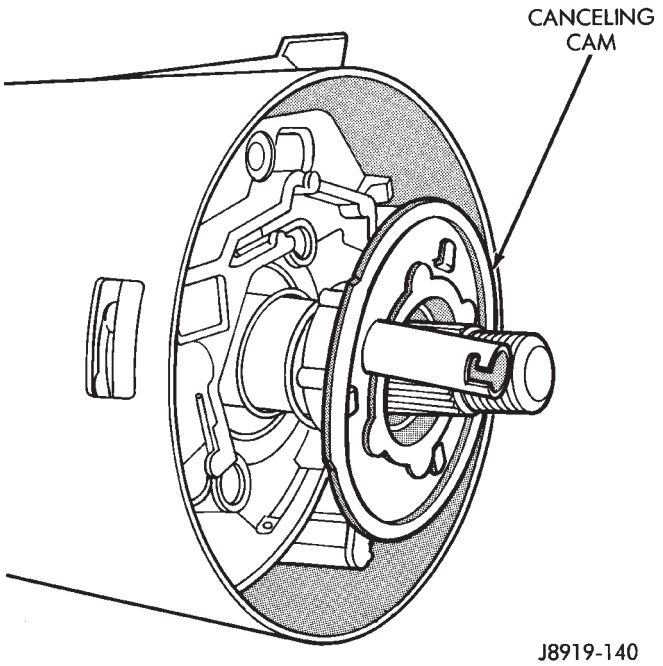


Fig. 30 Canceling Cam Position

(8) Align the turn signal switch in the housing and secure the switch with the attaching screws. Tighten the screws to 4 N·m (35 in. lbs.) torque.

(9) Install the dimmer switch actuator arm. Tighten the attaching screws to 4 N·m (35 in. lbs.) torque.

(10) If equipped, install the cruise control wire harness. Install the turn signal stalk by pushing it straight into the column.

(11) Position the thrust washer, the upper bearing preload spring and the canceling cam on the steering shaft (Fig. 30).

(12) Place the turn signal switch in the neutral (OFF) position and install the hazard warning switch knob.

(13) Position the lockplate on the steering shaft. Install a replacement lockplate retaining snap ring on the sleeve of the Lock Plate Compressor C-4156 (J-23653-B). Install the tool on the steering shaft (Fig. 31).

(14) Compress the lockplate with the compressor tool and position the retaining snap ring in the steering shaft groove.

(15) Ensure that the retaining snap ring is completely seated in the groove before removing the tool. Remove the tool and install the lockplate cover.

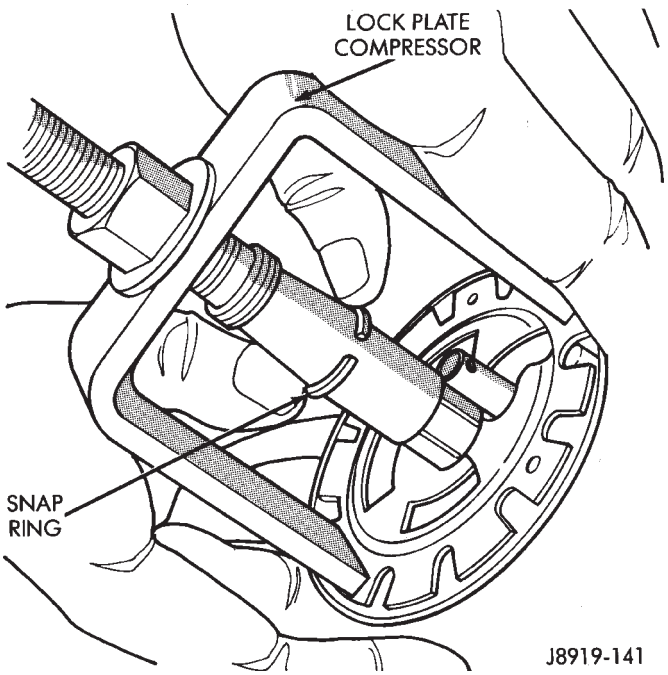


Fig. 31 Lockplate Snap Ring Installation

(16) Install the steering wheel. Refer to the installation procedure. Tighten the steering wheel retaining nut to 34 N·m (25 ft. lbs.) torque.

(17) If removed, install the steering column in the vehicle. Refer to the installation procedure.

(18) If disconnected, connect the battery negative cable and, if equipped, reset the clock

TILT STEERING COLUMN

DISASSEMBLY

(1) Remove the steering column from the vehicle, if necessary. Refer to the removal procedure.

(2) If the column is removed for service, fabricate a support fixture to clamp it in a vise (Fig. 1).

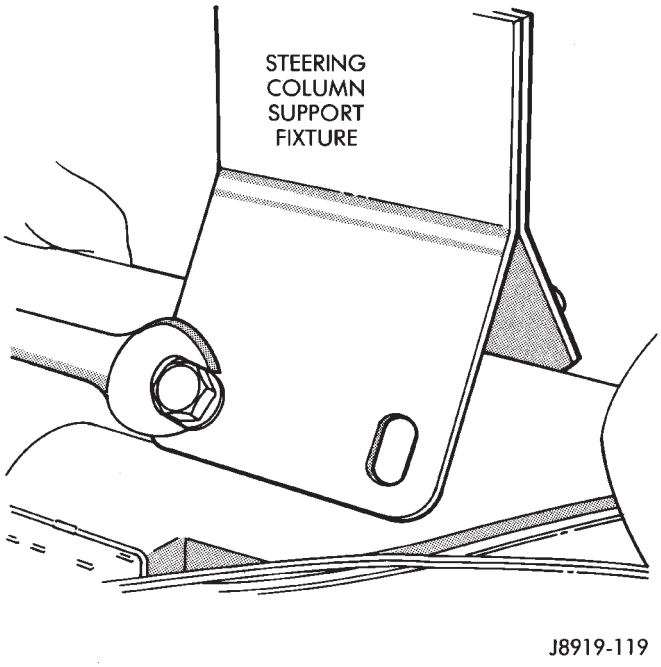


Fig. 1 Steering Column Support Fixture

(3) If the steering column has not been removed from the vehicle, place the front wheels in the straight-ahead position. Disconnect the battery negative cable.

(4) Protect the painted areas on the steering column.

(5) Remove the steering wheel. Refer to the removal procedure.

(6) Column shift: Remove the gear selector lever retaining pin and the lever from the housing.

(7) Remove the lockplate cover. Use two small pry bars to pry the cover off the lockplate.

WARNING: THE LOCKPLATE RETAINS A VERY STRONG, SPRING FORCE. DO NOT ATTEMPT TO REMOVE THE STEERING SHAFT RETAINING SNAP RING WITHOUT USING LOCKPLATE COMPRESSOR C-4156 (J-23653-B).

(8) Compress the lockplate with Lock Plate Compressor C-4156 (J-23653-B) and release the steering shaft retaining snap ring (Fig. 2).

(9) Remove the lockplate compressor tool and the retaining snap ring. Discard the snap ring.

(10) Remove the lockplate, canceling cam, upper bearing preload spring, and the thrust washer from the steering column/shaft.

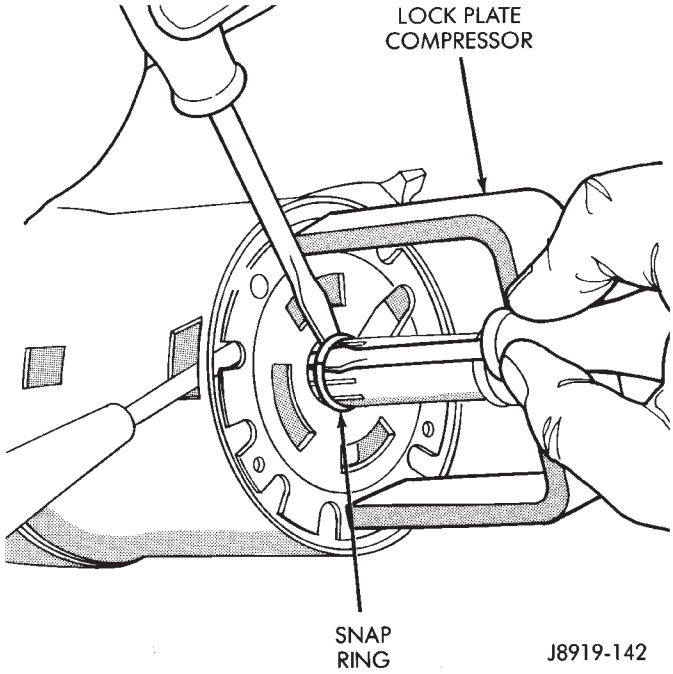


Fig. 2 Lockplate Snap Ring Removal

(11) Remove the hazard warning switch knob. Press the knob inward and remove it from the steering column by turning it counterclockwise.

(12) If the steering column is the column shift type, remove the two retaining screws and the gear selector indicator cover.

(13) If the steering column is the column shift type, remove the gear selector indicator lamp bracket retaining screw. Do not remove the lamp and bracket at this time.

(14) Remove the tilt-release lever.

(15) Disconnect the turn signal wire harness connector from the bracket located at the lower end of the steering column (Fig. 3).

CAUTION: Wrap tape around the turn signal switch wire harness connector to prevent it from becoming entangled during removal.

(16) Remove the plastic protector from the wire harness.

(17) Remove the turn signal switch retaining screws (Fig. 4), dimmer switch actuator arm, to remove the switch. Guide the switch straight up and out of the steering column.

(18) Remove the windshield wiper switch wire harness and all the other wire harnesses located within the steering column.

(19) Insert the ignition switch key into the key/lock cylinder. Turn the key to the ON position.

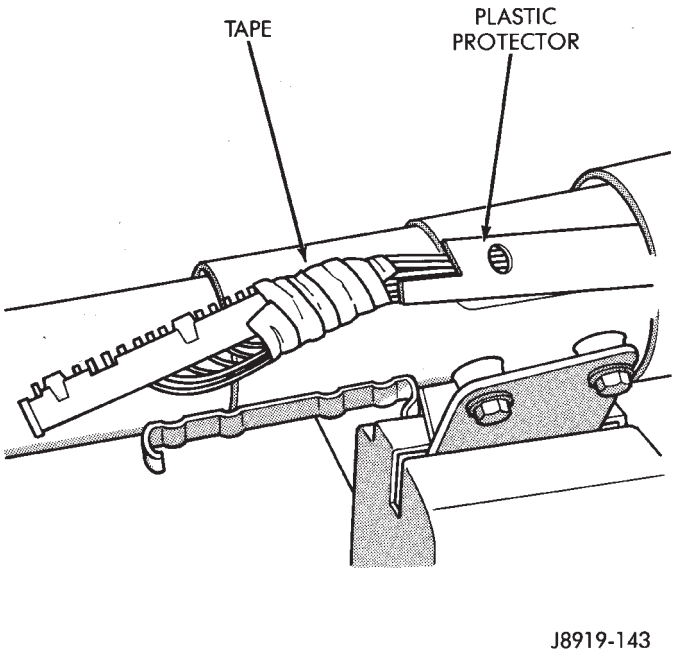


Fig. 3 Turn Signal Switch Wire Harness Connector

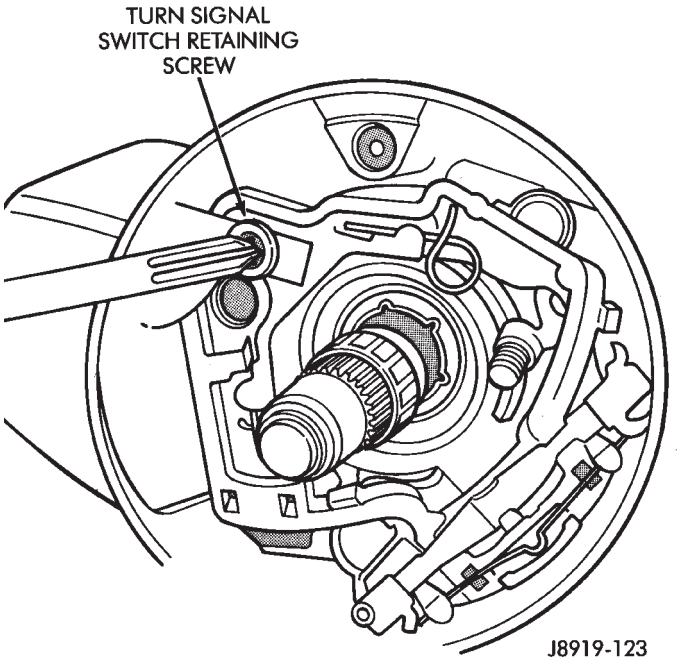


Fig. 4 Turn Signal Switch Removal

CAUTION: Do not attempt to remove the key warning buzzer switch and contacts separately. If separated, the contacts can detach and drop into the steering column.

(20) Remove the key warning buzzer switch and contacts as a unit (Fig. 5). Use needle-nose pliers or a paper clip bent at a right angle (90 degrees).

(21) Turn ignition key/lock cylinder to the ON position. Insert a thin screwdriver into the slot adjacent to the switch attaching screw boss (right-hand slot).

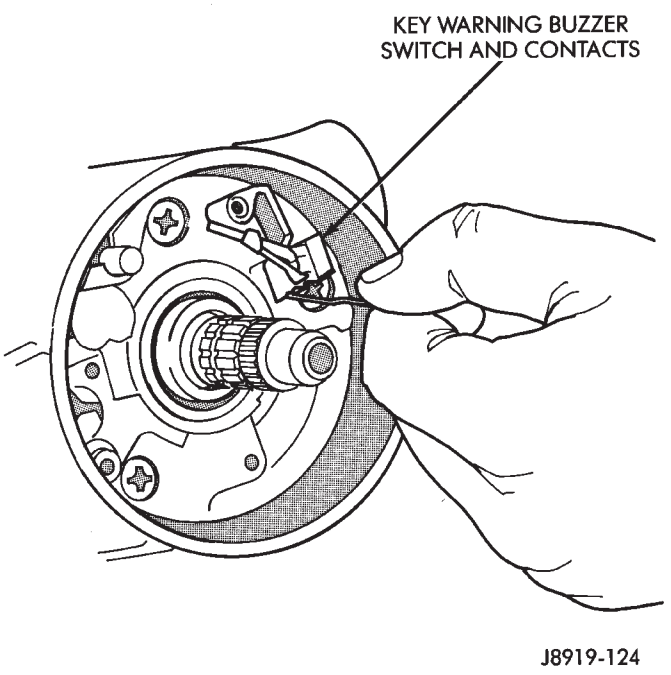


Fig. 5 Key Warning Buzzer/Contacts Removal

Depress the spring latch located at the bottom of the slot to release the key/lock cylinder. Remove the cylinder (Fig. 6).

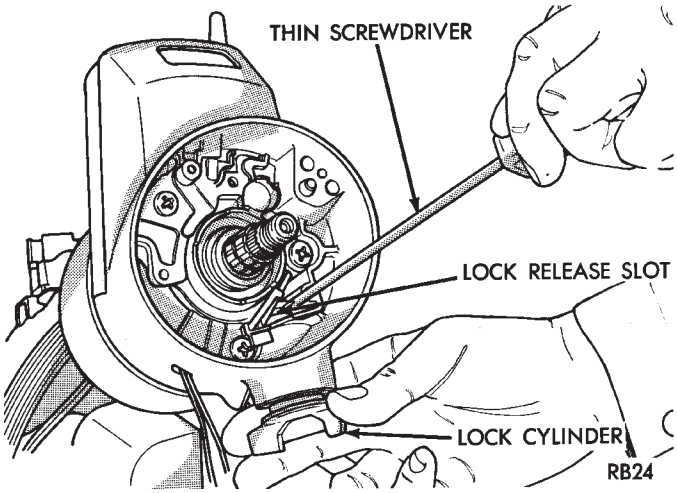


Fig. 6 Key/lock Cylinder Removal

(22) Remove the ignition switch and dimmer switch (Fig. 7) from the lower end of the steering column.

(23) Remove the screws that attach the key/lock cylinder housing cover to the steering column jacket. Remove the cover.

(24) Remove the upper bearing race and the bearing seat from the steering shaft (Fig. 8).

(25) Install the tilt-release lever and place the steering column in the full upward tilt position.

WARNING: THE TILT SPRING GUIDE RETAINER RETAINS STRONG SPRING FORCE.

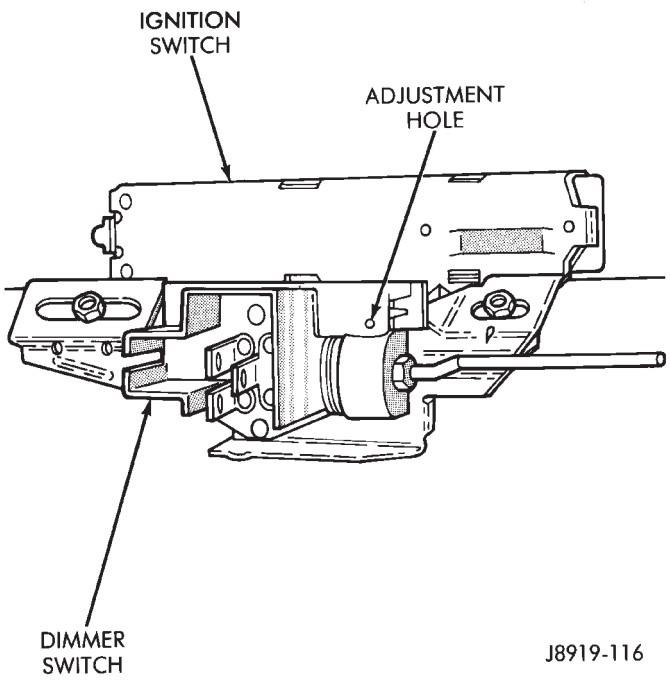


Fig. 7 Ignition Switch & Dimmer Switch

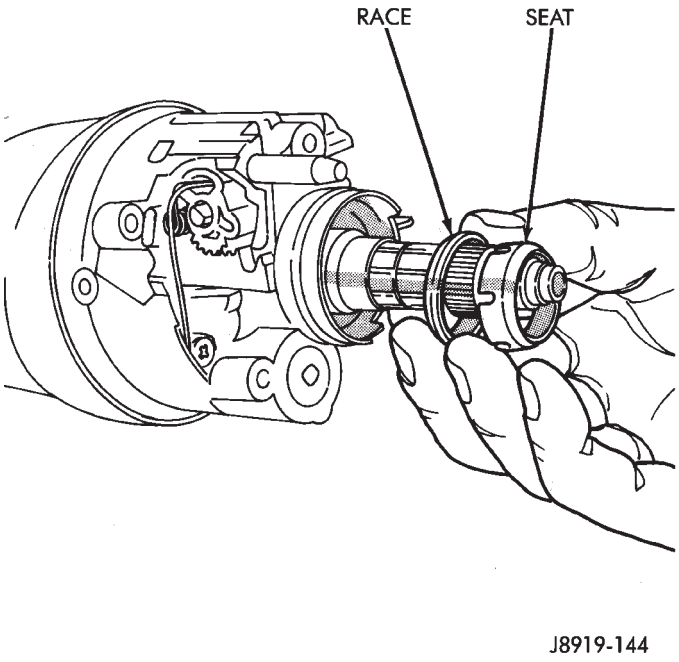


Fig. 8 Steering Shaft Bearing Race & Seat

(26) Press the tilt spring guide retainer inward. Turn it counterclockwise until the tabs disengage from the key/lock cylinder housing lugs. Ensure that the screwdriver blade properly fits the retainer slot. Remove the tilt spring guide retainer, the guide and the spring from the housing (Fig. 9).

(27) Position the steering column in the center, non-tilt position.

(28) Remove the support pivot pins with Pivot Pin Remover C-4016 (J-21854-01) (Fig. 10).

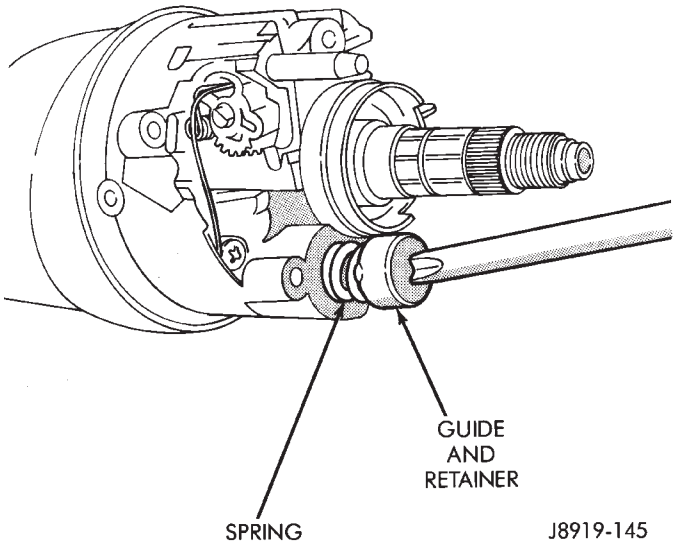


Fig. 9 Retainer/Guide/Spring Removal

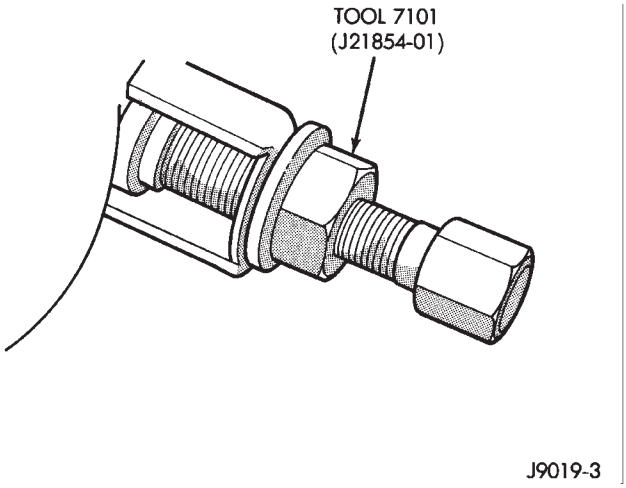


Fig. 10 Pivot Pin Removal

(29) Lift the tilt-release lever to release the lock shoes. Pull the key/lock cylinder housing upward to disengage the shoes. Turn the housing clockwise to separate the lock rack from the remote rod. Remove the cylinder housing from the support (Fig. 11).

(30) Remove the tilt-release lever from the key/lock cylinder housing.

(31) Remove the lock sector spring retaining screw and then remove the spring (Fig. 12). Rotate the spring in a clockwise direction to remove it from the lock bolt.

(32) Remove the lock bolt, the lock rack, the rack preload spring and the remote rod from the cylinder housing.

(33) Insert a wedge between the lock shoes and the key/lock cylinder housing (Fig. 13). This will relieve spring tension on the tilt-release lever pin and lock shoe pin.

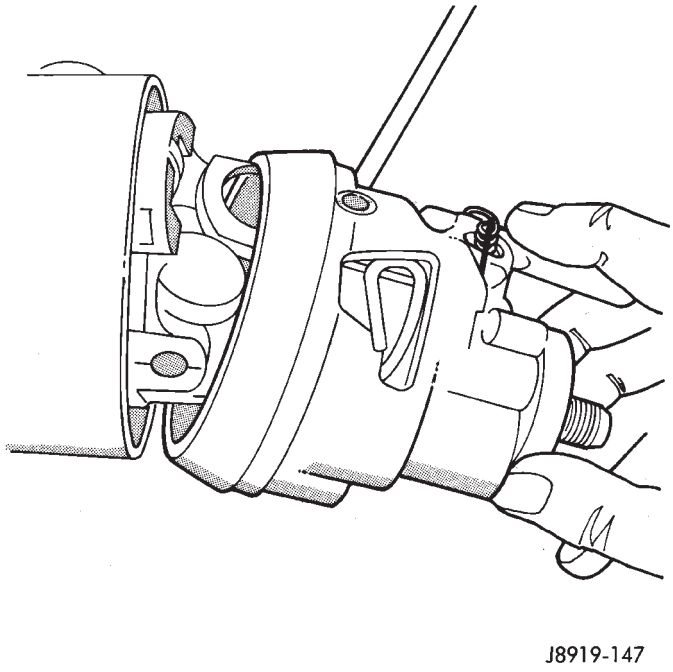


Fig. 11 Key/Lock Cylinder Housing Removal

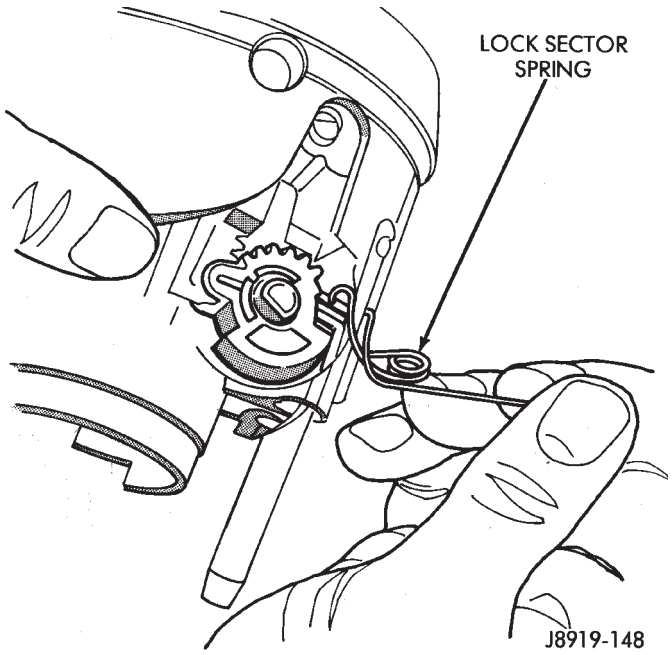


Fig. 12 Lock Sector Spring Removal

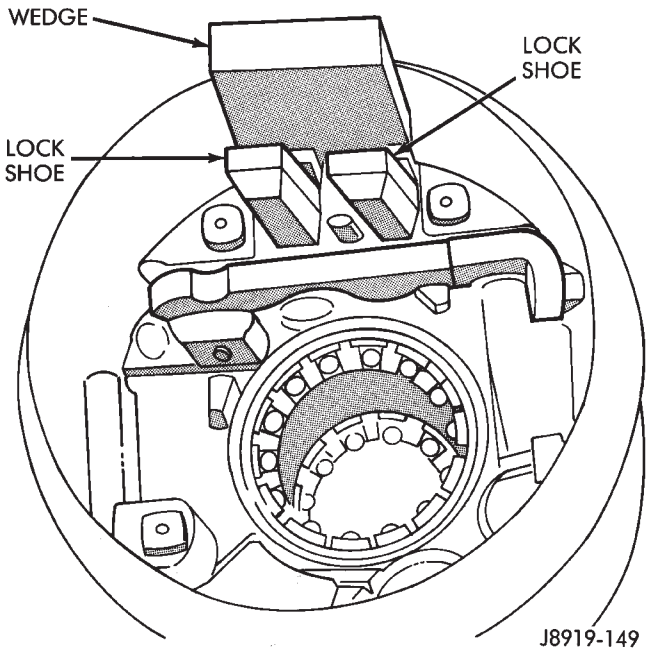


Fig. 13 Wedge Between Lock Shoes & Housing

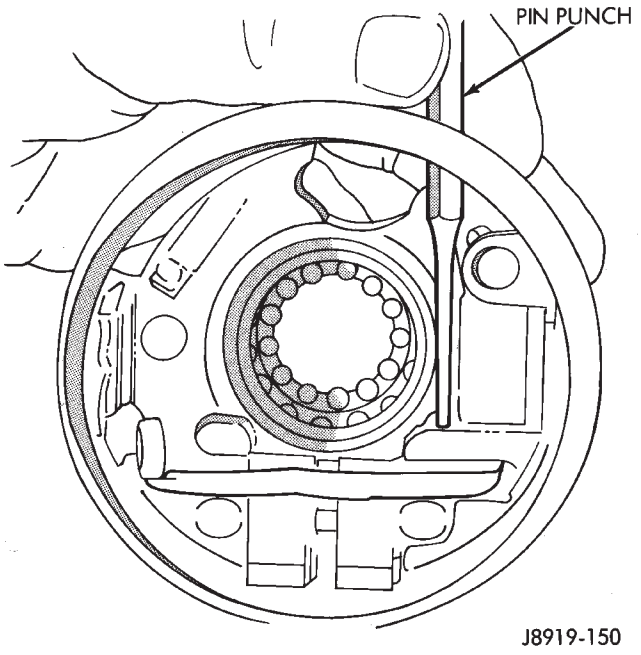


Fig. 14 Tilt-release Lever Pin Removal

(34) Remove the tilt-release lever pin from the key/lock cylinder housing with a standard pin punch (Fig. 14).

(35) Remove the lock shoe pin from the key/lock cylinder housing with a standard pin punch (Fig. 15). Remove the lock shoes, the springs and wedge.

(36) Remove the upper and the lower bearings and races from the key/lock cylinder only if they are damaged or worn. If the bearings and the races must be replaced, remove them with a hammer and punch. Discard the bearings and races after removal. They are not reusable.

(37) Remove the steering shaft from the upper end of the steering column.

(38) Separate the steering shaft by folding it 90 degrees at the flexible joint. Detach the upper and the lower shaft halves (Fig. 16).

(39) Remove the attaching bolts and the steering column support (Fig. 17).

(40) Remove the retaining screws and shift gate from the steering column support.

(41) Remove the retainer and the bearing from the lower end of the steering column.

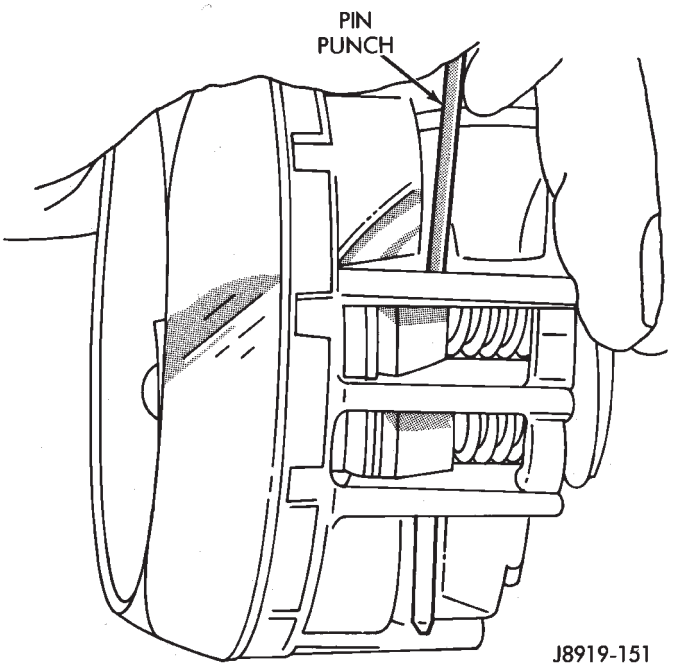


Fig. 15 Lock Shoe Pin Removal

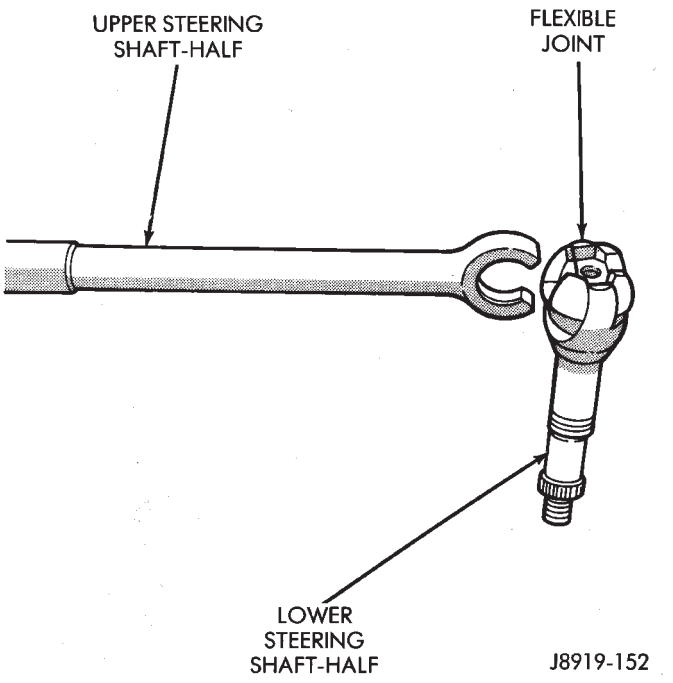


Fig. 16 Steering Shaft Separation

(42) Remove the shift tube retaining ring and the thrust washer.

(43) Remove the shift tube from the steering column jacket with Shift Tube Remover C-4120 (J-23072) (Fig. 18).

(44) Tilt the upper end of the retainer plate toward the lower end of the column, turn the plate counterclockwise and remove it (Fig. 19).

(45) If equipped with a column shift:

- Remove the wave washer and the shift tube spring

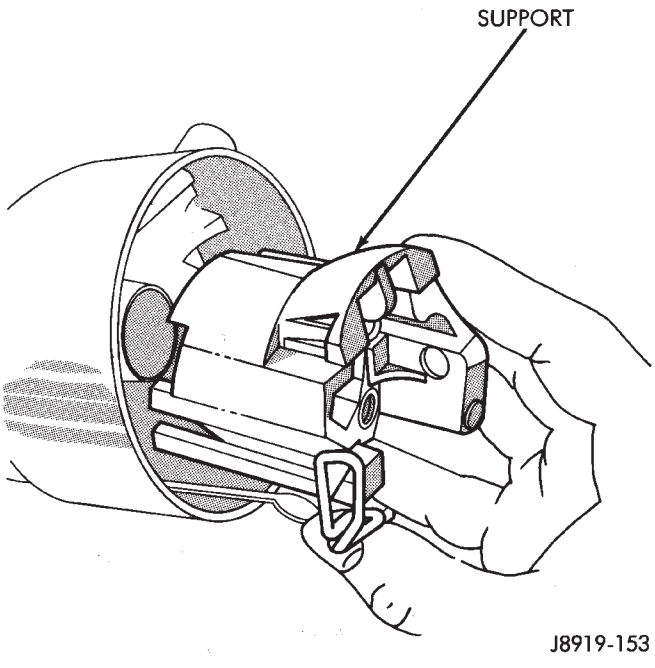


Fig. 17 Steering Column Support Removal

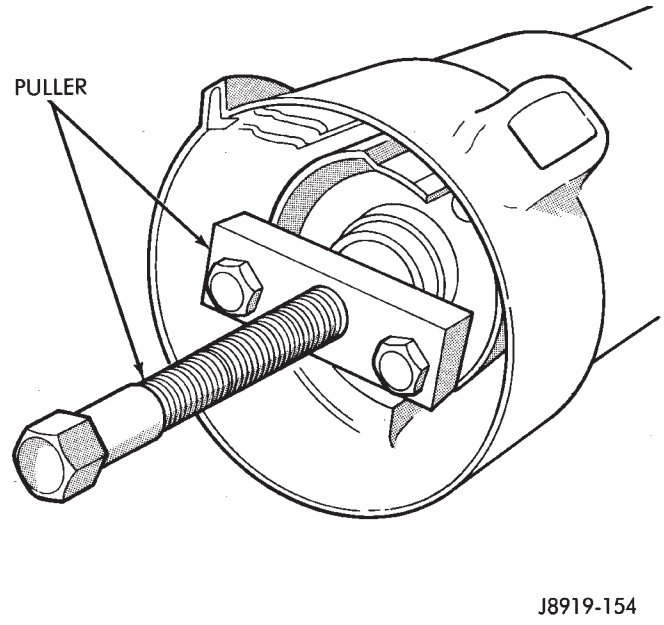


Fig. 18 Shift Tube Removal

- Remove the shift bowl from the steering column jacket

(46) If equipped with a console shift, remove the key-release lever and the lever spring from the shroud. Tilt the lever forward and lift upward to remove it (Fig. 20).

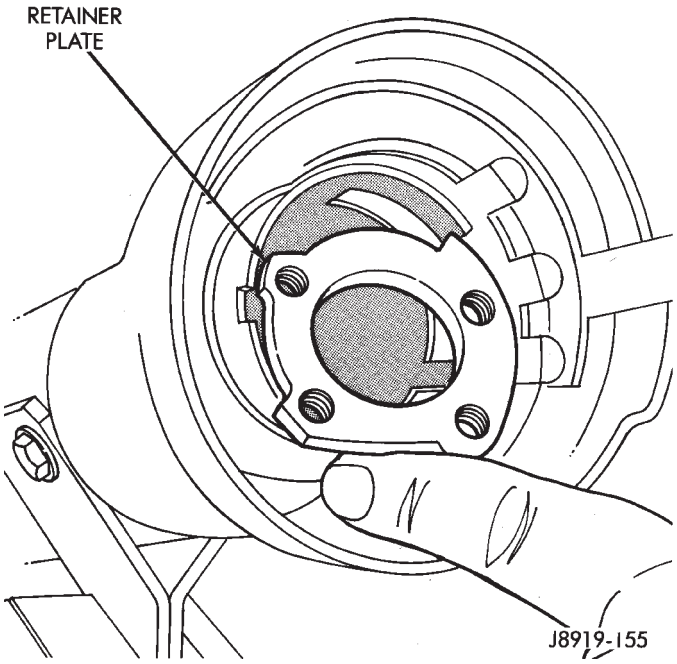


Fig. 19 Retainer Plate Removal

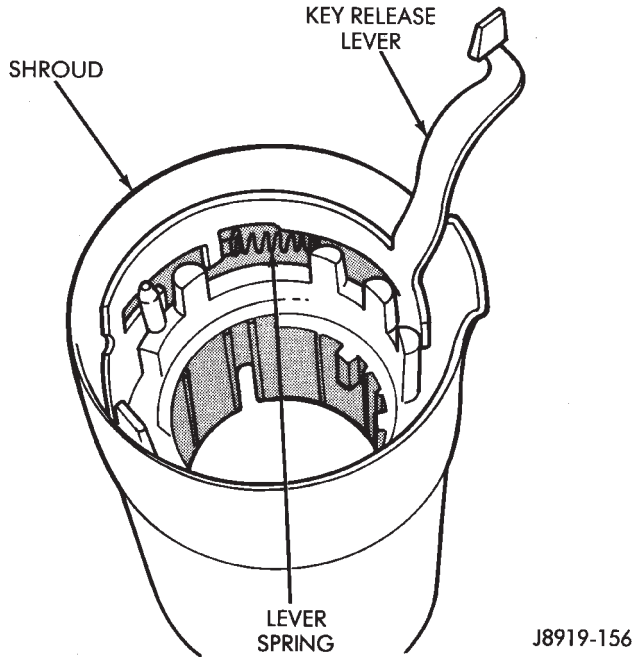


Fig. 20 Key-Release Lever & Spring Removal

ASSEMBLY

WARNING: USE ONLY THE ORIGINAL OR EXACT REPLACEMENT SCREWS, BOLTS AND NUTS TO ASSEMBLE THE STEERING COLUMN. INCORRECT SCREW OR BOLT LENGTH COULD PREVENT THE COLUMN FROM COMPRESSING WITH IMPACT (FRONT-END COLLISION). ALL FASTENERS USED FOR ASSEMBLY MUST BE TIGHTENED WITH THE CORRECT TORQUE. THIS WILL ENSURE THE COLUMN WILL BREAKAWAY WITH IMPACT.

CAUTION: Apply chassis lubricant to all the bearing, thrust and friction producing mating surfaces before assembly.

COLUMN SHIFT ASSEMBLY

(1) Install the shift bowl on the steering column jacket.

(2) Install the shift tube spring, wave washer and retainer plate in the shift bowl.

(3) Insert the shift tube through the lower end of the steering column jacket. Align the tube key/spline with the shift bowl keyway.

(4) Insert the Shift Tube Installer C-4119 (J-23073-01) in the shift tube. The spring-loaded lower foot of the tool must engage the shift tube inner shoulder. The tool guide must be seated in the shift tube (Fig. 21).

(5) Tighten the nut on the stud (Fig. 21) only enough to obtain a snug fit against the spring tension.

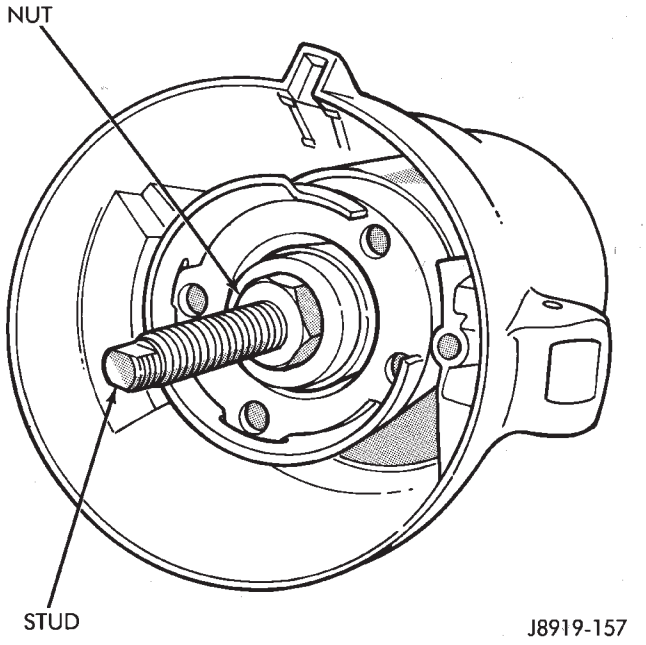


Fig. 21 Shift Tube Installation

(6) Remove the nut and place the receiver installation tool over the stud (Fig. 22).

(7) Install the nut and tighten it to force the shift tube into the shift bowl (Fig. 22).

(8) Remove the shift tube installation tools.

(9) Install the shift tube thrust washer and the retainer plate snap ring.

(10) Install the lower bearing in the steering column.

(11) Position the shift gate in the steering column support. Install the attaching screws.

(12) Position the support in the steering column.

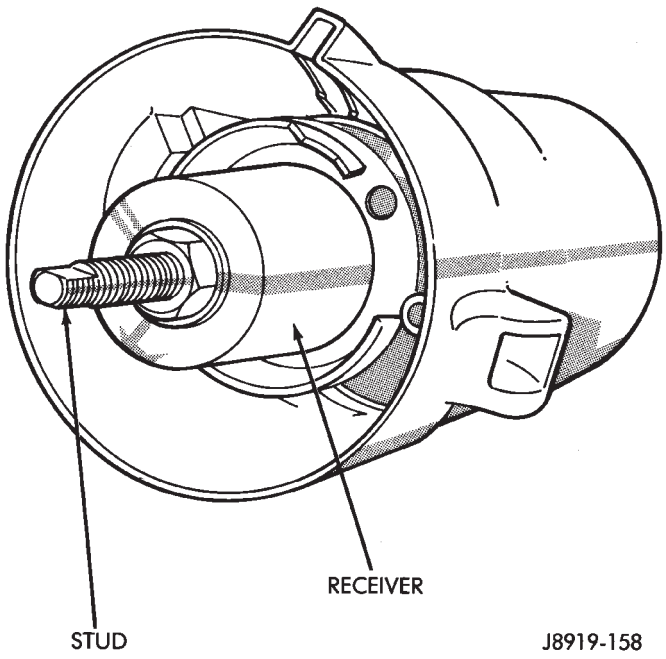


Fig. 22 Shift Tube Installation

(13) Install all support attaching screws finger-tight. Next, tighten the screws alternately and evenly to 7 N·m (60 in. lbs.) torque.

(14) Install the remote rod in the support. Route the rod through the upper end of the shroud and insert it into the rod slot located in the support.

(15) Install the dimmer switch and ignition switch.

(16) Install the steering shaft in the steering column.

(17) Install replacement races and bearings in the key/lock cylinder, if removed. **Ensure that the bearings are lubricated with chassis lubricant before installation.**

(18) Install the lock shoes, the lock shoe springs and the lock shoe pin the key/lock cylinder housing. Use a 4.5-mm (0.18-in) diameter rod to align the shoes and the pin during installation.

(19) Install the tilt-release lever, the lever spring and the lever pin in the key/lock cylinder housing. Insert a wedge between the housing and the lever to relieve the spring tension. This will allow easier release lever pin installation.

(20) Install the lock bolt in the key/lock cylinder housing and engage it in the lock sector cam surface.

(21) Install the lock rack, the rack preload spring and a replacement shim in the key/lock cylinder housing. Align and mate the square block tooth on the lock rack and the lock sector.

(22) Install the lock spring and the spring retaining screw. Tighten the screw to 4 N·m (35 in. lbs.) torque.

(23) Align and install the assembled key/lock cylinder housing on the support. Retain the lock shoes in the disengaged position for easier housing installation.

(24) Align the pivot pin holes in the housing with those in the support. Insert the pivot pins. **Press the housing firmly downward when inserting the pivot pins. This prevents damaging the holes in the support.** When the pivot pins are within both the housing and the support holes, seat them fully with a punch and a hammer.

(25) Insert tilt-release lever in key/lock cylinder housing and place housing in the full-upward tilt position.

(26) Lubricate the tilt spring guide and the tilt spring liberally with chassis lubricant and position the spring on the guide.

(27) Insert the tilt spring guide and the spring into the key/lock cylinder housing. Install the guide retainer over the spring. Engage the retainer lock tabs with the housing lugs by pressing the retainer downward and turning clockwise with a screwdriver.

(28) Place the cover on the key/lock cylinder housing. Align and install the cover retaining screws. Tighten the screws to 7 N·m (60 in. lbs.) torque.

(29) Install the gear selector indicator lamp mounting bracket screw.

(30) Install the gear selector indicator cover and retaining screws.

(31) Route the dimmer switch wire harness and gear selector indicator down through the steering column.

(32) To install ignition switch lock, turn the key to the LOCK position and remove the key. This will cause the buzzer operating lever to retract in the key/lock cylinder. Now insert the key/lock cylinder into the housing far enough to contact the drive shaft. Force it inward and move the ignition switch actuator rod up and down to align the components. When the components align, the key/lock cylinder will move inward and the spring-loaded retainer will snap and lock it in place (Fig. 23).

(33) Insert the ignition key in the cylinder and turn it to the ON position. Install the key warning buzzer switch.

(34) Install the turn signal switch. Fold the wires against the connector. Route the wire harness and connector down through the steering column. Position the switch in the key/lock cylinder housing. **Do not** install the switch retaining screws at this time.

(35) Install the windshield wiper wire harness and switch. Route the wire harness down through steering column jacket.

(36) If equipped, install the cruise control wire harness. Install the turn signal stalk by pushing it straight into the column.

(37) Insert the hazard warning knob in the hazard warning switch and press it inward. Align and install the turn signal switch retaining screws. Ensure that the turn signal switch is properly seated before tightening the screws. Tighten the screws to 4 N·m

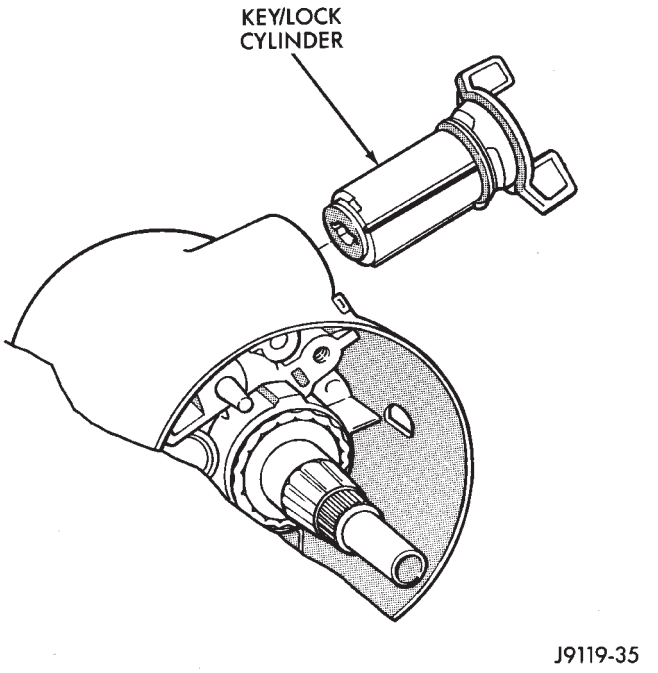


Fig. 23 Key/Lock Cylinder Installation

(33 in. lbs.) torque. Thread the hazard warning switch knob into the switch and pull the knob outward.

(38) Install and seat the upper bearing race in the key/lock cylinder housing.

(39) Install the upper bearing preload spring, the canceling cam and the lockplate.

(40) Install a replacement lockplate retaining snap ring on the sleeve of the Lock Plate Compressor C-4156 (J-23653-B). Install the tool on the steering shaft (Fig. 24).

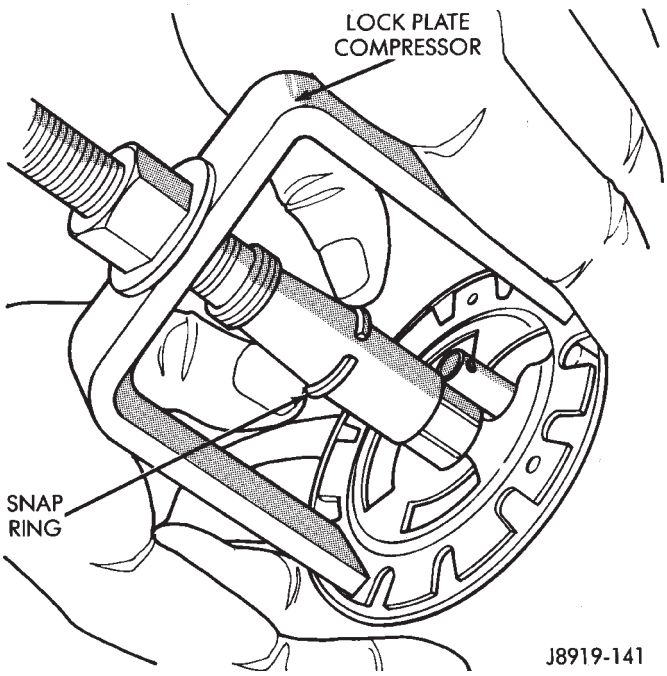


Fig. 24 Lockplate Retaining Ring Installation

(41) Compress the lockplate with the compressor tool and position the retaining snap ring in the steering shaft groove.

(42) Remove the compressor tool. Ensure that the retaining ring is completely seated in the groove before removing the tool.

(43) Position the wire harness protectors if equipped, over the harnesses and snap in place on steering column.

(44) Install the lockplate cover.

(45) Install the gear selector lever and the retaining pin.

(46) Install the steering wheel. Refer to the installation procedure.

(47) Insert the ignition key in the key/lock cylinder; turn the cylinder to the OFF-UNLOCK position; move the ignition switch downward to eliminate any switch-to-remote rod lash; and tighten the ignition switch attaching screws to 4 N·m (35 in. lbs.) torque.

(48) Depress the dimmer switch slightly and insert a 3/32-inch drill bit into the adjustment hole.

(49) Loosen the retaining screws and move the dimmer switch toward the steering wheel. Tighten the dimmer switch retaining screws to 4 N·m (35 in. lbs.) torque.

(50) Remove the drill bit and test operation by moving the dimmer switch stalk. Test the dimmer switch operation in the full-up, down and center steering wheel positions.

(51) Install the steering column, if applicable. Refer to the installation procedure.

CONSOLE SHIFT ASSEMBLY

(1) Position the key-release lever spring on the lever and install the lever with the spring in the shroud.

(2) Align and install the shroud on the steering column jacket.

(3) Install the retainer plate. Tilt the plate toward the 12 o'clock position, slide it under the steering column jacket opening, and seat it in the jacket notches.

(4) Align the steering column jacket V-notch with the corresponding **V** on the support. Install the support in the steering column. To completely seat the support, press the key-release lever downward while pressing the support into place (Fig. 25).

(5) Install all the support retaining screws finger-tight. Next, tighten the screws alternately and evenly to 7 N·m (60 in. lbs.) torque.

(6) Install the remote rod in the support. Route the rod through the upper end of the shroud and insert it into the rod slot located in the support.

(7) Install the dimmer switch and the ignition switch.

(8) Install the steering shaft in the steering column.

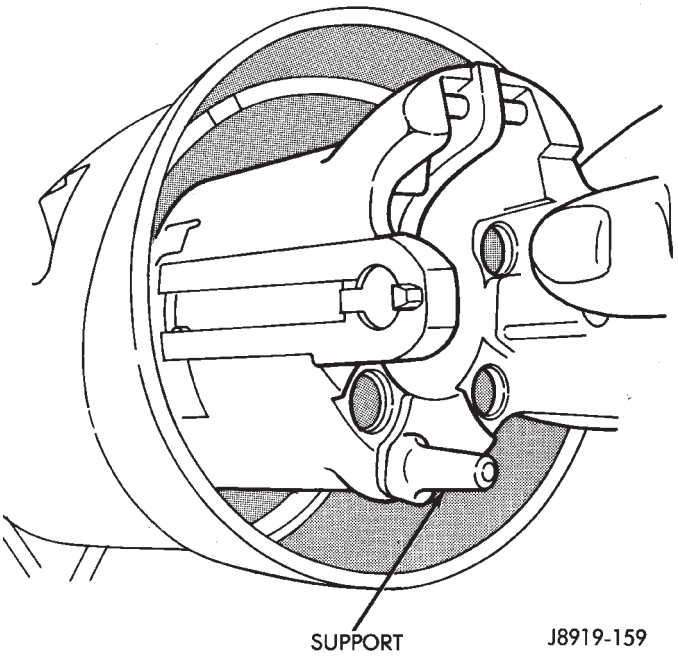


Fig. 25 Steering Column Support Installation

(9) Install replacement races and bearings in the key/lock cylinder, if removed. **Ensure that the bearings are lubricated with chassis lubricant before installation.**

(10) Install the lock shoes, the lock shoe springs and the lock shoe pin the key/lock cylinder housing. Use a 4.5-mm (0.18-in) diameter rod to align the shoes and the pin during installation.

(11) Install the tilt-release lever, the lever spring and the lever pin in the key/lock cylinder housing. Insert a wedge between the housing and the lever to relieve the spring tension. This will allow easier release lever pin installation.

(12) Install the lock bolt in the key/lock cylinder housing and engage it in the lock sector cam surface.

(13) Install the lock rack, the rack preload spring and a replacement shim in the key/lock cylinder housing. The square block tooth on the lock rack and lock sector must mate.

(14) Install the lock spring and the spring retaining screw. Tighten the screw to 4 N·m (35 in. lbs.) torque.

(15) Align and install the assembled key/lock cylinder housing on the support. Retain the lock shoes in the disengaged position for easier housing installation.

(16) Align the pivot pin holes in the key/lock cylinder housing with those in the support and insert the pivot pins. **Press the housing firmly downward when inserting the pivot pins to prevent damaging the holes in the support.** When the pivot pins are within both the housing and the support holes, seat them fully with a punch and a hammer.

(17) Insert the tilt-release lever in the key/lock cylinder housing and place the housing in the full-upward tilt position.

(18) Lubricate tilt spring guide and tilt spring liberally with chassis lubricant. Then position spring on guide.

(19) Insert the tilt spring guide and the spring into the key/lock cylinder housing. Install the guide retainer over the spring. Engage the retainer lock tabs with the housing lugs by pressing the retainer downward and turning clockwise with a screwdriver.

(20) Place the cover on the key/lock cylinder housing. Align and install the cover retaining screws. Tighten the screws to 7 N·m (60 in. lbs.) torque.

(21) Route the dimmer switch wire harness down through the steering column.

(22) To install ignition switch lock, turn the key to the LOCK position and remove the key. This will cause the buzzer operating lever to retract in the key/lock cylinder. Now insert the key/lock cylinder into the housing far enough to contact the drive shaft. Force it inward and move the ignition switch actuator rod up and down to align the components. When the components align, the key/lock cylinder will move inward and the spring-loaded retainer will snap and lock it in place (Fig. 26).

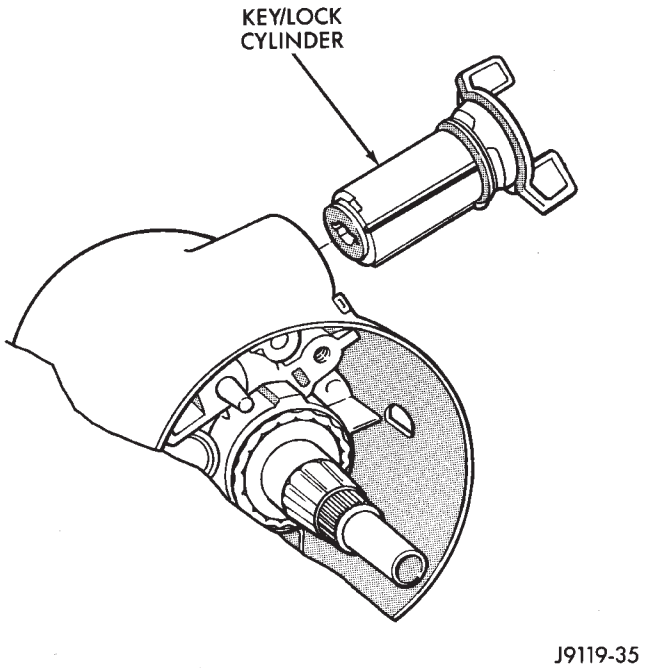


Fig. 26 Key/Lock Cylinder

(23) Insert the ignition key in the cylinder and turn it to the ON position. Install the key warning buzzer switch.

(24) Install the turn signal switch. Fold the wires against the connector. Route the wire harness and connector down through the steering column. Position the switch in the key/lock cylinder housing. **Do not** install the switch retaining screws at this time.

(25) Install the windshield wiper wire harness and switch. Route the wire harness down through steering column jacket.

(26) If equipped, install the cruise control wire harness. Install the turn signal stalk by pushing it straight into the column.

(27) Insert the hazard warning knob in the hazard warning switch and press it inward. Align and install the turn signal switch retaining screws. Ensure that the turn signal switch is properly seated before tightening the screws. Tighten the screws to 4 N·m (33 in. lbs.) torque. Thread the hazard warning switch knob into the switch and pull the knob outward.

(28) Install and seat the upper bearing race in the key/lock cylinder housing.

(29) Install the upper bearing preload spring, the canceling cam and the lockplate.

(30) Install a replacement lockplate retaining snap ring on the sleeve of the Lock Plate Compressor C-4156 (J-23653-B). Install the tool on the steering shaft (Fig. 27).

(31) Compress the lockplate with the compressor tool and position the retaining snap ring in the steering shaft groove.

(32) Remove the compressor tool. Ensure that the retaining ring is completely seated in the groove before removing the tool.

(33) Position the wire harness protectors, if equipped, over the wire harnesses and snap them in place on the steering column.

(34) Install the lockplate cover.

(35) Install the steering wheel. Refer to the installation procedure.

(36) Insert the ignition key in the key/lock cylinder; turn the cylinder to the OFF-UNLOCK position ; move the ignition switch downward to eliminate any switch-to-remote rod lash; and tighten the ignition switch attaching screws to 4 N·m (35 in. lbs.) torque.

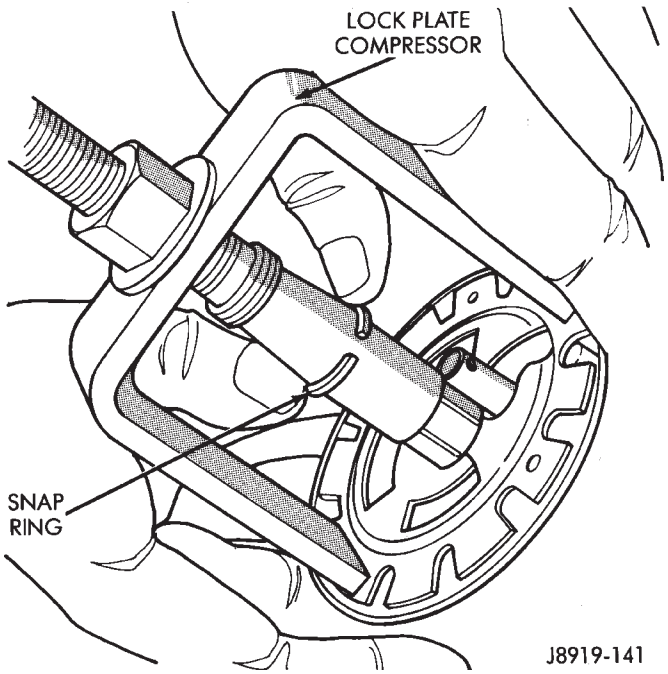


Fig. 27 Lockplate Retaining Ring Installation

(37) Depress the dimmer switch slightly and insert a 3/32-inch drill bit into the adjustment hole.

(38) Loosen the retaining screws and move the dimmer switch toward the steering wheel to remove any lash. Tighten the dimmer switch retaining screws to 4 N·m (35 in. lbs.) torque.

(39) Remove the drill bit and test operation by moving the dimmer switch stalk. Test the dimmer switch operation in the full-up, down and center steering wheel positions.

(40) Install the steering column and steering wheel. Refer to the installation procedure.

(41) Connect the battery negative cable.

STEERING RHD

GENERAL SERVICE PROCEDURE INFORMATION

Right hand drive service procedures and torque specifications involving steering; linkage, gear and column are the same as left hand drive vehicles except where shown. Refer to appropriate service procedures regarding each component in the system.

The steering linkage consists of a pitman arm, drag link, and tie rod. Adjustment sleeves are used on the tie rod and drag link for toe and steering wheel alignment (Fig. 1).

RECIRCULATING-BALL POWER STEERING GEARS

The steering gears can be adjusted and internally serviced. The components CANNOT be interchanged with those of a left hand drive vehicle.

The steering gear has a 17.5:1 ratio.

POWER STEERING PUMP

PRESSURE AND RETURN LINE REPLACEMENT

Cap hose open ends and pump/steering gear fittings to prevent entry of foreign material.

WARNING: POWER STEERING FLUID (AND PUMP COMPONENTS) AND THE EXHAUST SYSTEM CAN BE EXTREMELY HOT IF THE ENGINE HAS BEEN RECENTLY OPERATING. DO NOT START THE ENGINE WITH ANY LOOSE OR DISCONNECTED HOSES. DO NOT ALLOW THE LINES TO TOUCH A HOT EXHAUST MANIFOLD.

REMOVAL

(1) Place a drain pan under the pump and gear.

(2) Disconnect the pressure and return line from the steering gear (Fig. 2, 3).

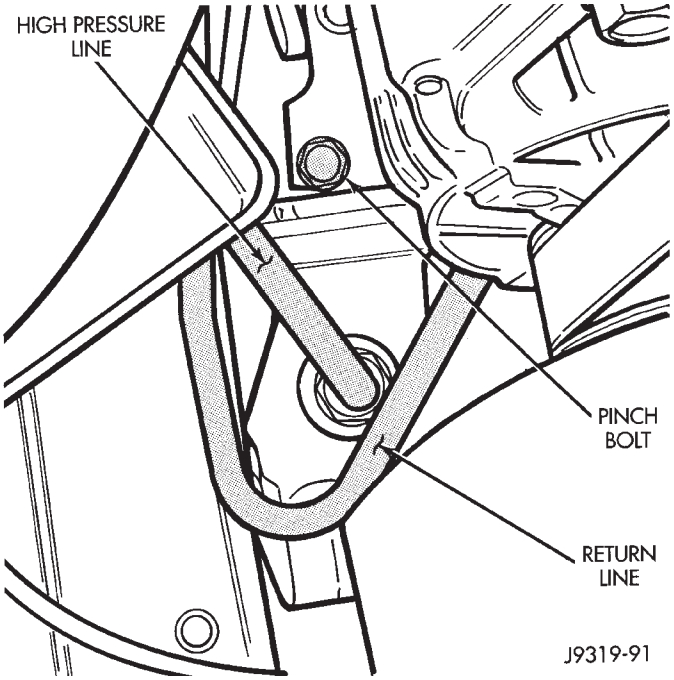


Fig. 2 Fluid Lines On Steering Gear

(3) Disconnect the pressure and return line from the pump (Fig. 4). Drain the fluid from pump and reservoir.

(4) Remove pressure and return line bracket at belt tensioner (Fig. 5).

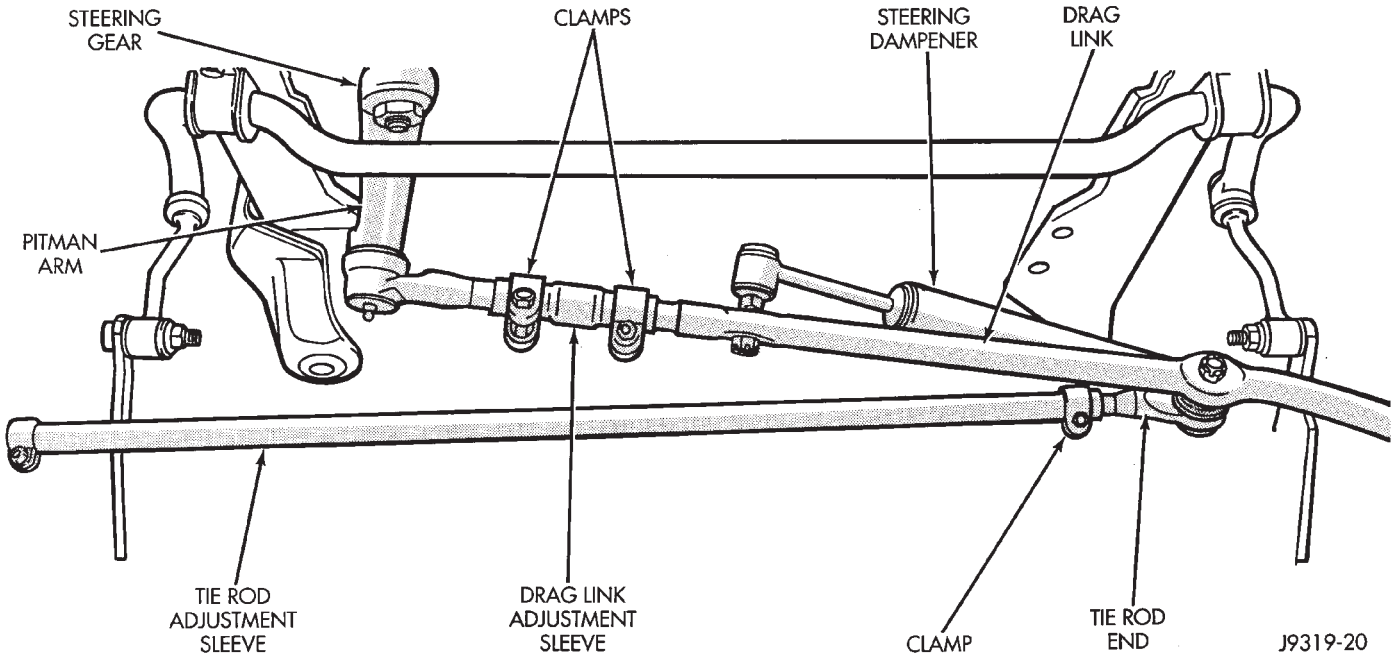


Fig. 1 RHD Steering Linkage

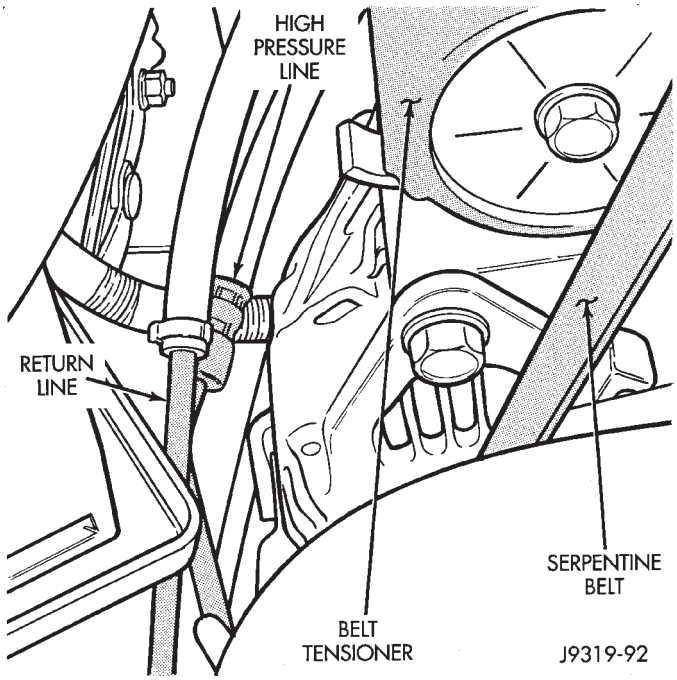


Fig. 3 Pressure And Return Lines

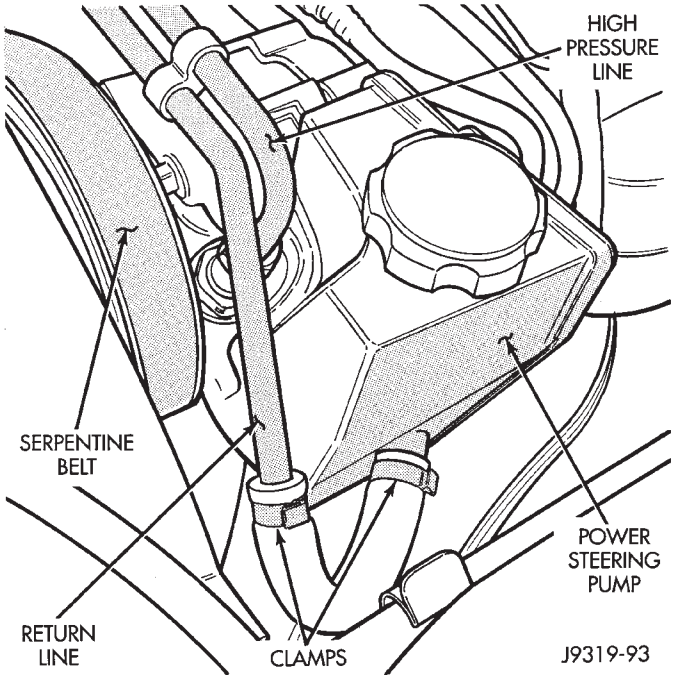


Fig. 4 Fluid Lines At Pump

INSTALLATION

(1) Wipe hose ends, pump and gear unions clean.

(2) Install pressure and return line on the pump and gear (Fig. 2, 3, 4).

(3) Align the pressure and return line bracket to the tensioner bracket. Install the screw. Tighten the screw to 28 N·m (21 ft. lbs.) torque.

(4) Tighten fittings at pump and gear to 28 N·m (21 ft. lbs.) torque.

(5) After installation, add power steering fluid, inspect and test for fluid leaks.

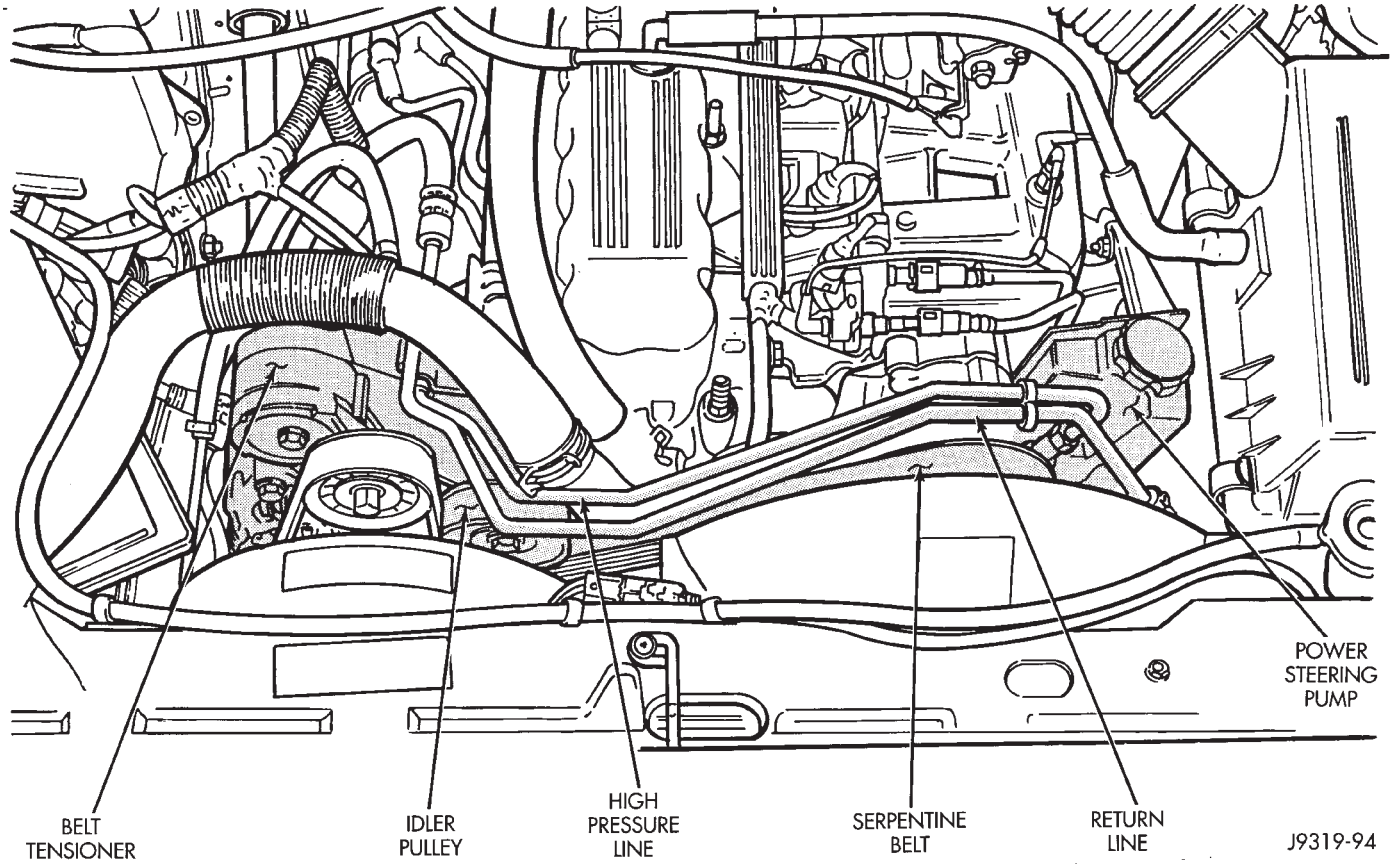


Fig. 5 Pressure And Return Line Routing

PUMP REPLACEMENT

REMOVAL

(1) Remove and cap pressure and return lines from pump. Refer to Pressure and Return Line Replacement in this section.

(2) Remove belt tension, turn tensioner clock-wise and slip belt off pulley (Fig. 6).

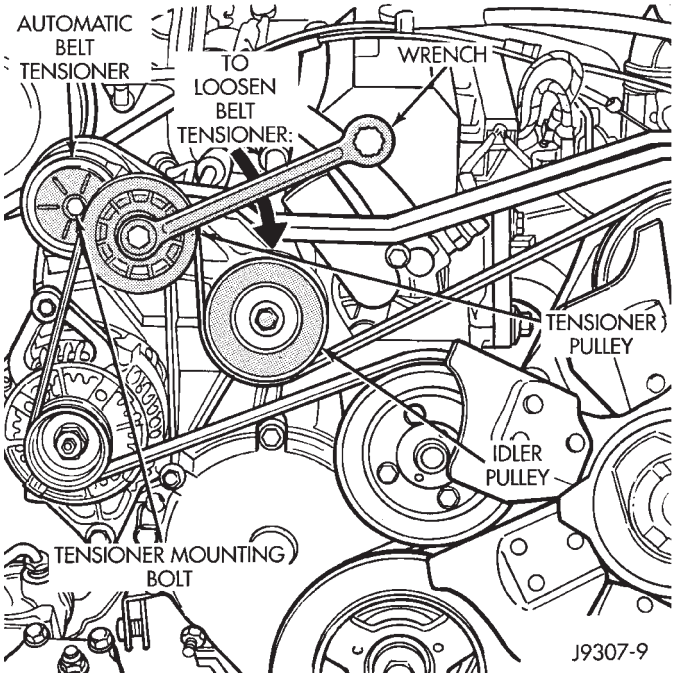


Fig. 6 Belt Tensioner

(3) Remove the screws retaining front bracket and pump to the rear bracket (Fig. 7, 8).

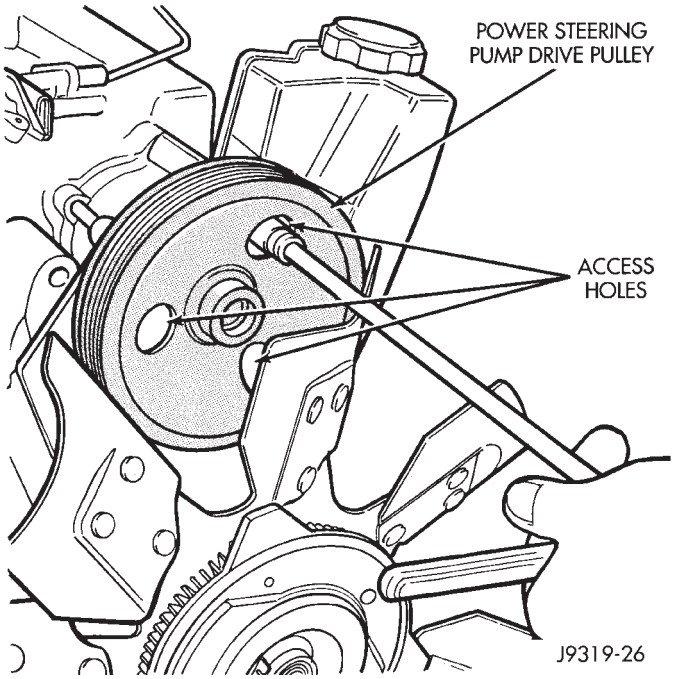


Fig. 7 Pump Mounting Screw Removal/Installation

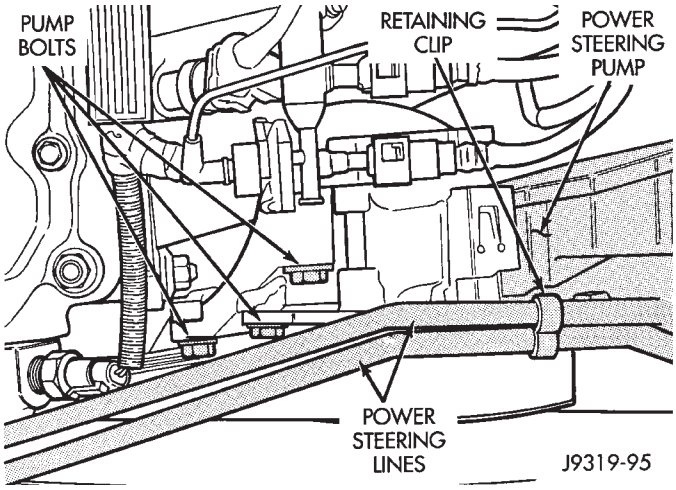


Fig. 8 Power Steering Pump Mounting

(4) Remove screws that attach the front bracket to the rear bracket (Fig. 9).

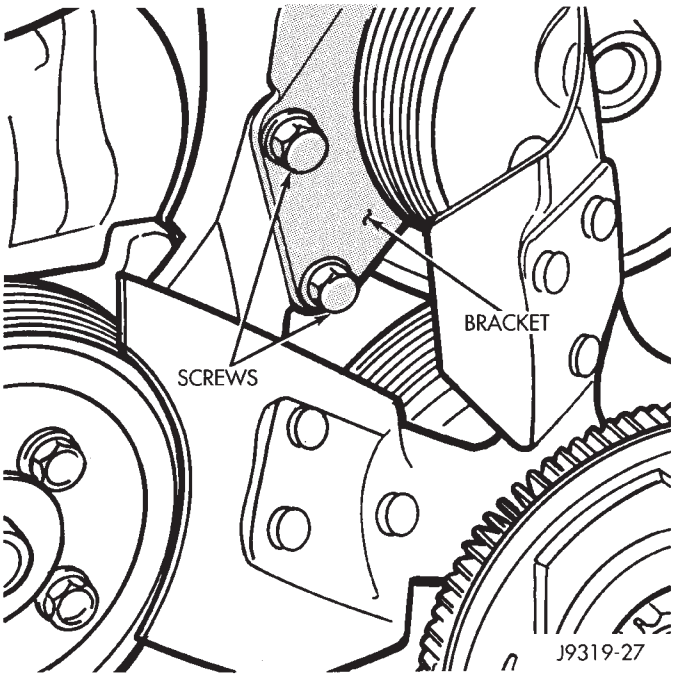


Fig. 9 Front Bracket

(5) Remove pump from bracket.

To remove the rear bracket from engine, the air conditioning compressor and bracket must be removed first. Refer to Group 24, Heating and Air Conditioning for removal procedures.

(6) Remove fan from pulley and hub on rear bracket.

(7) Remove 4 screws attaching the rear bracket to block (Fig. 10, 11).

(8) Remove bracket from engine.

INSTALLATION

(1) Install the rear bracket to engine. Install screws finger tight.

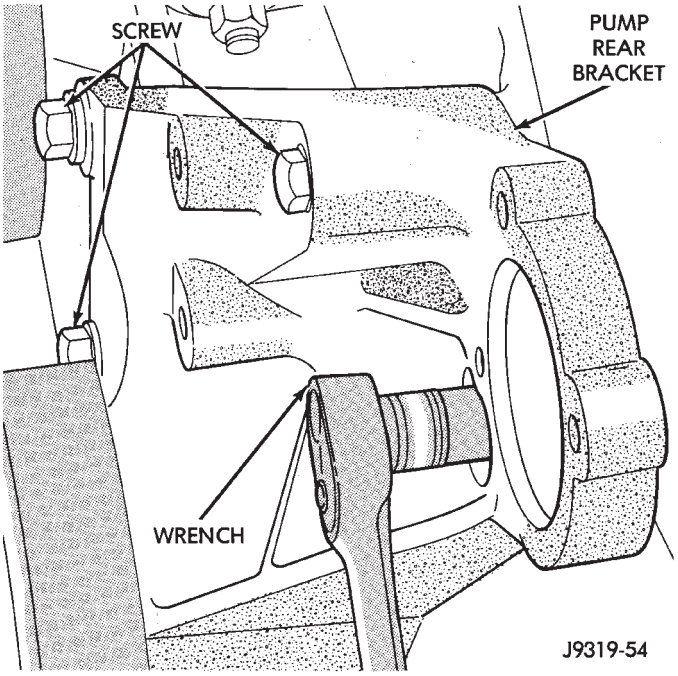


Fig. 10 Rear Bracket (Front View)

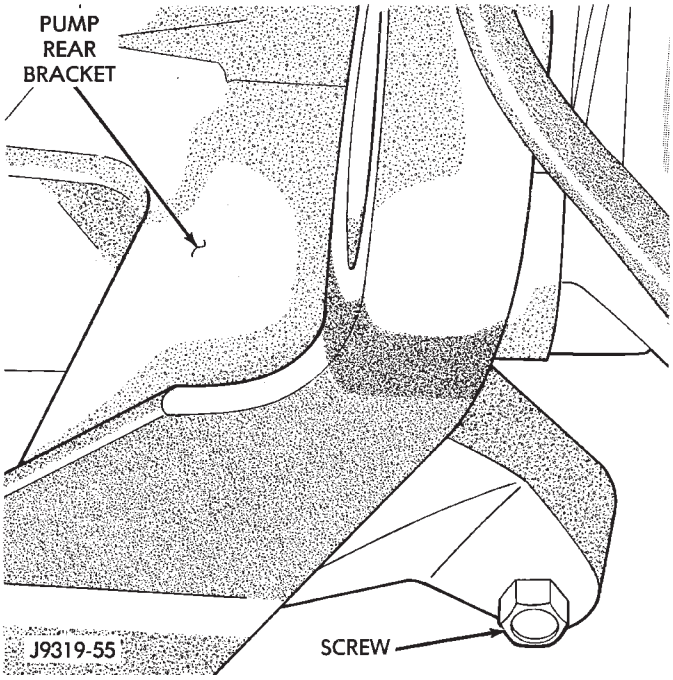


Fig. 11 Rear Bracket (Side View)

(2) Tighten front screws to 48 N·m (35 ft. lbs.) torque. Tighten side screw to 48 N·m (35 ft. lbs.) torque. It is important to torque the front screws FIRST and the side screw LAST. This will prevent the bracket from twisting or distorting.

(3) Install fan to pulley and hub. Tighten the nuts to 27 N·m (20 ft. lbs.) torque.

(4) Install air conditioning bracket and compressor to engine. Refer to Group 24, Heating and Air Conditioning for installation procedures.

(5) Loose assemble screws through front bracket, pump and into rear bracket.

(6) Install screws that attach the front bracket to the rear bracket (Fig. 8). Tighten the screws to 27 N·m (20 ft. lbs.) torque (Fig. 7).

(7) Install belt, turn tensioner clockwise and slip belt onto pulley (Fig. 6).

(8) Install pressure and return lines to pump. Refer to Pressure and Return Line Replacement in this section.

(9) After installation, add power steering fluid, inspect and test for fluid leaks. Refer to Power Steering Pump—Initial Operation.

TORQUE SPECIFICATIONS

POWER STEERING GEAR

DESCRIPTION	TORQUE
Adjustment Plug Initial Adjustment	109 N·m (80 ft. lbs.)
Adjustment Plug Locknut	109 N·m (80 ft. lbs.)
Adjustment Screw Locknut	49 N·m (36 ft. lbs.)
Coupler Shaft Pinch Bolts	47 N·m (35 ft. lbs.)
Gear to Frame Bolts (XJ)	95 N·m (70 ft. lbs.)
Gear to Frame Bolts (YJ)	106 N·m (78 ft. lbs.)
Pitman Arm (Shaft) Nut	251 N·m (185 ft. lbs.)
Return Guide Clamp Screw	58 N·m (43 in. lbs.)
Rack-Piston Plug	102 N·m (75 ft. lbs.)
Side Cover Bolts	60 N·m (44 ft. lbs.)

J9319-82

MANUAL STEERING GEAR

DESCRIPTION	TORQUE
Adjustment Locknut	68 N·m (50 ft. lbs.)
Adjustment Screw Locknut	34 N·m (25 ft. lbs.)
Return Guide Clamp Screw	14 N·m (10 in. lbs.)
Side Cover Bolts	61 N·m (45 ft. lbs.)
Adjustment Screw Locknut	34 N·m (25 ft. lbs.)
Gear to Frame Bolts (XJ)	95 N·m (70 ft. lbs.)
Gear to Frame Bolts (YJ)	106 N·m (78 ft. lbs.)

J9319-83

STEERING LINKAGE—XJ

DESCRIPTION	TORQUE
Drag Link to Steering Knuckle Nut	47 N·m (35 ft. lbs.)
Drag Link to Pitman Arm Nut	74 N·m (55 ft. lbs.)
Drag Link Adjustment Clamp Nut	49 N·m (36 ft. lbs.)
Pitman Arm (Shaft) Nut	251 N·m (185 ft. lbs.)
Steering Dampener to Axle Bracket Nut	74 N·m (55 ft. lbs.)
Steering Dampener to Drag Link Nut	74 N·m (55 ft. lbs.)
Tie Rod to Steering Knuckle Nut	47 N·m (35 ft. lbs.)
Tie Rod Clamp Nut	27 N·m (20 ft. lbs.)

J9319-84

STEERING LINKAGE—YJ

DESCRIPTION	TORQUE
Drag Link to Tie Rod Nut	47 N·m (35 ft. lbs.)
Drag Link to Pitman Arm Nut	74 N·m (55 ft. lbs.)
Drag Link Adjustment Clamp Nut	27 N·m (20 ft. lbs.)
Pitman Arm (Shaft) Nut	251 N·m (185 ft. lbs.)
Steering Dampener to Axle Bracket Nut	74 N·m (55 ft. lbs.)
Steering Dampener to Tie Rod Nut	74 N·m (55 ft. lbs.)
Tie Rod to Steering Knuckle Nut	47 N·m (35 ft. lbs.)
Tie Rod Adjustment Clamp Nut	49 N·m (36 ft. lbs.)

J9319-85

POWER STEERING PUMP

DESCRIPTION	TORQUE
Bracket to Block Bolts	47 N·m (35 ft. lbs.)
Pump to Adjustment Bracket	28 N·m (21 ft. lbs.)
Flow Control Valve to Pump Body	75 N·m (55 ft. lbs.)
High Pressure Fluid Fitting at Pump and Gear	28 N·m (21 ft. lbs.)
Return Fluid Fitting at Gear	28 N·m (21 ft. lbs.)

J9319-86

STEERING COLUMN—XJ

DESCRIPTION	TORQUE
Steering Wheel to Column Shaft Nut	35 N·m (26 ft. lbs.)
Toe Plate Bolts/Nuts	8 N·m (66 in. lbs.)
Upper Bracket Support Stud/Nuts	30 N·m (22 ft. lbs.)
Support Plate to Column	20 N·m (180 in. lbs.)
Coupler Shaft to Column	34 N·m (25 ft. lbs.)

J9319-87

STEERING COLUMN—YJ

DESCRIPTION	TORQUE
Steering Wheel to Column Shaft Nut	34 N·m (25 ft. lbs.)
Toe Plate Bolts/Nuts	21 N·m (192 in. lbs.)
Upper Bracket Support Bolts	30 N·m (270 in. lbs.)
Support Plate to Column	30 N·m (270 in. lbs.)
Coupler Shaft to Column	34 N·m (300 in. lbs.)

J9319-88

TRANSMISSION AND TRANSFER CASE

CONTENTS

AX 4/5 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

The AX 4 is a four speed manual transmission. The AX 5 is a five speed manual transmission. Fifth gear in the AX 5 is an overdrive range. The shift mechanism in both models is integral and mounted in the shift tower portion of the adapter housing (Fig. 1). The AX 4/5 is used for 2.5L engine applications.

TRANSMISSION IDENTIFICATION

The AX 4/5 identification code is on the bottom surface of the transmission case near the fill plug

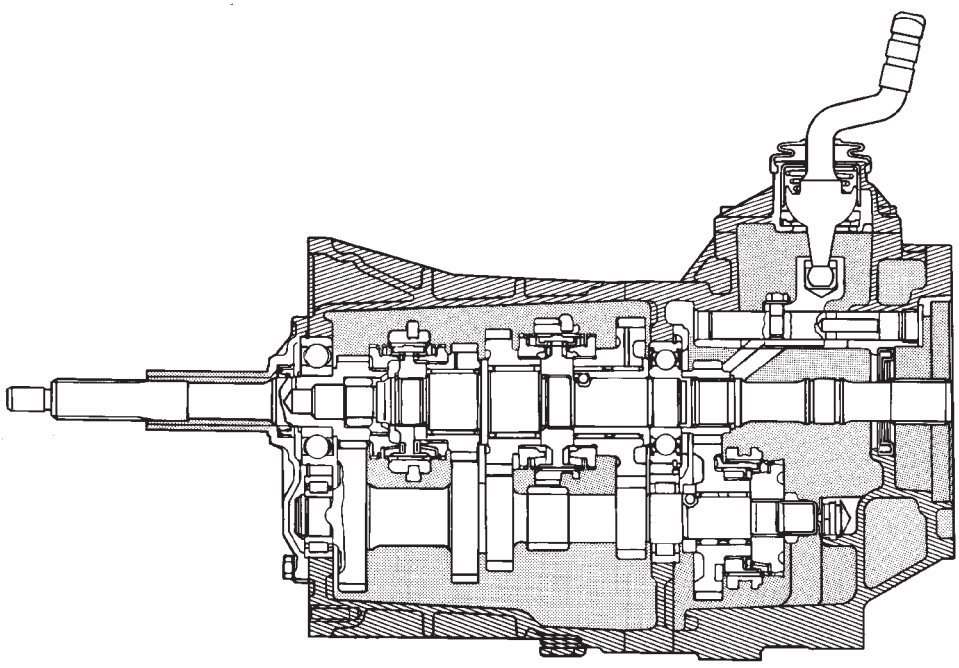


Fig. 1 AX 4/5 Manual Transmission

(Fig. 2). The first number is year of manufacture. The second and third numbers indicate month of manufacture. The next series of numbers is the transmission serial number.

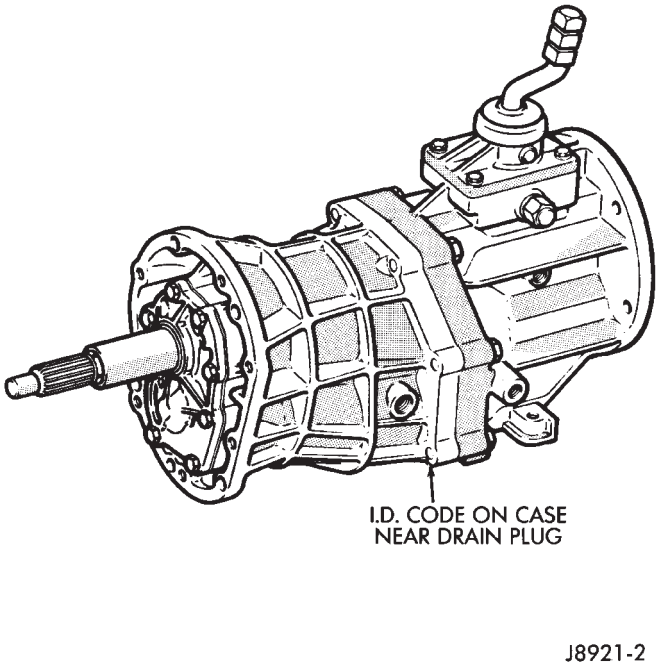


Fig. 2 Transmission Identification

GEAR RATIOS

AX 4 and AX 5 gear ratios are as follows:

- First gear: 3.93:1
- Second gear: 2.33:1
- Third gear: 1.45:1
- Fourth gear: 1.00:1
- Fifth gear (AX 5): 0.85:1
- Reverse gear: 4.74:1

SHIFT PATTERN

The AX 4/5 first through fourth gear shift pattern is in a conventional H configuration. On the AX 5, fifth gear is up and to the right and reverse gear is down and to the right (Fig. 3).

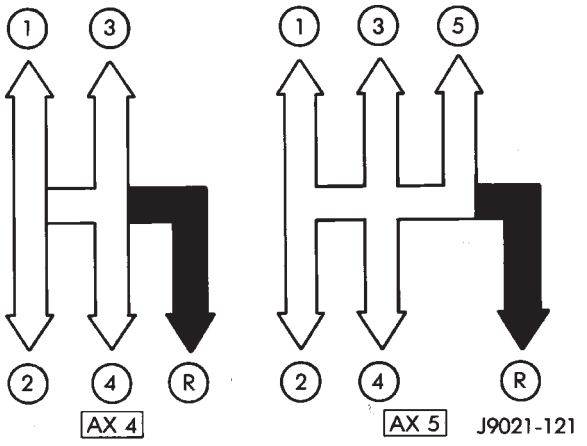


Fig. 3 Shift Pattern—AX 4/5 Transmission

RECOMMENDED LUBRICANT

Recommended lubricant for AX 4/5 transmissions is Mopar 75W-90, API Grade GL-5 gear lubricant, or equivalent SAE rated gear lubricant.

Correct lubricant fill level is to the bottom edge of the fill plug hole. The fill plug is at the passenger side of the adapter housing Fig. 4). The drain plug is at the bottom of the case.

Approximate dry fill lubricant capacity is 3.3 liters (3.5 qts.).

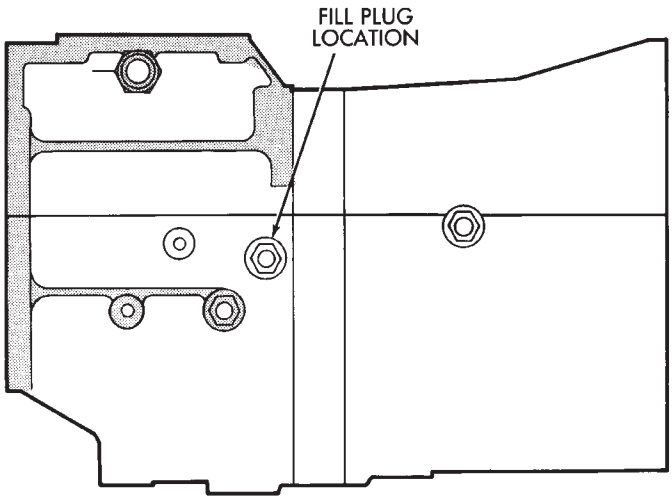


Fig. 4 Fill Plug Location

SERVICE DIAGNOSIS

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 slip, grab and chatter.

Transmissions filled from air or electrically powered lubricant containers can be underfilled. This generally happens when the container delivery mechanism is improperly calibrated. Always check the lubricant level after filling to avoid an under fill condition.

A correct lubricant level check can only be made when the vehicle is level; use a drive-on hoist to ensure this. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an under-or-overfill condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants, component damage, incorrect clutch adjustment, or by a damaged clutch pressure plate or disc.

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 a problem are usually hard shifting and noise.

Incorrect or contaminated lubricants can also contribute to hard shifting. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind and hard shifting.

Improper clutch release is a frequent cause of hard shifting. Incorrect adjustment or a worn, damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result.

Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing 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 can generate a mild whine that may only be audible at extreme speeds.

Severe, obviously audible transmission noise is generally the result of a lubricant problem. Insufficient, improper, or contaminated lubricant can promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

TRANSMISSION REMOVAL

(1) Shift transmission into first or third gear. Then raise vehicle on hoist.

(2) Support engine with adjustable jack stand. Be sure to position wood block between jack and oil pan.

(3) Disconnect necessary exhaust system components.

(4) Disconnect rear cushion and bracket from transmission (Fig. 5). Then remove skid plate, or rear crossmember.

(5) Disconnect transfer case shift linkage, vehicle speed sensor wires, and vent hose.

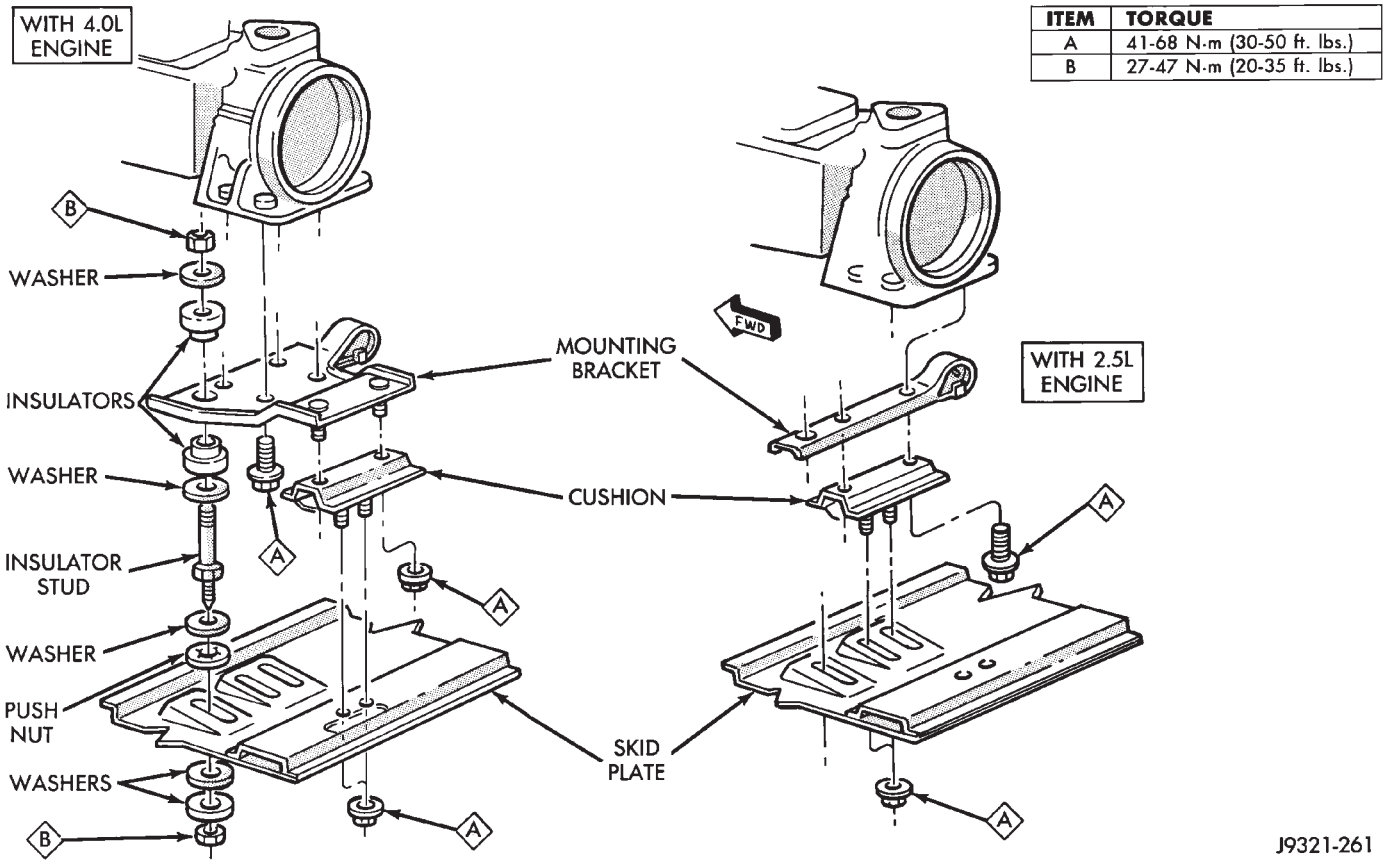


Fig. 5 Rear Mount Components (YJ Shown)

(6) Remove slave cylinder from clutch housing.

(7) Disconnect transmission shift lever as follows:

(a) Lower transmission-transfer case assembly approximately 7-8 cm (3 in.) for access to shift lever.

(b) Reach up and around transmission case and unseat shift lever dust boot from transmission shift tower (Fig. 6). Move boot upward on shift lever for access to retainer that secures lever in shift tower.

(c) Reach up and around transmission case and press shift lever retainer downward with your fingers. Turn retainer counterclockwise to release it.

(d) Lift lever and retainer out of shift tower (Fig. 6). **Do not remove the shift lever from the floorpan boots. Leave the lever in place for later transmission installation.**

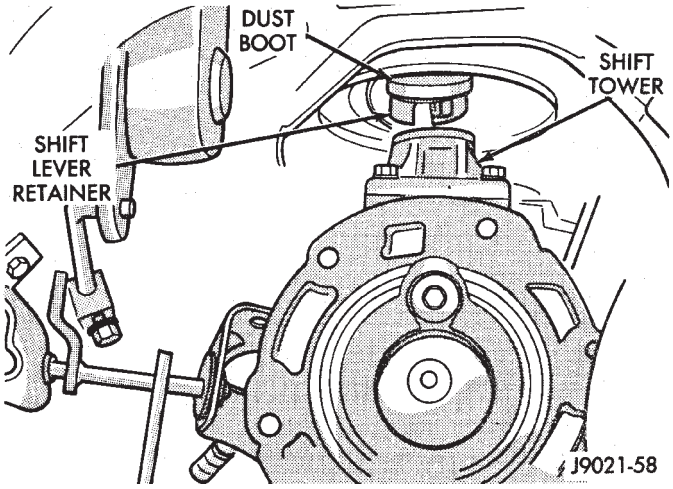


Fig. 6 Removing/Installing Shift Lever

(8) Mark front and rear propeller shafts for installation alignment (Fig. 7). Then remove shafts.

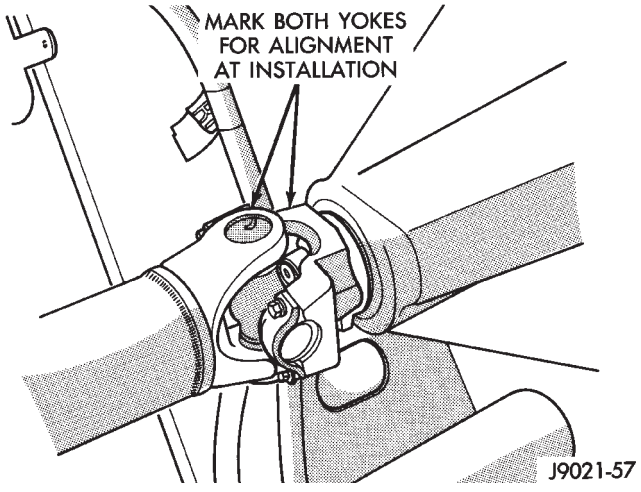


Fig. 7 Marking Propeller Shaft And Axle Yokes

(9) Remove crankshaft position position sensor (Fig. 8).

(10) Disconnect vehicle speed sensor wires.

(11) Disconnect transmission and transfer case vent hoses.

(12) Disconnect clutch master cylinder hydraulic line from concentric bearing inlet line (Fig. 8).

(13) Support transmission-transfer case assembly with a transmission jack. Secure assembly to jack with safety chains.

(14) Remove clutch housing brace rod on 4-cylinder models.

(15) Remove clutch housing-to-engine bolts and remove transmission-transfer case assembly.

(16) Remove bolts attaching transmission to transfer case and separate components.

(17) Remove release bearing, fork and retainer clip.

(18) Remove clutch housing.

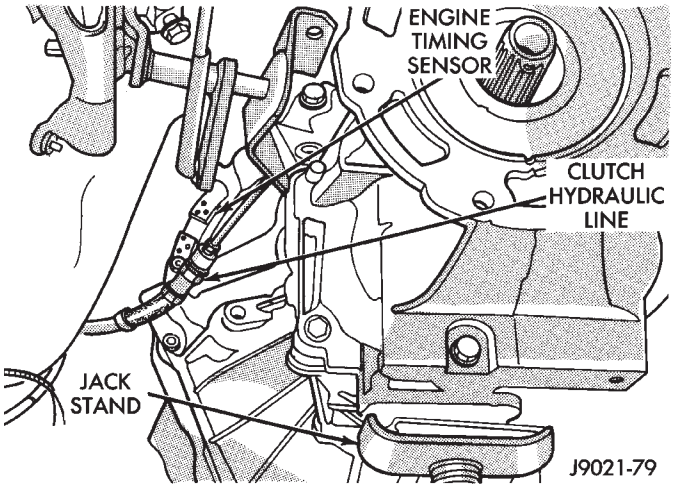


Fig. 8 Hydraulic Line And Timing Sensor Location

TRANSMISSION INSTALLATION

(1) Install clutch housing on transmission. Tighten housing bolts to 37 N·m (27 ft. lbs.) torque.

(2) Lubricate contact surfaces of release fork pivot ball stud and release fork with high temp grease. Then install release bearing, fork and retainer clip.

(3) Mount transmission on transmission jack.

(4) Lightly lubricate pilot bearing and transmission input shaft splines with Mopar high temperature grease.

(5) Align transmission input shaft and clutch disc splines and install transmission.

(6) Install and tighten clutch housing-to-engine bolts to 38 N·m (28 ft. lbs.) torque. **Be sure the housing is properly seated on engine block before tightening bolts.**

(7) Lower transmission approximately 7-8 cm (3 in.) for access to shift tower. Be sure transmission is in first or third gear.

(8) Reach up and around transmission and insert shift lever in shift tower. Press lever retainer downward and turn it clockwise to lock it in place. Then install lever dust boot on shift tower.

(9) Install slave cylinder in clutch housing.

(10) Connect engine timing sensor wires.

(11) Remove jack from under transmission and mount transfer case on jack.

(12) Align transfer case and transmission shafts and install transfer case. Tighten transfer case-to-transmission nuts/bolts to 35 N·m (26 ft. lbs.) torque.

(13) Remove jack stand from under engine and reposition jack under transmission. Then remove transmission jack.

(14) Connect transfer case vent hose and shift linkage. Check and adjust linkage if necessary.

(15) Connect transmission and transfer case vent hoses.

(16) Connect backup light switch wires.

(17) Connect vehicle speed sensor wires.

(18) Install and connect crankshaft position sensor if equipped.

(19) Install rear crossmember, or skid plate (Fig. 5). On XJ, tighten crossmember-to-frame bolts to 41 N·m (31 ft. lbs.) torque. Then tighten transmission-to-rear support bolts/nuts to 45 N·m (33 ft. lbs.) torque. On YJ, tighten bolts/nuts to indicated torque (Fig. 5).

(20) Align and install front/rear propeller shafts. Tighten shaft U-joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(21) On XJ, install skid plate, if removed. Tighten bolts to 42 N·m (31 ft. lbs.) torque. Tighten stud nuts to 17 N·m (150 in. lbs.) torque.

(22) Top off transmission and transfer case lubricant levels.

(23) Lower vehicle.

TRANSMISSION DISASSEMBLY AND OVERHAUL

ADAPTER HOUSING AND FRONT BEARING RETAINER REMOVAL

(1) Drain transmission lubricant.

(2) Remove concentric bearing.

(3) Remove clutch housing bolts and remove housing.

(4) On 2-wheel drive models, remove vehicle speed sensor, speedometer adapter and speedometer driven gear. Then remove extension housing seal (Fig. 9).

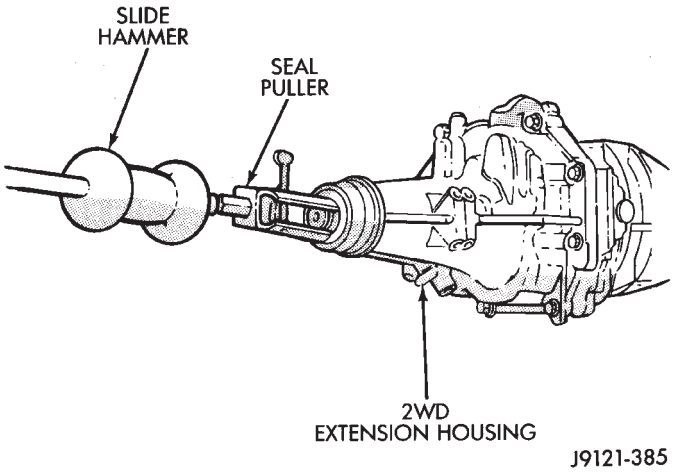


Fig. 9 Removing 2-Wheel Drive Extension Housing Seal

(5) Remove detent spring and ball. Remove detent plug (Fig. 10) and remove detent spring and ball with pencil magnet.

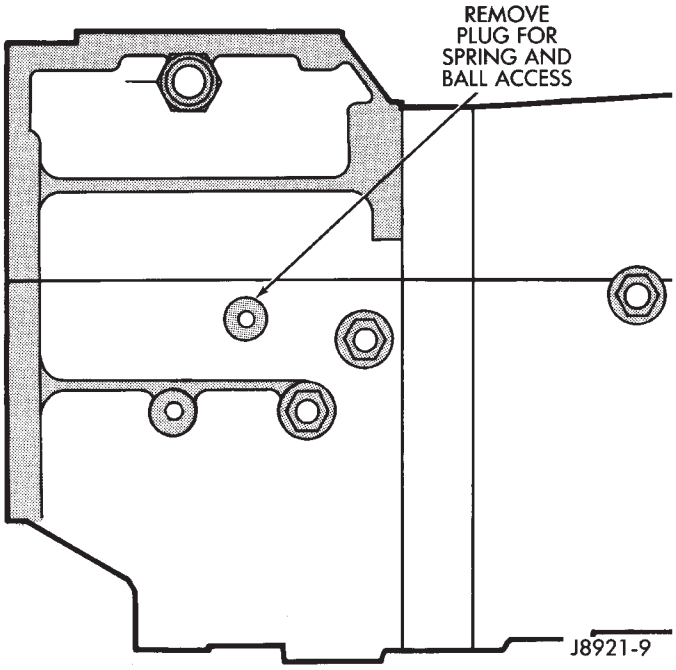


Fig. 10 Detent Ball Plug Location

(6) Remove shift arm set bolt (Fig. 11) and remove bolt and lockplate.

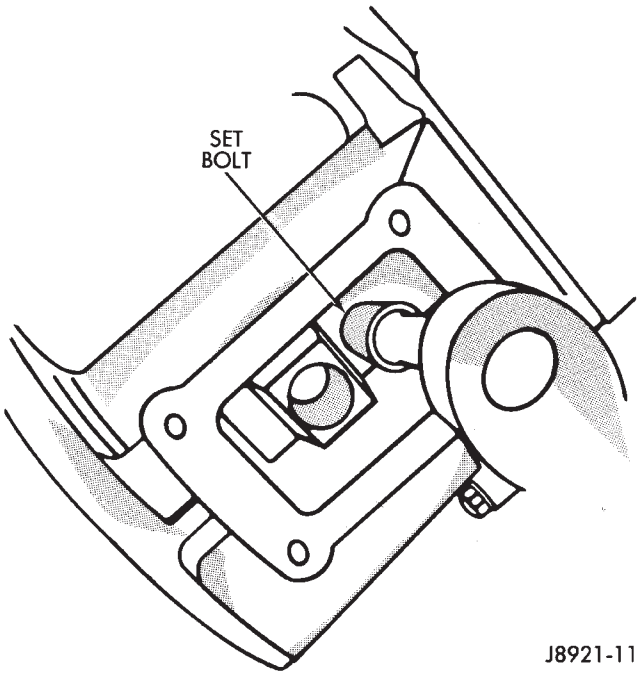


Fig. 11 Set Bolt Removal

(7) Remove shift lever shaft plug (Fig. 12). Then pull shaft out with large magnet.

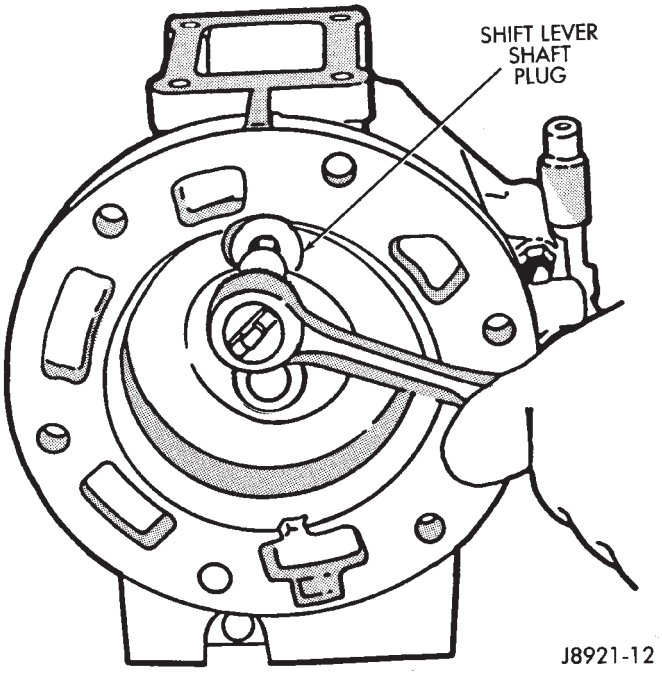


Fig. 12 Removing Shift Lever Shaft Plug

(8) Remove adapter housing bolts.

(9) Remove adapter housing by tapping it loose with plastic mallet.

(10) Remove front bearing snap rings (Fig. 13).

Fig. 13 Removing Bearing Retainer Snap Ring

(11) Remove front bearing retainer and intermediate plate by tapping them loose with plastic mallet (Fig. 14).

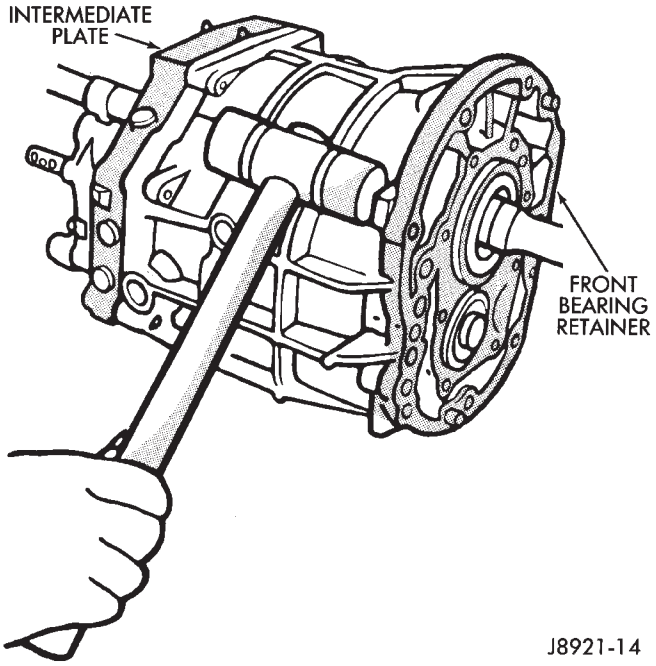


Fig. 14 Removing Bearing Retainer And Intermediate Plate

SHIFT MECHANISM DISASSEMBLY

(1) Install two clutch housing bolts and spare washers in intermediate plate (Fig. 15). Then clamp plate and gear assembly in vise. **Use enough washers to prevent bolts from touching. Also be sure vise jaws are clamped on bolt heads (Fig. 15).**

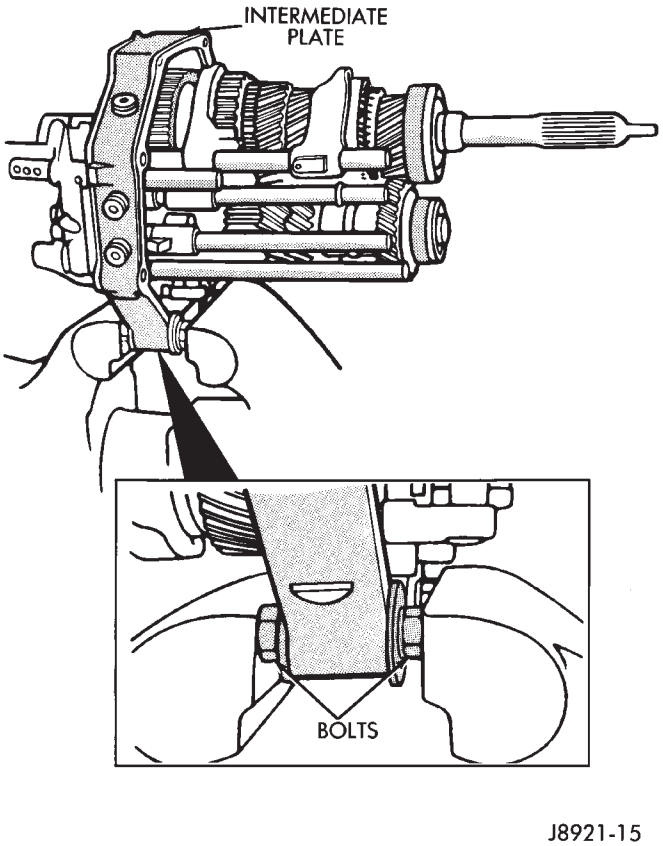


Fig. 15 Positioning Intermediate Plate In Vise

(2) Remove threaded plugs from intermediate plate. Then remove lock ball and spring from plug holes with pencil magnet (Fig. 16).

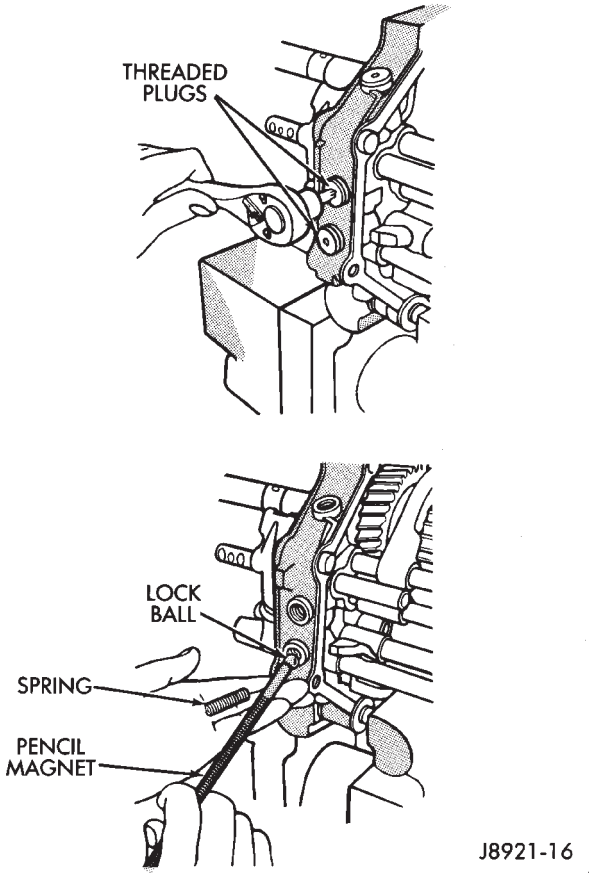


Fig. 16 Removing Lock Ball And Spring

(3) Remove shift fork pins with punch and hammer (Fig. 17).

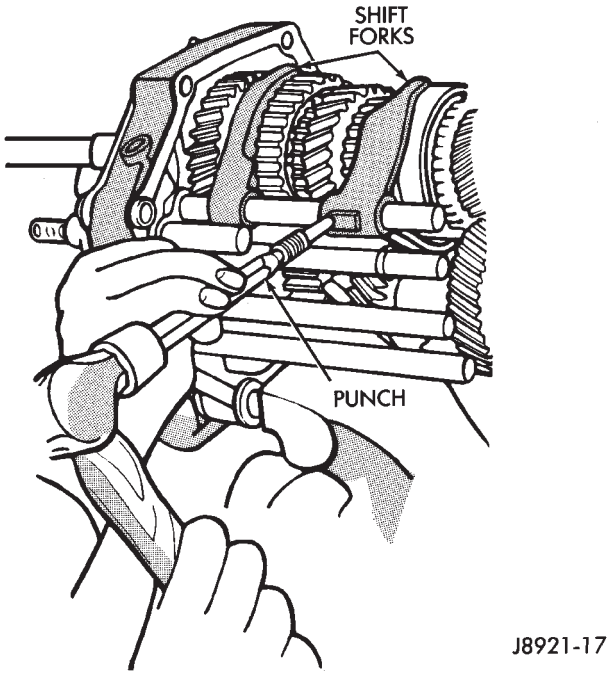


Fig. 17 Removing Shift Fork Pin

(4) Remove shift rail C-rings (Fig. 18).

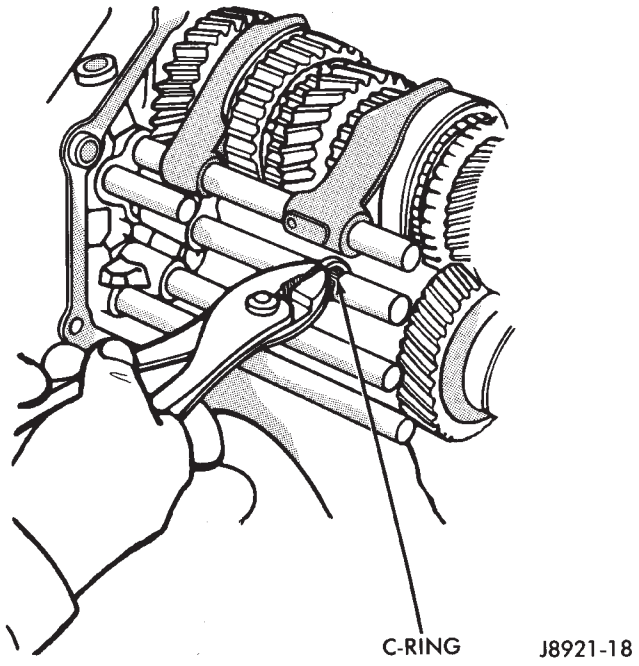


Fig. 18 Shift Rail C-Ring Removal

(5) Pull No. 4 shift rail outward and remove lock balls and pin (Fig. 19).

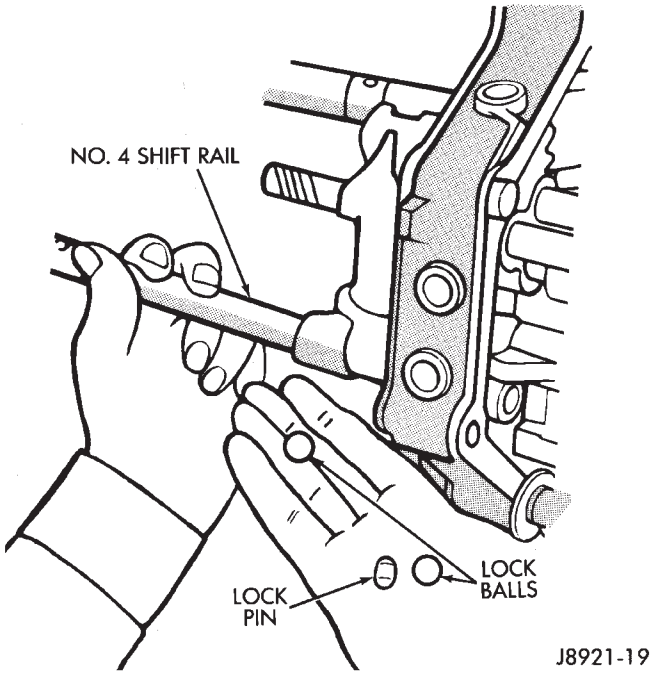


Fig. 19 Removing No. 4 Shift Rail, Lock Balls And Pin

(6) Remove No. 4 shift rail, fifth gear and No. 3 shift fork (Fig. 20).

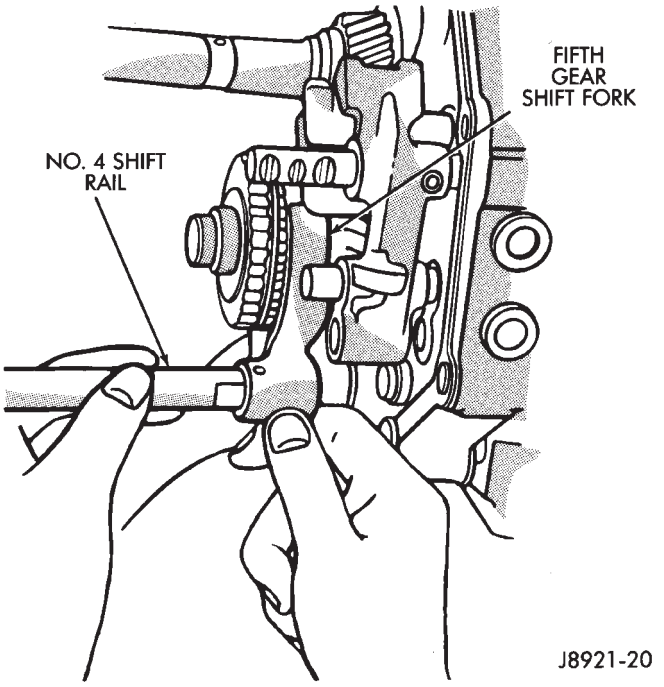


Fig. 20 Removing No. 4 Shift Rail And Fifth Gear Shift Fork

(7) Pull No. 5 shift rail and shift head out of plate (Fig. 21).

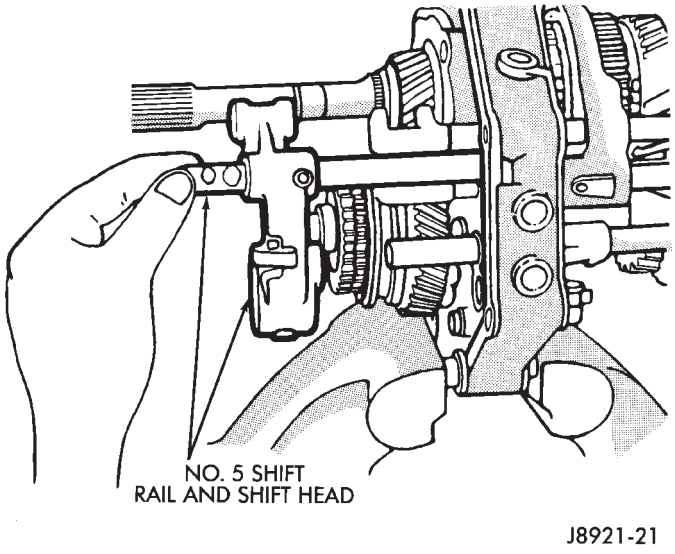


Fig. 21 Removing No. 5 Shift Rail And Shift Head

(8) Remove shift rail No.3. **Catch interlock pins as rail is removed (Fig. 22).**

(9) Remove No. 1 shift rail and interlock pin (Fig. 23).

(10) Remove shift rail No. 2 and shift forks 1 and 2 (Fig. 24).

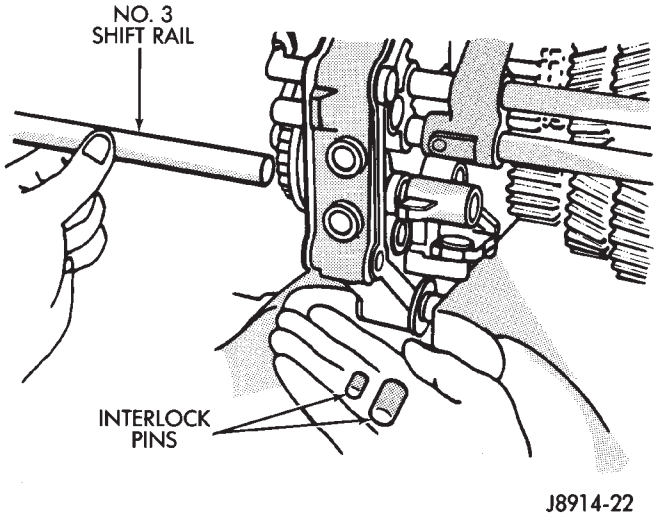
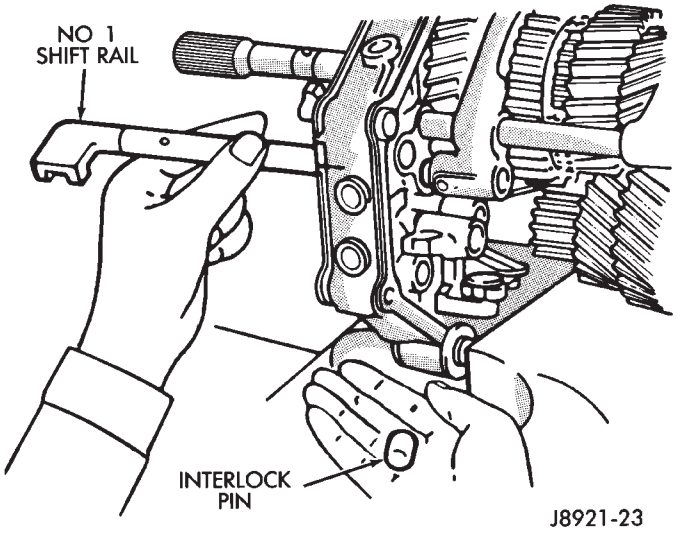


Fig. 22 Removing No. 3 Shift Rail And Interlock Pin



Fig, 23 Removing No. 1 Shift Rail And Interlock Pin

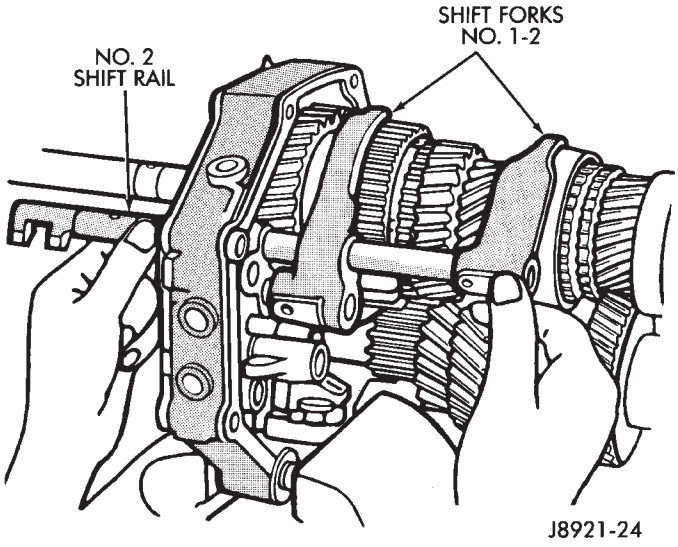


Fig. 24 Removing Shift Forks And No. 2 Shift Rail

(11) Remove reverse idler gear and shaft (Fig. 25).

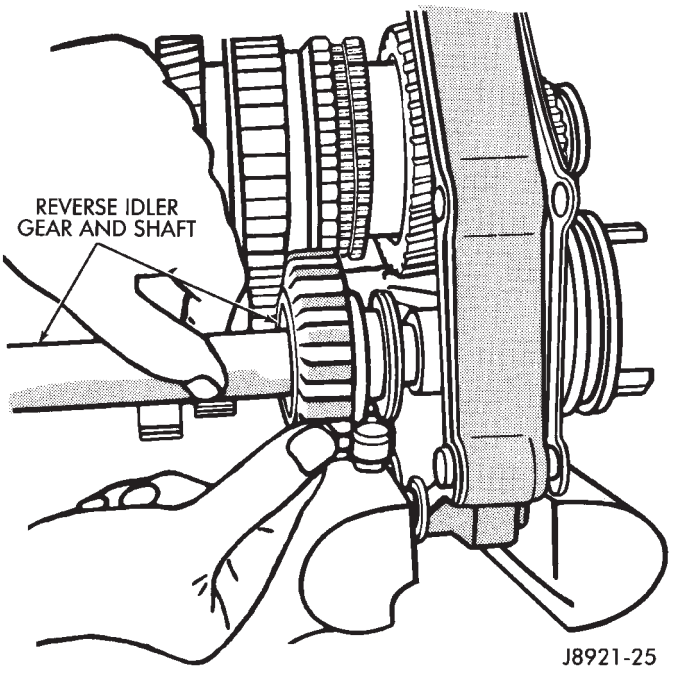


Fig. 25 Removing Reverse Idler Gear And Shaft

(12) Remove reverse shift arm and fork (Fig. 26).

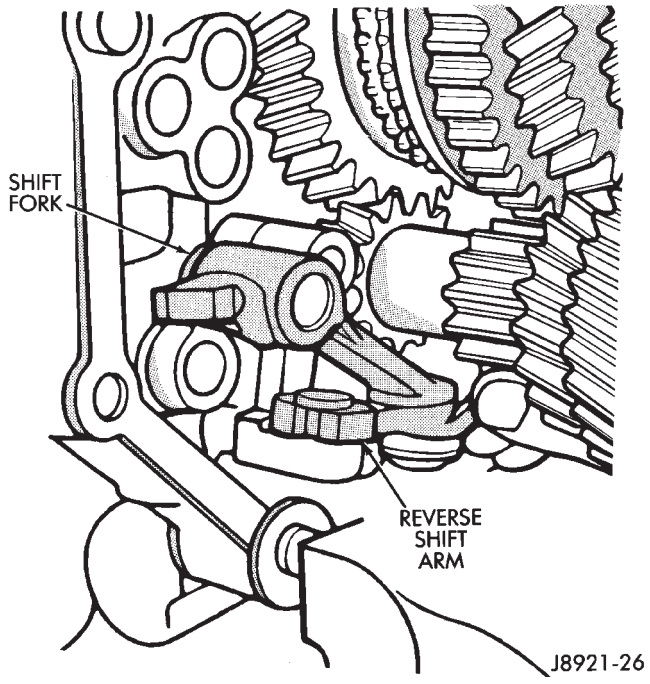


Fig. 26 Reverse Shift Arm Removal

MAINSHAFT DISASSEMBLY

(1) On AX 5, measure fifth counter gear thrust clearance with feeler gauge (Fig. 27). Clearance should be 0.10 - 0.30 mm (0.004 - 0.012 in.).

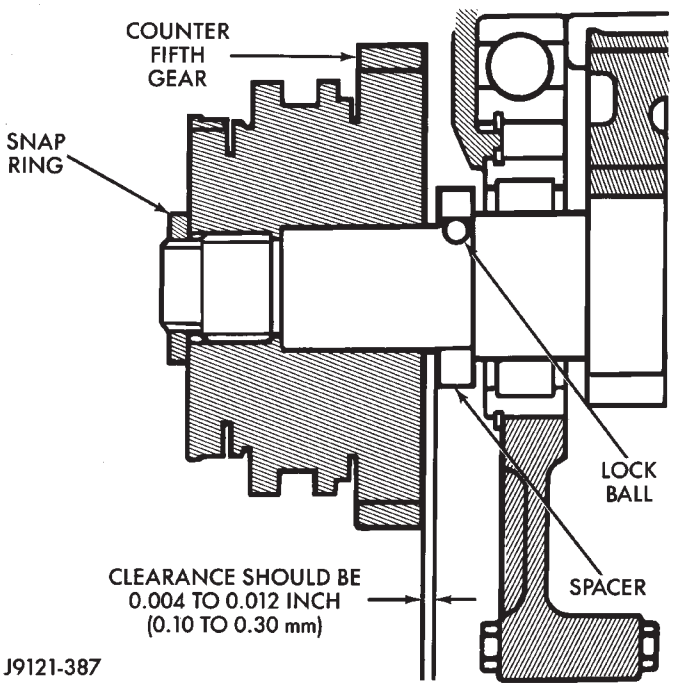


Fig. 27 Measuring Counter Fifth Gear Thrust Clearance

(2) Engage two synchro sleeves to lock mainshaft gears (Fig. 28).

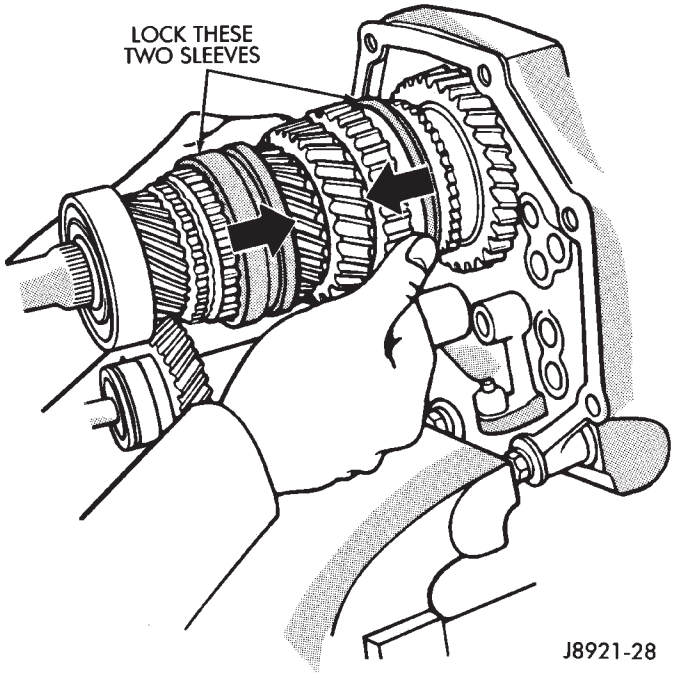


Fig. 28 Locking Mainshaft Gears

(3) On AX 4, remove counter gear nut and oil slinger. On AX 5, remove select fit snap ring that secures fifth spline gear and counter fifth gear on shaft (Fig. 29).

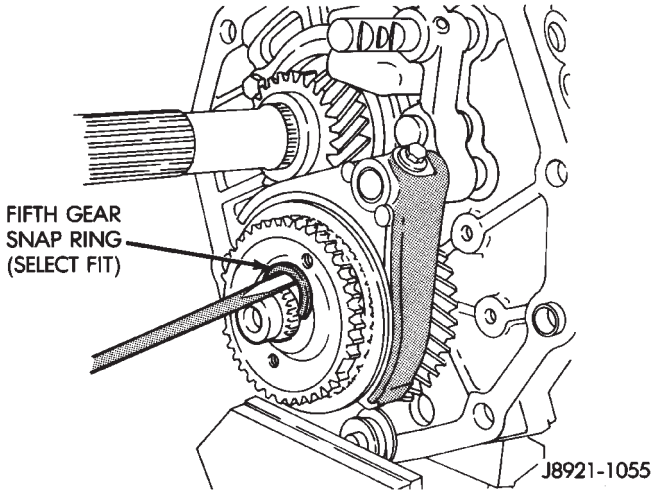


Fig. 29 Removing Fifth Gear Snap Ring

(4) Remove fifth spline gear, synchronizer and counter fifth gear with two-jaw puller (Fig. 30).

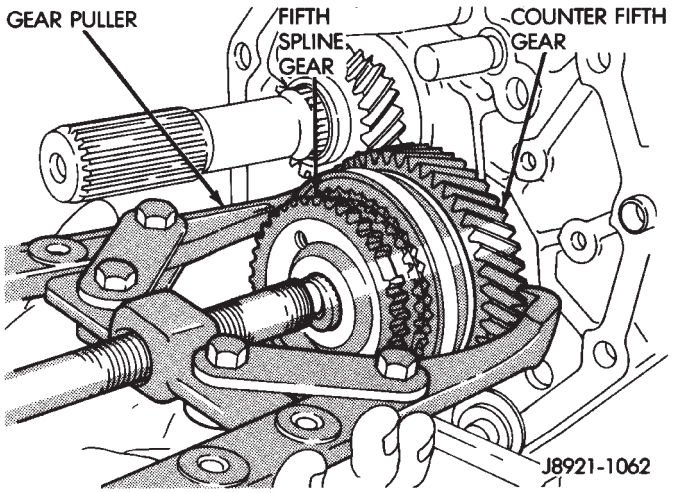


Fig. 30 Removing Fifth Gear Assembly

(5) Remove spacer and remove lock ball with pencil magnet (Fig. 31).

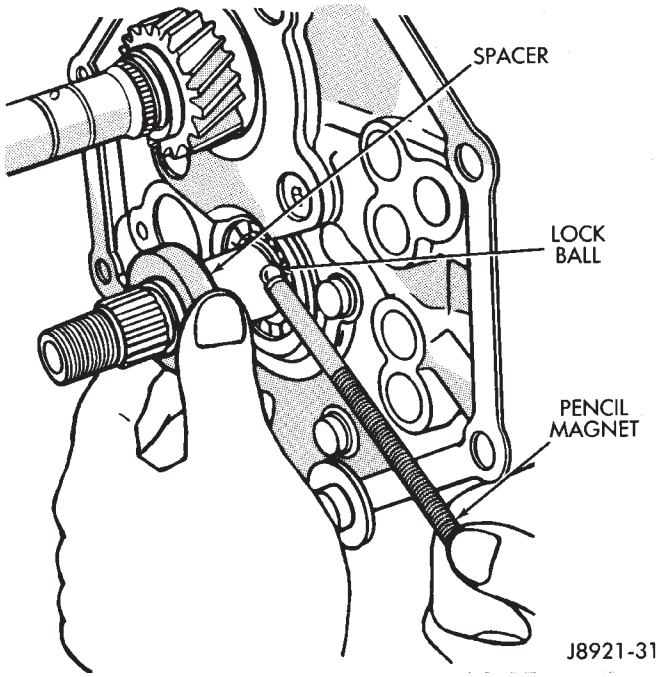


Fig. 31 Spacer And Lock Ball Removal

(6) Remove reverse shift arm bracket (Fig. 32).

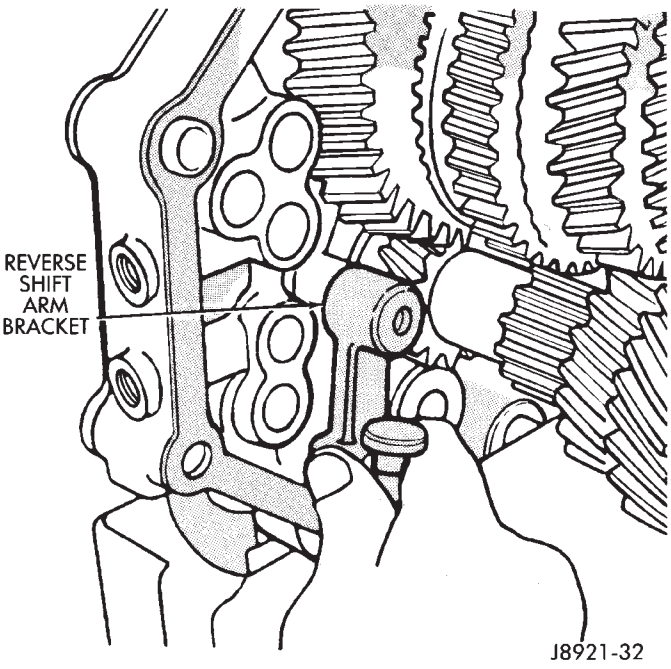


Fig. 32 Removing Reverse Shift Arm Bracket

(7) Remove rear bearing retainer bolts with appropriate size torx bit and remove retainer (Fig. 33).

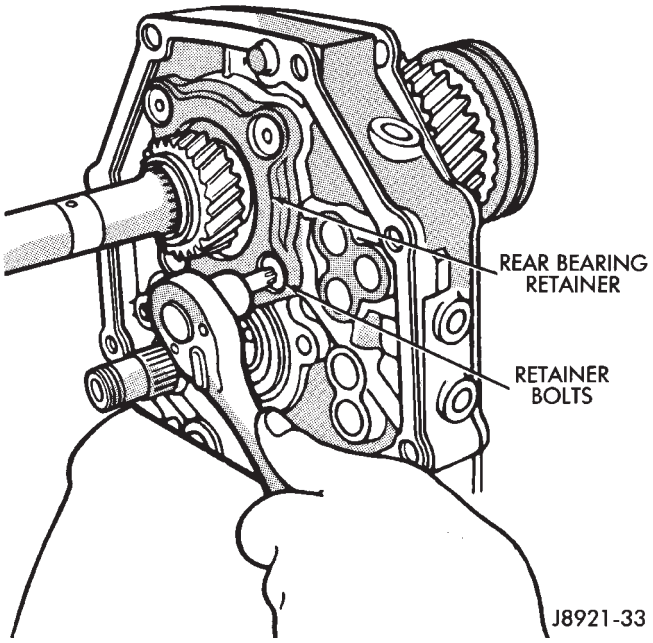


Fig. 33 Removing Rear Bearing Retainer

(8) Remove rear bearing snap ring (Fig. 34).

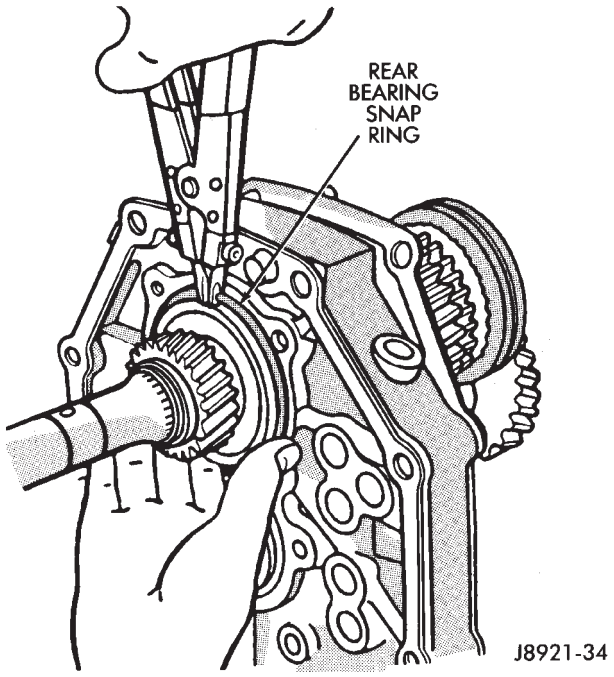


Fig. 34 Removing Rear Bearing Snap Ring

(9) Tap intermediate plate with plastic mallet and pull output shaft-counter gear assemblies out of plate (Fig. 35).

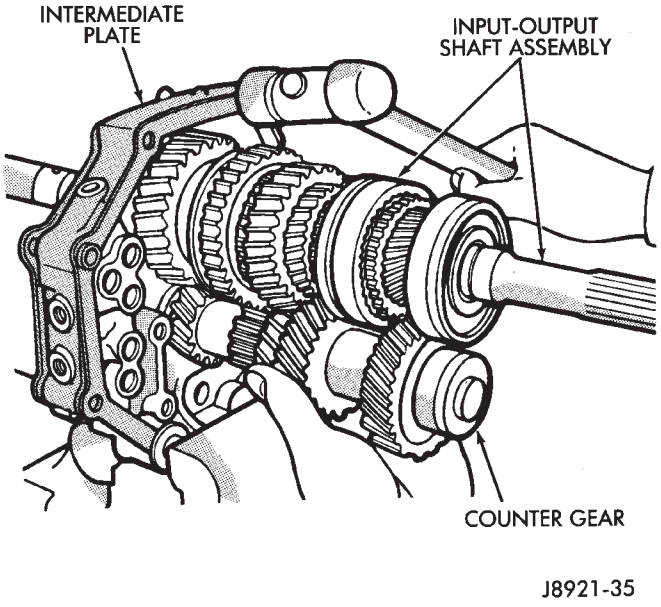


Fig. 35 Removing Counter Gear And Output Shaft

(10) Remove rear bearing from intermediate plate.

(11) Remove input shaft and shaft roller bearings from output shaft.

(12) Measure thrust clearance of output shaft gears (Fig. 36). Clearance should be 0.10 - 0.25 mm (0.004 - 0.010 in.).

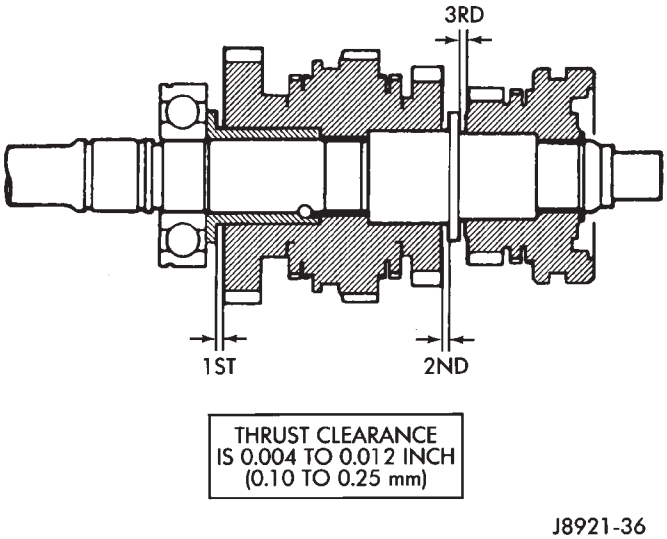


Fig. 36 Checking Output Shaft Gear Thrust Clearance

(13) Remove output shaft fifth gear snap ring with two screwdrivers (Fig. 37).

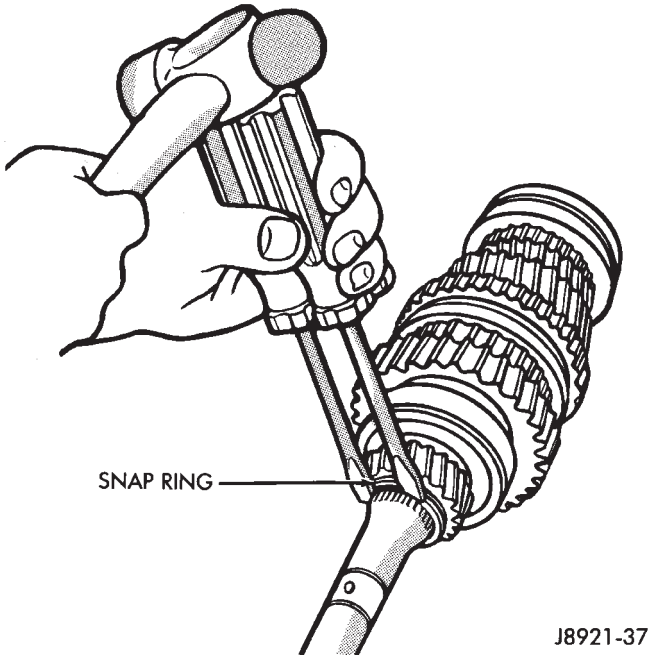


Fig. 37 Removing Fifth Gear Snap Ring

(14) Press fifth gear, rear bearing, first gear and inner race off output shaft (Fig. 38).

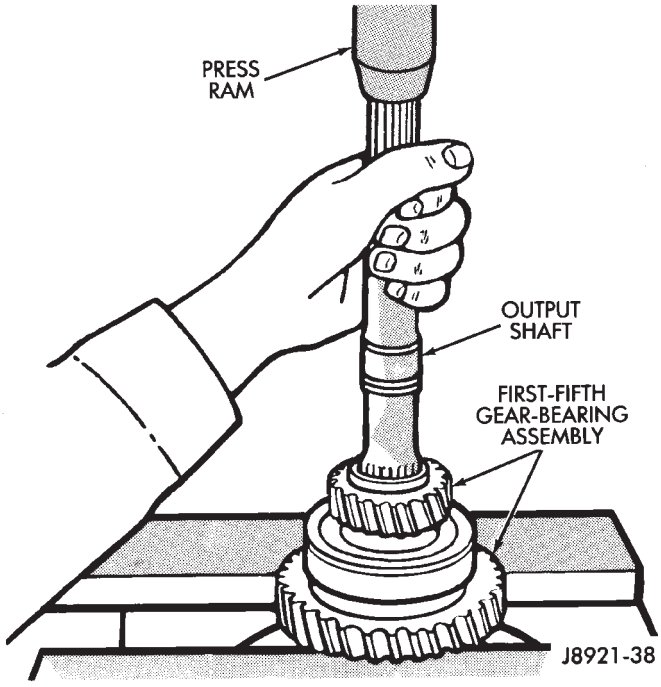


Fig. 38 Removing Fifth Gear And First Gear Bearing And Race

(15) Remove needle roller bearing.

(16) Remove synchronizer ring.

(17) Remove synchronizer lock ball with pencil magnet (Fig. 39).

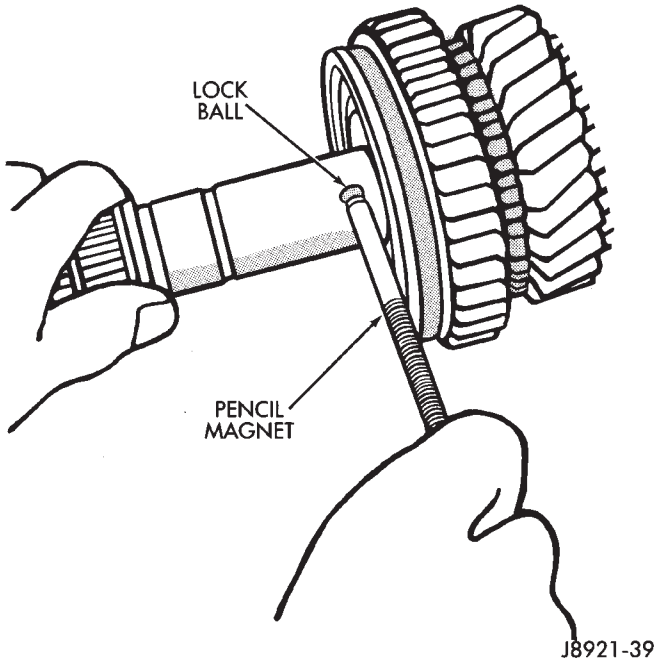


Fig. 39 Synchronizer Lock Ball Removal

(18) Press 1-2 synchronizer and second gear off output shaft (Fig. 40).

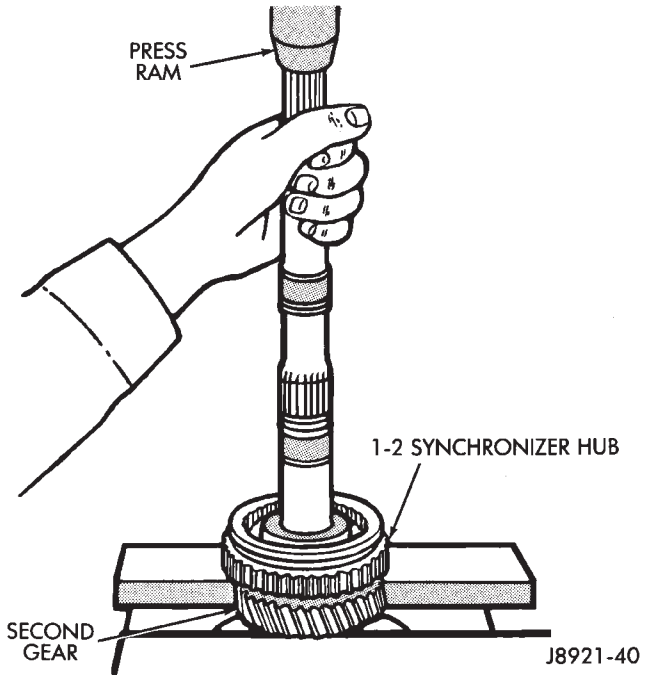


Fig. 40 1-2 Synchronizer And Second Gear Removal

(19) Remove needle roller bearing from the shaft or second gear.

(20) Remove 3-4 synchronizer snap ring (Fig. 41).

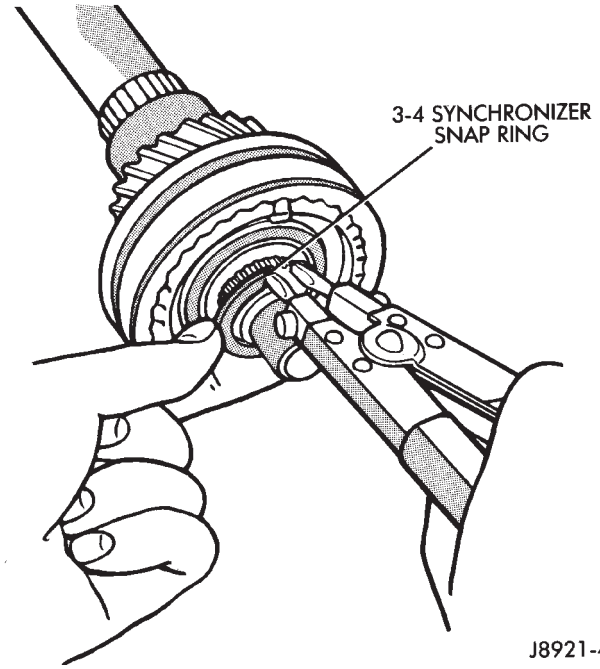


Fig. 41 Removing 3-4 Synchronizer Snap Ring

(21) Press 3-4 synchronizer and third gear off shaft (Fig. 42).

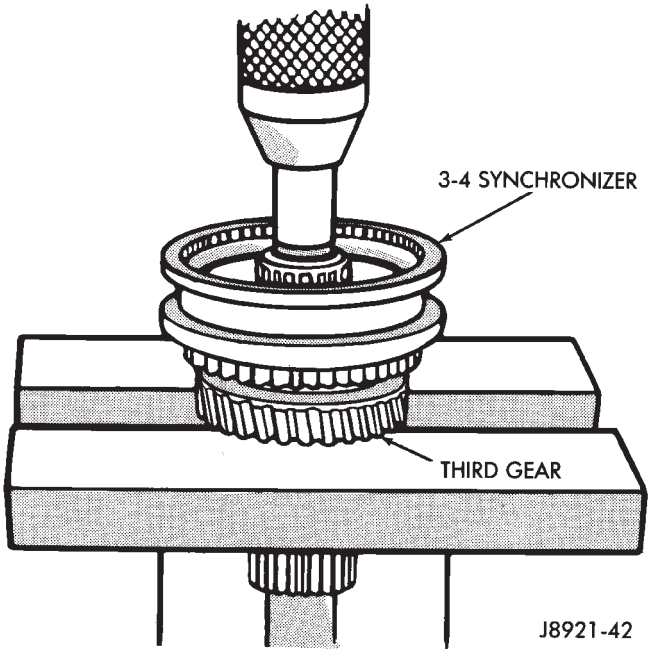


Fig. 42 Removing 3-4 Synchronizer And Third Gear

(22) Remove needle roller bearing from shaft or gear.

CLEANING AND INSPECTION

Clean the transmission components in solvent. Dry the cases, gears, shift mechanism and shafts with compressed air. **Dry the bearings with clean, dry shop towels only. Never use compressed air on the bearings. This could cause severe damage to the bearing roller and race surfaces.**

Inspect the transmission case. Replace the case if cracked, porous, or if any of the bearing and gear bores are damaged.

Check thickness of the output shaft and inner bearing race flanges with a micrometer or vernier calipers (Fig. 43). Minimum thickness for the shaft flange is 4.8 mm (0.189 in.). Minimum thickness for the bearing race flange is 3.99 mm (0.157 in.).

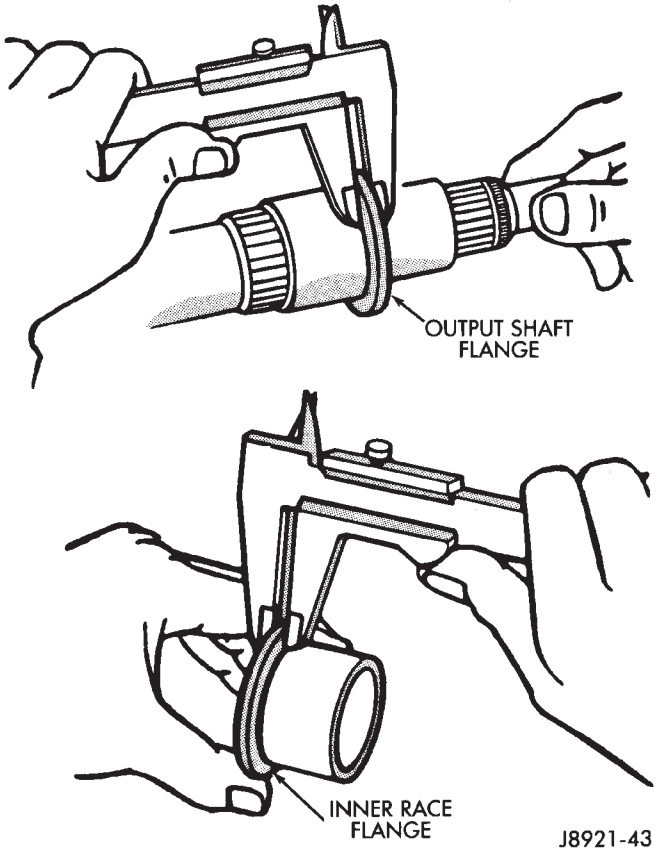


Fig. 43 Checking Flange Thickness

Measure diameter of the output shaft journal surfaces with a micrometer (Fig. 44). Second gear surface minimum diameter is 37.96 mm (1.495 in.). Third gear surface minimum diameter is 34.98 mm (1.377 in.). Replace the shaft if either of these surfaces are worn beyond specified limits.

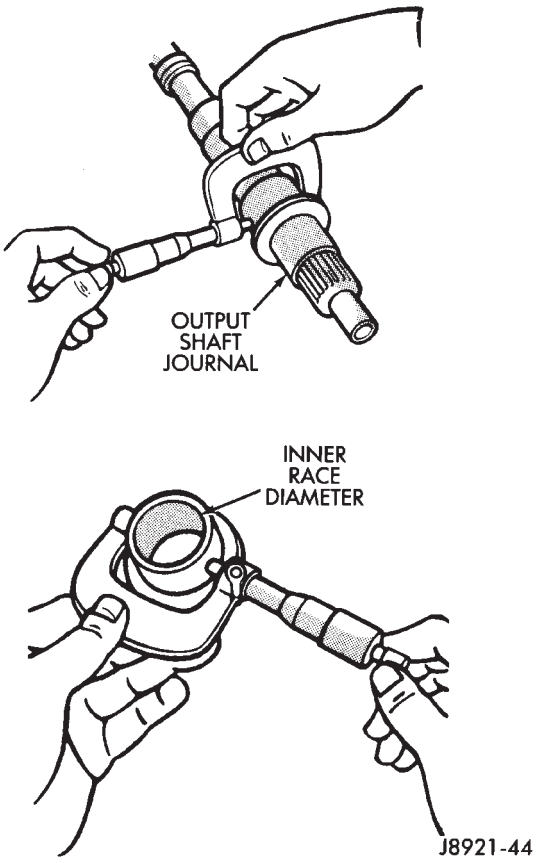


Fig. 44 Checking Shaft And Race Diameters

Measure output shaft runout with a dial indicator (Fig. 45). Runout should not exceed 0.05 mm (0.002 in.).

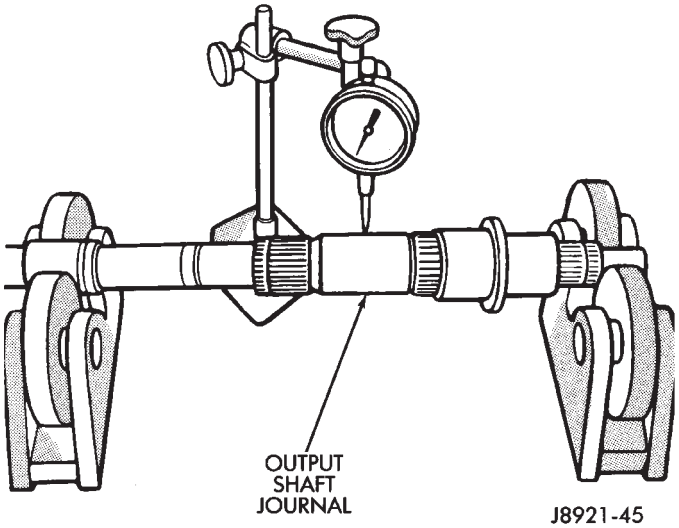


Fig. 45 Checking Output Shaft Runout

Install the needle bearing and inner race in the first gear. Then check oil clearance between the gear and inner race (Fig. 46). Clearance should be 0.009 - 0.032 mm (0.0004 - 0.0013 in.).

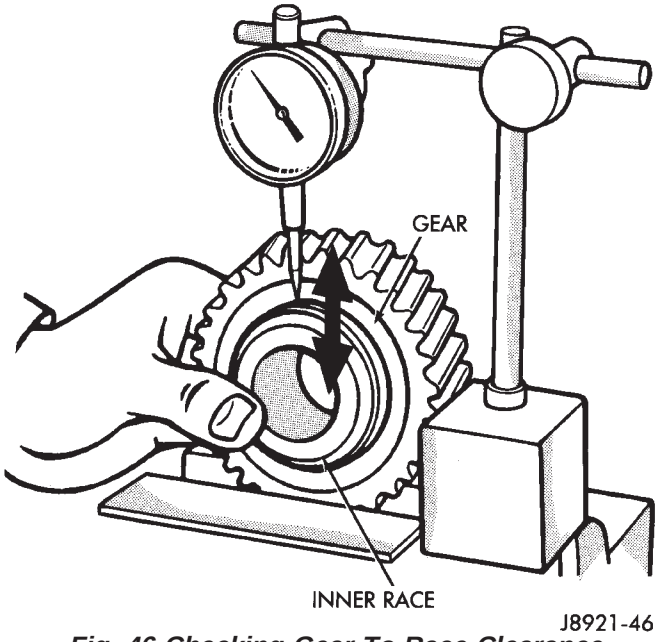


Fig. 46 Checking Gear-To-Race Clearance

Install the needle bearings and the second, third and counter fifth gears on the output shaft. Check oil clearance between the gears and shaft with a dial indicator (Fig. 47).

Oil clearance for all three gears is 0.009 - 0.0013 mm (0.0004 - 0.0013 in.).

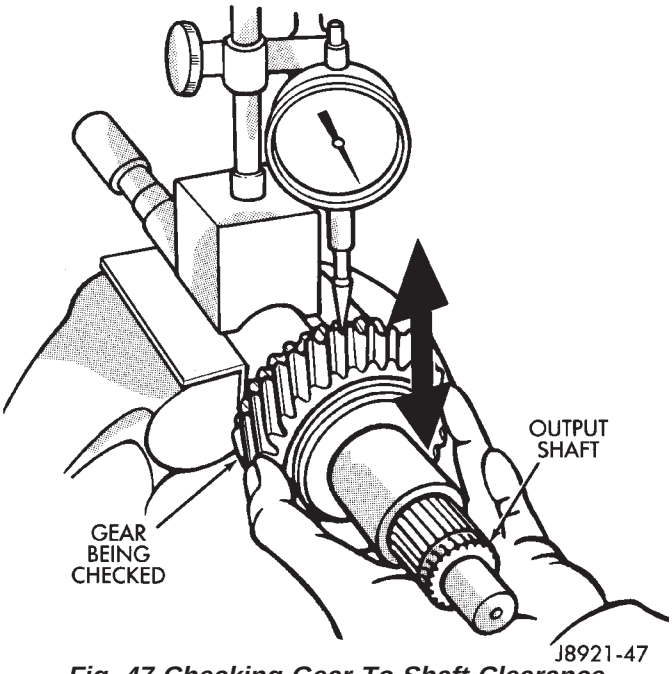


Fig. 47 Checking Gear-To-Shaft Clearance

Check synchronizer ring wear (Fig. 48). Insert each ring in matching gear. Measure clearance between

each ring and gear with feeler gauge. Replace ring if clearance exceeds 2.0 mm (0.078 in.).

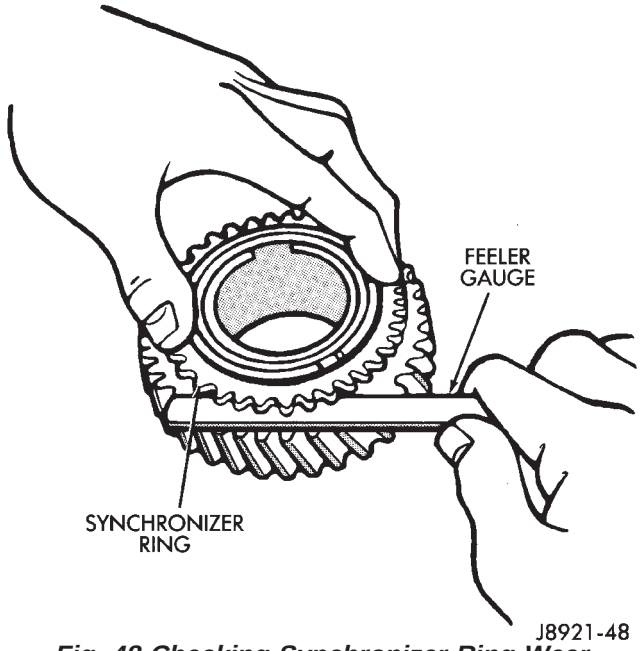


Fig. 48 Checking Synchronizer Ring Wear

Check shift fork-to-synchronizer hub clearance with a feeler gauge (Fig. 49). Replace the fork if clearance exceeds 1.0 mm (0.039 in.).

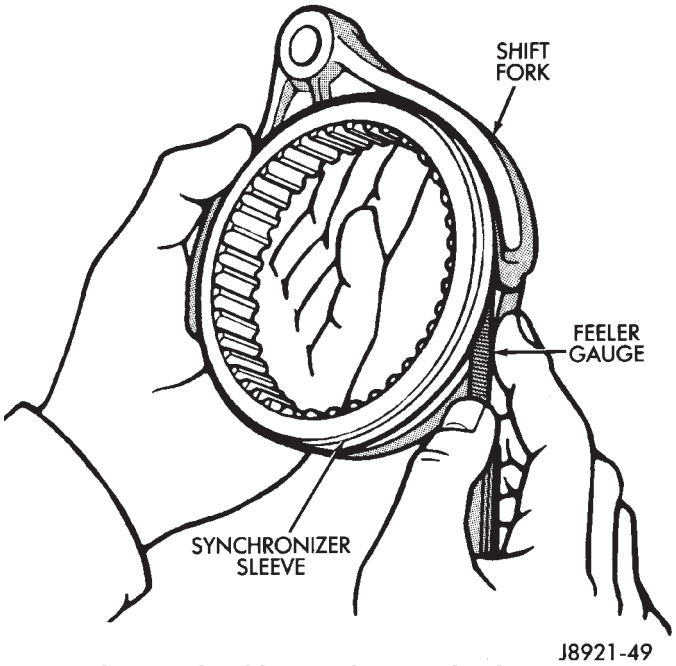


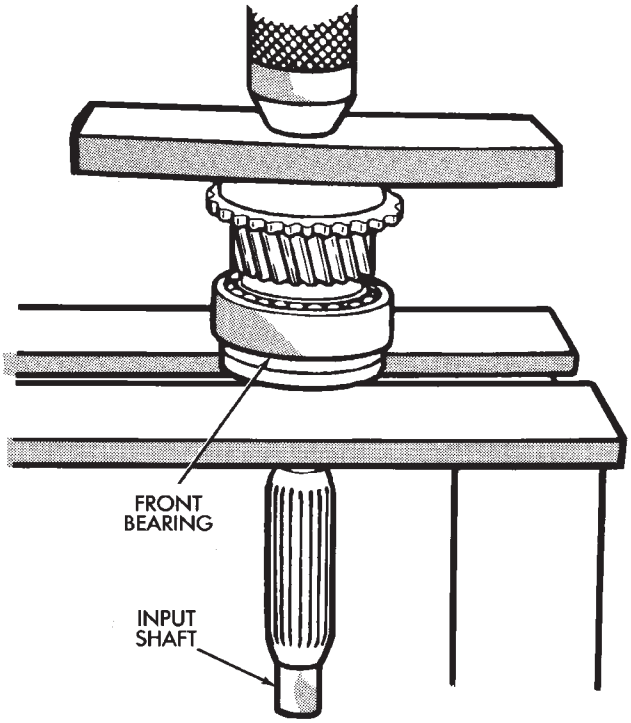
Fig. 49 Checking Fork-To-Hub Clearance

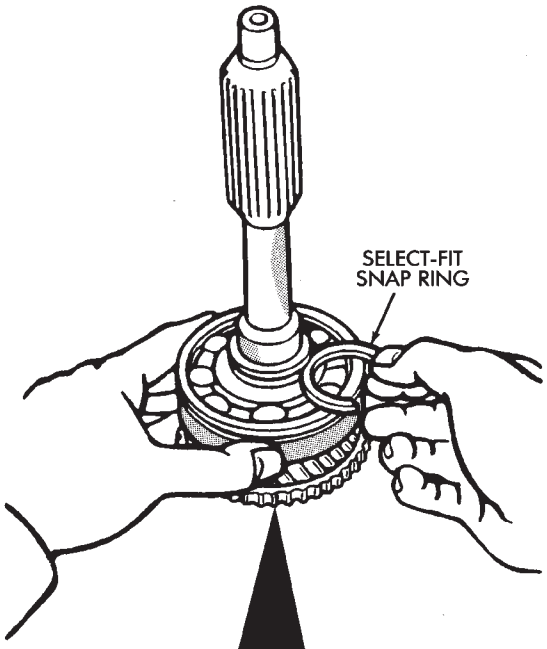
TRANSMISSION ASSEMBLY AND ADJUSTMENT

Lubricate the transmission components with Mopar 75W-90, GL 5 gear lubricant during assembly. Use petroleum jelly to lubricate seal lips and/or hold parts in place during installation. Refer to the Counter Gear Comparison Chart (Fig. 102) during assembly for AX 4/5 gear differences.

ASSEMBLING OUTPUT SHAFT, INPUT SHAFT AND COUNTER GEAR

(1) If front bearing was removed from input shaft, press new bearing on shaft (Fig. 50).





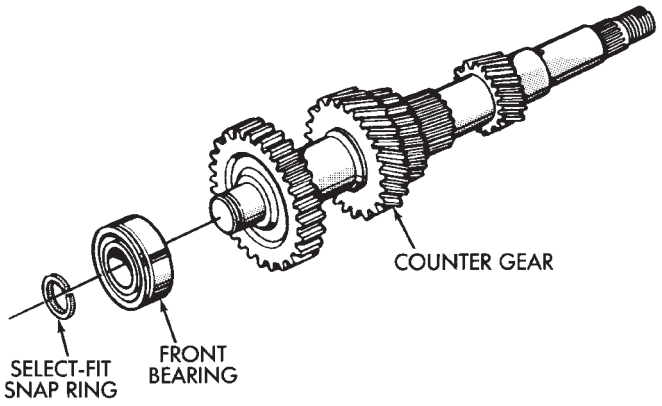
I.D. Mark	Snap Ring Thickness mm (in.)
0	2.05-2.10 (0.0807-0.0827)
1	2.10-2.15 (0.0827-0.0846)
2	2.15-2.20 (0.0846-0.0866)
3	2.20-2.25 (0.0866-0.0886)
4	2.25-2.30 (0.0886-0.0906)
5	2.30-2.35 (0.0906-0.0925)

J8921-50

Fig. 50 Installing Front Bearing And Snap Ring

(2) Secure front bearing with thickest snap ring that will fit in groove (Fig. 50).

(3) Press front bearing on counter gear. Secure bearing with thickest snap ring that will fit in ring groove (Fig. 51).



I.D. Mark	Snap Ring Thickness mm (in.)
1	2.05-2.10 (0.0807-0.0827)
2	2.10-2.15 (0.0827-0.0846)
3	2.15-2.20 (0.0846-0.0866)
4	2.20-2.25 (0.0866-0.0886)
5	2.25-2.30 (0.0886-0.0906)
6	2.30-2.35 (0.0906-0.0925)

J8921-51

Fig. 51 Installing Counter Gear Front Bearing And Snap Ring

(4) Install new oil seals in front bearing retainer and adapter (Fig. 52). Bearing retainer seal depth is 11.2 - 12.1 mm (0.441 - 0.480 in.).

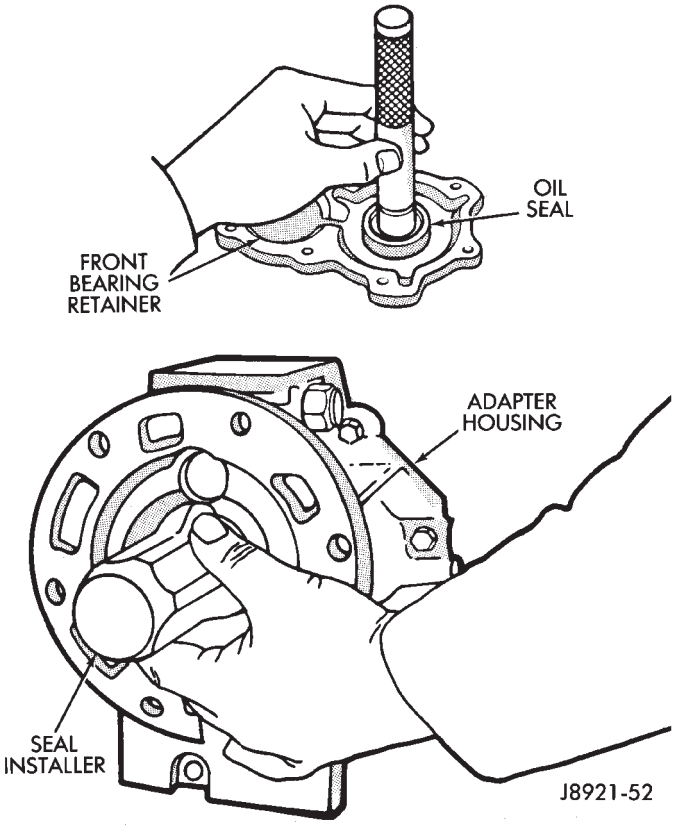


Fig. 52 Oil Seal Installation

(5) Install reverse shaft and shaft retaining pin in adapter. Then install access hole plug with torx bit (Fig. 53).

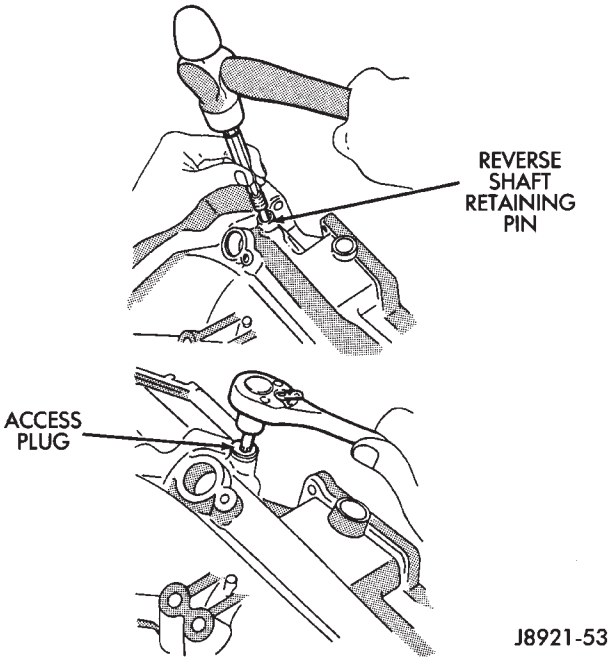


Fig. 53 Installing Reverse Shaft Pin

(6) Lubricate transmission components with specified gear lubricant.

(7) Assemble 1-2 and 3-4 synchronizer hubs, sleeves, springs and key inserts (Fig. 54).

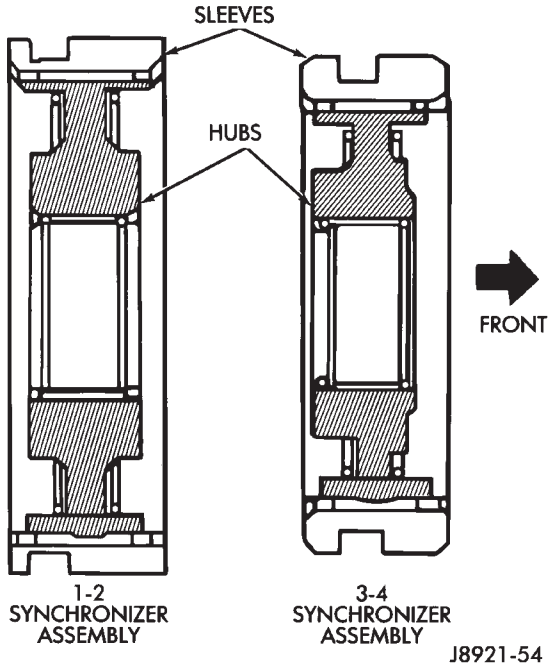
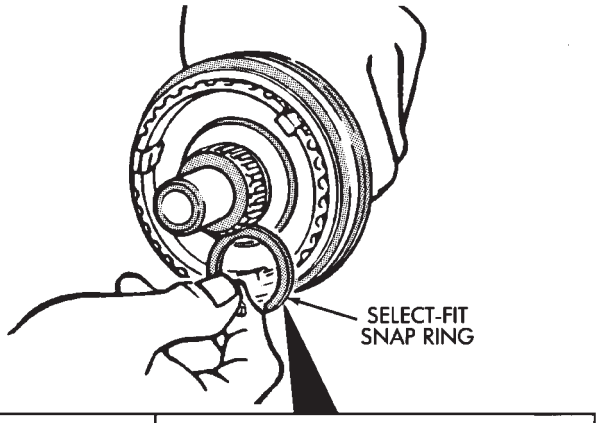


Fig. 54 Synchronizer Identification

(8) Assemble and install third gear, needle bearing, synchronizer ring, 3-4 synchronizer and snap ring on output shaft (Fig. 55). Use thickest snap ring that fits in shaft groove.



I.D. Mark	Snap Ring Thickness mm (in.)
C-1	1.75-1.80 (0.0689-0.0709)
D	1.80-1.85 (0.0709-0.0728)
D-1	1.85-1.90 (0.0728-0.0748)
E	1.90-1.95 (0.0748-0.0768)
E-1	1.95-2.00 (0.0768-0.0787)
F	2.00-2.05 (0.0788-0.0807)
F-1	2.05-2.10 (0.0807-0.0827)

J8921-55

Fig. 55 Installing Third Gear And 3-4 Synchronizer

(9) Verify third gear thrust clearance with feeler gauge (Fig. 56). Clearance should be 0.10 - 0.25 mm (0.004 - 0.010 in.).

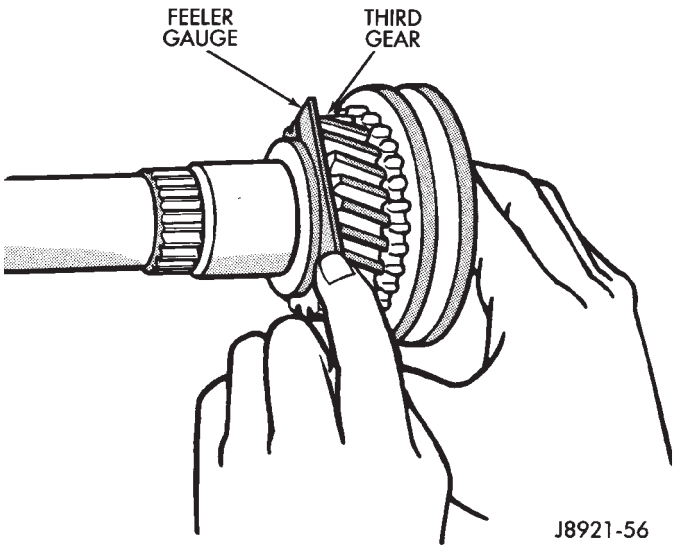


Fig. 56 Checking Third Gear Clearance

(10) Assemble second gear, gear needle bearing, synchronizer ring and 1-2 synchronizer. Then press assembly on output shaft (Fig. 57).

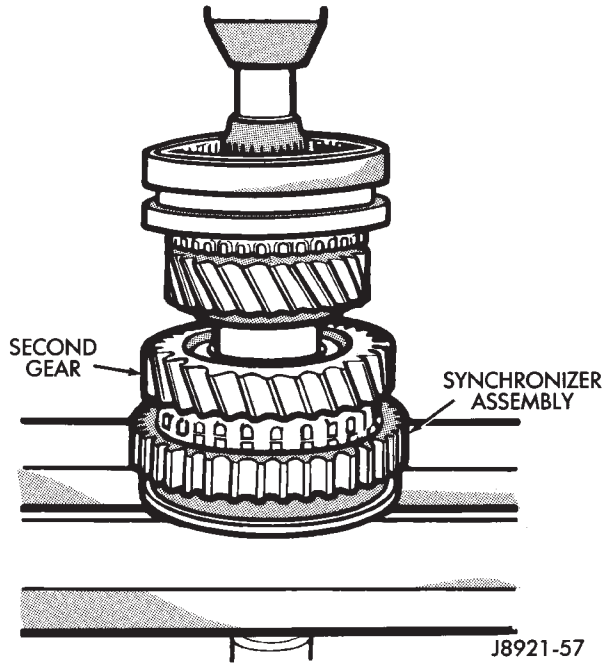


Fig. 57 Installing Second Gear And Synchronizer

(11) Install first gear lock ball in output shaft (Fig. 58).

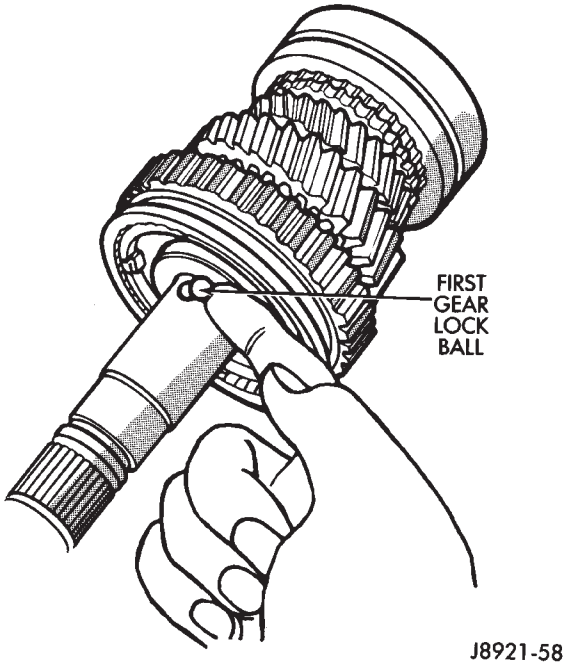


Fig. 58 Installing First Gear And Lock Ball

(12) Assemble first gear, synchronizer ring, gear needle bearing and inner race (Fig. 59). Then install assembly on output shaft. **Rotate inner race until aligned with locking ball.**

(13) Press rear bearing on shaft (Fig. 59). Snap ring groove in bearing goes toward rear. Use screwdriver to hold inner race in position when installing bearing (Fig. 60).

(14) Install snap ring on rear bearing.

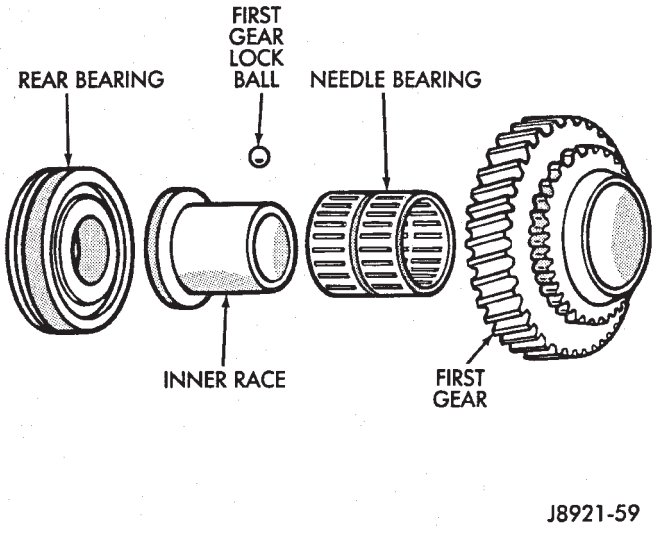


Fig. 59 First Gear Assembly

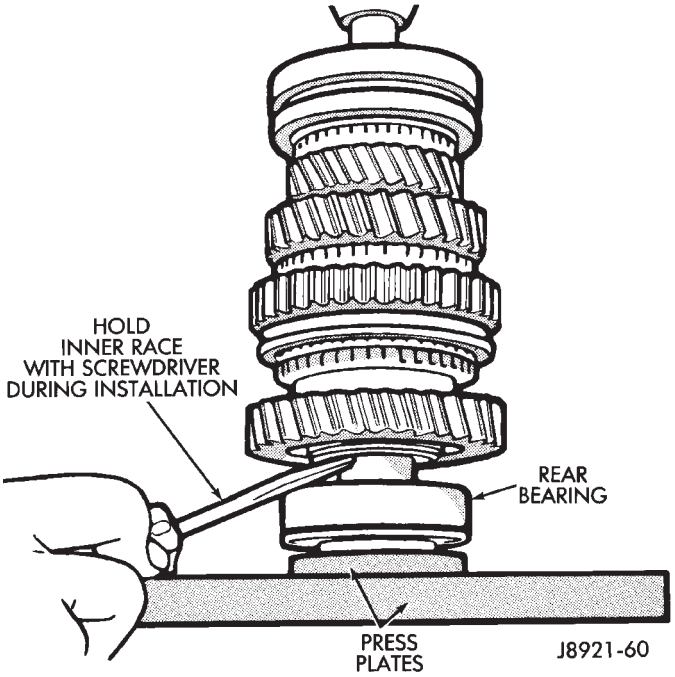


Fig. 60 Installing Output Shaft Rear Bearing

(15) Check first-second gear thrust clearance (Fig. 61). Standard clearance is 0.10 - 0.25 mm (0.004 - 0.010 in.).

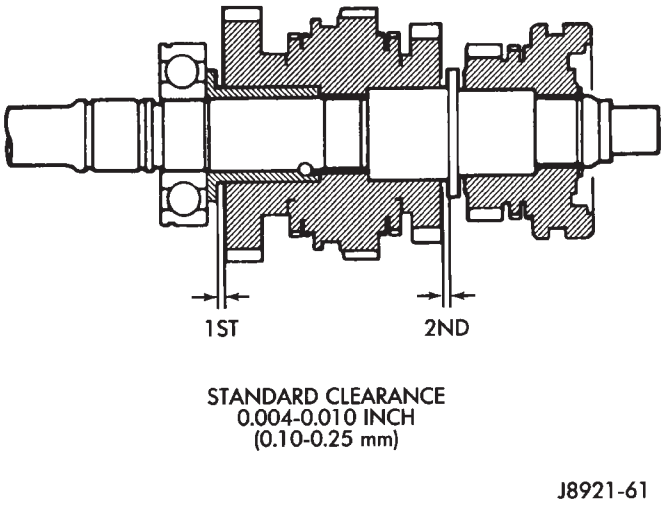


Fig. 61 Checking First-Second Gear Clearance

(16) Press fifth gear on output shaft (Fig. 62).

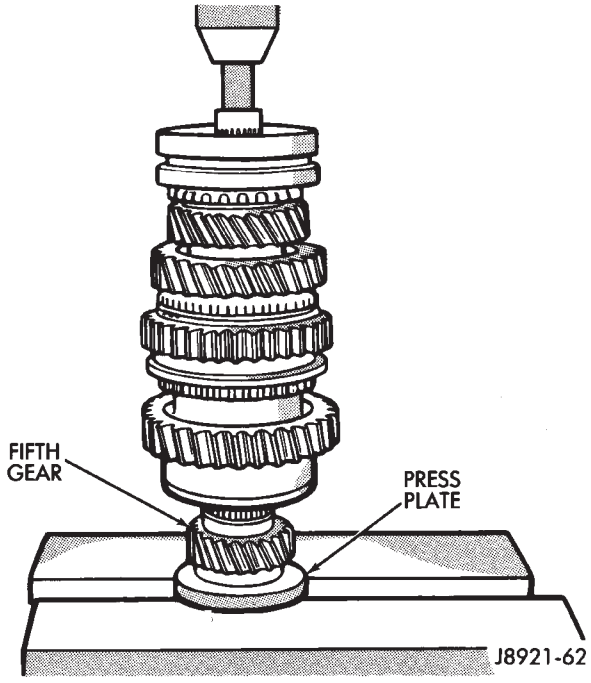
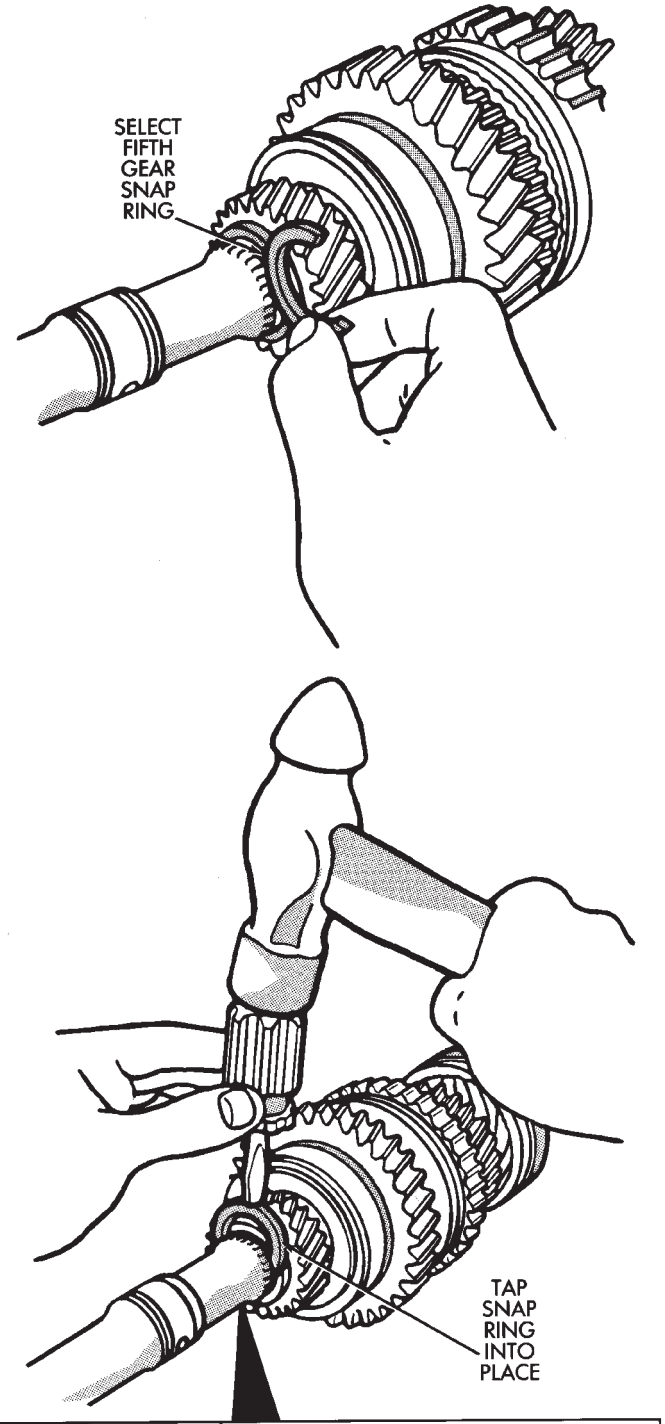


Fig. 62 Installing Output Shaft Fifth Gear

(17) Install fifth gear snap ring (Fig. 63). Use thickest snap ring that will fit in shaft groove.

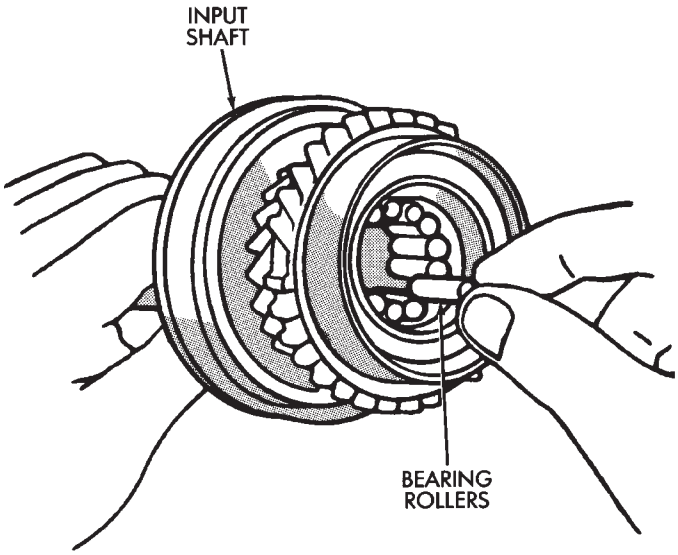


I.D. Mark	Snap Ring Thickness mm (in.)
A	2.67-2.72 (0.1051-0.1071)
B	2.73-2.78 (0.1075-0.1094)
C	2.79-2.84 (0.1098-0.1118)
D	2.85-2.90 (0.1122-0.1142)
E	2.91-2.96 (0.1146-0.1165)
F	2.97-3.02 (0.1169-0.1189)
G	3.03-3.08 (0.1193-0.1213)
H	3.09-3.14 (0.1217-0.1236)
J	3.15-3.20 (0.1240-0.1260)
K	3.21-3.26 (0.1264-0.1283)
L	3.27-3.32 (0.1287-0.1307)

J8921-63

Fig. 63 Selecting/Installing Fifth Gear Snap Ring

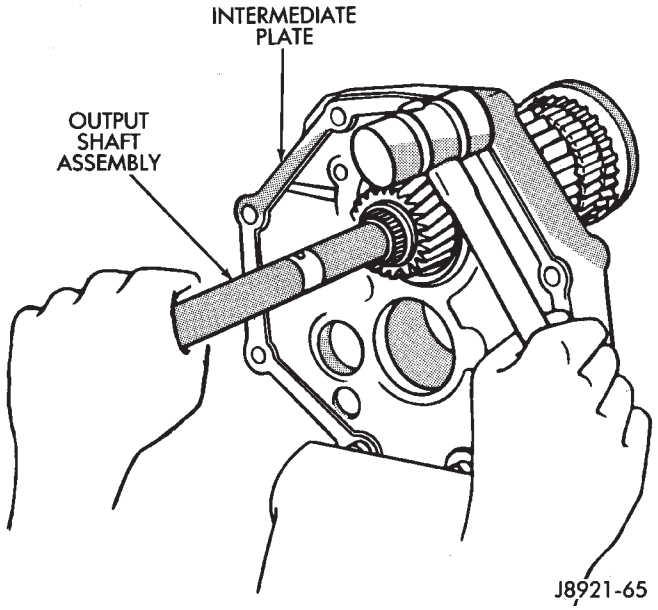
(18) Lubricate input shaft roller bearings with petroleum jelly and install rollers in shaft (Fig. 64).



J8921-64

Fig. 64 Installing Input Shaft Bearing Rollers

(19) Install output shaft assembly in intermediate plate (Fig. 65). Tap plate with mallet and pull on shaft to seat assembly.



J8921-65

Fig. 65 Installing Output Shaft In Intermediate Plate

(20) Install input shaft on output shaft.

(21) Install counter gear in intermediate plate (Fig. 66).

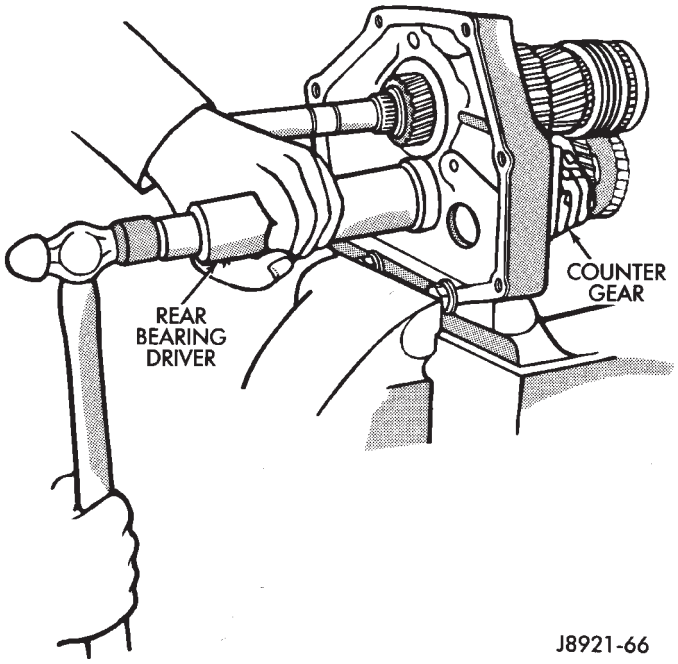


Fig. 66 Installing Counter Gear

(22) Install rear bearing snap ring and install bearing retainer (Fig. 67). Tighten retainer screws to 18 N·m (13 ft. lbs.) torque.

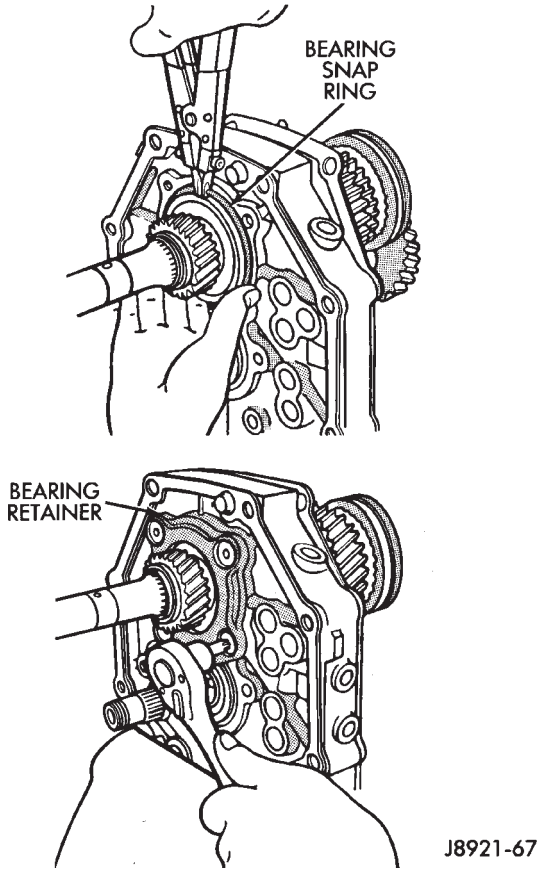


Fig. 67 Installing Bearing Retainer And Snap Ring

(23) Install reverse shift arm (Fig. 68). Tighten attaching bolt to 18 N·m (13 ft. lbs.) torque.

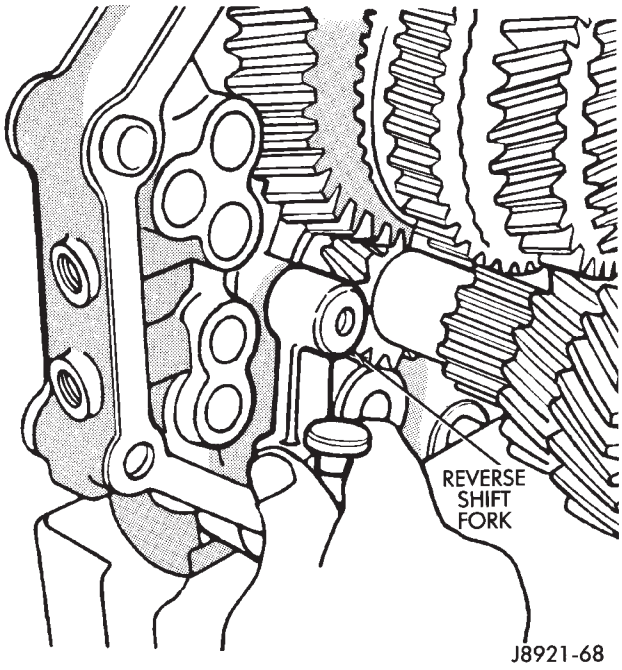


Fig. 68 Installing Reverse Shift Fork

(24) Install lock ball, spacer and needle bearing (Fig. 69) on counter shaft.

(25) On AX 5, assemble counter fifth gear and synchro components (Figs. 69 and 104).

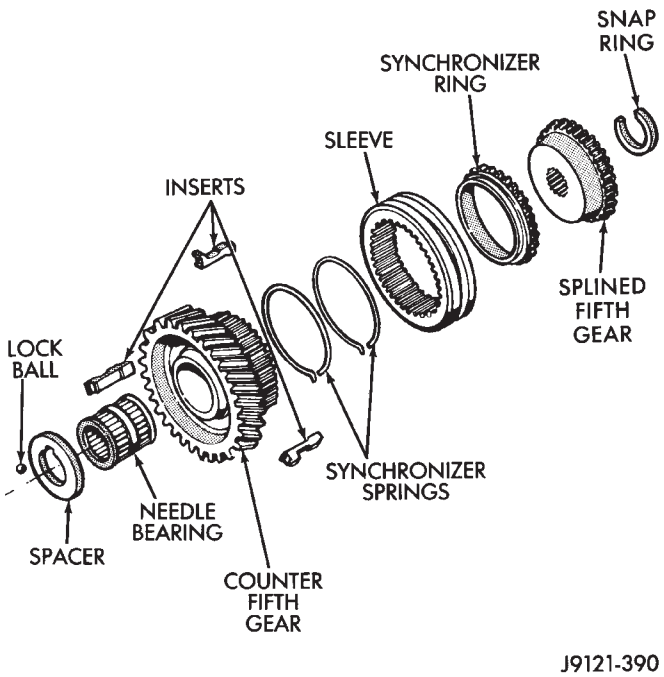


Fig. 69 Counter Fifth Gear And Synchronizer Assembly—AX 5

(26) On AX 5, install assembled gear and synchronizer on counter shaft (Fig. 70).

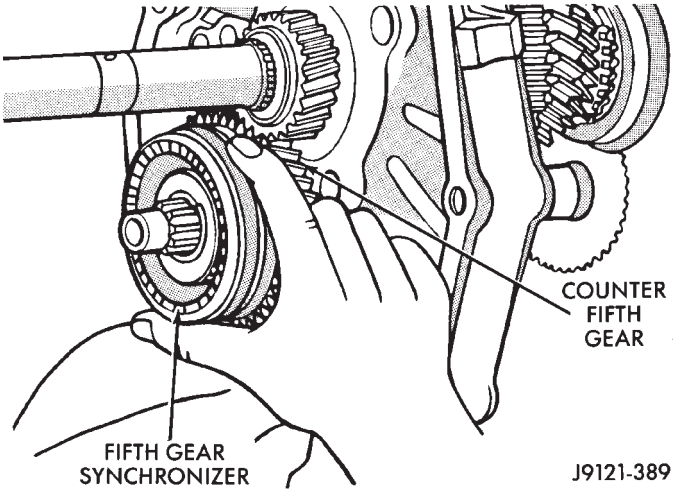


Fig. 70 Fifth Gear And Synchronizer Installation—AX 5

(27) Install remaining synchronizer ring and spline fifth gear (Fig. 71). Use length of pipe to tap gear into place.

(28) Shift 1-2 and 3-4 synchronizer sleeves into gear to lock output shaft and counter gear (Fig. 28).

(29) On AX 4, install oil slinger and lock nut on counter gear (Fig. 104).

(30) On AX 5, install fifth gear snap ring (Fig. 72).

(31) Disengage 1-2 and 3-4 synchronizer sleeves.

(32) On AX 5, check counter fifth gear thrust clearance (Fig. 72). Standard clearance is 0.10 - 0.30 mm (0.004 - 0.010 in.). Adjust clearance with different thickness snap ring if necessary.

SHIFT MECHANISM ASSEMBLY AND INSTALLATION

When assembling the shift mechanism, refer to Figure 73 for component details and location.

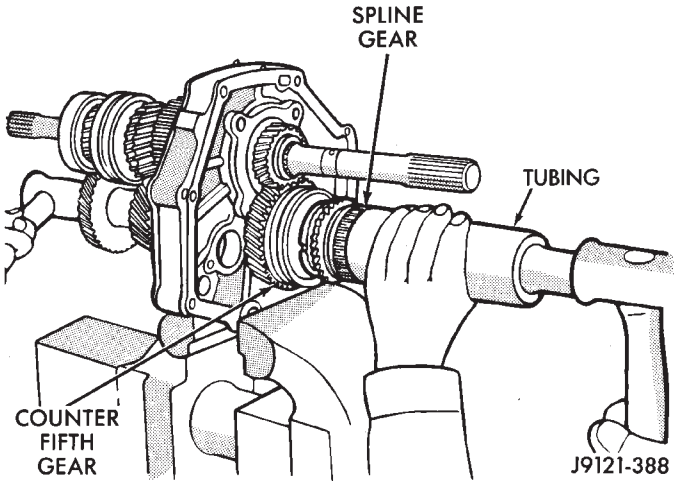


Fig. 71 Installing Fifth Gear—AX 5

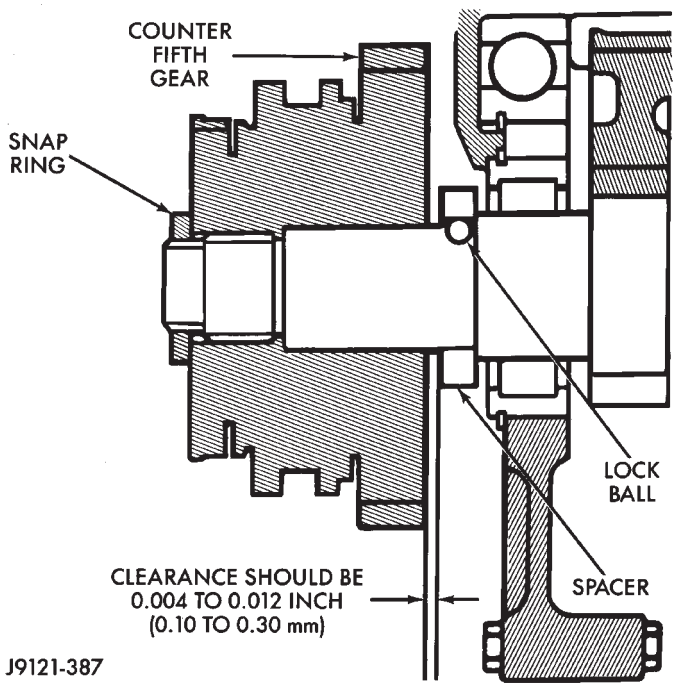
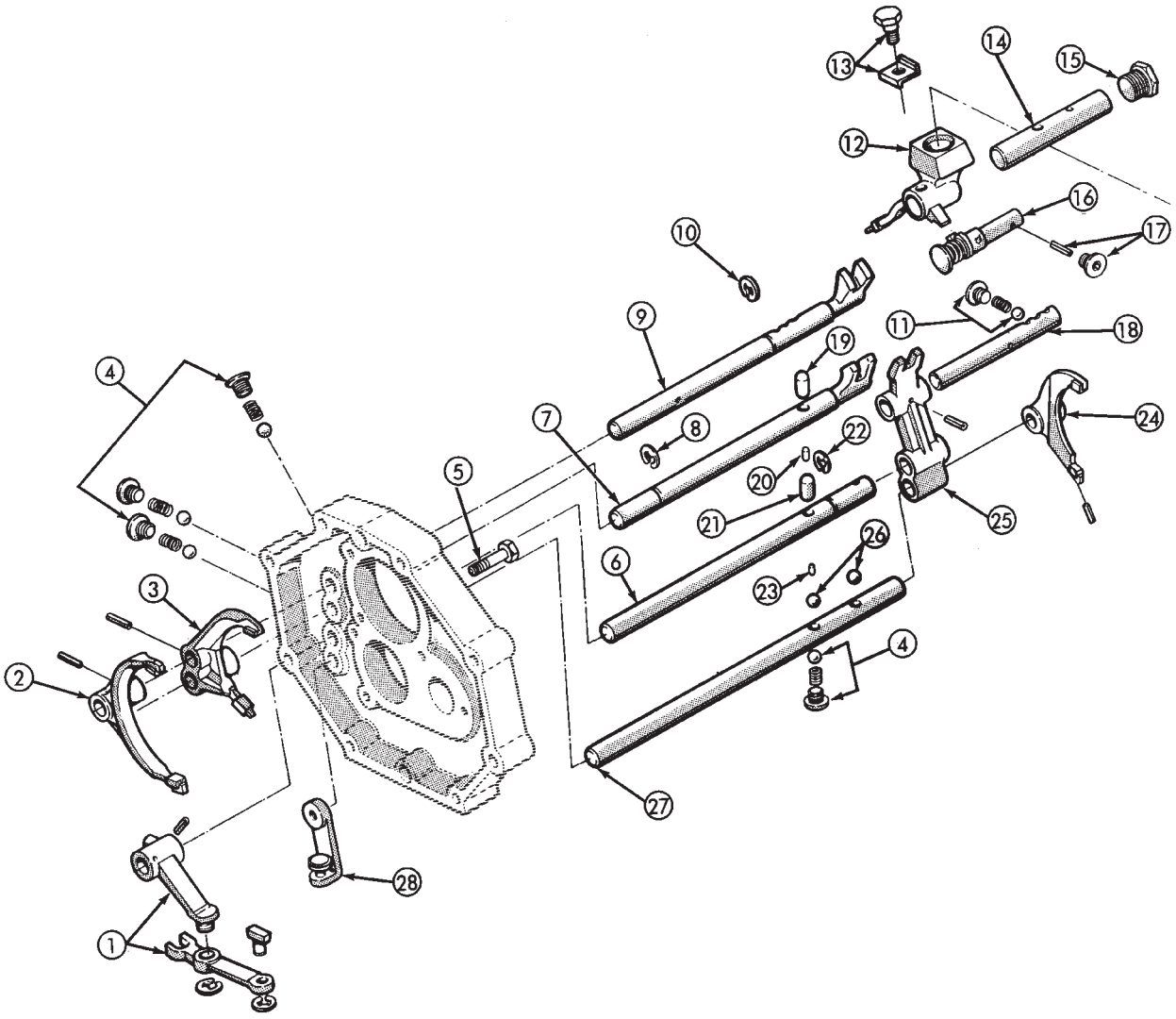


Fig. 72 Fifth Gear Thrust Clearance—AX 5



1. REVERSE FORK AND SHIFT ARM
2. 1-2 SHIFT FORK
3. 3-4 SHIFT FORK
4. LOCK BALL, SPRING AND PLUG (AX 5)
5. BRACKET BOLT
6. NO. 3 SHIFT RAIL
7. NO. 1 SHIFT RAIL
8. C-RING
9. NO. 2 SHIFT RAIL
10. C-RING
11. LOCK BALL, SPRING AND PLUG
12. SHIFT ARM
13. SET BOLT AND LOCK PLATE
14. SHIFT LEVER SHAFT
15. SHAFT PLUG
16. REVERSE PIN
17. RETAINING PIN AND PLUG
18. NO. 5 SHIFT RAIL
19. INTERLOCK PIN
20. INTERLOCK PIN
21. INTERLOCK PIN
22. C-RING
23. INTERLOCK PIN
24. FIFTH-REVERSE FORK (AX 5)
25. REVERSE SHIFT HEAD
26. LOCK BALLS (AX 5)
27. NO. 4 SHIFT RAIL (AX 5)
28. REVERSE ARM BRACKET

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Fig. 73 Shift Components

(1) Install reverse shift arm. Then seat shift fork in bracket (Fig. 74).

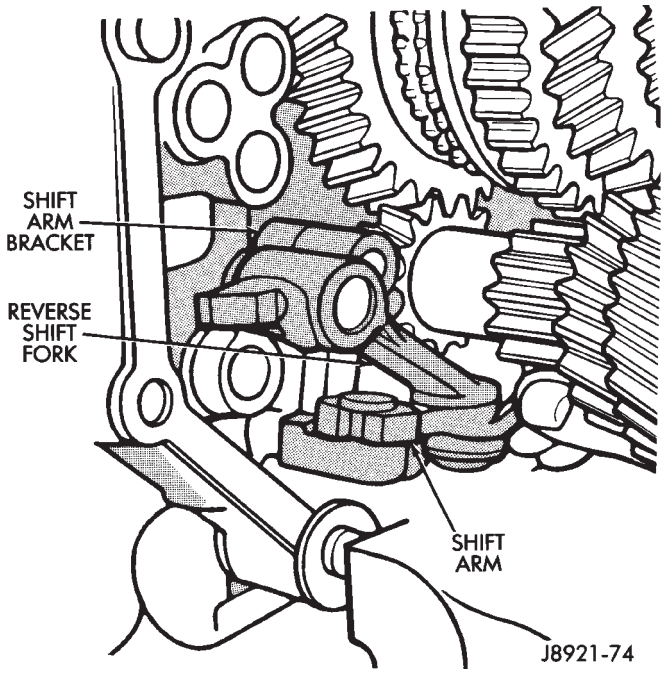


Fig. 74 Installing Reverse Shift Arm

(2) Install reverse idler gear on shaft. Then install shaft and gear in intermediate plate (Fig. 75). Install shaft lock plate and tighten attaching bolt to 18 N·m (13 ft. lbs.) torque.

(3) Install 1-2 and 3-4 shift forks in synchronizer sleeves. Then slide No. 2 shift rail through intermediate plate and into forks (Fig. 76).

(4) Coat shift rail interlock pins and balls with liberal quantity petroleum jelly to hold them in place.

(5) Refer to Figure 77 for interlock ball and pin positions during following assembly steps.

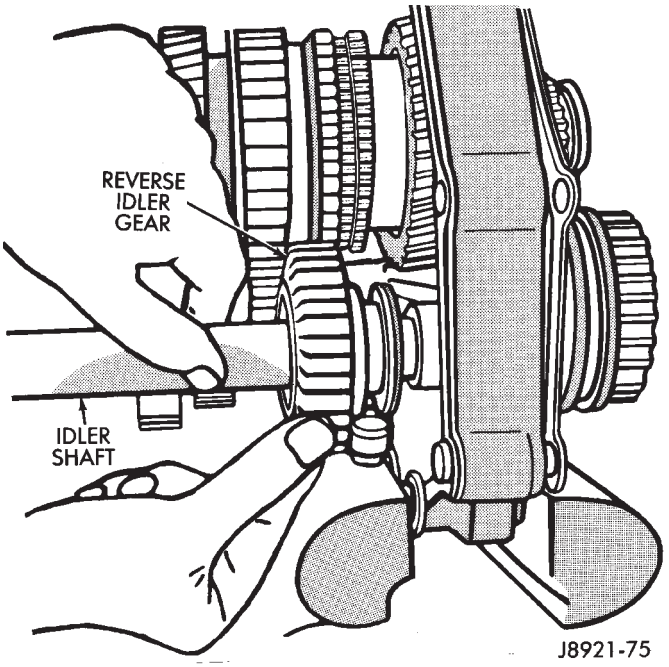


Fig. 75 Installing Reverse Idler Gear And Shaft

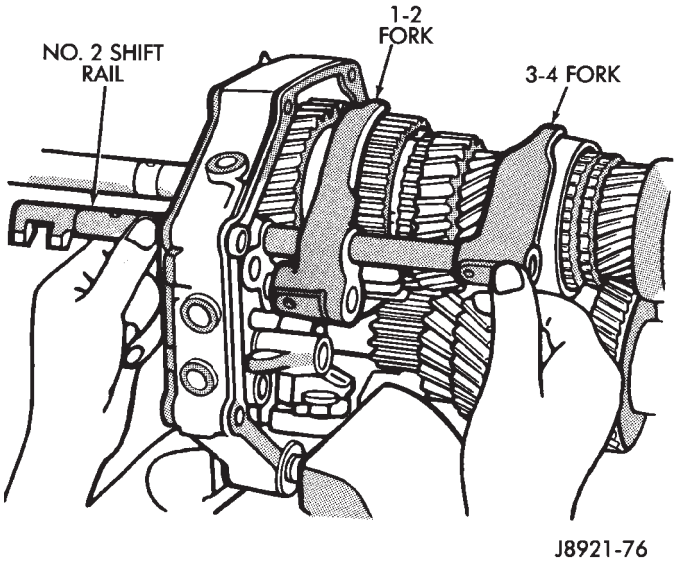


Fig. 76 Installing No. 2 Shift Rail and Shift Forks

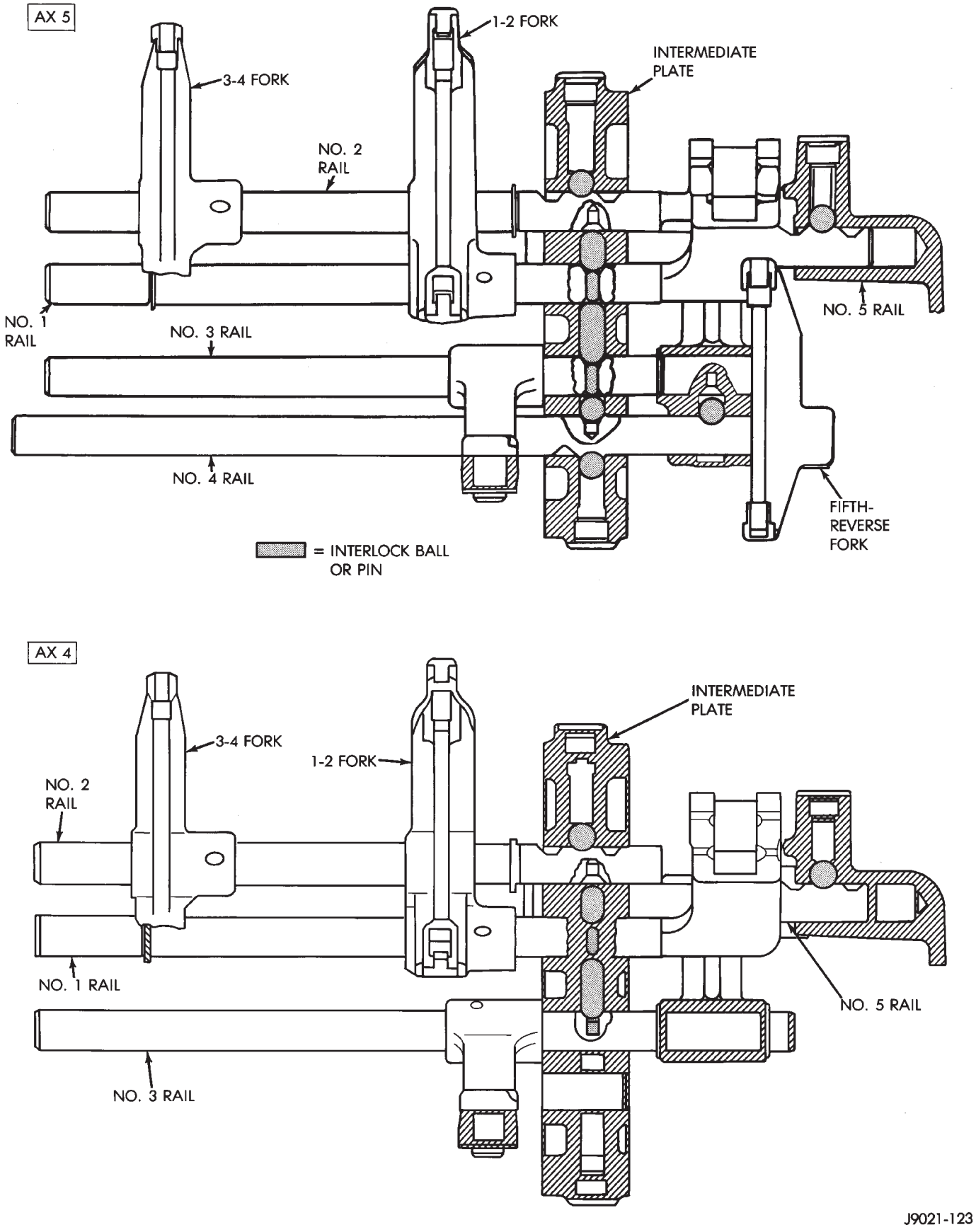


Fig. 77 Interlock Ball And Pin Position

(6) Insert first interlock pin in intermediate plate (Fig. 78). Use pencil magnet and screwdriver to install pin.

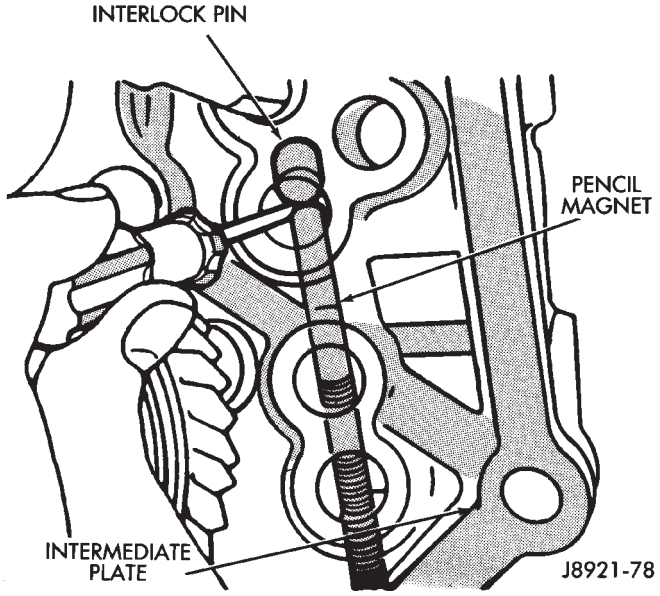


Fig. 78 Installing First Interlock Pin

(7) Install smaller diameter interlock pin in No. 1 rail (Fig. 79).

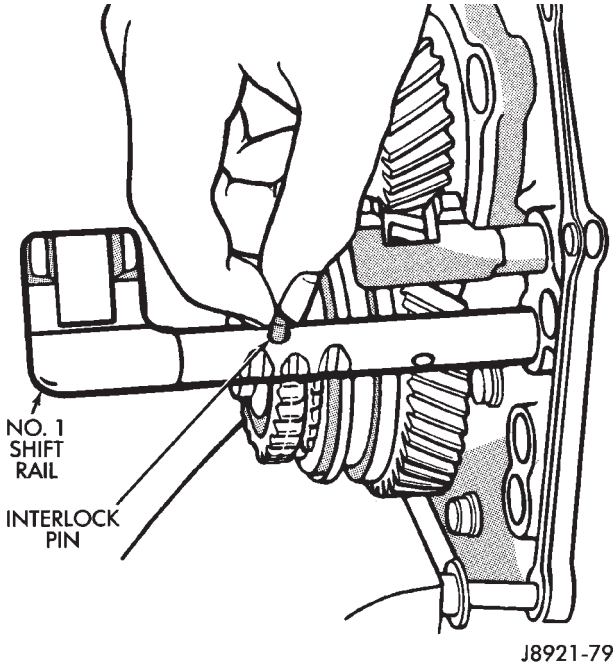


Fig. 79 Installing Interlock Pin In No. 1 Shift Rail

(8) Slide No. 1 rail through 1-2 shift fork (Fig. 80).

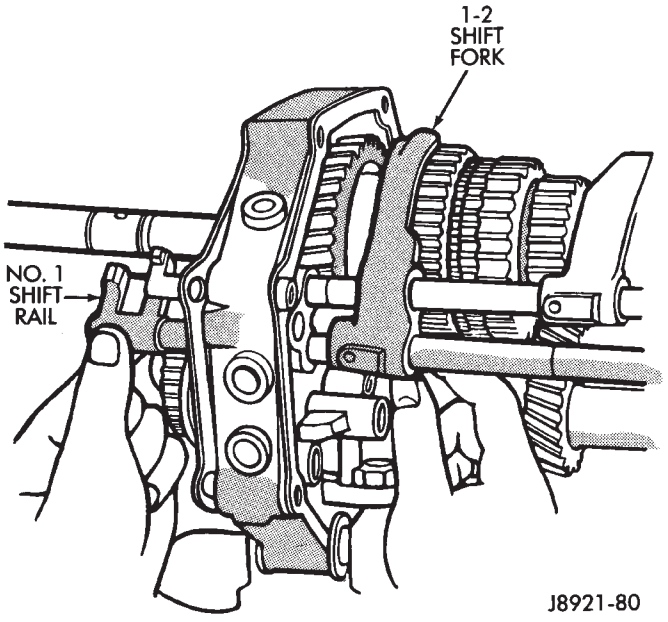


Fig. 80 Installing No. 1 Shift Rail

(9) Install largest interlock pin between Nos. 1 and 3 shift rails (Fig. 81).

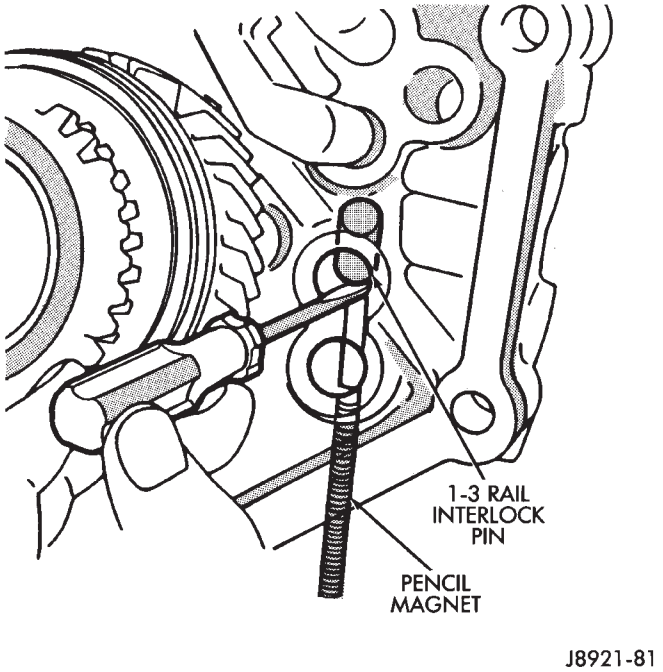


Fig. 81 Installing 1-3 Shift Rail Interlock Pin

(10) Install interlock pin in No. 3 shift rail (Fig. 82).

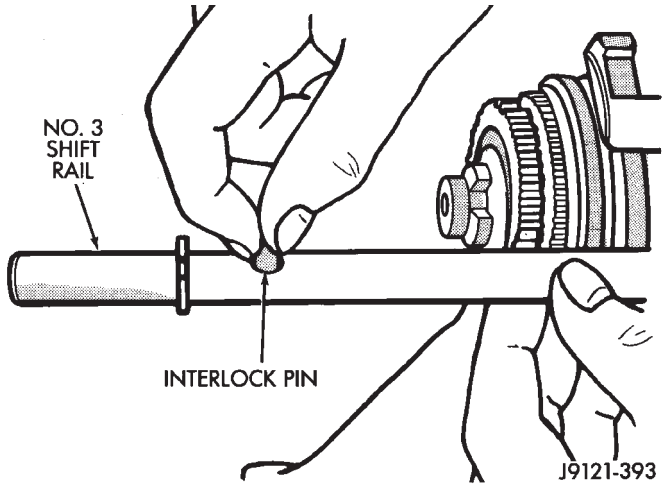


Fig. 82 Installing No. 3 Shift Rail Interlock Pin

(11) Slide No. 3 rail into reverse shift head (Fig. 83).

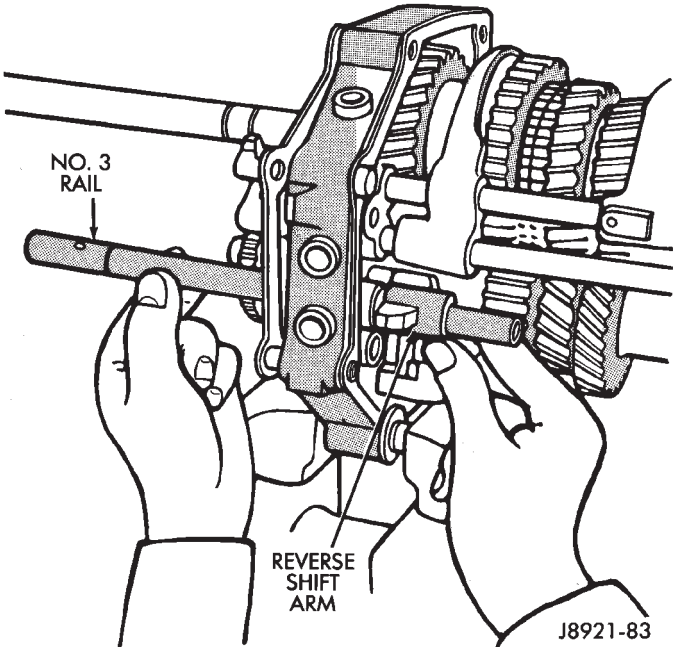


Fig. 83 Installing No. 3 Shift Rail

(12) Assemble reverse shift head and No. 5 shift rail.

(13) Install No. 5 shift rail in intermediate plate and engage shift head on No. 3 shift rail (Fig. 84).

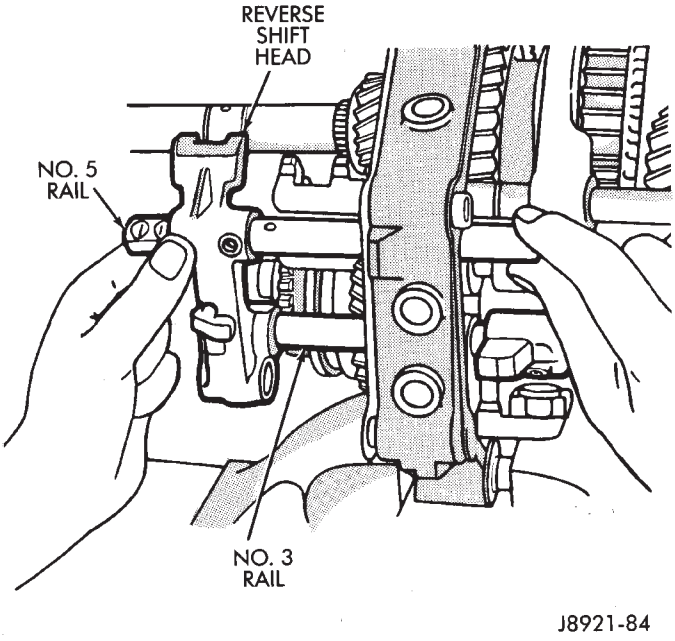


Fig. 84 Installing Reverse Shift Head

(14) Install reverse shift head lock ball with screwdriver and pencil magnet (Fig. 85).

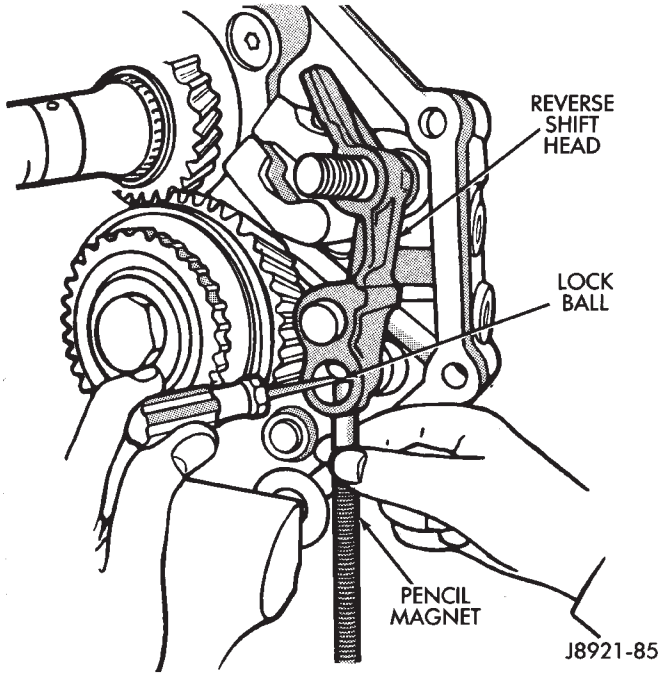


Fig. 85 Installing Reverse Shift Head Lock Ball

(15) Shift fifth gear synchronizer sleeve rearward to lock it (Fig. 86).

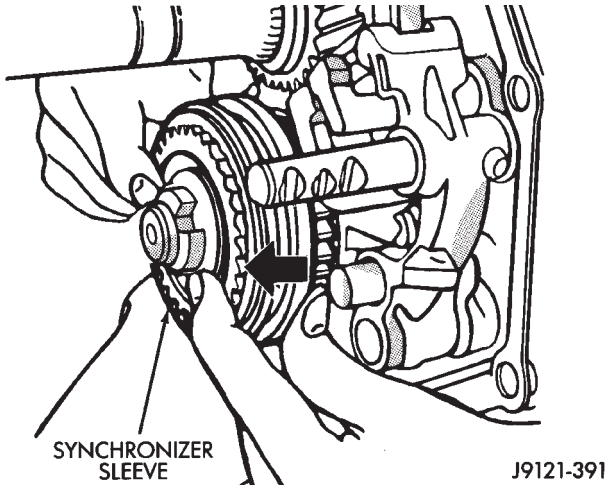


Fig. 86 Locking Fifth Synchronizer

(16) On AX 5, install fifth-reverse shift fork in synchronizer sleeve. Then slide No. 4 shift rail into fork (Fig. 87).

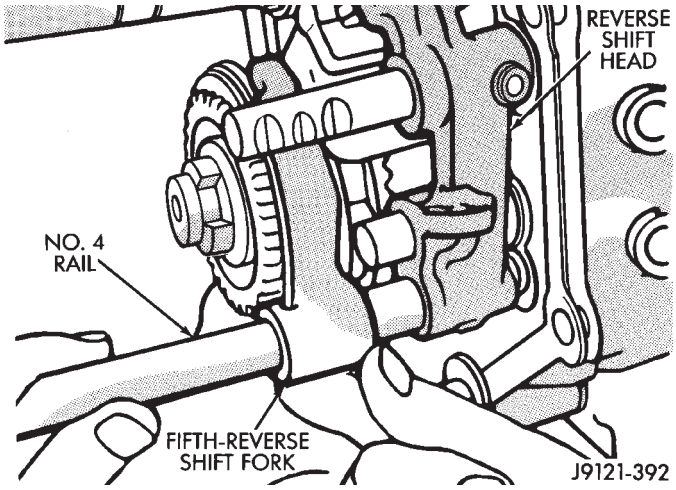


Fig. 87 Fifth-Reverse Shift Fork Installation

(17) Install shift rail lock ball with pencil magnet and screwdriver (Fig. 88).

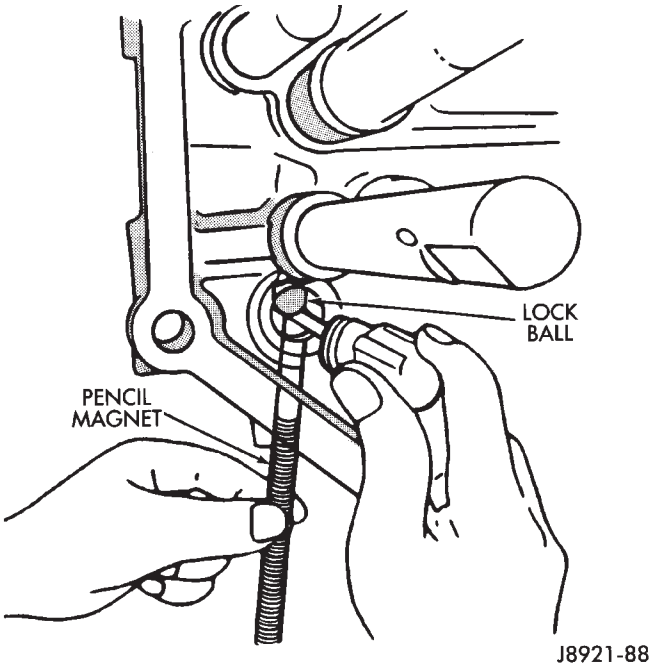


Fig. 88 Lock Ball Installation

(18) Check interlock operation as follows: Move No. 1 shift rail rearward to first gear position. Interlock operation is OK if remaining shift rails did not move.

(19) Install new shift fork pins (Fig. 89).

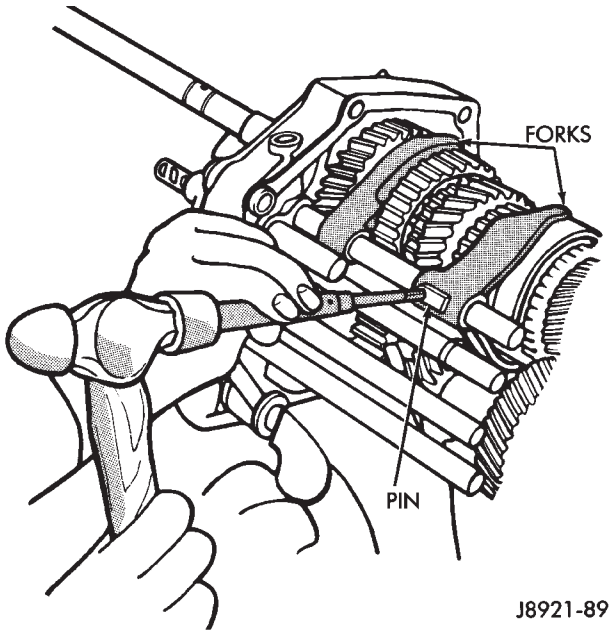


Fig. 89 Installing Shift Fork Pins

(20) Install new shift rail C-rings (Fig. 90).

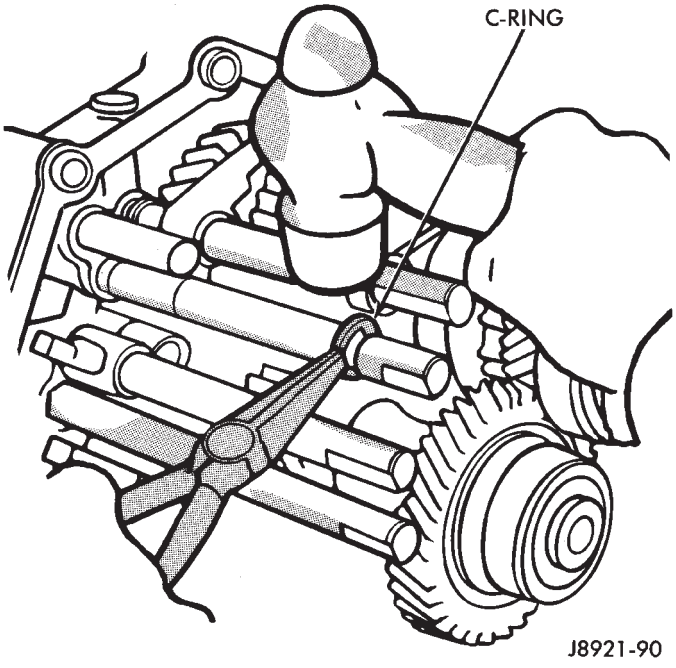


Fig. 90 Installing Shift Rail C-Rings

(21) Apply sealer to threads of lock ball plugs.

(22) Install lock balls and springs in intermediate plate. **Short spring goes in top hole of intermediate plate.**

(23) Install lock ball and spring plugs (Fig. 91). Tighten plugs to 19 N·m (14 ft. lbs.) torque.

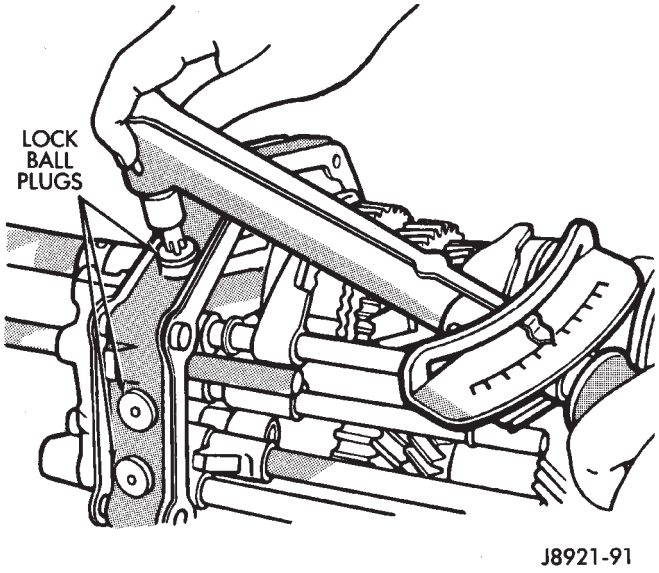


Fig. 91 Installing Lock Ball Plugs

ASSEMBLING GEARTRAIN AND TRANSMISSION CASE

(1) Remove intermediate plate from vise.

(2) Install new gaskets on intermediate plate.

(3) Install transmission case on intermediate plate (Fig. 92).

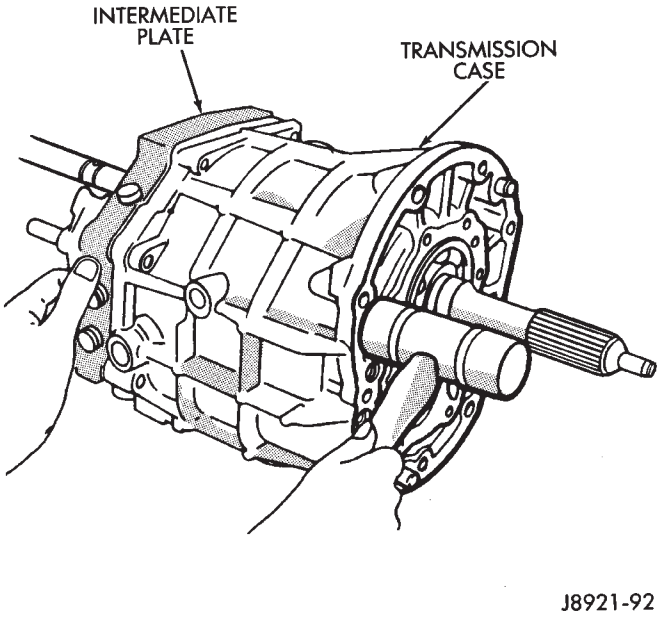


Fig. 92 Installing Transmission Case

(4) Install new front bearing snap ring (Fig. 93).

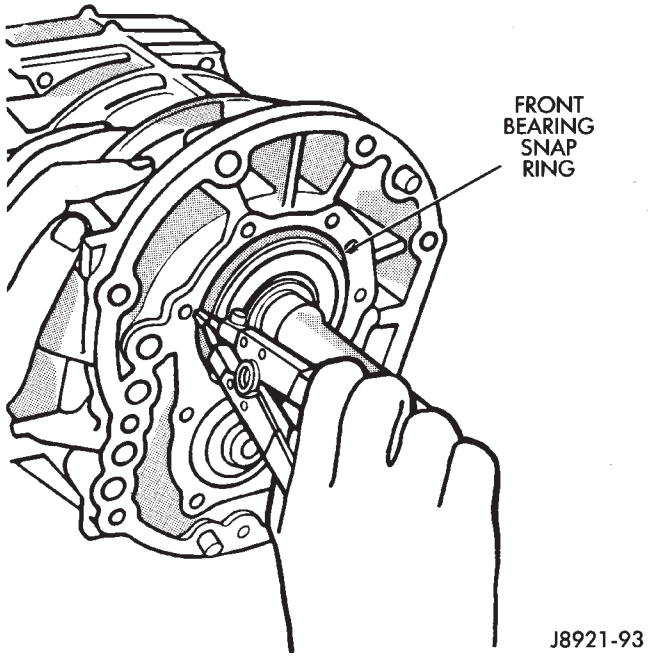


Fig. 93 Installing Front Bearing Snap Ring

(5) Install new gasket on front bearing retainer and install retainer on case (Fig. 94).

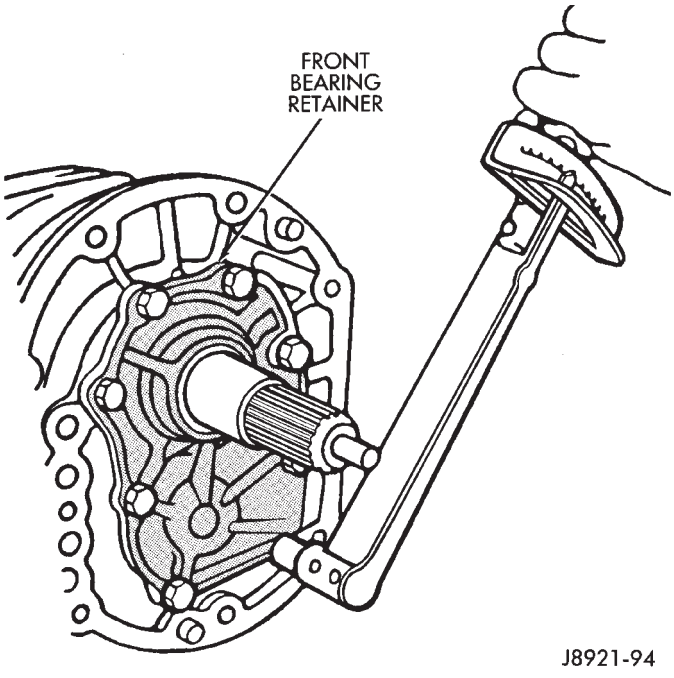


Fig. 94 Installing Front Bearing Retainer

(6) Install adapter or extension housing on intermediate plate (Fig. 95). Tighten housing bolts to 37 N·m (27 ft. lbs.) torque.

(7) Install shift arm (Fig. 95).

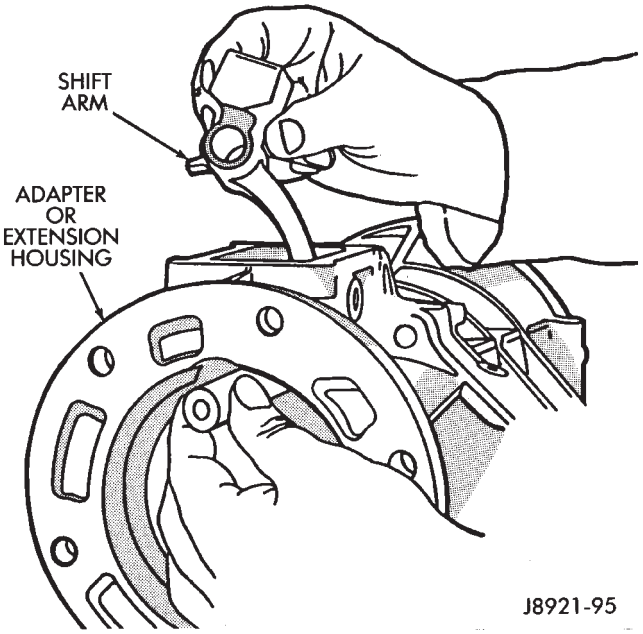


Fig. 95 Installing Adapter Housing And Shift Arm

(8) Install shift arm lock plate with pliers (Fig. 96). Then install and tighten lock plate set bolt to 38 N·m (28 ft. lbs.) torque.

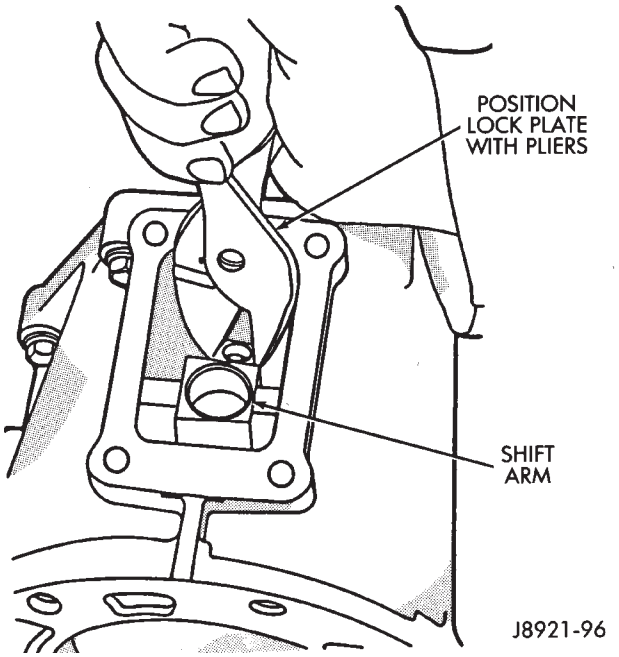


Fig. 96 Shift Arm Lock Plate Installation

(9) Install and tighten shaft plug to 18 N·m (13 ft. lbs.) torque (Fig. 97).

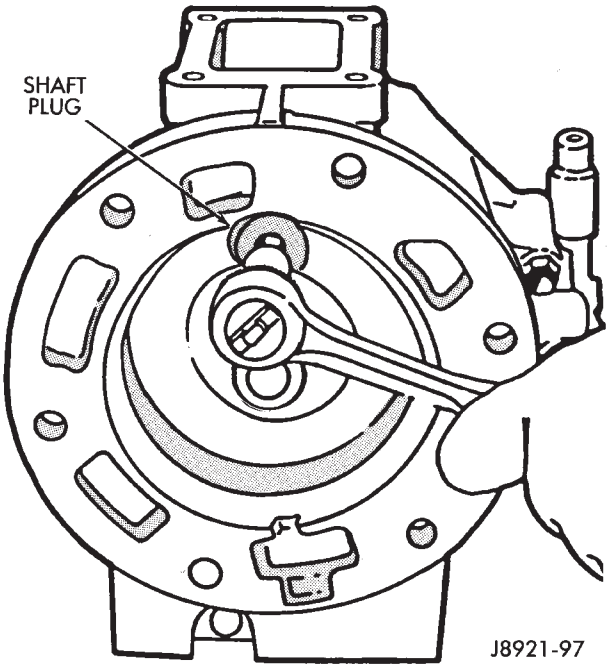


Fig. 97 Shaft Plug Installation

(10) Install lock ball and spring in housing. Then apply sealer to ball plug and install plug (Fig. 98). Tighten plug to 19 N·m (14 ft. lbs.) torque.

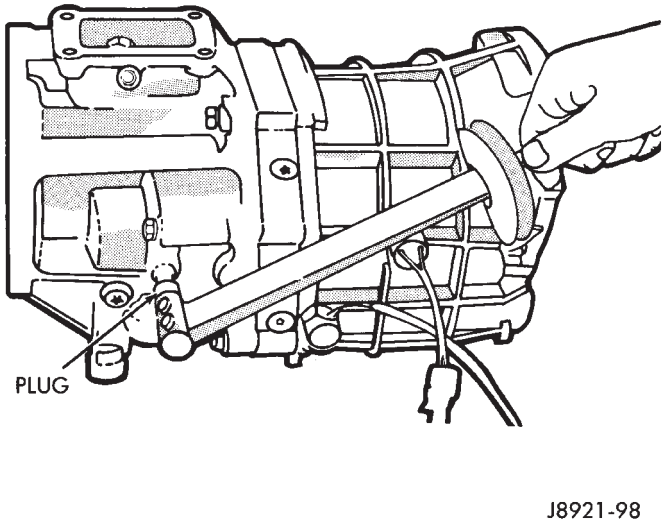


Fig. 98 Installing Ball Plug

(11) Install reverse pins in housing (Fig. 99). Tighten pins to 27 N·m (20 ft. lbs.) torque.

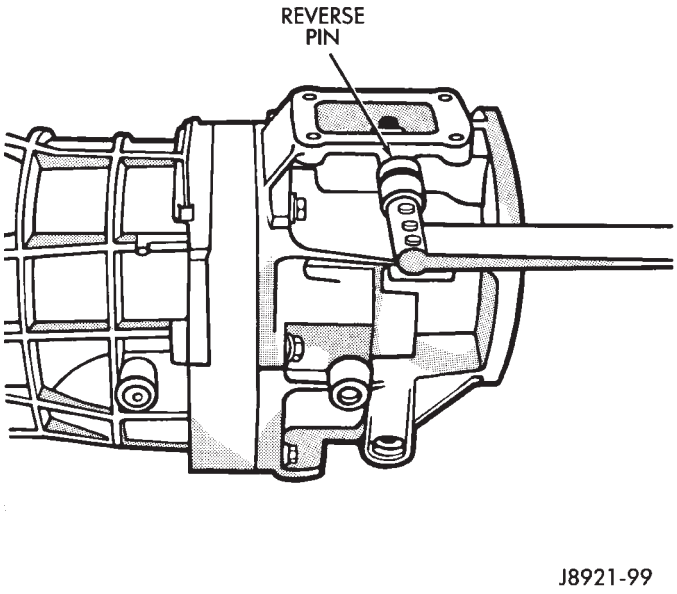


Fig. 99 Install Reverse Pins

(12) Install shift tower and new gasket on housing (Fig. 100). Tighten tower bolts to 18 N·m (13 ft. lbs.) torque.

(13) Install backup lamp switch (Fig. 100). Tighten switch to 37 N·m (27 ft. lbs.) torque.

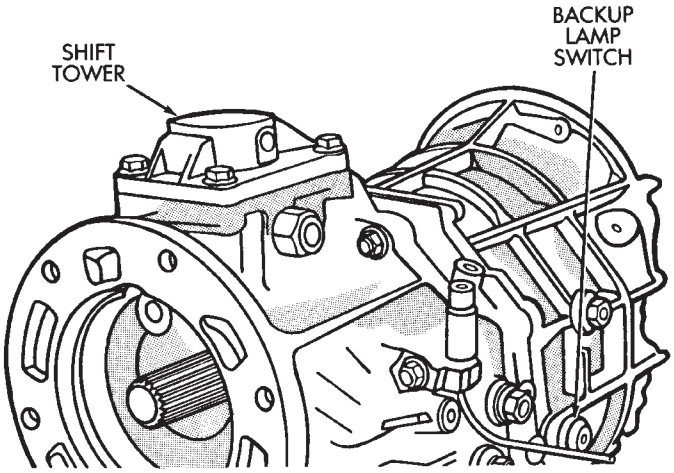


Fig. 100 Installing Shift Tower And Backup Lamp Switch

(14) On 2-wheel drive models, install new seal in extension housing (Fig. 101).

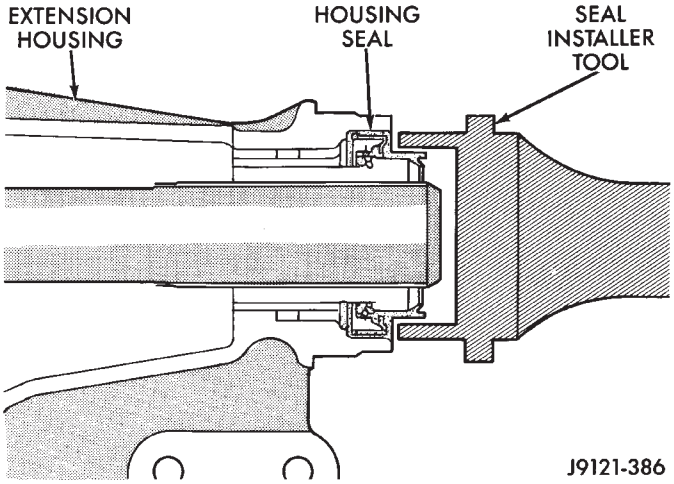


Fig. 101 Extension Housing Seal Installation—2WD Models

(15) Install vehicle speed sensor. Refer to procedure in In-Vehicle Service section.

(16) Install clutch housing, release bearing, fork and retainer clip.

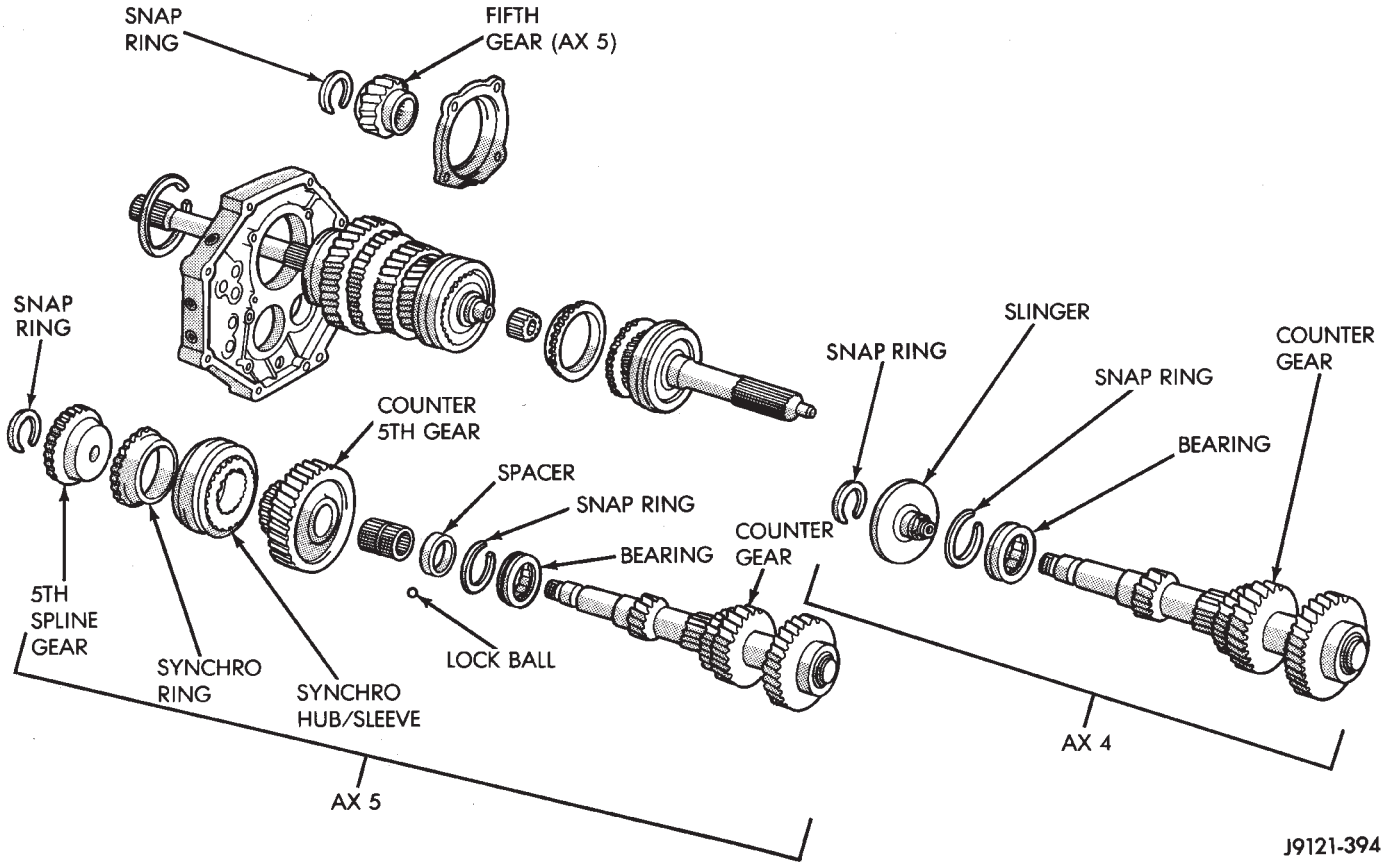


Fig. 102 Counter Gear Components

AX 15 MANUAL TRANSMISSION

INDEX

GENERAL INFORMATION

The AX 15 is a 5-speed, synchromesh, manual transmission. Fifth gear is an overdrive range with a ratio of 0.79:1. The shift mechanism is integral and mounted in the shift tower portion of the adapter housing (Fig. 1).

An adapter housing is used to attach the transmission to the transfer case on 4-wheel drive models. A standard extension housing is used on 2-wheel drive models.

The AX 15 is used in XJ and YJ models with a 4.0L engine. The AX 15 is designed for use with either two-wheel drive or four-wheel drive applications.

TRANSMISSION IDENTIFICATION

The AX 15 identification code numbers are on the bottom surface of the transmission gear case (Fig. 2).

The first number is year of manufacture. The second and third numbers indicate month of manufacture. The next series of numbers is the transmission serial number.

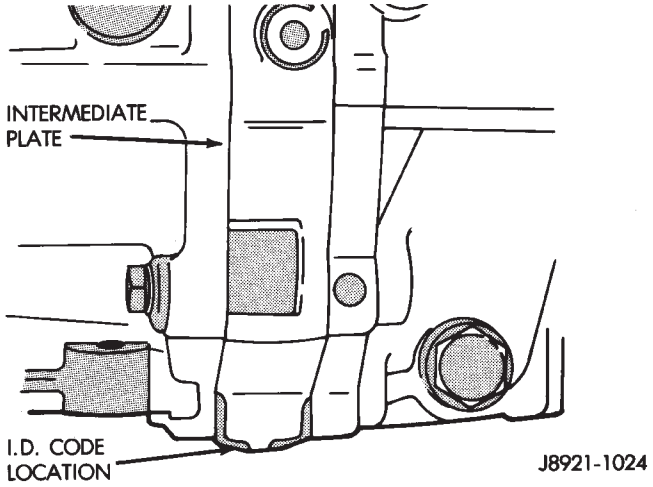


Fig. 2 Identification Code Number Location

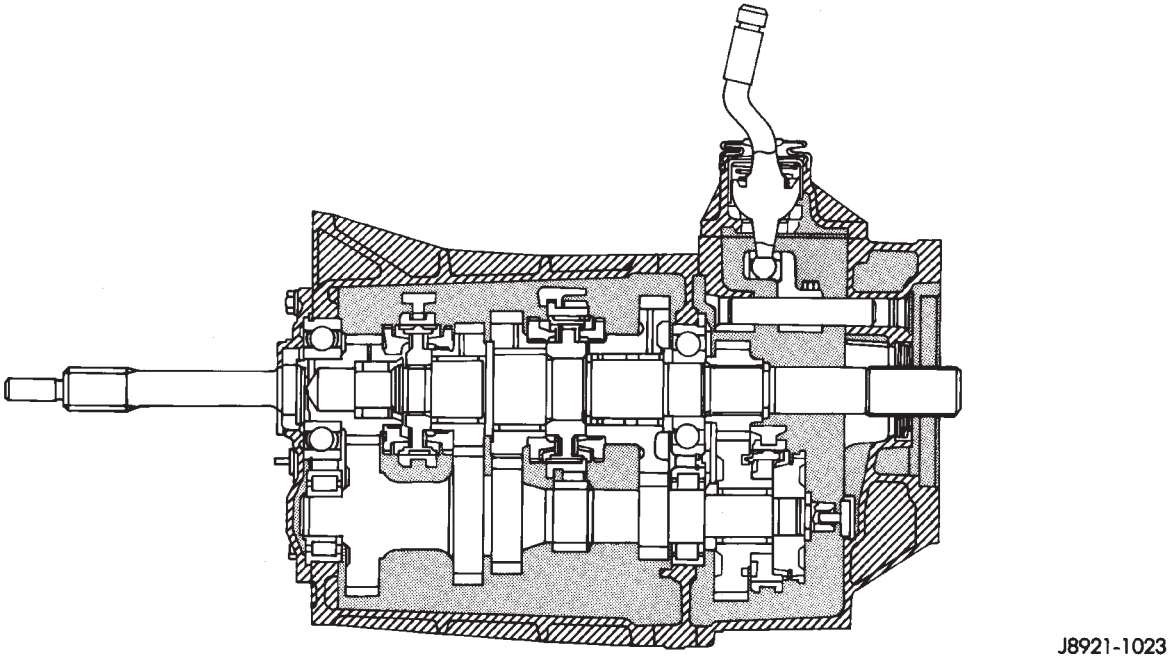


Fig. 1 AX 15 Manual Transmission

TRANSMISSION SHIFT PATTERN

The AX 15 shift pattern is shown in Figure 3. First and second and third and fourth gear ranges are in line for improved shifting. Fifth and reverse gear ranges are also in line at the extreme right of the pattern (Fig. 3).

The AX 15 is equipped with a reverse lockout mechanism. The shift lever must be moved through the Neutral detent before making a shift to reverse.

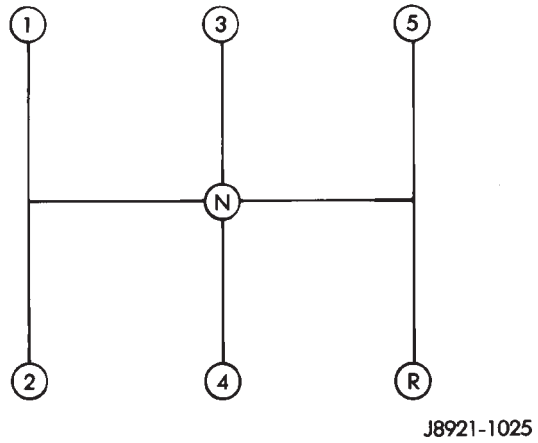


Fig. 3 AX 15 Shift Pattern

TRANSMISSION LUBRICANT

Recommended lubricant for AX 15 transmissions is Mopar 75W-90, API Grade GL-5 gear lubricant, or equivalent.

Correct lubricant refill or top-off level is to the bottom edge of the fill plug hole.

Lubricant capacity is:

- 3.10 liters (3.27 qts.) in 4-wheel drive models.
- 3.15 liters (3.32 qts.) in 2-wheel drive models.

TRANSMISSION SWITCH AND PLUG LOCATIONS

The fill plug is at the driver side of the gear case (Fig. 4).

The drain plug and backup light switch are on the passenger side of the gear case (Fig. 5).

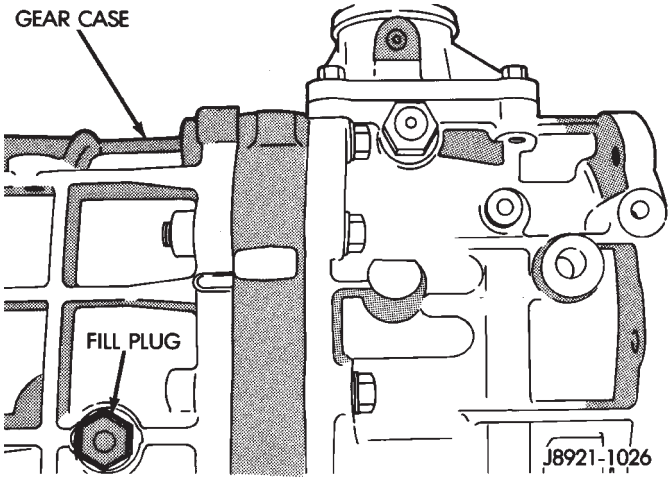


Fig. 4 Fill Plug Location

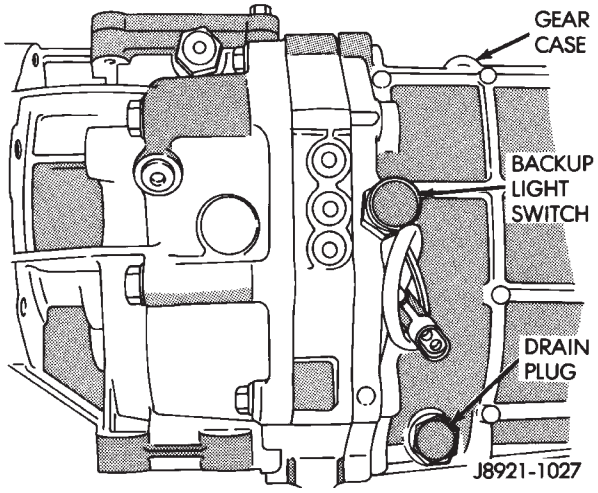


Fig. 5 Drain Plug And Backup Light Switch Location

TRANSMISSION GEAR RATIOS

The transmission gear ratios are as follows:

First gear - 3.83:1
Second gear - 2.33:1
Third gear - 1.44:1
Fourth gear - 1.00:1
Fifth gear - 0.79:1
Reverse - 4.22:1

SERVICE DIAGNOSIS

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 adapter 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 slip, grab and chatter.

Transmissions filled from air or electrically powered lubricant containers can be underfilled. This generally happens when the container delivery mechanism is improperly calibrated. Always check the lubricant level after filling to avoid an under fill condition.

A correct lubricant level check can only be made when the vehicle is level; use a drive-on hoist to ensure this. Also allow the lubricant to settle for a

minute or so before checking. These recommendations will ensure an accurate check and avoid an under-or-overfill condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants, component damage, incorrect clutch adjustment, or by a damaged clutch pressure plate or disc.

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 a problem are usually hard shifting and noise.

Incorrect or contaminated lubricants can also contribute to hard shifting. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind and hard shifting.

Improper clutch release is a frequent cause of hard shifting. Incorrect adjustment or a worn, damaged pressure plate or disc can cause incorrect release. If the clutch problem is advanced, gear clash during shifts can result.

Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing 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 can generate a mild whine that may only be audible at extreme speeds.

Severe, obviously audible transmission noise is generally the result of a lubricant problem. Insufficient, improper, or contaminated lubricant can promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

TRANSMISSION REMOVAL—AX 15

(1) Shift transmission into first or third gear.

(2) Raise vehicle on a hoist.

(3) Disconnect necessary exhaust system components.

(4) Support transmission with adjustable jack stand.

(5) Disconnect rear cushion and mounting bracket from transmission, or transfer case (Fig. 1).

(6) On XJ, remove rear crossmember. On YJ, remove skid plate (Fig. 1).

(7) Disconnect transmission shift linkage, speedometer cable, transfer case vacuum lines and clutch hydraulic lines.

(8) Lower transmission-transfer case assembly no more than 7.6 cm (3 in.) for access to shift lever.

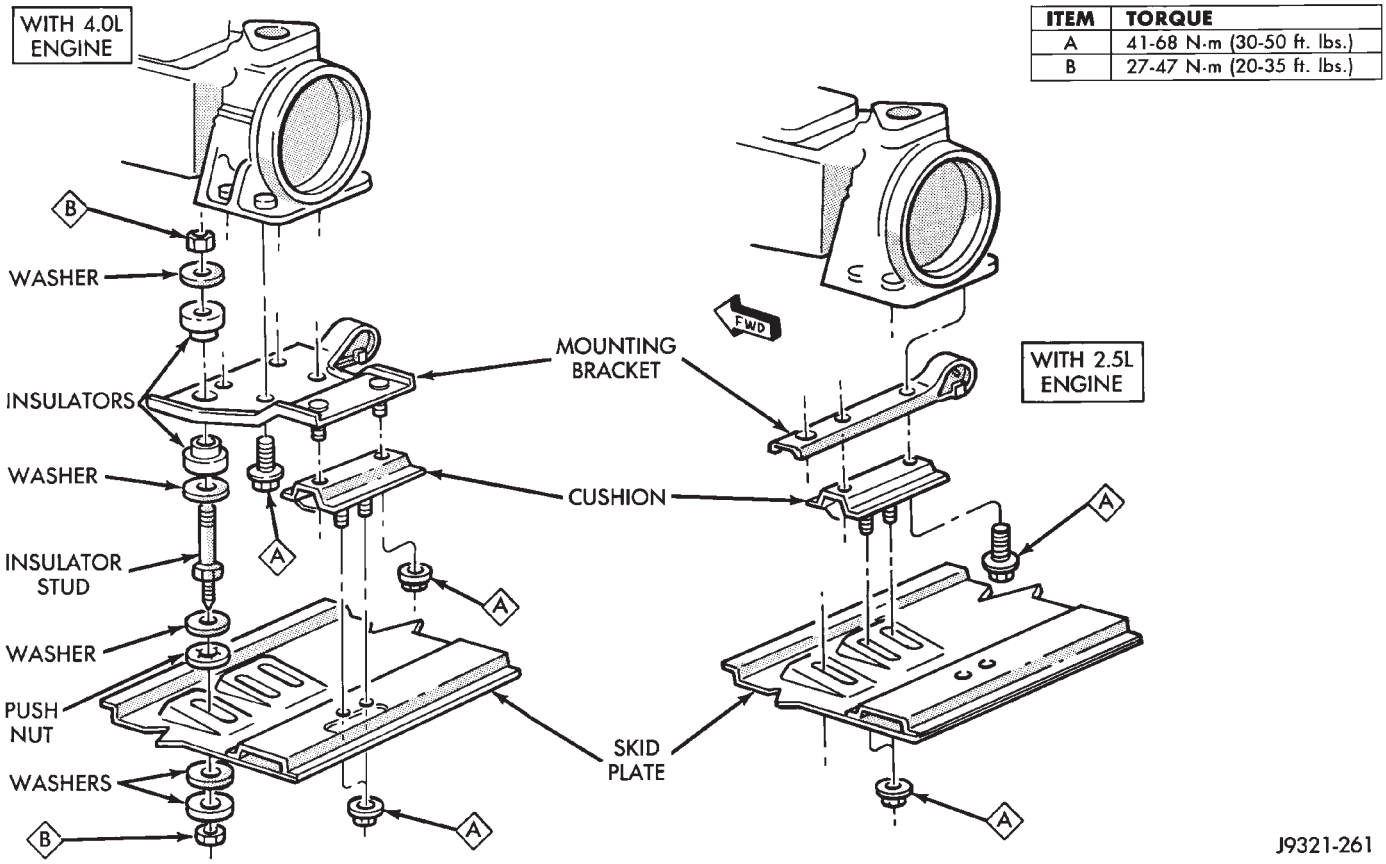


Fig. 1 Rear Mount Components (YJ Shown)

(9) Reach up and around transmission case and unseat shift lever dust boot from transmission shift tower (Fig. 2). Move boot upward on shift lever for access to lever retainer.

(10) Disengage shift lever as follows:

(a) Reach up and around transmission case and press shift lever retainer downward with your fingers.

(b) Turn retainer counterclockwise to release it.

(c) Lift lever and retainer out of shift tower (Fig. 2). **It is not necessary to remove shift lever from floorpan boot. Simply leave lever in place for later installation.**

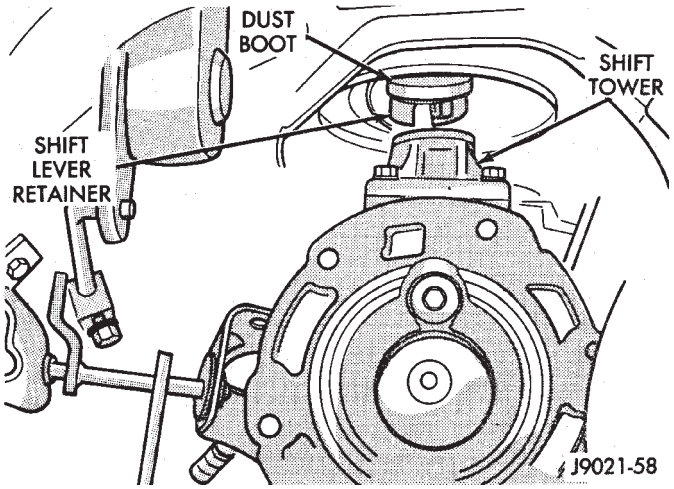


Fig. 2 Removing/Installing Shift Lever

(11) Mark front and rear propeller shafts for installation alignment (Fig. 3). Then remove both shafts.

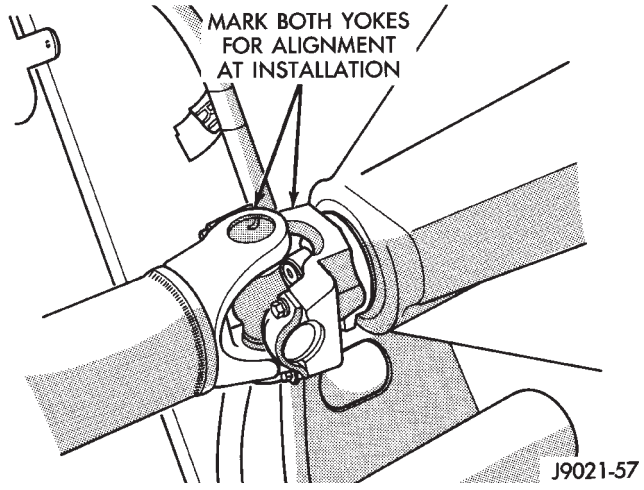


Fig. 3 Marking Propeller Shaft And Axle Yoke

(12) Remove crankshaft position/engine timing sensor (Fig. 4).

(13) Disconnect transmission and transfer case vent hoses.

(14) Remove slave cylinder from clutch housing.

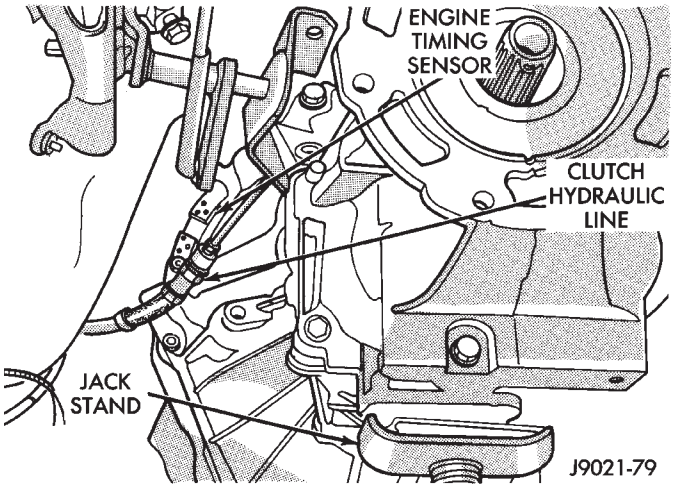


Fig. 4 Timing Sensor Location

(15) Support transmission-transfer case assembly with transmission jack. Secure assembly to jack with safety chains.

(16) Reposition adjustable jack stand under engine. Be sure to place wood block between jack and oil pan.

(17) Remove clutch housing brace rod.

(18) Remove clutch housing-to-engine bolts and remove transmission-transfer case assembly.

(19) Remove bolts attaching transmission to transfer case and separate components.

(20) Remove release bearing, fork and retainer clip.

(21) Remove clutch housing from transmission.

TRANSMISSION INSTALLATION—AX 15

(1) Install clutch housing on transmission. Tighten housing bolts to 37 N·m (27 ft-lbs) torque.

(2) Lubricate contact surfaces of release fork, lever and pivot ball stud. Then install bearing, fork and clip in clutch housing.

(3) Mount transmission on transmission jack. Secure transmission with safety chains.

(4) Lightly lubricate pilot bearing and transmission input shaft splines with Mopar high temperature grease.

(5) Align transmission input shaft and clutch disc splines and install transmission.

(6) Install and tighten clutch housing-to-engine bolts to 38 N·m (28 ft. lbs.) torque. **Be sure housing is properly seated on engine before tightening bolts.**

(7) Lower transmission no more than 7.6 cm (3 in.) for access to the shift tower.

(8) Reach up and around the transmission and insert shift lever in shift tower. Press lever retainer downward and turn it clockwise to lock it in place. Then install lever dust boot on shift tower.

(9) Connect engine timing sensor.

(10) Remove jack from under transmission and mount transfer case on jack.

(11) Align transfer case and transmission shafts and install transfer case. Tighten transfer case-to-transmission nuts/bolts to 35 N·m (26 ft. lbs.) torque.

(12) Move jack stand from under engine and reposition it under transmission. Then remove transmission jack.

(13) Connect transfer case vacuum hoses and linkage. Check and adjust linkage if necessary.

(14) Connect transmission and transfer case vent hoses and backup light switch wires.

(15) Install clutch sleeve cylinder.

(16) Connect vehicle speed sensor and wires.

(17) On XJ, install rear crossmember and attach cushion and bracket. Tighten crossmember-to-frame bolts to 41 N·m (30 ft. lbs.) torque. Tighten transmission-to-rear cushion and bracket bolts/nuts to 45 N·m (33 ft. lbs.) torque.

(18) On YJ, install rear cushion and bracket and skid plate. Tighten attaching bolts/nuts to indicated torque (Fig. 1).

(19) Align and install front/rear propeller shafts. Tighten shaft U-joint clamp bolts to 19 N·m (170 in. lbs.) torque.

(20) On XJ, install skid plate if removed. Tighten bolts to 42 N·m (31 ft. lbs.) torque. Tighten stud nuts to 17 N·m (150 in. lbs.) torque.

(21) Top off transmission and transfer lubricant levels.

(22) Remove supports and lower vehicle.

TRANSMISSION DISASSEMBLY AND OVERHAUL

ADAPTER/EXTENSION HOUSING REMOVAL

(1) Remove release bearing, fork, retainer clip and clutch housing from transmission. Also remove shift lever if not previously removed.

(2) On 2-wheel drive models, remove extension housing seal (Fig. 1).

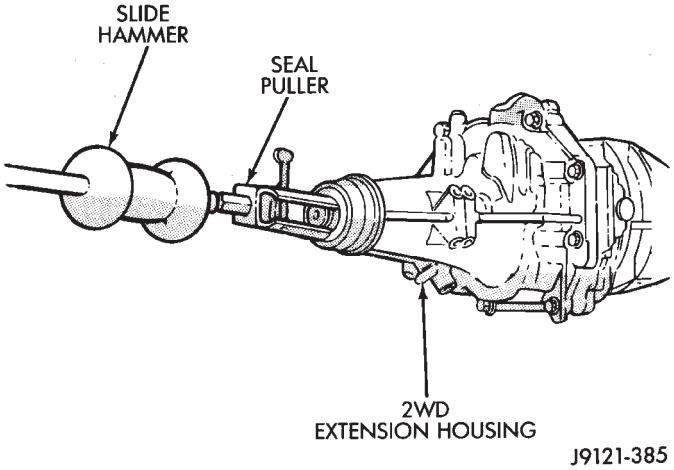


Fig. 1 Removing Extension Housing Seal

(3) Remove shift tower bolts and remove tower from adapter or extension housing (Fig. 2).

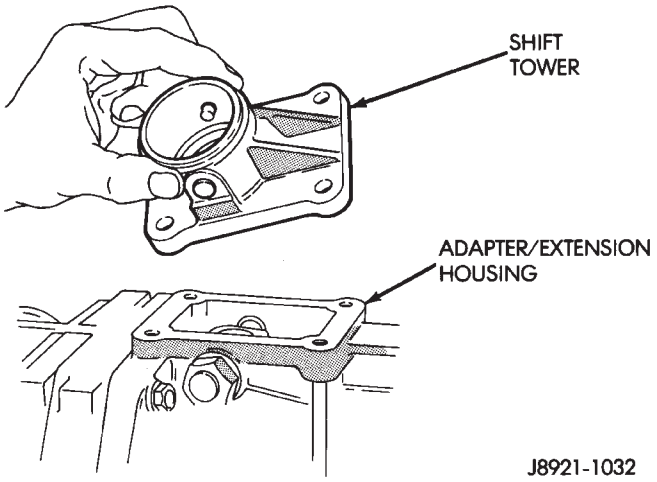


Fig. 2 Shift Tower Removal/Installation

(4) Remove gasket from shift tower (Fig. 3).

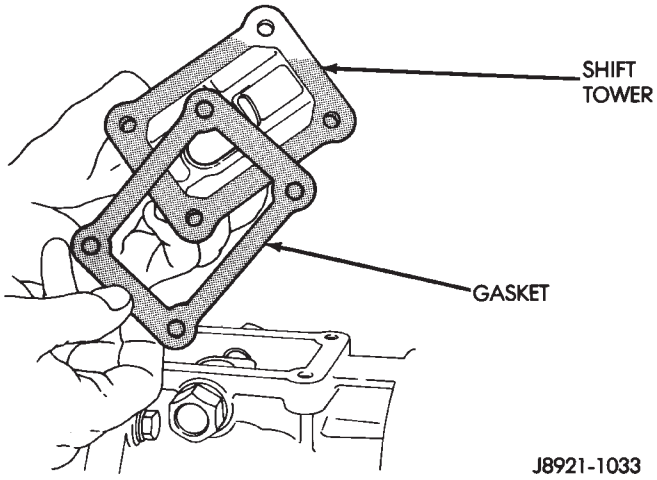


Fig. 3 Shift Tower Gasket Removal/Installation

(5) Remove shift arm retainer bolt (Fig. 4).

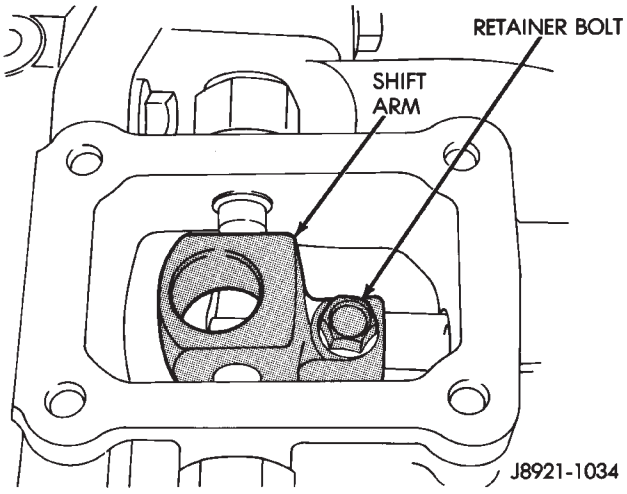


Fig. 4 Shift Arm Retainer Bolt Removal/Installation

(6) Loosen and remove restrictor pins (Fig. 5).

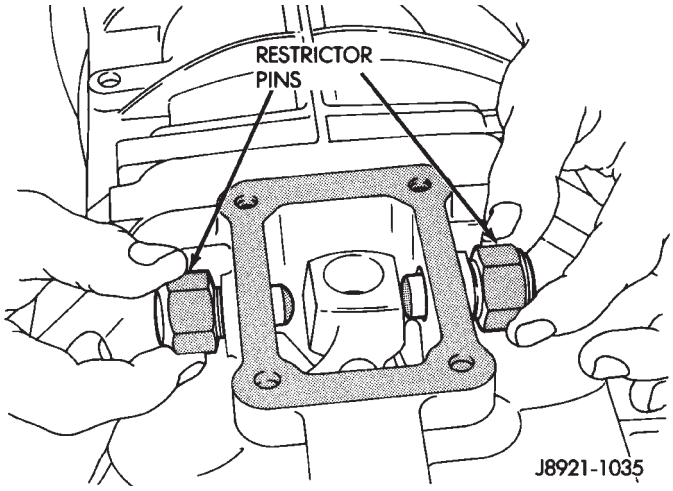


Fig. 5 Removing/Installing Restrictor Pins

(7) Remove shift arm shaft plug (Fig. 6).

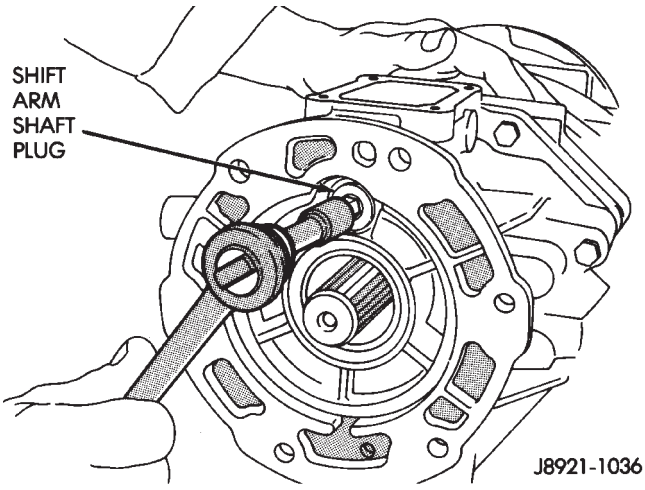


Fig. 6 Removing/Installing Shift Lever Shaft Plug

(8) Remove shift arm shaft with large magnet (Fig. 7).

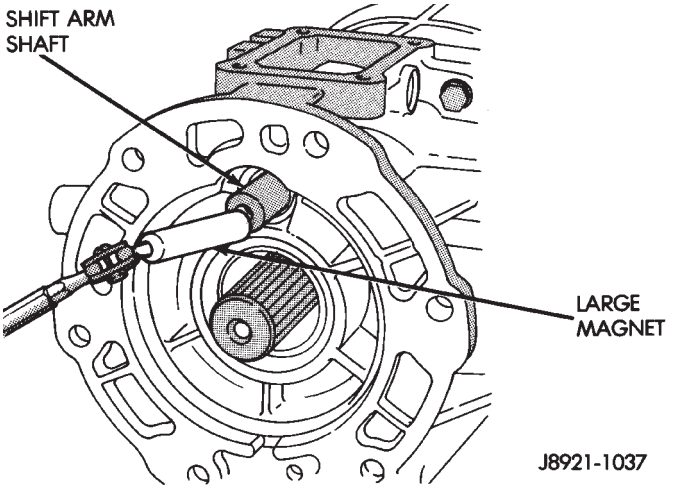


Fig. 7 Removing/Installing Shift Lever Shaft

(9) Remove shift arm (Fig. 8).

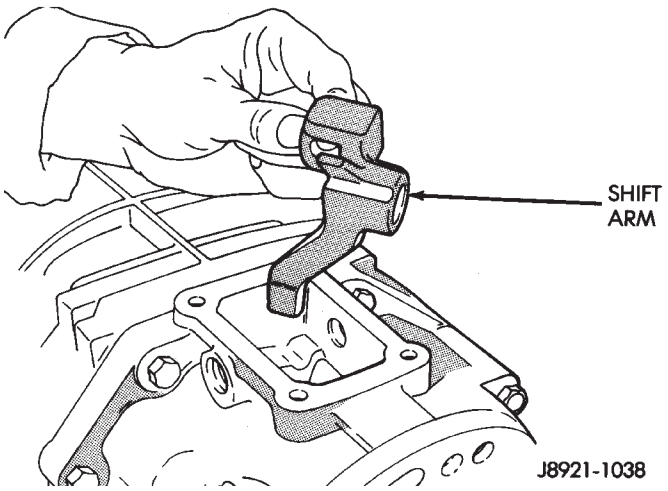


Fig. 8 Shift Arm Removal/Installation

(10) Remove plug for reverse shift head lock ball. Plug is at right side of adapter housing near backup light switch (Fig. 9).

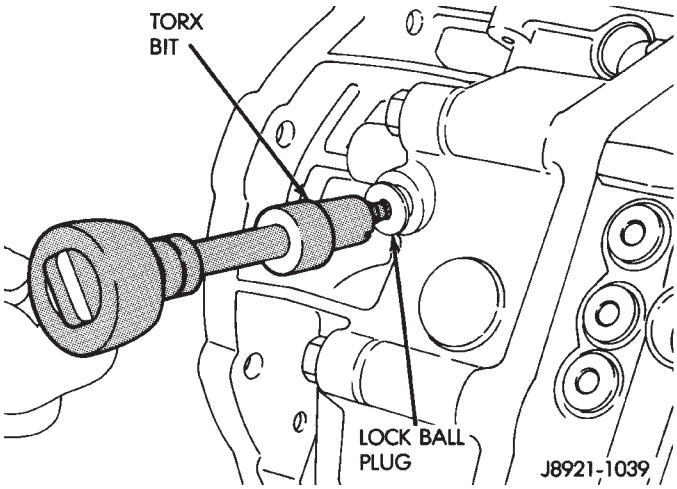


Fig. 9 Removing/Installing Lock Ball Plug

(11) Remove lock ball spring with pencil magnet (Fig. 10).

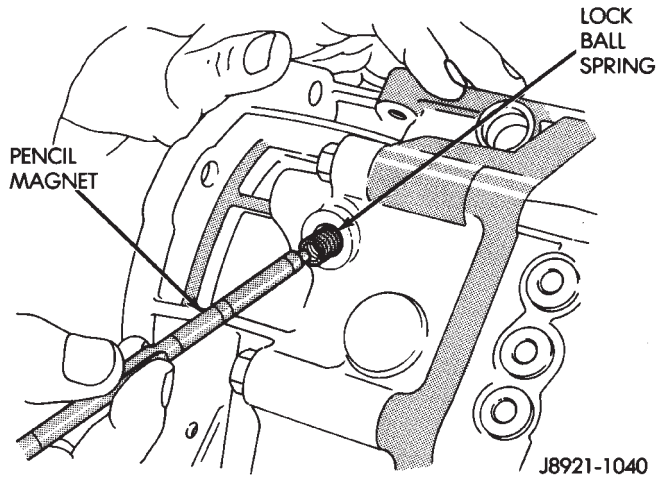


Fig. 10 Removing/Installing Lock Ball Spring

(12) Remove shift head lock ball with pencil magnet (Fig. 11).

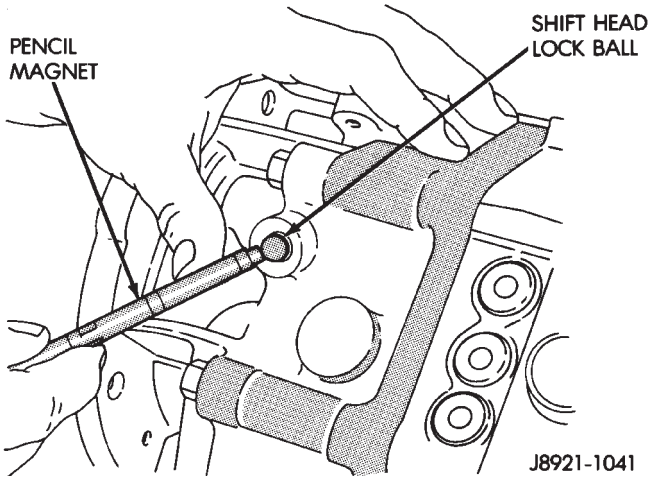


Fig. 11 Removing/Installing Shift Head Lock Ball

(13) Remove backup light switch from adapter/extension housing.

(14) On 2-wheel drive models, remove distance sensor, speedometer adapter and driven gear if not removed previously.

(15) Remove adapter/extension housing bolts (Fig. 12).

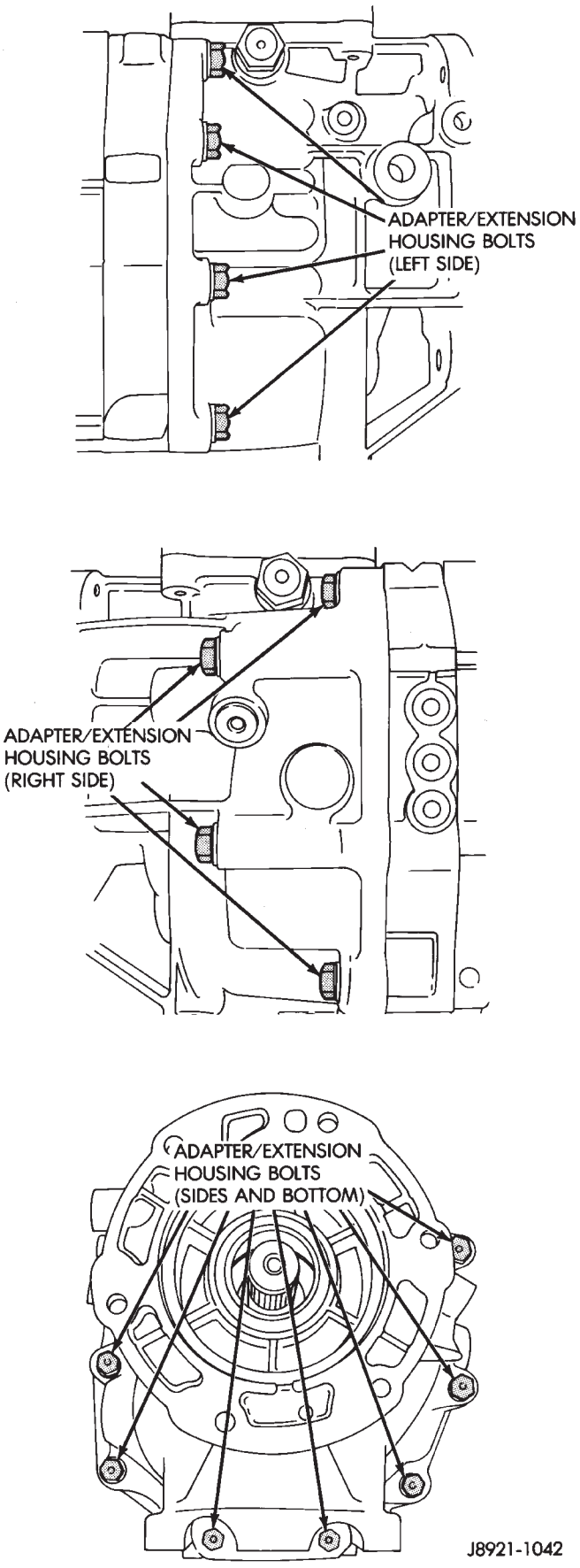


Fig. 12 Adapter Housing Bolt Locations

(16) Loosen adapter/extension housing with rubber mallet (Fig. 13).

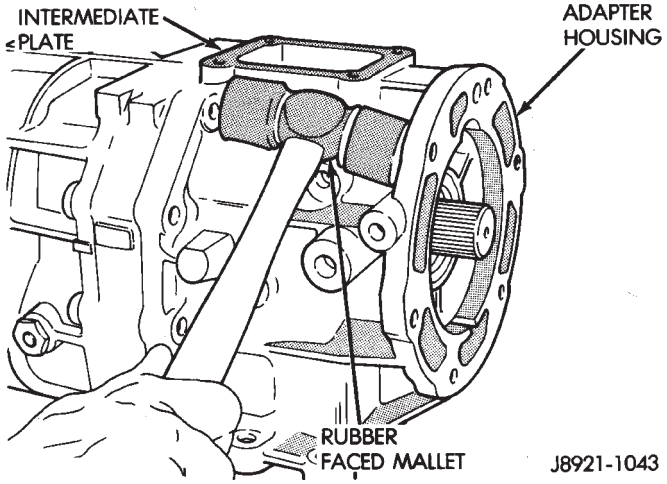


Fig. 13 Loosening Adapter Housing

(17) Remove housing after loosening it (Fig. 14)

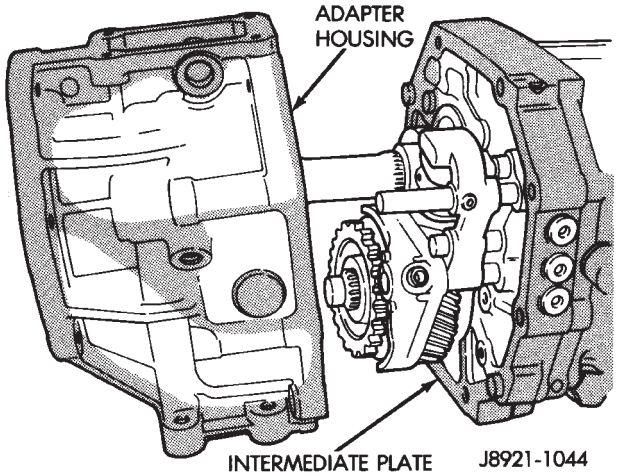


Fig. 14 Adapter Housing Removal

(18) Remove adapter housing oil seal with pry tool (Fig. 15).

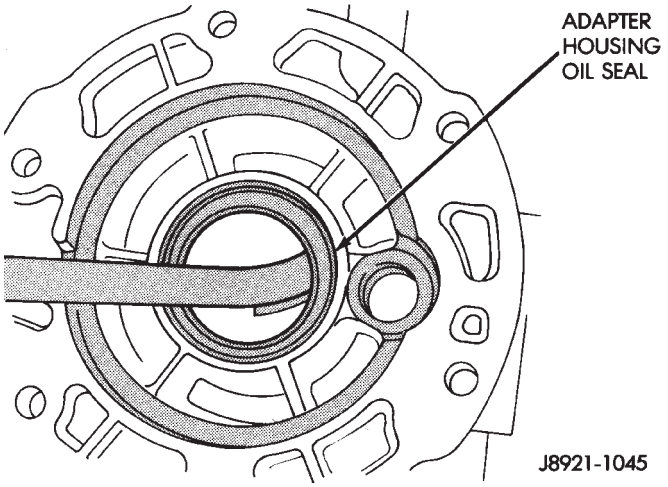


Fig. 15 Removing Adapter Housing Seal

GEAR CASE REMOVAL

(1) Remove bearing retainer bolts and remove retainer (Fig. 16).

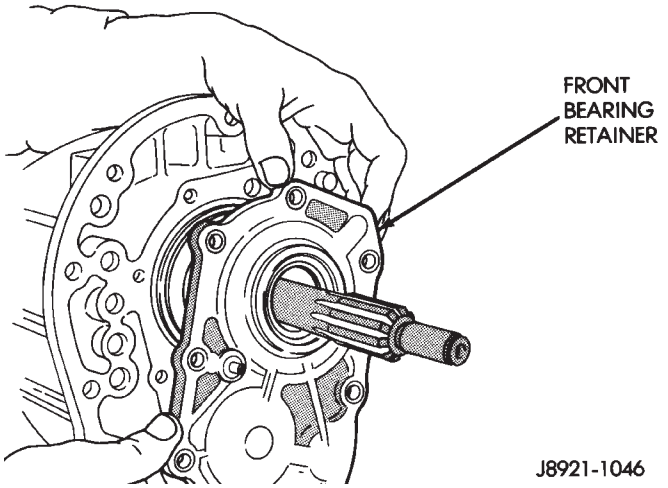


Fig. 16 Front Bearing Retainer Removal

(2) Remove retainer oil seal with pry tool (Fig. 17).

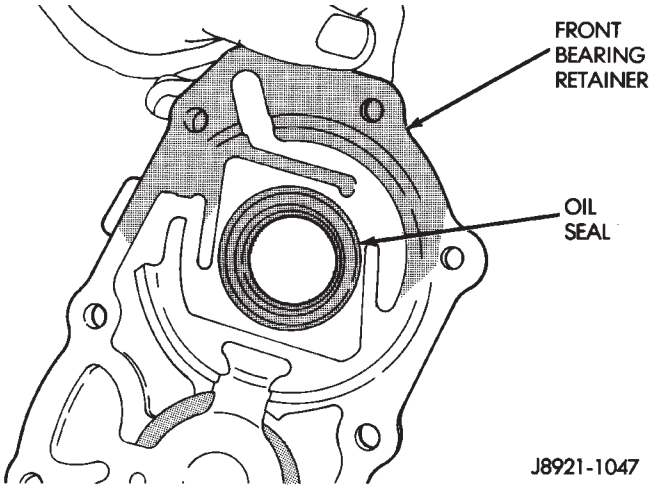


Fig. 17 Front Bearing Retainer Seal Location

(3) Remove input shaft bearing snap ring (Fig. 18).

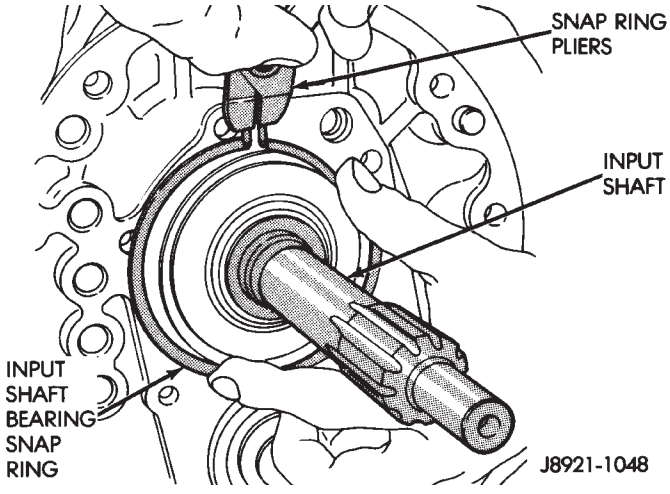


Fig. 18 Removing Input Shaft Bearing Snap Ring

(4) Remove cluster gear front bearing snap ring (Fig. 19).

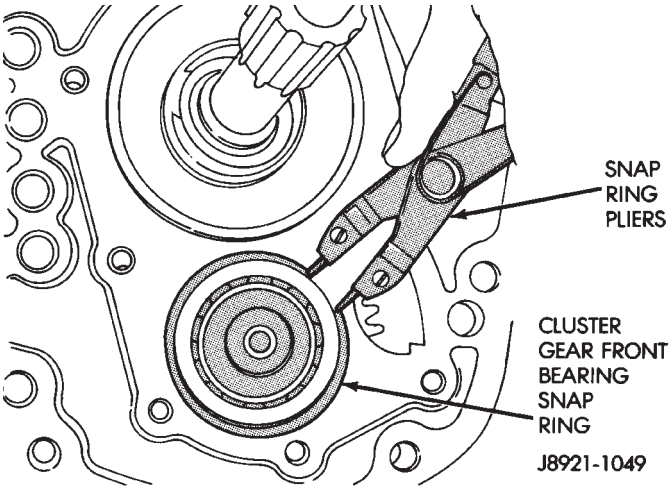


Fig. 19 Removing Cluster Gear Front Bearing Snap Ring

(5) Loosen gear case by tapping it away from intermediate plate with rubber mallet (Fig. 20).

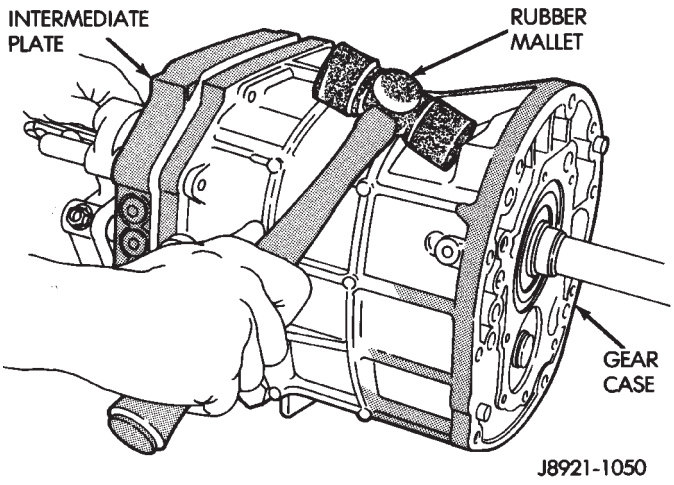


Fig. 20 Loosening Gear Case

(6) Remove gear case from geartrain and intermediate plate (Fig. 21).

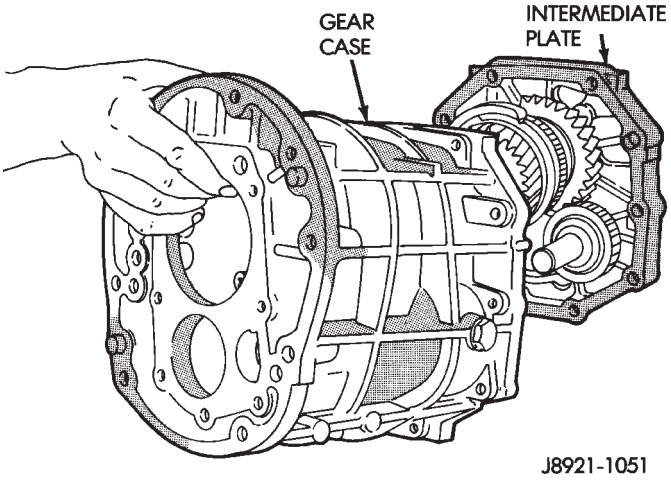


Fig. 21 Gear Case Removal

(7) On 2-wheel drive models, remove speedometer gear snap ring and remove speedometer gear and spacer from output shaft.

FIFTH GEAR AND SYNCHRO ASSEMBLY REMOVAL

(1) Remove three lock ball plugs from intermediate plate (Fig. 22).

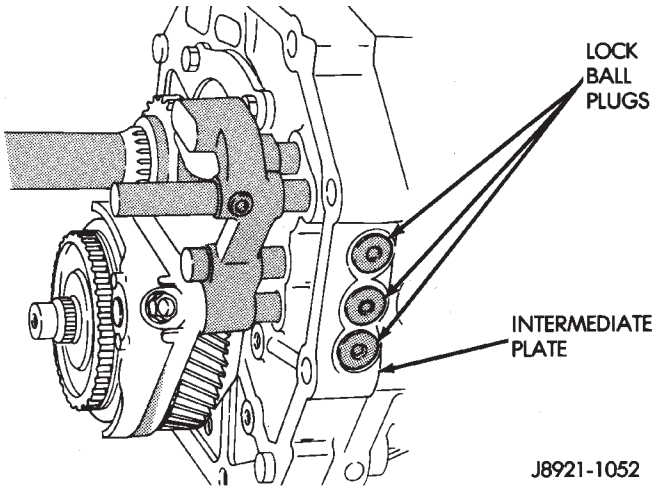


Fig. 22 Lock Ball Plug Locations

(2) Remove three lock ball springs and lock balls from intermediate plate with pencil magnet (Fig. 23).

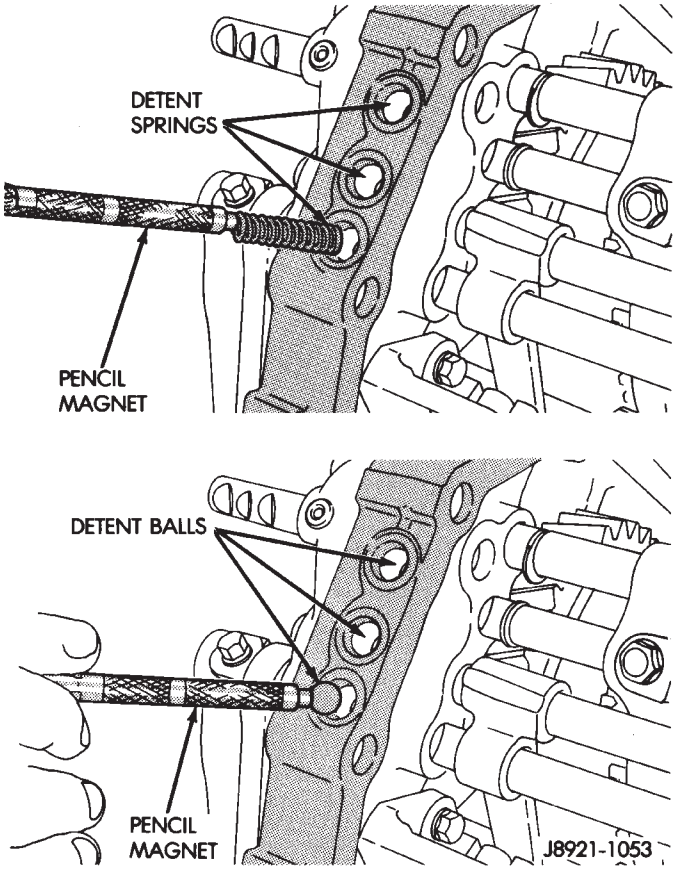


Fig. 23 Removing/Installing Lock Ball And Spring

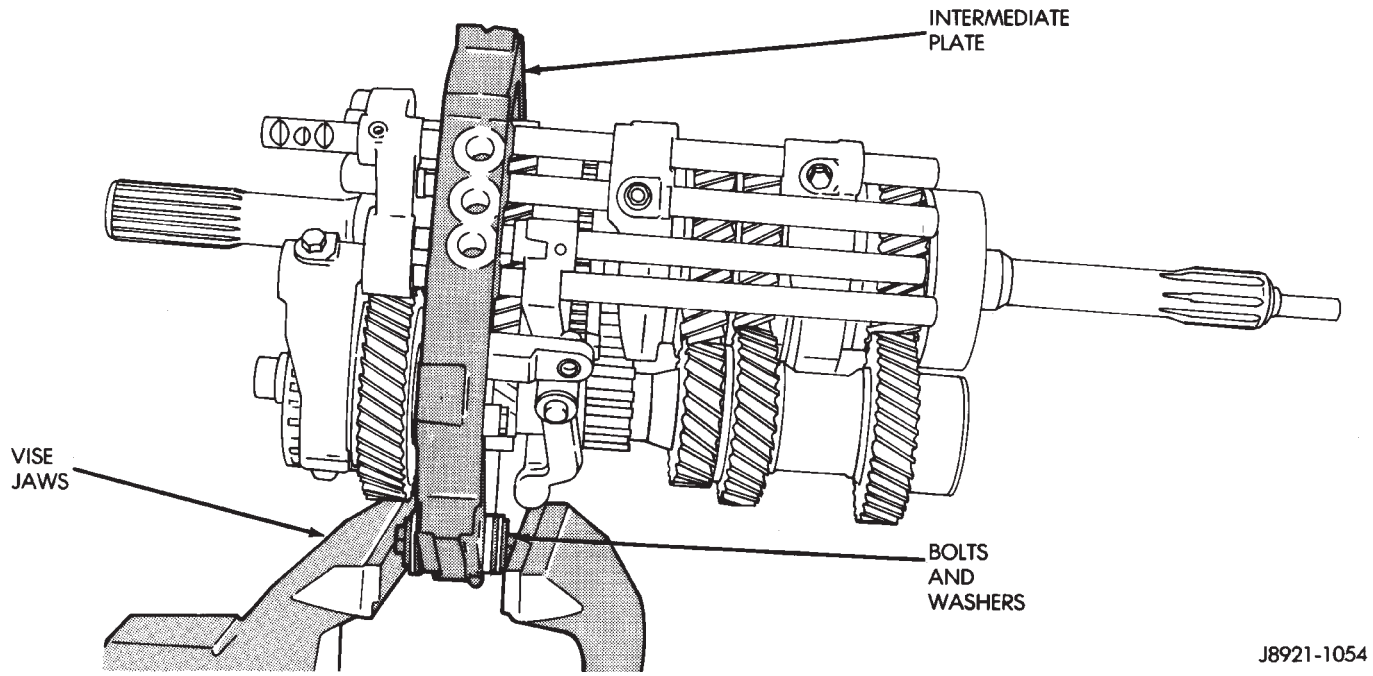


Fig. 24 Mounting Intermediate Plate And Geartrain In Vise

(3) Mount intermediate plate and geartrain assembly in vise as follows:

(a) Insert two spare bolts in one bottom bolt hole in intermediate plate. Insert bolts from opposite sides of plates (Fig. 24).

(b) Install enough flat washers under each bolt head to prevent bolts from touching (Fig. 24).

(c) Tape bolts and washers in place and mount intermediate plate in vise (Fig. 24).

(d) Clamp vise jaws securely against bolt heads (Fig. 24). **Do not clamp vise jaws on intermediate plate. Clamp only on bolt heads.**

(4) Remove fifth gear snap ring (Fig. 25). Retain snap ring for assembly reference. It is a select fit component.

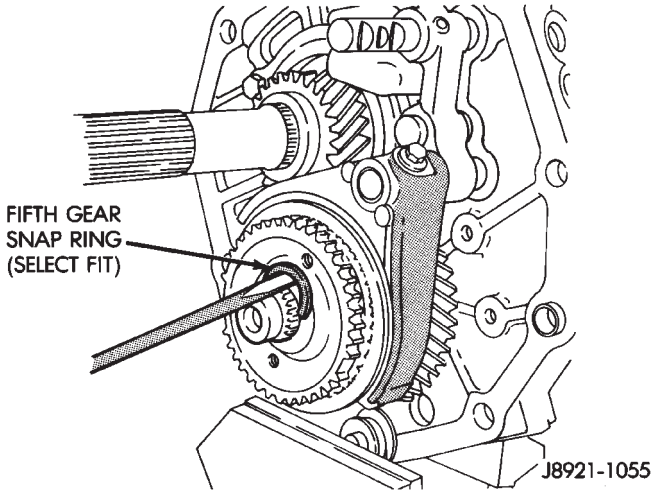


Fig. 25 Fifth Gear Snap Ring Removal

(5) Remove E-ring that secures reverse shift arm to fork (Fig. 26).

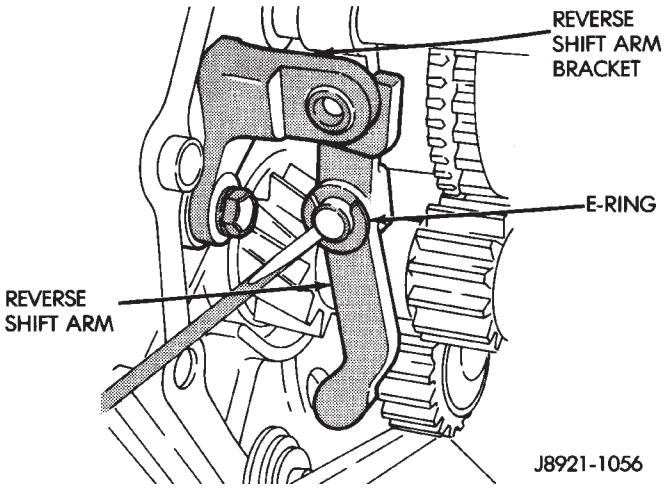


Fig. 26 Removing Reverse Shift Arm E-Ring

(6) Remove bolts attaching reverse shift arm bracket to intermediate plate. Then remove bracket (Fig. 27).

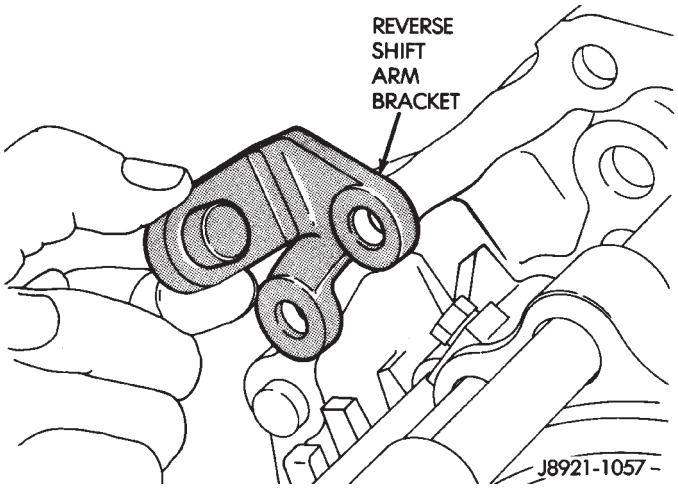


Fig. 27 Removing Reverse Shift Arm Bracket

(7) Remove reverse shift arm and shoe (Fig. 28).

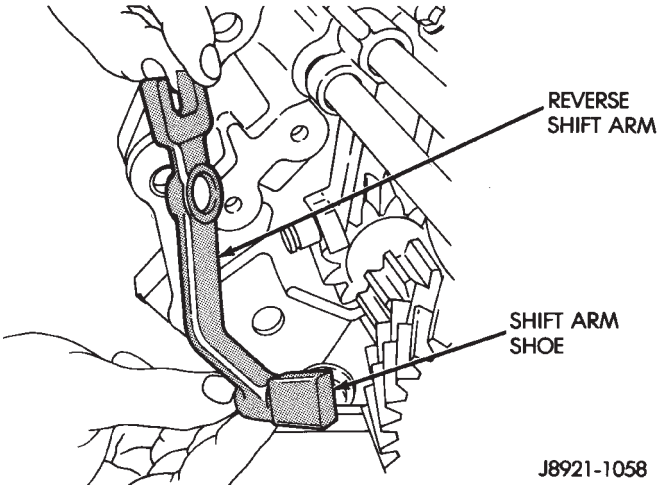


Fig. 28 Removing Reverse Shift Arm And Shoe

(8) Remove fifth gear shift fork set screw (Fig. 29).

(9) Move fifth gear shift rail forward until it clears shift fork.

(10) Remove fifth gear shift fork from synchro sleeve (Fig. 30).

(11) Remove reverse shift rail and reverse shift head as assembly (Fig. 31).

(12) Measure thrust clearance between counter fifth gear and thrust ring with feeler gauge. Clearance should be 0.10 - 0.40 mm (0.003 - 0.019 in.). If clearance exceeds limits, gear and/or ring will have to be replaced.

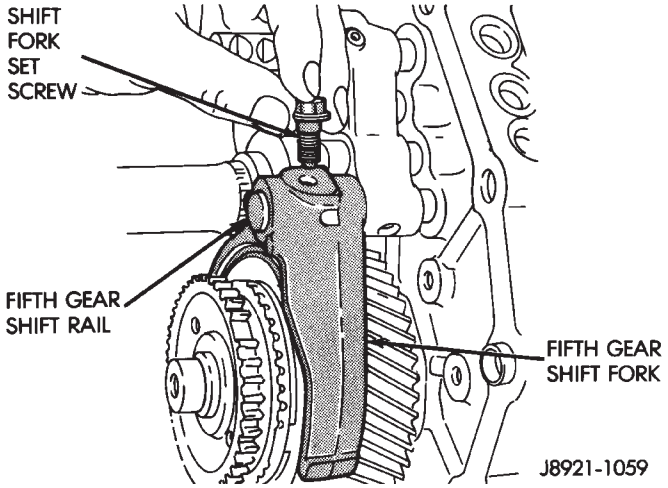


Fig. 29 Removing Fifth Gear Fork Set Screw

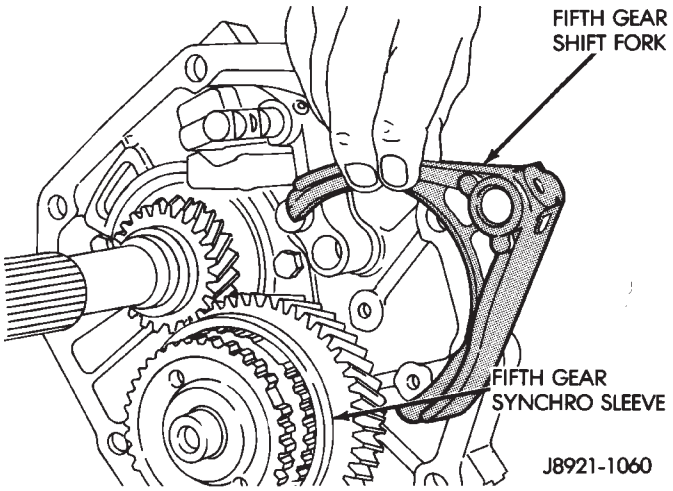


Fig. 30 Removing Fifth Gear Shift Fork

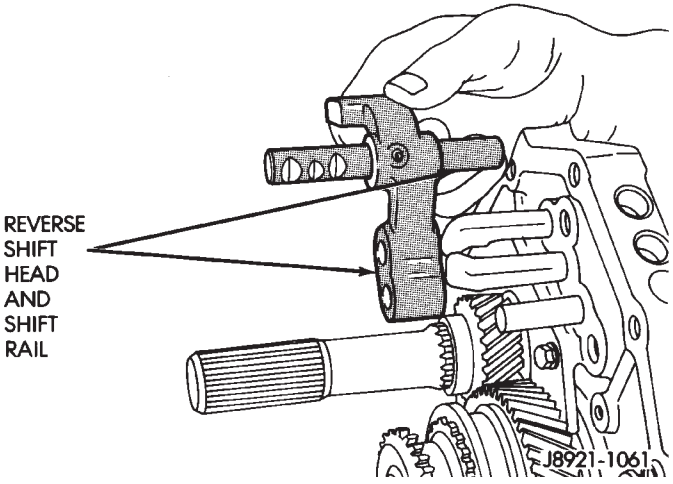


Fig. 31 Removing Reverse Shift Head And Rail

(13) Loosen fifth spline gear with standard two-jaw puller (Fig. 32). Position puller jaws **behind fifth counter gear** as shown.

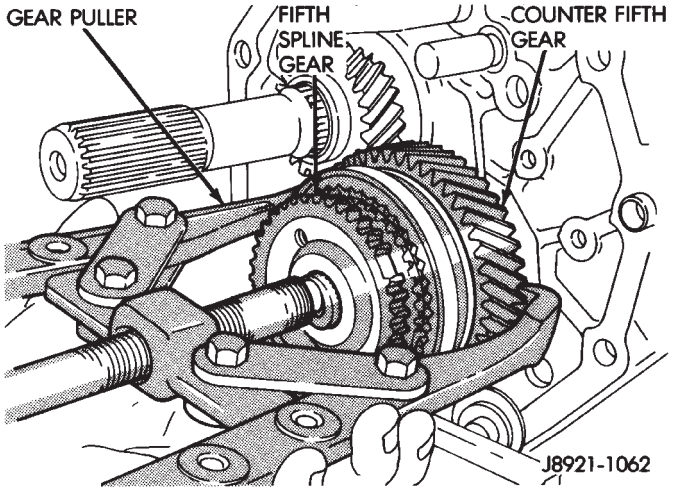


Fig. 32 Loosening Fifth Spline Gear

(14) Remove fifth spline gear (Fig. 33).

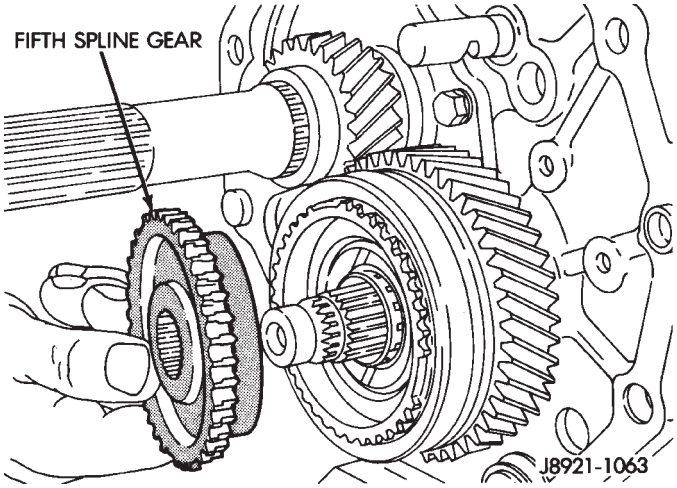


Fig. 33 Removing Fifth Spline Gear

(15) Remove fifth gear synchro ring (Fig. 34).

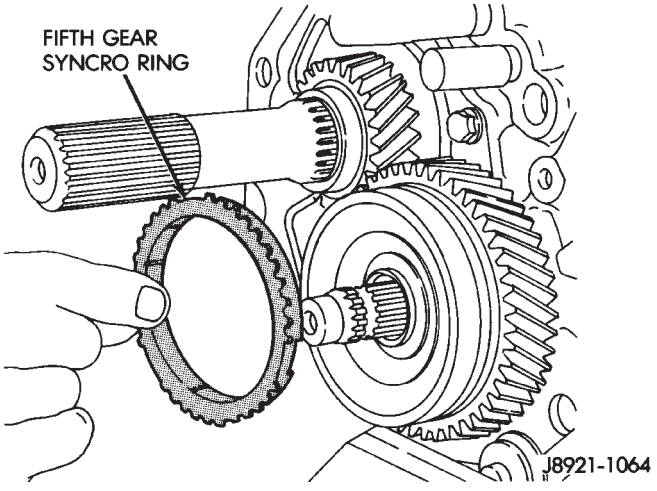


Fig. 34 Removing Fifth Gear Synchro Ring

(16) Remove fifth gear synchro and sleeve assembly (Fig. 35).

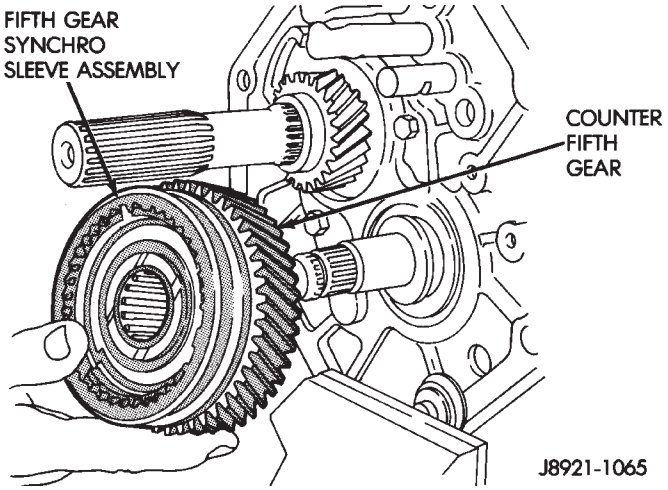


Fig. 35 Removing Counter Fifth Gear And Synchro Assembly

(17) Remove counter fifth gear thrust ring (Fig. 36).

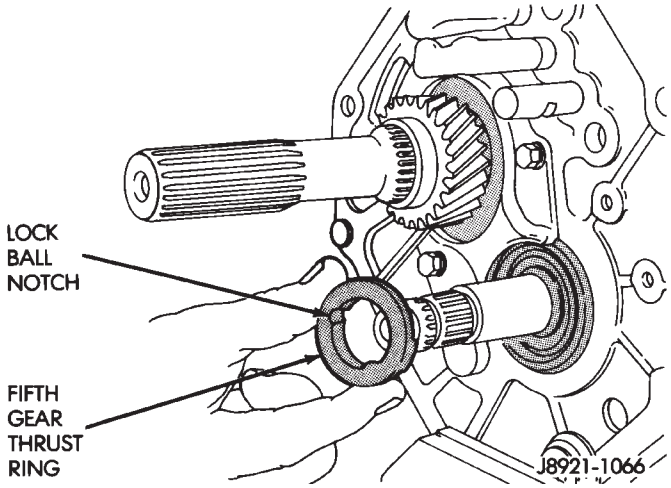


Fig. 36 Removing Fifth Gear Thrust Ring

(18) Remove thrust ring lock ball with pencil magnet (Fig. 37).

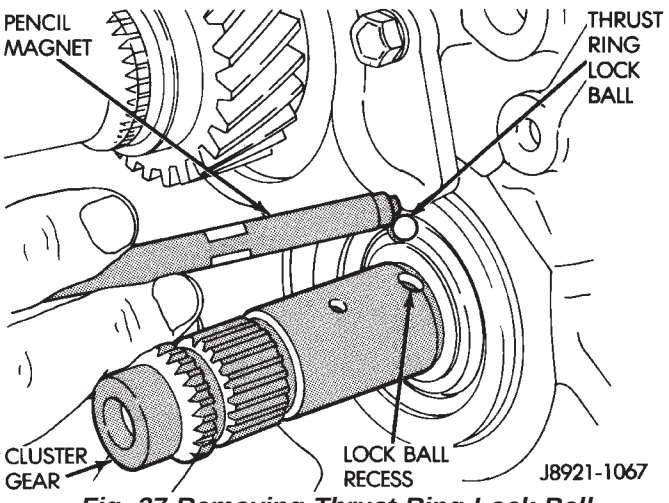


Fig. 37 Removing Thrust Ring Lock Ball

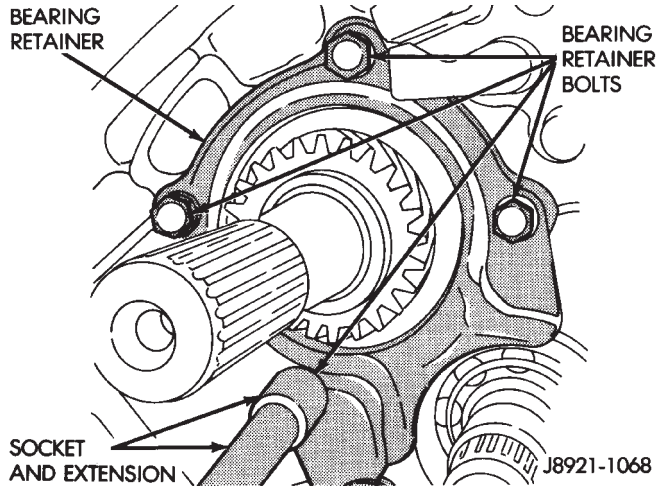


Fig. 38 Removing Output Shaft Rear Bearing Retainer Bolts

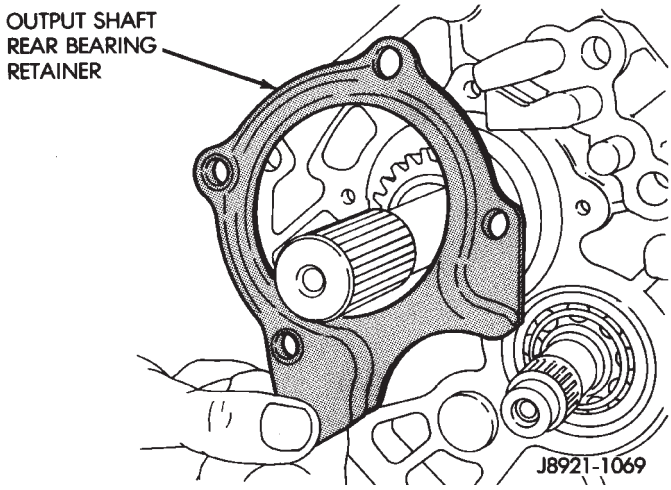


Fig. 39 Removing Output Shaft Rear Bearing Retainer

(19) Remove bolts attaching output shaft rear bearing retainer to intermediate plate (Fig. 38).

(20) Remove rear bearing retainer (Fig. 39).

(21) Remove reverse gear and shaft (Fig. 40).

SHIFT RAIL AND FORK REMOVAL

There are a total of five shift rails in the AX 15 transmission. The 1-2, 3-4, fifth gear and front reverse shift rails are shown in Figure 41.

Two shift rails are used for reverse gear range. The front reverse rail is at the forward side of the intermediate plate (Fig. 41). The short rear reverse rail and reverse shift head are at the rear side of the intermediate plate.

It is not necessary to remove the shift rails if they do not require service during overhaul.

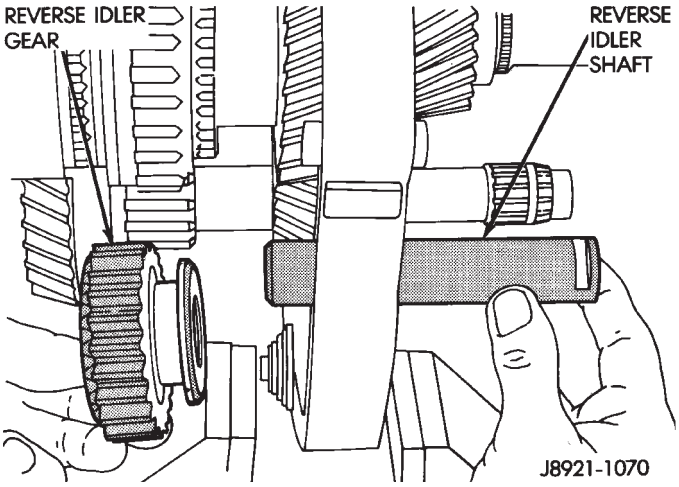


Fig. 40 Removing Reverse Idler Gear And Shaft

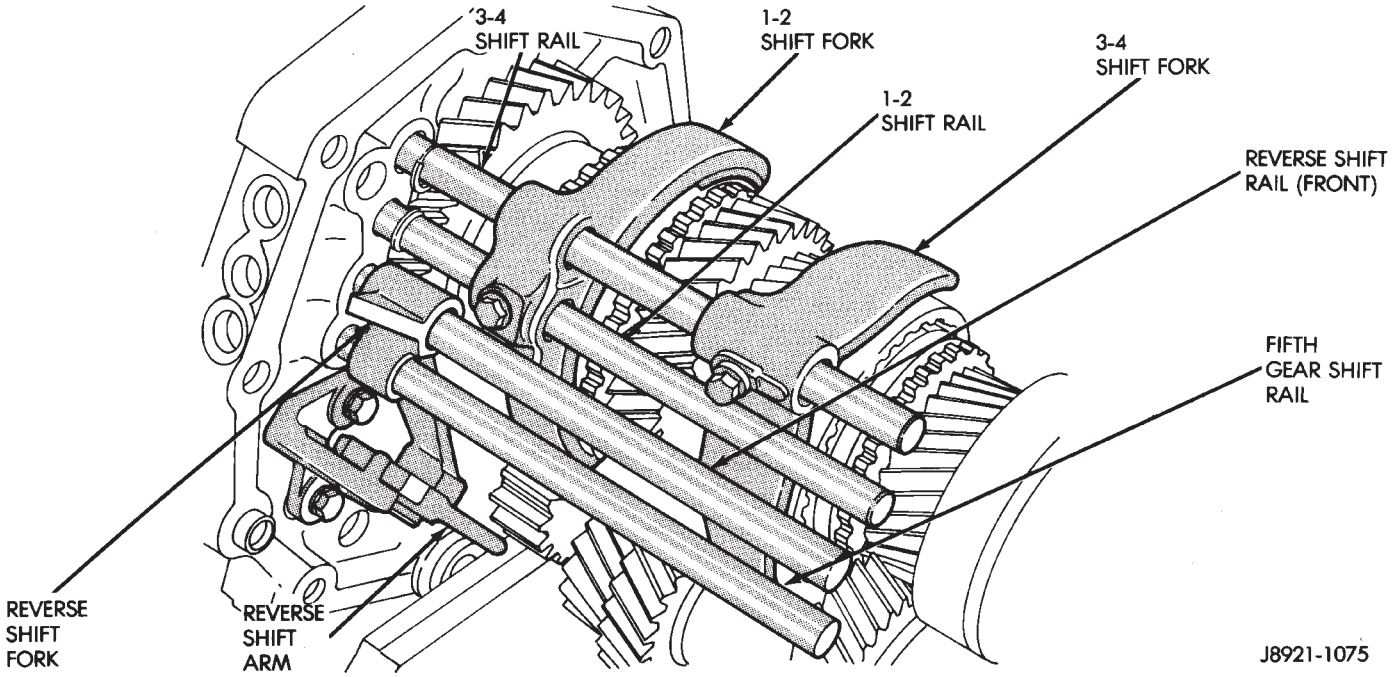


Fig. 41 Shift Rail Identification

Only the shift forks need be removed for access to the transmission shafts and gears.

(1) Remove fifth gear shift rail (Fig. 41). Catch lock ball in your hand as rail comes out of intermediate plate.

(2) Remove 1-2 and 3-4 shift rail C-rings with two screwdrivers of equal size and length (Fig. 42).

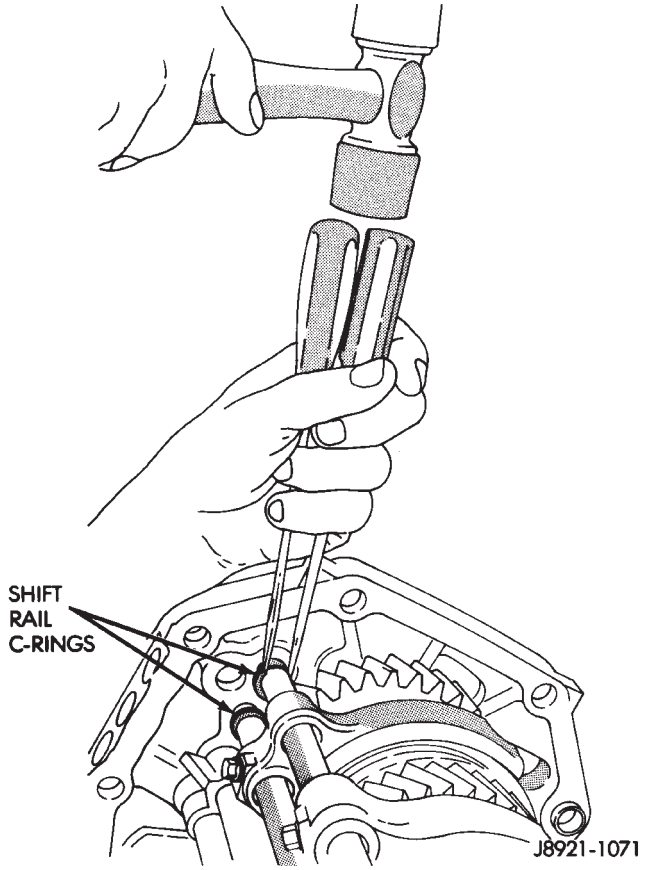


Fig. 42 Removing Shift Rail C-Rings

(3) Remove shift fork set screws (Fig. 43).

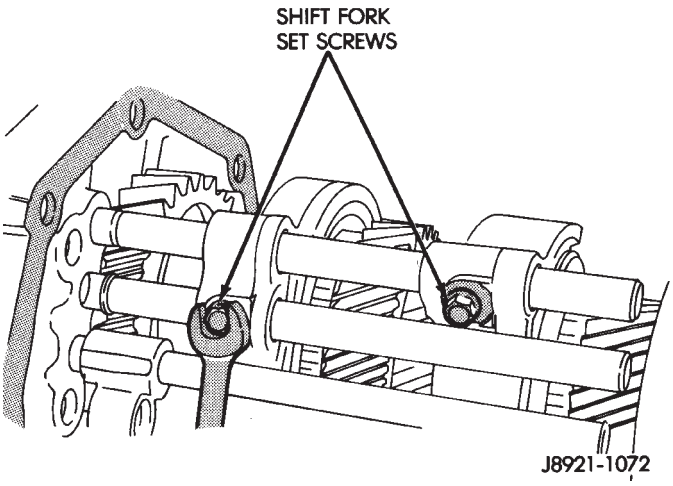


Fig. 43 Removing Shift Fork Set Screws

(4) Remove 3-4 shift rail from shift fork and intermediate plate (Fig. 44).

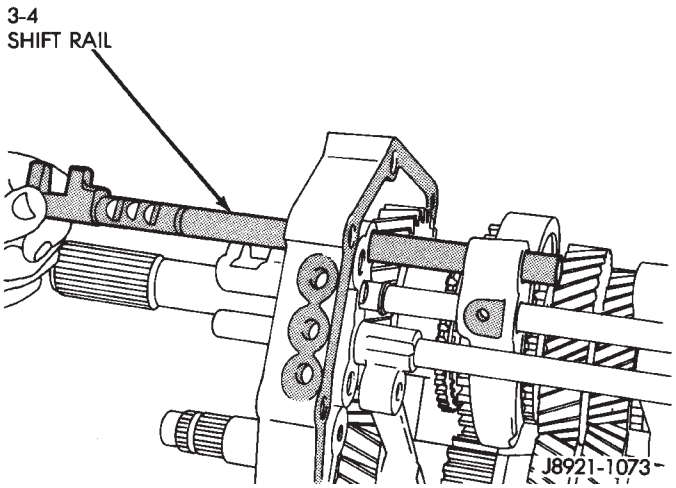


Fig. 44 Removing 3-4 Shift Rail

(5) Remove 3-4 shift rail interlock plug from intermediate plate with magnet (Fig. 45).

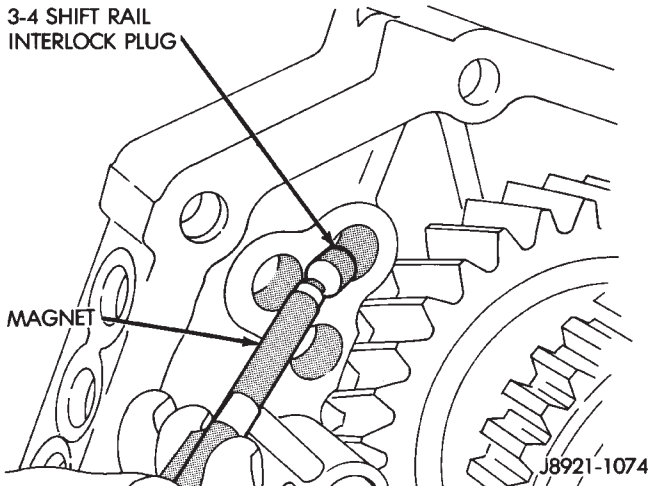


Fig. 45 Removing 3-4 Shift Rail Interlock Plug

(6) Remove 1-2 shift rail from shift fork and intermediate plate (Fig. 46).

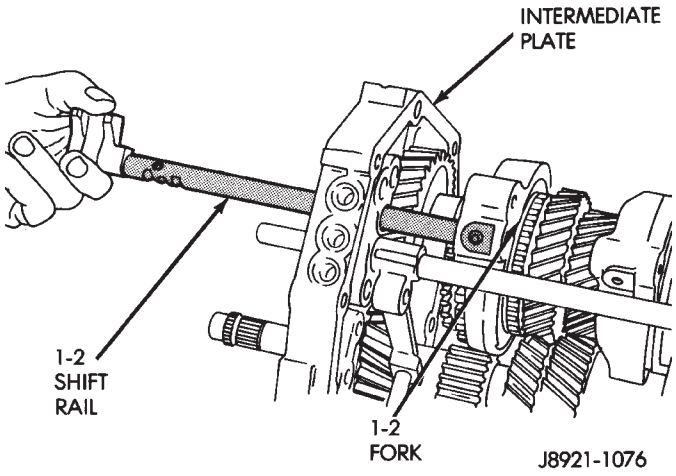


Fig. 46 Removing 1-2 Shift Rail

(7) Remove 1-2 shift rail interlock pin from shift rail (Fig. 47).

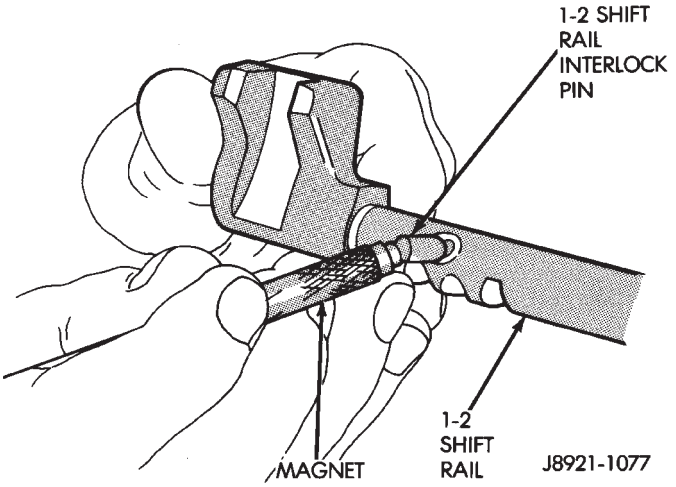


Fig. 47 Removing 1-2 Shift Rail Interlock Pin

(8) Remove 1-2 shift rail interlock plug from intermediate plate (Fig. 48).

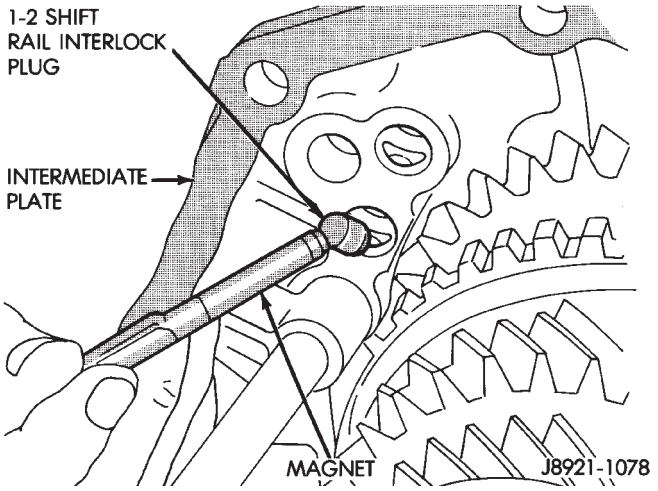


Fig. 48 Removing 1-2 Shift Rail Interlock Plug

(9) Lift reverse shift fork upward and remove fifth gear shift rail lock ball (Fig. 49).

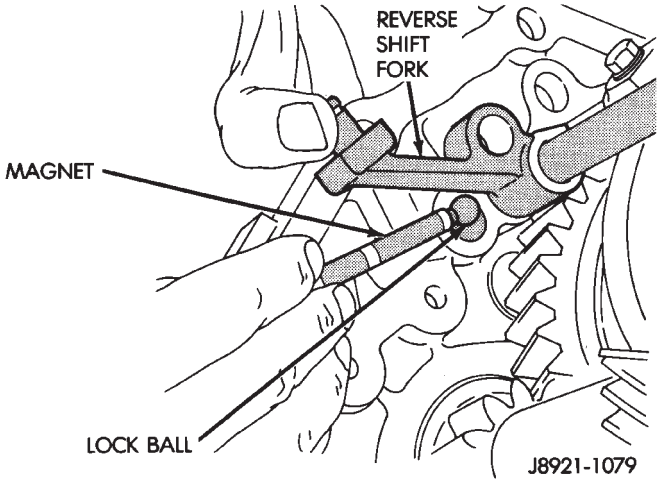


Fig. 49 Removing Fifth Gear Shift Rail Lock Ball

(10) Remove 3-4 shift fork (Fig. 50).

(11) Remove 1-2 shift fork (Fig. 50).

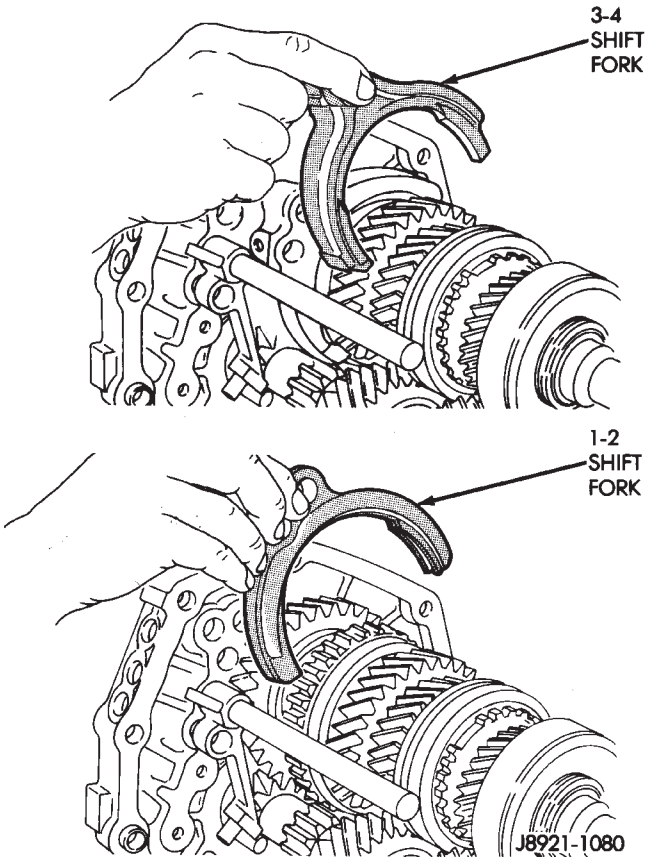


Fig. 50 Shift Fork Removal

(12) Remove reverse shift rail C-ring with two equal length and size screwdrivers (Fig. 51).

(13) Remove reverse shift rail and fork (Fig. 52).

(14) Remove interlock pin from reverse shift rail (Fig. 53).

(15) Position shift rails, shift forks, lock balls, interlock plugs and interlock pins on the workbench in order of removal. This will help in identifying components during inspection and assembly.

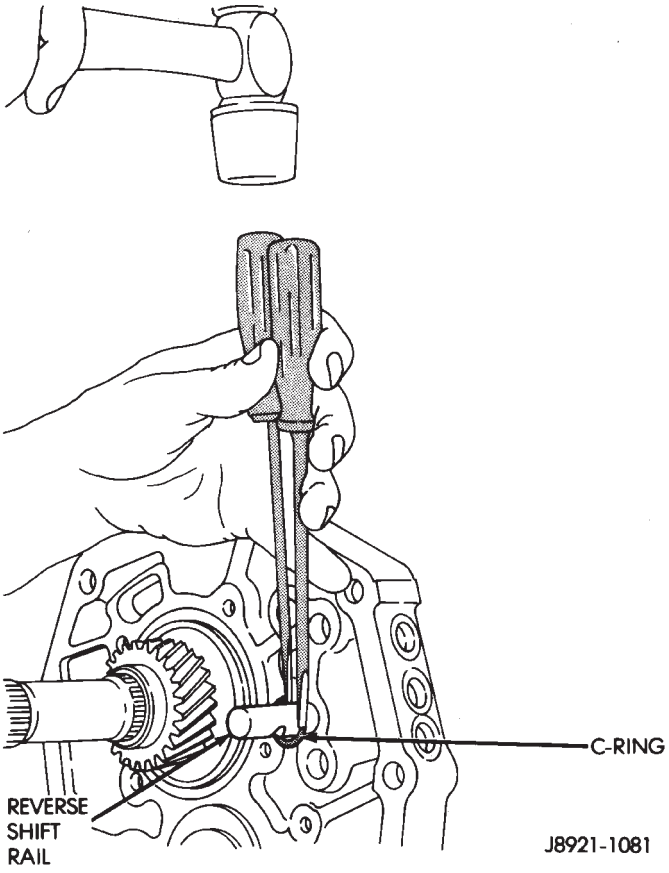


Fig. 51 Removing Reverse Shift Rail C-Ring

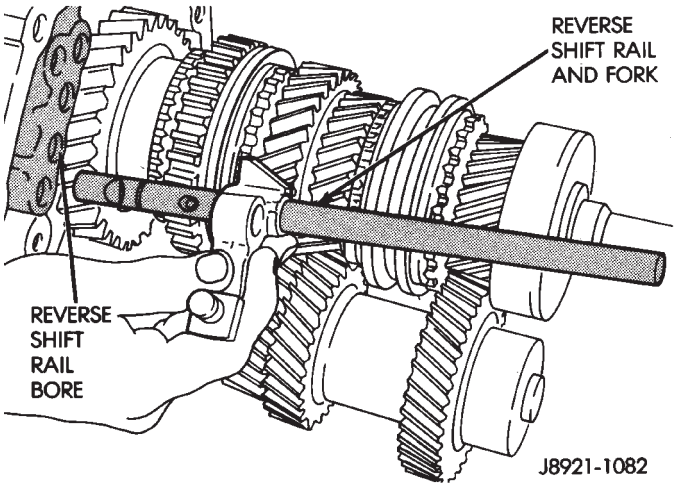


Fig. 52 Removing Reverse Shift Rail And Fork

OUTPUT SHAFT AND CLUSTER GEAR REMOVAL

(1) Remove output shaft rear bearing snap ring (Fig. 54).

(2) Remove cluster gear rear bearing snap ring (Fig. 54).

(3) Tap end of output shaft with mallet to unseat and start rear bearing out of intermediate plate (Fig. 55).

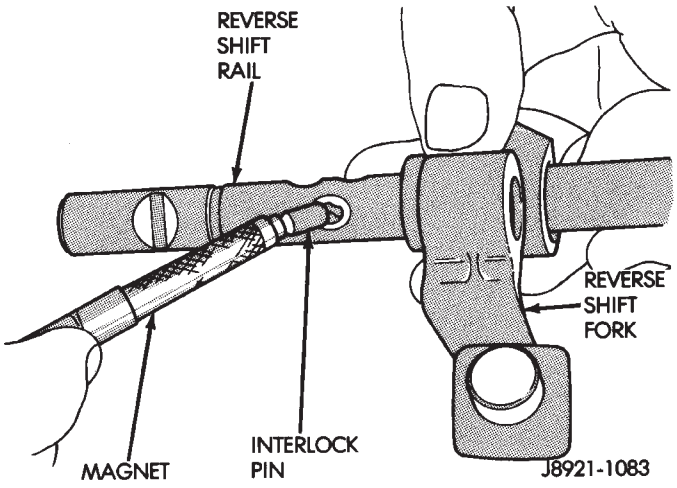
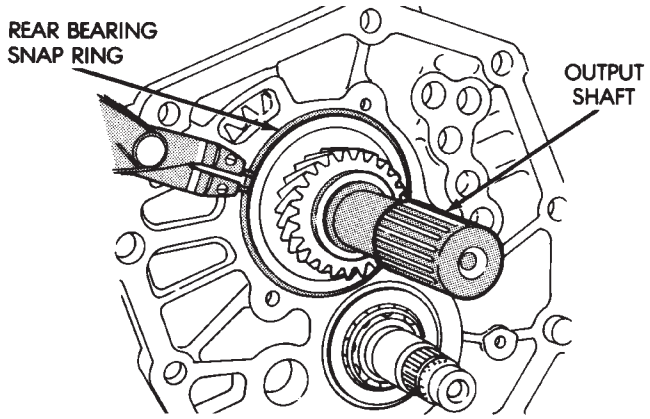


Fig. 53 Removing Reverse Shift Rail Interlock Pin



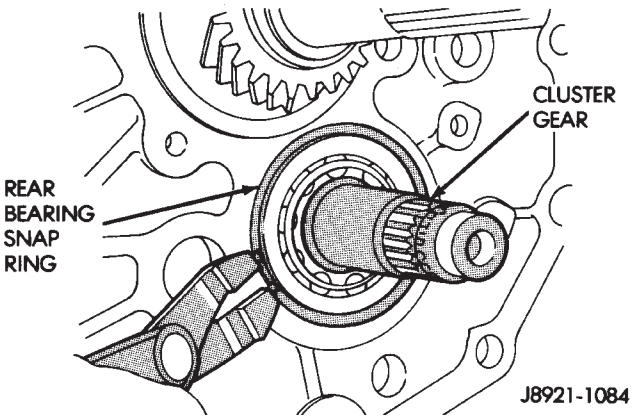


Fig. 54 Removing Bearing Snap Rings

(4) Remove output shaft by rocking it lightly until rear bearing comes out of intermediate plate (Fig. 56).

(5) Remove cluster gear by pulling it straight out of rear bearing (Fig. 57).

(6) Remove cluster gear rear bearing from intermediate plate (Fig. 58).

(7) Remove input shaft from output shaft (Fig. 59).

(8) Remove output shaft pilot bearing from input shaft (Fig. 60).

(9) Remove synchro ring from input shaft (Fig. 61).

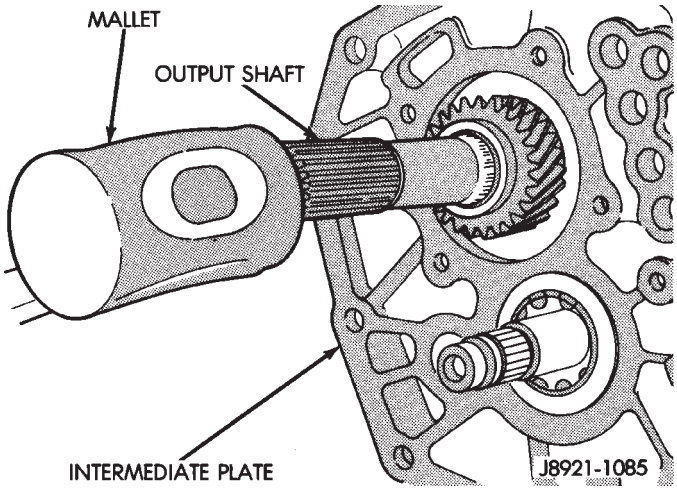


Fig. 55 Unseating Output Shaft Rear Bearing

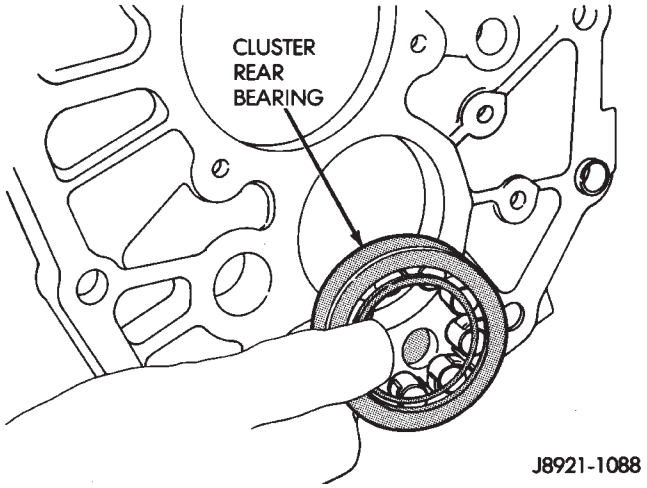


Fig. 58 Removing Cluster Gear Rear Bearing

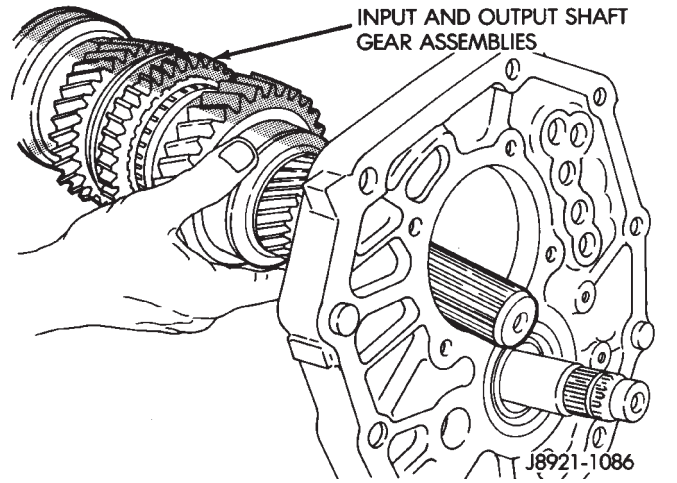


Fig. 56 Input/Output Shaft Assembly Removal

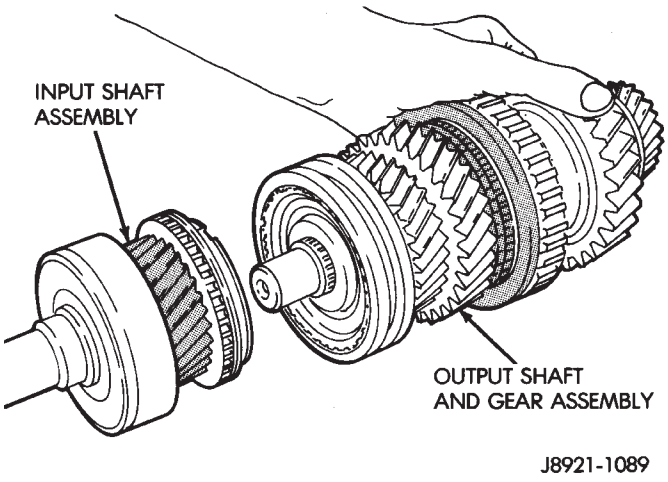


Fig. 59 Input Shaft Removal

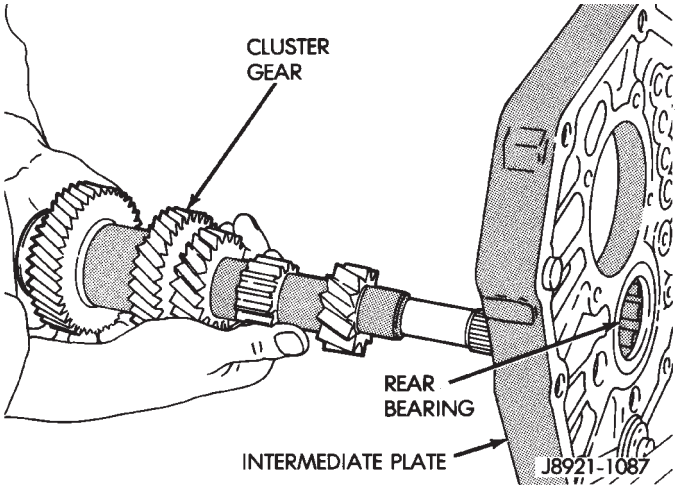


Fig. 57 Cluster Gear Removal

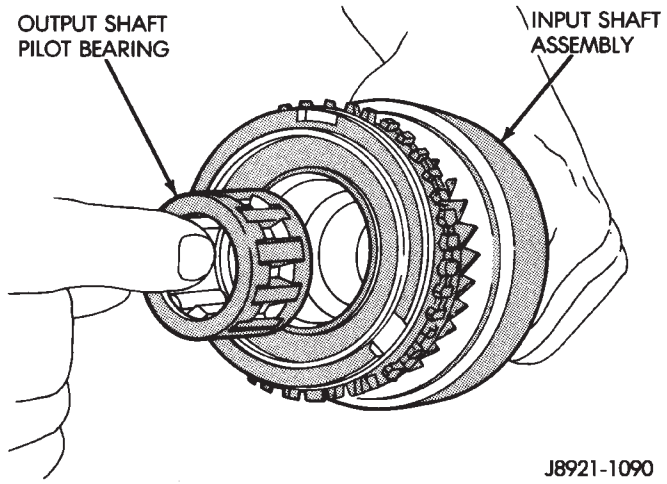


Fig. 60 Removing Input Shaft Pilot Bearing

(10) Remove bearing snap ring and press bearing off input shaft (Fig. 61).

OUTPUT SHAFT DISASSEMBLY

(1) Measure thrust clearance of output shaft first, second and third gears with feeler gauge (Fig. 62).

- First gear clearance should be 0.10 - 0.40 mm (0.003 - 0.0197 in).
- Second—third gear clearance should be 0.10 - 0.30 mm (0.003 - 0.0118 in.).

(2) If first gear thrust clearance is incorrect, replace gear and thrust washer. **If second or third gear clearance is incorrect, either gear and bearing, or out-**

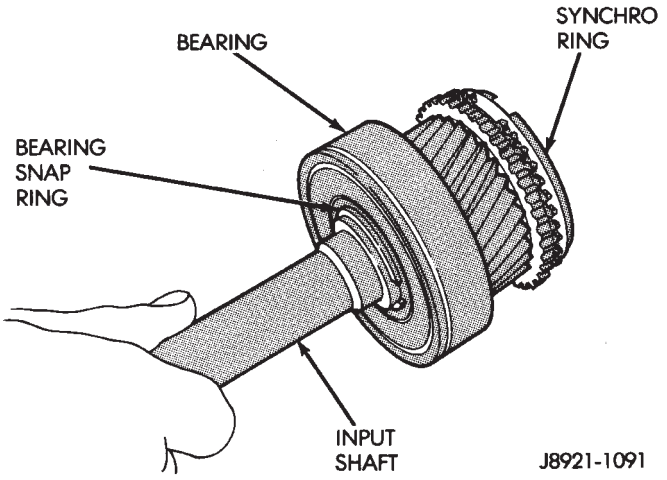


Fig. 61 Input Shaft Components

put shaft flange is worn. Refer to output shaft inspection in Cleaning and Inspection section.

(3) Press fifth gear and rear bearing off rear of output shaft.

(4) Remove thrust washer, pin, and first gear and bearing (Fig. 62).

(5) Remove first/reverse hub snap ring (Fig. 63).

(6) Remove synchro ring.

(7) Press reverse gear and first/reverse hub off shaft as assembly.

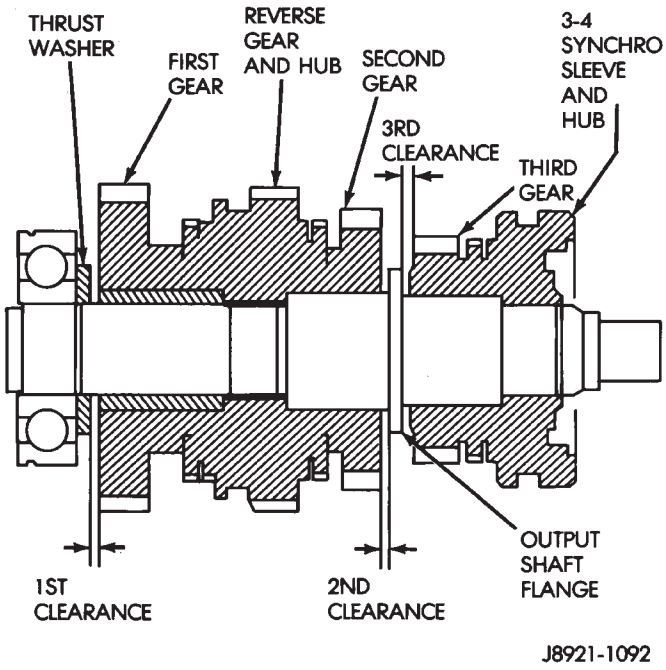


Fig. 62 Checking Output Shaft Gear Thrust Clearance

(8) Remove remaining synchro ring and second gear and bearing (Fig. 63).

(9) Remove snap ring at front of output shaft (Fig. 63).

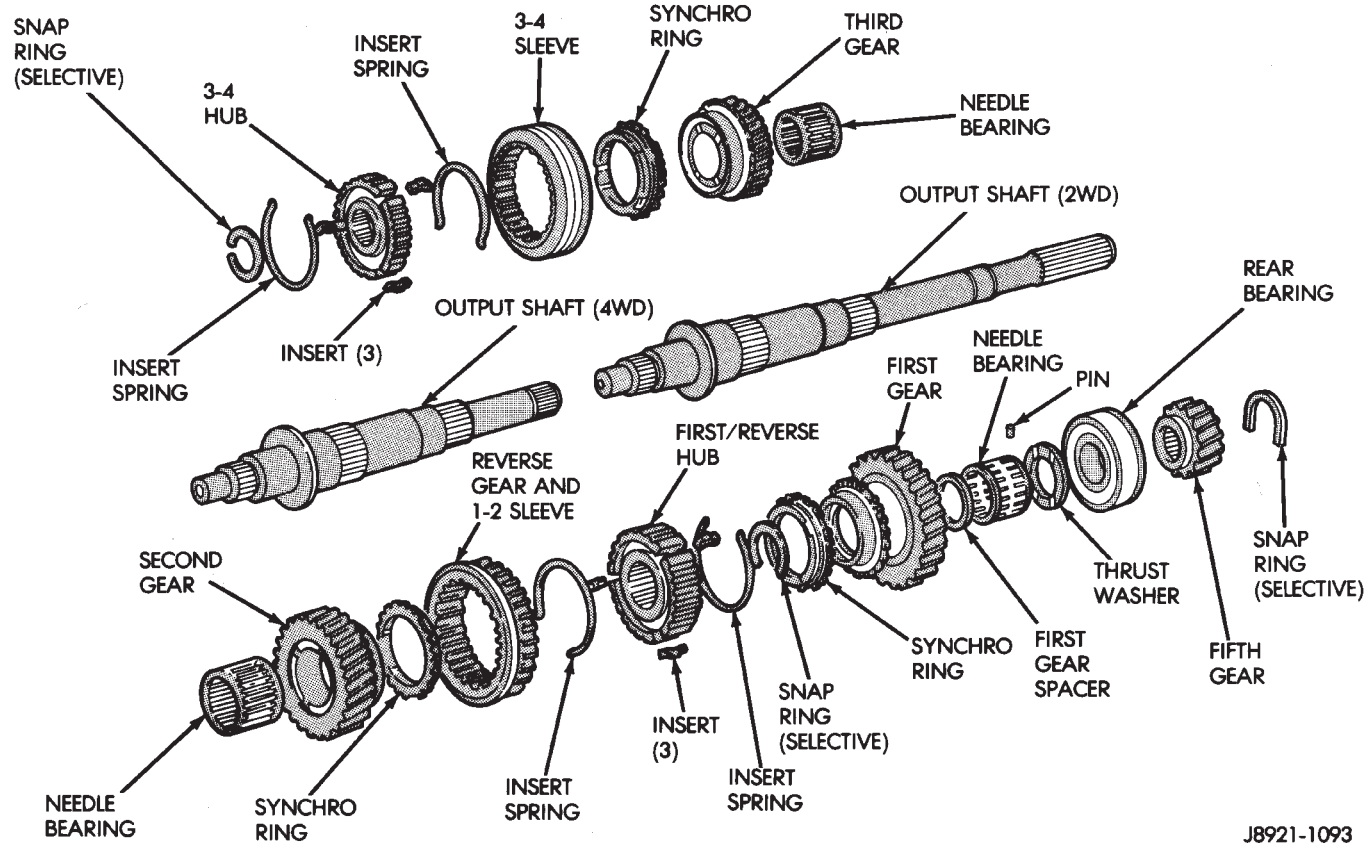


Fig. 63 Output Shaft And Gears

(10) Press 3-4 hub and sleeve off output shaft as assembly (Fig. 63).
(11) Remove synchro ring.
(12) Remove third gear and needle bearing (Fig. 63).

TRANSMISSION CLEANING AND INSPECTION

Clean the transmission components in solvent. Dry the cases, gears, shift mechanism and shafts with compressed air. **Dry the bearings with clean, dry shop towels only. Never use compressed air on the bearings. This could damage the bearing rollers.**

Replace components that are obviously worn, cracked, chipped or damaged in any way.

Inspect the transmission case. Replace the case if cracked or porous or if any of the bearing and gear bores are damaged.

Output Shaft Inspection

Measure thickness of the output shaft flange with a micrometer (Fig. 64). Minimum allowable flange thickness is 4.70 mm (0.185 in).

If shaft flange thickness is OK but previously measured second/third gear thrust clearance was incorrect (Fig. 62), replace the necessary gear and needle bearing as an assembly.

Check diameter of the first, second and third gear bearing surfaces of the output shaft (Fig. 64). Minimum allowable diameters are:

- 38.86 mm (1.529 in.) for first gear surface
- 46.86 mm (1.844 in.) for second gear surface
- 37.86 mm (1.490 in.) for third gear surface

Check output shaft runout with V-blocks and a dial indicator (Fig. 64). Maximum allowable runout is 0.06 mm (0.0024 in.).

Replace the output shaft if any surface measured fails to meet stated tolerance.

Cluster Gear Inspection

Inspect the cluster gear teeth. Replace the gear if any teeth are worn or damaged or if the bearing surfaces are damaged.

Check diameter of the cluster gear journal with a micrometer (Fig. 65). Minimum allowable diameter is 27.860 mm (1.096 in.).

Check condition of the cluster gear front bearing. Replace the bearing if worn, noisy, or damaged.

GEAR AND SYNCHRO INSPECTION

Install the synchro rings on their respective gears. Rotate each ring on the gear and note synchro action. Replace any synchro ring that exhibits a lack of braking action or binds on the gear. Also replace any ring that is worn or has chipped or broken teeth.

Measure end clearance between the synchro ring and the gear with a feeler gauge (Fig. 66). Clearance should be 0.06 mm - 1.6 mm (0.024 - 0.063 in.).

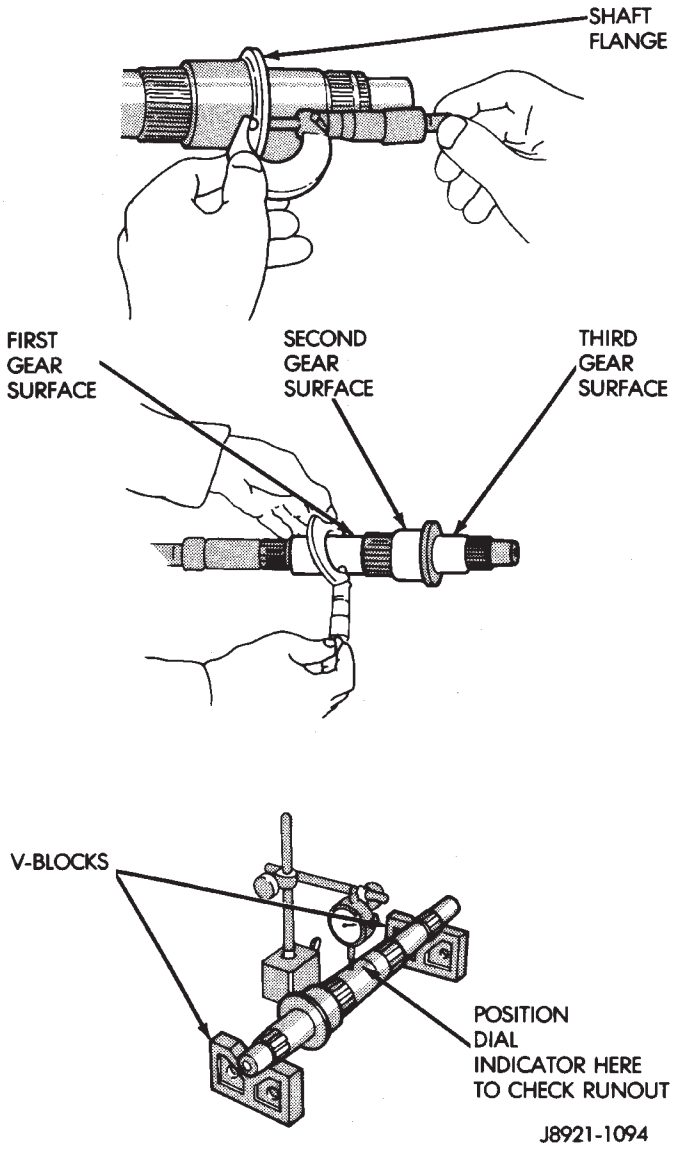


Fig. 64 Checking Output Shaft Tolerances

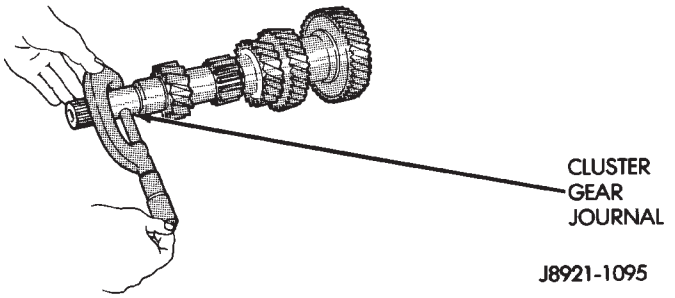


Fig. 65 Checking Cluster Gear Journal Diameter

Install the needle bearings in the first, second and third gears. Then install the gears on the output shaft and check shaft-to-gear clearance with a dial indicator (Fig. 67).

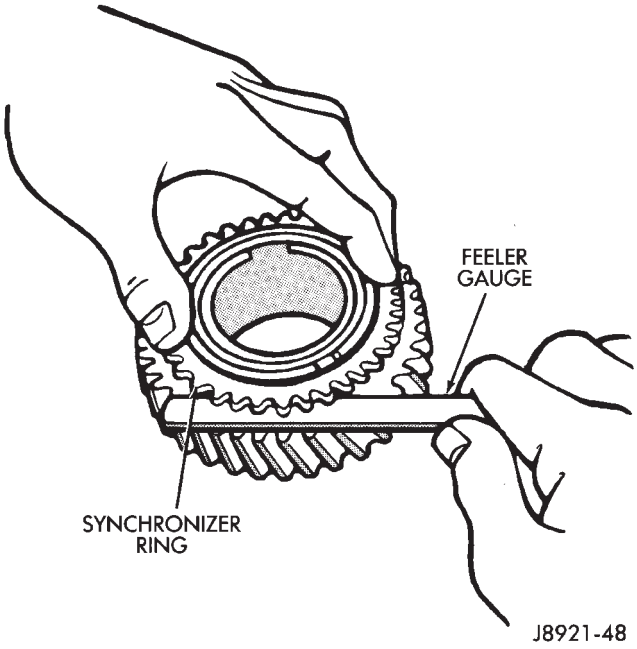


Fig. 66 Checking Synchro Ring End Clearance

Maximum allowable clearance is 0.16 mm (0.0063 in.). If any gear exhibits excessive clearance, replace the gear and needle bearing.

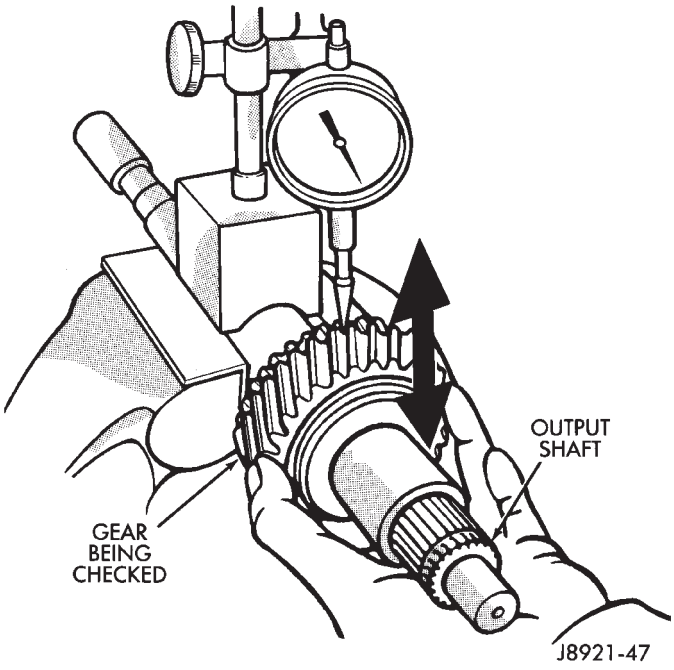


Fig. 67 Checking Gear-To-Shaft Clearance

Check clearance between the shift forks and synchro sleeves with a feeler gauge (Fig. 68). Clearance should not exceed 1.0 mm (0.039 in.). Replace the synchro sleeve (and matching hub) if clearance exceeds the stated limit.

Check condition of the reverse idler gear bushing (Fig. 69). Replace the gear if the bushing is damaged or worn.

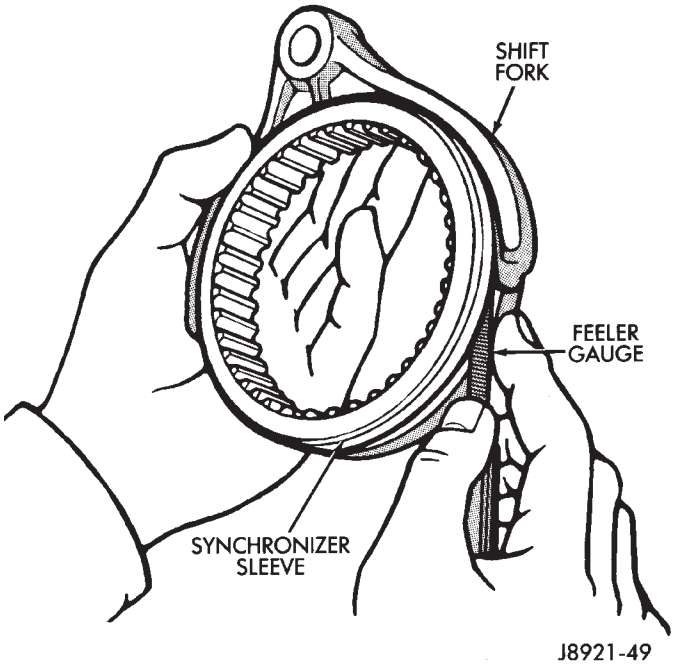


Fig. 68 Checking Shift Fork-To-Sleeve Clearance

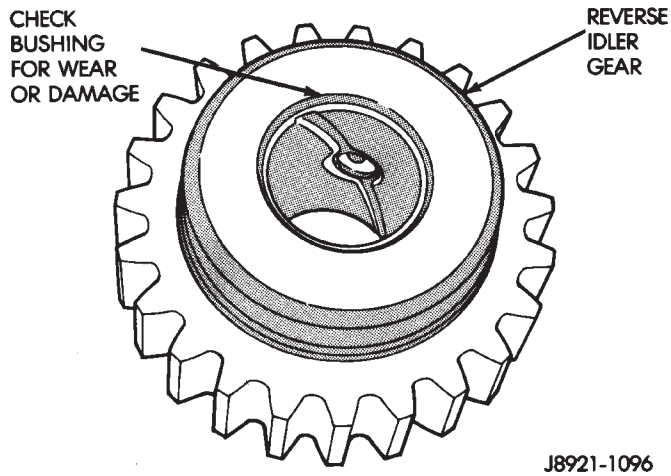


Fig. 69 Reverse Idler Gear Bushing

Gear Case, Housing And Intermediate Plate

Clean the case, housing and plate with solvent and dry with compressed air. Replace any component that is cracked, warped or damaged in any way.

Inspect the threads in the case, housing and plate. Minor thread damage can be repaired with steel thread inserts if necessary. However, do not attempt to repair if the cracks are evident around any threaded hole.

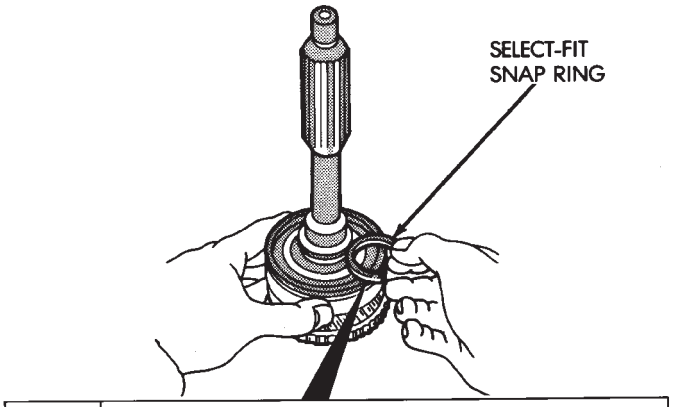
Inspect the reverse pin in the adapter/extension housing. Replace the pin if worn or damaged. Refer to the replacement procedure in the Transmission Assembly section.

TRANSMISSION ASSEMBLY AND ADJUSTMENT

Lubricate the transmission components with Mopar 75W-90 gear lubricant during assembly. Use petroleum jelly to lubricate seal lips and/or hold parts in place during installation.

FRONT BEARING, SEAL AND PIN INSTALLATION

(1) Press front bearing on input shaft. Then secure bearing with thickest snap ring that will fit in shaft groove (Fig. 70).

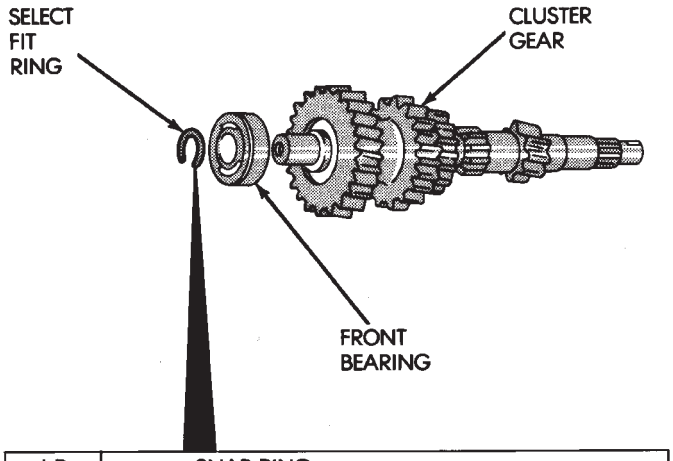


I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.10 - 2.15	(0.0827 - 0.0846)
B	2.15 - 2.20	(0.0846 - 0.0866)
C	2.20 - 2.25	(0.0866 - 0.0886)
D	2.25 - 2.30	(0.0886 - 0.0906)
E	2.30 - 2.35	(0.0906 - 0.0925)
F	2.35 - 2.40	(0.0925 - 0.0945)
G	2.40 - 2.45	(0.0945 - 0.0965)

J8921-1097

Fig. 70 Selecting Input Shaft Front Bearing Snap Ring

(2) Press front bearing on cluster gear. Then secure bearing with thickest snap ring that will fit in ring groove on gear (Fig. 71).



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.00 - 2.05	(0.0787 - 0.0807)
B	2.05 - 2.10	(0.0807 - 0.0827)
C	2.10 - 2.15	(0.0827 - 0.0846)
D	2.15 - 2.20	(0.0846 - 0.0866)
E	2.20 - 2.25	(0.0866 - 0.0886)

J8921-1098

Fig. 71 Selecting Cluster Gear Front Bearing Snap Ring

(3) Install new oil seals in front bearing retainer and adapter housing (Fig. 72). Installation depth for bearing retainer seal is 10.5 - 11.5 mm (0.414 - 0.453 in.).

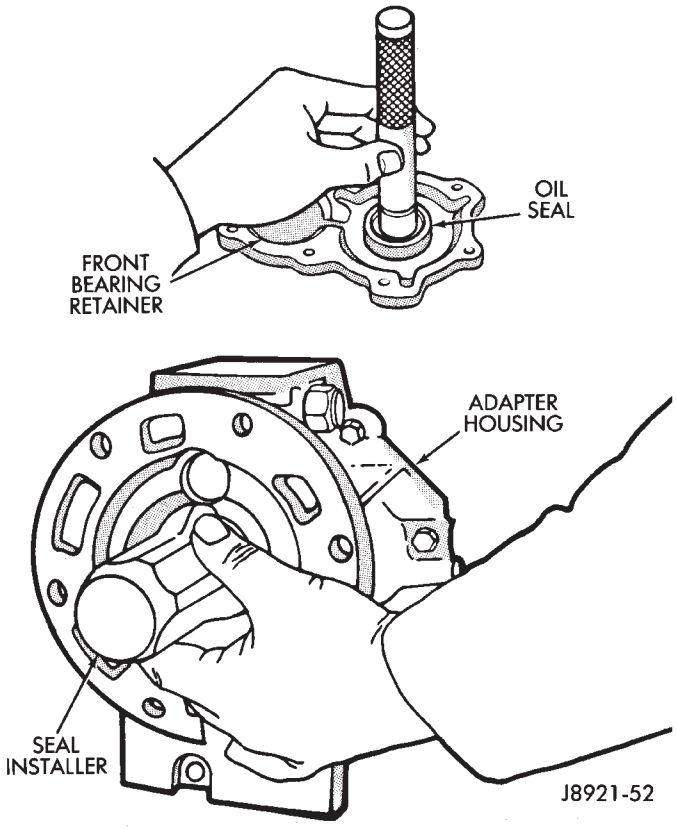


Fig. 72 Oil Seal Installation

(4) Install reverse shaft and shaft retaining pin in adapter housing. Then install access hole plug with torx bit (Fig. 73).

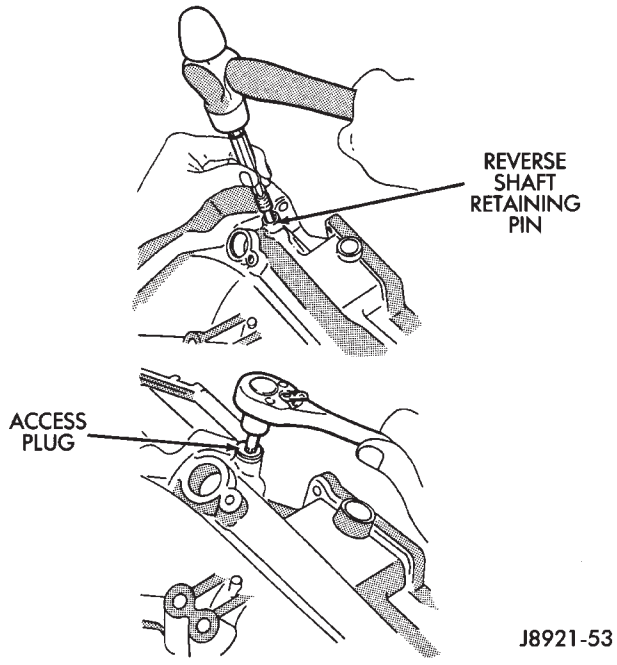


Fig. 73 Installing Reverse Shaft Pin

(5) Lubricate reverse shaft and gear components with Mopar 75W-90 gear lubricant.

OUTPUT SHAFT ASSEMBLY

(1) Lubricate output shaft journals, gears and needle bearings with Mopar 75W-90 gear lubricant.

(2) Install third gear and needle bearing on shaft (Fig. 63)

(3) Install synchro ring on third gear (Fig. 63).

(4) Assemble 1-2 and 3-4 synchro hubs and sleeves (Fig.74).

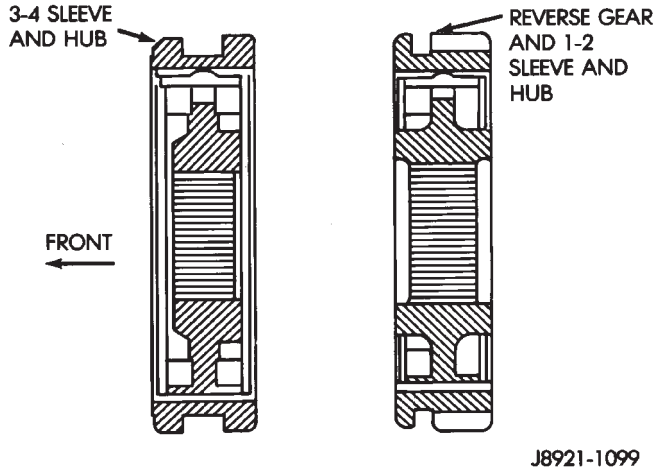


Fig. 74 Synchro Sleeve And Hub Identification

(5) Install inserts and springs in synchro sleeves. Position open ends of springs 180° apart as shown (Fig. 75).

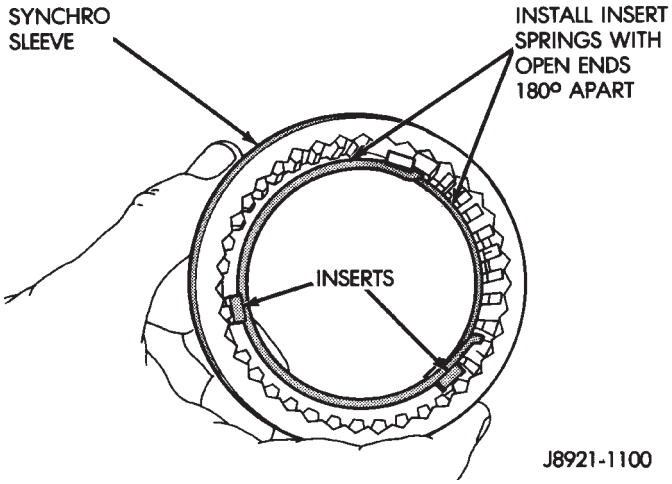
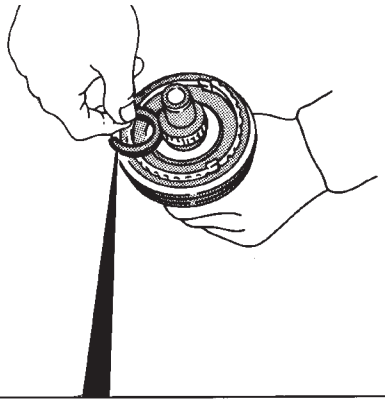


Fig. 75 Insert Spring Position

(6) Install 3-4 synchro hub and sleeve on output shaft. Press hub onto shaft if necessary.

(7) Install 3-4 synchro hub snap ring (Fig. 76). Use thickest snap ring that will fit in shaft groove.

(8) Verify third gear thrust clearance with feeler gauge (Fig. 56). Clearance should be 0.10 - 0.25 mm (0.004 - 0.010 in.).



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	1.80 - 1.85	(0.0709 - 0.0728)
B	1.85 - 1.90	(0.0728 - 0.0748)
C	1.90 - 1.95	(0.0748 - 0.0768)
D	1.95 - 2.00	(0.0768 - 0.0787)
E	2.00 - 2.05	(0.0787 - 0.0807)
F	2.05 - 2.10	(0.0807 - 0.0827)
G	2.10 - 2.15	(0.0827 - 0.0846)

J8921-1101

Fig. 76 Installing 3-4 Synchro Hub Snap Ring

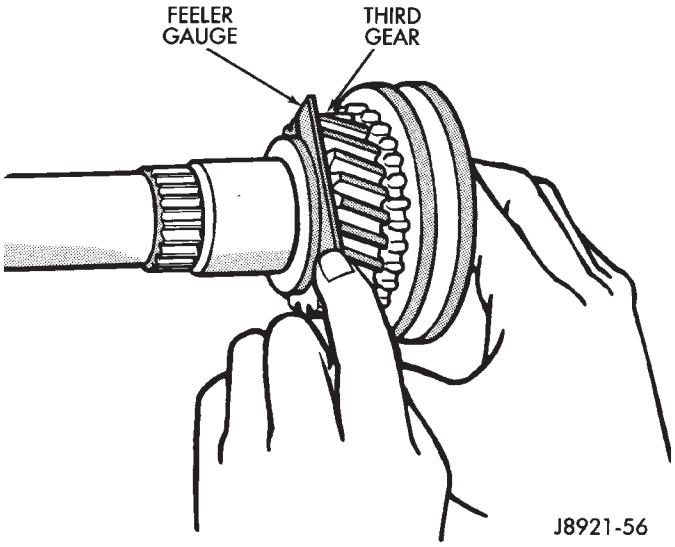


Fig. 77 Checking Third Gear Clearance

(9) Lubricate remaining output shaft gears and bearings with gear lubricant.

(10) Install second gear and needle bearing on shaft (Fig. 78).

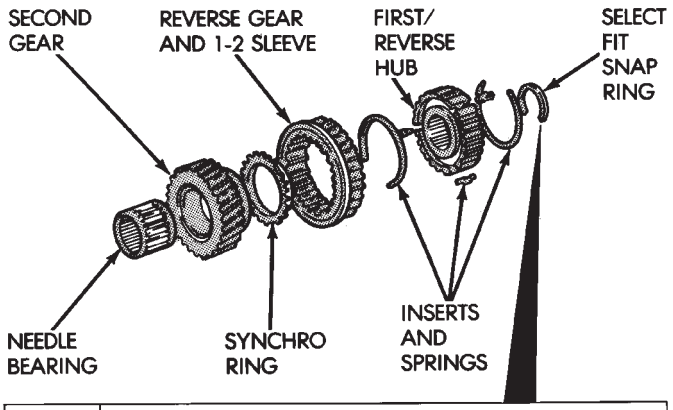
(11) Install synchro ring on second gear (Fig. 78).

(12) Assemble first/reverse hub, insert springs, inserts, reverse gear and 1-2 sleeve (Fig. 78). **Be sure spring ends are 180° apart. Note that splines in hub bore are chamfered on one side. Install hub so chamfered side faces front of output shaft.**

(13) Press assembled hub and sleeve on output shaft.

(14) Install selective snap ring (Fig. 78). Use thickest snap ring that will fit in output shaft groove.

(15) Install synchro ring on first gear (Fig. 79).



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
B	2.35 - 2.40	(0.0925 - 0.0945)
C	2.40 - 2.45	(0.0945 - 0.0965)
D	2.45 - 2.50	(0.0965 - 0.0984)
E	2.50 - 2.55	(0.0984 - 0.1004)
F	2.55 - 2.60	(0.1004 - 0.1024)
G	2.60 - 2.65	(0.1024 - 0.1043)

J8921-1102

Fig. 78 Second Gear And Synchro Assembly

(16) Install first gear spacer on shaft and against selective fit snap ring (Fig. 79).

(17) Install first gear and needle bearing (Fig. 79) on output shaft.

(18) Install locating pin and thrust washer on shaft (Fig. 79).

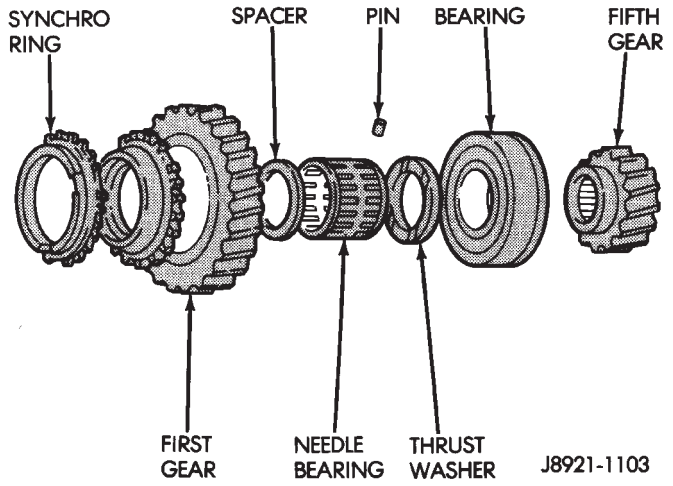


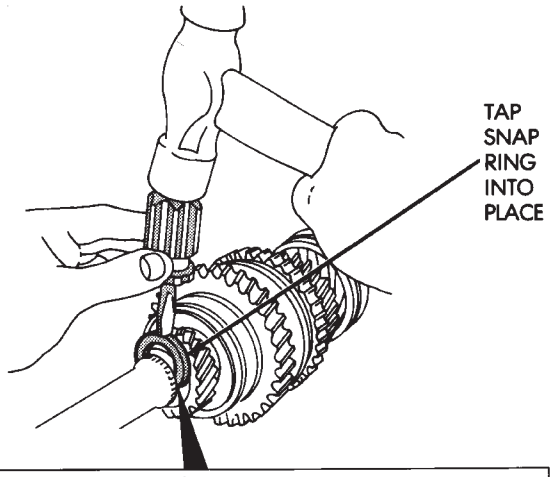
Fig. 79 First And Fifth Gear Components

(19) Press rear bearing on shaft. Position bearing snap ring groove so it is closest to end of output shaft.

(20) Check first and second gear thrust clearance with feeler gauge (Fig. 62).

- First gear clearance should be 0.10 - 0.40 mm (0.003 - 0.0197 in.)
- Second gear clearance should be 0.10 - 0.30 mm (0.003 - 0.0118 in.)

(21) Press fifth gear onto output shaft. Then install select fit snap ring (Fig. 80). Use thickest snap ring that will fit in shaft groove.



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.75 - 2.80	(0.1083 - 0.1102)
B	2.80 - 2.85	(0.1002 - 0.1122)
C	2.85 - 2.90	(0.1122 - 0.1142)
D	2.90 - 2.95	(0.1142 - 0.1161)
E	2.95 - 3.00	(0.1161 - 0.1181)
F	3.00 - 3.05	(0.1181 - 0.1201)
G	3.05 - 3.10	(0.1201 - 0.1220)
H	3.10 - 3.15	(0.1220 - 0.1240)
J	3.15 - 3.20	(0.1240 - 0.1260)
K	3.20 - 3.25	(0.1260 - 0.1280)
L	3.25 - 3.30	(0.1280 - 0.1299)
M	3.30 - 3.35	(0.1299 - 0.1319)

J8921-1104

Fig. 80 Selecting Fifth Gear Snap Ring

(22) Lubricate input shaft pilot bearing with petroleum jelly and install bearing in shaft (Fig. 60).

(23) Install input shaft on output shaft (Fig. 59). Be sure output shaft hub is fully seated in pilot bearing.

OUTPUT SHAFT AND CLUSTER GEAR INSTALLATION

(1) Mount intermediate plate in vise (Fig. 24).

(2) Lubricate cluster gear journal and rear bearing with petroleum jelly or gear lubricant.

(3) Install cluster gear rear bearing in intermediate plate (Fig. 81). Be sure snap ring groove in bearing is rearward as shown.

(4) Start cluster gear into bearing (Fig. 57). Then hold bearing and push gear into place. Use plastic or rawhide mallet to seat bearing if necessary.

(5) Start output shaft rear bearing in intermediate plate. Push shaft rearward and tap intermediate plate with mallet to seat bearing.

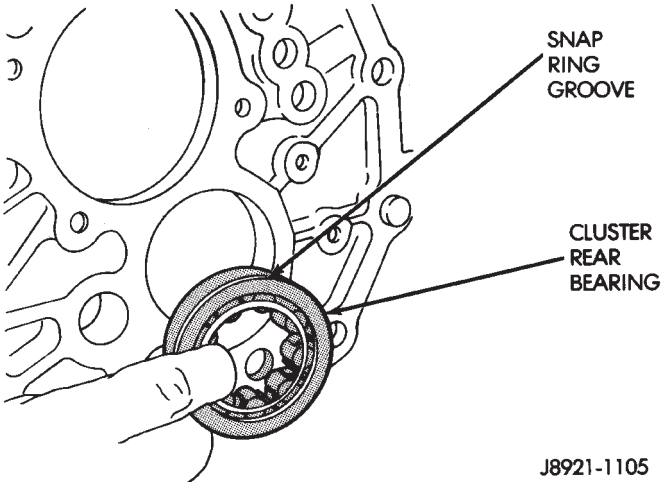


Fig. 81 Installing Cluster Gear Rear Bearing

(6) Install snap rings on cluster and output shaft **rear** bearings only (Fig. 82). Do not install front bearing snap rings at this time.

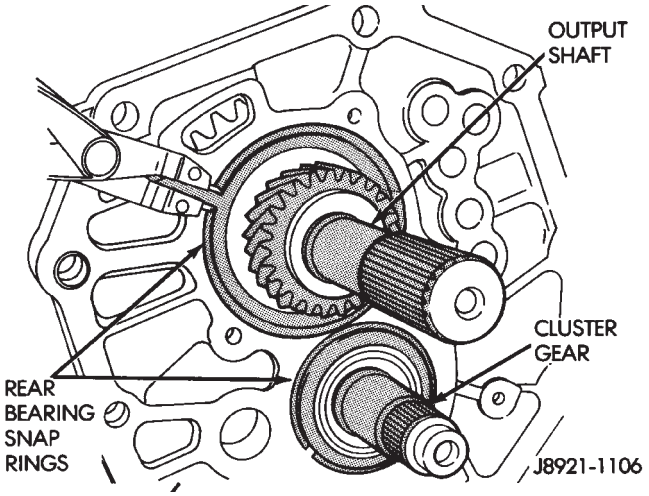


Fig. 82 Installing Rear Bearing Snap Rings

(7) Install reverse idler gear and shaft (Fig. 83).

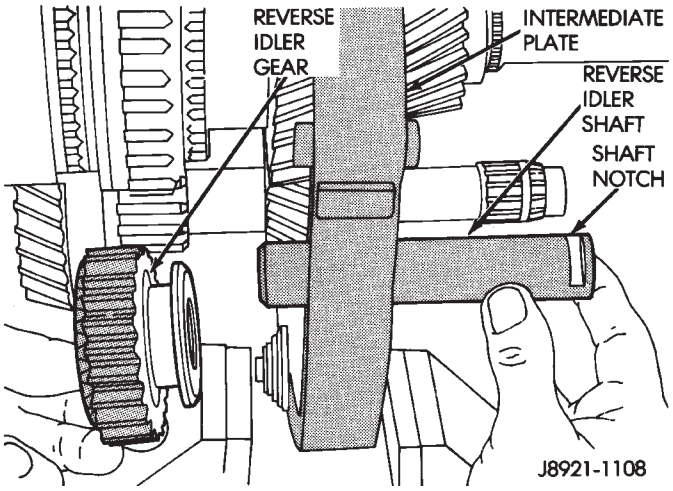


Fig. 83 Installing Reverse Idler Gear And Shaft

(8) Position rear bearing retainer over output shaft and rear bearing. **Be sure bearing retainer tab is engaged in reverse idler shaft notch (Fig. 84).**

(9) Install and tighten rear bearing retainer bolts to 18 N·m (13 ft-lbs).

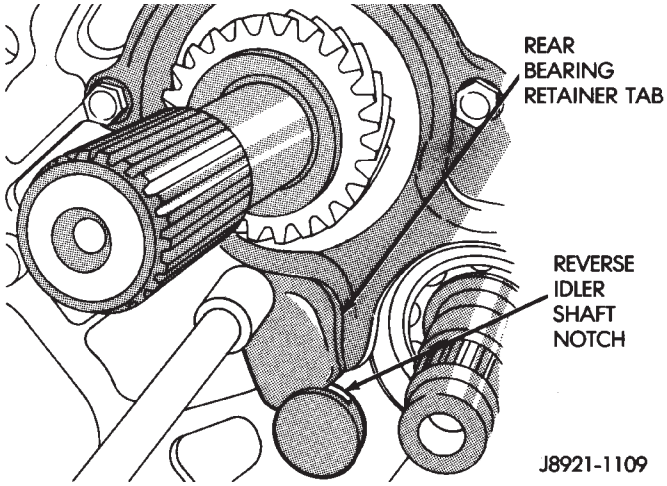


Fig. 84 Installing Rear Bearing Retainer

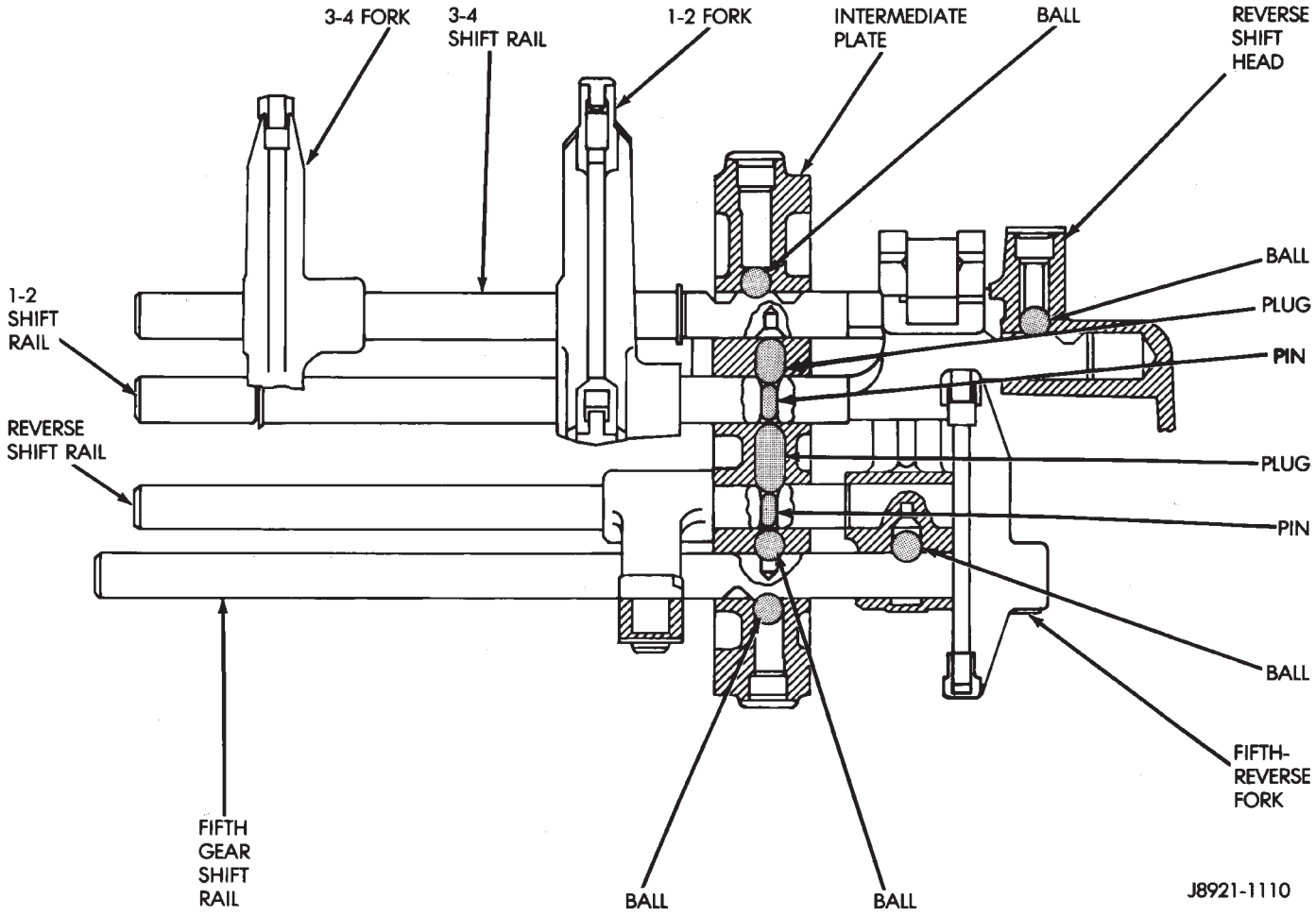


Fig. 85 Shift Rail Ball-Plug-Pin Position

SHIFT RAIL AND FORK INSTALLATION

The shift rail interlock pins, balls and plugs must be installed in the correct sequence for proper shifting. Refer to the installation diagram (Fig. 85) during assembly.

Coat the intermediate plate shift rail bores and the interlock balls, pins and plugs with a heavy coating of petroleum jelly before assembly. The jelly will hold the interlock components in place making installation easier. Use a pencil magnet to hold and insert the interlocks. Then use a small screwdriver to push the interlock components into place.

(1) Coat reverse rail interlock pin with petroleum jelly and install pin in rail (Fig. 86).

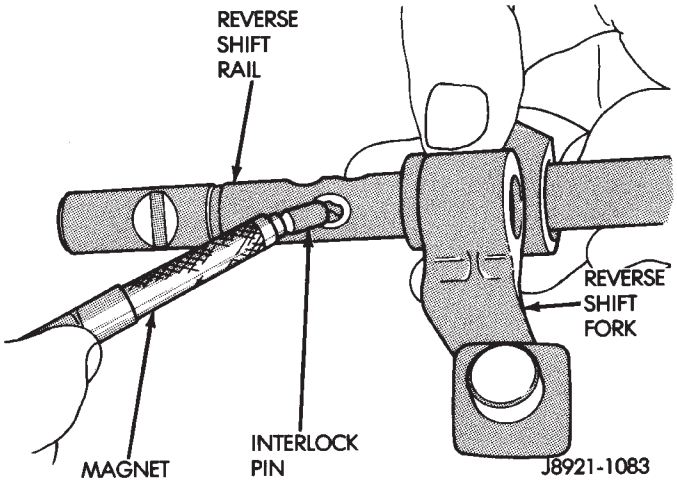


Fig. 86 Installing Reverse Shift Rail Interlock Pin

(2) Install reverse shift rail in intermediate plate (Fig. 87).

(3) Install reverse shift rail C-ring (Fig. 51).

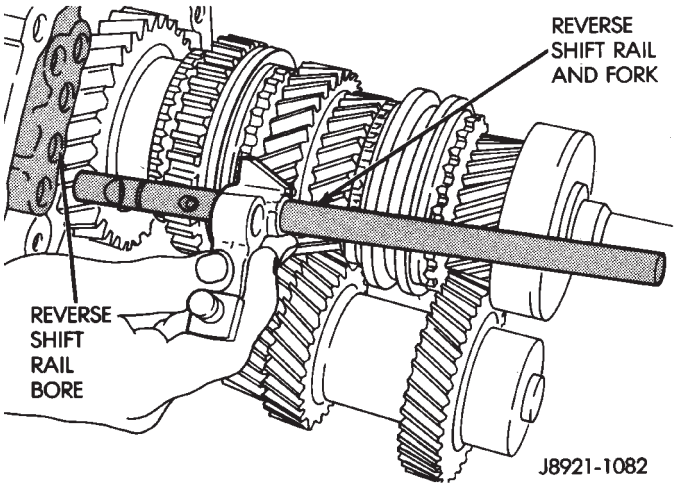


Fig. 87 Installing Reverse Shift Rail And Fork

(4) Position 1-2 and 3-4 shift forks in synchro sleeves (Fig. 88).

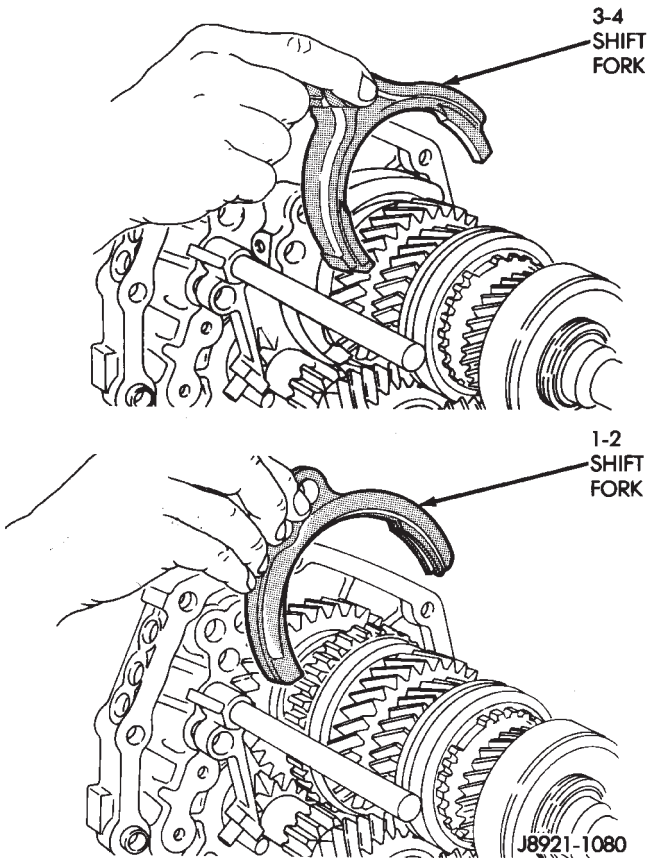


Fig. 88 Shift Fork Installation

(5) Coat reverse rail lock ball with petroleum jelly. Then tilt reverse shift fork upward and insert ball in intermediate plate (Fig. 89).

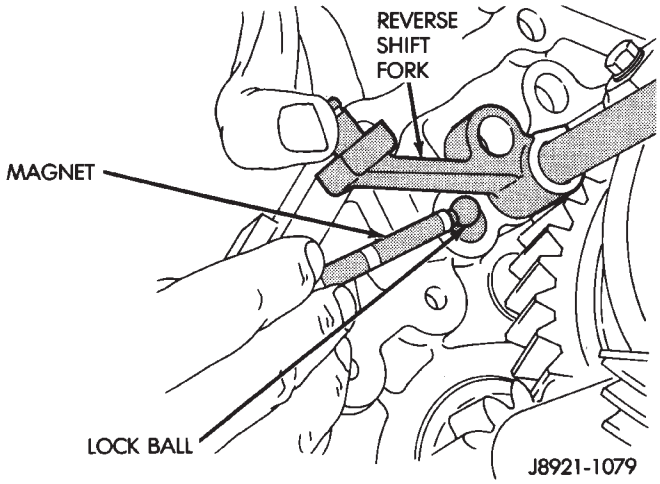


Fig. 89 Installing Reverse Shift Rail Lock Ball

(6) Coat 1-2 shift rail interlock plug with petroleum jelly and install it in intermediate plate bore (Fig. 90).

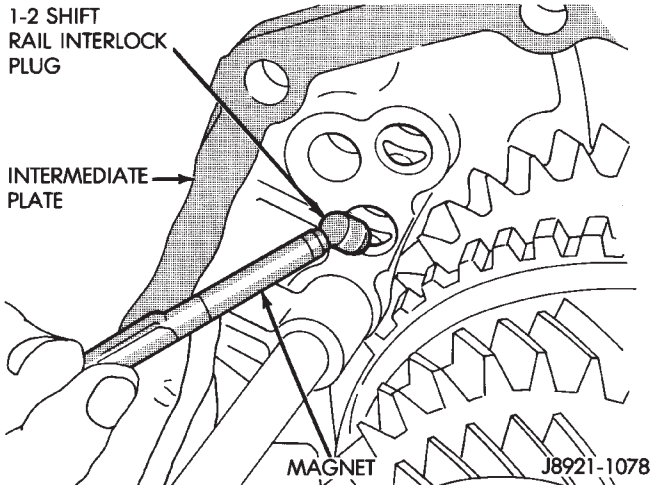


Fig. 90 Installing 1-2 Shift Rail Interlock Plug

(7) Coat 1-2 shift rail interlock pin with petroleum jelly and insert it in shift rail (Fig. 91).

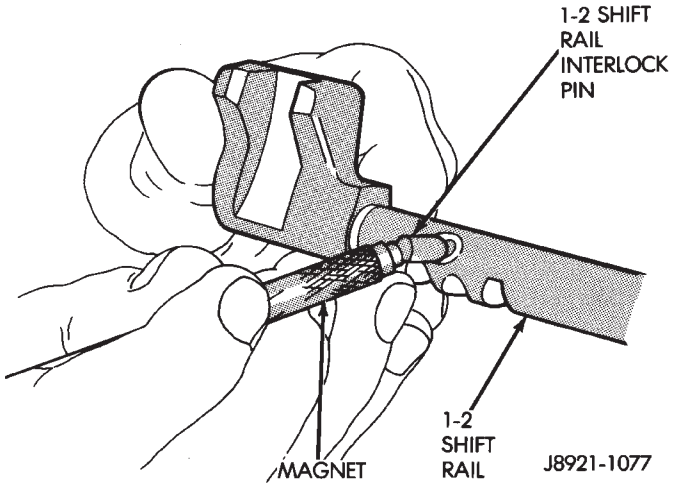


Fig. 91 Installing 1-2 Shift Rail Interlock Pin

(8) Install 1-2 shift rail in intermediate plate and 1-2 fork (Fig. 92).

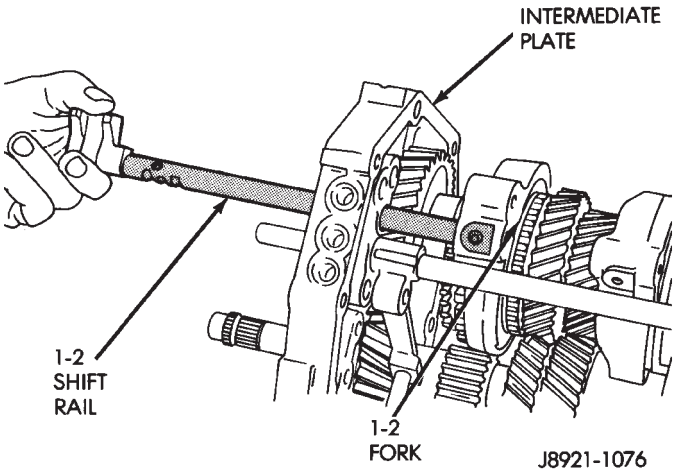


Fig. 92 Installing 1-2 Shift Rail

(9) Coat 3-4 shift rail interlock plug with petroleum jelly and install plug in intermediate plate (Fig. 93).

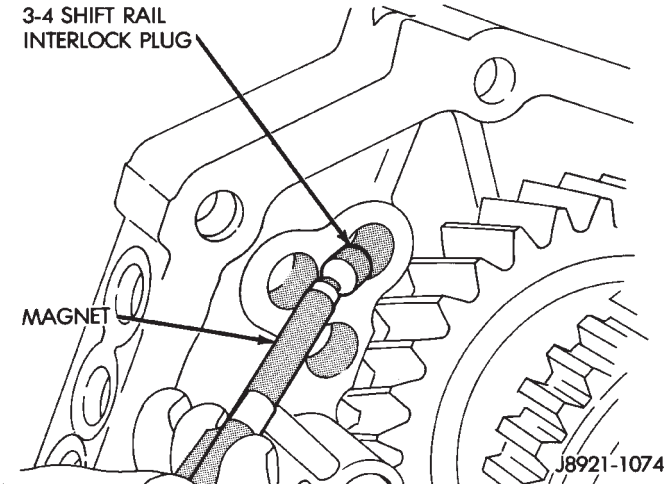


Fig. 93 Installing 3-4 Shift Rail Interlock Plug

(10) Install 3-4 shift rail in intermediate plate and in both shift forks (Fig. 94).

(11) Verify that none of interlock balls, plugs, or pins were displaced during shift rail installation.

(12) Install and tighten shift fork setscrews to 20 N·m (14 ft. lbs.) torque (Fig. 95).

(13) Install 1-2 and 3-4 shift rail C-rings (Fig. 96).

(14) Insert fifth gear shift rail through reverse shift fork. **Then slide rail into intermediate plate just far enough to secure interlock ball. Do not fully install shift rail at this time.**

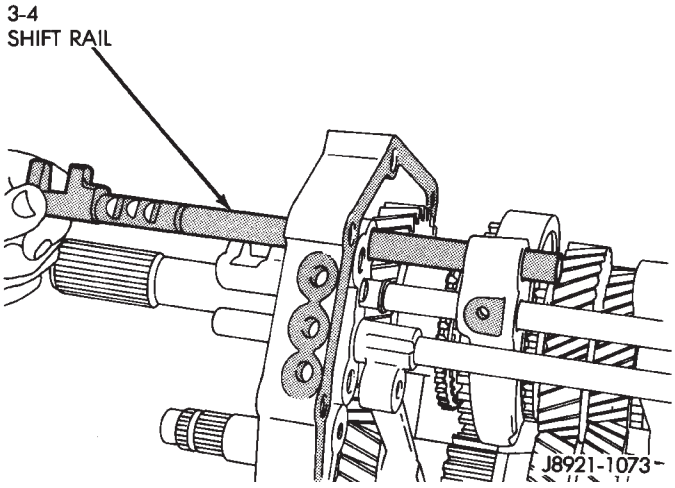


Fig. 94 Installing 3-4 Shift Rail

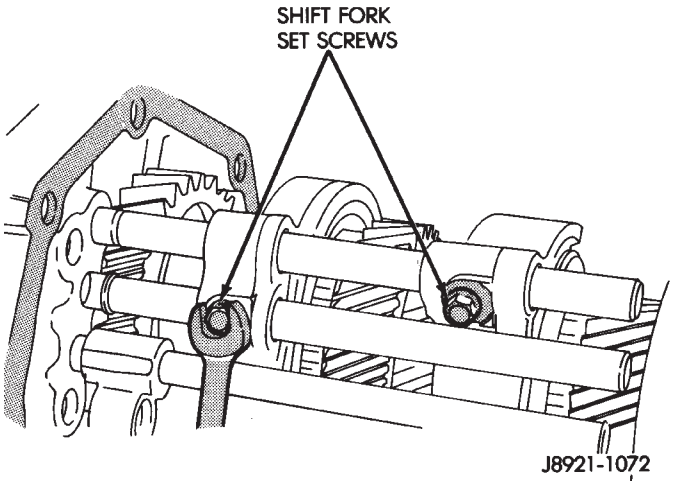


Fig. 95 Installing Shift Fork Set Screws

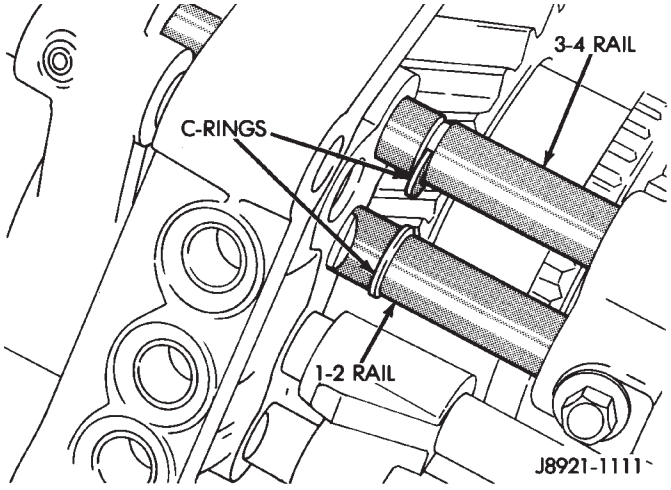


Fig. 96 Installing Shift Rail C-Rings

FIFTH-REVERSE GEAR AND SHIFT COMPONENT INSTALLATION

(1) Install thrust ring lock ball in cluster gear journal (Fig. 97). Use petroleum jelly to hold ball in place.

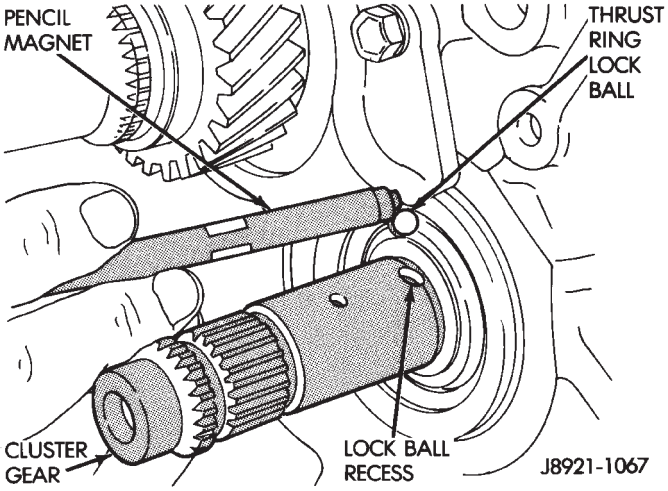


Fig. 97 Installing Thrust Ring Lock Ball

(2) Install fifth gear thrust ring (Fig. 98). Be sure thrust ring notch fits over lock ball.

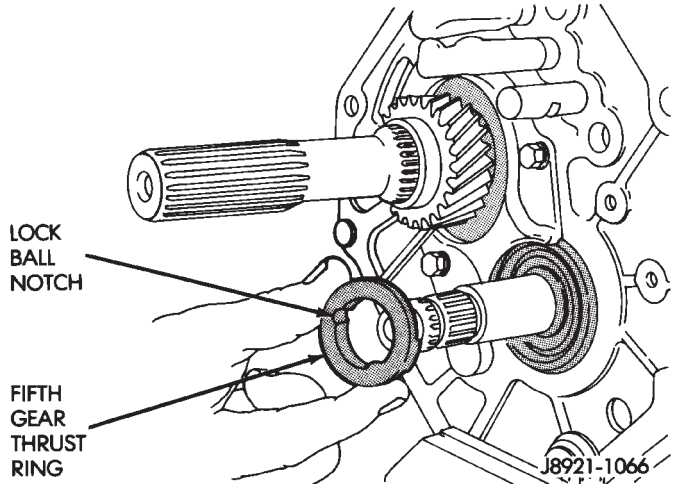


Fig. 98 Installing Fifth Gear Thrust Ring

(3) Assemble counter fifth gear, synchro sleeve, inserts and insert springs (Fig. 99).

(4) Lubricate two-piece bearing with petroleum jelly and install it in counter fifth gear (Fig. 100).

(5) Install counter fifth gear and synchro assembly on cluster gear journal (Fig. 101).

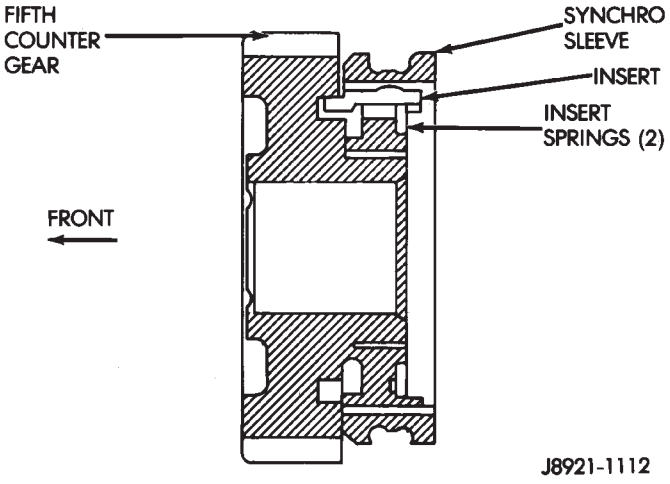


Fig. 99 Assembling Fifth Gear And Synchro Assembly

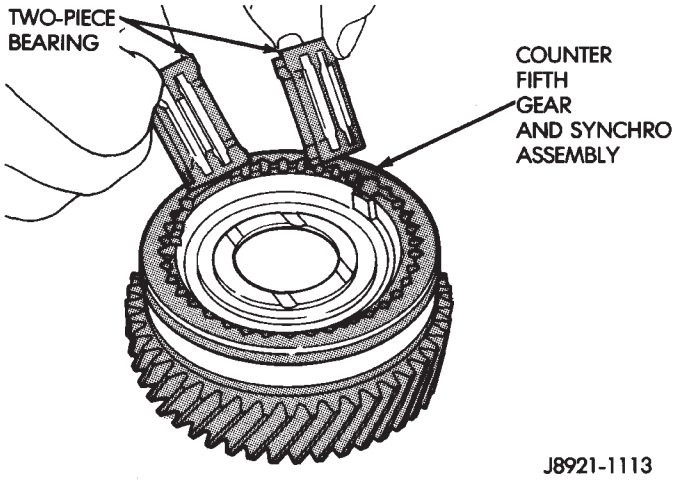


Fig. 100 Installing Counter Fifth Gear Bearing

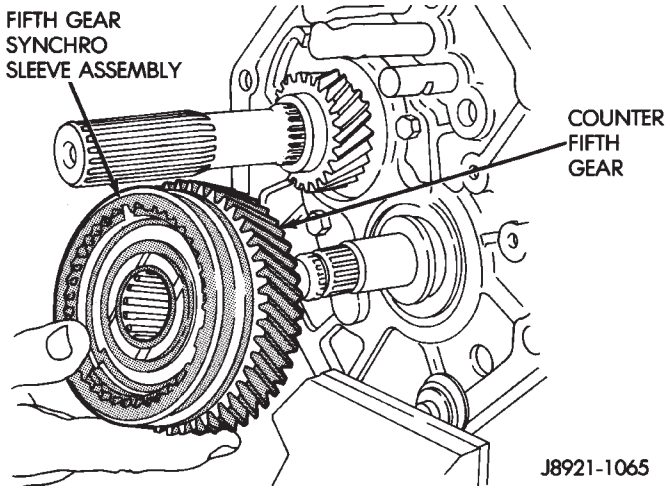


Fig. 101 Installing Counter Fifth Gear And Sleeve

(6) Install synchro ring in synchro sleeve (Fig. 102).

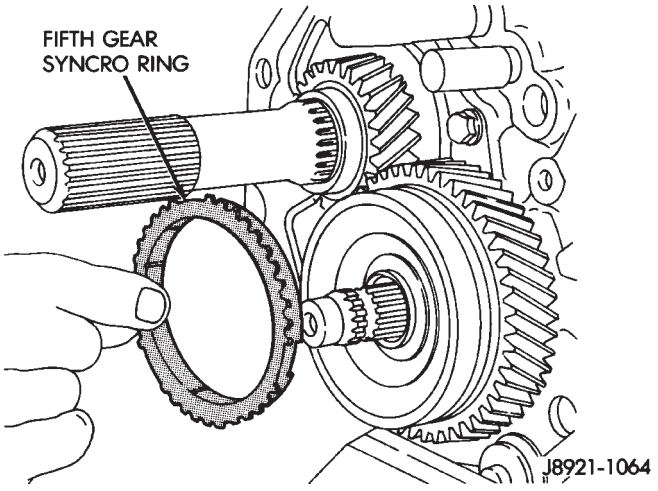


Fig. 102 Installing Fifth Gear Synchro Ring

(7) Install fifth spline gear on cluster journal (Fig. 103). Tap spline gear into place with plastic mallet if necessary.

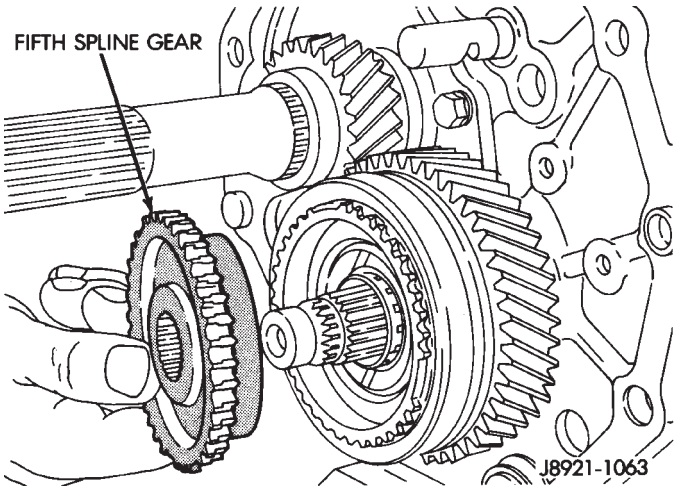


Fig. 103 Installing Fifth Spline Gear

(8) Install fifth gear selective snap ring (Fig. 104). Use thickest snap ring that will fit in shaft groove.

(9) Install reverse shift head and rail (Fig. 105). Then install lock ball in shift head.

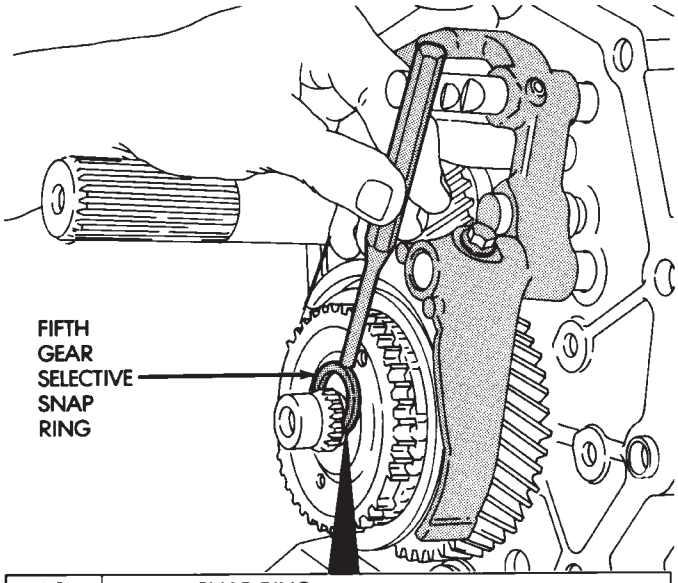
(10) Position fifth gear shift fork in synchro sleeve (Fig. 106).

(11) Install fifth gear shift rail (Fig. 107). Slide rail through fork, shift head, intermediate plate and reverse shift fork. Be sure interlock ball is not displaced during installation.

(12) Align screw holes in shift fork and rail and install set screw (Fig. 108). Tighten screw to 20 N·m (15 ft. lbs.) torque.

(13) Install lock balls and springs in intermediate plate (Fig. 109). Then install and tighten lock ball plugs to 19 N·m (14 ft. lbs.) torque.

(14) Install reverse shift arm bracket (Fig. 110). Tighten bracket bolts to 18 N·m (13 ft. lbs.) torque.



I.D. MARK	SNAP RING THICKNESS	MM (IN.)
A	2.85 - 2.90	(0.1122 - 0.1142)
B	2.90 - 2.95	(0.1142 - 0.1161)
C	2.95 - 3.00	(0.1161 - 0.1181)
D	3.00 - 3.05	(0.1181 - 0.1201)
E	3.05 - 3.10	(0.1201 - 0.1220)
F	3.10 - 3.15	(0.1220 - 0.1240)
G	3.15 - 3.20	(0.1240 - 0.1260)
H	3.20 - 3.25	(0.1260 - 0.1280)

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Fig. 104 Installing Fifth Gear Snap Ring

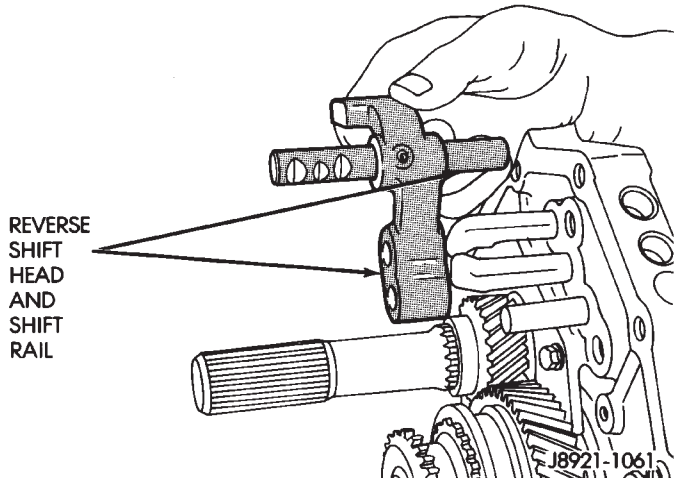


Fig. 105 Installing Reverse Shift Head And Rail

(15) Install reverse shift arm (Fig. 110). Position arm on reverse fork pin and engage it with pin on shift arm bracket.

(16) Verify that shift arm shoe is engaged in reverse idler gear. Then secure shift arm to pin on reverse fork with new E-clip.

GEAR CASE AND ADAPTER INSTALLATION

(1) Dismount intermediate and gear assemblies from vise.

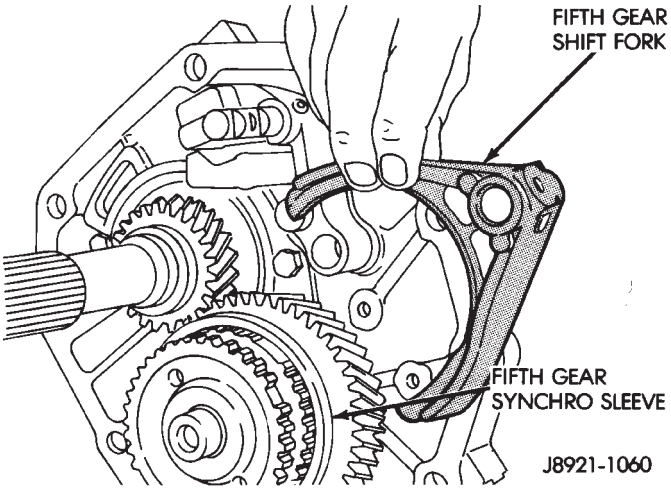


Fig. 106 Installing Fifth Gear Shift Fork

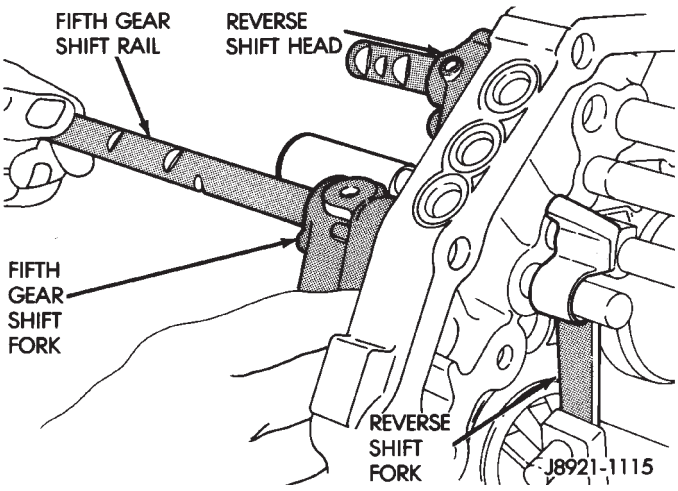


Fig. 107 Installing Fifth Gear Shift Rail

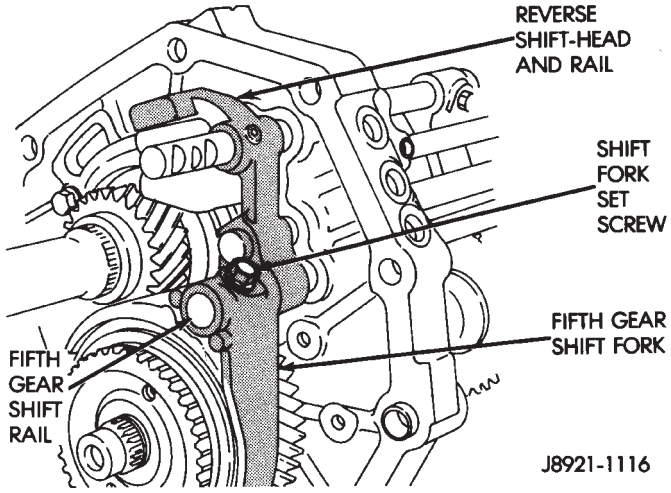
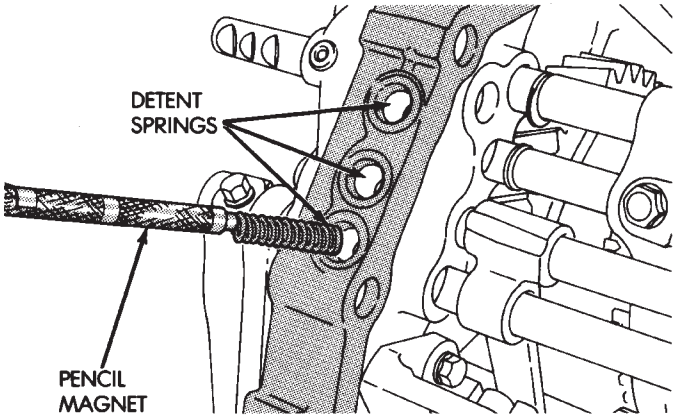


Fig. 108 Shift Fork Set Screw Installation

(2) Clean mating surfaces of intermediate plate and transmission gear case with wax and grease remover. Then wipe dry with a clean cloth.



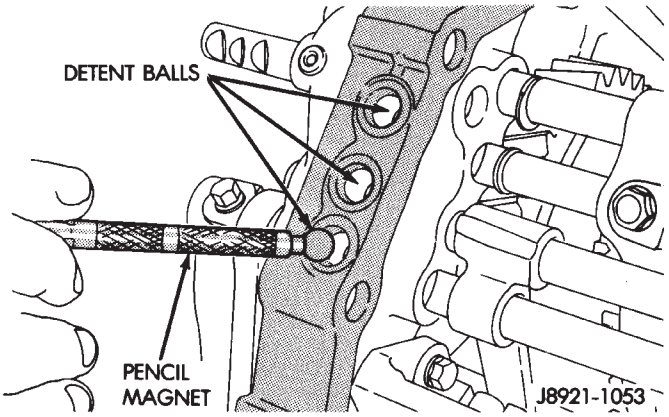


Fig. 109 Detent Ball And Spring Installation

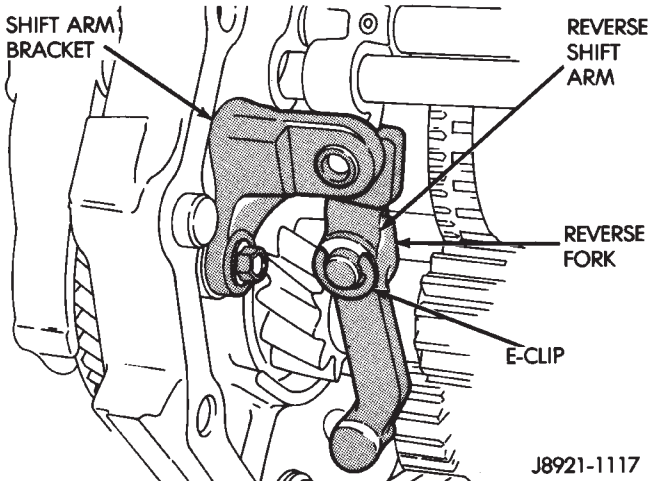


Fig. 110 Reverse Shift Arm And Bracket Installation

(3) Apply 3 mm (1/8 in.) wide bead of Mopar Gasket Maker to mating surface of gear case. Keep sealer bead inside bolt holes as shown (Fig. 111).

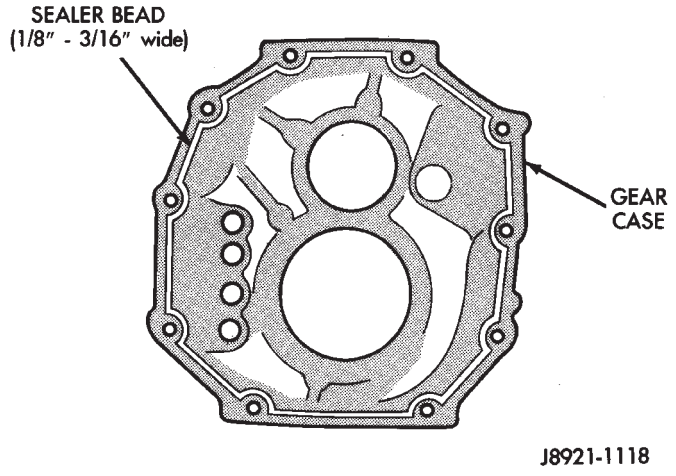


Fig. 111 Applying Sealer To Gear Case

(4) Install gear case (Fig. 112). Align shift rails and bearings in case and tap case into position.

(5) Verify that gear case is seated on intermediate plate dowel pins.

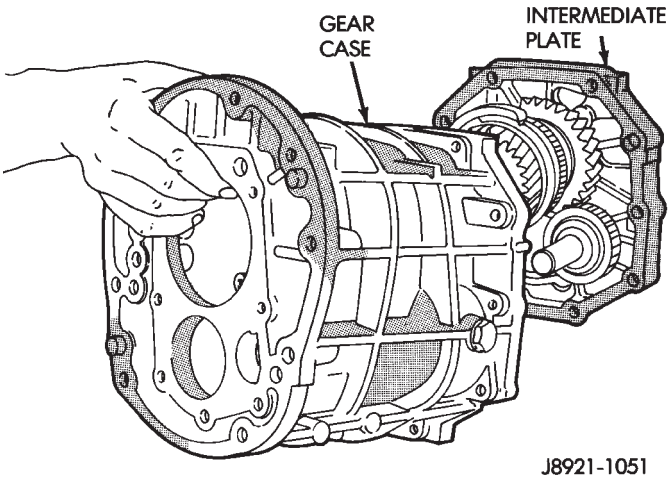


Fig. 112 Installing Gear Case

(6) Install front bearing snap rings (Fig. 113).

(7) Clean gear case and front bearing retainer sealing surfaces with wax and grease remover. Then wipe dry with a clean cloth.

(8) Install new seal in front bearing retainer. Then lubricate seal lip with petroleum jelly. **Installation depth for seal is 10.5 - 11.5 mm (0.413 - 0.453 in.).**

(9) Apply a 3 mm (1/8 in.) wide bead of Mopar Gasket Maker to front bearing retainer sealing surface.

(10) Align and install front bearing retainer (Fig. 114). Be sure retainer is properly seated on case and bearings.

(11) Install and tighten front bearing retainer bolts to 17 N·m (12 ft. lbs.) torque.

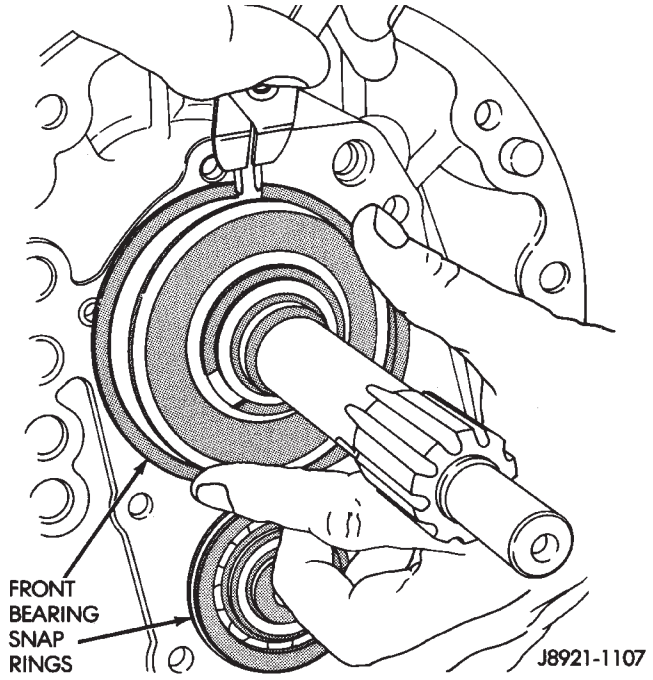


Fig. 113 Installing Front Bearing Snap Rings

(12) On 2-wheel drive models, install speedometer gear, lock ball and retaining rings (Fig. 115). Be sure lock ball is engaged in gear.

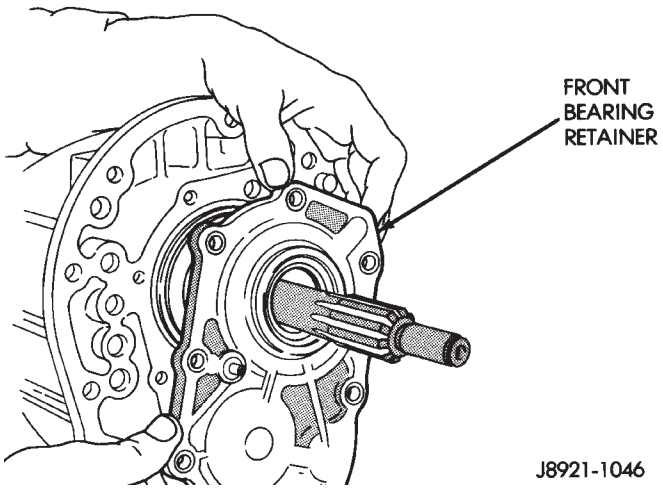


Fig. 114 Installing Front Bearing Retainer

(13) Inspect condition o reverse pin in adapter/extension housing (Fig. 116). If pin is worn or damaged, replace it as follows:

(a) Remove roll pin access plug (Fig. 117).

(b) Tap roll pin out of housing with pin punch (Fig. 118). Then remove old reverse pin.

(c) Install new reverse pin and secure it with roll pin. Then install and tighten access plug to 19 N·m (14 ft. lbs.) torque.

(14) Clean sealing surfaces of adapter or extension housing and intermediate plate with wax and grease remover. Then wipe dry with a clean cloth.

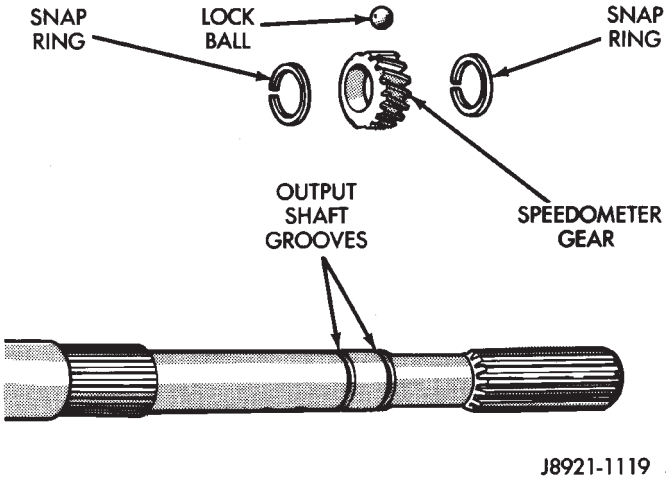


Fig. 115 Speedometer Gear Installation (2WD Models)

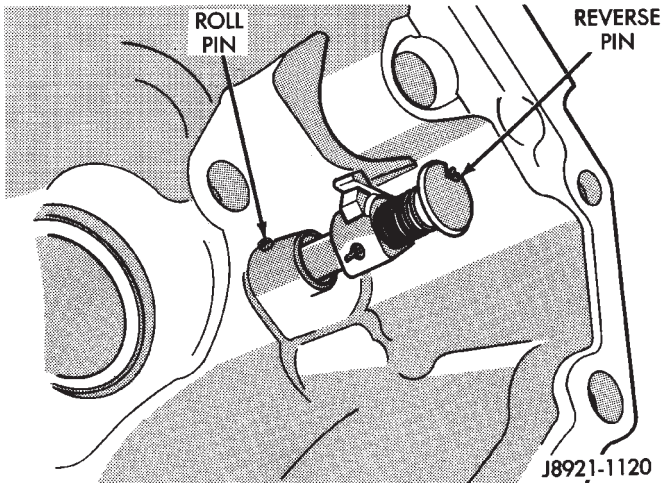


Fig. 116 Reverse Pin Position

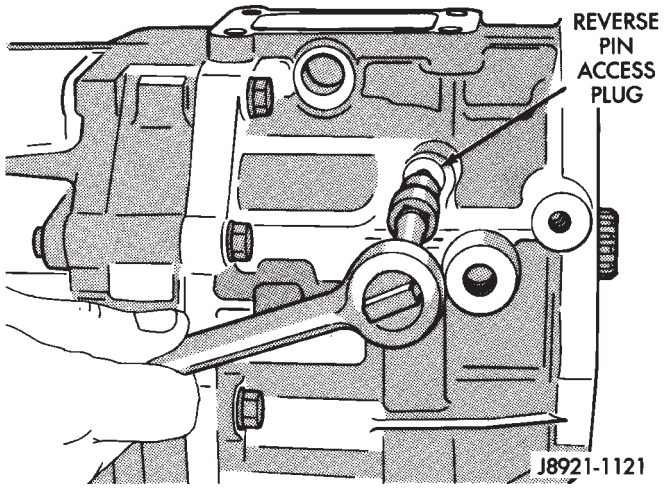


Fig. 117 Access Plug Removal/Installation

(15) Apply 3 mm (1/8 in.) wide bead of Mopar Gasket Maker to sealing surface of adapter or extension housing. Keep sealer bead inside bolt holes as shown in Figure 111.

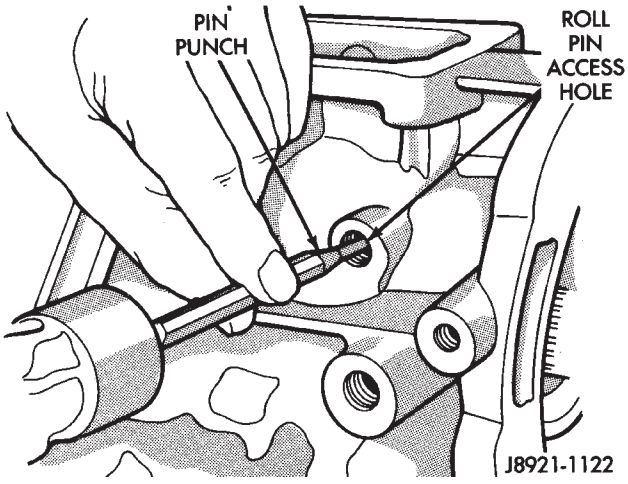


Fig. 118 Roll Pin Removal/Installation

(16) Align and install adapter or extension housing on intermediate plate (Fig. 119). Be sure housing is seated on intermediate plate dowel pins.

(17) Coat threads of housing attaching bolts with silicone sealer. Then install and tighten bolts to 37 N·m (27 ft. lbs.) torque.

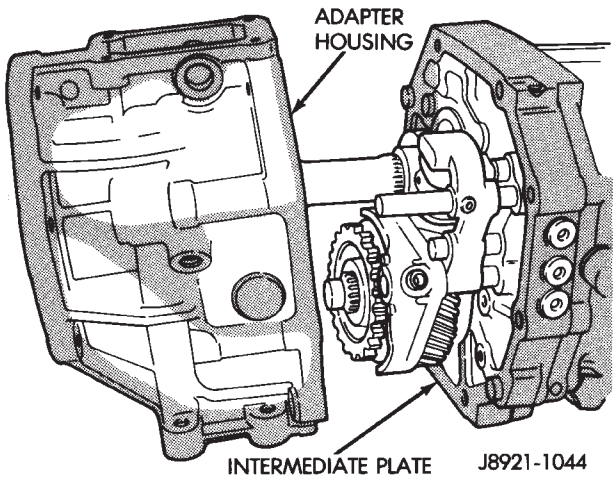


Fig. 119 Adapter/Extension Housing Installation

(18) Install detent ball (Fig. 120).

(19) Install detent spring (Fig. 121).

(20) Install detent access plug (Fig. 122). Tighten plug to 19 N·m (14 ft. lbs.) torque.

(21) Lubricate shift arm shaft and install it in adapter housing (Fig. 123).

(22) Position shift arm in adapter housing (Fig. 124). Be sure arm is engaged in shift rails.

(23) Align shift arm with shaft and push shaft into arm.

(24) Rotate shift arm shaft until set screw holes in shaft and arm are aligned.

(25) Install and tighten shift arm set screw to 38 N·m (28 ft. lbs.) torque (Fig. 125).

(26) Install and tighten restrictor pins to 19 N·m (14 ft. lbs.) torque (Fig. 125).

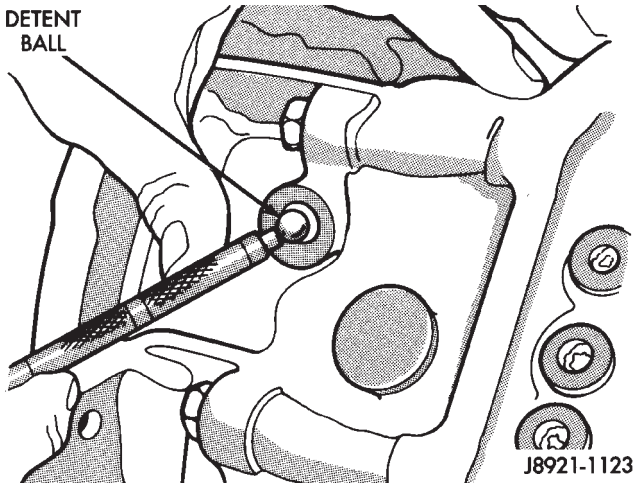


Fig. 120 Installing Detent Ball

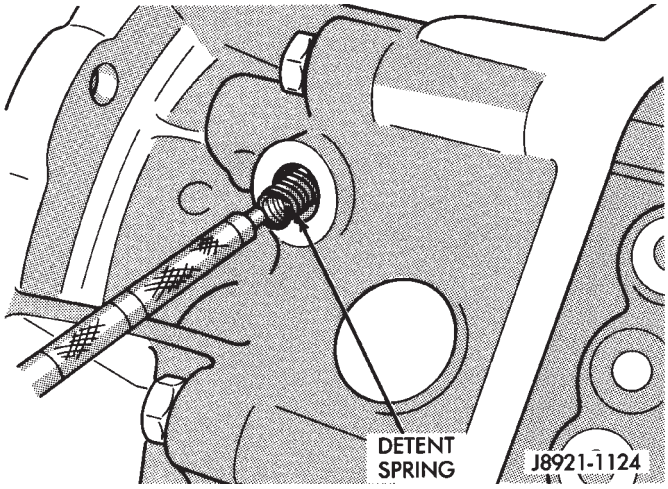


Fig. 121 Installing Detent Spring

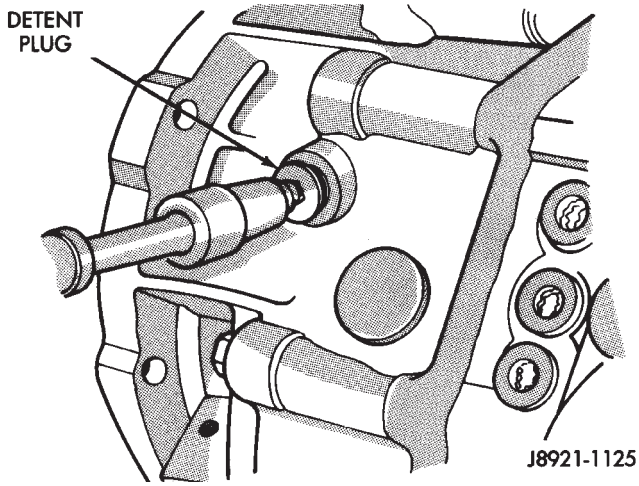


Fig. 122 Installing Detent Access Plug

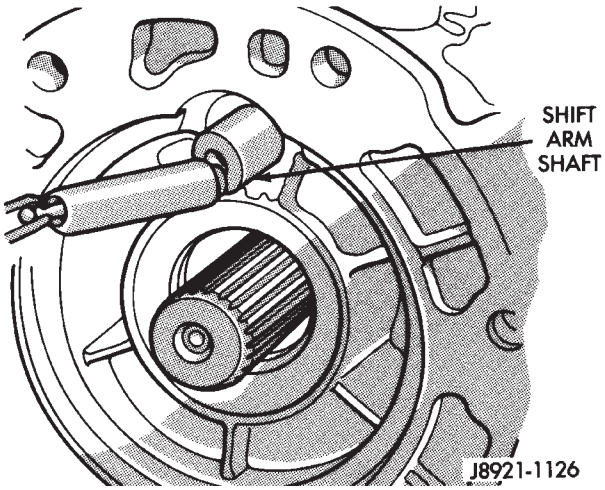


Fig. 123 Installing Shift Arm Shaft

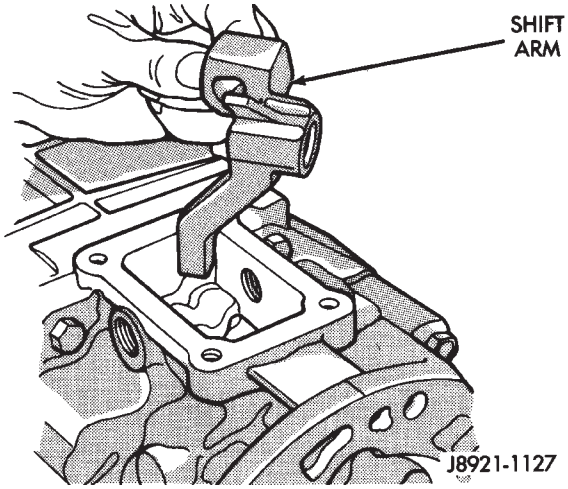


Fig. 124 Shift Arm Installation

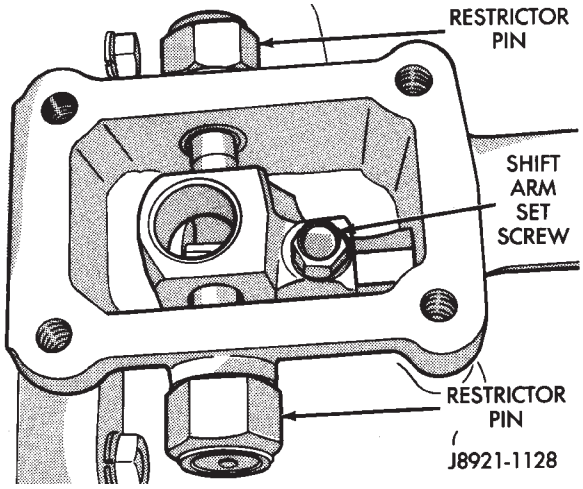


Fig. 125 Set Screw And Restrictor Pin Installation

(27) Install and tighten shift arm shaft access plug to 19 N·m (14 ft. lbs.) torque (Fig. 126).

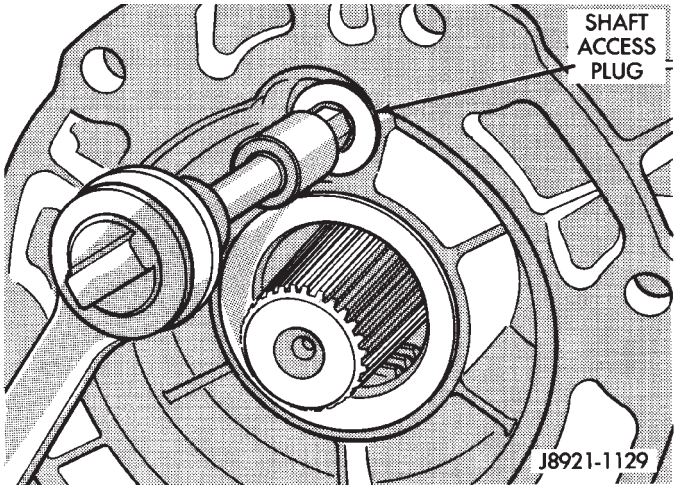


Fig. 126 Access Plug Installation

(28) Position new shift tower gasket on adapter housing (Fig 127).

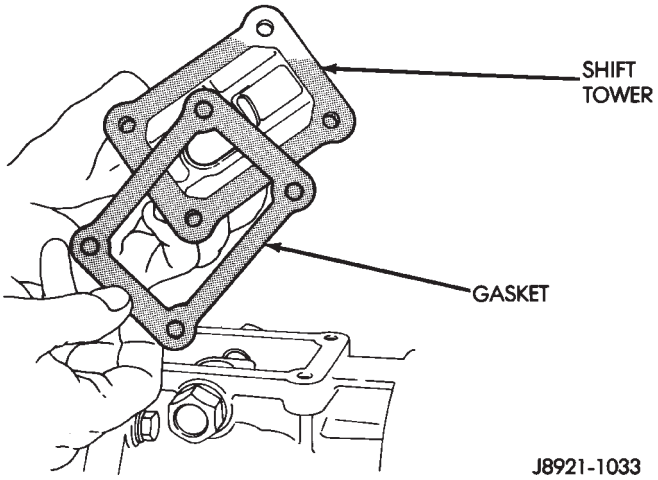


Fig. 127 Shift Tower Gasket Installation

(29) Install shift tower (Fig. 128). Tighten tower attaching bolts to 18 N·m (13 ft. lbs.) torque.

(30) Install new gasket on backup light switch and install switch. Tighten switch to 37 N·m (27 ft. lbs.) torque.

(31) Install new washer on drain plug. Then install and tighten plug to 37 N·m (27 ft. lbs.) torque.

(32) If transmission will be filled with gear lubricant before installation, place transmission in a level position. Then fill with Mopar 75W-90, grade GL-5 gear lubricant. Correct fill level is to bottom edge of fill plug hole.

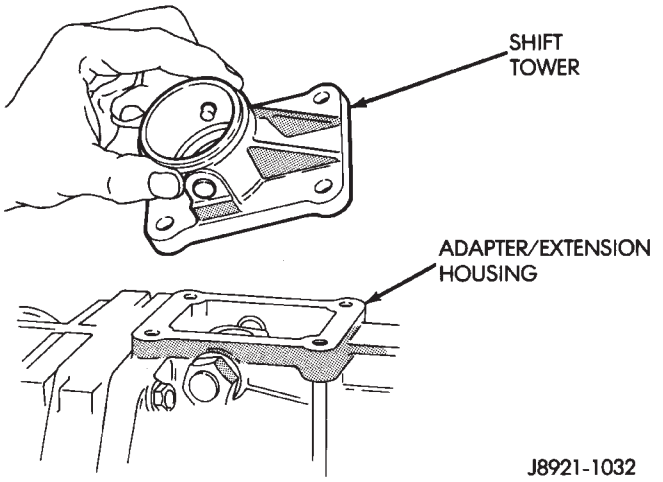


Fig. 128 Shift Tower Installation

(33) Install new washer on fill plug. Then install and tighten plug to 37 N·m (27 ft. lbs.) torque.

(34) Install clutch housing and release bearing components.

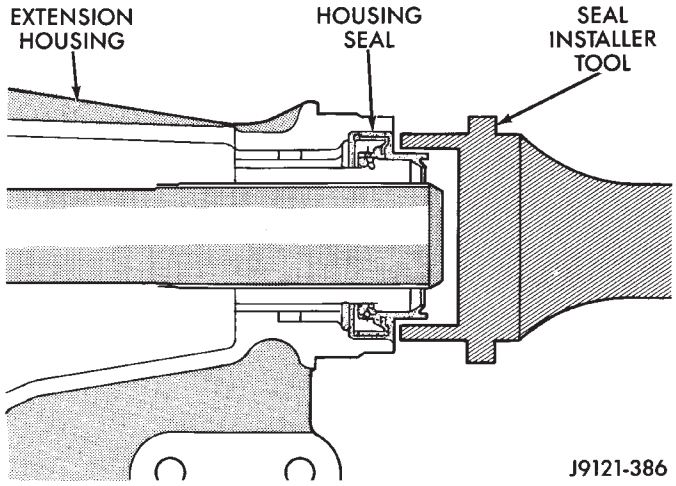


Fig. 129 Installing Extension Housing Seal—2WD Models

(35) On 2-wheel drive models, install new seal in extension housing with suitable size installer tool (Fig. 129). Lubricate seal lips with petroleum jelly before installation.

(36) On 2-wheel drive models, install speedometer driven gear (if removed), and vehicle speed sensor.

30RH/32RH AUTOMATIC TRANSMISSION

INDEX

GENERAL INFORMATION

TRANSMISSION APPLICATION

Chrysler 30RH and 32RH automatic transmissions are used in XJ/YJ models. Both transmissions are three speed, automatics with a gear-type oil pump, two clutches and bands and a planetary gear system (Fig. 1). The 30RH is used with 2.5L engines and the 32RH is used with 4.0L engines.

TORQUE CONVERTER

A three element, torque converter is used for all applications. The converter consists of the impeller, stator, and turbine.

The converter used with all 30RH/32RH transmissions is equipped with a converter clutch. The clutch is engaged by an electrical solenoid and mechanical clutch module on the valve body. The solenoid is operated by the powertrain control module.

The impeller is connected to the engine crankshaft through the front cover which is welded to the impeller. The turbine is splined to the transmission input shaft and the stator is splined to the transmission reaction shaft.

The torque converter is a welded assembly and is not a repairable component. The converter is serviced as an assembly.

RECOMMENDED FLUID

The recommended (and preferred) fluid for 30RH/32RH transmissions is Mopar ATF Plus, Type 7176.

Mopar Dexron II can be used but only if ATF Plus is not available.

Transmission fluid capacity is approximately 17 pints (7.9 liters). This is the approximate amount of fluid required to fill the transmission and torque converter after overhaul.

TRANSMISSION IDENTIFICATION

The transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). The first set of numbers is the transmission part number. The next set of code numbers set is the date of build. The final set of code numbers represents the transmission serial number.

SPECIFICATIONS AND BAND ADJUSTMENTS

Service specifications and torque values are located at the end of this group. Refer to the specifications during service operations.

The band adjustment specifications for 1994 transmissions are different. Refer to the front and rear band adjustment procedures in the In-Vehicle Service section for details.

PARTS INTERCHANGEABILITY

The 1994 version of the 30RH (A904) transmission is similar to previous models in appearance only. The current 30RH is quite different and interchanging new/old parts is definitely not recommended. Different component dimensions, fluid passages, input/output shafts, cases, bands, valve bodies and governor assemblies are just a few of the changed items. The 32RH transmission is also different from previous models and the same recommendations apply here as well.

CAUTION: On YJ models with a 2.5L engine and 30RH transmission, special bolts are used to attach the driveplate to the crankshaft. These bolts have a smaller hex head for torque converter clearance. DO NOT interchange these bolts with similar size bolts for any reason.

TRANSMISSION CONTROLS AND COMPONENTS

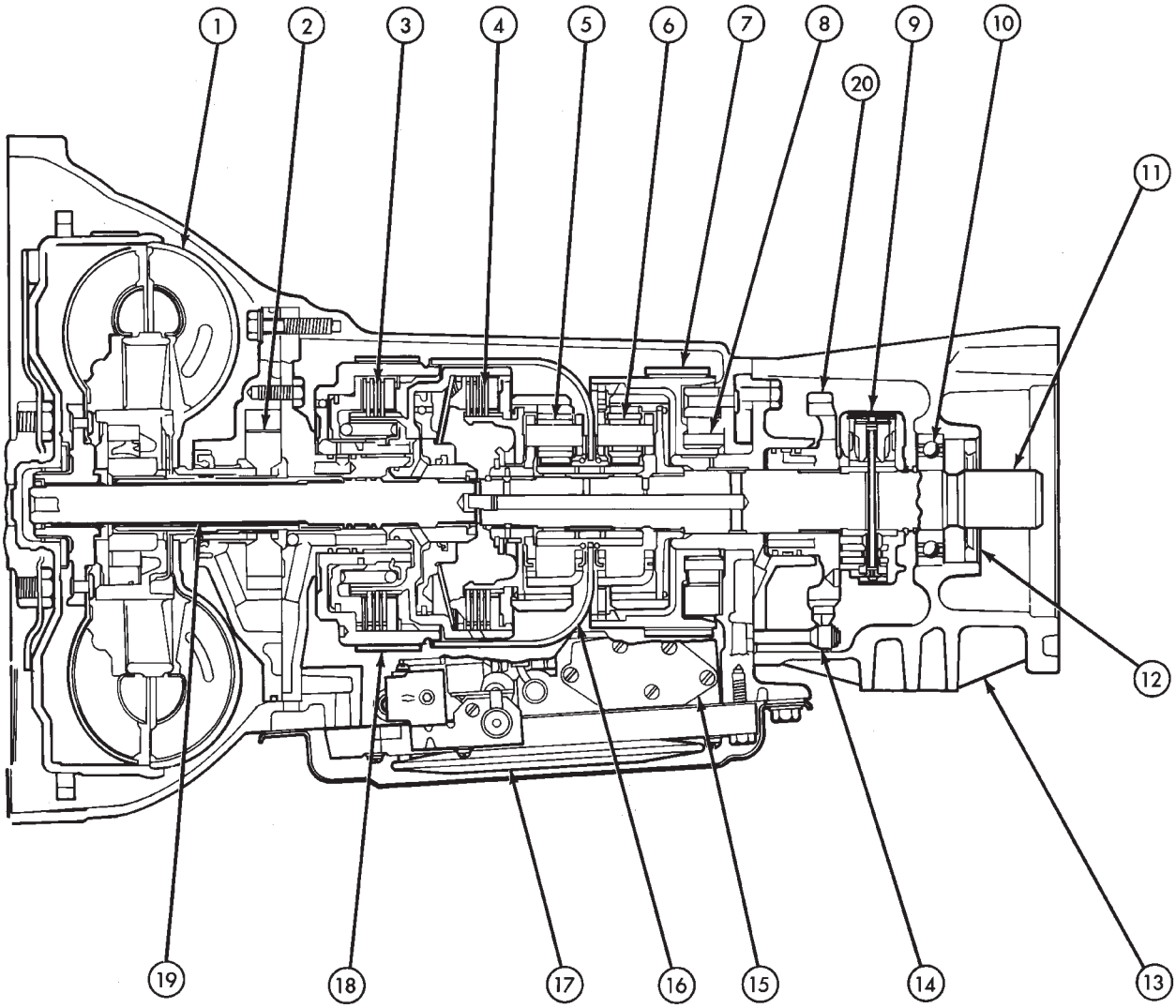
The transmission hydraulic control system performs five basic functions, which are:

- pressure supply
- pressure regulation
- flow control
- clutch/band apply and release
- lubrication

Pressure Supply And Regulation

The oil pump generates the fluid working pressure needed for operation and lubrication. The pump is driven by the torque converter. The converter is connected to the engine crankshaft through the driveplate.

The pressure regulator valve maintains operating (line) pressure. The regulator valve is located in the valve body. The amount of line pressure developed is



(1) CONVERTER
(2) OIL PUMP
(3) FRONT CLUTCH
(4) REAR CLUTCH
(5) FRONT PLANETARY GEAR SET
(6) REAR PLANETARY GEAR SET
(7) LOW AND REVERSE (REAR) BAND
(8) OVERRUNNING CLUTCH
(9) GOVERNOR
(10) BEARING
(11) OUTPUT SHAFT
(12) SEAL
(13) ADAPTER HOUSING
(14) PARK LOCK ROD
(15) VALVE BODY
(16) SUN GEAR DRIVING SHELL
(17) OIL FILTER
(18) KICK DOWN (FRONT) BAND
(19) INPUT SHAFT
(20) PARK GEAR

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Fig. 1 30RH/32RH Automatic Transmission

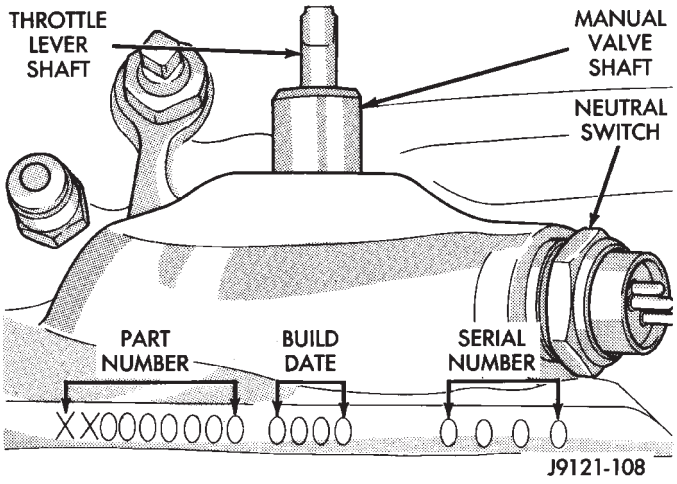

Fig. 2 Transmission Identification

controlled by throttle pressure, which is dependent on the degree of throttle opening.

The governor valve is operated by the transmission output shaft. Governor pressure increases in proportion to vehicle speed.

The throttle valve determines line pressure and shift speed. The throttle valve also controls upshift and downshift speeds by regulating pressure in conjunction with throttle position.

Shift Valves

The manual valve is operated by the gearshift linkage and provides the operating range selected by the driver.

The 1-2 shift valve provides automatic 1-2 or 2-1 shifts and the 2-3 shift valve provides automatic 2-3 or 3-2 shifts. The kickdown valve provides forced 3-2 or 3-1 downshifts depending on vehicle speed. Downshifts occur when the throttle is opened beyond downshift detent position which is just before wide open throttle.

The 2-3 valve throttle pressure plug provides 3-2 downshifts with varying throttle openings and depending on vehicle speed. The 1-2 shift control valve transmits 1-2 shift pressure to the accumulator piston to control kickdown band capacity on 1-2 upshifts and 3-2 downshifts.

The shuttle valve has two functions. First is fast front band release and smooth engagement during lift-foot 2-3 upshifts. The second is to regulate front clutch and band application during 3-2 downshifts.

Clutches-Bands-Servos-Accumulator

The front/rear clutch pistons and servo pistons are actuated by line pressure. When line pressure is removed, the pistons are released by spring tension.

On 2-3 upshifts, the front servo piston is released by spring tension and hydraulic pressure. The accumulator controls hydraulic pressure on the apply side of the front servo during 1-2 upshifts and at all throttle openings.

Converter Clutch Controls

Converter clutch operation is controlled by the power train control module, and by the solenoid and clutch module on the valve body. The solenoid is operated by a relay on the engine compartment side of the dash panel.

Activating the solenoid opens a vent allowing fluid to flow into the clutch module. When line pressure exceeds tension of the module valve springs, the module valves open. This allows fluid to be channeled to the converter clutch through the reaction shaft support and transmission shaft.

Gearshift And Parking Lock Controls

The gearshift lever provides six operating positions: Park (P), Reverse (R), Neutral (N), and the D, 2 and 1 forward drive ranges.

Manual 1 position provides first gear only. Overrun braking occurs in 1 range when the throttle is released. Upshifts are not provided in 1 range.

Manual 2 range provides first and second gear. A 1-2 upshift will take place but a 2-3 upshift will not occur.

D position provides 1-2, 2-3 upshifts and 3-2 and 3-1 downshifts.

Park position allows the park rod to move the park pawl into engagement with the park gear. This prevents rotation of the transmission output shaft. The park lock mechanism is only engaged when the shift lever is in the Park detent.

A park/neutral position switch controls engine starting. The switch is designed to allow engine starts only in park or neutral positions.

30RH/32RH TRANSMISSION DIAGNOSIS

INDEX

GENERAL INFORMATION

Automatic transmission problems are generally the result of:

- poor engine performance
- incorrect fluid level
- incorrect cable/linkage adjustment
- incorrect band adjustment
- incorrect hydraulic control pressure adjustments
- hydraulic component malfunctions
- mechanical component malfunctions.

Begin diagnosis by checking the easily accessible items such as fluid level, fluid condition and control linkage adjustment. A road test will determine if further diagnosis is necessary.

Procedures outlined in this section should be performed in the following sequence to realize the most accurate results:

- Preliminary diagnosis
- Check fluid Level and condition
- Check control linkage Adjustment
- Road test
- Stall test
- Hydraulic pressure test
- Air pressure tests
- Leak Tests
- Analyze test results and consult diagnosis charts

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are driveable and an alternate procedure for disabled vehicles (will not back up or move forward).

Vehicle Is Driveable

(1) Check fluid level and condition.

(2) Adjust throttle cable and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(3) Road test vehicle and note transmission operating characteristics.

(4) Perform stall test if complaint is based on sluggish, low speed acceleration or abnormal throttle opening needed to maintain normal speeds with properly tuned engine.

(5) Perform hydraulic pressure tests.

(6) Perform air pressure test to check clutch-band operation.

Vehicle Is Disabled

(1) Check fluid level and condition.

(2) Check for broken, disconnected throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose, missing pressure port plugs.

(4) Raise vehicle, start engine, shift transmission into gear and note following:

(a) If propeller shafts turn but wheels do not, problem is with differential or axle shafts.

(b) If propeller shafts do 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 drive plate, converter, oil pump or input shaft.

(c) If propeller shafts do not turn and transmission is not noisy, perform hydraulic pressure test to determine if problem is a hydraulic or mechanical.

FLUID LEVEL AND CONDITION

(1) Position vehicle on level surface. This is important in obtaining an accurate fluid level check.

(2) To avoid false readings, which could produce under or over fill condition, do not check level until fluid is at normal operating temperature.

(3) Shift transmission into Neutral.

(4) Apply parking brakes.

(5) Operate engine at curb idle speed.

WARNING: WHEN PERFORMING UNDERHOOD OPERATIONS WITH THE ENGINE RUNNING, KEEP YOUR HANDS WELL AWAY FROM HOT OR ROTATING ENGINE COMPONENTS. DO NOT WEAR LOOSE ARTICLES OF CLOTHING WHICH COULD BECOME ENTANGLED IN ENGINE COMPONENTS OR ACCESSORIES.

(6) Clean dipstick filler cap and tube before removing dipstick.

(7) Remove dipstick and inspect fluid level.

- Correct level is to FULL mark
- Acceptable level is between ADD and FULL marks

(8) Check fluid condition. Fluid should be dark to light red in color and free of dirt or debris.

(9) If fluid is discolored or smells burned but transmission operation was OK, check cooler flow, flush cooler and lines and change fluid and filter. Then road test again to confirm proper operation.

(10) If fluid is black or dark brown, burned/turned to sludge, contains large quantities of metal or friction material particles, transmission will need overhaul. Especially if problems were evident during road test and preliminary diagnosis. Fluid cooler should also be flow tested and flushed if necessary.

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 causing the same conditions that occur with a low level.

In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve, clutch and servo operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

TRANSMISSION THROTTLE VALVE CABLE ADJUSTMENT

Throttle cable adjustment is important to proper operation. This adjustment positions the throttle valve which controls shift speed, quality and part throttle downshift sensitivity.

If cable adjustment setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive. Refer to the In-Vehicle Service section for adjustment procedure.

GEARSHIFT LINKAGE

Gearshift linkage adjustment is important because it positions the valve body manual valve. Incorrect adjustment will cause creeping in Neutral, premature clutch wear, delayed engagement in any gear, or a no-start in Park or Neutral position.

Proper operation of the neutral start switch will provide a quick check of linkage adjustment. Refer to the In-Vehicle Service section for adjustment procedure.

ROAD TEST

Before road testing, be sure the fluid level and all linkage adjustments have been checked and adjusted if necessary.

Observe engine performance during the road test. A poorly tuned engine will not allow an accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for slippage and shift variations. Note whether the shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Watch closely for slippage or engine flare which usually indicates clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul may be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart (Fig. 3) provides a basis for analyzing road test results.

DRIVE ELEMENTS	Gearshift Lever Position								
	P	R	N	D			2		1
				1	2	3	1	2	
FRONT CLUTCH		•				•			
FRONT BAND (KICKDOWN)					•			•	
REAR CLUTCH				•	•	•	•	•	•
REAR BAND (LOW-REV.)		•							•
OVER-RUNNING CLUTCH				•			•		•

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Fig. 3 Clutch And Band Application Chart

ANALYZING THE ROAD TEST

Refer to the Clutch and Band Application chart (Fig. 3) and note which elements are in use in the various gear ranges.

The rear clutch is applied in all forward ranges (D, 2, 1). The overrunning clutch is applied in first gear (D and 2 range only). The rear band is applied in 1 and R range only.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the overrunning clutch is slipping. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that both clutches are applied in D range third gear only. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping. By selecting another gear which does not use one of these units, the slipping clutch can be determined.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction may not be determined until hydraulic and air pressure tests are performed. Practically any condition

can be caused by leaking hydraulic circuits or sticking valves. Unless the problem is an obvious one, do not remove and disassemble the transmission until hydraulic and air pressure tests have been performed.

HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068.5 kPa) at the rear servo pressure port in reverse.

Use 100 psi Pressure Gauge C-3292 to check pressure at the accumulator, front servo, governor and fluid cooler line. Use 300 psi Gauge C-3293 to check pressure at the rear servo. The 300 psi gauge can be used at any other port when more than one gauge is required for testing.

PRESSURE TEST PORT LOCATIONS

There are pressure test ports at the accumulator, front servo, rear servo and governor.

Line pressure is checked at the accumulator port on the right side of the case (Fig. 4). The front servo release pressure port is at the right side of the case just behind the filler tube opening (Fig. 4).

The rear servo pressure port is at the right rear of the transmission case (Fig. 5).

On 4 x 2 models, the governor pressure port is at the left side of case at the transmission rear (Fig. 5). On 4 x 4 transmissions, the test port is in the driver side of the adapter housing (Fig. 6).

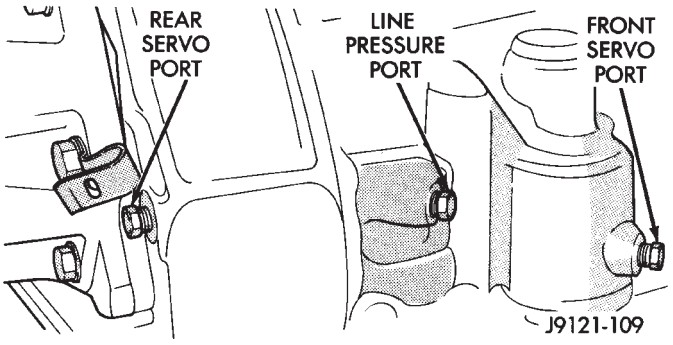

Fig. 4 Front Servo And Line Pressure Test Ports

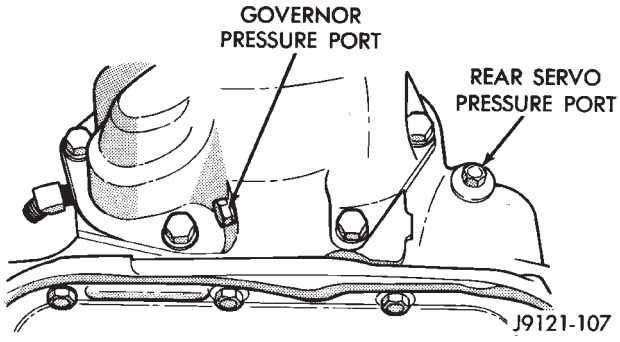

Fig. 5 Rear Servo And Governor Pressure Test Ports (4 x 2 Transmission)

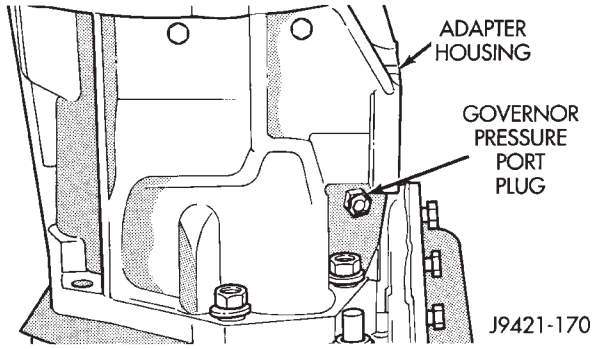

Fig. 6 Governor Pressure Test Port (4 x 4 Transmission)

PRESSURE TEST PROCEDURE

Connect a tachometer to the engine. Position the tachometer so it can be observed from under the vehicle. Raise the vehicle on hoist that will allow the wheels to rotate freely.

Test One-Transmission In 1 Range

This test checks pump output, pressure regulation, and condition of the rear clutch and rear servo circuits. Use 300 psi Test Gauge C-3293 for this test

(1) Connect test gauges to line pressure and rear servo ports (Figs. 4-6). **Be sure pressure test gauge is connected to rear servo port.**

(2) Disconnect throttle and gearshift rods at transmission.

(3) Start and run engine at 1000 rpm.

(4) Move valve body selector lever forward into 1 range.

(5) Read pressures on both gauges as transmission throttle lever is moved from full forward to full rearward position.

(6) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (620-662 kPa) as lever is moved rearward.

(7) Rear servo pressure should be same as line pressure within 3 psi.

Test Two-Transmission In 2 Range

This test checks pump output and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Connect test gauge to line pressure port (Fig. 4).

(2) Start and run engine at 1000 rpm.

(3) Move valve body selector lever one detent rearward from full forward position. This is 2 range.

(4) Move transmission throttle lever from full forward to full rearward position and read pressure at both gauges.

(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (620-662 kPa) as lever is moved rearward.

Test Three-Transmission In D Range

This test checks pressure regulation and condition of the front and rear clutch circuits. Both test gauges are required for this test.

(1) Connect one test gauge to line pressure port and other gauge to front servo pressure port (Fig. 4). Either gauge can be used at either port.

(2) Start and run engine at 1600 rpm.

(3) Move selector lever two detents rearward from full forward position. This is D range.

(4) Read pressures on both gauges as transmission throttle lever is moved from full forward to full rearward position.

(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase as lever is moved rearward.

(6) Front servo is pressurized only in D range and should be same as line pressure within 3 psi (21 kPa), up to downshift point.

Test Four-Transmission In Reverse

This test checks pump output, pressure regulation and the front clutch and rear servo circuits. Use 300 psi Pressure Test Gauge C-3293 for this test.

(1) Connect pressure test gauge to rear servo port (Fig. 5).

(2) Start and run engine at 1600 rpm for test.

(3) Move valve body selector lever four detents rearward from full forward position. This is Reverse range.

(4) Move throttle lever all way forward then all the way rearward and note gauge readings.

(5) Pressure should be 145 - 175 psi (1000-1207 kPa) with lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is moved rearward.

Test Five-Governor Pressure

This test checks governor operation by measuring governor pressure response to changes in engine speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not shift up or down. Use 100 psi Pressure Test Gauge C-3292 for this test.

(1) Connect test gauge to governor pressure port (Figs. 5 and 6).

(2) Move selector lever to D range.

(3) Apply service brakes. Start and run engine at curb idle speed and note pressure. At idle and with wheels stopped, pressure should be zero to 1-1/2 psi maximum. If pressure exceeds this figure, governor valve or weights are sticking open.

(4) Slowly increase engine speed and observe speedometer and pressure test gauge. Governor pressure should increase in proportion to vehicle speed (approximately 1 psi for every 1 mph shown on speedometer).

(5) Governor pressure rise should be smooth and drop back to 0 to 1-1/2 psi when throttle is closed and wheels are stopped.

(6) Compare results of pressure tests with analysis chart (Fig. 7).

TEST CONDITION	INDICATION
Line pressure OK during any one test	Pump and regulator valve OK
Line Pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (servo, clutch seals, governor support seal rings)
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area (servo, clutch seals, retainer bore, pump seal rings)
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck pressure regulator valve, worn or defective pump
Governor pressure too high at idle speed:	Governor valve sticking open
Governor pressure low at all mph figures	Governor valve sticking closed
Lubrication pressure low at all throttle positions	Clogged oil cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer

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Fig. 7 Pressure Test Analysis Chart

CONVERTER STALL TEST

Stall testing involves determining maximum engine rpm obtainable at full throttle with the rear wheels locked and the transmission in D range. This test checks the holding ability of the converter overrunning clutch and both of the transmission clutches. When stall testing is completed, refer to the Stall Speed Specifications chart and Stall Speed Diagnosis guides.

WARNING: NEVER ALLOW ANYONE TO STAND IN FRONT OF THE VEHICLE DURING A STALL TEST. ALWAYS BLOCK THE FRONT WHEELS AND APPLY THE SERVICE AND PARKING BRAKES DURING THE TEST.

STALL TEST PROCEDURE

(1) Connect tachometer to engine.
(2) Check and adjust transmission fluid level.
(3) Start and run engine until transmission fluid reaches normal operating temperature.
(4) Block front wheels.
(5) Fully apply service and parking brakes.
(6) Open throttle completely for no more than five seconds and record maximum engine rpm registered on tachometer.

CAUTION: Stall testing causes a rapid increase in transmission fluid temperature. Do not hold the throttle open any longer than five seconds. If more than one stall test is required, run the engine at 1000 rpm with the transmission in Neutral for at least 20 seconds to cool the fluid.

(7) If engine speed exceeds maximum shown in stall speed chart, release accelerator immediately. This indicates that transmission clutch slippage is occurring.
(8) Shift transmission into Neutral. Run engine for 20 seconds to cool fluid. Then stop engine, shift transmission into Park and release brakes.
(9) Stall speeds should be in 1700-2000 rpm range.
(10) Refer to Stall Test Diagnosis.

STALL TEST DIAGNOSIS

Stall Speed Too High

If the stall speed exceeds specifications by more than 200 rpm, transmission clutch slippage is indicated.

Stall Speed Too Low

Low stall speeds with a properly tuned engine indicate a torque converter overrunning clutch problem. The condition should be confirmed by road testing prior to converter replacement.

The converter overrunning clutch is slipping when stall speeds are 250 to 350 rpm below specified minimum. And when the vehicle operates properly at highway speeds but has poor low speed acceleration.

Stall Speed Normal

If stall speeds are normal but abnormal throttle opening is required to maintain highway speeds, the converter overrunning clutch is seized and the torque converter must be replaced.

Converter Noise During Test

A whining noise caused by fluid flow is normal during a stall test. However, loud metallic noises indicate a damaged converter. To confirm that noise is originating from the converter, operate the vehicle at light throttle in Drive and Neutral on a hoist and listen for noise coming from the converter housing.

AIR PRESSURE TEST

Air pressure testing can be used to check clutch and band operation with the transmission either in the vehicle, or on the work bench as a final check after overhaul.

Air pressure testing requires that the oil pan and valve body be removed from the transmission.

The servo and clutch apply passages are shown in Figure 8.

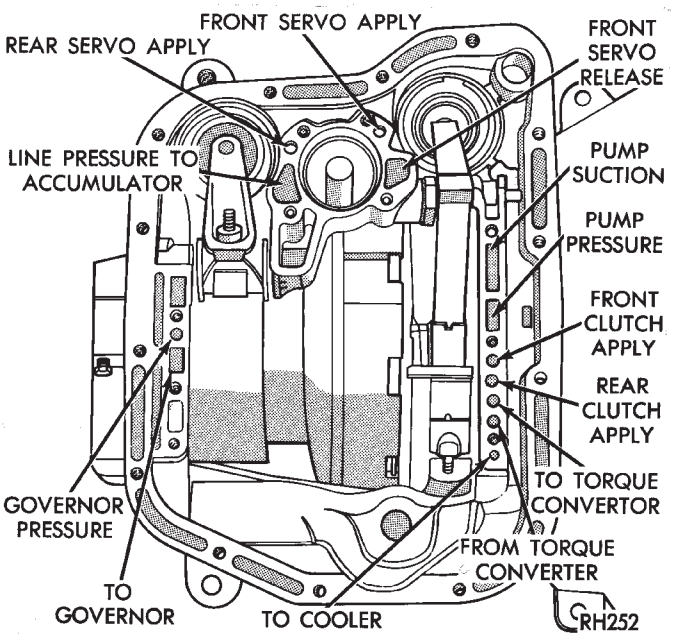


Fig. 8 Air Pressure Test Passages

Air Test Procedure

(1) Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage (Fig. 8). Piston movement can be felt and a soft thud heard as the clutch applies.
(2) Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage (Fig. 8). Piston movement can be felt and a soft thud heard as the clutch applies.
(3) Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring tension should release the servo when air pressure is removed.
(4) Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring tension should release the servo when air pressure is removed.

CONVERTER HOUSING LEAK DIAGNOSIS

Two items must be established when diagnosing leaks from the converter housing area. First, it must be verified that a leak condition actually exists. And second, the true source of the leak must be determined.

Some suspected converter housing fluid leaks may not be leaks at all. Residual fluid in the housing, or excess fluid spilled during factory fill or refill after repair can be mistaken for a leak. In addition, a rear main seal leak can also be mistaken for a pump seal leak if care is exercised.

Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair.

Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump O-ring or pump body leaks follow the same path as a seal leak (Fig. 9).

Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 9).

Pump seal or gasket leaks usually travel down the inside of the converter housing.

Front band lever pin plug leaks are generally deposited on the housing and not on the converter.

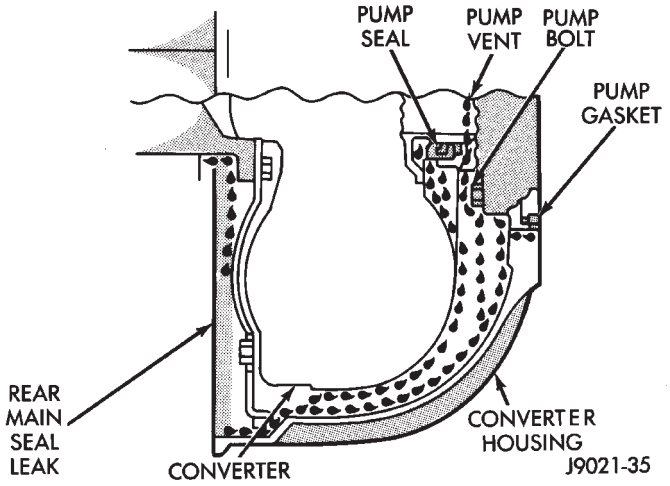


Fig. 9 Typical Converter Housing Leak Paths

LEAK DIAGNOSIS PROCEDURE

(1) Raise the rear of the vehicle and allow accumulated fluid to drain out of the converter housing.

(2) Check and adjust the transmission fluid level.

(3) Raise the vehicle. Remove the converter housing dust cover and wipe as much fluid as possible from the converter housing.

(4) Fabricate a test probe (Fig. 10). Then attach the probe to the converter housing with one of the dust shield bolts (Fig. 10).

(5) Have a helper run the engine at 2500 rpm (with the transmission in Neutral) for two minutes; then stop the engine.

(6) Inspect the test probe and converter housing. If a leak is evident, note the color of the fluid. Transmission fluid is red. Engine oil ranges in color from brown to green, or to black when the oil is dirty.

(7) If the probe upper surface is dry, the converter and seal are not at fault. A path of fluid across the probe upper surface indicates a converter or seal leak. Fluid leaking **under** the probe is coming from the pump housing area (Fig. 11).

(8) Fluid leaking under the probe could be from the: pump seal and/or bushing, pump vent, kickdown lever shaft access plug, pump bolts, or porous spots in the pump body or transmission case (Fig. 11).

(9) If porous spots in the transmission case or pump body are the suspected leak source, pressurize the transmission as described in Leak Testing With Air Pressure.

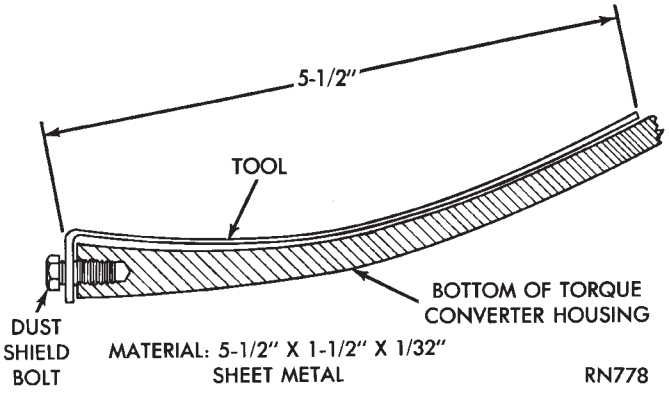


Fig. 10 Leak Test Probe

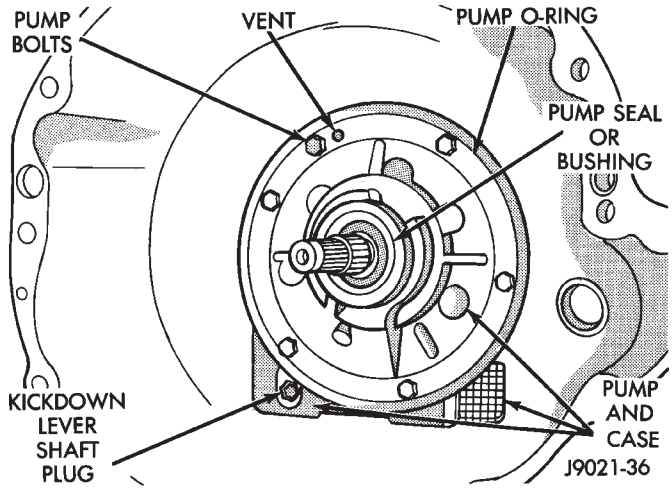


Fig. 11 Pump Area Inspection Points

LEAK TESTING WITH AIR PRESSURE

This test involves closing off the transmission openings and pressurizing the transmission to 8 psi with Air Pump Tool 7700. A soapy water solution is applied to suspected leak points before and during the pressure test. Leaks will be indicated by the presence of air bubbles coming through the solution.

Some transmission openings such as the fill tube and front cooler line fitting can be closed off with a rubber plug or similar device. Plugs can secured with wire or duct tape.

The transmission rear output shaft opening is closed off simply by leaving the transfer case bolted in place. However, if the transfer case has been removed, a shipping plug can used to close off this opening.

The torque converter hub opening in the pump and the pump vent require special tools to close them off. The converter hub seal cap is made from thin wall tube and a 3 mm (1/8 in.) thick disc (Fig. 12). A retaining strap is needed to secure the seal cup for testing. The strap can be made from 32 mm (1-1/4 in.) wide stock (Fig. 13). The strap attaching hole positions are approximate only. Measure hole position on the converter housing before drilling.

The pump vent tool is made from 6 mm (1/4 in.) rod and 5 mm (3/16 in.) plate (Fig. 14). The fabricated tools can all be made from mild steel or aluminum stock.

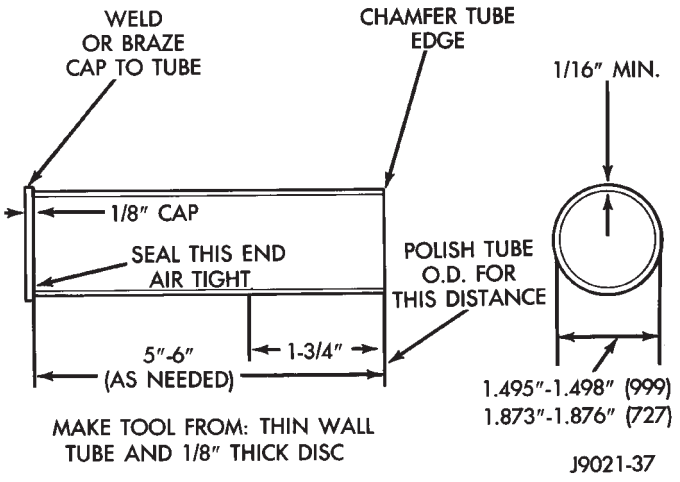


Fig. 12 Converter Hub Seal Cup

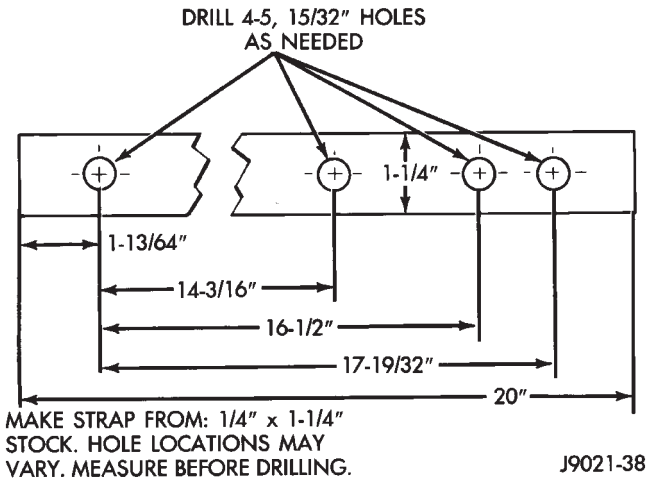


Fig. 13 Seal Cup Retaining Strap

AIR PRESSURE LEAK TEST PROCEDURE

(1) Install vent plug, converter hub seal cup and cup retaining strap (Fig. 15).

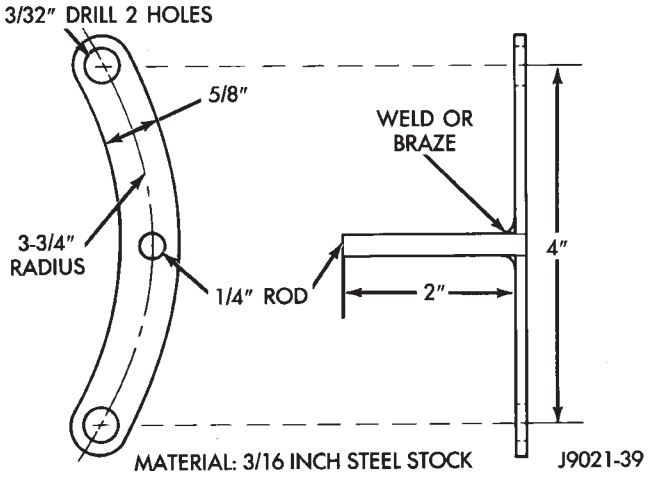


Fig. 14 Pump Vent Plug

(2) Close off remaining transmission openings with rubber plugs, or stoppers. **Do not close off rear cooler line fitting. Air pump will be attached to this fitting.**

(3) Attach Air Pump 7700 to rear cooler line fitting. Connect length of copper tube to fitting. Then attach air pump hose to tube with hose clamp (Fig. 16).

(4) Apply thick soapy water solution to suspected leak areas.

CAUTION: The recommended test pressure is 8 psi. The maximum allowable test pressure is 10 psi. Do not exceed specified test pressure.

(5) Pressurize transmission to 8 psi with air pump.

(6) Observe suspected leak areas. Air bubbles appearing in soapy water solution indicate leak points.

(7) Remove test tools and plugs after test completion and make necessary repairs as described in Leak Correction procedure.

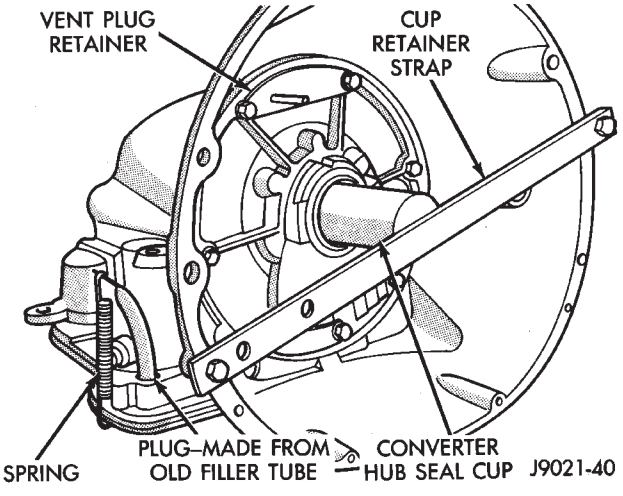


Fig. 15 Vent Plug And Hub Seal Cup Installation

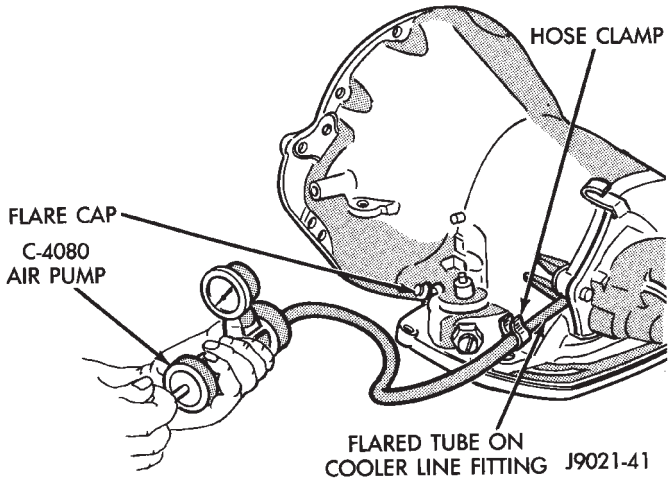


Fig. 16 Pressurizing Transmission

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around clutch retainer. This prevents clutches from coming out when oil pump is removed.

(3) Remove oil pump and seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter if scoring is severe.

(5) Install new pump seal, O-ring, gasket, bushing. Replace oil pump if cracked, porous or damaged in any way.

(6) Loosen kickdown lever pin plug two turns. Apply Permatex No. 2 or equivalent to plug threads and tighten plug to 17 N·m (150 in-lbs) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission.

(10) Install converter housing dust shield and lower vehicle.

DIAGNOSIS GUIDES AND CHARTS

The diagnosis charts provide additional reference for transmission diagnosis.

The hydraulic flow charts outline fluid flow and hydraulic circuitry. Circuit operation is provided for all gear ranges. Normal working pressures are also supplied for each of the various gear ranges.

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE) Note: The shift from neutral to reverse is normally quite firm. Hydraulic pressure at the rear servo can approach 300 psi in reverse gear. Do not confuse a firm engagement with a truly harsh engagement	1. Engine idle speed too high 2. Driver "riding" accelerator pedal during shift 3. Throttle cable or linkage misadjusted 4. Band adjustment needed 5. Loose mounting bolts 6 Worn or damaged U-joints 7. Loose axle pinion nut 8. Hydraulic pressure is incorrect 9. Accumulator piston spring, or seal worn or damaged 10. Faulty converter clutch (if equipped) 11. Clutch, band, or planetary component is damaged	1. Check/adjust idle speed 2. Advise owner/operator 3. Adjust cable or linkage; setting is either too long or too short 4. Adjust front/rear bands 5. Check engine, transmission, propeller shaft, crossmember, and axle bolt torque; tighten loose bolts and replace missing bolts 6. Remove propeller shaft and replace U-joints 7. Replace nut and check pinion threads before installing new nut; replace pinion gear if threads are damaged 8. Check pressures; remove, overhaul, or adjust valve body as needed; repair oil pump if necessary 9. Remove valve body and replace piston, seal, or spring as needed 10. Replace converter and flush cooler and lines before installing new converter 11. Remove, disassemble, and repair transmission as necessary
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Engine idle speed too low 2. Low fluid level 3. Gearshift linkage out of adjustment 4. Rear band out of adjustment 5. Valve body filter plugged 6. Oil pump gears worn or damaged or pump body or seal is damaged, allowing pump to take in air, causing fluid aeration 7. Reaction shaft seal rings worn or broken 8. Governor valve stuck or valve shaft is loose or damaged 9. Low hydraulic pressure 10. Clutch, band, or servo damage	1. Adjust idle speed 2. Correct level and check for leaks 3. Adjust cable or linkage and repair linkage if worn or damaged 4. Adjust band 5. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary 6. Remove transmission and replace oil pump 7. Remove transmission, remove oil pump, and replace seal rings 8. Remove and inspect governor components; replace worn or damaged parts 9. Perform pressure test, remove transmission, and repair as needed 10. Remove and disassemble transmission and repair as necessary

J9321-255

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Low fluid level 2. Throttle linkage out of adjustment 3. Throttle linkage is binding 4. Gearshift linkage out of adjustment 5. Fluid filter partially clogged 6. Air in fluid due to overfill condition or air leakage into pump suction passages 7. Clutch or servo problem 8. Front band out of adjustment (may cause harsh 1-2 shift)	1. Correct fluid level and check for leaks 2. Adjust linkage as described in service section 3. Disassemble, clean, and adjust linkage; replace linkage grommets if removed or if worn or cracked 4. Adjust linkage as described in service section 5. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary 6. Drain fluid to correct level if overfilled. If fluid is highly aerated (full of bubbles and foamy), oil pump gasket or seal may have failed, or pump body is porous or cracked 7. Remove valve body and air test clutch, band and servo operation; disassemble and repair transmission as needed 8. Adjust band
NO REVERSE (D RANGES OK)	1. Gearshift linkage is either out of adjustment or damaged 2. Rear band is out of adjustment 3. Valve body malfunction (stuck/damaged manual valve, regulator valve, or check ball) 4. Rear servo or front clutch malfunction	1. Repair or replace linkage parts as needed 2. Adjust band 3. Remove and service valve body; replace valve body if any valves or valve bores are worn or damaged 4. Remove and disassemble transmission; replace worn, damaged servo and clutch parts as necessary
HAS FIRST-REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor valve, shaft, weights, or body damaged	1. Remove governor assembly and repair as necessary

J9121-440

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
NO DRIVE RANGE (REVERSE OK)	1. Gearshift linkage either loose, damaged or out of adjustment 2. Low fluid level 3. Valve body malfunction (manual valve or shaft damaged or 1-2 shift valve stuck) 4. Rear clutch failure 5. Transmission overrunning clutch failure 6. Input shaft seal rings worn or damaged	1. Repair or replace linkage components 2. Correct fluid level and check for leaks 3. Remove and disassemble valve body; replace as assembly if any valves or bores are damaged 4. Remove and disassemble transmission and rear clutch; repair/replace worn, damaged parts as needed 5. Remove and disassemble transmission; replace overrunning clutch 6. Remove and disassemble transmission; replace seal rings and any other worn or damaged parts
NO DRIVE *OR* REVERSE (VEHICLE WILL NOT MOVE)	1. Low fluid level 2. Gearshift linkage loose, damaged, or misassembled 3. Failure of driveline component, such as U-joint, axle shaft, transfer case component, etc. 4. Low fluid pressure due to worn or damaged oil pump 5. Transmission internal component damaged 6. Valve body malfunction (seized valve, damaged manual lever, valve body screws loose or overtightened causing distortion and bind)	1. Add fluid and check for leaks if drive is restored 2. Inspect, adjust, and reassemble linkage as needed; replace worn, damaged parts 3. Perform preliminary inspection procedure for vehicle that will not move; refer to procedure in diagnosis section 4. Perform pressure test to confirm low pressure; replace pump body and/or gears if necessary 5. Remove and disassemble transmission; repair or replace failed components as needed 6. Remove, disassemble, and inspect valve body; replace valve body (as assembly) if any valve or bore is damaged; clean and reassemble correctly if all parts are in good condition

J9121-443

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Governor valve sticking 2. Valve body malfunction	1. Remove, clean, and inspect; replace faulty parts 2. Remove, clean, and inspect; look for stuck 1-2 valve or governor plug
SLIPS IN LOW GEAR D ONLY, BUT NOT IN 1 POSITION	1. Overrunning clutch faulty, not holding	1. Replace overrunning clutch
SLIPS IN FORWARD DRIVE RANGES	1. Low fluid level 2. Air in fluid (fluid is foamy, full of bubbles), shifts are spongy, caused by air getting into pump suction passages 3. Gearshift or throttle linkage out of adjustment 4. Low hydraulic pressures due to worn pump, incorrect control pressure adjustments, valve body warpage or malfunction, sticking governor, leaking seal rings, clutch seals leaking, servo leaks, clogged filter, or cooler lines 5. Accumulator piston cracked, spring broken or seal worn 6. Clutch or servo malfunction, leaking seals or worn plates 7. Overrunning clutch worn, not holding (slips in 1 only)	1. Add fluid and check for leaks 2. Check for bad pump gasket or seals, dirt between pump halves, and loose pump bolts or defective O-ring at filler tube 3. Adjust linkage 4. Perform hydraulic and air pressure tests to determine cause 5. Inspect and repair as necessary 6. Air pressure check clutch-servo operation and repair as required 7. Replace clutch
SLIPS IN REVERSE ONLY	1. Low fluid level 2. Aerated fluid; see Slips in Forward Drive Ranges 3. Gearshift linkage out of adjustment 4. Rear band out of adjustment 5. Hydraulic pressure too low due to worn pump, worn seal rings, clutch or servo seal leakage 6. Worn front clutch, leaking rear servo, or worn rear band 7. Band-linkage binding	1. Add fluid and check for leaks 2. See Slips in Forward Drive Ranges 3. Adjust linkage 4. Adjust band 5. Perform hydraulic pressure tests to determine cause 6. Air pressure check clutch-servo operation and repair as required 7. Inspect and repair as required

J9121-444

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Incorrect throttle linkage or cable adjustment 2. Incorrect gear shift linkage or cable adjustment 3. Front band out of adjustment 4. Hydraulic pressures too high or too low due to sticking governor, valve body malfunction, or incorrect hydraulic control pressure adjustments 5. Front servo, band, or linkage malfunction 6. Clutch or servo malfunction	1. Adjust linkage or cable 2. Adjust linkage or cable 3. Adjust band 4. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required 5. Air pressure test operation and repair as necessary 6. Air pressure test operation and repair as necessary
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Gearshift or throttle linkage or cable out of adjustment 2. Front band out of adjustment 3. Governor valve stuck closed; loose output shaft support or governor housing bolts, worn pump, leaking seal rings, or valve body problem (i.e., stuck 1-2 shift valve or governor plug) 4. Clutch or servo malfunction	1. Adjust linkage or cable. Repair linkage of worn or damaged. Relace damaged cable. 2. Adjust band 3. Check line and governor pressures to determine cause; correct as required 4. Air pressure check operation of clutches and bands; repair faulty component
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor valve sticking in partially open position 2. Valve body malfunction 3. Front servo piston cocked in bore 4. Front band linkage malfunction 5. Incorrect throttle or gearshift linkage or cable adjustment	1. Remove governor; clean, inspect, and repair as required 2. Remove, clean, and inspect. Look for sticking 1-2 valve, 2-3 valve, governor plug, or broken springs 3. Inspect servo and repair as required 4. Inspect linkage and look for bind in linkage 5. Adjust linkage or cable

J9321-256

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
CREEPS IN NEUTRAL	1. Gearshift linkage out of adjustment 2. Valve body malfunction (warped body, cross leakage) 3. Clutch dragging 4. Converter lockup clutch dragging	1. Adjust linkage 2. Perform hydraulic pressure test to determine cause and repair as required 3. Air pressure check operation of clutches and repair as required 4. Oil pump worn; replace pump
DRAGS OR LOCKS UP	1. Front or rear band out of adjustment 2. Servo band or linkage malfunction (i.e., binding linkage, warped band, servo piston stuck) 3. Dragging clutch (does not release fully) 4. Broken or seized planetary gears 5. Overrunning clutch worn, broken, or seized	1. Adjust bands 2. Air pressure check servo operation and repair as required 3. Air pressure check clutch operation and repair as required 4. Remove, inspect, and repair as required (look for debris in oil pan) 5. Remove and inspect clutch, repair as required
GROWLING, GRATING, OR SCRAPING NOISES	1. Planetary gear set broken or seized 2. Overrunning clutch worn, seized, or broken 3. Oil pump components scored, binding, or broken 4. Output shaft bearing or bushing damaged 5. Faulty clutch operation 6. Governor support (park gear) binding or seal rings broken 7. Front and rear bands out of adjustment	1. Check for debris in oil pan and repair as required 2. Inspect and check for debris in oil pan; repair as required 3. Remove, inspect, and repair as required 4. Remove, inspect, and repair as required 5. Perform air pressure check and repair as required 6. Remove, inspect, and repair as required 7. Adjust bands
BUZZING NOISE	1. Low fluid level 2. Air being drawn into pump suction passages 3. Overrunning clutch damaged 4. Valve body misassembled, bolts loose, weak spring, or mispositioned valve or check ball	1. Add fluid and check for leaks 2. Check pump for porous casting, scores on mating surfaces, and excess rotor clearance; repair as required 3. Replace clutch 4. Remove, disassemble, inspect valve body; reassemble correctly if necessary; replace assembly if valves or springs are damaged

J9121-446

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
OIL COMES OUT FILLER TUBE	1. Transmission overfilled	1. Drain fluid to correct level; remove neutral switch and drain through switch hole with suction gun
	2. Breather vent in oil pump blocked	2. Inspect and clear blockage
	3. Fluid cooler or cooler lines plugged	3. Flush cooler and lines
	4. Air in fluid (aerated)	4. See "Slips In Forward Drive Ranges"
	5. Oil filter clogged	5. Replace filter; determine the reason for clogged condition and repair
	6. Rear servo piston or seal failure	6. Check hydraulic pressure at servo in reverse (will register low or fluctuate rapidly)
	7. Valve body switch valve sticking	7. Remove and clean valve
OIL LEAKS (ITEMS LISTED REPRESENT POSSIBLE LEAK POINTS AND SHOULD ALL BE CHECKED)	1. Speedometer adapter	1. Replace both adapter seals
	2. Pan gasket	2. Tighten pan screws to 150 inch-pounds; if leaks persist, replace gasket; **do not overtighten screws**
	3. Filler tube (where tube enters case)	3. Replace O-ring seal
	4. Fluid lines and fittings	4. Tighten fittings; if leaks persist, replace fittings and lines if necessary
	5. Valve body manual lever shaft seal	5. Replace shaft seal
	6. Pressure port plug loose	6. Tighten to correct torque; replace plug if leak persists
	7. Rear bearing access plate	7. Replace gasket
	8. Gasket damaged or bolts are loose	8. Replace bolts or gasket or tighten bolts
	9. Adapter/extension gasket damaged	9. Replace gasket
	10. Neutral switch	10. Replace switch and gasket
	11. Converter housing area	11. Check for leaks at seal caused by worn seal or burr on converter hub (cutting seal), worn bushing, missing oil return, oil in front pump housing, or hole plugged. Check for leaks past O-ring seal on pump, or past pump-to-case bolts; pump housing porous, oil coming out vent due to overfill or leak past front band shaft access plug
	12. Cooler line fittings and hoses	12. Replace fittings and hoses
	13. Pump seal	13. Replace seal
	14. Torque converter	14. Replace converter

J9121-448

30RH/32RH TRANSMISSION DIAGNOSIS

Condition	Possible Cause	Correction
OVERHEAT DURING COMMERCIAL OPERATION OR WHILE TRAILER TOWING (FLUID DARK AND BURNED WITH SOME SLUDGE FORMATION)	1. Vehicle not properly equipped for trailer towing or commercial use	1. Be sure vehicle is equipped with recommended optional components (i.e., HD springs, transmission, axle, larger CID engine, auxiliary cooler, correct axle ratio, etc.). If vehicle is not so equipped, it should not be used for severe service operation
	2. Vehicle not equipped with auxiliary fluid cooler	2. Drain fluid, change filter, and install auxiliary cooler
	3. Extensive idling time or operation in heavy traffic in hot weather	3. Cut down on idling time; shift into neutral every so often and run engine at 1000 rpm to help circulate fluid through cooler
	4. Tow vehicle overloaded (exceeding vehicle tow capacity)	4. Be sure vehicle is properly equipped to handle load; do not tow Class III-type loads with a vehicle that is only rated for Class I or II operation
	5. Air flow to auxiliary cooler blocked by snow plow, front mounted spare tire, bug screen, or similar item	5. Remove or reposition item causing air flow blockage
OVERHEAT DURING NORMAL OPERATION (FLUID DISCOLORED, SMELLS BURNED)	1. Low fluid level	1. Add fluid and check for leaks
	2. Fluid cooler, lines blocked, or cooler cracked (oil in engine coolant)	2. Flush cooler and lines and replace radiator if transmission fluid has entered coolant
	3. Switch valve sticking	3. Remove, disassemble, clean valve body
	4. Clutch pack clearance incorrect (too tight)	4. Check and correct as required
	5. Bands too tight	5. Adjust bands

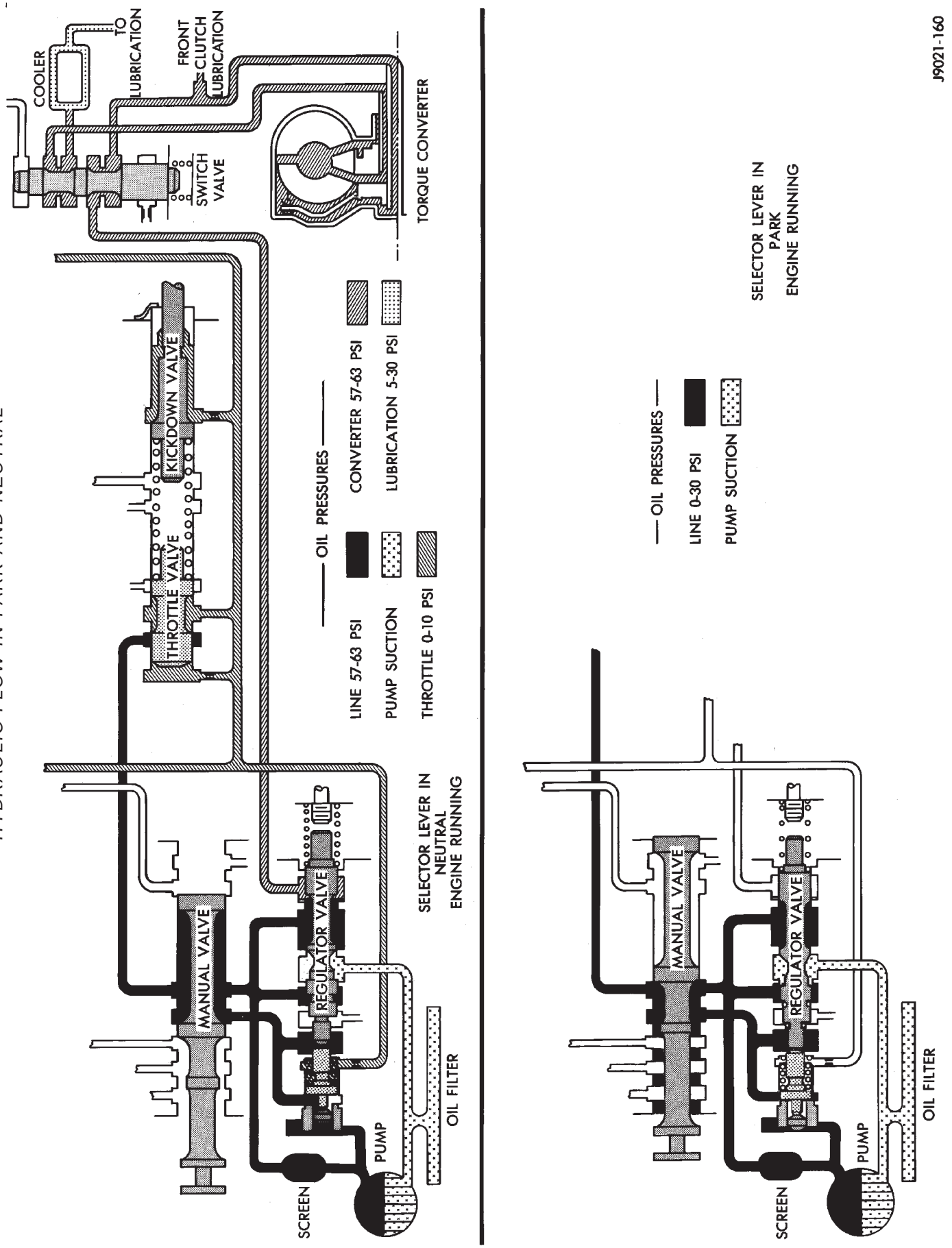
J9121-450

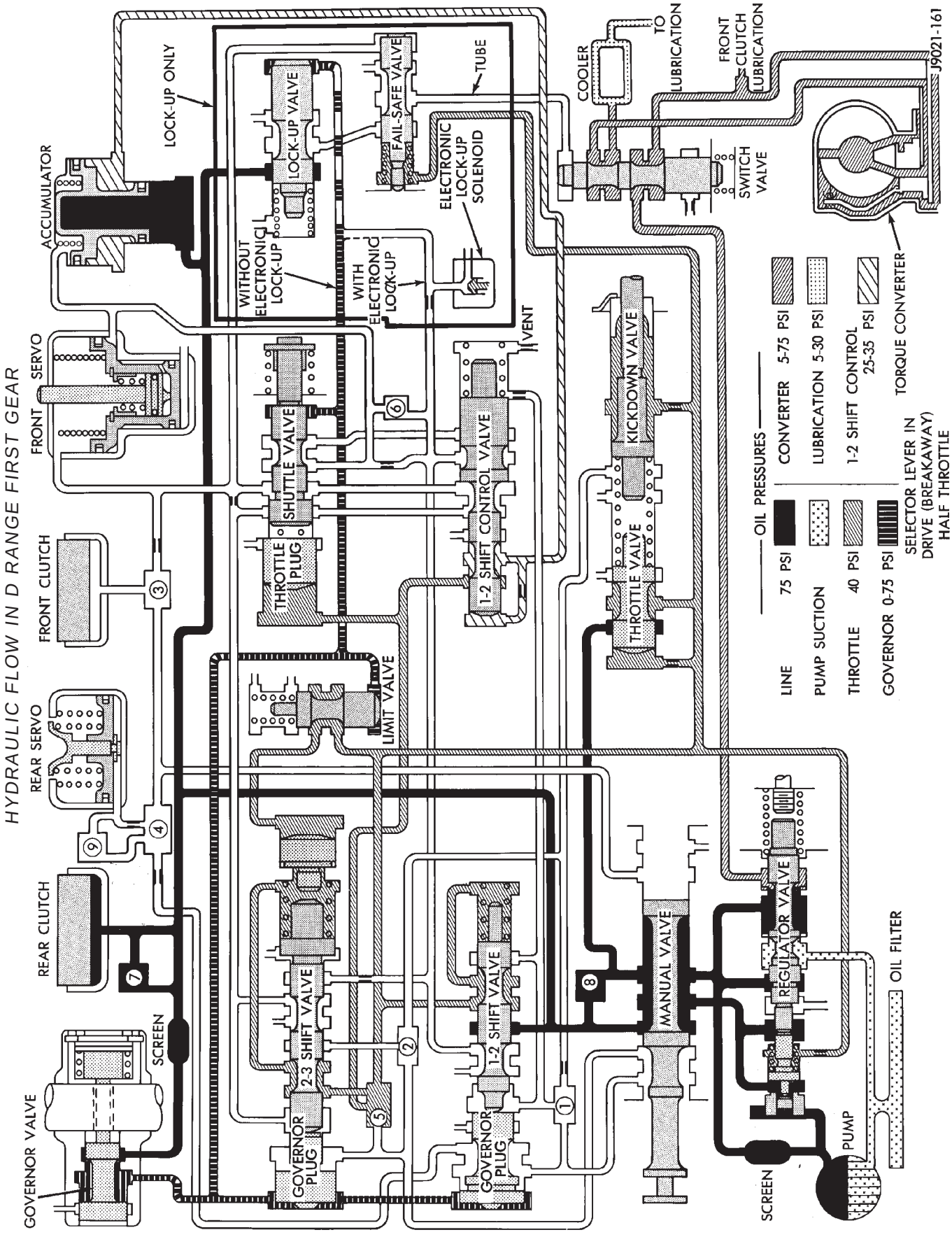
30RH/32RH TRANSMISSION DIAGNOSIS

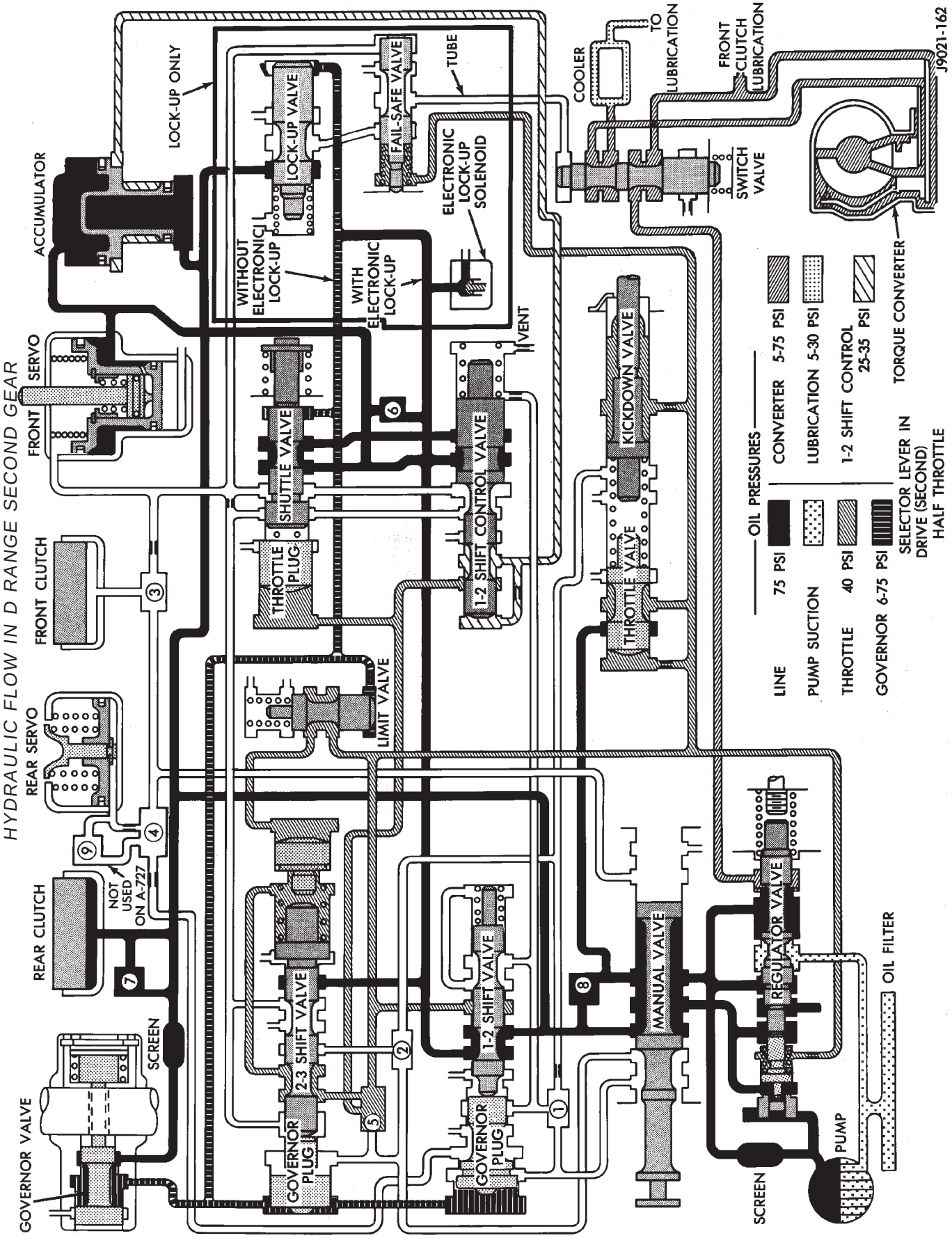
Condition	Possible Cause	Correction
NO START IN PARK OR NEUTRAL	1. Gearshift linkage out of adjustment 2. Neutral switch wire broken or open 3. Faulty neutral switch 4. Valve body manual lever assembly bent, worn, broken, or not aligned with switch	1. Adjust linkage 2. Check continuity with test lamp; repair as required 3. Refer to service section for test and replacement procedure 4. Inspect lever assembly and replace if damaged
SLUGGISH ACCELERATION AT LOW SPEEDS OR REQUIRES EXCESSIVE THROTTLE OPENING TO MAINTAIN HIGHWAY SPEEDS	1. Poor engine performance 2. Gearshift or throttle linkage out of adjustment 3. Transmission clutches slipping 4. Overrunning clutch in converter not holding 5. Converter overrunning clutch stuck	1. Check engine and repair as required 2. Adjust linkage 3. Perform stall test and repair as required 4. Perform stall test and replace converter if clutch has failed 5. Replace converter
FLUID CONTAMINATED (DISCOLORED, FULL OF SLUDGE AND/OR METAL AND FRICTION MATERIAL PARTICULAR)	1. If contamination occurred shortly after overhaul, fluid cooler and lines were not flushed and flow tested. This is especially true when original overhaul was to correct a problem that generated a large amount of debris, such as a gear failure or a clutch pack failure Note: Flushing the cooler and lines is mandatory after a failure of the converter lockup clutch 2. Incorrect fluid used in transmission 3. Main cooler in radiator is cracked, allowing engine coolant to enter transmission 4. Severe overload results in overheat, fluid breakdown, and accelerated wear, especially in high ambient temperatures. Most frequent causes are: • Vehicle is not properly equipped for heavy duty service • Tow vehicle and boat or trailer are both overloaded • Trailer or boat are too large for tow vehicle (load exceeds rated capacity of tow vehicle)	1. If contamination is severe, cooler flushing, converter replacement, and another overhaul may be necessary; particularly so if shift problems were also present 2. If transmission is operating properly, drain fluid, reverse flush cooler and lines, and change fluid and filter. However, if shift problem has developed, converter replacement and transmission overhaul may be required 3. Replace radiator (and cooler) and flush lines. If problem was diagnosed early enough, fluid and filter change may only be necessary. If contamination period was prolonged, overhaul and converter replacement may be required 4. Repair transmission, flush cooler, and lines. Replace converter if necessary. Install auxiliary cooler if needed. Also install HD cooling system if needed. If tow vehicle and unit being towed are both overloaded, the only repair is to reduce the load to rated limits. However, if trailer or boat is too large for tow vehicle, the only option is for the owner to move up to properly-equipped and load-rated tow vehicle

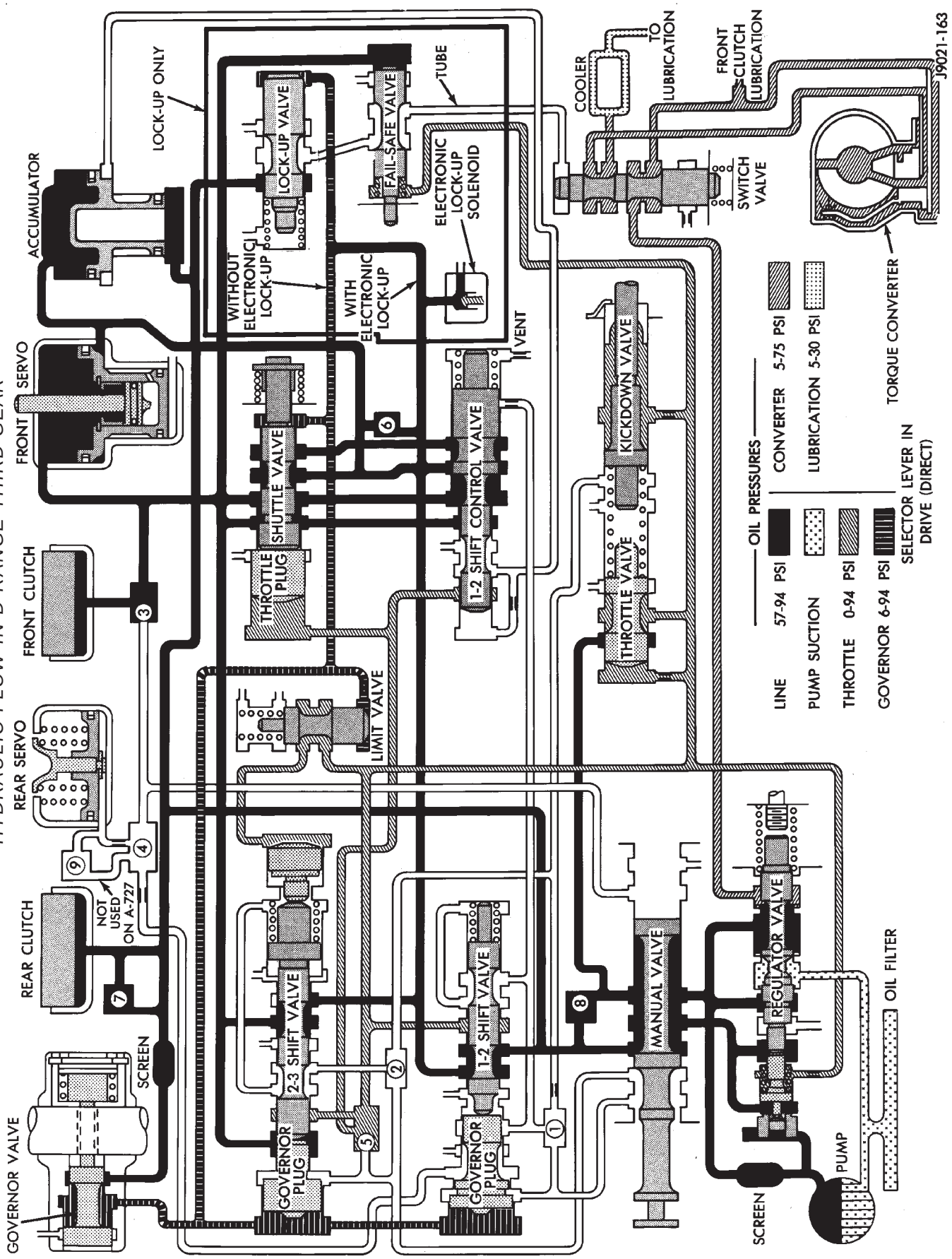
J9121-449

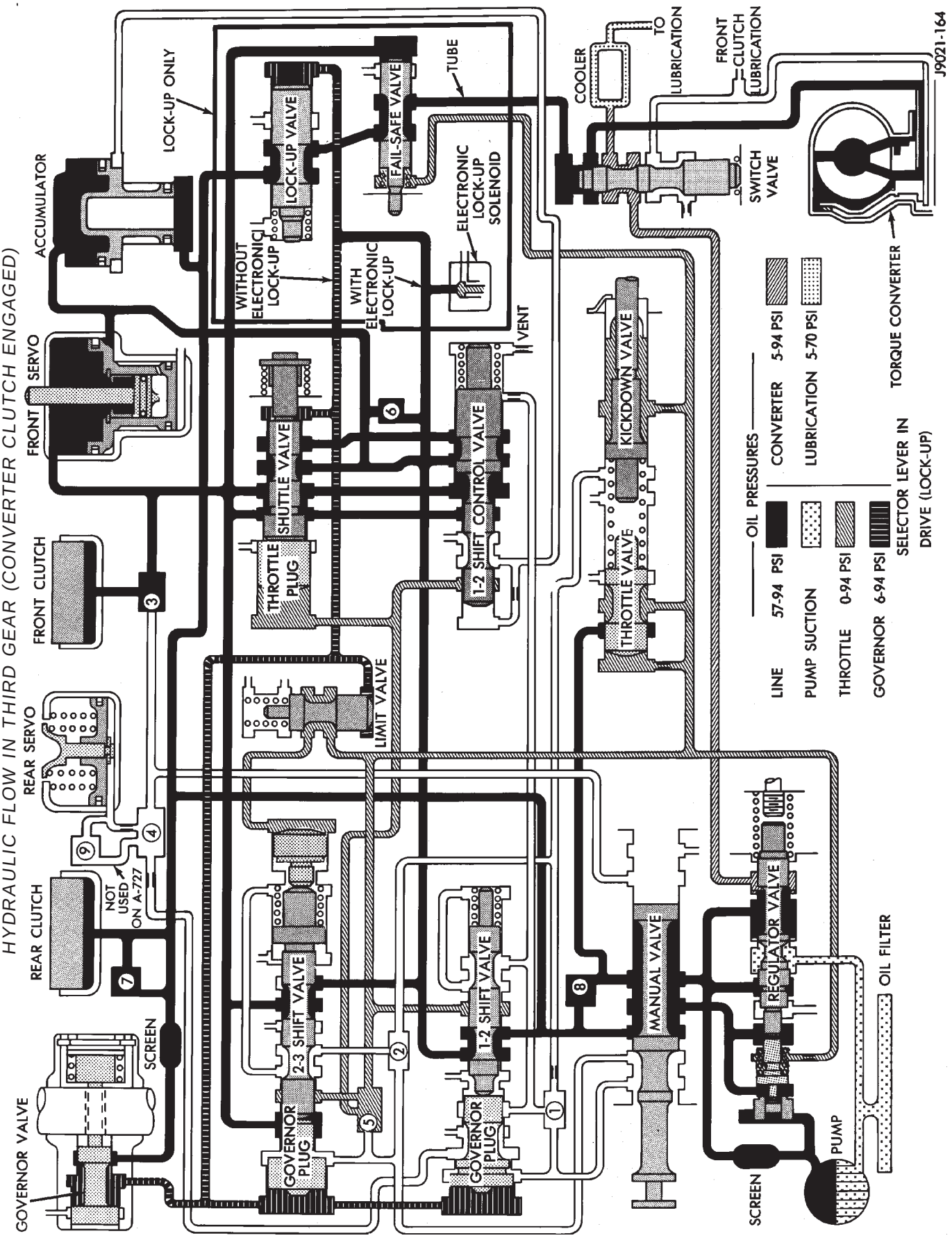
HYDRAULIC FLOW IN PARK AND NEUTRAL

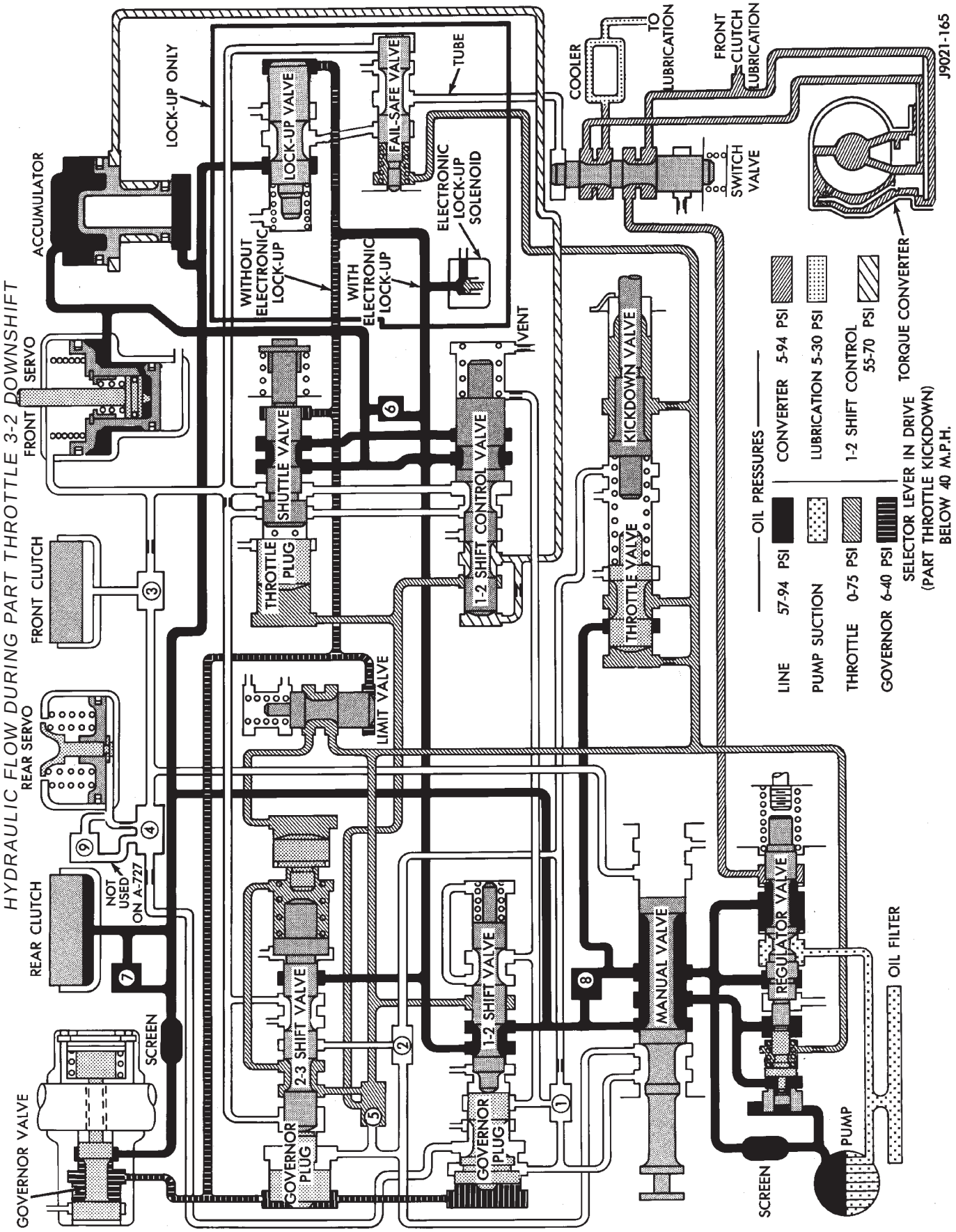


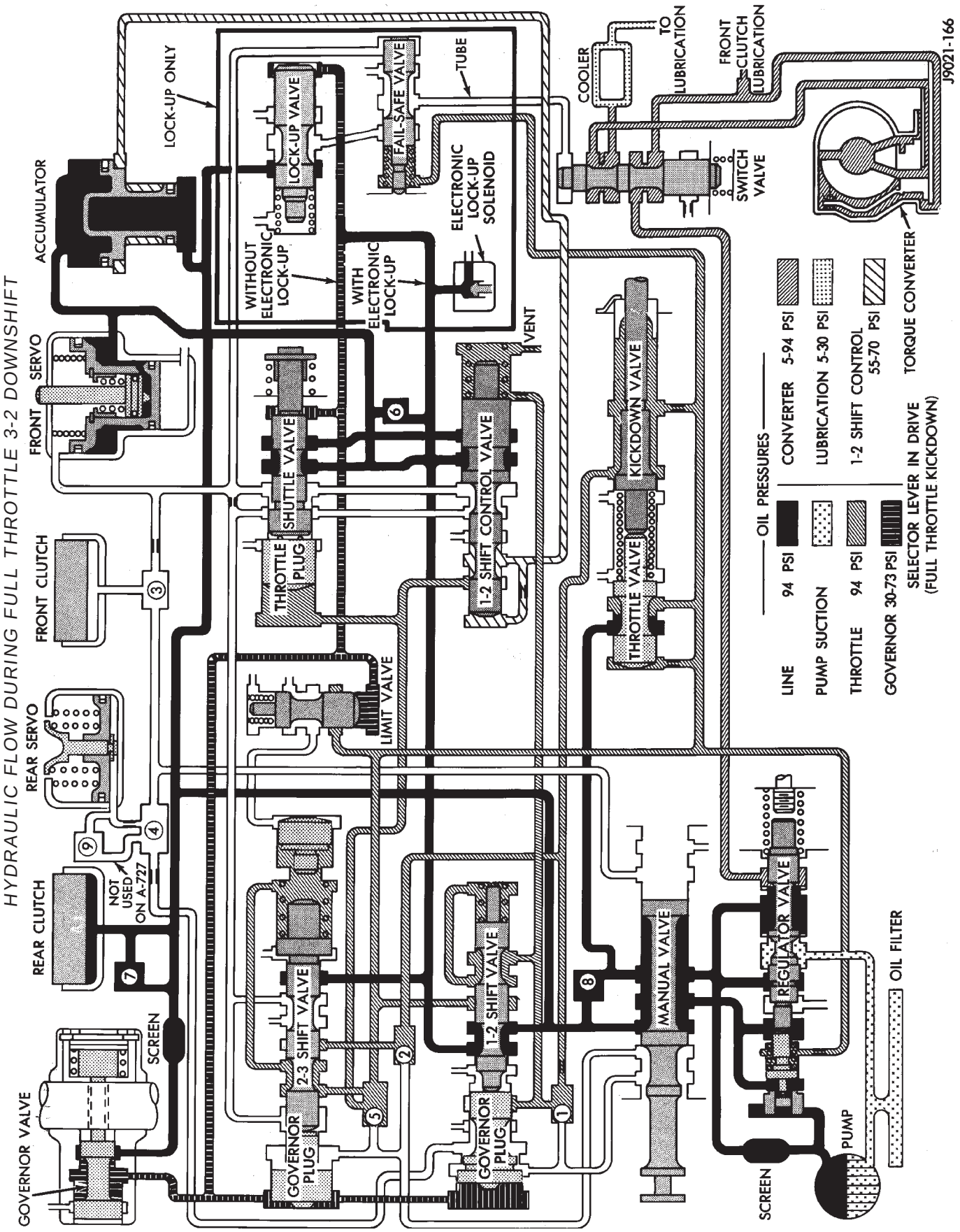

HYDRAULIC FLOW IN D RANGE FIRST GEAR
GOVERNOR VALVE
SCREEN
REAR CLUTCH
REAR SERVO
FRONT CLUTCH
FRONT SERVO
ACCUMULATOR
LOCK-UP ONLY
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
LOCK-UP VALVE
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
LIMIT VALVE
2-3 SHIFT VALVE
GOVERNOR PLUG
1-2 SHIFT VALVE
MANUAL VALVE
REGULATOR VALVE
OIL FILTER
PUMP
SCREEN
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
J9021-161
OIL PRESSURES
LINE 75 PSI
PUMP SUCTION
THROTTLE 40 PSI
GOVERNOR 0-75 PSI
CONVERTER 5-75 PSI
LUBRICATION 5-30 PSI
1-2 SHIFT CONTROL 25-35 PSI
SELECTOR LEVER IN DRIVE (BREAKAWAY)
HALF THROTTLE

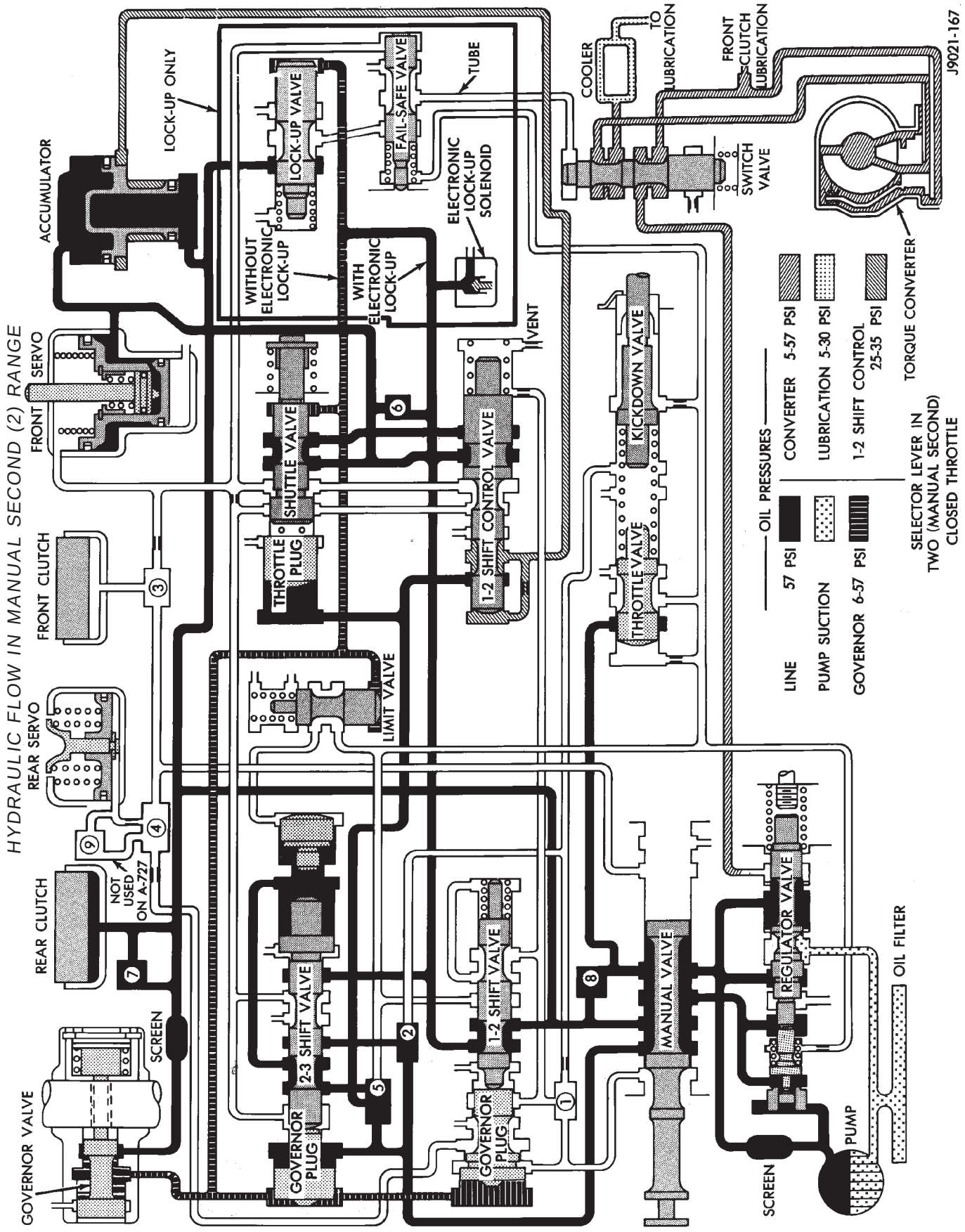

HYDRAULIC FLOW IN D RANGE SECOND GEAR
J9021-162
ACCUMULATOR
LOCK-UP ONLY
LOCK-UP VALVE
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
VENT
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
FRONT SERVO
FRONT CLUTCH
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
LIMIT VALVE
REAR SERVO
REAR CLUTCH
NOT USED ON A-727
2-3 SHIFT VALVE
1-2 SHIFT VALVE
MANUAL VALVE
REGULATOR VALVE
GOVERNOR PLUG
GOVERNOR VALVE
SCREEN
PUMP
OIL FILTER
TORQUE CONVERTER
OIL PRESSURES
LINE 75 PSI
PUMP SUCTION
THROTTLE 40 PSI
GOVERNOR 6-75 PSI
CONVERTER 5-75 PSI
LUBRICATION 5-30 PSI
1-2 SHIFT CONTROL 25-35 PSI
SELECTOR LEVER IN DRIVE (SECOND) HALF THROTTLE

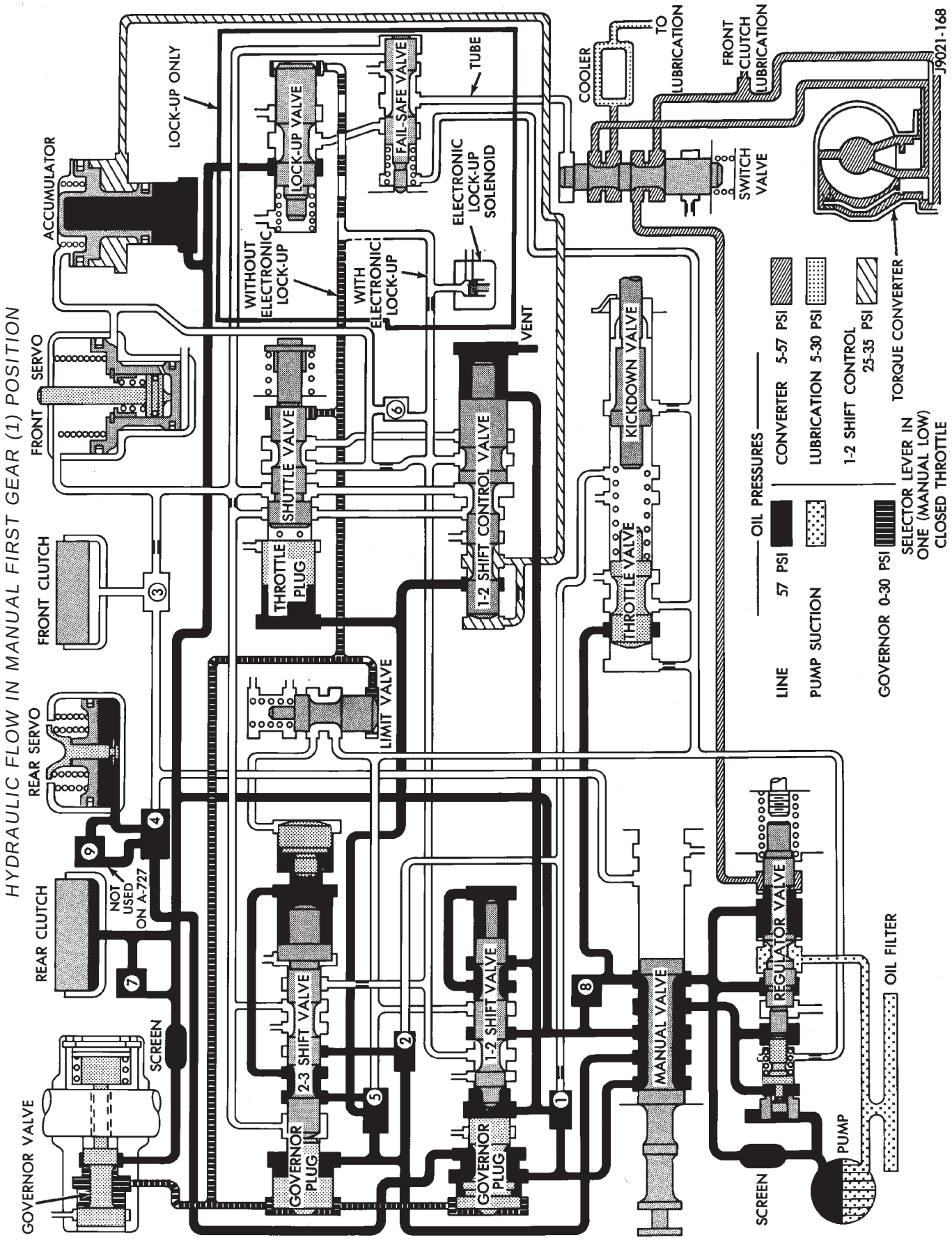

HYDRAULIC FLOW IN D RANGE THIRD GEAR
LOCK-UP ONLY
ACCUMULATOR
FRONT SERVO
FRONT CLUTCH
REAR SERVO
REAR CLUTCH
NOT USED ON A-727
SCREEN
GOVERNOR VALVE
2-3 SHIFT VALVE
GOVERNOR PLUG
1-2 SHIFT VALVE
GOVERNOR PLUG
LIMIT VALVE
THROTTLE PLUG
SHUTTLE VALVE
WITHOUT ELECTRONIC LOCK-UP
LOCK-UP VALVE
WITH ELECTRONIC LOCK-UP
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
MANUAL VALVE
REGULATOR VALVE
SCREEN
PUMP
OIL FILTER
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
OIL PRESSURES
LINE 57-94 PSI
CONVERTER 5-75 PSI
PUMP SUCTION
LUBRICATION 5-30 PSI
THROTTLE 0-94 PSI
GOVERNOR 6-94 PSI
SELECTOR LEVER IN DRIVE (DIRECT)
J9021-163

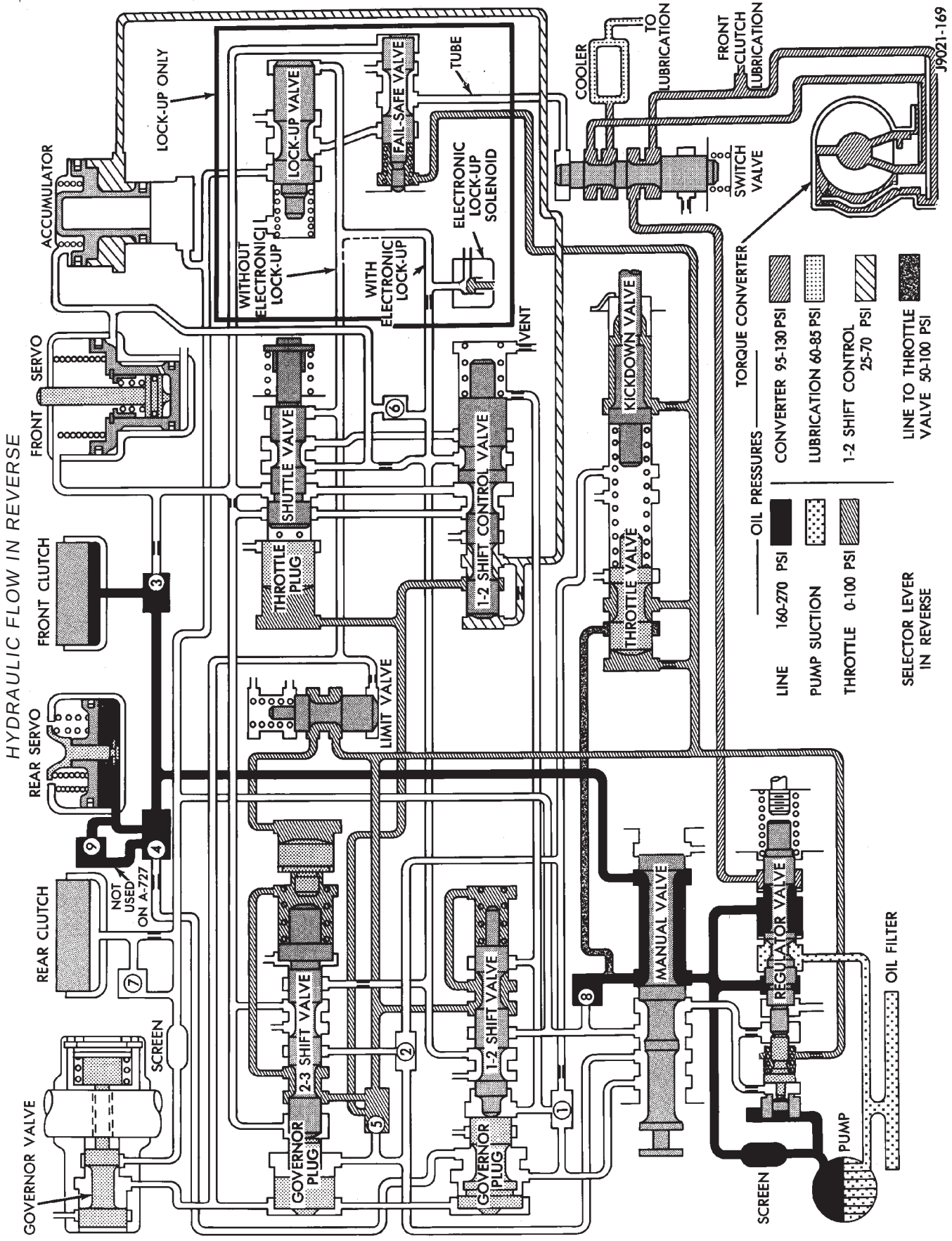

HYDRAULIC FLOW IN THIRD GEAR (CONVERTER CLUTCH ENGAGED)
ACCUMULATOR
LOCK-UP ONLY
FRONT SERVO
FRONT CLUTCH
REAR SERVO
REAR CLUTCH
NOT USED ON A-727
SCREEN
GOVERNOR VALVE
GOVERNOR PLUG
2-3 SHIFT VALVE
1-2 SHIFT VALVE
GOVERNOR PLUG
LIMIT VALVE
THROTTLE PLUG
SHUTTLE VALVE
WITHOUT ELECTRONIC LOCK-UP
LOCK-UP VALVE
WITH ELECTRONIC LOCK-UP
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
MANUAL VALVE
REGULATOR VALVE
SCREEN
PUMP
OIL FILTER
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
J9021-164
OIL PRESSURES
LINE 57-94 PSI
PUMP SUCTION
THROTTLE 0-94 PSI
GOVERNOR 6-94 PSI
CONVERTER 5-94 PSI
LUBRICATION 5-70 PSI
SELECTOR LEVER IN DRIVE (LOCK-UP)


HYDRAULIC FLOW DURING PART THROTTLE 3-2 DOWNSHIFT
GOVERNOR VALVE
SCREEN
REAR CLUTCH
REAR SERVO
NOT USED ON A-727
FRONT CLUTCH
FRONT SERVO
ACCUMULATOR
LOCK-UP ONLY
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
LOCK-UP VALVE
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
LIMIT VALVE
2-3 SHIFT VALVE
GOVERNOR PLUG
1-2 SHIFT VALVE
MANUAL VALVE
REGULATOR VALVE
OIL FILTER
PUMP
SCREEN
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
J9021-165
OIL PRESSURES
LINE 57-94 PSI
PUMP SUCTION
THROTTLE 0-75 PSI
GOVERNOR 6-40 PSI
CONVERTER 5-94 PSI
LUBRICATION 5-30 PSI
1-2 SHIFT CONTROL 55-70 PSI
SELECTOR LEVER IN DRIVE
(PART THROTTLE KICKDOWN)
BELOW 40 M.P.H.


HYDRAULIC FLOW DURING FULL THROTTLE 3-2 DOWNSHIFT
GOVERNOR VALVE
SCREEN
REAR CLUTCH
NOT USED ON A-727
REAR SERVO
FRONT CLUTCH
FRONT SERVO
ACCUMULATOR
LOCK-UP ONLY
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
LOCK-UP VALVE
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
LIMIT VALVE
2-3 SHIFT VALVE
GOVERNOR PLUG
1-2 SHIFT VALVE
MANUAL VALVE
REGULATOR VALVE
OIL FILTER
PUMP
SCREEN
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
J9021-166
OIL PRESSURES
LINE 94 PSI
PUMP SUCTION
THROTTLE 94 PSI
GOVERNOR 30-73 PSI
CONVERTER 5-94 PSI
LUBRICATION 5-30 PSI
1-2 SHIFT CONTROL 55-70 PSI
SELECTOR LEVER IN DRIVE
(FULL THROTTLE KICKDOWN)


HYDRAULIC FLOW IN MANUAL SECOND (2) RANGE
ACCUMULATOR
LOCK-UP ONLY
FRONT SERVO
FRONT CLUTCH
REAR SERVO
REAR CLUTCH
NOT USED ON A-727
SCREEN
GOVERNOR VALVE
GOVERNOR PLUG
2-3 SHIFT VALVE
1-2 SHIFT VALVE
LIMIT VALVE
THROTTLE PLUG
SHUTTLE VALVE
LOCK-UP VALVE
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
MANUAL VALVE
REGULATOR VALVE
OIL FILTER
PUMP
SCREEN
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
OIL PRESSURES
LINE 57 PSI
PUMP SUCTION
GOVERNOR 6-57 PSI
CONVERTER 5-57 PSI
LUBRICATION 5-30 PSI
1-2 SHIFT CONTROL 25-35 PSI
SELECTOR LEVER IN TWO (MANUAL SECOND) CLOSED THROTTLE
J9021-167


HYDRAULIC FLOW IN MANUAL FIRST GEAR (1) POSITION
GOVERNOR VALVE
SCREEN
REAR CLUTCH
REAR SERVO
NOT USED ON A-727
FRONT CLUTCH
FRONT SERVO
ACCUMULATOR
LOCK-UP ONLY
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
LOCK-UP VALVE
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
LIMIT VALVE
2-3 SHIFT VALVE
1-2 SHIFT VALVE
GOVERNOR PLUG
GOVERNOR PLUG
MANUAL VALVE
REGULATOR VALVE
SCREEN
PUMP
OIL FILTER
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
J9021-168
OIL PRESSURES
LINE 57 PSI
PUMP SUCTION
CONVERTER 5-57 PSI
LUBRICATION 5-30 PSI
1-2 SHIFT CONTROL 25-35 PSI
GOVERNOR 0-30 PSI
SELECTOR LEVER IN ONE (MANUAL LOW) CLOSED THROTTLE


HYDRAULIC FLOW IN REVERSE
GOVERNOR VALVE
SCREEN
REAR CLUTCH
NOT USED ON A-727
REAR SERVO
FRONT CLUTCH
FRONT SERVO
ACCUMULATOR
LOCK-UP ONLY
WITHOUT ELECTRONIC LOCK-UP
WITH ELECTRONIC LOCK-UP
LOCK-UP VALVE
FAIL-SAFE VALVE
TUBE
ELECTRONIC LOCK-UP SOLENOID
VENT
SHUTTLE VALVE
THROTTLE PLUG
1-2 SHIFT CONTROL VALVE
KICKDOWN VALVE
THROTTLE VALVE
LIMIT VALVE
2-3 SHIFT VALVE
1-2 SHIFT VALVE
GOVERNOR PLUG
GOVERNOR PLUG
MANUAL VALVE
REGULATOR VALVE
SCREEN
PUMP
OIL FILTER
COOLER
TO LUBRICATION
FRONT CLUTCH LUBRICATION
SWITCH VALVE
TORQUE CONVERTER
OIL PRESSURES
LINE 160-270 PSI
PUMP SUCTION
THROTTLE 0-100 PSI
CONVERTER 95-130 PSI
LUBRICATION 60-85 PSI
1-2 SHIFT CONTROL 25-70 PSI
LINE TO THROTTLE VALVE 50-100 PSI
SELECTOR LEVER IN REVERSE
J9021-169

30RH/32RH IN-VEHICLE SERVICE

INDEX

RECOMMENDED FLUID

The recommended and preferred fluid for 30RH/32RH transmissions is Mopar ATF Plus, Type 7176.

Mopar Dexron II is acceptable but should only be used when ATF Plus is not available.

Transmission fluid capacity is approximately 17 pints (7.9 liters). This is the approximate amount of fluid required to fill the transmission and torque converter after overhaul.

CHECKING FLUID LEVEL AND CONDITION

(1) Position vehicle on flat, level surface. This is important in obtaining an accurate fluid level check.

(2) To avoid false readings, which could produce under or over fill condition, do not check level until fluid is at normal operating temperature.

(3) Shift transmission into Neutral.

(4) Apply parking brakes.

(5) Operate engine at curb idle speed.

WARNING: WHEN PERFORMING UNDERHOOD OPERATIONS WITH THE ENGINE RUNNING, KEEP YOUR HANDS WELL AWAY FROM HOT OR ROTATING ENGINE COMPONENTS. DO NOT WEAR LOOSE ARTICLES OF CLOTHING WHICH COULD BECOME ENTANGLED IN ENGINE COMPONENTS OR ACCESSORIES.

(6) Shift transmission through all gear ranges and back to Neutral (leave engine running).

(7) Clean exterior of dipstick cap and fill tube before removing transmission dipstick.

(8) Remove dipstick and inspect fluid level.

- Correct level is to FULL mark
- Acceptable level is between ADD and FULL marks

(9) Check fluid condition. Fluid should be dark to light red in color and free of dirt or debris.

(10) If fluid is discolored or smells burned but transmission operation was OK, check cooler flow, flush cooler and lines and change fluid and filter. Then road test again to confirm proper operation.

(11) If fluid is black or dark brown, burned/turned to sludge, contains large quantities of metal or friction material particles, transmission will need overhaul. Especially if problems were evident during road test and preliminary diagnosis. Fluid cooler should also be flow tested and flushed if necessary.

GEARSHIFT LINKAGE ADJUSTMENT (YJ)

(1) Check linkage adjustment by starting engine in Park and Neutral.

(2) Adjustment is OK if engine starts only in park and Neutral. Adjustment is incorrect if engine starts in one but not both positions.

(3) If engine starts in any position other than Park or Neutral, or if engine will not start at all, park/neutral position switch may be faulty.

(4) Shift transmission into Park.

(5) Raise vehicle.

(6) Check condition of shift rods, bellcrank, bellcrank brackets and linkage bushings/grommets (Fig. 1). Tighten, repair, replace worn, damaged parts. Do not attempt adjustment if linkage components are worn or damaged.

(7) Loosen shift rod trunnion lock bolt or nut. Be sure upper shift rod slides freely in trunnion (Fig. 1). Also be sure shift rods and bellcrank rotate freely and do not bind at any point.

(8) Verify that manual lever is in Park detent (Fig. 1). Move lever all the way rearward to be sure it is in Park.

(9) Check for positive engagement of park lock by attempting to rotate propeller shaft. Shaft will not turn when park pawl is engaged.

(10) Adjust shift rod trunnion to a obtain free pin fit in bellcrank arm and tighten trunnion lock bolt or nut. Prevent shift rod from turning while tightening bolt or nut. Gearshift linkage lash must be eliminated to obtain proper adjustment. Eliminate lash by pulling downward on shift rod and pressing upward on bellcrank.

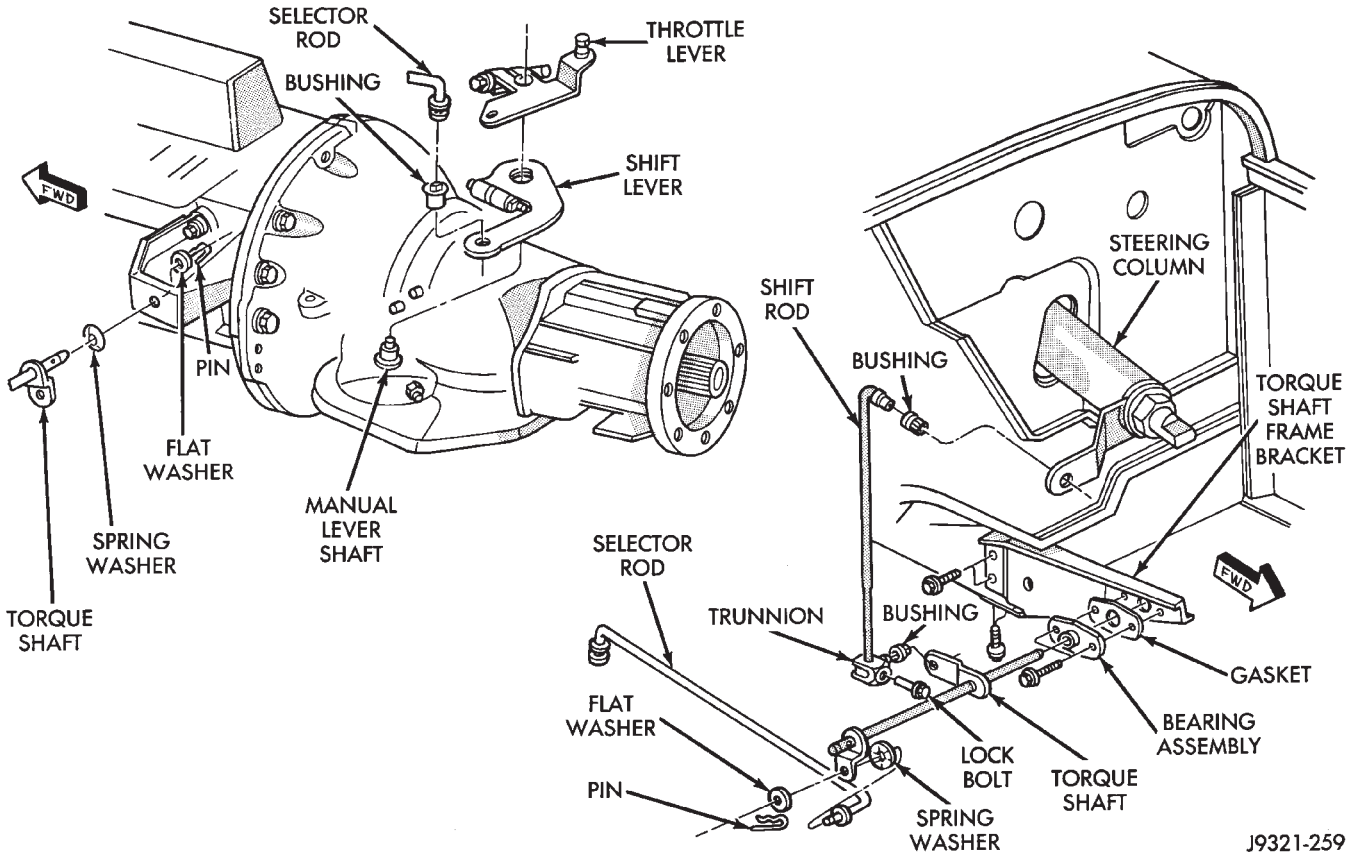


Fig. 1 Gearshift Linkage (YJ)

(11) Confirm proper adjustment by starting engine in Park and Neutral. Engine should start in these positions only. **If engine starts in any position other than Park or Neutral, adjustment is incorrect or neutral switch is faulty.**

(12) Lower vehicle and verify that steering lock operates correctly.

SHIFT CABLE ADJUSTMENT (XJ)

(1) Shift transmission into Park.

(2) Raise vehicle.

(3) Release cable adjuster clamp to unlock cable (Figs. 2 and 3). Clamp is at transmission end of cable.

(4) Unsnap cable from transmission cable bracket (Figs. 2 and 3).

(5) Move transmission shift lever fully rearward to Park detent. Lever is on manual valve shaft at driver side of case.

(6) Verify positive engagement of park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap cable into cable bracket.

(8) Lock shift cable by pressing cable adjuster clamp down until it snaps into place.

(9) Check engine starting. Engine should start only in Park and Neutral.

(10) Lower vehicle.

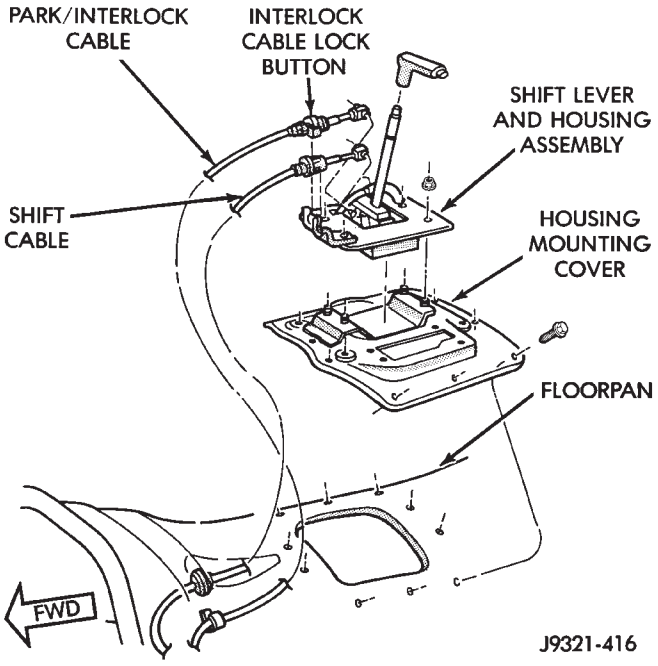


Fig. 2 Shift Cable (XJ)

PARK INTERLOCK CABLE ADJUSTMENT (XJ)

(1) Shift transmission into Park.

(2) Turn ignition switch to Lock position.

(3) Remove shift lever bezel and console screws. Raise bezel and console for access to cable.

(4) Pull cable lock button up to release cable (Fig. 3).

(5) Pull cable forward. Then release cable and press cable lock button down until it snaps in place.

(6) Check adjustment as follows:

(a) Check movement of release shift handle button (floor shift) or release lever (column shift). You should not be able to press button inward or move column lever.

(b) Turn ignition switch to On position.

(c) Press floor shift lever release button or move column lever. Then shift into Neutral. If cable adjustment is correct, ignition switch can not be turned to Lock position. Perform same check with transmission in D range.

(7) Move shift lever back to Park and check ignition switch operation. You should be able to turn switch to Lock position and shift lever release button/lever should not move.

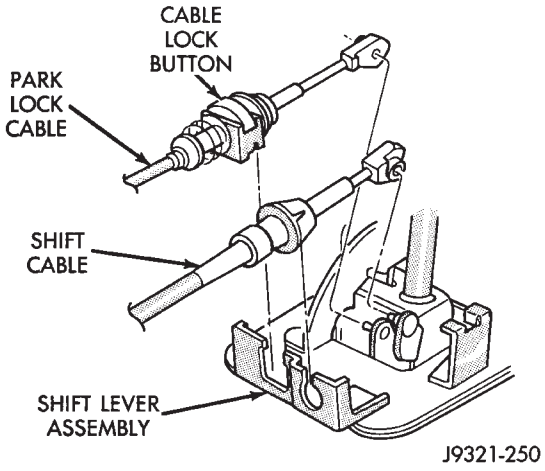


Fig. 3 Park Lock Cable Attachment (XJ)

TRANSMISSION THROTTLE CABLE ADJUSTMENT (XJ/YJ)

A cable is used to control throttle pressure and kickdown on 30RH/32RH transmissions (Fig. 4).

Correct cable adjustment is important to proper operation. The cable positions the throttle valve which controls shift speed, shift quality and part throttle downshift sensitivity. If the setting is incorrect, shift quality and shift speeds will be unsatisfactory.

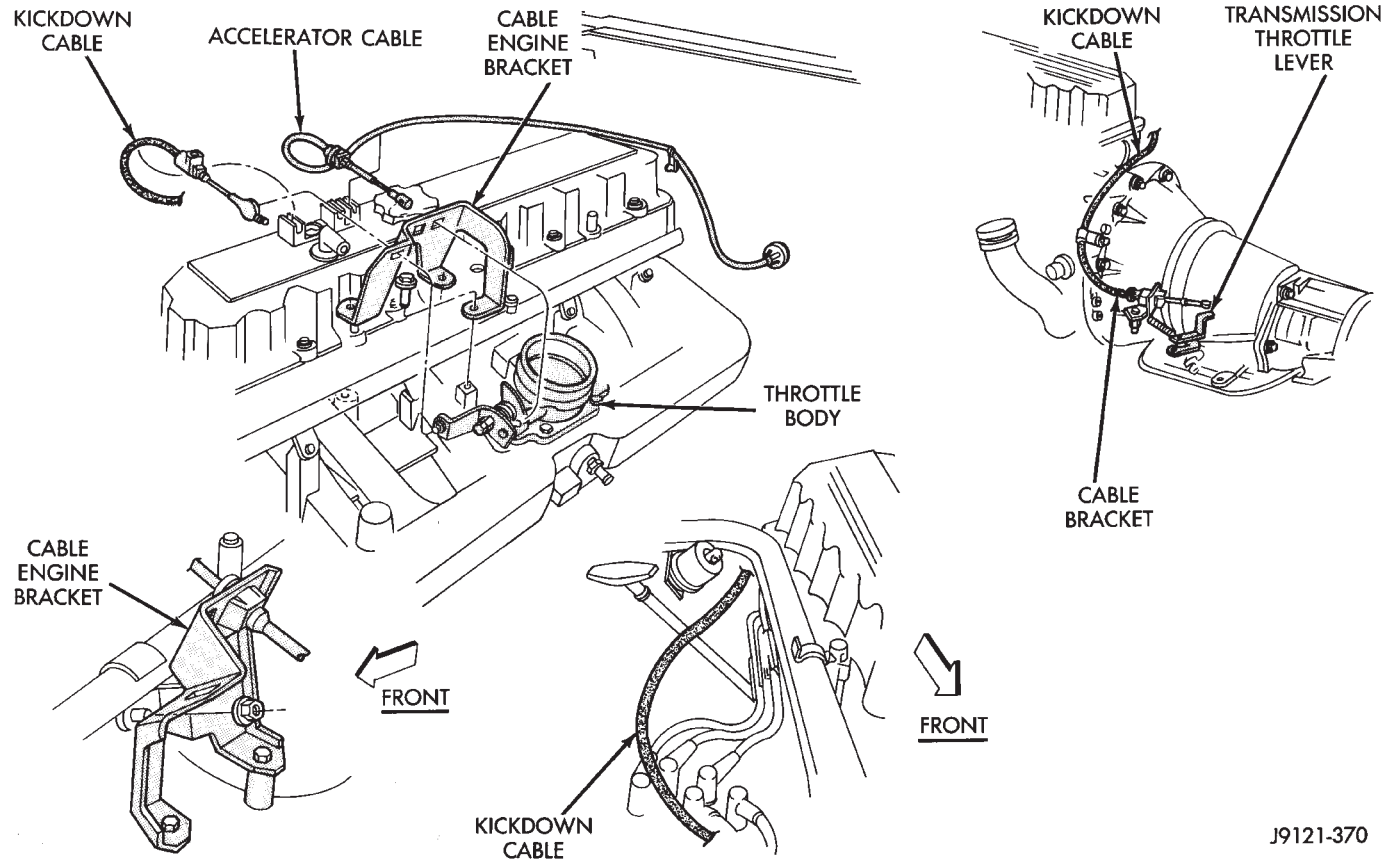


Fig. 4 Transmission Throttle Valve (Kickdown) Cable

THROTTLE CABLE ADJUSTMENT PROCEDURE

Cable adjustment is performed entirely in the engine compartment. It is not necessary to raise the vehicle for access to any other components.

(1) Shift transmission into Park and shut engine off.

(2) Press cable release button (Fig. 5).

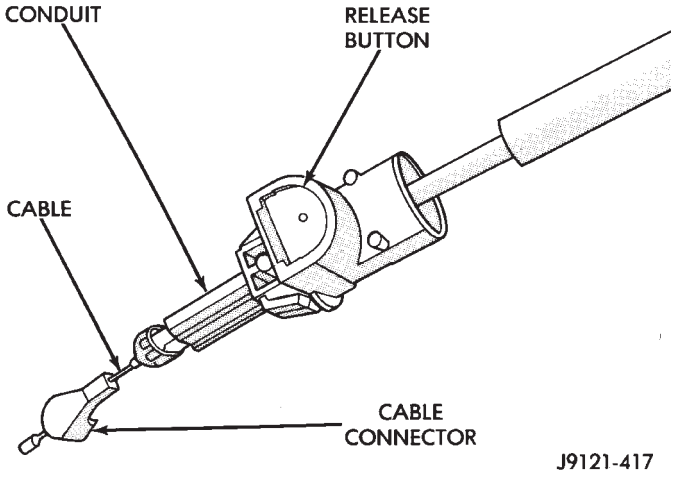


Fig. 5 Throttle Valve Cable Components

(3) Push cable conduit back into cable adjuster body as far as possible (Fig. 6).

(4) Rotate throttle body lever to wide open throttle position. Cable will ratchet to correct adjustment point as lever is rotated (Fig. 6).

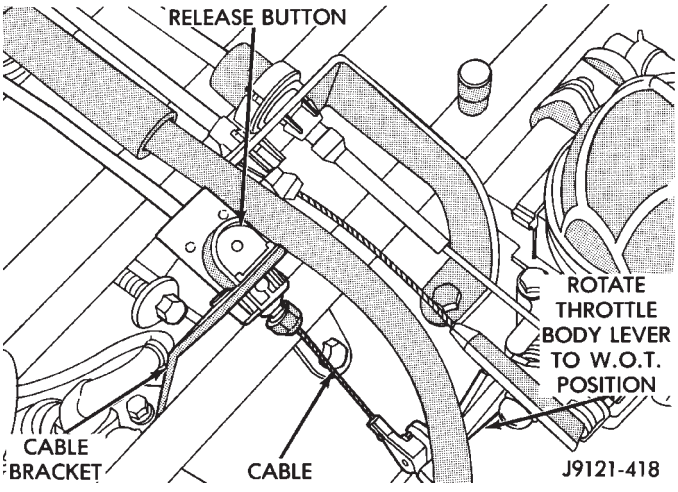


Fig. 6 Throttle Valve Cable Adjustment

FRONT BAND ADJUSTMENT

The front band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut. Then back locknut off 4-5 turns.

(3) Clean adjusting screw threads with Mopar rust penetrant if necessary. Then lubricate threads with Mopar spray lube or petroleum jelly. Be sure screw turns freely in case. This is necessary for accurate adjustment.

(4) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with inch-pound torque wrench. **If Adapter Extension C-3705 is needed in order to reach adjusting screw, tighten screw to only 5-6 N·m (47-50 in. lbs.) torque (Fig. 7).**

(5) Back off front band adjusting screw as follows:

- **On 30RH (2.5L), back adjusting screw off 2-1/2 turns**
- **On 32RH (4.0L), back adjusting screw off 2-1/4 turns**

(6) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(7) Lower vehicle.

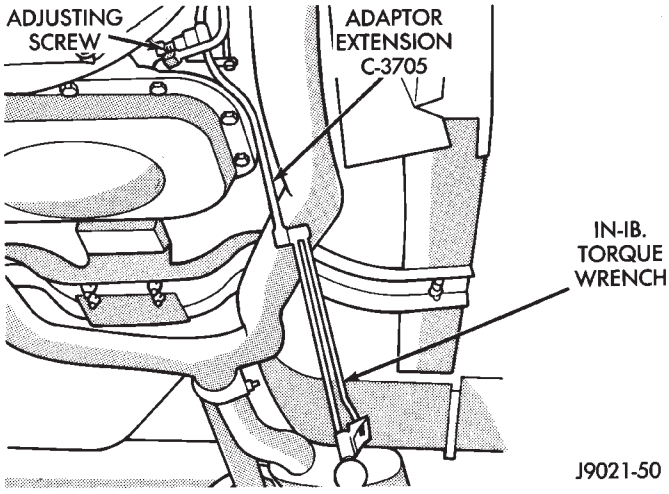


Fig. 7 Front Band Adjustment

REAR BAND ADJUSTMENT

The transmission oil pan must be removed for access to the rear (low-reverse) band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw as follows: On 32Rh transmission, tighten screw to 8 N·m (72 in. lbs.) torque. On 30RH transmission, tighten adjusting screw to 5 N·m (41 in. lbs.) torque (Fig. 8).

(5) Back off rear band adjusting screw as follows:

- **On 30RH (2.5L), back adjusting screw off 7 turns**
- **On 32RH (4.0L), back adjusting screw off 4 turns**

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (150 in. lbs.) torque.

(8) Lower vehicle and refill transmission with recommended fluid.

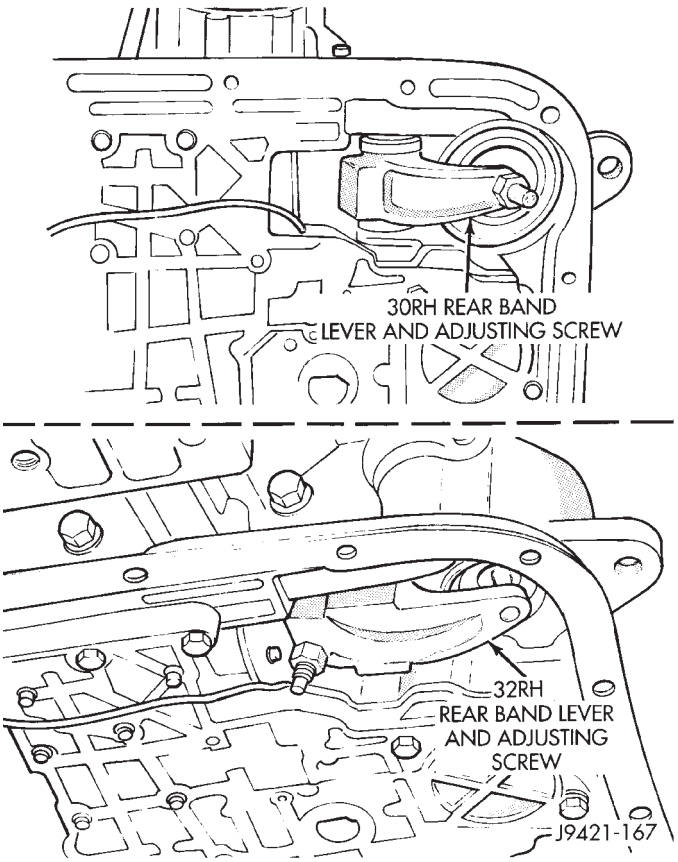


Fig. 8 Rear Band Lever And Adjusting Screw Location

OIL FILTER REPLACEMENT

(1) Raise vehicle.

(2) Remove oil pan and drain fluid.

(3) Remove filter screws and remove oil filter (Fig. 9).

(4) Position new filter on valve body and install filter screws finger tight.

(5) Tighten filter screws to 4 N·m (35 in. lbs.) with inch pound torque wrench.

(6) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (150 in. lbs.) torque.

(7) Lower vehicle.

(8) Refill transmission with Mopar ATF Plus, Type 7176. Mopar Dexron II can be used if ATF Plus is not readily available.

VALVE BODY REMOVAL

(1) Raise vehicle.

(2) Remove oil pan and drain fluid.

(3) Disconnect gearshift and throttle linkage at transmission levers.

(4) Loosen clamp bolts and remove throttle and manual valve levers from manual valve shaft.

(5) Disconnect park/neutral position switch wires and remove switch and switch seal.

(6) Remove valve body oil filter.

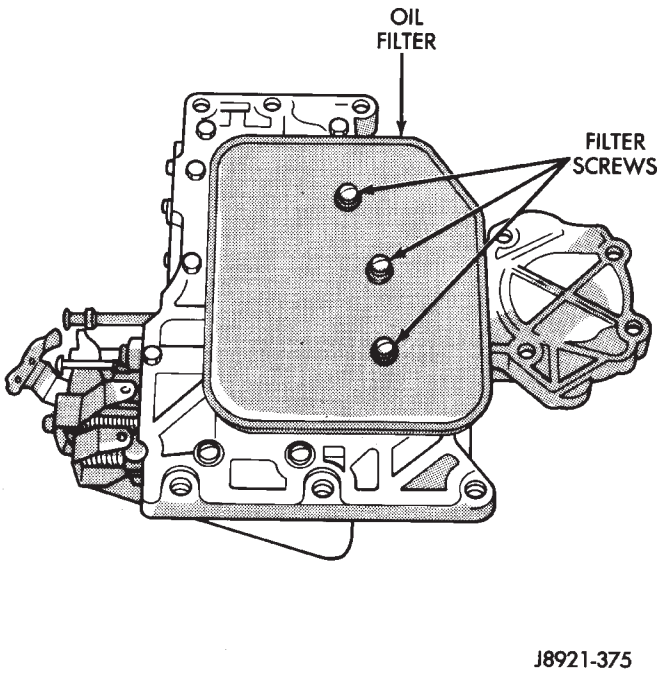


Fig. 9 Oil Filter Screw Locations

(7) Remove valve body attaching screws. Lower valve body slightly and remove accumulator piston and spring (Fig. 10). Rotate valve body down and away from case. Pull it forward to disengage park rod and remove valve body.

(8) Position valve body on bench or on repair stand for disassembly, cleaning and inspection (Fig. 11).

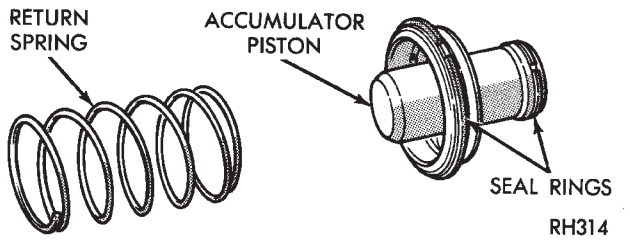


Fig. 10 Accumulator Piston And Spring

VALVE BODY SERVICE

The valve body can be disassembled for cleaning and inspection of the individual components. Valve body service procedures are detailed in the overhaul section.

The only serviceable valve body components are:

- park lock rod and E-clip
- switch valve and spring
- pressure adjusting screw bracket
- throttle valve lever
- manual lever
- manual lever shaft seal, washer, E-clip and detent ball
- fluid filter
- converter clutch solenoid

The remaining valve body components are serviced only as part of a complete valve body assembly.

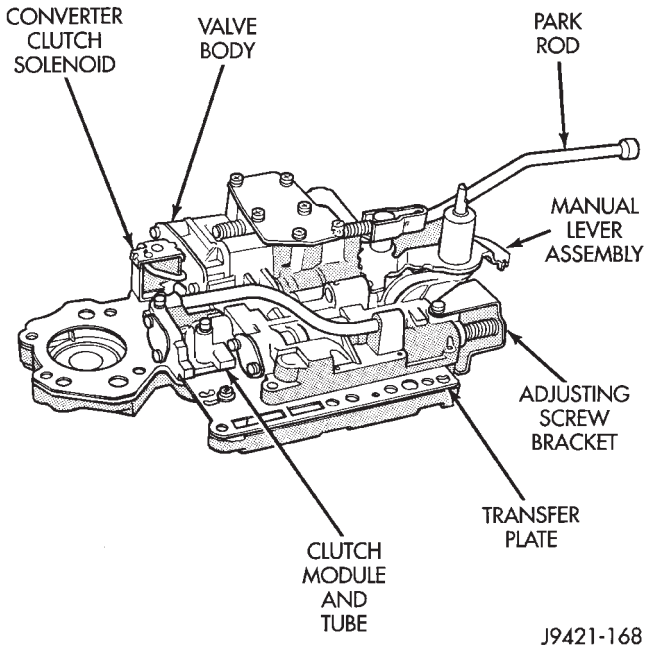


Fig. 11 Valve Body Assembly

VALVE BODY INSTALLATION

(1) Place valve body manual lever in low (1 position) so park lock rod can be installed in sprag.

(2) Position park sprag with screwdriver to ease lock rod installation and engagement.

(3) Install new seals on accumulator piston if necessary and install piston in case. A small amount of petroleum jelly can be used to hold piston in place.

(4) Lubricate shaft of manual lever and lip of shaft seal with petroleum jelly.

(5) Raise valve body and align park rod with case opening and park sprag. Then push rod end through opening and past sprag. Rotate propeller shaft if necessary.

(6) Position accumulator spring on transfer plate.

(7) Align valve body and seat it on case. Be sure manual lever shaft and accumulator spring are properly seated.

(8) Hold valve body in position and install one or two attaching bolts to hold valve body in place.

(9) Install remaining valve body bolts. Tighten all bolts evenly in a diagonal pattern to 12 N·m (105 in-lbs) torque.

(10) Install new oil filter and tighten filter screws to 4 N·m (35 in. lbs.) torque.

(11) Connect converter solenoid wire to case connector.

(12) Install manual and throttle levers on throttle lever shaft. Tighten lever clamp screws and check for free operation. Shaft and levers must operate freely without any bind.

(13) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(14) Install seal on neutral switch, install switch in case, and connect switch wires.

(15) Lower vehicle.

(16) Fill transmission with Mopar ATF Plus, Type 7176 fluid.

(17) Adjust gearshift linkage and throttle valve (kickdown) cable if necessary.

GOVERNOR AND PARK GEAR SERVICE

GOVERNOR REMOVAL

(1) Raise vehicle.

(2) Mark both propeller shaft yokes for assembly reference and disconnect propeller shafts at transfer case.

(3) Disconnect speedometer cable.

(4) Position support stand under transmission converter housing.

(5) Remove rear crossmember.

(6) Disconnect parking brake cable at equalizer and disconnect exhaust pipe support brackets, if necessary.

(7) Support transfer case with jack.

(8) Remove bolts attaching transfer case to transmission adapter housing and remove transfer case.

(9) Remove bolts attaching adapter, or extension housing to transmission and remove housing.

(10) Rotate transmission output shaft until governor valve shaft E-clip faces downward (Fig. 12).

(11) Remove E-clip from one end of governor valve shaft (Fig. 12).

(12) Remove governor valve and shaft from governor body.

(13) Remove snap ring that retains governor body-park gear assembly on output shaft (Fig. 12).

(14) Remove governor body-park gear assembly from output shaft.

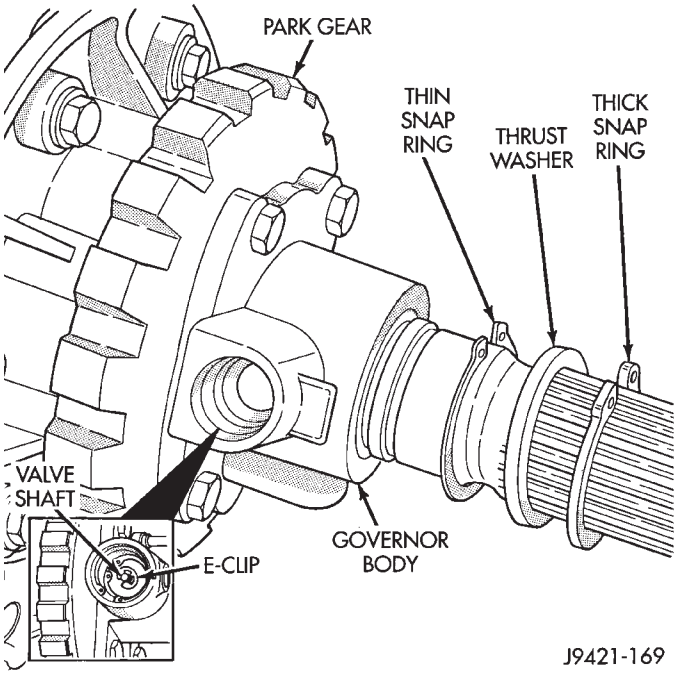


Fig. 12 Governor E-clips And Attaching Bolts

GOVERNOR DISASSEMBLY

(1) Remove governor weights and spring from body (Fig. 13).

(2) Remove snap ring and separate inner weight and outer weight and spring (Fig 13).

(3) Remove bolts attaching governor to park gear (Fig. 13).

(4) Remove park gear from governor body.

(5) Remove filter screen from park gear or governor body (Fig. 13).

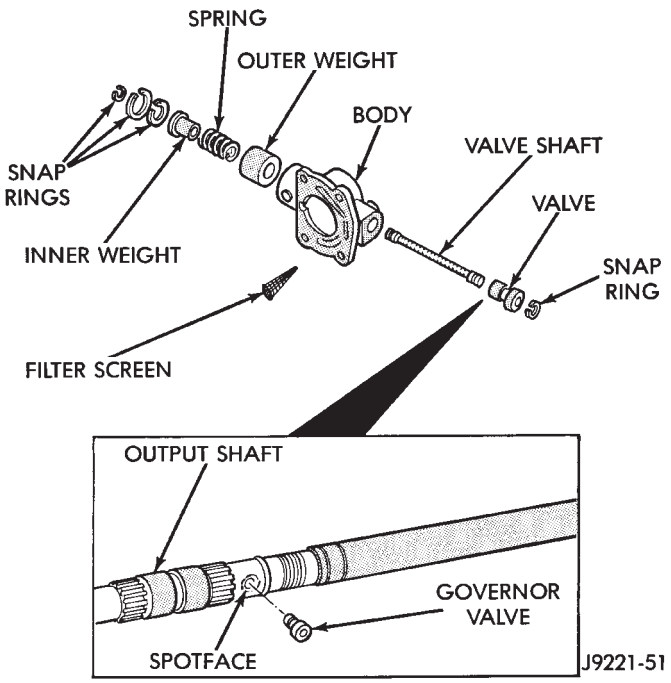


Fig. 13 Governor Components

CLEANING AND INSPECTION

Thoroughly clean all the governor parts in a suitable cleaning solution but do not use any type of caustic cleaning agents.

The weights and valves should fall freely in their bores when clean and dry. Minor surface scratches and burrs can be removed with crocus cloth.

Inspect the governor weight spring for distortion. Replace the spring, if damaged. Clean the filter in solvent and dry it with compressed air. Replace the filter, if damaged. Inspect the park gear for chipped or worn gear teeth or damaged ring grooves. Replace the gear, if damaged.

GOVERNOR ASSEMBLY

The governor valve used in 30RH/31RH/32RH transmissions built since the 1992 model year, is made of aluminum. In addition, the output shaft has been spotfaced to accept the new aluminum valve. The aluminum valve must not be used in previous transmissions. The valve can only be used with an output shaft that has been spotfaced for valve end clearance. In addition, the governor body and output shaft must be properly indexed during reassembly. Be sure to index these components as described in the Transmission Assembly and Adjustment procedures.

(1) Install filter screen in park gear.

(2) Assemble governor body and park gear. Be sure oil passages in body and gear are aligned.

(3) Install governor-to-park gear bolts finger tight only at this time.

(4) Install governor weight snap ring in governor body. Then install governor weight and spring assembly in governor body.

GOVERNOR INSTALLATION

(1) Align and install park gear/governor assembly on output shaft.

(2) Align valve shaft bore in governor body with bore in output shaft. **Be sure hole in output shaft for governor valve shaft is aligned with governor valve bore in governor body. Valve shaft will bind if misalignment occurs. Remove and reposition governor body if necessary.**

(3) Install governor valve and shaft. Be sure shaft slides freely in bore before installing E-clip on shaft.

(4) Install governor valve on shaft and in governor body. Then install remaining shaft retaining snap ring.

(5) Install components that retain governor body and park gear on output shaft as follows:

(a) On models with single snap ring, install snap ring (Fig. 12). Be sure ring is seated in shaft.

(b) On models with thrust washer and two snap rings, install thin snap ring first. Then install thrust washer second and thick snap ring last (Fig. 12).

16(c) Verify correct position of snap rings. **Be sure flat side of each snap ring is toward governor body.**

(6) Tighten governor-to-park gear bolts to 11 N·m (95 in. lbs.).

(7) Install adapter and gasket on transmission. Tighten adapter bolts to 32 N·m (24 ft. lbs.).

(8) Install transfer case and rear crossmember.

(9) Connect speedometer cable, or vehicle speed sensor wires exhaust pipe brackets and brake cable, if removed.

(10) Align and connect propeller shafts. Tighten clamp bolts to 19 N·m (14 ft. lbs.) torque.

(11) Remove supports and lower vehicle.

(12) Check and adjust transmission fluid level.

PARK LOCK COMPONENT REPLACEMENT

COMPONENT REMOVAL

(1) Raise vehicle and remove transfer case and adapter housing from transmission.

(2) Slide sprag shaft out of adapter housing and remove park sprag and spring (Fig. 14).

(3) Remove snap ring and slide plug and pin assembly out of housing (Fig. 14).

(4) If park rod must be serviced, remove valve body and remove rod.

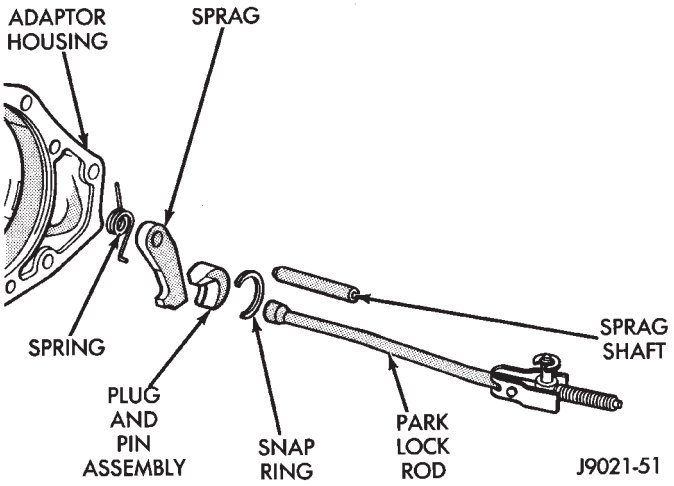


Fig. 14 Park Lock Components

Inspection

Check the sprag shaft for scores and for free movement in the housing and sprag.

Check the sprag and control rod springs for loss of tension or distortion. Check the square lug on the sprag for broken edges. Check the lugs on the governor support (park gear) for broken edges.

Check the knob on the end of the control rod for nicks, burrs and free turning.

Replace any park lock components that are worn or damaged.

The park lock rods used in Chrysler 3-speed transmissions are different lengths. If the rod must be replaced, be sure to install the correct length and shape rod.

COMPONENT INSTALLATION

(1) Install park lock rod on valve body.

(2) Install reaction plug and pin assembly in the housing and install the snap ring.

(3) Position sprag and spring in housing and install sprag shaft. Be sure square lug on sprag is facing park gear and that spring is positioned so it moves sprag away from park gear.

(4) Install valve body.

(5) Install adapter housing and transfer case.

PARK/NEUTRAL POSITION SWITCH SERVICE

The starter feed circuit of the switch is through the switch center terminal (Fig. 15). It provides a ground for the starter solenoid circuit through the gearshift lever in park and neutral only.

The two outer terminals of the park/neutral position switch are for the backup lamp switch circuit.

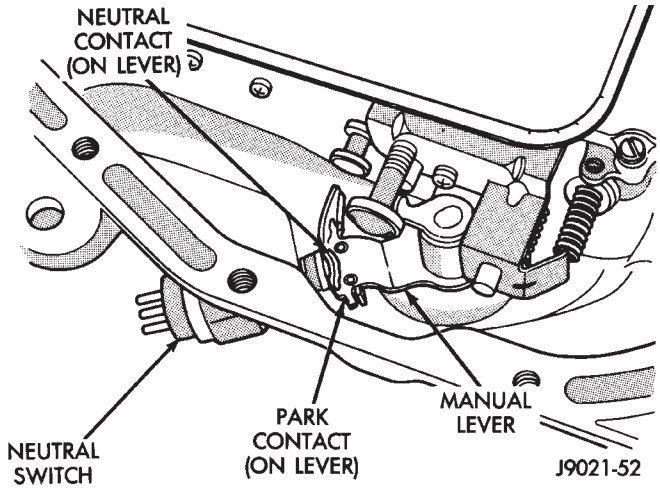


Fig. 15 Park/Neutral Position Switch And Manual Lever

SWITCH TEST PROCEDURE

(1) Remove wiring connector from switch.

(2) Test continuity between switch center terminal and transmission case. Continuity should exist only when transmission is in Park or Neutral. Replace switch if continuity occurs in any gear other than Park or Neutral.

(3) Shift into reverse and test continuity between two outside terminals on switch. Continuity should exist only when transmission is in reverse.

(4) Leave transmission in reverse and test continuity between each switch outer terminal and transmission case. Continuity should not exist between either pin and case in reverse.

(5) If switch tests OK, check gearshift linkage adjustment or backup light circuit. Replace switch if it fails continuity tests.

SWITCH REPLACEMENT

(1) Position drain pan under neutral switch.

(2) Disconnect switch wires.

(3) Remove switch from transmission.

(4) Move shift lever to Park and Neutral positions. Inspect manual lever fingers, lever and shaft for proper alignment with switch opening in case. Replace lever if worn or bent. Do not attempt to straighten the lever.

(5) Install new switch and seal in case. Tighten switch to 33 N·m (24 ft. lbs.) torque.

(6) Adjust transmission fluid level as required.

(7) Verify switch operation.

SPEEDOMETER SERVICE

Rear axle gear ratio and tire size determine speedometer pinion requirements. If the pinion must be replaced, refer to the parts catalogue information for the correct part. It is important for speedometer accuracy that the pinion have the correct number of teeth.

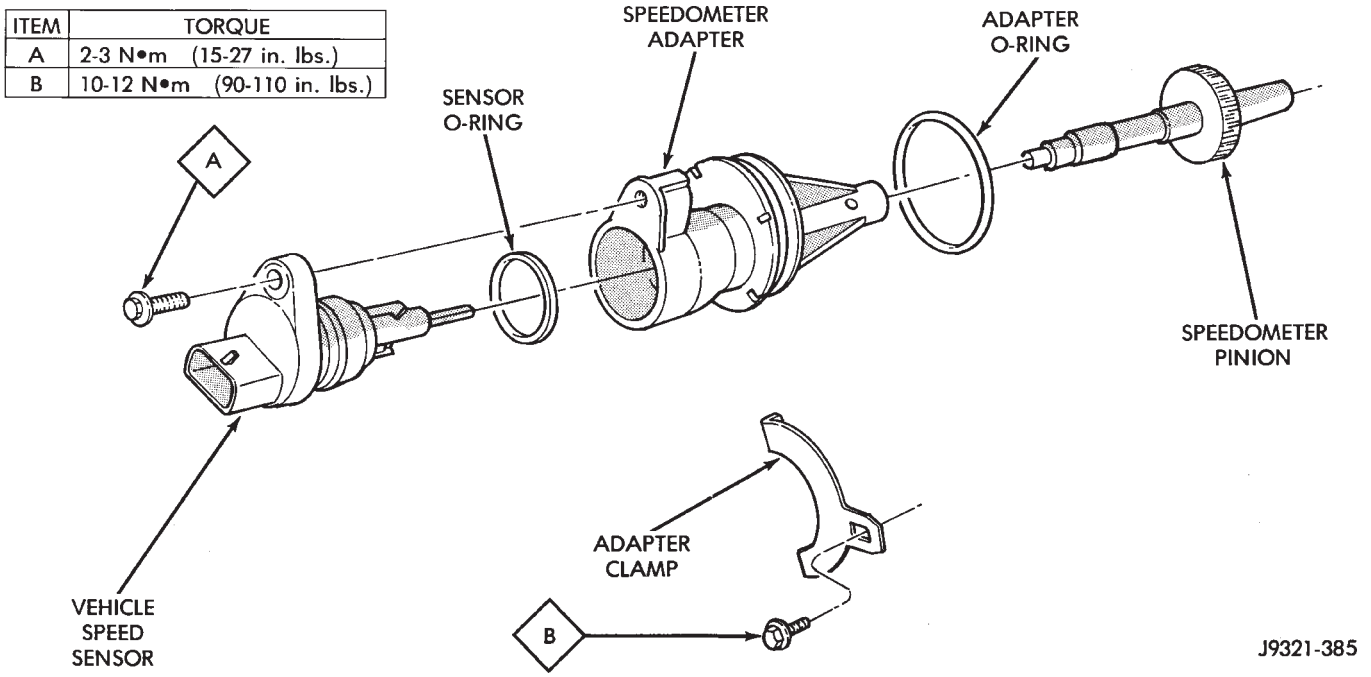


Fig. 16 Speedometer Components (With Unit Style Sensor)

The speedometer assembly used in XJ models is the new unit type (one-piece) speed sensor (Fig. 16). However, YJ models may be equipped with either the new unit style, or the older style that has a two-piece speed sensor and a metal adapter (Fig. 16). Service procedures for both styles are described in the following procedures.

SPEEDOMETER ASSEMBLY REMOVAL (WITH UNIT STYLE SENSOR)

(1) Raise vehicle.
(2) Disconnect wires from vehicle speed sensor.
(3) Remove adapter clamp and screw (Fig. 16).
(4) Remove speed sensor and speedometer adapter as assembly.
(5) Remove speed sensor retaining screw and remove sensor from adapter.
(6) Remove speedometer pinion from adapter.
(7) Inspect sensor and adapter O-rings (Fig. 16). Remove and discard O-rings if worn or damaged.
(8) Inspect terminal pins in vehicle speed sensor. Clean pins with Mopar electrical spray cleaner if dirty or oxidized. Replace sensor if faulty, or pins are loose, severely corroded, or damaged.

SPEEDOMETER INSTALLATION AND INDEXING (UNIT STYLE)

(1) Thoroughly clean adapter flange and adapter mounting surface in housing. Surfaces must be clean for proper adapter alignment and speedometer operation.
(2) Install new O-rings on speed sensor and speedometer adapter if necessary (Fig. 17).
(3) Lubricate sensor and adapter O-rings with transmission fluid.
(4) Install vehicle speed sensor in speedometer adapter. Tighten sensor attaching screw to 2-3 N·m (15-27 in. lbs.) torque.
(5) Install speedometer pinion in adapter.
(6) Count number of teeth on speedometer pinion. Do this before installing assembly in housing. Then lubricate pinion teeth with transmission fluid.
(7) Note index numbers on adapter body (Fig. 17). These numbers will correspond to number of teeth on pinion.

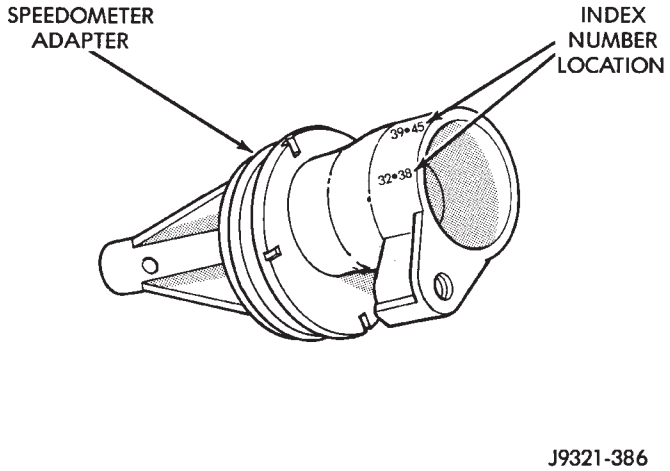


Fig. 17 Location Of Index Numbers On Speedometer Adapter (Unit Style Sensor)

(8) Install speedometer assembly in housing.
(9) Rotate adapter until required **range numbers are at 6 o-clock position. Be sure range index numbers correspond to number of teeth on pinion gear.**

(10) Install speedometer adapter clamp and retaining screw. Tighten clamp screw to 10-12 N·m (90-110 in. lbs.) torque.

(11) Connect wires to vehicle speed sensor.

(12) Lower vehicle and top off transmission fluid level if necessary.

SPEEDOMETER COMPONENT REMOVAL (TWO-PIECE SENSOR)

(1) Raise vehicle.

(2) Disconnect speed sensor wires.

(3) Remove bolt attaching vehicle speed sensor to sensor adapter. Then slide sensor out of adapter.

(4) Inspect speed sensor mounting area in sensor adapter. If transmission fluid is found in this area, oil seal in metal speedometer adapter is leaking and will have to be replaced.

(5) Remove speedometer adapter clamp bolt and remove clamp (Fig. 18).

(6) Remove speedometer adapter, sensor adapter and speedometer pinion as assembly.

SPEEDOMETER COMPONENT INSTALLATION AND INDEXING (TWO-PIECE SENSOR)

(1) Replace speedometer O-ring if cut, torn, or worn.

(2) If oil seal in metal speedometer adapter needs replacement, remove old seal with pointed tool. Then install new seal with Special Tool C-4004. Push seal into place with tool until tool bottoms (Fig. 19).

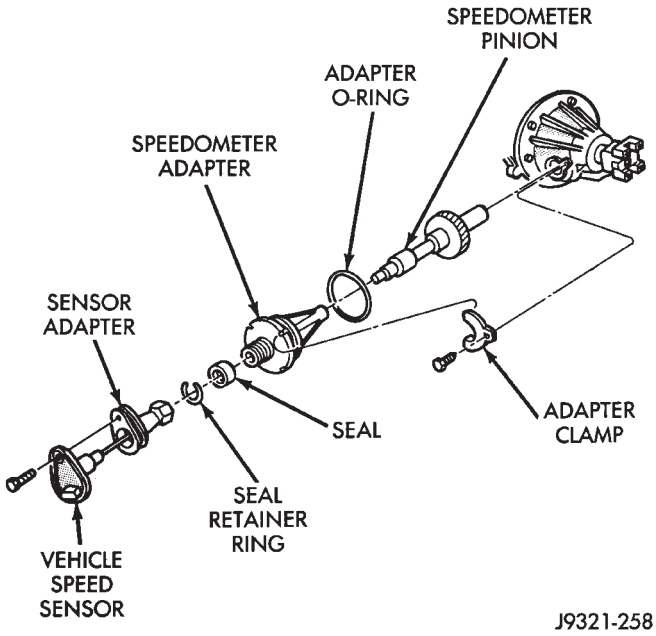


Fig. 18 Speedometer Components (With Two-Piece Sensor)

(3) Clean speedometer adapter mounting surface of transmission, or transfer case thoroughly.

(4) Lubricate adapter seals with transmission fluid.

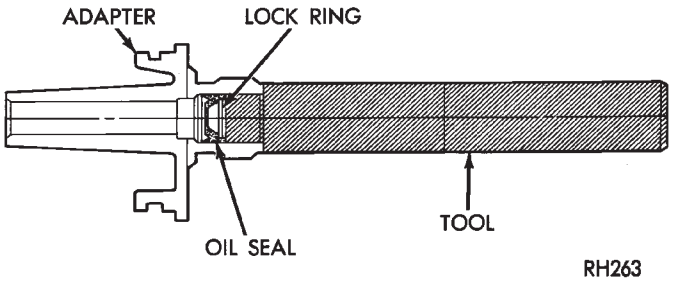


Fig. 19 Installing Speedometer Adapter Seal (With Two-Piece Sensor And Metal Adapter)

(5) Count number of teeth on speedometer pinion. Do this before installing pinion and adapter.

(6) Note range numbers on face of speedometer adapter (Fig. 20). These numbers correspond to number of teeth on speedometer pinion.

(7) Install pinion in adapter and install assembled pinion and adapter in transmission or transfer case.

(8) Rotate speedometer adapter until required range numbers are at 6 o'clock position (Fig. 20). **Verify that range numbers correspond to number of teeth on pinion.**

(9) Push speedometer adapter into place until seated.

(10) Install speedometer adapter clamp and bolt. Tighten bolt to 11 N·m (100 in. lbs.) torque.

(11) Install sensor adapter on speedometer adapter (Fig. 18). Tighten sensor adapter coupling nut to 17 N·m (150 in. lbs.) torque.

(12) Carefully align and insert vehicle speed sensor into sensor adapter.

(13) Install bolt that attaches speed sensor to adapter. Tighten bolt to 5-8 N·m (48-72 in. lbs.)

(14) Connect wires to speed sensor.

(15) Lower vehicle.

(16) Check top off transmission fluid level if necessary.

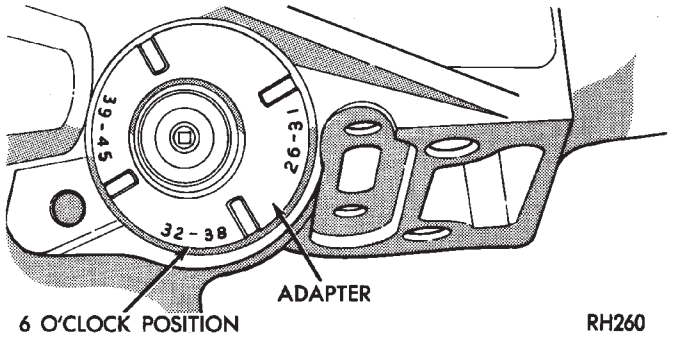


Fig. 20 Indexing Speedometer Adapter (With Two-Piece Sensor)

TRANSMISSION COOLER REVERSE FLUSHING

The transmission main cooler is located in the radiator lower tank. The cooler is not a serviceable component. If the cooler is damaged in any way, the radiator will have to be replaced.

On models with an auxiliary cooler, the cooler is mounted in front of the radiator or air conditioning

condenser. The auxiliary cooler is a serviceable component and can be repaired if necessary.

The main and auxiliary coolers should be thoroughly reverse flushed if a transmission failure contaminates the fluid. Reverse flushing the cooler and lines will prevent sludge and particles from flowing back into the transmission after repair.

The same flushing procedure is used for main and auxiliary coolers. Pressure equipment is preferred for reverse flushing. However, reverse flushing can be performed using hand operated equipment as described in the following procedure.

REVERSE FLUSHING PROCEDURE

(1) Disconnect cooler lines at transmission. Refer to Figure 21 for cooler line fitting identification. Front fitting is outlet to cooler and rear fitting is inlet from cooler.

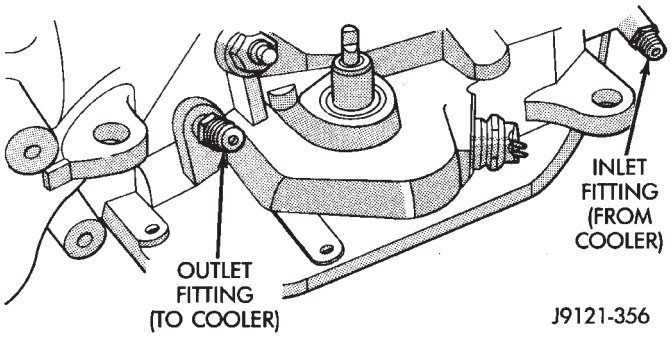


Fig. 21 Identifying Transmission Cooler Lines

(2) Position drain pan under cooler outlet line to material flushed through cooler and lines.

(3) Reverse flush cooler using hand operated suction gun filled with mineral spirits. Insert gun nozzle (or hose) into cooler inlet (return) line. Then force mineral spirits through Line and cooler.

(4) Continue reverse flushing until fluid exiting inlet (pressure) line is clear and free of debris/residue. **Replace radiator if fluid cannot be pumped through cooler.**

(5) Clear flushing materials from cooler and lines with short pulses of compressed air. Insert air gun nozzle into cooler inlet (return) line and continue short pulses of air until all fluid is cleared from cooler and lines.

(6) Pump one quart of fresh automatic transmission fluid through cooler and lines before reconnecting cooler lines.

TRANSMISSION COOLER FLOW TESTING

The transmission main and auxiliary coolers should be flow tested whenever a fluid overheat condition is suspected. An overheat condition is indicated when the fluid changes from the normal red, to a dark orange, or brown color.

The same method of flow testing is used for both coolers.

Cooler flow is checked by measuring the amount of fluid flow through the cooler in a 20 second time period. The test is performed with the engine running and transmission in neutral. Fluid is then pumped through the cooler by the transmission oil pump.

(1) Disconnect cooler inlet line at transmission fitting.

(2) Securely attach hose to end of inlet line and position line in a one quart test container.

(3) Add extra quart of fluid to transmission.

(4) Use stopwatch to check flow test time.

(5) Shift transmission into neutral and set parking brake.

(6) Start and run engine at curb idle speed and immediately note cooler flow. Approximately one quart of fluid should flow into test container in 20 second period.

(7) If cooler flow is intermittent, flows less than one quart in 20 seconds, or does not flow at all, cooler is faulty and must be replaced.

SERVICING TRANSMISSION COOLER LINES AND FITTINGS

Fitting Types

The transmission cooler lines are attached with quick disconnect fittings.

A flange on the cooler line serves as the sealing mechanism. The wire retainer clip (Fig. 22), secures the cooler line in the fitting by this flange. The clip fits behind the flange to hold the line in place.

Three different fitting styles may be used. Type 1 fittings have the retainer clip exposed (Fig. 22). Type 2 fittings have the retainer clip and fitting body encased in a shrink wrap material (Fig. 23). Type 3 fittings have the retainer clip encased in a metal sleeve crimped onto the fitting body (Fig. 24).

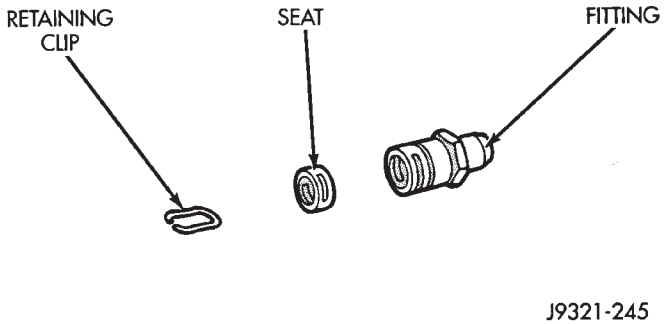


Fig. 22 Type 1 Quick Disconnect Fitting

Fitting Release Tool

A release tool is **required** to disconnect each of the fitting types. A plastic tool is clipped directly to one of the cooler lines on models with the type 2 and 3 fittings. This tool can also be used to disconnect type 1 fittings. The tool is needed to spread the wire retainer clip in each fitting. The clip must be opened in order to release the cooler line from the fitting.

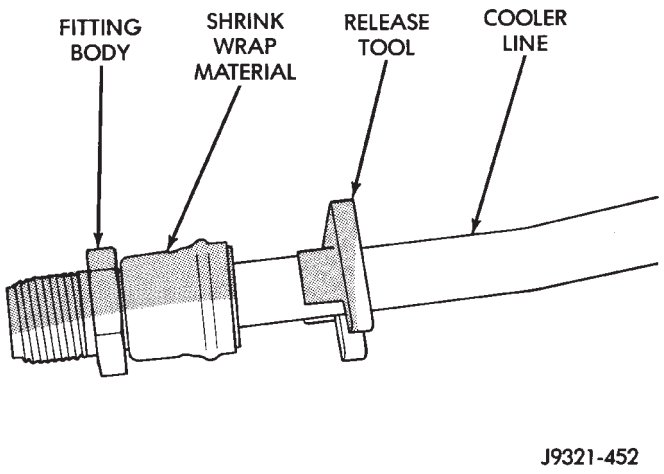


Fig. 23 Type 2 Quick Disconnect fitting

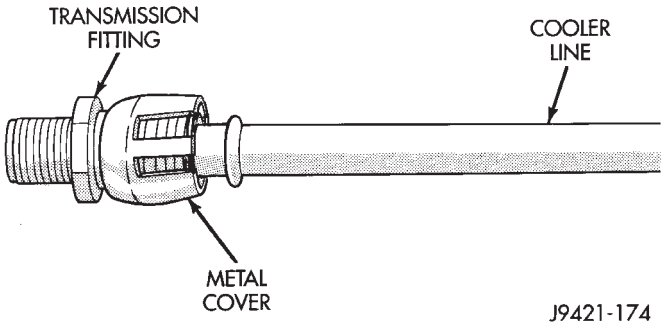


Fig. 24 Type 3 Quick Disconnect fitting

Fitting And Cooler Line Service

The cooler lines and quick disconnect fittings are NOT serviceable. Damaged fittings or cooler lines are to be replaced as assemblies.

Fittings swedged into cooler line hoses (Fig. 25) are serviced only as part of the entire cooler line.

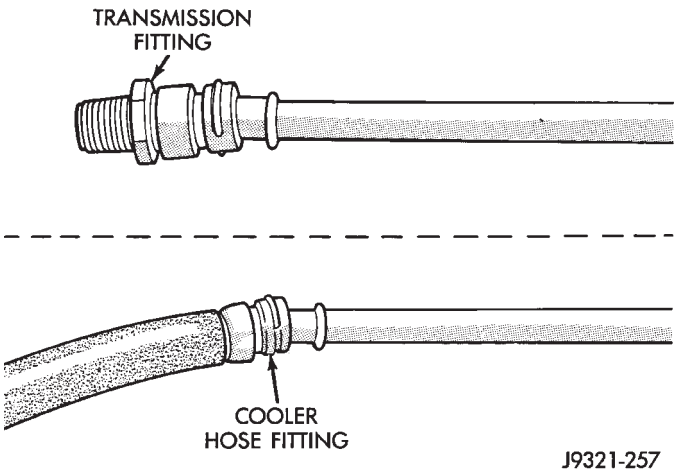


Fig. 25 Transmission And Cooler Line Fitting Placement

DISCONNECTING COOLER LINES WITH QUICK DISCONNECT FITTINGS

(1) If fitting and cooler line are encrusted with dirt, mud, or grease, clean fitting and cooler line with Mopar spray type carburetor or brake cleaner. Plastic release tool will not fit into retainer clip if fitting is full of foreign material.

(2) Slide small plastic release tool into fitting until tool bottoms against flange on cooler line (Fig. 26).

(3) Push and turn tool to spread retainer clip and pull cooler line out of fitting (Fig. 26).

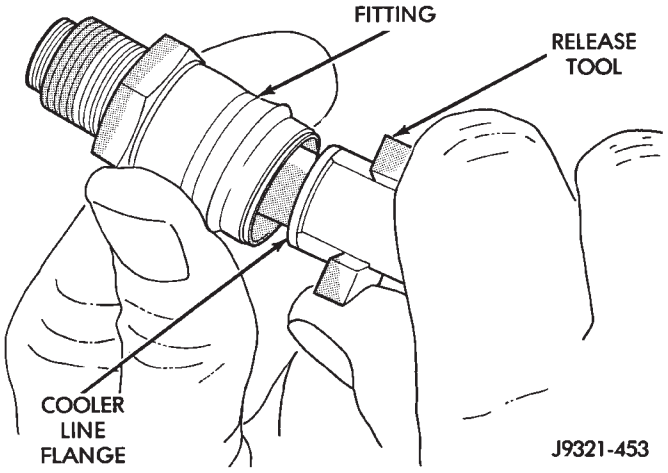


Fig. 26 Disconnecting Cooler Line With Release Tool (Type 2 Fitting Shown)

(4) Cover open ends of cooler lines and fittings to prevent dirt entry.

(5) Inspect condition of fitting. Replace transmission fitting as an assembly if fitting body or retainer clip is damaged. Replace cooler line as assembly, if fitting swedged into cooler line hose, is damaged.

REATTACHING COOLER LINES WITH QUICK DISCONNECT FITTINGS

(1) If transmission or radiator fittings require replacement, apply Mopar Lock N' Seal, or Loctite 242 to fitting threads before installation.

(2) Wipe off cooler line and fitting with clean, dry cloth.

(3) Insert cooler line into fitting. Then push line inward until retainer clip secures line. A snap or click sound will be heard and felt through the line when the retainer clip seats behind the cooler line flange.

(4) **Pull outward on cooler lines to verify that they are properly secured.**

CAUTION: The wire retainer clips must secure the cooler lines in the fittings. If the clips are deformed, or distorted, normal fluid pressure could unseat the cooler lines resulting in fluid loss and transmission damage. Be very sure the cooler lines are firmly secured by the retainer clip as described in step (4) above.

30RH/32RH TRANSMISSION REMOVAL AND INSTALLATION

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TRANSMISSION AND CONVERTER REMOVAL

(1) Remove fan shroud attaching bolts.

(2) Disconnect transmission fill tube at upper bracket.

(3) Raise vehicle.

(4) Remove inspection cover from converter housing and remove skid plate for access, if necessary.

(5) Remove transmission fill tube and fill tube O-ring.

(6) Remove starter motor.

(7) Mark propeller shafts and axle yokes for alignment reference.

(8) Disconnect propeller shafts at yokes. Secure shafts to frame rails with wire.

(9) Disconnect exhaust pipes at exhaust manifolds, if necessary.

(10) Drain transfer case lubricant.

(11) Disconnect vehicle speed sensor wires.

(12) Disconnect transfer case shift linkage.

(13) Disconnect gearshift linkage and throttle cable at transmission levers.

(14) Disconnect park/neutral position switch wires.

(15) Disconnect and remove crankshaft position sensor. Retain sensor bolt for reinstallation.

CAUTION: The crankshaft position sensor can be damaged during transmission removal (or installation) if the sensor is still bolted to the engine block. To avoid damage, remove the sensor before removing the transmission.

(16) Remove converter housing access cover and mark drive plate and converter for alignment reference.

(17) Remove bolts attaching converter to drive plate.

(18) Support engine with support stand.

(19) Support transmission-transfer case assembly with transmission jack. Secure transmission to jack with safety chain.

(20) Remove bolts/nuts attaching cushion and torque arm bracket to skid plate (Fig. 1).

(21) Remove skid plate, or rear crossmember, if equipped.

(22) Lower transmission slightly and disconnect cooler lines at transmission. **Refer to In-Vehicle Service section for procedures.**

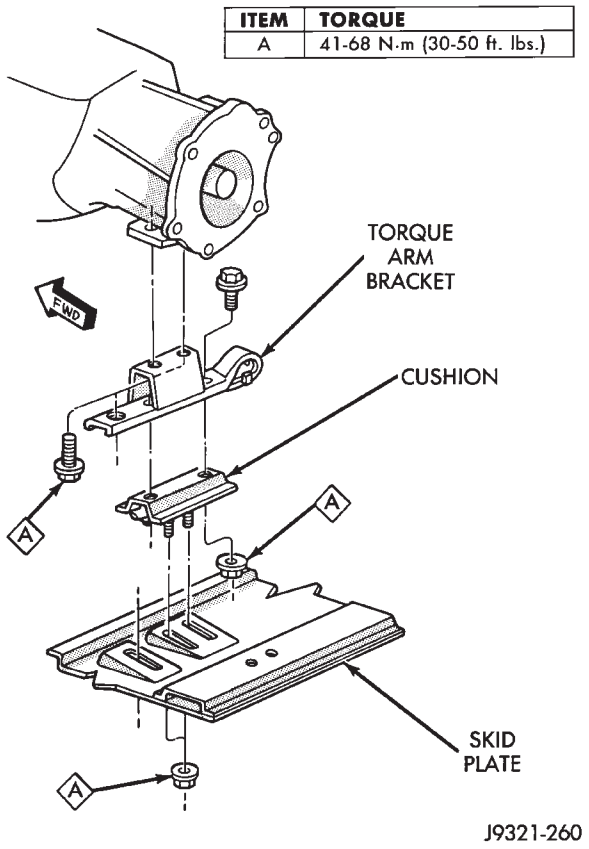

Fig. 1 Transmission Rear Mount

(23) Remove bolts attaching transmission to engine.

(24) Move transmission and converter rearward until clear of crankshaft.

(25) Hold converter in position and lower transmission until converter housing clears engine.

(26) Remove converter from transmission.

(27) Remove transfer case from transmission.

(28) If necessary, following components can now be serviced:

- torque converter
- torque converter drive plate
- oil pump seal
- engine rear core hole plugs
- engine rear oil galley plugs

CONVERTER—PUMP SEAL—DRIVE PLATE SERVICE

Drive Plate

The drive plate can be replaced or removed for service access after the transmission is out of the vehicle (Fig. 2).

CAUTION: On YJ models with a 2.5L engine and 30RH transmission, special bolts are used to attach the driveplate to the crankshaft. These bolts have a smaller hex head for torque converter clearance. DO NOT interchange these bolts with similar size bolts for any reason.

Torque Converter

The torque converter can be replaced or removed for service access after the transmission has been removed (Fig. 2).

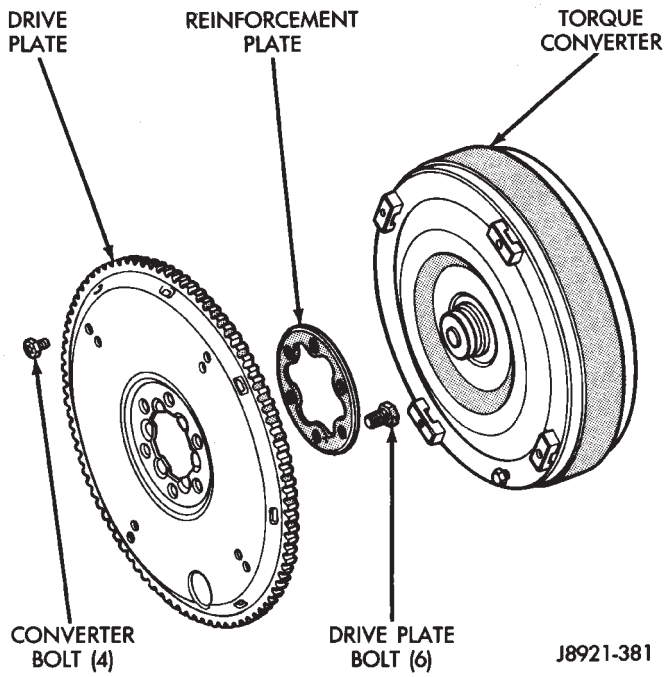

Fig. 2 Typical Converter And Drive Plate

The torque converter is not a serviceable part. If the converter is contaminated or damaged in any way, it must be replaced as an assembly. **Do not attempt to flush a converter contaminated by metal or clutch facing particles. Flushing will not remove these contaminants.**

A new torque converter and oil pump are used in 30RH/32RH transmissions built after the 1993 model year. The new converter has a different style drive hub. The hub was changed to accept the new design drive flats on the oil pump inner gear. The drive flats replace the square lugs used previously. If converter replacement should become necessary, be sure to use the new style converter. The new converter and oil pump are not interchangeable with previous style parts.

The oil pump seal is accessible and can be replaced after the transmission and torque converter are removed.

Use Remover Tool C-3981B to remove the seal (Fig. 3). To use the tool, first start the tool into the seal by hand. Next, thread the tool into the seal as far as it will go. Use a wrench on the tool hex to turn the tool. Continue tightening until all the tool threads firmly grip the metal part of the seal. Then tighten the tool puller screw to withdraw the seal from the pump body.

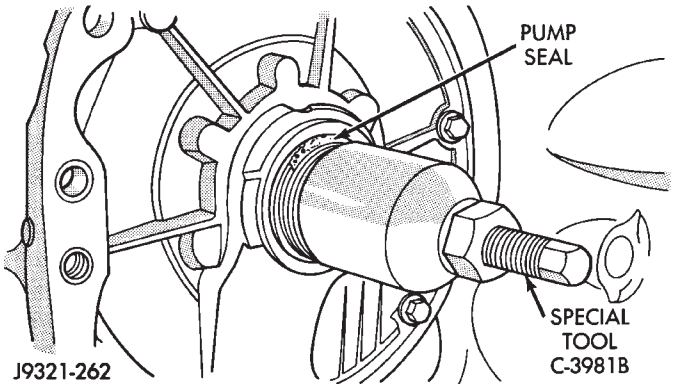

Fig. 3 Pump Seal Removal

Use Installer Tool C-4193 to install and seat the seal (Fig. 4).

Be sure to lubricate the pump seal and converter hub with transmission fluid before installation.

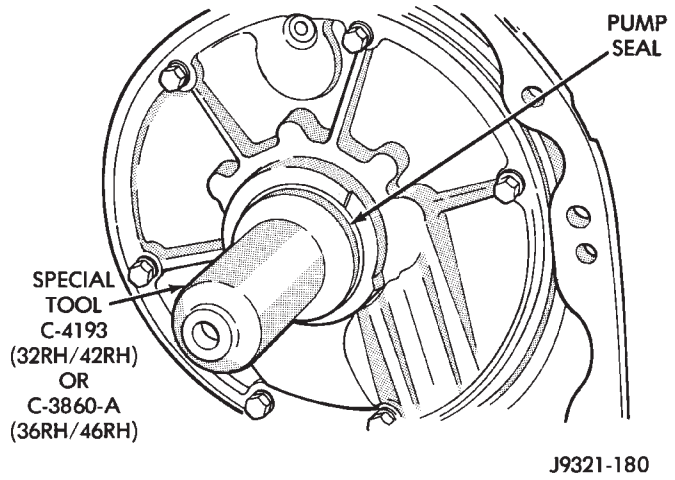

Fig. 4 Pump Seal Installation

TRANSMISSION AND CONVERTER INSTALLATION

CAUTION: The transmission oil cooler and lines must be reverse flushed if repair corrected a problem that generated sludge and/or debris. Sludge and metal or friction particles from a gear or clutch pack failure must be removed before reinstalling the transmission. This is necessary to avoid re-contaminating the repaired transmission. Failure to remove sludge or debris from the cooler and lines will result in a repeat failure and shop comeback.

(1) Lubricate converter drive hub and pump seal with Mopar ATF Plus, or Dexron II transmission fluid. Then install converter. Turn converter back and forth to align drive slots in converter hub with pump gear lugs. Be sure converter is fully seated in pump (Fig. 5).

(2) Temporarily secure converter with C-clamp or metal strap attached across converter housing.

(3) Position transmission on jack and secure it with safety chains.

(4) Raise transmission and align converter with drive plate.

(5) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(6) Install two converter housing lower attaching bolts and tighten bolts to draw housing toward engine.

(7) Install and tighten converter attaching bolts.

(8) Install and tighten bolts that attach transmission to engine (Fig. 6).

(9) Install crankshaft position sensor as follows:

CAUTION: Clearance between the sensor pickup face and driveplate ring gear must be correctly established before engine startup. A cardboard spacer, attached to the sensor face, is used for this purpose. Failure to establish correct clearance will result in sensor breakage.

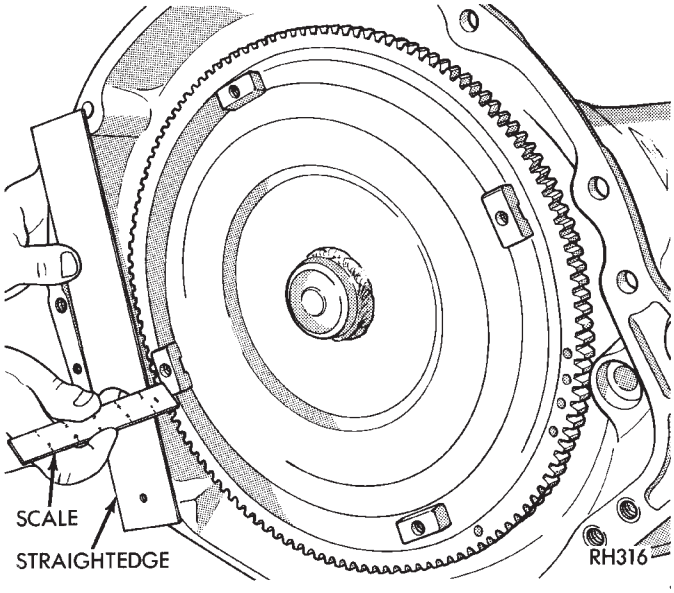

Fig. 5 Checking Torque Converter Seating

(a) Remove any remaining fragments of original cardboard spacer from sensor pickup face.

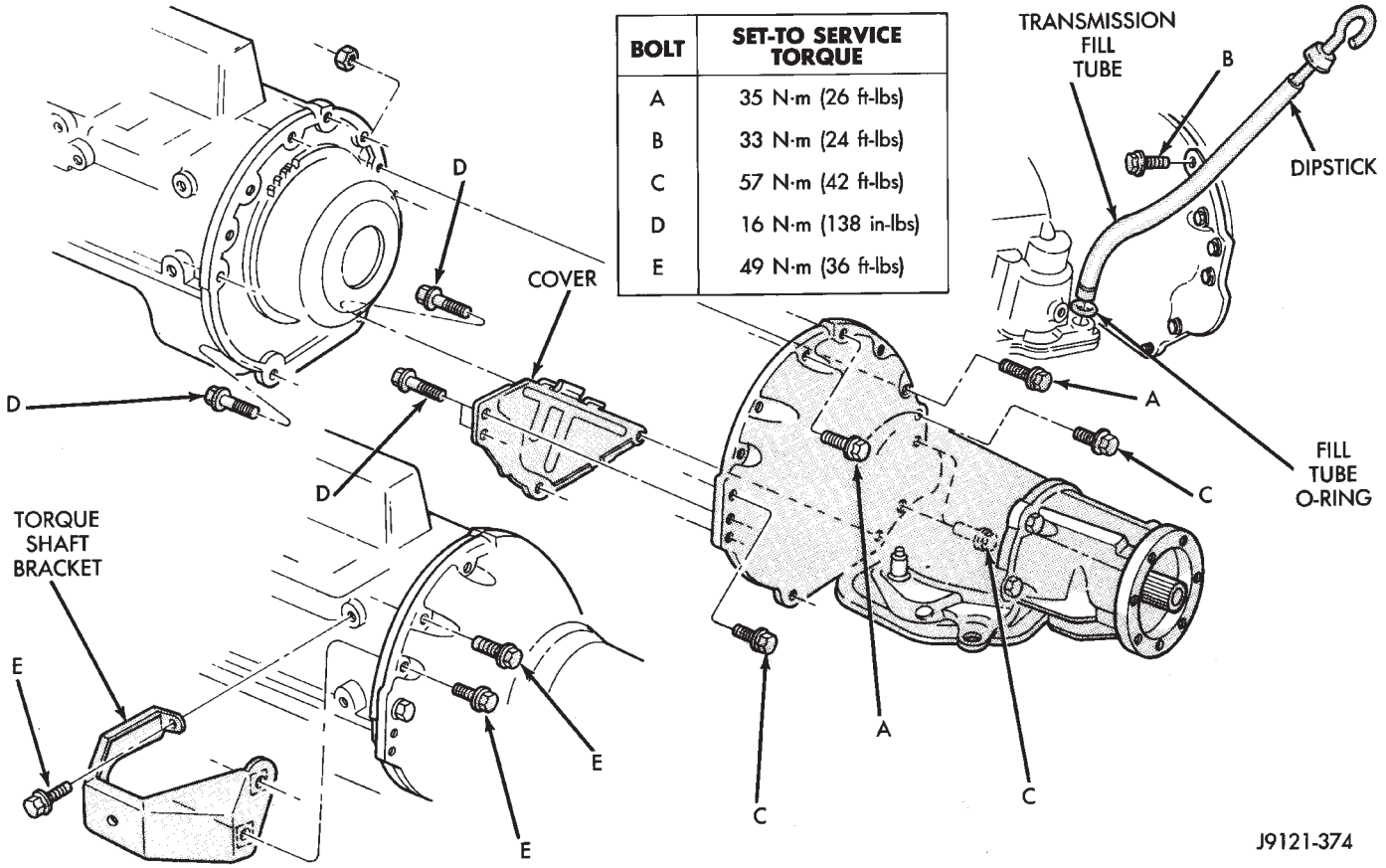

Fig. 6 Transmission Attachment

(b) Align and install new spacer on sensor pickup face. Spacer has adhesive backing so it will adhere to sensor face.

(c) Insert sensor into housing until it just touches ring gear teeth. Then install and tighten sensor attaching bolt. Correct clearance is established when spacer is peeled off by ring gear during engine startup.

(10) Install transmission fill tube and O-ring (Fig. 6).

(11) Connect transmission cooler lines to fittings. Refer to Figure 7 for cooler line identification.

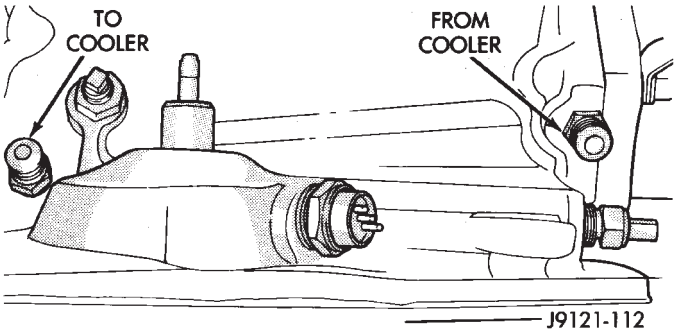

Fig. 7 Transmission Cooler Line Location And Identification

(12) Position support stand under transmission and remove transmission jack.

(13) Install transfer case on transmission adapter. Tighten attaching nuts to 41 N·m (30 ft. lbs.) torque.

(14) Install rear crossmember and attach transmission rear support to crossmember.

(15) Connect vehicle speed sensor wires.

(16) Install inspection cover on converter housing.

(17) Install exhaust pipes and support brackets, if removed.

(18) Install starter motor.

(19) Connect wires to park/neutral position switch.

(20) Connect gearshift and linkage and throttle cable.

(21) Connect transfer case shift linkage.

(22) Connect propeller shafts to transfer case yokes.

(23) Connect front exhaust pipes and catalytic converter support bracket bolts (if removed).

(24) Install skid plate, rear cushion and bracket, if removed.

(25) Fill transfer case to bottom edge of fill plug hole with Mopar Dexron II.

(26) Lower vehicle and fill transmission to correct level with ATF Plus, type 7176 fluid.

(27) Install fan shroud and bolts (if removed).

(28) Check and adjust gearshift linkage if necessary. Then check and adjust throttle cable if necessary.

30RH/32RH TRANSMISSION OVERHAUL

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TRANSMISSION DISASSEMBLY

(1) Clean transmission exterior with steam gun or with solvent. Wear eye protection during cleaning process.

(2) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.

(3) Mount transmission in repair stand C-3750-B (Fig. 1).

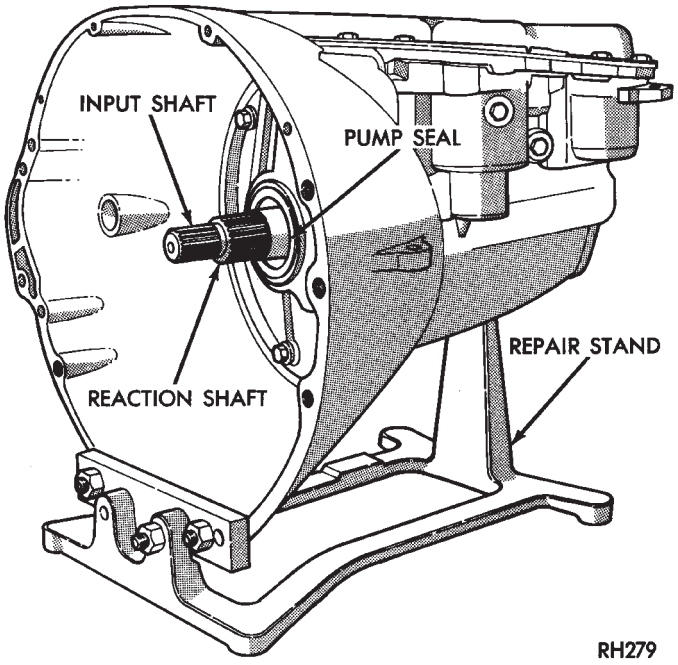

Fig. 1 Transmission Mounted On Typical Repair Stand

(4) Remove nuts attaching adapter, or extension housing to transmission case.

(5) Remove adapter/extension housing and gasket (Fig. 2).

(6) Remove rear bearing and snap ring, if equipped.

(7) Remove park/neutral position switch and seal (Fig. 3).

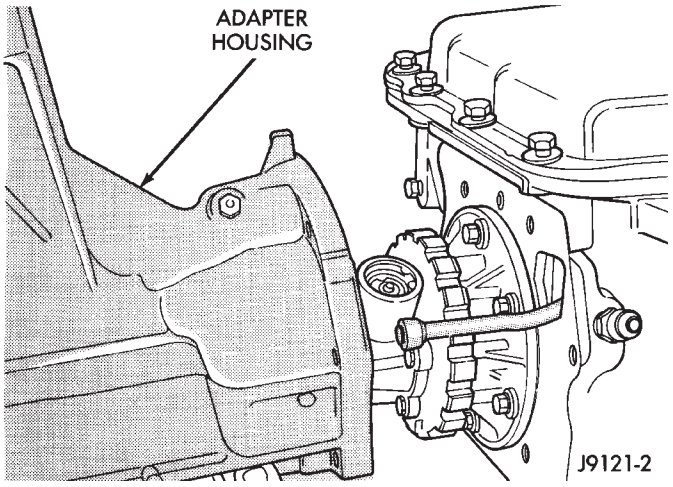

Fig. 2 Adapter Housing Removal/Installation (4 x 4 Models)

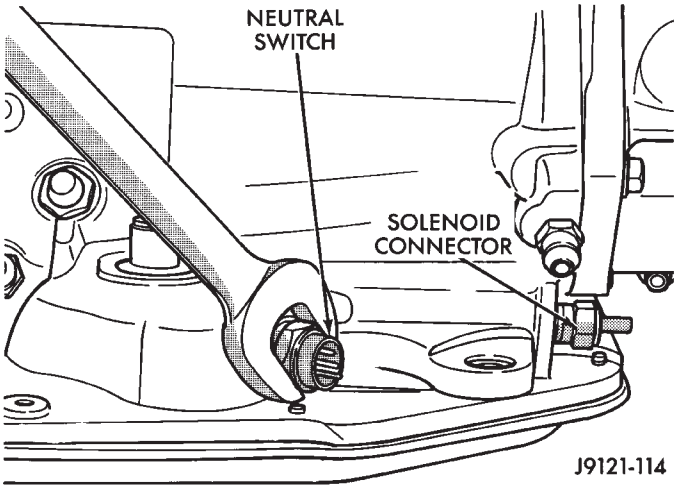

Fig. 3 Park/Neutral Position Switch Removal/ Installation

(8) Remove oil pan bolts and remove pan and gasket (Fig. 4).

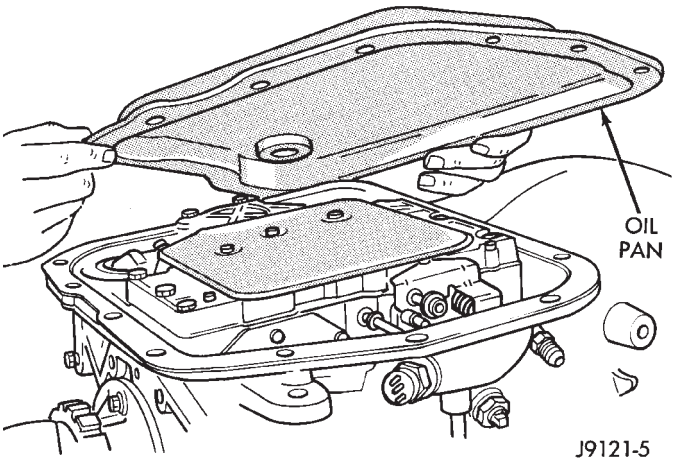

Fig. 4 Oil Pan Removal/Installation

(9) Remove hex head valve body attaching bolts (Fig. 5).

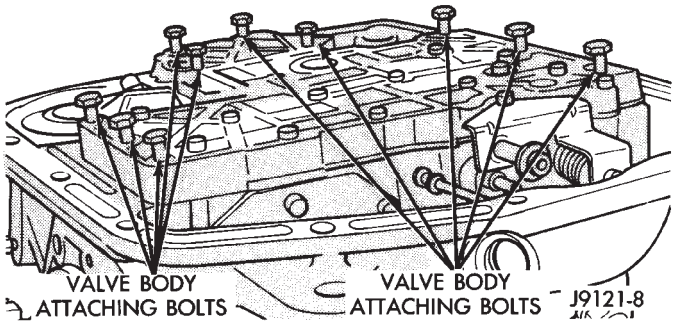

Fig. 5 Valve Body Attaching Bolt Locations (Typical)

(10) Disconnect solenoid wire from case connector (Fig. 6).

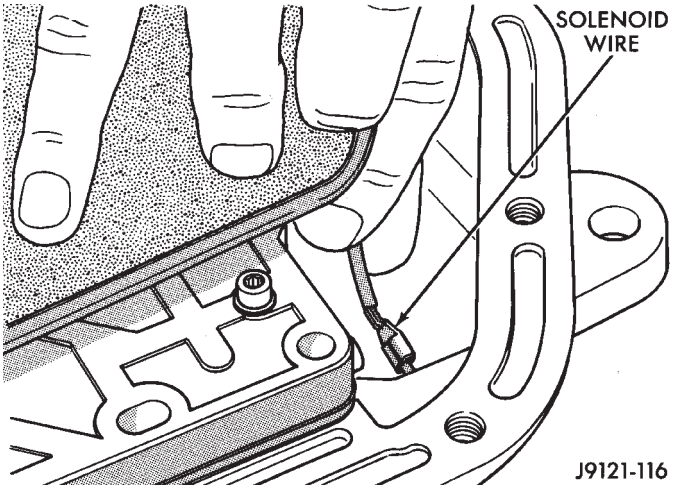

Fig. 6 Solenoid Wire Connection

(11) Lift valve body upward, guide park rod out of case opening and remove valve body (Fig. 7).

(12) Remove accumulator spring and piston (Fig. 8).

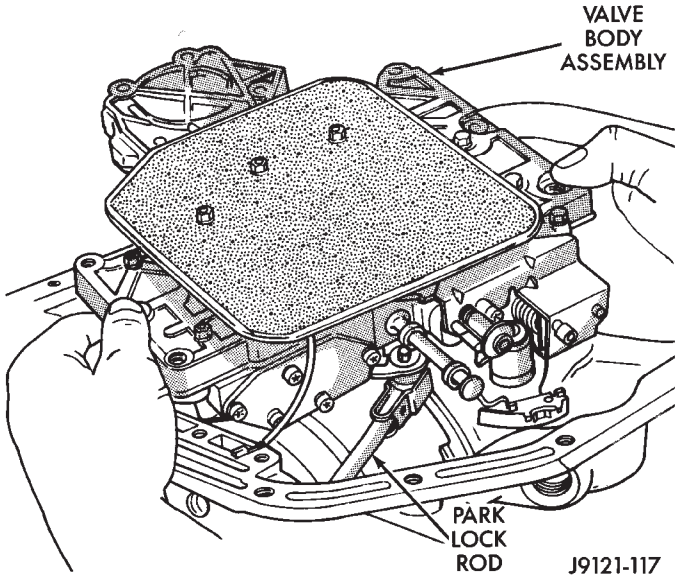

Fig. 7 Valve Body Removal/Installation

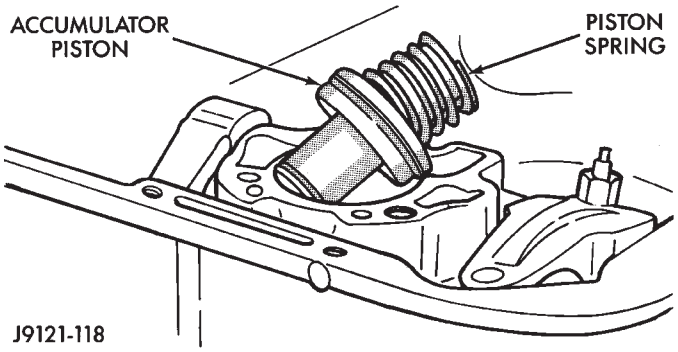

Fig. 8 Removing/Installing Accumulator Piston And Spring

(13) Remove front band pivot pin access plug (Fig. 9). Plug is accessible through converter housing. Use 1/4 inch drive extension to remove plug as shown.

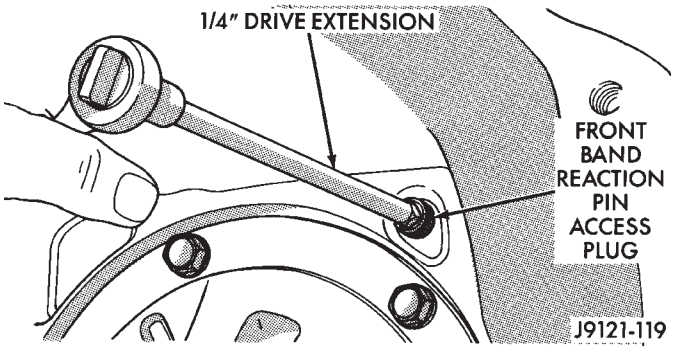

Fig. 9 Removing/Installing Front Band Pivot Pin Access Plug

(14) Loosen front band adjusting screw locknut 4-5 turns. Then tighten band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out with pump and possibly damaging clutch or pump components.

(15) Remove oil pump bolts.

(16) Thread bolts of Slide Hammer Tools C-3752 into threaded holes in pump body flange (Fig. 10).

(17) Bump slide hammer weights outward to remove pump and reaction shaft support assembly from case (Fig. 10).

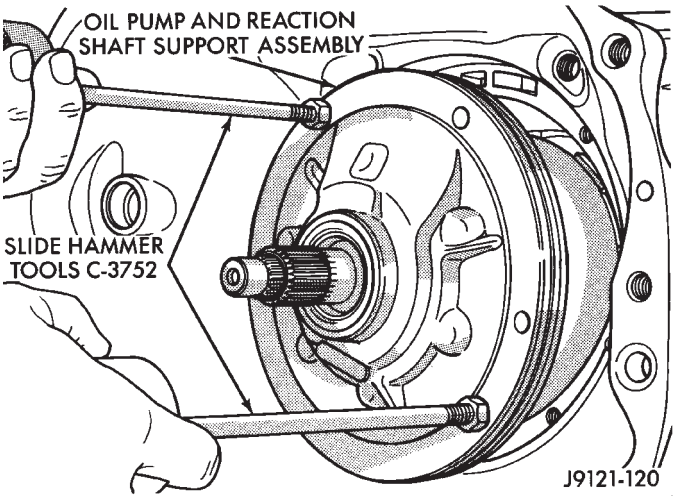

Fig. 10 Removing Oil Pump/Reaction Shaft Support

(18) Loosen front band adjusting screw until band is completely loose.

(19) Squeeze front band together and remove band strut (Fig. 11).

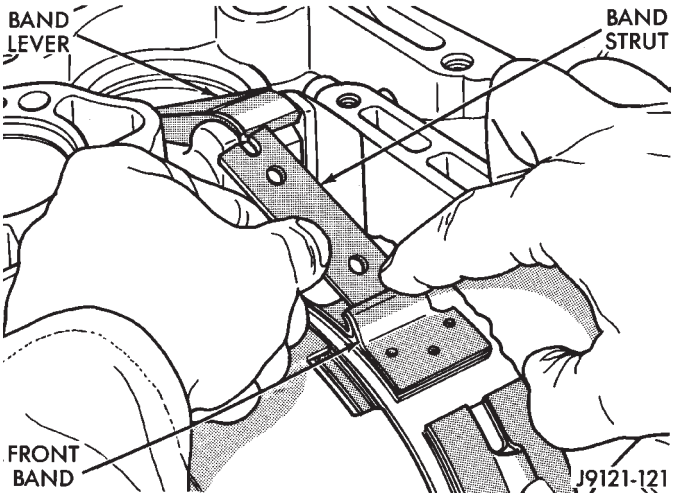

Fig. 11 Removing/Installing Front Band Strut

(20) Remove front band reaction pin with pencil magnet. Pin is accessible from converter housing side of case (Fig. 12).

(21) Remove front band lever (Fig. 13)

(22) Slide front band rearward and onto driving shell. Band will not be removed until after front/rear clutch removal.

(23) Remove front and rear clutch units as assembly. Grasp input shaft, hold clutch units together and remove them from case (Fig. 14).

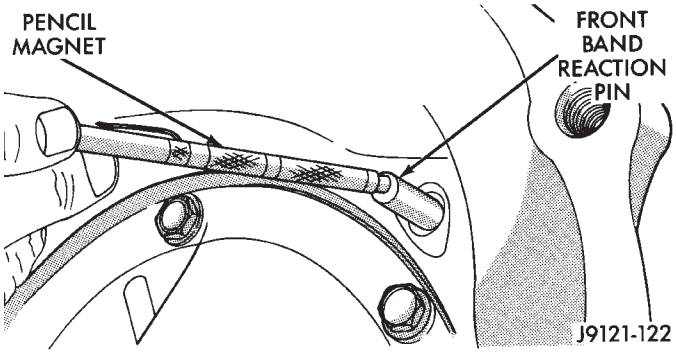

Fig. 12 Removing Front Band Reaction Pin

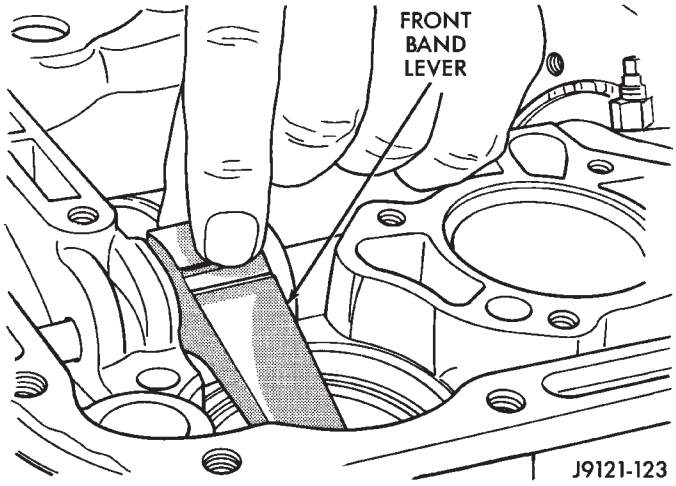

Fig. 13 Removing/Installing Front Band Lever

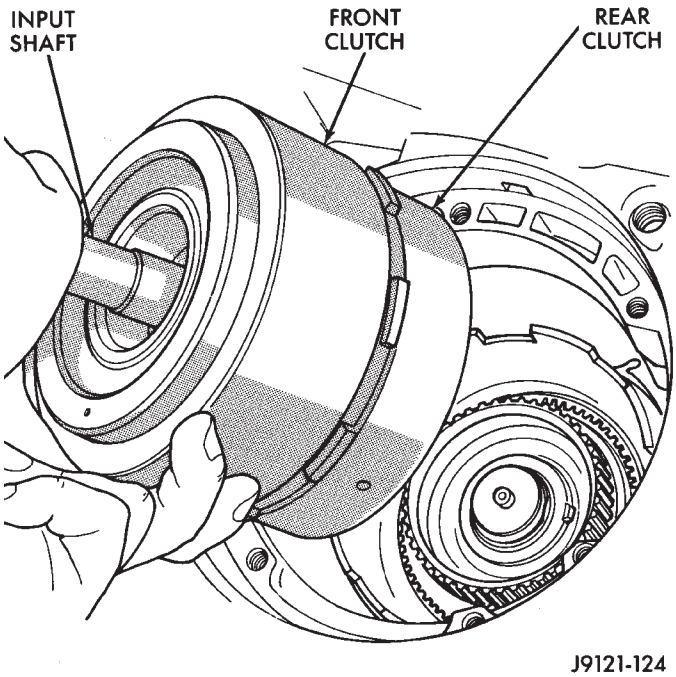

Fig. 14 Removing Front/Rear Clutch Assemblies

(24) Lift front clutch off rear clutch (Fig. 15). Set clutch units aside for disassembly, cleaning and overhaul.

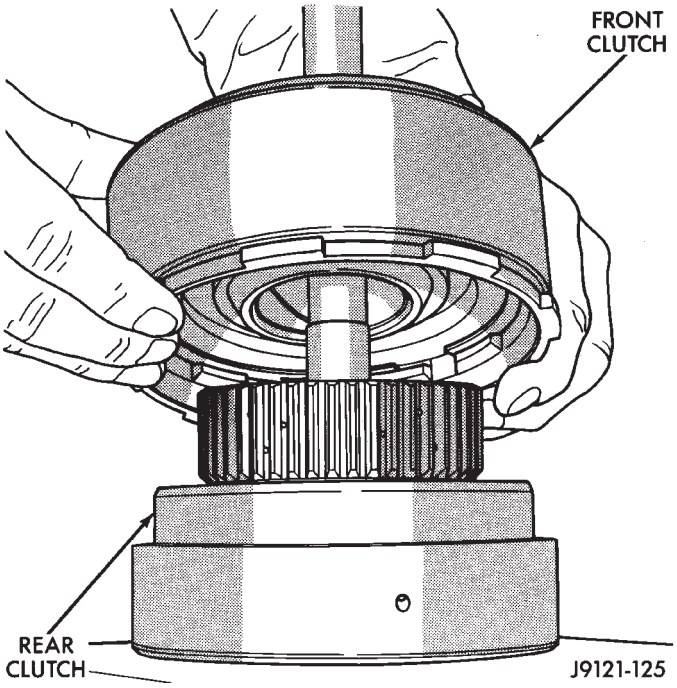

Fig. 15 Separating Front/Rear Clutch Assemblies

(25) Remove output shaft thrust washer from output shaft (or from rear clutch hub).

(26) Remove output shaft thrust plate from output shaft hub (Fig. 16).

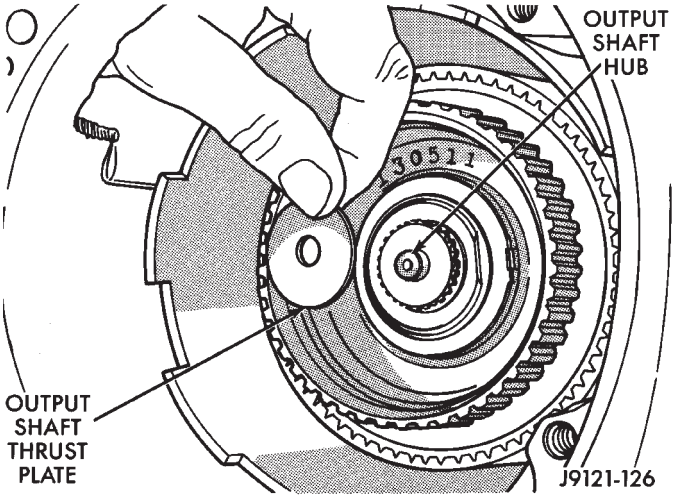

Fig. 16 Removing/Installing Output Shaft Thrust Plate

(27) Slide front band off driving shell (Fig. 17) and remove band from case.

(28) Remove E-clip from one end of governor valve shaft and remove valve and shaft from governor body (Fig. 19). Reinstall E-clip on shaft to avoid losing it.

(29) Remove thick snap, thrust washer and thin snap ring that retain governor body and park gear on shaft (Fig. 19).

(30) Loosen bolts attaching governor body to park gear.

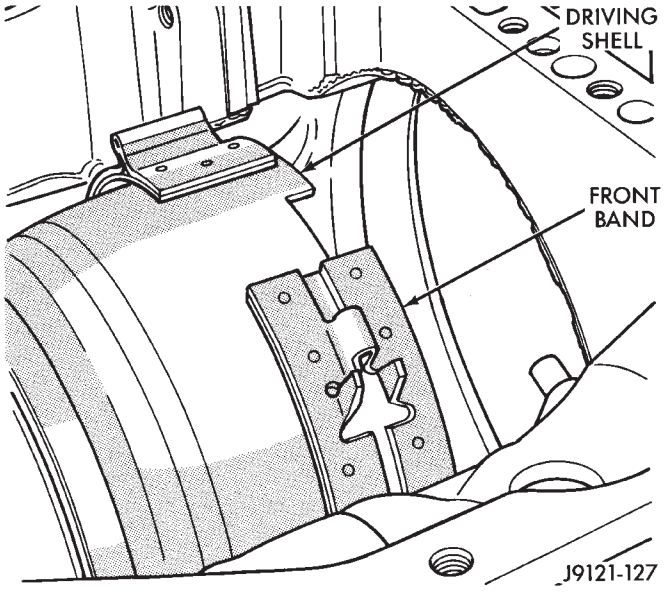

Fig. 17 Front Band Removal/Installation

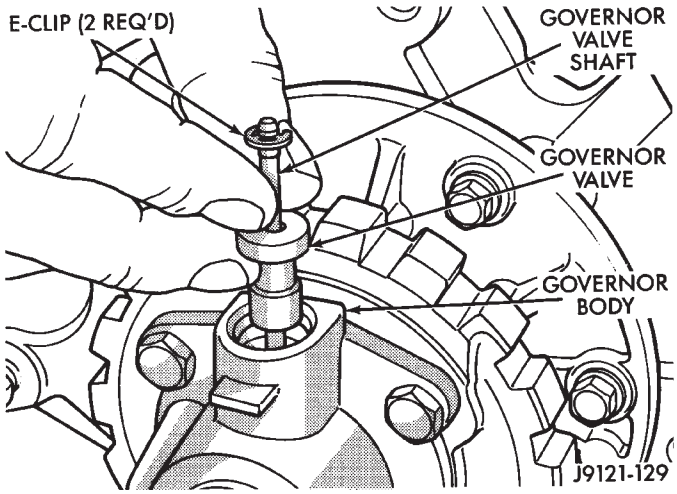

Fig. 18 Removing Governor Valve And Shaft

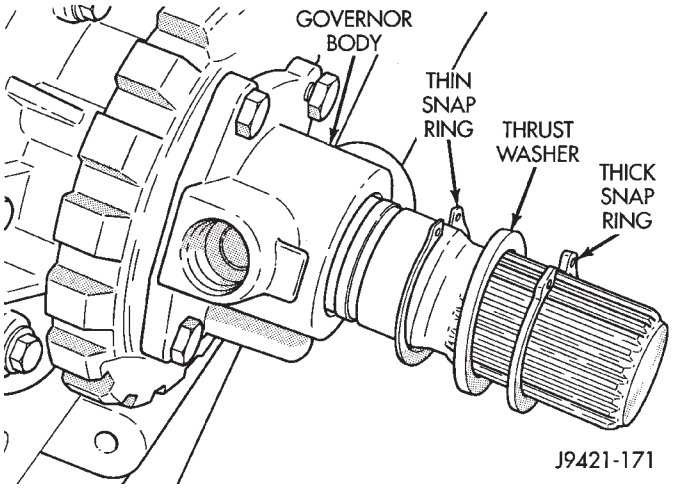

Fig. 19 Governor Body/Park Gear Attachment

(31) Mark position of governor body on park gear with center punch or scriber.

(32) Remove governor body and park gear as assembly (Fig. 20). Work park gear out of rear support and slide assembly off output shaft.

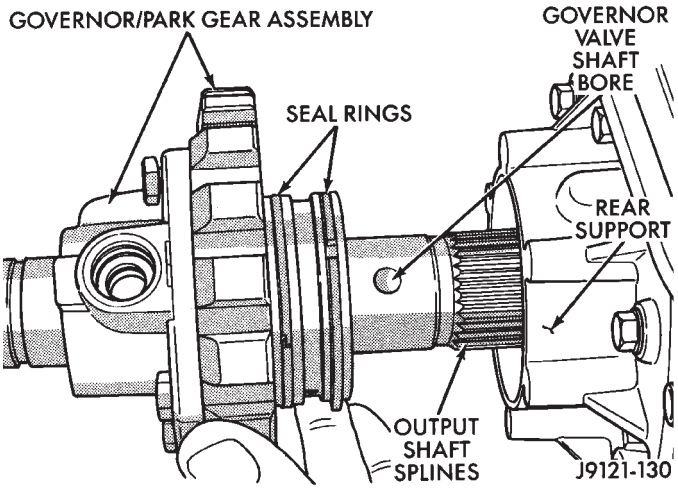

Fig. 20 Removing/Installing Governor Body And Park Gear

(33) Remove planetary geartrain as assembly (Fig. 21). Support geartrain with both hands during removal. Do not allow machined surfaces on output shaft to become nicked or scratched.

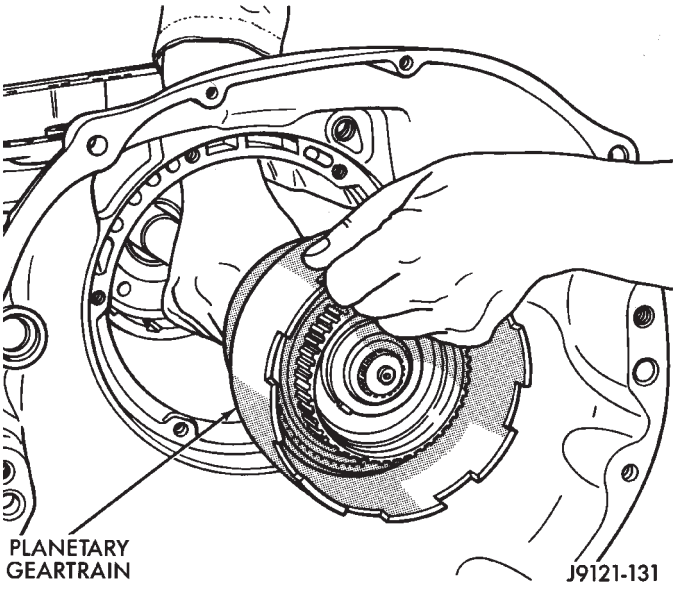

Fig. 21 Planetary Geartrain Removal

(34) Loosen rear band adjusting screw until band is fully released and does not grip low reverse drum.

(35) Remove snap ring that secures low-reverse drum to rear support (Fig. 22).

(36) Remove rear band lever pins as follows:

(a) On 30RH transmission, rear band has only one pivot pin. Remove pin with parallel jaw snap ring pliers (Fig. 23). Spread plier jaws in pin bore to grip pin. Then remove pin with a twist and pull motion.

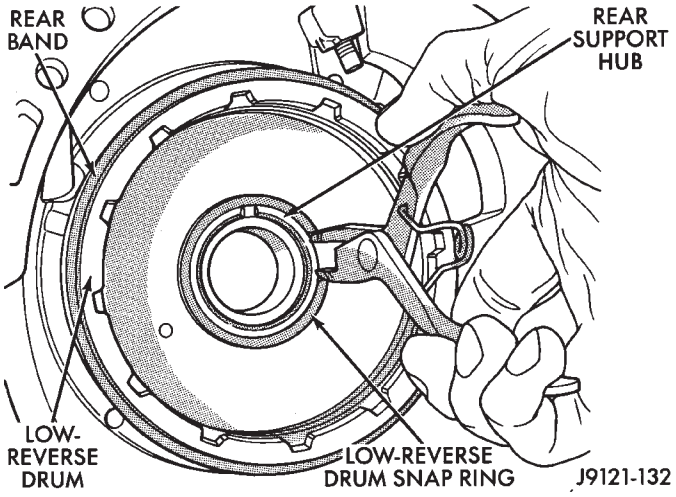

Fig. 22 Removing Low-Reverse Drum Snap Ring

(b) On 32RH transmission, rear band has two pins. Remove pivot pin and reaction pin with parallel jaw snap ring pliers (Fig. 24).

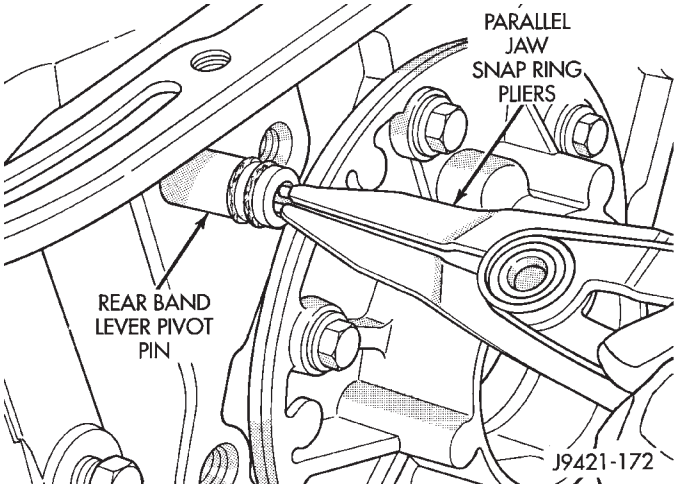

Fig. 23 Removing Rear Band Lever Pivot Pin (30RH)

(37) Remove rear band lever, link and strut.

(38) Mark position of rear support for assembly reference (Fig. 25). Use scriber or center punch to mark case and support.

(39) Remove rear support bolts and remove support from low-reverse drum and case (Fig. 26). Keep rear support bolts together for assembly reference.

(40) Remove bolts attaching overrunning clutch cam to case (Fig. 27).

(41) Remove low-reverse drum and overrunning clutch as assembly. Slide drum and clutch through rear band and out of case. Set drum and clutch assembly aside for cleaning and inspection.

(42) Remove rear band and link from case.

(43) Compress front servo rod guide about 3 mm (1/8 in.) with Valve Spring Compressor Tool C-3422-B (Fig. 28). A C-clamp and tool C-4470 can also be used to compress rod guide.

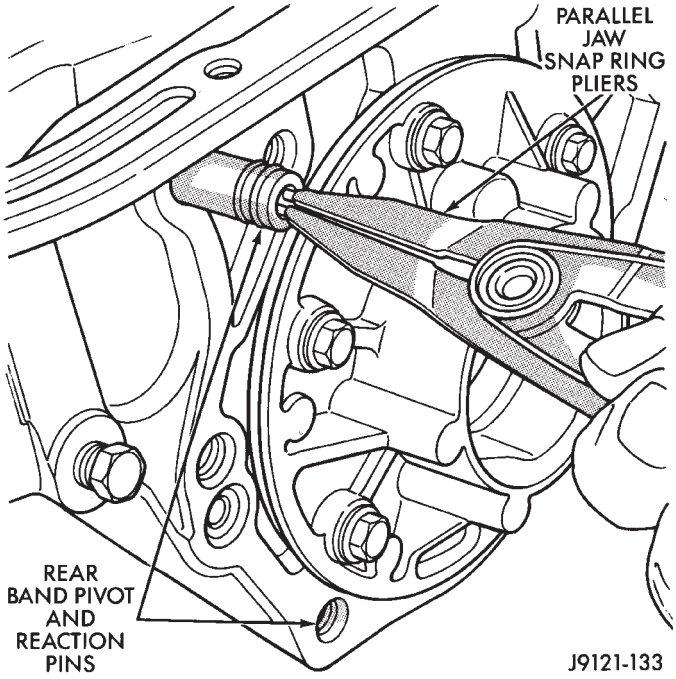

Fig. 24 Removing Rear Band Pivot And Reaction Pins (32RH)

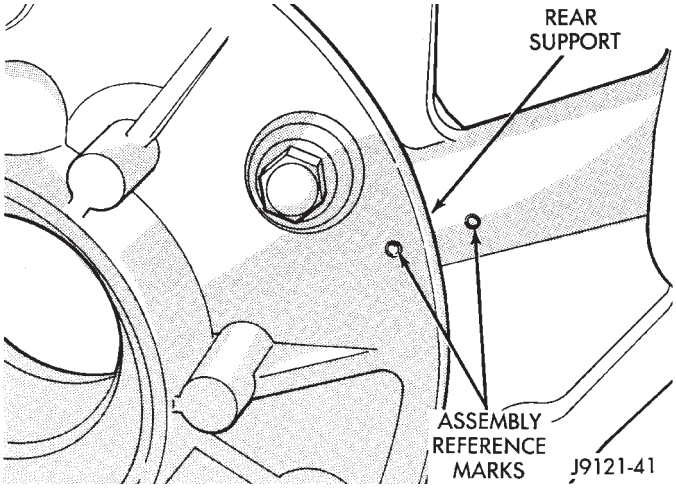

Fig. 25 Marking Rear Support For Assembly Reference

(44) Remove front servo rod guide snap ring (Fig. 28). **Exercise caution when removing snap ring. Servo bore can be scratched or nicked if care is not exercised.**

(45) Remove compressor tools and remove front servo rod guide, spring and servo piston.

(46) Compress rear servo spring retainer about 1.5 mm (1/16 in.) with C-clamp and Tool C-4470 or SP-5560 (Fig. 29). Valve Spring Compressor C-3422-B can also be used to compress spring retainer.

(47) Remove rear servo spring retainer snap ring. Then remove compressor tools and remove rear servo spring and piston.

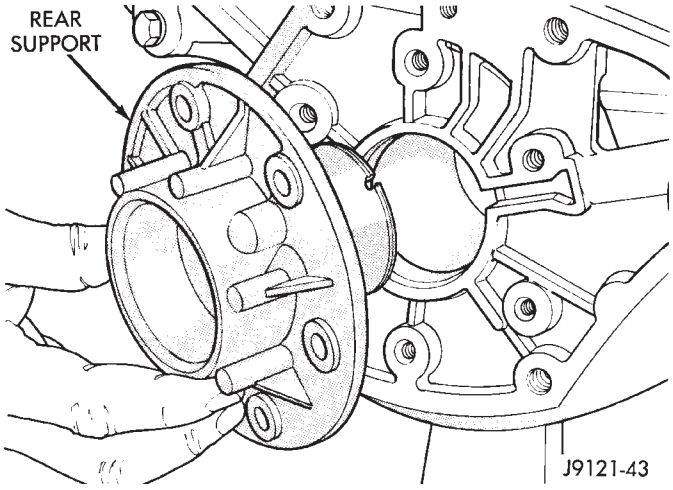

Fig. 26 Removing Rear Support

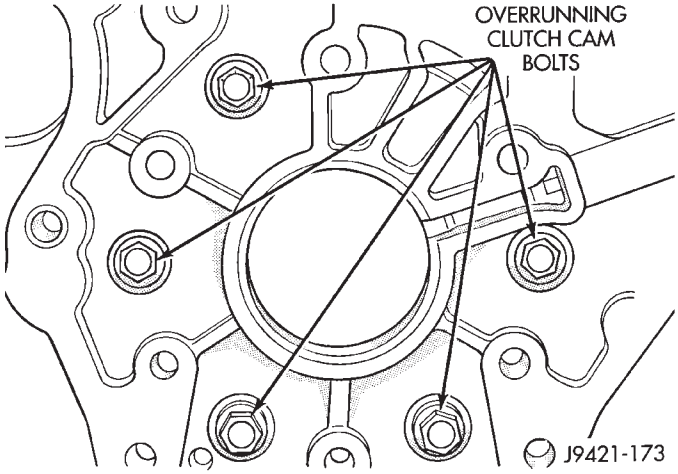

Fig. 27 Overrunning Clutch Cam Bolt Locations

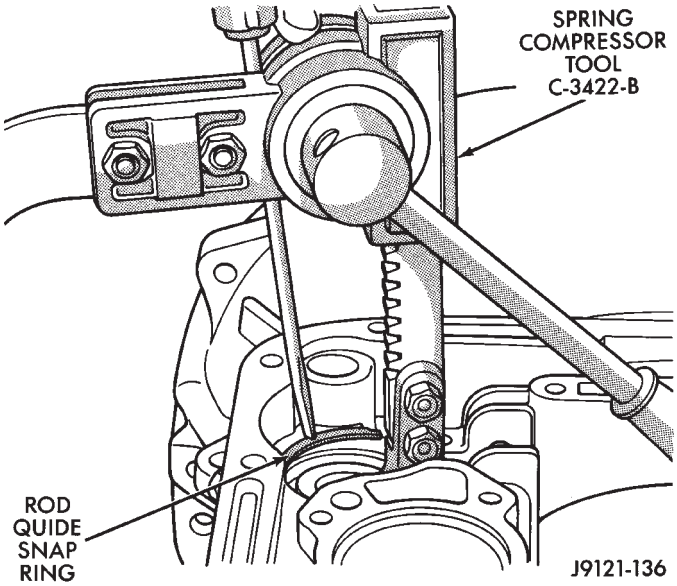

Fig. 28 Compressing Front Servo Rod Guide

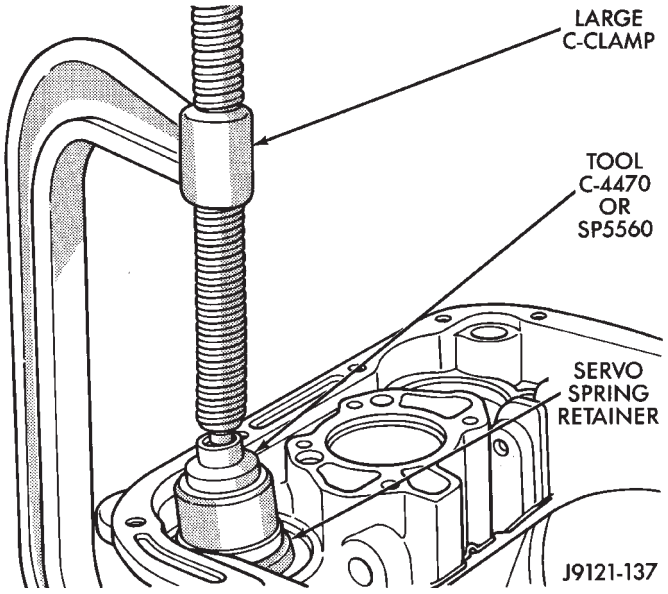

Fig. 29 Compressing Rear Servo Spring

OVERHAUL SERVICE INFORMATION

Inspect the transmission bushings during overhaul. Bushing condition is important as severely worn, or scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. **However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.**

Use recommended tools to replace bushings. The tools are sized and designed to remove, install and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B. The tool set is manufactured by Miller Tool Co. and is available through the dealer tool program.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced. Low cost of the sun gear assembly makes it easier to simply replace the gear and bushings as an assembly.

Heli-Coil inserts are recommended for repairing damaged, stripped or worn threads in aluminum parts. These inserts are available from most automotive jobbers. Stainless steel inserts are preferred.

The use of crocus cloth is permissible where necessary. When used on valves, use care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar ATF Plus, Type 7176 transmission fluid during overhaul and assembly.

Use petroleum jelly to hold parts like thrust washers in place during assembly. Use Ru-Glyde, Door Eze, or similar products to lubricate piston seals and O-rings to ease installation. Petroleum jelly can also be used to prelubricate parts during reassembly if desired.

TRANSMISSION CASE CLEANING AND INSPECTION

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

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 readily adhere to case surfaces and transmission components and will circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

Remount the case in a repair stand after cleaning and inspection.

OVERRUNNING CLUTCH—LOW-REVERSE DRUM—REAR SUPPORT OVERHAUL

DISASSEMBLING OVERRUNNING CLUTCH/ LOW-REVERSE DRUM

If the clutch assembly came out with the low-reverse drum, thread two clutch cam bolts into the cam. Then lift the cam out of the drum with the bolts (Fig. 30). Rotate the cam back and forth to ease removal if necessary. Remove the clutch roller and spring assembly from the race afterward.

CLEANING AND INSPECTION

Clean the overrunning clutch assembly, clutch cam, low-reverse drum and rear support in solvent. Dry them with compressed air after cleaning.

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the**

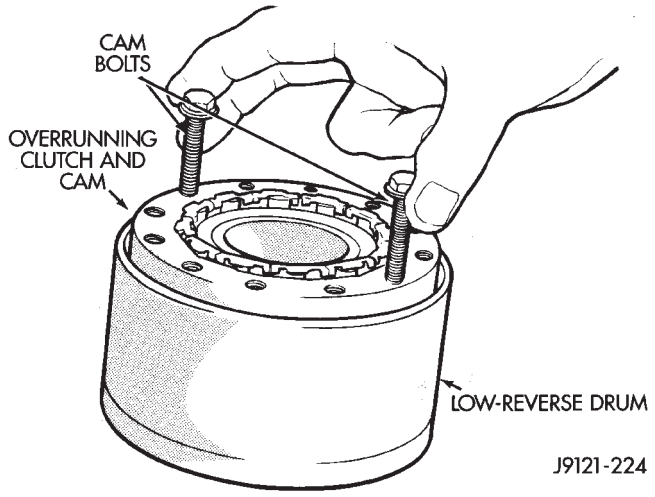

Fig. 30 Removing Overrunning Clutch From Low-Reverse Drum

low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.

Examine the rear support carefully for wear, cracks, scoring or other damage. Be sure the support hub is a snug fit in the case and drum. Replace the support if worn or damaged.

ASSEMBLING OVERRUNNING CLUTCH/LOW-REVERSE DRUM

(1) Assemble clutch rollers and springs in retainer if necessary (Fig. 31).

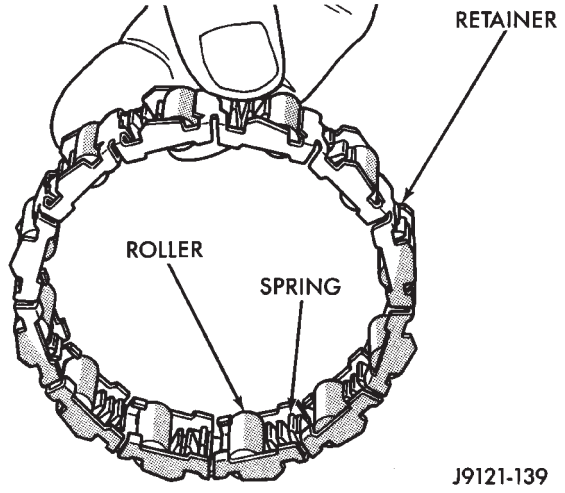

Fig. 31 Overrunning Clutch Rollers, Springs, Retainer

(2) Install overrunning clutch roller, spring and retainer assembly in clutch cam (Fig. 32).

(3) Temporarily assemble and check overrunning clutch operation as follows:

(a) Assemble cam and clutch.

(b) Install clutch assembly on low-reverse drum with twisting motion (Fig. 33).

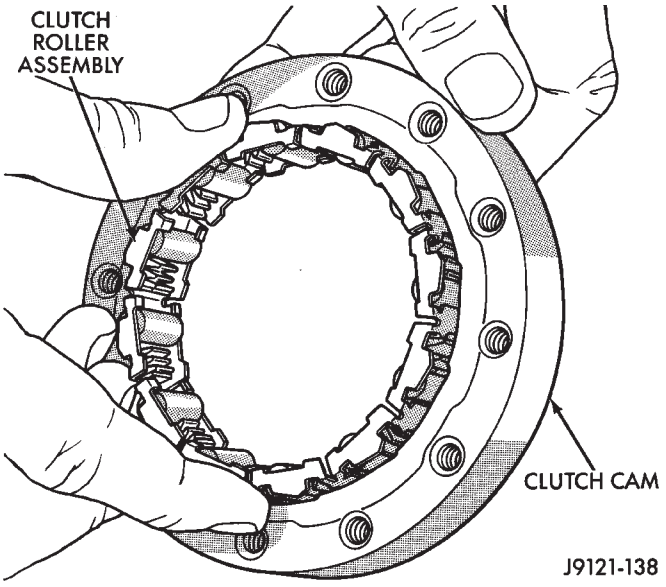

Fig. 32 Assembling Overrunning Clutch And Cam

(c) Install drum-clutch assembly in case and install clutch cam bolts.

(d) Install rear support and support attaching bolts.

(e) Check low-reverse drum rotation. **Drum should rotate freely in clockwise direction and lock when turned in counterclockwise direction (as viewed from front of case).**

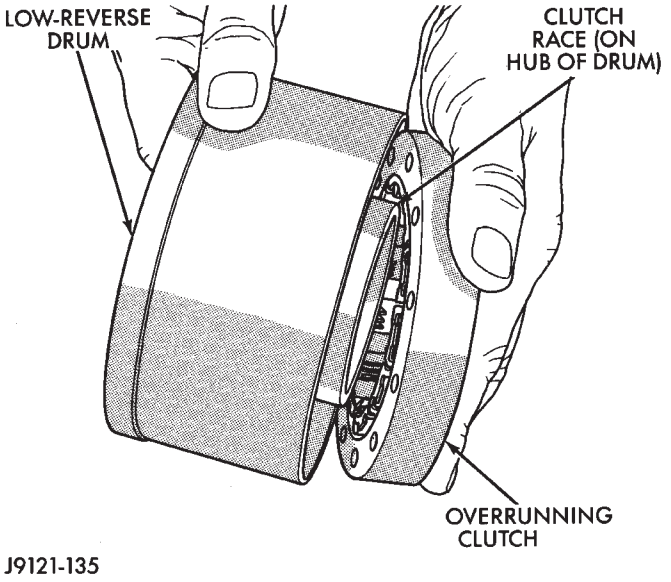

Fig. 33 Temporary Assembly Of Clutch And Drum To Check Operation

(4) Note component position for assembly reference. Bolt holes in clutch cam are countersunk on one side, Be sure this side of cam will face rearward when installed (Fig. 34).

(5) Remove rear support, overrunning clutch and low-reverse drum. Set components aside for final assembly. **If overrunning clutch will be installed**

before final assembly, install cam only as described in Transmission Assembly And Adjustment section. Clutch cam must be properly indexed in case to fit and operate properly.

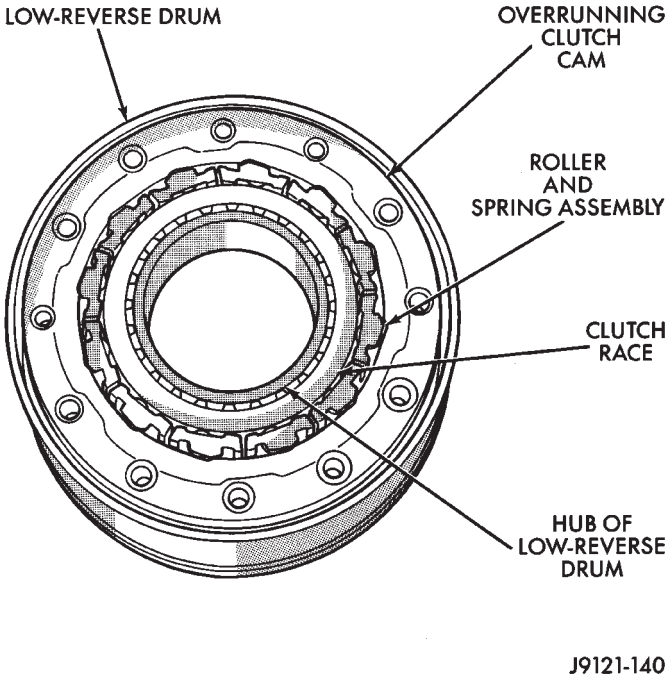

Fig. 34 Assembled Overrunning Clutch Components

ADAPTER HOUSING AND PARK LOCK COMPONENT OVERHAUL

Clean the housing and park lock components in solvent and dry them with compressed air.

Inspect the output shaft bearing in the housing (Fig. 35). Replace the bearing if worn, damaged, or noisy.

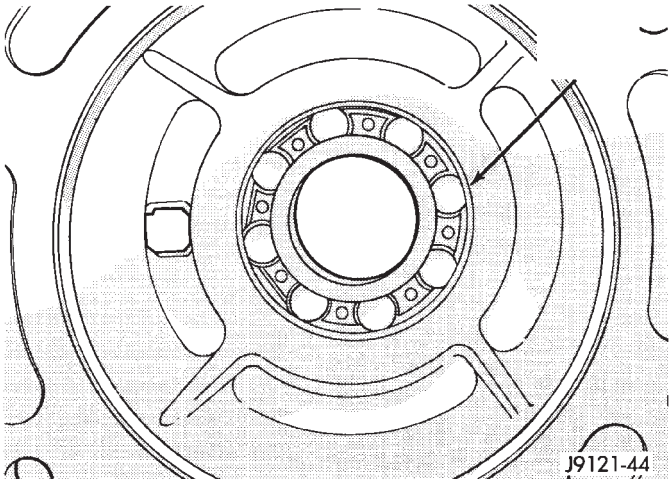

Fig. 35 Adapter Housing Bearing (4 x 4 Models)

Examine the park lock components in the housing. If replacement is necessary, remove the shaft with parallel jaw snap ring pliers (Fig. 36) and remove the sprag and spring. Then remove the spring clip and reaction plug (Fig. 37).

Compress the reaction plug spring clip only enough to remove or install it. The clip is easily distorted if overcompressed. Replace the clip if it becomes bent or distorted. Do not straighten and reuse the clip if this occurs.

Be sure a replacement sprag is installed so the sprag locking lug will face the park gear. Also be sure the spring is correctly positioned as shown (Fig. 38). **The sprag may not retract if the spring is improperly installed.**

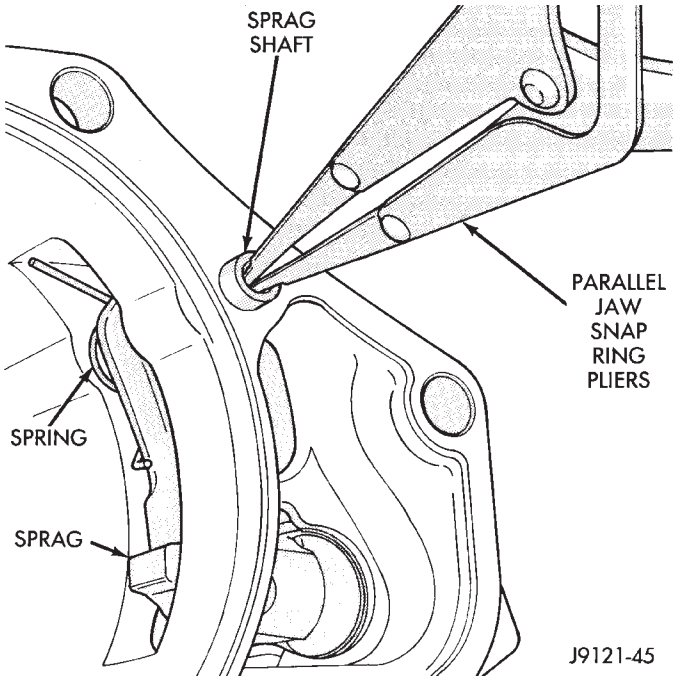

Fig. 36 Park Sprag, Shaft And Spring Removal

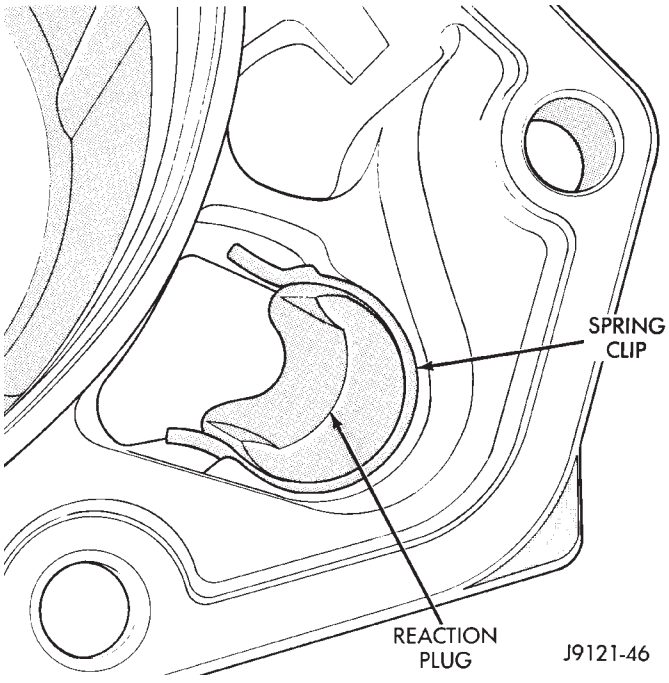

Fig. 37 Park Sprag Reaction Plug And Spring Location

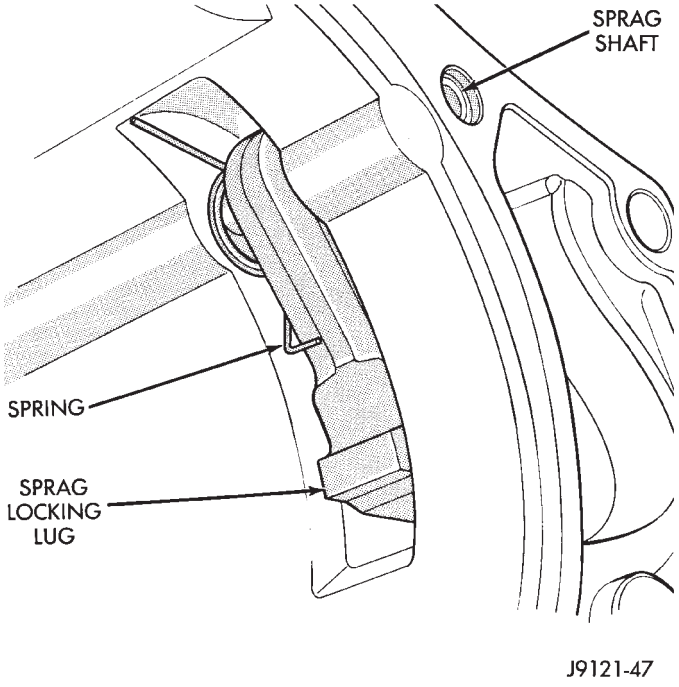

Fig. 38 Correct Position Of Sprag And Spring

GOVERNOR AND PARK GEAR OVERHAUL

GOVERNOR/PARK GEAR DISASSEMBLY

(1) Loosen bolts attaching governor to park gear.

(2) Remove governor snap ring and locating snap ring from output shaft (Fig. 39).

(3) Remove E-clip securing governor valve shaft and remove shaft and valve from governor body.

(4) Slide governor and park gear off output shaft.

(5) Remove governor retaining bolts and separate governor from park gear.

(6) Remove governor filter from park gear. Keep filter with governor body.

(7) Remove governor weight snap ring and remove weight assembly from governor body. Remove inner snap ring and separate governor weights.

GOVERNOR/PARK GEAR CLEANING AND INSPECTION

Clean the governor and park gear components in solvent and dry with compressed air.

Examine the governor components carefully (Fig. 39). Discard any snap rings or E-clips if distorted, or worn. Be sure the governor weights operate freely in the bores and do not bind. Also verify that the governor valve slides freely on the shaft and in the bore.

Minor scratches, or burrs on governor components can be cleaned up with oil-soaked crocus cloth. However, do not attempt to salvage components that are severely worn or scored.

The governor valve used in 30RH/32RH transmissions built starting with the 1992 model year, is now made of aluminum. In addition, the output shaft has been spotfaced to accept the new aluminum valve (Fig. 39). The aluminum valve must not be used in prior transmissions. The valve can only be used with an output shaft that has been spotfaced for valve end clearance. In addition, the governor body and output shaft must be properly indexed during reassembly. Be sure to index these components as described in the Transmission Assembly and Adjustment procedures.

Check condition of the park gear seal rings, ring grooves and gear teeth (Fig. 40). Replace the gear as an assembly if the teeth or ring grooves are worn, or damaged.

Replace the park gear front and rear seal rings if cracked, or worn. The production style front ring is a plain type and the rear ring is a hook style. If replacement rings are both hook-style, be sure the ring ends are properly hooked together.

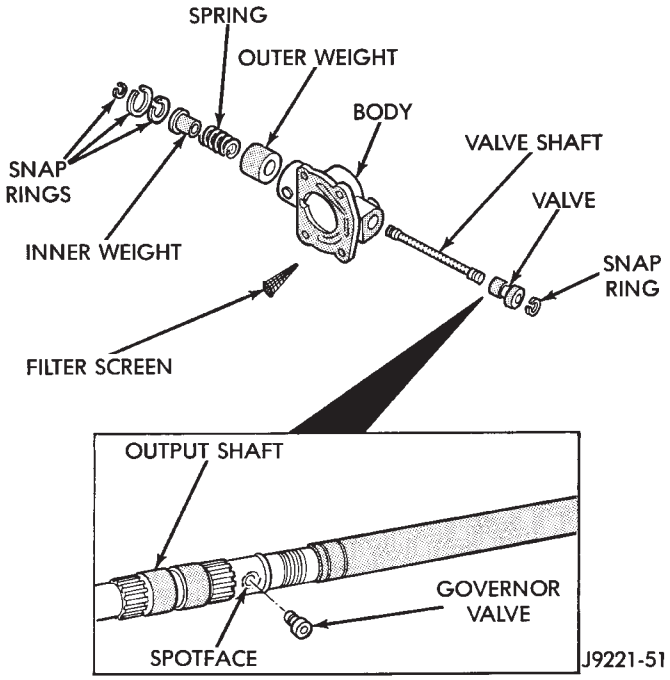

Fig. 39 Governor Components

ASSEMBLING GOVERNOR AND PARK GEAR

(1) Coat governor body bores and valves with transmission fluid.

(2) Assemble governor weights and springs. Then install weight assembly in governor body but do not install valve and shaft at this time. These parts are not installed until after governor and park gear are in place on output shaft.

(3) Install new seal rings on park gear if necessary.

(4) Insert filter screen in park gear and position governor body on park gear.

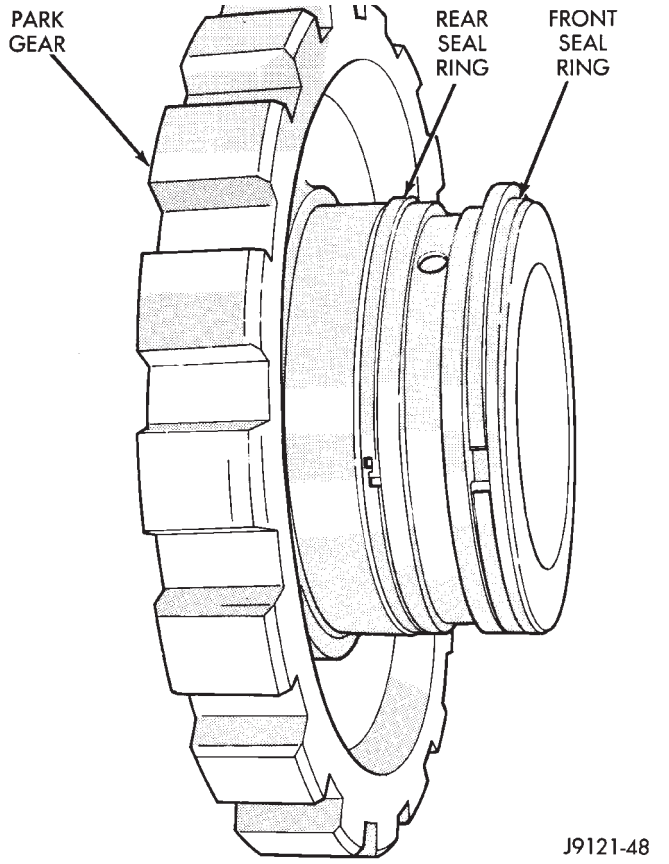

Fig. 40 Park Gear And Seal Rings

(5) Tighten governor body attaching bolts finger tight only. Bolts will not be final tightened until after governor and park gear are mounted on output shaft.

OIL PUMP OVERHAUL

PUMP AND REACTION SHAFT SUPPORT DISASSEMBLY

(1) Remove seal ring from housing and reaction shaft support (Fig. 41).

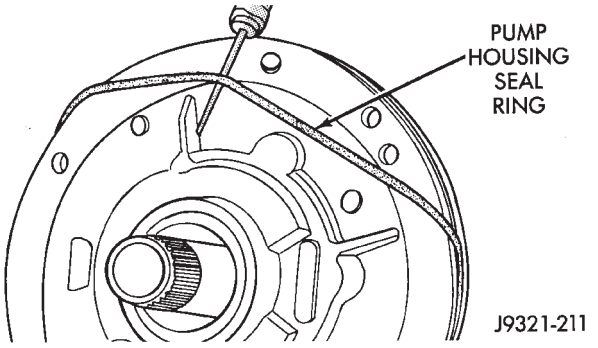

Fig. 41 Removing Pump Seal Ring

(2) Mark pump housing and support assembly for alignment reference.

(3) Loosen bolts that attach pump body to support (Fig. 42).

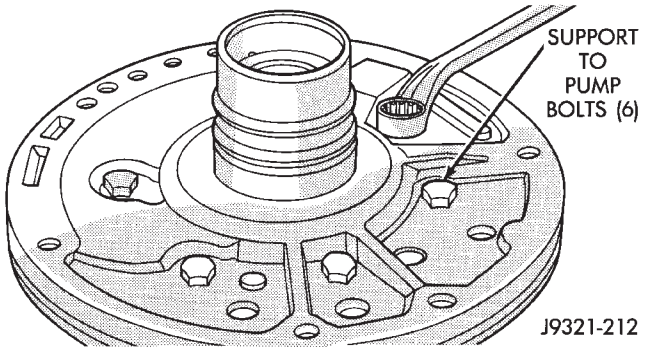

Fig. 42 Loosening Pump Support Bolts

(4) Remove pump-to-support bolts and separate support from pump housing (Fig. 43).

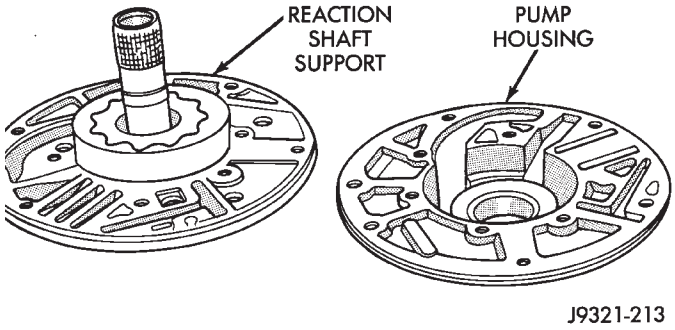

Fig. 43 Separating Pump Housing From Reaction Shaft Support

(5) Remove inner and outer gears from reaction shaft support (Fig. 44).

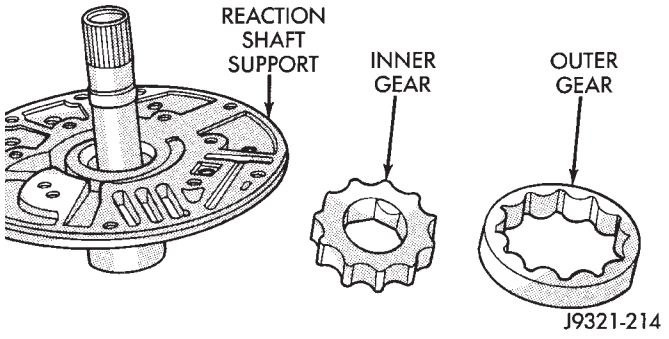

Fig. 44 Pump Gear Removal

(6) If pump seal was not removed during transmission disassembly, remove seal with punch and hammer.

(7) Remove front clutch thrust washer from support hub (Fig. 45).

OIL PUMP AND REACTION SHAFT SUPPORT CLEANING AND INSPECTION

Clean pump and reaction shaft support components with solvent and dry them with compressed air.

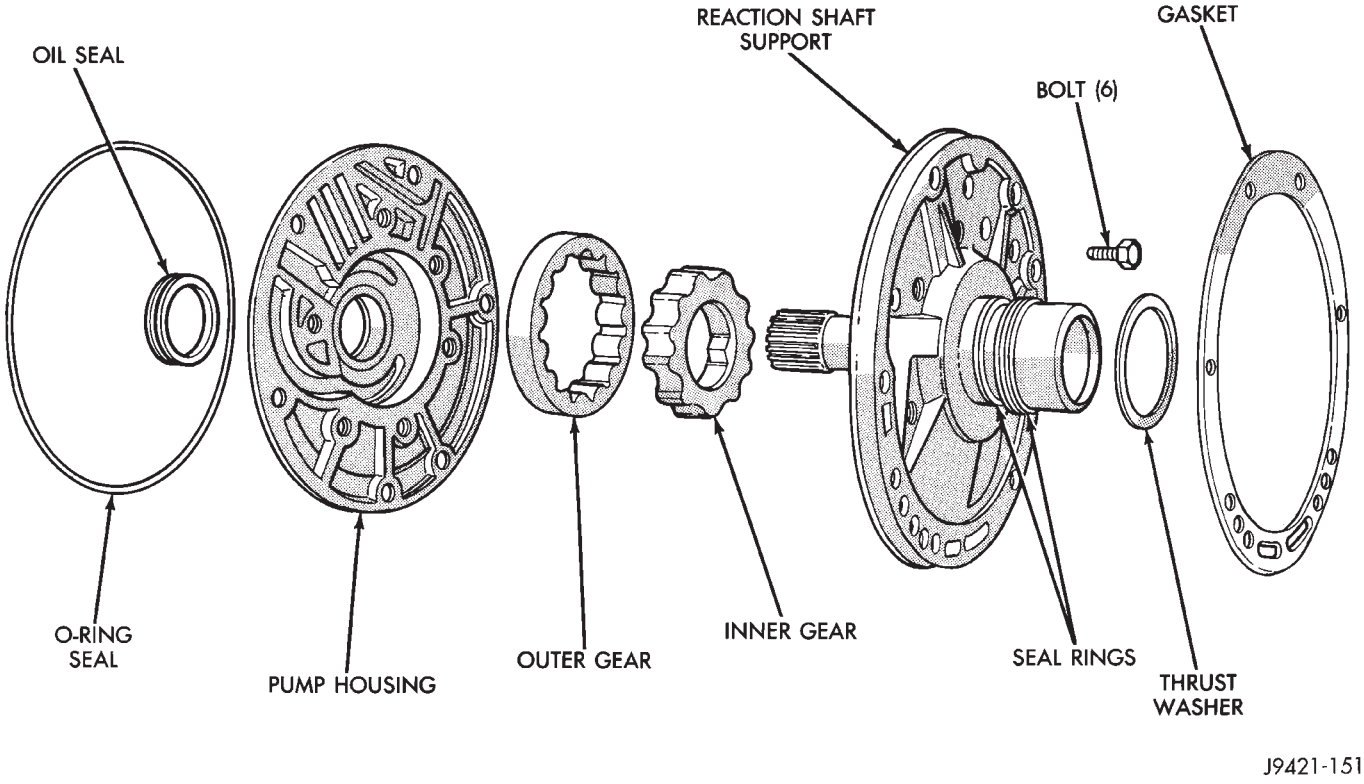

Fig. 45 Oil Pump And Reaction Shaft Support Components (All)

Inspect the pump housing and support components. Replace the housing 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 thrust washer for wear or damage. Replace the washer if necessary. **Note that the inner gear used in 1993 and later 30RH/32RH oil pumps has a new design drive lug. The new design incorporates tapered drive flats instead of the square lug used previously. The torque converter hub has also been redesigned to accept the new drive flats. If pump gear replacement is necessary, be very sure to order and install the correct style gears.**

Inspect the pump and reaction shaft support bushings. Minor bushing wear is acceptable. Replace the bushings only if scored, or severely worn.

Install the gears in the pump housing and measure end clearance with a feeler gauge and straightedge (Fig. 46). Clearance should be 0.010 - 0.06 mm (0.0004 - 0.0025 in.).

Measure clearance between the outer gear and the pump body (Fig. 47). Clearance should be 0.08 - 0.19 mm (0.0035 - 0.0075 in.).

Measure gear tooth clearance with a feeler gauge. Align one tooth of the outer gear in inner gear and measure clearance (Fig. 48). Clearance should be 0.08 - 0.19 mm (0.0035 - 0.0075 in.).

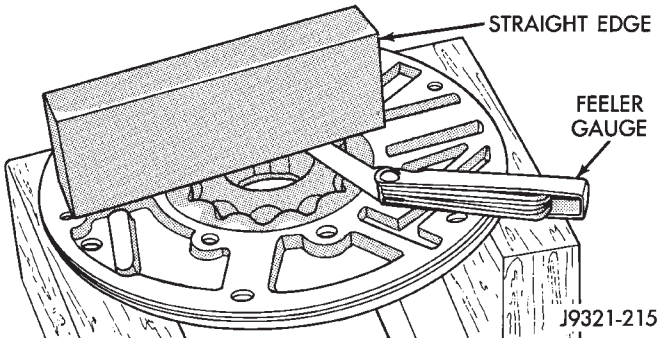

Fig. 46 Measuring Pump Gear End Clearance

OIL PUMP BUSHING REPLACEMENT

(1) Remove pump bushing with Tool Handle C-4171 and Bushing Remover SP-3551 (Fig. 49).

(2) Install new pump bushing with Tool Handle C-4171 and Bushing Installer SP-5117 (Fig. 49). Bushing should be flush with pump housing bore.

(3) Stake new pump bushing in two places with blunt punch (Fig. 50). Remove burrs from stake points with knife blade afterward.

REACTION SHAFT SUPPORT BUSHING REPLACEMENT

(1) Assemble Bushing Remover Tools SP-1191,

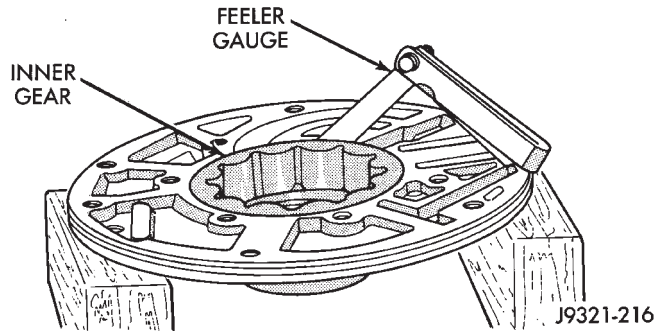

Fig. 47 Measuring Pump Housing-To-Inner Gear Clearances

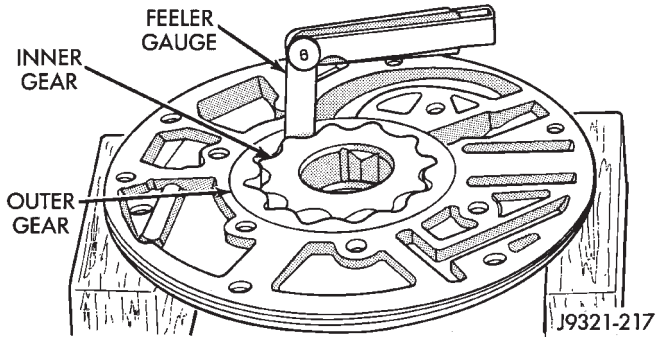

Fig. 48 Measuring Pump Gear Tooth Clearance

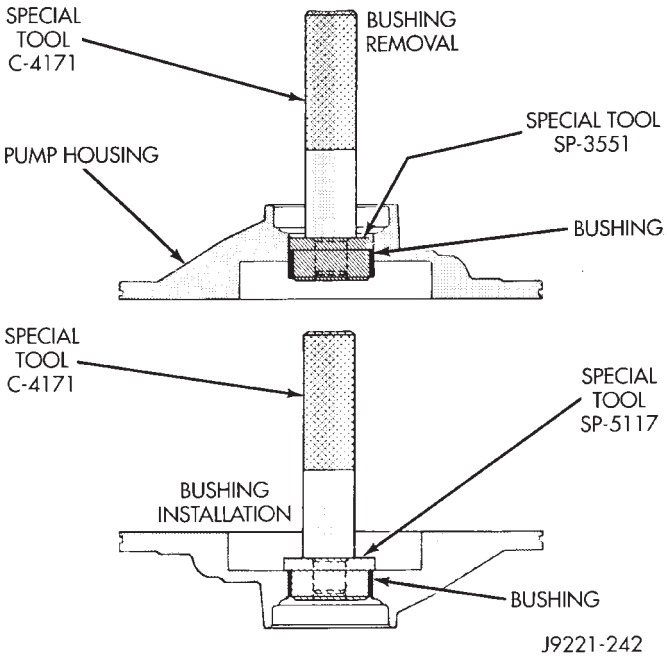

Fig. 49 Removing Oil Pump Bushing

3633 and 5324 (Fig. 51). **Do not clamp any part of reaction shaft or support in vise.**

(2) Hold Cup Tool SP-3633 firmly against reaction shaft and thread remover SP-5324 into bushing as far as possible by hand. Then thread remover tool 3-4 additional turns into bushing with a wrench.

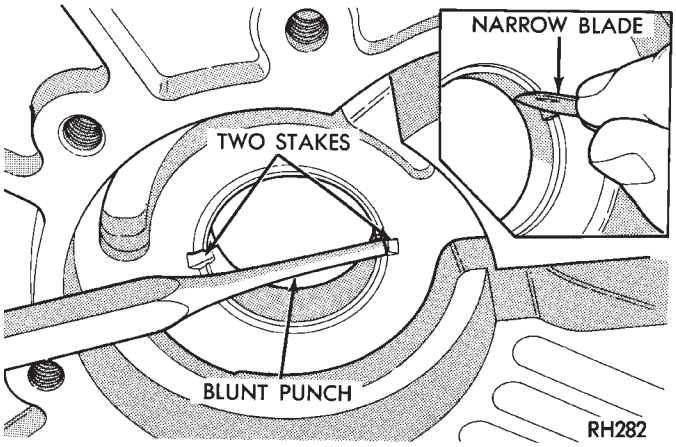

Fig. 50 Staking Oil Pump Bushing

(3) Turn remover tool hex nut down against remover cup to pull bushing from shaft. Clean all chips from shaft after bushing removal.

(4) Lightly grip old bushing in vise or with pliers and back remover tool out of bushing.

(5) Assemble Bushing Installer Tools C-4171 and SP-5325 (Fig. 51).

(6) Slide new bushing onto Installer Tool SP-5325.

(7) Position reaction shaft support upright on a clean smooth surface.

(8) Align bushing in bore. Then tap bushing into place until Bushing Installer SP-5325 bottoms.

(9) Clean reaction shaft support thoroughly after installing bushing.

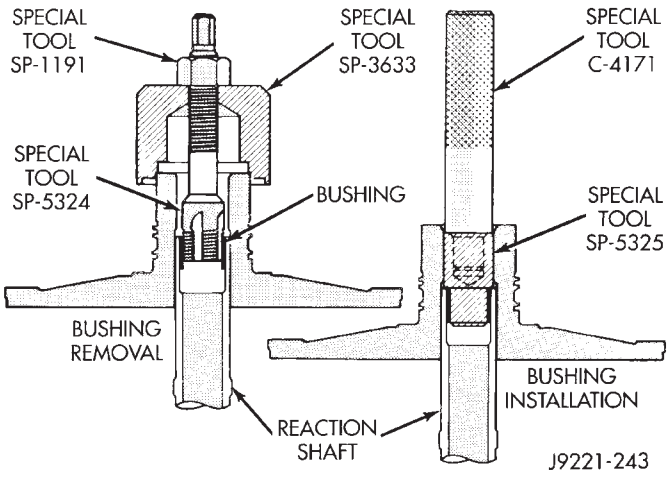

Fig. 51 Replacing Reaction Shaft Support Bushing

ASSEMBLING OIL PUMP AND REACTION SHAFT SUPPORT

(1) Lubricate gear bore in pump housing with transmission fluid.

(2) Lubricate pump gears with transmission fluid.

(3) Support pump housing on wood blocks (Fig. 52).

(4) Install outer gear in pump housing (Fig. 52). Gear can be installed either way (it is not a one-way fit).

(5) Install pump inner gear (Fig. 53).

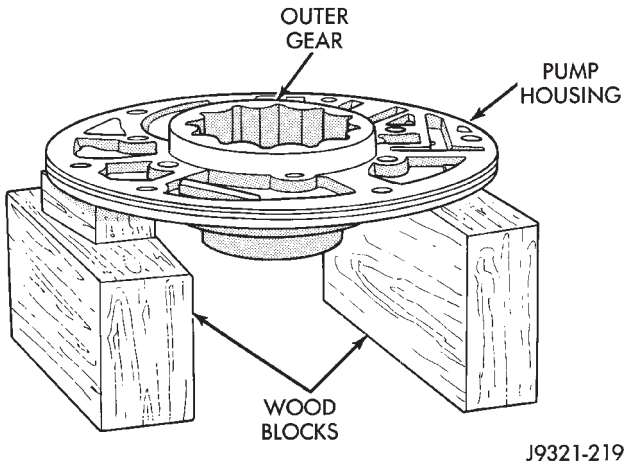

Fig. 52 Supporting Pump And Installing Outer Gear

CAUTION: The pump inner gear is a one way fit. The bore on one side of the gear inside diameter (I.D.) is chamfered. Be sure the chamfered side faces forward (to front of pump).

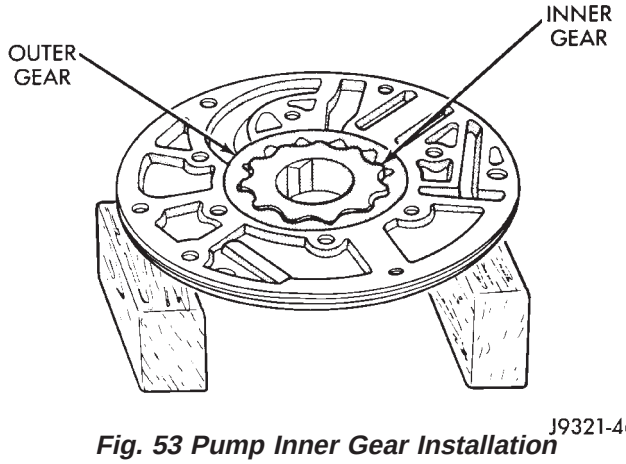

Fig. 53 Pump Inner Gear Installation

(6) Install new thrust washer on hub of reaction shaft support. Lubricate washer with transmission fluid or petroleum jelly.

(7) If reaction shaft seal rings are being replaced, install new seal rings on support hub (Fig. 54). Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(8) Install reaction shaft support on pump housing (Fig. 55).

(9) Align reaction support on pump housing. Use alignment marks made at disassembly. Or, rotate

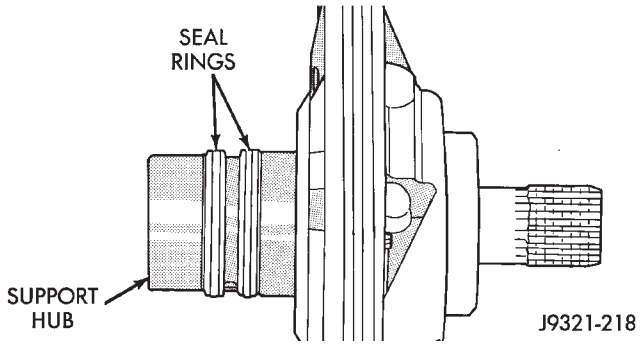

Fig. 54 Hub Seal Ring Position

support until bolt holes in support and pump housing are all aligned (holes are offset for one-way fit).

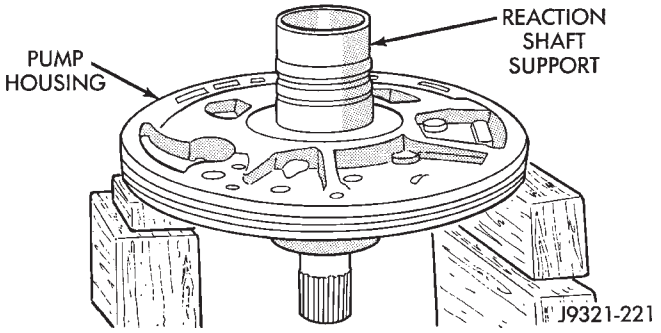

Fig. 55 Assembling Reaction Shaft Support And Pump Housing

(10) Install all bolts that attach support to pump housing. Then tighten bolts finger tight.

(11) Tighten support-to-pump bolts to required torque as follows:

(a) Reverse pump assembly and install it in transmission case. Position pump so bolts are facing out and are accessible.

(b) Secure pump assembly in case with 2 or 3 bolts, or with pilot studs.

(c) Tighten support-to-pump bolts to 20 N·m (15 ft. lbs.).

(d) Remove pump assembly from transmission case.

(12) Install new oil seal in pump with Special Tool C-4193 and Tool Handle C-4171 (Fig. 56). Be sure seal lip faces inward.

(13) Install new seal ring around pump housing. Be sure seal is properly seated in groove.

(14) Lubricate lip of pump oil seal and O-ring seal with transmission fluid.

FRONT CLUTCH OVERHAUL

FRONT CLUTCH DISASSEMBLY

(1) Remove waved snap ring and remove pressure plate, clutch plates and clutch discs (Fig. 57).

(2) Compress clutch piston spring with Compressor Tool C-3575-A (Fig. 58). Be sure legs of tool are seated squarely on spring retainer before compressing spring.

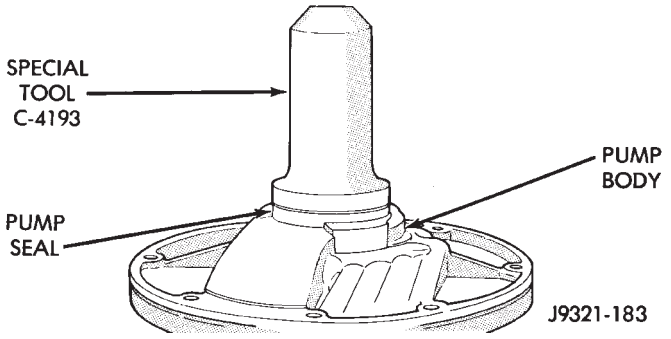

Fig. 56 Pump Oil Seal Installation

(3) Remove retainer snap ring and remove compressor tool.

(4) Remove spring retainer and clutch spring. Note position of retainer on spring for assembly reference.

(5) Remove clutch piston from clutch retainer. Remove piston by rotating it up and out of retainer.

(6) Remove seals from clutch piston and clutch retainer hub. Discard both seals as they are not reusable.

FRONT CLUTCH INSPECTION

Clean the front clutch components in solvent and dry them with compressed air only. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to the component surfaces and could restrict or block fluid passages after assembly.

Replace the clutch discs if warped, worn, scored, burned or charred, or if the facing is flaking off. Replace the steel plates if heavily scored, warped, or broken. Be sure the driving lugs on the plates are in good condition. The lugs must not be bent, cracked or damaged in any way.

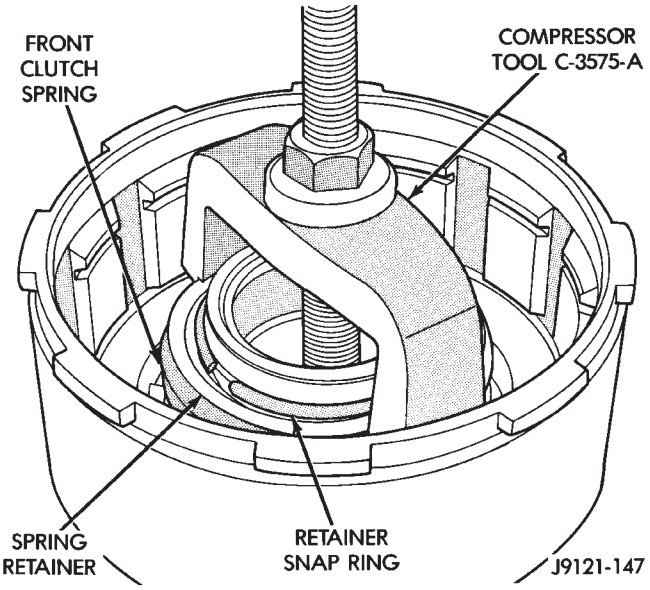

Fig. 58 Compressing Front Clutch Piston Spring

Replace the clutch spring and spring retainer if either is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The steel plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged.

Check action of the check ball in the retainer (Fig. 59). The ball must move freely and not stick.

Inspect the clutch retainer bushings carefully (Fig. 60). The retainer bushings are not service-

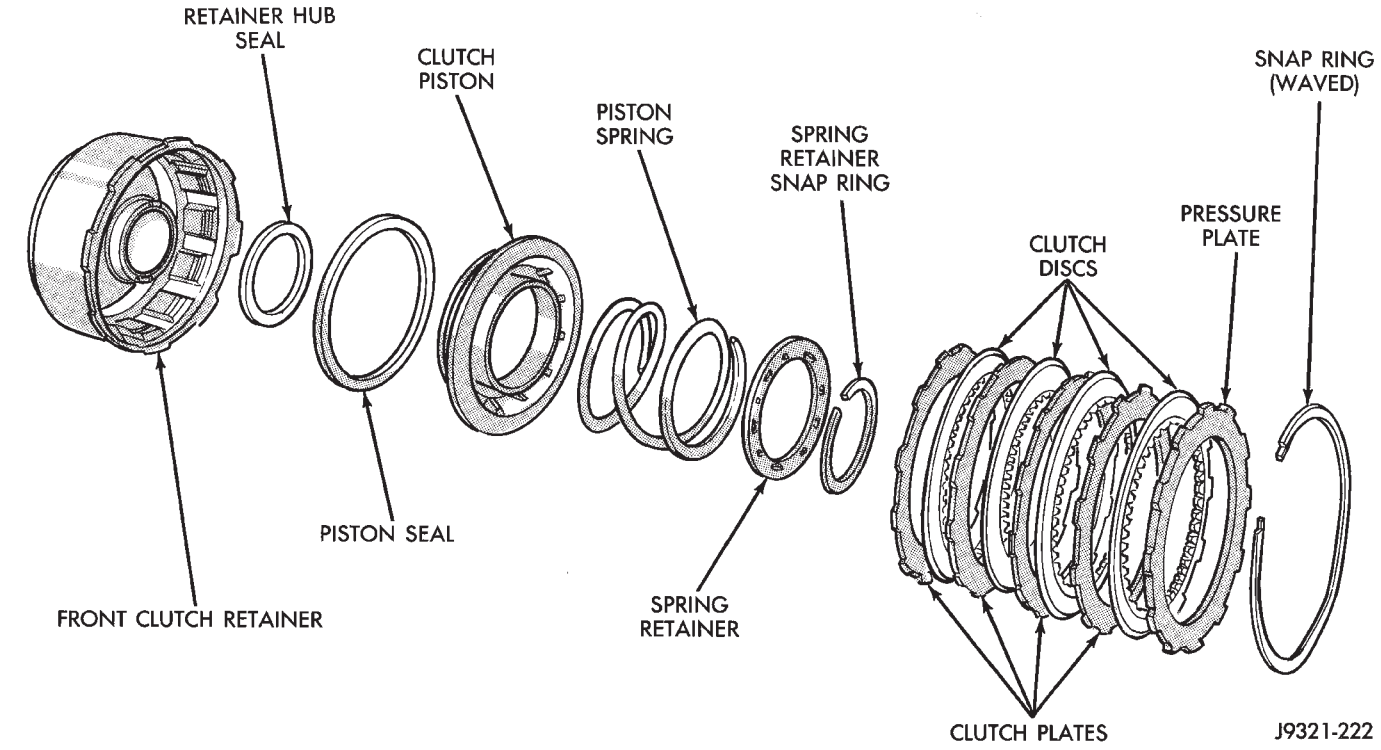

Fig. 57 Front Clutch Components (30RH/32RH)

able. It will be necessary to replace the retainer if either bushing is scored, or worn.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

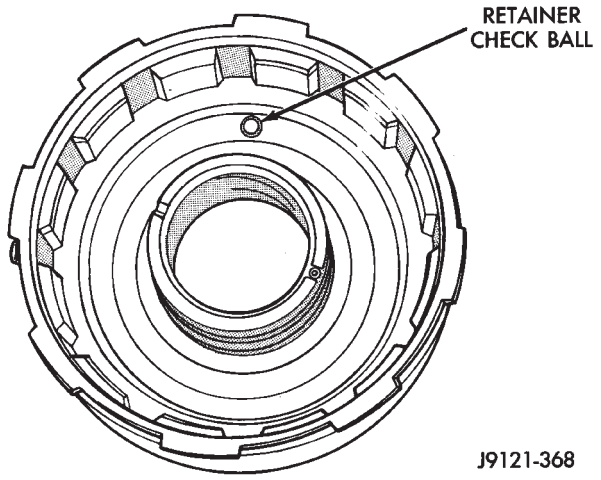

Fig. 59 Front Clutch Piston Retainer Check Ball Location

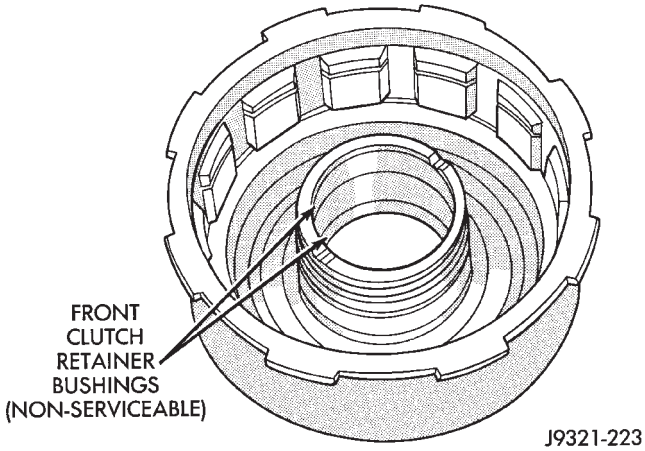

Fig. 60 Retainer Bushing Locations

FRONT CLUTCH ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seals on piston and in hub of retainer. Be sure lip of each seal faces interior of clutch retainer.

(3) Lubricate lips of piston and retainer seals with liberal quantity of Door Eze, or petroleum jelly. Then lubricate retainer hub, bore and piston with transmission fluid.

(4) Install clutch piston in retainer (Fig. 61). Use twisting motion to seat piston in bottom of retainer. **Do not attempt to push the piston straight in. This could fold the seals over causing leakage and clutch slip.**

(5) Position spring in clutch piston (Fig. 62).

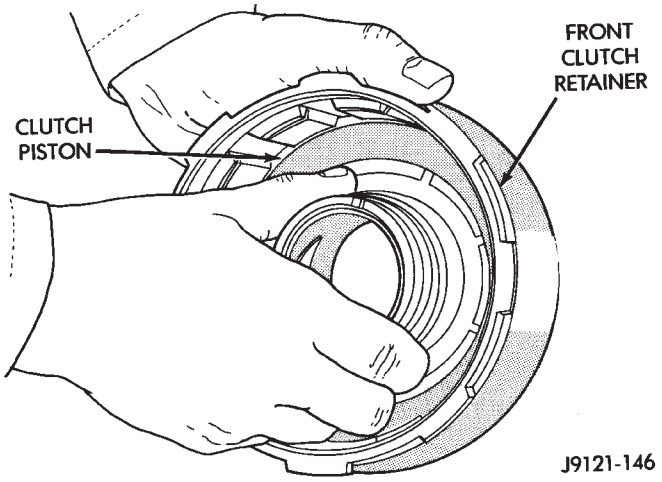

Fig. 61 Front Clutch Piston Installation

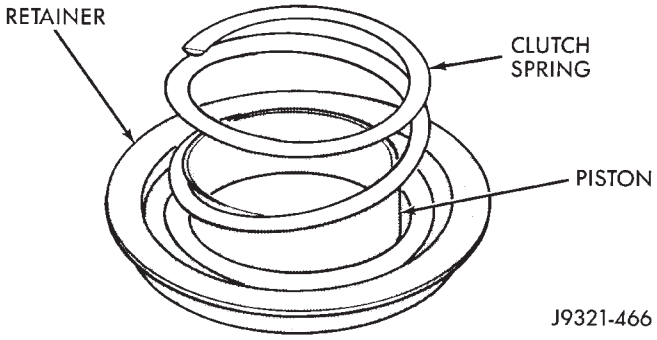

Fig. 62 Clutch Piston Spring Installation

(6) Position spring retainer on top of piston spring (Fig. 63). **Make sure retainer is properly installed. Small raised tabs should be facing upward. Semicircular lugs on underside of retainer are for positioning retainer in spring.**

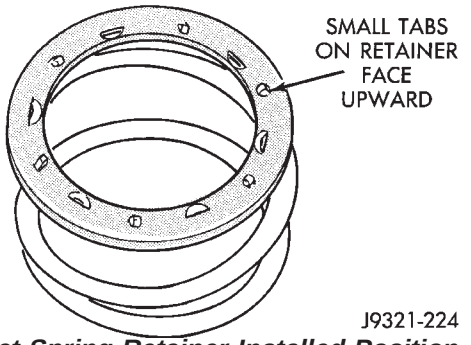

Fig. 63 Correct Spring Retainer Installed Position

(7) Compress piston spring and retainer with Compressor Tool C-3575-A (Fig. 64). Then install new snap ring to secure spring retainer and spring.

(8) Install clutch plates and discs (Fig. 57). Install steel plate then disc until all plates and discs are installed.

(9) Install pressure plate and waved snap ring (Fig. 57).

(10) Check clutch plate clearance (Fig. 64). Clearance should be 1.70 to 3.40 mm (0.067 to 0.134 in.). If clearance is incorrect, clutch discs, plates pressure plates and snap ring may have to be changed.

REAR CLUTCH OVERHAUL

REAR CLUTCH DISASSEMBLY

(1) Remove fiber thrust washer from forward side of clutch retainer.

(2) Remove selective clutch pack snap ring (Figs. 65 and 66).

(3) Remove top pressure plate, clutch discs, steel plates, bottom pressure plate and wave spring (Figs. 65 and 66).

(4) Remove clutch piston with rotating motion.

(5) Remove and discard piston seals.

(6) Remove input shaft snap ring (Fig. 67).

(7) Press input shaft out of retainer with shop press and suitable size press tool (Fig. 68).

(8) Remove input shaft front/rear seal rings.

REAR CLUTCH INSPECTION

Clean the clutch components with solvent and dry them with compressed air. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to component surfaces and could restrict or block fluid passages after assembly.

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the top and bottom pressure plates if scored, warped, or cracked. Be sure the driving lugs on the pressure and clutch plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

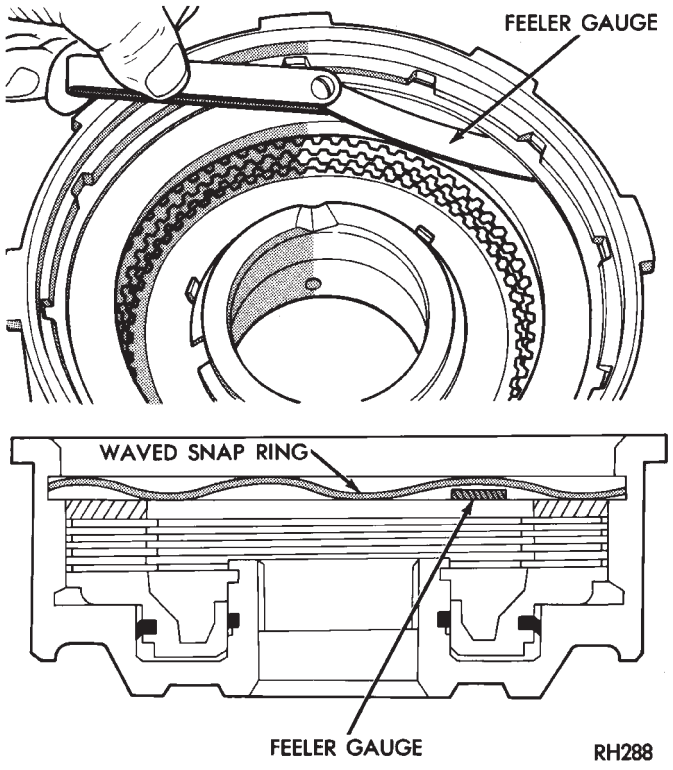

Fig. 64 Measuring Front Clutch Pack Clearance

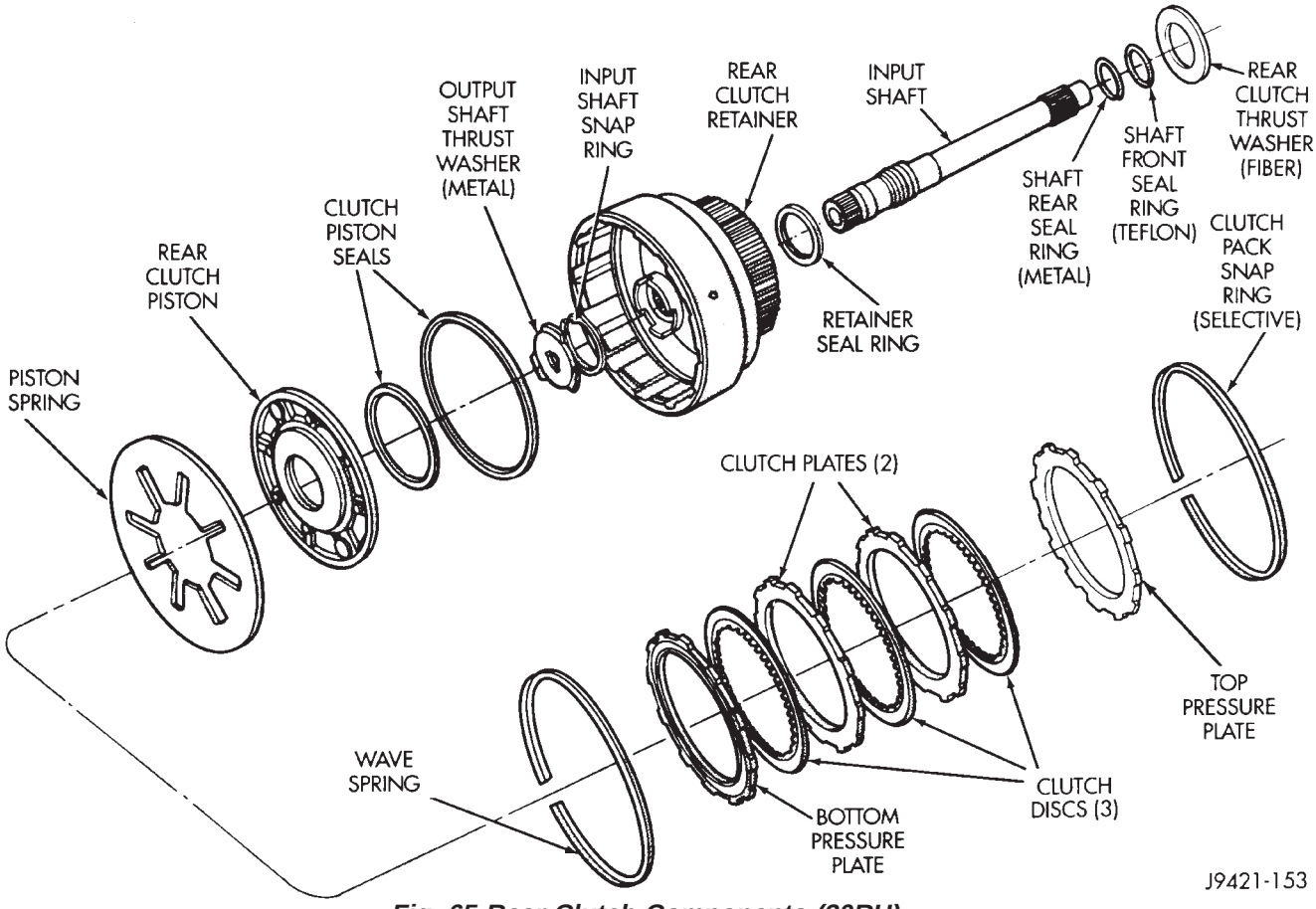

Fig. 65 Rear Clutch Components (30RH)

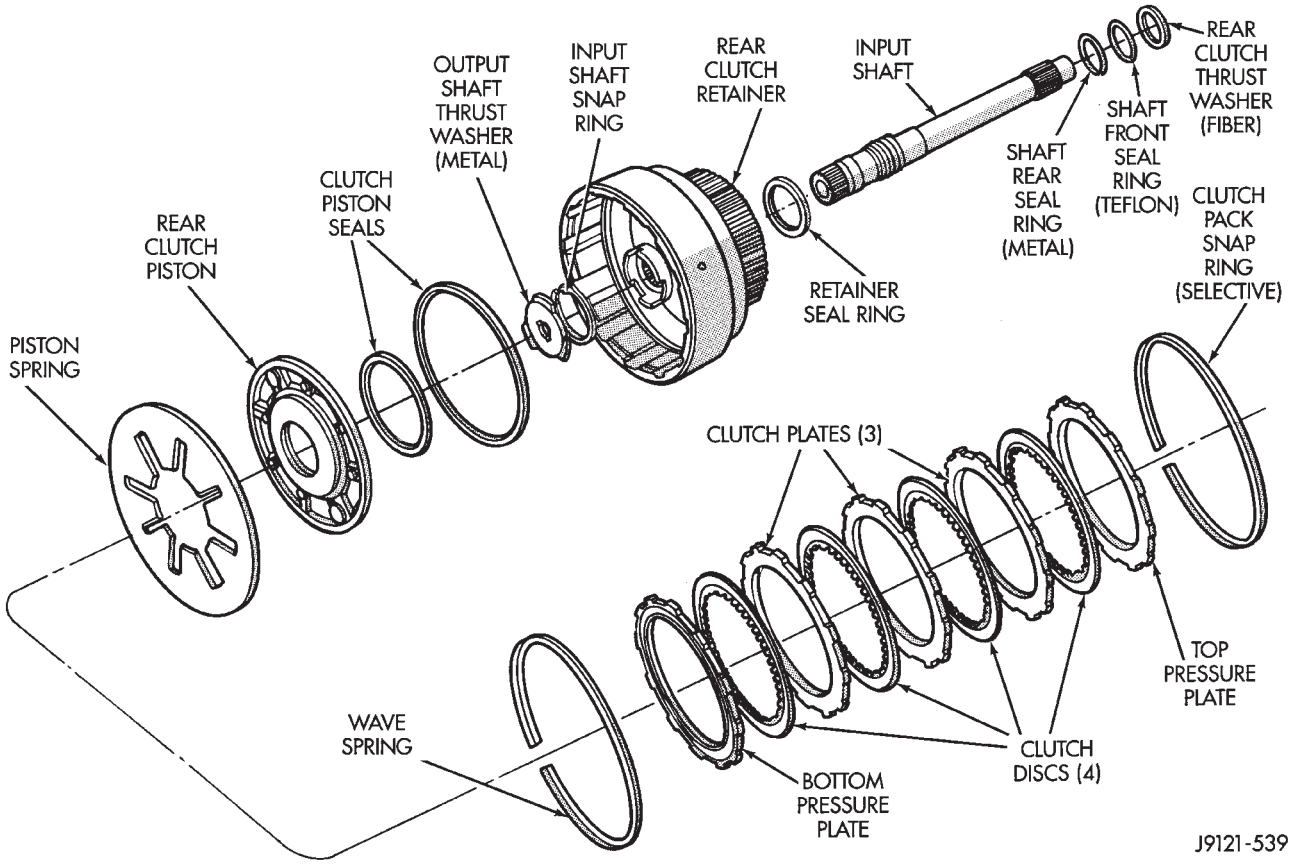

Fig. 66 Rear Clutch Components (32RH)

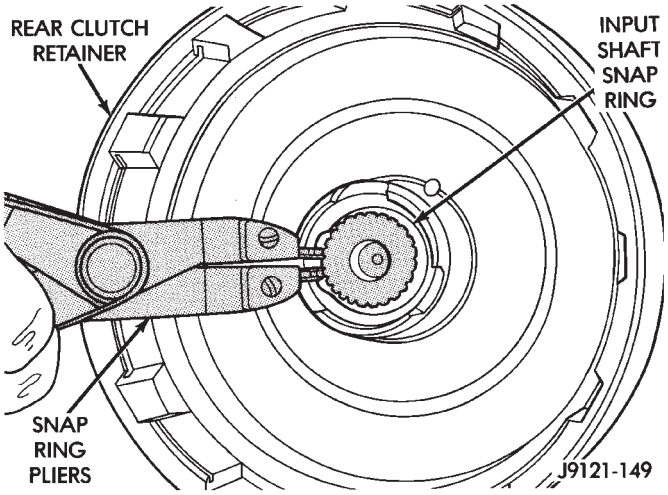

Fig. 67 Removing/Installing Input Shaft Snap Ring

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The clutch and pressure plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the check balls in the retainer and piston. Each check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

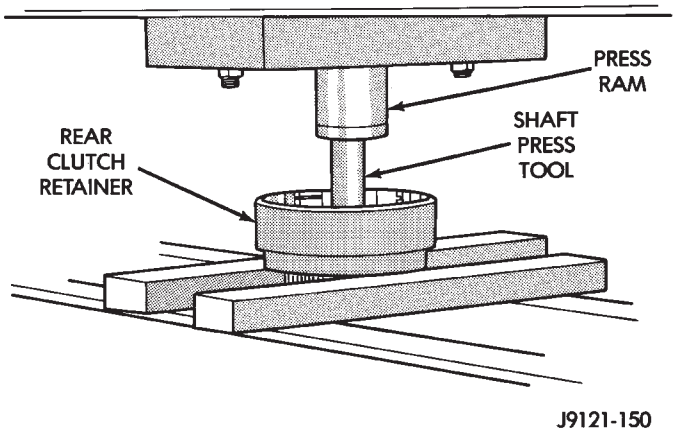

Fig. 68 Pressing Input Shaft Out Of Rear Clutch Retainer

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if worn, distorted, or damaged. The input shaft front

seal ring is teflon with chamfered ends. The rear ring is metal with interlocking ends.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

ASSEMBLING REAR CLUTCH

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seal rings on clutch retainer hub and input shaft if necessary (Fig. 69).

(a) Be sure clutch hub seal ring is fully seated in groove and is not twisted.

(b) Note that input shaft front seal ring is teflon and rear seal ring is metal (Fig. 70). Be sure chamfered ends of teflon ring are properly joined and that ends of rear ring are securely hooked together. Lubricate both rings with transmission fluid after installation.

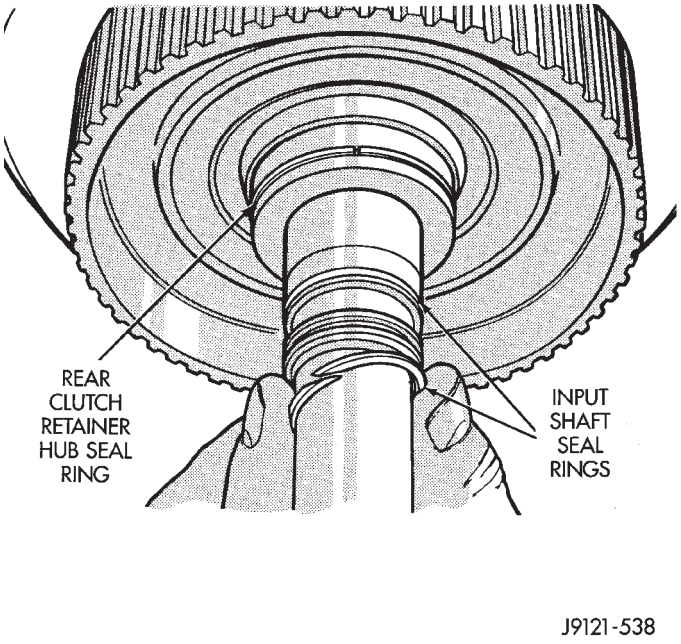

Fig. 69 Rear Clutch Retainer And Input Shaft Seal Ring Installation

(3) Lubricate splined end of input shaft and clutch retainer with transmission fluid. Then press input shaft into retainer (Fig. 71).

(4) Install input shaft snap ring (Figs. 65-66).

(5) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(6) Lubricate lip of piston seals with Ru-Glyde, Door Eze, or petroleum jelly. Then lubricate retainer hub and bore with transmission fluid.

(7) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. **Do not attempt to push the piston straight in. This could fold the seals over causing leakage and clutch slip.**

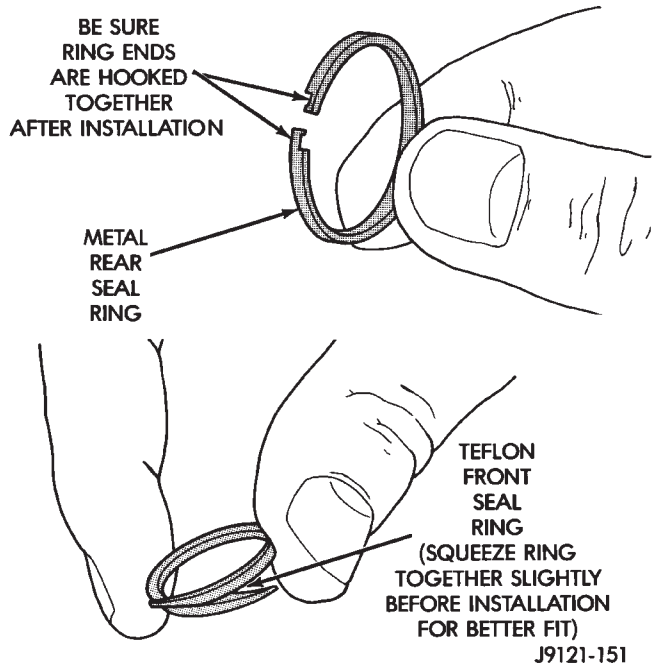

Fig. 70 Input Shaft Seal Ring Identification

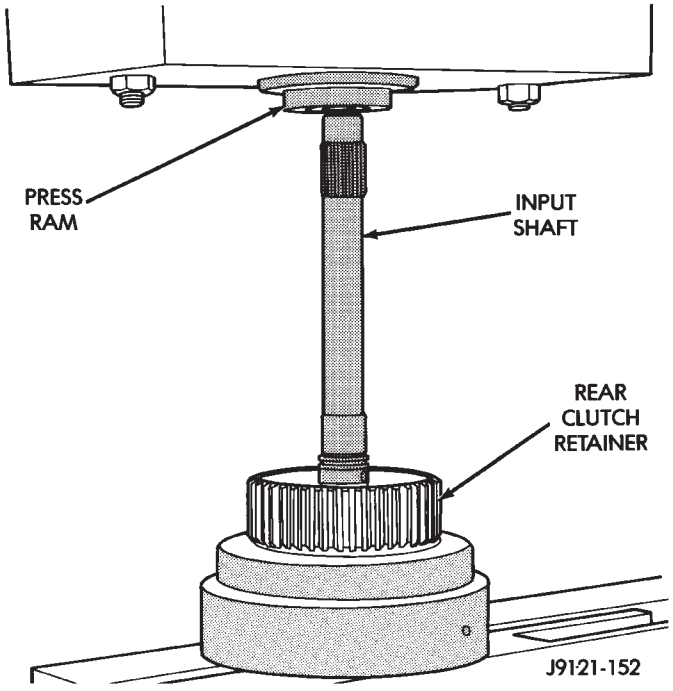

Fig. 71 Pressing Input Shaft Into Rear Clutch Retainer

(8) Install piston spring in retainer and on top of piston (Fig. 72). Concave side of spring faces downward (toward piston).

(9) Install wave spring in retainer (Fig. 72). Be sure spring is completely seated in retainer groove.

(10) Install bottom pressure plate (Fig. 65). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

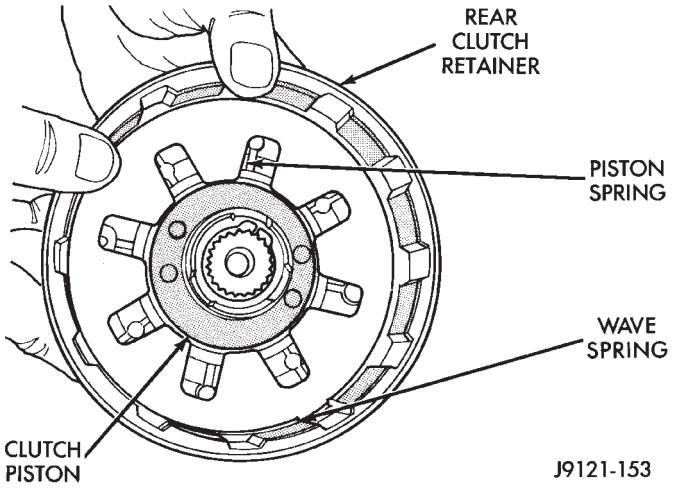

Fig. 72 Piston And Wave Spring Position

(11) Install first clutch disc in retainer on top of bottom pressure plate. Then install a clutch plate followed by a clutch disc until entire clutch pack is installed.

- 3 discs and 2 plates are used in 30RH (Fig. 65)
- 4 discs and 3 plates are required in 32RH (Fig. 66).

(12) Install top pressure plate (Figs. 65-66).

(13) Install selective snap ring (Figs. 65-66). Be sure snap ring is fully seated in retainer groove.

(14) Measure clutch pack clearance (Fig. 73). Clearance should be 0.64 - 1.14 mm (0.025 - 0.045 in.). If clearance is incorrect, steel plates, discs, snap ring and pressure plates may have to be changed.

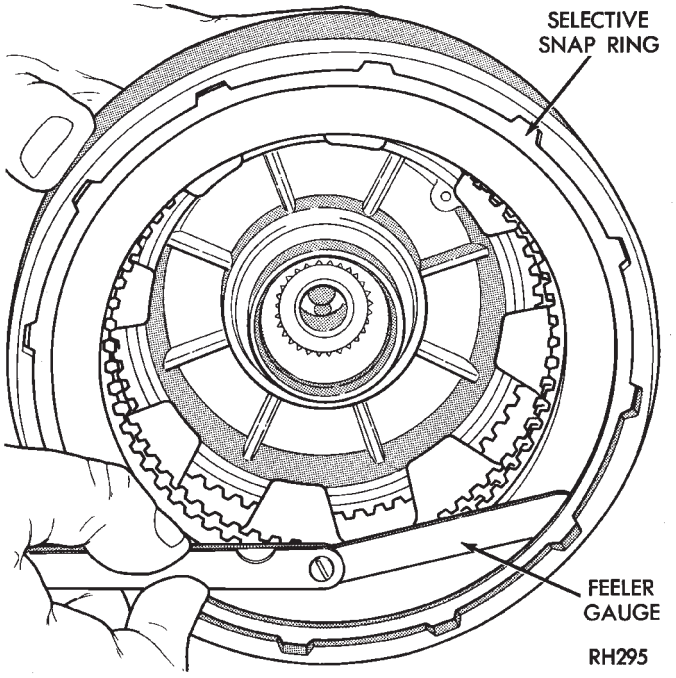

Fig. 73 Typical Method Of Checking Rear Clutch Pack Clearance

(15) Coat rear clutch fiber thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 74). Use enough petroleum jelly to hold washer in place.

(16) Set rear clutch aside for installation during final assembly.

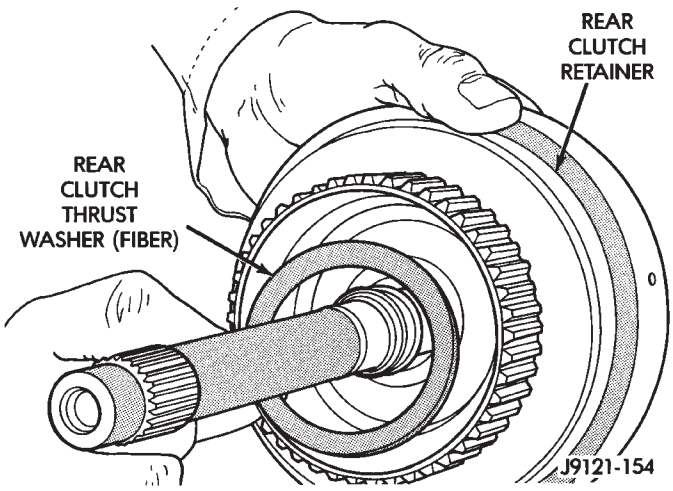

Fig. 74 Installing Rear Clutch Thrust Washer

PLANETARY GEAR TRAIN OVERHAUL

PLANETARY GEARTRAIN DISASSEMBLY

(1) Remove planetary snap ring (Fig. 75).

(2) Remove front annulus and planetary assembly from driving shell (Fig. 75).

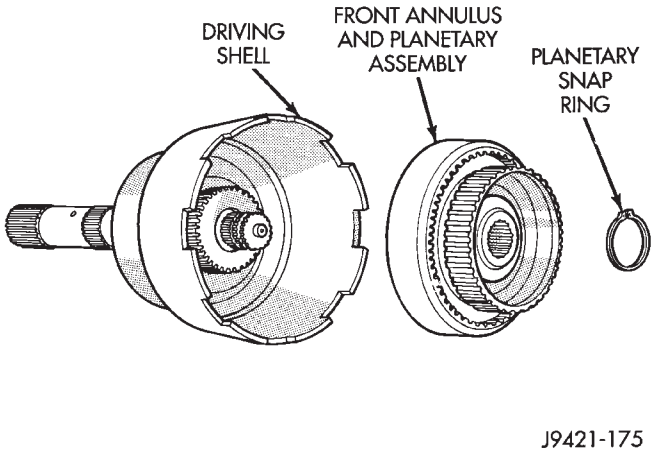

Fig. 75 Front Annulus And Planetary Assembly Removal

(3) Remove snap ring that retains front planetary gear in annulus gear (Fig. 76).

(4) Remove tabbed thrust washer and tabbed thrust plate from hub of front annulus (Fig. 77).

(5) Separate front annulus and planetary gears (Fig. 77).

(6) Remove front planetary gear front thrust washer from annulus gear hub (Fig. 77).

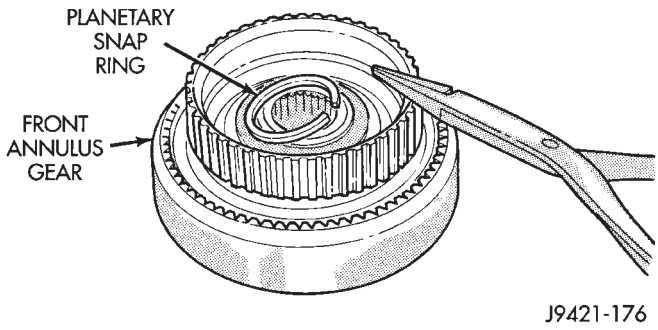

Fig. 76 Front Planetary Snap Ring Removal

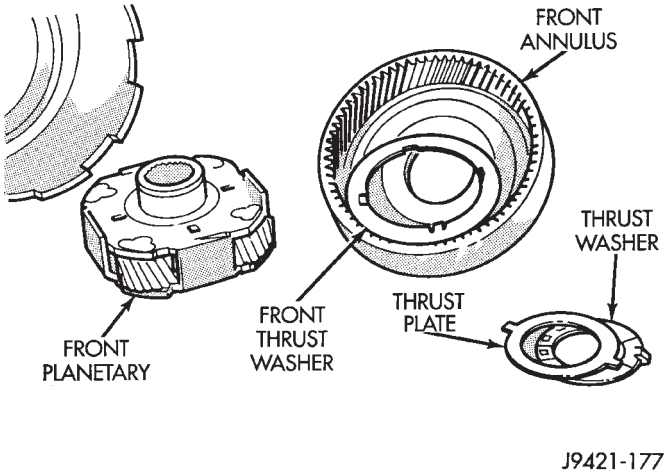

Fig. 77 Front Planetary And Annulus Gear Disassembly

(7) Remove front planetary rear thrust washer from driving shell.

(8) Separate and remove driving shell, rear planetary and rear annulus from output shaft (Fig. 78).

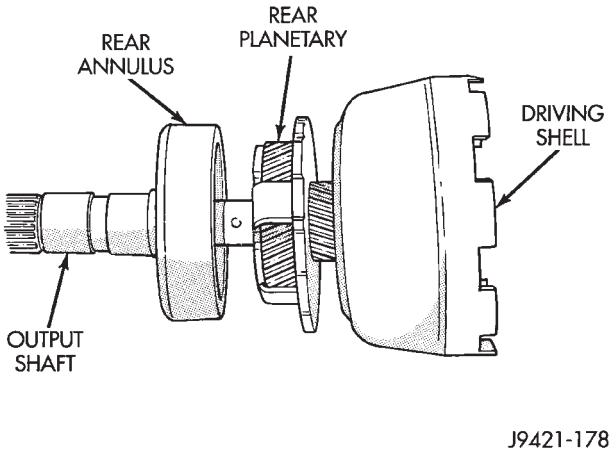

Fig. 78 Removing Driving Shell, Rear Planetary And Rear Annulus

(9) Remove tabbed thrust washers from rear planetary gear.

(10) Remove snap ring that retains sun gear in driving shell. Then remove sun gear, spacer and thrust plates.

PLANETARY GEARTRAIN INSPECTION

Clean the planetary components in solvent and dry them with compressed air.

Check sun gear and driving shell condition (Fig. 79). Replace the gear if damaged or if the bushings are scored or worn. The bushings are not serviceable. Replace the driving shell if worn, cracked or damaged.

Replace planetary gear sets if gears, pinion pins, or carrier are damaged in any way. Replace the annulus gears and supports if either component is worn or damaged.

Inspect the geartrain spacers, thrust plates, snap rings, and thrust washers (Fig. 79). Replace any of these parts that are worn, distorted or damaged. Do not attempt to reuse these parts.

The planetary gear thrust washers are different sizes. The large diameter washers go on the front planetary and the smaller washers go on the rear planetary. All the washers have four locating tabs on them. These tabs fit in the holes or slots provided in each planetary gear.

Inspect the output shaft carefully. Pay particular attention to the machined bushing/bearing surfaces on the shaft and the governor valve shaft bore at the shaft rear.

Replace the output shaft if the machined surfaces are scored, pitted, or damaged in any way. Also replace the shaft if the splines are damaged, or exhibits cracks at any location (especially at the governor valve shaft bore).

The annulus gears can be removed from their supports if necessary. Just remove the snap rings and separate the two parts when replacement is necessary. In addition, the annulus gear bushings can be replaced if severely worn, or scored. However it is not necessary to replace the bushings if they only exhibit normal wear. Check bushing fit on the output shaft to be sure.

ASSEMBLING PLANETARY GEARTRAIN

(1) Lubricate output shaft and planetary components with transmission fluid. Use petroleum jelly to lubricate and hold thrust washers and plates in position.

(2) Assemble rear annulus gear and support if disassembled. Be sure support snap ring is seated and that shoulder-side of support faces rearward (Fig. 80).

(3) Install rear thrust washer on rear planetary gear (Fig. 79). Use enough petroleum jelly to hold washer in place. Also be sure all four washer tabs are properly engaged in gear slots.

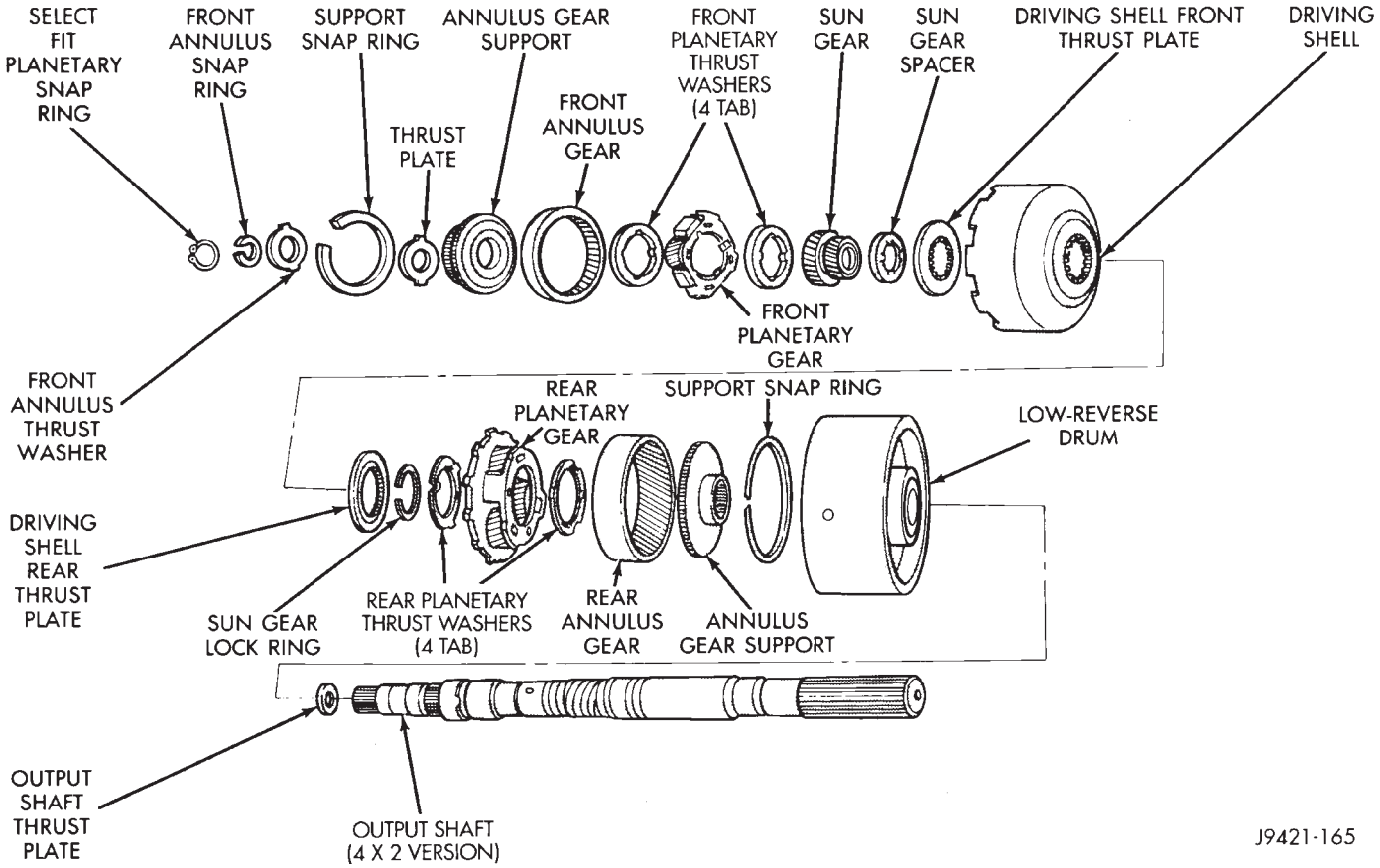

Fig. 79 Planetary Geartrain Components (30RH/32RH)

(4) Install rear annulus over and onto rear planetary gear (Fig. 80).

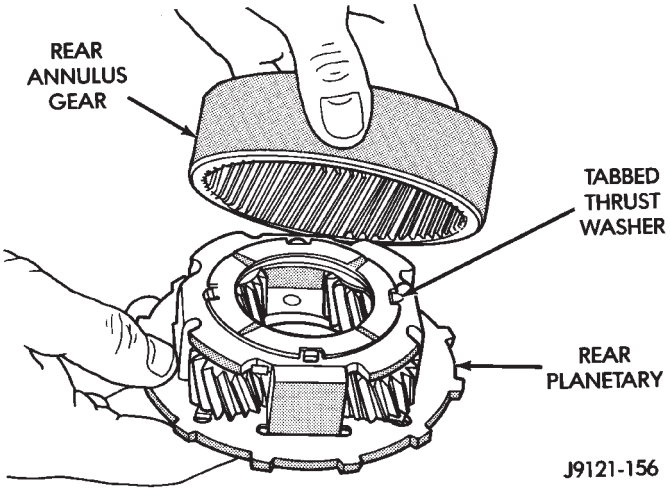

Fig. 80 Assembling Rear Annulus And Planetary Gear

(5) Install assembled rear planetary and annulus gear on output shaft (Fig. 81). Verify that assembly is fully seated on shaft.

(6) Install front thrust washer on rear planetary gear (Fig. 82). Use enough petroleum jelly to hold washer on gear. Be sure all four washer tabs are seated in slots.

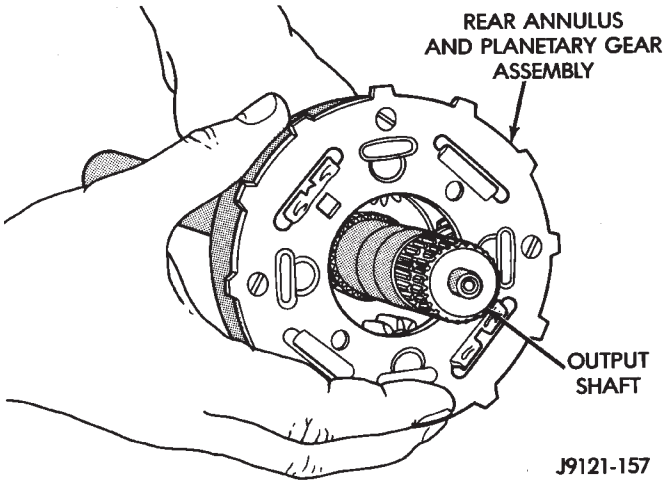

Fig. 81 Installing Rear Annulus And Planetary On Output Shaft

(7) Install spacer on sun gear (Fig. 83).

(8) Install thrust plate on sun gear (Fig. 84). Note that driving shell thrust plates are interchangeable. Use either plate on sun gear and at front/rear of shell.

(9) Hold sun gear in place and install thrust plate over sun gear at rear of driving shell (Fig. 85).

(10) Position wood block on bench and support sun gear on block (Fig. 86). This makes it easier to align

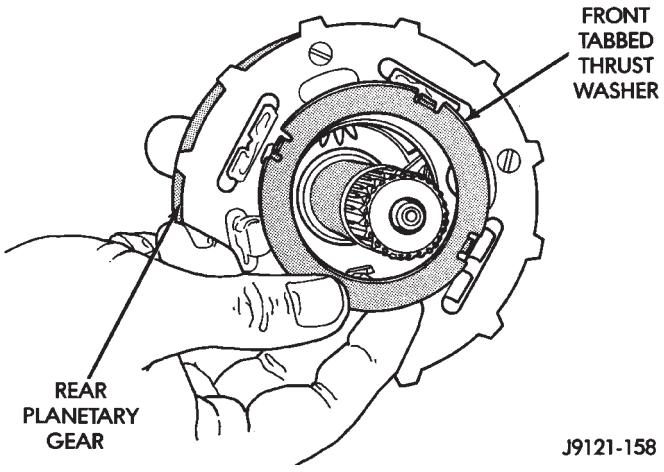

Fig. 82 Installing Rear Planetary Front Thrust Washer

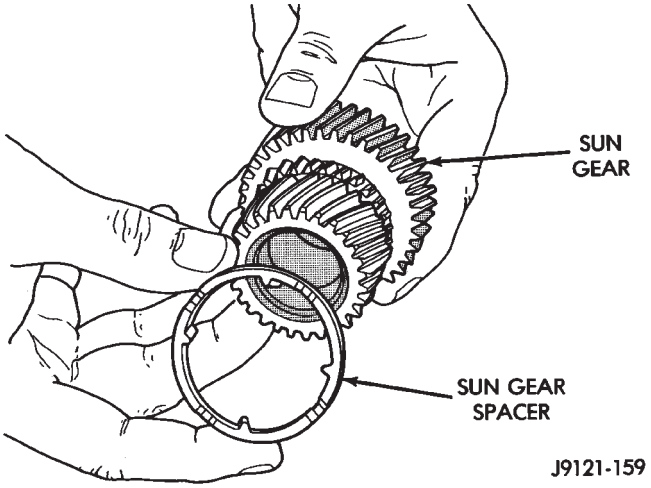

Fig. 83 Installing Spacer On Sun Gear

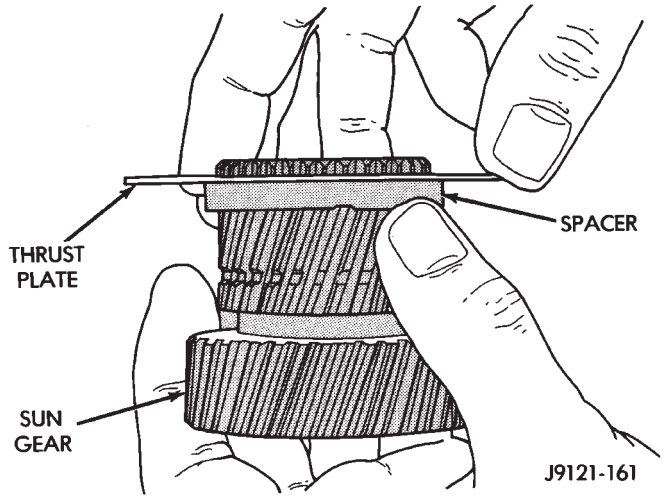

Fig. 84 Installing Driving Shell Front Thrust Plate On Sun Gear

and install sun gear lock ring. Keep wood block handy as it will also be used for geartrain end play check.

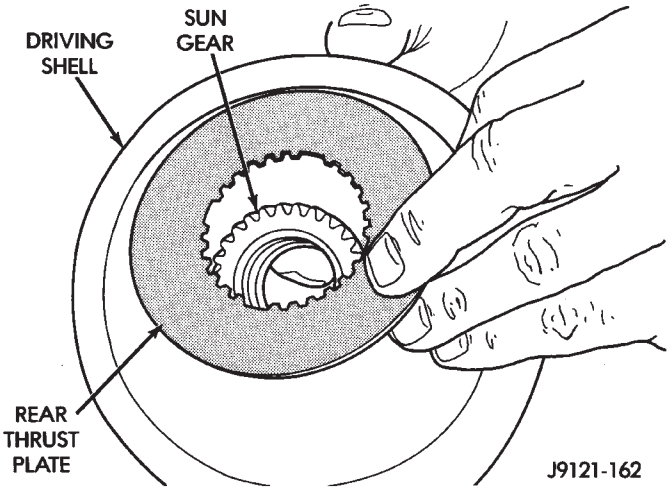

Fig. 85 Installing Driving Shell Rear Thrust Plate

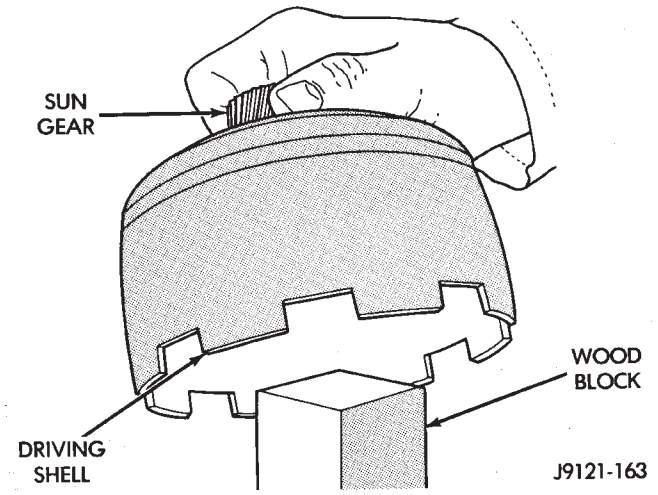

Fig. 86 Supporting Sun Gear On Wood Block

(11) Align rear thrust plate on driving shell and install sun gear lock ring. Be sure ring is fully seated in sun gear ring groove (Fig. 87).

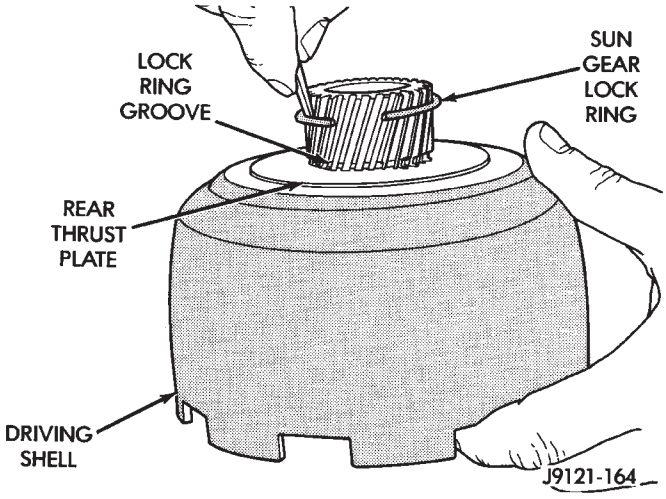

Fig. 87 Installing Sun Gear Lock Ring

(12) Install assembled driving shell and sun gear on output shaft (Fig. 88).

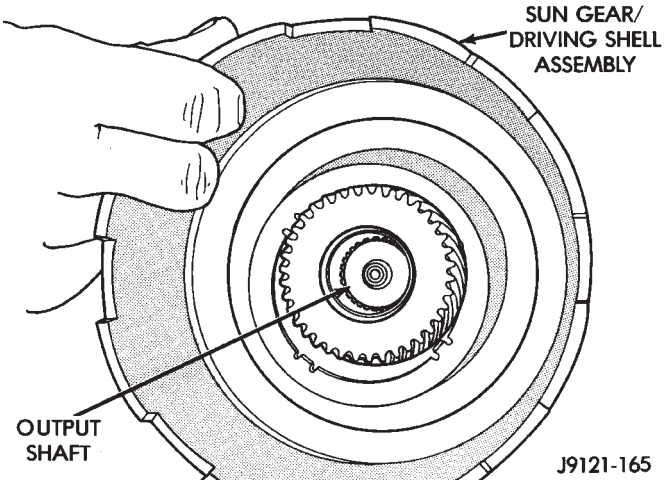

Fig. 88 Installing Assembled Sun Gear And Driving Shell On Output Shaft

(13) Install rear thrust washer on front planetary gear (Fig. 89). Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

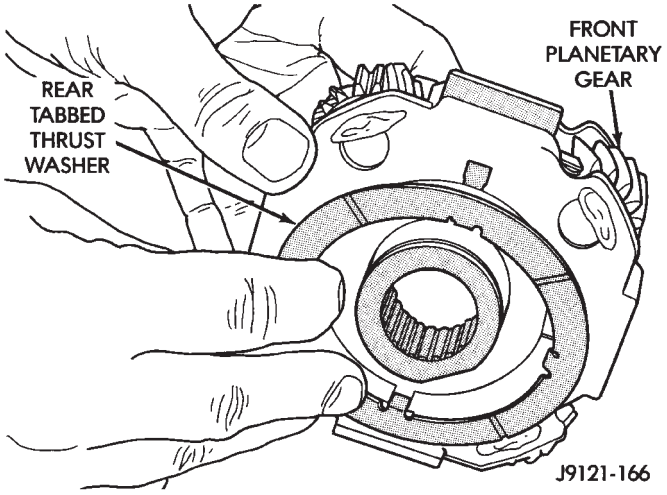

Fig. 89 Installing Rear Thrust Washer On Front Planetary Gear

(14) Install front planetary gear on output shaft and in driving shell (Fig. 90).

(15) Install front thrust washer on front planetary gear. Use enough petroleum jelly to hold washer in place and be sure all four washer tabs are seated.

(16) Assemble front annulus gear and support, if necessary. Be sure support snap ring is seated.

(17) Install front annulus on front planetary (Fig. 90).

(18) Position thrust plate on front annulus gear support (Fig. 91). **Note that plate has two tabs on it. These tabs fit in notches of annulus hub.**

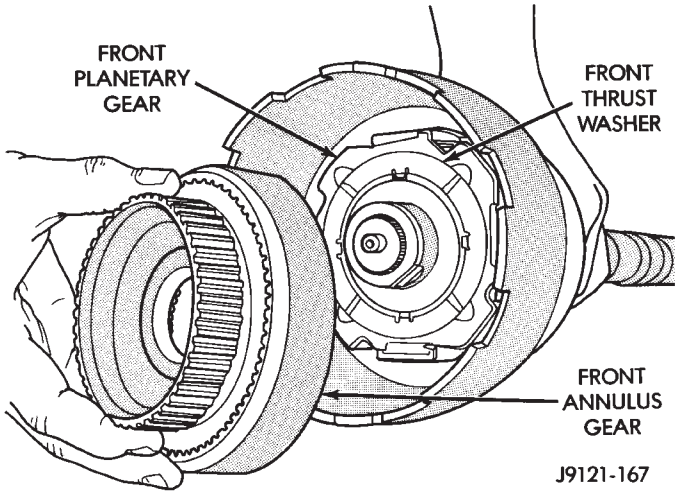

Fig. 90 Installing Front Planetary And Annulus Gears

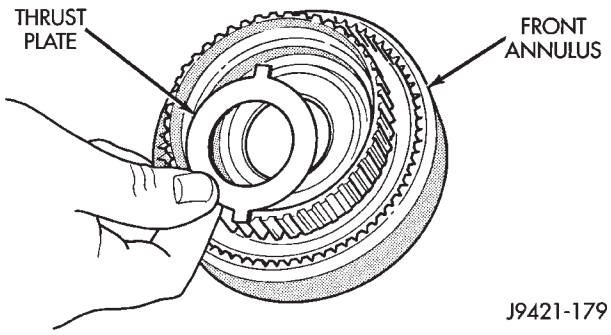

Fig. 91 Positioning Thrust Plate On Annulus Support

(19) Install thrust washer in front annulus (Fig. 92). **Align flat on washer with flat on planetary hub. Also be sure washer tab is facing up.**

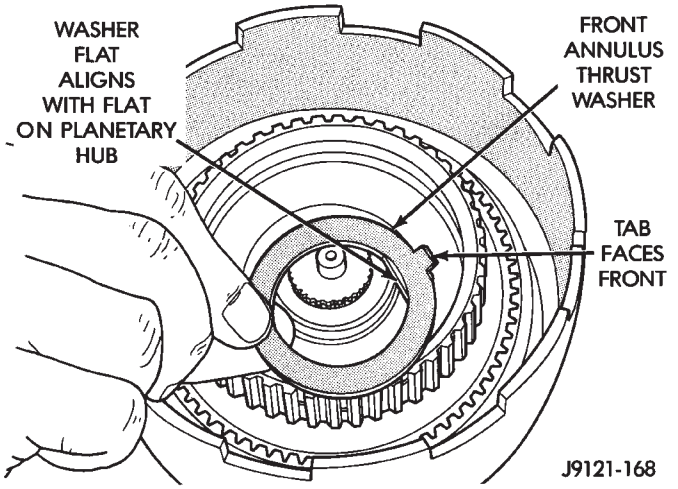

Fig. 92 Installing Front Annulus Thrust Washer

(20) Install front annulus snap ring (Fig. 93). Use snap ring pliers to avoid distorting ring during installation. Also be sure ring is fully seated.

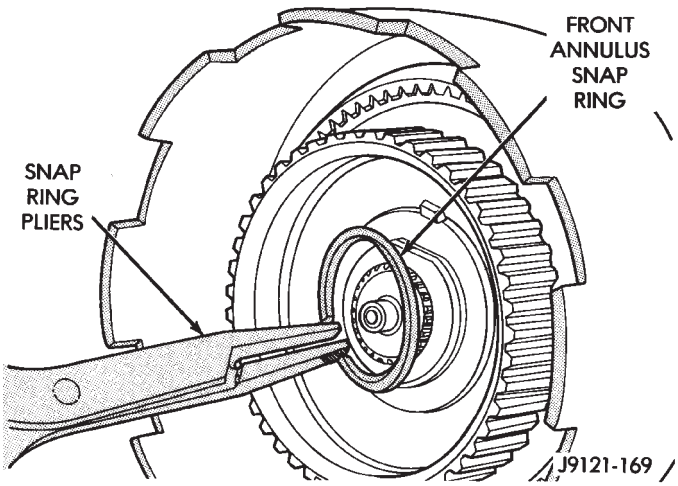

Fig. 93 Installing Front Annulus Snap Ring

(21) Install planetary selective snap ring with snap ring pliers (Fig. 94). Be sure ring is fully seated.

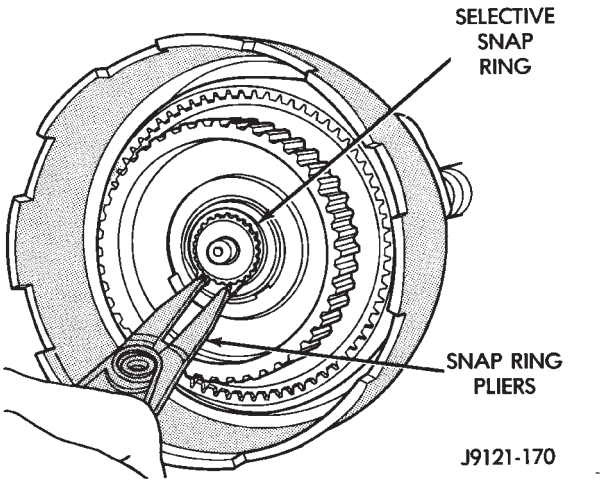

Fig. 94 Installing Planetary Selective Snap Ring

(22) Turn planetary geartrain assembly over so driving shell is facing workbench. Then support geartrain on wood block positioned under forward end of output shaft. This allow geartrain components to move forward for accurate end play check.

(23) Check planetary geartrain end play with feeler gauge (Fig. 95). Gauge goes between shoulder on output shaft and end of rear annulus support.

(24) Geartrain end play should be 0.12 to 1.22 mm (0.005 to 0.048 in.). If end play is incorrect, snap ring (or thrust washers) may have to be replaced. Snap ring is available in three different thicknesses for adjustment purposes.

FRONT SERVO AND BAND OVERHAUL

FRONT SERVO DISASSEMBLY (FIG. 96)

(1) Remove small snap ring from servo piston.

(2) Remove piston, rod, springs and guide.

(3) Remove and discard servo piston rings and O-ring.

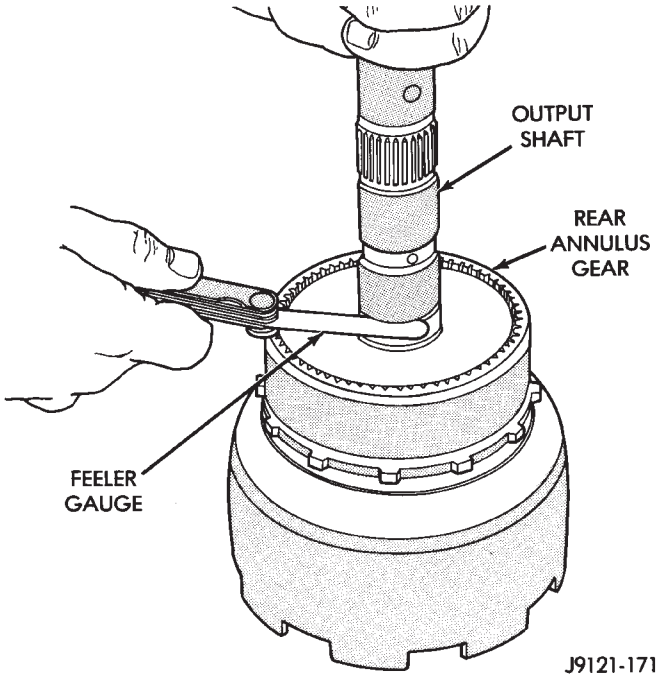

Fig. 95 Checking Planetary Geartrain End Play

FRONT SERVO AND BAND INSPECTION

Clean the servo components with solvent and dry them with compressed air.

Inspect the servo components. Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap ring if distorted or warped.

Replace the front band if distorted, the lining is burned or flaking off, or excessively worn.

Check the servo piston bore for wear. Replace the piston and rod as an assembly if either part is worn or damaged.

Replace any servo component if doubt exists about its condition. Do not reuse suspect parts.

ASSEMBLING FRONT SERVO PISTON

(1) Lubricate servo parts with transmission fluid.

(2) Install new O-ring on servo piston rod.

(3) Install new seal on piston rod guide and install new seal rings on piston.

(4) Assemble rod, piston, servo springs and snap ring (Fig. 96).

REAR SERVO AND BAND OVERHAUL

REAR SERVO PISTON DISASSEMBLY

(1) Remove seal from servo piston. Note which way seal lip faces for assembly reference.

(2) Compress cushion spring in vise only enough to allow piston plug snap ring removal (Fig. 97). Use wood block between vise jaws and end of piston plug to keep plug aligned and in position.

(3) Remove snap ring from end of piston plug (Fig. 97).

(4) Open vise and remove wood block, piston plug, cushion spring and servo piston.

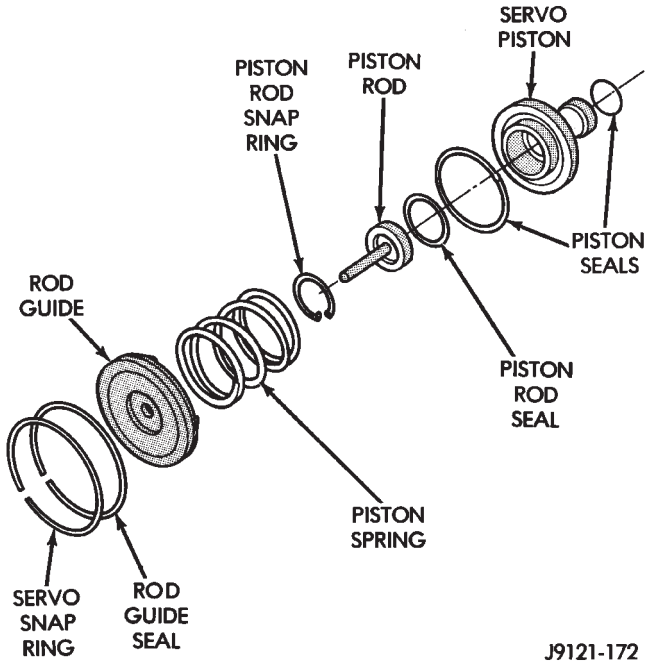

Fig. 96 Front Servo Components

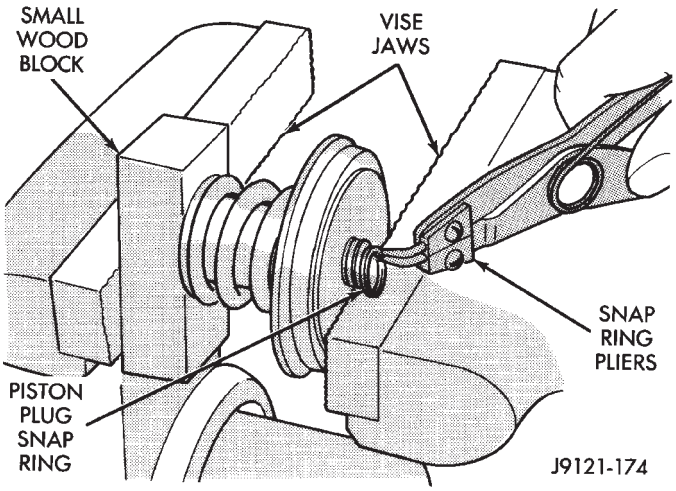

Fig. 97 Removing/Installing Servo Piston Plug Snap Ring

REAR SERVO INSPECTION

Clean the servo components with solvent and dry them with compressed air.

Check rear band condition. Replace the band if distorted, the lining is burned or flaking off, or the lining is excessively worn.

On 30RH models, inspect the rear band link (Fig. 98). Replace the link if bent, or damaged. Check the band reaction pin. Replace the O-rings if they are cut, or torn. Minor pin scoring can be cleaned up with crocus cloth. However, replace the pin if worn, severely scored, or cracked.

Inspect the servo components (Fig. 99). Replace the servo and cushion springs if collapsed, distorted or broken. Replace the plug or piston if cracked, bent, or worn. Discard the servo snap ring and spring retainer if distorted or warped.

If doubt exists about the condition of any servo component, replace it. Do not reuse suspect parts.

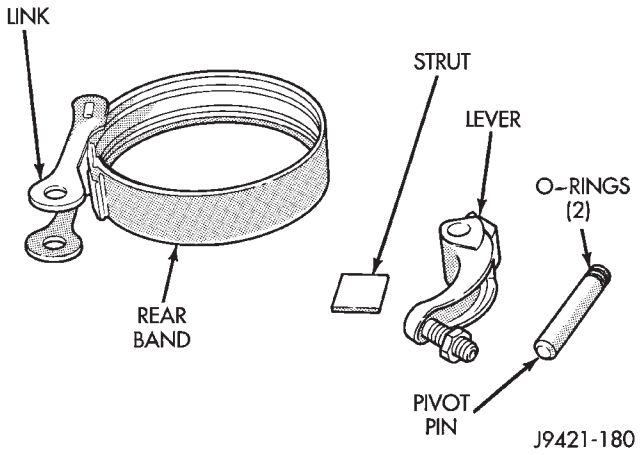

Fig. 98 Rear Band Components (30RH Shown)

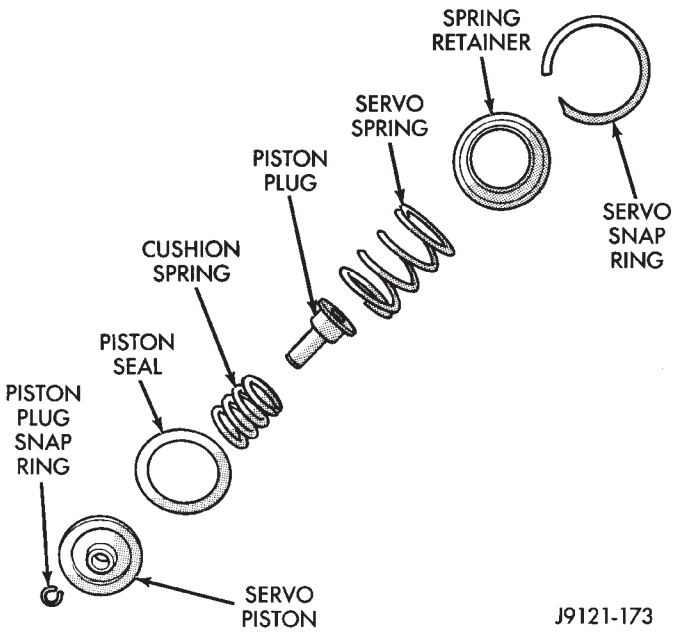

Fig. 99 Rear Servo Components

ASSEMBLING REAR SERVO PISTON

(1) Assemble piston plug, cushion spring and piston (Fig. 99).

(2) Compress cushion spring in vise and install piston plug snap ring.

(3) Install new seal on piston. Be sure seal lip is toward servo bore (Fig. 100).

(4) Lubricate piston seal with petroleum jelly. Lubricate other servo parts with transmission fluid.

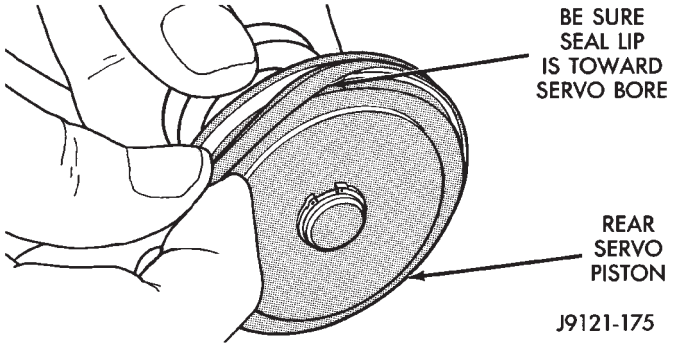

Fig. 100 Installing Rear Servo Piston Seal

VALVE BODY DISASSEMBLY AND INSPECTION

CAUTION: Do not clamp any part of the valve body assembly (Fig. 101) in a vise. This practice will distort the valve body and transfer plate resulting in valve bind. Slide valves and plugs out carefully. Do not use force at any time. The valves and valve body will be damaged if force is used. Also tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

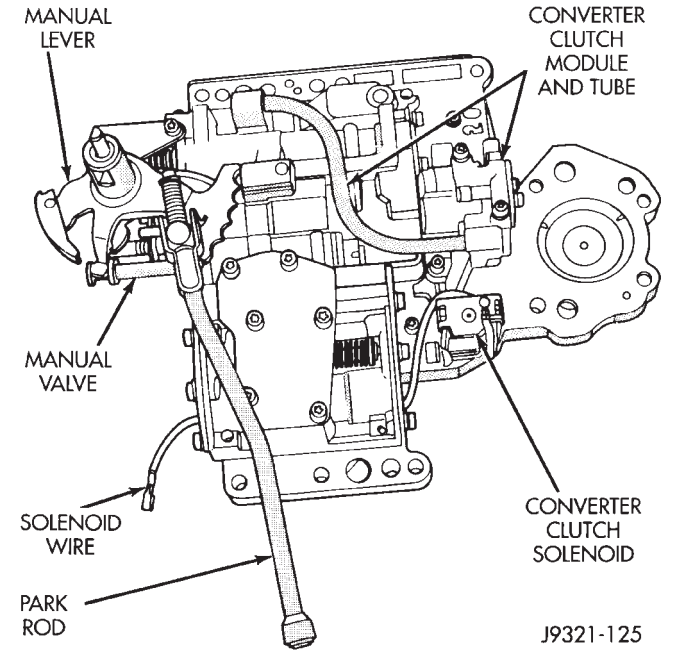

Fig. 101 Valve Body Assembly

(1) Remove screws attaching adjusting screw bracket to valve body and transfer plate. Hold bracket firmly against spring force while removing last screw.

(2) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator spring and switch valve spring (Fig. 102). **Do not remove throttle pressure adjusting screw from bracket and do not disturb adjusting screw settings during removal.**

(3) Secure detent ball and spring in housing with retainer tool 6583 (Fig. 103).

(4) Remove manual shaft E-clip and washer (Fig. 104).

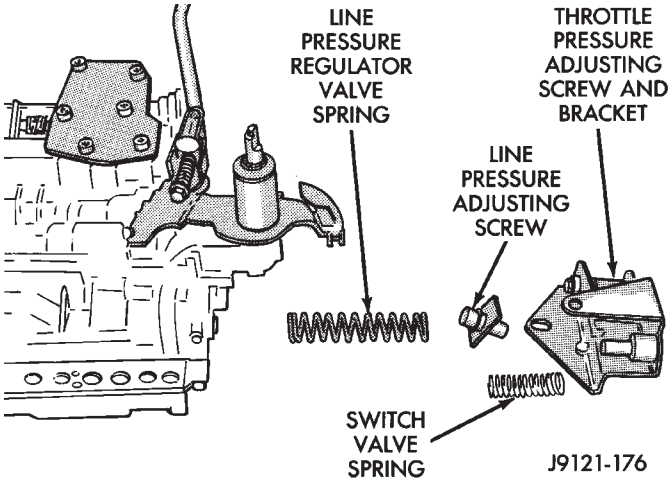

Fig. 102 Adjusting Screw Bracket And Spring Removal

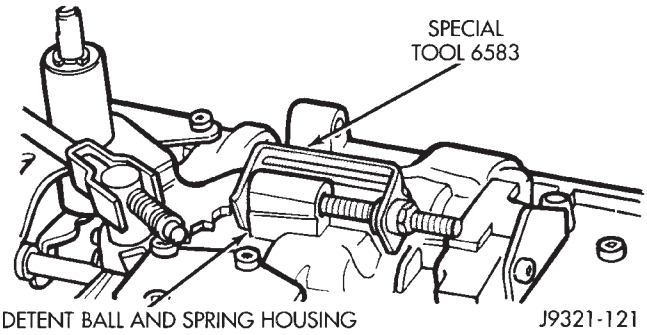

Fig. 103 Securing Detent Ball And Spring With Retainer Tool

(5) Pull manual shaft and park rod assembly upward out of valve body and off throttle lever (Fig. 104).

(6) Remove Retainer Tool 6583. Then remove and retain detent ball and spring.

(7) Remove throttle lever (Fig. 104).

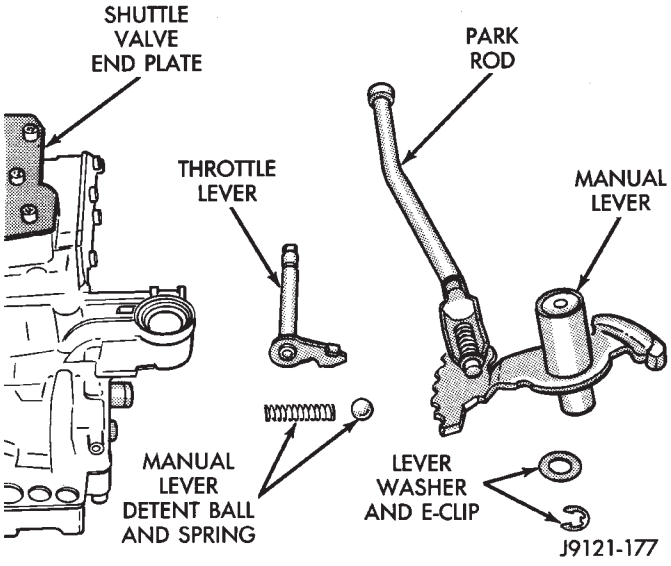

Fig. 104 Removing Manual And Throttle Levers

(8) Remove park rod E-clip and separate rod from manual lever (Fig. 105).

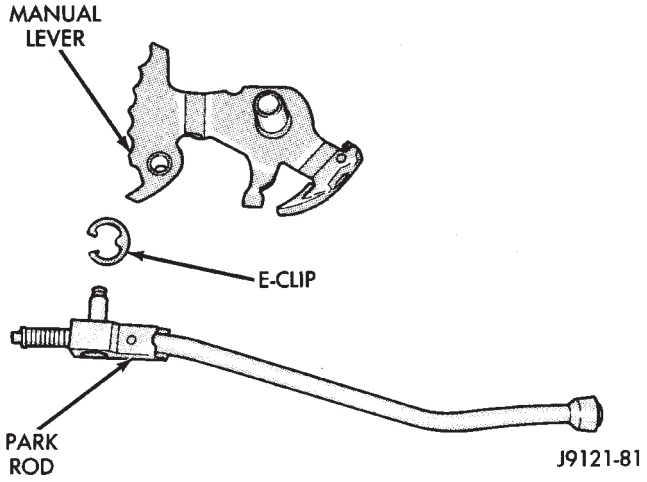

Fig. 105 Park Rod Removal

(9) Remove screws attaching converter clutch module to valve body and remove module and connecting tube (Fig. 106).

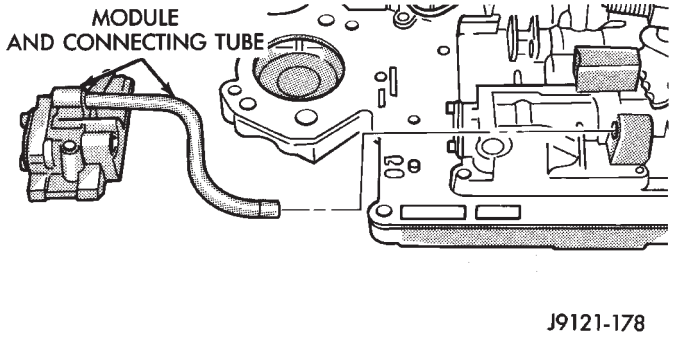

Fig. 106 Clutch Module And Connecting Tube Removal/Installation

(10) Turn valve body over so transfer plate is facing upward (Fig. 107). With valve body in this position, valve body check balls will remain in place and not fall out when transfer plate is removed.

(11) Remove screws attaching transfer plate to valve body (Fig. 107).

(12) Remove transfer plate and separator plate from valve body. Note position of filter and clutch solenoid for reference (Fig. 108).

(13) Position transfer plate on bench so separator plate, filter and lockup solenoid are facing up. This will avoid having rear clutch and rear servo check balls fall out when plates are separated.

(14) Remove screws attaching separator plate to transfer plate.

(15) Remove converter clutch solenoid from separator plate (Fig. 109). A T25 torx bit is required to remove solenoid attaching screw.

(16) Note position of filter, solenoid and rear clutch/rear servo check balls for assembly reference (Fig. 110).

(17) Remove shuttle valve end plate (Fig. 111).

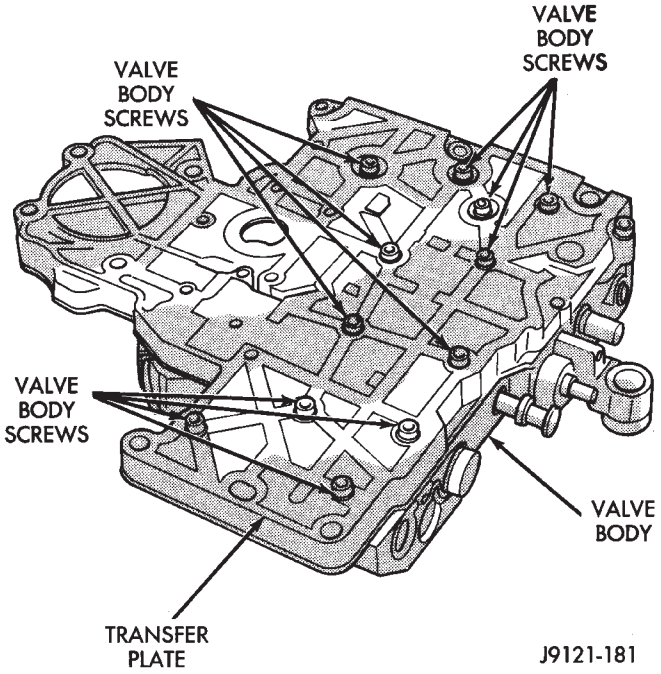

Fig. 107 Valve Body-To-Transfer Plate Screw Locations

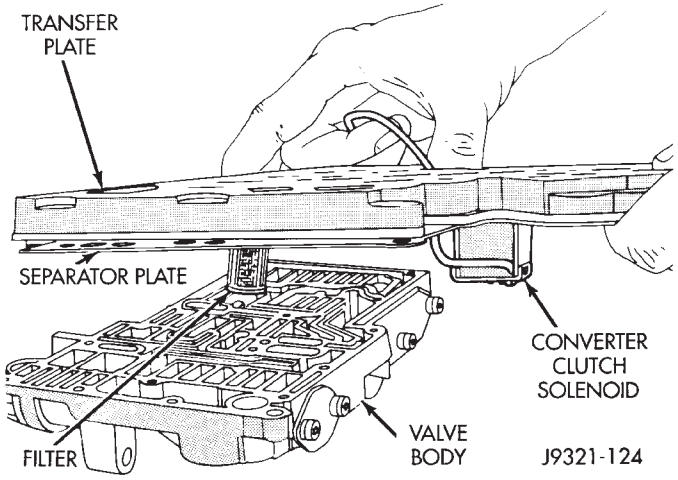

Fig. 108 Transfer Plate Removal/Installation

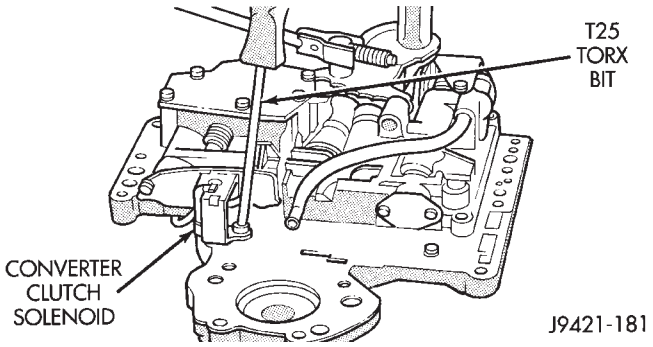

Fig. 109 Converter Clutch Solenoid Removal

(18) Remove shuttle valve E-clip and remove secondary spring and spring guides from end of valve (Fig. 111).

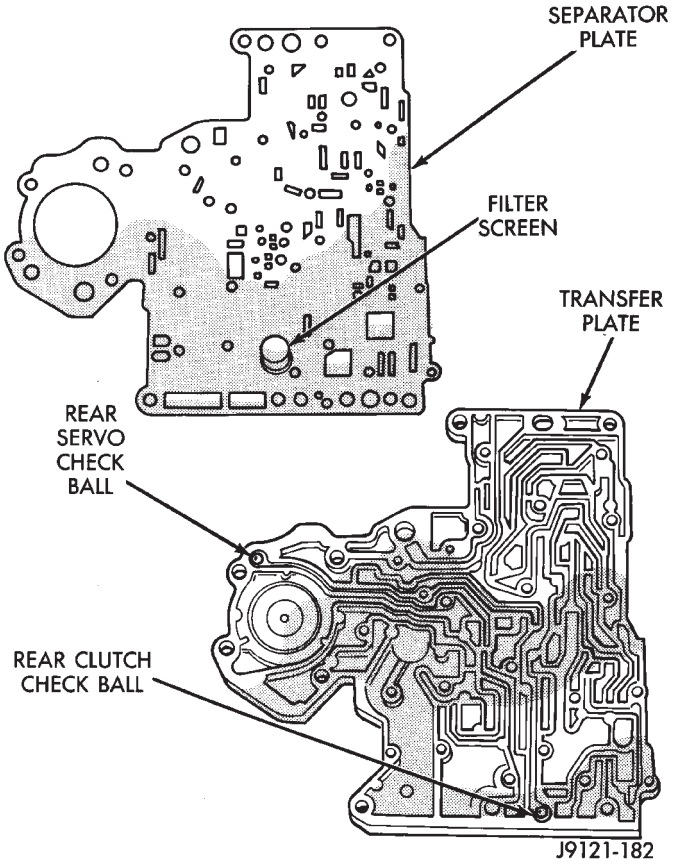

Fig. 110 Transfer And Separator Plates

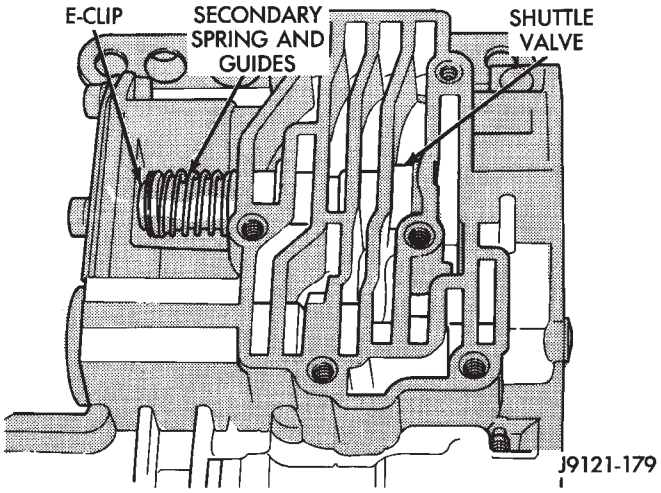

Fig. 111 Shuttle Valve E-Clip And Secondary Spring Location

(19) Remove governor valve end plate (Fig. 112).

(20) Remove switch valve and pressure regulator valve from valve body (Fig. 112).

(21) Remove throttle valve and spring, kickdown valve and detent and manual valve from valve body (Fig. 112).

(22) Remove 1-2 and 2-3 shift valve governor plugs from valve body (Fig. 112).

(23) Remove shuttle valve throttle plug, primary spring and shuttle valve from valve body (Fig. 112).

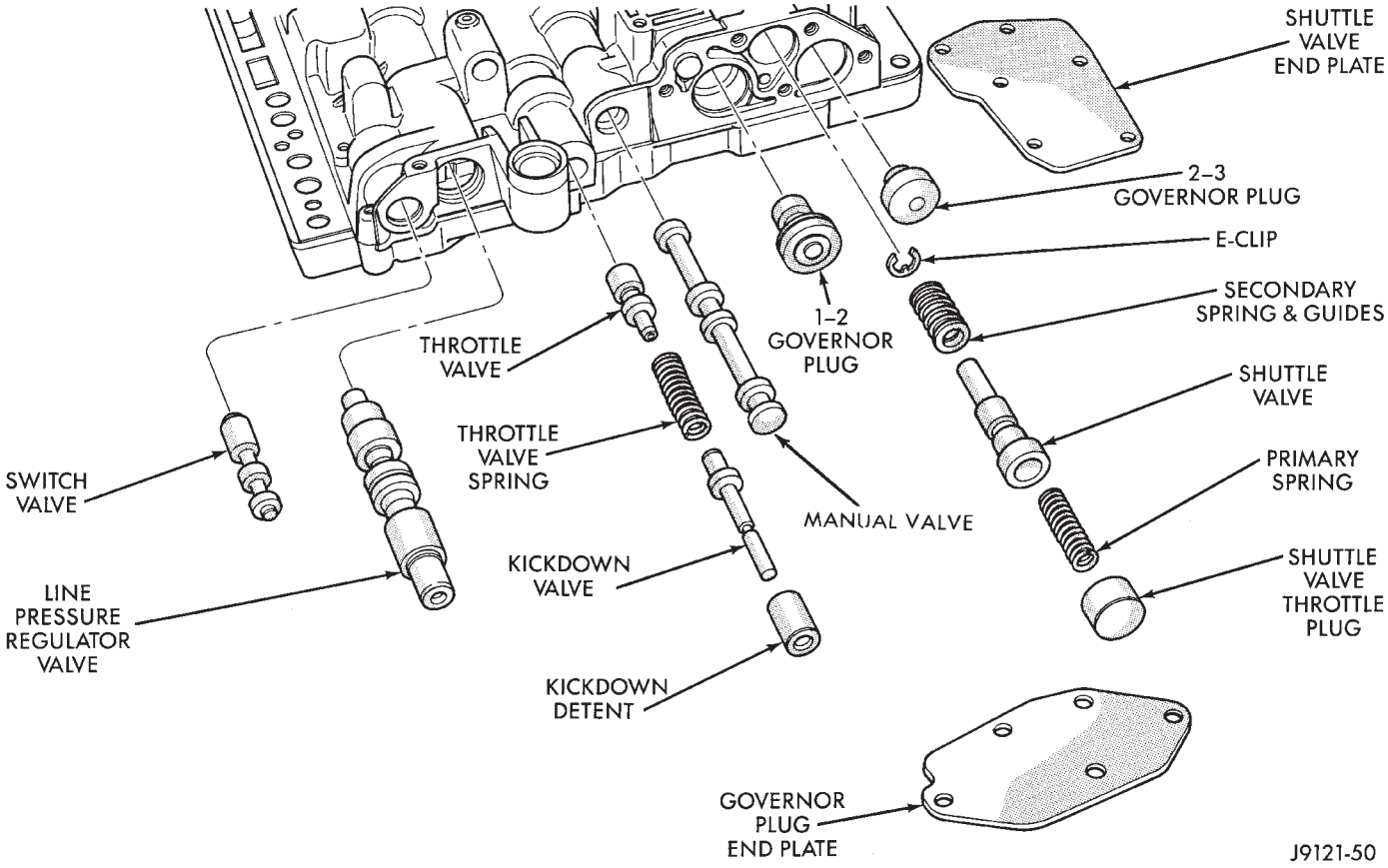

Fig. 112 Control Valves And Governor Plugs

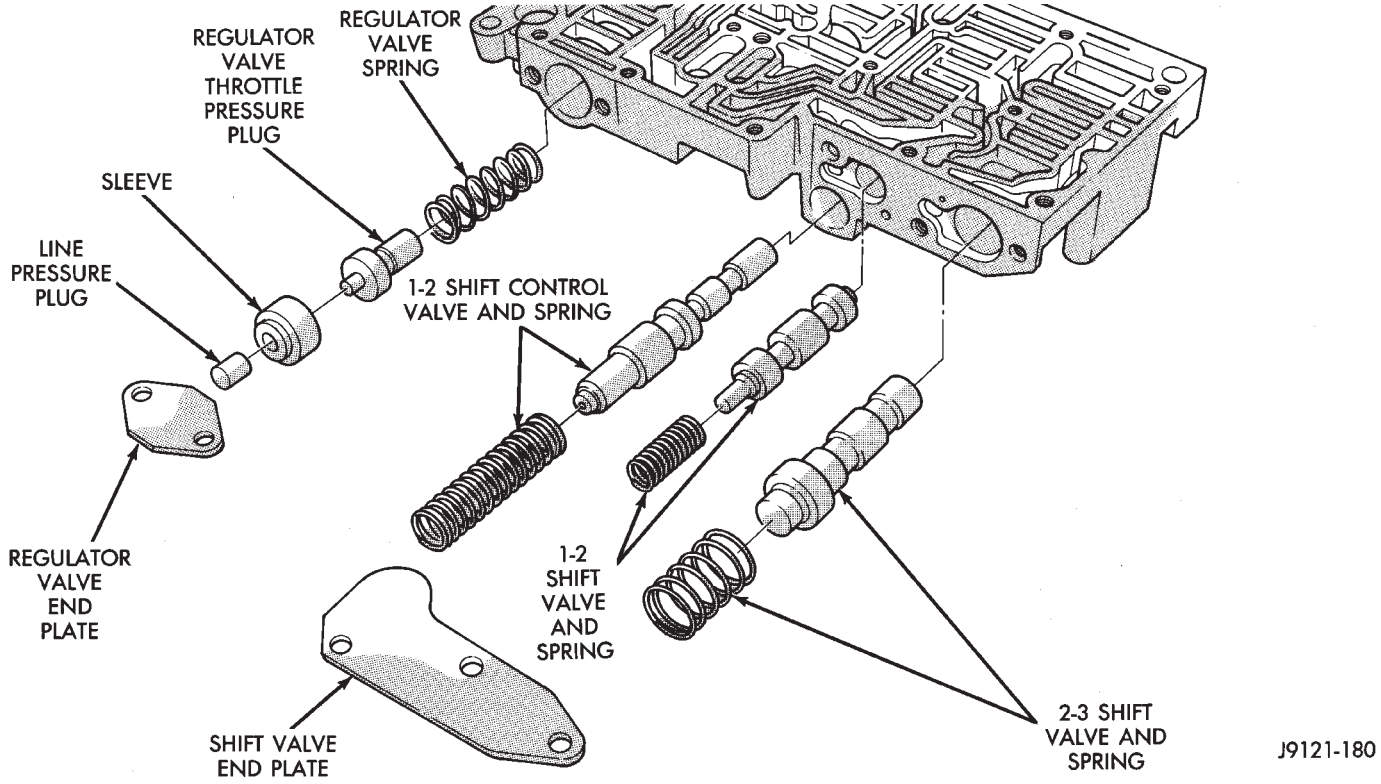

Fig. 113 Shift Valves And Pressure Regulator Plugs

(24) Remove 1-2 shift control valve and spring from valve body (Fig. 113).

(25) Remove 2-3 shift valve and spring from valve body (Fig. 113).

(26) Remove 1-2 shift valve and spring from valve body (Fig. 113).

(27) Remove regulator valve end plate (Fig. 113).

(28) Remove regulator valve line pressure plug, pressure plug sleeve, throttle pressure plug and spring (Fig. 113).

VALVE BODY CLEANING AND INSPECTION

The only serviceable valve body components are:

- park lock rod and E-clip
- switch valve and spring
- pressure adjusting screw bracket
- throttle valve lever
- manual lever
- manual lever shaft seal, washer, E-clip and detent ball
- fluid filter
- converter clutch solenoid

The remaining valve body components are serviced only as part of a complete valve body assembly.

Clean the valve body components in a parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution. Dry the parts with compressed air. Make sure all passages are clean and free from obstructions.

Do not use rags or shop towels to wipe off valve body components. Lint from these materials will adhere to the valve body components. Lint will interfere with valve operation and may clog filters and fluid passages.

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with crocus cloth. The cloth should be in sheet form and be positioned on a surface plate, sheet of plate glass, or equally flat surface. However, if distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: The throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug are made of coated aluminum. These components are identified in Figure 114 with the abbreviation (Alum.). Aluminum components can be identified by the dark color of the special coating applied to the surface (or by testing with a magnet). DO NOT polish or sand aluminum valves or plugs with any type of material, or under any circumstances. This practice might damage the special coating and cause the valves and plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Also inspect the coating on the aluminum valves and plugs (Fig. 114). If the coating is damaged or worn through, the valve (or valve body) should be replaced.

Aluminum valves and plugs should not be sanded or polished under any circumstances. However, minor burrs or scratches on steel valves and plugs can be removed with crocus cloth but do not round off the valve or plug edges. Squareness of these edges is vitally important. These edges prevent foreign matter from lodging between the valves, plugs and bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

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.

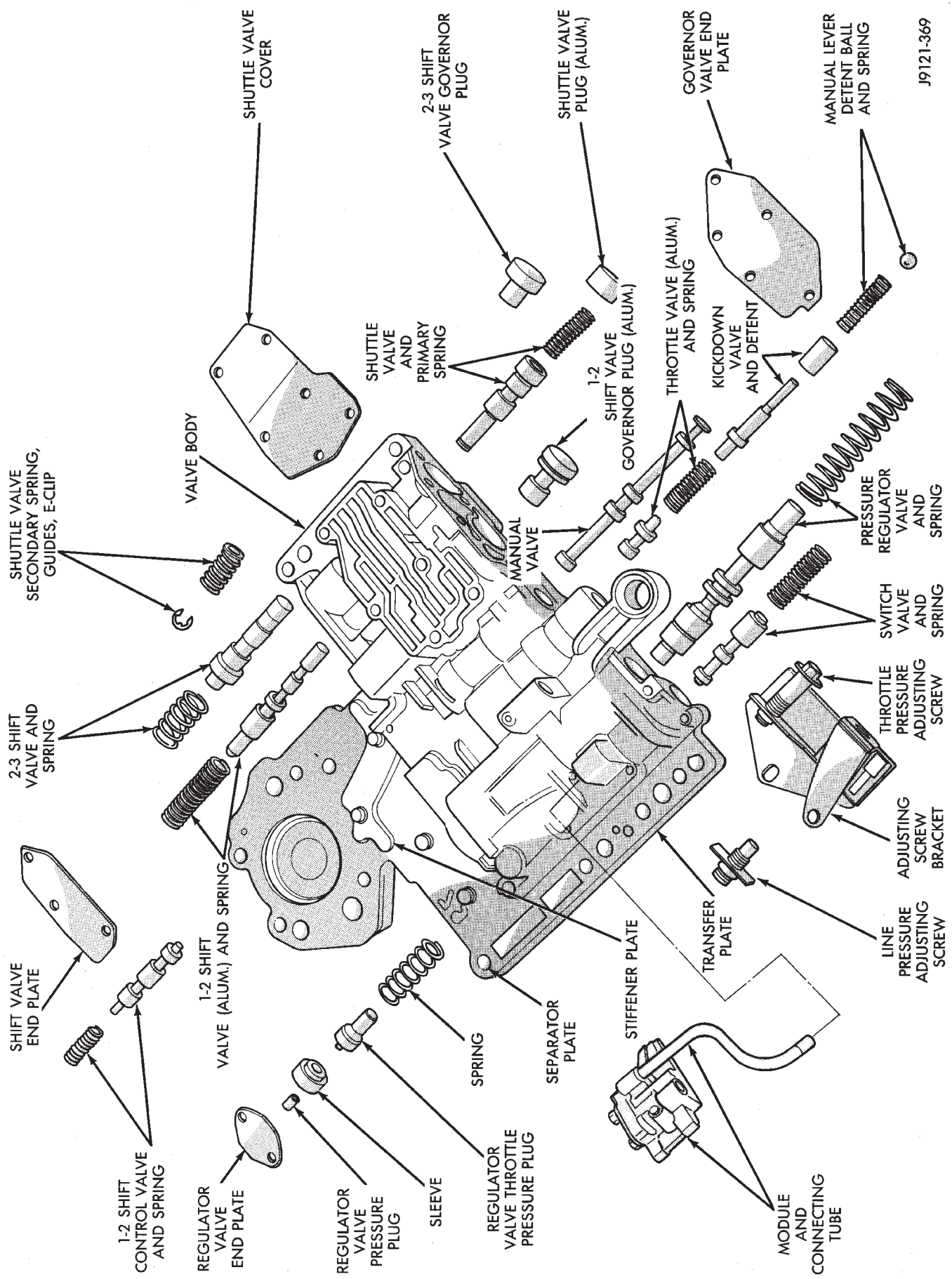

Fig. 114 Valve Body Components (Alum. Indicates Aluminum Part)

VALVE BODY ASSEMBLY AND ADJUSTMENT

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the valve body resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

(1) Lubricate valve body bores, valves and plugs with ATF Plus, or Dexron II™ transmission fluid.

(2) Insert rear clutch and rear servo check balls in transfer plate (Fig. 110).

(3) Install filter screen in separator plate (Fig. 110).

(4) Align and install separator plate on transfer plate. Verify check ball position before installing separator plate on transfer plate.

(5) Install new O-ring on converter clutch solenoid and insert solenoid in separator plate (Fig. 115). Then secure solenoid in position with attaching screw. Tighten screw to 4 N·m 35 in. lbs.) torque.

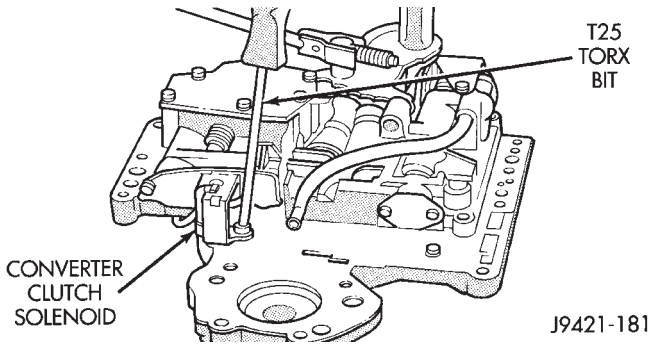

Fig. 115 Installing Converter Clutch Solenoid

(6) Position valve body so internal passages and check ball seats are facing upward. Then install steel/plastic check balls in valve body (Fig. 116). The one large check ball is approximately 11/32 inch in diameter. The remaining check balls are approximately 1/4 inch in diameter.

(7) Align and install assembled transfer and separator plates on valve body. Install and tighten valve body screws alternately in a diagonal pattern to 4 N·m (35 in. lbs.) torque.

(8) Assemble and install clutch module and components on valve body (Fig. 117).

(9) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring (Fig. 108). Insert assembly in valve body and install end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

(10) Install 1-2 and 2-3 shift valves and springs (Fig. 113).

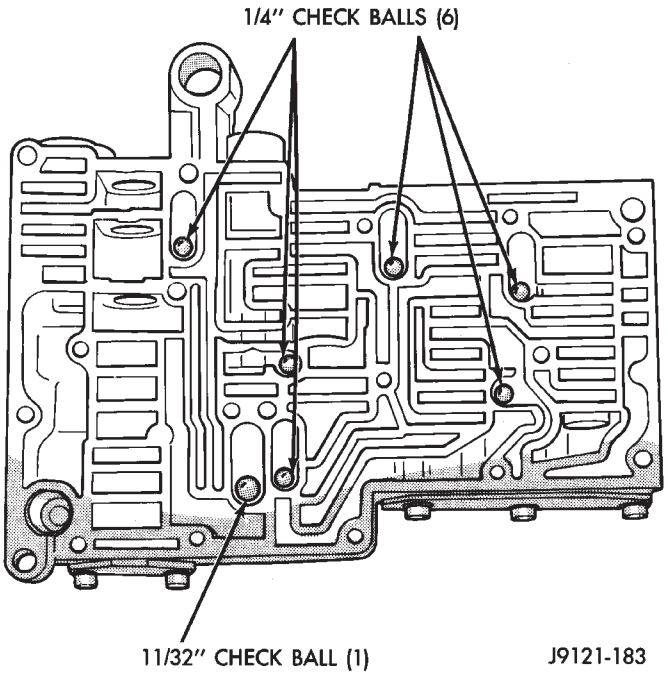

Fig. 116 Correct Position Of Valve Body Check Balls

(11) Install 1-2 shift control valve and spring (Fig. 113)

(12) Install shuttle valve as follows:

(a) Insert shuttle valve in bore.

(b) Insert plastic guides in shuttle valve secondary spring.

(c) Install spring on end of valve.

(d) Hold shuttle valve in place. Then compress secondary spring and install E-clip in groove at end of valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(13) Install shuttle valve cover plate (Fig. 113). Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

(14) Install 1-2 and 2-3 valve governor plugs in valve body (Fig. 113). Then install shuttle valve primary spring and throttle plug.

(15) Align and install governor plug end plate on valve body and install end plate screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

(16) Install manual valve (Fig. 112).

(17) Install throttle valve and spring. Then install kickdown valve and detent (Fig. 112).

(18) Install pressure regulator valve and switch valve in valve body.

(19) Install manual lever detent spring in housing. Place detent ball on end of spring and push ball and spring into housing. Secure ball and spring with Detent Retainer 6583 (Fig. 103).

(20) Insert line pressure adjusting screw in adjusting screw bracket (Fig. 102).

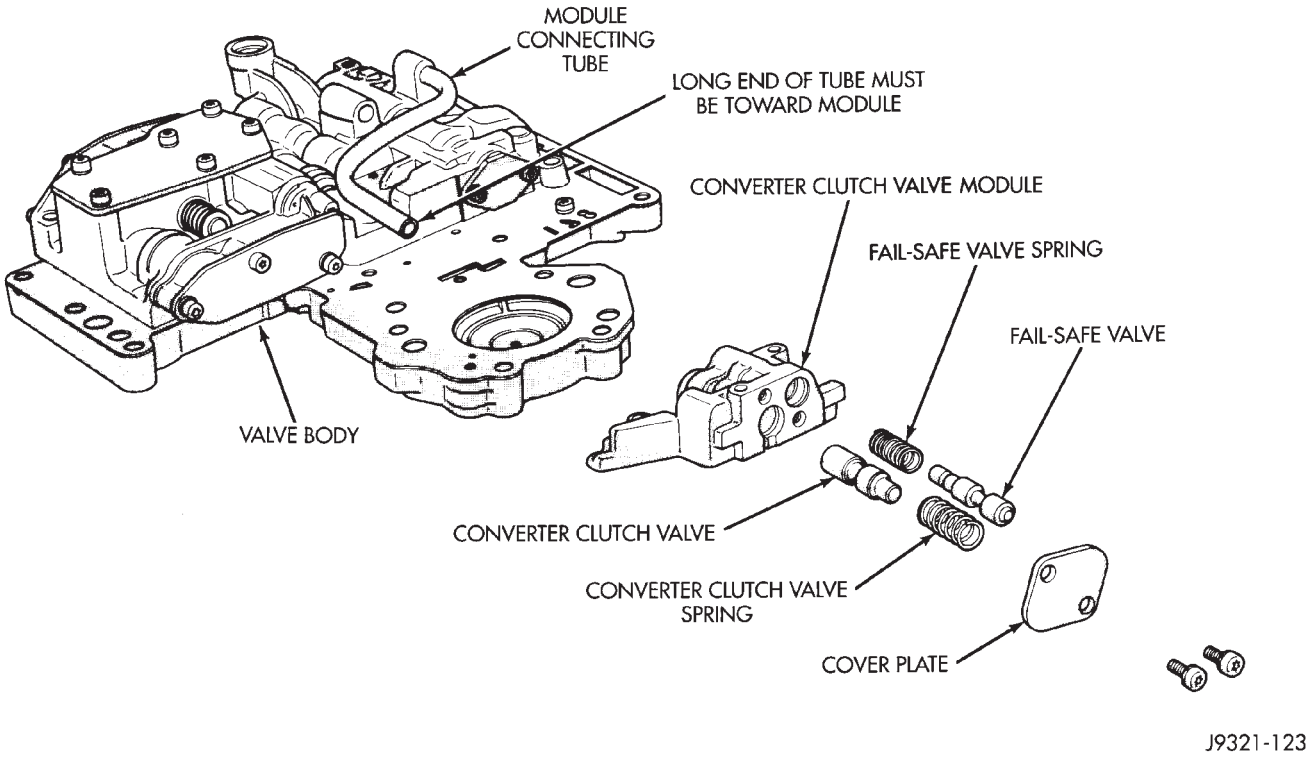

Fig. 117 Converter Clutch Module Components

(21) Install spring on end of line pressure regulator valve.

(22) Install switch valve spring on tang at end of adjusting screw bracket (Fig. 102).

(23) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

(24) Install module and connecting tube. Be sure long end of tube goes to module (Fig. 106). Tighten module screws to 4 N·m (35 in. lbs.) torque.

(25) Install throttle lever in valve body. Then install manual lever over throttle lever and start manual lever into valve body.

(26) Align manual lever detent with detent ball and align lever arm with manual valve. Hold throttle lever upward. Then press down on manual lever until lever is fully seated.

(27) Install manual lever seal, washer and retaining E-clip.

(28) Lubricate shaft of manual lever with light coat of petroleum jelly. This will help protect seal lip when manual shaft seal is installed.

(29) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 118).

(30) If line pressure and/or throttle pressure adjustment screw settings were not disturbed, continue with overhaul or reassembly. However, if adjustment

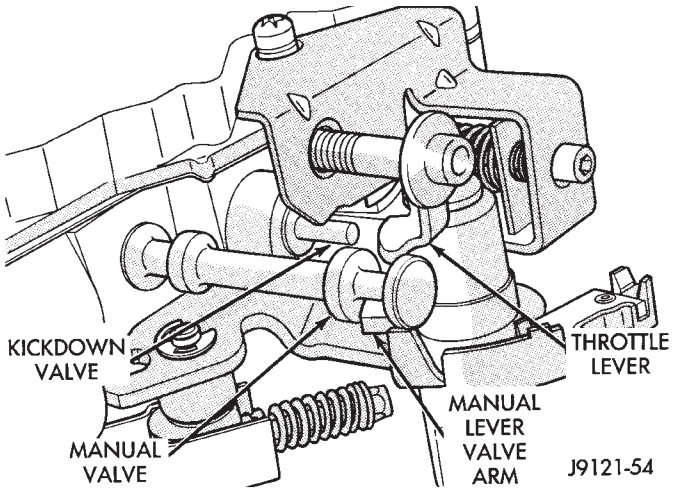

Fig. 118 Manual And Throttle Lever Alignment

screw settings **were** moved or changed, readjust as described in Valve Body Control Pressure Adjustment procedure.

VALVE BODY CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body which are, line pressure and throttle pressure.

The two pressures are interdependent because each affects shift quality and timing. Each pressure adjustment must be performed properly and in the cor-

rect sequence. The correct sequence is line pressure adjustment first and throttle pressure adjustment last.

Line Pressure Adjustment

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 119).

Distance should be 33.4 mm (1-5/16 in.).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

The 33.4 mm (1-5/16 in.) setting is an approximate setting. Because of manufacturing tolerances, it may be necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa). Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

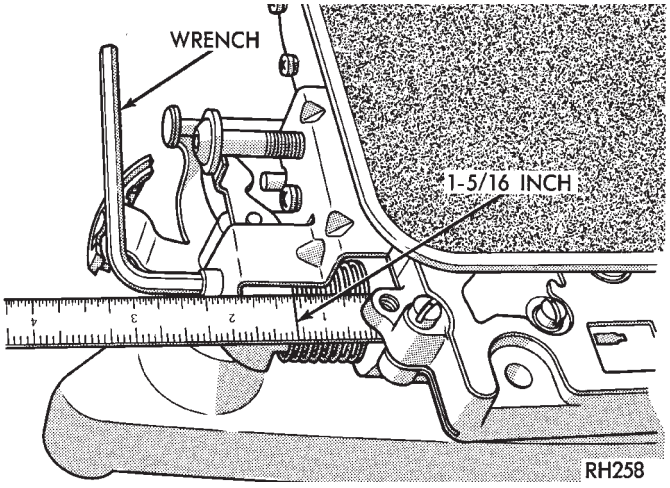

Fig. 119 Line Pressure Adjustment

Throttle Pressure Adjustment

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 120).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

TRANSMISSION ASSEMBLY TIPS

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for assembly are equally clean.

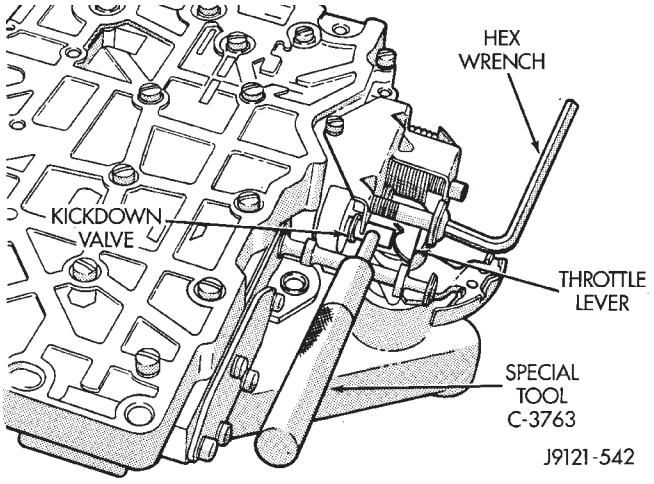

Fig. 120 Throttle Pressure Adjustment

Shop towels used for wiping off your hands and service tools must be made of **lint free** materials. Lint will adhere to transmission parts and could interfere with valve operation, or even restrict fluid passages.

Lubricate the transmission components with ATF Plus, or Dexron II™ during reassembly. Use petroleum jelly, Door Eze, or Ru-Glyde on seals and O-rings to ease installation.

Petroleum jelly can also be used to hold thrust washers and plates in position during assembly operations. However, **do not** use chassis grease, bearing grease, white grease, or similar lubricants on any transmission part. These types of lubricants can eventually block or restrict fluid passages and valve operation. Use petroleum jelly only.

Do not force parts into place. Most of the transmission components are easily installed by hand when properly aligned. If a part seems extremely difficult to install, it is either misaligned or incorrectly assembled. Also verify that thrust washers, thrust plates and seal rings are correctly positioned before assembly. These parts can interfere with proper assembly if mispositioned or "left out" by accident.

TRANSMISSION ASSEMBLY AND ADJUSTMENT PROCEDURES

SERVO INSTALLATION

(1) Install rear servo piston, spring and spring retainer. Compress rear servo spring and retainer with Compressor Tool C-3422-B or a large C-clamp.

(2) Install front servo piston, spring and rod guide. Compress front servo rod guide with Valve Spring Compressor C-3422-B and install servo snap ring.

OVERRUNNING CLUTCH INSTALLATION

(1) Examine bolt holes in overrunning clutch cam. Note that one hole is **not threaded** (Fig. 121). This hole must align with blank area in clutch cam bolt circle (Fig. 122).

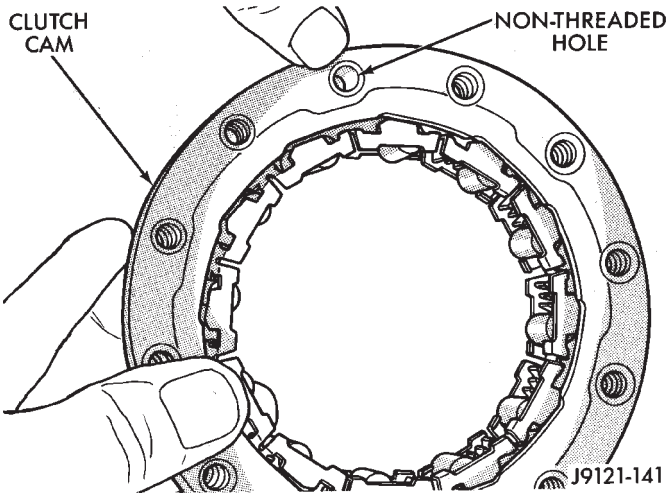

Fig. 121 Location Of Non-Threaded Hole In Clutch Cam

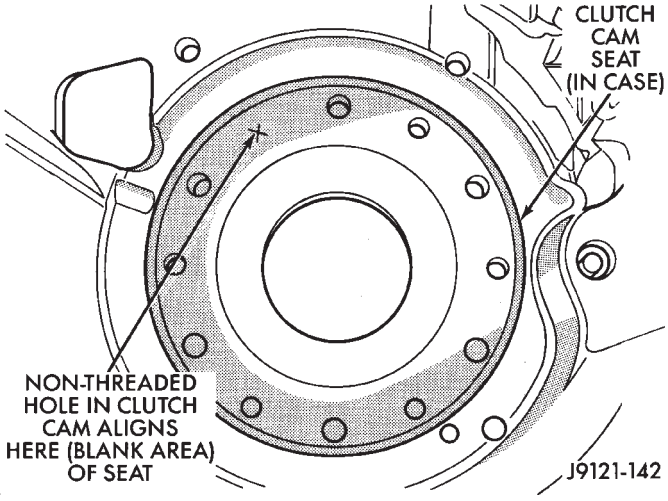

Fig. 122 Location Of Blank Area In Clutch Cam Seat Of Case

(2) Mark location of non threaded hole in clutch cam and blank area of case with paint stripe (Fig. 123).

(3) Align and install overrunning clutch cam in case (Fig. 123). **Be sure cam is correctly installed. Bolt holes in cam are slightly countersunk on one side. This side of cam faces rearward (toward rear support).**

(4) Partially install overrunning clutch in cam (Fig. 123).

(5) Verify that non threaded hole in clutch cam is properly aligned (Fig. 123). Check alignment by threading a clutch cam bolt into each hole. Adjust cam position if necessary before proceeding.

(6) Seat overrunning clutch in clutch cam after verifying correct cam alignment.

(7) Install overrunning clutch cam bolts. **Clutch cam bolts are shorter than rear support bolts.** Tighten cam bolts to 17 N·m (150 in. lbs. or 13 ft. lbs.) torque.

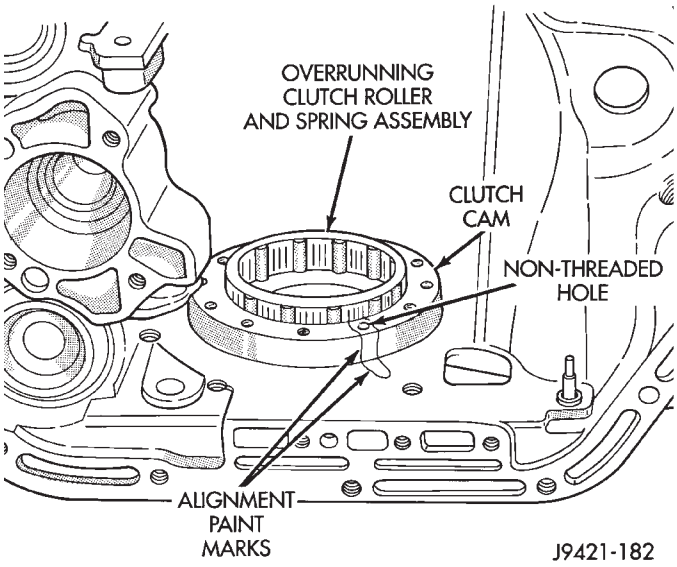

Fig. 123 Overrunning Clutch Cam Alignment

(8) Lubricate overrunning clutch rollers, springs and cam with ATF Plus transmission fluid.

REAR BAND, LOW-REVERSE DRUM AND REAR SUPPORT INSTALLATION

A different rear band and linkage is used in 30RH and 32RH transmissions.

The 30RH transmission has a single wrap band, one pivot pin and a band link to connect the lever (Fig. 124). The lever adjusting screw is in direct contact with the servo piston. A strut is used to connect the lever to the band lug.

The 32RH transmission has a double wrap band, a pivot pin, and a reaction pin (Fig. 125). The band lever pivots against a lug on the band. A strut is not used. The reaction pin functions as the stop, or locating mechanism for the band lower lug.

Rear Band Installation Procedure

(1) On 32RH transmission, install band components and low-reverse drum as follows:

(a) Install reaction pin in case (Fig. 126).

(b) Position band in case and seat band lug against reaction pin.

(c) Slide low-reverse drum through band (Fig. 127). Then tilt drum slightly and start clutch race into overrunning clutch rollers.

(d) Rotate drum in clockwise direction and push drum inward until race is seated in overrunning clutch.

(e) Install rear band lever (Fig. 128). Be sure lever pivot pin is fully seated in case afterward.

(2) On 30RH transmission, install band components and low-reverse drum as follows:

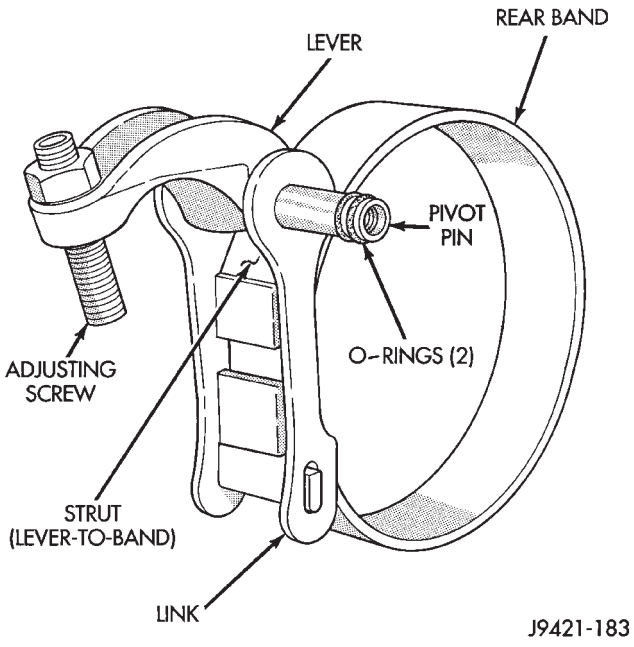

Fig. 124 Rear Band Components (30RH)

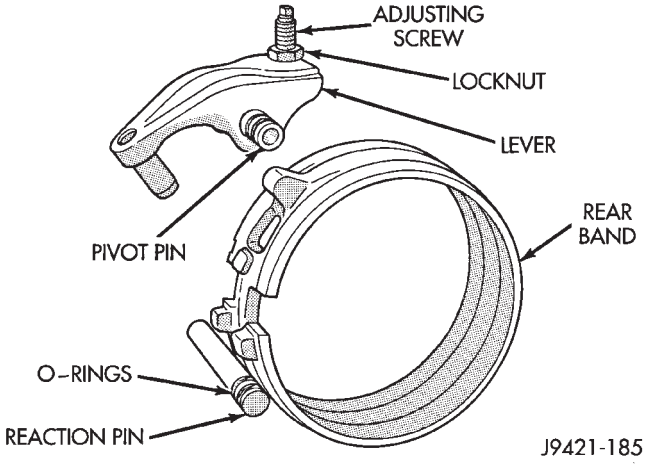

Fig. 125 Rear Band Components (32RH)

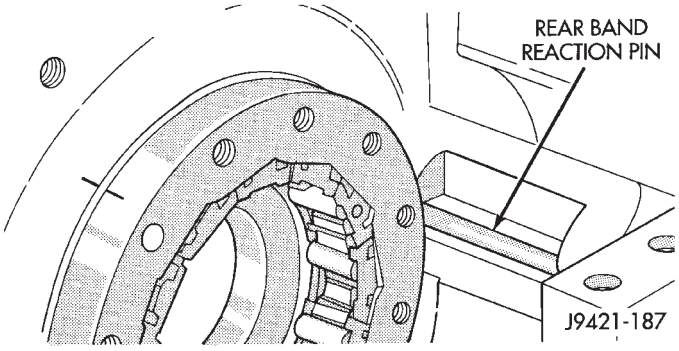

Fig. 126 Rear Band Reaction Pin Installation (32RH)

(a) Assemble band and link. Be sure that notch in one side of link is facing band (Fig. 129).

(b) Position band and link in case (Fig. 130).

(c) Slide low-reverse drum through band (Fig. 131). Then tilt drum slightly and start clutch race into overrunning clutch rollers.

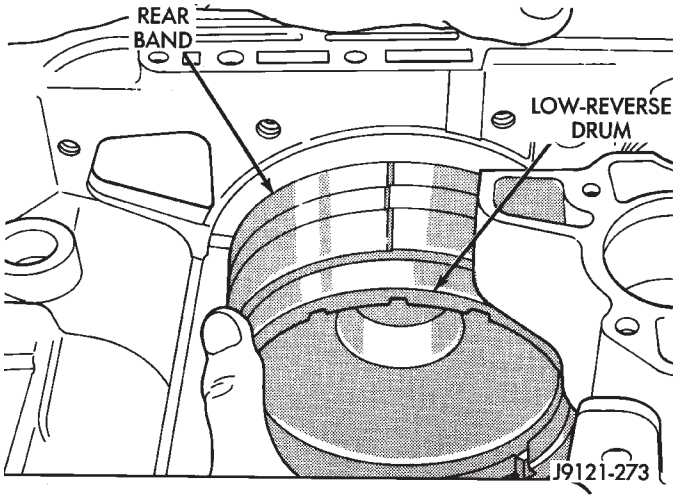

Fig. 127 Rear Band And Low-Reverse Drum Installation (32RH)

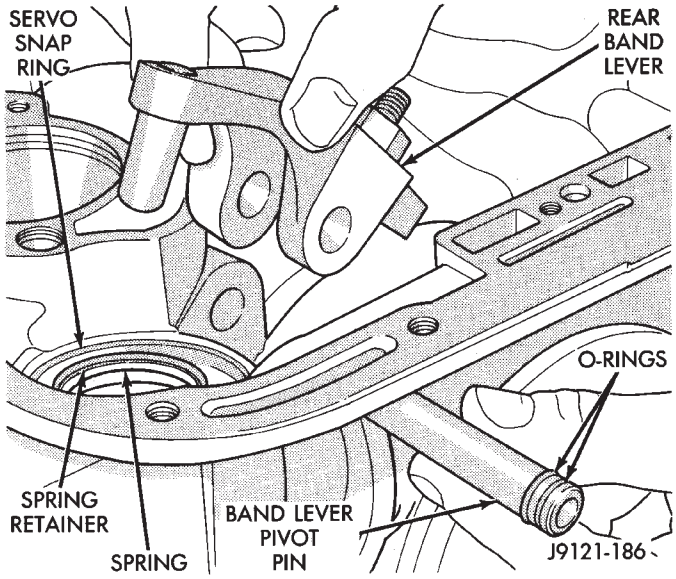

Fig. 128 Rear Band Lever And Pivot Pin Installation (32RH)

(d) Rotate drum in clockwise direction and push drum inward until race is seated in overrunning clutch.

(e) Install rear band lever and pivot pin. Be sure lever pivot pin is fully seated in case afterward.

(3) Hold low-reverse drum in position and install rear support (Fig. 132)

(4) Align support with punch marks made during disassembly.

(5) Install and tighten rear support bolts to 17 N·m (150 in. lbs.) torque.

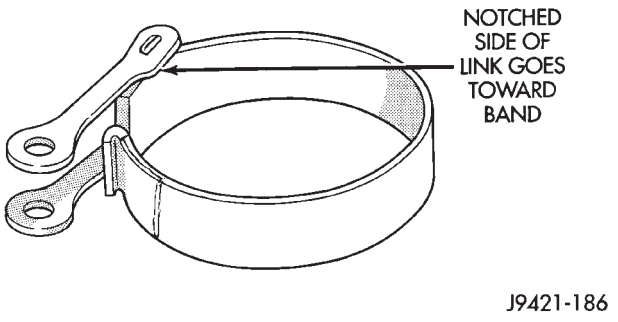

Fig. 129 Assembling Rear Band And Link (30RH)

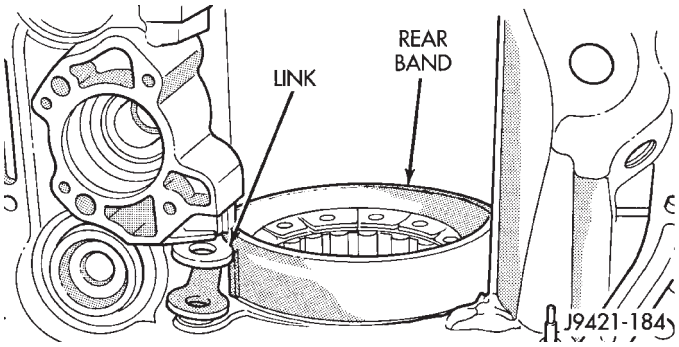

Fig. 130 Rear Band Positioned In Case (30RH)

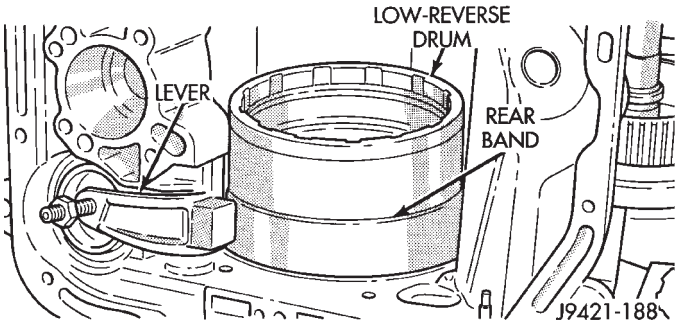

Fig. 131 Low-Reverse Drum And Band Lever Installation (30RH)

(6) Install snap ring that retains low-reverse drum to hub of rear support (Fig. 133).

PLANETARY GEARTRAIN AND OUTPUT SHAFT INSTALLATION

(1) Lubricate output shaft, rear support bore and low-reverse drum hub with transmission fluid.

(2) Install assembled output shaft and planetary geartrain in case (Fig. 134).

(3) Align drive lugs on rear planetary gear with slots in low-reverse drum (Fig. 135). Then seat planetary assembly in drum.

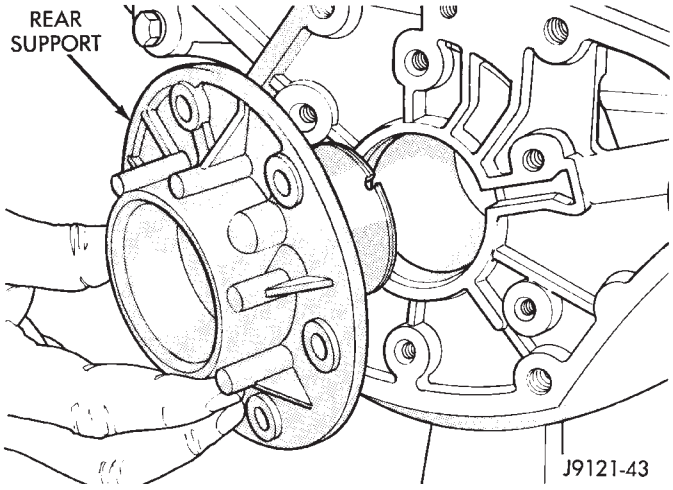

Fig. 132 Rear Support Installation

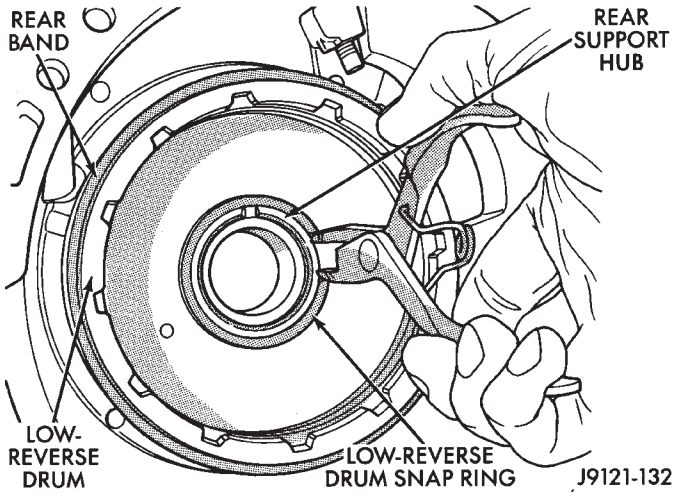

Fig. 133 Installing Low-Reverse Drum Snap Ring

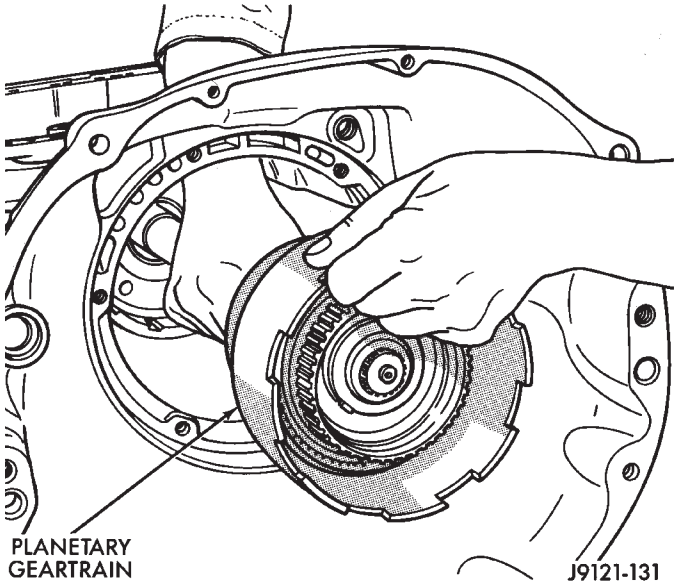

Fig. 134 Installing Output Shaft And Planetary Geartrain

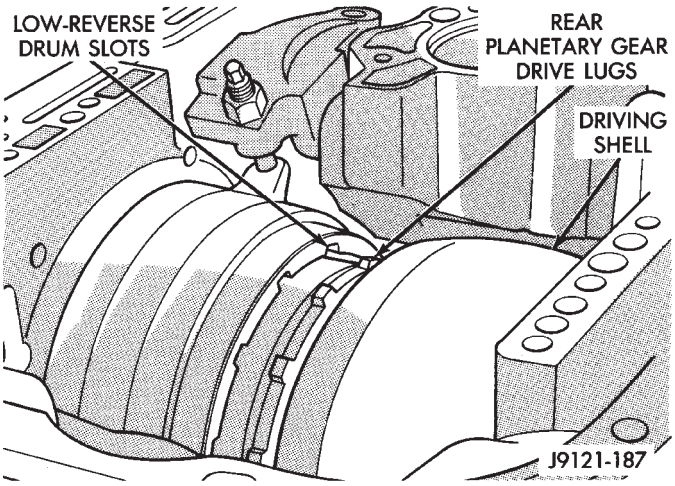

Fig. 135 Aligning/Seating Rear Planetary In Low-Reverse Drum

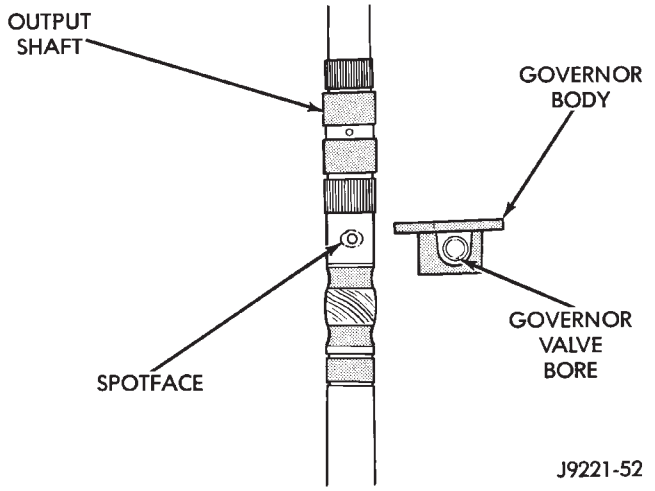

Fig. 136 Governor Valve And Output Shaft Spotface Alignment

GOVERNOR AND PARK GEAR INSTALLATION

(1) Lubricate governor components and park gear seal rings with transmission fluid.

(2) Install governor filter in park gear and install governor body on gear. Align governor body on gear using marks made at disassembly.

(3) Install new seal rings on hub of park gear if necessary. Be sure ring (or rings) with hooked ends are properly connected.

(4) Install governor weight assembly in governor body. Be sure governor weight snap rings are securely seated.

(5) Align and install governor/park gear assembly on output shaft as follows:

(a) **Note that output shaft in current transmission is spotfaced for governor valve end clearance (Fig. 136). Shaft must be indexed so that small end of governor valve will seat in this spotface. Install governor body and park as follows to ensure proper alignment and operation.**

(b) Rotate output shaft until spotface (at governor valve shaft hole) is facing upward (Fig. 136).

(c) Position valve bore in governor body over spotface on output shaft. Then align valve shaft holes in governor body and output shaft.

(d) Align splines in output shaft and park gear hub.

(e) Carefully push assembly into place in rear support (Fig. 137).

(f) Verify that governor valve shaft holes in output shaft and governor body are still in alignment. Reposition governor body and park gear if alignment is not correct.

(g) Tighten bolts attaching governor body to park gear to 11 N·m (95 in. lbs.) torque.

(6) Install first E-clip on governor valve shaft. Then install governor valve and shaft in governor body (Fig. 138). **Be sure valve shaft moves freely**

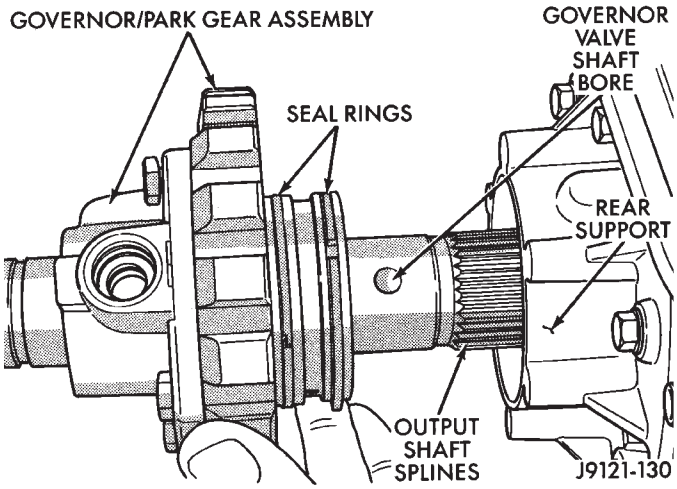

Fig. 137 Installing Governor Body And Park Gear

in valve and in output shaft. If valve shaft binds, governor/park gear is misaligned.

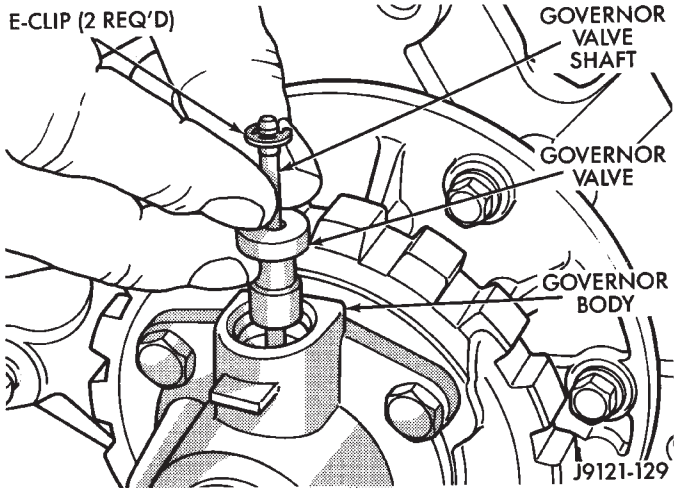

Fig. 138 Installing Governor Valve And Shaft

(7) Rotate output shaft until opposite end of governor valve shaft is facing upward. Then install remaining E-clip on governor valve shaft (Fig. 139). **Be very sure both E-clips are firmly seated on shaft.**

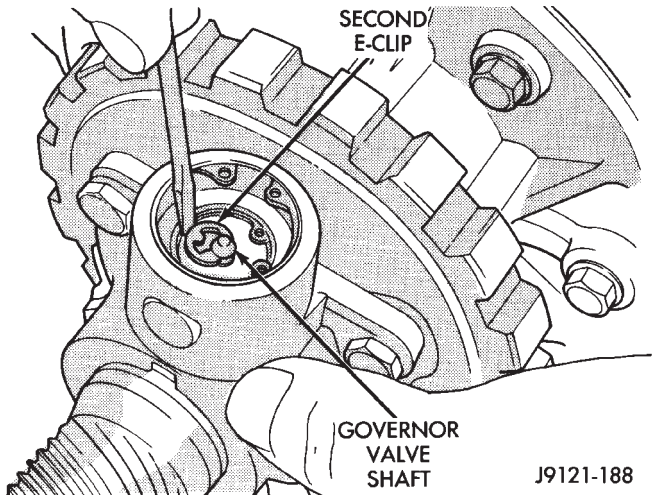

Fig. 139 Securing Governor Valve Shaft With New E-Clip

(8) Install snap ring that retains governor body on output shaft (Fig. 140).

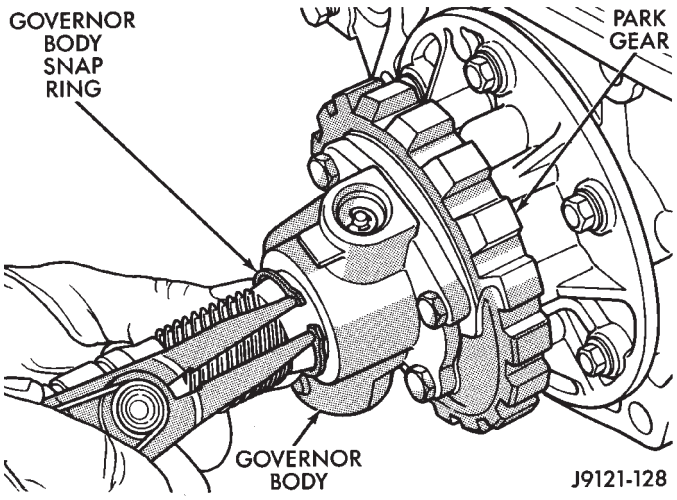

Fig. 140 Installing Governor Body Snap Ring

FRONT/REAR CLUTCH INSTALLATION

(1) Install output shaft thrust plate on shaft hub (Fig. 141). Use petroleum jelly to hold thrust plate in place.

(2) Check input shaft seal rings (Fig. 142). Verify that diagonal-cut ends of teflon seal ring are properly joined and ends of metal ring are correctly hooked together. Also be sure rings are installed sequence shown.

(3) Check rear clutch thrust washer. Use additional petroleum jelly to hold washer in place if necessary.

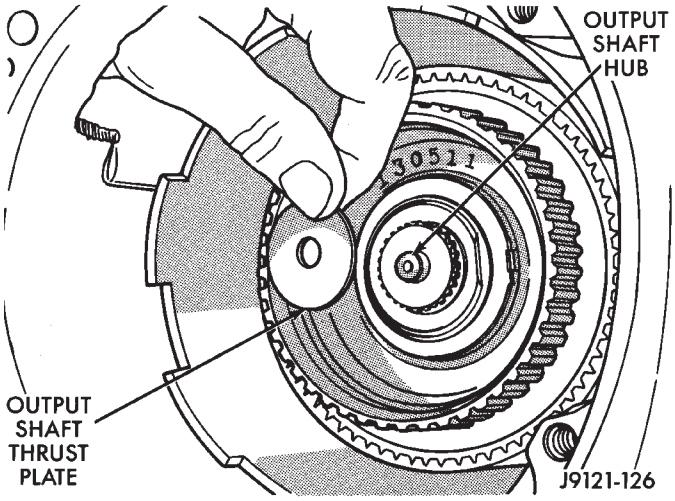

Fig. 141 Installing Output Shaft Thrust Plate

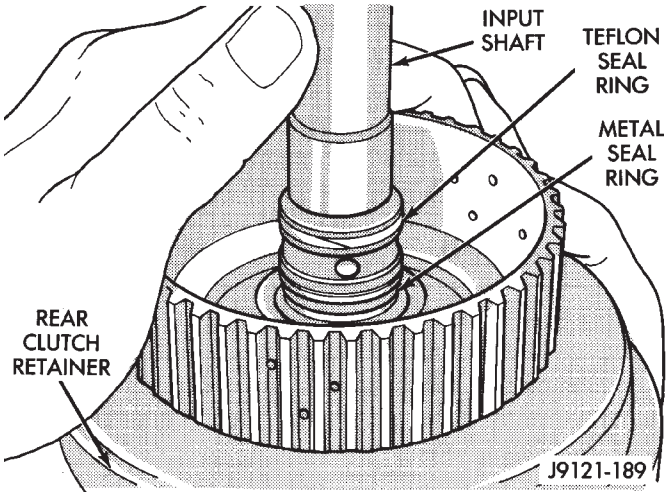

Fig. 142 Input Shaft Seal Ring Location

(4) Align clutch discs in front clutch and install front clutch on rear clutch (Fig. 143). Rotate front clutch retainer back and forth until completely seated on rear clutch.

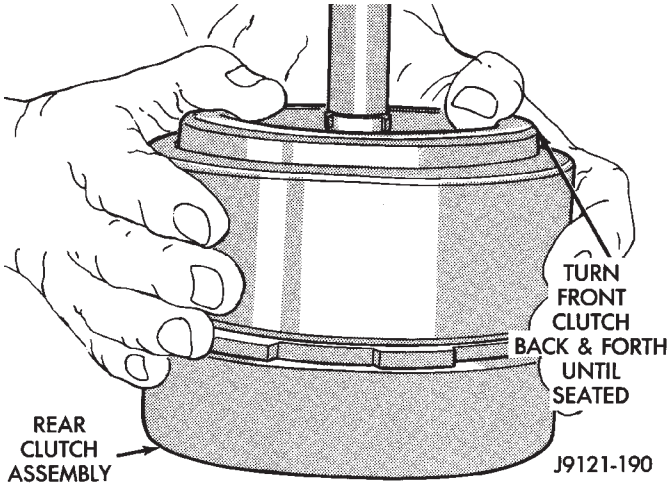

Fig. 143 Assembling Front And Rear Clutch Units

(5) Coat output shaft thrust washer with petroleum jelly. Then install washer in rear clutch hub (Fig. 144). Use enough petroleum jelly to hold washer in place. **Be sure grooved side of washer faces rearward (toward output shaft) as shown. Also note that washer only fits one way in clutch hub.**

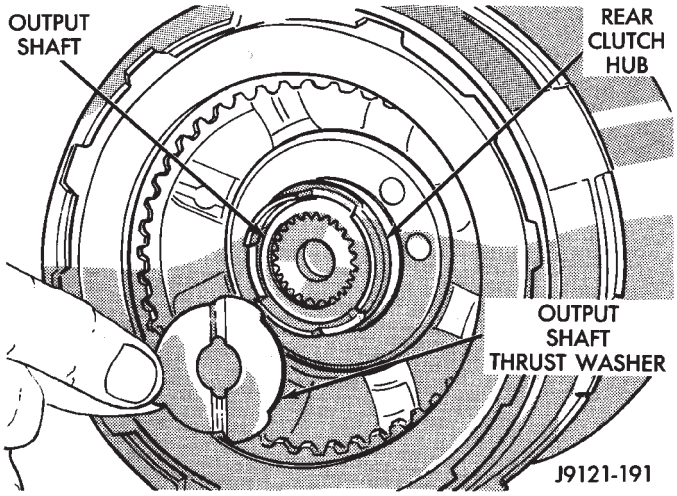

Fig. 144 Installing Output Shaft Thrust Washer

(6) Align drive teeth on rear clutch discs with small screwdriver (Fig. 145). This will make installation on front planetary easier.

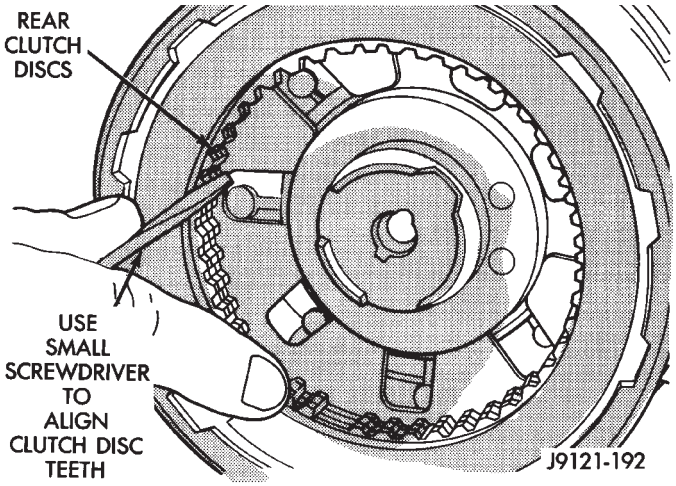

Fig. 145 Aligning Rear Clutch Disc Lugs

(7) Raise front end of transmission upward as far as possible and support case with wood blocks. Front/rear clutch and oil pump assemblies are easier to install if transmission is as close to upright position as possible.

(8) Install front and rear clutch units as assembly (Fig. 146). Align rear clutch with front annulus gear and install assembly in driving shell. **Be sure output shaft thrust washer and thrust plate are not displaced during installation.**

(9) Carefully work assembled clutches back and forth to engage and seat rear clutch discs on front annulus gear. Verify that front clutch drive lugs are fully engaged in slots of driving shell after installation.

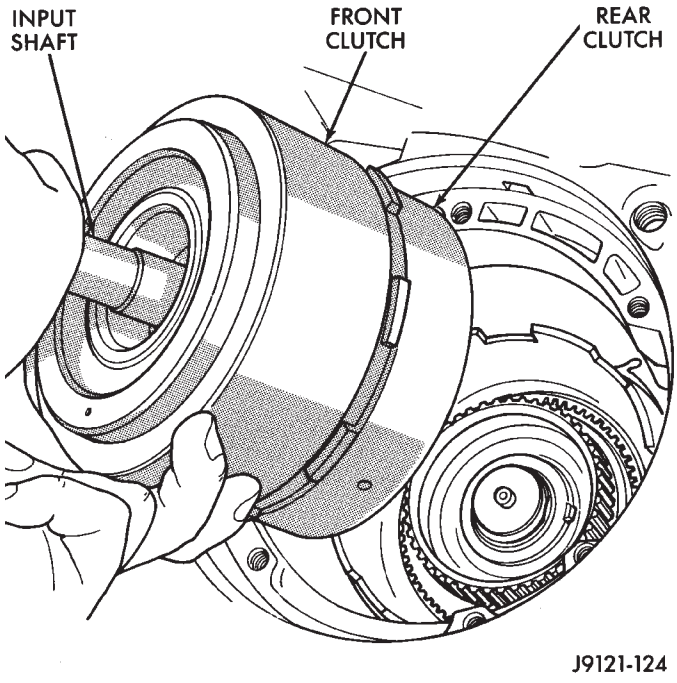

Fig. 146 Installing Front/Rear Clutch Assemblies

FRONT BAND AND OIL PUMP INSTALLATION

(1) Slide front band over front clutch retainer (Fig. 147).

(2) Insert front band reaction pin part way into case (Fig. 147).

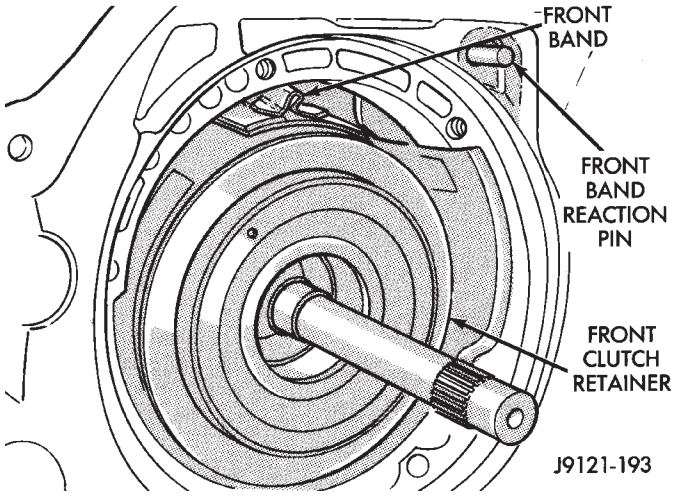

Fig. 147 Installing Front Band And Reaction Pin

(3) Install front band lever, strut, lever pin and adjusting screw (Fig. 148).

(4) Tighten front band adjusting screw until band just grips clutch retainer. Verify that front/rear clutches are still seated before continuing.

(5) Coat band lever pin access plug with sealer and install plug in converter housing (Fig. 149).

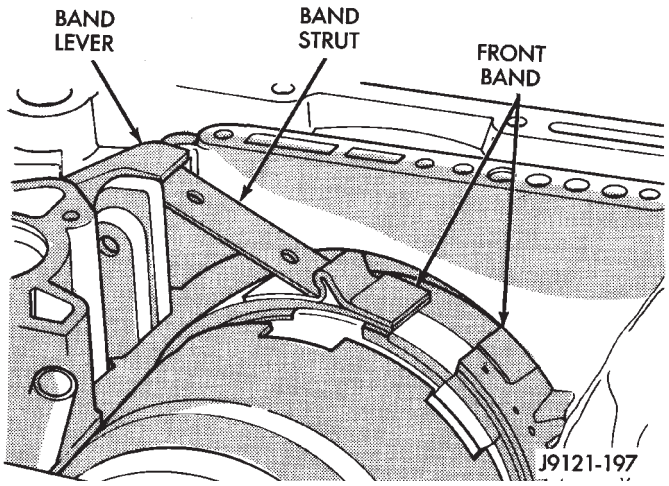

Fig. 148 Front Band Linkage Installation

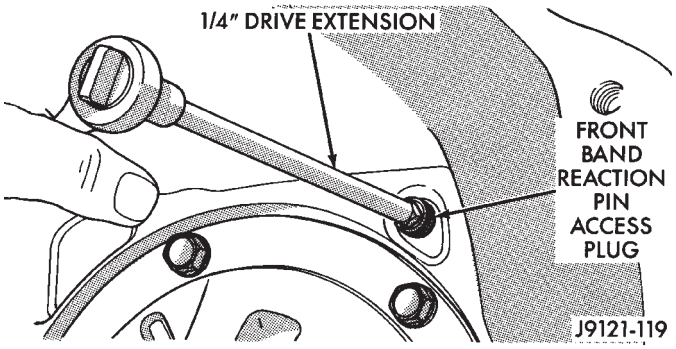

Fig. 149 Installing Front Band Pivot Pin Access Plug

(6) Verify that reaction shaft support hub seal rings are hooked together (Fig. 150).

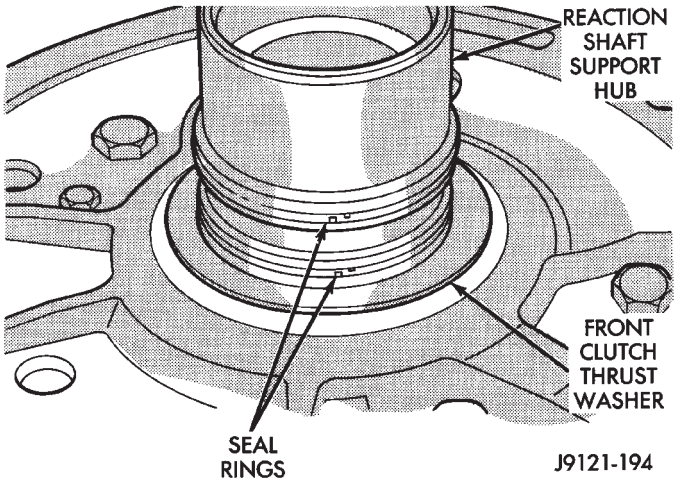

Fig. 150 Reaction Shaft Support Seal Rings

(7) Coat front clutch thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 151).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

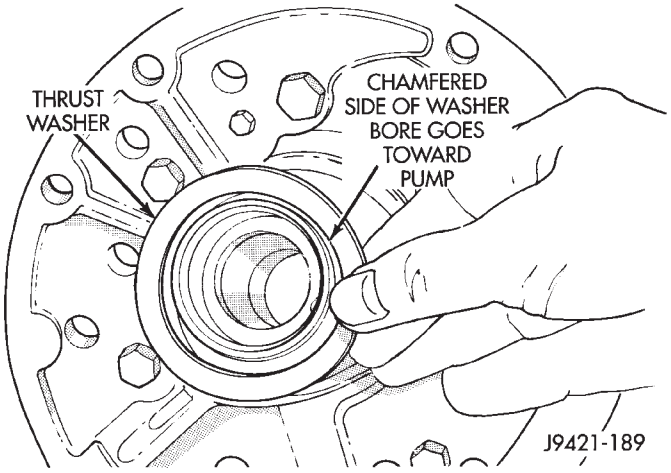

Fig. 151 Front Clutch Thrust Washer Installation

(8) Thread two Pilot Stud Tools C-3288-B into bolt holes in oil pump flange (Fig. 152).

(9) Align and install oil pump gasket (Fig. 152).

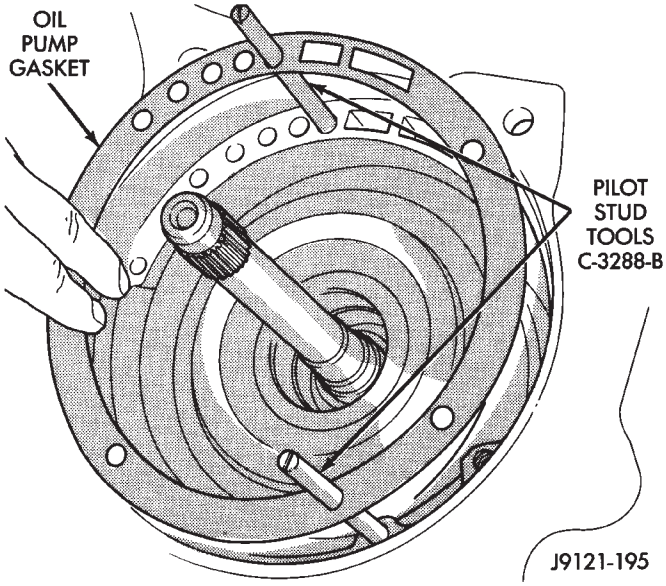

Fig. 152 Installing Pilot Studs And Oil Pump Gasket

(10) Lubricate oil pump seals with Ru-Glyde, Door Eze, or transmission fluid.

(11) Install oil pump (Fig. 153). Align and position pump on pilot studs. Slide pump down studs and work it into front clutch hub and case by hand. Then install two or three pump bolts to hold pump in place.

(12) Remove pilot stud tools and install remaining oil pump bolts. Tighten bolts alternately in diagonal pattern to 20 N·m (15 ft-lbs).

CHECKING INPUT SHAFT END PLAY

(1) Measure input shaft end play (Fig. 154).

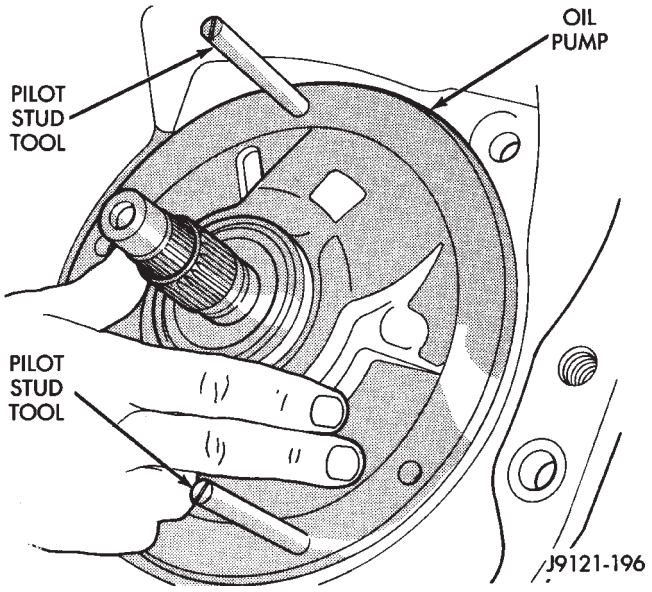

Fig. 153 Installing Oil Pump And Reaction Shaft Support

(2) Attach dial indicator to converter housing. Position indicator plunger against input shaft and zero indicator.

(3) Move input shaft in and out and record reading. End play should be 0.56 - 2.31 mm (0.022 - 0.091 in.).

(4) If end play is incorrect, transmission is incorrectly assembled, or output shaft thrust washer and/or thrust plate are worn and need to be changed.

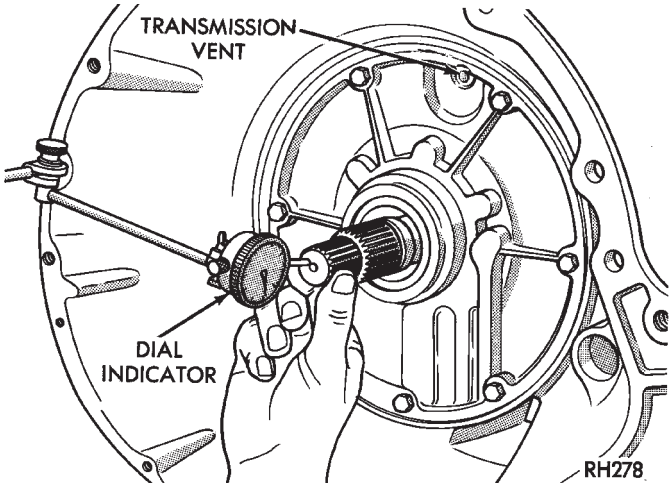

Fig. 154 Checking Input Shaft End Play

VALVE BODY INSTALLATION

(1) Install new manual lever shaft seal in case. Use 15/16 deep well socket to install seal.

(2) Make sure neutral switch has **not** been installed in case. Remove switch if necessary as it will interfere with valve body installation.

(3) Install new seal rings on accumulator piston (Fig. 155). Lubricate accumulator piston, seals and accumulator bore with transmission fluid.

(4) Install accumulator piston and spring (Fig. 155) in case.

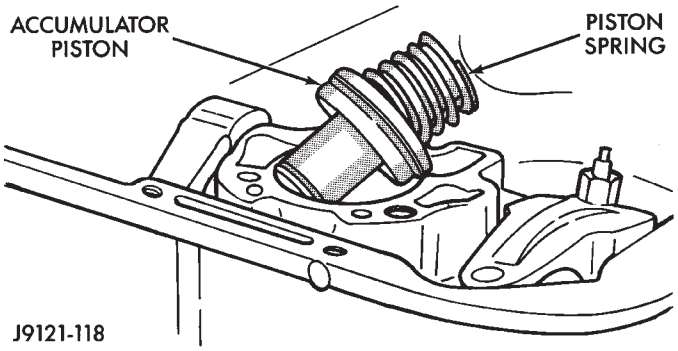

Fig. 155 Installing Accumulator Piston And Spring

(5) Place valve body manual lever in low to move park lock rod rearward.

(6) Position valve body on case. Work park rod past sprag and install valve body-to-case bolts finger tight.

(7) Install park/neutral position switch in case. Tighten switch to 34 N·m (25 ft. lbs.) torque.

(8) Align valve body on case (Fig. 156).

(9) Install and tighten valve body-to-case bolts alternately and evenly to 12 N·m (105 in. lbs.) torque. Start at center and work outward when tightening bolts. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

(10) Connect converter clutch solenoid wire to case connector (Fig. 156).

(11) Install new filter on valve body (Fig. 157). Tighten filter screws to 4 N·m (35 in. lbs.).

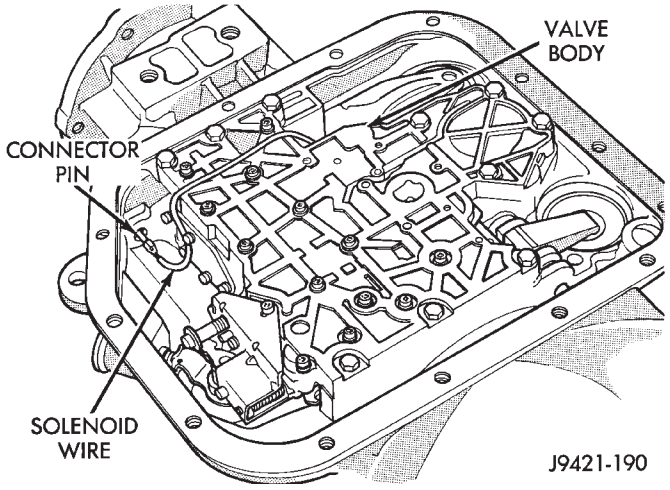

Fig. 156 Valve Body Installation

BAND ADJUSTMENT AND OIL PAN INSTALLATION

(1) Adjust **front band** as follows:

(a) Loosen locknut.

(b) Tighten adjusting screw to 72 in. lbs. torque.

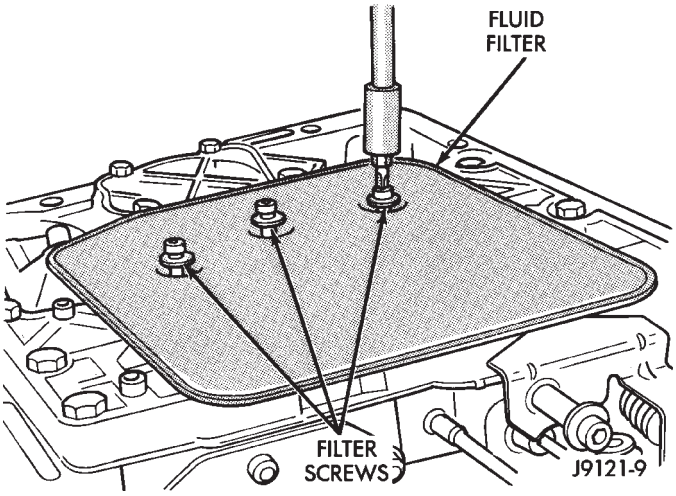

Fig. 157 Fluid Filter Installation

(c) Back off front band adjusting screw as follows:

- **On 30RH (2.5L), back adjusting screw off 2 1/2 turns**
- **On 32RH (4.0L), back adjusting screw off 2 1/4 turns**

(d) Hold adjusting screw in position and tighten locknut to 34 N·m (25 ft. lbs.).

(2) Adjust **rear band** as follows:

(a) Loosen locknut.

(b) Tighten adjusting screw as follows: On 32RH transmission, tighten screw to 8 N·m (72 in. lbs). torque. On 30RH transmission. Tighten screw to 5 N·m (41 in. lbs.) torque.

(c) Back off rear band adjusting screw as follows:

- **On 30RH (2.5L), back adjusting screw off 7 turns**
- **On 32RH (4.0L), back adjusting screw off 4 turns**

(d) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(3) Install new pan gasket on transmission and install oil pan. Tighten pan bolts to 17 N·m (13 ft. lbs.).

(4) Turn transmission over.

EXTENSION HOUSING, CONTROL LEVER AND CONVERTER INSTALLATION

(1) Install throttle valve and manual valve levers on shaft.

(2) Position new extension adapter housing gasket on transmission case. Use petroleum jelly to hold gasket in place.

(3) Install new rear seal in extension housing if required.

(4) Install extension/adapter housing on transmission case. Tighten housing fasteners to 33 N·m (24 ft. lbs.). Be sure park lock rod is properly engaged in sprag before tightening fasteners.

(5) Lubricate converter hub with transmission fluid and carefully install converter. Turn converter back and forth until seated. Be sure converter hub slots are fully seated in oil pump gear lugs.

(6) Secure converter in oil pump before mounting transmission on jack and before moving transmission back under vehicle. Use metal strapping, C-clamp, or locking pliers to hold converter in place. Attach holding tool to converter housing.

CAUTION: The transmission cooler and lines must be reverse flushed if overhaul corrected a malfunction that generated sludge, metal particles, or clutch friction material. The torque converter should also be replaced if contaminated by the same malfunction. Debris and residue not flushed from the cooler and lines will flow back into the transmission and converter. The result could be a repeat failure and shop comeback.

AW-4 AUTOMATIC TRANSMISSION

CONTENTS

GENERAL INFORMATION

INDEX

DESCRIPTION

The AW-4 is a 4-speed, electronically controlled automatic transmission (Fig. 1). Running gear consists of a torque converter, oil pump, three planetary gear sets, clutch and brake units, hydraulic accumulators, a valve body with electrical solenoids and a transmission control module (TCM). The AW-4 is used in XJ models with a 4.0L engine.

Cables are used for shifting and transmission throttle pressure control. A park/neutral position switch permits engine starting in Park and Neutral range only.

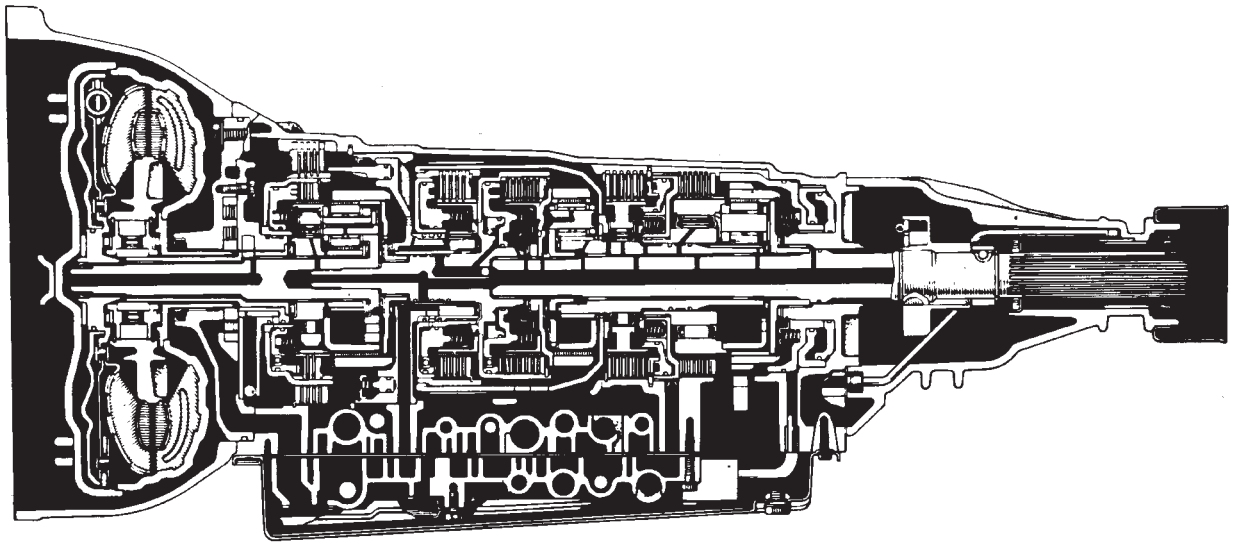

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Fig. 1 AW-4 Automatic Transmission

The valve body solenoids are controlled by signals from the transmission control module (TCM). Signal sequence is determined by vehicle speed and throttle position.

Fourth gear is an 0.75:1 ratio overdrive range. First, second, third and reverse gear are conventional ranges. Third gear ratio is 1:1. A separate planetary gear set provides overdrive operation in fourth gear.

TRANSMISSION RANGES AND SHIFT LEVER POSITIONS

The AW-4 transmission has six ranges and shift lever positions. Park, Reverse and Neutral are conventional and mechanically operated. The 1-2, 3 and D ranges provide electronically controlled shifting.

The 1-2 position provides first and second gear only. The 3 position provides first, second and third gear.

The D range provides first through fourth gear. Overdrive fourth gear range is available only when the shift lever is in D position (Fig. 2).

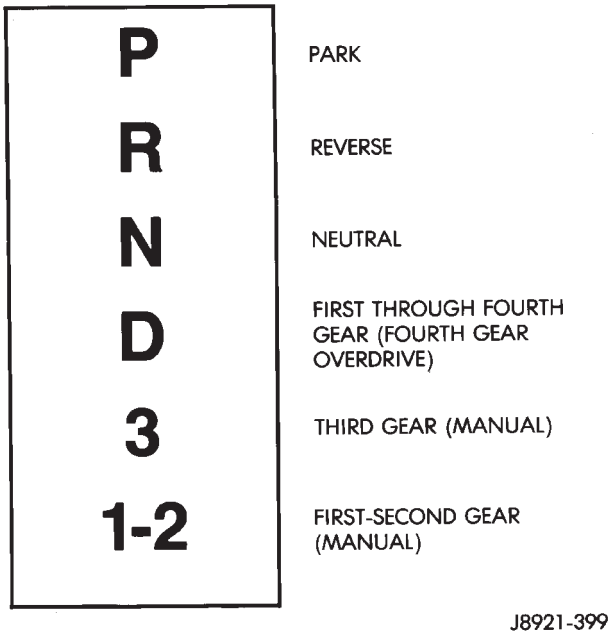

Fig. 2 AW-4 Shift Lever Positions And Transmission Ranges

TRANSMISSION IDENTIFICATION

The transmission I.D. plate is attached to the case (Fig. 3). The plate contains the transmission serial and model numbers. Refer to the information on this plate when ordering service parts.

COMPONENTS AND OPERATION

ELECTRONIC CONTROLS

The AW-4 is electronically controlled in the 1, 2, 3 and D ranges. Controls consist of the transmission control module (TCM), valve body solenoids and various sensors. The sensors monitor vehicle speed, throttle opening, shift lever position and brake pedal application.

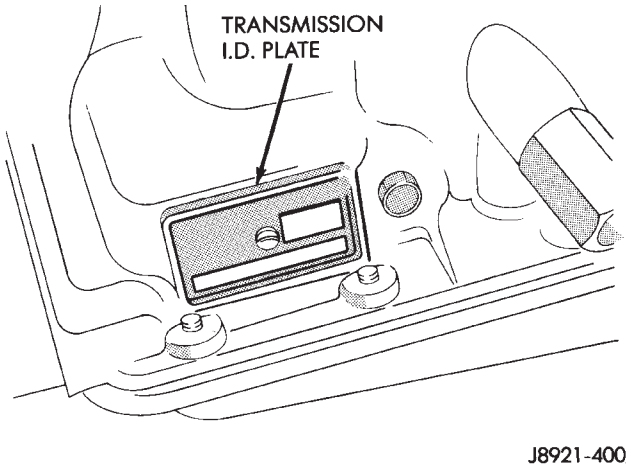

Fig. 3 Transmission Identification

TRANSMISSION CONTROL MODULE (TCM)

The module determines shift and converter clutch engagement timing based on signals from the sensors. The valve body solenoids are activated, or deactivated accordingly.

The module has a self diagnostic program. Component and circuitry malfunctions can be diagnosed with the DRB II scan tool. Once a malfunction is noted and stored in control module memory, it is retained even after the problem has been corrected. To cancel a stored malfunction, simply disconnect and reconnect the "Trans." fuse in the module harness.

TRANSMISSION VALVE BODY SOLENOIDS

The solenoids are mounted on the valve body and operated by the transmission control module. The solenoids control operation of the converter clutch and shift valves in response to input signals from the module.

SENSORS

The sensors include the throttle position sensor (TPS), transmission output speed sensor, vehicle speed sensor, park/neutral position switch and brake switch.

The throttle position sensor is mounted on the throttle body. It electronically determines throttle position and relays this information to the transmission control module to determine shift points and converter clutch engagement.

The transmission speed sensor consists of a rotor and magnet on the transmission output shaft and a switch in the extension housing or adapter. The sensor switch is activated each time the rotor and mag-

net complete one revolution. Sensor signals are sent to the transmission control module.

The park/neutral position switch is mounted on the valve body manual shaft. The switch signals shift linkage and manual valve position to the transmission control module through an interconnecting harness. The switch prevents engine starting in all gears other than Park or Neutral.

The brake switch is in circuit with the torque converter clutch solenoid. The switch disengages the converter clutch whenever the brakes are applied. The switch is mounted on the brake pedal bracket and signals the transmission control module when the pedal is pressed or released.

TORQUE CONVERTER

A four element torque converter is used for all applications. The converter consists of the front cover and pump, stator, turbine, and an electronic modulated converter clutch mechanism.

The converter clutch mechanism consists of a sliding clutch piston, clutch springs and the clutch disc material (Fig. 4). The clutch provides optimum torque transfer and economy when engaged.

The clutch disc is attached to the converter front cover. The clutch piston and clutch springs are attached to the turbine hub. The springs dampen engine firing impulses and loads during the initial phase of converter clutch engagement.

Clutch engagement is controlled by transmission valve body solenoid number three and by the converter clutch relay valve. The solenoid channels line pressure to the clutch through the relay valve at clutch engagement speeds.

Torque converter clutch engagement occurs in second gear in 1-2 position; third gear in 3 position and third and fourth gear in D position.

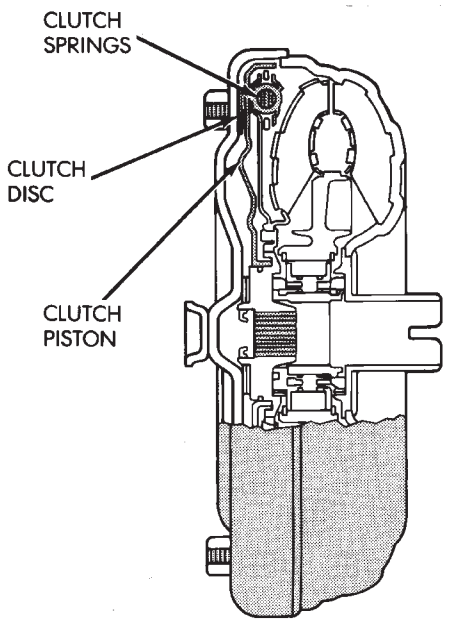

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Fig. 4 Torque Converter With Modulated Clutch

FOURTH GEAR OVERDRIVE COMPONENTS

The overdrive system consists of the input shaft, one-way clutch, planetary sun gear, ring gear, planetary carrier, direct clutch and overdrive brake (Fig. 5). The overdrive elements are controlled and applied through transmission valve body solenoid number two.

In overdrive fourth gear, the brake prevents the overdrive sun gear from turning. During operation, the overdrive elements operate as follows:

The overdrive input shaft and planetary carrier rotate as a unit. The sun gear and overdrive direct clutch drum are in mesh and operate as a single unit. The direct clutch splines function as the hub for the overdrive brake. The one-way clutch outer race is in mesh with the planetary carrier. The inner race is fixed to the sun gear shaft.

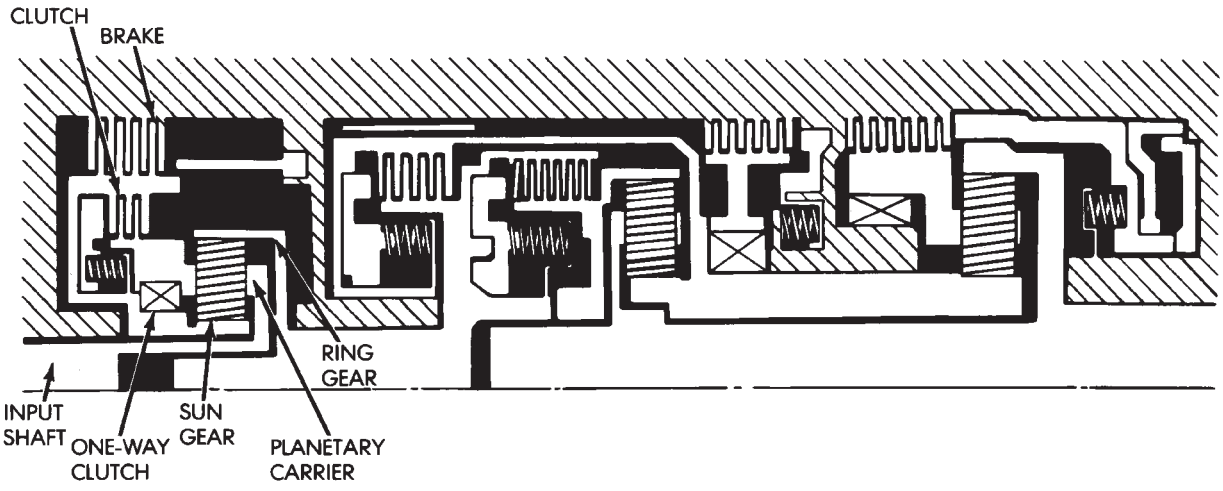

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Fig. 5 Fourth Gear Overdrive Components

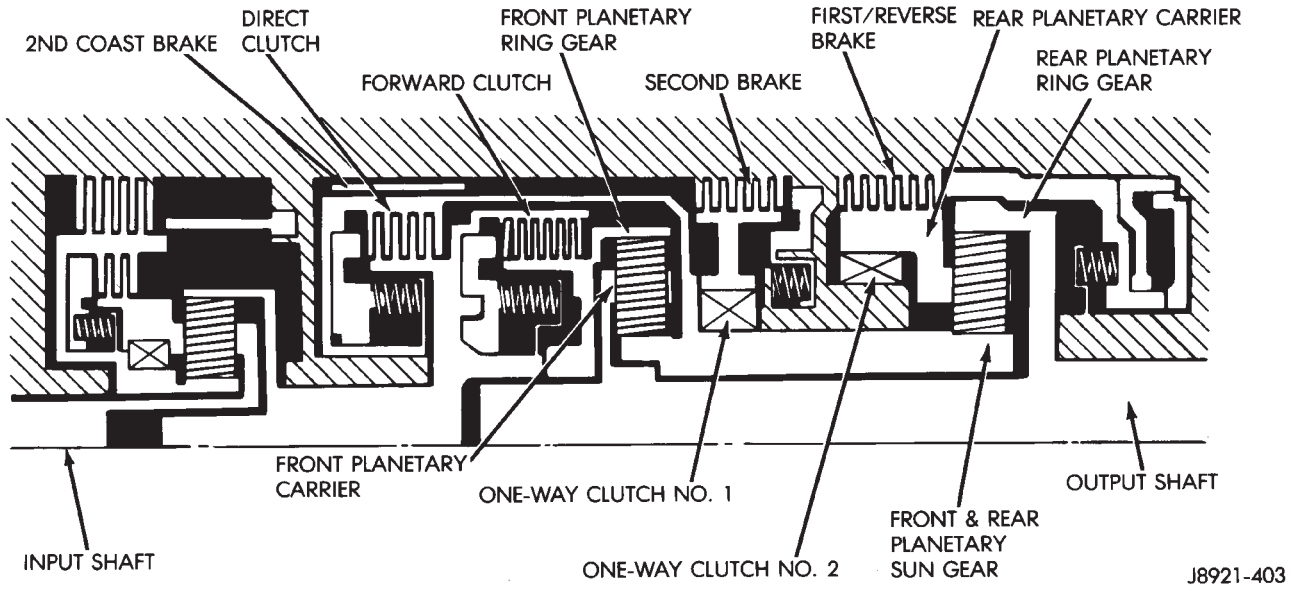

Fig. 6 First, Third And Reverse Gear Components

FIRST—THIRD—REVERSE GEAR COMPONENTS

First, third and reverse gear components are outlined in Figure 6.

The input shaft is meshed with the direct clutch hub and the forward clutch drum. These elements rotate as a unit. The forward clutch hub rotates as a unit with the front planetary ring gear. The direct clutch drum is meshed with the forward end of the planetary sun gear.

The second brake hub serves as the outer race of one-way clutch No. 1. The clutch inner race is locked with the front/rear sun gear. The inner race of one-way clutch No. 2 is splined to the transmission case and is locked. The outer race rotates as a unit with the rear planetary carrier.

The rear planetary ring gear is splined to the output shaft. The front planetary carrier and rear carrier ring gear are meshed and rotate as a unit with the output shaft.

GEARTRAIN OPERATION AND APPLICATION CHARTS

Operation and application of the first through fourth and reverse gear elements are outlined in the function and application charts.

NOMENCLATURE	FUNCTION
Overdrive Direct Clutch	Connects overdrive sun gear and overdrive carrier
Overdrive Brake	Prevents overdrive sun gear from turning either clockwise or counterclockwise
Overdrive One-Way Clutch	When transmission is driven by engine, connects overdrive sun gear and overdrive carrier
Forward Clutch	Connects input shaft and front ring gear
Direct Clutch	Connects input shaft and front and rear sun gear
Second Coast Brake	Prevents front and rear sun gear from turning either clockwise or counterclockwise
Second Brake	Prevents outer race of No. 1 one-way clutch from turning either clockwise or counterclockwise, thus preventing front and rear sun gear from turning counterclockwise
First/Reverse Brake	Prevents rear planetary carrier from turning either clockwise or counterclockwise
One-Way Clutch No. 1	When second brake is operating, prevents front and rear sun gear from turning counterclockwise
One-Way Clutch No. 2	Prevents rear planetary carrier from turning counterclockwise

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Fig. 7 Component Function Chart

Shift Lever Position	Gear	Valve Body Solenoid No. 1	Valve Body Solenoid No. 2	OVERDRIVE CLUTCH	FORWARD CLUTCH	DIRECT CLUTCH	OVERDRIVE BRAKE	SECOND COAST BRAKE	SECOND BRAKE	FIRST/ REVERSE BRAKE	OVERDRIVE ONE-WAY CLUTCH	NO.1 ONE-WAY CLUTCH	NO.2 ONE-WAY CLUTCH
P	Park	ON	OFF	•									
R	Reverse	ON	OFF	•		•				•	•		
N	Neutral	ON	OFF	•									
D	First	ON	OFF	•	•						•		•
	Second	ON	ON	•	•				•		•	•	
	Third	OFF	ON	•	•	•			•		•		
	OD	OFF	OFF		•	•	•		•				
3	First	ON	OFF	•	•						•		•
	Second	ON	ON	•	•			•	•		•	•	
	Third	OFF	ON	•	•	•			•		•		
1-2	First	ON	OFF	•	•					•	•		•
	Second	ON	ON	•	•			•	•		•	•	

• = Applied J8921-405

Fig. 8 Component Application Chart

The Component Function Chart (Fig. 7) describes basic function of various geartrain elements. The Component Application Chart (Fig. 8) indicates which elements (including valve body solenoids), are applied in the various gear ranges.

HYDRAULIC SYSTEM

The basic hydraulic system consists of the oil pump, valve body and solenoids and four hydraulic accumulators. The oil pump provides the necessary system lubrication and operating pressure.

The valve body controls application of the clutches, brakes, second coast band and the torque converter clutch. The valve body solenoids control sequencing of the 1-2, 2-3 and 3-4 shift valves within the valve body. The solenoids are activated by signals from the transmission control module.

The accumulators are used in the clutch and brake feed circuits to control initial apply pressure. Spring loaded accumulator pistons modulate the initial surge of apply pressure for smooth engagement.

OIL PUMP

A gear-type oil pump is used. The pump gears are mounted in the pump body. The pump drive gear is operated by the torque converter hub. Drive tangs on the hub engage in drive slots in the drive gear.

TRANSMISSION VALVE BODY COMPONENTS

Transmission operating pressure is supplied to the clutch and brake apply circuits through the transmission valve body. The valve body consists of an upper body, lower body, separator plate and upper and lower gaskets (Fig. 9). The various spool valves, sleeves, plugs and springs are located within the two body sections.

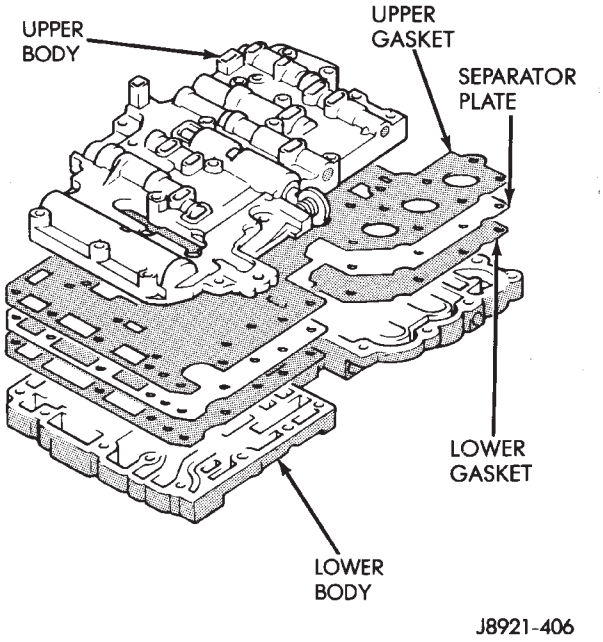

Fig. 9 Two-Section Transmission Valve Body

The manual valve, 1-2 shift valve, primary regulator valve, accumulator control valve, check balls, solenoids and oil strainers are located in the lower body section (Fig. 10). The remaining control and shift valves plus check balls and one additional oil strainer are located in the upper body section (Fig. 11).

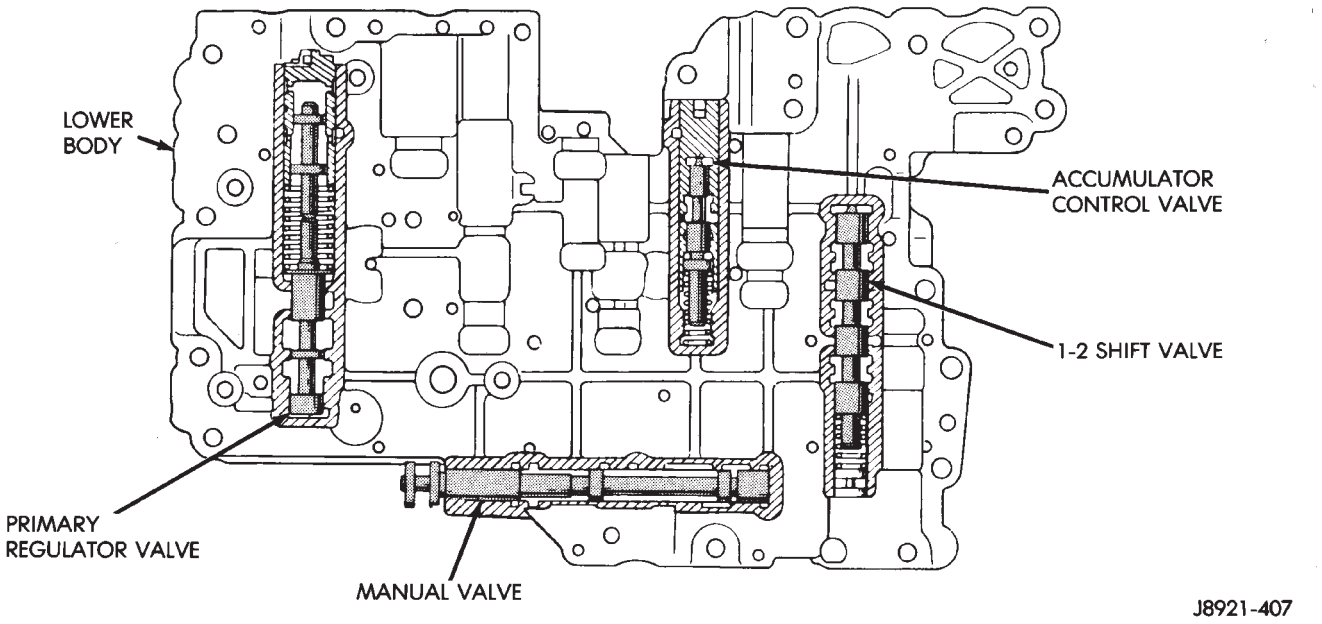

Fig. 10 Upper Body Components

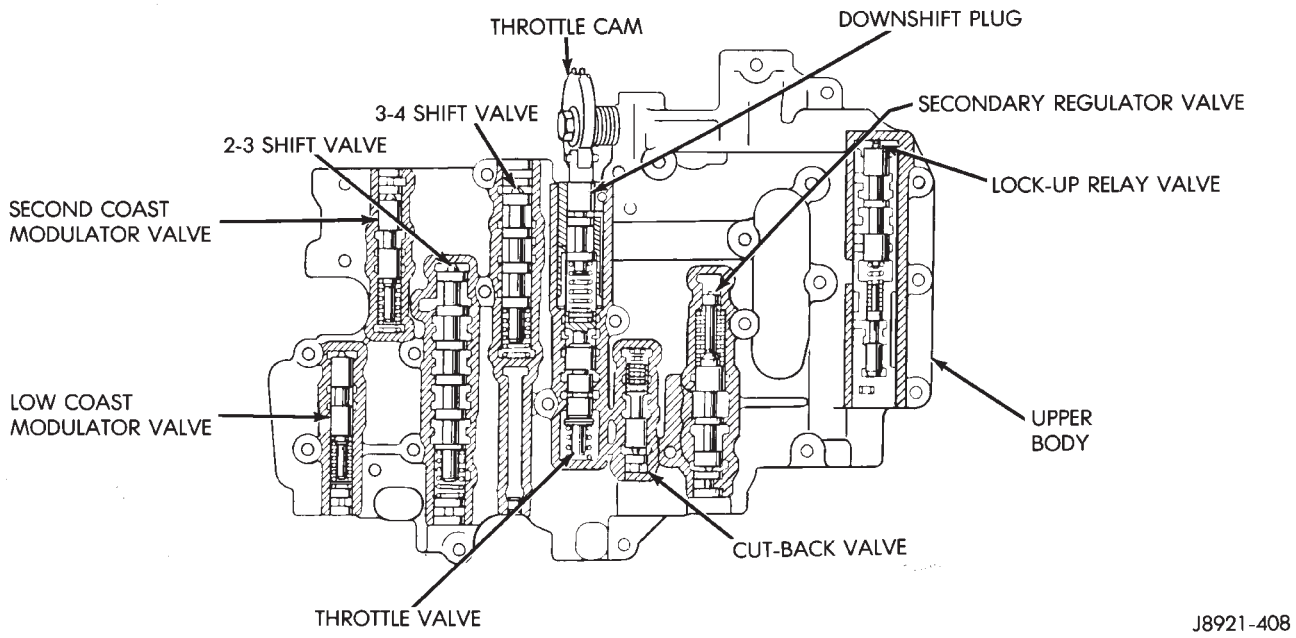

Fig. 11 Lower Body Components

Manual Valve

The manual valve is operated by the gearshift linkage. The valve diverts fluid to the apply circuits according to shift lever position.

Primary Regulator Valve

The primary regulator valve (Fig. 13) modulates line pressure to the clutches and brakes according to engine load. The valve is actuated by throttle valve pressure.

During high load operation, the valve increases line pressure to maintain positive clutch and brake engagement. At light load, the valve decreases line pressure just enough to maintain smooth engagement.

Throttle Valve and Downshift Plug

The throttle valve and downshift plug (Fig. 14) control throttle pressure to the primary regulator valve.

The downshift plug and throttle valve are operated by the throttle valve cam and throttle cable in response to engine throttle position. Throttle valve pressure is also modulated by the cut-back valve in second, third and fourth gear ranges.

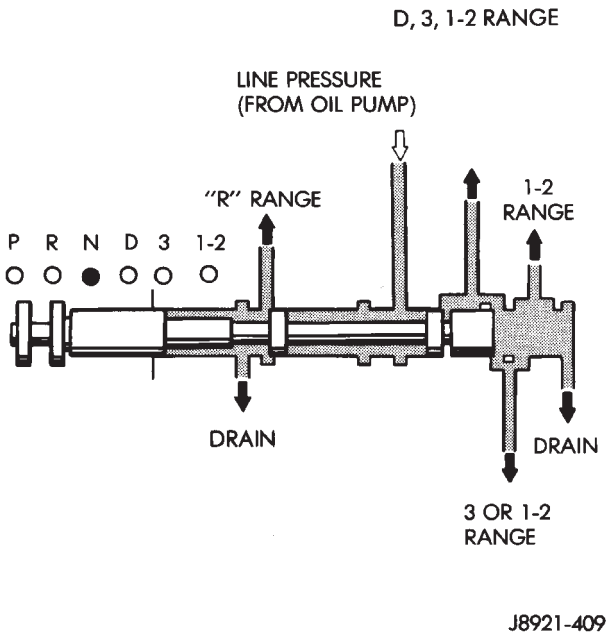

Fig. 12 Manual Valve

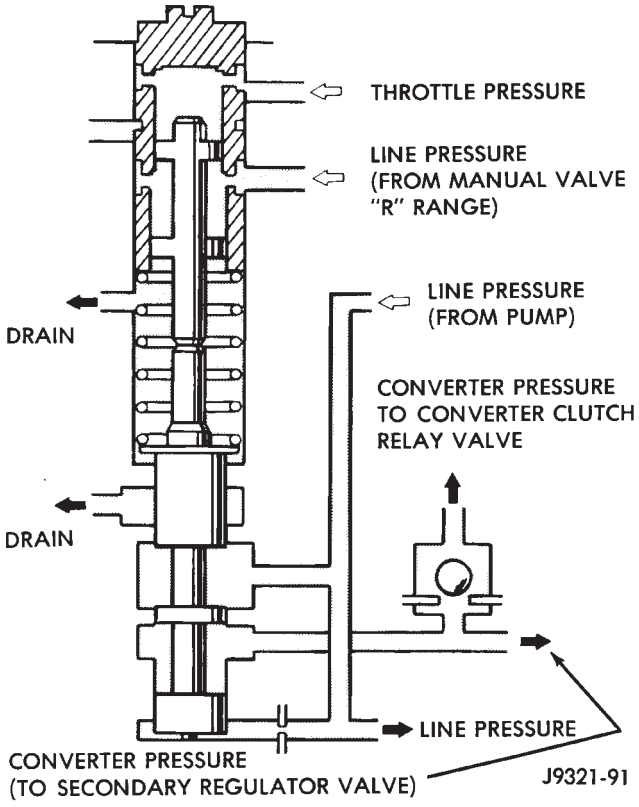

Fig. 13 Primary Regulator Valve

Cut-Back Valve

The cut-back valve (Fig. 15) helps prevent excessive pump pressure buildup in second, third and fourth gear. The valve is actuated by throttle pressure and by line pressure from the second brake. The valve also helps regulate line pressure by controlling the amount of cut-back pressure to the throttle valve.

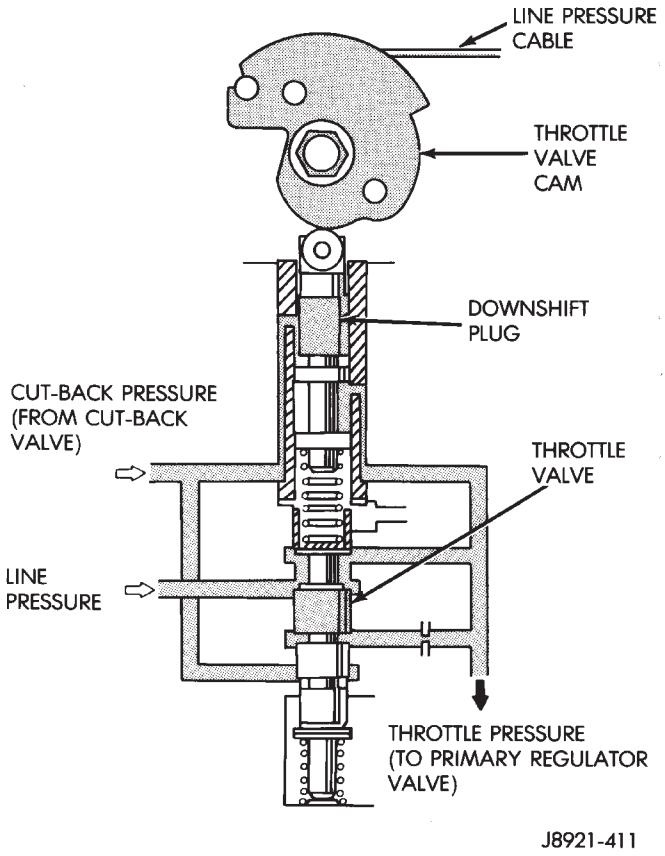

Fig. 14 Throttle Valve And Downshift Plug

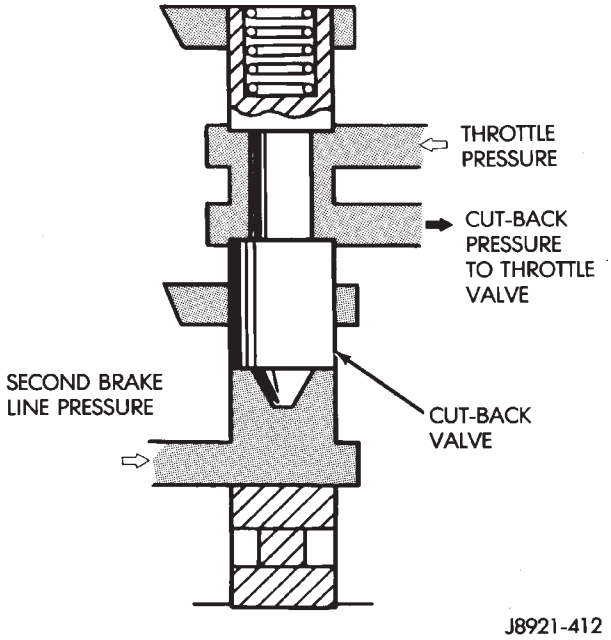

Fig. 15 Cut-Back Valve

Secondary Regulator Valve

The secondary regulator valve (Fig. 16) regulates converter clutch and transmission lubrication pressure. When primary regulator valve pressure exceeds requirements for clutch engagement or transmission lubrication, the secondary regulator valve is moved

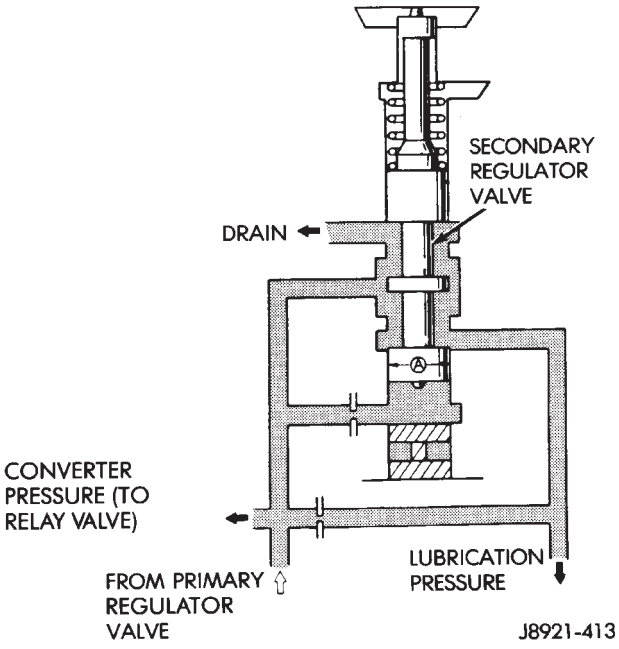

Fig. 16 Secondary Regulator Valve

upward exposing the drain port. Excess pressure then bleeds off as needed. As pressure drops, spring tension moves the valve downward closing the drain port.

Converter Clutch Relay Valve

The relay valve (Fig. 17) controls fluid flow to the converter clutch. The valve is operated by line pressure from the 1-2 shift valve and is controlled by solenoid valve number three.

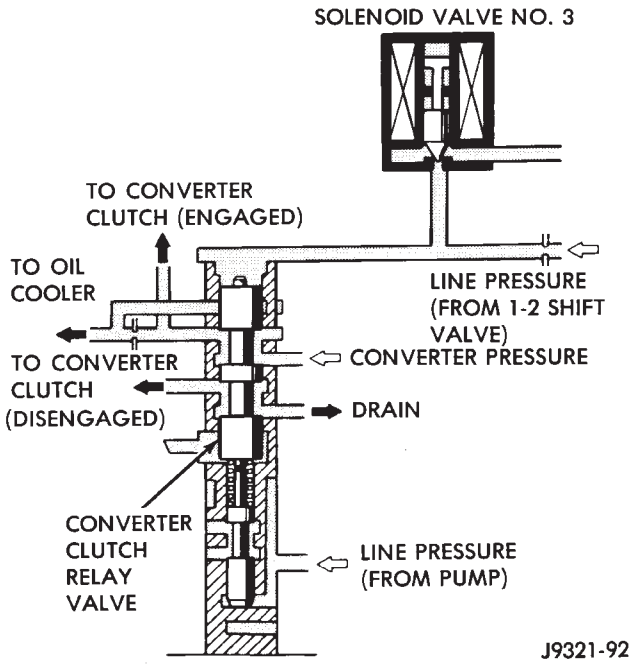

Fig. 17 Converter Clutch Relay Valve

1-2 Shift Valve

The 1-2 shift valve (Fig. 18) controls 1-2 upshifts and downshifts. The valve is operated by the No. 2 valve body solenoid and line pressure from the manual valve, second coast modulator valve and the 2-3 shift valve.

When the transmission control module deactivates the solenoid, line pressure at the top of the valve moves the valve down closing the second brake accumulator feed port. As the solenoid is activated and

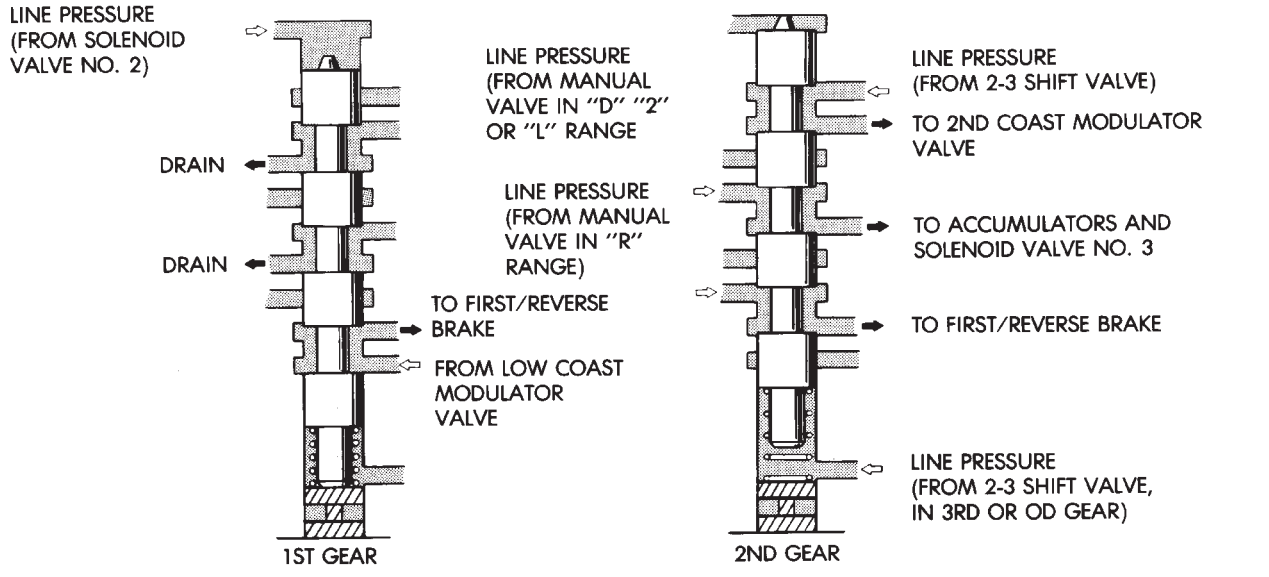

Fig. 18 1-2 Shift Valve

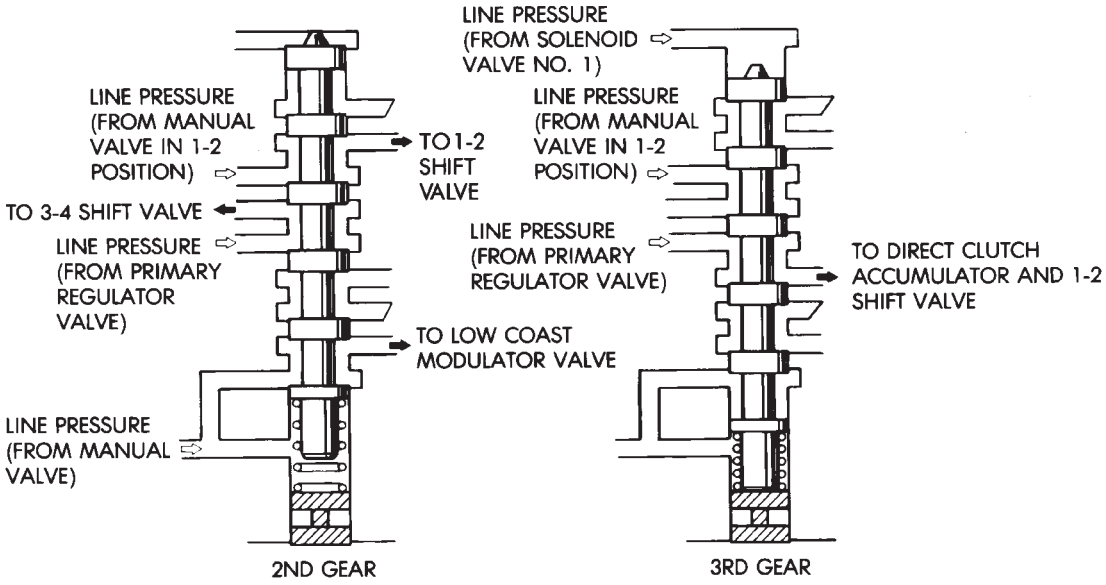

Fig. 19 2-3 Shift Valve

the drain port opens, spring force moves the valve up exposing the second brake feed port for the shift to second gear.

2-3 Shift Valve

The 2-3 shift valve (Fig. 19) controls 2-3 upshifts and downshifts. The valve is actuated by the No. 1 valve body solenoid and by line pressure from the manual valve and primary regulator valve.

When the transmission control module activates solenoid No. 1, line pressure at the top of the 2-3 valve is released through the solenoid drain port. Spring tension moves the valve up to hold the valve in second gear position. As the solenoid is deactivated, line pressure then moves the valve down exposing the direct clutch feed port for the shift to third gear.

3-4 Shift Valve

The 3-4 shift valve (Fig. 20) is operated by the No. 2 solenoid and by line pressure from the manual valve, 2-3 valve and primary regulator valve.

Energizing the No. 2 solenoid causes line pressure at the top of the 3-4 valve to be released through the solenoid valve drain port. Spring tension moves the valve up exposing the overdrive clutch accumulator feed port to apply the clutch.

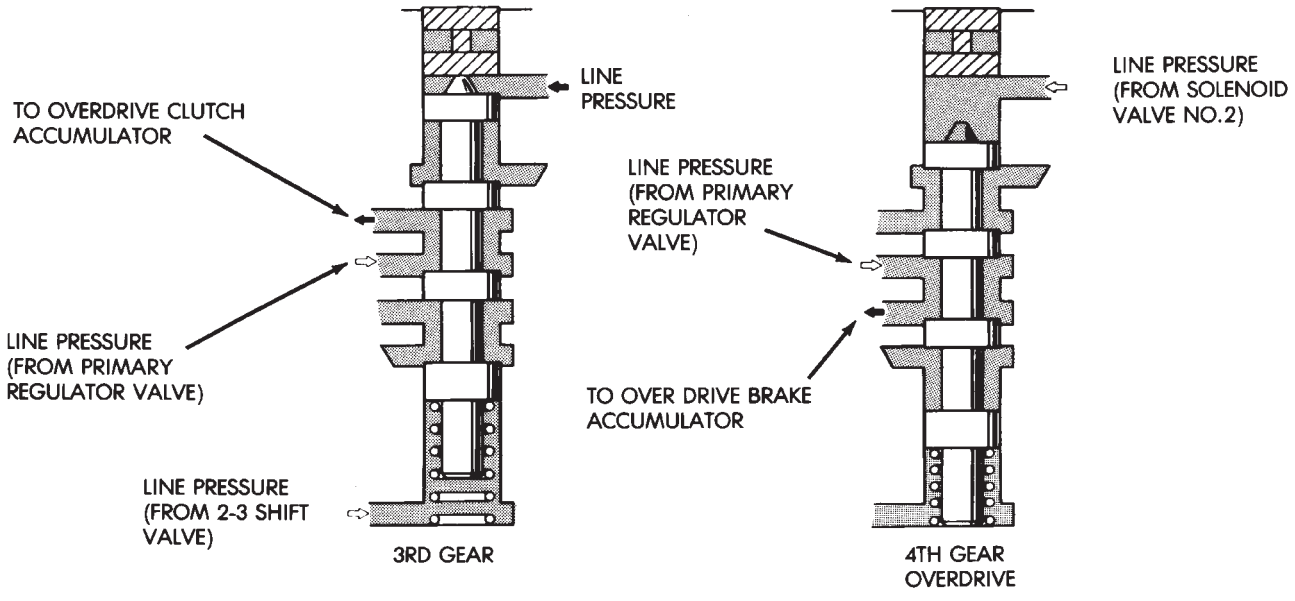

Fig. 20 3-4 Shift Valve

De-energizing the solenoid causes the drain port to close. Line pressure then moves the valve down exposing the overdrive brake accumulator feed port for the shift to fourth gear.

In the 1-2 or 3 gearshift lever positions, line pressure from the 2-3 shift valve is applied to the lower end of the 3-4 valve. This holds the valve upward, closing off the overdrive brake feed port preventing a shift into fourth gear.

Second Coast Modulator Valve

The second coast modulator valve (Fig. 21) momentarily reduces line pressure from the 1-2 shift valve. This cushions application of the second coast brake. The valve is operative when the shift lever and manual valve are in the 3 position.

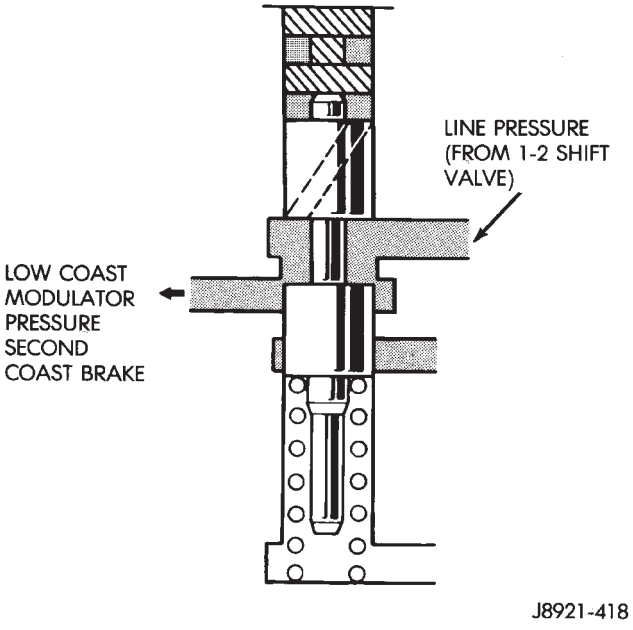

Fig. 21 Second Coast Modulator Valve

Low Coast Modulator Valve

The low coast modulator valve (Fig. 22) momentarily reduces line pressure from the 2-3 shift valve to cushion application of the first/reverse brake. The valve operates when the shift lever and manual valve are in the 1-2 position.

Accumulator Control Valve

The accumulator control valve (Fig. 23) cushions clutch and brake application by reducing back pressure to the accumulators when throttle opening is small. The valve is operated by oil pump (line) pressure and by throttle pressure.

Accumulators

Four accumulators are used to cushion application of the clutches and brakes (Fig. 24). The accumulators consist of spring loaded pistons which dampen the initial surge of apply pressure to provide smooth engagement during shifts.

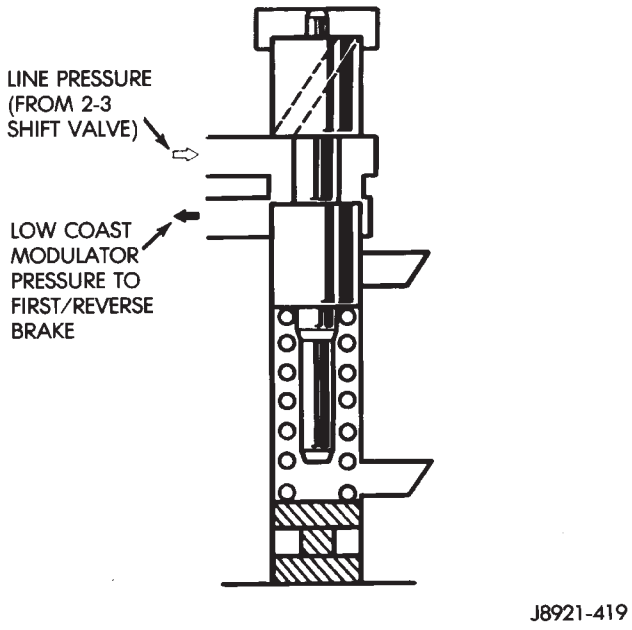

Fig. 22 Low Coast Modulator Valve

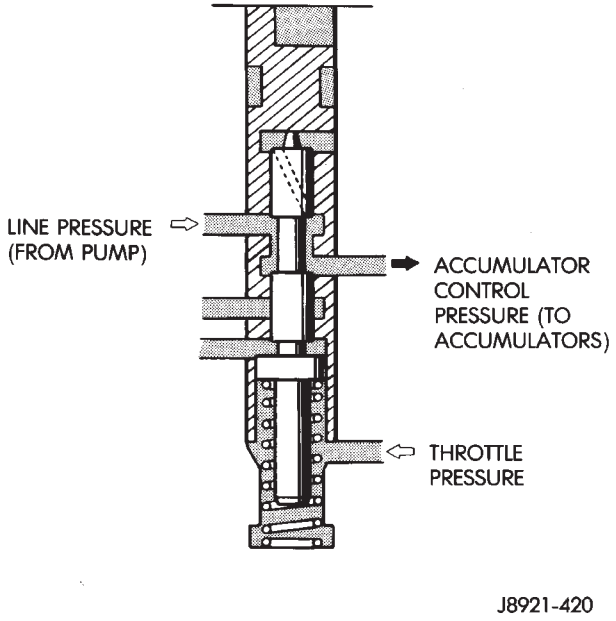

Fig. 23 Accumulator Control Valve

Control pressure from the accumulator control valve is continuously applied to the back pressure side of the accumulator pistons. This pressure plus spring tension holds the pistons down. As line pressure from the shift valves enters the opposite end of the piston bore, control pressure and spring tension momentarily delay application of full line pressure to cushion engagement. The accumulators are all located in the transmission case (Fig. 24).

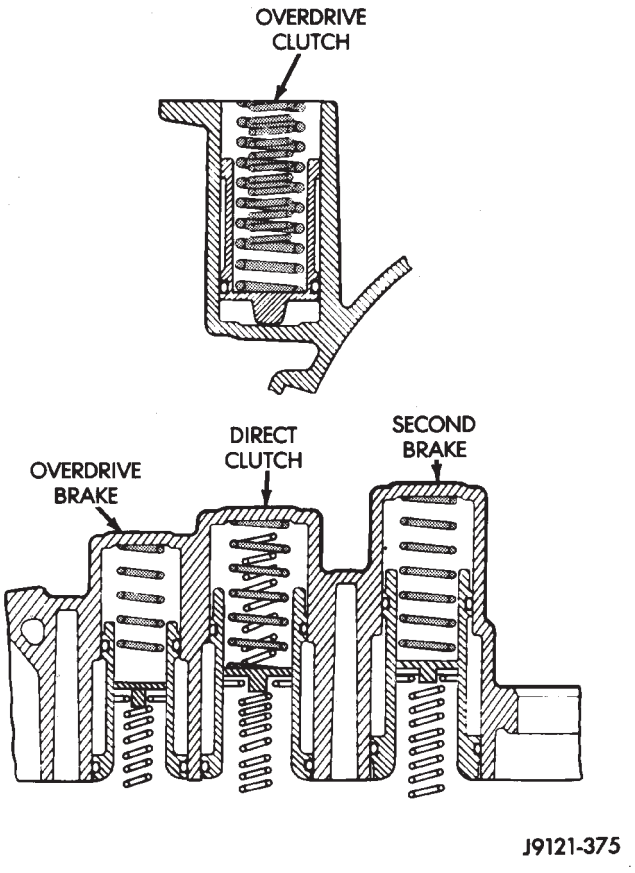

Fig. 24 Accumulators

Transmission Valve Body Solenoids

Three solenoids are used (Fig. 25). The No. 1 and 2 solenoids control shift valve operation by applying or releasing line pressure. The signal to apply or release pressure is provided by the transmission control module.

The No. 3 solenoid controls operation of the torque converter clutch. The solenoid operates in response to signals from the transmission control module.

When the No. 1 and 2 solenoids are activated, the solenoid plunger is moved off its seat opening the drain port to release line pressure. When either solenoid is deactivated, the plunger closes the drain port.

The No. 3 solenoid operates in reverse. When the solenoid is deactivated, the solenoid plunger is moved off its seat opening the drain port to release line pressure. When the solenoid is activated, the plunger closes the drain port.

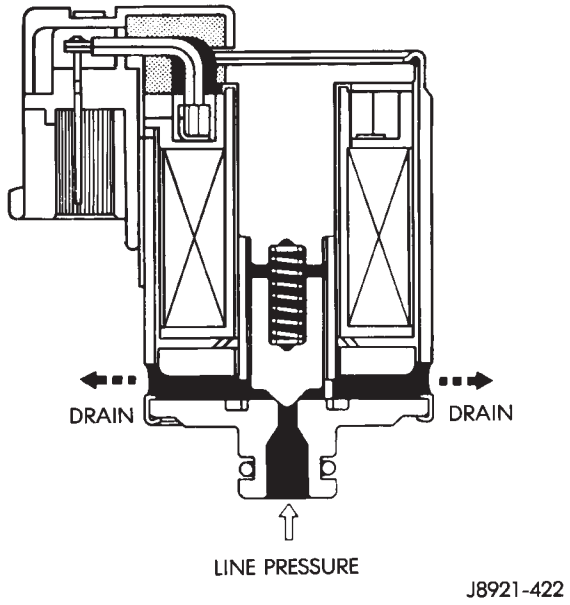

Fig. 25 Transmission Valve Body Solenoids

AW-4 TRANSMISSION DIAGNOSIS

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GENERAL DIAGNOSIS INFORMATION

Shift points are controlled by the transmission control module (TCM). Before attempting repair, determine if a malfunction is electrical or mechanical.

The TCM used with the AW-4 transmission has a self-diagnostic program compatible with the DRB II scan tool. The tester will identify faults in the electrical control system.

Diagnosis should begin with the Preliminary Inspection And Adjustment procedure. It is will help determine if a problem is mechanical or electrical. The first procedure step is Initial Inspection and Adjustment.

PRELIMINARY INSPECTION AND ADJUSTMENT

(1) Check and adjust transmission shift cable if necessary.

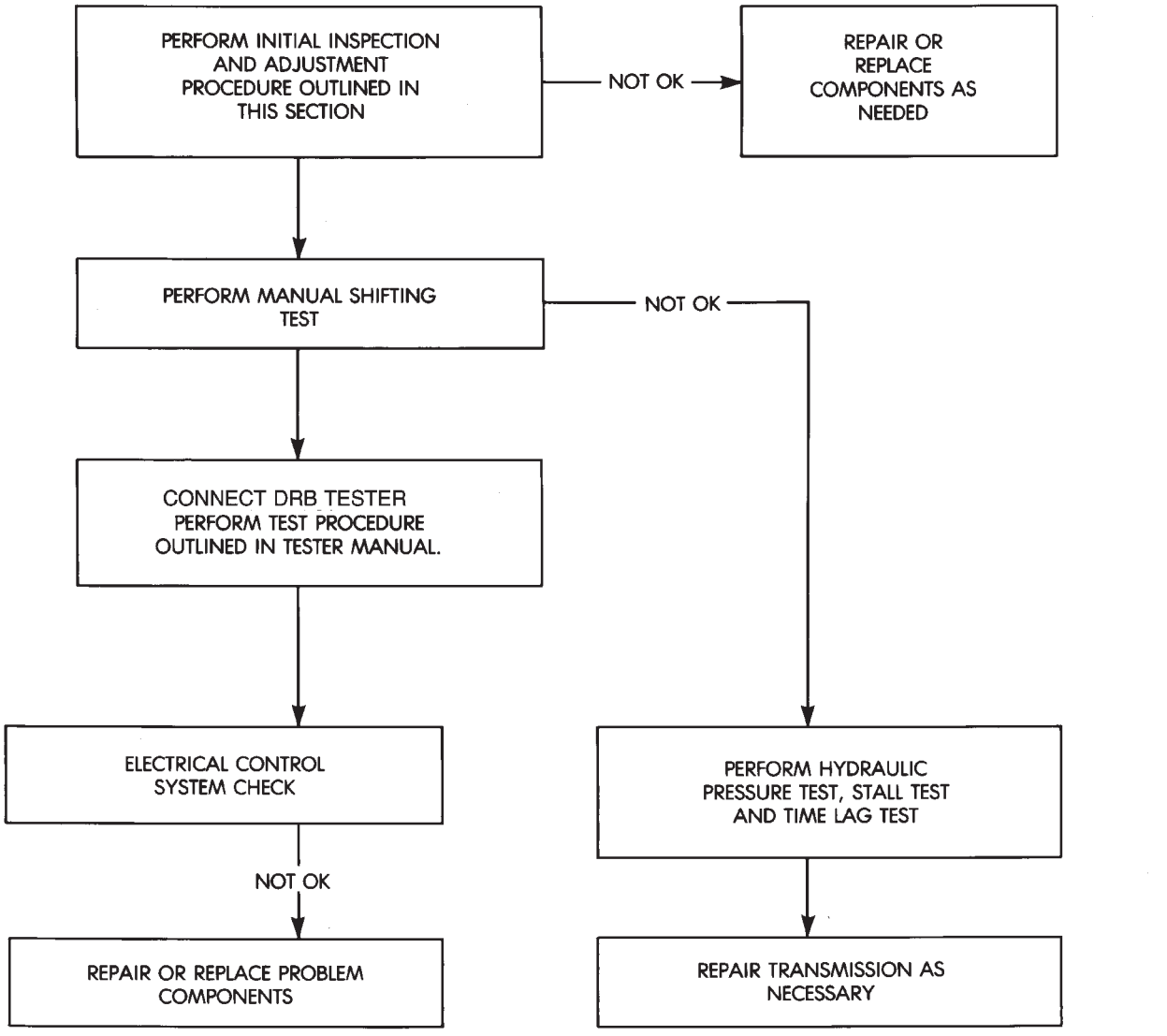

Fig. 26 Preliminary Diagnosis Check Procedure

(2) Verify transmission throttle cable operation. Repair or replace cable if necessary.

(3) Check engine throttle operation. Operate accelerator pedal and observe injector throttle plate movement. Adjust linkage if throttle plate does not reach wide open position.

(4) Check transmission fluid level when fluid is at normal operating temperature. Start engine. Shift transmission through all gear ranges then back to Neutral. Correct level is to Full or Add mark on dipstick with engine at curb idle speed.

(5) Check and adjust park/neutral position switch if necessary.

(6) Check throttle position sensor adjustment and operation. Adjust the sensor if necessary.

MANUAL SHIFTING TEST

(1) This test determines if problem is related to mechanical or electrical component.

(2) Stop engine and disconnect transmission control module or module fuse.

(3) Road test vehicle. Shift transmission into each gear range. Transmission should operate as follows:

- lock in Park
- back up in Reverse
- not move in Neutral
- provide first gear only with shift lever in 1-2 position
- operate in third gear only with shift lever in 3 position
- operate in overdrive fourth gear in D position

(4) If transmission operates as described, proceed to next step. However, if forward gear ranges were difficult to distinguish (all feel the same), or vehicle would not back up, refer to diagnosis charts. Do not perform stall or time lag tests.

CAUTION: Do not overspeed the engine during the next test step. Ease off the throttle and allow the vehicle to slow before downshifting.

(5) Continue road test. Manually downshift transmission from D to 3, and from 3 to 1-2 position. Then manually upshift transmission through forward ranges again.

(6) If transmission operation is OK, perform stall, time lag and pressure tests. If transmission shifting problem is encountered, refer to diagnosis charts.

(7) If a problem still exists, continue testing with DRB II scan tool.

HYDRAULIC PRESSURE TEST

PRESSURE TEST PROCEDURE

(1) Connect pressure test gauge to test port on passenger side of transmission. Use Adapter 7554 to connect gauge. Be sure test gauge has minimum capacity of 300 psi (2100 kPa).

(2) Be sure transmission fluid is at normal operating temperature.

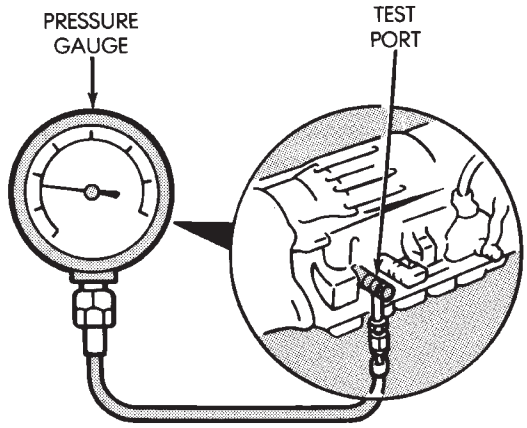

Fig. 27 Pressure Test Gauge Connection

(3) Apply parking brakes and block wheels.

WARNING: DO NOT ALLOW ANYONE TO STAND AT THE FRONT OR REAR OF THE VEHICLE WHILE PERFORMING THE FOLLOWING STEPS IN THE PRESSURE TEST.

(4) Check and adjust engine curb idle speed.

(5) Apply service brakes.

(6) Shift transmission into D range and note line pressure with engine at curb idle speed. Pressure should be 61-to-70 psi (421-to-481 kPa).

(7) Press accelerator pedal to wide open throttle position and note line pressure. Pressure should be 173-to-209 psi (1196-to-1442 kPa).

CAUTION: Do not maintain wide open throttle for more than three or four seconds at a time.

(8) Shift transmission into Reverse and note line pressure with engine at curb idle speed. Pressure should be 75-to-90 psi (519-to-618 kPa).

(9) Press accelerator to wide open throttle position and note line pressure in Reverse. Pressure should be 213-to-263 psi (1471-to-1814 kPa).

CAUTION: Do not maintain wide open throttle for more than three or four seconds at a time.

(10) If line pressure is not within specifications, adjust transmission throttle cable and repeat pressure test.

PRESSURE TEST ANALYSIS

If pressures in D and Reverse are higher than specified, check for the following:

- throttle cable loose, worn, binding or out of adjustment
- throttle valve, downshift plug, throttle cam, or primary regulator valve are sticking, worn or damaged

If pressures in D and Reverse are lower than specified, check for following:

- throttle cable loose, worn, binding or out of adjustment
- throttle valve, downshift plug, throttle cam sticking, worn or damaged
- primary regulator valve sticking, worn, or damaged
- oil pump gears or housing worn or damaged
- overdrive clutch worn or damaged

If pressures are low in D range only, check for following:

- forward clutch worn or damaged
- fluid leakage in D range circuit (component seal and O-rings)

If pressures are low in Reverse only, check for following:

- shift cable and manual valve out of adjustment
- fluid leakage in reverse circuit (component seal and O-rings)
- direct clutch worn or damaged
- first/reverse brake worn or damaged

TORQUE CONVERTER STALL TEST

Stall testing checks the holding ability of the transmission clutches and brakes and of the torque converter stator overrunning clutch.

(1) Be sure transmission fluid is at normal operating temperature.

(2) Connect tachometer to engine. Position tachometer so it can be viewed from drivers seat.

(3) Apply parking brakes and block wheels.

(4) Apply and hold service brakes.

(5) Shift transfer case into 2H position. On models with NP249 transfer case, leave transfer case in 4H position.

(6) Start engine.

WARNING: DO NOT ALLOW ANYONE TO STAND AT THE FRONT OR REAR OF THE VEHICLE DURING THE TEST.

(7) Shift transmission into D range.

(8) Press accelerator pedal to wide open throttle position and note maximum engine rpm. Stall speed should be 2100 to 2400 rpm in D range.

CAUTION: Do not maintain wide open throttle for more than 3-4 seconds at a time.

(9) Release throttle and shift transmission into Neutral. Allow transmission fluid to cool for 15-20 seconds.

(10) Shift transmission into Reverse.

(11) Press accelerator down to wide open throttle position and note maximum engine rpm. Stall speed should be 2100-to-2400 rpm in Reverse.

STALL SPEED TEST ANALYSIS

If engine rpm is lower than specified in D and Reverse, check for the following:

- engine output/performance insufficient
- stator overrunning clutch in torque converter not holding if engine speed was 1500 rpm or less.

If stall speed in D range is higher than specified, check for the following:

- line pressure low
- forward clutch slipping
- No. 2 one-way clutch not holding
- overdrive one-way clutch not holding

If stall speed in Reverse was higher than specified, check for the following:

- line pressure low
- direct clutch slipping
- first/ reverse brake slipping
- overdrive one-way clutch not holding

If stall speeds were higher than specified in both D and Reverse, check for the following:

- low fluid level
- line pressure low
- overdrive one-way clutch not holding

TIME LAG TEST

This test checks general condition of the overdrive clutch, forward clutch, rear clutch and first/reverse brake. Condition is indicated by the amount of time required for clutch/brake engagement with the engine at curb idle speed. Engagement time is measured for D and Reverse positions. A stop watch is recommended for test accuracy.

TEST PROCEDURE

(1) Check and adjust transmission fluid level if necessary.

(2) Bring transmission to normal operating temperature.

(3) Apply parking brakes and turn off air conditioning unit.

(4) Shift transfer case into 2H range. On models with NP249 transfer case, leave transfer case in 4H range.

(5) Start engine and check curb idle speed. Adjust speed if necessary. Curb idle must be correct to ensure accurate test results.

(6) Shift transmission into Neutral and set stop watch.

(7) During following test steps, start stop watch as soon as shift lever reaches D and Reverse ranges.

(8) Shift transmission into D range and record time it takes for engagement. Repeat test two more times.

(9) Reset stop watch and shift transmission back to Neutral.

(10) Shift transmission into Reverse and record time it takes for engagement. Repeat test two more times.

(11) Engagement time in D range should be a maximum of 1.2 seconds. Engagement time for Reverse should be a maximum of 1.5 seconds.

TIME LAG TEST ANALYSIS

If engagement time is longer than specified for D range, check for the following:

- shift cable misadjusted
- line pressure low
- forward clutch worn
- overdrive clutch worn or damaged

If engagement time is longer than specified for Reverse, check for the following:

- shift cable misadjusted
- line pressure low
- direct clutch worn
- first/reverse brake worn
- overdrive clutch worn or damaged

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
VEHICLE WILL NOT BACK UP OR MOVE FORWARD	Shift cable out of adjustment or damaged Valve body or primary regulator faulty Park lock pawl faulty Torque converter faulty Converter drive plate broken Oil pump intake screen blocked Transmission faulty	Adjust cable or replace cable Inspect/repair valve body Repair park pawl Replace torque converter Replace drive plate Clean screen Disassemble and repair transmission
SHIFT LEVER POSITION INCORRECT	Shift cable out of adjustment Manual valve and lever faulty	Adjust cable Repair valve body
HARSH ENGAGEMENT	Throttle cable out of adjustment Valve body or primary regulator faulty Accumulator pistons faulty Transmission faulty	Adjust throttle cable Repair valve body Repair pistons Disassemble and repair transmission
DELAYED 1-2, 2-3 OR 3-4 UP-SHIFT, OR DOWN-SHIFTS FROM 4-3 OR 3-2 AND SHIFTS BACK TO 4 OR 3	Electronic control problem Valve body faulty Solenoid faulty	Locate problem with DRB II Tester Repair valve body Repair solenoid
SLIPS ON 1-2, 2-3 OR 3-4 UP-SHIFT, OR SLIPS OR SHUDDERS DURING ACCELERATION	Shift cable out of adjustment Throttle cable out of adjustment Valve body faulty Solenoid faulty Transmission faulty	Adjust cable Adjust cable Repair valve body Replace solenoid Disassemble and repair transmission
DRAG OR BIND ON 1-2, 2-3 OR 3-4 UP-SHIFT	Shift cable out of adjustment Valve body faulty Transmission faulty	Adjust cable Repair valve body Disassemble and repair transmission
CONVERTER CLUTCH DOES NOT ENGAGE IN 2ND, 3RD OR 4TH	Electronic control problem Valve body faulty Solenoid faulty Transmission faulty	Check with DRB II Tester Repair valve body Replace solenoid Disassemble and repair transmission
HARSH DOWN-SHIFT	Throttle cable out of adjustment Throttle cable and cam faulty Accumulator pistons faulty Valve body faulty Transmission faulty	Adjust cable Replace cable and cam Repair pistons Repair valve body Disassemble and repair transmission
NO DOWN-SHIFT WHEN COASTING	Valve body faulty Solenoid faulty Electronic control problem	Repair valve body Replace solenoid Locate problem with DRB II Tester

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SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
DOWN-SHIFT LATE OR EARLY DURING COAST	Throttle cable faulty Valve body faulty Transmission faulty Solenoid faulty Electronic control problem	Replace cable Repair valve body Disassemble and repair transmission Replace solenoid Locate problem with DRB II Tester
NO 4-3, 3-2 OR 2-1 KICKDOWN	Solenoid faulty Electronic control problem Valve body faulty	Replace solenoid Locate problem with DRB II Tester Repair valve body
NO ENGINE BRAKING IN 1-2 POSITION	Solenoid faulty Electronic control problem Valve body faulty Transmission faulty	Replace solenoid Locate problem with DRB II Tester Repair valve body Disassemble and repair transmission
VEHICLE DOES NOT HOLD IN PARK	Shift cable out of adjustment Parking lock pawl cam and spring faulty	Adjust cable Replace cam and spring
OVERHEAT DURING NORMAL OPERATION (FLUID DISCOLORED, SMELLS BURNED)	Low fluid level	Add fluid and check for leaks
	Fluid cooler, lines blocked, or cooler cracked (oil in engine coolant)	Flush cooler and lines and replace radiator if transmission fluid has entered coolant
OVERHEAT DURING COMMERCIAL OPERATION OR WHILE TRAILER TOWING (FLUID DARK AND BURNED WITH SOME SLUDGE FORMATION)	Vehicle not properly equipped for trailer towing or commercial use	Be sure vehicle is equipped with recommended optional components (i.e., HD springs, transmission, axle, larger CID engine, auxiliary cooler, correct axle ratio, etc.). If vehicle is not so equipped, it should not be used for severe service operation
	Vehicle not equipped with auxiliary fluid cooler	Drain fluid, change filter, and install auxiliary cooler
	Extensive idling time or operation in heavy traffic in hot weather	Cut down on idling time; shift into neutral every so often and run engine at 1000 rpm to help circulate fluid through cooler
	Tow vehicle overloaded (exceeding vehicle tow capacity)	Be sure vehicle is properly equipped to handle load; do not tow Class III-type loads with a vehicle that is only rated for Class I or II operation
	Air flow to auxiliary cooler blocked by snow plow, front mounted spare tire, bug screen, or similar item	Remove or reposition item causing air flow blockage
OIL COMES OUT FILLER TUBE	Transmission overfilled	Drain fluid to correct level; remove neutral switch and drain through switch hole with suction gun
	Breather vent in oil pump blocked	Inspect and clear blockage
	Fluid cooler or cooler lines plugged	Flush cooler and lines

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AW-4 IN-VEHICLE SERVICE

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CHECKING FLUID LEVEL AND CONDITION

Recommended fluid for AW-4 transmissions is Mopar Dexron IIE/Mercon. Mopar Dexron II may be used if Mercon fluid is not readily available.

CHECKING FLUID LEVEL

(1) Be sure transmission fluid is at normal operating temperature. Normal operating temperature is reached after approximately 15 miles (25 km) of operation.

(2) Position vehicle on level surface. This is important for an accurate fluid level check.

(3) Shift transmission through all gear ranges and back to Park.

(4) Apply parking brakes.

(5) Verify that transmission is in Park.

(6) Wipe off dipstick handle to prevent dirt from entering fill tube. Then remove dipstick and check fluid level and condition.

(7) Correct fluid level is **to FULL mark on dipstick when fluid is at normal operating temperature** (Fig. 1).

(8) If fluid level is low, top off level with Mopar Dexron IIE/Mercon. Mopar Dexron II may also be used if Mercon is not available. **Do not overfill transmission. Add only enough fluid to bring level to Full mark.**

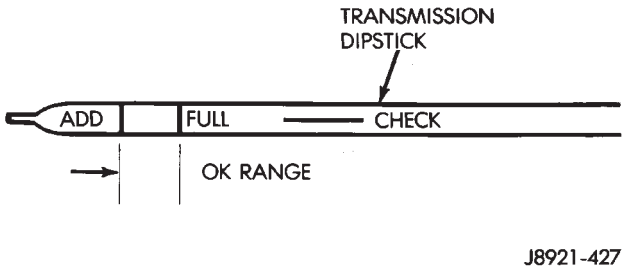

Fig. 1 Transmission Fluid Level

CHECKING FLUID CONDITION

Inspect the appearance of the fluid during the fluid level check. The fluid should be clear and free of foreign material or particles. If the fluid is dark brown or black in color and smells burnt, the fluid has been overheated and should be replaced.

Transmission operation should also be checked if the fluid is severely discolored and contains quantities of foreign material, metal particles, or clutch disc friction material.

A small quantity of friction material or metal particles in the oil pan is normal. The particles are usually generated during the break-in period and indicate normal seating of the various transmission components.

TRANSMISSION CONTROL MODULE (TCM) SERVICE

Use the DRB II scan tool to diagnose transmission control module function whenever a fault is suspected. Replace the module only when actually faulty.

TRANSMISSION CONTROL MODULE REPLACEMENT

The transmission control module is mounted under the instrument panel. On left hand drive models, it is at the driver side of the lower finish panel (Fig. 2). On right hand drive models, it is at the passenger side of the lower finish panel (Fig. 3).

To remove the module, disconnect the wire harness, remove the mounting screws and remove the module from the finish panel. Tighten the module mounting screws securely after installation. Also be sure the wire harness is not twisted, kinked or touching any body panels.

PARK/NEUTRAL POSITION SWITCH

SWITCH TESTING

Test switch continuity with an ohmmeter. Disconnect the switch and check continuity at the connector terminal positions and in the gear ranges indicated in Figure 3. Switch continuity should be as follows:

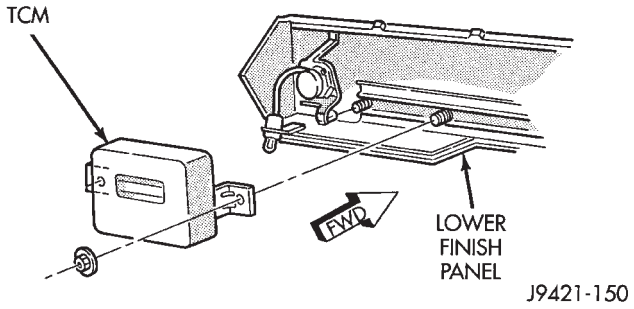

Fig. 2 Transmission Control Module Location And Mounting (Left Hand Drive)

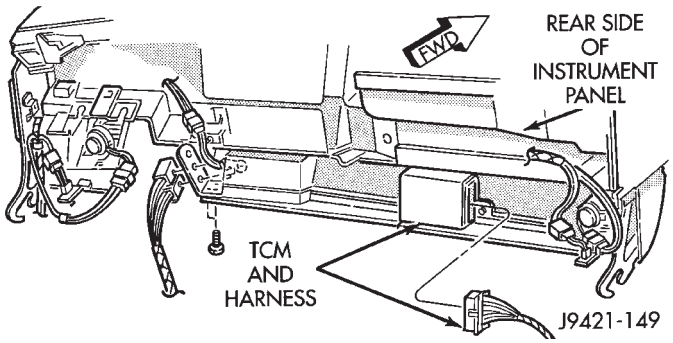

Fig. 3 Transmission Control Module Location And Mounting (Right Hand Drive)

- Continuity should exist between terminals B and C with the transmission in Park and Neutral only (Fig. 4).
- Continuity should exist between terminals A and E with the transmission in Reverse (Fig. 4).
- Continuity should exist between terminals A and G with the transmission in third gear (Fig. 4).
- Continuity should exist between terminals A and H with the transmission in first and/or second gear (Fig. 4).
- Continuity should not exist in D position.

PARK/NEUTRAL POSITION SWITCH REMOVAL

(1) Raise vehicle.

(2) Disconnect switch wire harness connector.

(3) Pry washer lock tabs upward and remove switch attaching nut and tabbed washer (Fig. 5).

(4) Remove switch adjusting bolt (Fig. 5).

(5) Slide switch off manual valve shaft.

PARK/NEUTRAL POSITION SWITCH INSTALLATION AND ADJUSTMENT

(1) Disconnect shift linkage rod from shift lever on left side of transmission.

(2) Rotate manual shift lever all the way rearward. Then rotate lever forward two detent positions to Neutral.

(3) Install switch on manual valve shaft and install switch adjusting bolt finger tight. Do not tighten bolt at this time.

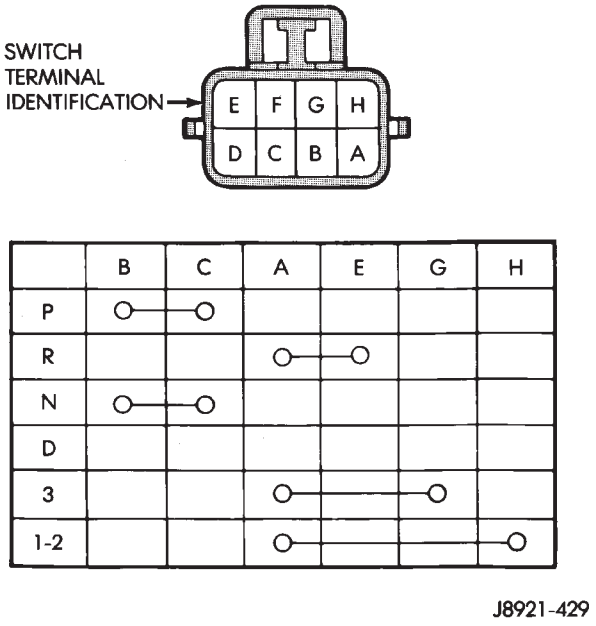

Fig. 4 Park/Neutral Position Switch Terminals And Testing

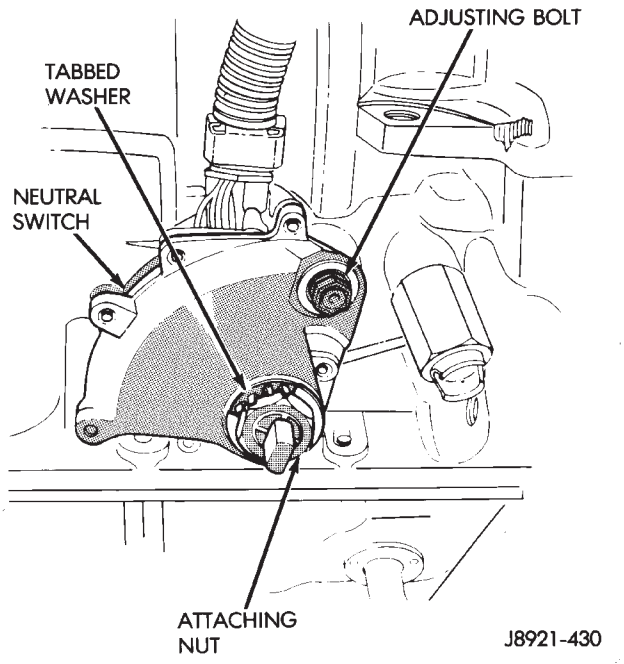

Fig. 5 Park/Neutral Position Switch Removal/ Installation

(4) Install tabbed washer on manual valve shaft and install switch attaching nut. Tighten nut to 6.9 N·m (61 in. lbs.) torque but do not bend washer lock tabs over nut at this time.

(5) Verify that transmission is in Neutral.

(6) Rotate switch to align neutral standard line with vertical groove on manual valve shaft (Fig. 6).

(7) Align switch standard line with groove or flat on manual valve shaft.

(8) Tighten switch adjusting bolt to 13 N·m (9 ft. lbs.) torque.

(9) Bend at least two washer lock tabs over switch attaching nut to secure it.

(10) Connect shift linkage rod to shift lever on left side of case.

(11) Connect switch wires to harness and lower vehicle.

(12) Check switch operation. Engine should start in Park and Neutral only.

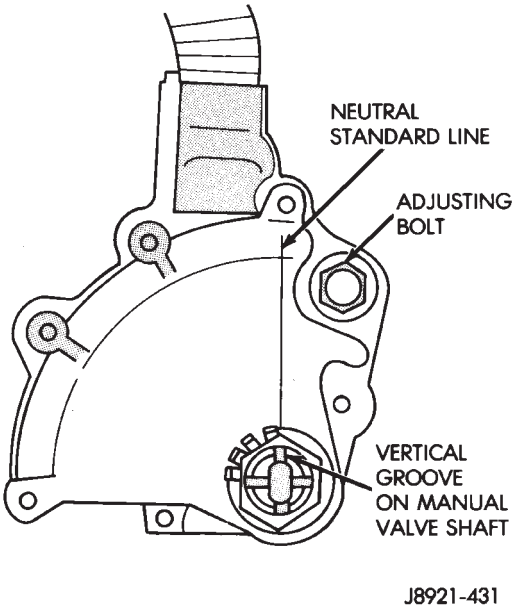

Fig. 6 Park/Neutral Position Switch Adjustment

TRANSMISSION VALVE BODY SOLENOIDS

SOLENOID REMOVAL

(1) Remove transmission oil pan drain plug and drain fluid.

(2) Remove pan bolts and remove oil pan.

(3) Remove oil screen bolts and remove screen (Fig. 7) and gasket. Discard the gasket.

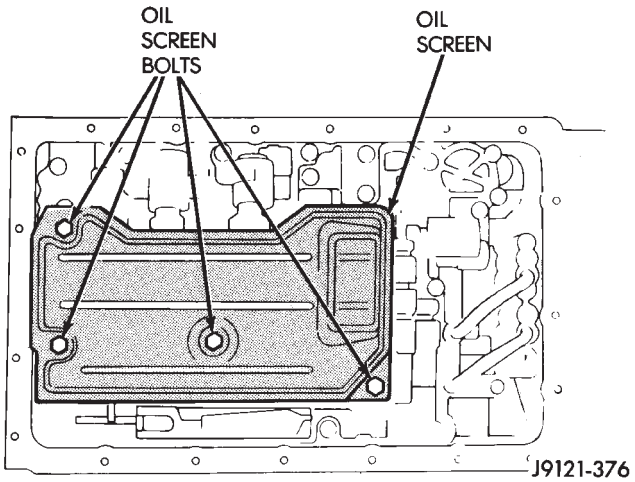

Fig. 7 Oil Screen Removal/Installation

(4) Disconnect solenoid wire connector (Fig. 8).

(5) If all solenoids are being removed, mark or tag wires for assembly reference before disconnecting them.

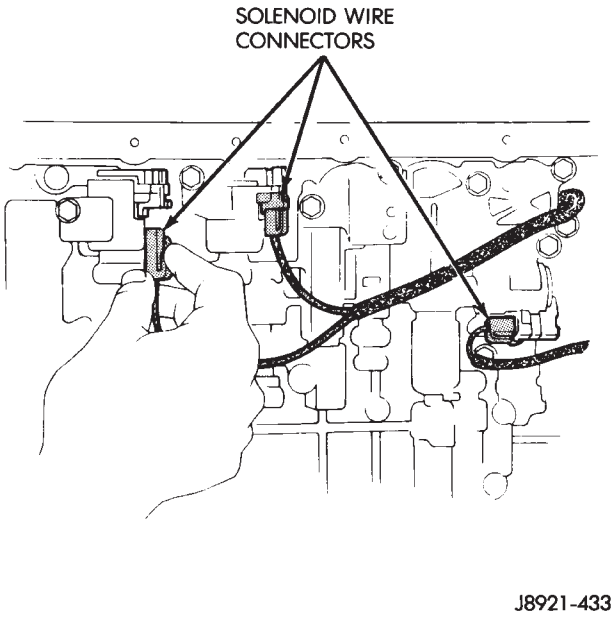

Fig. 8 Solenoid Wire Connectors

(6) Remove bolt attaching solenoids to valve body and remove solenoids (Fig. 9). Do not allow any valve body components to fall out when solenoids are removed.

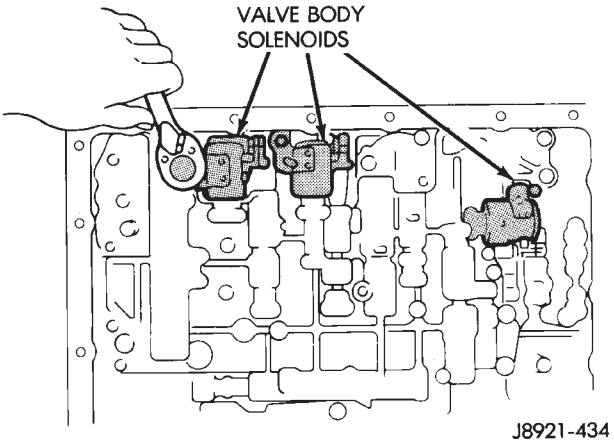

Fig. 9 Transmission Valve Body Solenoids

(7) Clean oil filter and pan with solvent and dry with compressed air.

(8) Remove old sealer material from oil pan and transmission case.

Solenoid Testing

Test solenoid resistance with an ohmmeter. Connect the ohmmeter leads to the solenoid mounting bracket and to the solenoid wire terminal (Fig. 10).

Solenoid resistance should be 11-15 ohms. Replace the solenoid if resistance is above or below the specified range.

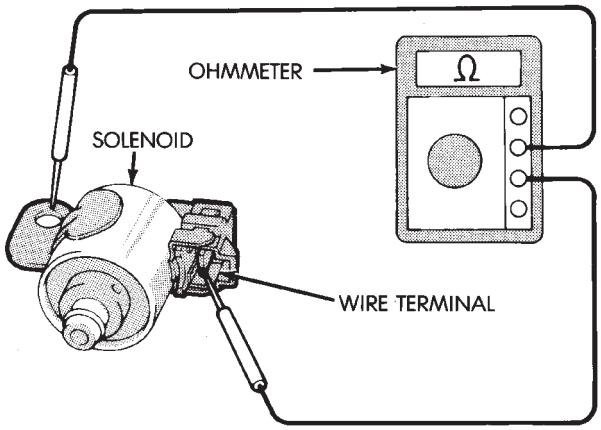

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Fig. 10 Testing Transmission Valve Body Solenoid

SOLENOID INSTALLATION

(1) Position solenoids on valve body and install solenoid bolts. Tighten bolts to 10 N·m (7 ft. lbs.) torque.

(2) Connect feed wires to solenoids.

(3) Install new gaskets on oil screen and install screen. Tighten screen bolts to 10 N·m (7 ft. lbs.) torque.

(4) Apply bead of Three-Bond TB 1281 or equivalent sealer to oil pan sealing surface. Sealer bead should be at least 3.0 mm (1/8 in.) wide.

(5) Install oil pan on transmission. Tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(6) Install and tighten oil pan drain plug to 20 N·m (15 ft. lbs.) torque.

(7) Fill transmission with Mopar Mercon or Dexron II.

SOLENOID HARNESS ADAPTER SEAL REPLACEMENT

(1) Remove oil pan and oil screen. Refer to Solenoid Removal procedure.

(2) Disconnect solenoid wire connectors (Fig. 8).

(3) Remove bracket securing solenoid harness adaptor (Fig. 11) to case.

(4) Pull harness adapter and wires out of case.

(5) Remove and discard adapter O-ring.

(6) Lubricate new O-ring and install it on adapter.

(7) Install solenoid wire harness and adapter in case.

(8) Install adapter bracket and bracket bolt.

(9) Connect wires to solenoids.

(10) Install oil screen and oil pan.

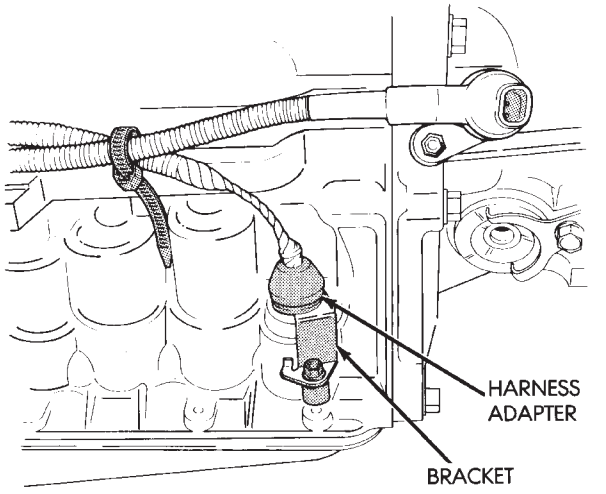

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Fig. 11 Harness Adapter Removal/Installation

TRANSMISSION VALVE BODY REMOVAL

Removal and installation are the only valve body service procedures covered in this section. Refer to the transmission overhaul section for valve body disassembly, cleaning, inspection and reassembly.

(1) Remove oil pan plug and drain transmission fluid.

(2) Remove oil pan and oil screen. Clean pan and screen in solvent and dry them with compressed air.

(3) Disconnect solenoid wire connectors (Fig. 8). Mark wires for assembly reference.

(4) Remove valve body oil tubes (Fig. 12). Carefully pry tubes out of valve body with screwdriver.

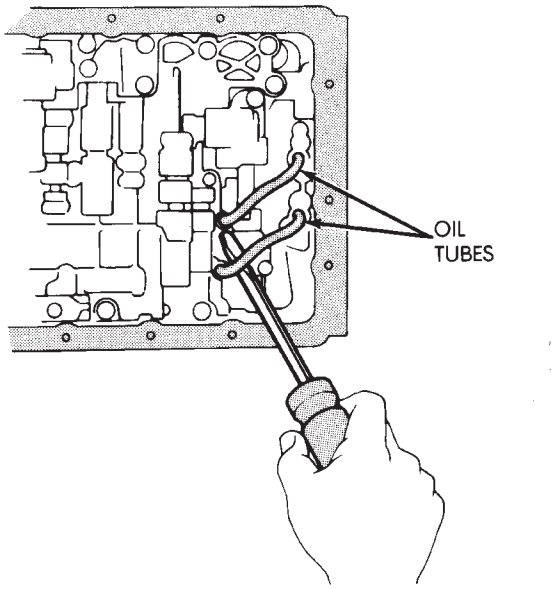

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Fig. 12 Removing Transmission Valve Body Oil Tubes

(5) Disconnect throttle cable from throttle cam (Fig. 13).

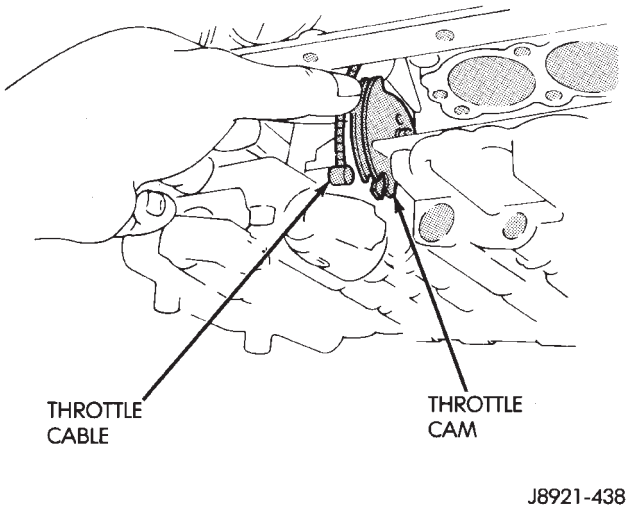


Fig. 13 Removing/Installing Throttle Cable

(6) Remove valve body bolts. Bolt locations are outlined in Figure 14.

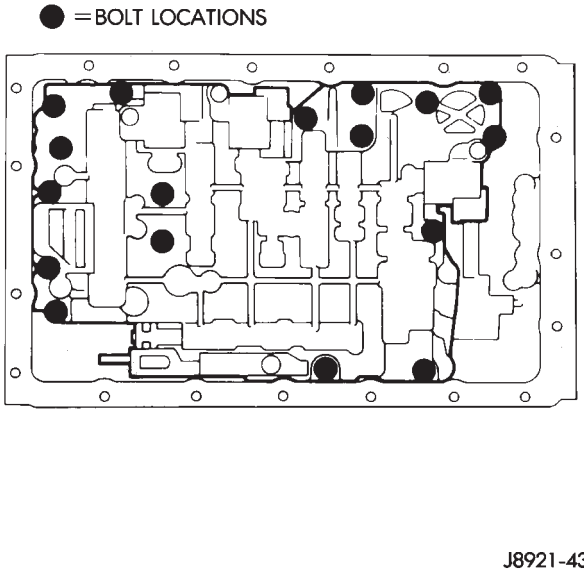


Fig. 14 Transmission Valve Body Bolt Locations

(7) Lower valve body and remove overdrive clutch accumulator springs, direct clutch accumulator springs and second brake accumulator spring (Fig. 15)

(8) Remove valve body and check ball and spring (Fig. 16).

TRANSMISSION VALVE BODY INSTALLATION

(1) Connect cable to throttle cam (Fig. 13).

(2) Install check ball and spring (Fig. 16).

(3) Position accumulator springs and spacers on valve body.

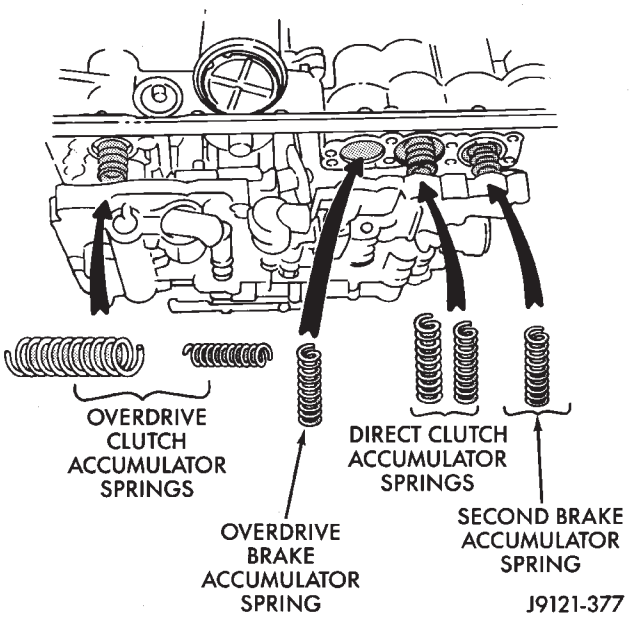


Fig. 15 Accumulator Springs

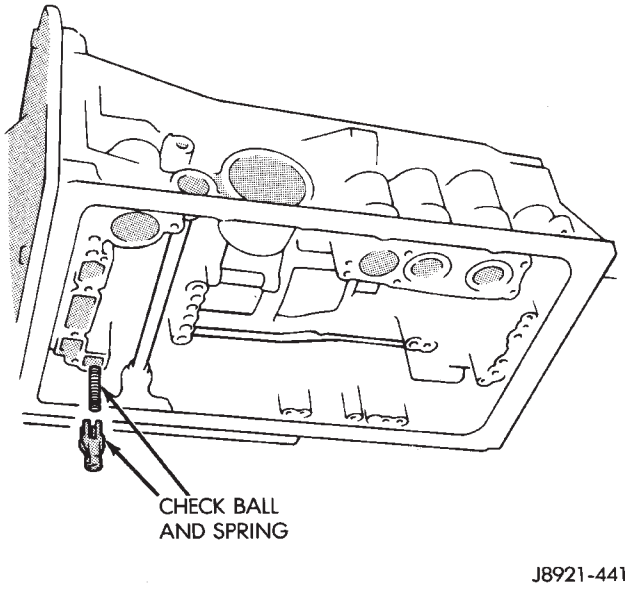


Fig. 16 Removing/Installing Check Ball And Spring

(4) Align valve body manual valve with shift sector (Fig. 17) and carefully position valve body on case.

(5) Install valve body bolts (Fig. 14). Tighten bolts evenly to 10 N·m (7 ft. lbs.) torque.

(6) Install valve body oil tubes. Be sure tube ends (L) and (M) are installed as shown in Figure 18.

(7) Remove old sealer material from oil pan and transmission case.

(8) Clean oil screen and oil pan with solvent (if not done previously). Dry both components with compressed air only. Do not use shop towels.

(9) Install new gaskets on oil screen and install screen on case. Tighten screen attaching bolts to 10 N·m (7 ft. lbs.) torque.

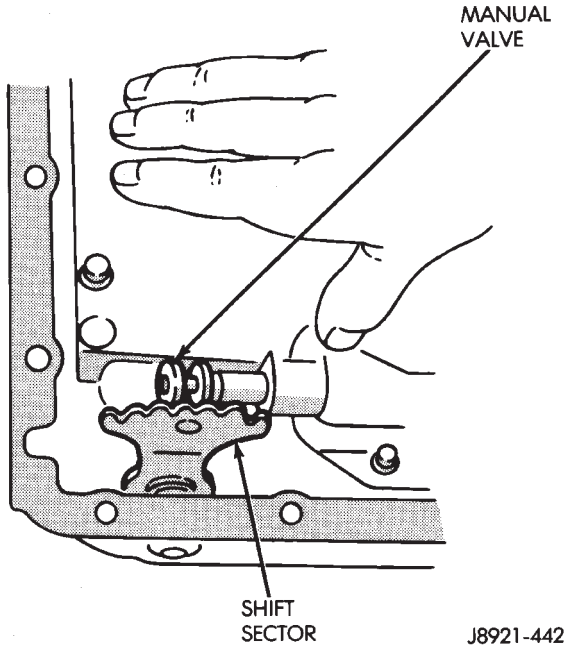


Fig. 17 Shift Sector And Manual Valve Alignment

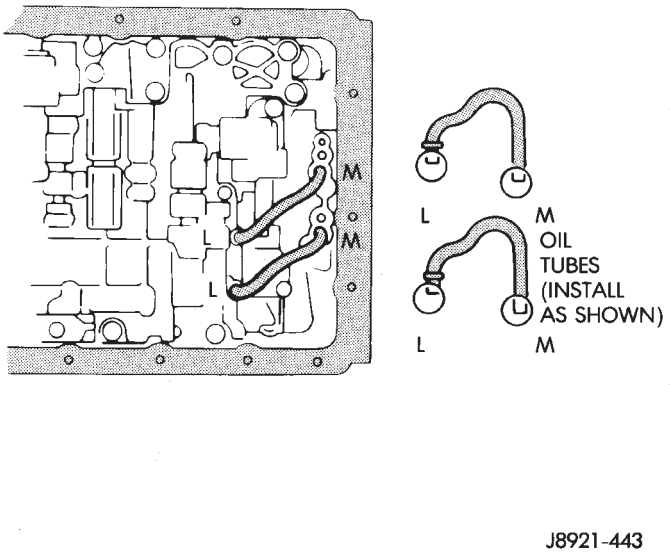


Fig. 18 Installing Transmission Valve Body Oil Tubes

(10) Apply bead of Mopar or Loctite 599 sealer to sealing surface of oil pan. Sealer bead should be at least 3 mm (1/8 in.) wide. Then install oil pan and tighten pan bolts to 7.4 N·m (65 in. lbs.) torque.

(11) Install new gasket on oil pan drain plug and install plug in pan. Tighten plug to 20 N·m (15 ft. lbs.) torque.

(12) Fill transmission with Mopar Mercon™ fluid.

MANUAL VALVE SHAFT SEAL REPLACEMENT

(1) Remove park/neutral position switch and disconnect transmission shift lever.

(2) Remove oil pan and valve body.

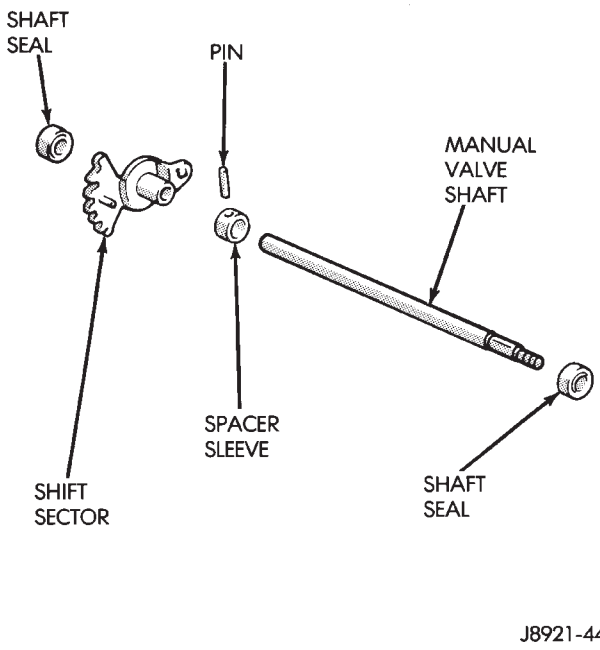


Fig. 19 Manual Valve Shaft And Seals

(3) Remove bolts attaching park rod bracket to case (Fig. 20).

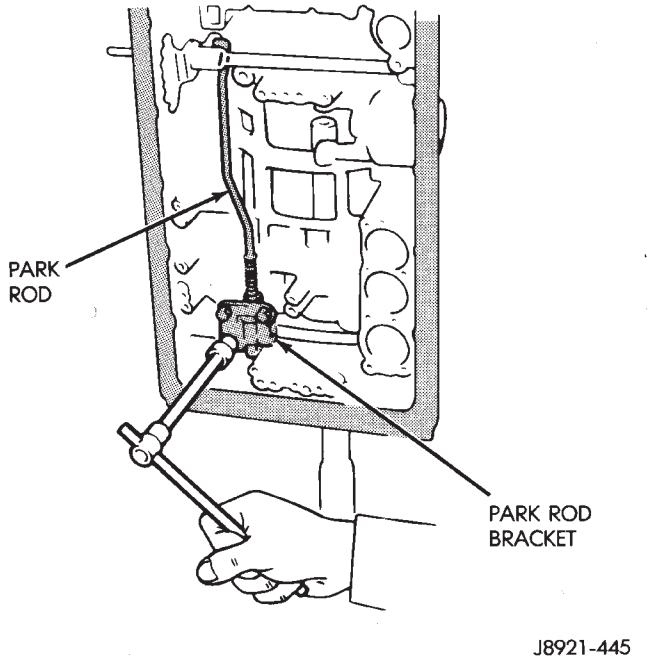


Fig. 20 Removing/Installing Park Rod Bracket

(4) Remove park rod from shift sector (Fig. 21).

(5) Cut spacer sleeve with chisel and remove it from manual valve shaft (Fig. 22).

(6) Remove pin from shaft and sector with pin punch.

(7) Remove shaft and sector from case.

(8) Pry shaft seals out of case (Fig. 23).

(9) Inspect the manual valve shaft and sector. Replace either component if worn or damaged.

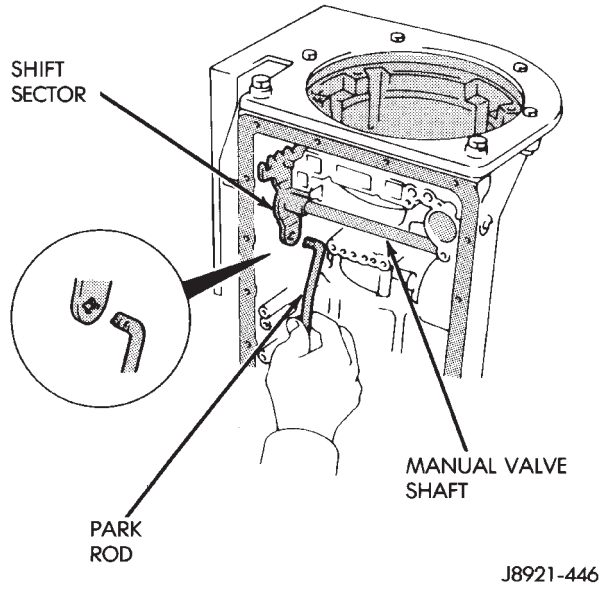


Fig. 21 Removing/Installing Park Rod

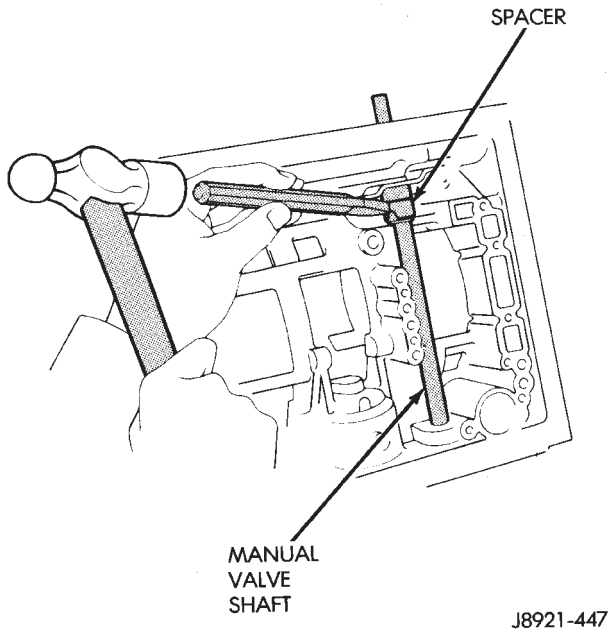


Fig. 22 Cutting Spacer Sleeve

(10) Coat replacement shaft seals with petroleum jelly and seat them in the case (Fig. 24).

(11) Install new spacer sleeve on sector (Fig. 25).

(12) Lubricate manual valve shaft with petroleum jelly and install it in case.

(13) Lubricate sector and sleeve with petroleum jelly and install them on shaft.

(14) Align hole in spacer sleeve with notch in sector. Then install shift sector roll pin. Tap pin into sector and shaft and stake sleeve to sector and shaft securely.

(15) Connect park rod to sector (Fig. 21).

(16) Install park rod bracket (Fig. 26). Tighten bracket bolts to 10 N·m (7 ft. lbs.) torque.

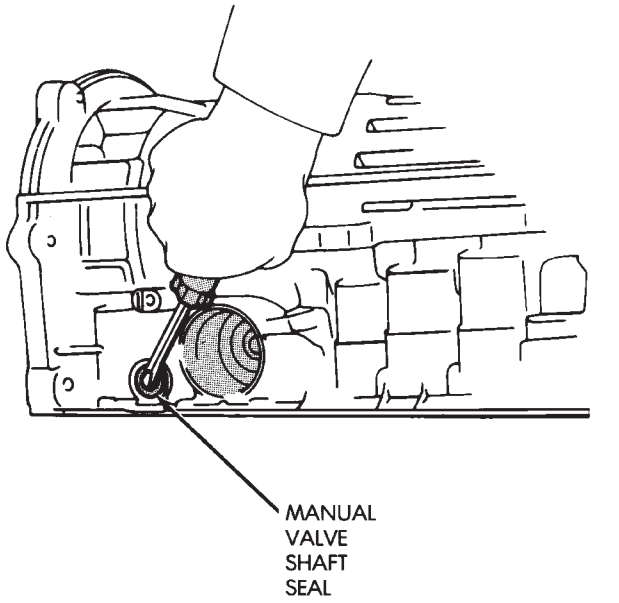


Fig. 23 Removing Manual Valve Shaft Seals

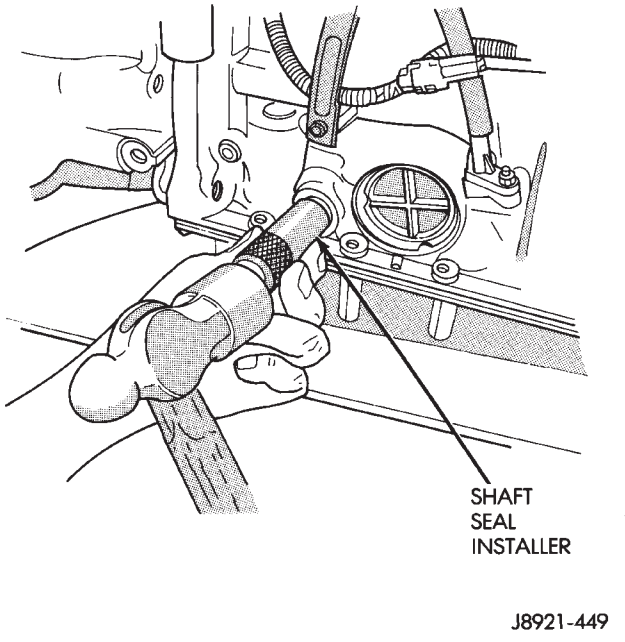


Fig. 24 Installing Manual Valve Shaft Seals

(17) Install valve body, oil screen and oil pan. Use Mopar or Loctite 599 sealer on oil pan seal surface.

(18) Install park/neutral position switch.

ACCUMULATOR PISTONS AND SPRINGS

ACCUMULATOR PISTON AND SPRING REMOVAL

(1) Remove valve body. Refer to procedure in this section.

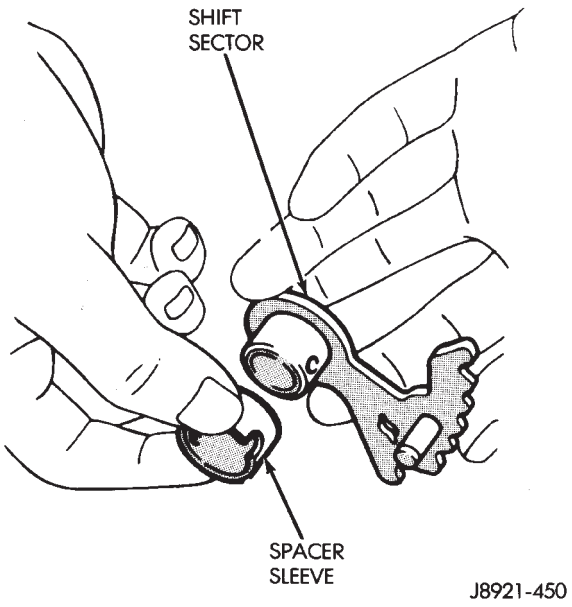


Fig. 25 Installing Spacer Sleeve On Sector

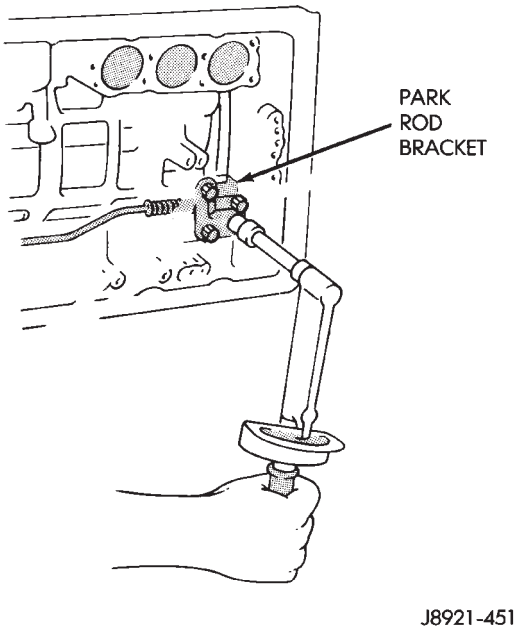


Fig. 26 Installing Park Rod Bracket

(2) Remove accumulator pistons with compressed air (Fig. 27). Apply air through small feed hole next to each piston bore. Catch each piston in a shop towel as it exits bore.

CAUTION: Use only enough air pressure to ease each piston out of the bore. In addition, remove the pistons one at a time and tag the pistons and springs for assembly reference. Do not intermix them.

(3) Remove and discard piston O-ring seals. Then clean pistons and springs with solvent.

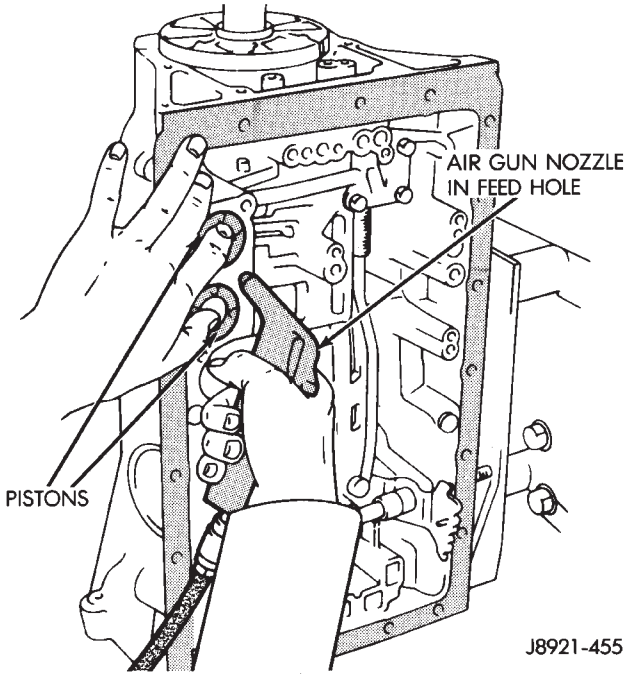


Fig. 27 Accumulator Piston Removal

(4) Inspect pistons, springs and piston bores. Replace worn damaged pistons. Replace broken, collapsed or distorted springs. Replace case if piston bores are damaged.

(5) If small cushion spring in any piston must be replaced, remove spring retainer clip and remove spring from piston (Fig. 28). A small hooked tool or small thin blade screwdriver can be used to remove clip. A thin wall, deep socket, or pin punch can be used to reseat clip after spring replacement.

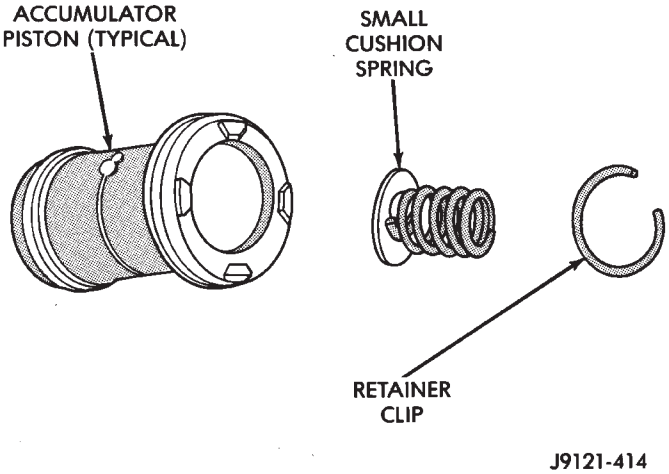
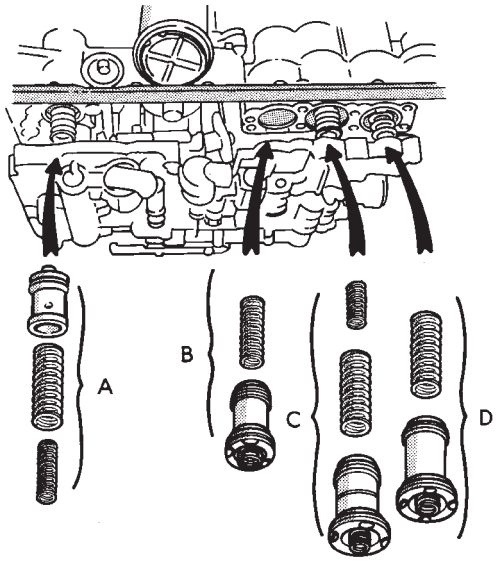


Fig. 28 Small Cushion Spring Retention

(6) Install new O-ring seals on pistons. Lubricate seals and pistons and piston bores with transmission fluid.

(7) Install pistons and springs (Fig. 29).

(8) Install valve body, oil screen and oil pan. Use Mopar or Loctite 599 on oil pan sealing surface.



A. OVERDRIVE CLUTCH ACCUMULATOR PISTON AND SPRINGS
B. OVERDRIVE BRAKE ACCUMULATOR PISTON AND SPRINGS
C. DIRECT CLUTCH ACCUMULATOR PISTON AND SPRINGS
D. SECOND BRAKE ACCUMULATOR PISTON AND SPRINGS

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Fig. 29 Accumulator Pistons, Springs And Spacers

SECOND COAST BRAKE SERVO

SERVO OVERHAUL

(1) Remove valve body as outlined in this section.

(2) Remove servo piston cover snap ring with snap ring pliers (Fig. 30).

(3) Remove servo piston and cover with compressed air. Apply compressed air through oil hole in servo boss to ease piston out of bore (Fig. 31).

(4) Remove and discard seal and O-rings from cover and piston (Fig. 32). Inspect E-ring, piston, spring and retainer, piston rod and piston spring. Replace worn or damaged parts.

(5) Install new seals on cover and piston.

(6) Lubricate servo components with transmission fluid.

(7) Assemble and install servo components in case. Be sure servo piston rod is properly engaged in the second coast brake band.

(8) Compress cover and piston and install cover snap ring.

(9) Install valve body, oil screen and oil pan. Use Mopar or Loctite 599 on oil pan sealing surface.

PARK ROD AND PAWL SERVICE

(1) Remove valve body as outlined in this section.

(2) Remove bolts attaching park rod bracket to case (Fig. 33).

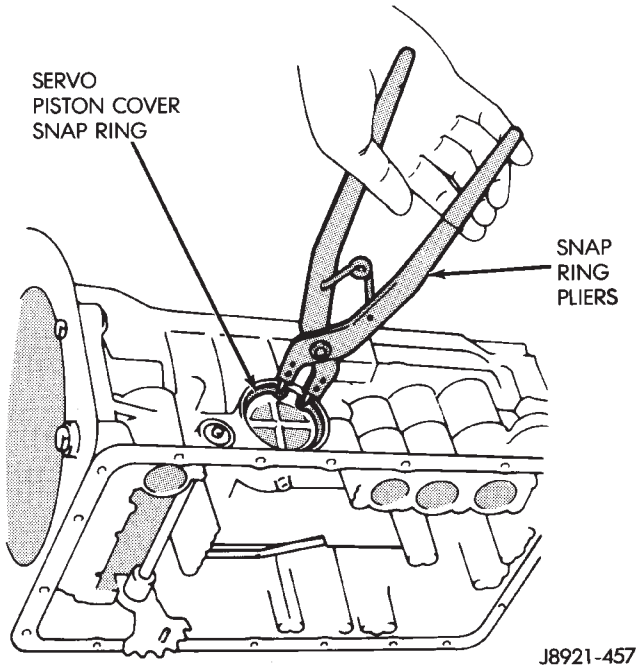

Fig. 30 Removing/Installing Servo Piston Cover Snap Ring

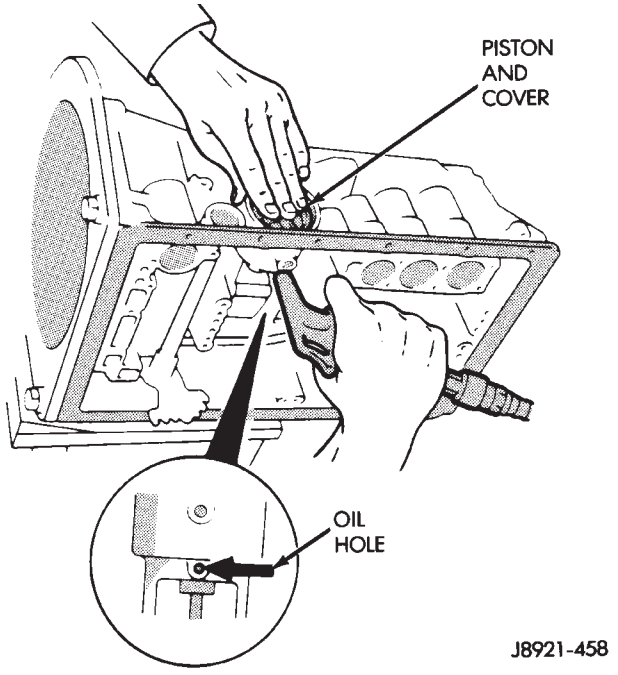

Fig. 31 Removing Servo Cover And Piston

(3) Remove park rod from manual valve shaft sector (Fig. 34).

(4) Remove park rod.

(5) Remove park pawl, pin and spring (Fig. 35).

(6) Examine park rod, pawl, pin and spring. Replace any component that is worn or damaged.

(7) Install pawl in case. Insert pin and install spring. Be sure spring is positioned as shown in Figure 35.

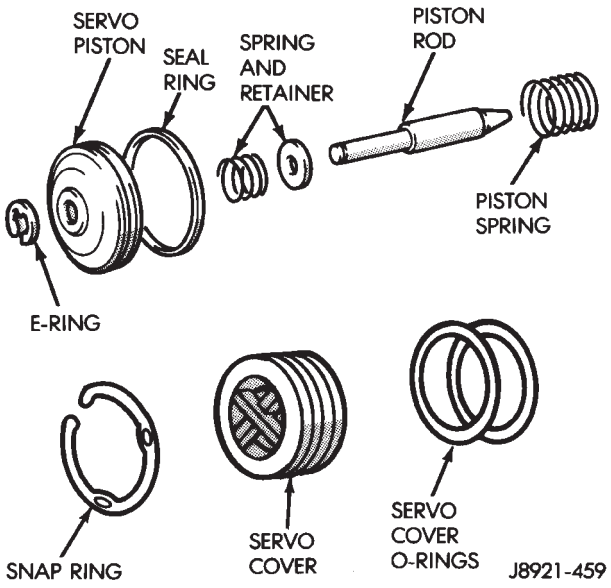

Fig. 32 Second Coast Brake Servo Components

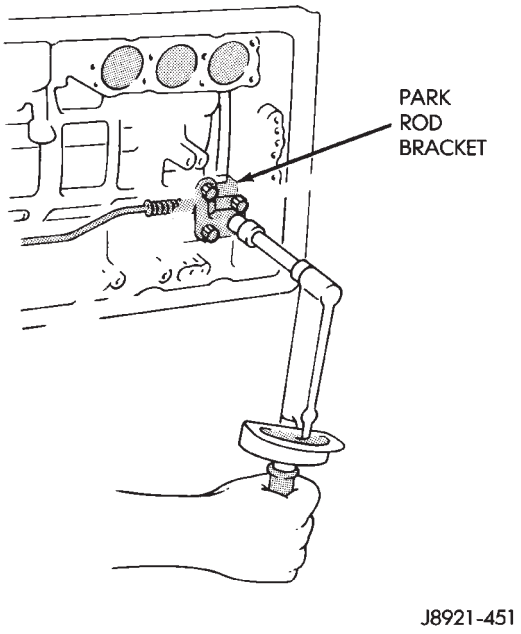

Fig. 33 Removing/Installing Park Rod Bracket

(8) Install park rod and bracket (Fig. 33). Tighten bracket bolts to 10 N·m (7 ft. lbs.) torque.

(9) Install valve body, oil screen and oil pan as outlined in this section.

ADAPTER HOUSING SEAL REPLACEMENT

(1) Raise vehicle.

(2) Disconnect or remove components necessary to gain access to seal (e.g. propeller shaft, crossmember, shift linkage, transfer case, exhaust components, hoses, wires).

(3) Remove dust shield and remove seal from adapter housing (Fig. 36).

(4) Install new seal with appropriate size seal installer and install dust shield.

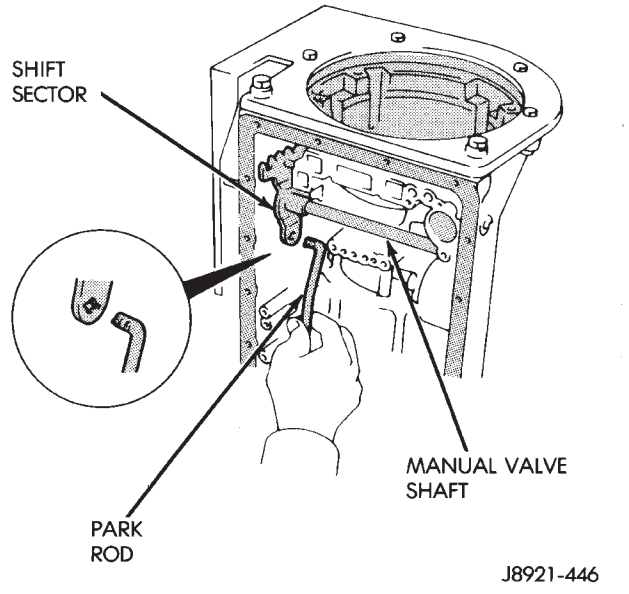

Fig. 34 Removing/Installing Park Rod

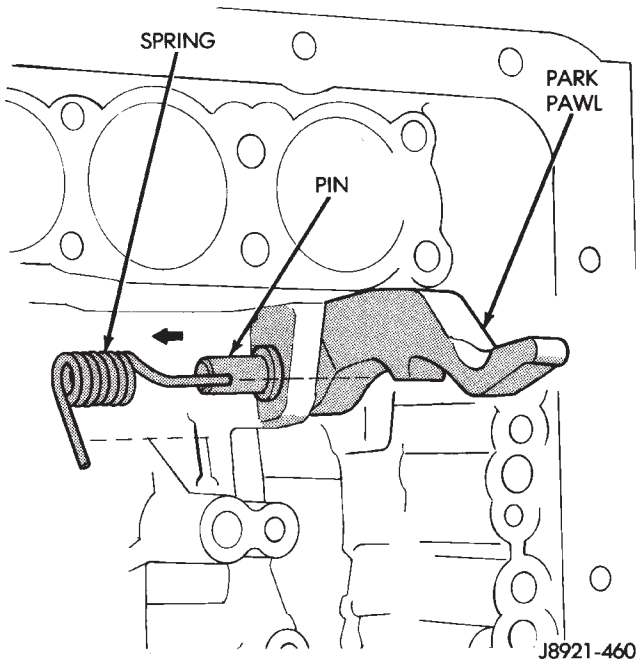

Fig. 35 Removing/Installing Park Pawl, Pin And Spring

(5) Reinstall components removed to gain access to seal.

(6) Top off transmission fluid if necessary.

SPEED SENSOR

SPEED SENSOR TESTING

Test the speed sensor with an ohmmeter. Place the ohmmeter leads on the terminals in the sensor connector (Fig. 37).

Rotate the transmission output shaft and observe the ohmmeter needle. The needle should deflect indicating the switch is opening/closing as the rotor

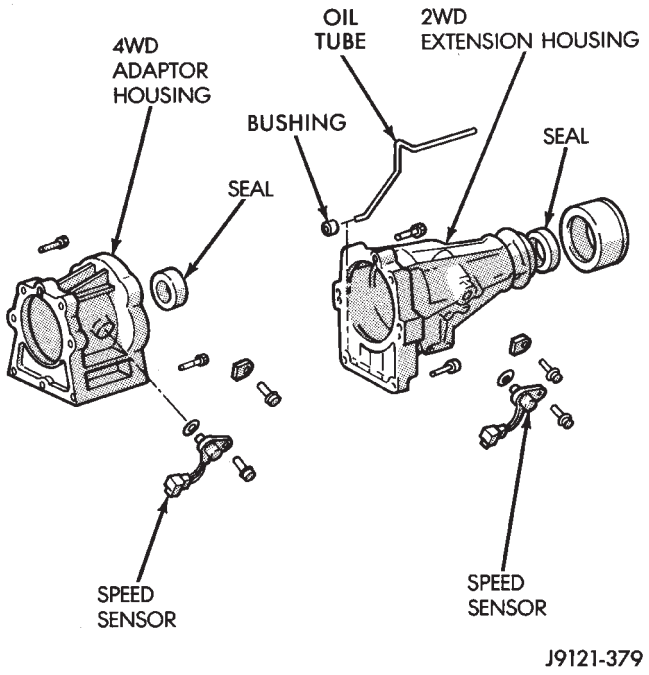

Fig. 36 Adapter Housing Seals

moves past the sensor (Fig. 37). Replace the sensor if the ohmmeter does not display any kind of reading.

If a digital ohmmeter is being used, the sensor should generate an ohmmeter readout each time the switch opens and closes.

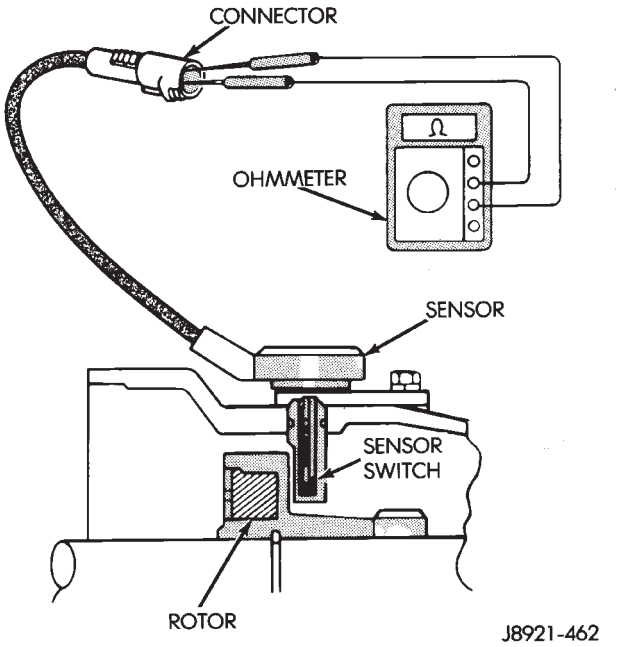

Fig. 37 Speed Sensor Testing

SPEED SENSOR REPLACEMENT

(1) Disconnect sensor wire harness connector.

(2) Remove sensor retainer bolt and remove sensor (Fig. 38).

(3) Remove and discard speed sensor O-ring.

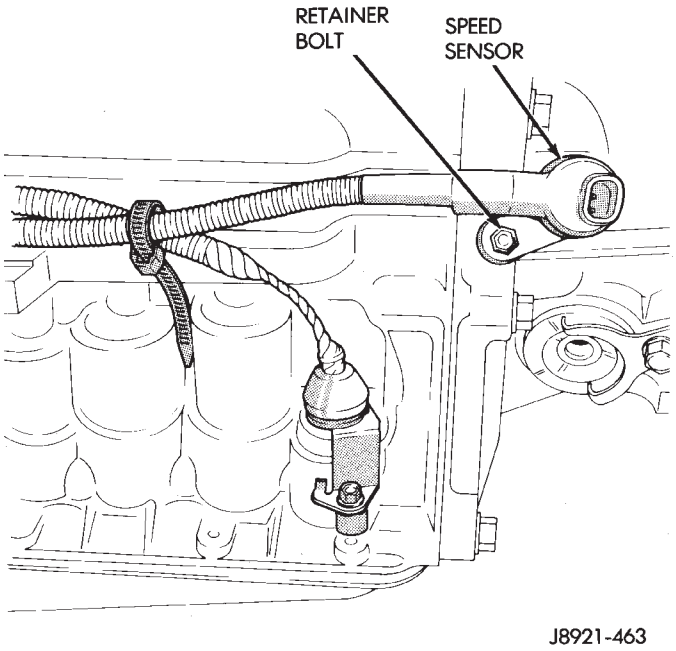

Fig. 38 Transmission Speed Sensor Removal/ Installation

(4) Install new O-ring on speed sensor and install sensor in transmission case.

(5) Install sensor bracket and retainer bolt. Tighten bolt to 7.4 N·m (65 in. lbs.) torque.

(6) Connect sensor wire harness connector.

SPEED SENSOR ROTOR—SPEEDOMETER DRIVE GEAR

ROTOR—DRIVE GEAR REMOVAL

(1) Raise vehicle.

(2) Remove components necessary to gain access to rotor and drive gear such as propeller shaft, transfer case, crossmember, and shift linkage.

(3) Disconnect speedometer cable and/or speed sensor.

(4) Remove adaptor housing.

(5) Remove speedometer drive gear snap ring (Fig. 39).

(6) Remove the speedometer drive gear and spacer (if equipped).

(7) Remove rotor by carefully prying it off output shaft with wood dowel or hammer handle (Fig. 40).

(8) Clean sealing surfaces of transmission case and extension/adaptor housing.

ROTOR AND DRIVE GEAR INSTALLATION

(1) Install rotor, spacer (if equipped) and drive gear on output shaft. Then install drive gear snap ring (Fig. 39).

(2) Apply bead of Mopar or Loctite 599 sealer, to transmission case sealing surface and install extension/adapter housing on case.

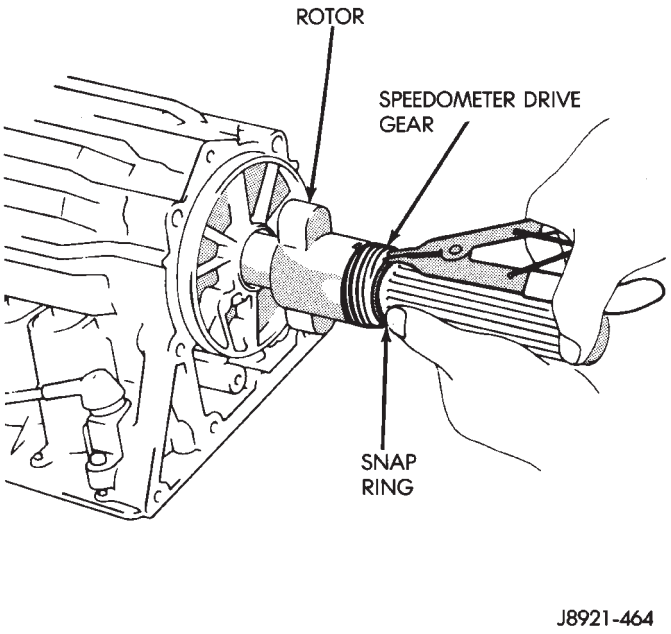

Fig. 39 Removing/Installation Speedometer Drive Gear

(3) Tighten adaptor housing bolts to 34 N·m (25 ft. lbs.) torque.

(4) Install components removed to gain access to rotor and drive gear.

THROTTLE POSITION SENSOR (TPS) SERVICE

A separate throttle position sensor is used for automatic transmission applications. The sensor is attached to the base of the throttle body. Refer to Group 14 for TPS service and adjustment.

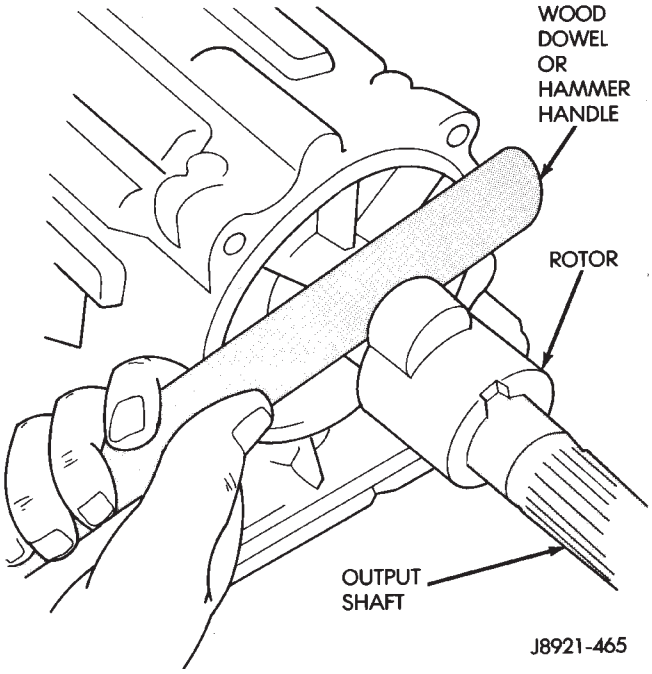

Fig. 40 Removing Speed Sensor Rotor

TRANSMISSION THROTTLE CABLE REPLACEMENT

THROTTLE CABLE REMOVAL

(1) In engine compartment, disconnect cable from throttle linkage. Then compress cable mounting ears and remove cable from engine bracket (Fig. 41).

(2) Raise vehicle.

(3) Remove transmission oil pan.

(4) Disengage cable from throttle valve cam (Fig. 42).

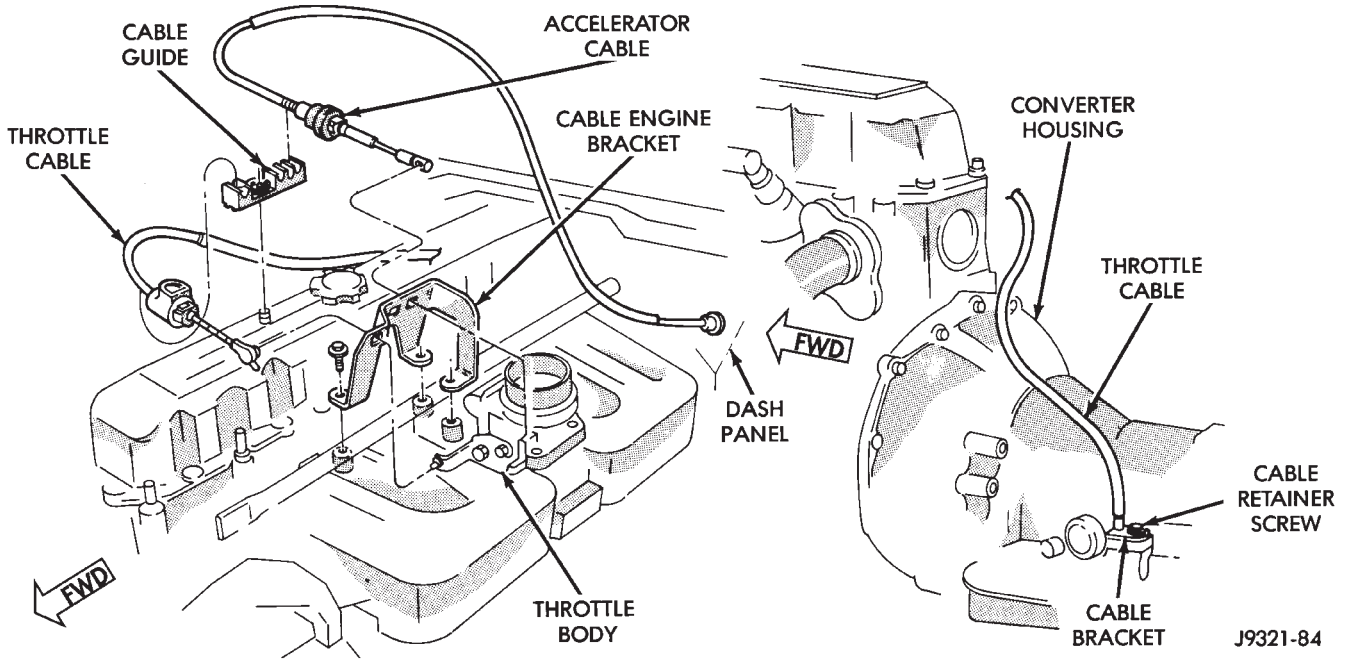

Fig. 41 Transmission Throttle Cable Attachment

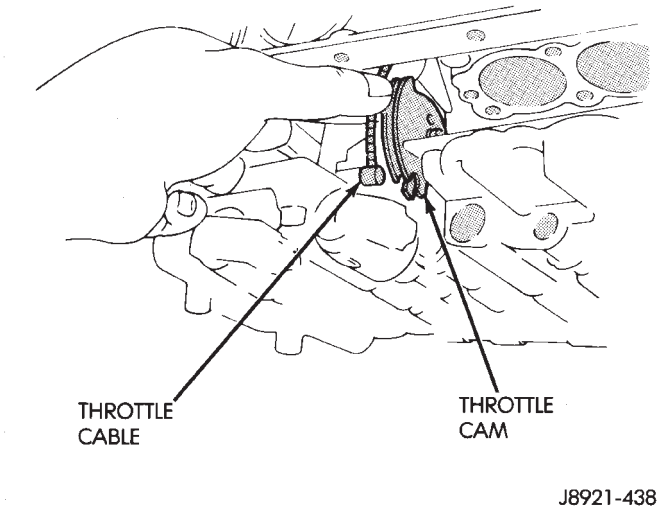

Fig. 42 Removing/Installing Transmission Throttle Cable

(5) Remove cable bracket bolt and remove cable and bracket from case (Fig. 43).

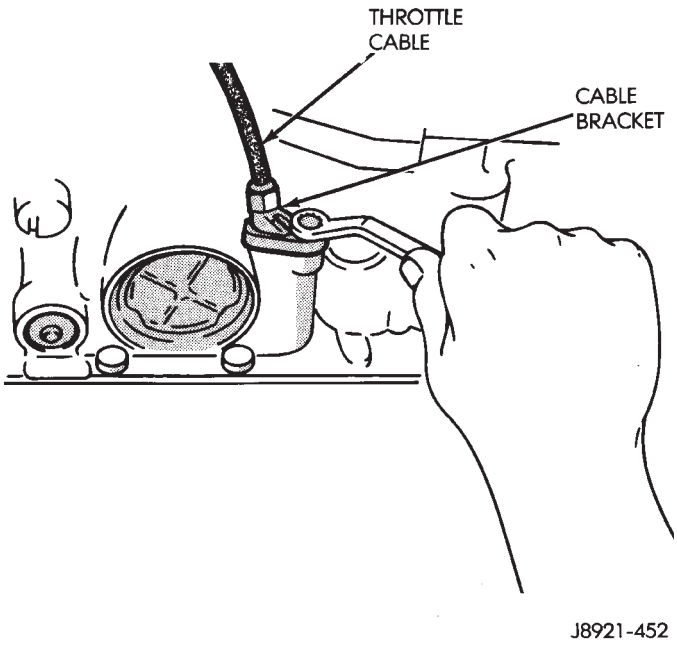

Fig. 43 Removing/Installing Transmission Throttle Cable And Bracket

(6) Remove and discard cable seal.

THROTTLE CABLE INSTALLATION

(1) Lubricate and install new seal on cable.

(2) Insert cable in transmission case.

(3) Attach cable to throttle cam (Fig. 42).

(4) Install cable bracket on case and tighten attaching bolt to 10 N·m (7 ft-lbs) torque (Fig. 43).

(5) Remove old sealer material from oil pan and transmission case. Clean oil pan with solvent and dry it with compressed air.

(6) Apply bead of Mopar or Loctite 599 sealer to oil pan sealing surface. Sealer bead should be at least 3 mm (1/8 in.) wide. Then install pan and tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(7) Install new gasket on oil pan drain plug. Install and tighten plug to 20 N·m (15 ft. lbs.) torque.

(8) Connect cable to engine bracket and throttle linkage.

(9) Fill transmission with Mopar Mercon.

(10) Adjust the cable as described in cable adjustment procedure.

TRANSMISSION THROTTLE CABLE ADJUSTMENT

(1) Shift transmission into Park, shut engine off and raise hood.

(2) Press cable release button (Fig. 44).

(3) Push cable conduit back into cable sheath as far as possible (Fig. 45).

(4) Rotate lever on throttle body to wide open throttle position. Cable will ratchet to correct adjustment point as lever is rotated (Fig. 45).

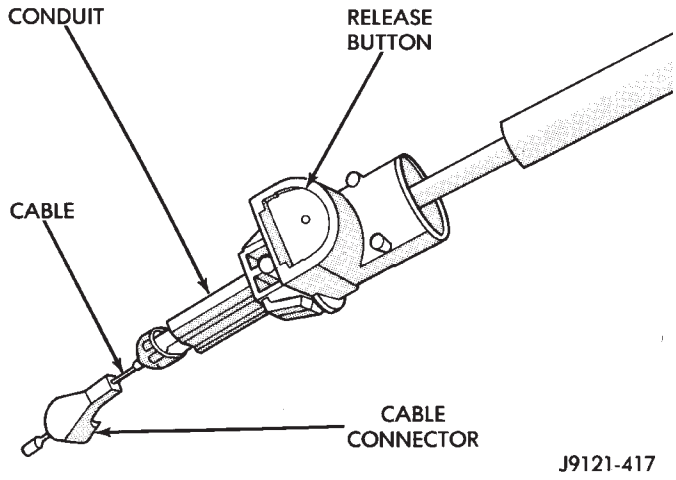

Fig. 44 Throttle Cable Components

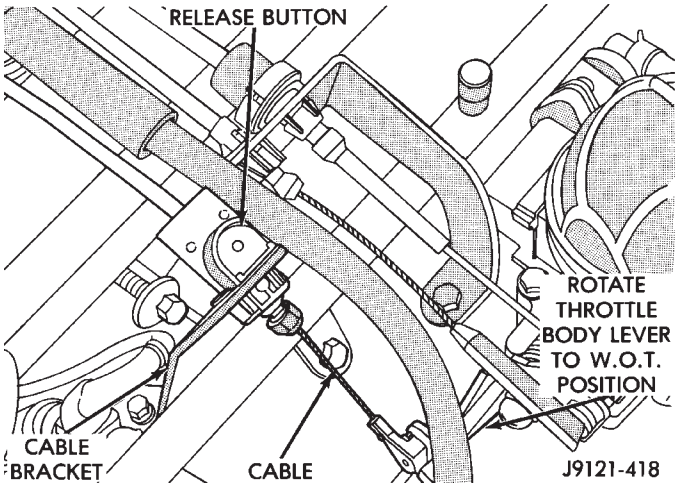

Fig. 45 Throttle Cable Adjustment

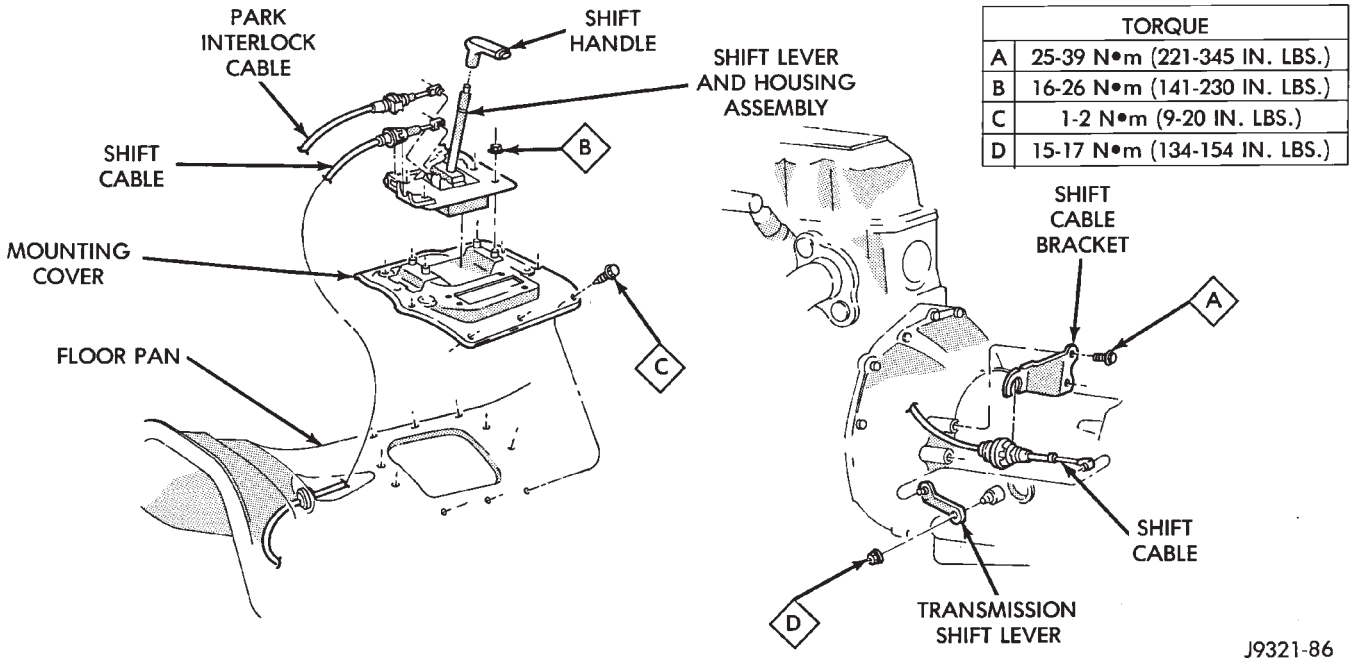

Fig. 46 Shift Cable

SHIFT CABLE ADJUSTMENT

(1) Shift transmission into Park.

(2) Raise vehicle.

(3) Release cable adjuster clamp to unlock cable (Figs. 46 and 47). Clamp is at transmission end of cable.

(4) Unsnap cable from transmission cable bracket (Figs. 46 and 47).

(5) Move transmission shift lever fully rearward to Park detent. Lever is on manual valve shaft at driver side of case.

(6) Verify positive engagement of park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap cable into cable bracket.

(8) Lock shift cable by pressing cable adjuster clamp down until it snaps into place.

(9) Check engine starting. Engine should start only in Park and Neutral.

(10) Lower vehicle.

PARK INTERLOCK CABLE ADJUSTMENT

(1) Shift transmission into Park.

(2) Turn ignition switch to Lock position.

(3) Remove shift lever bezel and console screws. Raise bezel and console for access to cable.

(4) Pull cable lock button up to release cable (Fig. 47).

(5) Pull cable forward. Then release cable and press cable lock button down until it snaps in place.

(6) Check adjustment as follows:

(a) Check movement of release shift handle button (floor shift) or release lever (column shift). You should not be able to press button inward or move column lever.

(b) Turn ignition switch to On position.

(c) Press floor shift lever release button or move column lever. Then shift into Neutral. If cable adjustment is correct, ignition switch can not be turned to Lock position. Perform same check with transmission in D range.

(7) Move shift lever back to Park and check ignition switch operation. You should be able to turn switch to Lock position and shift lever release button/lever should not move.

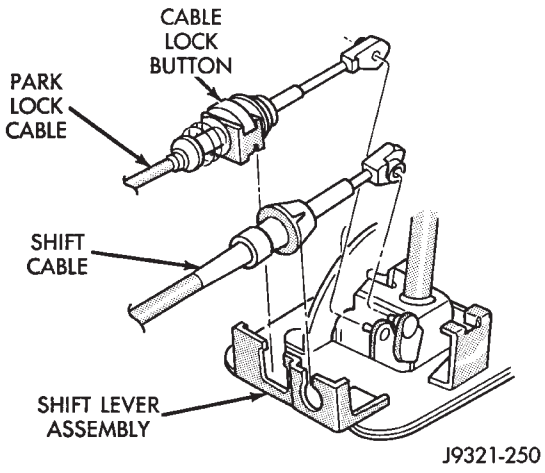

Fig. 47 Park Lock Cable Attachment (XJ)

TRANSMISSION COOLER SERVICE

Main Cooler

The transmission main cooler is located in the radiator. The main cooler can be flushed when necessary, however, the cooler is not a repairable component. If the cooler is damaged, plugged, or leaking, the radiator will have to be replaced.

Auxiliary Cooler

The auxiliary cooler is mounted in front of the radiator at the driver side of the vehicle (Fig. 48). The cooler can be flushed when necessary, while mounted in the vehicle. The cooler can also be removed for access, repair, or replacement as needed.

The main and auxiliary coolers should both be flushed whenever a transmission or converter clutch malfunction generates sludge, debris, or particles of clutch friction material.

Cooler Service

The main cooler (and radiator) and the auxiliary cooler can be removed for service or access to other components. Auxiliary cooler removal requires that the front bumper and radiator support be removed for access to the cooler lines and attaching bracket.

REVERSE FLUSHING MAIN AND AUXILIARY COOLERS AND COOLER LINES

Reverse flushing the cooler and lines will prevent sludge and particles from flowing back into the transmission after repair. The flushing procedure applies to standard (in-radiator) coolers and auxiliary coolers equally.

Pressure equipment is preferred for reverse flushing. However, reverse flushing can be performed using hand operated equipment as described in the following procedure.

(1) Disconnect cooler lines at transmission and at auxiliary cooler (Figs. 48 and 49).

(2) Position drain pan under cooler line to catch material flushed through coolers and lines.

(3) Reverse flush each cooler using hand operated suction gun filled with mineral spirits. Insert gun nozzle (or hose) into cooler inlet (return) line. Then force mineral spirits through into line and through cooler.

(4) Continue reverse flushing until fluid exiting inlet (pressure) line is clear and free of debris/residue.

(5) Replace radiator if fluid cannot be pumped through main cooler. Replace auxiliary cooler if leaks are evident, or if fluid cannot be pumped through it.

(6) Clear flushing materials from coolers and lines with short pulses of compressed air. Insert air gun nozzle into cooler inlet (return) line and continue short pulses of air until all fluid is cleared from cooler and lines.

(7) Pump one quart of fresh automatic transmission fluid through cooler and lines before reconnecting cooler lines.

FLOW TESTING TRANSMISSION MAIN COOLER

Cooler flow is checked by measuring the amount of fluid flow through the cooler in a 20 second time period. The test is performed with the engine running and transmission in neutral. Fluid is then pumped through the cooler by the transmission oil pump.

(1) Disconnect cooler inlet line at transmission fitting.

(2) Securely attach hose to end of inlet line and position line in a one quart test container.

(3) Add extra quart of fluid to transmission.

(4) Use stopwatch to check flow test time.

(5) Shift transmission into neutral and set parking brake.

(6) Start and run engine at curb idle speed and immediately note cooler flow. Approximately one quart of fluid should flow into test container in 20 second period.

(7) If cooler flow is intermittent, flows less than one quart in 20 seconds, or does not flow at all, cooler is faulty and must be replaced.

TRANSMISSION COOLER LINE FITTINGS

Quick disconnect fittings are used at the transmission cooler line connections. The fitting seals and guides are serviceable.

Replace the seals and guides whenever the fittings exhibit leakage, or will not properly snap into place.

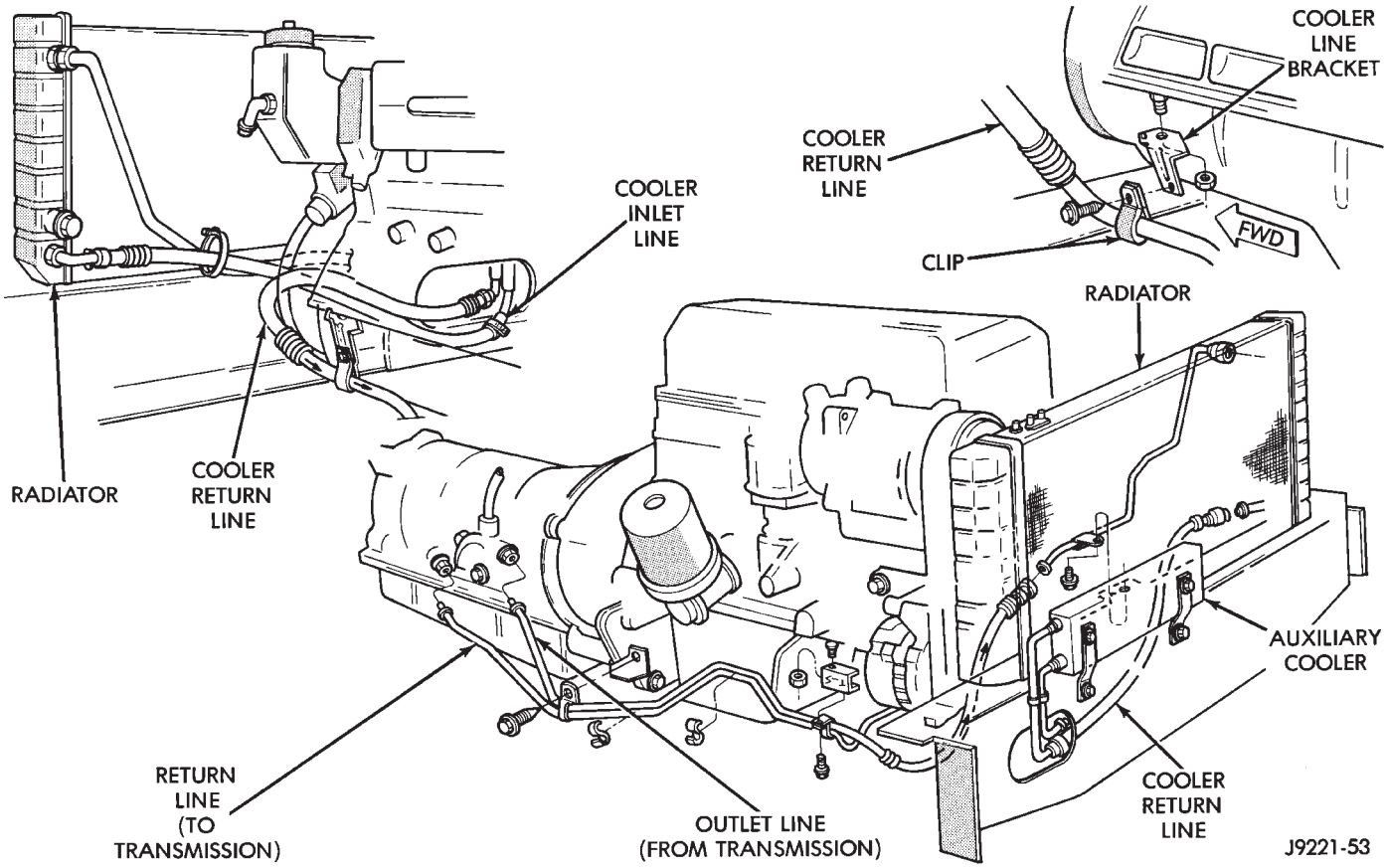

Fig. 48 Auxiliary Cooler Mounting (Left Hand Drive)

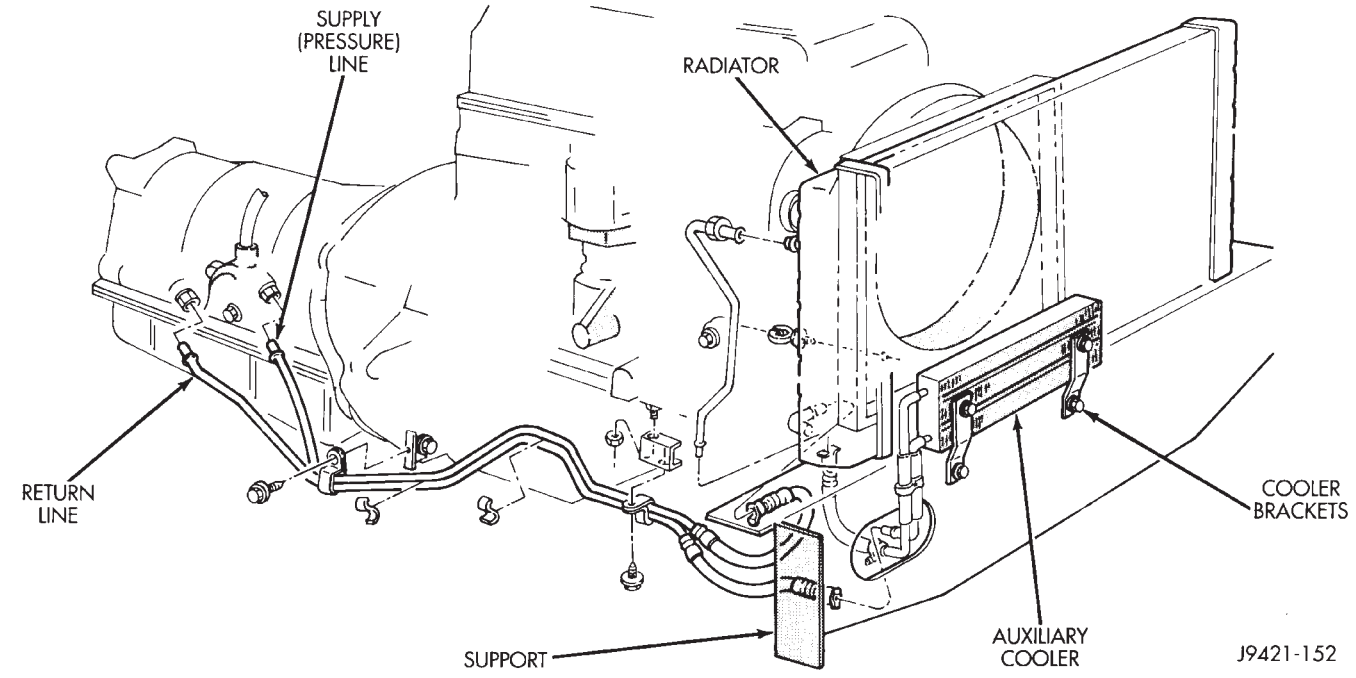

Fig. 49 Auxiliary Cooler Mounting (Right Hand Drive)

AW-4 TRANSMISSION REMOVAL AND INSTALLATION

INDEX

TRANSMISSION AND TORQUE CONVERTER REMOVAL

(1) Raise vehicle.

(2) Drain transmission fluid and reinstall oil pan drain plug.

(3) Remove upper half of transmission fill tube (Fig. 50).

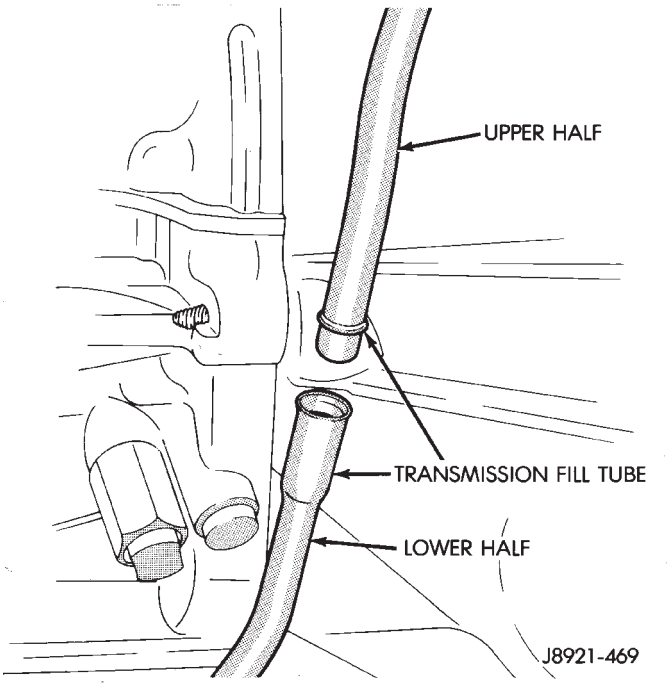

Fig. 50 Two-Piece Transmission Fill Tube

(4) Disconnect cooler lines at transmission. Cooler lines have quick-disconnect fittings. Press fitting release tabs and pull cooler lines and fittings out of case or use Special Tool 7555 to disconnect them.

(5) Support engine with safety stand and support transmission with jack.

(6) Disconnect transmission and transfer case shift linkage.

(7) Remove necessary exhaust components.

(8) Disconnect vehicle speed sensor wires

(9) Mark position of front and rear propeller shafts for alignment reference. Then remove shafts from vehicle.

(10) Remove rear crossmember.

(11) Disconnect transmission shift cable at transmission. Then disconnect transmission throttle valve cable at engine.

(12) Disconnect necessary vacuum and fluid hoses.

(13) Remove transfer case from transmission.

(14) Disconnect and remove crankshaft position sensor.

CAUTION: The crankshaft position sensor can be damaged if the sensor is still in place when the transmission is removed. To avoid damage, remove the sensor before transmission removal.

(15) Remove starter motor.

(16) Remove bolts attaching converter to drive plate.

(17) Remove bolts attaching converter housing to engine.

(18) Secure transmission to jack with safety chains.

(19) Pull transmission rearward for access to converter. Then secure converter in pump with C-clamp or strap bolted to converter housing.

(20) Remove transmission from under vehicle.

(21) Remove torque converter if converter or oil pump seal are to be serviced.

TORQUE CONVERTER STATOR CLUTCH INSPECTION

(1) Insert Rotating Tool 7547 into converter hub and seat tool in one-way clutch (Fig. 51).

(2) Insert Stopper Tool 7548 in one converter hub notch and into outer race of rotating tool.

(3) Turn rotating tool clockwise. Converter clutch should rotate freely and smoothly. Less than 2.5 N·m (22 in. lbs.) of torque should be required to rotate clutch in clockwise direction.

(4) Turn rotating tool in counterclockwise direction. Converter clutch should lock.

(5) Replace converter if clutch binds or will not lock.

OIL PUMP SEAL REPLACEMENT

(1) Remove converter.

(2) Remove old seal. Use blunt punch to collapse seal and pry seal out of pump housing. Do not scratch or damage seal bore.

(3) Lubricate lip of new seal with Mopar Mercon transmission fluid and install seal in pump with tool 7549 (Fig. 52).

(4) Lubricate converter drive hub with Mopar Mercon transmission fluid.

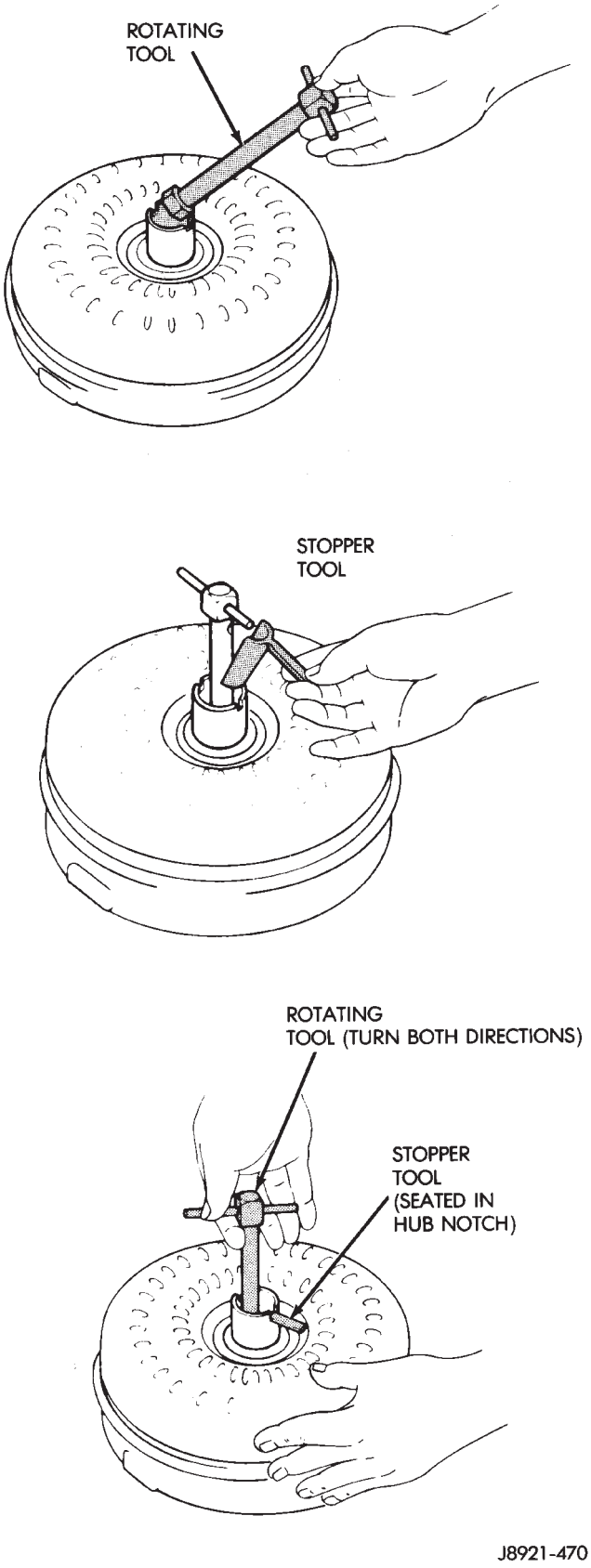

Fig. 51 Checking Operation Of Torque Converter Stator One-Way Clutch

(5) Align and install converter in oil pump.

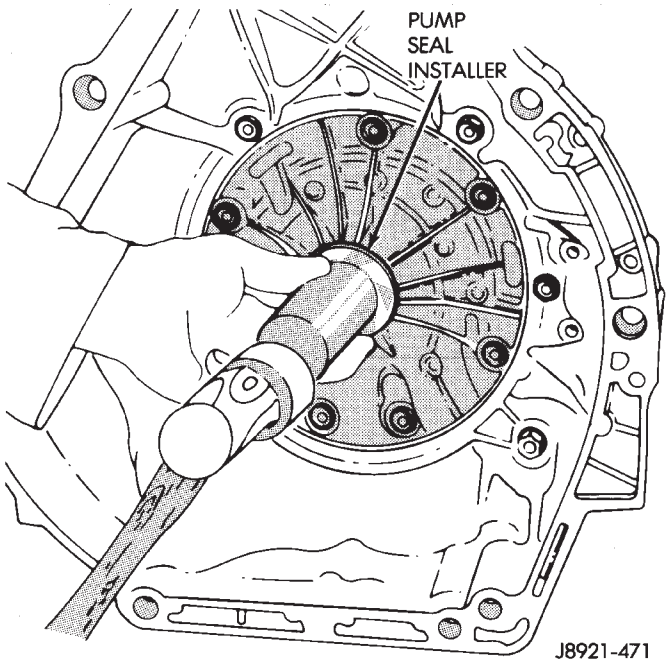

Fig. 52 Installing Oil Pump Seal

TRANSMISSION AND TORQUE CONVERTER INSTALLATION

(1) Mount transmission on transmission jack. Then secure transmission to jack with safety chains.

(2) Lubricate converter drive hub and oil pump seal lip with Mopar Mercon transmission fluid. Then install converter. Be sure converter is fully seated in oil pump gears before proceeding. Hold converter in place with C-clamp or strap attached to converter housing.

(3) Align and position transmission and converter on engine.

(4) Remove clamp or strap used to hold torque converter in place.

(5) Move transmission forward seat and it on engine. Be sure torque converter hub is fully seated.

(6) Install converter housing-to-engine bolts (Fig. 53).

(7) Install converter-to-drive plate bolts.

(8) Install and connect starter motor.

(9) Install and connect crankshaft position sensor.

(10) Install transfer case on transmission. Tighten transfer case attaching nuts to 41 N·m (30 ft. lbs.) torque

(11) Connect transfer case shift linkage and vacuum hoses.

(12) Connect exhaust components.

(13) Install rear crossmember and remove jack used to support transmission assembly.

(14) Connect speed sensor wire harness to sensor.

(15) Connect wire harness to park/neutral position switch.

(16) Align and connect front and rear propeller shafts.

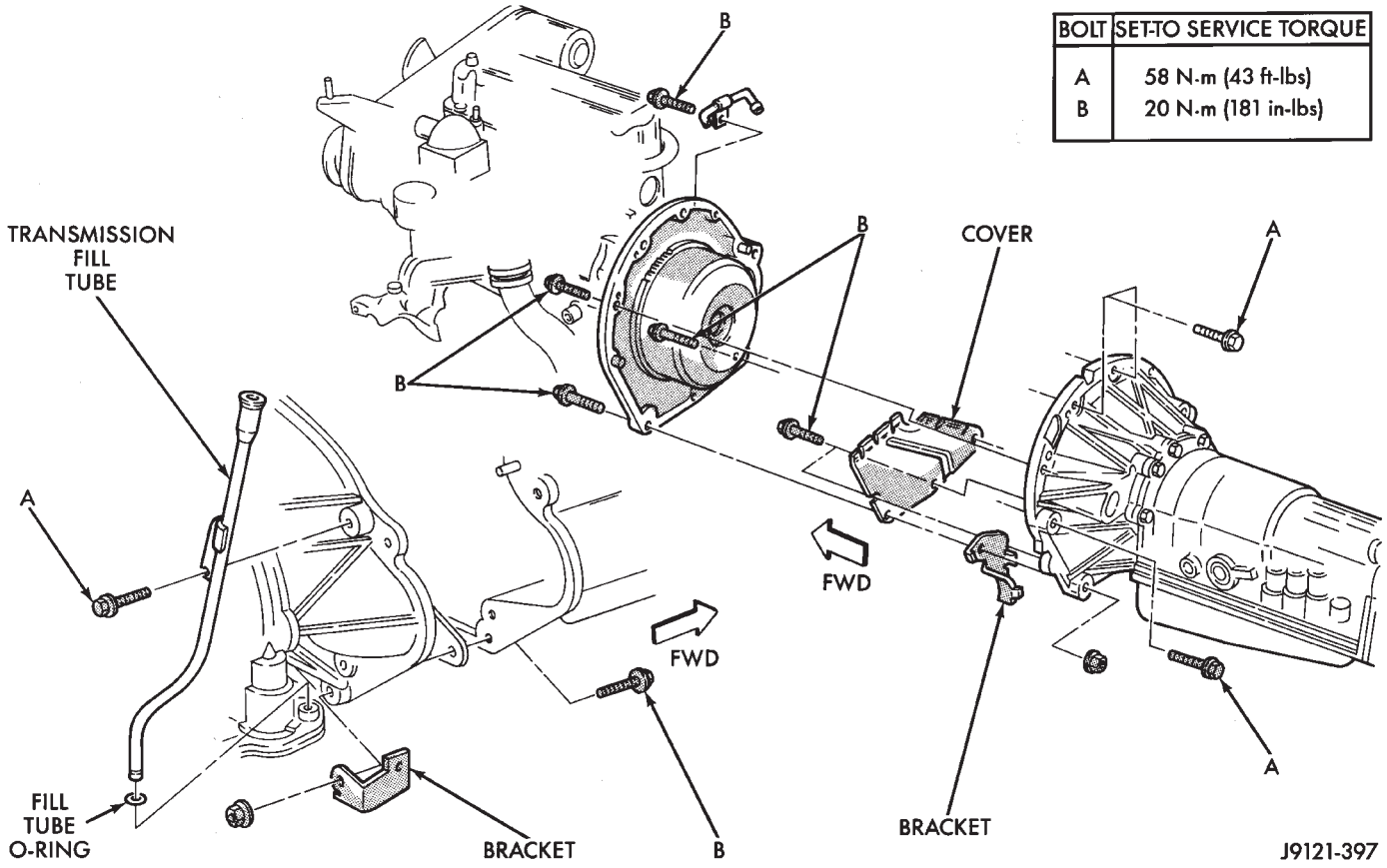

Fig. 53 AW-4 Transmission Attachment

(17) Connect transmission wire harnesses and transfer case vacuum and wire harnesses.

(18) Connect transmission cooler lines.

(19) Connect transmission throttle cable at engine.

(20) Install new O-ring seal on upper half of transmission fill tube. Then connect upper and lower tube halves.

(21) Lower vehicle.

(22) Fill transmission with Mopar Mercon automatic transmission fluid. Mopar Dexron II can be used if Mercon is not readily available.

AW-4 TRANSMISSION OVERHAUL

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OVERHAUL SERVICE TOOLS

The special tools needed to overhaul the AW-4 transmission are provided in Tool Kit 6294. However, Pressure Test Port Adapter 7554 is not included in this kit and must be ordered separately. The overhaul tool kit and test port adapter are available through the parts division and dealer special tool program.

TRANSMISSION DISASSEMBLY

(1) Remove torque converter.

(2) Remove lower half of filler tube if not previously removed.

(3) Remove clamps attaching wire harness and throttle cable (Fig. 1) to transmission.

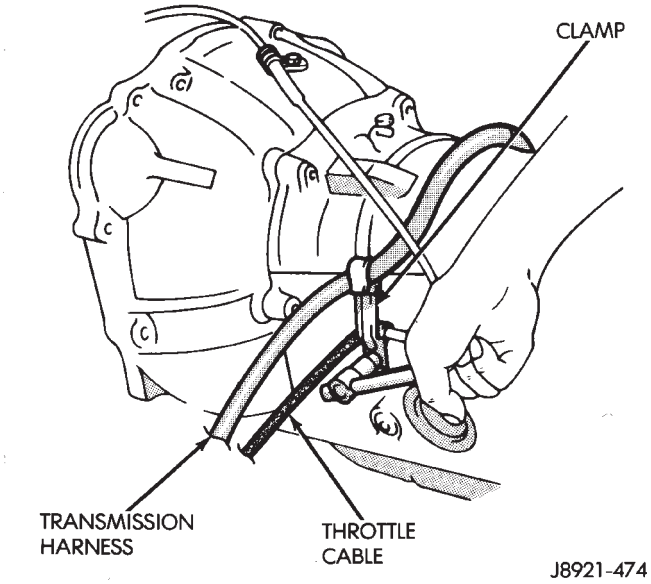


Fig. 1 Typical Harness And Cable Clamp Attachment

(4) Remove shift lever from manual valve shaft at left side of transmission.

(5) Remove park/neutral position switch.

(6) Remove speed sensor (Fig. 2).

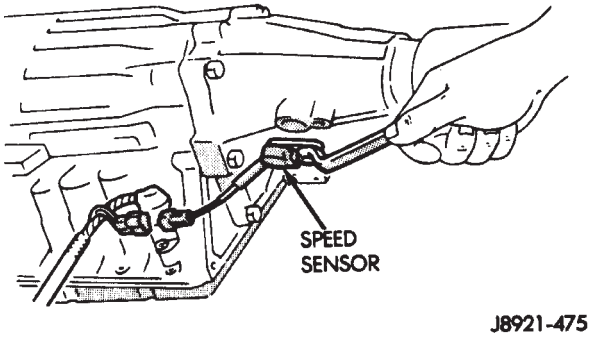


Fig. 2 Speed Sensor Removal

(7) Remove converter housing bolts and remove housing (Fig. 3) from case.

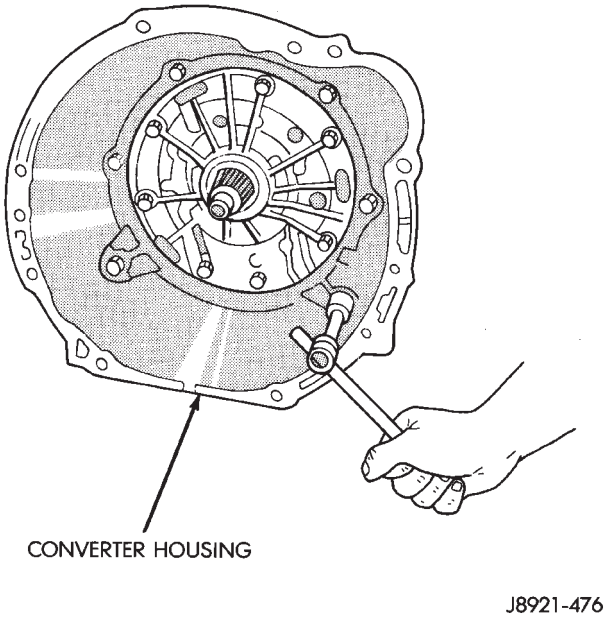


Fig. 3 Removing/Installing Converter Housing

(8) Remove adapter housing.

(9) Remove speedometer drive gear snap ring and remove gear and gear spacer if equipped (Fig. 4).

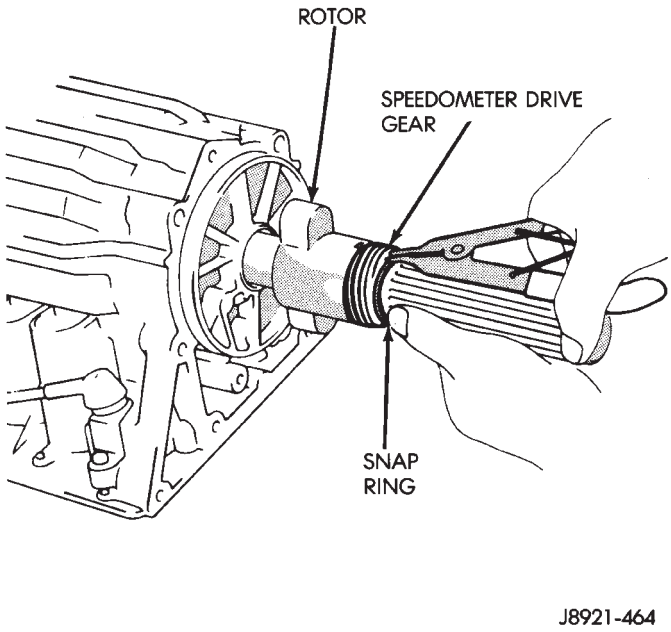


Fig. 4 Removing Speed Sensor And Speedometer Drive Gear

(10) Remove speed sensor rotor and key. Use wood dowel or hammer handle to loosen and remove rotor (Fig. 5).

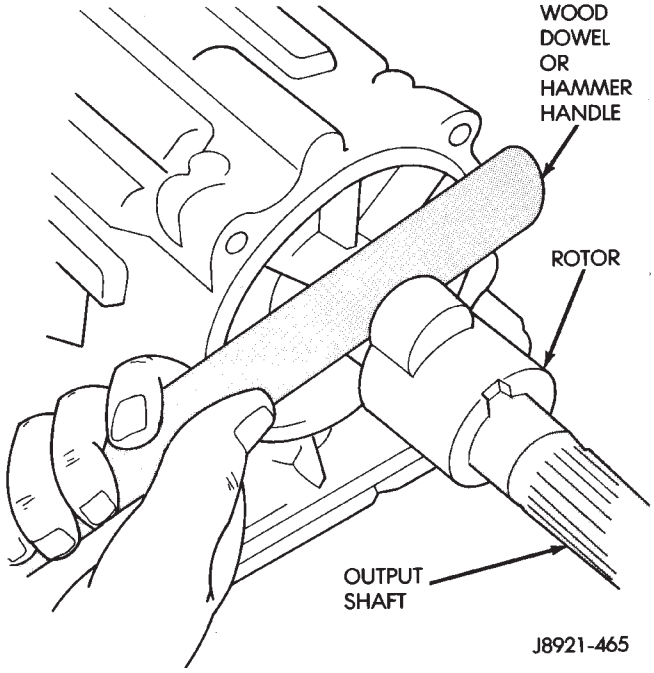


Fig. 5 Removing Transmission Speed Sensor Rotor

(11) Remove transmission oil pan, oil screen and screen gaskets (Fig. 6). Then mount transmission in holding fixture.

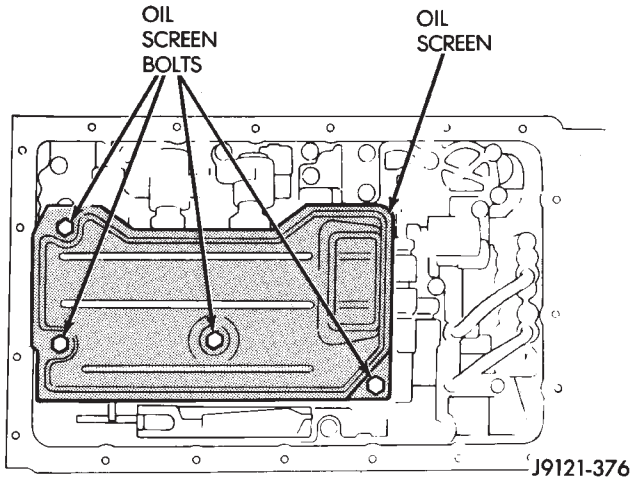


Fig. 6 Removing Oil Screen

(12) Remove valve body oil feed tubes (Fig. 7).

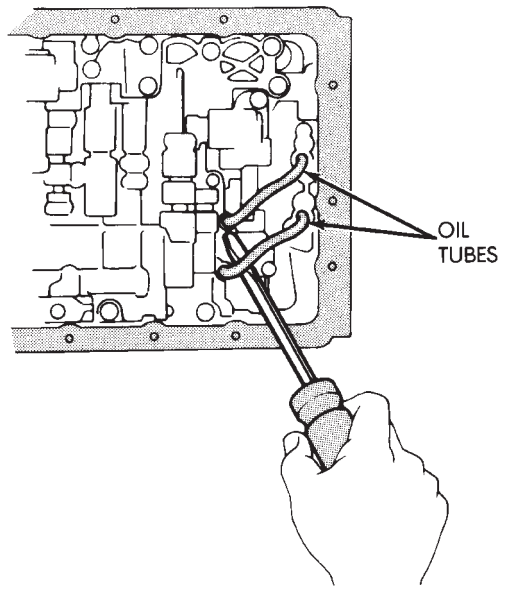


Fig. 7 Removing Valve Body Oil Tubes

(13) Disconnect valve body solenoid wires (Fig. 8).

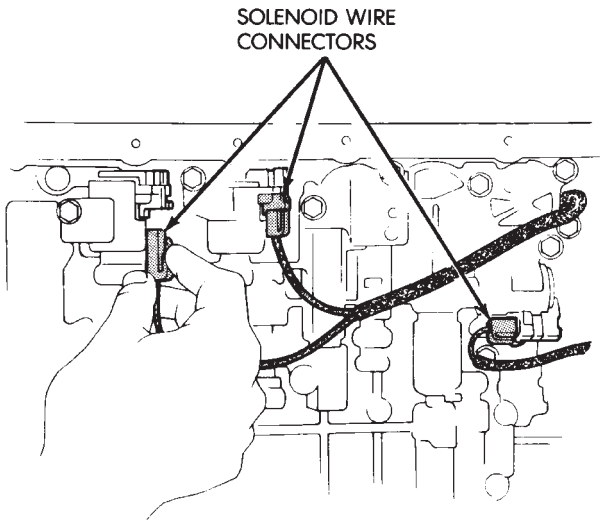


Fig. 8 Solenoid Wire Location

(14) Remove harness bracket bolt and remove harness and bracket Fig. 9).

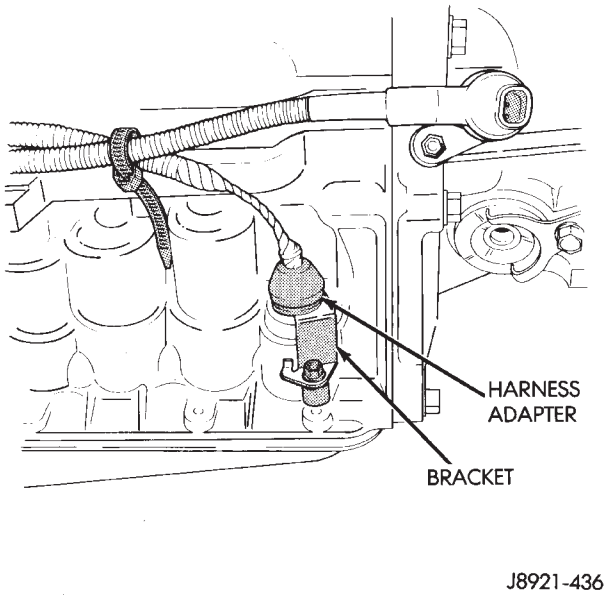


Fig. 9 Removing Bracket And Harness

(15) Remove valve body bolts (Fig. 10).

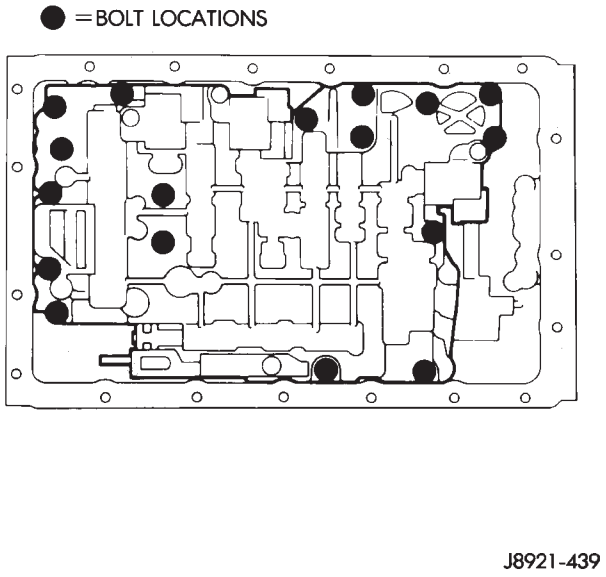


Fig. 10 Valve Body Bolt Locations

(16) Disconnect throttle cable from throttle cam (Fig. 11).

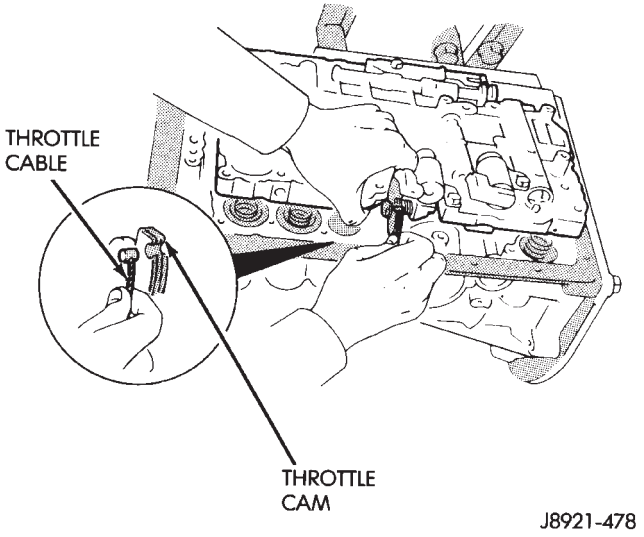


Fig. 11 Disconnecting Throttle Cable

(17) Remove valve body from case. Then remove accumulator springs, spacers and check ball and spring (Fig. 12).

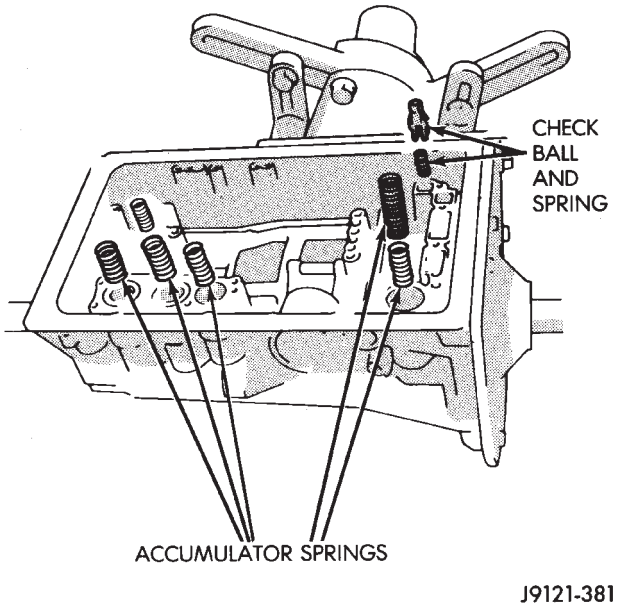


Fig. 12 Removing Accumulator Springs, Spacers And Check Ball

(18) Remove second brake and clutch accumulator pistons with compressed air (Fig. 13). Apply air pressure through feed port and ease the pistons out of the bore.

(19) Remove overdrive brake accumulator piston with compressed air (Fig. 13).

(20) Remove overdrive clutch accumulator piston with compressed air (Fig. 13).

(21) Remove throttle cable.

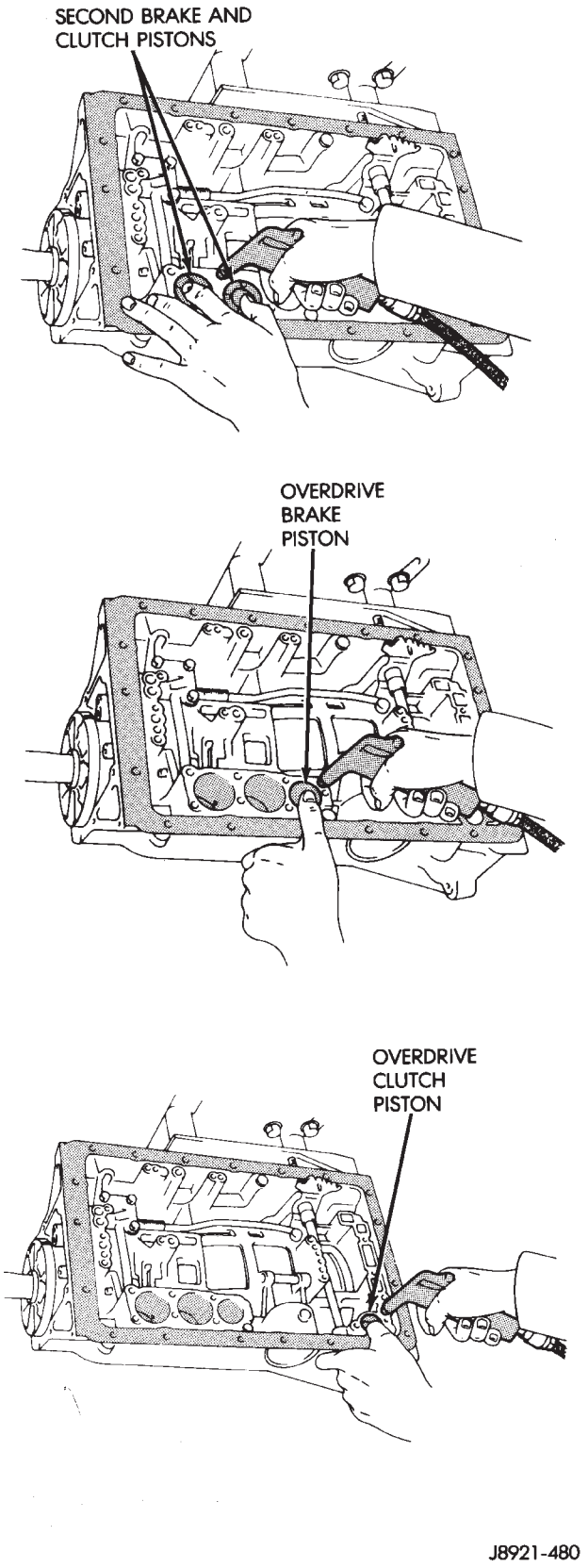


Fig. 13 Removing Accumulator Pistons

(22) Remove oil pump bolts and remove pump with bridge-type Puller 7536 (Fig. 14).

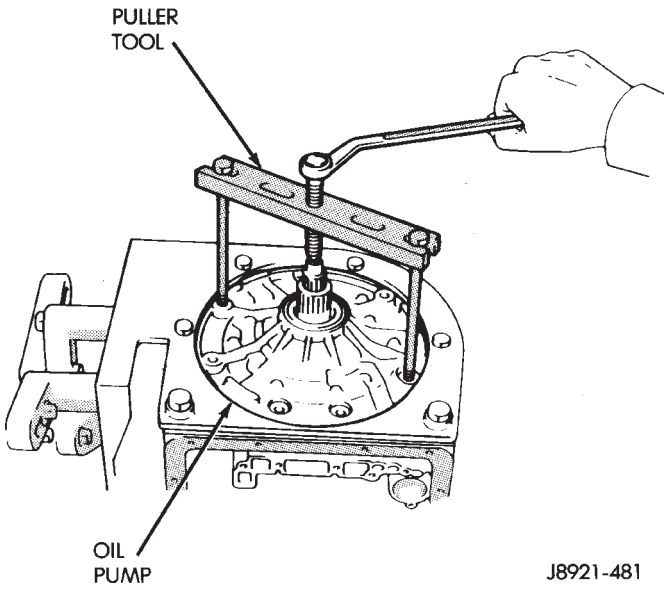


Fig. 14 Oil Pump Removal

(23) Remove race from oil pump (Fig. 15).

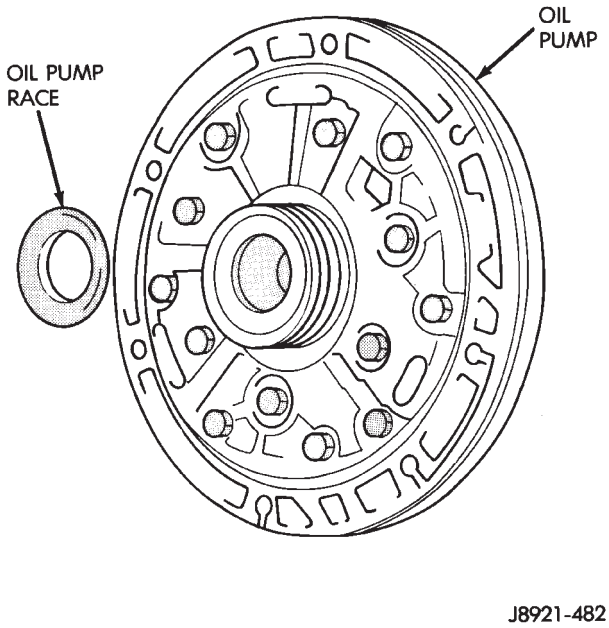


Fig. 15 Oil Pump Race Removal

(24) Remove fourth gear overdrive planetary gear and overdrive direct clutch assembly (Fig. 16).

(25) Remove race from fourth gear overdrive planetary (Fig. 17).

(26) Remove thrust bearing, race and overdrive planetary ring gear (Fig. 18).

(27) Measure stroke length of overdrive brake piston as follows:

(a) Mount dial indicator on case (Fig. 19).

(b) Mount Gauge Tool 7546 so it contacts piston (Fig. 19).

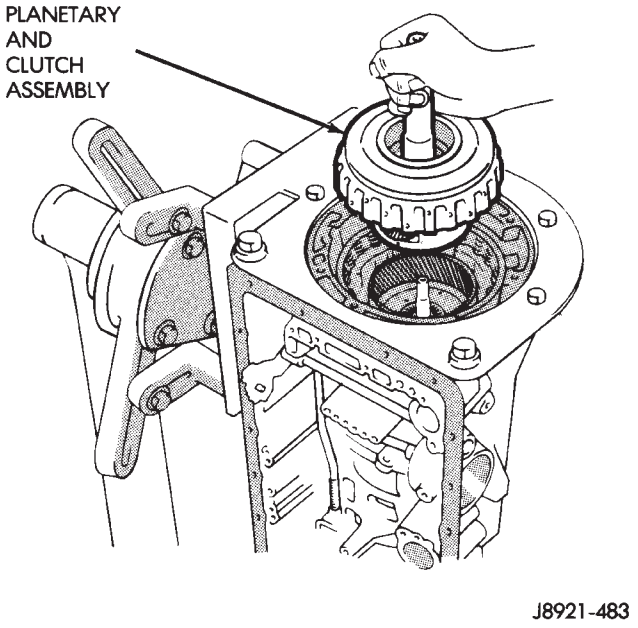


Fig. 16 Removing Fourth Gear Planetary And Direct Clutch Assembly

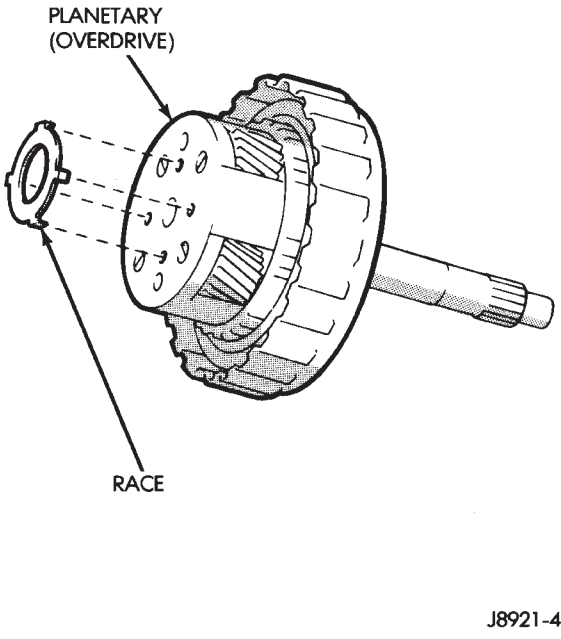


Fig. 17 Fourth Gear Planetary Race Removal

(c) Apply 57-114 psi air pressure through piston apply port and note piston stroke on dial indicator. Stroke length should be: 1.40 - 1.70 mm (0.055 - 0.0699 in.).

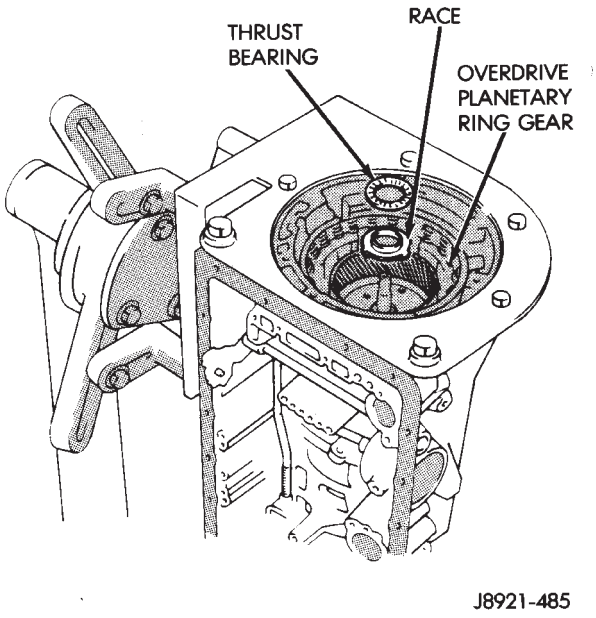


Fig. 18 Removing Bearing, Race And Planetary Ring Gear

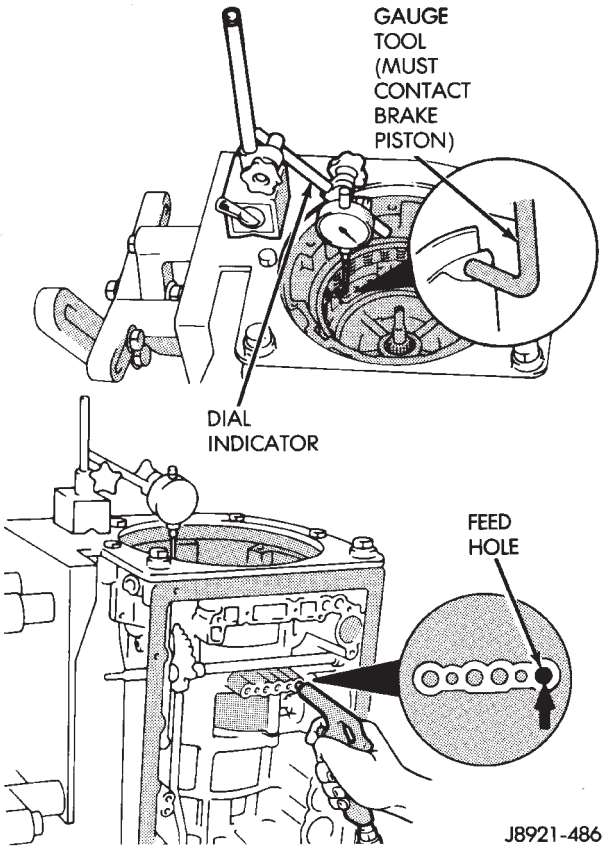


Fig. 19 Measuring Overdrive Brake Piston Stroke

(d) If stroke is not within limits, replace brake pack retainer. Select required retainer from Overdrive Brake Retainer Selection chart in Specifications section.

(28) Remove overdrive brake snap ring (Fig. 20).

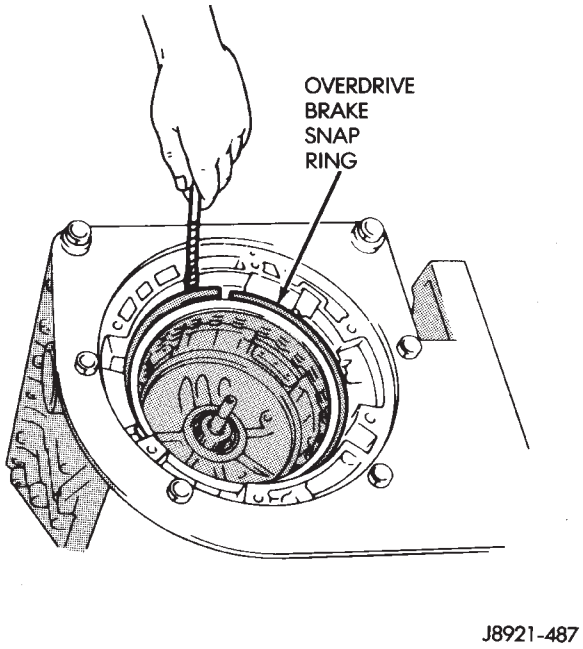


Fig. 20 Removing Overdrive Brake Snap Ring

(29) Remove overdrive brake discs and plates (Fig. 21). Then measure disc thickness with a micrometer. Minimum disc thickness is 1.84 mm (0.0724 in.). Replace discs if thickness is less than specified.

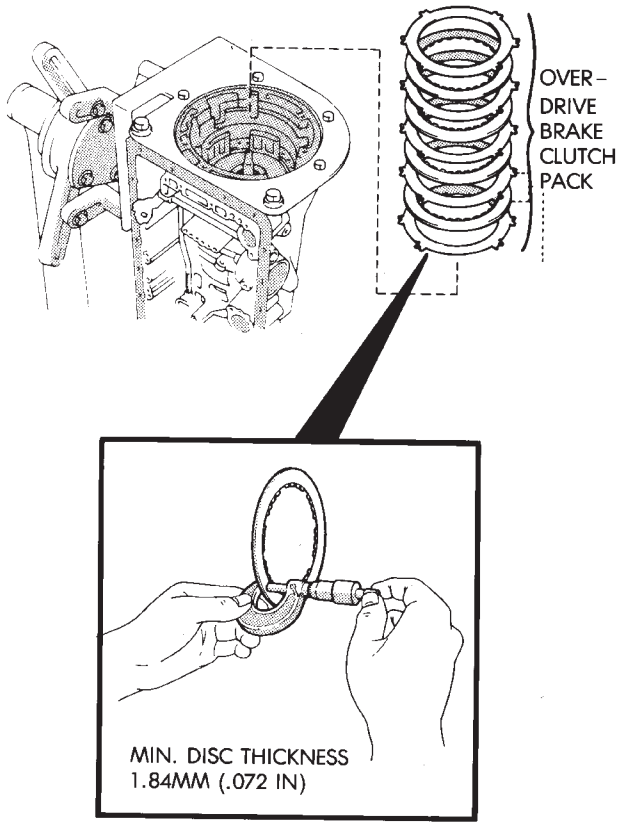


Fig. 21 Removing/Measuring Overdrive Brake Disc Thickness

(30) Remove overdrive support lower race and upper bearing and race assembly (Fig. 22).

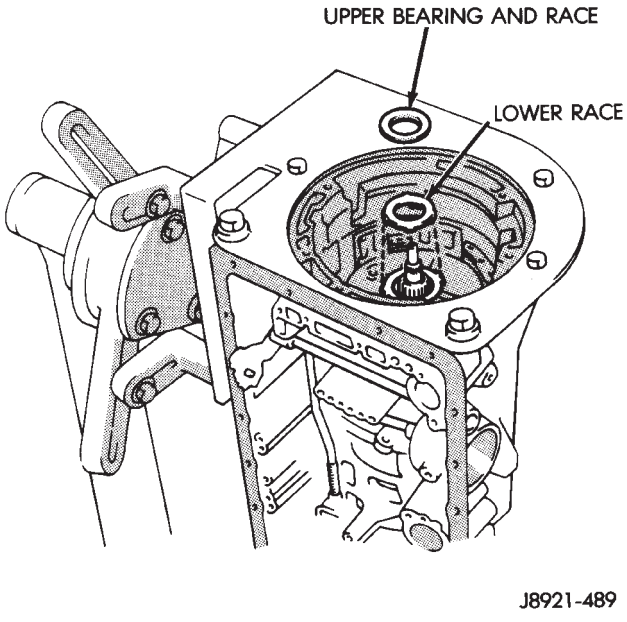


Fig. 22 Overdrive Support Bearing/Race Removal

(31) Remove overdrive support bolts (Fig. 23).

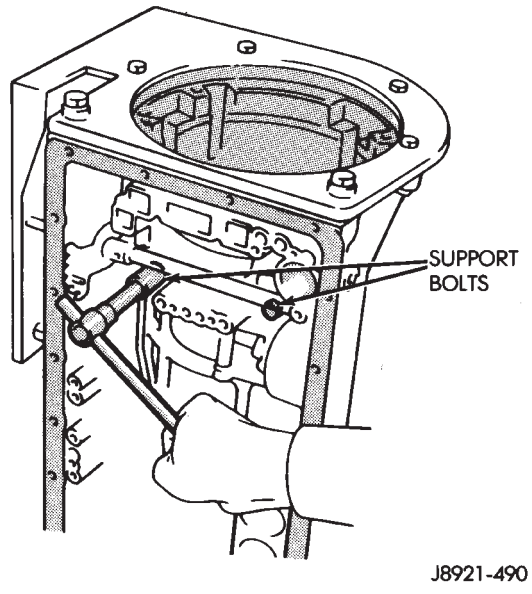


Fig. 23 Overdrive Support Bolt Removal

(32) Remove overdrive support snap ring with Snap Ring Plier Tool 7540 (Fig. 24).

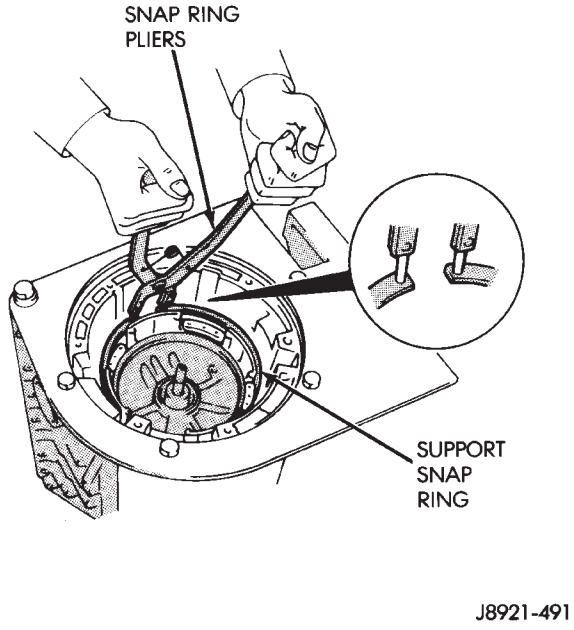


Fig. 24 Removing/Installing Overdrive Support Snap Ring

(33) Remove overdrive support (Fig. 25) with bridge-type Puller 7536.

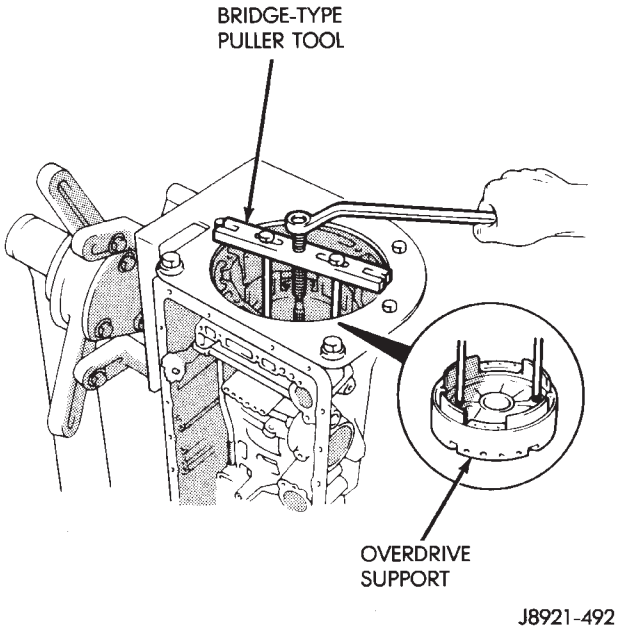


Fig. 25 Removing Overdrive Support

(34) Remove race from hub of overdrive support (Fig. 26).

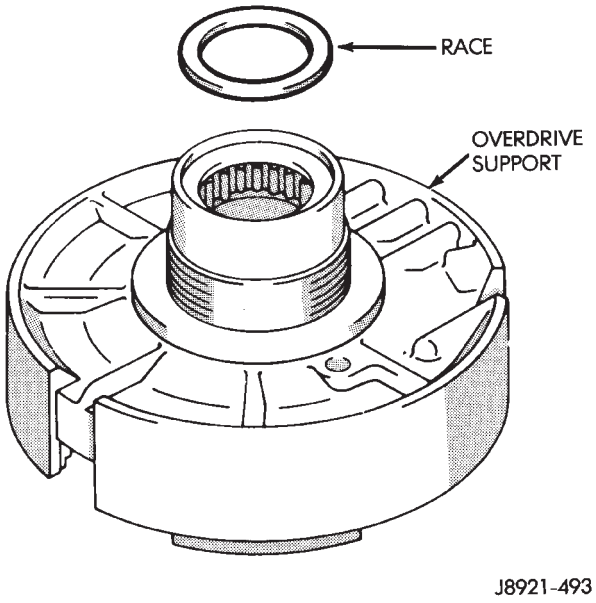


Fig. 26 Remove Overdrive Support Race

(35) Measure stroke length of second coast brake piston rod as follows:

(a) Make reference mark on piston rod (Fig. 27) as shown.

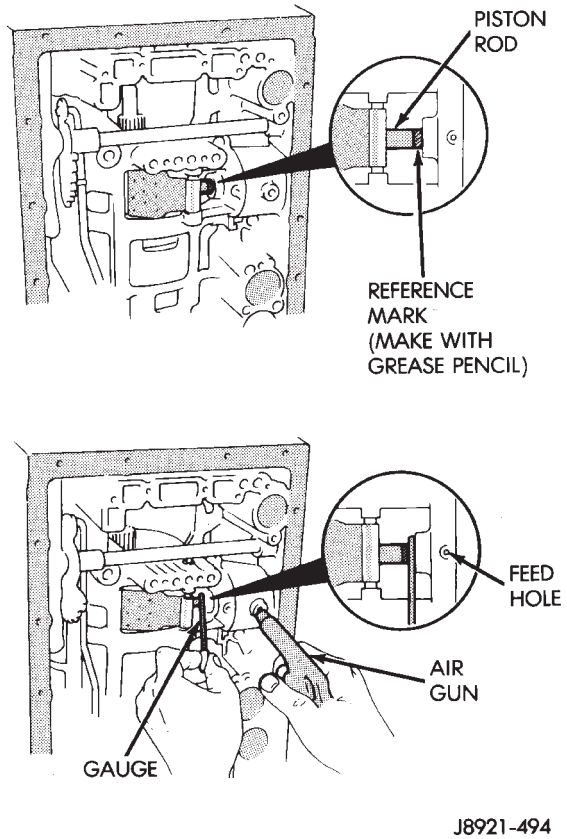


Fig. 27 Measuring Second Coast Brake Piston Rod Stroke

(b) Apply 57-114 psi air pressure through piston feed hole and check stroke length with Gauge Tool 7552 (Fig. 27).

(c) Stroke length should be 1.5 - 3.0 mm (0.059 - 0.118 in.).

(d) If stroke length is incorrect, install new piston rod and recheck stroke. If stroke is still incorrect, replace second coast brake band.

(e) Replacement piston rods are available in two different lengths which are: 71.4 mm (2.811 in.) and 72.9 mm (2.870 in.).

(36) Remove second coast brake piston snap ring with Snap Ring Plier Tool 7540. Then remove piston cover and piston assembly with compressed air applied through piston feed hole (Fig. 28).

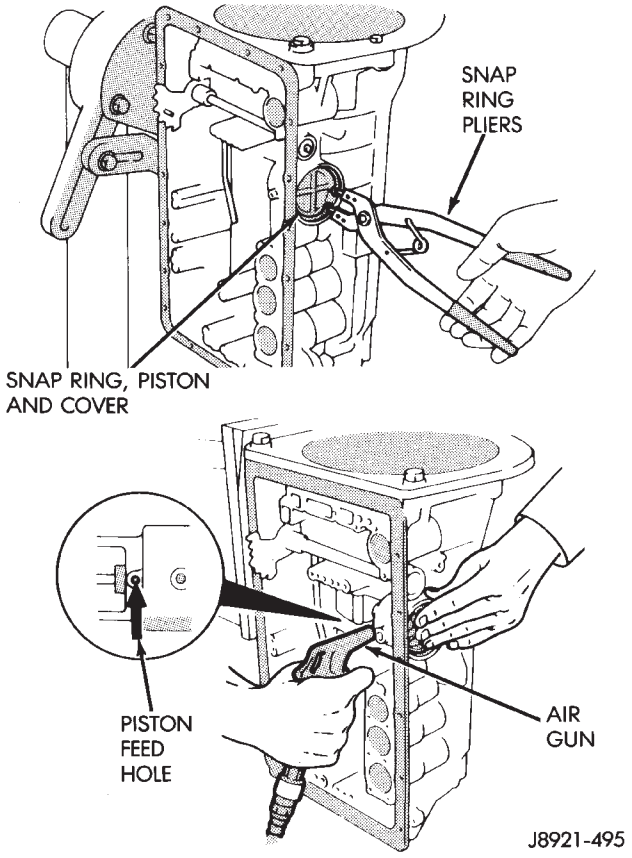


Fig. 28 Removing Second Coast Brake Cover And Piston

(37) Disassemble second coast brake piston (Fig. 29).

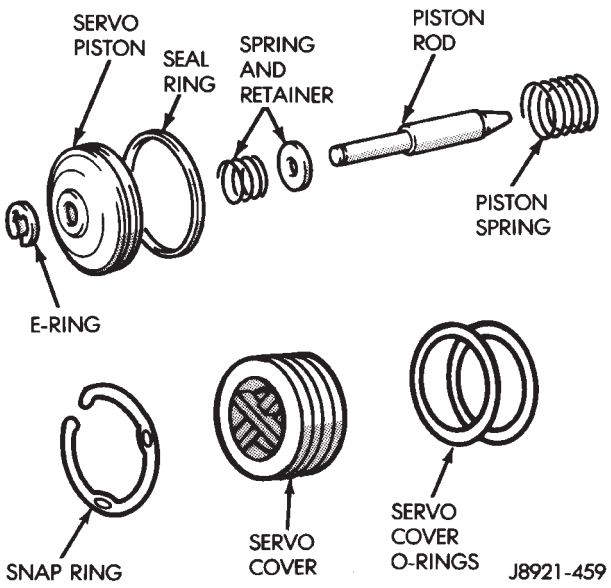


Fig. 29 Second Coast Brake Piston Components

(38) Remove direct and forward clutch assembly (Fig. 30).

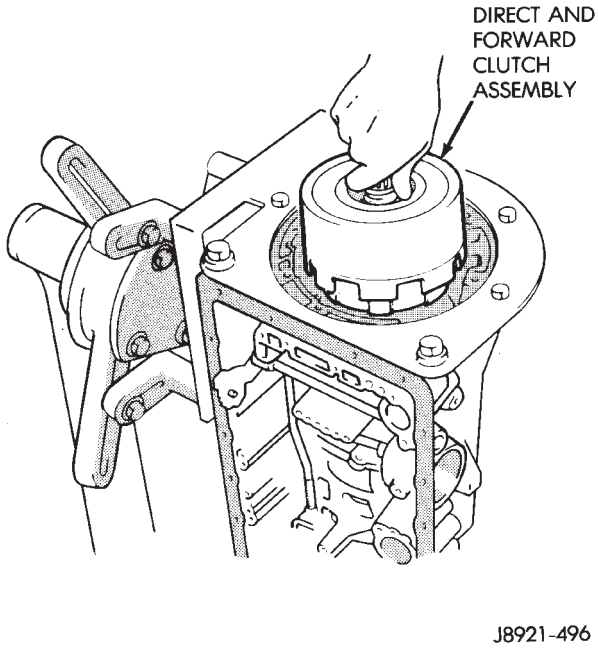


Fig. 30 Removing Direct And Forward Clutch Assembly

(39) Remove thrust bearing and race from clutch hub (Fig. 31).

(40) Remove second coast brake band E-ring from band pin and remove brake band (Fig. 32).

(41) Remove front planetary ring gear front bearing race and remove front planetary ring gear (Fig. 33).

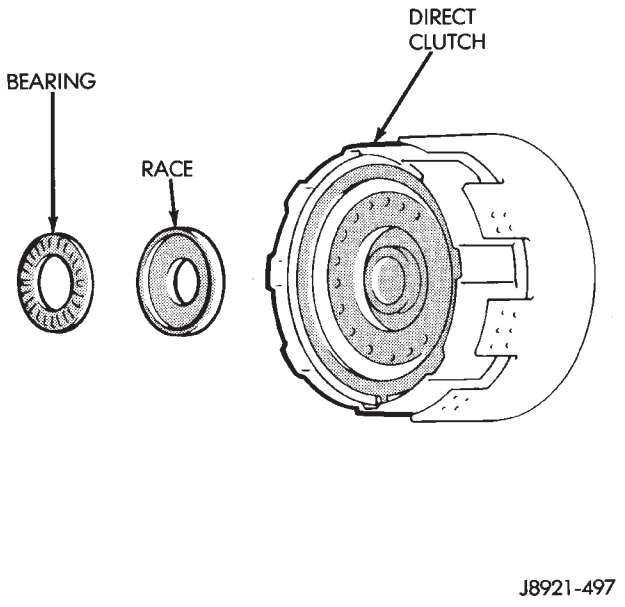


Fig. 31 Remove Bearing And Race From Clutch Hub

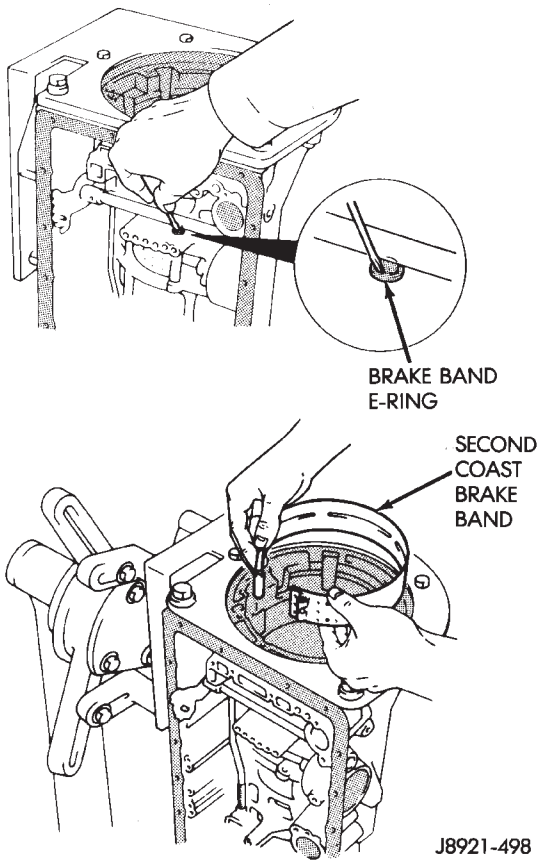


Fig. 32 Removing Second Coast Brake Band

(42) Remove thrust bearing and rear race from ring gear (Fig. 34).

(43) Remove planetary thrust race (Fig. 35).

(44) Relieve load on planetary snap ring as follows: Loosen transmission holding fixture. Turn transmis-

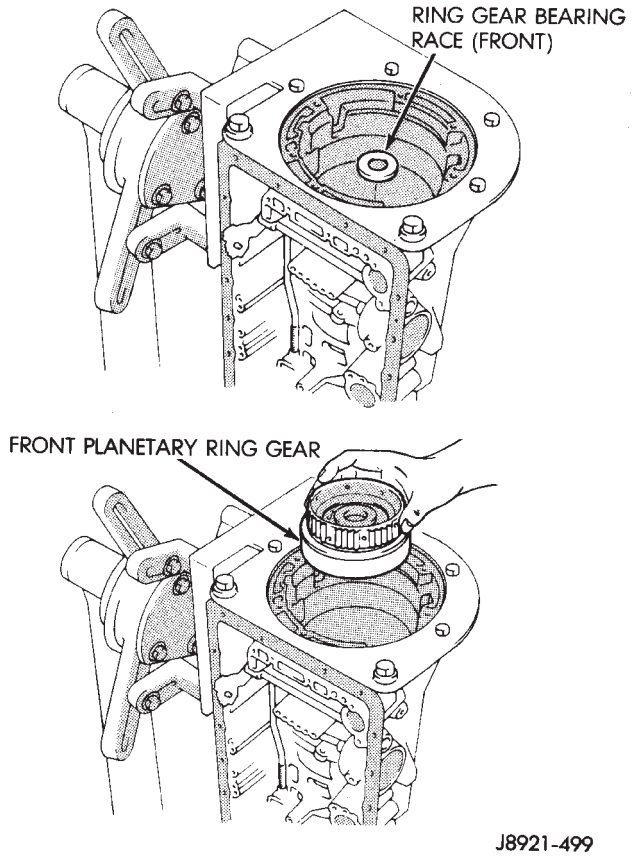


Fig. 33 Removing Front Planetary Ring Gear

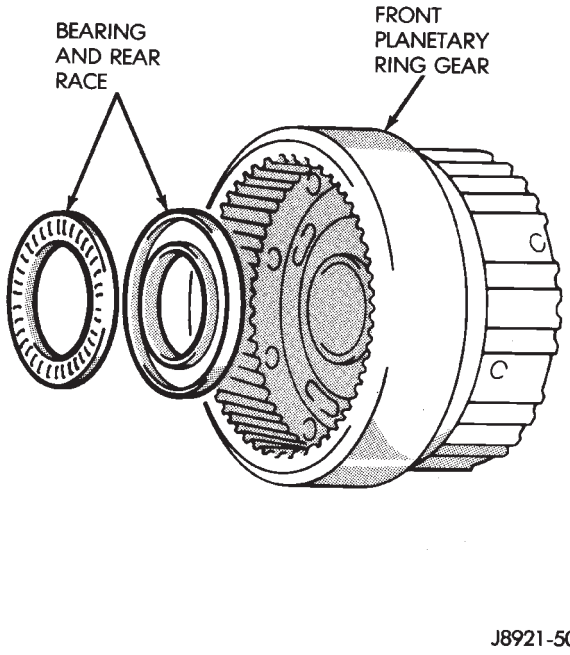


Fig. 34 Removing Ring Gear Bearing And Rear Race

sion over and allow output shaft to support transmission weight. Place wood blocks under shaft to protect splines (Fig. 35).

(45) Remove planetary snap ring and remove planetary gear (Fig. 36).

(46) Remove sun gear, input drum and one-way

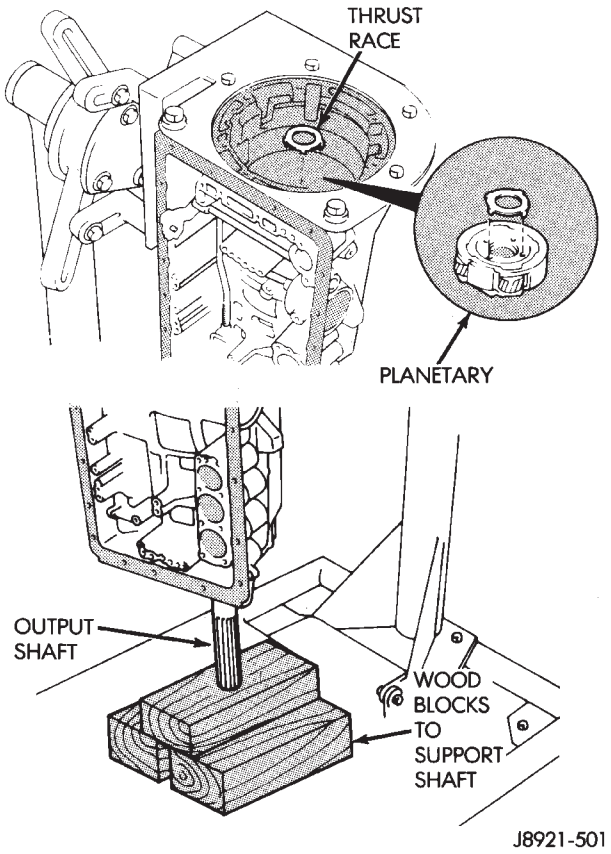


Fig. 35 Relieving Load On Planetary Snap Ring

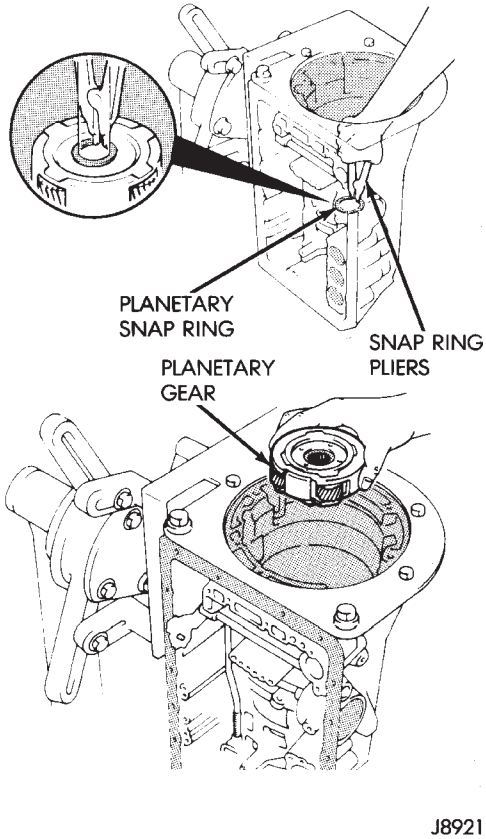


Fig. 36 Removing Planetary Snap Ring And Gear

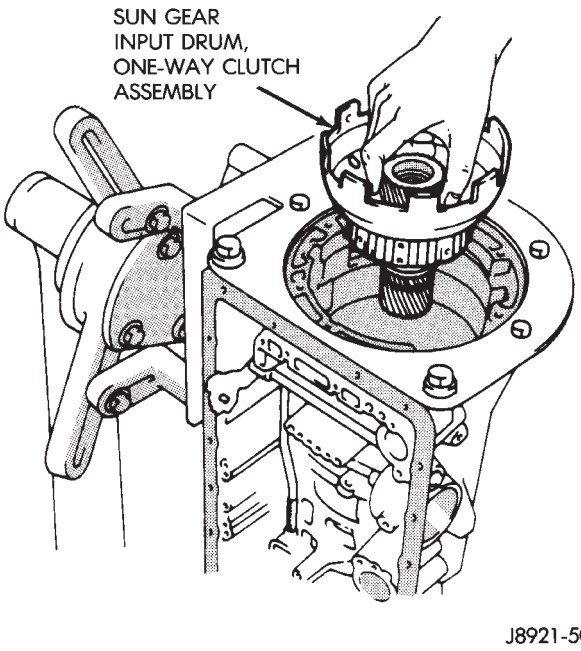


Fig. 37 Removing Sun Gear, Input Drum And One-Way Clutch

clutch as assembly (Fig. 37).

(47) Measure second brake clutch pack clearance (Fig. 38). Clearance should be 0.62 - 1.98 mm (0.0244 - 0.0780 in.). Replace discs if clearance is not within specifications.

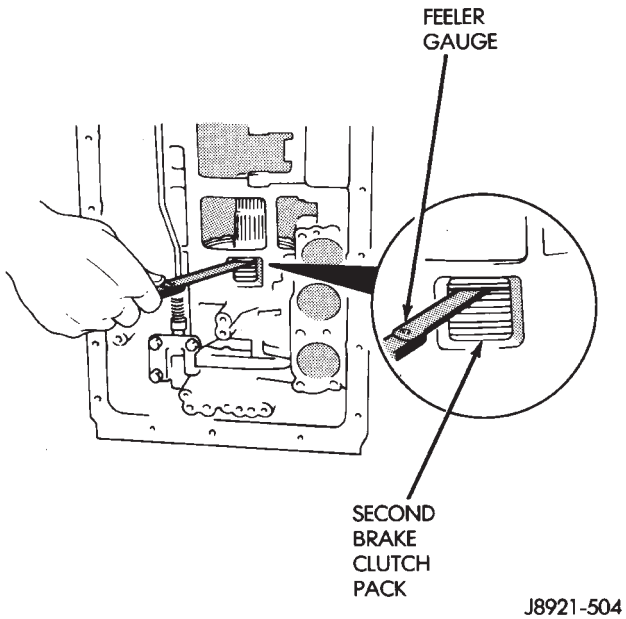


Fig. 38 Checking Second Brake Clutch Pack Clearance

(48) Remove second brake clutch pack snap ring (Fig. 39).

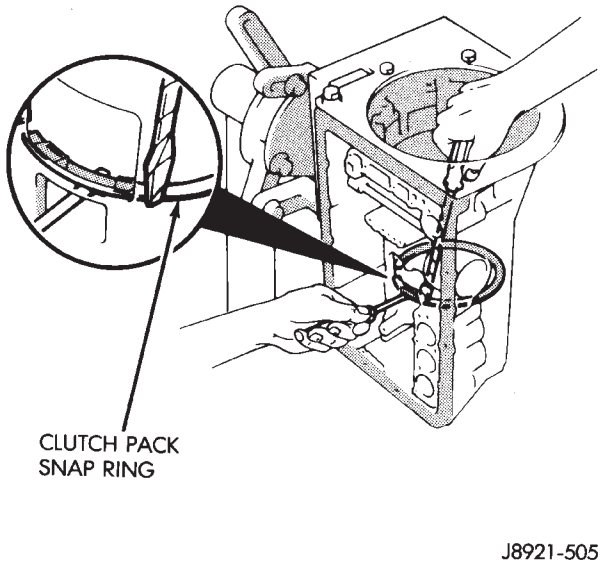


Fig. 39 Removing Second Brake Clutch Pack Snap Ring

(49) Remove second brake clutch pack (Fig. 40). Measure disc thickness with micrometer. Minimum thickness should be 1.84 mm (0.0724 in.). Replace discs if not within specifications.

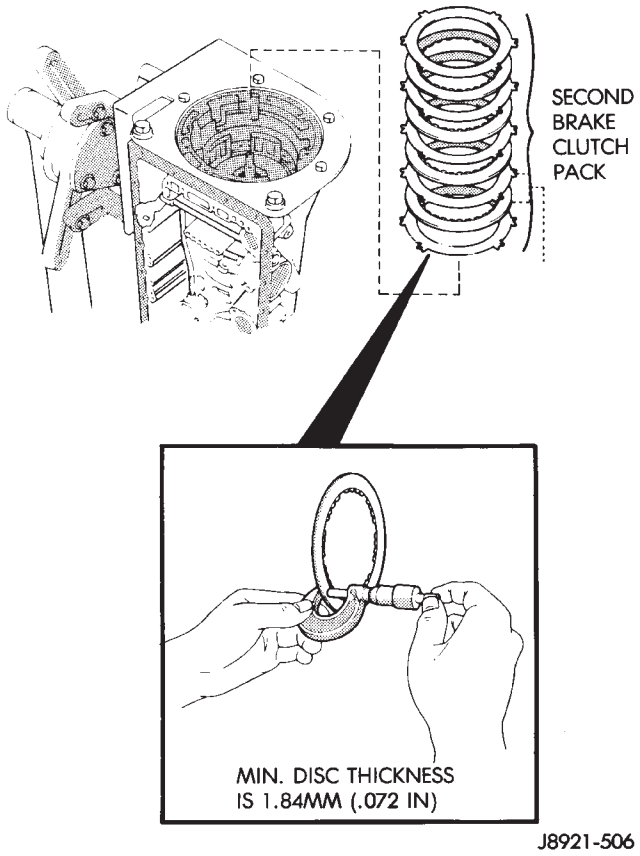


Fig. 40 Remove/Measure Second Brake Clutch Disc Thickness

(50) Remove bolts attaching park rod bracket to case. Then disconnect park rod from manual shaft lever and remove rod and bracket (Fig. 41).

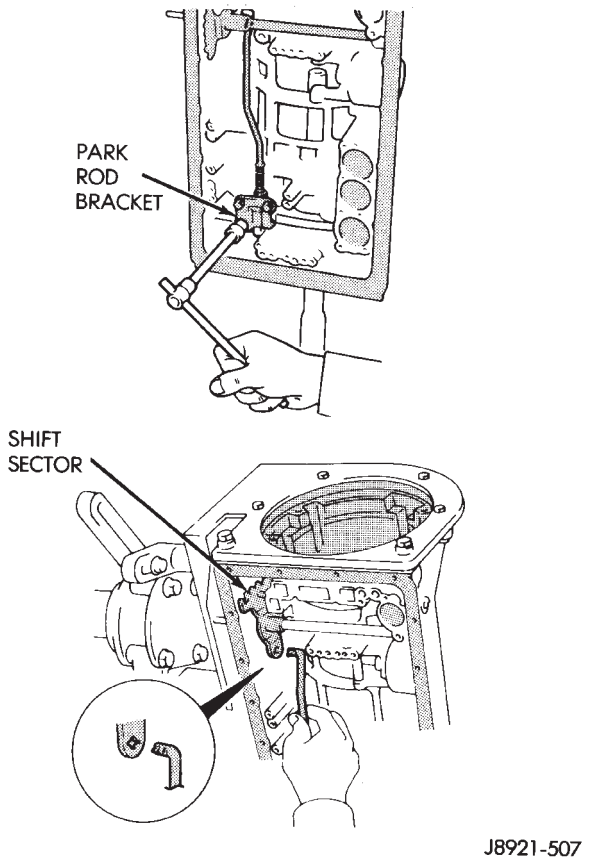


Fig. 41 Removing Park Rod And Bracket

(51) Remove park pawl spring, pin and pawl (Fig. 42).

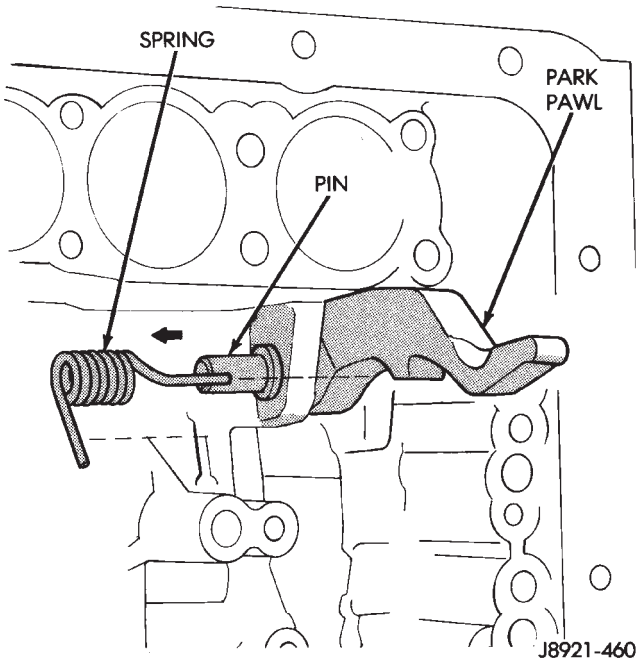


Fig. 42 Removing Park Pawl, Pin And Spring

(52) Measure clearance of first-reverse brake clutch pack (Fig. 43). Clearance should be: 0.70 - 1.2 mm (0.028 - 0.047 in.). Replace discs if clearance is not as specified.

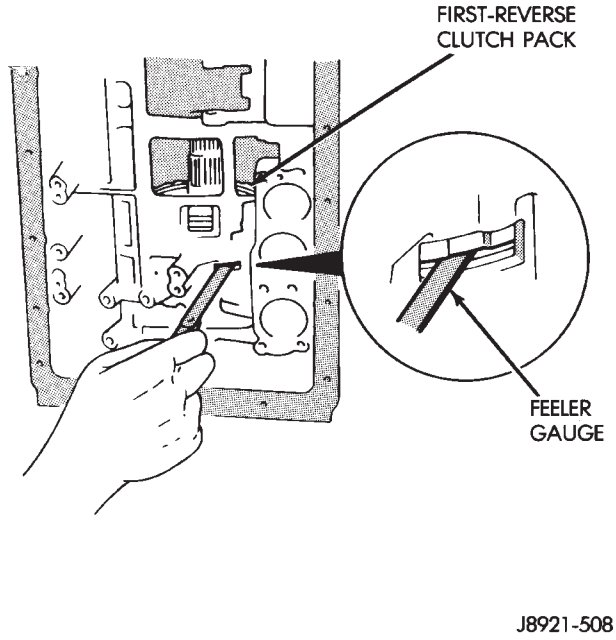


Fig. 43 Checking First-Reverse Brake Clutch Pack Clearance

(53) Remove second brake piston sleeve (Fig. 44). Cover remover tool with tape to avoid damaging case.

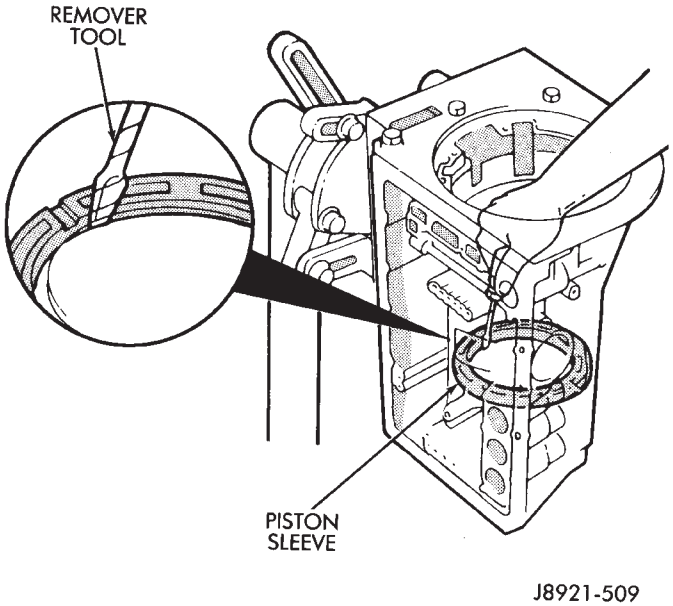


Fig. 44 Removing Second Brake Piston Sleeve

(54) Remove rear planetary gear, second brake drum and output shaft as an assembly (Fig. 45).

(55) Remove planetary and brake drum thrust bearing and race assembly (Fig. 46).

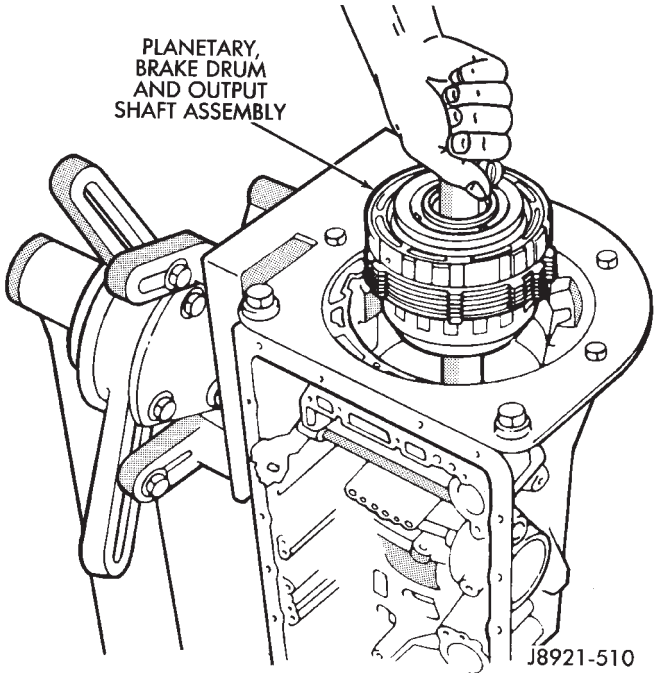


Fig. 45 Removing Rear Planetary, Second Brake Drum And Output Shaft

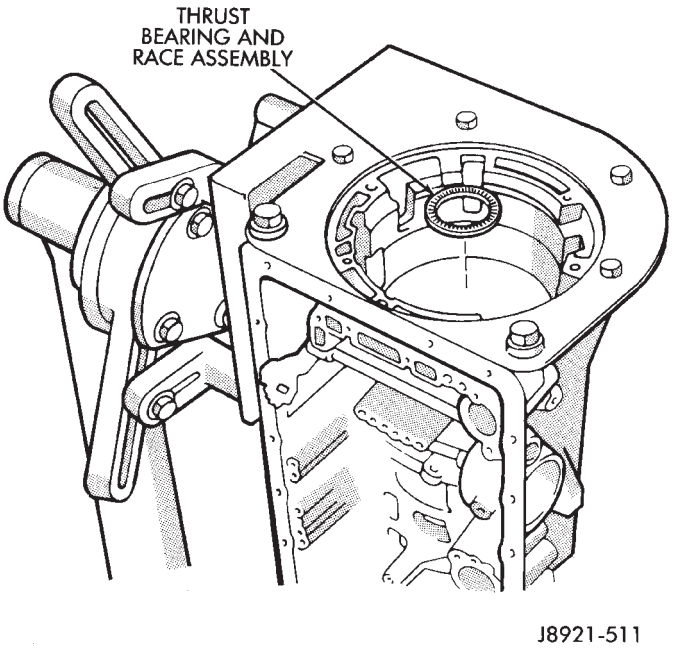


Fig. 46 Removing Planetary And Brake Drum Thrust Bearing And Race Assembly

(56) Remove second brake drum gasket from case with gasket scraper or screwdriver (Fig. 47). Retain tube shaped gasket if condition is OK.

(57) Measure inside diameter of transmission case rear bushing with bore gauge or inside micrometer (Fig. 48). Maximum allowable diameter is 38.18 mm (1.5031 in.). **Replace transmission case if bushing I.D. is greater than specified. Bushing is not serviceable.**

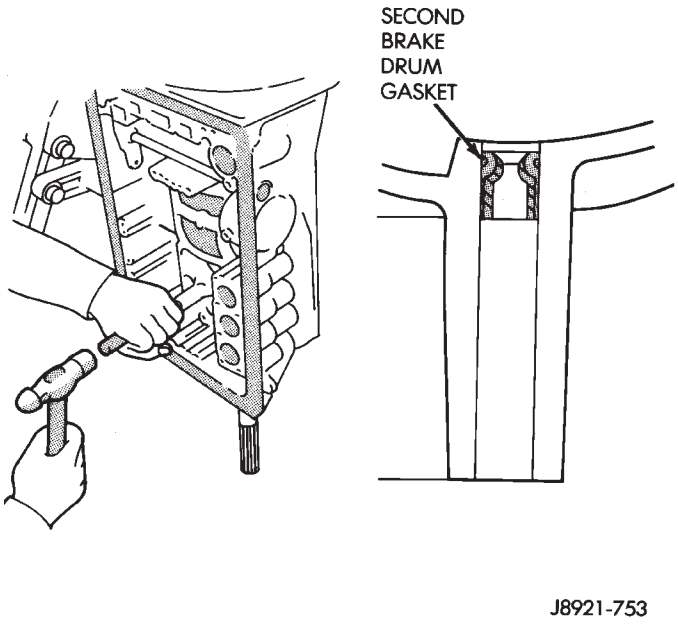


Fig. 47 Removing Brake Drum Gasket

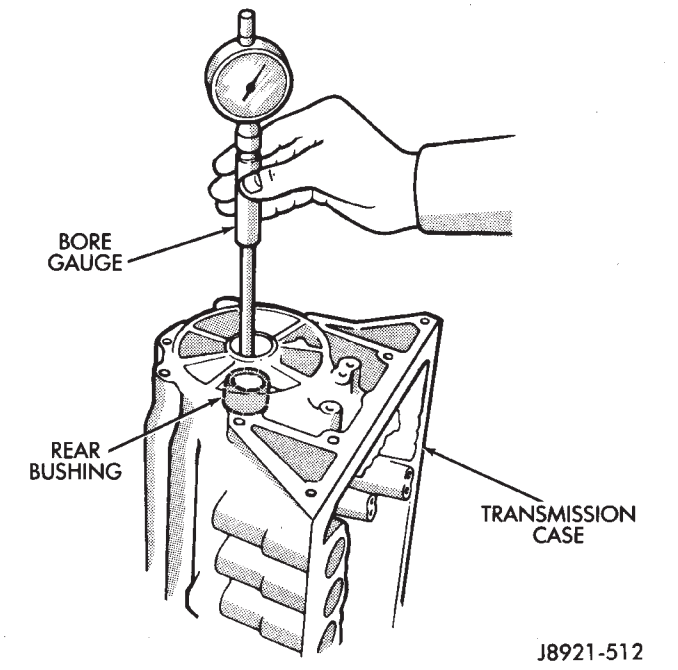


Fig. 48 Checking Rear Bushing Inside Diameter

CLEANING AND INSPECTION

Clean the transmission components with solvent and dry them with compressed air only. Do not use shop towels or rags.

Blow compressed air through all oil feed passages and channels to be sure they are clear. Inspect the transmission components for wear and damage. Replace components that are damaged or worn beyond the limits specified in the individual overhaul procedures.

Replace all O-rings, gaskets and seals. These components are not reusable. Also replace any snap ring that is distorted or damaged.

During overhaul assembly operations, lubricate the transmission components with Jeep or Mopar Mercon™ automatic transmission fluid or petroleum jelly as indicated. Petroleum jelly should be used to prelubricate thrust bearings, washers and races. It can also be used to hold parts in position during assembly.

Soak replacement clutch and brake pack components in transmission fluid for at least 30 minutes before installation.

MANUAL VALVE SHAFT OVERHAUL

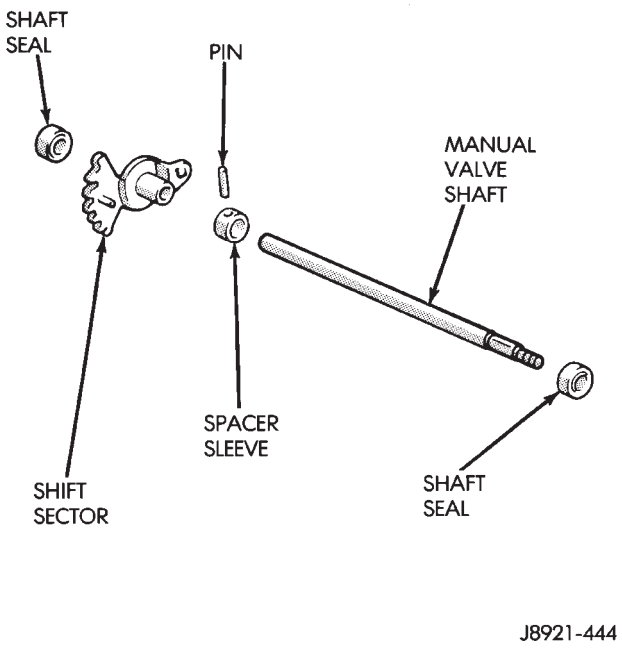


Fig. 1 Manual Valve Shaft Components

(1) Cut shaft spacer sleeve in half with chisel and remove it from lever and shaft (Fig. 2).

(2) Remove shift sector retaining pin with pin punch (Fig. 3).

(3) Pull shaft out of case and remove manual lever.

(4) Carefully pry shaft seals from case.

(5) Lubricate new seals with petroleum jelly and install them in case (Fig. 4).

(6) Install new spacer sleeve on shift sector (Fig. 5).

(7) Install sector and sleeve on shaft and install shaft in case.

(8) Align sector and sleeve and install new retaining pin.

(9) Align notch in sleeve with depression in sector and stake sleeve in two places. Be sure lever and shaft rotate smoothly.

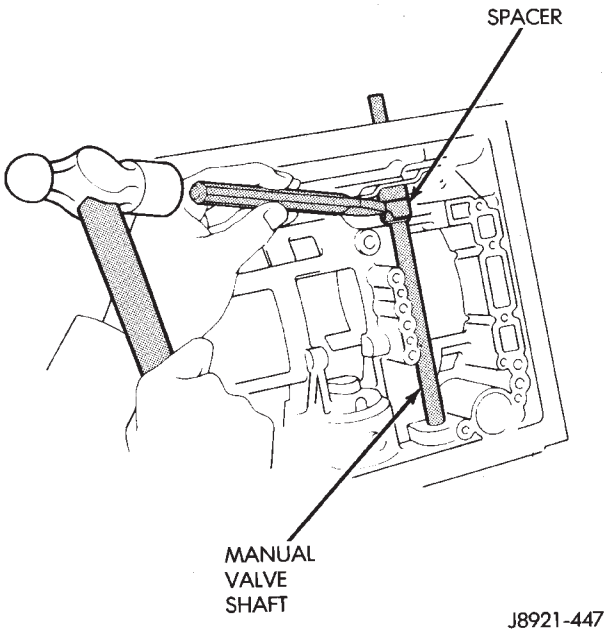


Fig. 2 Cutting Shaft Spacer Sleeve

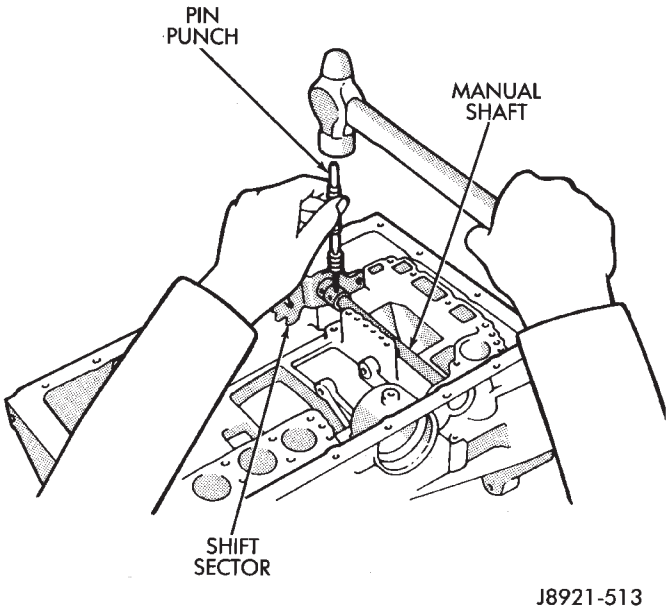


Fig. 3 Removing/Installing Sector Retaining Pin

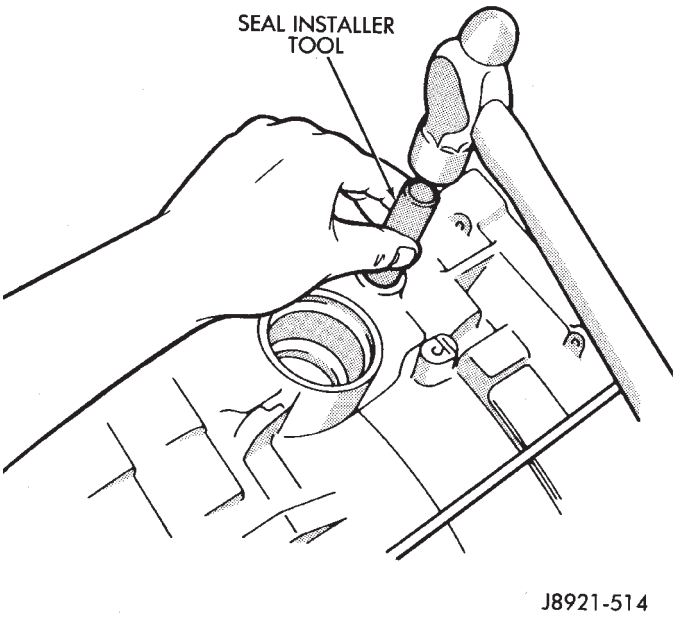


Fig. 4 Installing Manual Shaft Seals

OIL PUMP OVERHAUL

(1) Remove pump body O-ring (Fig. 1).

(2) Remove pump seal rings (Fig. 1).

(3) Remove bolts attaching stator shaft to pump body and separate components.

(4) Remove drive gear and driven gear from pump body (Fig. 1).

(5) Measure inside diameter of pump body bushing with bore gauge or inside micrometer (Fig. 2). Diameter should be maximum of 38.19 mm (1.5035 in.). Replace pump body if bushing I.D. is greater than specified.

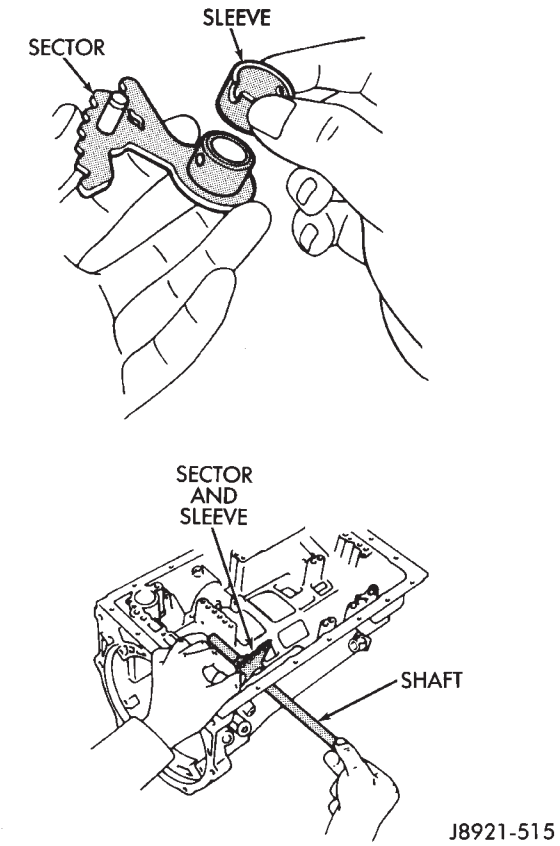


Fig. 5 Installing Manual Shaft And Sector

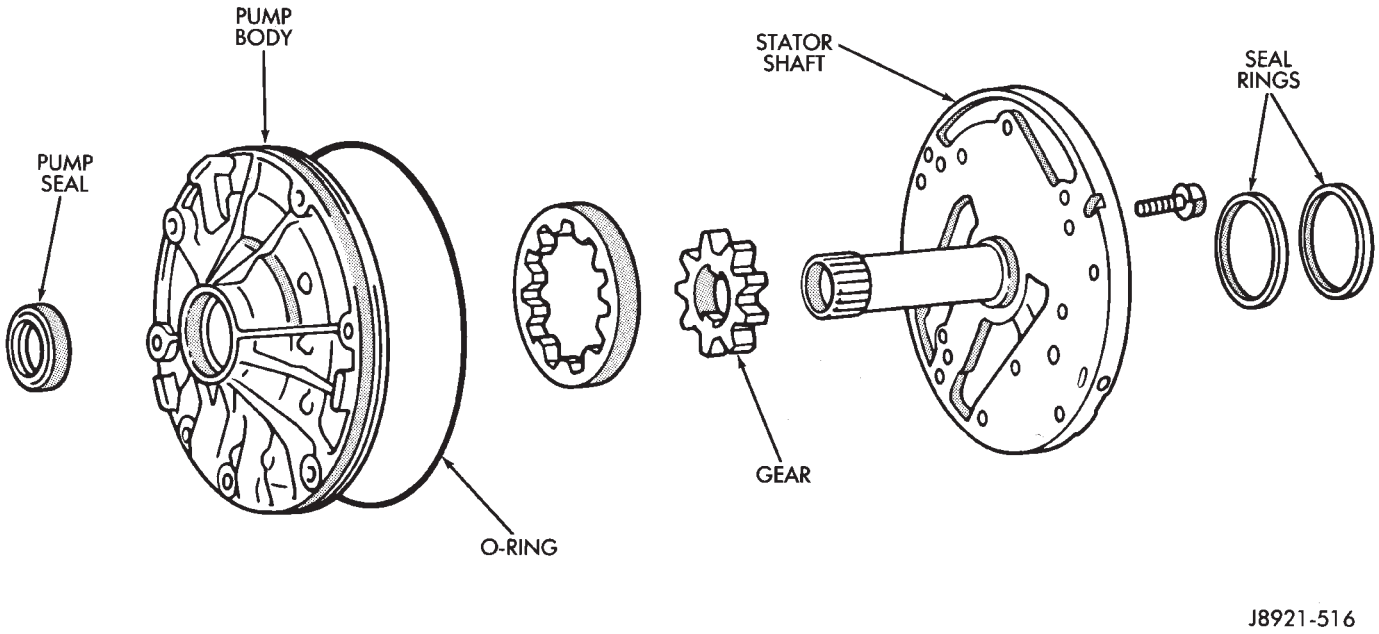


Fig. 1 Oil Pump Components

(6) Measure inside diameter of stator shaft bushing (Fig. 2). Take measurements at front and rear of bushing. Diameter should be maximum of 21.58 mm (0.08496 in.) at front and 27.08 mm (1.0661 in.) at rear. Replace stator shaft if bushing diameter is greater than specified.

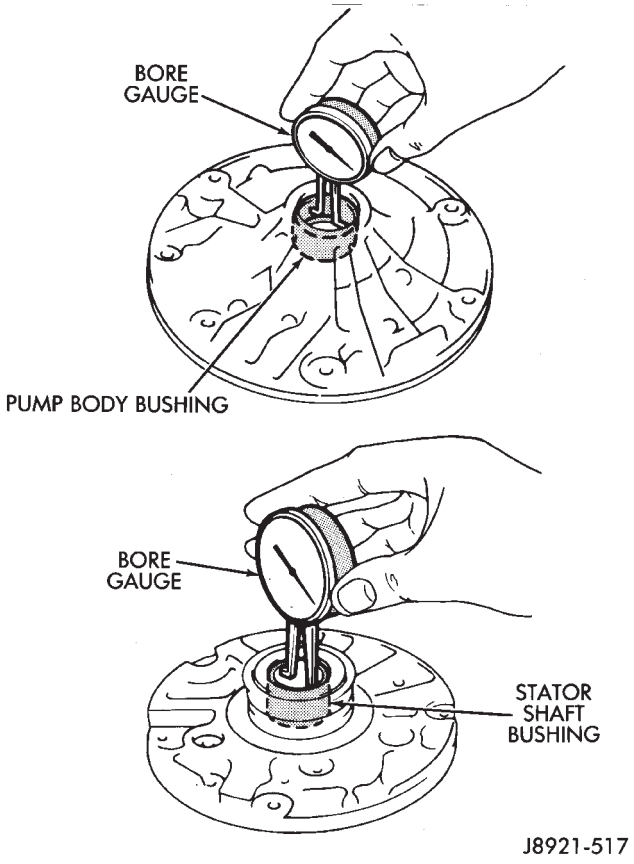


Fig. 2 Checking Pump/Stator Shaft Bushings

(7) Measure oil pump clearances (Fig. 3).

- Clearance between pump driven gear and pump body should be maximum of 0.3 mm (0.012 in).
- Clearance between tips of pump gear teeth should be maximum of 0.3 mm (0.012 in).
- Clearance between rear surface of pump housing and pump gears should be maximum of 0.1 mm (0.004 in.).

(8) Replace pump body and gears if any clearance is greater than specified.

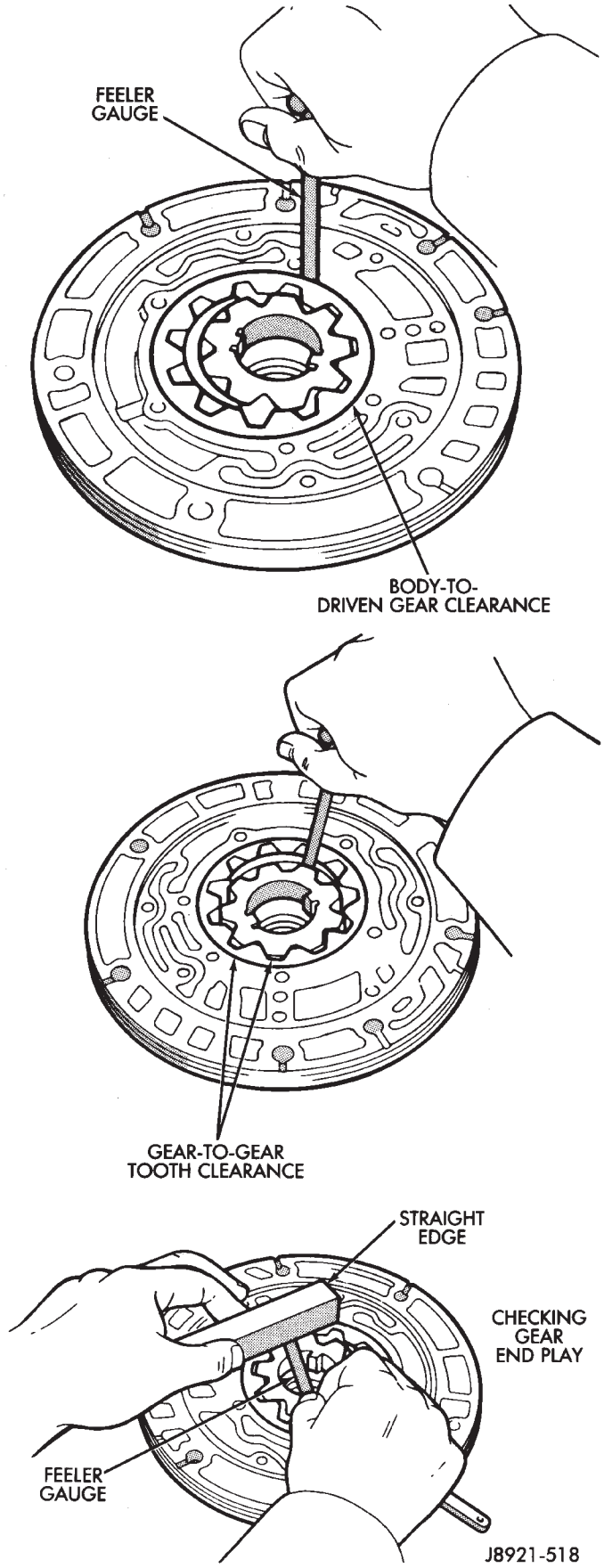


Fig. 3 Checking Pump Gear Clearances

(9) Remove old pump seal. Install new seal with Seal Installer 7549 (Fig. 4).

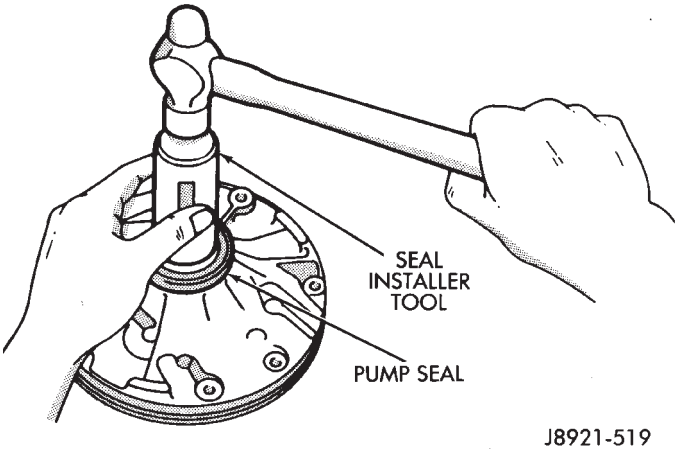


Fig. 4 Installing Pump Seal

(10) Lubricate and install gears in pump body.

(11) Assemble stator shaft and pump body. Tighten shaft-to-body bolts to 10 N·m (7 ft. lbs.) torque.

(12) Install new O-ring on pump body and new seal rings on stator shaft.

(13) Install pump in torque converter and check pump gear rotation. Gears must rotate smoothly when turned clockwise and counterclockwise.

(14) Lubricate pump O-ring and seal rings with petroleum jelly.

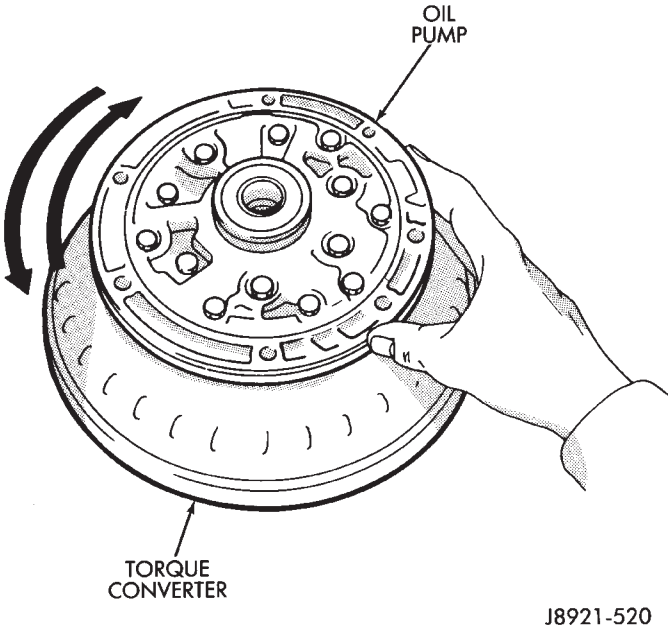


Fig. 5 Checking Pump Gear Rotation

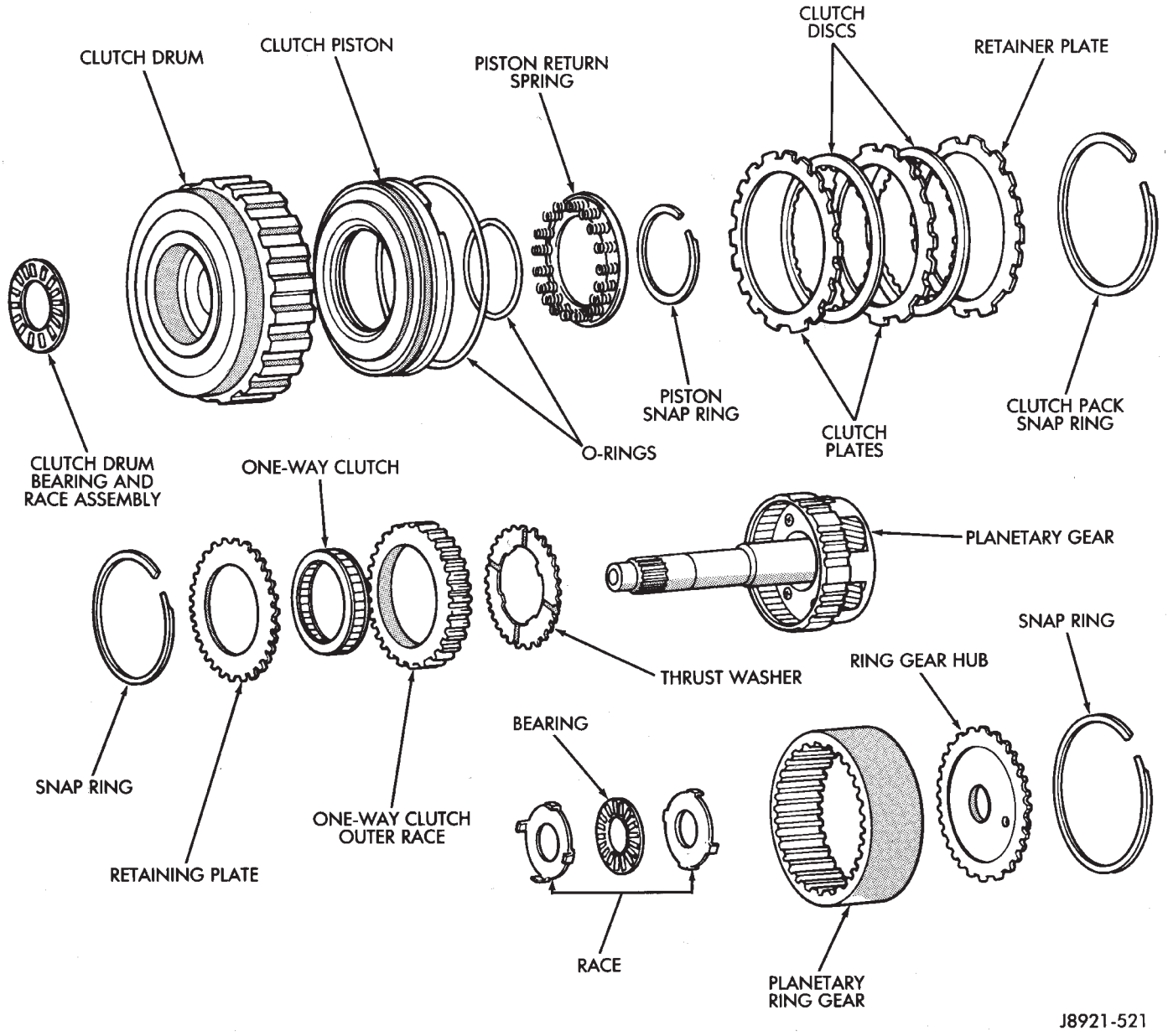


Fig. 1 Overdrive Planetary Gear And Clutch Components

OVERDRIVE PLANETARY GEAR AND CLUTCH OVERHAUL

GEAR AND CLUTCH DISASSEMBLY

(1) Check operation of one-way clutch in clutch drum. Hold drum and turn planetary shaft clockwise and counterclockwise. Shaft should turn clockwise freely but lock when turned counterclockwise. Replace one-way clutch if necessary.

(2) Remove overdrive clutch from planetary gear (Fig. 3).

(3) Remove thrust bearing and race assembly from clutch drum (Fig. 4).

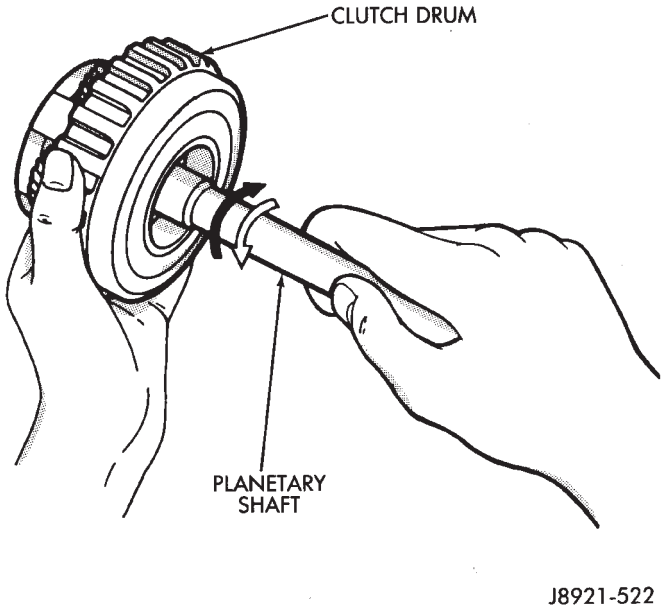


Fig. 2 Checking One-Way Clutch

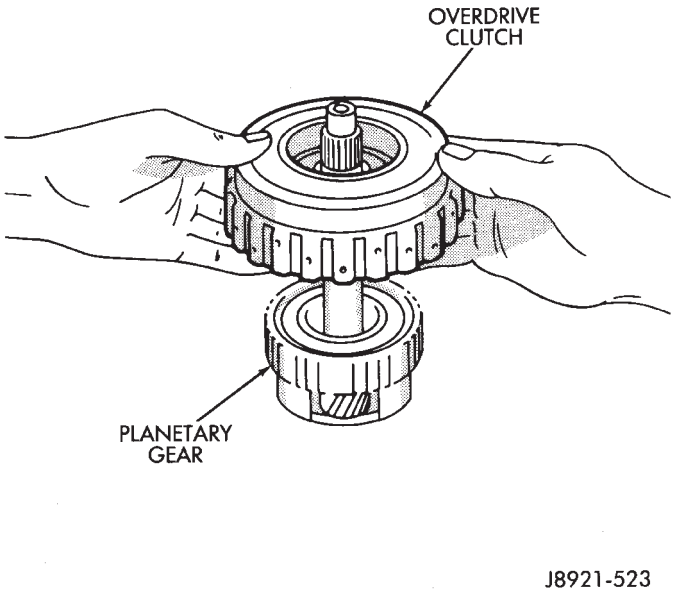


Fig. 3 Removing Overdrive Clutch From Gear

(4) Measure stroke length of clutch piston as follows:

(a) Mount oil pump on torque converter. Then mount clutch on oil pump (Fig. 5).

(b) Mount dial indicator on clutch and position indicator stylus on clutch piston (Fig. 6).

(c) Apply compressed air through clutch feed hole in oil pump and note piston stroke length. Stroke length should be 1.85 - 2.15 mm (0.0728 - 0.0846 in.).

(5) Replace clutch pack retainer if stroke length is incorrect. Refer to chart in Specifications section for replacement retainer thicknesses.

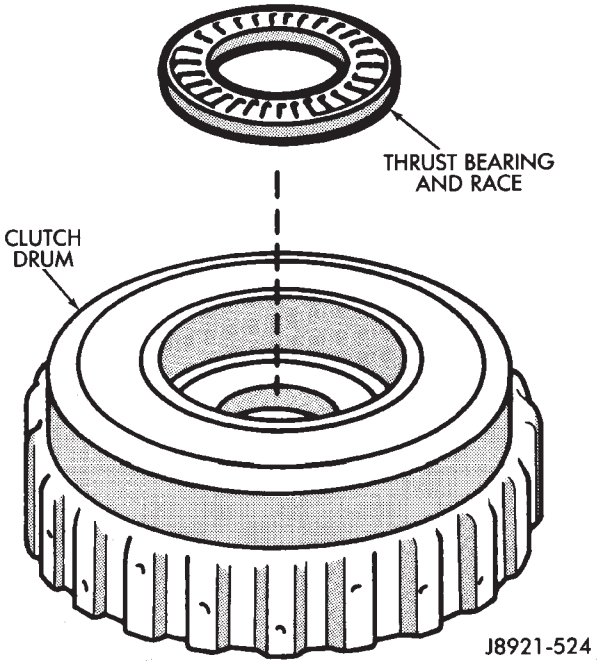


Fig. 4 Removing Clutch Drum Bearing And Race

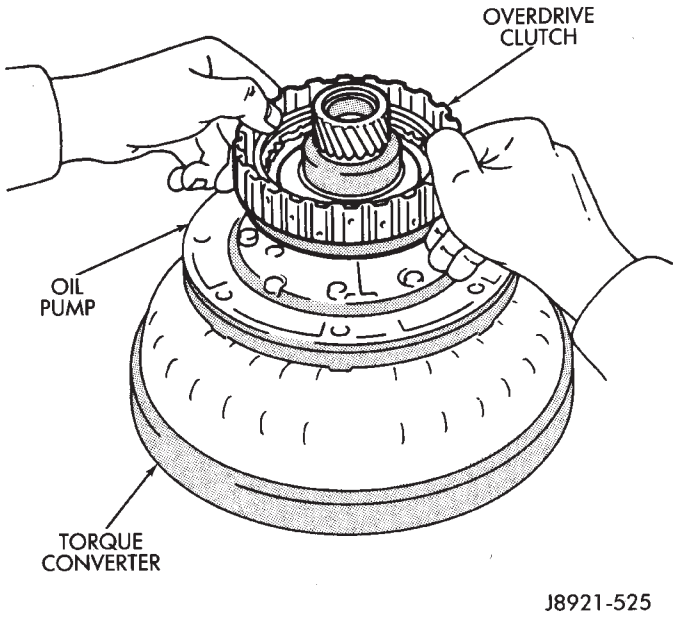


Fig. 5 Assembling Converter, Pump And Clutch For Test

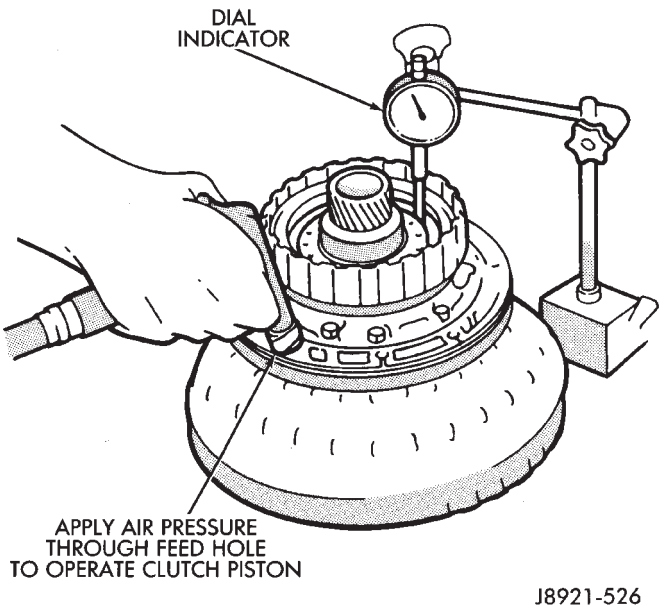


Fig. 6 Checking Overdrive Clutch Piston Stroke

(6) Remove clutch pack snap ring and remove the clutch pack.

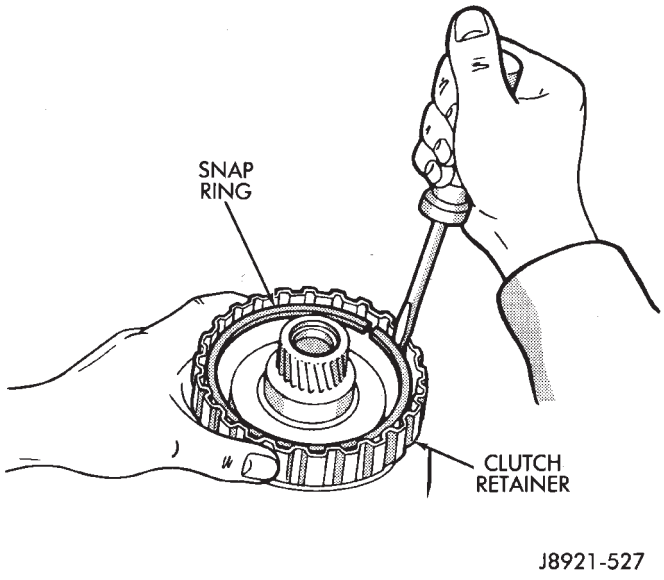


Fig. 7 Removing Clutch Pack Snap Ring

(7) Compress piston return spring with Tool 7538 (Fig. 8). Remove snap ring and remove compressor tool.

(8) Remove compressor tool and piston return springs.

(9) Mount oil pump on converter. Then mount clutch on oil pump (Fig. 9).

(10) Hold clutch piston by hand and apply compressed air through oil pump feed hole to ease piston out (Fig. 9). Apply only enough air pressure to remove piston.

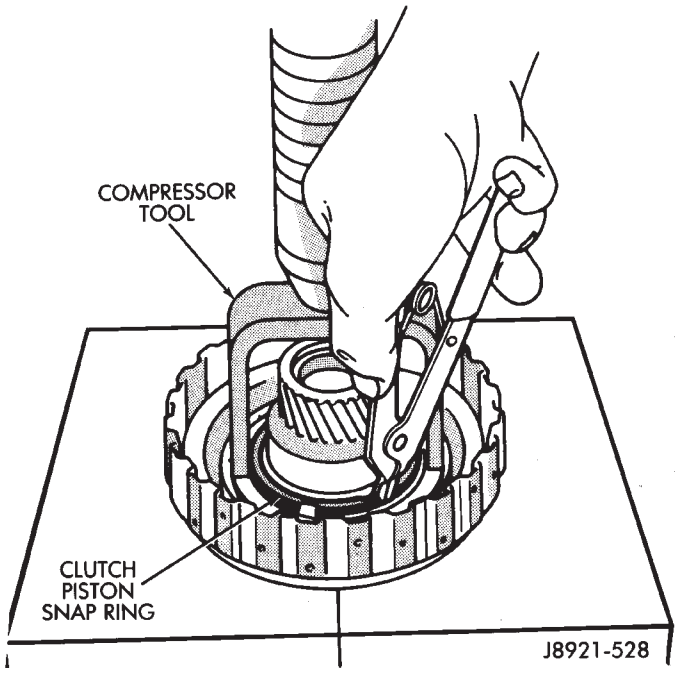


Fig. 8 Removing Clutch Piston Snap Ring

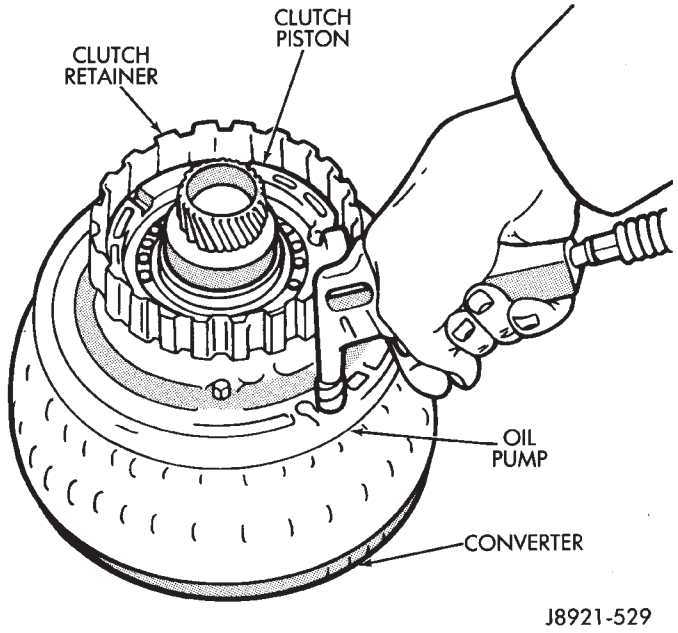


Fig. 9 Removing Overdrive Clutch Piston

(11) Remove bearing and race from ring gear (Fig. 10).

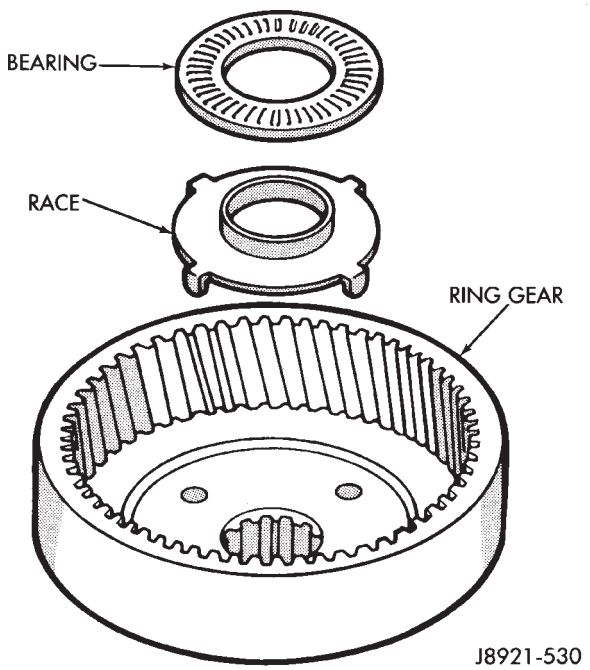


Fig. 10 Removing Ring Gear Bearing And Race

(12) Remove snap ring from ring gear and remove ring gear hub (Fig. 11).

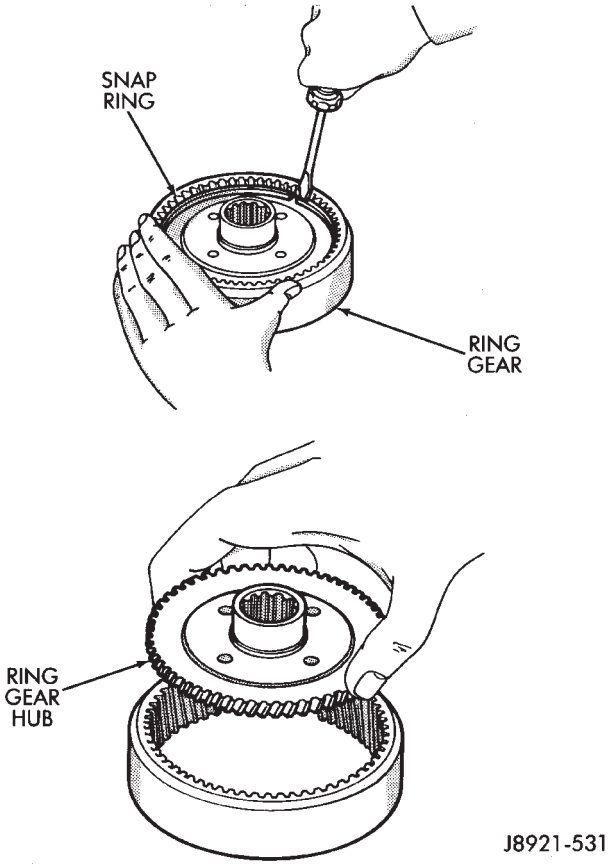


Fig. 11 Removing Ring Gear Hub

(13) Remove race from planetary gear (Fig. 12).

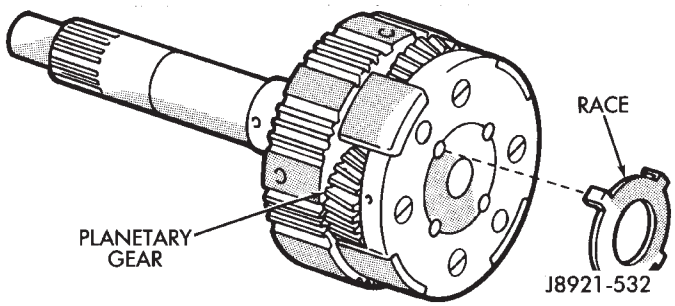


Fig. 12 Remove Planetary Gear Race

(14) Remove snap ring and remove retaining plate (Fig. 13).

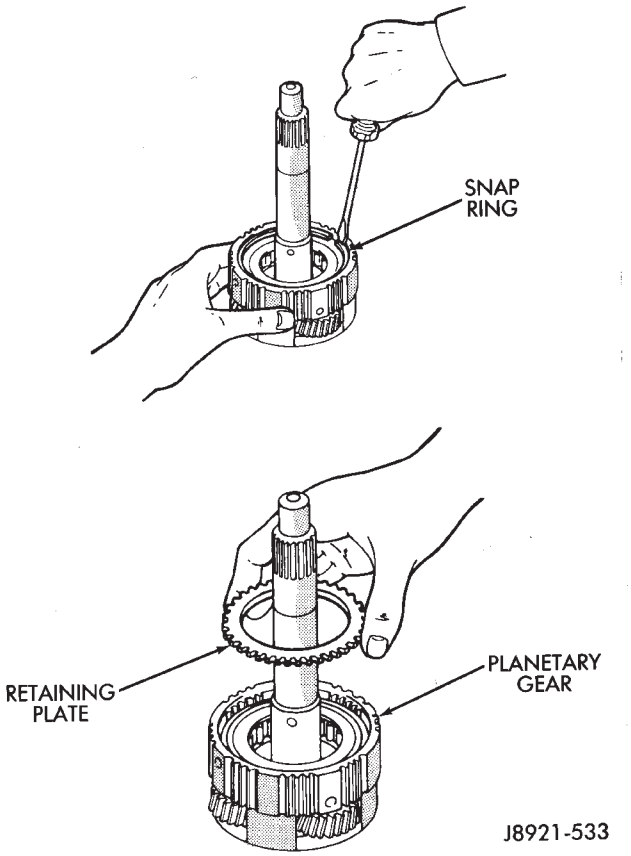


Fig. 13 Removing Snap Ring And Retaining Plate

(15) Remove one-way clutch and outer race as assembly. Then separate race from clutch (Fig. 14).

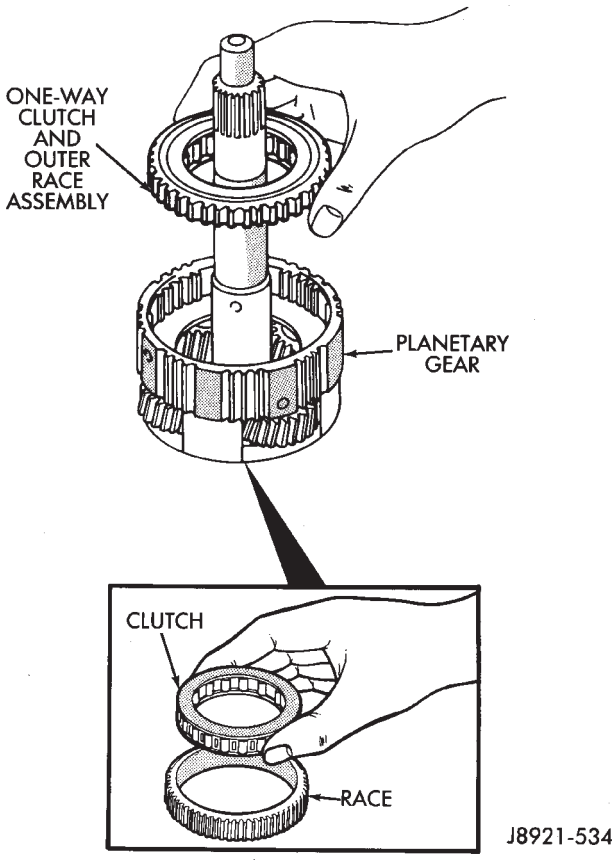


Fig. 14 Removing One-Way Clutch

(16) Remove thrust washer (Fig. 15).

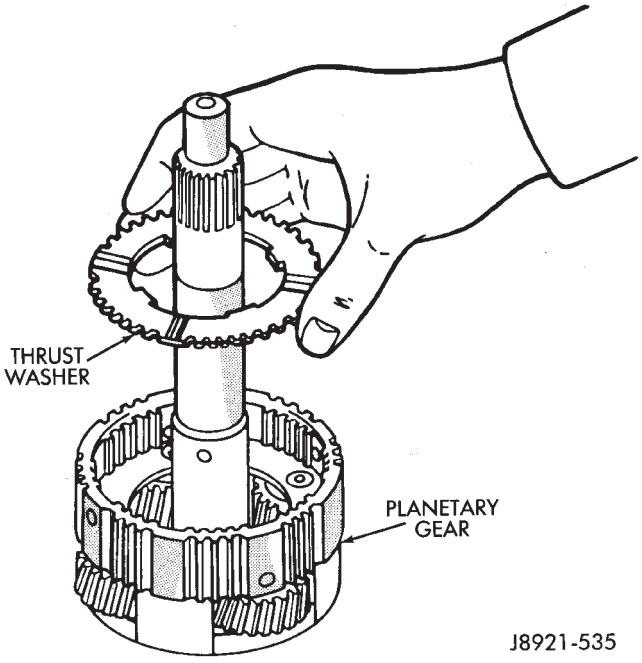


Fig. 15 Removing Planetary Thrust Washer

(17) Measure clutch disc thickness. Minimum allowable thickness is 1.84 mm (0.0724 in.).

(18) Measure free length of piston return springs with springs in retainer (Fig. 16). Length should be 16.8 mm (0.661 in.).

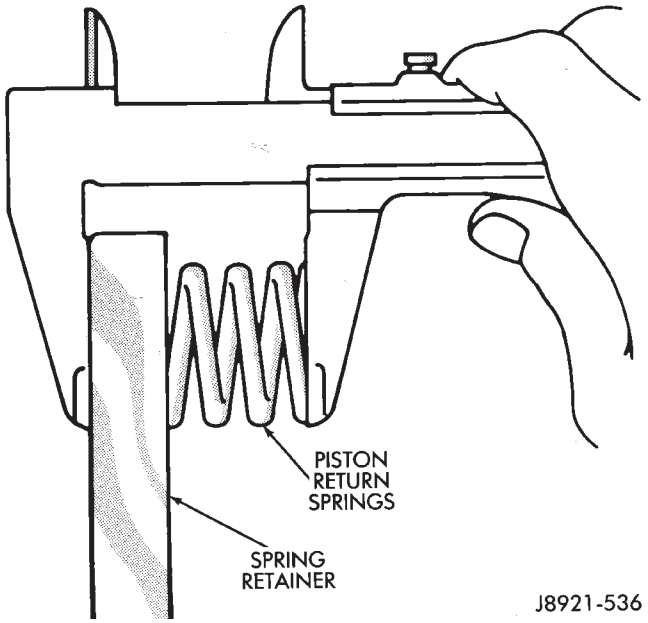


Fig. 16 Checking Piston Return Spring Length

(19) Check clutch piston check ball (Fig. 17). Shake piston to see if ball moves freely. Then check ball sealing by applying low pressure compressed air to ball inlet as shown. Air should not leak past check ball.

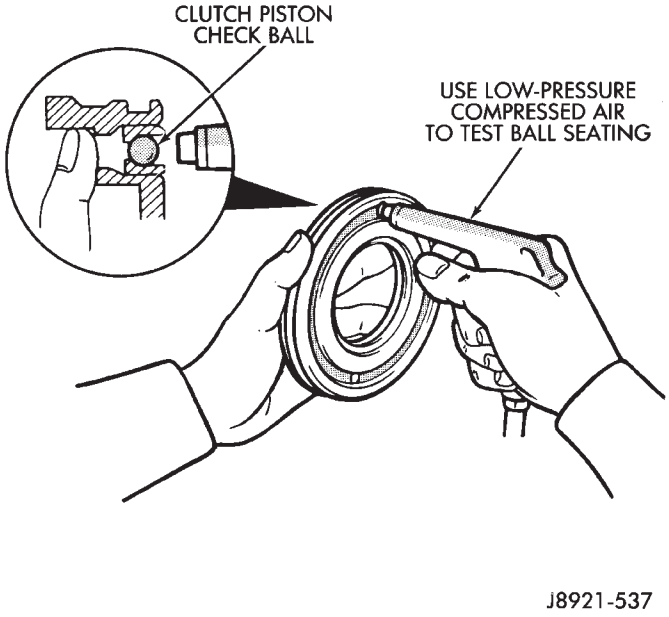


Fig. 17 Testing Clutch Piston Check Ball

(20) Check inside diameter of clutch drum bushings with bore gauge or inside micrometer (Fig. 18). Maximum inside diameter is 27.11 mm (1.0673 in.). Replace drum if bushing inside diameter is greater than specified.

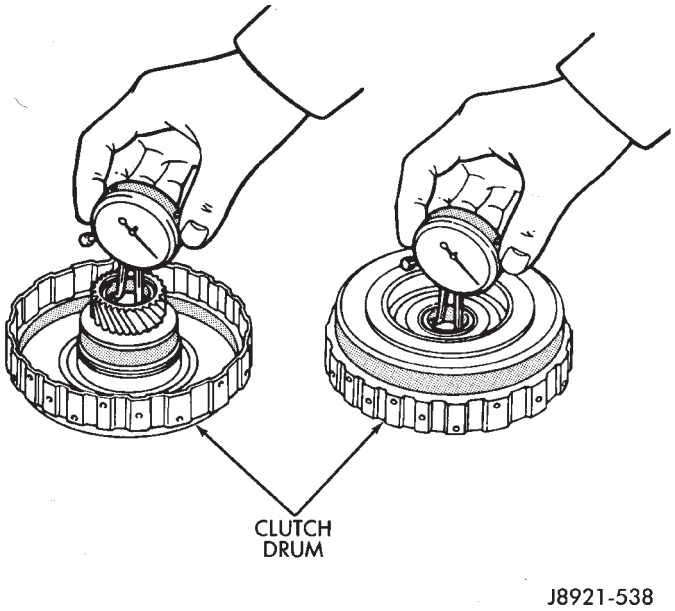


Fig. 18 Checking Clutch Drum Bushings

(21) Check inside diameter of planetary gear bushing (Fig. 19). Maximum inside diameter is 11.27 mm (0.4437 in.). Replace planetary gear if bushing inside diameter is greater then specified.

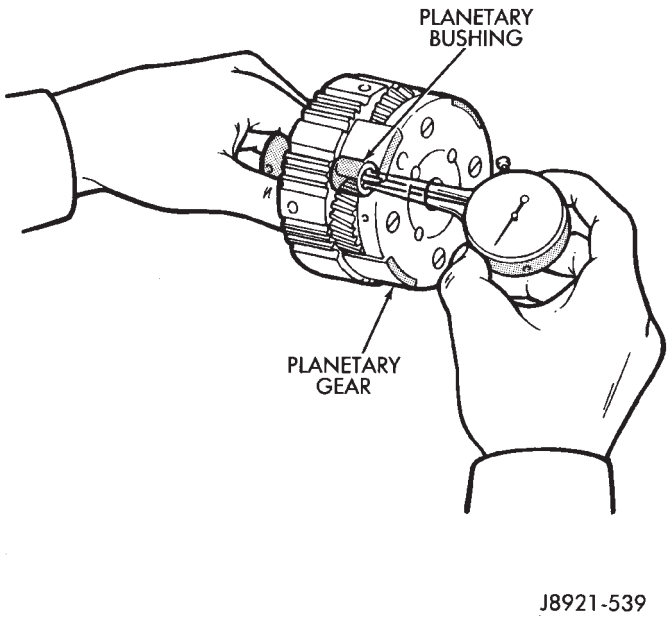


Fig. 19 Checking Planetary Bushing

Assembling Gear And Clutch

(1) Install thrust washer in planetary gear (Fig. 20). **Grooved side of washer faces up and toward front.**

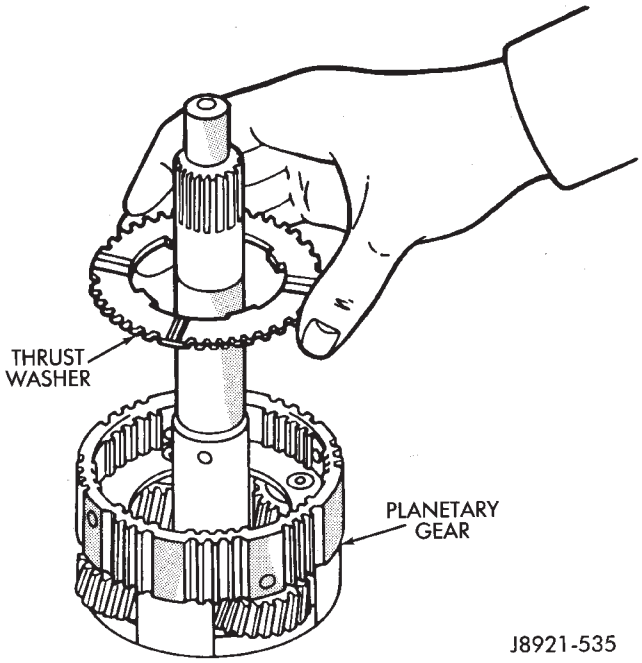


Fig. 20 Install Planetary Thrust Washer

(2) Install one-way clutch in race (Fig. 21). Flanged side of clutch must face upward as shown.

(3) Install assembled one-way clutch and outer race in planetary gear. Be sure flanged side of clutch is facing upward.

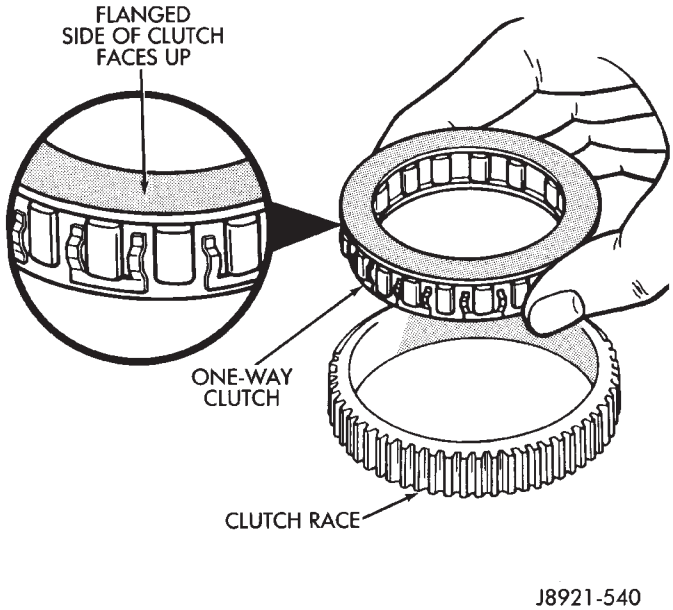


Fig. 21 Assembling One-Way Clutch And Race

(4) Install clutch pack retaining plate and snap ring in planetary gear.

(5) Coat planetary race with petroleum jelly and install it on planetary gear. Outside diameter of race is 41.8 mm (1.646 in.); inside diameter is 27.1 mm (1.067 in.).

(6) Install hub in planetary ring gear and install snap ring.

(7) Coat race and bearing with petroleum jelly and install in planetary ring gear (Fig. 22).

(8) Verify bearing/race size. Outside diameter of race is 47.8 mm (1.882 in.) and inside diameter is 24.2 mm (0.953 in.). Outside diameter of bearing is 46.8 mm (1.843 in.) and inside diameter is 26 mm (1.024 in.).

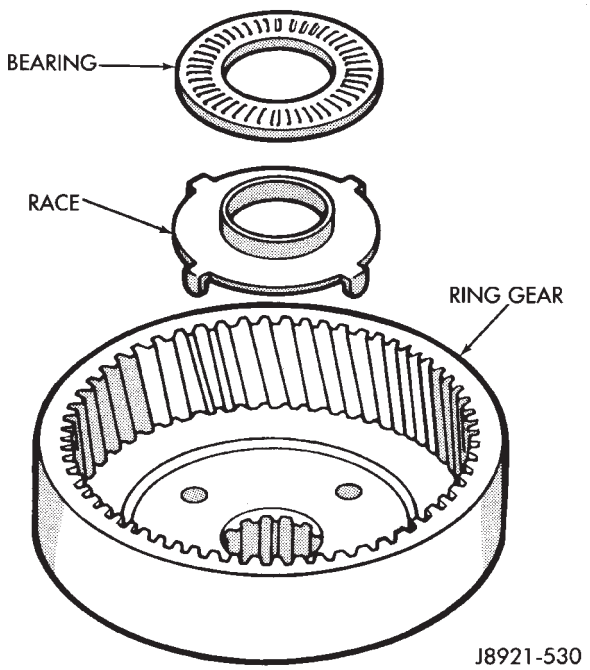


Fig. 22 Install Ring Gear Bearing And Race

(9) Lubricate and install new O-rings on clutch piston. Then install piston in clutch drum.

(10) Install piston return springs in clutch piston (Fig. 23).

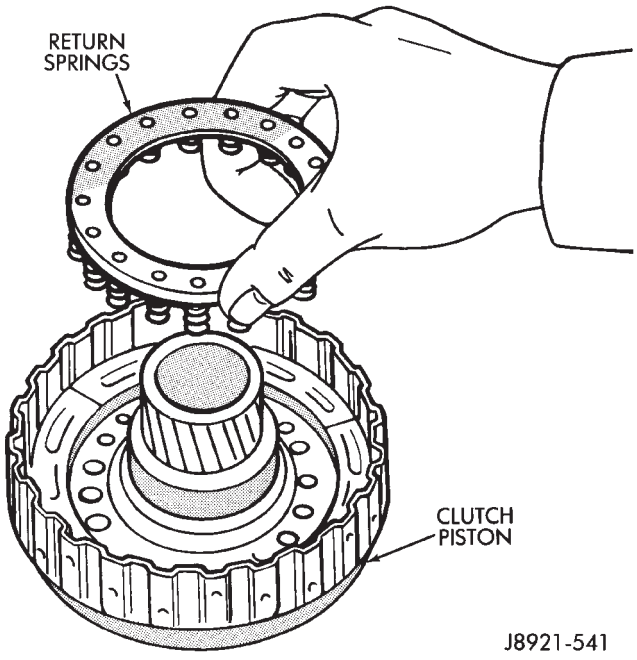


Fig. 23 Installing Piston Return Springs

(11) Install piston snap ring. Compress piston return springs with Tool 7538 and shop press (Fig. 24).

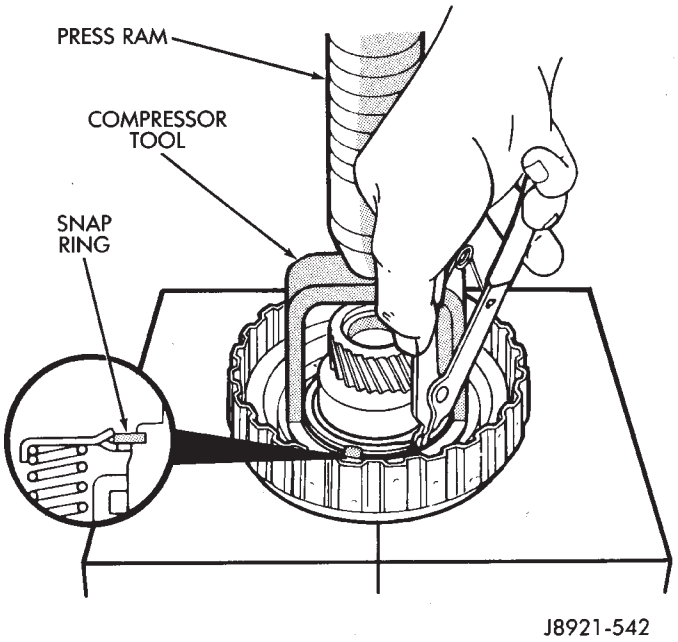


Fig. 24 Installing Clutch Piston Snap Ring

(12) Install clutch pack in drum. Install steel plate first, then a disc (Fig. 25). Continue installation sequence until required number of discs and plates have been installed.

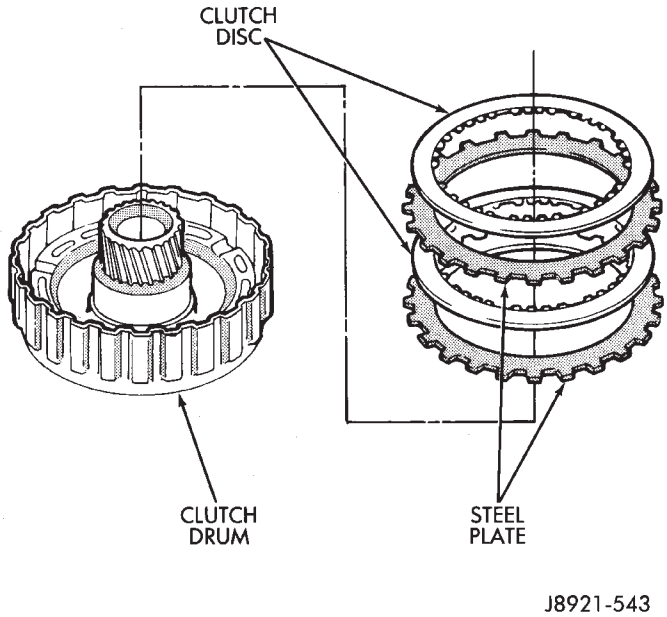


Fig. 25 Installing Clutch Discs And Plates

(13) Install clutch pack retainer with flat side facing downward. Then install retainer snap ring (Fig. 26). Compress springs with suitable tool.

(14) Measure clutch piston stroke length again (refer to procedure outlined in disassembly procedure). If stroke length is incorrect, install new clutch discs or select fit retainer. Retainer thicknesses are outlined in the Specifications section.

(15) Install clutch drum bearing and race assembly (Fig. 27). Be sure bearing rollers face upward as shown. Outside diameter of assembled bearing and race is 50.2

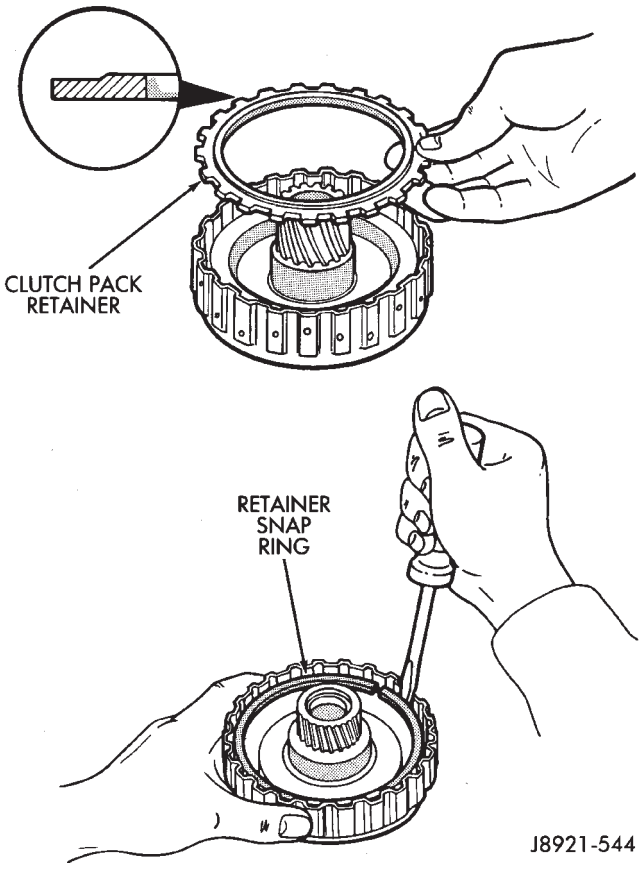


Fig. 26 Installing Retainer And Snap Ring

mm (1.976 in.). Inside diameter is 28.9 mm (1.138 in.).

(16) Install clutch on planetary gear.

(17) Verify one-way clutch operation. Hold drum and turn planetary shaft clockwise and counterclockwise. Shaft should turn clockwise freely but lock when turned counterclockwise.

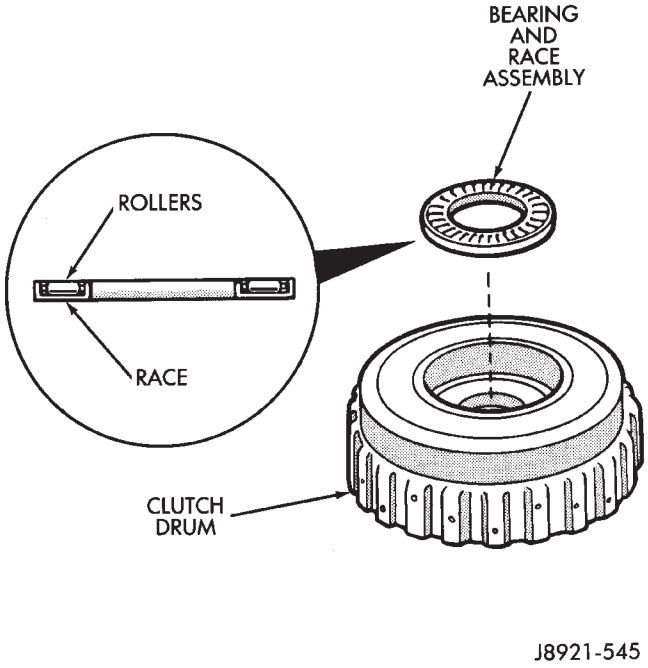


Fig. 27 Installing Clutch Drum Bearing And Race Assembly

OVERDRIVE SUPPORT OVERHAUL

SUPPORT DISASSEMBLY

(1) Check brake piston operation. Mount support on clutch (Fig. 2).

(2) Apply compressed air through support feed hole and observe brake piston movement (Fig. 2). Piston

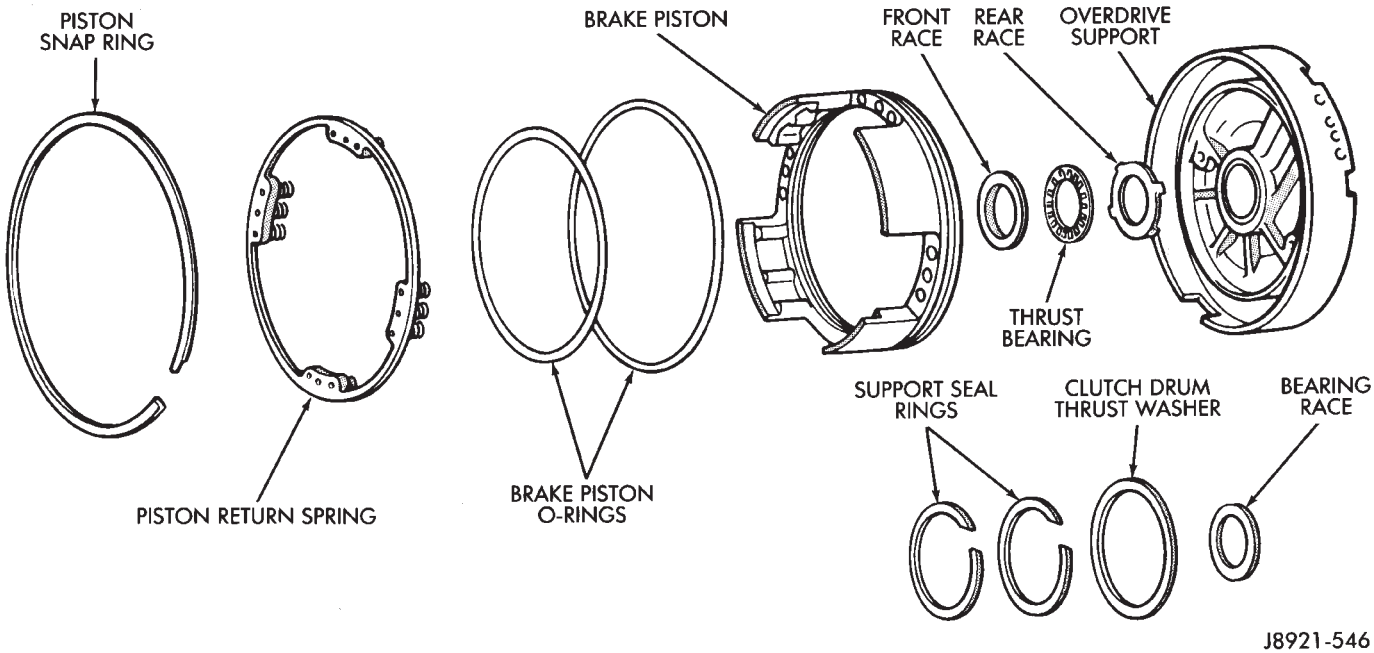


Fig. 1 Overdrive Support Components

should move smoothly and not bind or stick. If operation is incorrect, replace piston and support.

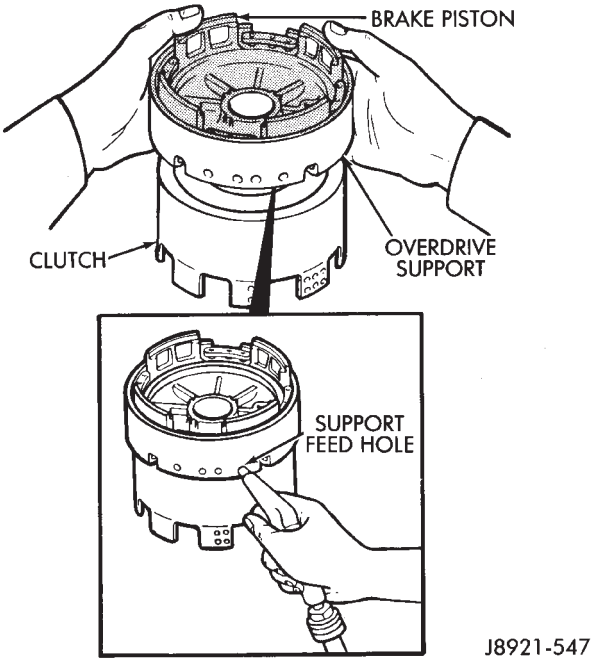


Fig. 2 Checking Brake Piston Movement

(3) Remove thrust bearing front race, thrust bearing and rear race (Fig. 3).

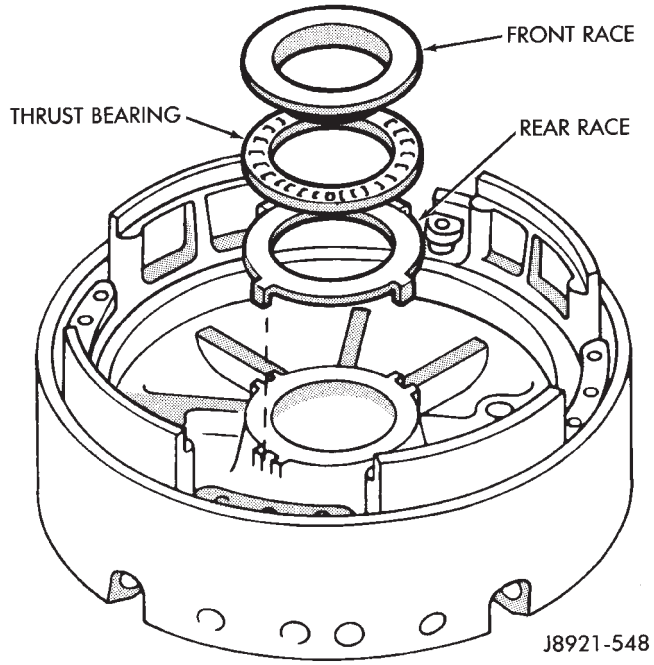


Fig. 3 Removing Support Thrust Bearing And Races

(4) Turn overdrive support over and remove bearing race and clutch drum thrust washer (Fig. 4).

(5) Compress piston return spring with Spring Compressor 7537 and remove piston snap ring (Fig. 5).

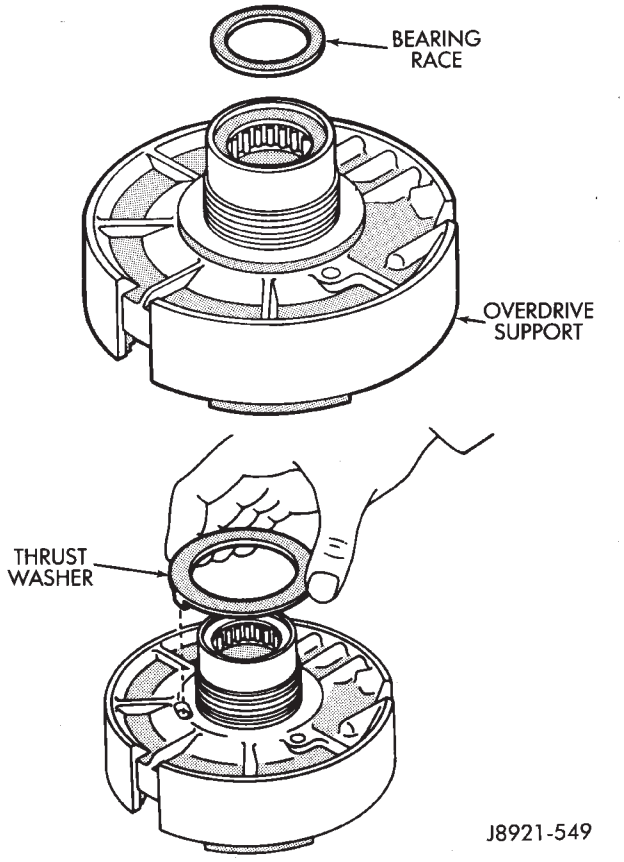


Fig. 4 Removing Clutch Drum Thrust Washer And Race

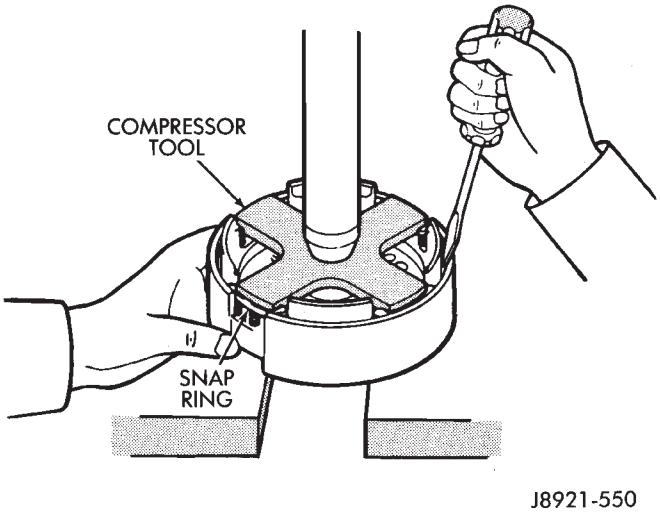


Fig. 5 Removing/Installing Piston Snap Ring

(6) Mount support in direct clutch and remove brake piston with compressed air. Apply air to same feed hole used when checking piston operation.

(7) Remove and discard support O-rings (Fig. 1).

(8) Remove support seal rings (Fig. 6).

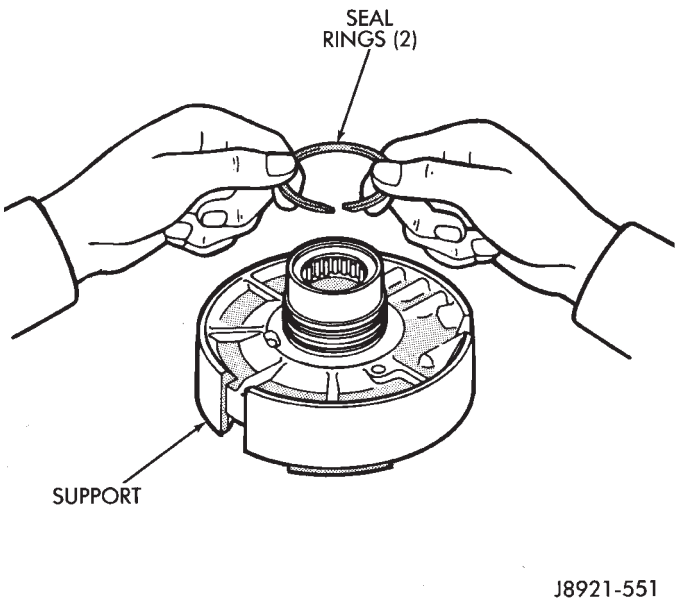


Fig. 6 Removing Support Seal Rings

(9) Measure free length of piston return springs with springs mounted in retainer (Fig. 7). Length should be 17.23 mm (0.678 in.).

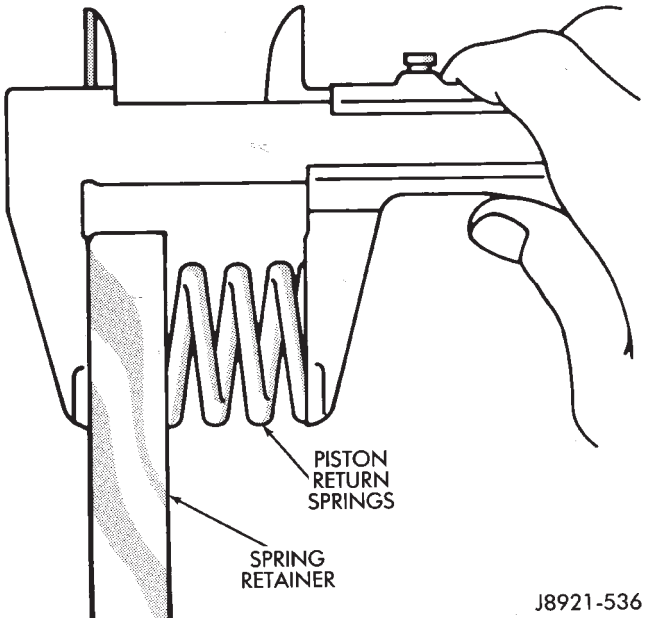


Fig. 7 Checking Piston Return Spring Length

(10) Clean support components and dry them with compressed air.

(11) Inspect overdrive support and brake piston. Replace support and piston if either part is worn or damaged.

ASSEMBLING OVERDRIVE SUPPORT

(1) Lubricate new support seal rings. Then compress rings and install them on support (Fig. 8).

(2) Lubricate and install new O-rings on brake piston. Then carefully seat piston in support.

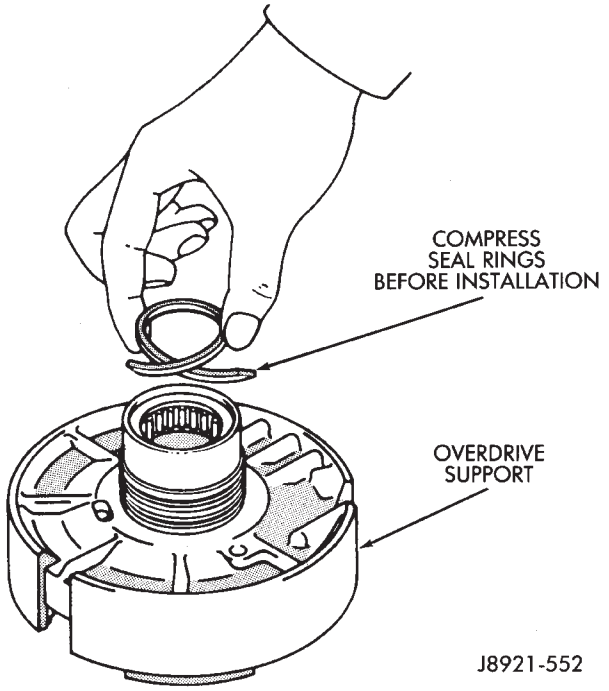


Fig. 8 Installing Support Seal Rings

(3) Install return springs on brake piston.

(4) Compress return springs with Spring Compressor 7537 (Fig. 5) and install piston snap ring.

(5) Install support bearing race and clutch drum thrust washer (Fig. 4).

(6) Install thrust bearing and front and rear bearing races. Thrust bearing rollers should face upward as shown (Fig. 9).

(7) Verify thrust bearing/race sizes (Fig. 9).

- Front race outer diameter is 47.8 mm (1.882 in.) and inside diameter is 30.7 mm (1.209 in.).

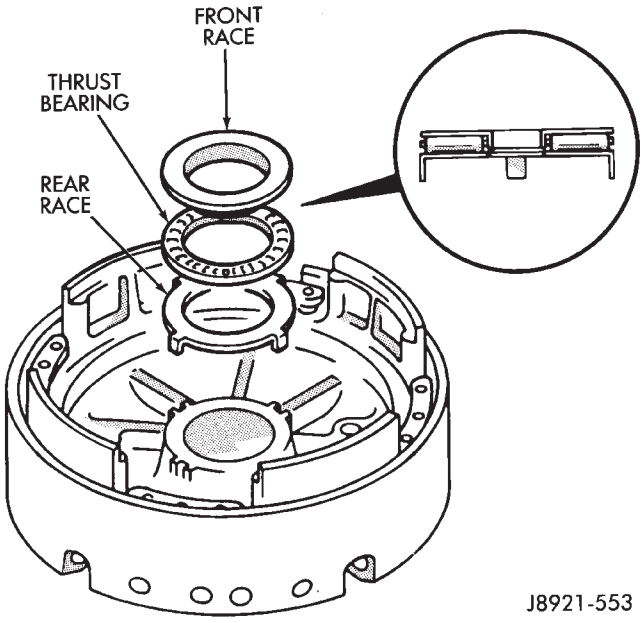


Fig. 9 Installing Support Thrust Bearing And Races

• Rear race outer diameter is 47.8 mm (1.882 in.) and inside diameter is 34.3 mm (1.350 in.).
• Bearing outer diameter is 47.7 mm (1.878 in.) and inside diameter is 32.7 mm (1.287 in.).

(8) Verify brake piston operation. Use same procedure described at beginning of disassembly. Piston should operate smoothly and not bind or stick.

DIRECT CLUTCH OVERHAUL

CLUTCH DISASSEMBLY

(1) Remove direct clutch from forward clutch (Fig. 1).

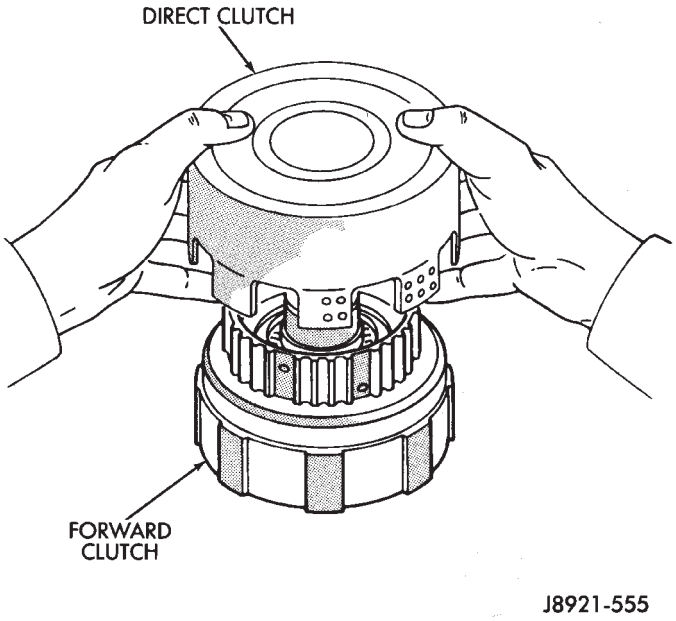


Fig. 1 Separate Direct Clutch From Forward Clutch

(2) Remove clutch drum thrust washer (Fig. 2).

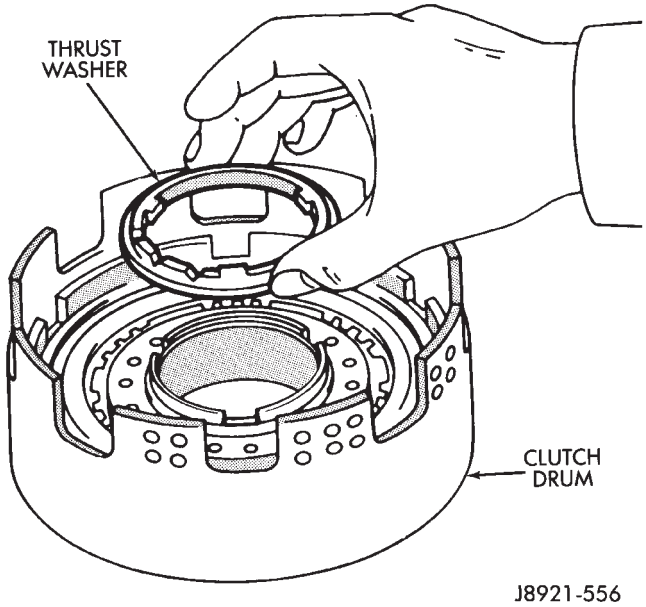


Fig. 2 Removing Clutch Drum Thrust Washer

(3) Check clutch piston stroke length as outlined in following steps.

(4) Mount direct clutch on overdrive support assembly (Fig. 3).

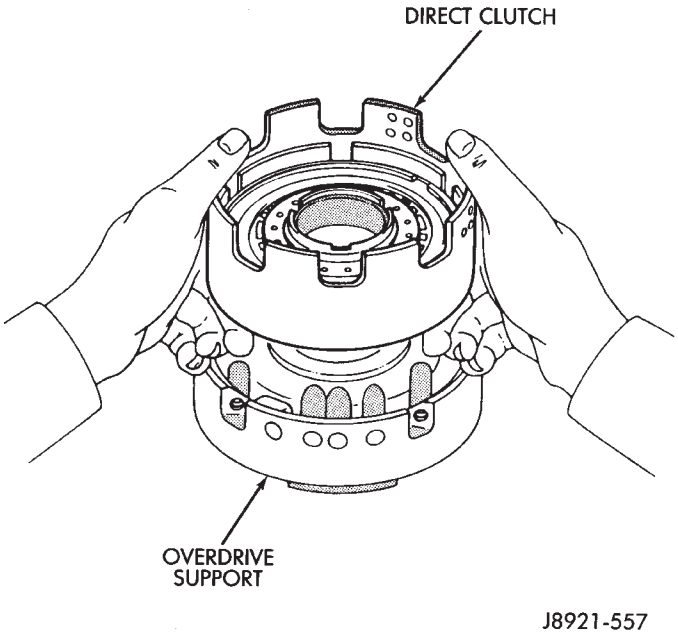


Fig. 3 Mount Direct Clutch On Overdrive Support

(5) Mount dial indicator on clutch and position indicator plunger on clutch piston (Fig. 4).

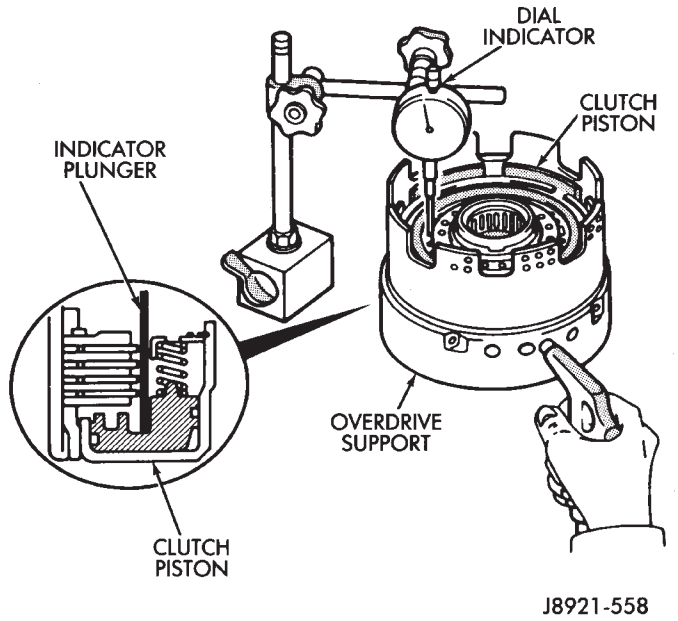


Fig. 4 Checking Direct Clutch Piston Stroke Length

(6) Apply 57-114 psi air pressure through feed hole in overdrive support and note piston stroke length (Fig. 4). Check stroke at least twice.

(7) Piston stroke length should be 1.37 mm - 1.67 mm (0.054 -0.065 in.). If stroke length is incorrect, either the clutch pack retainer or clutch discs will have to be replaced.

(8) Remove clutch pack snap ring and remove retainer and clutch pack from drum (Fig. 5).

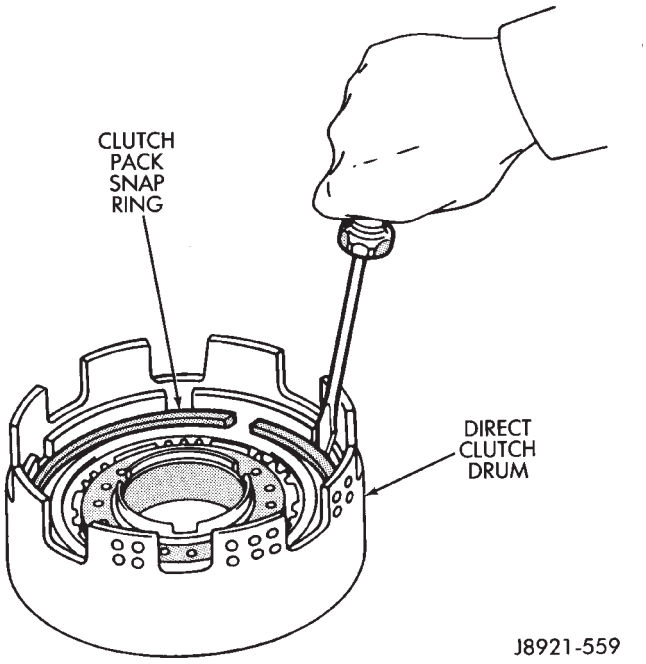


Fig. 5 Removing Clutch Pack Snap Ring

(9) Compress clutch piston return springs with tool 7538 and remove clutch piston snap ring (Fig. 6).

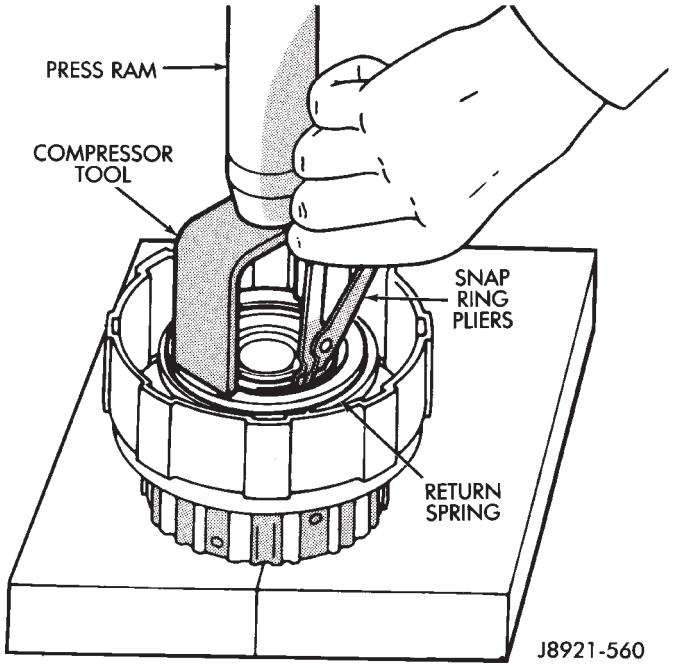


Fig. 6 Removing Piston Return Spring

(10) Remove compressor tool and return spring.

(11) Remove clutch piston. Remount clutch on overdrive support (Fig. 7). Apply compressed air through piston feed hole in support to remove piston. Use only enough air to ease piston out.

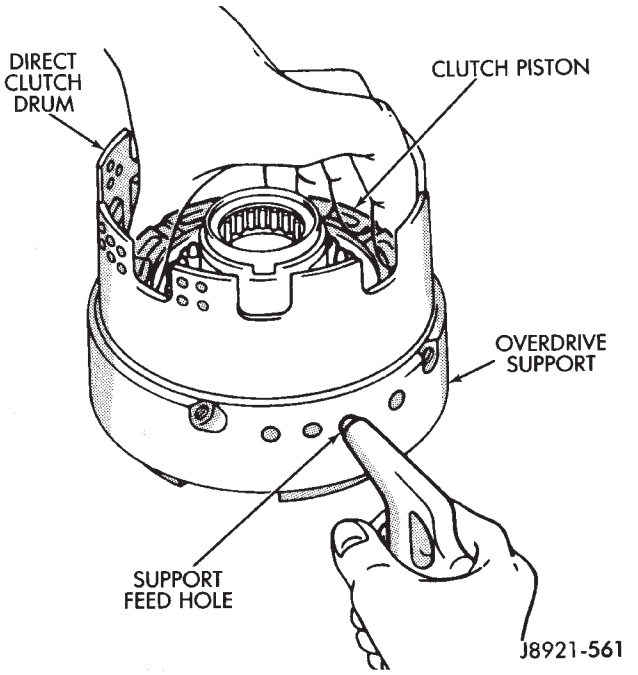


Fig. 7 Removing Direct Clutch Piston

(12) Remove and discard clutch piston O-rings.

(13) Measure clutch disc thickness. Minimum allowable thickness is 1.84 mm (0.0724 in). Replace discs if below minimum thickness.

(14) Measure free length of piston return springs with springs in retainer (Fig. 8). Length should be 21.32 mm (0.839 in.). Replace return springs if not within specification.

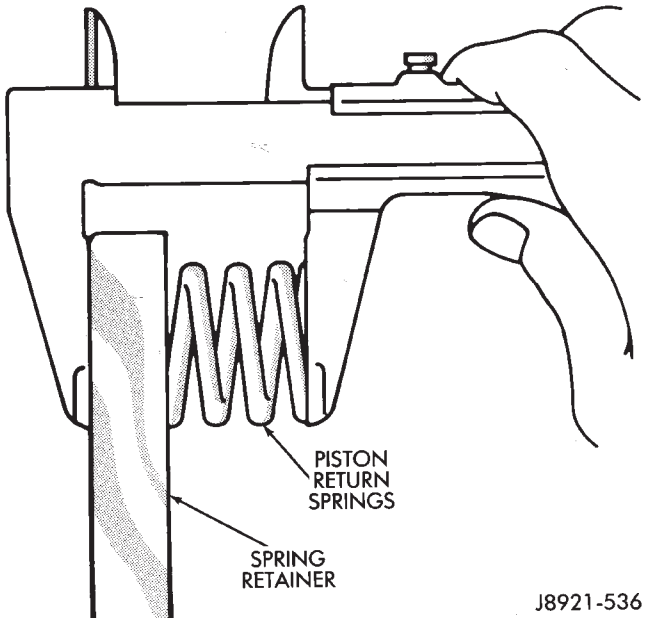


Fig. 8 Checking Piston Return Spring Length

(15) Check clutch piston check ball (Fig. 9). Shake piston to see if ball moves freely. Then check ball seating by applying low pressure compressed air to ball inlet as shown. Air should not leak past check ball.

(16) Measure inside diameter of clutch drum bushing. Inside diameter should be no more than 53.97 mm (2.1248 in.). Replace drum if bushing inside diameter is greater than specified.

DIRECT CLUTCH ASSEMBLY

(1) Lubricate and install replacement O-rings on clutch piston (Fig. 10).

(2) Install clutch piston in drum and install return springs on piston.

(3) Compress piston return springs with Tool 7538 and install snap ring (Fig. 6). Be sure snap ring end gap is not aligned with spring retainer tab.

(4) Install clutch discs and plates (Fig. 11). Install plate then disc until all plates and discs are installed. Four plates and discs are required.

(5) Install clutch pack retainer in drum (Fig. 12).

(6) Install clutch pack snap ring (Fig. 12).

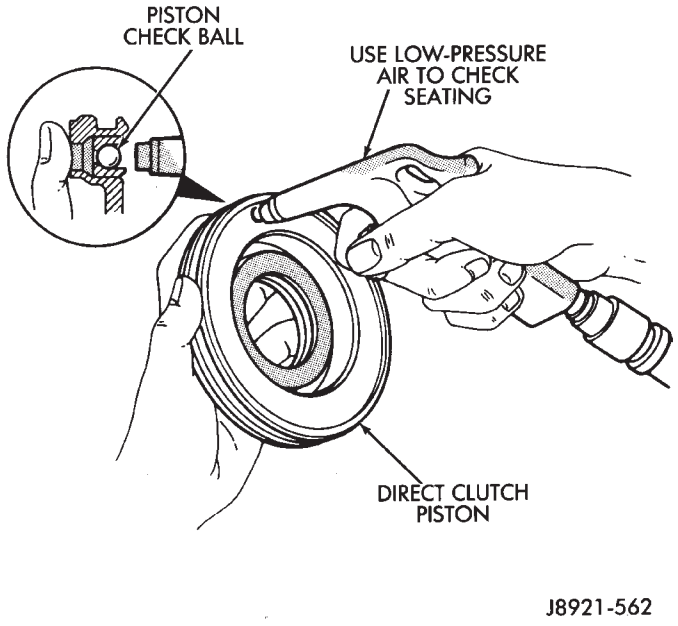


Fig. 9 Testing Piston Check Ball Seating

(7) Check snap ring position. If necessary, shift snap ring until end gap is **not** aligned with any notches in clutch drum (Fig. 12).

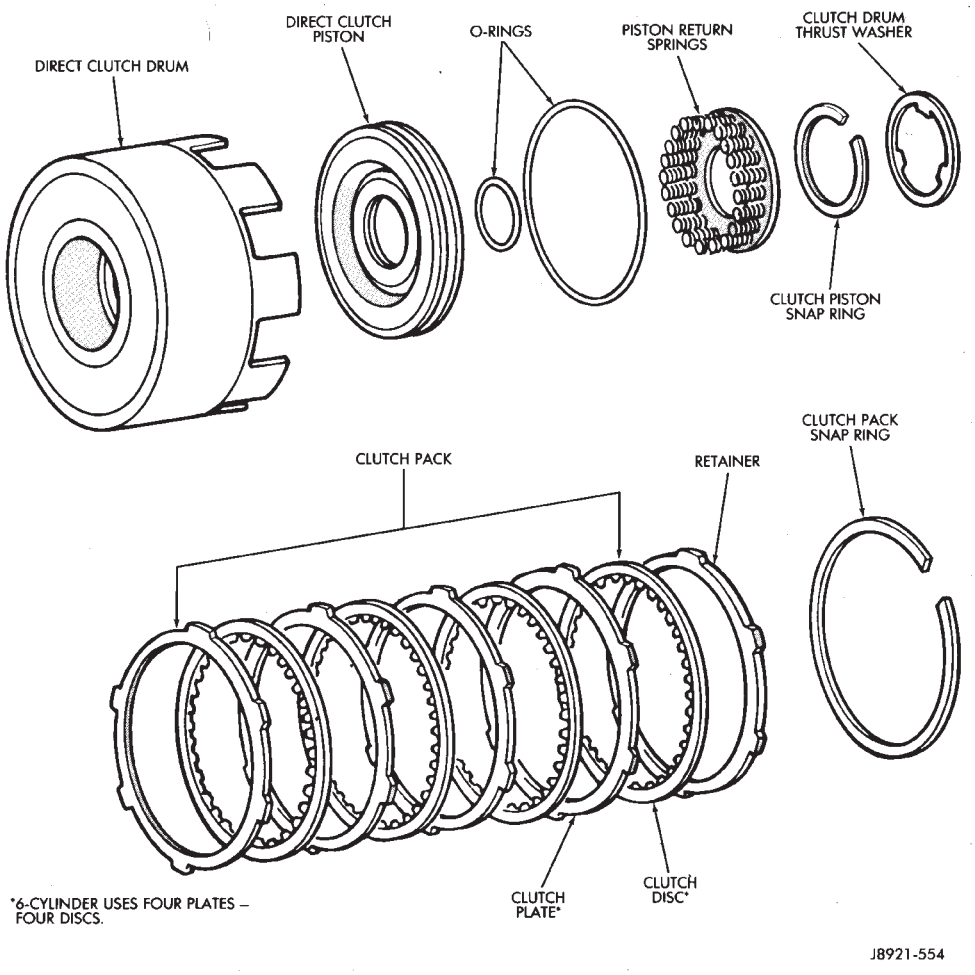


Fig. 10 Direct Clutch Components

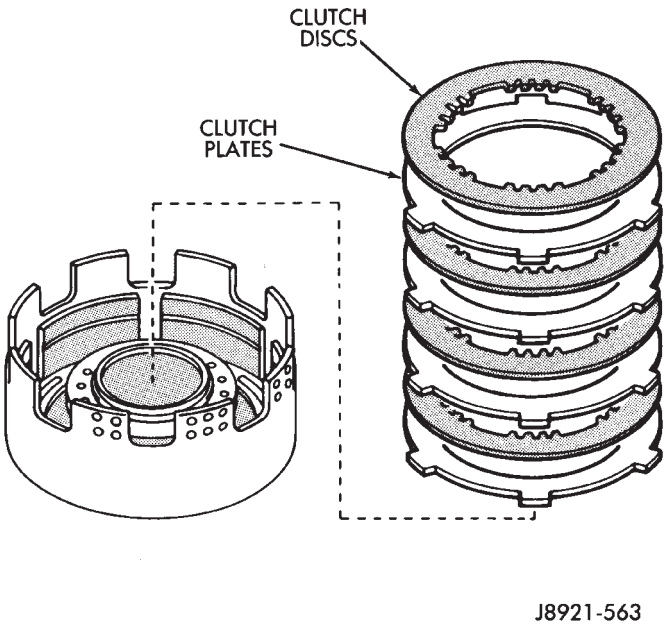


Fig. 11 Installing Direct Clutch Discs And Plates

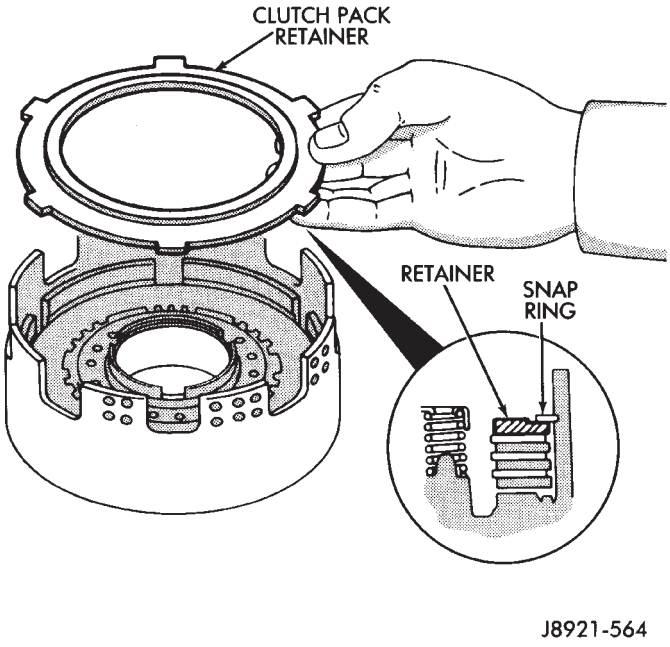


Fig. 12 Install Clutch Pack Retainer

(8) Check clutch piston stroke length a second time. If length is OK, continue with assembly. If stroke length is incorrect, replace clutch discs or use different thickness clutch pack retainer (Fig. 12). See Specifications section for retainer thicknesses.

(9) Lubricate clutch drum thrust washer with petroleum jelly and install it in drum (Fig. 3).

(10) Mount direct clutch assembly on forward clutch assembly and check assembled height (Fig. 14). Height should be 70.3 to 71.5 mm (2.767 to 2.815 in.).

(11) If assembled height is incorrect, clutches are not seated.

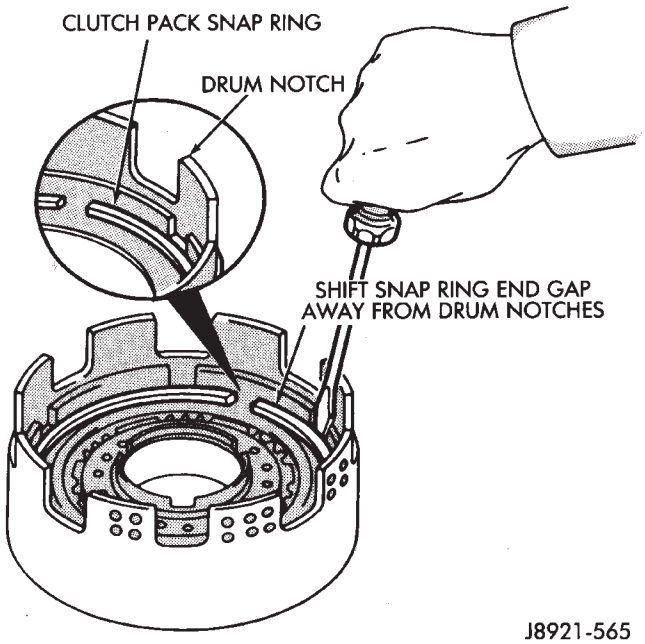


Fig. 13 Adjusting Clutch Pack Snap Ring Position

(12) If clutch height is OK, remove direct clutch from forward clutch and proceed to forward clutch overhaul.

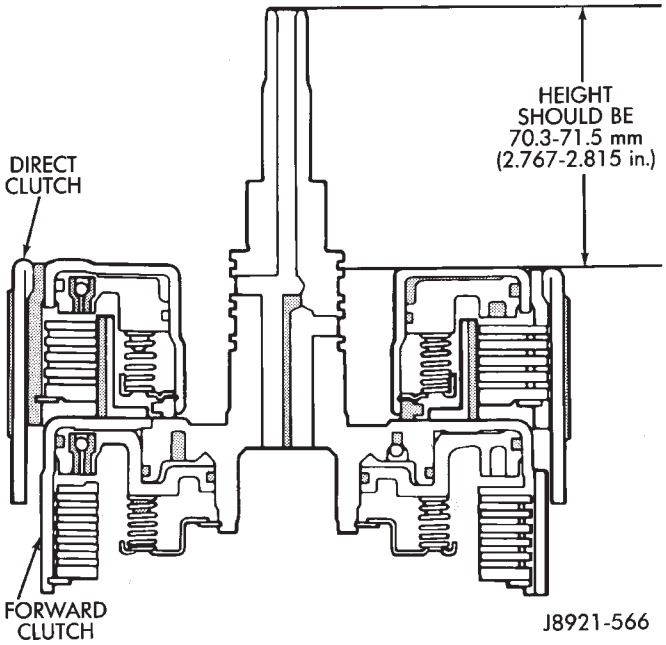


Fig. 14 Checking Direct Clutch Assembled Height

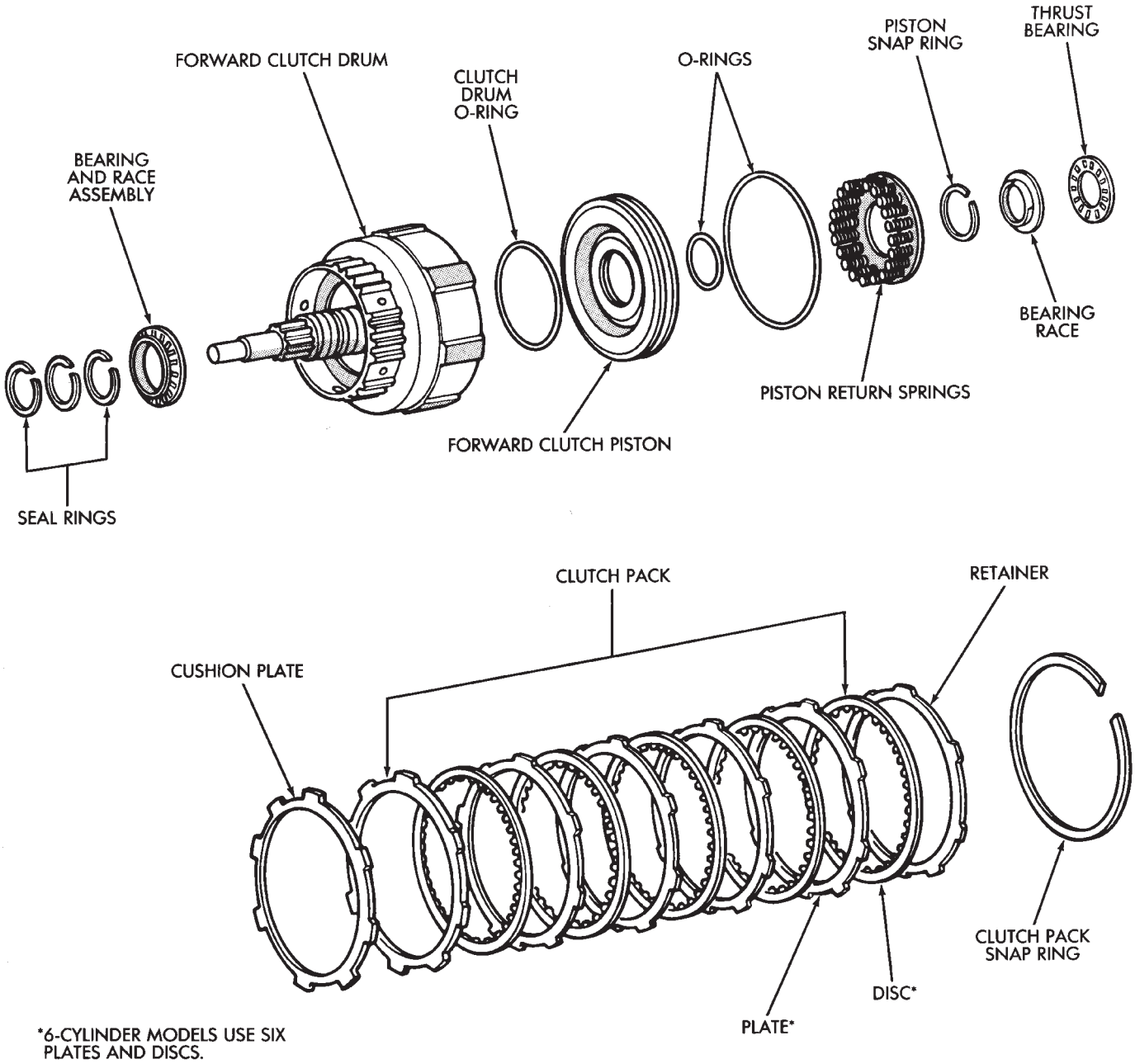


Fig. 1 Forward Clutch Components

FORWARD CLUTCH OVERHAUL

FORWARD CLUTCH DISASSEMBLY (FIG. 1)

(1) Check clutch piston stroke as outlined in following steps.

(2) Position overdrive support on wood blocks and mount forward clutch drum on support (Fig. 2).

(3) Remove bearing and race from forward clutch drum (Fig. 2).

(4) Mount dial indicator on clutch drum. Position dial indicator plunger against clutch piston (Fig. 3).

(5) Apply compressed air through right side feed hole in support and note piston stroke length on dial indicator.

(6) Stroke length should be 3.55 - 3.73 mm (0.1348 - 0.1469 in.).

(7) Replace clutch discs if stroke length is incorrect.

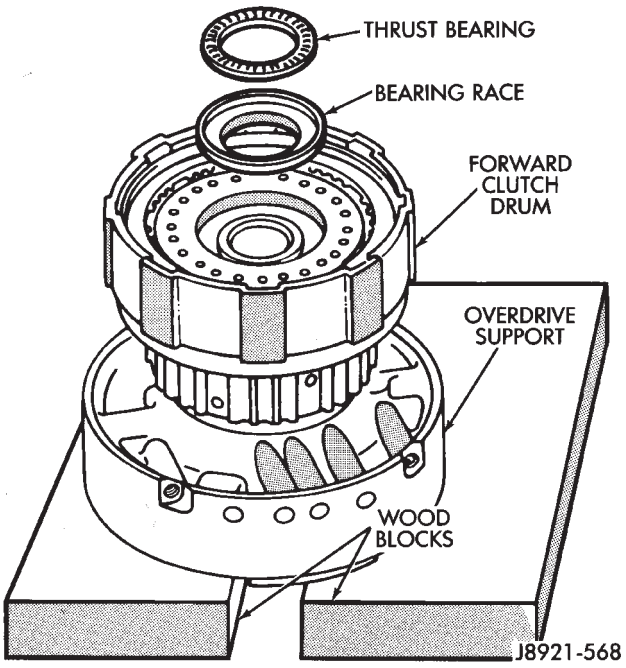


Fig. 2 Positioning Drum And Support On Wood Blocks

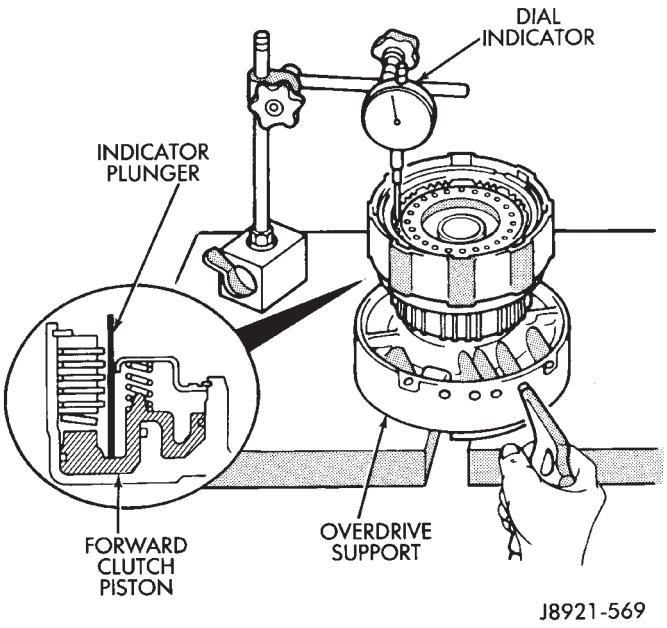


Fig. 3 Checking Forward Clutch Piston Stroke Length

(8) Remove clutch pack snap ring and remove retainer and clutch pack (Fig. 4).

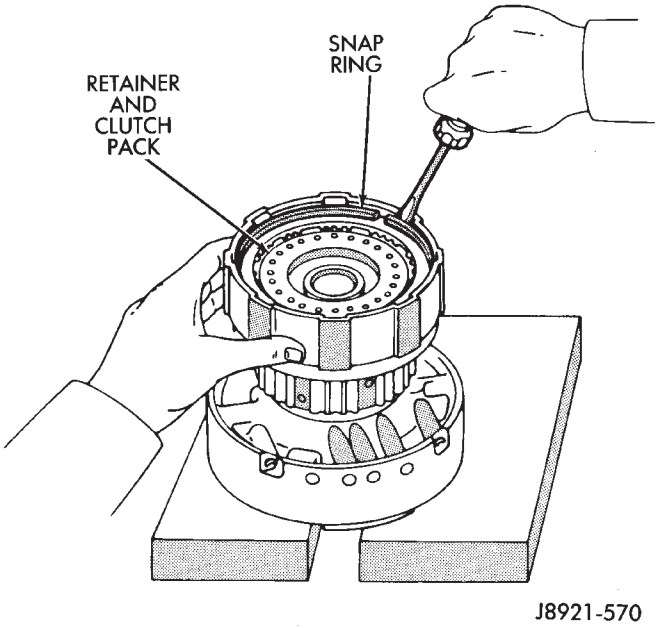


Fig. 4 Removing Retainer And Clutch Pack

(9) Remove clutch pack cushion plate (Fig. 5).

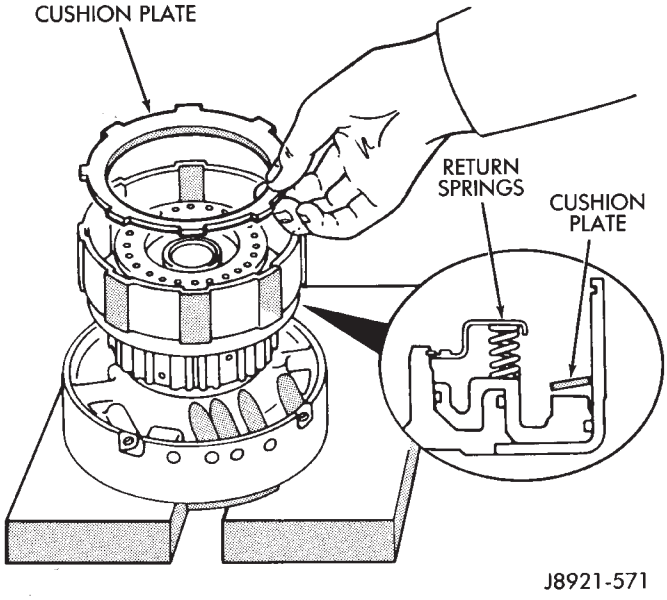


Fig. 5 Removing Cushion Plate

(10) Compress clutch springs with Tool 7538 and remove piston snap ring.

(11) Remove spring compressor tool and piston return springs.

(12) Remount forward clutch drum on overdrive support (Fig. 6).

(13) Apply compressed air through feed hole in support to remove piston (Fig. 6). Use only enough air pressure to ease piston out of drum.

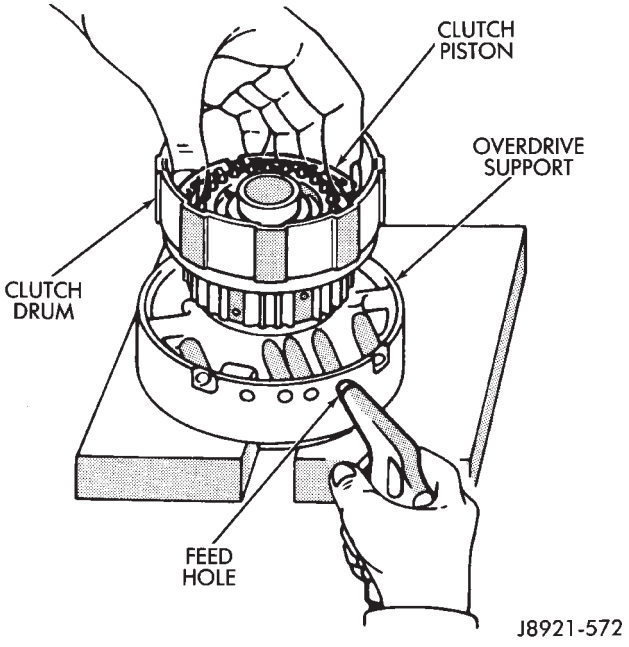


Fig. 6 Removing Forward Clutch Piston

(14) Remove and discard clutch piston O-rings.

(15) Remove clutch drum O-ring from rear hub of drum.

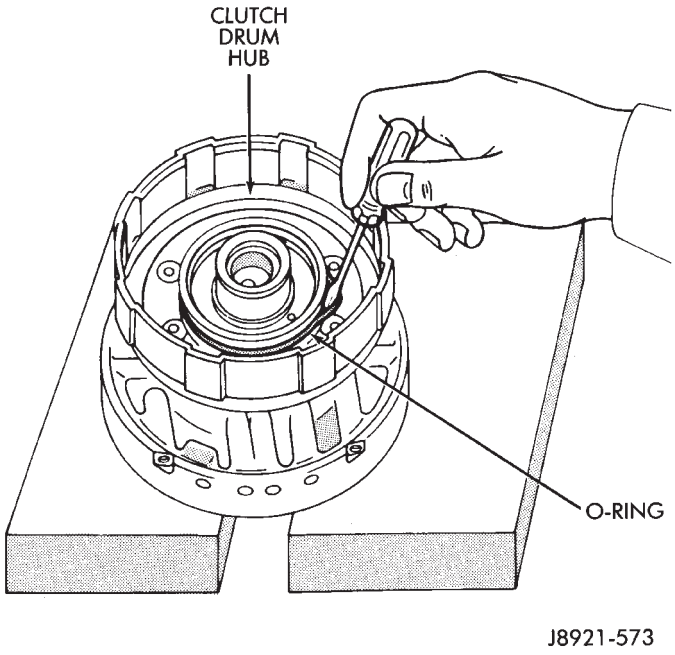


Fig. 7 Removing/Installing Clutch Drum O-Ring

(16) Remove three seal rings from clutch drum shaft (Fig. 8).

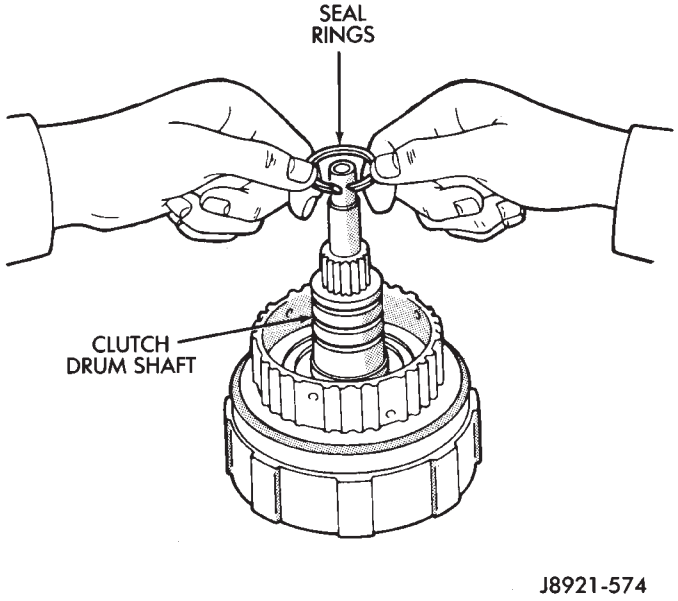


Fig. 8 Removing Clutch Drum Seal Rings

(17) Remove thrust bearing and race assembly from clutch drum (Fig. 9).

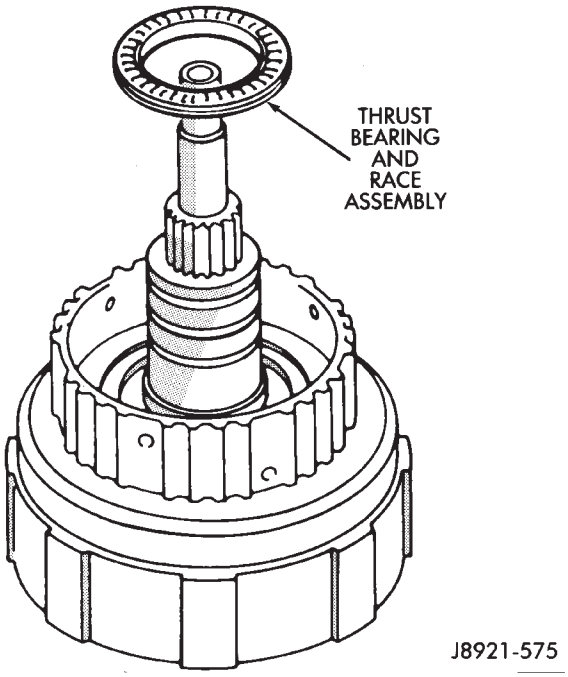


Fig. 9 Removing Clutch Drum Thrust Bearing Assembly

(18) Measure clutch disc thickness (Fig. 10). Minimum allowable thickness is 1.51 mm (0.0595 in.).

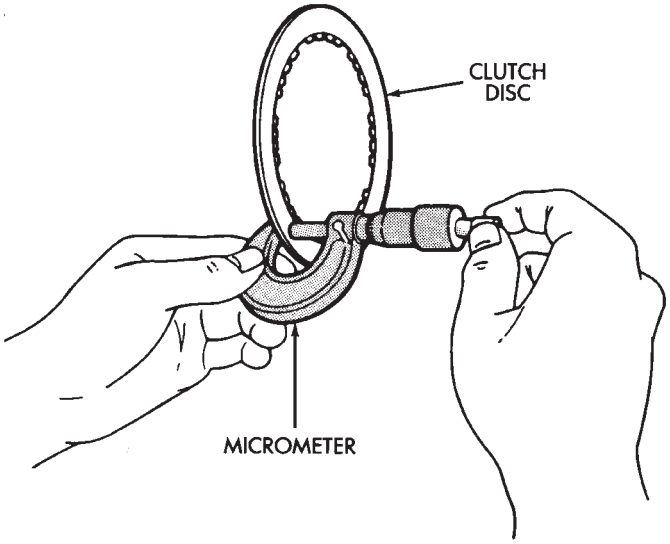


Fig. 10 Measuring Clutch Disc Thickness

(19) Measure free length of piston return springs with springs mounted in retainer (Fig. 11). Length should be 19.47 mm (0.767 in.). Replace springs and retainer if length is incorrect.

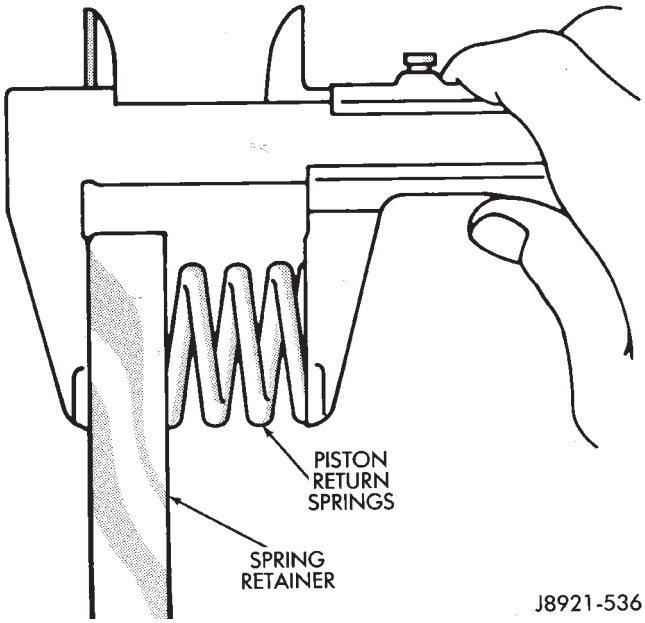


Fig. 11 Checking Return Spring Length

(20) Inspect clutch piston check ball (Fig. 12). Ball should move freely within piston. Check ball seating by applying low pressure compressed air to ball feed hole. Ball should seat firmly and not leak air.

(21) Measure inside diameter of bushing in clutch drum hub. Maximum allowable diameter is 24.08 mm (0.9480 in.). Replace clutch drum if bushing inside diameter is greater than specified.

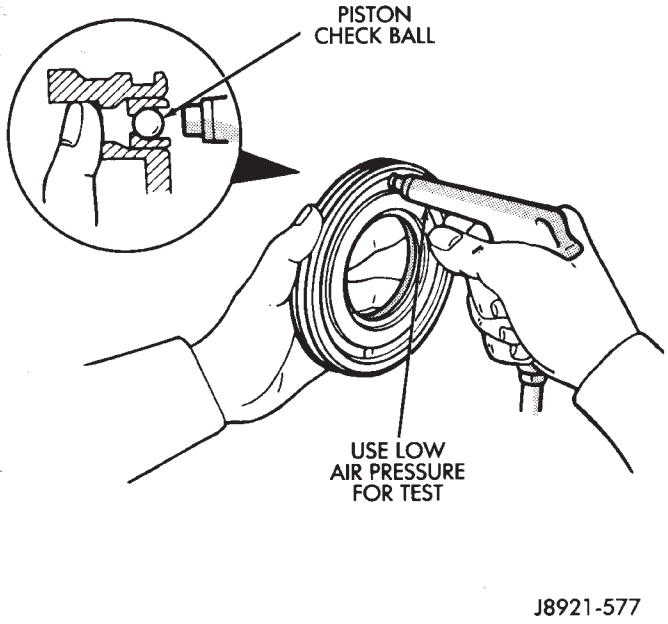


Fig. 12 Testing Piston Check Ball

FORWARD CLUTCH ASSEMBLY

(1) Lubricate bearing and race assembly with petroleum jelly and install it in clutch drum (Fig. 13). Race side of assembly faces downward and toward drum. Bearing rollers face up (Fig. 13)

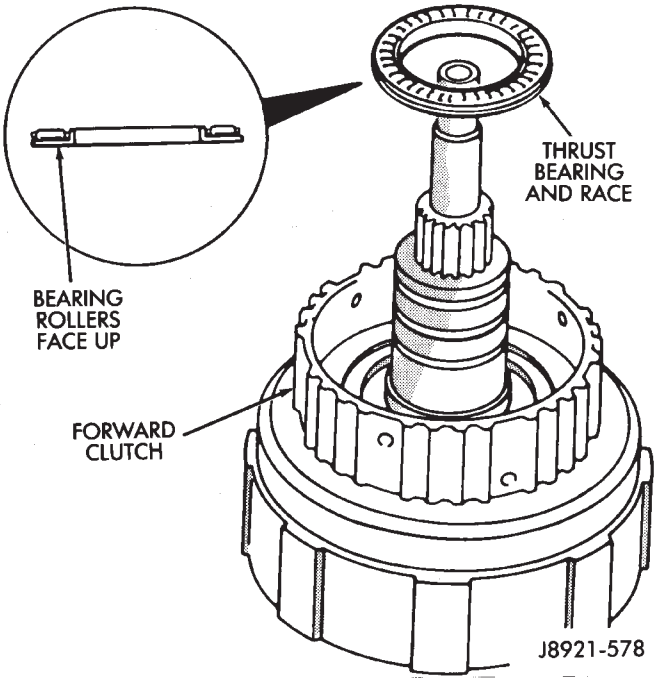


Fig. 13 Installing Thrust Bearing And Race

(2) Coat new clutch drum shaft seal rings with petroleum jelly. Before installing drum shaft seal rings, squeeze each ring so ring ends overlap (Fig. 14). This tightens ring making clutch installation easier.

(3) Install seal rings on shaft. Keep rings closed as tightly as possible during installation. Avoid overspreading them.

(4) Mount clutch drum on overdrive support.

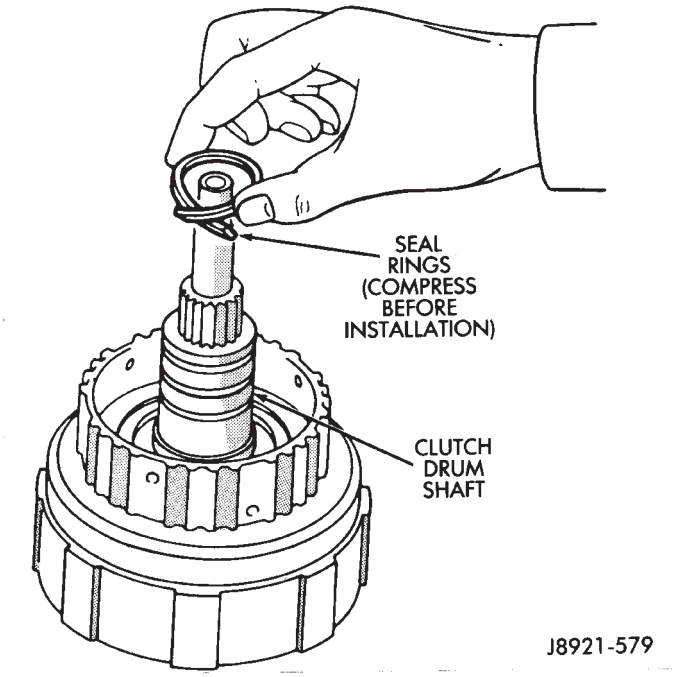


Fig. 14 Installing Clutch Drum Shaft Seal Rings

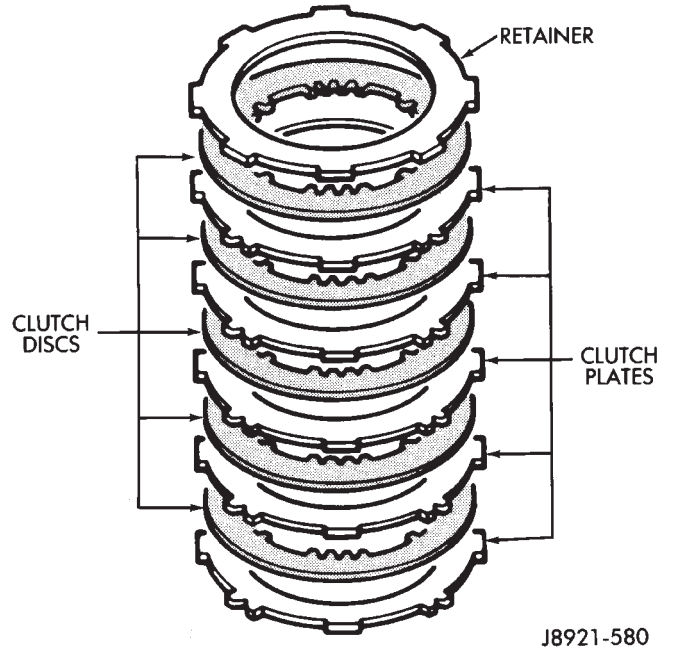


Fig. 15 Installing Forward Clutch Discs And Plates

(5) Lubricate and install new O-ring on clutch drum hub (Fig. 7).

(6) Lubricate and install new O-rings on clutch piston and install piston in drum.

(7) Install piston return springs.

(8) Compress piston return springs with Tool 7538 and shop press and install piston snap ring. Be sure snap ring end gap is not aligned with any notches in drum.

(9) Install cushion plate in drum. Concave side of plate faces downward (Fig. 5).

(10) Install clutch discs, plates and retainer (Fig. 15). Install tabbed plate followed by disc until required number of plates and discs are installed. Use six plates and discs.

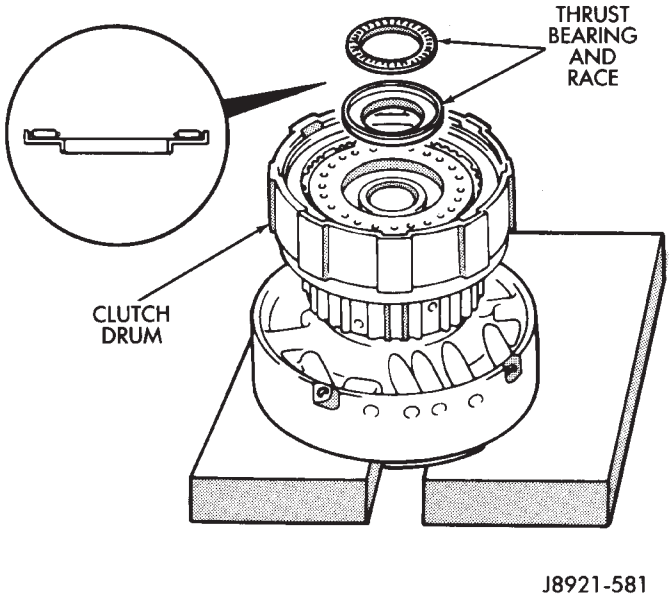


Fig. 16 Installing Thrust Bearing And Race

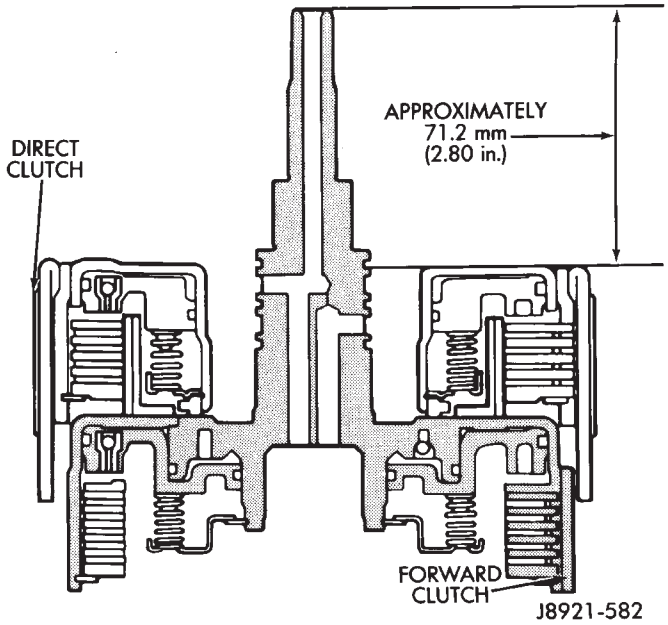


Fig. 17 Checking Forward Clutch Assembled Height

(11) Install clutch pack snap ring.

(12) Recheck clutch piston stroke length using same method outlined at beginning of disassembly procedure. If stroke length is not within specified limits, replace clutch discs.

(13) Lubricate race and bearing with petroleum jelly and install them in clutch drum (Fig. 16). Be sure bearing rollers face up and race lip seats in drum as shown.

(14) Verify bearing and race size.

- Outer diameter of bearing is 46.7 mm (1.839 in).
- Outer diameter of race is 48.9 mm (1.925 in.).
- Inner diameter of bearing and race is 26.0 mm (1.024 in.).

(15) Mount forward clutch on direct clutch and check assembled height (Fig. 17). Height should be 70.3 - 71.5 mm (2.767 - 2.815 in.).

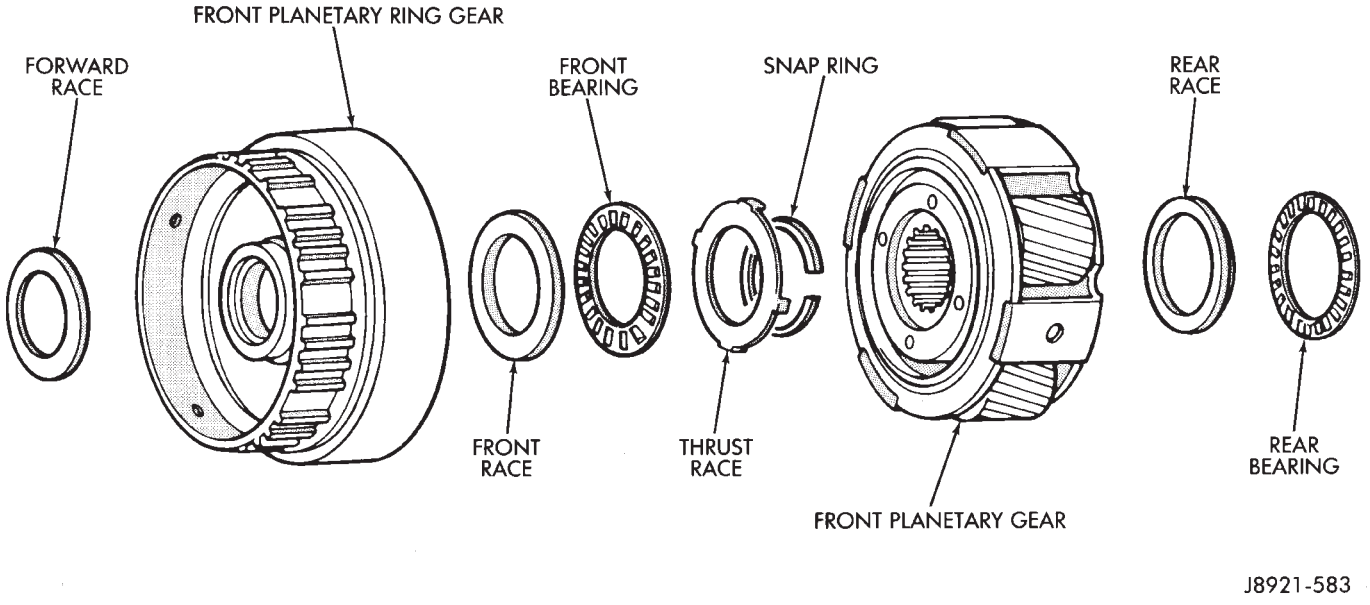


Fig. 1 Front Planetary Gear Components

FRONT PLANETARY GEAR OVERHAUL

FRONT PLANETARY DISASSEMBLY

(1) Remove ring gear from planetary gear (Fig. 1).

(2) Remove front bearing and the two races from ring gear (Fig. 1).

(3) Remove tabbed thrust race from planetary gear (Fig. 1).

(4) Remove snap ring attaching planetary gear to shaft and remove gear.

(5) Remove rear bearing and race from planetary gear.

(6) Measure inside diameter of ring gear bushing. Maximum allowable diameter is 24.08 mm (0.9480 in.). Replace ring gear if bushing inside diameter is greater than specified.

FRONT PLANETARY ASSEMBLY

(1) Lubricate planetary and ring gear bearings and races with petroleum jelly.

(2) Identify planetary bearings and races before installation. (Fig. 1). Bearings and races can be identified by following dimensions:

- Outer diameter of rear bearing is 47.7 mm (1.878 in.). Inner diameter is 35.5 mm (1.398 in.).
- Outer diameter of rear race 47.6 mm (1.874 in.). Inner diameter is 33.7 mm (1.327 in.).
- Outer diameter of front race is 53.6 mm (2.110 in.). Inner diameter is 30.5 mm (1.201 in.).
- Outer diameter of front bearing is 47.7 mm (1.878 in.). Inner diameter is 32.6 (1.283 in.).
- Outer diameter of forward race is 47.0 mm (1.850 in.). Inner diameter is 26.5 mm 1.043 in.).

(3) Install rear race and bearing in gear (Fig. 2).

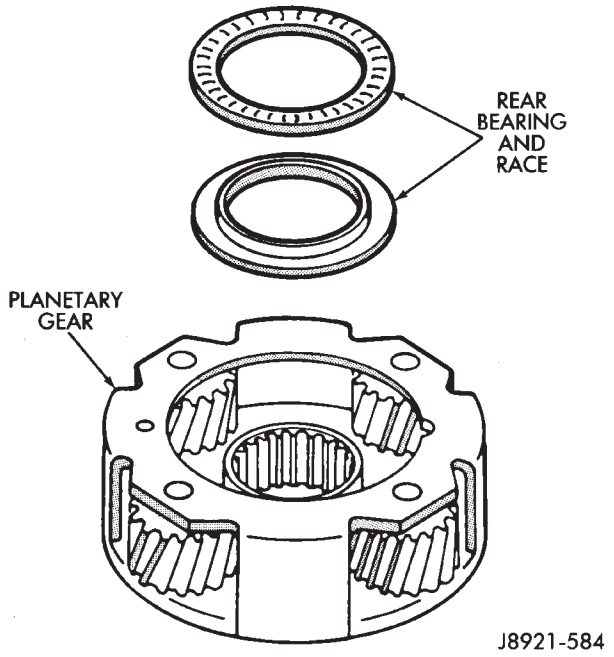


Fig. 2 Installing Front Planetary Rear Bearing and Race

(4) Turn planetary over and install race thrust race (Fig. 3).

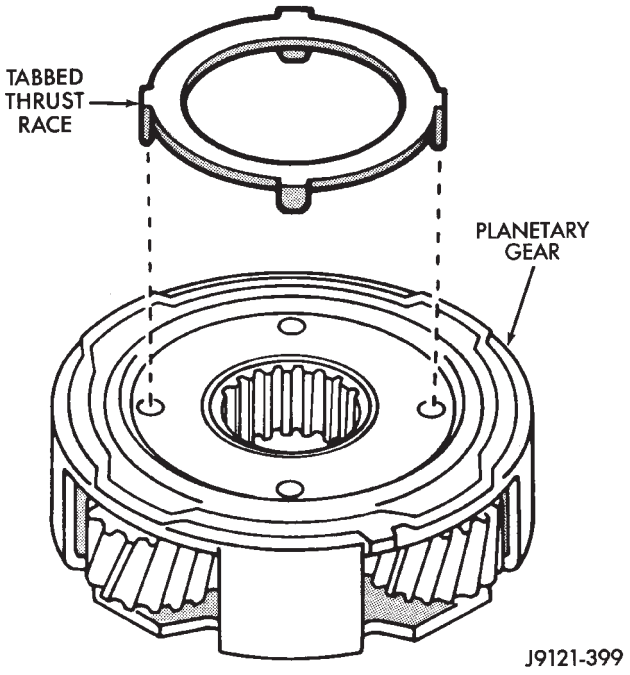


Fig. 3 Installing Front Planetary Thrust Race

(5) Install front race and bearing and forward race in ring gear (Fig. 4).

(6) Set planetary gear assembly aside for final assembly.

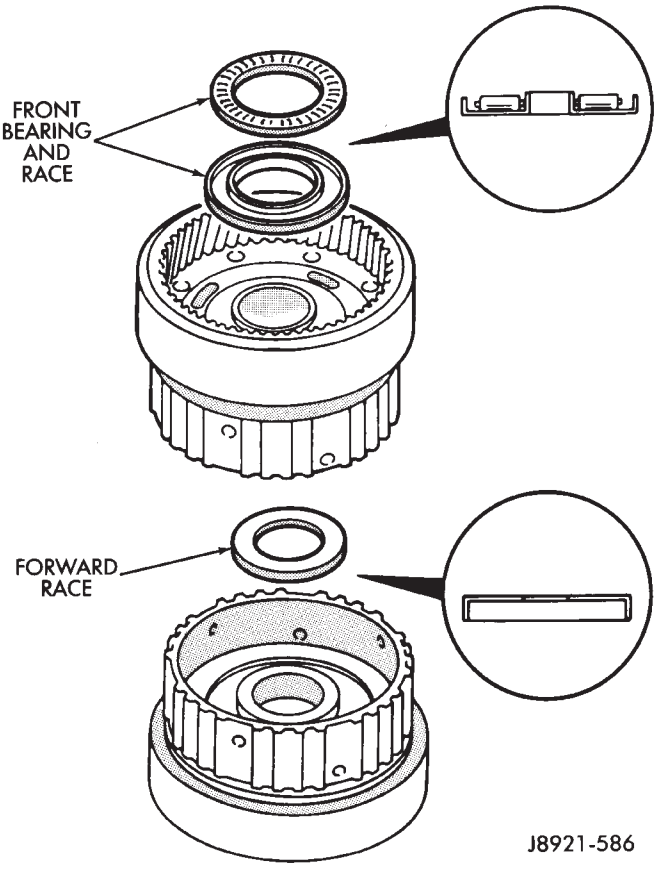


Fig. 4 Installing Front Planetary Front Bearing And Races

SUN GEAR AND NO. 1 ONE-WAY CLUTCH OVERHAUL

SUN GEAR AND CLUTCH DISASSEMBLY

(1) Hold sun gear and turn second brake hub clockwise and counterclockwise (Fig. 2). Hub should rotate freely clockwise but lock when turned counterclockwise. Replace one-way clutch and hub if they do not operate properly.

(2) Remove one-way clutch/second brake hub assembly from drum (Fig. 3).

(3) Remove thrust washer from drum (Fig. 4).

(4) Remove two seal rings from sun gear (Fig. 5).

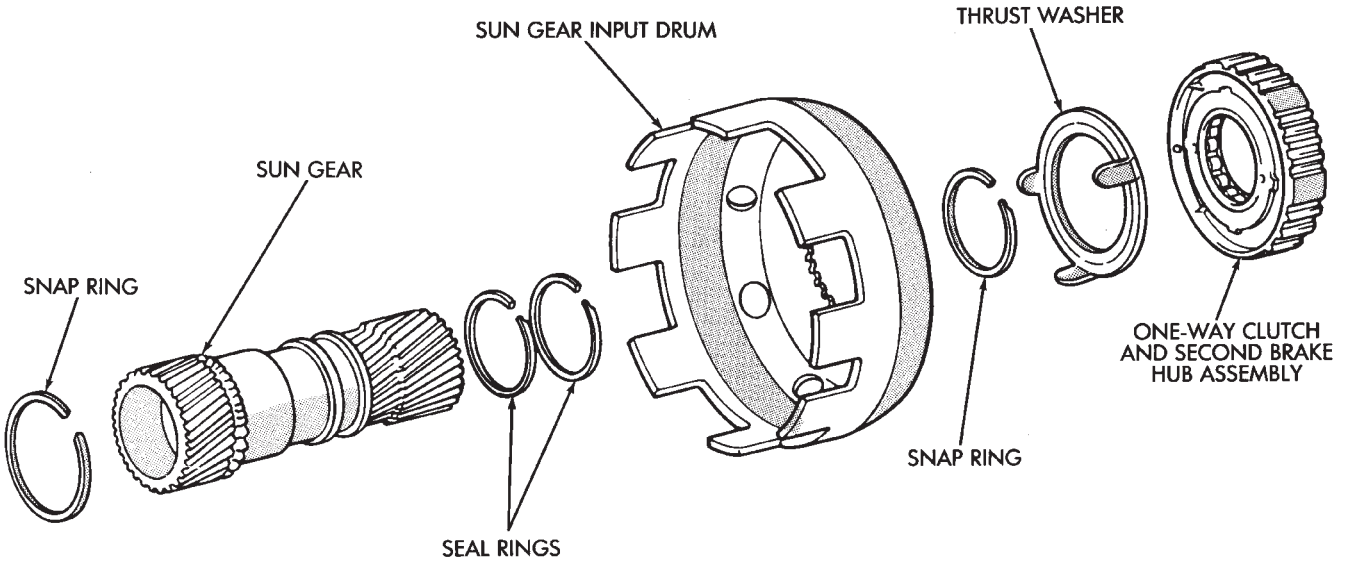


Fig. 1 Sun Gear And One-Way Clutch Components

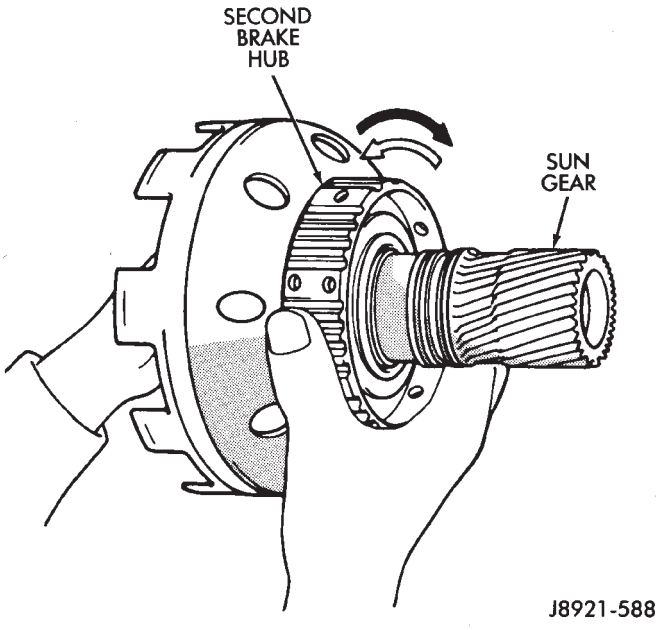


Fig. 2 Checking One-Way Clutch Operation

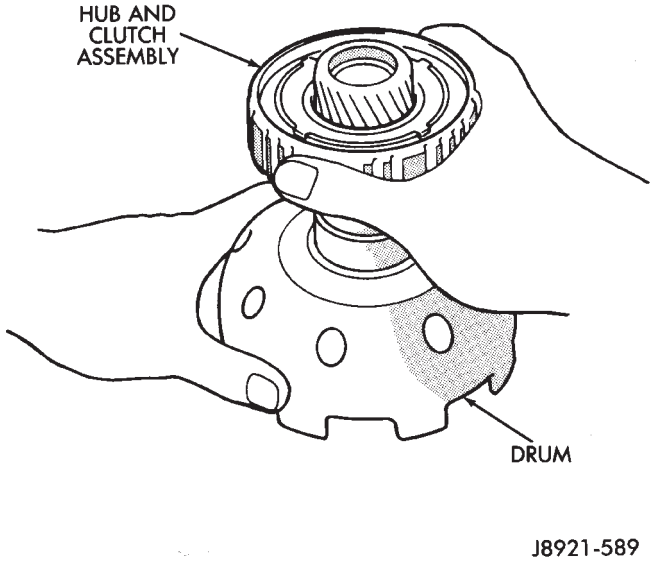


Fig. 3 Removing/Installing Brake Hub And Clutch Assembly

(5) Support sun gear on wood block (Fig. 6). Then remove first sun gear snap ring and separate drum from gear.

(6) Remove remaining snap ring from sun gear (Fig. 7).

(7) Measure inside diameter of sun gear bushings with bore gauge or inside micrometer (Fig. 8). Maximum allowable diameter is 27.08 mm (1.0661 in.). Replace sun gear if bushing inside diameter is greater than specified.

SUN GEAR AND CLUTCH ASSEMBLY

(1) Install first snap ring on sun gear.

(2) Install sun gear in drum and install remaining snap ring.

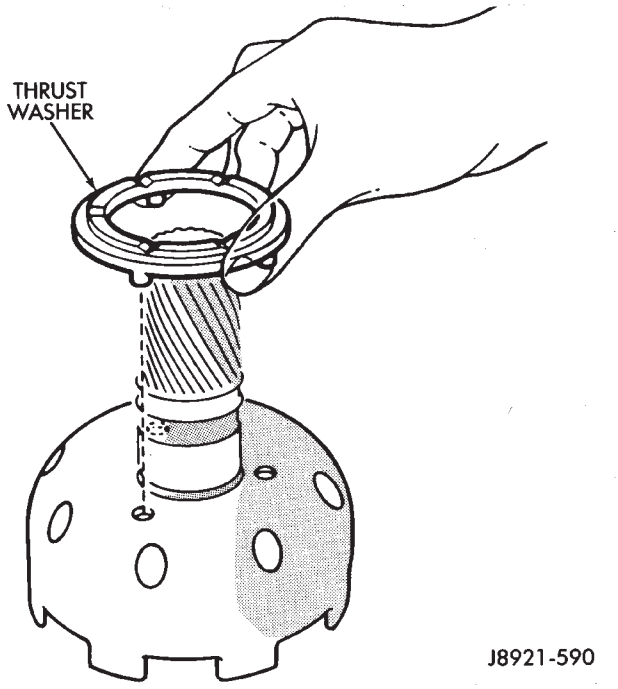


Fig. 4 Removing/Installing Thrust Washer

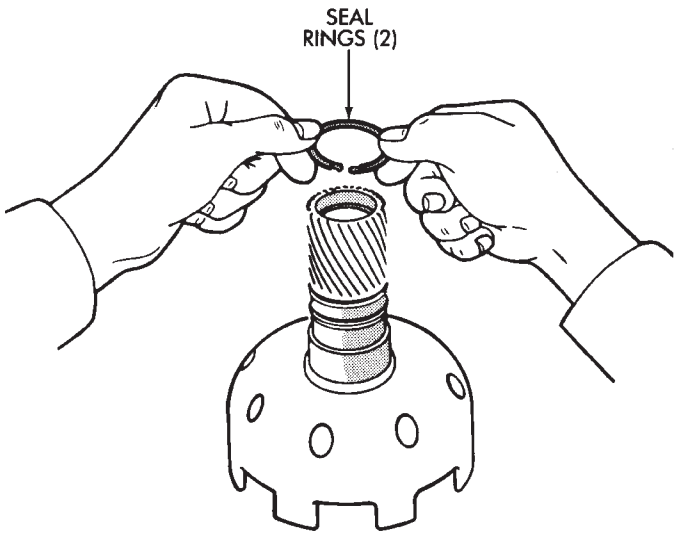


Fig. 5 Removing/Installing Sun Gear Seal Rings

(3) Coat replacement seal rings with petroleum jelly and install them on sun gear. **Be sure seal ring ends are interlocked.**

(4) Install thrust washer. Be sure washer tabs are seated in drum slots.

(5) Install one-way clutch/second brake hub assembly on sun gear. Deep side of hub flange faces upward (Fig. 9).

(6) Check one-way clutch operation again (Fig. 2). Hold sun gear and turn second brake hub clockwise and counterclockwise. Hub should turn clockwise freely, but lock when turned counterclockwise.

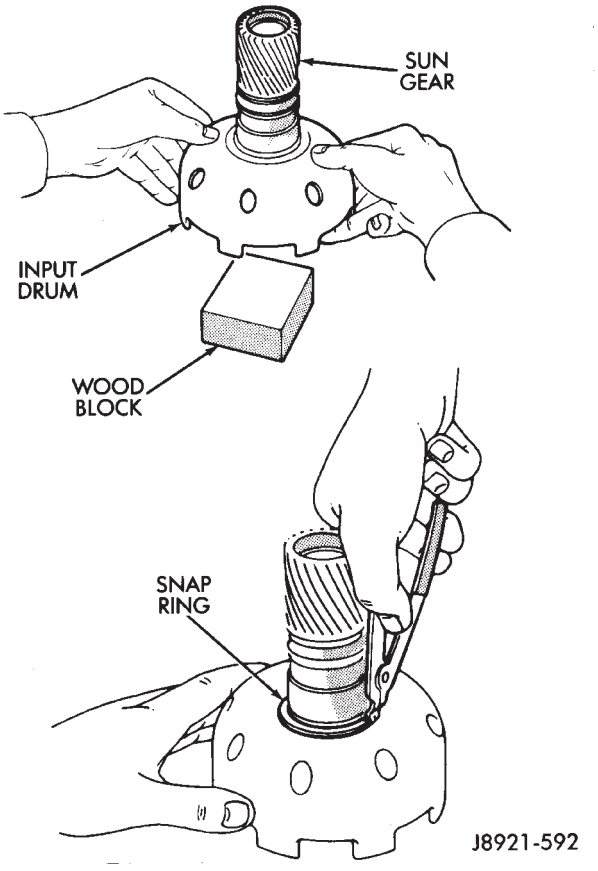


Fig. 6 Removing/Installing Sun Gear

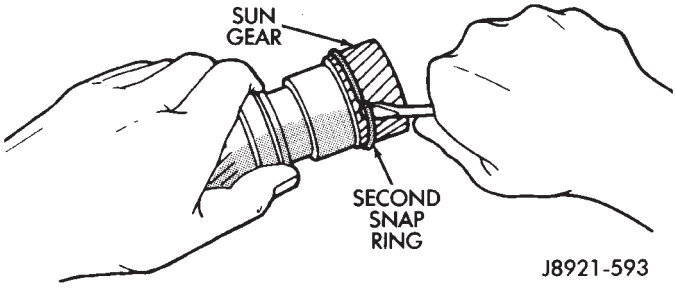


Fig. 7 Removing/Installing Second Snap Ring

(7) Set sun gear/clutch assembly aside for final assembly.

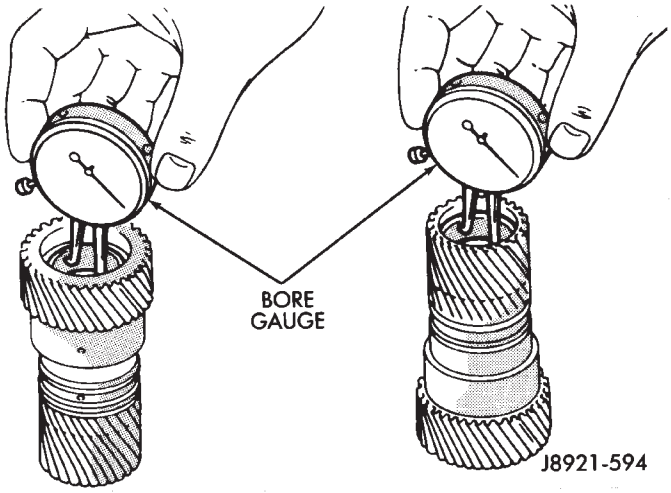


Fig. 8 Checking Sun Gear Bushings

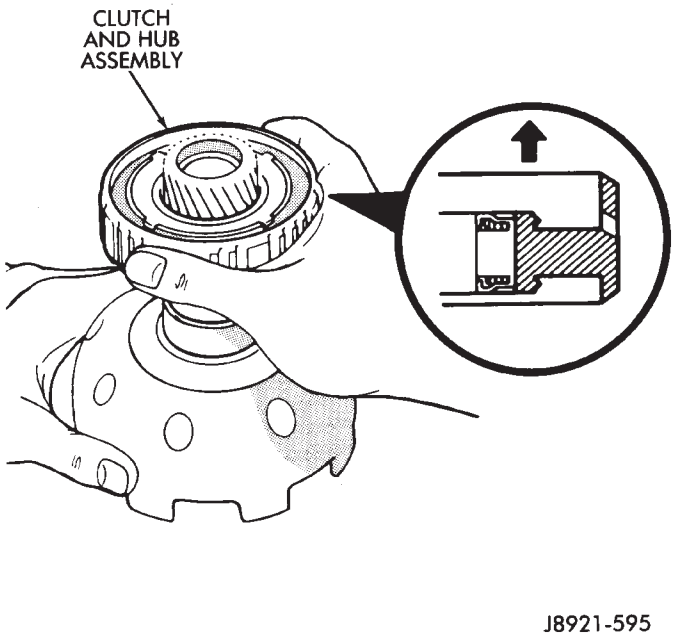


Fig. 9 Installing Clutch And Hub Assembly On Sun Gear

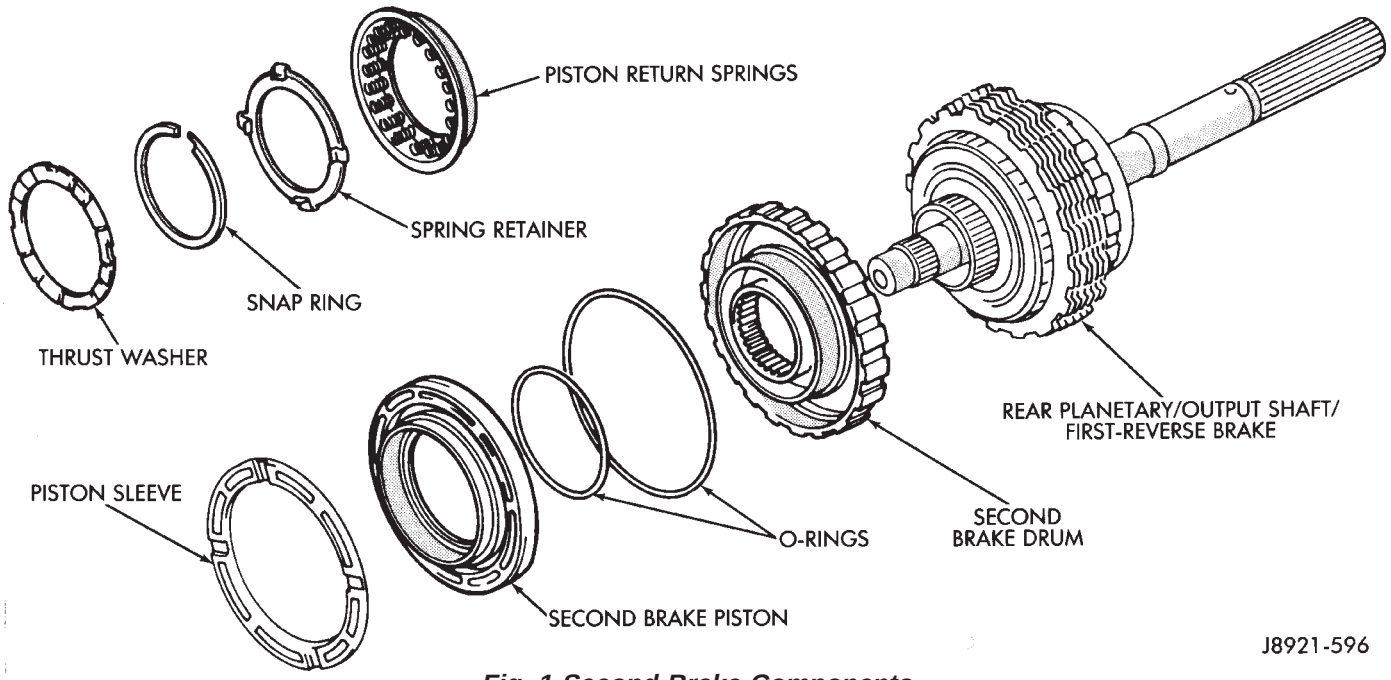


Fig. 1 Second Brake Components

SECOND BRAKE OVERHAUL

BRAKE DISASSEMBLY

(1) Remove second brake drum from output shaft (Fig. 2).

(2) Set output shaft assembly aside for overhaul. Refer to Rear Planetary Gear and Output Shaft Overhaul procedures.

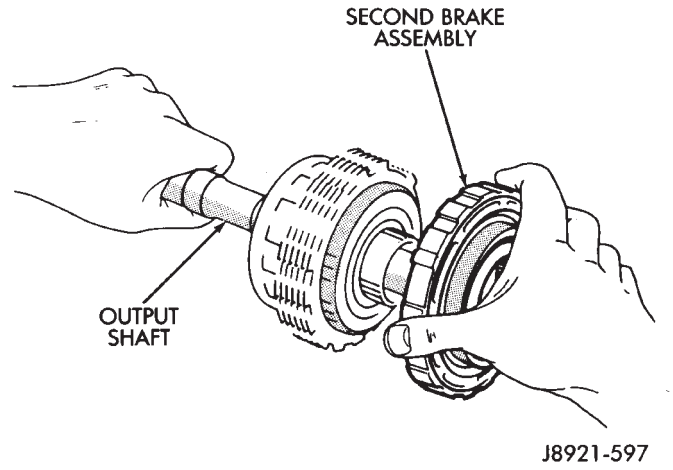


Fig. 2 Removing/Installing Second Brake Assembly

(3) Remove thrust washer from second brake drum (Fig. 3).

(4) Compress piston return springs with shop press and tool 7538. Then remove piston snap ring (Fig. 4).

(5) Remove compressor tool and remove spring retainer and return springs.

(6) Remove second brake piston and sleeve from drum with compressed air (Fig. 5). Use only enough air pressure to ease piston out of drum.

(7) Remove and discard brake piston O-rings.

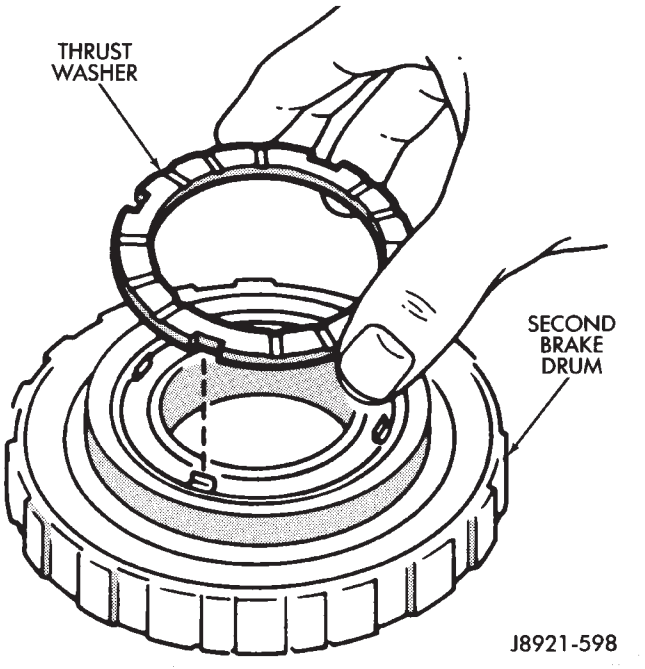


Fig. 3 Removing/Installing Second Brake Drum Thrust Washer

(8) Measure free length of piston return springs with springs mounted in retainer (Fig. 6). Length should be approximately 16.05 mm (0.632 in.). Replace return springs if length is less than specified.

SECOND BRAKE ASSEMBLY

(1) Lubricate and install new O-rings on brake piston. Then install brake piston in drum.

(2) Install return springs and retainer on brake piston.

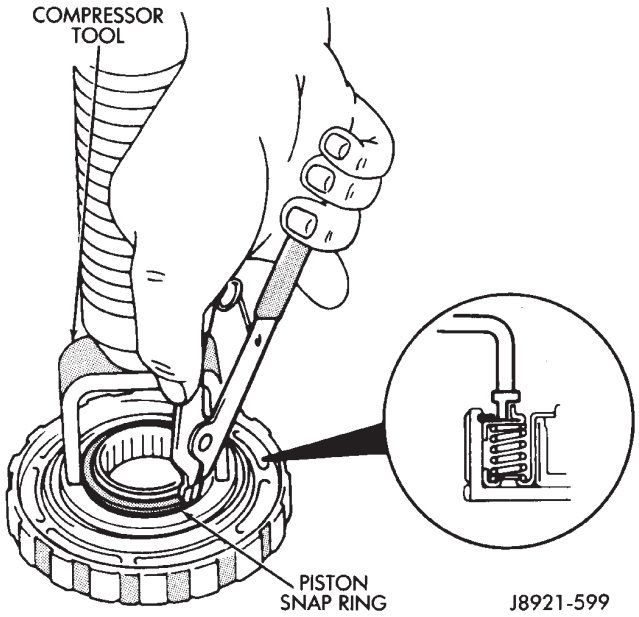


Fig. 4 Removing/Installing Second Brake Piston Snap Ring

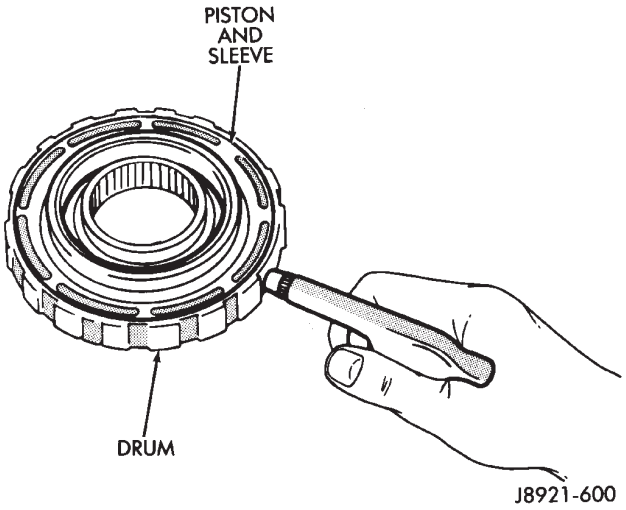


Fig. 5 Removing/Installing Piston And Sleeve

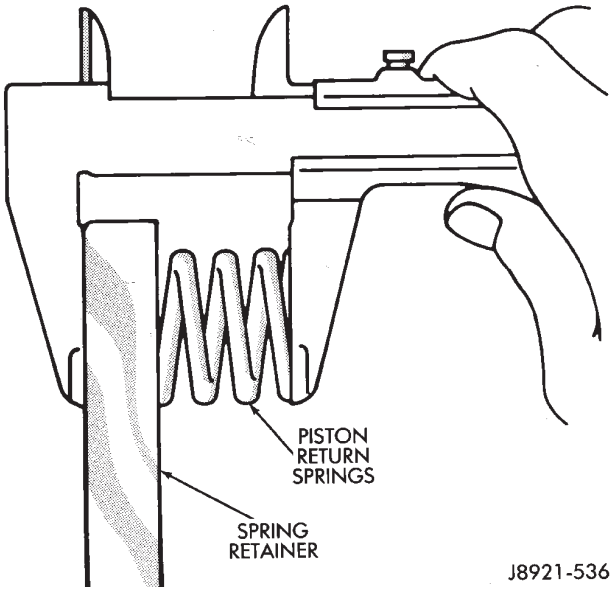


Fig. 6 Measuring Second Brake Piston Return Springs

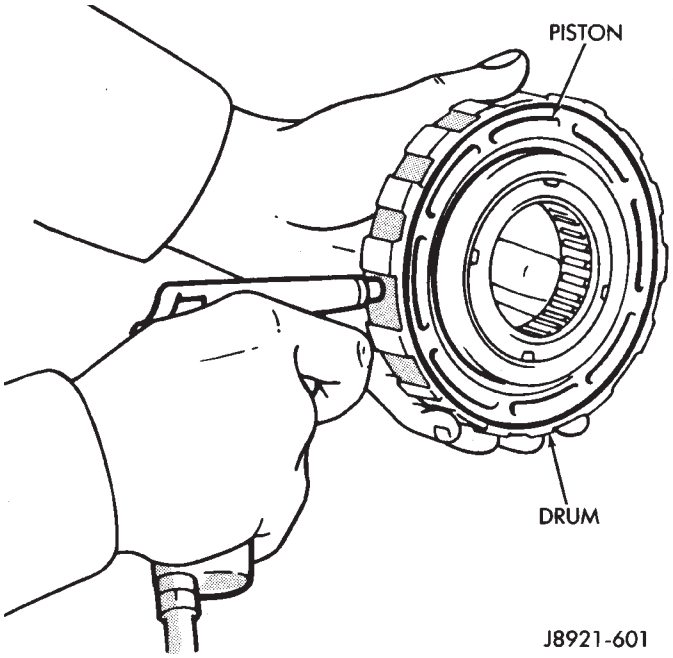


Fig. 7 Checking Second Brake Piston Operation

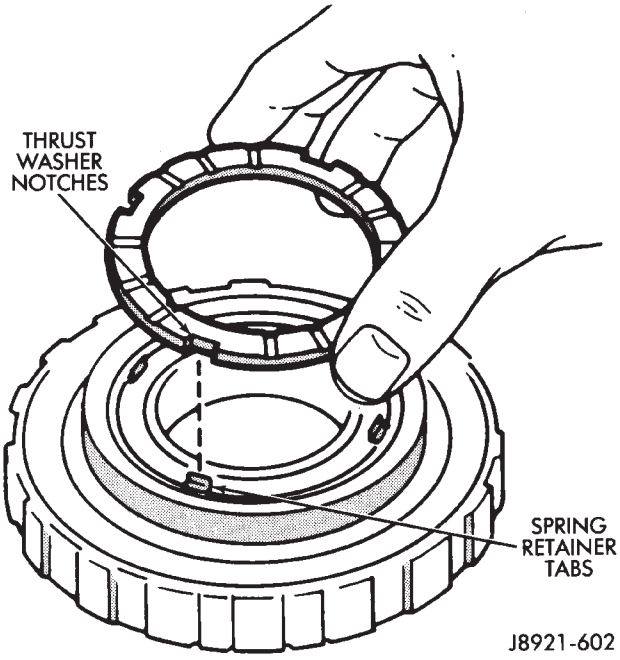


Fig. 8 Installing Second Brake Thrust Washer

(3) Compress return springs with shop press and Compressor Tool 7538. Install piston snap ring and remove brake assembly from press.

(4) Check brake piston operation with low pressure compressed air (Fig. 7). Apply air pressure through feed hole in drum. Piston should move smoothly when applying-releasing air pressure.

(5) Coat thrust washer with petroleum jelly and install it in drum. Be sure washer notches are aligned with tabs on spring retainer (Fig. 8).

(6) Set brake components aside for final assembly.

REAR PLANETARY, NO. 2 ONE-WAY CLUTCH AND OUTPUT SHAFT OVERHAUL

PLANETARY/BRAKE PACK/OUTPUT SHAFT DISASSEMBLY

(1) Remove output shaft from gear assembly (Fig. 2).

(2) Remove and discard shaft seal ring (Fig. 4).

(3) Remove brake pack from planetary gear (Fig. 4).

(4) Measure thickness of each brake pack disc. Minimum thickness is 1.51 mm (0.0594 in.). Replace all discs if any disc is thinner than specified.

(5) Remove planetary gear from ring gear (Fig. 5).

(6) Check No. 2 one-way clutch. Hold planetary gear and turn clutch inner race in both directions.

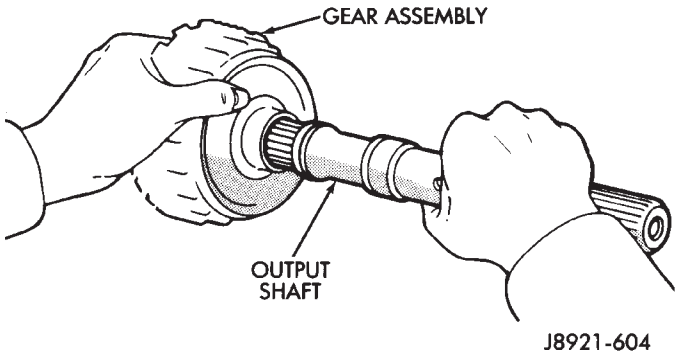


Fig. 2 Removing/Installing Output Shaft

Race should turn freely counterclockwise, but lock when turned clockwise. Replace one-way clutch if necessary.

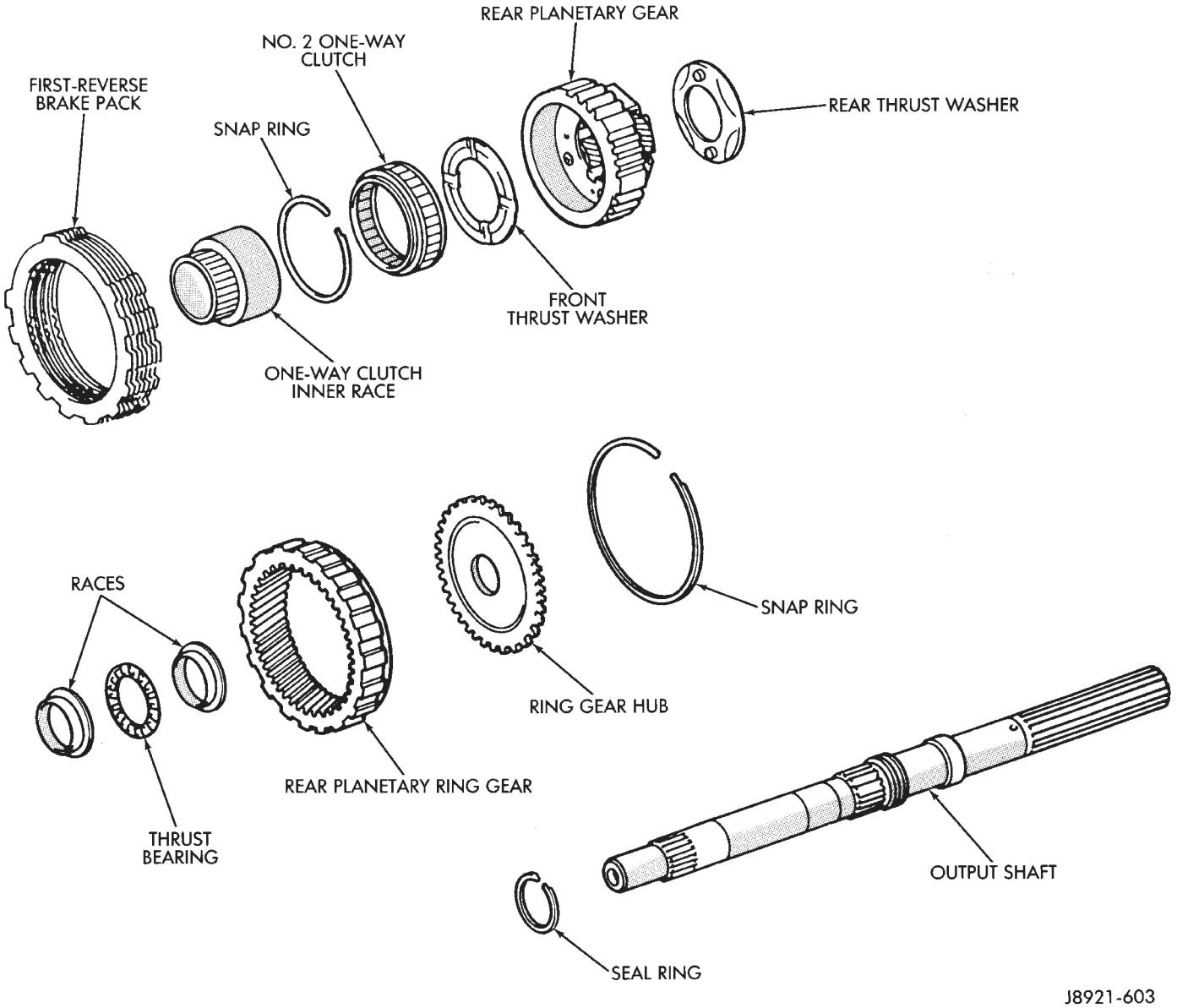


Fig. 1 Rear Planetary, Brake Pack, Clutch And Output Shaft Components

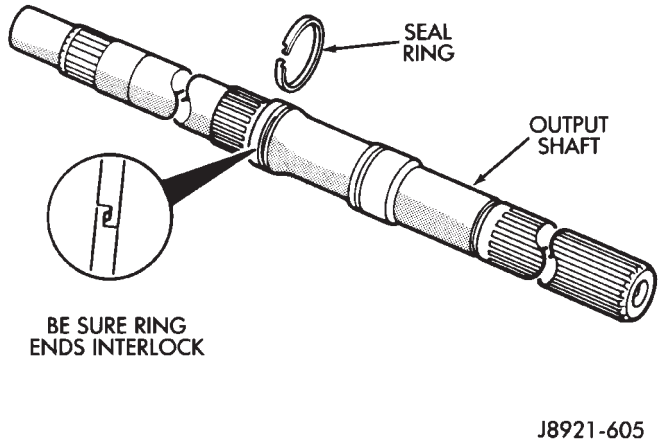


Fig. 3 Removing/Installing Shaft Seal Ring

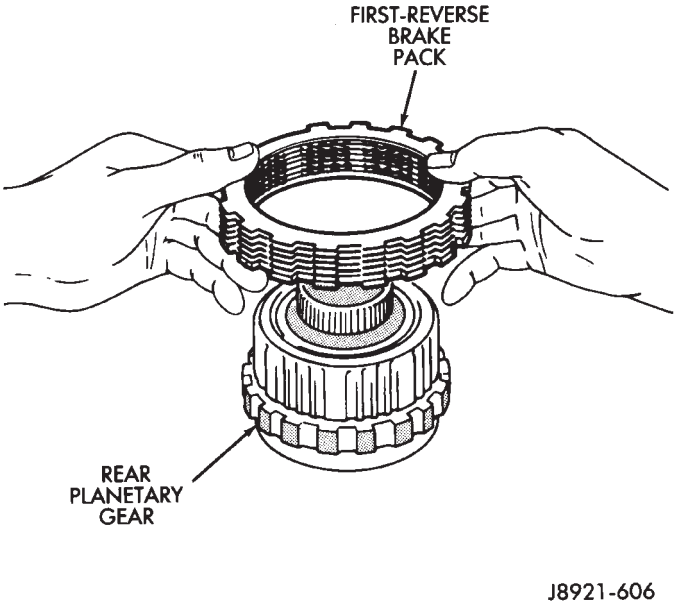


Fig. 4 Removing/Installing First-Reverse Brake Pack

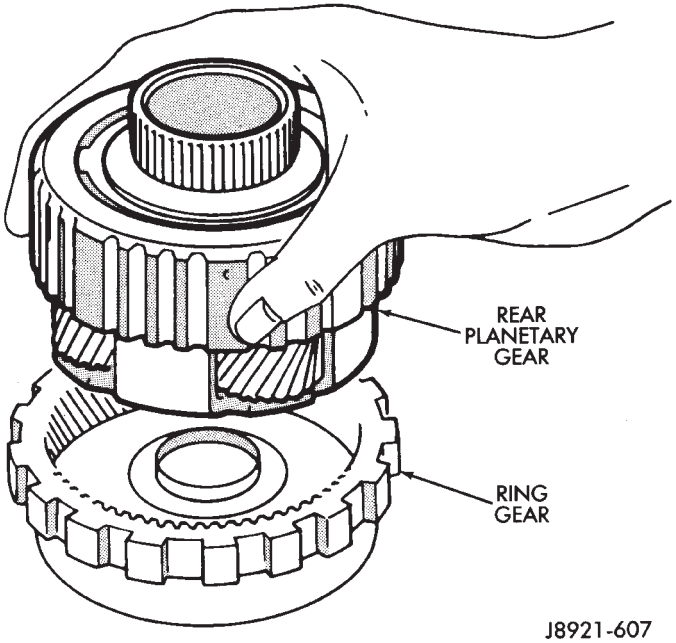


Fig. 5 Removing/Installing Rear Planetary

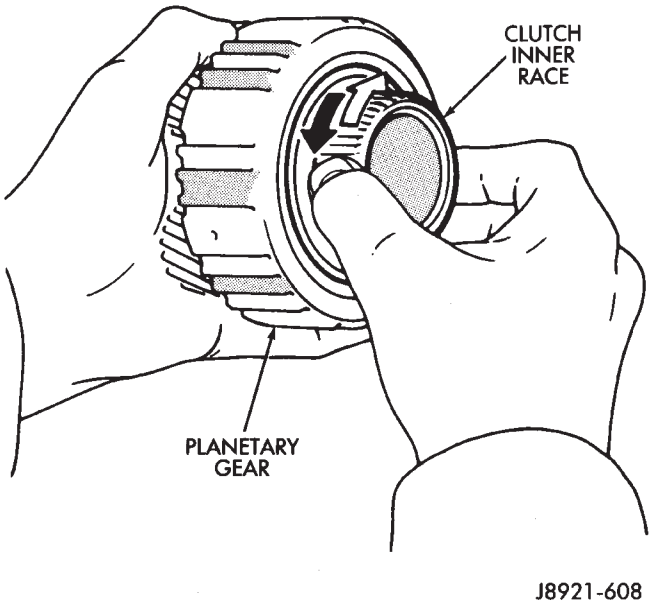


Fig. 6 Checking No. 2 One-Way Clutch Operation

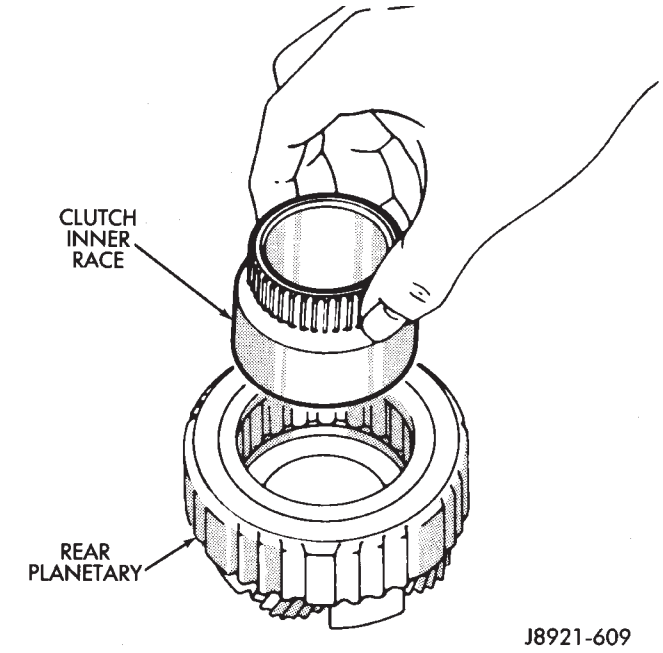


Fig. 7 Removing/Installing Clutch Inner Race

(7) Remove clutch inner race from planetary gear (Fig. 7).

(8) Remove clutch snap ring and remove No. 2 one-way clutch from planetary (Fig. 8).

(9) Remove front and rear thrust washers from planetary gear (Fig. 9).

(10) Remove thrust bearing and washers from ring gear (Fig. 10).

(11) Remove ring gear snap ring and remove ring gear hub (Fig. 11).

(12) Inspect and replace any worn or damaged planetary gear components.

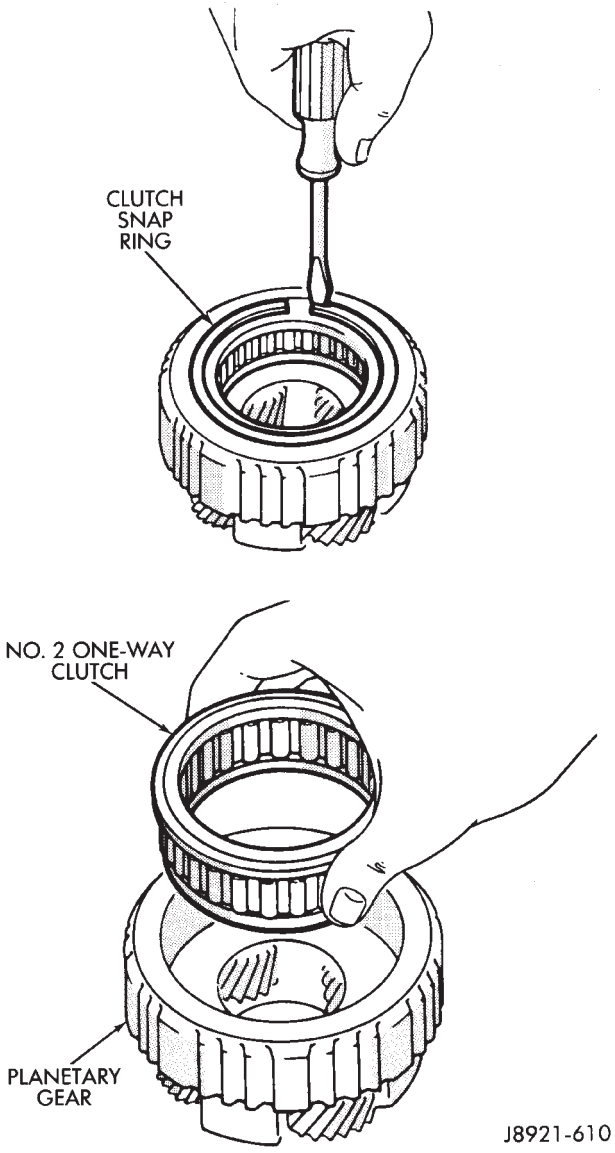


Fig. 8 Removing.Installing One-Way Clutch

ASSEMBLING REAR PLANETARY, BRAKE PACK, CLUTCH AND SHAFT

(1) Install hub and snap ring in ring gear (Fig. 11)

(2) Identify ring gear thrust bearing and races by following dimensions (Fig. 10):

- Outer diameter of bottom race is 44.8 mm (1.764 in.) and inner diameter is 27.6 mm (1.087 in.).
- Outer diameter of bearing is 44.7 mm (1.760 in.) and inner diameter is 30.1 mm (1.185 in.).
- Outer diameter of upper race is 44.8 mm (1.764 in.) and inner diameter is 28.8 mm (1.134 in.).

(3) Lubricate ring gear thrust bearing and races with petroleum jelly and install them in ring gear (Fig. 10).

(4) Coat planetary thrust washers with petroleum jelly and install them in gear (Fig. 9).

(5) Install No. 2 one-way clutch in planetary gear. Be sure flanged side of clutch faces upward (Fig. 12).

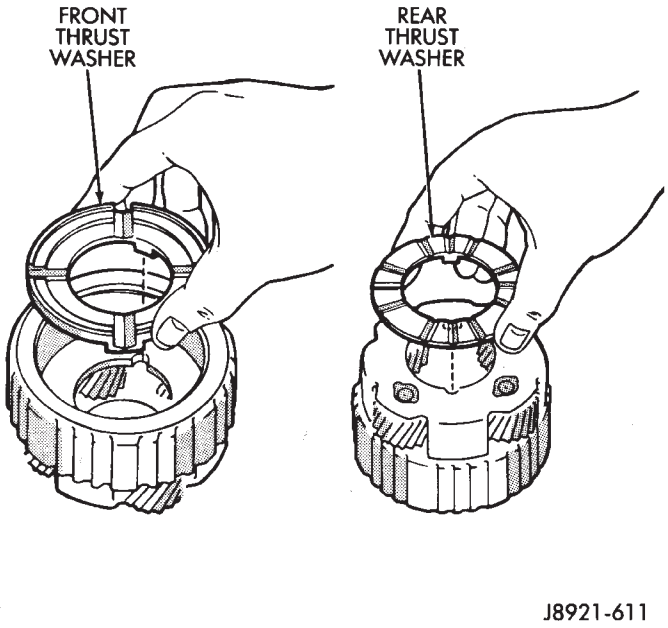


Fig. 9 Removing/Installing Rear Planetary Thrust Washers

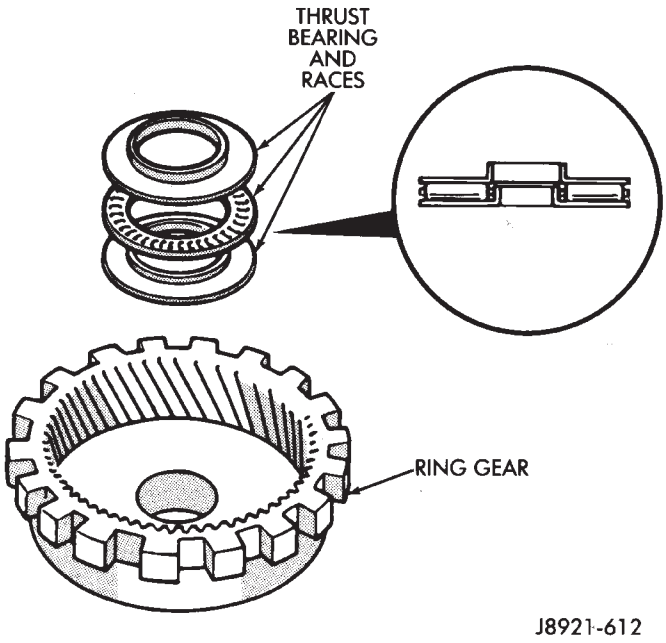


Fig. 10 Removing/Installing Ring Gear Thrust Bearing And Races

(6) Install clutch retaining snap ring and install clutch inner race (Fig. 7). Turn race counterclockwise to ease installation.

(7) Verify one-way clutch operation. Hold gear and turn inner race in both directions. Race should turn freely counterclockwise, but lock when turned clockwise.

(8) Install planetary gear in ring gear.

(9) Assemble clutch discs and clutch plates (Fig. 4). Sequence is disc first, then a plate. Use seven discs and plates in a 6-cyl. transmission.

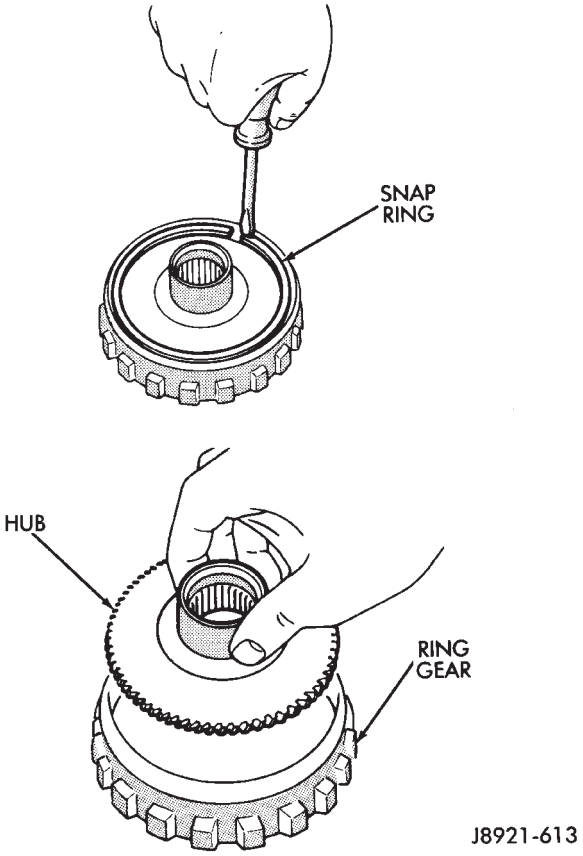


Fig. 11 Removing/Installing Ring Gear Hub

(10) Install brake pack on planetary gear (Fig. 4).

(11) Install new seal ring on output shaft (Fig. 3). Be sure ring ends are interlocked as shown.

(12) Set assembled components aside for final assembly.

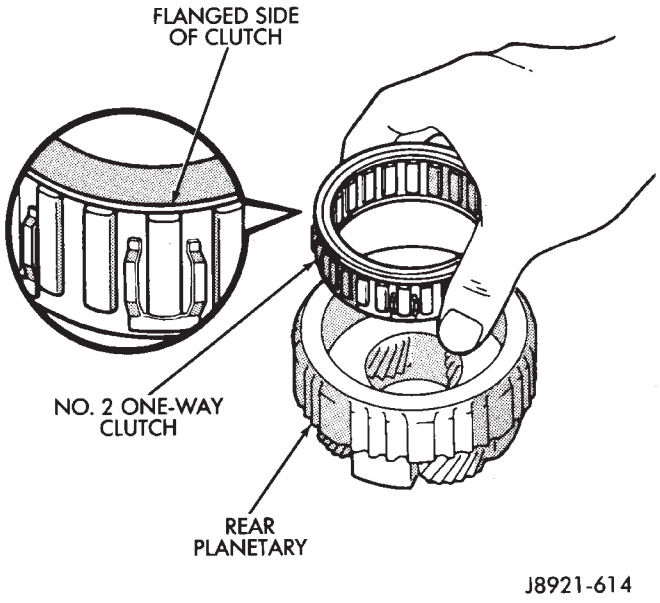


Fig. 12 Installing No. 2 One-Way Clutch

FIRST-REVERSE BRAKE PISTON AND TRANSMISSION CASE OVERHAUL

BRAKE DISASSEMBLY AND INSPECTION

(1) Remove bearing and race assembly from transmission case (Fig. 2).

(2) Check first/reverse brake piston operation with compressed air (Fig. 3). Piston should move smoothly and not bind or stick. If piston operation is incorrect, case or piston may require replacement.

(3) Compress piston return springs with Tool 7539 and remove piston snap ring (Fig. 4).

(4) Remove Tool 7539 and remove piston return springs.

(5) Remove No. 2 first-reverse brake piston with compressed air. Apply air through same transmission

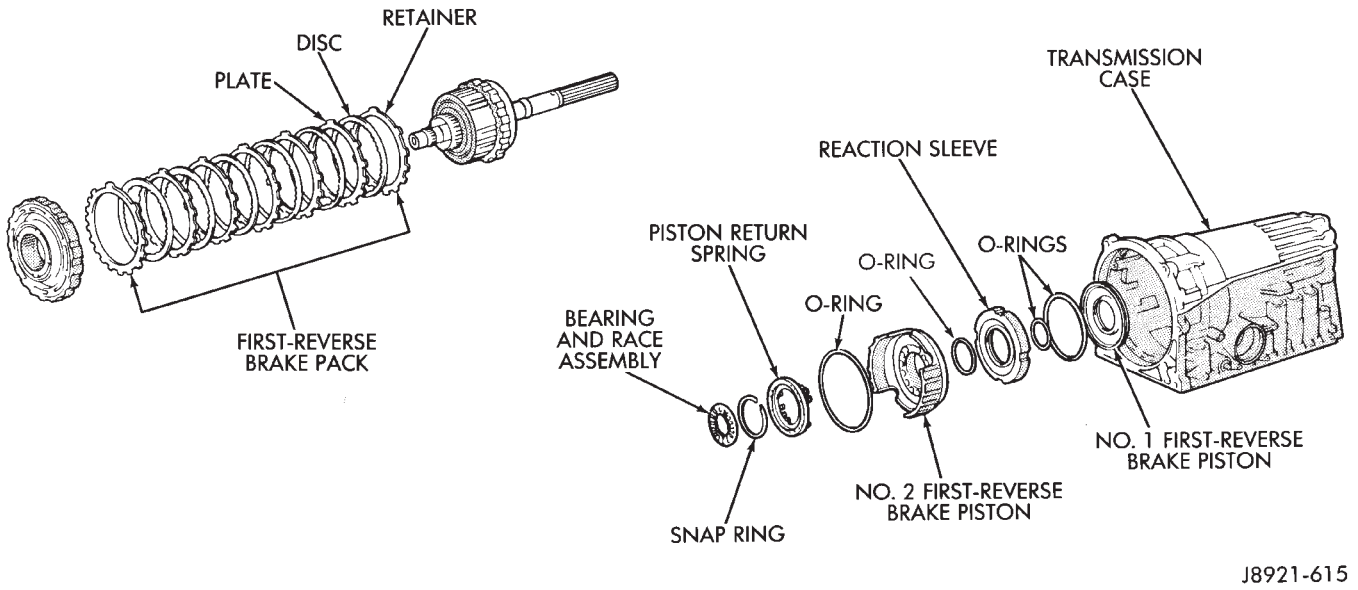


Fig. 1 First-Reverse Brake Pistons And Transmission Case

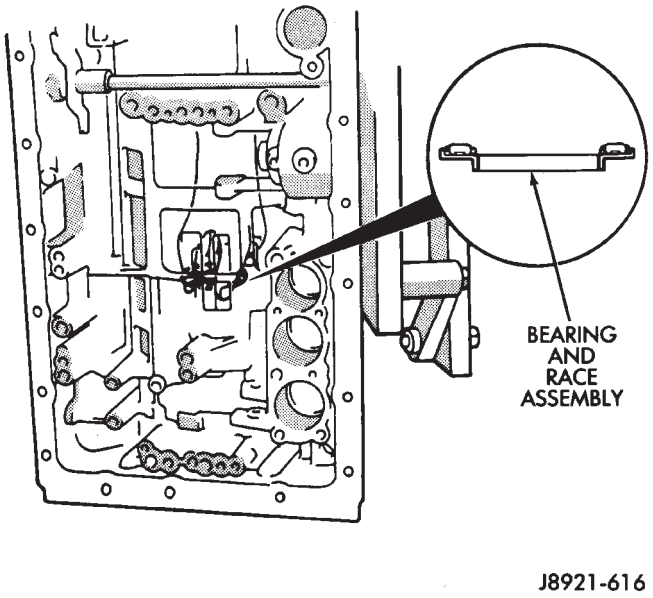


Fig. 2 Removing/Installing Bearing And Race Assembly

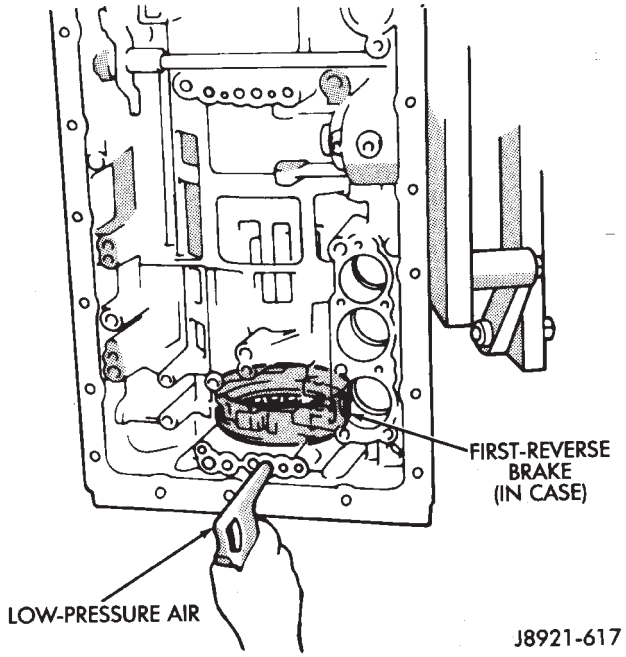


Fig. 3 Checking First-Reverse Brake Piston Operation

feed hole used for checking piston operation.

(6) Remove reaction sleeve with Sleeve Remover Tool 7542 (Fig. 5). Insert tool flanges under sleeve and lift tool and sleeve out of case.

(7) Remove No. 1 first/reverse brake piston with Piston Puller 7543 (Fig. 6). Slip tool under piston and lift tool and piston out of case.

(8) Measure free length of piston return springs with springs mounted in retainer. Length should be 18.382 mm (0.724 in.). Replace springs if length is less than this.

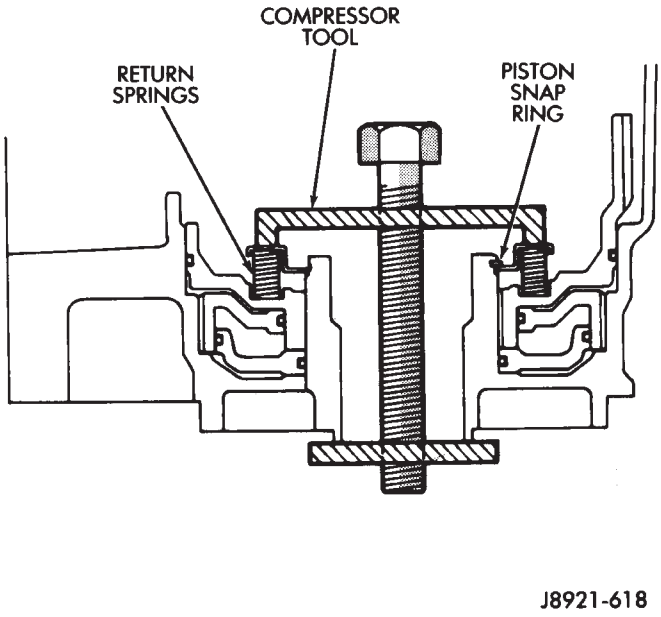


Fig. 4 Removing/Installing Piston Snap Ring

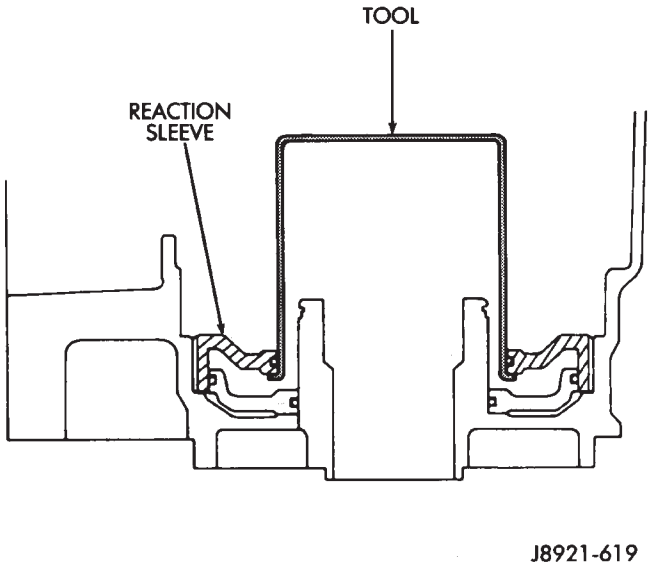


Fig. 5 Removing/Installing Reaction Sleeve

(9) Clean transmission case thoroughly with solvent and dry it with compressed air. Blow compressed air through oil feed passages to remove solvent residue and ensure that passages are clear. Inspect the case for wear or damage. Replace case if necessary.

ASSEMBLING FIRST/REVERSE BRAKE PISTON

(1) Lubricate and install new O-rings on No. 1 first/reverse brake piston and on reaction sleeve (Fig. 7). Then install piston in sleeve.

(2) Lubricate and install new O-ring on No. 2 brake piston.

(3) Install assembled No. 1 piston and reaction sleeve on No. 2 piston (Fig. 8).

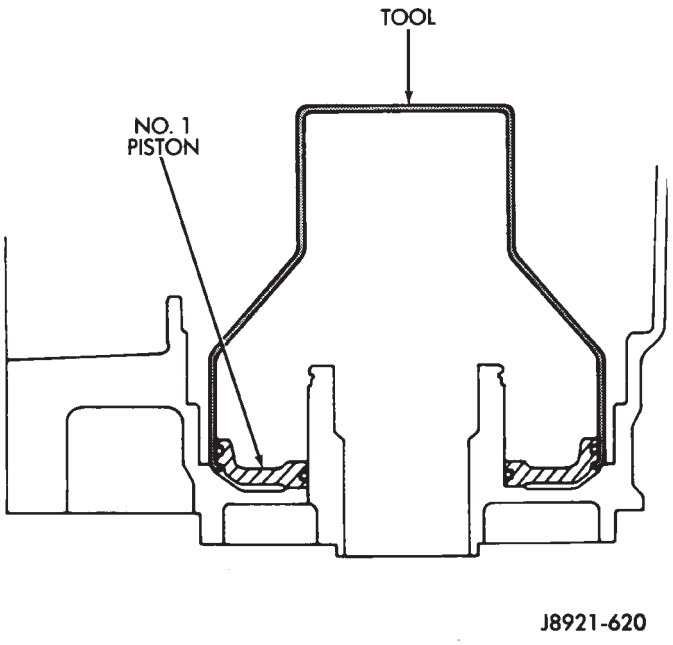


Fig. 6 Removing/Installing First-Reverse Brake No.1 Piston

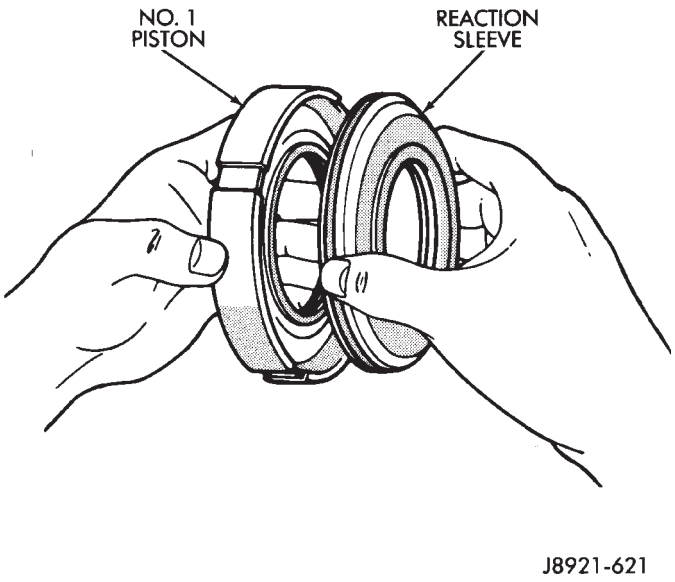


Fig. 7 Assembling No. 1 Piston And Sleeve

(4) Lubricate and install piston assembly in case (Fig. 9). Align piston and case slots and press piston assembly into case with hand pressure.

(5) Position piston return springs on No. 2 piston.

(6) Compress piston return springs with Tool 7539 and install piston snap ring (Fig. 4). Be sure snap ring end gap is not aligned with any tangs on return spring retainer.

(7) Verify piston operation with compressed air as outlined in disassembly procedure.

(8) Coat bearing and race assembly with petroleum jelly and install it in piston assembly (Fig. 2). Bearing and race assembly outer diameter is 57.7 mm (2.272 in.) and inner diameter is 39.2 mm (1.543 in.).

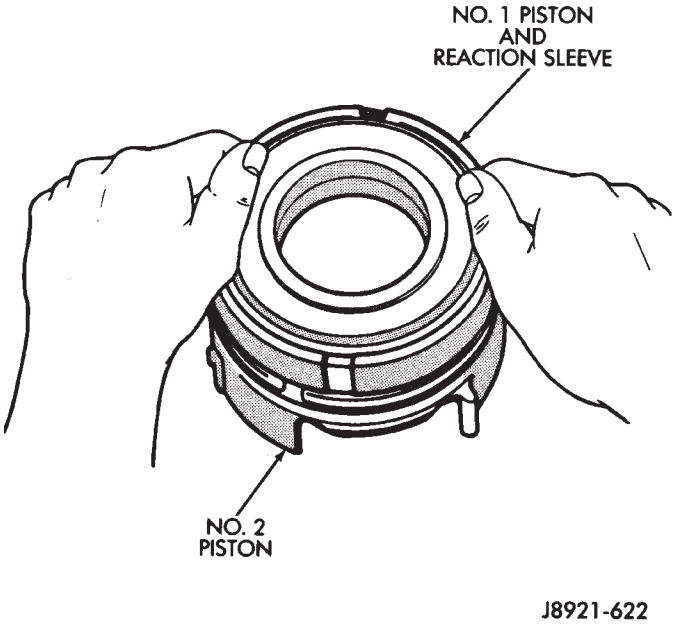


Fig. 8 Assembling First-Reverse Brake Pistons

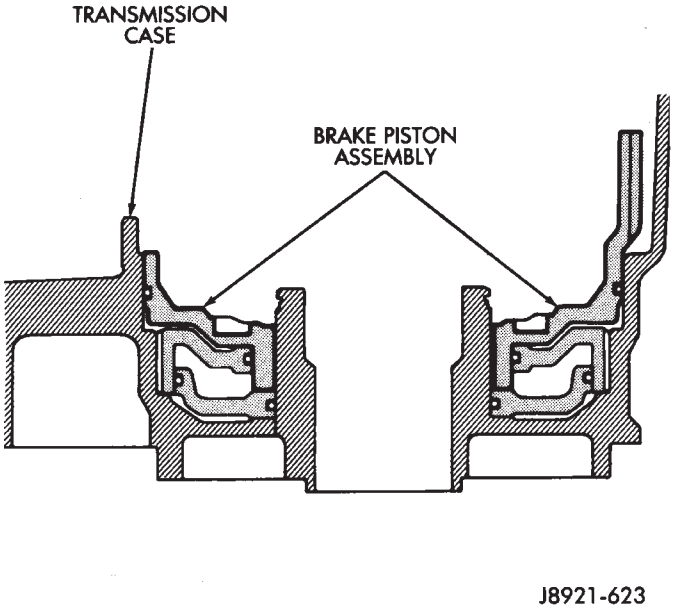


Fig. 9 Installing First-Reverse Brake Piston Assembly

TRANSMISSION VALVE BODY OVERHAUL

The valve body assembly consists of two sections which are the upper body and lower body (Figures 1 and 2). Disassembly, inspection and overhaul procedures for each section are outlined separately. Refer to the appropriate procedure as needed.

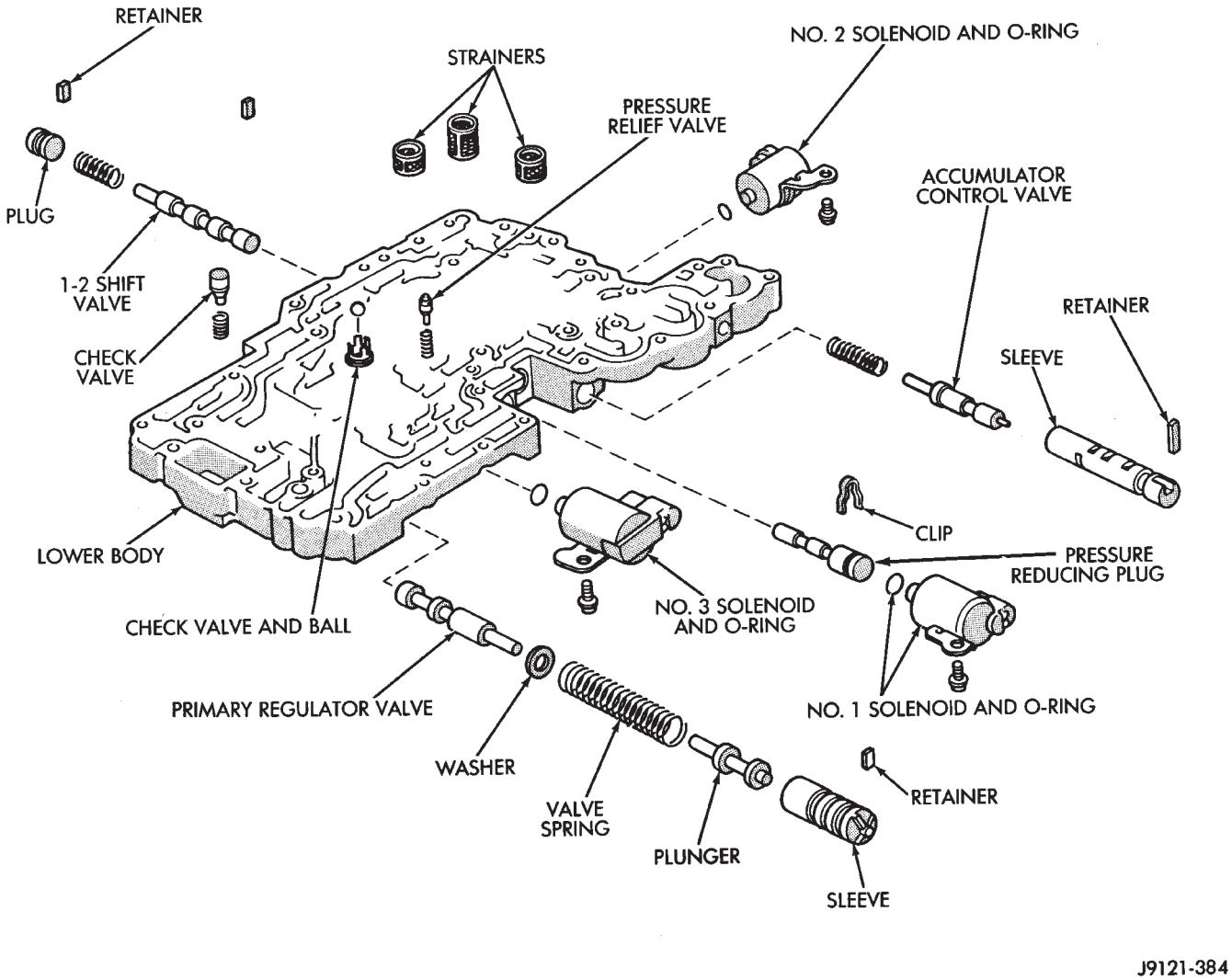


Fig. 1 Lower Body Components

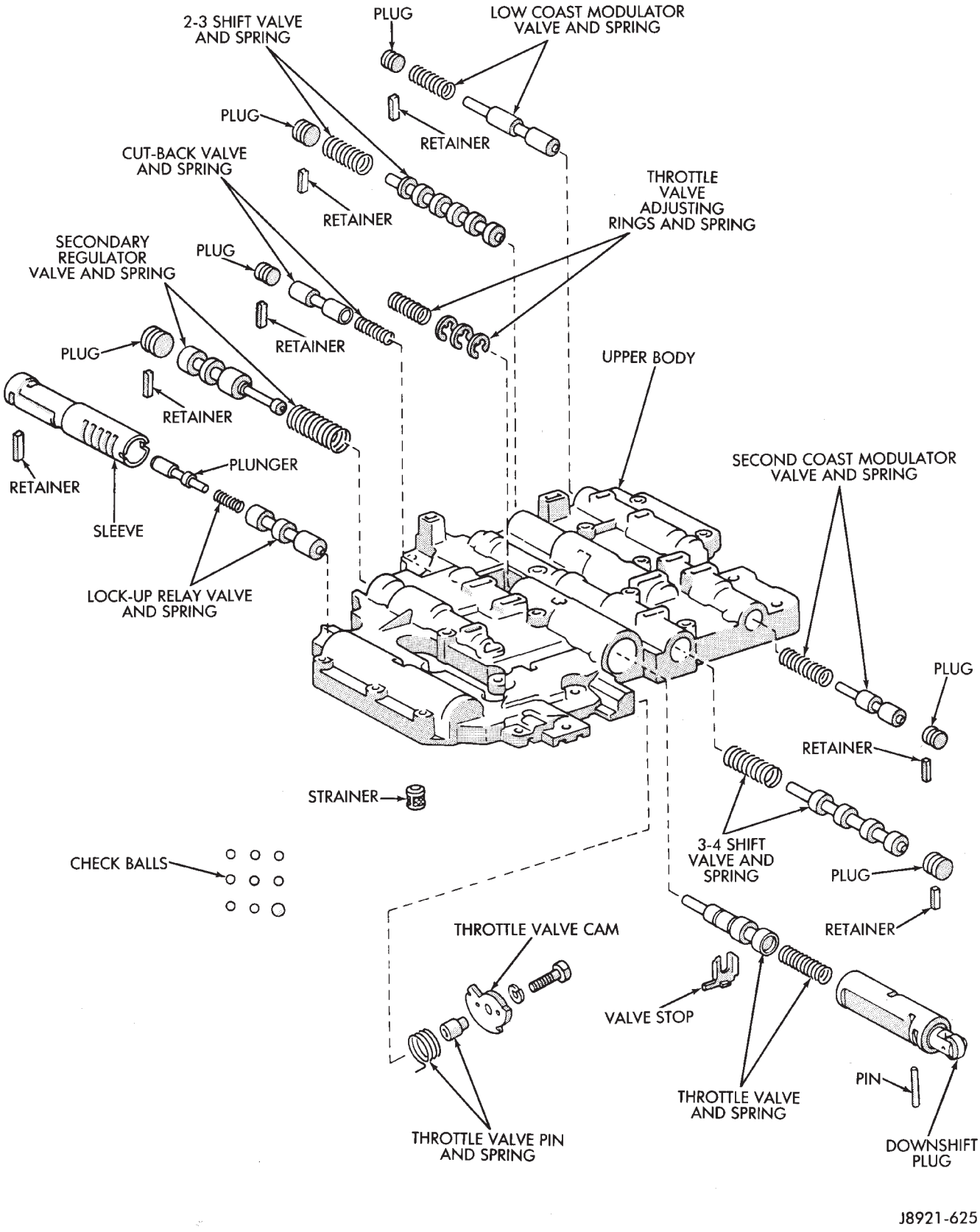


Fig. 2 Upper Body Components

REMOVING UPPER BODY FROM LOWER BODY

(1) Remove two-piece detent spring (Fig. 3). Note position of spring sections for assembly reference.

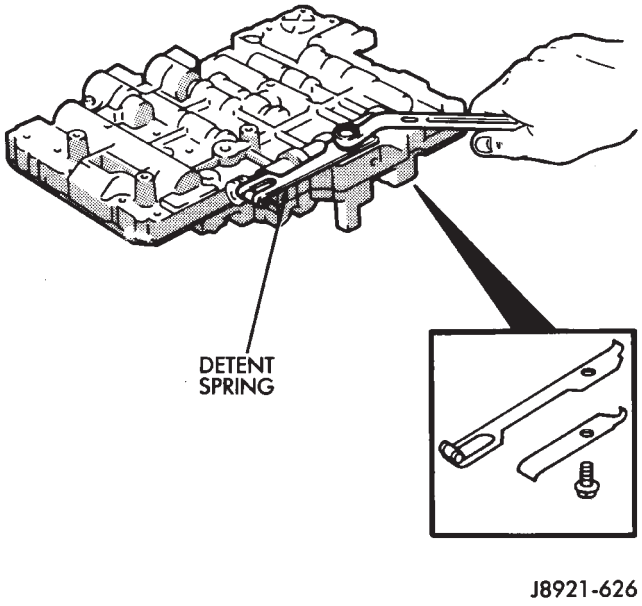


Fig. 3 Removing/Installing Detent Spring

(2) Remove manual valve from lower body (Fig. 4).

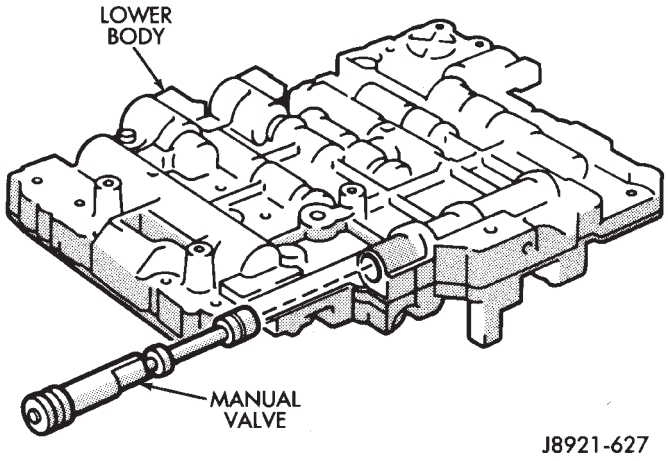


Fig. 4 Removing/Installing Manual Valve

(3) Remove bolts attaching upper body to lower body (Fig. 5).

(4) Carefully lift and remove upper body, plate and gaskets from lower body (Fig. 6).

(5) Disassemble and overhaul upper and lower body sections as outlined in following procedures.

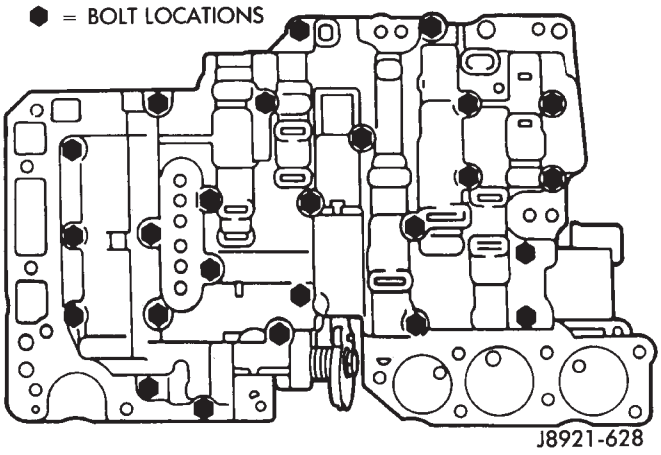


Fig. 5 Valve Body Bolt Locations

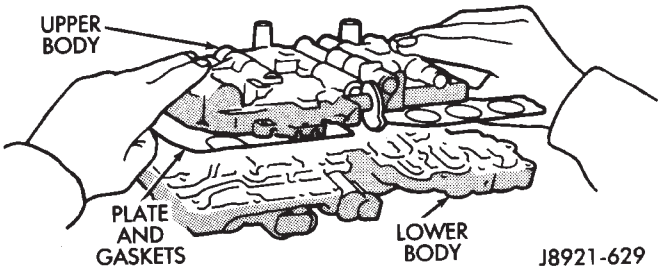


Fig. 6 Upper Body, Plate And Gaskets

LOWER BODY DISASSEMBLY

(1) Remove check valve and spring, pressure relief valve and spring and ball check and seat from lower body. Note location of each valve for assembly reference (Fig. 1).

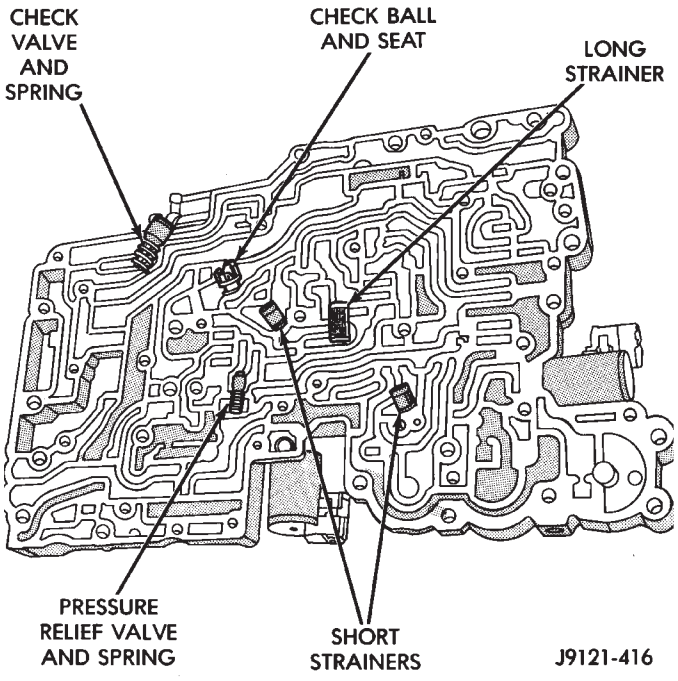


Fig. 1 Lower Body Check Valve And Strainer Location

(2) Remove oil strainers (Fig. 2).

(3) Note or mark position of valve retainers and pressure reducing plug clip for assembly reference (Fig. 2). Do not remove the retainers at this time.

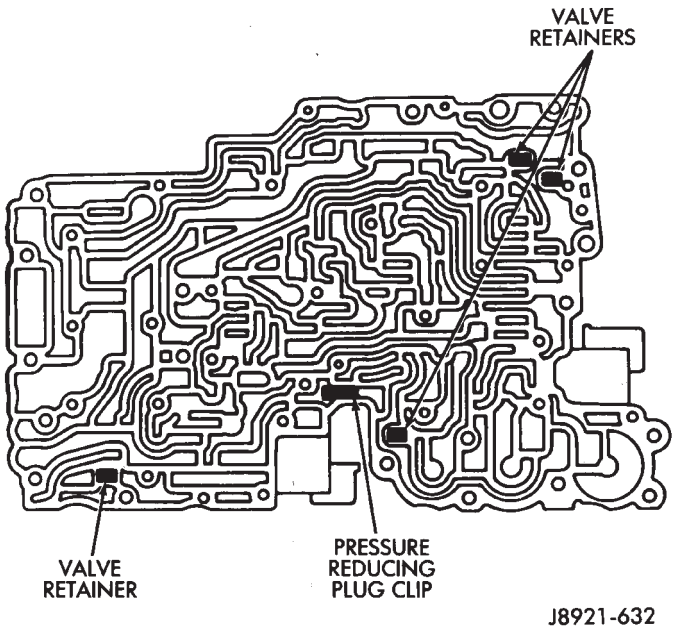


Fig. 2 Valve Retainer And Clip Location

(4) Remove solenoid No. 1, 2 and 3. Discard solenoid O-rings.

(5) Remove 1-2 shift valve retainer (Fig. 3).

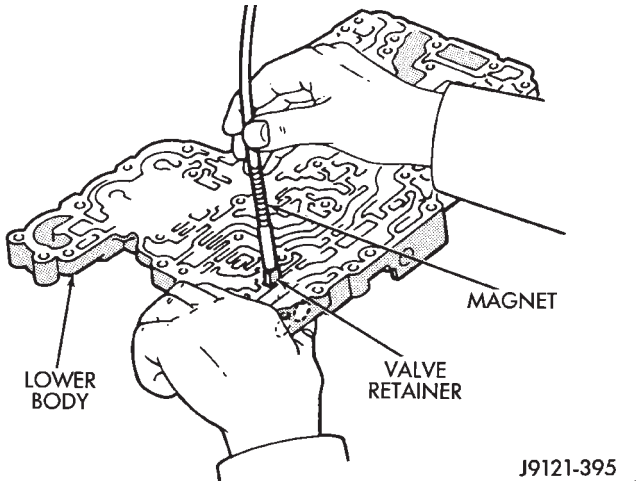


Fig. 3 Removing 1-2 Shift Valve Retainer

(6) Remove 1-2 shift valve plug, valve spring and valve (Fig. 4).

(7) Remove primary regulator valve as follows:

WARNING: THE PRIMARY REGULATOR VALVE SLEEVE AND PLUNGER ARE UNDER TENSION FROM THE VALVE SPRING. EXERT COUNTER-PRESSURE ON THE SPRING WHILE REMOVING THE VALVE RETAINER TO PREVENT COMPONENTS FROM FLYING OUT.

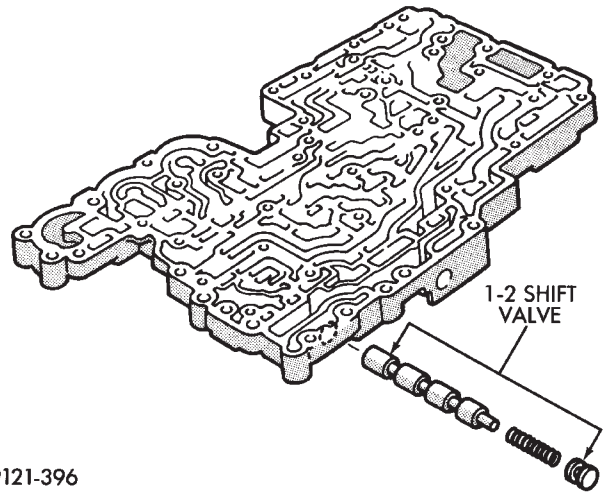


Fig. 4 Removing/Installing 1-2 Shift Valve

(a) Note position of valve retainer for assembly reference (Fig. 5). Then press valve sleeve inward with your thumb and remove retainer with magnet.

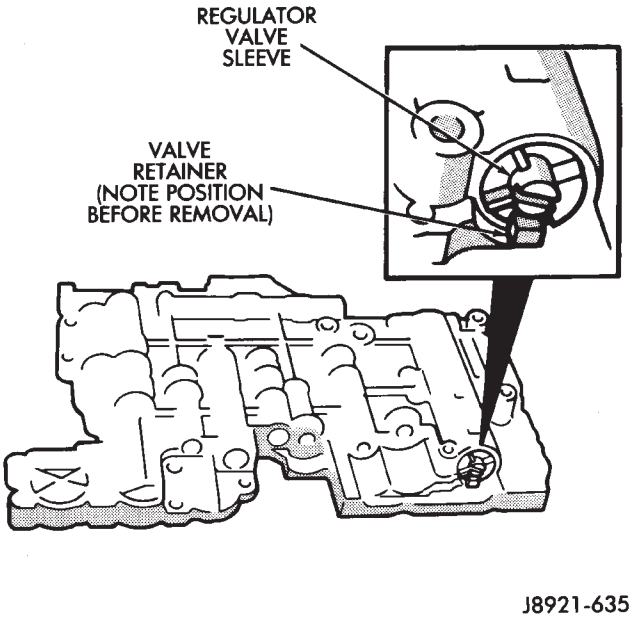


Fig. 5 Regulator Valve Retainer Position

(b) Slowly release thumb pressure on sleeve and remove sleeve, spring and washer and valve (Fig. 6). Use magnet to remove valve if necessary.

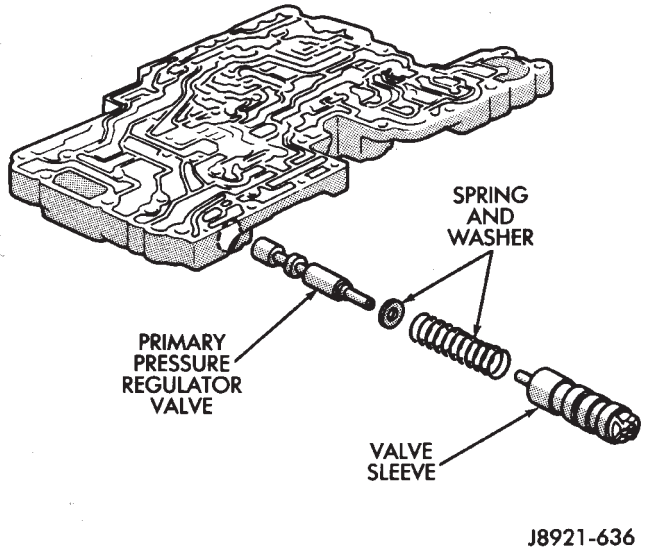


Fig. 6 Removing/Installing Primary Pressure Regulator Valve

(8) Remove regulator valve plunger from sleeve (Fig. 7).

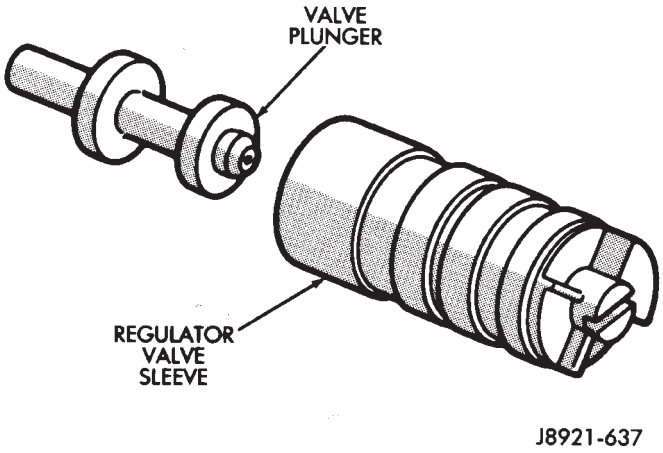


Fig. 7 Removing/Installing Regulator Valve Plunger

(9) Remove retaining clip and remove pressure reducing plug (Fig. 8). Cover screwdriver blade with tape to avoid scratching valve body surface.

(10) Remove accumulator control valve retainer and remove control valve assembly (Fig. 9).

(11) Remove spring and control valve from valve sleeve (Fig. 10).

(12) Clean lower body valve components with solvent and dry them with compressed air only. Do not use shop towels or rags. Lint or foreign material from towels or rags can interfere with valve operation.

(13) Inspect condition of lower body components. Replace lower body if any bores are scored or cor-

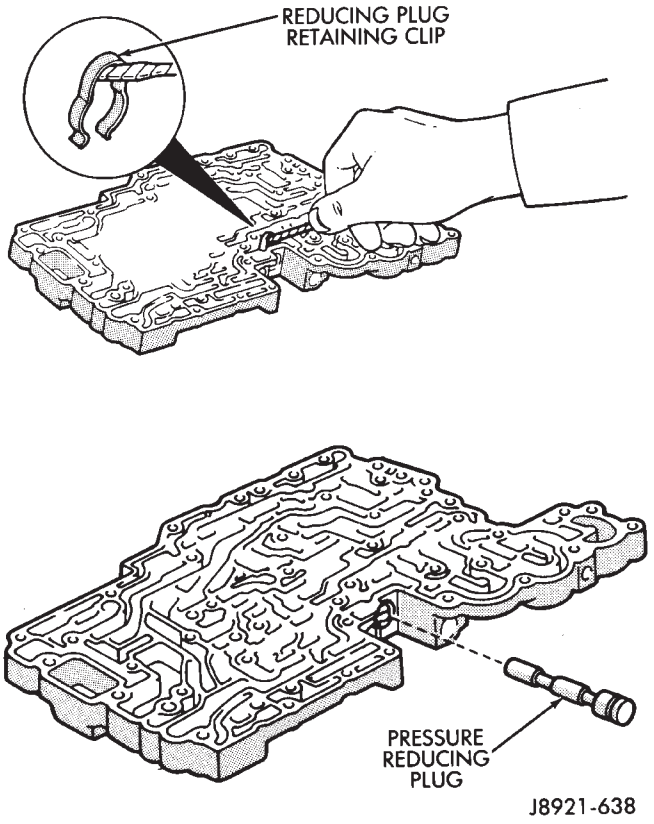


Fig. 8 Removing/Installing Pressure Reducing Plug

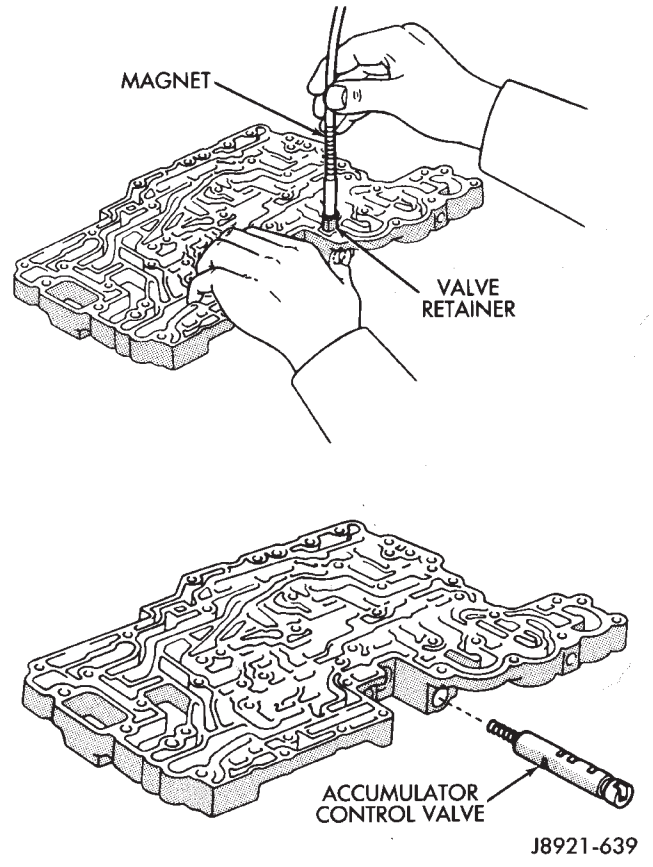


Fig. 9 Removing/Installing Accumulator Control Valve Assembly

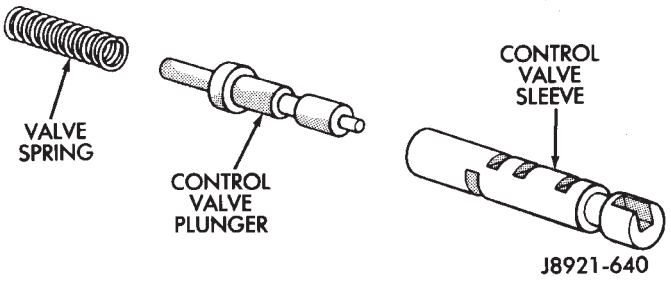


Fig. 10 Accumulator Control Valve Components

roded. Replace valves, plugs or sleeves that are scored or worn. Replace oil strainers if cut, torn or damaged in any way.

(14) Inspect valve body springs. Replace any spring having rusted, distorted, or collapsed coils. Measure length of each valve body spring. Replace any spring if free length is less than length specified in following chart (Fig. 11).

LOWER BODY ASSEMBLY

(1) Lubricate lower body components with automatic transmission fluid.

(2) Install spring and accumulator control valve in sleeve (Fig. 11). Then install assembled components in lower body (Fig. 9).

(3) Press accumulator control valve assembly into valve bore and install retainer (Fig. 9).

(4) Install pressure reducing plug in plug bore. Then secure plug with retaining clip (Fig. 8).

(5) Install washer on primary regulator valve plunger (Fig. 12).

(6) Install primary regulator valve plunger in valve sleeve (Fig. 7).

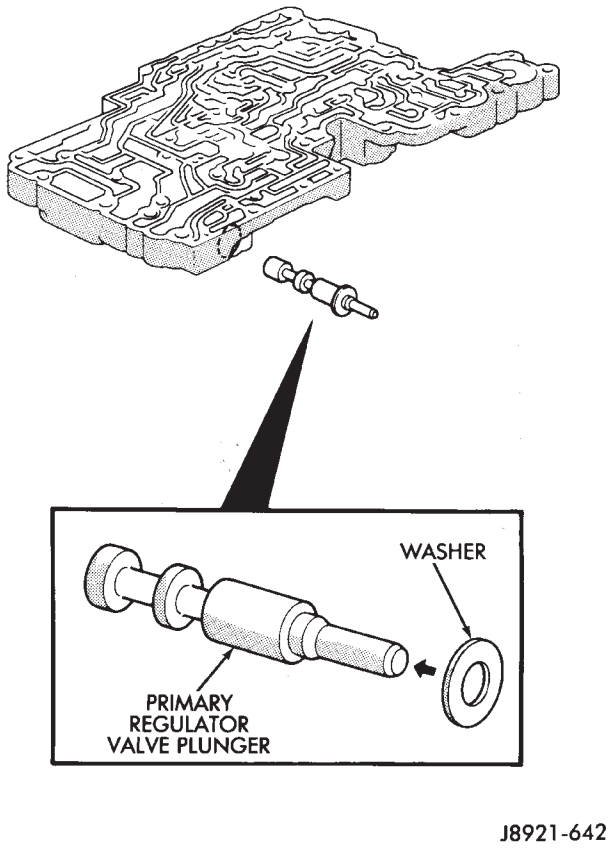
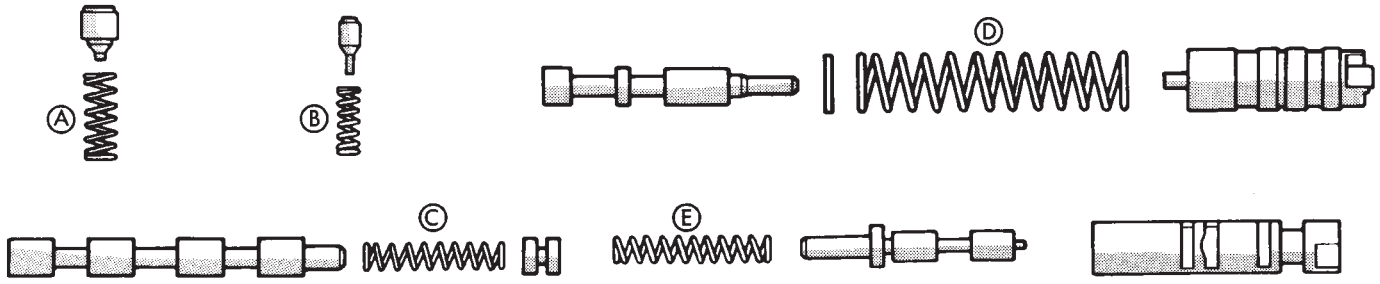


Fig. 12 Installing Washer On Regulator Valve Plunger

(7) Install valve spring and regulator valve sleeve and plunger.



Spring	Free Length
(A) Check Valve	20.2 mm (0.801 in.)
(B) Pressure Relief Valve	11.2 mm (0.441 in.)
(C) 1-2 Shift Valve	30.8 mm (1.213 in.)
(D) Primary Regulator Valve	62.3 mm (2.453 in)
(E) Accumulator Control Valve	29.8 mm (1.173 in)

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Fig. 11 Lower Body Valve Spring Dimensions

(8) Press regulator valve sleeve into bore and install retainer (Fig. 5 and 6). Be sure retainer is positioned in sleeve lugs as shown.

(9) Install 1-2 shift valve, spring and plug (Fig. 4). Then press valve assembly into bore and install retainer.

(10) Install replacement O-rings on solenoids and install solenoids on valve body. Tighten solenoid attaching bolts to 10 N·m (7 ft-lbs) torque.

(11) Install oil strainers (Fig. 13). **Identify strainers before installation. The three strainers are all the same diameter but are different lengths. Two strainers are 11.0 mm (0.443 in.) long while one strainer is 19.5 mm (0.76 in.) long (Fig. 14).**

(12) Install check valve and spring (Fig. 13).

(13) Install check ball and seat (Fig. 13).

(14) Install pressure relief valve and spring (Fig. 13).

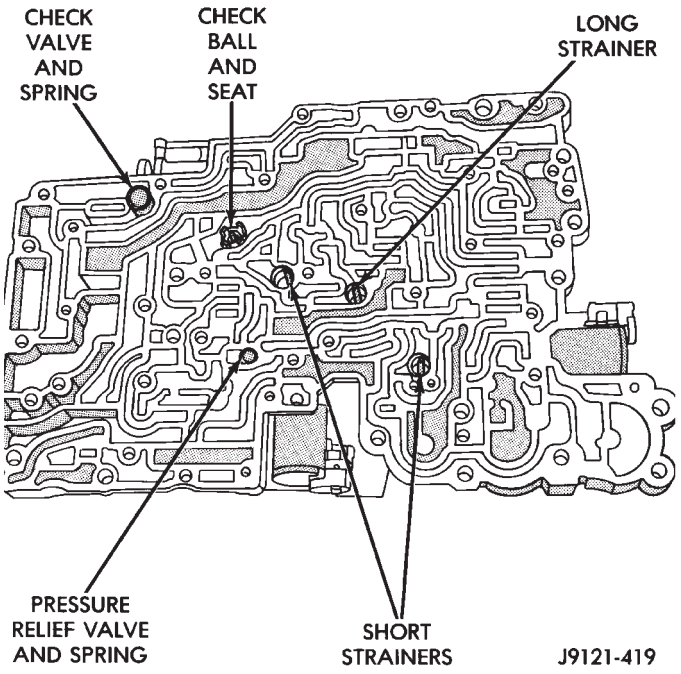


Fig. 13 Oil Strainer And Check Valve Installation

UPPER BODY DISASSEMBLY AND INSPECTION

(1) Remove valve body plate and gaskets (Fig. 1). Discard gaskets.

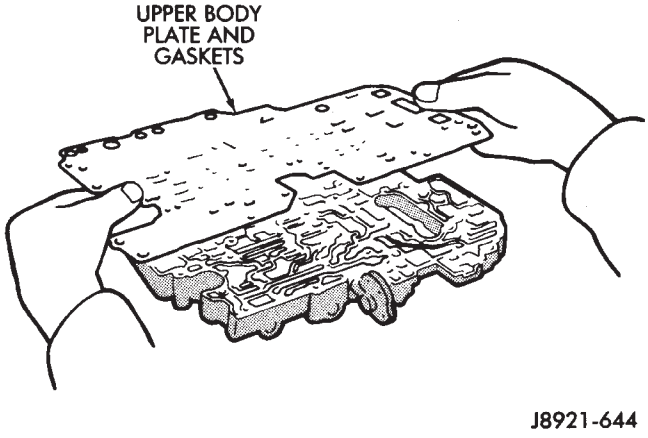
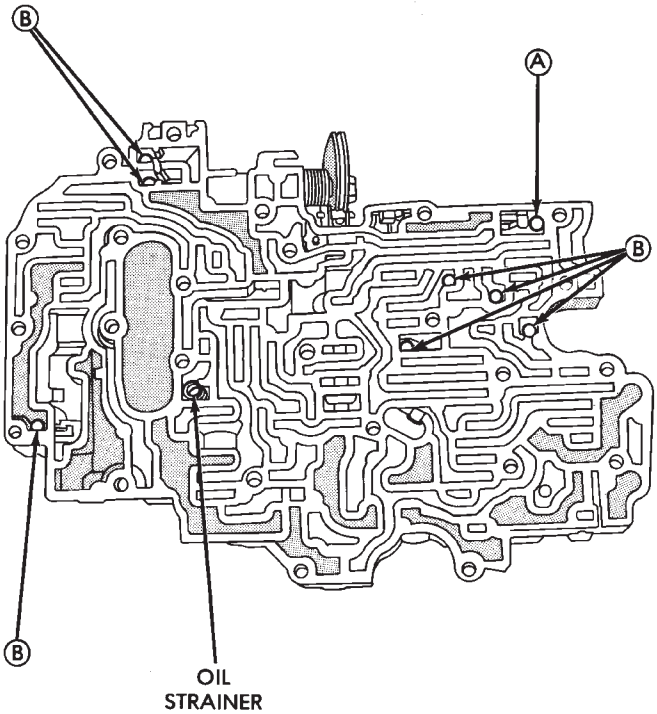


Fig. 1 Removing/Installing Upper Body Plate And Gaskets

(2) Remove strainer and eight check balls (Fig. 2). Note check ball and strainer position for assembly reference.



CHECK BALL	DIAMETER
Ⓐ	6.35 mm (.250 in.)
Ⓑ	5.535 mm (.218 in.)

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Fig. 2 Check Ball And Strainer Location/Identification

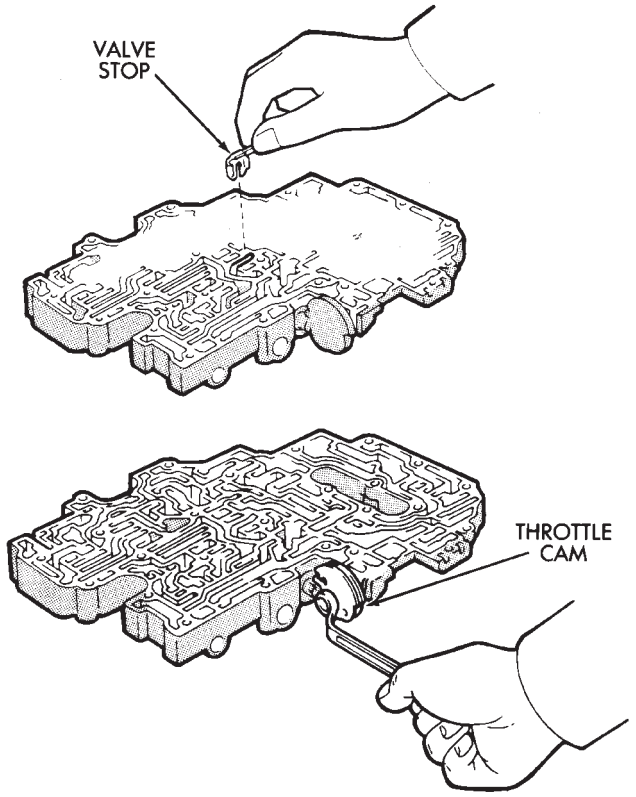


Fig. 3 Removing/Installing Valve Stop And Throttle Cam

(3) Remove valve stop and throttle cam (Fig. 3).

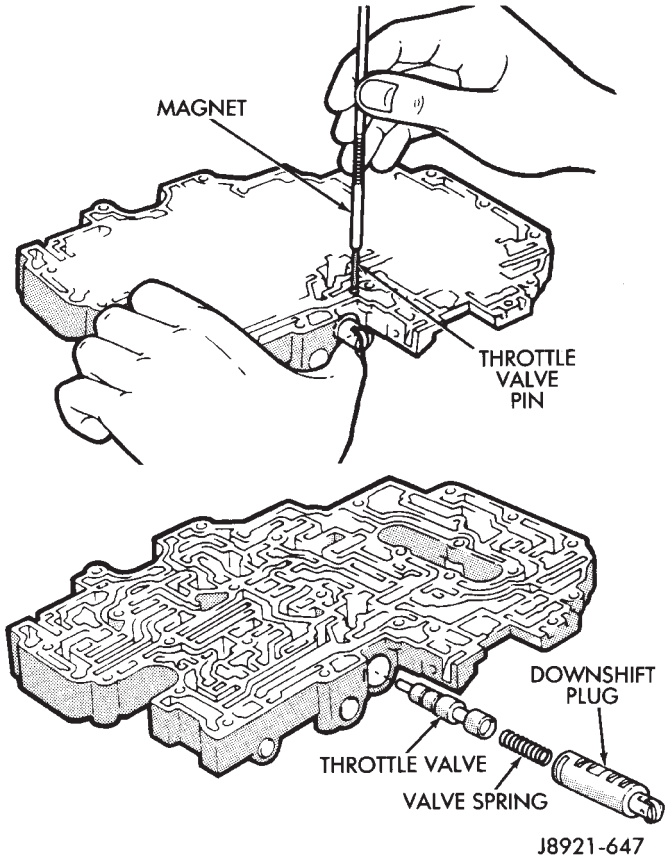


Fig. 4 Removing/Installing Throttle Valve

(4) Remove throttle valve pin with magnet and remove downshift plug, valve spring and throttle valve (Fig. 4).

(5) Turn upper body over and remove throttle valve adjusting rings and spring (Fig. 5). Note number of adjusting rings if valve is equipped with them.

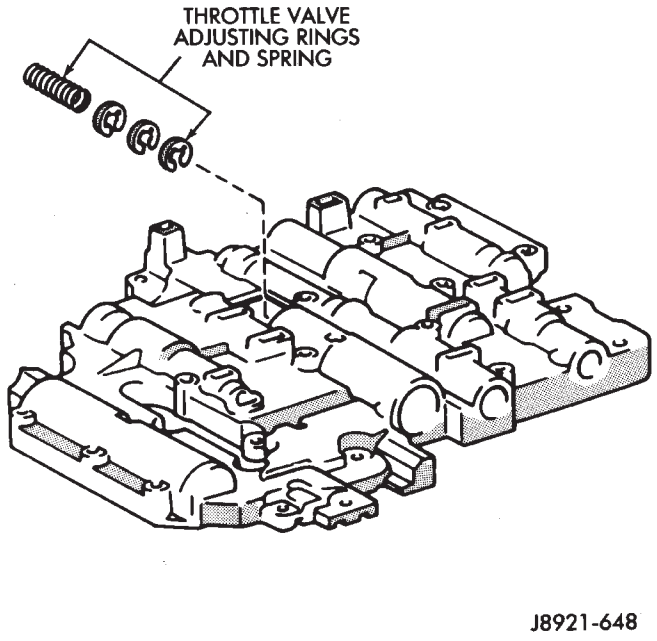


Fig. 5 Throttle Valve Adjusting Ring Location (If Equipped)

(6) Remove 3-4 shift valve retainer with magnet and remove valve plug, spring and 3-4 shift valve (Fig. 6).

(7) Remove second coast modulator valve retainer and remove valve plug, spring and valve.

(8) Remove lock-up relay valve retainer and remove relay valve and sleeve assembly (Fig. 8).

(9) Remove relay valve, spring and plunger from valve sleeve (Fig. 9).

(10) Remove secondary pressure regulator valve retainer and remove plug, regulator valve and spring (Fig. 10).

(11) Remove cut-back valve retainer and remove plug, cut-back valve and spring (Fig. 11).

(12) Remove 2-3 shift valve retainer and remove plug, spring and 2-3 shift valve (Fig. 12).

(13) Remove low coast modulator valve retainer and remove valve plug, spring and low coast modulator valve (Fig. 13).

(14) Clean the upper body components with solvent and dry them with compressed air only. Do not use shop towels or rags. Lint or foreign material from towels or rags can interfere with valve operation.

(15) Inspect condition of the upper body components. Replace the upper body if any of the bores are scored or corroded. Replace any valves, plugs or sleeves if scored or worn. Replace the oil strainer if cut, torn or damaged in any way.

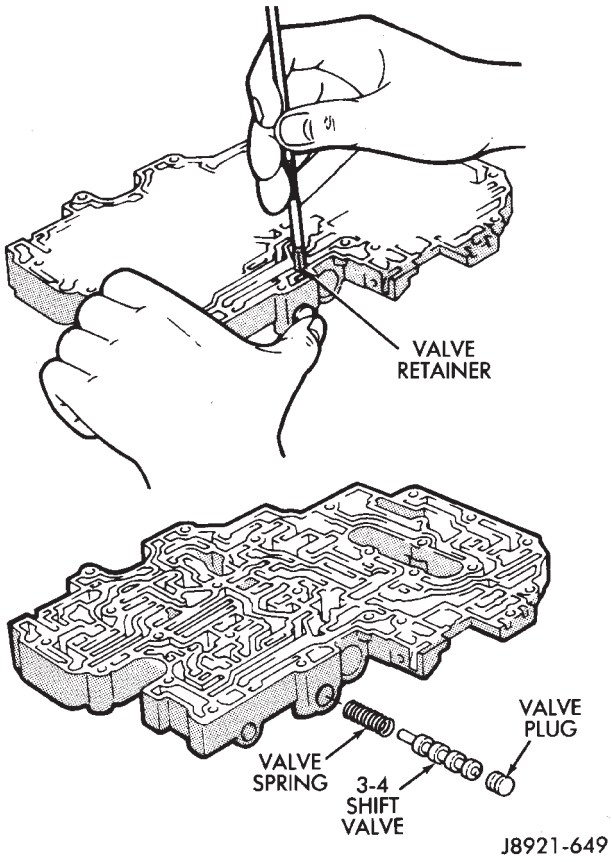


Fig. 6 Removing/Installing 3-4 Shift Valve

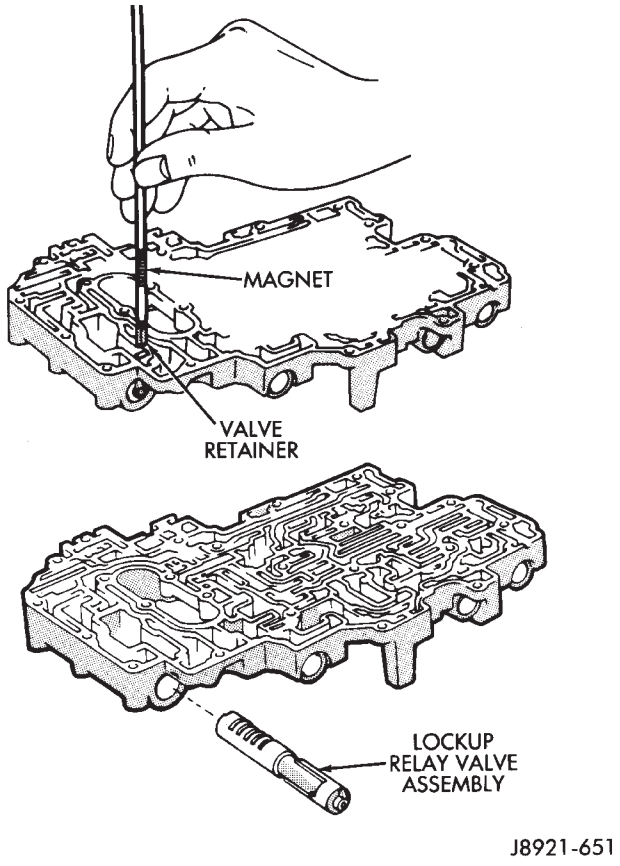


Fig. 8 Removing/Installing Converter Clutch Relay Valve

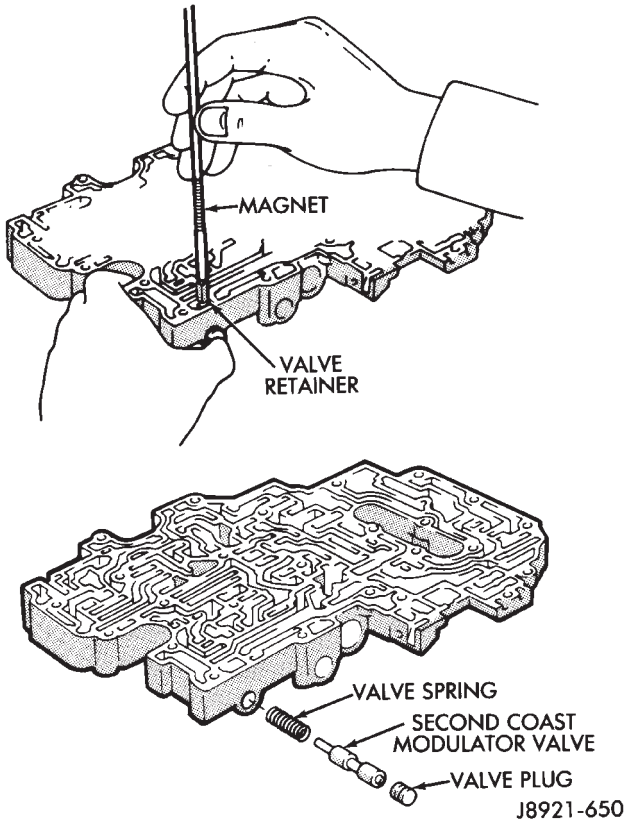


Fig. 7 Removing/Installing Second Coast Modulator Valve

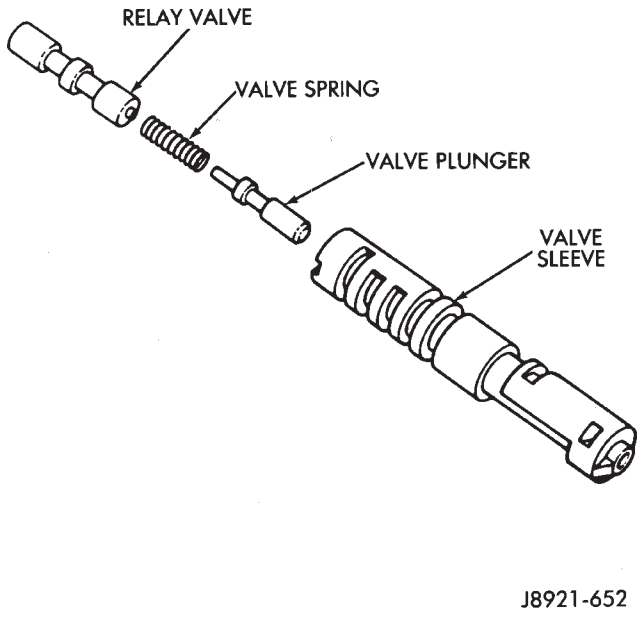


Fig. 9 Relay Valve Components

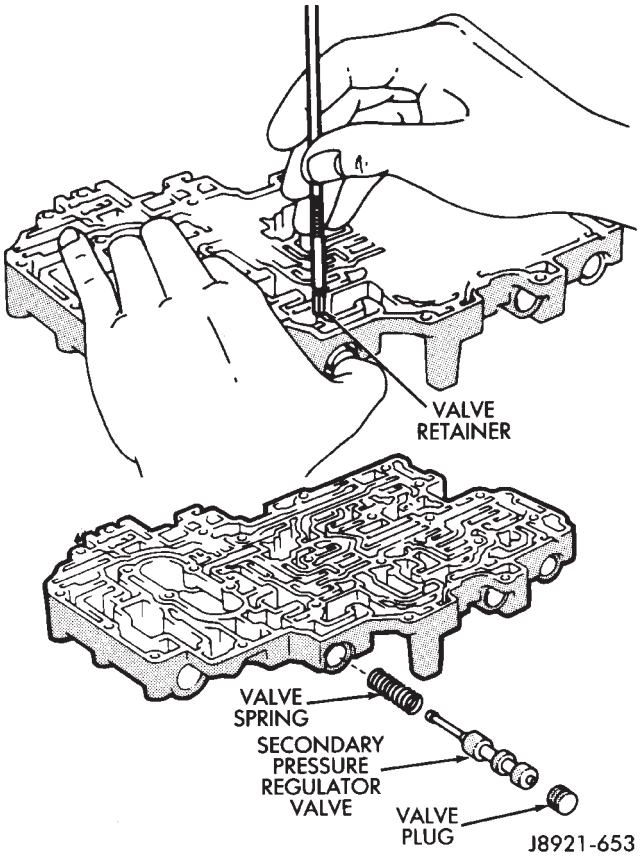


Fig. 10 Removing/Installing Secondary Pressure Regulator Valve

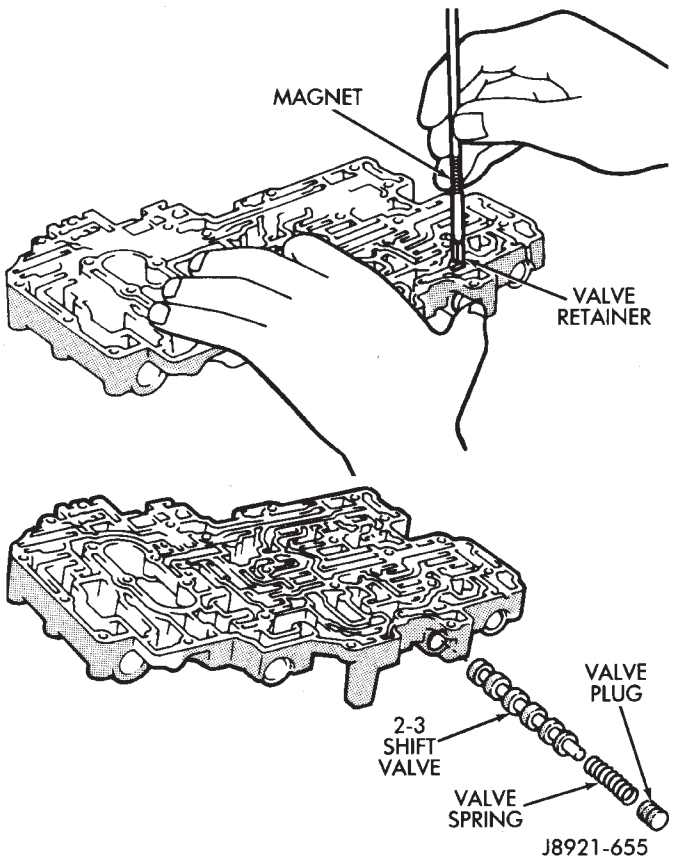


Fig. 12 Removing/Installing 2-3 Shift Valve

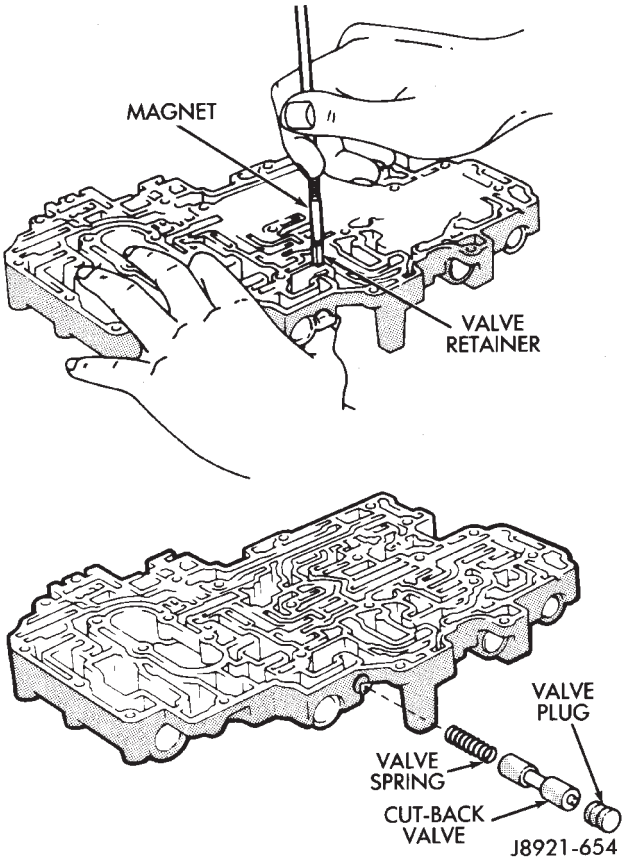


Fig. 11 Removing/Installing Cut-Back Valve

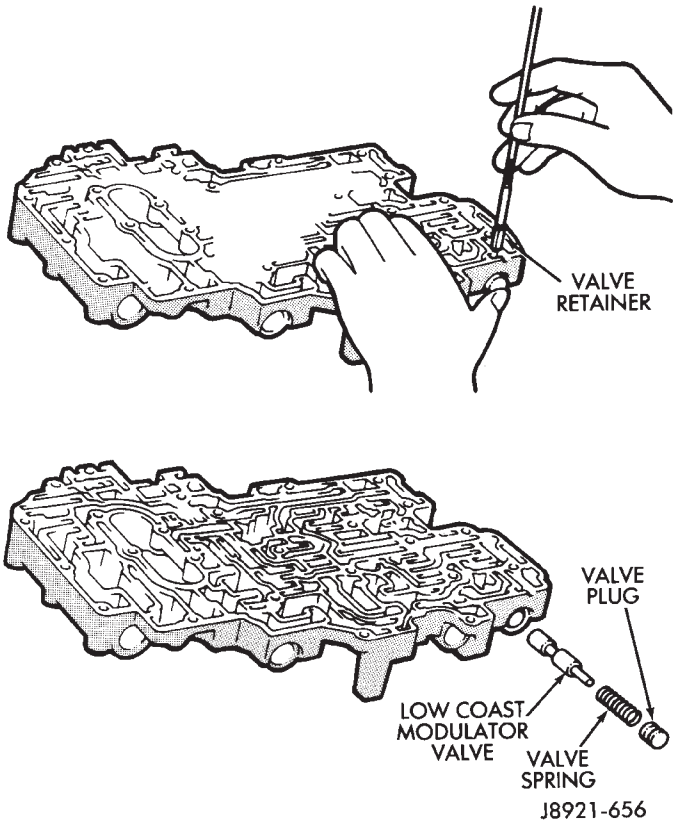


Fig. 13 Removing/Installing Low Coast Modulator Valve

(16) Inspect the valve body springs. Replace any spring having rusted, distorted, or collapsed coils. Measure length of each spring. Replace any spring if free length is less than specified in the chart (Fig. 14).

UPPER BODY ASSEMBLY

(1) Lubricate the valves, springs, plugs, sleeves and the valve bores in the upper body with automatic transmission fluid.

(2) Note position of the valve retainers (A) and stop (B) for assembly reference (Fig. 15).

(3) Install low coast modulator valve, spring and plug in valve bore. Press valve plug inward and install retainer (Fig. 13).

(4) Install 2-3 shift valve, spring and plug in valve bore. Press plug inward and install retainer (Fig. 12).

(5) Install cut-back valve spring, valve and plug (Fig. 11). Press plug inward and install retainer.

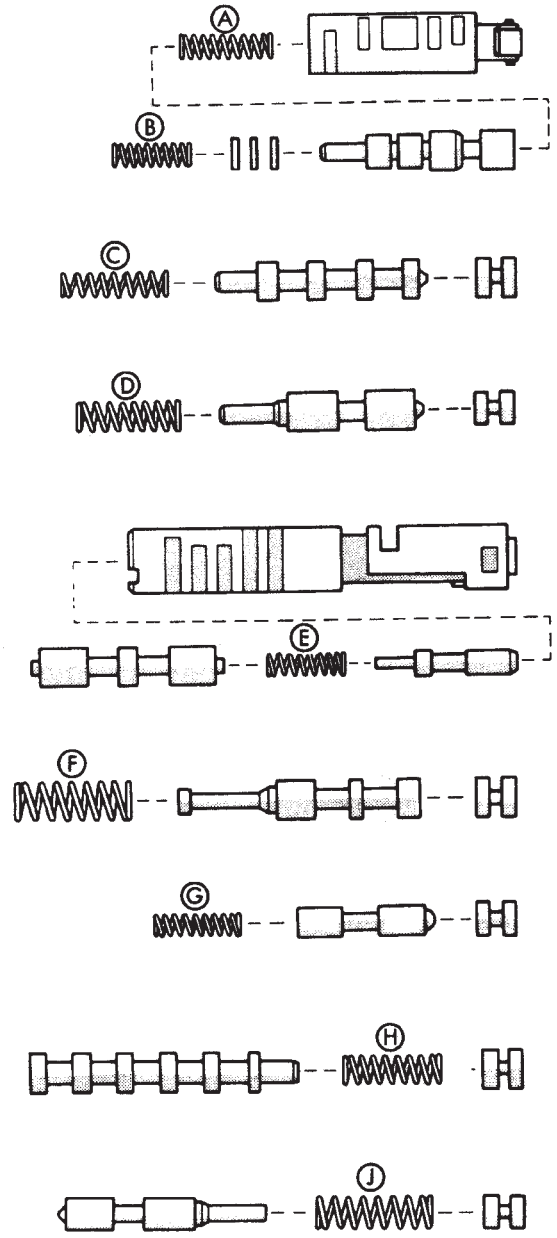
(6) Install secondary regulator valve spring, valve and plug in valve bore. Press plug inward and install retainer (Fig. 10).

(7) Assemble lock-up relay valve. Install spring and plunger in valve sleeve (Fig. 9). Then install assembled valve in sleeve.

(8) Install assembled lock-up relay valve in valve bore and install retainer (Fig. 8).

(9) Install second coast modulator valve, spring and plug in valve bore. Press plug inward and install retainer (Fig. 7).

(10) Install 3-4 shift valve, spring and plug in bore. Press plug inward and install retainer (Fig. 6).



Spring	Free Length
(A) Downshift Plug	27.3 mm (1.074 in.)
(B) Throttle Valve	20.6 mm (0.811 in.)
(C) 3-4 Shift Valve	30.8 mm (1.212 in.)
(D) Second Coast Modulator Valve	25.3 mm (0.996 in.)
(E) Lockup Relay Valve	21.4 mm (0.843 in.)
(F) Second Regulator Valve	30.9 mm (1.217 in.)
(G) Cut-Back Valve	21.8 mm (0.858 in.)
(H) 2-3 Shift Valve	30.8 mm (1.212 in.)
(J) Low Coast Modulator Valve	27.8 mm (1.094 in.)

Fig. 14 Upper Body Spring/Valve Identification

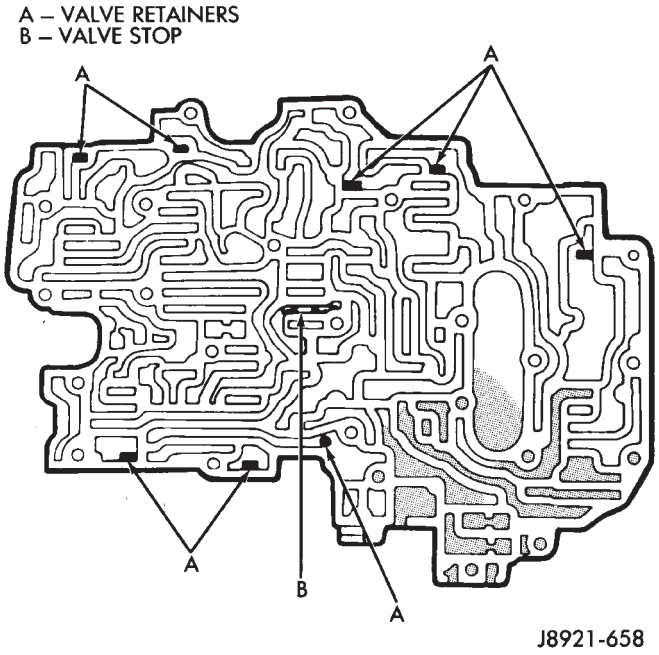


Fig. 15 Valve Retainer And Stop Locations

(11) Install throttle valve in valve bore. Push valve into place and install valve stop (Fig. 16).

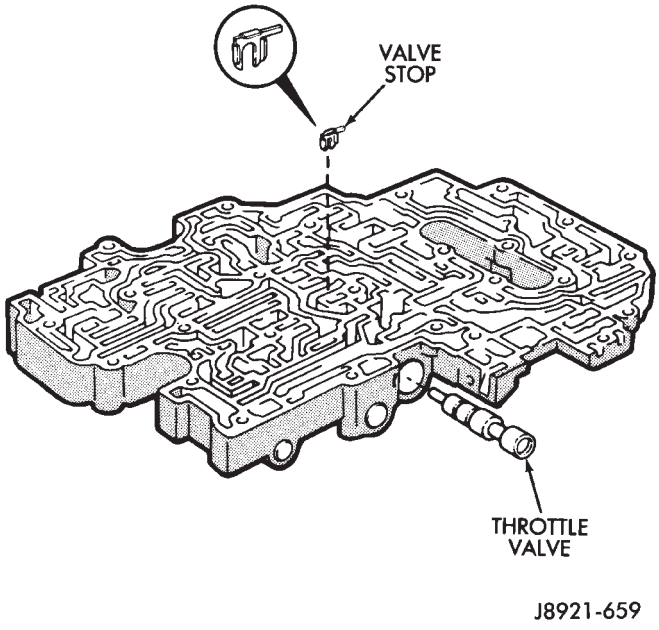


Fig. 16 Installing Throttle Valve And Stop

(12) On models with adjusting rings, turn upper body over and install adjusting rings (Fig. 17). Be sure to install same number of rings as were removed.

(13) Install throttle valve adjusting spring in bore and onto end of throttle valve (Fig. 18).

(14) Install downshift spring and plug in throttle valve bore. Press plug inward against throttle valve and spring and install retainer pin (Fig. 19).

(15) Install sleeve in throttle cam (Fig. 20).

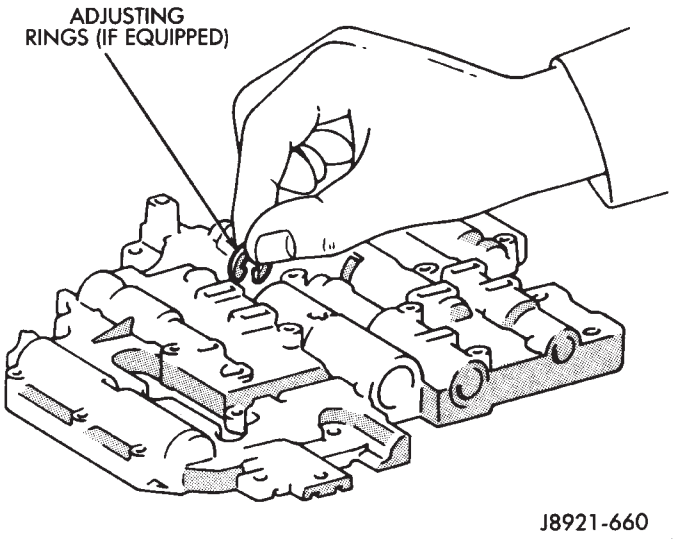


Fig. 17 Install Throttle Valve Adjusting Rings (If Equipped)

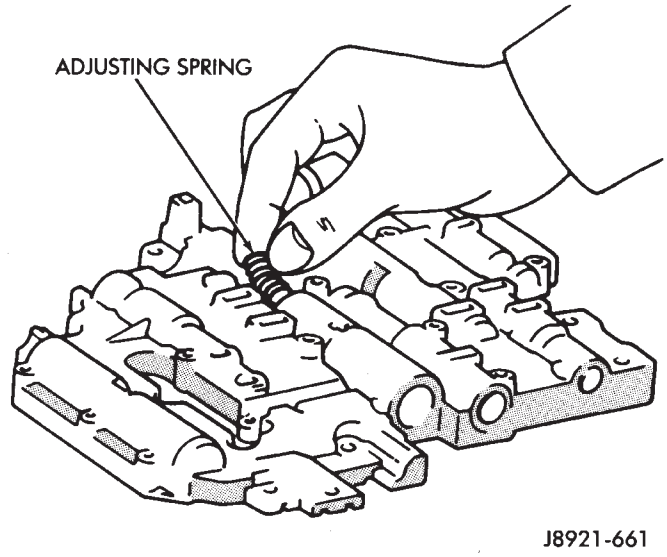


Fig. 18 Installing Throttle Valve Adjusting Spring

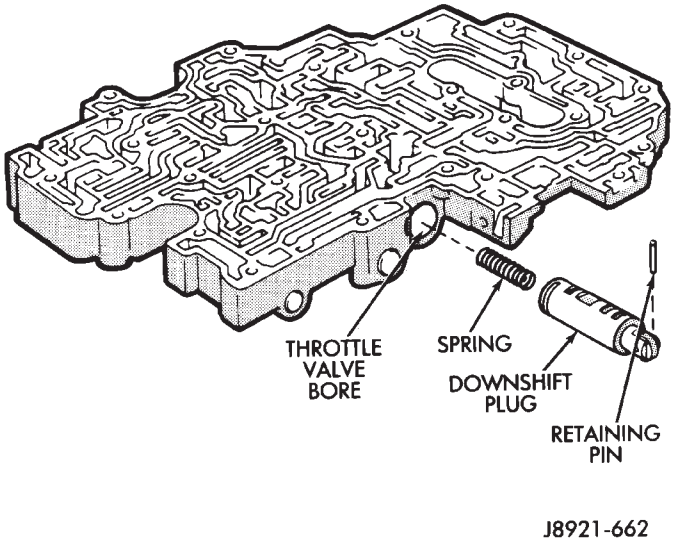


Fig. 19 Installing Downshift Plug

(16) Install spring on cam (Fig. 20). Hook curved end of spring through hole in cam as shown.

(17) Mount cam on upper body and install cam attaching bolt and spacer (Fig. 20). Tighten bolt to 10 N·m (7 ft. lbs.) torque.

(18) Be sure straight end of spring is seated in upper body slot as shown (Fig. 20).

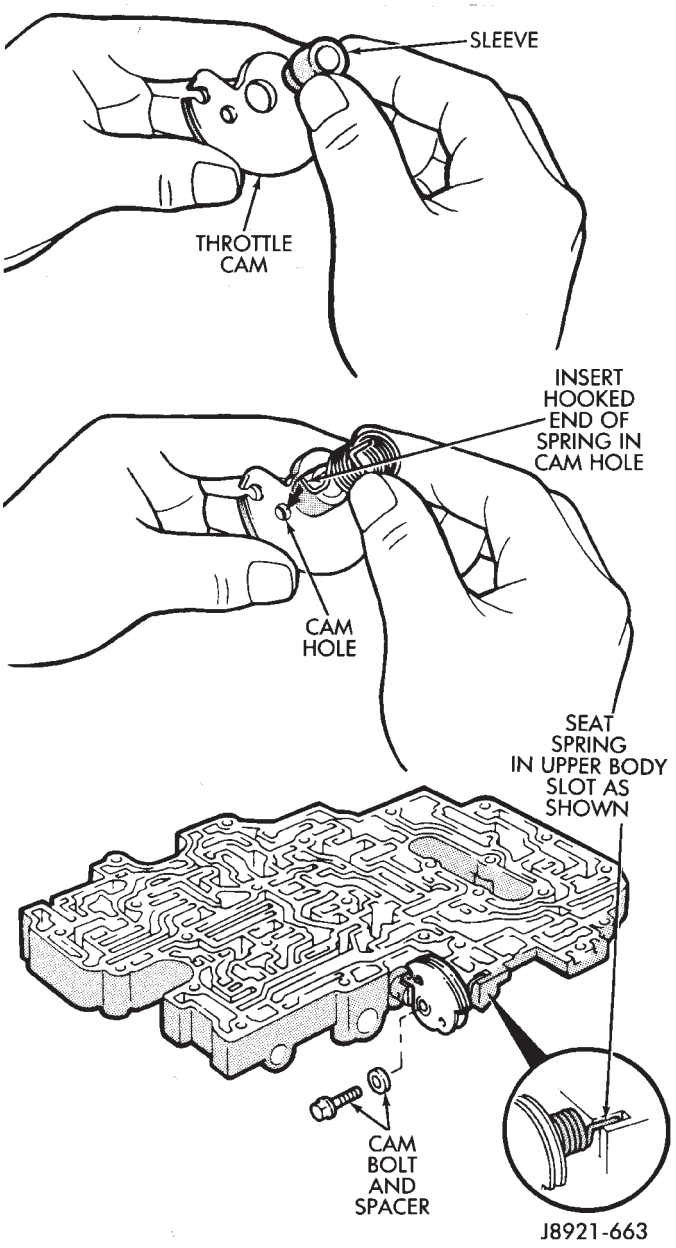


Fig. 20 Installing Throttle Cam

(19) Install check balls in upper body (Fig. 2).

(20) Install oil strainer (Fig. 2).

INSTALLING UPPER BODY ON LOWER BODY

If valve body was equipped with gaskets, start at step (1). However, if valve body is not equipped with gaskets, start at step (4).

(1) Position new No. 1 gasket (Fig. 1) on upper body.

(2) Position valve body plate on No. 1 gasket.

(3) Position new No. 2 gasket (Fig. 2) on valve body plate and align gaskets and plate using bolt holes as guides.

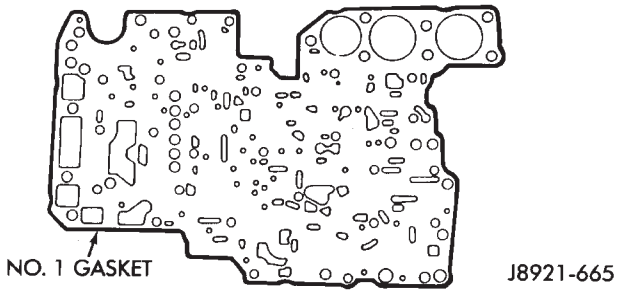


Fig. 1 Valve Body Gasket No. 1

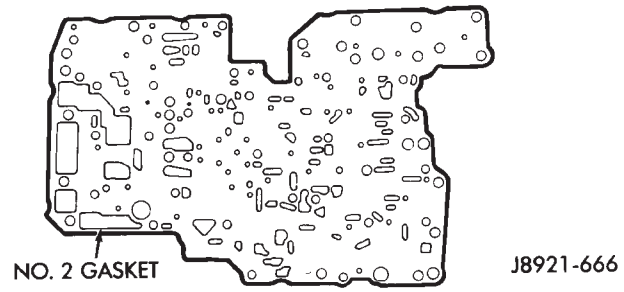


Fig. 2 Valve Body Gasket No. 2

(4) Install valve body bolts. **Three different length bolts are used. Refer to the Figure 3 for bolt locations. Chart symbols indicate bolt location and length in millimeters.**

(5) Tighten valve body bolts to 6.4 N·m (56 in. lbs.) torque.

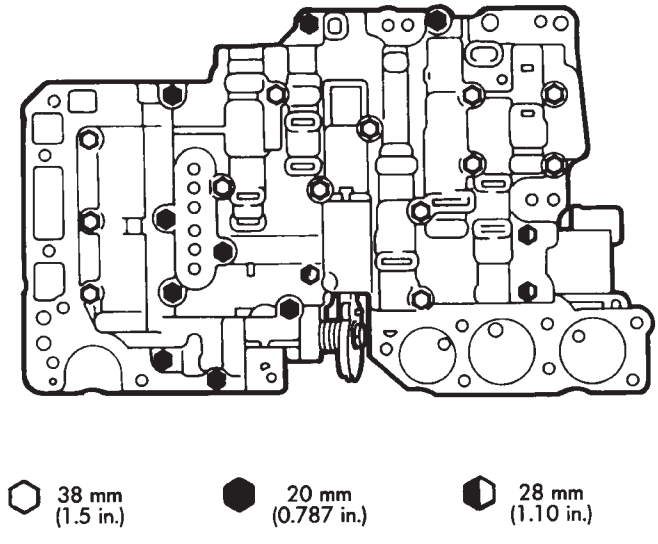


Fig. 3 Valve Body Bolt Location/Size

(6) Install manual valve (Fig. 4).

(7) Install two-piece detent spring (Fig. 5). Tighten spring attaching bolt to 10 N·m (7 ft. lbs.) torque.

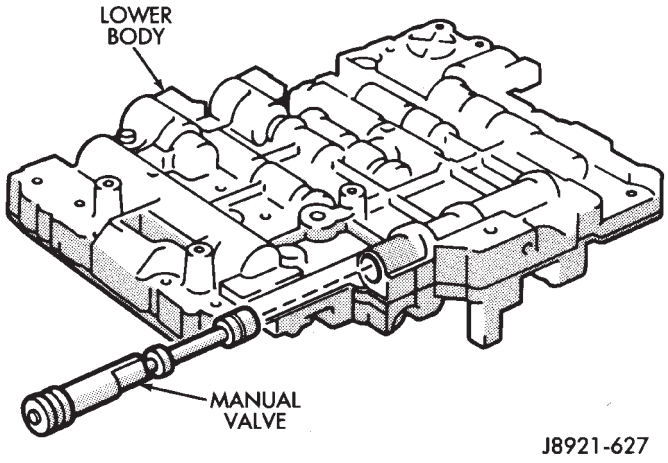


Fig. 4 Installing Manual Valve

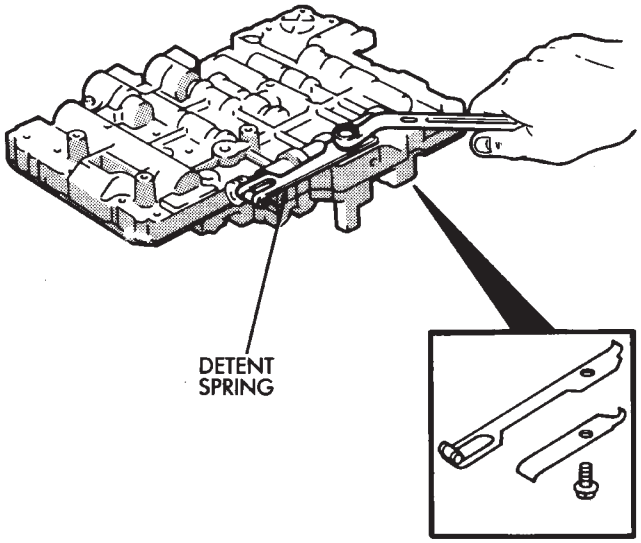


Fig. 5 Installing Detent Spring

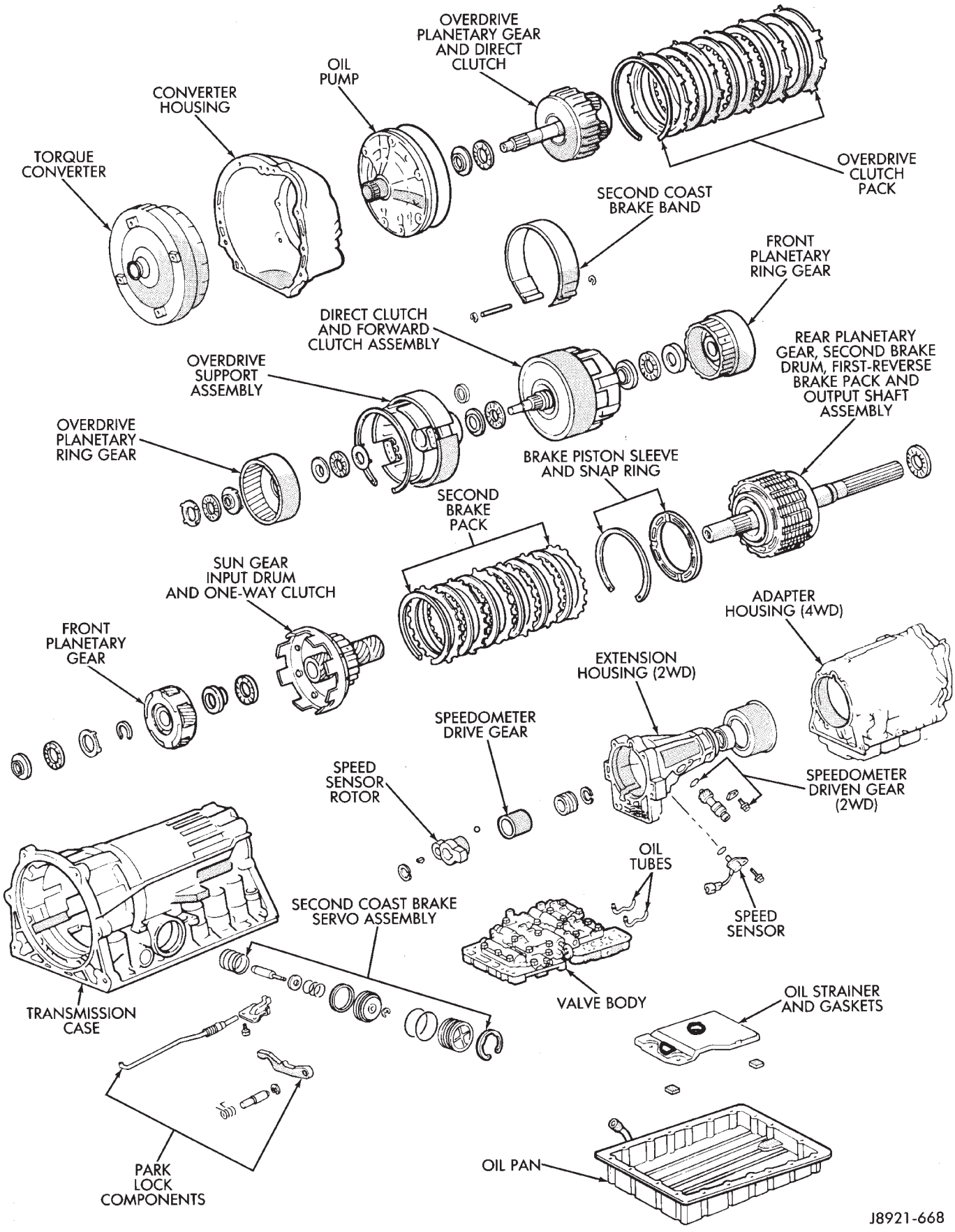


Fig. 1 AW-4 Transmission Components

TRANSMISSION ASSEMBLY AND ADJUSTMENT

(1) During assembly, lubricate components with transmission fluid or petroleum jelly as indicated.

(2) If any of the transmission components are still assembled after overhaul checking procedures, disassemble as necessary in preparation for transmission assembly.

(3) Verify thrust bearing and race installation during assembly. Refer to the Thrust Bearing Chart (Fig. 2) for bearing and race location and correct positioning.

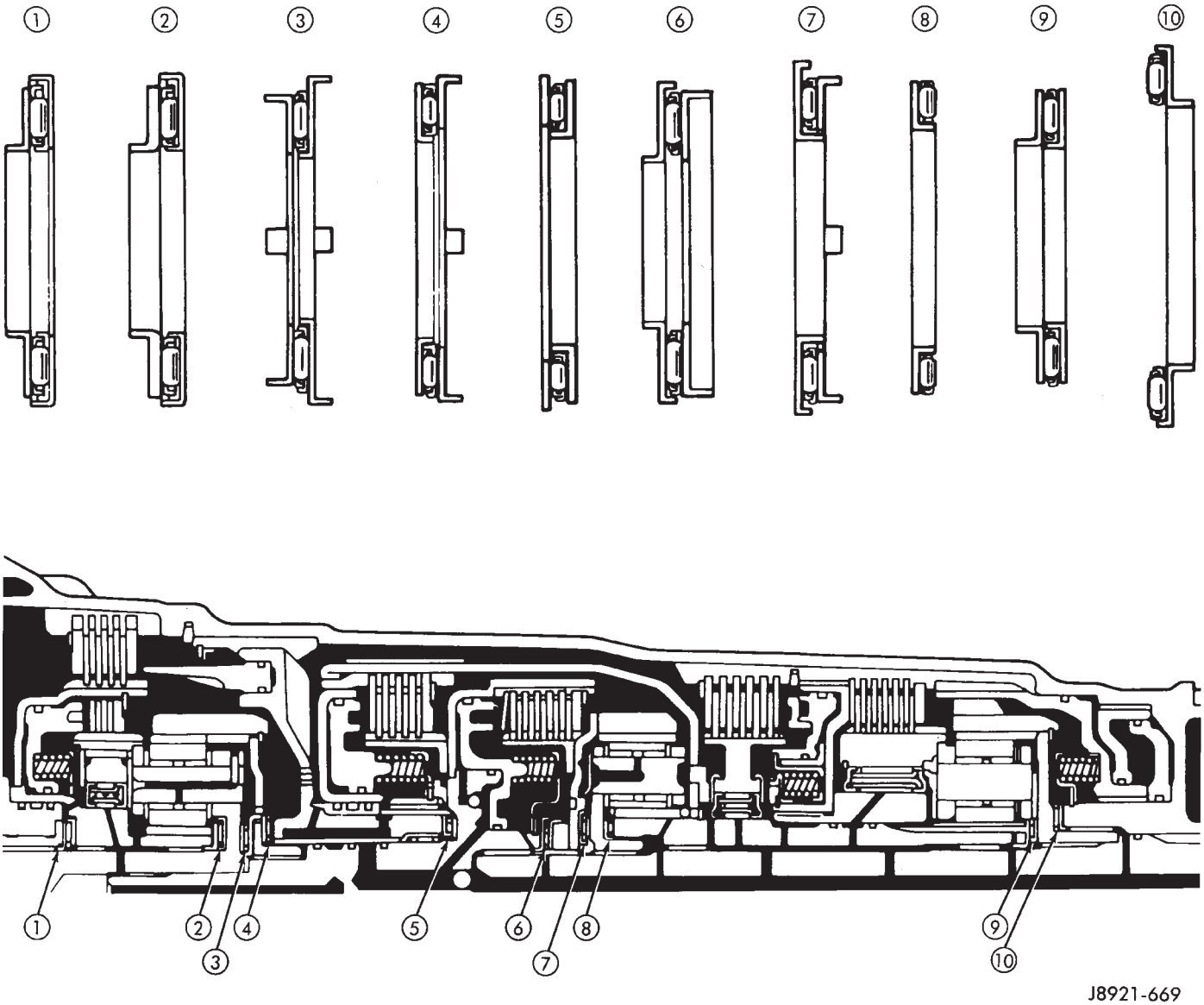


Fig. 2 Thrust Bearing Chart

(4) Install rear planetary gear, second brake drum and output shaft as outlined in following steps:

(5) Verify No. 10 thrust bearing and race (Fig. 2). Bearing and race outer diameter is 57.7 mm (2.272 in.) and inside diameter is 39.2 mm (1.543 in.).

(6) Coat thrust bearing and race assembly with petroleum jelly and install in case (Fig. 3). Race faces down. Bearing rollers face up.

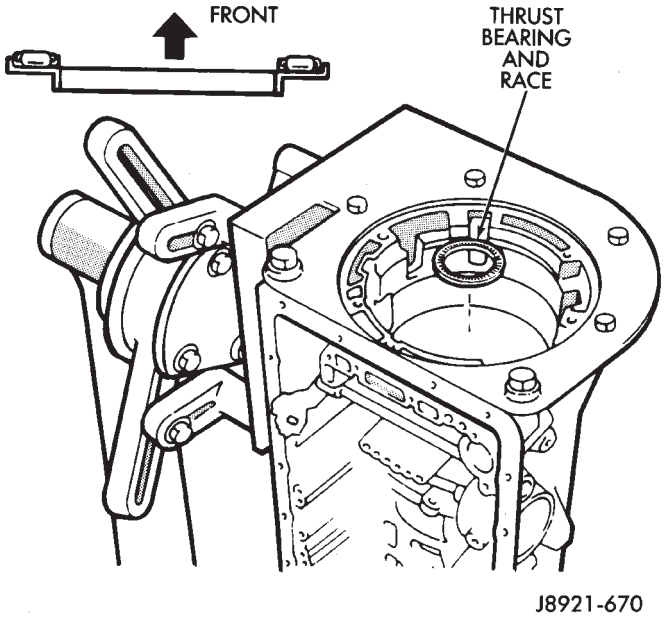


Fig. 3 Installing Thrust Bearing And Race (No. 10)

(7) Align teeth of second brake drum and clutch pack (Fig. 4).

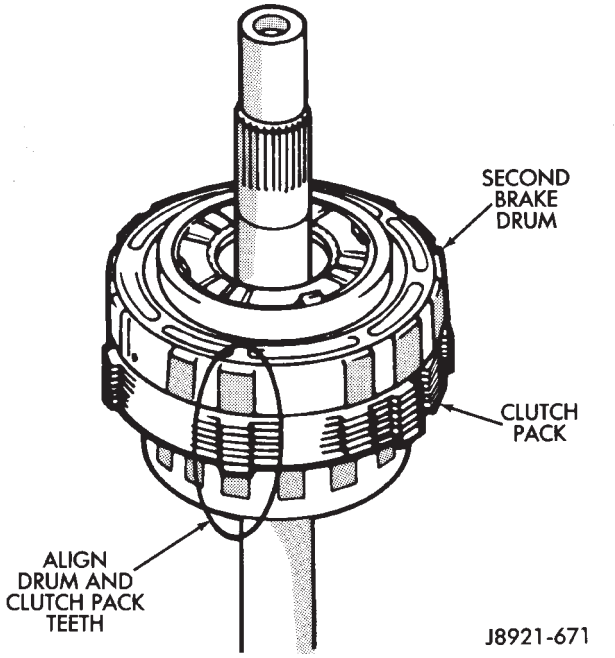


Fig. 4 Aligning Second Brake Drum And Clutch Pack Teeth

(8) Align rear planetary-output shaft assembly teeth with case slots and install assembly in case (Fig. 5).

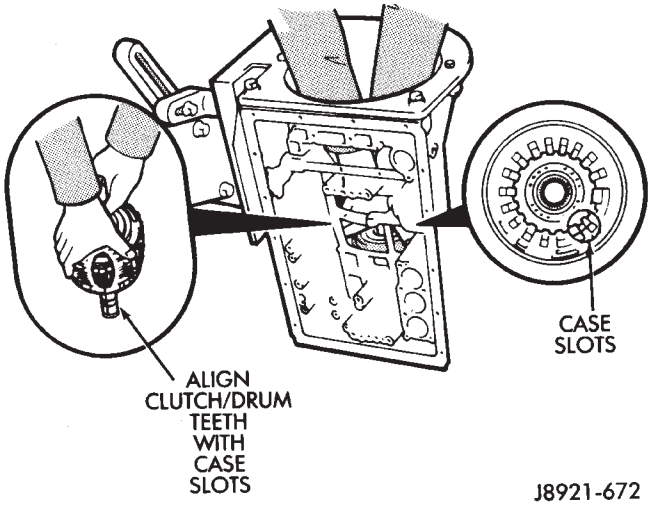


Fig. 5 Installing Output Shaft And Rear Planetary Assembly

(9) Install rear planetary snap ring with snap ring pliers. Chamfered side of snap ring faces up and toward case front (Fig. 6).

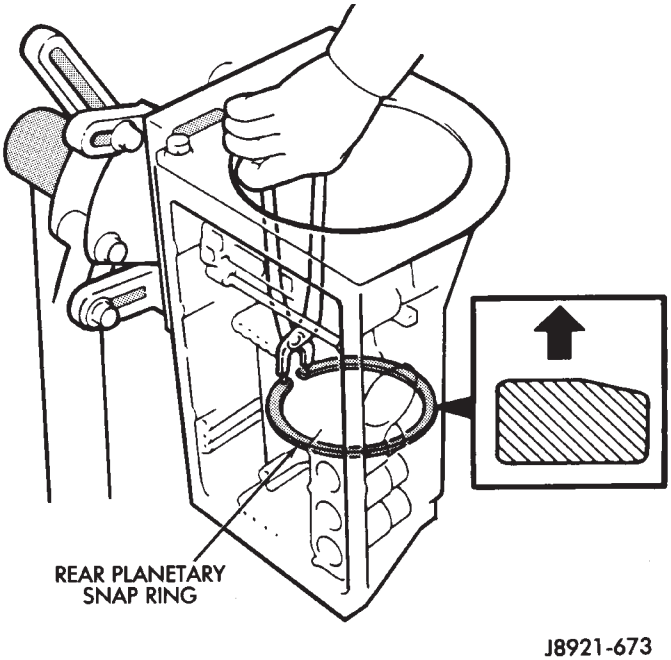


Fig. 6 Installing Planetary Snap Ring

(10) Check first-reverse brake pack clearance with feeler gauge. Clearance should be 0.70 - 1.20 mm (0.028 - 0.047 in.). If clearance is incorrect, planetary assembly, thrust bearing or snap ring is not properly seated in case. Remove and reinstall components if necessary.

(11) Install second brake piston sleeve (Fig. 8). Sleeve lip faces up and toward case front as shown.

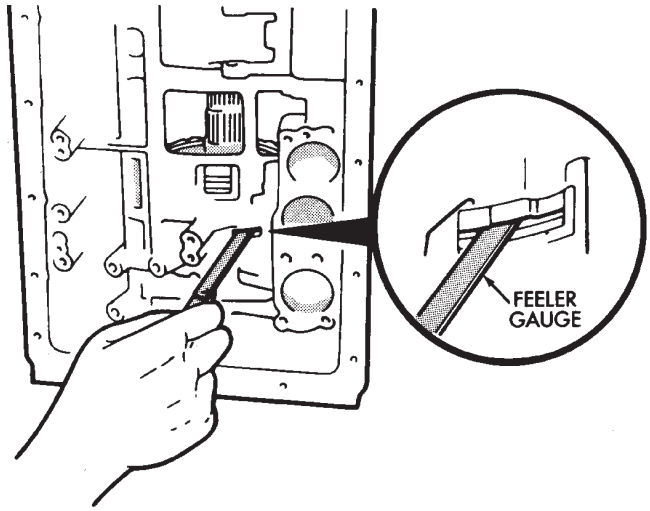


Fig. 7 Checking First-Reverse Brake Pack Clearance

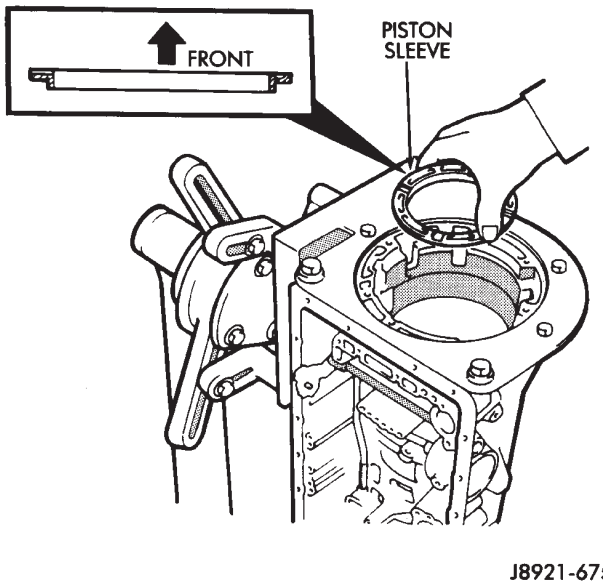


Fig. 8 Installing Second Brake piston Sleeve

(12) Install second brake drum gasket with Installer Tool 7544 (Fig. 9). Gasket depth is 43.7 mm (1.720 in.).

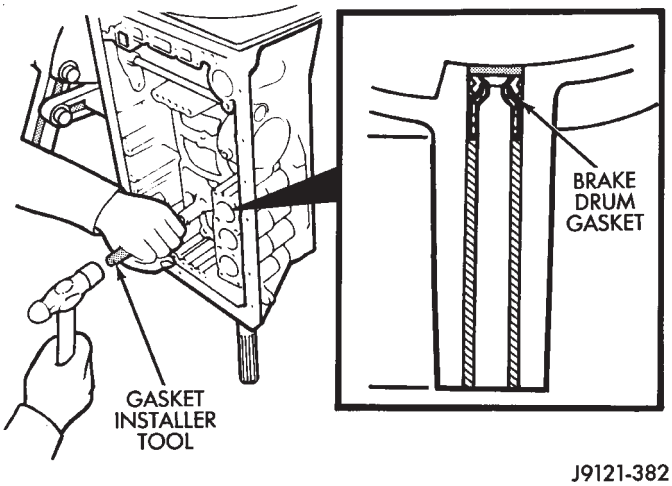


Fig. 9 Installing Second Brake Drum Gasket

(13) Install park lock pawl, spring and pin (Fig. 10).

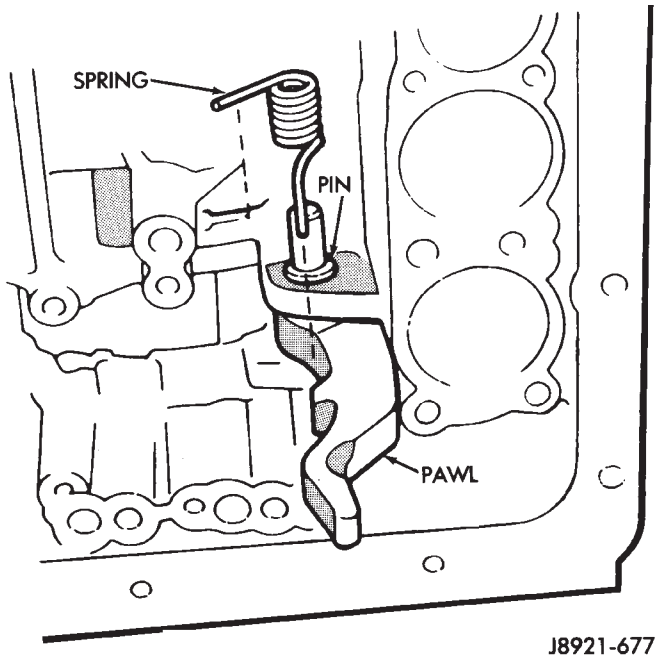


Fig. 10 Installing Park Lock Pin, Spring And Pawl

(14) Connect park lock rod to manual valve shift sector (Fig. 11).

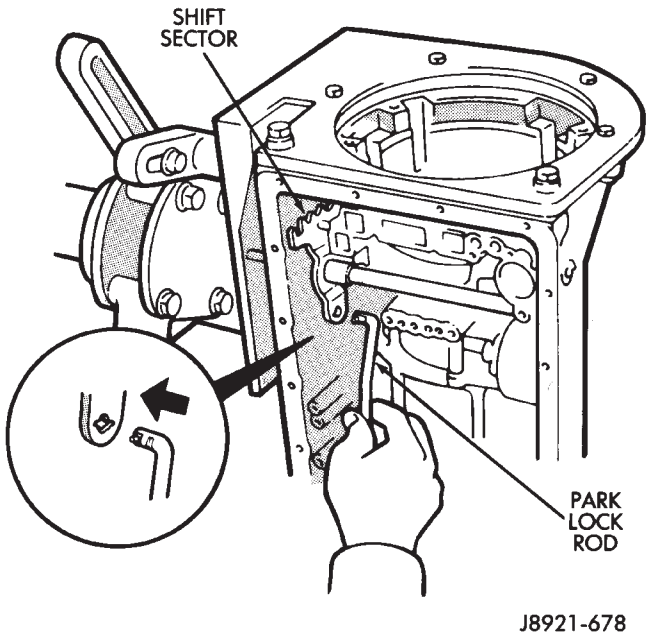


Fig. 11 Installing Park Lock Rod

(15) Position park lock rod bracket on case and tighten bracket attaching bolts to 10 N·m (7 ft. lbs.) torque (Fig. 12).

(16) Verify park lock operation. Move shift sector to Park position. Park pawl should be firmly engaged (locked) in planetary ring gear (Fig. 13).

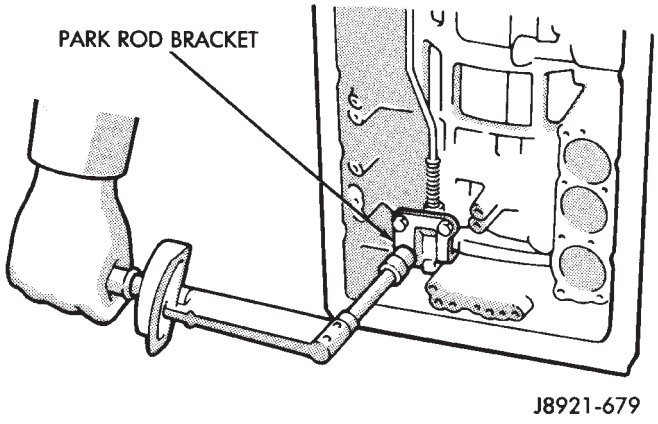


Fig. 12 Installing Park Rod Bracket

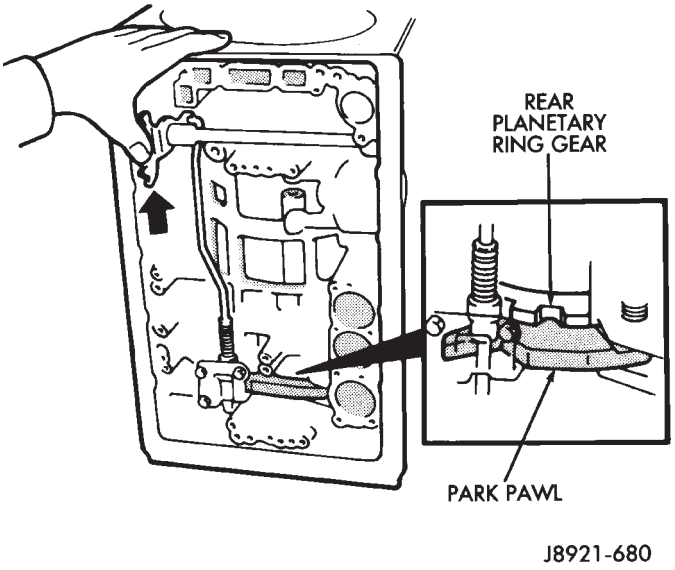


Fig. 13 Checking Park Pawl Engagement

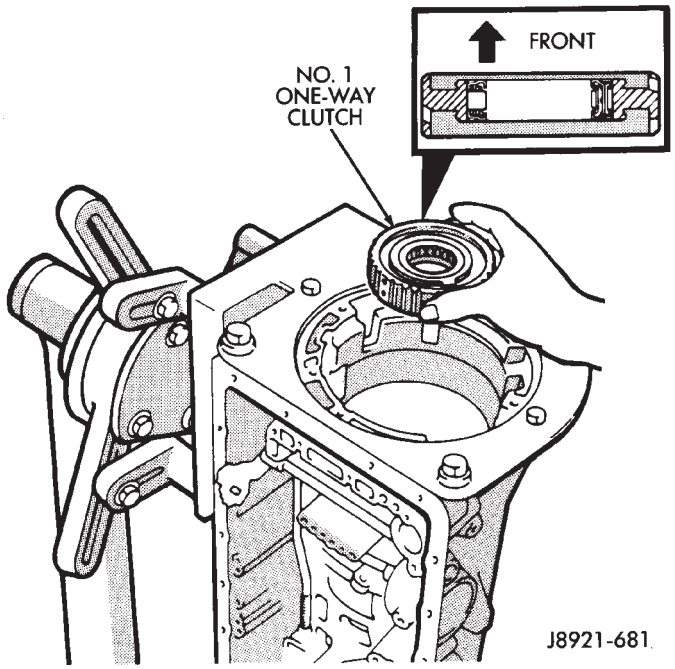


Fig. 14 Installing No. 1 One-Way Clutch

(17) Install No. 1 one-way clutch (Fig. 14). Short flanged side of clutch faces up and toward case front.

(18) Install second brake pack (Fig. 15). Install disc then plate. Continue installation sequence until correct number of discs-plates are installed. Use five discs and five plates.

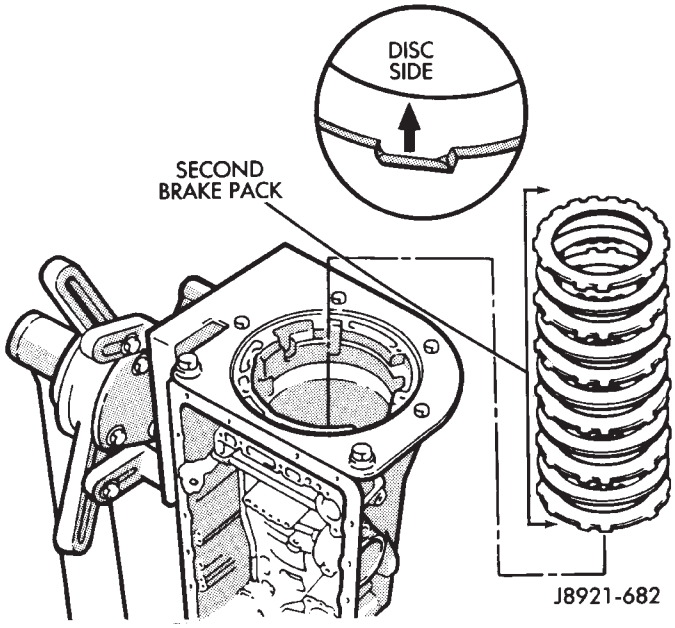


Fig. 15 Installing Second Brake Pack

(19) Install second brake pack retainer with rounded edge of retainer facing disc.

(20) Install second brake pack snap ring.

(21) Check brake pack clearance with feeler gauge (Fig. 16). Clearance should be 0.062 - 1.98 mm (0.024 - 0.078 in.). If brake pack clearance is not correct, brake pack components are not seated. Reassemble brake pack if necessary.

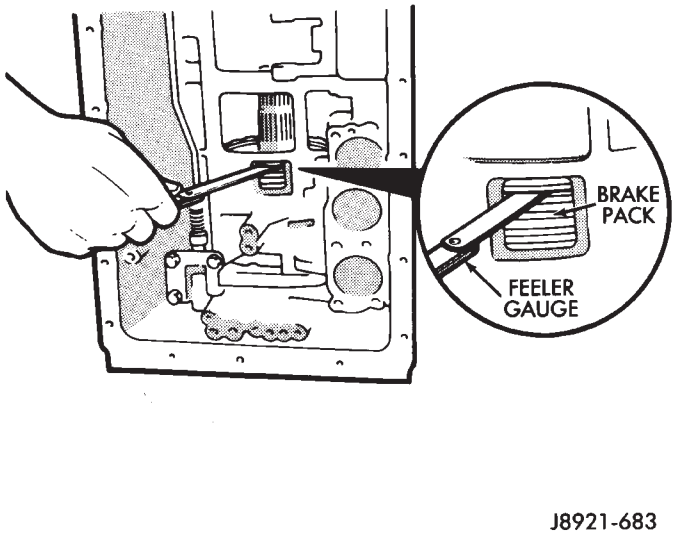


Fig. 16 Checking Second Brake Pack Clearance

(22) Install planetary sun gear and input drum (Fig. 17). Be sure drum thrust washer tabs are seated in drum. Use petroleum jelly to hold thrust washer in position if necessary.

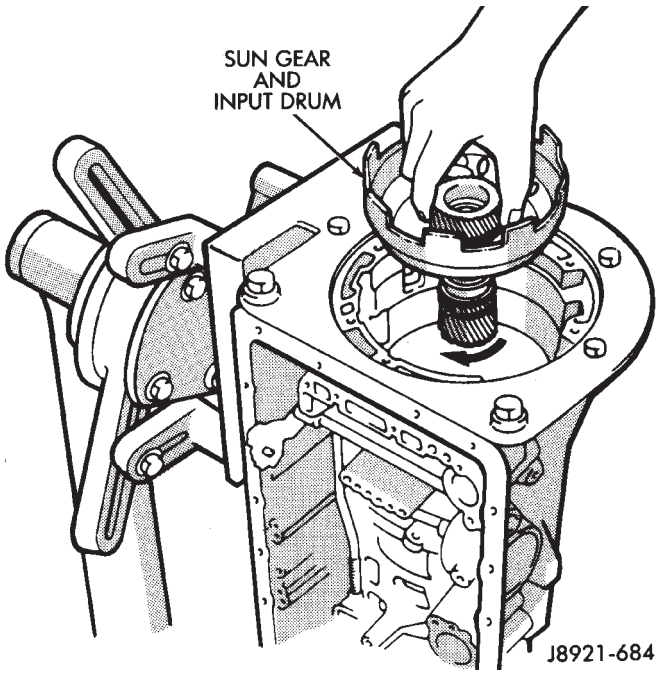


Fig. 17 Installing Sun Gear And Input Drum

(23) Install front planetary gear on sun gear (Fig. 18).

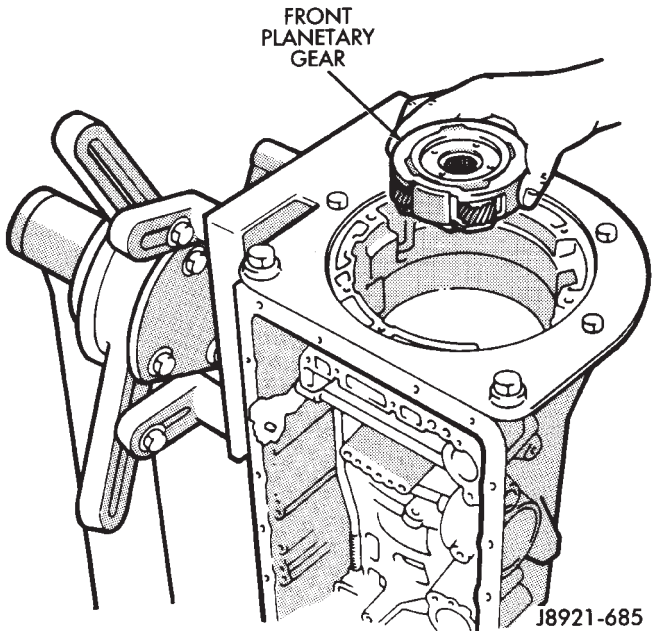


Fig. 18 Installing Front Planetary Gear

(24) Support output shaft with wood blocks (Fig. 19).

(25) Install planetary snap ring on sun gear with snap ring plier tool 7541 (Fig. 20).

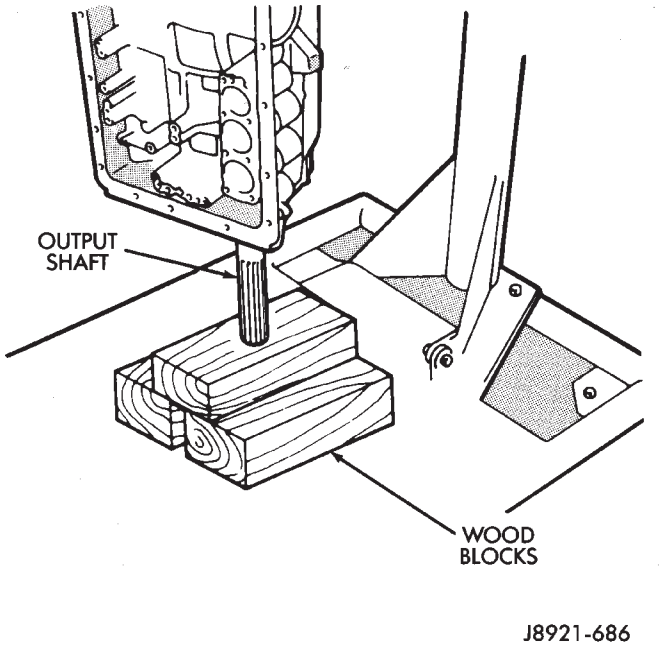


Fig. 19 Supporting Output Shaft

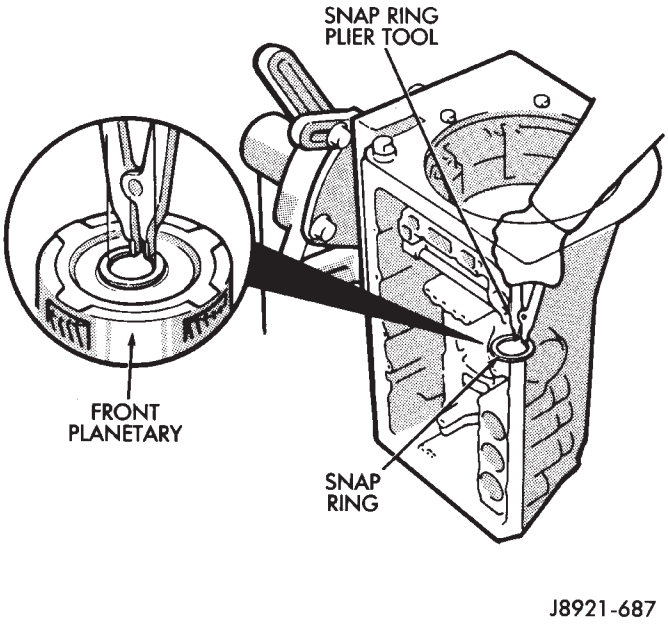


Fig. 20 Installing Front Planetary Snap Ring

(26) Install tabbed thrust race on front planetary gear (Fig. 21). Washer tabs face down and toward gear. Race outer diameter is 47.8 mm (1.882 in.). Inside diameter is 34.3 mm (1.350 in.).

(27) Install second coast brake band (Fig. 22).

(28) Install pin in second coast brake band. Then install retaining ring on pin (Fig. 23).

(29) Install thrust bearing and race in forward-direct clutch (Fig. 24). Coat bearing/race with petroleum jelly to hold them in place.

(30) Verify forward-direct clutch thrust bearing size.

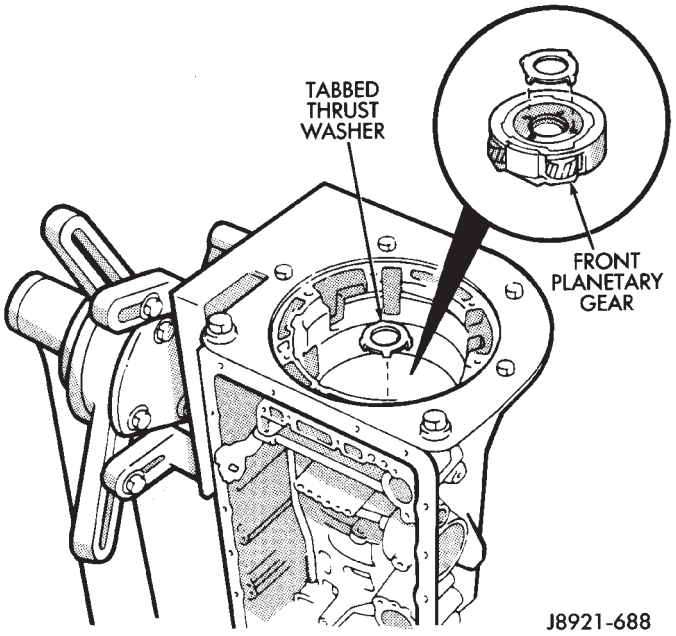


Fig. 21 Installing Planetary Thrust Race

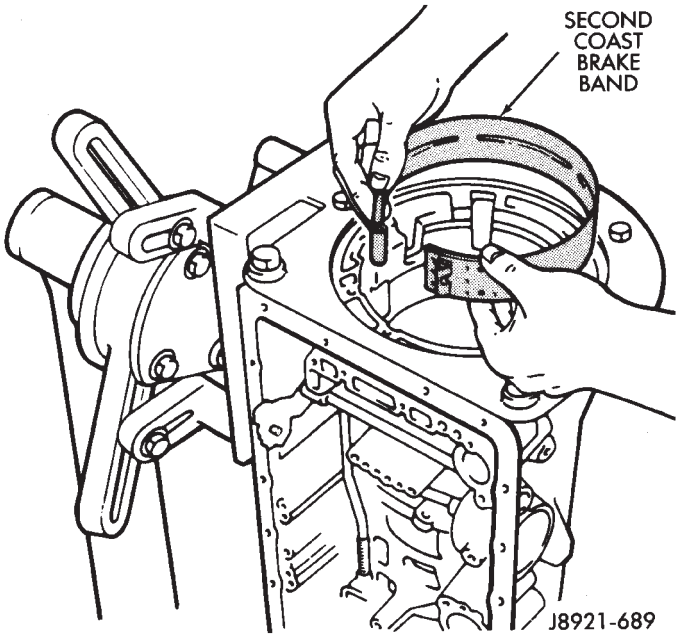


Fig. 22 Installing Second Coast Brake Band

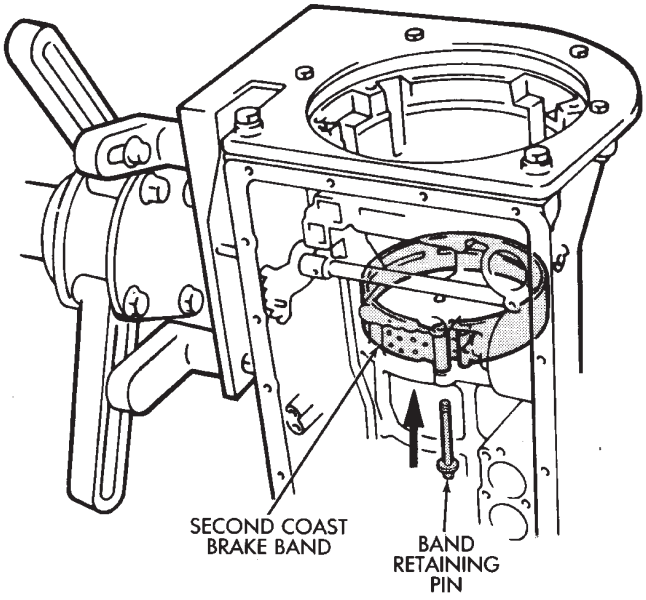
- Race outer diameter is 48.9 mm (1.925 in.) and inside diameter is 26.0 mm (1.024 in.).
- Bearing outer diameter is 46.7 mm (1.839 in.) and inside diameter is 26.0 mm (1.024 in.).

(31) Coat front planetary ring gear race with petroleum jelly and install it in ring gear (Fig. 25).

(32) Verify ring gear race size. Outer diameter is 47.0 mm (1.850 in.) and inside diameter is 26.5 mm (1.045 in.).

(33) Align forward-direct clutch disc splines with screwdriver (Fig. 26).

(34) Align and install front planetary ring gear in forward-direct clutch (Fig. 27).



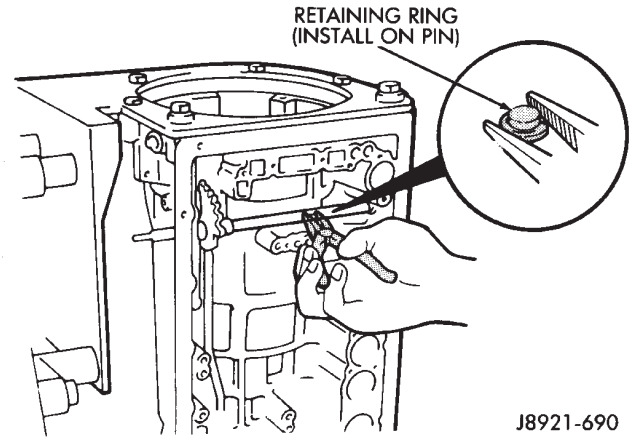


Fig. 23 Installing Second Coast Brake Band Retaining Pin

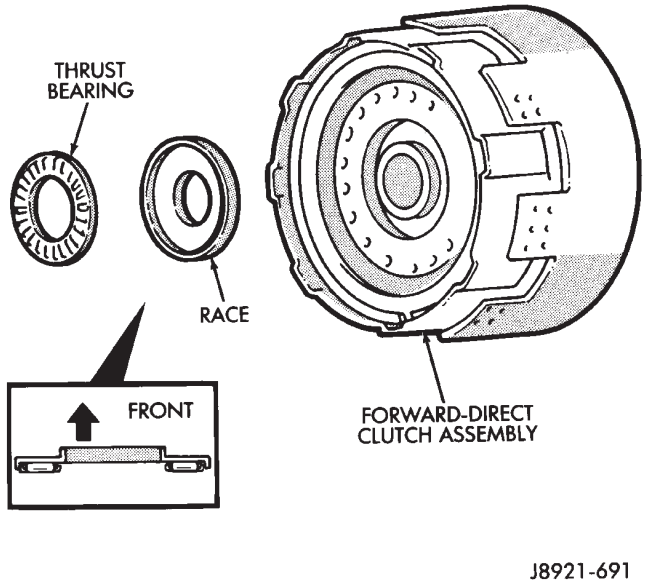


Fig. 24 Installing Forward-Direct Clutch Thrust Bearing And Race

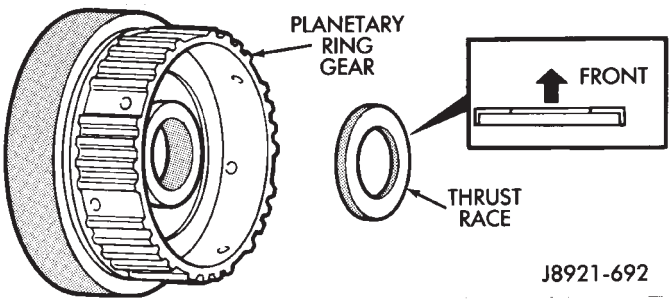


Fig. 25 Installing Planetary Ring Gear Race

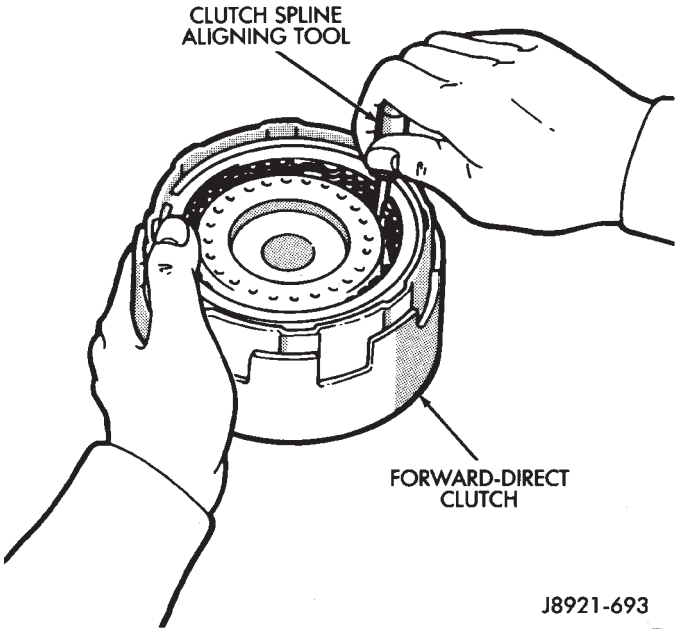


Fig. 26 Aligning Forward-Direct Clutch Splines

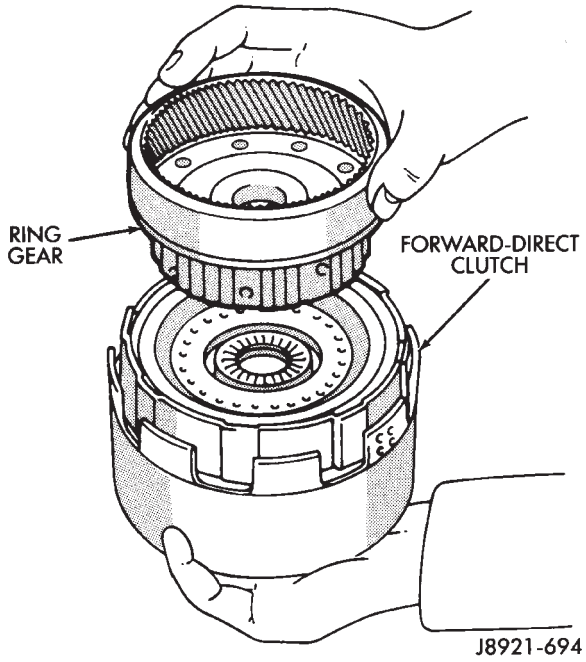


Fig. 27 Installing Front Planetary Ring Gear

(35) Coat bearing and race with petroleum jelly and install them in ring gear (Fig. 28). Verify bearing/race size.

- Bearing outer diameter is 47.7 mm (1.878 in.) and inside diameter is 32.6 mm (1.283 in.).
- Race outer diameter is 53.6 mm (2.110 in.) and inside diameter is 30.6 mm (1.205 in.).

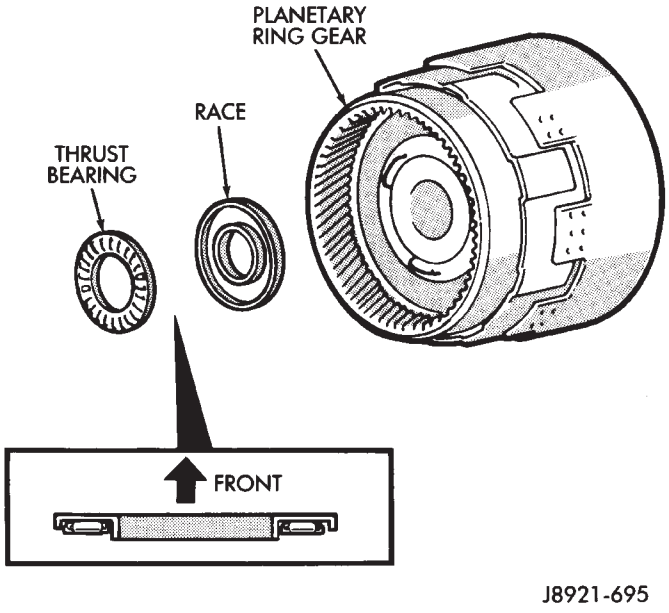


Fig. 28 Installing Ring Gear Bearing And Race

(36) Rotate front of transmission case downward and install assembled planetary gear/forward-direct clutch (Fig. 29).

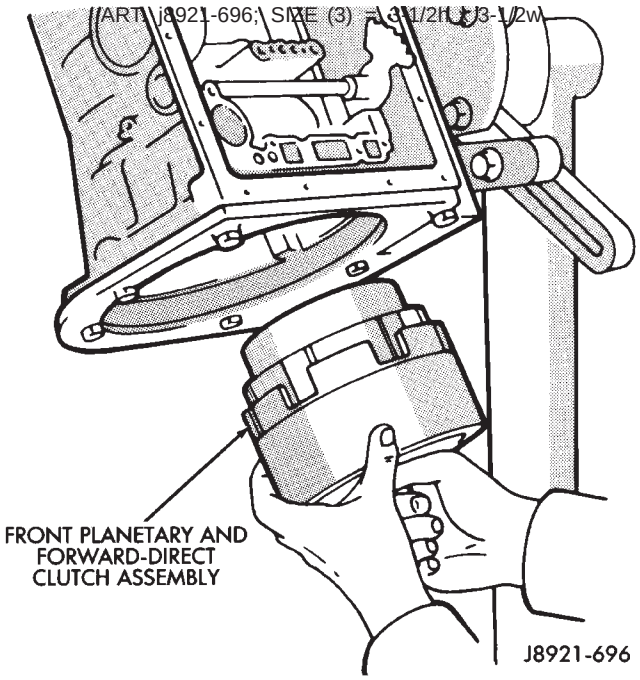


Fig. 29 Installing Front Planetary And Forward-Direct Clutch Assembly

(37) Check clearance between sun gear input drum and direct clutch drum (Fig. 30). Clearance should be 9.8 - 11.8 mm (0.386 - 0.465 in.). If clearance is incorrect, planetary gear/forward-direct clutch assembly is not seated or is improperly assembled. Remove, and correct if necessary.

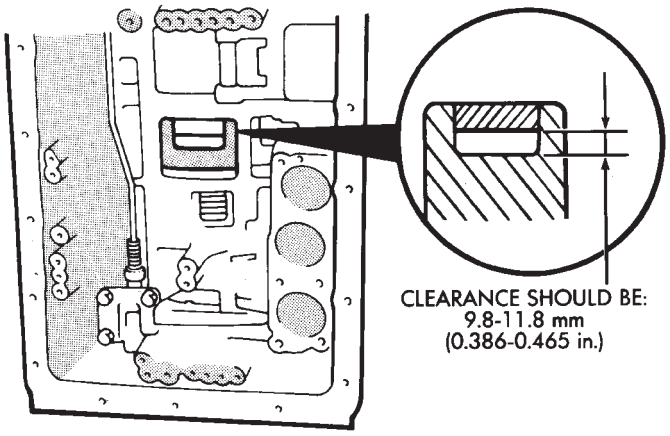


Fig. 30 Checking Input Drum-To-Direct Clutch Drum Clearance

(38) Coat thrust bearing and race assembly with petroleum jelly and install it on clutch shaft. Bearing faces up and toward case front as shown (Fig. 31). Verify bearing/race size. Bearing and race outer diameter is 47.8 mm (1.882 in.) and inside diameter is 33.6 mm (1.301 in.).

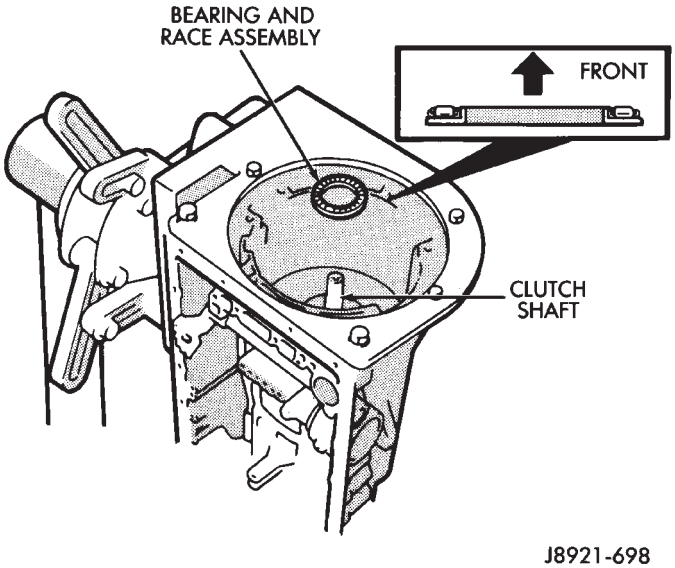


Fig. 31 Installing Clutch Shaft Thrust Bearing And Race Assembly

(39) Assemble second coast brake piston components (Fig. 32).

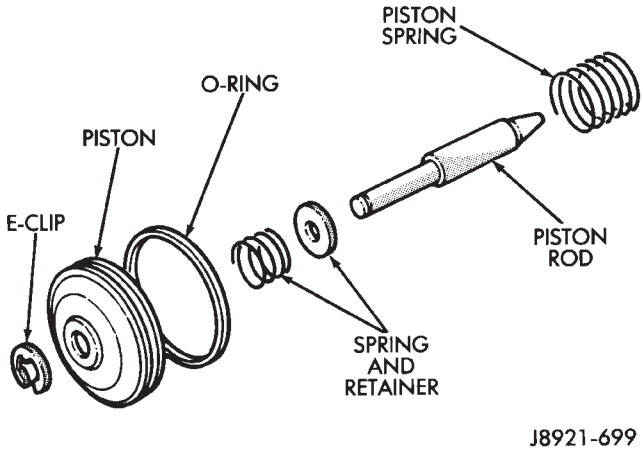


Fig. 32 Assembling Second Coast Brake Piston

(40) Install assembled second coast brake piston in case.

(41) Install replacement seals on second coast brake piston cover and install cover in case.

(42) Install second coast brake piston snap ring with snap ring plier tool (Fig. 33).

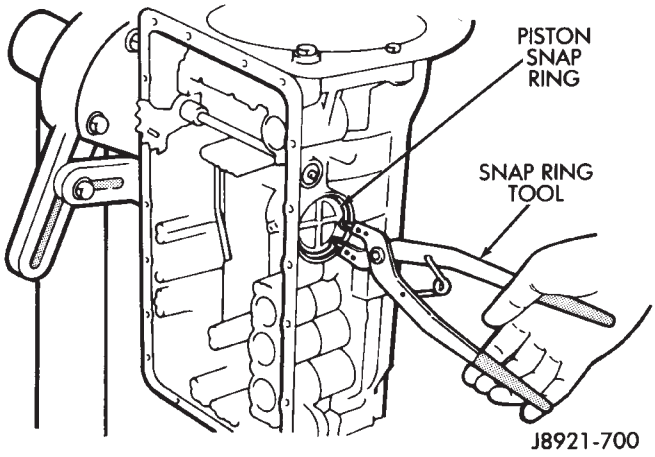


Fig. 33 Installing Second Coast Brake Piston Snap Ring

(43) Check second coast brake piston stroke as follows:

(a) Make reference mark on brake piston rod (Fig. 34).

(b) Apply 57-114 psi air pressure through feed hole (Fig. 34). Alternately apply and release air pressure to operate piston.

(c) Check stroke with gauge 7552 (Fig. 35).

(d) If stroke length is incorrect, piston, cover or snap ring is not seated. Reassemble and check stroke again if necessary.

(44) Coat thrust race and tabbed washer with petroleum jelly and install them on overdrive support (Fig. 36). Verify race size. Race outer diameter is 50.9 mm (2.004 in.) and inside diameter is 36.2 mm (1.426 in.).

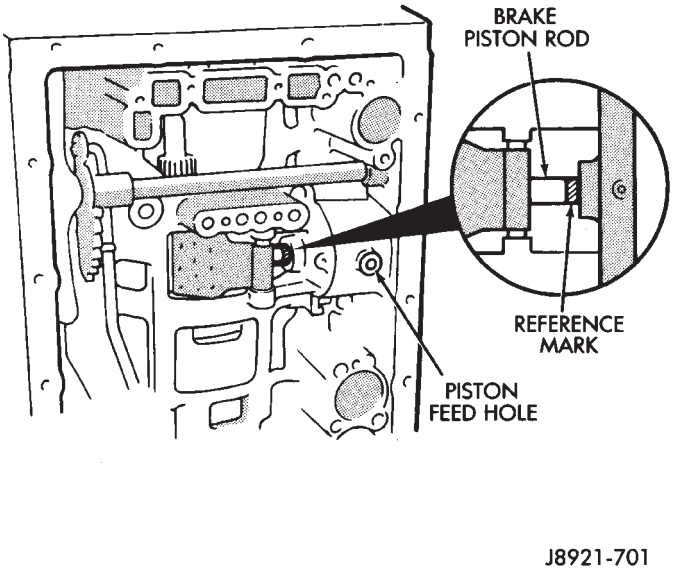


Fig. 34 Marking Brake Piston Rod

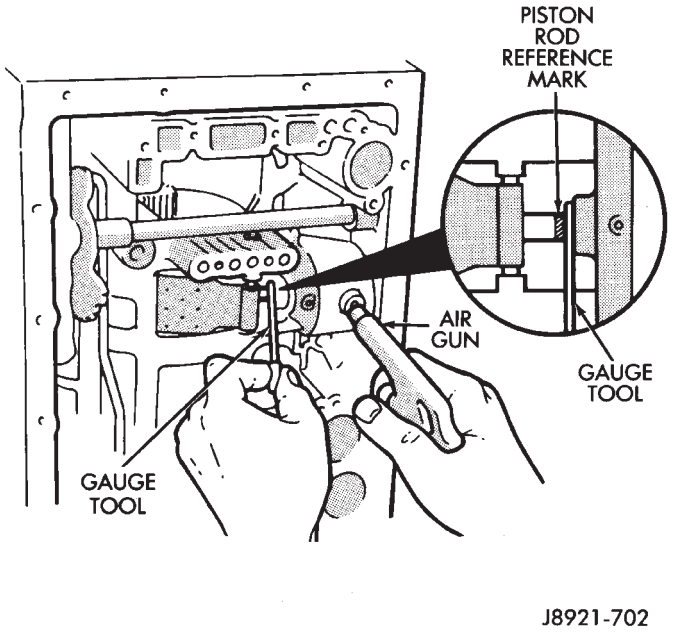


Fig. 35 Checking Second Coast Brake Piston Stroke

(45) Install overdrive support in case. Use two long bolts to help align and guide support into position (Fig. 37).

(46) Install overdrive support snap ring with Snap Ring Plier Tool 7540 (Fig. 38). Chamfered side of snap ring faces up and toward case front. **Snap ring ends must be aligned with case opening with ring ends approximately 24 mm (0.94 in.) from centerline of case opening.**

(47) Install and tighten overdrive support bolts to 25 N·m (19 ft-lbs) torque (Fig. 39).

(48) Check output shaft end play with dial indicator (Fig. 40). End play should be 0.27 - 0.86 mm (0.0106 - 0.0339 in.).

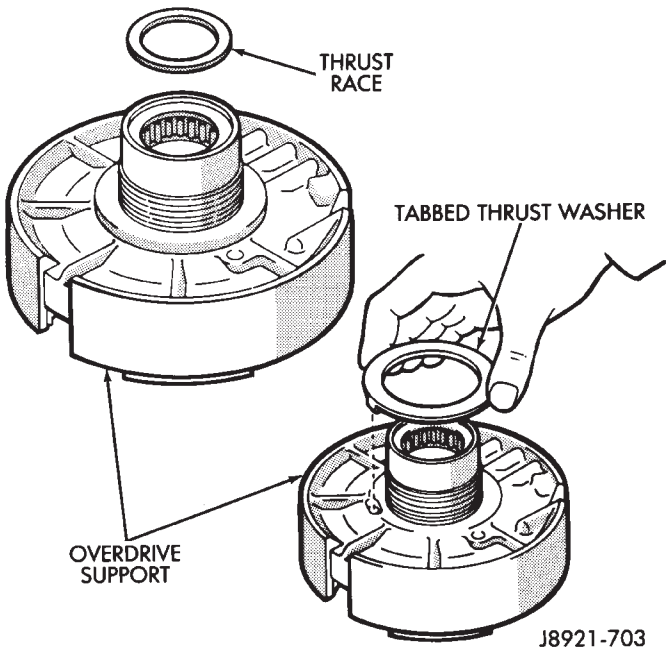


Fig. 36 Installing Overdrive Support Thrust Race And Washer

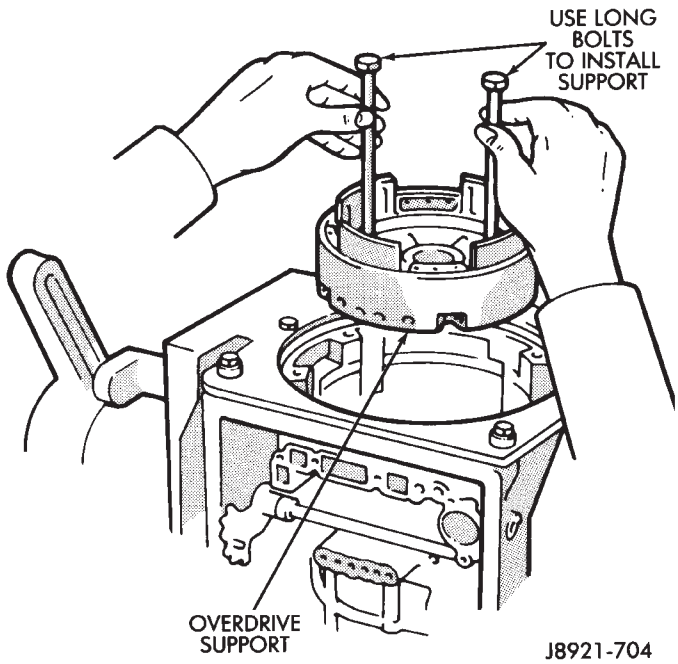


Fig. 37 Installing Overdrive Support

(49) If output shaft end play is incorrect, one or more of installed components is not seated. Reassemble as necessary and check end play again.

(50) Install overdrive clutch pack (Fig. 41). Install thickest clutch plate first. Rounded edge of plate faces up. Install first disc followed by another plate until correct number of discs-plates are installed. Install four discs and three plates.

(51) Install stepped ring retainer plate with flat side facing disc. Then install brake pack snap ring (Fig. 42).

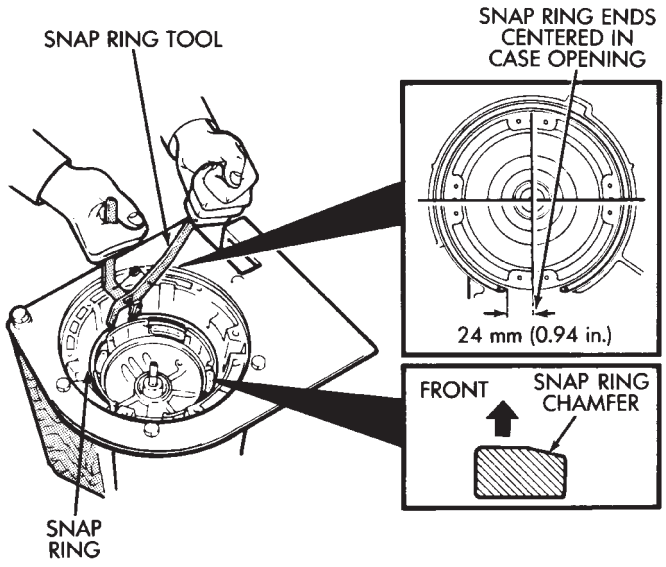


Fig. 38 Installing Overdrive Support Snap Ring

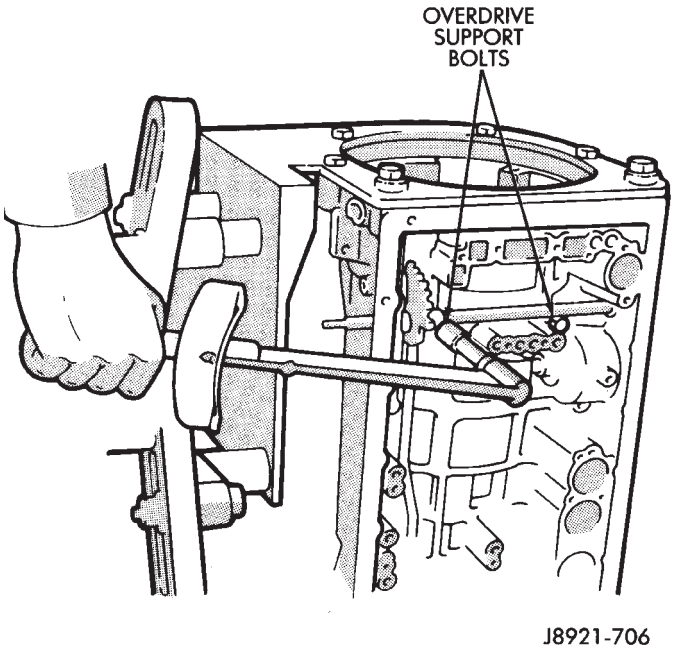


Fig. 39 Installing Overdrive Support Bolts

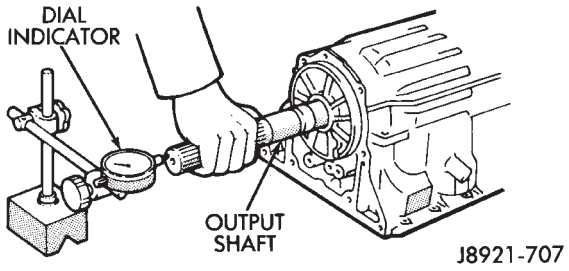


Fig. 40 Checking Output Shaft End Play

(52) Check overdrive brake piston stroke as follows:

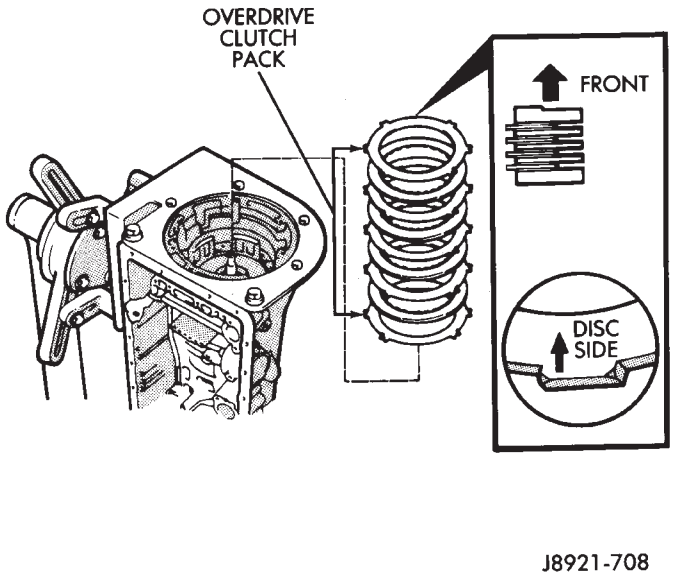


Fig. 41 Install Overdrive Clutch Pack

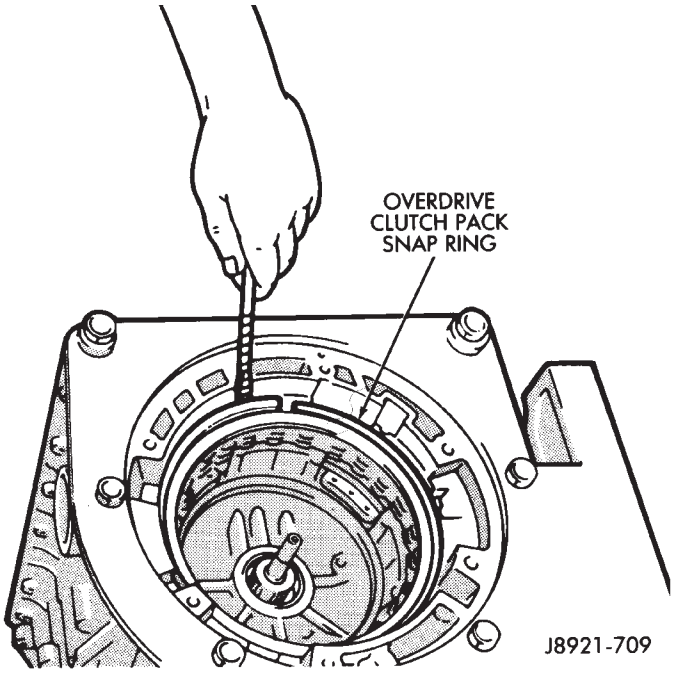


Fig. 42 installing Overdrive Brake Snap Ring

(a) Mount Gauge 7546 in dial indicator and position gauge tool against overdrive brake piston (Fig. 43).

(b) Apply and release overdrive brake piston with compressed air and note piston stroke length on dial indicator. Apply air pressure through feed hole in case (Fig. 44).

(c) Piston stroke length should be 1.40 - 1.70 mm (0.55 - 0.66 in.).

(d) If stroke is incorrect, brake pack or piston is installed incorrectly. Check and correct as necessary and measure piston stroke again.

(53) Remove dial indicator and gauge tool.

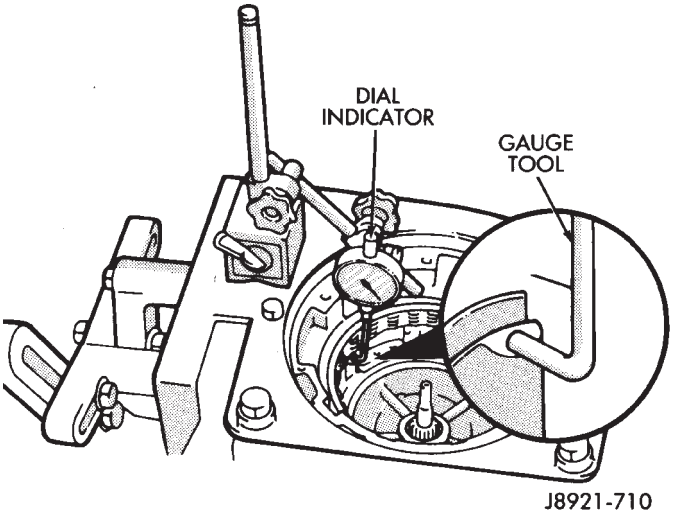


Fig. 43 Positioning Gauge Tool And Dial Indicator

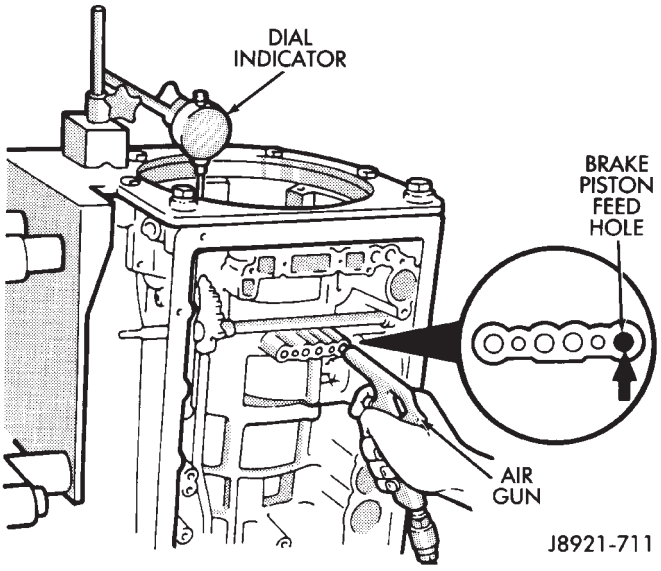


Fig. 44 Checking Overdrive Brake Piston Stroke

(54) Remove overdrive brake piston snap ring and remove overdrive clutch pack components.

(55) Coat overdrive lower race, thrust bearing and upper race with petroleum jelly and install them in overdrive support (Fig. 45). Be sure races and bearing are assembled and installed as shown.

(56) Verify bearing/race sizes before proceeding. Bearing-race sizes are:

- Outer diameter of lower race is 47.8 mm (1.882 in.) and inside diameter is 34.3 mm (1.350 in.).
- Outer diameter of bearing is 47.7 mm (1.878 in.) and inside diameter is 32.7 mm (1.287 in.).
- Outer diameter of upper race is 47.8 mm (1.882 in.) and inside diameter is 30.7 mm (1.209 in.).

(57) Install overdrive planetary ring gear in support (Fig. 46).

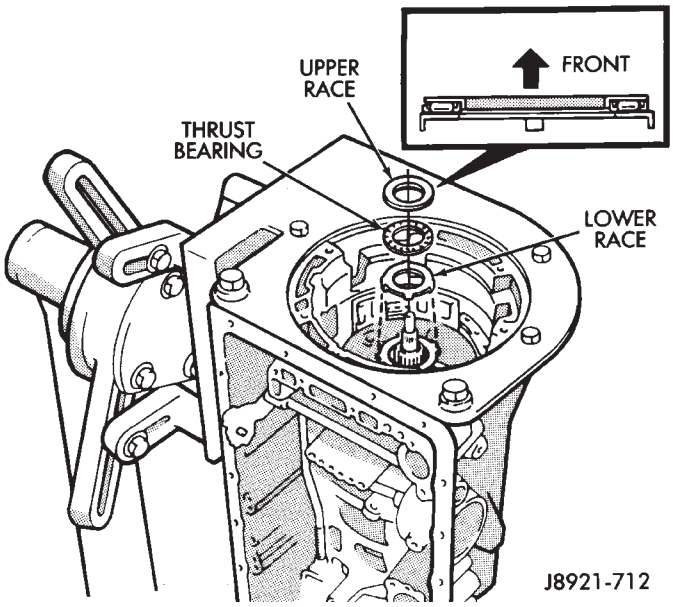


Fig. 45 Installing Overdrive Support Thrust Bearing And Races

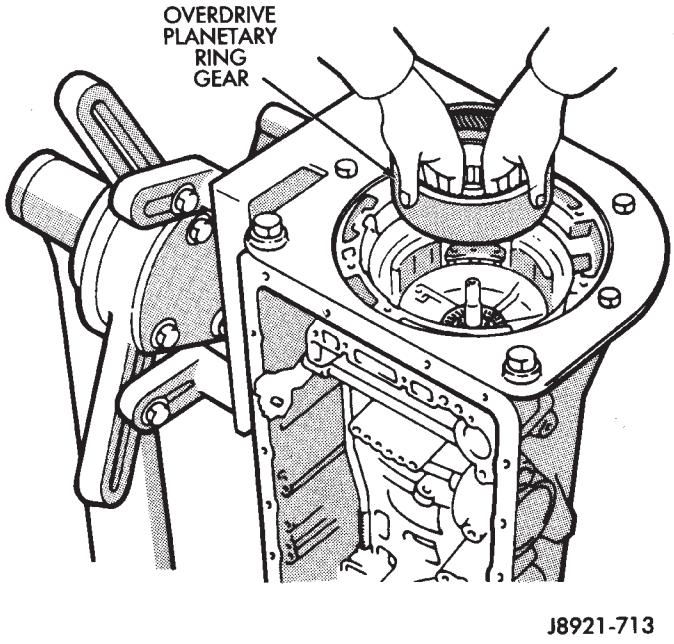


Fig. 46 Installing Overdrive Planetary Ring Gear

(58) Coat ring gear thrust race and thrust bearing assembly with petroleum jelly and install them in gear (Fig. 47).

(59) Verify bearing/race size before proceeding.

- Outer diameter of ring gear race-bearing is 47.8 mm (1.882 in.) and inside diameter is 24.2 mm (0.953 in.).

• Outer diameter of bearing is 46.8 mm (1.844 in.) and inside diameter is 26.0 mm (1.024 in.).

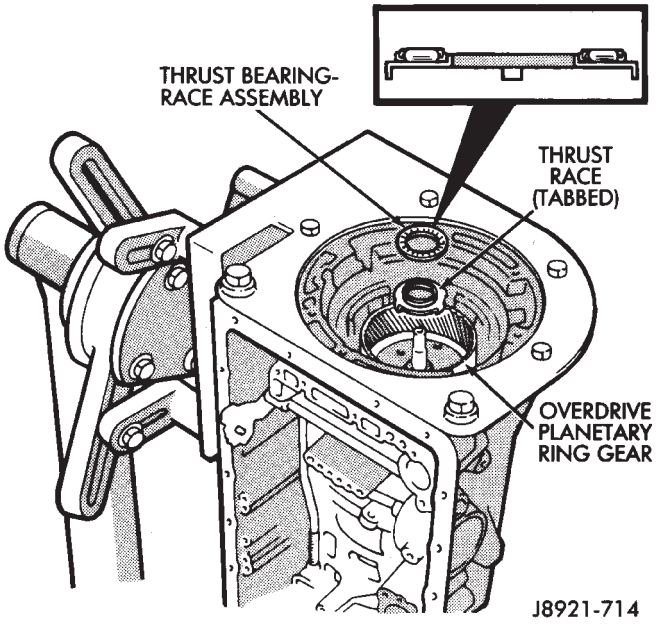


Fig. 47 Installing Ring Gear Thrust Bearing And Race

(60) Coat tabbed thrust race with petroleum jelly and install it on planetary gear (Fig. 48). Race outer diameter is 41.8 mm (1.646 in.) and inside diameter is 27.1 mm (1.067 in.).

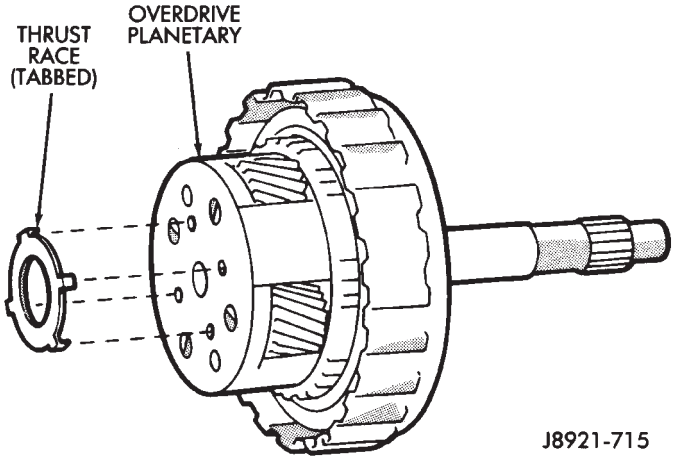


Fig. 48 Installing Planetary thrust Race

(61) Install assembled overdrive planetary gear and clutch (Fig. 49).

(62) Coat thrust bearing and race assembly with petroleum jelly and install it on clutch input shaft (Fig. 50). Bearing and race outer diameter is 50.2 mm (1.976 in.) and inside diameter is 28.9 mm (1.138 in.).

(63) Install overdrive brake pack as follows:

(a) Install 4.0 mm (0.157 in.) thick plate first. Rounded edge of plate must face upward.

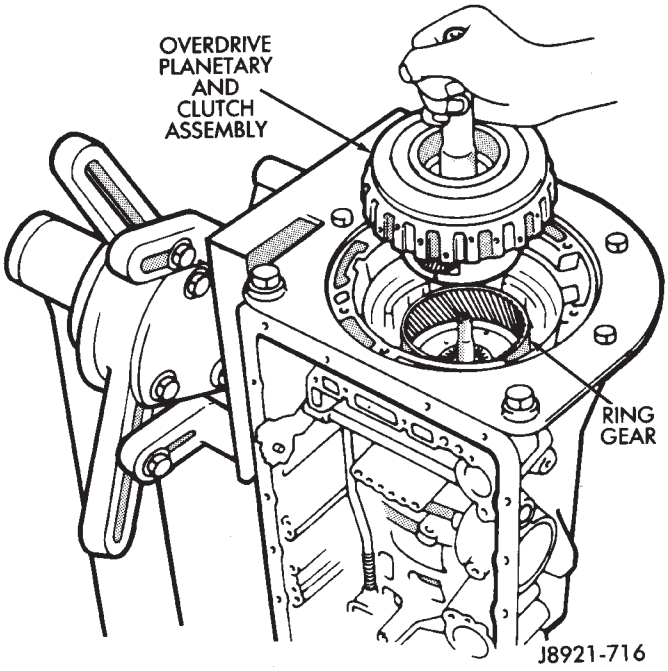


Fig. 49 Installing Overdrive Planetary And Clutch Assembly

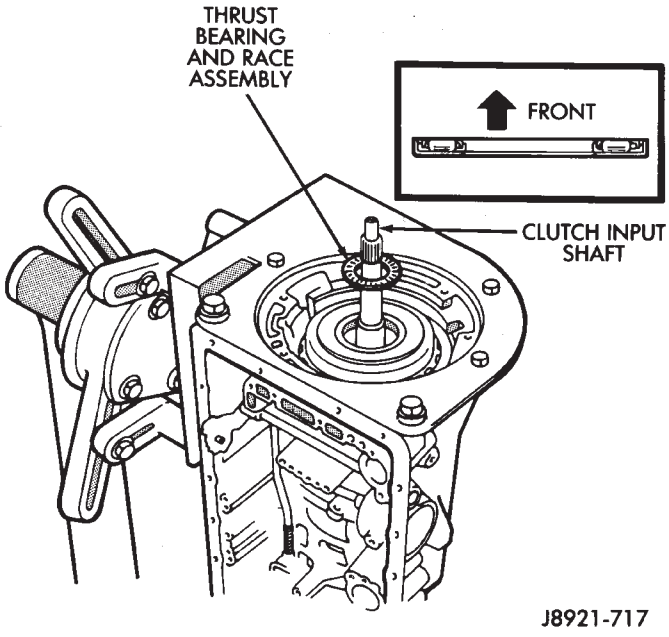


Fig. 50 Installing Input Shaft Thrust Bearing And Race Assembly

(b) Install a disc followed by a plate until the required number of discs and plates are installed. Be sure to install the stepped plate last with the flat side of the plate facing the disc (Fig. 51).

(c) Confirm that four discs and three plates have been installed.

(64) Install clutch pack snap ring (Fig. 52).

(65) Coat thrust bearing race with petroleum jelly and install it in oil pump (Fig. 53). Bearing race

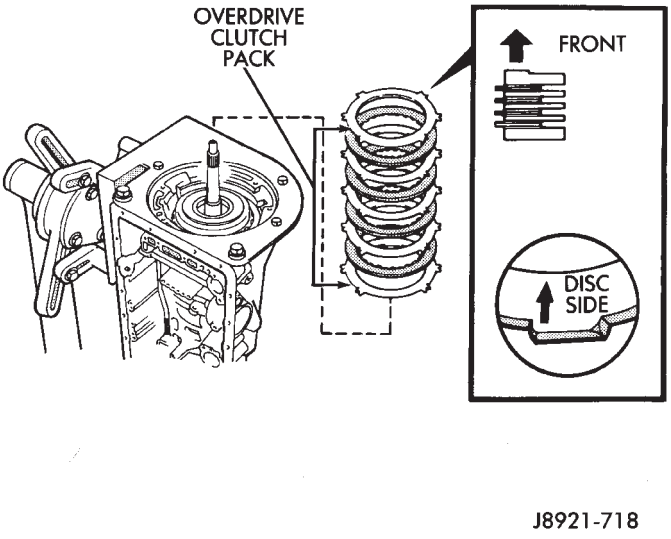


Fig. 51 Installing Overdrive Clutch Pack

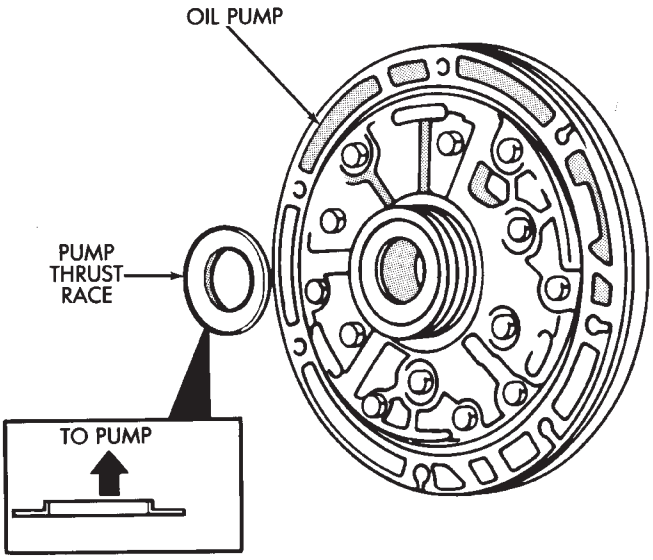


Fig. 53 Installing Oil Pump Thrust Race

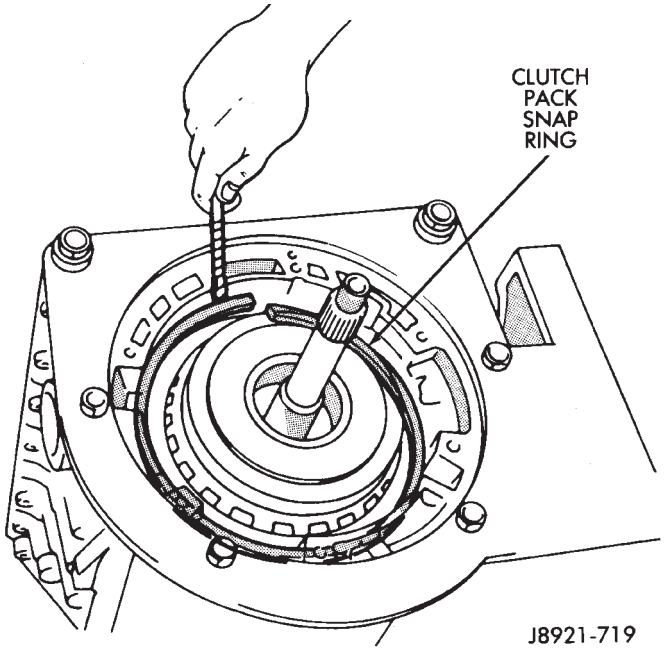


Fig. 52 Installing Clutch Pack Snap Ring

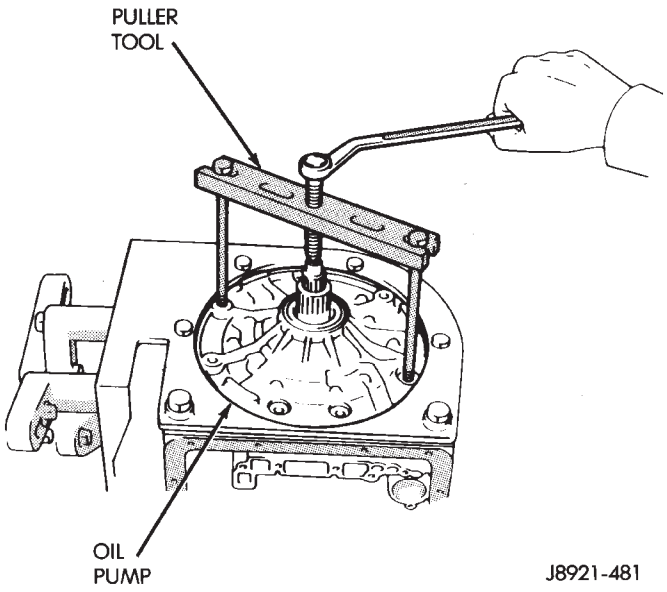


Fig. 54 Installing Oil Pump

outer diameter is 47.2 mm (1.858 in.) and inside diameter is 28.1 mm (1.106 in.).

(66) Lubricate and install replacement O-ring on oil pump body.

(67) Install oil pump in case. Align pump and case bolt holes and carefully ease pump into place (Fig. 54).

CAUTION: Do not use force to seat the pump. The seal rings on the stator shaft could be damaged if they bind or stick to the direct clutch drum.

(68) Tighten oil pump bolts to 22 N·m (16 ft. lbs.) torque.

(69) Verify input shaft rotation. Shaft should rotate smoothly and not bind.

(70) Lubricate and install new O-ring on transmission throttle cable adapter and install cable in case (Fig. 55).

(71) Check clutch and brake operation. Operate clutches and brakes with compressed air applied through feed holes in case (Fig. 56). Listen for clutch and brake application. If you do not hear a clutch or brake apply, disassemble transmission and repair fault before proceeding. **It is necessary to block the overdrive clutch accumulator feed hole No. 8 (Fig. 56) in order to check direct clutch operation.**

(72) Lubricate and install new O-rings on accumulator pistons (Fig. 57).

(73) Assemble and install accumulator pistons and springs (Fig. 57).

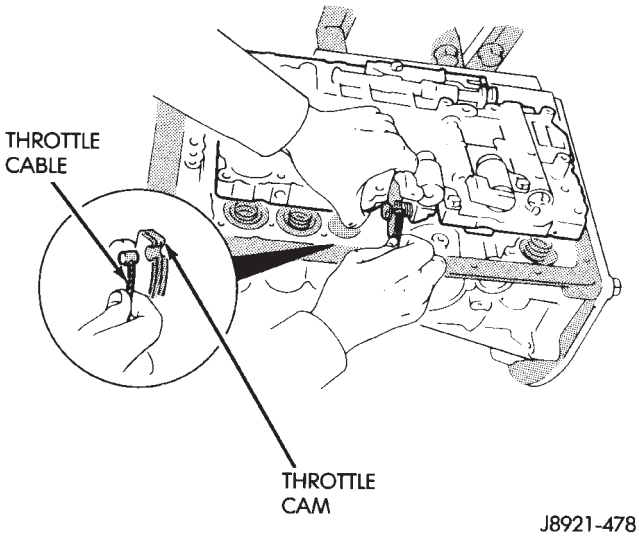
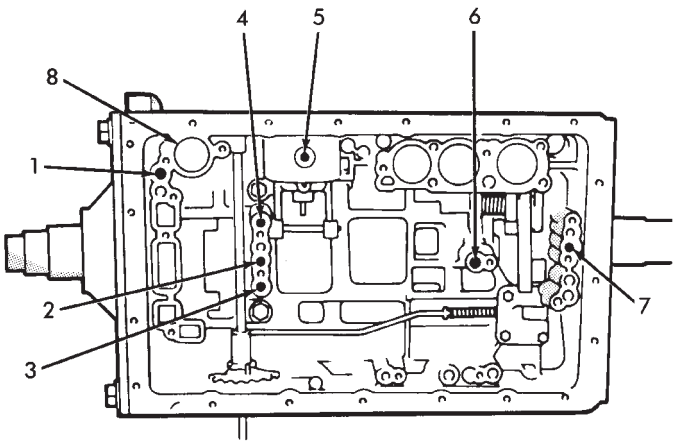


Fig. 55 Installing Transmission Throttle Cable



1. OVERDRIVE DIRECT CLUTCH FEED
2. DIRECT CLUTCH FEED
3. FORWARD CLUTCH FEED
4. OVERDRIVE BRAKE FEED
5. SECOND COAST BRAKE FEED
6. SECOND BRAKE FEED
7. FIRST-REVERSE BRAKE FEED
8. OVERDRIVE CLUTCH ACCUMULATOR PISTON HOLE (BLOCK THIS HOLE WHEN CHECKING DIRECT CLUTCH OPERATION)

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Fig. 56 Clutch And Brake Feed Hole Locations

(74) Install new check ball body and spring (Fig. 58).

(75) Position valve body on case (Fig. 59).

(76) Install detent spring (Fig. 59).

(77) Align manual valve, detent spring and shift sector (Fig. 59).

(78) Connect transmission throttle cable to throttle valve cam (Fig. 60).

(79) Install and tighten valve body-to-case bolts to 10 N·m (7 ft. lbs.) torque.

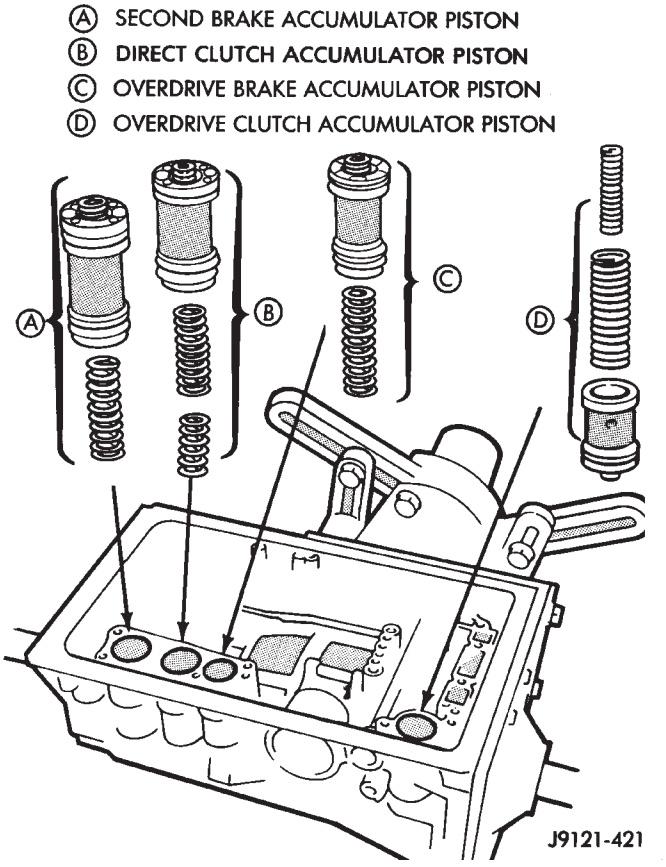

Fig. 57 Accumulator Piston And Spring Installation

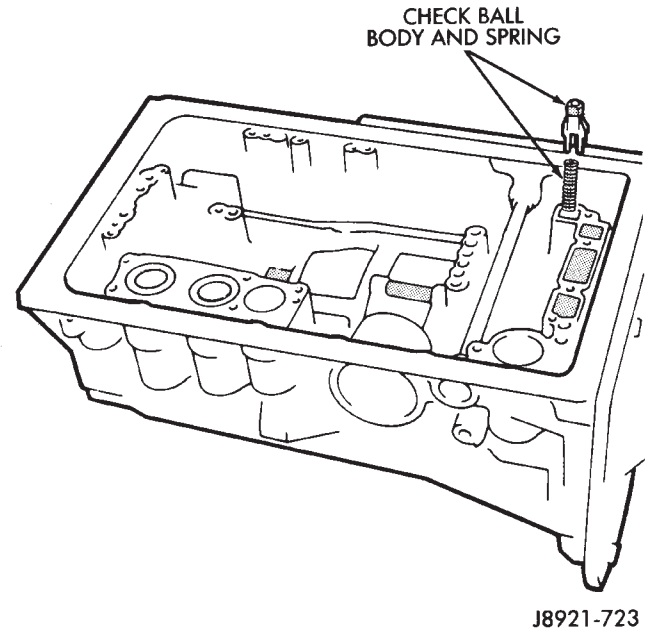

Fig. 58 Installing Check Ball Body And Spring

(80) Connect valve body solenoid wires to solenoids (Fig. 61).

(81) Install new O-ring on solenoid harness adapter and secure adapter to case.

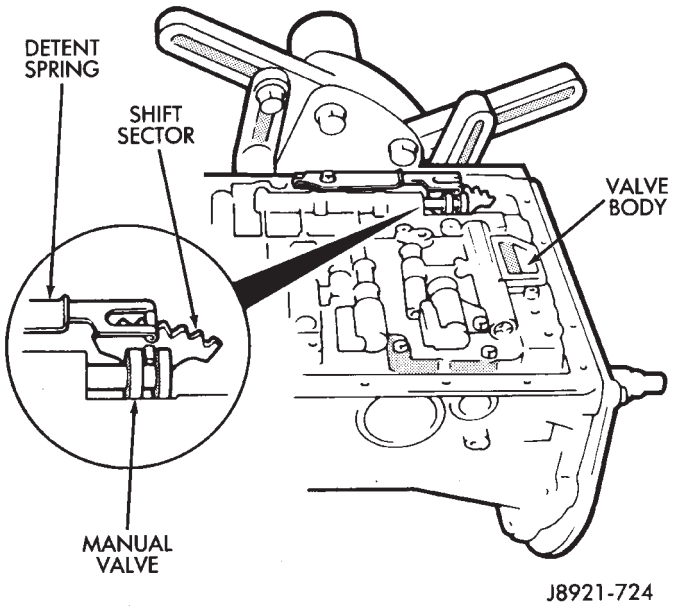

Fig. 59 Aligning Manual Valve, Shift Sector And Detent Spring

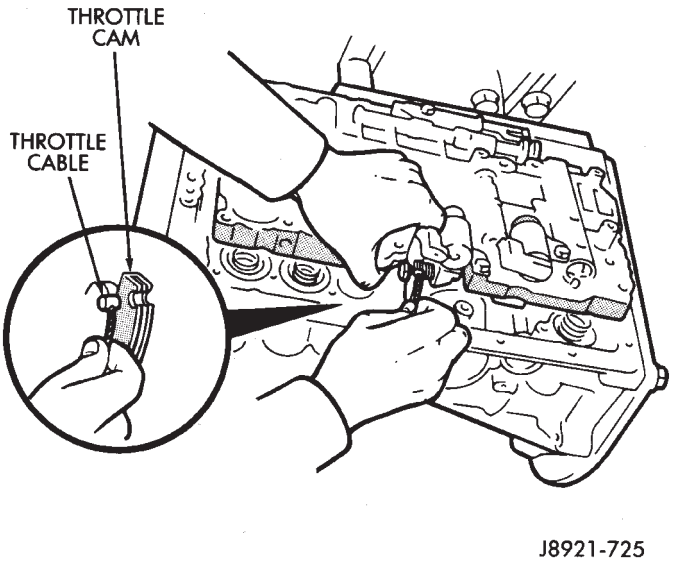

Fig. 60 Connecting Transmission Throttle Cable

(82) Install valve body oil tubes (Fig. 62). Tap tubes into place with a plastic mallet. Be sure the flanged tube ends and straight tube ends are installed as shown.

(83) Install new gaskets on oil screen and install screen on valve body. Tighten screen bolts to 10 N·m (7 ft. lbs.) torque.

(84) Install magnet in oil pan. Be sure magnet does not interfere with valve body oil tubes.

(85) Apply Mopar or Loctite 599 to sealing surface of oil pan. Sealer bead should be at least 3 mm (1/8 in.) wide. Install pan on case and tighten pan bolts to 7 N·m (65 in. lbs.) torque.

(86) Install transmission speed sensor rotor and key on output shaft (Fig. 63).

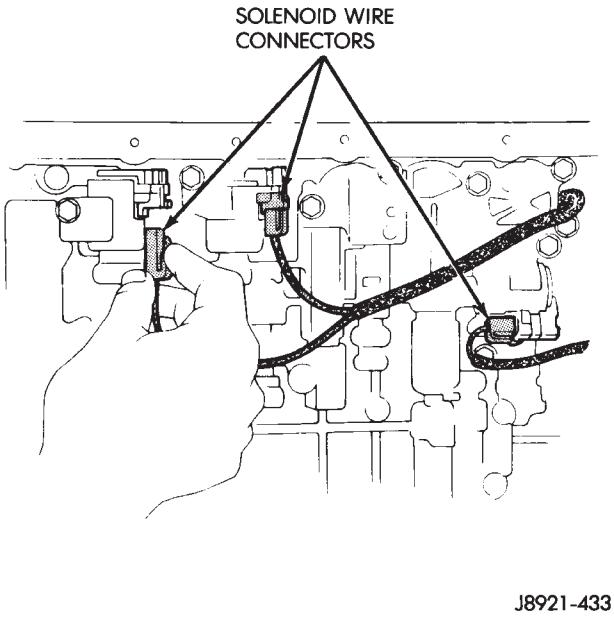

Fig. 61 Connecting Valve Body Solenoid Wires

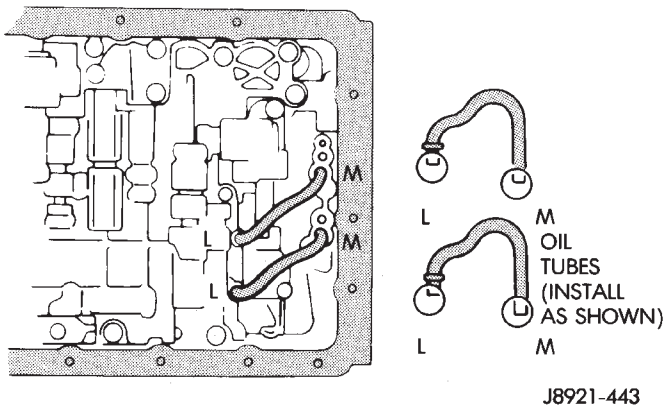

Fig. 62 Installing Valve Body Oil Tubes

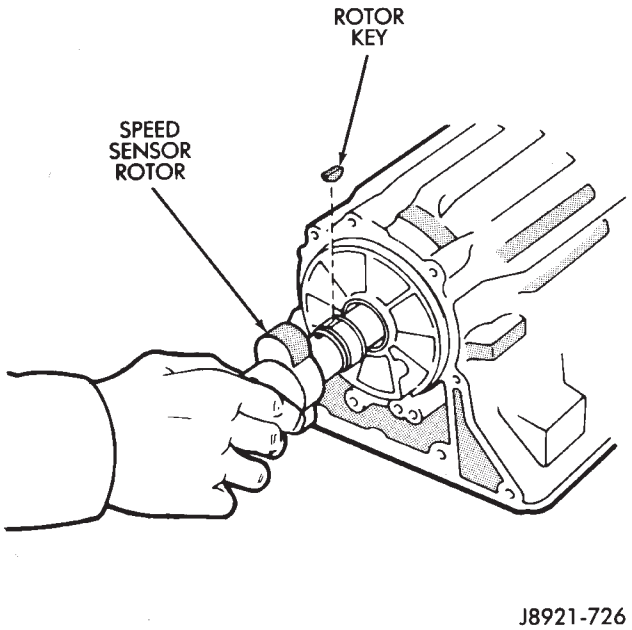

Fig. 63 Installing Transmission Speed Sensor Rotor And Key

(87) Install spacer and speedometer drive gear on output shaft. Then install retaining snap ring (Fig. 64).

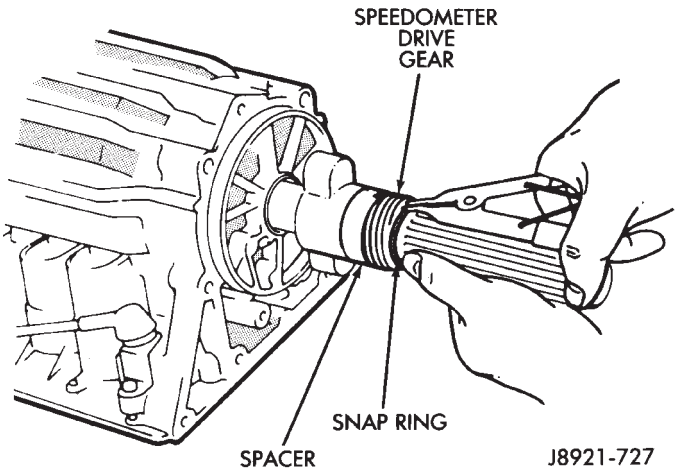

Fig. 64 Installing Spacer And Speedometer Drive Gear

(88) Apply bead of Mopar or Loctite 599 sealer to sealing surface at rear of case (Fig. 65).

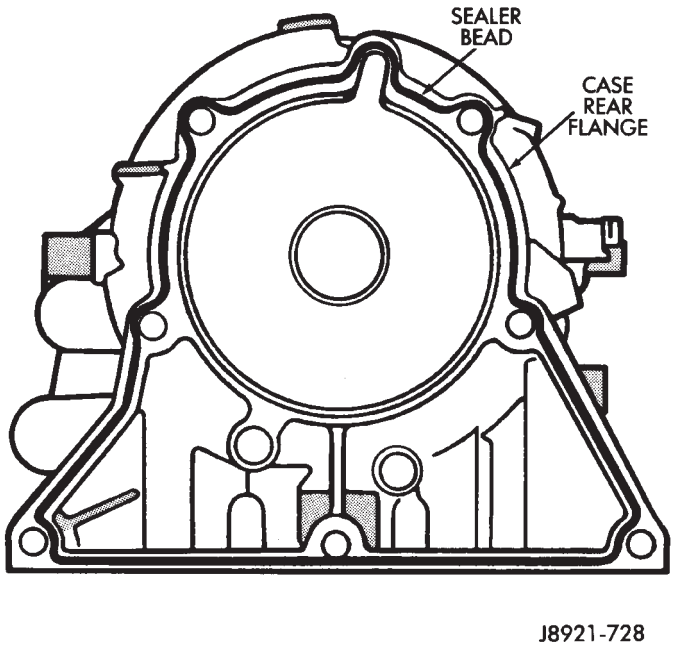

Fig. 65 Applying Sealer To Case Rear Flange

(89) Install adapter housing on transmission. Tighten adapter bolts to 34 N·m (25 ft. lbs.) torque.

(90) Install transmission speed sensor (Fig. 66). Tighten sensor bolt to 7.4 N·m (65 in. lbs.) torque and connect sensor wire harness connector.

(91) Install converter housing (Fig. 67). Tighten 12 mm diameter housing bolts to 57 N·m (42 ft. lbs.) torque. Tighten 10 mm diameter housing bolts to 34 N·m (25 ft. lbs.) torque.

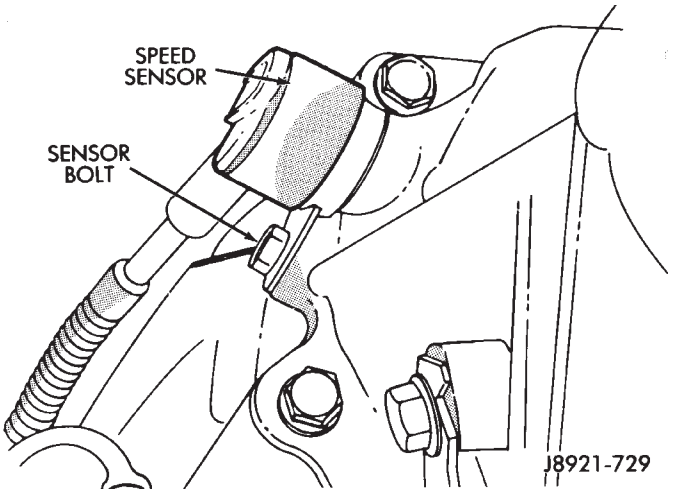

Fig. 66 Installing Transmission Speed Sensor

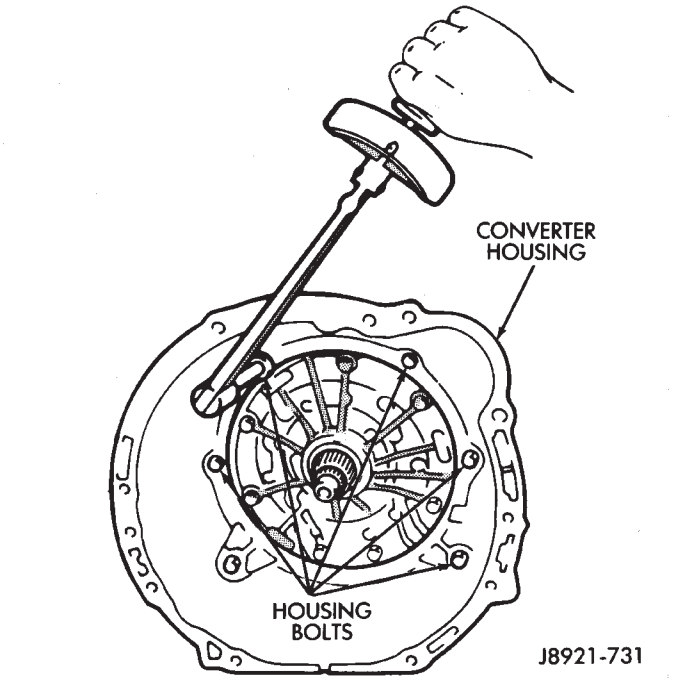

Fig. 67 Installing Converter Housing

(92) Install transmission shift lever on manual valve shaft. Do not install lever attaching nut at this time.

(93) Move transmission shift lever fully rearward. Then move lever two detent positions forward.

(94) Mount park/neutral position switch on manual valve shaft and tighten switch adjusting bolt just enough to keep switch from moving (Fig. 68).

(95) Install park/neutral position switch tabbed washer and retaining nut (Fig. 68). Tighten nut to 6.9 N·m (61 in. lbs.) torque, but do not bend any of the washer tabs against the nut at this time.

(96) Align park/neutral position switch standard line with groove or flat on manual shaft (Fig. 68).

(97) Tighten park/neutral position switch adjusting bolt to 13 N·m (9 ft. lbs.) torque.

(98) Install transmission shift lever on manual

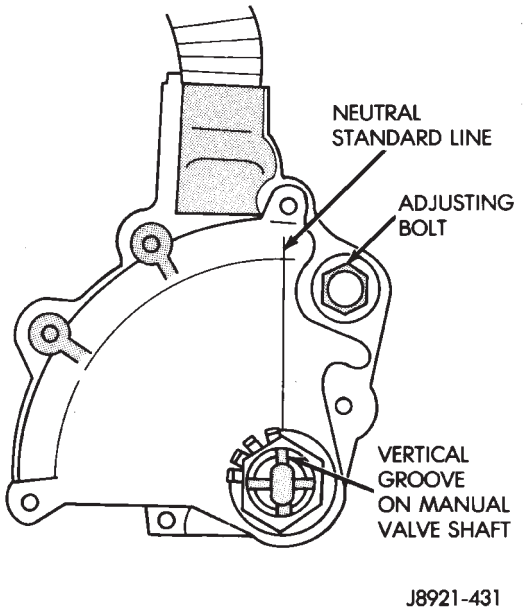

Fig. 68 Park/Neutral Position Switch Installation/ Adjustment

valve shaft. Tighten lever attaching nut to 16 N·m (12 ft. lbs.) torque.

(99) Install retaining clamp for wire harness and throttle cable (Fig. 69).

(100) Install torque converter.

(101) Verify that converter is seated by measuring distance between converter housing flange and one of the converter mounting pads (Fig. 70). Use straightedge and vernier calipers to measure distance. On 6-cyl. transmissions, distance should be 16.5 mm (0.650 in.).

(102) Secure converter in transmission with C-clamp or metal strapping. Do this before mounting transmission on jack or moving transmission under vehicle.

(103) Install lower half of transmission fill tube (install upper half after transmission is in vehicle).

CAUTION: The transmission cooler and lines must be reverse flushed if overhaul corrected a malfunction that generated sludge, metal particles, or clutch friction material. The torque converter should also be replaced if contaminated by the same malfunction. Debris and residue not flushed from the cooler and lines will flow back into the transmission and converter. The result will be a repeat failure and shop comeback.

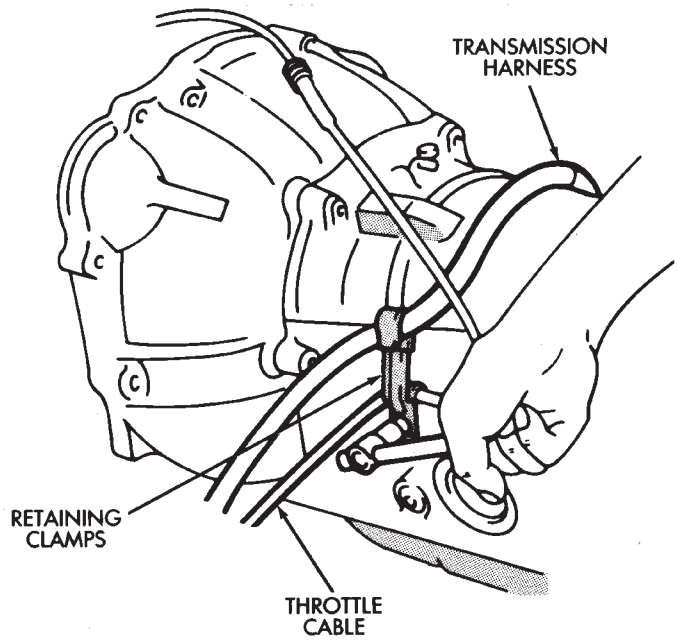

Fig. 69 Installing Cable/Harness Clamps

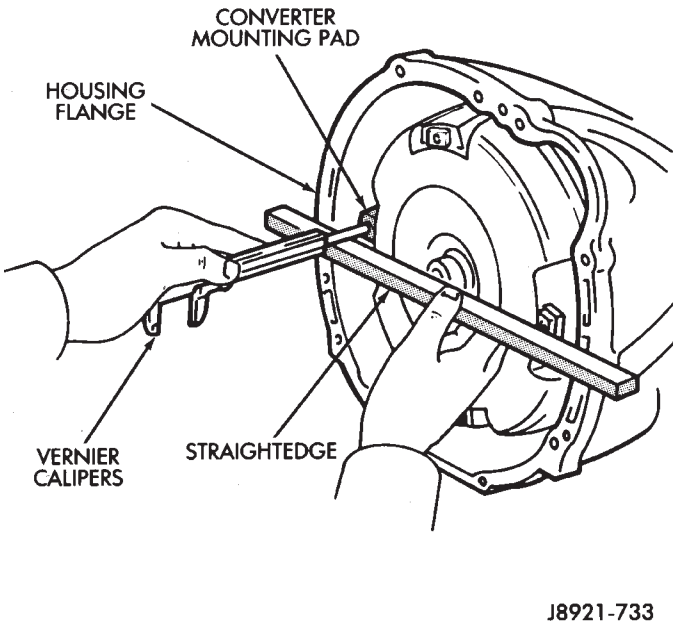

Fig. 70 Checking Converter Installation

NP231 TRANSFER CASE

INDEX

GENERAL INFORMATION

The NP231 is a part-time transfer case with a low range reduction gear system (Fig. 1). The NP231 has three operating ranges plus a Neutral position. A low range system provides a reduction ratio for increased low speed torque capability.

The NP231 is the Command Trac transfer case. It is used in XJ and YJ models.

Two versions of the NP231 are used. One version retains the synchronizer components used in previous models. A newly introduced version is not equipped with synchro components.

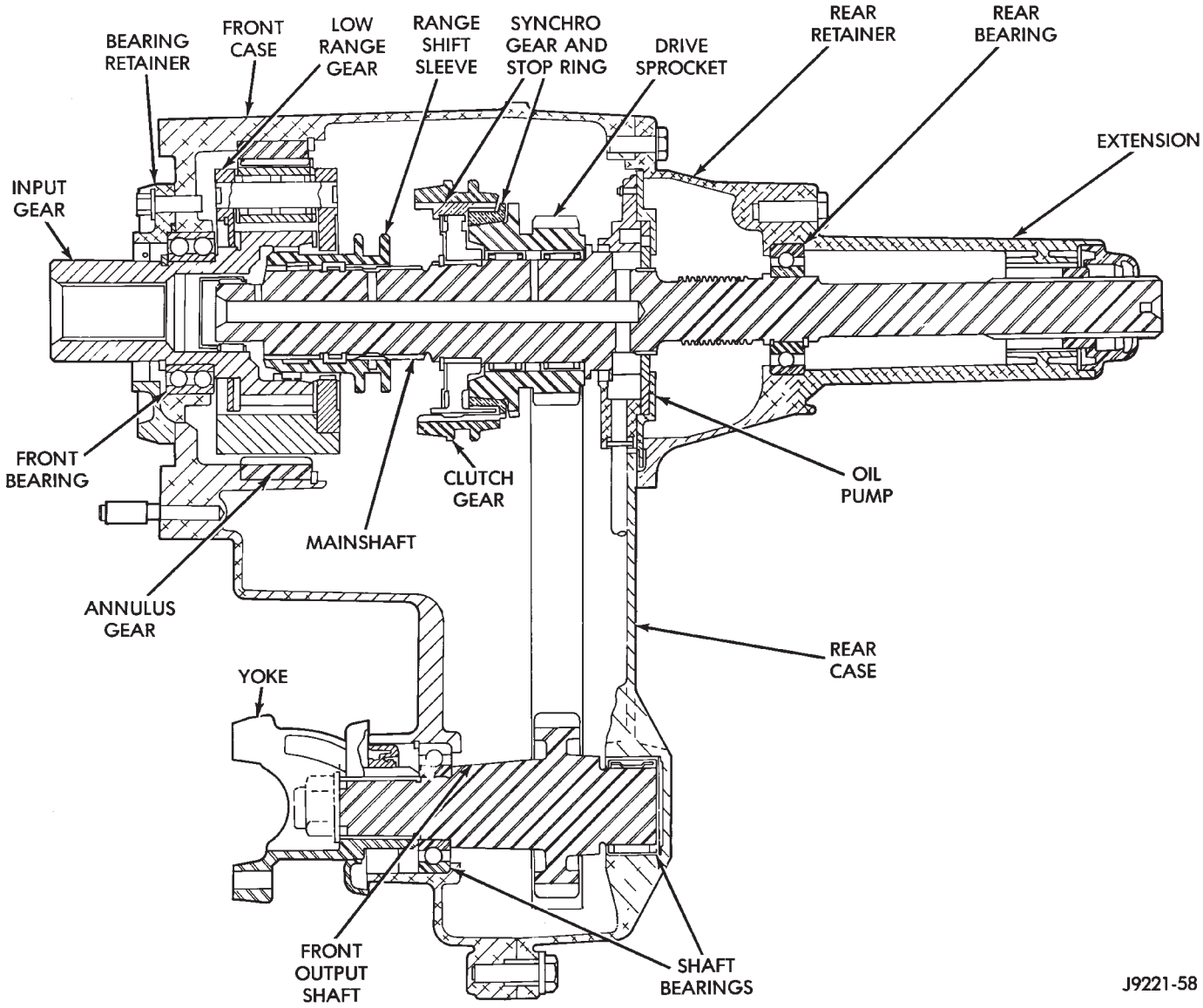

Fig. 1 NP231 Transfer Case

OPERATING RANGES

NP231 operating ranges are: 2-wheel drive high; 4-wheel drive high and 4-wheel drive low (Fig. 2).

2-wheel drive range is for use on all surfaces. The 4-wheel drive high and low ranges are undifferentiated and should only be used on unpaved, low traction surfaces only.

SHIFT MECHANISM

Operating ranges are selected with a floor mounted shift lever. The shift lever is connected to the transfer case range lever by an adjustable linkage rod. A straight line shift pattern is used (Fig. 2). Range positions are marked on the shifter bezel cover plate. A front axle disconnect mechanism is only used on certain models.

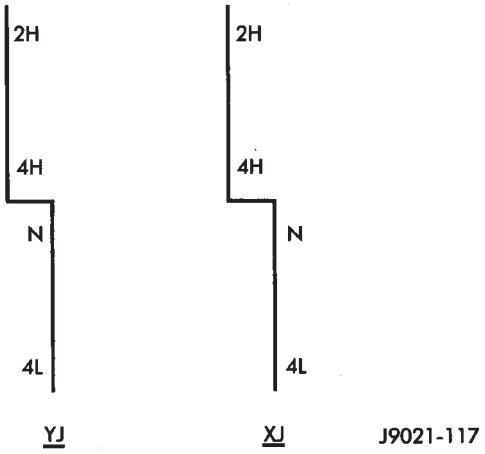

Fig. 2 NP231 Shift Pattern

TRANSFER CASE IDENTIFICATION

A circular ID tag is attached to the rear case of each NP231 transfer case (Fig. 3). 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. For example, a serial number of 8-10-92 would represent August 10, 1992.

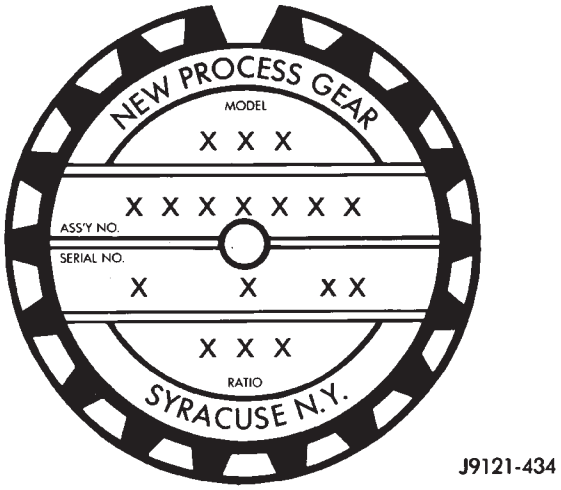

Fig. 3 Transfer Case Identification Tag

TRANSFER CASE LUBRICANT

Recommended Lubricant

Use Mopar Dexron II, or ATF Plus, type 7176 automatic transmission fluid in the NP231 transfer case.

Lubricant Capacity

Approximate refill lubricant capacity is 1.54 liters (3.25 pints) for YJ and 1.04 liters (2.2 pints) for XJ.

Fill Level

The correct fill level is to the bottom edge of the fill plug hole. The vehicle must be level in order to ensure an accurate fluid level check.

NP231 SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting.	(1) Stop vehicle and shift into desired range. Or reduce speed to 3-4 km/h (2-3 mph) before attempting to shift.
	(2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficulty.	(2) Stop vehicle, shift transmission to Neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces.
	(3) Transfer case external shift linkage binding.	(3) Lubricate, repair or replace linkage bushings or tighten loose components as necessary.
	(4) Insufficient or incorrect lubricant.	(4) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid.
	(5) Internal components binding, worn or damaged.	(5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. Check for leaks and repair if necessary. **Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.**
NOISY IN – OR JUMPS OUT OF – FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position.	(1) Stop vehicle, shift transfer case to Neutral, then shift back into 4L position.
	(2) Shift linkage out of adjustment.	(2) Adjust linkage.
	(3) Shift linkage loose or binding.	(3) Tighten, lubricate or repair linkage as necessary.
	(4) Range fork damaged, inserts worn, or fork is binding on shift rail.	(4) Disassemble unit and repair as necessary.
	(5) Low range gear worn or damaged.	(5) Disassemble and repair as necessary.
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clear or replace vent if necessary.
	(3) Output shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

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SHIFT LINKAGE ADJUSTMENT

LINKAGE ADJUSTMENT—YJ

(1) Remove transfer case shift knob locknut and remove knob (Fig. 4).

(2) Remove outer boot attaching screws and remove boot (Fig. 4).

(3) Remove inner boot attaching screws and remove boot (Fig. 4).

(4) Move shift lever into 4L position.

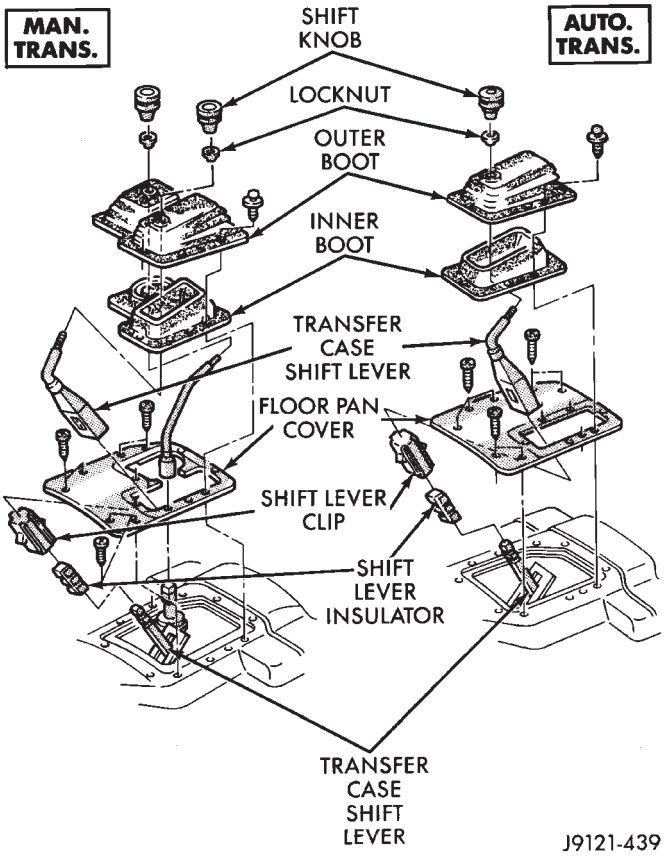


Fig. 4 Transfer Case Shift Lever And Boots—YJ

(5) Insert 3 mm (1/8 in.) spacer between shift lever and forward edge of shift lever gate (Fig. 5). Secure lever and spacer in place with tape or wire.

(6) Secure shift lever and spacer with tape or wire.

(7) Raise vehicle.

(8) Loosen lock bolt on adjusting trunnion (Fig. 6). Linkage rod should now slide freely in trunnion.

(9) Verify that range lever is in 4L position (Fig. 6).

(10) Position linkage rod so it is a free fit in range lever. Then tighten trunnion lock bolt (Fig. 6).

(11) Lower vehicle.

(12) Remove shift lever spacer and install inner and outer boots and shift knob (Fig. 4).

LINKAGE ADJUSTMENT—XJ

(1) Remove shift lever bezel.

(2) Move shift lever into 4L position.

(3) Insert 3 mm (1/8 in.) spacer between shift lever and forward edge of shift lever gate (Fig. 7). Secure

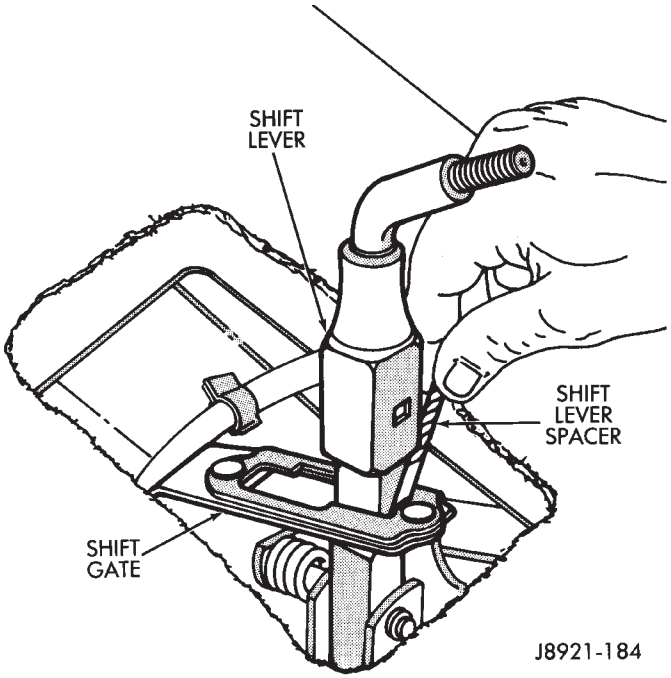


Fig. 5 Installing Shift Lever Spacer—YJ

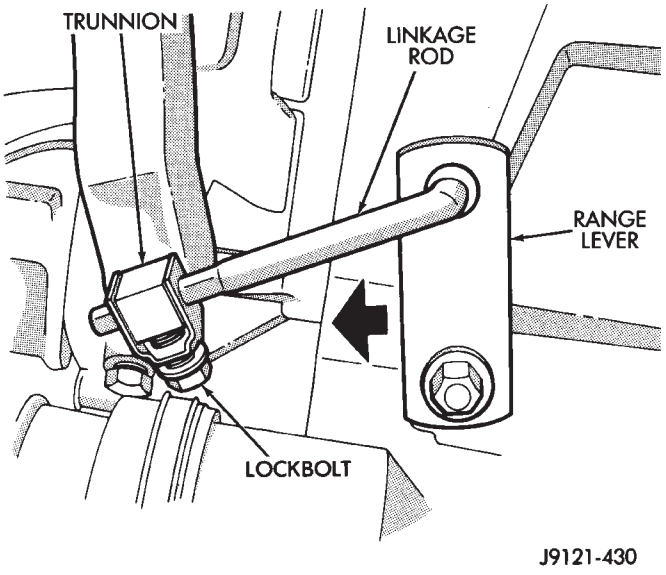


Fig. 6 Shift Trunnion Lock Bolt Position—YJ

lever and spacer in place with tape or wire.

(4) Raise vehicle.

(5) Loosen trunnion lock bolt (Figs. 8 and 9). Linkage rod should now slide freely in trunnion.

(6) Verify that transfer case range lever is in 4L position.

(7) Position linkage rod so it is a free fit in range lever (Figs. 8 and 9). Then tighten trunnion locknut.

(8) Lower vehicle.

(9) Remove shift lever spacer and install bezel.

SPEEDOMETER SERVICE

Speedometer service is covered in the automatic transmission sections in this group. Refer to the appropriate section as needed.

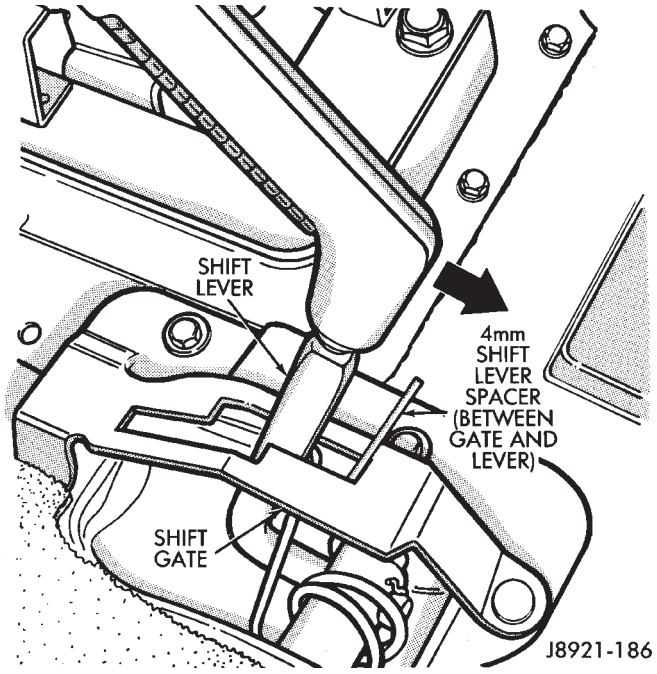


Fig. 7 Installing Shift Lever Spacer—XJ

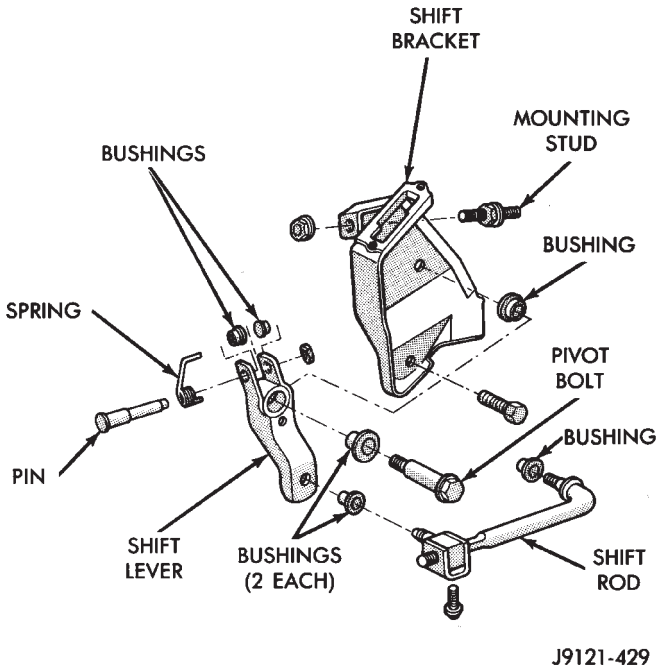


Fig. 8 Shift Linkage—YJ

TRANSFER CASE REMOVAL

(1) Shift transfer case into Neutral.

(2) Raise vehicle.

(3) Drain transfer case lubricant.

(4) Mark front and rear propeller shaft yokes for alignment reference.

(5) Support transmission with jack stand.

(6) Remove rear crossmember, or skid plate.

(7) Disconnect front/rear propeller shafts at transfer case.

(8) Disconnect vehicle speed sensor wires.

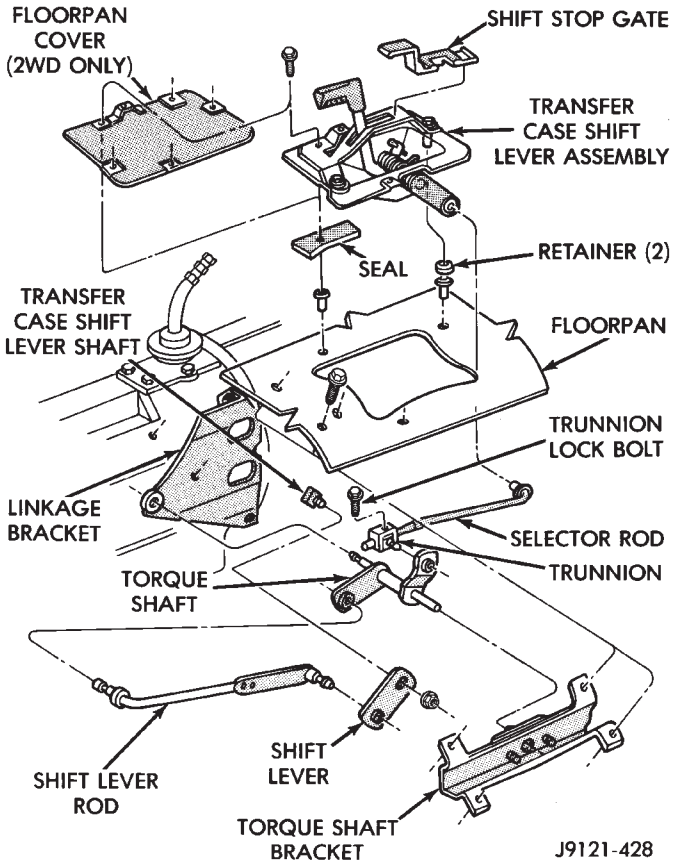


Fig. 9 Shift Linkage—XJ

(9) Disconnect transfer case linkage rod from range lever.

(10) Disconnect transfer case vent hose.

(11) Support transfer case with transmission jack.

(12) Remove nuts attaching transfer case to transmission.

(13) Secure transfer case to jack with chains.

(14) Pull transfer case and jack rearward to disengage transfer case.

(15) Remove transfer case from under vehicle.

TRANSFER CASE INSTALLATION

(1) Mount transfer case on a transmission jack. Secure transfer case to jack with chains.

(2) Position transfer case under vehicle.

(3) Align transfer case and transmission shafts and install transfer case on transmission.

(4) Install and tighten transfer case attaching nuts to 35 N·m (26 ft. lbs.) torque.

(5) Connect vehicle speed sensor wires, and vent hose.

(6) Align and connect propeller shafts. Tighten shaft attaching bolts to 19 N·m (170 in. lbs.) torque.

(7) Fill transfer case with Mopar ATF Plus, or Dexron II automatic transmission fluid.

(8) Install rear crossmember, or skid plate. Tighten crossmember bolts to 41 N·m (30 ft. lbs.) torque.

(9) Remove transmission jack and transmission support stand.

(10) Connect transfer case range lever to linkage rod.

(11) Adjust transfer case shift linkage.
(12) Lower vehicle.

TRANSFER CASE DISASSEMBLY AND OVERHAUL

Two versions of the NP231 are used in current models. One version retains the synchronizer components used in previous years. A newly introduced version does not have synchro components. The non-synchro version does not have a synchro gear, struts, spring and stop ring. During overhaul, note which version is being serviced and order needed parts accordingly.

(1) Remove fill and drain plugs.
(2) Remove front yoke. Discard yoke seal washer and nut. They should not be reused.
(3) Move transfer case range lever rearward to 4L position.
(4) Remove extension housing attaching bolts.
(5) Tap extension housing in clockwise direction to break sealer bead and remove housing (Fig. 1).

CAUTION: To avoid damaging the sealing surfaces of the extension housing and rear retainer, do not pry or wedge the housing off the retainer.

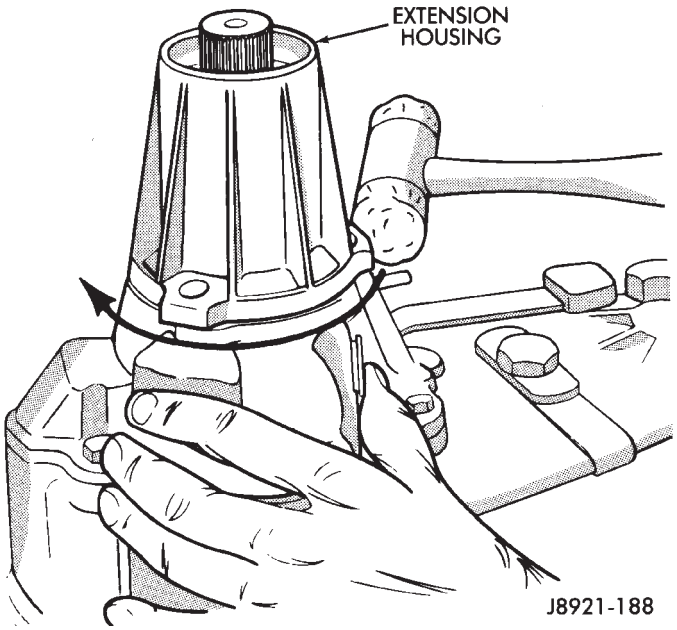


Fig. 1 Extension Housing Removal

(6) Remove rear bearing snap ring (Fig. 2).
(7) Remove rear retainer attaching bolts.
(8) Remove rear retainer. Position screwdriver under each tab on retainer housing (Fig. 3). Then carefully pry retainer upward and off rear case.

CAUTION: Do not pry against the sealing surfaces of the retainer or rear case. The surfaces could be damaged.

(9) Remove bolts attaching rear case to front case. Retain bolts and washers.

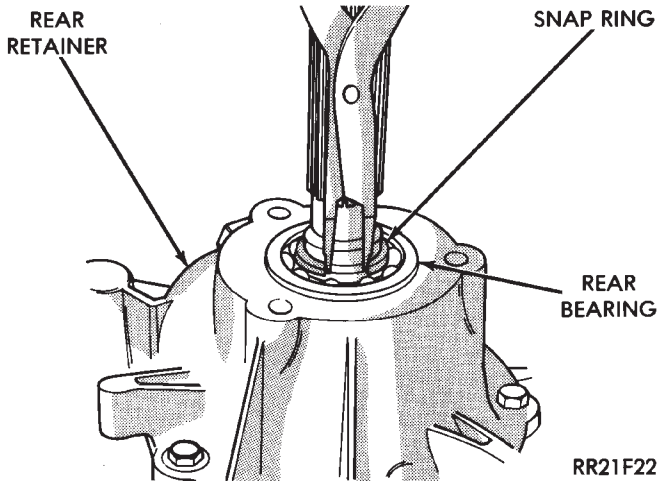


Fig. 2 Rear Bearing Snap Ring Removal

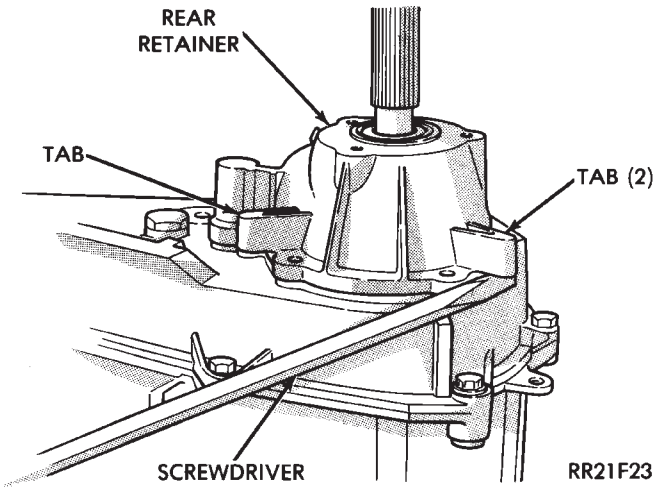


Fig. 3 Rear Retainer Removal

(10) Separate rear case from front case (Fig. 4) Insert screwdrivers into slots cast in case ends. Then gently pry upward to break sealer bead and loosen rear case.

CAUTION: Do not pry against the sealing surfaces of the retainer or rear case. The surfaces could be damaged.

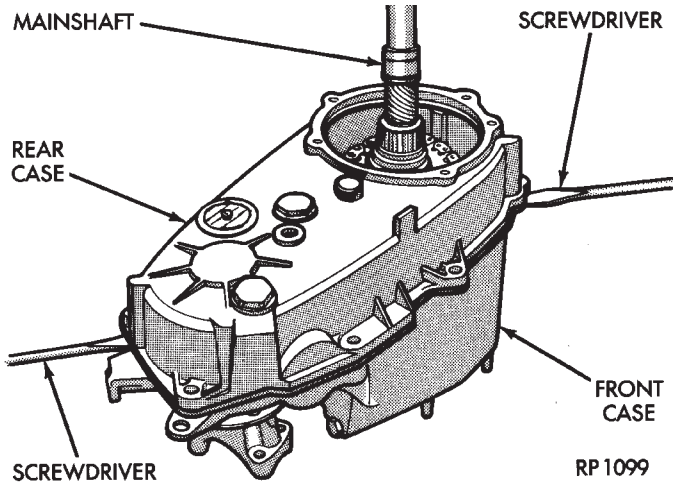


Fig. 4 Loosening Rear Case

(11) Remove oil pump and rear case as an assembly (Fig. 5).

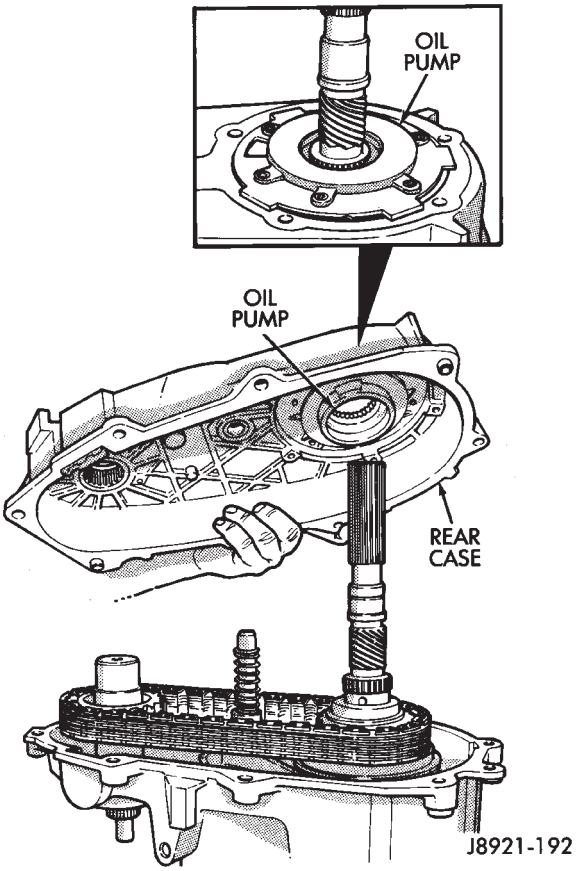


Fig. 5 Rear Case And Oil Pump Removal

(12) Slide oil screen out of case pocket. Disconnect screen from pickup tube and remove screen (Fig. 6).

(13) Remove pickup tube from oil pump (Fig. 6).

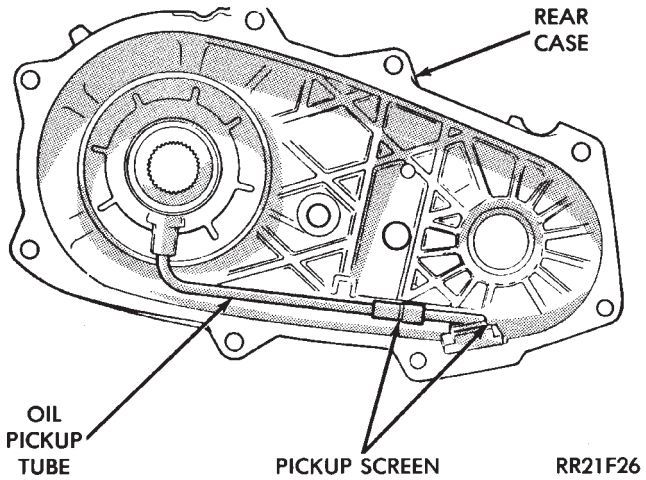


Fig. 6 Removing Oil Screen And Pickup Tube 16

(14) Remove oil pump from rear case.

(15) Remove pickup tube O-ring from oil pump (Fig. 7).

(16) **The oil pump can be disassembled for cleaning and inspection as described in steps (17) and (18). However, the pump parts are NOT serviceable separately. If any pump component is worn, or damaged, the pump must be replaced as an assembly.**

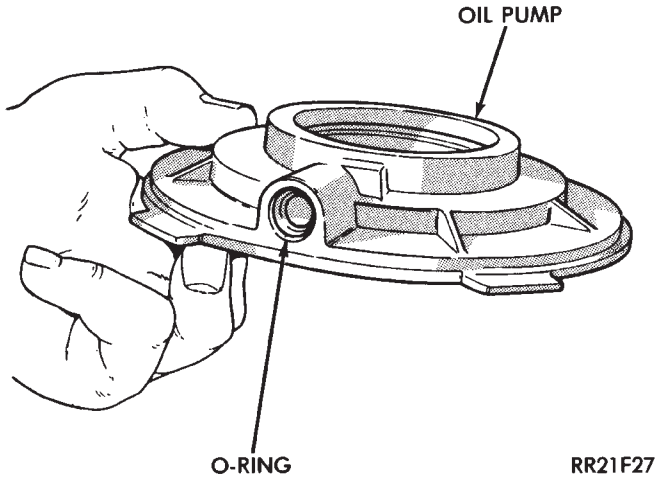


Fig. 7 Pickup Tube O-Ring Location

(17) If oil pump will be disassembled for inspection, mark position of oil pump housings for reference (Fig. 8). Remove screws that attach two halves of the pump. Then remove feed housing from gear housing (Fig. 8).

(18) Mark position of pump gears and remove them from housing (Fig. 8).

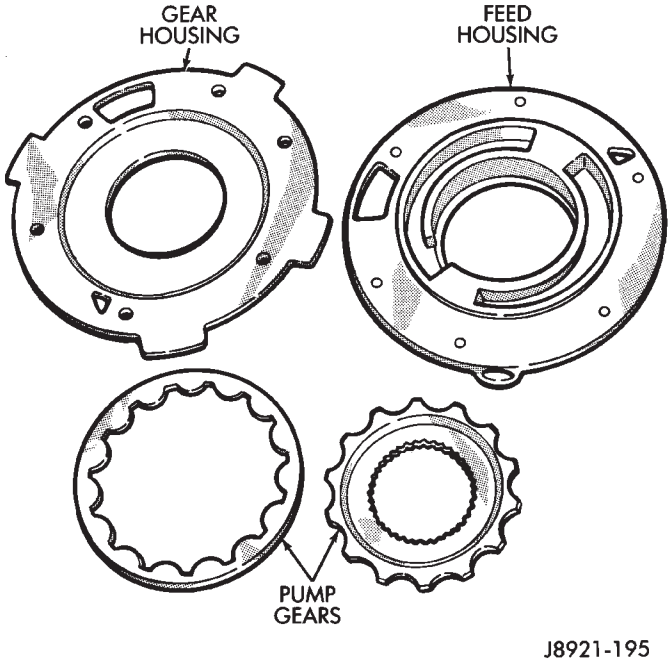


Fig. 8 Oil Pump Components

(19) Remove mode spring (Fig. 9).

(20) Tap front output shaft upward with a rawhide mallet to free it from shaft bearing.

(21) Remove front output shaft and drive chain as assembly (Fig. 10).

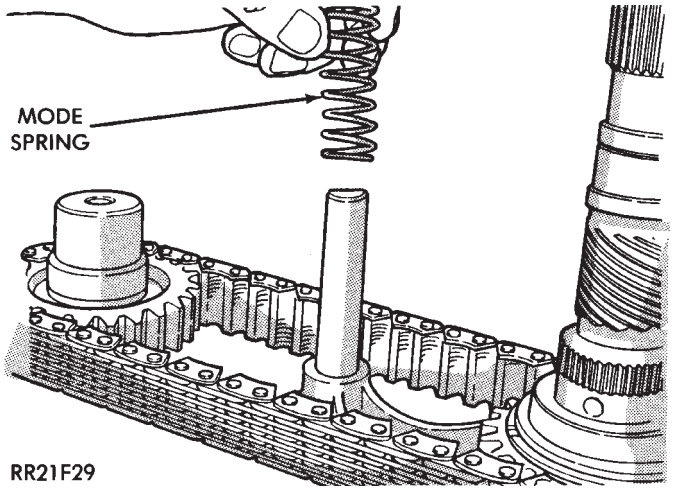


Fig. 9 Mode Spring Removal

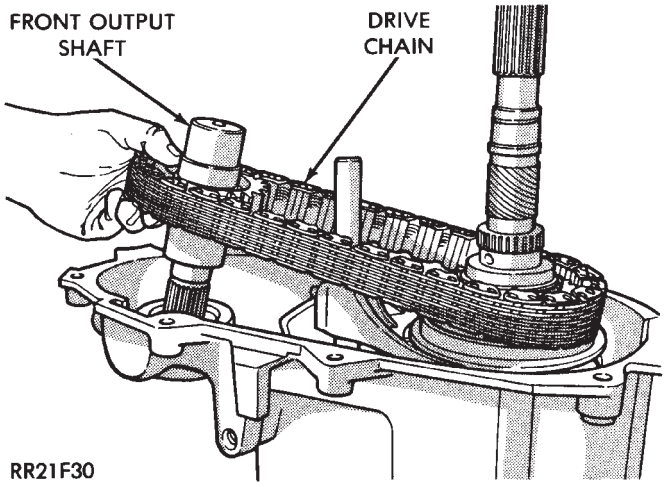


Fig. 10 Front Output Shaft And Drive Chain Removal

(22) Remove mainshaft, mode fork and shift rail as assembly (Fig. 11).

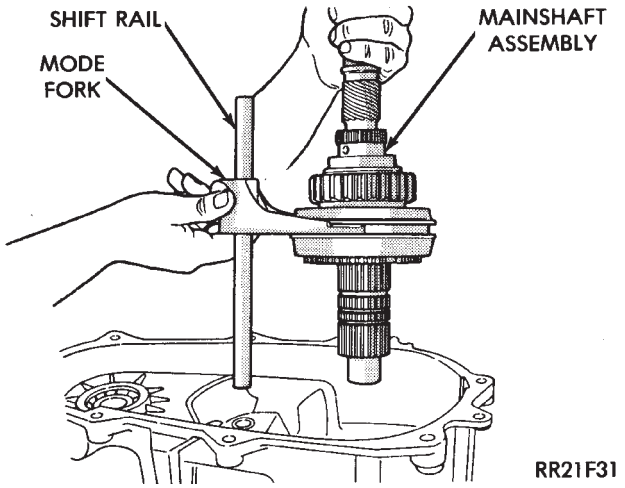


Fig. 11 Removing Mainshaft, Mode Fork And Shift Rail

(23) Remove mode fork and shift rail from synchro sleeve (Fig. 12).

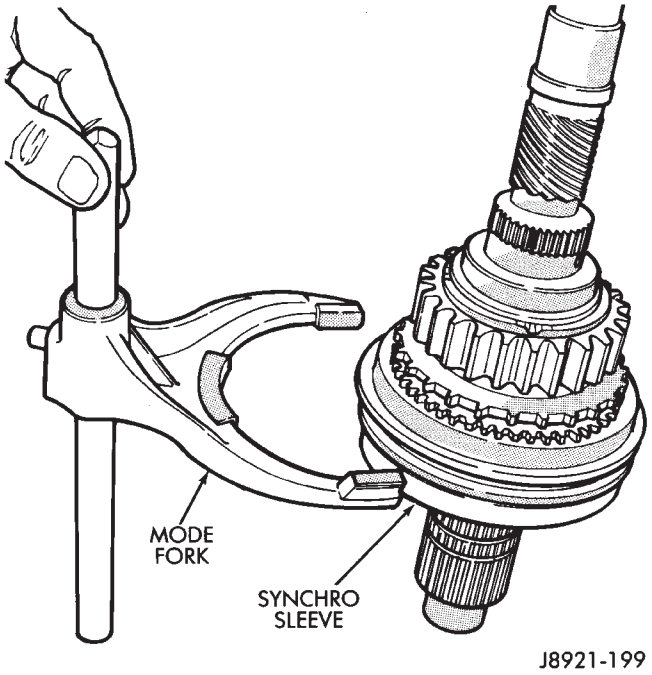


Fig. 12 Removing Mode Fork From Sleeve

(24) Remove synchro hub snap ring (Fig. 13).

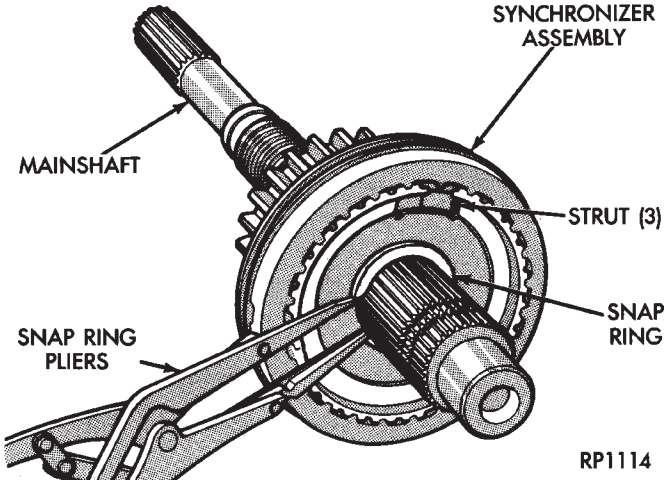


Fig. 13 Synchro Hub Snap Ring Removal/Installation

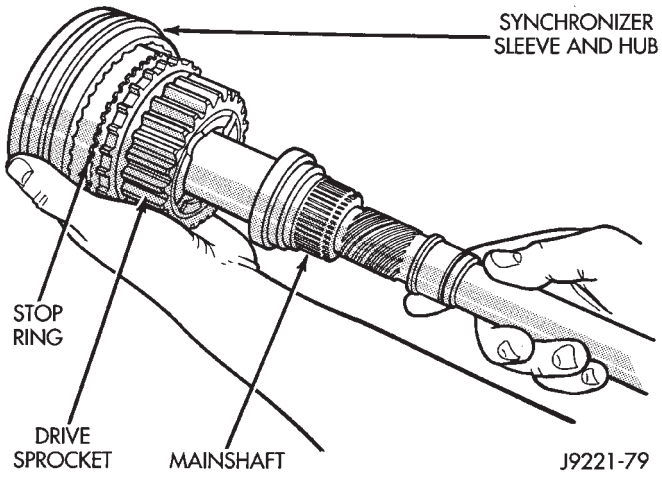


Fig. 14 Removing Synchro Sleeve, Hub And Struts

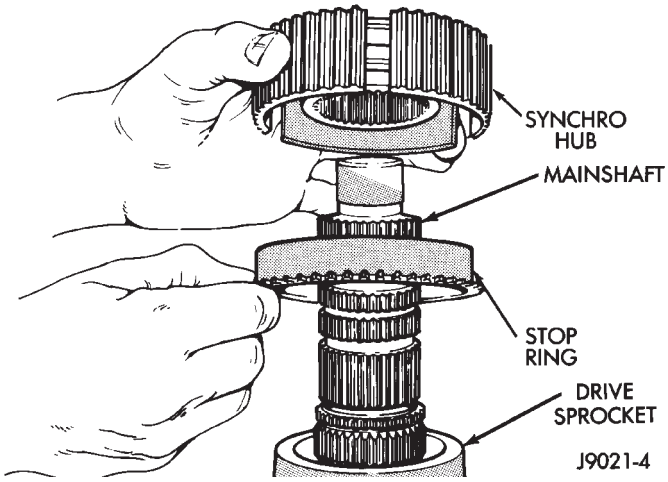


Fig. 15 Removing Synchro Hub And Stop Ring

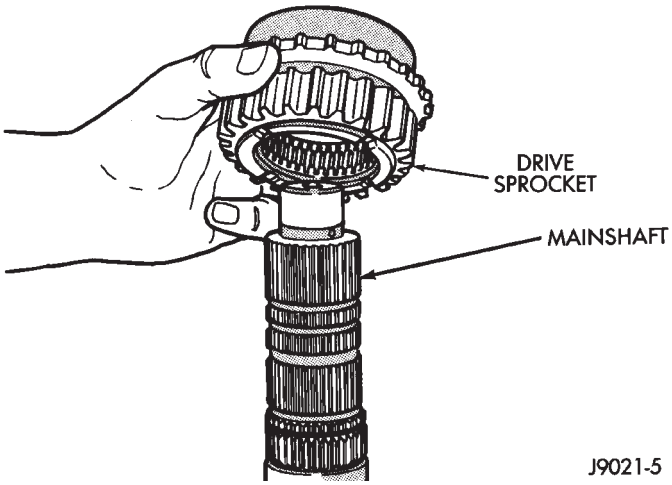


Fig. 16 Drive Sprocket Removal/Installation

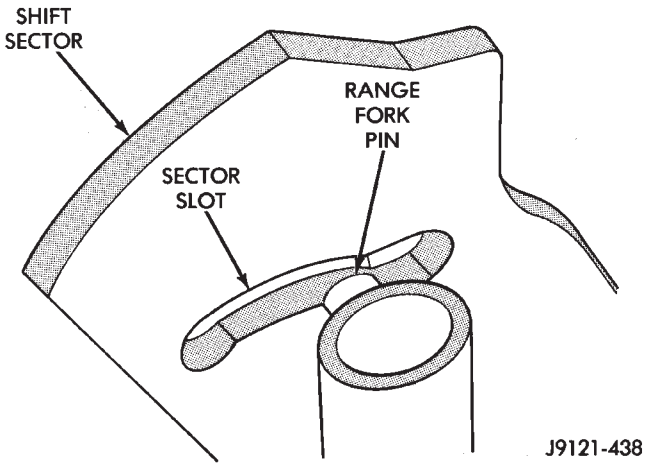


Fig. 17 Disengaging Range Fork

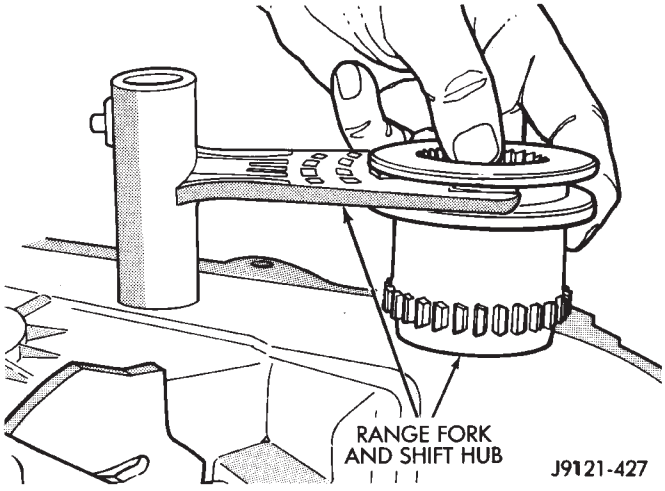


Fig. 18 Range Fork And Hub Removal/Installation

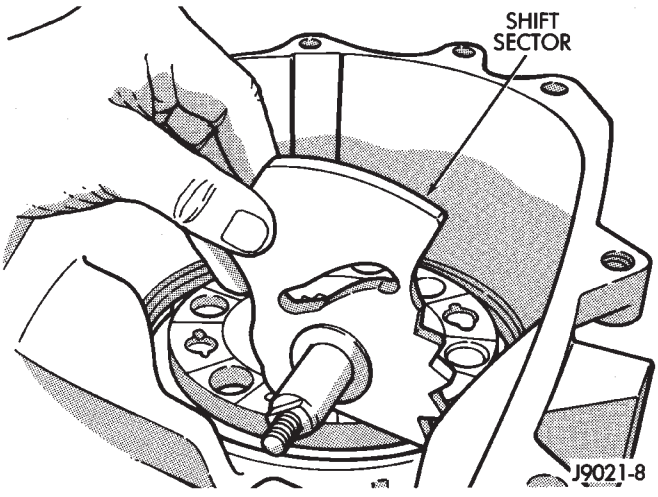


Fig. 19 Shift Sector Removal/Installation

(25) Remove synchro sleeve, hub and struts (Fig. 14).
(26) Remove synchro hub and stop ring (Fig. 15).
(27) Remove drive sprocket (Fig. 16).
(28) Slide range fork pin out of shift sector (Fig. 17).
(29) Remove range fork and shift hub (Fig. 18).
(30) Remove range lever from sector shaft.
(31) Remove shift sector (Fig. 19).

(32) Remove sector shaft bushing and O-ring (Fig. 20).

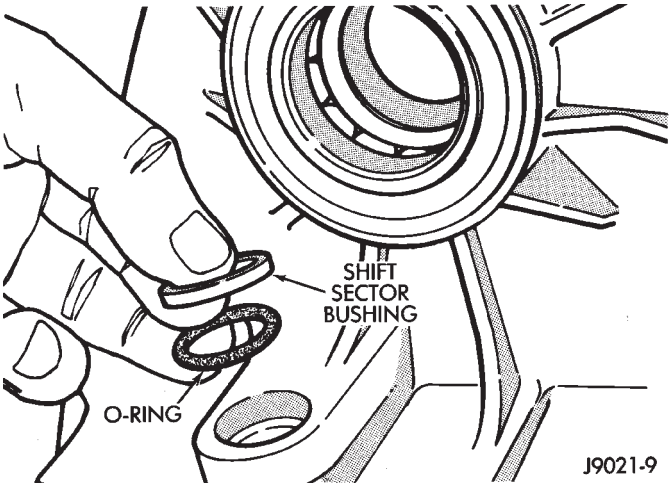


Fig. 20 Removing/Installing Sector Shaft Bushing And O-Ring

(33) Remove shift detent plunger, spring and plug (Fig. 21). Remove O-ring from plug after removal.

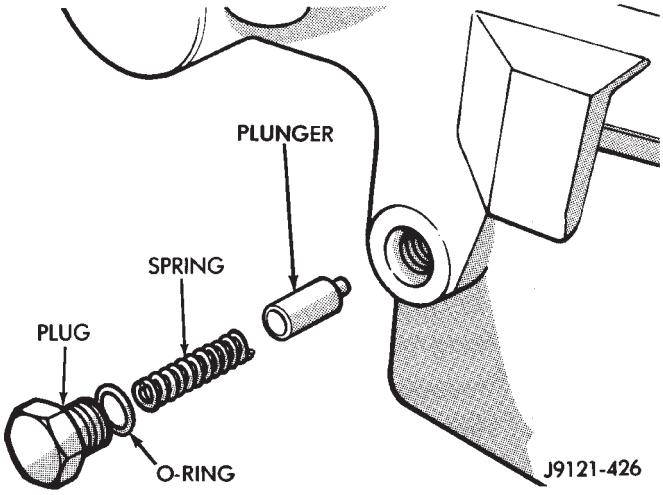


Fig. 21 Detent Component Removal

(34) Turn front case over and remove front bearing retainer bolts (Fig. 22).

(35) Remove front bearing retainer. Position screwdrivers in retainer slots and lift upward to loosen and remove retainer (Fig. 23).

(36) Remove input gear snap ring (Fig. 24).

(37) Press input and low range gear assembly out of input gear bearing with shop press (Fig. 25).

(38) Remove low range gear snap ring (Fig. 26).

(39) Remove retainer, thrust washers and input gear from low range gear (Fig. 27).

(40) Remove oil seals from rear retainer, rear extension housing, oil pump feed housing and case halves.

(41) Remove magnet from front case.

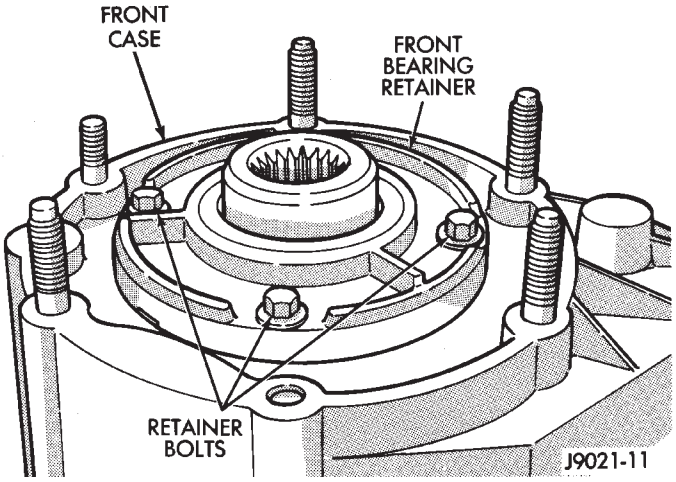


Fig. 22 Front Bearing Retainer Bolt Locations

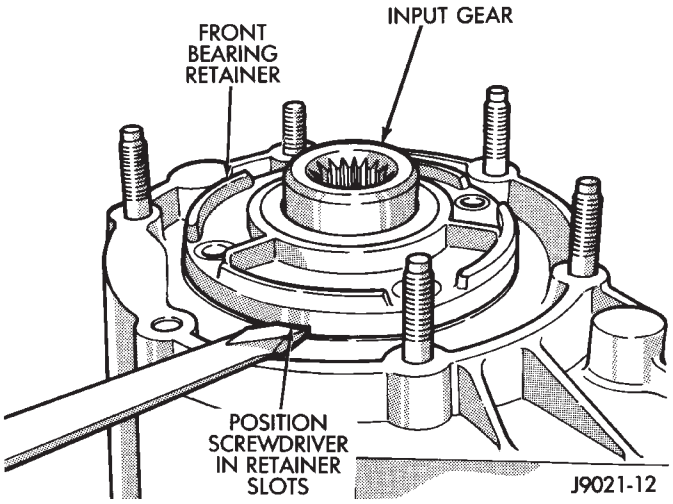


Fig. 23 Removing Front Bearing Retainer

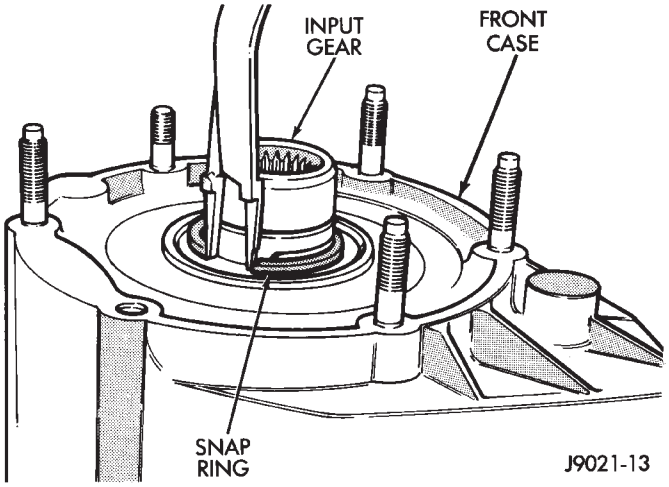


Fig. 24 Removing Input Gear Snap Ring

(42) Remove the speedometer driven gear, seals and adapter.

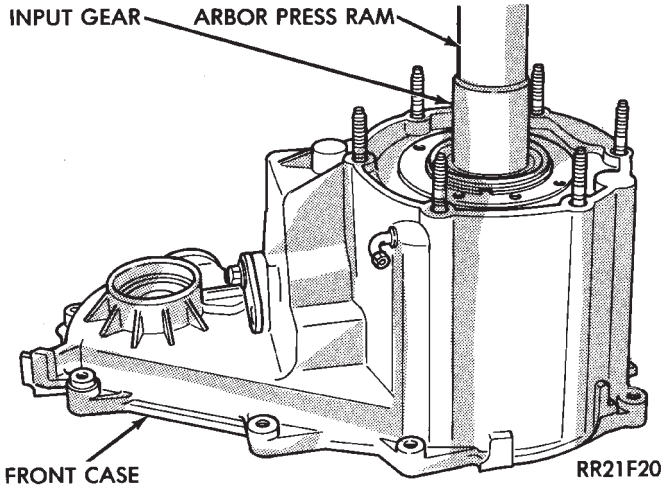


Fig. 25 Removing Input And Low Range Gear Assembly

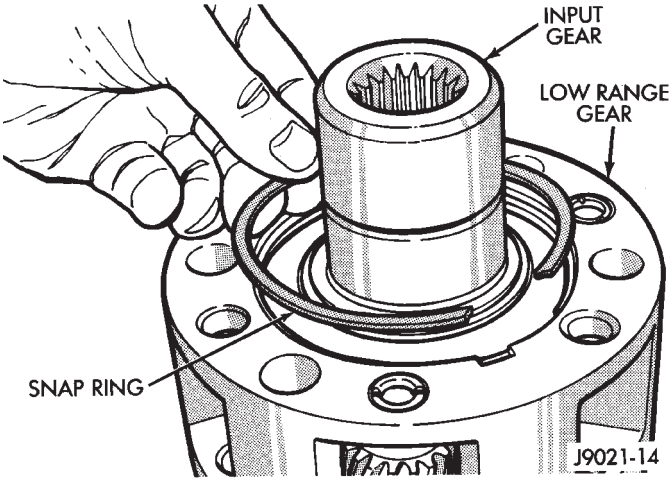


Fig. 26 Removing Low Range Gear Snap Ring

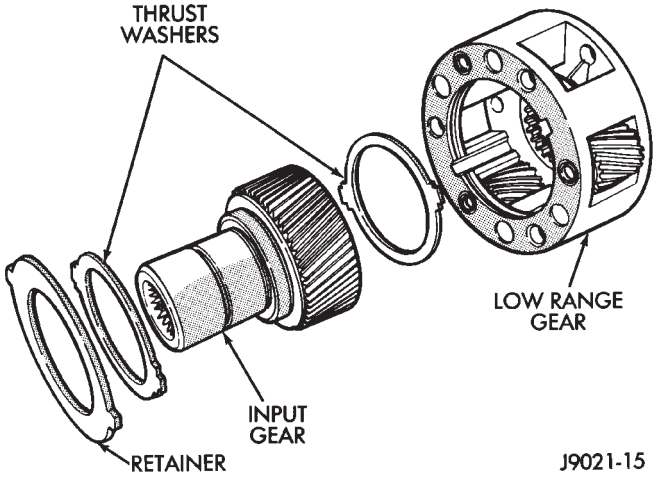


Fig. 27 Input And Low Range Gear Components

CLEANING AND INSPECTION

Clean the transfer case components thoroughly with solvent. Remove all traces of sealer from the case and retainer seal surfaces.

Clean the oil pickup screen with solvent and dry it with compressed air. Also use compressed air to remove solvent residue from all oil feed passages and channels.

Inspect the low range annulus gear (Fig. 28). **If the gear is damaged, replace the gear and front case as an assembly. Do not attempt to remove the gear.**

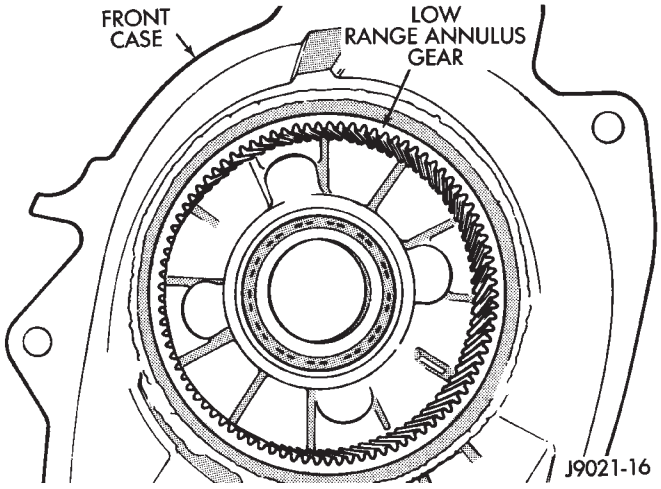


Fig. 28 Low Range Annulus Gear Location

Inspect the case halves, extension housing and retainers for cracks, porosity, or damaged sealing surfaces. Inspect the shafts, gears, chain and shift components for wear or damage. Replace the oil pump as an assembly if any pump part is worn or damaged.

Inspect all of the transfer case bearings for wear, roughness, pitting, or galling. Replace worn or damaged bearings as outlined in the assembly section.

TRANSFER CASE ASSEMBLY

CAUTION: The bearing bores in various transfer case components contain oil feed holes. Be sure replacement bearings do not block these feed holes.

(1) Lubricate components with automatic transmission fluid (or petroleum jelly where indicated) during assembly.

(2) Remove front output shaft seal from front case.

(3) Remove front output shaft bearing snap ring (Fig. 29).

(4) Tap old front output shaft bearing out of front case with plastic mallet. Install new bearing with Tool Handle C-4171 and Installer Tool 5064 (Fig. 30).

(5) Secure front output shaft bearing in front case with new snap ring (Fig. 29).

(6) Install new front output shaft seal in front case.

(7) Press input gear bearing from the front case with Tool Handle C-4171 and Installer Tool C-4210 (Fig. 31). Then turn front case over.

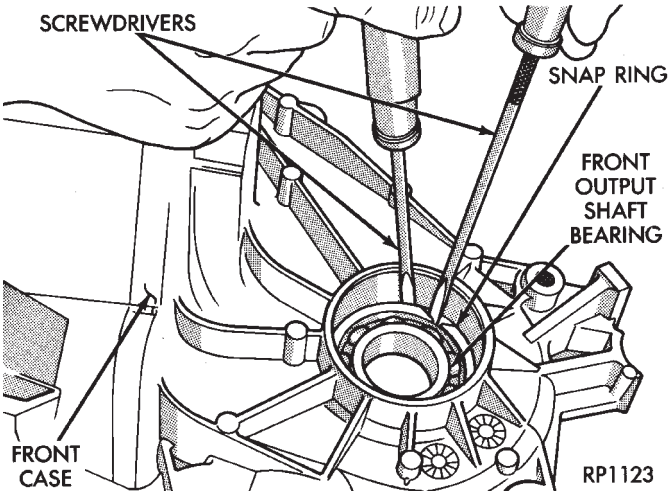


Fig. 29 Removing/Installing Front Output Shaft Bearing Snap Ring

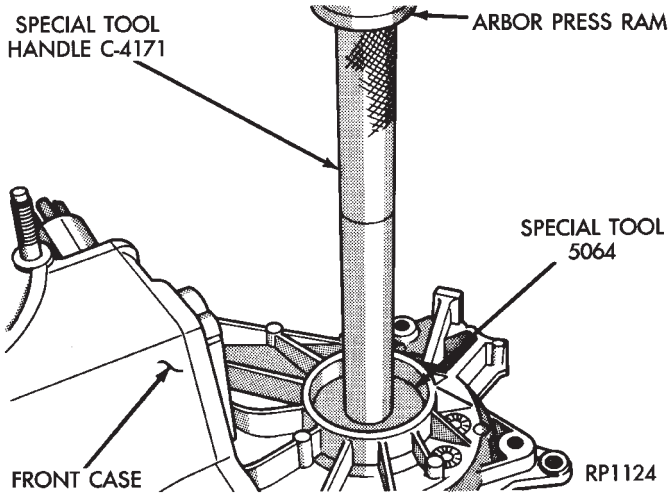


Fig. 30 Installing Output Shaft Front Bearing

(8) Install snap ring on new input gear bearing and start bearing in case.

(9) Carefully press input gear bearing into case until bearing snap ring seats against case (Fig. 32).

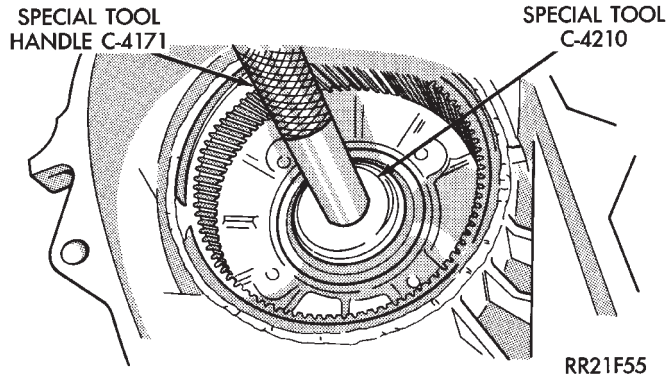


Fig. 31 Removing Input Gear Bearing

(10) Remove mainshaft pilot bearing from input gear with Tool MD-998346 and two suitable size open end wrenches (Fig. 33).

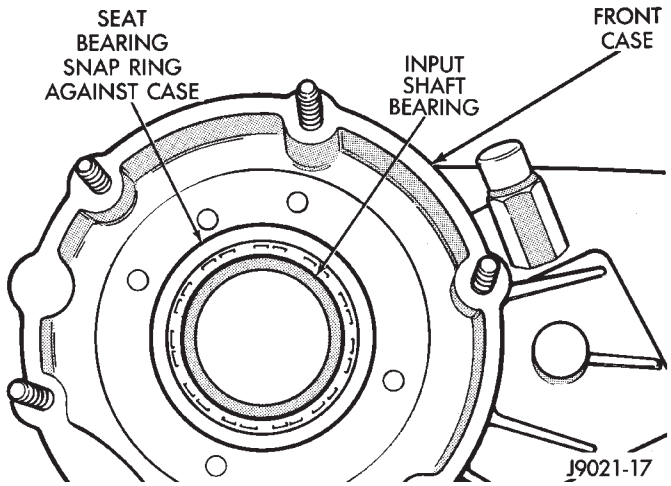


Fig. 32 Input Gear Bearing Installation

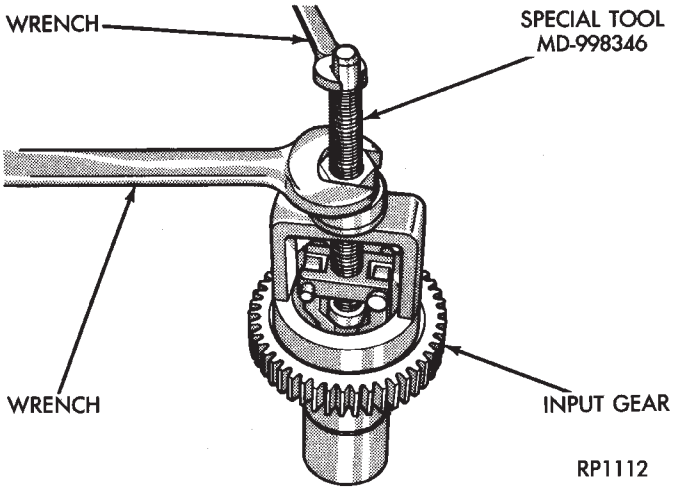


Fig. 33 Removing Mainshaft Pilot Bearing From Input Gear

(11) Install new pilot bearing in input gear with shop press, Tool Handle C-4171 and Installer 5065 (Fig. 34).

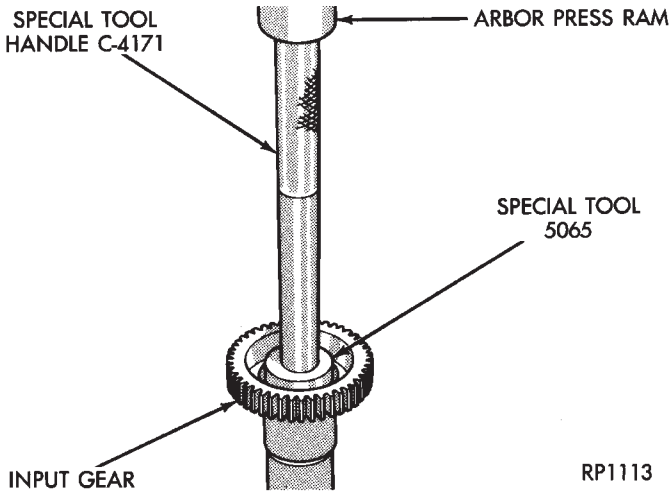


Fig. 34 Installing Mainshaft Pilot Bearing In Input Gear

(12) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 35).

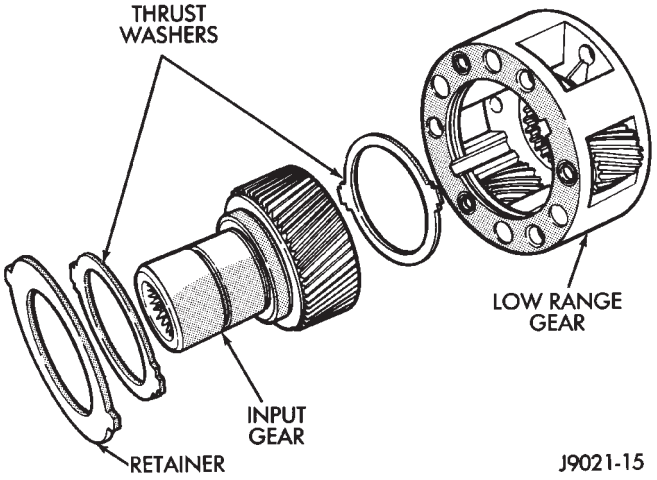


Fig. 35 Input And Low Range Gear Assembly

(13) Install input gear snap ring (Fig. 36).

(14) Lubricate input gear with automatic transmission fluid.

(15) Start input gear in front bearing.

(16) Press input gear into front bearing (Fig. 36).

CAUTION: Use a proper size tool to press the input gear into the front bearing. An incorrect tool could push the input gear pilot bearing too far into the gear bore (Fig. 45). Also, do not press against the end surfaces of the low range gear. The gear case and thrust washers could be damaged.

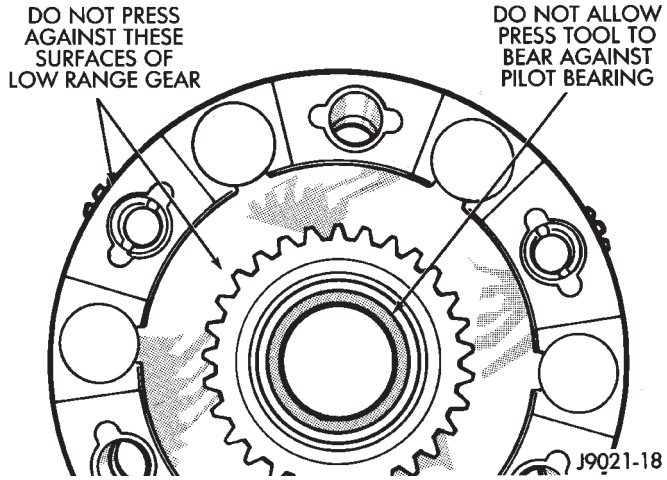


Fig. 36 Input And Low Range Gear Installation

(17) Install input gear snap ring (Fig. 37).

(18) Install new oil seal in front bearing retainer.

(19) Apply 3 mm (1/8 in.) wide bead of Mopar Gasket Maker, silicone adhesive/sealer, or Loctite 518 to front bearing retainer seal surface (Fig. 38).

(20) Install front bearing retainer on front case (Fig. 22). Tighten retainer bolts to 21 N·m (16 ft. lbs.) torque.

(21) Install new sector shaft O-ring and bushing (Fig. 39).

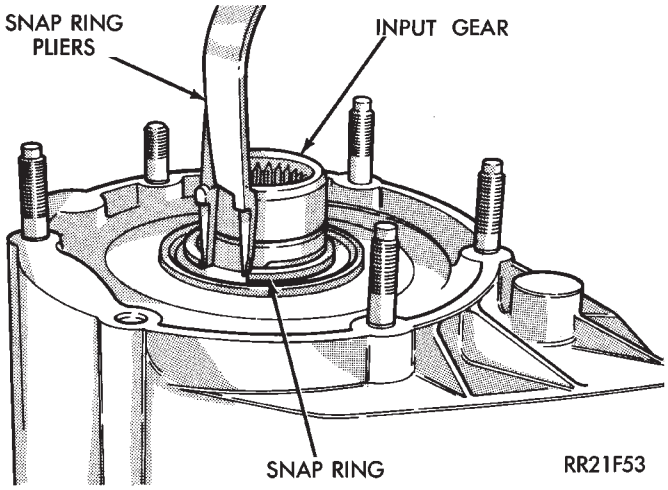


Fig. 37 Installing Input Gear Snap Ring

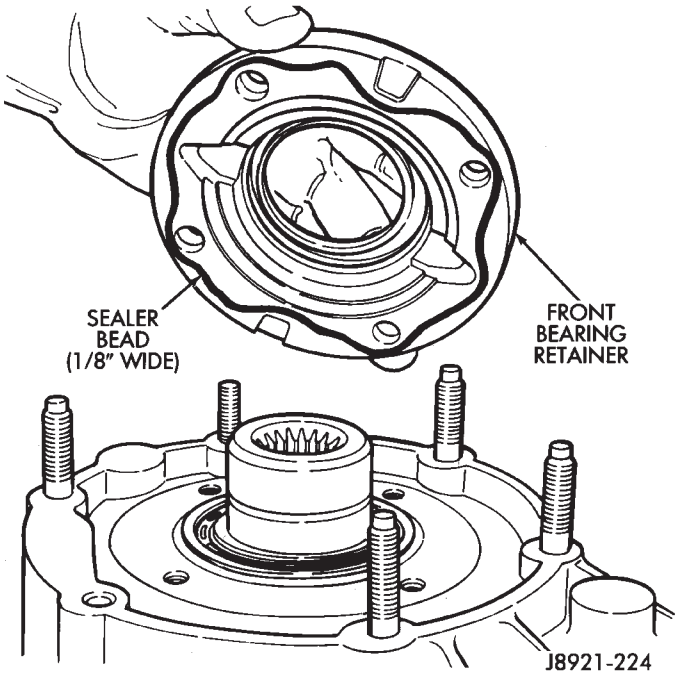


Fig. 38 Applying Sealer To Front Bearing Retainer

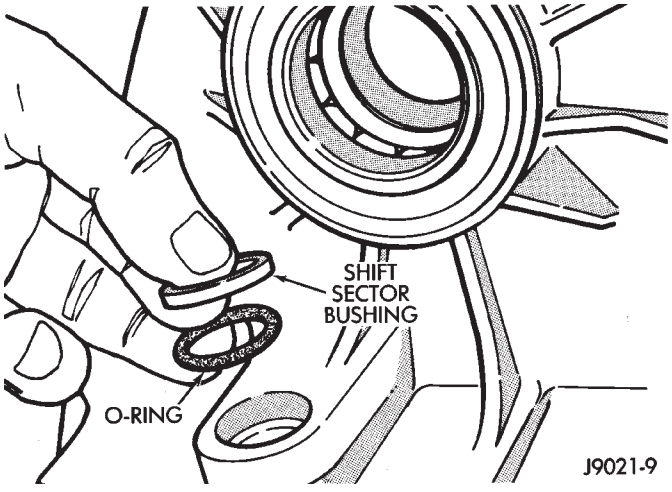


Fig. 39 Installing Sector O-Ring And Bushing

(22) Install shift sector in the case (Fig. 40).

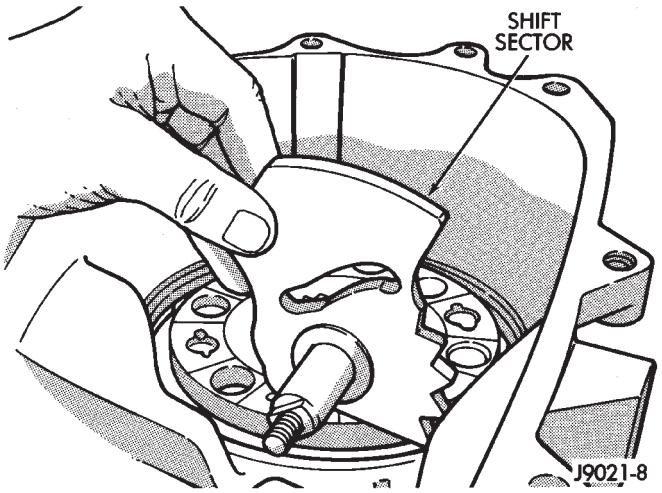


Fig. 40 Installing Shift Sector

(23) Install range lever and lever attaching nut on shift sector. Tighten attaching nut to 30 N·m (22 ft. lbs.) torque.

(24) Install detent plunger, spring and plug (Fig. 41). Tighten plug to 20 N·m (15 ft. lbs.) torque.

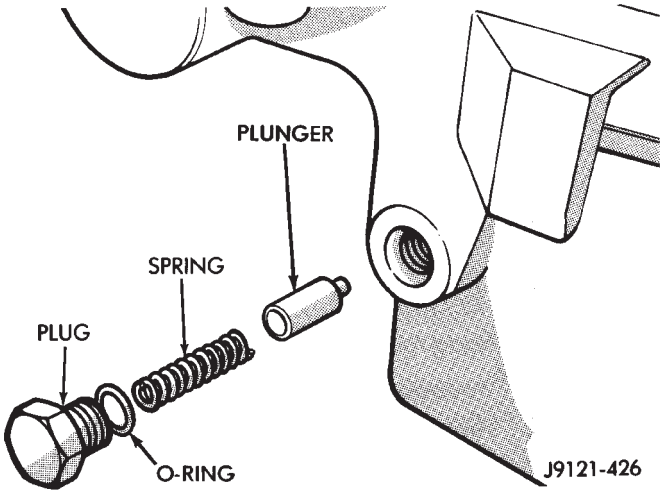


Fig. 41 Installing Detent Plunger, Spring And Plug

(25) Inspect range fork pads (Fig. 42). Be sure pads are secure and in position.

(26) Assemble range fork and shift hub (Fig. 43).

(27) Engage range fork pin in sector slot (Fig. 44).

(28) If drive sprocket bearings are to be replaced, remove and install them as follows:

(a) Press both bearings out of sprocket simultaneously with Remover Tool C-4667, or 5066 and Tool Handle C-4171 (Fig. 45).

(b) Before installing new bearings, refer to Figure 46 and note correct bearing position in sprocket. Bearings must be also be installed in proper sequence. Install front bearing first and rear bearing last.

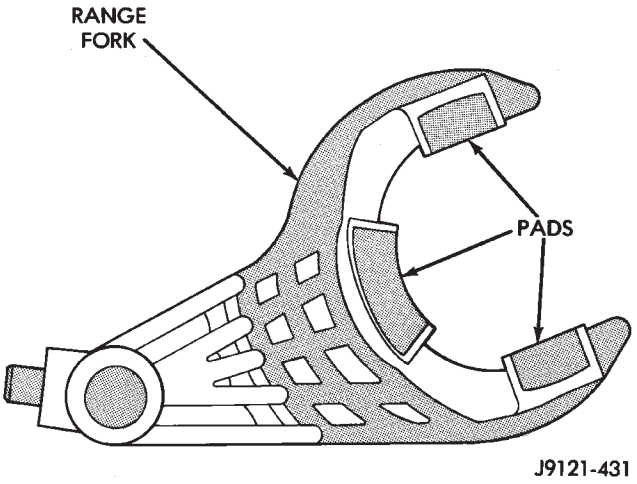


Fig. 42 Range Fork Pads

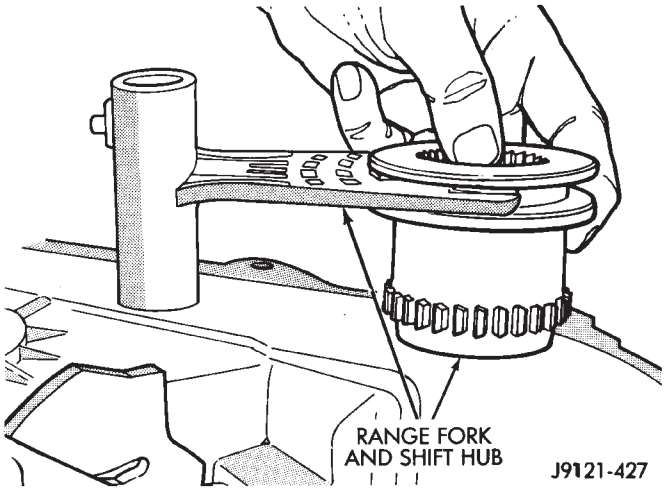


Fig. 43 Assembling Range Fork And Shift Hub

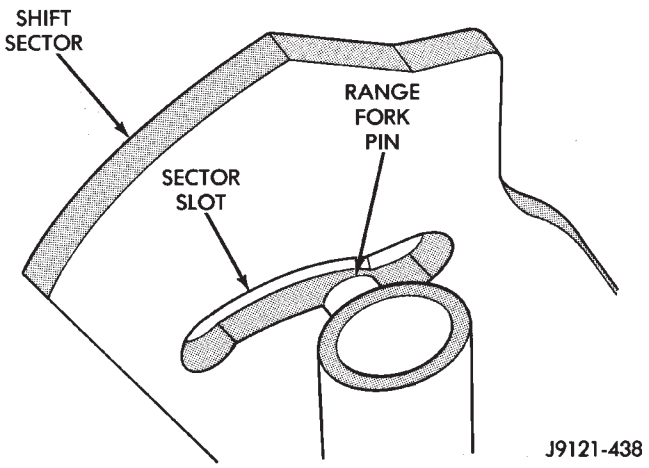


Fig. 44 Seating Range Fork In Sector

CAUTION: Do not press the bearings any farther into the sprocket than indicated in Figure 46. The bearings could block the mainshaft oil feed hole if pressed too deeply into the sprocket.

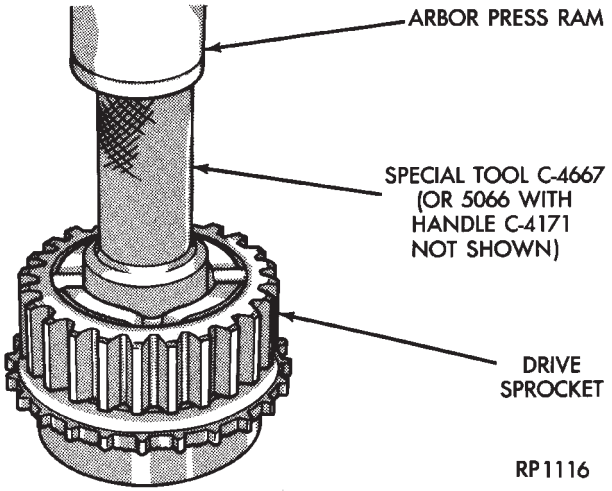


Fig. 45 Removing Drive Sprocket Bearings

(c) Install new **front** bearing first. Press bearing flush with edge of sprocket bore (Fig. 47).

(d) Install new **rear** bearing (Fig. 48). Press bearing in until 4.6 mm (3/16 in.) below edge of bore as shown in Figure 46.

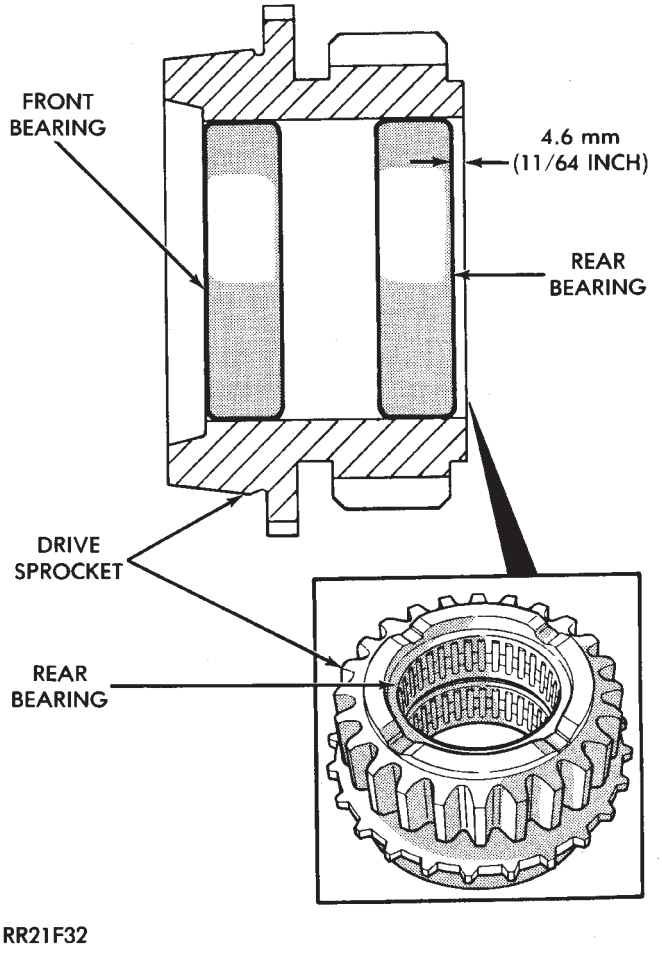


Fig. 46 Correct Position Of Bearings In Sprocket

(29) Install spring and three struts in synchro hub (Fig. 49).

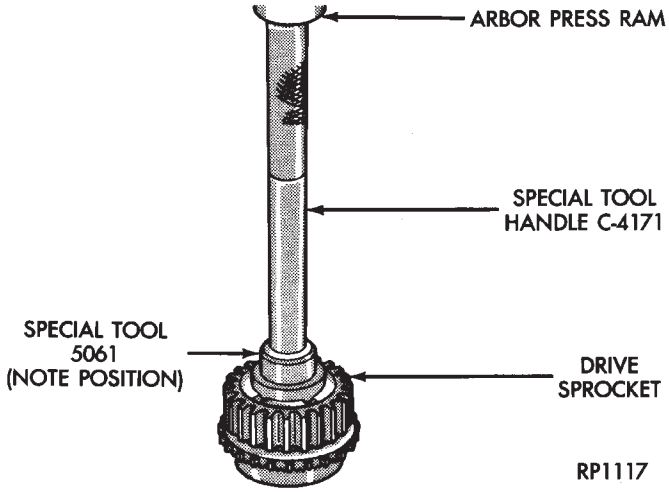


Fig. 47 Installing Drive Sprocket Front Bearing

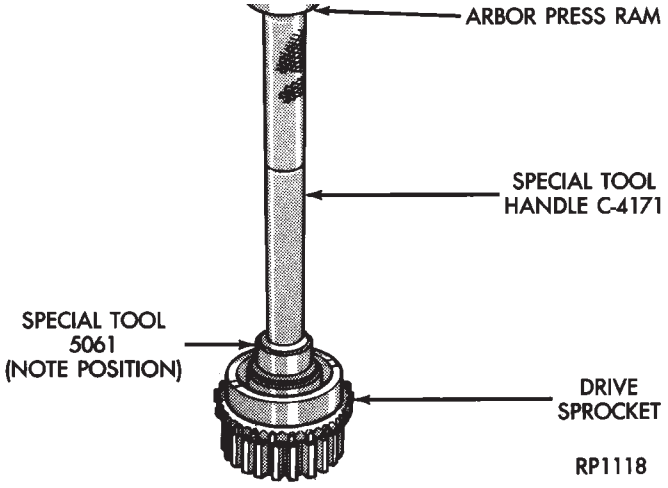


Fig. 48 Installing Drive Sprocket Rear Bearing

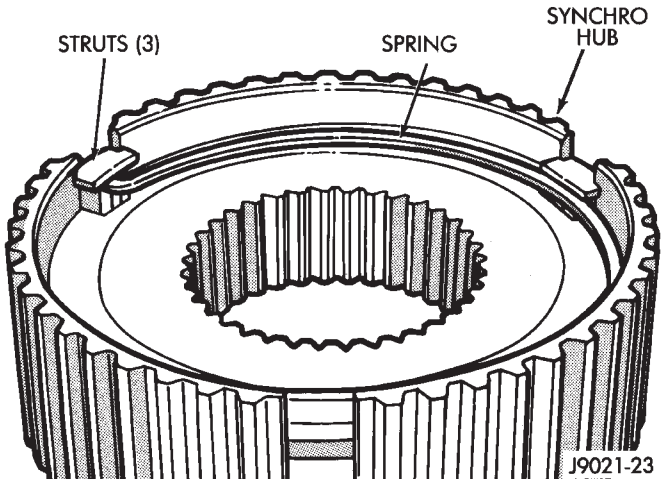


Fig. 49 Installing Synchro Hub Spring And Struts

(30) Lubricate drive sprocket bearings, stop ring and synchro hub with automatic transmission fluid.

(31) Install sprocket, stop ring and synchro hub on mainshaft (Fig. 50). **Be sure to seat hub struts on stop ring lugs.**

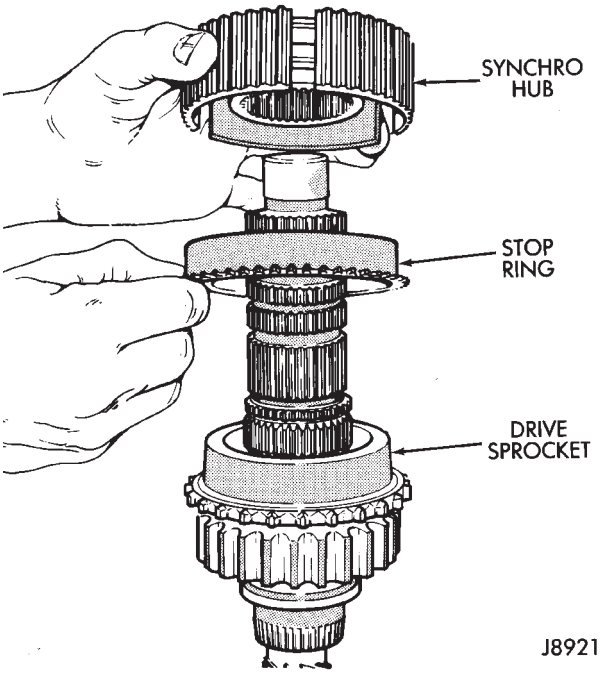


Fig. 50 Drive Sprocket, Stop Ring And Synchro Hub Installation

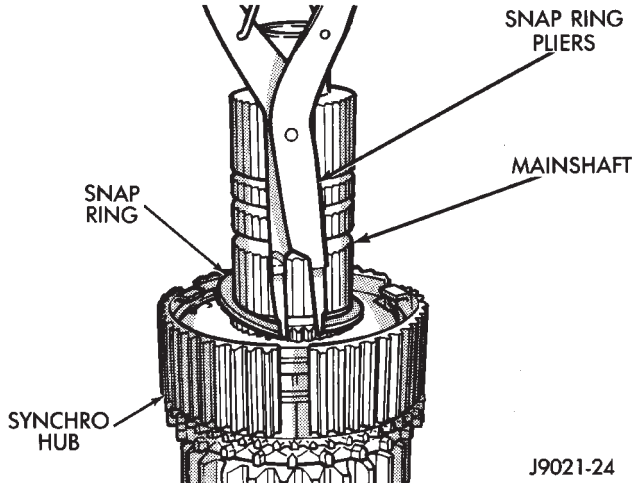


Fig. 51 Installing Synchro Hub Snap Ring

(32) Install new synchro hub snap ring (Fig. 51).

(33) Install sleeve on synchro hub. Be sure sleeve is installed with beveled spline ends facing stop ring.

(34) Install new pads on mode fork and install shift rail in fork.

(35) Engage mode fork in synchro sleeve (Fig. 52).

(36) Install mode fork-mainshaft assembly in case (Fig. 52). Be sure the mode fork rail is seated in both range fork bushings.

(37) Assemble and install output shaft and drive chain (Fig. 53). Lift mainshaft slightly to ease chain and shaft installation.

(38) Install mode spring on shift rail (Fig. 54).

(39) If front output shaft rear bearing is to be replaced, install new bearing as follows:

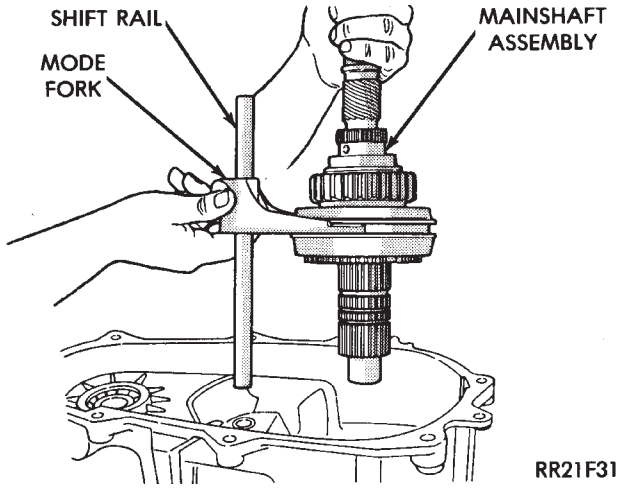


Fig. 52 Installing Mainshaft And Mode Fork Assembly

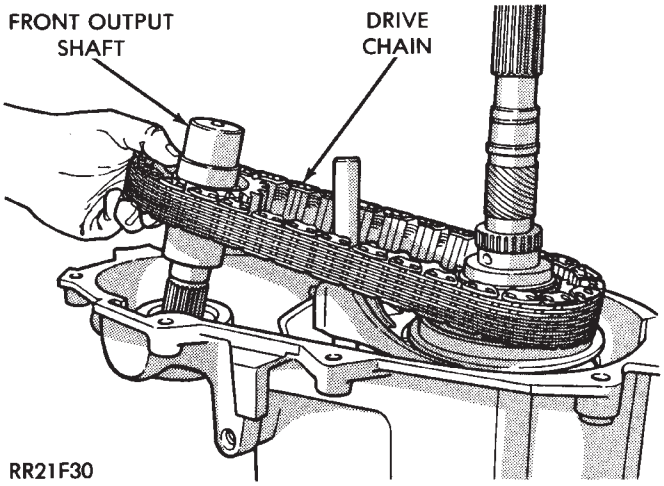


Fig. 53 Drive Chain And Front Output Shaft Installation

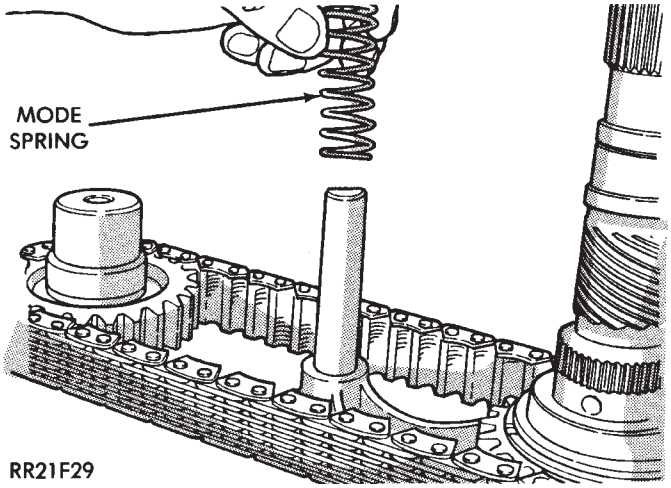


Fig. 54 Installing Mode Spring

(a) Remove bearing from rear case with Bearing Remover MD-998346 and two suitable size wrenches (Fig. 55).

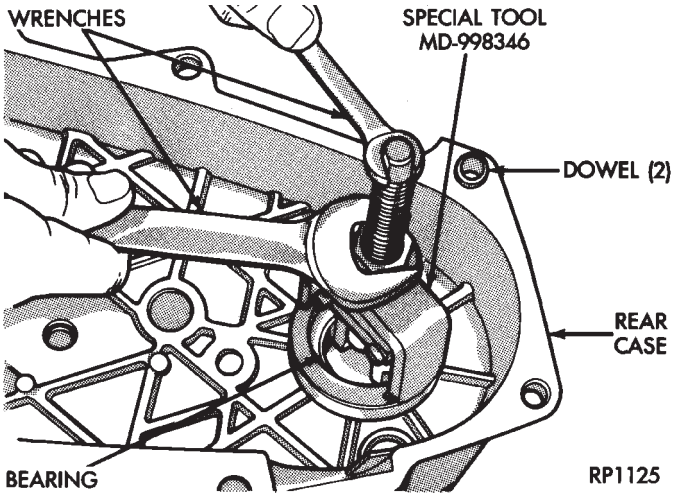


Fig. 55 Removing Front Output Shaft Rear Bearing

(b) Seat new bearing in rear case with Tool Handle C-4171 and Bearing Installer 5063 (Fig. 56).

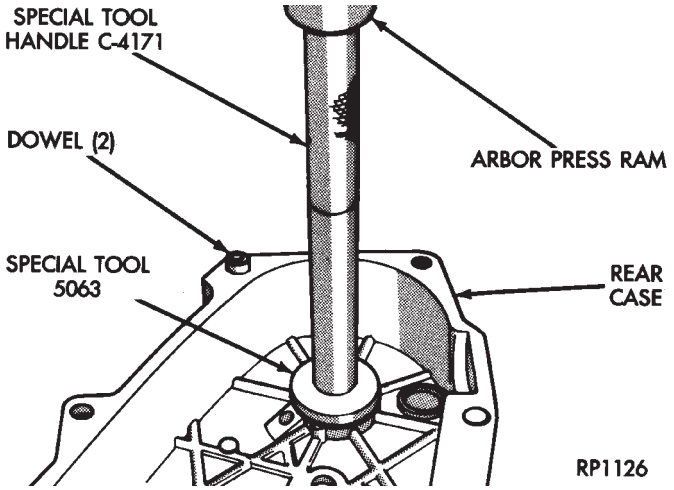


Fig. 56 Installing Front Output Shaft Rear Bearing

(40) Install new seal in oil pump feed housing (Fig. 57).

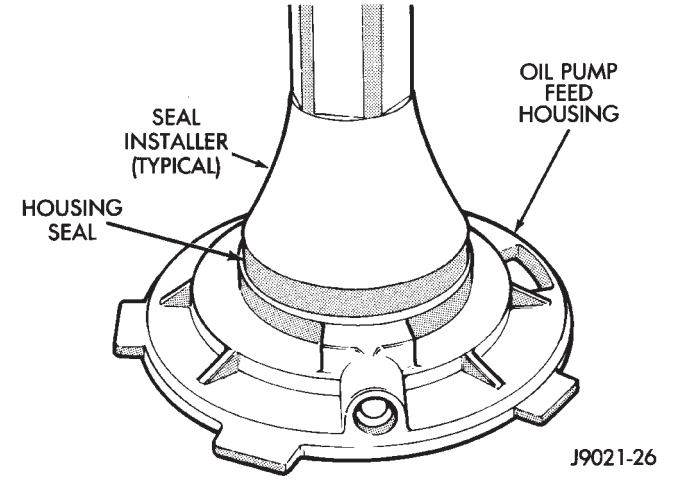


Fig. 57 Installing Oil Pump Feed Housing Seal

(41) **If new oil pump is being installed, proceed to step (43). If original pump was only disassembled for cleaning and inspection, proceed to step (42).**

(42) Assemble oil pump. Lubricate and install two gears in gear housing. Align and install feed housing on gear housing (Fig. 58). Install and tighten oil pump screws to 2 N·m (14 in. lbs.) torque.

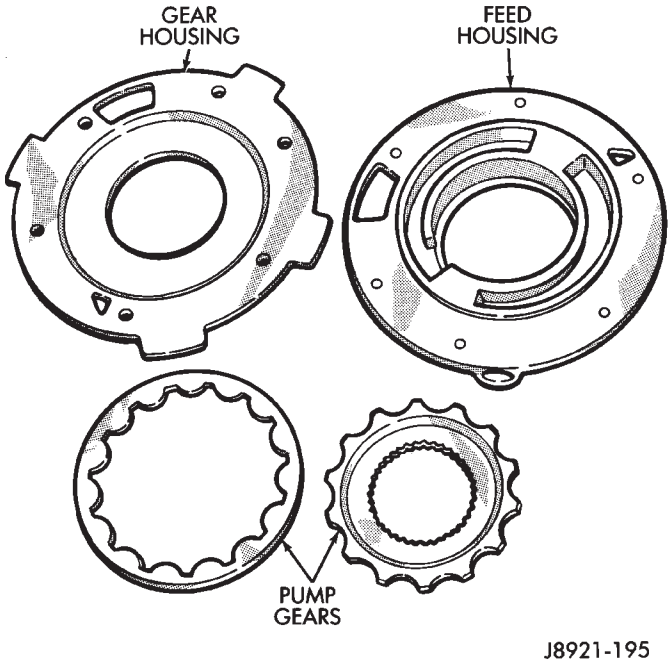


Fig. 58 Oil Pump Components

(43) Install new pickup tube O-ring in oil pump (Fig. 59).

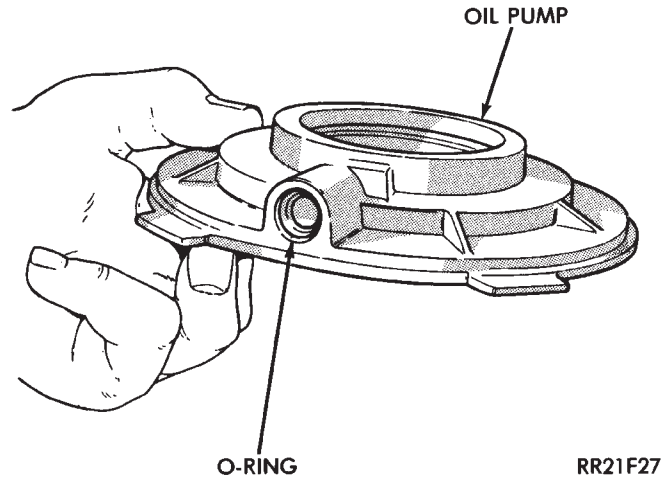


Fig. 59 Pickup Tube O-Ring Installation

(44) Insert oil pickup tube in oil pump. Then attach oil screen and connecting hose to pickup tube (Fig. 60).

(45) Install assembled oil pump, pickup tube and screen in rear case. Be sure screen is seated in case slot as shown (Fig. 60).

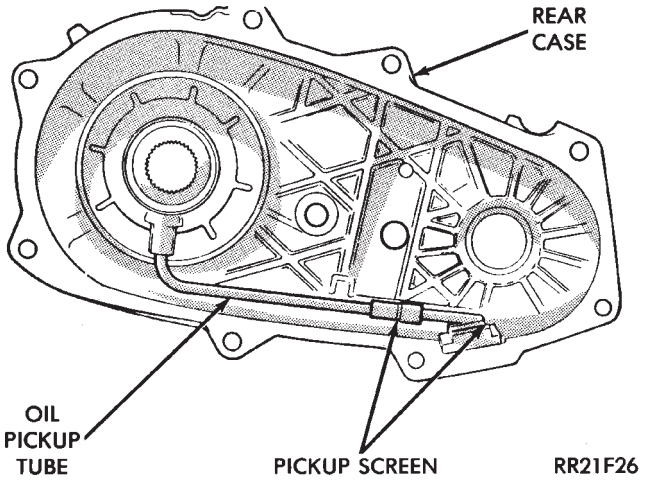


Fig. 60 Pickup Tube, Oil Screen And Pump Installation

(46) Install magnet in front case.

(47) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker, silicone adhesive sealer, or Loctite 518 to seal surface of front case.

(48) Align and install rear case on front case (Fig. 61). Be sure case locating dowels are in place and that mainshaft splines are engaged in oil pump inner gear.

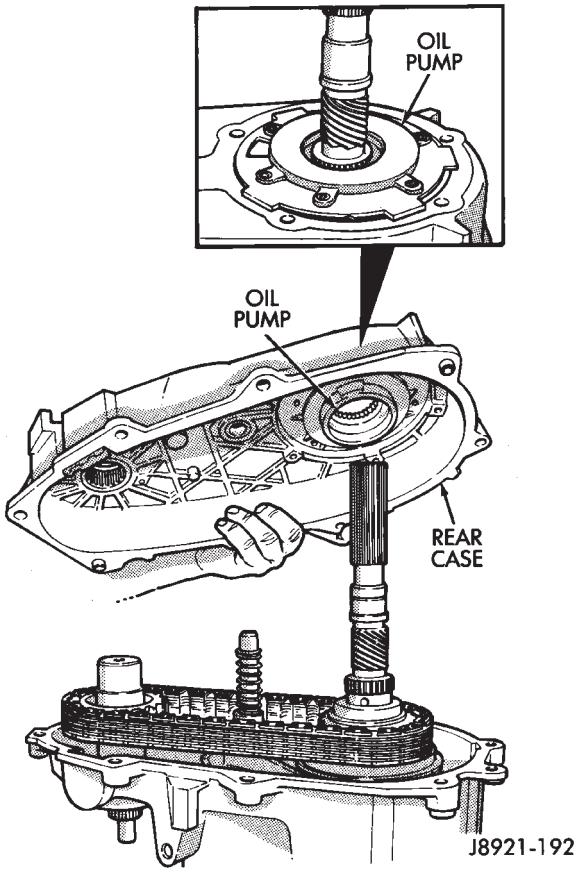


Fig. 61 Installing Rear Case On Front Case

(49) Install and tighten front case-to-rear case attaching bolts to 41 N·m (30 ft. lbs.) torque. **Be sure to install a washer under each bolt used at case dowel locations.**

(50) Install mainshaft rear bearing in rear retainer (Fig. 62). Tap old bearing out of retainer with hammer and brass drift. Then install new bearing with Tool Handle C-4171 and Installer 5064.

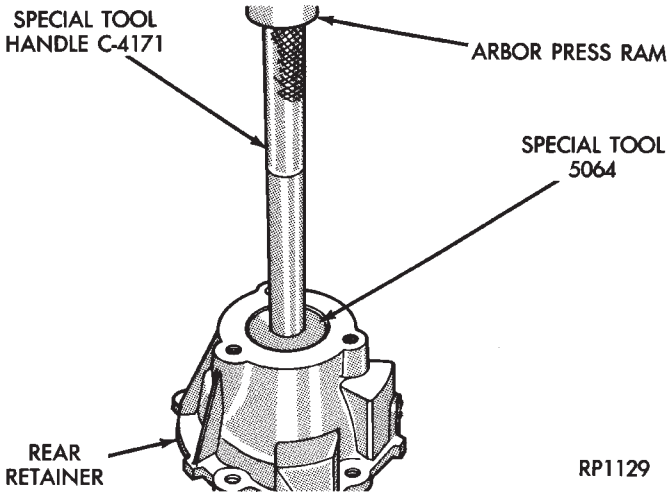


Fig. 62 Installing Mainshaft Rear Bearing In Rear Retainer

(51) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker, silicone adhesive sealer, or Loctite 518 to flange surface of rear retainer.

(52) Install locating dowel in rear retainer and install retainer on case. Tighten retainer bolts to 24 N·m (18 ft. lbs.) torque.

(53) Install new rear bearing snap ring (Fig. 63). Lift mainshaft slightly to seat snap ring in shaft groove.

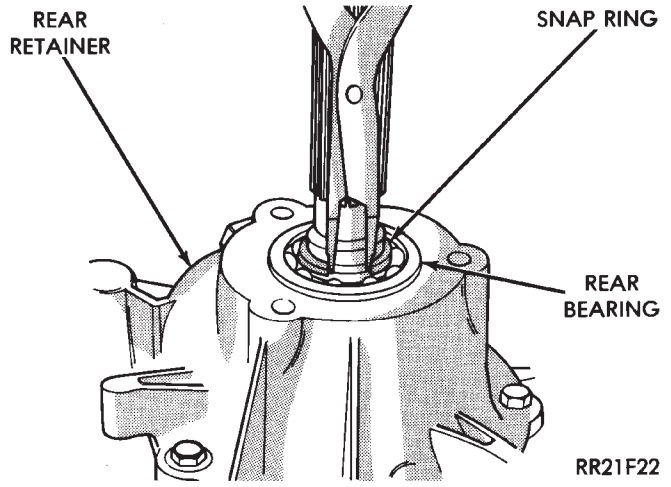


Fig. 63 Installing Rear Bearing Snap Ring

(54) Remove extension housing seal if not removed previously.

(55) Remove extension housing bushing with Bushing Installer Tools C-4171 and C-4338-A (Fig. 64).

(56) Install new extension housing bushing with Installer Tools C-4171 and 5066 (Fig. 65).

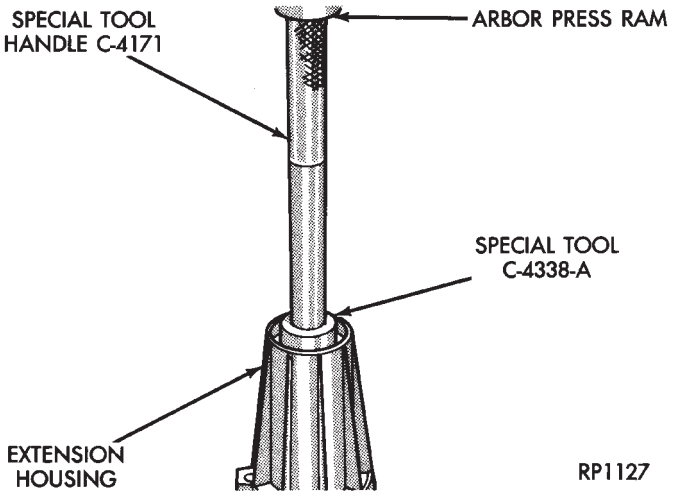


Fig. 64 Removing Extension Housing Bushing

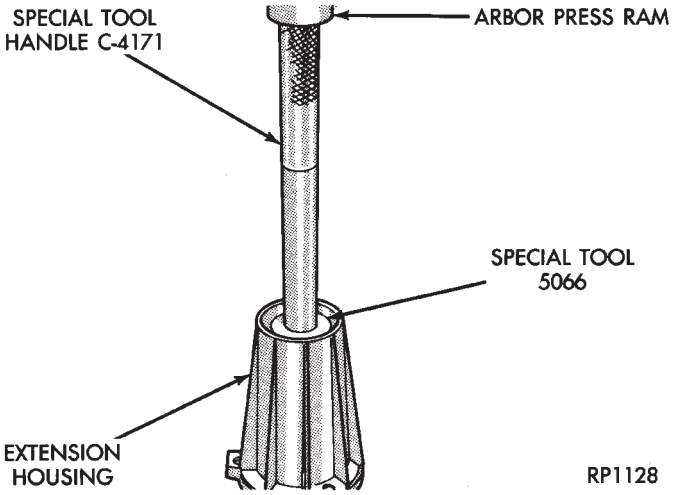


Fig. 65 Installing Extension Housing Bushing

(57) Install new seal in extension housing.

(58) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker, silicone adhesive sealer, or Loctite 518 to mounting surface of extension housing.

(59) Install extension housing on case and tighten housing bolts to 41 N·m (30 ft. lbs.) torque.

(60) Install front yoke. Secure yoke with replacement seal washer and nut. Tighten nut to 149 N·m (110 ft. lbs.) torque.

(61) Install replacement gasket on vacuum switch and install switch in case.

(62) Install tighten drain plug to 47 N·m (35 ft. lbs.) torque.

(63) Install vacuum switch in case. Tighten switch to 47 N·m (35 ft. lbs.) torque.

(64) Install speedometer pinion and adapter (Fig. 66).

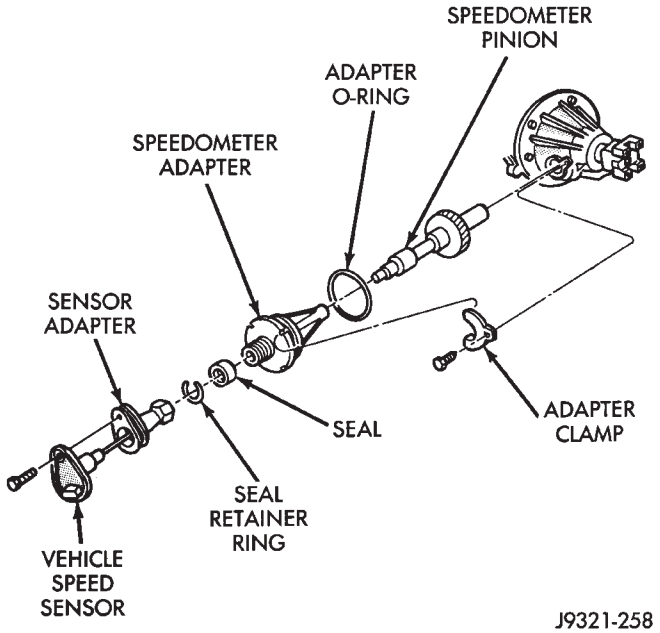
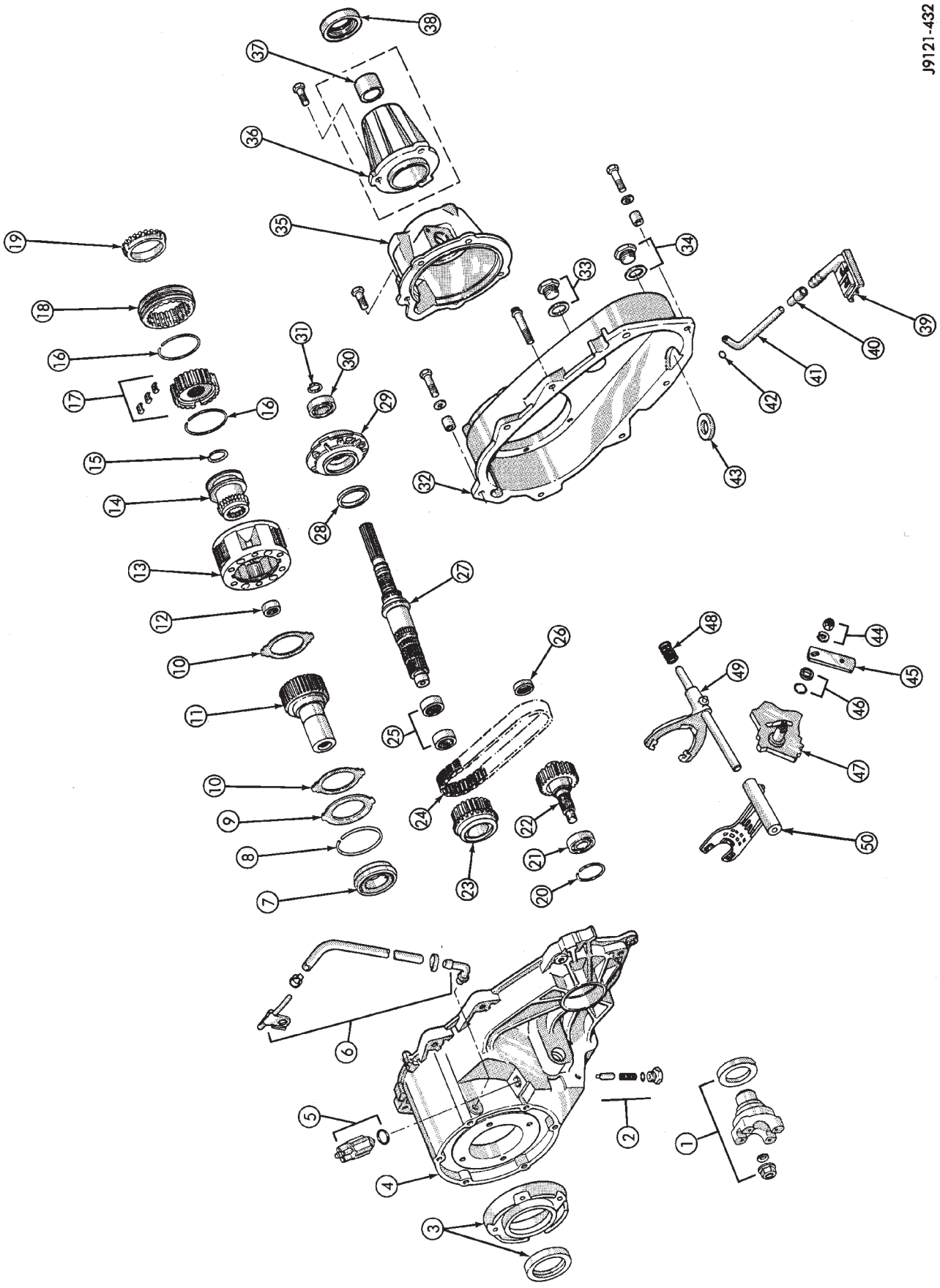


Fig. 66 Speedometer Components (YJ Shown)

(65) Fill transfer case with Mopar ATF Plus or Dexron II automatic transmission fluid after installation.

(66) Install and tighten fill plug to 41 N·m (35 ft. lbs.) torque.


J9121-432
NP231 TRANSFER CASE

LEGEND FOR NP231 TRANSFER CASE

1. Front Yoke, Nut, Seal Washer, and Oil Seal	18. Synchro Sleeve*	35. Rear Retainer
2. Shift Detent Plug, Spring and Pin	19. Stop Ring*	36. Extension Housing
3. Front Retainer and Seal	20. Snap Ring	37. Bushing
4. Front Case	21. Output Shaft Front Bearing	38. Oil Seal
5. Vacuum Switch and Seal	22. Front Output Shaft	39. Oil Pickup Screen
6. Vent Assembly	23. Drive Sprocket	40. Tube Connector
7. Input Gear Bearing and Snap Ring	24. Drive Chain	41. Oil Pickup Tube
8. Low Range Gear Snap Ring	25. Drive Sprocket Bearings	42. Pickup Tube O-Ring
9. Input Gear Retainer	26. Output Shaft Rear Bearing	43. Magnet
10. Low Range Gear Thrust Washers	27. Mainshaft	44. Range Lever Nut and Washer
11. Input Gear	28. Oil Seal	45. Range Lever
12. Input Gear Pilot Bearing	29. Oil Pump Assembly	46. Sector O-Ring and Seal
13. Low Range Gear	30. Mainshaft Rear Bearing	47. Sector
14. Range Fork Shift Hub	31. Snap Ring	48. Mode Spring
15. Synchro Hub Snap Ring*	32. Rear Case	49. Mode Fork
16. Synchro Hub Springs*	33. Fill Plug and Gasket	50. Range Fork
17. Synchro Hub and Struts*	34. Drain Plug and Gasket	

*Synchro equipped models only.

J9221-76

NP242 TRANSFER CASE

INDEX

GENERAL INFORMATION

The NP242 is a both a full and part time transfer case with four operating ranges (Fig. 1). The NP242 provides either 2-wheel drive or full time 4-wheel drive operation. An interaxle differential is used to control torque transfer to the front and rear axles. A low range gear reduction system provides increased low speed torque capability.

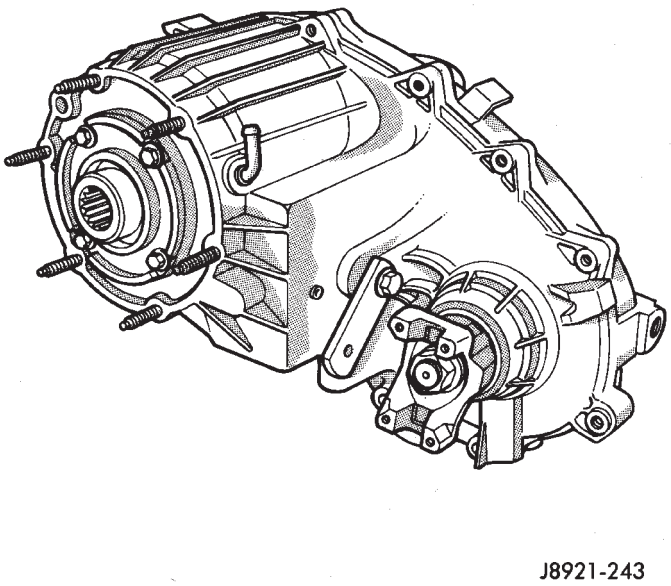


Fig. 1 NP242 Transfer Case

OPERATING RANGES

The NP242 transfer case operating ranges are: 2-wheel drive, part-time 4-wheel drive, full time 4-wheel drive and 4-wheel drive low.

The 2H and 4 x 4 full time ranges are for all road surfaces. The 2H range provides 2-wheel drive. The 4 x 4 full time range provides differentiated, 4-wheel drive. The vehicle can be operated on any road surface in either of these ranges if desired.

The transfer case differential also has a locking mechanism for undifferentiated operation in: 4 x 4 part time and, 4 x 4 low ranges. These ranges are only for use on low traction surfaces.

The 4 x 4 full time range is fully differentiated and can be used at any time and on any road surface. The 4 x 4 part time and low ranges are not differentiated. They are for off road use only.

The low range reduction gear system is operative in 4-low range only. Low range reduction ratio is 2.72:1.

In summary, 2H and 4 x 4 full time ranges are for normal on-road, highway operation. The 4 x 4 part-time and low ranges are for off road operation exclusively. Or, or when the vehicle is driven on surfaces covered by snow, ice or similar low traction elements.

SHIFT MECHANISM

Transfer case operating ranges are selected with a floor mounted shift lever. The shift lever is connected to the transfer case range lever by an adjustable linkage rod. Range positions are marked on the shifter bezel plate (Fig. 2).

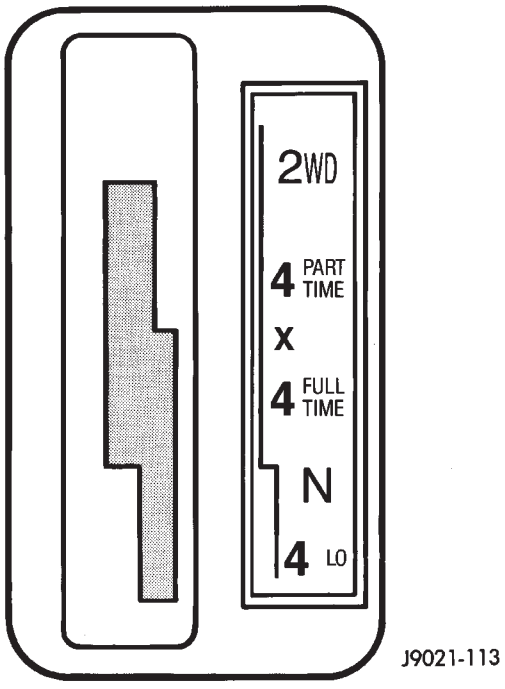


Fig. 2 NP242 Shift Pattern

TRANSFER CASE IDENTIFICATION

A circular I.D. tag is attached to the rear case of each NP242 transfer case (Fig. 3). The tag provides the transfer case model number, assembly number, serial number and low range ratio.

The transfer case serial number also represents the date of build. For example, a serial number of 10-5-91 would represent October 5, 1991.

TRANSFER CASE LUBRICANT

Recommended fluid for the NP242 transfer case is Mopar Dexron II, or ATF Plus, Type 7176 automatic transmission fluid.

Lubricant capacity of the Model 242 transfer case is: 1.4 liters (1.48 qts.).

TRANSFER CASE FILL LEVEL

Correct fill level for the NP242 transfer case is to the bottom edge of the fill plug hole.

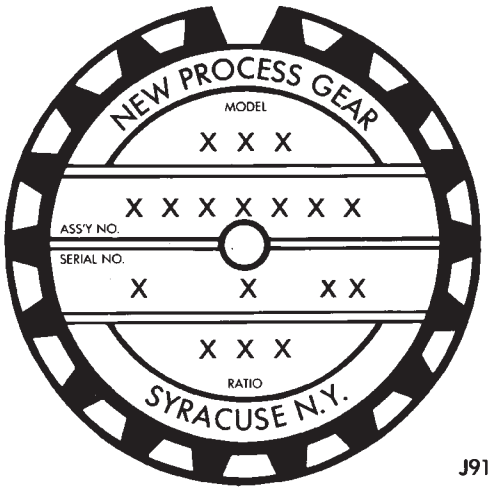


Fig. 3 Transfer Case I.D. Tag

NP242 SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Transfer case external shift linkage binding.	(1) Lubricate, repair or replace linkage, or tighten loose components as necessary.
	(2) Insufficient or incorrect lubricant.	(2) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid.
	(3) Internal components binding, worn or damaged.	(3) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE POSITIONS	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with DEXRON II® or MOPAR-MERCON® Automatic Transmission Fluid. Check for leaks and repair if necessary **Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.**
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clear or replace vent if necessary.
	(3) Output shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores and nicks with fine sandpaper or replace yoke(s) if necessary.
TRANSFER CASE WILL NOT SHIFT THROUGH 4 X 4 PART-TIME RANGE (Light Remains On).	(1) Incomplete shift due to drivetrain torque load.	(1) Driver must momentarily release the accelerator pedal to complete the shift.
	(2) Incorrect tire pressure(s).	(2) Inflate all tires equally to correct pressure.
	(3) Excessive tire wear.	(3) Switch tires — Install the two tires with the most wear (one on the front axle and one on the rear axle).
	(4) Excessive vehicle loading.	(4) Check vehicle loading — **Do not exceed the vehicle's GVW.**

J9121-435

SHIFT LINKAGE ADJUSTMENT

(1) Remove shift lever bezel.

(2) Move shift lever into 4L position.

(3) Insert 3 mm (1/8 in.) spacer between shift lever and forward edge of shift lever gate (Fig. 4). Secure lever and spacer in place with tape or wire.

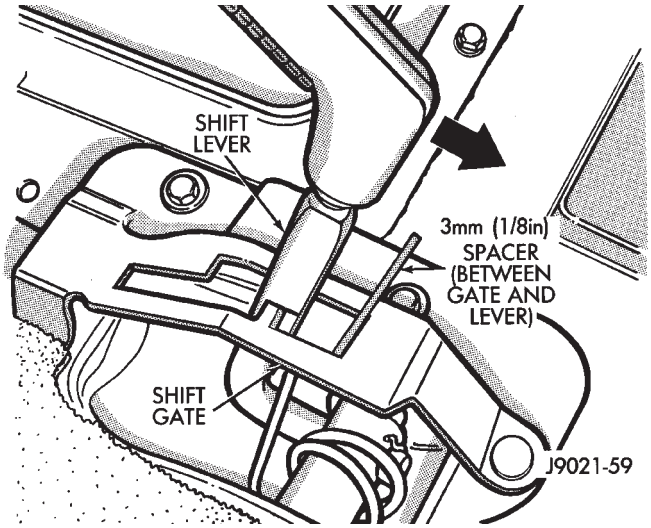


Fig. 4 Installing Shift Lever Spacer

(4) Raise vehicle.

(5) Loosen trunnion lock bolt (Fig. 5). Linkage rod should now slide freely in trunnion.

(6) Verify that transfer case range lever is in 4L position.

(7) Position linkage rod so it is free fit in range lever (Fig. 5). Then tighten trunnion lock bolt.

(8) Lower vehicle.

(9) Remove shift lever spacer and install bezel.

SPEEDOMETER SERVICE

Speedometer service is covered in the automatic transmission sections within this group.

TRANSFER CASE REMOVAL

(1) Shift transfer case into Neutral.

(2) Raise vehicle.

(3) Drain transfer case lubricant.

(4) Mark front and rear propeller shaft yokes for alignment reference.

(5) Place support stand under transmission.

(6) Remove rear crossmember.

(7) Disconnect front/rear propeller shafts at transfer case.

(8) Disconnect vehicle speed sensor wires and remove sensor and adapter assembly if necessary.

(9) Disconnect transfer case shift rod from range lever.

(10) Disconnect transfer case vent hoses and electrical switch connector.

(11) Support transfer case with transmission jack.

(12) Remove bolts attaching the transfer case to transmission.

(13) Secure transfer case to jack with chains.

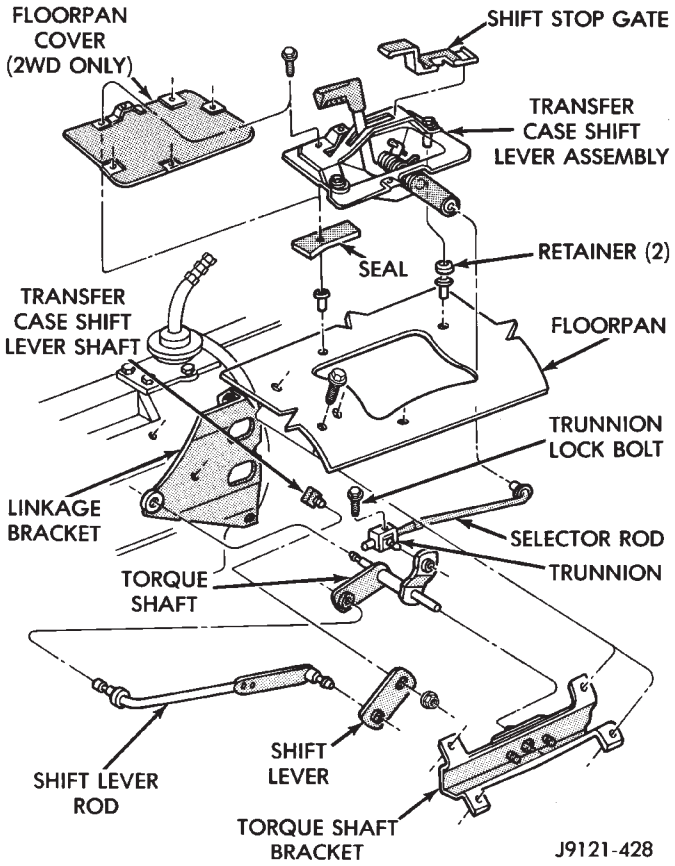


Fig. 5 Transfer Case Shift Linkage

(14) Pull transfer case and jack rearward to disengage transfer case.

(15) Remove transfer case from under vehicle.

TRANSFER CASE INSTALLATION

(1) Mount transfer case on transmission jack. Secure transfer case to jack with safety chains.

(2) Position transfer case under vehicle.

(3) Align transfer case and transmission shafts and install transfer case on transmission.

(4) Install and tighten transfer case attaching nuts to 35 N·m (26 ft. lbs.) torque.

(5) Install vehicle speed sensor and adapter, if removed. Then connect vehicle speed sensor wires, vent hoses and electrical switch connector.

(6) Align and connect propeller shafts. Tighten shaft U-joint clamp bolts to 19 N·m (14 ft. lbs.) torque.

(7) Fill transfer case with recommended automatic transmission fluid.

(8) Install rear crossmember. Tighten crossmember bolts to 41 N·m (30 ft. lbs.) torque.

(9) Remove transmission jack and transmission support stand.

(10) Connect transfer case range lever to shift rod.

(11) Check and adjust transfer case shift linkage if necessary.

(12) Lower vehicle.

TRANSFER CASE DISASSEMBLY AND OVERHAUL

(1) Remove fill and drain plugs.

(2) Remove front yoke. Discard yoke seal washer and nut.

(3) Move range lever rearward to 4L position.

(4) Remove extension housing attaching bolts.

(5) Tap extension housing in a clockwise direction to break sealer bead and remove housing (Fig. 6).

CAUTION: To avoid damaging the sealing surfaces of the extension housing and rear retainer, do not attempt to pry or wedge the housing off the retainer.

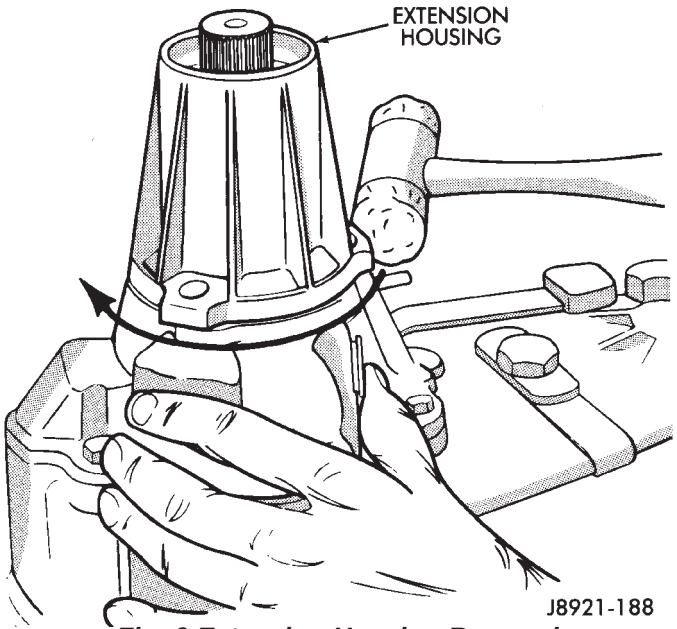


Fig. 6 Extension Housing Removal

(6) Remove rear bearing snap ring from mainshaft (Fig. 7). Discard snap ring.

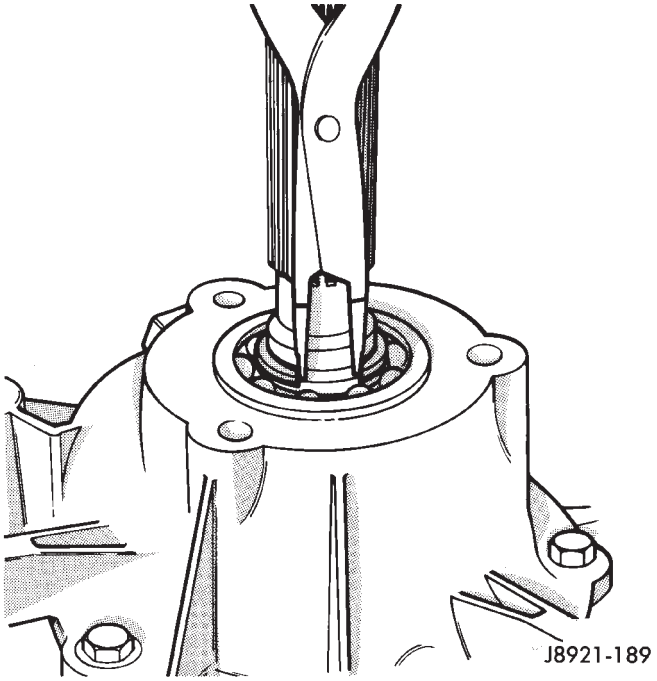


Fig. 7 Removing Rear Bearing Snap Ring

(7) Remove rear retainer attaching bolts.

(8) Loosen rear retainer (Fig. 8). Position long screwdriver under each tab at ends of retainer housing and pry retainer upward.

CAUTION: Do not pry against the sealing surfaces of the retainer or rear case. The surfaces could be damaged.

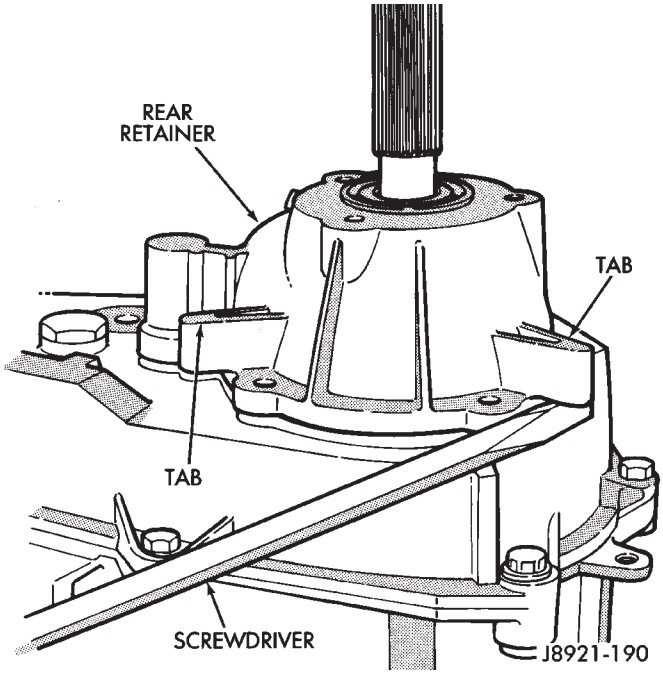


Fig. 8 Loosening Rear Retainer

(9) Lift rear retainer up and off case and mainshaft (Fig. 9).

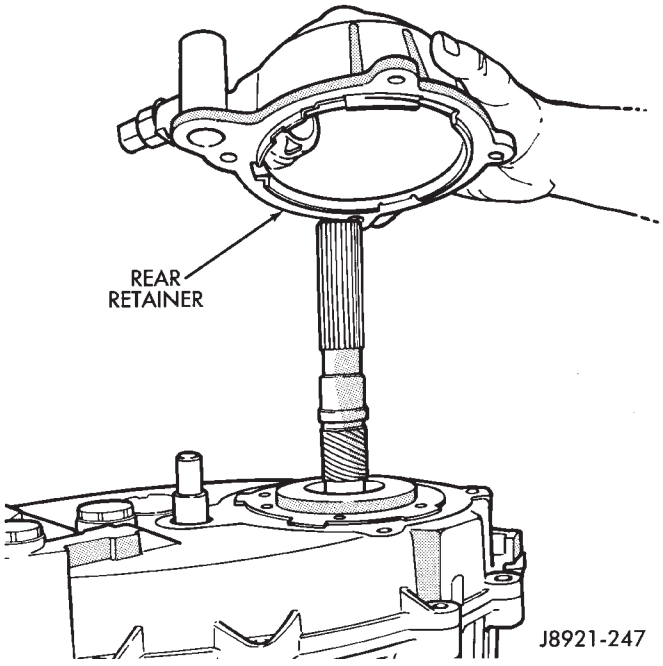


Fig. 9 Remove Rear retainer

(10) Remove bolts attaching rear case to front case. Retain bolts and the washers.

(11) Loosen rear case with two screwdrivers (Fig. 10). Insert screwdrivers into slots cast in case ends. Then gently pry upward to break sealer bead.

CAUTION: Do not pry against the sealing surfaces of the front case or rear case. The surfaces could be damaged.

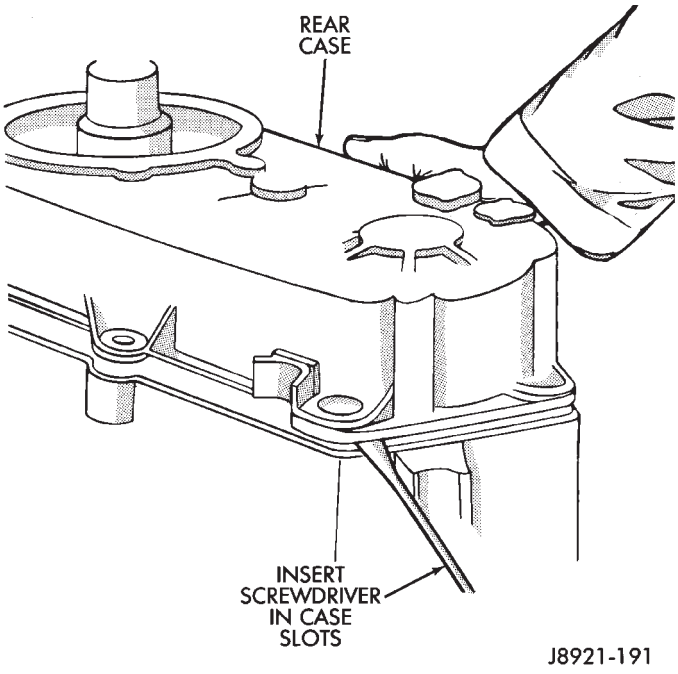


Fig. 10 Loosening Rear Case

(12) Remove rear case and oil pump as assembly (Fig. 11).

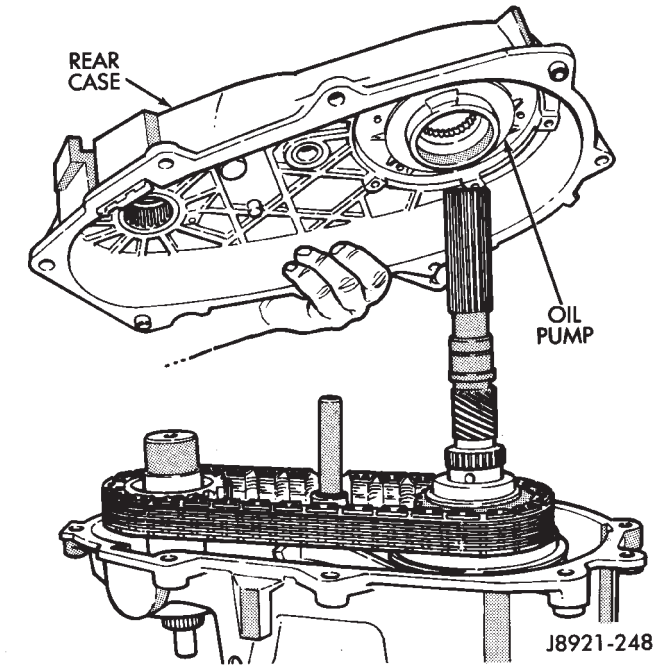


Fig. 11 Removing Rear Case And Oil Pump

(13) Slide oil screen (Fig. 12) out of case pocket.

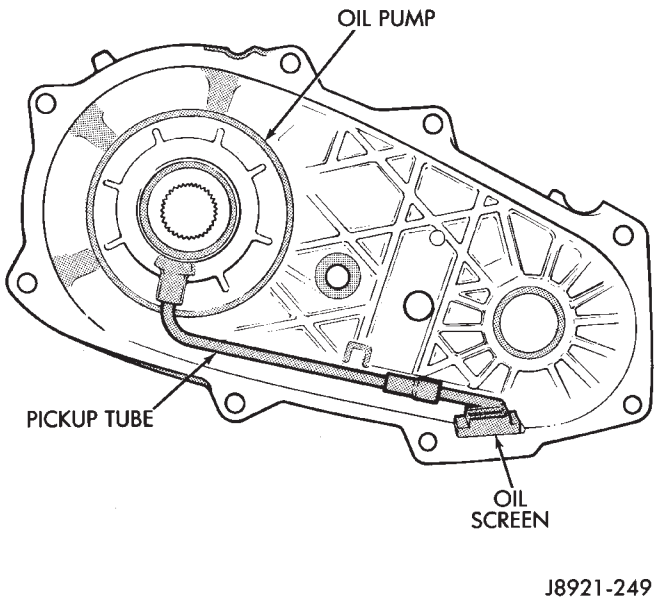


Fig. 12 Unseating Oil Screen

(14) Remove oil pump, pickup tube and oil screen from rear case (Fig. 13).

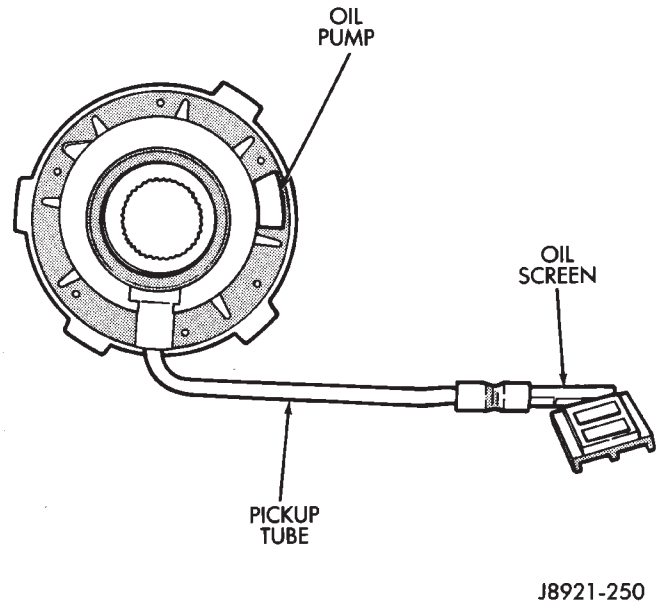


Fig. 13 Removing Oil Pump, Tube And Screen

(15) Remove pickup tube and screen from pump.

(16) Remove pickup tube O-ring from oil pump (Fig. 14).

(17) Remove and discard oil pump seal.

(18) The oil pump can be disassembled for cleaning and inspection as described in step (19). **However, pump parts are not serviceable separately. If any pump component is worn, or damaged, pump must be replaced as an assembly.**

(19) If oil pump will be disassembled for inspection, mark position of oil pump housings for refer-

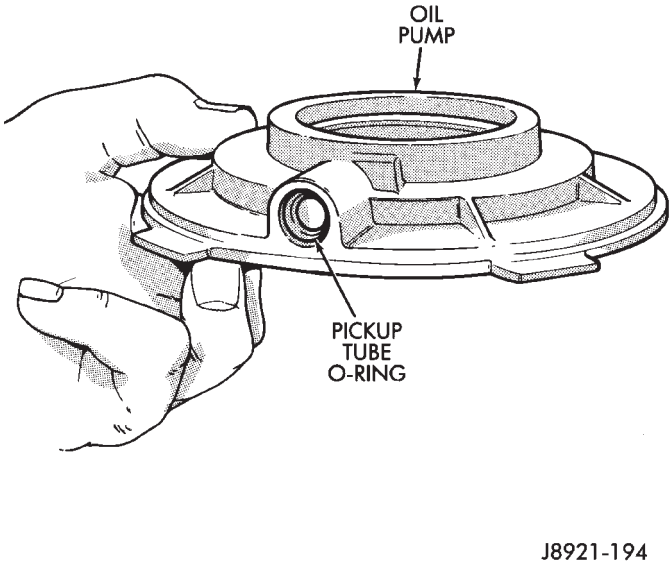


Fig. 14 Removing Pickup Tube O-Ring

ence (Fig. 15). Remove screws that attach two halves of the pump. Remove feed housing from gear housing (Fig. 15). Then mark position of pump gears and remove them from housing (Fig. 15).

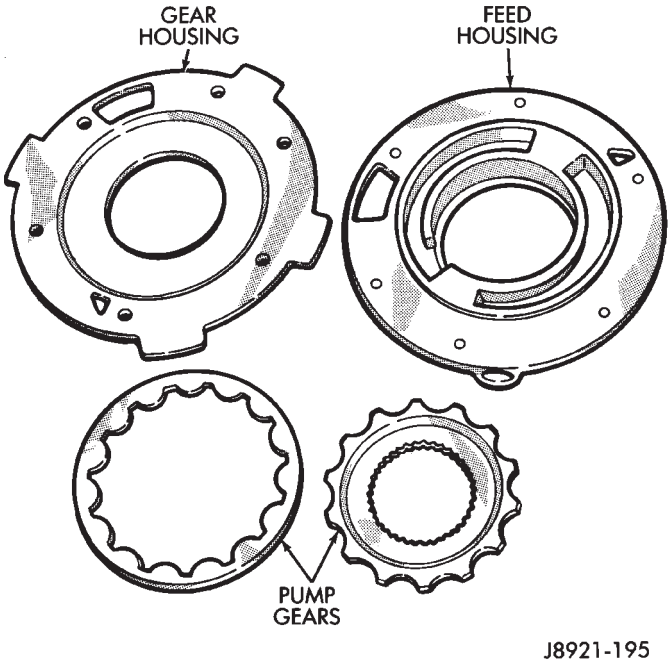


Fig. 15 Oil Pump Components

(20) Remove magnet from front case.
(21) Remove drive sprocket snap ring (Fig. 16).

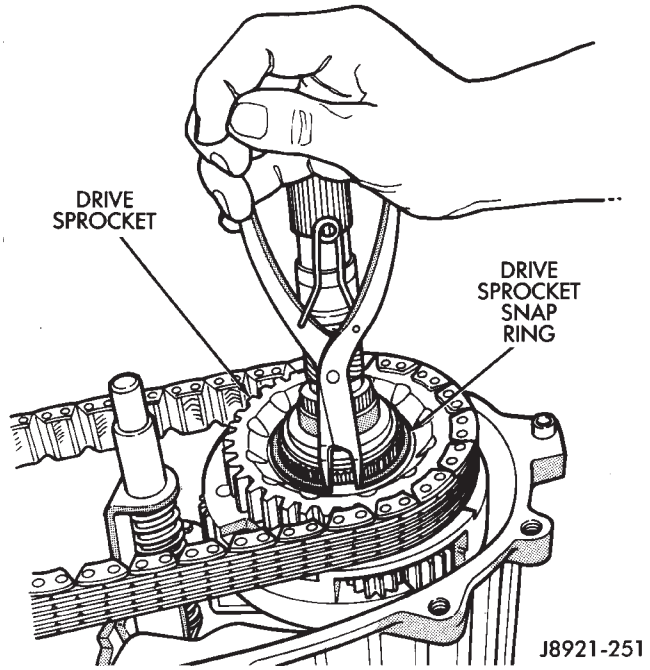


Fig. 16 Removing Drive Sprocket Snap Ring

(22) Remove drive sprocket and chain (Fig. 17).

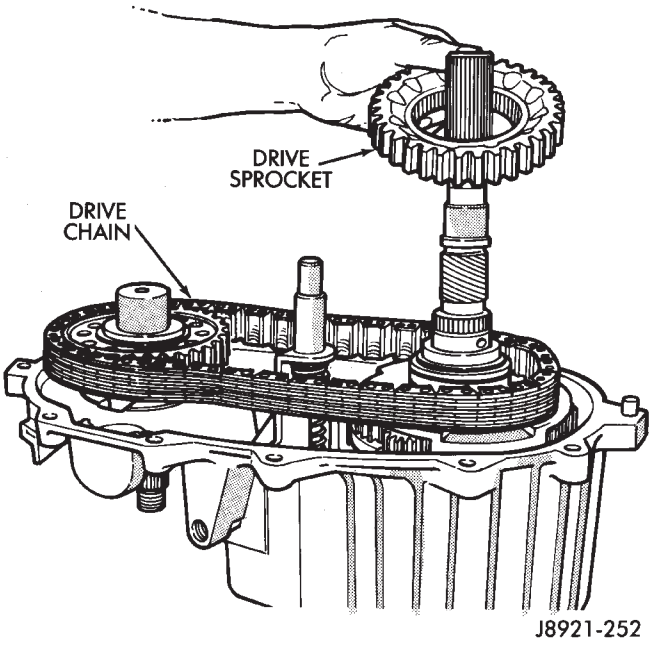


fig. 17 Removing Drive Sprocket And Chain

(23) Remove front output shaft (Fig. 18).

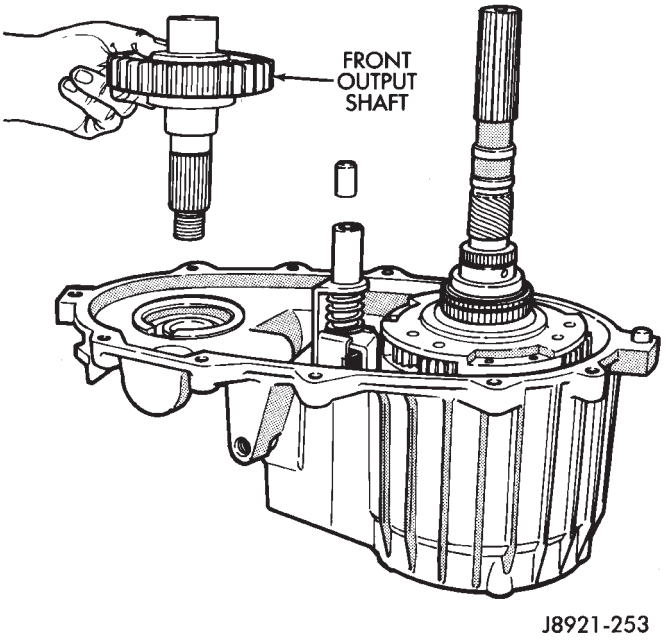


Fig. 18 Removing Front Output Shaft

(24) Remove transfer case shift lever nut and lever.

(25) Remove shift detent plug, spring and pin (Fig. 19).

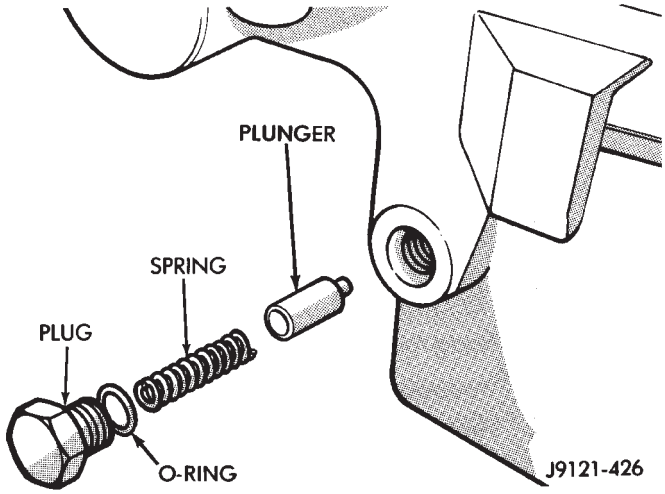


Fig. 19 Removing Detent Components

(26) Remove seal plug from low range fork lockpin access hole. Then move shift sector to align low range fork lockpin with access hole (Fig. 20).

(27) Remove range fork lockpin with size number one easy-out tool. Grip easy-out tool with locking pliers and remove pin with counterclockwise, twist and pull motion (Fig. 20).

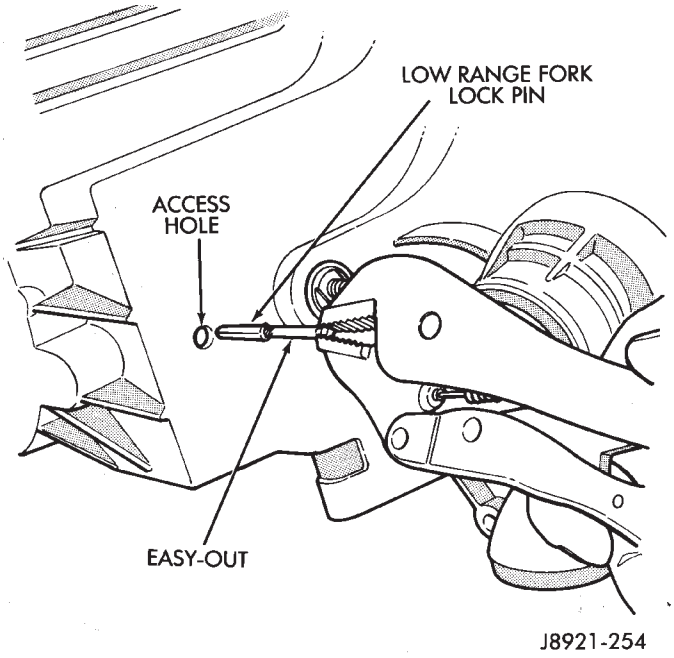


Fig. 20 Removing Low Range Fork Lockpin

(28) Remove shift rail by pulling it straight up and out of fork (Fig. 21).

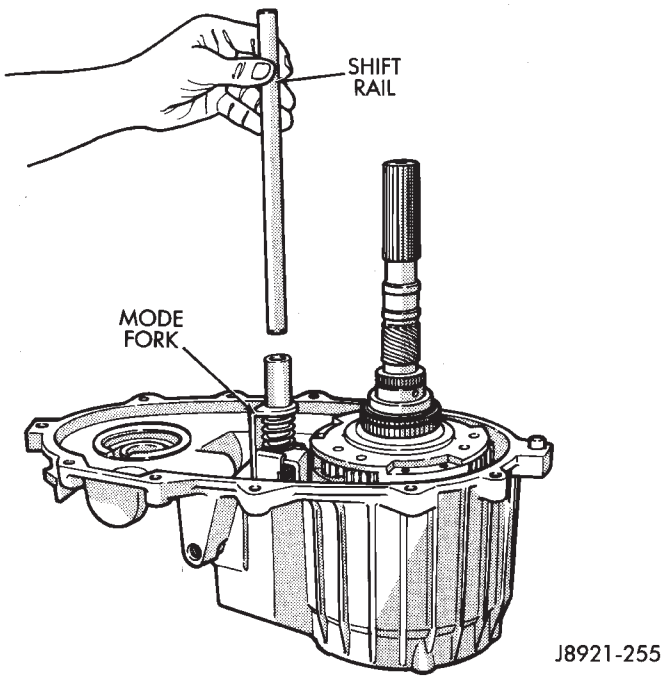


Fig. 21 Removing Shift Rail

(29) Remove mode fork and mainshaft as assembly (Fig. 22).

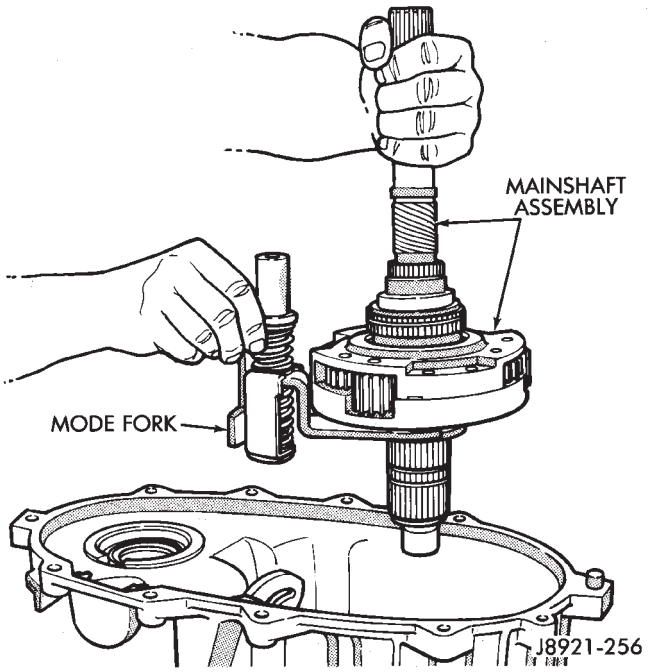


Fig. 22 Removing Mode Fork And Mainshaft

(30) Remove mode shift sleeve and mode fork assembly from mainshaft (Fig. 23). Note position of mode sleeve in fork and remove sleeve.

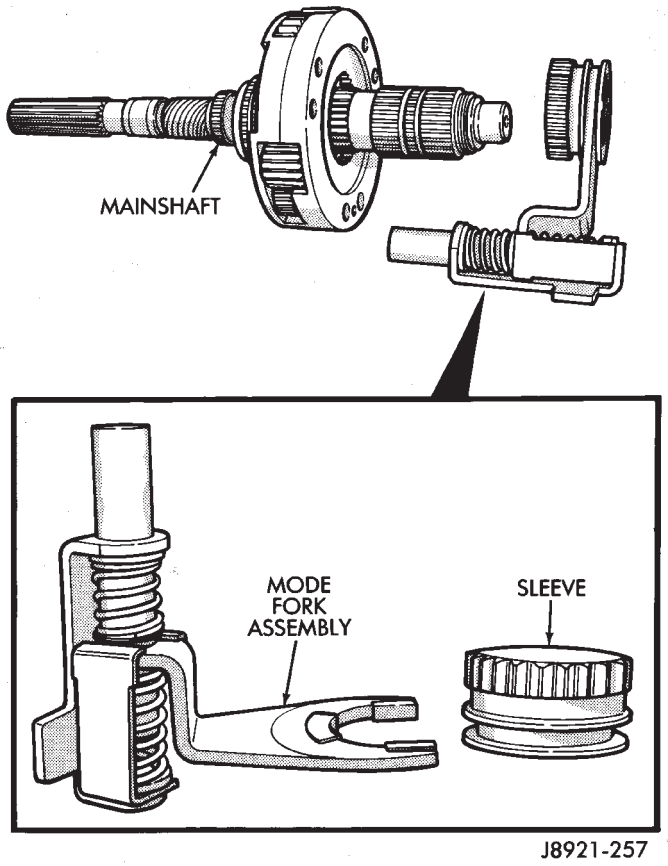


Fig. 23 Removing Mode Fork And Sleeve

(31) Remove intermediate clutch shaft snap ring (Fig. 24).

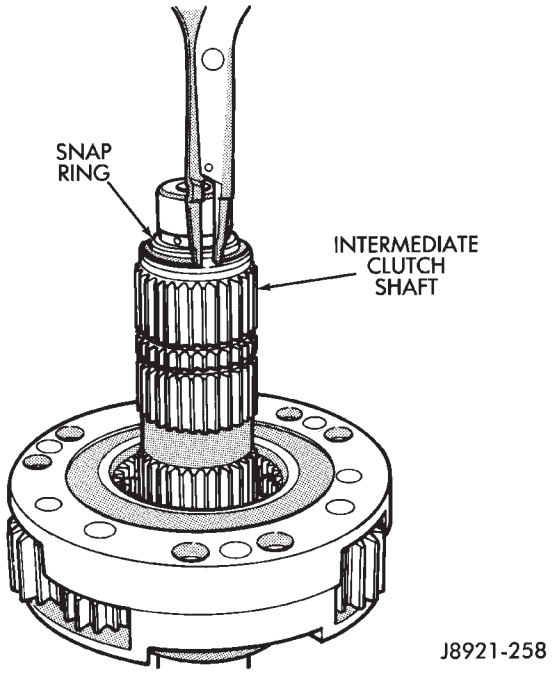


Fig. 24 Removing Intermediate Clutch Shaft Snap Ring

(32) Remove clutch shaft thrust ring (Fig. 25).

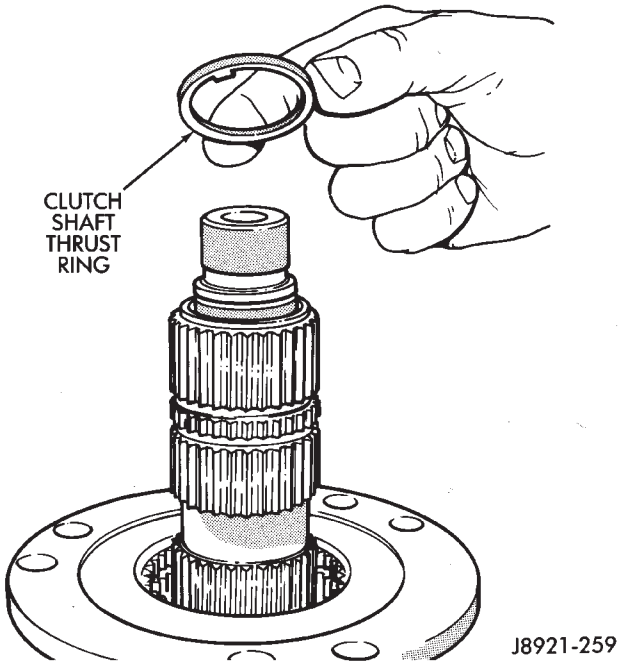


Fig. 25 Removing Clutch Shaft Thrust Ring

(33) Remove intermediate clutch shaft (Fig. 26).

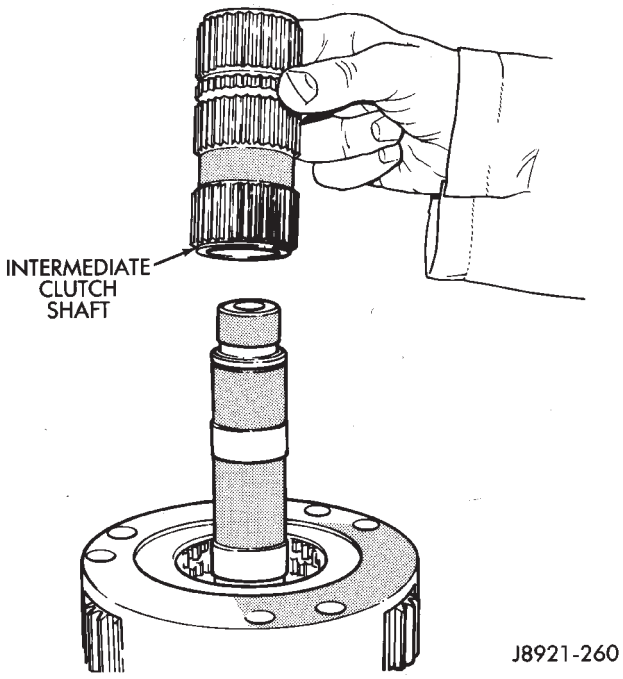


Fig. 26 Removing Intermediate Clutch Shaft

(34) Remove differential snap ring (Fig. 27).

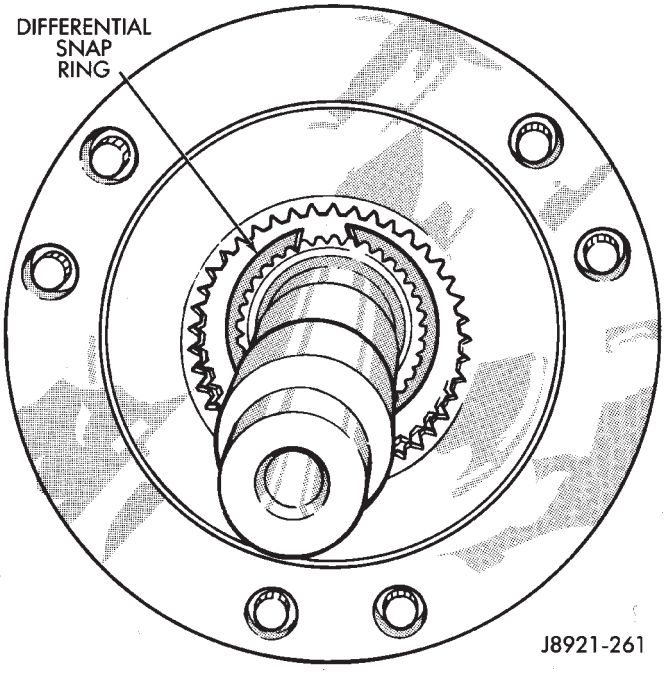


Fig. 27 Removing Differential Snap Ring

(35) Remove differential (Fig. 28).

(36) Remove differential needle bearings and both needle bearing thrust washers from mainshaft.

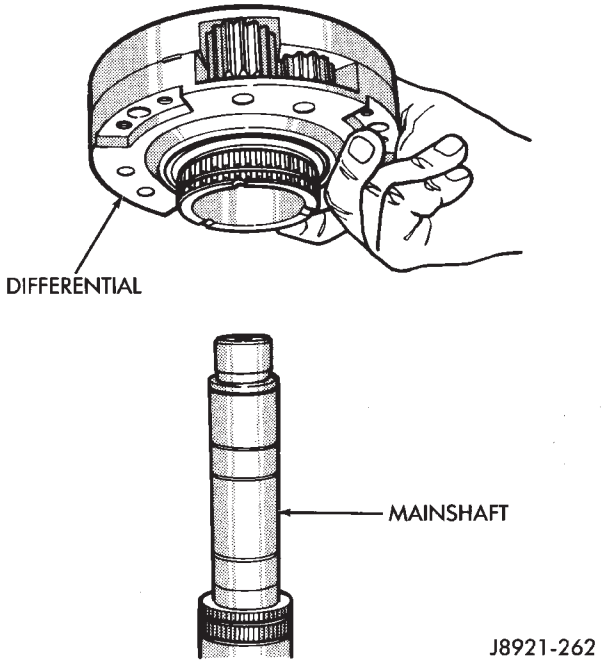


Fig. 28 Differential Removal

(37) Slide low range fork pin out of shift sector slot (Fig. 29)

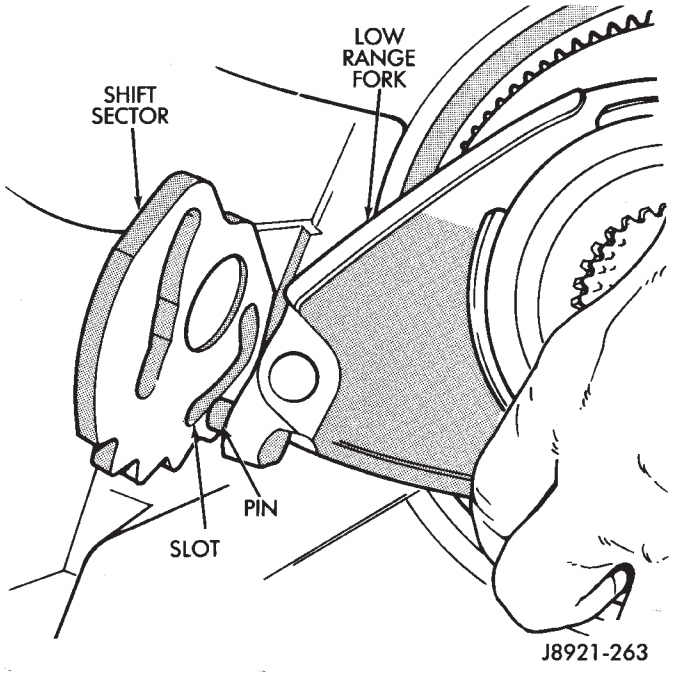


Fig. 29 Disengage Low Range Fork

(38) Remove low range fork and hub (Fig. 30).

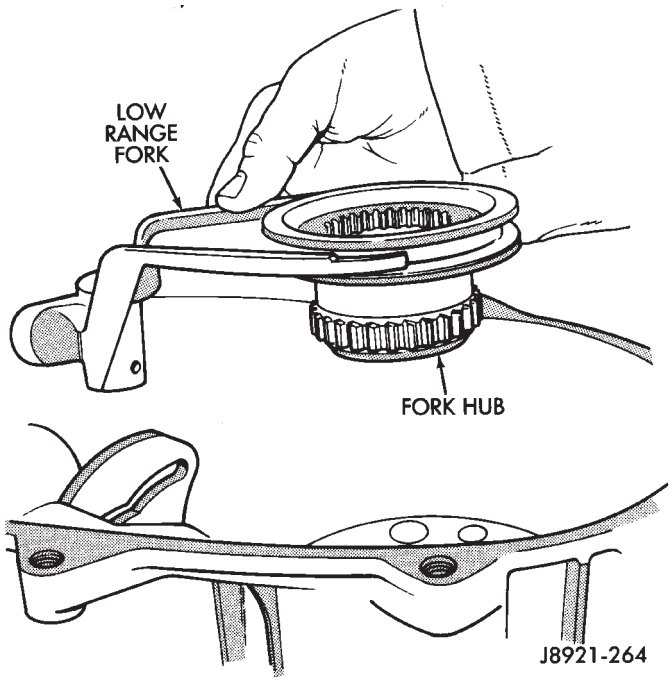


Fig. 30 Removing Low Range Fork And Hub

(39) Remove the shift sector (Fig. 31).

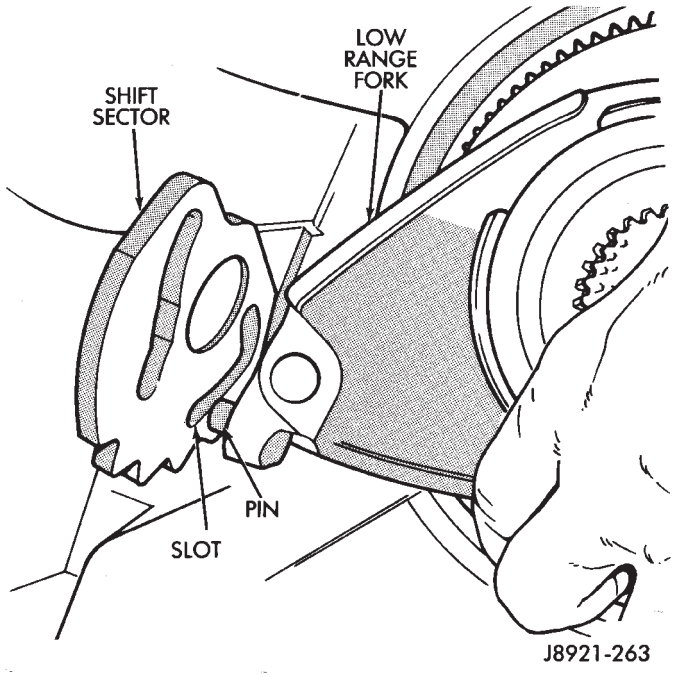


Fig. 31 Shift Sector Position

(40) Remove shift sector bushing and O-ring (Fig. 32).

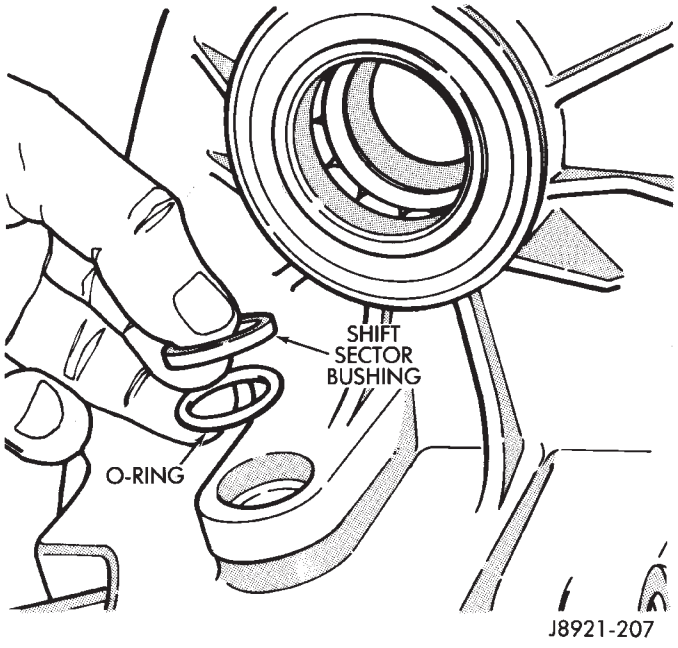


Fig. 32 Removing Sector Bushing And O-Ring

(41) Remove front bearing retainer bolts.

(42) Remove front bearing retainer. Carefully pry retainer loose with screwdriver (Fig. 33). Position the screwdriver in the slots cast into retainer.

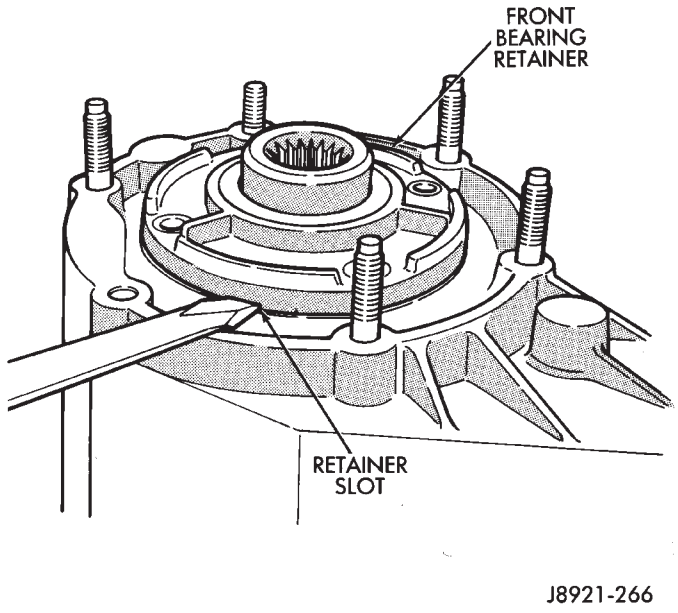


Fig. 33 Removing Front Bearing Retainer

(43) Remove the input gear snap ring (Fig. 34).

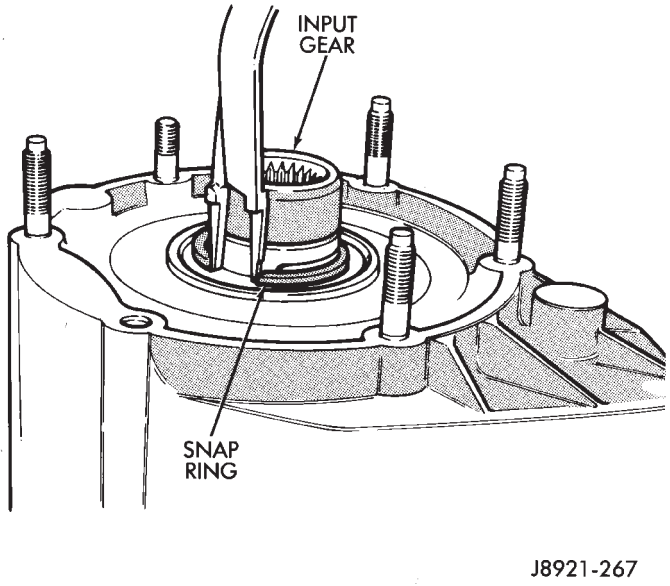


Fig. 34 Removing Input Gear Snap Ring

(44) Press input and low range gears out of input gear bearing and case (Fig. 35).

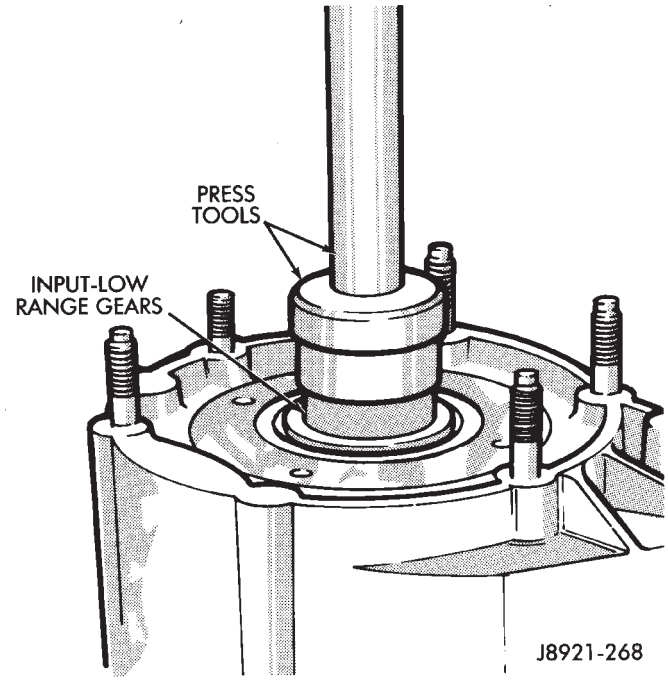


Fig. 35 Removing Input And Low Range Gears

(45) Remove the low range gear snap ring (Fig. 36).

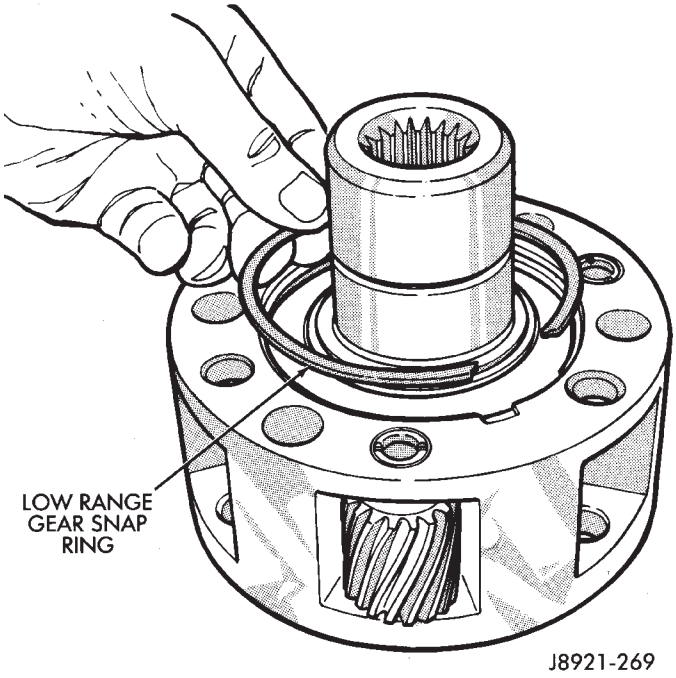


Fig. 36 Removing/Installing Low Range Gear Snap Ring

(46) Remove input gear retainer, thrust washers and input gear from low range gear (Fig. 37).

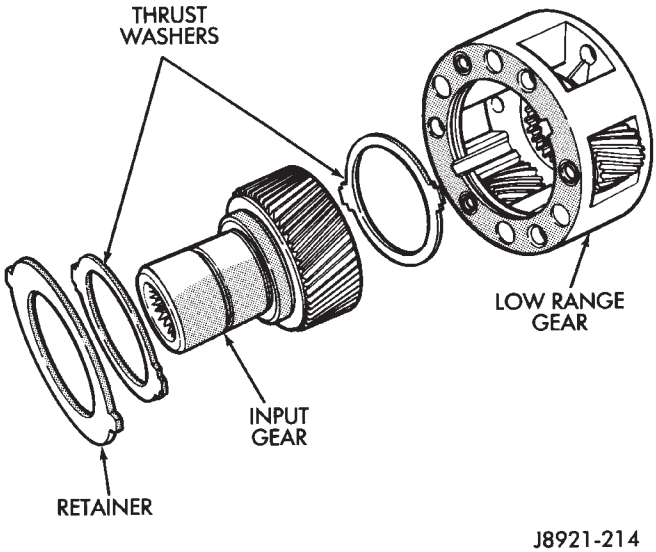


Fig. 37 Low Range Gear Disassembly

(47) Inspect the low range annulus gear (Fig. 38). **The gear is not a serviceable component. If damaged, replace the gear and front case as an assembly.**

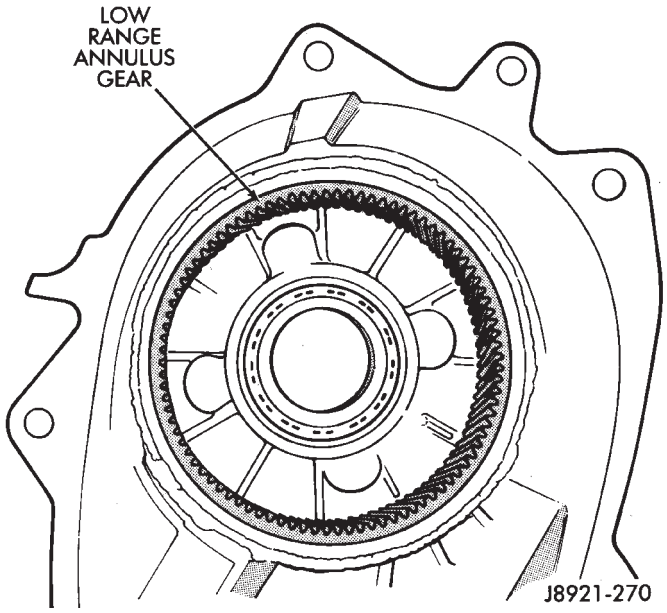


Fig. 38 Inspecting Low Range Annulus Gear

(48) Remove the oil seals from the rear retainer, extension housing, oil pump and case halves.

(49) Mark differential case halves for reference.

(50) Remove differential case bolts and separate top case from bottom case. Use slots in case halves to pry them apart (Fig. 39).

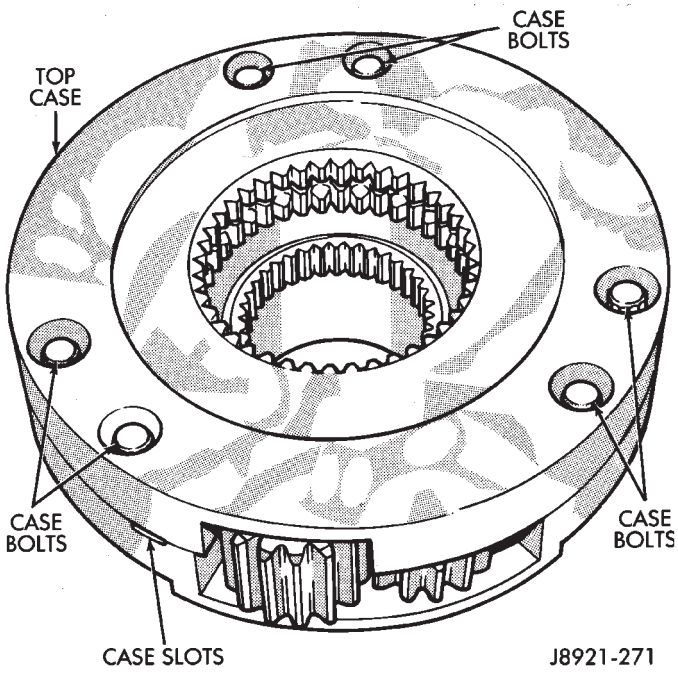


Fig. 39 Separating Differential Case Halves

(51) Remove thrust washers and planet gears from case pins (Fig. 40).

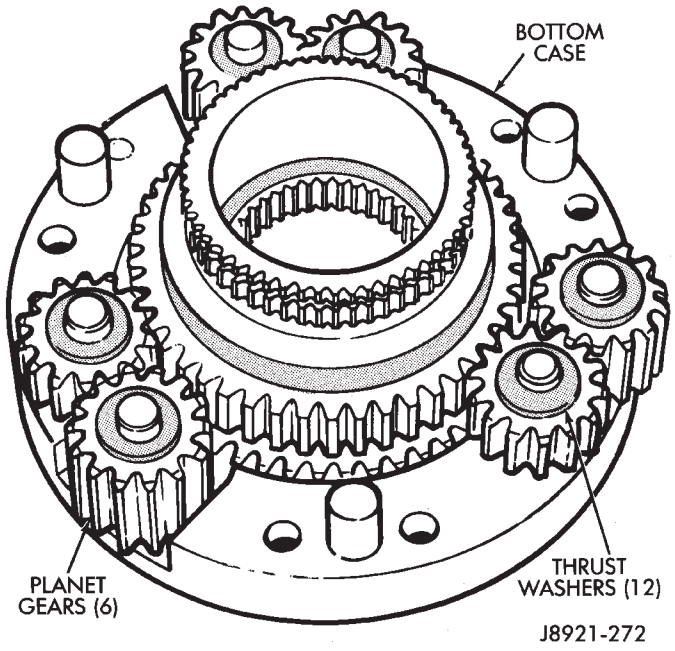


Fig. 40 Removing Planet Gears And Thrust Washers

(52) Remove mainshaft and sprocket gears from bottom case (Fig. 41). Note gear position for reference before separating them.

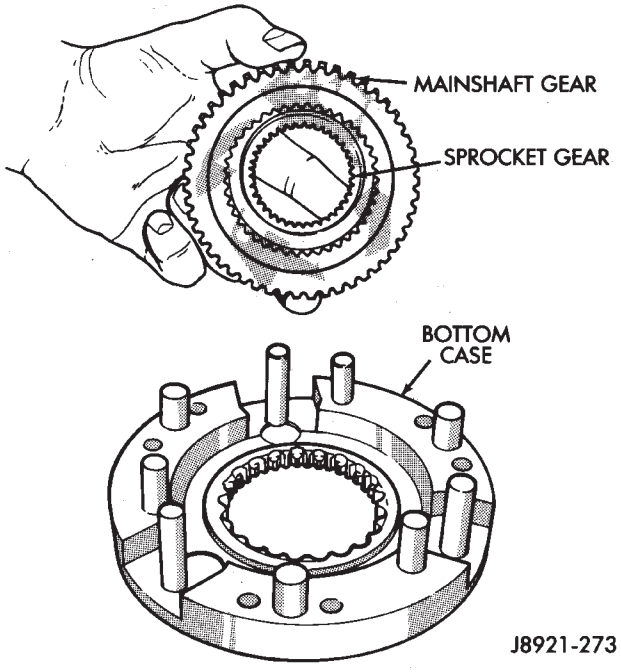


Fig. 41 Removing Mainshaft And Sprocket Gears

CLEANING AND INSPECTION

Clean the transfer case components thoroughly with solvent. Remove all traces of sealer from the case and retainer seal surfaces.

Clean the oil pickup screen with solvent and dry it with compressed air. Also use compressed air to remove solvent residue from all oil feed passages and channels.

Inspect the differential gears, thrust washers and case halves. Replace the mainshaft gear if the gear teeth or the brass ring on the underside of the gear are damaged. Replace the differential as an assembly if the gears, case halves, or the pins in the lower case half are damaged.

Inspect the case halves, extension housing and retainers for cracks, porosity, or damaged sealing surfaces. Inspect the shafts, gears, chain and shift components for wear or damage.

Inspect all of the transfer case bearings for wear, roughness, pitting, or galling. Replace worn or damaged bearings as outlined in the assembly section.

TRANSFER CASE ASSEMBLY

(1) Lubricate the 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. Be sure replacement bearings do not block these feed holes.

(2) Remove the front output shaft, front bearing snap ring (Fig. 42).

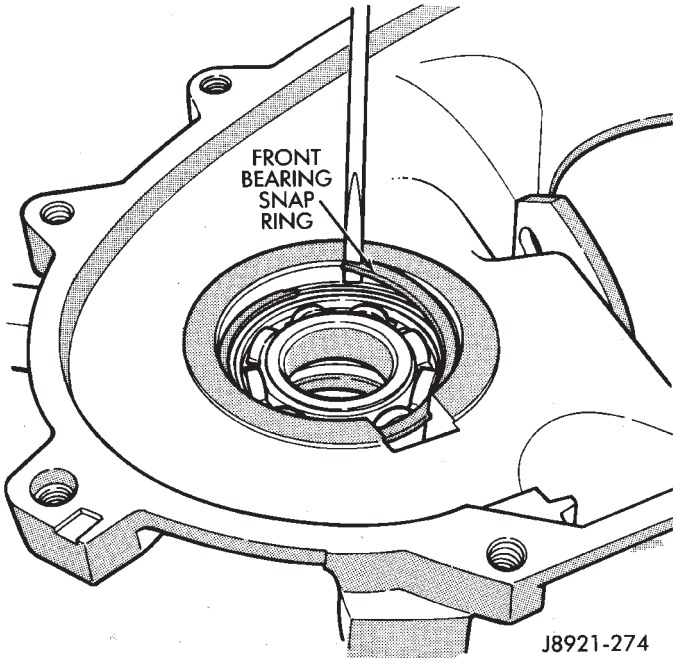


Fig. 42 Removing/Installing Front Output Shaft Front Bearing Snap Ring

(3) Remove the old bearing and install the new bearing with a driver handle and installer tool (Fig. 43).

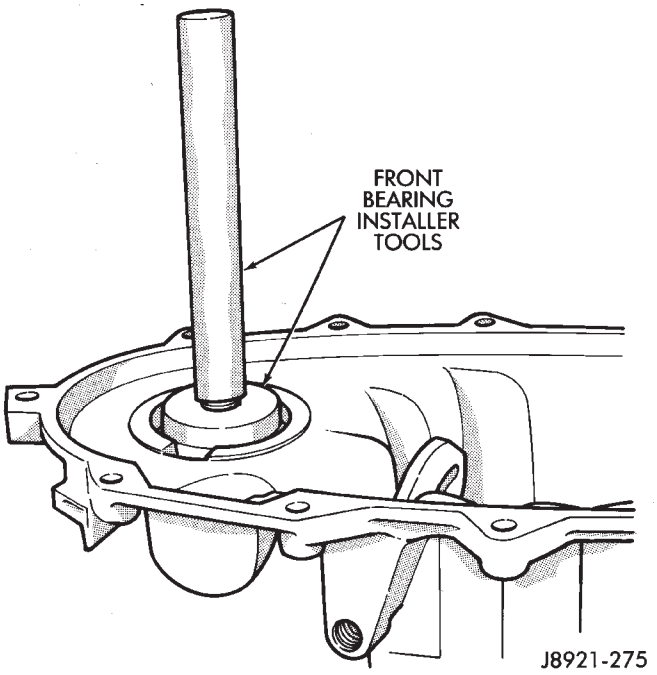


Fig. 43 Replacing Output Shaft Front Bearing

(4) Install the front bearing snap ring (Fig. 42).

(5) Install new front output shaft oil seal (Fig. 44).

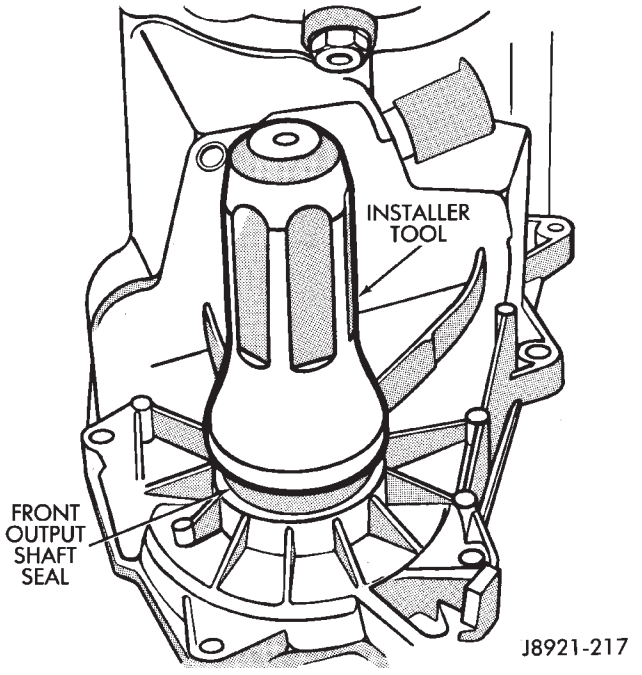


Fig. 44 Installing Front Output Shaft Seal

(6) Press input gear bearing out of front case with driver tool and shop press (Fig. 45).

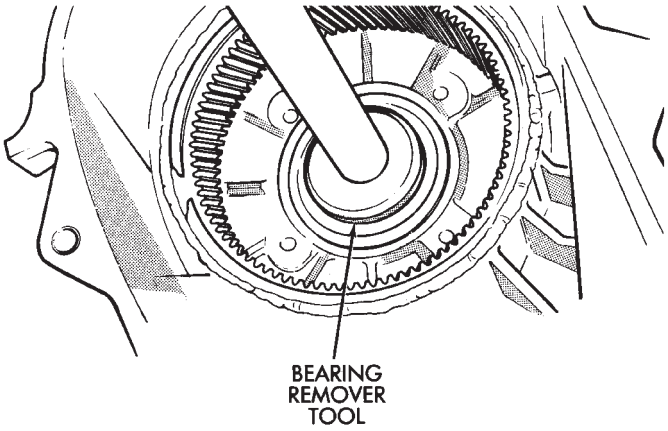


Fig. 45 Removing Input Gear Bearing

(7) Install the snap ring on the new bearing.

(8) Install the new input gear bearing with a shop press and wood block. Install the bearing far enough to seat the snap ring against the case (Fig. 46).

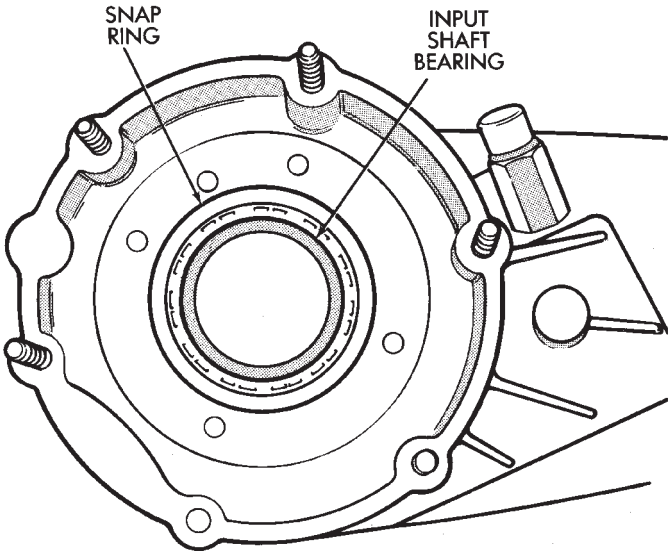


Fig. 46 Seating Input Gear Bearing

(9) Remove input gear pilot bearing with slide hammer and internal puller (Fig. 47).

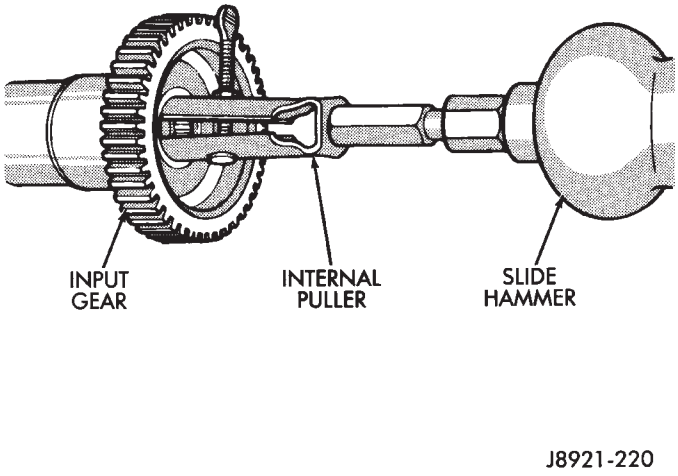


Fig. 47 Removing Input Gear Pilot Bearing

(10) Install new pilot bearing with driver tools (Fig. 48).

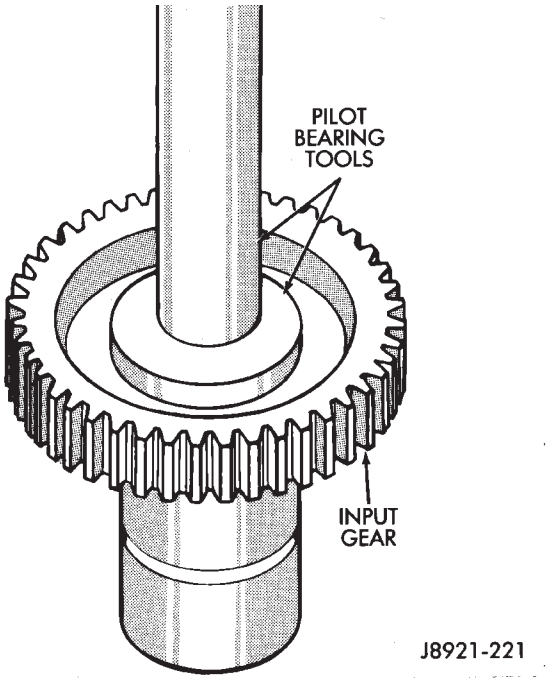


Fig. 48 Installing Input Gear Pilot Bearing

(11) Assemble low range gear, input gear thrust washers, input gear and input gear retainer (Fig. 49).

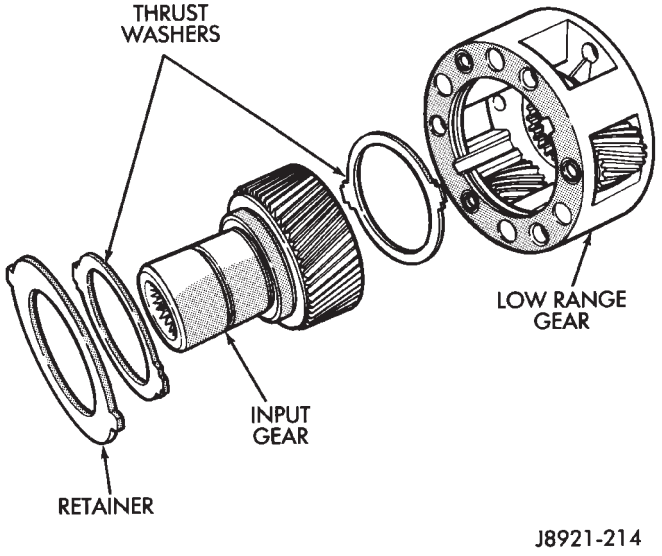


Fig. 49 Low Range And Input Gear Assembly

(12) Install low range gear snap ring (Fig. 50).

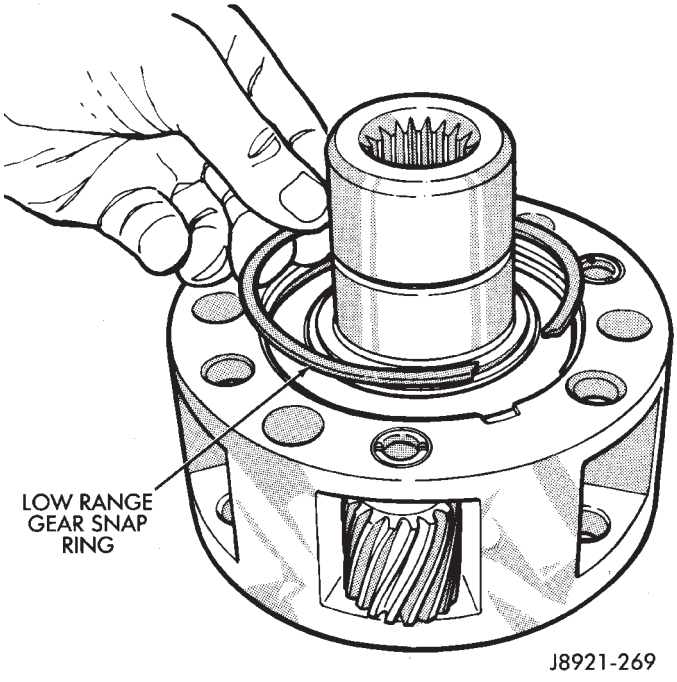


Fig. 50 Install Low Range Gear Snap Ring

(13) Lubricate input gear and low range gears with automatic transmission fluid.

(14) Start the input gear shaft into the front case bearing.

(15) Press the input gear shaft into the front bearing.

CAUTION: Be sure the input gear installer tool is the proper size. The wrong size tool could push the input gear pilot bearing too far into the gear bore (Fig. 51). Also, do not press against the end surfaces of the low range gear. The gear case and thrust washers could be damaged.

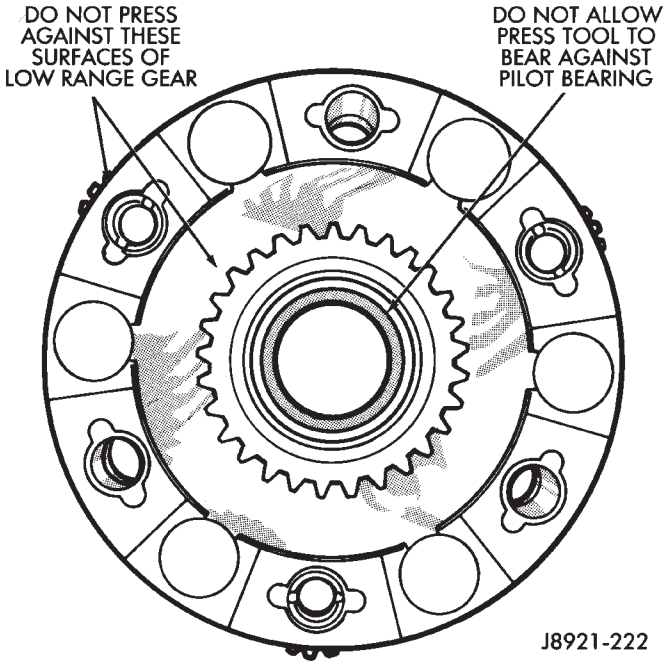


Fig. 51 Input Gear Installation

(16) Install new input gear snap ring (Fig. 52).

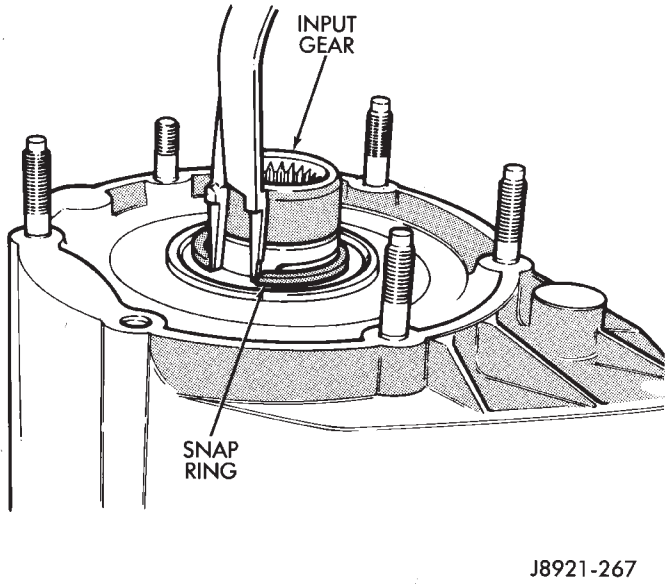


Fig. 52 Install Input Gear Snap Ring

(17) Install new seal in front bearing retainer (Fig. 53).

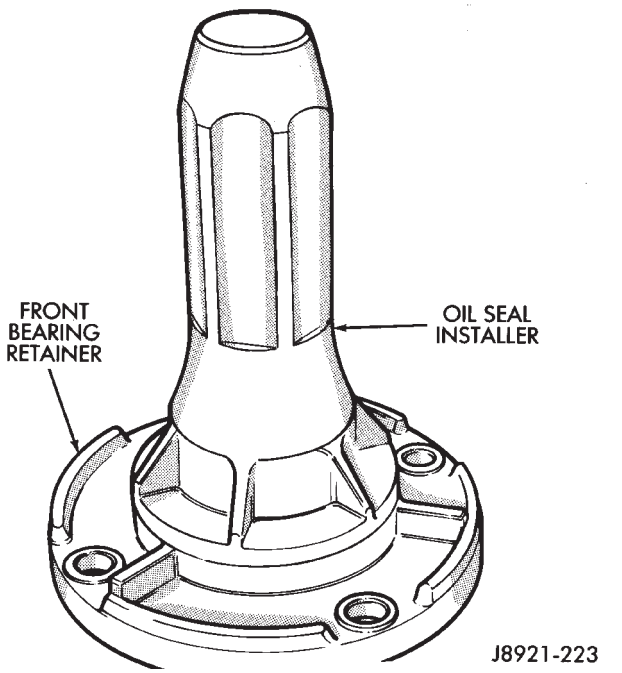


Fig. 53 Install Front Bearing Retainer Seal

(18) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker. silicone adhesive sealer, or Loctite 518 to seal surface of front bearing retainer.

(19) Install the front bearing retainer (Fig. 54). Tighten the retainer bolts to 16 ft. lbs. (21 N·m) torque.

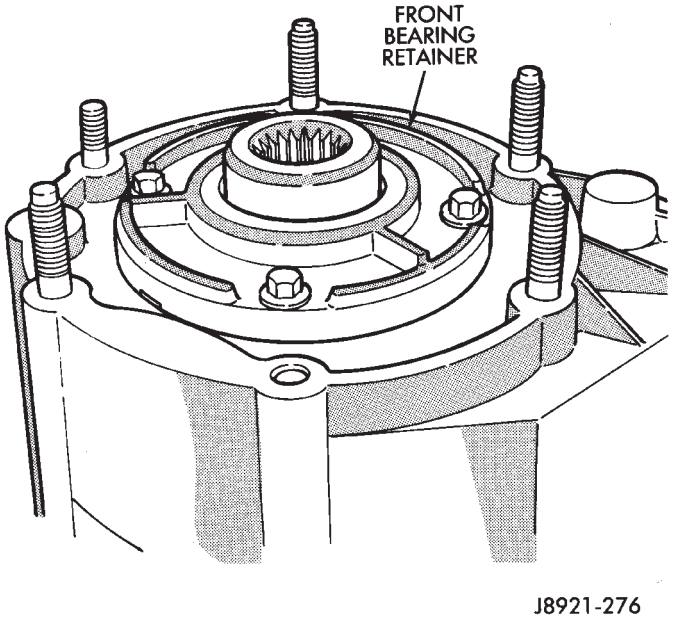


Fig. 54 Installing Front Bearing Retainer

(20) Install new sector shaft O-ring and bushing (Fig. 55).

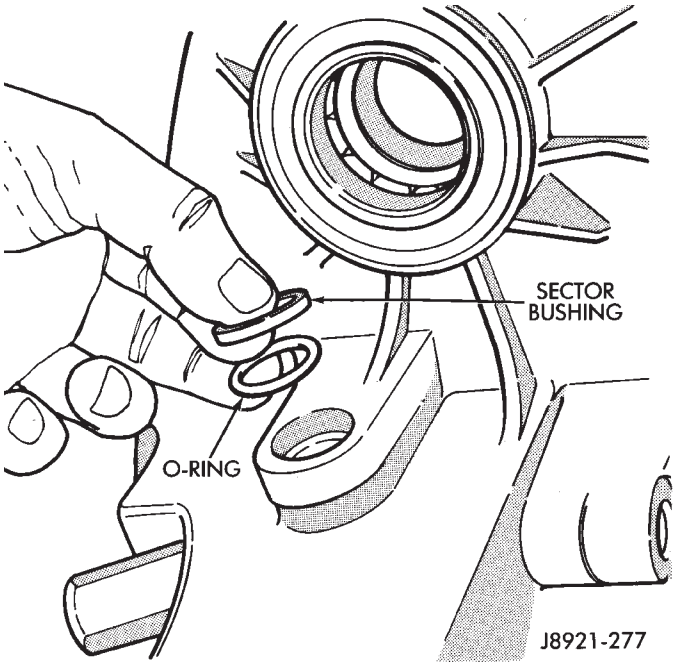


Fig. 55 Installing Sector O-Ring And Bushing

(21) Install the shift sector.

(22) Install new pads in low range fork (Fig. 56).

(23) Assemble low range fork and hub (Fig. 56).

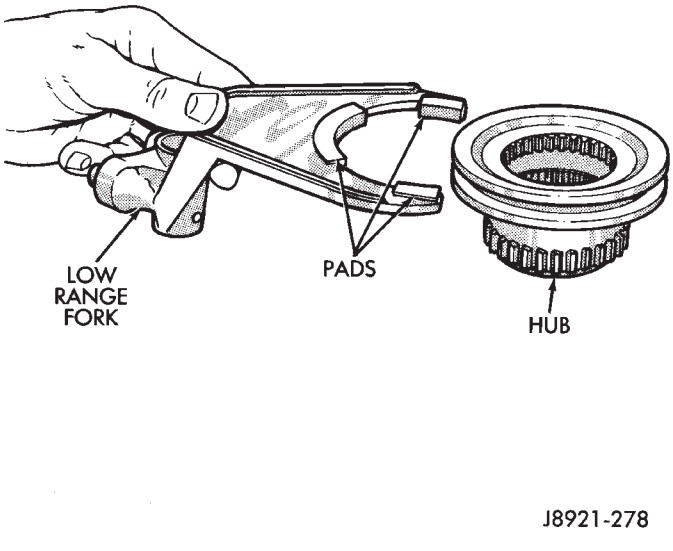


Fig. 56 Assembling Low Range Fork And Hub

(24) Position low range fork and hub in case. Be sure low range fork pin is engaged in the shift sector slot (Fig. 57).

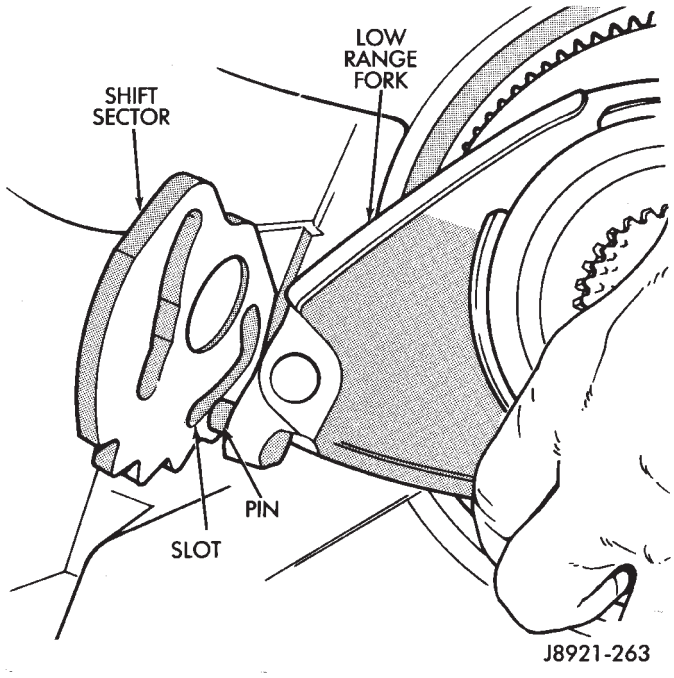


Fig. 57 Positioning Low Range Fork

(25) Lubricate differential components with automatic transmission fluid.

(26) Install sprocket gear in differential bottom case (Fig. 58).

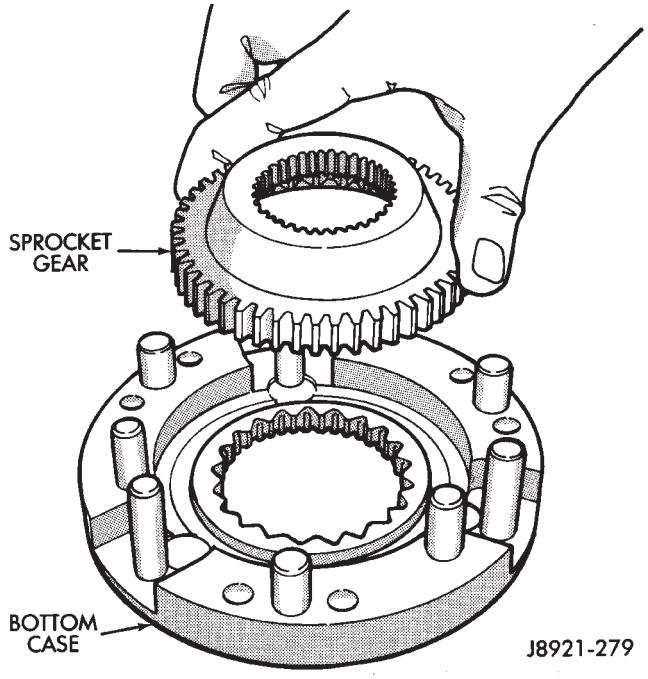


Fig. 58 Installing Differential Sprocket Gear

(27) Install differential planet gears and new thrust washers (Fig. 59). **Be sure thrust washers are installed at top and bottom of each planet gear.**

(28) Install differential mainshaft gear (Fig. 59).

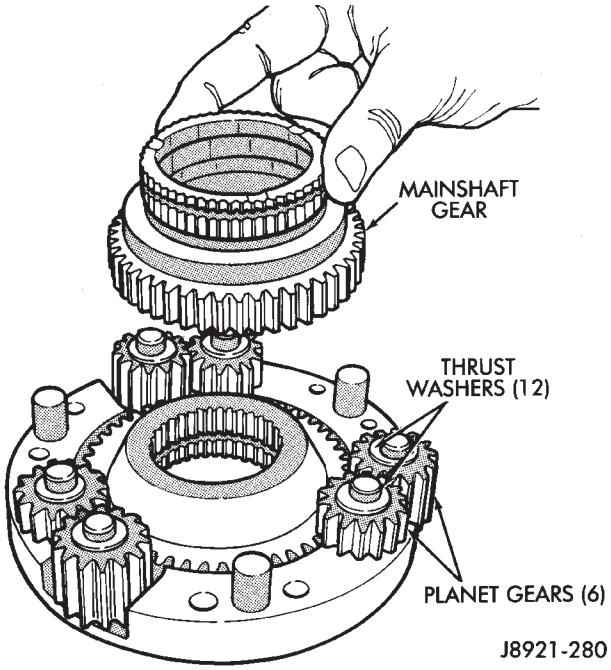


Fig. 59 Installing Mainshaft And Planet Gears

(29) Align and position differential top case on bottom case (Fig. 60). Align using scribe marks made at disassembly.

(30) Install and tighten the differential case bolts to specified torque.

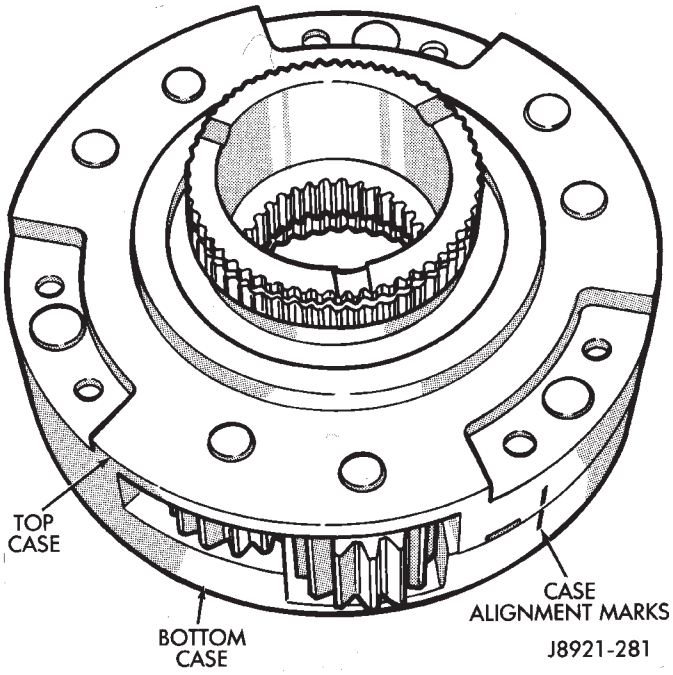


Fig. 60 Differential Case Assembly

(31) Install first mainshaft bearing spacer on mainshaft (Fig. 61).

(32) Install bearing rollers on mainshaft (Fig. 61). **Coat bearing rollers with generous quantity of petroleum jelly to hold them in place.**

(33) Install remaining bearing spacer on mainshaft (Fig. 61). Do not displace any bearings while installing spacer.

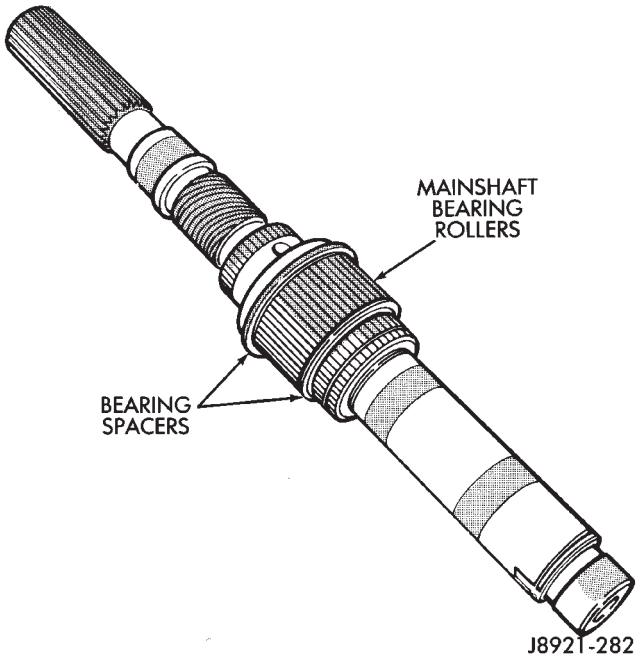


Fig. 61 Installing Mainshaft Bearing Rollers and Spacers

(34) Install the differential (Fig. 62). **Do not displace the mainshaft bearings when installing the differential.**

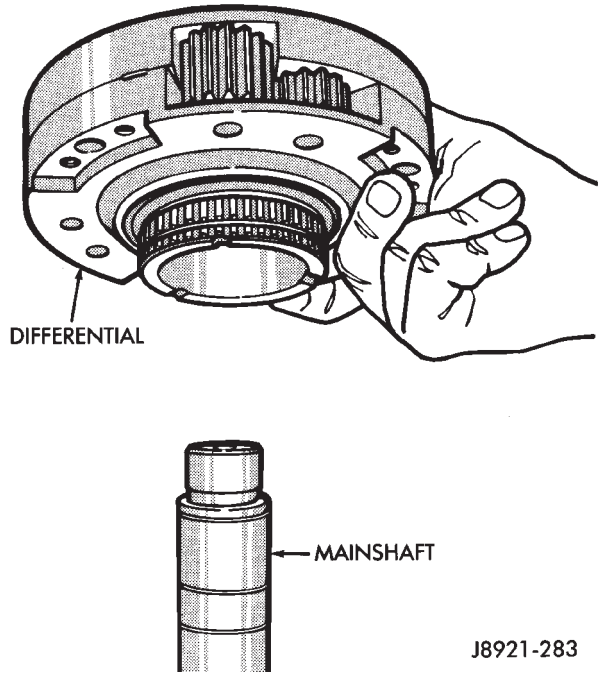


Fig. 62 Differential Installation

(35) Install the differential snap ring (Fig. 63).

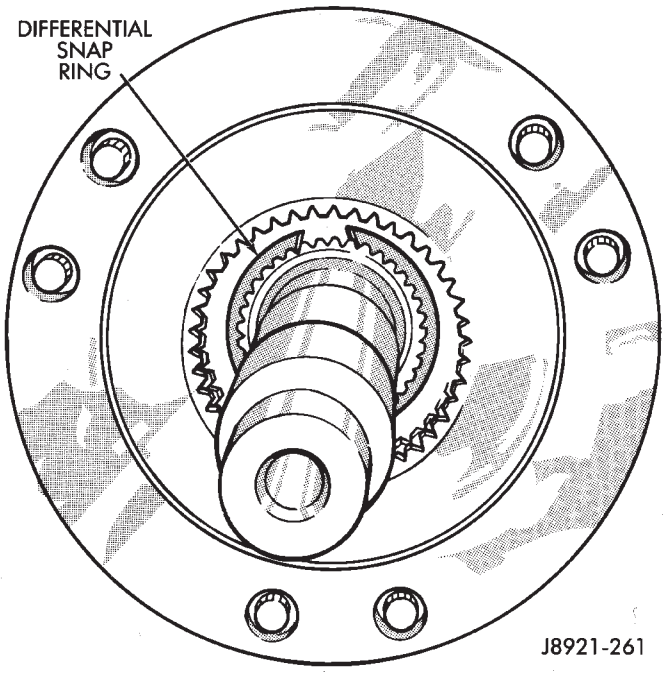


Fig. 63 Installing Differential Snap Ring

(36) Install the intermediate clutch shaft (Fig. 64).

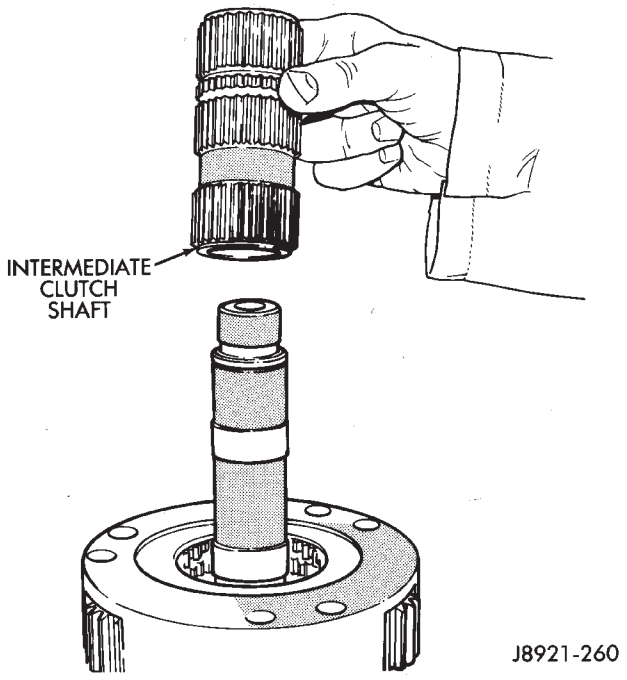


Fig. 64 Installing Intermediate Clutch Shaft

(37) Install clutch shaft thrust washer (Fig. 65).

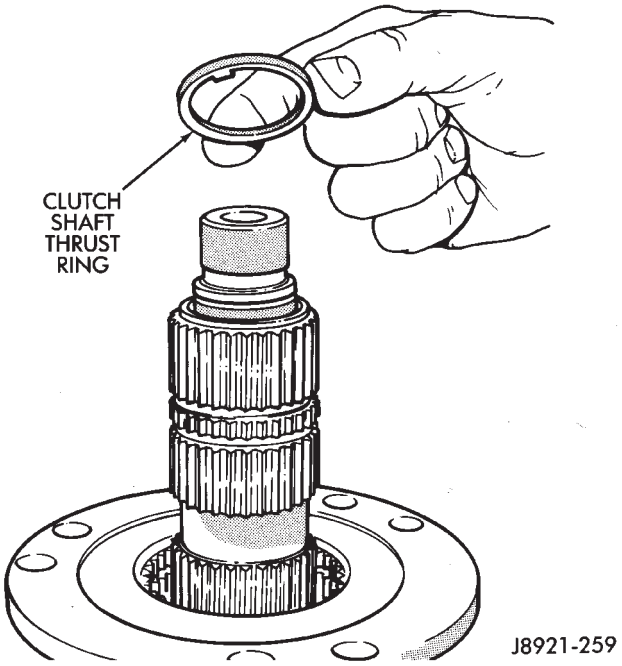


Fig. 65 Installing Clutch Shaft Thrust Washer

(38) Install clutch shaft snap ring (Fig. 66).

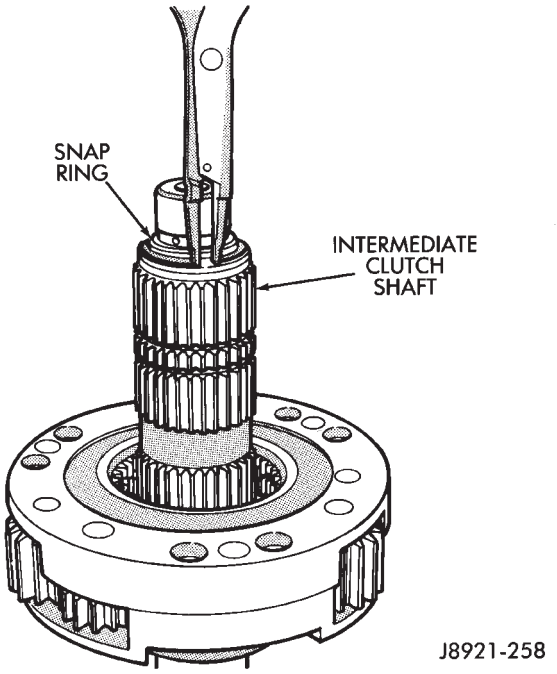


Fig. 66 Installing Clutch Shaft Snap Ring

(39) Inspect mode fork assembly (Fig. 67). Replace pads and bushing if necessary. Replace fork tube if bushings inside tube are worn or damaged. Also check springs and slider bracket (Fig. 67). Replace worn, damaged components.

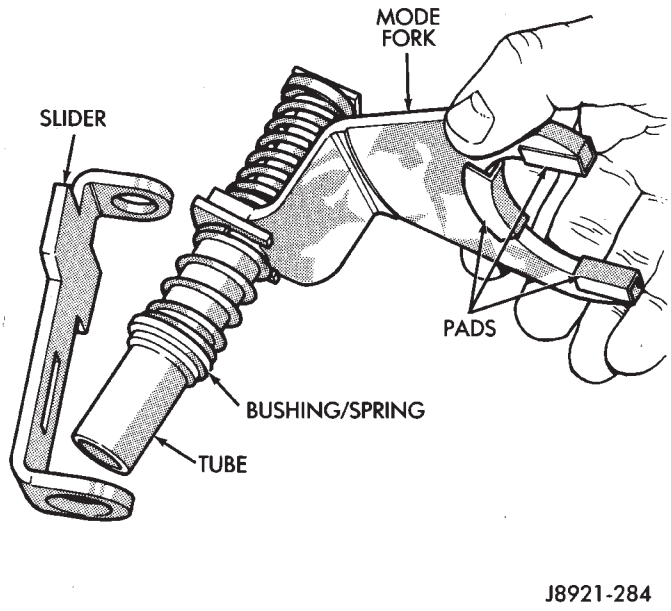


Fig. 67 Inspect Mode Fork Assembly

(40) Install mode sleeve in mode fork (Fig. 68). Then install assembled sleeve and fork on mainshaft. Be sure mode sleeve splines are engaged in differential splines.

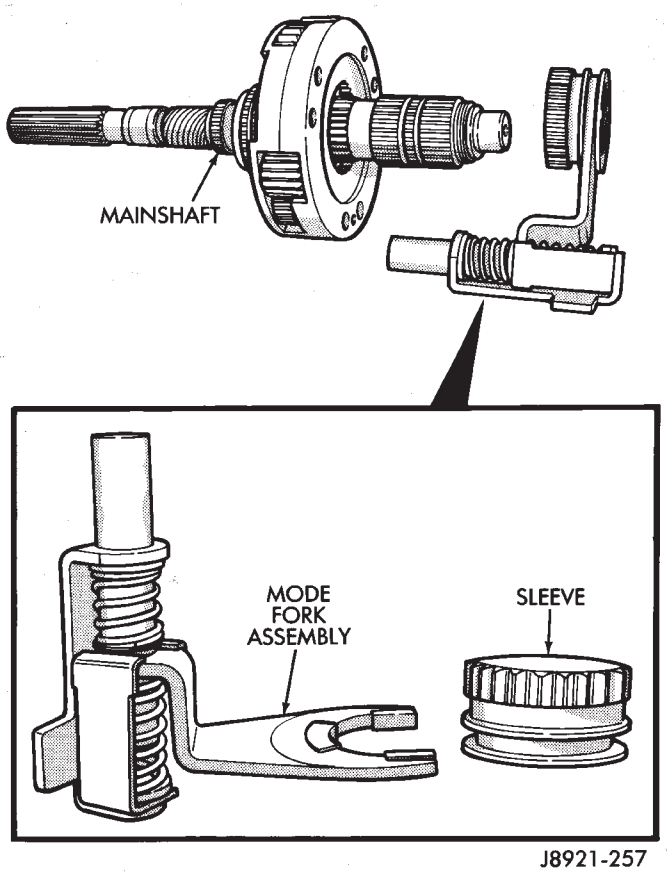


Fig. 68 Installing Mode Fork And Sleeve

(41) Install mode fork and mainshaft assembly in case (Fig. 69). Rotate mainshaft slightly to engage shaft with low range gears.

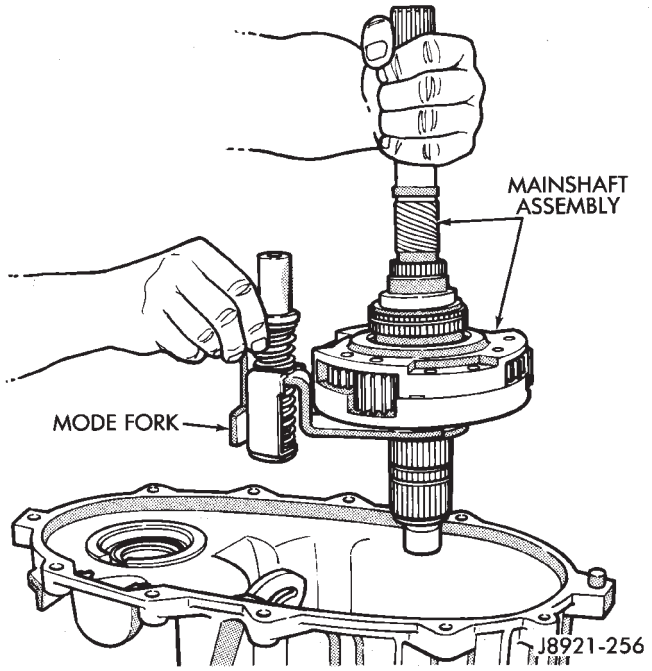


Fig. 69 Installing Mainshaft And Mode Fork

(42) Rotate mode fork pin into shift sector slot.

(43) Install shift rail (Fig. 70). **Be sure rail is seated in both shift forks.**

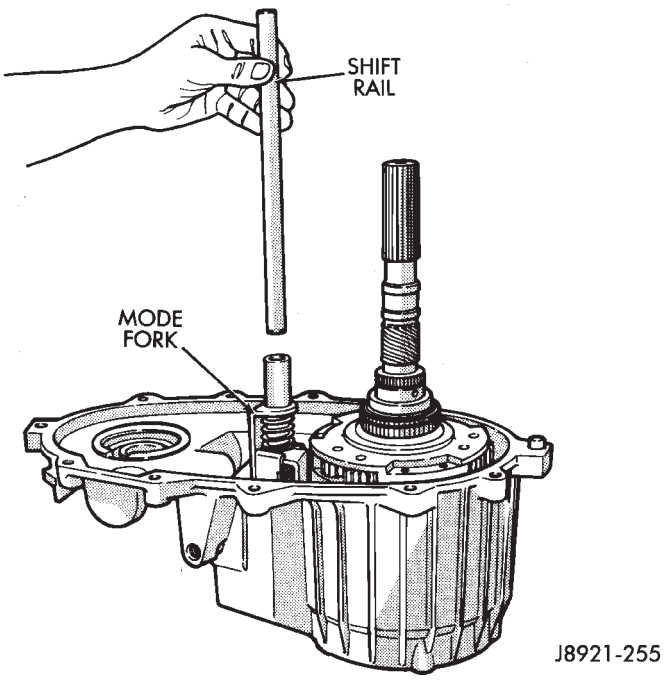


Fig. 70 Installing Shift Rail

(44) Rotate shift sector to align lockpin hole in low range fork with access hole in case.

(45) Insert an easy-out in range fork lockpin to hold it securely for installation (Fig. 71). **Lockpin is slightly tapered on one end. Insert tapered end into fork and rail.**

(46) Insert lockpin through access hole and into shift fork (Fig. 71). Then remove the easy-out and seat the pin with pin punch.

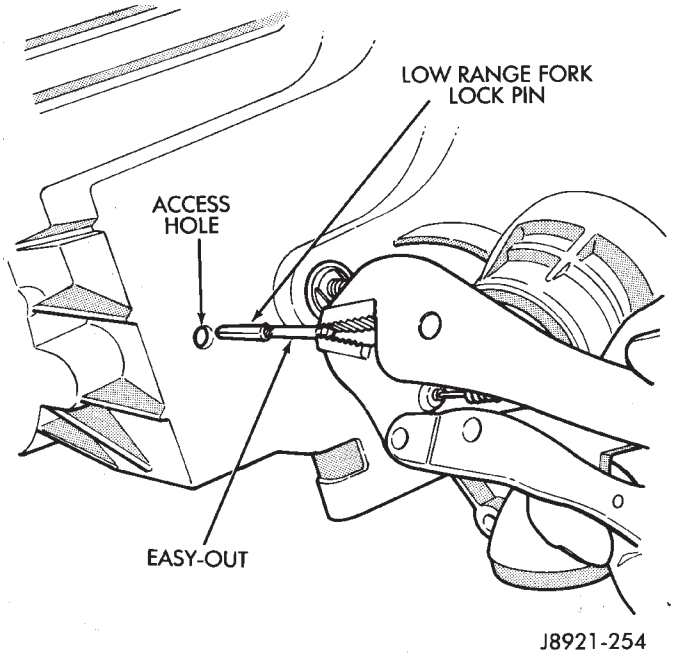


Fig. 71 Installing Low Range Fork Lockpin

(47) Install plug in lockpin access hole.

(48) Install transfer case shift lever and attaching nut. Tighten nut to 30 N·m (22 ft. lbs.) torque.

(49) Install detent plunger, detent spring and detent plug in the case (Fig. 72).

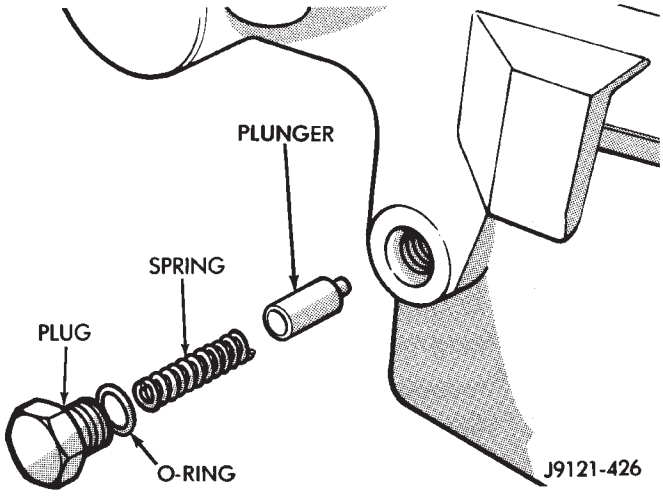


Fig. 72 Installing Detent Pin, Spring And Plug

(50) Install front output shaft (Fig. 73).

(51) Install drive chain (Fig. 73). Engage chain with front output shaft sprocket teeth.

(52) Install drive sprocket (Fig. 73).

(53) Engage drive sprocket teeth with chain. Then engage sprocket splines with mainshaft splines.

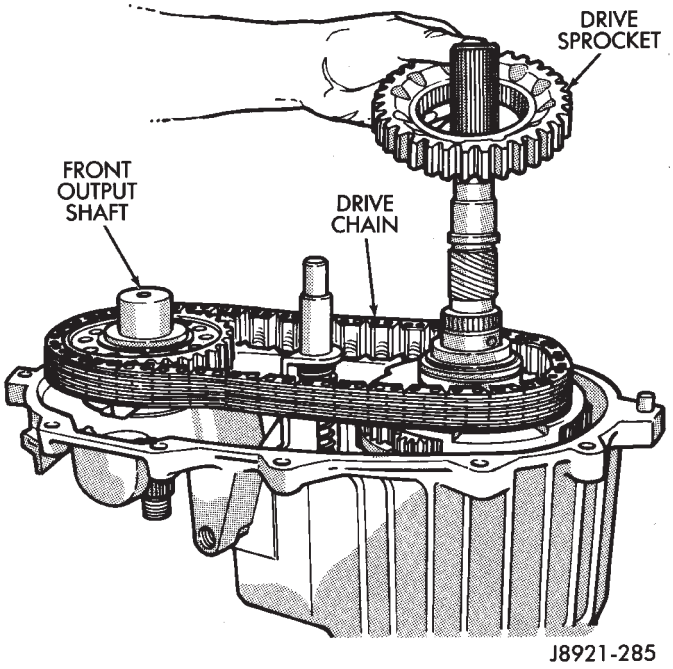


Fig. 73 Installing Drive Chain And Sprocket

(54) Install drive sprocket snap ring (Fig. 74).

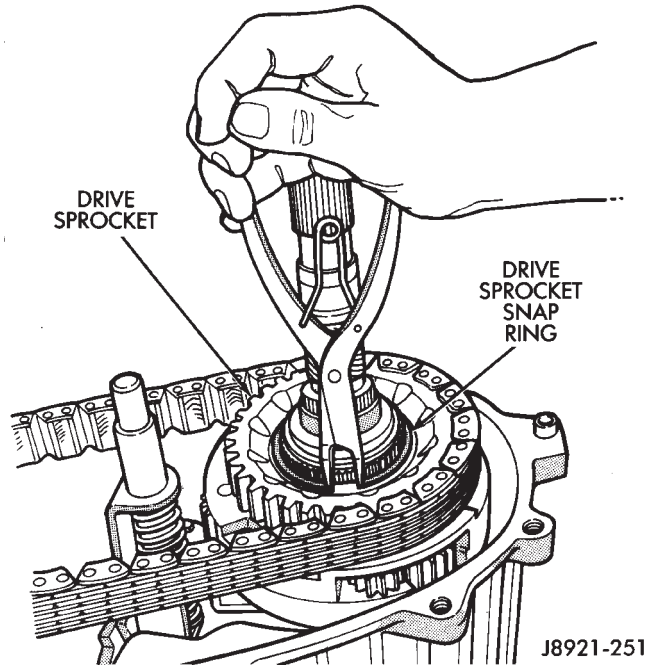


Fig. 74 Installing Drive Sprocket Snap Ring

(55) Replace front output shaft rear bearing. Remove bearing with internal puller and slide hammer (Fig. 75). Install new bearing with bearing driver tools (Fig. 75). Lubricate bearing after installation.

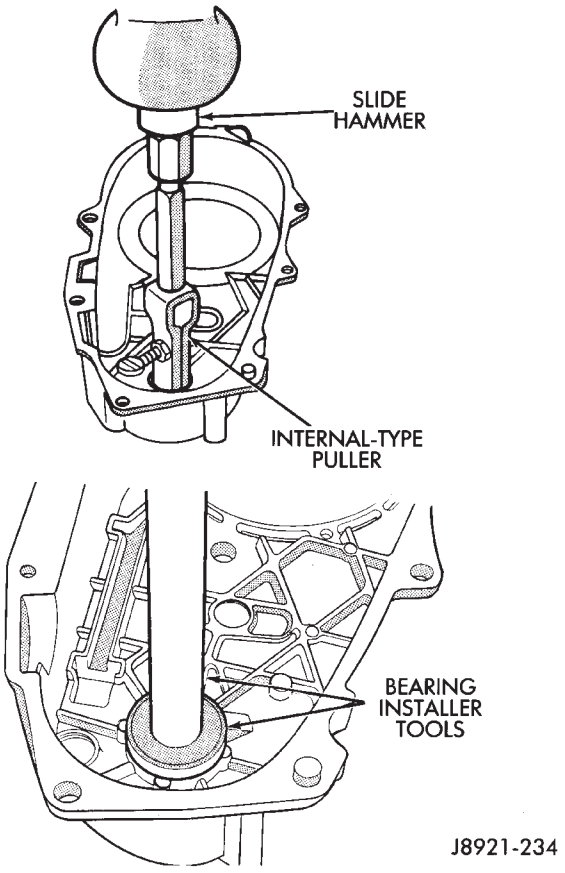


Fig. 75 Installing Front Output Shaft Rear Bearing

(56) Assemble oil pump (Fig. 76). Replace any pump components that are worn or damaged.

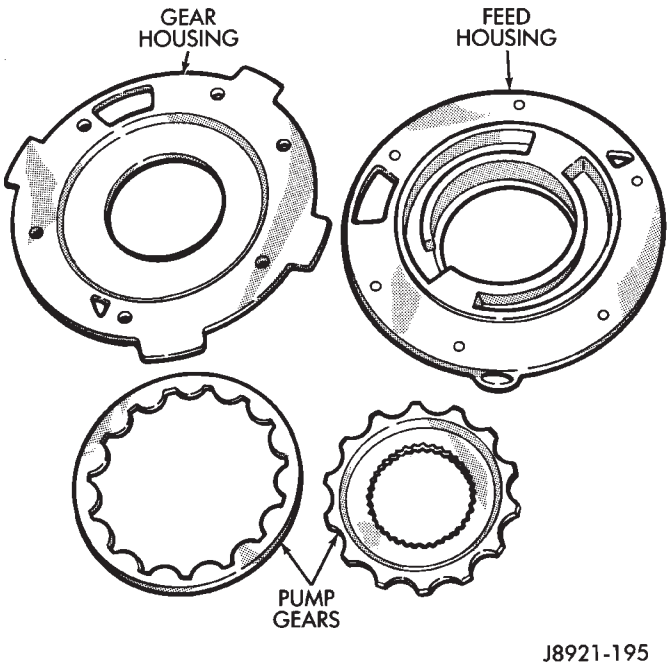


Fig. 76 Oil Pump Assembly

(57) Install new seal in oil pump feed housing (Fig. 77).

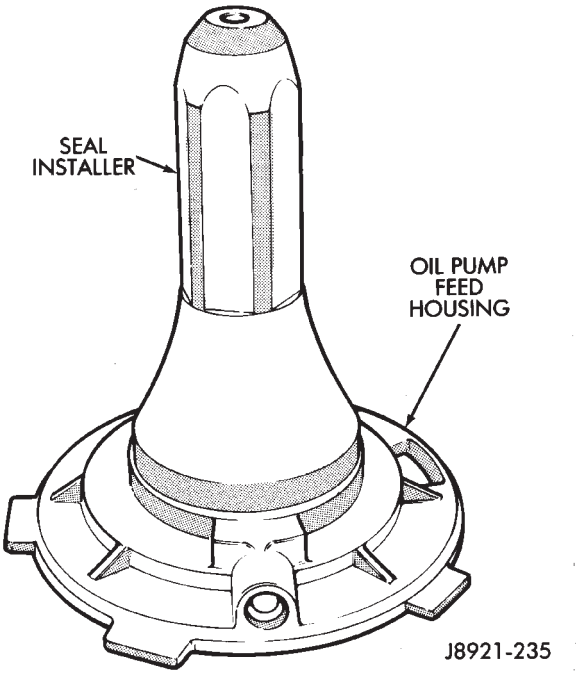


Fig. 77 Installing Oil Pump seal

(58) Install new pickup tube O-ring in oil pump (Fig. 78).

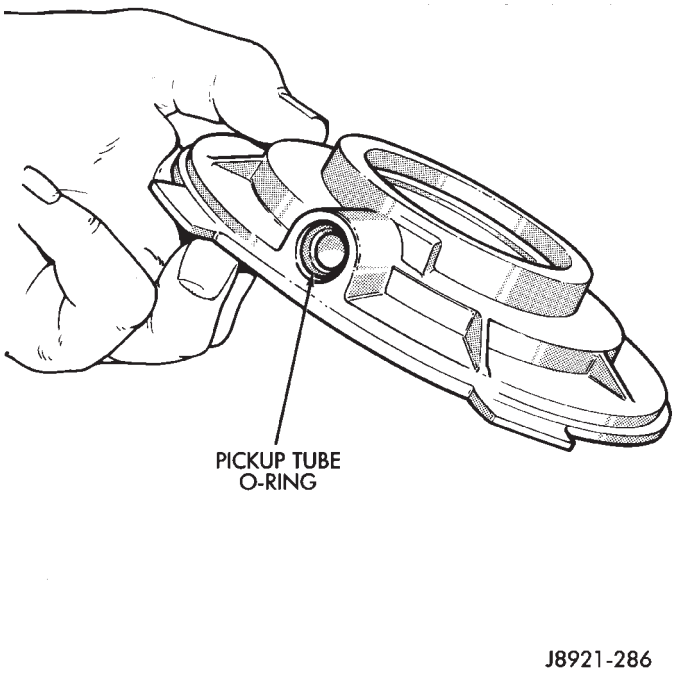


Fig. 78 Installing Pickup Tube O-Ring

(59) Insert oil pickup tube in oil pump and attach oil screen and connecter hose to pickup tube. Then install assembled pump, tube and screen in rear case (Fig. 79). Be sure screen is seated in case slot as shown.

(60) Install magnet in front case pocket (Fig. 80).

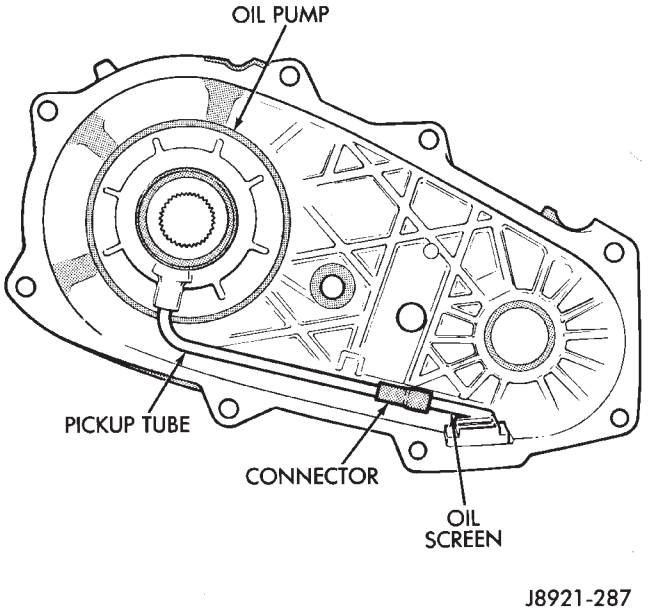


Fig. 79 Installing Oil Screen And Pickup Tube

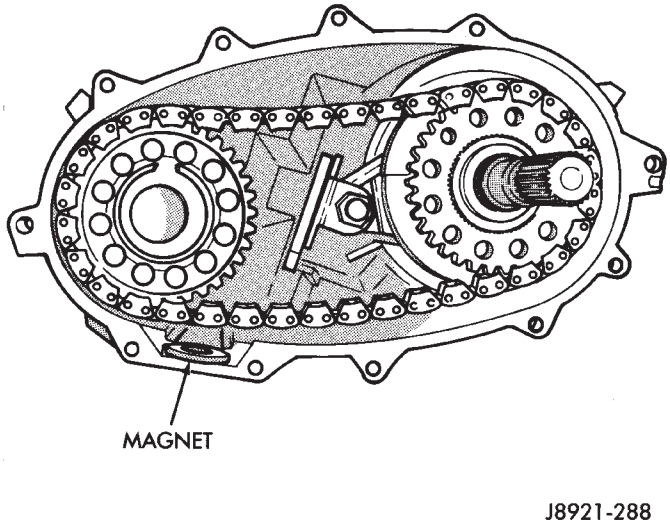


Fig. 80 Installing Case Magnet

(61) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker, silicone adhesive sealer, or Loctite 518 to seal surface of front case.

(62) 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.

(63) Install and tighten the front case-to-rear case bolts to 41 N·m (30 ft. lbs.) torque. **Be sure to install a washer under each of the bolts used at the case dowel locations.**

(64) Tap rear retainer bearing out of retainer with hammer and brass drift.

(65) Install new bearing in rear retainer with driver tools (Fig. 81).

(66) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker, silicone adhesive sealer, or Loctite 518 to seal surface of rear retainer.

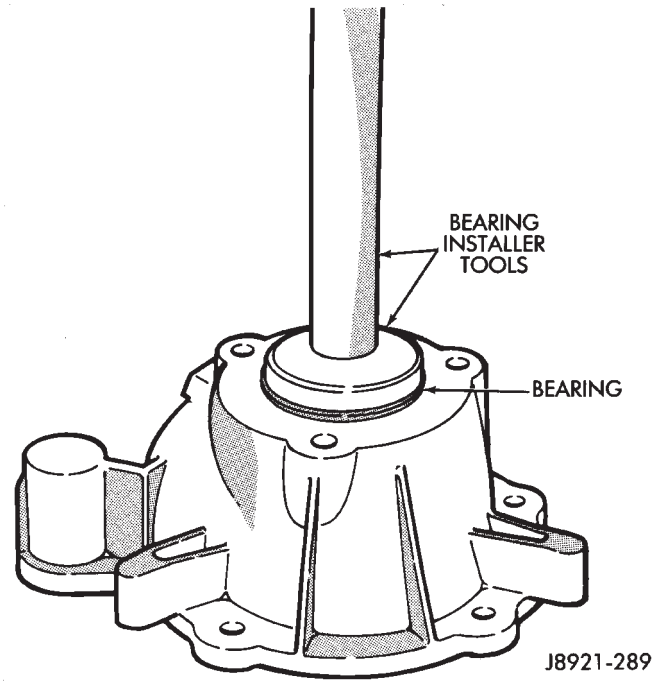


Fig. 81 Installing Rear Bearing In Retainer

(67) Install locating dowel in rear retainer (if removed) and install the retainer on the case. Tighten the retainer bolts to 41 N·m (30 ft. lbs.) torque.

(68) Install new rear bearing snap ring (Fig. 82). Lift mainshaft slightly to seat the snap ring if necessary.

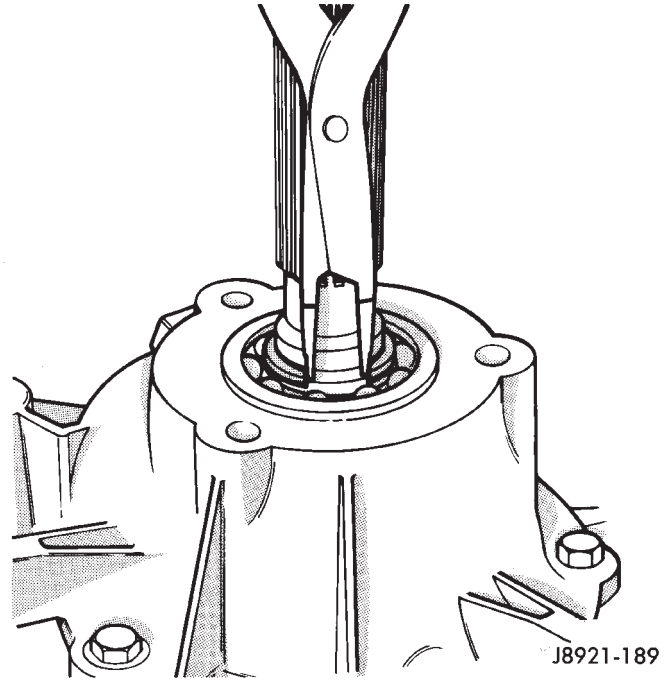


Fig. 82 Installing Rear Bearing Snap Ring

(69) Remove extension housing seal if not removed previously.

(70) Replace extension housing bushing with driver tools (Fig. 83).

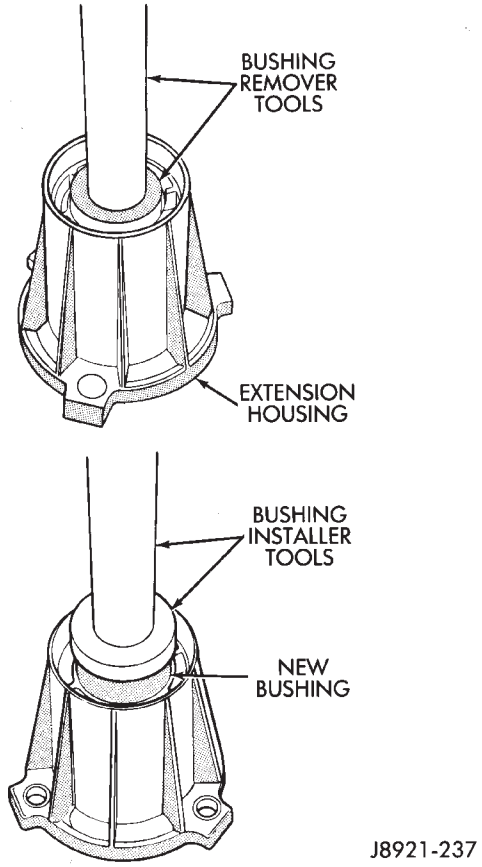


Fig. 83 Replacing Extension Housing Bushing

(71) Install new extension housing oil seal (Fig. 84).

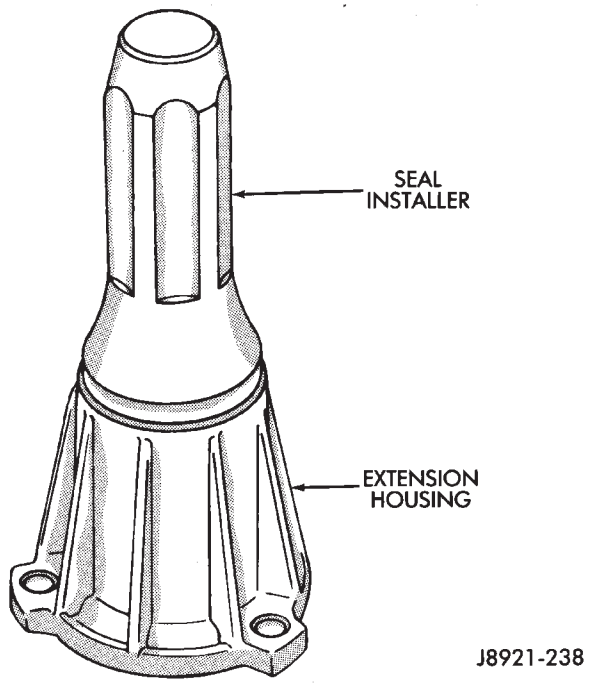


Fig. 84 Replacing Extension Housing Seal

(72) Apply 3 mm (1/8 in.) wide bead of Mopar gasket maker, silicone adhesive sealer, or Loctite 518 to seal surface of extension housing.

(73) Install extension housing on case. Tighten housing bolts to 41 N·m (30 ft. lbs.) torque.

(74) Install front yoke. Secure yoke with new seal washer and nut. Tighten nut to 149 N·m (110 ft. lbs.) torque.

(75) Install new gasket on vacuum switch and install switch in the case. Tighten switch to 27 N·m (20 ft. lbs.) torque.

(76) Install speedometer components (Fig. 85).

(77) Install and tighten drain plug to 47 N·m (35 ft. lbs.) torque.

(78) After installing transfer case, refill with recommended transmission fluid.

(79) Tighten fill plug to 47 N·m (35 ft. lbs.) torque.

(80) Adjust transfer case shift linkage.

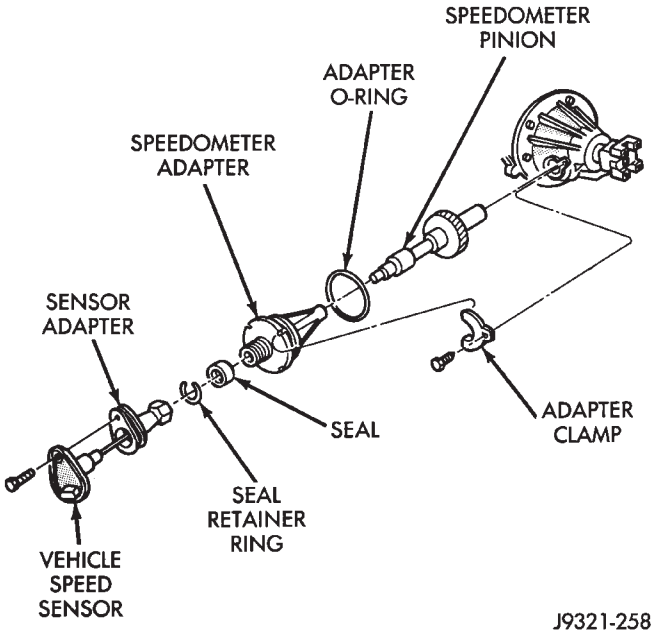
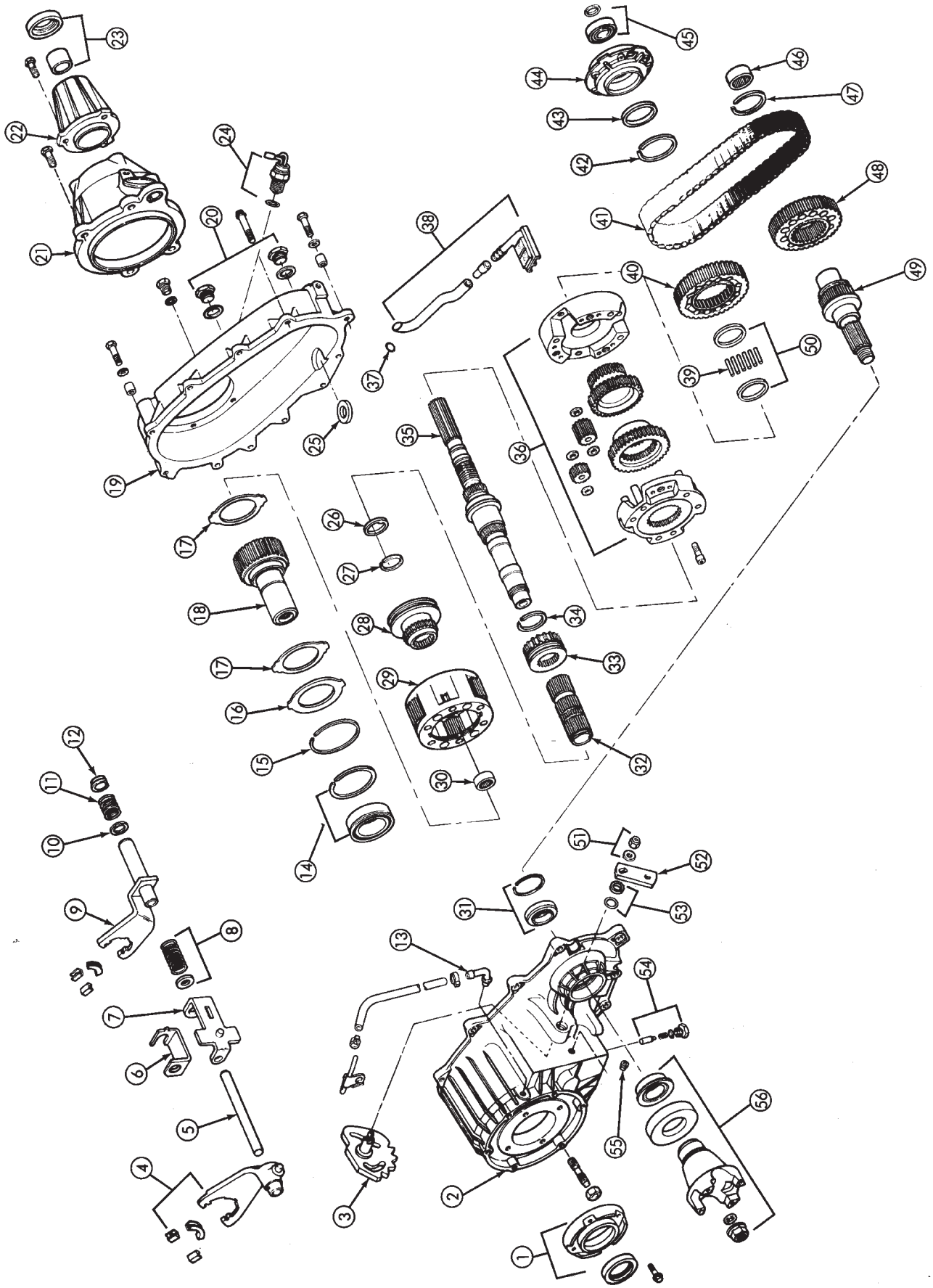


Fig. 85 Speedometer Components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LEGEND FOR NP242 TRANSFER CASE

1 FRONT BEARING RETAINER AND SEAL
2 FRONT CASE
3 SHIFT SECTOR
4 LOW RANGE FORK AND INSERTS
5 SHIFT RAIL
6 SHIFT BRACKET
7 SLIDER BRACKET
8 BUSHING AND SPRING
9 MODE FORK AND INSERTS
10 BUSHING
11 FORK SPRING
12 BUSHING
13 VENT TUBE ASSEMBLY
14 INPUT GEAR BEARING AND SNAP RING
15 LOW RANGE GEAR SNAP RING
16 RETAINER, LOW RANGE GEAR
17 THRUST WASHER, LOW RANGE GEAR
18 INPUT GEAR
19 REAR CASE
20 DRAIN/FILL PLUGS
21 REAR BEARING RETAINER
22 EXTENSION HOUSING
23 BUSHING AND OIL SEAL
24 VACUUM SWITCH
25 MAGNET
26 THRUST RING
27 SNAP RING
28 SHIFT SLEEVE
29 LOW RANGE GEAR
30 PILOT BUSHING (INPUT GEAR/MAINSHAFT)
31 FRONT OUTPUT SHAFT FRONT BEARING AND SNAP RING
32 INTERMEDIATE CLUTCH SHAFT
33 SHIFT SLEEVE
34 SNAP RING
35 MAINSHAFT
36 DIFFERENTIAL ASSEMBLY
37 OIL PUMP TUBE O-RING
38 OIL PUMP PICKUP TUBE AND SCREEN
39 MAINSHAFT BEARING ROLLERS
40 DRIVE SPROCKET
41 DRIVE CHAIN
42 SNAP RING
43 OIL PUMP SEAL
44 OIL PUMP
45 REAR BEARING AND SNAP RING
46 FRONT OUTPUT SHAFT REAR BEARING
47 SNAP RING
48 DRIVEN SPROCKET
49 FRONT OUTPUT SHAFT
50 MAINSHAFT BEARING SPACERS
51 SHIFT LEVER WASHER AND NUT
52 SHIFT LEVER
53 SECTOR O-RING AND SEAL
54 DETENT PIN, SPRING AND PLUG
55 SEAL PLUG
56 FRONT YOKE NUT, SEAL WASHER, YOKE, SLINGER AND OIL SEAL

J8921-291

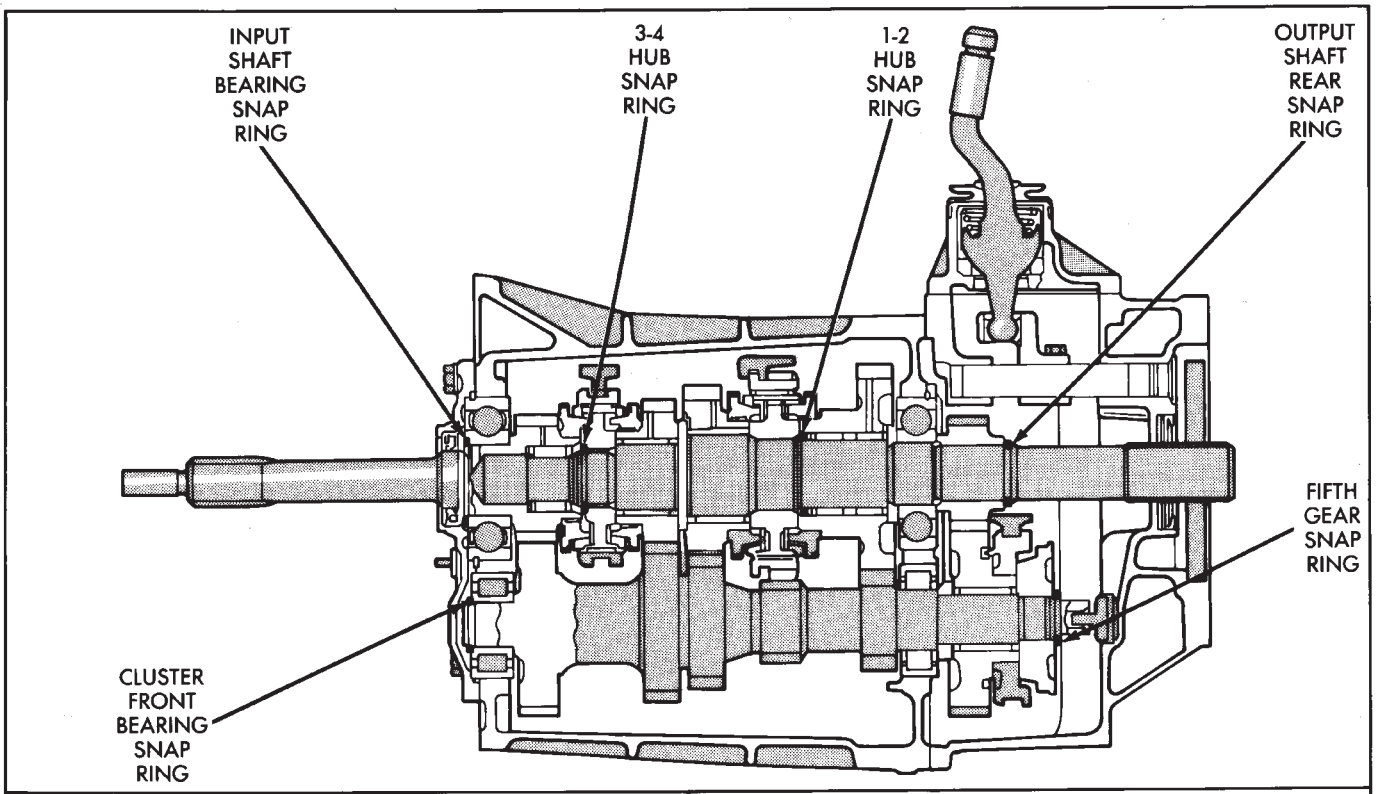
TRANSMISSION/TRANSFER CASE SPECIFICATIONS

TORQUE SPECIFICATIONS— AX 15 MANUAL TRANSMISSION

Description	Torque
Access Plugs	19 N•m (14 ft. lbs.)
Adapter Housing Bolts	37 N•m (27 ft. lbs.)
Backup Light Switch	37 N•m (27 ft. lbs.)
Drain and Fill Plugs	37 N•m (27 ft. lbs.)
Front Bearing Retainer Bolts	17 N•m (12 ft. lbs.)
Interlock and Detent Ball Plugs	19 N•m (14 ft. lbs.)
Propeller Shaft Clamp Screws	16-23 N•m (140-200 in. lbs.)
Rear Mount-To-Transmission Bolts	33-60 N•m (24-44 ft. lbs.)
Rear Mount Clevis Bolt/Nut	54-75 N•m (40-55 ft. lbs.)
Rear Mount-To-Crossmember Nuts	33-49 N•m (24-36 ft. lbs.)
Restrictor Pins	19 N•m (14 ft. lbs.)
Reverse Shift Arm Bracket Bolts	18 N•m (13 ft. lbs.)
Shift Arm Set Screw	38 N•m (28 ft. lbs.)
Shift Fork Set Screws	20 N•m (15 ft. lbs.)
Shift Knob Nut	20-34 N•m (15-25 ft. lbs.)
Shift Lever Floor Cover Screws	2-3 N•m (17-30 in. lbs.)
Shift Tower Bolts	18 N•m (13 ft. lbs.)
Transfer Case Mounting Nuts	30-41 N•m (22-30 ft. lbs.)

J9321-89

SELECTIVE SNAP RING CHART—AX 15 MANUAL TRANSMISSION



INPUT SHAFT BEARING SNAP RING

I.D. MARK	THICKNESS
A	2.10-2.15 mm
B	2.15-2.20 mm
C	2.20-2.25 mm
D	2.25-2.30 mm
E	2.30-2.35 mm
F	2.35-2.40 mm
G	2.40-2.45 mm

1-2 HUB SNAP RING

I.D. MARK	THICKNESS
B	2.35-2.40 mm
C	2.40-2.45 mm
D	2.45-2.50 mm
E	2.50-2.55 mm
F	2.55-2.60 mm
G	2.60-2.65 mm

CLUSTER FRONT BEARING SNAP RING

I.D. MARK	THICKNESS
A	2.00-2.05 mm
B	2.05-2.10 mm
C	2.10-2.15 mm
D	2.15-2.20 mm
E	2.20-2.25 mm

OUTPUT SHAFT REAR SNAP RING

I.D. MARK	THICKNESS
A	2.75-2.80 mm
B	2.80-2.85 mm
C	2.85-2.90 mm
D	2.90-2.95 mm
E	2.95-3.00 mm
F	3.00-3.05 mm
G	3.05-3.10 mm
H	3.10-3.15 mm
I	3.15-3.20 mm
J	3.20-3.25 mm
K	3.25-3.30 mm
L	3.30-3.35 mm

3-4 HUB SNAP RING

I.D. MARK	THICKNESS
A	1.80-1.85 mm
B	1.85-1.90 mm
C	1.90-1.95 mm
D	1.95-2.00 mm
E	2.00-2.05 mm
F	2.05-2.10 mm
G	2.10-2.15 mm

FIFTH GEAR SNAP RING

I.D. MARK	THICKNESS
A	2.80-2.85 mm
B	2.85-2.90 mm
C	2.90-2.95 mm
D	2.95-3.00 mm
E	3.00-3.05 mm
F	3.05-3.10 mm
G	3.10-3.15 mm
H	3.15-3.20 mm

J8921-1131

30RH/32RH GENERAL SPECIFICATIONS

TRANSMISSION MODEL	32RH	30RH
Oil Pump Clearances	0.089-0.190 mm (0.0035-0.0075 in.)	0.089-0.190 mm (0.0035-0.0075 in.)
Planetary End Play	0.127-1.22 mm (0.005-0.048 in.)	0.025-1.19 mm (0.001-0.047 in.)
Input Shaft End Play	0.56-2.31 mm (0.002-0.091 in.)	0.050-2.31 mm (0.002-0.091 in.)
Clutch Pack Clearance:		
Front Clutch – 4 Disc	1.70-3.40 mm 0.067-0.134 in.	1.70-3.40 mm (0.067-0.134 in.)
Rear Clutch – 3 Disc		
Rear Clutch – 4 Disc	0.81-1.40 mm 0.032-0.055 in.	0.635-1.14 mm (0.025-0.045 in.)
Clutch Disc Usage:		
Front Clutch	4	4
Rear Clutch	4	3
Band Adjustments: (Turns backed off from indicated torque)		
Front	2¼ Ⓐ	2 ½ Ⓐ
Rear	4 Ⓐ	7 Ⓑ
Ⓐ Backed off from 72 in. lbs.		
Ⓑ Backed off from 41 in. lbs.		
Recommended (and preferred) Fluid (all)	MOPAR ATF Plus, Type 7176 Automatic Transmission Fluid	

J9421-194

30RH/32RH SNAP RING/THRUST WASHER/THRUST PLATE SPECIFICATIONS

	TRANSMISSION MODEL	
COMPONENT	32RH	30RH
Front Clutch Thrust Washer (on reaction shaft support hub)	0.061 in.	0.061-0.063 in.
Rear Clutch Thrust Washer (on clutch retainer)	0.061 in.	0.061-0.063 in.
Output Shaft Thrust Plate (on output shaft pilot hub)	0.060-0.063 in.	0.060-0.063 in.
Output Shaft Thrust Washer (in rear clutch hub)	0.052-0.054 in. 0.068-0.070 in. 0.083-0.085 in.	0.052-0.054 in. 0.068-0.070 in. 0.083-0.086 in.
Rear Clutch Pack Snap Ring	0.068 in. 0.060 in. 0.076 in. 0.098 in.	0.06-0.062 in. 0.068-0.070 in. 0.076-0.078 in.
Planetary Geartrain Snap Ring (At front end of output shaft)	0.040-0.044 in. 0.062-0.066 in. 0.082-0.086 in.	0.040-0.044 in. 0.062-0.066 in. 0.082-0.086 in.

J9421-193

30RH/32RH PRESSURE TEST SPECIFICATIONS

Line Pressure	Closed Throttle 1000 rpm	372-414 kPa (54-60 psi) 648 kPa (94 psi)
Front Servo Release	Third Gear Only	No more than 21 kPa (3 psi) lower than line pressure.
Rear Servo Apply	1 Range R Range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D Range and Closed Throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1½ psi) when stopped with transmission in D, 1, 2. **Pressure above 7 kPa (1½ psi) at standstill will prevent transmission from downshifting.** J9421-191

30RH/32RH TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Cooler Line Fittings	18 N•m (13 ft. lbs.)
Converter Bolts:	
9.5 in., 3-lug converter	54 N•m (40 ft. lbs.)
9.5 in., 4-lug converter	74 N•m (55 ft. lbs.)
10.0 in., 4-lug converter	74 N•m (55 ft. lbs.)
Crossmember Bolts/Nuts	68 N•m (50 ft. lbs.)
Driveplate Bolts	75 N•m (55 ft. lbs.)
Extension/Adapter Housing Bolts	43 N•m (32 ft. lbs.)
Front Band Pivot Pin Access Plug	17 N•m (13 ft. lbs.)
Front Band Adjusting Screw Locknut	34 N•m (25 ft. lbs.)
Governor Body-to-Park Gear Bolts	11 N•m (8 ft. lbs.)
Converter Clutch Park/Module Screws	4 N•m (35 in. lbs.)
Neutral Position Switch	34 N•m (25 ft. lbs.)
Oil Filter Screws	4 N•m (35 in. lbs.)
Oil Pan Bolts	17 N•m (13 ft. lbs.)
Oil Pump Bolts	20 N•m (15 ft. lbs.)

DESCRIPTION	TORQUE
Rear Support Bolts	17 N•m (150 in. lbs.)
Pressure Test Port Plugs	14 N•m (10 ft. lbs.)
Propeller Shaft Clamp Bolts	19 N•m (170 in. lbs.)
Reaction Shaft Support Bolts	10 N•m (15 ft. lbs.)
Rear Band Adjusting Screw Locknut	41 N•m (30 ft. lbs.)
Rear Mount Bolts/Nuts	68 N•m (50 ft. lbs.)
Solenoid-to-Transfer Plate Screw	4 N•m (35 in. lbs.)
Speedometer Adapter Clamp Bolt	11 N•m (8 ft. lbs.)
Valve Body Screws	4 N•m (35 in. lbs.)
Valve Body-to-Case Bolts	12 N•m (100 in. lbs.)

J9421-192

AW-4 GENERAL SPECIFICATIONS

Gear Ratios:

First	2.804:1
Second	1.531:1
Third	1.000:1
Fourth (Overdrive)	0.753:1
Reverse	2.393:1

Transmission Fluid	Mopar Dexron II E/Mercon
Fluid Level	To "Full" mark with fluid hot (normal operating temperature)
Fluid Capacity (all models)	8.0 Liters (8.45 qts.)

Test Specifications

Stall Speed:

In D Range and Reverse	2100–2400 rpm

LIne Pressure:

In D at Curb Idle	61–70 psi (421–481 kPa)
In D at WOT	173–209 psi (1196–1442 kPa)
In Reverse at Curb Idle	75–90 psi (519–618 kPa)
In Reverse at WOT	213–263 psi (1471–1814 kPa)

Time Lag Test:

Engagement in D Range	1.2 seconds
Engagement in Reverse	1.5 seconds

Valve Body Solenoid Resistance	11–15 ohms
Transmission Fluid Normal Operating Temperature	50–80°C (122–176°F)
TPS Input Voltage (AU)	5.0 Volts (approx.)

TPS Output Voltage

4-Cylinder	0.2 Volts (approx.)
6-Cylinder	4.2 Volts (approx.)

J9121-401X

AW-4 OIL PUMP WEAR LIMITS

Drive Gear

Tip Clearance:

Standard ..... 0.11-0.14 mm (0.0043-0.0055 in.)

Maximum Allowance ..... 0.3 mm (0.012 in.)

Gear-to-Pump Body

End Clearance:

Standard ..... 0.02-0.05 mm (0.0008-0.0020 in.)

Maximum Allowance ..... 0.1 mm (0.004 in.)

Driven Gear-to-Pump

Body Clearance:

Standard ..... 0.07-0.15 mm (0.0028-0.0059 in.)

Maximum Allowance ..... 0.3 mm (0.012 in.)

J8921-740

AW-4 CLUTCH DISC AND PLATE THICKNESS

Component	Minimum Allowable Thickness
Clutch Disc (all except first-reverse and forward clutch discs)	1.84 mm (0.0724 in.)
6-Cylinder Forward Clutch Disc	1.51 mm (0.0594 in.)
6 Cylinder Direct Clutch Plates: Thin Plate (1) Thick Plates (3)	 2.3 mm (0.905 in.) 3.0 mm (0.118 in.)
6-Cylinder Forward Clutch Plate	1.8 mm (0.070 in.)
First-Reverse Brake Disc (all)	1.51 mm (0.0594 in.)

J9121-402

AW-4 BUSHING AND PISTON CLEARANCE

BUSHING INSIDE DIAMETER (MAXIMUM)

Bushing Location	Maximum Allowance Inside Diameter
Extension Housing	38.09 mm (1.4996 in.)
Direct Clutch Drum	53.97 mm (2.1248 in.)
Overdrive Planetary Gear	11.27 mm (.4437 in.)
Overdrive Direct Clutch Drum	27.11 mm (1.0673 in.)
Stator Shaft (Front)	21.58 mm (.8496 in.)
Stator Shaft (Rear)	27.08 mm (1.0661 in.)
Oil Pump Body	38.19 mm (1.5035 in.)
Transmission Case	38.18 mm (1.5031 in.)

PISTON STROKE LENGTH

Piston Location	Specification
Direct Clutch (all)	1.37–1.67 mm (.0539–.0657 in.)
6-Cylinder Overdrive Brake	1.40–1.70 mm (.0551–.0669 in.)
Second Coast Brake (all)	1.5–3.0 mm (.059–.118 in.)
6-Cylinder Forward Clutch	3.55–3.73 (.1397–.1468 in.)
Overdrive Direct Clutch (all)	1.85–2.15 mm (.0728–.0846 in.)

END PLAY AND CLEARANCE

Component	Specification
Output Shaft End Play	.27–.86 mm (.0106–.0339 in.)
6-Cylinder First-Reverse Brake Pack Clearance	.70–1.20 mm (.028–.047 in.)
6-Cylinder Second Brake Pack Clearance	.62–1.98 mm (.024–.078 in.)

J9121-403

AW-4 RETAINER AND PISTON SPECIFICATIONS

OVERDRIVE BRAKE RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
26	3.3 mm (.130 in.)	11	3.8 mm (.150 in.)
25	3.5 mm (.138 in.)	23	3.9 mm (.154 in.)
12	3.6 mm (.142 in.)	Not Marked	4.0 mm (.157 in.)
24	3.7 mm (.146 in.)	—	—

DIRECT CLUTCH RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
33	3.0 mm (.118 in.)	29	3.4 mm (.134 in.)
32	3.1 mm (.122 in.)	28	3.5 mm (.138 in.)
31	3.2 mm (.126 in.)	27	3.6 mm (.142 in.)
30	3.3 mm (.130 in.)	34	3.7 mm (.146 in.)

OVERDRIVE CLUTCH RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
16	3.6 mm (.142 in.)	19	3.3 mm (.130 in.)
17	3.5 mm (.138 in.)	20	3.2 mm (.126 in.)
18	3.4 mm (.134 in.)	21	3.1 mm (.122 in.)

SECOND COAST BRAKE PISTON ROD SELECTION

Rod	Rod Length
No. 1	71.4 mm (2.811 in.)
No. 2	72.9 mm (2.870 in.)

FORWARD CLUTCH RETAINER SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
42	4.0 mm (.157 in.)	61	3.0 mm (.118 in.)
44	3.8 mm (.149 in.)	62	3.6 mm (.142 in.)
45	3.4 mm (.134 in.)	63	4.2 mm (.165 in.)
60	3.2 mm (.126 in.)	64	4.4 mm (.173 in.)

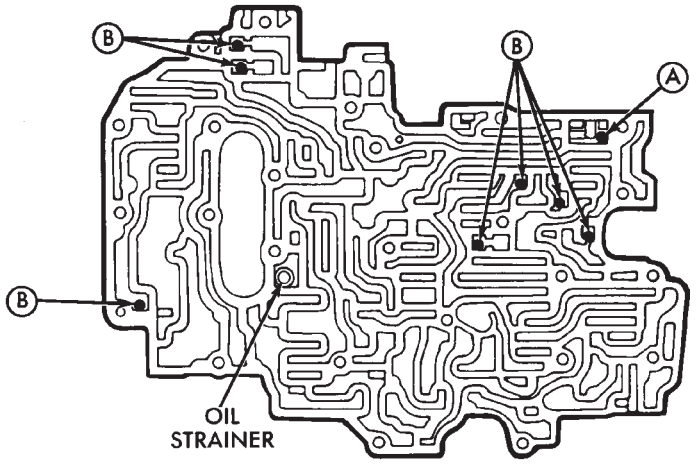
FIRST-REVERSE BRAKE CLEARANCE SELECTION

Retainer No.	Thickness	Retainer No.	Thickness
50	5.0 mm (.197 in.)	53	4.4 mm (.173 in.)
51	4.8 mm (.189 in.)	54	4.2 mm (.165 in.)
52	4.6 mm (.181 in.)	55	4.0 mm (.157 in.)

J9121-404

AW-4 VALVE BODY CHECK BALL DIMENSIONS

Check Ball	Diameter
(A) Rubber Ball	6.35 mm (0.250 in.)
(B) Rubber Ball	5.535 mm (.218 in.)



J9121-405

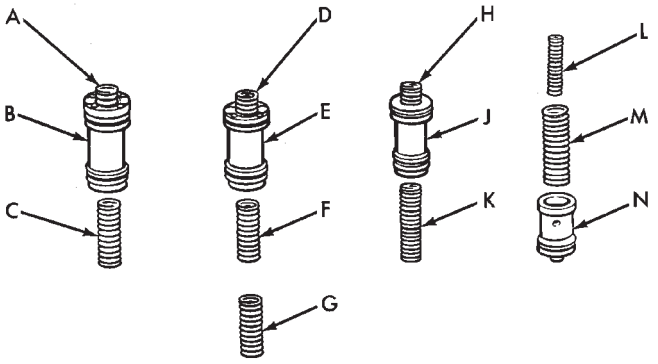
AW-4 CLUTCH AND BRAKE PACK REQUIREMENTS

Component	Discs Required	Plates Required	Retainers Required
6-Cylinder Overdrive Brake	4	3	2
6-Cylinder Second Brake	5	5	1
6-Cylinder Overdrive Direct Clutch	2	2	1
6-Cylinder Direct Clutch	4	4	1
6-Cylinder Forward Clutch	6	6	1
6-Cylinder First-Reverse Brake	7	7	1

J9121-406

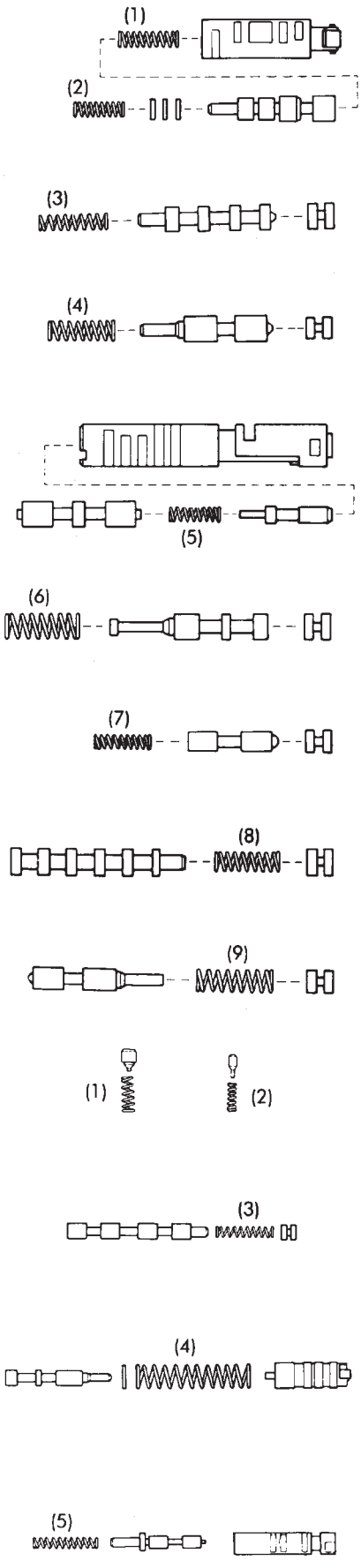
AW-4 ACCUMULATOR COMPONENT IDENTIFICATION

	Component	Approximate Outside Diameter
SECOND BRAKE ACCUMULATOR	SPRING A	14.17 mm (.558 in.)
	PISTON B	36.9 mm (1.453 in.)
	SPRING C	19.91 mm (.784 in.)
DIRECT CLUTCH ACCUMULATOR	SPRING D	12.07 mm (.475 in.)
	PISTON E	36.9 mm (1.453 in.)
	SPRING F	20.19 mm (.795 in.)
	SPRING G	14.81 mm (.583 in.)
OVERDRIVE BRAKE ACCUMULATOR	SPRING H	14.10 mm (.555 in.)
	PISTON J	31.9 mm (1.256 in.)
	SPRING K	19.99 mm (.785 in.)
OVERDRIVE CLUTCH ACCUMULATOR	SPRING L	14.0 mm (0.551 in.)
	SPRING M	20.3 mm (0.799 in.)
	PISTON N	29.9 mm (1.177 in.)



J9121-407

AW-4 VALVE AND SPRING IDENTIFICATION



Spring	Free Length
(1) Downshift Plug	27.3 mm (1.074 in.)
(2) Throttle Valve	20.6 mm (.811 in.)
(3) 3-4 Shift Valve	30.8 mm (1.212 in.)
(4) Second Coast Modulator Valve	25.3 mm (.996 in.)
(5) Lockup Relay Valve	21.4 mm (.843 in.)
(6)Secondary Regulator Valve	30.9 mm (1.217 in.)
(7) Cut-Back Valve	21.8 mm (.858 in.)
(8) 2-3 Shift Valve	30.8 mm (1.212 in.)
(9) Low Coast Modulator Valve	27.8 mm (1.094)

Spring	Spring Length
(1) Check Valve	20.2 mm (.797 in.)
(2) Pressure Relief Valve	11.2 mm (.441 in.)
(3) 1-2 Shift Valve	30.8 mm (1.213 in.)
(4) Primary Regulator Valve	62.3 mm (2.453 in.)
(5) Accumulator Control Valve	29.8 mm (1.173 in.)

J9121-408

AW-4 TORQUE SPECIFICATIONS

Description	Torque
Converter Housing Bolts	
10 mm	32-36 N•m (23-27 ft. lbs.)
12 mm	55-59 N•m (40-43 ft. lbs.)
Cooler Line Retaining Clip Nuts	2-4 N•m (18-35 in. lbs.)
Cooler Line Bracket Nuts	5-11 N•m (48-96 in. lbs.)
Cooler Line Fitting Nuts (at auto. trans. fittings)	18-23 N•m (160-200 in. lbs.)
Detent Spring Bolt	9-11 N•m (80-96 in. lbs.)
Dust Cover Nuts/Bolts	18-23 N•m (159-203 in. lbs.)
Extension Housing Bolts	32-36 N•m (23-27 ft. lbs.)
Fill Tube Bracket Bolt	50-64 N•m (37-47 ft. lbs.)
Neutral Switch	
Bolt	12-14 N•m (8-10 ft. lbs.)
Nut	6-8 N•m (53-70 in. lbs.)
OD Support Bolt (to case)	23-27 N•m (18-20 ft. lbs.)
Oil Pan Bolts	6-8 N•m (53-70 in. lbs.)
Oil Pan Drain Plug	19-21 N•m (14-16 ft. lbs.)
Oil Pump Bolt (to case)	21-23 N•m (16-18 ft. lbs.)
Oil Pump Bolt (to stator shaft)	9-11 N•m (80-96 in. lbs.)
Oil Screen Bolt	9-11 N•m (80-96 in. lbs.)
Park Pawl Bracket	9-11 N•m (80-96 in. lbs.)
Propeller Shaft Clamp Screws	16-23 N•m (140-200 in. lbs.)
Rear Mount-To-Transmission Bolts	60-81 N•m (44-66 ft. lbs.)
Rear Mount-To-Clevis Bracket Bolt/Nut	54-75 N•m (40-55 ft. lbs.)
Rear Mount Clevis Bracket-To-Crossmember Nuts	33-49 N•m (24-36 ft. lbs.)
Shift Cable Bracket Screws At Transmission	25-39 N•m (221-345 in. lbs.)
Shift Lever Mounting Cover Screws	1-2 N•m (9-20 in. lbs.)
Shift Lever Housing Nuts	16-26 N•m (141-230 in. lbs.)
Solenoid Harness Bolt	6-8 N•m (57-75 in. lbs.)
Speedometer Adapter Clamp Screw	10-12 N•m (90-110 in. lbs.)
Speed Sensor Coupling Nut	14-20 N•m (125-175 in. lbs.)
Throttle Cable Engine Bracket Screws	7-11 N•m (63-94 in. lbs.)
Throttle Cable Retaining Screw (at transmission)	8-10 N•m (70-98 in. lbs.)
Transfer Case Mounting Nuts	30-41 N•m (22-30 ft. lbs.)
Transmission Shift Lever Nut	15-17 N•m (134-154 in. lbs.)
Transmission-To-Engine Block Bolts	50-64 N•m (37-47 ft. lbs.)
Valve Body Bolts (to case)	9-11 N•m (80-96 in. lbs.)
Valve Body Bolts (to valve body)	6-7 N•m (54-58 in. lbs.)

J9321-88

NP231/NP242 TORQUE SPECIFICATIONS

Description	Torque
Detent Plug	16-24 N•m (12-18 ft. lbs.)
Differential Case Bolt	17-27 N•m (150-240 in. lbs.)
Drain/Fill Plugs	40-54 N•m (30-40 ft. lbs.)
Extension Housing Bolt	35-46 N•m (26-34 ft. lbs.)
Front Bearing Retainer Bolt	16-27 N•m (12-20 ft. lbs.)
Front Case-To-Rear Case Bolt	35-46 N•m (26-34 ft. lbs.)
Front Yoke Nut	122-176 N•m (90-130 ft. lbs.)
Oil Pump Screw	1.4-1.8 N•m (12-15 in. lbs.)
Range Lever Nut	27-34 N•m (20-25 ft. lbs.)
Rear Retainer Bolt	35-46 N•m (26-34 ft. lbs.)
Transfer Case Mounting Nuts	35-47 N•m (26-35 ft. lbs.)
U-Joint Clamp Bolts	19 N•m (170 in. lbs.)
Vacuum Switch	20-34 N•m (15-25 ft. lbs.)

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WHEELS AND TIRES

CONTENTS

TIRES

INDEX

GENERAL INFORMATION

Tires are designed 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. These tires have specific load carrying capacities. When correctly inflated, they will operate properly.

Tires used in cool climates, and with light loads will have a longer life than tires used in hot climates with heavy loads. Abrasive road surfaces will accelerate tire wear.

Driving habits have more effect on tire life than any other factor. Careful drivers will obtain much greater mileage than careless drivers.

Driving habits that shorten the life of any tire;

- Rapid acceleration and deceleration
- Severe application of brakes
- High-speed driving
- Taking turns at excessive speeds
- Striking curbs and other obstacles

It is very important to follow the tire rotation interval

IDENTIFICATION

Tire type, size, aspect ratio and speed rating are encoded in the letters and numbers imprinted on the side wall of the tire. Refer to the chart to decipher the tire identification code (Fig. 1).

Performance tires will have a speed rating letter after the aspect ratio number. The speed rating is not always printed on the tire sidewall. The letter **S** indicates that the tire is speed rated up to 112 mph.

- **Q** up to 100 mph
- **T** up to 118 mph
- **U** up to 124 mph
- **H** up to 130 mph
- **V** up to 149 mph
- **Z** more than 149 mph (consult the tire manufacturer for the specific speed rating)

An All Season type tire will have either **M + S, M & S or M—S** (indicating mud and snow traction) imprinted on the side wall.

RADIAL-PLY TIRES

Radial-ply tires improve handling, tread life, 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, but reduced speeds are recommended.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They use the same recommended inflation pressures.

SPARE TIRE (TEMPORARY)

The compact spare tire is designed for emergency use only. The original tire should be repaired and reinstalled at the first opportunity. Refer to Owner's Manual for complete details.

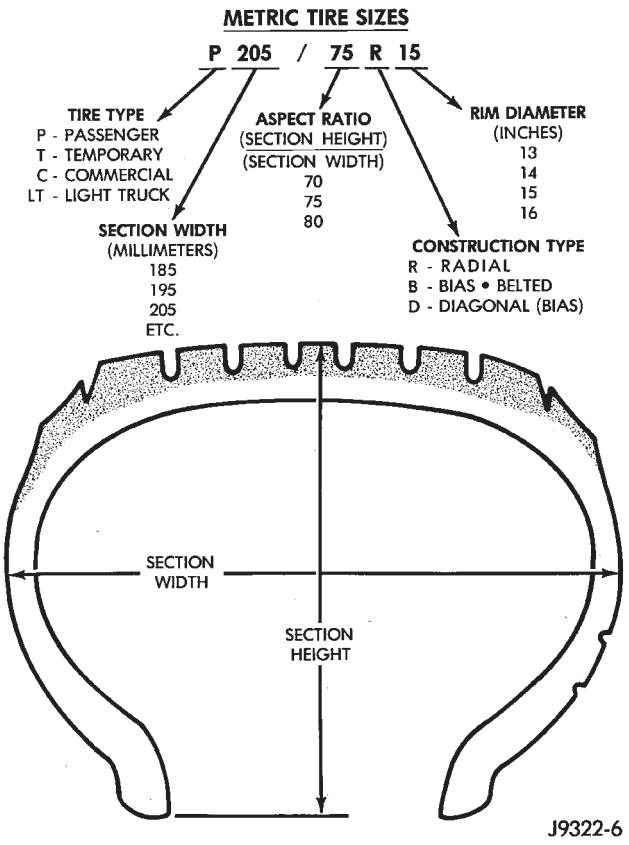


Fig. 1 Tire Size Identification

TIRE CHAINS

Tire snow chains may be used on certain models. Refer to Owner's Manual for more information.

CLEANING OF TIRES

Steam cleaning may be used for cleaning.

DO NOT use gasoline or wire brush for cleaning.

DO NOT use mineral oil or an oil-based solvent.

PRESSURE GAUGES

High-quality, dial-type, air-pressure gauges are recommended. After checking with the gauge, replace valve cap and finger tight.

TIRE INFLATION PRESSURES

Under inflation (Fig. 2) causes rapid shoulder wear and tire flexing.

Over inflation (Fig. 3) causes rapid center wear and loss of the tire's ability to cushion shocks.

Improper inflation can cause;

- Uneven wear patterns
- Reduced tread life
- Reduced fuel economy
- Unsatisfactory ride
- Cause the vehicle to drift

Refer to the Owner's Manual for information regarding proper tire inflation pressure.

This pressure has been carefully selected to provide for safe vehicle operation. Tire pressure should be checked **cold** once per month. Tire pressure decreases when the outside temperature drops.

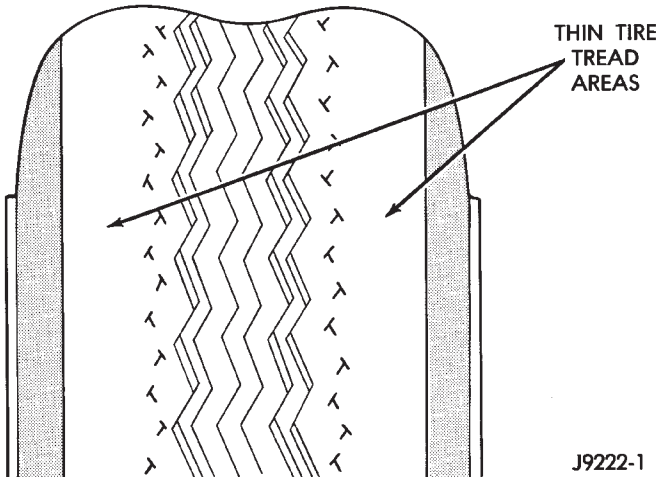


Fig. 2 Under Inflation Wear

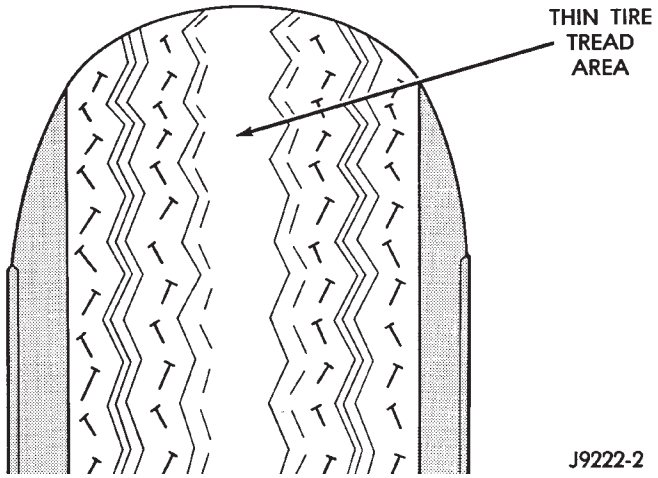


Fig. 3 Over Inflation Wear

Inflation pressures specified on the placards are always **cold inflation pressure**. Cold inflation pressure is obtained after the vehicle has not been operated for at least 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation. **Do not** reduce this normal pressure build-up.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND CAN FAIL SUDDENLY, RESULTING IN LOSS OF VEHICLE CONTROL.

REPLACEMENT TIRES

OEM tires provide a proper balance of many features such as;

- Ride

- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

Original equipment tires should be used when replacement is needed.

Refer to the placard on the vehicle or the Owner's Manual for the correct replacement tire.

Failure to use original or equivalent replacement tires may adversely affect the handling of the vehicle.

The use of oversize tires **is not recommended.** They may cause interference with vehicle suspension and steering travel. This can cause tire damage or failure.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE LOAD CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

ROTATION

Tires on the front and rear axles operate at different loads and perform different steering, driving, and braking functions. For these reasons, the tires wear at unequal rates. They may also develop irregular wear patterns. These effects can be reduced by rotating the tires according to the maintenance schedule in the Owners Manual. This will improve tread life, traction and maintain a smooth quiet ride.

The suggested method of tire rotation is the **same side front to rear** pattern (Fig. 4). Other rotation methods can be used, but may not provide the same tire longevity benefits.

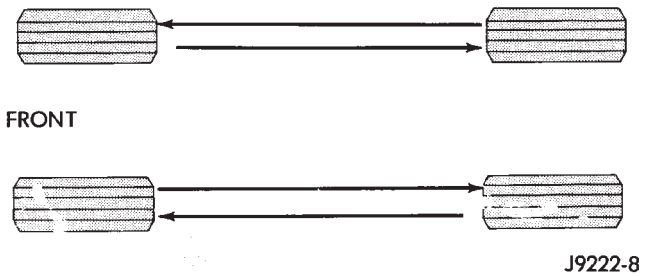


Fig. 4 Tire Rotation Pattern

TREAD WEAR INDICATORS

Tread wear indicators are molded into the bottom of the tread grooves. When tread is 1.6 mm (1/16 in.), the tread wear indicators will appear as a 13 mm (1/2 in.) band across the tread width.

Tire replacement is necessary when indicators appear in two or more grooves Fig. 5).

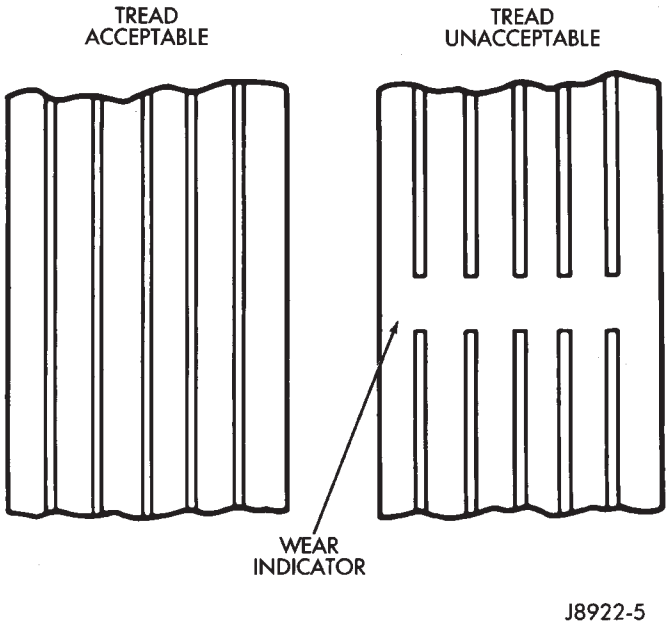


Fig. 5 Tread Wear Indicators

REPAIRING LEAKS

For proper repairing, a radial tire it must be removed from the wheel. Repairs should only be made if the puncture is in the **tread area** (Fig. 6). If outside the tread area the tire should be replaced.

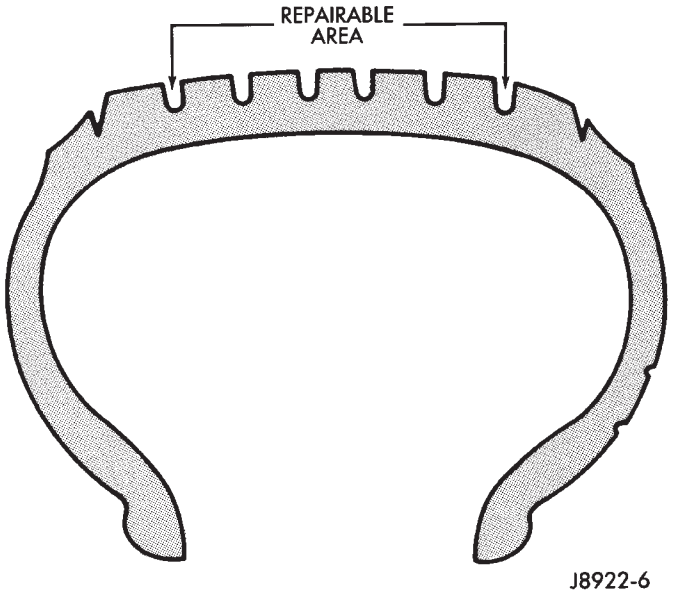


Fig. 6 Tire Repair Area

Deflate tire completely before dismounting 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.

Before mounting tire on wheel, make sure all rust scale is removed from the rim. Repaint or seal if necessary.

TIRE NOISE OR VIBRATION

The radial-ply tire on your vehicle is more sensitive to improper mounting, or imbalance.

To determine if tires are the cause of vibration, drive the vehicle over a smooth road at different speeds. Note the effect of acceleration and deceleration on noise level. Differential and exhaust noise will change in intensity as speed varies. Tire noise will usually remain constant.

TIRE WEAR PATTERNS

Under inflation will increase wear on the shoulders of the tire. Over inflation will increase wear at the center of the tread.

Excessive camber causes the tire to run at an angle to the road. One side of tread is worn more than the other.

Excessive toe-in or toe-out causes wear on the tread edges. There is a feathered effect across the tread (Fig. 7).

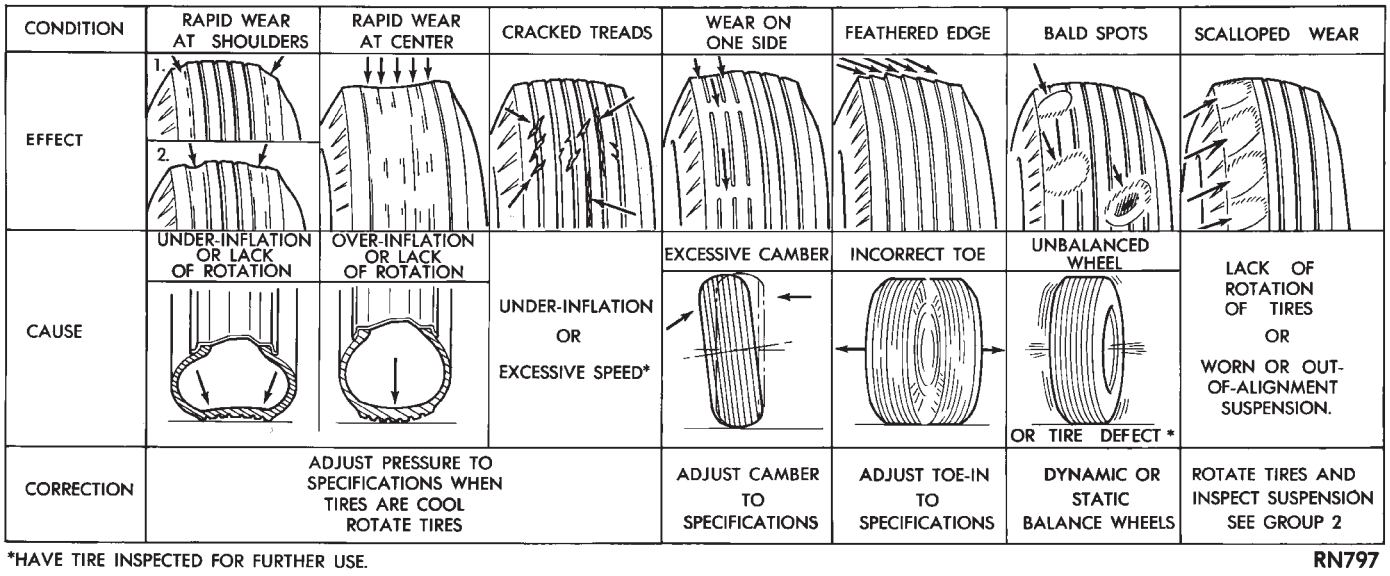
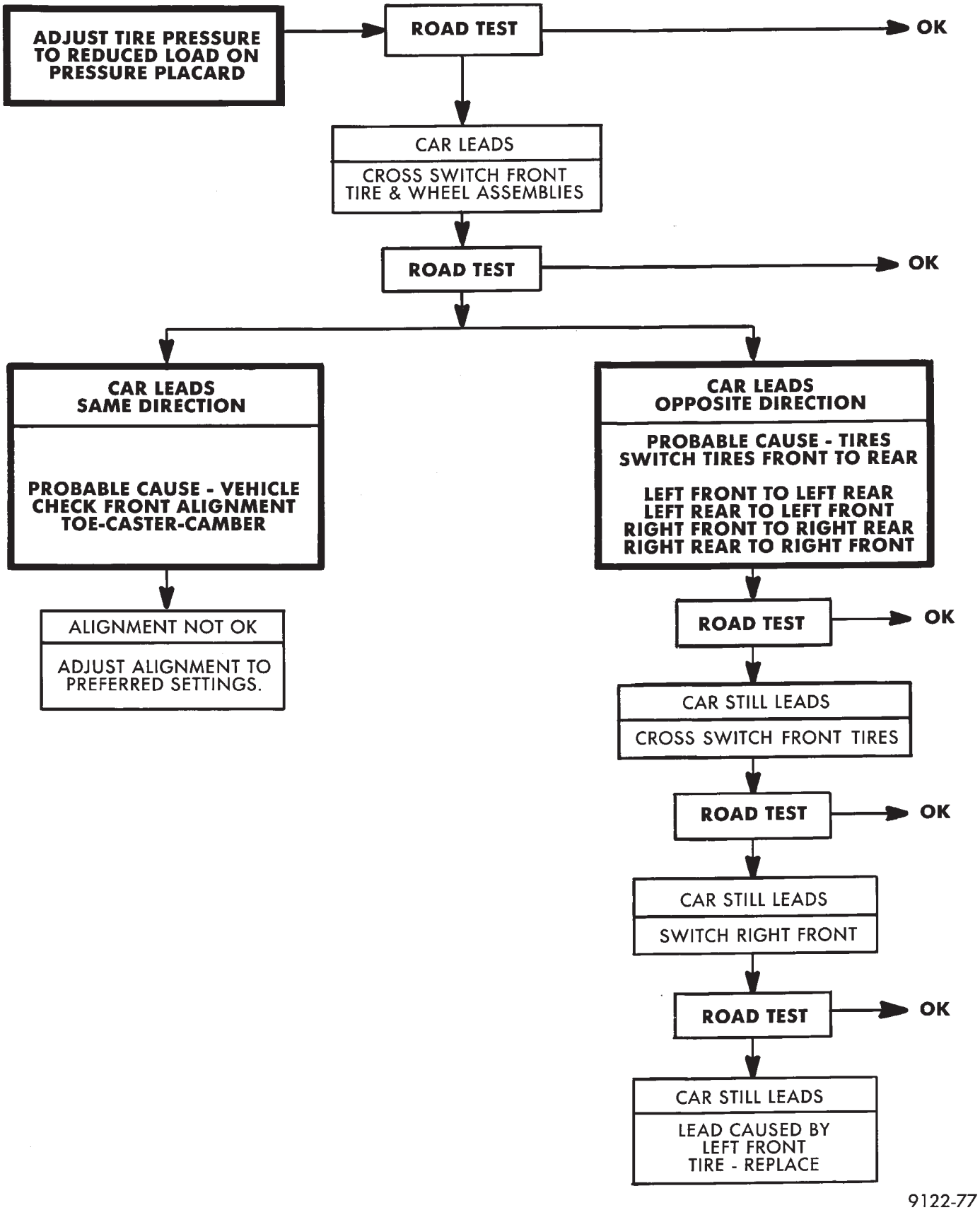


Fig. 7 Abnormal Tire Tread Wear Patterns

LEAD CORRECTION CHART



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WHEELS

GENERAL INFORMATION

Original equipment wheels are designed for the specified Maximum Vehicle Capacity.

All models use steel or cast aluminum drop center wheels. The safety rim wheel (Fig. 1) has raised sections between the rim flanges and the rim well.

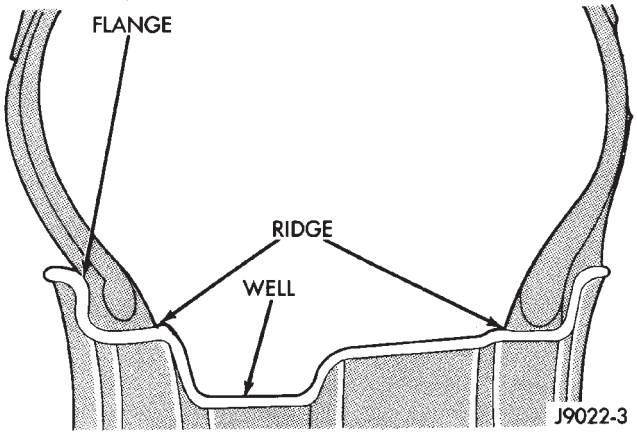


Fig. 1 Wheel Safety Rim

Initial inflation of the tire forces the bead over these raised sections. In case of tire failure, the raised sections hold the tire in position on the wheel until the vehicle can be brought to a safe stop.

Cast aluminum wheels require special balance weights and alignment equipment.

WHEEL INSTALLATION

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.

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 129 N·m (95 ft. lbs.) torque (Fig. 2). **Never use oil or grease on studs or nuts.**

WHEEL REPLACEMENT

Wheels must be replaced if they have:

- Excessive runout

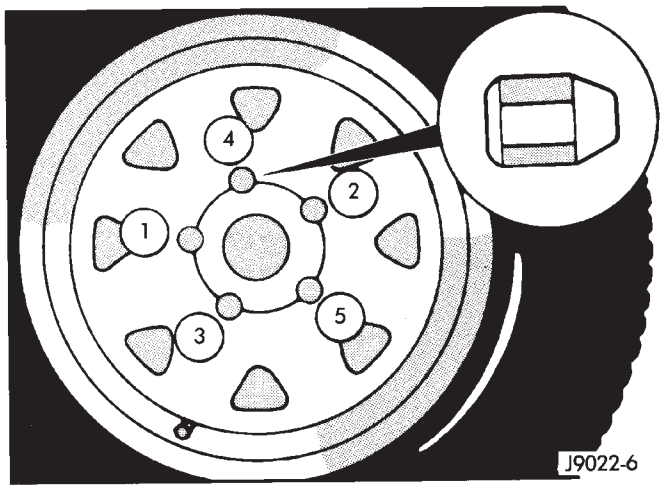


Fig. 2 Lug Nut Tightening Pattern

- 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.

Refer to the Specifications Chart for information regarding above requirements.

WHEEL ORNAMENTATION

WARNING: HANDLE ALL WHEEL ORNAMENTATION WITH EXTREME CARE DURING REMOVAL AND INSTALLATION. SHARP EDGES ON THE COVERS OR CAPS CAN CAUSE PERSONAL INJURY.

TIRE AND WHEEL BALANCE

It is recommended that a two plane dynamic balancer be used when a wheel and tire assembly require balancing. Static should be used only when a two plane balancer is not available.

For static imbalance, find location of heavy spot causing imbalance. Counter balance wheel directly opposite the heavy spot. Determine weight required to counterbalance the area of imbalance. Place half of this weight on the **inner** rim flange and the other

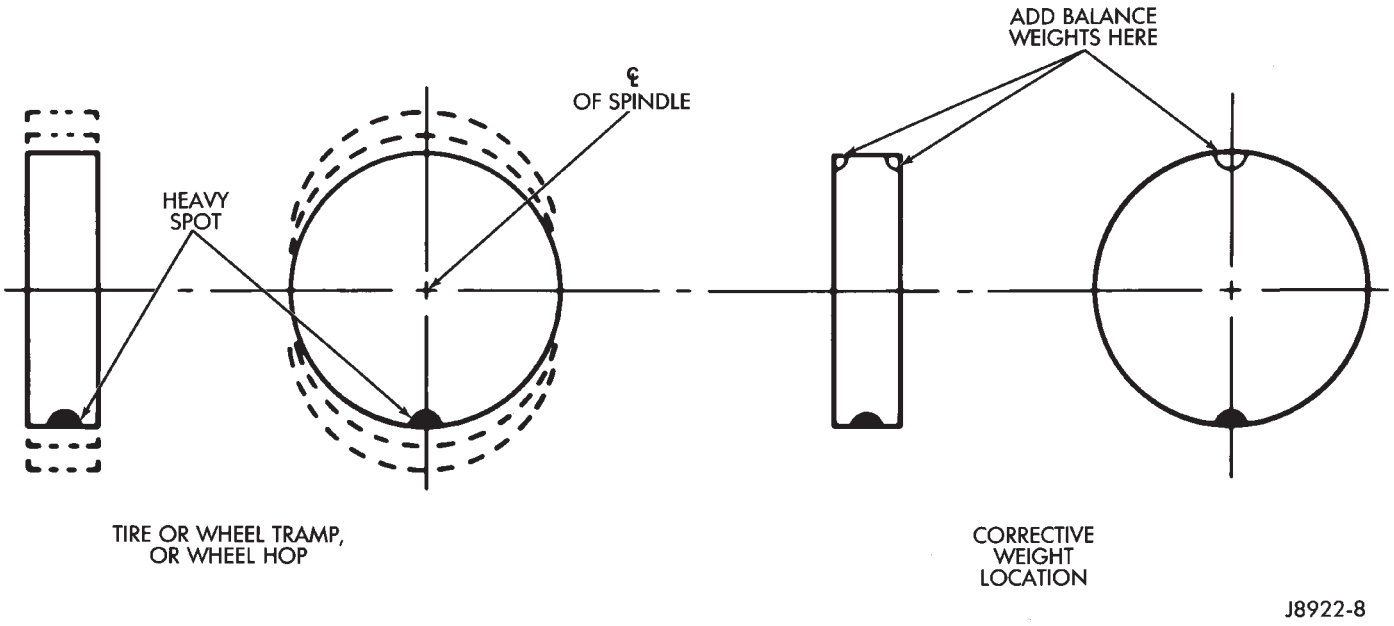


Fig. 3 Static Unbalance & Balance

half on the **outer** rim flange (Fig. 3, Fig. 4). Off-vehicle balancing is necessary.

Wheel balancing can be accomplished with either on or off vehicle equipment. When using on-vehicle balancing equipment, follow these precautions:

- Limited-slip rear axle differential, remove the opposite wheel/tire
- Before balancing the wheels/tires on a vehicle equipped with a transfer case, disconnect the drive shafts

MATCH MOUNTING

Wheels and tires are match mounted at the factory. This means that the high spot of the tire is matched to the low spot on the wheel rim. This technique is used to reduce run-out in the wheel/tire assembly. 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 at the valve stem location on the wheel 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) Measure the total indicator runout on the center of the tire tread rib. Record the indicator reading.

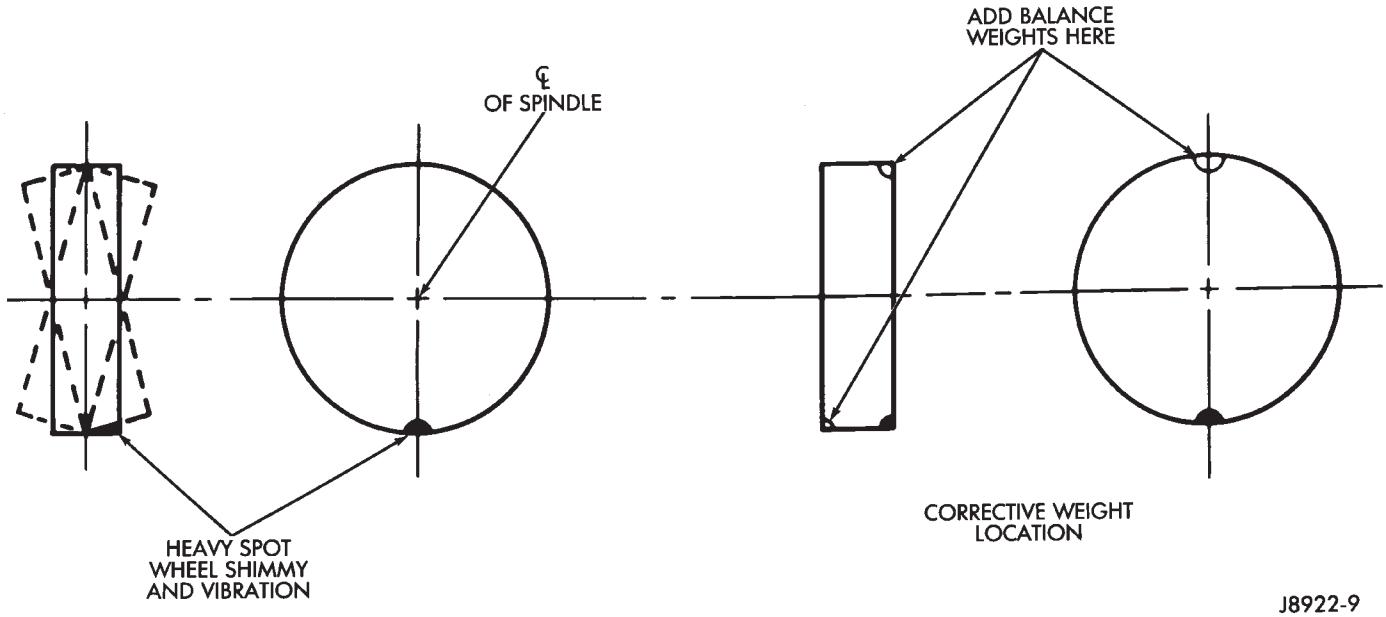


Fig. 4 Dynamic Unbalance & Balance

Mark the tire to indicate the high spot. Place a mark on the tire at the valve stem location (Fig. 5).

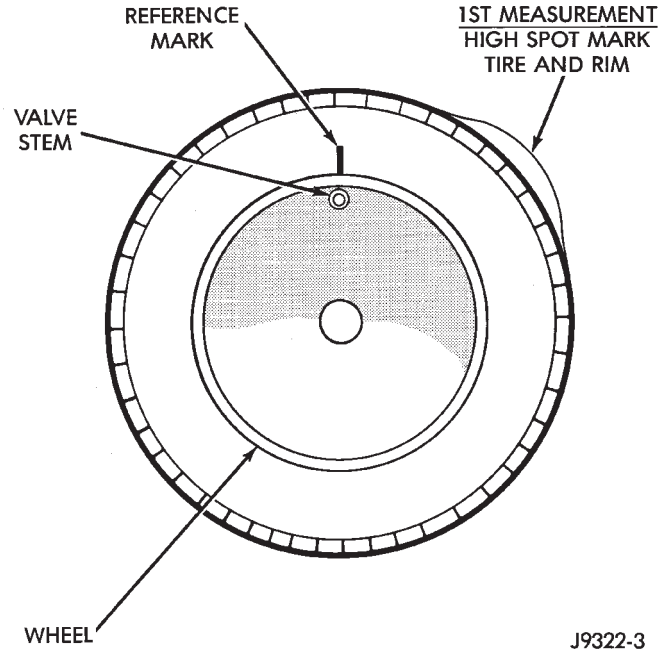


Fig. 5 First Measurement On Tire

(2) Break down the tire and remount it 180 degrees on the rim (Fig. 6).

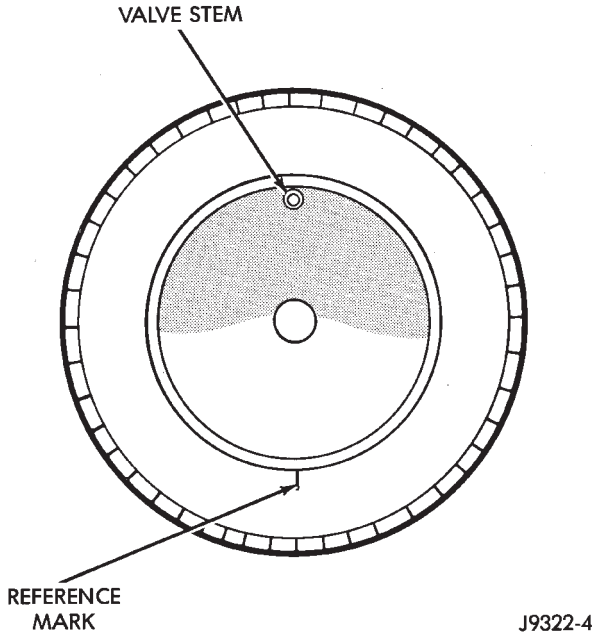


Fig. 6 Remount Tire 180 Degrees

(3) Measure the total indicator runout again. Mark the tire to indicate the high spot.

(4) If runout is still excessive, the following procedures must be done.

- If the high spot is within 101.6 mm (4.0 in.) of the first spot and is still excessive, replace the tire.
- If the high spot is within 101.6 mm (4.0 in.) of the first spot on the wheel, the wheel may be out of specifications. Refer to Wheel and Tire Runout.
- If the high spot is NOT within 101.6 mm (4.0 in.) of either high spot, draw an arrow on the tread from second high spot to first. Break down the tire and remount it 90 degrees on the rim in that direction (Fig. 7). This procedure will normally reduce the runout to an acceptable amount.

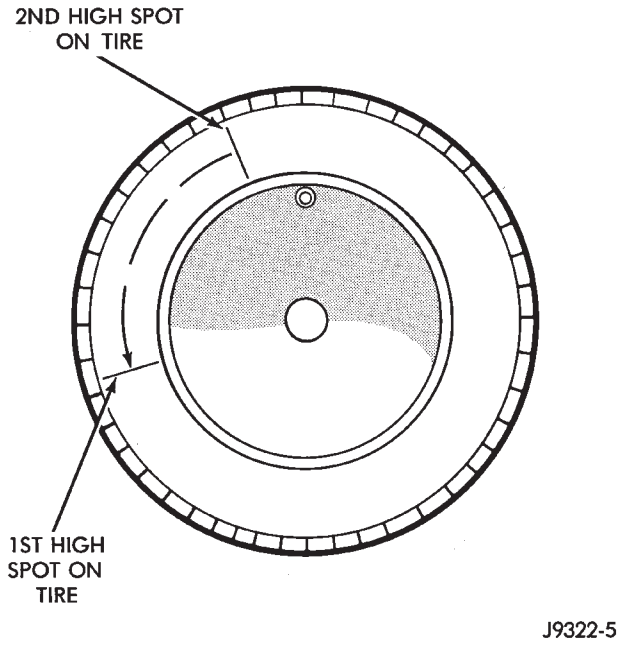


Fig. 7 Remount Tire 90 Degrees In Direction of Arrow

TIRE AND WHEEL RUNOUT

Radial runout is the difference between the high and low points on the tire or wheel (Fig. 8).

Lateral runout is the **wobble** of the tire or wheel.

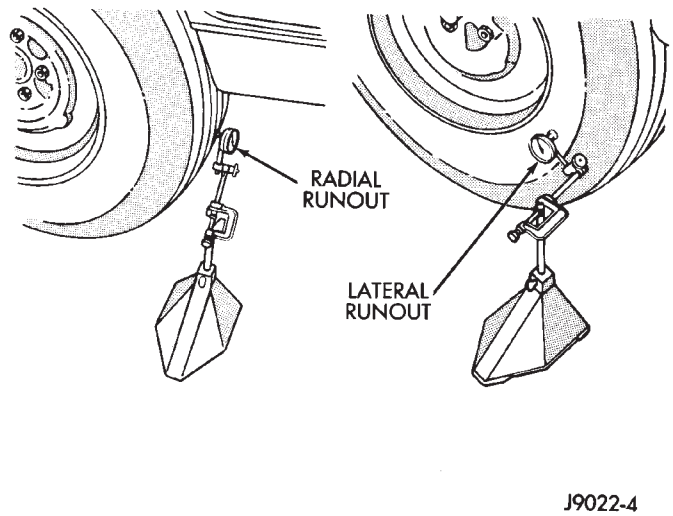


Fig. 8 Checking Tire Runout

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

Check accuracy of the wheel mounting surface; adjust wheel bearings.

Drive vehicle a short distance to eliminate tire flat spotting from a parked position.

Make sure all wheel nuts are properly torqued.

Relocate wheel on the mounting, two studs over from the original position.

Re-tighten wheel nuts until all are properly torqued, to eliminate brake distortion.

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)

Rotating tire on wheel is particularly effective when there is runout in both tire and wheel.

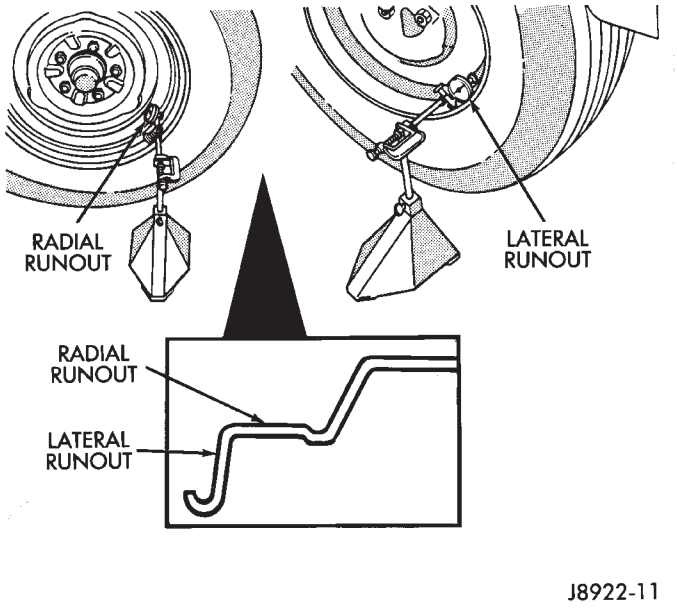


Fig. 9 Checking Wheel Runout

Remove tire from wheel and re-mount wheel on hub in former position.

Check wheel radial runout (Fig. 9).

- STEEL WHEELS: Radial runout 0.040 in., Lateral runout 0.045 in.
- ALUMINUM WHEELS: Radial runout 0.030 in., Lateral runout 0.035 in.

If point of greatest runout is near original chalk mark, remount tire 180 degrees. Recheck runout.

VEHICLE VIBRATION

Vehicle vibration can be caused by:

- Tire/wheel unbalance or excessive runout
- Defective tires with extreme tread wear
- Nylon overlay flat spots (performance tires only)
- Incorrect wheel bearing adjustment (if applicable)
- Loose or worn suspension/steering components
- Certain tire tread patterns
- Incorrect drive shaft angles or excessive drive shaft/yoke runout
- Defective or worn U-joints
- Excessive brake rotor or drum runout
- Loose engine or transmission supports/mounts
- And by engine operated accessories

Refer to the appropriate Groups in this manual for additional information.

VIBRATION TYPES

There are two types of vehicle vibration:

- Mechanical
- Audible.

Mechanical vehicle vibration can be felt through the seats, floor pan and/or steering wheel.

Audible vehicle vibration is heard above normal background noise. The sound can be a droning or drumming noise.

Vibrations are sensitive to change in engine torque, vehicle speed or engine speed.

ENGINE TORQUE SENSITIVE VIBRATION

This vibration can be increased or decreased by:

- Accelerating
- Decelerating
- Coasting
- Maintaining a constant vehicle speed

VEHICLE SPEED SENSITIVE VIBRATION

This vibration condition always occurs at the same vehicle speed regardless of the engine torque or engine speed.

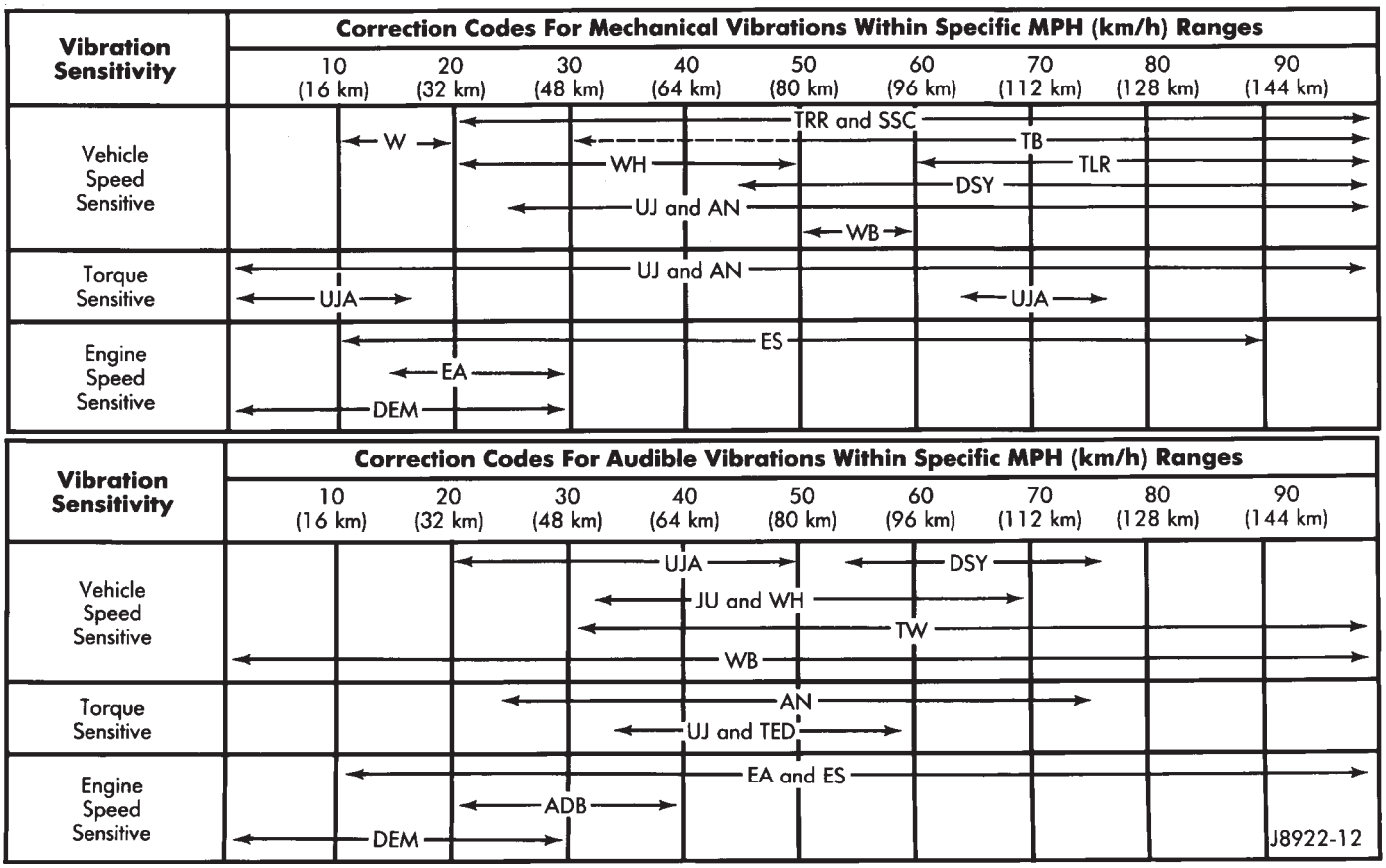
ENGINE SPEED (RPM) SENSITIVE VIBRATION

This vibration occurs at varying engine speeds. It can be isolated by increasing or decreasing the engine speed with the transmission in NEUTRAL position.

VIBRATION DIAGNOSIS

A vibration diagnosis should always begin with a 10 mile (16 km) trip (to warm the vehicle and tires). Then a road test to identify the vibration. Corrective

VIBRATION DIAGNOSIS



action should not be attempted until the vibration type has been identified via a road test.

During the road test, drive the vehicle on a smooth surface. If vibration exists, note and record the following information:

- Identify the vehicle speed range when the vibration occurs
- Identify the type of vibration
- Identify the vibration sensitivity
- Determine if the vibration is affected by changes in vehicle speed, engine speed and engine torque.

When the vibration has been identified, refer to the Vibration Diagnosis chart for causes. Consider correcting only those causes coded in the chart that are related to the vibration condition.

Refer to the following cause codes and descriptions for explanations when referring to the chart.

TRR—Tire and Wheel Radial Runout: Vehicle speed sensitive, mechanical vibration. The runout will not cause vibration below 20 mph (32 km/h).

WH—Wheel Hop: Vehicle speed sensitive, mechanical vibration. The wheel hop generates rapid up-down movement in the steering wheel. The vibration is most noticeable in the 20 - 40 mph (32 - 64 km/h) range. The wheel hop will not cause vibration below 20 mph (32 km/h). Wheel hop is caused by a tire/wheel that has a radial runout of more than 0.045 of-an-inch (1.14 mm). If wheel runout is acceptable and combined runout cannot be reduced by repositioning the tire on wheel, replace tire.

TB—Tire/Wheel Balance: Vehicle speed sensitive, mechanical vibration. Static tire/wheel unbalance will not cause vibration below 30 mph (46 km/h). Dynamic tire/wheel unbalance will not cause vibration below 40 mph (64 km/h).

TLR—Tire/Wheel Lateral runout: Vehicle speed sensitive, mechanical vibration. The runout will not cause vibration below 50 - 55 mph (80 - 88 km/h). Excessive lateral runout will also cause front-end shimmy.

TW—Tire Wear: Vehicle speed sensitive, audible vibration. Abnormal tire wear causes small vibration in the 30 - 55 mph (88 km/h) range. This will produce a whine noise at high speed. The whine will change to a growl noise when the speed is reduced.

W—Tire Waddle: Vehicle speed sensitive, mechanical vibration. Irregular tire uniformity can cause side-to-side motion during speeds up to 15 mph (24 km/h). If the motion is excessive, identify the defective tire and replace it.

UAJ—Universal Joint (Drive Shaft) Angles: Torque/vehicle speed sensitive, mechanical/audible vibration. Incorrect drive shaft angles cause mechanical vibration below 20 mph (32 km/h) and in the 70

mph (112 km/h) range. The incorrect angles can also produce an audible vibration in the 20 - 50 mph (32 - 80 km/h) range. Caster adjustment could be required to correct the angles.

UJ—Universal Joints: Engine torque/vehicle speed sensitive, mechanical/audible vibration. If the U-joint is worn it will cause vibration with almost any vehicle speed/engine torque condition.

DSY—Drive Shaft and Yokes: Vehicle speed sensitive, mechanical/audible vibration. The condition will not cause vibration below 35 mph (56 km/h). Excessive runout, unbalance or dents and bends in the shaft will cause the vibration. Identify the actual cause and repair/replace as necessary.

WB—Wheel Bearings: Vehicle speed sensitive, mechanical/audible vibration. Loose wheel bearings cause shimmy-like vibration at 35 mph (56 km/h) and above. Worn bearings will also produce a growl noise at low vehicle speed and a whine noise at high vehicle speed. The wheel bearings must be adjusted or replaced, as applicable.

AN—Axle Noise: Engine torque/vehicle speed sensitive, mechanical/audible vibration. The axle will not cause mechanical vibration unless the axle shaft is bent. Worn or damaged axle pinion shaft or differential gears and bearings will cause noise. Replace the defective component(s) as necessary.

SSC—Suspension and Steering Components: Vehicle speed sensitive, mechanical vibration. Worn suspension/steering components can cause mechanical vibration at speeds above 20 mph (32 km/h). Identify and repair or replace the defective component(s).

EA—Engine Driven Accessories: Engine speed sensitive, mechanical/audible vibration. Vibration can be caused by loose or broken A/C compressor, PS pump, water pump, generator or brackets, etc. Usually more noticeable when the transmission is shifted into the NEUTRAL position and the engine speed (rpm) increased. Inspect the engine driven accessories in the engine compartment. Repair/replace as necessary.

ADB—Accessory Drive Belts: Engine speed sensitive, audible vibration. Worn drive belts can cause a vibration that produces either a droning, fluttering or rumbling noise. Inspect the drive belt(s) and tighten/replace as necessary.

DEM—Damaged Engine or Transmission Support Mounts: Engine speed sensitive, mechanical/audible vibration. If a support mount is worn, noise or vibration will occur. Inspect the support mounts and repair/replace as necessary.

ES—Exhaust System: Engine speed sensitive, mechanical/audible vibration. If loose exhaust components contact the vehicle body they will cause noise and vibration. Inspect the exhaust system for loose, broken and mis-aligned components and repair/replace as necessary.

SPECIFICATIONS

WHEEL LUG NUT

DESCRIPTION	TORQUE
1/2 x 20 with 60° Cone	109 to 150 N·m (80 to 110 ft. lbs.)

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BODY COMPONENTS—XJ VEHICLES

CONTENTS

GENERAL BODY SERVICE INFORMATION

RIGHT HAND DRIVE VEHICLES

The XJ Body Components procedures in this section were developed on a left hand drive (LHD) vehicle. Unless a component is unique to a right hand drive vehicle, it will not be specifically covered in this section, i.e. cargo barrier. In general, components on left hand drive vehicles will be located on the opposite side in right hand drive vehicles.

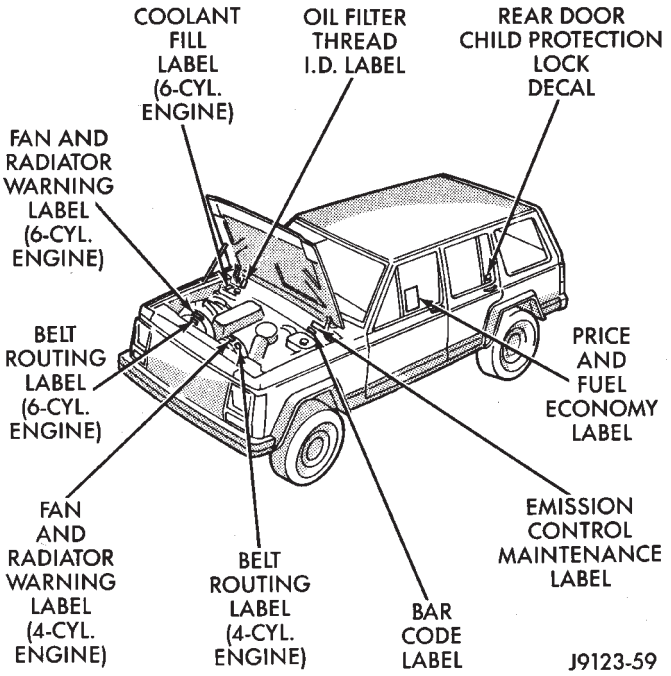


Fig. 1 XJ Underhood & Window Glass Labels/Decals

LABELS/DECALS/PLATES

Most of the labels that are affixed to the vehicles (Figs. 1 through 5) contain safety or maintenance information. If a body component or window glass are replaced, a replacement label should be installed. In most cases, label location on right hand drive (RHD) vehicles will be on the opposite side of the vehicle.

Refer to the Introduction of this manual for more information involving labels and plates.

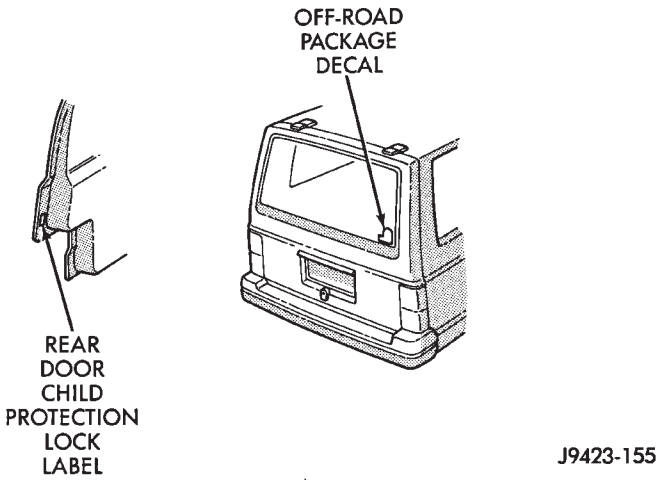


Fig. 2 XJ Exterior Labels/Decals

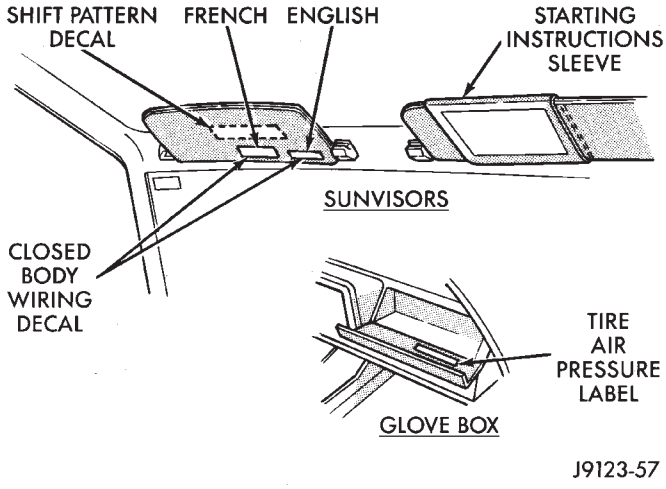


Fig. 3 XJ Interior Labels/Decals

INSTALLATION

Follow the instructions included with each replacement label.

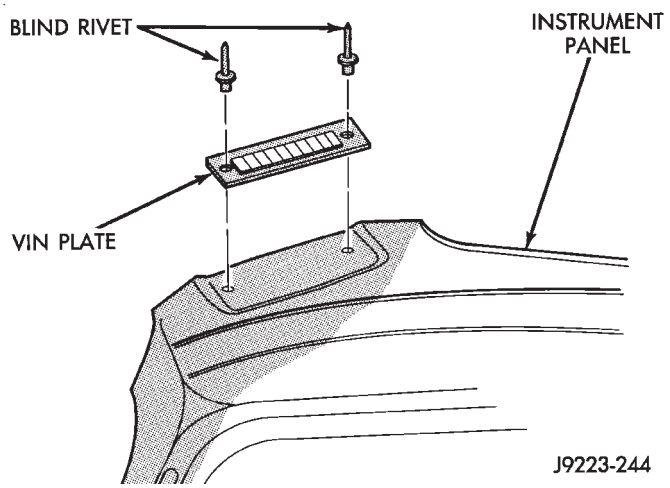


Fig. 4 XJ VIN Plate

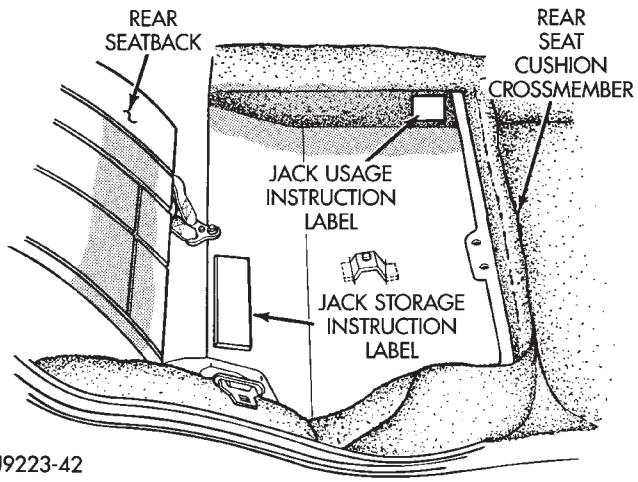


Fig. 5 XJ Jack Usage & Storage Instruction Labels

KEY LOCK CYLINDERS

The ignition switch, glove box door, front doors and liftgate all have key lock cylinders (Fig. 6). When lock cylinder access or replacement is necessary, refer to the applicable service information source:

- Ignition Switch—Group 8D,
- Instrument Panel,
- Front Doors, and
- Liftgate.

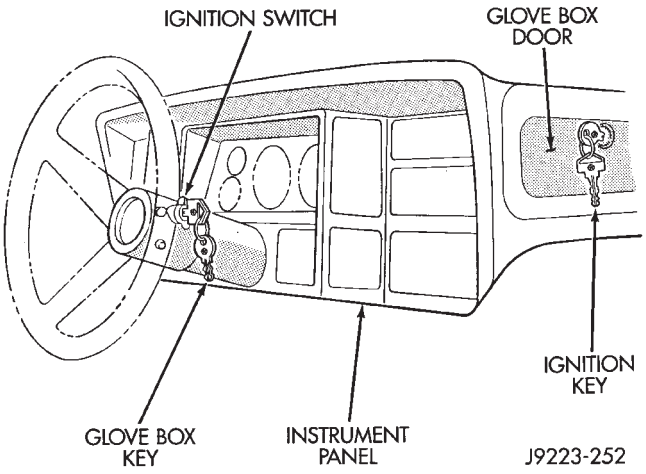


Fig. 6 Ignition Switch & Glove Box Door Key Lock Cylinders

EXTERIOR COMPONENTS

BRUSH GUARD

REMOVAL

(1) Remove the bolts and washers that attach the brush guard (Fig. 1) to the side sills.

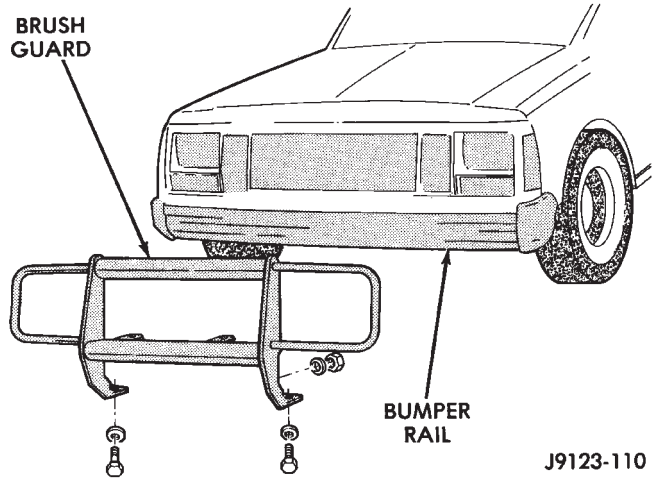


Fig. 1 Brush Guard Removal/Installation

(32 Remove the nuts and washers that the attach brush guard to the bumper. Remove the brush guard from the bumper.

INSTALLATION

(1) Position and support the brush guard on the bumper. Install the attaching washers and nuts.

Do not tighten the nuts until the brush guard is properly positioned on the vehicle and aligned.

(2) Install the bolts and washers to attach the brush guard to side sills.

(3) Align the brush guard and tighten the bolts.

GRILLE AND GRILLE OPENING PANEL (GOP)

REMOVAL

(1) Remove the screws and grille (Fig. 2) from the grille opening panel (GOP).

(2) Remove the screws, side marker lenses and the headlamp bezels from the grille opening panel (GOP) (Fig. 3).

(3) Remove the headlamps and park/turn signal lamps from the GOP (Fig. 4).

(4) Open the hood.

(5) Remove the nuts that attach the grille opening panel (GOP) to the bracket on radiator support cross-member.

(6) Remove the nuts that attach the grille opening panel (GOP) to the front fenders (Fig.5).

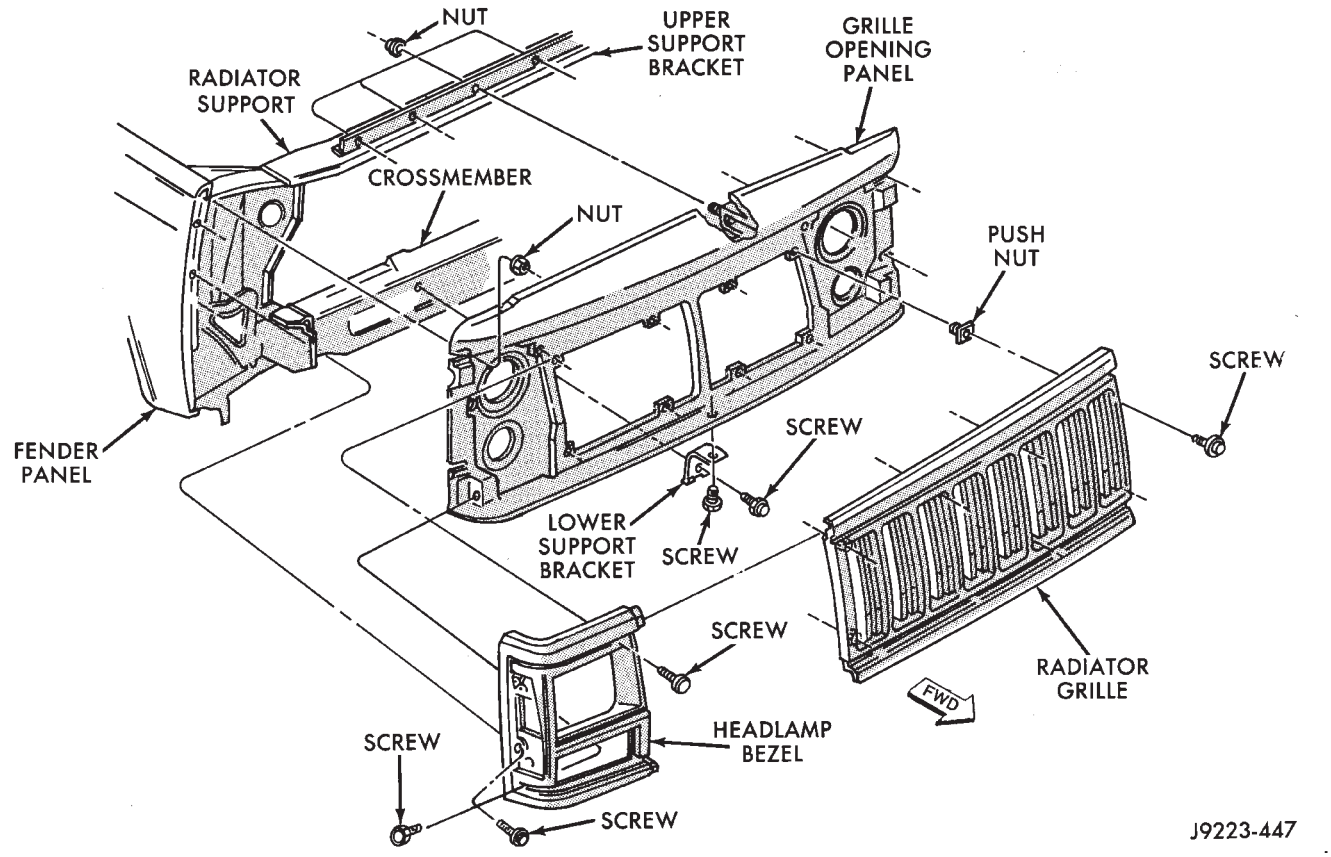


Fig. 2 Grille & GOP

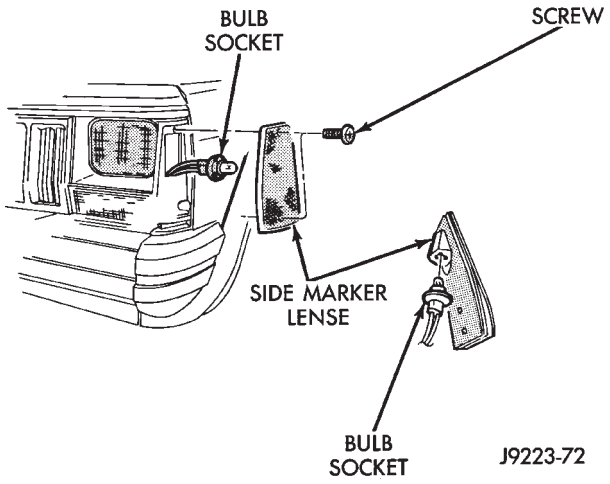


Fig. 3 Side Marker Lamp Removal/Installation

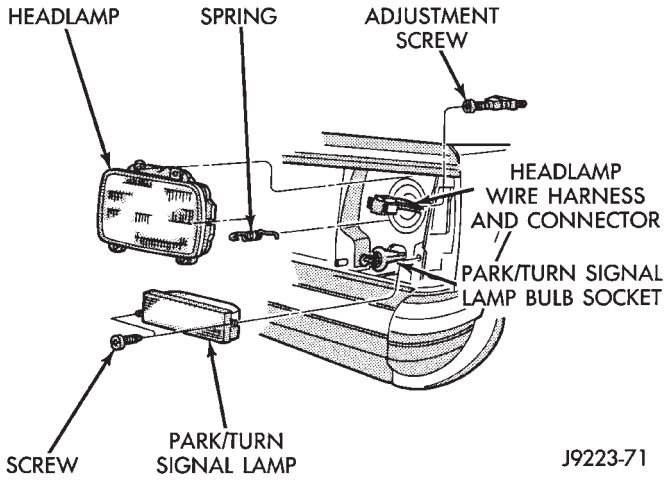


Fig. 4 Headlamp & Park/Turn Signal Lamp Removal/ Installation

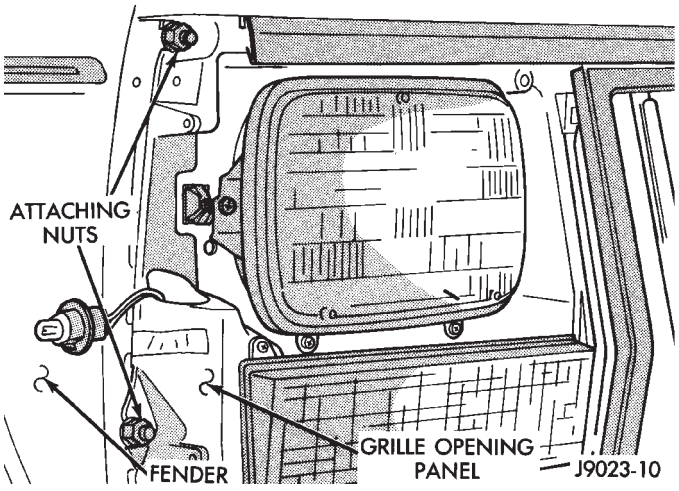


Fig. 5 GOP Attaching Nuts At Front Fender

(7) Remove the screws that attach the grille opening panel (GOP) support bracket to the front sill crossmember (Fig. 6).

(8) Pull the grille opening panel (GOP) forward and disconnect the clips and all the front lamp harness connectors (Fig. 7).

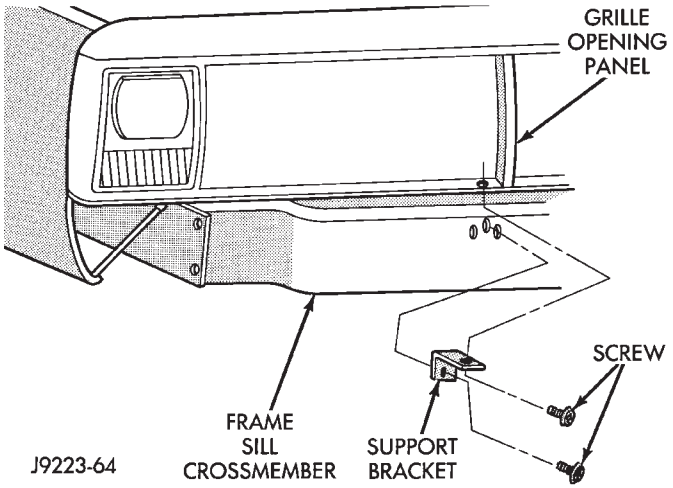


Fig. 6 Crossmember-to-GOP Support Bracket

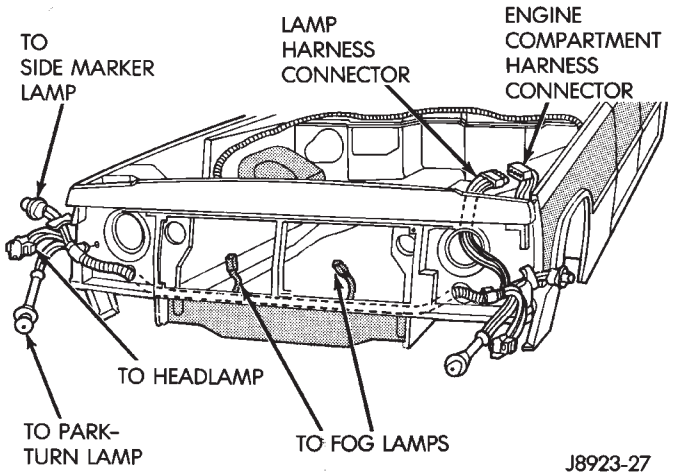


Fig. 7 Front Lamp Wire Harness Connectors

(9) Remove the grille opening panel (GOP) from the vehicle.

(10) If necessary, remove the air inlet baffles from GOP (Fig. 8).

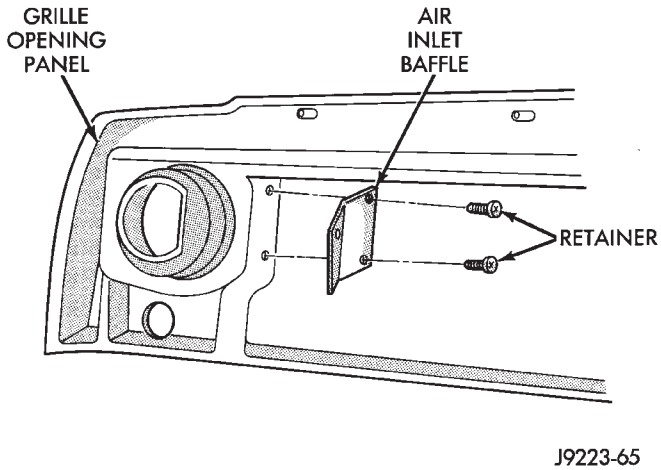


Fig. 8 GOP Air Inlet Baffles

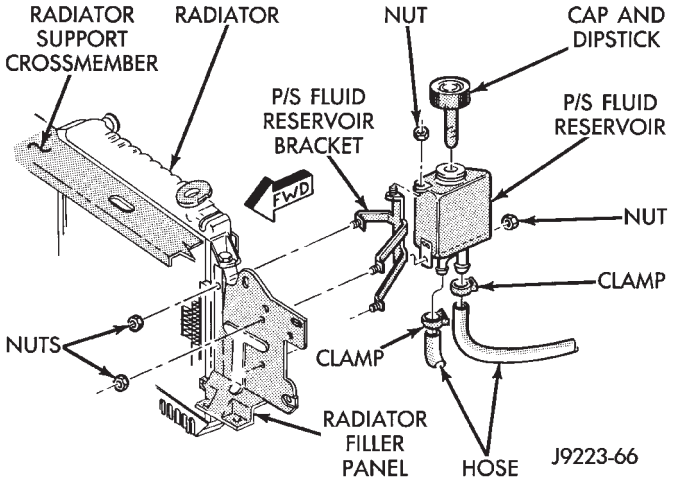


Fig. 9 P/S Pump Reservoir Removal/Installation

INSTALLATION

(1) Place the grille opening panel (GOP) on bumper and connect all front lamp wire harness connectors.

(2) Position the grille opening panel (GOP) on the vehicle and install the side and upper nuts. Tighten nuts to 7 N·m (58 in-lbs) torque.

(3) Install the screw to attach grille opening panel (GOP) to the crossmember support bracket. Tighten the screw to 1 N·m (11 in-lbs) torque.

(4) Install headlamps and park/turn signal lamps in GOP.

(5) Install the headlamp bezels on the GOP. Tighten the screws to 1 N·m (13 in-lbs) torque.

(6) Install the side marker lenses and screws on the grille opening panel (GOP). Tighten the screws to 1 N·m (13 in-lbs) torque.

(7) Install the grille on the GOP. Tighten screws to 1 N·m (13 in-lbs) torque.

(8) Adjust the headlamp aim, if necessary. Refer to the headlamp beam adjustment procedure within Group 8L.

RADIATOR SUPPORT CROSSMEMBER

REMOVAL

(1) Remove the grille opening panel (GOP) (Fig. 2).

(2) For 2.5L engines, remove the power steering pump reservoir from the left filler panel (Fig. 9).

(3) Remove the radiator support crossmember and radiator from the front of vehicle (Fig. 10).

(4) If additional disassembly is required, remove the horns, baffle braces and the wire harnesses from the baffles (Fig. 11).

INSTALLATION

(1) If removed, install the horns, baffle braces and the wire harnesses on the baffles (Fig. 11).

(2) Position the radiator and the radiator support

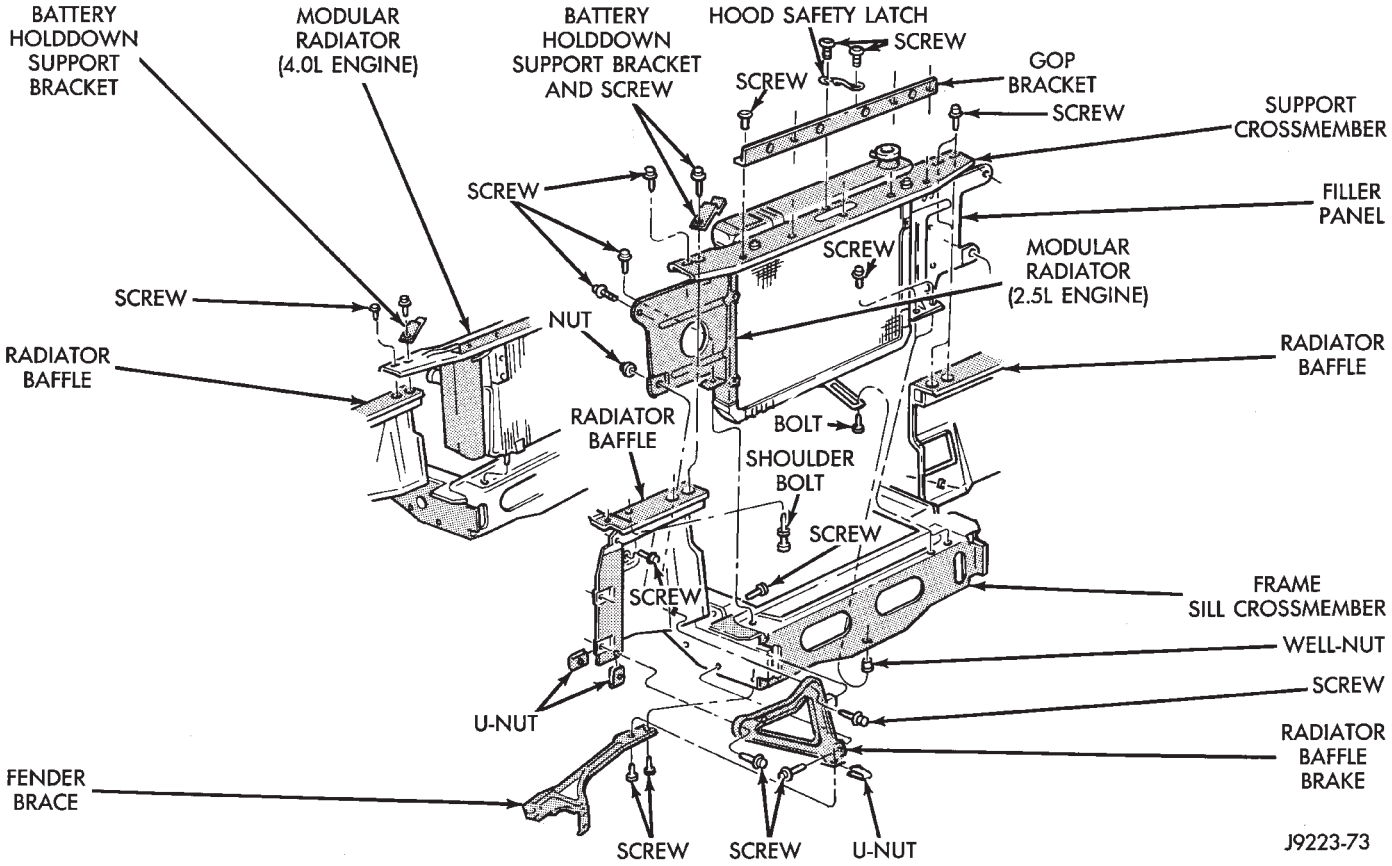


Fig. 10 Radiator Support Crossmember & Modular Radiator

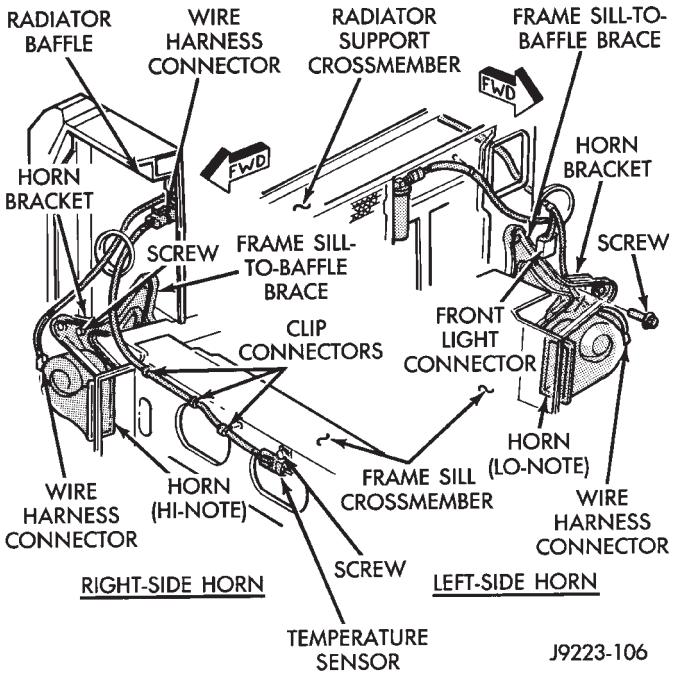


Fig. 11 Horns, Baffle Braces & Wire Harnesses

crossmember at the front of vehicle (Fig. 10). Install and tighten screws to 9 N·m (76 in-lbs) torque.

(3) For 2.5L engines, install the power steering pump reservoir on the left filler panel (Fig. 9).

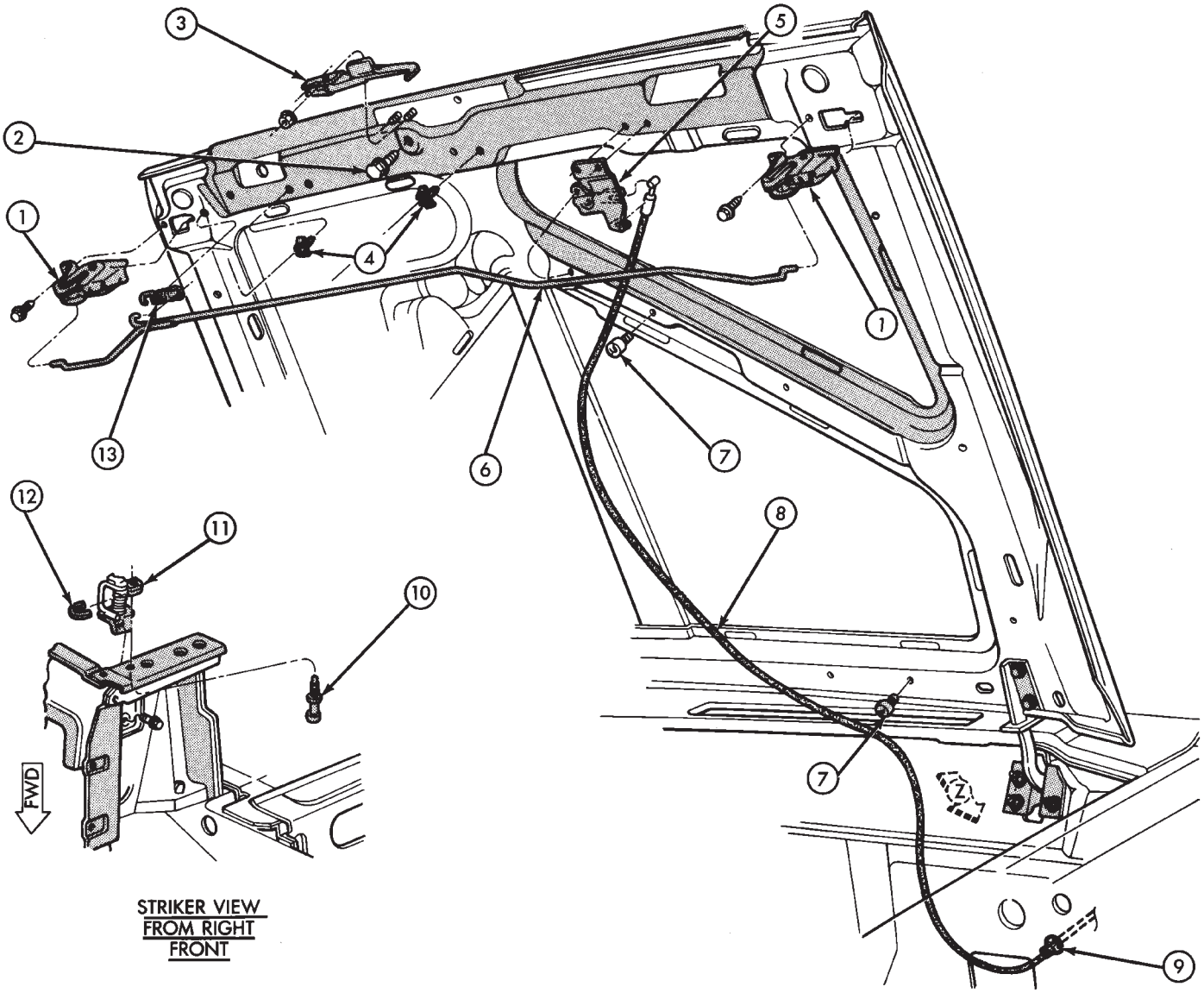
(4) Install the grille opening panel (GOP).

HOOD

The hood service procedures included in this section include:

- hood removal and installation;
- hood adjustment;
- hinge—latch—striker service; and
- latch release cable service.

Refer to Figures 12—16 for the hood component reference.



1. LATCH
2. BUMPER
3. CATCH
4. CLIP
5. BELLCRANK
6. ROD
7. CLIP
8. CABLE
9. GROMMET
10. SHOULDER BOLT
11. STRIKER
12. SHIM
13. SPRING

Fig. 12 Hood Latches, Rod, Release Cable, Striker & Safety Latch

HOOD REMOVAL

(1) Raise hood.

(2) Disconnect the underhood lamp wire harness connector, if equipped (Fig. 13).

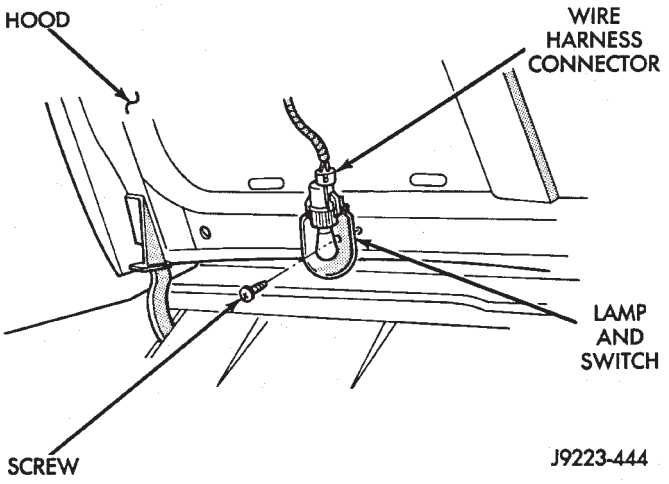


Fig. 13 Underhood Lamp

(3) Drill out and remove the rivets that attach the hood release cable bellcrank to the hood (Fig. 14).

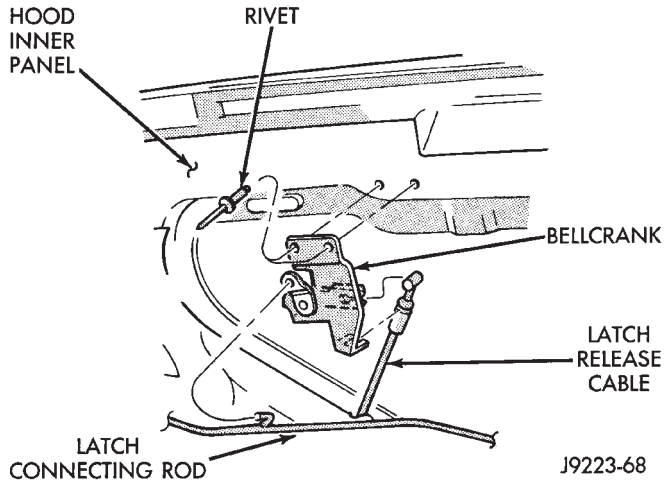


Fig. 14 Hood Release Cable Bellcrank

(4) Disconnect the bellcrank from the latch connecting rod and the release cable. Remove the bellcrank from the hood.

(5) Remove the latch release cable clips and remove the cable from the hood (Fig. 12).

(6) Remove the screws that attach the latches to the hood (Fig. 15).

(7) Disconnect the latches from the hood and latch connecting rod. Remove the latches from the hood.

(8) Remove the nuts that attach the safety latch to the hood. Remove the safety latch from the hood.

(9) Remove the clips and latch connecting rod from the hood.

(10) Mark the location of hood, the hinges and the hinge shims for installation (Fig. 16).

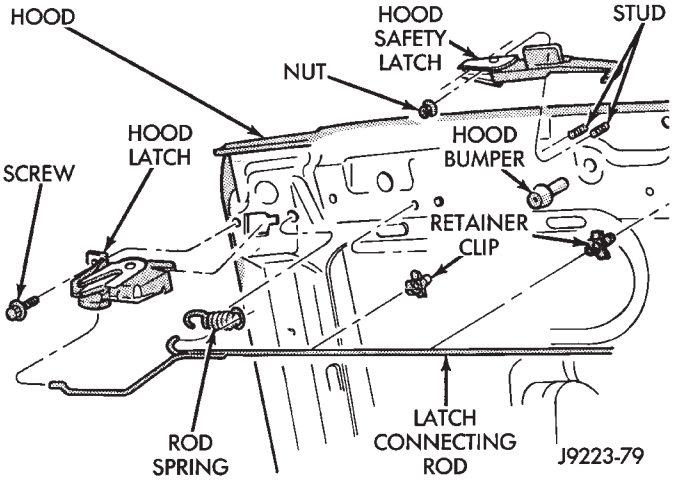


Fig. 15 Hood Latch & Safety Latch

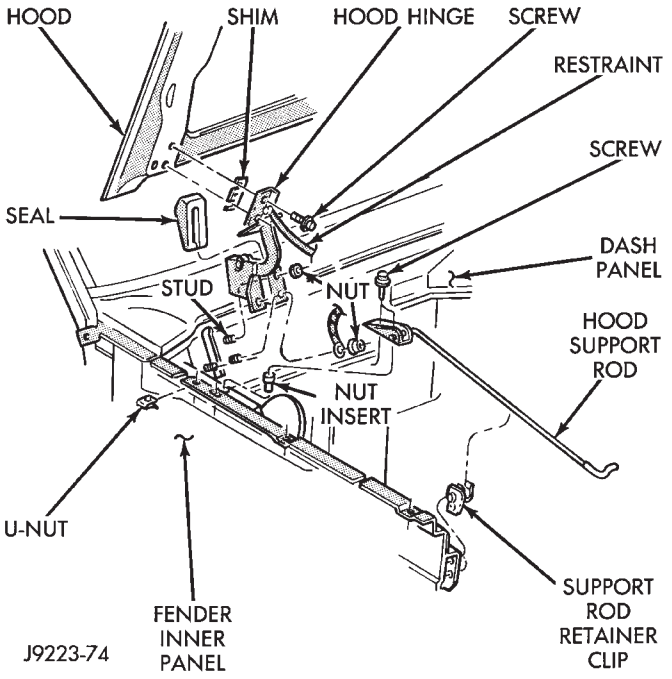


Fig. 16 Hood Hinges and Support Rod

(11) Remove the screws that attach the hinges to the hood. Remove the hood from the vehicle with the aid of a helper.

(12) Remove the insulation panel from the hood (Fig. 17).

HOOD INSTALLATION

(1) Install the insulation panel on the hood.

(2) Position the hood on the shims and hinges; finger-tighten the hinge bolts.

(3) Align the hinges and shims with the reference marks. Tighten the hinge bolts to 30 N·m (22 ft-lbs) torque.

(4) Connect the latch release cable and latch connecting rod to the bellcrank.

(5) Position the bellcrank on the hood and install the rivets.

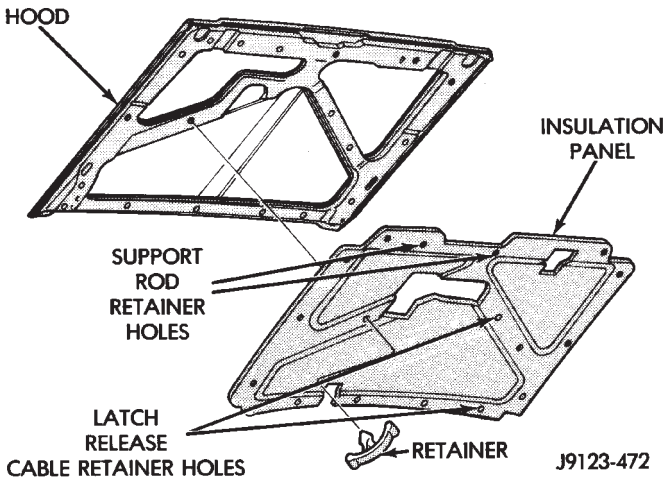


Fig. 17 Hood Insulation Panel

(6) Attach the latch release cable to the clips.

(7) Connect the latches to the latch rod and position them on the hood.

(8) Install the screws to attach the latches to the hood.

Tighten the screws to 9 N·m (77 in-lbs) torque.

(9) Position the safety latch on the hood and install the attaching nuts. Tighten the screws to 13 N·m (115 in-lbs) torque.

(10) Test latch release cable and latches for proper operation.

(11) Connect the underhood lamp wire harness connector.

(12) Inspect the hood for proper alignment and adjust as necessary.

HOOD ADJUSTMENT

The hood bolt holes are elongated for fore and aft and side-to-side adjustment.

(1) If hood is low to the cowl panel, insert shims between the hinge and hood at the rear hinge bolts.

(2) Adjust the hood bumper (Fig. 18) in or out to provide proper hood-to-fender height alignment.

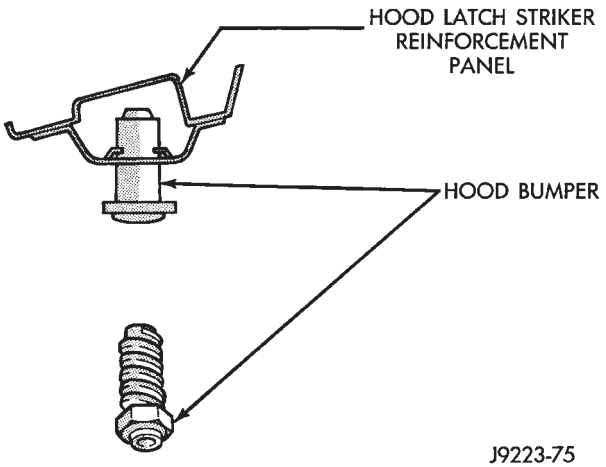


Fig. 18 Hood Bumper

(3) Adjust the hood strikers (Fig. 19) with shims as necessary. Tighten the screws to 22 N·m (16 ft-lbs) torque after adjustment.

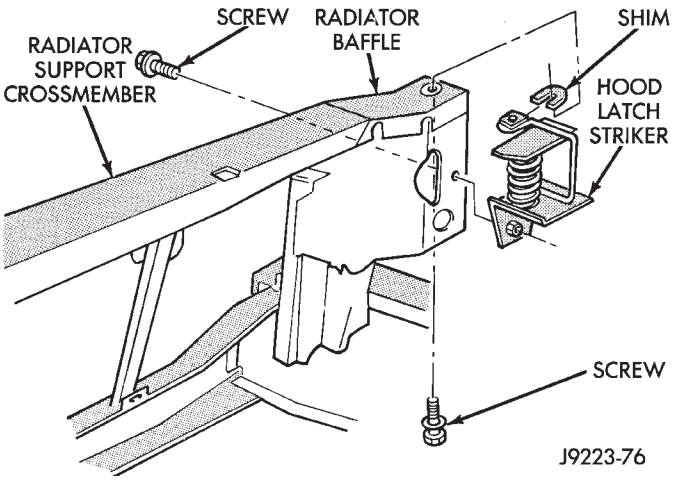


Fig. 19 Hood Latch Striker

(4) Align each latch and striker so that the striker enters latch squarely.

HOOD HINGE REPLACEMENT

REMOVAL

(1) Remove the hood from the vehicle.

(2) Remove the seal from the hinge base (Fig. 20).

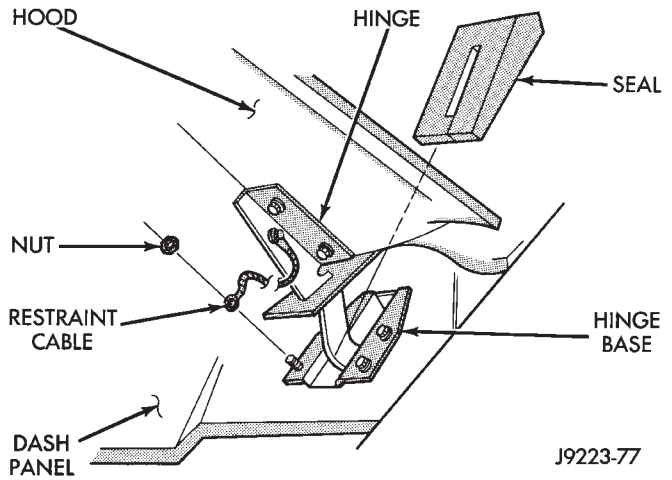


Fig. 20 Hood Hinge and Seal

(3) Remove the hinge retaining nuts from the studs.

(4) Remove the restraint cable and hinge from the cowl panel.

INSTALLATION

(1) Position the hinge over the studs and place the restraint cable on the right side, lower stud.

(2) Install the hinge nuts on the studs. Tighten the restraint cable nut to 4 N·m (38 in-lbs) torque. Tighten the remaining nuts to 9 N·m (77 in-lbs) torque.

If a replacement hinge seal is being installed, position it around the hinge arm, force it against the hinge base.

(3) Position the hinge seal around the hinge arm and on hinge base.

(4) Install the hood.

(5) Adjust the hood as necessary.

HOOD LATCH REPLACEMENT

REMOVAL

(1) Remove the screw that attaches the latch to the hood inner panel (Fig. 15).

(2) Disconnect the latch from the hood and latch connecting rod. Remove the latch from the hood.

INSTALLATION

(1) Connect the latch to the latch connecting rod and position it on the hood inner panel.

(2) Install the screw that attaches the latch to the hood inner panel.

(3) Tighten the screw to 9 N·m (77 in-lbs) torque.

(4) Test the operation of the latch release cable and latch.

HOOD LATCH STRIKER REPLACEMENT

REMOVE

(1) Remove the grille opening panel (GOP).

(2) Remove the screws that attach the striker to the radiator baffle (Fig. 19).

(3) Remove the striker and shims from the baffle.

INSTALLATION

(1) Position the shims and striker on the radiator baffle and install the screws.

(2) Tighten the screws to 21 N·m (15 ft-lbs) torque.

(3) Test the striker/hood alignment by opening and closing the hood several times. Adjust the striker, if necessary.

LATCH RELEASE CABLE REPLACEMENT

REMOVAL

(1) Drill out the bellcrank to hood rivet heads and remove the rivets (Fig. 14).

(2) Disconnect the bellcrank from the latch rod and the latch release cable. Remove the bellcrank from the hood.

(3) Disconnect the latch release cable from the clips on the hood.

(4) Remove the left cowl side trim panel.

(5) Remove the cable bracket screws from the cowl side panel.

(6) Pull the cable through the dash panel and remove it from under the instrument panel.

INSTALLATION

(1) Insert the replacement cable end through the hole in the dash panel into the engine compartment.

(2) Pull the cable forward and seat the grommet in the dash panel.

(3) Position the cable bracket on the cowl side panel and install the screws. Tighten the screws to 13 N·m (111 in-lbs) torque.

(4) Install the left cowl side trim panel.

(5) Connect the cable and latch rod to the bellcrank (Fig. 14).

(6) Position the bellcrank on the hood and install the rivets.

(7) Attach the cable to the clips.

(8) Test release the cable for proper operation.

SAFETY LATCH STRIKER REPLACEMENT

REMOVAL

(1) Remove the striker screws from the radiator support crossmember (Fig. 21).

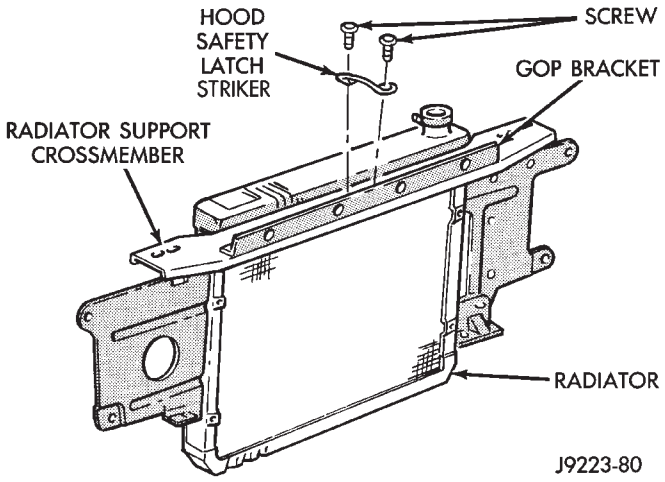


Fig. 21 Hood Safety Latch Striker—2.5L Engine (Typical)

(2) Remove the striker from the crossmember.

INSTALLATION

(1) Position the striker on the radiator support crossmember and install the screws. Tighten the screws to 9 N·m (77 in-lbs) torque.

(2) Test the safety latch operation.

COWL WEATHERSTRIP SEAL/CROSSMEMBER AIR DEFLECTOR

WEATHERSTRIP SEAL REPLACEMENT

(1) Pry upward along the length of seal (Fig. 22).

(2) Detach the seal retainers from the cowl panel.

(3) Remove the seal from cowl panel.

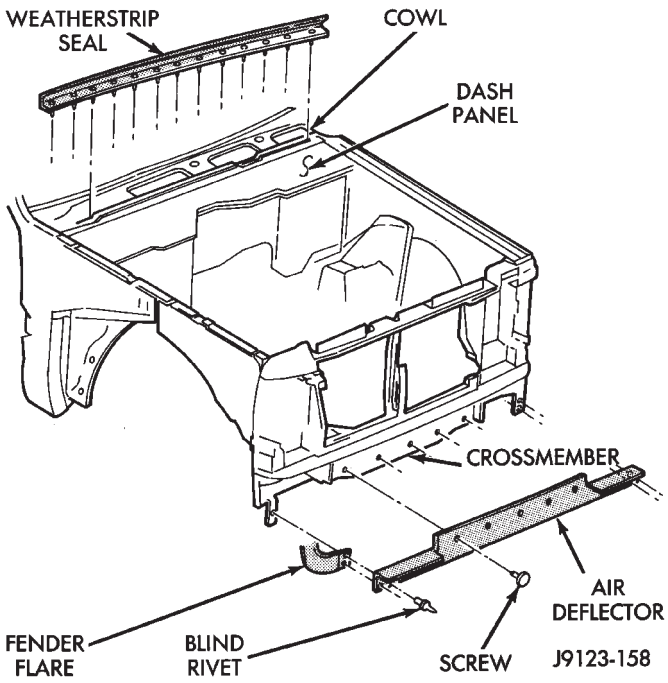


Fig. 22 Cowl Seal and Crossmember Air Deflector

(4) Position the weatherstrip seal on the cowl panel. Press to insert retainers into the cowl panel holes (Fig. 23).

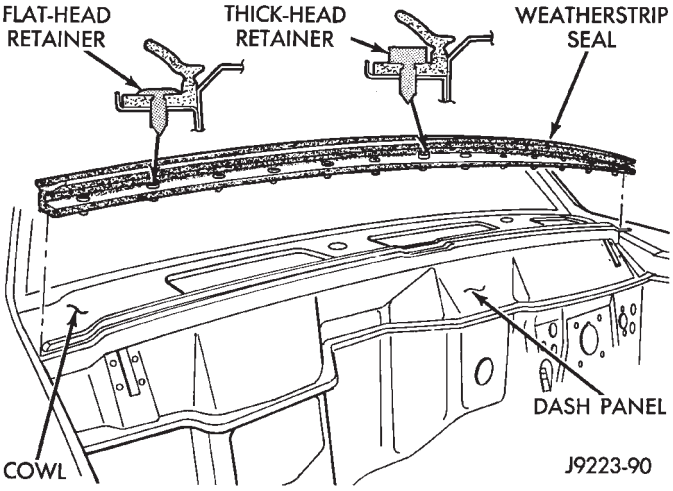


Fig. 23 Cowl Seal and Retainers

CROSSMEMBER AIR DEFLECTOR REMOVAL

(1) Remove the rivets that attach the air deflector to the fender flares (Fig. 22).

(2) Remove screws that attach air deflector to the crossmember.

(3) Remove the air deflector from the crossmember.

CROSSMEMBER AIR DEFLECTOR INSTALLATION

(1) Position the air deflector on the crossmember.

(2) Attach the air deflector to the crossmember with the screws.

(3) Attach the air deflector to the fender flares with blind rivets.

DASH PANEL INSULATOR PANEL

REMOVAL

(1) Remove the push-on nuts from the studs (Fig. 24).

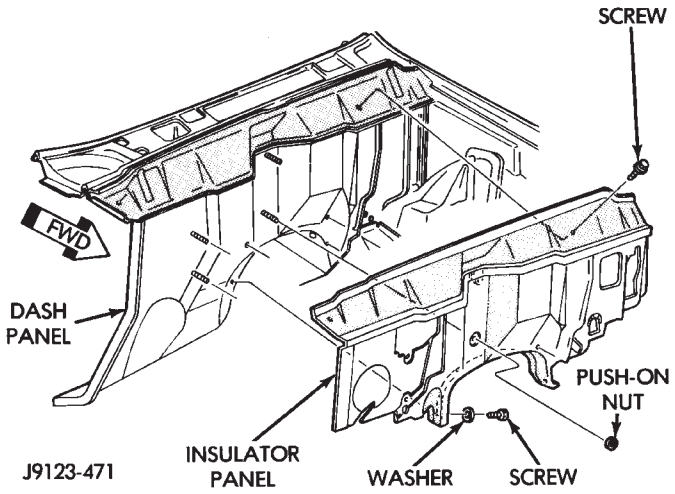


Fig. 24 Dash Panel Insulator Panel

(2) Remove the screws that attach the panel to the dash panel.

(3) Remove the insulator panel from the dash panel and engine compartment.

INSTALLATION

(1) Position the insulator panel on the dash panel.

(2) Install the push-on nuts on the studs.

(3) Attach the panel to the dash panel with screws. Tighten the screws to 2 N·m (18 in-lbs) torque.

COWL GRILLE AND SCREEN

REMOVAL

(1) Use a wax pencil to mark the position of the wiper arms (Fig. 25).

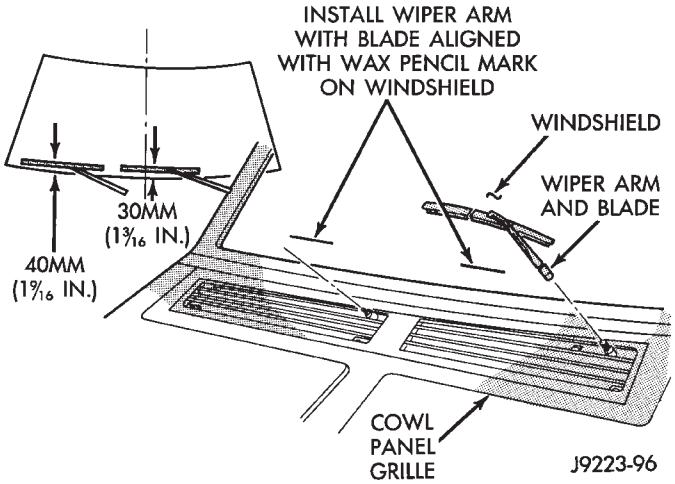


Fig. 25 Wiper Locations On Windshield

(2) Remove the windshield wiper arms from the pivots (Fig. 26).

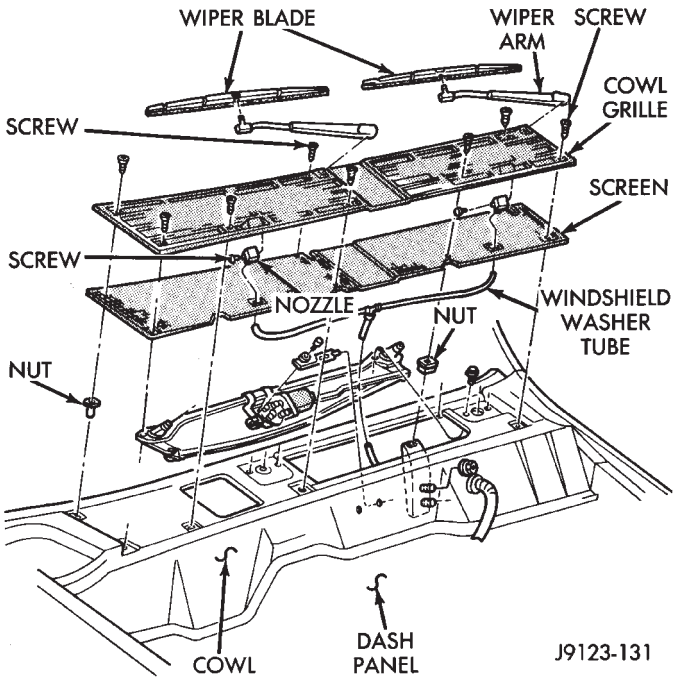


Fig. 26 Cowl Grille Components

(3) Remove the screws that attach the grille to the cowl.

(3) Remove the windshield washer tubes from the nozzles (Fig. 27).

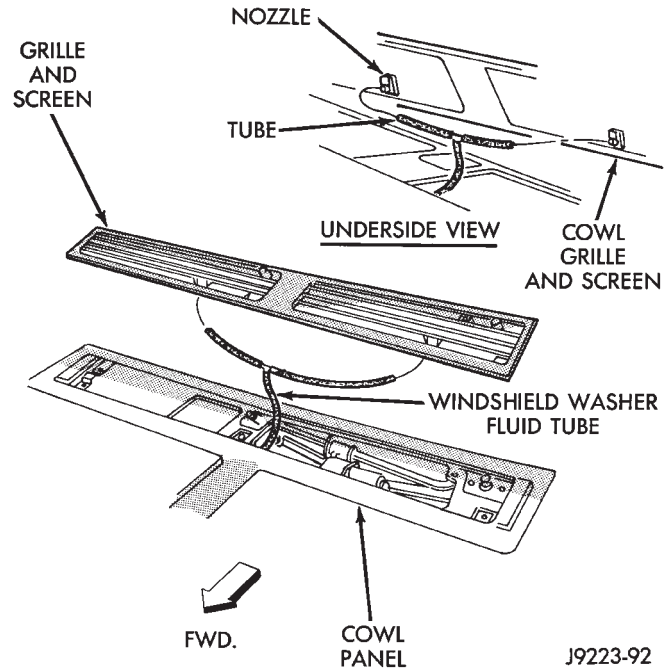


Fig. 27 Washer Fluid Tubes

(4) Remove the cowl grille and screen from the cowl (Fig. 28).

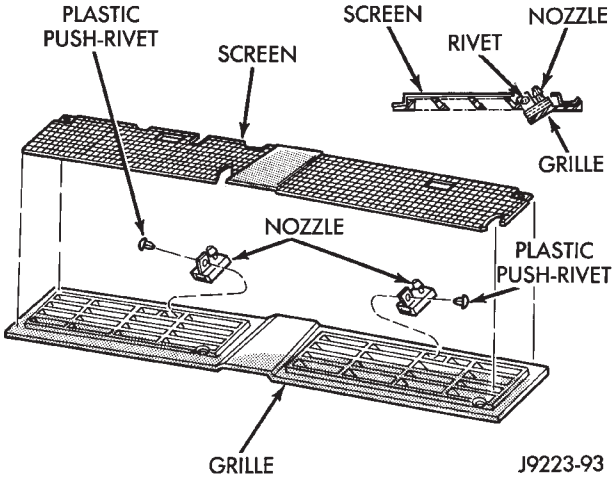


Fig. 28 Cowl Grille, Screen & Washer Nozzles

(5) If necessary, remove the push-rivets and washer nozzles from the cowl grille (Fig. 28).

(6) If necessary, remove the cowl grille push-nuts from the cowl panel (Fig. 29).

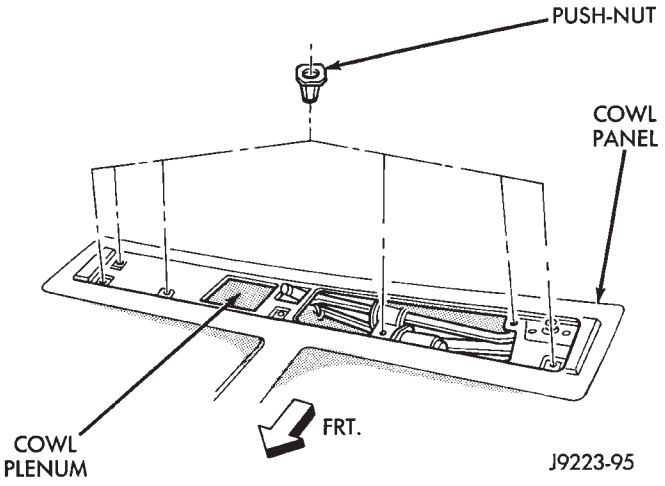


Fig. 29 Cowl Grille Push-Nuts

(7) If necessary, remove the nuts and cowl grille support bracket from the dash panel (Fig. 30).

INSTALLATION

(1) If removed, install the cowl grille support bracket on the dash panel (Fig. 30). Tighten the nuts to 9 N·m (77 in-lbs) torque.

(2) If removed, install the push-nuts in the cowl panel and the support bracket.

(3) If removed, install the push-rivets and washer nozzles in the cowl grille.

CAUTION: The washer fluid tubes must be routed and installed so that they are not pinched.

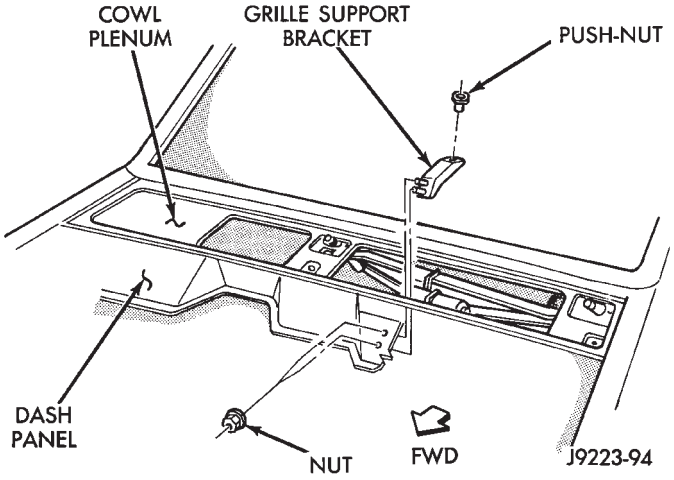


Fig. 30 Cowl Grille Support Bracket

(4) Position the cowl grille and screen on the cowl. Install the windshield washer tubes on the nozzles.

(5) Install the cowl screen and grille screws and tighten in the sequence shown in Figure 31.

Force the cowl grille rearward while tightening the screws.

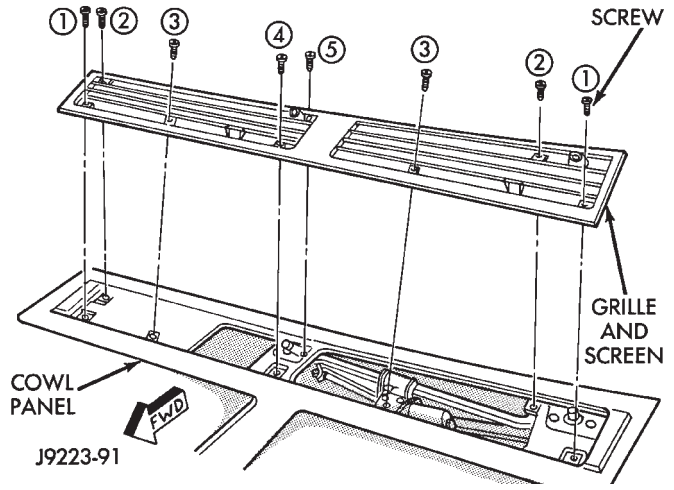


Fig. 31 Cowl Grille Screw Tightening Sequence

(6) Install the windshield wiper arms on the pivots.

BATTERY TRAY

REMOVAL

(1) Remove the screw, nuts, holddown support bracket and upper holddown bracket from the holddown rods (Fig. 32).

(2) Remove the battery from tray.

(3) Remove the nuts that attach battery tray to the inner fender panel.

(4) Remove the battery tray from the vehicle.

(5) If necessary, remove the retainers and holddown rods from the battery tray (Fig. 33).

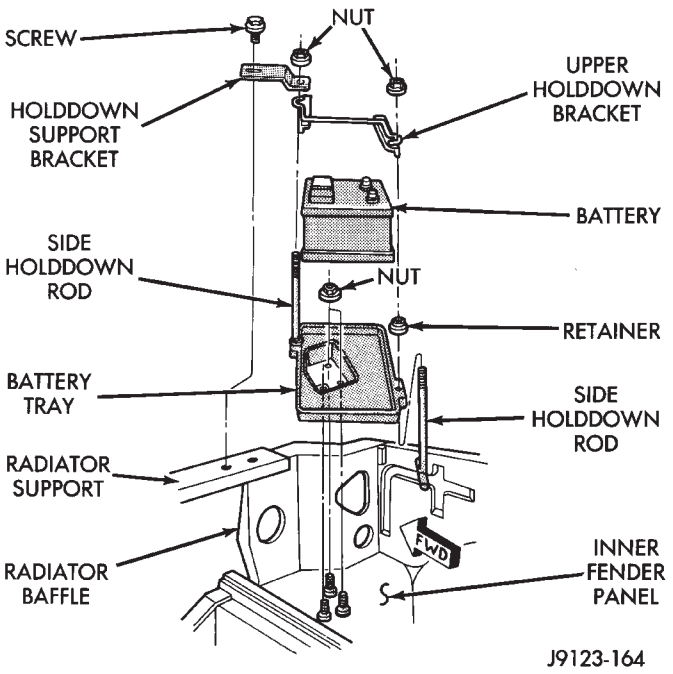


Fig. 32 Battery Tray Removal/Installation

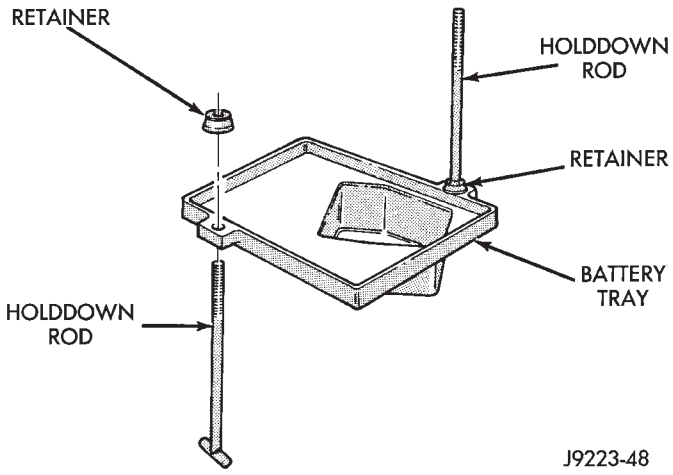


Fig. 33 Battery Holddown Rods & Retainers

INSTALLATION

(1) If removed, install side the holddown rods and retainers on the battery tray.

(2) Position the battery tray on the inner fender panel with the studs inserted in the holes.

(3) Attach the battery tray to the inner fender panel with the nuts. Tighten the nuts to 30 N·m (22 ft-lbs) torque.

(4) Install the battery in tray.

(5) Position the upper holddown bracket over the holddown rods.

(6) Install the holddown support bracket, screw, and nuts on the holddown rods. Tighten the screw and nuts.

FRONT FENDER

The following information includes procedures for removal/installation of:

- a fender liner,
- a front fender flare and retainers, and
- a front fender.

REMOVAL

(1) Remove the front bumper.

(2) Right fender only:

• if equipped, remove the radio antenna mast, and components from the fender (Figs. 34 and 35);

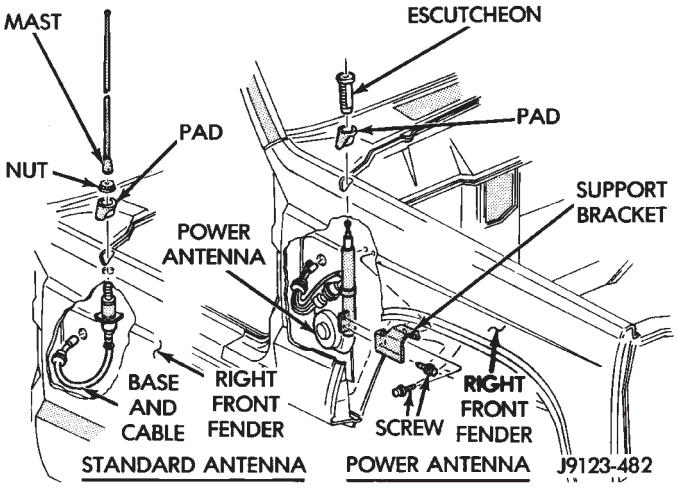


Fig. 34 Radio Antenna Removal/Installation

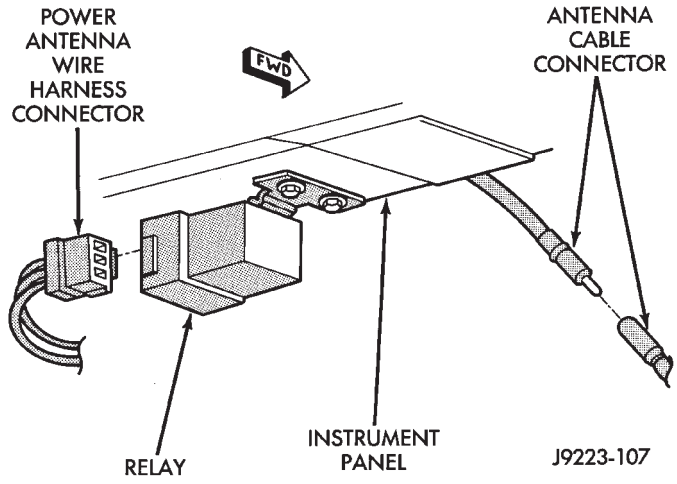


Fig. 35 Power Antenna Wire Harness & Cable Connectors

• remove the battery and tray from the fender inner panel (Figs. 36, 37 and 38);

• remove windshield washer reservoir from fender inner panel (Fig. 39);

• remove the hood ajar switch, if equipped, from fender (Figs. 40 and 41);

• remove the Power Distribution Center (PDC), the coolant recovery bottle and speed servo from fender the inner panel.

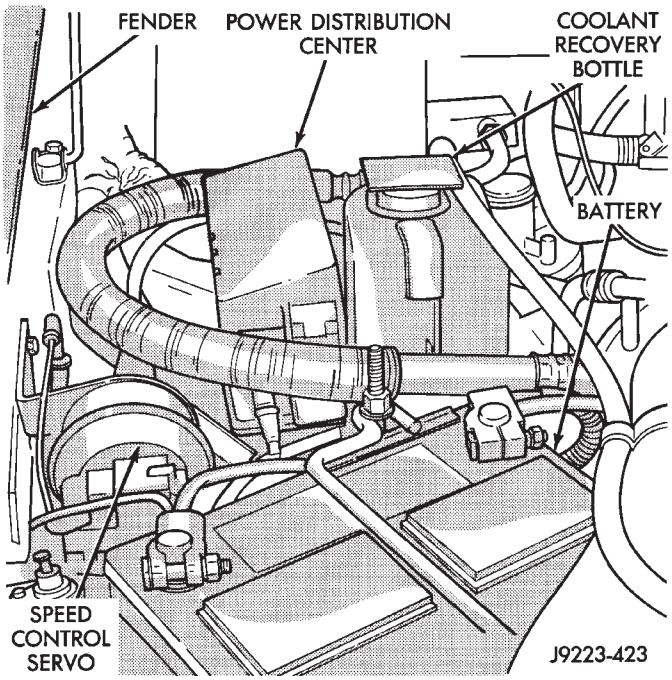


Fig. 36 Battery, Speed Servo, PDC & Coolant Recovery Bottle

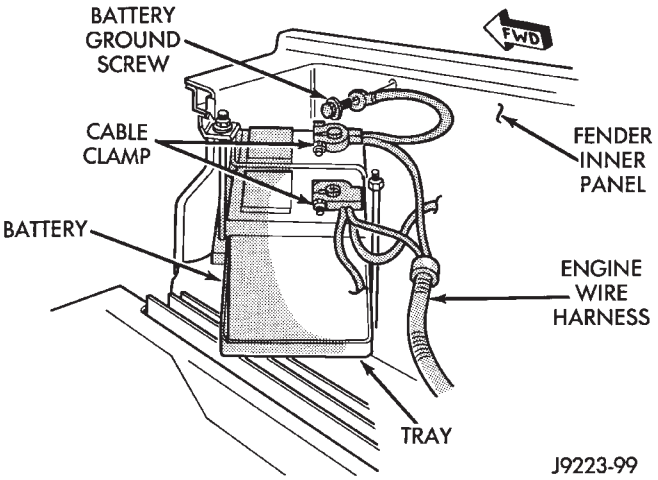


Fig. 37 Battery Removal/Installation

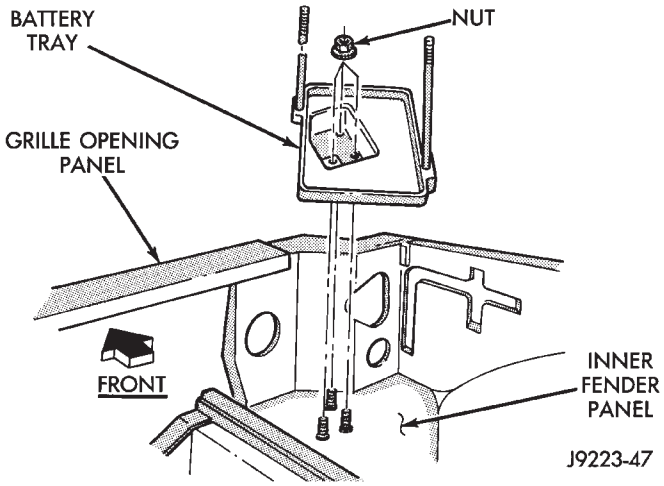


Fig. 38 Battery Tray Removal/Installation

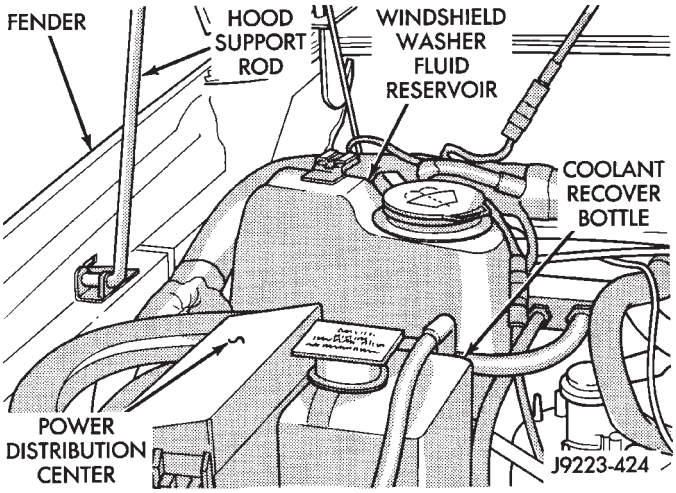


Fig. 39 Coolant Recovery Bottle, Windshield Washer Fluid Reservoir & Hood Support Rod

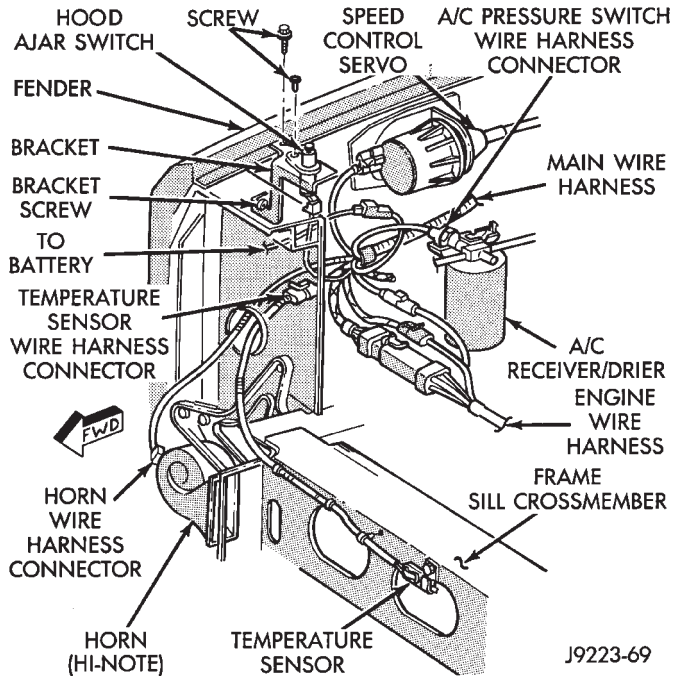


Fig. 40 Hood Ajar Switch, Speed Servo & A/C Receiver/Drier

• remove the vapor canister from the fender inner panel (Figs. 42 and 45);
• remove the A/C Receiver/Drier from the fender inner panel (Fig. 40); and
• if equipped, remove the Daytime Running Light (DRL) module from the fender inner panel (Fig. 46).
• support the hood and remove the hood support rod from the fender inner panel.

(3) Remove the hood bumper from the fender inner panel (Fig. 47).

(4) Raise and support the vehicle.

(5) Remove the front wheel.

(6) Remove the fender liner, fender flare and retainers (Fig. 48):

• remove the screws that attach the lower part of

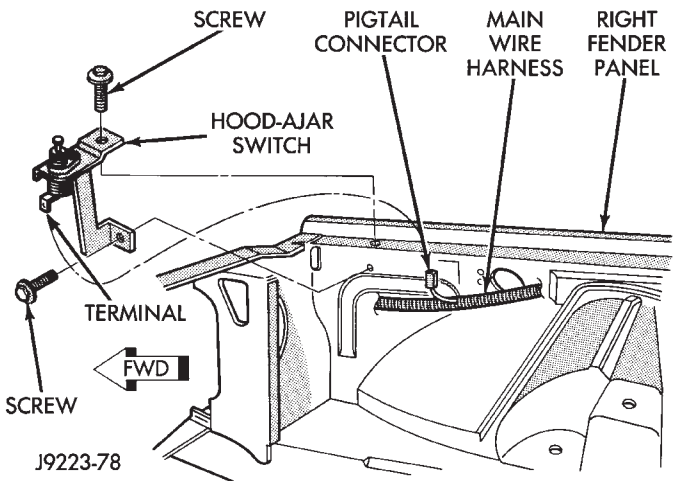


Fig. 41 Hood Ajar Switch Removal/Installation

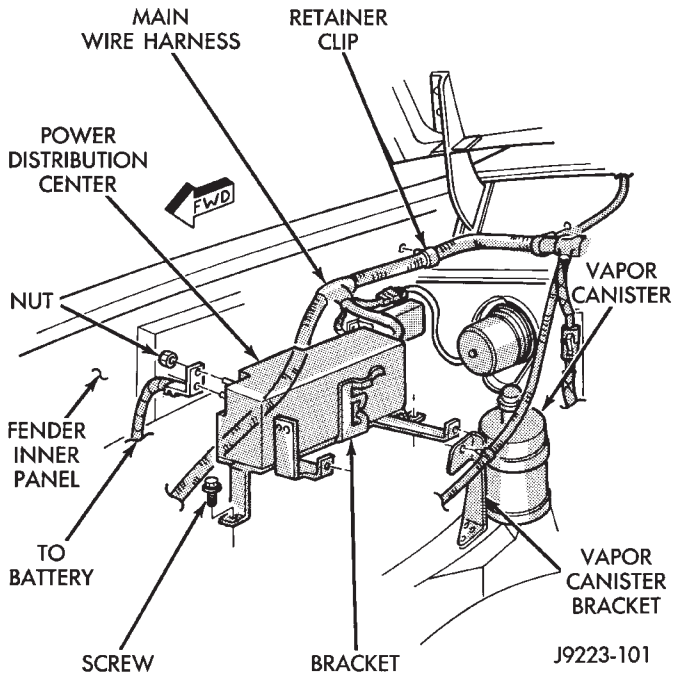


Fig. 42 Power Distribution Center and Vapor Canister

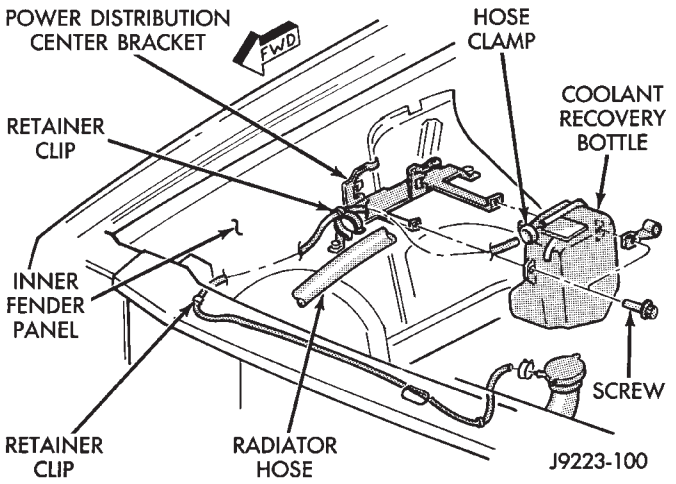


Fig. 43 Coolant Recovery Bottle

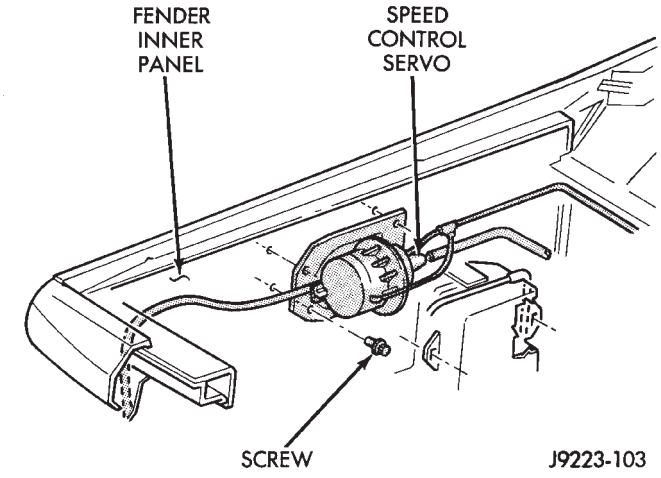


Fig. 44 Speed Servo

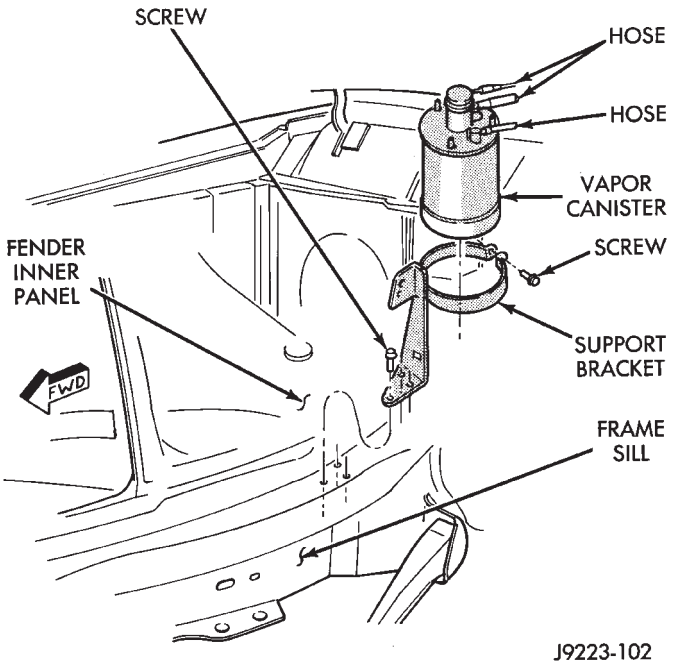


Fig. 45 Vapor Canister

flare to the fender outer panel;

- remove the rivets that attach the flare to the air deflector;
- remove the retainers that attach the fender liner to the fender inner panel;
- remove the nuts that attach the fender liner to the fender outer panel and flare retainers;
- remove the fender liner from between the fender panels;
- remove the push-nuts that attach the retainers to the fender outer panel; and
- remove the retainers and flare from the fender outer panel.

(7) Remove the grille opening panel (GOP).

(8) Remove the air deflector.

(9) Remove the rocker panel moulding from the fender.

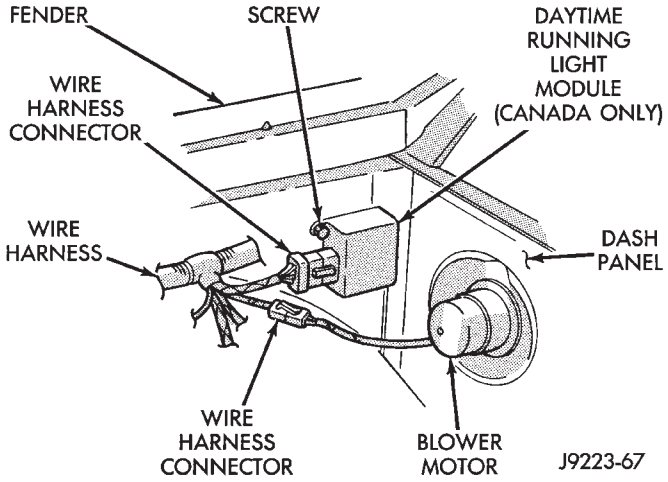


Fig. 46 Daytime Running Light (DRL) Module

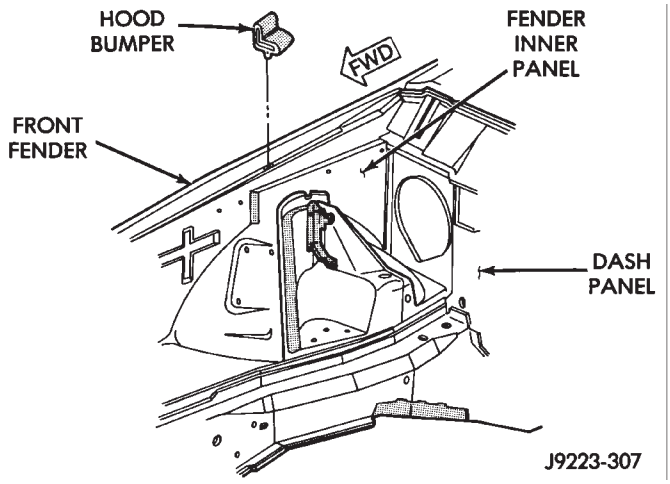


Fig. 47 Hood Bumper

(10) Remove all the fender braces (Fig. 49).

(11) Remove the fender lower screws (Fig. 49).

(12) Remove the fender top, front and the rear screws. Remove the fender from the inner fender panel (Fig. 49).

INSTALLATION

(1) Position the fender on the inner fender panel.

(2) Install all of the fender screws finger-tight.

(3) Install the fender braces.

(4) Align the fender with the body panels and tighten the fender screws to 8.5 N·m (76 in-lbs) torque.

(5) Install the grille opening panel (GOP).

(6) Install the air deflector.

(7) Install the fender flare and retainers (Fig. 50). Then install the fender liner.

- position the retainers and the flare on the fender;
- install the push-nuts to attach the retainers to the fender;
- position the fender liner between the fender and fender inner panel (Fig. 51);

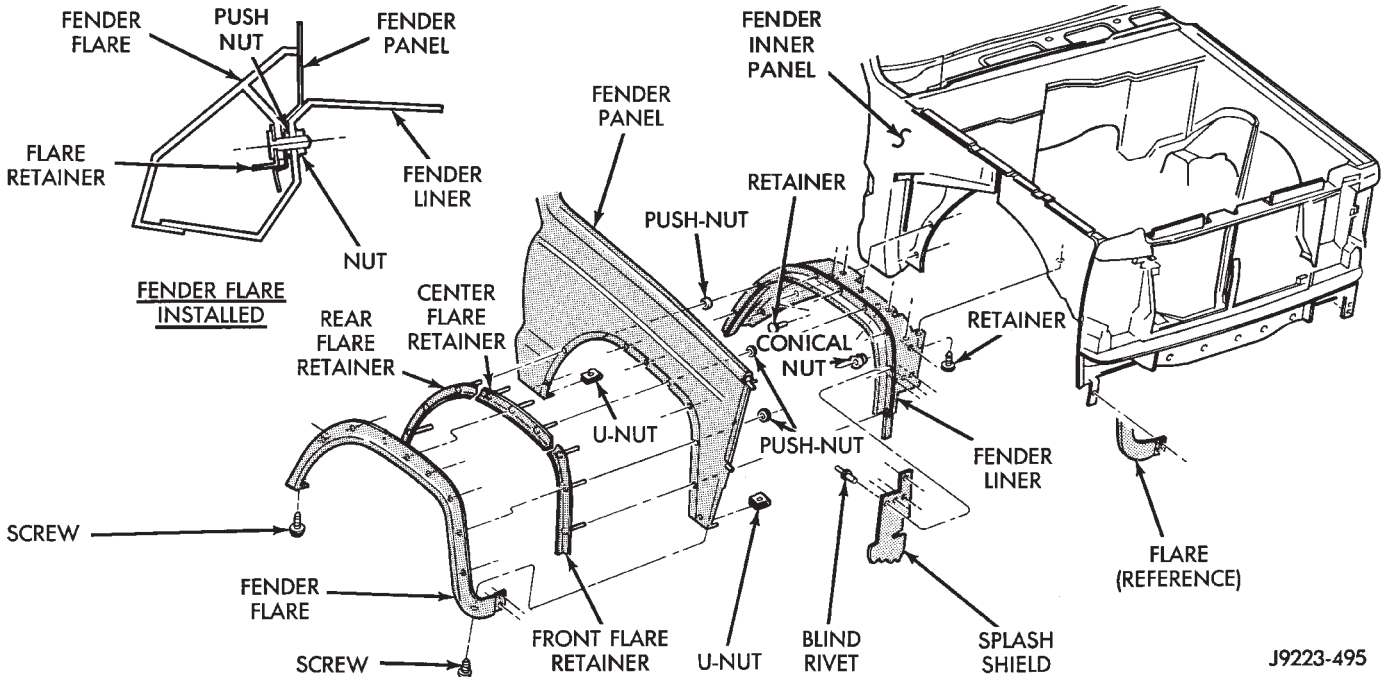


Fig. 48 Fender Flare & Liner Removal/Installation

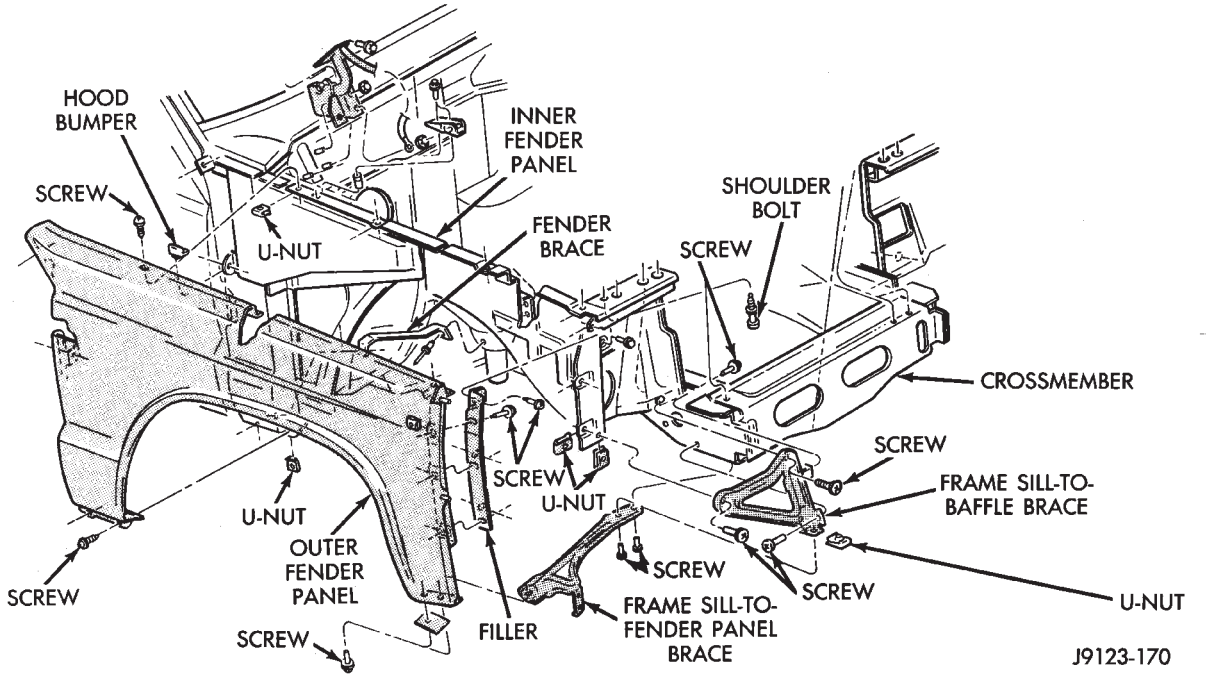


Fig. 49 Fender Removal/Installation

• install the nuts to attach the fender liner to the fender and flare retainers (Fig. 48);
• install the retainers to attach the fender liner to the fender inner panel;
• install the rivets to attach the flare to the air deflector (Figs. 48 and 50); and
• install the screws to attach the flare to the fender. Tighten the screws to 1 N·m (13 in-lbs) torque.

(8) Connect the front lamp wire harness connectors to the engine wire harness connectors (Fig. 52).

(9) Install the front lamps.

(10) Install the front bumper.

(11) Install the wheel, remove the support and lower the vehicle.

(12) Right fender only: install the hood support rod on the fender inner panel.

(13) Install the hood bumper on the fender inner panel.

(14) Right fender only: install the Daytime Running Light (DRL) module on fender inner panel.

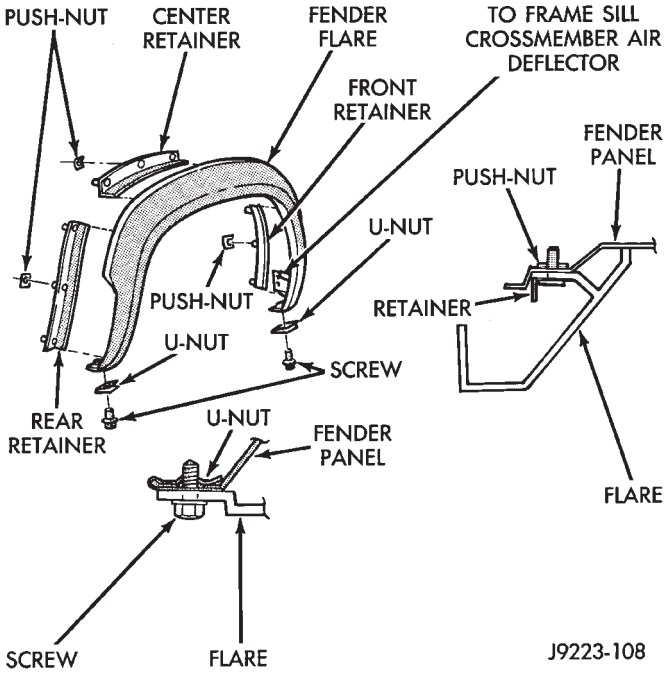


Fig. 50 Fender Flare & Retainers

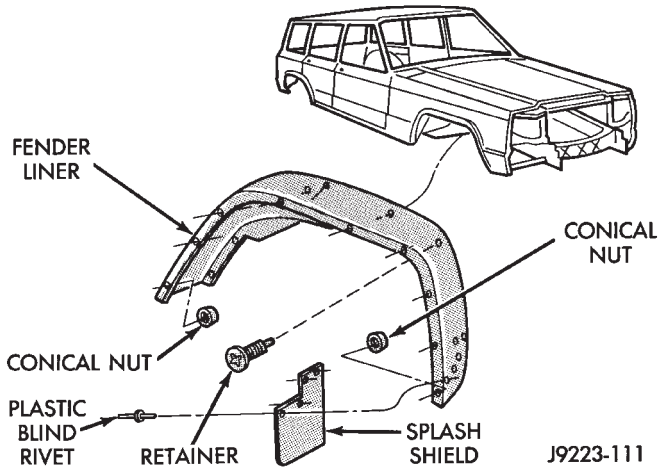


Fig. 51 Fender Liner and Retainers

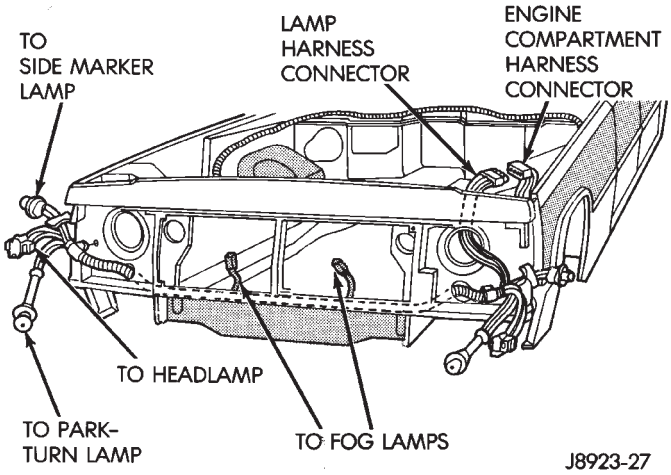


Fig. 52 Front Lamp Wire Harness Connectors

(15) Right fender only: install the A/C Receiver/ Drier on the fender inner panel.

(16) Right fender only: install the vapor canister on the fender inner panel. Tighten the vapor canister screws to 5 N·m (45 in-lbs) torque.

(17) Right fender only: install the PDC, coolant recovery bottle and speed servo on the fender inner panel.

(18) Right fender only: install the hood ajar switch, if equipped. Tighten the screws to 2 N·m (15 in-lbs) torque.

(19) Right fender only: install the windshield washer fluid reservoir on the inner panel (Fig. 39).

(20) Right fender only: install the battery tray and battery on the inner panel.

(21) Right fender only: if equipped, install the radio antenna. Tighten the nut/escutcheon to 4.5 N·m (40 in-lbs) torque. Tighten the power antenna bracket screws to 2 N·m (20 in-lbs) torque.

REAR WHEELHOUSE FLARES AND LINERS

REMOVAL

(1) Remove the flare and liner lower screws.

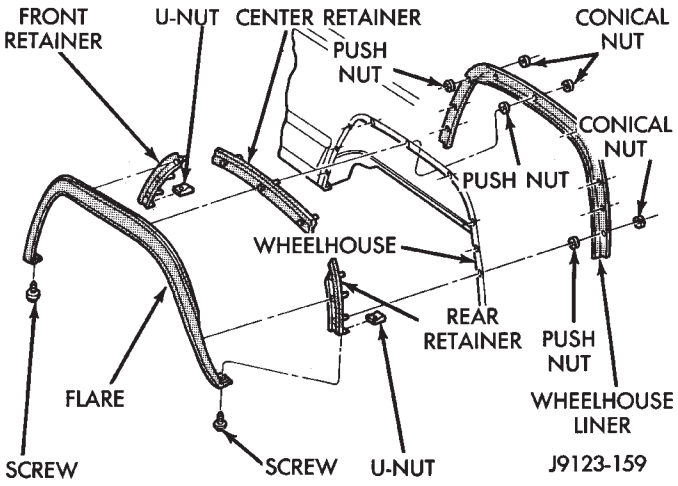


Fig. 53 Rear Wheelhouse Flare, Retainers and Liner

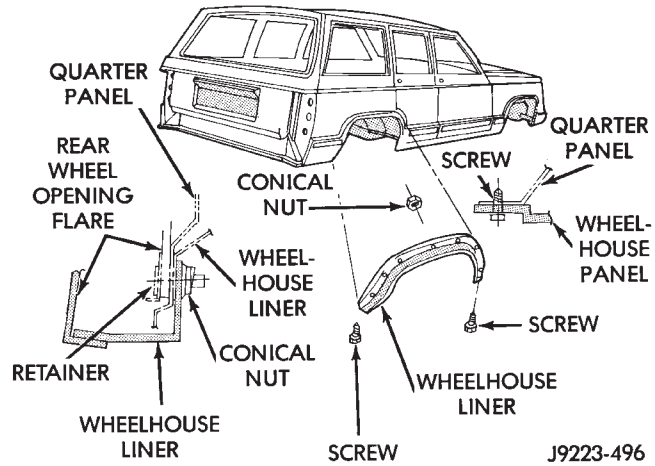


Fig. 54 Rear Wheelhouse Liner—XJ Vehicles

(2) Remove the nuts that attach the liner to the wheelhouse.

(3) Remove the liner from the wheelhouse.

(4) Remove the push-nuts that attach the flare retainers to the wheelhouse.

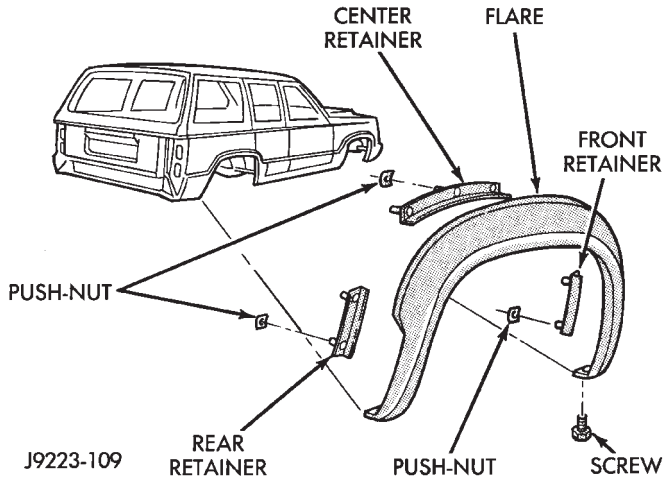


Fig. 55 Rear Wheel Opening Flare—XJ Vehicles

(5) Remove the flare and retainers from the wheelhouse.

INSTALLATION

(1) Position the flare and retainers at the wheelhouse.

(2) Install the push-nuts to attach the flare retainers to the wheelhouse.

(3) Position the liner in the wheelhouse.

(4) Install the nuts to attach the liner to the wheelhouse and flare retainers.

(5) Install the flare and liner lower screws. Tighten the screws to 1 N·m (13 in-lbs) torque.

BODY SIDE MOULDING/CLADDING

REMOVAL

(1) Loosen the vinyl body side moulding with a heat gun.

(2) Lift edge of moulding with a putty knife and peel moulding from body panel. Apply heat to any location where the moulding remains adhered to a panel.

(3) Remove the adhesive from the body panel with 3M All Purpose Cleaner, or an equivalent cleaner.

(4) If the original moulding will be installed, also remove all adhesive from it.

INSTALLATION

(1) Install 3M 06379 double-sided tape on the moulding.

(2) For vertical alignment, use masking tape or a string as reference.

(3) Remove the backing from the tape, align the moulding and position it on the body panel.

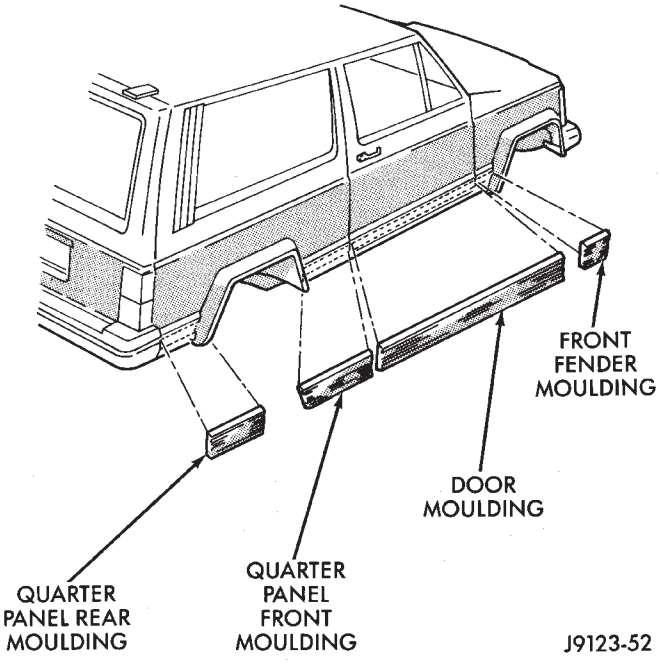


Fig. 56 Body Side Moulding—2-Door XJ Vehicles

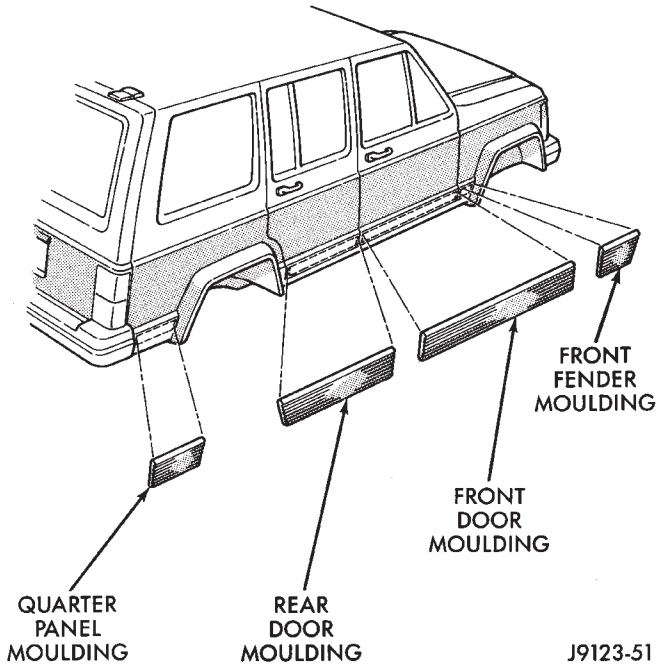


Fig. 57 Body Side Moulding/Cladding—4-Door XJ Vehicles

(4) Press the moulding onto the body panel with a roller or hand pressure.

WOODGRAIN MOULDING

SERVICE INFORMATION

Woodgrain mouldings are attached to the vehicle outer panels by four types of fasteners (Fig. 58):

- tubular clips,
- screws,
- nuts, and
- rivets.

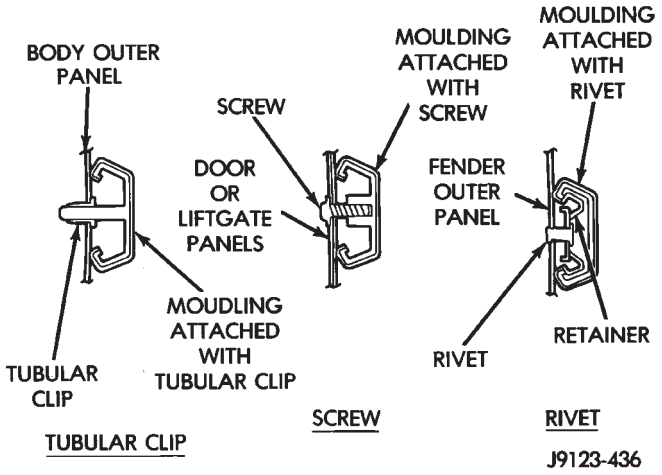


Fig. 58 Woodgrain Moulding Attaching Methods

Ensure that the method of moulding attachment is known (Fig. 62) before attempting removal.

FRONT FENDER MOULDINGS

REMOVAL/INSTALLATION

(1) Pry the moulding off outer fender panel.

(2) Align the moulding with retainers and with the clips in the fender panel. Press the moulding into place on the fender panel.

DOOR MOULDINGS

REMOVAL

(1) Remove the screw that attaches the moulding to the door panel edge.

(2) Pry the moulding off the door panel.

INSTALLATION

(1) Align the moulding with the clips in the door panel. Press the moulding into place on the door panel.

(2) Install the screw to attach the moulding to door panel edge. Tighten screw to 1 N·m (9 in-lbs) torque.

QUARTER PANEL MOULDINGS

REMOVAL/INSTALLATION

(1) Pry the moulding off the quarter panel.

(2) Align the moulding with clips in the quarter panel then press the moulding into place on the quarter panel.

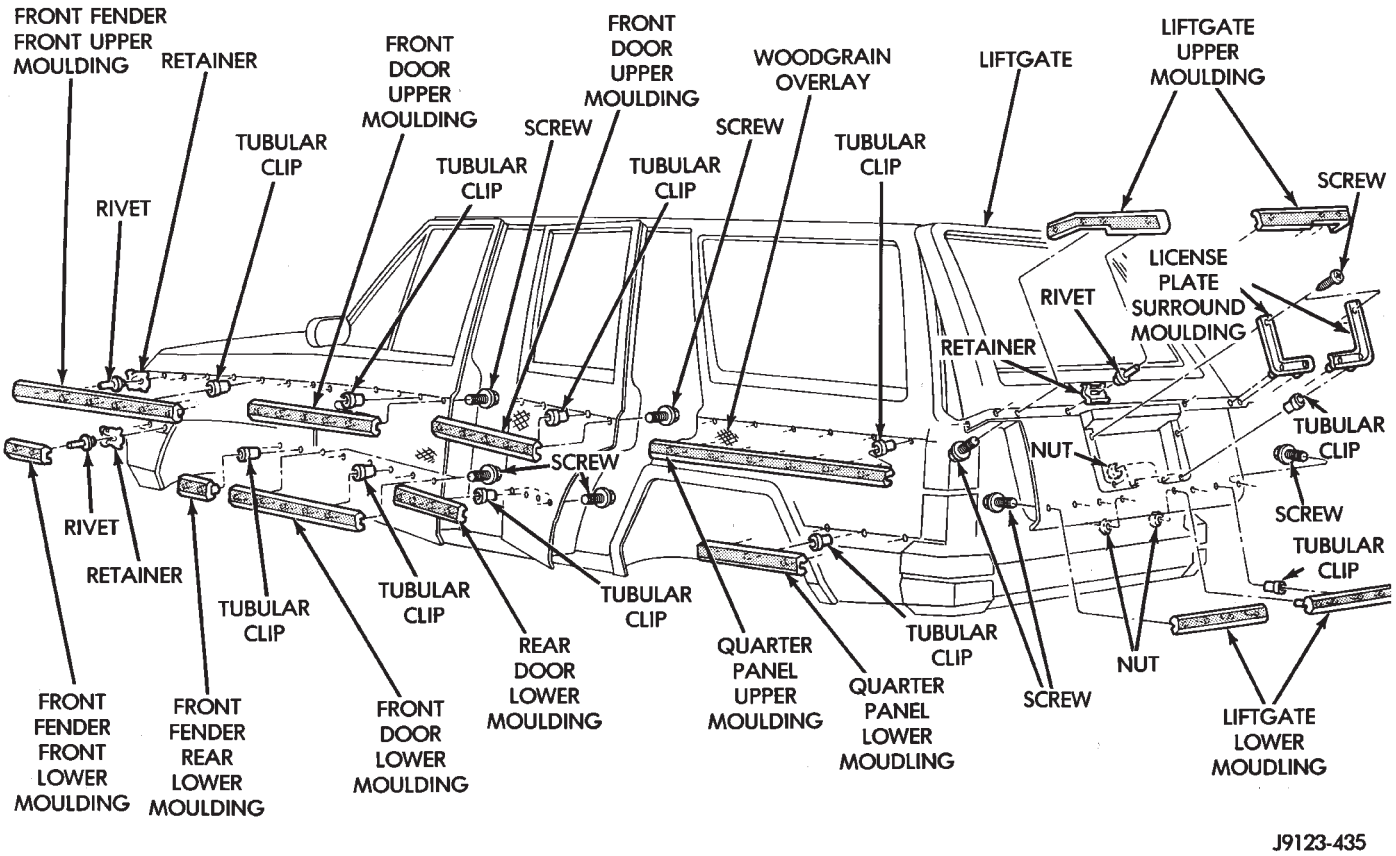


Fig. 59 Woodgrain Moulding—XJ

LIFTGATE UPPER MOULDING

REMOVAL

(1) Remove the screws that attach the moulding to the liftgate panel edge.

(2) Pry the moulding off the liftgate panel.

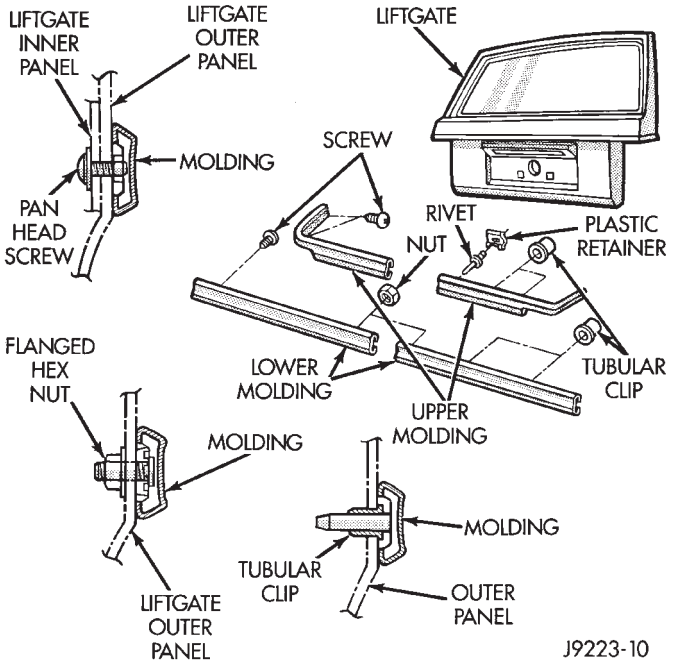


Fig. 60 Liftgate Mouldings—XJ

INSTALLATION

(1) Align the moulding with the retainer on the liftgate panel. Press the moulding into place on the liftgate panel.

(2) Install screws to attach the moulding to the liftgate panel edge. Tighten screws to 1 N·m (9 in-lbs) torque.

LIFTGATE LOWER MOULDING

REMOVAL

(1) Remove screw that attaches the moulding to the liftgate panel edge.

(2) Remove nut that attaches the inboard end of moulding to the liftgate panel.

(3) Pry the moulding off the liftgate panel.

INSTALLATION

(1) Align the moulding with the clips in liftgate panel. Press the moulding into place on the liftgate panel.

(2) Install the screw and nut to attach the ends of moulding. Tighten screw to 1 N·m (9 in-lbs) torque. Tighten the nut to 3 N·m (27 in-lbs) torque.

LICENSE PLATE SURROUND MOULDING

REMOVAL

(1) Remove the screw that attaches upper end of the moulding.

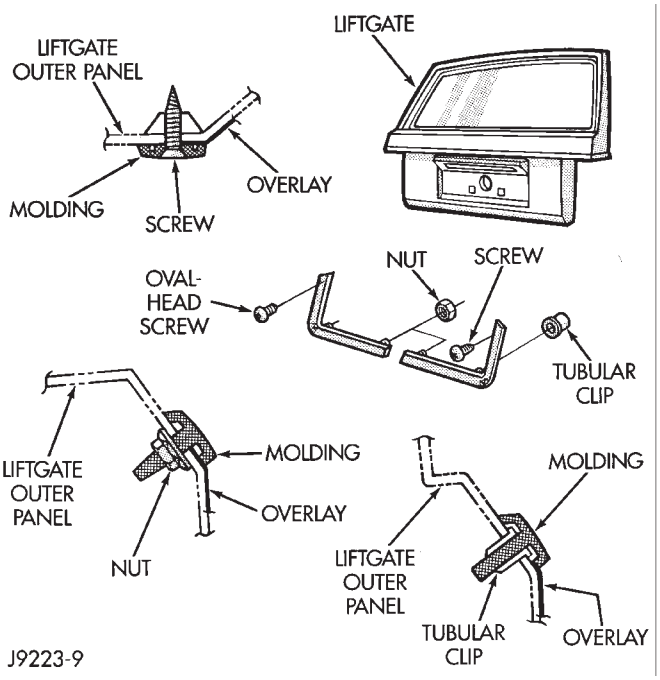


Fig. 61 License Plate Surround Moulding—XJ

(2) Remove the nut that attaches the inboard end of the moulding.

(3) Pry the moulding off the liftgate panel.

INSTALLATION

(1) Align the moulding with the clip in the liftgate panel. Press the moulding into place.

(2) Install the screw and nut to attach the ends of the moulding. Tighten the screw to 1 N·m (9 in-lbs) torque. Tighten nut to 3 N·m (27 in-lbs) torque.

LICENSE PLATE VISOR APPLIQUE

REMOVAL

(1) Drill the heads and remove the rivets that attach the outboard ends of the applique to the tailgate.

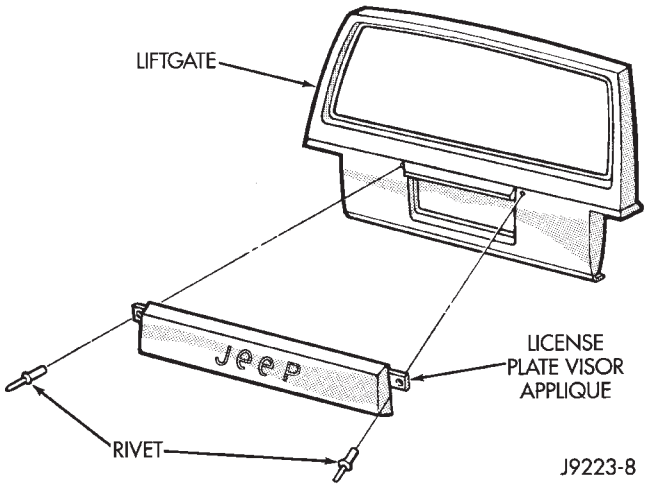


Fig. 62 License Plate Visor Applique

(2) Carefully pry the applique off the license plate visor and tailgate (Fig. 62).

INSTALLATION

(1) Align the moulding with the visor and then press the applique into place.

(2) Install the rivets to attach the outboard tabs on applique to the tailgate.

WOODGRAIN OVERLAY

SERVICE INFORMATION

Exterior woodgrain overlay is a weather-resistant vinyl. The adhesive backing is protected by a paper liner until removed for installation.

OVERLAY REPAIR

Small nicks and scratches on an overlay can be touched-up with paint.

To eliminate blisters and air bubbles, pierce them with a needle or pin. Force the trapped air out of the hole and press firmly on the overlay. Heat also can be applied to remove small wrinkles.

Whenever an overlay must be stretched, do not slit or cut it. Instead, apply heat and press or squeegee the overlay into place.

INSTALLATION REQUIREMENTS

Overlay replacement requires metal repair and paint refinish to be completed before the overlay is installed.

The work area temperature should be between 18°C (65°F) and 32°C (90°F). **A woodgrain overlay should not be replaced if the work area temperature is less than 18°C (65°F).**

The following equipment and material are necessary for overlay installation:

- a commercial woodgrain overlay removal solution;
- a commercial adhesive removal solution;
- liquid dish detergent (for wetting solution);
- a mixture of wetting solution;
- a commercial wax and silicone removal solution;
- isopropyl alcohol (rubbing alcohol);
- a squeegee (4 to 5 inches wide, plastic or hard rubber);
- a water bucket and sponge;
- sandpaper (no. 360 or no. 400, wet or dry type);
- a heat gun (or infra-red heat bulb);
- clean wiping rags or paper towels;
- a pair of scissors;
- a needle or pin; and
- a wax pencil.

Using a wetting solution helps the installation of an overlay. Prepare a solution by mixing two or three teaspoons of dish detergent with 1 gallon of water. **Do not use soap.**

Too much detergent will reduce the effectiveness of the mixture.

OVERLAY REMOVAL

(1) Remove the adjacent moulding from panel.

(2) Start at one corner and apply heat with a heat gun. Slowly peel the overlay from the panel (Fig. 63).

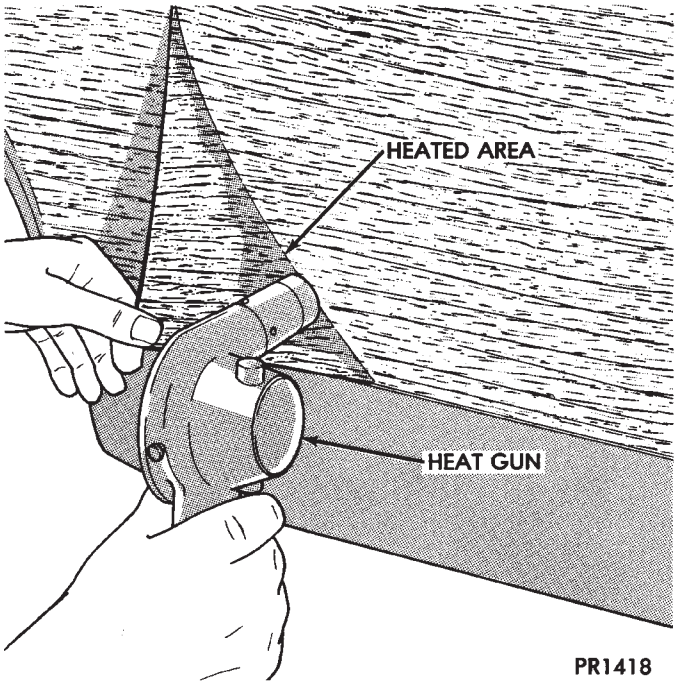


Fig. 63 Woodgrain Overlay Removal

WARNING: USE THE WOODGRAIN OVERLAY AND ADHESIVE REMOVAL SOLUTIONS IN A WELL-VENTILATED AREA ONLY.

(3) A commercial solution can be used for overlay removal where a heat gun is ineffective.

(4) Remove any adhesive remaining with a commercial solution.

(5) Wipe the panel with a cloth saturated with a cleaning solution.

OVERLAY INSTALLATION

The panel area that will be covered by the woodgrain overlay must be scuff sanded and then cleaned with a cleaning solution.

SURFACE PREPARATION

(1) Scuff-sand the painted surface with no. 360 or 400 sandpaper. **Freshly painted surfaces must be dry.**

(2) Clean the painted surface with a commercial wax and silicone removal solution. Wipe the surface with a clean cloth and allow it to dry.

OVERLAY PREPARATION

(1) If a complete panel overlay is not to be installed, position the overlay on the panel surface to be covered:

- mark the approximate outline on the overlay with a wax pencil;

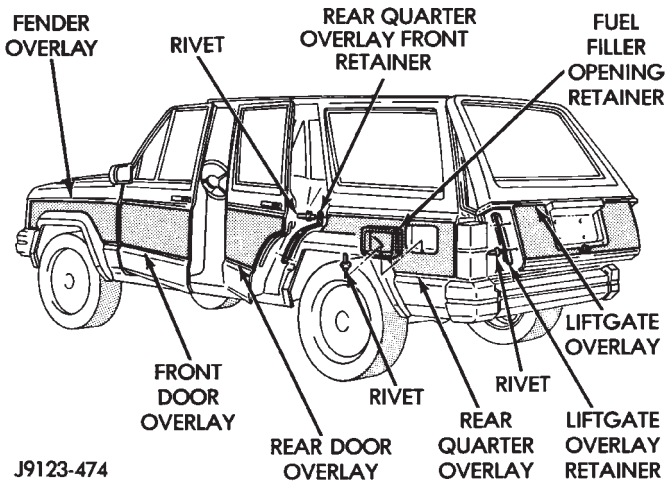


Fig. 64 Woodgrain Overlay—XJ Vehicles

• ensure that 12 mm (1/2 in) excess overlay material is allowed for wrapping around the door and fender flanges; and
• cut the overlay to the approximate size with scissors.

(2) Place the overlay on a clean, flat surface with the paper liner facing upward.

(3) Bend the corner of the overlay toward the woodgrain side and, with a flick of the finger, separate the paper liner from the overlay.

OVERLAY APPLICATION

(1) Use a clean sponge and apply the wetting solution to the overlay adhesive and to the painted panel surface.

(2) Position the adhesive side of the overlay on the panel.

(3) Apply solution to the woodgrain side of the overlay.

(4) For a complete, or a large section of overlay, the following method should be used:
• position a squeegee at the center and slide it across a short horizontal area of overlay;
• lift the right or left edge of the overlay, align it with the panel. Slide the squeegee toward the lifted edge with firm strokes;
• avoid stretching the overlay at its lifted edge;
• continue until all of the air bubbles and wetting solution are removed from the underside of the overlay.

If a wrinkle is trapped in the overlay, stop immediately. Lift the wrinkled area and re-align it to remove the wrinkle. Do not lift the overlay if only a few air bubbles exist.

(5) Notch the corner and curved edges of the overlay and trim the excess.

(6) Allow 12 mm (1/2 in) extra overlay to extend beyond the edges.

CAUTION: Use extreme care to avoid spilling isopropyl (rubbing) alcohol on the moulding or painted surfaces. Wipe spills immediately.

(7) Wipe the adhesive side of edges with isopropyl alcohol.

(8) Heat the overlay edges with a heat gun to soften and make them more pliable.

(9) Fold the edges over onto the panel flange area and press the overlay into place. Alternately heat and press the edge until it is bonded to the flange area.

(10) Carefully cut away the excess from panel the openings with a knife.

(11) Inspect the overlay. Remove all the air and moisture bubbles with a needle or pin.

(12) Install all the removed components and clean the vehicle as necessary.

FRONT FENDER OVERLAY APPLICATION

Install a complete front fender overlay according to the following instructions.

(1) Position the top edge of the front fender overlay at the character line and rear edge at the panel welds.

(2) Wipe the adhesive side of fender overlay edges with isopropyl alcohol.

(3) Heat the fender overlay edges with a heat gun to soften and make them more pliable.

CAUTION: Avoid unnecessary pulling and stretching at the ends.

(4) Fold the edges over onto the fender panel flange and press them into place.

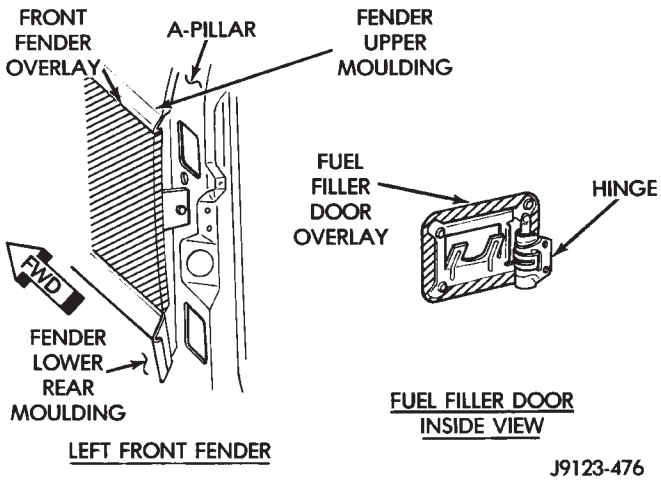


Fig. 65 Woodgrain Overlay Installation

(5) Install the fender moulding.

DOOR OVERLAY APPLICATION

Install a complete front or rear door overlay according to the following instructions.

(1) Position the top edge of the door overlay at the character line and the front edge at the panel welds.
(2) Wipe the adhesive side of the door overlay edges with isopropyl alcohol.
(3) Heat the door overlay edges with a heat gun to soften and make them more pliable.

CAUTION: Avoid unnecessary pulling and stretching at the ends.

(4) Fold edges over onto the door panel flange areas and press them into place.
(5) Install the overlay retainer at door front flange with rivets (Fig. 66).

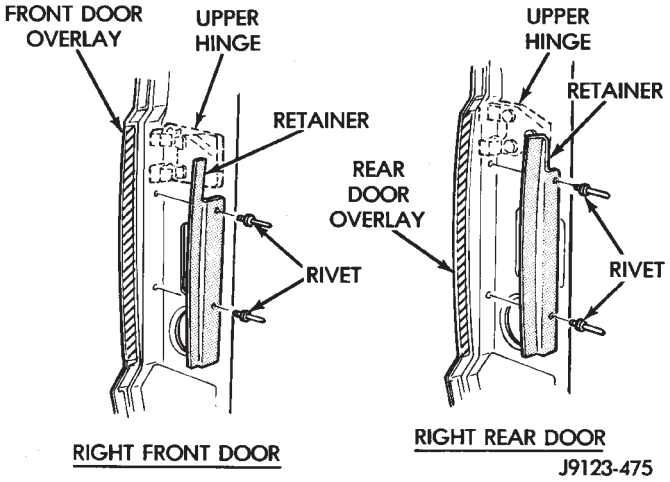


Fig. 66 Overlay Retainer At Door Front Flange

(6) Install the door edge guard (Fig. 67).

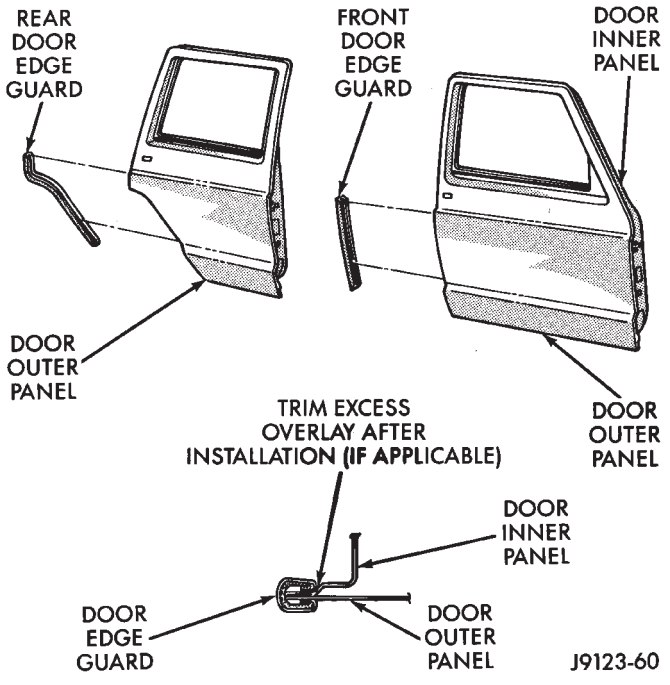


Fig. 67 Door Edge Guards

(7) Install the door moulding.

QUARTER PANEL OVERLAY APPLICATION

(1) Position the top edge of quarter panel overlay at character line and the rear edge at panel welds.
(2) Wipe the adhesive side of quarter panel overlay edges with isopropyl alcohol.
(3) Heat the quarter panel overlay edges with a heat gun to soften and make them more pliable.

CAUTION: Avoid unnecessary pulling and stretching at ends.

(4) Firmly fold the edges over onto quarter panel flange areas and press them into place.
(5) Install the overlay retainer at the rear door opening with rivets.

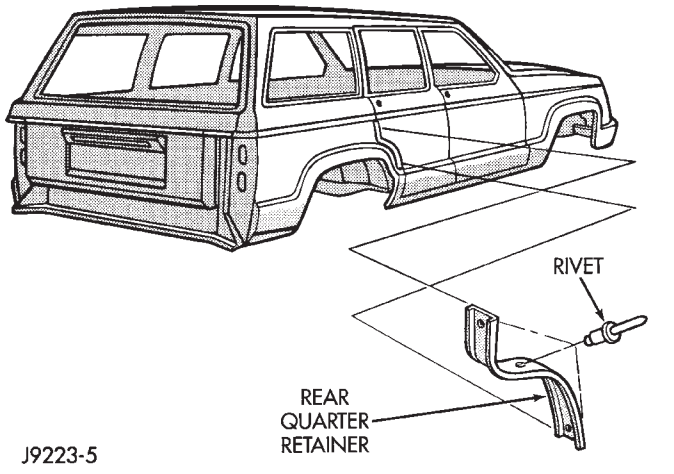


Fig. 68 Rear Door Opening Overlay Retainer

(6) Cut an opening in the overlay for the fuel filler opening.
(7) Install the overlay retainer at the fuel filler opening with rivets.

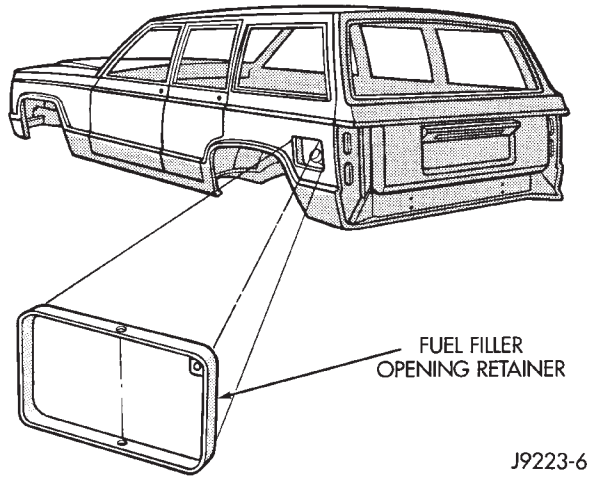


Fig. 69 Fuel Filler Opening Overlay Retainer

(8) Install the quarter panel moulding.

FUEL FILLER DOOR OVERLAY APPLICATION

(1) Clean the door flange with an appropriate solution.

(2) Position the top edge of the overlay at the character line and notches at door edge.

(3) Wipe the adhesive side of fuel filler door overlay edges with isopropyl alcohol.

(4) Heat the door overlay edges with a heat gun to soften and make them more pliable.

CAUTION: Avoid unnecessary pulling and stretching at the ends.

(5) Fold the overlay edges over onto the door panel flange areas and press them into place.

LIFTGATE OVERLAY APPLICATION

(1) Position the top edge of the overlay at character line and inner edges at the license plate recess.

(2) Wipe the adhesive side of the liftgate overlay edges with isopropyl alcohol.

(3) Heat the liftgate overlay edges with a heat gun to soften and make them more pliable.

CAUTION: Avoid unnecessary pulling and stretching at the ends.

(4) Fold the overlay edges over onto liftgate panel flange and press them into place.

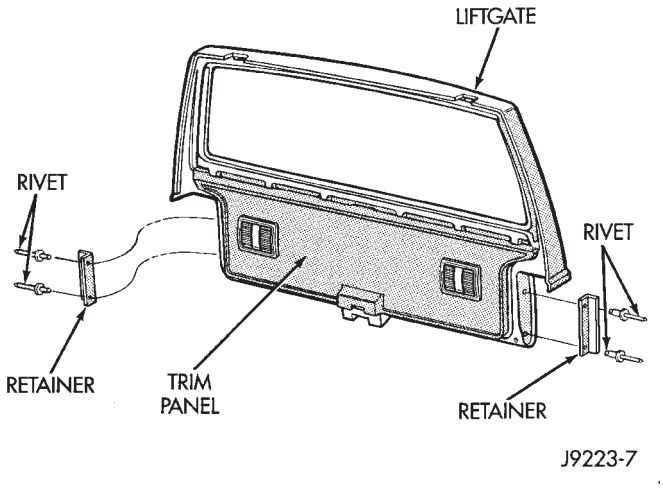


Fig. 70 Liftgate Overlay Side Retainers

(6) Install the liftgate moulding.

(7) Install the license plate visor applique.

BODY STRIPES/DECALS

SERVICE INFORMATION

XJ body stripes and decals are weather resistant tape with a adhesive backing.

REPAIR

Small nicks, scratches and other surface marks in a body stripe/decal can be touched-up with paint.

To eliminate blisters and air bubbles in a body stripe/decal, pierce them with a needle or pin.

A heat gun can also be used to remove small wrinkles in a stripe/decal.

REQUIREMENTS

Body stripe/decal replacement requires that the metal repair and paint refinish be completed first.

The work area temperature should be between 18°C (65°F) and 32°C (90°F). **A tape stripe/decal should not be replaced if the work area temperature is less than 18°C (65°F).**

The following equipment and material are necessary for removal and installation:

- a commercial tape stripe/decal removal solution;
- a commercial adhesive removal solution;
- liquid dish detergent (for the wetting solution);
- a mixture of wetting solution;
- a commercial wax and silicone removal solution;
- isopropyl (rubbing) alcohol;
- a small squeegee (plastic or hard rubber);
- a water bucket and sponge;
- clean wiping rags or paper towels;
- a heat gun (or infra-red heat bulb);
- a wax pencil;
- a sharp knife, single edge razor blade or X-acto knife;
- a pair of scissors; and
- a needle or pin.

The use of a wetting solution aids the installation of a tape stripe/decal on a painted panel. Prepare the wetting solution by mixing two or three teaspoons of dish detergent with 1 gallon of water. **Do not use soap.**

Too much detergent will reduce the effectiveness of the mixture.

REMOVAL

(1) Clean the repaired surface, adjacent panels and door the openings as necessary.

(2) Start at one end of the tape stripe/decal and apply heat with a heat gun. Slowly peel the stripe/decal from the panel by pulling it back. **Do not pull the tape stripe/decal outward from panel.**

WARNING: USE TAPE STRIPE/DECAL REMOVAL SOLUTION IN A WELL-VENTILATED AREA ONLY.

(3) A tape stripe/decal removal solution can be used for removal at areas where a heat gun is ineffective:

- Mask-off the body panel area surrounding the tape stripe/decal (Fig. 71);
- move solution spray across the complete length of stripe/decal with a steady motion;
- ensure that the complete stripe/decal is covered with solution;

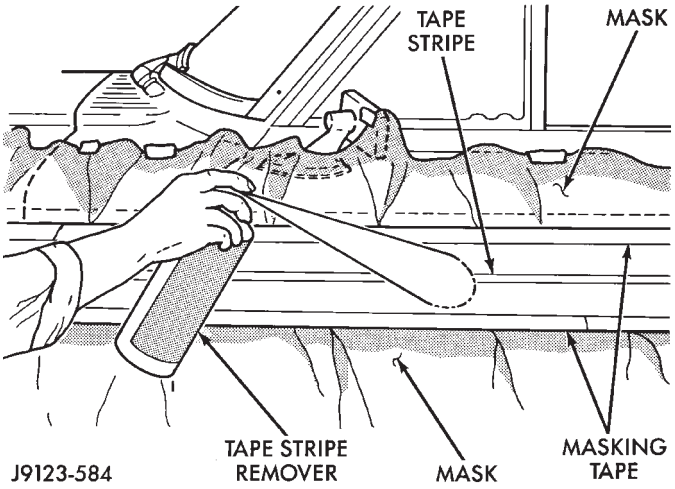


Fig. 71 Stripe/Decal Removal Solution Application

• allow stripe/decal removal solution to remain on the stripe/decal for 20 minutes;
• after 20 minutes, peel the stripe/decal away from flange area;

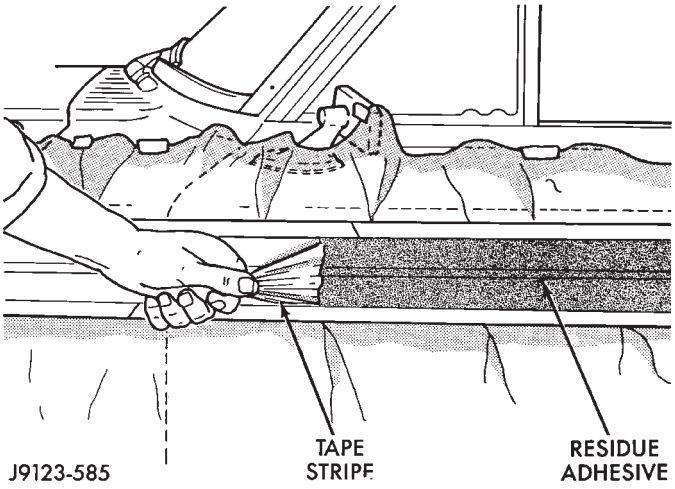


Fig. 72 Body Stripe/Decal Removal

• if there is difficulty with peeling the stripe/decal away from the body panel, use a squeegee (Fig. 73).
• with the stripe/decal removed, scrape all the stripe/decal solution from the panel surface before proceeding.

WARNING: USE THE ADHESIVE REMOVAL SOLUTION IN A WELL-VENTILATED AREA ONLY.

(4) After the stripe/decal is removed, remove any adhesive remaining with a removal solution.

Allow the adhesive removal solution to remain on the panel for 3 to 5 minutes only.

(5) After 3 to 5 minutes, use a squeegee to remove the adhesive (Fig. 74).

(6) Remove the masking tape and mask from the panel.

(7) Wipe the panel with a cloth saturated with an adhesive cleaning solution.

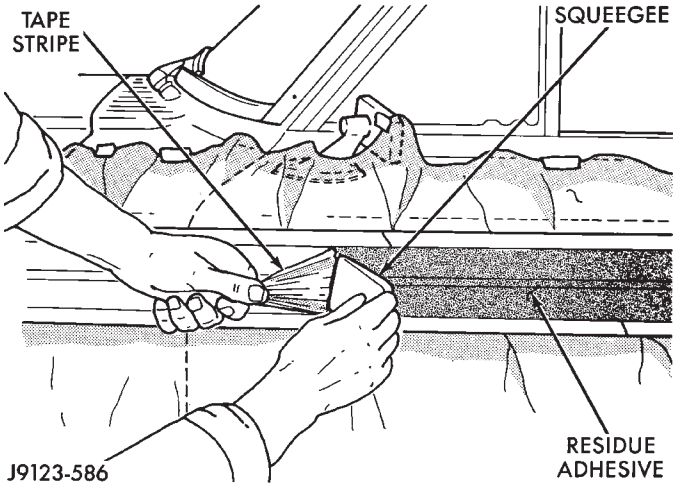


Fig. 73 Body Stripe/Decal Removal With A Squeegee

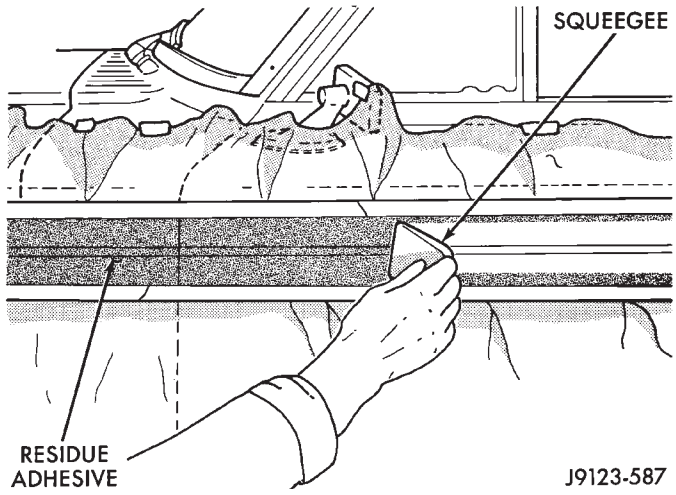


Fig. 74 Adhesive Removal With A Squeegee

BODY PANEL SURFACE PREPARATION

(1) The area that will be covered by the tape stripe/decal must be cleaned with cleaning solution.

(2) Freshly painted surfaces must be thoroughly dry.

(3) Clean the painted surface with a commercial wax and silicone removal solution. Wipe the surface with a clean cloth and allow it to dry.

REPLACEMENT ON ONE PANEL

For tape stripes/decals, use a clean sponge and apply the wetting solution:

• to the adhesive side of the tape stripe/decal, and
• to the painted panel surface.

The wetting solution will permit ease of tape stripe/decal movement when positioning it.

(1) Align a straight edge with the existing tape stripe/decal ends (Fig. 75).

If applicable, the body panel character line can be used as the tape stripe/decal alignment reference.

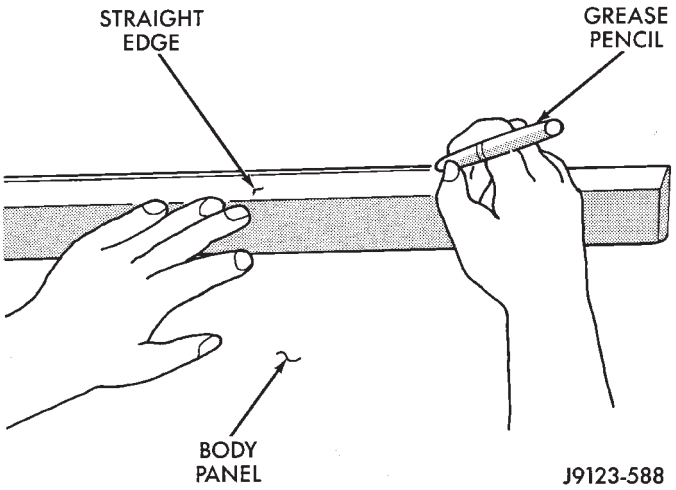


Fig. 75 Stripe/Decal Alignment Reference Mark

(2) Position the tape stripe/decal and carrier on the body panel and the mark length with a wax pencil.

(3) Cut the stripe/decal and carrier at the required length with scissors.

(4) Position the stripe/decal and carrier on the body panel and hold it in-place with masking tape (Fig. 76).

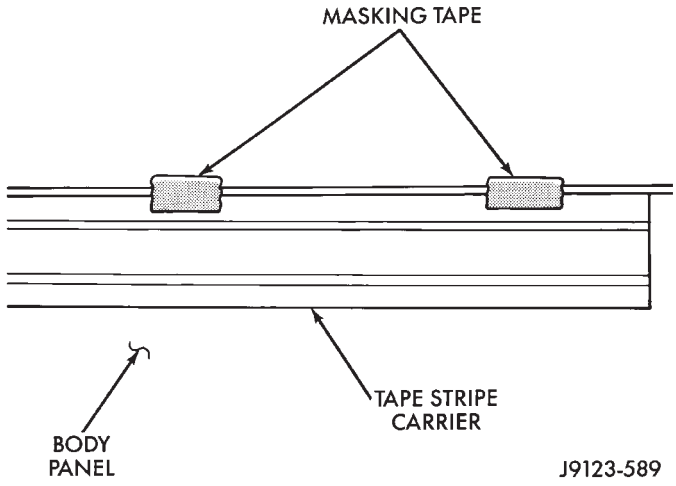


Fig. 76 Tape Stripe/Decal And Carrier Retained On Body Panel

(5) Lift the bottom edge of tape stripe/decal and carrier. Use the tape sections as hinges, and reverse the position of stripe/decal and carrier.

CAUTION: Always remove the carrier from the tape stripe/decal, never remove the tape stripe/decal from carrier

(6) Bend a corner of carrier outward and then, with a flick of the finger, separate the corner of carrier from the decal.

(7) Separate approximately 15 cm (6 in) of the carrier from one end of the tape stripe/decal.

(8) Return the tape stripe/decal back to its original position. If a solution is being used, position adhesive

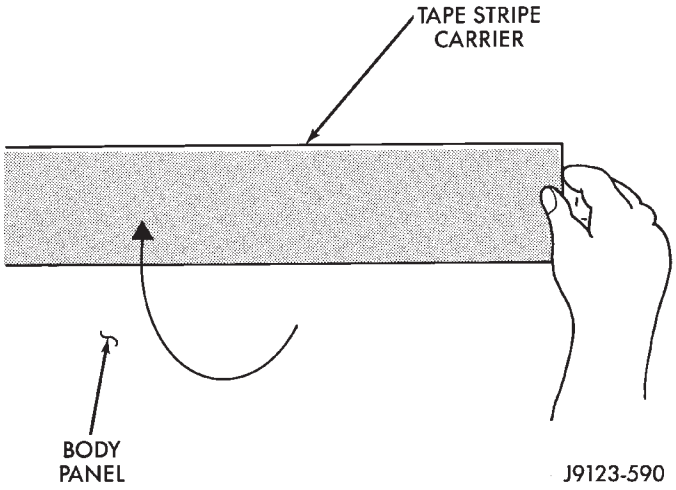


Fig. 77 Tape Stripe/Decal And Carrier Reversed On Body Panel

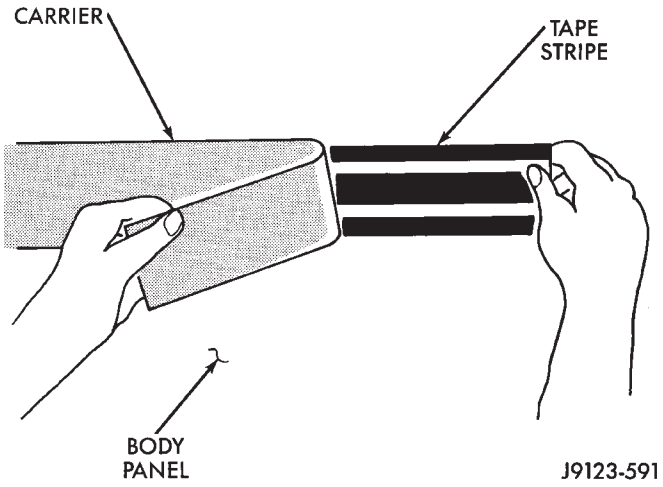


Fig. 78 Tape Stripe/Decal and Carrier Separated

side of the tape stripe/decal on panel. Apply the solution to the outside of the tape stripe/decal.

(9) Hold the tape stripe/decal against the panel surface while separating the carrier from the stripe/decal.

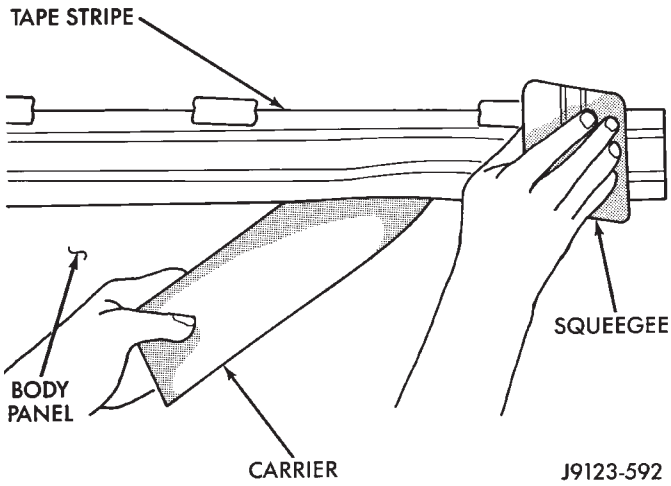


Fig. 79 Tape Stripe/Decal Installation

(10) Where applicable, extend the tape stripe/decal 12 mm (1/2 in) beyond door edge. Wrap it around the edge and press it to the door flange.

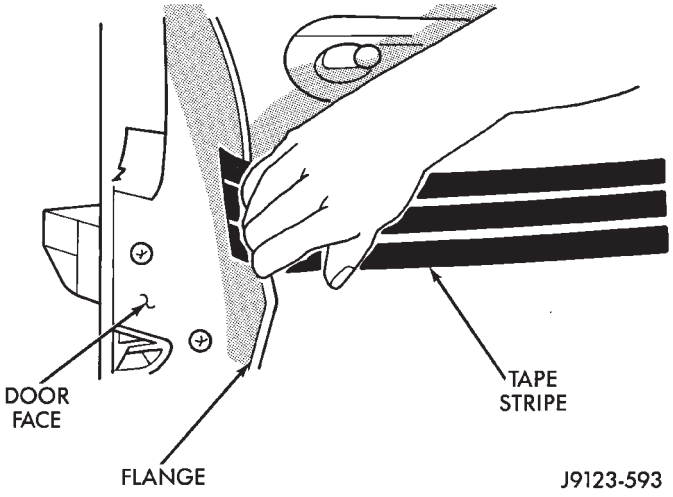


Fig. 80 Tape Stripe/Decal Installation On Door Flange

(11) If applicable, remove the cover from face of tape stripe/decal.

(12) Inspect the tape stripe/decal with reflected light to find any damage. Remove all the air and/or moisture bubbles.

COMPLETE REPLACEMENT

The following procedure will simplify the installation of a complete or very large section.

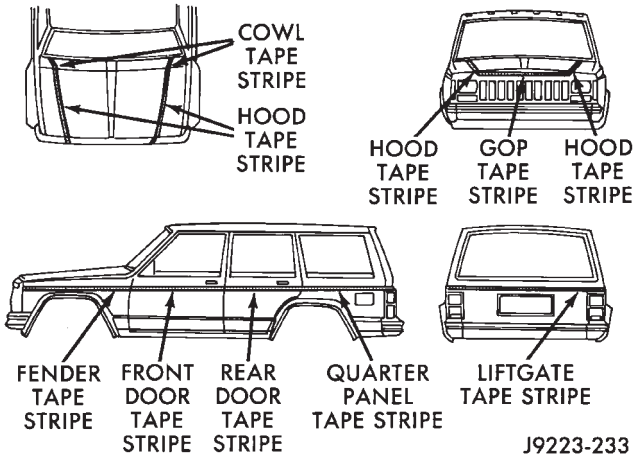


Fig. 81 Tape Stripes—XJ

(1) Place the tape stripe/decal on a clean, flat surface with the carrier side facing upward.

CAUTION: Always remove the carrier from tape stripe/decal, never remove the tape stripe/decal from the carrier.

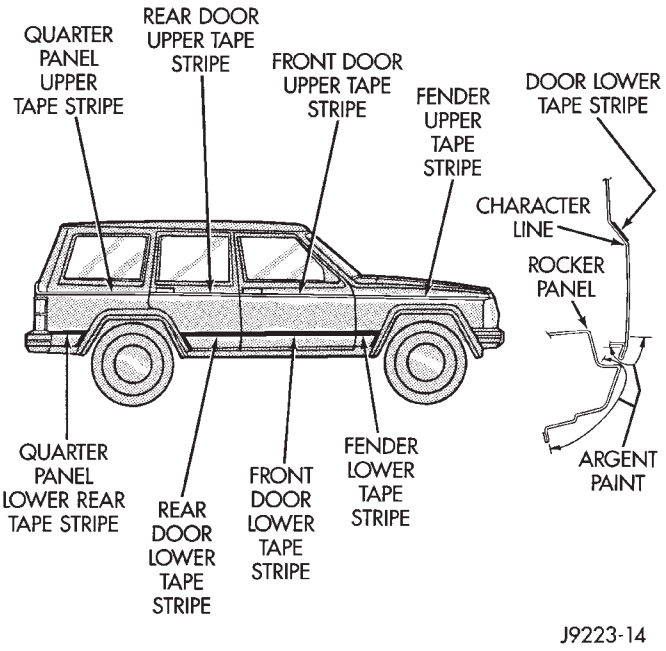


Fig. 82 Upper and Lower Body Side Tape Stripes—XJ Vehicles

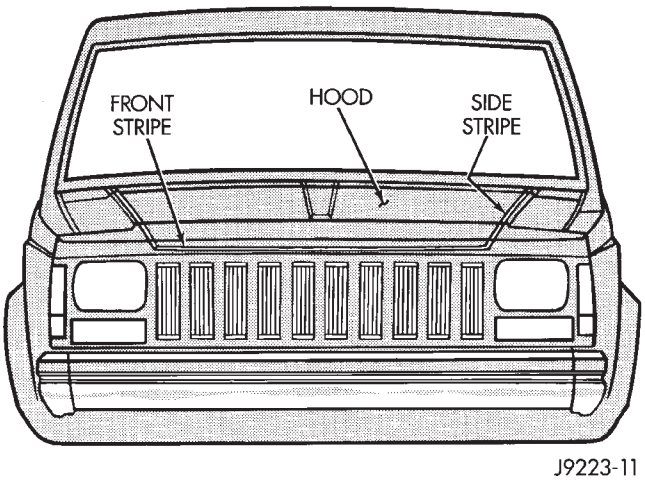


Fig. 83 Hood Tape Stripes—XJ Vehicles

(2) Bend a corner of the carrier inward and then, with a flick of the finger, separate the corner of carrier from the tape stripe/decal.

(3) Retain the tape stripe/decal firmly against flat surface and separate the carrier from tape stripe/decal.

(4) Use a sponge and apply solution to the tape stripe/decal adhesive and to panel surface.

(5) Position the adhesive side of tape stripe/decal on the panel with the bottom aligned with the character line.

- align the end of the replacement tape stripe/decal with the end of existing tape stripe/decal, and
- correctly align the index darts and index notches.

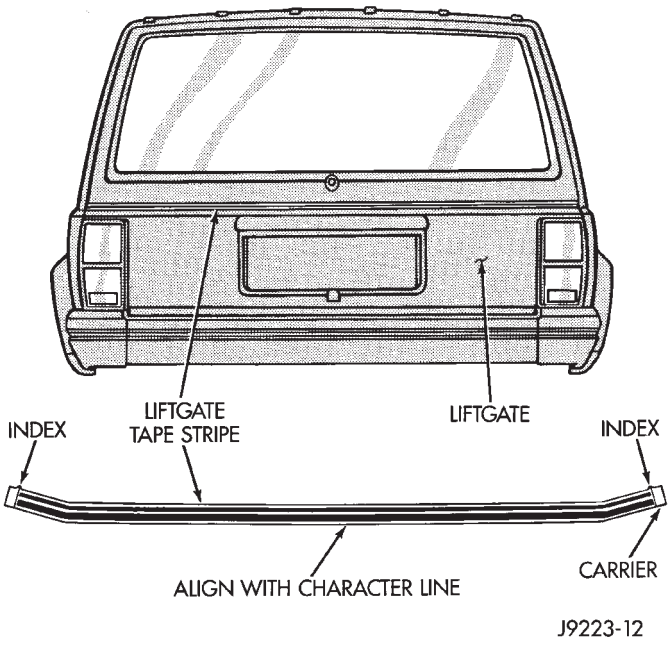


Fig. 84 Tailgate Tape Stripes—XJ Vehicles

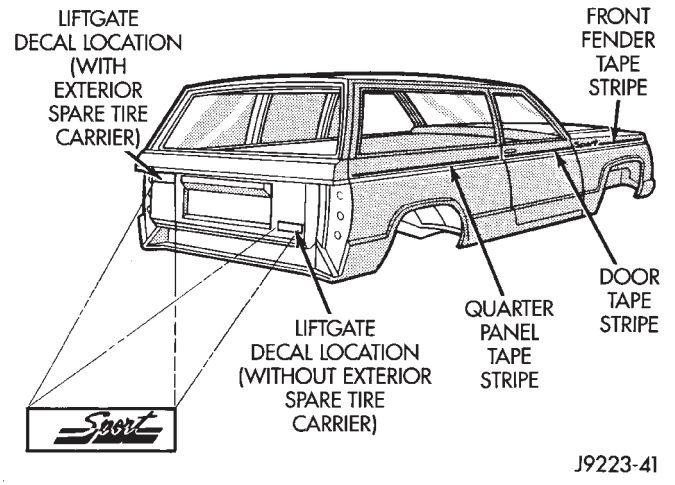


Fig. 85 Tape Stripes and Decal—XJ Sport

(6) If a complete replacement tape stripe/decal is not being installed:

- position the replacement tape stripe/decal section at the center of the repair area,
- align it with the existing tape stripe/decal, and
- allow at least 12 mm (1/2 in) of the tape stripe/decal section to overlap the tape stripe/decal edges.

(7) Apply the wetting solution to the outer side of the tape stripe/decal.

CAUTION: Avoid unnecessary pulling and stretching at the ends.

(8) Slide a squeegee from the center to the ends of the tape stripe/decal. Use firm strokes to remove all of the air bubbles.

(9) If a wrinkle is trapped in the tape stripe/decal stop immediately. Lift the wrinkled area and re-align it with the character line to remove the wrinkle. **Do not lift the tape stripe/decal if only a few air bubbles exist.**

(10) Where applicable, allow 12 mm (1/2 in) extra tape stripe/decal to extend beyond edges.

(11) Fold the excess tape onto the inside flange and adhere it with finger pressure.

(12) Inspect the tape stripe/decal installation with the reflected light to find any damage.

(13) Remove all the air and moisture bubbles from the tape stripe/decal with a needle or pin.

(14) Install any removed components and clean the vehicle as necessary.

QUARTER WINDOW APPLIQUE—XJ VEHICLES

REMOVAL/INSTALLATION

(1) Remove nuts from inside vehicle.

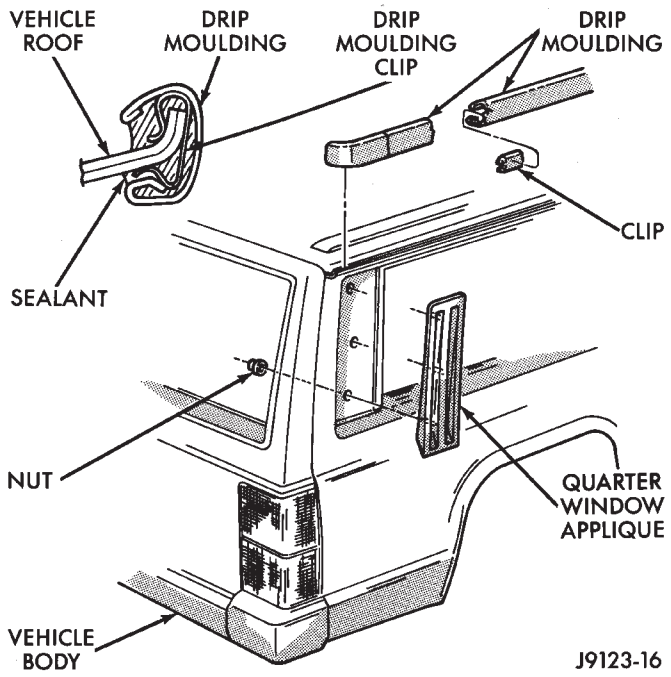


Fig. 86 Quarter Window Applique and Drip Moulding

(2) Carefully pry the applique the from panel.

(3) Position the replacement applique the on panel and install the nuts.

DRIP RAIL MOULDING—XJ VEHICLES

REMOVAL

(1) Pry the clips from the roof flange.

(2) Remove the clips and moulding from the roof flange.

(3) Remove the remaining sealant and clean the roof flange.

INSTALLATION

(1) Position the drip rail moulding with clips at the roof flange and force the clips onto the roof flange.

(2) Apply sealant to the inner side of the moulding to seal the roof flange.

AIR EXHAUST GRILLE—XJ VEHICLES

REMOVAL

(1) Remove the screw that attaches the grille to door the opening panel (Fig. 87).

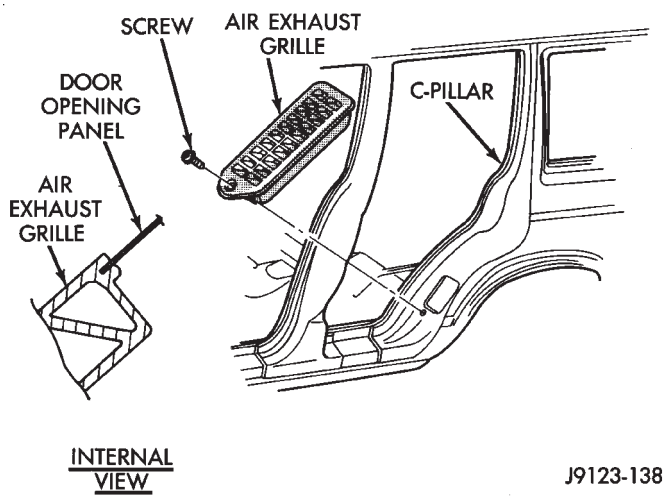


Fig. 87 Door Opening Air Exhaust Grille

(2) Pry the bottom edge of the grille from the door opening panel.

(3) Pull downward and remove the grille from exhaust port in the door opening panel.

INSTALLATION

(1) Position the slot located in the upper end of replacement grille at the exhaust port and insert edge in the slot.

(2) Push inward and seat the grille in the exhaust port.

(3) Install the screw to attach the grille to the door opening panel.

EXTERIOR NAMEPLATES

SERVICE INFORMATION

All of nameplates, with the exception of the JEEP nameplate located on the grille are attached with adhesive.

GRILLE OPENING PANEL NAMEPLATE

REMOVAL

(1) Remove the grille opening panel (GOP) support bracket.

(2) As applicable, remove the nut(s) from the letter(s) that must be replaced.

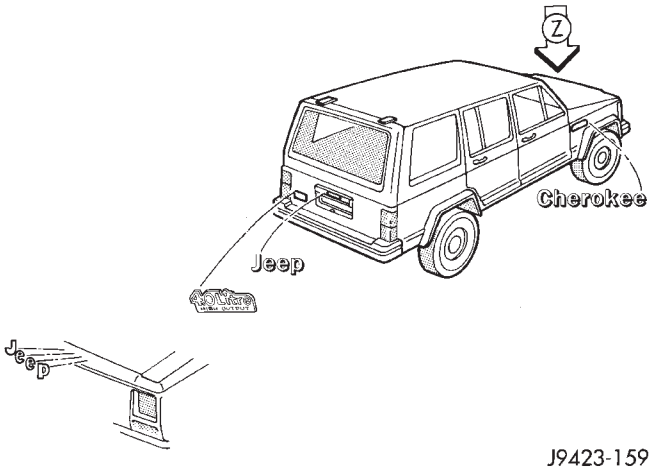


Fig. 88 XJ Exterior Nameplates

(3) Remove the nameplate letter(s) from GOP.

INSTALLATION

(1) Clean the panel surface.

(2) Position the replacement letter(s) on the GOP.

(3) Install the nut(s) and tighten.

ADHESIVE-BACKED NAMEPLATES

REMOVAL/INSTALLATION

(1) Pry the nameplate from vehicle panel.

(2) Clean the panel surface.

(3) Position the replacement nameplate on the panel push inward to seat it.

FUEL FILLER NOZZLE/TUBE

REMOVAL

(1) Remove the fuel filler door from the quarter panel (Fig. 89).

(2) For XJ vehicles, remove the fuel filler hose splash shield from the quarter inner panel and frame rail (Fig. 89).

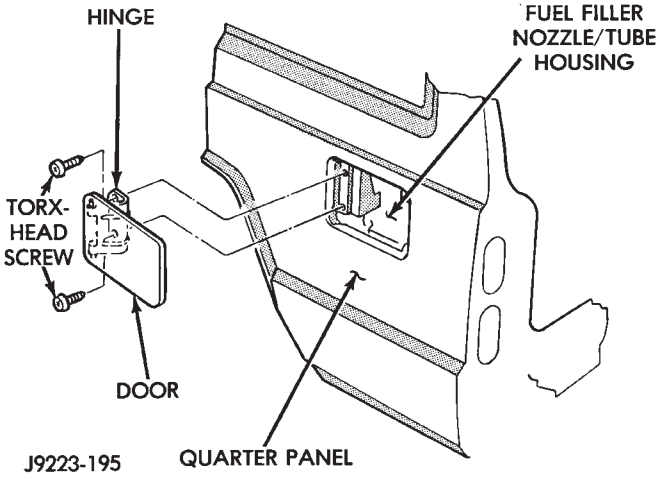


Fig. 89 Fuel Filler Door—Typical

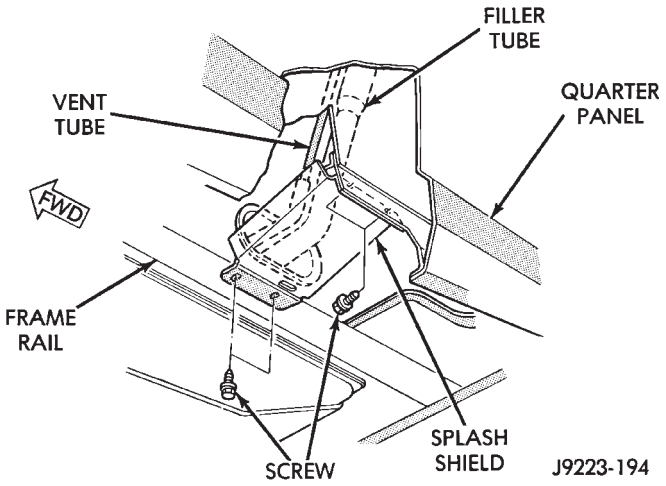


Fig. 90 Fuel Filler Hose Splash Shield—XJ Vehicles

(3) Remove the cap from the nozzle.

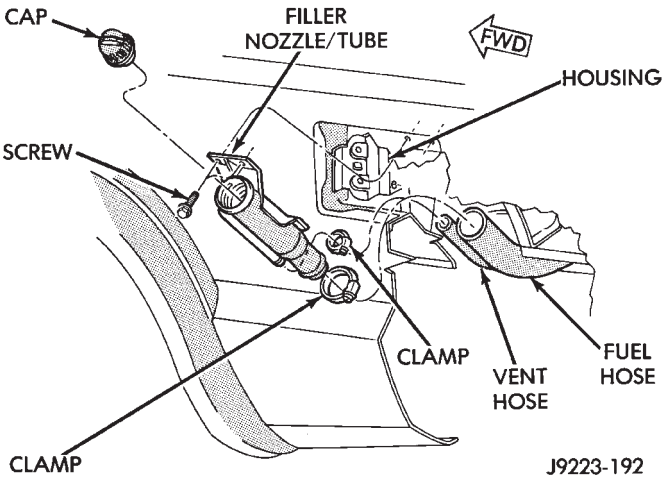


Fig. 91 Fuel Filler Nozzle/Tube—XJ Vehicles

(3) Loosen the clamps and separate the hoses from the tubes.

(4) Remove the screws that attach the nozzle to the housing.

(5) Remove the nozzle/tube from the fuel filler housing.

INSTALLATION

(1) Insert the fuel filler nozzle/tube into the housing.

(2) Install the screws to attach the nozzle/tube to the housing. Tighten screws to 2 N·m (20 in-lbs) torque.

(3) Attach the hoses to the tubes with clamps. Tighten the clamp screws to 4 N·m (35 in-lbs) torque.

(4) Install the cap on nozzle.

(5) For XJ vehicles, install the fuel filler hose splash shield on the quarter inner panel and frame rail.

(6) Install the fuel filler door on the quarter panel.

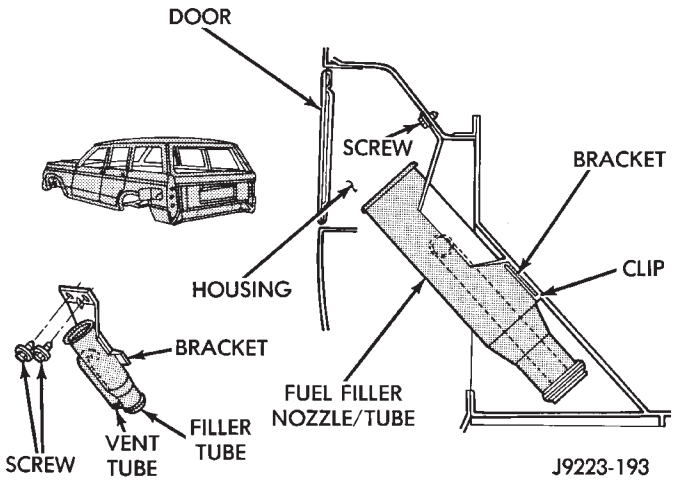


Fig. 92 Fuel Filler Nozzle/Tube Removal/Installation—XJ Vehicles

FUEL FILLER DOOR BUMPERS

REPLACEMENT

(1) Grasp the bumper with pliers and pull outward to remove it from the hole.

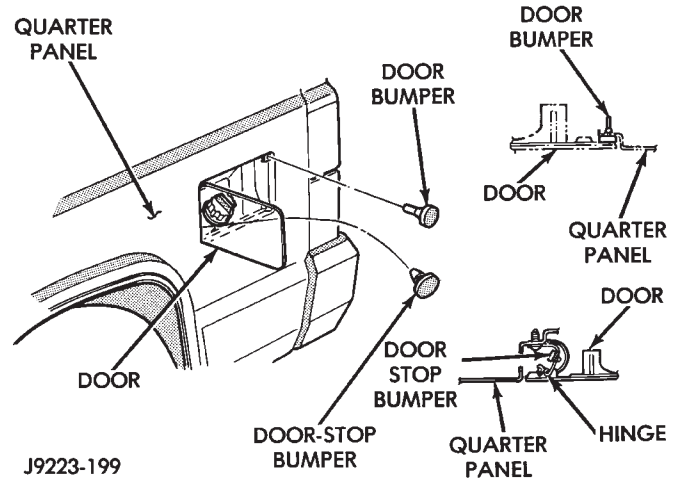


Fig. 93 Fuel Filler Door Bumpers

It may be necessary to remove the door to replace the door-stop bumper.

(2) Insert bumpers in the holes and force them inward until they are seated in the holes.

EXTERNAL MIRRORS

SERVICE INFORMATION

Service procedures for all external rear view mirrors are below.

REMOTE AND POWER/MANUAL MIRRORS

REMOVAL

(1) Remove the door trim panel.

(2) Remove the mirror inside trim cover screw.

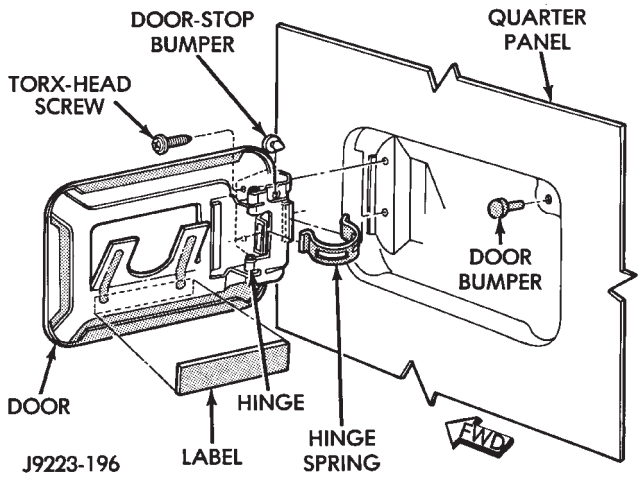


Fig. 94 Fuel Filler Door-Stop Bumper

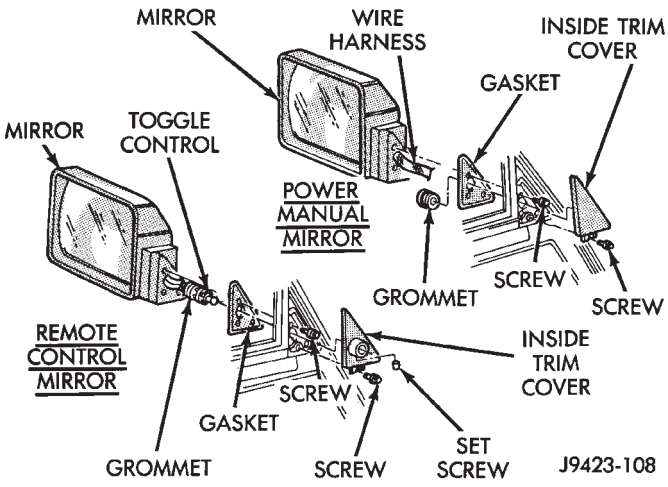


Fig. 95 Remote and Power/Manual Mirrors

(3) For power/manual mirrors, remove the inside trim cover.

(4) For remote control mirrors, loosen the toggle control setscrew.

(5) For remote control mirrors, remove the inside trim cover.

(6) Remove the mirror screws.

(7) Remove the mirror from the door. Refer to Group 8—Electrical.

INSTALLATION

(1) Position the mirror adjacent to the vent window.

(2) Install the mirror screws. Tighten the screws securely.

(3) For remote mirrors, position the inside trim cover over the toggle control and tighten the setscrew.

(4) Install the inside trim cover.

(5) Install the inside trim cover screw.

(6) Install the door trim panel.

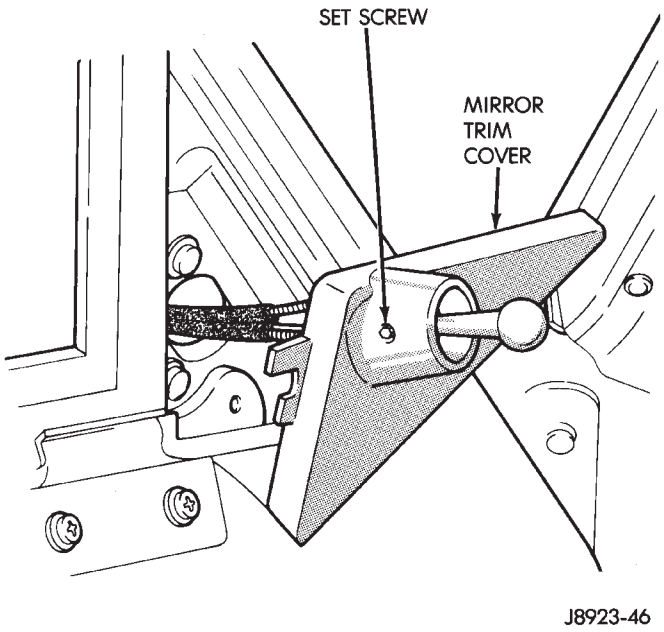


Fig. 96 Remote Mirror Toggle Control Set Screw

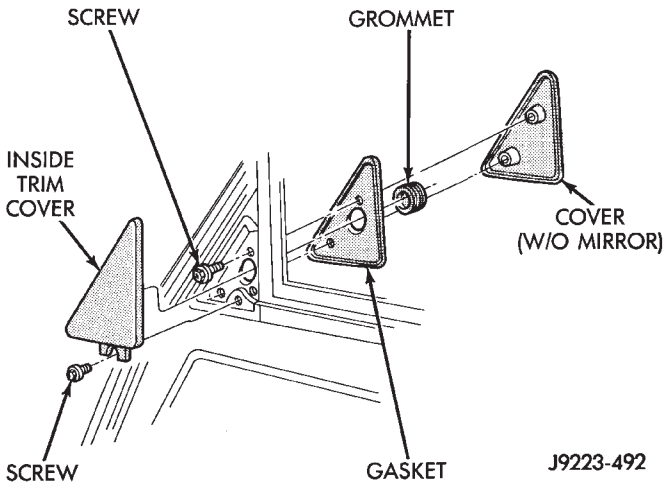


Fig. 97 Trim Covers Without External Mirror

LUGGAGE RACK—XJ VEHICLES

REMOVAL

(1) Remove the slide rail screws.

(2) Remove the luggage rack from the roof.

The skid strips are attached to the roof panel with adhesive.

(3) Loosen each skid strip with a heat gun.

(4) Lift one edge of each skid strip with a putty knife and peel it from the roof panel.

(5) Remove the original adhesive from the roof with an adhesive removal solution.

(6) If the original skid strips are installed, remove all the original adhesive from them.

INSTALLATION

(1) Install 3M 06379 double-sided tape, or an equivalent on skid strips.

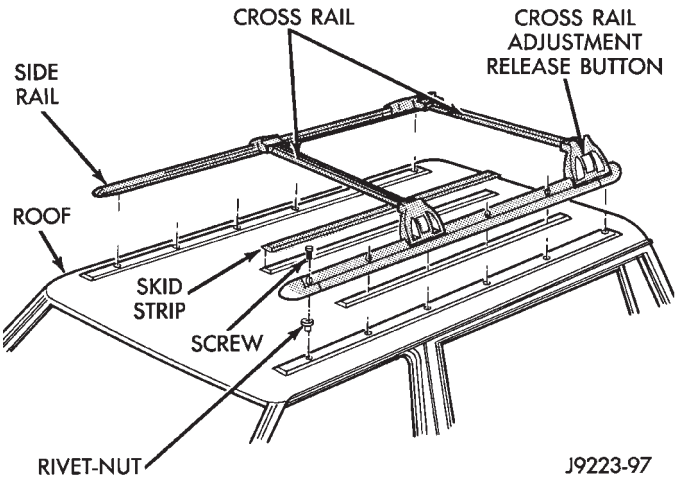


Fig. 114 Luggage Rack—XJ Vehicles

(2) Remove the backing from the double-sided tape, align each skid strip on the roof, and position it on the roof panel.

(3) Verify that each skid strip is properly aligned.

(4) Press each skid strip onto the roof panel with a roller (or use hand pressure).

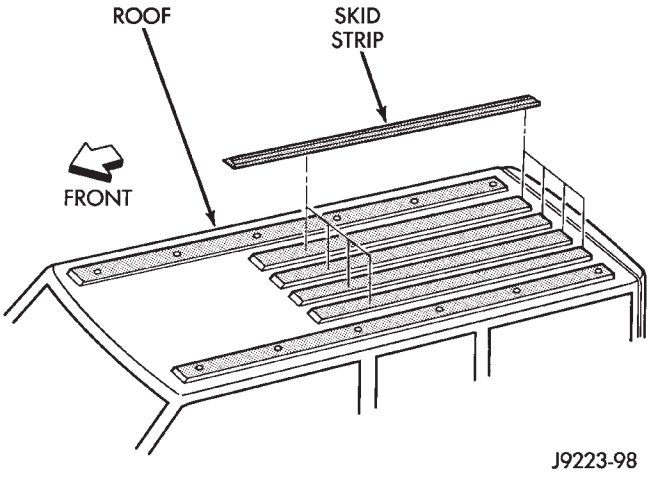


Fig. 115 Skid Strip Installation

To prevent water leaks, apply 3M Drip-Chek Sealant, or equivalent.

(5) Position the luggage rack on the roof with the screw holes aligned.

(6) Install and tighten the slide rail screws to 3 N·m (28 in-lbs) torque.

DOORS

INDEX

SERVICE INFORMATION

The door service procedures includes removal, installation and/or replacement of the following door components:

- door handles,
- armrests,
- trim panels,
- waterdams,
- door restraints,
- front doors,
- rear doors (XJ vehicles only),
- window glass regulators,

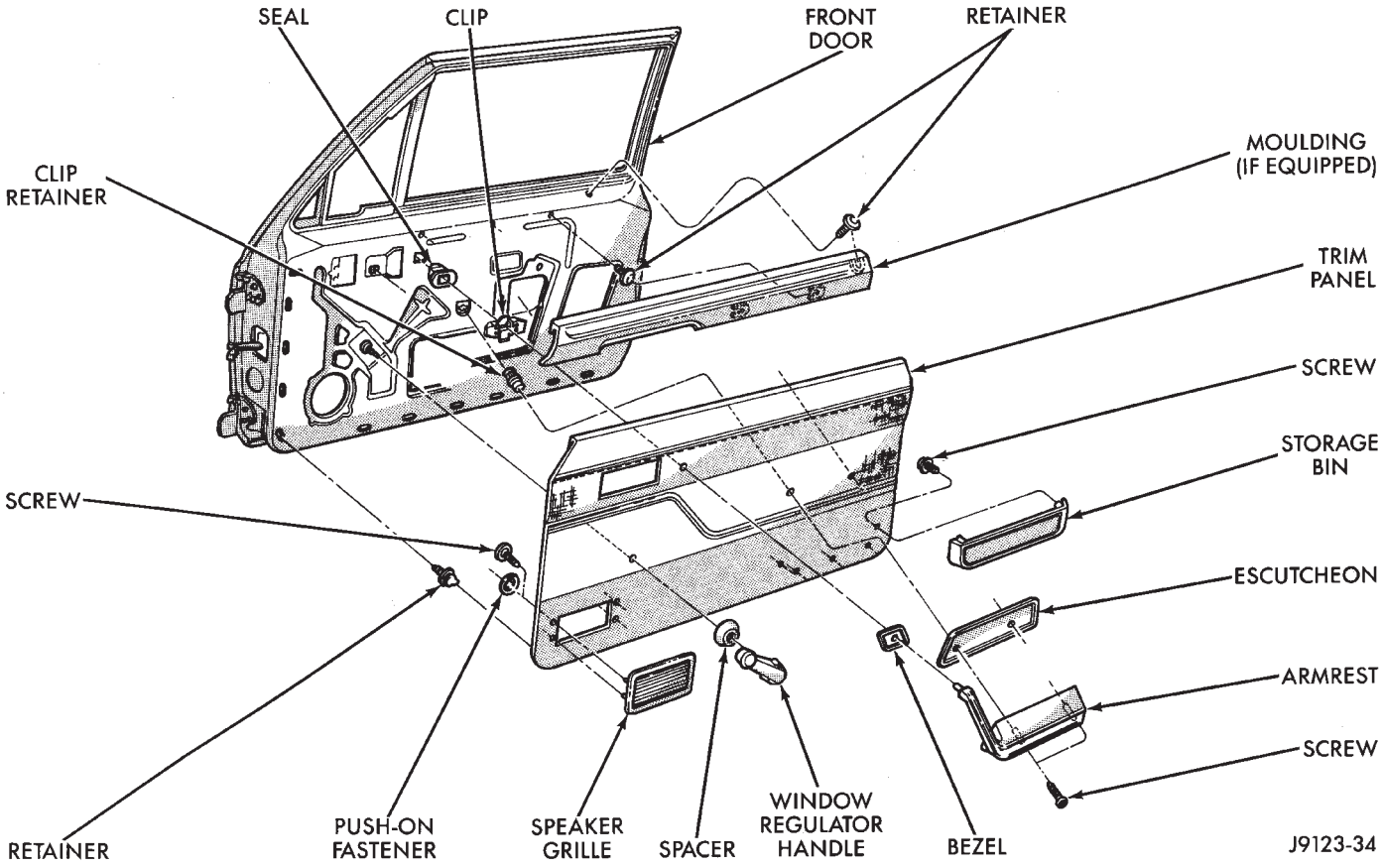


Fig. 1 Front Door Trim Panel

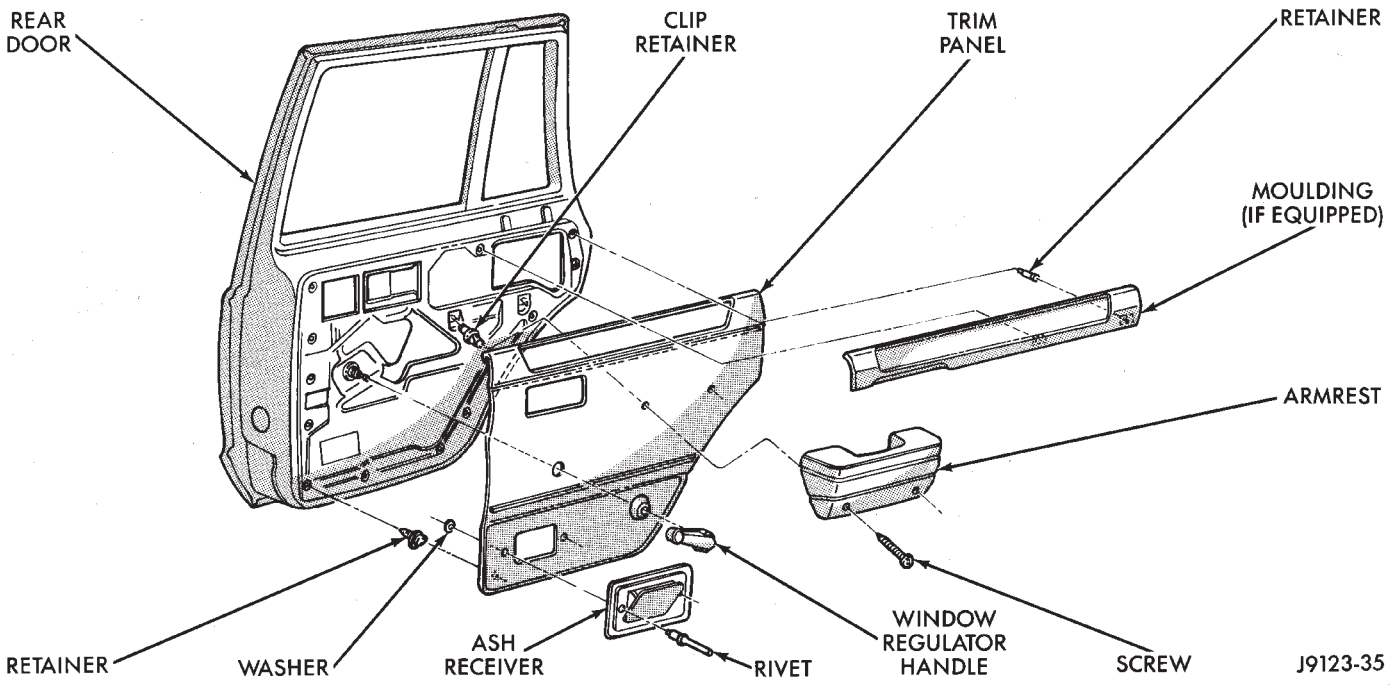


Fig. 2 Rear Door Trim Panel

- door vent and window glass,
- key lock cylinders,
- door half-hinges,
- liftgate (XJ vehicles only),
- liftgate hinges (XJ vehicles only),
- liftgate gas support rod cylinders (XJ vehicles only),
- rocker panel seals, and
- mouldings/weatherstrip seals.

DOOR TRIM PANEL

SERVICE INFORMATION

All attached components can be removed from door trim panels (Figs. 1 and 2).

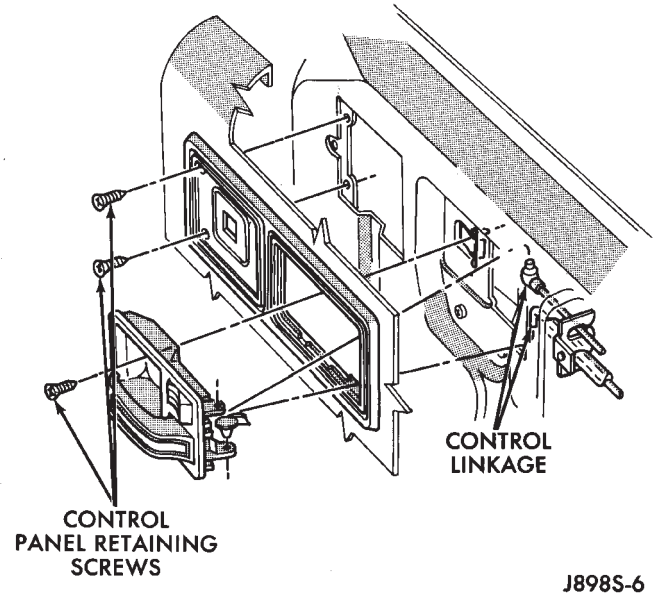


Fig. 3 Front Door Inside Latch Release Handle

REMOVAL

(1) Remove the door inside latch release handle screws (Figs. 3 and 4).

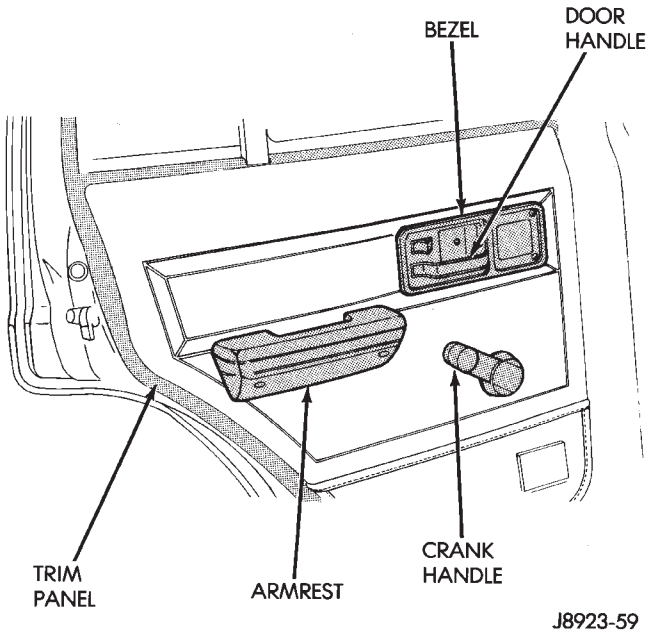


Fig. 4 Rear Door Inside Latch Release Handle

(2) Move the door handle outward and disconnect the handle-to-latch rods (Fig. 5). For vehicles equipped with power door locks/windows, disconnect the wire harness connector (Fig. 6).

(3) Remove the regulator handle (Fig. 7) or, if equipped, power window switches and bezel.

(4) Remove the armrest lower screws.

(5) Pull armrest straight outward from panel and remove the bezel.

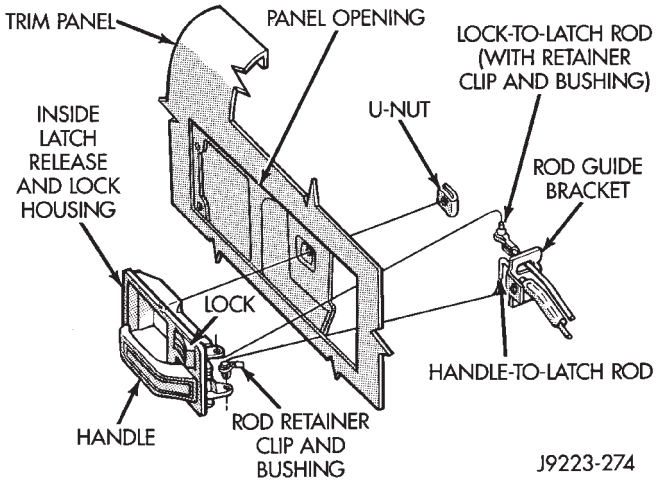


Fig. 5 Door Inside Latch Release Rods

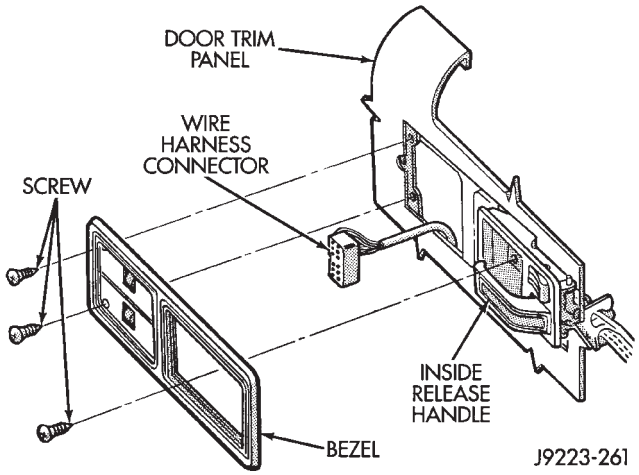


Fig. 6 Power Switch Wire Harness Connector

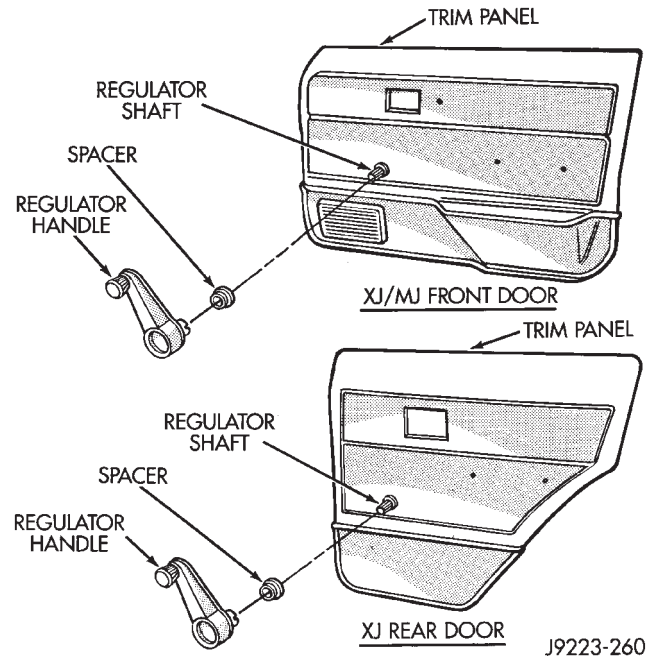


Fig. 7 Window Regulator Handles

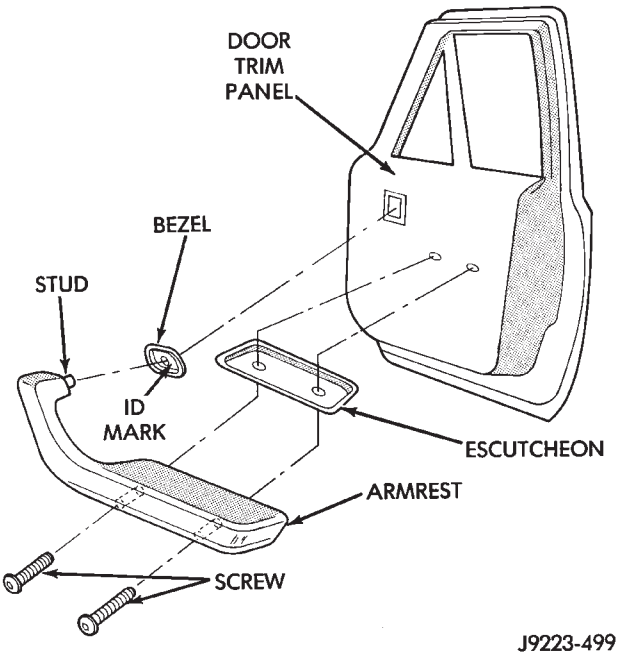


Fig. 8 XJ Front Door Armrest Removal/Installation

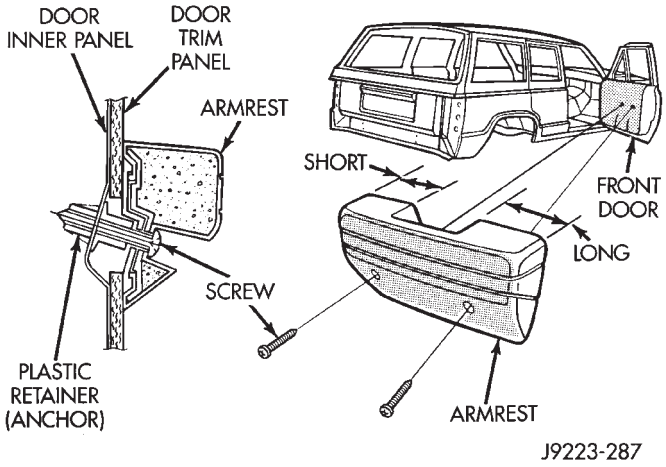


Fig. 9 XJ Front Door Armrest Removal/Installation

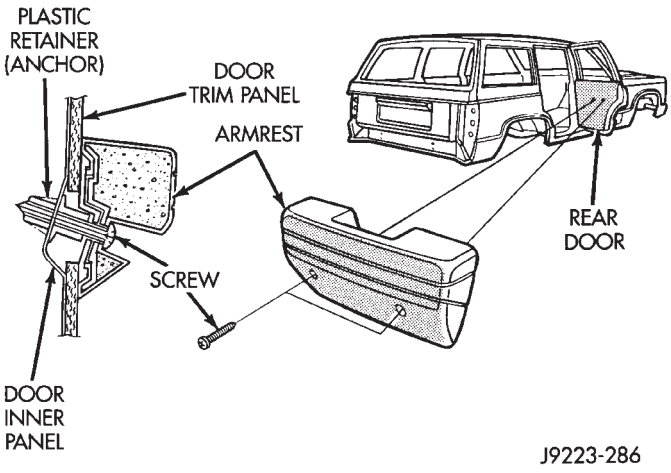


Fig. 10 XJ Rear Door Armrest Removal/Installation

(6) For XJ vehicles, remove the woodgrain moulding from the door inner panel and the inner weatherstrip seal (Figs. 11 and 12).

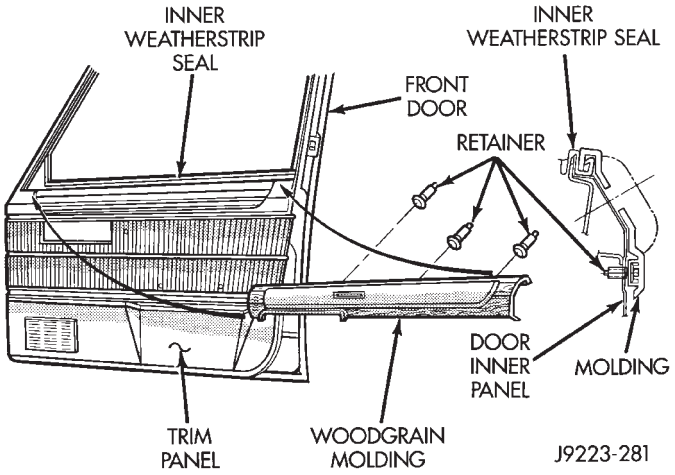


Fig. 11 XJ Woodgrain Moulding—Front Door

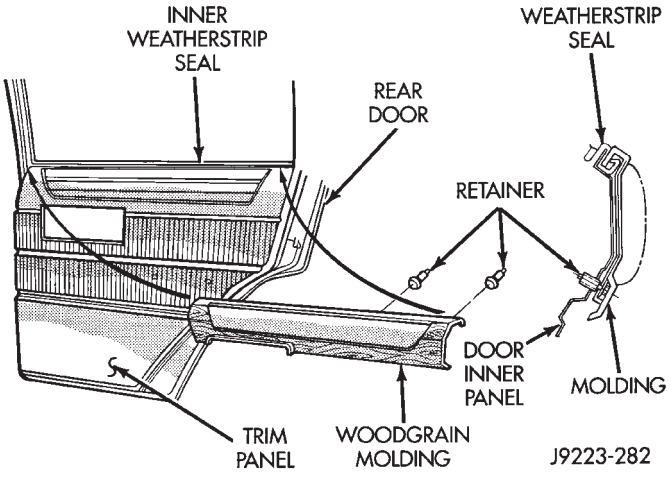


Fig. 12 XJ Woodgrain Moulding—Rear Door

(7) Remove the trim panel retainers from door inner panel with a pry tool (Fig. 13).

(8) Remove the trim panel from door (Fig. 14).

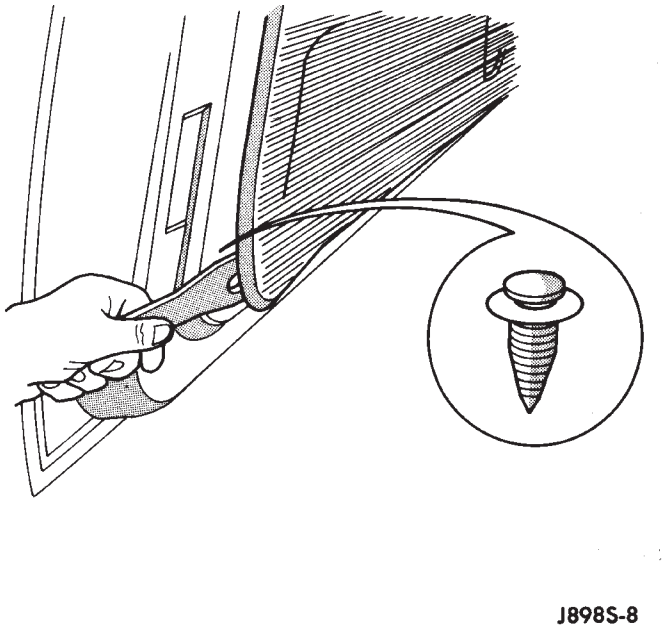


Fig. 13 Detaching Trim Panel Serrated Retainers

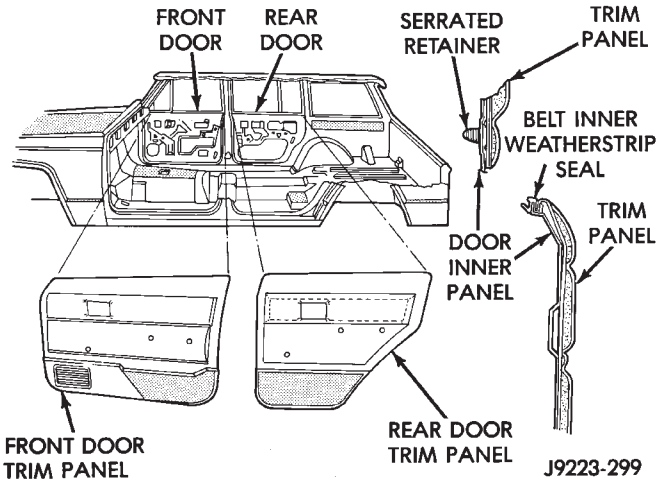


Fig. 14 Front and Rear Door Trim Panels

(9) If necessary, remove the waterdam from the door.

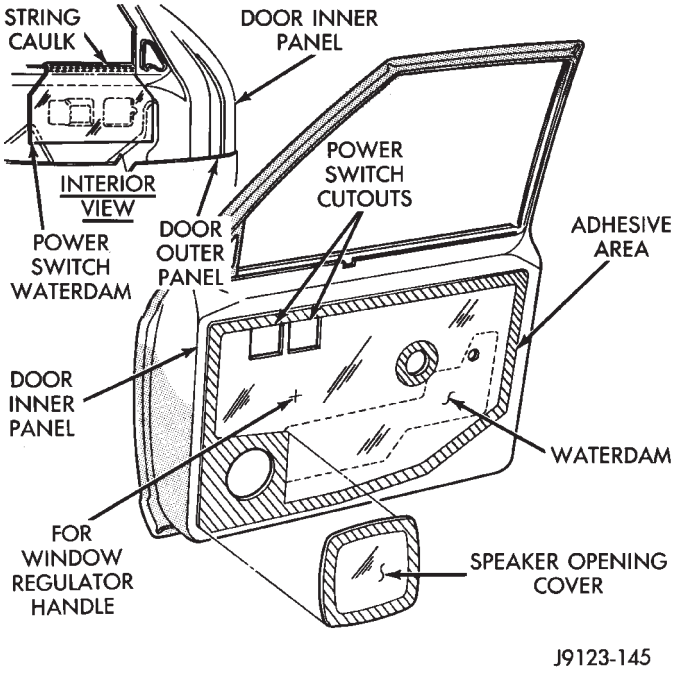


Fig. 15 Front Door Waterdam

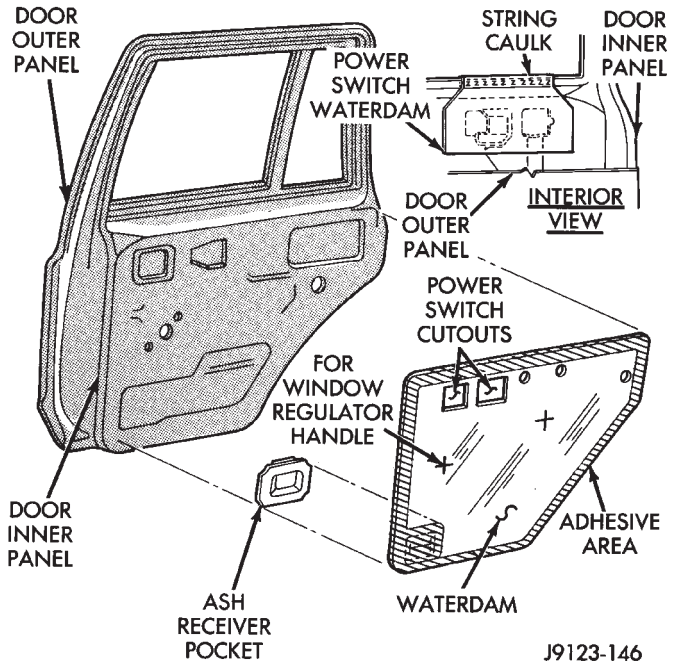


Fig. 16 Rear Door Waterdam

(10) If necessary, remove the storage bin panel and speaker grille from the front door trim panel (Fig. 19).

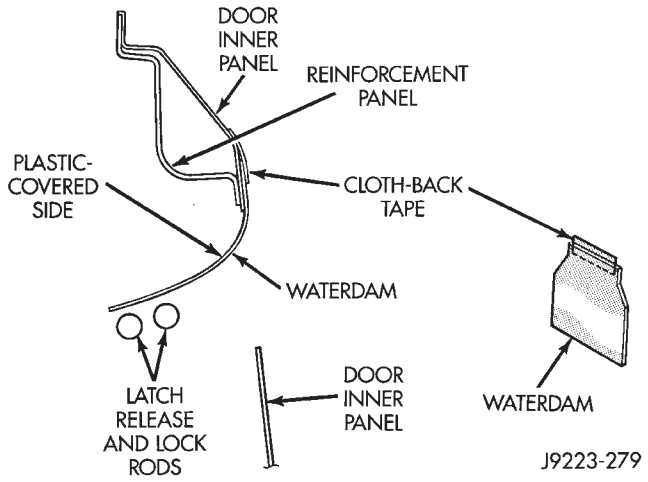


Fig. 17 Latch Release and Lock Rod Waterdam

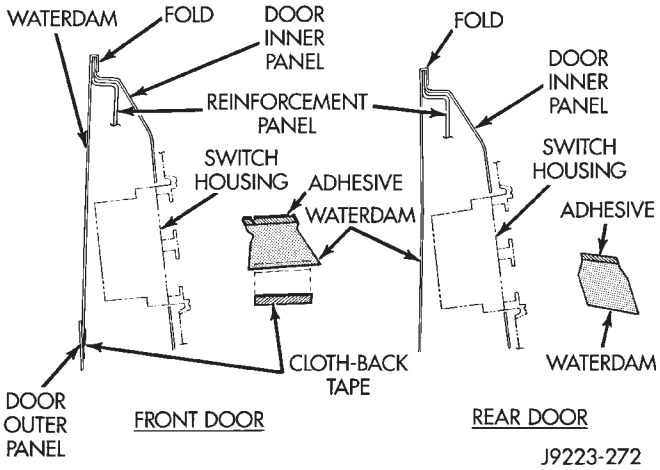


Fig. 18 Power Switch Waterdam

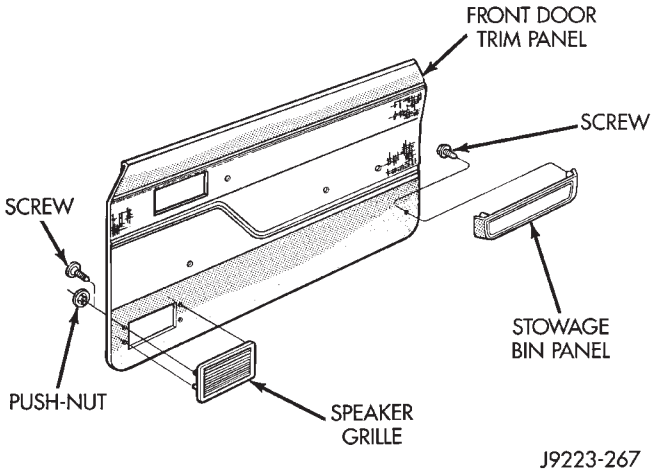


Fig. 19 Storage Bin Panel and Speaker Grille

(11) If necessary, remove the ash receiver tray housing from the rear door trim panel (Fig. 20).

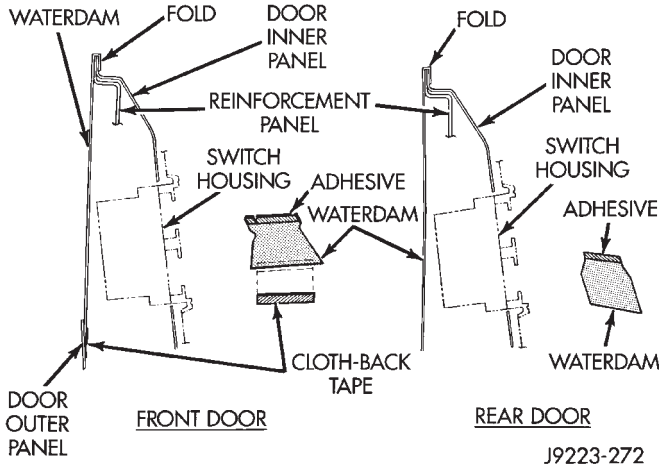


Fig. 20 Ash Receiver Tray Housing

(12) If necessary, replace the armrest upper retainer clip, retainer clip anchor and armrest support bracket.

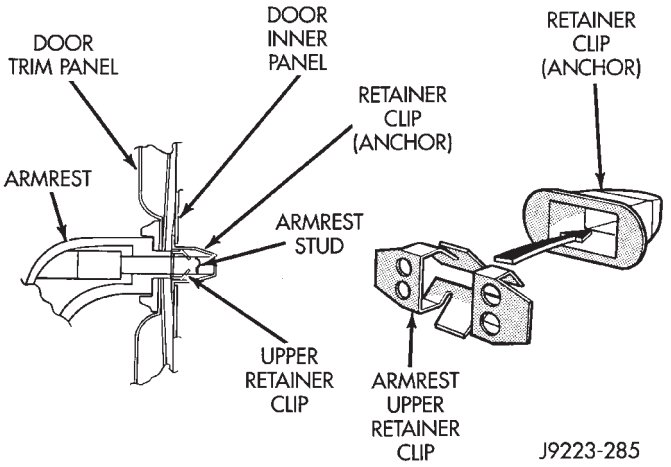


Fig. 21 Armrest Upper Retainer Clip and Anchor

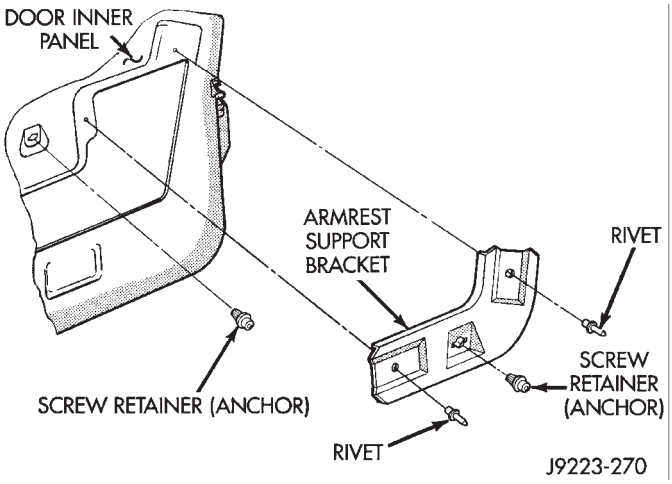


Fig. 22 Armrest Support Bracket

INSTALLATION

(1) If door waterdam was removed, apply sealant to the edges before installing (Fig. 23).

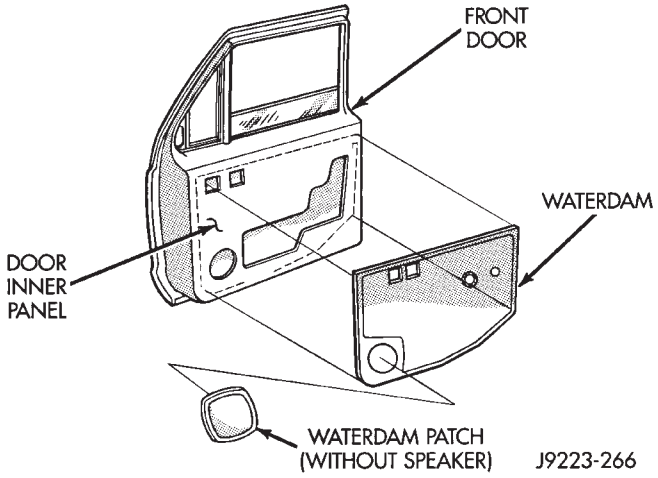


Fig. 23 Waterdam Installation

(2) Position the waterdam on door inner panel (Fig. 23).

(3) If removed, install the storage bin panel and speaker grille on the front door trim panel.

(4) If removed, install the ash receiver tray housing on the rear door trim panel.

(5) Position the trim panel on the door inner panel and press the retainers inward.

(6) Install the armrest and window glass regulator handle. Or (if equipped) the power window switches and bezel. Tighten the armrest screws to 4 N·m (34 in-lbs) torque.

(7) Connect the rods to the inside latch release handle and install the handle. Tighten the screws to 2 N·m (16 in-lbs) torque. For vehicles with power door locks/windows, connect the wire harness connector.

DOOR REMOVAL/INSTALLATION

REMOVAL

(1) Remove the door restraint (check) retaining pin (Fig. 24) with a punch.

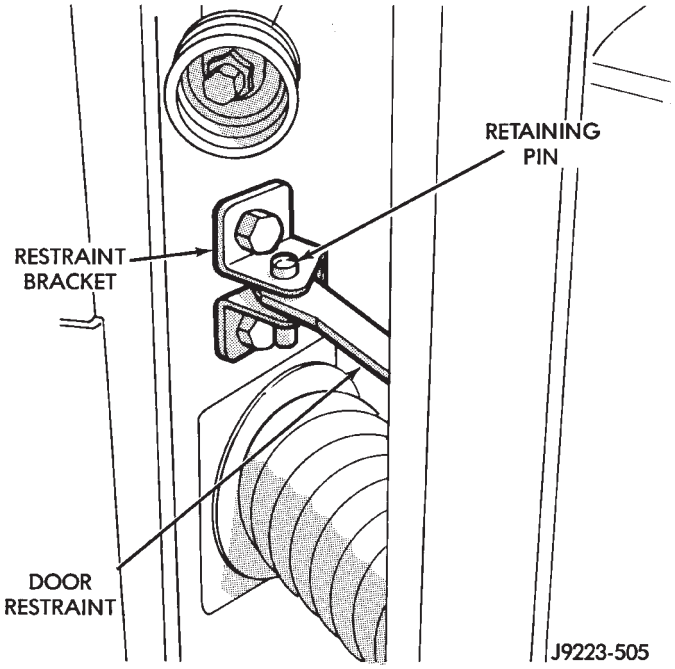


Fig. 24 Door Restraint Retaining Pin

(2) For vehicles equipped with power windows and power door locks, remove the trim panel and disconnect all components. Slide the wire harness out of the boot and door.

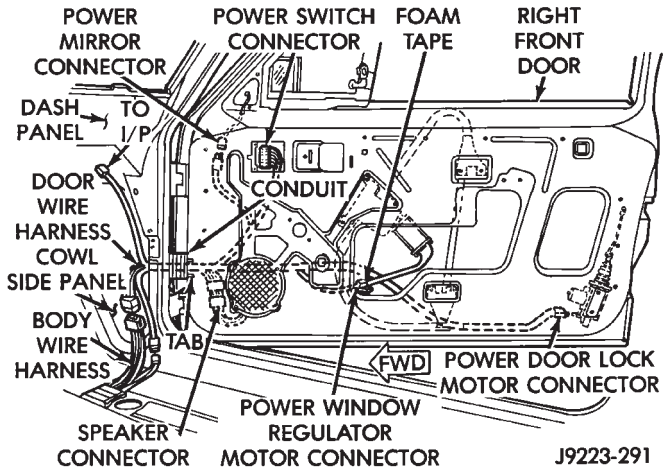


Fig. 25 XJ Right Front Door Wire Harness Connectors

(3) Remove the door hinge bolts, plates and shims (Fig. 30). Remove the door from the vehicle.

(4) Identify and retain the door hinge plates and the shims for correct installation (Fig. 30).

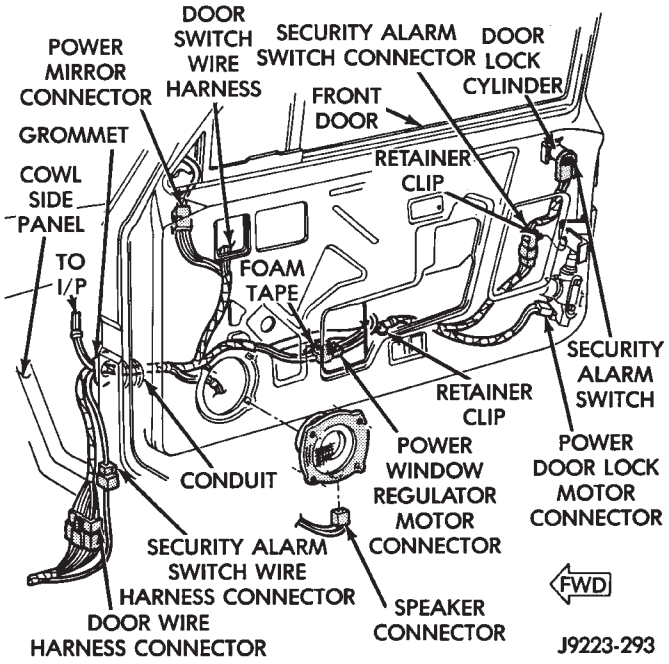


Fig. 26 XJ Right Front Door Wire Harness Connectors—With Security Alarm Switch

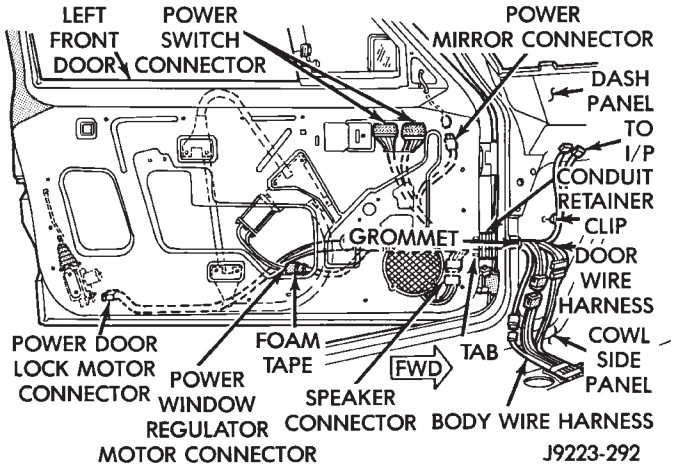


Fig. 27 XJ Left Front Door Wire Harness Connectors

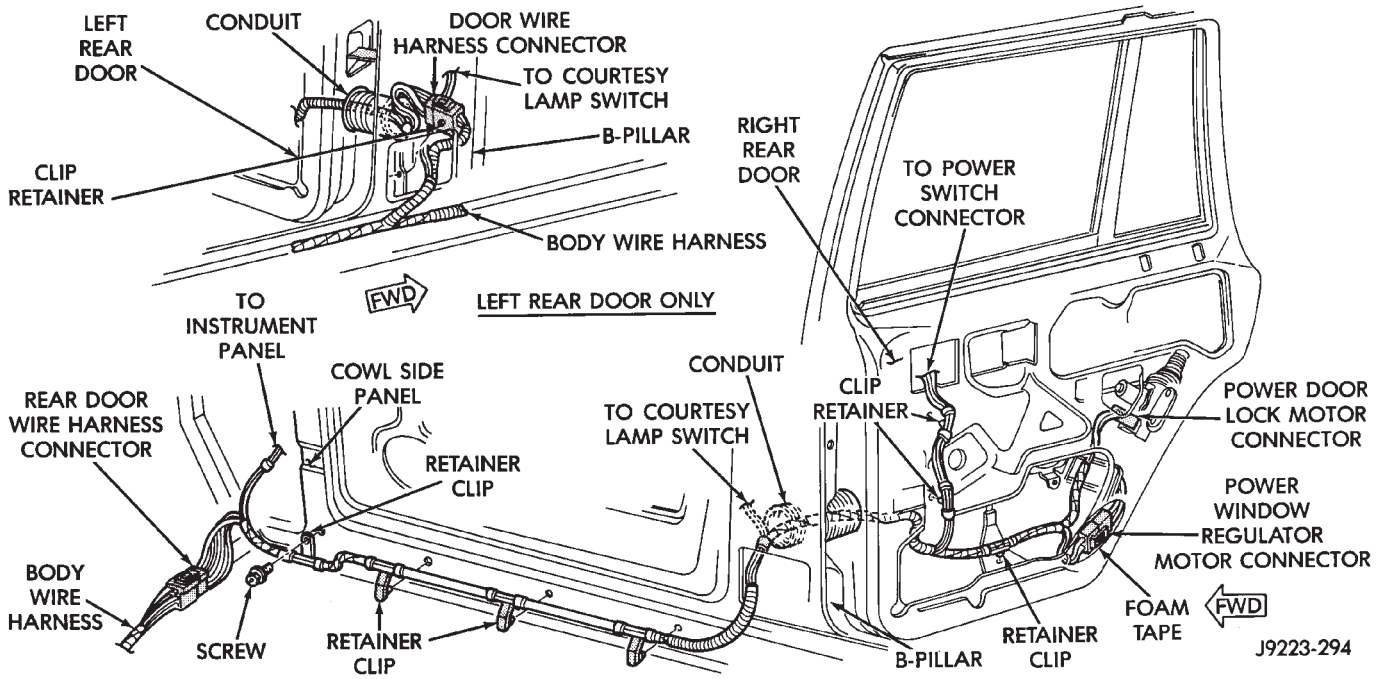


Fig. 28 XJ Rear Door Wire Harness Connectors

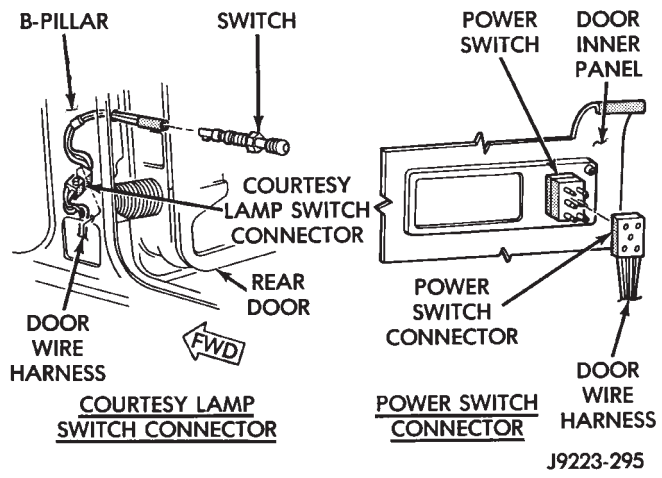


Fig. 29 XJ Rear Door Courtesy Lamp and Power Switch Wire Harness Connectors

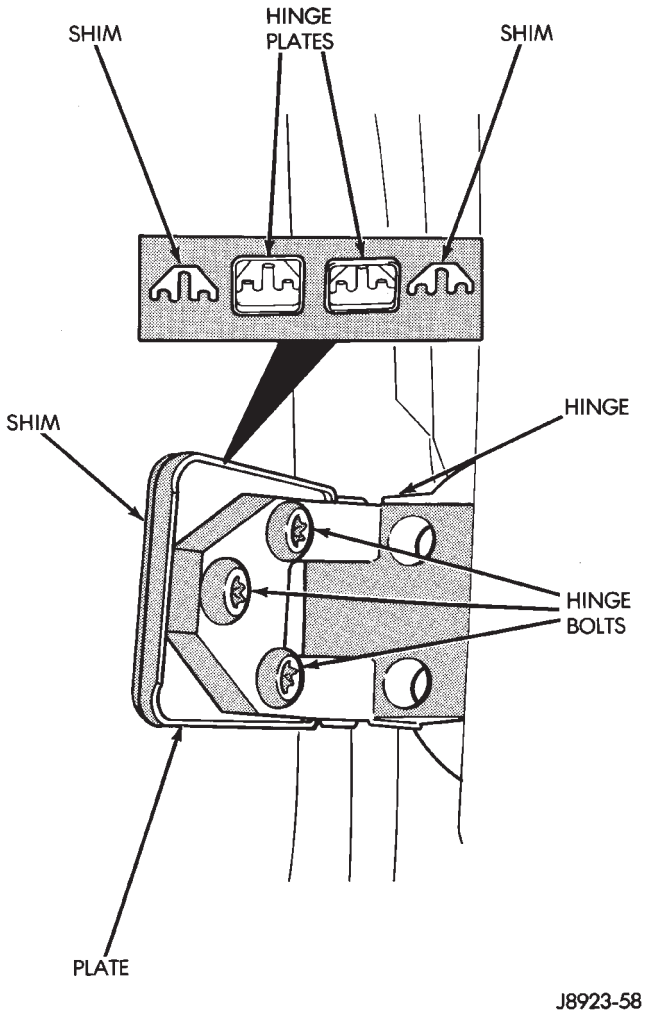


Fig. 30 Door Hinges, Bolts, Plates and Shims

INSTALLATION

(1) If a new front door is being installed, coat the door interior with anti-corrosion wax. Seal the door flange with sealant (Fig. 31).

(2) Before installing a replacement door, transfer original window glass, and components to replacement door.

(3) Position the door in the body opening.

(4) Align the door hinges, plates and shims with bolt holes and install the hinge bolts.

(5) Position the door restraint (check) in the bracket with the holes aligned and insert the pin. Tap the pin to seat it in the bracket.

(6) Align/adjust the door as necessary. Tighten the hinge bolts to 35 N·m (26 ft-lbs) torque.

(7) Apply general purpose sealant around the door hinges/door face mating area (Fig. 31).

(8) Adjust/align the latch striker and latch as necessary.

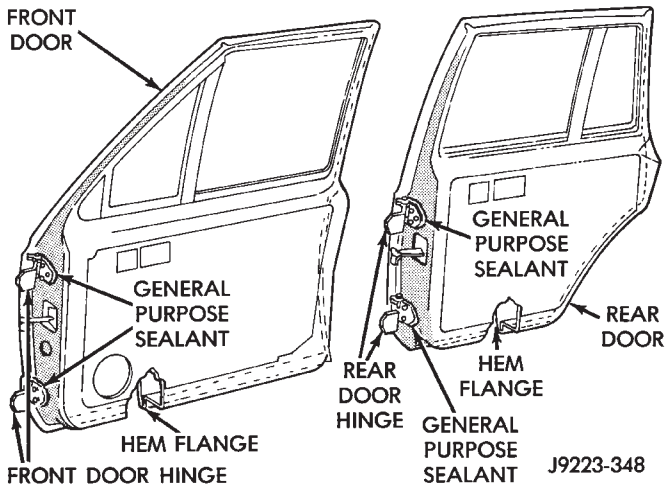


Fig. 31 Replacement Door Preparation

(9) If applicable, route and connect the wire harness connectors.

(10) Install the door waterdam (if removed), trim panel, armrest and regulator handle.

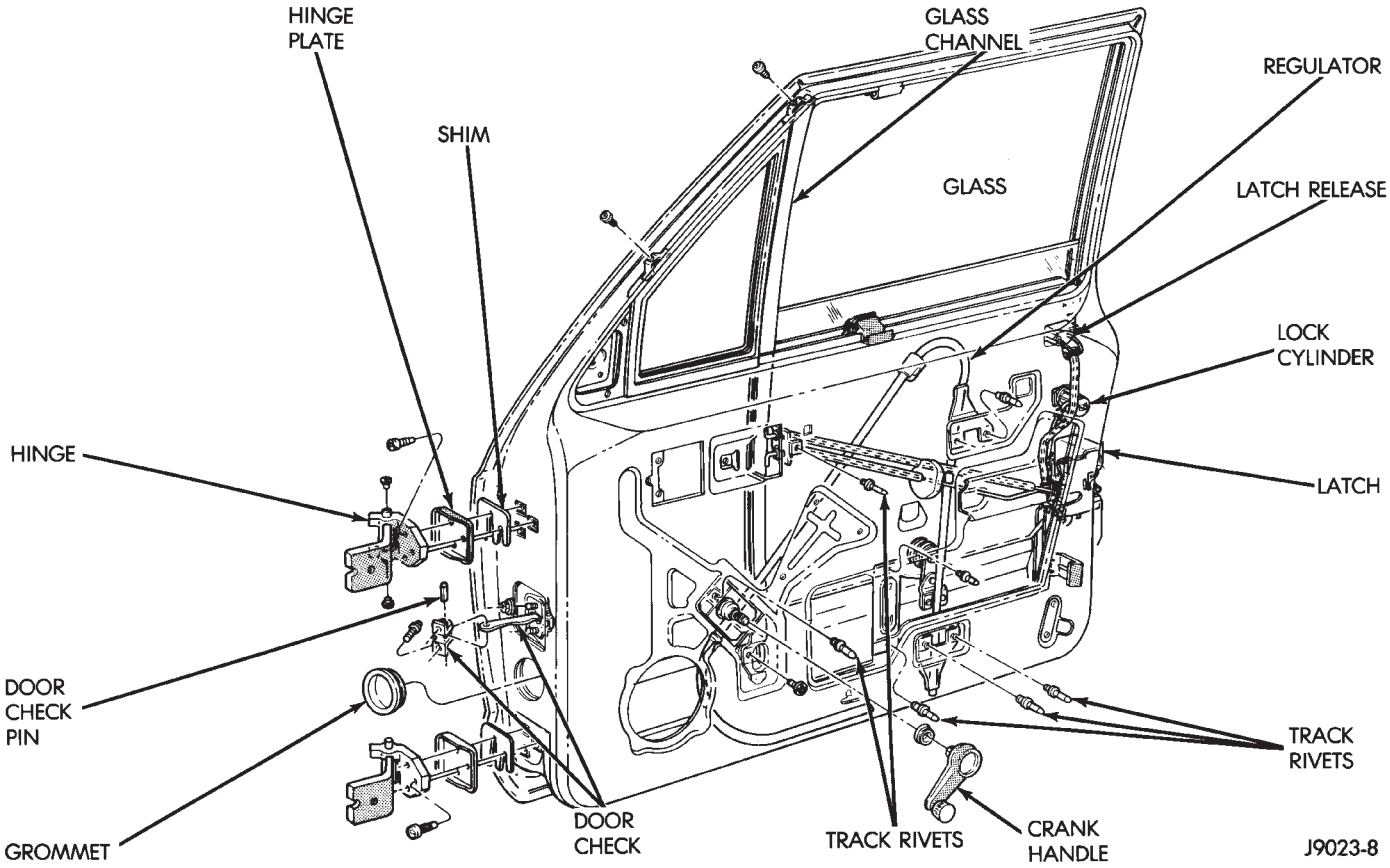


Fig. 32 Front Door Without Power Windows

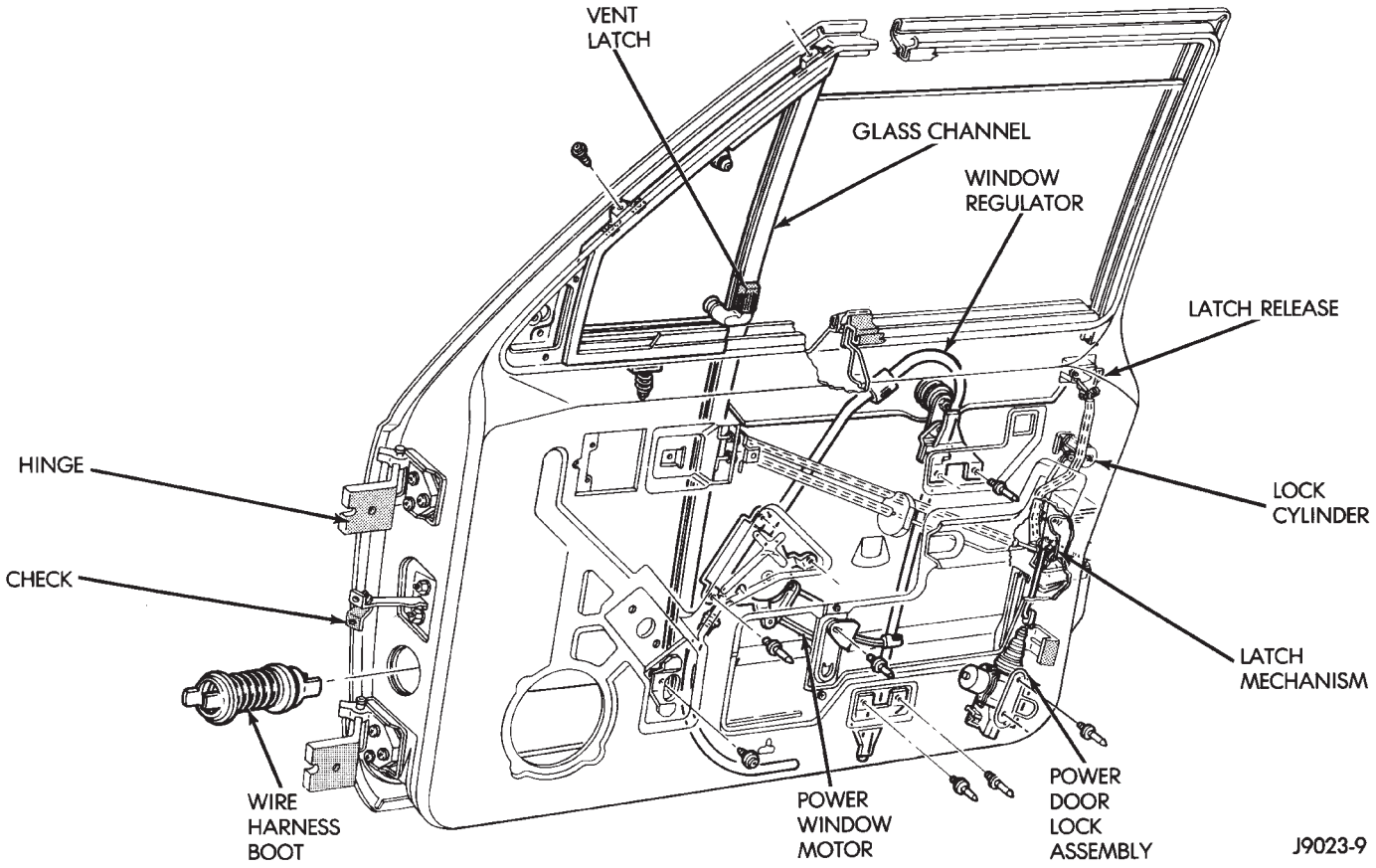


Fig. 33 Front Door With Power Windows

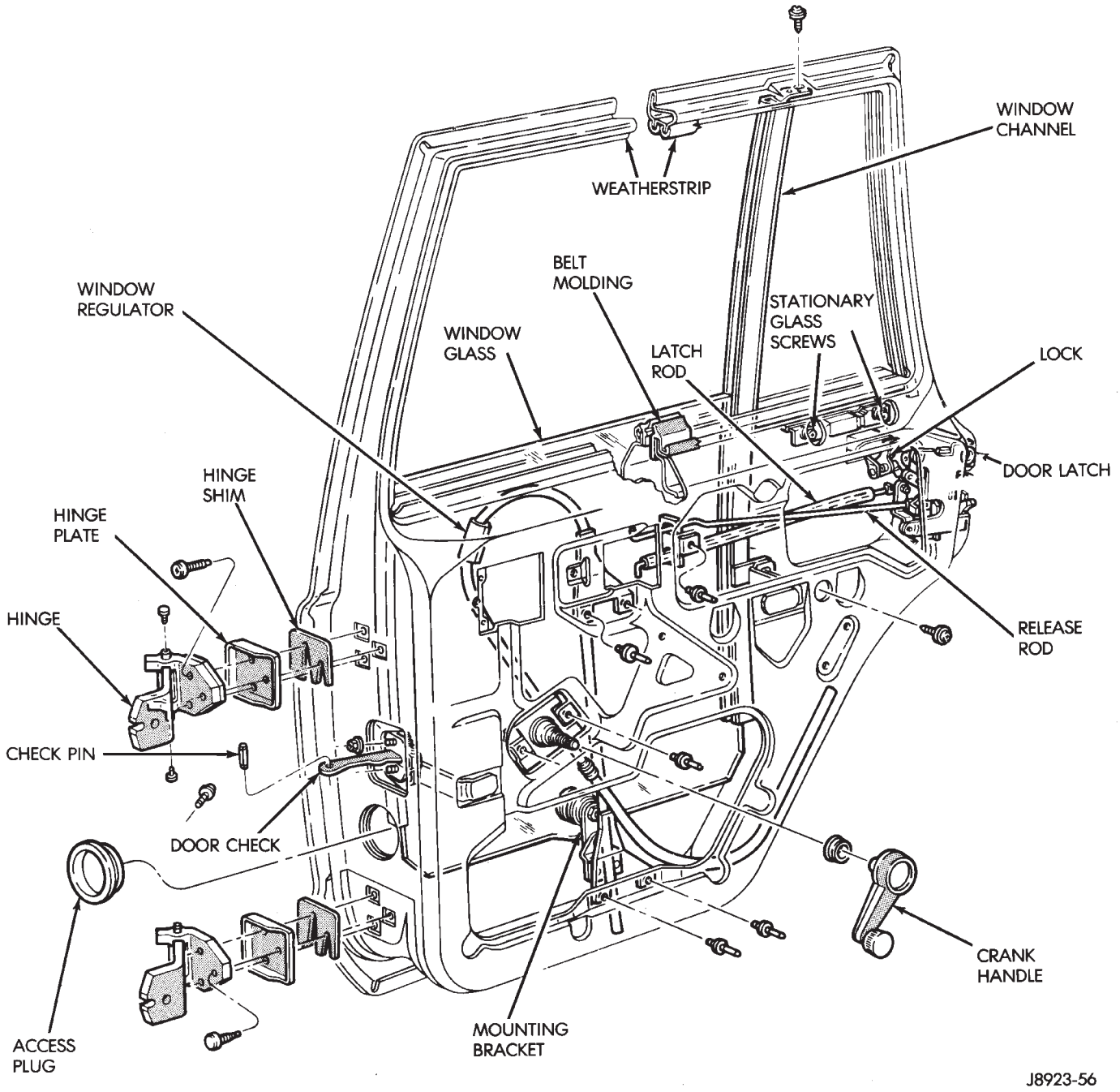


Fig. 34 Rear Door Without Power Windows

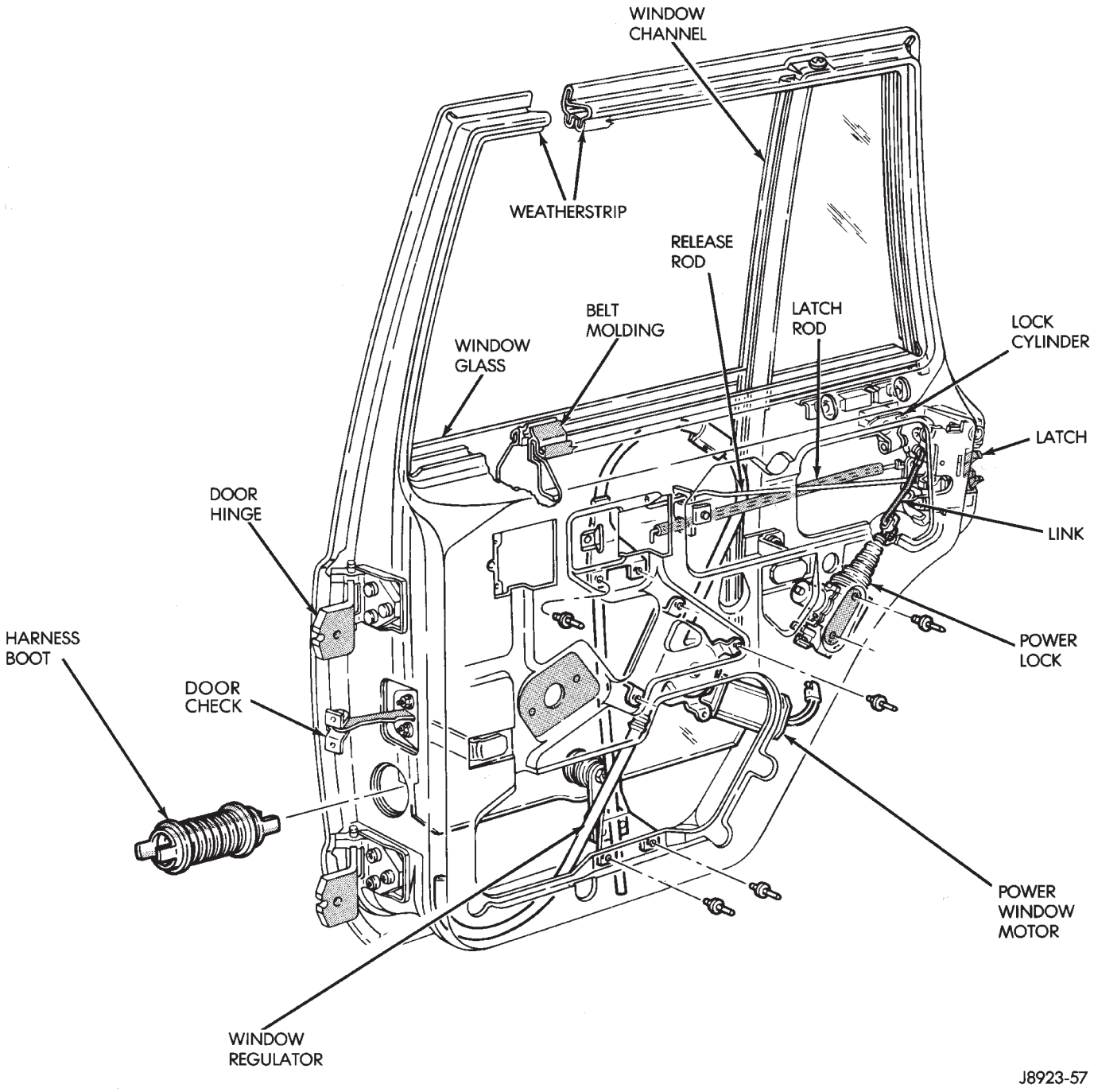
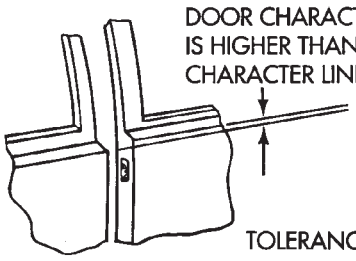
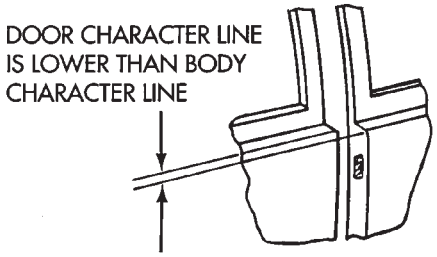
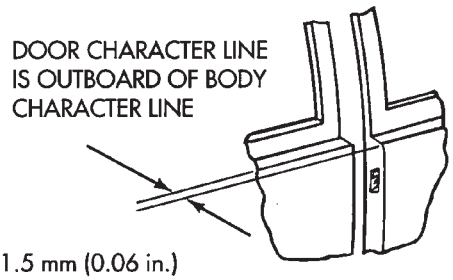
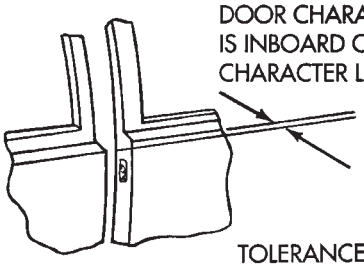


Fig. 35 Rear Door With Power Windows

DOOR ALIGNMENT ADJUSTMENT—MINOR

Minor adjustment for alignment of the door is made by moving the latch striker. Refer to Door Alignment (Minor) chart.

XJ DOOR ALIGNMENT—MINOR

DOOR/BODY ALIGNMENT CONDITION		ALIGNMENT CORRECTION
A.  TOLERANCE: 1.5 mm (0.06 in.)	1	Open the door and loosen the striker.
	2	Tap the striker downward a sufficient distance to correct mismatch.
	3	Tighten the striker and close the door.
	4	Observe the door/body alignment.
	5	If alignment is OK, open the door and tighten striker* with 71 N·m (52 ft. lbs.) torque.
	6	If alignment is not OK, adjust striker as described above.
B.  TOLERANCE: 1.5 mm (0.06 in.)	1	Open the door and loosen the striker.
	2	Tap the striker upward a sufficient distance to correct mismatch.
	3	Tighten the striker and close the door.
	4	Observe the door/body alignment.
	5	If alignment is OK, open the door and tighten the striker* with 71 N·m (52 ft. lbs.) torque.
	6	If alignment is not OK, adjust striker as described above.
C.  TOLERANCE: 1.5 mm (0.06 in.)	1	Open the door and loosen the striker.
	2	Tap the striker inward a sufficient distance to correct mismatch.
	3	Tighten the striker and close the door.
	4	Observe the door/body alignment.
	5	If alignment is OK, open the door and tighten the striker* with 71 N·m (52 ft. lbs.) torque.
	6	If alignment is not OK, adjust striker as described above.
D.  TOLERANCE: 1.5 mm (0.06 in.)	1	Open the door and loosen the striker.
	2	Tap the striker outward a sufficient distance to correct mismatch.
	3	Tighten the striker and close the door.
	4	Observe the door/body alignment.
	5	If alignment is OK, open the door and tighten the striker* with 71 N·m (52 ft. lbs.) torque.
	6	If alignment is not OK, adjust striker as described above.
	*The center line (℄) of the striker anti-snag tab must be horizontal (±6 mm/1/4 in.).	

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DOOR ALIGNMENT ADJUSTMENT—MAJOR

Adjustment for alignment of the door is made by installing shims between hinge plates and door face (Fig. 36).

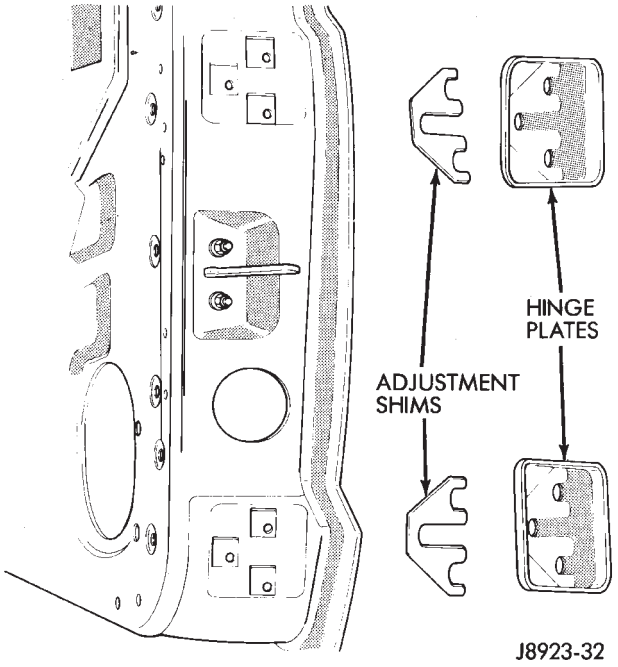

Fig. 36 Door Adjustment Shims

(1) If not loosened, loosen the door hinge bolts (Fig. 30).

(2) Add or remove shims as necessary to obtain the best door fit.

(3) Tighten door hinge bolts to 35 N·m (26 ft-lbs) torque after adjustment is completed.

(4) Apply general purpose sealant around the door hinges/door face mating area.

DOOR RESTRAINT REPLACEMENT

REMOVAL

(1) Remove the door trim panel.

(2) Front door: remove the door radio speaker from door inner panel.

(3) Remove the door restraint (check) retaining pin from the bracket with a punch (Fig. 37).

(4) Remove the nuts and remove the restraint via the speaker opening (front door) or access opening (rear door) in the door inner panel.

INSTALLATION

(1) Position the door restraint in the door by way of the opening and install the nuts. Tighten the nuts to 10 N·m (7 ft-lbs) torque.

(2) Position the door restraint in bracket with the holes aligned and insert the retaining pin (Fig. 37).

(3) Front door: install the radio speaker and door trim panel.

(4) Rear door: install the door trim panel.

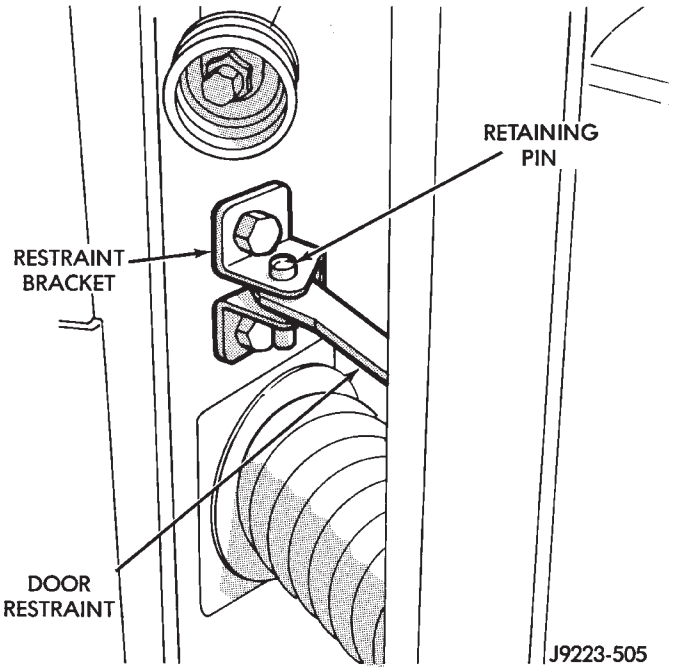

Fig. 37 Door Restraint (Check) Retaining Pin

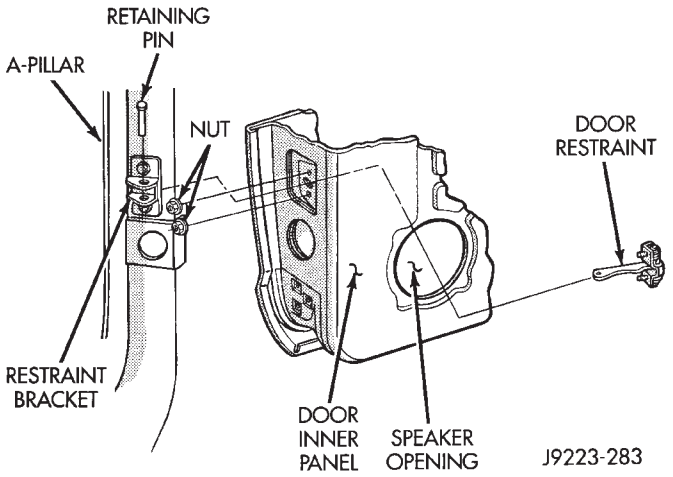

Fig. 38 Door Restraint (Check)—Front Door

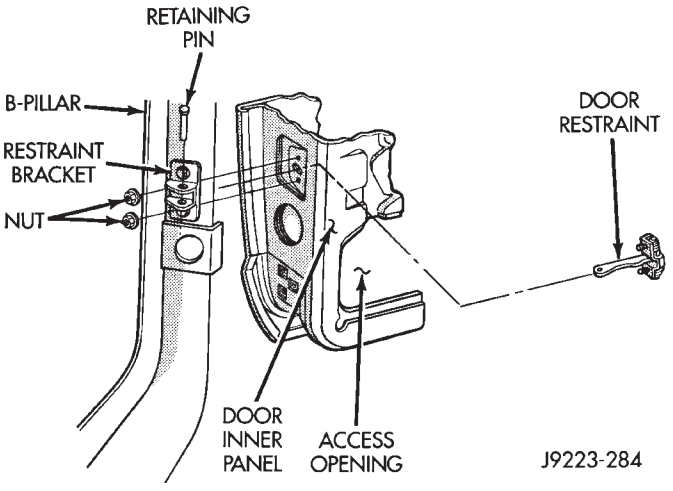

Fig. 39 Door Restraint (Check)—Rear Door

FRONT DOOR WINDOW GLASS REGULATOR

REMOVAL

(1) Remove the door trim panel and waterdam.

(2) Remove the window glass front channel bottom screw (Fig. 40).

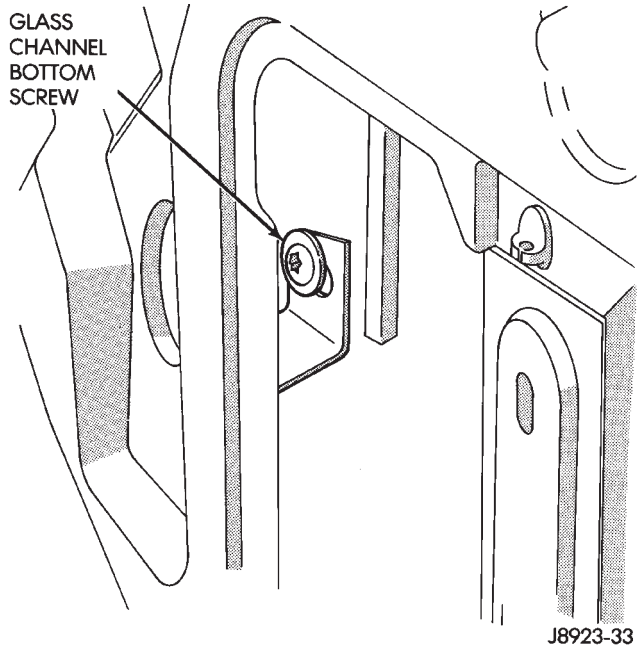

Fig. 40 Window Glass Front Channel Bottom Screw

(3) Remove the window regulator rivets by driving the rivet centers out with a punch. Remove the rivets with a 1/4-inch drill bit (Figs. 41 and 42).

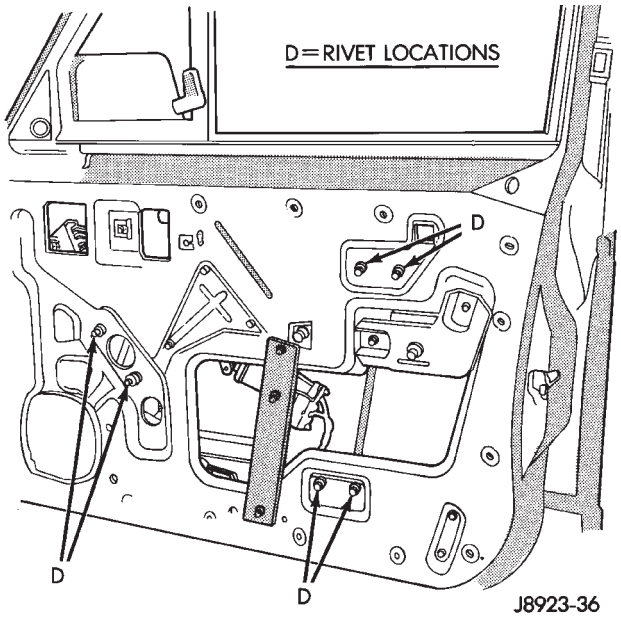

Fig. 41 Manual Window Regulator Rivets

(4) Lower the window to provide access to the regulator-to-glass screw.

(5) Remove the regulator-to-glass screw, bushing and retainer from the regulator (Fig. 43).

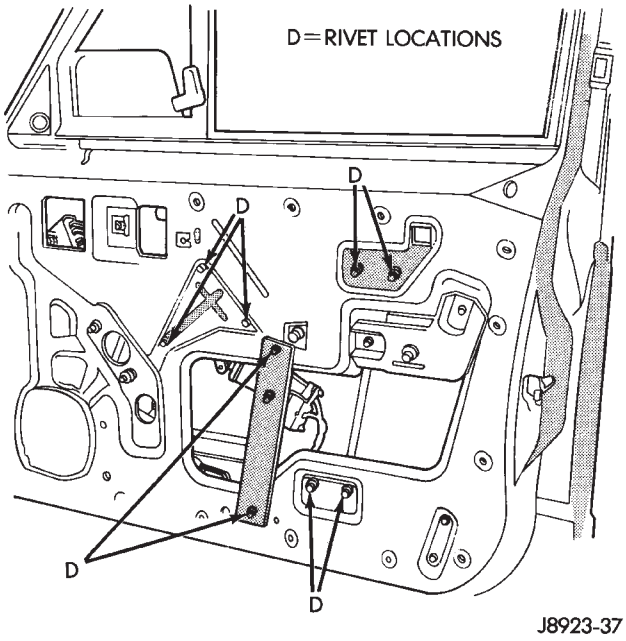

Fig. 42 Power Window Regulator Rivets

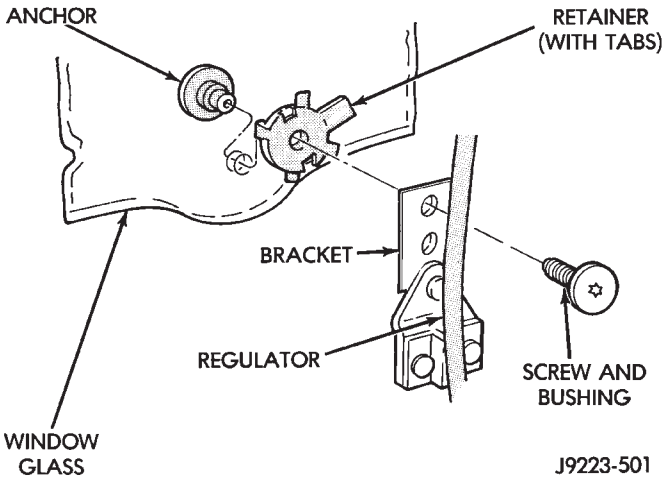

Fig. 43 Regulator-To-Glass Screw Removal/ Installation

(6) Lift the window glass upward and separate it from the regulator. Support the window glass.

(7) Remove the window glass regulator from the door.

INSTALLATION

(1) Position the window glass regulator within the door panels.

(2) Attach the regulator on door inner panel with replacement rivets or screws and nuts.

(3) Remove the support and position window glass at regulator. Install the regulator-to-window retainer, bushing and screw.

(4) Tighten the regulator-to-glass screw to 4 N·m (36 in-lbs) torque.

(5) Install the glass channel bottom screw (Fig. 40). Tighten screw to 9 N·m (7 ft-lbs) torque.

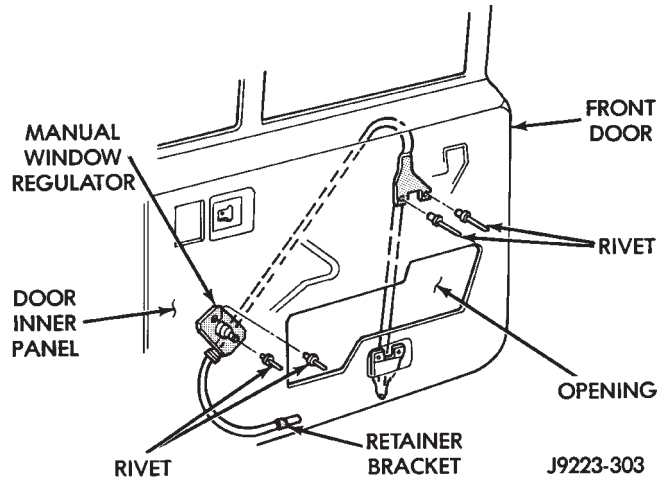

Fig. 44 Manual Regulator Installation—Upper Rivets

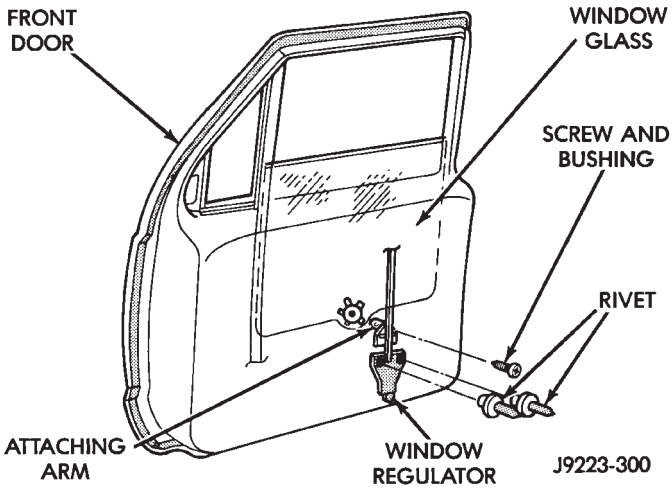

Fig. 45 Manual Regulator Installation—Lower Rivets and Glass Retaining Screw

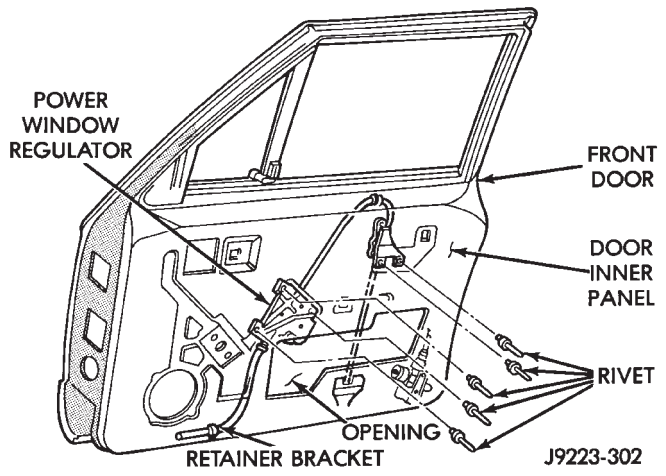

Fig. 46 Power Regulator Installation—Upper Rivets

(6) Attach the door waterdam to the door inner panel with sealant.

(7) Install the trim panel.

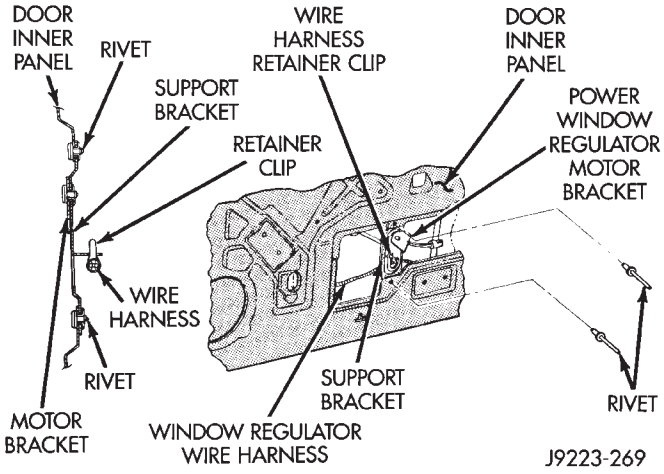

Fig. 47 Power Regulator Installation—Lower Rivets

FRONT DOOR WINDOW GLASS

REMOVAL

(1) Remove the door trim panel and waterdam.

(2) Remove the window glass channel hardware, beltline moulding and weatherstrip seals (Figs. 48 and 49).

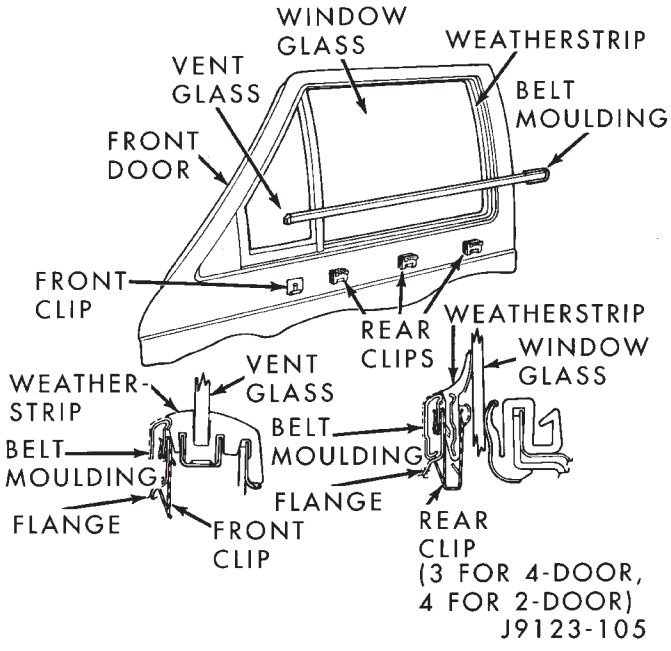

Fig. 48 Front Door Beltline Moulding and Weatherstrip Seals

(3) Remove the glass channel bottom screw.

(4) Remove the regulator-to-window glass screw, bushing and retainer (Fig. 43).

(5) Lift the glass upward and out of the door.

INSTALLATION

(1) Position the glass in the door and install the regulator-to-glass retainer, bushing and screw.

(2) Tighten the screw to 4 N·m (36 in-lbs) torque.

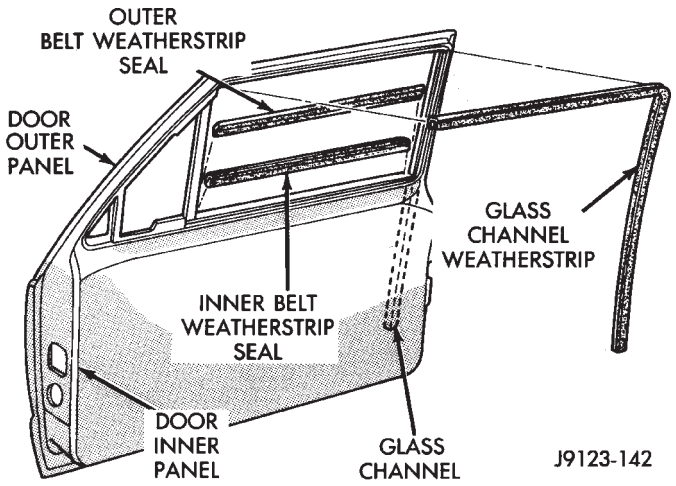

Fig. 49 Front Door Weatherstrip Seals

(3) Install the channel bottom screw. Tighten the screw to 9 N·m (7 ft-lbs) torque.

(4) Install the channel hardware, beltline moulding and weatherstrip seals.

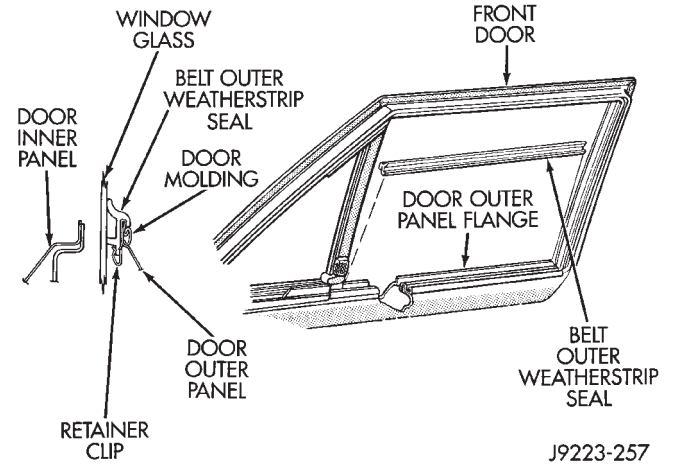

Fig. 50 Front Door Belt Outer Weatherstrip Seal

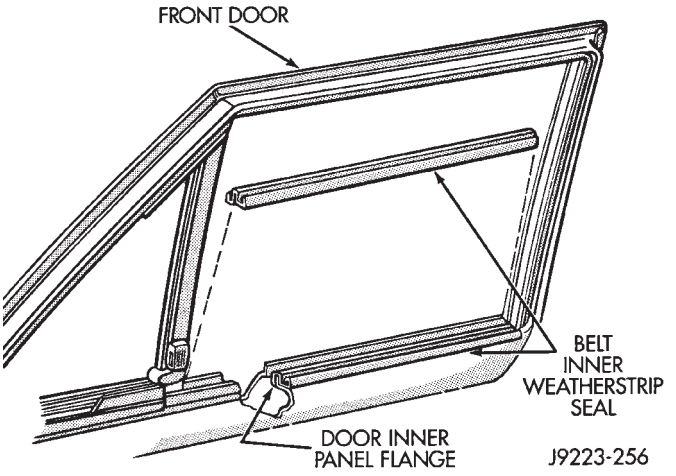

Fig. 51 Front Door Belt Outer Weatherstrip Seal

(5) Attach the door waterdam to the door inner panel with adhesive/sealant.

(6) Install the door trim panel.

FRONT DOOR VENT WINDOW

REMOVAL

(1) Remove the door trim panel and waterdam.

(2) Remove the window glass channel bottom screw.

(3) Remove the vent window glass frame screws (Fig. 52).

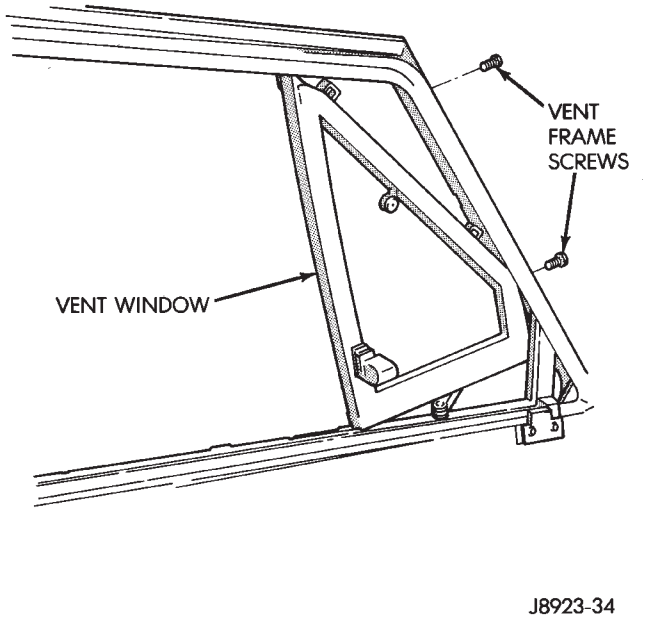

Fig. 52 Vent Window Glass Frame Screws

(4) Tilt the vent window glass frame and front channel rearward, and remove both as a unit (Fig. 52).

(5) Remove the vent window glass latch pin and latch (Fig. 53).

(6) Remove the glass hinge screw.

(7) Remove the pivot nut and the spring.

(8) Remove the vent window glass from the frame.

INSTALLATION

(1) Position the vent window glass in the frame and install the hinge screw, spring and pivot nut (Fig. 53).

(2) Install the window glass latch and pin.

(3) Install the vent window glass and the channel in the door (Fig. 54).

(4) Install the vent window glass frame screws (Fig. 54).

(5) Install the door window glass channel bottom screw.

(6) Install the door waterdam and trim panel.

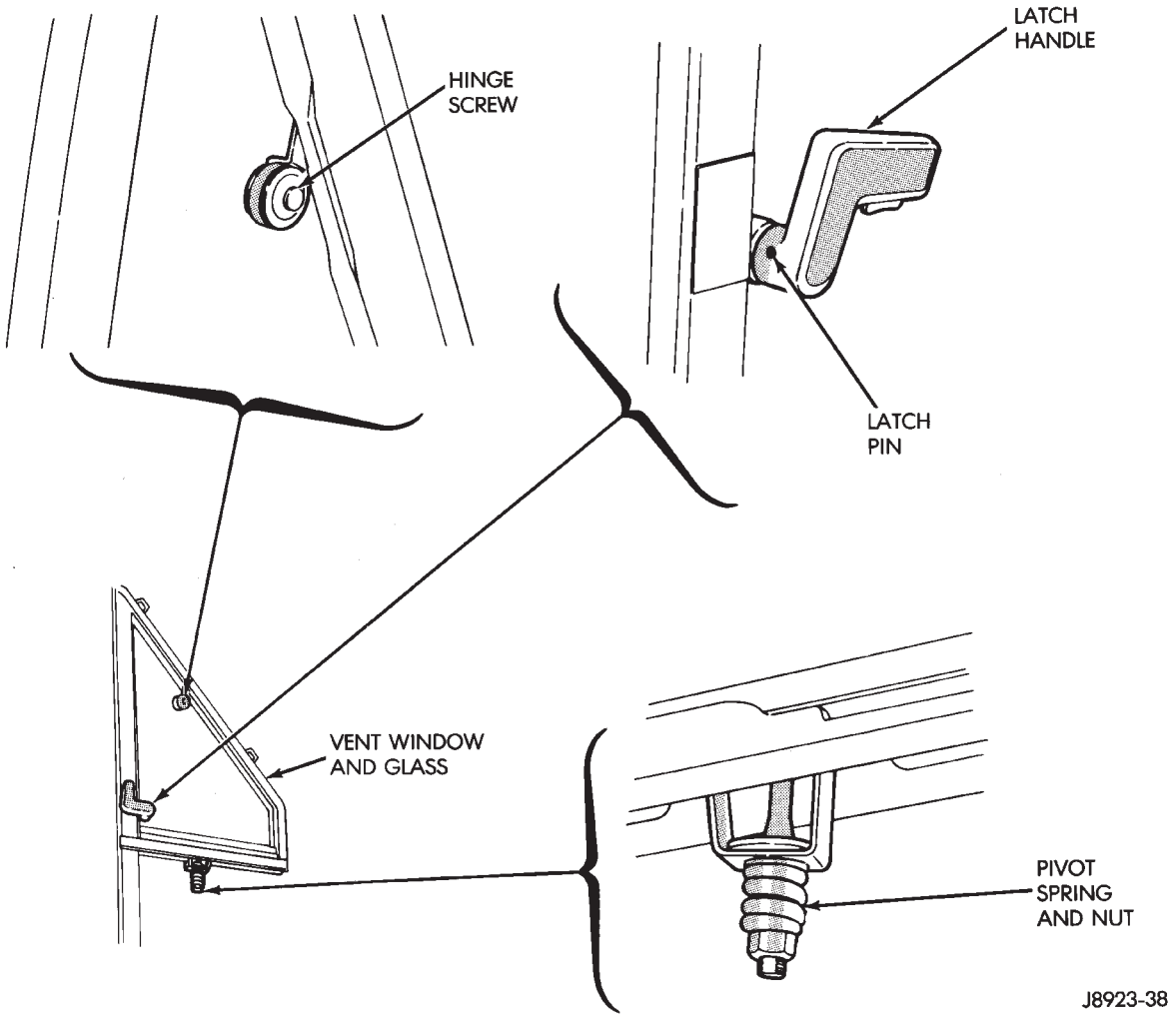

Fig. 53 Vent Window Glass Disassembly/Assembly

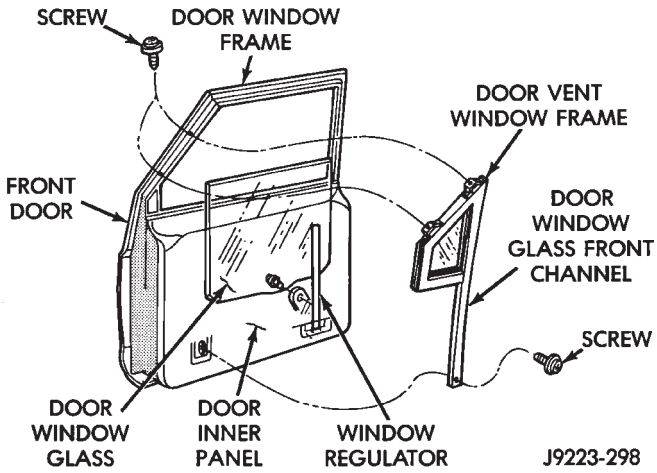

Fig. 54 Vent Window Frame and Front Channel Installation

REAR DOOR WINDOW GLASS REGULATOR

REMOVAL

(1) Remove the door trim panel and waterdam.

(2) Remove the window glass attaching screw, bushing and retainer from the regulator (Fig. 55). Support the glass.

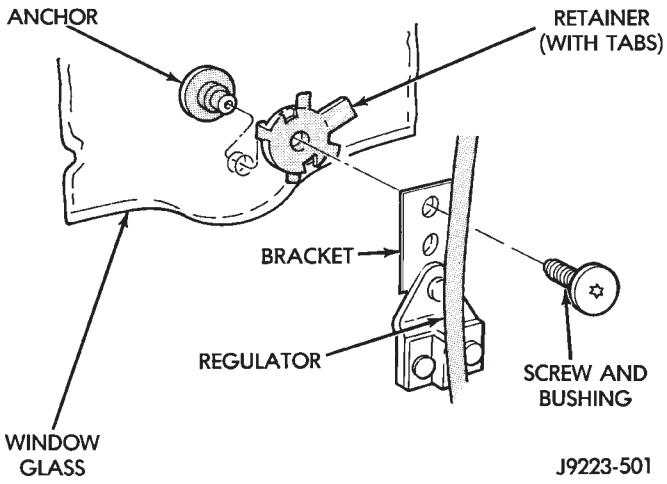

Fig. 55 Regulator-To-Glass Screw Removal/Installation

(3) Remove the regulator rivets by driving out the rivet center with a punch. Next, drill out the rivet body with a 1/4 inch diameter drill bit (Fig. 56).

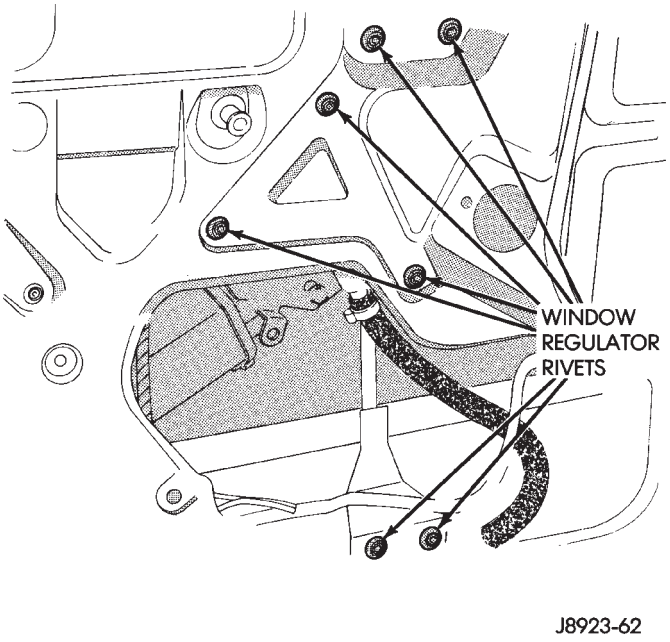

Fig. 56 Rear Door Window Regulator Rivets

(4) Power window: disconnect the wire harness connector from the regulator drive motor.

(5) Remove the regulator and drive motor, if equipped.

INSTALLATION

(1) Position window regulator and, if equipped, drive motor within the door panels.

(2) Attach the regulator to door inner panel with replacement rivets or with screws and nuts.

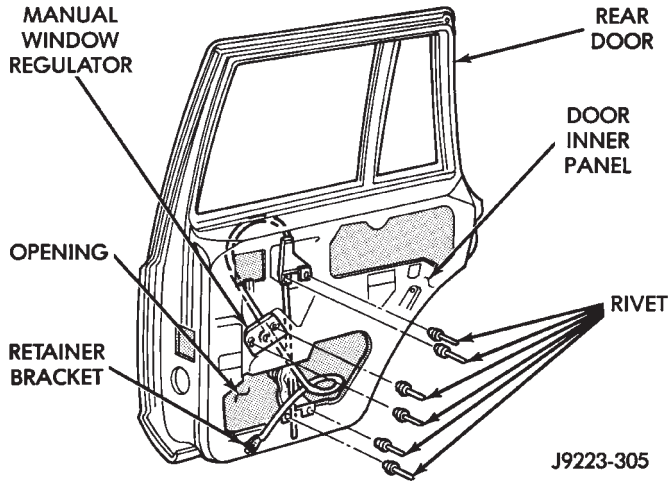

Fig. 57 Manual Regulator Rivet Installation

(3) Connect the regulator wire harness connector.

(4) Position the window glass at the regulator and install the retainer, bushing and screw.

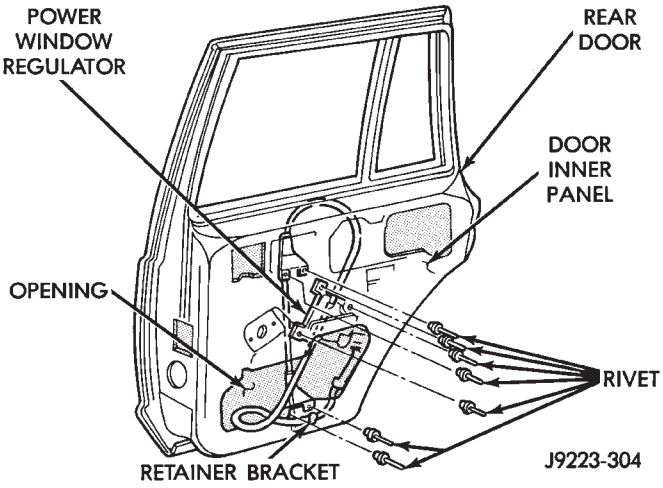

Fig. 58 Power Regulator Rivet Installation

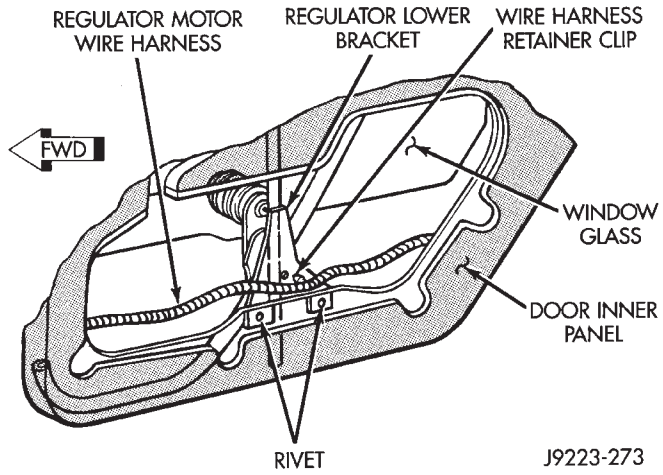

Fig. 59 Power Regulator Lower Bracket Rivet Installation

(5) Tighten the glass screw to 4 N·m (36 in-lbs) torque.

(6) Install the waterdam and trim panel.

REAR DOOR WINDOW GLASS

REMOVAL

(1) Lower the window glass.

(2) Pry the window beltline moulding from the clips and remove the moulding from the door.

(3) Remove the window weatherstrip seals from the door (Fig. 60).

(4) Remove the trim panel and waterdam from the door inner panel.

(5) Remove the channel/division bar screws and drill-out the rivet head to remove.

(6) Tilt the channel/division bar forward and remove it from the door.

(7) Remove the window glass screw, bushing and retainer from the regulator (Fig. 63).

(8) Remove the window glass from door.

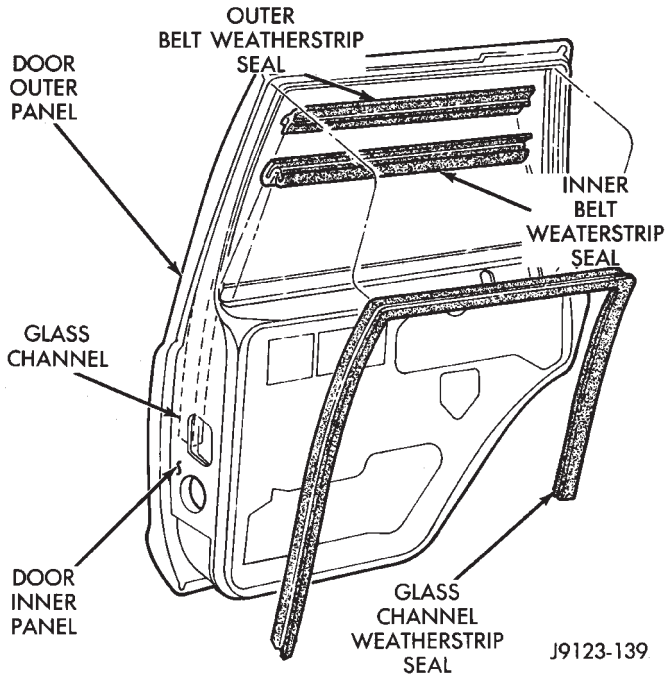

Fig. 60 Rear Door Window Weatherstrip Seals

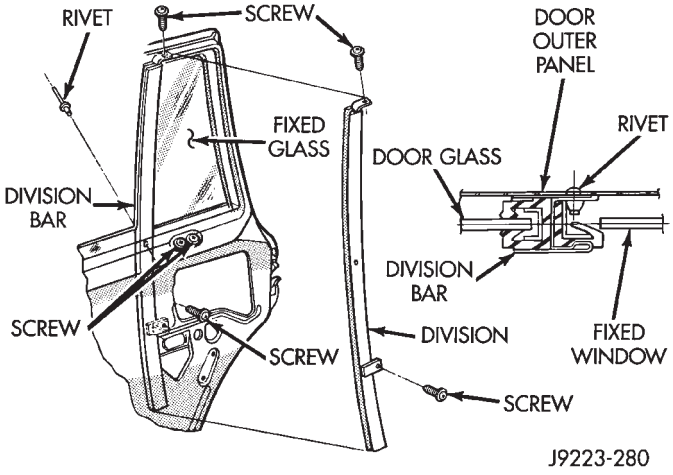

Fig. 61 Window Channel/Division Bar Screws and Rivet

INSTALLATION

(1) Install the glass in the door, and install the retainer, bushing and screw (Fig. 63).

(2) Tighten the glass attaching screw 6 N·m (53 in-lbs) torque.

(3) Install the window glass channel/division bar in the door.

(4) Install the window glass channel/division bar screws and rivet. Tighten the screws to 6 N·m (5 ft-lbs) torque.

(5) Install the window glass channel and belt weatherstrip seals.

(6) Install the window beltline moulding.

(7) Install the door waterdam and trim panel.

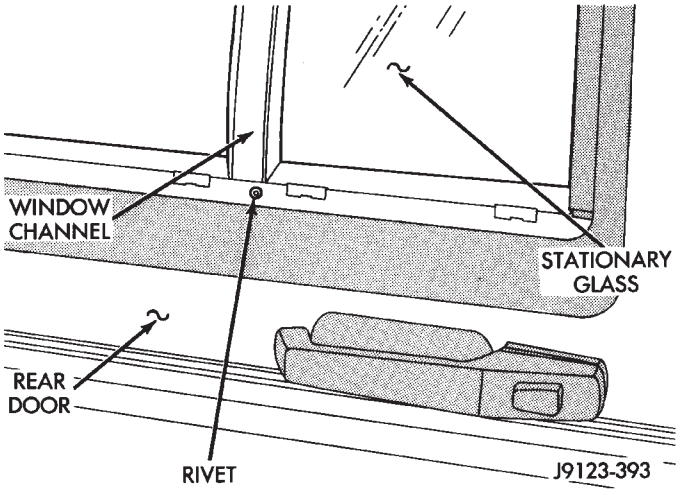

Fig. 62 Window Channel/Division Bar Rivet

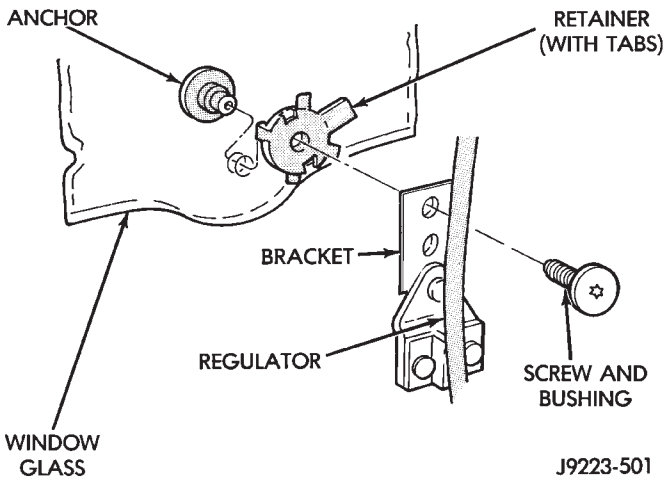

Fig. 63 Regulator-To-Glass Screw Removal/Installation

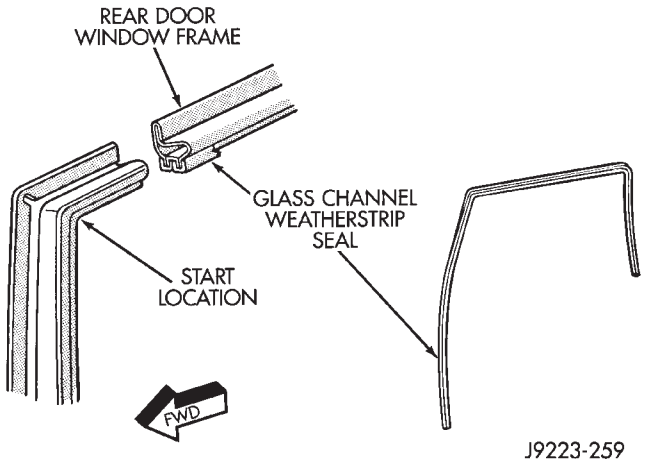

Fig. 64 Glass Channel Weatherstrip Seal

REAR DOOR FIXED WINDOW GLASS

REMOVAL

(1) Lower the window glass.

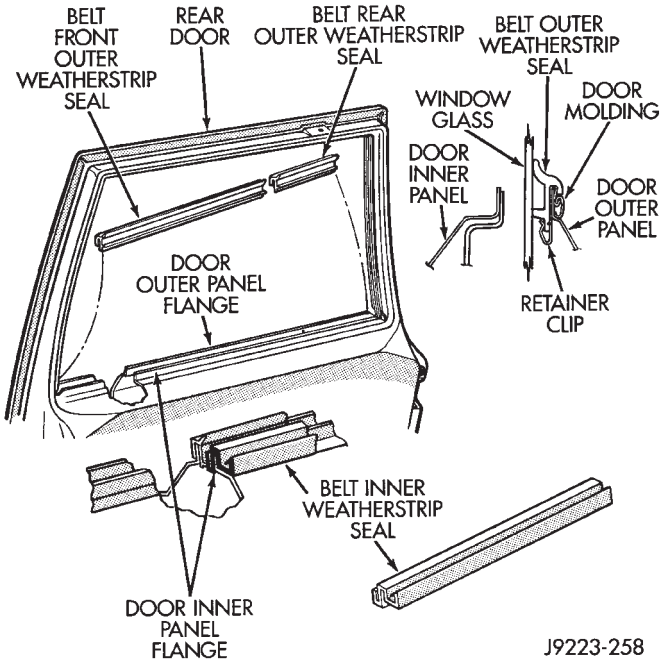

Fig. 65 Belt Weatherstrip Seals

(2) Pry the window beltline moulding away from the clips and remove the moulding from the door.

(3) Remove the window weatherstrip seals from the door.

(4) Remove the trim panel and waterdam from door inner panel.

(5) Remove the channel/division bar screws. Drill out the rivet head to remove it from the inner panel.

(6) Tilt the channel/division bar forward and remove it from the door.

(7) Remove the fixed glass support bracket bolts from the door inner panel reinforcement bracket (Fig. 66).

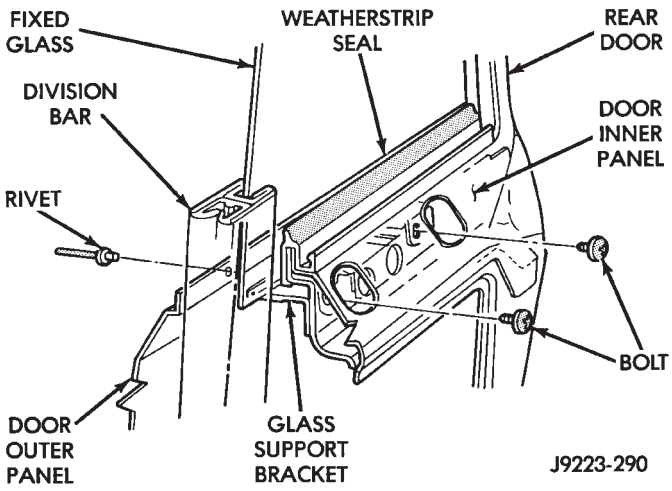

Fig. 66 Fixed Glass Support Bracket Bolts

(8) Remove the fixed glass from the door (Fig. 67).

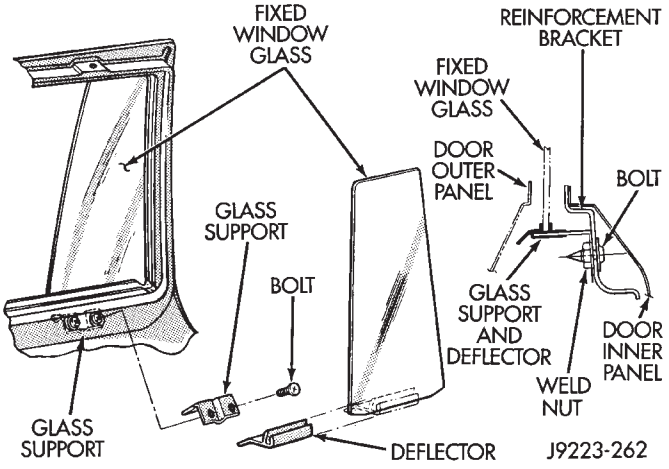

Fig. 67 Fixed Glass Removal/Installation

INSTALLATION

(1) Install the fixed glass in the door, and install the bolts in the reinforcement and support brackets.

(2) Tighten the bracket retaining bolts to 9 N·m (79 in-lbs) torque.

(3) Install the channel/division bar in the door.

(4) Install the channel/division bar screws and rivet. Tighten the screws to 6 N·m (5 ft-lbs) torque.

(5) Install the channel and belt weatherstrip seals.

(6) Install the beltline moulding.

(7) Install the door waterdam and trim panel.

DOOR KEY LOCK CYLINDER

REMOVAL

(1) Remove the door trim panel and waterdam.

(2) Disconnect the door latch-to-lock cylinder rod at the door latch (Fig. 68).

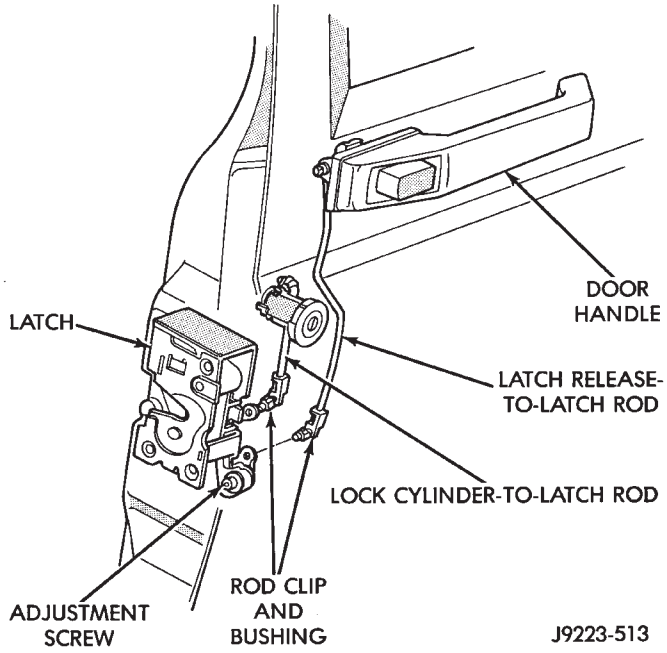

Fig. 68 Key Lock Cylinder and Door Latch

(3) If equipped, disconnect the security alarm switch connector from the lock cylinder (Fig. 69).

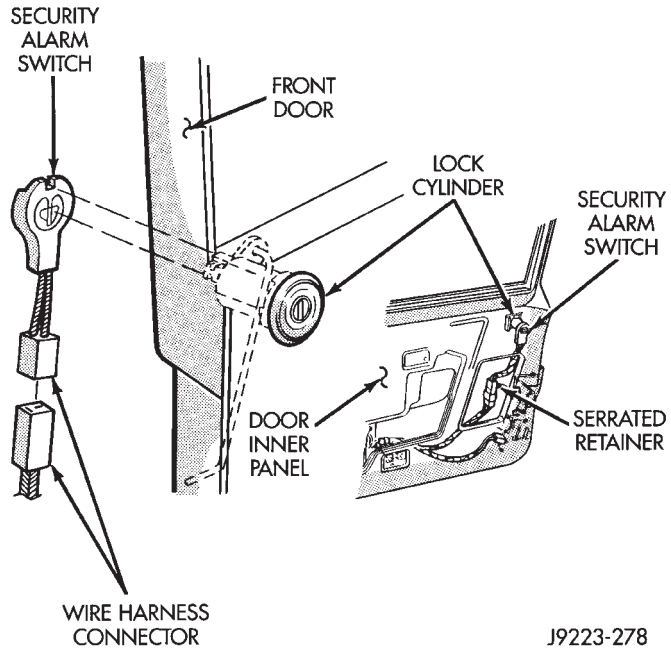

Fig. 69 Security Alarm Switch

(4) Remove the key lock cylinder retainer clip. Remove the lock cylinder, gasket and clip from the door opening (Fig. 70).

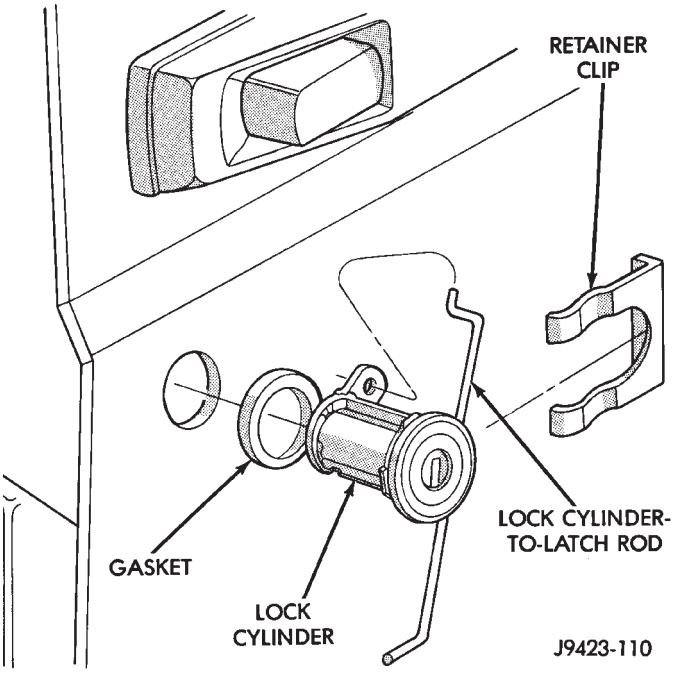

Fig. 70 Key Lock Cylinder Removal/Installation

(5) If applicable, remove the door latch-to-lock cylinder rod from the original lock cylinder. Connect it to the replacement lock cylinder.

INSTALLATION

(1) Position the lock cylinder and gasket in the door opening. Hold the lock cylinder in the opening with the retainer clip.

(2) Connect the door latch-to-lock cylinder rod to the door latch.

(3) If equipped, connect the security alarm switch connector to the lock cylinder.

(4) Test and, if necessary, adjust the door latch-to-lock cylinder rod operation.

(5) Install the door trim panel and waterdam.

(6) Adjust the door latch as described in DOOR LATCH ADJUSTMENT.

DOOR LATCH ADJUSTMENT

(1) Remove the access hole plug from the latch face (Fig. 71).

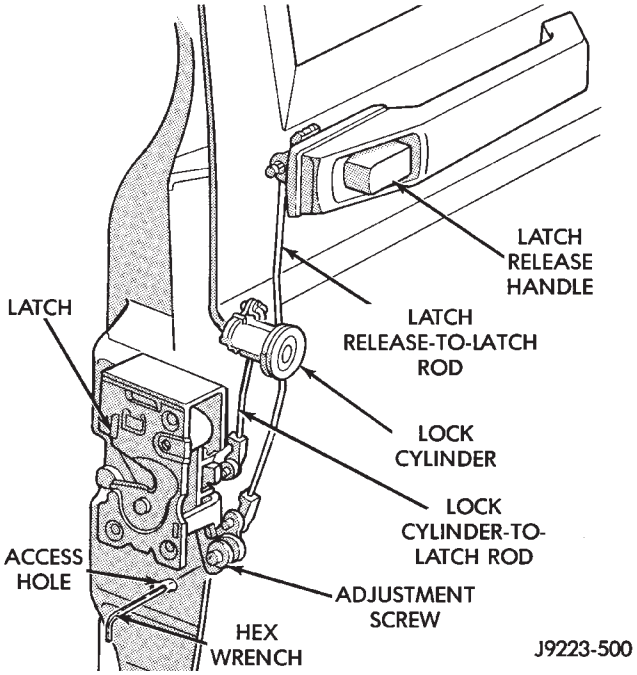

Fig. 71 Door Latch Adjustment

(2) Insert a 5/32-inch wrench through the hole and into the latch release lever adjustment screw and loosen.

(3) Press and release the outside door handle latch release button several times.

(4) Release the button and tighten adjustment screw to 3 N·m (30 in-lbs) torque.

(5) Test the release handle button and key lock cylinder for proper latch release.

(6) Install the door waterdam and trim panel.

DOOR EXTERNAL HANDLE

REMOVAL

(1) Remove the door trim panel and waterdam.

(2) Remove the access hole cover and remove the door handle nuts (Fig. 72).

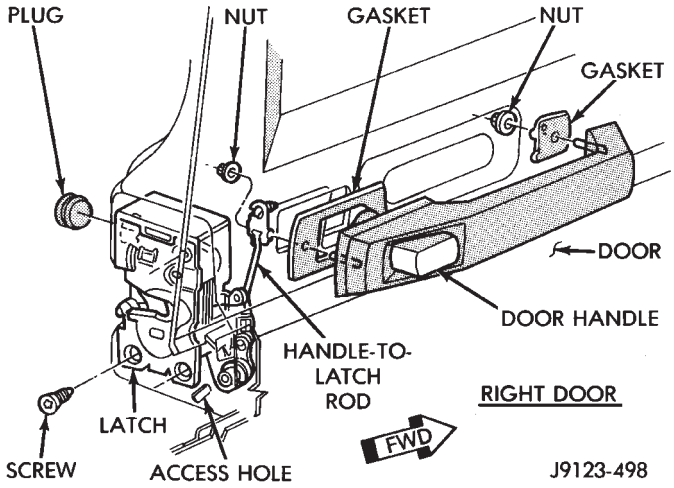

Fig. 72 Door External Handle Removal/Installation

(3) Disconnect the handle-to-latch rod from the handle latch release lever arm.

(4) Remove the nuts and handle from the door.

(5) Remove the gaskets from the door outer panel surface, if necessary.

INSTALLATION

(1) Assemble the replacement door handle, if necessary (Fig. 73). Apply silicone spray lubricant to the components.

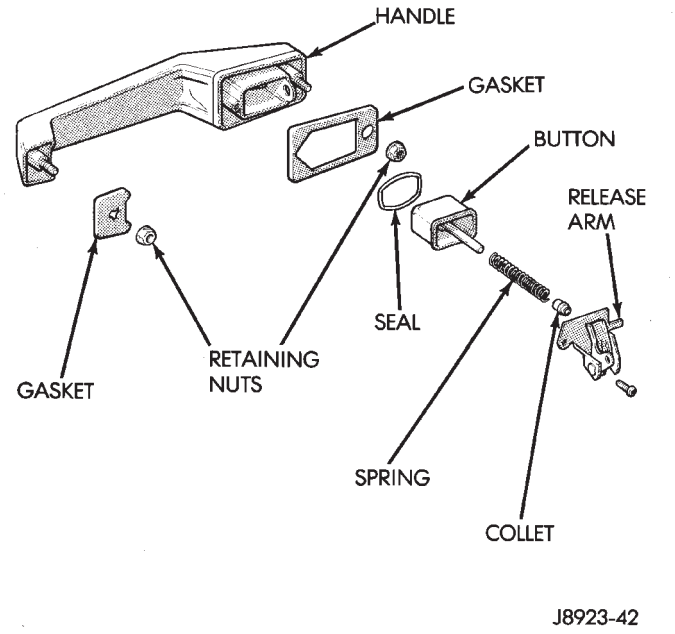

Fig. 73 Door Handle Components

(2) If the original gaskets were removed, position the replacement gaskets on the handle. Position the handle on the door outer panel.

(3) Install and tighten the handle nuts.

(4) Connect the latch-to-handle rod to the handle latch release lever arm.

(5) Install the door waterdam and trim panel.

(6) Adjust the door latch as described in DOOR LATCH ADJUSTMENT.

DOOR LATCH

REMOVAL

(1) Remove the access plug located at the upper end of the door (Fig. 74).

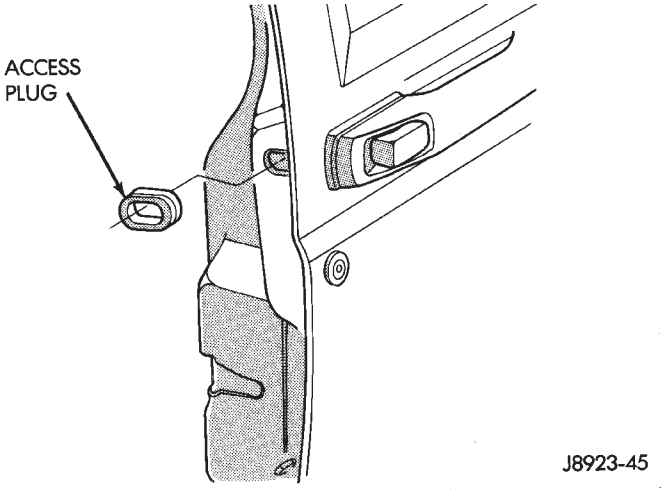

Fig. 74 Access Plug

(2) Remove the door trim panel and waterdam.

(3) Remove the door external handle from the door outer panel.

(4) Remove the door latch screws (Fig. 75).

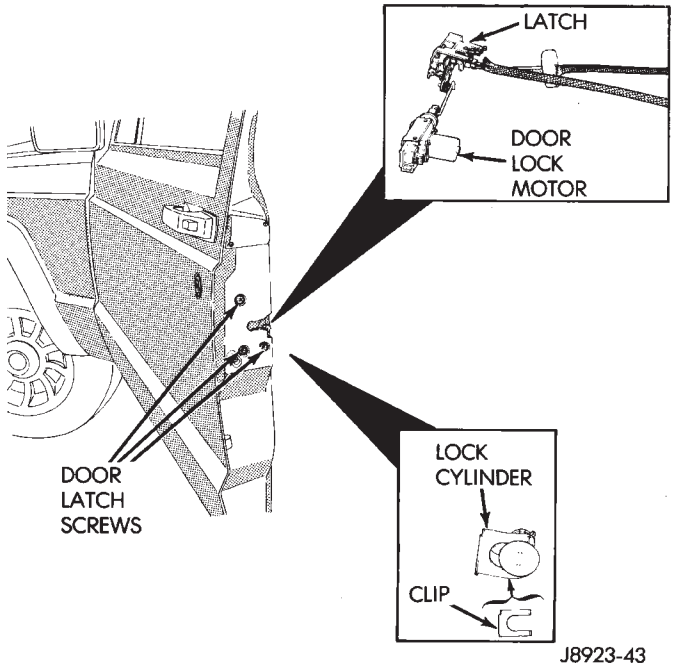

Fig. 75 Door Latch Retaining Screws

(5) Remove the retainer clip and key lock cylinder from the door outer panel.

(6) Disconnect all the rods from the door latch (Fig. 76).

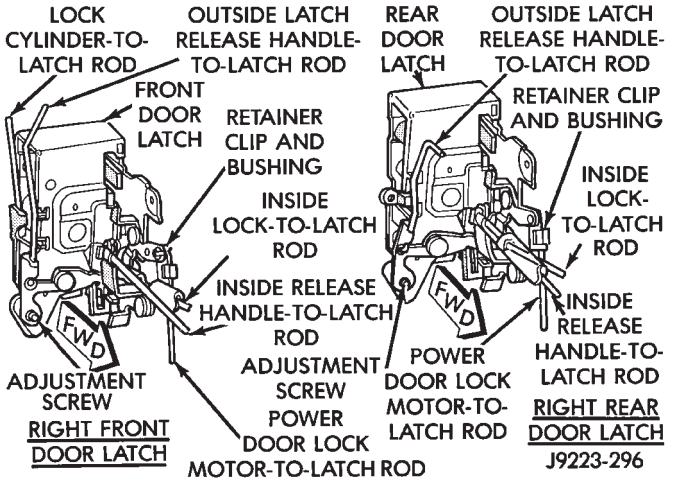

Fig. 76 Door Latches

(7) Remove the door latch from the door face.

(8) For vehicles equipped with power door locks, remove the lock motor rivets. Remove the motor and latch as a unit from the door. Detach the rod and motor from the latch (Fig. 77).

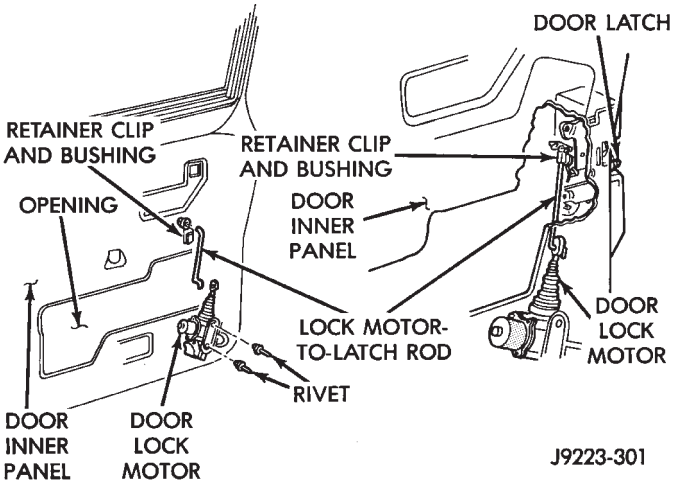

Fig. 77 Door Lock Motor

INSTALLATION

(1) If necessary, install a replacement latch striker.

(2) For vehicles equipped with power door locks, attach the rod and lock motor to the latch. Attach the lock motor to the door panel with either rivets or with bolts and nuts (Fig. 77).

(3) Install the door latch at the door face and connect all the rods to the latch (Fig. 76).

(4) Install the latch screws. Tighten the screws to 9 N·m (77 in-lbs) torque.

(5) Install the external handle.

(6) Install the latch-to-door handle rod.

(7) Install the key lock cylinder and retainer clip.

(8) Install the door waterdam and trim panel.

(9) Install the door access plug.

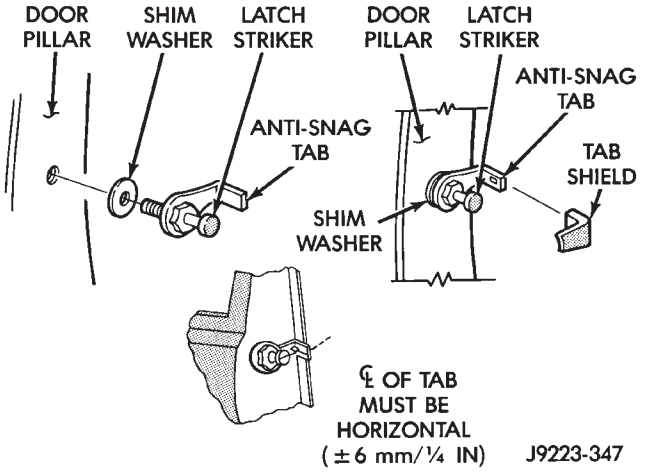

Fig. 78 Door Latch Striker Removal/Installation

(10) Adjust the door latch as described in DOOR LATCH ADJUSTMENT.

DOOR INSIDE LATCH RELEASE AND LOCK RODS

REMOVAL

(1) Remove the door inside latch release handle screws (Figs. 79 and 80).

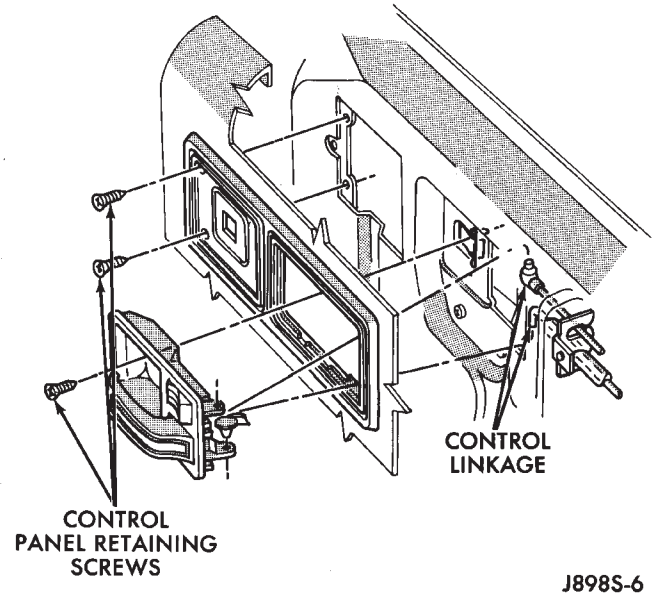

Fig. 79 Front Door Inside Latch Release Handle

(2) Move the door release handle outward and disconnect the handle-to-latch rods (Fig. 81). For vehicles equipped with power door locks/windows, also disconnect the wire harness connector (Fig. 82).

(3) Remove the door trim panel and waterdam.

(4) Drill-out the rivet heads and remove the rod guide bracket rivets from the door inner panel (Figs. 83 and 84).

(5) Remove the rod guide brackets and rods from the door.

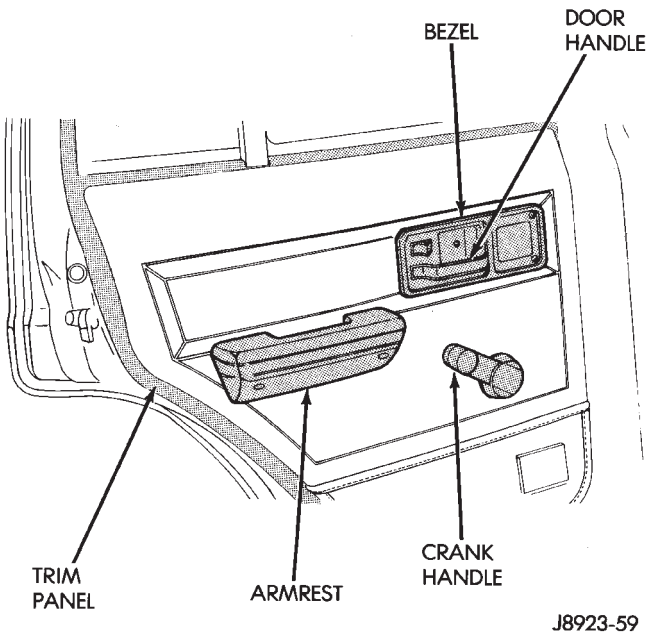

Fig. 80 Rear Door Inside Latch Release Handle

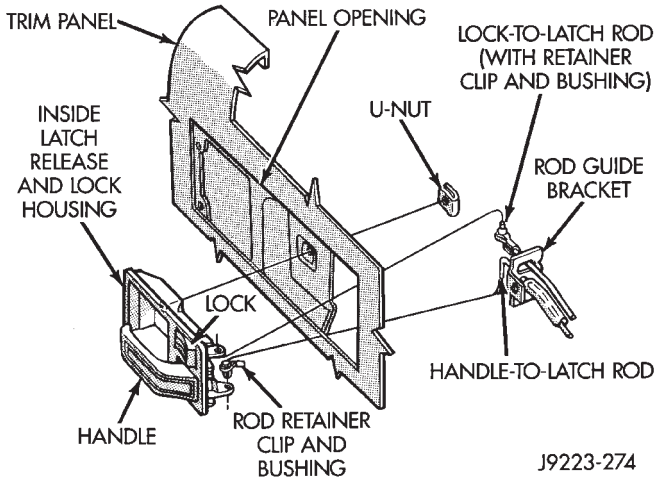

Fig. 81 Door Inside Latch Release Rods

INSTALLATION

(1) Position the rod guide brackets and rods in the door.

(2) Install rod the guide bracket rivets in the door inner panel (Fig. 85).

(3) Install the door trim panel and waterdam.

(4) Adjust the door latch as described in DOOR LATCH ADJUSTMENT.

DOOR HINGE/HINGE PIN REPLACEMENT

REMOVAL

(1) Remove the door restraint (check) retaining pin (Fig. 86) with a punch.

(2) Front door: open the door wide for access and remove the door hinge pin and bushing with a punch.

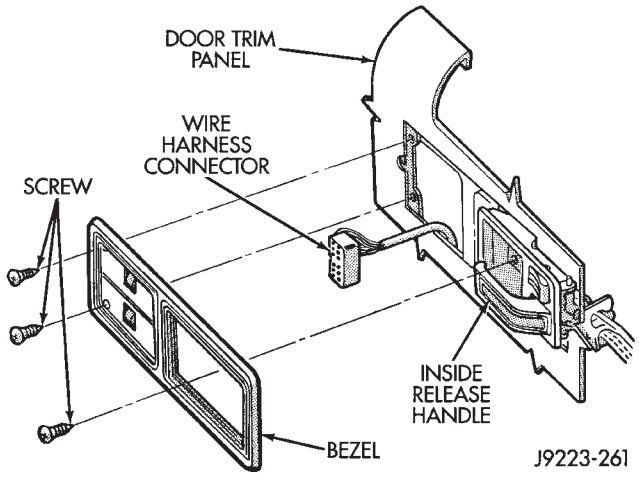

Fig. 82 Power Switch Wire Harness Connector

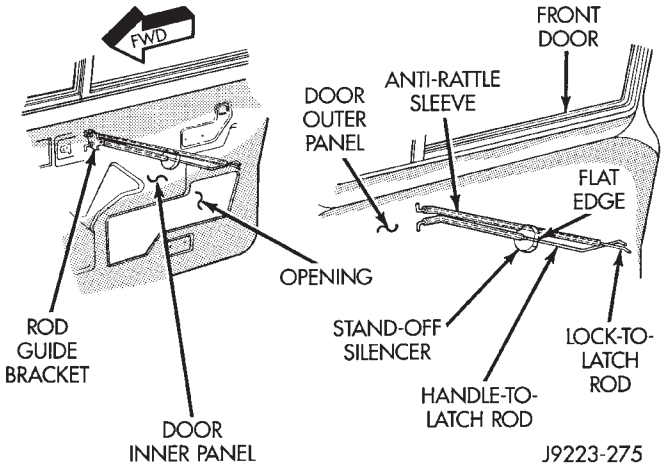

Fig. 83 Front Door Rod Guide Bracket and Rods

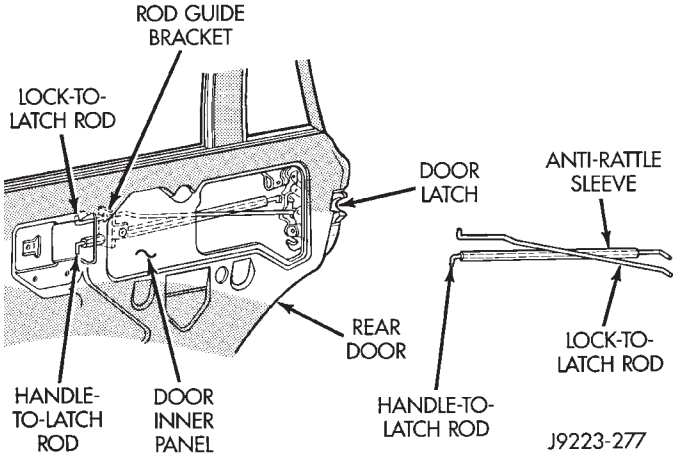

Fig. 84 Rear Door Rod Guide Bracket and Rods

(3) Rear door: with the door closed, remove the door hinge pin and bushing with a punch (Fig. 87).

(4) Remove the door hinge bolts, plates and shims (Fig. 88).

(5) Retain the door hinge plates and shims for correct installation.

(6) Separate the hinge halves.

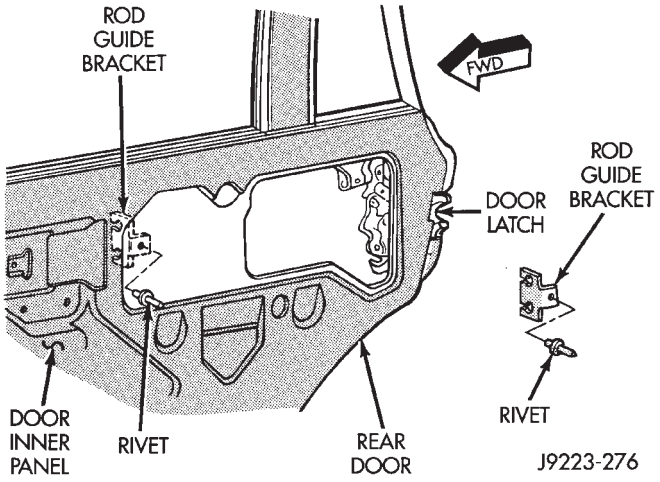

Fig. 85 Rod Guide Bracket Installation

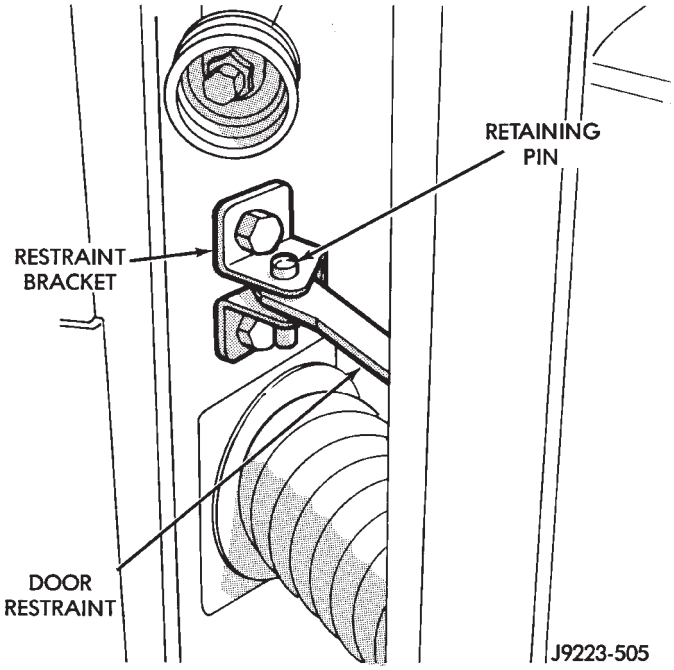

Fig. 86 Door Restraint (Check) Retaining Pin

INSTALLATION

(1) Position the hinge plates, shims and replacement hinge-half on the door face.

(2) Align the door hinges, plates and shims with bolt holes and install hinge bolts (Fig. 88).

(3) Insert a bushing in both body hinge halves from the bottom (Fig. 89).

(4) Allow the bushing material to stick out of the top of the hinge. Use the round end of a ball-peen hammer, lightly tap the bushing material to begin to roll it outward (Fig. 90).

(5) When the entire edge of the bushing is rolled outward, turn the hammer over and lightly tap the bushing material to form a flat head (Fig. 91). The head must be flat without overlapping or distorting the bushing material.

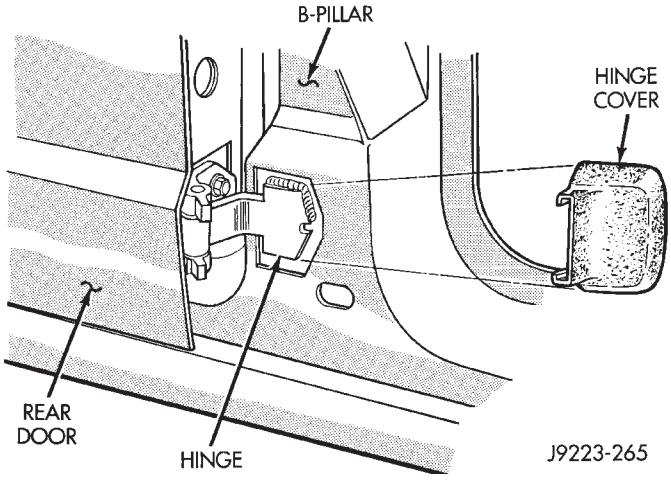

Fig. 87 Rear Door Hinge

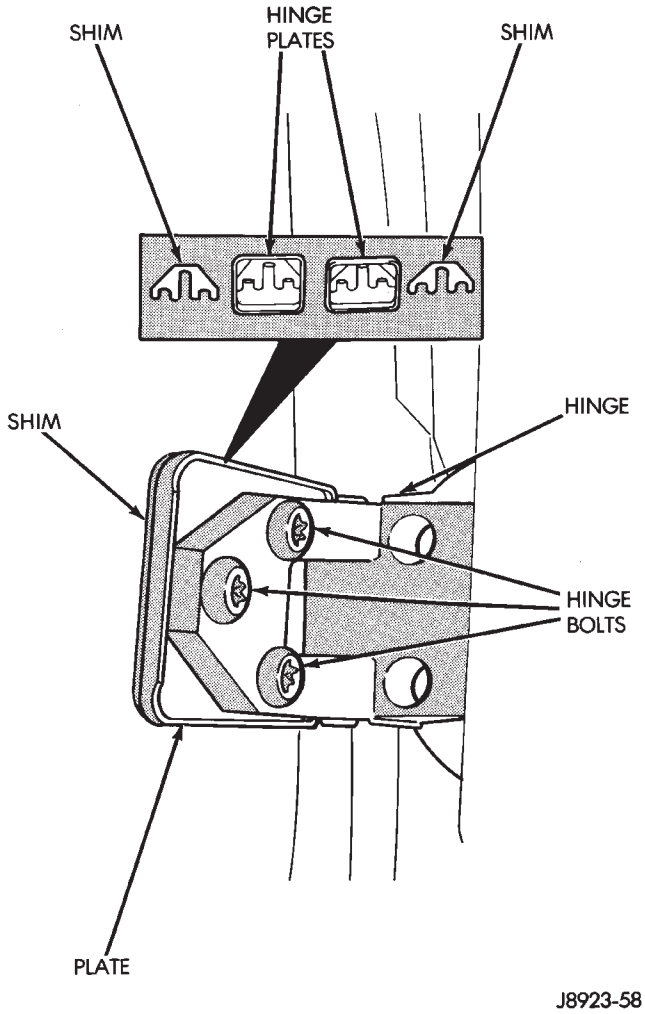

Fig. 88 Door Hinges, Bolts, Plates and Shims

(6) Slide the door half of the upper and lower hinges onto the body half of both hinges and align the hinge pin holes.

(7) Carefully start the hinge pins through the hinges (they will fit snugly) and then use a two pound hammer, carefully seat both hinge pins (Fig.

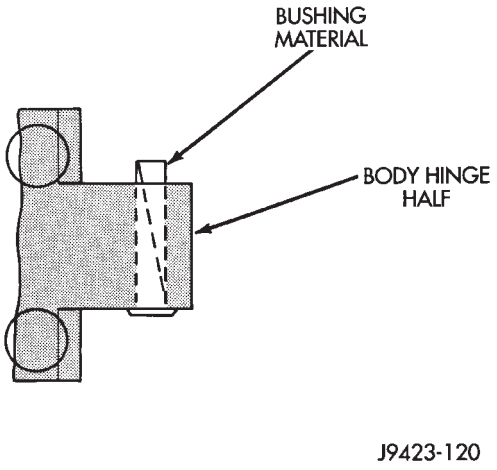

Fig 89 Install Bushing In Hinge

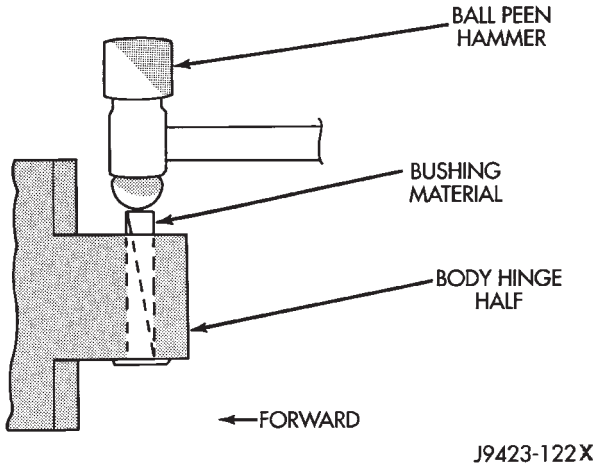

Fig. 90 Begin To Roll Bushing Material Outward

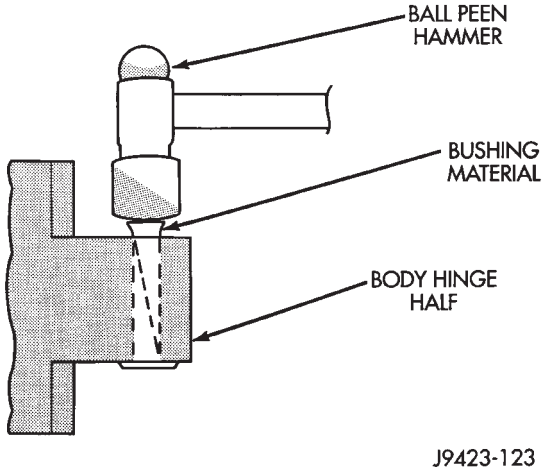

Fig. 91 Forming A Head On The Bushing

92). Be careful not to bend the hinge when driving the hinge pin, support may be required under the hinge.

(8) Adjust/align latch striker and latch as necessary.

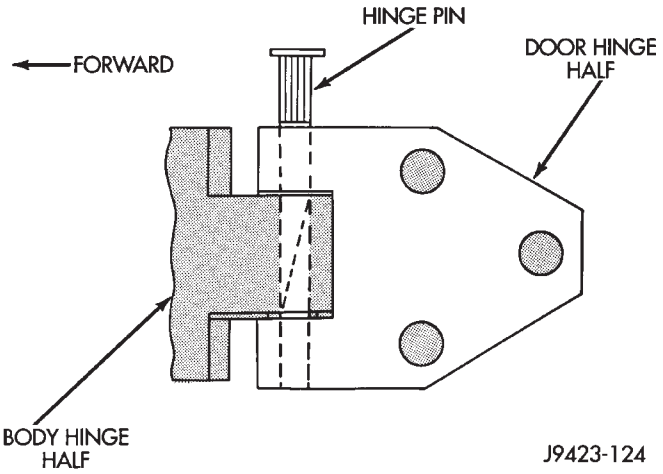

Fig. 92 Installing The Hinge Pin

(9) Install the door restraint (check) retaining pin with a punch.

FRONT DOOR SPACER BLOCKS—TWO-DOOR VEHICLES

REMOVAL

(1) Upper spacer block: drill-out the rivet heads and remove them from the reinforcement plate (Fig.93).

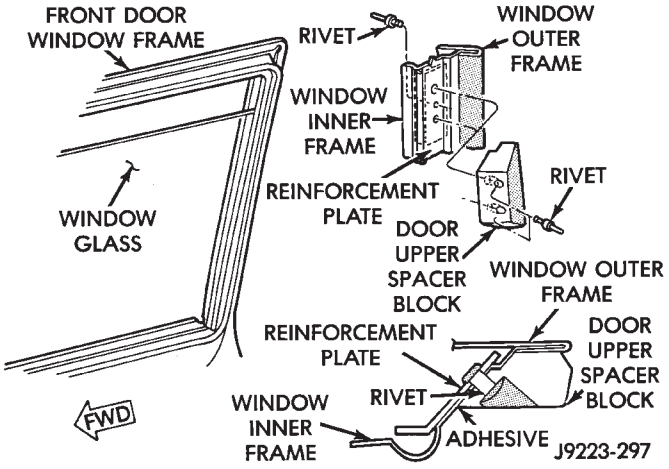

Fig. 93 Front Door Upper Spacer Block—Two-Door Vehicles

(2) Lower spacer block: remove the screws from the door face Fig. 94).

(3) As applicable, remove the spacer block from the door window frame or door face.

INSTALLATION

(1) As applicable, position the spacer block on the door window frame or door face.

(2) Upper spacer block: Install the replacement rivets in the spacer block and reinforcement plate.

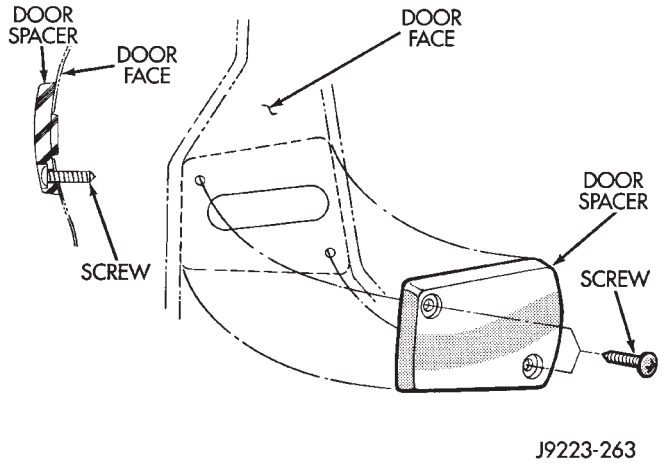

Fig. 94 Front Door Lower Spacer Block—Two-Door Vehicles

(3) Lower spacer block: install the screws in the door face. Tighten the screws to 1 N·m (11 in-lbs) torque.

DOOR EDGE GUARD/EDGE PROTECTOR STRIP

REPLACEMENT

(1) Pull outward and remove the door edge guard strip from the door edge (Fig. 95).

(2) Position the door edge guard strip on the door edge.

(3) Force the door edge guard strip inward until it is seated on the door edge.

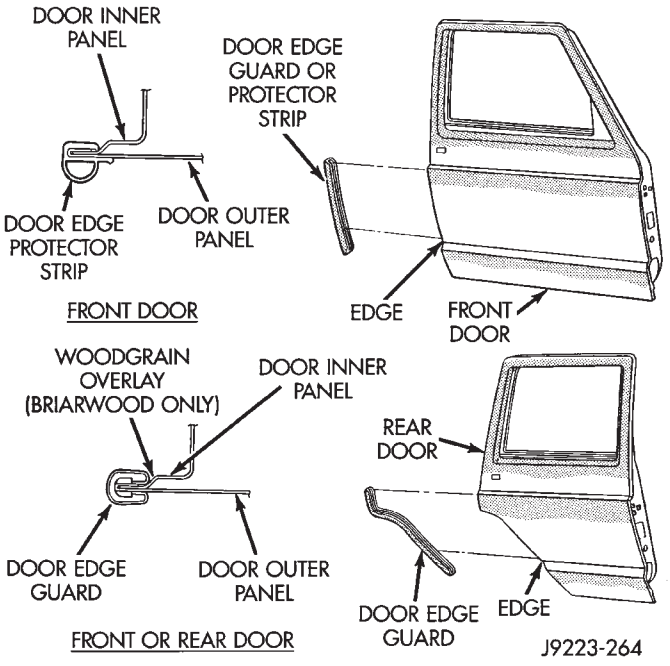

Fig. 95 Door Edge Guard/Protector Strip

DOOR WINDOW EXTERIOR MOULDINGS

REMOVAL

(1) When removing the front or rear door window exterior moulding, open the window completely (Figs. 96 and 97).

(2) Pry and pull the moulding sections from the door panel flange and clips.

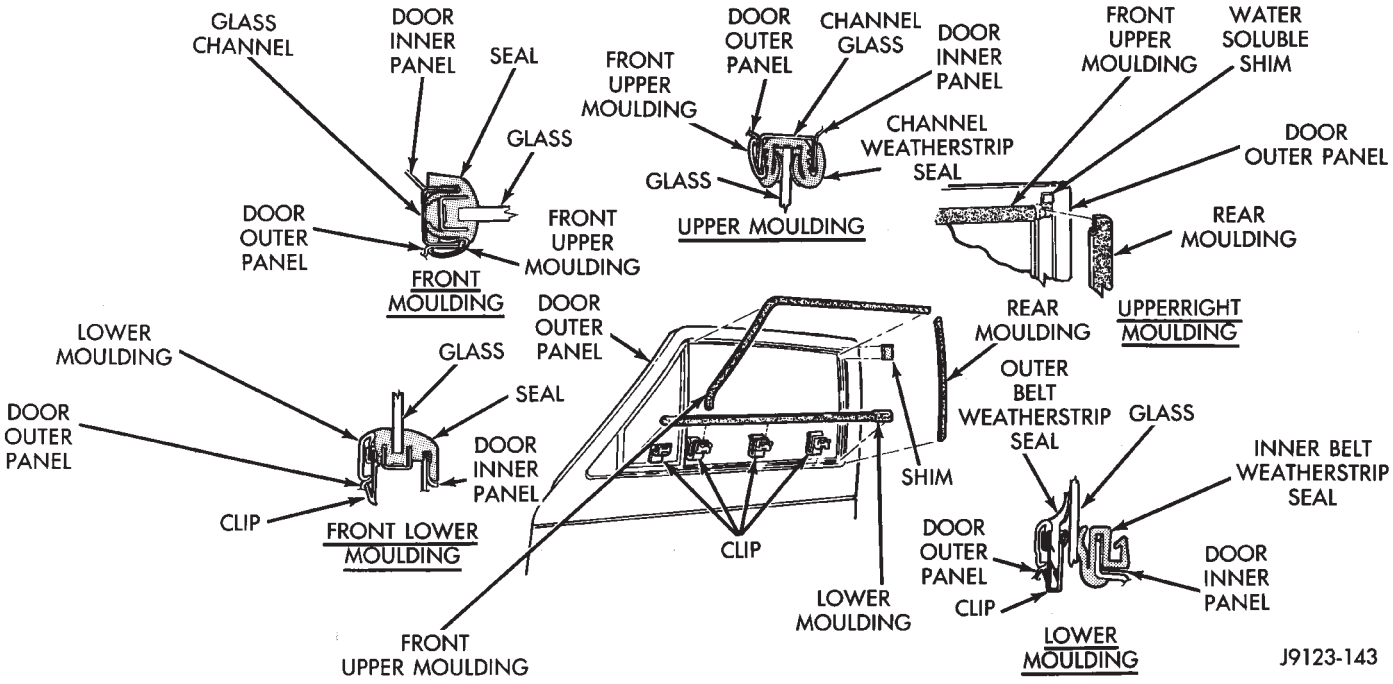

Fig. 96 Front Door Window Exterior Moulding

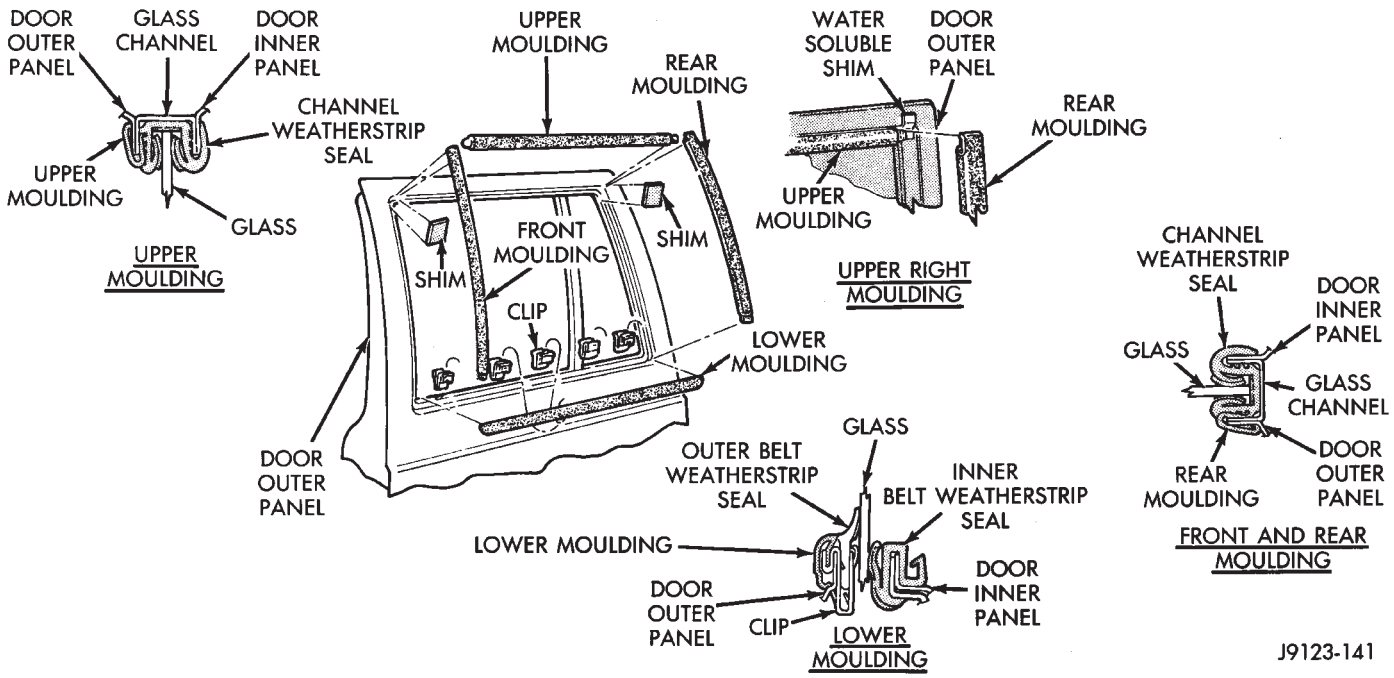

Fig. 97 Rear Door Window Exterior Moulding

INSTALLATION

(1) When installing window mouldings, start at the forward end of the upper moulding.

(2) Force the moulding onto the door panel and continue rearward until it is completely seated on the flange.

(3) Mate the rear moulding with the upper moulding and force the moulding edge inward.

(4) Continue pressing and moving downward to complete the installation.

(5) Position the lower moulding on the clips and force it downward.

DOOR WINDOW GLASS AND DOOR OPENING WEATHERSTRIP SEALS

REMOVAL

When removing the front or rear door window glass weatherstrip seals, open the window.

The window weatherstrip seals can be removed by hand or with the aid of a small putty knife (or similar tool).

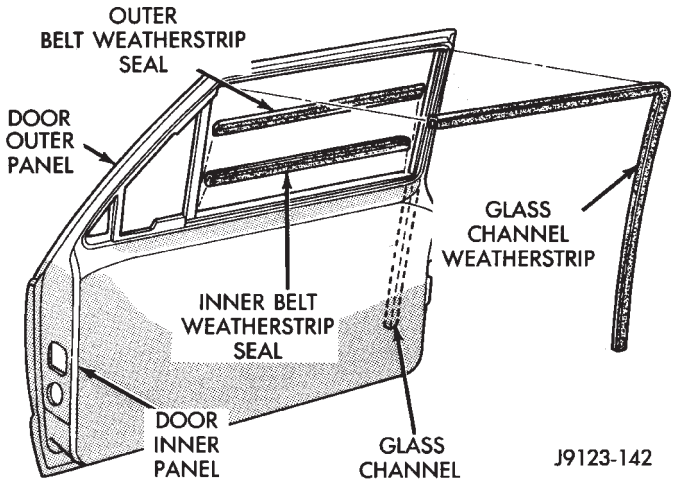

Fig. 98 Front Door Window Glass Weatherstrip Seals

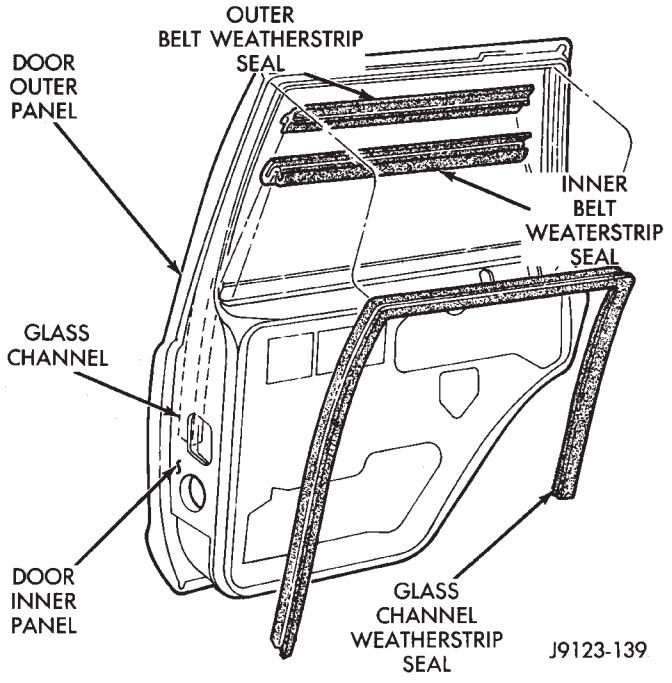

Fig. 99 Rear Door Window Glass Weatherstrip Seals

The door opening weatherstrip seal is attached to the periphery of the door opening in the body. The retaining push-studs can be removed with an appropriate pry tool. The front door secondary seal is attached to the A-pillar with plastic blind rivets (Fig. 100).

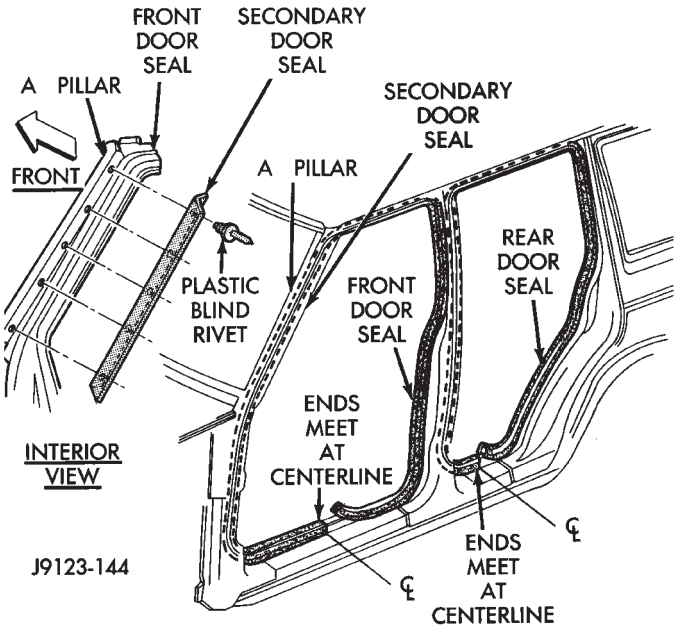

Fig. 100 Door Opening Weatherstrip Seals

The door-to-rocker panel seals are attached to the door inner panels with rivets (Fig. 101). The rivets can be removed with an appropriate pry tool.

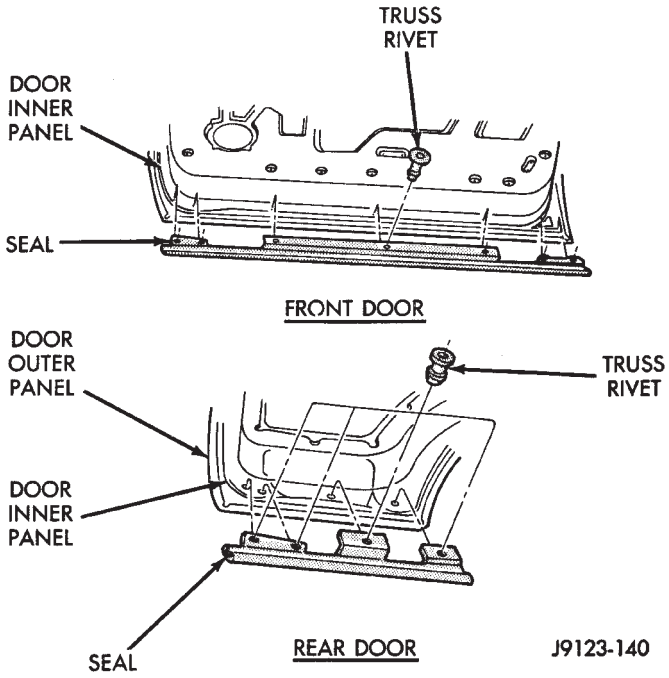

Fig. 101 Door-To-Rocker Panel Seals

WINDOW GLASS WEATHERSTRIP SEAL INSTALLATION

When installing front or rear door window glass weatherstrip seals, open the window completely.

(1) To install a front door window glass channel weatherstrip seal, start at the upper, rear corner (Fig. 102).

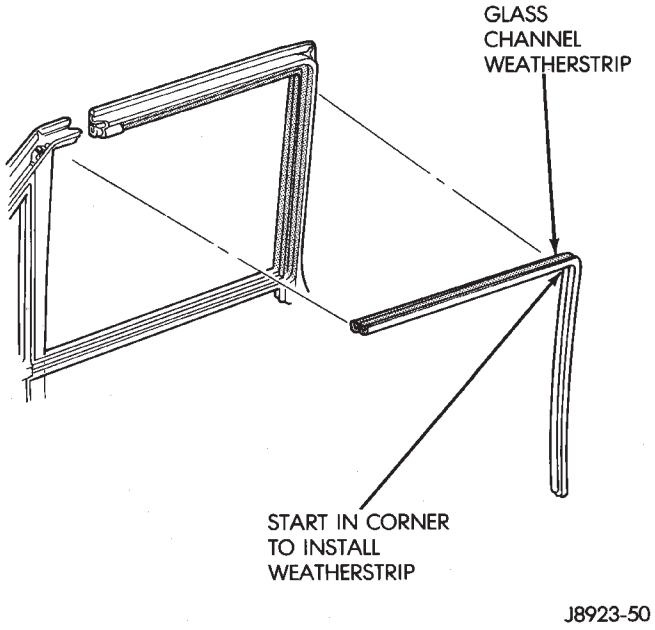

Fig. 102 Front Door Window Glass Channel Weatherstrip Seal

(2) To install a rear door window glass channel weatherstrip seal, start at the upper, front corner (Fig. 103).

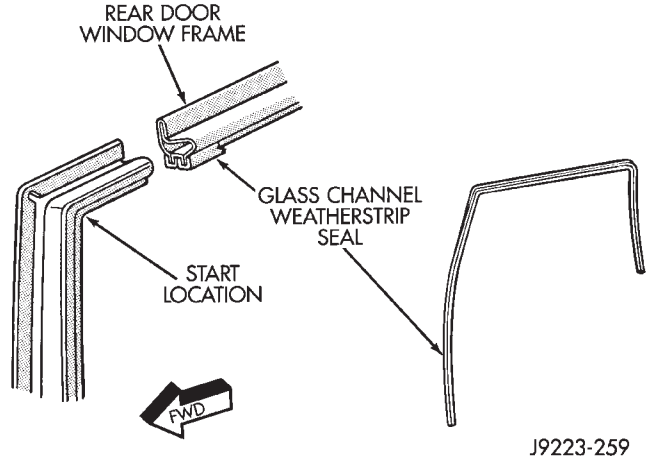

Fig. 103 Rear Door Window Glass Channel Weatherstrip Seal

(3) A small amount of adhesive can be used to hold the weatherstrip seal in-place, if necessary.

(4) As applicable, move forward or rearward and downward evenly until the weatherstrip seal is fully seated in the channel.

(5) Position the belt weatherstrip seals at the window edge (Figs. 104, 105 and 106) and force them downward until seated on the flange.

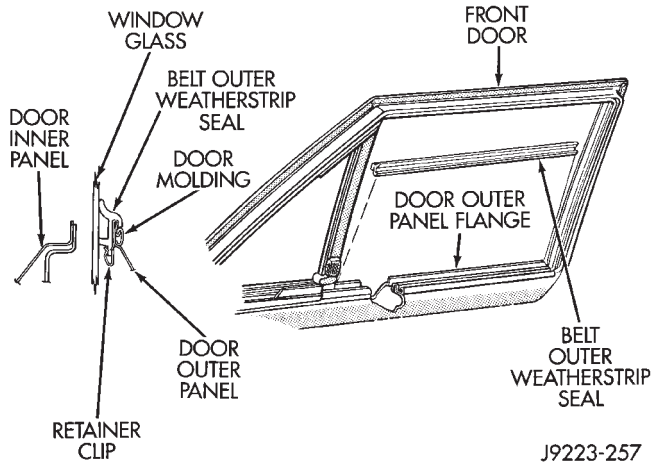

Fig. 105 Front Door Belt Outer Weatherstrip Seal

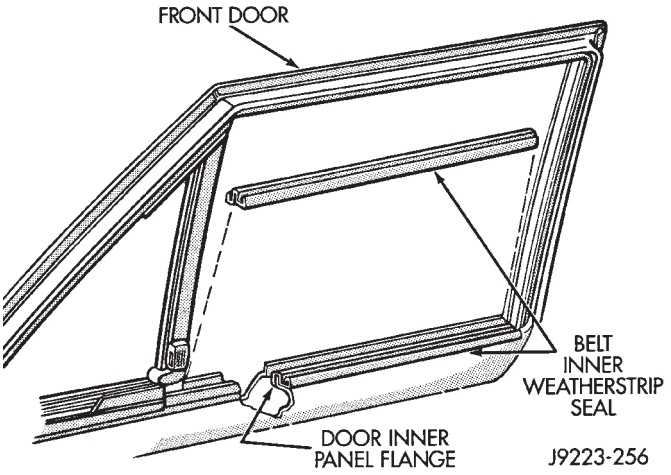

Fig. 106 Front Door Belt Inner Weatherstrip Seal

DOOR OPENING WEATHERSTRIP SEAL INSTALLATION

The weatherstrip seal is attached to the flange around the perimeter of the door opening with adhesive and plastic push-studs.

(1) When installing a door opening weatherstrip seal, start at the door sill center line.

(2) Use adhesive along with the push-studs to aid in retaining a weatherstrip seal.

(3) Move upward and around the perimeter of the door opening and seat the weatherstrip seal on flange (Fig. 108).

(4) Install the front door secondary seal with plastic blind rivets.

DOOR-TO-ROCKER PANEL SEAL INSTALLATION

(1) Position the seal on the door inner panel with the holes aligned.

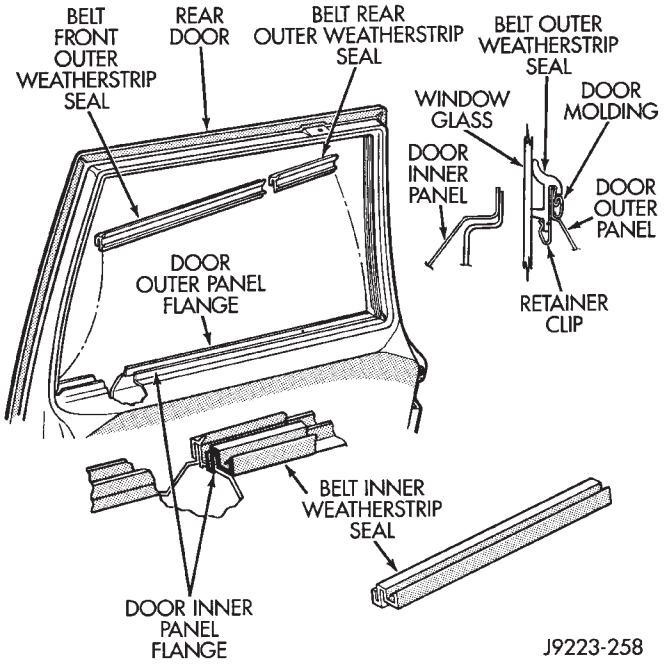

Fig. 107 Rear Door Belt Outer and Inner Weatherstrip Seal

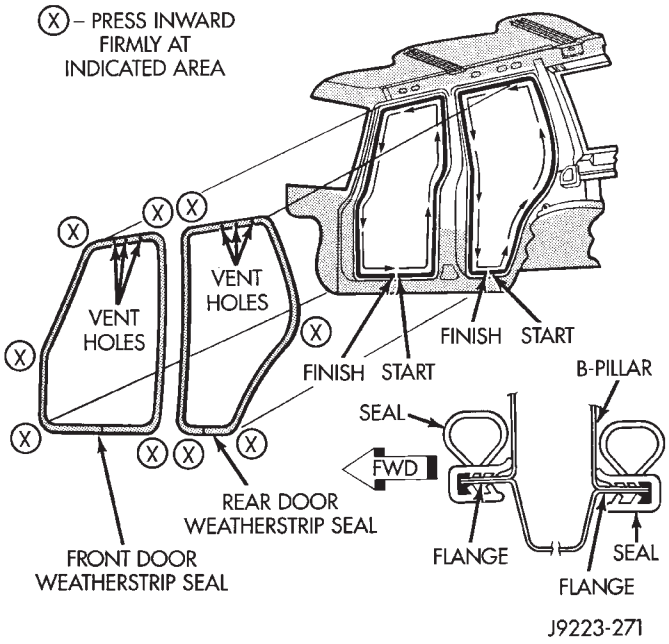

Fig. 108 Door Opening Weatherstrip Seals

(2) Attach the seal to the door inner panel with truss rivets.

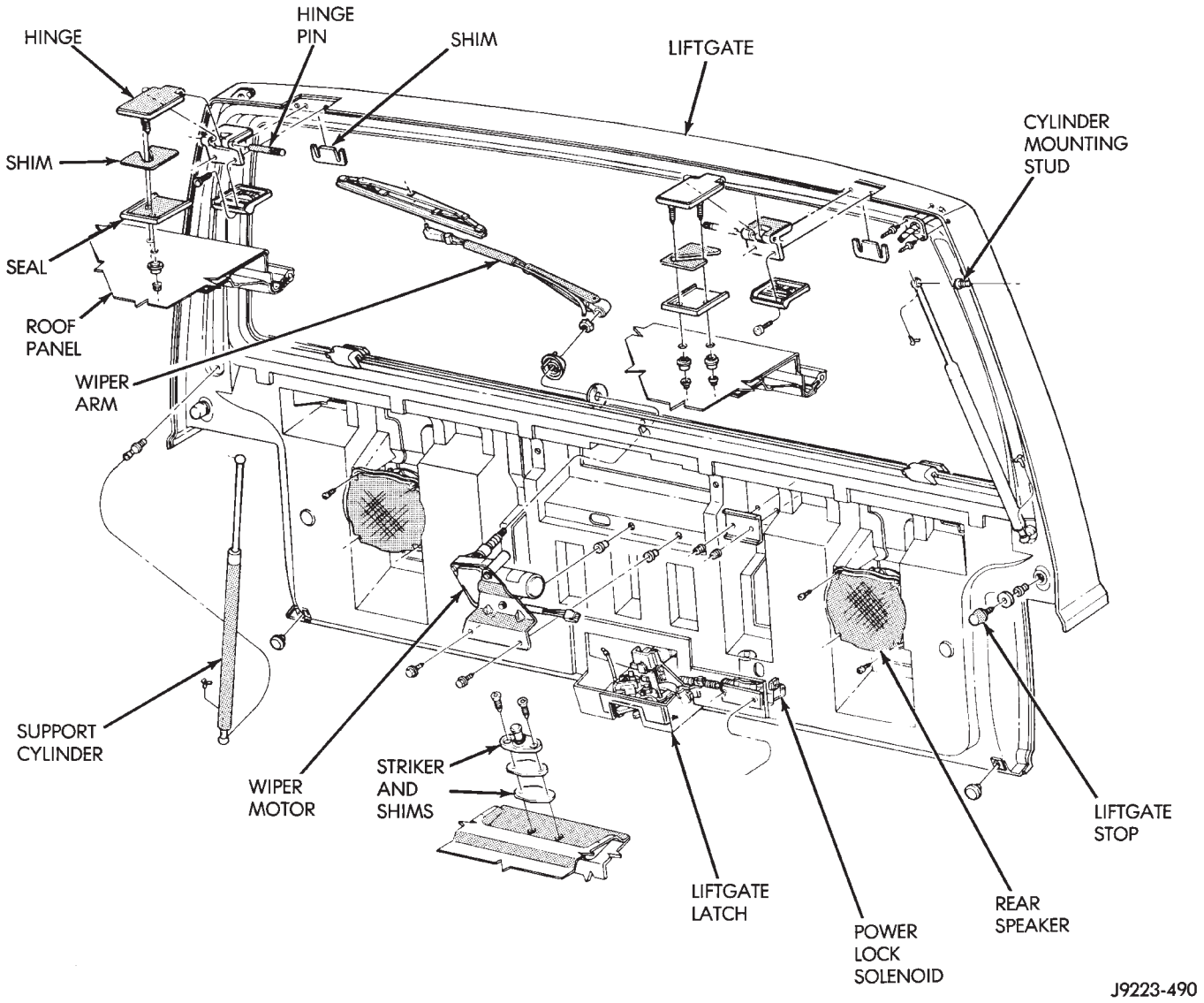

Fig. 109 Liftgate Components

LIFTGATE SERVICE INFORMATION—XJ VEHICLES

The liftgate components are illustrated in Figure 109.

LIFTGATE REMOVAL/INSTALLATION

REMOVAL

WARNING: DO NOT DISCONNECT THE SUPPORT ROD CYLINDERS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS. THIS COULD CAUSE DAMAGE AND/OR PERSONAL INJURY IF THEY ARE REMOVED WHILE PISTONS ARE COMPRESSED.

(1) Open the liftgate.
(2) Remove the liftgate trim panel (Fig. 110).
(3) Remove the retainer clips that secure the support rod cylinders to the ball studs (Fig. 111).
(4) Remove the support rod cylinders from the ball studs.
(5) Remove the screws and the wire harness trim cover from the liftgate header (Fig. 112).
(6) Disconnect the connectors and remove the wire harness from the liftgate (Fig. 113).
(7) Remove the hinge-to-liftgate screws.
(8) Remove the liftgate from the vehicle.

INSTALLATION

(1) Position and support the liftgate at the opening in the body and install the hinge-to-liftgate screws.
(2) Adjust the liftgate to fit properly in the body opening. Refer to Liftgate Adjustment.
(3) Tighten the hinge-to-liftgate screws to 9 N·m (7 ft-lbs) torque.
(4) Connect the liftgate rod cylinders to the ball studs and install the rod cylinder retainer clips.
(5) Insert and connect the wire harness connectors.
(6) Position the wire harness trim cover on the header and install the screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

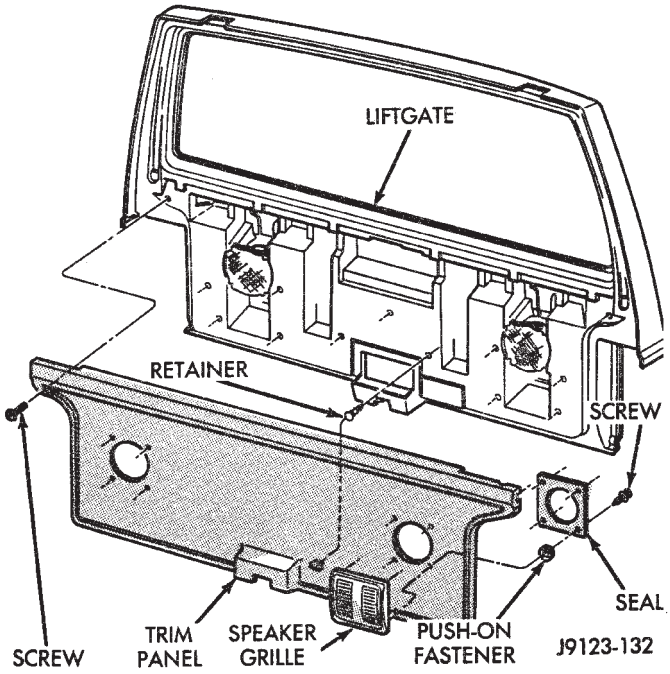

Fig. 110 Liftgate Trim Panel

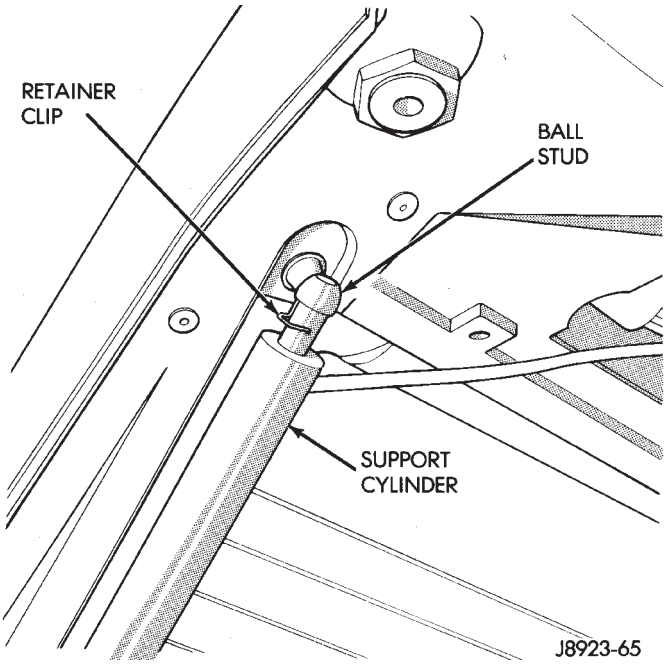

Fig. 111 Support Rod Retainer Clip

(7) Install the trim panel.

LIFTGATE TRIM PANEL

REMOVAL

(1) Remove the screws that attach the panel upper sides to the liftgate.

(2) Use a trim stick to detach the panel retainers from the liftgate.

(3) Remove the trim panel from the liftgate.

(4) If necessary, drill-out the rivet heads and remove the trim panel strip from the liftgate (Fig. 114).

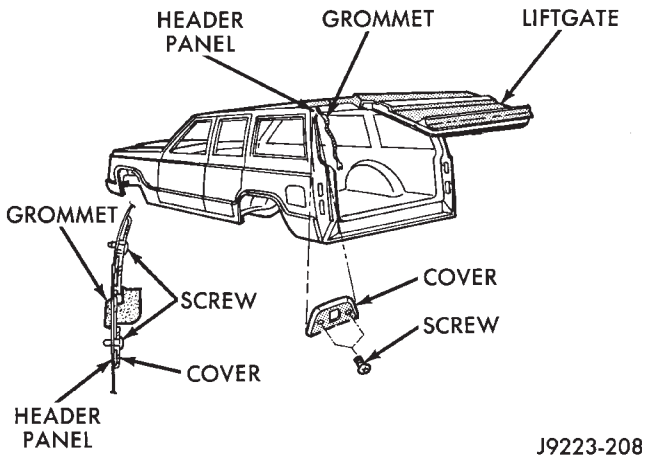

Fig. 112 Liftgate Wire Harness Trim Cover

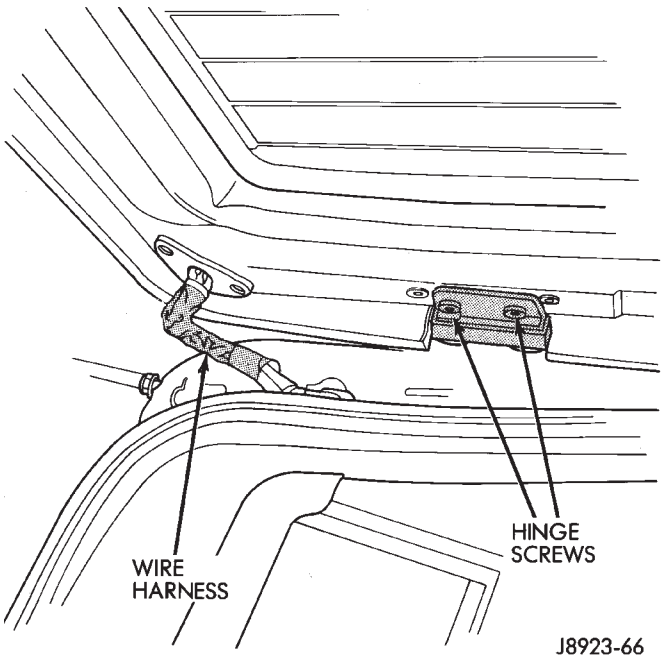

Fig. 113 Liftgate Wire Harness and Hinge Screws

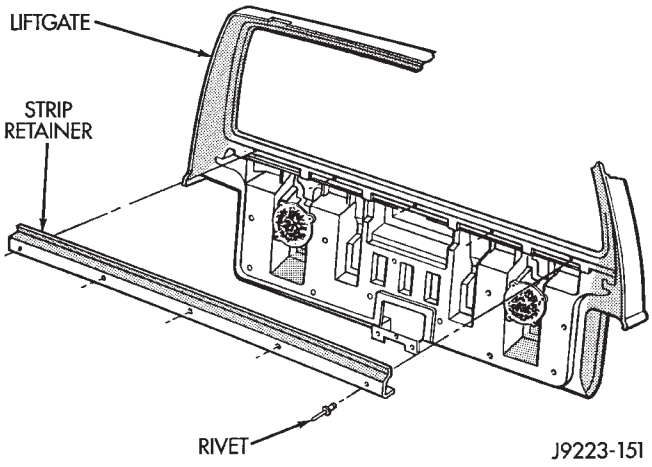

Fig. 114 Liftgate Trim Panel Strip Retainer

(5) If necessary, remove the screws and remove the speaker grilles from the trim panel (Fig. 115).

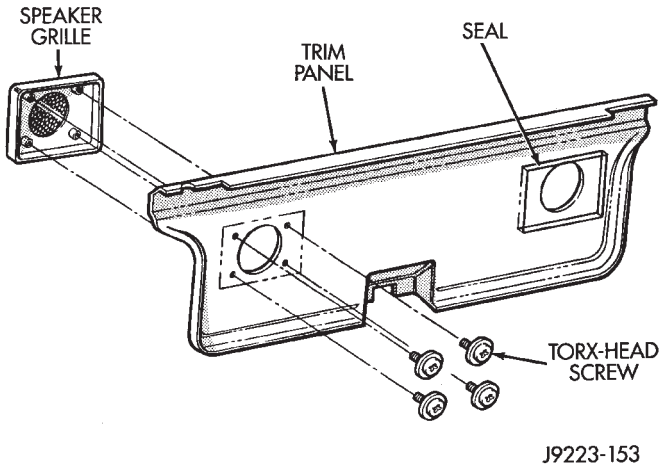

Fig. 115 Liftgate Trim Panel Speaker Grilles

INSTALLATION

(1) If removed, install the trim panel retainer strip on the liftgate with replacement rivets.

(2) If removed, install the speaker grilles on trim panel. Tighten the screws to 1 N·m (11 in-lbs) torque.

(3) Position the trim panel on liftgate.

(4) Align the trim panel retainers with the holes in the liftgate inner panel and force the trim panel inward.

(5) Install the screws to attach the panel upper sides to the liftgate.

LIFTGATE HINGE

REMOVAL

It is not necessary to remove the liftgate to replace one or both hinges.

(1) Remove the liftgate (headliner) upper trim moulding (Fig. 116).

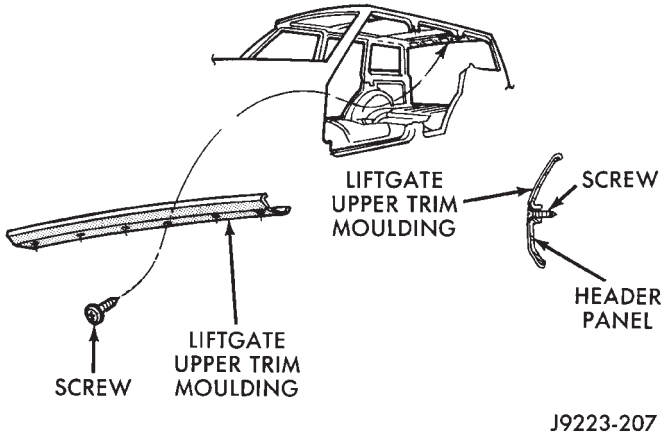

Fig. 116 Liftgate Upper Trim Moulding

(2) Remove the hinge-to-roof panel nuts (Fig. 117).

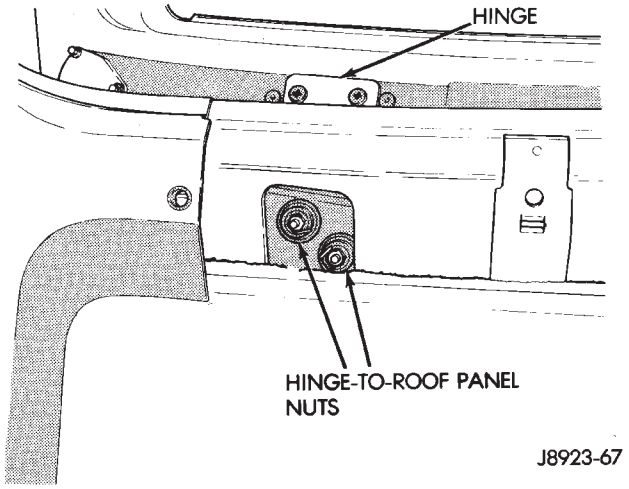

Fig. 117 Liftgate Hinge-To-Roof Panel Nuts

(3) Remove the hinge-to-liftgate screws and remove the hinge from the liftgate (Fig. 118).

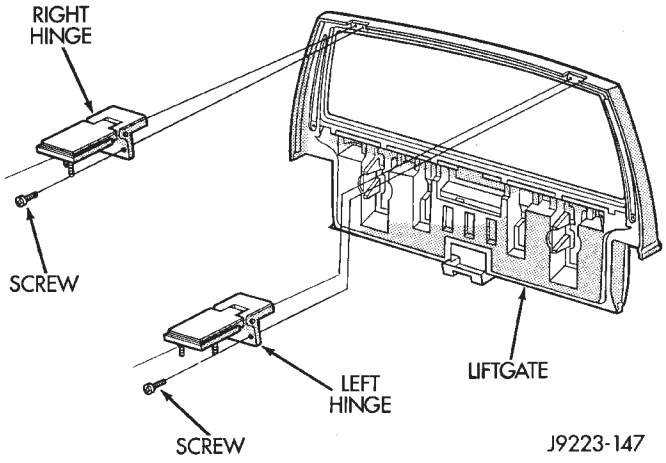

Fig. 118 Liftgate Hinges

INSTALLATION

(1) Position the gaskets, shim and hinge on the liftgate and the roof panel (Fig. 119).

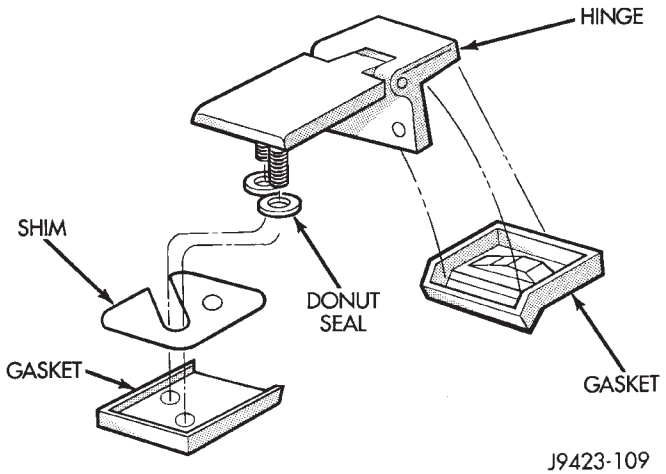

Fig. 119 Liftgate Hinge, Gaskets and Shim

(2) Install and tighten hinge-to-roof panel nuts to 9 N·m (7 ft-lbs) torque.

(3) Install the liftgate-to-hinge screws. Tighten screws to 9 N·m (7 ft-lbs) torque.

(4) Install the liftgate (headliner) upper trim moulding (Fig. 111).

LIFTGATE LATCH/KEY LOCK CYLINDER/STRIKER

REMOVAL

(1) Raise the liftgate and remove the latch screws (Fig. 120).

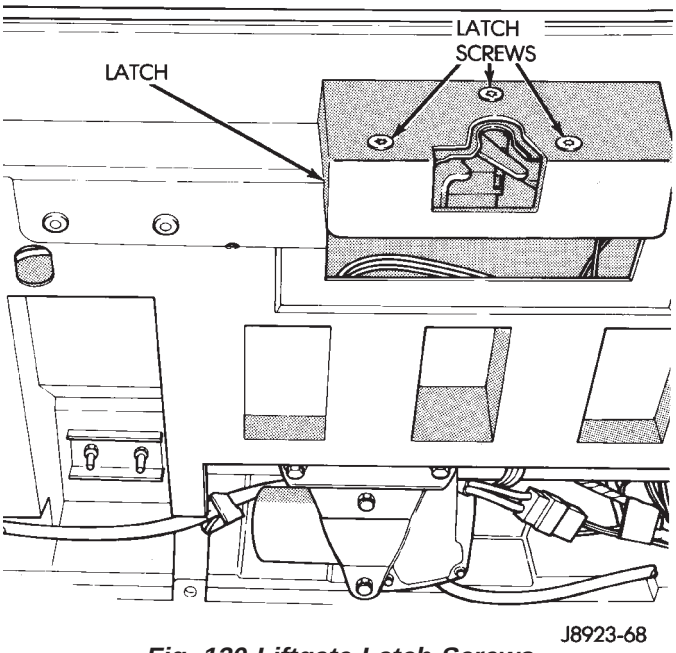

Fig. 120 Liftgate Latch Screws

(2) Disconnect the rod from the latch (Fig. 121).

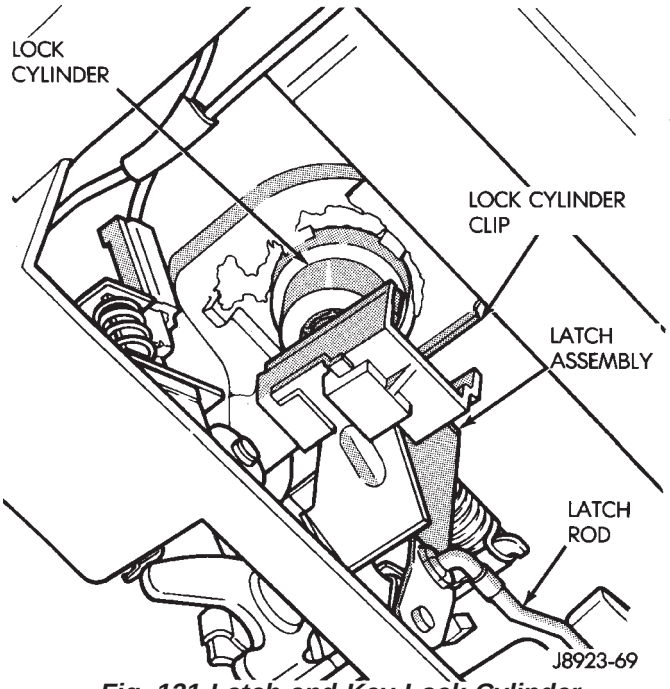

Fig. 121 Latch and Key Lock Cylinder

(3) Remove the latch from the liftgate (Fig. 122).

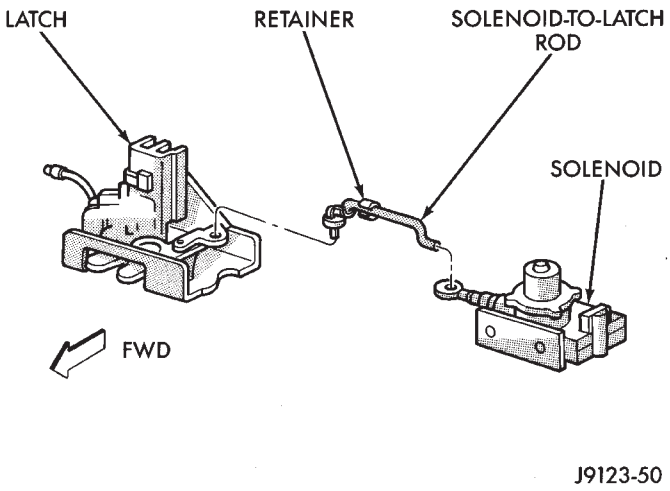

Fig. 122 Liftgate Latch and Solenoid

(4) Drill-out the rivet heads and remove the lock solenoid from liftgate (Fig. 123).

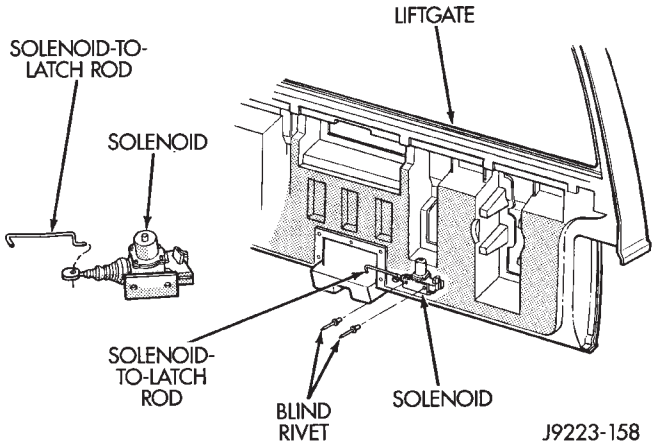

Fig. 123 Liftgate Lock Solenoid

(5) Remove the lock cylinder retainer clip (Fig. 124).

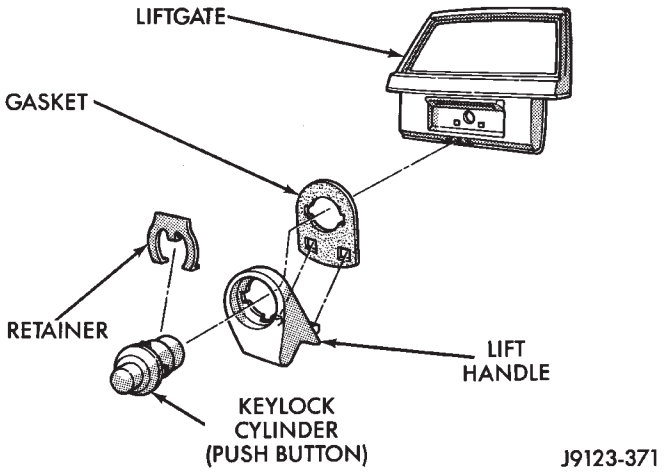

Fig. 124 Liftgate Key Lock Cylinder

(6) Remove the key lock cylinder.
(7) Remove the latch striker screws from the scuff plate and cross sill (Fig. 125)

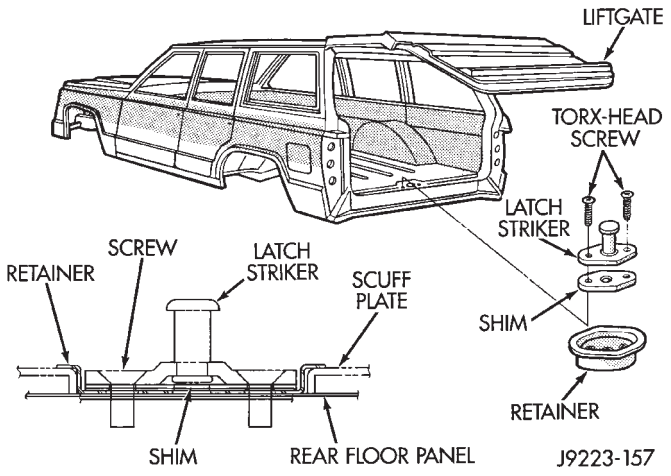

Fig. 125 Liftgate Latch Striker

(8) Remove the striker and shim from the retainer.

INSTALLATION

(1) Install the key lock cylinder. Secure the lock cylinder with the retainer clip (Fig. 126).

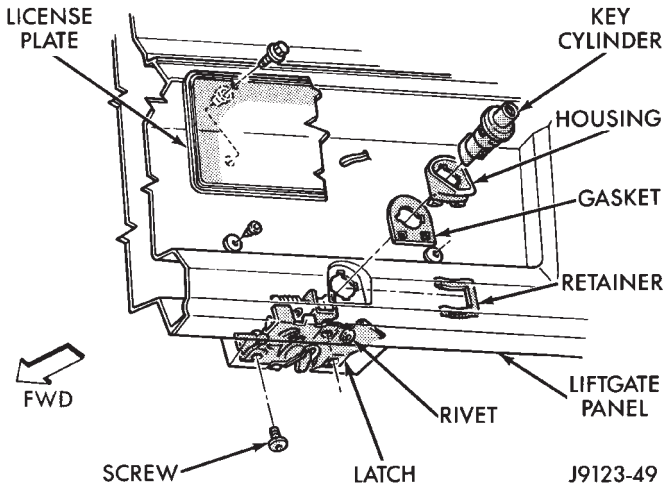

Fig. 126 Liftgate Key Lock Cylinder and Latch

(2) Position the latch in the liftgate.
(3) Connect the latch rod.
(4) Install and tighten the latch screws to 12 N·m (110 in-lbs) torque.
(5) Install the striker retainer, shim, striker and screws in the scuff plate cross sill.

LIFTGATE SUPPORT ROD CYLINDER

REMOVAL

WARNING: DO NOT REMOVE A SUPPORT ROD CYLINDER WITH THE LIFTGATE CLOSED. EACH SUPPORT ROD PISTON IS OPERATED BY HIGH PRESSURE GAS. IT CAN CAUSE DAMAGE AND/OR PERSONAL INJURY IF IT IS REMOVED WITH THE PISTON COMPRESSED. DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR A SUPPORT ROD CYLINDER .

(1) Open the liftgate.
(2) Support the liftgate in the open position.
(3) Remove the clips that attach the support rod and cylinder to the ball studs (Fig. 127).

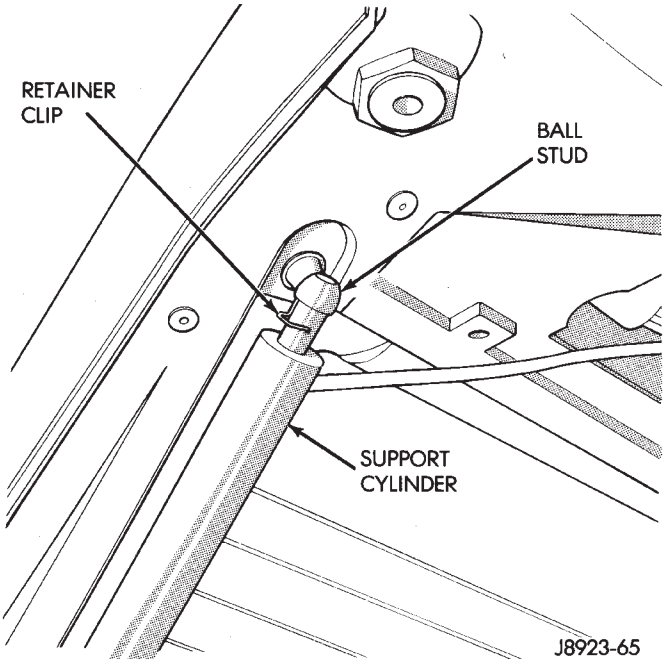

Fig. 127 Support Rod Retainer Clip

(4) Disconnect the support rod and cylinder from the ball studs and remove the cylinder from vehicle (Fig. 128).

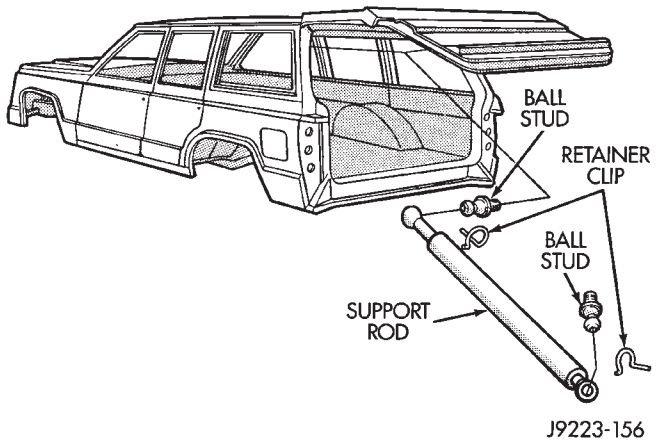

Fig. 128 Support Rod, Retainer Clips and Ball Studs

(5) De-pressurize the original rod cylinder before disposal. Refer to the procedure below.

INSTALLATION

(1) Connect the replacement support rod and cylinder to the ball studs.

(2) Secure the support rod and cylinder to the ball studs with the retainer clips.

(3) Remove the support from the liftgate and test the operation of the support rod.

LIFTGATE SUPPORT ROD CYLINDER DISPOSAL

WARNING: SAFETY GOGGLES MUST BE WORN DURING THE DISPOSAL PROCEDURE. THE HIGH PRESSURE GAS CHARGE IN THE SUPPORT ROD CYLINDERS WILL BE RELEASED DURING THE PROCEDURE .

(1) Remove the support rod cylinder(s) from the liftgate.

(2) Position the support rod cylinder horizontally in a vise and clamp the cylinder securely.

(3) Wrap the cylinder with 4-5 layers of shop towels.

(4) Measure 1 and 1/2 inches inward from the end of the cylinder. Mark this location on the towels with chalk. The cylinder will be punctured at this location to release the gas charge.

(5) Use a punch and hammer to puncture cylinder. Force the punch through towels and into the cylinder with a hammer. Continue striking the punch until the gas begins to escape **but do not remove the punch.**

(6) Hold the towels and punch in position until all the gas has escaped. Complete de-pressurization will require about 4 to 10 seconds. After all the gas has escaped, slowly remove the punch.

(7) Hold a towel over the hole in cylinder and press the support rod piston all the way into the cylinder to purge remaining oil.

(8) Remove the support rod cylinder from the vise and discard it.

(9) If both support rod cylinders are being replaced, repeat this procedure for the remaining cylinder.

LIFTGATE SUPPORT ROD BALL STUD REPLACEMENT

REMOVAL

(1) Open the liftgate.

(2) Support the liftgate in the open position.

(3) Remove the retainer clip that attaches the support rod and cylinder to the ball stud.

(4) Disconnect the support rod from the ball stud.

(5) Remove the ball stud from the liftgate with a T-30 Torx-head socket wrench (Fig. 129).

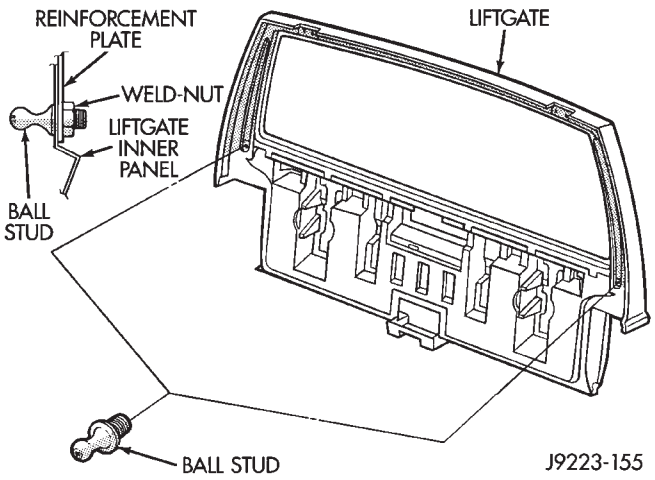

Fig. 129 Support Rod Ball Studs

INSTALLATION

(1) Install the replacement ball stud in the liftgate with a T-30 Torx-head socket wrench. Tighten the ball stud to 7 N·m (62 in-lbs) torque.

(2) Connect the support rod to the ball stud.

(3) Secure the support rod to the ball stud with the clip.

(4) Remove the support from the liftgate and test the operation of support rod.

LIFTGATE ADJUSTMENT

SERVICE INFORMATION

The position of the liftgate can be adjusted upward or downward, and inward or outward by the use of hinge shims. The liftgate stop bumpers must also be adjusted if liftgate hinges are adjusted. The inward/outward position of each stop bumper is adjusted by the use of shims (Fig. 130).

ADJUSTMENT PROCEDURE

(1) To move the position of the liftgate inward or outward, remove or add shims between the hinge-halves and liftgate.

(2) To move the position of the liftgate upward or downward, remove or add shims between the hinge-halves and roof panel.

(3) To move the position of liftgate stop bumpers inward or outward, remove or add shims between the stop bumper screws and anchors (Fig. 131).

LIFTGATE OPENING WEATHERSTRIP SEAL

REMOVAL

(1) Pull the seal away from the flange around the perimeter of liftgate opening and remove it (Figs. 132 and 133).

(2) Clean the flange as necessary.

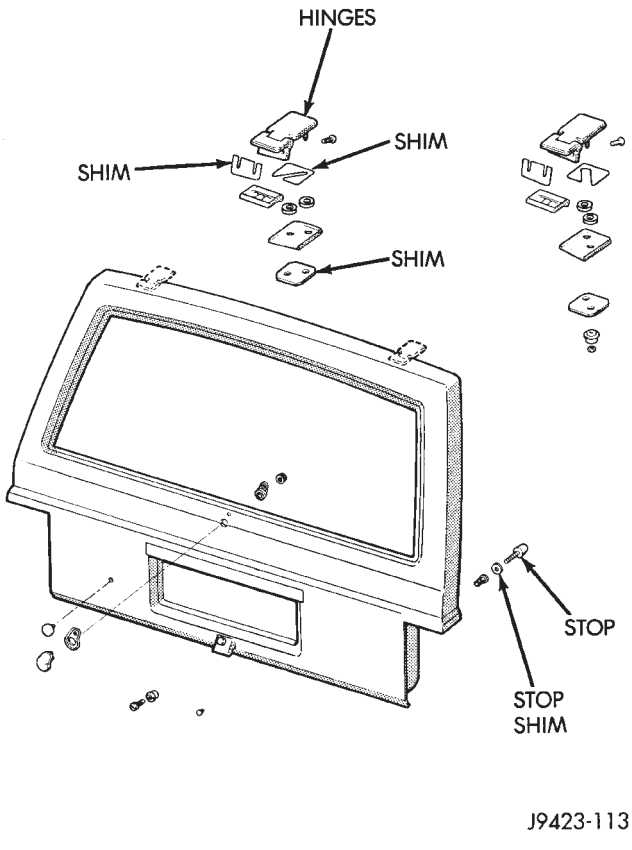

Fig. 130 Liftgate Adjustment Shims

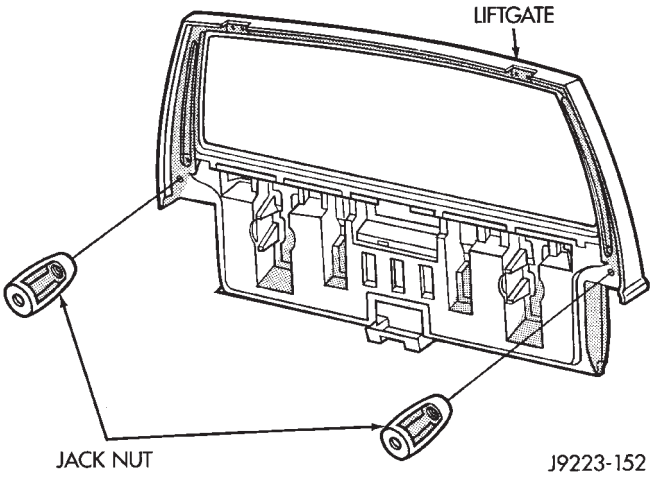

Fig. 131 Stop Bumper Screw Anchors

INSTALLATION

(1) Position weatherstrip seal in the opening with the left end of the seal at the opening centerline. Install the seal in a clockwise direction.

(2) Move to the left and mate the seal with the bottom-left flange (Fig. 122).

(3) Move upward and mate the seal with the left-side flange.

(4) Move to the right and mate the seal with the top-left roof flange.

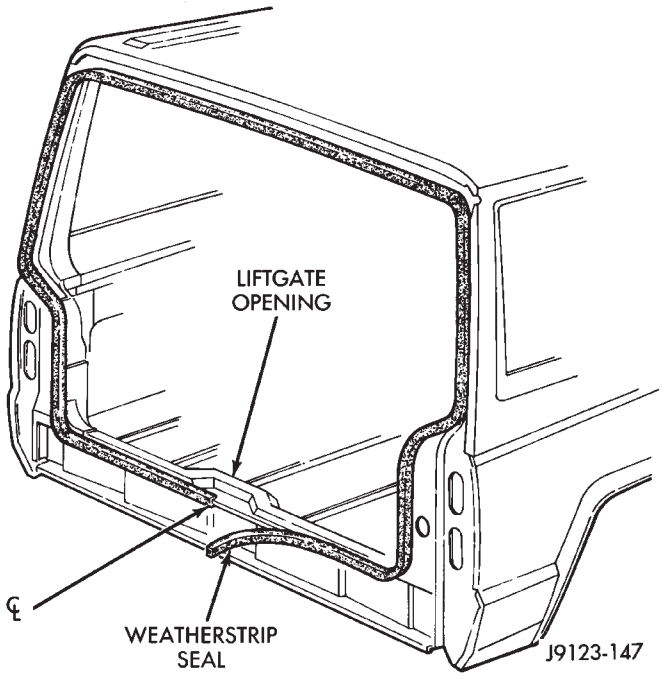

Fig. 132 Liftgate Opening Weatherstrip Seal Removal/Installation

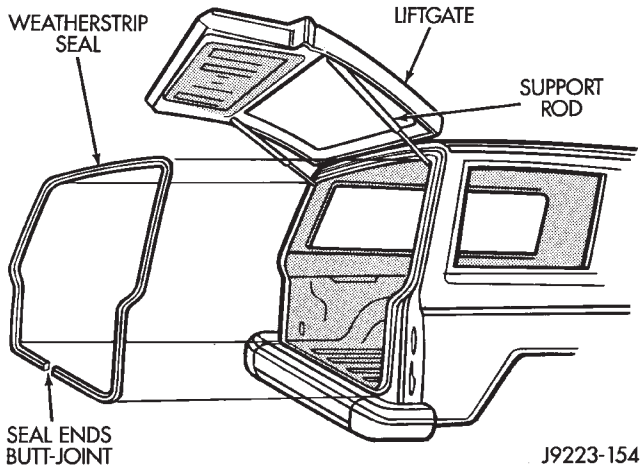

Fig. 133 Liftgate Opening Weatherstrip Seal

(5) Seat the installed part of the seal with a roller. Move the roller from the left-bottom end of seal to the top-left half of the seal.

(6) Move to the right and mate the seal with the top-right roof flange.

(7) Move downward and mate the seal with the right-side flange.

(8) Move to the left and mate the seal with the bottom-right flange.

(9) Center and butt seal the ends together at the centerline.

(10) Seat the remaining part of the seal with a roller. Move the roller the from top-left half of the seal to the right-bottom end of the seal.

LIFTGATE LICENSE PLATE LAMP HOUSING

REMOVAL

(1) Remove the lamp housing screws from the liftgate (Fig. 134).

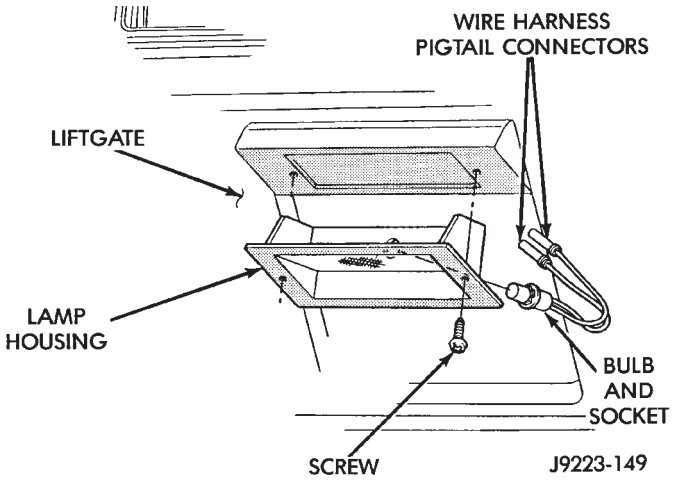

Fig. 134 Liftgate License Plate Lamp Housing

(2) Disconnect bulb socket from lamp housing.

(3) Remove the housing from the liftgate.

INSTALLATION

(1) Position the lamp housing at the liftgate.

(2) Connect the bulb socket to the lamp housing.

(3) Install the lamp housing retaining screws in the liftgate.

LIFTGATE LICENSE PLATE SCREW ANCHOR AND BUMPER

ANCHOR REPLACEMENT

(1) Remove the screw from the anchor (Fig. 135).

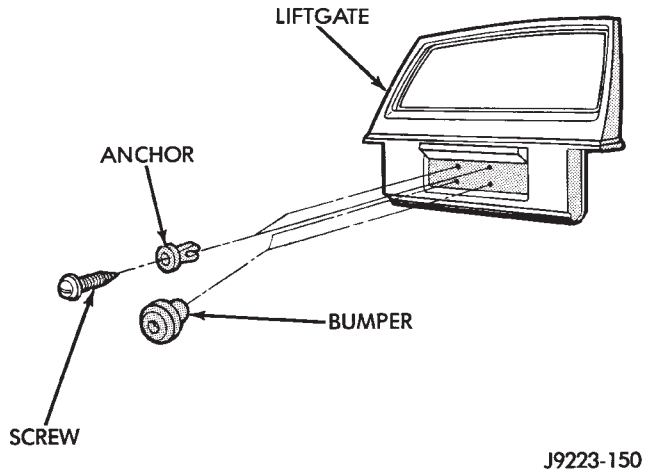

Fig. 135 Liftgate License Plate Screw Anchors and Bumpers

(2) Pry the anchor from the liftgate.

(3) Compress the ends and insert the anchor in the liftgate hole.

(4) Install the screw in the anchor.

BUMPER REPLACEMENT

(1) Pry the bumper from the liftgate.

(2) Insert the replacement screw anchor in the liftgate hole.

FIXED WINDOW GLASS

INDEX

SERVICE INFORMATION

The following service procedures include removal and installation of the:

- windshield reveal moulding,
- interior rearview mirror,
- windshield glass (using both the short and the extended installation method),
- rear quarter vent window glass,
- rear quarter window glass,
- liftgate window glass,
- cab rear window, and
- leak detection and repair.

WINDSHIELD REVEAL MOULDING

REMOVAL

(1) Disconnect the reveal mouldings from the clips around the windshield glass with an appropriate tool (Fig. 1).

(2) Remove the mouldings from the windshield frame.

(3) Inspect the reveal moulding retainer clips (Fig. 2). Replace broken, or loose clips (Fig. 3).

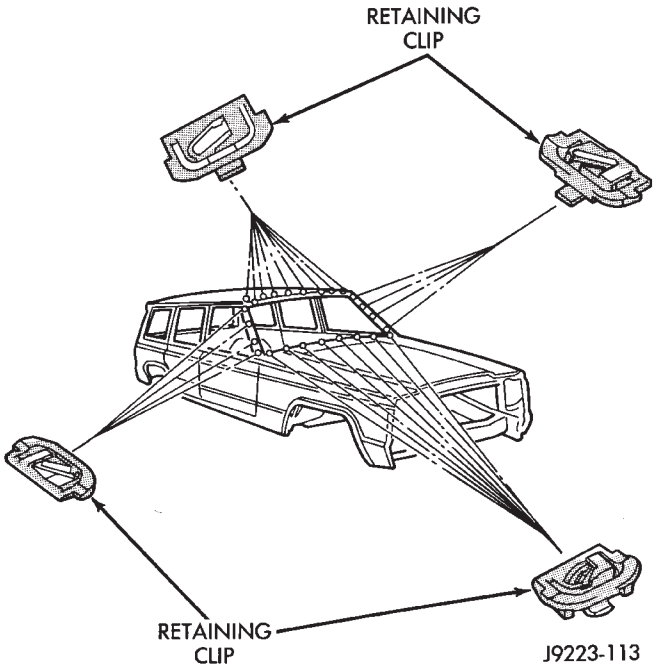

Fig. 2 Windshield Reveal Moulding Retainer Clips

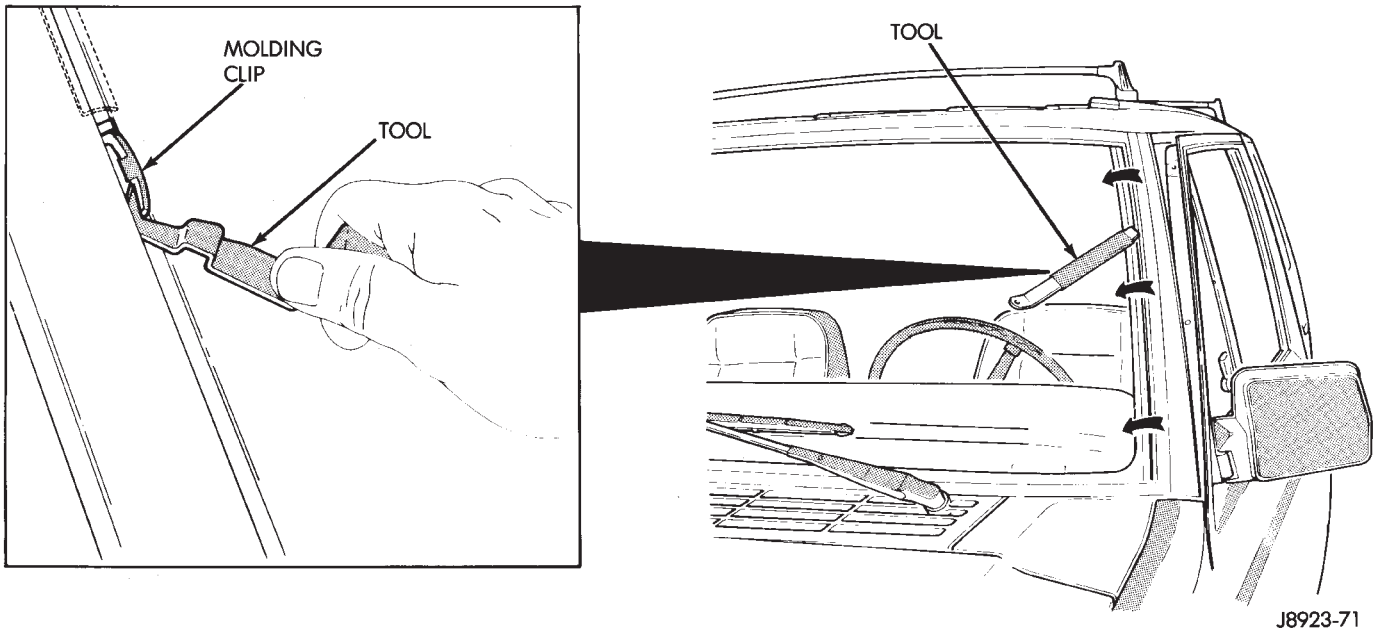

Fig. 1 Windshield Reveal Moulding Disengagement

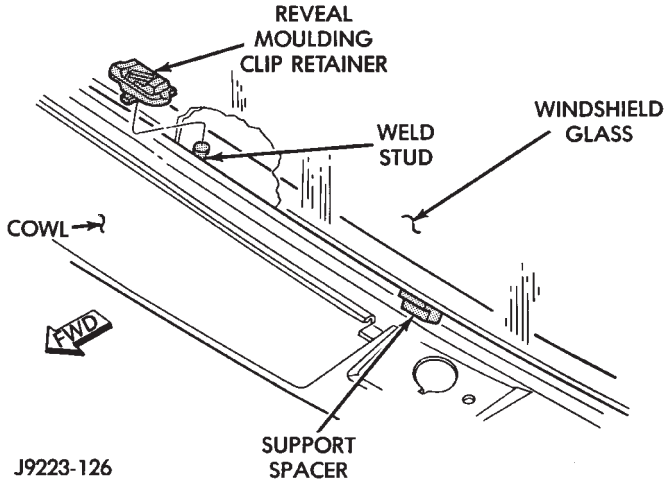

Fig. 3 Retainer Clip Removal/Installation

INSTALLATION

(1) Position mouldings on the windshield frame (Fig. 4).

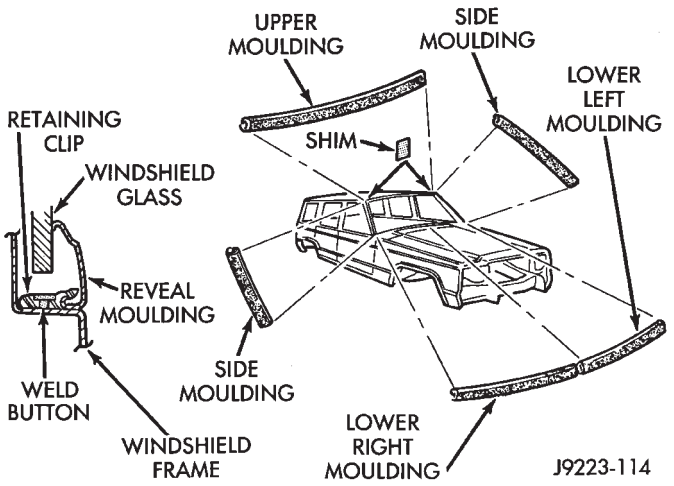

Fig. 4 Windshield Reveal Moulding

(2) Attach mouldings to the clips by tapping each moulding with a rubber mallet to seat it on the clips.

INTERIOR REARVIEW MIRROR

MIRROR REMOVAL

(1) Loosen the mirror base-to-bracket setscrew (Fig. 6).

(2) Slide the mirror base upward and off the support bracket (Fig. 7).

MIRROR INSTALLATION

(1) Slide the mirror base onto the support bracket (Fig. 7).

CAUTION: Do not over-tighten setscrew because glass chipping or breakage could result.

(2) Tighten the setscrew to 1 N·m (9 in-lbs) torque (Fig. 6).

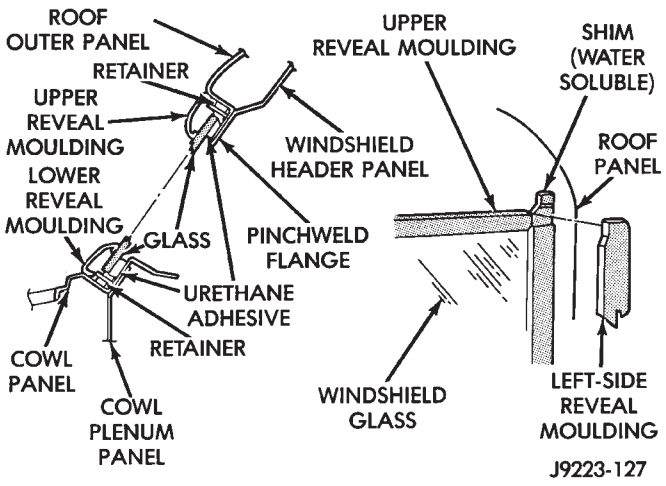

Fig. 5 Windshield Reveal Moulding Installation

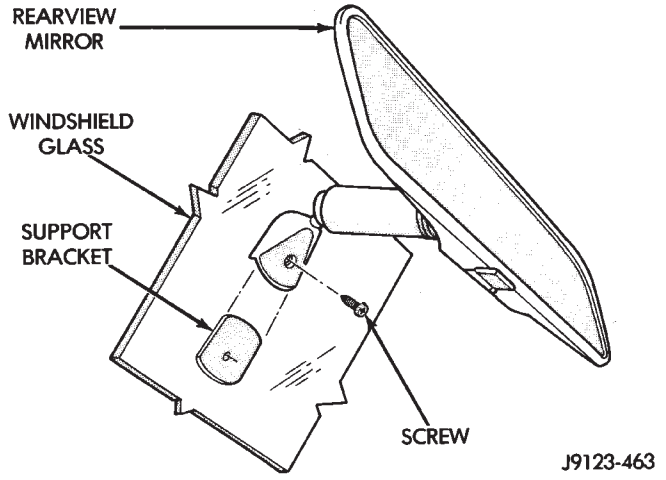

Fig. 6 Interior Rearview Mirror Setscrew Removal/ Installation

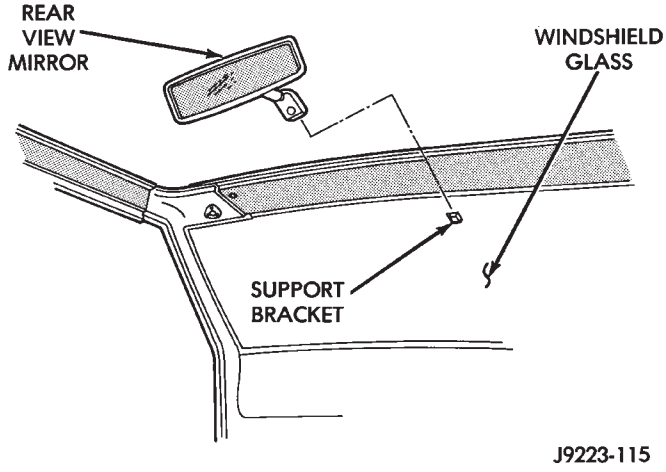

Fig. 7 Interior Rearview Mirror Removal/Installation

INTERIOR REARVIEW MIRROR SUPPORT BRACKET REPLACEMENT

PREPARATION

(1) Mark reference lines for the mirror support bracket on the outside of windshield glass with a wax pencil.

(2) If the vinyl pad remained on the windshield glass, soften and remove it with a heat gun.

(3) Clean the support bracket surface area on the glass. Use a mild abrasive cleaning powder on a cloth saturated with isopropyl (rubbing) alcohol.

(4) Lightly sand the contact surface on the support bracket with fine grit sandpaper. Wipe bracket contact surface clean with a paper towel and alcohol.

INSTALLATION

(1) Apply adhesive to the act surface on the support bracket according as follows:

- crush the vial in the plastic housing of the accelerator to saturate the felt applicator;
- remove the paper sleeve;
- apply a generous amount of accelerator to the contact surface on the mirror support bracket;
- do not touch the support bracket contact surface after the accelerator has been applied.
- allow the accelerator to dry for at least five minutes; and

(2) Apply accelerator to the support bracket contact surface on the windshield glass. Allow the accelerator to dry for one minute.

(3) Install the mirror bracket on the windshield glass follows:

- apply one drop of adhesive at the center of support bracket contact surface on windshield glass;
- immediately apply an even coat of adhesive to the contact surface on the support bracket;
- align the support bracket with the position reference lines on the windshield glass, then
- press and hold the support bracket in-place for at least one minute.

Ensure that the mirror support bracket is correctly aligned because the adhesive will cure rapidly.

(4) Allow the adhesive to cure for 8-10 minutes, then remove any residue adhesive with an alcohol-dampened cloth.

(5) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror base on the support bracket.

WINDSHIELD SERVICE INFORMATION

URETHANE ADHESIVE BONDING

The windshield glass is bonded to the body pinchweld flanges with urethane adhesive (Fig. 8). This method of windshield installation complies with the applicable Federal Motor Vehicle Safety Standards (FMVSS).

WARNING: DO NOT OPERATE THE VEHICLE FOR AT LEAST 24 HOURS AFTER WINDSHIELD INSTALLATION. THE URETHANE ADHESIVE MAY NOT PERFORM PROPERLY IN THE EVENT OF A COLLISION IF IT IS NOT SUFFICIENTLY CURED. REFER TO THE MANUFACTURER OF THE URETHANE BEING USED FOR CURING TIME SPECIFICATIONS. WHEN INSTALLING THE WINDSHIELD, DO NOT USE URETHANE ADHESIVE IF THE EXPIRATION DATE ON THE PRODUCT HAS PASSED. SAFETY AND QUALITY ON THE REPAIR WOULD BE QUESTIONABLE.

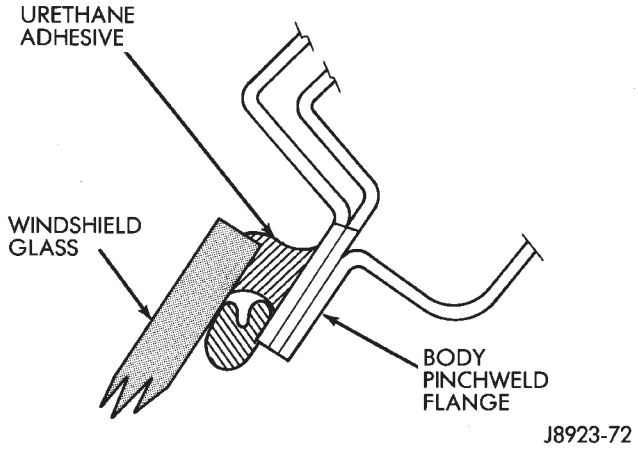

Fig. 8 Windshield Glass Bonding With Urethane

REMOVAL/INSTALLATION METHODS

Windshield glass removal is accomplished by the use of a razor knife and an electric hot knife to cut through the urethane adhesive. This removal method applies in all instances.

Depending on the circumstances, either one of two windshield glass installation methods can be used:

- the short method, and
- the extended method.

The short method is used when the windshield glass is removed intact, and the body opening and the pinchweld flanges do not require repair.

The extended method must be used when the body opening or a flange is damaged. The extended method must also be used when urethane no longer adheres to either the windshield glass or the pinchweld flanges.

WINDSHIELD GLASS REPLACEMENT

REMOVAL

(1) If the windshield glass short installation method will be used, ensure that a bead of urethane remains on the pinchweld flange.

(2) Cover the interior and exterior body surface areas with a protective covering.

(3) Remove the windshield wiper arms, reveal moulding, interior trim mouldings and rearview mirror.

(4) Make a cut around the **perimeter** of the windshield glass along the glass edge with a razor knife (Fig. 9).

(5) Clean the blade of the hot knife with solvent and a cloth. Sharpen the blade with a fine-tooth file.

CAUTION: When cutting through urethane with a hot knife, do not allow the knife blade to remain stationary at any location. Excessive heat will permanently soften urethane and cause complete replacement of the urethane.

(6) Start the hot knife blade between the glass and the urethane. Next, cut the adhesive as close to the glass edge as possible (Fig. 10). Allow as much adhesive to remain on the pinchweld flange as possible. **For best cutting results, clean the knife blade frequently with steel wool while the blade is hot.**

(7) Remove the windshield glass from the body opening.

(8) After the hot knife blade has cooled, clean the blade with solvent and a clean cloth.

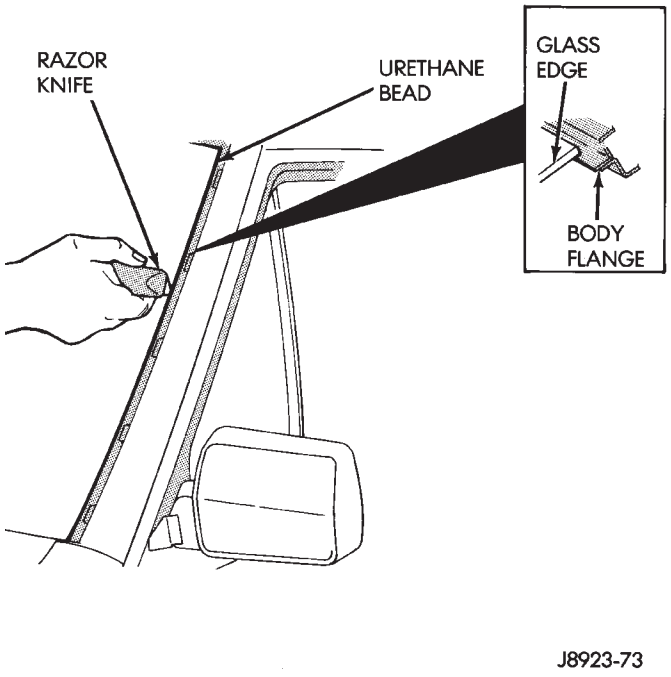

Fig. 9 Cutting Urethane Along the Glass Edge

INSTALLATION—SHORT METHOD

Normally, after a replacement windshield glass is installed, the rearview mirror bracket also requires

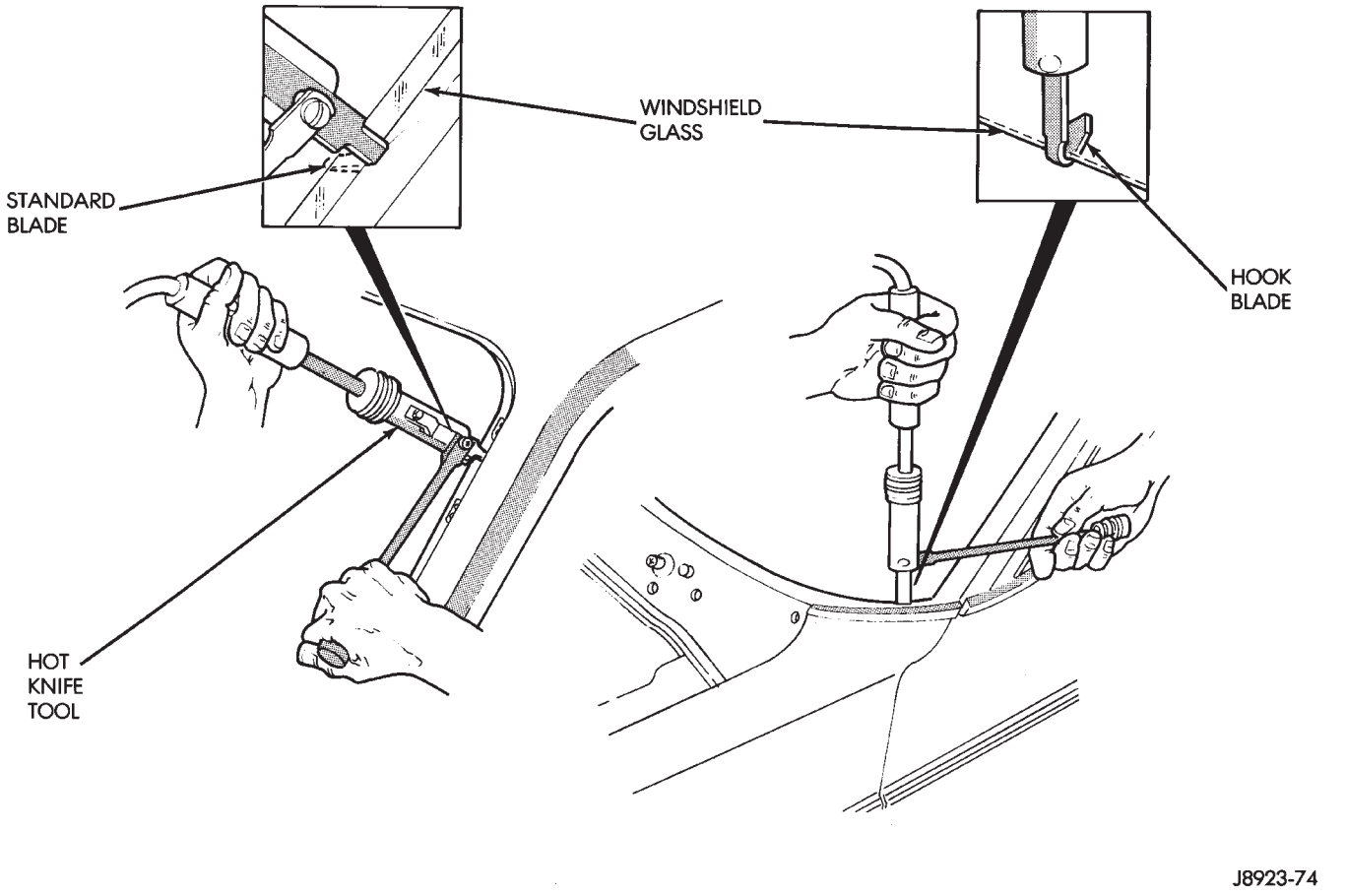

Fig. 10 Cutting Glass Urethane Adhesive With Hot Knife

installation. **Do not install the bracket until after the windshield glass installation is completed.**

(1) Inspect the windshield opening pinchweld flanges (Fig. 11). Prime any bare spots with urethane primer. Allow a minimum of 18 minutes for dry time.

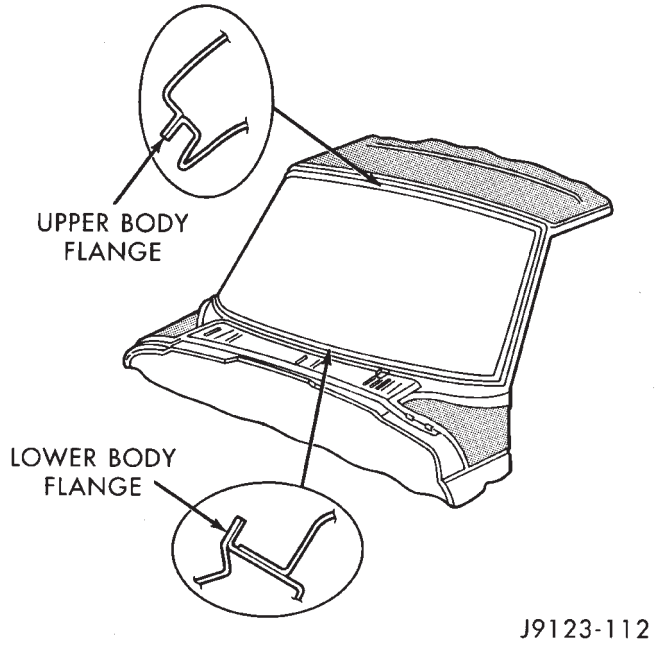

Fig. 11 Pinchweld Flanges

(2) Inspect urethane bead for high spots. Level bead by shaving off high spots with a razor knife.

(3) Inspect the reveal moulding retainer clips. Replace any broken, or loose clips (Fig. 12).

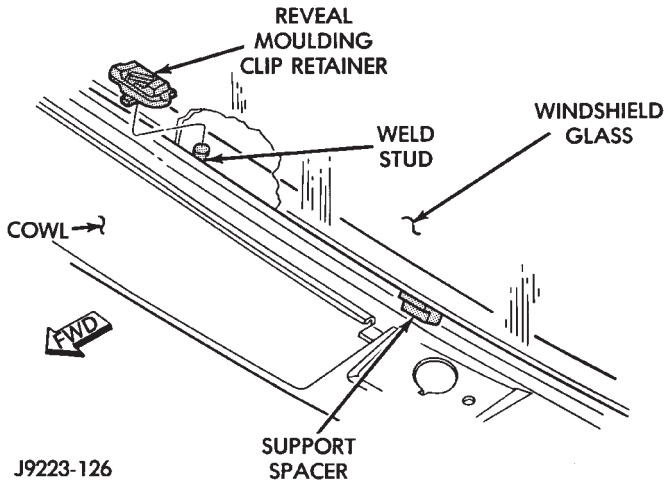

Fig. 12 Reveal Moulding Clip

(4) Clean the outer edge of windshield glass with naphtha or a equivalent product.

(5) Prime outer perimeter of interior side of glass 16 mm (5/8 inch) from edge. Use a wipe-off type urethane primer and wipe glass dry after primer application.

(6) Install two support spacers at the bottom of the windshield glass (Fig. 13).

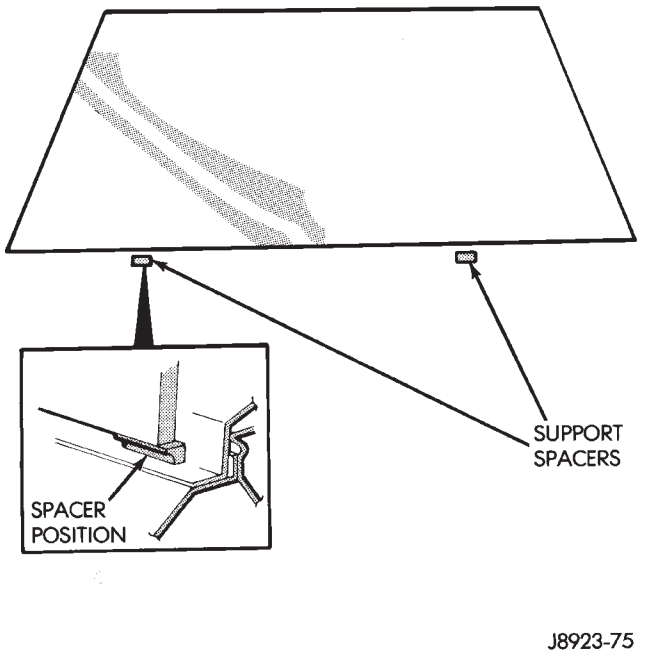

Fig. 13 Windshield Glass Bottom Support Spacers

(7) Place the glass on the pinchweld flanges and inspect for gaps in the urethane. Gaps in excess of 3 mm (1/8 inch) must be filled with urethane.

(8) Adjust windshield glass position until it is aligned with the flanges and adhesive. Next, make alignment marks on the glass and body.

(9) Remove the windshield glass (but not the support spacers) and position it on a flat surface.

(10) If the replacement windshield glass does not have blackout primer:

- attach a 25 mm (1 in) wide masking tape band around the interior side of the glass 16 mm (5/8 in) from the edge of the glass (Fig. 14);
- do not attach tape along the bottom of the glass and **attach it only to the inside of the glass;**

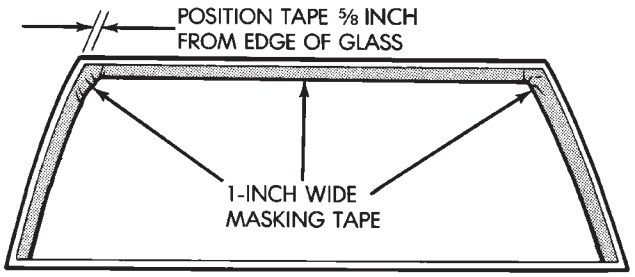

Fig. 14 Masking Tape Location For Blackout Primer

- clean the 16-mm (5/8-in) wide surface area around the glass with isopropyl alcohol;

CAUTION: Avoid spilling or dripping primer on painted surfaces. Clean spills or drips immediately. The primer will damage the paint if it remains on the surface for any length of time.

• thoroughly mix and apply glass blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass (Fig. 15); then

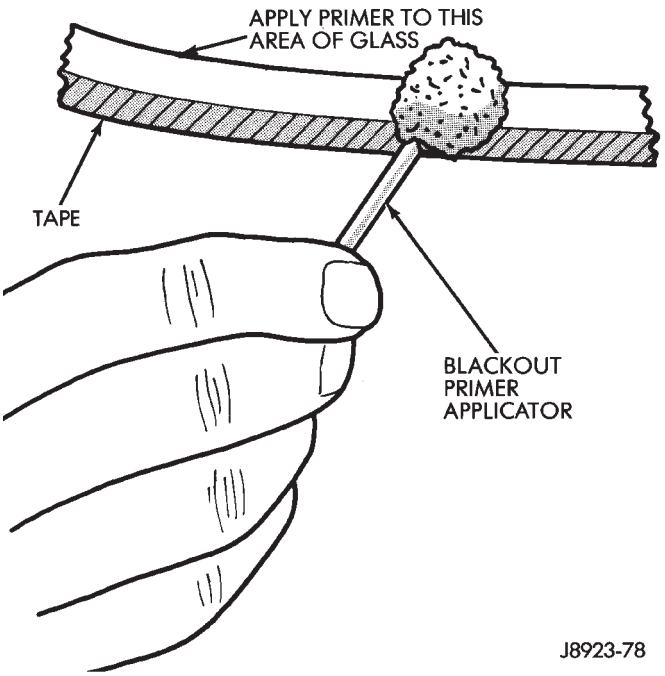

Fig. 15 Blackout Primer Application

• allow the primer to dry for at least 10-12 minutes.

(11) Cut the urethane adhesive applicator nozzle according to the instructions in Figure 16.

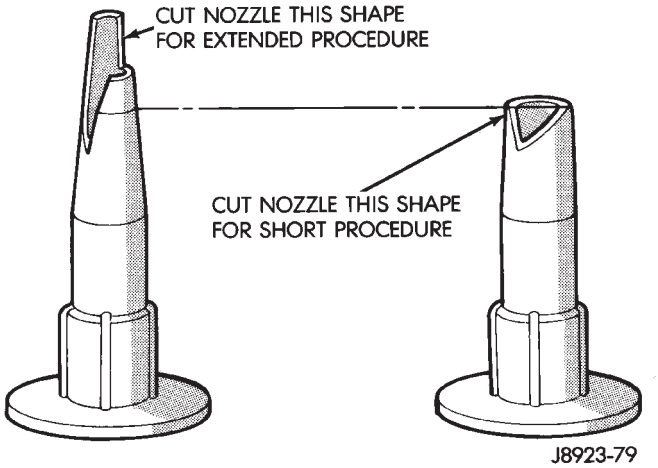

Fig. 16 Applicator Nozzle Preparation

(12) Apply a continuous, 6-mm (1/4-in) diameter bead of urethane adhesive to the surface area.

CAUTION: Be prepared to install glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(13) Align the glass with the reference marks and position the glass on the pinchweld flanges. Ensure that the windshield glass is correctly seated on the support spacers.

(14) Force the windshield glass inward just enough to wet-out and set the urethane. Use care to avoid excessive squeeze-out of adhesive.

(15) Water test the windshield with a water spray after installation. Do not direct high pressure streams of water directly at urethane. If any leaks are detected, apply urethane as necessary.

(16) Install reveal mouldings and (if used) remove the masking tape from the inner surface of the glass.

(17) Install all components and clean the vehicle.

(18) Open the vehicle windows to prevent interior pressure while the urethane is curing. **If not vented, pressure in the interior of the vehicle may interfere with proper glass bonding.**

(19) Install the rearview mirror on the bracket and tighten mirror setscrew to 2 N·m (15 in-lbs) torque.

INSTALLATION—EXTENDED METHOD

Normally, after a windshield is installed, the rearview mirror bracket also requires installation.**Do not install the bracket until after the windshield installation is completed.**

(1) Remove the all of urethane from all pinchweld flanges. Use an electric hot knife and a plow-type knife blade to remove the adhesive.

(2) Inspect and repair the windshield opening and pinchweld flanges (Fig. 11).

(3) Inspect and replace any reveal moulding clips if bent, distorted, broken or loose (Fig. 12).

(4) Prime the pinchweld flanges with a urethane base primer (Fig. 17). However, if the flange is color-coated with paint, prime the flanges with a paint finish primer. **This is important because urethane adhesive will not adhere to all color-coat paints.** Allow primer sufficient time to dry.

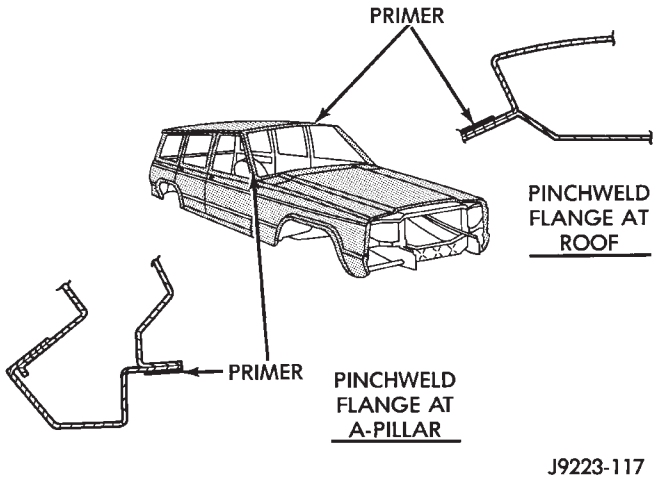

Fig. 17 Pinchweld Flange Primer

(5) Install the bottom support spacers and the stand-off spacers on the pinchweld flanges (Fig. 18). Ensure that all spacers are water soluble.

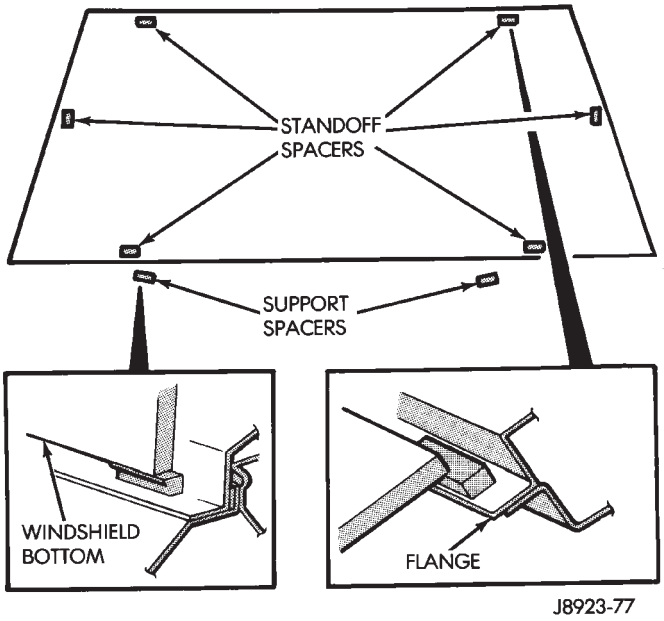

Fig. 18 Bottom Support and Stand-Off Spacers

(6) Install and inspect the fit of the windshield on the pinchweld flanges as follows:

- position windshield on spacers (Fig. 19) and adjust the position until it is aligned within windshield opening;

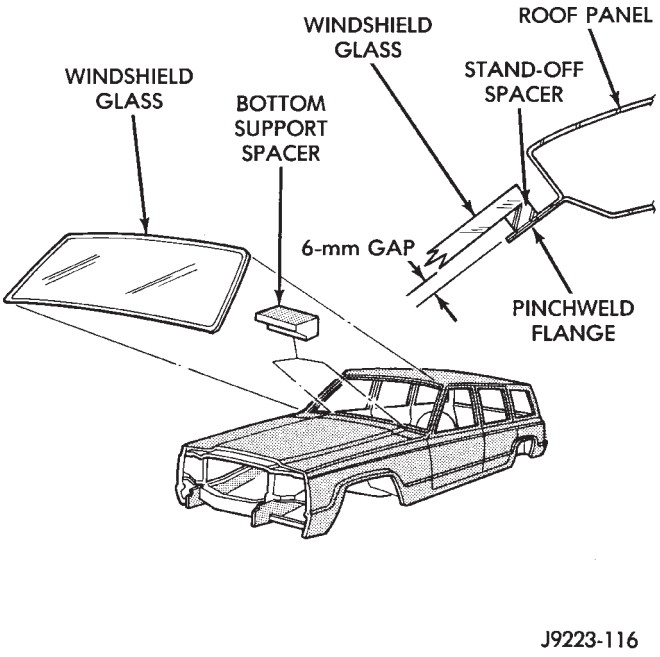

Fig. 19 Windshield Glass On Spacers

- measure the gap between the pinchweld flanges and glass around perimeter of the glass and flange;
- the gap should be at least 3 mm (1/8 in), but no more than 6 mm (1/4 in) at any point around the perimeter; and
- the flanges should also extend above the glass edge equally around the perimeter of the opening.

(7) If the pinchweld flanges require repair, remove the windshield glass and straighten, align, or repair the flange(s) as necessary.

(8) Position the windshield on the spacers and inspect the windshield fit again. Mark the windshield final position on the glass and body with a wax pencil (or use masking tape). The marks (or masking tape) will be used for installation alignment reference.

(9) If the replacement windshield does not have blackout primer:

- attach a 25-mm (1-in) wide masking tape band around the interior side of glass 16 mm (5/8 in) from edge of glass (Fig. 14);
- do not attach tape along the bottom of the glass and **attach only to the inside of glass;**
- thoroughly mix and apply blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass (Fig. 15); then
- allow the primer to dry for at least 10-12 minutes.

(10) Cut the urethane applicator nozzle according to the instructions in Figure 16.

(11) Apply a continuous bead of urethane to the surface area with blackout primer on the interior side of glass. The bead should be 6-mm (1/4-in) wide by 9-mm (3/8-in) deep for best results.

CAUTION: Be prepared to install the windshield immediately after applying the urethane adhesive. Most urethane adhesive begins to cure within 10-15 minutes.

(12) Align the windshield with the wax pencil installation alignment reference marks (or the tape strips). Position the windshield on pinchweld flanges and spacers (Fig. 20).

(13) Force the windshield inward just enough to wet-out and set the urethane. Use care to avoid excessive squeeze-out of adhesive.

(14) Water test the windshield with a water spray after installation. Do not direct high pressure streams of water directly at the urethane. If any leaks are detected, apply urethane as necessary.

(15) Install the windshield reveal mouldings and (if used) remove the masking tape from the inner surface of glass.

(16) Install all components and clean the vehicle. If necessary, refer to the installation procedures.

(17) Open the vehicle windows to prevent interior pressure while the urethane adhesive is curing. **If not vented, pressure in the interior of vehicle will interfere with glass bonding.**

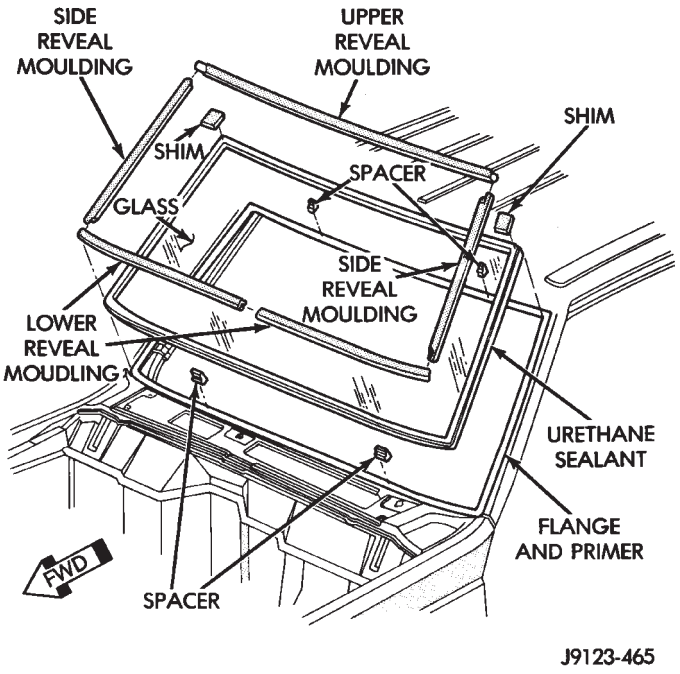

Fig. 20 Windshield Glass Installation

(18) Install the rearview mirror on the bracket and tighten the mirror setscrew to 2 N·m (15 in-lbs) torque.

REAR QUARTER VENT WINDOW GLASS—XJ VEHICLES

REMOVAL

(1) Remove the vent window handle retaining pin and nut (Fig. 21).

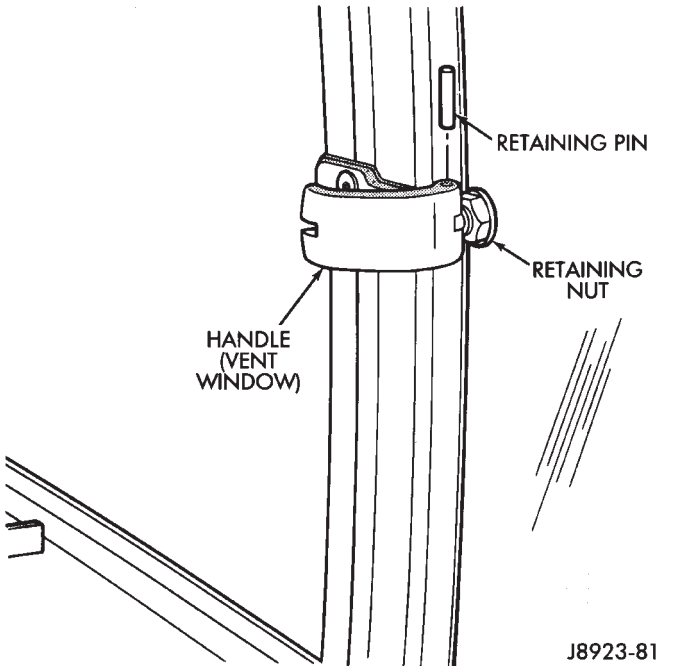

Fig. 21 Vent Window Handle Removal/Installation

(2) Remove the hinge-to-glass screws and remove the window glass. If glass adheres to the hinges, remove the glass by carefully pushing out hinge screw inserts.

INSTALLATION

(1) Position the vent window glass at the hinges and install the screws.

(2) Install the handle, pin and nut (Fig. 21).

(3) Test the vent window for water leaks.

REAR QUARTER WINDOW GLASS/REAR QUARTER PLASTIC INSERT —XJ VEHICLES

REMOVAL

(1) If equipped, remove the quarter window reveal moulding (Fig. 22).

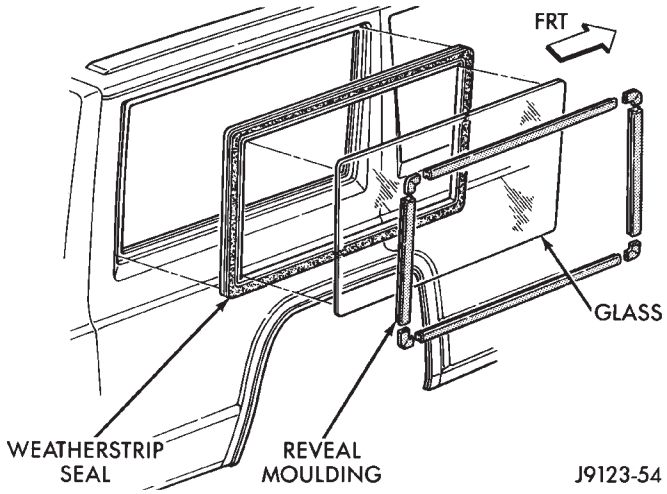

Fig. 22 Quarter Window Reveal Moulding, Glass and Seal

(2) Remove the quarter window interior trim covers.

(3) Separate the weatherstrip seal lip from the window opening flanges. Use a pry tool and carefully push the window glass and seal outward.

(4) Remove the weatherstrip seal and window glass from window opening.

(5) Remove the weatherstrip seal from the window glass (Fig. 23).

INSTALLATION

(1) Clean the original sealant from the weatherstrip channels and window opening flanges.

(2) Apply a 4-mm (1/6-in) diameter bead of sealant to the window channel in the weatherstrip seal.

(3) Install the weatherstrip on the window glass. Install the seal installation cord in the window opening flange channel (Fig. 24) using as follows:

- moisten a length of 6-mm (1/4-in) diameter cord with a soap and water solution;
- ensure that the cord is long enough to go all the way around the perimeter of the weatherstrip; and
- insert the cord into the window opening flange channel in the weatherstrip seal.

(4) Apply a 6-mm (1/4-in) diameter bead of sealant to the window opening flanges.

(5) For two-door vehicles, apply a 3-mm (1/8-in) diameter bead of sealant at the quarter panel applique and liftgate pillar seam.

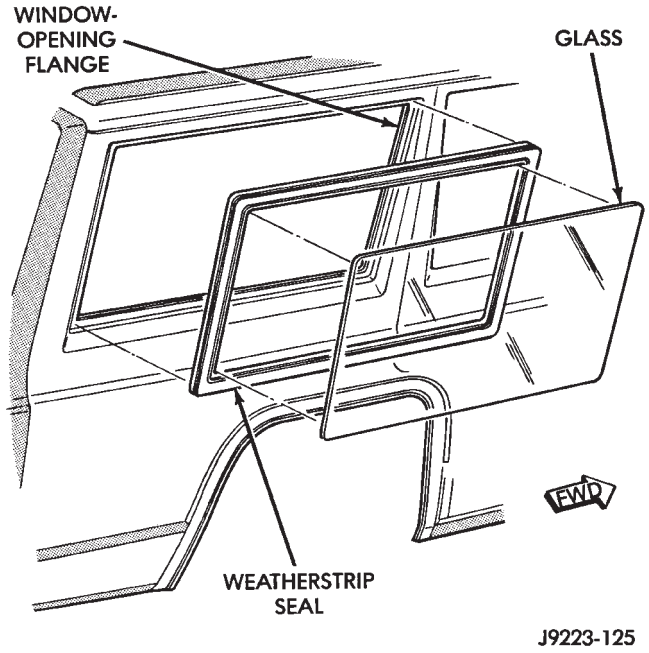

Fig. 23 Quarter Window Glass and Seal

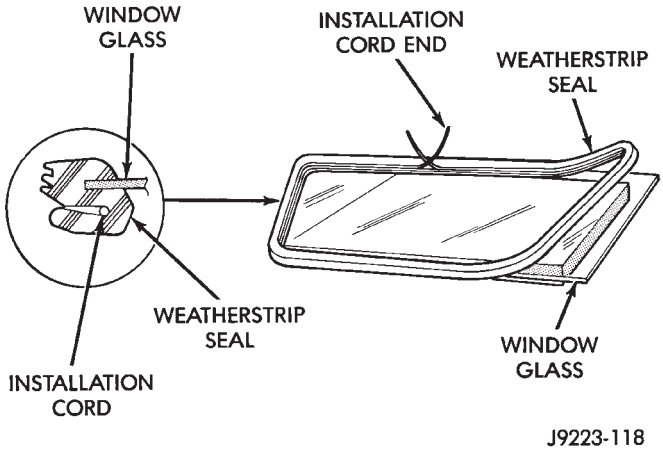

Fig. 24 Weatherstrip Seal and Cord Installation

(6) Position the quarter window glass and the weatherstrip seal in the window opening (Figs. 25 and 26) with the free ends of the cord inside the vehicle (Fig. 27).

(7) Pull on each end of the cord to pull the weatherstrip seal channel lip over the window opening flanges.

(7) Test the vent window for water leaks.

(8) Install the interior trim cover.

(9) If equipped, install the quarter window reveal moulding.

LIFTGATE WINDOW GLASS—XJ VEHICLES

REMOVAL

(1) If equipped, remove the liftgate window reveal moulding (Fig. 30).

(2) Remove the interior trim panels.

(3) Use a pry tool to separate the weatherstrip seal lip from the window opening flanges. Push the glass and weatherstrip seal outward from the top toward the rear of the vehicle.

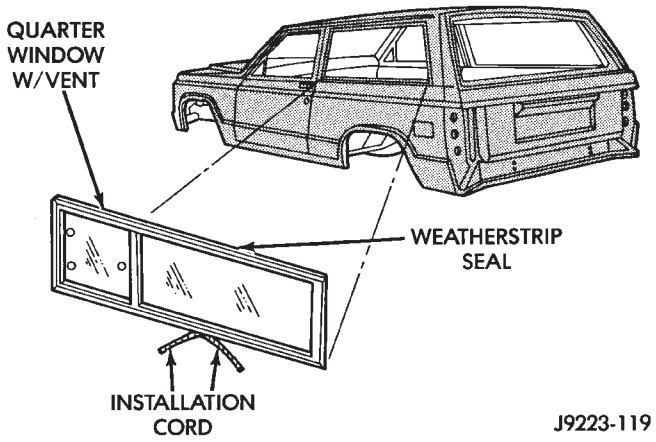

Fig. 25 Quarter Window With Vent

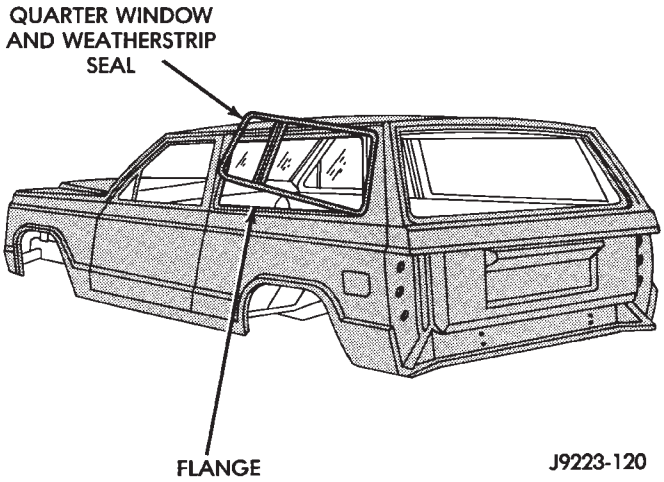

Fig. 26 Quarter Window Glass and Seal In Window Opening

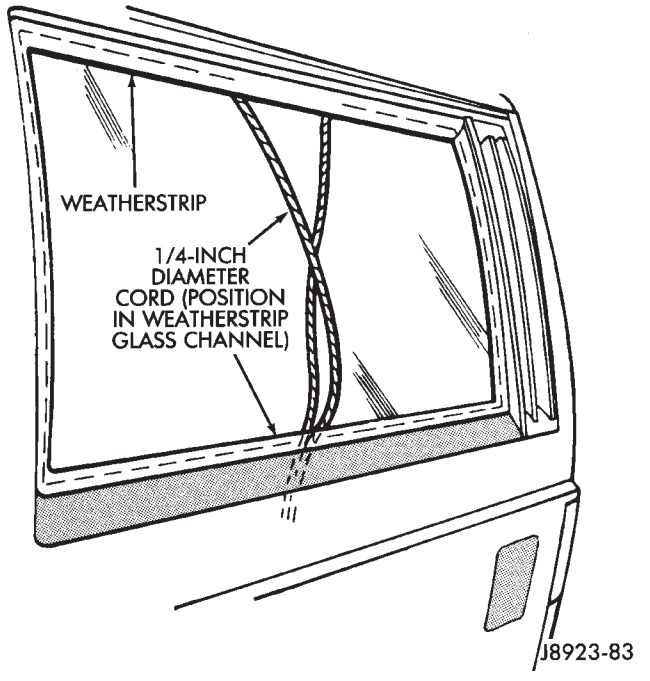

Fig. 27 Quarter Window Glass and Seal Installation

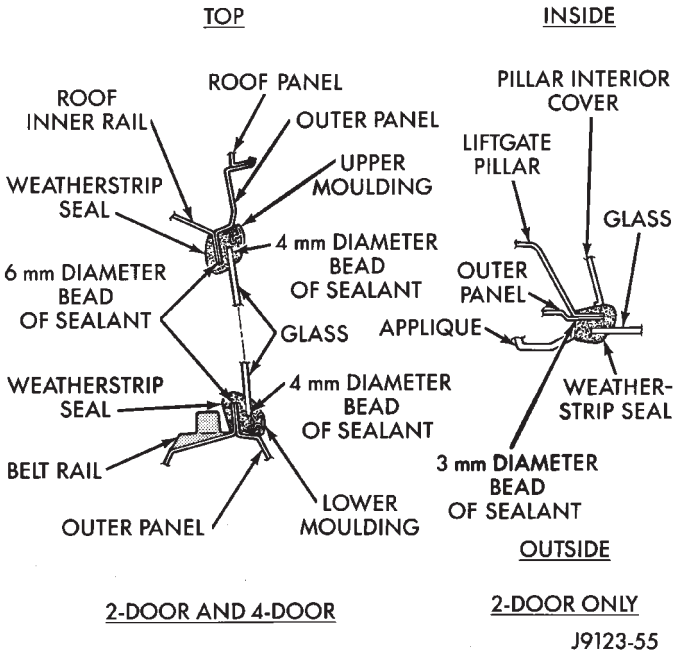

Fig. 28 Quarter Window Glass and Seal Installed

(4) Remove the glass and weatherstrip seal from the liftgate (Fig. 30).

(5) Remove the weatherstrip seal from the window glass.

(6) Clean the weatherstrip channels and window opening flanges.

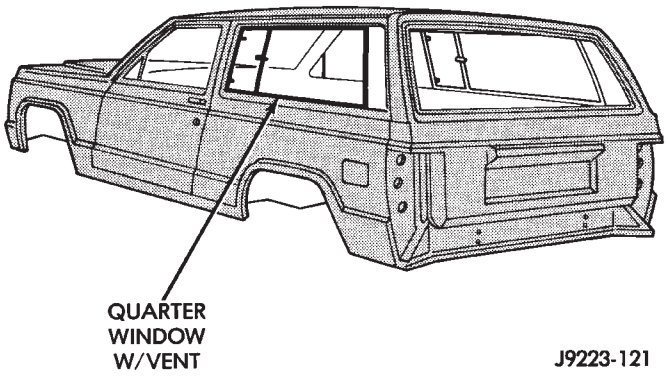

Fig. 29 Quarter Window Glass With Vent Installed

INSTALLATION

(1) Apply a 4-mm (1/6-in) diameter bead of sealant to liftgate glass channel in the weatherstrip seal (Fig. 30).

(2) Install weatherstrip seal on the glass (Fig. 31). Install the seal installation cord in the window opening channel as follows:

- moisten a length of 6-mm (1/4-in) diameter cord with a soap and water solution;
- insert the cord into the window opening flange channel in the weatherstrip seal.

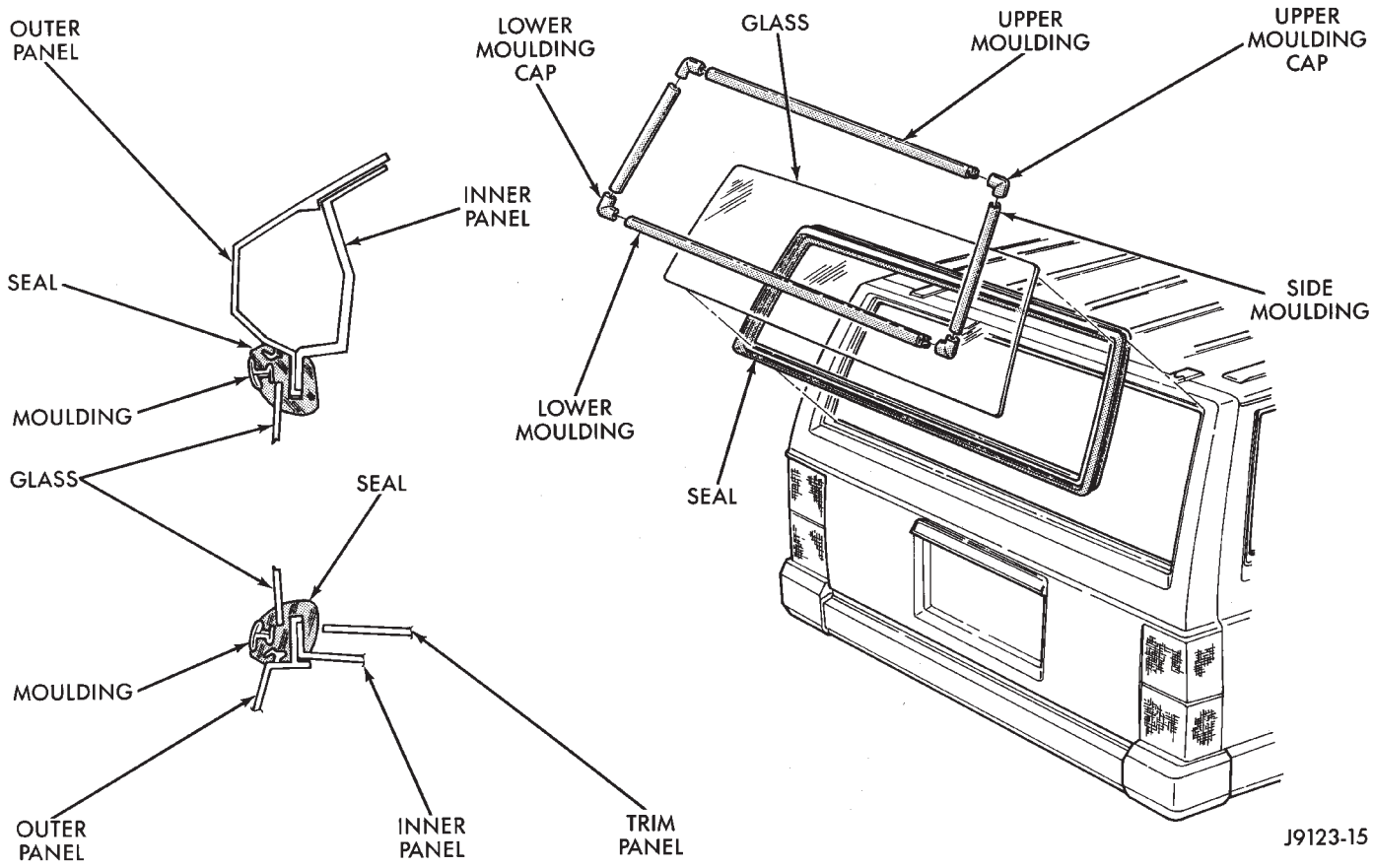

Fig. 30 Liftgate Window Glass Reveal Moulding, Glass and Seal

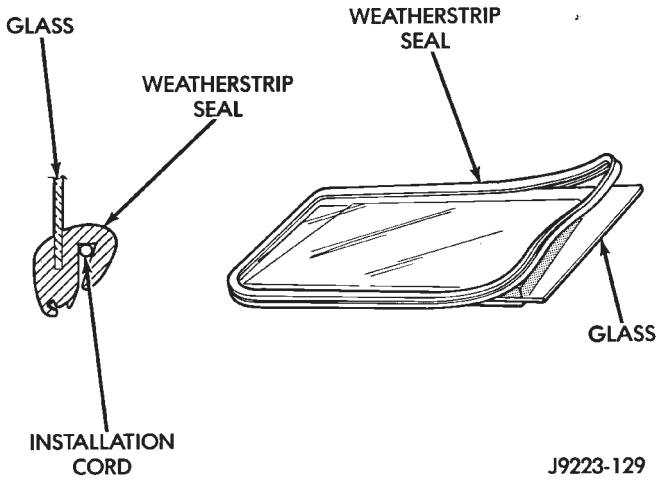

Fig. 31 Weatherstrip Seal and Cord Installation

(3) Apply a 6-mm (1/4-in) diameter bead of sealant around the perimeter of the window opening flange in the liftgate (Fig. 30).

(4) Install the window glass and the weatherstrip seal in the window opening with the cord according to the following instructions:

- position the window glass and the weatherstrip seal in the window opening with the free ends of the cord inside the vehicle (Fig. 32); and

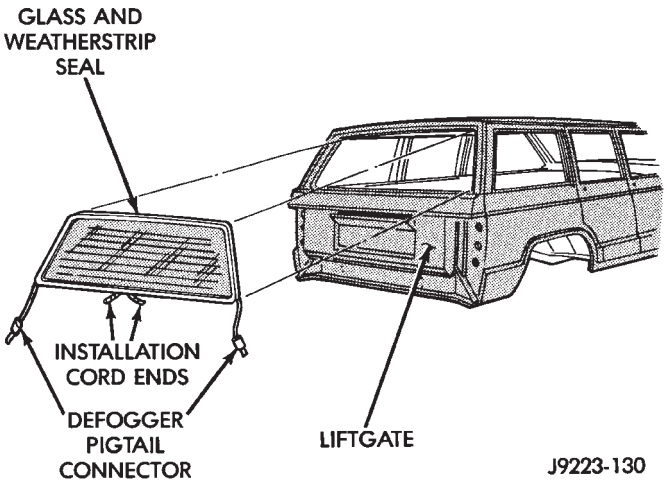

Fig. 32 Liftgate Window Glass Installation With Cord

- pull on each end of the cord to pull the weatherstrip seal channel lip over the window opening flange (Fig. 33).

(5) Test the liftgate window for water leaks.

(6) Install the interior trim covers.

(7) If equipped, install the liftgate window reveal moulding (Fig. 30).

FIXED GLASS WATER LEAK DETECTION AND REPAIR

SERVICE INFORMATION

Water leaks around the windshield or a fixed window glass can be sealed without removing the glass. If the windshield/window glass is bonded and only has a small leak, seal it with a liquid butyl sealant. If the weatherstrip seal or urethane adhesive has a large break, a urethane adhesive must be used to seal the leak.

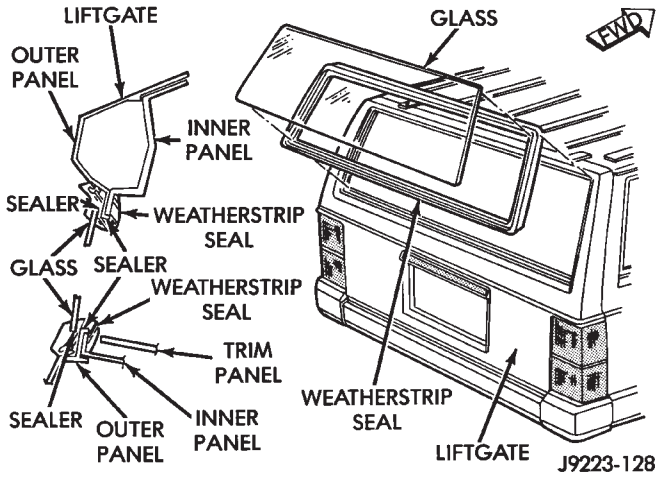

Fig. 33 Liftgate Window Glass and Weatherstrip Seal

LEAK TEST

Water test the windshield/window with a spray only. **Do not use hard streams of water.** Work from the bottom to the top of windshield/window glass.

If a water leak exists between the glass and weatherstrip seal (or between the seal and a body flange):

- push the glass outward at the leak area, and
- determine the extent of the gap.

Push the glass outward while a helper sprays the windshield/window with water.

SEALING MINOR LEAK AREAS

(1) Thoroughly clean and remove all foreign material from the leak area. Dry area with compressed air.

(2) Seal the leak area with butyl sealant. Allow the sealant to cure for at least 1/2 hour. Next, water test the glass to ensure that the leak is sealed.

SEALING MAJOR LEAK AREAS

(1) Thoroughly clean the leak area.

(2) As applicable, apply primer to either the windshield/window or weatherstrip seal leak area. Use blackout primer on the windshield/window and urethane primer on the weatherstrip seal.

(3) Apply urethane adhesive to the leak area. Use an adhesive cartridge with a pointed nozzle.

(4) Water test the windshield/window immediately with cold water spray. Allow water to spill over the edge of the windshield/window and weatherstrip seal. **Do not direct a hard stream of water on recently applied urethane.**

(5) Apply additional urethane adhesive, if necessary.

(6) Remove any excess urethane adhesive.

UNDERBODY COMPONENTS

INDEX

SERVICE INFORMATION

In some cases, components in the following procedures either support, or are concealed by other components. When necessary, refer to component removal procedure for service access.

FRONT SKID PLATE

REMOVAL

(1) Remove the screws that attach skid plate to side sills (Fig. 1).

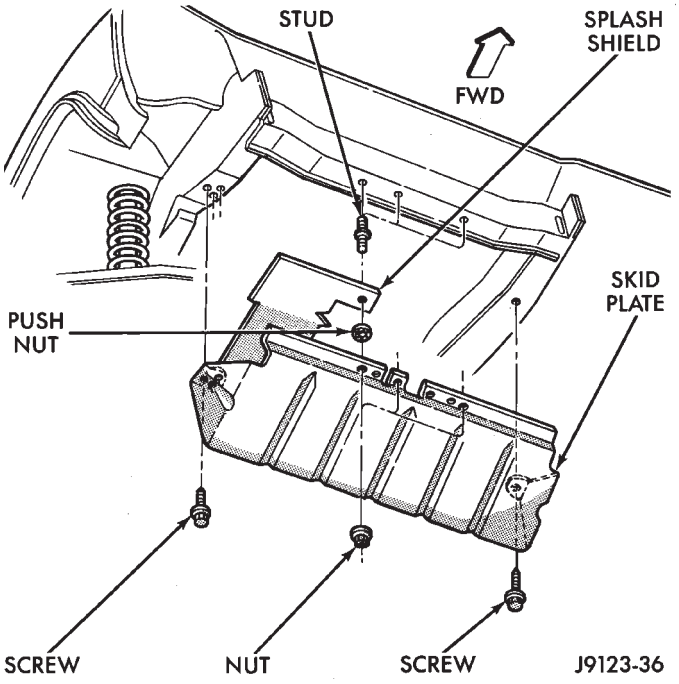

Fig. 1 Front Skid Plate Removal/Installation

(2) Remove the nuts that attach the skid plate to the crossmember (Fig. 1).

(3) Remove the skid plate from the vehicle (Fig. 1).

INSTALLATION

(1) Position the skid plate at front crossmember and side sills (Fig. 1).

(2) Install the nuts to attach the skid plate to crossmember.

(3) Install the screws to attach skid plate to side sills.

TRANSFER CASE SKID PLATE

REMOVAL

(1) Support the skid plate.

(2) Remove the bolts that attach the skid plate to the transmission support crossmember and frame sill (Fig. 2).

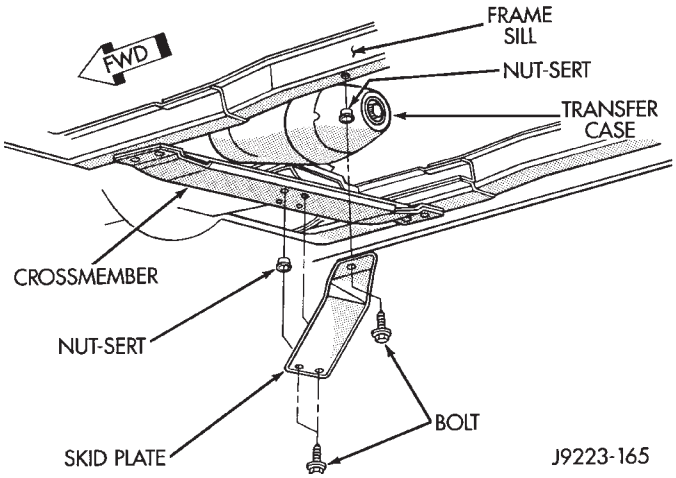

Fig. 2 Transfer Case Skid Plate

(3) Remove the support and skid plate from the vehicle.

INSTALLATION

(1) Position and support the skid plate at the frame sill and transmission support crossmember (Fig. 2).

(2) Attach the skid plate to the frame sill and crossmember with bolts. Tighten bolts to 22 N·m (16 ft-lbs) torque.

FUEL TANK SKID PLATE

REMOVAL—XJ VEHICLES

(1) Position a support under skid plate.

(2) Remove the bolts that attach skid plate to underbody side rails (Figs. 3 and 4).

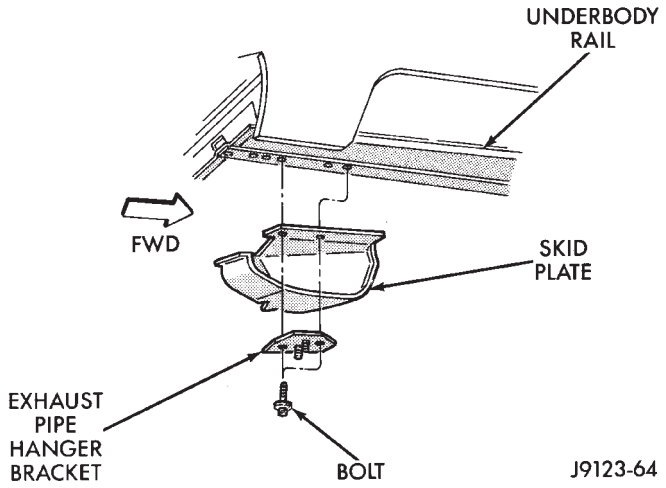

Fig. 3 Fuel Tank Skid Plate W/O Trailer Hitch Or Tow Hook

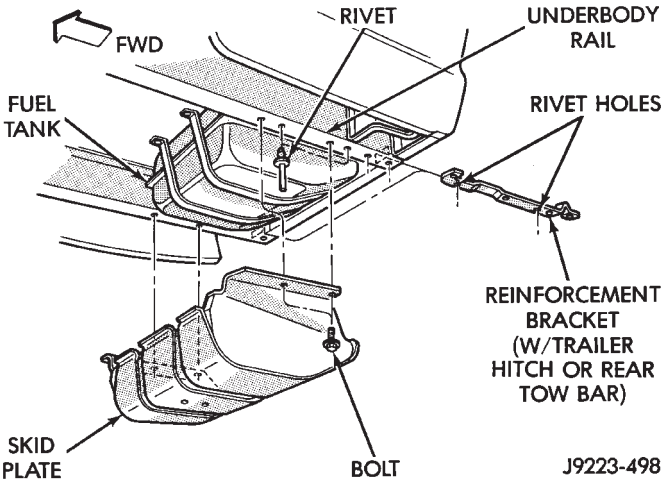

Fig. 4 Fuel Tank Skid Plate With Trailer Hitch Or Tow Hook

(3) Remove the support and the skid plate from the vehicle.

INSTALLATION—XJ VEHICLES

(1) Position and support skid plate under fuel tank.

(2) Install bolts to attach the skid plate to underbody rails. Tighten the bolts to 50 N·m (37 ft-lbs) torque.

(3) Remove the support from under skid plate.

CATALYTIC CONVERTER/MUFFLER/TAILPIPE SUPPORT BRACKETS

REMOVAL

(1) As applicable, detach the catalytic converter, muffler or tailpipe support bracket from insulator. Remove the insulator from bracket.

(1) As applicable, install nuts and bolts, or screws that attach bracket to frame. Tighten nuts/screws to 21 N·m (16 ft-lbs) torque.

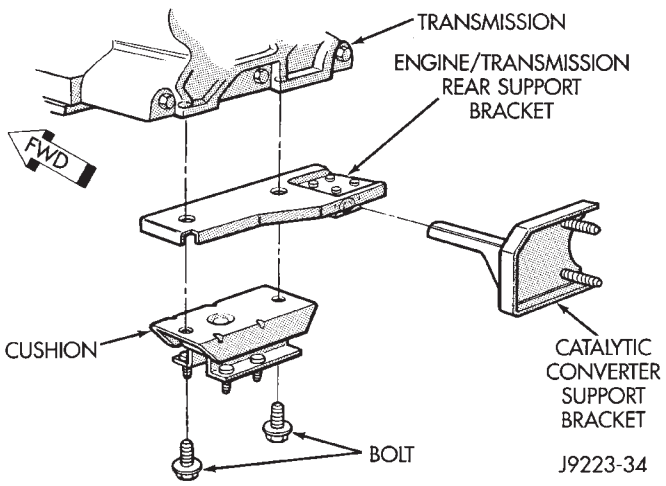

Fig. 1 Catalytic Converter Support Bracket

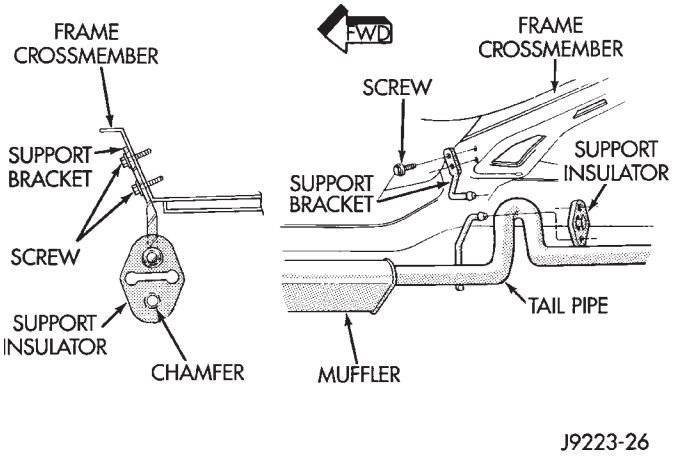

Fig. 2 Muffler/Tailpipe Support Bracket—XJ Vehicles

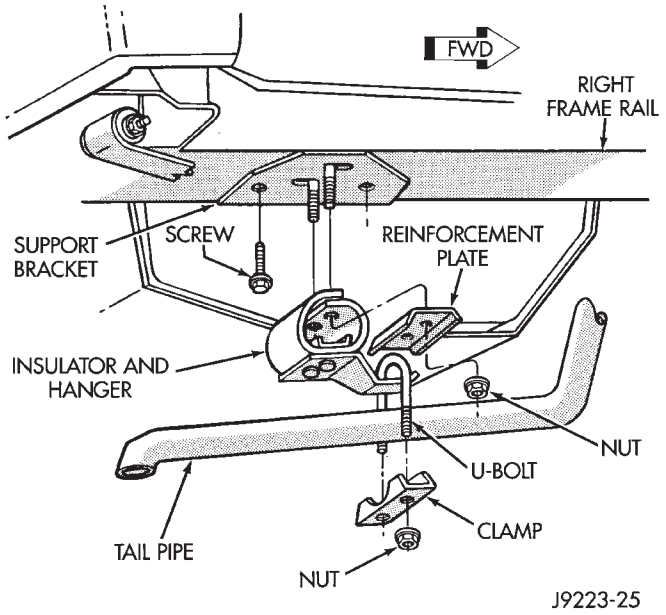

Fig. 3 Tailpipe Support Bracket—XJ Vehicles

(2) Install insulator on support bracket.

(3) Attach catalytic converter, muffler or tailpipe insulator to support hanger to insulator.

FUEL AND BRAKE FLUID TUBE RETAINER CLIP

REMOVAL

(1) Remove the fuel/brake fluid tubes from clip grooves.

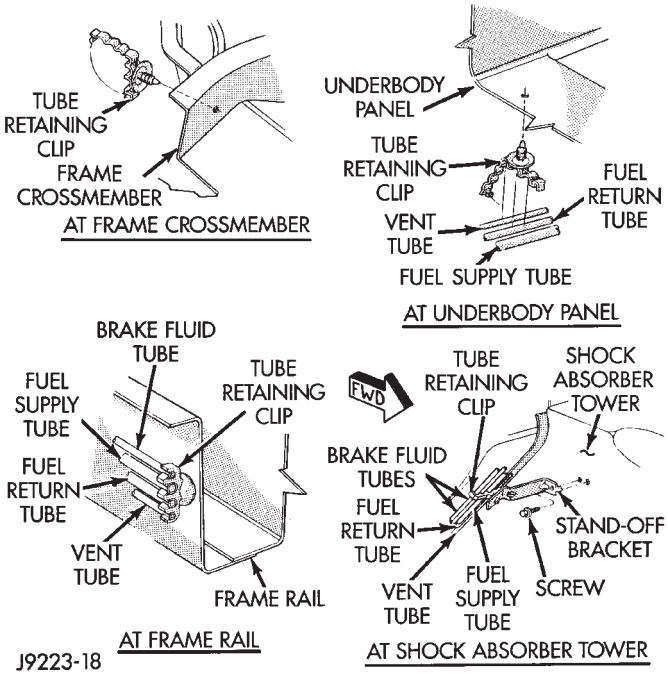

Fig. 4 Fuel and Brake Tube Serrated/Bracket-Type Retainer Clips—XJ Vehicles

(2) As applicable, pry serrated clip outward and remove it from frame rail hole, or remove stand-off bracket screw.

INSTALLATION

(1) Position clip at the frame/panel hole.

(2) As applicable, force serrated clip inward and seat it against the frame/panel, or install the stand-off bracket screw.

(3) Insert fuel/brake fluid tubes in clip grooves and press inward to seat them.

FUEL FILTER BRACKET

REMOVAL

(1) Remove screws that attach fuel filter bracket to frame rail.

(2) Remove the screw from fuel filter bracket clamp.

(3) Remove the clamp and fuel filter from bracket.

(4) Remove the bracket from filter.

INSTALLATION

(1) Position fuel filter bracket on filter.

(2) Position clamp on bracket and install screw. Tighten screw to 8 N·m (74 in-lbs) torque.

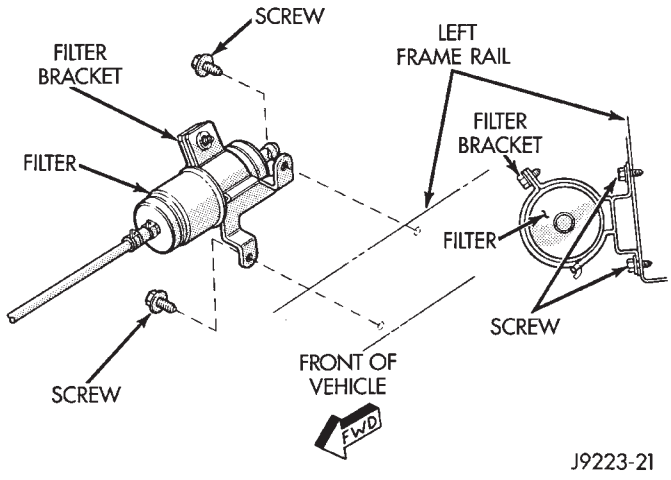

Fig. 5 Fuel Filter Bracket Removal/Installation

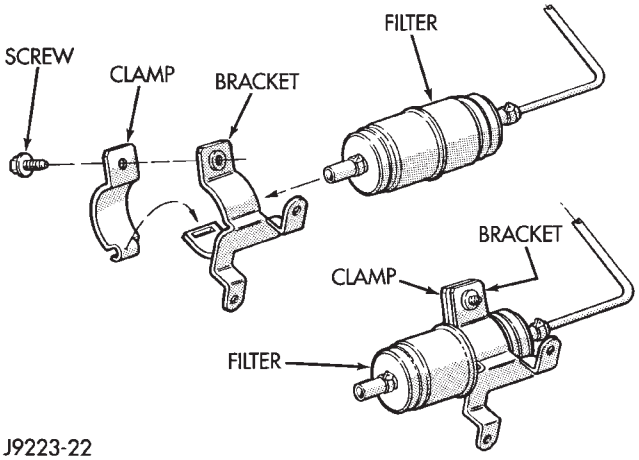

Fig. 6 Fuel Filter Bracket Clamp Removal/Installation

(3) Position fuel filter bracket on frame rail.

(4) Install the screws that attach bracket to frame rail. Tighten screws to 42 N·m (31 ft-lbs) torque.

FUEL FILLER HOSE SPLASH SHIELD—XJ VEHICLES

REMOVAL

(1) Remove the screws that attach fuel filler hose splash shield to wheelhouse panel and frame rail.

(2) Remove the hose splash shield from wheelhouse panel and frame rail (Fig. 7).

INSTALLATION

(1) Position fuel filler hose splash shield at wheelhouse panel and frame rail.

(2) Install screws to attach splash shield to wheelhouse panel and frame rail.

FUEL TANK SUPPORT STRAP

SERVICE INFORMATION

XJ fuel tank support straps are attached to the un-

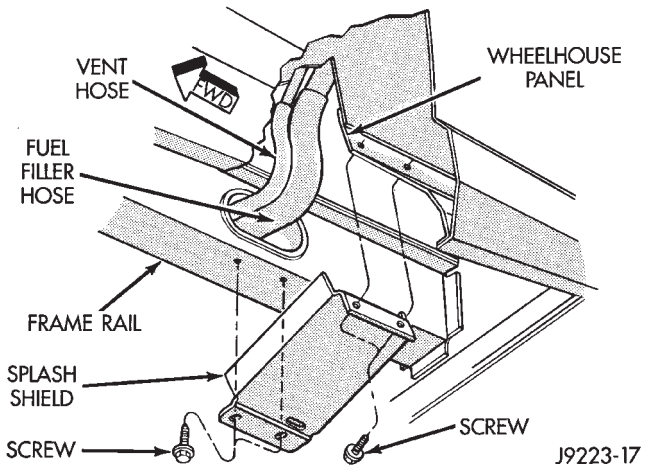

Fig. 7 Fuel Filler Hose Splash Shield—XJ Vehicles

derside of the vehicle via T-slots and hole-slots in the frame members.

REMOVAL

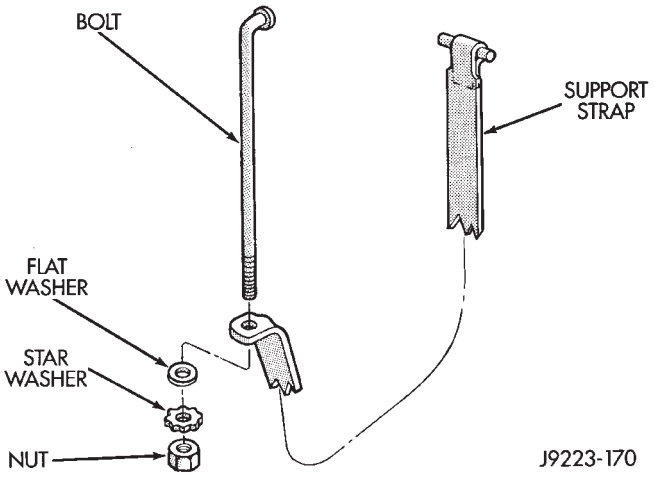

Fig. 8 Fuel Tank Support Strap—XJ Vehicles

(1) If equipped, position a support under skid plate.

(2) If equipped, remove the bolts that attach skid plate to underbody side rails.

(3) If applicable, remove the support and skid plate from fuel tank.

(4) Support fuel tank.

(5) Loosen nut from fuel tank support strap bolt to allow bolt head to be removed from hole-slot in frame member.

(6) Remove the strap T-end from frame member T-slot.

(7) Separate support strap from fuel tank and remove it from vehicle.

INSTALLATION

(1) Position support strap around fuel tank.

(2) Insert strap T-end in frame member T-slot.

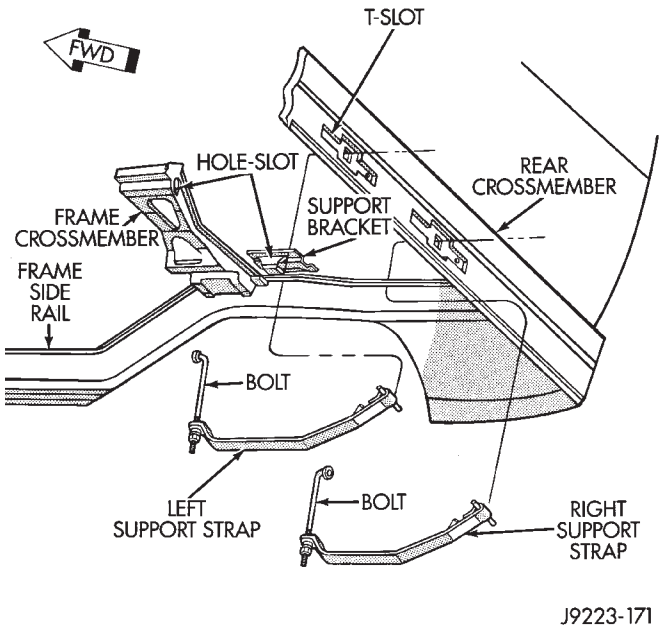

Fig. 9 Fuel Tank Support Straps—XJ Vehicles

(3) Insert bolt in hole-slot in frame member. Tighten nut on the bolt until bolt-head and T-end are seat and strap is tight against the bottom of fuel tank.

(4) Remove the support from the fuel tank.

(5) If removed, position and support and the fuel tank skid plate under the fuel tank.

(6) If applicable, install the bolts that attach the skid plate to the underbody side rails. Tighten the bolts to 50 N·m (37 ft-lbs) torque.

(7) Remove the support from under the skid plate.

REAR TOW HOOK—XJ VEHICLES

REMOVAL

(1) Remove the bolts that attach tow hook bracket to the frame rail and reinforcement bracket.

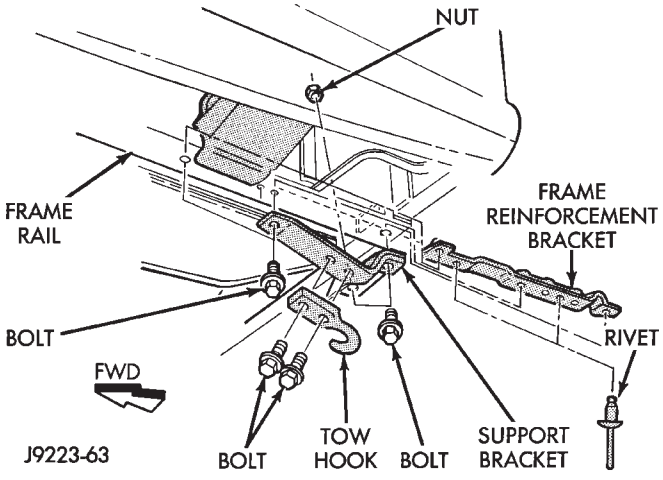

Fig. 10 Rear Tow Hook—XJ Vehicles

The reinforcement bracket is held on the frame rail with two blind rivets.

(2) Remove the bracket and tow hook from frame rail.

INSTALLATION

(1) Position bracket and tow hook on the frame rail.

(2) Install bolts that attach tow hook bracket to frame rail and reinforcement bracket. Tighten bolts to 75 N·m (55 ft-lbs) torque.

TRAILER HITCHES

CLASS III HITCH—XJ VEHICLES

A class III weight-distributing/equalizer type hitch can be used to tow a trailer:

- having a maximum gross weight of 5,000 lbs/2250 kg, and
- having a maximum tongue weight of 750 lbs/332 kg).

The following vehicle basic equipment is required for class III trailer towing:

- P205/75R15 or larger tires;
- full size spare tire;
- trailer sway control;
- trailer tow wire harness and connector;
- heavy duty turn signal flasher element;
- heavy duty axle (with synthetic lubricant);
- heavy duty cooling system;
- heavy duty generator/battery;
- auxiliary automatic transmission fluid cooler; and
- I-6, 4.0L engine.

Wide-angle type door mirrors are recommended but not required.

WIRE HARNESS CONNECTORS

CLASS I HITCH CONNECTOR

The trailer tow wire harness connector for class I trailer hitches is a 5-terminal, in-line type connector. Terminal 5 is the source for vehicle ground.

CLASS III HITCH CONNECTOR

The trailer tow wire harness connector for class III trailer-tow hitches is a 7-terminal, circular type connector.

The 12-volt circuit for the trailer is protected from overloads. A auto-reset type circuit breaker is located in the trailer tow wire harness near the plug-in relays.

CAUTION: The trailer tow wire harness package does not include a vehicle battery isolator unit. Because of this, the trailer battery can totally discharge the vehicle battery if the engine is not operated for an extended period of time.

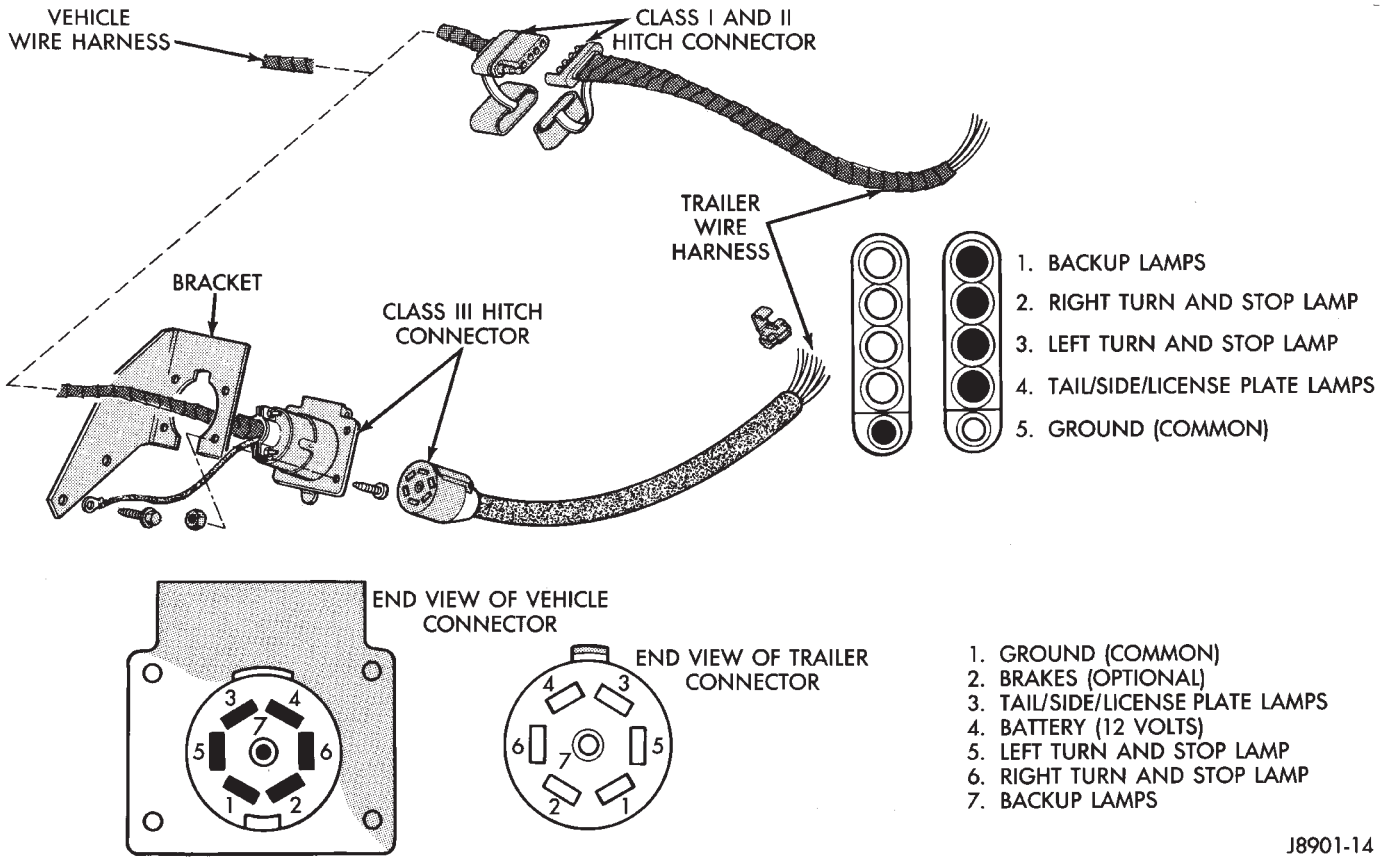

Fig. 11 Trailer Tow Wire Harness Connectors

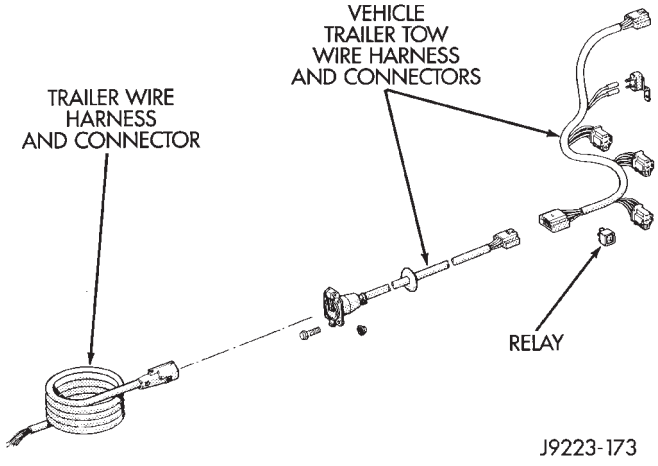

Fig. 12 Class III Trailer Tow Wire Harness and Connectors

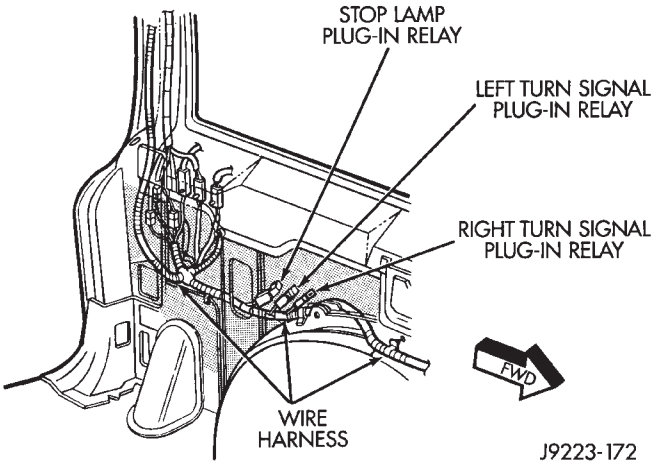

Fig. 13 Class III Trailer Tow Wire Harness Plug-In Relays

A blue wire (without a connector) located under instrument panel near fuse panel is available for trailer electric brake control unit.

The stop lamp and turn signal plug-in relays are located behind left quarter trim panel.

HITCH REMOVAL—XJ VEHICLES

An XJ class III, weight-distributing/equalizer type hitch is comprised of:

- a towing tube with a ball mount receptacle, and
- various reinforcement/support brackets that are attached to the vehicle frame sills and rear crossmember with bolts.

(1) If necessary, remove the trailer tow wire harness connector from the hitch.

(2) Support the hitch.

(3) Remove the bolts that attach the towing tube to the frame sills and reinforcement bracket. If equipped, remove the fuel tank skid plate.

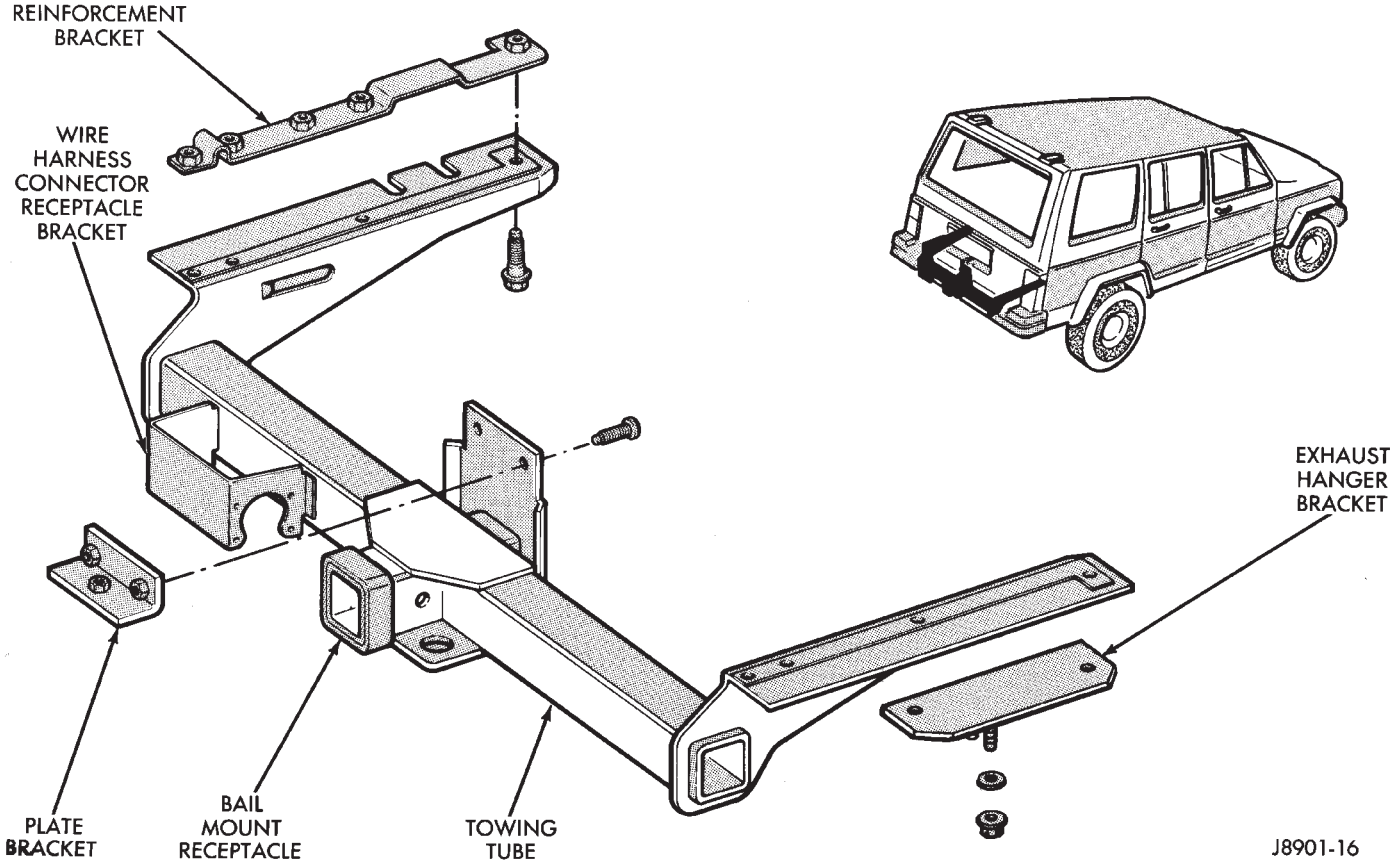

Fig. 14 Equalizer Type Hitch—XJ Vehicles

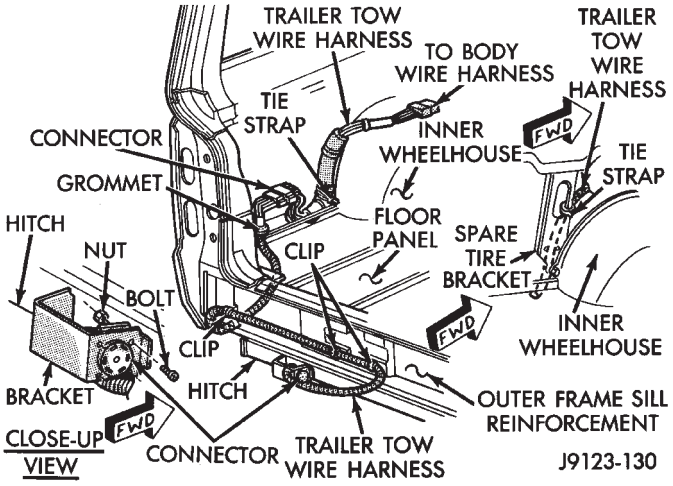

Fig. 15 Trailer Tow Wire Harness Connector

The reinforcement brackets are held on the frame sills with two blind rivets.

(4) Remove the bolts from the plate bracket and rear crossmember and lower the support and hitch.

INSTALLATION—XJ VEHICLES

(1) Install frame reinforcement brackets, if removed. Slide the brackets through the vehicle rear sill openings and hold in position on the frame sills with blind rivets.

(2) Place hitch on a lifting device. Raise, position hitch at the proper location for installation on vehicle and support it.

(3) If equipped, position fuel tank skid plate on vehicle frame sills.

(4) Loosely install the bolts to attach the towing tube (and the skid plate) to frame sills and reinforcement brackets.

(5) Position the plate bracket and install the attaching bolts through the vehicle rear crossmember.

(6) Tighten all bolts/nuts to the specified torque:

- towing tube-to-reinforcement bracket bolt, and
- plate bracket-to-rear crossmember nut.

(7) Remove the lift/support and, if removed, attach the trailer wire harness connector to the hitch.

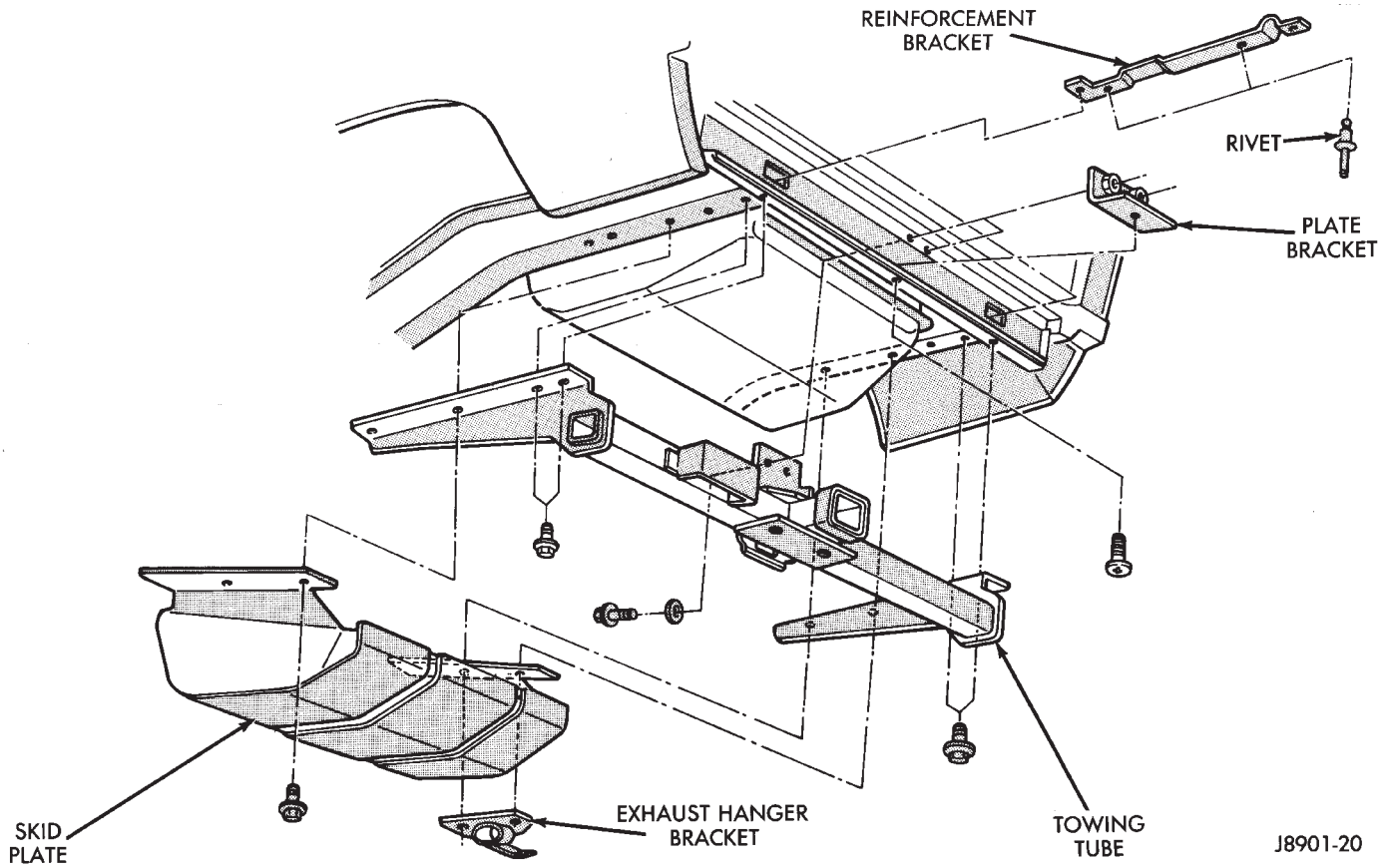

Fig. 16 Reinforcement Bracket and Hitch Installation

INTERIOR COMPONENTS

INDEX

INSTRUMENT CLUSTER BEZEL

REMOVAL

(1) Remove the bezel retaining screws (Fig. 1).

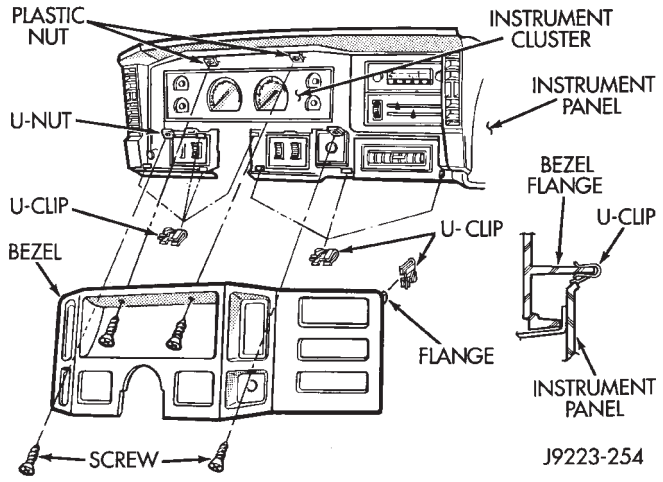

Fig. 1 Instrument Cluster Bezel Removal/Installation

(2) Separate the bezel from the U-clips and remove it from the upper section of the instrument panel.

(3) If necessary, remove or install rocker switch cover plates (Fig. 2).

INSTALLATION

(1) Position the bezel on the upper instrument panel and engage it with the U-clips.

(2) Install the bezel retaining screws. Tighten the screws with 1 N·m (11 in-lbs) torque.

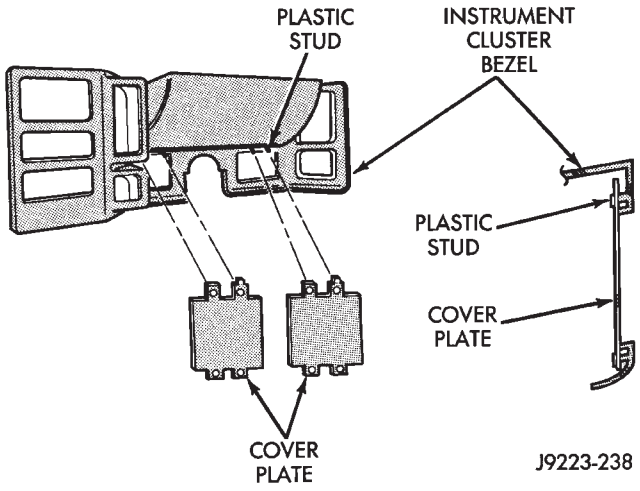

Fig. 2 Instrument Cluster Bezel Removal/Installation

INSTRUMENT CLUSTER/SWITCH/LIGHTER/RADIO/HEVAC

REMOVAL

(1) Remove the screws and instrument cluster bezel from instrument panel (Fig. 3).

(2) As applicable, remove the instrument cluster or other I/P component screws.

(3) Disconnect wire harness connector(s) from cluster or other I/P component. Refer to Group 8—Electrical.

(4) Remove the cluster or other I/P component from the upper section of instrument panel (Fig. 9).

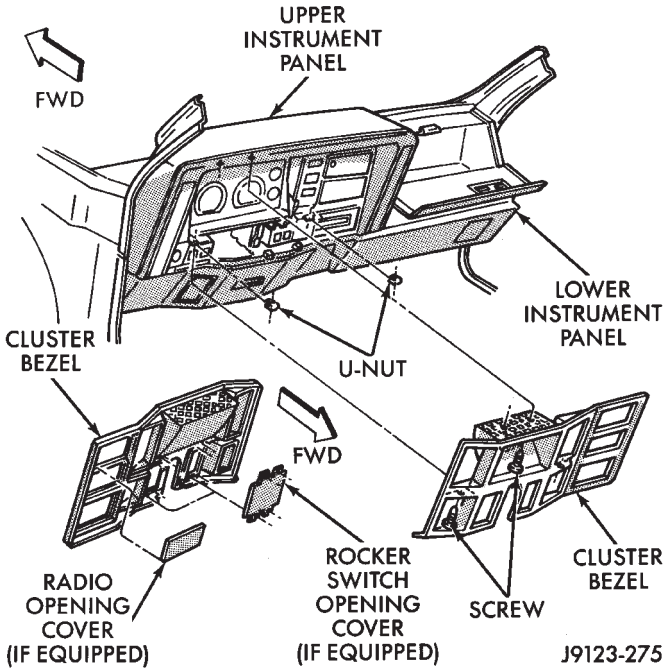

Fig. 3 Instrument Cluster Bezel

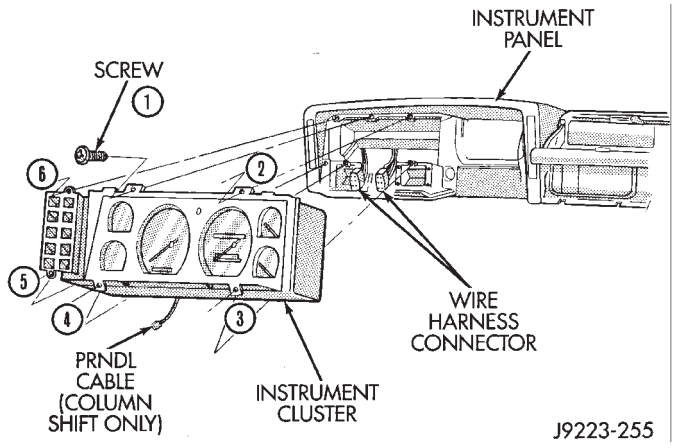

Fig. 4 Instrument Cluster

INSTALLATION

(1) Position the cluster or other I/P component at the upper section of the instrument panel and connect the wire harness connectors.

(2) Install the cluster or other I/P component retaining screws. Tighten the screws with 1 N·m (11 in-lbs) torque.

(3) Install the instrument cluster bezel on the instrument panel with the retaining screws.

I/P ASH RECEIVER TRAY LAMP

REMOVAL

(1) Remove the ash receiver tray from instrument panel (Fig. 10).

(2) Remove the lamp retaining screw from the ash receiver tray cavity (Fig. 11).

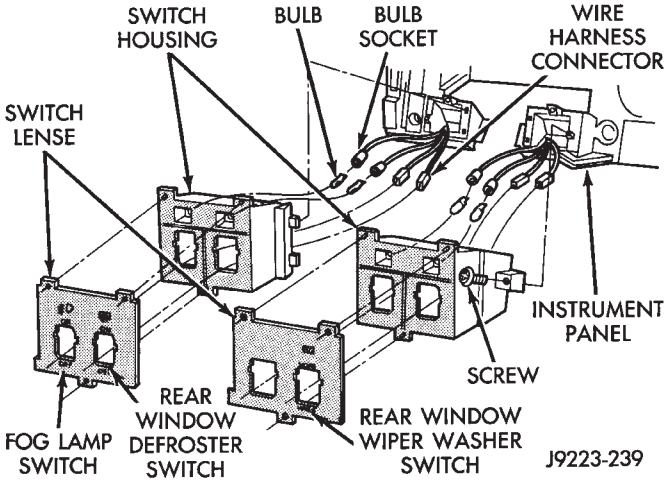

Fig. 5 Switch Housings and Lenses

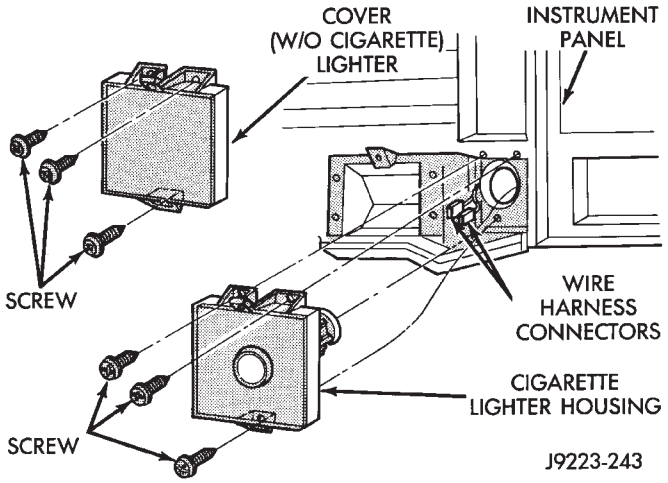

Fig. 6 Cigarette Lighter

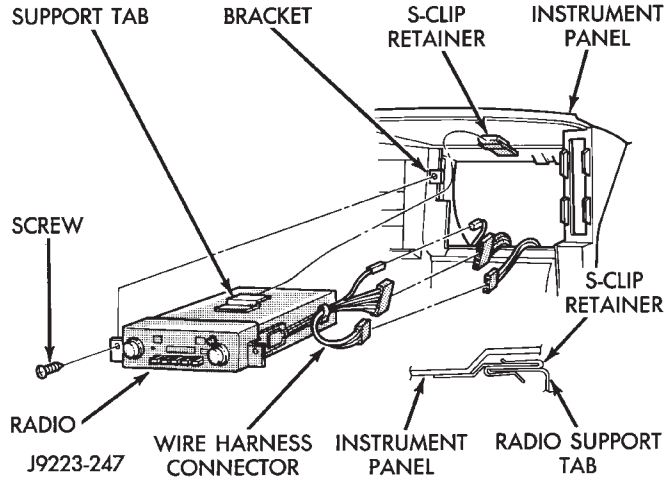

Fig. 7 Radio

(3) Disconnect the lamp wire harness connector and remove the lamp from the instrument panel.

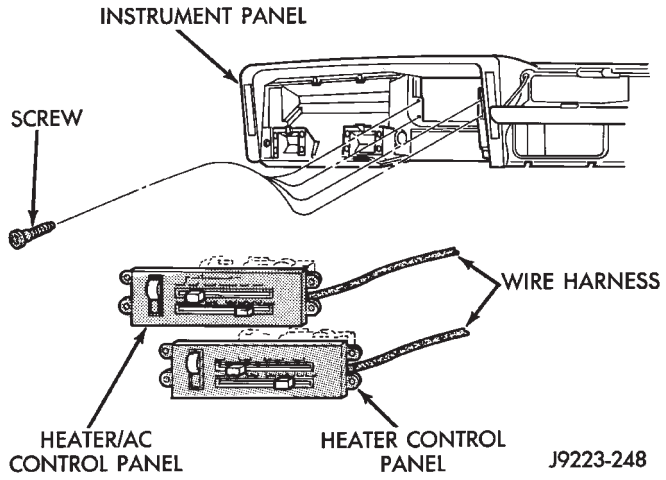

Fig. 8 Heater/AC and Heater Control Panels

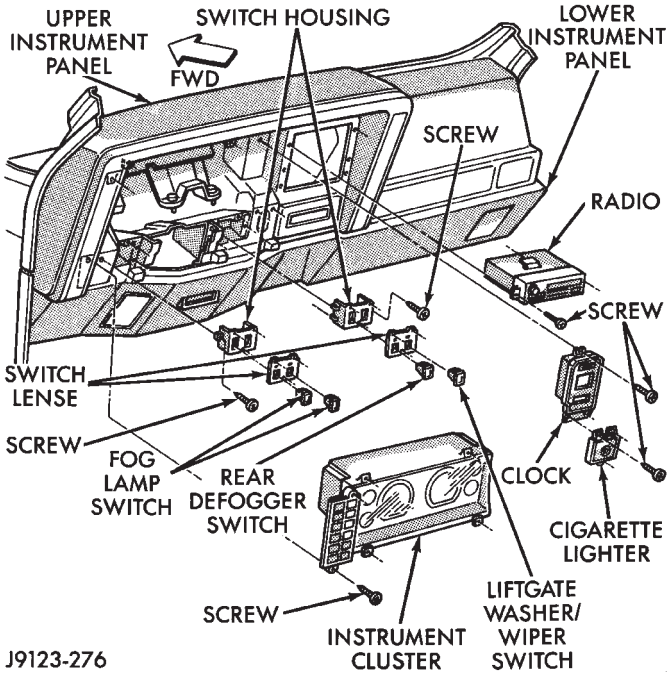

Fig. 9 Instrument Cluster and Other I/P Components

INSTALLATION

(1) Position the lamp under the instrument panel and connect the lamp wire harness connector.

(2) Install the lamp retaining screw in the ash receiver tray cavity.

(3) Install the ash receiver tray in the instrument panel.

INSTRUMENT PANEL

REMOVAL

(1) Remove the defroster duct bezel from the instrument panel.

(2) Remove the steering column cover insert from the instrument panel (Fig. 13).

(3) Remove the park brake screw from the lower section of the instrument panel (Fig. 14).

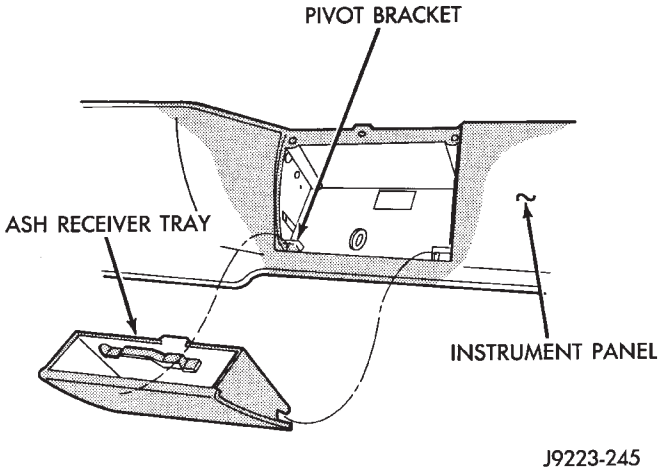

Fig. 10 Ash Receiver Tray

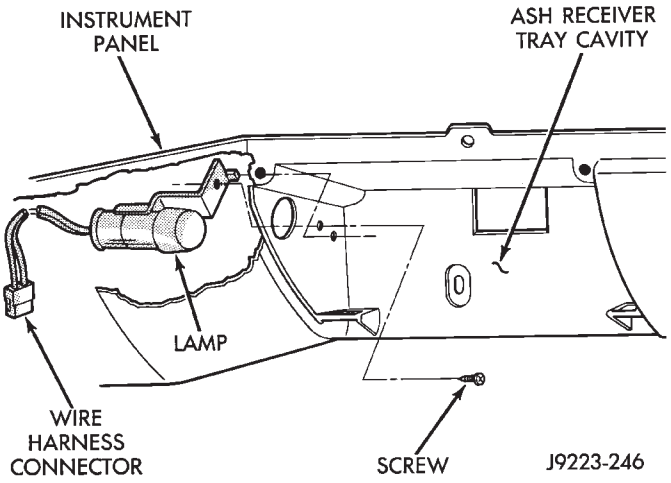

Fig. 11 Ash Receiver Tray Lamp

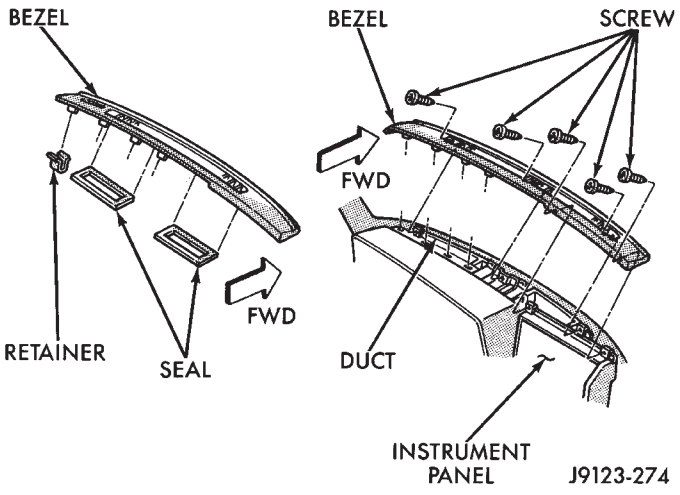

Fig. 12 Defroster Duct Bezel Removal/Installation

(4) Remove the screws from the lower section of the instrument panel (Fig. 15).

(5) Remove the lower section of the instrument panel from the upper section.

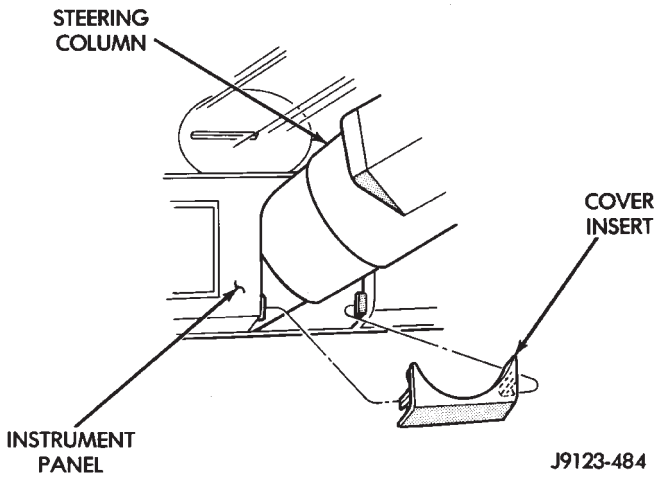

Fig. 13 Steering Column Cover Insert

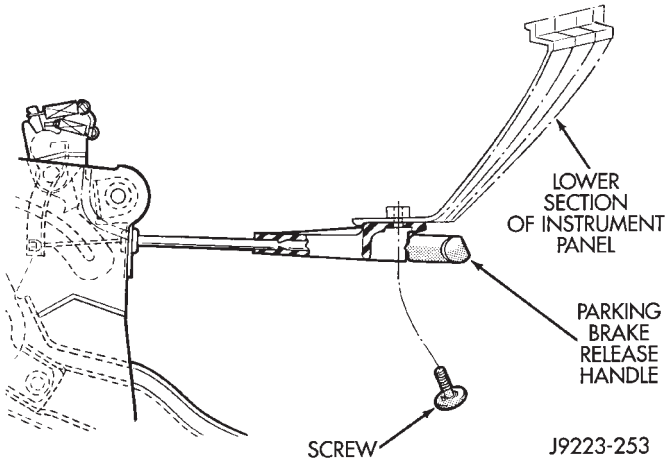

Fig. 14 Park Brake Release Handle

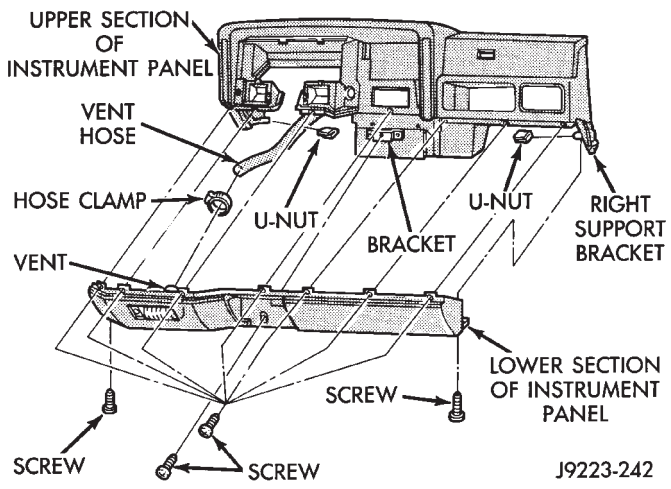

Fig. 15 Lower Section Of Instrument Panel Removal/ Installation

(6) Remove the screw and the ground wire from the upper section of the instrument panel (Fig. 16).

(7) Loosen the I/P-to-cowl side panel screws (Fig. 17).

(8) Pull the instrument panel outward from the

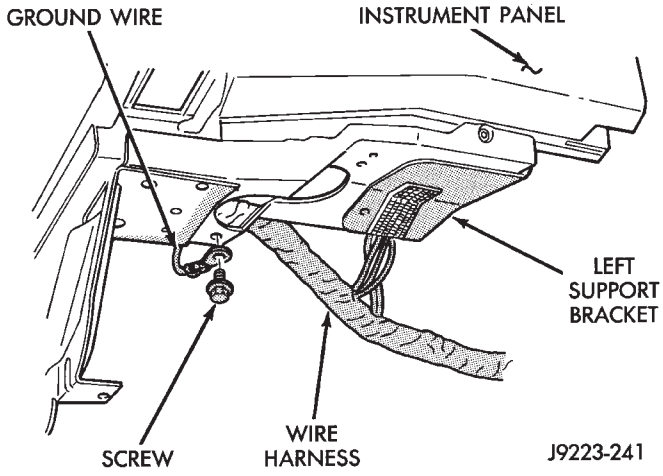

Fig. 16 Instrument Panel Ground Wire

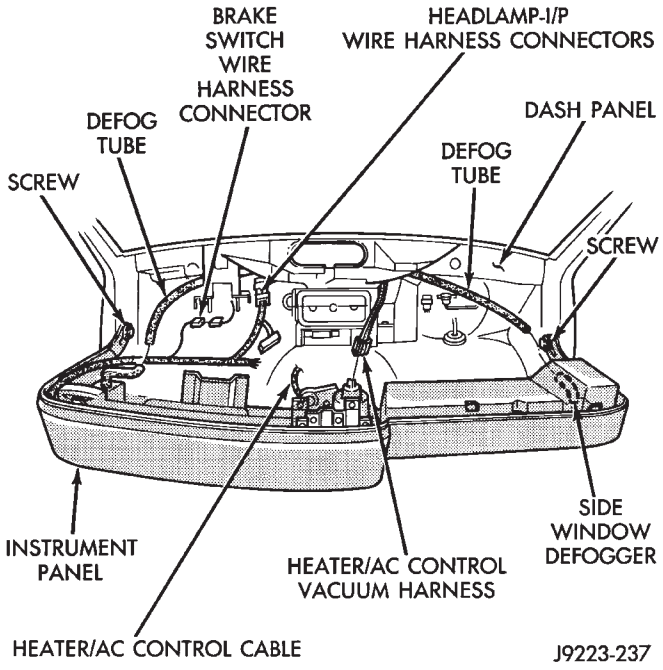

Fig. 17 Instrument Panel Tilted Rearward

dash panel for clearance, tilt it rearward and disconnect:

- the wire harness connectors,
- the side window defogger tubes,
- the heat/vent tube, and
- the temperature control cable from the upper section of instrument panel (Fig. 17).

(9) Remove the upper section of instrument panel from dash panel (Fig. 18).

INSTALLATION

(1) Position upper section of instrument panel at dash panel and supported by the I/P-to-cowl side panel screws.

(2) Connect wire harness connectors, side window defog tubes, heat/vent tube, and temperature control cable to the upper instrument panel.

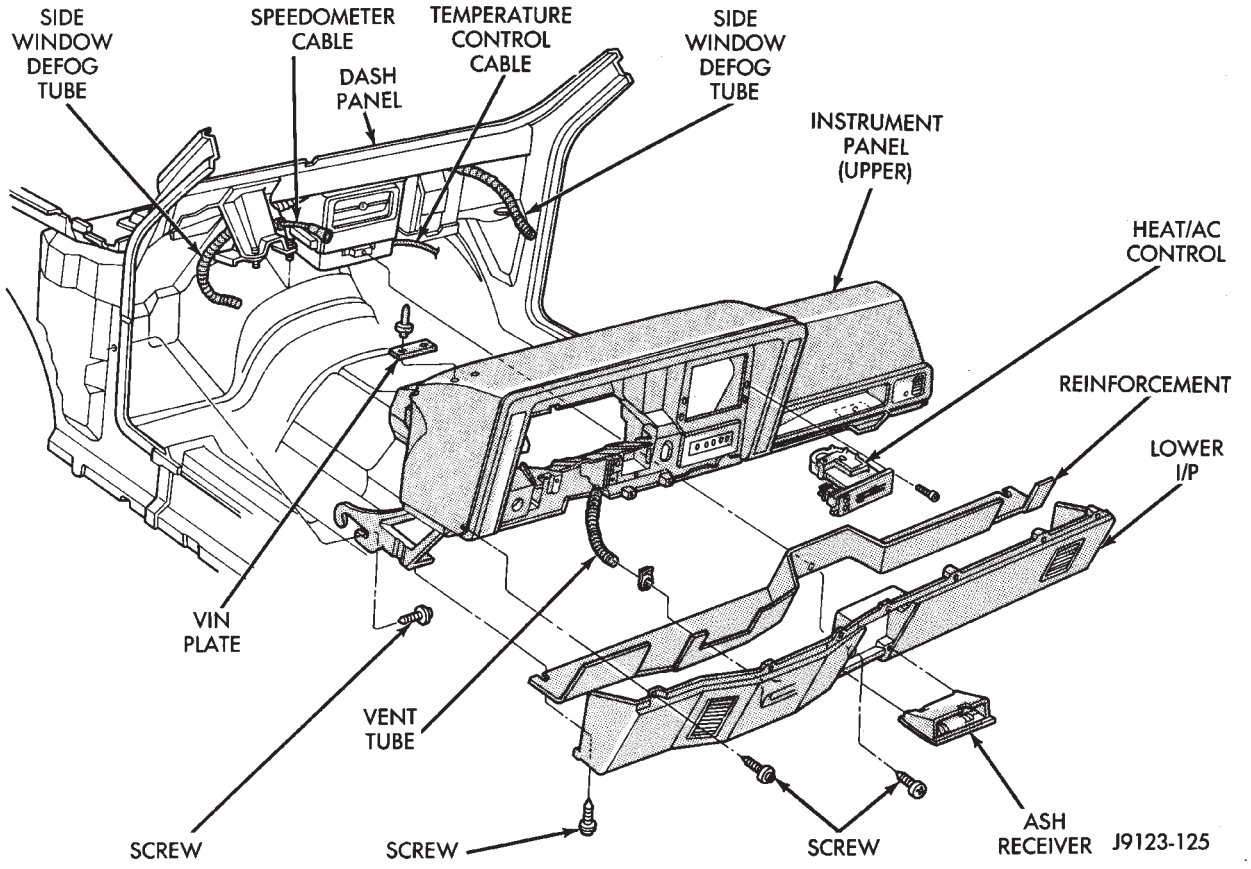

Fig. 18 Instrument Panel Disassembled

(3) Tilt instrument panel forward and tighten the I/P-to-side cowl panel screws and ground wire.

(4) Position lower section of the instrument panel at upper section.

(5) Install screws in lower section of the instrument panel. Tighten screws securely.

(6) Install the park brake and screw in lower section of the instrument panel. Tighten screw securely.

(7) Install steering column cover insert on instrument panel.

(8) Install the defroster duct bezel on the instrument panel.

(9) Install the defroster duct bezel on the instrument panel.

I/P TWEETER SPEAKER/COURTESY LAMP SUPPORT BRACKET

REMOVAL

(1) Remove the park brake retaining screw from the lower section of the instrument panel.

(2) Remove the retaining screws from the lower section of the instrument panel.

(3) Remove the lower section of the instrument panel from the upper section.

(4) Disconnect the wire harness connector and remove the speaker screws from lower section of instrument panel (Fig. 19).

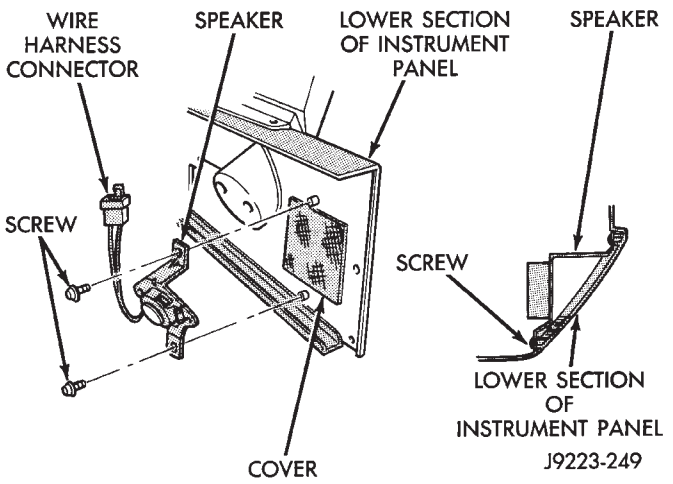

Fig. 19 Tweeter Speaker Removal/Installation

(5) Disconnect the wire harness connector and remove the courtesy lamp support bracket screw (Fig. 20).

DASH PANEL INSULATION PANEL

REMOVAL

(1) Remove the instrument panel from the dash panel. Remove the defroster tubes from the ducts (Fig. 21).

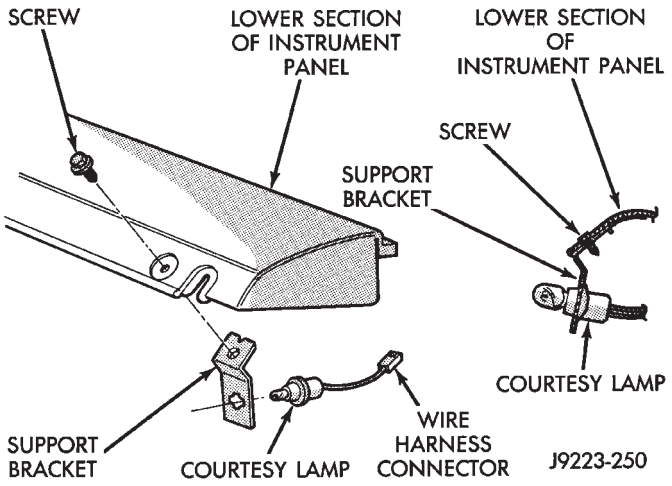

Fig. 20 Courtesy Lamp Support Bracket

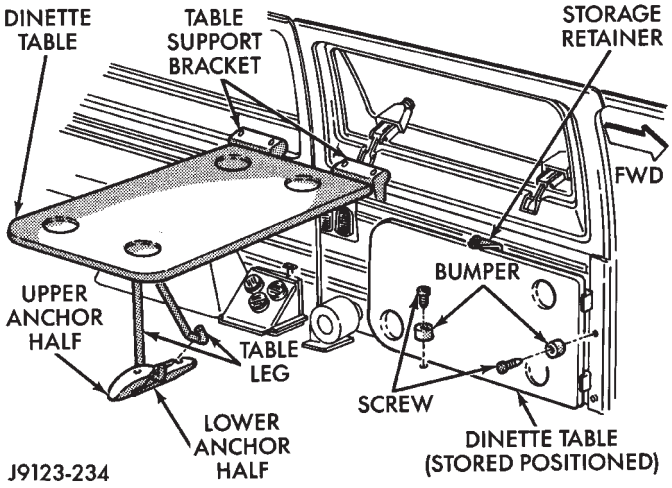

Fig. 21 Side window Defroster Tubes

(3) Remove the retaining screws at the cowl tabs and remove the defroster duct from the dash panel (Fig. 22).

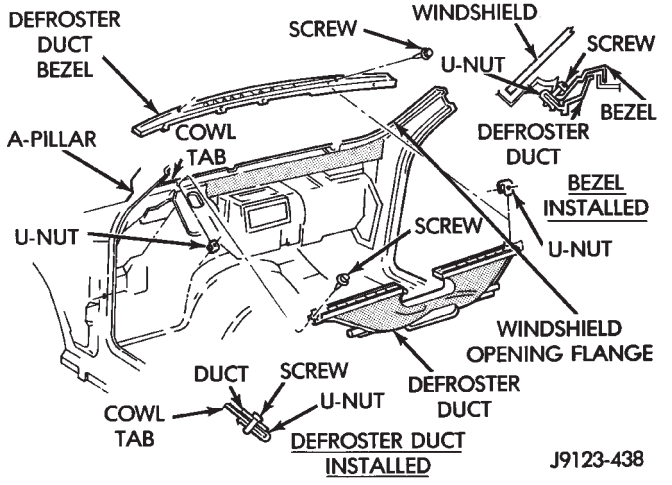

Fig. 22 Defroster Duct Removal/Installation

(4) Remove the steering column. Refer to the removal procedure in Group 19.

(5) Remove the screws and remove the control cable and vacuum motor covers from the cowl side and dash panel (Fig. 23).

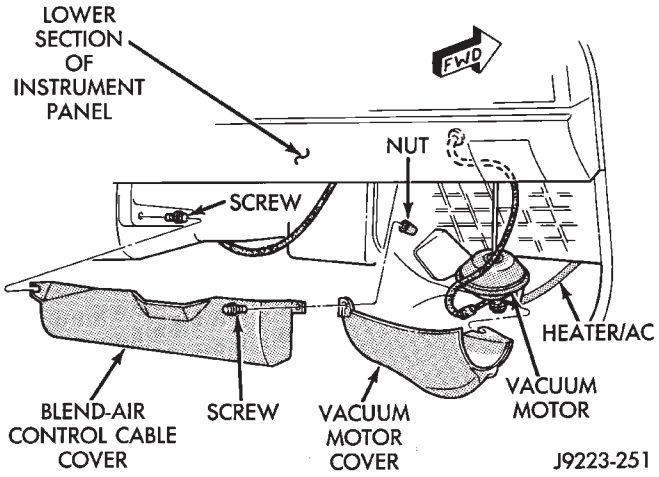

Fig. 23 Blend-Air and Vacuum Motor Covers

(6) Remove the heater and A/C evaporator unit from the dash panel (Figs. 24 and 25).

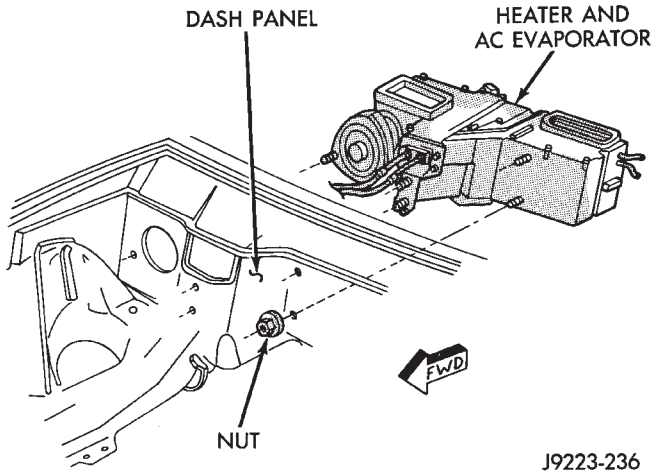

Fig. 24 Heater and A/C Evaporator Unit Retaining Nuts

(5) Remove the retainers, the push-on nuts and the insulation panel from the dash panel (Fig. 26).

INSTALLATION

(1) Position the insulation panel on the dash panel and install the retainers and the push-on nuts (Fig. 26).

(2) Install the heater and A/C evaporator unit on the dash panel. If necessary, refer to the installation procedure in Group 24.

(3) Install the steering column.

(4) Position the defroster duct on the cowl tabs and install screws. Tighten screws to 2 N·m (20 in-lbs) torque.

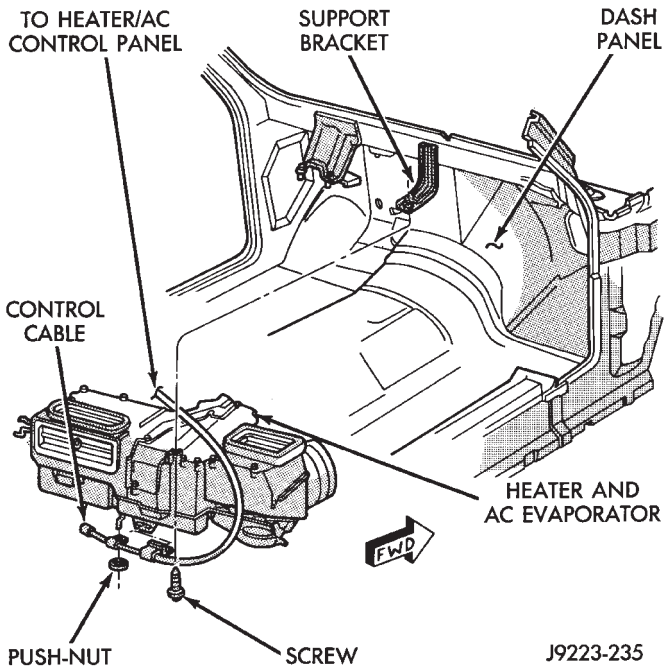

Fig. 25 Heater and A/C Evaporator Unit Removal/ Installation

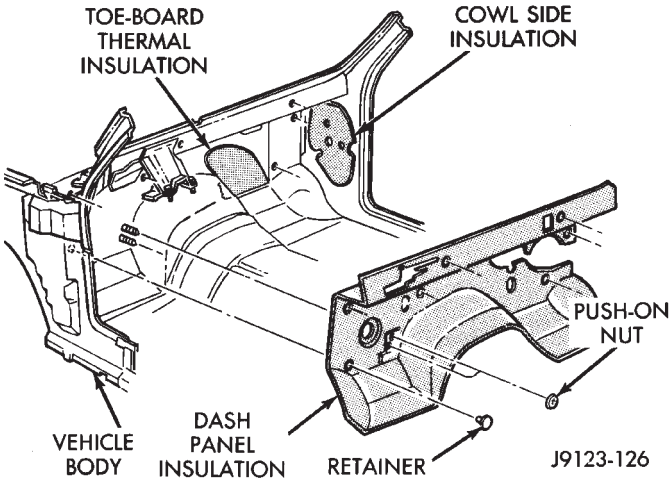

Fig. 26 Insulation Panel Removal/Installation

(5) Install the defroster tubes on the ducts.

(6) Install the instrument panel on the dash panel. If necessary, refer to the installation procedure.

FRONT BUCKET SEATS

REMOVAL

Bucket seat platforms are attached to the floor panel with studs and nuts. The trim covers are attached to the platform with either push-on fasteners (manual seats) or screws (power seats).

(1) Remove the seat platform trim cover push-on fasteners/screws and remove the trim covers from the seat platform.

(2) For power seats, disconnect the wire harness connector.

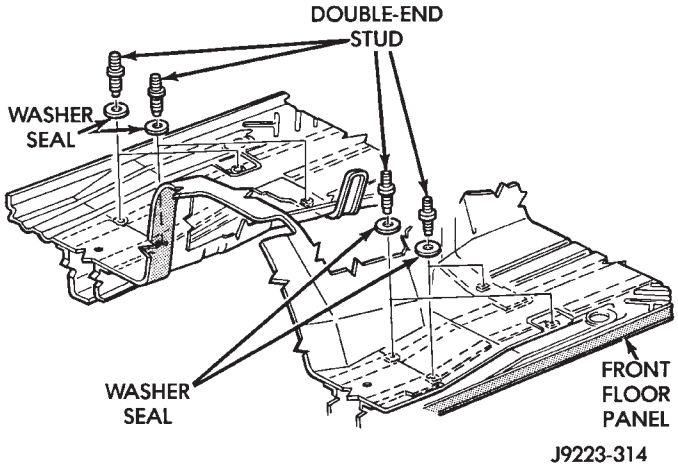

Fig. 27 Floor Panel Studs and Washer Seals

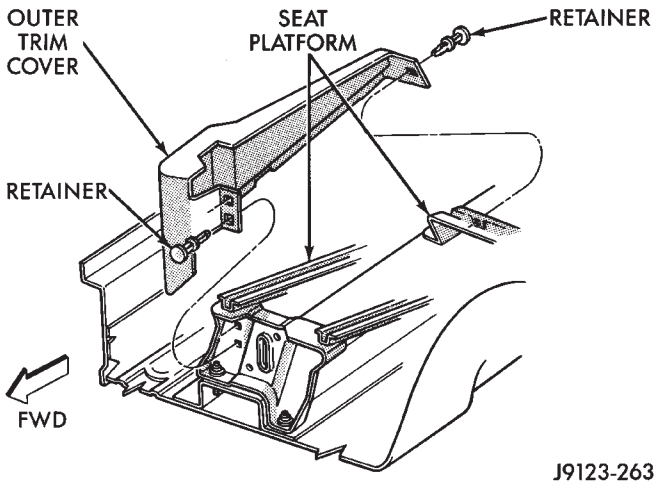

Fig. 28 Manual Bucket Seat Outer Trim Cover—Right Seat

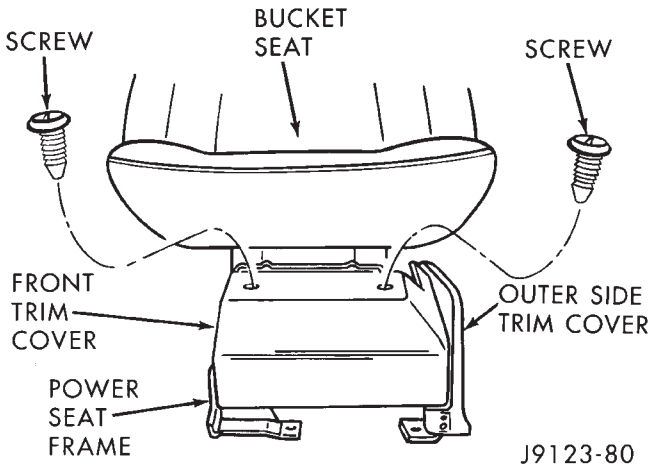

Fig. 29 Power Bucket Seat Front Trim Cover

(3) Remove the seat frame retaining nuts.

(4) Remove the seat from the floor panel.

INSTALLATION

(1) Position the seat on the floor panel.

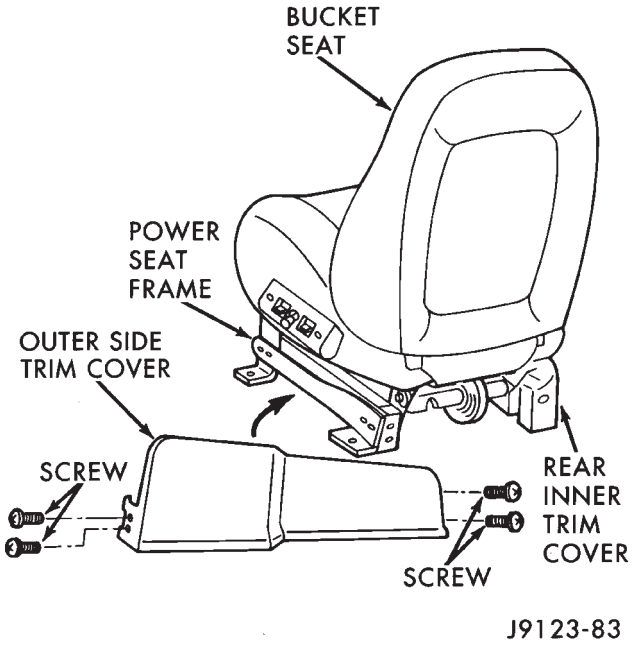

Fig. 30 Power Bucket Seat Outer Side Trim Cover

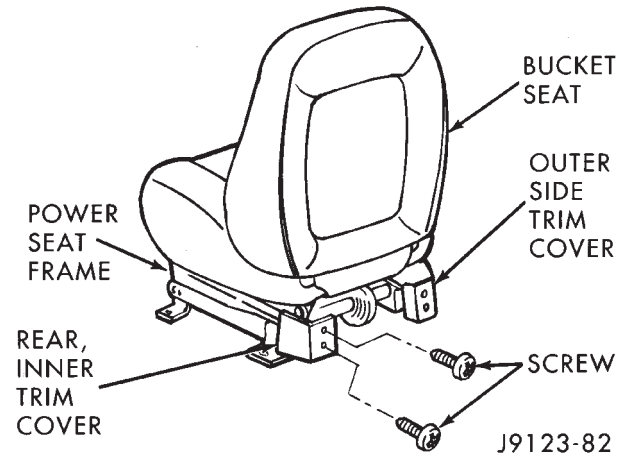

Fig. 31 Power Bucket Seat Rear, Inner Trim Cover

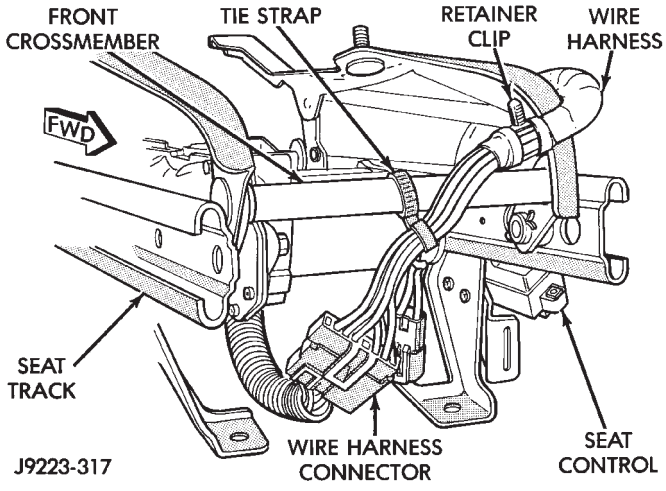

Fig. 32 Power Bucket Seat Wire Harness Connector

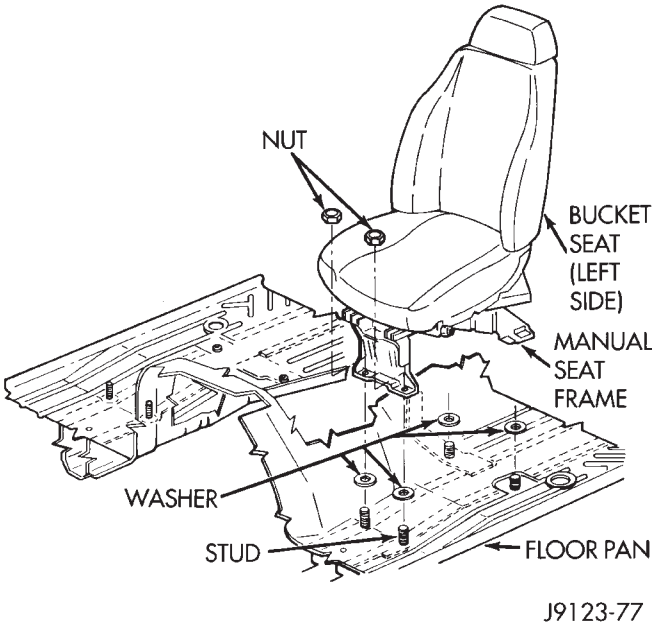

Fig. 33 Driver-Side Bucket Seat

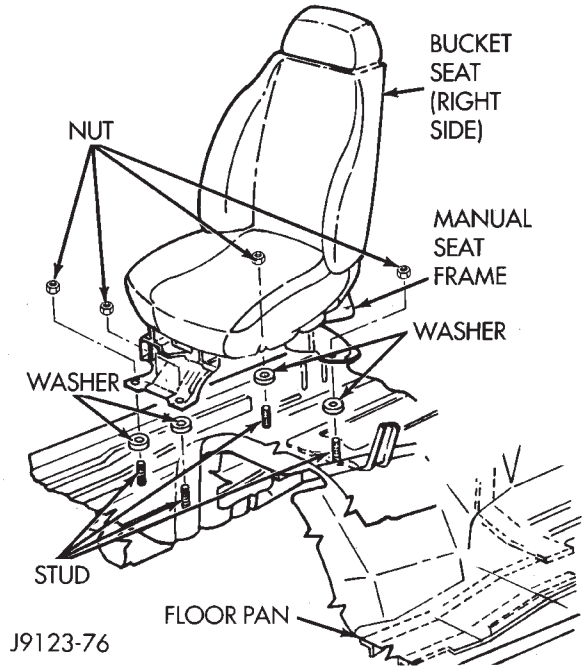

Fig. 34 Right-Side Bucket Seat

(2) Install and tighten the seat retaining nuts with 25 N·m (18 ft-lbs) torque.

(3) For power seats, connect the wire harness connector.

(4) Install the seat platform trim covers.

BUCKET SEAT CUSHION AND COVER

REMOVAL

(1) Remove the seat from the vehicle. If necessary, refer to the removal procedure.

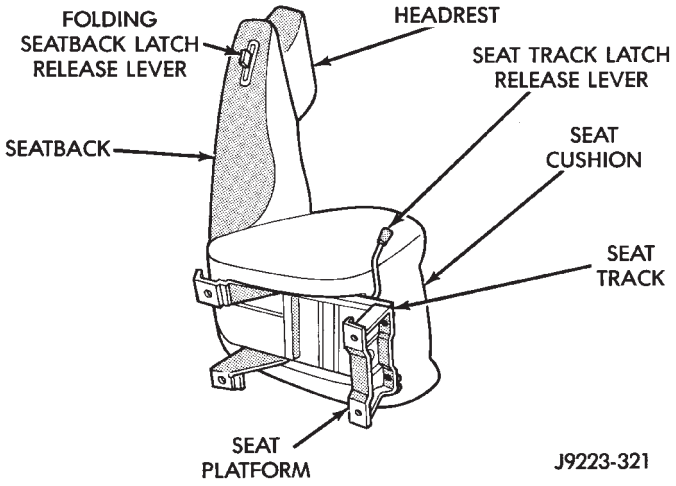

Fig. 35 Bucket Seat

(2) Remove the wire rod and rear carpet seat track cover (4-door vehicles only), and the flap retainer and elastic band wire ring from the seat.

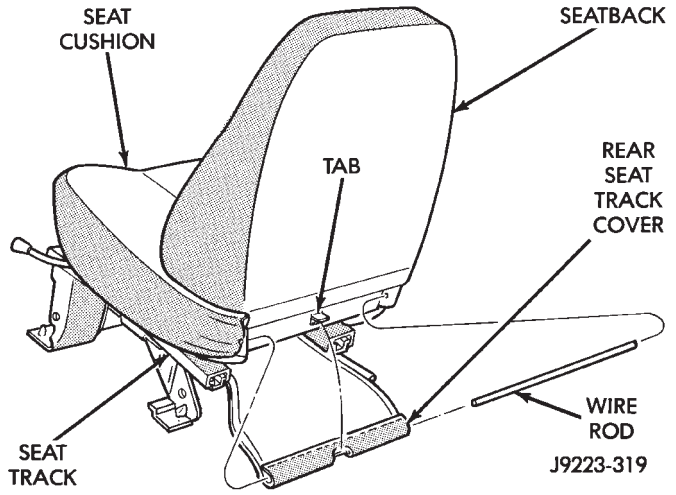

Fig. 36 Seat Track Cover Wire Rod—4-Door Vehicles

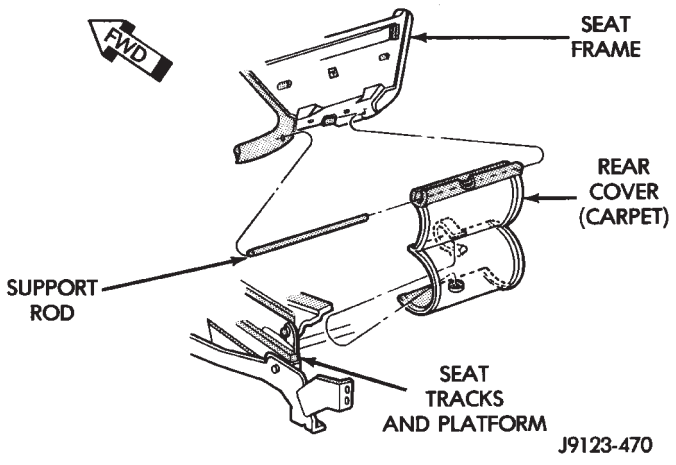

Fig. 37 Seat Track Cover—Removal/Installation

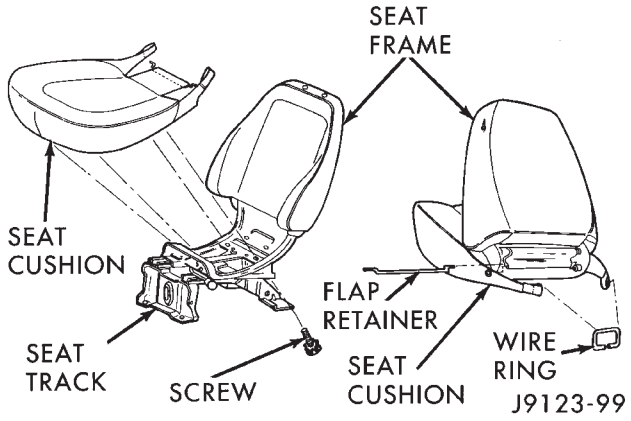

Fig. 38 Flap Retainer, Wire Ring and Seat Cushion Removal/Installation

(3) For power seats, remove the control housing from the seat cushion.

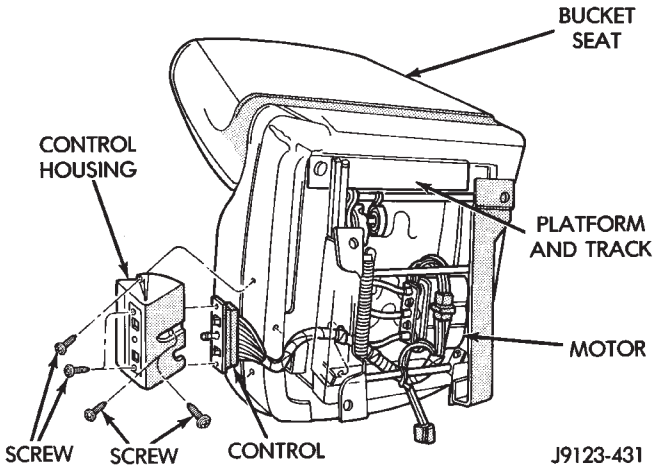

Fig. 39 Power Seat Control Housing Removal/ Installation

(4) Remove the retaining screws and the seat cushion from the seat frame.

(5) Remove the seat cushion cover screws and wire rods from the cushion cover. Remove the cover from the cushion frame.

INSTALLATION

(1) Install the seat cushion cover on the cushion frame. Install the wire rods and retaining screws. Tighten the screws to 2 N·m (13 in-lbs) torque.

(2) Install the cushion and the retaining screws on the seat frame.

(3) For power seats, install the control housing on the seat cushion. Tighten the screws to 2 N·m (13 in-lbs) torque.

(4) Install rear carpet seat track cover and the support rod (4-door vehicles only), and the flap retainer and elastic band wire ring on the seat.

(5) Install the seat in the vehicle.

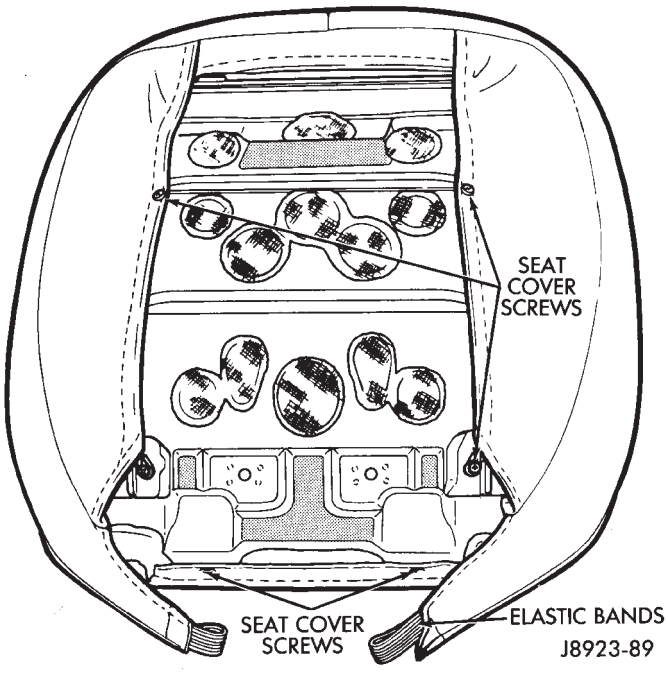

Fig. 40 Seat Cushion Cover Screws

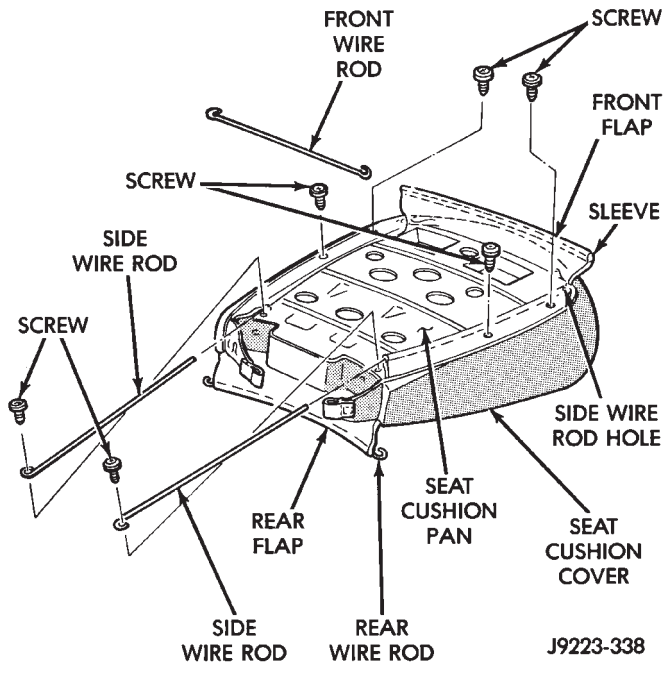

Fig. 41 Seat Cushion Cover Wire Rods

BUCKET SEATBACK COVER AND FRAME

REMOVAL

(1) Remove the seat from the vehicle. If necessary, refer to the removal procedure.

(2) Remove the seat cushion from the frame.

(3) If equipped, remove the reclining seatback release handle by pulling it outward from the shaft.

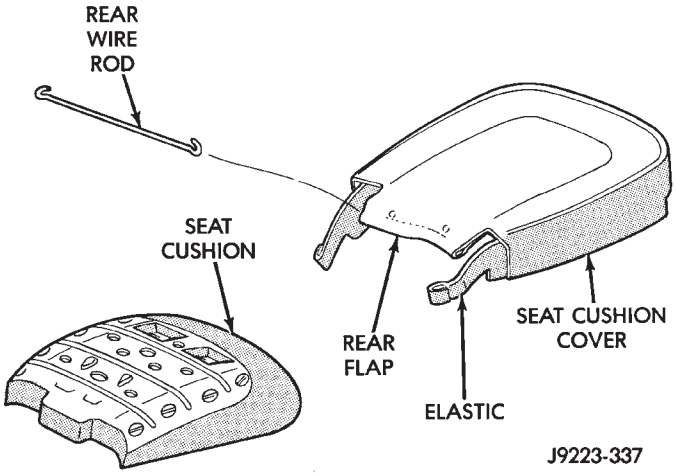

Fig. 42 Seat Cushion Cover Removal/Installation

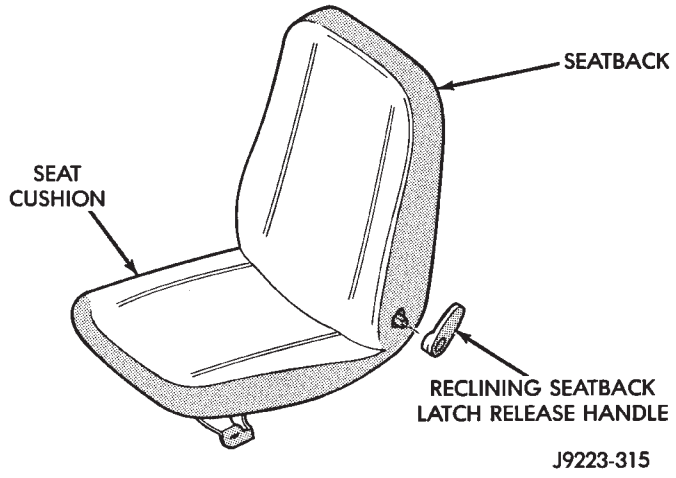

Fig. 43 Reclining Seatback Release Handle

(4) For two-door vehicles, remove the folding seatback release knob spring pin and knob from the lever. Remove the retaining screws and the bezel from the seatback.

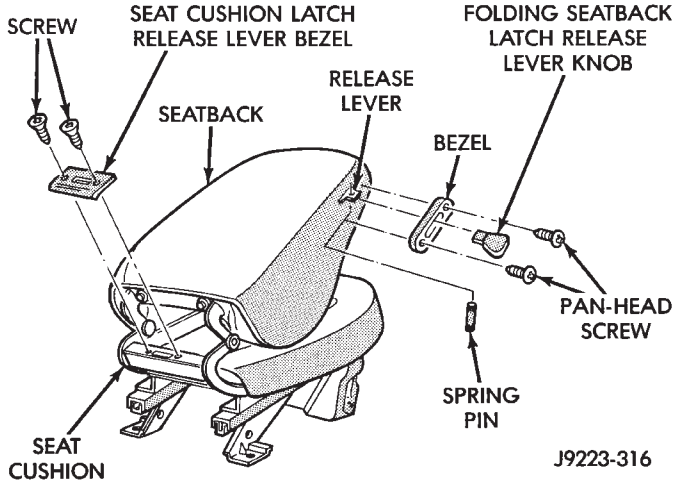

Fig. 44 Folding Seatback Release Lever and Knob

(5) Engage the headrest release lever and remove the headrest by pulling it up and out of the cylinders in the seatback.

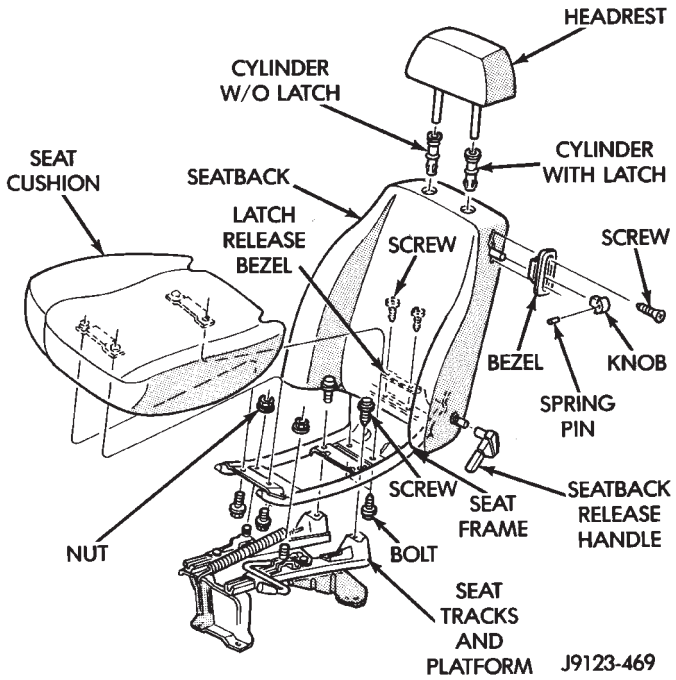

Fig. 45 Bucket Seat Components

(6) Remove the headrest latch release lever knob spring pin and remove the knob from the lever.

(7) Remove the headrest latch release lever bezel retaining screw and remove the bezel from the seatback.

(8) Pry the seatback insert upward to release the insert clips.

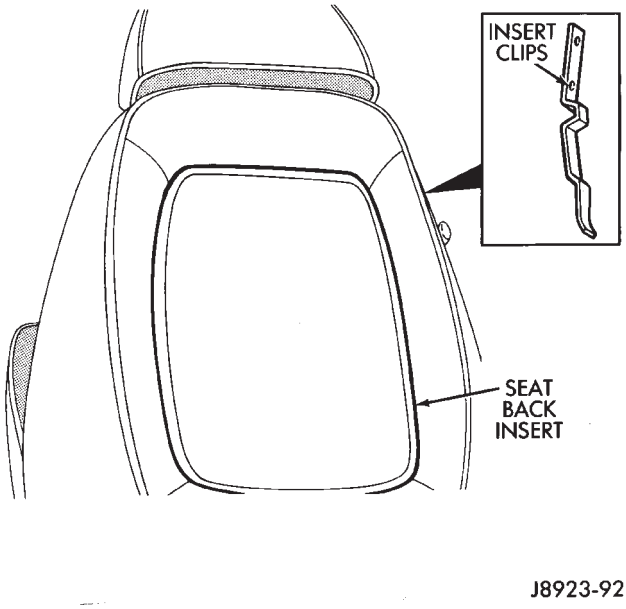

Fig. 46 Seatback Insert Removal/Installation

(9) Detach the Velcro flap from the front of the cover or elastic band at the bottom of the cover.

(10) Remove the cover retainer clips and remove the cover from the seatback.

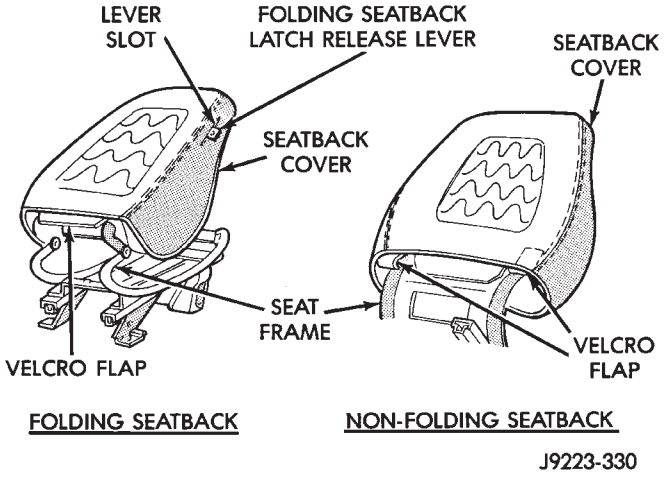

Fig. 47 Seatback Velcro Flap

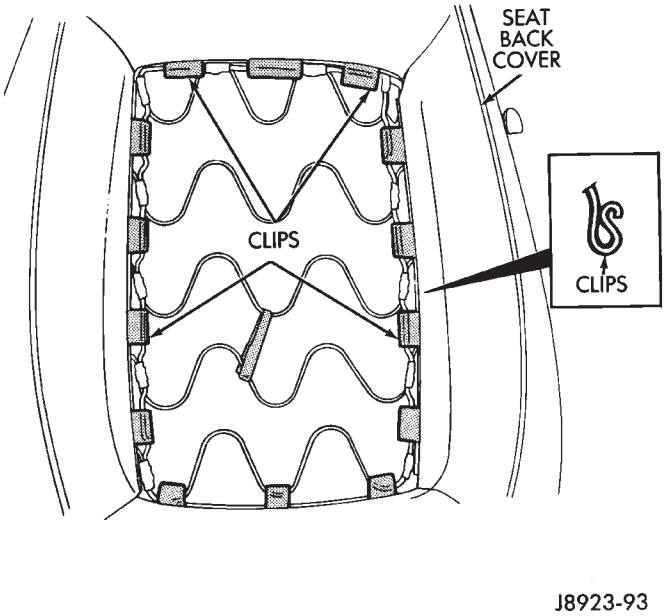

Fig. 48 Seatback Cover Retainer Clips

(11) For power seats, remove the retaining screws and remove the seat control from the seat track/platform.

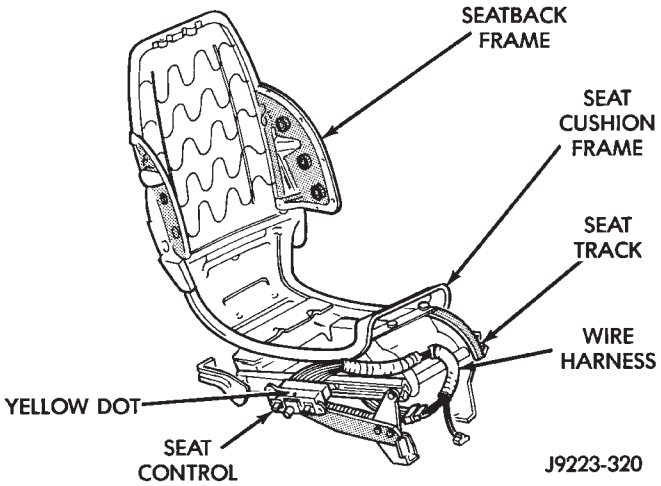

Fig. 49 Power Seat Control

(12) Remove the retaining screws and nuts, and remove the seat frame from the seat track/platform.

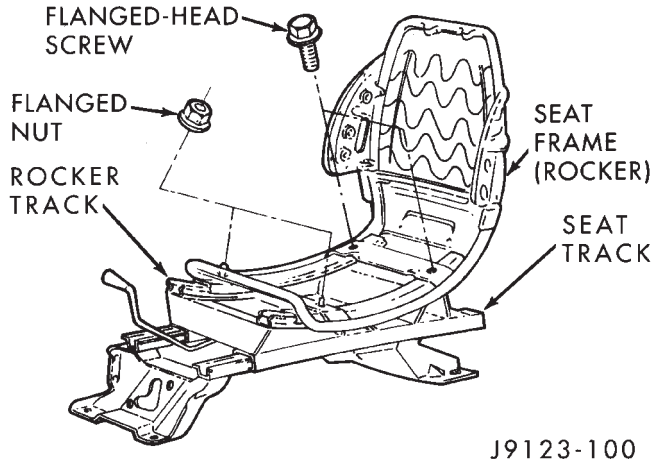

Fig. 50 Manual Seat Frame (Rocker) Removal/ Installation

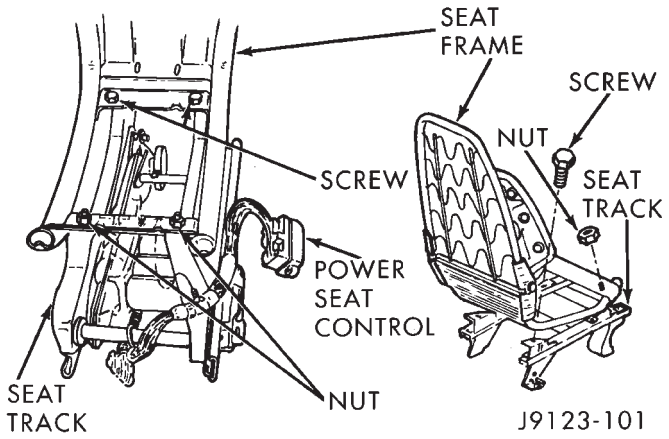

Fig. 51 Power Seat Frame Removal/Installation

INSTALLATION

(1) Position the seat frame on the seat track/platform and install screws and nuts.

(2) For power seats, position the seat control on the seat track/platform install screws. Tighten screws securely.

(3) Position the cover on the seatback and install the cover retainer clips.

(4) Attach the cover bottom elastic band or attach the Velcro flap to the front of the cover:

- folding seatback — tilt the seatback forward and attach the Velcro flap to the front of the cover; and
- non-folding seatback — slip the Velcro flap through the frame and attach the Velcro flap to the front of the cover.

(5) For non-folding seatbacks, install the seatback cover-to-frame wire rods.

(6) Install the seatback insert.

(7) Install the headrest latch release lever bezel and the retaining screw.

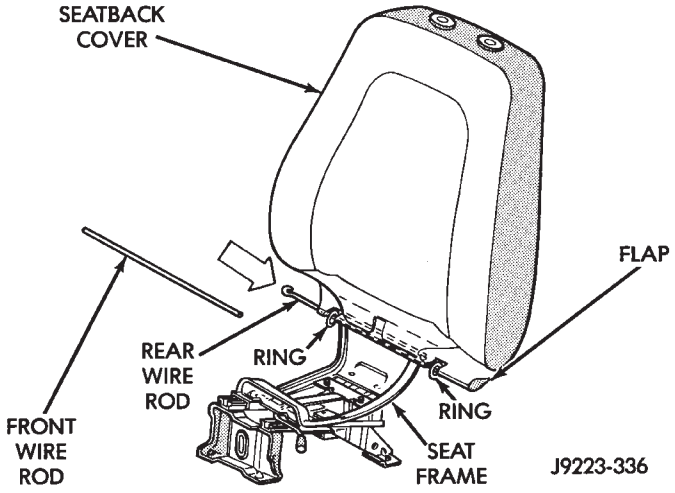

Fig. 52 Seatback Cover-To-Frame Wire Rod Installation

(8) Install the headrest latch release lever knob on the lever with the spring pin.

(9) Install the headrest by pushing it down into the seatback cylinders.

(10) For two-door vehicles, install the folding seatback release lever bezel with the retaining screws. Install the knob and spring pin on the lever.

(11) If equipped, install the reclining seatback release handle by positioning it on the shaft and pushing inward.

(12) Install the cushion on the frame. If necessary, refer to the installation procedure.

(13) Install the seat in the vehicle.

(14) For power seats, test the seat operation.

BUCKET SEATBACK RECONDITIONING

ASSEMBLY

(1) If equipped, install the reclining seatback latch cover.

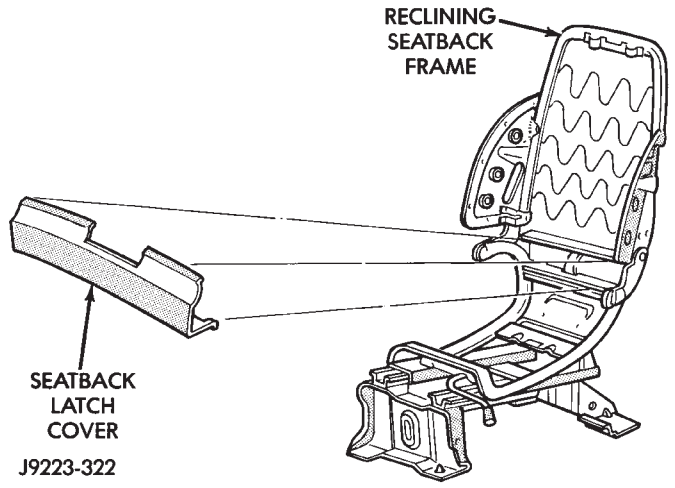

Fig. 53 Reclining Seatback Latch Cover Installation

(2) For wingback bucket seats, install the pivot bracket covers.

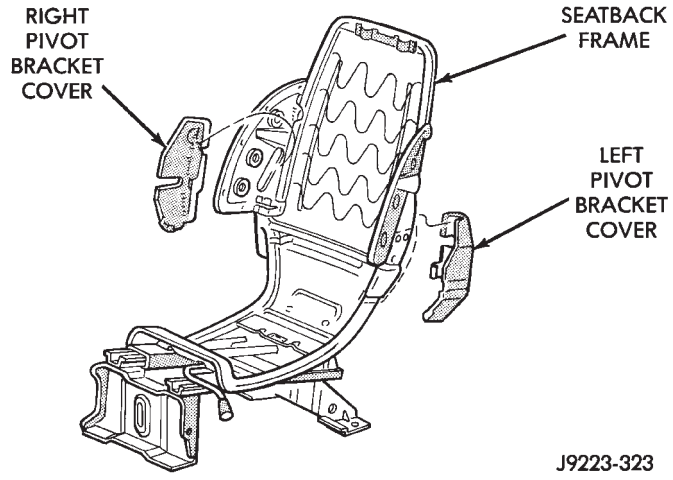

Fig. 54 Pivot Bracket Cover Installation—Wingback Seat

(3) For wingback bucket seats, install the side panel (wing) edge covers.

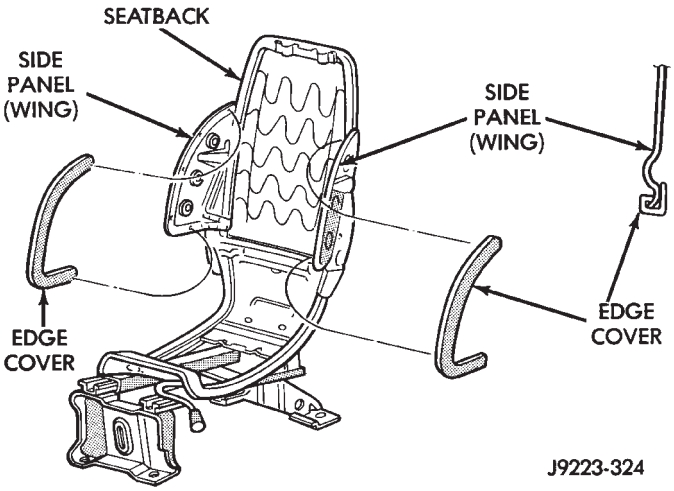

Fig. 55 Side Panel (Wing) Edge Cover Installation—Wingback Seat

(4) For wingback bucket seats, install the side panel (wing) pads.

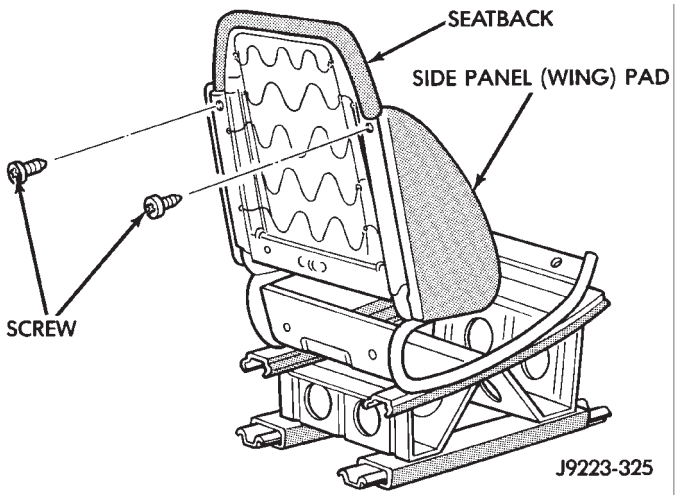

Fig. 56 Side Panel (Wing) Pad Installation—Wingback Seat

(5) Install the seatback pad.

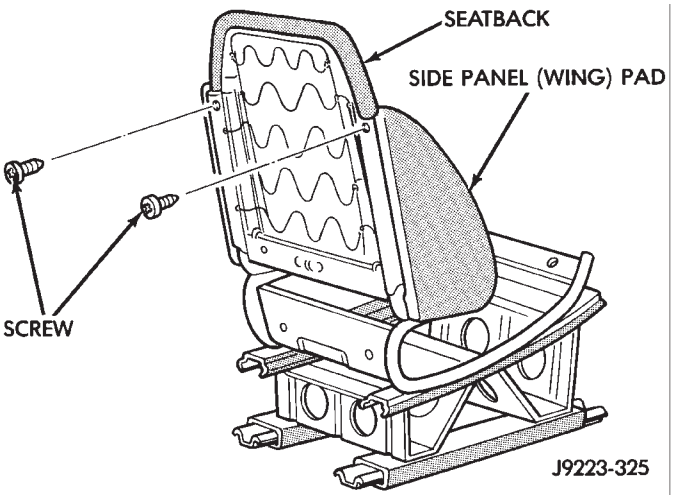

Fig. 57 Seatback Pad Installation—Wingback Seat

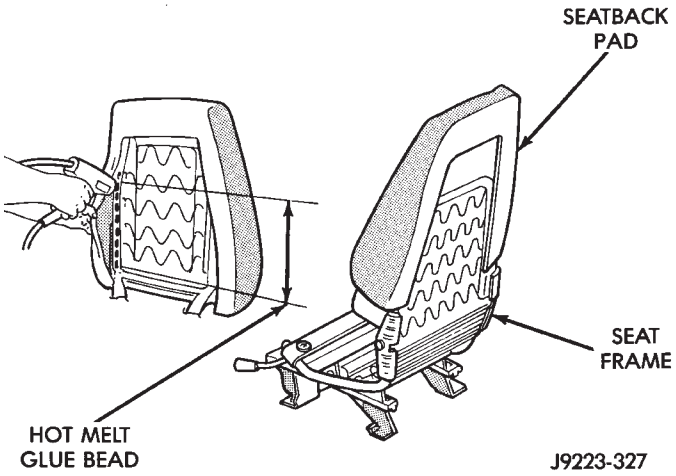

Fig. 58 Seatback Pad Installation—Lo-Back Seat

(6) Cut an opening for the folding seatback latch release lever. Position the reclining latch shaft at the center of the embossed area in the pad and push it through the pad).

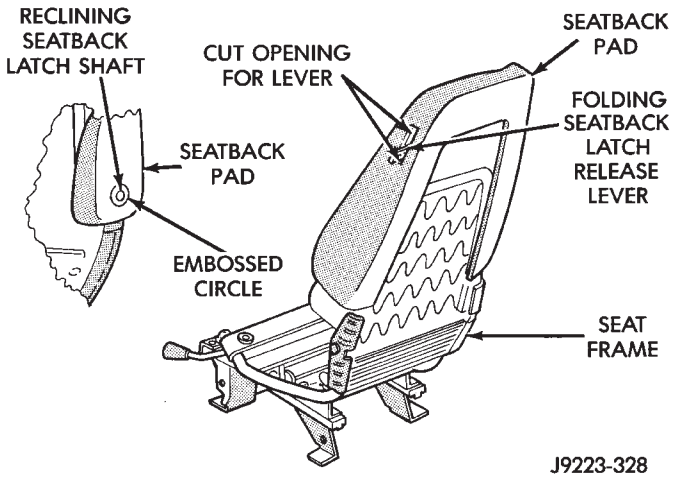

Fig. 59 Seatback Pad Latch Lever/Shaft Openings

(7) For wingback seatbacks, turn the side panel (wing) covers inside-out and install the seatback cover.

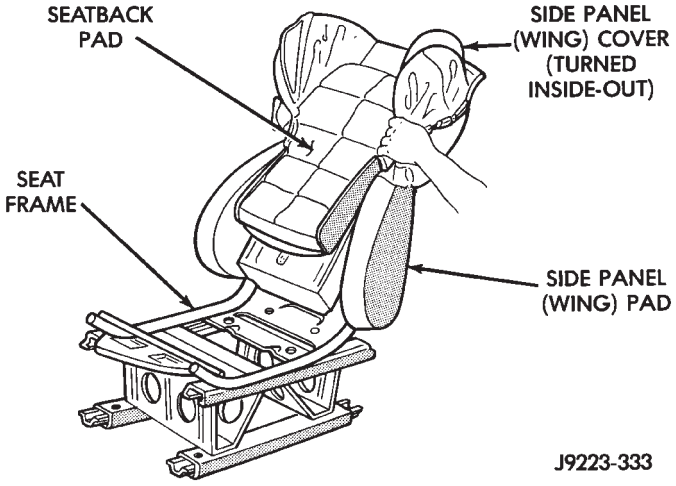

Fig. 60 Side Panel (Wing) Covers Inside-Out—Wingback Seat

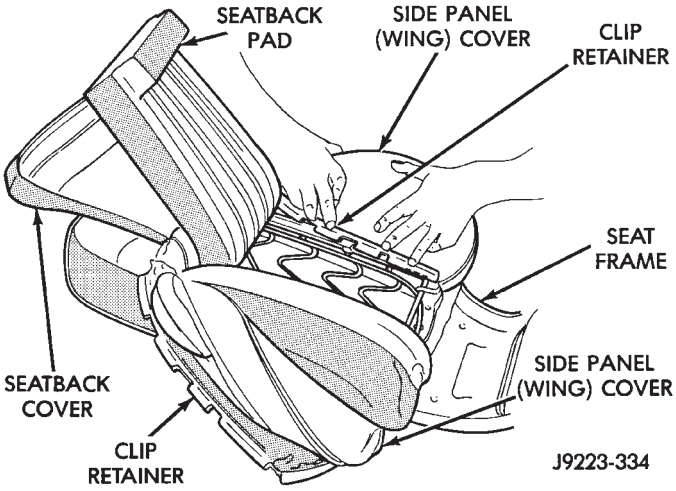

Fig. 61 Side Panel (Wing) Cover Installation—Wingback Seat

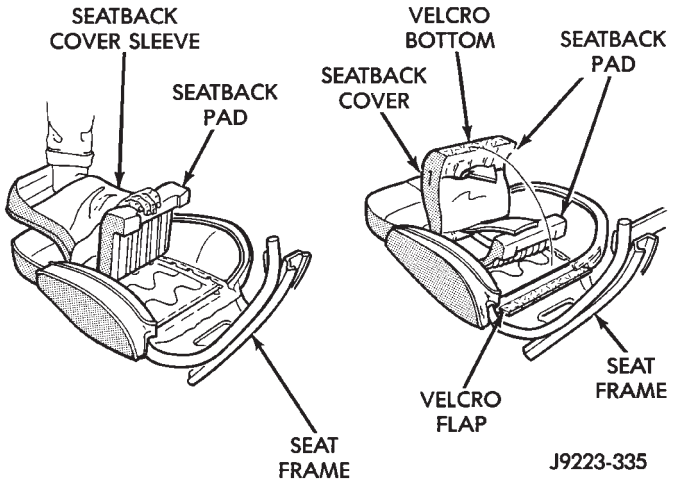

Fig. 62 Seatback Cover Installation—Wingback Seat

(8) For standard seatbacks, turn the cover inside-out and install over the pad. Ensure that the seam welts and the cover lining are straight.

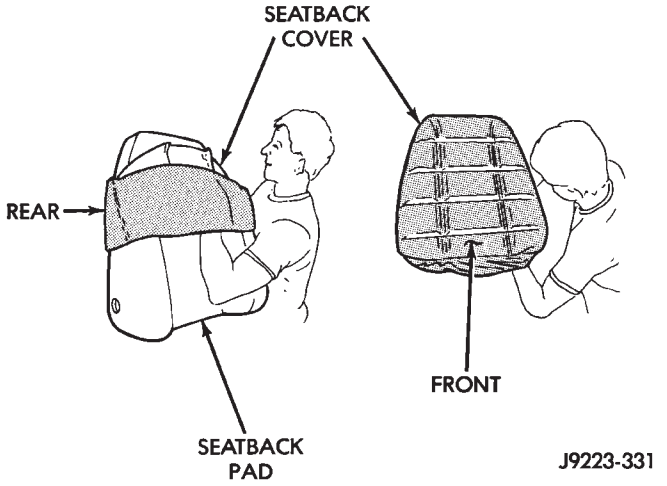

Fig. 63 Seatback Cover Installation—Standard Seat

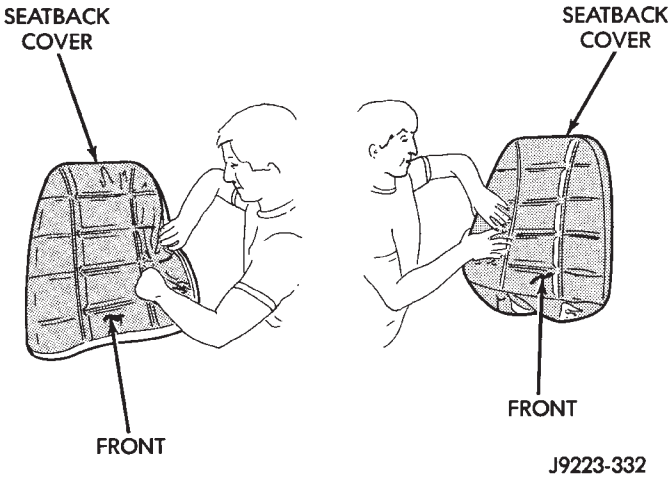

Fig. 64 Straightening Seam Welts and Lining—Standard Seat

(9) Install the seatback retainer clips and headrest cylinders.

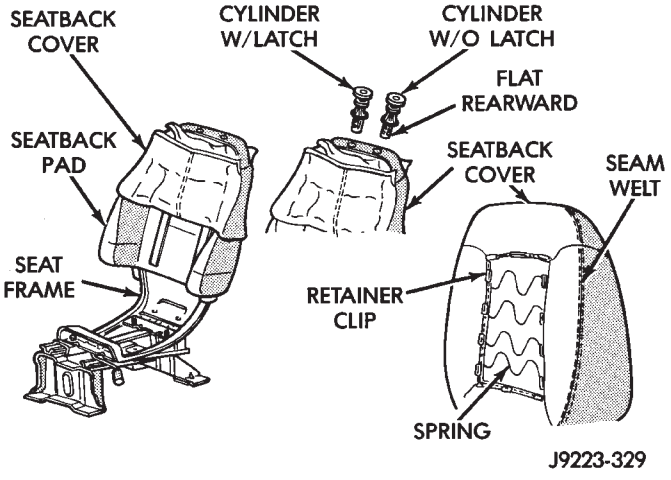

Fig. 65 Seatback Cover Retainer Clip and Headrest Cylinder Installation

(10) Attach the Velcro flap to the front of the cover:
• folding seatback — tilt the seatback forward and attach the Velcro flap to the front of the cover; and
• non-folding seatback — slip the Velcro flap through the frame and attach the Velcro flap to the front of the cover.

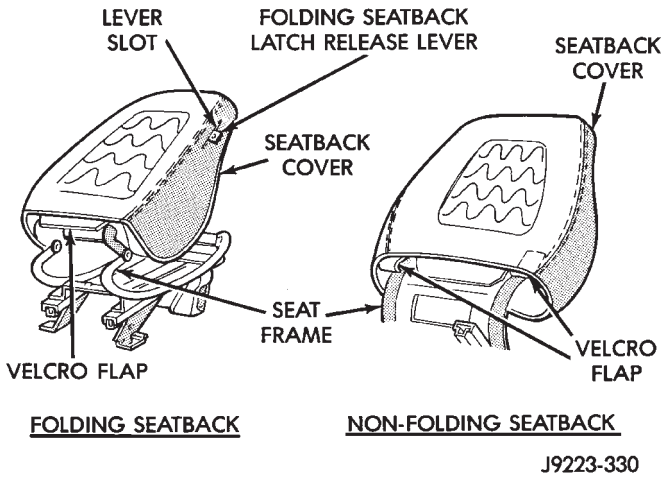

Fig. 66 Seatback Velcro Flap Installation

(11) For non-folding seatbacks, install the seatback cover-to-frame wire rods.

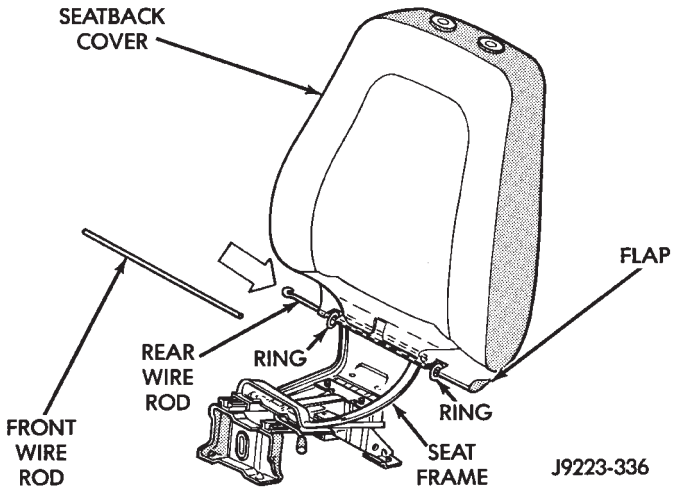

Fig. 67 Seatback Cover-To-Frame Wire Rod Installation

(12) Install the seatback insert.
(13) Install the headrest latch release lever bezel and the retaining screw.
(14) Install the headrest latch release lever knob on the lever with the spring pin.
(15) Install the headrest by pushing it down into the seatback cylinders.
(16) For two-door vehicles, install the folding seatback release lever bezel with screws. Install the knob and spring pin on the lever.

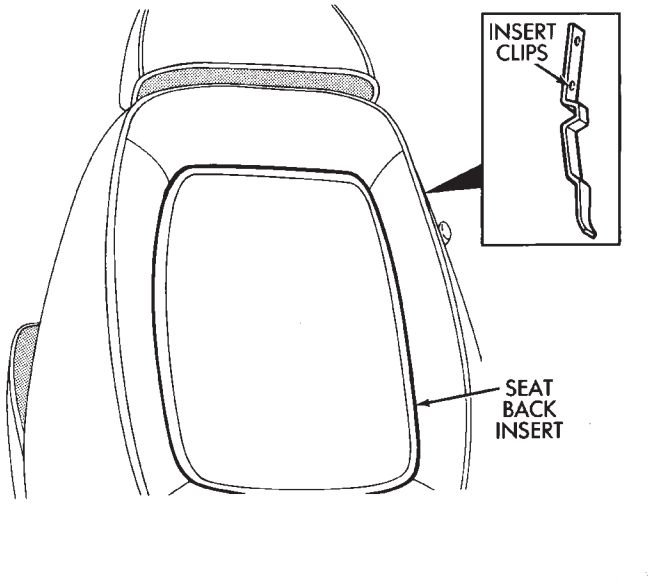

Fig. 68 Seatback Insert Installation

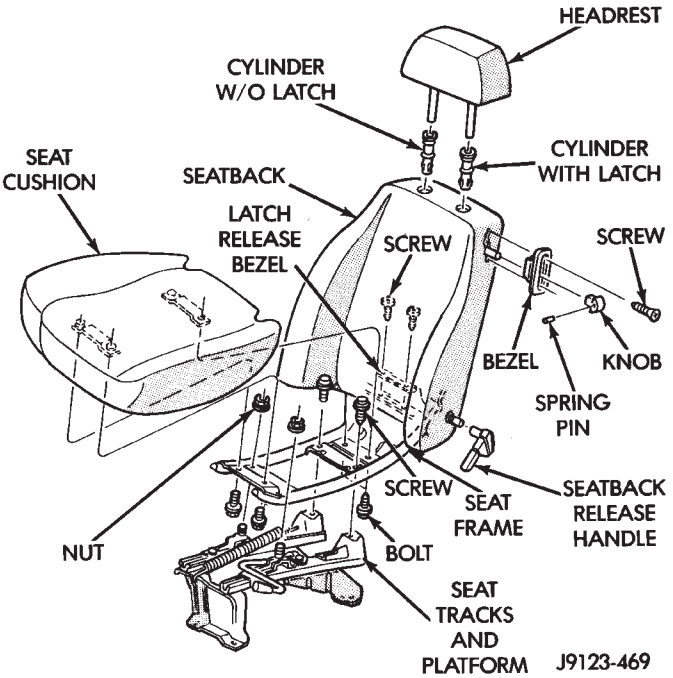

Fig. 69 Bucket Seat Components

(17) If equipped, install the reclining seatback release handle by positioning it on the shaft and pushing inward.
(18) Install the cushion on the frame. If necessary, refer to the installation procedure.
(19) Install the seat in the vehicle.
(20) For power seats, test the seat operation.

BUCKET SEAT PLATFORM AND TRACKS

REPLACEMENT

Bucket seat platforms and tracks are not repairable. If the seat platform or the tracks is/are damaged or defective, replace the platform and the tracks

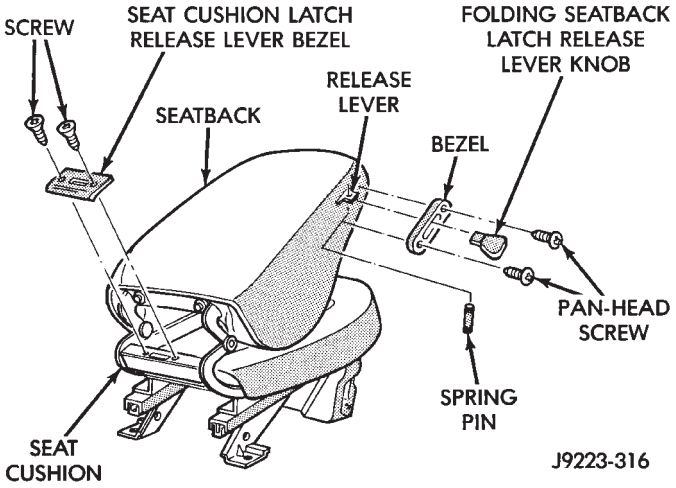

Fig. 70 Folding Seatback Release Lever and Knob

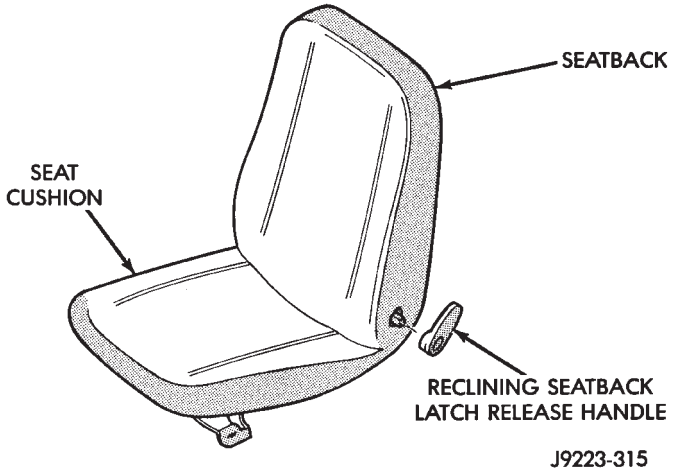

Fig. 71 Reclining Seatback Release Handle

as a unit. Refer to Power Seat Components (below) and to Group 8—Electrical.

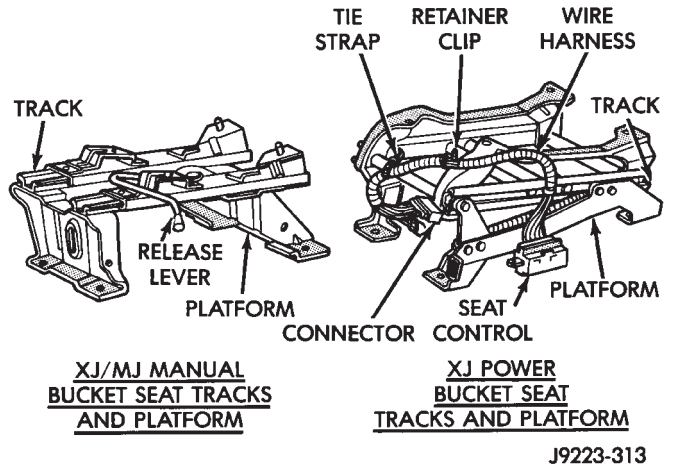

Fig. 72 Seat Tracks and Platform

A standard bucket seat platform has straight tracks. A rocker recliner seat platform has curved tracks.

Bucket seat platforms are attached to the floor panel with studs and nuts. The trim covers are attached to the platform with either push-on fasteners (manual seats) or screws (power seats).

Refer to the seatback cover and frame removal/installation procedures when seat platform (with tracks) replacement is necessary.

POWER BUCKET SEAT COMPONENTS

The power seat control is located at the outboard side of the seat. The power seat motor is located under the seat.

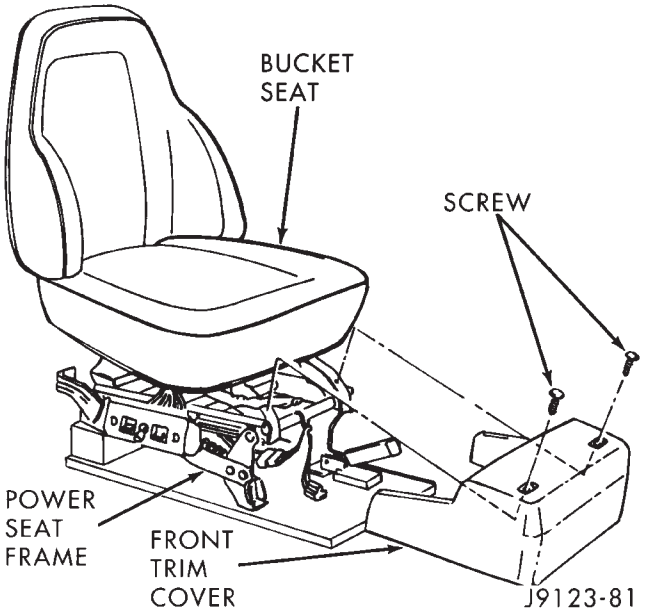

Fig. 73 Power Bucket Seat Control

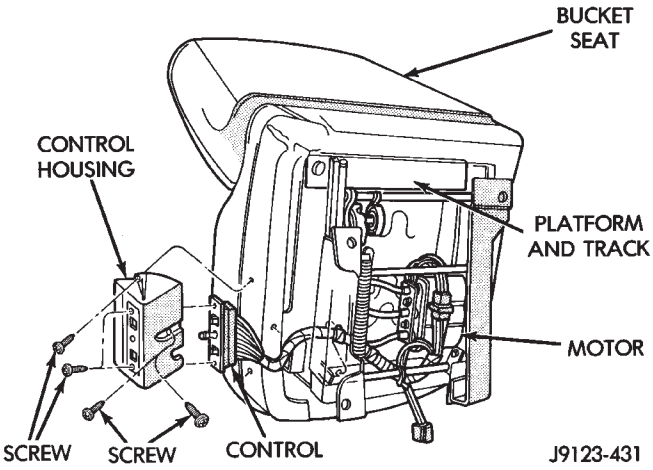

Fig. 74 Power Bucket Seat Motor and Control

The control housing, control and wire harness are accessible without removing the seat from the vehicle but if the motor requires service, the seat must be removed from the vehicle. Refer to Group 8—Electrical.

REAR SEAT CUSHION—XJ VEHICLES

REMOVAL

(1) Disengage the seat cushion at the rear by pulling upward on the release strap.

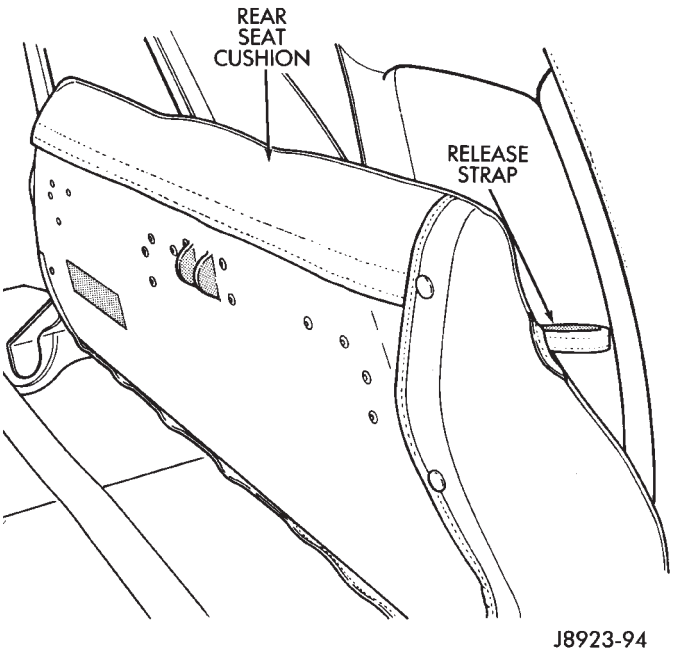

Fig. 75 Seat Cushion Disengagement At Rear

(2) Tilt the seat cushion forward.

(3) Disengage the seat cushion latch with the release lever knob. Separate the right side latch and then the left side seat bracket from the floor anchor bolts, and remove the cushion from the vehicle.

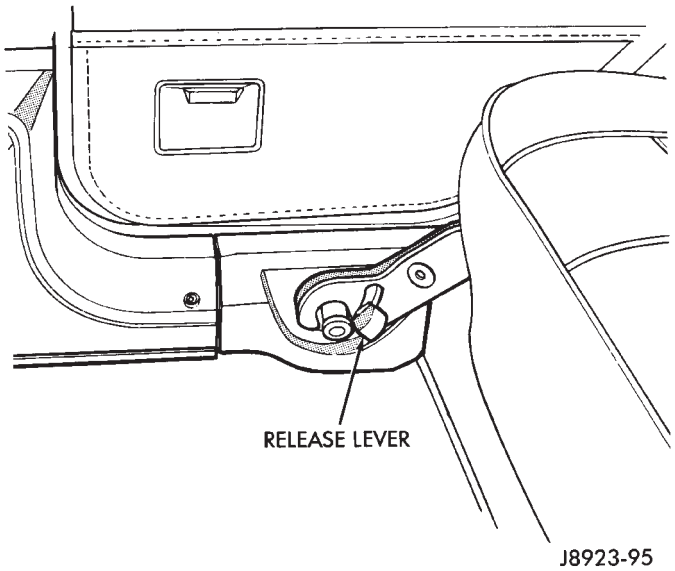

Fig. 76 Seat Cushion Disengagement At Front

INSTALLATION

(1) Position the seat cushion in the vehicle.

(2) Insert the left pivot in the anchor grommet.

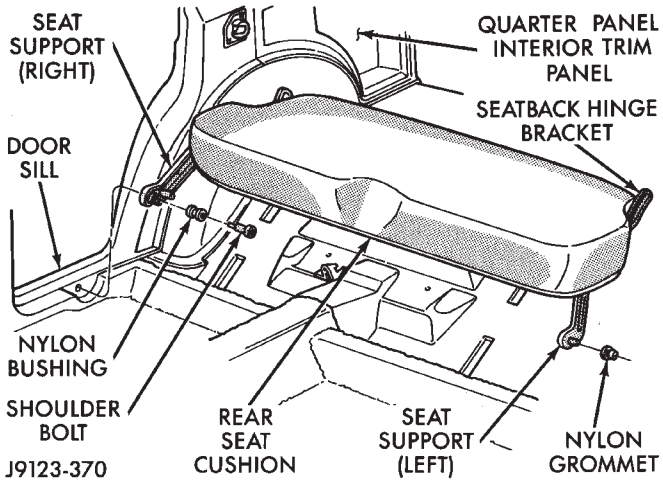

Fig. 77 Rear Seat Cushion Removal/Installation

(3) Force the right side latch onto the anchor bolt and pivot the seat cushion to the horizontal position.

(4) Lock the seat cushion in-place by pressing firmly on the center of the cushion until the latch engages.

REAR SEAT CUSHION COVER—XJ VEHICLES

REMOVAL

(1) Remove the seat cushion from the vehicle.

(2) Remove the cover side, front and rear retaining clips from the wire retainers with an appropriate removal tool.

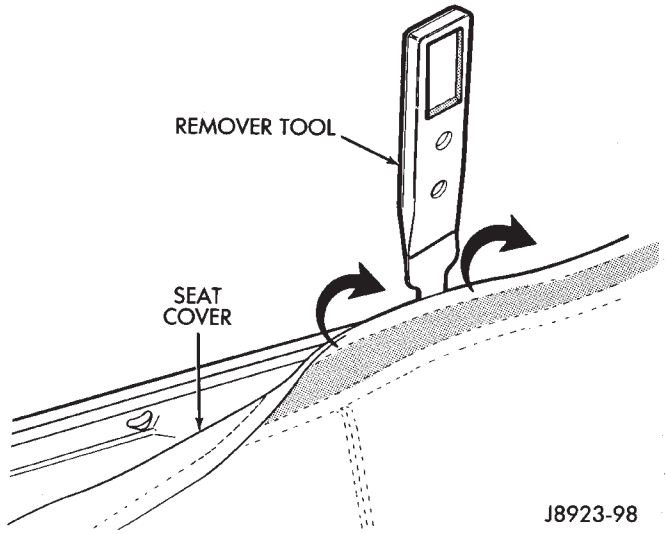

Fig. 78 Seat Cushion Cover Retaining Clip Removal

(3) Remove the serrated retainers from the front ends of the cover with a trim panel removal tool.

(4) Remove the seat cover from the cushion.

INSTALLATION

(1) Position the replacement cover on the cushion.

(2) Compress the cover and attach the retaining clips to the front and rear wire retainers.

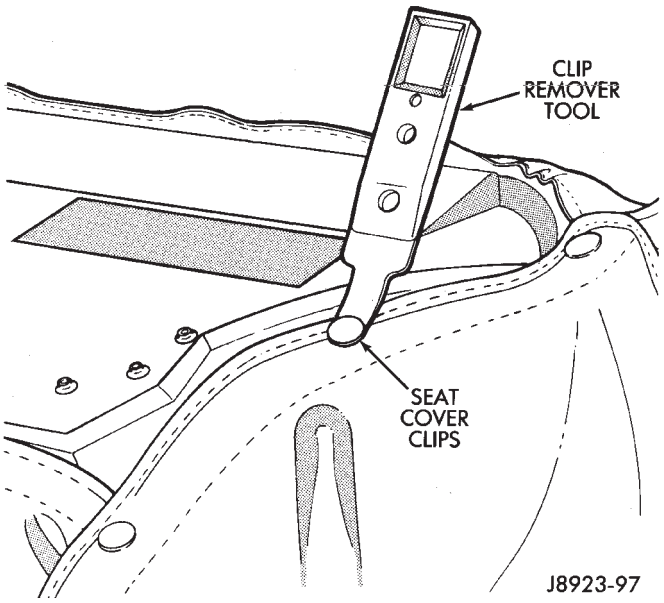

Fig. 79 Seat Cushion Cover Retaining Clip Removal

(3) Install the serrated retainers at the ends of the cover.

(4) Install the seat cushion in the vehicle. If necessary, refer to the installation procedure.

REAR SEAT CUSHION RECONDITIONING—XJ VEHICLES

ASSEMBLY

(1) Position the trim covers on the hinge arms and install the retaining ratchet rivets.

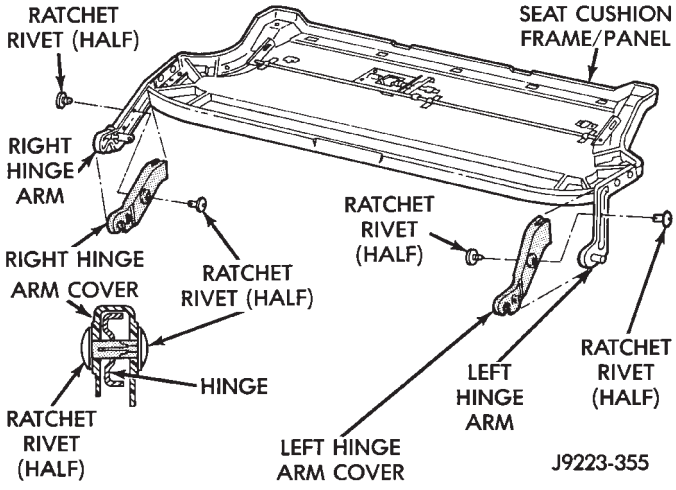

Fig. 80 Seat Cushion Hinge Arm Cover Installation

(2) Install the latch release knob and spring pin on the lever.

(3) Position the seat cushion pad on the frame/panel and engage the wire tab retainers in the brackets.

(4) Turn the seat cushion cover inside-out and insert the wire retainers in the cover sleeves.

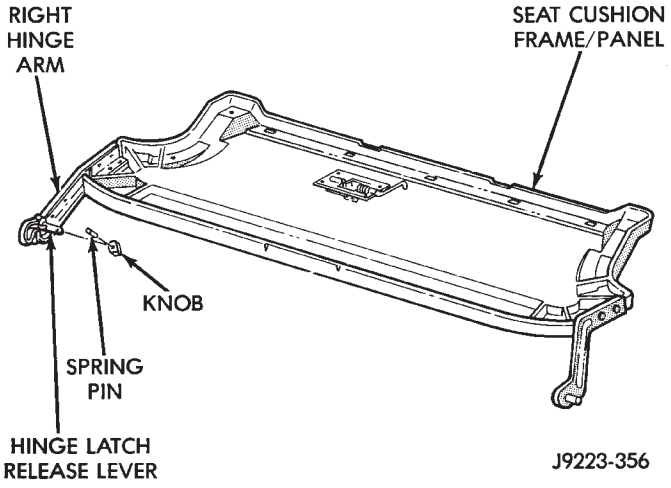

Fig. 81 Seat Cushion Latch Lever Knob Installation

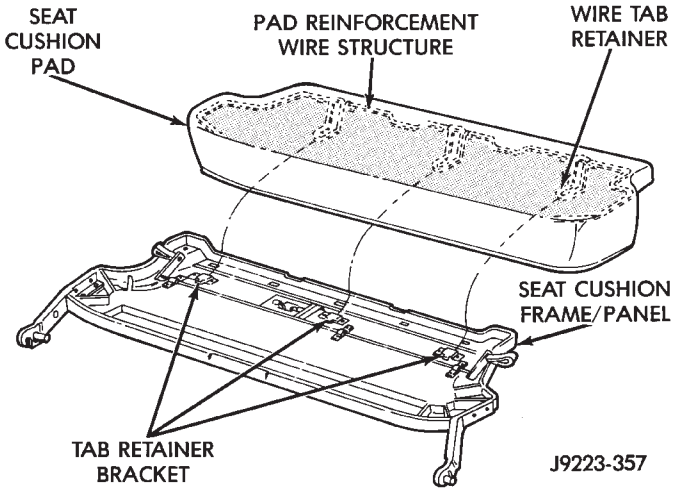

Fig. 82 Bench Seat Cushion Pad Installation

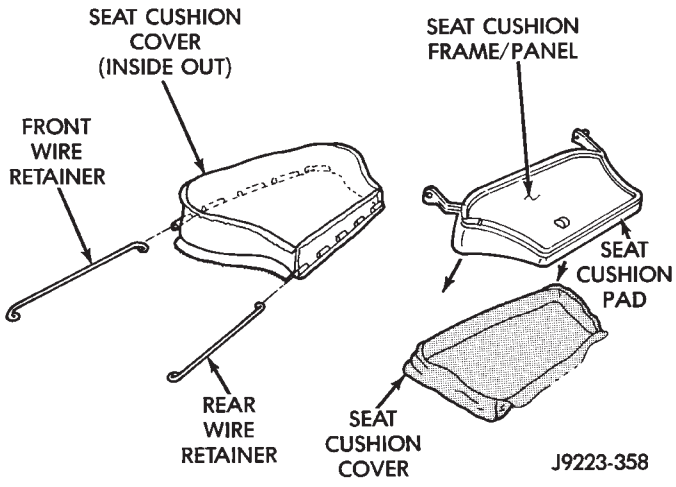

Fig. 83 Seat Cushion Cover Retainer Wire Installation

(5) Position the seat cushion pad on the cover. Pull seat cushion cover up around the pad.

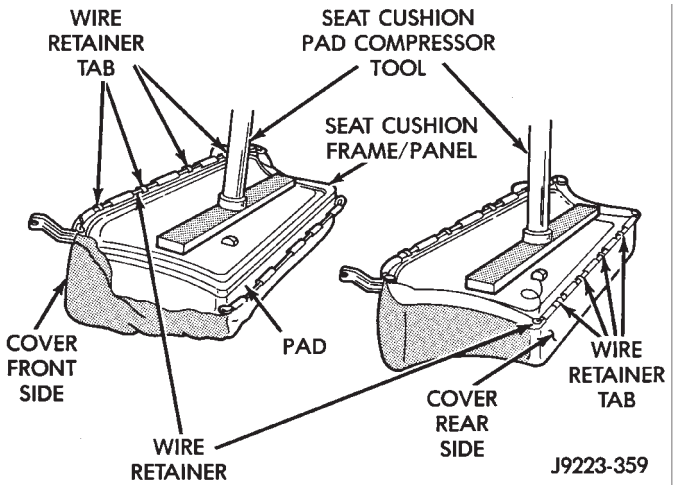

Fig. 84 Seat Cushion Cover On Pad

(7) Compress the seat cushion and attach the retainer tabs at the front and rear of the cover to the retainer wire.

(8) With the seat cushion compressed, install the serrated retainers at the sides of the cover and the frame edge.

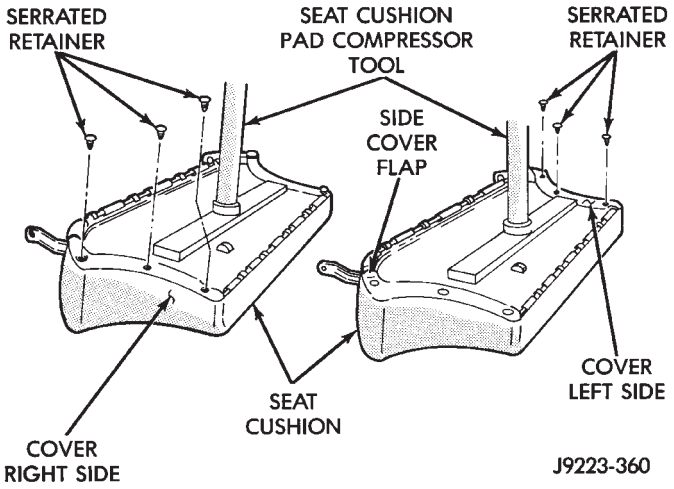

Fig. 85 Seat Cushion Cover Serrated Retainer Installation

REAR SEATBACK—XJ VEHICLES

REMOVAL

(1) Disengage the seat cushion at the rear by pulling upward on the release strap.

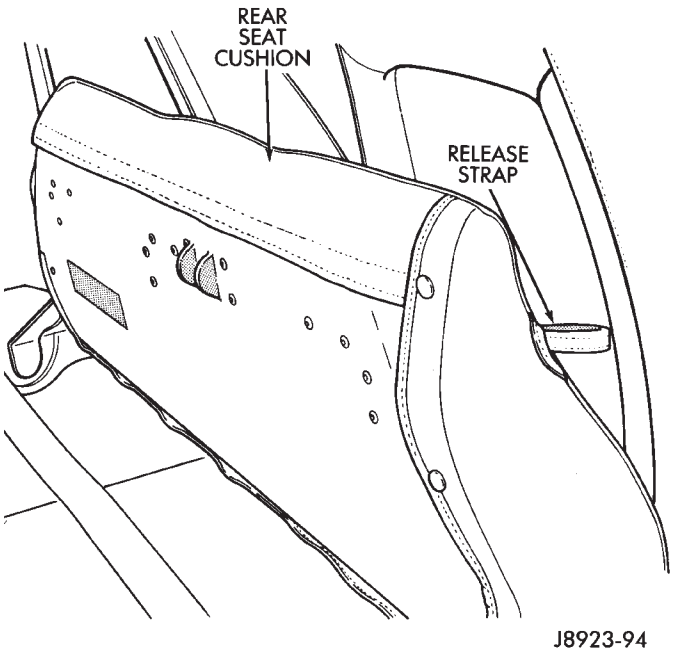

Fig. 86 Seat Cushion Disengagement At Rear

(2) Tilt the seat cushion forward.

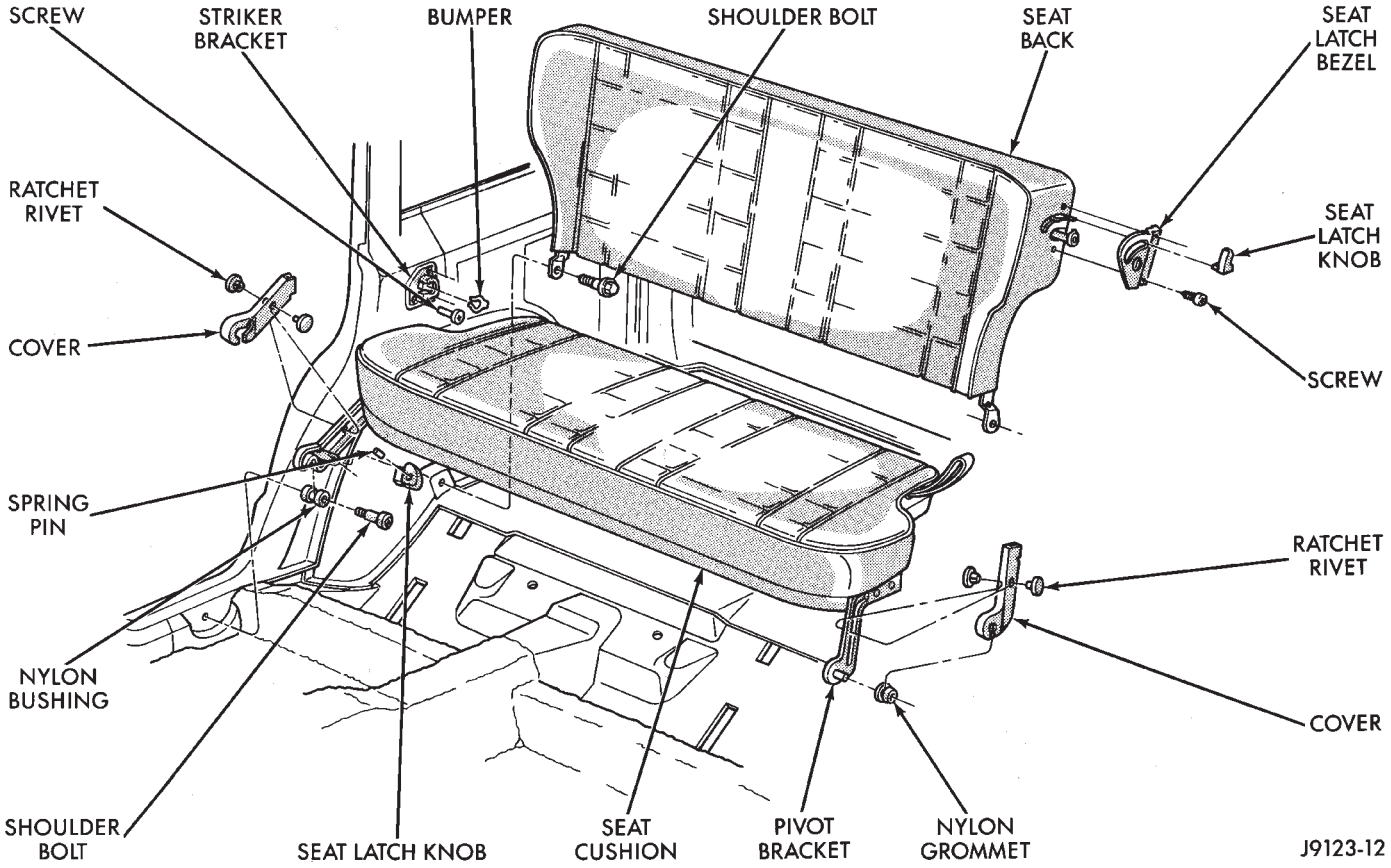

Fig. 87 Rear Seat—XJ Vehicles

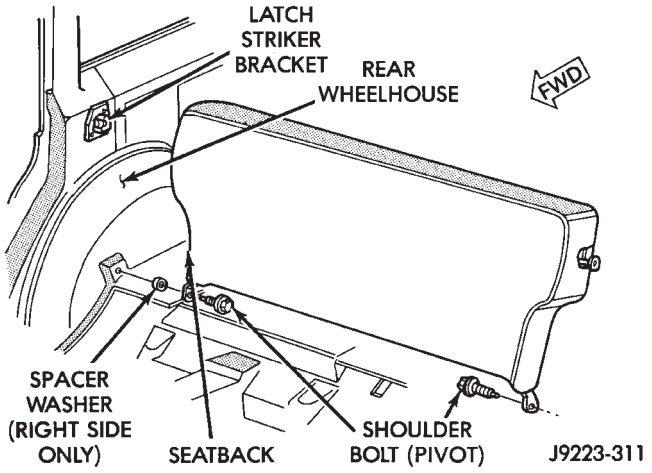

Fig. 88 Rear Seatback Removal/Installation

(3) Remove the shoulder/lap belt buckles from the elastic straps.

(4) Release the seatback latch from the striker.

(5) Remove the pivot bolts and the washers from the wheelhouse panel anchors.

(6) Tilt the seatback forward, lift it upward and remove it from the vehicle.

INSTALLATION

(1) Position the seatback in the vehicle.

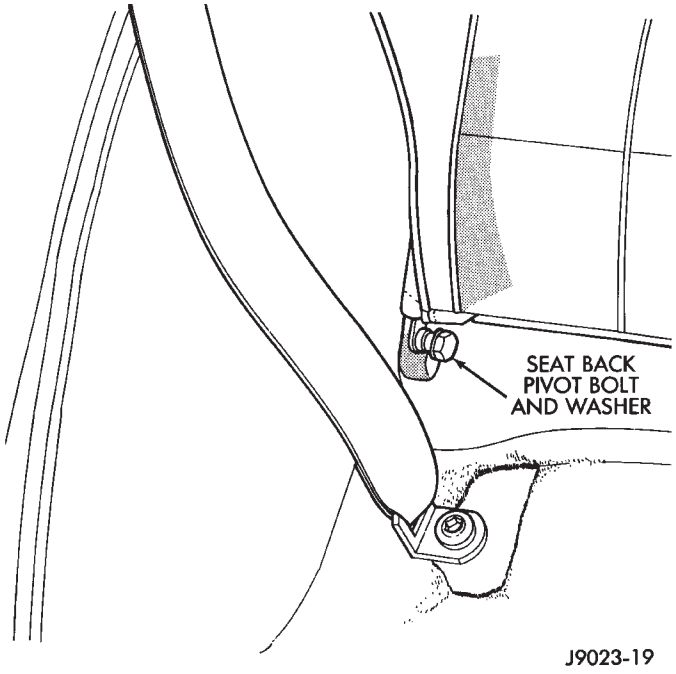

Fig. 89 Seatback Pivot Bolts

(2) Install the pivot bolts and the washer—right side only. Tighten the bolts with 45 N·m (33 ft-lbs) torque.

(3) Engage the seatback latch with the striker.

(4) Insert the shoulder/lap belt buckles in the elastic straps.

(5) Pivot the seat cushion to the horizontal position and lock the it in-place by pressing firmly on the center of the cushion until the latch engages.

REAR SEATBACK LATCH STRIKER AND BUMPER—XJ VEHICLES

REMOVAL

(1) Disengage the seat cushion at the rear by pulling upward on the release strap.

(2) Tilt the seat cushion forward.

(3) Release the seatback latch from the striker.

(4) Tilt the seatback forward for access to the striker bracket.

(5) Remove the retaining screws and the latch striker bracket from the trim panel.

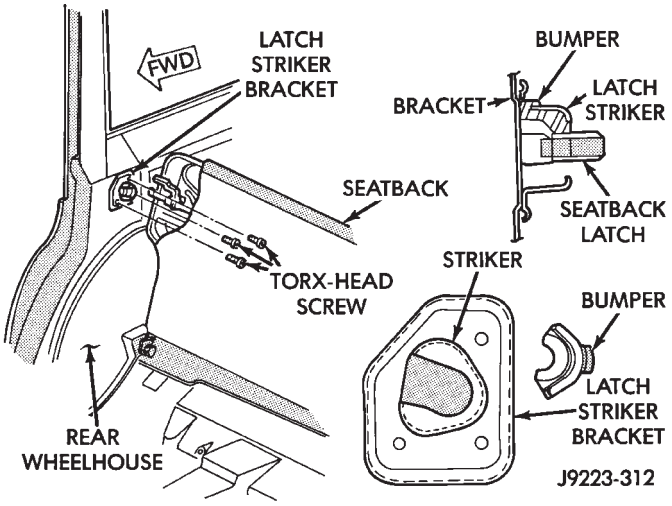

Fig. 90 Seatback Latch Striker Bracket Removal/ Installation

INSTALLATION

(1) Position the latch striker bracket on the trim panel and install the retaining screws. Tighten the screws with 6 N·m (50 in-lbs) torque.

(2) Engage the seatback latch with the striker.

(3) Pivot the seat cushion to the horizontal position and lock the it in-place by pressing firmly on the center of the cushion until the latch engages.

REAR SEATBACK COVER—XJ VEHICLES

REMOVAL

(1) Remove the seatback from the vehicle.

(2) Remove the seatback latch release handle and bezel from the seatback.

(3) Disengage the cover zipper and J-rail retainer. Remove the cover from the seatback pad.

INSTALLATION

(1) Install the replacement cover on the seatback.

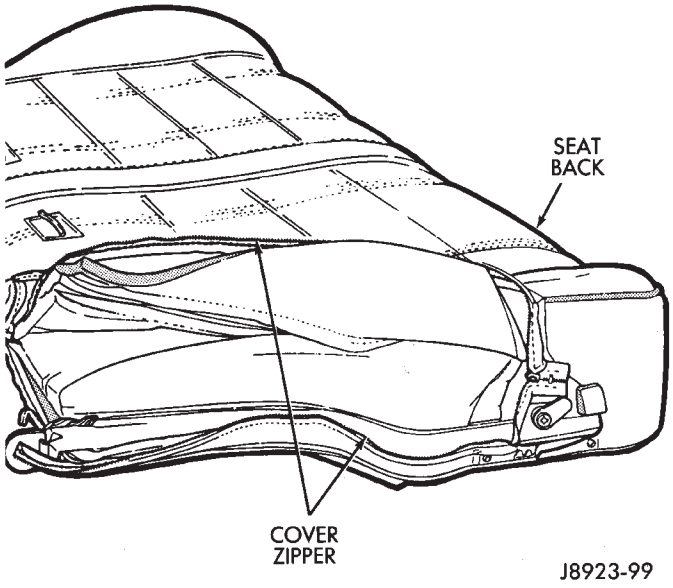

Fig. 91 Seatback Cover Removal

(2) Attach the cover J-rail retainer clip to the frame/panel edge and engage the cover zipper.

(3) Install the seat latch release bezel and handle on the cover and pad.

(4) Install the seatback in the vehicle.

REAR SEATBACK RECONDITIONING—XJ VEHICLES

ASSEMBLY

(1) Apply hot melt glue to the rear side of the frame/panel and position the seatback foundation board on the panel.

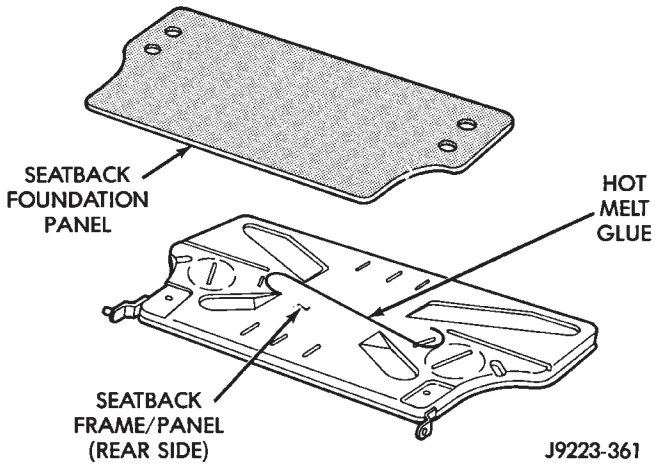

Fig. 92 Rear Seatback Foundation Board Installation

(2) Turn the seatback frame/panel over apply hot melt glue to the front side of the panel.

(3) Position the seatback pad on the frame/panel and hot melt glue.

(4) Position the seatback cover on the pad.

(5) Pull the seat cushion cover down around the pad.

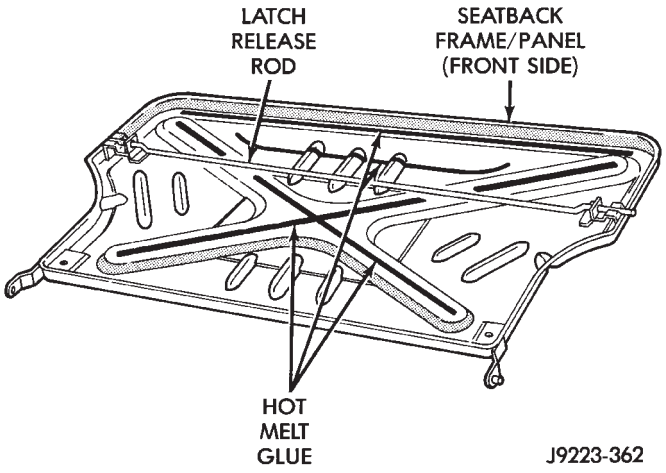

Fig. 93 Rear Seatback Hot Melt Glue Application

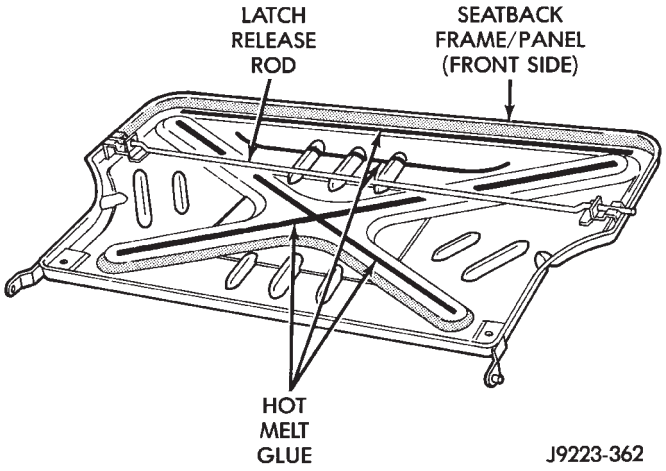

Fig. 94 Rear Seatback Pad Installation

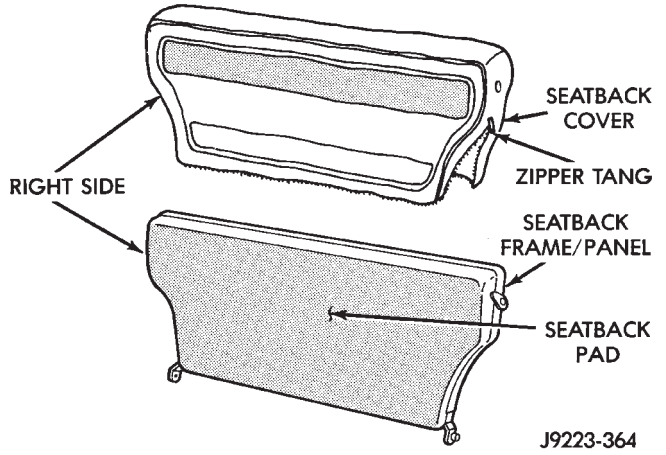

Fig. 95 Rear Seatback Cover and Pad

(6) Attach the cover J-rail retainer clip to the frame/panel edge and engage the cover zipper.

(7) Install the seatback latch release handle bezel and handle on the cover and pad.

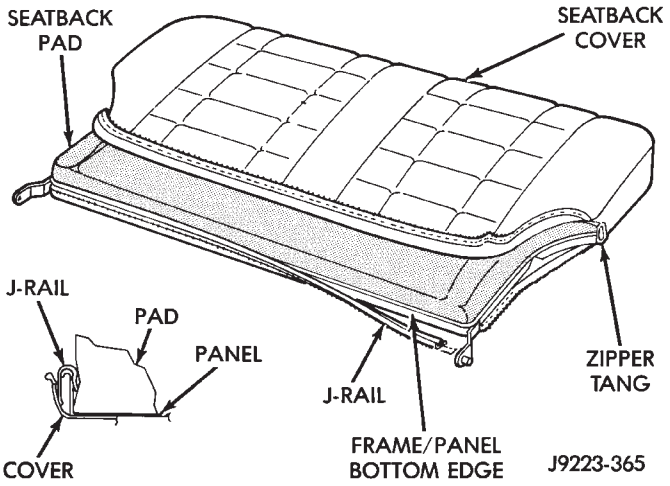

Fig. 96 Seatback Cover On Pad

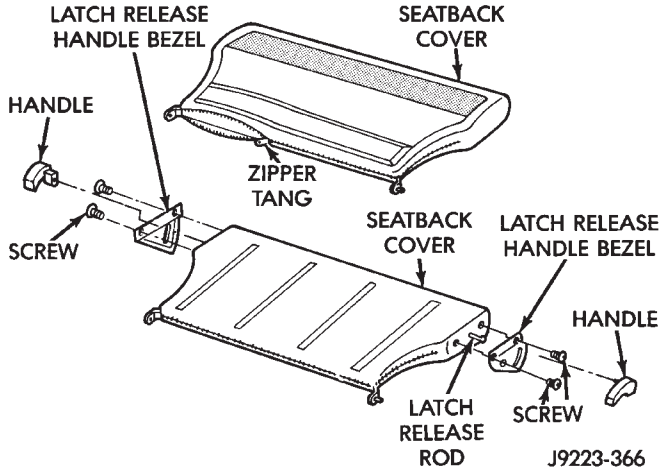

Fig. 97 Seatback Latch Release Bezel and Handle

INTERIOR TRIM PANELS AND SCUFF PLATES—XJ VEHICLES

SERVICE INFORMATION

The XJ interior trim panels, mouldings and inner scuff plate are illustrated in Figures 98 and 99. Most of the components are attached with either push-in screws or Phillips-head screws. Retainer clips are used to attach the rear quarter trim panels.

CAUTION: Do not remove trim panels/mouldings without first removing the overlapping panels, interior lamps, and other components. To avoid damaging the panels, ensure that all the screws and clips are removed before attempting to remove a trim panel/moulding.

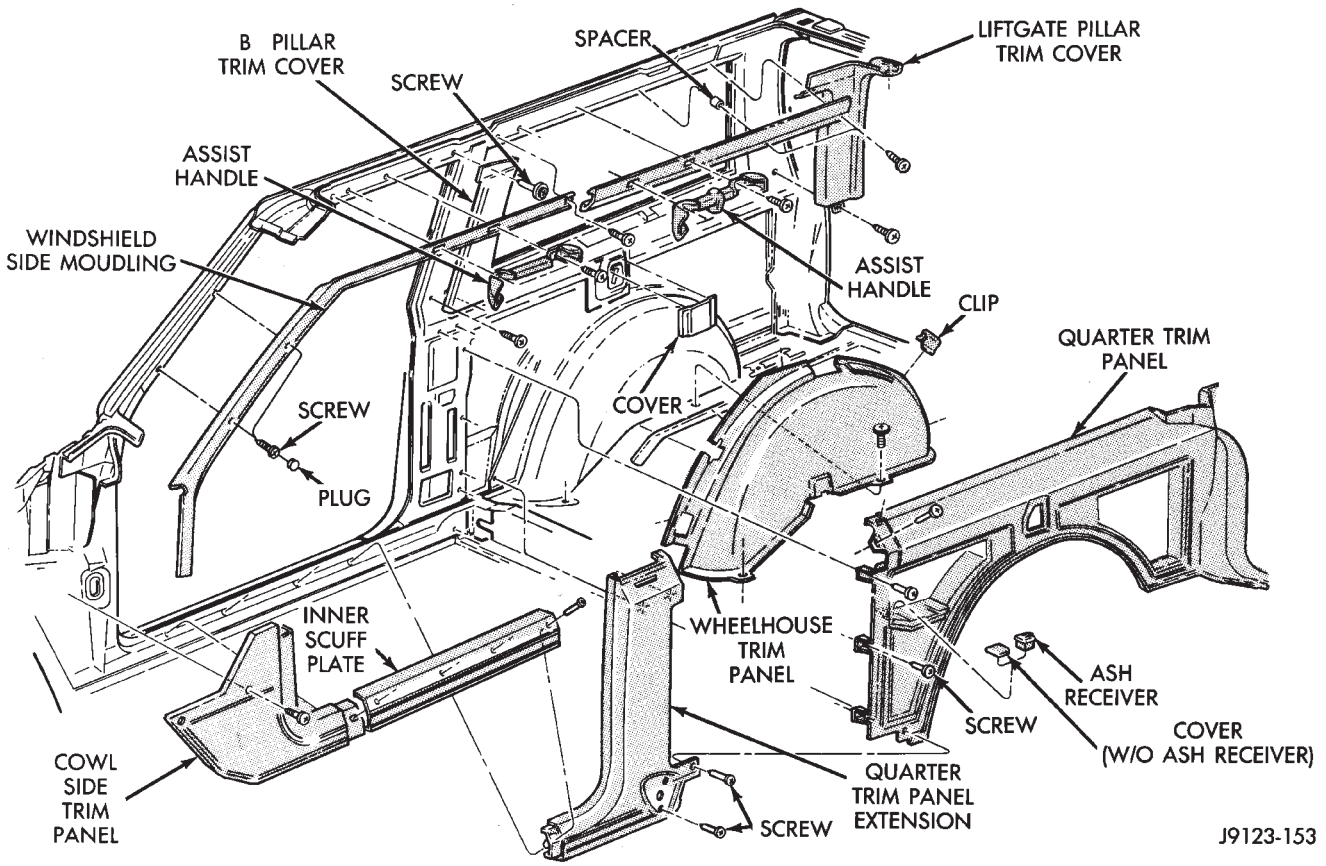

Fig. 98 Interior Trim Panels/Mouldings/Scuff Plate—XJ 2-Door Vehicles

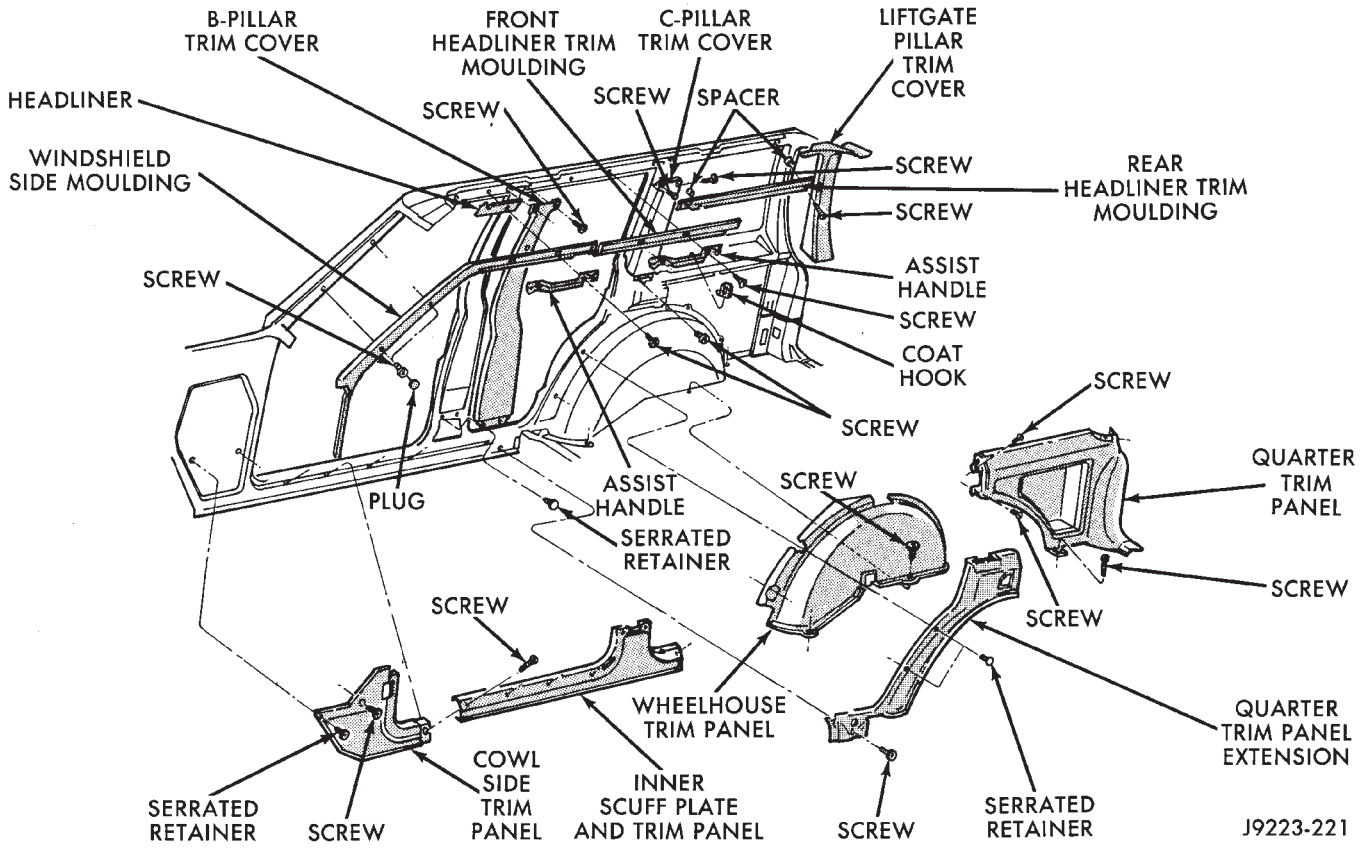

Fig. 99 Interior Trim Panels/Mouldings/Scuff Plate—XJ 4-Door Vehicles

FRONT INNER SCUFF PLATE/COWL SIDE TRIM PANEL—XJ VEHICLES

REMOVAL

(1) Remove the retaining screws and the inner scuff plate from the front door sill.

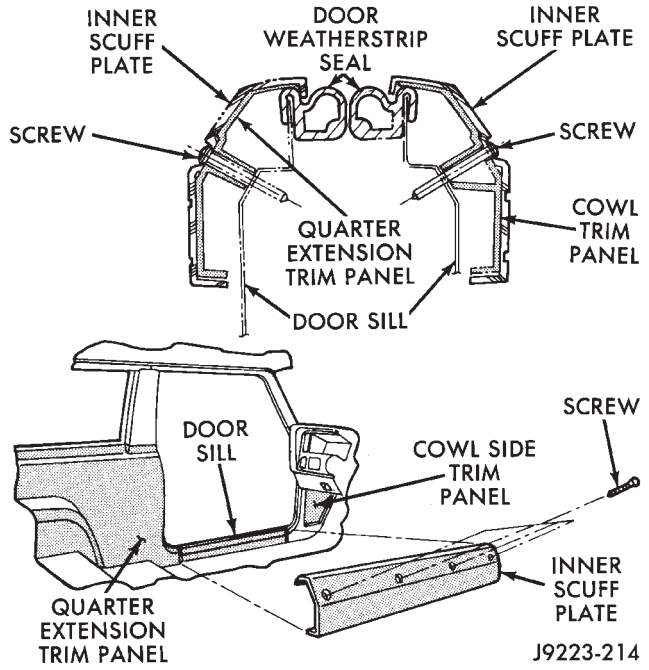

Fig. 100 Front Inner Scuff Plate—2-Door Vehicles

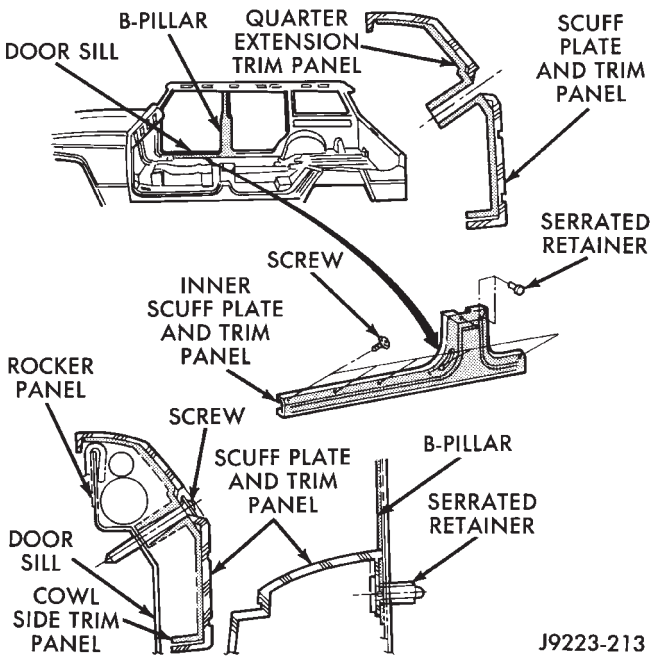

Fig. 101 Front Inner Scuff Plate—4-Door Vehicles

(2) Remove the retaining screws and cowl side trim panel from the cowl side panel.

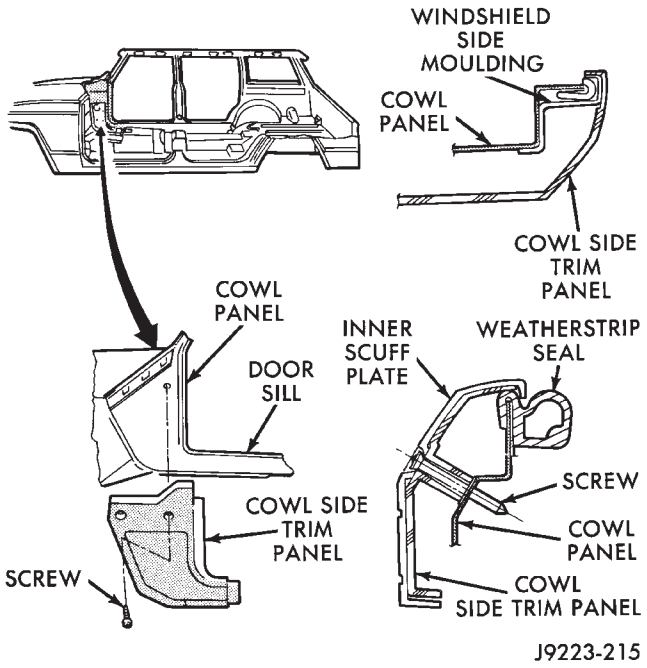

Fig. 102 Cowl Side Trim Panel

INSTALLATION

(1) Position the cowl side trim panel on the cowl side panel and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(2) Position the inner scuff plate on the front door sill and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

WINDSHIELD SIDE MOULDING—XJ VEHICLES

REMOVAL

(1) Remove the retaining screws and the inner scuff plate, cowl side trim panel and headliner front trim moulding from the interior of the vehicle.

(2) Remove the retaining screws and the windshield side moulding from the A-pillar and door header.

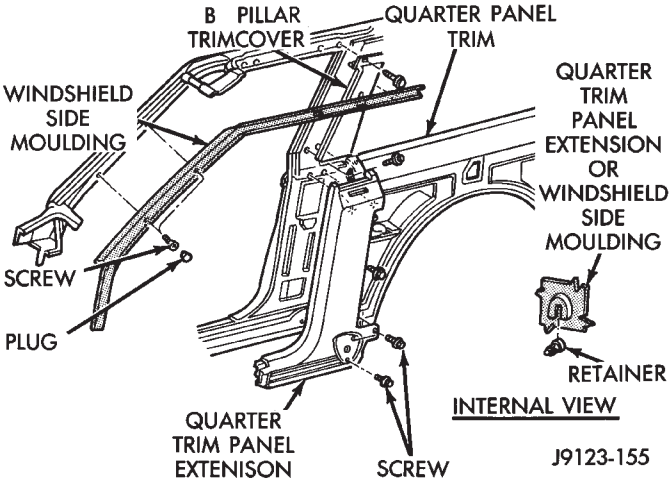

Fig. 103 Windshield Side Moulding, Quarter Trim and Extension Panels

INSTALLATION

(1) Position the windshield side moulding on the A-pillar and door header. Install the retaining screws and tighten to 1 N·m (11 in-lbs) torque.

(2) Install the headliner front trim moulding, the cowl side trim panel and the inner scuff plate in the interior of the vehicle. Tighten the retaining screw to 1 N·m (11 in-lbs) torque.

QUARTER TRIM PANEL EXTENSION—XJ VEHICLES

REMOVAL

(1) Remove the retaining screws and the inner scuff plate from the door sill.

(2) Remove the retaining screws and serrated retainers, and remove the panel extension from the wheelhouse and quarter trim panels.

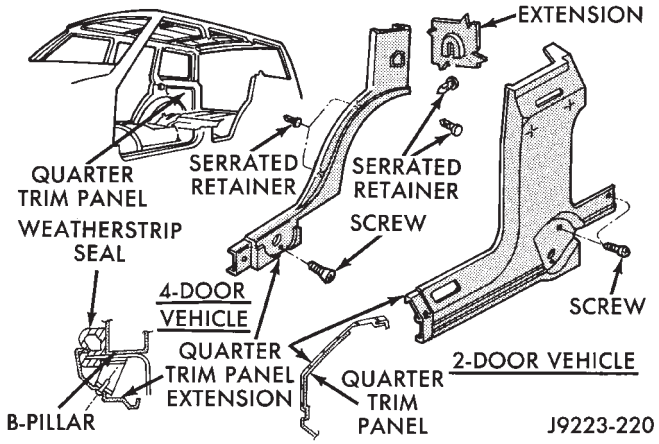

Fig. 104 Quarter Trim Panel Extension

INSTALLATION

(1) Position the quarter trim panel extension on the wheelhouse and quarter trim panels. Install the serrated retainers and retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(2) Position the inner scuff plate on the door sill. Install the retaining screws and tighten to 1 N·m (11 in-lbs) torque.

QUARTER AND WHEELHOUSE TRIM PANELS—XJ VEHICLES

REMOVAL

(1) Remove the retaining screws and the inner scuff plate from the door sill.

(2) Remove the retaining screws and serrated retainers, and remove the panel extension from the wheelhouse and quarter trim panels.

(3) Remove the retaining screws, and the liftgate scuff plate and latch striker from the carpet and cross sill.

(4) Remove the retaining screws and the quarter trim panel from the quarter panel and wheelhouse trim panel.

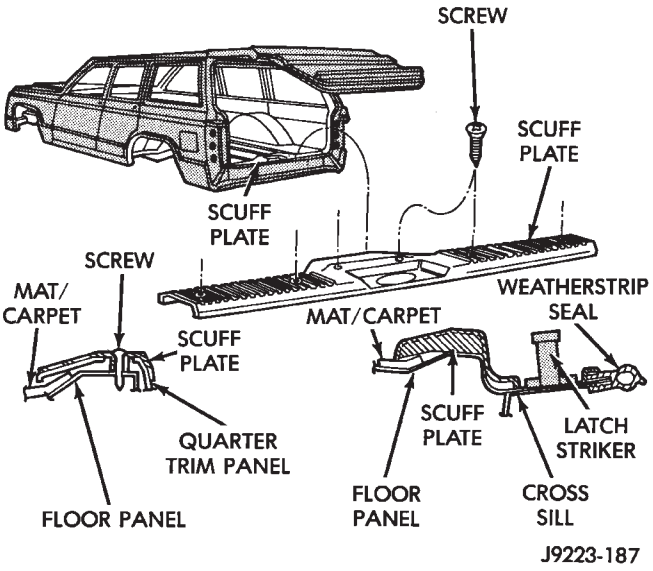

Fig. 105 Liftgate Scuff Plate

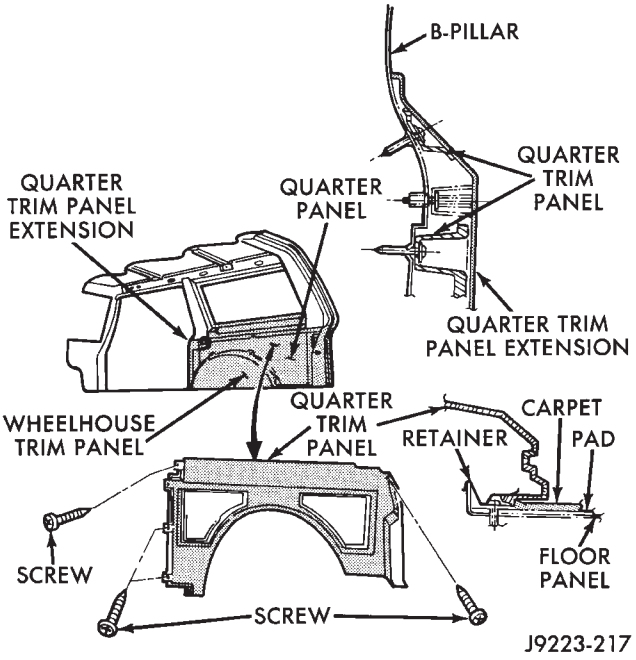

Fig. 106 Quarter Trim Panel—2-Door Vehicles

(5) If necessary, remove the retaining screws and the tire stand-off from the left quarter trim panel.

(6) If necessary, remove the ash receiver/cover plate from the quarter trim panel.

(7) Remove the retaining screws and U-clip retainers, and remove the wheelhouse trim panel from the quarter panel.

INSTALLATION

(1) Position the wheelhouse trim panel on the quarter panel and install the retaining screws and U-clip retainers. Tighten the screws to 1 N·m (11 in-lbs) torque.

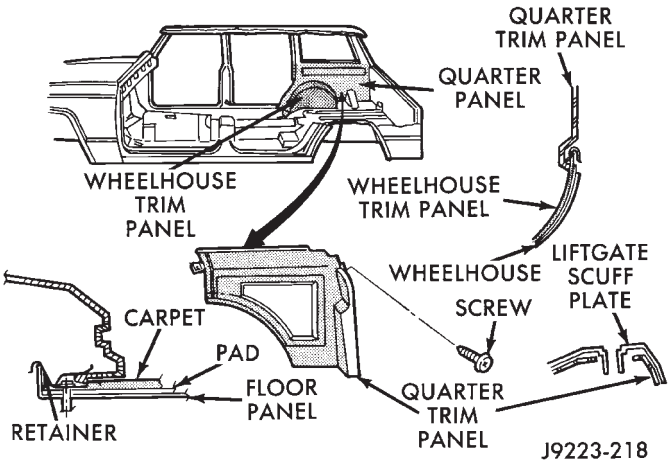

Fig. 107 Quarter Trim Panel—4-Door Vehicles

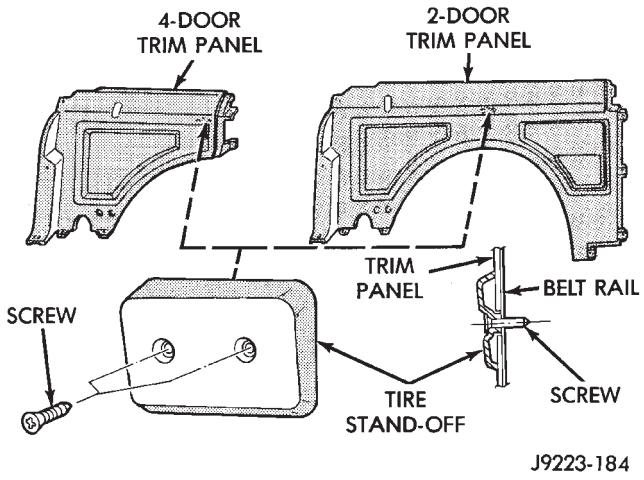

Fig. 108 Tire Stand-Off—Left Quarter Trim Panel

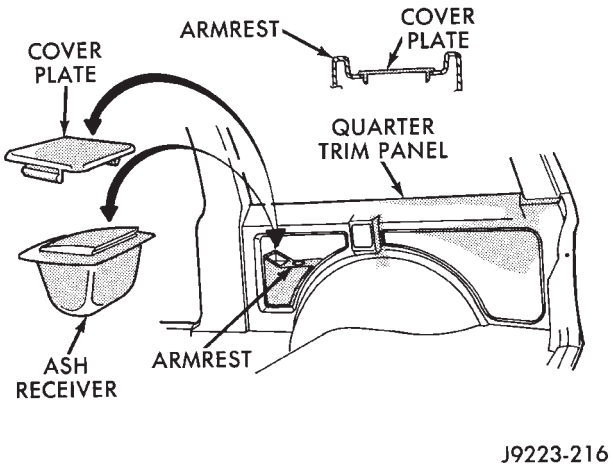

Fig. 109 Ash Receiver/Cover Plate

(2) If removed, install the tire stand-off on the left quarter trim panel. Tighten the retaining screws to 1 N·m (11 in-lbs) torque.

(3) If removed, install the ash receiver/cover plate on the quarter trim panel.

(4) Position the quarter trim panel on the quarter panel and wheelhouse trim panel. Install and tighten the retaining screws to 1 N·m (11 in-lbs) torque.

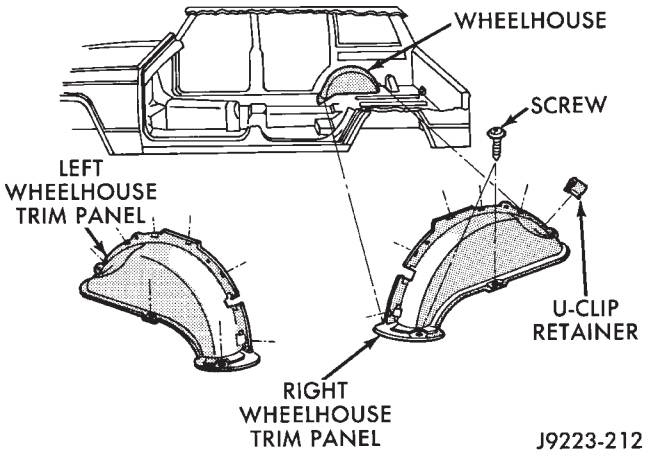

Fig. 110 Wheelhouse Trim Panel—Typical

(5) Position scuff plate and latch striker on the carpet and cross sill, and install the retaining screws.Tighten the scuff plate screws to 1 N·m (11 in-lbs) torque. Tighten the latch striker screws to 30 N·m (22 ft-lbs) torque.

(6) Position the quarter trim panel extension on the wheelhouse and quarter trim panels. Install the serrated retainers and retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(7) Position the inner scuff plate on the door sill. Install the retaining screws and tighten to 1 N·m (11 in-lbs) torque.

B/C-PILLAR AND LIFTGATE PILLAR TRIM COVERS—XJ VEHICLES

REMOVAL

(1) Remove the retaining screws and the inner scuff plate from the door sill.

(2) Remove the cowl side trim panel, the headliner trim moulding and the windshield side moulding from the interior of the vehicle.

(3) For 4-door vehicles, remove the retaining screws and remove the trim cover from the B-pillar.

(4) Remove the retaining screws and serrated retainers, and remove the panel extension from the wheelhouse and quarter trim panels.

(5) For 2-door vehicles, remove the retaining screws and remove the trim cover from the B-pillar.

(6) For 4-door vehicles, remove the retaining screws and remove the trim cover from the C-pillar.

(7) Remove the retaining screws, and the liftgate scuff plate and latch striker from the carpet and cross sill.

(8) Remove the retaining screws and the quarter trim panel from the quarter panel and wheelhouse trim panel.

(9) Remove the retaining screws and the liftgate upper trim moulding from the liftgate header.

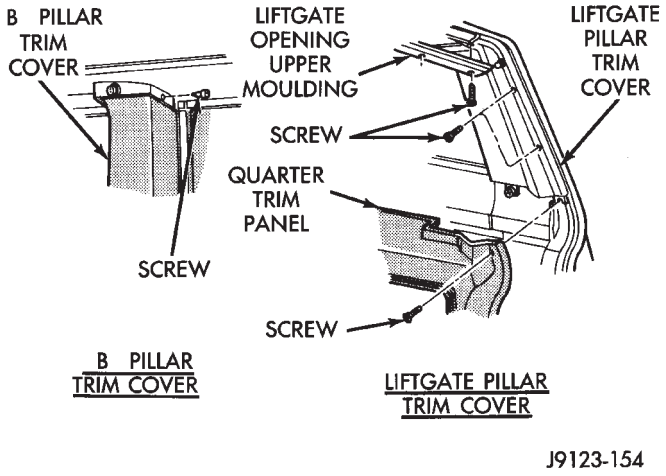

Fig. 111 B-Pillar and Liftgate Pillar Trim Covers

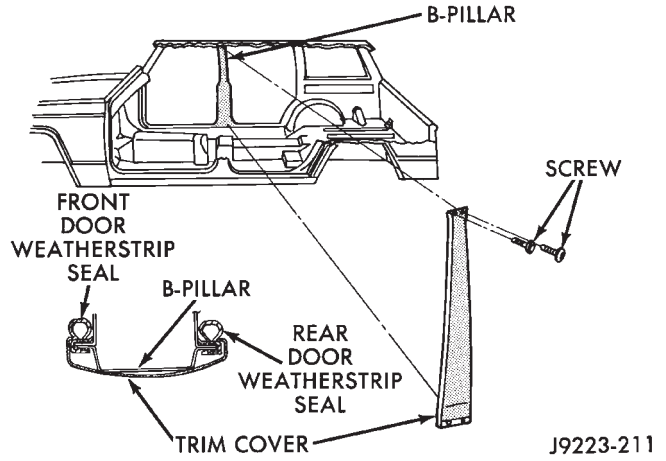

Fig. 112 B-Pillar Trim Cover—4-Door Vehicles

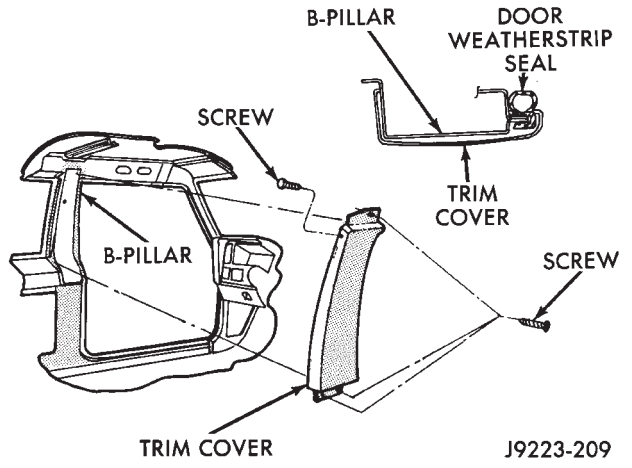

Fig. 113 B-Pillar Trim Cover—2-Door Vehicles

(10) Remove the retaining screws and the trim cover from the liftgate pillar.

INSTALLATION

(1) Position the trim cover on the liftgate pillar and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

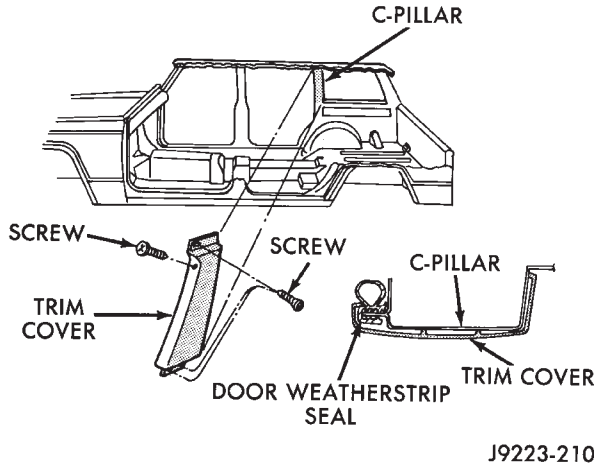

Fig. 114 C-Pillar Trim Cover—4-Door Vehicles

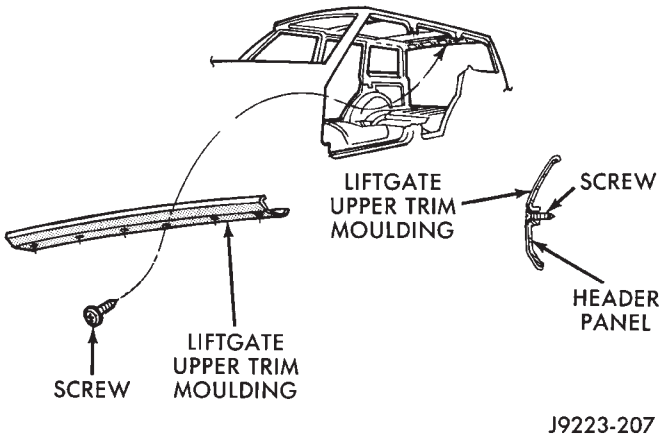

Fig. 115 Liftgate Upper Trim Moulding

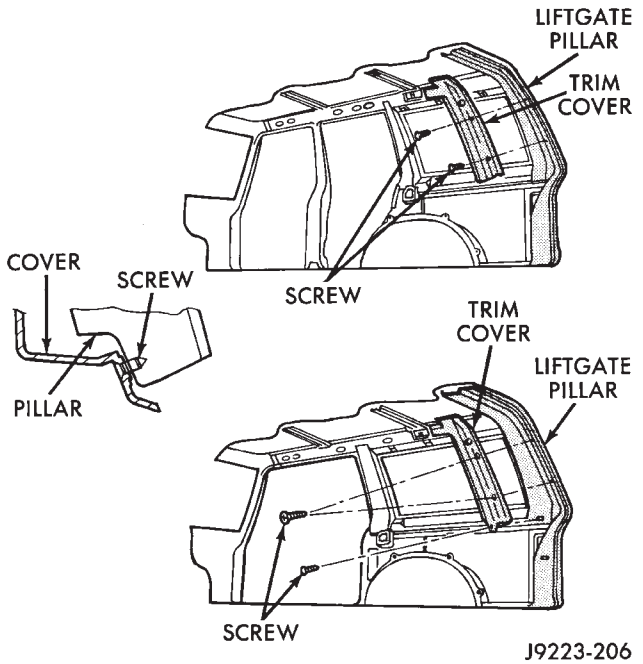

Fig. 116 Liftgate Pillar Trim Cover

(2) Position the upper trim moulding on the liftgate header and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(3) Position the quarter trim panel on the quarter panel and wheelhouse trim panel. Install and tighten the retaining screws to 1 N·m (11 in-lbs) torque.

(4) Position the scuff plate and latch striker on the carpet and cross sill, and install the retaining screws. Tighten the scuff plate screws to 1 N·m (11 in-lbs) torque. Tighten the latch striker screws to 30 N·m (22 ft-lbs) torque.

(5) For 4-door vehicles, position the trim cover on the C-pillar and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(6) For 2-door vehicles, position the trim cover on the B-pillar and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(7) Position the quarter trim panel extension on the wheelhouse and quarter trim panels. Install the serrated retainers and retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(8) For 4-door vehicles, position the trim cover on the B-pillar. Install the retaining screws and tighten to 1 N·m (11 in-lbs) torque.

(9) Install the windshield side moulding, the headliner trim moulding and the cowl side trim panel in the interior of the vehicle. Tighten the screws to 1 N·m (11 in-lbs) torque.

(10) Position the inner scuff plate on the door sill. Install the retaining screws and tighten to 1 N·m (11 in-lbs) torque.

OUTER SCUFF PLATES—XJ VEHICLES

REMOVAL/INSTALLATION

The door sill outer and the liftgate scuff plates are attached to the sills with screws. Refer to Liftgate for latch striker information.

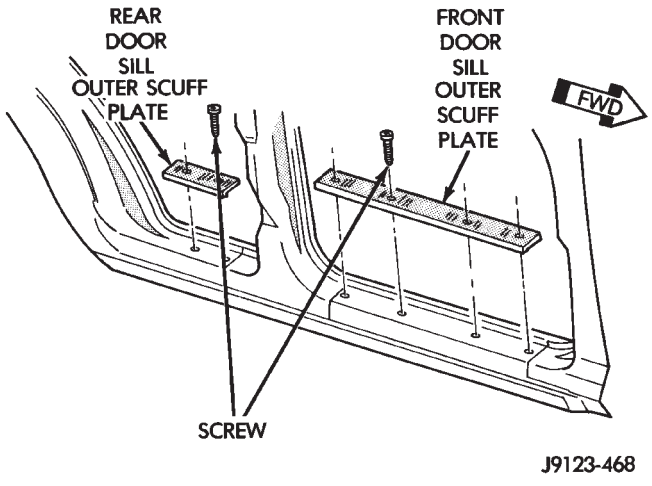

Fig. 117 Outer Scuff Plates—4-Door Vehicles

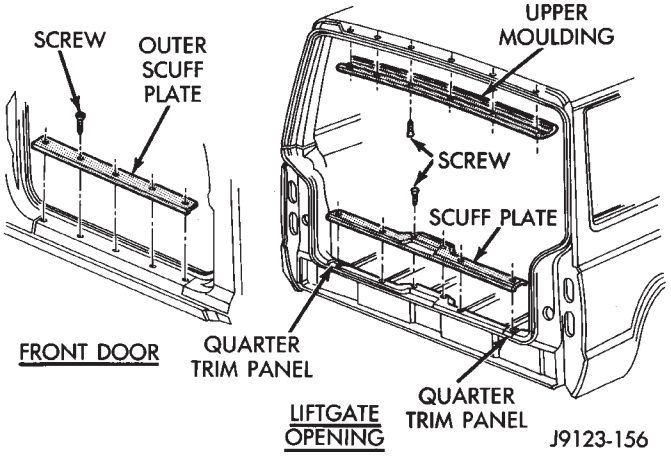

Fig. 118 Liftgate and Door Sill Outer Scuff Plate

ASSIST HANDLE—XJ VEHICLES

SERVICE INFORMATION

XJ assist handles are attached to the:

- windshield side trim moulding,
- A-pillar and door header trim moulding, and
- upper (headliner) trim mouldings with screws that concealed by the handle end covers (Fig. 119).

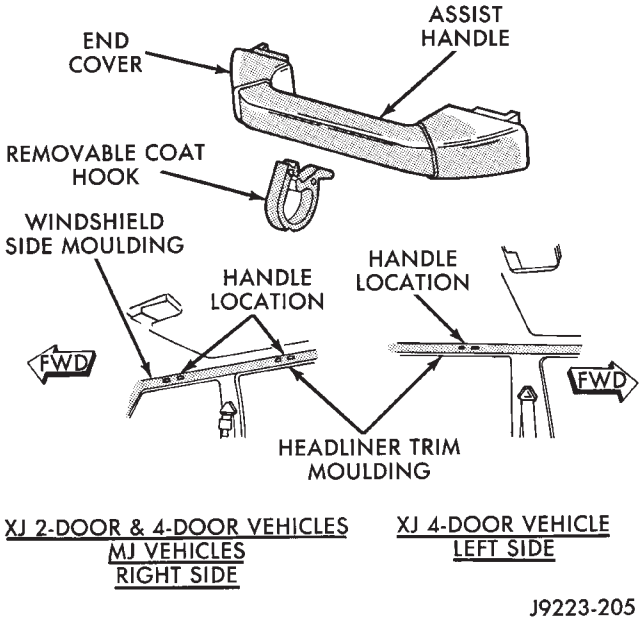

Fig. 119 Assist Handles—XJ Vehicles

REMOVAL

(1) Open the end covers that conceal the assist handle retaining screws.

(2) Remove the handle retaining screws.

(3) Remove the assist handle from the trim moulding.

INSTALLATION

(1) Position the handle on the trim moulding and install the retaining screws. Tighten the retaining screws to 3 N·m (22 in-lbs) torque.

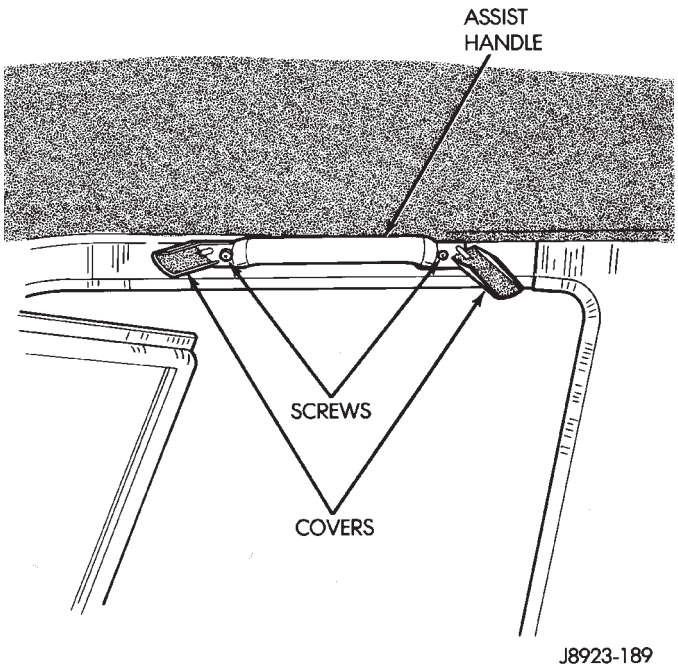

Fig. 120 Assist Handle Removal/Installation

(2) Fold the end covers over the retaining screws.

FRONT SHOULDER BELT/BUCKLE—XJ VEHICLES

REMOVAL

(1) Slide the front seats all the way forward for access to the belt anchor bolt.

(2) Disconnect the belt wire harness connector.

(3) Remove the anchor bolt cover.

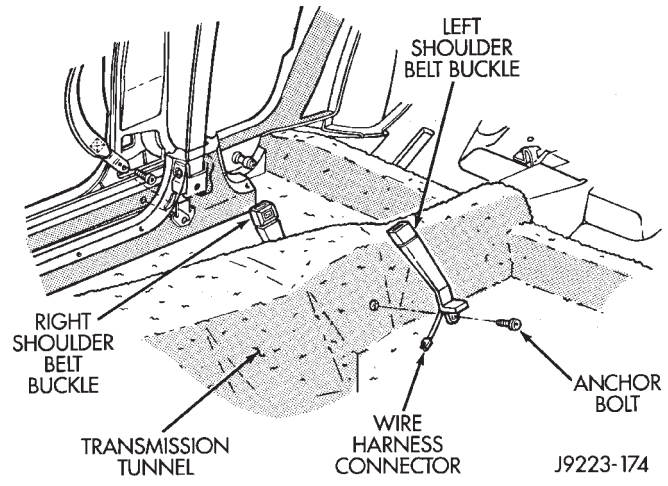

Fig. 121 Front Shoulder Belt Buckles

(4) Remove the shoulder belt buckle anchor bolt with a Torx bit.

(5) Remove the shoulder belt buckle from the transmission tunnel.

(6) Remove the cap concealing the shoulder belt upper anchor bolt.

(7) Use a Torx bit to remove the upper anchor bolt. Remove the support/guide washer.

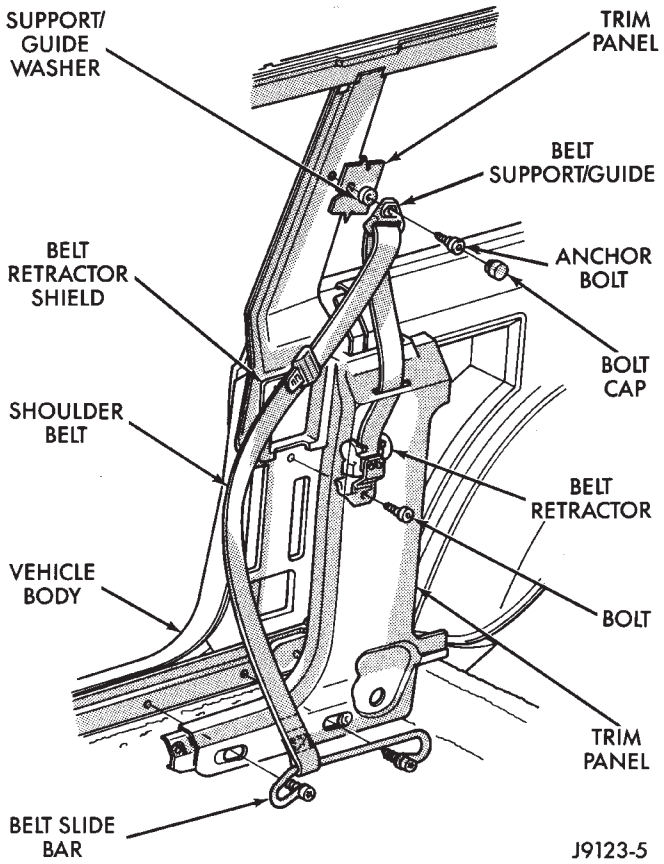

Fig. 122 Front Shoulder Belt—2-Door Vehicles

(8) Remove the inner scuff plate/trim panel from the door sill and remove the shoulder belt lower anchor bolt(s) with a Torx bit.

(9) Remove the shoulder belt and the retractor.

INSPECTION

Inspect the front shoulder belts and buckles. Replace any belt that is either cut, frayed, torn or damaged in any way. Replace the shoulder belt if the retractor is damaged or inoperative.

INSTALLATION

(1) Position the shoulder belt retractor in the shield and install the lower anchor bolt with a Torx bit.

(2) Position the support/guide washer and shoulder belt upper anchor plate on the trim panel. Install the upper anchor bolt with a Torx bit.

(3) Tighten the upper and lower anchor bolts to 41 N·m (30 ft-lbs) torque.

(4) Install the door sill inner scuff plate/trim panel and install the cap over the upper anchor bolt.

(5) Install the shoulder belt buckle and anchor bolt. Connect the wire harness connectors. Tighten the buckle anchor bolt to 41 N·m (30 ft-lbs) torque.

(6) Position the cover over the anchor bolt.

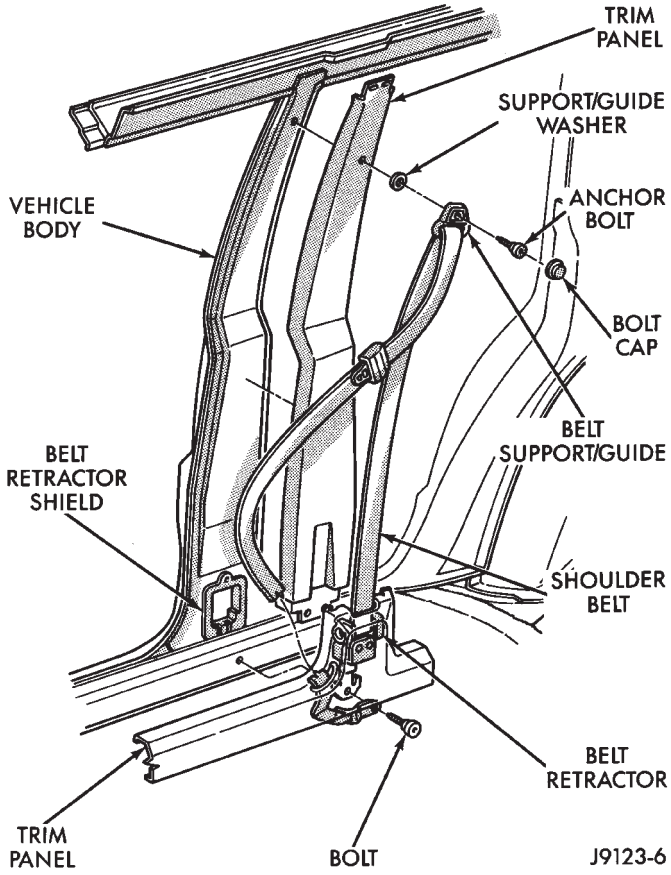

Fig. 123 Front Shoulder Belt—4-Door Vehicles

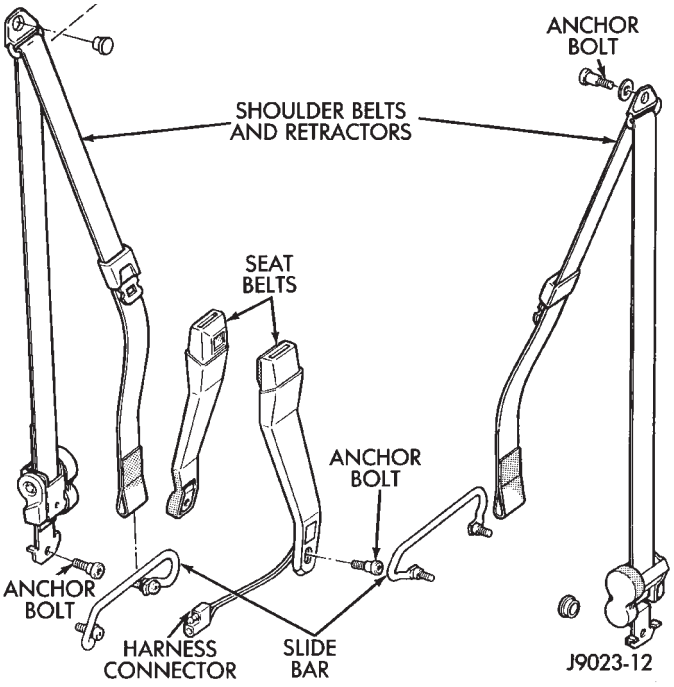

Fig. 124 Shoulder Belt Set—2-Door Vehicles

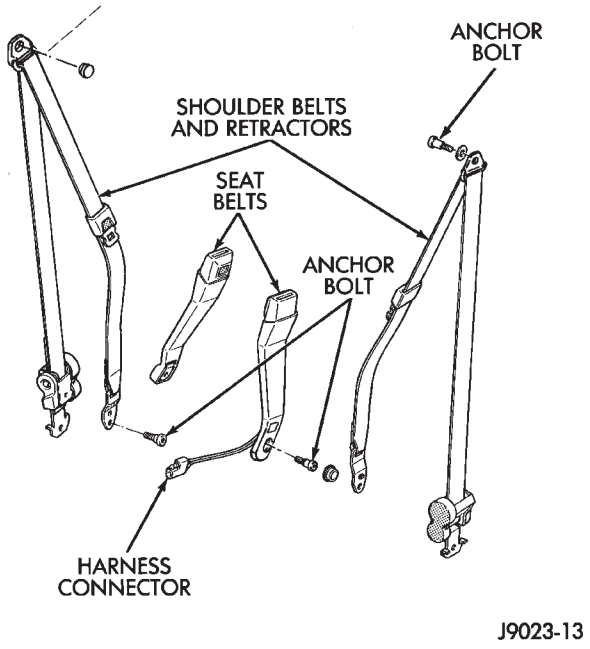

Fig. 125 Shoulder Belt Set—4-Door Vehicles

REAR SHOULDER/LAP BELT/BUCKLE—XJ VEHICLES

REMOVAL

(1) Pull the rear seat release strap and tilt the complete seat forward.

(2) Remove the shoulder belt buckle and lap belt/buckle anchor plate bolts from the floor panel.

(3) Remove the shoulder belt lower anchor bolt.

(4) Remove the quarter trim panel. If necessary, refer to the removal procedure.

(5) Remove the shoulder belt upper anchor bolt.

(6) Remove the belt retractor support retaining screw from the rear quarter rail.

(7) Remove the retractor and shoulder belt from the trim panel.

INSPECTION

Inspect the rear shoulder/lap belts and buckles. Replace any belt that is either cut, frayed, torn or damaged in any way. Replace the shoulder belt if the retractor is damaged or inoperative.

INSTALLATION

(1) Position the shoulder belt buckle and the lap belt/buckle anchor plates on the floor panel.

(2) Install the anchor bolts. Tighten the bolts to 37 N·m (27 ft-lbs) torque.

(3) Position the shoulder belt at the roof rail and install the upper anchor bolt. Tighten the bolt to 37 N·m (27 ft-lbs) torque.

(4) Route the shoulder belt through the quarter trim panel slot. Install the retractor support on the rear quarter rail. Tighten the screw to 5 N·m (45 in-lbs) torque.

(5) Install the quarter trim panel.

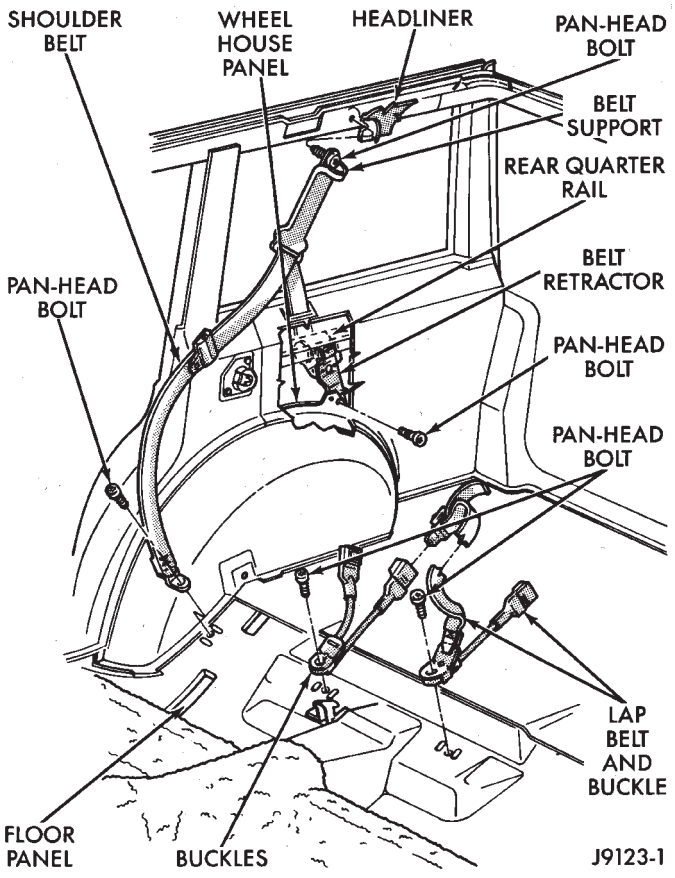

Fig. 126 Rear Seat Shoulder/Lap Belts and Buckles—XJ Vehicles

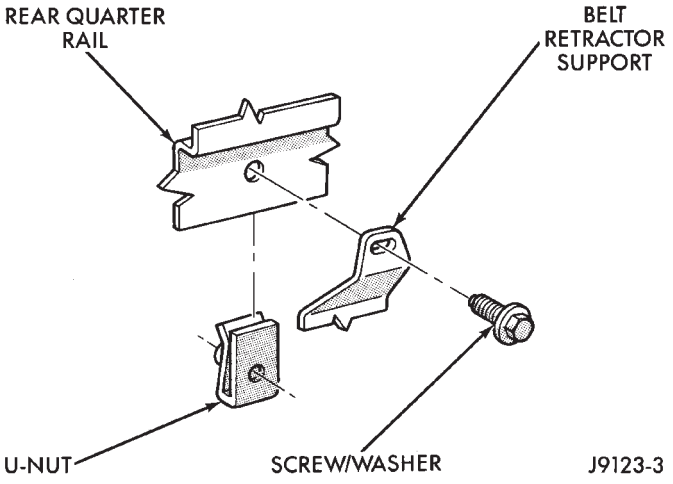

Fig. 127 Shoulder Belt Retractor Support Removal/ Installation

(6) Install the shoulder belt lower anchor bolt. Tighten the bolt to 37 N·m (27 ft-lbs) torque.

(7) Return the rear seat to the normal position and engage the latch.

HEADLINER

SERVICE INFORMATION

The upper trim mouldings and the headliner are attached to the roof rail with a combination of screws, velcro strips, clip retainers and rail retainers.

To remove a headliner, all of the upper trim mouldings must be removed from the perimeter of the headliner along with (as applicable):

- the assist handles,
- the sunvisors,
- the dome/cargo lamps,
- the overhead console,
- the keyless entry receiver module,
- the sunroof inner rubber seal and
- all other attached/overlapping components.

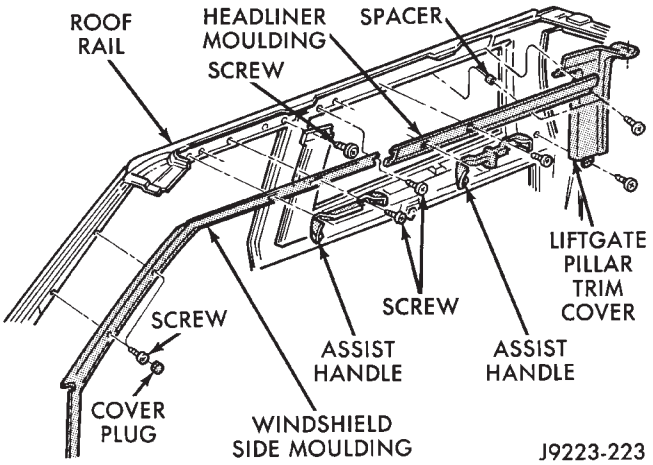

Fig. 128 Headliner Trim Mouldings—XJ Vehicles

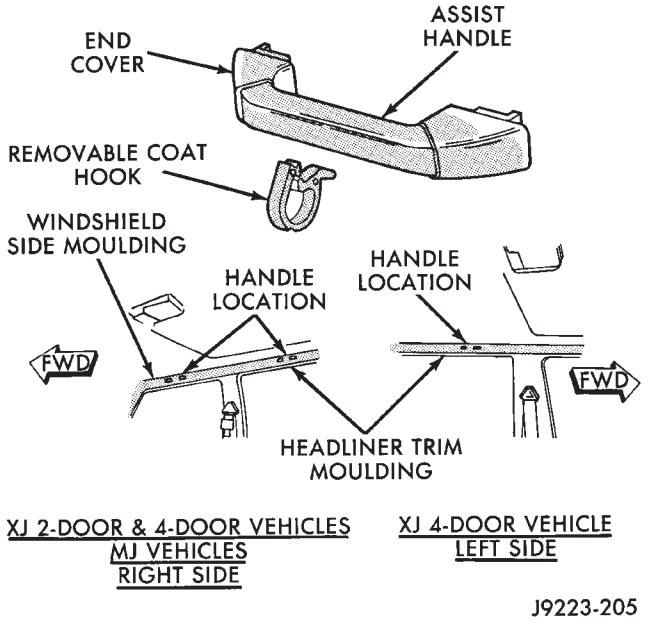

Fig. 129 Assist Handles—XJ Vehicles

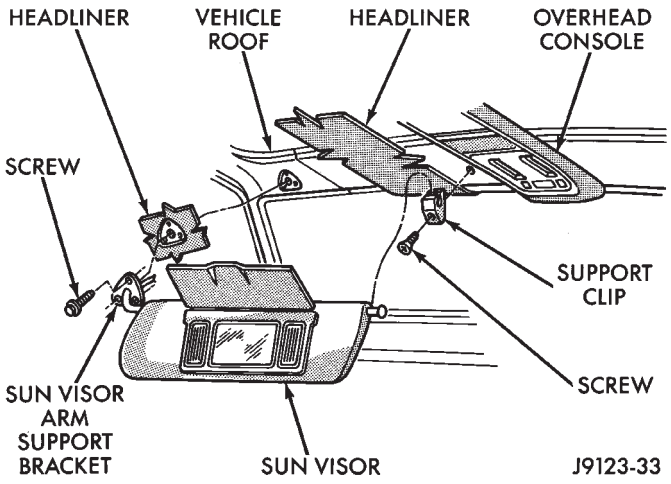

Fig. 130 Sunvisor and Overhead Console

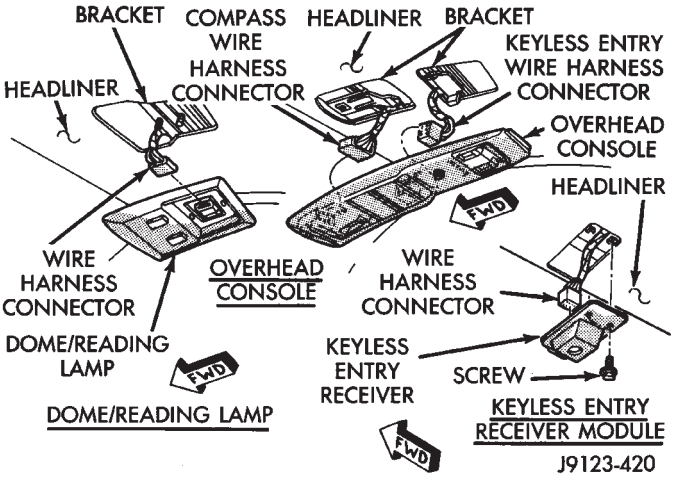

Fig. 131 Dome/Reading Lamp/Overhead Console/ Keyless Entry Module

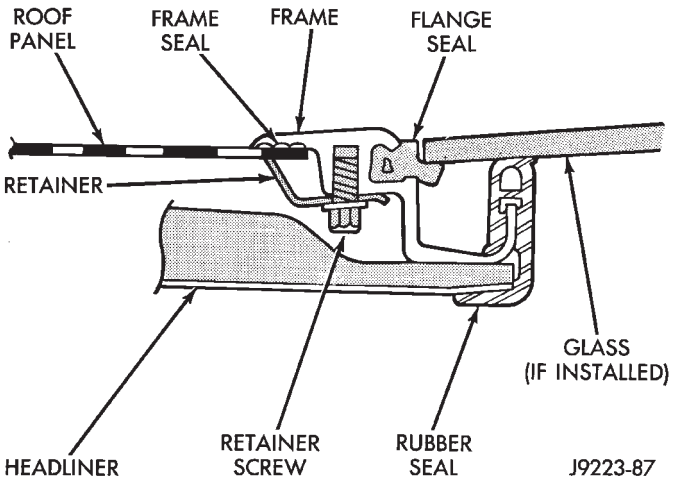

Fig. 132 Sunroof Rubber Seal

DOME/CARGO LAMP—XJ VEHICLES

REMOVAL

(1) Remove the dome lamp lens by squeezing both sides to release the retaining clips. Pull downward to remove the lens.

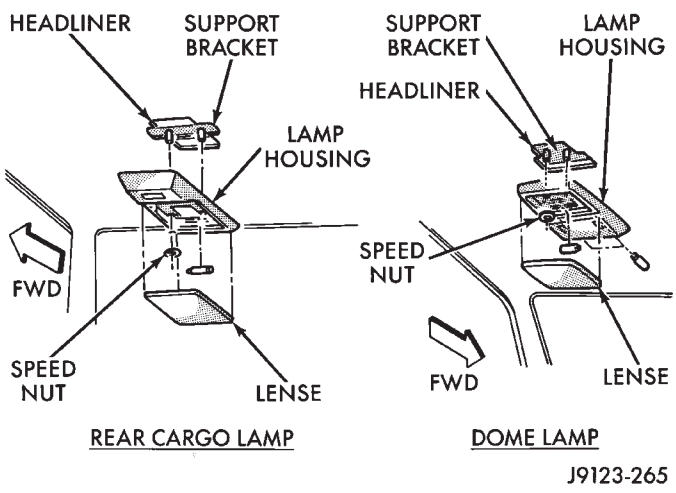

Fig. 133 Dome Lamp and Cargo Lamp

(2) Remove the speed nuts.
(3) Disconnect the wire harness connector.
(4) Remove the lamp from the headliner.

INSTALLATION

(1) Connect the dome lamp wire harness connector.
(2) Position the dome lamp in the headliner hole and install the speed nuts.
(3) Install the dome lamp lens.

HEADLINER REMOVAL

CAUTION: The headliner is a one-piece, molded component. It has limited flexibility and must not be bent during removal/installation.

(1) Remove the upper trim mouldings from the perimeter of the headliner.

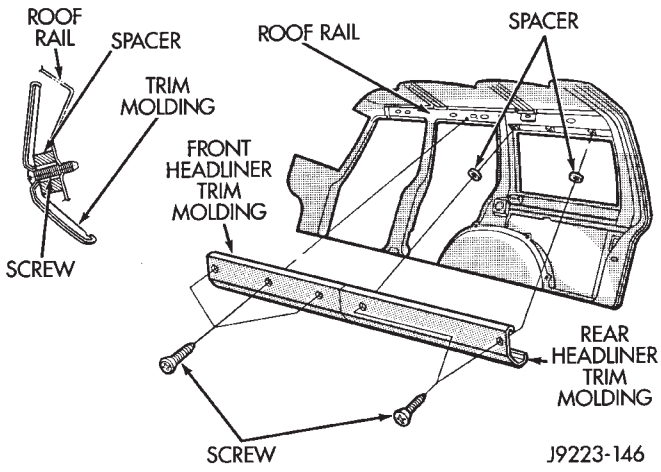

Fig. 134 Upper Trim Moulding—4-Door XJ Vehicles

(2) Ensure that all the retainer clips, screws and Velcro strips are disengaged before removing the headliner.

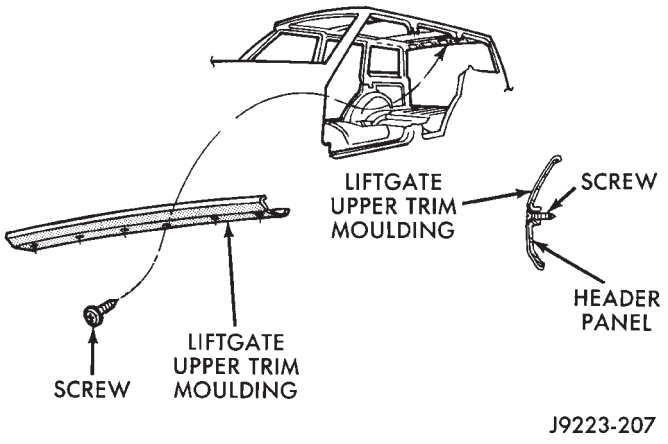

Fig. 135 Liftgate Trim Moulding—XJ Vehicles

HEADLINER INSTALLATION

(1) When installing a headliner, ensure that the retainer clips and rails are installed.

(2) Install the upper trim mouldings around the perimeter of the headliner. Tighten the retaining screws to 1 N·m (11 in-lbs) torque.

(3) As applicable, install:

- the assist handles,
- the sunvisors,
- the dome/cargo lamps,
- the overhead console,
- the keyless entry receiver module,
- the sunroof inner rubber seal and
- all other components removed to facilitate headliner removal.

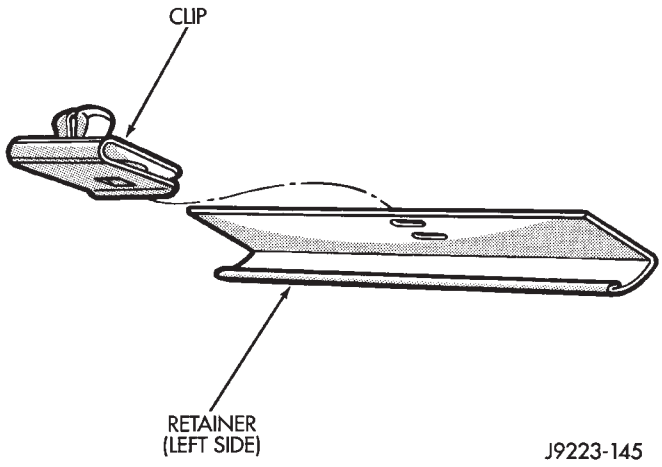

Fig. 137 Headliner Retainer Clip and Retainer Rail

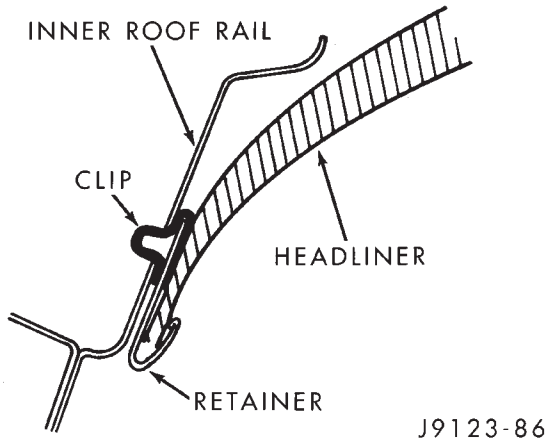

Fig. 138 Headliner Correctly Installed

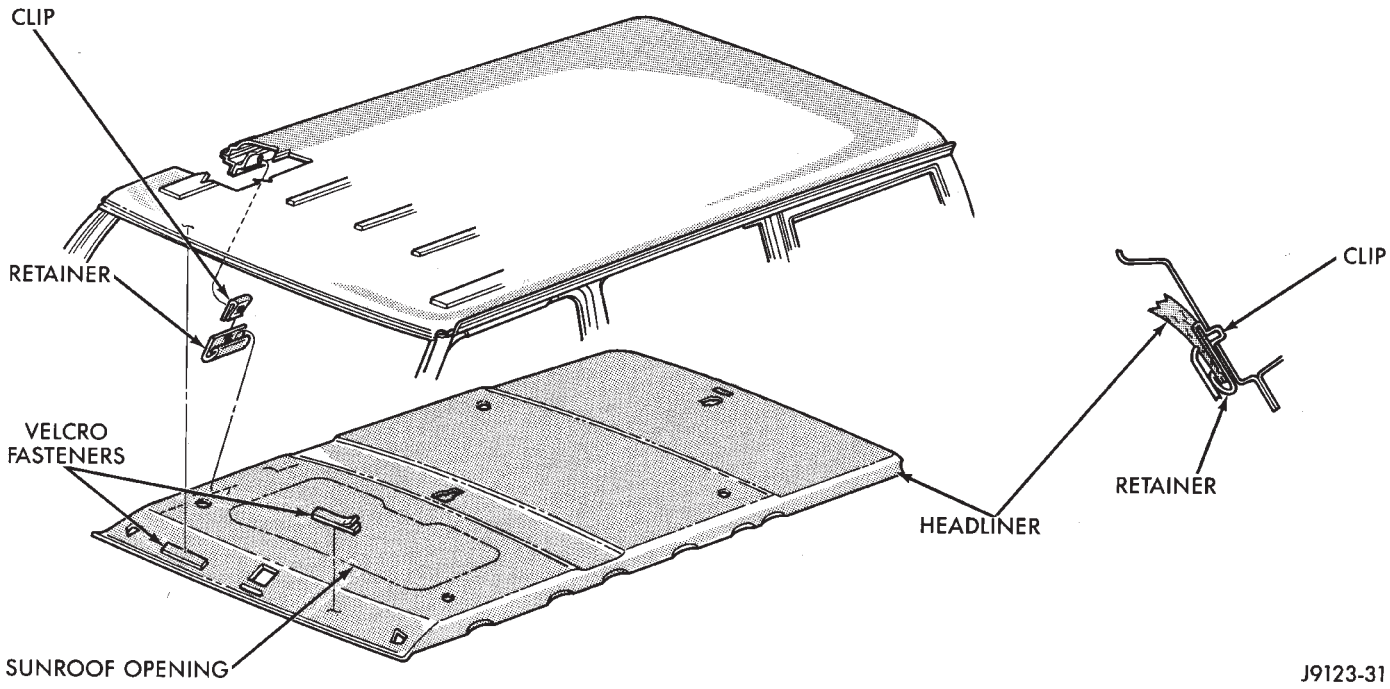

Fig. 136 Headliner—XJ Vehicles

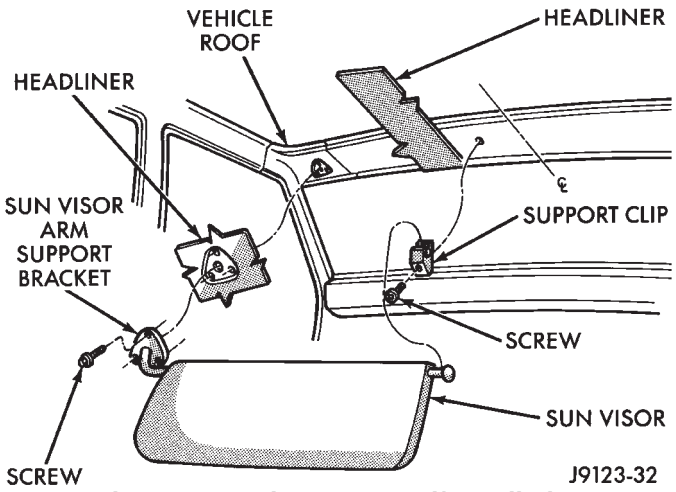

Fig. 139 Sunvisor Removal/Installation

SUNVISORS

REMOVAL

(1) Remove the screws that attach the sunvisor arm support bracket to the headliner and the roof panel.

(2) Detach the sunvisor from the support bracket.

(3) Remove the sunvisor from the vehicle.

(4) Remove the retaining screw and the support bracket.

INSTALLATION

(1) Install the support bracket and the retaining screw. Tighten the screw to 1 N·m (9 in-lbs) torque.

(2) Position the sunvisor in the support clip and align the arm support bracket holes with the headliner holes.

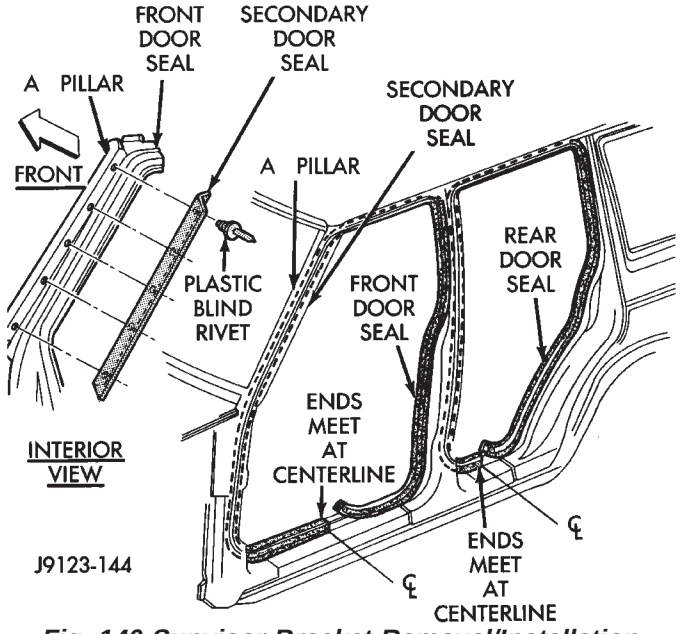

Fig. 140 Sunvisor Bracket Removal/Installation

(3) Install the screws that attach the sunvisor arm support bracket to the headliner and the roof panel. Tighten the screws to 4 N·m (35 in-lbs) torque.

MINI-FLOOR CONSOLE—XJ VEHICLES

SERVICE INFORMATION

Mini-consoles are installed in XJ vehicles with and without a transmission floor shift.

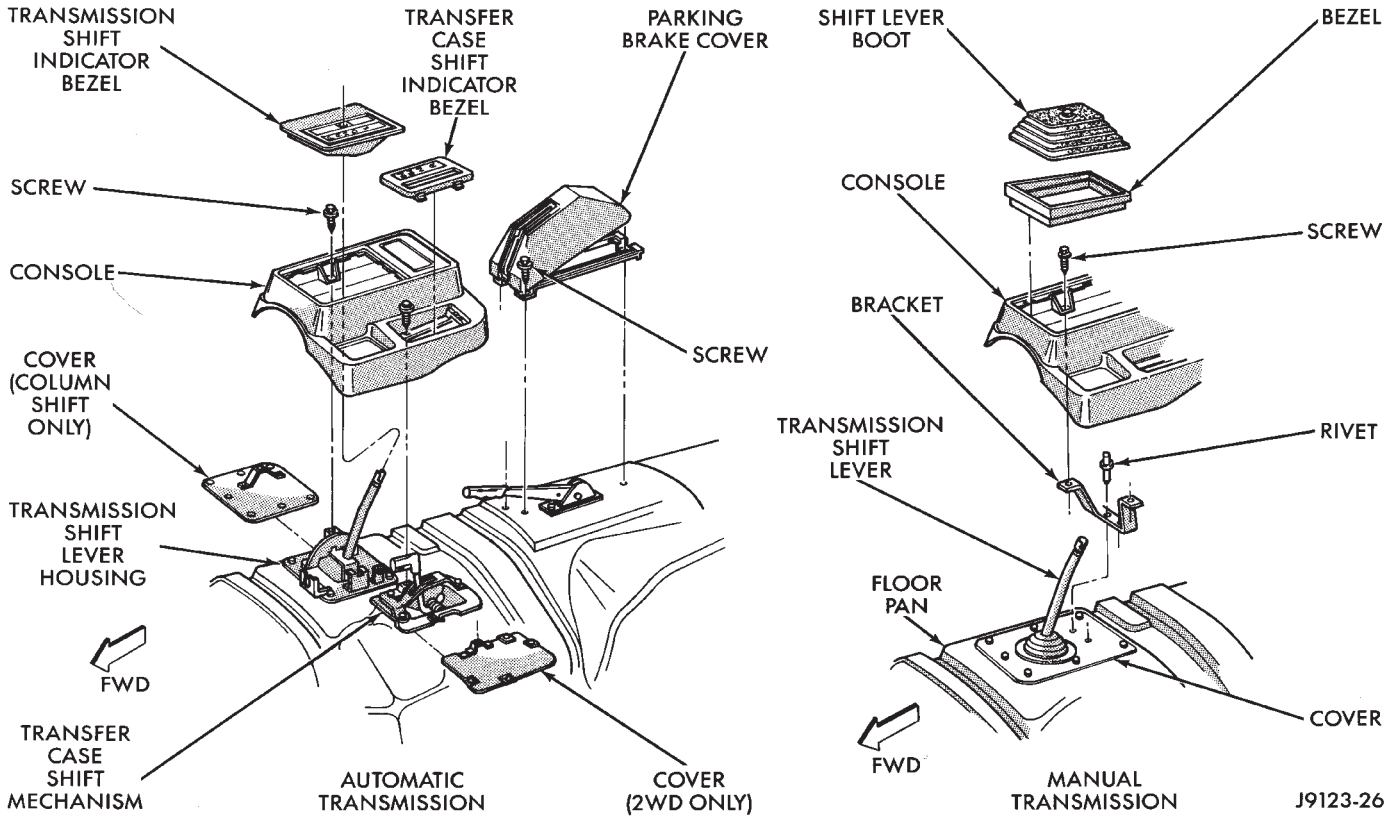

Fig. 141 Mini-Console With Floor Shift

PARKING BRAKE HANDLE COVER—XJ VEHICLES

REMOVAL

(1) Detach the rear of the cover from the base and pivot it upward.

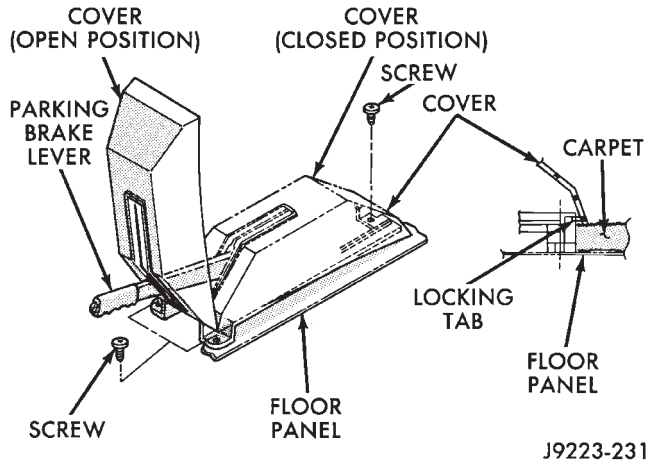

Fig. 142 Park Brake Cover With Mini-Console—XJ Vehicles

(2) Remove the retaining screws from the cover base.

(3) Remove the trim cover from the from the floor.

INSTALLATION

(1) Position the cover on the floor and install the retaining screws.

(2) Pivot the cover to the closed position and engage the locking tab.

MINI-CONSOLE WITH FLOOR SHIFT

REMOVAL

(1) Remove the transmission shift lever handle/knob. For vehicles with an automatic transmission, pull the handle straight up. For vehicles with a manual transmission, loosen the locknut and un-thread the shift knob from the shaft.

(2) Remove the automatic transmission and transfer case shift indicator bezel by prying upward to release them.

(4) Disconnect the lamp socket from the bezel.

(5) Remove the console retaining screws.

(6) Disconnect the wire harness connector.

(7) Remove the mini-console from the transmission tunnel.

INSTALLATION

(1) Position the mini-console on the transmission tunnel, connect the wire harness connector and install the retaining screws. Tighten the screws to 1 N·m (13 in-lbs) torque.

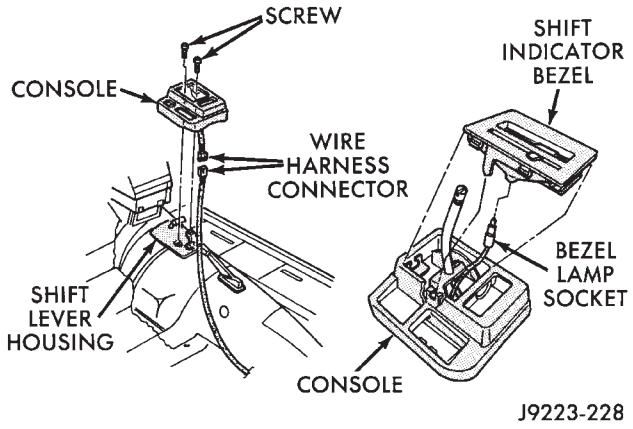

Fig. 143 Mini-Console With Floor Shift

(2) Position the shift indicator bezel at the console and connect the lamp socket to the bezel. Install the bezel in the console.

(3) Install the shift lever handle/knob. For automatic transmissions, push the handle downward until it is engaged. For manual transmissions, thread the knob onto the shaft and tighten the locknut.

FULL FLOOR CONSOLE—XJ VEHICLES

REMOVAL

(1) Remove the transmission shift lever handle/knob. For automatic transmissions, pull the handle straight upward to remove it. For manual transmissions, loosen the locknut and un-thread the shift knob from the shaft.

(2) Remove the automatic transmission shift indicator bezel. Remove the transfer case shift indicator bezel (if equipped) or cover plate from the console.

(3) If equipped, insert a thin-blade tool under the edge of the outside mirror remote control switch and pry outward to detach it from the console. Disconnect the wire harness connector from the switch (Fig. 195).

(4) Remove the cover retaining screws and remove the cover from the console.

(5) Remove the remainder of the console attaching screws from the brackets and disconnect the wire harness connector.

(6) Separate the console floor air duct from the air outlet duct.

(7) Remove the console and air duct from the floor.

(8) Separate the floor air duct from the console.

(9) Remove the retaining screws and detach the floor duct from the heater housing, if necessary.

(10) Remove the console support brackets.

The brackets are attached directly to the floor panel below the carpet.

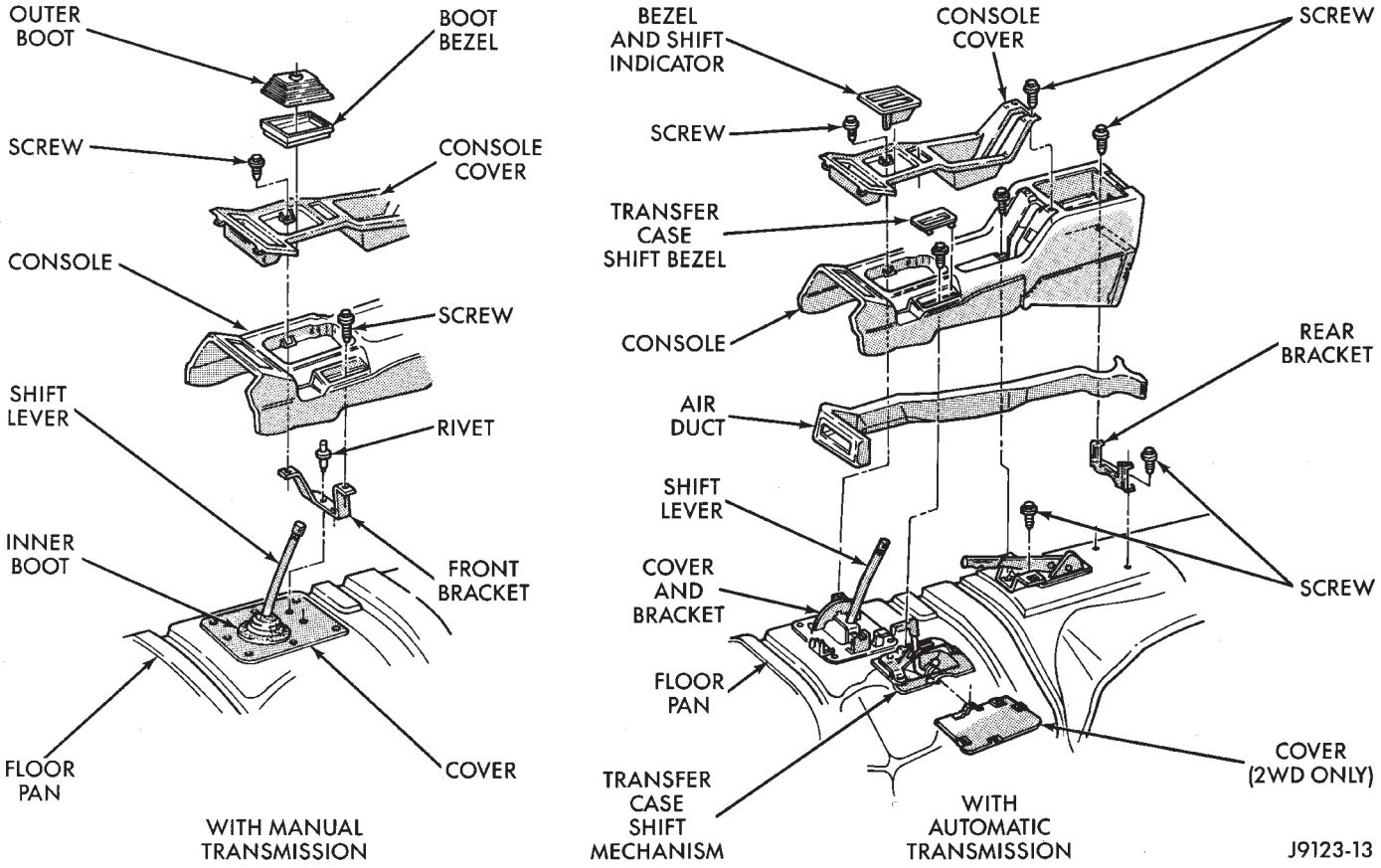

Fig. 144 Full Console—XJ Vehicles

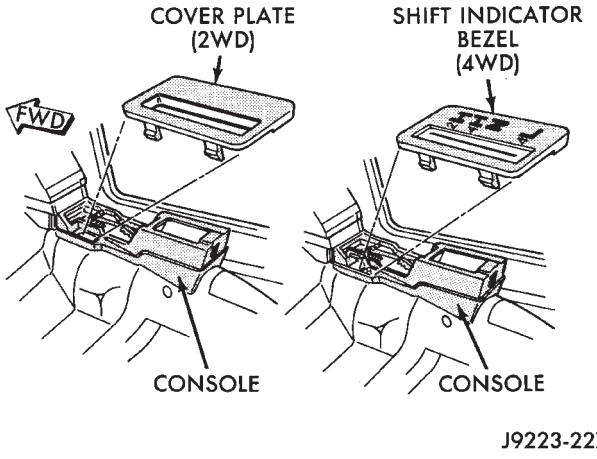

Fig. 145 Transfer Case Shift Indicator Bezel/Cover Plate

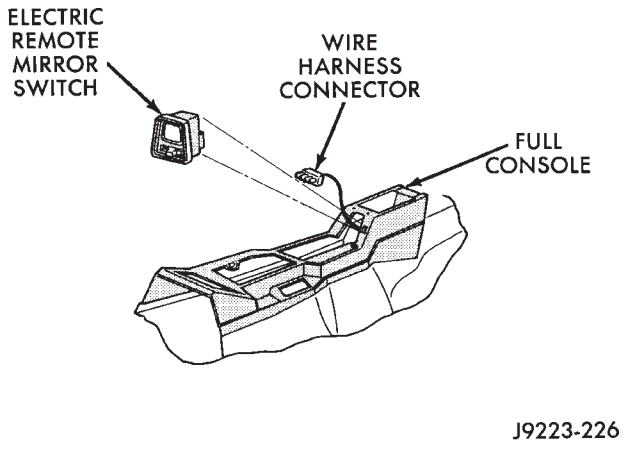

Fig. 146 Outside Mirror Remote Control Switch—XJ Vehicles

INSTALLATION

(1) Install the console support brackets, if removed. Tighten the screws to 1 N·m (11 In-lbs) torque.

The brackets are attached directly to the floor panel below the carpet.

(2) Attach the floor duct to the heater housing, if removed. Tighten the screws to 1 N·m (11 In-lbs) torque.

(2) Attach the air duct to the console.

(3) Position the console on the floor, attach the air duct to the air outlet duct, connect the wire harness connector and install the console retaining screws in the brackets. Tighten the screws to 1 N·m (11 In-lbs) torque.

(4) Install the console cover and shift indicator bezels (or cover plate). Tighten the screws to 1 N·m (11 In-lbs) torque.

(5) If equipped:

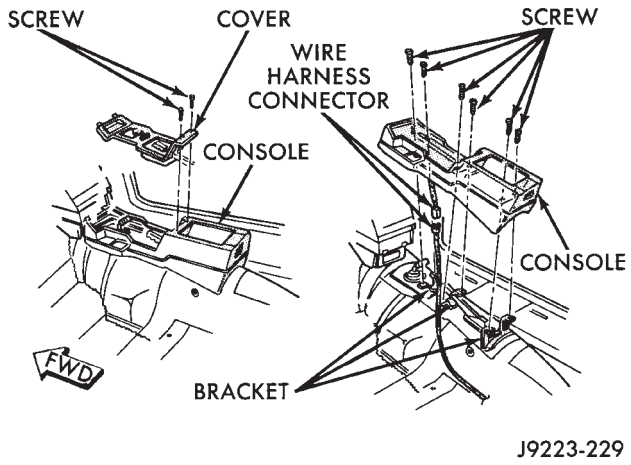

Fig. 147 Full Console Removal/Installation

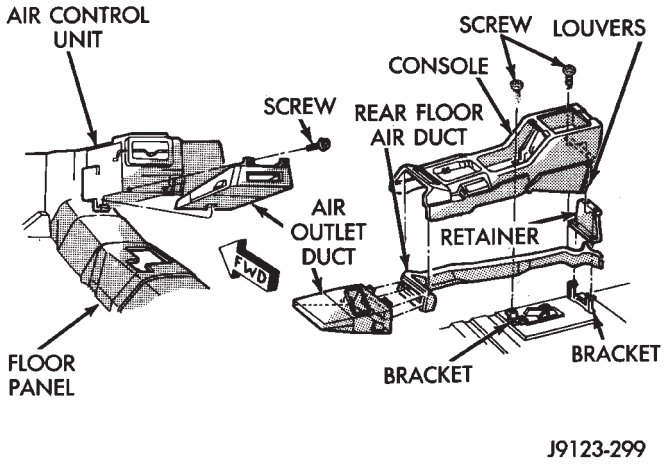

Fig. 148 Air Outlet and Console Floor Air Ducts

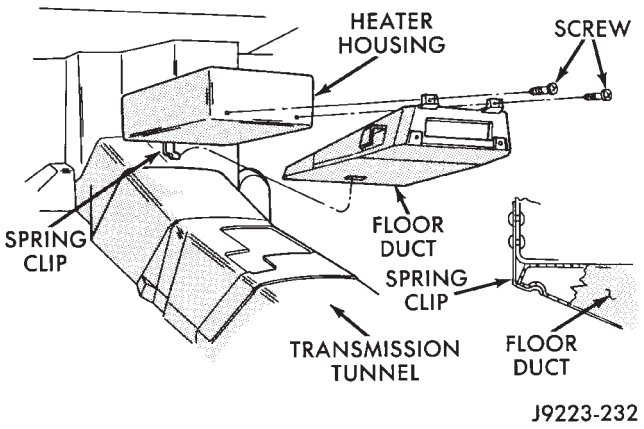

Fig. 149 Floor Duct Removal/Installation

- connect the wire harness connector to the outside mirror remote control switch,
- insert the switch into the console hole, and
- push inward to engage the retaining clips.

(6) Install the shift lever handle/knob.

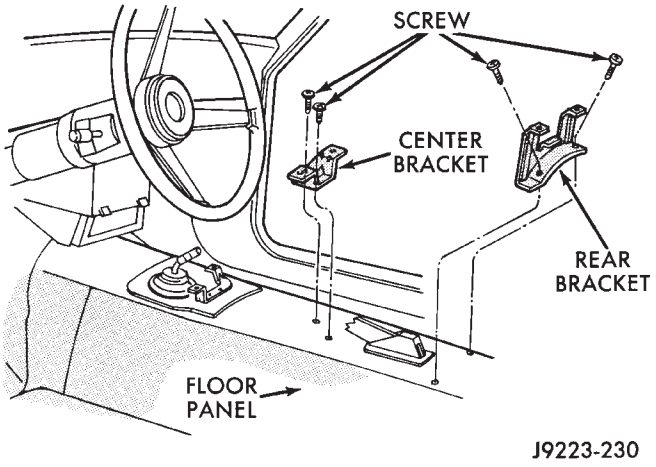

Fig. 150 Floor Console Support Brackets

JACK STORAGE—XJ VEHICLES

SERVICE INFORMATION

The XJ lift jack and related tools are stored under the rear seat behind the front passenger's seat. The jack and tools are attached to the floor panel and seat cushion crossmember with a retainer and holddown bolt.

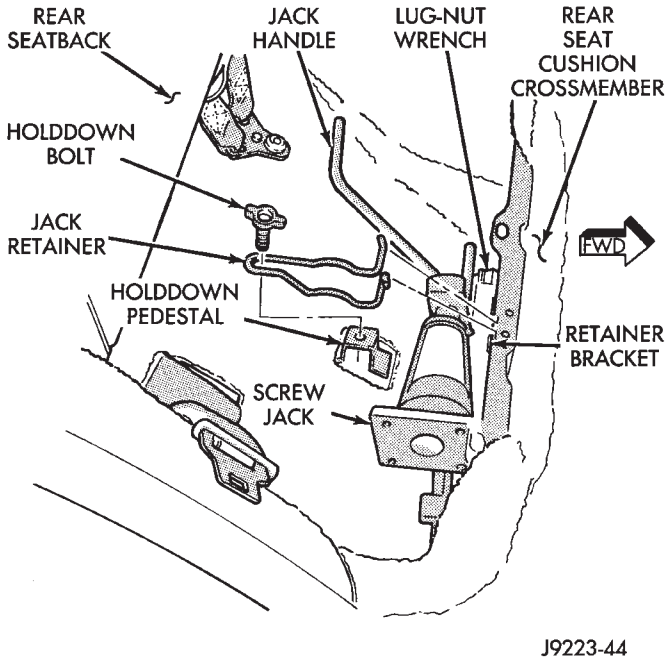

Fig. 151 Jack and Related Tools—XJ Vehicles

When necessary, the jack retainer bracket can be removed from the crossmember by drilling-out the rivet heads and then removing the rivet bodies with a punch. Install the retainer bracket with either rivets or bolts and nuts.

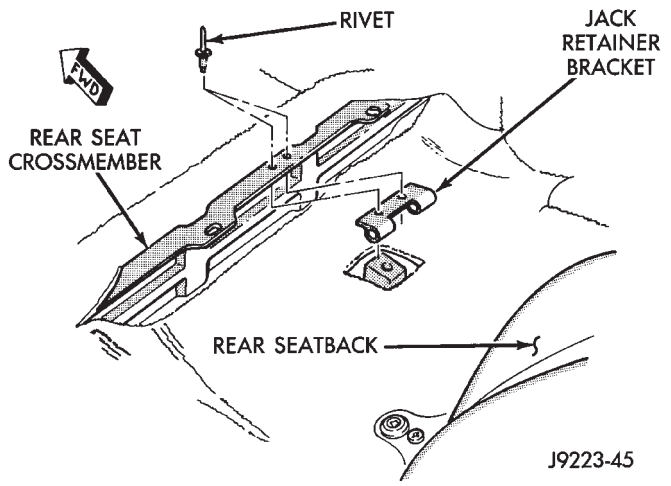

Fig. 152 Jack Retainer Bracket—XJ Vehicles

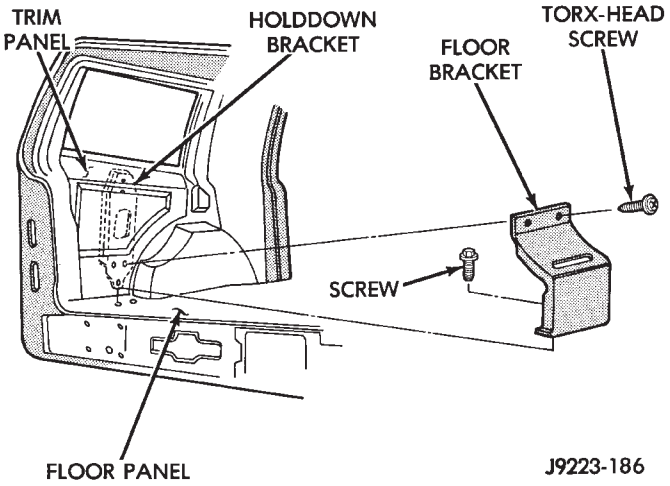

Fig. 154 Spare Tire/Wheel Floor Bracket

SPARE TIRE/WHEEL HOLDDOWN AND FLOOR BRACKETS—XJ VEHICLES

REMOVAL

(1) Remove the spare tire and wheel.

(2) Remove the floor bracket retaining screws.

(3) Remove the holddown bolt from the holddown bracket.

(4) Remove the trim panel from the quarter panel. If necessary, refer to the removal procedure.

(5) Remove the retaining screws and the holddown bracket from the quarter panel.

INSTALLATION

(1) Position the holddown bracket on the quarter panel and install the retaining screws. Tighten the screws to 8 N·m (71 in-lbs) torque.

(2) Install the quarter trim panel. If necessary, refer to the installation procedure.

(3) Install the holddown bolt in the holddown bracket.

The length of the holddown bolt is different for P195 and P225 tires.

(4) Position the floor bracket on the trim panel and install the retaining screws. Tighten the screws to 1 N·m (11 in-lbs) torque.

(5) Install the spare tire and wheel.

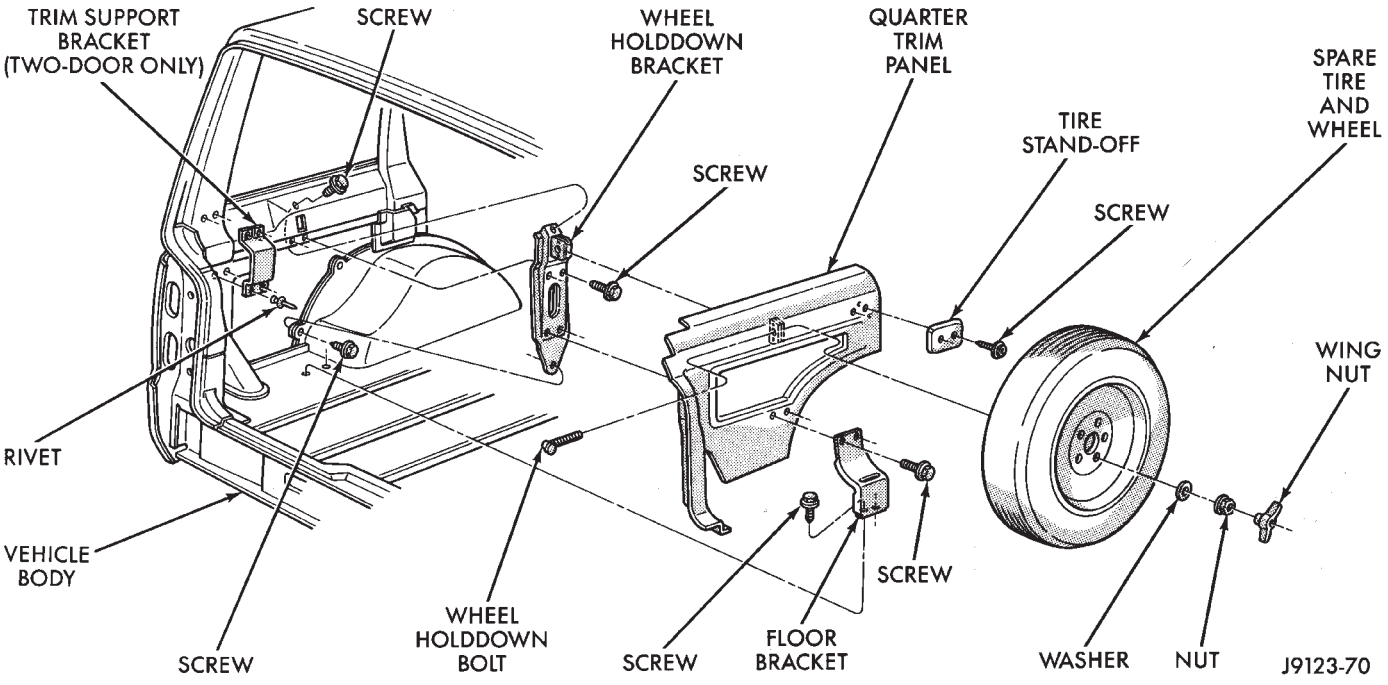

Fig. 153 Interior Spare Tire/Wheel Holddown and Floor Brackets

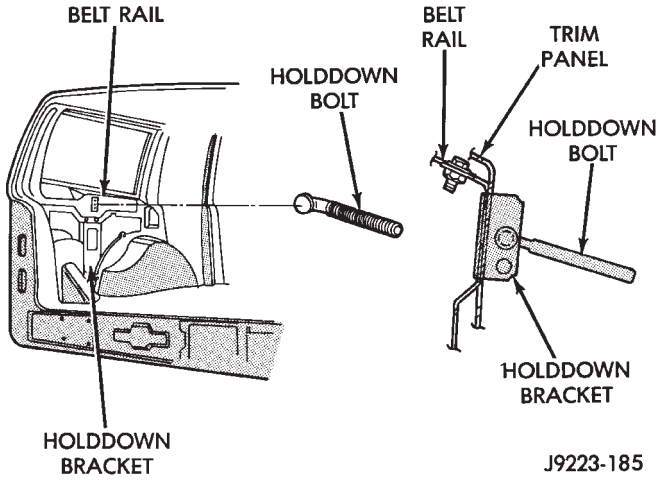

Fig. 155 Spare Tire/Wheel Holddown Bolt and Bracket (LHD)

CARPETS AND FLOOR MATS

SERVICE INFORMATION

The carpets/mats are retained around the perimeter of the floor panel by the interior trim mouldings and trim panels. To remove a carpet/mat, all of the retaining trim mouldings and panels must be removed along with all the interfering components (as applicable):

- the seat(s),
- the parking brake lever cover—XJ vehicles,
- the floor console, and
- the transmission and transfer case (if equipped) floor shift cover/boot.

If necessary, refer to the applicable removal procedure(s) within this manual.

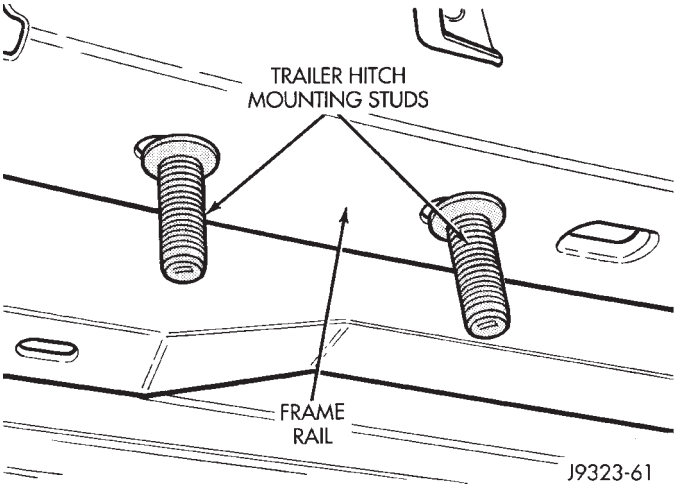

Fig. 156 Spare Tire/Wheel Holddown Bolt and Bracket (RHD)

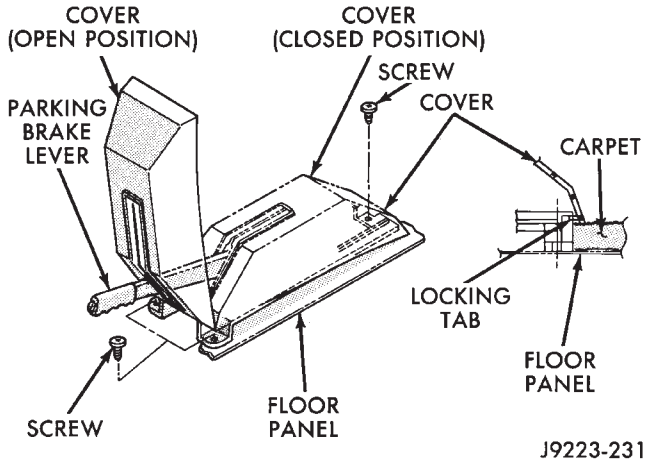

Fig. 157 Parking Brake Lever Removal/Installation

FRONT CARPET/MAT—XJ VEHICLES

REMOVAL

(1) Remove the door sill inner scuff plates.
(2) Remove the front and rear seats (as applicable).
(3) As necessary, remove the trim panels and mouldings.
(4) Remove all other interfering components.
(5) Remove the carpet and mat from the floor panel.

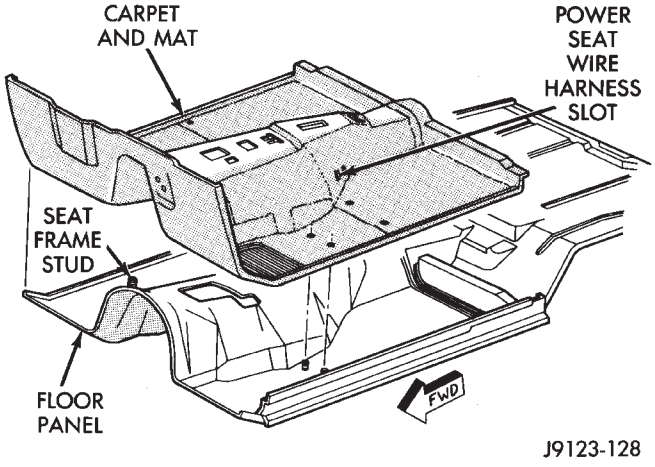

Fig. 158 Front Carpet and Mat—XJ Vehicles

INSTALLATION

(1) Position the carpet and mat on the floor panel.
(2) Install all the components that were removed to facilitate carpet/mat removal.
(3) Install the trim panels and mouldings.
(4) Install the door sill inner scuff plates.
(5) Install the front and rear seats (as applicable).

REAR CARPET/MAT—XJ VEHICLES

REMOVAL

(1) Remove the retaining screws, and the liftgate latch striker and scuff plate.

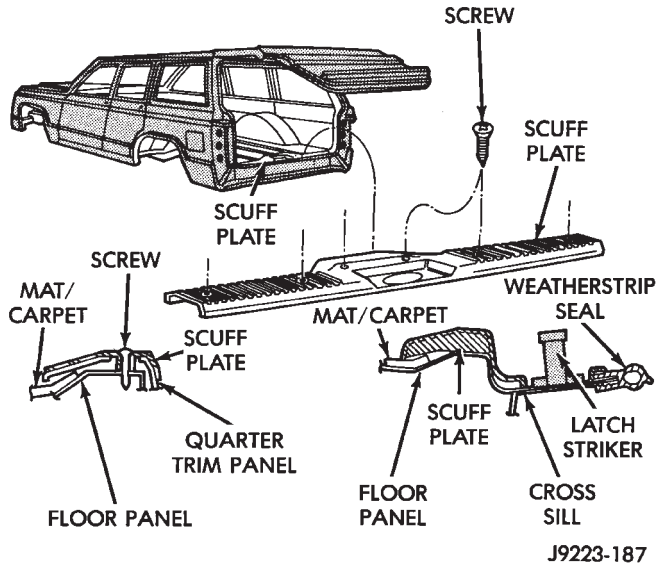

Fig. 159 Liftgate Latch Striker and Scuff Plate

(2) Drill-out the retaining rivet heads and remove the cargo tie-down footman loops from the carpet.

(3) As necessary, remove the trim panels and mouldings.

(4) Remove the all other interfering components.

(5) Remove the carpet and mat from the floor panel.

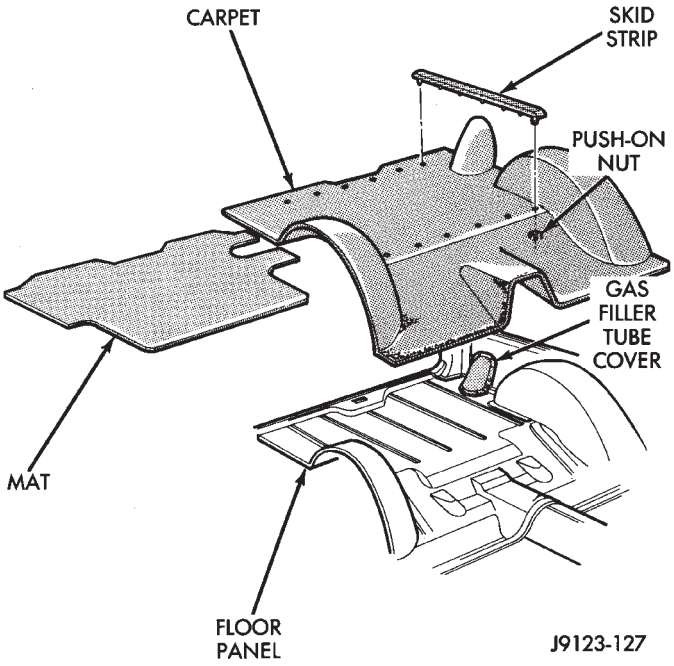

Fig. 160 Rear Carpet and Mat—XJ Vehicles

(6) If necessary, remove the skid strips from the carpet.

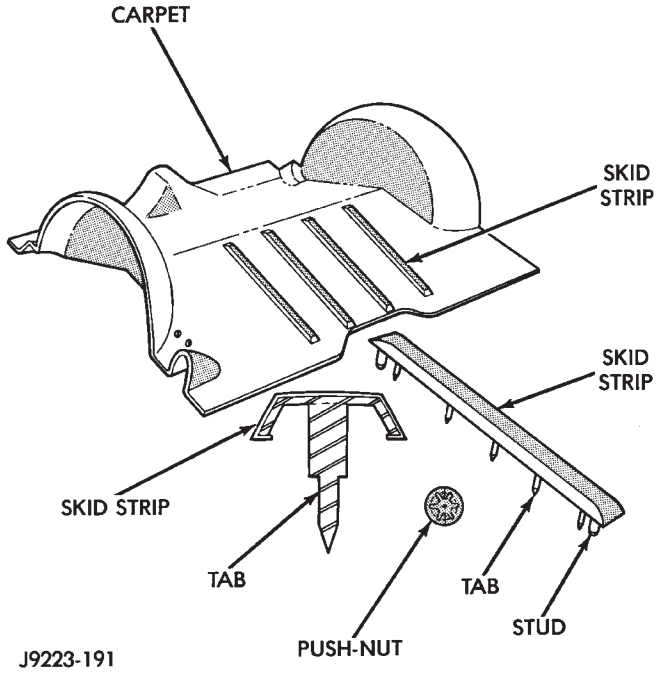

Fig. 161 Rear Carpet Skid Strips—XJ Vehicles

(7) If necessary, remove the insulation from the wheelhouses.

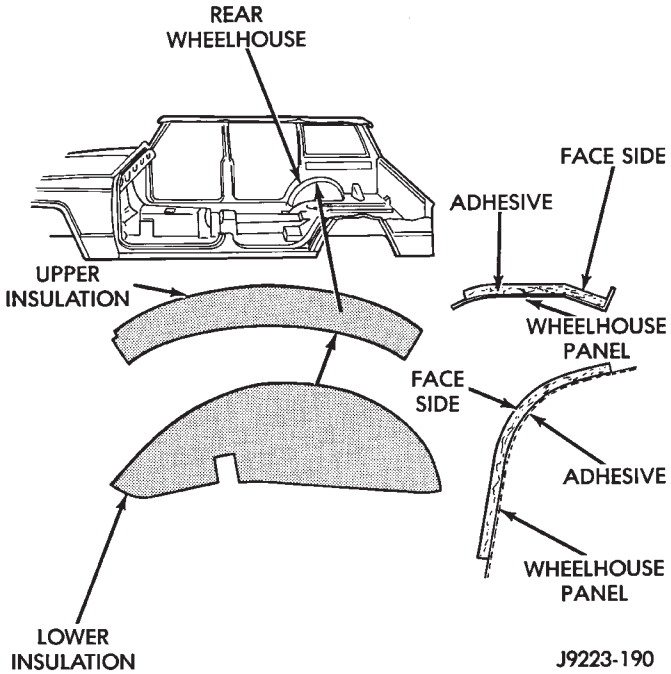

Fig. 162 Wheelhouse Insulation

INSTALLATION

(1) If removed, install the skid strips on the carpet.

(2) If removed, install the insulation on the wheelhouses.

(3) Position the mat on the floor panel.

(4) Position the carpet on the mat.

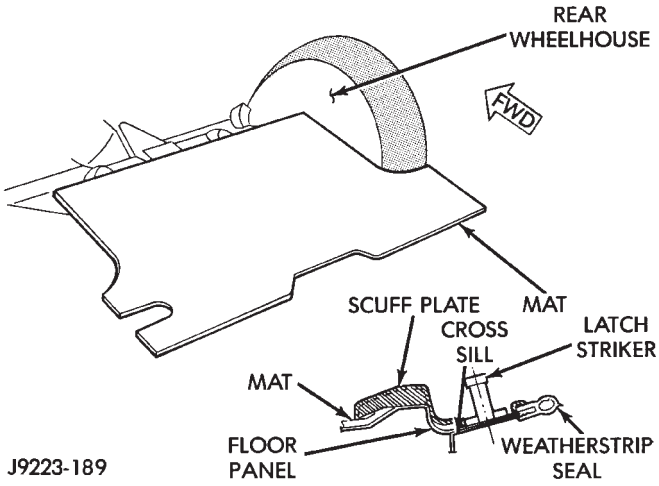

Fig. 163 Cargo Area Mat—XJ Vehicles

(5) Install all the components that were removed to facilitate carpet and mat removal.

(6) Install the trim panels and mouldings.

(7) Install the cargo tie-down footman loops on the carpet with replacement rivets.

(8) Position the liftgate scuff plate and latch striker on the carpet and cross sill. Install and tighten the scuff plate screws to 1 N·m (11 in-lbs) torque. Tighten the latch striker screws to 30 N·m (22 ft-lbs) torque.

●CARGO BARRIER

REMOVAL

(1) Tilt both seats forward and raise the storage compartment lid.

(2) Remove the wing nuts from the front side of the cargo barrier (Fig. 164).

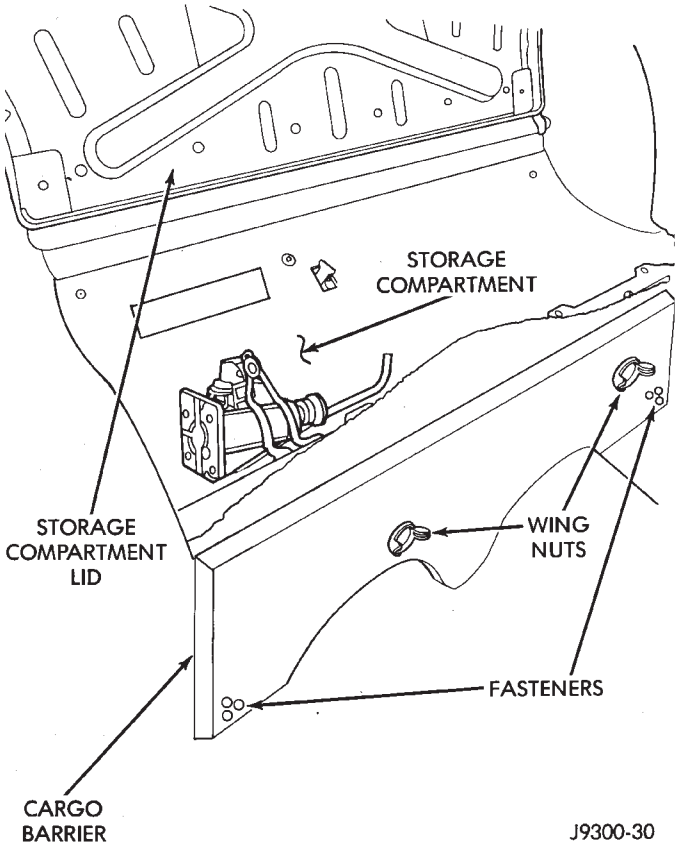

Fig. 164 Cargo Barrier

(3) Remove the fasteners from the lower outer corners of the cargo barrier.

(4) Remove the cargo barrier.

INSTALLATION

(1) Reverse the removal procedure to install the cargo barrier.

BODY COMPONENTS—YJ VEHICLES

CONTENTS

GENERAL SERVICE INFORMATION

LABELS/DECALS/PLATES

Most of the labels, decals and metal plates that are affixed to YJ vehicles (Figs. 1, 2, 3, 4 and 5) contain either safety or otherwise essential information.

Refer to the Introduction of this manual for additional information involving labels and metal plates.

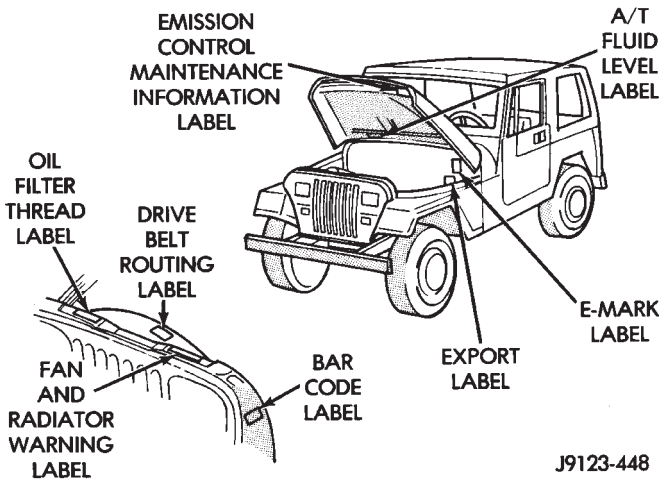

Fig. 1 YJ Underhood Labels/Decals

INSTALLATION

Follow the instructions included with each replacement label/decal/plate to affix it to a panel, component or window glass.

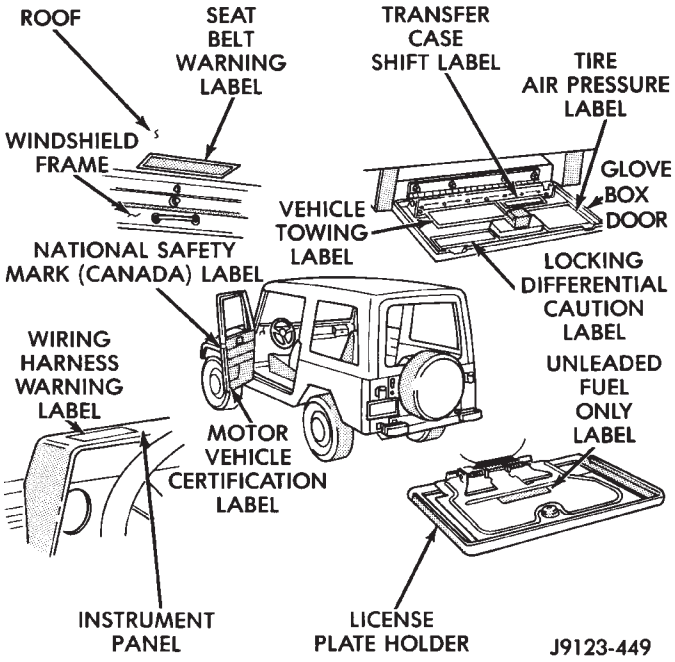

Fig. 2 YJ Interior and License Plate Holder Labels/ Decals

KEY LOCK CYLINDERS

The ignition switch, glove box door, floor console, metal front doors and the tailgate all have key lock cylinders. When lock cylinder service is necessary, refer to the applicable service information source:

- Ignition Switch—Group 8D,
- Instrument Panel,
- Floor Consoles,
- Front Doors, and
- Tailgate.

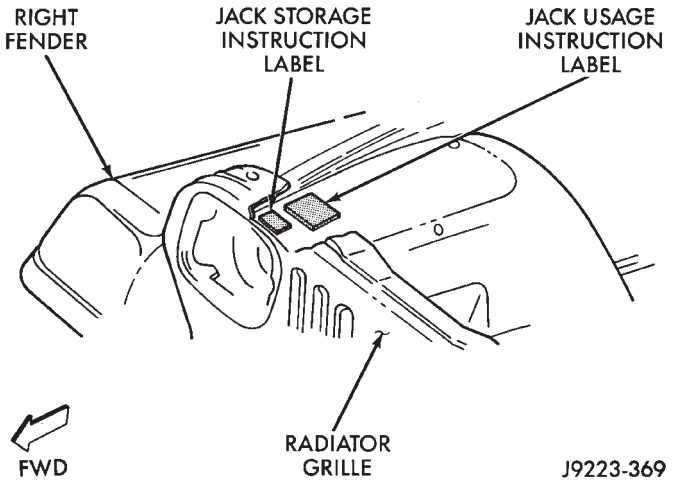

Fig. 3 YJ Jack Storage and Usage Labels

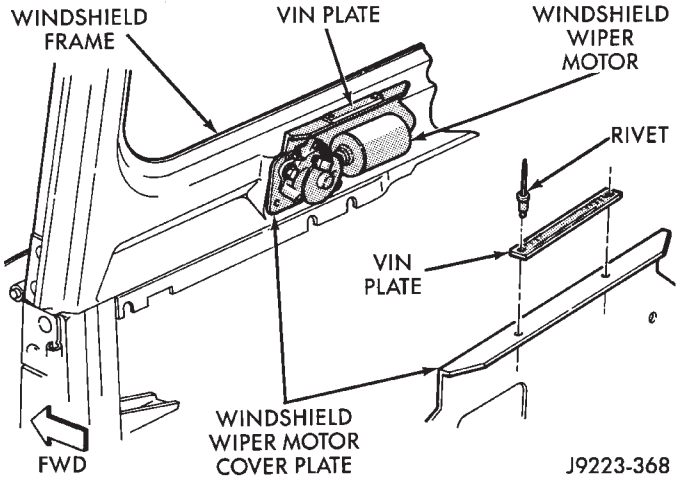

Fig. 5 YJ VIN Plate

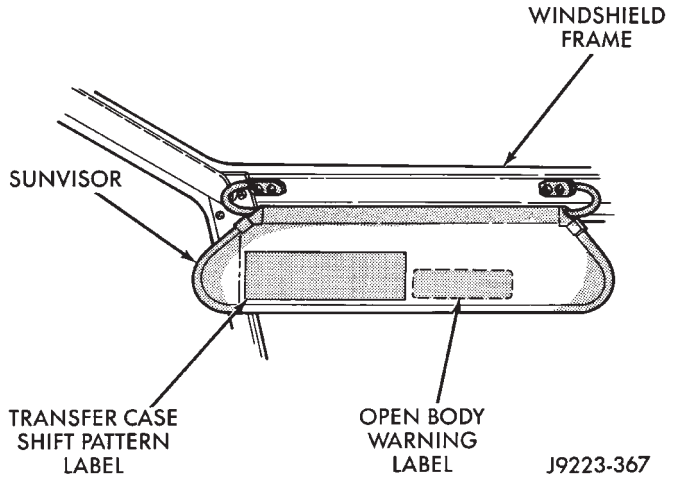

Fig. 4 YJ Sunvisor Labels

EXTERIOR COMPONENTS

INDEX

RADIATOR GRILLE APPLIQUE

REMOVAL

(1) Raise the hood.

(2) Remove the headlamp bezels (Fig. 1).

(3) Remove the headlamp bulb retainer screws (Fig. 2).

(4) Disconnect and remove the headlamps and buckets as a unit (Fig. 2).

(5) Remove the parking lamp retaining screws (Fig. 2).

(6) Disconnect the wire harness connectors and remove the parking lamps (Fig. 2).

(7) Remove the front crossmember cover.

(8) Remove the retaining screws and the bumper inserts at the top of the grille panel (Fig. 1).

(9) Detach the grille applique from the grille panel (Fig. 1).

(10) Remove the double faced foam adhesive tape at the bottom of the grille applique (Fig. 1).

INSTALLATION

(1) Install double faced foam tape at the bottom, interior side of the grille applique (Fig. 1).

(2) Position the grille applique over the grille panel and press inward along the bottom where the tape is located (Fig. 1).

(3) Install the grille applique retaining screws and the bumper inserts (Fig. 1).

(4) Connect the wire harness connectors and position the headlamp buckets and headlamps in the grille panel (Fig. 2).

(5) Install the headlamp bulb retainer and the screws (Fig. 1). Tighten the screws to 2 N·m (18 in-lbs) torque.

(6) Install the headlamp bezels and the retaining screws (Fig. 1). Tighten the screws securely.

(7) Connect the wire harness connectors and install the parking lamps (Fig. 2).

(8) Install the parking lamp retaining screws. Tighten the screws to 2 N·m (18 in-lbs) torque.

(9) Close the hood.

(10) Install the front crossmember cover.

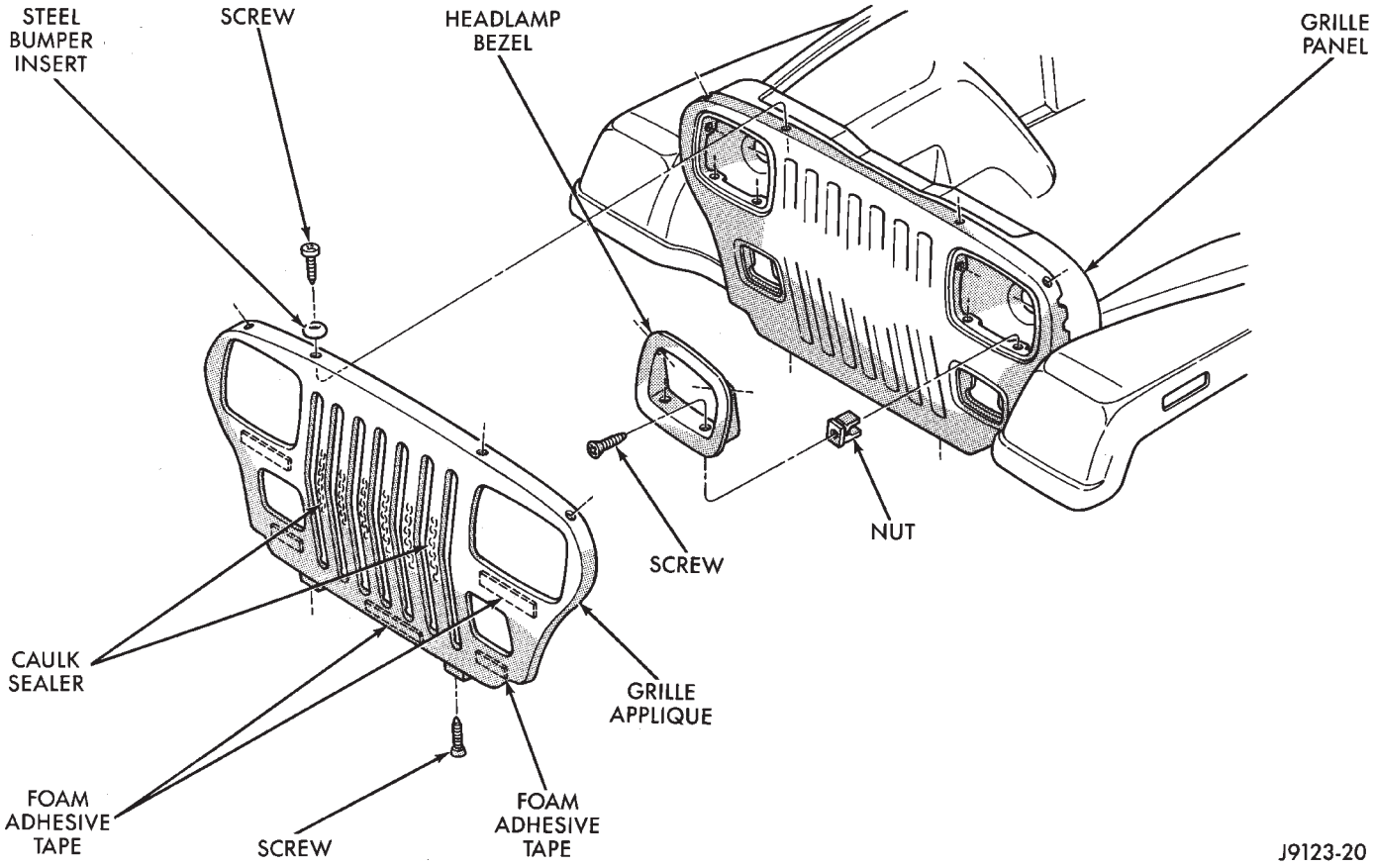

Fig. 1 Grille Applique, Headlamp Bezel and Grille Panel

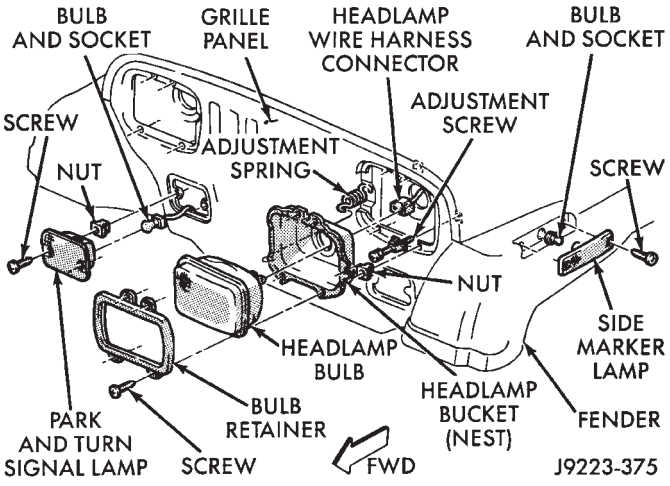

Fig. 2 Front Lamps

RADIATOR GRILLE PANEL

REMOVAL

(1) Remove the front crossmember cover.

(2) Remove the screws and washers, and separate the radiator and shroud from the grille panel (Fig. 3).

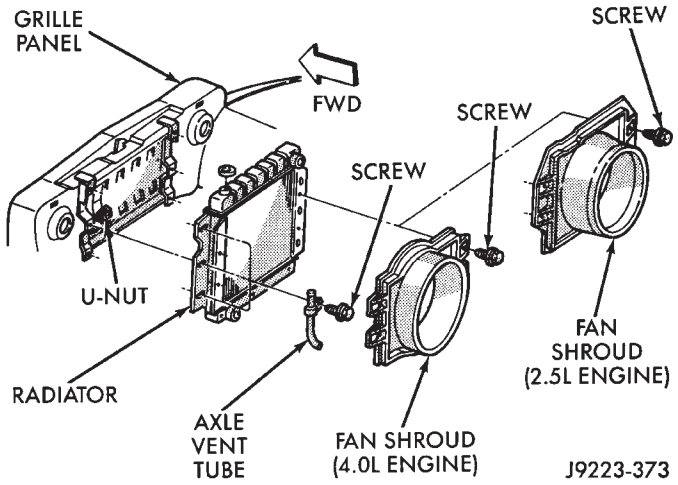

Fig. 3 Radiator and Shroud

(3) If equipped, remove the retaining bolts and separate the A/C condenser from the grille panel (Fig. 4).

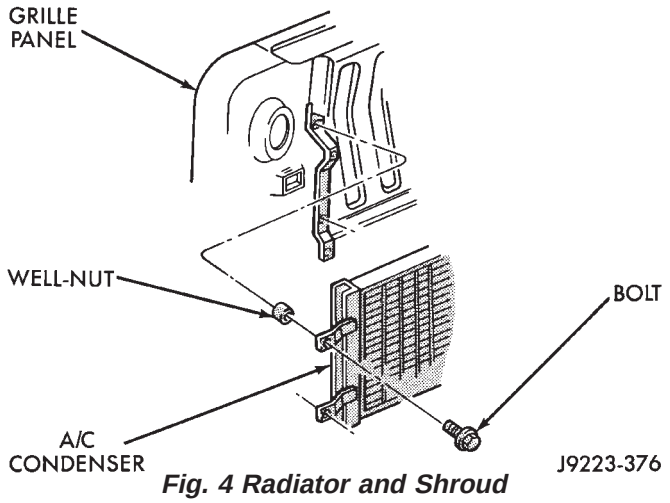

Fig. 4 Radiator and Shroud

(4) Remove the retaining screws and the P/S fluid reservoir from the grille panel (Fig. 5).

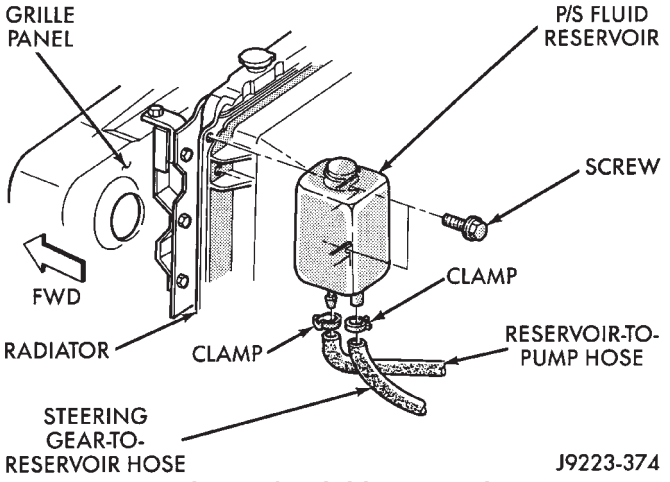

Fig. 5 P/S Fluid Reservoir

(5) Remove the retaining screws and the air intake adapters from the grille panel (Fig. 6).

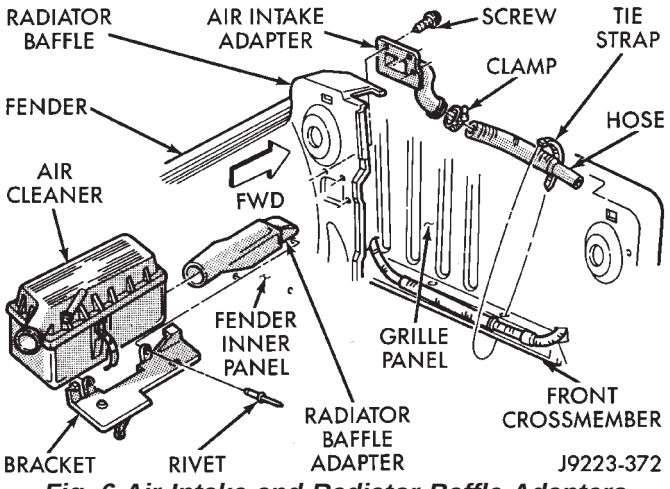

Fig. 6 Air Intake and Radiator Baffle Adapters

(6) Remove the bolts and washers that attach the grille panel to the fenders (Fig. 7).

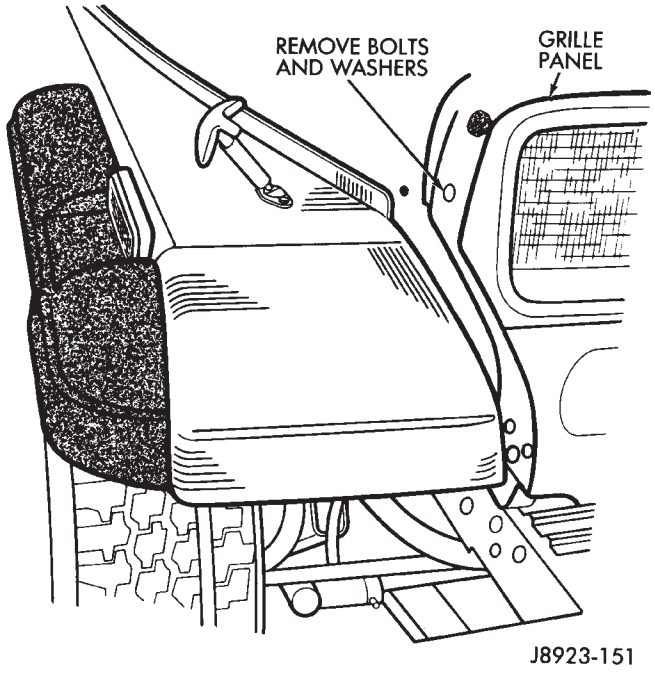

Fig. 7 Grille Panel Front Bolt

(7) Remove the bolts, washers and spacers that attach the grille panel to the front crossmember (Fig. 8).

(8) Remove the nuts that attach the radiator support rods to the front brackets (Fig. 9). Remove the rods from the brackets.

(9) Tilt the grille panel forward and disconnect the head lamp, turn signal and marker lamp wire harness connectors.

(10) For vehicles equipped with A/C, discharge the A/C system. Disconnect the high pressure hose at the sight glass connection and at the compressor. Cap the hose and fittings to prevent foreign material entry. If necessary, refer to Group 24—Heating And Air Conditioning.

(11) Remove the grille panel from the vehicle (Fig. 8).

(12) If a replacement radiator grille panel will be installed, remove the grille applique (Fig. 8) and transfer the lamps, the headlamp buckets and the retaining brackets.

INSTALLATION

(1) Position the grille panel on the vehicle.

(2) Connect the marker, park and headlamp wire harness connectors.

(3) Connect the radiator support rods with the retaining brackets (Fig. 9).

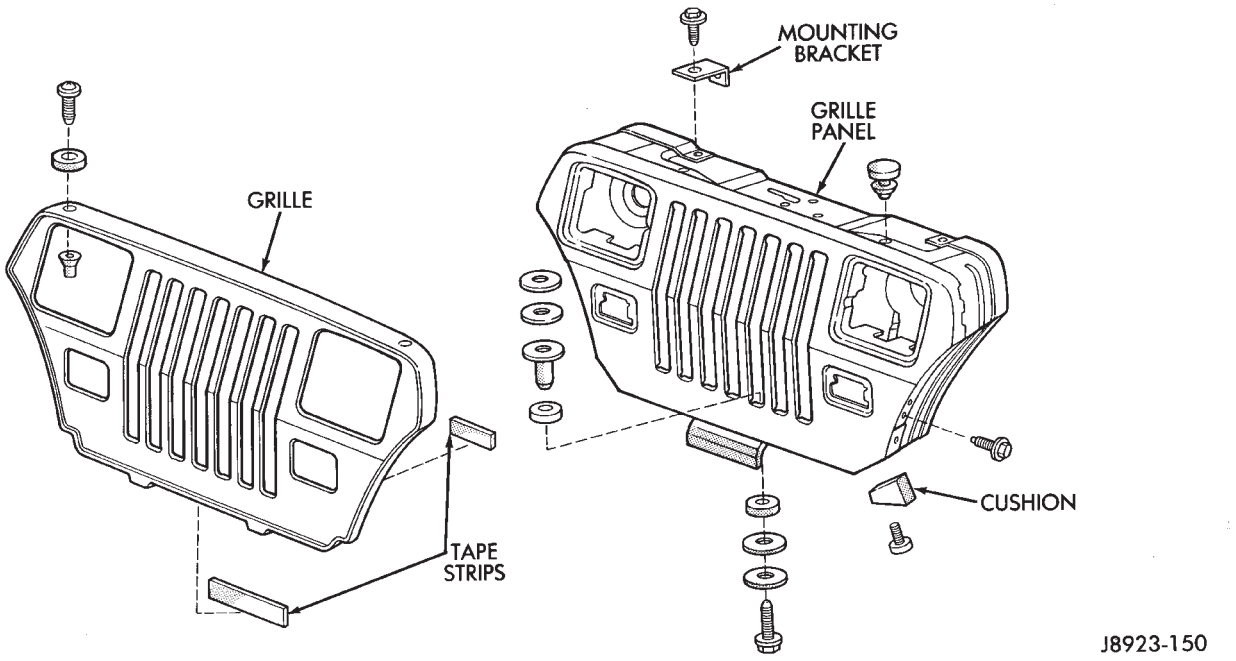

Fig. 8 Radiator Grille Applique and Grille Panel

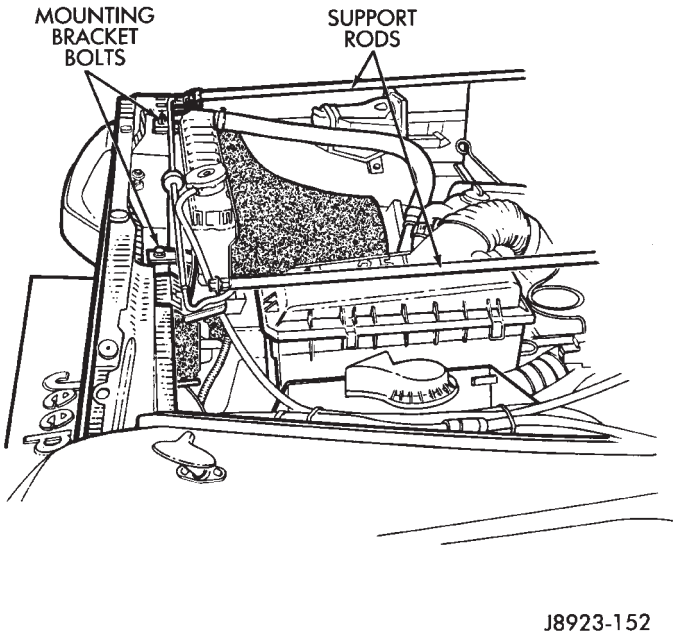

Fig. 9 Radiator Support Rods

(4) Attach the grille panel to the front crossmember.

(5) Install the grille panel-to-front fender bolts (Fig. 7). Tighten the retaining screws to 27 N·m (20 ft-lbs) torque.

(6) Install the air intake adapters on the grille panel (Fig. 6). Tighten the retaining screws to 3 N·m (25 in-lbs) torque.

(7) Install the P/S fluid reservoir on the grille panel (Fig. 5). Tighten the retaining screws to 8 N·m (72 in-lbs) torque.

(8) If equipped, install the A/C condenser on the grille panel (Fig. 4). Tighten the retaining screws to 2 N·m (20 in-lbs) torque. Connect the high pressure hose at the sight glass connection and at the compressor.

(9) Install the radiator and shroud on the grille panel (Fig. 3). Tighten the retaining screws to 15 N·m (132 in-lbs) torque.

(10) Install the front crossmember cover.

(11) If removed, install the grille applique (Fig. 8).

(12) Evacuate and charge the A/C system.

HOOD

REMOVAL

(1) Raise and support the hood.

(2) Disconnect the underhood lamp wire harness connector (Fig. 10).

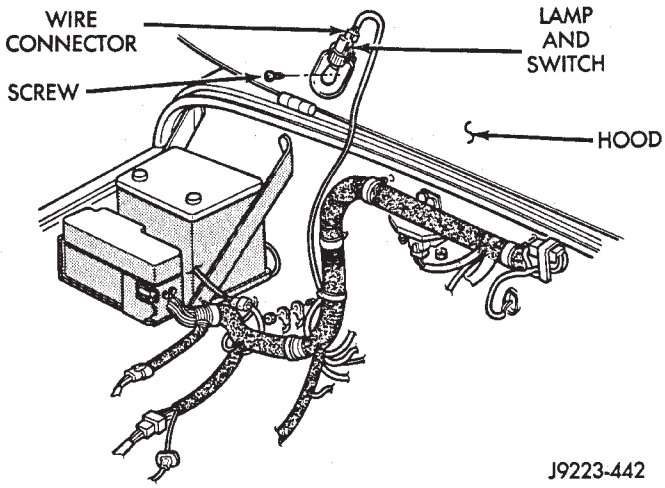

Fig. 10 Underhood Lamp

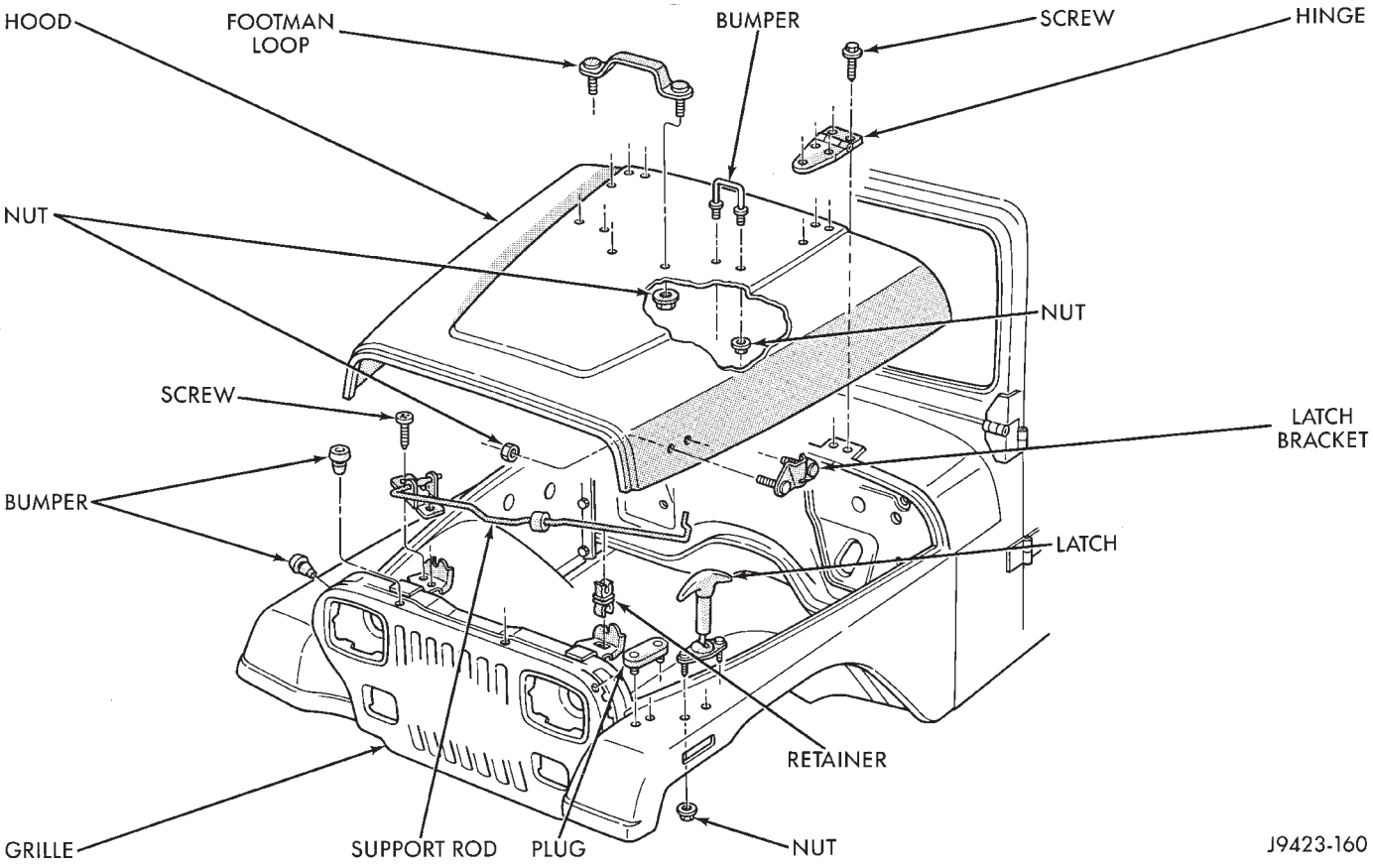

Fig. 11 Hood and Components

(3) Mark the position of the hinges on the hood for installation alignment reference (Fig. 11).

(4) Remove the hinge attaching screws and remove the hood (Fig. 11).

(5) If the hood must be replaced, remove and transfer the insulator panel, hinges, latches, bumpers, brackets, footman loop, hood lamp, support rod, and safety latch to the replacement hood.

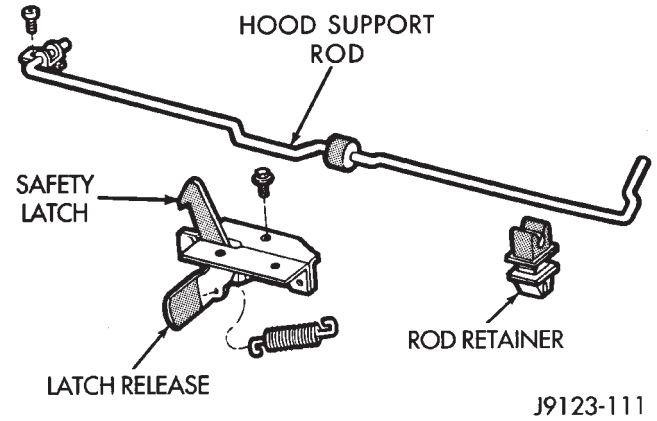

Fig. 12 Safety Latch and Support Rod

INSTALLATION

(1) Position the hood on the vehicle and install the hinge attaching screws (Fig. 11).

(2) Align the hinges with the installation reference marks on the hood and tighten the hinge screws securely.

(3) Connect the underhood lamp wire harness connector (Fig. 10).

(4) Close the hood.

HOOD ALIGNMENT

The hood hinge attaching screw holes are oversized to facilitate hood adjustment movement.

(1) Loosen the hinge attaching screws.

(2) Move the hood in the direction(s) required for correct alignment.

(3) Tighten the hinge attaching screws.

HOOD INSULATOR PANEL

REMOVAL

(1) Raise and support the hood.

(2) Remove the insulator panel retainers (Fig. 13).

(3) Remove the insulator panel from the hood.

INSTALLATION

(1) Position the insulator panel on the hood.

(2) Install the insulator panel retainers.

(3) Remove the support rod and close the hood.

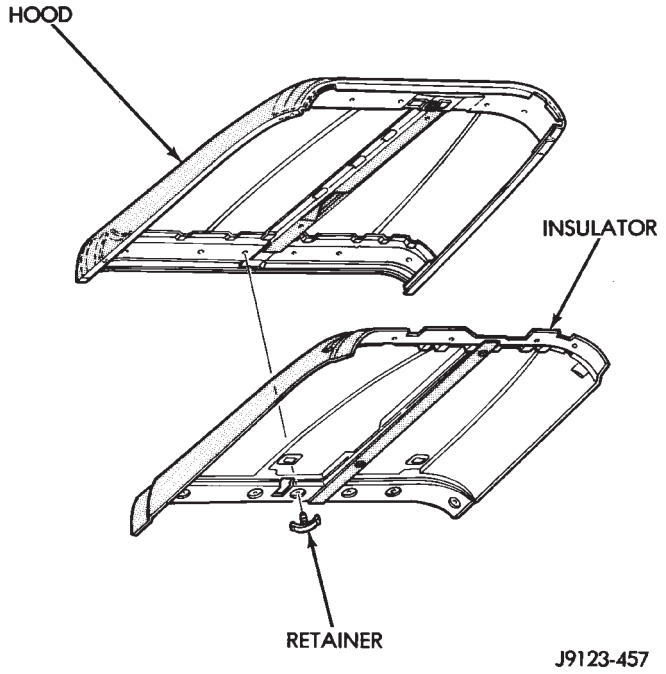

Fig. 13 Hood Insulator Panel

HOOD SAFETY LATCH

REMOVAL

(1) Raise and support the hood.

(2) Remove the latch retaining screws from the grille panel (Fig. 14).

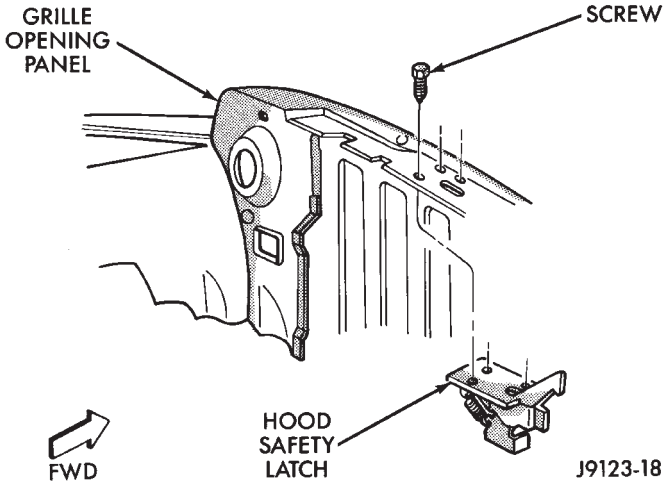

Fig. 14 Hood Safety Latch Removal/Installation

(3) Remove the latch from the grille panel.

INSTALLATION

(1) Position the latch on the grille panel (Fig. 14).

(2) Install the latch retaining screws.

(3) Remove the support rod and close the hood.

COWL WEATHERSTRIP SEAL

REMOVAL/INSTALLATION

(1) Carefully separate the seal from the cowl/dash panel flange (Fig. 15).

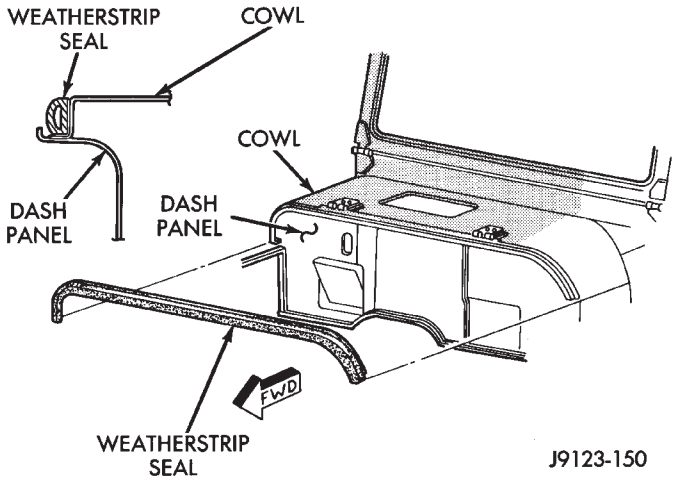

Fig. 15 Cowl Weatherstrip Seal

(2) Position the seal on the cowl/dash panel flange (Fig. 15) and press it against the panel edge.

COWL GRILLE AND SCREEN

REMOVAL

(1) Remove the screws that attach the cowl air intake grille to the cowl and to the air intake duct (Fig. 16).

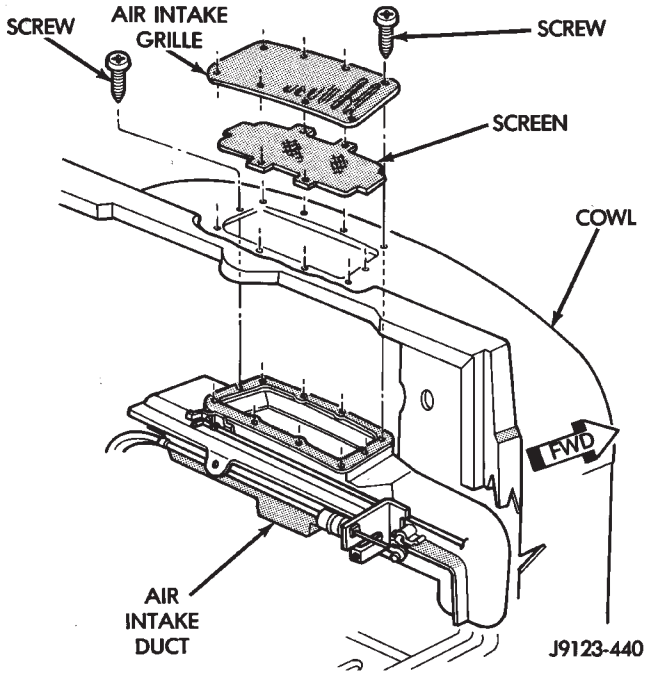

Fig. 16 Cowl Grille Removal/Installation

(2) Remove the grille and screen from the cowl (Fig. 16).

INSTALLATION

(1) Position the cowl screen and grille on the cowl.

(2) Attach the grille and screen to the cowl and the air intake duct with the screws (Fig. 16).

BATTERY TRAY

REMOVAL

(1) Remove the cables from the battery and power distribution center (Fig. 17).

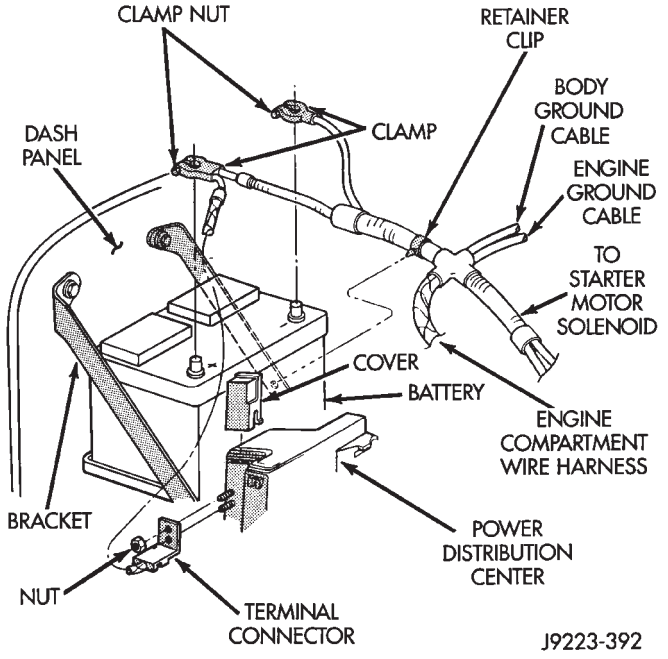

Fig. 17 Battery and PDC Cables

(2) Remove the retaining nuts and the battery holddown bracket from the holddown J-bolts (Fig. 19).

(3) Remove the battery from the tray (Fig. 18).

(4) Remove the retaining screws, the support bracket and the PDC from the battery tray (Fig. 19).

(5) Remove the nuts that attach the battery tray to the cowl panel (Fig. 19).

(6) Remove the screws that attach the support brackets to the fender inner panel (Fig. 19).

(7) Remove the screw that attaches the brace to the battery tray (Fig. 19).

(8) Remove the battery tray from the vehicle (Fig. 19).

INSTALLATION

(1) If removed, install the J-bolts on the battery tray.

(2) Position the battery tray on the cowl panel with the studs inserted in the holes.

(3) Attach the battery tray to the cowl panel studs with the attaching nuts.Tighten the nuts on the studs to 4 N·m (35 in-lbs) torque.

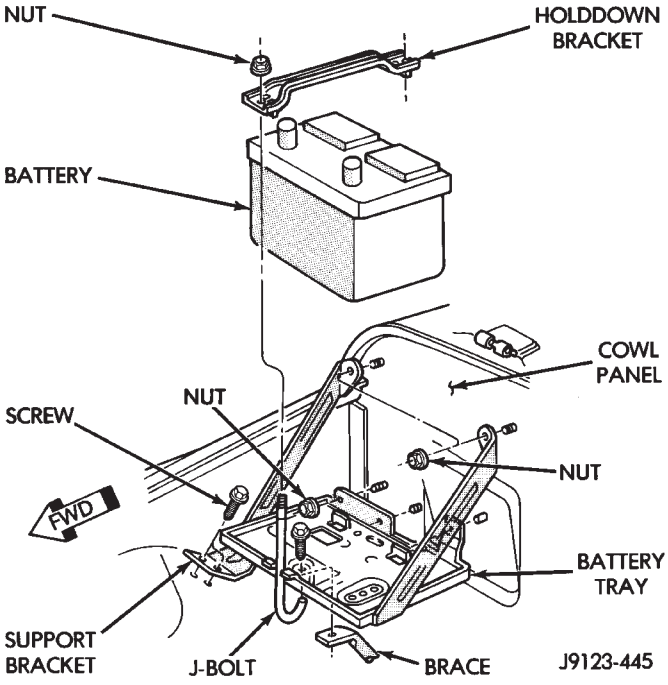

Fig. 18 Battery Tray Removal/Installation

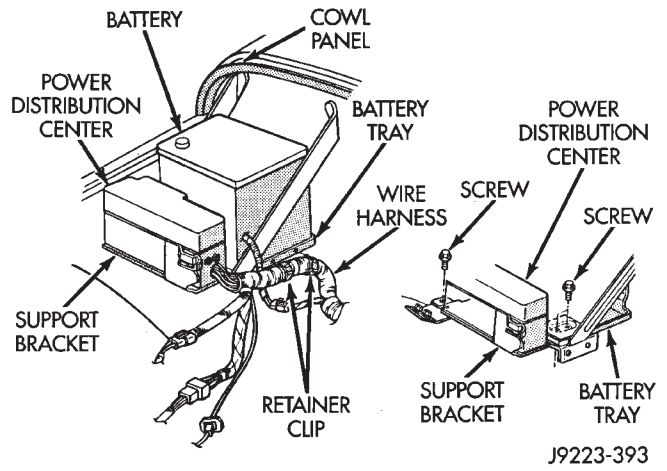

Fig. 19 PDC and Bracket Removal/Installation

(4) Install the screw that attaches the brace to the battery tray. Tighten the screw to 18 N·m (156 in-lbs) torque.

(5) Install the screws that attach the support brackets to the fender inner panel. Tighten the screws to 18 N·m (156 in-lbs) torque.

(6) Install the support bracket and PDC on the battery tray. Tighten the screws to 18 N·m (156 in-lbs) torque.

(7) Install the battery in the tray.

(8) Position the holddown bracket over the J-bolts.

(9) Install the retaining nuts on the J-bolts. Tighten the nuts to 4 N·m (35 in-lbs) torque.

(10) Remove the cables from the battery and power distribution center.

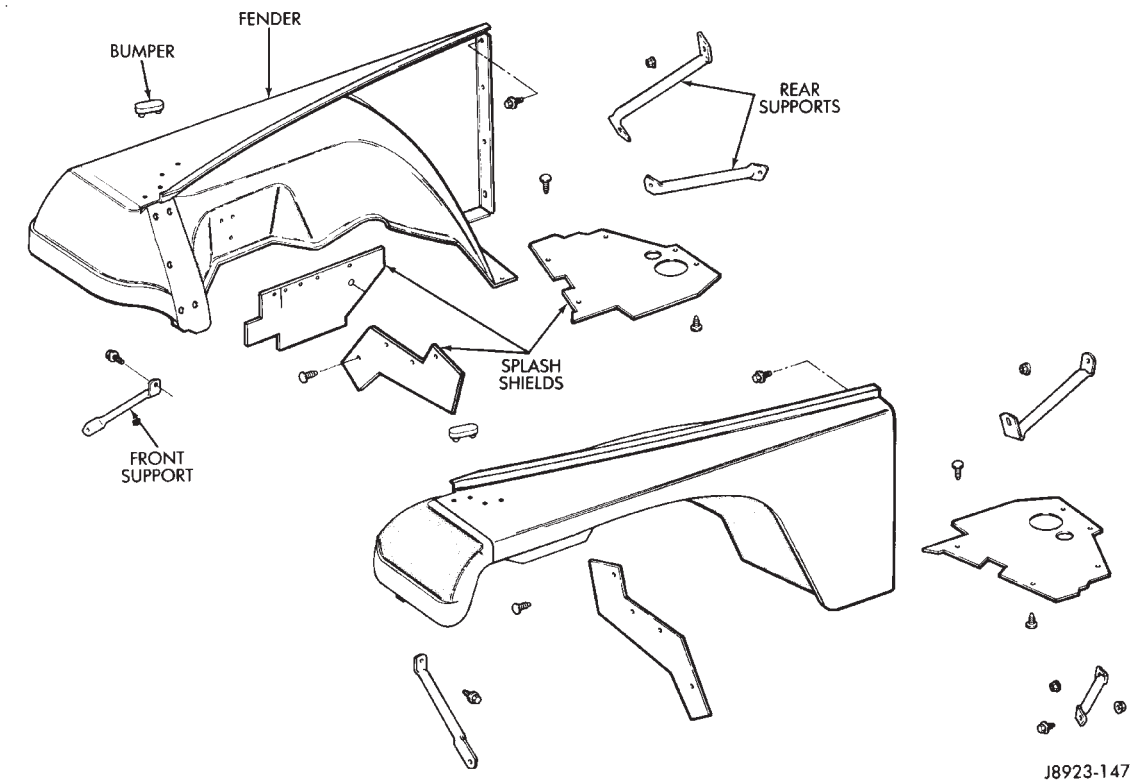

Fig. 20 Fender Components

FENDERS

SERVICE INFORMATION

YJ fenders are comprised of the fender outer panel, the fender inner panel, the front and rear support brackets, and the splash shields (Fig. 20).

Standard YJ fenders can not be used for installation on YJ Renegade vehicles. Renegade fender must have additional metal removed for tire clearance. The Renegade fender must have a section of metal removed for fog lamp installation (Fig. 21).

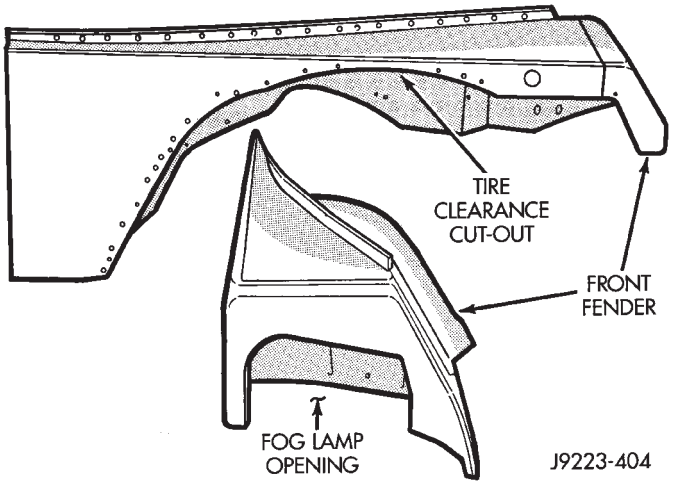

Fig. 21 YJ Renegade Fender

Before installation of a YJ Renegade fender, all newly drilled holes must be pre-primed with a primer before any bolts/screws are installed.

REMOVAL

(1) For YJ Renegade vehicles, refer to Front Fender Extension Panel Removal.

(2) As applicable, remove or disconnect all components attached to the fender inner panel.

(3) Left fender:

• remove the air cleaner housing and support bracket from the fender inner panel (Figs. 22 and 23);

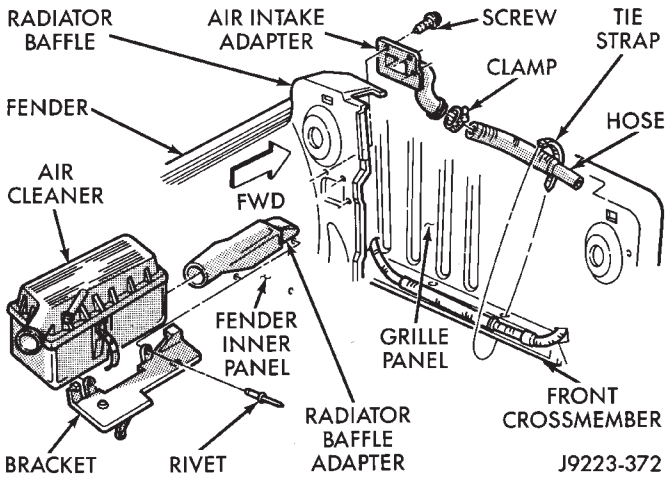

Fig. 22 Air Cleaner Housing and Radiator Baffle Adapter Fender

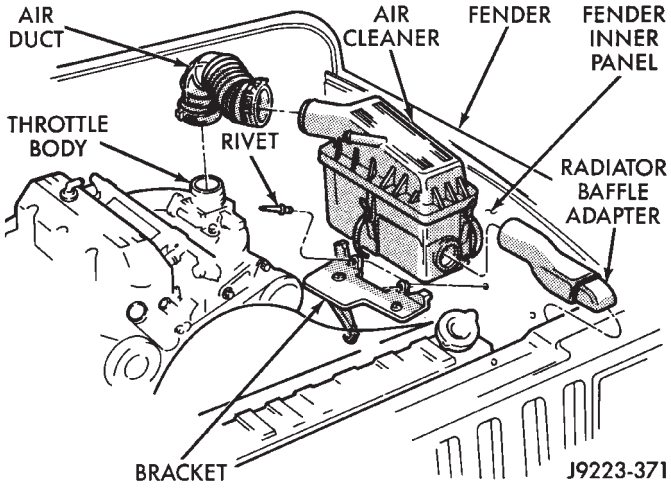

Fig. 23 Air Cleaner Housing and Support Bracket

• remove the horn from the fender inner panel (Fig. 24); and

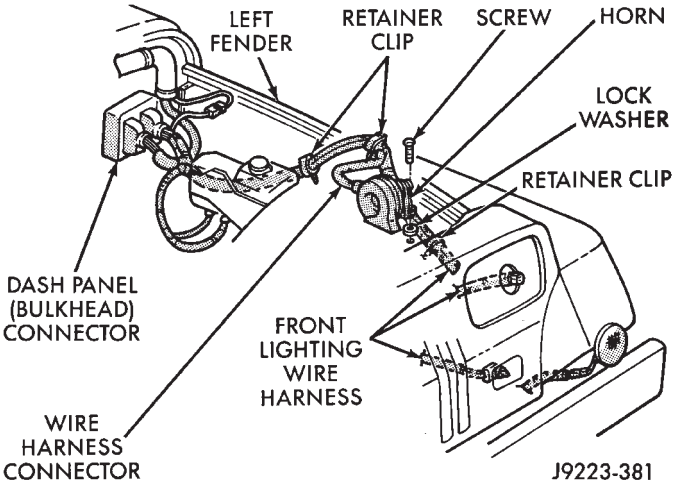

Fig. 24 Horn Removal/Installation

• remove the windshield washer fluid reservoir and coolant reserve bottle from the fender inner panel (Figs. 25 and 26).

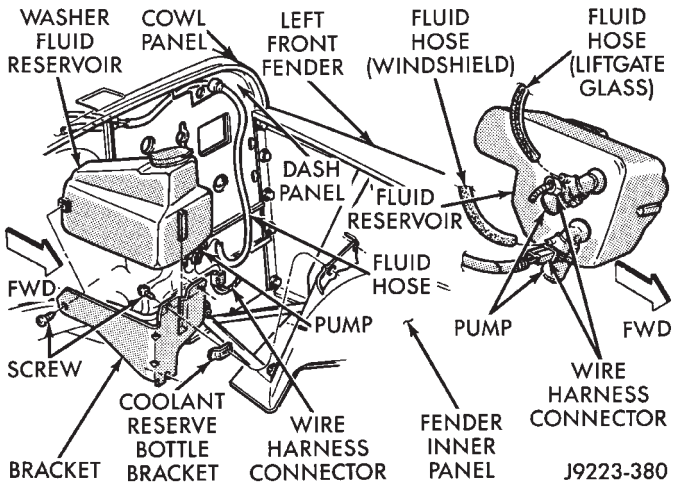

Fig. 25 Windshield Washer Fluid Reservoir

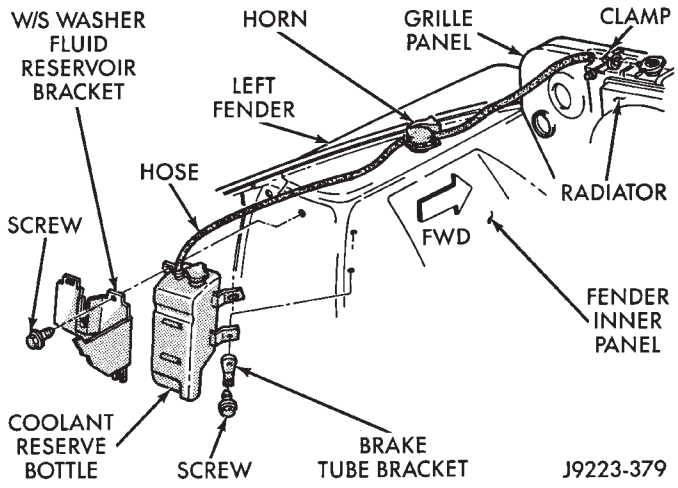

Fig. 26 Coolant Reserve Bottle

(4) Right fender:

• remove the jack and related tools from the jack storage tray (Fig. 27);

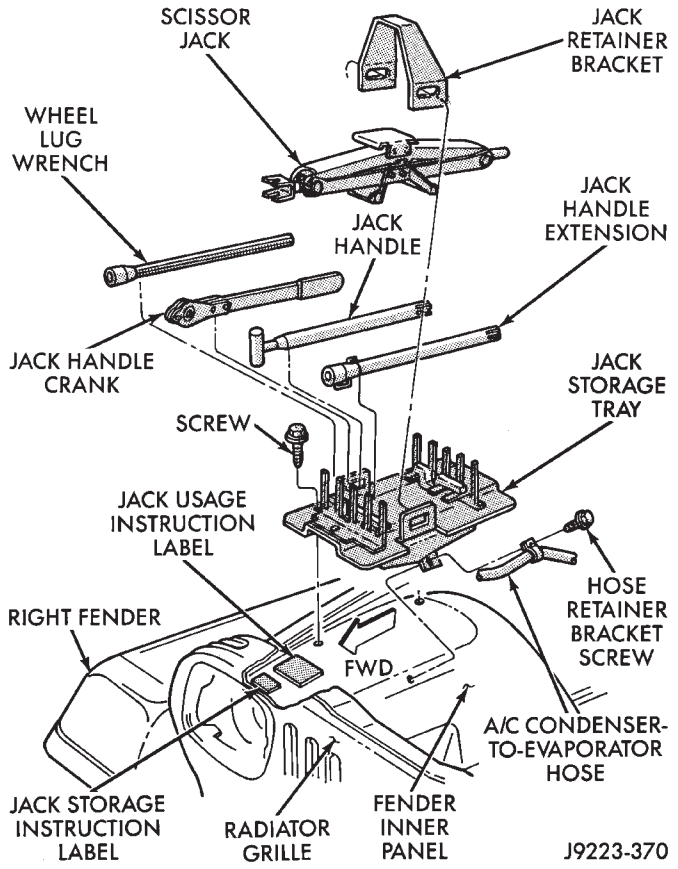

Fig. 27 Jack and Related Tools

• remove the jack storage tray and A/C receiver/drier from the fender inner panel (Fig. 28); and

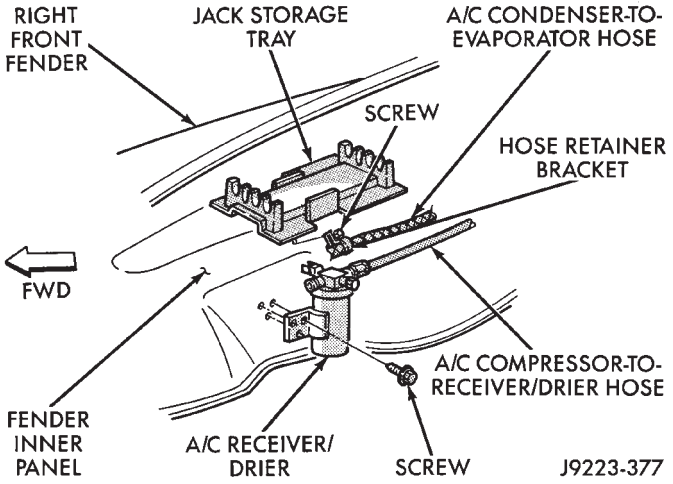

Fig. 28 Jack Storage Tray and A/C Receiver/Drier

• remove the radio antenna (if equipped) from the fender outer panel (Figs. 29 and 30).

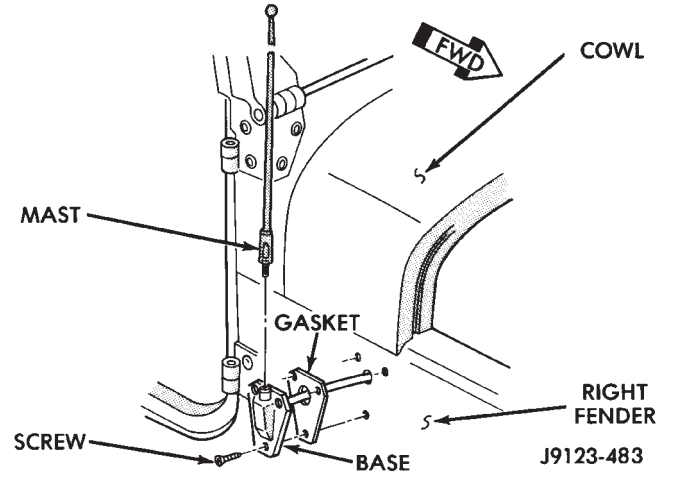

Fig. 29 Radio Antenna

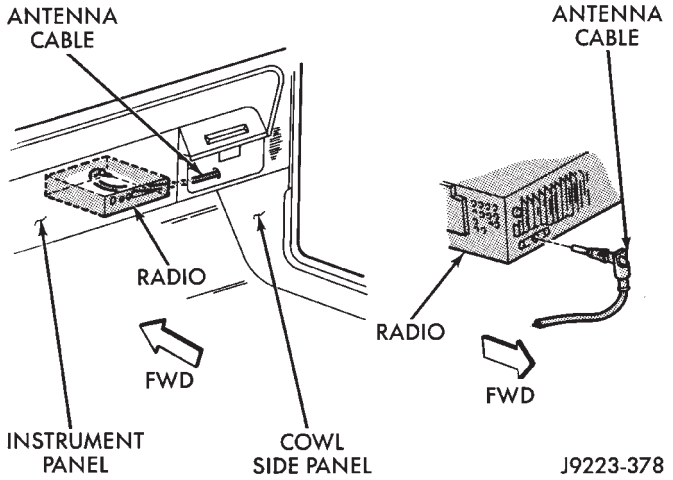

Fig. 30 Radio Antenna Cable

(5) Disconnect the side marker lamp wire harness bulb socket and the hood holddown clamp (Fig. 31).

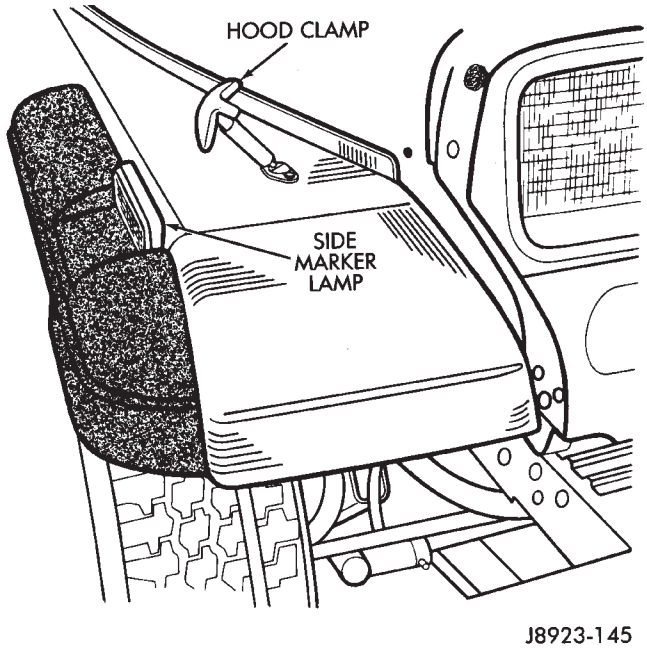

Fig. 31 Hood Holddown Clamp and Side Marker Lamp

(6) Remove the screws that attach the battery tray support brackets to the right fender inner panel (Fig. 32).

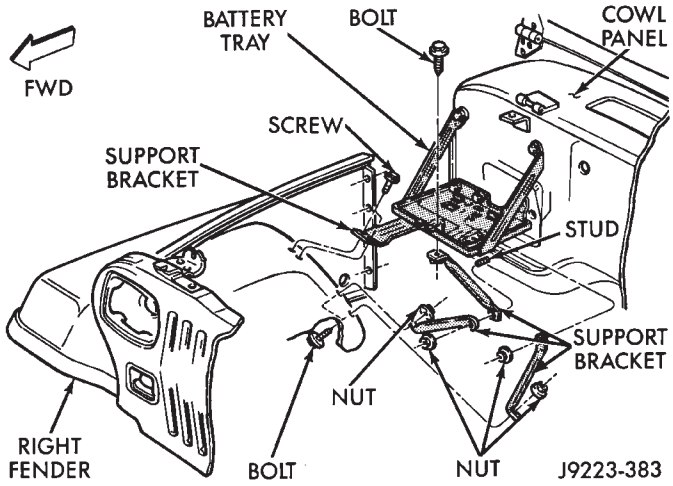

Fig. 32 Battery Tray Support Brackets

(7) Remove the fender front attaching bolts/nuts and brackets from the grille panel (Fig. 33).

(8) Remove the splash shields from the fender (Fig. 34).

(9) Remove the bolts that attach the fender and rear supports to the cowl panel (Fig. 33).

(10) Pull the fender outward and lift it from the vehicle.

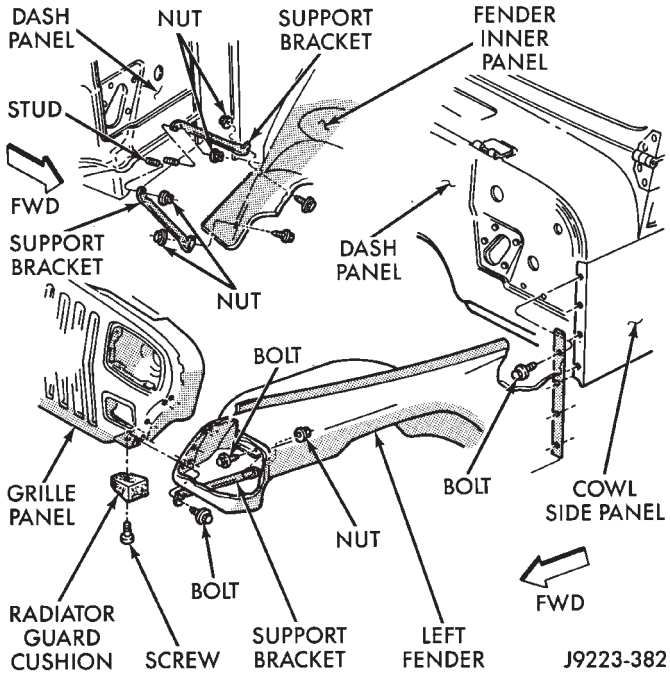

Fig. 33 Fender Front and Rear Attaching Bolts/Nuts

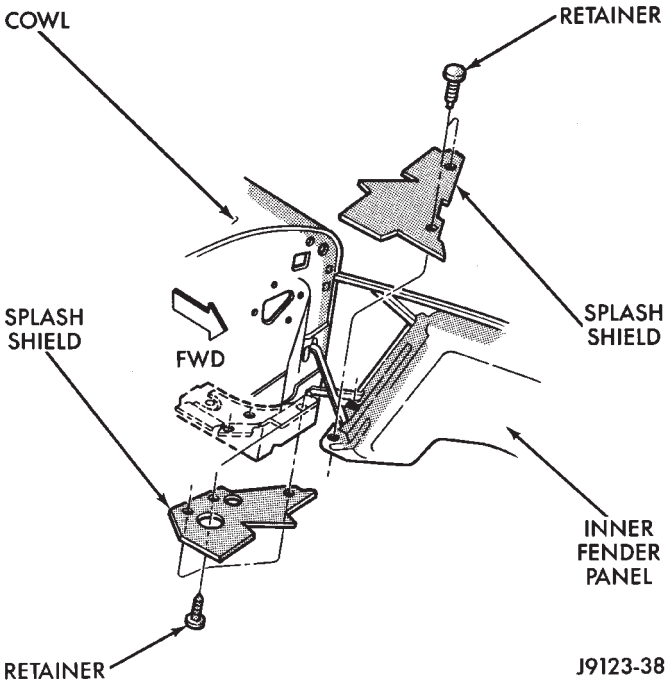

Fig. 34 Fender Splash Shields

INSTALLATION

(1) Position the fender and rear support brackets at the vehicle body and install the attaching washers and bolts (Fig. 33). Tighten the bolts and nuts to 18 N·m (156 in-lbs) torque.

(2) Install the fender front attaching bolts/nuts. Tighten the bolts and nuts to 18 N·m (156 in-lbs) torque.

(3) Install the splash shields with the serrated retainers (Fig. 34).

(4) Install the battery tray support bracket-to-right fender inner panel screws (Fig. 32). Tighten the screws to 18 N·m (156 in-lbs) torque.

(5) Connect the side marker lamp wire harness connector and the hood holddown clamp (Fig. 31).

(6) Connect the radio antenna, if equipped.

(7) Install/connect all the components removed/disconnected from the fender inner panel.

(8) Left fender:

- install the air cleaner housing and support bracket on the fender inner panel (Figs. 22 and 23);
- install the horn on the fender inner panel (Fig. 24); and
- install the windshield washer fluid reservoir and coolant reserve bottle on the fender inner panel.

(9) Right fender:

- install the jack storage tray and A/C receiver/drier on the fender inner panel (Fig. 28); and
- install the jack and related tools in the jack storage tray (Fig. 35).

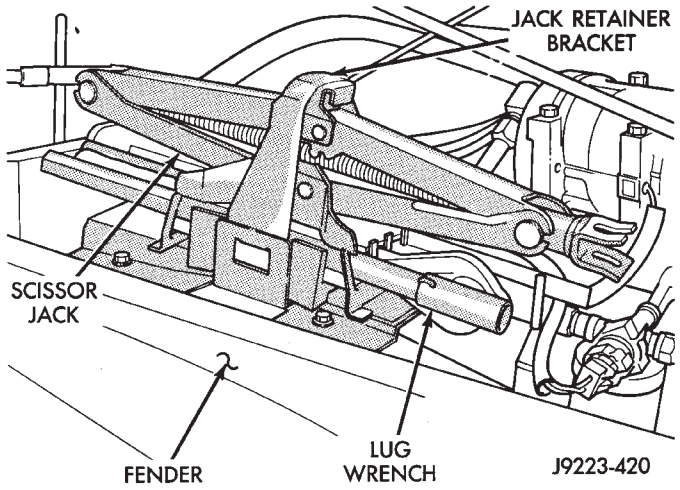

Fig. 35 Jack Installation

(10) For YJ Renegade vehicles, refer to Front Fender Extension Panel Installation.

FENDER FLARE

REMOVAL

(1) Remove the side marker lamp lens and disconnect the wire harness bulb socket.

(2) Remove the serrated retainers, screws and plastic nuts that attach the flare to the front fender or rear wheelhouse.

(3) Remove the flare and clean the contact surface on the body.

(4) Inspect the flare serrated retainers and plastic nuts. Replace any hardware that is loose or damaged.

INSTALLATION

(1) Clean the contact surface on the flare and position it on the front fender or wheelhouse.

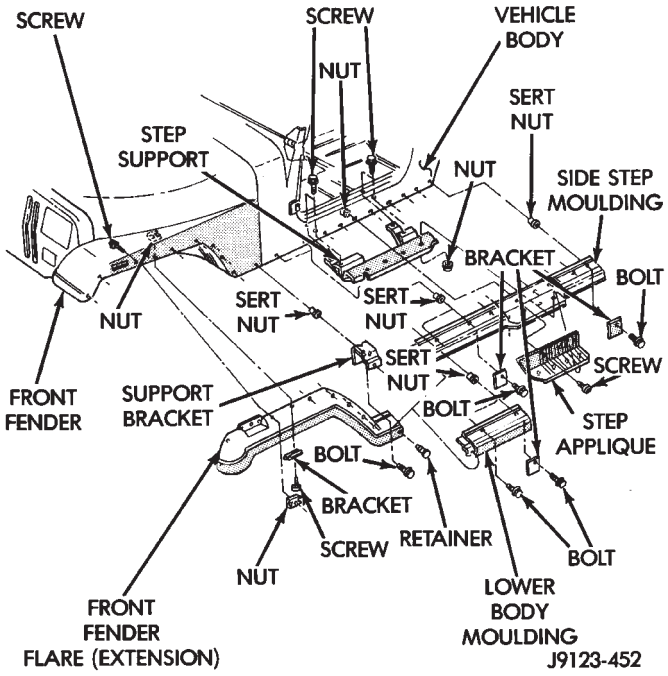

Fig. 36 Front Fender Flare and Side Step Moulding

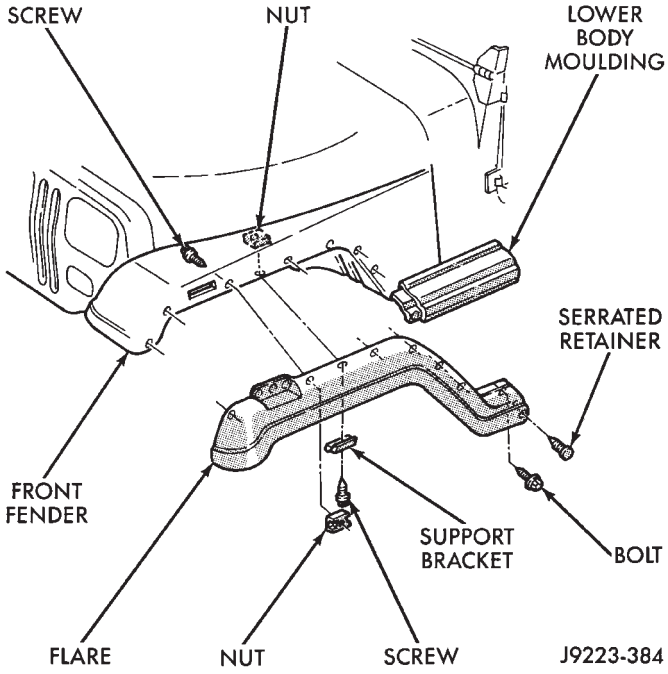

Fig. 37 Front Fender Flare and Side Step Moulding

(2) Install the flare serrated retainers, screws and nuts (Figs. 36, 37 and 38). Tighten the screw at the lower moulding (Fig. 37) to 11 N·m (96 in-lbs) torque. Tighten the upper screws (Fig. 37) to 11 N·m (96 in-lbs) torque.

BODY SIDE STEP MOULDING

REMOVAL/INSTALLATION

The body side mouldings are attached to the step supports and to the body side panels.

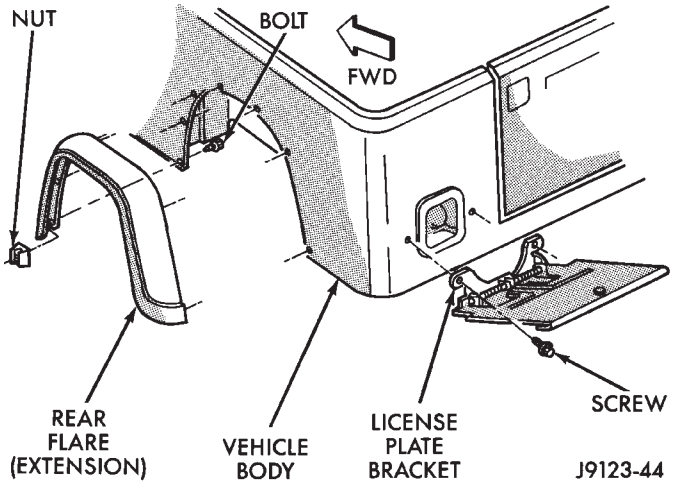

Fig. 38 Rear Flare and license Plate Bracket

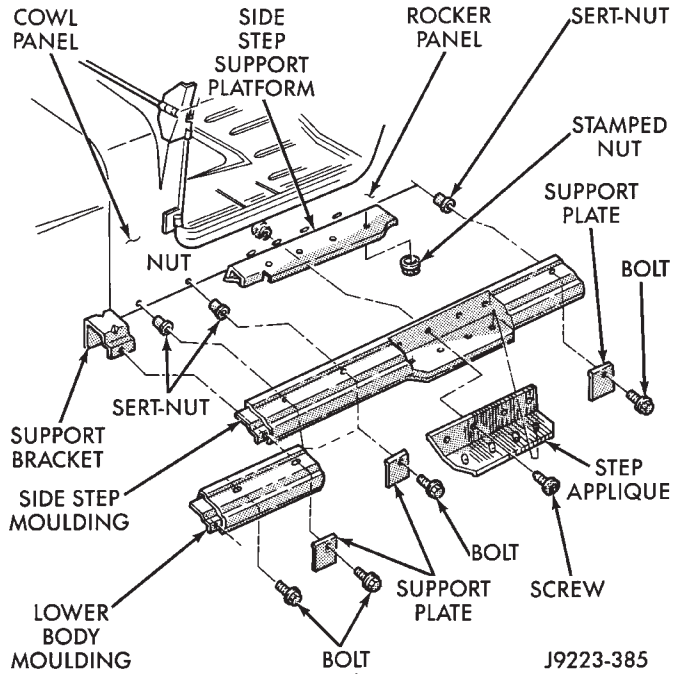

Fig. 39 Side Step Support Platform and Moulding/ Applique

(1) It is necessary to loosen the fender flare retaining screws (Figs. 36, 37 and 38) before removing the lower body and step mouldings.

(2) Remove the retaining bolts and the lower body moulding from the support bracket and cowl side panel (Fig. 39).

(3) Remove the retaining bolts/screws, the applique and the side step moulding from the cowl side panel/ rocker panel (Fig. 39).

(4) If necessary, remove the retaining bolt/screws and the support bracket and side step support platform from the cowl side panel/rocker panel (Fig. 40).

INSTALLATION

(1) If removed, install the support bracket and side step support platform on the cowl side panel/rocker

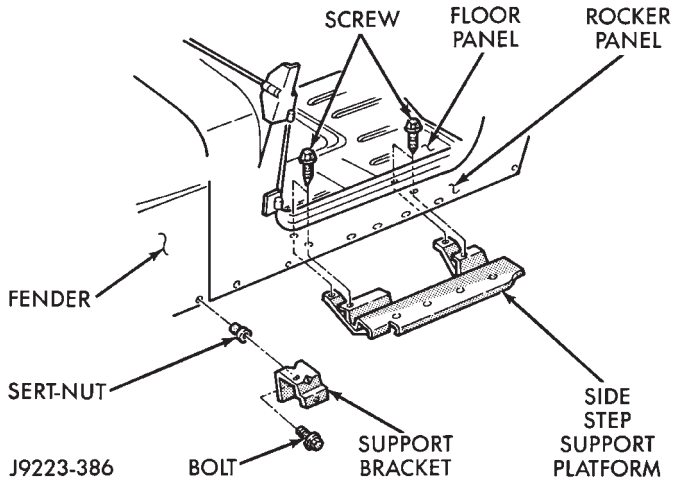

Fig. 40 Side Step Support Platform and Support Bracket

panel (Fig. 40). Install and tighten the support bracket retaining bolt to 11 N·m (96 in-lbs) torque. Install and tighten the support platform retaining screws to 41 N·m (30 ft-lbs) torque.

(2) Install the side step moulding and applique on the cowl side panel/rocker panel (Fig. 39). Install and tighten the moulding retaining bolts to 11 N·m (96 in-lbs) torque. Install and tighten the applique retaining screws to 41 N·m (30 ft-lbs) torque.

(3) Install the lower body moulding on the support bracket and cowl side panel with the retaining bolts and (Fig. 39). Tighten the moulding retaining bolts to 11 N·m (96 in-lbs) torque.

(4) Tighten the fender flare retaining screws (Figs. 36, 37 and 38) to 11 N·m (96 in-lbs) torque.

WHEELHOUSE SPLASH LINERS

REMOVAL

(1) Remove the liner attaching screws (Fig. 41).

(2) Remove the rivets that attach the liner to the wheelhouse (Fig. 41).

(3) Remove the rivets that attach the liner rear splash shield to the rear crossmember (Fig. 41).

(4) Remove the liner from the wheelhouse (Fig. 41).

(5) Remove the rivets that attach the rear splash shield to the wheelhouse liner (Fig. 41).

INSTALLATION

(1) Attach the rear splash shield to the wheelhouse liner with rivets (Fig. 41).

(2) Position the liner in the wheelhouse (Fig. 41).

(3) Install the screws and rivets to attach the liner to the wheelhouse (Fig. 41).

(4) Install the rivets to attach the rear splash shield to the crossmember (Fig. 41).

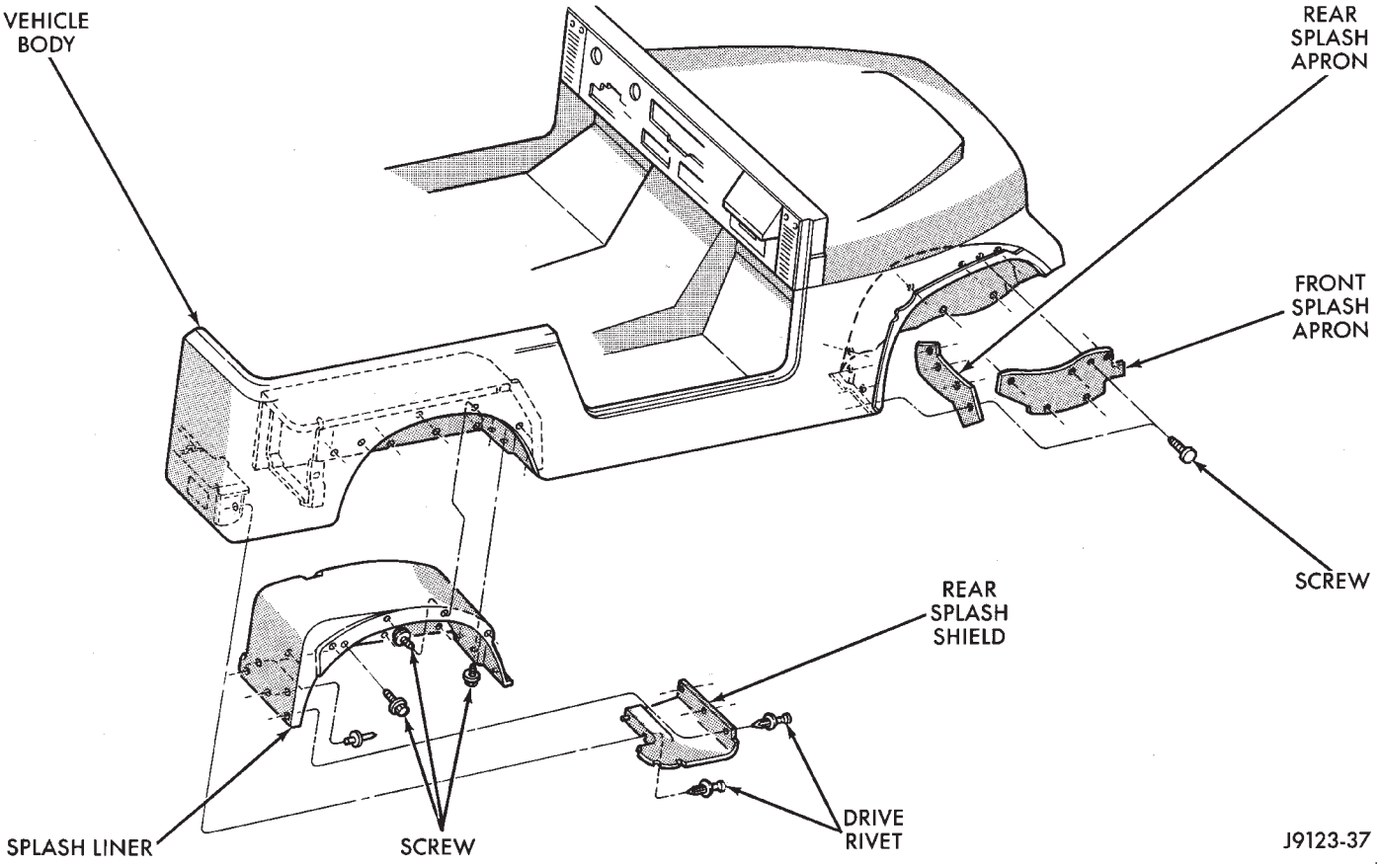

Fig. 41 Wheelhouse Liner, Splash Shield and Splash Aprons

FENDER SPLASH APRONS

REMOVAL

(1) Remove the splash apron attaching screws (Fig. 41).

(2) Remove the aprons from the fender well (Fig. 41).

INSTALLATION

(1) Position the aprons in the fender well (Fig. 41).

(2) Install the screws to attach the splash aprons to the fender well (Fig. 41).

FENDER INNER SPLASH SHIELDS

REMOVAL

(1) Remove the splash shield retainers from the cowl panel and inner fender panel (Fig. 42).

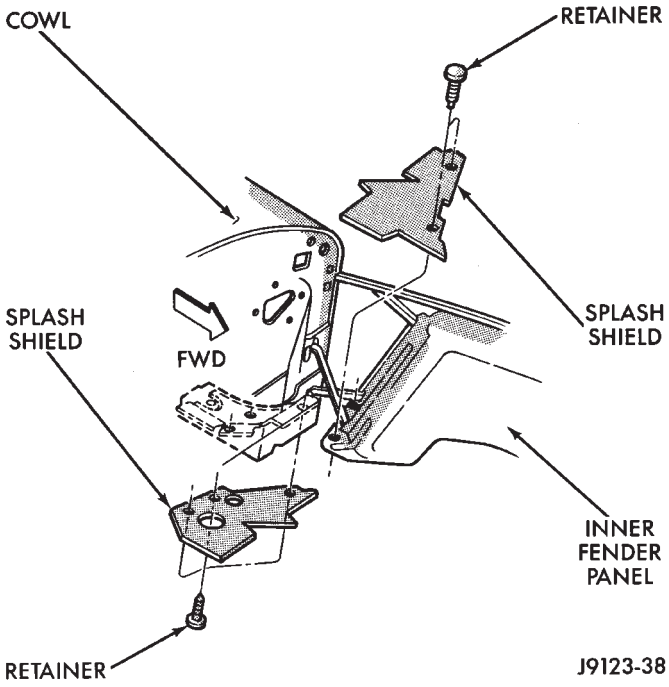

Fig. 42 Fender Inner Splash Shields

(2) Remove the splash shields from the inner fender and cowl panel (Fig. 42).

INSTALLATION

(1) Position the splash shields on the inner fender panel rear flange and on the cowl panel extension (Fig. 42).

(2) Install the splash shield retainers (Fig. 42).

BODY EXTENSION PANELS AND FASCIAS—YJ RENEGADE VEHICLES

SERVICE INFORMATION

The extension panels, the front and rear fascias, and the front and rear skid plates that are attached to YJ Renegade bodies (Figs. 43 and 44). are attached with:

- push pins,
- bolts,
- rivnuts,
- U-nuts,
- stamped nuts,
- self-tapping screws, and
- rivets.

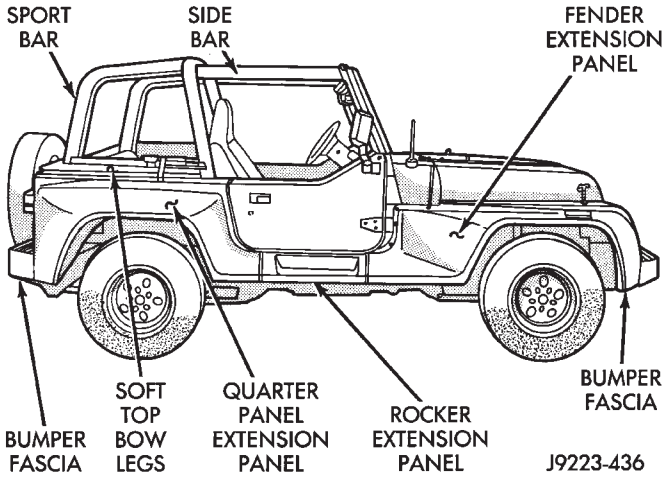

Fig. 43 YJ Renegade Extension Panels

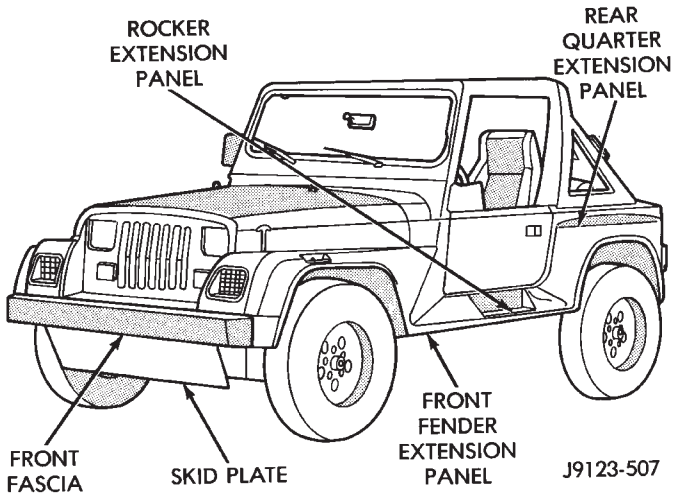

Fig. 44 YJ Renegade Extension Panels, Fascias and Skid Plates

If a Renegade front fender must be replaced, a template will be included with the replacement fender for removing a section of the metal for fog lamp installation (Fig. 45).

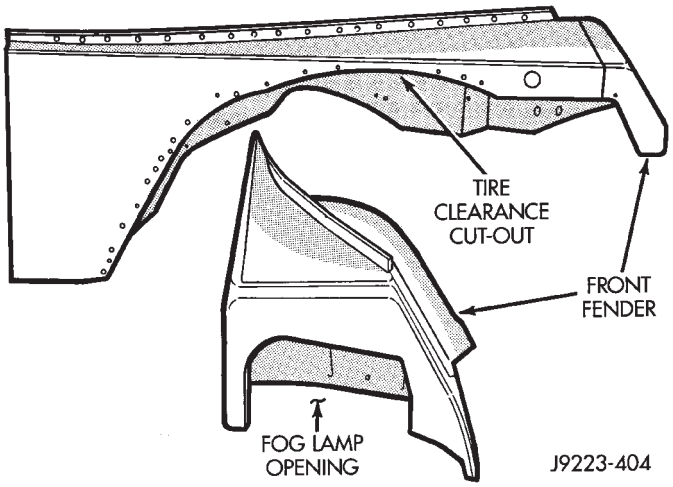

Fig. 45 YJ Renegade Front Fender

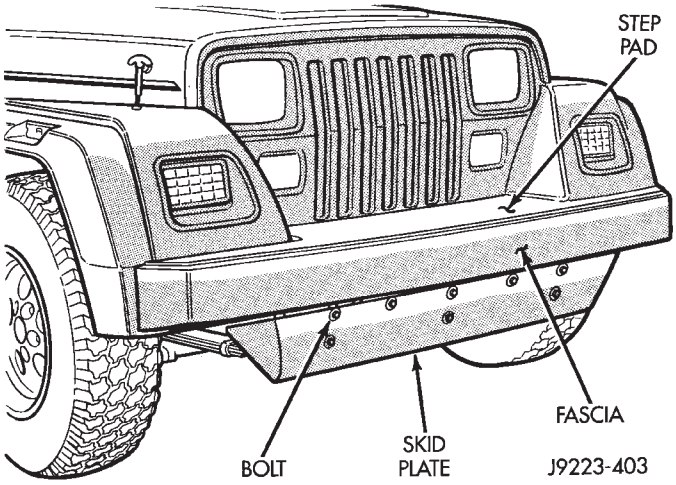

Fig. 46 Front Fascia and Skid Plate

FRONT FASCIA AND SKID PLATE—YJ RENEGADE VEHICLES

The skid plate and the front fascia can also be removed independently.

REMOVAL

(1) For convenience, lift the vehicle to a comfortable height on a hoist. Support the vehicle.

(2) If necessary, remove the step pad from the fascia (Figs. 46 and 47).

(3) Remove the fascia push pins from the fascia support and retaining bolts from the skid plate. Remove the fascia from the frame crossmember (Fig. 48).

(4) Remove the retaining bolts and the fascia spacer from the frame crossmember (Fig. 47).

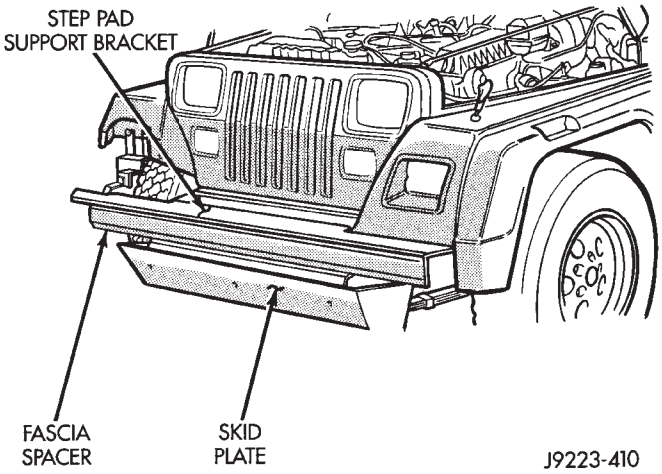

Fig. 48 Front Fascia Removed

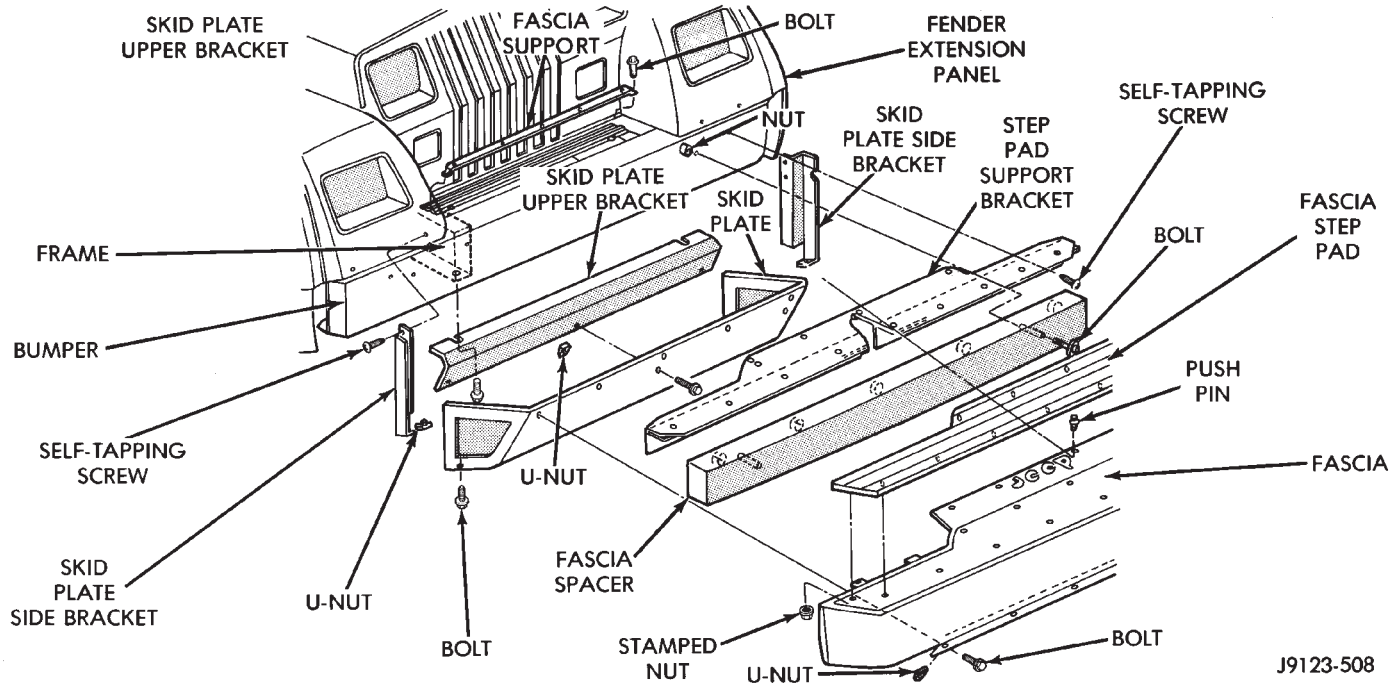

Fig. 47 Front Fascia and Skid Plate—Exploded View

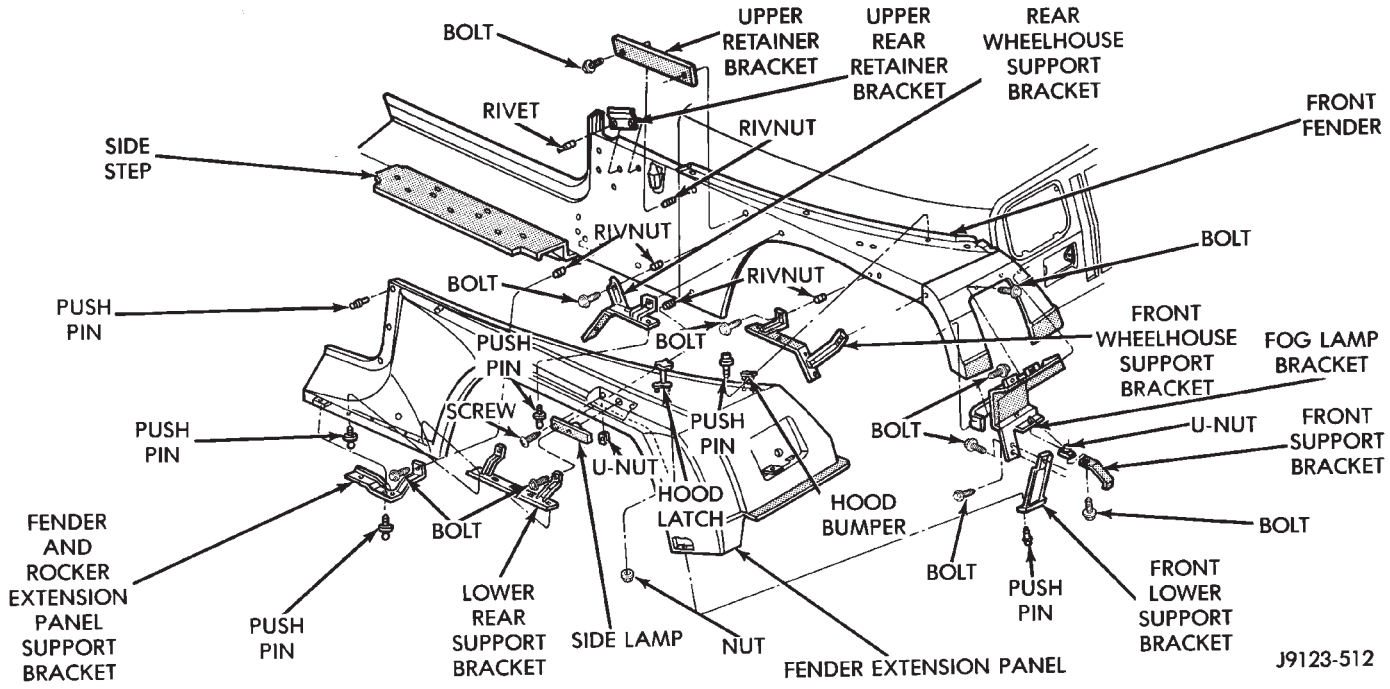

Fig. 49 Front Fender Extension Panel

(5) Remove the retaining screws and the fascia step pad support bracket from the frame crossmember (Fig. 47).

(6) Remove the retaining bolts from the skid plate. Remove the skid plate from the brackets.

(7) Remove the retaining screws from the skid plate brackets. Remove the brackets from the frame rails.

(8) Remove the retaining bolts and the fascia support from the cover plate.

INSTALLATION

(1) Position the fascia support on the cover plate and install the retaining bolts (Fig. 47). Tighten the bolts to 5 N·m (44 in-lbs) torque.

(2) Position the skid plate brackets at the frame rails and install the retaining screws. Tighten the screws to 25 N·m (18 ft-lbs) torque.

(3) Position the skid plate at the brackets and install the retaining bolts. Tighten the bolts to 25 N·m (18 ft-lbs) torque.

(4) Position the fascia step pad support bracket at the frame crossmember and install the retaining screws. Tighten the screws to 25 N·m (18 ft-lbs) torque.

(5) Position the fascia spacer at the frame crossmember and install the retaining bolts. Tighten the nuts to 6 N·m (53 in-lbs) torque.

(6) Position the fascia at the frame crossmember and install the retaining bolts and push pins. Tighten the bolts to 10 N·m (7 ft-lbs) torque.

(7) Install the step pad on the fascia.

(8) If applicable, remove the support and lower the vehicle.

FRONT FENDER EXTENSION PANEL—YJ RENEGADE VEHICLES

REMOVAL

(1) For convenience, lift the vehicle to a comfortable height on a hoist. Support the vehicle.

(2) Remove the radio antenna mast from the fender extension panel.

(3) Remove the hood bumper from the extension panel.

(4) Remove the fog lamp from the extension panel. If necessary, refer to the removal procedure.

(5) Detach the hood latch from the hood.

(6) Disconnect the side marker lamp wire harness bulb socket.

(7) Remove the push pins that attach the fender extension panel to the support brackets (Fig. 49). Remove the panel from the from the front fender.

(8) If necessary, remove the hood latch and the side marker lamp from the extension panel (Fig. 49).

(9) Remove the retaining bolts and the support/retainer brackets from the front fender (Figs. 49 and 50).

The fender and rocker extension panel support bracket (Fig. 50) also supports the rocker extension panel. Before the bracket can be removed, the rocker extension panel must first be separated from the bracket.

INSTALLATION

(1) If removed, install the hood latch and the side marker lamp on the extension panel (Fig. 49).

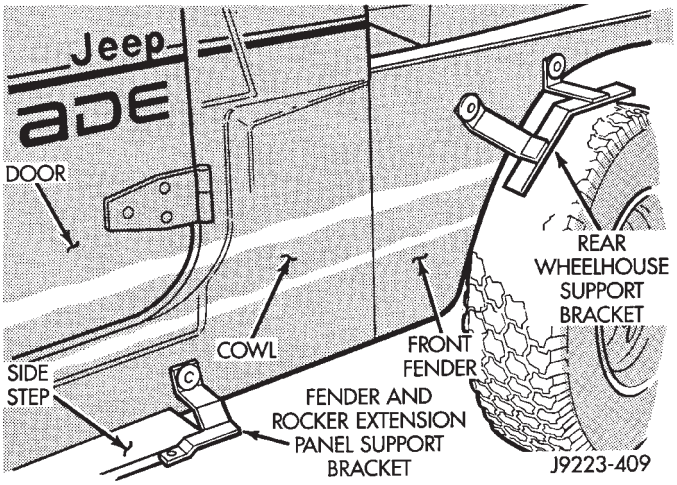

Fig. 50 Front Fender Extension Panel Removed

(2) If removed, install the fender and rocker extension panel support bracket (Fig. 50), and attach the rocker extension panel to the bracket.

(3) Position the support/retainer brackets on the front fender and install the retaining bolts. Tighten the bolts to 10 N·m (7 ft-lbs) torque.

(4) Position the extension panel on the brackets and install the push pins (Fig. 49).

(5) Connect the side marker lamp wire harness bulb socket.

(6) Install the fog lamp in the extension panel. If necessary, refer to the installation procedure.

(7) Attach the hood latch to the hood.

(8) Install the radio antenna mast.

(9) Install the hood bumper on the extension panel.

(10) If applicable, remove the support and lower the vehicle.

FOG LAMP—YJ RENEGADE VEHICLES

REMOVAL

(1) Disconnect the wire harness connector.

(2) Remove the fog lamp retaining nut and washer from the fog lamp and bracket (Fig. 51).

(3) Remove the bezel retaining screws (Fig. 51).

(4) Remove the fog lamp and the bezel from the fender extension panel (Fig. 51).

If it is necessary to remove the fog lamp bracket from the front fender, the fender extension panel must first be removed.

(5) With the fender extension panel removed, remove the fog lamp bracket retaining bolts from the front fender (Fig. 51).

INSTALLATION

(1) If removed, install the fog lamp bracket and the retaining bolts on the front fender (Fig. 51). Tighten the bolts to 10 N·m (7 ft-lbs) torque.

(2) If removed, install the fender extension panel. If necessary, refer to the installation procedure.

(3) Position the bezel and the fog lamp in the fender extension panel (Fig. 51).

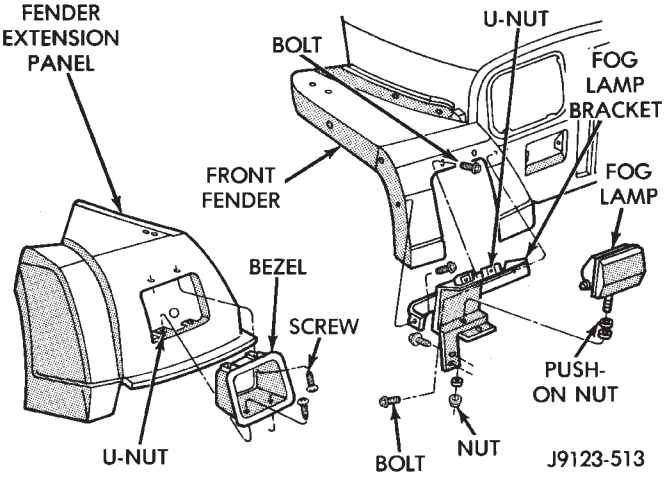

Fig. 51 Fog Lamp Removal/Installation

(4) Install the bezel retaining screws (Fig. 51). Tighten the screws to 1.5 N·m (13 in-lbs) torque.

(5) Install the fog lamp washer and retaining nut on the fog lamp and bracket (Fig. 51). Tighten the nut to 10 N·m (7 ft-lbs) torque.

(6) Connect the fog lamp wire harness connector.

ROCKER EXTENSION PANEL—YJ RENEGADE VEHICLES

REMOVAL

(1) For convenience, lift the vehicle to a comfortable height on a hoist. Support the vehicle.

(2) From inside the vehicle, remove the nuts from the upper retainer bracket studs (Fig. 52).

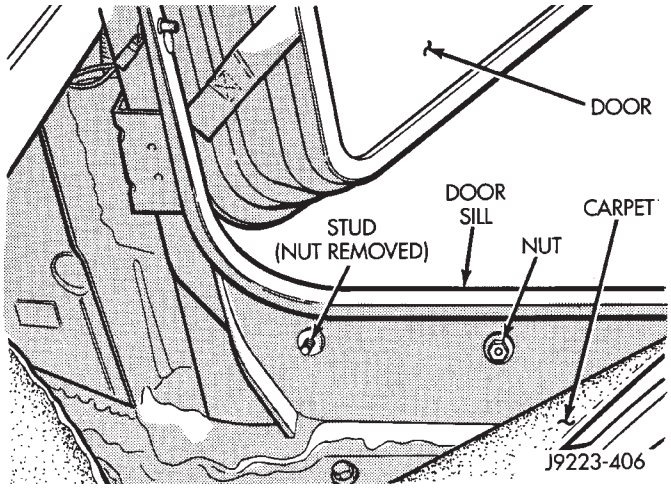

Fig. 52 Upper Retainer Bracket Stud Nuts Removal/ Installation

(3) Remove the push pins from the support brackets (Fig. 53).

(4) Remove the step pad, extension panel and spacer retaining nuts from the bottom of the side step (Fig. 53).

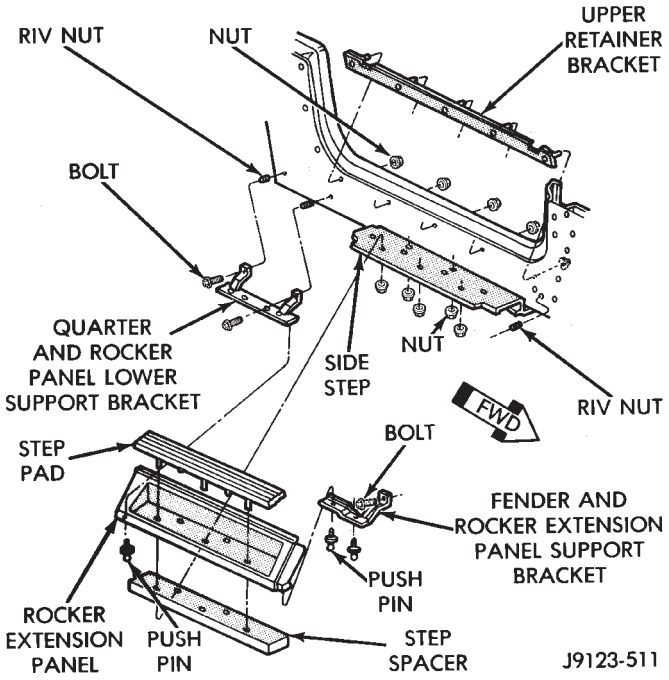

Fig. 53 Rocker Extension Panel—Exploded View

(5) Pull the front fender extension panel outward (Fig. 54) and remove the extension panel (with step pad and spacer) from the side step (Fig. 54).

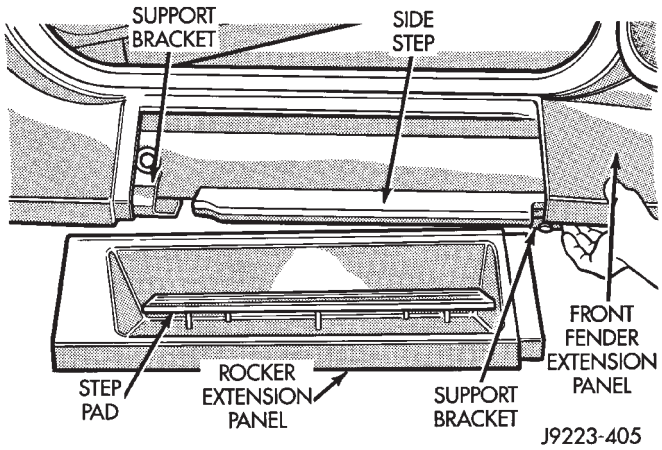

Fig. 54 Rocker Extension Panel Removal/Installation

(6) Remove the retaining nuts and upper retaining bracket from the rocker panel (Fig. 53).

(7) If necessary, separate and remove the step pad and spacer from the extension panel (Fig. 53).

The fender/quarter and rocker extension panel support brackets also support the fender/quarter extension panel. Before either bracket can be removed, the applicable extension panel must first be separated from the bracket.

INSTALLATION

(1) If removed, install the fender/quarter and rocker extension panel support bracket(s) (Fig. 53), and attach it to the applicable extension panel(s). If necessary, refer to the installation procedure(s).

(2) Install the upper retainer bracket and the retaining nuts (Fig. 52). Tighten the nuts to 6 N·m (53 in-lbs) torque.

(3) If removed, install the spacer and step pad on the extension panel (Fig. 53).

(4) Position the extension panel (with step pad and spacer) on the side step (Fig. 54).

(5) Install the push pins in the support brackets (Fig. 53).

(6) Install the step pad, extension panel and spacer retaining nuts at the bottom of the side step (Fig. 53). Tighten the nuts to 6 N·m (53 in-lbs) torque.

(7) If applicable, remove the support and lower the vehicle.

REAR QUARTER EXTENSION PANEL—YJ RENEGADE VEHICLES

REMOVAL

(1) For convenience, lift the vehicle to a comfortable height on a hoist. Support the vehicle.

(2) Remove the rear bumper fascia. If necessary, refer to the removal procedure.

(3) Loosen the fascia support bracket.

(4) Remove the retaining bolts and the support brackets from the quarter panel (Fig. 55).

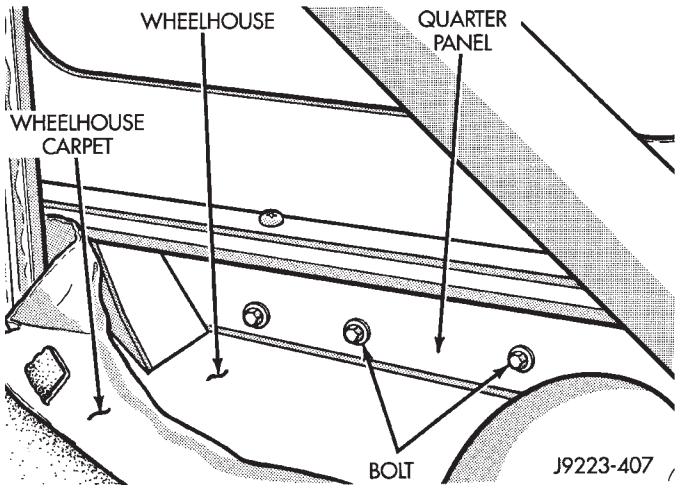

Fig. 55 Upper Retainer Bracket Removal/Installation

(5) Remove the screws that attach the extension panel to the wheelhouse lower, rear support brackets (Fig. 56).

(6) Remove the push pins that attach the extension panel to the quarter panel at the rear of the vehicle (Fig. 57).

(7) Remove the extension panel from the quarter panel and the support brackets (Fig. 55).

The quarter and rocker extension panel support bracket (Fig. 58) also supports the rocker extension panel. Before the bracket can be re-

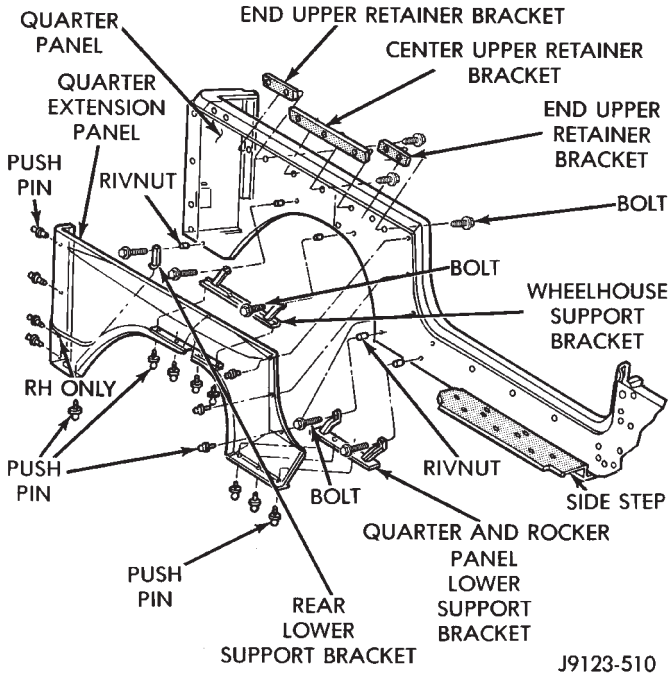

Fig. 56 Rear Quarter Extension Panel—Exploded View

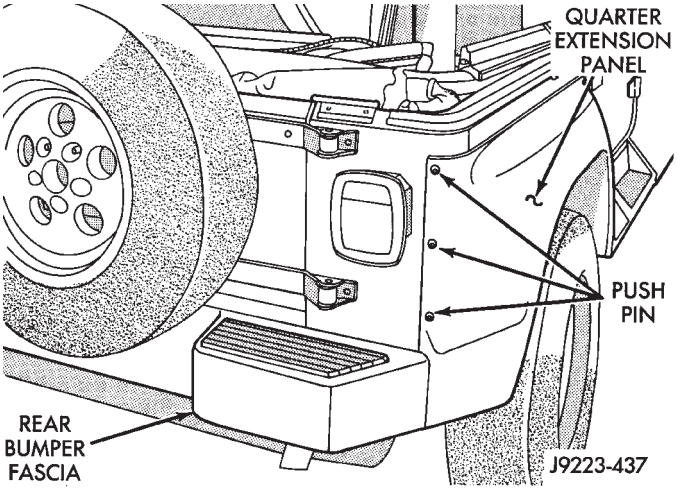

Fig. 57 Rear Quarter Extension Push Pins

moved, the rocker extension panel must first be separated from the bracket.

INSTALLATION

(1) If removed, install the quarter and rocker extension panel support bracket (Fig. 58), and attach the rocker extension panel to it. If necessary, refer to the installation procedure.

(2) Position the support brackets on the quarter panel and install the retaining bolts (Figs. 55 and 56). Tighten the bolts to 6 N·m (53 in-lbs) torque.

(3) Position the extension panel on the brackets and the quarter panel, and install the screws to attach the panel to the brackets (Fig. 56).

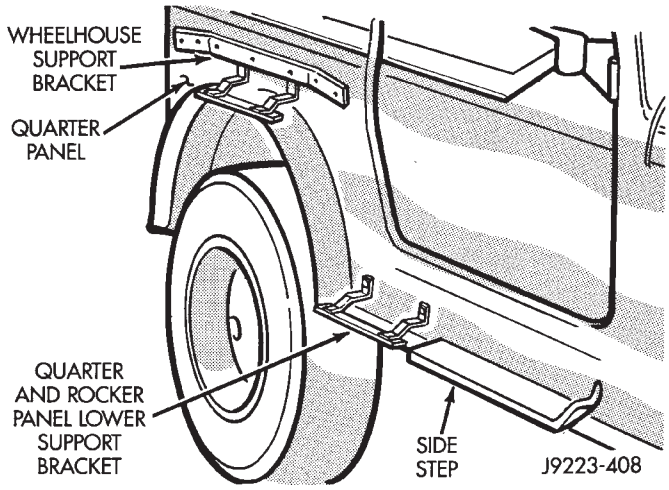

Fig. 58 Rear Quarter Extension Panel Brackets

(4) Install the push pins to attach the extension panel to the quarter panel at the rear of the vehicle (Fig. 57).

(5) If applicable, remove the support and lower the vehicle.

(6) Tighten the fascia support bracket:

- tighten the screws to 25 N·m (18 ft-lbs) torque; and
- tighten the nuts to 50 N·m (37 ft-lbs) torque.

(7) Install the rear bumper fascia. If necessary, refer to the installation procedure.

REAR FASCIA AND SKID PLATE—YJ RENEGADE VEHICLES

The skid plate and the rear fascia (Fig. 59) can also be removed independently.

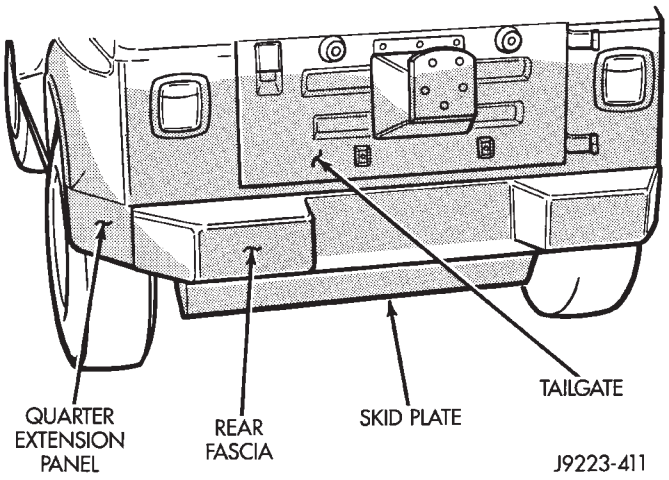

Fig. 59 Rear Fascia and Skid Plate

REMOVAL

(1) For convenience, lift the vehicle to a comfortable height on a hoist. Support the vehicle.

(2) Remove the retaining bolts and from the skid plate. Remove the skid plate from the brackets and the fascia (Fig. 60).

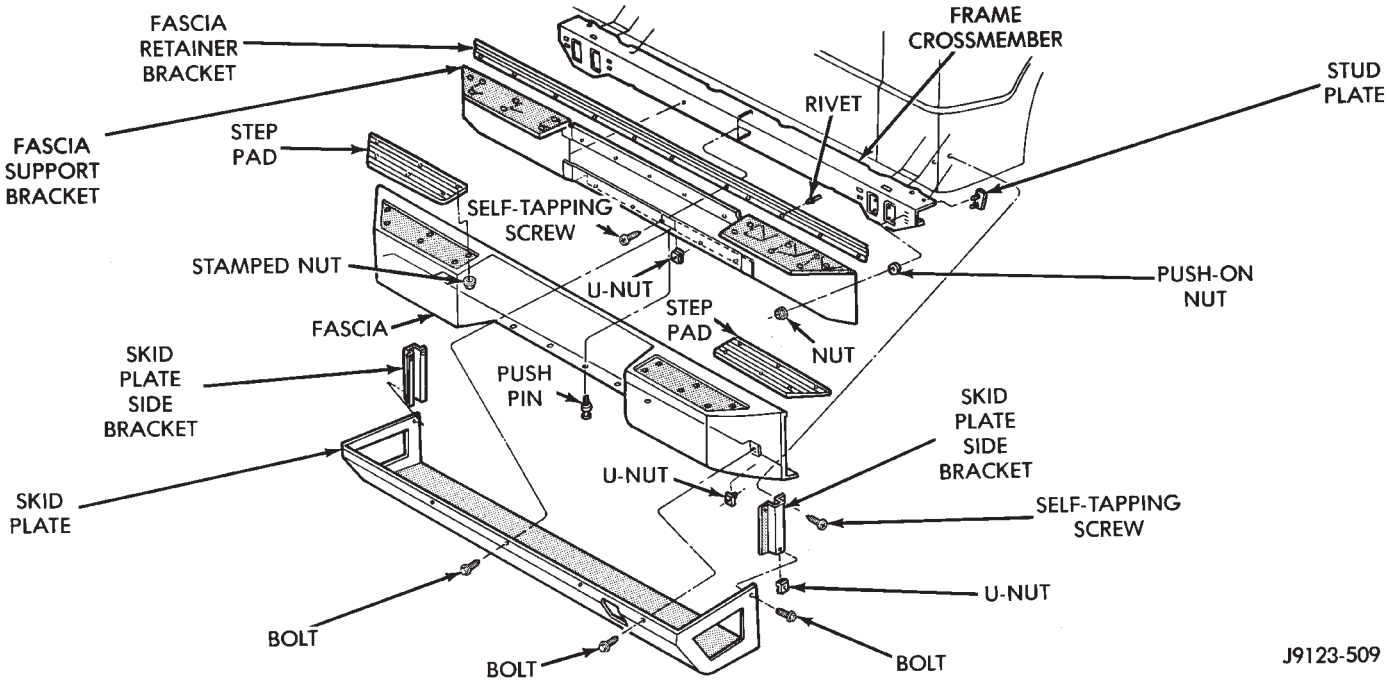

Fig. 60 Rear Fascia and Skid Plate—Exploded View

(3) Remove the retaining bolts from the skid plate brackets. Remove the brackets from the frame rails (Fig. 60).

(4) Remove the fascia retaining push pins from the fascia support bracket. Remove the fascia from the retainer and the support bracket (Fig. 60).

(5) If necessary, remove the retaining nuts and the step pads from the fascia (Fig. 60).

(6) Remove the retaining nuts and screws, and the fascia support bracket from the frame crossmember (Fig. 60).

(7) If necessary, remove the rivets and the fascia retainer from the support bracket (Fig. 60).

INSTALLATION

(1) If removed, position the fascia retainer on the support bracket and install the retaining rivets (Fig. 60).

(2) Position the fascia support bracket at the frame crossmember and install the retaining screws and nuts (Fig. 60). Tighten the screws to 25 N·m (18 ft-lbs) torque. Tighten the nuts to 50 N·m (37 ft-lbs) torque.

(3) Position the skid plate brackets at the frame rails and install the retaining screws (Fig. 60). Tighten the screws to 10 N·m (7 ft-lbs) torque.

(4) If removed, install the fascia step pads on the fascia and retain them in-place with the stamped nuts (Fig. 60). Tighten the nuts to 6 N·m (4 ft-lbs) torque.

(5) Position the fascia at the support bracket and retainer, and install the retaining push pins (Fig. 60).

(6) Position the skid plate at the brackets and fascia, and install the retaining bolts (Fig. 60). Tighten the center bolt to 25 N·m (18 ft-lbs) torque. Tighten the outer bolts to 10 N·m (7 ft-lbs) torque. Tighten the skid plate-to-bracket bolt to 25 N·m (18 ft-lbs) torque.

(7) If applicable, remove the support and lower the vehicle.

BODY STRIPES/DECALS

SERVICE INFORMATION

YJ body stripes and decals are durable tape stripes/decals with a adhesive backing.

REPAIR

Small nicks, scratches can be touched-up with paint. A correct color match can be obtained by blending small amounts of appropriate paint colors.

To eliminate blisters and air bubbles in a body stripe/decal, pierce them with a needle or pin. Force the trapped air out of the hole.

A heat gun can also be used to remove small wrinkles and irregularities in a stripe/decal.

REQUIREMENTS

Body stripe/decal replacement because of collision damage requires that the metal repair and paint refinish be completed first.

The work area temperature should be between 18°C (65°F) and 32°C (90°F). **A tape stripe/decal should not be replaced if the work area temperature is less than 18°C (65°F).**

The following equipment and material are necessary for body stripe/decal removal and installation:
- a commercial tape stripe/decal removal solution;
- a commercial adhesive removal solution;
- liquid dish detergent (for the wetting solution);
- a mixture of wetting solution;
- a commercial wax and silicone removal solution;
- isopropyl (rubbing) alcohol;
- a small squeegee (plastic or hard rubber);
- a water bucket and sponge;
- clean wiping rags or paper towels;
- a heat gun (or infra-red heat bulb);
- a wax pencil;
- a sharp knife, single edge razor blade or X-acto knife;
- a pair of scissors; and
- a needle or pin.

A wetting solution assures a better bond between the painted surface of the body and the tape stripe/decal. Prepare a supply of wetting solution by mixing two or three teaspoons of dish detergent with 1 gallon of water. **Do not use soap.**

Too much detergent will reduce the effectiveness of the mixture.

REMOVAL

The key to successful tape stripe/decal removal is to apply heat to area and slowly peel stripe/decal from panel.

(1) Clean the repaired surface, adjacent panels and door openings as necessary.

(2) Start at one end of the tape stripe/decal and apply heat with a heat gun. Slowly peel the stripe/decal from the panel by pulling it back. **Do not pull the tape stripe/decal outward from the panel.**

WARNING: USE THE TAPE STRIPE/DECAL REMOVAL SOLUTION IN A WELL-VENTILATED AREA ONLY.

(3) A commercial tape stripe/decal removal solution can be used for stripe/decal removal at areas where a heat gun is ineffective:
- mask-off the body panel area surrounding the tape stripe/decal (Fig. 61);
- move the removal solution spray back and forth across the complete length of the stripe/decal with a smooth, steady motion;
- ensure that the complete stripe/decal is covered with the solution;
- allow the stripe/decal removal solution to remain on the stripe/decal for 20 minutes;
- after 20 minutes, peel stripe/decal away from the flange and, starting at a corner, peel the stripe/decal from the body (Fig. 62);
- if there is difficulty with peeling stripe/decal away from body use a squeegee for stripe/decal removal (Fig. 63); and

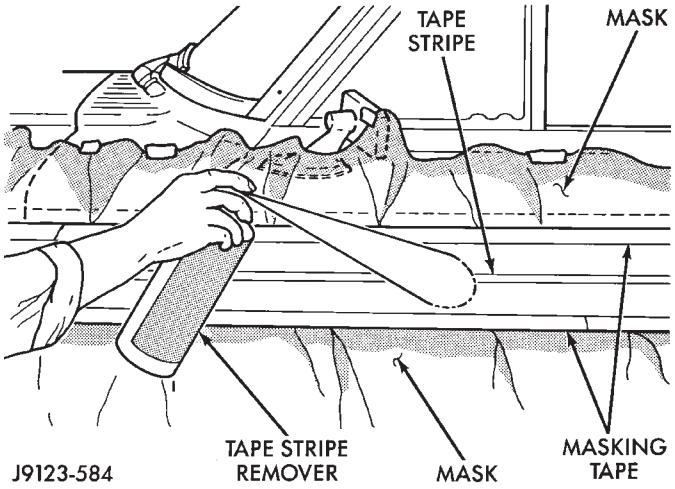

Fig. 61 Stripe/Decal Removal Solution Application

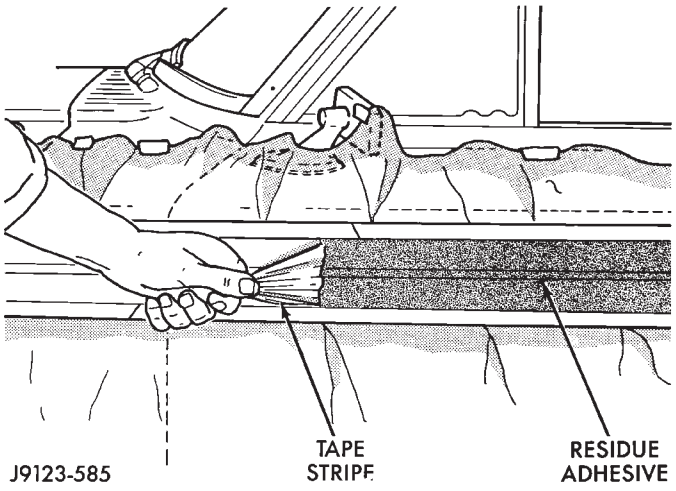

Fig. 62 Body Stripe/Decal Removal

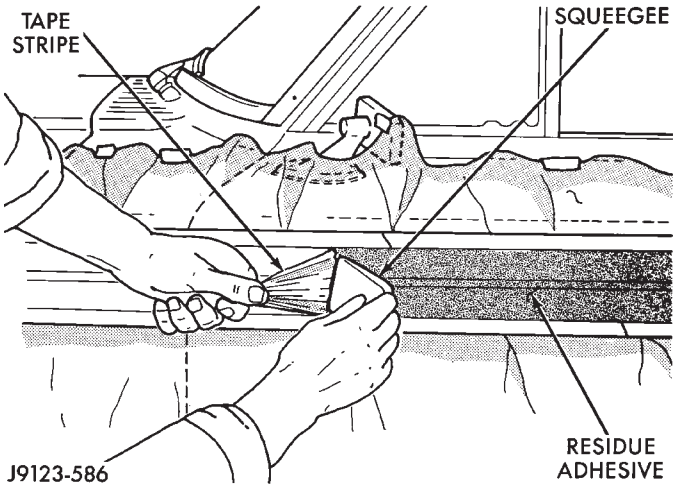

Fig. 63 Body Stripe/Decal Removal With A Squeegee

- with the stripe/decal removed, scrape all the stripe/decal removal solution from the panel surface before proceeding.

WARNING: USE THE ADHESIVE REMOVAL SOLUTION IN A WELL-VENTILATED AREA ONLY.

(4) After the stripe/decal is removed, remove any adhesive remaining on body with a removal solution.

(5) After 3 to 5 minutes, use a squeegee to remove adhesive (Fig. 64).

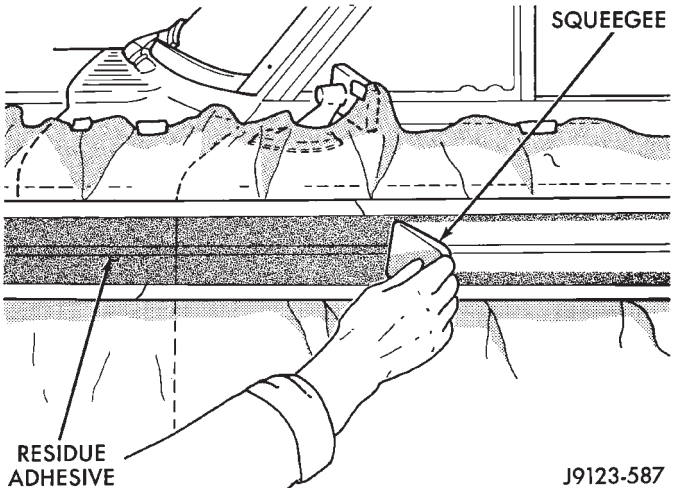

Fig. 64 Adhesive Removal With A Squeegee

(6) Remove the masking tape and mask from the panel.

(7) Wipe the panel with a cloth with a general purpose cleaning solution.

BODY PANEL SURFACE PREPARATION

(1) The area that will be covered by the tape stripe/decal must be cleaned with an cleaning solution to remove any residue paint.

(2) Freshly painted surfaces must be thoroughly dry.

(3) Clean painted surface with a commercial wax and silicone removal solution. Wipe surface with a clean cloth and allow to dry.

REPLACEMENT ON ONE PANEL

For large tape stripes/decals, use a clean sponge and apply ample wetting solution:

- to the adhesive side of the tape stripe/decal, and
- to the painted panel surface.

The wetting solution will permit ease of tape stripe/decal movement when positioning it on the panel.

(1) Align a straight edge with the existing tape stripe/decal ends and use a wax pencil to mark a line on the panel (Fig. 65).

If applicable, the body panel character line can be used as the tape stripe/decal alignment reference.

(2) Position tape stripe/decal and carrier on panel and mark the required length with a wax pencil.

(3) Cut the stripe/decal and carrier at the required length with scissors.

(4) Position stripe/decal and carrier on panel and hold it in-place with pieces masking tape (Fig. 66).

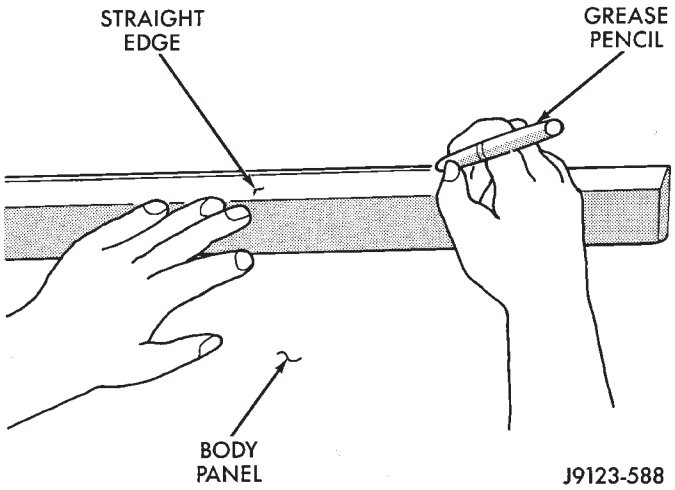

Fig. 65 Stripe/Decal Alignment Reference Mark

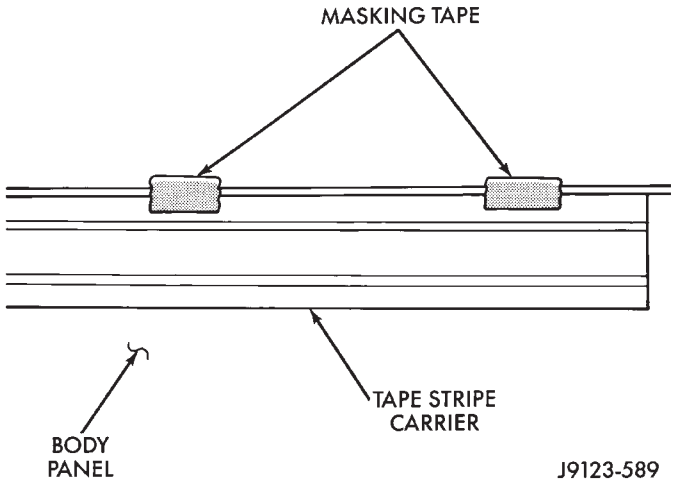

Fig. 66 Tape Stripe/Decal and Carrier Retained On Body Panel

(5) Lift the bottom edge of the tape stripe/decal and carrier, use the tape sections as hinges, and reverse the position of the stripe/decal and carrier (Fig. 67).

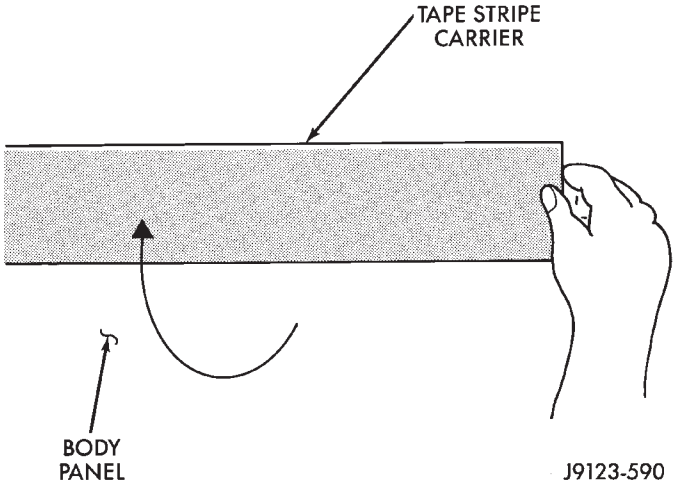

Fig. 67 Tape Stripe/Decal and Carrier Reversed On Body Panel

CAUTION: Always remove the carrier from the tape stripe/decal, never remove the tape stripe/decal from the carrier.

(6) Bend a corner of the carrier outward with a flick of the finger, separate the corner of the carrier from the tape stripe/decal.

(7) Separate approximately 15 cm (6 in) of the carrier from one end of the tape stripe/decal (Fig. 68).

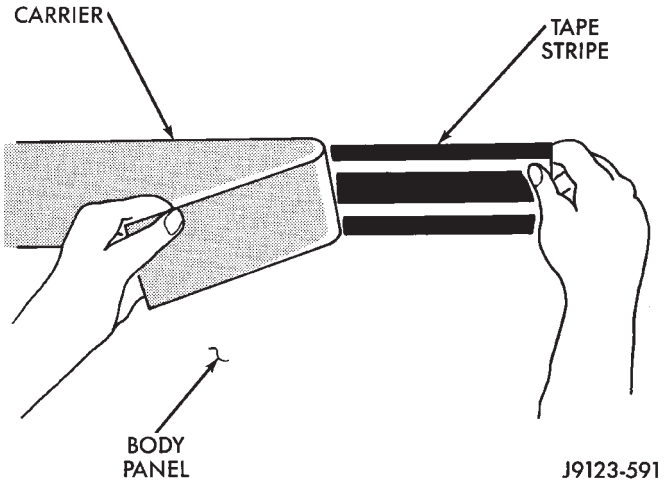

Fig. 68 Tape Stripe/Decal and Carrier Separated

(8) Return the tape stripe/decal back to its original position. If a wetting solution is used, position the adhesive side of the tape stripe/decal on the panel. Apply wetting solution to the outside of the tape stripe/decal. Use firm strokes with a squeegee to adhere the tape stripe/decal to the body.

(9) Hold tape stripe/decal firmly against the panel surface while separating the carrier from the tape stripe/decal (Fig. 69).

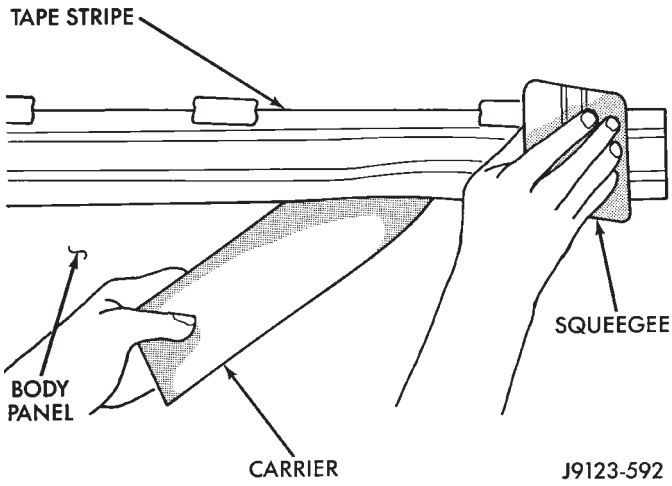

Fig. 69 Tape Stripe/Decal Installation

(10) Where applicable, extend the tape stripe/decal 12 mm (1/2 in) beyond the door edge. Next, wrap it around on the flange and adhere it to the door flange Fig. 70). **Use care to avoid trapping air under the tape stripe/decal.** Where necessary, trim excess tape stripe/decal.

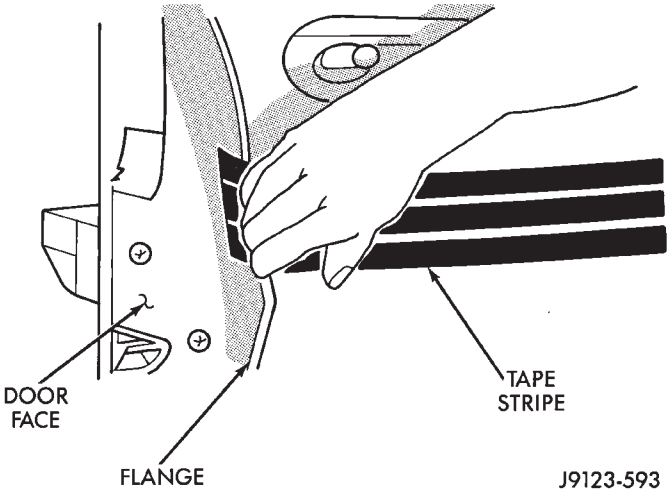

Fig. 70 Tape Stripe/Decal Installation On Door Flange

(11) If applicable, remove the cover from the face of the tape stripe/decal.

(12) Inspect tape stripe/decal with reflected light to check for defects that could have developed during the installation process. Remove all air and/or moisture bubbles.

COMPLETE REPLACEMENT

The following procedure will simplify installation of a complete or large section(s) of tape stripe/decal on a vehicle.

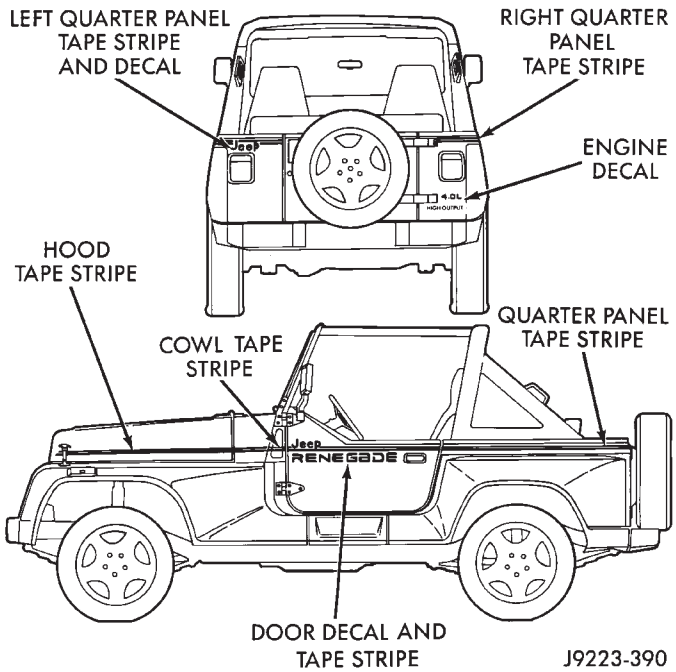

Fig. 71 Renegade Tape Stripes/Decals

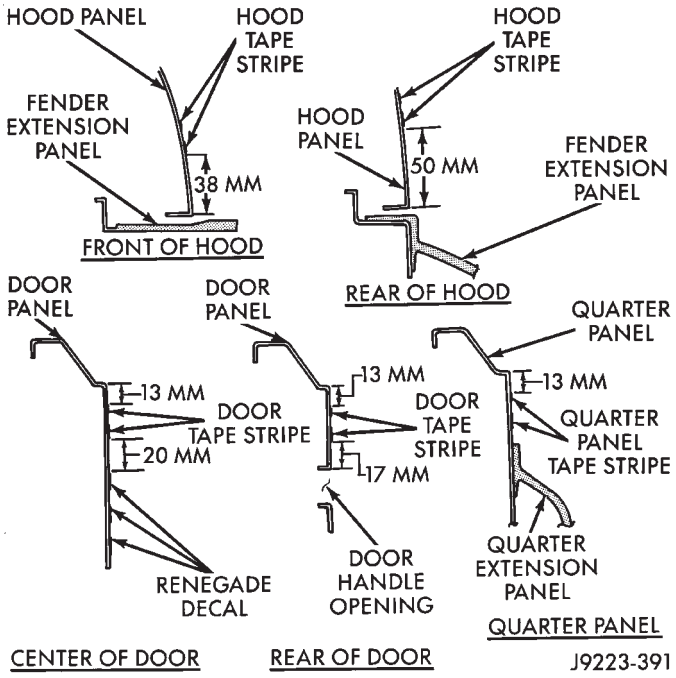

Fig. 72 Renegade Tape Stripe/Decal Positioning

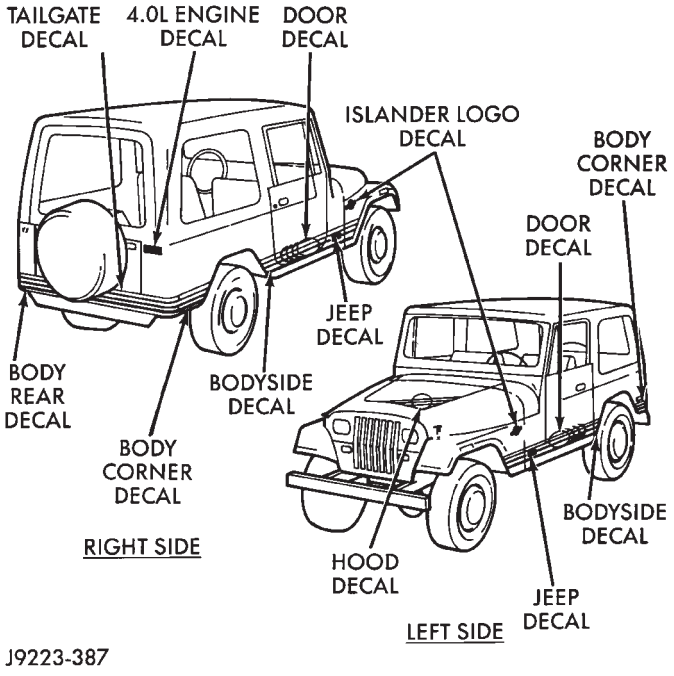

Fig. 73 Islander Decals

(1) Place the tape stripe/decal on a clean, flat surface with the carrier side facing upward.

(2) Bend a corner of the carrier inward and then, with a flick of the finger, separate the corner of the carrier from the tape stripe/decal.

CAUTION: Hold tape stripe/decal at extreme outer edges of the corners while separating the carrier.

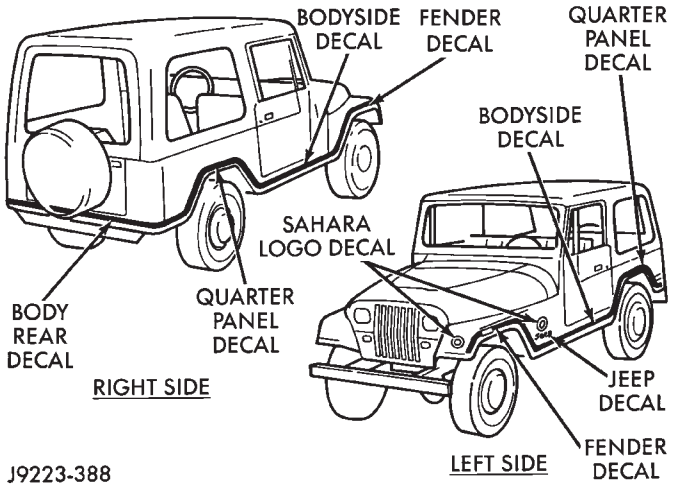

Fig. 74 Sahara Decals

(3) Hold tape stripe/decal firmly against the flat surface and separate the carrier from the tape stripe/decal.

If hot and humid, a slight jerking motion will aid separating the carrier from the tape stripe/decal.

(4) Use a clean sponge and apply ample wetting solution to the tape stripe/decal adhesive and to the painted panel surface. The solution will permit ease of tape stripe/decal movement when positioning it on the panel.

(5) Position adhesive-coated side of tape stripe/decal on the panel with the bottom aligned with character line. Where applicable:

- align the end of the replacement tape stripe/decal with the end of the existing tape stripe/decal, and
- correctly align the index darts and index notches.

(6) If a complete replacement tape stripe/decal is not being installed:

- position the replacement tape stripe/decal section at the center of the repair area,
- align it with the existing tape stripe/decal, and
- allow at least 12 mm (1/2 in) of the tape stripe/decal section to overlap the existing tape stripe/decal edges.

(7) Apply wetting solution to the outer side of the tape stripe/decal to allow the squeegee to freely slide while adhering the stripe/decal to the panel.

CAUTION: Avoid unnecessary pulling and stretching at the ends of the tape stripe/decal because this could cause it to tear.

(8) Position and slide a squeegee from the center to the ends of the tape stripe/decal. This will ensure complete bonding of the tape stripe/decal to the painted panel surface.

(9) If a wrinkle is trapped in the tape stripe/decal during the squeegee operation, stop. Lift wrinkled

area and re-align stripe/decal with panel character line. **Do not lift the tape stripe/decal if only a few air bubbles exist.**

(10) Where applicable, allow 12 mm (1/2 in) extra tape stripe/decal to extend beyond the edges to be folded over.

(11) Fold the excess tape stripe/decal back onto inside flange area. **Use care to avoid trapping air under the tape stripe/decal.** Where necessary, trim excess tape stripe/decal.

(12) Inspect tape installation with reflected light to detect any defects that could have developed during the installation.

(13) Remove all air and moisture bubbles from the tape stripe/decal with a needle or pin.

(14) Install any removed components and clean the vehicle as necessary.

EXTERIOR NAMEPLATES (ADHESIVE-BACKED)

All of the YJ exterior nameplates (Fig. 75) are attached to the vehicle panels with adhesive.

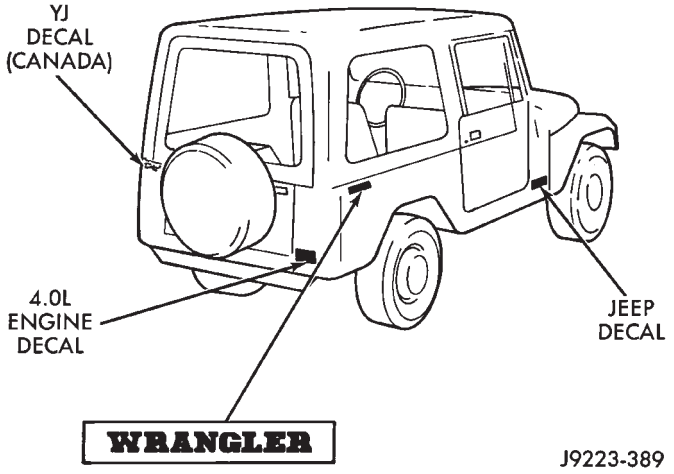

Fig. 75 YJ Nameplate Decals

REMOVAL/INSTALLATION

(1) Carefully pry the nameplate (Fig. 75) from the body outer panel.

(2) Clean the panel surface.

(3) Position the replacement nameplate (Fig. 75) on the panel and apply inward force to seat it.

FUEL FILLER PROTECTOR/NOZZLE

REMOVAL

(1) Either remove it or support the license plate bracket away from the fuel filler protector and nozzle (Fig. 76).

(2) Remove the cap from the nozzle (Fig. 76).

(3) Loosen the clamps at the nozzle and separate the hoses from the nozzle (Fig. 76).

(4) Remove the screws that attach the protector to the body panel (Fig. 76).

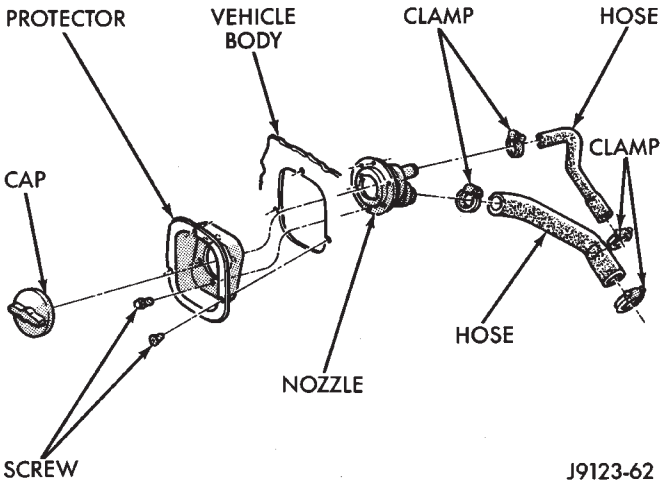

Fig. 76 Fuel Filler Cap, Protector, Nozzle and Hoses

(5) Remove the protector and nozzle from the opening in the body (Fig. 76).

(6) Remove the screws and separate the nozzle from the protector (Fig. 76).

INSTALLATION

(1) Position the fuel filler nozzle on the protector and install screws (Fig. 76). Tighten the screws to 2 N·m (20 in-lbs) torque.

(2) Position the protector and the nozzle in body panel opening, and install (Fig. 76). Tighten the screws to 3 N·m (25 in-lbs) torque.

(3) Attach the hoses to the tubes and tighten the clamp screws to 3 N·m (30 in-lbs) torque (Fig. 76).

(4) Install the cap on the nozzle (Fig. 76).

(5) If removed, install the license plate bracket.

HALF METAL DOOR MIRROR (EXTERNAL)

REMOVAL

(1) Remove the mirror base attaching screws from the door hinge (Fig. 78).

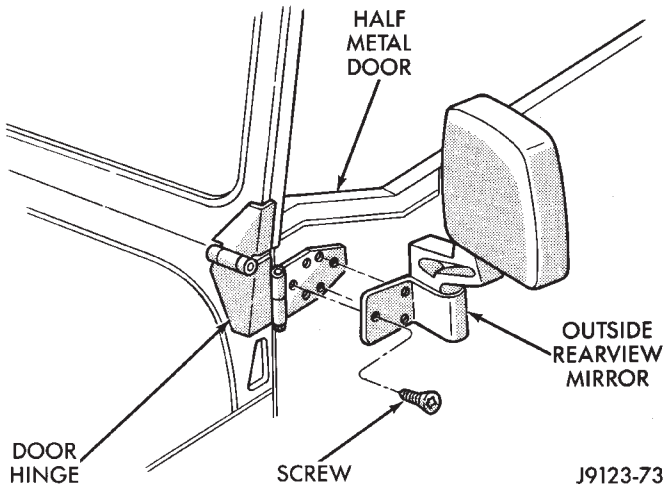

Fig. 78 Half Metal Door Mirror

(2) Remove the mirror from the door hinge (Fig. 78).

INSTALLATION

(1) Clean the door hinge-mirror base contact surface.

(2) Position the mirror base at the door hinge (Fig. 78).

(3) Install the mirror base attaching screws in the door hinge (Fig. 78). Tighten the attaching screws to 11 N·m (96 in-lbs) torque.

TAILGATE SERVICE INFORMATION

The following tailgate service procedures include:

- tailgate removal/installation,
- tailgate hinge replacement,
- tailgate adjustment,
- tailgate latch removal/installation,
- tailgate lock cylinder removal/installation,
- tailgate latch striker removal/installation, and
- tailgate seal replacement.

TAILGATE SERVICE

REMOVAL

(1) For YJ Renegade vehicles:

- open the tailgate;
- remove the tailgate check rod cover by removing the screws located at the outer edge of the cover (Fig. 80);

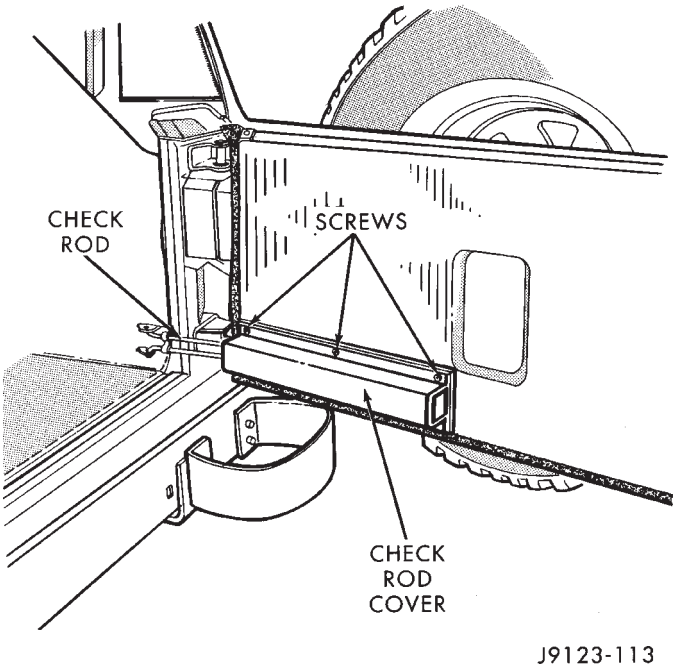

Fig. 80 Check Rod Cover Removal/Installation—Renegade Vehicles

- use a small pry bar to pry out the rod spacer that retains the check rod in the bracket (Fig. 81);

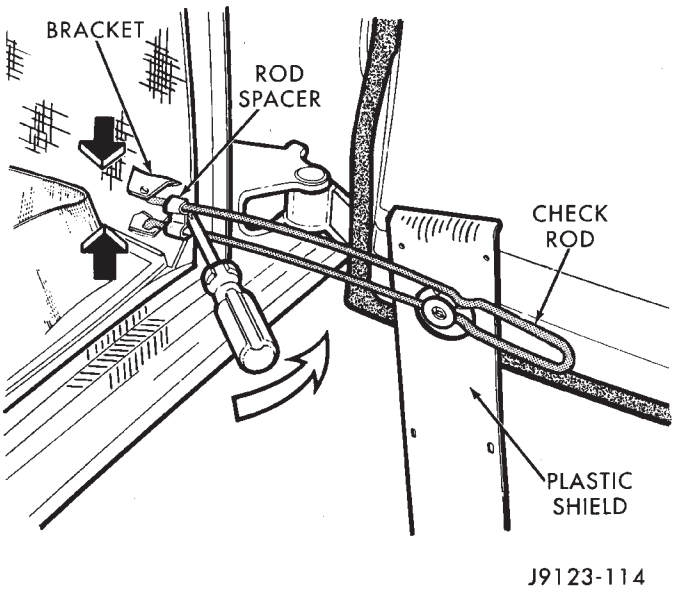

Fig. 81 Check Rod Spacer Removal—Renegade Vehicles

- apply inward pressure on the rod to release it from the bracket (Fig. 81);
- remove the check rod from the tailgate;
- remove the plastic shield from the tailgate (Fig. 81); and
- close the tailgate.

(2) For all vehicles, remove the tailgate hinge screws with a Torx bit (Fig. 82).

(3) Disengage the latch and remove the tailgate from the vehicle.

INSTALLATION

(1) Position and align the tailgate in the body opening and engage the latch.

(2) Install the hinge retaining screws (Fig. 82). Tighten the screws to 18 N·m (156 in-lbs) torque.

(3) For YJ Renegade vehicles, install the shield, check rod and spacer (Figs. 81 and 82). Tighten the slide pin to 75 N·m (55 ft-lbs) torque.

(4) For YJ Renegade vehicles, install the check rod cover (Figs. 80 and 82). Tighten the screws to 3 N·m (24 in-lbs) torque.

TAILGATE HINGE

REPLACEMENT

(1) Remove the hinge retaining screws and remove the hinge (Fig. 82).

(2) Prepare and paint the replacement hinge to match the body paint color.

(3) Lubricate the hinge with spray lubricant.

(4) Position the hinge on the body and install the retaining screws (Fig. 82). Tighten the screws to 18 N·m (156 in-lbs) torque.

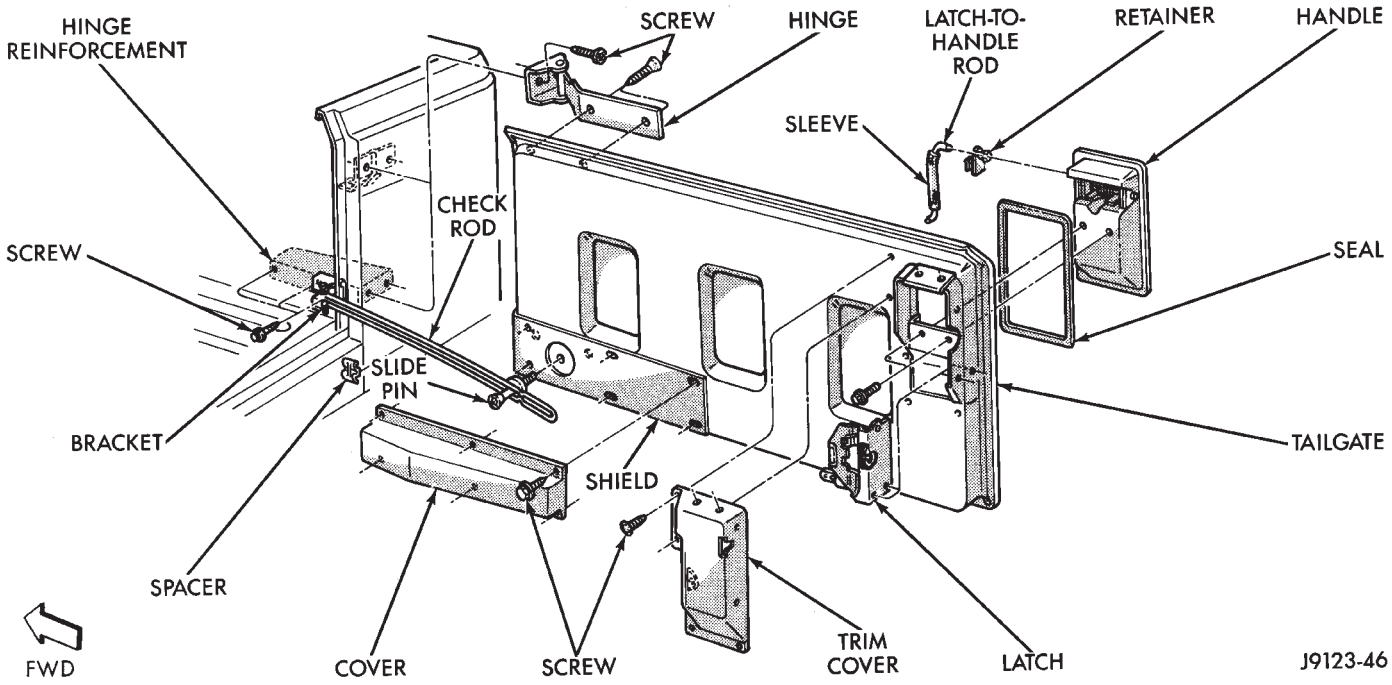

Fig. 82 Tailgate and Components

(5) Align the tailgate with the hinge and install the hinge-to-tailgate screws (Fig. 82). Tighten the screws to 18 N·m (156 in-lbs) torque.

TAILGATE ADJUSTMENT

(1) Loosen the tailgate hinge-to-body screws (Fig. 82).

(2) Align the tailgate in the body opening and tighten the hinge screws to 18 N·m (156 in-lbs) torque (Fig. 82).

TAILGATE LATCH AND RELEASE HANDLE

REMOVAL

(1) Open the tailgate and remove the latch trim cover (Fig. 82).

(2) Remove the tailgate latch-to-handle rod retainer and disconnect the rod from the latch (Fig. 82).

(3) Remove the latch-to-tailgate screws (Fig. 82).

(4) Remove the retainer clip from the latch-to-lock cylinder rod and disconnect the rod from the lock cylinder (Fig. 83).

(5) Remove the retainer clip from the latch-to-release handle rod and disconnect the rod from the release handle (Fig. 83).

(6) Remove the latch from the tailgate (Fig. 82).

(7) Remove the latch release handle screws (Fig. 82).

(8) Remove the release handle and seal from the tailgate (Fig. 82).

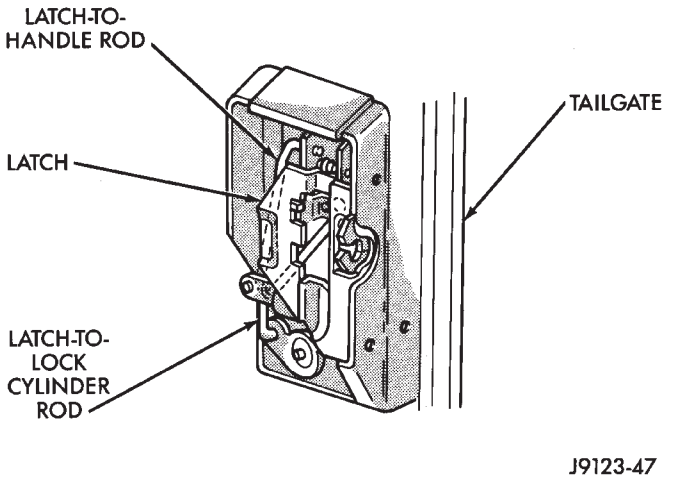

Fig. 83 Tailgate Latch and Rods

INSTALLATION

(1) Position seal latch release handle on the tailgate and install screws (Fig. 82). Tighten the screws to 6 N·m (50 in-lbs) torque.

(2) Position the latch at the tailgate (Fig. 82).

(3) Install the latch retaining screws and connect the latch rods and rod retainers (Figs. 83 and 84). Tighten the screws to 6 N·m (50 in-lbs) torque.

(4) Install the latch cover (Fig. 82). Tighten the screws to 11 N·m (96 in-lbs) torque.

TAILGATE LOCK CYLINDER

REMOVAL

(1) Open the tailgate.

(2) Remove the latch cover (Fig. 82).

(3) Remove the lock cylinder retainer clip (Fig. 85).

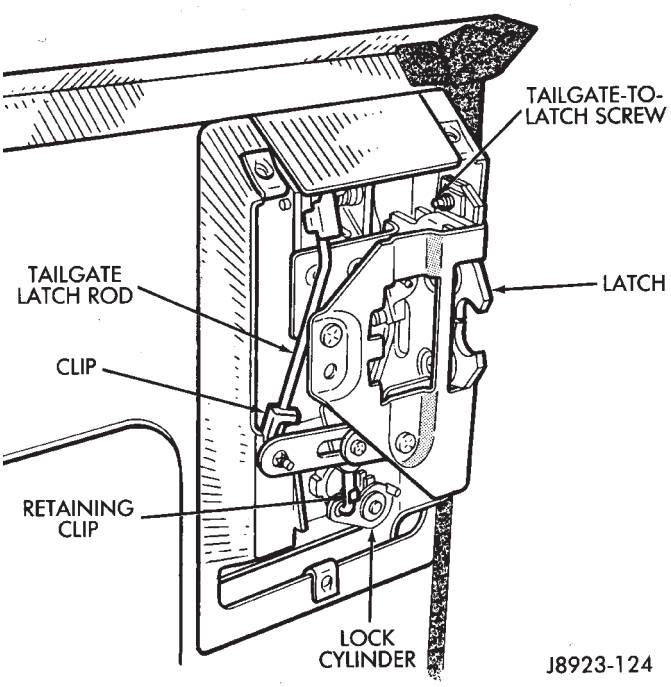

Fig. 84 Tailgate Latch Installation

(4) Disengage the lock cylinder lever (Fig. 85) from

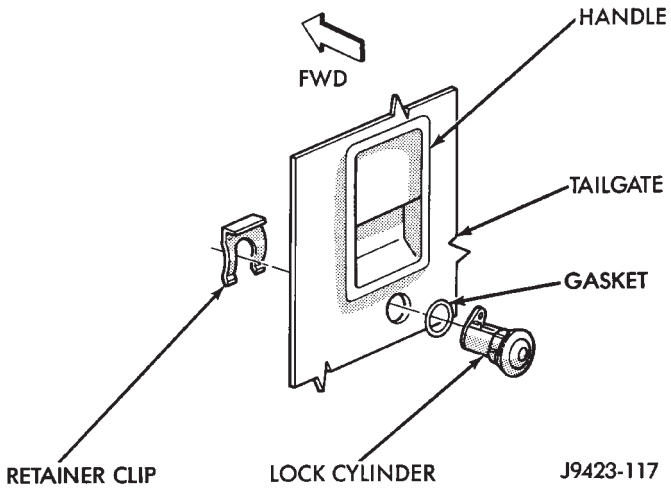

Fig. 85 Tailgate Lock Cylinder Removal/Installation

the latch-to-lock cylinder rod.

(5) Remove the lock cylinder from the tailgate opening.

(6) Remove the E-clip and separate the lever from the lock cylinder (Fig. 85).

INSTALLATION

(1) Inspect the retainer clip and the gasket. As applicable, replace if distorted or damaged.

(2) Attach the lever to the lock cylinder with the E-clip and position the lock cylinder in the tailgate opening (Fig. 85).

(3) Connect the latch-to-lock cylinder rod to the lever.

(4) Install the lock cylinder retainer clip (Fig. 85).

(5) Install the latch cover (Fig. 82). Tighten the screws to 11 N·m (96 in-lbs) torque.

TAILGATE LATCH STRIKER

REMOVAL

(1) Remove the striker from the bracket with a Torx bit (Fig. 86).

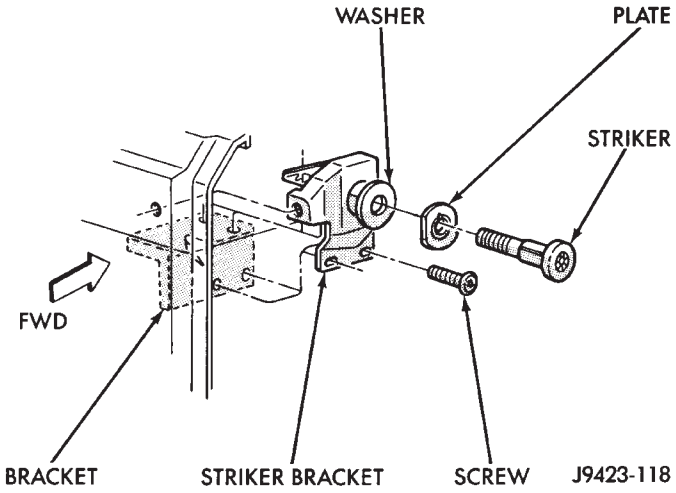

Fig. 86 Tailgate Latch Striker Removal/Installation

(2) Remove the plate, shim and washer from the bracket (Fig. 86).

(3) Remove the retaining screws and the striker bracket from the tailgate reinforcement bracket (Fig. 86).

INSTALLATION

(1) Position the striker bracket on the tailgate and install the retaining screws in the reinforcement bracket (Fig. 86). Tighten the screws to 11 N·m (96 in-lbs) torque.

(2) Position the washer, shim and plate on the striker bracket (Fig. 86).

(3) Install the striker in the bracket with a Torx bit (Fig. 86). Tighten the striker to 71 N·m (52 ft-lbs) torque while retaining the striker plate in-place.

TAILGATE WEATHERSTRIP SEAL

REMOVAL

(1) Remove the seal retaining rivets (Fig. 87).

(2) Carefully separate the seal and the retainers from the tailgate edge (Fig. 87).

(3) If the original seal will be installed, clean it with a dampened cloth.

(4) Clean the seal contact surface on the tailgate (Fig. 87).

(5) Inspect the seal and retainers (Fig. 87). Replace the seal if damaged.

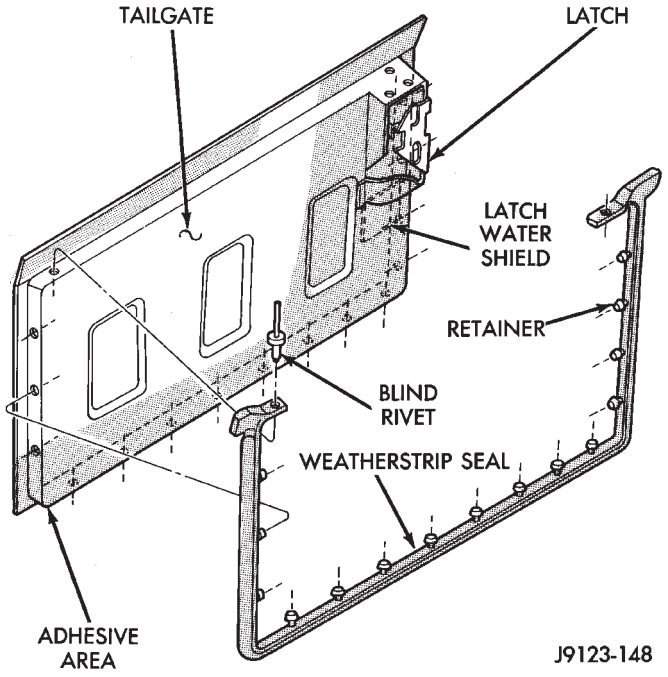

Fig. 87 Tailgate Weatherstrip Seal Removal/Installation

INSTALLATION

(1) Apply weatherstrip adhesive around the perimeter of the seal contact surface on the tailgate edge (Fig. 87).

(2) Position the seal on the tailgate and press it against the inner panel and flange.

(3) Install the seal retaining rivets (Fig. 87).

CAUTION: Do not apply graphite, brake fluid or wax to the seal.

HARD TOP LIFTGATE GLASS

REMOVAL

(1) Disconnect the rear defroster/dome lamp wire harness connectors.

(2) Remove the wiper motor cover. Disconnect the wiper motor wire harness connector and the washer fluid hose (Fig. 88).

(3) Remove the wiper arm and blade (Fig. 88).

WARNING: DO NOT REMOVE THE LIFTGATE SUPPORT RODS WITH THE LIFTGATE CLOSED. THE SUPPORT ROD PISTONS ARE OPERATED BY HIGH PRESSURE GAS AND COULD CAUSE PERSONAL INJURY AND/OR VEHICLE DAMAGE IF THEY ARE REMOVED WITH THE PISTONS COMPRESSED (LIFTGATE CLOSED). ONCE REMOVED, DO NOT ATTEMPT TO DISASSEMBLE OR REPAIR THE SUPPORT RODS.

(4) Open the tailgate (Fig. 89).

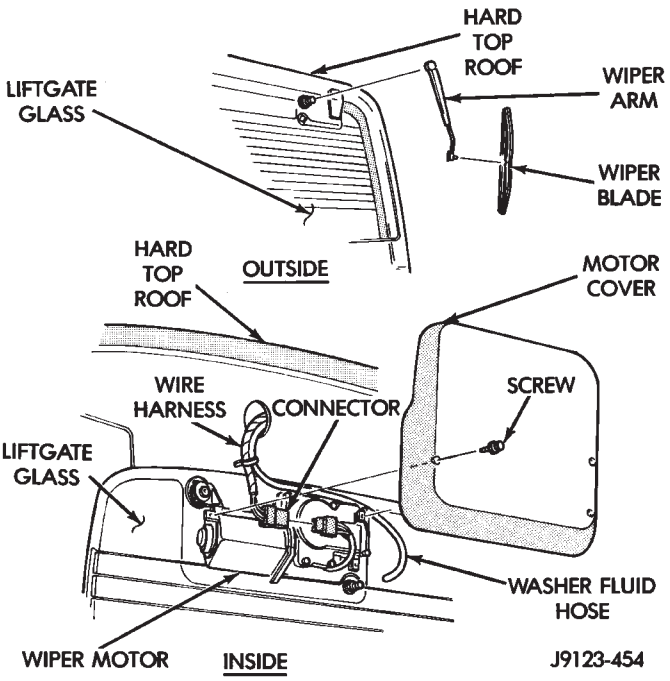

Fig. 88 Liftgate Wiper Motor

(5) Remove the support rod cylinder retaining clips at both ends of each support rod cylinder (Fig. 89)

(6) Pull the support rods off the ball studs (Fig. 89).

(7) Remove the liftgate glass hinge bolts (Fig. 89).

(8) Remove the liftgate glass from the hard top (Fig. 89).

(9) Remove the weatherstrip seal (Fig. 89), if necessary.

INSTALLATION

(1) Assemble the liftgate components, if necessary

(2) Position the liftgate glass in the hard top opening and install the hinge bolts (Fig. 89). Do not tighten the bolts.

(3) Adjust the liftgate glass to fit the hard top opening.

(4) Tighten the hinge bolts to 11 N·m (95 in-lbs) torque.

(5) Position the support rod cylinders on the ball studs (Fig. 89).

(6) Install the support rod cylinder retainer clips (Fig. 89).

(7) Connect the wiper motor wire harness connector and the washer fluid hose. Install the wiper motor cover (Fig. 88).

(8) Install the wiper arm and blade (Fig. 88).

(9) Connect the rear window defroster/dome lamp wire harness connectors.

DISASSEMBLY

(1) Remove retaining screws and the lower, inner trim moulding from the latch panel (Fig. 90).

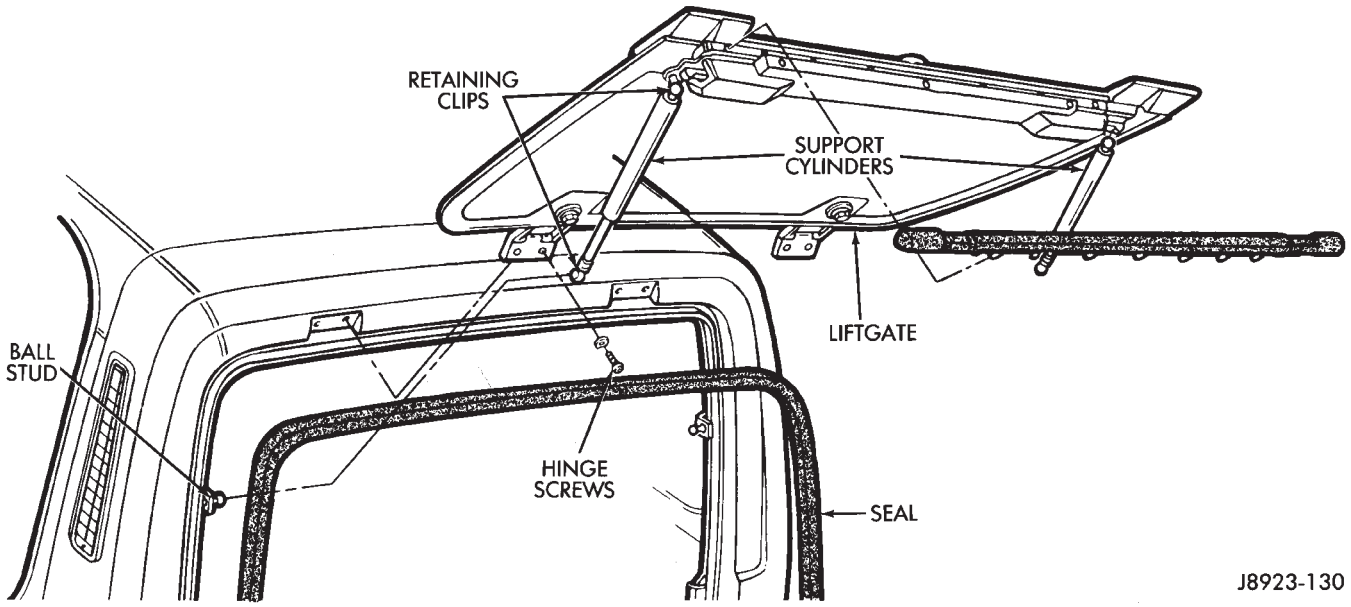

Fig. 89 Liftgate Removal/Installation

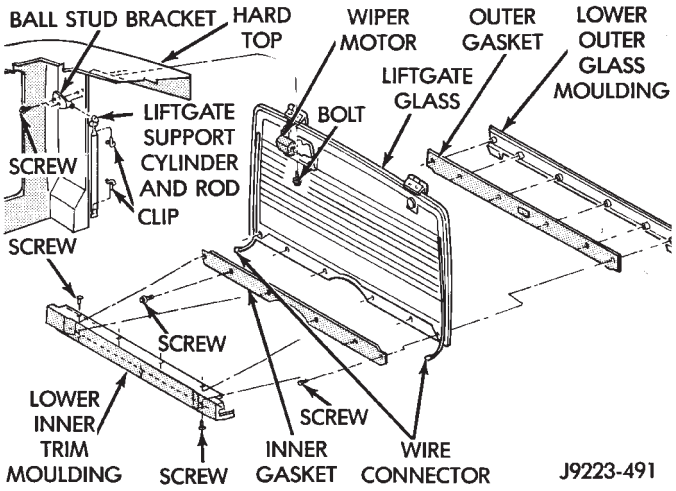

Fig. 90 Liftgate and Components

(2) Remove the retaining screws and the latch panel, inner gasket, outer gasket, and the lower, outer liftgate moulding from the liftgate (Fig. 90).

(3) Refer to Group 8—Electrical for service information involving the wiper motor and the defroster.

(4) If necessary, remove the latch strikers and the ball stud brackets from the hard top inner panel (Fig. 90).

ASSEMBLY

(1) If removed, install the latch strikers and the ball stud brackets on the hard top inner panel (Fig. 90).

(2) Position the latch panel, and gaskets, and liftgate moulding on liftgate and install screws (Fig. 90). Tighten the screws to 7 N·m (60 in-lbs) torque.

(3) Position the lower, inner trim moulding on the latch panel. Install screws (Fig. 90). Tighten the screws to 2 N·m (12 in-lbs) torque.

LIFTGATE GLASS WEATHERSTRIP SEAL REPLACEMENT

REMOVAL

(1) Remove the liftgate glass from the hard top. If necessary, refer to the removal procedure.

(2) Remove the retaining screws from the liftgate-to-tailgate weatherstrip seal (Fig. 91).

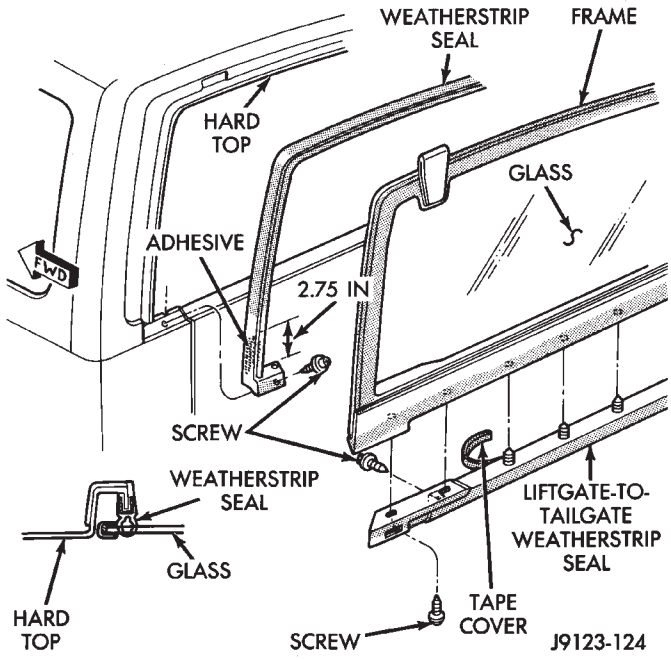

Fig. 91 Liftgate Glass Weatherstrip Seals

(3) Carefully separate the seal and retainers from the bottom of the liftgate glass (Fig. 91).

(4) Remove the hard top weatherstrip seal retaining screws from body rear panels (Fig. 91).

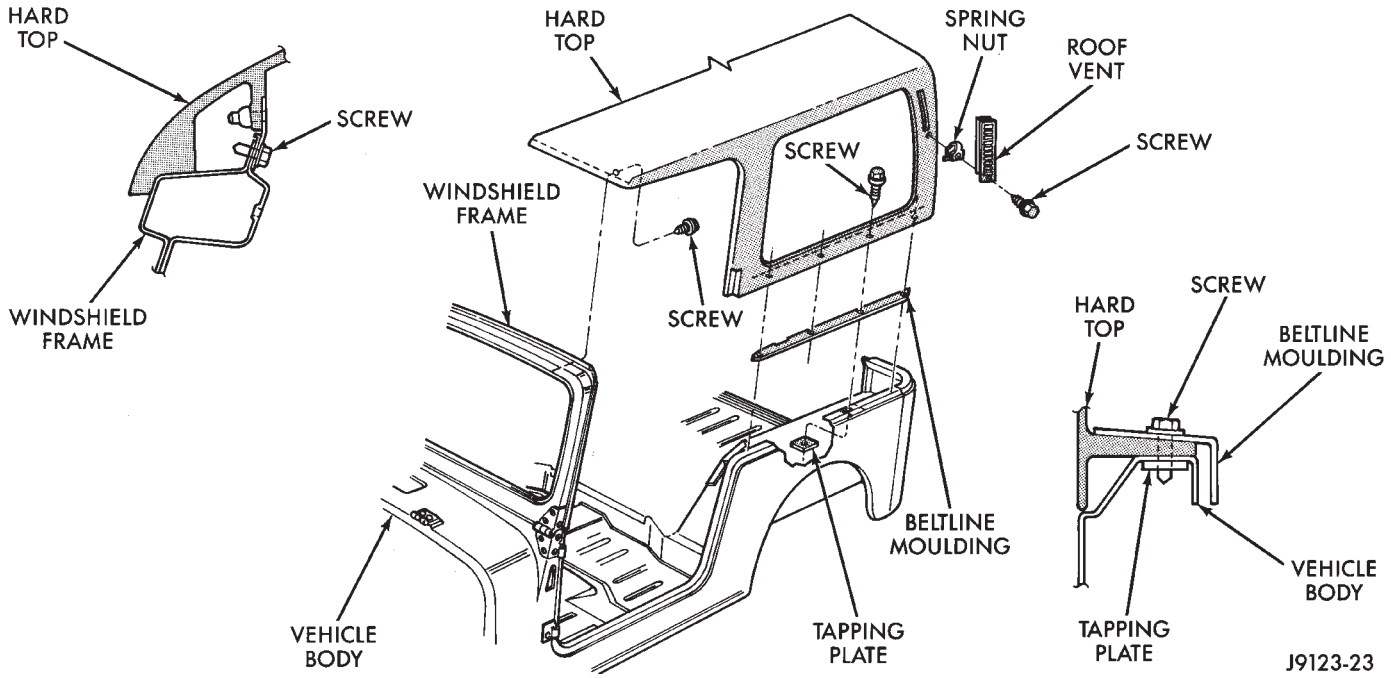

Fig. 92 Hard Top Removal/Installation

(5) Carefully separate the weatherstrip seal from the rear panels and the hard top (Fig. 91).

(6) Remove the residual adhesive from the seal contact areas.

INSTALLATION

(1) Remove the tape cover and position the liftgate-to-tailgate weatherstrip seal at the bottom of the liftgate glass (Fig. 91).

(2) Carefully insert the retainers into the holes and press the seal against the bottom of the liftgate glass (Fig. 91).

(3) Install the liftgate-to-tailgate weatherstrip seal screws (Fig. 91). Tighten the screws securely.

(4) Apply weatherstrip adhesive to the hard top weatherstrip seal as indicated in Figure 91.

(5) Carefully position the weatherstrip seal on the rear panels and the hard top (Fig. 91).

(6) Press the seal onto the hard top flange and ensure that it is correctly seated on the flange (Fig. 91).

(7) Install the seal retaining screws in the rear panels and tighten them securely (Fig. 91).

HARD TOP SERVICE INFORMATION

The following service procedures include:

- hard top removal/installation, and
- hard top repair procedures.

The hard top is constructed of compressed molded fiberglass and painted to a special spatter paint. The hard top can be removed for service access or for other purposes.

HARD TOP SERVICE

REMOVAL

CAUTION: When removing the hard top, avoid damaging the foam sealant between the hard top and body panels.

(1) Remove the screws that attach the hard top to the windshield frame (Figs. 92 and 93).

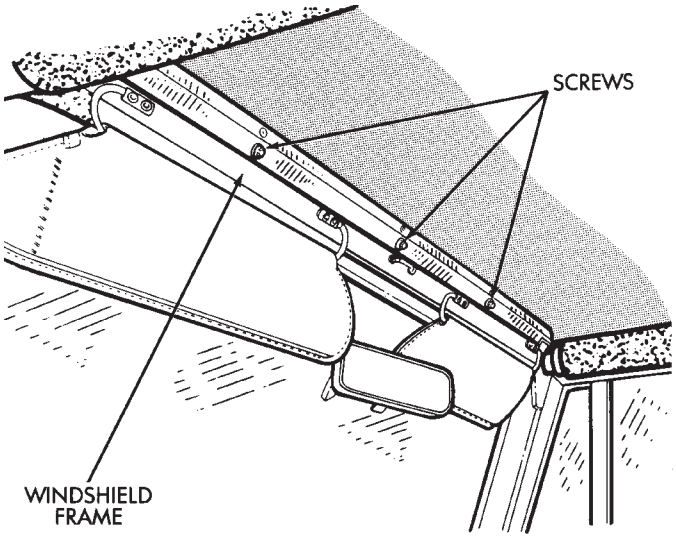

Fig. 93 Hard Top-To-Windshield Frame Screws

(2) Remove the screws that attach the hard top to the rear beltline mouldings, body panels and tapping plates (Figs. 92 and 94).

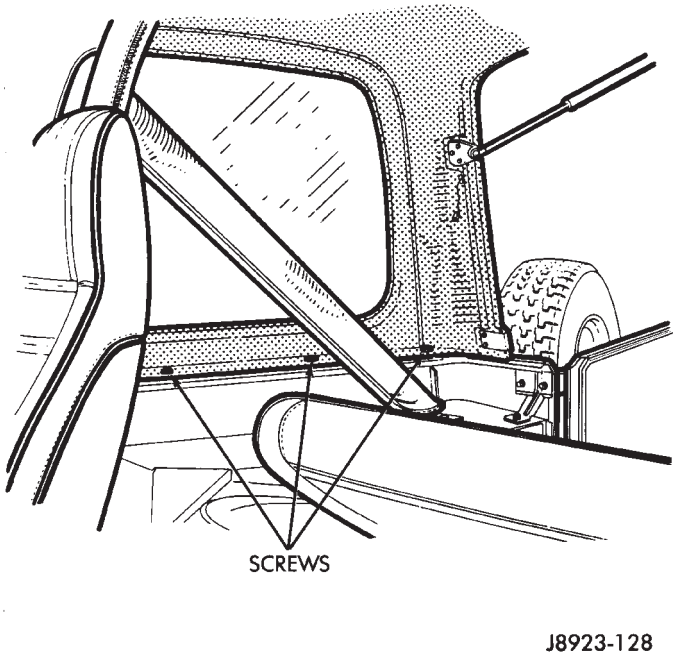

Fig. 94 Hard Top-To-Body Panel Screws

(3) Disconnect the wire harness connectors (Fig. 95).

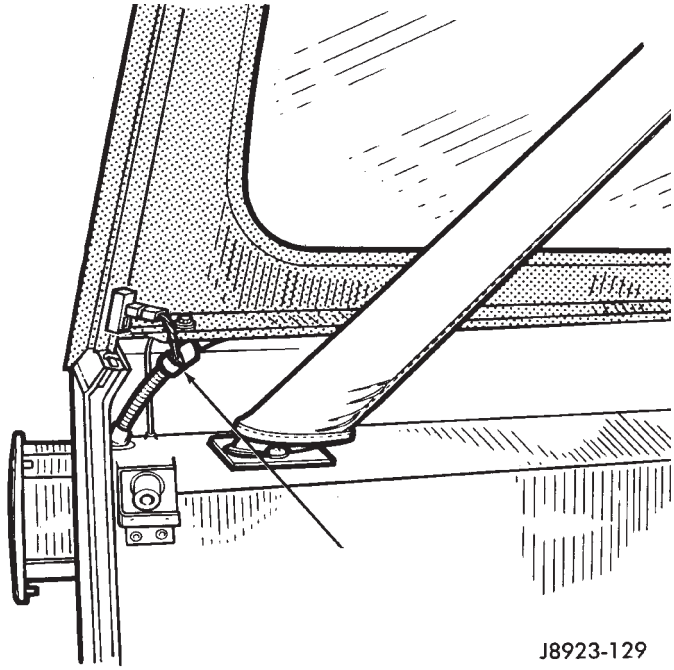

Fig. 95 Wire Harness Connection—Typical

(4) Remove the beltline mouldings and the hard top from the vehicle (Fig. 92).

INSTALLATION

(1) Inspect the hard top seals for damage and replace, if necessary.

(2) Carefully position the hard top on the vehicle (Fig. 92).

CAUTION: When installing the hard top, avoid damaging the foam sealant located between the top and body panels.

(3) Position the beltline moulding on the hard top flange and install the screws (Figs. 92 and 94). Tighten the screws securely.

(4) Connect the wire harness connectors (Fig. 95).

(5) Install the screws to attach the hard top to the windshield frame (Figs. 92 and 93). Tighten the screws securely.

HARD TOP ROOF VENT

REMOVAL/INSTALLATION

(1) Remove the roof vent retaining screw from the spring nut (Fig. 92).

(2) Remove the roof vent from the hard top (Fig. 92).

(3) Position the roof vent on the hard top and install the retaining screw (Fig. 92).

HARD TOP REPAIR

The hard top fiberglass material can be repaired. The required repair materials include:

- fiberglass mat or cloth;
- fiberglass resin and hardener;
- structural adhesive (3M brand or an equivalent product);
- glazing putty;
- aluminum foil; and
- plastic spreader.

HARD TOP HOLE REPAIR

(1) Use a grinder to remove the paint and outline the damaged area. Use a grade 24 grit disc for paint removal.

(2) Grind the outlined surface area again to a 50 grit disc to prevent coarse scratches from appearing in the final finish.

(3) If cracks extend from the hole, it will be necessary to stop-drill the crack(s) with a 3-mm (1/8-in) diameter drill bit.

(4) Position a fiberglass mat or cloth on the repair surface area. Cut the mat to allow a 2.5-cm (1-in) overlap of the repair surface area.

(5) Clean the repair surface area.

(6) Place the fiberglass cloth on aluminum foil.

(7) Pour the fiberglass resin into a clean container.

(8) Mix the appropriate amount of hardener and resin. Follow the manufacturers instructions.

(9) Apply the hardener/resin mixture to both sides of the fiberglass cloth.

(10) Place the fiberglass cloth over the repair surface area. Next, place the aluminum foil over the

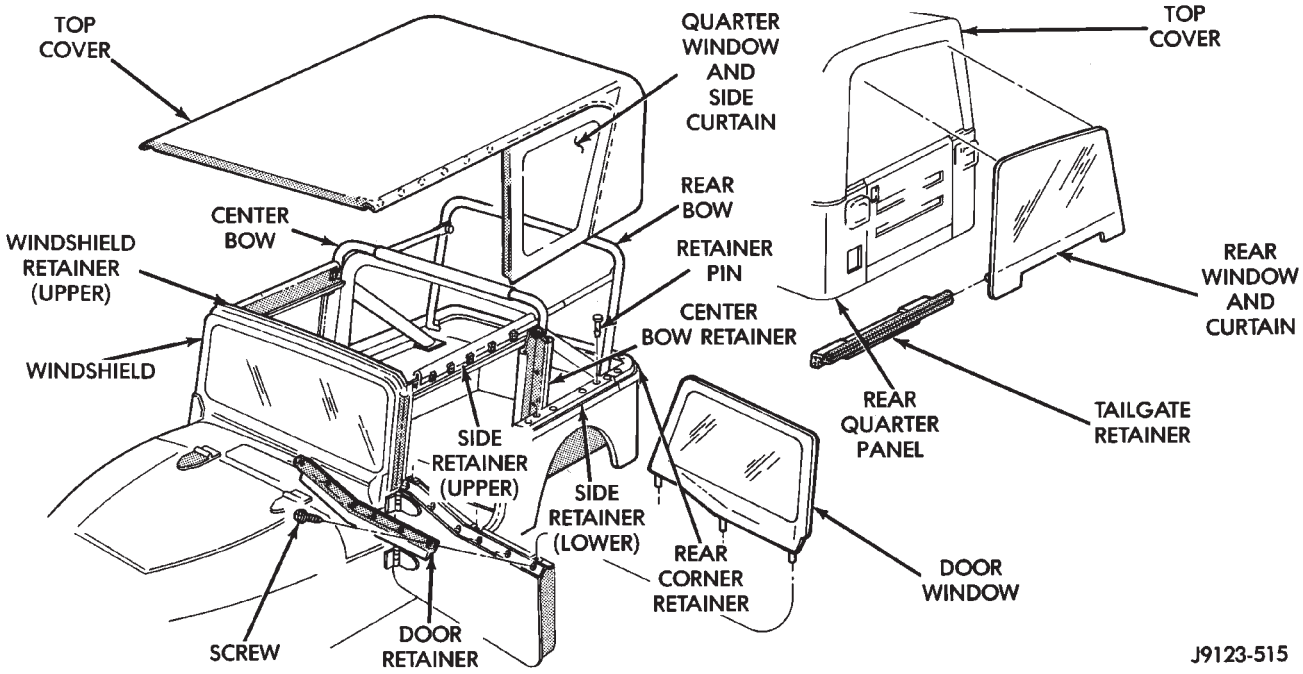

Fig. 96 Soft Top Cover, Curtains and Windows

cloth. Use a plastic spreader to smooth-out the cloth and resin. Use firm pressure to remove air bubbles and to smooth-out the cloth.

(11) Allow the resin to "cure".

(12) Smooth-out the surface area to the contour of the hard top with a 50-grit disc.

(13) Apply plastic filler to complete the repair. Finish smoothing the surface area with 80-grit paper.

(14) Repeat the previous step on the inside surface area of the hard top.

(15) "Featheredge" the repaired surface area.

(16) Prime the repaired surface area with Ditzler Epoxy Chromate Primer (DP-40/401), or an equivalent product.

(17) Apply surface primer to the surface area.

(18) Sand the surface area for paint preparation. After sanding, re-prime the surface area, if necessary.

(19) Prime the surface area for the color coat.

(20) Color coat the repaired surface area.

FRACTURE REPAIR

(1) Use a grinder to remove the paint (from both, the inner and outer surface areas of the hard top) and to outline the damaged area.

(2) "Stop-drill" the crack(s) with a 3-mm (1/8-in) diameter drill bit.

(3) Bevel the edges of the crack(s) on both sides with a rotary file.

The edges should be beveled on the inside and outside of the top to ensure sufficient surface area for good bonding.

(4) Complete the repairs with fiberglass cloth and resin as described above in the hard top hole repair procedure.

TEXTURED PAINT REPAIR

The textured paint applied to hard tops is available from Mopar Parts sources. The paint supplied will duplicate the original texture on the hard top.

SOFT TOP SERVICE INFORMATION

The soft top fabric consists of the top cover and the side and rear curtains (Fig. 96). The top cover is supported by a tubular bow (frame) and is attached to the upper side retainers (above the doors) with snap-on retainers (Fig. 97).

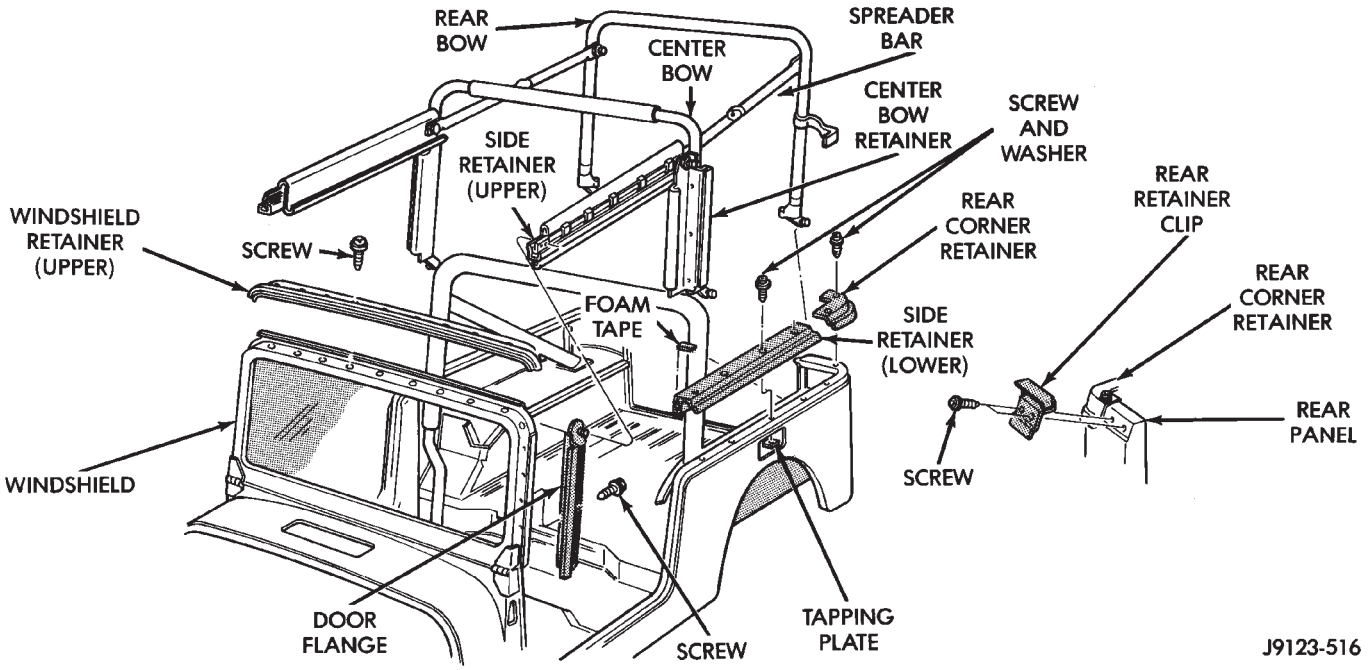

Fig. 97 Soft Top Bow, Spreader Bar and Retainers

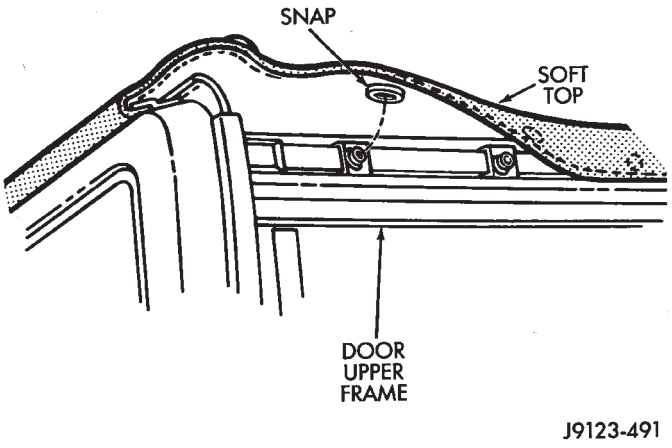

Fig. 98 Upper Side Retainers

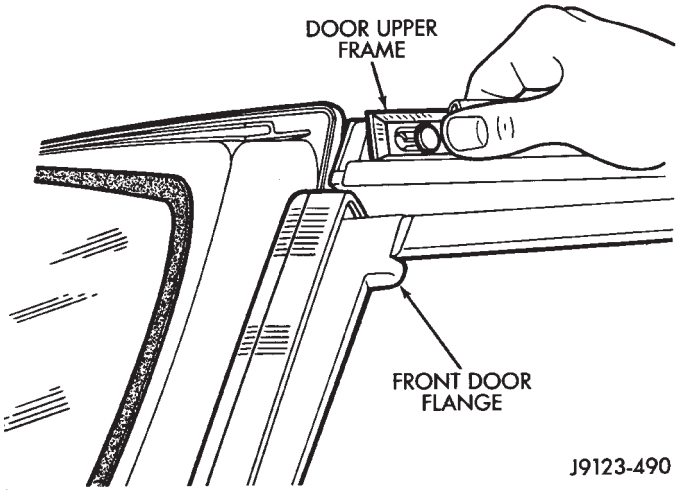

Fig. 99 Upper Side Retainer Removal From Door Flange

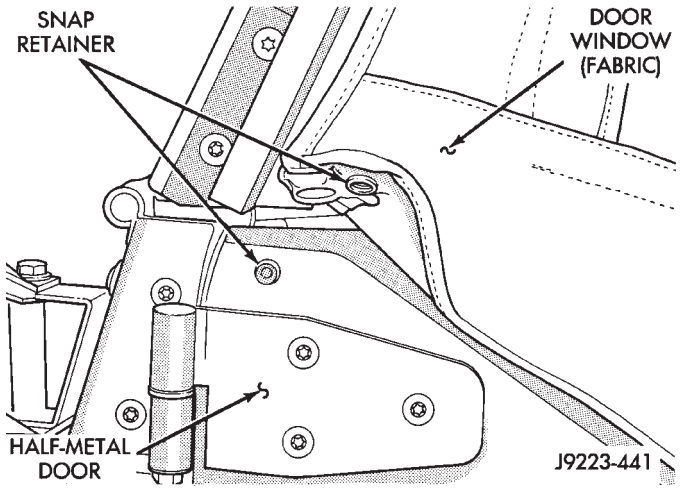

Fig. 100 Door Window Snap-On Retainer

SOFT TOP SERVICE

REMOVAL

(1) Detach the snap-on retainers from the upper side retainers (Figs. 96 and 98).

(2) Slide the upper side retainer lock forward. Next, disengage the lock from the pin and remove the retainer from the door flange (Figs. 96, 97 and 99).

(3) Detach the snap-on retainer at the front corner (Fig. 100, turn the retainers and remove the door windows (Fig. 101).

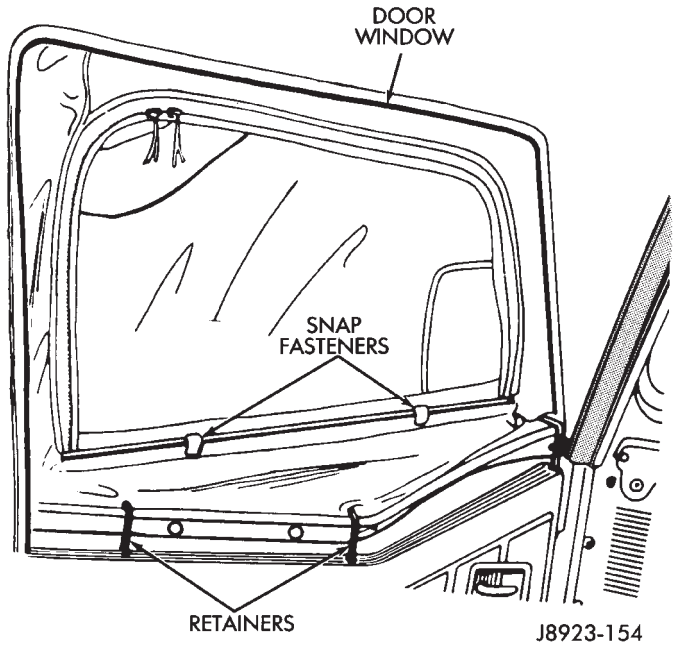

Fig. 101 Door Window Removal/Installation

(4) Open the side curtain upper and rear zippers (Figs. 96 and 102).

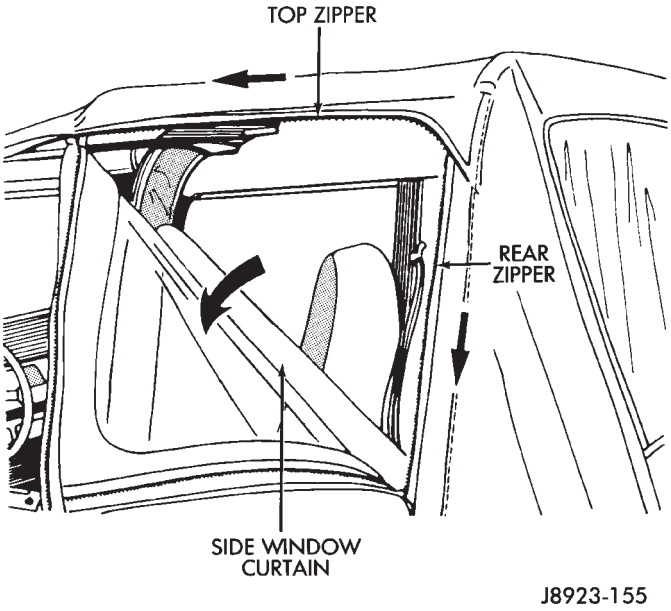

Fig. 102 Side Curtain Zippers

(5) Detach the interior snap-on retainer and tab, and pull the bottom edge of each side curtain out of the lower side retainer channel (Fig. 103).

(6) Slide the front edge of the side curtain downward and remove it from the center bow retainer channel (Figs. 96 and 104).

(7) Pull downward on the spreader bar to release the lock and the tension on the center and rear bows (Figs. 97 and 105).

(8) Open the tailgate.

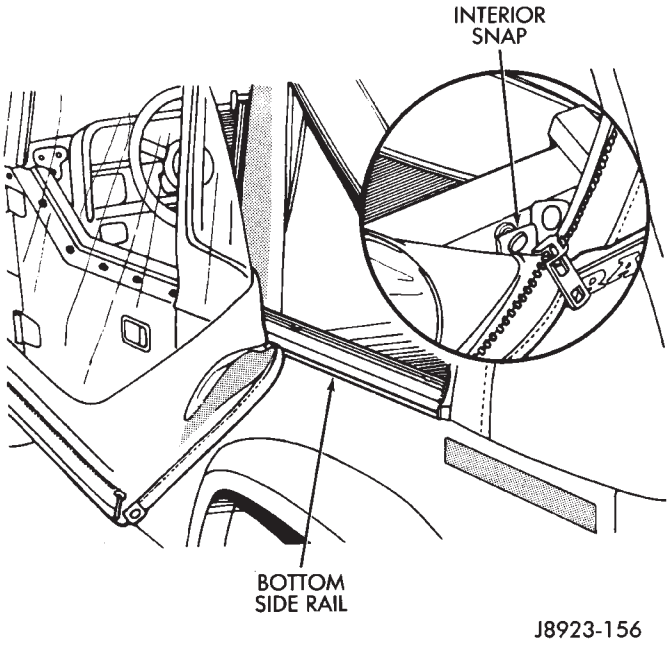

Fig. 103 Side Curtain and Lower Side Retainer

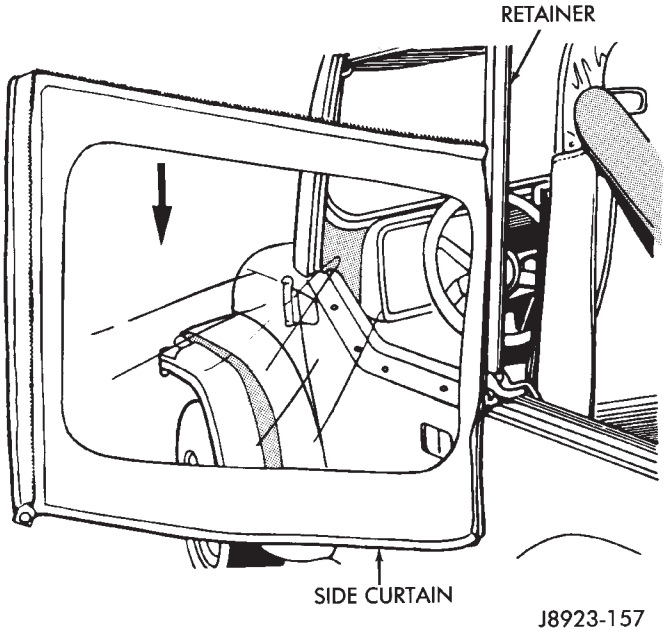

Fig. 104 Side Curtain Removal/Installation

(9) Open the rear curtain upper and side zippers (Fig. 106).

(10) Roll up the rear curtain and attach it to the top cover with the elastic straps and snap-on retainers (Fig. 107).

(11) Pull the bottom edge of the rear corners outward and detach from the side (lower) retainer (Fig. 108).

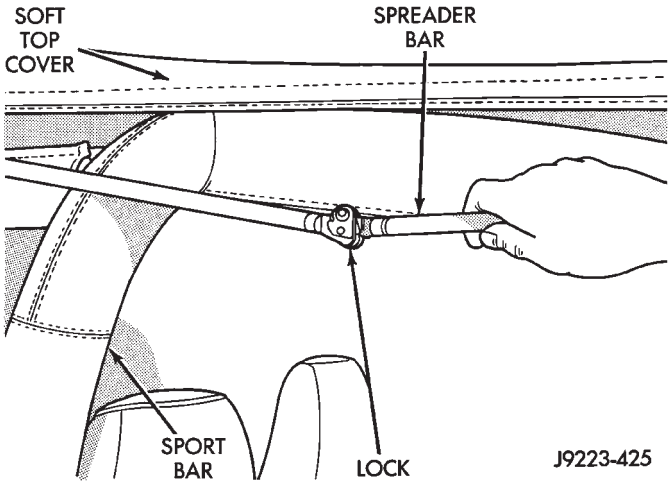

Fig. 105 Releasing Spreader Bar Tension

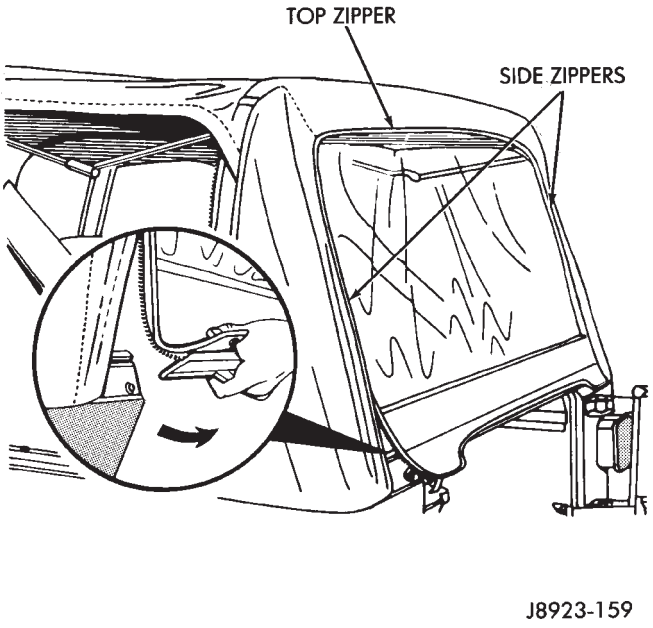

Fig. 106 Rear Curtain Upper and Side Zippers

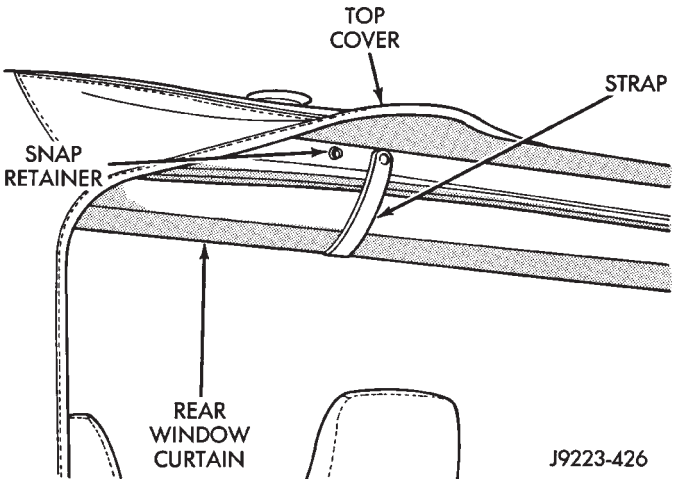

Fig. 107 Rear Curtain Upper and Side Zippers

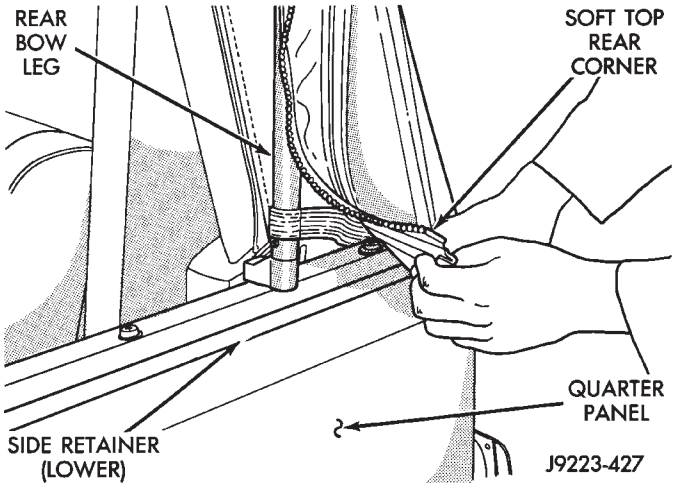

Fig. 108 Detaching Rear Corner Side (Lower) Retainer

(12) Detach the top cover from the upper side retainers located above the doors (Fig. 109). Next, detach the top cover from the retainer channel located along the upper edge of the windshield frame (Figs. 96 and 110).

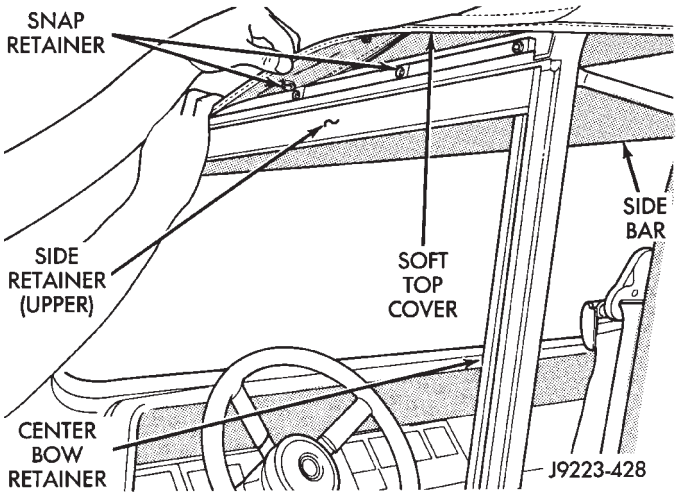

Fig. 109 Top Cover Snap-On Retainers At Upper Side Retainers

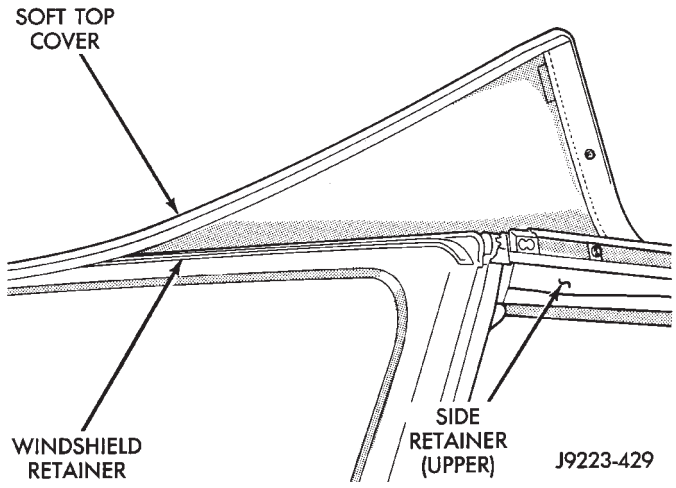

Fig. 110 Detaching Top Cover At Windshield

(13) Pull the top cover rearward from the windshield frame and fold it above the center bow (Fig. 111).

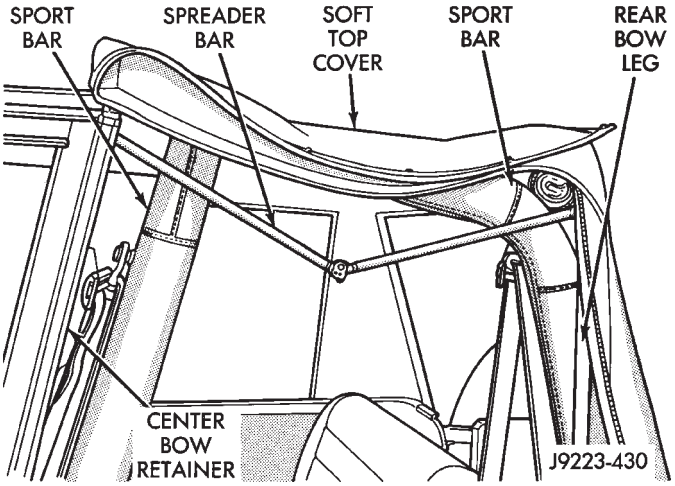

Fig. 111 Folding Top Cover

(14) Slide the top cover rearward (Fig. 112). The rear bow legs should move forward and fold under the center bow legs and the upper side retainers.

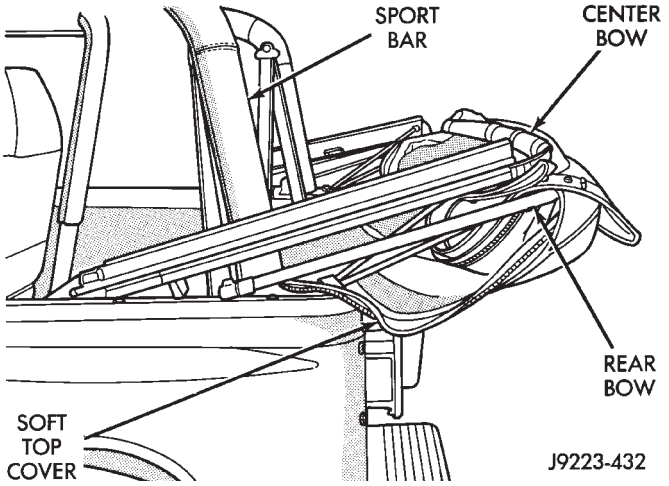

Fig. 112 Sliding Top Cover Rearward

(15) Slide the center bow legs out of the lower side retainers and remove the top cover from the vehicle.

INSTALLATION

(1) If stowed at the rear of the vehicle, detach the elastic straps that retain the top cover (Fig. 113).

(2) If not stowed, position the center bow legs anchor pins in the lower side retainer receptacles (Fig. 114).

(3) Grasp the cover at the upper side snap retainers (Fig. 115) and pull the top cover upward and forward.

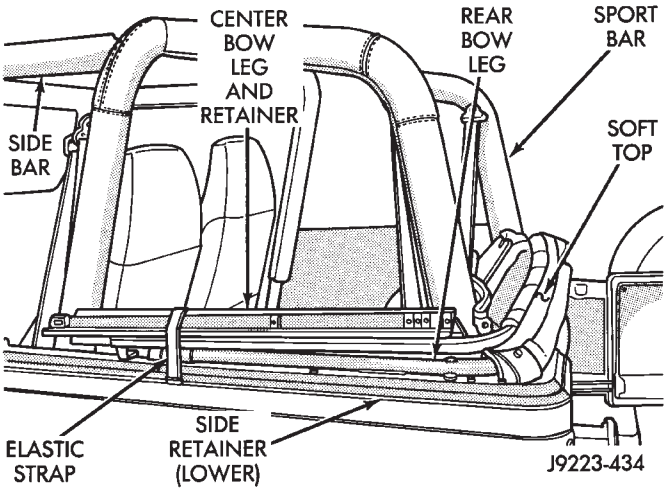

Fig. 113 Stowed Top Cover

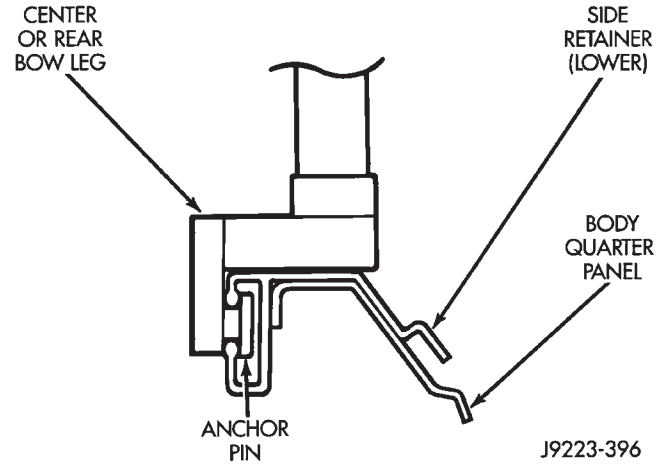

Fig. 114 Bow Leg and Anchor Pin

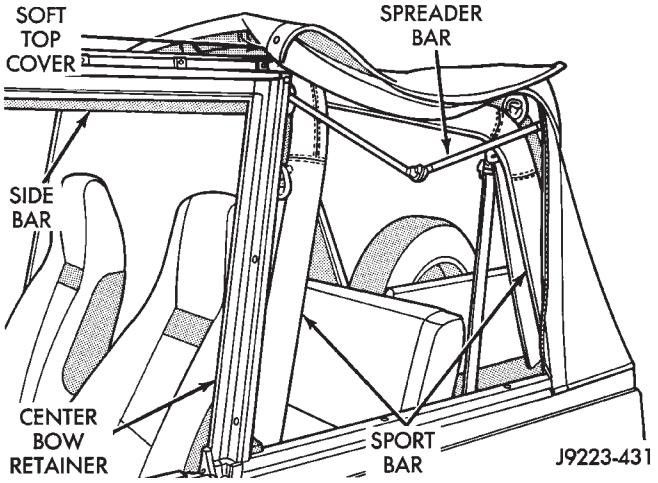

Fig. 115 Top Cover Up

(4) Position front of the upper side snap retainers at the door flanges and lock pin at each side of the vehicle (Fig. 116). Engage the locks with the pins and then slide the locks rearward.

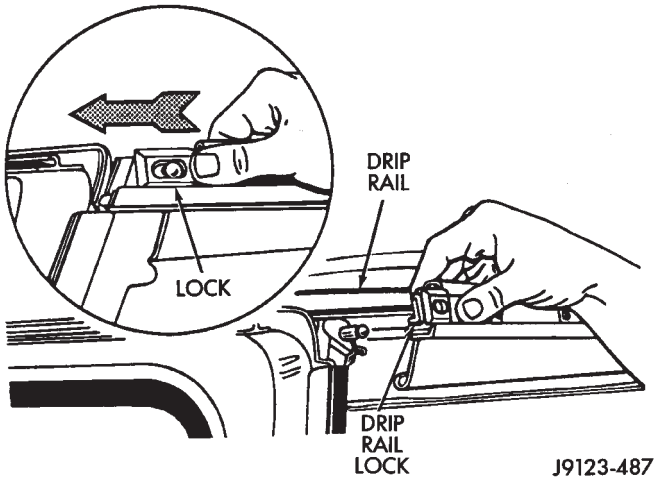

Fig. 116 Upper Side Retainer Lock Engagement

(5) Insert the front edge of the top cover into the retainer channel on the windshield frame (Figs. 110 and 117).

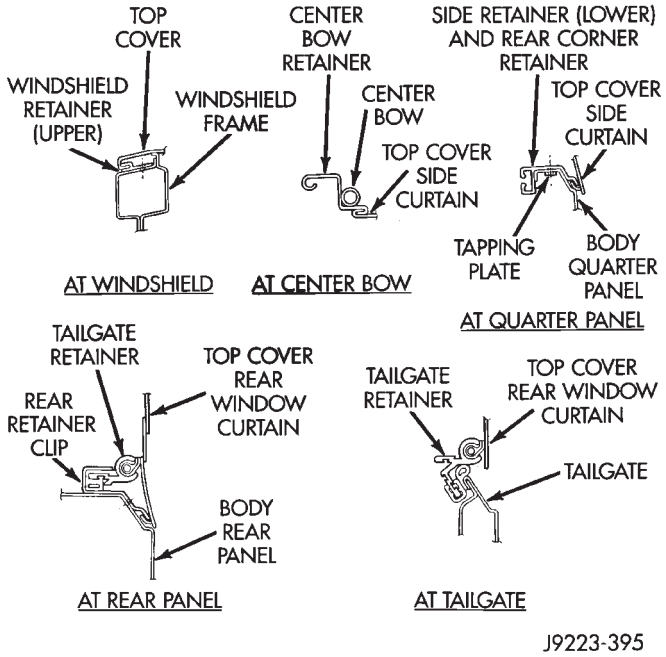

Fig. 117 Soft Top Installation

(6) Ensure that the center bow leg is positioned all the way forward in the receptacle.

(7) Ensure that the rear corners of the top cover are inserted in the retainer channels (Fig. 117).

(8) Pull the rear bow legs rearward until they engage with the notch in the lower side retainers. Ensure that the side curtain rear zippers are not entrapped or folded behind the rear bow.

(9) Force the spreader bars (Fig. 118) upward until the lock engages.

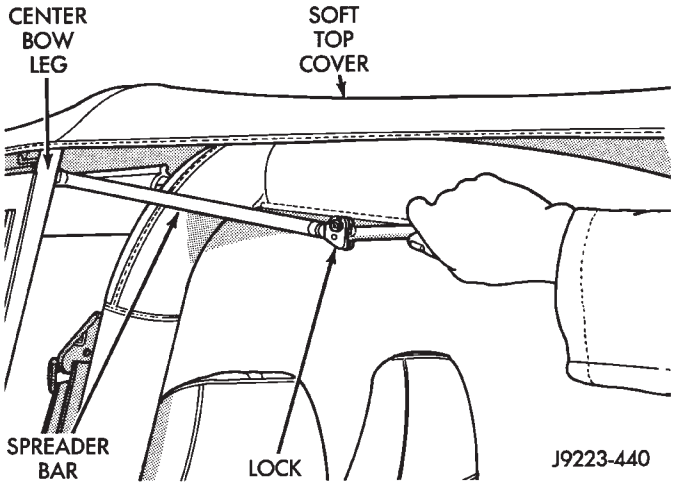

Fig. 118 Engaging Spreader Bar Lock

(10) Slide the front edge of each side curtain upward into the retainer channel on the center bow (Figs. 104 and 117).

(11) Close top zipper on each side curtain 5 - 8 cm (2 - 3 in). Next, close the rear zipper at the bottom corner of the curtain 5 - 8 cm (2 - 3 in).

(12) Attach the side curtain front and rear tab snap-on retainers to the lower side retainer (Fig. 103).

(13) Completely close both side curtain zippers.

(14) Pull downward firmly on the side curtains. Start at one end and move toward the opposite end. The bottom edge of the curtains must be completely inserted in the lower side retainer channels (Fig. 103).

(15) Release the rear window curtain straps and insert the bottom edge into the tailgate retainer channel (Fig. 117). Close the rear window curtain zippers and attach the side snap-on retainers.

(16) Attach all the top cover snap-on retainers to the upper side retainers located above both doors (Fig. 109). As necessary, slide the mating half of the snap-on retainers so that they will align with the snap-on retainers on the top cover. Tuck the edge of the top cover inside the side retainer.

(17) Install the door windows by inserting the retainers into the door grommets. Attach the snap-on retainers located along the bottom edge of the window to the door retainer (Fig. 100).

SPORT BAR

REMOVAL

(1) Remove the screws that attach the sport bar base plates to the floor and wheelhouse panels (Fig. 119).

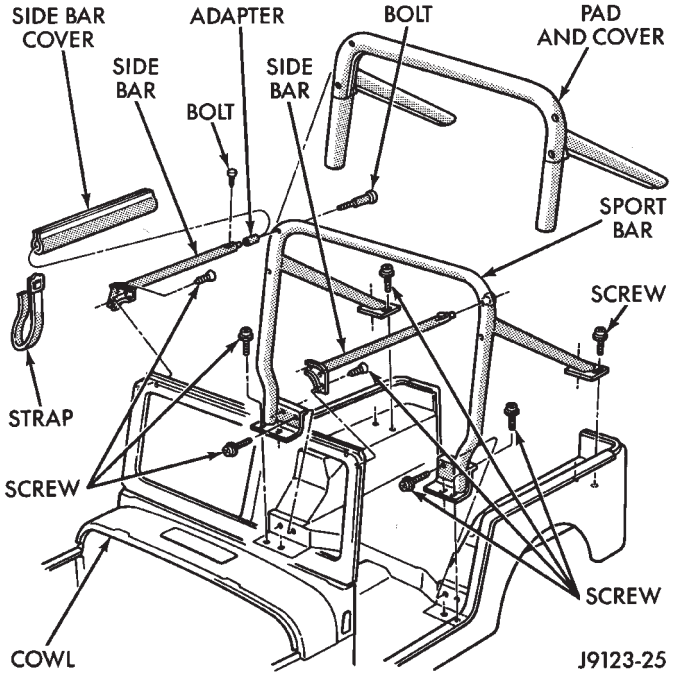

Fig. 119 Sport Bar

(2) Remove the retaining screws and bolts, and remove the side bars from the windshield frame and the sport bar (Figs. 119 and 120).

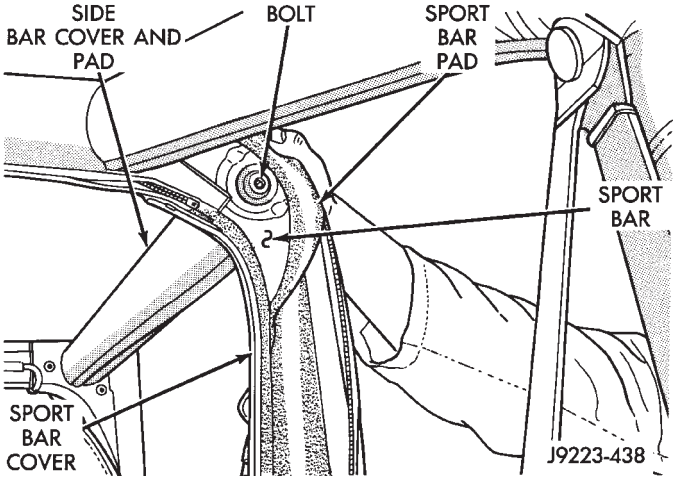

Fig. 120 Sport Bar-To-Side Bar Bolt

(3) Carefully lift the sport bar upward (Fig. 119) and remove it from the vehicle.

(4) If necessary, remove the pads and covers from the sport bar (Figs. 119 and 120)

INSTALLATION

(1) Clean the base plate contact surface areas on the floor and wheelhouse panels.

(2) Apply epoxy chromate primer to the attaching screw hole edges for protection against corrosion.

(3) Position the sport bar base plates on the floor and wheelhouse panels with the screw holes aligned (Fig. 119).

To prevent water seepage, apply 3M Drip-Chek Sealant (or an equivalent product) to the underside of all the screw heads before installation.

(4) Apply sealant to the underside of each base plate attaching screw head. Install and tighten the screws securely (Fig. 119).

(5) Position the side bars at the windshield frame and at the sport bar (Fig. 119). Install screws and bolts in the windshield frame and the sport bar (Fig. 120). Tighten the screws securely.

EXTERNAL SPARE/WHEEL TIRE CARRIER

REMOVAL

(1) Remove the spare tire and wheel from the wheel bracket (Fig. 121).

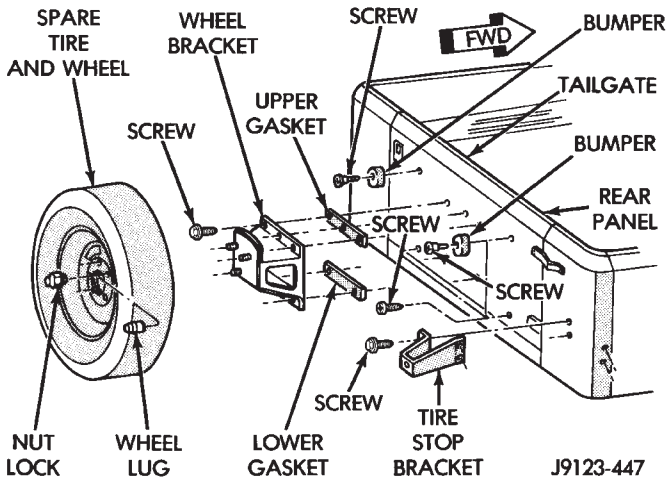

Fig. 121 External Spare Tire/Wheel Carrier

(2) Remove the screws that attach the wheel bracket to the tailgate (Fig. 121).

(3) Remove the bracket and the gaskets from the tailgate (Fig. 121).

(4) Remove the screws that attach the stop bracket to the rear panel and the bumpers to the tailgate (Fig. 121).

(5) Remove the stop bracket and the bumpers from the vehicle (Fig. 121).

(6) Clean the contact surface areas on the tailgate and the rear panel.

INSTALLATION

(1) Position the stop bracket and the bumpers on the vehicle (Fig. 121) and install screws. Tighten the screws to 11 N·m (95 in-lbs) torque.

(2) Position the gaskets and the wheel bracket on the tailgate and install the attaching screws (Fig. 121). Tighten the screws to 23 N·m (204 in-lbs) torque.

(3) Install the spare tire and wheel on the wheel bracket (Fig. 121). Tighten the wheel lug nuts and the nut lock to 68 N·m (50 ft-lbs) torque.

DOORS

INDEX

HALF-METAL SOFT TOP DOOR

REMOVAL/DISASSEMBLY

(1) Open the door.

(2) Disconnect the door restraint strap from the pin (Fig. 1).

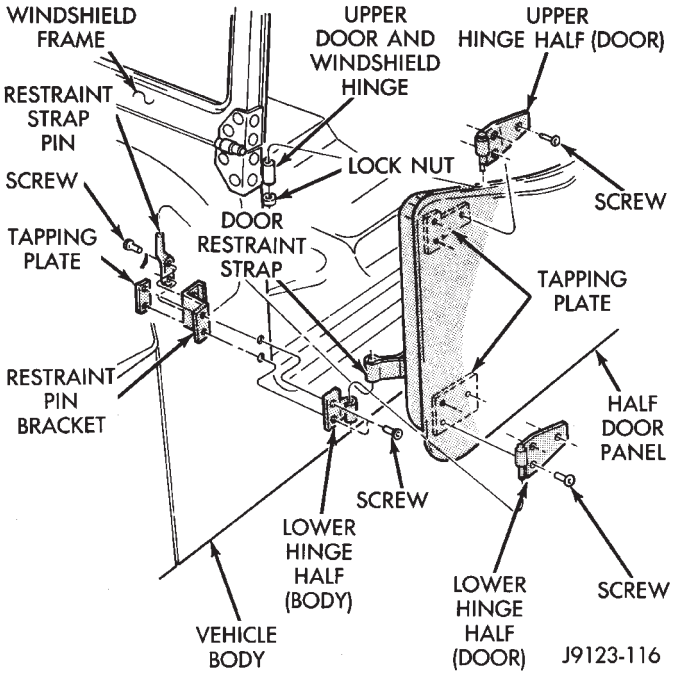

Fig. 1 Half-Metal Soft Top Door

(3) Turn the window retaining sleeves 1/4 turn to the left and pull them up and out of the door (Fig. 2).

(4) Remove the window from the door by detaching the soft top-to-door snap fasteners and pulling the window up and out of the door (Fig. 3).

(5) Remove the latch interior release handle (Fig. 4).

(6) Remove the assist handle (Fig. 4).

(7) Remove the trim panel by detaching the retainers around the perimeter of the trim panel (Fig. 4).

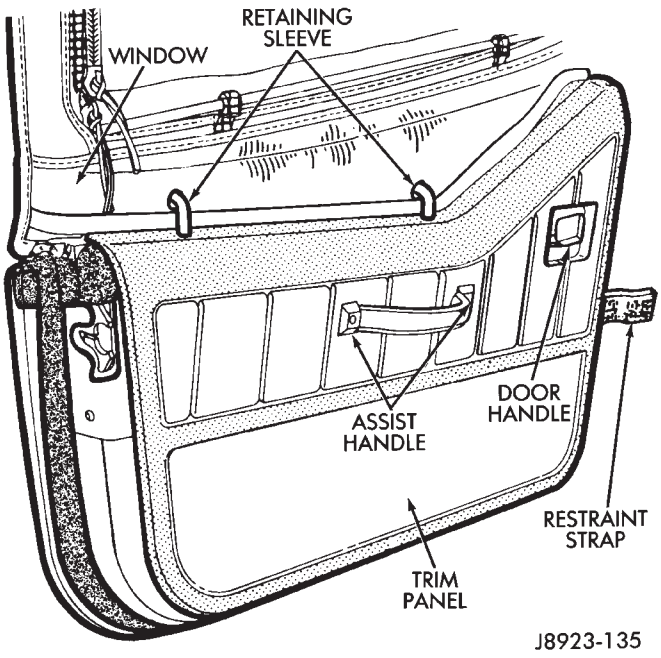

Fig. 2 Window Retaining Sleeves

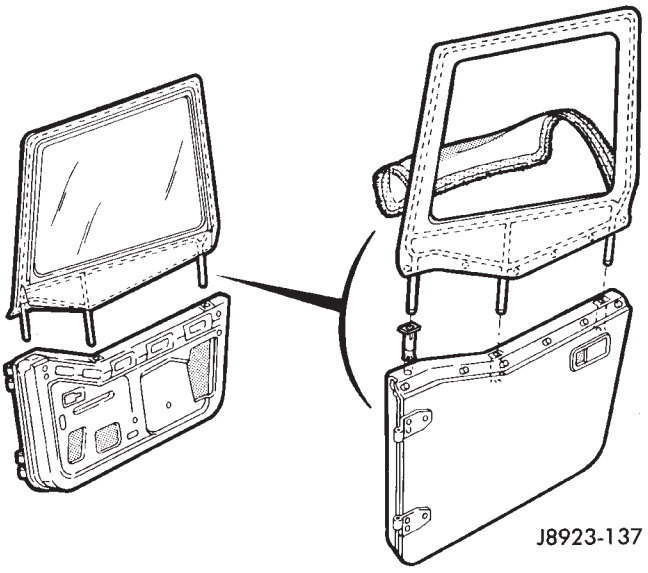

Fig. 3 Window Removal/Installation

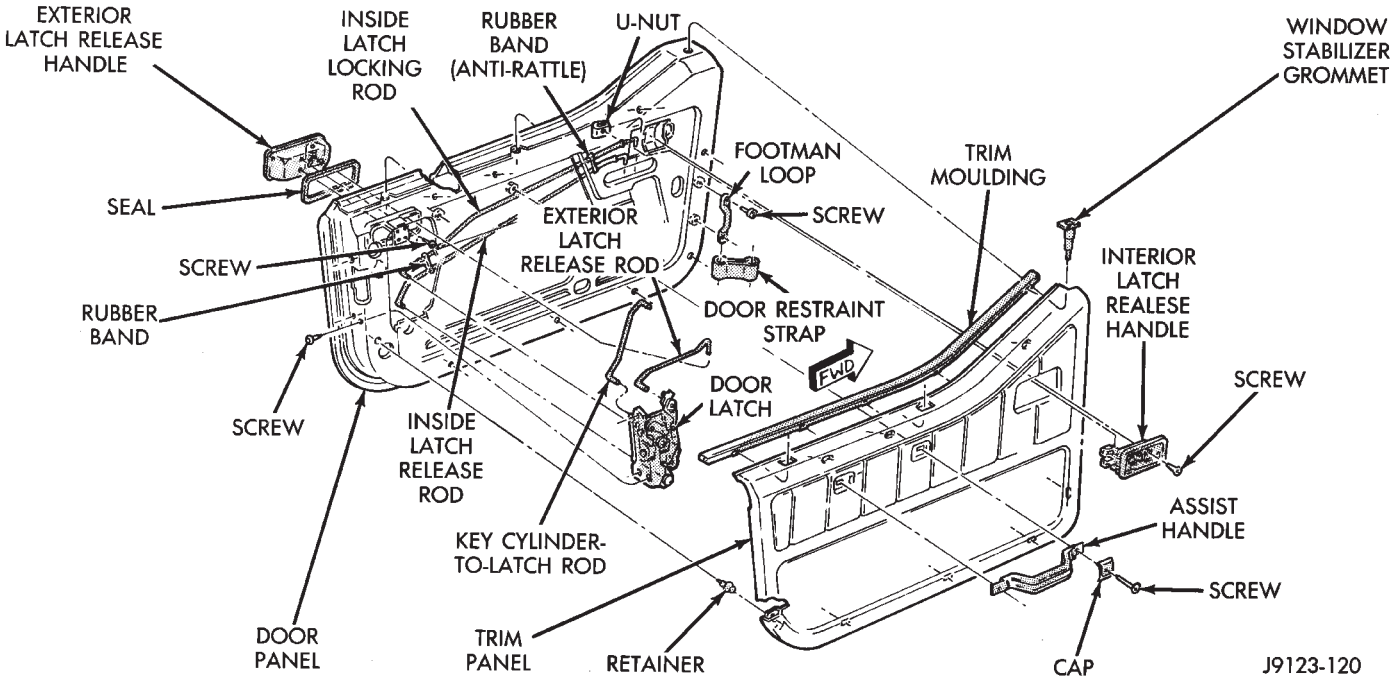

Fig. 4 Half-Metal Door Interior Trim Panel

(8) Remove the screws from the door latch handle, disconnect the latch release rod and remove the handle (Fig. 4).

(9) Remove the door latch screws (Fig. 4). Remove the door latch with the rods attached.

(10) Remove the weatherstrip seal screws and carefully remove the weatherstrip seal from door edge (Fig. 5).

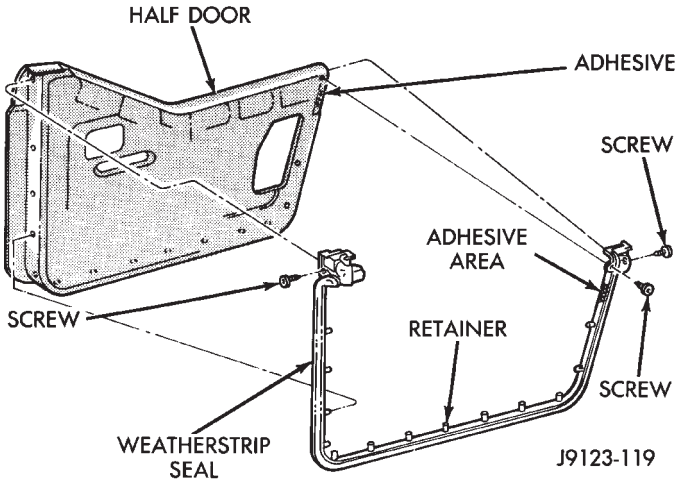

Fig. 5 Half-Metal Door Weatherstrip Seal

(11) Remove the retaining nuts from the door hinge pivots and remove the door from the body (Fig. 1).

(12) Remove the retaining screws and the hinges from the door.

ASSEMBLY/INSTALLATION

(1) Install the hinges and the retaining screws on the door. Tighten the screws securely.

(2) Position the door at the vehicle, insert the hinge pivots in the hinge receptacles and install the retaining nuts (Fig. 1). Tighten the nuts securely.

(3) Install the weatherstrip seal on the door edge and install the seal retaining screws (Fig. 5).

(4) Position the latch in the door and install the retaining screws (Fig. 4). Tighten the screws securely.

(5) Position the door latch external release handle and install the retaining screws (Fig. 4). Tighten the screws securely. Connect the latch release rod to the external release handle and the key lock-to-latch rod (Fig. 6).

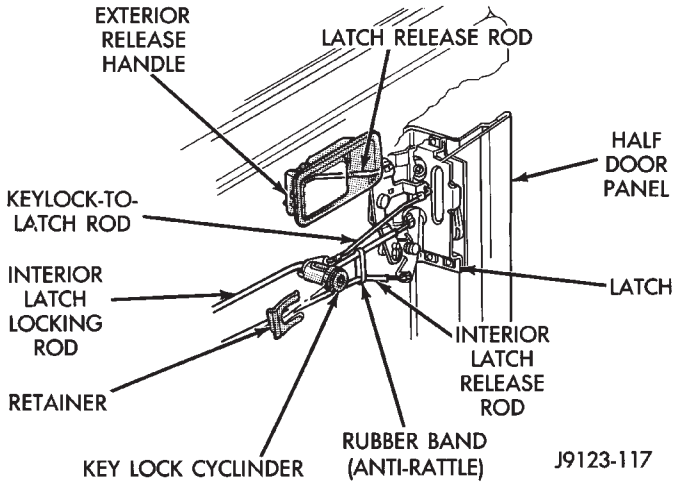

Fig. 6 Half-Metal Door Latch

(6) Install the interior trim panel (Fig. 4).
(7) Connect the latch release rod to the door latch interior release handle and install the handle (Fig. 4).
(8) Install the assist handle (Fig. 4).
(9) Install the window retaining sleeves (Fig. 2).
(10) Install the window (Fig. 1).
(11) Attach the restraint strap to the pin (Fig. 1).

HALF-METAL DOOR LATCH STRIKER

REPLACEMENT

(1) Remove the striker with a Torx bit (Fig. 7).

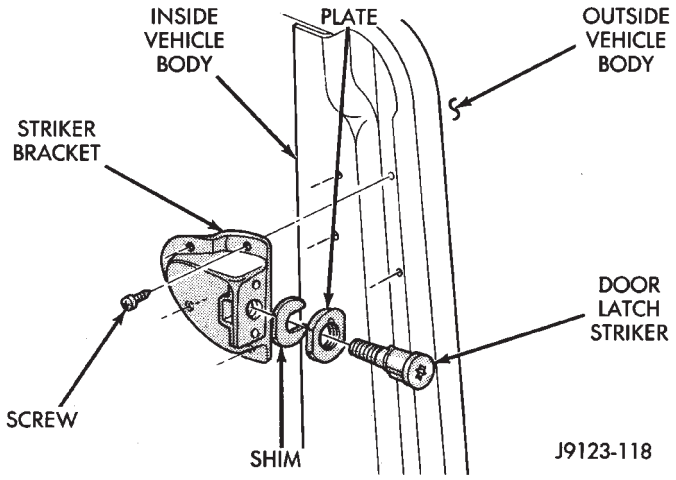

Fig. 7 Half-Metal Door Latch Striker

(2) Install the plate, shim and replacement striker with a Torx bit (Fig. 7).

FULL-METAL DOOR WINDOW GLASS REGULATOR HANDLE

REMOVAL/INSTALLATION

The window glass regulator handle is attached to the splined regulator shaft with an internal hex-head screw (Fig. 8).

(1) To remove the handle:
- remove the cover;
- remove the screw; and
- pull the handle straight out and off the shaft (Fig. 8).

(2) Install the handle with the knob positioned forward, the handle horizontal and the window glass closed.

FULL-METAL DOOR ASSIST HANDLE

REMOVAL

(1) Remove the screws that attach the door assist handle to the trim panel (Fig. 8).
(2) Remove the handle from the door (Fig. 8).

INSTALLATION

(1) Position the handle on the door.
(2) Install the attaching screws.
(3) Close the jaws on the latch.
(4) Push the lock-to-latch rod forward toward the inside release handle. Check to ensure the lock lever on the latch is in the unlocked position.
(5) Position the threaded end of the lock rod over the lever clip on the latch and push the rod into the lock lever clip (Fig. 9). The lock lever should have a full sweep of travel when activated by the inside control button. It should not bind or be stiff.
(7) Position the threaded end of the release lever rod over the release lever clip on the latch and push the rod into the release lever clip. The release lever on the latch should be resting against the stop with no preload after the rod is engaged in the retaining clip. Visual observation will reveal any preload. If preload is noted, disconnect the release lever rod and install it again to eliminate the preload.
(8) Pull up on the outside handle release rod to position it as far up as possible and push the rod into the release lever clip on the latch. The release lever on the latch should be resting against stop with no preload after the rod is engaged in the retaining clip.
(9) Close the latch jaws.
(10) Activate the inside lock control button. It should not bind or be stiff, if either condition exists, the latch should replaced.
(11) With the inside lock control button in the unlock position, pull the inside door handle to open the jaws on the latch and close the door.

FULL-METAL DOOR LATCH INSIDE RELEASE AND LOCK HANDLE

REMOVAL

(1) Remove the retaining screw (Fig. 8).
(2) Pull the handle outward and detach the lock and release rods from handle (Fig. 9).
(3) Remove the handle from the upper trim panel (Fig. 8).

INSTALLATION

(1) Position the handle adjacent to the rods in the upper trim panel opening and attach the rods to the handle (Fig. 9).
(2) Position the handle in the upper trim cover and install the retaining screw Fig. 8).

FULL-METAL DOOR TRIM PANEL

The door interior trim panels are covered with a vinyl material (Fig. 8). They are attached to the door inner panel rail retainer and with plastic clips inserted into holes in the door inner panel.

REMOVAL

(1) Remove the door assist handle (Fig. 8).

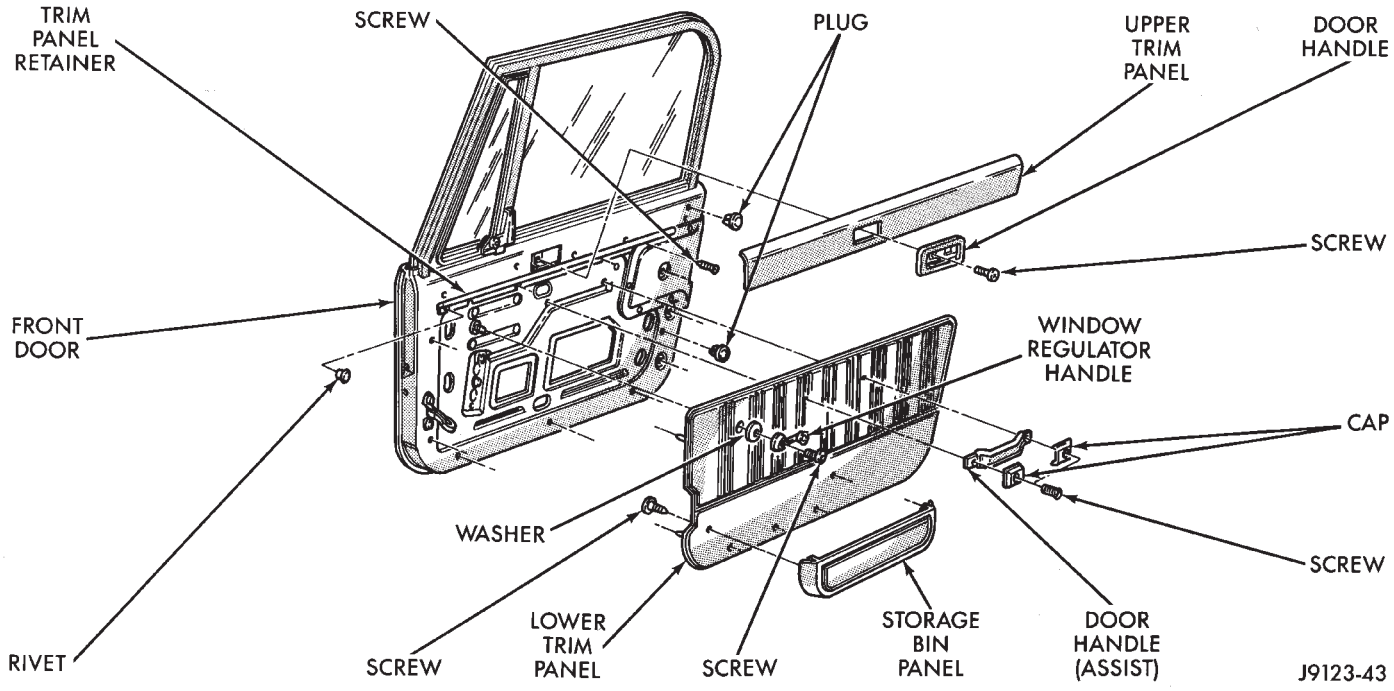

Fig. 8 Full Metal Door Trim Panels and External Components

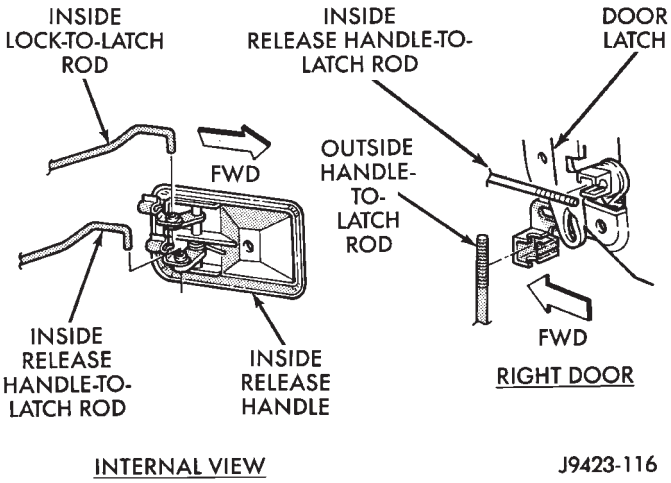

Fig. 9 Inside Door Handle and Rods

(2) Remove the window glass regulator handle (Fig. 8).

(3) Remove the door latch release handle and the upper trim panel (Figs. 8 and 9).

(4) Pry the lower trim panel-to-door retainers (located around the perimeter of the panel) outward and remove the panel (Fig. 8).

INSTALLATION

(1) Position the lower trim panel on the door inner panel and insert the retainers in the holes in the door inner panel (Fig. 8).

To prevent creasing the trim panel vinyl cover, do not hammer or exert excessive force on the retainers.

(2) Install the upper trim panel and the door handle (Figs. 8 and 9).

(3) Install the window glass regulator handle (Fig. 8).

(4) Install the door assist handle (Fig. 8).

FULL-METAL DOOR WATERDAM

The waterdam is attached to the door inner panel with adhesive and tape (Fig. 10).

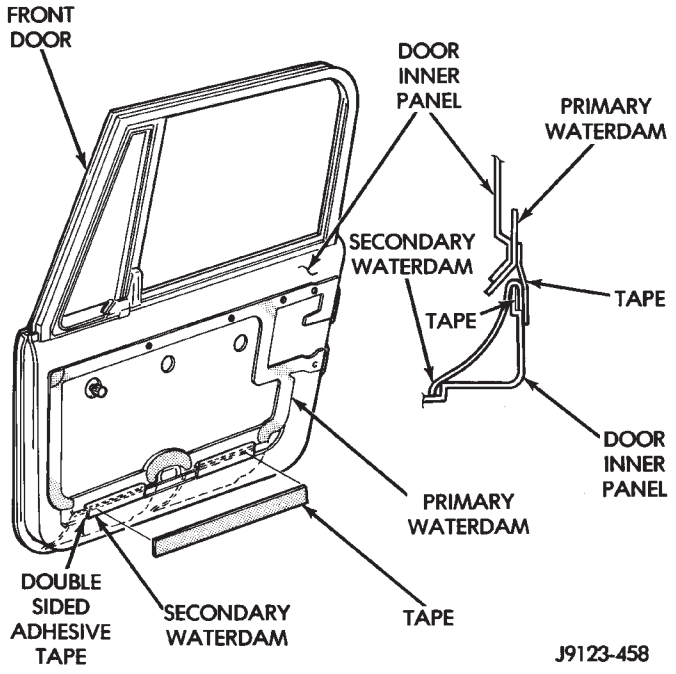

Fig. 10 Door Waterdam

REMOVAL/INSTALLATION

(1) To remove a waterdam, insert a putty knife between it and the door inner panel.

(2) When installing a waterdam, ensure that lower portion of waterdam is tucked inside the door panel at the access opening.

FULL-METAL DOOR VENT WINDOW GLASS

REMOVAL

(1) Remove the door trim panel and the waterdam (Figs. 8 and 9).

(2) Lower the door window glass to the "down-stop".

(3) Remove the division channel upper attaching screw and the lower adjustment screw (Fig. 11).

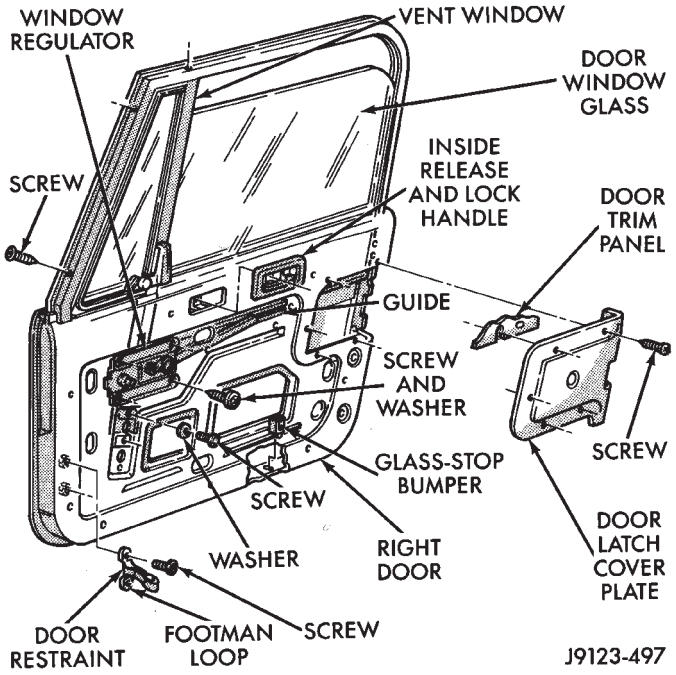

Fig. 11 Door Internal Components

(4) Detach the front three inches of weatherstrip seal from the door upper frame. Lower the division channel and tilt it toward the rear of the door.

(5) Remove the vent window glass from the door frame.

INSTALLATION

(1) Position the vent window glass in the door frame.

(2) Install the division channel in the door and position the channel on the window glass.

(3) Install the upper attaching screw and the lower adjustment screw.

(4) Attach the weatherstrip seal to the door upper frame.

(5) Water test the window and inspect for leaks.

(6) If water leakage is evident, apply windshield sealant to seal the area or re-align the weatherstrip seal.

(7) Test the operation and adjustment of the door window glass.

(8) Install the door waterdam and the trim panel (Figs. 8 and 10).

FULL-METAL DOOR WINDOW GLASS REGULATOR

REMOVAL

(1) Remove the door trim panel and the waterdam (Figs. 8 and 10).

(2) Lower the door window glass to expose the regulator arm guide retainer screws (Figs. 11 and 12). Remove the bushings, the nuts and the guide channel (Fig. 12).

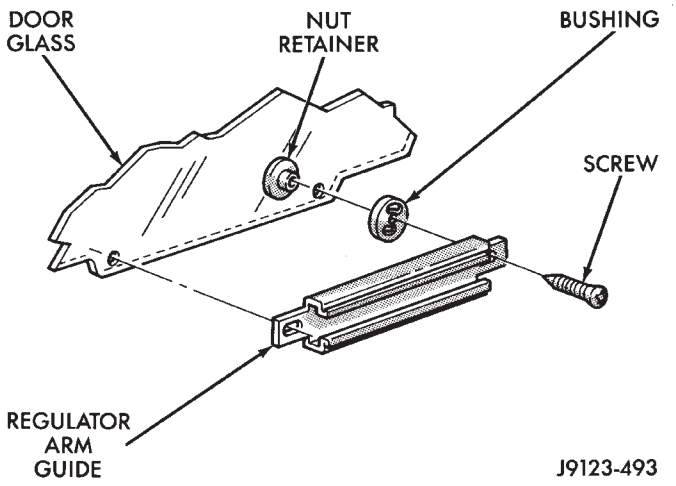

Fig. 12 Regulator Arm Guide

(3) Lift the window glass to the fully closed position and apply masking tape to the window glass and over the top of the window frame to retain it.

(4) Remove the division channel lower adjustment screw.

(5) Remove the window glass regulator attaching screws (Fig. 11).

(6) Push the division channel outward and remove the window glass regulator through the access hole in the door inner panel (Fig. 41).

INSTALLATION

(1) Position the window glass regulator within the door panels and install the attaching screws (Fig. 11).

(2) Remove the masking tape from the window glass and lower it.

(3) Slide the regulator arm guide onto the regulator arm and position the guide on the window glass (Fig. 12). Install the nuts, bushings and screws.

(4) Install the division channel lower adjustment screw.

(5) Test the window glass for proper operation.

(6) Install the door waterdam and the trim panel (Figs. 8 and 10).

FULL-METAL DOOR WINDOW GLASS

ADJUSTMENT

One adjustment location provides amount of effort required to raise and lower the door window glass. The door window glass division channel is adjustable fore and aft at the lower attaching location.

(1) Remove the door trim panel and the waterdam (Figs. 8 and 10).

(2) Loosen channel lower adjustment screw and move the division channel fore or aft to obtain the desired door window glass operation.

Movement of the division channel fore or aft will decrease or increase the free-play between the channels.

(3) Tighten the division channel lower adjustment screw.

(4) Install the door waterdam and the trim panel (Figs. 8 and 10).

REMOVAL

(1) Remove the door trim panel and the waterdam (Figs. 8 and 10).

(2) Remove the window glass down-stop bumper (Fig. 11).

(3) Remove the screws that attach the regulator arm guide to the window glass. Remove the screws, bushings, nuts and the guide from the glass (Fig. 11).

(4) Lower the window glass to the bottom of the door.

(5) Remove the division channel upper attaching screw and the lower adjustment screw. Detach the front 3 inches of window glass weatherstrip seal from the door upper frame.

(6) Separate the division channel from the front window glass rubber seal. Pull the division channel up and in toward the inside of vehicle.

(7) Raise and tilt the window glass toward the hinge side of the door and disengage it from the rear channel.

(8) Pull the window glass up and out of the door panel.

INSTALLATION

(1) Lower the window glass into the door, while inserting the window glass into the front and rear channels.

(2) Slide the window glass downward to the bottom of the door panel.

(3) Lower the division channel into the door and position the window glass securely in the channel.

(4) Install the weatherstrip seal in the upper door frame and install the upper attaching screw and the lower adjustment screw.

(5) Slide the guide onto the regulator arm and position the guide on the window glass. Install the retaining nuts, bushings and screws (Fig. 12).

(6) Install the window glass down-stop bumper (Fig. 11).

(7) Test the window operation for proper adjustment.

(8) Install the door waterdam and the trim panel (Fig. 8 and 10).

FULL-METAL DOOR KEY LOCK CYLINDER

REMOVAL

(1) Remove the door trim panel and the waterdam (Figs. 8 and 10).

(2) Remove the door latch cover screws and remove the cover (Fig. 11).

(3) Remove the retaining clip and remove lock cylinder-to-latch rod (Fig. 13).

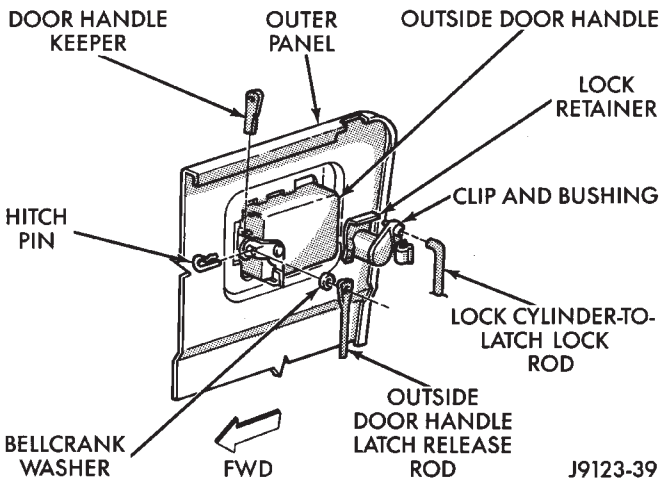

Fig. 13 Key Lock Cylinder and Door Handle

(4) Remove the lock cylinder retainer and the lock cylinder from the door panel (Figs. 13 and 14).

INSTALLATION

(1) Install the lock cylinder in the door panel (Fig. 14).

(2) Install the lock cylinder retainer, the lock cylinder-to-latch rod and the retaining clip (Fig. 13).

(3) Install the door latch cover and the cover screws (Fig. 11).

(4) Install the door waterdam and the trim panel (Figs. 8 and 10).

FULL-METAL DOOR LATCH EXTERNAL RELEASE HANDLE

REMOVAL

(1) Remove the door trim panel and the waterdam from the door inner panel (Figs. 8 and 10).

(2) Remove the door latch cover attaching screws (Fig. 11).

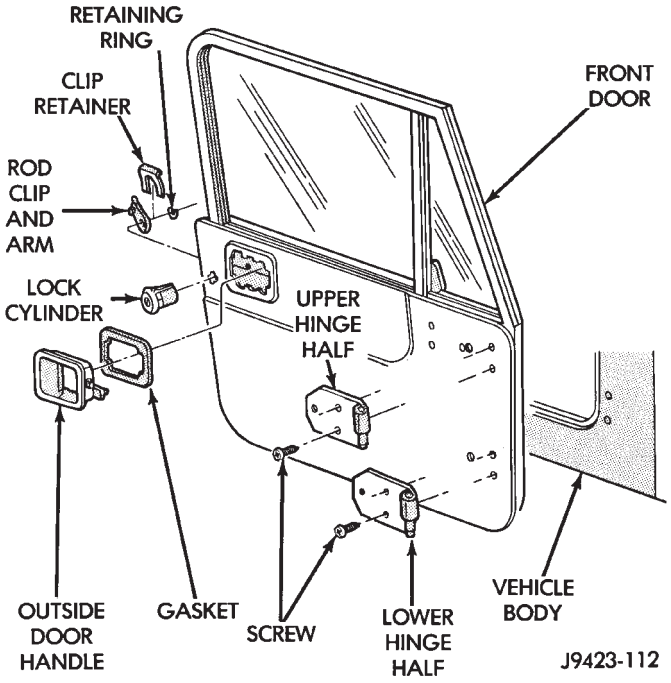

Fig. 14 Key Lock Cylinder and Door Handle Removal/Installation

(3) Remove the hitch pin and the latch release rod from the door external handle (Fig. 13).

(4) Close the window completely and tap the handle keepers upward (Fig. 13).

(5) Disconnect the window glass from the regulator arm guide (Fig. 12).

(6) Remove the division channel upper and lower attaching screws.

(7) Separate the division channel from the front window glass weatherstrip seal.

(8) Pull the division channel upward and remove the window glass from the door.

(9) Remove the keepers from the door handle with needlenose pliers and remove the handle and gasket from the door (Figs. 13 and 14).

INSTALLATION

(1) Install the gasket and the door external handle and slide the keepers into the door handle from the top (Figs. 13 and 14).

(2) Tap the retainers downward lightly to tighten the handle.

(3) Install the latch release rod and the hitch pin and attach the rod to the latch (Fig. 13).

(4) Position the window glass in the door and the channels.

(5) Install the division channel and the attaching screws.

(6) Attach the window glass to the regulator arm guide (Fig. 12).

(7) Install the door latch cover (Fig. 11).

(8) Install the door waterdam and the trim panel (Figs. 8 and 10).

FULL-METAL DOOR LATCH

REMOVAL

(1) Remove the trim panel and the waterdam from the door inner panel (Figs. 8 and 10) .

(2) Remove the door latch cover (Fig. 11).

(3) Disconnect the inside release handle-to-latch rod. Disconnect the lock cylinder-to-latch rod. Disconnect the inside lock-to-latch rod. Disconnect the external handle-to-latch rod from the door latch (Fig. 15).

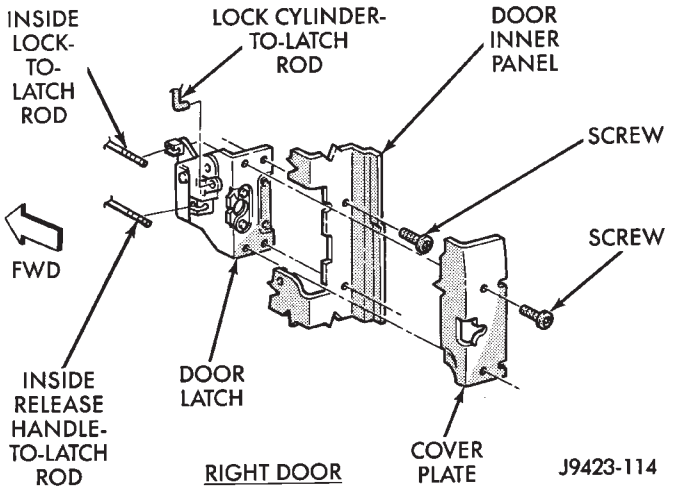

Fig. 15 Latch Removal/installation

(4) Remove the door latch attaching screws and remove the latch from the door (Fig. 15).

INSTALLATION

(1) Install the door latch with the attaching screws (Fig. 15).

(2) Connect the rods to the latch (Fig. 15).

(3) Install the latch cover with the cover screws (Fig. 11).

(4) Install the door waterdam and the trim panel (Fig. 8 and 10).

FULL-METAL DOOR HINGES

ADJUSTMENT

The doors are adjusted at the hinge attaching locations on either the body or the door. Enlarged holes are located in the body (lower hinge only) for fore, aft and tilt adjustments. Enlarged holes are also located in the door (upper and lower hinges) for up, down, fore, aft and tilt adjustments.

Prior to door adjustment or alignment, the door latch must be removed to allow the door to close freely and be properly aligned.

The door latch striker should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

REPLACEMENT

(1) Mark the outline of the existing hinge on the body and the door with a wax pencil for installation alignment reference.

When removing the door or hinge DO NOT discard the plastic shims or the hinge pin.

(2) Remove the hinge-to-body screws and the hinge-to-door screws (Fig. 16). Remove the hinge from the door and body.

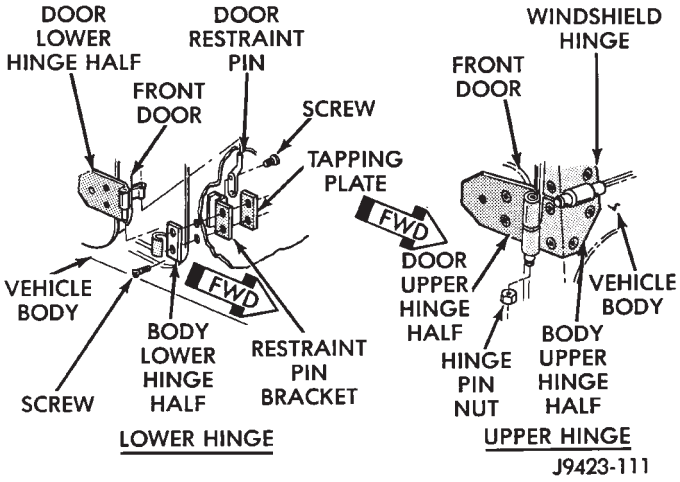

Fig. 16 Door Hinges

The upper hinge is also part of the windshield hinge (Fig. 16). When replacing it, support the windshield frame with an appropriate device prior to removal. Inspect the windshield alignment after hinge installation.

(3) Clean the replacement hinge with an appropriate solvent and dry it with compressed air.

(4) Color-coat the hinge to match the vehicle body with MOPAR exterior spray paint, or an equivalent product.

(5) Lubricate the hinge with spray lubricant.

(6) Position the hinge on the door, align carefully with the wax pencil installation alignment reference marks, and install the retaining screws (Fig. 16).

(7) Position the hinge on the vehicle body. Align the wax pencil marks installation alignment reference marks. Install the retaining screws (Fig. 16).

(8) Inspect the door alignment. Adjust, if necessary. Refer to Door Hinges—Adjustment.

FULL-METAL DOOR WEATHERSTRIP SEALS

SERVICE INFORMATION

The door weatherstrip seals are molded latex foam with a smooth rubber reinforcement layer on the outside (Fig. 17).

Plastic retainers are used to retain the seal on the door panel below the door beltline (Fig. 17). Above the beltline, the seal is retained in a channel formed in the door upper frame.

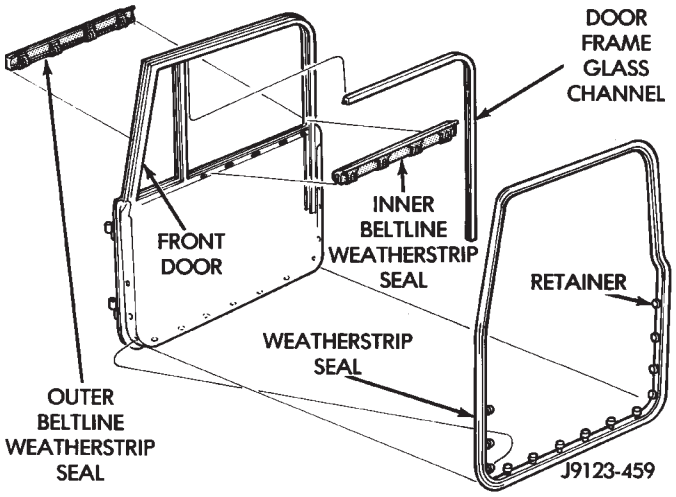

Fig. 17 Door Weatherstrip Seals

The beltline weatherstrip seals are retained within the door panels by spring-clip retainers (Fig. 17).

The door frame glass channel is retained within the door frame by the press-fit between it and the frame.

WEATHERSTRIP SEAL MAINTENANCE

Cold temperatures can cause rubber seals to harden and lose resiliency. This possibly will cause the door to loosen in the body opening and result in noise. When servicing, use a dampened cloth to clean the rubber seals. Remove the foreign material from all areas where the rubber seal contacts the body panels. Apply silicone lubricant to the seals after they are cleaned.

CAUTION: Do not apply graphite, brake fluid, or wax to rubber seals.

Replacement rubber weatherstrip seals are coated with powder to prevent adhesion to the container during storage. Before installation, remove all the powder with a cloth dampened with a general purpose adhesive removal solution.

DOOR WEATHERSTRIP SEAL REPLACEMENT

REMOVAL

(1) Carefully remove the weatherstrip seal from the door with a weatherstrip seal removal tool. Pry the seal outward to separate the plastic retainers from the door panel holes.

(2) Remove the upper portion of the seal from the door upper frame with your fingers or a wooden wand.

(3) Remove the dust and residual adhesive from the door panel and body panel.

INSTALLATION

(1) Apply adhesive to the front, rear and bottom edges of the door from the beltline downward.

(2) Install the upper front corner of the seal on the door first using your fingers or a wooden wand to position the seal in the channel. Place the inner shoulder of the seal in the channel-to-window frame above the beltline.

(3) Force the retainers, starting at the rear edge of the door, into the door panel holes.

(4) Ensure that the seal is completely seated around the door.

BELTLINE SEAL REPLACEMENT

REMOVAL

(1) Carefully remove the beltline weatherstrip seal (Fig. 17) from the door with a weatherstrip seal removal tool or similar pry tool.

(2) Pry the seal upward to remove it from within the glass and door panel.

INSTALLATION

(1) Position the seal between the door panel and the glass. Force the seal downward with your fingers to seat it against the glass and panel (Fig. 18).

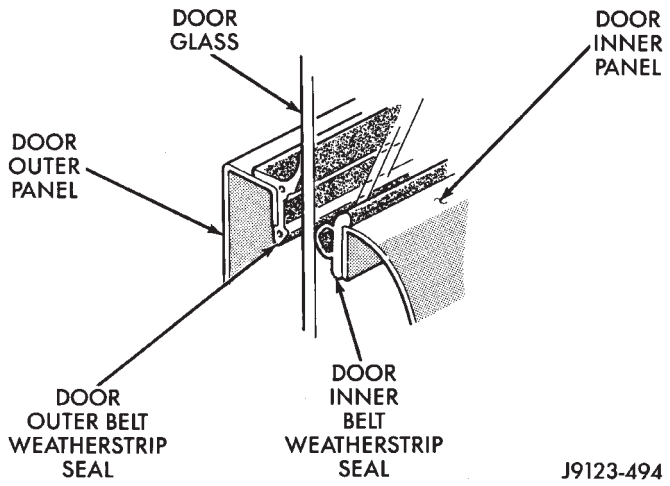

Fig. 18 Beltline Weatherstrip Seals

(2) Ensure that the seal is completely seated within the door (Fig. 18).

DOOR FRAME GLASS CHANNEL REPLACEMENT

REMOVAL

(1) Carefully remove the glass channel (Fig. 17) from the door with a pry tool.

(2) Pry the seal outward to remove it from the frame.

INSTALLATION

(1) Position the channel in the frame and force it inward with your fingers to seat it within the frame.

(2) Ensure that the seal is completely seated within the door frame.

FULL-METAL DOOR SERVICE

REMOVAL/DISASSEMBLY

(1) Open the door.

(2) Remove the door restraint strap from the pin.

(3) Remove the door latch inside release handle (Fig. 8).

(4) Remove the assist handle (Fig. 8).

(5) Remove the window glass regulator handle (Fig. 8).

(6) Remove the upper trim panel. Remove the lower trim panel by detaching the retainers around the perimeter of the trim panel (Fig. 8).

(7) Remove the waterdam from the door inner panel (Fig. 10).

(8) Remove the door latch cover plate from the door inner panel (Fig. 11).

(9) Remove the retaining screws and the door latch with the rods attached (Fig. 15).

(10) Remove the beltline weatherstrip seals from the door (Fig. 18).

(11) Remove the window glass from the regulator arm guide (Fig. 12).

(12) Carefully remove the window glass from the channel and the door.

(13) Remove the key lock cylinder from the door (Fig. 14).

(14) Remove the door outside handle keepers, disconnect the latch release rod and remove the handle from the door panel (Fig. 13).

(15) Carefully remove the weatherstrip seal from door edge (Fig. 18).

(16) Remove the retaining nuts from the door hinge pins and remove the door from the body (Fig. 16).

(17) Remove the retaining screws and the hinges from the door panel (Fig. 14).

ASSEMBLY/INSTALLATION

(1) Install the hinges on the door (Fig. 14).

(2) Position the door at the body opening, insert the hinge pins in the hinge receptacles and install the retaining nuts (Fig. 16). Tighten the nuts securely.

(3) Install the weatherstrip seal on the door edge (Fig. 18).

(4) Install the door outside handle and the keepers. Connect the latch release rod to the handle (Fig. 13).

(5) Install the key lock cylinder (Fig. 14).

(6) Position the window glass in the channel and the door.

(7) Attach the window glass to the regulator arm guide (Fig. 12).

(8) Install the beltline weatherstrip seals in the door (Fig. 18).

(9) Position the latch in the door and install the retaining screws (Fig. 15). Tighten the screws securely.

(10) Connect the latch rods (Fig. 19). Attach the inside release handle securely. Attach the rods to the latch making sure the lock position of the lock position of the latch toggle button are the same (Fig. 20).

The ends of the latch rods are threaded and the overall length of each rod is adjustable within the retainer clip. Adjust as necessary.

(11) Install the door latch cover plate on the door inner panel (Fig. 11).

(12) Install the waterdam on the door inner panel (Fig. 10).

(13) Install the interior trim panels (Fig. 8).

(14) Install the window regulator handle.

(15) Connect the handle-to-latch rod and the lock-to-latch rod to the door latch inside release handle and install the handle (Figs. 19 and 8).

(16) Install the assist handle.

(17) Attach the restraint strap to the pin.

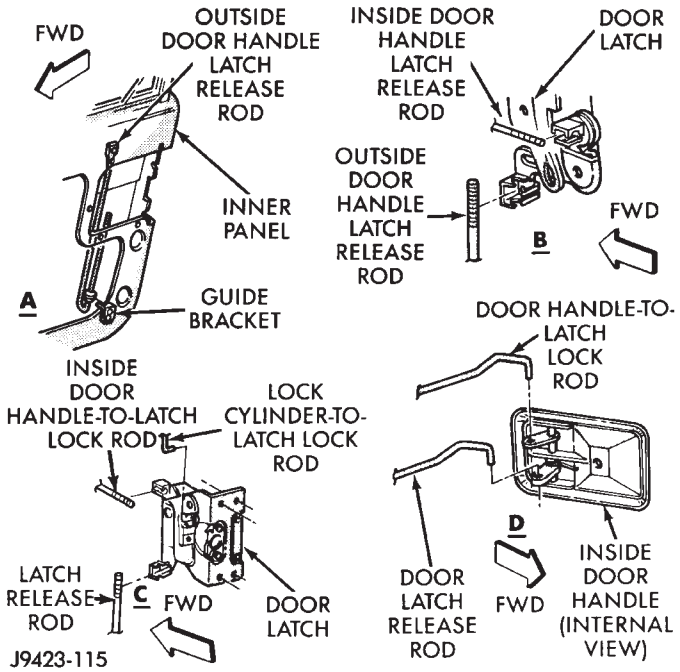

Fig. 19 Latch Rod Connections

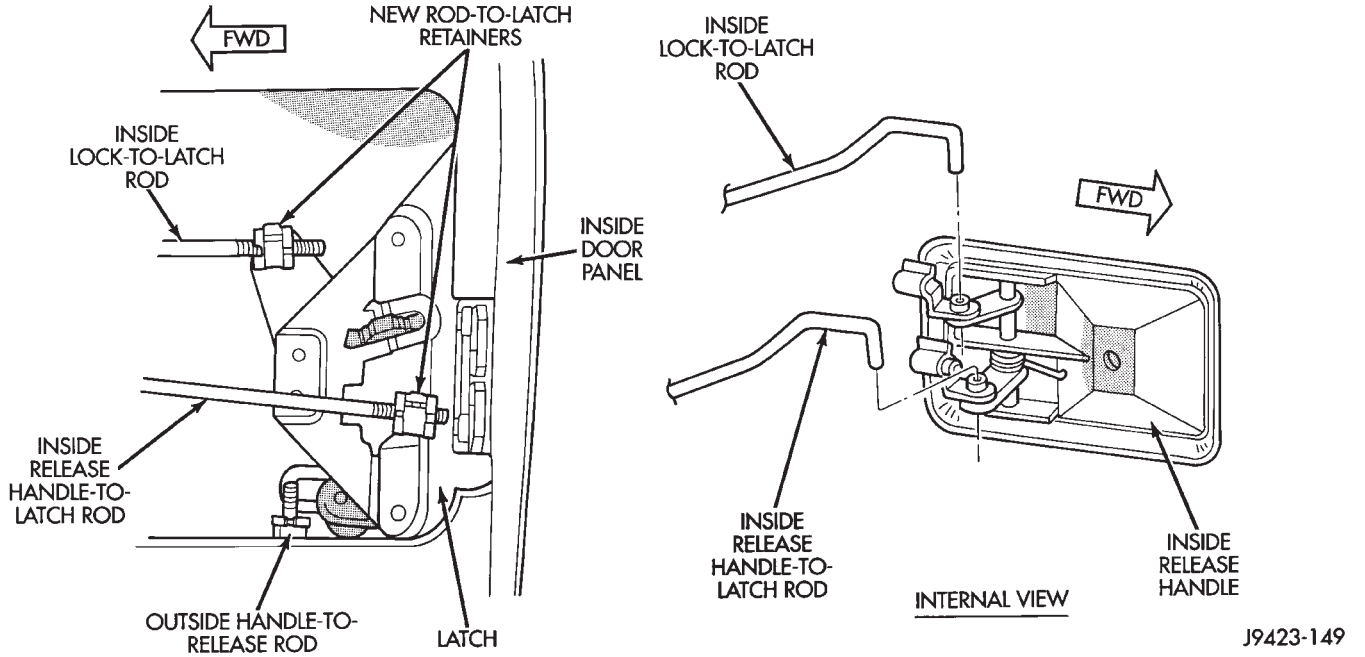

Fig. 20 Latch Rod Positions

FIXED WINDOW GLASS

INDEX

SERVICE INFORMATION

The following fixed window service information includes removal/installation procedures for the:

- windshield reveal moulding,
- rearview mirror,
- windshield frame,
- windshield frame weatherstrip seal,
- windshield glass (using both the short and the extended installation method), and
- hard top quarter (side) window glass.

WINDSHIELD REVEAL MOULDING

REMOVAL

(1) Disengage the reveal moulding around the perimeter of the windshield glass with an appropriate tool.

(2) Remove the mouldings from the windshield frame.

(3) Inspect the reveal moulding retainers. Replace the moulding if it has broken, distorted or ineffective retainers.

INSTALLATION

(1) Position the reveal mouldings on the windshield frame.

(2) Attach the mouldings to the frame by tapping each moulding with a rubber mallet to seat the retainers.

REARVIEW MIRROR

REMOVAL/INSTALLATION

(1) Loosen the mirror set screw and slide the mirror up and off the retaining bracket (Fig. 1).

(2) To install the mirror, slide the mirror onto the retaining bracket and install the set screw.

(3) Tighten the mirror setscrew to 1 N·m (9 in-lbs) torque.

CAUTION: Do not over-tighten the setscrew because glass chipping and/or breakage could result.

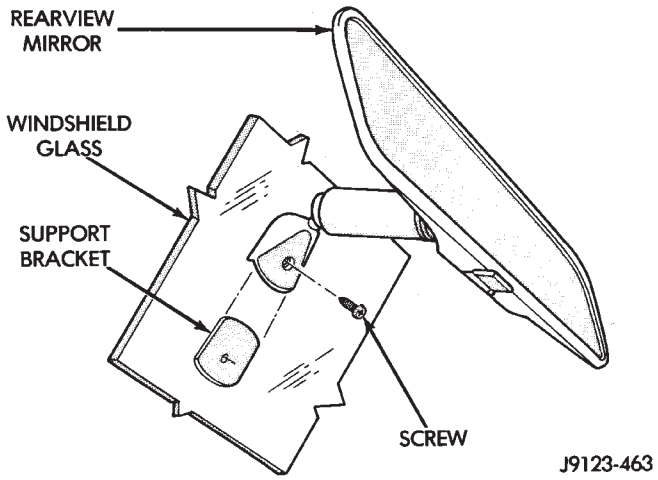

Fig. 1 Rearview Mirror Removal/Installation

REARVIEW MIRROR RETAINING BRACKET

REPLACEMENT

(1) Mark reference position lines for the mirror retaining bracket on the **outside** of the windshield glass with a wax pencil. Mark both horizontal and vertical reference lines for accurate bracket positioning.

(2) If the vinyl pad remained on the windshield glass, soften and remove it with a heat gun. Application of low heat will be sufficient to soften the pad.

(3) Thoroughly clean the bracket contact area on the glass. Use a mild abrasive cleaning powder on a cloth saturated with isopropyl (rubbing) alcohol. Final-clean the glass with a paper dampened with alcohol.

(4) Lightly sand the contact surface on the replacement bracket with fine grit sandpaper. Next, wipe the bracket contact surface clean with a paper towel and alcohol.

(5) Apply adhesive accelerator to the contact surface on the mirror bracket according to the following instructions:

- crush the vial in the plastic housing of the accelerator to saturate the felt applicator;
- remove the paper sleeve;
- apply a generous amount of accelerator to the contact surface on the mirror retaining bracket;

• do not touch the retaining bracket contact surface after the accelerator has been applied.
• allow the accelerator to dry for at least five minutes; and

(6) Apply accelerator to 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.

(7) Install the mirror retaining bracket according to the following instructions:
• apply one drop of adhesive at the center of the retaining bracket contact surface on the windshield glass;
• immediately apply an even coat of adhesive to the contact surface on the retaining bracket;
• align the retaining bracket with the position reference lines on the windshield glass, then
• press and hold the retaining bracket in-place for at least one minute.

Ensure that the mirror retaining bracket is correctly aligned because the adhesive will cure rapidly.

(8) Allow the adhesive to cure for 8-10 minutes, then remove any residue adhesive with an alcohol dampened cloth.

(9) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror on the retaining bracket (Fig. 1).

WINDSHIELD FRAME

SERVICE INFORMATION

The windshield frame and glass can be removed as a unit for service access (Fig. 2). The windshield frame can also be tilted forward to a full horizontal position and retained in-place with the strap when complete removal is not necessary.

REMOVAL

(1) Remove the windshield wipers. Refer to the removal procedure.

(2) For vehicles equipped with a soft top, disconnect the fabric top from the windshield frame retainer rail. If necessary, refer to the soft top removal procedure.

(3) For vehicles equipped with a hard top, disconnect the top from the windshield frame. Loosen the retaining screws, tilt the top rearward and support the top away from the windshield frame (Fig. 3).

(4) Remove the retaining screws and the windshield/door hinges from the cowl (Fig. 2).

(5) Remove the holddown bracket retaining screws from the cowl (Fig. 2).

(6) Remove the windshield frame and glass from the cowl as a unit (Fig. 2).

(7) If necessary, remove the sunvisors.

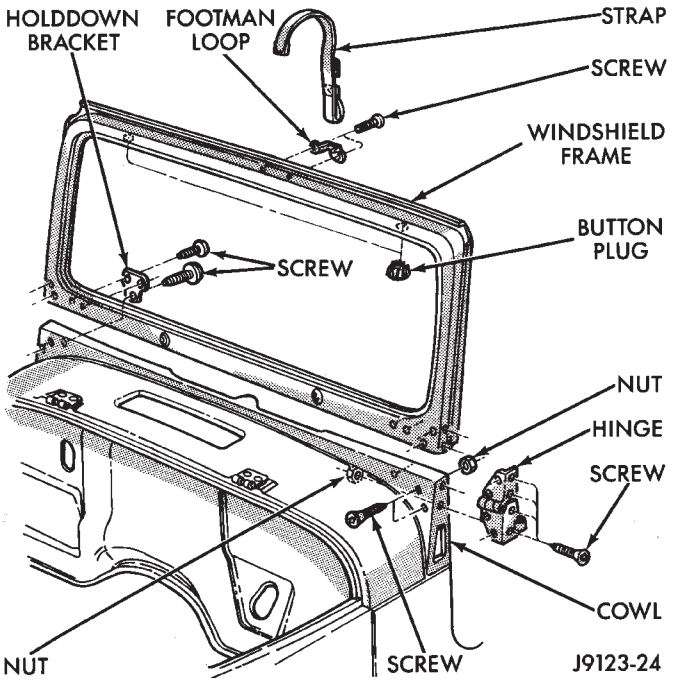

Fig. 2 Windshield Frame Removal/Installation

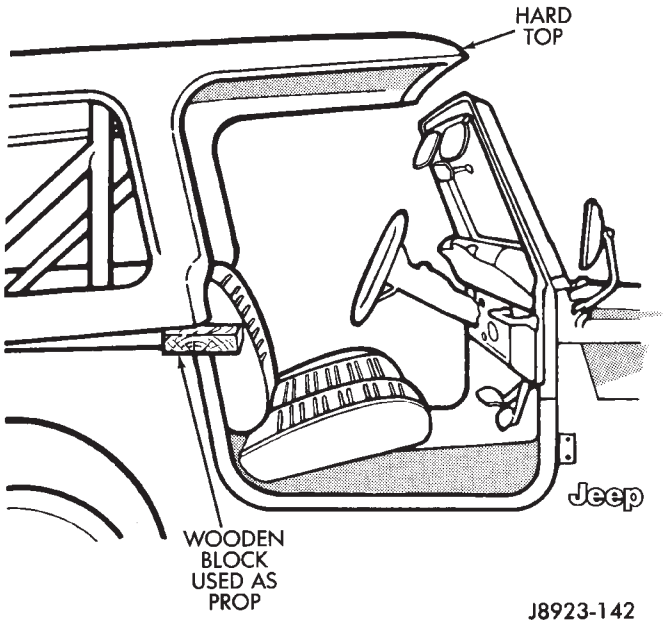

Fig. 3 Hard Top Detached From Windshield Frame

INSTALLATION

(1) Position the windshield frame on the cowl (Fig. 2).

(2) Install the holddown bracket retaining screws in the cowl (Fig. 2).

(3) Install the windshield/door hinge retaining screws (Fig. 2).

(4) Connect the top to the windshield frame. If necessary, refer to the applicable top installation procedure.

(5) For vehicles equipped with a soft top, connect the fabric top to the windshield frame retainer rail. If necessary, refer to the soft top installation procedure.

(6) For vehicles equipped with a hard top, remove the supports, tighten the retaining screws, and connect the top to the windshield frame (Fig. 3).

(7) Install the windshield wipers. Refer to the installation procedure.

(8) If removed, install the sunvisors.

WINDSHIELD FRAME WEATHERSTRIP SEAL

REMOVAL

The windshield frame weatherstrip seal can be removed and installed with the frame tilted forward to the full horizontal position (Fig. 4).

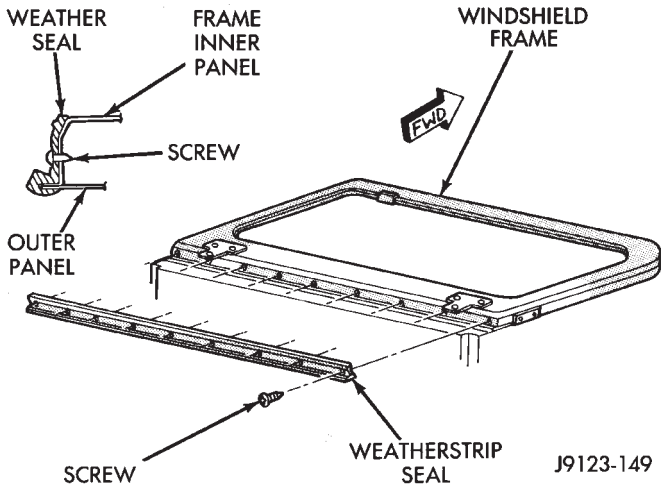

Fig. 4 Windshield Frame Weatherstrip Seal

(1) Disconnect the top from the windshield frame. If necessary, refer to the windshield frame removal procedure.

(2) Remove the holddown bracket retaining screws from the cowl (Fig. 2).

(3) Tilt the windshield frame forward to the full horizontal position (Fig. 94.

(4) Remove the retaining screws and the weatherstrip seal from the windshield frame (Fig. 4).

INSTALLATION

(1) Position the weatherstrip seal on the windshield frame (Fig. 4). Ensure that the frame outer panel flange is properly "seated" in the seal groove.

(2) Install the seal retaining screws in the windshield frame (Fig. 4).

(3) Tilt the windshield frame rearward to the full vertical position.

(4) Install the holddown bracket retaining screws in the cowl (Fig. 2).

(5) Connect the top to the windshield frame. If necessary, refer to the windshield frame installation procedure.

WINDSHIELD GLASS

SERVICE INFORMATION

URETHANE ADHESIVE BONDING

The one-piece windshield glass (Fig. 5) is comprised of two laminated sheets of glass. The glass is bonded to the windshield frame with urethane adhesive (Fig. 5). This method of windshield glass installation complies with the applicable Federal Motor Vehicle Safety Standards (FMVSS).

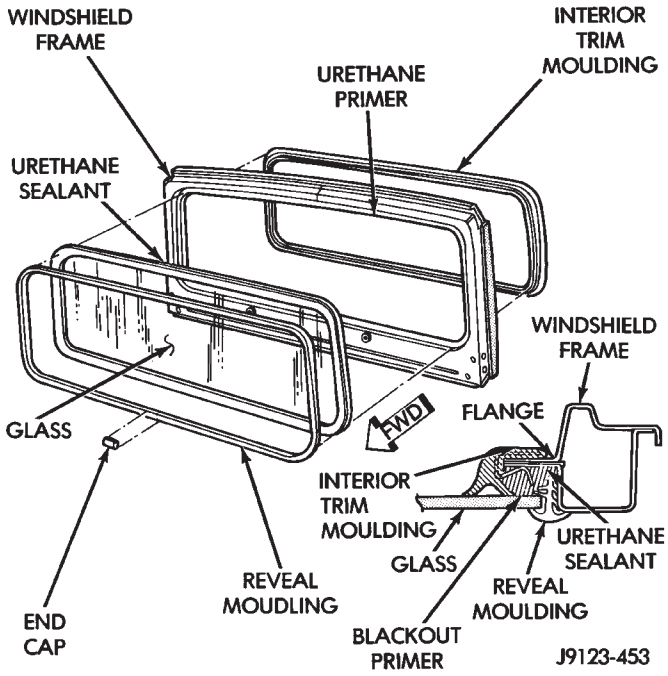

Fig. 5 Windshield Components

REMOVAL/INSTALLATION METHODS

For windshield glass removal use a razor knife or an electric hot knife to cut through the urethane. This removal method applies in all instances.

Depending on the circumstances, either one of two windshield glass installation methods can be used:

- the short method, and
- the extended method.

The short method is used when the windshield glass is removed intact and the windshield frame pinchweld flanges do not require repair.

The extended method must be used when a windshield frame and/or a pinchweld flange is damaged. The extended method must also be used when the urethane no longer adheres to either the windshield glass or the frame pinchweld flanges.

Remove windshield glass according to the procedure described below. Next, determine the condition of the adhesive bond and the windshield frame flanges, and then select the installation method required.

When the windshield glass short installation method is used, an even, uniform bead of urethane adhesive must remain on the frame pinchweld flanges. This adhesive bead is needed as a base for the replacement glass.

If the extended installation method is used, the original windshield interior trim moulding must be removed and discarded. The adhesive cannot be removed from the original moulding.

REMOVAL

(1) Cover body surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Remove the windshield wiper arms, the reveal moulding (Fig. 5) and the rearview mirror. If necessary, refer to the applicable removal procedures.

(3) Make a preliminary cut around the **perimeter** of the windshield glass along the glass edge with a razor knife.

CAUTION: When cutting through the urethane with a hot knife blade, do not allow the knife blade to remain stationary at any location.

(4) Cut the adhesive bead with a hot knife and a straight or hooked knife blade.

(5) Start the hot knife blade between the glass and the urethane. Next, cut the adhesive as close to the glass edge as possible. Allow as much adhesive to remain on the frame flange as possible. **For best cutting results, clean the knife blade frequently with steel wool while the blade is hot.**

(6) Remove the windshield glass from the frame (Fig. 5).

(7) After the hot knife blade has cooled, clean the hot knife blade with solvent and a cloth. Sharpen the blade with a fine-tooth file.

(8) If the extended windshield glass installation method will be used, remove and discard the interior trim moulding (Fig. 5).

INSTALLATION—SHORT METHOD

Normally, after a windshield is installed, the rearview mirror bracket also requires installation. If so, refer to the rearview mirror bracket replacement procedure. **Do not install bracket until after windshield installation is completed.**

(1) Inspect the windshield frame pinchweld flanges (Fig. 5) Prime any bare spots with urethane primer. Allow a minimum of 18 minutes for dry time.

(2) Inspect the urethane bead for high spots. Level the bead by shaving off high spots with a razor knife. This is necessary for a flush-fit of the windshield glass.

(3) Inspect the windshield moulding. Replace the moulding if it has broken, distorted or ineffective retainers.

(4) Clean the outer edge of the windshield glass with naphtha or a similar product.

(5) Prime the outer perimeter of the interior side of the glass 16 mm (5/8 inch) from the edge. Use a wipe-off type urethane primer and wipe the glass dry after primer application.

(6) Place the windshield glass in the frame on the pinchweld flanges and inspect for gaps in the urethane adhesive. Gaps in excess of 3 mm (1/8 inch) must be filled with additional urethane adhesive.

(7) Adjust windshield glass position until it is aligned with the flanges and the adhesive. Next, make alignment marks on glass and body with a grease pencil.

(8) Remove the windshield glass and position it on a flat surface.

(9) If the replacement windshield glass does not have blackout primer:

- attach a 25-mm (1-in) wide masking tape band around the interior side of the glass 16 mm (5/8 in) from the edge of the glass (Fig. 6);
- **attach the tape only to the interior side of the glass;**
- thoroughly mix and apply blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass (Fig. 6); then

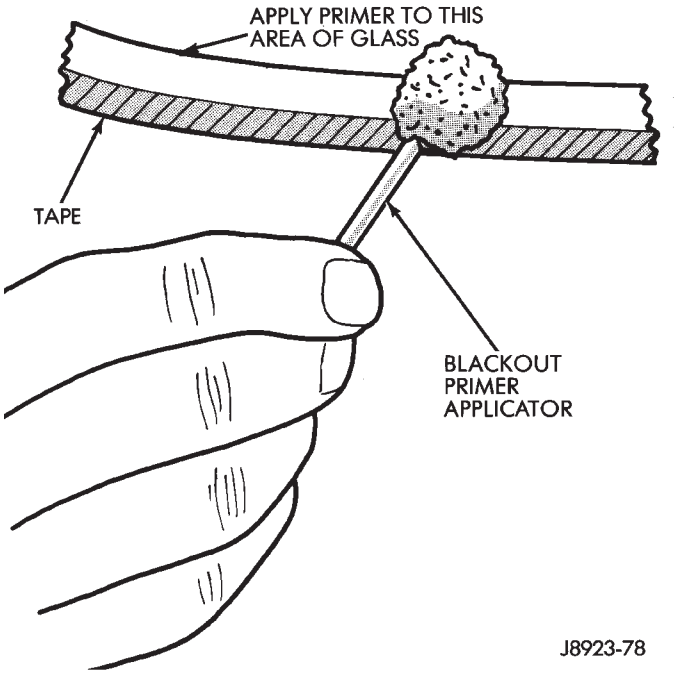

Fig. 6 Blackout Primer Application

- allow the primer to dry for at least 10-12 minutes.

(10) Cut the urethane adhesive applicator nozzle according to the instructions in Figure 7.

(11) Apply a 3-mm (1/8-in) diameter bead of urethane to the surface area.

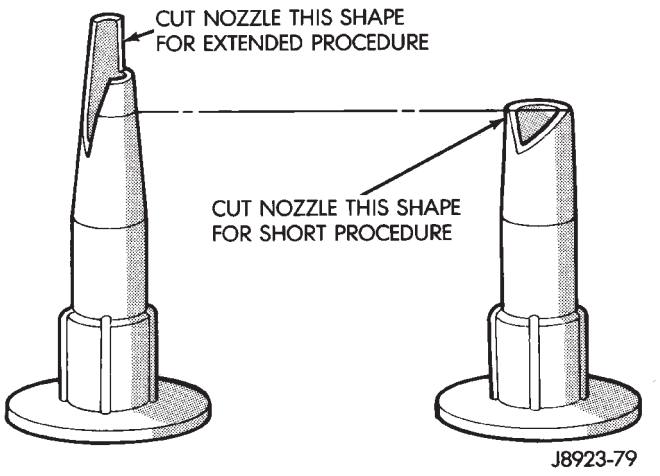

Fig. 7 Applicator Nozzle Preparation

CAUTION: Be prepared to install the windshield glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(12) Align the windshield with the grease pencil marks (or the tape strips) and position windshield on frame flanges.

(13) Force the windshield glass inward just enough to wet-out and set urethane. Use care to avoid excessive squeeze-out of adhesive.

(14) Water test the windshield with a cold water spray after installation. Do not direct high pressure streams of water directly at the urethane. Use a moderate spray only. If any leaks are detected, apply urethane as necessary.

(15) Install the windshield reveal moulding and (if used) remove the masking tape from the inner surface of the glass.

(16) Install all removed components and clean the vehicle. If necessary, refer to the applicable installation procedures.

(17) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

(18) Install the rearview mirror on the bracket and tighten the mirror setscrew with 2 N·m (15 in-lbs) torque.

INSTALLATION—EXTENDED METHOD

Normally, after a windshield is installed, the rearview mirror bracket also requires installation.**Do not install the bracket until after the windshield installation is completed.**

(1) Remove all of the original urethane from all the frame pinchweld flanges. Use an electric hot knife and a plow-type knife blade to remove the adhesive.

(2) Inspect and repair the windshield frame and the pinchweld flanges as necessary.

(3) Inspect and replace the reveal moulding if the retainers are damaged.

(4) Prime the frame pinchweld flanges with a urethane base primer. However, if the flange is topcoated with paint, prime the flanges with a paint finish primer. **This is important because urethane adhesive will not adhere to all top coat paints.**

(5) Install the replacement interior trim moulding (Fig. 5) on the frame pinchweld flanges (Fig. 5).

(6) Install and inspect the fit of the windshield glass on the pinchweld flanges according to the following instructions:

- position the windshield glass on the flanges and adjust the position until it is correctly aligned within the windshield frame;
- measure the gap between the frame and the glass around the entire perimeter of the glass and the flange;
- the gap should be at least 3 mm (1/8 in) but no more than 6 mm (1/4 in) at any point around the perimeter; and
- the flanges should in complete contact with the glass around the perimeter of the frame.

(7) If the pinchweld flanges require repair, remove the windshield glass and straighten, align, or repair the flange(s) as necessary.

(8) Position the windshield on the flanges and inspect the windshield fit again. If the fit is acceptable, mark windshield final position on the glass and the frame. The marks (or masking tape) will be used for installation alignment reference.

(9) If the replacement windshield glass does not have blackout primer:

- attach a 25-mm (1-in) wide masking tape band around the interior side of the glass 16 mm (5/8 in) from the edge of the glass (Fig. 6);
- **attach the tape only to the interior side of the glass;**
- thoroughly mix and apply blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass (Fig. 6); then
- allow the primer to dry for at least 10-12 minutes.

(10) Cut the urethane adhesive applicator nozzle according to the instructions in Figure 7.

(11) Apply a 3-mm (1/8-in) diameter bead of urethane to the surface area.

CAUTION: Be prepared to install the windshield glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(12) Align windshield with reference marks (or the tape strips) and position it on the frame pinchweld flanges.

(13) Force the windshield glass inward just enough to wet-out and set urethane. Use care to avoid excessive squeeze-out of adhesive.

(14) Water test the windshield with a cold water spray after installation. Do not direct high pressure

streams of water directly at the urethane. Use a moderate spray only. If any leaks are detected, apply urethane as necessary.

(15) Install the windshield reveal moulding and (if used) remove the masking tape from the inner surface of the glass.

(16) Install all the other previously removed components and clean the vehicle. If necessary, refer to the applicable installation procedures.

(17) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

(18) Install the rearview mirror on the bracket and tighten the mirror setscrew to 2 N·m (15 in-lbs) torque.

HARD TOP QUARTER WINDOW GLASS

REMOVAL

(1) Cover surface areas with protective covering to avoid paint damage and extra clean-up time.

(2) Remove the reveal moulding (Fig. 8).

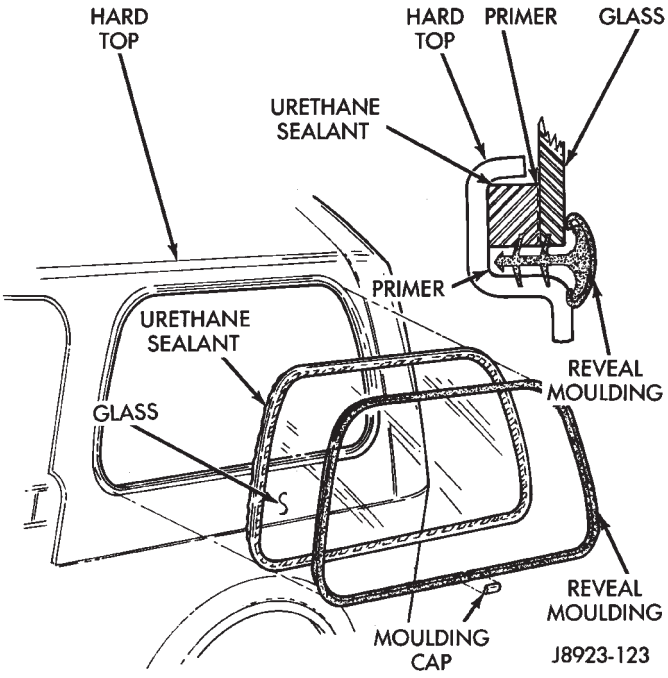

Fig. 8 Hard Top Quarter Window Glass

(3) Make a preliminary cut around the **perimeter** of the window glass along the glass edge with a razor knife.

CAUTION: When cutting through the urethane with a hot knife blade, do not allow the knife blade to remain stationary at any location.

(4) Cut the adhesive bead with a hot knife and a hooked knife blade.

(5) Start hot knife between glass and urethane. Next, cut the adhesive as close to the glass edge as possible. Allow as much adhesive to remain on the window opening flange as possible. **For best cutting results, clean the knife blade frequently with steel wool while the blade is hot.**

(6) Remove the window glass from the opening (Fig. 8).

(7) After the hot knife blade has cooled, clean the hot knife blade with solvent and a cloth. Sharpen the blade with a fine-tooth file.

INSTALLATION

(1) Inspect the window opening (Fig. 8) Prime any bare spots with urethane primer. Allow a minimum of 18 minutes for dry time.

(2) Inspect the urethane bead for high spots. Level the bead by shaving off high spots with a razor knife. This is necessary for a flush-fit of the window glass.

(3) Inspect the window moulding. Replace the moulding if damaged.

(4) Clean the outer edge of the window glass with naphtha or a similar product.

(5) Prime the outer perimeter of the interior side of the glass 16 mm (5/8 inch) from the edge. Use a wipe-off type urethane primer and wipe the glass dry after primer application.

(6) Place windshield in the opening and inspect for gaps in the urethane. Gaps in excess of 3 mm (1/8 inch) must be filled with urethane.

(7) Adjust window glass position until it is aligned with the opening and the adhesive.

(8) Remove the window glass and position it on a flat surface.

(9) If the replacement window glass does not have blackout primer:

- attach a 25-mm (1-in) wide masking tape band around the interior side of the glass 16 mm (5/8 in) from the edge of the glass;
- **attach the tape only to the interior side of the glass;**
- thoroughly mix and apply blackout primer to the 16 mm (5/8 in) surface area around the interior side of the glass; then
- allow the primer to dry for at least 10-12 minutes.

(10) Apply a 3-mm (1/8-in) diameter bead of urethane to the surface area with the blackout primer on the interior side of the glass.

CAUTION: Be prepared to install glass immediately after applying the adhesive. The adhesive begins to cure within 10-15 minutes.

(11) Align the window glass with the grease pencil alignment reference marks (or the tape strips) and position it in the window opening.

(12) Force glass inward just enough to wet-out and set urethane. Use care to avoid excessive squeeze-out of adhesive.

(13) Water test with a cold water spray after installation. Do not direct high pressure streams of wa-

ter directly at the urethane. Use a moderate spray only. If any leaks are detected, apply urethane as necessary.

(14) Install the window reveal moulding and (if used) remove the masking tape from the inner surface of the glass.

(15) Clean the vehicle.

(16) Open windows and liftgate to prevent pressure build-up while the urethane is curing.

FIXED GLASS WATER LEAK DETECTION AND REPAIR

The sources of water leaks around windshield/window glass can be sealed without removing the windshield/window glass. If the glass is firmly bonded and only has a small leak, seal areas with a liquid butyl sealant. However, if weatherstrip seal or urethane sealant has large breaks, a urethane sealant must be used.

LEAK TEST

Water test the windshield/window with a spray only. **Do not use hard streams of water.** Work from the bottom to the top of the windshield/window.

Water test the windshield/window with a spray only. **Do not use hard streams of water.** Work from the bottom to the top of the windshield/window glass.

If a water leak exists between the glass and weatherstrip seal (or between the seal and a body flange):

- push the glass outward at the leak area, and
- determine the extent of the gap.

Push the glass outward while a helper sprays the windshield/window glass with water.

SEALING MINOR LEAK AREAS

(1) Thoroughly clean and remove all foreign material from the leak area. Dry the area with compressed air.

(2) Seal the leak area with butyl sealant. Allow the sealant to cure for at least 1/2 hour. Next, water test the glass to ensure that the leak area is sealed.

SEALING MAJOR LEAK AREAS

(1) Thoroughly clean the leak area.

(2) As applicable, apply primer to either glass or weatherstrip seal leak area. Use blackout primer on the glass and urethane primer on the weatherstrip seal.

(3) Apply urethane to the leak area. Use an adhesive cartridge with a pointed nozzle.

(4) Water test glass immediately with cold water spray. Allow the water to spill over the edge of glass and weatherstrip seal.

(5) Apply additional adhesive, if necessary.

(6) Remove any excess adhesive.

INTERIOR COMPONENTS

INDEX

INSTRUMENT PANEL

SERVICE INFORMATION

The instrument panel is constructed of sheet metal and is attached to cowl panel with screws. The instrument panel and defroster grille pad is attached to the instrument panel with screws.

INSTRUMENT CLUSTER AND GAUGE HOUSINGS

REMOVAL

(1) Remove the instrument cluster and gauge housing attaching screws (Figs. 1, 2 and 3).

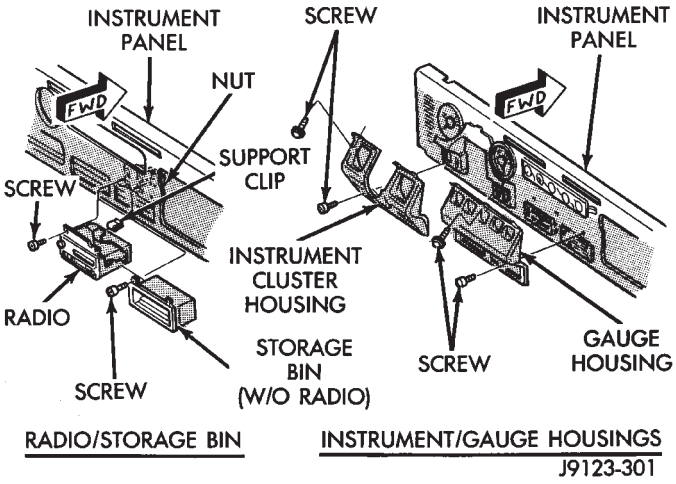

Fig. 1 Instrument Cluster/Gauge Housing and Radio

(2) Disconnect the switch illumination bulb socket from the instrument cluster housing (Fig. 4). Remove the housings from the instrument panel (Fig. 1).

INSTALLATION

(1) Position the instrument cluster and gauge housings on the instrument panel (Fig. 1). Connect the switch illumination bulb socket to the instrument cluster housing (Fig. 4).

(2) Install the attaching screws (Figs. 1, 2 and 3). Tighten the screws to 3 N·m (24 in-lbs) torque.

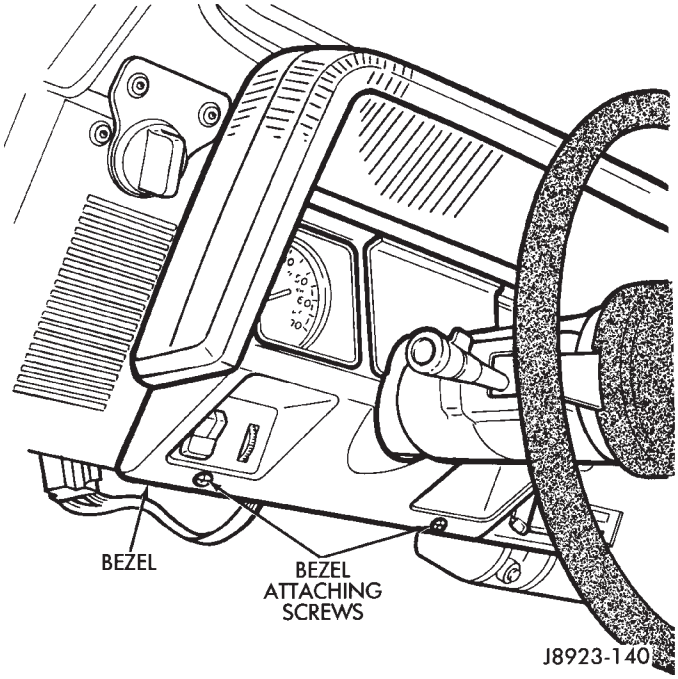

Fig. 2 Instrument Cluster Housing Lower Screws

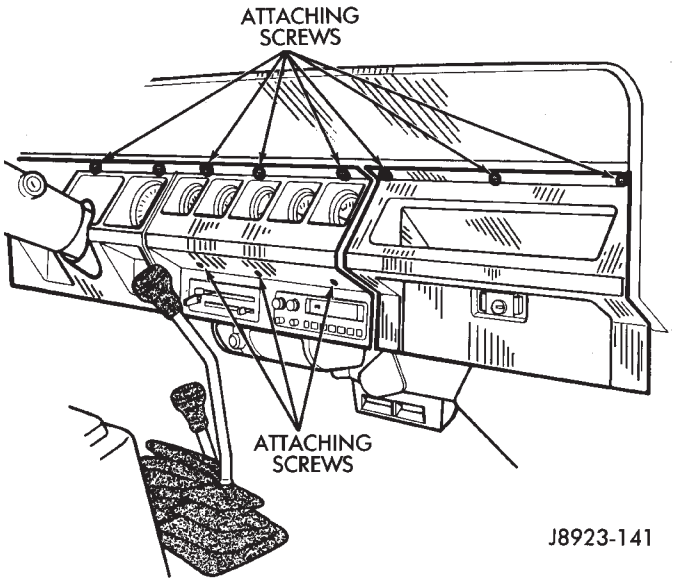

Fig. 3 Instrument Gauge Housing Screws

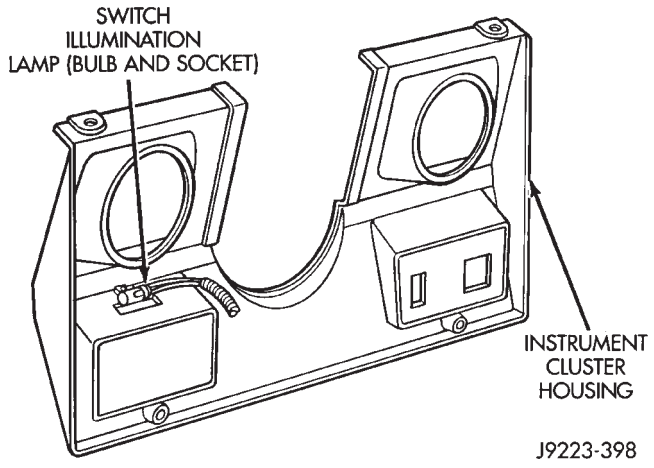

Fig. 4 Instrument Cluster Housing and Lamp

INSTRUMENT CLUSTER BEZEL

REMOVAL

(1) Remove the instrument cluster housing attaching screws (Figs. 1, 2 and 3).

(2) Disconnect the switch illumination bulb from instrument cluster (Fig. 4). Remove the housing from the instrument panel (Fig. 1).

(3) Remove the bezel retaining screws.

(4) Disconnect the accessory switch, warning indicator, rheostat and lamp wire harness connectors from the bezel (Fig. 5).

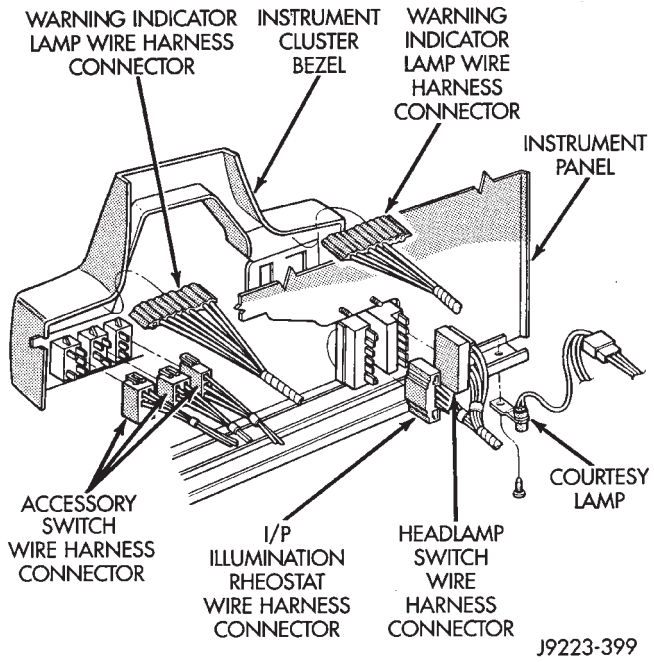

Fig. 5 Instrument Cluster Bezel

(5) Remove the bezel from the instrument panel (Fig. 6).

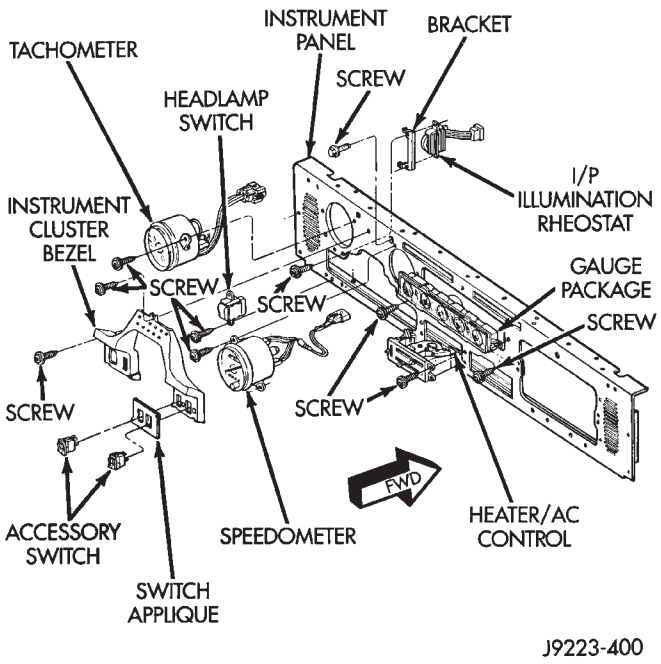

Fig. 6 Instrument Panel Components

INSTALLATION

(1) Position bezel at the instrument panel and connect accessory switch, warning indicator, rheostat and lamp wire harness to bezel.

(2) Install the bezel screws. Tighten the screws to 3 N·m (24 in-lbs) torque.

(3) Position the instrument cluster housing on the instrument panel (Fig. 1). Connect the switch illumination bulb socket to the instrument cluster housing (Fig. 4).

(4) Install the attaching screws (Figs. 1, 2 and 3). Tighten the screws to 3 N·m (24 in-lbs) torque.

INSTRUMENT PANEL COMPONENTS

REMOVAL

(1) Remove the instrument cluster and gauge housings from the instrument panel (Fig. 1). If applicable, remove the bezel from the instrument panel.

(2) Remove the screws, disconnect the wire harness connector(s) and remove the component from the instrument panel.

INSTALLATION

(1) Position the component at the instrument panel, connect the wire harness connector(s) and install screws. Tighten the screws to 3 N·m (24 in-lbs) torque.

(2) If removed, install the instrument cluster bezel on the instrument panel. Install the instrument cluster and gauge housings on the instrument panel (Fig. 1).

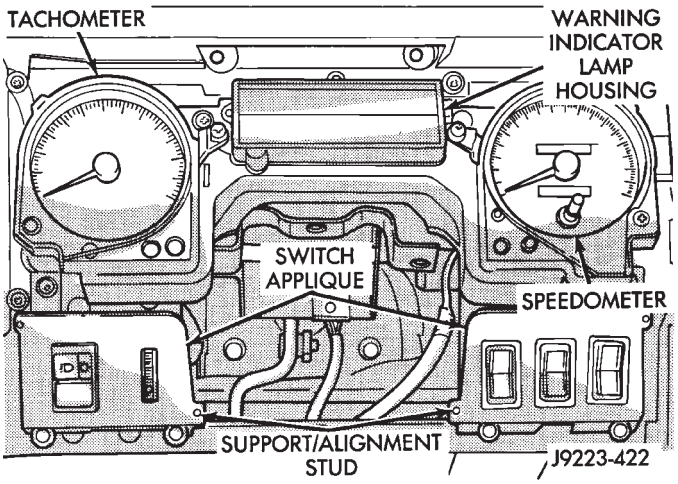

Fig. 7 Instrument Cluster

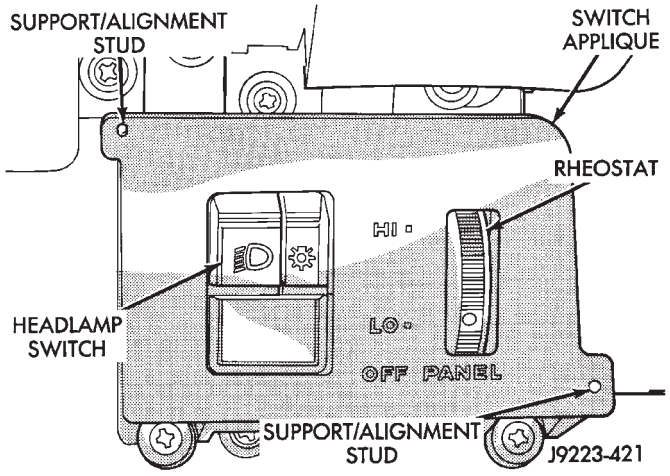

Fig. 8 Headlamp Switch, Rheostat and Applique

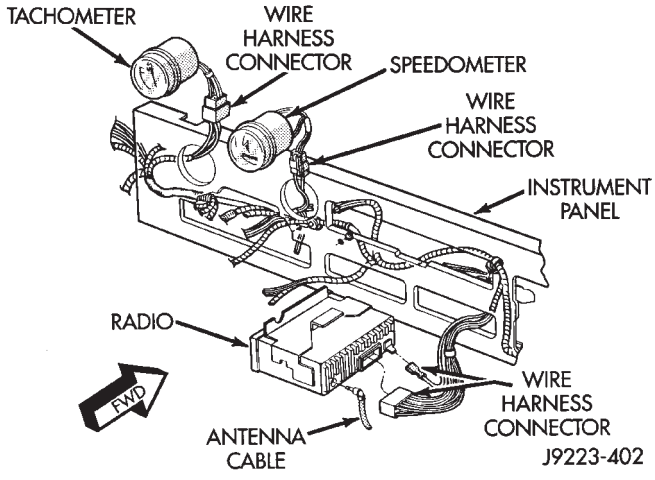

Fig. 9 Tachometer, Speedometer and Radio

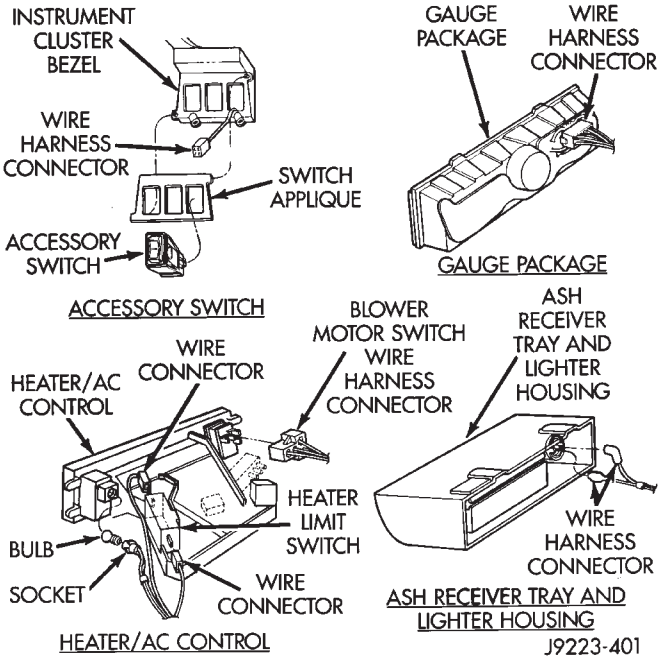

Fig. 10 Switch, Gauge Package, HEVAC Control and Ash Receiver

INSTRUMENT PANEL SERVICE

REMOVAL

(1) Disconnect the battery negative cable.

(2) For vehicles equipped with a soft top, disconnect the top from the windshield frame. If necessary, refer to the top removal procedure.

(3) For vehicles equipped with a hard top, disconnect the top from the windshield frame. Loosen screws, tilt the top rearward and support it away from the windshield frame (Fig. 11).

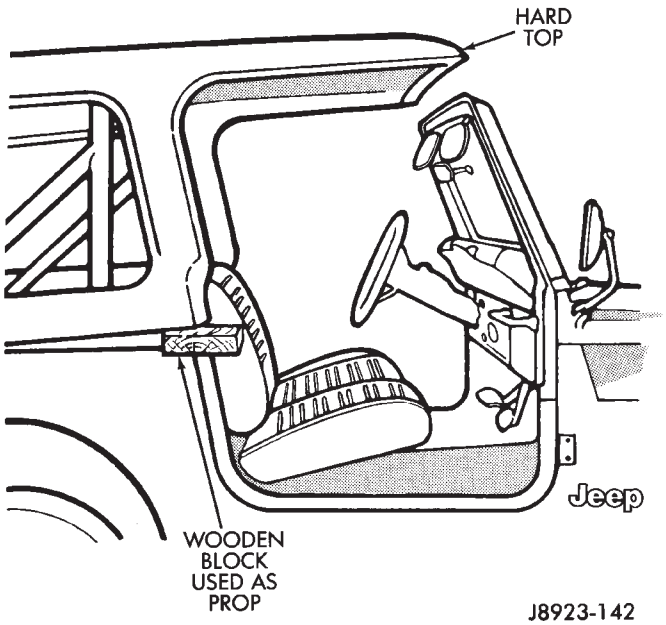

Fig. 11 Hard Top Detached From Windshield Frame

(4) Cover the hood surface area in front of the windshield.

(5) Remove the windshield-to-instrument panel retaining brackets (Fig. 12) and tilt the windshield forward onto the top of the hood.

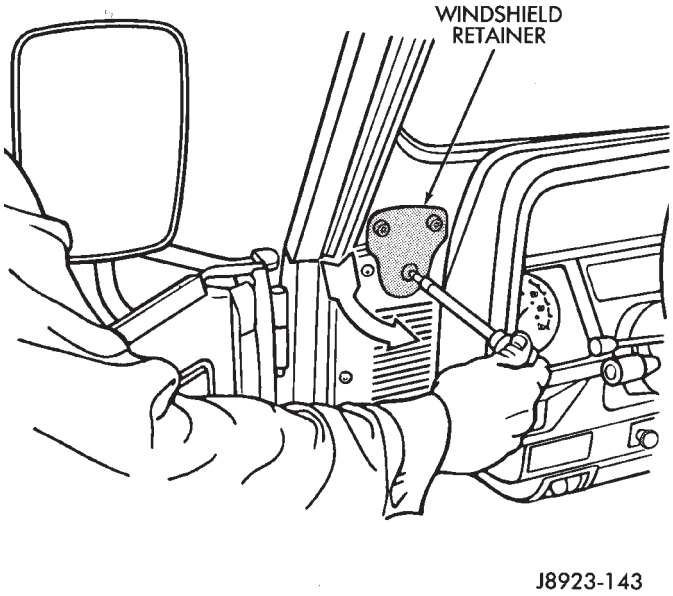

Fig. 12 Windshield Frame Retaining Bracket

(6) Remove the instrument cluster and gauge housings (Fig. 1) from the panel.

(7) For vehicles with air conditioning, remove the screws from evaporator to instrument panel. Lower the evaporator to the floor panel (Fig. 13).

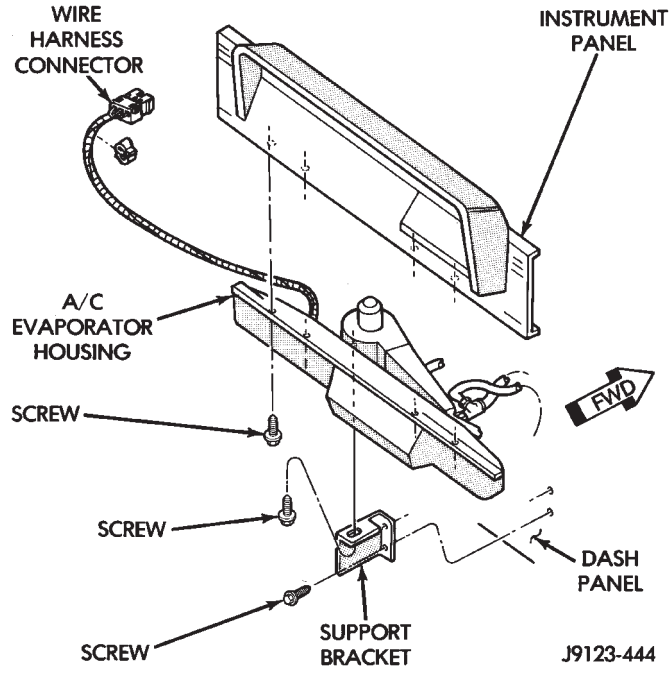

Fig. 13 Evaporator Removal/Installation

(8) Remove the assist handle and the glove box housing (Fig. 14).

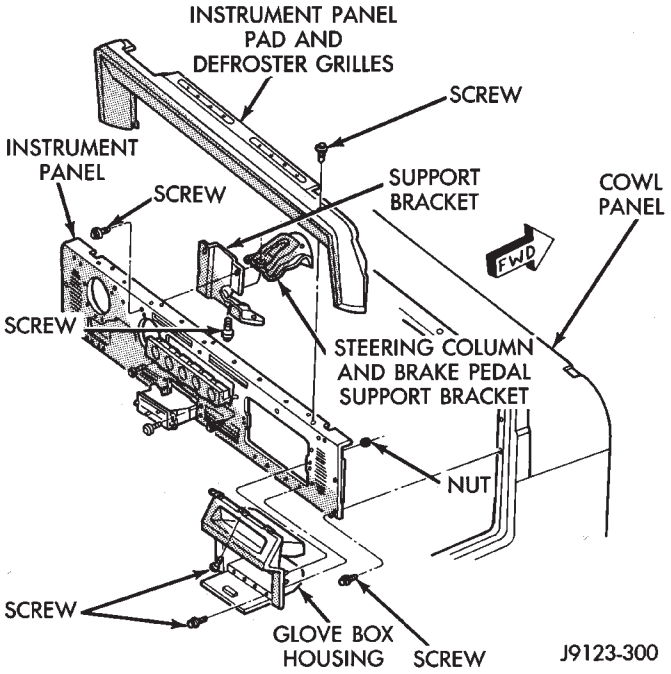

Fig. 14 Instrument Panel Removal/Installation

(9) Remove the screws that attach the pad to the instrument panel and remove the pad (Fig. 14).

(10) Disconnect the parking brake lever bracket from the dash panel.

(11) Disconnect the speedometer cable and the instrument cluster wire harness connectors.

(12) Disconnect HEVAC control cables from the damper door levers.

(13) Remove screws and separate the steering column support brackets (Fig. 15).

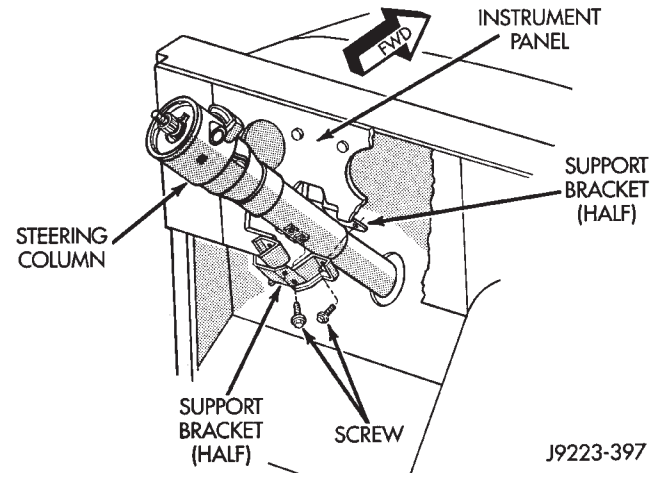

Fig. 15 Steering Column Bracket Separation

(14) Remove steering column from vehicle.

(15) Remove the instrument panel-to-cowl panel attaching screws (Fig. 14) and remove the instrument panel from the vehicle.

(16) If necessary, remove the defroster duct outlet from the dash panel (Fig. 16).

(17) If necessary, remove the ash receiver tray/

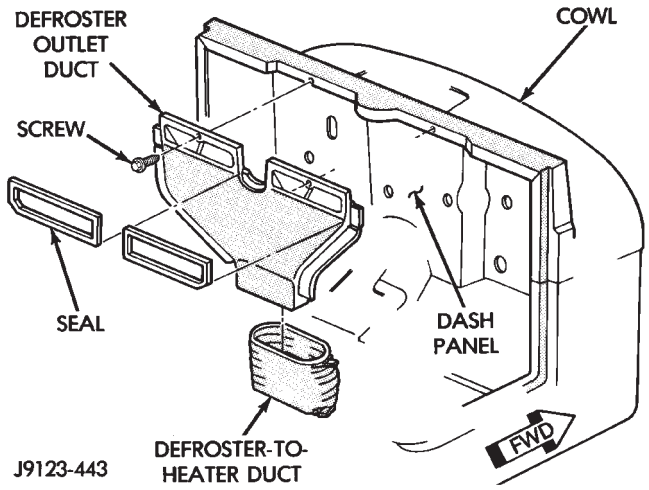

Fig. 16 Defroster Duct Outlet Removal/Installation

housing and the radio speaker from the instrument panel (Fig. 17).

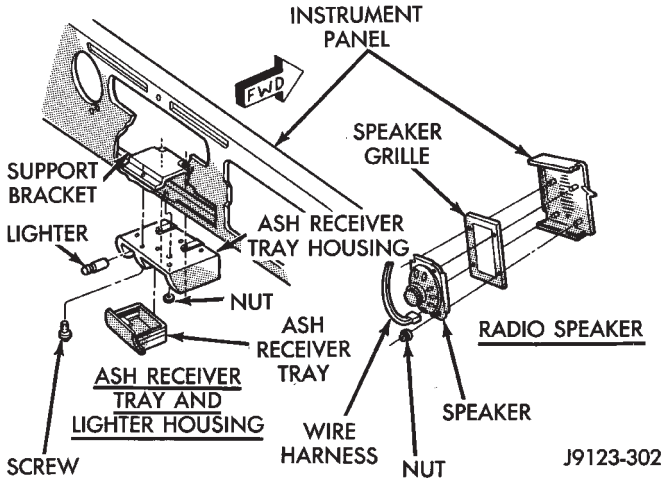

Fig. 17 Ash Receiver and Radio Speaker Removal/ Installation

INSTALLATION

(1) As necessary, install the components that were removed from the instrument panel (Fig. 17).

(2) If removed, install the defroster duct outlet on the dash panel (Fig. 16).

(3) Position the instrument panel on the dash panel and install the attaching screws (Figs. 18 and 14).

(4) Install steering column in vehicle.

(5) Join the steering column support brackets and install screws (Fig. 15). Tighten the screws to 27 N·m (20 ft-lbs) torque.

(6) Install the pad on the instrument panel (Fig. 14).

(7) Connect the speedometer cable and the instrument cluster wire harness connectors.

(8) Install the instrument cluster and gauge housings (Fig. 1).

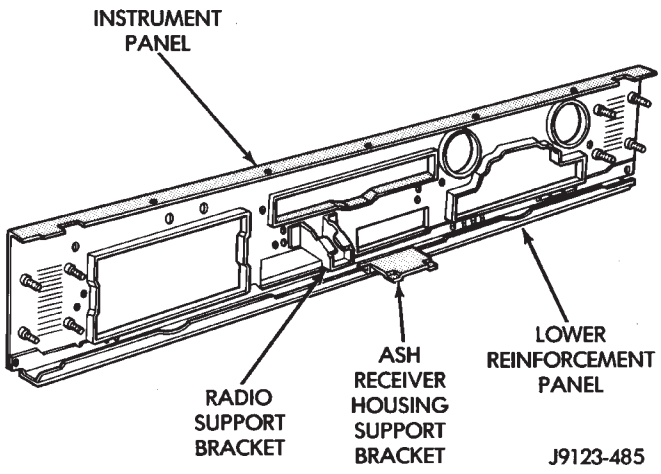

Fig. 18 Instrument Panel

(9) If equipped, raise and install the A/C evaporator on the instrument panel (Fig. 13). Tighten the screws to 3 N·m (30 in-lbs) torque.

(10) Install the HEVAC control cables.

(11) Install the parking brake lever bracket.

(12) Install the glove box housing (Fig. 14).

(13) Move the windshield to the upright position and install the windshield retaining brackets (Fig. 12).

(14) For hard top equipped vehicles, remove the supports. Correctly position the top on the windshield and the body, and install screws securely.

(15) For soft top equipped vehicles, attach the top to the windshield and side retainers.

(16) Connect the battery negative cable.

GLOVE BOX

HOUSING REMOVAL

(1) Remove the glove box-to-instrument panel retaining screws (Fig. 14).

(2) Pull the glove box housing out of the instrument panel opening (Fig. 14).

HOUSING INSTALLATION

(1) Position the glove box housing in the instrument panel opening (Fig. 14).

(2) Install the glove box-to-instrument panel screws (Fig. 14). Tighten the screws securely.

DOOR AND HINGE

The glove box door hinge attaching screw holes are elongated for adjustment. The hinge screws can be loosened and the door moved in direction for the best fit within the door opening.

REMOVAL

(1) Remove the hinge-to-glove box housing retaining screws.

(2) Remove the door and the hinge from the glove box housing.

(3) If necessary, remove the retaining screws and the hinge from the glove box door.

INSTALLATION

(1) If removed, install the hinge on the glove box door with screws. Tighten the screws securely.

(2) Position the glove box door and hinge on the glove box housing.

(3) Install the hinge-to-glove box housing screws and adjust the door for proper fit within the opening. Tighten the screws securely.

DOOR LATCH STRIKER ADJUSTMENT

The glove box door lock cylinder latch striker is attached to the glove box housing opening with screws. The striker can be moved in or out for adjustment.

SEATS

Bucket-type front seats (Fig. 19) are standard on YJ vehicles. The rear passenger seat is a forward pivoting/folding, bench-type seat (Fig. 20).

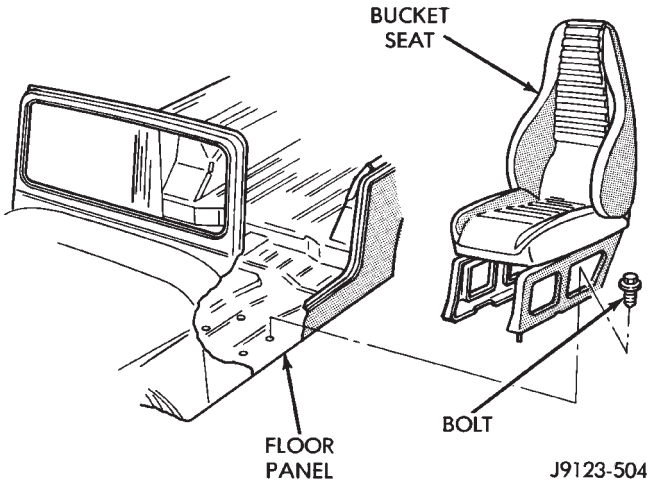

Fig. 19 Bucket Front Seat

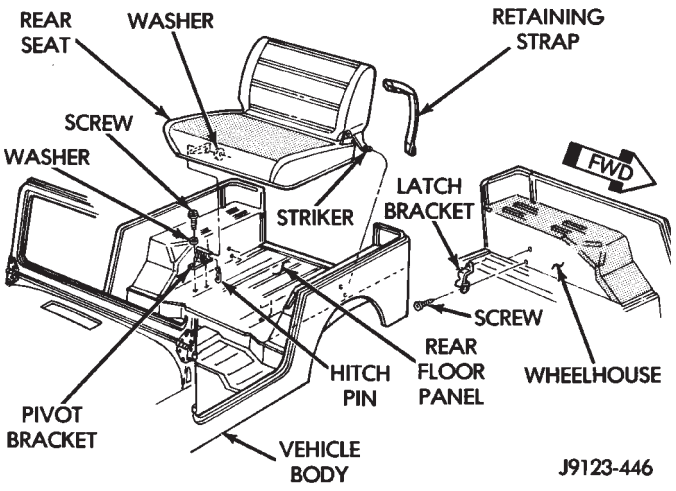

Fig. 20 Pivoting/Folding, Bench-Type Rear Seat

The passenger-side (RH), front bucket seat frame is the tilt-type (Fig. 21). The driver-side (LH) seat is fixed in-place.

Both the passenger-side (RH) seat and the driver-side (LH) seat have fore-and-aft track adjustment.

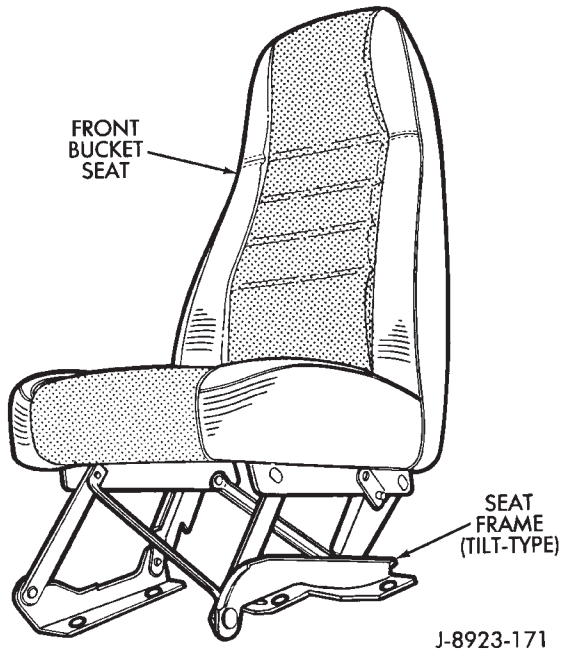

Fig. 21 Passenger-Side Bucket Front Seat

BUCKET SEATS

REMOVAL/INSTALLATION

The front seat frames/platforms are attached to the floor panel.

REAR BENCH SEAT

The rear bench seat pivot brackets are attached to the floor panel with screws. The front of the seat is attached to the pivot brackets with washers and hitch pins.

REMOVAL

(1) Disengage the strikers from the latches (Fig. 20).

(2) Remove the hitch pin, disengage the seat frame from the pivots and remove the seat from the vehicle (Fig. 20).

INSTALLATION

(1) Position the seat on the rear floor panel and engage the seat frame with the pivots (Fig. 20).

(2) Install the hitch pin (Fig. 20).

(3) Pivot the seat rearward and engage the strikers with the latch brackets (Fig. 20).

FRONT SHOULDER BELTS

REMOVAL

(1) Remove the cover and the shoulder belt buckle anchor bolt from the floor panel (Fig. 22).

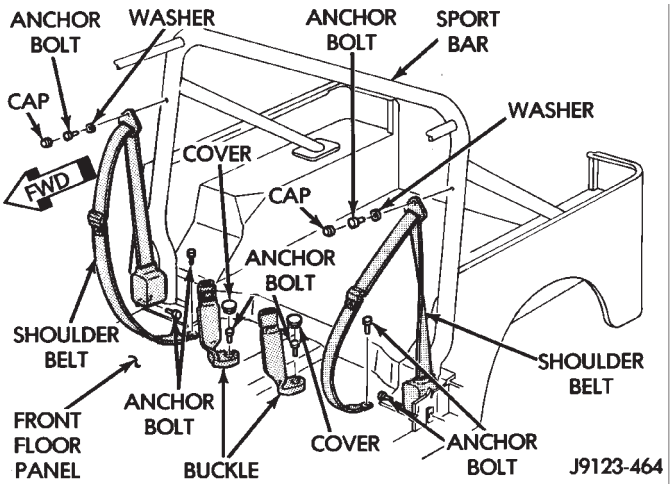

Fig. 22 Front Shoulder Belts

(2) Remove the shoulder belt buckle from the floor panel (Fig. 22).

(3) Remove the cap, shoulder belt upper anchor bolt, washer and guide from the sport bar (Fig. 22).

(4) Remove the retractor anchor bolt from the door sill (Fig. 22).

(5) Remove the anchor bolt that attaches the lower part of the shoulder belt to the floor panel (Fig. 22).

(6) Remove the shoulder belt from the vehicle.

(7) Inspect the shoulder belt for evidence of wear, cuts and fraying. Replace any belt that is damaged.

INSTALLATION

(1) Position the end of the shoulder belt at the floor panel and the retractor at the door sill (Fig. 22).

(2) Install the anchor bolts (Fig. 22). Tighten the bolts to 41 N·m (30 ft-lbs) torque.

(3) Position the shoulder belt guide on the sport bar and install the anchor bolt (Fig. 22). Tighten the bolt to 41 N·m (30 ft-lbs) torque.

(4) Install the cap on the anchor bolt (Fig. 22).

(5) Install the shoulder belt buckle at the floor panel with the anchor bolt. Tighten the bolt to 41 N·m (30 ft-lbs) torque.

(6) Install the cover on the anchor bolt (Fig. 22).

REAR SHOULDER BELTS

REMOVAL

(1) Remove the shoulder belt buckle anchor bolt from the rear floor panel.

(2) Remove the shoulder belt buckle from the rear floor panel.

(3) Remove the shoulder belt upper anchor bolt, washer and support/guide from the sport bar (Fig. 23).

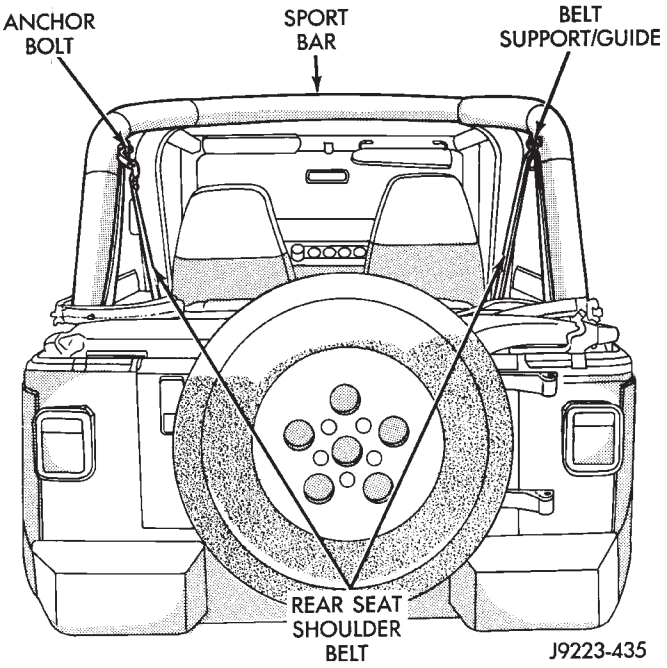

Fig. 23 Rear Shoulder Belts

(4) Remove the retractor anchor bolt from the quarter panel.

(5) Remove the anchor bolt that attaches the lower part of the shoulder belt to the floor panel.

(6) Remove the shoulder belt from the vehicle.

INSTALLATION

(1) Position the lower end of the shoulder belt at the floor panel and the retractor at the quarter panel.

(2) Install the anchor bolts. Tighten the bolts to 41 N·m (30 ft-lbs) torque.

(3) Position the shoulder belt support/guide on the sport bar and install the anchor bolt (Fig. 24). Tighten the bolt to 41 N·m (30 ft-lbs) torque.

(4) Install the shoulder belt buckle at the floor panel with the anchor bolt. Tighten the bolt to 41 N·m (30 ft-lbs) torque.

SUNVISORS

REMOVAL

(1) Remove the screws that attach the sunvisor arm support brackets to the windshield frame (Fig. 25).

(2) Remove the sunvisor from the windshield frame (Fig. 25).

(3) Remove the sunvisor from the vehicle.

INSTALLATION

(1) If applicable, replace the labels (Fig. 25).

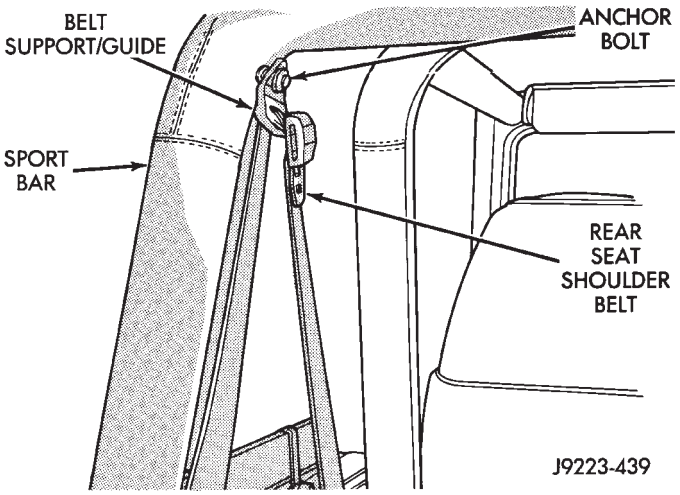

Fig. 24 Rear Shoulder Belt

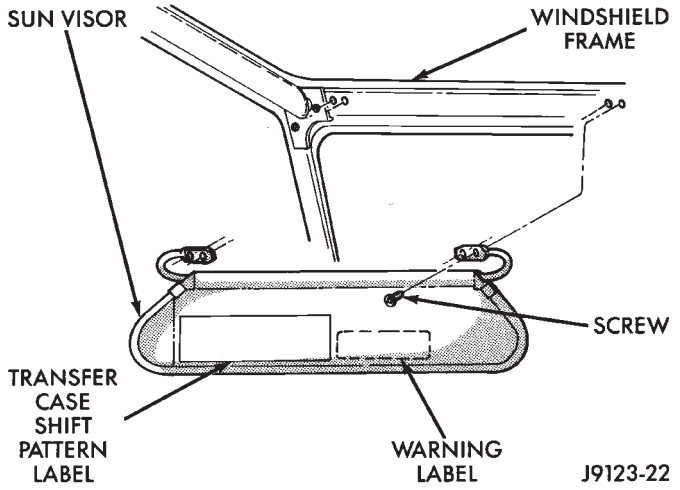

Fig. 25 Sunvisor Removal/Installation

(2) Position the sunvisor on the windshield frame and align the arm support bracket holes with the frame (Fig. 25).

(3) Install the screws that attach the sunvisor arm support brackets to the frame (Fig. 25). Tighten the screws securely.

FLOOR CONSOLES

Floor consoles (Figs. 26 and 27) are fabricated from molded plastic material. The console covers have a locking top and provisions for beverage containers.

REMOVAL

(1) Open the console cover (Figs. 26 and 27).

(2) Remove the screws that attach the console to the floor panel (Figs. 26 and 27).

(3) Remove the console from the vehicle.

INSTALLATION

(1) Position the console in the vehicle.

(2) Align the console screw holes with the holes in the floor panel and install the attaching screws (Figs. 26 and 27).

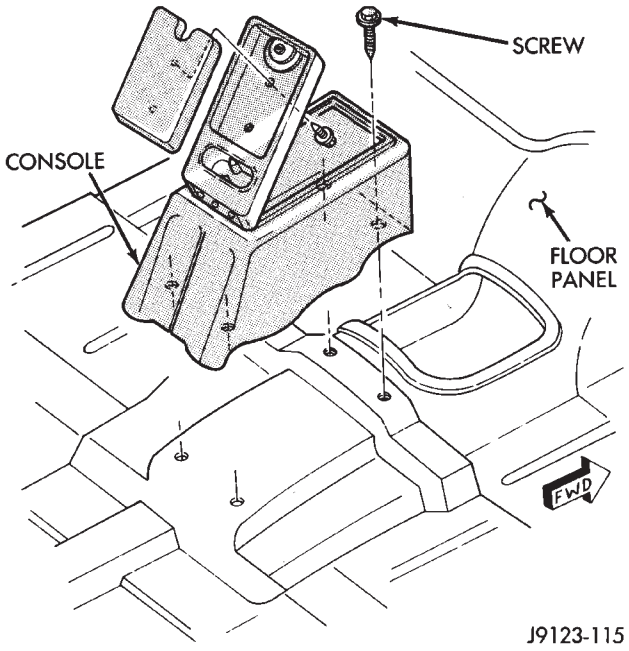

Fig. 26 Deluxe Floor Console

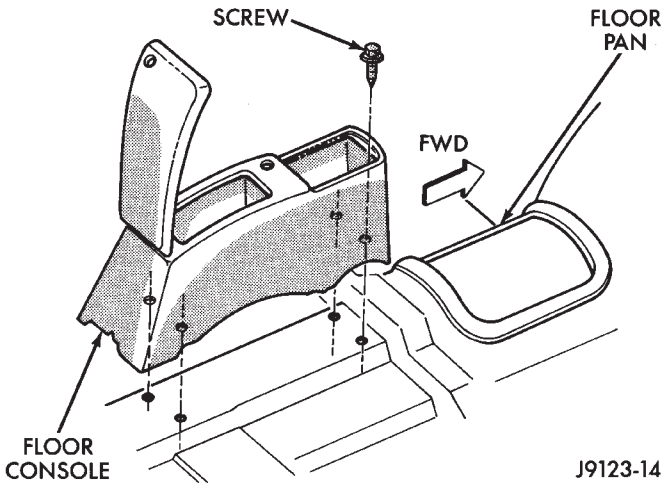

Fig. 27 Standard Floor Console

(3) Close and the console cover.

COVER AND SEAL REPLACEMENT

Console cover replacement involves removing the hinge screws from the console, and components (Fig. 28). The seal can be replaced with the cover in the open position.

COVER LOCK REPLACEMENT

(1) Open the console cover.

(2) Remove the screw that attaches the retainer to the lock and then remove the retainer from the lock (Fig. 29).

(3) Remove the lock, cylinder and key as a unit from the console cover (Fig. 29).

(4) Manually position the lock latch to simulate a closed cover position.

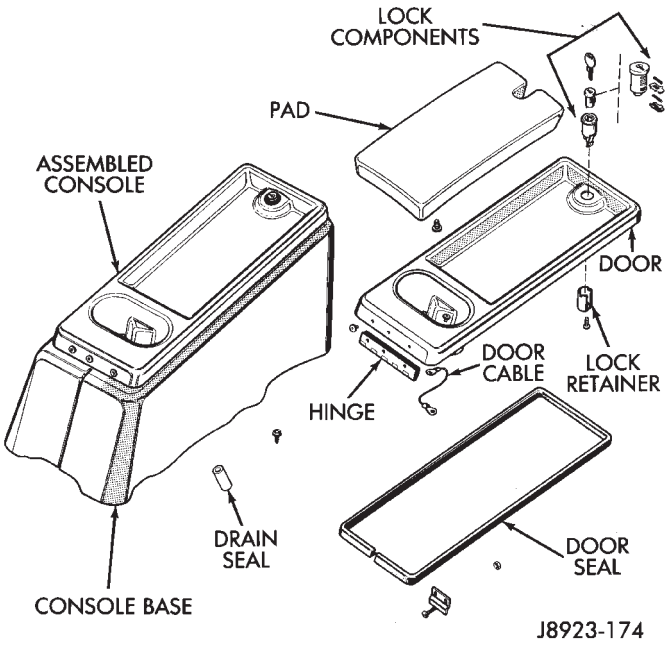

Fig. 28 Console Cover and Seal

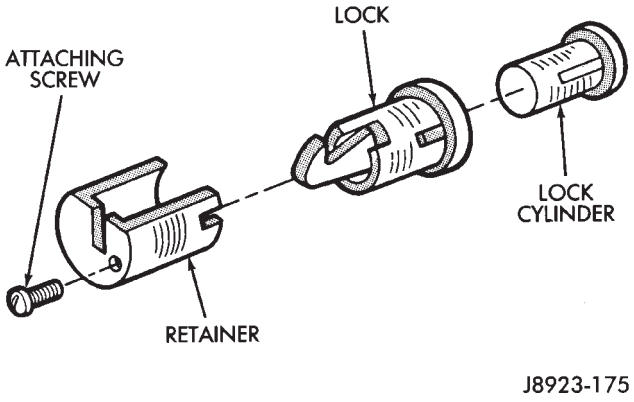

Fig. 29 Console Cover Lock Removal/Installation

(5) Insert the key and cylinder into the lock and turn clockwise. Release the lock latch and remove the key.

(6) Insert the assembled lock in the console cover hole (Fig. 28) and install the retainer with the attaching screw.

CARPET/FLOOR MATS

SERVICE INFORMATION

FRONT FLOOR REAR CARPET

The front floor rear carpet (Fig. 30) is retained in place by the:

- front seats,
- floor console,
- shoulder belt buckle anchors, and
- door sill carpets.

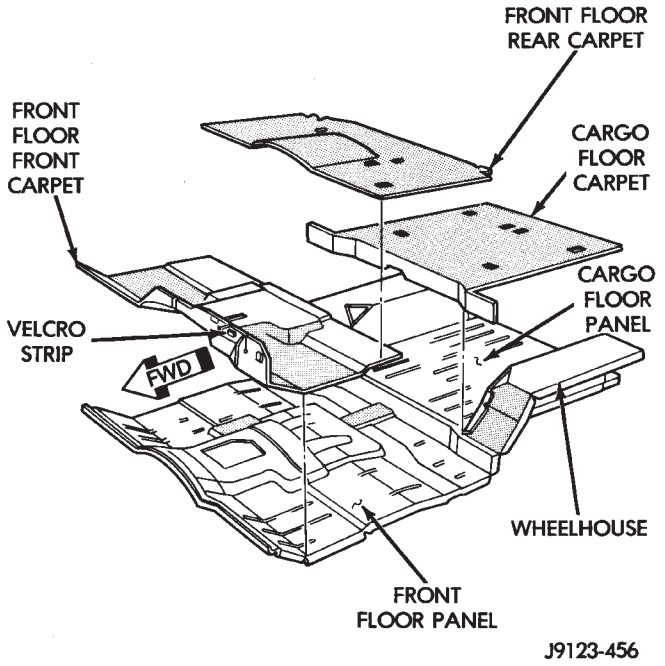

Fig. 30 Floor Carpets

To remove and then install a front floor rear carpet (Fig. 30), it is necessary to remove and then install the front seats and the floor console.

FRONT FLOOR FRONT CARPET

The front floor front carpet (Fig. 30) is retained in place by the:

- transmission/transfer case shift lever boots (Fig. 31),
- rear carpet, and
- Velcro strips.

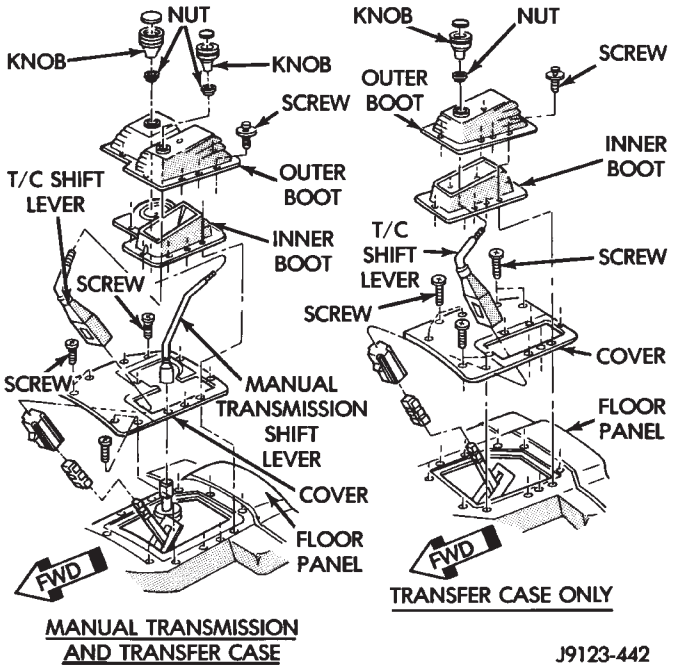

Fig. 31 Shift Lever Boots

To remove and install a front floor front carpet (Fig. 30), it is necessary to remove and then install the shift lever boots (Fig. 31).

When replacing a front carpet, position and cut openings in carpet with a razor knife for shift levers and boots (Fig. 31).

CARGO FLOOR CARPET

The cargo floor carpet (Fig. 30) is retained in place by the:

- rear seat,
- shoulder belt buckle anchors, and
- wheelhouse carpets.

To remove and then install a cargo floor carpet (Fig. 30), it is necessary to remove and then install the rear seat.

WHEELHOUSE, DOOR SILL AND TAILGATE CARPETS

The wheelhouse, door sill and tailgate carpets (Fig. 32) are retained in place with:

- adhesive,
- velcro strips, and
- screws.

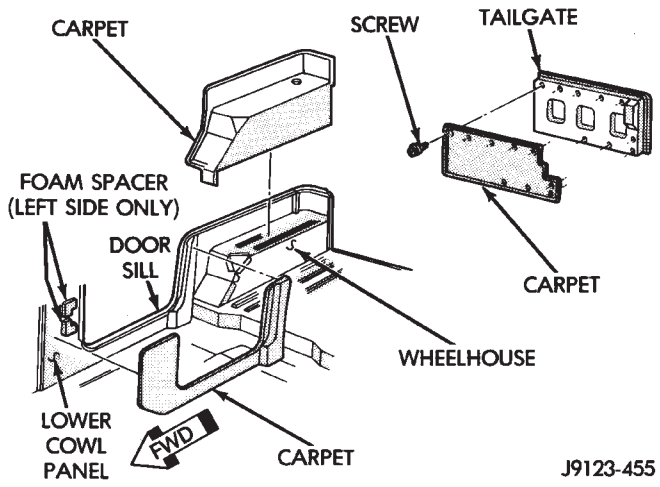

Fig. 32 Wheelhouse, Door Sill and Tailgate Carpets

A replacement carpet for any of the three possibly will require some modifications to accommodate the attached components.

ADD-A-TRUNK

REMOVAL

1. Remove the nylon thumb screws (Fig. 33).
2. Remove the trunk.

INSTALLATION

1. Position the trunk in the cargo space and insert the nylon thumbscrews with washers through the predrilled holes and into the well nuts.
2. Tighten the thumb screws.

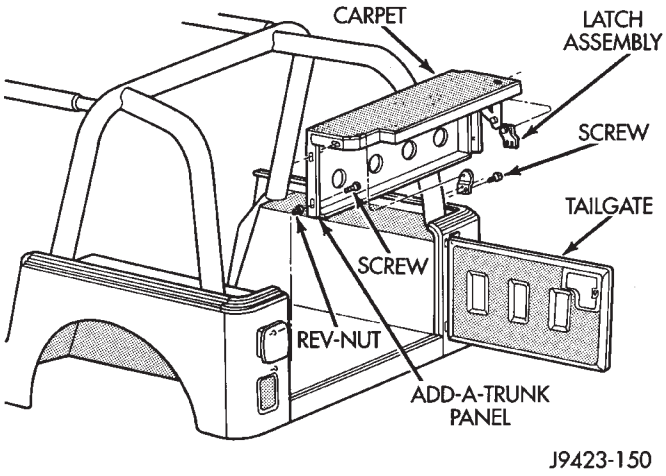

Fig. 32 Add-A-Trunk Assembly

BODY COMPONENTS—REFINISHING

CONTENTS

SERVICE INFORMATION

SAFETY PRECAUTIONS

Protective eye shields, masks, respirators, should be used.

For maximum protection from paint solvent vapor, use a fresh-air type, compressor-powered respirator.

PREPARATION

Do not allow any type of open flame or other source of vapor ignition in the painting area. Paint vapor is highly flammable when it is concentrated.

- Paint only in a well ventilated area.
- Use a good quality, high capacity respirator.
- Use protective goggles and clothing.
- Use rubber or latex gloves when mixing paint and other, similar liquid products.
- When not in use, keep paint containers in a protective cabinet or locker.
- Keep the paint storage area well ventilated.

TECHNICAL TERMS

SINGLE COAT

A single-coat spray pattern is applied from left-to-right. Then, the returning right-to-left spray pattern is applied so that it overlaps the lower one-half of the initial spray pattern. This process is repeated until a complete, single-coat coverage of a body panel is obtained.

DOUBLE COAT

A double-coat spray pattern is applied from left-to-right. Then, the returning right-to-left spray pattern is applied.

DRYING

Drying and hardening of paint film involves three stages of evaporation.

The first stage is referred to as dust-free stage.

The second stage is referred to as tack-free stage.

The third and final stage is referred to as hard-dry0 stage.

DE-GREASE/DE-WAX

De-greasing/de-waxing involves cleaning a panel surface with either 3M All purpose cleaner, or a similar product. This removes the surface grease, or wax.

FEATHEREDGING

Tapering and blending the edges of repaired areas is referred to as featheredging.

FERROUS AND NON-FERROUS METAL

Iron and steel are ferrous metals. Non-ferrous metal includes aluminum, brass, copper, magnesium and several types of alloy metal.

FLASH TIME

The time required for most of the solvent to evaporate from an applied primer/paint coat.

MIST COAT

A mist coat is frequently used as the final color coat. Mist coats are over-thinned paint that is sprayed wet.

SURFACE PRIMER COAT

A surface primer coat must be applied over repaired as well as bare metal substrate. The primer provides a bond between the metal and the color (base) coat. Various types of surface primers and primer/sealants are available. Surface primers are available in either sandable or non-sandable form.

Glazing or spot putty can be applied to primer covered surfaces. The putty is used to fill the small imperfections that a standard primer will not to cover.

REDUCERS/THINNERS

Enamel reducers and lacquer thinners are mixtures of volatile liquids and are used to reduce surface primers and color-coat paints. Use only the type of reducer/thinner that is specified by the paint manufacturer. **Do not intermix different types of reducer/thinner.**

TACK RAG

Tack rags are used to wipe dust from a body panel surface prior to primer/paint application. Dust particles will adhere to the tacky surface of the rag when it is moved over a panel surface.

PAINT APPLICATION

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SURFACE PREPARATION

Proper surface preparation is the key to top-quality body panel refinishing. The bare metal must be cleaned, de-greased, de-waxed and treated with phosphate.

Always clean the panel surface with a wax and grease removal solution, and then wipe the surface with a tack rag before applying primer or paint. Cleaning will also remove any residual silicone from the painted surface.

Body putty that is procured from a major supplier is highly recommended. If a synthetic body filler is to be used, it should also be a quality product.

STONE CHIP PROTECTION

When applicable, the stone chip protection coat (Fig. 1) must be applied before the primer coat. The coating extends downward from the character line to the bottom flanges. Then horizontally to the wheelhouse opening flanges.

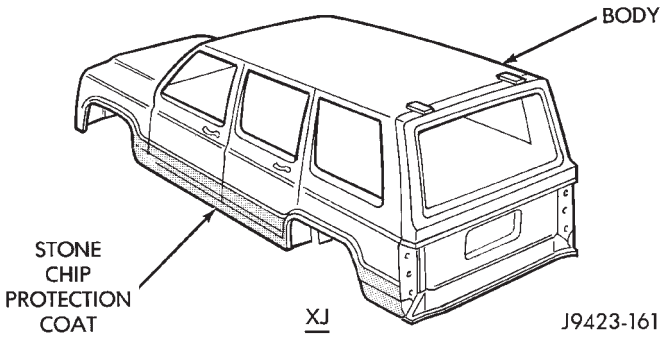

Fig. 1 Stone Chip Protection Coat—Typical

PRIMER

The type of primer to be used is dependent on the condition of the panel surface. Bare metal should be primed with an epoxy-base. A sealant is recommended when applying a second color coat over an existing color coat. With certain colors, sealants are also important in preventing color bleed-through.

BASE/COLOR COAT

Base/color coat paint finishes must be applied in an clean environment. Top-loader guns are recommended for applying the base/color coat paint.

Base/color coat paint (Figs. 2, 3, and 4) should be reduced/thinned and applied according to the manufacturers recommendations. Refer to the suppliers instructions.

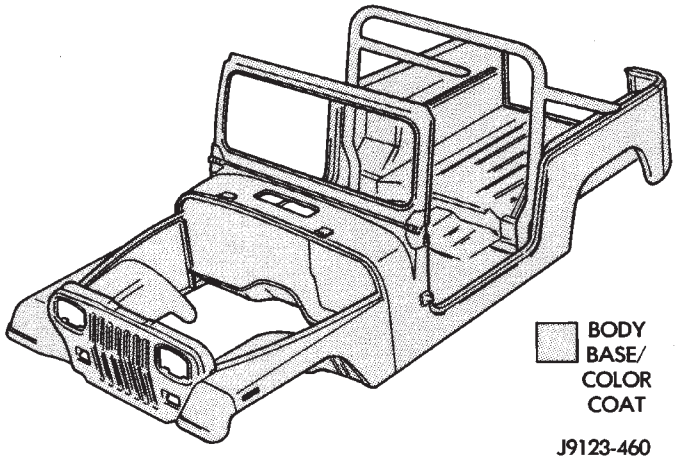

Fig. 2 Body Base/Color Coat Paint Finish—YJ Vehicles

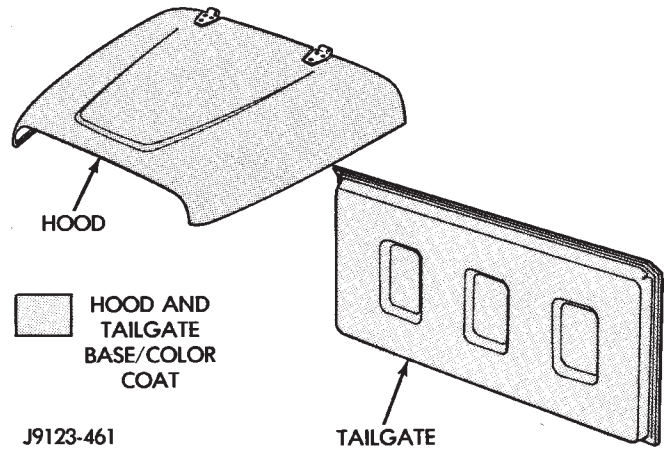

Fig. 3 Hood and Tailgate Base/Color Coat Paint Finish—YJ Vehicles

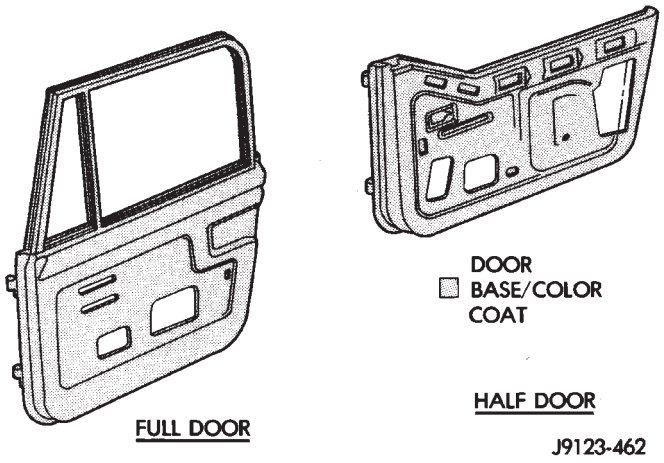

Fig. 4 Door Base/Color Coat Paint Finish—YJ Vehicles

BASECOAT/CLEARCOAT

Basecoat/clearcoat paint finishes must be applied in a very clean environment. Top-loader guns are recommended for applying the basecoat paint and the clearcoat paint.

Basecoat/clearcoat application is a two-stage process. The basecoat is applied over the final primer coat. The clearcoat is then applied over the basecoat. The clearcoat provides the paint finish with a high gloss and increased durability.

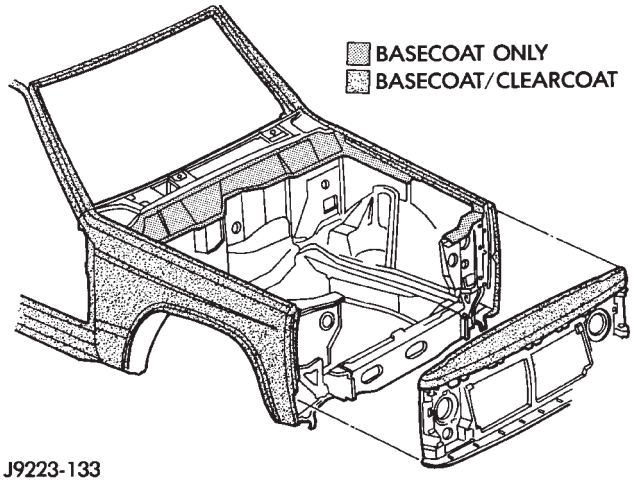

Fig. 5 Front Body Basecoat/Clearcoat Paint Finish—XJ Vehicles

The work area should be well ventilated for application of basecoat and clearcoat paints; especially when applying the clearcoat paint.

ACCENT PAINT

When applicable, argent accent paint (Fig. 9) is applied to the grille opening panel, sill crossmember and radiator baffles. The argent paint coating covers the rocker panel and extends upward 25 mm (1 in) from the door panel lower edge.

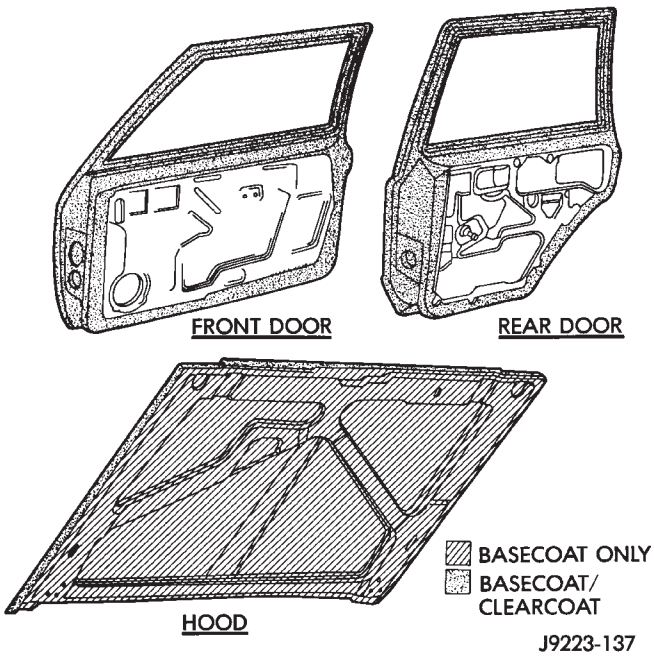

Fig. 6 Hood and Doors Basecoat/Clearcoat Paint Finish—XJ Vehicles

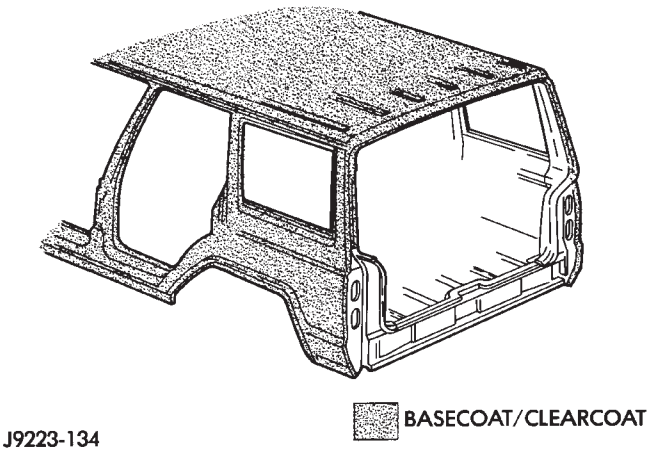

Fig. 7 Rear Body Basecoat/Clearcoat Paint Finish—XJ Vehicles

PAINT REPAIR ON GALVANIZED METALS

Many body panels are made from galvanized sheet metal. Proper surface preparation of galvanized panels is important in regard to rust protection and the finish coat.

Repaired surface areas on galvanized panels should be sanded, cleaned and re-coated with Galva Prep or a similar product.

Use only those primers recommended for use on galvanized panels. Consult the paint suppliers product and application instructions. Do not apply a base/colorcoat directly on galvanized panel.

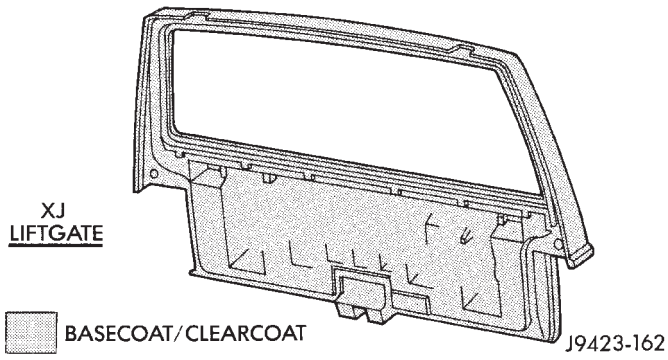

Fig. 8 Liftgate Basecoat/Clearcoat Paint Finish—XJ Vehicles

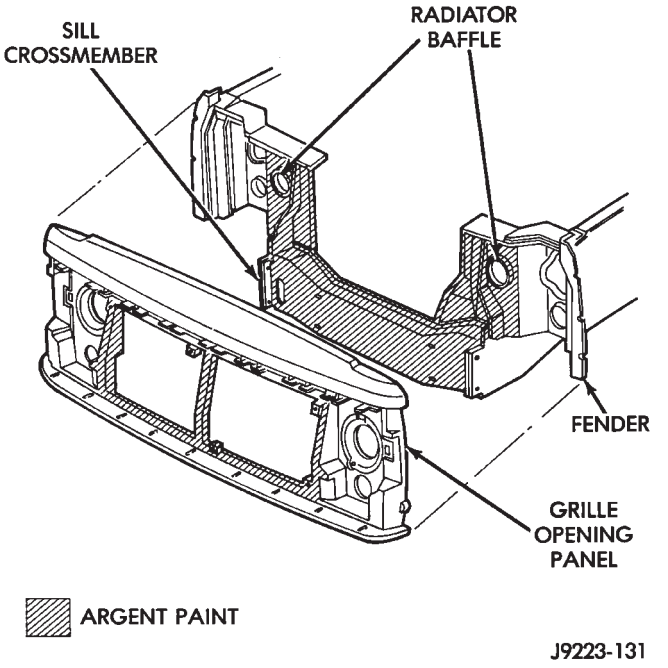

Fig. 9 Grille Opening Panel, Crossmember and Baffle Argent Accent Paint

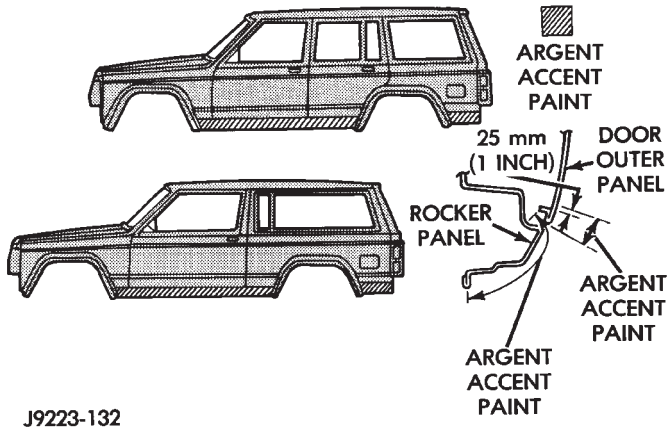

Fig. 10 Body Side Argent Accent Paint Finish

BUFFING AND POLISHING

Minor paint defects in a base/colorcoat can frequently be removed by light sanding, buffing and polishing. Wet sand the defect with 600 grit paper soaked in mineral spirits.

Buff the surface area with a fine grade buffing compound. Finish the repair with a quality polishing compound to blend and restore the gloss.

BODY UNDERCOAT

Undercoat is applied to the exterior side of wheelhouses and underbody panels.

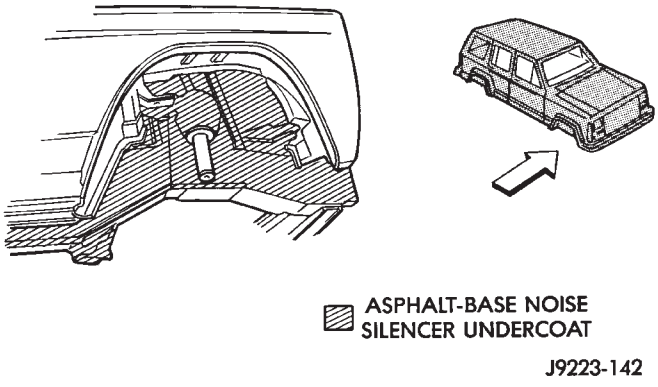

Fig. 11 Front Wheelhouse Undercoat—XJ Vehicles

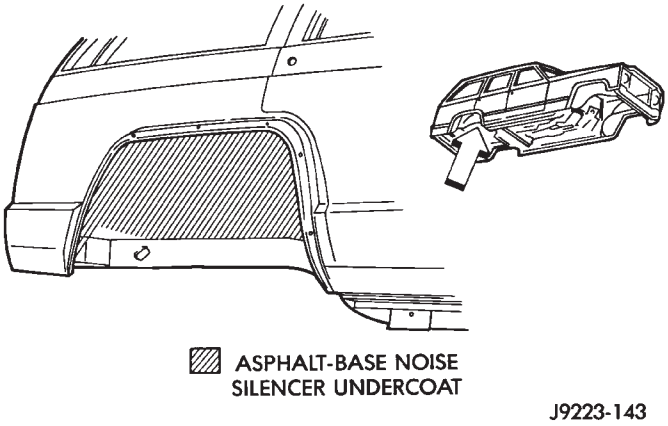

Fig. 12 Rear Wheelhouse Undercoat—XJ Vehicles

PLASTIC COMPONENTS

Plastic components are molded from three different types of plastic compounds. The three compounds are: ABS (acrylo-nitrile, butadiene, styrene); polypropylene and vinyl. Minor cracks in any of the three types can be repaired with 3M 8101 structural adhesive, or an equivalent product.

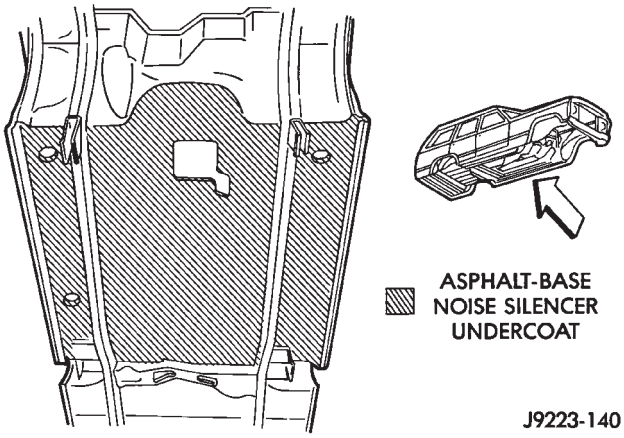

Fig. 13 Underbody Center Section Undercoat—XJ Vehicles

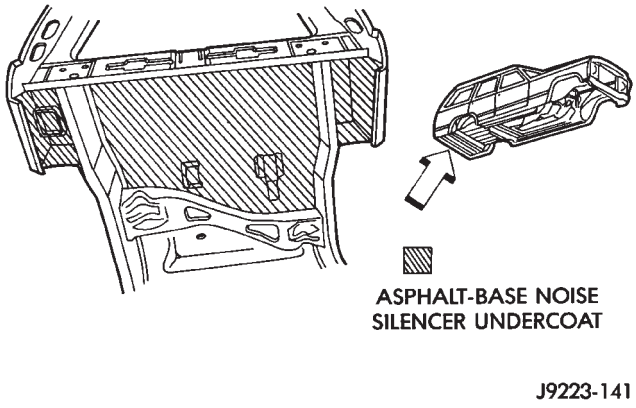

Fig. 14 Underbody Rear Section (Above Fuel Tank) Undercoat—XJ Vehicles

The three compounds can be identified with a flame test (Fig. 15). To perform the test, first cut a small sample of the material from a non-visible portion of the plastic. Then apply an open flame to the sample and observe the smoke or flame color.

ABS and polypropylene only require an open flame for testing. However, vinyl must be burned in combination with copper.

To test vinyl, heat a length of solid copper wire until it is red hot. Immediately apply the hot wire to the plastic sample until some of the material adheres to the copper. Then expose the copper wire and sample to an open flame (Fig. 15).

- ABS material will produce black smoke when burned.
- Polypropylene will produce little or no smoke.
- Vinyl will produce a blue green flame when burned in combination with copper.

EXTERIOR BODY COLORS

Exterior vehicle body colors are identified on the Vehicle Code plate. The plate is located on the left side of the dash panel in the engine compartment. The color code location is described in the Introduction of this manual.

OEM paint colors are generally available from all of the major paint suppliers. They are supplied in the form of either mixing formulas or factory packaged (pre-mixed) paint.

The exterior body and interior trim colors and corresponding Jeep™ paint codes are listed in the following charts.

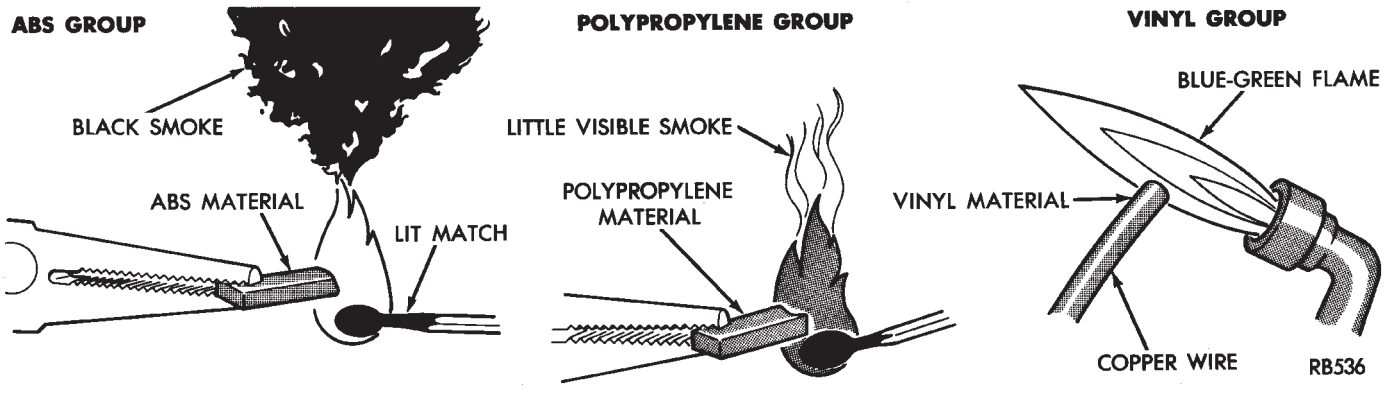

Fig. 15 Plastic Flame Tests

XJ EXTERIOR PAINT CODES

COLOR NAME	CHRY.[1] CODE	PPG	BASF	DuPONT	S-W ACME M-S	AKZO/ SIKKENS
Poppy Red C.C.	PR4	4679	23043	B9326	46916	CHA93:PR4
Lt. Champagne Met. C.C.	KV4	4320	21086	B9148	44429	CHA91:KV4
Glamour Tourquoise Met. C.C.	KQ2	4272	21073	B9133	44044	CHA91:KQ2
Hunter Green Met. C.C.	JG5	4329	21089	B9165	44900	CHA92:JG5
Jewel Blue P.C.	MC9	4449	22109	B9241	45868	CHA92:MC9
Black C.C.	DX8	9700	15214	99	34858	CHA85:DX8
Dk. Silver Met. C.C.	KS7	4272	21077	B9137	44046	CHA91:KS7
Bright White C.C.	GW7	4037	18238	B8833	37298	CHA88:GW7

[1]Standox and Spies Hecker use the Chrysler paint code as listed on the Vehicle Code Plate.

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XJ INTERIOR PAINT CODES

COLOR NAME	CHRY. CODE	PPG	BASF	DuPONT	S-W ACME M-S
Charcoal (HS1/HA8)	SA	34427/ 2-1312 34466/ 2-1323	18825 18826	C8823 C8824	38500/ 38501
Dk. Sand	Y6	26375/ 2-1358	19139	C8914	40079

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YJ EXTERIOR PAINT CODES

COLOR NAME	CHRY.[1] CODE	PPG	BASF	DuPONT	S-W ACME M-S	AKZO/ SIKKENS
Poppy Red C.C.	PR4	4679	23043	B9326	46916	CHA93:PR4
Lt. Champagne Met. C.C.	KV4	4320	21086	B9148	44429	CHA91:KV4
Glamour Tourquoise Met. C.C.	KQ2	4272	21073	B9133	44044	CHA91:KQ2
Hunter Green Met. C.C.	JG5	4329	21089	B9165	44900	CHA91:JG5
Jewel Blue P.C.	MC9	4449	22109	B9241	45868	CHA92:MC9
Black C.C.	DX8	9700	15214	99	34858 M-S 90-5950	CHA85:DX8
Dk. Silver Met. C.C.	KS7	4272	21077	B9137	44046	CHA91:KS7
Bright White C.C.	GW7	4037	18238	B8833	37298	CHA88:GW7

[1]Standox and Spies Hecker use the Chrysler paint code as listed on the Vehicle Code Plate.

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YJ INTERIOR PAINT CODES

COLOR NAME	CHRY. CODE	PPG	BASF	DuPONT	S-W ACME M-S
Cinder/Lt. Charcoal (HXA/HS1)	XS	35215/2-1445 34427/2-1312	18825 21009	C9127 C8823	44567 38500
Cinder/Radiant Red (HXA/KRC)	RX	35215/2-1445 73473/2-1427	21099 21096	C9127 C9118	44567 44569
Cinder/Dk. Green (HXA/LG8)	XG	35215/2-1445 47091/2-1464	21099 22138	C9127 C9272	44567 45995
Spice	TB	27240/2-1466	22142	C9253	45996

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TORQUE SPECIFICATIONS—XJ VEHICLES

Component	Service Set-To Torque	Service Recheck Torque
Hood Hinge-to-Hood Screws	31 N•m (23 ft-lbs)	24-37 N•m (18-27 ft-lbs)
Hood Hinge-to-Cowl Nuts	31 N•m (23 ft-lbs)	24-37 N•m (18-27 ft-lbs)
Hood Lock Assembly Attaching Screws	16 N•m (138 in-lbs)	14-27 N•m (125-235 in-lbs)
Hood Lock Striker-to-Hood Screws	16 N•m (138 in-lbs)	14-27 N•m (125-235 in-lbs)
Inside Hood Release Handle-to-Instrument Panel	8 N•m (78 in-lbs)	7-11 N•m (65-95 in-lbs)
Door Hinge Screws	35 N•m (26 ft-lbs)	30-40 N•m (22-30 ft-lbs)
Door Latch Screw	9 N•m (7 ft-lbs)	7-11 N•m (5-9 ft-lbs)
Exterior Door Handle Nut	5 N•m (4 ft-lbs)	4-6 N•m (3-5 ft-lbs)
Vent Window-to-Door Screw	1 N•m (1 ft-lb)	0.7-21 N•m (.5-1.5 ft-lb)
Door Check-to-A-pillar Screw	9 N•m (7 ft-lbs)	7-11 N•m (5-9 ft-lbs)
Door Check-to-Front Door Screw	10 N•m (7 ft-lbs)	10-11 N•m (7.4-8.1 ft-lbs)
Glass Channel Bottom Screw	9 N•m (7 ft-lbs)	7-11 N•m (5-8 ft-lbs)
Vent Window Upper Screws	1.2 N•m (1 ft-lb)	0.7-1 N•m (.5-1.5 ft-lbs)
Door Glass Stud Nut	6 N•m (4 ft-lbs)	5-7 N•m (4-6 ft-lbs)
Glass Panel Bottom Screw	9 N•m (7 ft-lbs)	7-11 N•m (5-8 ft-lbs)
Vent Window Upper Screws	1.2 N•m (1 ft-lb)	0.7-2 N•m (.5-1.5 ft-lbs)
Door Latch Screws	9 N•m (7 ft-lbs)	7-11 N•m (5-9 ft-lbs)
Exterior Door Handle Nut	5 N•m (4 ft-lbs)	4-6 N•m (3-5 ft-lbs)
Liftgate Hinge Screw	9 N•m (7 ft-lbs)	5-7 N•m (4-5 ft-lbs)
Liftgate Hinge Nut	9 N•m (7 ft-lbs)	5-7 N•m (4-5 ft-lbs)
Support Ball Stud	7 N•m (5 ft-lbs)	4-7 N•m (3-5 ft-lbs)
Liftgate Latch Screw	9 N•m (7 ft-lbs)	5-7 N•m (4-5 ft-lbs)
Striker Screw	30 N•m (22 ft-lbs)	18-26 N•m (13-18 ft-lbs)

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TORQUE SPECIFICATIONS—ACCESSORIES

COMPONENT	SERVICE SET-TO TORQUE	SERVICE RECHECK TORQUE
Towing tube-to-reinforcement bolt	50 N•m (37 ft-lbs)	40-60 N•m (30-44 ft-lbs)
T-bolt nut (M12 x 1.75)	85 N•m (63 ft-lbs)	75-95 N•m (56-70 ft-lbs)
Draw bar-to-towing tube bolt/nut (M12 x 1.75)	85 N•m (63 ft-lbs)	75-95 N•m (56-70 ft-lbs)
Rear crossmember-to-plate bracket bolt	52 N•m (40 ft-lbs)	42-62 N•m (34-46 ft-lbs)
Hitch ball-to-draw bar nut	217 N•m (160 ft-lbs)	—
Draw bar-to-draw bar bumper bracket bolt (M12 X 1.75)	85 N•m (63 ft-lbs)	75-95 N•m (56-70 ft-lbs)
Rear bumper-to-rear bumper reinforcement plate torx head bolt	20 N•m (15 ft-lbs)	15-25 N•m (11-18 ft-lbs)
Draw bar support bracket bolt (M12 x 1.75)	85 N•m (63 ft-lbs)	75-95 N•m (56-70 ft-lbs)
Trailer Hitch Bolts (Model 15)		
1/2 inch	102 N•m (75 ft-lbs)	—
5/8 inch	203 N•m (150 ft-lbs)	—
Luggage Rack Support Screws	3 N•m (28 in-lbs)	2-5 N•m (15-40 in-lbs)

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HEATING AND AIR CONDITIONING

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A/C OPERATION

The compressor increases the pressure and temperature of the refrigerant. The heated refrigerant vapor is then pumped into the condenser where it cools by the air passing over the condenser fins. As the refrigerant cools in the condenser, it condenses into a liquid. Still under high pressure, the liquid refrigerant passes into the receiver. The receiver acts as a reservoir to furnish refrigerant to the expansion (H) valve at all times. From the receiver, the high pressure liquid refrigerant passes to the expansion (H) valve. The expansion (H) valve meters refrigerant into the evaporator where a low pressure is maintained by the suction side of the compressor. As it enters the evaporator, the refrigerant immediately begins to boil by absorbing heat from the air passing over the evaporator core. Having given up its heat to boil the refrigerant, the air is cooled and passes into the passenger compartment of the vehicle. From the evaporator the vaporized refrigerant is drawn back to the compressor to repeat the cycle.

REFRIGERANT (R-12)

It is illegal to release R-12 into the atmosphere.

SAFETY PRECAUTIONS

WARNING: EXTREME CARE MUST BE TAKEN TO PREVENT ANY LIQUID REFRIGERANT FROM COMING IN CONTACT WITH THE SKIN AND ESPECIALLY THE EYES. ALWAYS WEAR SAFETY GOGGLES WHEN SERVICING ANY PART OF THE REFRIGERANT SYSTEM. IF EYE CONTACT IS MADE, APPLY A FEW DROPS OF MINERAL OIL TO THE EYES AND FLUSH WITH WATER FOR SEVERAL MINUTES. SEEK MEDICAL ATTENTION IMMEDIATELY.

The refrigerant used in the air conditioner system is Refrigerant-12 (R-12). R-12 is nonexplosive, nonflammable, non-corrosive, has practically no odor and is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit. Liquid R-12, at normal atmosphere pressures and temperatures, evaporates so quickly that it has the tendency to freeze anything it contacts.

WARNING: TO AVOID A DANGEROUS EXPLOSION, NEVER WELD OR STEAM CLEAN NEAR AIR CONDITIONING LINES OR COMPONENTS. DO NOT HEAT R-12 ABOVE 52°C (125°F).

The R-12 in the system is always under pressure. Because the system is tightly sealed, heat applied to any part could cause this pressure to build up excessively.

WARNING: LARGE AMOUNTS OF REFRIGERANT RELEASED IN A CLOSED WORK AREA WILL DISPLACE THE OXYGEN AND CAUSE SUFFOCATION. ALWAYS MAINTAIN GOOD VENTILATION SURROUNDING THE WORK AREA.

R-12 gas, under normal conditions, is non-poisonous.

WARNING: THE DISCHARGE OF R-12 GAS NEAR AN OPEN FLAME CAN PRODUCE A VERY POISONOUS GAS CALLED PHOSGENE. PHOSGENE IS GENERATED WHEN A FLAME-TYPE LEAK DETECTOR IS USED.

CAUTION: When charging an A/C system always keep the tank in an upright position. If the tank is on its side or upside down, liquid refrigerant will enter the system and may damage the compressor.

In most instances when charging or adding refrigerant, moderate heat is required to bring the pressure of the refrigerant above the pressure of the system. A bucket or large pan of hot water, not over 52°C (125°F), is all the heat required for this purpose. DO NOT heat the refrigerant container with a blow torch or any other means that would raise the temperature and pressure above this temperature.

CAUTION: DO NOT allow liquid refrigerant to touch bright metal. Refrigerant will tarnish bright metal and chrome surfaces. Refrigerant in combination with moisture is very corrosive and can cause extensive damage to all metal surfaces.

Avoid splashing the refrigerant on any surface.

RECYCLING

(R-12) refrigerant is a chloroflorocarbon (CFC) that can contribute to the depletion of the ozone layer in the upper atmosphere. Ozone filters out harmful radiation from the sun. To assist in protecting the ozone layer, Chrysler Corporation requires that an (R-12) refrigerant recovery device that meets SAE standard J1991 be used. Contact an automotive service equipment supplier for refrigerant recycling equipment that is available in your area. Refer to the operating instructions provided with the recycling equipment for proper operation.

SERVICE PRECAUTIONS

Never open or loosen a connection before discharging the system refrigerant.

A system which has been opened to replace a component or one which has discharged through leakage must be evacuated before charging.

Immediately after disconnecting a component from the system, seal the open fittings with a cap or plug.

Before disconnecting a component from the system, clean the outside of the fittings thoroughly.

DO NOT remove the sealing caps from a replacement component until ready to install.

Refrigerant oil will absorb moisture from the atmosphere if left uncapped. DO NOT open an oil container until ready to use and install the cap immediately after using. Store the oil only in a clean moisture-free container.

Before connecting an open fitting always install a new seal ring. Coat the fitting and seal with clean refrigerant oil before connecting.

When installing a refrigerant line avoid sharp bends. Position the line away from the exhaust or any sharp edges which may chafe the line.

Tighten fittings only to the specified torque. The copper and aluminum fittings used in the A/C system will not tolerate over tightening.

When disconnecting a fitting use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.

DO NOT open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature. This will prevent condensation from forming inside of a component which is cooler than the surrounding air.

Keep service tools and the work area clean. Contamination of A/C system through careless work habits must be avoided.

PRESSURE GAUGE AND MANIFOLD ASSEMBLY

Pressure Gauge and Manifold Assembly Tool C-3740-B (Fig. 1) is the most important tool used to service the air conditioning system. The gauge assembly is used to determine:

- System high side gauge pressures
- System low side gauge pressures
- The correct refrigerant charge
- System diagnosis

It is designed to provide simultaneous high and low side pressure indications, because these pressures must be compared to determine the correct system operation.

LOW SIDE GAUGE

The low side gauge is a compound gauge, which means that it will register both pressure and vacuum (Fig. 1). The compound gauge is calibrated 0-1034 kPa (0-150 psi) pressure and 0-760 mm (0-30 in.) of mercury vacuum. It is connected to the suction service valve to check the low side pressure or vacuum.

HIGH SIDE GAUGE

The high side gauge is used to check the pressure in the discharge side of the air conditioning system (Fig. 1).

MANIFOLD

The gauges are connected into the air conditioning systems through a manifold. The manifold has 3 connections (Fig. 1). The low side hose and fitting is connected directly below the low side gauge. The high side hose and fitting is connected below the high side gauge.

The center connection of the manifold is used for recovery and any other necessary service (Fig. 1). Both the high and low sides of the manifold have hand shutoff valves. The hand shutoff valves open or close the respective gauge connections to the center service connection or to each other (Fig. 1). The manifold is constructed so that pressure will be indicated on the gauges regardless of the hand valve position.

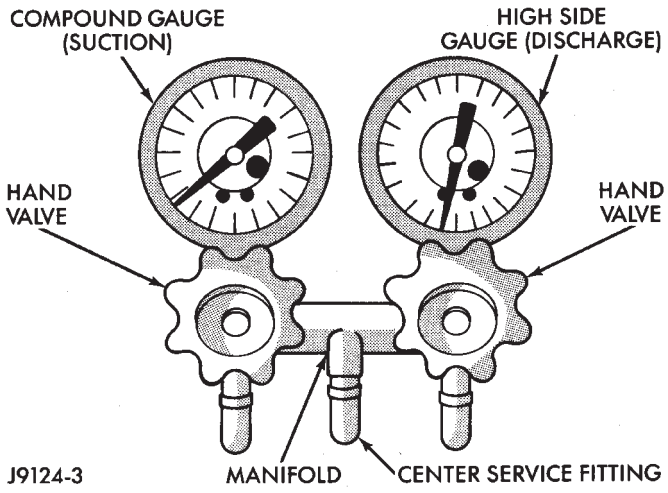

Fig. 1 Pressure Gauge and Manifold Assembly Tool C-3740-B

CONNECTING THE PRESSURE GAUGE AND MANIFOLD ASSEMBLY

Remove the protective caps from the service valve gauge ports and valve stems.

Close both of the hand valves on the gauge manifold set.

Connect the compound gauge hose to the compressor suction service valve gauge port (low-side).

Connect the high pressure gauge hose to the discharge service valve gauge port (high-side).

If necessary, to facilitate installation of the gauge set, loosen the service valve-to-compressor fitting and rotate the service valve slightly. DO NOT allow the hose to contact the engine or body components. Tighten the service valve-to-compressor fitting to 34 N•m (25 ft. lbs.) torque. Tighten the flange-type service valve screws to 20 N•m (15 ft. lbs.) torque.

Set both the service valve stems to the mid-position or the cracked-position. The gauges will indicate high and low side pressure respectively.

Purge any air from the high side test hose by opening the high side hand valve on the manifold for 3 to 5 seconds. The center connection on the manifold must be open.

Purge any air from the low side test hose by opening the low side hand valve on the manifold for 3 to 5 seconds. The center connection on the manifold must be open.

The air conditioning system may be operated with the gauge manifold assembly connected in this manner. The gauges will indicate respective operative pressures.

SERVICE VALVES

DESCRIPTION

The discharge (high pressure) and inlet (suction) service valves are used for diagnosis and recovery of the system. They are also used to isolate the system during component Removal and Installation.

The service valves are three-position valves (Fig. 2). Normal operating position for the valve stem is the back-seated (full-out) position. The stem is turned counterclockwise to place it in this position.

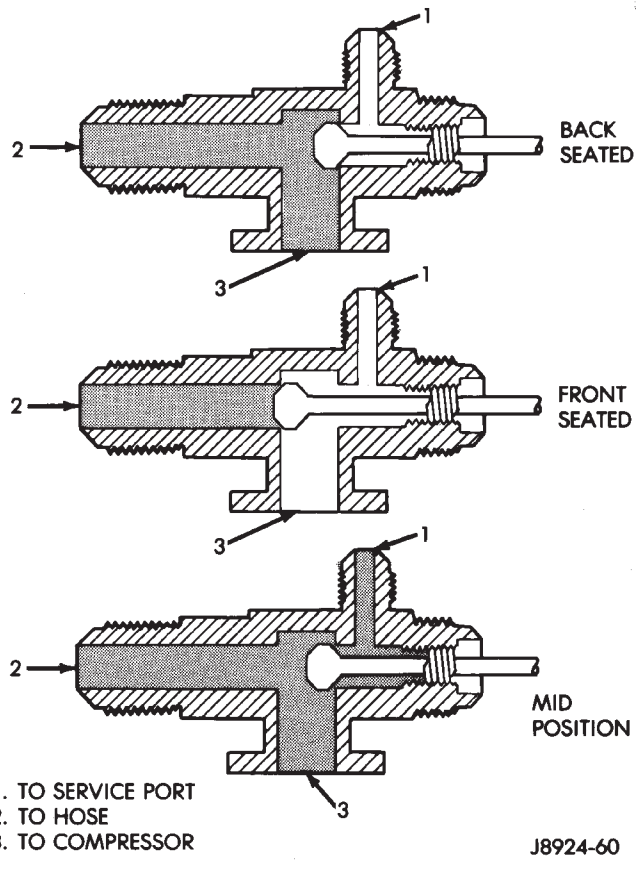

Fig. 2 Service Valve

The front seated (full-in) position is used to isolate the compressor from the system. The stem is turned clockwise to place it in this position.

In the mid-position the gauge port is open. This position is used for pressure testing and for recovery of the system.

DISCHARGE SERVICE VALVE ADAPTERS

On occasion, a service hose may not fit a service valve fitting. Adapters are available and can be used to achieve service valve connection (Fig. 3).

MANUFACTURER	STRAIGHT	RIGHT ANGLE	FLEX
Miller Tools	7763	7754	—
	C-4803	C-4843	—
Draf Tools	AC 354	—	AC 355

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Fig. 3 Discharge Service Valve Adapters

SYSTEM DISCHARGE

(R-12) refrigerant is a chlorofluorocarbon (CFC) that can contribute to the depletion of the ozone layer in the upper atmosphere. To help protect the ozone layer, an R-12 refrigerant recycling device must be used. Use this device when it is necessary to empty the refrigerant system. Contact an automotive service equipment supplier for refrigerant recycling equipment. Refer to the operating instructions provided with the recycling equipment for proper operation.

SYSTEM EVACUATION

The system must be evacuated whenever refrigerant has been discharged or when system refrigerant level has become abnormally low. A vacuum pump is used for the evacuation process.

The system must be evacuated to remove any moisture or air that may have collected in the system. If moisture is not removed from the system, it will combine with R-12 to form a highly corrosive substance.

VACUUM PUMP

The Vacuum Pump Tool C-4069-B and motor must be kept upright at all times to prevent oil spills.

(1) Connect the Pressure Gauge and Manifold Assembly Tool C-3740-B to the service valves.

(2) Discharge the system.

(3) Connect the center service hose on the gauge and manifold to the vacuum pump inlet fitting.

(4) Turn both manifold hand valves to the wide open position.

(5) Start the vacuum pump and observe the vacuum gauge reading.

(6) Test the system for leaks as follows:

- Close the manifold hand valves.
- Stop the vacuum pump and observe the vacuum reading.
- If the system is leak-free, vacuum will hold steady at the level indicated when the pump was stopped. If vacuum remains steady for 3-5 minutes, resume and continue evacuation for a minimum of 30 minutes.
- If the system has a leak, vacuum will fall off or rapidly drop to a 0 reading. If a leak exists, partially charge the system. Find and repair the leak and resume evacuation.

(7) Continue operating the pump for a minimum of 30 minutes after attaining lowest vacuum indicated on the gauge.

(8) Close the manifold hand valves and stop the vacuum pump.

(9) Disconnect the center service hose from the vacuum pump. The system is now ready for charging.

PORTABLE SERVICE STATION

The air conditioner service station is a self contained, portable unit. It is equipped with a vacuum pump, metering-charging cylinder, refrigerant supply, pressure and vacuum gauges, service hoses and control valves (Fig. 4).

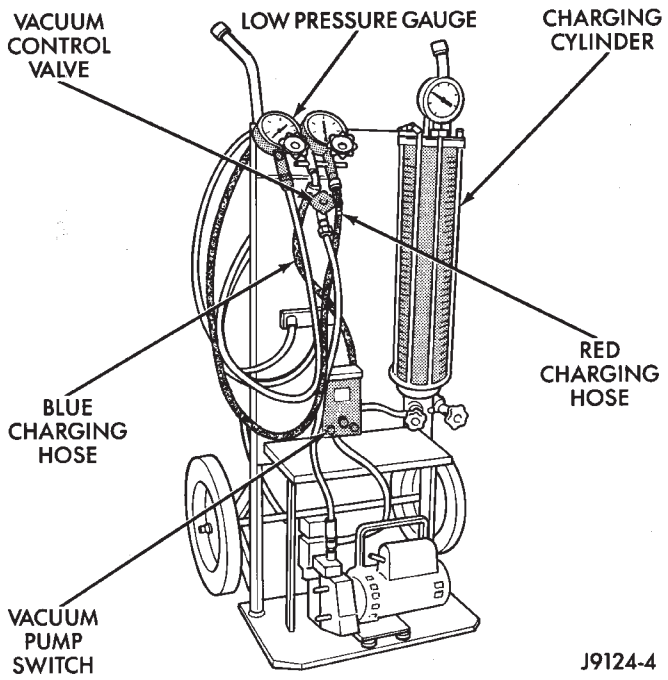

Fig. 4 Portable Service Station

(1) Turn the station vacuum pump control switch OFF (the switch is at the front of the station). The pump control switch must be OFF before connecting the station to an electrical power source.

(2) Close all the hand valves.
(3) Connect the red charging hose to the discharge service valve.
(4) Connect the blue charging hose to the inlet (suction) service valve.
(5) Discharge the system. Leave the suction and discharge service valves in the mid-position.

CAUTION: The system must be completely discharged into a recovery device before evacuating. If the system is still charged, refrigerant can enter and damage the vacuum pump.

(6) Connect the vacuum pump hose to the vacuum pump inlet.
(7) Open the low and high pressure control valves on the charging station.
(8) Start the vacuum pump. Open the vacuum control valve and note the vacuum reading.
(9) Test the system for leaks as follows:
- Close the manifold hand valves.
- Stop the vacuum pump and observe the vacuum reading.
- If the system is leak-free, vacuum will hold steady at the level indicated when the pump was stopped. If vacuum remains steady for 3-5 minutes, resume and continue evacuation for a minimum of 30 minutes.
- If the system has a leak, vacuum will fall off or rapidly drop to a 0 reading. If a leak exists, partially charge the system. Find and repair the leak and resume evacuation.

(10) Continue evacuating the system for a minimum of 30 minutes after attaining the lowest vacuum level.
(11) Fill the station charging cylinder while the system is evacuating.
(12) Close the vacuum control valve and stop the vacuum pump.
(13) Observe low pressure gauge to determine if a system leak exists. If the system is leak-free, the system is now ready for charging.

SYSTEM CHARGE

CHARGE CAPACITY

The recommended system charge is 1.1 kg (38 oz.) of R-12 refrigerant for XJ vehicles and 0.9 kg (32 oz.) for YJ vehicles.

Add an additional 28 grams (1 fluid oz.) of compressor oil to the system when a hose, receiver-drier, condenser, expansion valve or evaporator core is replaced.

PORTABLE SERVICE STATION

(1) Fill the station charging cylinder. Refrigerant should be observed rising in the cylinder sight glass.
(2) Slightly open the valve at the top of the cylinder when pressure in the charging cylinder and refrigerant supply tank are equal. This relieves head pressure allowing refrigerant to continue filling the cylinder.
(3) Observe the pressure gauge at the top of the cylinder. Rotate the plastic cover on the cylinder until the pressure heading column corresponds with the gauge pressure in-line with the sight glass.

FOR EXAMPLE:—The pressure gauge at the top of the cylinder indicates 483 kPa (70 psi). Locate the column with the pressure heading of 483 (70) and rotate the cover so the 483 (70) column aligns with the sight glass.

(4) When refrigerant reaches the correct level in the sight glass, close the right hand valve at cylinder base and on the refrigerant drum.
(5) Close the valve at the top of the charging cylinder.
(6) Check for bubbles in the refrigerant using the cylinder sight glass. If bubbles appear in the refrigerant, tilt the charging station rearward momentarily.
(7) Connect the heating element cord to the power pack receptacle and turn the heater switch ON.
(8) Allow the refrigerant to warm for about 10 minutes while the vacuum pump is operating.

WARNING: WEAR GOGGLES TO PROTECT THE EYES.

(9) Discharge and evacuate the system.
(10) Close the low pressure valve on the charging station.
(11) Fully open the left hand refrigerant control valve at the base of the cylinder and the high pressure valve on the charging station.
(12) Charge the system.
(13) Close the refrigerant control valve and the high pressure valve on the charging station.

CAUTION: DO NOT permit the liquid level to drop below 0 on the cylinder sight glass.

(14) Close the manifold gauges after completion of the charging operation and check the high and low side pressures.
(15) Check system operation.

CAUTION: DO NOT check system pressures until the high and low pressure valves on the charging station are closed. The low pressure gauge could be damaged if the valves are open.

(16) Close all the valves on the charging station and close the refrigerant drum valve when all the operations are completed.
(17) Back-seat the service valves by turning them fully counterclockwise. Install the quick seal caps on the valves afterward.

(18) Disconnect the charging hoses from the service valves.

COMPRESSOR OIL LEVEL

The compressor oil level must be checked and adjusted if the system has been discharged rapidly, or when a component has been replaced. If a replacement compressor is being installed, it must be filled with new compressor oil (Suniso 5GS, or equivalent).

The normal quantity of oil required for the compressor and entire system is 136 ml (4.6 fluid oz.) for SD 709 compressor. DO NOT overfill the compressor. Excessive amounts of oil in the system will hinder compressor operation and reduce A/C performance.

CAUTION: The compressor is a high speed unit. Satisfactory operation is dependent on sufficient lubrication; however, excess oil will hinder A/C performance.

Two oil level checking procedures are necessary. Use Procedure (A) when the compressor is being replaced and the system was discharged properly (no oil loss). Use Procedure (B) for routine maintenance or when checking oil level after replacing a system component.

In cases where rapid loss of refrigerant and oil occurred, the system must be evacuated and purged. Then the compressor must be filled with the necessary amount of oil to fill the entire system.

PROCEDURE A

(1) Remove the oil filler plug, discharge cap and suction port caps from the original and replacement compressor.

(2) Use a clean container to drain the oil from the replacement compressor. Drain the oil through the oil filler plug hole, the discharge and suction. Then rotate clutch front plate several times to push the oil on cylinder out to discharge chamber of cylinder head and drain the oil from discharge port.

(3) Drain the oil from the original compressor into a measuring cup or graduated beaker in the same way as Step 2. Note the amount of oil drained.

(4) Fill the replacement compressor with the same amount of oil drained from the original compressor plus 30 ml (1 fluid oz.).

FOR EXAMPLE:—If the old compressor contained 103.5 ml (3.5 fluid oz.) of oil, fill the replacement compressor with a total of 133 ml (4.5 fluid oz.) of oil.

PROCEDURE B

(1) Start the engine and operate the engine at idle.

(2) Operate the air conditioning system for 10 minutes to return the maximum amount of oil in the system to the compressor.

(3) Stop the engine and disconnect the magnetic clutch feed wire.

(4) Front-seat the discharge and suction service valves.

(5) Determine the mounting angle.

(a) Position an Angle Gauge across the flat surfaces of the front mounting ears.

(b) Center the bubble.

(c) Read the mounting angle to the closest degree.

(d) These vehicles should have 0° mounting angle.

(6) Remove the oil filler plug. Position internal parts by rotation of front plate counterweight to 30° angle (Fig. 5).

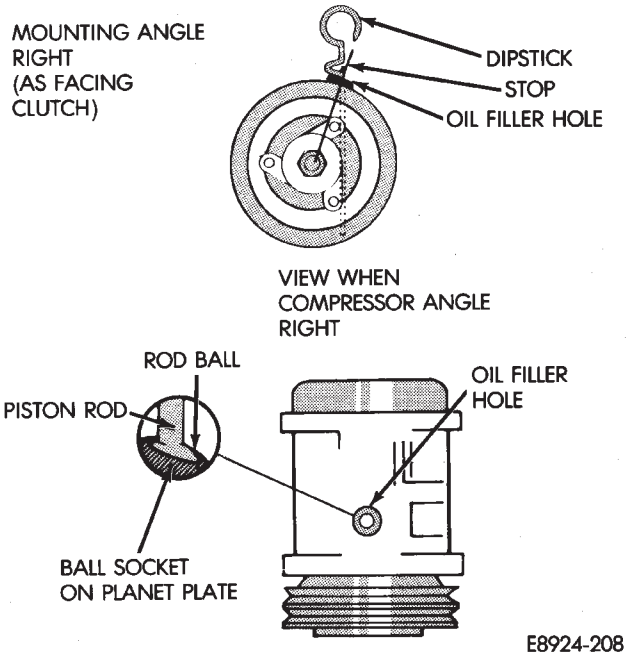

Fig. 5 Check Oil Level

(7) Insert the dipstick tool to its STOP position. The Dipstick Tool is part of Tool Kit 7851. The stop is the angle near the top of the dipstick. The bottom surface of the angle must be flush with the surface of the oil filler hole.

(8) Remove dipstick. Count increments of oil.

(9) Use mounting angle table to determine correct oil level for the compressor (Fig. 6).

(10) If the increments read on the dipstick do not match the table, add or subtract oil to the mid-range value.

FOR EXAMPLE:—If the mounting angle is 10° and the dipstick increment is 3, add oil in 30 ml (1 fluid oz.) increments until 5 is read on dipstick.

(11) Check that the sealing O-ring is not twisted.

(12) Seat and O-ring must be clean.

MOUNTING ANGLE (DEGREE)	ACCEPTABLE OIL LEVEL INCREMENTS	MOUNTING ANGLE (DEGREE)	ACCEPTABLE OIL LEVEL INCREMENTS
0	3–5	40	7–9
10	4–6	50	8–10
20	5–7	60	9–11
30	6–8	90	10–12

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Fig. 6 Mounting Angle/Oil Level Table

(13) Install the compressor oil filler plug. Tighten the plug to 10 N•m (7 ft. lbs.) torque. DO NOT overtighten the plug to stop a leak.

SERVICE DIAGNOSIS—MECHANICAL

GENERAL

The reason for a decrease in cooling or heating efficiency must be understood before attempting repair or replacement of parts. Determined if the condition is the air conditioner, the heating system, its components or the in the air flow system.

The air conditioning system generally operates at peak efficiency at normal highway speeds. However, a slight reduction in A/C performance may be experienced in congested city driving conditions; especially when ambient temperatures are high.

When diagnosing a gradual decrease in A/C performance, remember to check condition of the condenser and radiator fins. Air flow blockage of either component, caused by dirt, foreign material or insects, will affect the air conditioning and engine cooling systems. Vehicles equipped with a protective screen, can restrict air flow to the radiator and condenser.

During high outside operating temperatures, a slight increase in engine coolant temperature will occur when the air conditioner is operating.

A/C PERFORMANCE TEST

The pressure developed on the high side and low side of the compressor indicates whether the system is operating properly.

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.

WARNING: WEAR SAFETY GOGGLES WHEN SERVICING THE REFRIGERATION SYSTEM

(1) Attach an engine tachometer and refrigerant Pressure Gauge and Manifold Assembly Tool C-4740-A.

(2) Close both hand valves on the gauge and manifold assembly.

(3) Set both service hand valve stems to the mid-position.

(4) Engine should be warmed up with doors, windows and hood closed.

(5) Operate air conditioning system with the engine running at 1,000 RPM. Set the controls for maximum A/C, temperature control on full cool and blower switch on high.

(6) Insert a thermometer into center discharge air outlet and observe the air temperature. The temperature should be approximately 7°C (45°F) at 27°C (80°F) ambient temperature after 5 minutes of operation.

(7) Observe the high and low side pressures. The evaporator suction pressure should be 207-241 kPag (30-35 psig). The compressor discharge pressure should be 1103-1633 kPag (160-235 psig). It should be noted that high ambient temperature and humidity conditions will cause higher pressures and temperature conditions. If the clutch cycles, take readings before clutch disengages.

(8) If pressures are abnormal, refer to the Pressure and Performance Diagnosis Charts.

The following charts have been developed for quick reference. If the step by step method used is not completely understood, refer to the correct section of the Service Manual for more detailed information.

COMPRESSOR VALVE PLATE—LEAK TESTS

This test can be preformed with the compressor installed in the vehicle.

Discharge or Suction Valve Breakage—When compressor is operating at idle speed, compressor makes a "clacking" sound. Preform the Pressure Balancing Test.

Head Gasket Breakage—At idle speed, discharge pressure does not increase to normal condition and suction pressure is high. Preform the Pressure Balancing Test.

Pressure Balancing Test:

(1) Connect manifold gauge set to suction and discharge ports.

(2) Run compressor for 5 minutes at idle speed and stop.

(3) Measure elapsed time that discharge pressure is balanced to suction pressure. If less than 2 minutes, it is determined that discharge valve or head gasket is broken.

REFRIGERANT LEAK TEST

External leaks in the system can be located using an electronic detector.

The electronic leak detector is recommended because it is light, accurate and most important, does not expose the user to toxic gas fumes. An electronic leak detector will locate R-12 leaks as small as 15 ml (0.5 fluid oz.) per year.

WARNING: DO NOT USE A HALIDE TORCH. THE HALIDE TORCH REQUIRES AN OPEN FLAME FOR LEAK DETECTION. WHEN R-12 IS EXPOSED TO AN OPEN FLAME, IT TURNS INTO PHOSGENE GAS WHICH IS POISONOUS.

(1) Calibrate the detector as outlined in the manufacturer's instructions.

(2) Remove the flexible detector probe from the case.

(3) Turn the detector control switch ON.

PRESSURE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
LOW SIDE LOW — HIGH SIDE LOW	(1) System refrigerant is low. (2) Expansion valve is restricted.	(1) Evacuate, leak test and charge the system. (2) Replace the expansion valve.
LOW SIDE HIGH — HIGH SIDE LOW	(1) Internal leak in the compressor - worn. (2) Cylinder head gasket is leaking. (3) Drive belt slipping.	(1) Remove the compressor cylinder head and inspect the compressor. Replace the valve plate assembly if necessary. If the compressor pistons, rings or cylinders are excessively worn or scored, replace the compressor. (2) Install a replacement cylinder head gasket. (3) Adjust the belt tension.
LOW SIDE HIGH — HIGH SIDE HIGH	(1) Condenser fins obstructed. (2) Air in the system. (3) Expansion valve is defective. (4) Loose or worn fan belts. (5) Refrigerant overcharge.	(1) Clean the condenser fins. (2) Evacuate, leak test and charge the system. (3) Replace the expansion valve. (4) Adjust or replace the belts as necessary. (5) Bleed off refrigerant.
LOW SIDE LOW — HIGH SIDE HIGH	(1) Expansion valve is defective. (2) Restriction in the refrigerant hose. (3) Restriction in the receiver/drier. (4) Restriction in the condenser.	(1) Replace the expansion valve. (2) Check the hose for kinks—replace if necessary. (3) Replace the receiver/drier. (4) Replace the condenser.
LOW SIDE AND HIGH SIDE NORMAL (INADEQUATE COOLING)	(1) Air in the system. (2) Excessive oil in system.	(1) Evacuate, leak test and charge the system. (2) Discharge and drain oil. Restore proper oil level, evacuate, leak test and charge system.

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PERFORMANCE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
COMPRESSOR NOISE	(1) Broken valves. (2) Overcharged. (3) Incorrect oil level. (4) Piston slap. (5) Broken rings. (6) Drive belt pulley bolts are loose.	(1) Replace the valve plate. (2) Discharge, evacuate and install the correct charge. (3) Isolate the compressor and check the oil level. Correct as necessary. (4) Replace the compressor. (5) Replace the compressor. (6) Tighten with the correct torque specification.
EXCESSIVE VIBRATION	(1) Incorrect belt tension. (2) Clutch loose. (3) Overcharged. (4) Pulley is misaligned.	(1) Adjust the belt tension. (2) Tighten the clutch. (3) Discharge, evacuate and install the correct charge. (4) Align the pulley.
CONDENSATION DRIPPING IN THE PASSENGER COMPARTMENT	(1) Drain hose plugged or improperly positioned. (2) Insulation removed or improperly installed.	(1) Clean the drain hose and check for proper installation. (2) Replace the insulation on the expansion valve and hoses.
FROZEN EVAPORATOR COIL	(1) Faulty thermostat or thermistor probe. (2) Thermostat capillary tube or thermistor improperly installed. (3) Thermostat not adjusted properly.	(1) Replace the thermostat or thermistor probe. (2) Install the capillary tube or thermistor correctly. (3) Adjust the thermostat.

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HEATING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
BLOWER MOTOR WILL NOT TURN AT ANY SPEED	(1) Blown fuse. (2) Loose connection. (3) Defective ground. (4) Faulty switch. (5) Faulty motor. (6) Faulty resistor.	(1) Replace fuse. (2) Inspect and tighten. (3) Clean and tighten. (4) Replace switch. (5) Replace motor. (6) Replace resistor.
BLOWER MOTOR TURNS AT ONE SPEED ONLY	(1) Faulty switch. (2) Faulty resistor.	(1) Replace switch. (2) Replace resistor.
BLOWER MOTOR TURNS BUT DOES NOT CIRCULATE AIR	(1) Intake blocked. (2) Fan not secured to the motor shaft.. (3) Outside air mode door inoperative.	(1) Clean intake. (2) Tighten securely. (3) a. Check and replace outside air door vacuum motor, if necessary. b. Check and repair vacuum controls, as required.
HEATER WILL NOT HEAT	(1) Coolant does not reach proper temperature. (2) Heater core blocked internally. (3) Heater core air-bound. (4) Blend-air door not in proper position.	(1) Check and replace thermostat if necessary. (2) Flush or replace core if necessary. (3) Purge air from core. (4) Adjust cable.
HEATER WILL NOT DEFROST	(1) Control cable adjustment incorrect or vacuum motor inoperative. (2) Defroster hose damaged or duct seal leakage.	(1) Adjust control cable or replace vacuum motor. (2) Replace defroster hose or correct duct seal.

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(4) Prepare the detector for use.

• Place the flexible probe tip near the leak port on the detector.

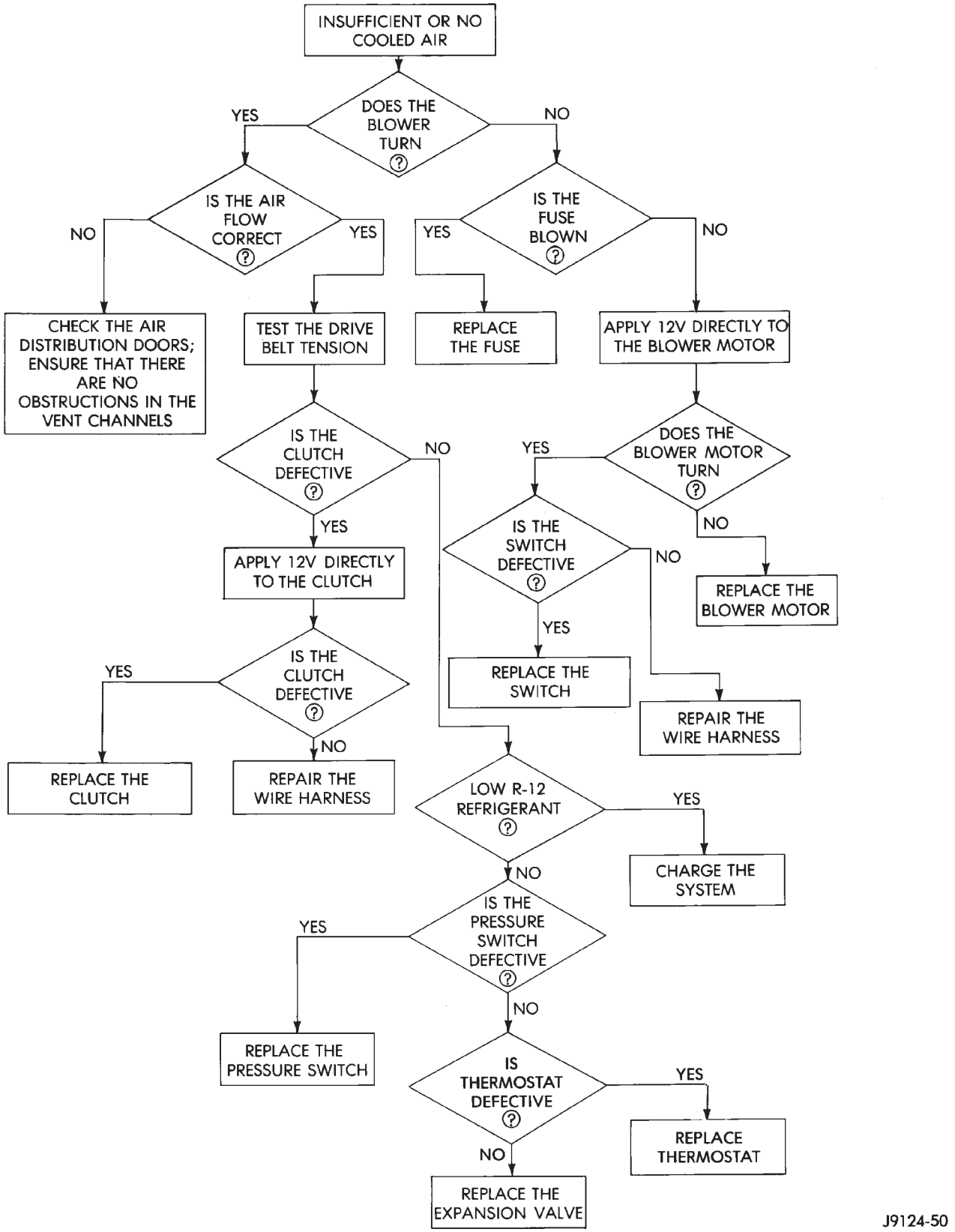
• Adjust the BAT thumb-wheel a few teeth at a time, until the light illuminates-then goes out when the tip is removed from the leak port.

(5) Begin leak testing. Move the flexible probe slowly under all suspect connections, joints and seals. Because R-12 refrigerant is heavier than air, leaks are more readily detected on the lower side of components being checked. The leak indicator light will illuminate when a leak is detected. The indicator light will go out if the probe tip is held near the leak point for an extended period.

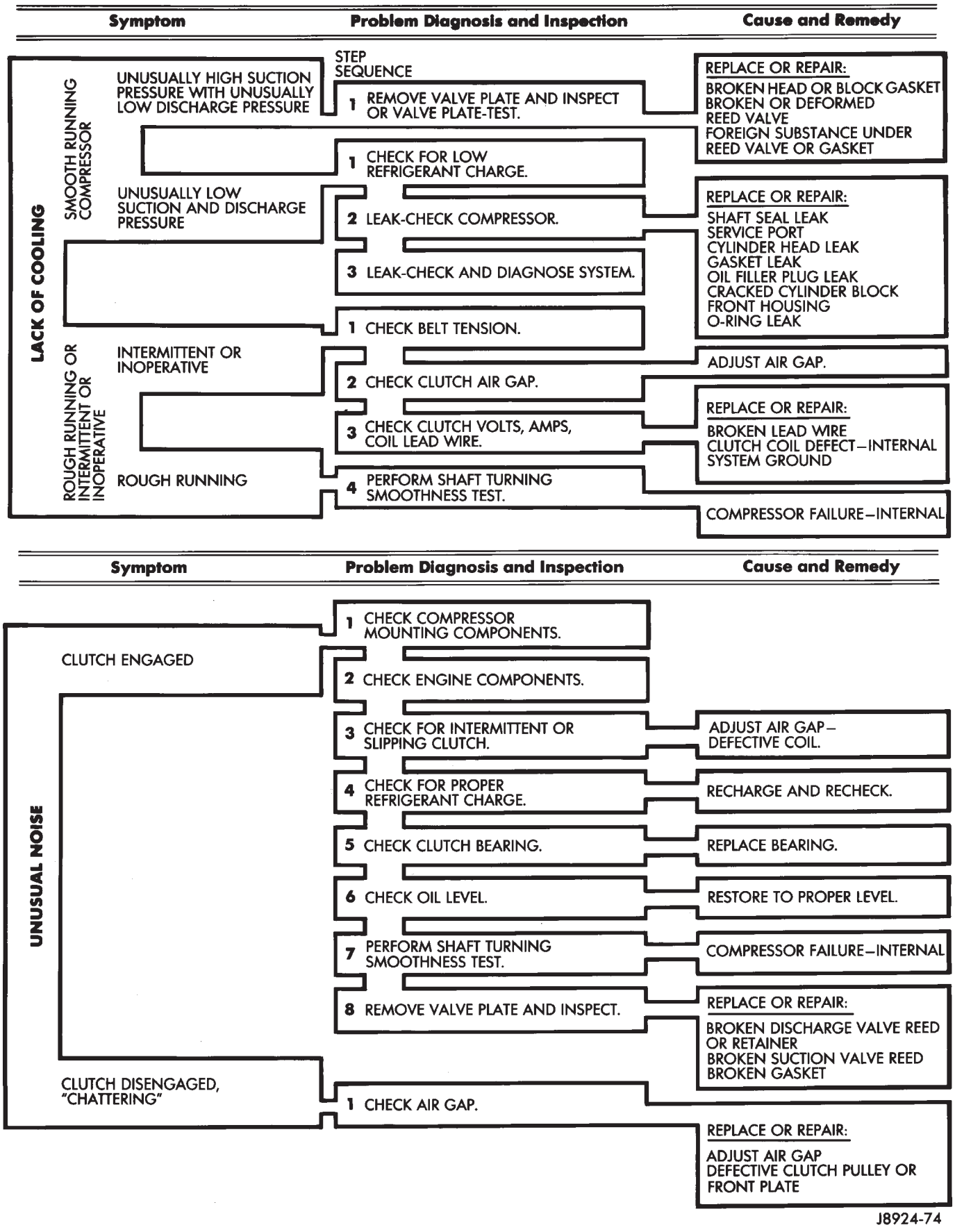
(6) Repair leaks as required.

(7) Evacuate and charge the system after leaks are corrected.

AIR CONDITIONING SYSTEM DIAGNOSIS



COMPRESSOR DIAGNOSIS



SERVICE DIAGNOSIS—ELECTRICAL

BLOWER CONTROLS—XJ VEHICLES

DESCRIPTION

The blower motor delivers air to the inside of the vehicle. Its speed is controlled by the blower switch and the blower resistors. With the switch in LO, part of the battery voltage is supplied to the motor through all of the resistors. The motor runs slowly. As the blower switch is moved to a higher speed, the switch allows more voltage to be applied to the blower motor, which will increase its speed. When the switch is in HI, the blower resistors are bypassed and battery voltage is applied directly to the blower motor. The motor runs at the fastest speed in this mode.

DIAGNOSIS

Refer to the Group 8W, Wiring Diagrams for complete system schematic.

1. BLOWER MOTOR INOPERATIVE

- Remove and inspect fuse. If the fuse is blown, replace fuse.

2. BLOWER MOTOR INOPERATIVE (HI Position)

Put the ignition switch in RUN, the select switch in HEAT and the blower switch on HI.

- Blower motor connector (Terminal A) should be battery voltage. If not go to next step.
- Blower motor connector (Terminal B) should be 0 ohms. If not, repair wire to ground.
- Blower switch connector (Terminal C) should be battery voltage. If battery voltage replace blower switch. If not, replace select switch.

3. BLOWER MOTOR INOPERATIVE (LO, M1 & M2 Positions)

Ignition switch in RUN, select switch in HEAT.

- Blower resistors connector (Terminal D) should be battery voltage. If not, replace select switch.
- Blower resistors connector (Terminal C) should be battery voltage. If not, replace blower switch.
- Blower resistors connector (Terminal A) should be battery voltage. If not, replace blower switch.
- Blower resistors connector (Terminal B) should be battery voltage. If not, replace blower resistor.

AIR CONDITIONING SYSTEM—XJ VEHICLES

DESCRIPTION

The A/C Compressor Clutch is belt-driven by the engine. A clutch, operated by a solenoid, automatically turns the compressor on and off to control evaporator icing.

The A/C Compressor Clutch operation is controlled by several components: the A/C Low-Pressure Switch, Thermostat Switch, Fuel Pump Relay, A/C Clutch Relay and the Engine Controller.

The A/C low pressure switch opens when there is not enough refrigerant in the system. When this happens, voltage is no longer present at the Engine Controller. The Engine Controller will turn off the A/C clutch relay. With the proper refrigerant level in the system, the low pressure switch remains closed.

When the evaporator temperature is low enough to ice the cooling coils, the thermostat switch opens. The Engine Controller will turn off the A/C clutch. The thermostat switch closes when the temperature rises. The Engine Controller will then turn the A/C clutch relay on again.

DIAGNOSIS

Refer to the Group 8W, Wiring Diagrams for complete system schematic.

With engine running, Engine Controller may delay A/C clutch up to 30 seconds.

1. A/C COMPRESSOR CLUTCH INOPERATIVE

Clutch connector disconnected.

- Jumper fused test lead, battery to clutch connector, clutch should operate. If not, replace compressor clutch assembly.

2. A/C LOW PRESSURE SWITCH

Ignition in RUN, A/C controls in MAX or NORM.

- Low pressure switch connector (Terminal A) should be battery voltage. If not, repair open to select switch.
- Low pressure switch connector (Terminal C) should be battery voltage. If not, check switch resistance and check freon pressure.

3. A/C CLUTCH RELAY

Engine RUNNING, A/C controls in MAX or NORM.

- Relay connector Pin 4 to ground should be battery voltage. If not, check fuse F6 in Power Distribution Center.
- Ground A/C clutch relay (Terminal 5) should have A/C compressor clutch engagement. If not, check Engine Controller Terminals 27, 28 and 34.

HEATING SYSTEM—YJ VEHICLES

DESCRIPTION

The blower motor circuit begins at a 25 amp fuse that receives its battery feed from the ignition switch. From the fuse the circuit extends to a micro-switch mounted on the heater control.

The micro-switch is normally closed is operated by a cam on the heater control lever. In all heater control lever positions, except OFF and VENT, the blower motor electrical circuit is complete. In the OFF and VENT positions the cam depresses the micro-switch lever opening the electrical circuit to the blower motor.

The blower switch allows the driver to select 1 of 3 blower speeds—low, medium and high. In the high speed position, the switch connects the motor directly to the battery source. The remaining 2 slower speeds are accomplished by routing the battery source through a resistor assembly.

The resistor and switch are wired in such a way that only a single wire is needed to operate the blower motor at 3 different speeds.

DIAGNOSIS

Refer to Group 8W, Wiring Diagrams for complete system schematic.

1. HEAT/OFF MICRO-SWITCH

Place selector lever in heat mode and turn ignition switch to RUN.

- Heat/Off micro-switch connector supply side should be battery voltage. If not, repair open from fuse No.12.
- Heat/Off micro-switch connector output side should be battery voltage. If not, replace Heat/Off micro-switch.

2. BLOWER SWITCH

Turn ignition switch to RUN and place selector lever in HEAT mode.

- Blower switch (terminal A) should be battery voltage. If not, repair open from HEAT/OFF switch connector output side to blower switch.
- Blower switch (terminal D) with blower switch in HI should be battery voltage. If not, replace blower switch.
- Blower switch (terminal C) with blower switch in LO should be battery voltage. If not, replace blower switch.
- Blower switch (terminal B) with blower switch in MED should be battery voltage. If not replace blower switch.

3. BLOWER RESISTOR

Turn ignition switch to RUN for voltage tests and turn ignition switch to OFF for resistance tests.

- Blower resistor (Terminal A) with blower switch in LO should be battery voltage. If not, repair open between blower switch and blower resistor.
- Blower resistor (Terminal C) with blower switch in MED should be battery voltage. If not, repair open between blower switch and blower resistor.
- Blower resistor (Terminal B) with blower switch in HI should be battery voltage. If not, repair open between blower switch and blower resistor.
- Blower resistor between Terminals A and B should be 3.25 ohms, if not replace blower resistor.
- Blower resistor between Terminals B and C should be 0.60 ohms. If not, replace blower resistor.
- Blower resistor between terminals A and C should be 2.65 ohms, if not replace blower resistor.

4. BLOWER MOTOR

Turn blower motor switch to HI and place selector lever in HEAT mode. Turn ignition switch to RUN for voltage tests or to OFF for resistance tests.

- Blower motor voltage should be battery voltage. If not, repair open from blower switch.
- Blower motor case to clean chassis ground should be 0 ohms. If not, repair/replace blower motor.

AIR CONDITIONING SYSTEM—YJ VEHICLES

DESCRIPTION

The air conditioning circuit consists of 3 segments; battery supply, blower motor and compressor clutch. The 3 segments have a common connection point at the blower switch.

The power supply segment of the circuit extends from the 25 amp HTR/FAN fuse to the blower switch. From the blower switch, battery feed is routed to the blower motor and compressor clutch segments of the circuit.

The blower motor segment consists of the 3 wires from the blower switch to the motor, the motor itself and the motor ground wire. Through the switch, the 3 wires connect the motor brushes to battery supply. When connected to battery feed, the separate brushes provide the 3 blower speeds—LO, MED, and HIGH.

In all blower switch positions except OFF, the compressor clutch segment of the circuit also receives battery feed. ON and OFF cycling of the compressor and therefore the temperature of the outlet air is regulated by the thermostatic control. A thermal sensor extends from the control to the evaporator housing. When the temperature of the evaporator drops below the set temperature, the thermostatic control opens the clutch circuit. The circuit remains open until evaporator temperature rises above the set temperature.

The compressor clutch segment of the circuit also contains a low pressure switch. If the pressure in the refrigerant system drops due to a leak, the circuit is opened to prevent damage to the compressor.

The last component in the compressor clutch segment of the circuit is the clutch coil. When the coil is connected to battery feed, its windings form an electromagnet that pulls the clutch hub against the clutch pulley.

DIAGNOSIS

BLOWER MOTOR

Refer to Group 8W, Wiring Diagrams for complete system schematic.

1. FUSE—Ignition in RUN.

- Heater blower motor operates. If not, check fuse No.12.

• Battery side of fuse No.12 should be battery voltage. If not, repair open from ignition switch.
• A/C blower switch (terminal A) should be battery voltage. If not, repair open from fuse No.12.

2. BLOWER SWITCH—Ignition in RUN.

• A/C blower switch (Terminal A) with blower switch in any position should be battery voltage. If not, repair open from fuse panel.
• A/C blower switch (Terminal L) with blower switch in LO should be battery voltage. If not, replace switch.
• A/C blower switch (Terminal M) with blower switch in MED should be battery voltage. If not, replace switch.
• A/C blower switch (Terminal H) with blower switch in HI should be battery voltage. If not, replace switch.

3. BLOWER MOTOR

Turn ignition switch to RUN for voltage tests and turn ignition switch to OFF for resistance tests.
• A/C blower housing to ground (Terminal G) should be 0 ohms. If not, repair ground connection. If the blower motor is still inoperative, replace motor.
• A/C blower motor connector (Terminal C) with blower switch in LO should be battery voltage. If not, repair open from blower switch. If the blower motor is still inoperative, replace motor.
• A/C blower motor connector (Terminal B) with blower switch in MED should be battery voltage. If not, repair open from blower switch. If the blower motor is still inoperative, replace motor.
• A/C blower motor connector (Terminal A) with blower switch in HI should be battery voltage. If not, repair open from blower switch. If the blower motor is still inoperative, replace motor.

COMPRESSOR CLUTCH

Refer to Group 8W, Wiring Diagrams for complete system schematic.

With engine running, Engine Controller may delay A/C clutch up to 30 seconds.

1. COMPRESSOR CLUTCH.

• Jumper wire from battery positive post to A/C compressor clutch connector (Terminal A), clutch should engage. If not, go to next step with jumper installed.
• Jumper wire from clutch coil frame to chassis ground, clutch should engage. If not, repair clutch coil ground or replace coil.

2. LOW PRESSURE SWITCH

Turn ignition switch to RUN, A/C blower switch to ON and thermostatic control set to MAX cool.
• A/C low pressure switch connector (Terminal A) should be battery voltage. If not, proceed to thermostatic control tests (Step 3).
• Jumper wire across A/C low pressure switch connector (Terminals A and B), clutch should engage. If not, check system refrigerant charge. If system is properly charged, replace A/C low pressure switch.

3. THERMOSTATIC CONTROL

Turn ignition switch to RUN, A/C blower switch to ON and thermostatic control set to MAX cool.
• Thermostatic control connector (Terminal A) should be battery voltage. If not, repair open from blower switch.
• Thermostatic control connector (Terminal B) should be battery voltage. If not, replace thermostatic control.
• A/C low pressure switch connector (Terminal A) should be battery voltage. If not, repair open from thermostatic control.

COMPRESSOR OVERHAUL

INDEX

DESCRIPTION

The A/C system uses a Sanden compressor. This compressor is a 7 piston design. Designated the SD-709, the compressor is mounted on the front right side of the engine and is driven by a serpentine belt. System lubrication is provided by 135cc ±15cc (4.6 cu. in. ±0.5 cu. in.) of 500 viscosity refrigerant oil.

The clutch used on the compressor consists of 3 basic components: the pulley, front plate and the field coil. The pulley and field coil are attached to the front head of the compressor with tapered snap rings. The hub is keyed to the compressor shaft and is retained on the shaft with a self-locking nut. Special service tools are required to remove and install the clutch plate on the compressor shaft.

COMPRESSOR ISOLATION

It is not necessary to discharge the system for compressor removal. The compressor can be isolated from the remainder of the system and eliminate the need for recharging when performing compressor service.

(1) Connect pressure gauge and manifold.
(2) Close both gauge hand valves.
(3) Mid-position both service valves.

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.

(4) Start the engine and operate the air conditioning system.
(5) Turn the suction service valve slowly clockwise toward the front seated position.
(6) When pressure drops to zero, stop the engine and compressor and quickly finish front-seating the suction service valve.
(7) Front-seat the discharge service valve.
(8) Loosen the oil level check plug slowly to release any internal pressure in the compressor.

The compressor is now isolated from the remainder of the system.

The service valves can be removed from the compressor.

PURGING COMPRESSOR OF AIR

The compressor must be purged of air whenever it has been isolated for an oil level check or other service procedures without discharging the entire system.

(1) Cap the service gauge ports on both of the service valves.
(2) Back-seat the suction service valve to allow the system refrigerant to enter the compressor.
(3) Place the discharge service valve in the mid-position or cracked-position.
(4) Loosen the discharge service valve gauge port cap to permit the refrigerant to force any air out of the compressor.
(5) Back-seat the discharge service valve and tighten the gauge port cap.
(6) The compressor is now ready for service.

COMPRESSOR

REMOVAL

(1) Isolate the compressor.
(2) Disconnect negative cable from battery.
(3) Disconnect the clutch lead wire.
(4) Remove the discharge and inlet (suction) service valves from the compressor. Plug or tape all the openings.
(5) Remove the serpentine drive belt (refer to Group 7, Cooling System for the proper procedure).
(6) Remove the bolts and lift the compressor from the mounting bracket (Figs. 1 and 2).

INSTALLATION

If a replacement compressor is being installed; check the oil level. Add or subtract oil as necessary and install the magnetic clutch on the compressor.

(1) If the mounting bracket was removed, install the bracket to the block. Tighten the mounting bolts to 27 N•m (20 ft. lbs.) torque.
(2) Install the compressor on the mounting bracket. Tighten the bolts to 27 N•m (20 ft. lbs.) torque.
(3) Install the serpentine drive belt (refer to Group 7, Cooling System for the proper procedure).
(4) Tighten the serpentine drive belt to the specified tension.

- New belt tension—800-900 N (180-200 lb-f).

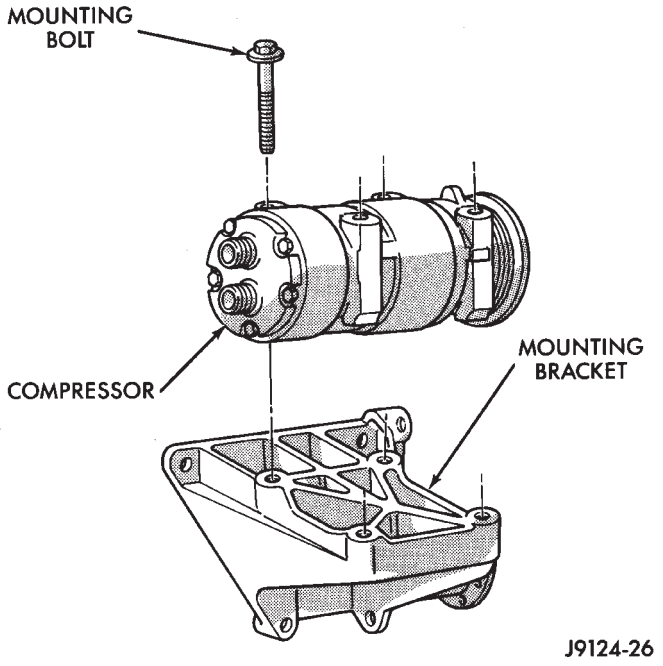


Fig. 1 Compressor and Mounting Bracket (LH Drive Vehicles)

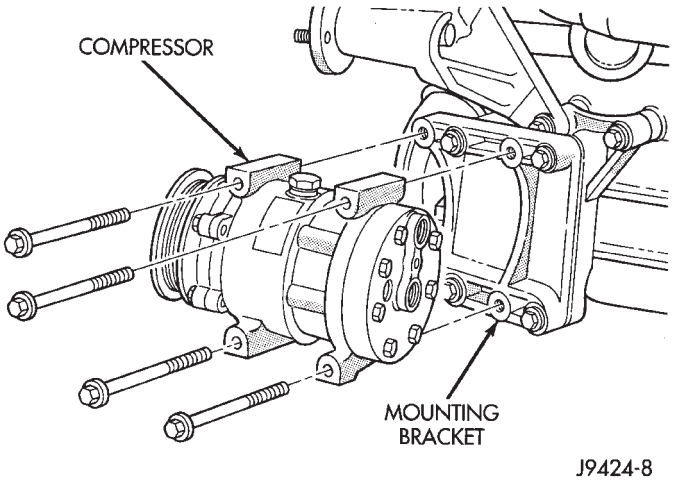


Fig. 2 Compressor and Mounting Bracket (RH Drive Vehicles)

- Used belt tension—623-712 N (140-160 lb-f).

(5) Remove the tape or plastic plugs from all the suction and discharge openings and install the service valves on the compressor.

(6) Connect the clutch lead wire.

(7) Connect negative cable to battery.

(8) Evacuate, charge and test the system for leaks.

MAGNETIC CLUTCH

The magnetic clutch consists of a stationary electro-magnetic coil and a rotating pulley and plate assembly.

The electromagnetic coil is retained on the compressor with a snap ring and is dimpled to maintain its position.

The pulley and plate assembly are mounted on the compressor shaft.

When the compressor is not in operation, the pulley free wheels on the clutch hub bearing. When the coil is energized the plate is magnetically engaged with the pulley and turns the compressor shaft.

REMOVAL

(1) Insert the 2 pins of the front plate spanner into any 2 threaded holes of the clutch front plate (Fig. 3). Hold clutch plate stationary. Remove hex nut with 19 mm (3/4 inch) socket (Fig. 3).

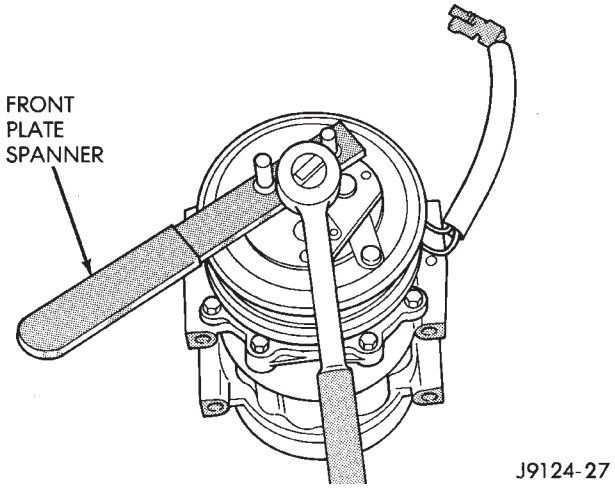


Fig. 3 Hex Nut Removal

(2) Remove clutch front plate using puller. Align puller center bolt to compressor shaft (Fig. 4). Thumb tighten the puller bolts into the threaded holes.

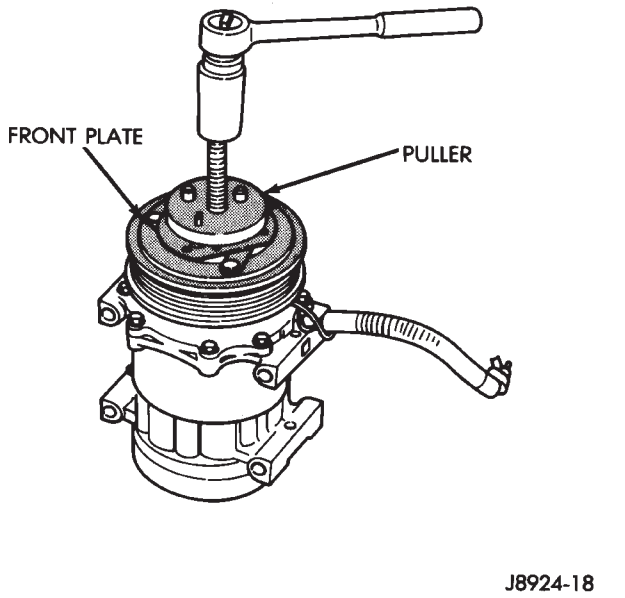


Fig. 4 Clutch Front Plate Removal

(3) Turn center bolt clockwise with 19 mm (3/4 inch) socket until front plate is loosened.

(4) Remove shaft key by lightly tapping it loose with a slot screwdriver and hammer (Fig. 5).

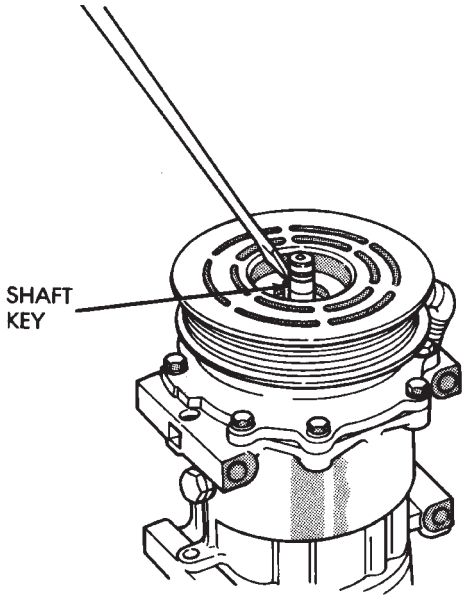


Fig. 5 Shaft Key Removal

(5) Remove the external front housing snap ring by using spread type snap ring pliers (Fig. 6).

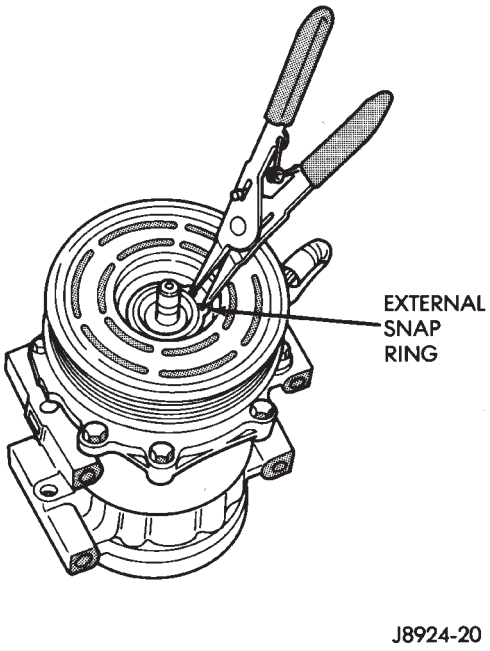


Fig. 6 External Snap Ring Removal

(6) Insert the lip of the jaws of the rotor puller into the snap ring groove exposed in the previous step (Fig. 7).

(7) Place rotor puller shaft protector over the exposed shaft.

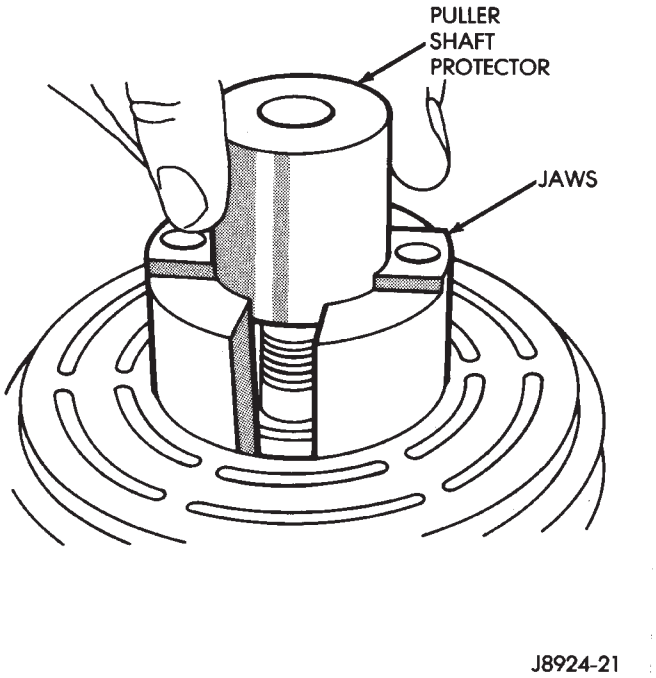


Fig. 7 Install Shaft Protector

(8) Install the puller plate and bolt (Fig. 8). 2 bolts go through the plate and into the jaws. Finger tighten bolts.

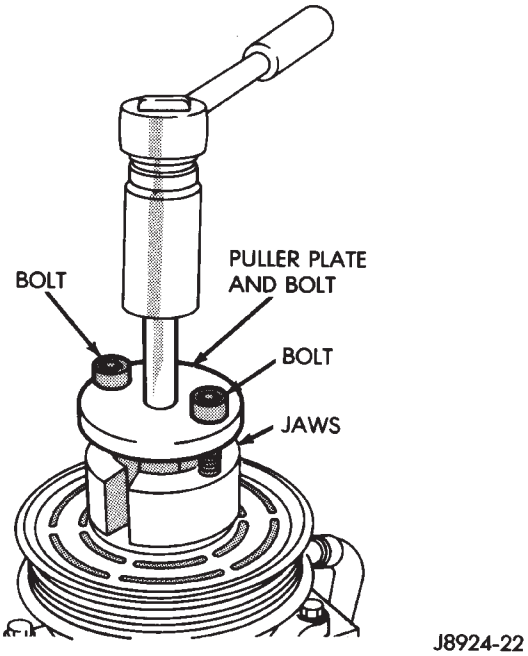


Fig. 8 Install Puller Plate

(9) Turn puller center bolt clockwise using 3/4 inch socket until rotor pulley is free.

(10) Loosen coil lead wire from clip on top of compressor front housing (Fig. 9).

(11) Using spread type snap ring pliers, remove snap ring and field coil (Fig. 10).

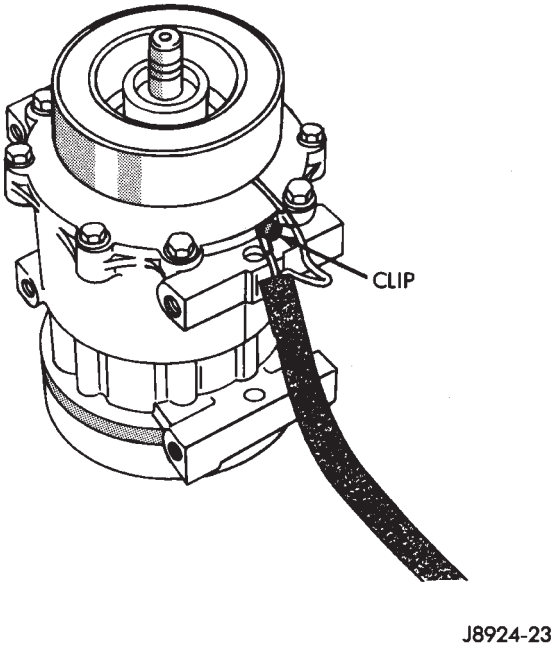


Fig. 9 Loosen Coil Lead Wire

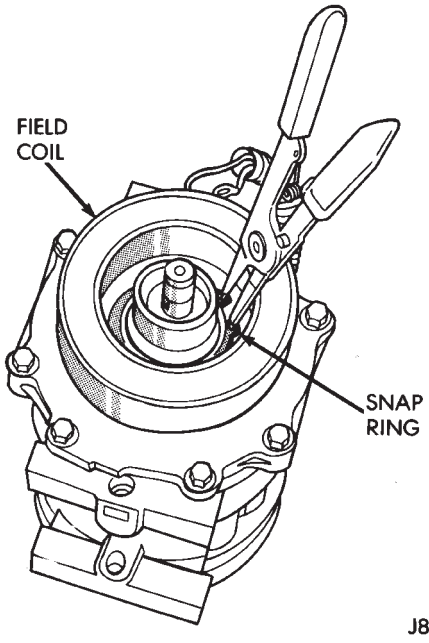


Fig. 10 Snap Ring and Field Coil Removal

INSTALLATION

(1) Install the field coil with the snap ring.

(2) Place coil lead wire under clip on top of compressor front housing and tighten the retaining screw.

(3) Support the compressor on the 4 mounting ears at the compressor rear. If a vise is being used, clamp only on the mounting ears. Never clamp on the compressor body.

(4) Align rotor assembly squarely on the front housing hub.

(5) Using Rotor Installer Set, place the ring part of the set into the bearing cavity (Fig. 11). Make certain the outer edge rests firmly on the rotor bearing inner race.

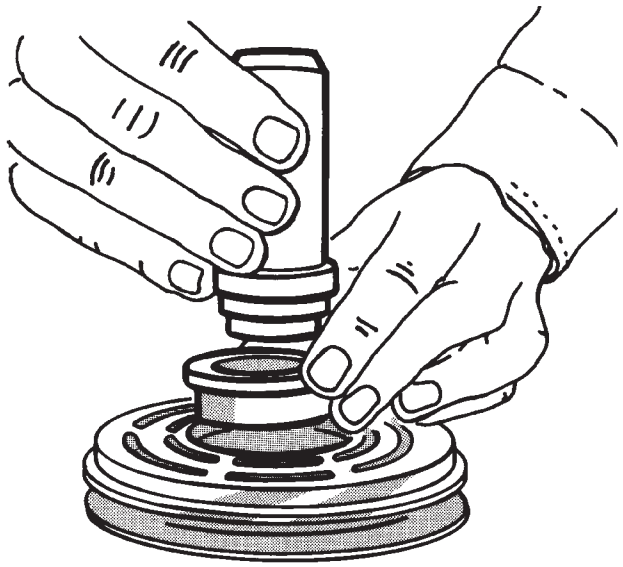


Fig. 11 Rotor Installer Set

(6) Place the tool set driver into the ring (Fig. 12).

(7) With a hammer, tap the end of the driver while guiding the rotor to prevent binding. Tap until the rotor bottoms against the compressor front housing hub. Listen for a distinct change of sound during the tapping process.

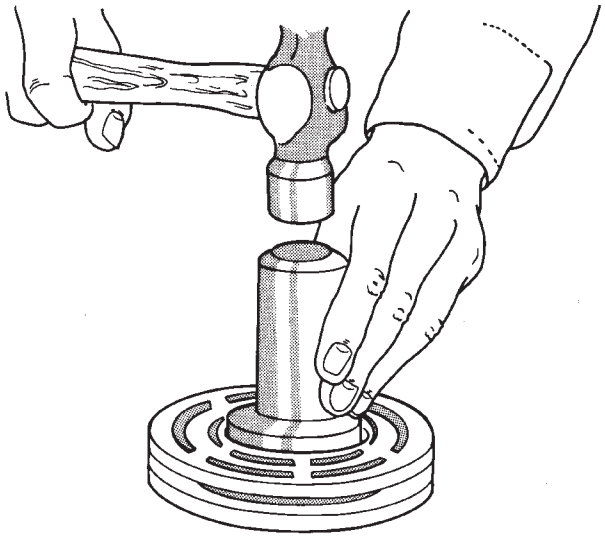


Fig. 12 Tool Set Driver

(8) Install external front housing snap ring with spread type snap ring pliers.

(9) Install front plate assembly.

- Check that original clutch shims are in place on compressor shaft.
- Replace compressor shaft key.
- Align front plate keyway to compressor shaft key.

(10) Using shaft protector, tap front plate to shaft until it has bottomed to the clutch shims (Fig. 13). Listen for a distinct change of sound during the tapping process.

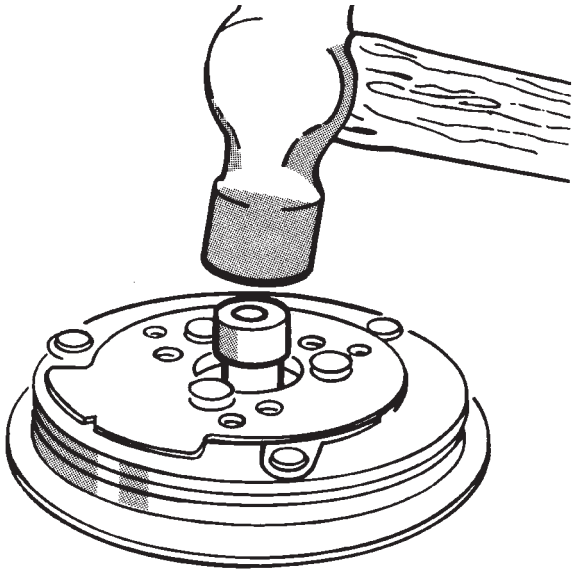


Fig. 13 Front Plate Installation

(11) Replace shaft hex nut. Tighten the hex nut to 37 N•m (27 ft. lbs.) torque.

(12) Check air gap with feeler gauge (Fig. 14). The specification is 0.406-0.787 mm (0.016-0.031 inch). If air gap is not consistent around the circumference, lightly pry up at the minimum variations. Lightly tap down at points of maximum variation.

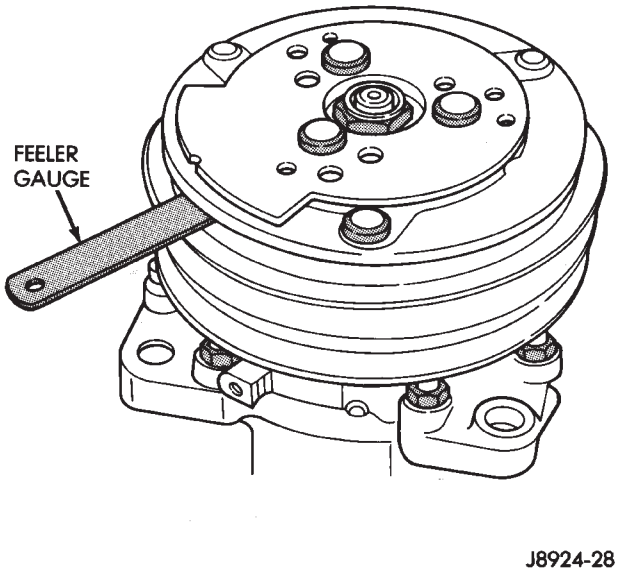


Fig. 14 Check Air Gap

The air gap is determined by the spacer shims. When installing the 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 0.040, 0.020, and 0.005 shims from the clutch accessory sack.

(13) If the air gap does not meet the specification given, add or subtract shims as required.

CLIMATE CONTROL SYSTEM—XJ VEHICLES

INDEX

DESCRIPTION

The Climate Control System combines air conditioning, heating and ventilating capabilities for vehicles equipped with air conditioning. Vehicles without air conditioning perform heating and ventilating functions without the air conditioning evaporator.

Both systems consist basically of 2 parts:

- Blower and Air Inlet Assembly
- Heater Core and Air Distribution Assembly

These assemblies, initially installed as a single unit, may be removed separately from under the instrument panel as required for service.

HEATER SYSTEM

The heater system is a blend air type. Outside air is heated and then blended in varying amounts with cooler outside air to obtain the desired discharge temperature. A heater coolant valve provides full flow to the heater core for all heating modes. The heater coolant valve remains closed for the ventilation mode, allowing discharge air to approach the outside ambient air temperature.

AIR CONDITIONING SYSTEM

The air conditioning system has an evaporator to cool and dehumidify the incoming outside air prior to blending with the heated air. The evaporator is in operation during the A/C mode and also in the defrost mode for defogging purposes. The evaporator is not in operation at ambient temperatures below approximately -1°C (30°F). To maintain minimum evaporator temperature, a fixed thermostat setting switch cycles the compressor clutch. The blower is operating the heater or air conditioning systems, except the OFF mode. In this mode (OFF) the blower and the outside air are shut off.

The cooling unit is mounted on the dash panel and the cooled air is discharged from the instrument panel registers. The registers are adjusted to provide general or localized cooling.

SIGHT GLASS

The sight glass is located on top of the receiver/drier. The sight glass provides a visual check of the system refrigerant level. A continuous stream of bubbles will appear in the sight glass when the system charge is low. Bubbles will not appear when the system is fully charged.

LOW PRESSURE SWITCH

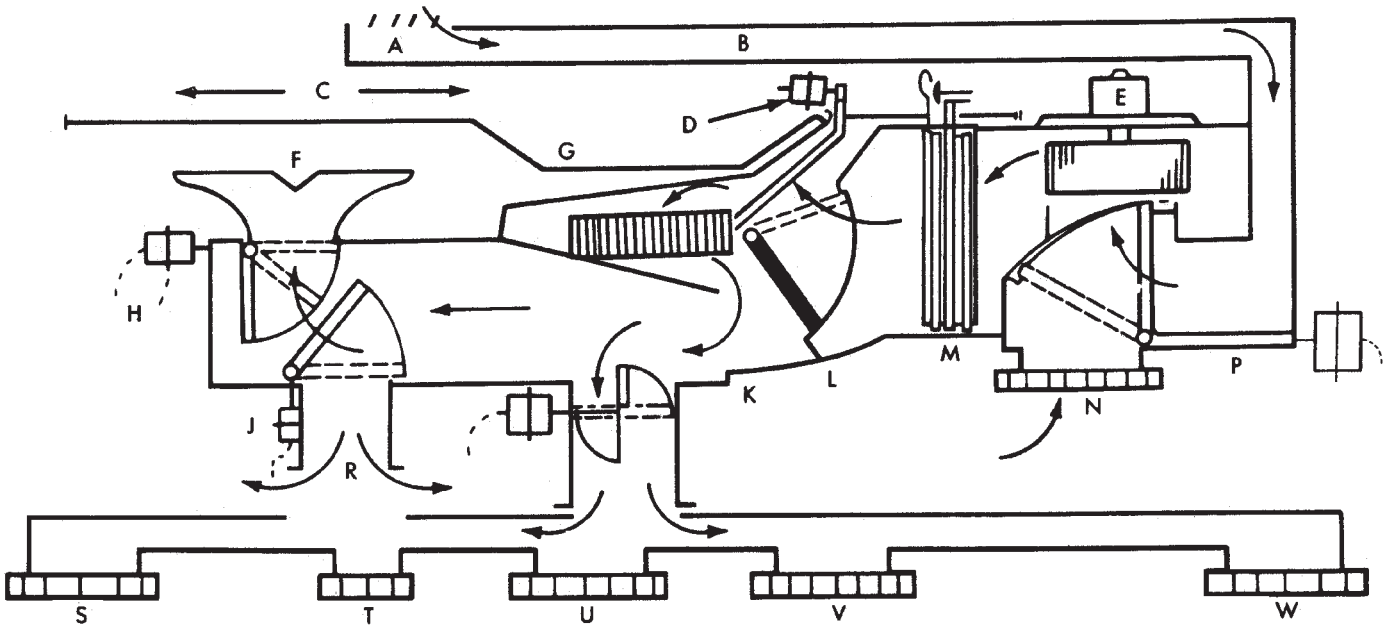
The low pressure switch disengages the magnetic clutch if the pressure in the system drops below 193 kPa (28 psi). This will occur with a loss in refrigerant or with cold ambient temperature.

HEATER VALVE

The heater valve regulates coolant flow to the heater core. It requires vacuum to shut off flow to the heater core.

These vehicles are equipped with a bypass-type heater water valve. When the heater valve is closed, coolant flow to the heater core is bypassed back to the engine. When the heater valve is open, coolant is directed through the heater core and back to the engine.

AIRFLOW DIAGRAM



A - OUTSIDE AIR INLET
B - COWL
C - DASH PANEL
D - WATER VALVE
E - BLOWER ASSEMBLY
F - DEFROSTER
G - HEATER CORE
H - DEFROSTER DOOR
J - FLOOR DOOR
K - PANEL DOOR
L - BLEND DOOR
M - EVAPORATOR CORE
N - RECIRCULATION AIR INLET
P - RECIRCULATION DOOR
R - FLOOR OUTLET
S - LEFT HAND REGISTER
T - LEFT HAND LAP COOLER
U - LEFT CENTER REGISTER
V - RIGHT CENTER REGISTER
W - RIGHT HAND REGISTER

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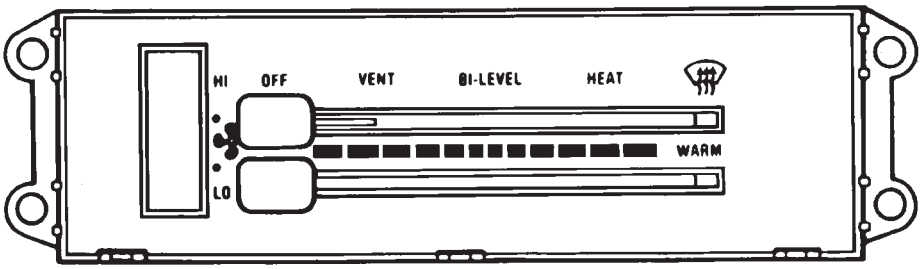
HEATING SCHEMATIC

HEATER CONTROL UNIT

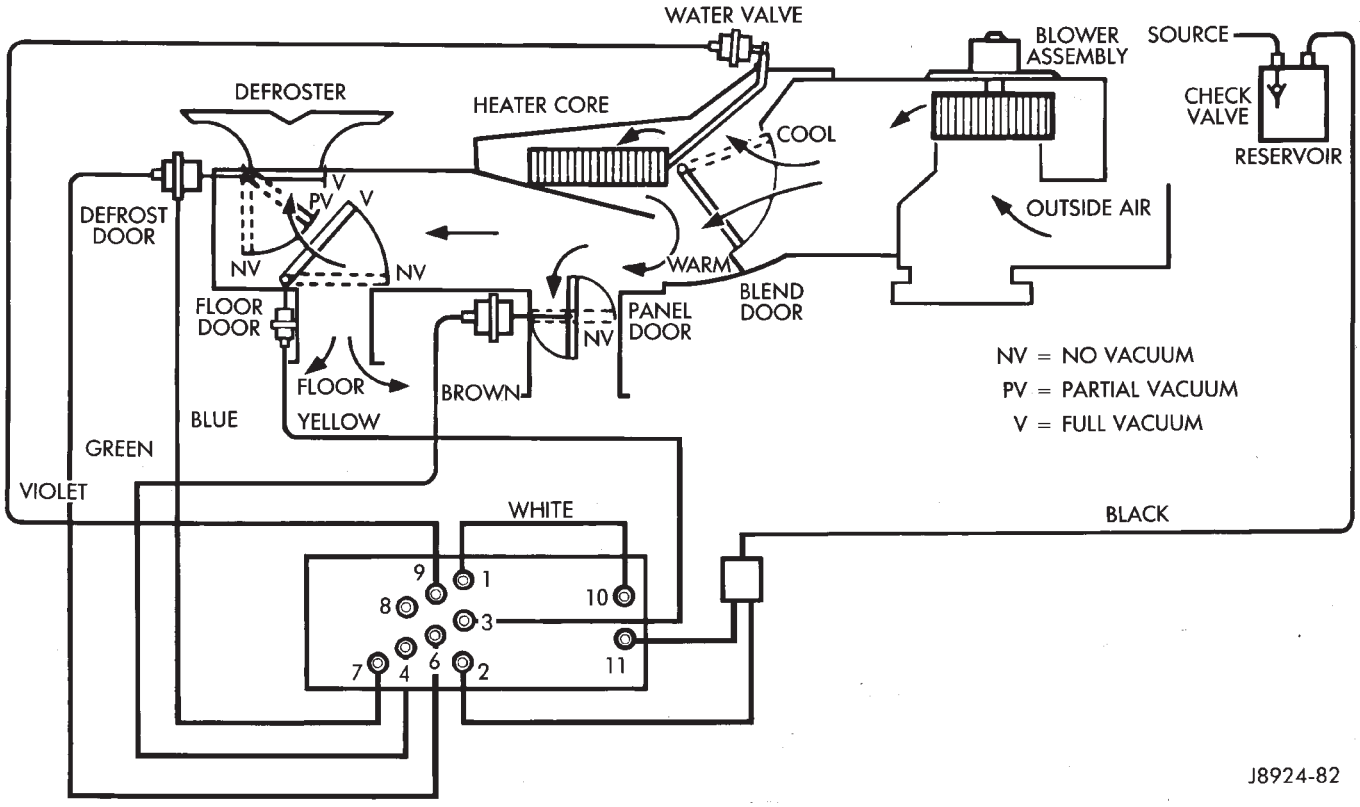


HEATER SYSTEM OPERATION

Mode Lever Position	Air Discharge	Blower Speeds	Panel Door	Floor Door	Defrost Door	Water Valve
Off	Closed	None	Closed	Closed	Closed	Closed
Vent	Panel Registers	4	Open	Closed	Closed	Closed
Bi-Level	Panel Registers and Floor With Def. Bleed	4	Open	Open	Bleed	Open (1)
Heat	Floor With Def. Bleed	4	Closed	Open	Bleed	Open (1)
	Defroster	4	Closed	Closed	Open	Open (1)

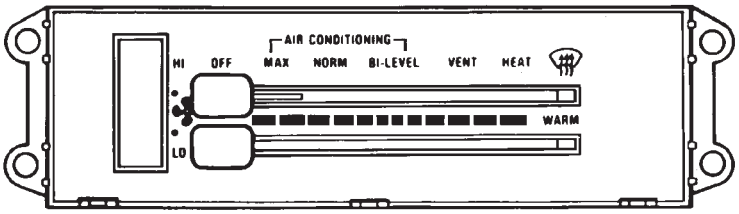
(1) WATER VALVE CLOSES IN FULL "COOL" TEMPERATURE LEVER POSITION.

HEATER CONTROL SYSTEM VACUUM SCHEMATIC



AIR CONDITIONING SCHEMATIC

A/C CONTROL UNIT

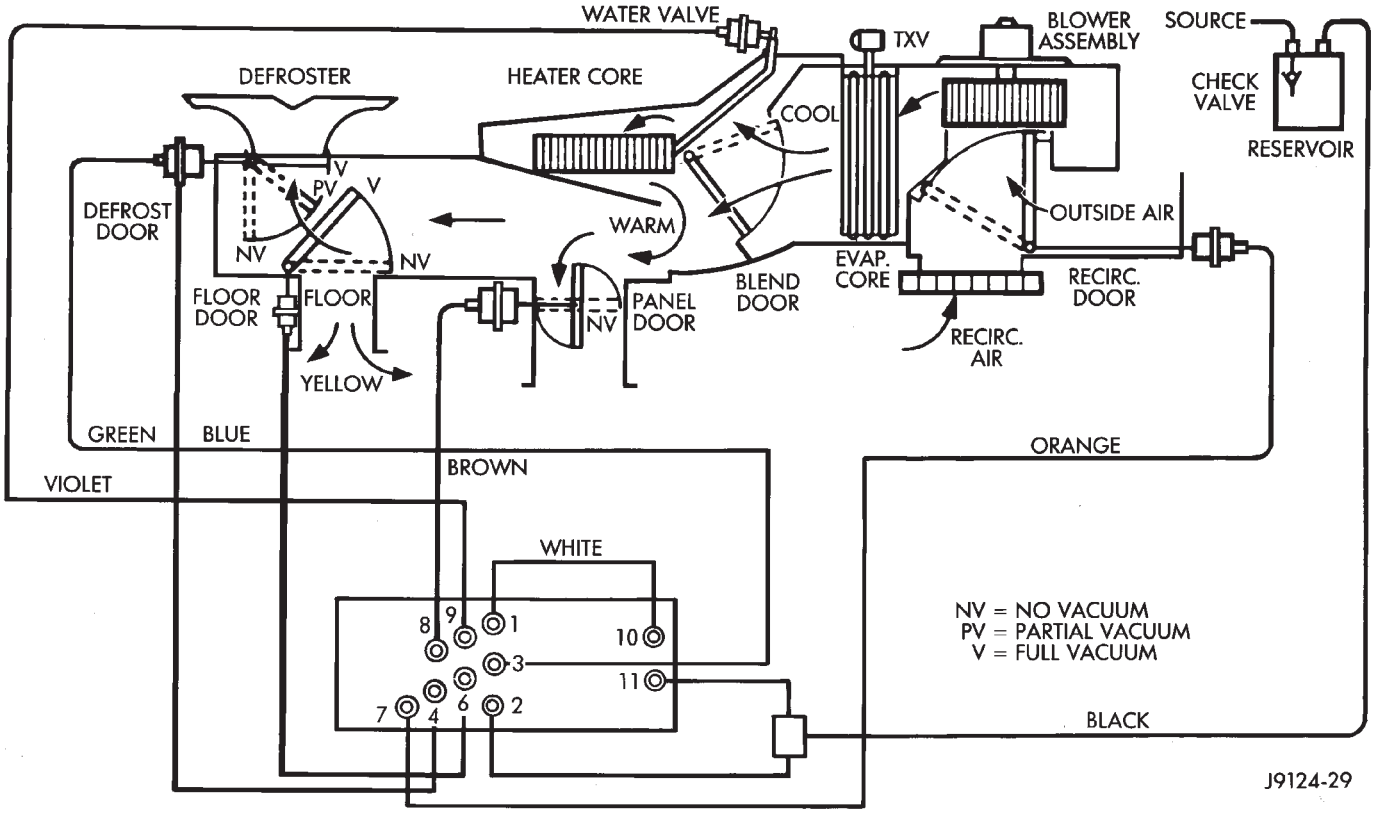


A/C SYSTEM OPERATION

Mode Lever Position	Air Discharge	Blower Speeds	Recirc. Door	Panel Door	Floor Door	Defrost Door	A/C Cmp.	Water Valve
Off	Closed	None	Recirc.	Open	Indeter-minate	Open	Off	Closed
Max A/C	Panel Registers With Floor Bleed	4	Recirc.	Open	Bleed	Closed	On	Open (1)
Norm A/C	Panel Registers With Floor Bleed	4	Outside	Open	Bleed	Closed	On	Open (1)
Bi-Level	Panel Registers and Floor With Def. Bleed	4	Outside	Open	Open	Bleed	On	Open (1)
Vent	Panel Registers With Floor Bleed	4	Outside	Open	Bleed	Closed	Off	Open (1)
Heat	Floor With Def. Bleed	4	Outside	Closed	Open	Bleed	Off	Open (1)
	Def. With Floor Bleed	4	Outside	Closed	Bleed	Open	On	Open (1)

(1) WATER VALVE CLOSES IN FULL COOL TEMPERATURE LEVER POSITION.

AIR CONDITIONING CONTROL SYSTEM VACUUM SCHEMATIC



HEATER AND A/C CONTROL PANEL REPLACEMENT

(1) Disconnect negative cable from battery.

(2) Remove the instrument panel bezel attaching screws and remove the instrument panel bezel (Fig. 1). Bezel is snap fit at locations shown.

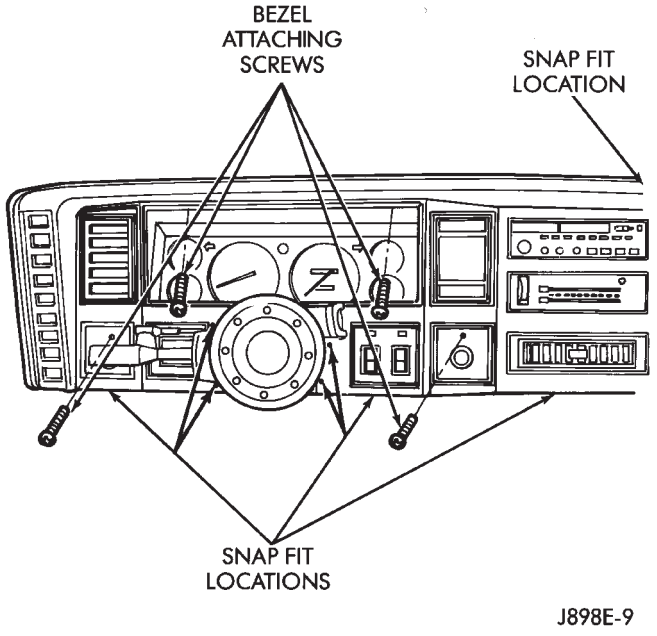


Fig. 1 Instrument Bezel

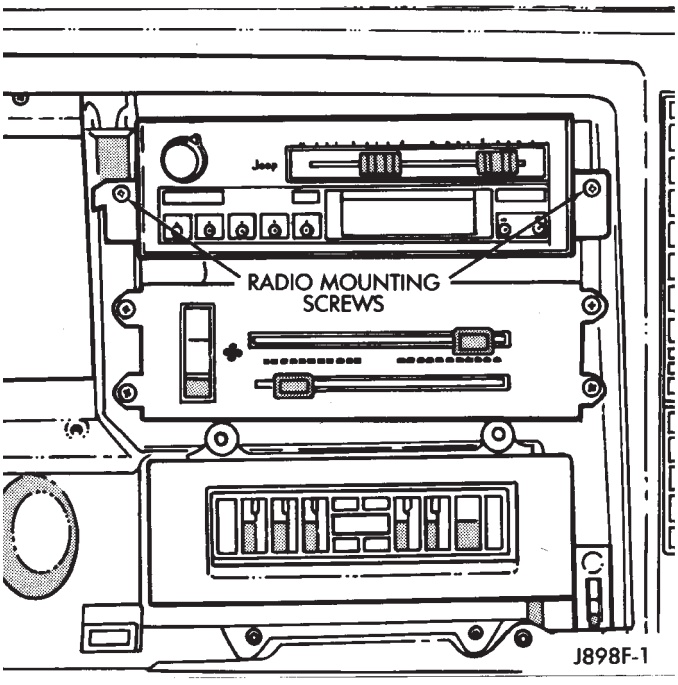


Fig. 2 Radio Mounting Screws

(3) Remove the radio attaching screws (Fig. 2).

(4) Disconnect the radio electrical connector, ground lead and antenna lead (Fig. 3).

(5) Remove the A/C-heater control panel screws (Fig. 4).

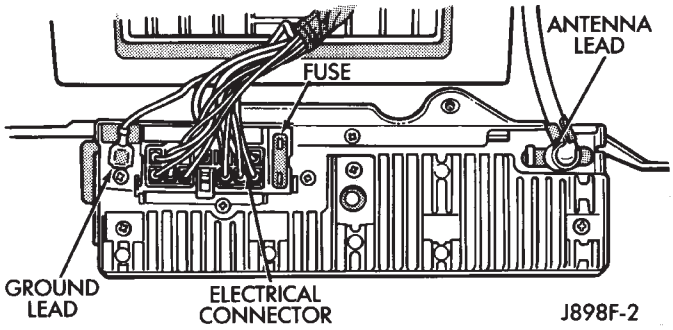


Fig. 3 Radio Wiring Harness

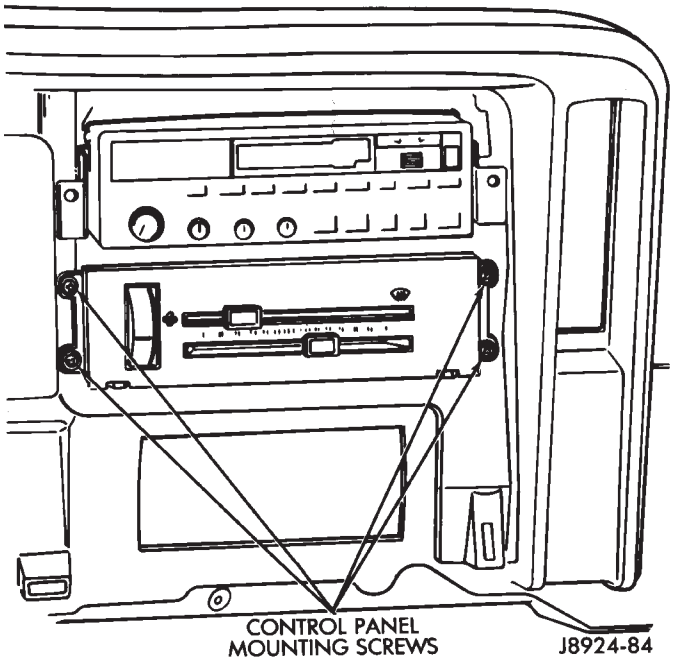


Fig. 4 Control Panel Mounting Screws

(6) Remove the electrical connectors (Fig. 5).

(7) Disconnect the vacuum hoses by releasing the locking tabs (Fig. 6).

(8) Remove the control cable locking tab by using a screwdriver to release the tab (Fig. 7).

(9) Remove the ring on the end of the control cable from the arm on the bottom of the control panel (Fig. 8).

To Install the A/C-heater control panel, reverse the removal procedures.

BLOWER MOTOR/FAN REPLACEMENT

The blower motor and fan are accessible and may be removed from the engine compartment.

2.5L ENGINE

(1) Disconnect the blower motor wires (Fig. 9).

(2) Remove the blower motor and fan assembly mounting screws (Fig. 10).

(3) Remove the blower motor and fan assembly.

(4) Remove the blower motor fan from the motor shaft for access to the motor attaching nuts (Fig. 11).

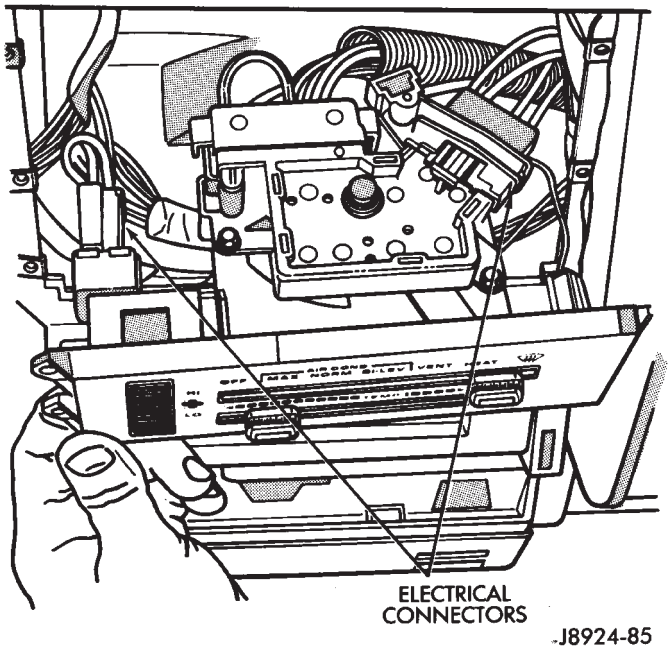


Fig. 5 Electrical Connectors

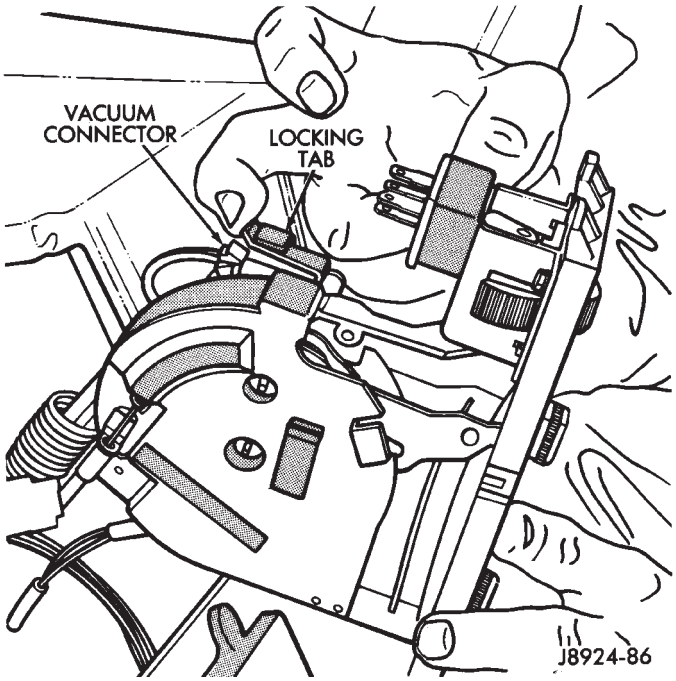


Fig. 6 Vacuum Hose Connector

To install the blower fan and motor, reverse the removal procedures.

4.0L ENGINE

(1) Remove the coolant bottle retaining strap and move bottle aside.

(2) Remove the coolant bottle bracket.

(3) Remove the anti-lock brake pump and bracket as an assembly (if equipped) and move the pump aside.

(4) Disconnect the blower motor wires (Fig. 9).

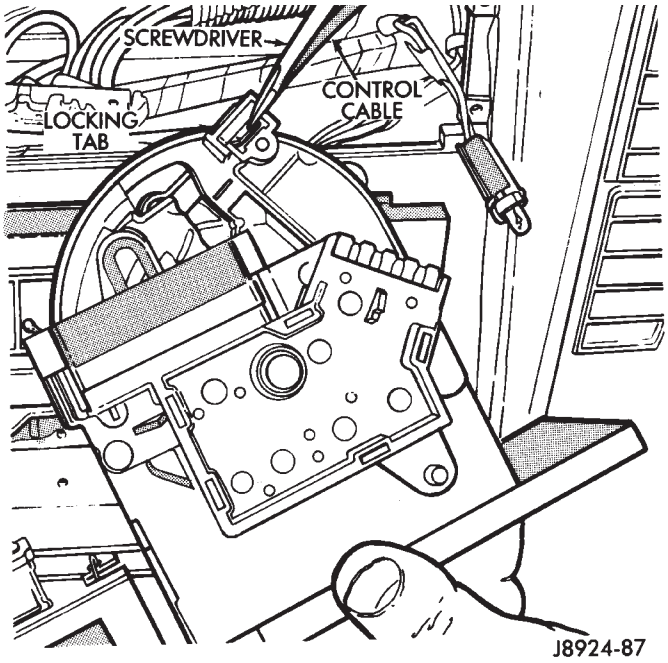


Fig. 7 Control Cable Locking Tab

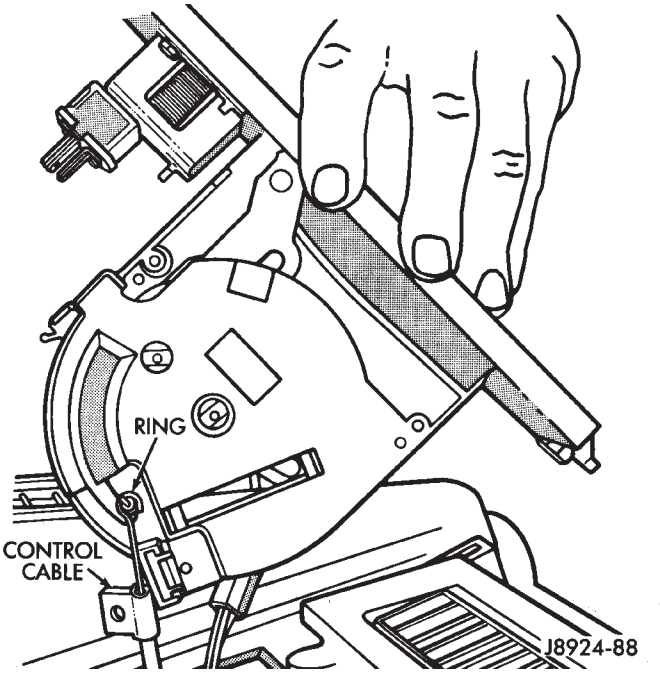


Fig. 8 Control Cable and Ring

(5) Remove the blower motor and fan assembly mounting screws (Fig. 10).

(6) Remove the blower motor and fan assembly.

(7) Remove the blower motor fan from the motor shaft for access to the motor attaching nuts (Fig. 11).

To install the blower fan and motor, reverse the removal procedures. **The ears (A) and (B) of the retainer clip must be over the flat surface on the motor shaft (Fig. 11).**

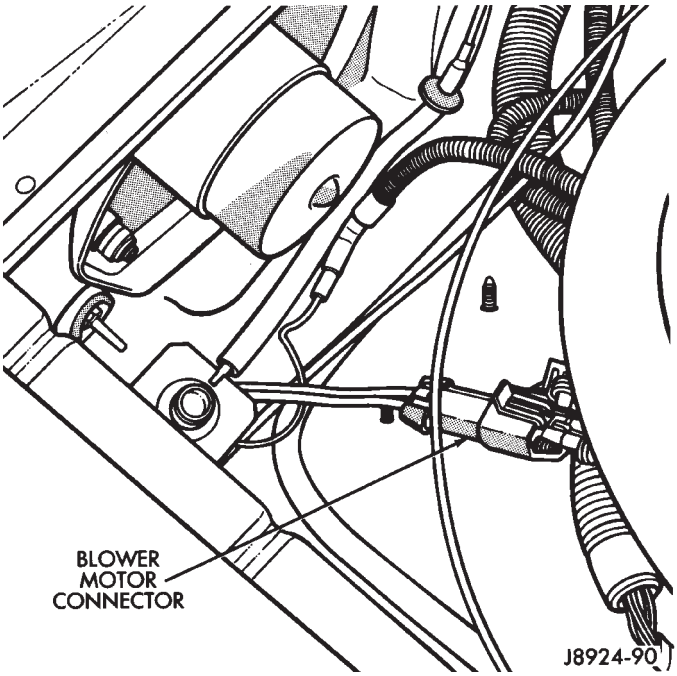


Fig. 9 Blower Motor Connector

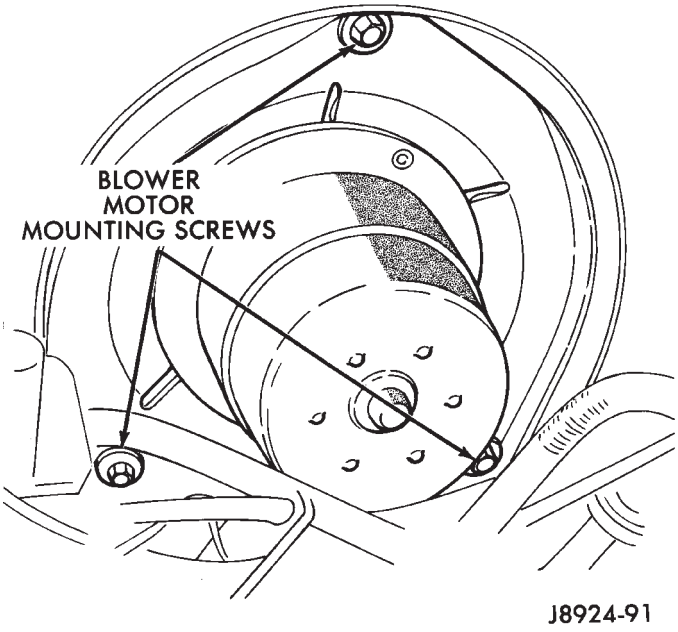


Fig. 10 Blower Motor Mounting Screws

HEATER CORE

REMOVAL

(1) Drain the radiator.

(2) Disconnect the heater hoses at the heater core inlet and outlet tubes.

(3) Remove the evaporator/blower housing.

(4) Remove the retaining screws and remove the heater core by pulling it straight out of the housing (Fig. 12).

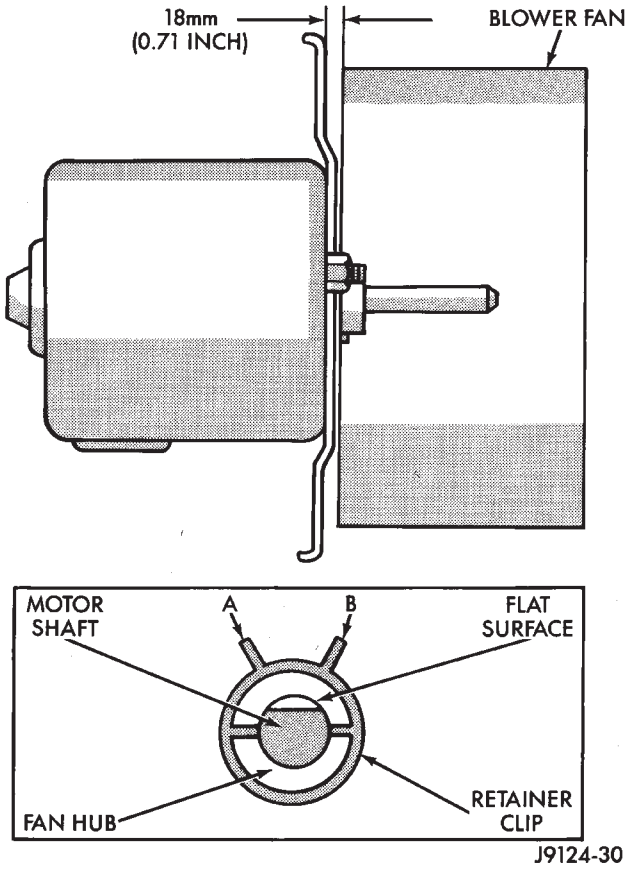


Fig. 11 Blower Fan

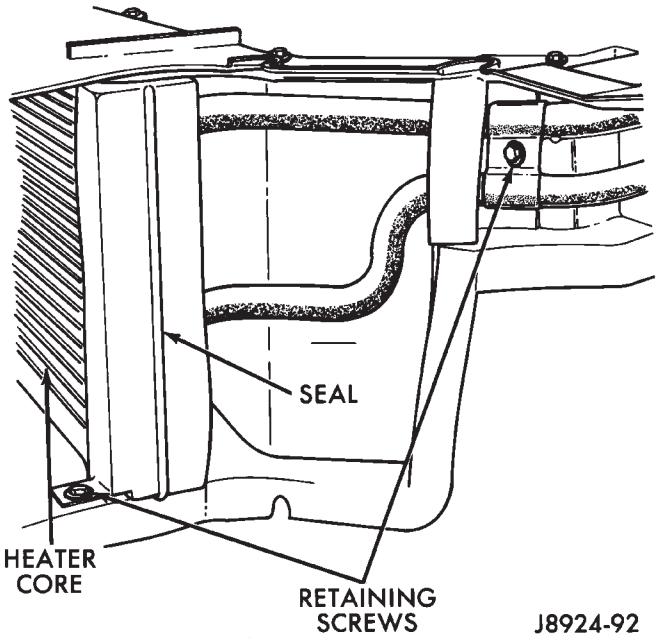


Fig. 12 Heater Core

INSTALLATION

(1) Install the heater core into the housing and install the screws.

(2) Install the evaporator/blower housing.

(3) Cement the seal into place in order to keep it from moving when the blower assembly is installed.

(4) Connect the heater hoses to the heater core.
(5) Fill the cooling system.

HEATER CORE HOUSING REPLACEMENT

(1) Remove the evaporator/blower housing.
(2) Remove the heater core.
(3) Remove the defroster duct.
(4) Disconnect the vacuum hoses from the heater core housing vacuum motors.
(5) Remove the heater housing retaining nuts in the engine compartment. Remove the heater core housing.
(6) Transfer the vacuum motors, etc. to the replacement housing.

To install the heater core housing, reverse the removal procedure.

DEFROSTER DUCT REPLACEMENT

REMOVAL

(1) Disconnect negative cable from battery.
(2) If equipped with center console remove the console as follows:
(a) MANUAL TRANSMISSION—Remove shift knob, boot and bezel.
(b) AUTOMATIC TRANSMISSION—Remove shift handle by pulling up. Remove the shift bezel.
(c) POWER MIRRORS—Pry mirror switch out of console cover (Fig. 13). Disconnect switch connector (Fig. 14).
(d) Remove console cover screws (Fig. 14).

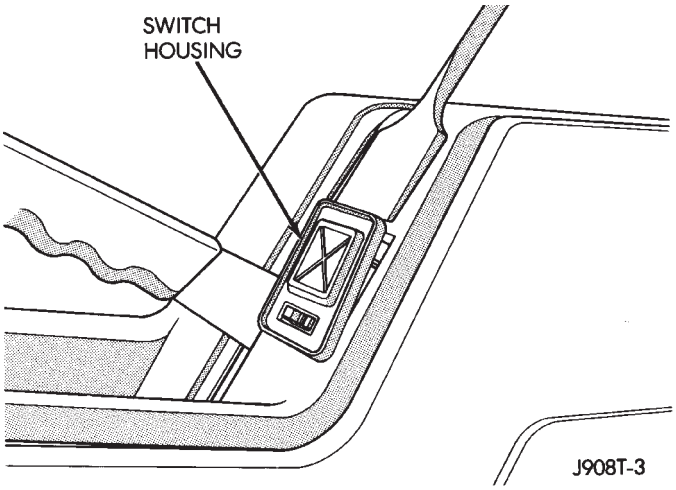


Fig. 13 Power Mirror Switch

(e) Remove console cover from base (Fig. 15).
(f) Remove console base (Fig. 15).
(3) Remove the lower instrument panel.
(4) Remove the left kick panel.
(5) Remove the instrument panel retaining bolt.
(6) Remove the instrument panel retaining bolts located at the steering column.
(7) Remove the right and left A-pillar trim.

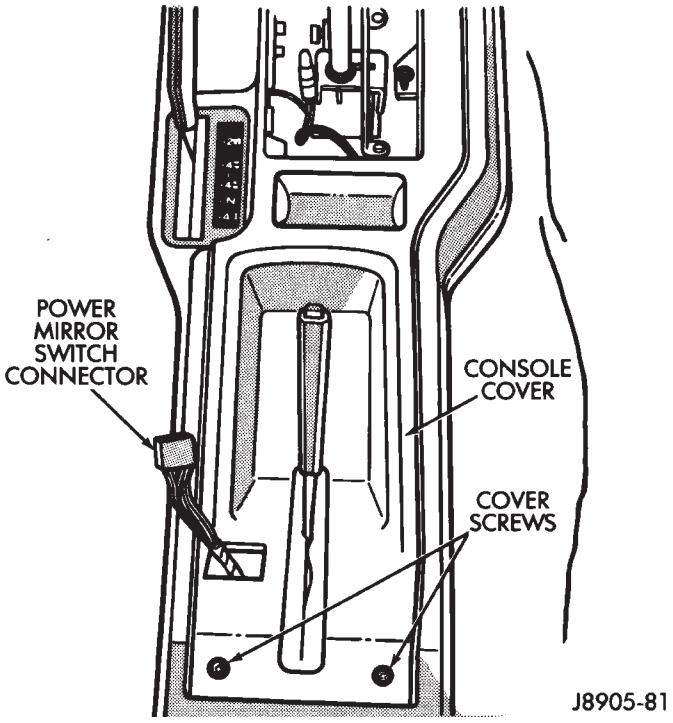


Fig. 14 Console Cover Screws and Power Mirror Switch Connector

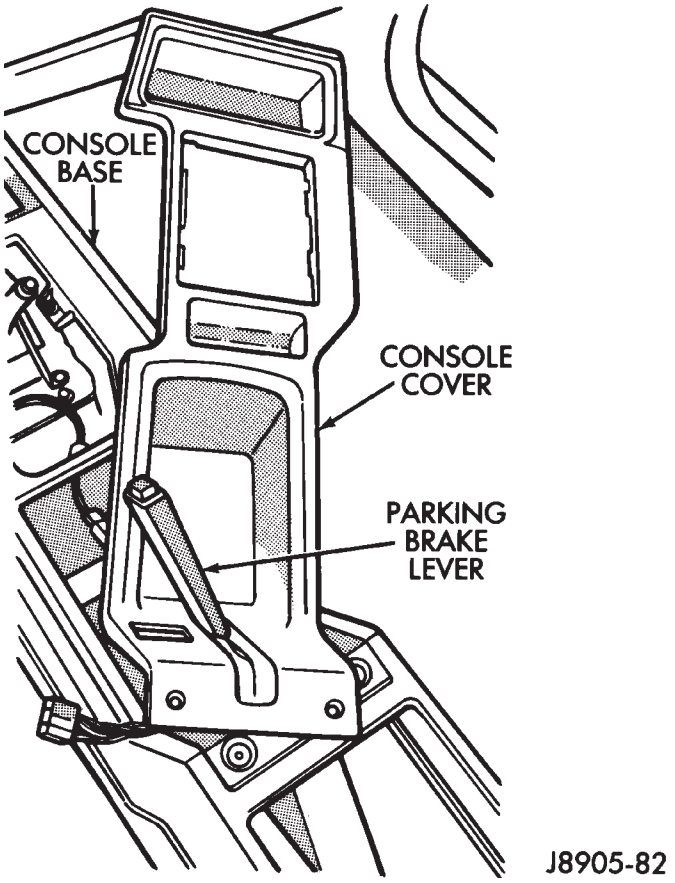


Fig. 15 Console Cover and Base

(8) Remove the defroster bezel attaching screws and bezel (Fig. 16).

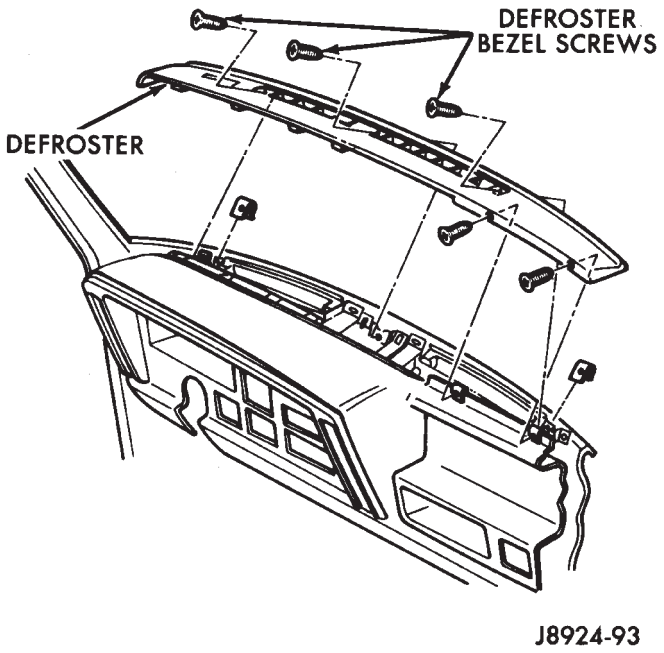


Fig. 16 Defroster Bezel

(9) Remove the instrument panel retaining screws.
(10) Lower the steering column.
(11) Pull the instrument panel, approximately 3 inches, away from the dash panel.
(12) Remove the defroster duct retaining screws. Remove the defroster duct.
(13) Disconnect the hoses.

INSTALLATION

(1) Connect the hoses.
(2) Install the defroster duct. Install the defroster duct retaining screws.
(3) Position the instrument panel into the dash panel.
(4) Position the steering column.
(5) Install the instrument panel retaining screws.
(6) Install the defroster bezel attaching screws and bezel.
(7) Install the right and left A-pillar trim.
(8) Install the instrument panel retaining bolts located at the steering column. Tighten the steering column retaining nuts to 27 N•m (20 ft. lbs.) torque.
(9) Install and tighten the instrument panel retaining bolt.
(10) Install the left kick panel.
(11) Install the lower instrument panel.
(12) If equipped with center console, install the console as follows:
(a) Install console base.
(b) Install console cover to base.
(c) Install and tighten console cover screws.
(d) POWER MIRRORS—Snap mirror switch into the console cover. Connect switch connector.
(e) MANUAL TRANSMISSION—Install shift knob, boot and bezel.
(f) AUTOMATIC TRANSMISSION—Install the shift bezel. Install shift handle by pushing down.
(13) Connect negative cable to battery.

HEATER CONTROL CABLE REPLACEMENT

(1) Remove the heater control panel.
(2) Remove the clip and the cable self-adjusting clip from the blend air door lever at the bottom of the evaporator/blower housing (Fig. 17). Then remove the cable by squeezing the tabs with needle nose pliers being careful not to break the housing.
To install the heater control cable, reverse the removal procedure.

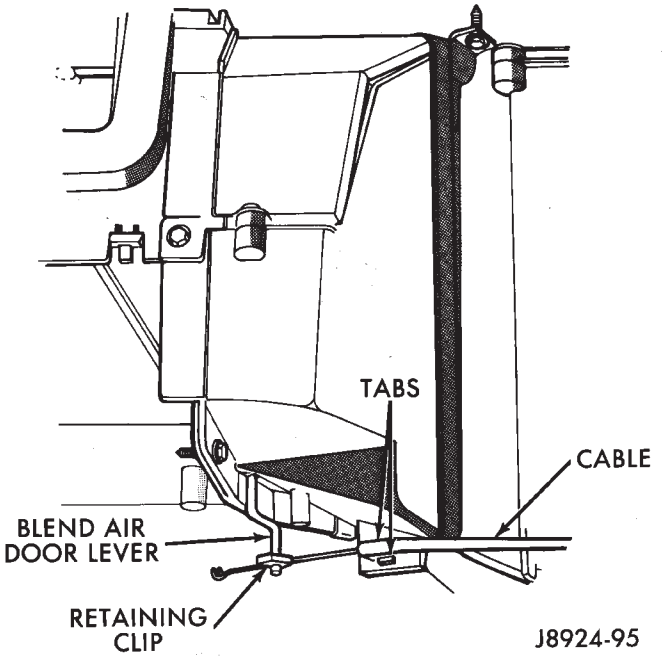


Fig. 17 Heater Control

HEATER/DEFROSTER/INSTRUMENT PANEL OUTLET DOOR VACUUM MOTOR REPLACEMENT

(1) If equipped with center console remove the console as follows:
(a) MANUAL TRANSMISSION—Remove shift knob, boot and bezel.
(b) AUTOMATIC TRANSMISSION—Remove shift handle by pulling up. Remove the shift bezel.
(c) POWER MIRRORS—Pry mirror switch out of console cover (Fig. 13). Disconnect switch connector (Fig. 14).
(d) Remove console cover screws (Fig. 14).
(e) Remove console cover from base (Fig. 15).
(f) Remove console base.
(2) Remove the lower instrument panel.
(3) Disconnect the vacuum hose(s) from the vacuum motor.
(4) Remove the vacuum motor attaching nuts and remove the vacuum motor from the bracket.

(5) Remove the vacuum motor linkage retaining clip and remove the rod from the door actuating lever (Fig. 18).

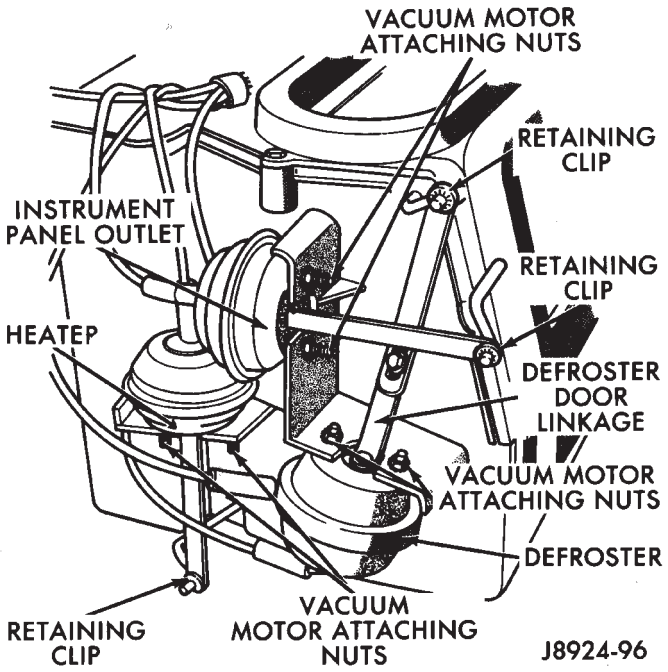


Fig. 18 Vacuum Motor

To install a vacuum motor, reverse the removal procedure.

A/C RECIRCULATING AIR DOOR VACUUM MOTOR REPLACEMENT

(1) Remove the vacuum motor cover (Fig. 19).

(2) Disconnect the vacuum hose (Fig. 20).

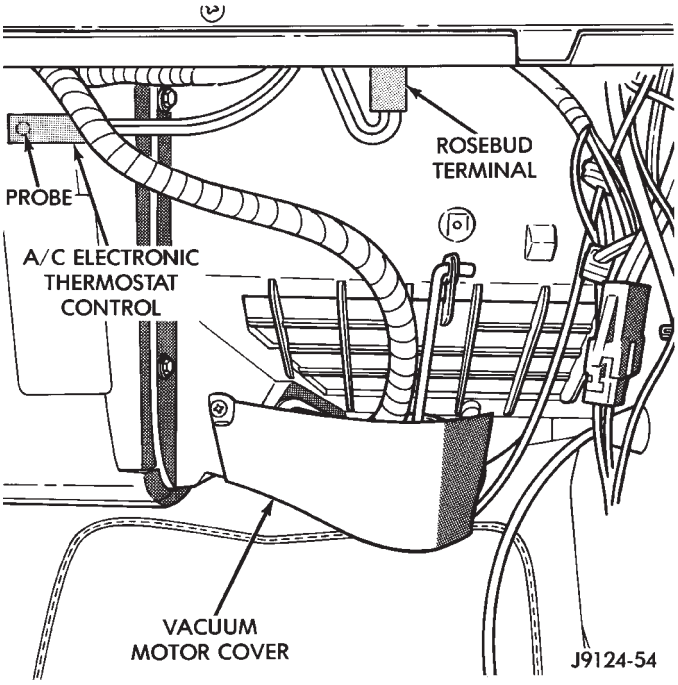


Fig. 19 Vacuum Door Motor Cover

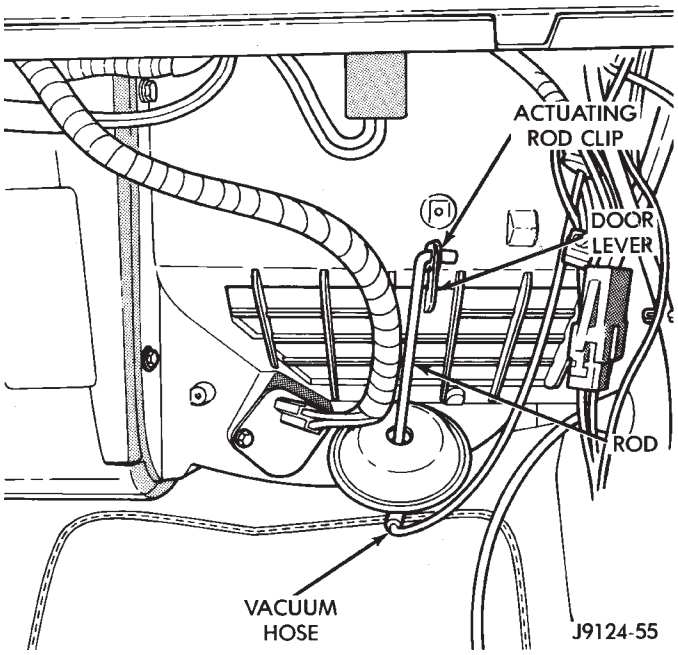


Fig. 20 Vacuum Door Motor

(3) Remove the actuating rod clip and disengage the rod from the door lever.

(4) Remove the vacuum motor retaining nuts and then remove the vacuum motor.

To install the motor, reverse the removal procedures.

CONDENSER/RECEIVER DRIER—2.5L ENGINES

REMOVAL

(1) Drain the radiator.

(2) Disconnect the fan shroud and the radiator hoses.

(3) Disconnect the transmission cooler lines (if equipped with automatic transmission).

(4) Evacuate the A/C system. Disconnect the A/C hoses from the condenser.

(5) Unplug the harness from the low pressure switch (Fig. 21).

(6) Remove the radiator and condenser as an assembly.

(7) Remove the retaining bolts and separate the condenser from the radiator.

(8) Remove the receiver/drier from the condenser. **Keep receiver/drier openings plugged at all times to prevent moisture from entering the receiver/drier.**

INSPECTION

When servicing a condenser for a leak at the bottom, inspect the lower crossmember for an ID tag. This tag may rub against the condenser. If the condition exists, remove the tag prior to installing a new condenser.

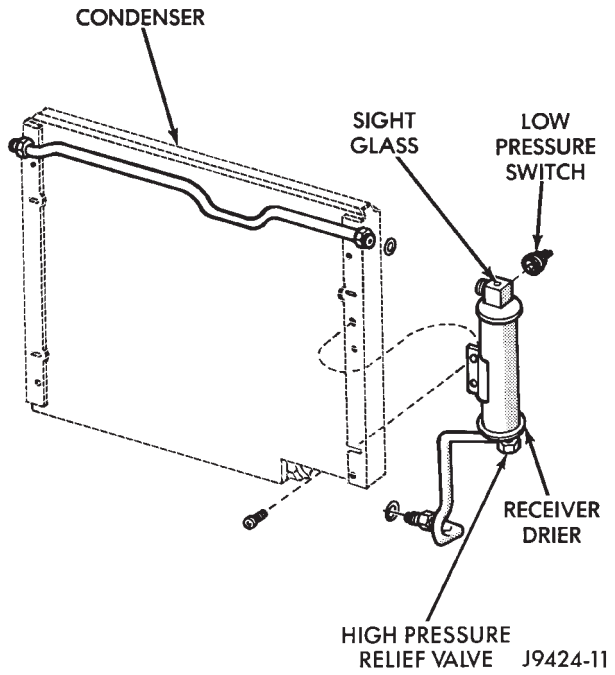


Fig. 21 Condenser Receiver Drier—2.5L Engine

INSTALLATION

(1) Remove the plugs from the receiver/drier openings. Install receiver/drier into the condenser.

(2) Install the condenser to the radiator. Tighten the retaining bolts.

(3) Install the radiator and condenser as an assembly (refer to Group 7, Cooling System for the proper procedure).

(4) Plug the harness into the low pressure switch (Fig. 21).

(5) Connect the A/C hoses to the condenser.

(6) Connect the transmission cooler lines (if equipped with automatic transmission).

(7) Connect the fan shroud and the radiator hoses.

(8) Add 30 ml (1 fluid oz.) of refrigerant oil to the system if the condenser was replaced.

(9) Fill the cooling system.

(10) Charge the A/C system.

CONDENSER—4.0L ENGINES

REMOVAL

(1) Disconnect the fan shroud and electric fan from the radiator.

(2) Remove the upper crossmember and bracket.

(3) Evacuate the A/C system, disconnect the A/C hoses from the condenser and plug the openings.

(4) Remove the attaching hardware and brackets securing the condenser to the radiator.

(5) Remove the condenser.

INSPECTION

When servicing a condenser for a leak at the bottom, inspect the lower crossmember for an ID tag. This tag may rub against the condenser. If the condition exists, remove the tag prior to installing a new condenser.

INSTALLATION

(1) Install the condenser.

(2) Remove the plugs from the openings. Connect the A/C hoses to the condenser.

(3) Install the upper crossmember and bracket.

(4) Connect the fan shroud and electric fan to the radiator.

(5) Add 30 ml (1 fluid oz.) of refrigerant oil to the A/C system if the condenser was replaced.

(6) Charge the A/C system.

RECEIVER DRIER—4.0L ENGINES

REMOVAL

(1) Evacuate the A/C system, disconnect the A/C hoses from the receiver dryer and plug the openings (Fig. 22).

(2) Unplug the harness from the low pressure switch.

(3) Remove the nut attaching the receiver dryer to the side sill weld stud.

(4) Remove the receiver dryer.

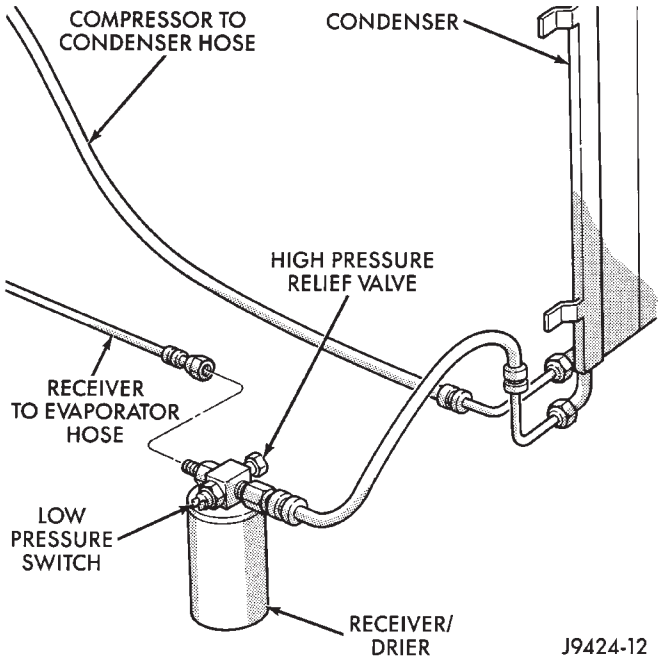


Fig. 22 Receiver Dryer—4.0L Engine

INSTALLATION

(1) Install the receiver dryer.

(2) Install and tighten the nut attaching the receiver dryer to the side sill weld stud.

(3) Plug the harness to the low pressure switch.

(4) Remove the plugs the openings. Connect the A/C hoses to the receiver dryer.

(5) Charge the A/C system.

EVAPORATOR/BLOWER HOUSING

REMOVAL

(1) Disconnect negative cable from battery.

(2) Discharge the A/C system as described in this section and disconnect the A/C hoses from the expansion valve.

(3) Disconnect the blower motor wires and the vent tube.

(4) If equipped with center console remove the console as follows:

(a) MANUAL TRANSMISSION—Remove shift knob, boot and bezel.

(b) AUTOMATIC TRANSMISSION—Remove shift handle by pulling up. Remove the shift bezel.

(c) POWER MIRRORS—Pry mirror switch out of console cover (Fig. 13) and disconnect switch connector (Fig. 14).

(d) Remove console cover screws (Fig. 14).

(e) Remove console cover from base (Fig. 15).

(f) Remove console base.

(5) Remove the lower instrument panel.

(6) Disconnect the electrical connections at the blower motor resistors and the A/C thermostat. Disconnect the vacuum hose at the vacuum motor (Fig. 23).

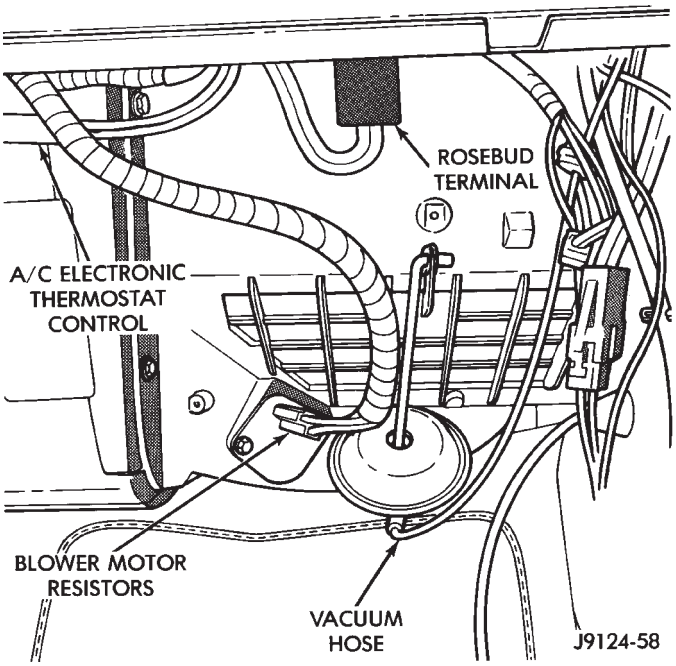


Fig. 23 Evaporator Housing Components

(7) Cut the plastic retaining strap that retains the evaporator/blower housing to the heater core housing (Fig. 24).

(8) Disconnect and remove the heater control cable.

(9) Remove the clip at the rear of the blower housing flange and remove the retaining screws.

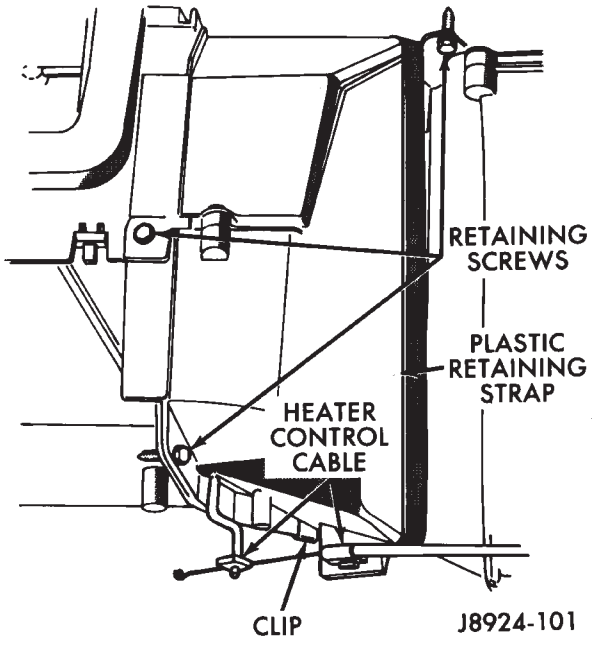


Fig. 24 Evaporator Housing

(10) Remove the housing attaching nuts from the studs on the engine compartment side of the dash panel (Fig. 25). Remove the evaporator drain tube.

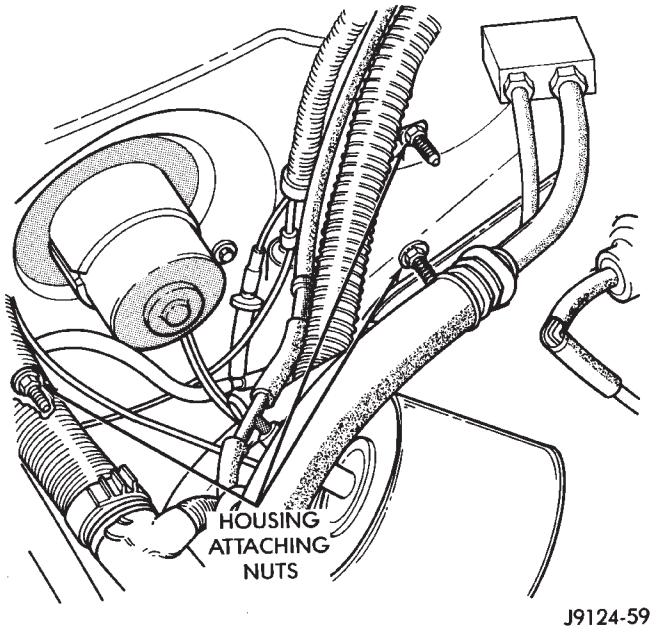


Fig. 25 Evaporator Housing Mounting

(11) Remove the right kick panel and then remove the instrument panel support bolt.

(12) To disengage the housing studs from the dash panel, gently pull out on the right side of the dash. Then rotate the housing downward and toward the rear of the vehicle. Remove the evaporator/blower housing.

INSTALLATION

(1) Position the evaporator/blower housing into place, being sure to line up the housings using the provided alignment tabs (Figs. 26 and 27).

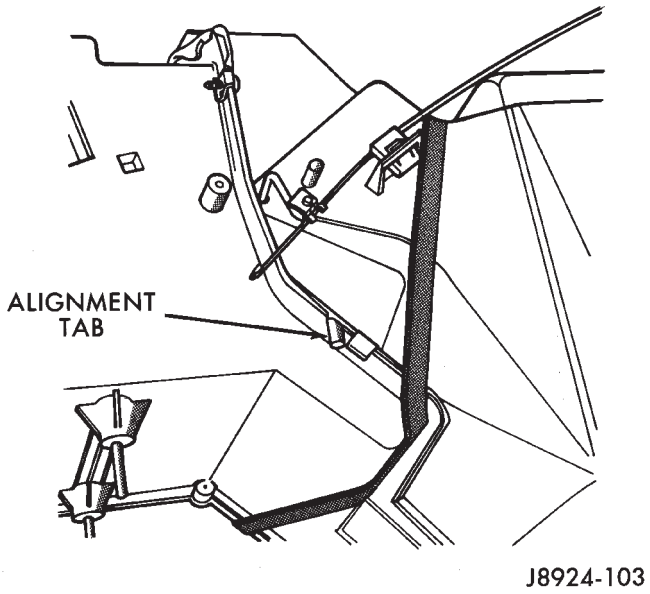


Fig. 26 Evaporator Housing Alignment Tab

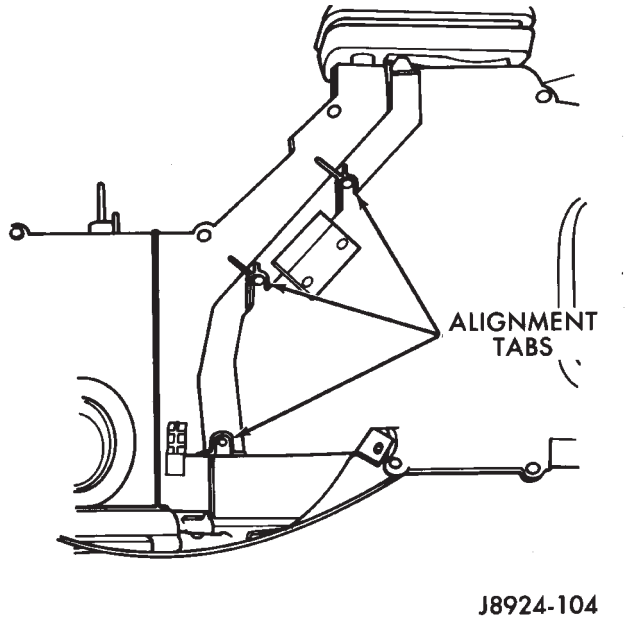


Fig. 27 Evaporator Housing

(2) Install the housing retaining screws and the rear housing clip (Fig. 25).

CAUTION: When installing the evaporator/blower housing, DO NOT trap wires between the housing fresh air inlet and the dash panel (right side of housing).

(3) Install the housing retaining nuts on the engine compartment side of the dash panel (Fig. 25).

(4) Connect the A/C hoses to the expansion valve and connect the heater blower motor wires.

(5) Attach the wire connections at the blower motor resistors and the A/C thermostat (Fig. 23).

(6) Connect the vacuum hose at the vacuum motor and attach the heater control cable.

(7) Install the instrument panel bolt and the kick panel.

(8) Install the lower instrument panel and screws.

(9) Install the console (if equipped).

(10) Connect negative cable to battery.

(11) Evacuate and charge the A/C system as outlined in this section.

(12) Start the vehicle and check for proper operation at all vacuum motors.

EVAPORATOR COIL

REMOVAL

(1) Remove the evaporator/blower housing.

(2) Remove the top housing retaining screws. Remove the top of the evaporator housing (Fig. 28).

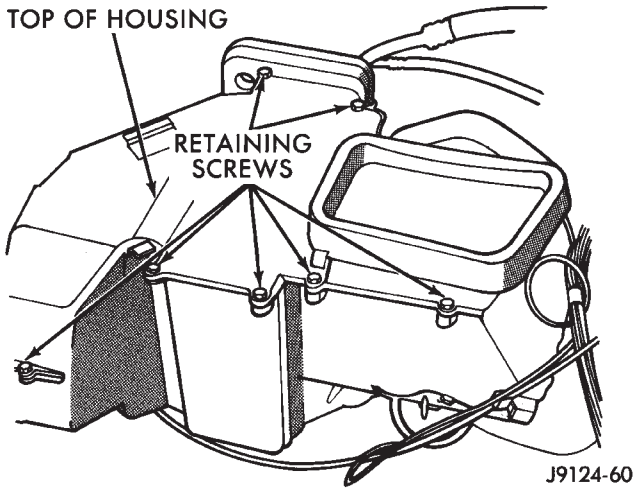


Fig. 28 Top of Housing

(3) Remove the thermostatic switch and capillary tube after removing the top of the evaporator housing.

(4) Remove the evaporator retaining screws and lift the evaporator out of the housing (Fig. 29).

(5) Remove the expansion valve from the evaporator.

INSTALLATION

(1) Install the expansion valve into the evaporator.

(2) Position the evaporator in the housing. Install and tighten the evaporator retaining screws (Fig. 29).

(3) Install the thermostatic switch and capillary tube. Install the top of the evaporator housing.

(4) Position the top of the evaporator housing in place. Install and tighten the top housing retaining screws.

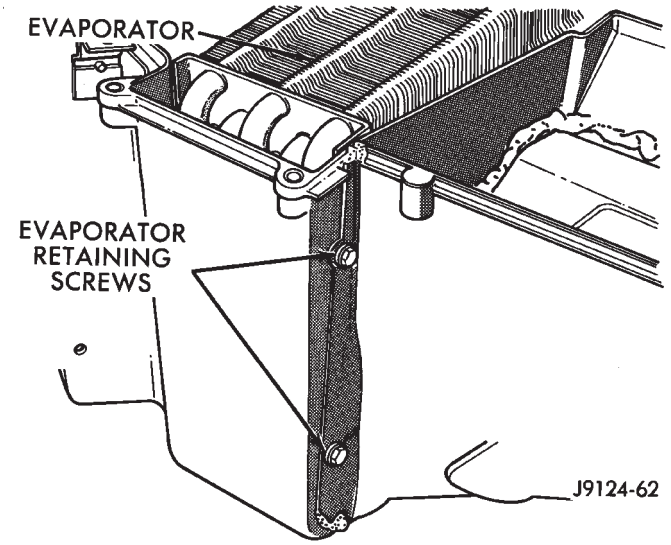


Fig. 29 Evaporator

(5) Install the evaporator/blower housing.

(6) Add 30 ml (1 fluid oz.) of refrigerant oil to the air conditioning system if the evaporator was replaced.

EXPANSION (H) VALVE

REMOVAL

(1) Discharge the A/C system.

(2) Remove the coolant bottle and bracket.

(3) Disconnect A/C hoses from the expansion valve (Fig. 30).

(4) Disconnect the expansion valve from the evaporator core inlet and outlet tubes. Remove the expansion valve.

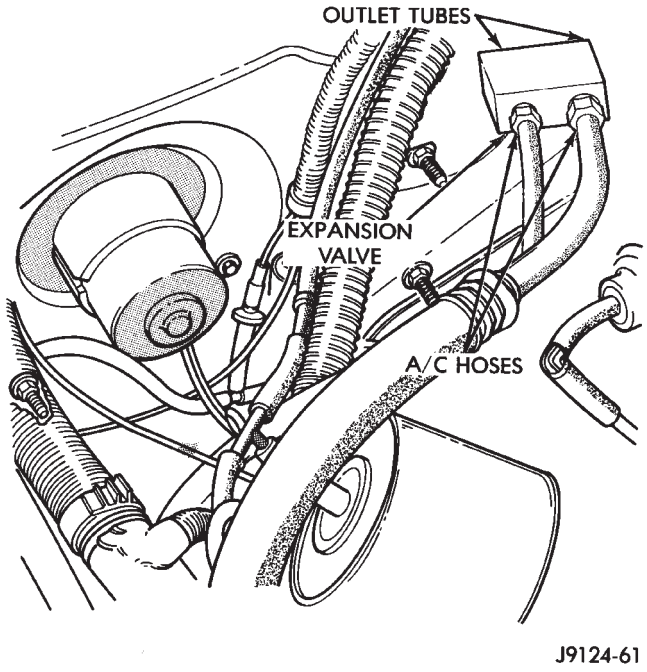


Fig. 30 Expansion (H) Valve

INSTALLATION

(1) Install the expansion valve. Connect the expansion valve to the evaporator core inlet and outlet tubes.

(2) Connect A/C hoses to the expansion valve (Fig. 30).

(3) Install the coolant bottle and bracket.

(4) Charge the A/C system.

(5) Preform the leak test.

BLOWER MOTOR RESISTORS REPLACEMENT

(1) Remove the vacuum motor cover retaining screw and lower the cover.

(2) Remove the blower motor resistor connector, remove the resistor retaining screws, and then remove the resistor.

To install the blower motor resistor reverse the removal procedures.

TEMPERATURE CONTROL THERMOSTAT

REMOVAL

(1) Disconnect negative cable from battery.

(2) If equipped with center console remove the console as follows:

(a) MANUAL TRANSMISSION—Remove shift knob, boot and bezel.

(b) AUTOMATIC TRANSMISSION—Remove shift handle by pulling up. Remove the shift bezel.

(c) POWER MIRRORS—Pry mirror switch out of console cover (Fig. 31) and disconnect switch connector (Fig. 32).

(d) Remove console cover screws (Fig. 32).

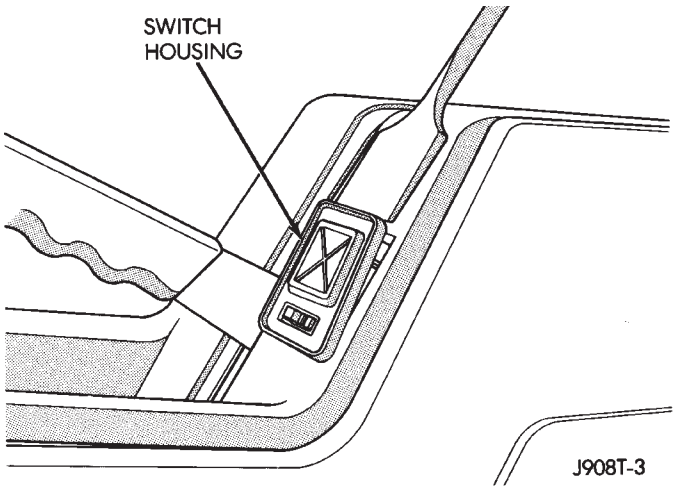


Fig. 31 Power Mirror Switch

(e) Remove console cover from base (Fig. 33).

(f) Remove console base (Fig. 33).

(3) Remove the lower instrument panel.

(4) Pull the rosebud terminal out of the housing (Fig. 34).

(5) Disconnect the electrical connection.

(6) Remove the wires from the retaining clip.

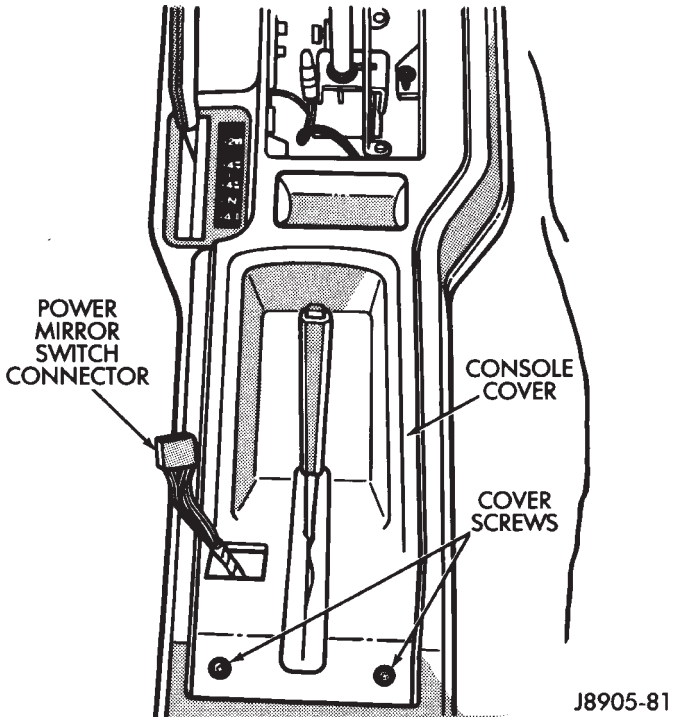


Fig. 32 Console Cover Screws and Power Mirror Switch Connector

(7) Carefully remove the thermostat probe/thermostat electronic cycling switch from the tube guide hole (Fig. 34).

INSTALLATION

(1) Carefully insert the thermostat probe into the tube guide hole until the thermostat electronic cycling switch body butts up against the housing.

(2) Connect the rosebud terminal (Fig. 34).

(3) Snap the terminal into the hole in the housing.

(4) Install the wires into the retaining clip.

(5) Reverse the removal procedures for the remainder of the installation.

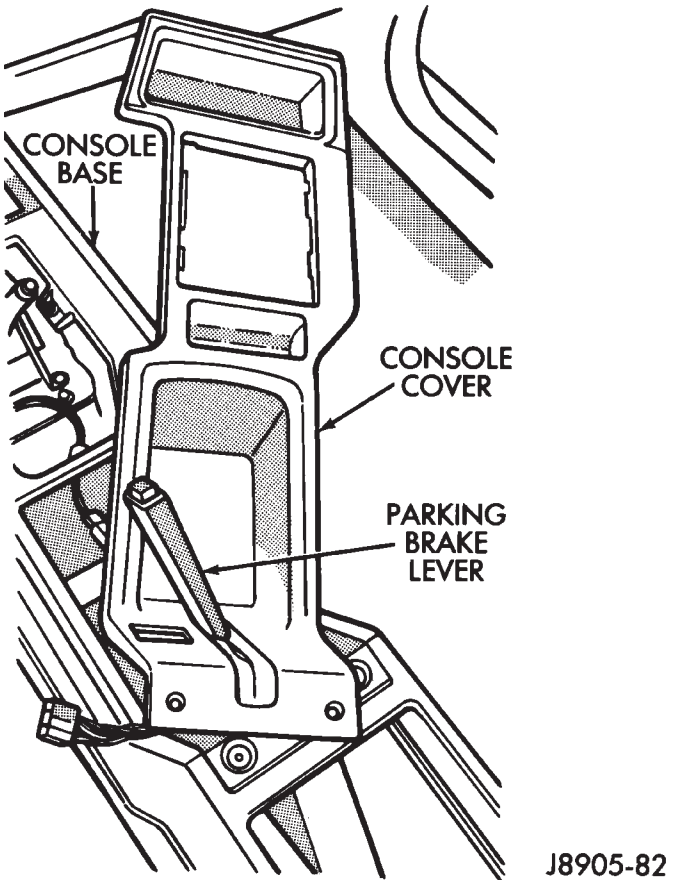


Fig. 33 Console Cover and Base

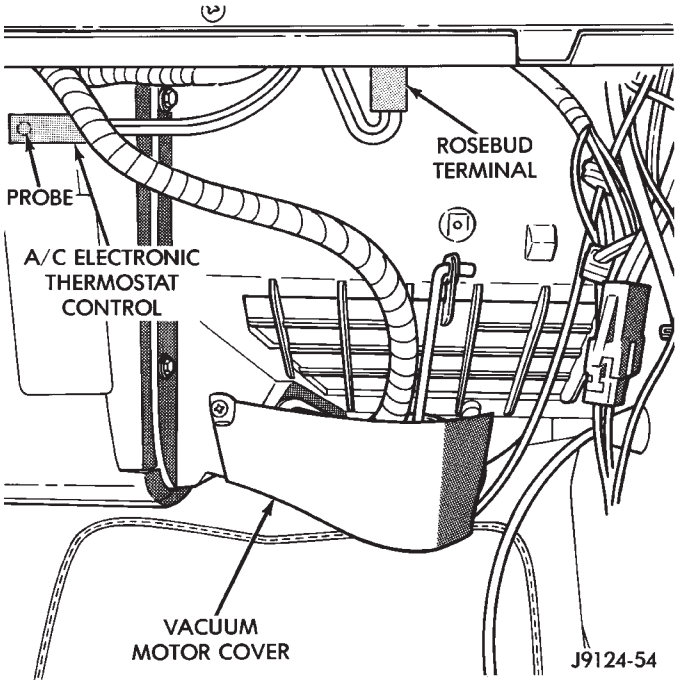


Fig. 34 Thermostat Electronic Cycling Switch and Probe

CLIMATE CONTROL SYSTEM—YJ VEHICLES

INDEX

DESCRIPTION (HEATING)

A blend-air heating system is used in YJ vehicles. The blend-air system provides a constant flow of engine coolant through the heater core.

The temperature of heated air entering the passenger compartment is controlled by regulating the quantity of air flow through the heater core. This is accomplished by blending a controlled amount of unheated air from outside the vehicle with heated air from the heater core.

HEATER/DEFROSTER OPERATION

The heater core is connected to the engine cooling system. It operates on the circulation of heated engine coolant through the core and a supply of fresh air drawn in through the intake grille on the cowl. Engine coolant flows through the heater core at all times.

The heater controls are on the heater control panel (Fig. 1).

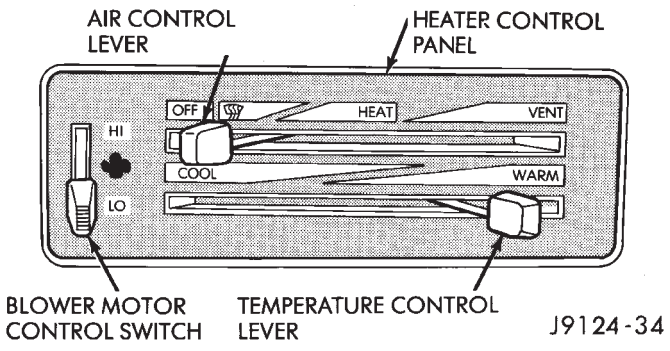


Fig. 1 Heater Control Panel

The air control lever (Fig. 1) operates a door in the fresh air intake duct. The door controls the amount of fresh air flow into the heater housing and core. When the lever is in the OFF position, the intake door is closed preventing air flow into the housing.

The temperature control lever (Fig. 1) determines air flow through the heater core. The lever operates the heater housing blend-air door which controls air flow through the core.

The blower motor is operated by the control switch (Fig. 1). The switch provides 3 blower speeds for increased air flow in heat or defrost mode.

HEATING

Maximum air flow and heater output occurs when the air control lever is in HEAT position and the temperature control lever is in WARM position. The blend-air door is closed and all intake air is directed through the heater core in this operating mode (Fig. 2).

Temperature regulation of the heated air is determined by position of the temperature control lever. Moving the control lever from WARM to an in-between position, opens the blend-air door in the heater housing. As the door opens, unheated outside air is drawn into the system and blended with heated air from the core.

DEFROSTING

The heater housing contains a defroster door to divert heated air to the defroster duct and windshield outlets (Fig. 2). Defrost air flow is controlled by the air control lever.

For defroster operation, the air control lever must be moved to the defrost detent. The detent is identified by the defrost symbol on the control panel. In this position, the defroster door in the heater housing diverts all heated air (from the core) to the defroster duct windshield outlets.

If the air control lever is moved to any position between the heat and defrost detents, the defroster door does not close completely. In this mode, the door remains partially open causing heated air to be divided equally between the heat and defrost outlets.

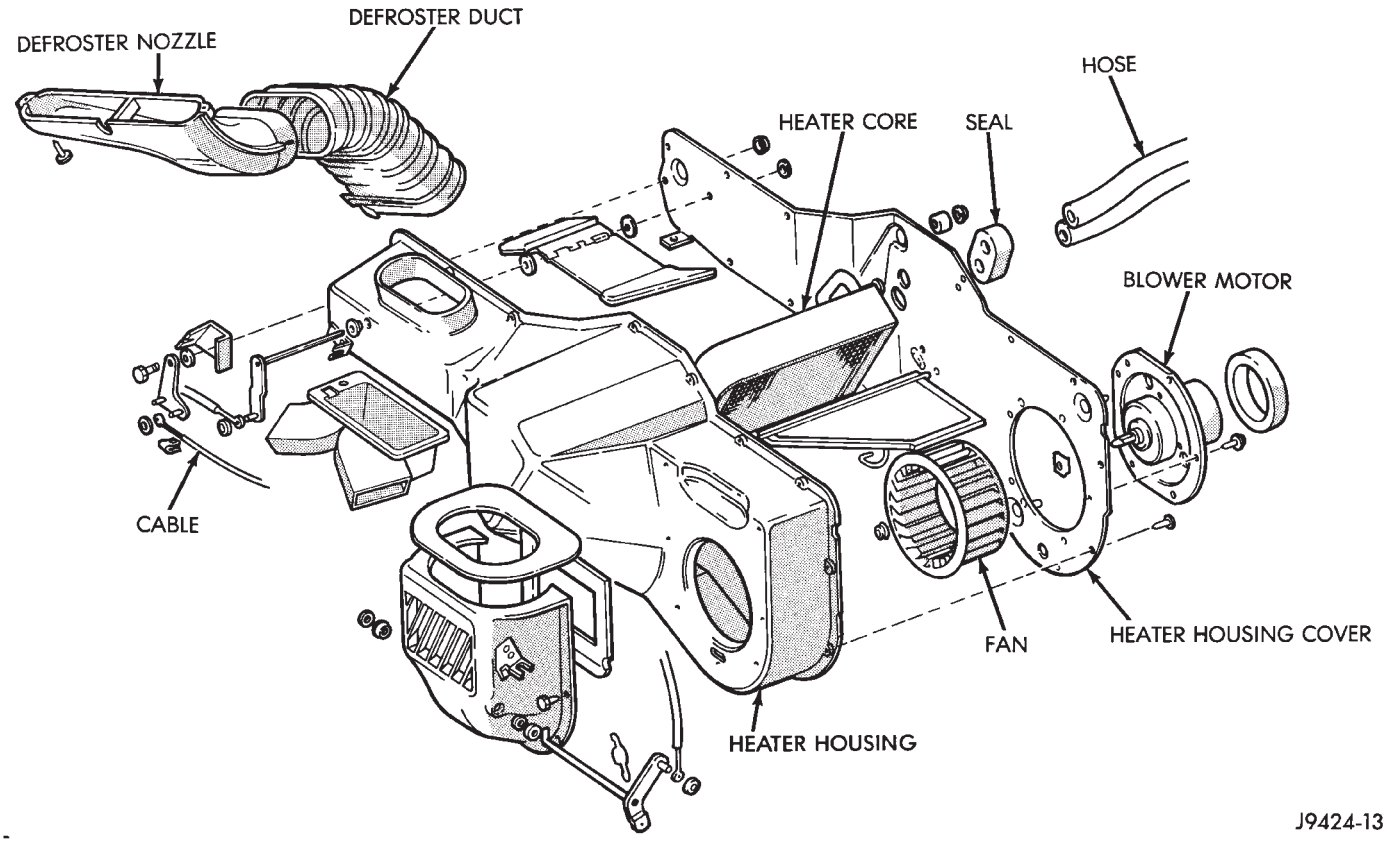


Fig. 2 Heating System Components

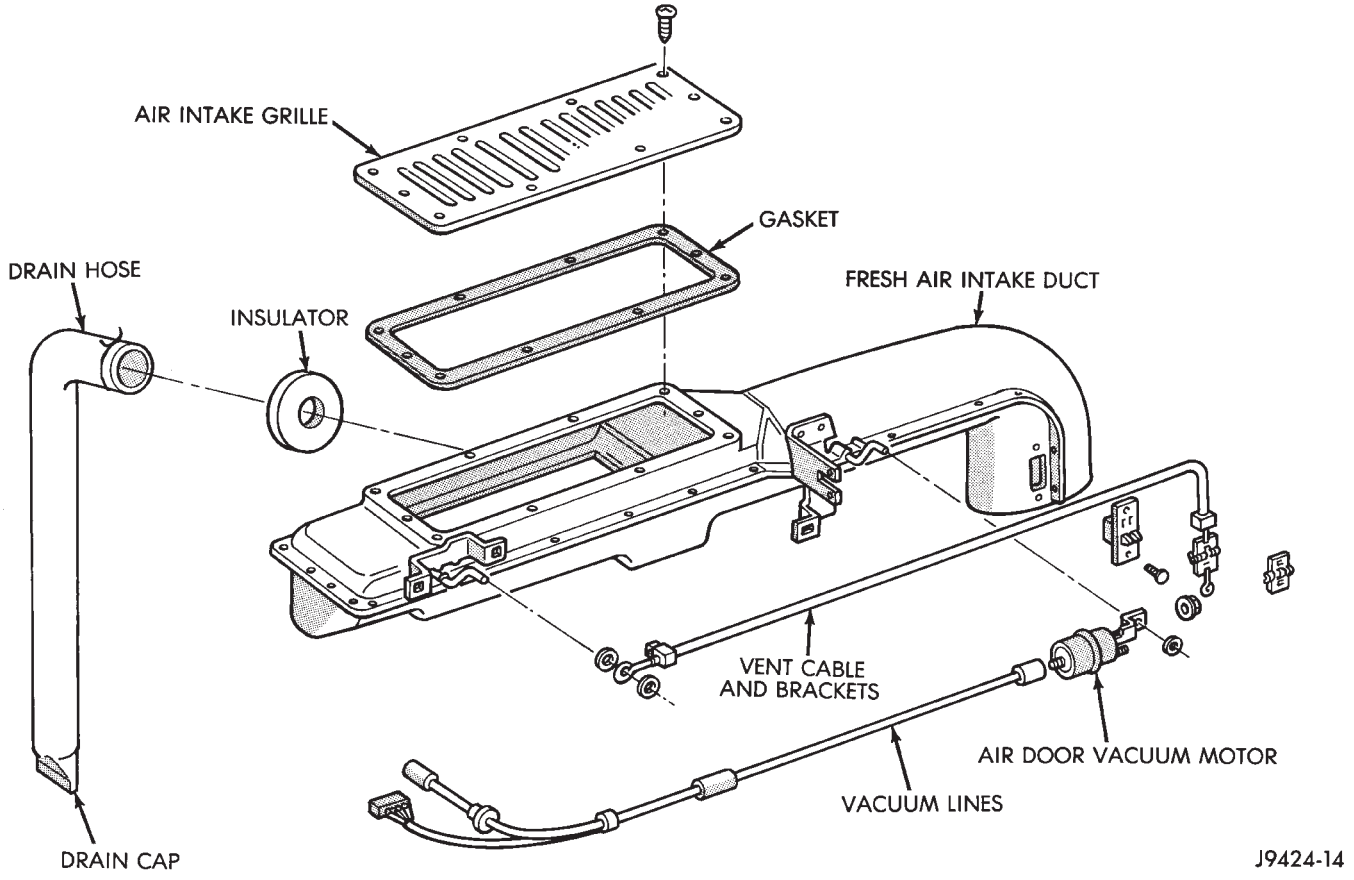


Fig. 3 Fresh Air Intake System Components

FRESH AIR VENTILATION

The fresh air ventilating system (Fig. 3) is operated by the air control lever. When the lever is moved to VENT position, outside air from the cowl intake flows into the heater housing. Incoming air is directed into the vehicle interior through vent doors in the housing.

A door in the intake duct controls air flow into the duct. The door is operated by a vacuum motor. The motor is controlled by a vacuum switch in the heater control panel. The vent air doors are opened and closed by a cable and linkage operated by the air control lever. Fresh air intake occurs only when the lever is in the VENT position.

HEATER CONTROL PANEL REPLACEMENT

(1) Remove the instrument cluster bezel attaching screws (Fig. 4).

(2) Remove the instrument cluster bezel.

(3) Remove the screws attaching the heater control panel to the instrument panel.

(4) Slide the control panel outward and disconnect the cables, vacuum hoses and electrical wires from the control panel.

(5) Remove the control panel.

To install the control panel, reverse the removal procedures.

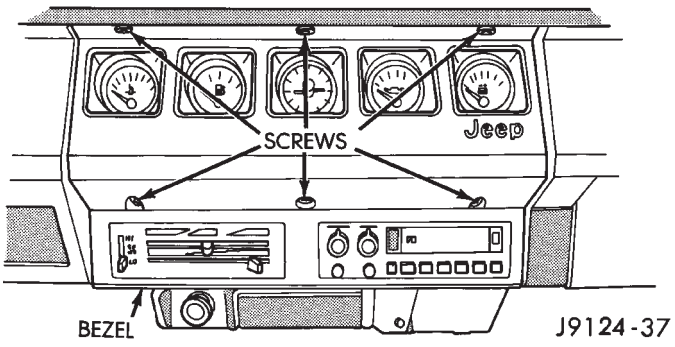


Fig. 4 Instrument Cluster Bezel

BLOWER MOTOR/AIR DOOR MOTOR SWITCH REPLACEMENT

(1) Remove the heater control panel (Fig. 5).

(2) Remove the air door motor switch.

(3) Remove the control knob from the blower switch.

(4) Remove the screws that attach the switch to the control panel.

(5) Remove the switch from the control panel.

To install the switches, reverse the removal procedures.

VENT DOOR CONTROL CABLES

REMOVAL

(1) Disconnect the cable from the vent door.

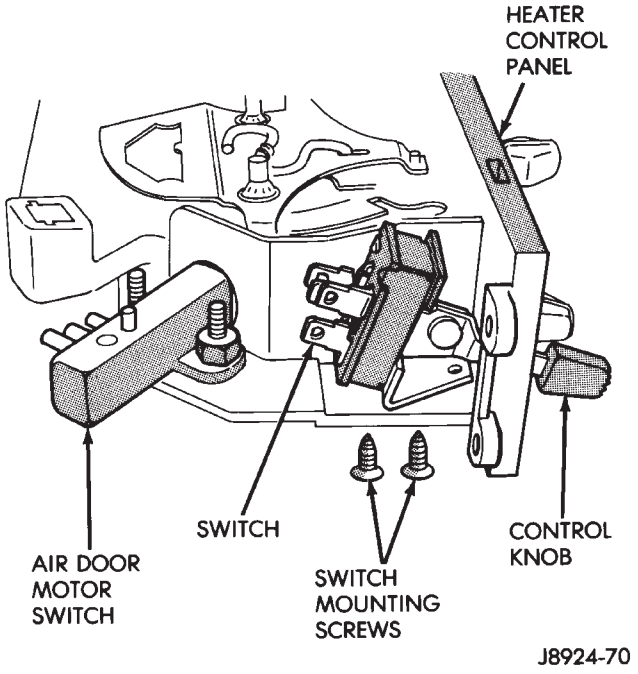


Fig. 5 Control Switches

(2) Disconnect the cable from the heater control panel lever. The cables are attached to the control panel levers with plastic tabs. Press the tabs together and lift the cable upward to disengage it from the lever.

(3) Remove the cable. The clip on the cable wire has 2 functions. It attaches the cable to the vent door and is also the self adjusting mechanism. Because the left cable operates the right cable, the cables must be installed as outlined to maintain the self adjusting feature and ensure proper vent door operation.

INSTALLATION

(1) To install the cables, connect the cables to the heater control panel.

(2) Connect the right vent door cable. DO NOT connect the left door cable at this time.

(3) Open and close the right vent door (one time) using the air control lever on the heater control panel.

(4) Connect the left vent door cable.

(5) Open and close both vent doors with the air control lever. Verify that both vent doors open at the same time.

HEATER CORE AND HOUSING

REMOVAL

WARNING: HOT ENGINE COOLANT CAN CAUSE SEVERE BURNS. DO NOT OPEN THE RADIATOR DRAIN COCK WHEN THE COOLING SYSTEM IS HOT AND PRESSURIZED. ALLOW THE COOLANT TO DECREASE TO ROOM TEMPERATURE BEFORE STARTING REPAIR OPERATIONS.

(1) Drain approximately 1.9 liters (2 qts) of coolant from the radiator. Drain the coolant into a clean container.
(2) Disconnect the heater hoses.
(3) Disconnect the vent door cables.
(4) Disconnect the blower motor wire.
(5) Disconnect the defroster duct.
(6) Remove the nuts that attach the heater housing studs to the engine compartment side of the dash panel.
(7) Remove the heater housing assembly by tilting it downward, to disengage it from the defroster duct. Pull it rearward and out from under the instrument panel.
(8) Remove the heater hosing cover from the housing.
(9) Remove the heater core from the housing.

INSTALLATION

(1) Install the heater core in the housing and install the cover on the housing.
(2) Position the heater housing on the dash panel. Be sure the housing studs all extend through the dash panel.
(3) Install the seals on the heater core outlet and inlet tubes and over the blower motor housing.
(4) Install the attaching nuts on the housing studs.

CAUTION: DO NOT over tighten the attaching nuts. The housing could become distorted causing air leaks and improper heater door operation. Tighten the nuts alternately and evenly until 2 stud threads are visible beyond each nut.

(5) Connect the defroster duct to the housing.
(6) Connect the blower motor wire.
(7) Connect the vent door control cables.
(8) Connect the heater hoses.
(9) Fill and bleed the cooling system.
(10) Check system operation.

BLOWER MOTOR (HEATING)

REMOVAL

(1) Remove the heater housing.
(2) Remove the blower motor-to-heater housing attaching screws/nuts.
(3) Remove the blower motor from the housing.

INSTALLATION

(1) Position the blower motor into the housing.
(2) Install and tighten the blower motor-to-heater housing attaching screws/nuts.
(3) Install the heater housing.
(4) Check blower motor and heater operation.

DEFROSTER NOZZLE AND DUCT

REMOVAL

WARNING: HOT ENGINE COOLANT CAN CAUSE SEVERE BURNS. DO NOT OPEN THE RADIATOR DRAIN COCK WHEN THE COOLING SYSTEM IS HOT AND PRESSURIZED. ALLOW THE COOLANT TO DECREASE TO ROOM TEMPERATURE BEFORE STARTING REPAIR OPERATIONS.

(1) Drain approximately 1.9 liters (2 qts) of coolant from the radiator. Drain the coolant into a clean container.
(2) Disconnect the heater hoses.
(3) Remove the nuts attaching the heater housing studs to the engine compartment side of the dash panel.
(4) Disconnect the speedometer cable.
(5) Remove the glove box.
(6) Tilt the heater housing back and pull it rearward and out from under the instrument panel.
(7) Disconnect the vent control cables.
(8) Remove the fresh air intake grille from the cowl.
(9) Remove the fresh air intake duct.
(10) Lower the windshield.
(11) Remove the defroster nozzle attaching screws and remove the nozzle and duct.

INSTALLATION

(1) Install the defroster nozzle and duct.
(2) Raise and secure the windshield.
(3) Install the fresh air intake duct.
(4) Install the fresh air intake grille on the cowl.
(5) Install the vent cables.
(6) Position the heater housing on the dash panel. Be sure all the housing studs extend through the dash panel.
(7) Install the seals on the blower motor and the heater core inlet and outlet tubes.
(8) Install the attaching nuts on the housing studs.

CAUTION: DO NOT over tighten the attaching nuts. The housing could become distorted causing air leaks and improper heater door operation. Tighten the nuts alternately and evenly until 2 stud threads are visible beyond each nut.

(9) Install the glove box.
(10) Connect the speedometer cable.
(11) Connect the heater hoses.

(12) Fill and bleed the cooling system.

FRESH AIR DOOR VACUUM MOTOR

REMOVAL

(1) Remove the glove box and assist handle.
(2) Disconnect the vacuum hose from the motor.
(3) Remove the motor lever retaining clip.
(4) Remove the motor attaching nuts and remove the motor from the fresh air duct.

INSTALLATION

(1) Position the motor on the fresh air duct and install the motor attaching nuts.
(2) Align the motor lever with the air door lever and install the lever retaining clip.
(3) Connect the vacuum hose to the motor.
(4) Install the glove box and assist handle.

FRESH AIR INTAKE DUCT

REMOVAL

WARNING: HOT ENGINE COOLANT CAN CAUSE SEVERE BURNS. DO NOT OPEN THE RADIATOR DRAIN COCK WHEN THE COOLING SYSTEM IS HOT AND PRESSURIZED. ALLOW THE COOLANT TO DECREASE TO ROOM TEMPERATURE BEFORE STARTING REPAIR OPERATIONS.

(1) Drain approximately 1.9 liters (2 qts) of coolant from the radiator. Drain the coolant into a clean container.
(2) Disconnect the heater hoses.
(3) Remove the nuts attaching the heater housing studs to the dash panel from inside the engine compartment.
(4) Disconnect the speedometer cable.
(5) Remove the glove box and assist handle.
(6) Tilt the heater housing back and pull it rearward and out from under the instrument panel.
(7) Disconnect the vent cables.
(8) Remove the fresh air intake grille from the cowl.
(9) Remove the fresh air intake duct.

INSTALLATION

(1) Install the fresh air intake duct.
(2) Install the defroster nozzle and duct.
(3) Raise and secure the windshield.
(4) Install the fresh air grille on the cowl.
(5) Install the vent cables.
(6) Position the heater housing on the dash panel. Be sure all the housing studs extend through the dash panel.
(7) Install the seals on the blower motor and heater core inlet and outlet tubes.
(8) Install the attaching nuts on the heater housing studs.

CAUTION: DO NOT over tighten the attaching nuts. The housing could become distorted causing air leaks and improper heater door operation. Tighten the nuts alternately and evenly until 2 stud threads are visible beyond each nut.

(9) Install the glove box and assist handle.
(10) Connect the speedometer cable.
(11) Connect the heater hoses.
(12) Fill and bleed the cooling system.

DESCRIPTION (AIR CONDITIONING)

The evaporator, blower fan and motor, thermostat, expansion valve, capillary tube, air outlets and system controls are located in the evaporator housing. The evaporator housing is mounted under the instrument panel. The compressor, condenser, receiver-dryer and refrigerant lines are located in the engine compartment.

A rotary-type compressor with magnetic clutch operated drive pulley is used for all vehicles equipped with air conditioning.

SIGHT GLASS

A sight glass is located on the top of the receiver-drier (Fig. 6). The sight glass provides a visual check of system refrigerant level. A continuous stream of bubbles will appear in the sight glass when system charge is low. Bubbles will not appear when the system is fully charged.

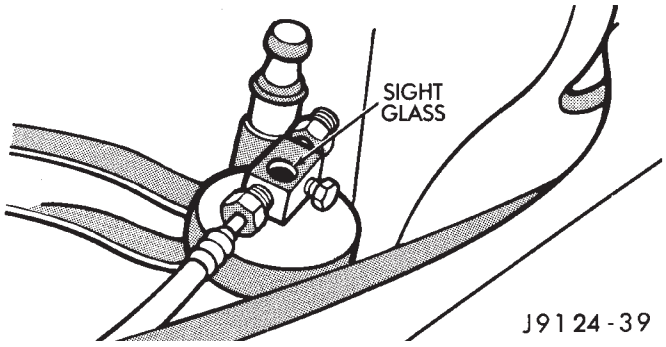


Fig. 6 Sight Glass (Typical)

A/C CONTROL PANEL

FAN SWITCH

The fan switch may be serviced by removing the access plate located on the lower evaporator core housing.

TEMPERATURE CONTROL THERMOSTAT

REMOVAL

(1) Lower the evaporator housing.
(2) Remove the attaching screws holding the top and bottom housings together.
(3) Separate the housings.
(4) Remove the thermostat.

INSTALLATION

(1) When installing a replacement temperature control thermostat, insert the capillary tube into the evaporator coil a minimum of 50 mm (2 inch) (Fig. 7).

CAUTION: Handle the tube with care to avoid bends or kinks that could cause the thermostat to malfunction.

(2) Assemble the housing and install the attaching screws. DO NOT over tighten the attaching screws.
(3) Install the evaporator housing.

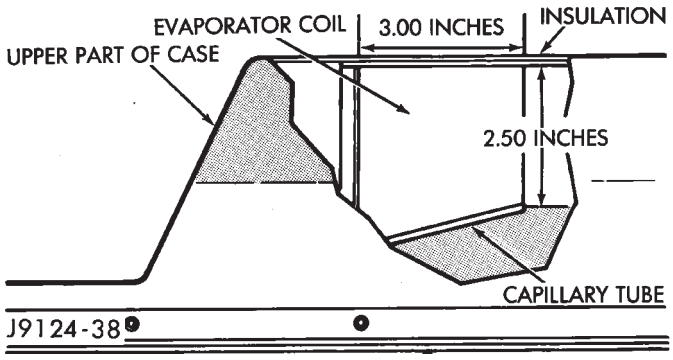


Fig. 7 Temperature Control Thermostat

A/C CONDENSER

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAIN COCK WHEN THE COOLING SYSTEM IS HOT AND PRESSURIZED. HOT COOLANT CAN CAUSE SERIOUS BURNS.

(1) Discharge the system slowly to prevent loss of compressor oil.
(2) Drain the radiator. Drain the coolant into a clean container.
(3) Remove the fan shroud and radiator.
(4) Disconnect the pressure pipe fitting from the condenser.
(5) Remove the condenser attaching screws and tilt the bottom of the condenser toward the engine. **Plug all the condenser openings to prevent entry of dirt or moisture.**
(6) Working from under the vehicle, disconnect the receiver-drier to-evaporator hose fitting from the receiver-drier.
(7) Remove the condenser and receiver-drier as an assembly.
(8) Remove the receiver-drier from the condenser, if necessary.

INSTALLATION

(1) If the condenser is replaced, add 30 ml (1 fluid oz.) of refrigerant oil to the system.
(2) Attach the receiver-drier to the condenser.
(3) Place the condenser in position and connect the hose fitting to the receiver-drier.
(4) Install the condenser attaching screws.
(5) Connect the condenser pressure pipe fitting.
(6) Install the radiator and fan shroud.
(7) Fill the cooling system.
(8) Evacuate, charge and leak test the air conditioning system.

RECEIVER-DRIER REPLACEMENT

REMOVAL

(1) Discharge the system slowly to prevent loss of compressor oil.
(2) Disconnect the evaporator and condenser hose fittings from the receiver-drier.
(3) Remove the receiver-drier attaching screws. Remove the receiver-drier.

INSTALLATION

(1) Position the receiver-drier in place. Install and tighten the receiver-drier attaching screws.
(2) Connect the evaporator and condenser hose fittings to the receiver-drier.
(3) Charge the system.
(4) Preform the leak test on the system.

EVAPORATOR AND HOUSING

REMOVAL

(1) Discharge the system. **Discharge the system slowly to prevent loss of compressor oil.**
(2) Disconnect the inlet (suction) hose.
(3) Disconnect the receiver-drier-to-evaporator hoses.
(4) Remove the hose clamps and dash grommet retaining screws.
(5) Remove the evaporator housing-to-instrument panel attaching screws and the housing mounting bracket screw (Fig. 8).

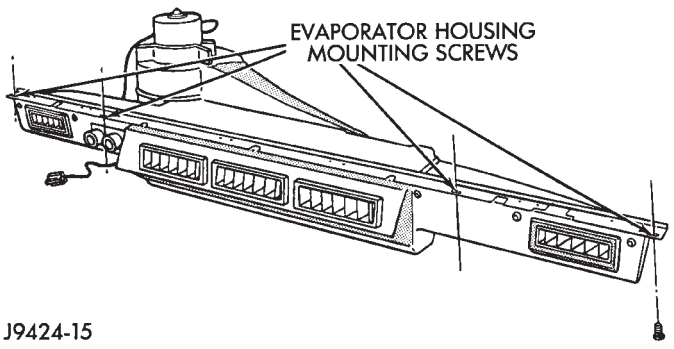


Fig. 8 Evaporator Housing

(6) Lower the evaporator housing and pull the hoses and hose grommet through the dash opening.

The blower motor, blower motor housing, evaporator core, control switches and expansion valve can all be serviced after removing the evaporator housing (Fig. 9).

INSTALLATION

(1) If the evaporator is replaced, add 30 ml (1 fluid oz.) of refrigerant oil to the system.

(2) Push the hoses through the grommet openings and install the hose grommet by pushing it toward the engine compartment.

(3) Install the hose grommet attaching screws.

(4) Raise the evaporator housing. Install the evaporator housing-to- instrument panel attaching screws and the evaporator housing mounting bracket screw.

(5) Install the hose clamps.

(6) Connect the receiver-drier hoses.

(7) Connect the inlet (suction) hose.

(8) Evacuate, charge and leak test the system.

EXPANSION (H) VALVE

REMOVAL

(1) Discharge the system slowly to prevent loss of compressor oil.

(2) Remove the evaporator housing.

(3) Remove the insulation wrapped around the suction hose fitting, expansion valve and evaporator tubing.

(4) Mark the capillary tube location on the evaporator tubing.

(5) Disconnect the inlet and outlet hose fittings, and remove the capillary tube clamp.

(6) Disconnect and remove the expansion valve.

INSTALLATION

(1) Clean the evaporator tubing to provide a positive metal-to-metal contact for the replacement expansion valve capillary tube.

(2) Install the replacement expansion valve.

(3) Clamp the capillary tube at the marked location on the evaporator tubing.

(4) Connect the inlet and outlet hose fittings. **The capillary tube must be securely clamped and have positive metal-to-metal contact with the evaporator tubing.**

(5) Wrap the expansion valve, inlet hose fitting and capillary tube with insulation.

(6) Install the evaporator housing.

(7) Evacuate, charge and leak test the system.

A/C BLOWER MOTOR

It is not necessary to discharge the system to service the blower motor. The evaporator housing need only be lowered for access to the blower motor attaching screws.

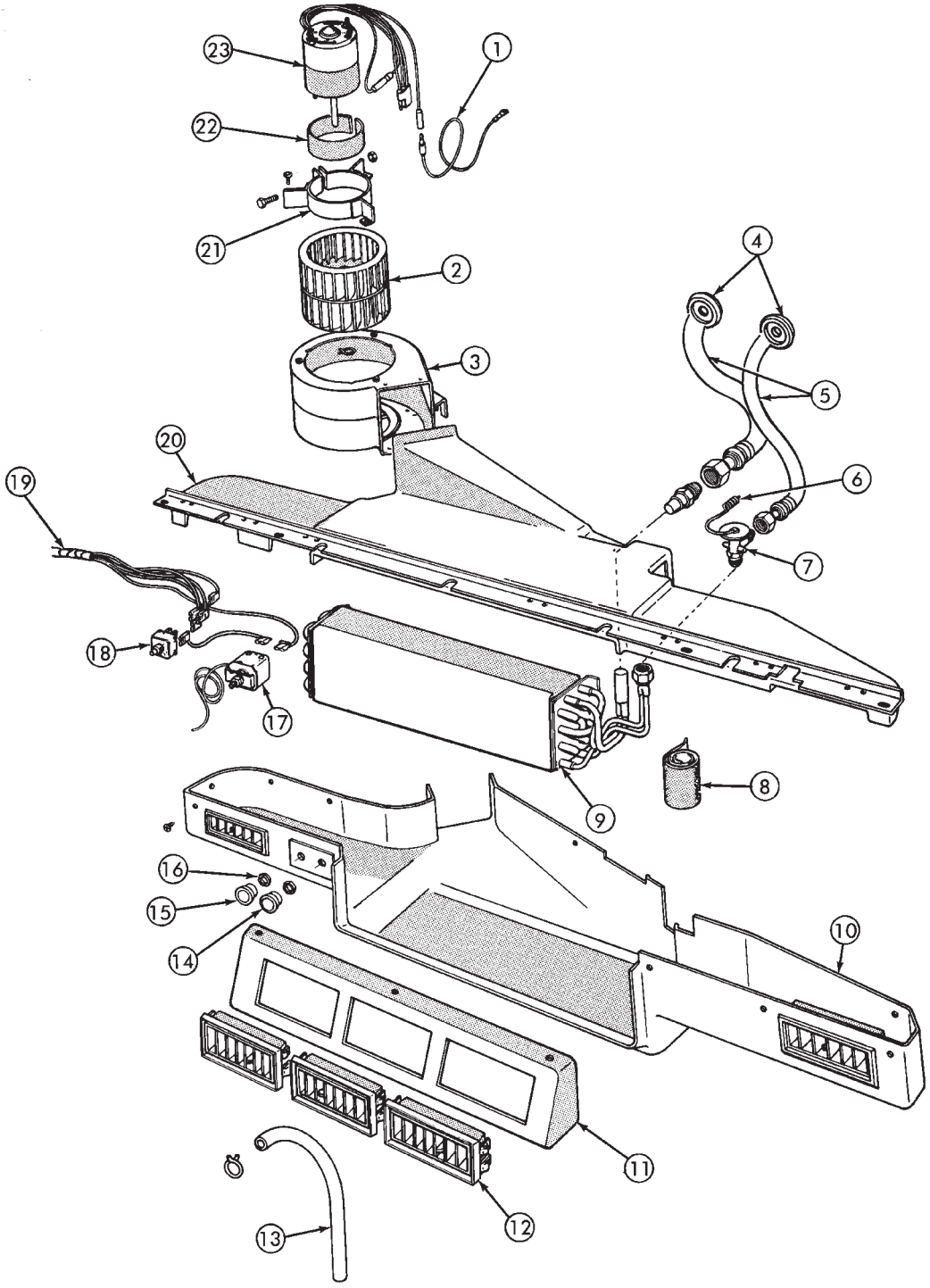


Fig. 9 Evaporative Housing and Components

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
Compressor Cylinder Head Bolts	32 N•m (24 ft. lbs.)
Compressor Mounting Bolts	27 N•m (20 ft. lbs.)
Compressor Mounting Bracket Bolts	27 N•m (20 ft. lbs.)
Compressor Oil Filter Plug	10 N•m (7 ft. lbs.)
Condenser Screws – 2.5L	6 N•m (55 in. lbs.)
4.0L	2 N•m (20 in. lbs.)
Condenser Nuts – 4.0L	3 N•m (26 in. lbs.)
Discharge/Suction Hose Fitting O-Ring Type	33 N•m (24 ft. lbs.)
Evaporator/Receiver Hose Coupling	14 N•m (10 ft. lbs.)
Expansion Valve-to-Evaporator Connection	24 N•m (18 ft. lbs.)
Heater Hose Clamps Worm Type	3.4 N•m (30 in. lbs.)
Heater Housing/Dash Panel Stud Nuts	6 N•m (55 in. lbs.)
Magnetic Clutch Hex Nut	37 N•m (27 ft. lbs.)
Receiver Screws – 2.5L	3.7 N•m (33 in. lbs.)
4.0L	7 N•m (62 in. lbs.)
Service Valve/Compressor Fitting**	34 N•m (25 ft. lbs.)
Service Valve Screws Flange Type	20 N•m (15 ft. lbs.)
Steering Column Retaining Nuts	27 N•m (20 ft. lbs.)

** Wet Torque – Lubricate the service valve coupling threads and O-ring with compressor oil.

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AIR CONDITIONING

CONTENTS

GENERAL INFORMATION

A/C COMPONENTS

COMPRESSOR—The SD-709 Compressor is used on all models. The compressor compresses the low-pressure refrigerant vapor from the evaporator into a high pressure, high temperature vapor. The compressor is serviced as an assembly only.

CLUTCH PULLEY AND COIL—They are mounted on the compressor and providing a way to drive the compressor. The compressor clutch and coil are the only serviced parts on the SD-709 compressor. When the compressor is not in operation, the pulley free wheels on the clutch hub bearing. When the coil is energized the clutch plate is magnetically engaged with the pulley and turns the compressor shaft.

CONDENSER—The condenser is located in front of the engine radiator. Its function is to cool the hot high pressure refrigerant gas. This causes it to condense into high pressure liquid refrigerant.

FILTER-DRIER—The drier is used to remove contaminates and traces of moisture from the refrigerant system.

SIGHT-GLASS—The sight glass is located on top of the filter drier. It is used as a diagnostic tool to observe refrigerant flow.

LOW-PRESSURE HIGH-PRESSURE CUT-OFF SWITCH—The switch is located on the filter drier and is wired in series with compressor clutch. When the pressure drops down to 193 kPa (28 psi) the switch interrupts the power to the compressor clutch. When the pressure increases above 3100 to 3375 kPa (450 to 490 psi) the switch interrupts the power to the compressor clutch.

HIGH PRESSURE RELIEF VALVE—The valve is located on the filter drier. The valve is used to prevent excessive pressure up build of 3445 to 4135 kPag (500 to 600 psi) and above. This will prevent damage to the compressor and other system components.

EXPANSION VALVE—The expansion valve is located in the engine compartment on XJ vehicles. On YJ vehicles it is located behind the A/C housing. Its function is to meter refrigerant into the evaporator in accordance with cooling requirements.

EVAPORATOR COIL—The coil is located in the A/C housing. Its function is to remove heat and dehumidify the air before it enters the vehicle.

FIN SENSING CYCLING CLUTCH SWITCH—The switch is attached to the evaporator coil. This switch prevents condensate water on the evaporator coil from freezing. It does this by cycling the compressor clutch on and off. This switch is used on **XJ** only

THERMOSTAT—The thermostat is located in the evaporator housing. Its function is to cycle the compressor clutch to control temperature. The thermostat is used on the **YJ** only.

REFRIGERANT LINES—The lines are used to carry the refrigerant between the various system components.

SERVICE PORTS—The high pressure service port is located on the discharge line near the compressor. The low pressure service port is located on the suction line near the compressor. The compressor no longer uses service valves.

After servicing the refrigerant system, always install service port caps.

REFRIGERANT

The vehicles use a new type of refrigerant called R-134a. It is a non-toxic, non-flammable, clear colorless liquified gas.

R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. A small amount of R-12 in a R-134a system will cause compressor failure, refrigerant oil sludge or poor A/C performance.

New service ports are used to ensure that the system is not accidentally filled with the wrong refrigerant.

Due to the different characteristics of R-134a it requires all new service procedures. Refer to Refrigerant Service Procedures in this section before making any repairs to the air conditioning system.

Chrysler Corporation recommends that a R-134a refrigerant Recovery/Recycling Station that meets SAE standard J2210 be used. Refer to the operating instructions provided with the equipment for proper operation.

REFRIGERANT OIL

R-134a refrigerant requires a special type of compressor oil. The system uses polyalklene glycol synthetic wax-free refrigerant oil SP-20 PAG. No other oil should be used.

R-12 compressor oil can not be mixed with the R-134a compressor oil. They ARE NOT compatible.

WARNINGS AND CAUTIONS FOR R134A SYSTEM

WARNING: AVOID BREATHING A/C REFRIGERANT AND LUBRICANT VAPOR OR MIST. EXPOSURE MAY IRRITATE EYES, NOSE AND/OR THROAT. WEAR EYE PROTECTION WHEN SERVICING THE AIR CONDITIONING REFRIGERANT SYSTEM. SERIOUS EYE INJURY CAN RESULT FROM EYE CONTACT WITH REFRIGERANT. IF EYE CONTACT IS MADE, SEEK MEDICAL ATTENTION IMMEDIATELY.

WARNING: DO NOT EXPOSE REFRIGERANT TO OPEN FLAME. POISONOUS GAS IS CREATED WHEN REFRIGERANT IS BURNED. AN ELECTRONIC LEAK DETECTOR IS RECOMMENDED.

WARNING: 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.

WARNING: 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 SKIN OR DELICATE OBJECTS FROM DIRECT CONTACT WITH REFRIGERANT.

WARNING: R-134A SERVICE EQUIPMENT OR VEHICLE A/C SYSTEM SHOULD NOT BE PRESSURE TESTED OR LEAK TESTED WITH COMPRESSED AIR. SOME MIXTURES OF AIR AND R-134A HAVE BEEN SHOWN TO BE COMBUSTIBLE AT ELEVATED PRESSURES. THESE MIXTURES ARE POTENTIALLY DANGEROUS AND MAY RESULT IN FIRE OR EXPLOSION CAUSING INJURY OR PROPERTY DAMAGE.

CAUTION: Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with equipment being used.

CAUTION: Never add R-12 to a system designed to use R-134a. Damage to the system will result.

CAUTION: R-12 compressor oil can not be mixed with the R-134a compressor oil. They ARE NOT compatible.

CAUTION: DO NOT use R-12 equipment or parts on the R-134a system. Damage to the system will result.

SERVICE PRECAUTIONS

Never open or loosen a connection before discharging the system refrigerant.

The A/C system must always be evacuated before charging.

DO NOT open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature. This will prevent condensation from forming inside of a component which is cooler than the surrounding air.

Before disconnecting a component from the system, clean the outside of the fittings thoroughly.

Immediately after disconnecting a component from the system, seal the open fittings with a cap or plug.

Before connecting an open fitting always insall a new seal/gasket. Coat the fitting and seal with clean refrigerant oil before connecting.

DO NOT remove the sealing caps from a replacement component until ready to install.

When installing a refrigerant line avoid sharp bends. Position the line away from the exhaust or any sharp edges which may chafe the line.

Tighten fittings only to the specified torque. The aluminum fittings used in the A/C system will not tolerate over tightening.

When disconnecting a 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 an oil container until ready to use and install the cap immediately after using. Store the oil only in a clean moisture-free container.

Keep service tools and the work area clean. Contamination of A/C system through careless work habits must be avoided.

AIR CONDITIONING EQUIPMENT

WARNING: EYE PROTECTION MUST BE USED WHEN SERVICING AN AIR CONDITIONING REFRIGERANT SYSTEM. TURN OFF (ROTATE CLOCKWISE) ALL VALVES ON THE EQUIPMENT BEING USED BEFORE PROCEEDING WITH THIS OPERATION. PERSONNEL INJURY CAN RESULT.

When servicing an air conditioning system, a R-134a Charging Station and a Recovery/Recycling Station is required. These devices must meet SAE standard J2210. Refer to the operating instructions provided with the equipment for proper operation.

A manifold gauge set (Fig. 1) must also be used with the Charging and or Recovery/Recycling Station. The service hoses on the gauge set uses a Quick-Disconnect coupler. The coupler has a knob on top which is used to engage and disengage the sharder valve in the service port.

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.

CENTER GAUGE HOSE

The center hose is YELLOW or WHITE with BLACK STRIP. It is used to recover, evacuate and charge the refrigerant system. When the low or high pressure gauge valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

This hose attaches to the Recovery/Recycling station. Refer to the Recovery/Recycling station Operators Manual for proper procedures.

LOW PRESSURE GAUGE HOSE

The low pressure hose is BLUE with BLACK STRIP. The low pressure port is located on the suction line.

HIGH PRESSURE GAUGE HOSE

The high pressure hose is RED with BLACK STRIP. The high pressure port is located on the discharge line.

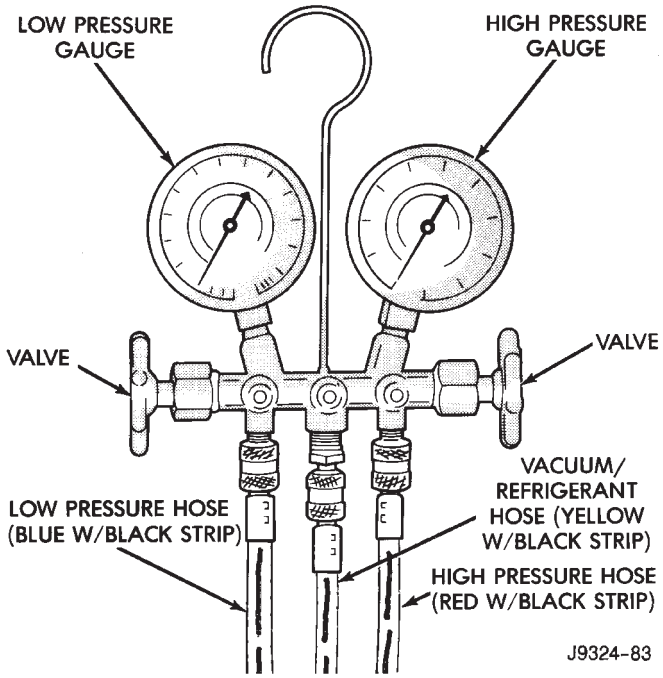

Fig. 1 Manifold Gauge Set

CONNECTION

(1) Remove the service port cap.

(2) Check all valves on the equipment being used to verify they are closed.

(3) Attach the Quick-Disconnect coupler to the service port and turn knob clockwise to depress sharder valve.

DISCONNECT

(1) Turn coupler knob counter clockwise to release sharder valve.

(2) Remove the coupler.

(3) Install the service port cap.

AIR CONDITIONING PERFORMANCE TESTS

Humidity has an improtant bearing on the temprature of the air delivered to the vehicle's interior. It is important to understand the effect humidity has on the performance of the system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature and the temperature of the moisture carried in the air. 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 evaporator's ability to lower the temperature of the air.

Evaporator capacity used to reduce the amount of moisture in the air is not wasted. Wringing some of the moisture out of the air entering the vehicle adds to the comfort of the passengers. However, an owner may expect too much from their air conditioning system on humid days. A performance test is the best way to determine whether or not the system is performing up to standard. This test also provides valuable clues to the possible cause of trouble.

PERFORMANCE TEST

Air temperature in test room must be 21°C (70°F) minimum for this test.

(1) Connect a Tachometer and manifold gauge set.

(2) Set A/C controls to Max A/C, temperature lever on full cool and blower on high.

(3) Start engine and adjust idle to 1,000 RPM with A/C clutch engaged.

(4) Engine should be warmed up with doors, windows and hood closed.

(5) Insert a thermometer in the left center A/C outlet. Operate the engine for 5 minutes. The A/C clutch may cycle depending on ambient temperatures.

(6) After 5 minutes note the discharge air temperature. If the clutch cycles, take the reading before the clutch disengages.

(7) Open the hood and disconnect vacuum line going to the heater water control valve. Observe the valve arm for movement as the line is disconnected. If it does not move repair vacuum circuit. Plug the vacuum line to prevent leakage.

(8) Operate the A/C for 2 more minutes and take the discharge air temperature reading again. On XJ vehicles if the temperature increased by more than 2°C (5°F) check the blend air door cable for correct operation.

(9) Compare the discharge air temperature to the A/C Performance (Temperature and Pressure) Chart. If discharge air temperature is high, refer to Refrigerant Leak Testing and Refrigerant System Diagnosis Chart.

(10) Compare the compressor discharge and suction pressures to the A/C Performance (Temperature and Pressure) Chart. If the discharge or suction pressure is not normal, check the operation of the refrigerant system, referring to Refrigerant System Diagnosis Chart.

The following charts have been developed for quick reference.

YJ PERFORMANCE TEMPERATURE AND PRESSURE CHART

Ambient 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	3- 8°C (38-46°F)	4- 10°C (39-50°F)	7- 13°C (44-55°F)	10- 17°C (50-62°F)	13- 21°C (56-70°F)
Evaporator Inlet Pressure At Charge Port	124 207 kPag	138 241 kPag	152 269 kPag	172 296 kPag	179 324 kPag
	18 30 psi	20 35 psi	22 39 psi	25 43 psi	26 47 psi
Compressor Discharge Pressure	1034 1516 kPag	1103 1620 kPag	1516 2136 kPag	1723 2205 kPag	1379 2344 kPag
	150 220 psi	160 235 psi	220 310 psi	250 320 psi	280 340 psi

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XJ PERFORMANCE TEMPERATURE AND PRESSURE CHART

Ambient 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	2- 7°C (36-44°F)	3- 8°C (38-46°F)	6- 12°C (42-53°F)	9- 16°C (48-60°F)	12- 20°C (54-68°F)
Evaporator Inlet Pressure At Charge Port	124 207 kPag	138 241 kPag	152 269 kPag	172 296 kPag	179 324 kPag
	18 30 psi	20 35 psi	22 39 psi	25 43 psi	26 47 psi
Compressor Discharge Pressure	1034 1516 kPag	1103 1620 kPag	1516 2136 kPag	1723 2205 kPag	1379 2344 kPag
	150 220 psi	160 235 psi	220 310 psi	250 320 psi	280 340 psi

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PRESSURE DIAGNOSIS

Condition	Possible Cause	Correction
Low side and high side pressure low.	(1) System refrigerant low. (2) Expansion valve is restricted. (3) Evaporator plugged.ga	(1) Evacuate, leak test and charge system. (2) Replace the expansion valve. (3) Replace evaporator.
Low side pressure high and high side pressure low.	(1) Internal leak in the compressor. (2) Cylinder head gasket is leaking. (3) Drive belt slipping.	(1) Replace the compressor. (2) Replace the compressor. (3) Adjust the belt tension.
Low side and high side pressure high.	(1) Condenser fins obstructed. (2) Air in the system. (3) Expansion valve is defective. (4) Loose or worn fan belt. (5) Refrigerant system overcharged.	(1) Clean condenser fins. (2) Evacuate, leak test and charge system. (3) Replace the expansion valve. (4) Adjust or replace belt. (5) Recover refrigerant and recharge.
Low side pressure low and high side pressure high.	(1) Expansion valve is defective. (2) Restriction in refrigerant hose. (3) Restriction in receiver/drier. (4) Restriction in condenser.	(1) Replace the expansion valve. (2) Check hoses for kinks and replace if necessary. (3) Replace receiver/drier. (4) Replace condenser.
Low side and high side pressures normal (inadequate cooling).	(1) Excessive oil in system.	(1) Discharge and drain oil. Restore proper oil level. Evacuate, leak test and charge system.

PERFORMANCE DIAGNOSIS

Condition	Possible Cause	Correction
Compressor noise	(1) Broken valve or piston ring. (2) Refrigerant system overcharged. (3) Incorrect oil level. (4) Loose or worn fan belt.	(1) Replace compressor. (2) Evacuate, leak test and charge system. (3) Discharge and drain oil. Restore proper oil level. Evacuate, leak test and charge system. (4) Adjust or replace belt.
Excessive vibration	(1) Incorrect belt tension. (2) Clutch loose. (3) Refrigerant system overcharged. (4) Pulley is misaligned.	(1) Adjust belt tension. (2) Tighten clutch. (3) Recover refrigerant and recharge. (4) Align pulley.
Condensation leaking inside vehicle.	(1) Evaporator drain plugged or kinked.	(2) Clean drain hose and check for proper installation.
Frozen Evaporator coil	(1) Faulty thermostat on YJ vehicle. (2) Faulty fin sensing cycling clutch switch XJ vehicle.	(1) Check for proper installation and adjustment. Replace if necessary. (2) Check for proper installation. Replace if necessary.

REFRIGERANT LEAK TESTING, DISCHARGING, EVACUATING AND CHARGING

LEAK TESTING REFRIGERANT

WARNING: REVIEW WARNINGS AND CAUTIONS IN GENERAL INFORMATION SECTION OF THIS GROUP BEFORE LEAK TESTING.

If A/C system is not cooling properly, determine if system is fully charged. Refer to Refrigerant System Diagnosis Chart. If the system is empty evacuate the A/C system and charge system with 0.283 kPa (0.6 lbs. or 10 oz.) R-134a refrigerant. Refer to Charging Refrigerant System for instructions. To detect a leak in the system, perform the following procedures.

(1) Position the vehicle in a wind free work area. This will aid in detecting small leaks.

(2) Bring A/C system up to operating temperature and pressure. This is done by allowing the engine to run with the A/C on for 5 to 7 minutes.

(3) Open hood 5 minutes prior to leak test. This will dissipate any accumulated refrigerant in the engine compartment.

(4) With the engine not running, use an R-134a Electronic Leak Detector and search for leaks. Move probe slowly along the bottom side of lines and fittings, because R-134a is heavier than air. Fittings, lines, or components that appear to be oily usually indicates a refrigerant leak.

(5) To inspect the evaporator core for leaks. Set the blower at low speed and the selector in PANEL and RECIRC mode check for leaks at CENTER panel oulets.

DISCHARGING REFRIGERANT SYSTEM

WARNING: REVIEW WARNINGS AND CAUTIONS IN GENERAL INFORMATION SECTION OF THIS GROUP BEFORE DISCHARGING SYSTEM.

R-134a refrigrant is a hydrofluorocarbon (HFC) that does not contain chlorine. R-134a refrigerant Recovery/Recycling Station that meets SAE standard J2210 must be used to discharge the refrigerant system. Refer to the operating instructions provided with the equipment for proper operation.

EVACUATING REFRIGERANT SYSTEM

WARNING: REVIEW WARNINGS AND CAUTIONS IN GENERAL INFORMATION SECTION OF THIS GROUP BEFORE EVACUATING SYSTEM.

If the A/C system has been open to the atmosphere, it must be evacuated before the system can be charged. Moisture and air mixed with refrigerant will raise the compressor head pressure above acceptable operating levels. This will reduce the performance of the air conditioner and damage the compressor. Moisture will boil at near room temperature when exposed to vacuum. To evacuate the refrigerant system use following procedure:

(1) Connect a suitable charging station and manifold gauge set to the vehicle.

(2) Open the low and high side valves and start vacuum pump. When suction gauge reads 88 kPag (26 in. Hg) vacuum or greater, close all valves and turn off vacuum pump. If system fails to reach specified vacuum, the system has a leak that must be corrected. If system maintains the specified vacuum for 30 minutes, start the vacuum pump. Then open the suction and discharge valves and evacuate an additional 10 minutes.

(3) Close all valves. Turn off and disconnect the vacuum pump.

The system is now ready to be charged with refrigerant.

CHARGING REFRIGERANT SYSTEM

WARNING: REVIEW WARNINGS AND CAUTIONS IN GENERAL INFORMATION SECTION OF THIS GROUP BEFORE CHARGING SYSTEM.

After the system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. Refer to refrigerant capacities for proper amount of refrigerant charge.

The most accurate method of charging is to completely evacuate the system. Then charge the system using a Recovery/Recycling Station approved for R-134a refrigerant. Refer to the operating instructions provided with the equipment for proper operation.

CAUTION: Do not over charge refrigerant system. This will cause excessive compressor head pressure and can cause noise and system failure.

REFRIGERANT CHARGE CAPACITY

The R-134a system charge capacity is 0.9 kPag (32 oz.) for XJ and YJ vehicles.

REFRIGERANT OIL

It is important to have the correct amount of oil in the A/C system. This will ensure proper lubrication of the compressor. Too little oil will result in damage to the compressor. Too much oil will reduce the cooling capacity of the system.

The oil used in the SD-709 compressor is a polyalkylene glycol synthetic oil SP-20 PAG. This is a wax-free refrigerant oil. Only refrigerant oil of the same type should be used to service the system. Do not use any other oil. The oil container should be kept tightly capped until it is ready for use and then capped after use to prevent contamination. Refrigerant oil will quickly absorb any moisture it comes in contact with.

It will not be necessary to check oil level in the compressor or to add oil unless there has been an oil loss. This may be due to a rupture or leak from a line, shaft seal, evaporator or condenser. Oil loss at a leak point will be evident by the presence of a wet, shiny surface around the leak.

Add an additional 28 grams (1 fluid oz.) of compressor oil to the system when a receiver-drier, condenser or evaporator core is replaced.

OIL LEVEL

When an A/C system is assembled at the factory, all components (except the compressor) are refrigerant oil free. After the system has been charged and operated, the oil in the compressor is dispersed through the system. The evaporator, condenser and compressor will retain a significant amount of oil (refer to the Refrigerant Oil Capacities Chart).

When a component is replaced, the specified amount of refrigerant oil must be added. When the compressor is replaced, the oil must be drained from the replaced compressor and measured. Drain all the oil from the new compressor. Add back into the new compressor the amount of oil that was drained out of the old compressor.

EMISSION CONTROL SYSTEMS

CONTENTS

GENERAL INFORMATION

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SERVICE REMINDER INDICATOR (SRI) LAMP

The instrument panel mounted SRI lamp was formerly referred to as the emission maintenance reminder (EMR) lamp. It is **not used** on any Jeep model for the 1994 model year.

VEHICLE EMISSION CONTROL INFORMATION (VECI) LABEL

All vehicles are equipped with a combined VECI label. The label is located in the engine compartment (Figs. 1 or 2). The 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 plug gap

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. These labels are permanently attached and cannot be removed without defacing information and destroying it.

The VECI label illustration (Fig. 3) is used as an example only. Refer to the VECI label located in the engine compartment (Figs. 1 or 2) for actual emission information.

VACUUM HOSE ROUTING SCHEMATICS

The vacuum hose routing schematics are used as examples only. If there are any differences between these schematics and the Vehicle Emission

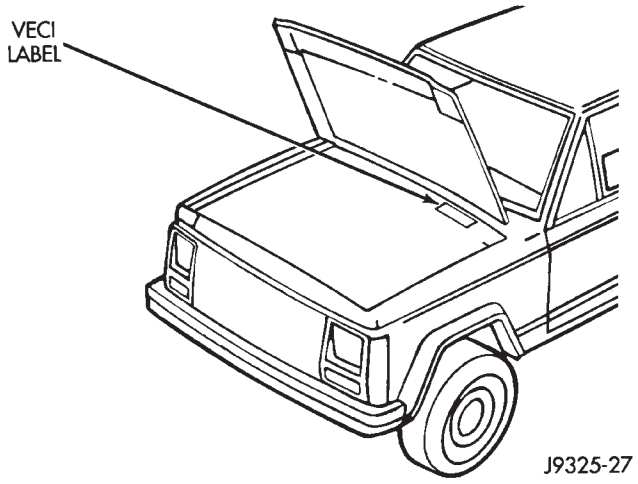

Fig. 1 VECI Label Location—XJ Models

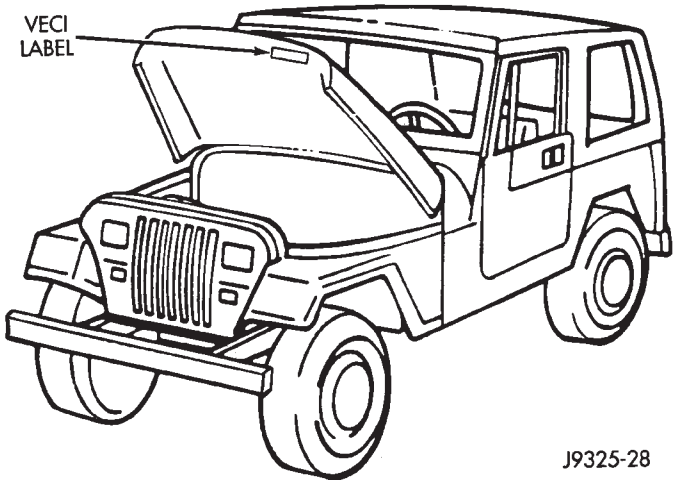

Fig. 2 VECI Label Location—YJ Models

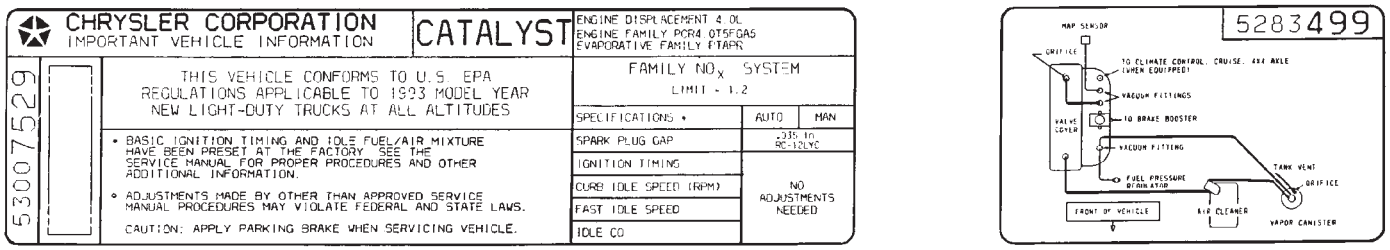

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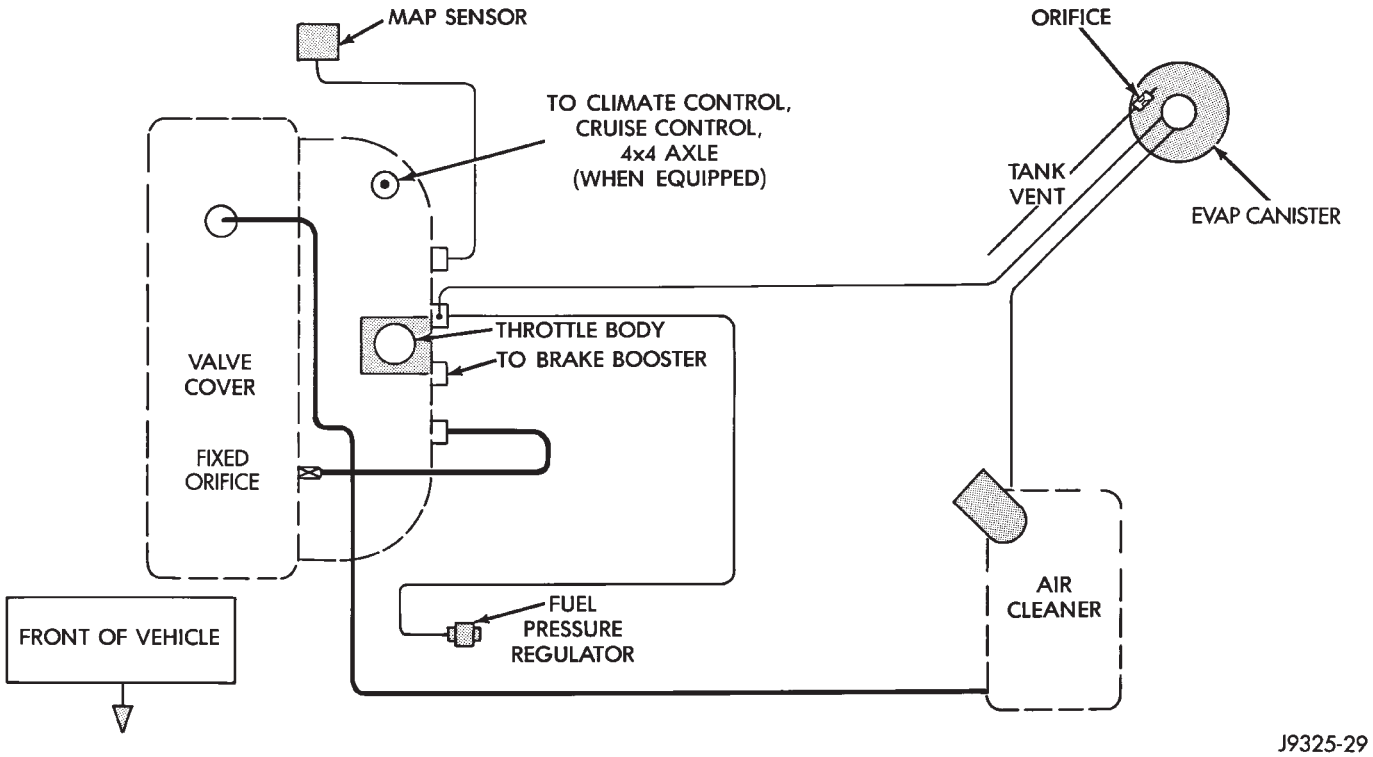
Fig. 3 VECI Label—Typical

Control Information (VECI) label schematics, those shown on the VECI label should be used.

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

VACUUM ROUTING SCHEMATIC—2.5L 4 CYLINDER ENGINE



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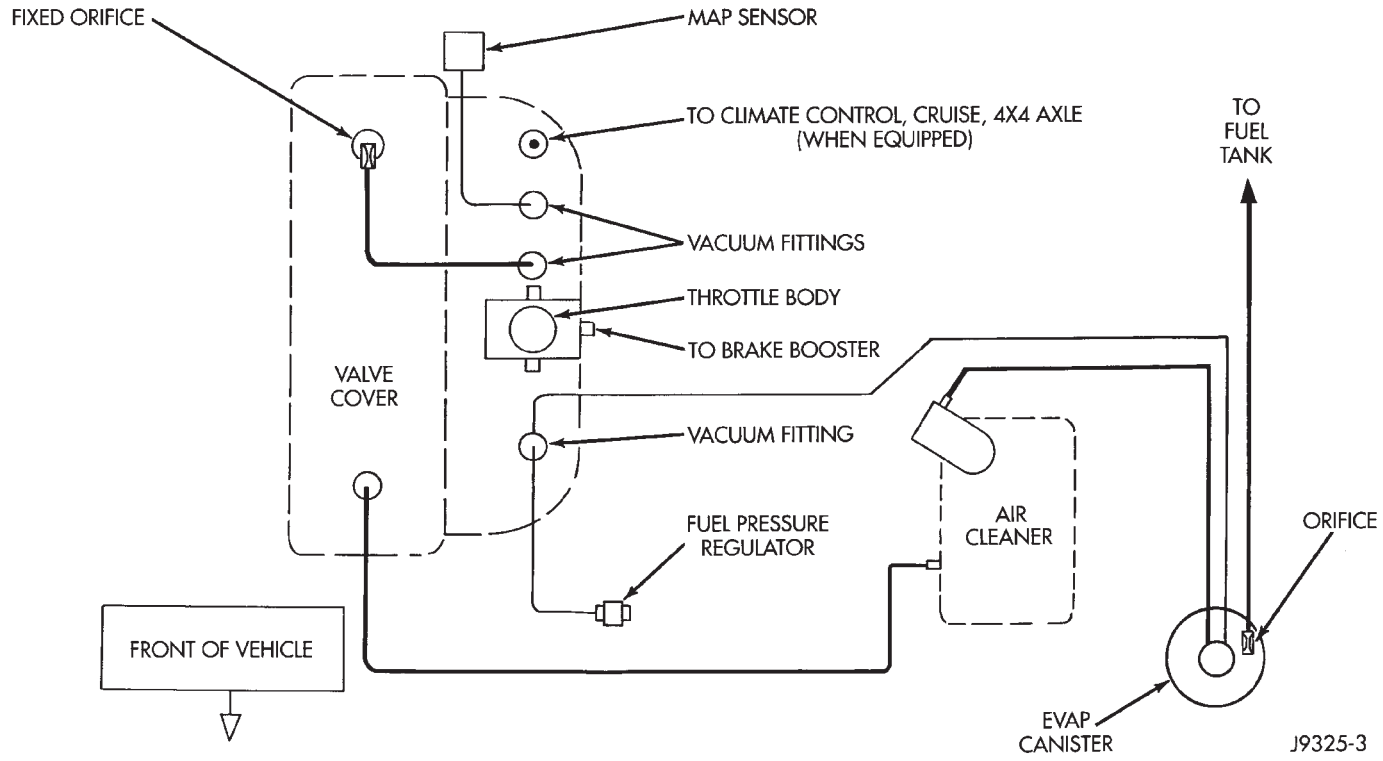
VACUUM ROUTING SCHEMATIC—4.0L 6 CYLINDER ENGINE



EVAPORATIVE EMISSION CONTROLS

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EVAP (EVAPORATION) CONTROL SYSTEM

GENERAL INFORMATION

The function of the EVAP control system is to prevent the emissions of gasoline vapors from the fuel tank into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to a carbon filled EVAP canister. They are temporarily held in the canister until they can be drawn into the intake manifold when the engine is running.

The EVAP canister is a feature on all models for the storage of fuel vapors from the fuel tank.

The hoses used in this system are specially manufactured. If replacement becomes necessary, it is important to use only fuel resistant hose.

EVAP CANISTER

A sealed, maintenance free, EVAP canister is used on all vehicles. On XJ models, the EVAP canister is located in the engine compartment on the passenger side frame rail (Fig. 4). On YJ models, the EVAP canister is located in the engine compartment on the dash panel and below the brake master cylinder (Fig. 5). The EVAP canister is filled with granules of an activated carbon mixture. Fuel vapors entering the EVAP canister are absorbed by the charcoal granules.

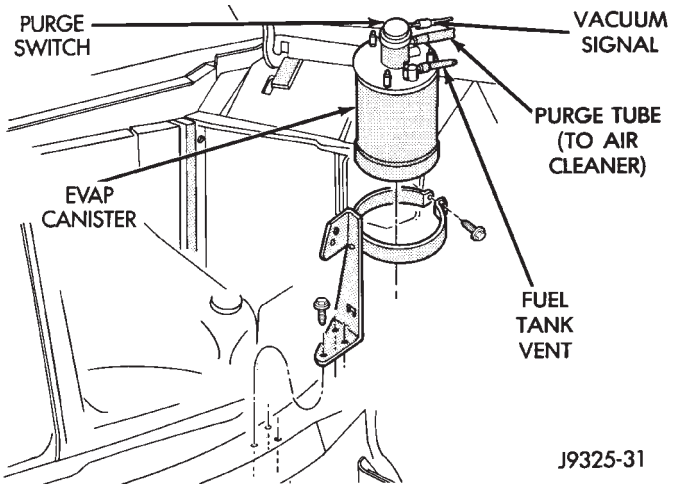

Fig. 4 EVAP Canister Location—XJ Models

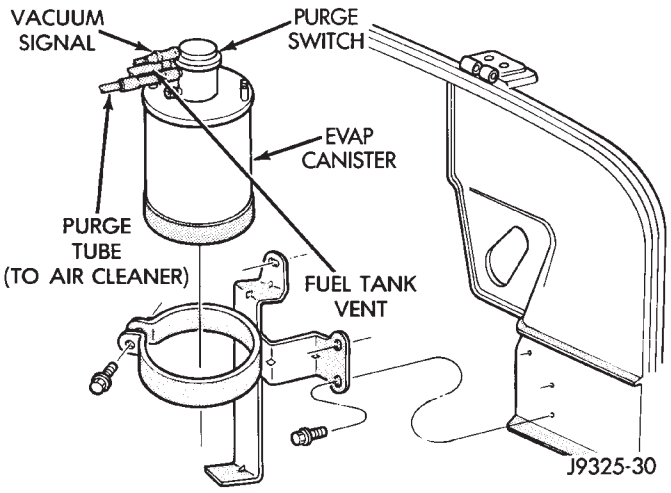

Fig. 5 EVAP Canister Location—YJ Models

CANISTER OPERATION

The EVAP canister is equipped with a vacuum controlled purge shutoff switch (orifice) (Figs. 4 or 5) that controls canister purge operation. The switch is open when manifold vacuum is applied to it. When the engine is operating, the EVAP canister purge function draws fresh air through the top of the canister. This causes the stored vapors to be drawn out of the canister and into the airstream in the air cleaner snorkel (Fig. 6).

The air cleaner contains a venturi in the air cleaner cover used as a purge line vacuum source (Fig. 6). The venturi effect increases the speed of the intake air flowing by the slots in the venturi wall. This creates a low pressure area around the slots. When the purge shutoff switch is open, vapors from the canister are drawn through slots and into the airstream flowing through the venturi (Fig. 7). The vapors pass through the intake manifold into the engine combustion chambers where they are consumed during engine combustion.

FUEL TANK FILLER TUBE CAP

The fuel tank filler tube cap incorporates a two-way relief valve that is closed to atmosphere during normal operating conditions. The relief valve used in fuel filler caps of all models is calibrated at a pressure of 10 kPa (1.5 psi) or a vacuum of 6 kPa (1.8 in. Hg). When the pressure or vacuum is relieved, the valve returns to the normally closed position.

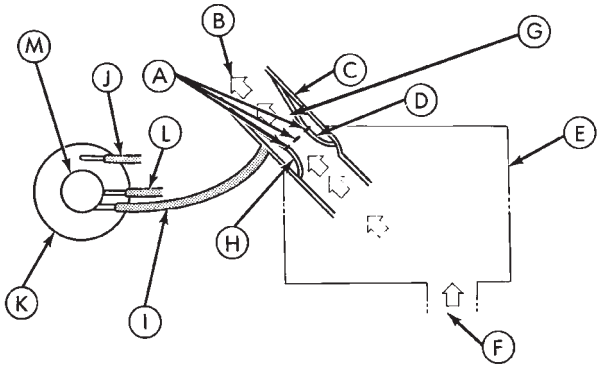

Fig. 6 EVAP System—Typical

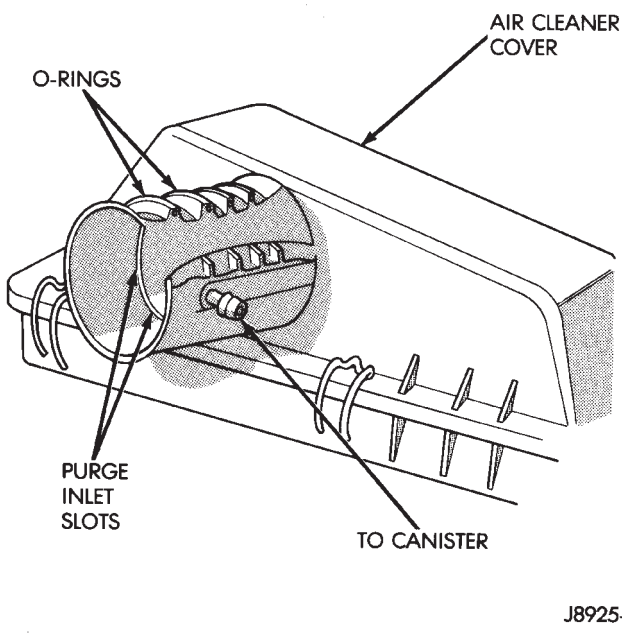

Fig. 7 Air Cleaner Venturi—Typical

CAUTION: The fuel filler cap must be removed prior to disconnecting any fuel system component.

CRANKCASE VENTILATION SYSTEM

All 2.5L 4 cylinder and 4.0L 6 cylinder engines are equipped with a Crankcase Ventilation (CCV) system (Figs. 8 or 9). The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve.

On 4.0L engines, a molded vacuum tube connects manifold vacuum to top of cylinder head (valve) cover at dash panel end. The vacuum tube contains a fixed orifice of a calibrated size. It meters the amount of crankcase vapors drawn out of the engine.

On 2.5L engines, a fitting on drivers side of cylinder head (valve) cover contains the metered orifice. It is connected to manifold vacuum.

A fresh air supply hose from the air cleaner is connected to front of cylinder head cover on 4.0L engines. It is connected to rear of cover on 2.5L engines.

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during combustion.

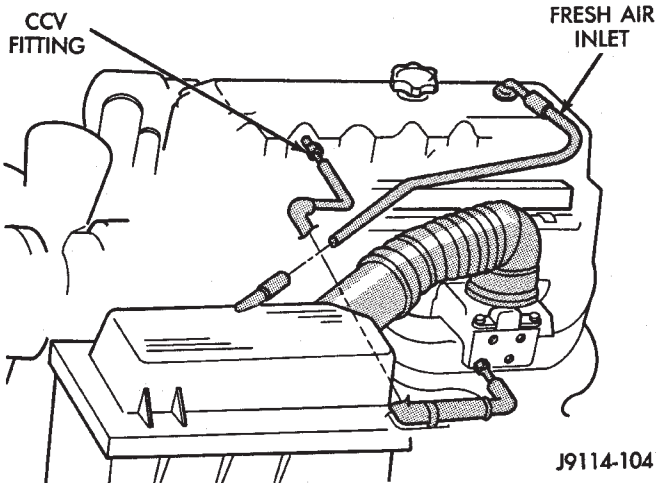

Fig. 8 CCV System—2.5L Engine—Typical

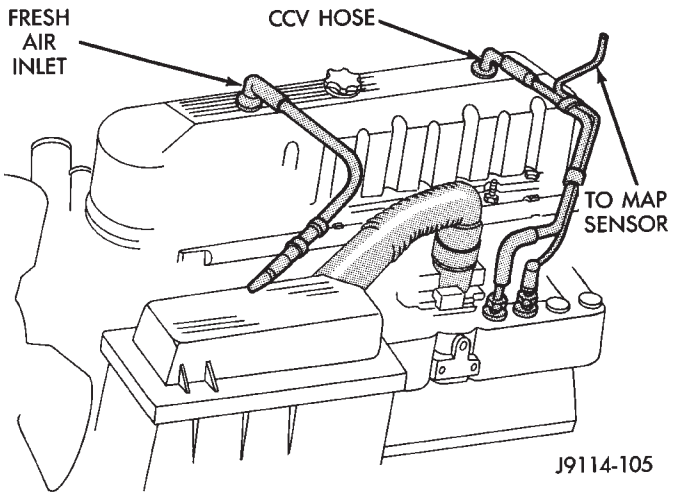

Fig. 9 CCV System—4.0L Engine—Typical

PRESSURE RELIEF/ROLLOVER VALVE

All vehicles are equipped with a combination fuel tank pressure relief and rollover valve (Fig. 10). This dual function valve will relieve fuel tank pressure and also prevent fuel flow through the fuel tank vent hoses in the event of an accidental vehicle rollover.

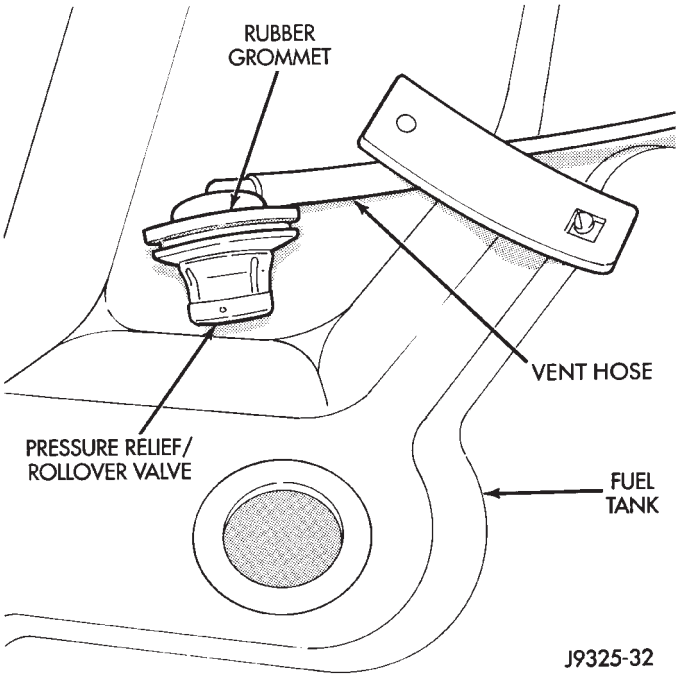

Fig. 10 Pressure Relief/Rollover Valve Location—Typical

The valve incorporates a pressure relief mechanism (Fig. 11) that releases fuel tank pressure when the pressure increases above the calibrated sealing value. Refer to the Fuel Tank section of Group 14, Fuel Systems for removal and installation procedures.

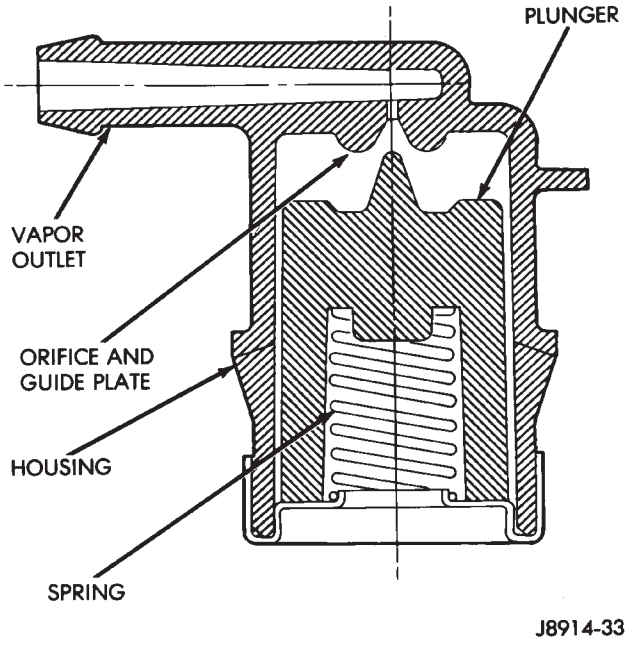

Fig. 11 Pressure Relief/Rollover Valve Operation

EXHAUST EMISSION CONTROLS

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AIR CLEANER

The air cleaner used on all models (Figs. 1 or 2) is open to ambient air. The blend air door and vacuum motor that was used on engines of previous model years to supply heated air, is no longer used. The air cleaner housing assembly contains the engine air filter.

The Powertrain Control Module (PCM) monitors air temperature in the intake manifold through the Intake Manifold Air Temperature sensor. The PCM adjusts injector pulse width and ignition timing to compensate for intake air temperature. Refer to Powertrain Control Module (PCM) in Group 14, Fuel System for more information.

Refer to the Component Removal/Installation section of this group for removal and installation procedures.

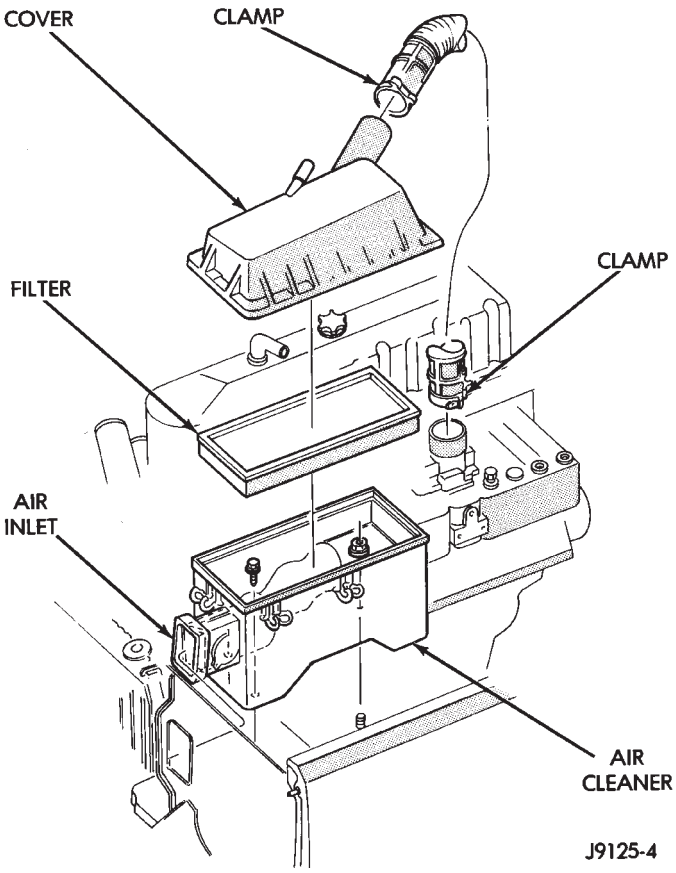

Fig. 1 Air Cleaner—XJ Models—Typical

OXYGEN (O2S) SENSOR

For description, operation, diagnosis and removal/installation procedures of the O2S sensor, refer to Group 14, Fuel Systems.

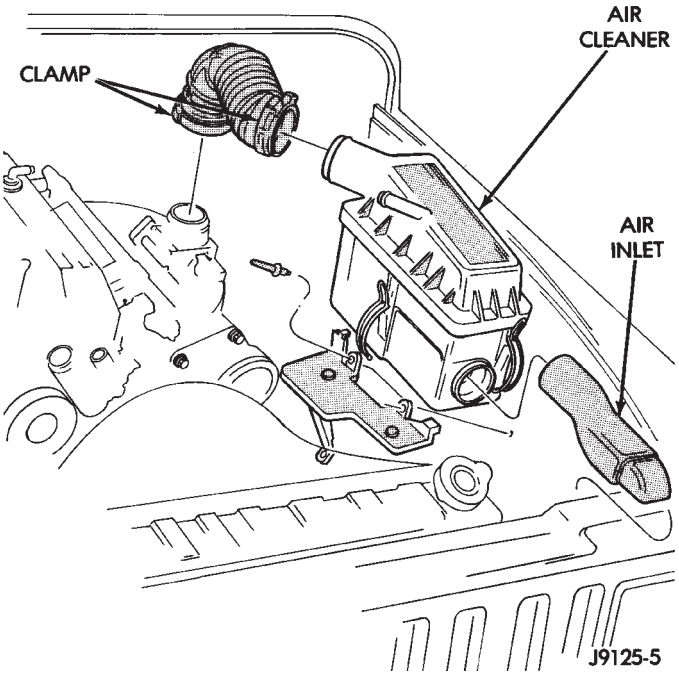

Fig. 2 Air Cleaner—YJ Models—Typical

COMPONENT REMOVAL/INSTALLATION

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AIR CLEANER HOUSING

REMOVAL

(1) Unlock clean air hose clamp (Figs. 3 or 4) at air cleaner cover. To unlock the clamp, attach adjustable pliers to clamp and rotate pliers as shown in figure 3. Remove clean air hose at cover.

(2) Disconnect vacuum lines at air cleaner housing.

(3) YJ Models: Release the three over-center type clamps securing the housing to the housing bracket. XJ Models: Remove the housing cover and remove air filter. Remove two bolts and one nut.

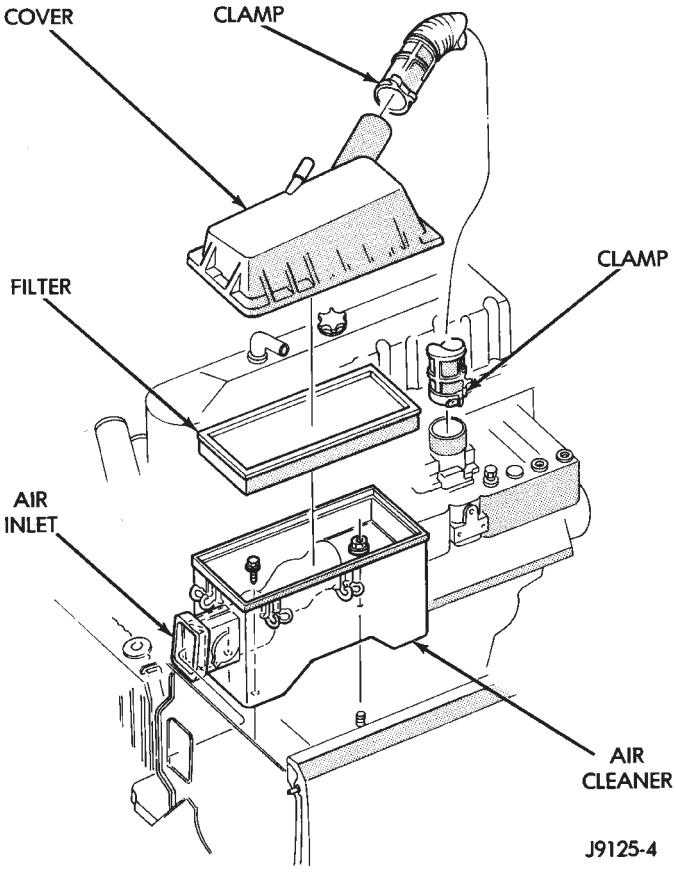

Fig. 3 Air Cleaner—XJ Models—Typical

(4) Release the air cleaner housing from the ambient air inlet and remove housing from vehicle.

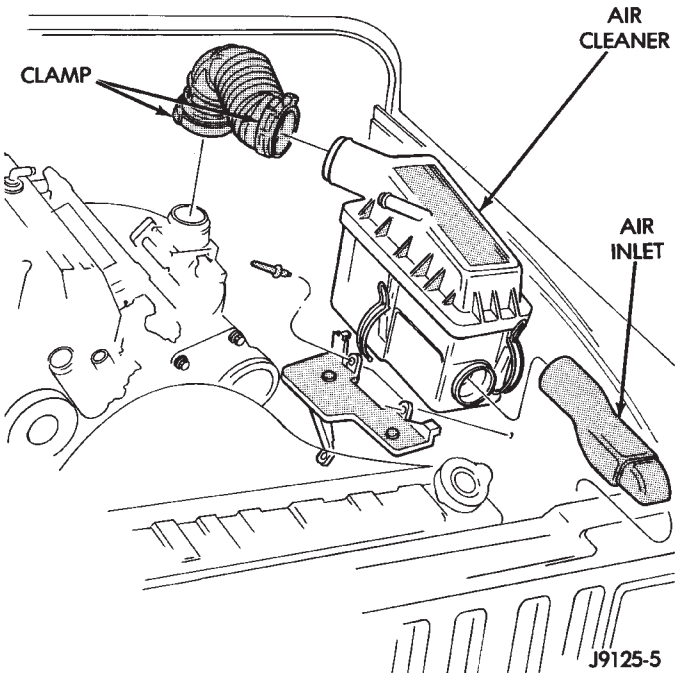

Fig. 4 Air Cleaner—YJ Models—Typical

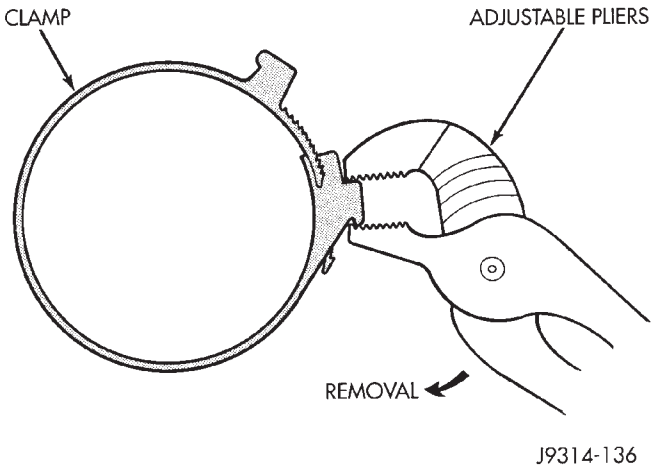

Fig. 5 Clamp Removal

INSTALLATION

(1) Position air cleaner housing to body and ambient air inlet.

(2) YJ Models: Lock the three over-center type clamps securing the housing to the housing bracket. XJ Models: Install two bolts and one nut to housing.

Install air filter and cover.

(3) Install vacuum lines to housing.

(4) Install clean air hose and clamp to cover. Compress the clamp snugly with adjustable pliers as shown in figure 6.

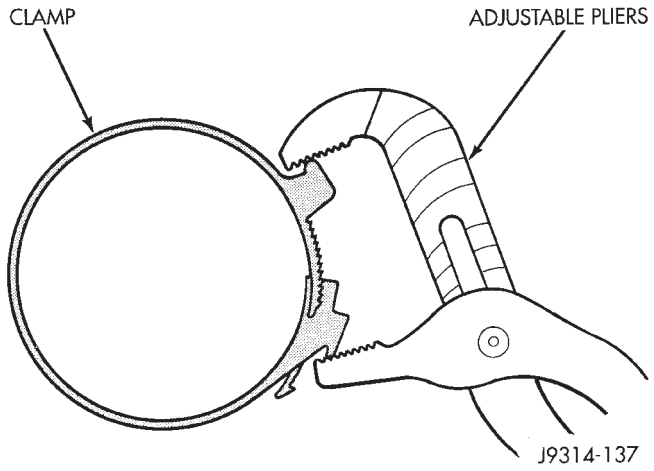

Fig. 6 Clamp Installation

AIR FILTER

REMOVAL/INSTALLATION

(1) Pry back the six clips (YJ Models) or three clips (XJ Models) retaining the air cleaner cover to the air cleaner housing.

(2) Lift the cover up and position to the side.

(3) Remove air filter.

(4) Clean the inside of air cleaner housing before installing new filter.

(5) Reverse the preceding operation for installation. Be sure the air cleaner cover is properly seated to air cleaner housing.

COOLANT TEMPERATURE SENSOR

For description, operation, diagnosis and removal/installation procedures of the engine coolant temperature sensor, refer to Group 14, Fuel Systems.

EVAP CANISTER

On XJ models, the EVAP canister is located in the engine compartment on the passenger side frame rail (Fig. 7). On YJ models, the EVAP canister is located in the engine compartment on the dash panel and below the brake master cylinder (Fig. 8).

REMOVAL/INSTALLATION

(1) Disconnect the vacuum lines at the EVAP canister. Note location of lines before removal.

(2) Remove canister retaining strap bolt.

(3) Remove canister from vehicle.

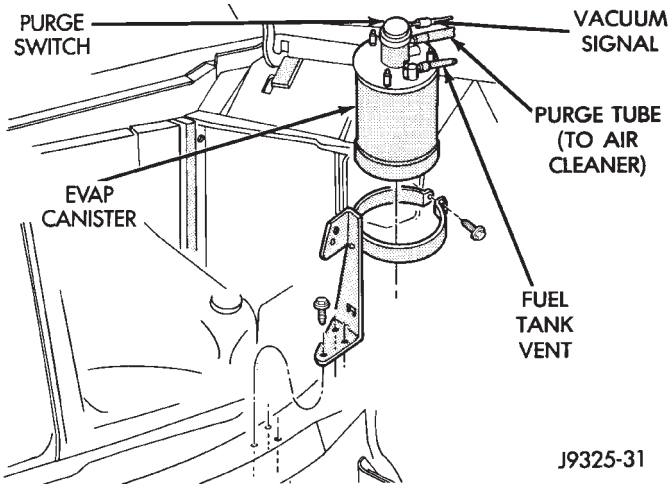

Fig. 7 EVAP Canister—XJ Models

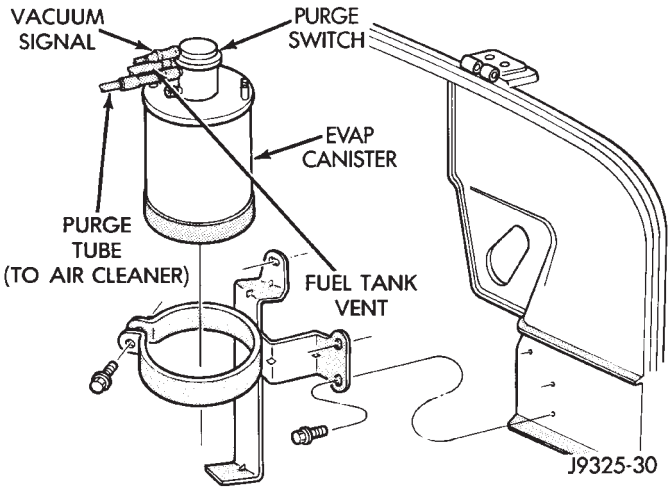

Fig. 8 EVAP Canister—YJ Models

Reverse the procedure for installation.

FUEL TANK FILLER TUBE CAP

If replacement of the fuel filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

OXYGEN (O2S) SENSOR

For description, operation, diagnosis and removal/installation procedures of the O2S sensor, refer to Group 14, Fuel Systems.

POWERTRAIN CONTROL MODULE (PCM)

For removal and installation procedures, refer to Group 14, Fuel Systems.

PRESSURE RELIEF/ROLLOVER VALVE

For removal and installation procedures, refer to the Fuel Tank section of Group 14, Fuel Systems.